Final Preliminary Design Memorandum (PDM)

Fleming Key Bridge Pipe Support Piling Repairs

Prepared for

City of Key West, Florida

November 14, 2013

Prepared by

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1 Introduction

The City of Key West, Florida (City), requested a follow-up structural condition inspection, to verify the conclusions of the August-2003 "Underwater Substructure Evaluation", conducted by Seamar Divers, Inc. The City retained the engineering services of CH2M HILL, Inc., to conduct updated topside and underwater inspections, for the "Fleming Key Bridge Pipe Support Piling Repairs" project.

CH2M HILL was requested to provide "Engineering Services for the Design, Permitting, and Bid Phase Services for the Fleming Key Bridge Pipe Support Piling Repairs" project. The first phase of the project includes the topside and underwater inspections of the concrete pile caps, on which the water and wastewater piping and electrical conduits are attached and supported, and the precast concrete piling, which support the individual pile caps. The project does not include the inspection of the water or wastewater piping, nor the electrical conduits.

2 Project Description

The City of Key West (City) is planning on implementing the recommendations of the 2003 Seamar Divers, Inc. Report entitled, "Underwater Substructure Evaluations Fleming Key Force Mains Bridge Concrete Support Pilings" (copy attached in Appendix A), to repair the damaged precast concrete piling, which support the primary influent piping that conveys sewage to the Richard A. Heyman Environmental Protection Facility (Wastewater Treatment Plant). The Seamar Divers' Report recommended that all of the existing support piling be repaired, by encapsulating each piling to prevent further deterioration, increase structural integrity, and to provide less resistance to the tidal currents.

Additionally, the City is looking into the potential of implementing reuse water for irrigation in certain areas of Key West. In order to supply reuse water to these areas, a new pipeline will need to be installed on and supported by the Fleming Key Bridge Pipe Supports.

As part of the due diligence effort, the City retained CH2M HILL, Inc. in 2008 to conduct an updated structural evaluation of the existing pipe support system and the potential impacts of the additional reuse pipeline's weight, based on the 2003 Seamar Divers' Report and the original 1986 construction drawings. The CH2M HILL Technical Memorandum, "Structural Evaluation of the Fleming Key Bridge Pipe Crossing Support Pilings", City of Key West, Florida, Work Order F-09 SWR, dated July 17, 2009, recommended a comprehensive topside and underwater inspection be conducted to determine the types of repairs required and their extent, to bring the existing structure up to its original "as-built" condition. A copy of the CH2M HILL 2009 Technical Memorandum may be found in Appendix B. A copy of the original construction drawings for the Fleming Key Bridge Pipe Supports may be found in Appendix C.

The CH2M HILL 2009 Technical Memorandum was prepared using only the findings and recommendations of the 2003 Seamar Divers' Report and the 1986 Fleming Key Bridge Pipe Crossing Support drawings. In 2009, the repair recommendations of the 2003 Seamar Divers' Report had not been implemented and there was good probability the structural condition of the precast concrete support piling had deteriorated further during the interim 6 year period. Based solely on this information, the CH2M HILL 2009 Technical Memorandum deemed the pipe supports to not be in "as-built" condition, in agreement with the Seamar Divers' findings.

Accordingly, the CH2M HILL 2009 Technical Memorandum recommended that a new, more comprehensive topside and underwater structural evaluation be performed, to determine the current condition of the structural components. It was further recommended that the necessary repairs indicated by this more comprehensive inspection and evaluation report be implemented to bring the existing structure up to its original "as-built" condition. Based on the 2003 Seamar Divers' Report, and the presumed current structural condition of the existing pipe crossing piling support system, the CH2M HILL 2009 Technical Memorandum recommended that the City not superimpose any additional weight to the pipe support piling, without implementing the recommended repairs.

During the interim time period between the 2003 Seamar Divers' Report and today, the City made overtures to work with the U.S. Navy, to complete the recommended pipe support piling repairs under last year's Navy design/build construction contract, for the Fleming Key Bridge Improvements. However, the City was not successful, with this effort.

3 Purpose

In 2012, the City of Key West requested and authorized CH2M HILL, Inc. to provide engineering services for the design, permitting, and bid phase services, associated with the proposed structural improvements to the Fleming Key Bridge Pipe Support Piling System, under Task Order 4-12 SWR.

Specific activities to be performed under this Task Order include:

- Task A: Prepare a Preliminary Design Memorandum (PDM), which is this document.
- Task B: Prepare detailed design with submission of 90 percent Review Documents and 100 percent Bid Documents.
- Task C: Prepare Environmental Regulatory Permitting Agency Applications.
- Task D: Provide Bid Phase Services.

4 Task A Scope of Services

Task Order 4-12SWR directed CH2M HILL to prepare and submit a PDM, based on the comprehensive topside and underwater inspections and structural evaluation, of the existing precast concrete piling and cast-in-place concrete pile caps. In conformance with the task order, CH2M HILL:

- Retained the services of an underwater dive inspection company, to perform a subwater structural inspection and evaluation of the existing precast concrete piling, from the mudline to the soffits of the pile caps and prepare a condition survey report.
- Performed a comprehensive topside structural inspection and evaluation, to determine the current topside structural condition of the existing pilings and pile caps and prepare a condition survey report.
- Discussed potential repair methods and products with City staff, to be included in the Bid Documents.
- Prepared a preliminary probable construction cost estimate.
- Prepared a PDM, which is this document.

5 Background

In August-2003, Seamar Divers, Inc., a diving and salvage company, performed an underwater inspection of the Fleming Key Bridge pipe support piling, as documented in its report entitled, "Underwater Substructure Evaluations Fleming Key Force Mains Bridge Concrete Support Pilings". To provide detailed background, a complete copy of the Seamar Divers' Report is attached in Appendix A, with only specific report text excerpted herein for background information.

The predominate structural damage or defect to the precast concrete piles, with the exception of the damage caused by the mid-1990s boat impact to Pile 6, as reported in the 2003 Seamar Divers' Report, was "minor pitting" of the four surfaces of the square precast concrete piles. Seamar Divers' Report stated, "…minor pitting that may be attributed to loss of aggregate during the forming phase of piling." The depth of the "minor pitting" ranged from 0 inches to 3/4 inches. Table 1 summarizes data obtained from the Seamar Divers' Report and provides the breakdown of depth of pitting measured for each of the 14 piles, the deemed severity of the damage, and the recommended repairs.

The precast concrete piles are 14 inches by 14 inches square and typically precast concrete piles placed in a salt laden marine environment have 3 inches of concrete cover over the reinforcement, which conforms with the Florida Department of Transportation (FDOT) "Standard Precast Piling Details". Based on the presumption there are 3 inches of concrete cover over the reinforcement (As-Built Precast Concrete Piling Drawings were not available), a 3/4 inch pitting depth, which the Seamar Divers' Report called "major pitting," results in

marginal 2-1/4 inches of concrete cover over the reinforcement, when taking into consideration the 3/4 inch pitting depth occurs randomly over the face of the piles.

TABLE 1

Summary of "Minor Pitting" Depths as Presented in the 2003 Seamar Divers' Report

Depth of Pitting	Pile Quantity	Percent of Total Piles	Cumulative Percent of Total	Severity of Damage	Recommend Repairs
0 inches	4	29%	29%	None	None
Up to 1/8 inch	2	14%	43%	None	None
Up to 1/4 inch	1	7%	50%	None	None
Up to 1/2 inch	5	36%	86%	Minor	None
Up to 3/4 inch	2	14%	100%	Minor	Localized

The original pipe support pile construction drawings (attached herewith in Appendix C) indicate the precast concrete piles were installed in 1986, which means the precast concrete piles had been in service for 17 years, at the time of the 2003 Seamar Divers' inspection, and 26 years at the time of the most recent 2009 CH2M HILL inspection. The Seamar Divers' Report indicated minimal corrosion problems at the 17-year mark. The recent CH2M HILL subwater dive inspection confirmed the previous Seamar Divers' findings and reported minimal corrosion problems were found. Although there was no documentation to indicate that both Seamars' and Denizens' cleaned inspection areas on each pile were taken in the same locations. Future underwater inspection dive report's data should be correlated with the current dive inspection data, to better determine the rate of corrosion of the precast concrete piles' reinforcement.

6 Underwater Dive Inspection

In 2012, CH2M HILL retained the underwater dive inspection services of Denizens of the Deep, Inc., a professional dive inspection company, which CH2M HILL has historically used to provide the same type of dive inspection services for numerous marine projects. The guidance CH2M HILL gave Denizens was to provide a Level II Inspection Effort, as defined in the American Society of Civil Engineers (ASCE) Ports and Harbors Committee's Standard Practice Manual for Underwater Investigations, dated May-2000 (ASCE Manual). Specifically, the underwater dive inspection included the 15 precast concrete piling of the pipe supports; however, it did not include the Fleming Key Bridge piling.

The following paragraphs briefly outline the ASCE Manual's Level II Inspection Effort:

A. A close visual examination or a tactile examination using large sweeping motions of the hands where visibility is limited. Inspection shall be detailed enough to detect obvious major damage or deterioration due to overstress or other severe deterioration. It shall

confirm the continuity of the full length of all members and detect undermining or exposure of normally buried elements.

B. A detailed inspection which requires marine growth to be removed from portions of the structure. For piles, a 12 inch high band shall be cleaned at the low waterline, at the mudline, and midway between the low waterline and the mudline. Remove marine growth from all four sides of each pile.

C. Where visual observations or spot marine growth removal reveals damaged or cracked piles, additional marine growth shall be removed to define the extent of the repair required.

D. The Level II effort is intended to detect and identify damaged and deteriorated areas that may be hidden by surface biofouling. The thoroughness of cleaning should be governed by what is necessary to discern the condition of the underlying material. Removal of all biofouling staining is generally not required.

E. Assess the general overall condition of the element being inspected; assign a condition assessment rating based on the ASCE Manual's Table 2-4 – Routine Underwater Condition Assessment Ratings, and recommend what type of repair and the extent of the repair required.

F. Document findings with hand sketched drawings of each defect, showing the specific location and extent of the defect to be repaired.

G. Record relevant attributes of each defect to be repaired, so the extent, quantity, and cost of the repairs can be determined.

The ASCE Manual provides guidance for obtaining a statistically representative sampling of structural components to be inspected, for three levels of inspection effort, Levels I, II, and III. A Level II Inspection Effort typically requires the sampling or inspecting of 10 percent of all structural components. However, in this case there were only 14 precast concrete support piles to be inspected, not including Pile 6 which was damaged by a boat impact. Inspecting only 10 percent of the piles would result in only 1.4 piles being inspected. Therefore, it was decided to inspect all 14 of the precast concrete piling, or 100 percent of all structural components. The current structural condition of each of the 14 pipe support piles is reported herein. However, the dive inspection could not observe the condition of the portion of each pile below the mudline nor behind the marine growth, other than in the three 12-inch wide bands cleaned for each pile.

The ASCE Manual also provides an Underwater Condition Assessment Rating System, based on a scale of 1 to 6 being used to rate the magnitude of damage to a specific structural component. To quote from the ASCE Manual, "A rating of 6 represents a structure in Good Condition while a rating of 1 represents a structure in Critical Condition." Table 2 presents a description of each of the six Underwater Condition Assessment Ratings.

Use of this condition rating system allows for an opinion of condition based on the worst structural components of the facility, which is the controlling parameter for determination of fitness for continued service.

Photo No. 1 is a view of the "Fleming Key Bridge taken from the West Side" of the bridge. Figure No. 1 shows the layout of the 14 inch square precast concrete piles in the "Key West - Fleming Key Bridge Pipe Support". Note this plan view shows only the pipe support piles and concrete pile caps (outline in dashed lines). The plan view does not show the bridge piles.

The pile numbering system presented in the 2003 Seamar Divers' Report has been followed herein, so that comments and photos of a specific pile will be referenced to the same pile discussed in the Seamar Divers' Report. Note there are fifteen (15) – 14 inch square precast concrete piles shown. Pile 6 was struck by a boat in the mid-1990s and sustained structural damage. To address the unknown load capacity of Pile 6, Pile 5 was installed to replace it, together with a cast-in-place concrete pile cap extension, to provide the necessary structural support for Pile Cap 5-6-7. The additional pile in Pile Cap 5-6-7 will become obvious when viewing the photos and Figure 1.

TABLE 2

Tabulation of the Underwater Condition Assessment Rating System

Rating		Description
6	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.
5	Satisfactory	Limited minor to moderate defects or deterioration observed, but no overstressing observed. No repairs are required.
4	Fair	All primary structural elements are sound; but minor to moderate defects or deterioration 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.
3	Poor	Advanced deterioration or overstressing observed on widespread portions of the structure, but does not significantly reduce the load bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2	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.
1	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.

Photo No. 1: Fleming Key Bridge taken from the West Side.

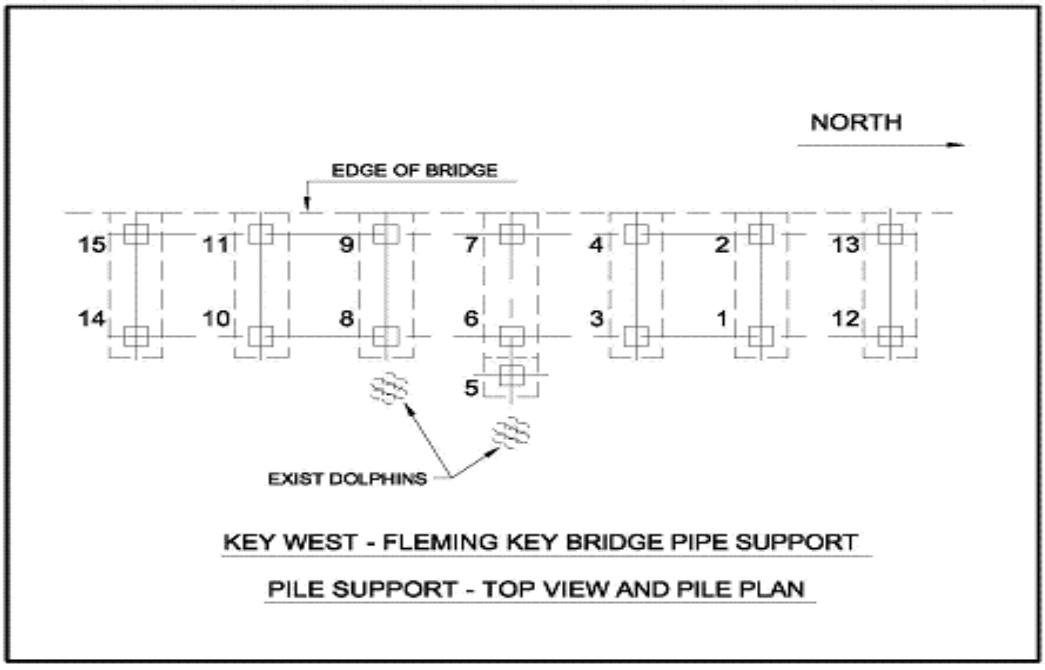

Figure No. 1: Key West – Fleming Key Bridge Pipe Support Plan View.

Pile 13: Denizens' underwater dive inspection began at the North end of the Fleming Key Bridge, with pipe support Pile Cap 12-13; following the same pile inspection order that Seamar Divers followed in 2003. Therefore, the following narrative is presented in the same order, beginning with Pile 13, which as seen in Photo No. 2 is in shallow water. No cracks were found in this pile. Pile 13 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 2: East Face of Pile 13.

Pile 12: No cracks were found in this pile. Pile 12 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 3: West Face of Pile 12, with no apparent pitting visible.

Pile 2: No cracks were found in this pile. Pile 2 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 4: Northwest Corner of Pile 2, random pitting visible.

Photo No. 5: Close-up view of Northwest Corner of Pile 2, random pitting visible.

Pile 1: No cracks were found in this pile. There is a spall above the water line on the Southeast corner that measures 2 inches wide by 15 inches tall by 1½ inches deep with no rust observed. Pile 1 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 6: South Face of Pile 1, with two 12 inch bands of marine growth removed.

Pile 4: No cracks were found in this pile. Minor pitting up to 1/4 inch deep around this pile. Pile 4 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 7: East Face of Pile 4, with marine growth removed and minor pitting visible.

Photo No. 8: East Face of Pile 4, upper portion of marine growth removed.

Pile 3: No cracks were found in this pile. Minor pitting up to 3/8 inch deep around this pile. Pile 3 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 9: Close-up view of North Face of Pile 3, with marine growth removed and pitting visible.

Pile 7: No cracks were found in this pile. Minor pitting up to 1/8 inch deep around the pile. Pile 7 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 10: West Face of Pile 7, with minor pitting visible.

Photo No. 11: Close-up view of West Face of Pile 7, with minor pitting visible.

Pile 6: In the mid-1990s, Pile 6 was struck by a boat and sustained structural damage. To provide supplemental load capacity to Pile 6, a new pile (Pile 5) was driven to the outside of Pile 6 and the cast-in-place concrete pile cap was extended. No damage was noted to Pile 6 below the water line. However, the structural condition of Pile 6 was not determined below the mudline. The portion of Pile 6 above the water line has several cracks in both the exposed pile face and the shotcrete repair, which was made several years ago. These are mostly vertical cracks, with the exception of the West Face of the pile, where horizontal cracks were found. Although this pile had been repaired in the past with shotcrete, some of the cracks have rust bleeding through them. The largest cracks are roughly 3/8 inch wide by 4 feet long. Minor pitting below the waterline, up to 1/4 inch deep, was recorded around the pile. Pile 6 is considered to have a Condition Rating of 2 and is in Serious Condition, because of the damage caused by the boat impact.

Photo No. 12: Southeast Corner of Pile 6, with no visible damage.

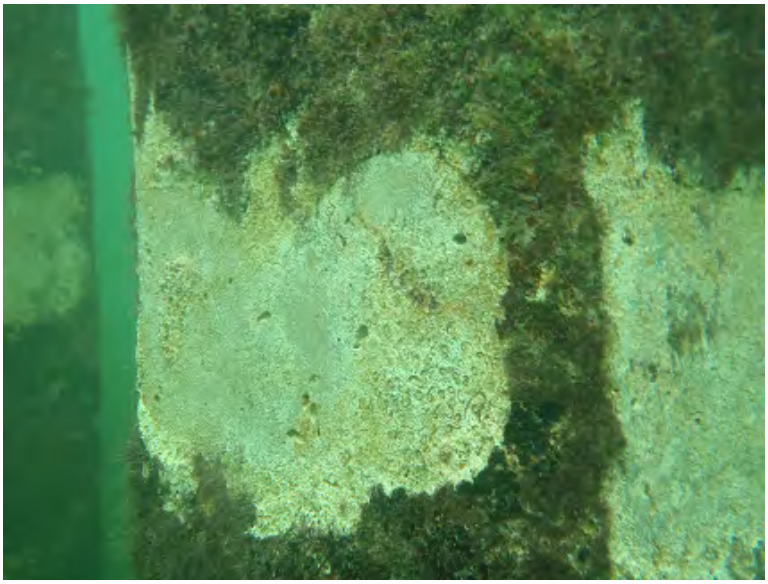

Photo No. 13: Close-up view of Southeast Corner of Pile 6, with minor pitting visible.

Photo No. 14: Above water view of the East Face of Pile 6, with vertical cracks visible in shotcrete repair.

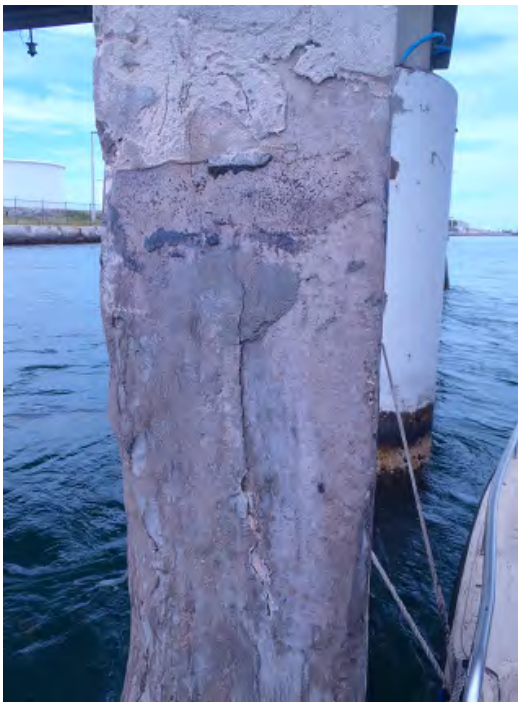

Photo No. 15: East Face of Pile 6, with vertical cracks visible in shotcrete repair.

Photo No. 16: Above water view of the North Face of Pile 6, with cracks visible in shotcrete repair.

Photo No. 17: South Face of Pile 6, with vertical cracks visible in shotcrete repair. Vertical cracks extend beyond the limits of the shotcrete repair and into the concrete pile itself.

Photo No. 18: Northwest Corner of Pile 6, where the top of the pile intersects the concrete pile cap.

Photo No. 19: West Face of Pile 6, with horizontal cracks visible, with rust stains bleeding through.

Photo No. 20: Upper portion of South Face of Pile 6, with vertical cracks visible in shotcrete repair and rust stains bleeding through.

Photo No. 21: Lower portion of South Face of Pile 6, with vertical cracks visible in shotcrete repair and rust stains bleeding through.

Pile 5: No cracks were found in this pile. Pile 5 is one of the piles that make up the only pile cap, with three piles. This pile appears to have been installed, due to the damage that has occurred to Pile 6. It appears that a block of wood or a concrete brick was part of the casting of this pile and has either deteriorated or has been removed. It has left a depression in the west face of the pile, which is approximately 3 feet above the mudline. The depressed area is approximately 3 inches wide by 6 inches long by 3/4 inch deep. Pile 5 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 22: West Face of Pile 5, with the depressed area visible.

Photo No. 23: Close-up view of the West Face of Pile 5, with the depressed area visible.

Pile 9: No cracks were found in the pile. Minor pitting up to 1/4 inch deep was noted around the pile. Pile 9 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 24: View of East Face of Pile 9.

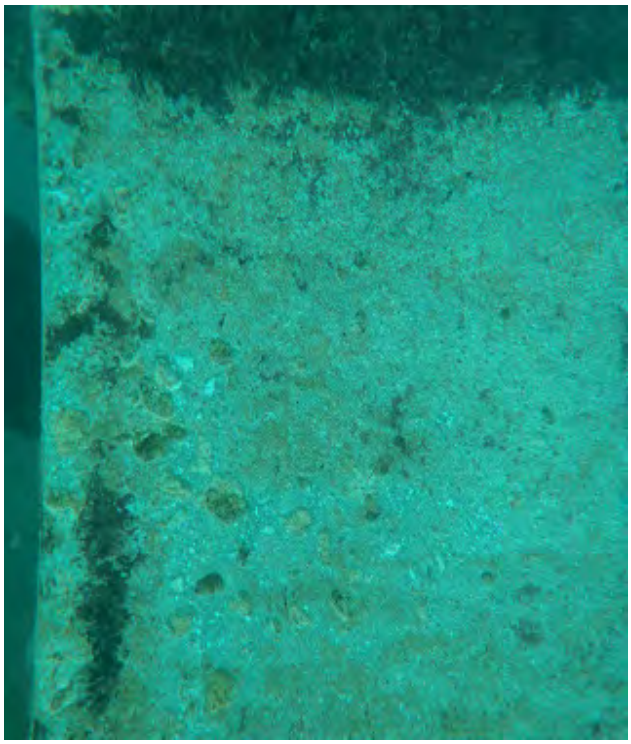

Photo No. 25: Close-up view of the East Face of Pile 9, with minor pitting visible.

Pile 8: No cracks were found in this pile. The Southeast Corner is slightly eroded where the cleaning took place. The eroded area is approximately 12 inches tall by 3/4 inch deep at the corner. Pile 8 is considered to have a Condition Rating of 6 and is in Good Condition.

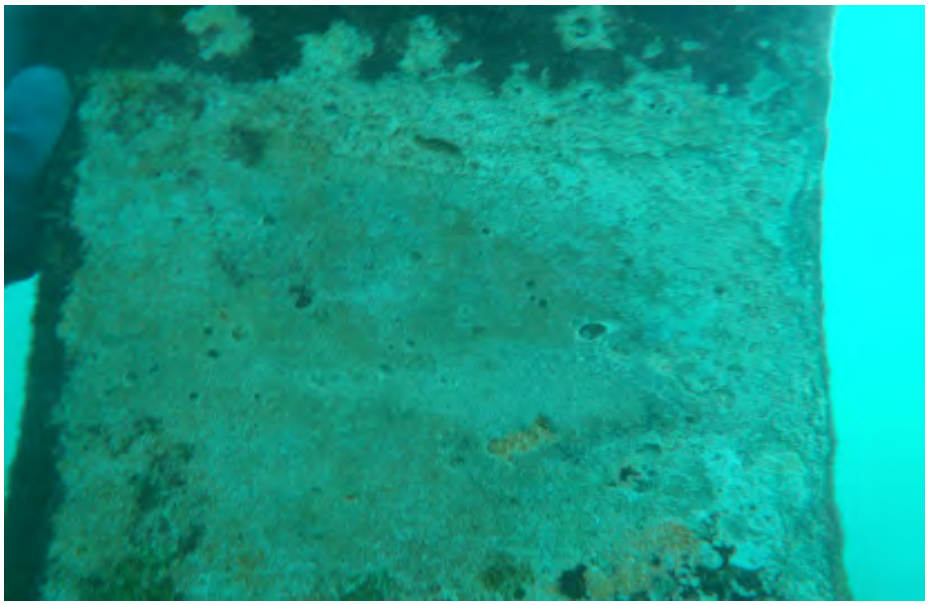

Photo No. 26: Close-up view of the South Face of Pile 8, with minor pitting visible.

Pile 11: No cracks were found in this pile. Pile 11 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 27: View of South Face of Pile 11, with minor pitting visible.

Pile 10: No cracks were found in this pile. Pile 10 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 28: View of Southeast Corner of Pile 10.

Pile 15: No cracks were found in this pile. Pile 15 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 29: Close-up view of East Face of Pile 15, with minimal pitting evident.

Pile 14: No cracks were found in this pile. Pile 14 is considered to have a Condition Rating of 6 and is in Good Condition.

Photo No. 30: View of Pile 14 North Face above water.

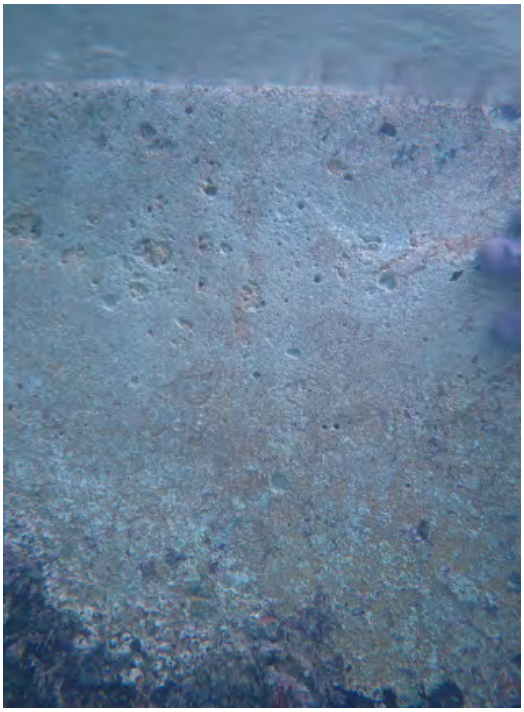

Photo No. 31: Close-up view of Pile 14 North Face below water, minor pitting is visible.

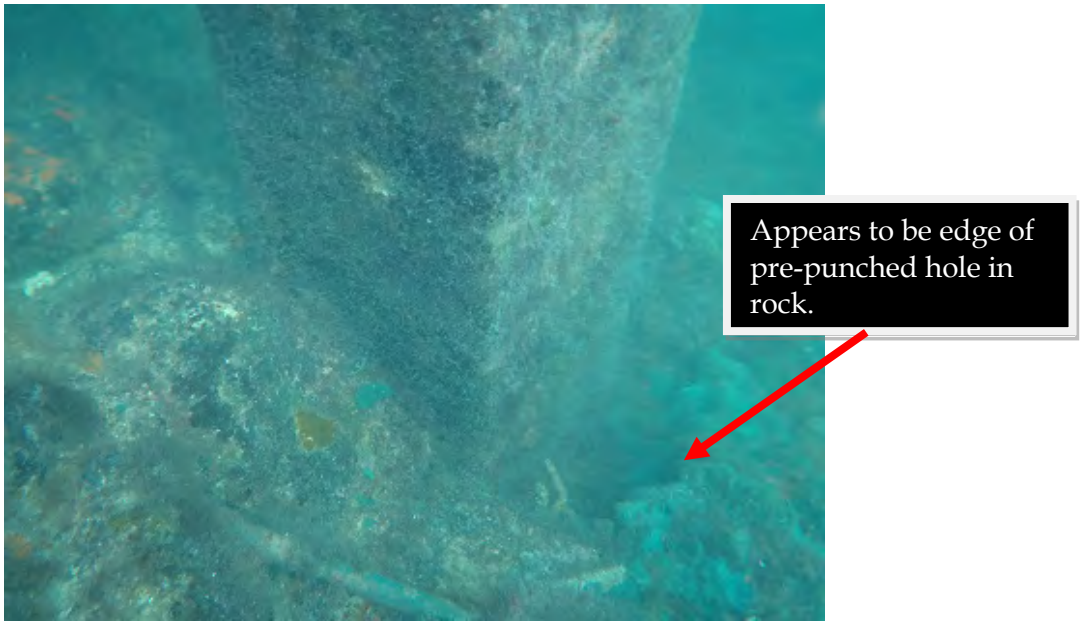

Photo No. 32: Typical bottom conditions at precast concrete pile, before cleaning. The bottom or mudline consists of rock, most likely coral or limestone; and it appears the rock was pre-punched before driving the pile.

As shown in Photo No. 32, the bottom or mudline beneath the Fleming Key Bridge and associated Pipe Support Pilings consists typically of coral or limestone rock. The Denizens of the Deep divers commented on the presence of rock at the mudline. Similar comments were made by the Seamar Divers, Inc's divers who also noted the existence of rock at the mudline.

The channel bottom beneath the Fleming Key Bridge is very shallow at each of the two end pile cap locations (Pile Cap 12-13 and Pile Cap 14-15), and then deepens at the location of the boat channel, located between Pile Cap 3-4 and Pile Cap 5-6-7. Table 3 indicates water depths of 2 feet and 4 feet at Pile Cap 12-13 and Pile Cap 14-15, respectively. However, Table 3 also indicates a water depth of 13 feet, at Pile Cap 3-4 and Pile Cap 5-6-7. It is presumed that it is because of the hard rock bottom through-out, that no pile damage or no piling toe washout, or undermining was noted.

TABLE 3

Tabulation of Water Depths at each Pair of Piles.

Pile Nos.	Water Depth
14 & 15	4 feet
10 & 11	9 feet
8 & 9	12 feet
5, 6 & 7	13 feet
3 & 4	13 feet
1 & 2	6 feet
12 & 13	2 feet

7 Topside Structural Inspection

The Topside Inspection was started at the north end supports, at Pile Cap 12-13, for Piles 12 and 13, and preceded southward, to the south end Pile Cap 14-15, for Piles 14 and 15. See Figure No. 1: Key West - Fleming Key Bridge Pipe Support Plan View on page 7 of this document, for pile numbers and locations. As previously mentioned, the CH2M HILL topside inspection's scope of work did not include inspecting the wastewater pipes and brackets, nor the electrical conduits and attachments.

The top surface of the Pile Cap 12-13 is in good condition. A spall is visible on the underside of the pile cap above Pile 13, as may be seen in Photo No. 34. The underside and sides of the pile cap have a visible crack at Pile 12, as may be seen in Photo No. 35. Access could not be gained to the underside of the pile cap, to sound the concrete and determine the severity of the cracked and spalled section. The crack does not appear to be affecting the structural integrity of the pile

cap at this time. However, corroded reinforcement is visible at the spalled section above Pile 13. Both piles appear to be in good condition above the waterline.

Photo No. 33: Top View of Pile Cap 12-13, showing the two 30-in water mains and numerous electrical conduit.

Photo No. 34: View of Pile Cap 12-13 and Pile 13, with rust stains from corroded reinforcement bleeding through pile cap soffit and spalled concrete pile cap soffit.

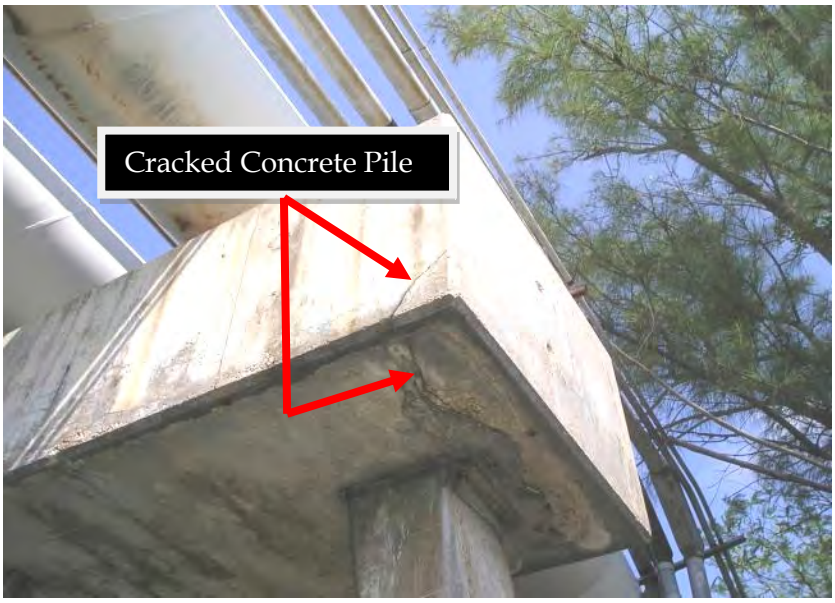

Photo No. 35: Pile Cap 12–13 showing cracks in concrete cap at Pile 12 along the east bottom edge of the cap.

Pile Cap 1–2 appears to be in Good Condition. Both piles, Pile 1 and Pile 2, appear to be in Good Condition above the waterline.

Photo No. 36: Top view of Pile Cap 1-2.

Pile Cap 3-4 appears to be in Good Condition, except for a minor delamination at the north side of the eastern pipe support saddle. Both piles, Pile 3 and Pile 4, appear to be in Good Condition above the waterline.

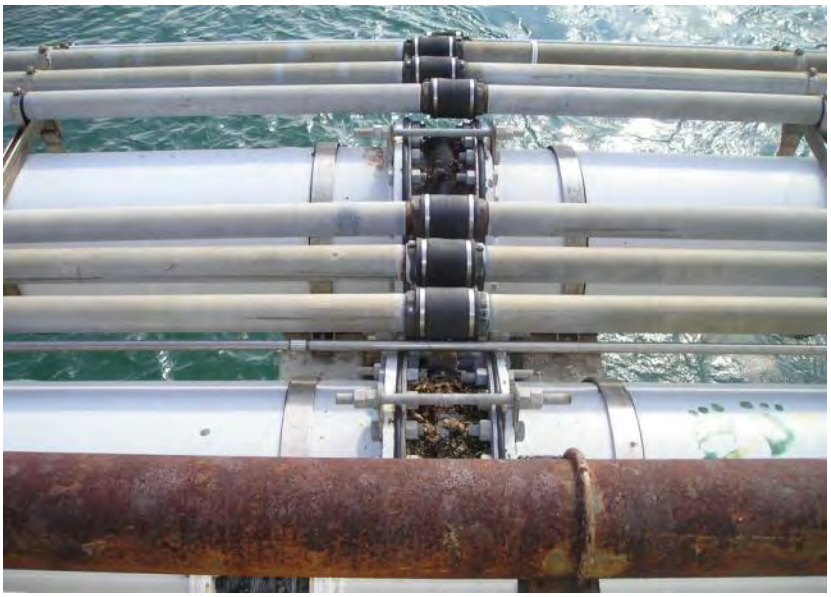

Photo No. 37: Top view of Pile Cap 3-4.

Photo No. 38: Cracked and delaminating concrete visible on north side of pipe support on Pile Cap 3-4.

Pile Cap 5-6-7 appears to be is in Good Condition. This pile cap is the only cap with three piles. The center pile (Pile 6) was damaged as the result of a mid-1990s boat impact. The pile cap was extended to the east, to accommodate a third, outer pile (Pile 5). Even though damaged Pile 6 exhibits the results of the mid-1990s boat impact, as may be seen in Photos No. 40 and No. 41, as well as Photos No. 14 through No. 21, Pile 6 continues to carry an unknown percentage of the load from the concrete pile cap. The magnitude of the load is indeterminable, because of the possibility of load sharing, by both Pile 5 and Pile 7, in addition to Pile 6. Because of this fact, it is recommended that Pile 6 be repaired by installing a pile jacket from the mudline to the pile cap. Pile 5 and Pile 7 appear to be in Good Condition above the water line.

Photo No. 39: Top view of Pile Cap 5-6-7.

Photo No. 40: Damaged Pile 6, with Pile 7 to the left and Pile 5 to the right.

Photo No. 41: Close-up view of damaged Pile 6, with cracked and delaminated shotcrete repair visible.

Pile Cap 8-9 appears to be in Good Condition. Both piles, Pile 8 and Pile 9, appear to be in Good Condition above the waterline.

Photo No. 42: Top view of Pile Cap 8-9.

Pile Cap 10-11 appears to be in Good Condition. The rubber gasket between the pipe clamp and the east side pipe has been dislodged and is hanging down loose. Both piles, Pile 10 and Pile 11, appear to be in Good Condition above the waterline.

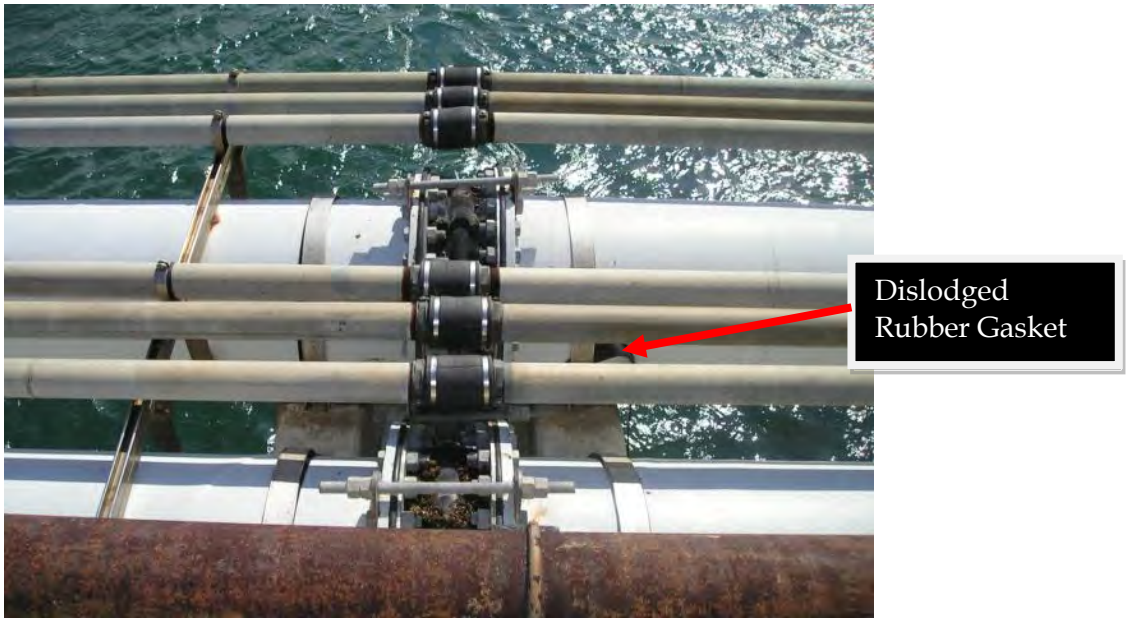

Photo No. 43: Top view of Pile Cap 10-11.

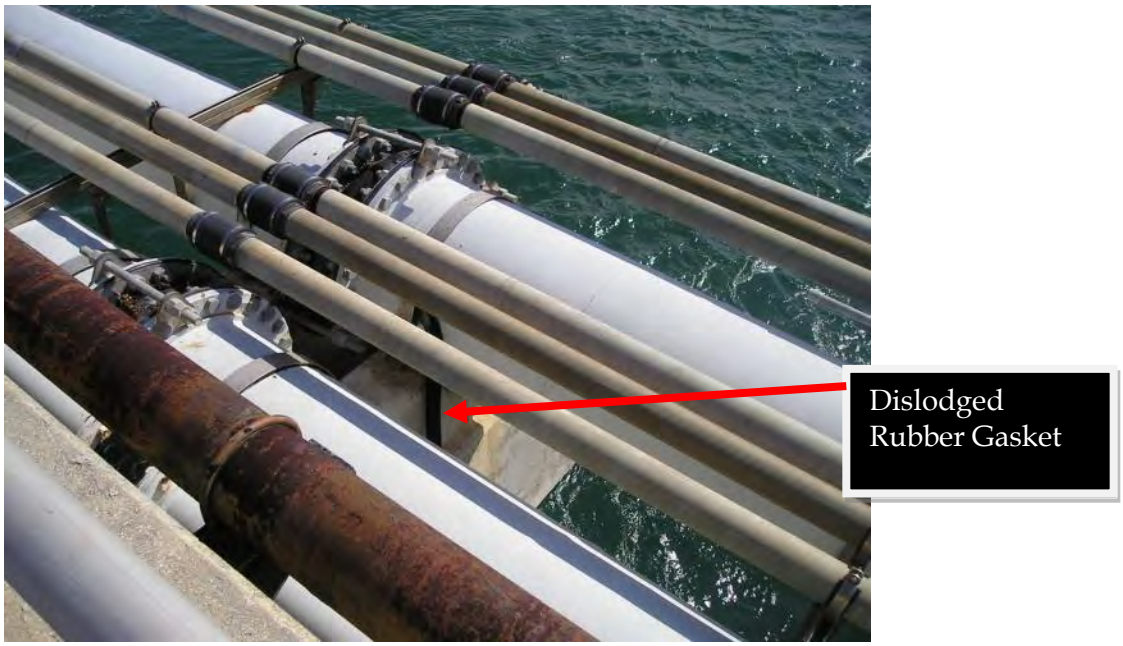

Photo No. 44: Dislodged rubber gasket at pipe clamp at Pile Cap 10-11.

Pile Cap 14-15 appears to be in Good Condition, except for a small concrete spall on the south side of the easternmost pipe saddle and initial stage of concrete delamination on the pile cap soffit. Both piles, Pile 14 and Pile 15, appear to be in Good Condition above the waterline.

Photo No. 45: Top view of Pile Cap 14-15.

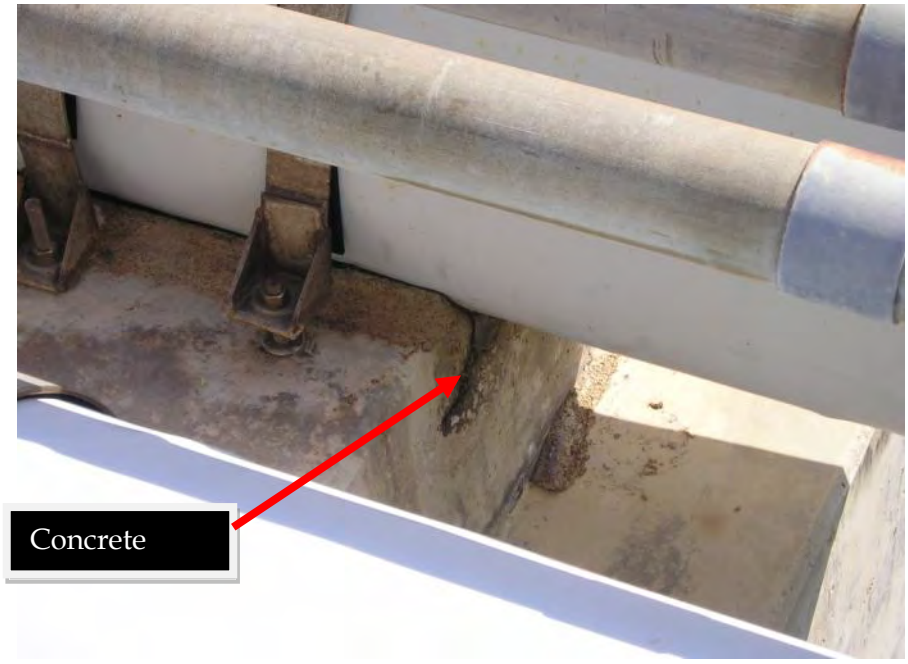

Photo No. 46: Concrete spall on south side of pipe support on Pile Cap 14-15.

Photo No. 47: Delaminating concrete on underside, or soffit, of Pile Cap 14-15.

8 Conclusions and Recommendations

With the exception of Pile 6, which sustained structural damage in the mid-1990s, the overall condition, of both the above water and the underwater sections of the Fleming Key Bridge Pipe Support Piling, is considered to be in "Good Condition," with a Condition Rating of 6. Periodic inspections are recommended to occur on 5-year intervals, with all newly found deterioration or damage repaired on a timely basis. With timely repairs, the piling should give many more years of service.

Although Pile 5 was installed to pick-up the load from Pile 6, it is recommended that Pile 6 be stripped of the previous shotcrete repair, all marine growth removed, the deteriorated concrete removed, the pile concrete and steel reinforcing bars properly cleaned and prepared; and then a structural pile jacket be installed to maintain whatever structural load capacity Pile 6 currently has, to reduce further corrosion to the pile reinforcement, and to extend the service life of Pile 6.

The 2003 Seamar Divers' Report recommended that not only should Pile 6 be encapsulated in a pile jacket, it also recommended that the remaining 14 precast concrete piles be encapsulated in pile jackets. Seamar's Report stated their reason for encapsulating all 15 of the pipe support piling was to "…prevent any further deterioration of the substructures surfaces due to the substantial currents experienced during tidal transitions, …as well as providing less resistance to the tidal fluctuations."

Considering the cost of each pile jacket, as compared to the negative structural effect the "minor pitting" has upon the structural load capacity of each precast concrete pile, it is our opinion that the cost of the pile jackets far outweighs the benefit. If it was felt the "minor pitting" of the pile faces posed a significant negative structural impact on the structural load capacity and/or the service life of the piles, a less costly repair can be implemented. As for streamlining the piles to provide less resistance to the tidal fluctuations and currents, it is felt this is not significant enough of a problem, to warrant the expenditure of roughly three-quarters of a million dollars.

The only other potential underwater pile repairs are to repair or patch the "minor pitting" areas on the four flat surfaces of the 14-inch square precast concrete piles. The severity of the pitting ranges from zero to roughly 3/4-inches deep, with an average depth of about 5/16-inches. Only two piles had pitting that was 3/4-inch deep or less and five piles had pitting that was 1/2-inch deep or less. Therefore, 50 percent of the 14 remaining piles had pitting that was 1/4-inch deep or less, with four piles not exhibiting pitting.

Because of the relatively small depth of the pitting, with 50 percent being negligible, it is recommended that the "minor pitting" areas not be repaired or patched at this time. However, the "minor pitting" condition should be inspected and monitored at recurring 5-year inspection intervals.

It should be noted that only three 12-inch high bands of marine growth were cleaned/removed from each pile for the Level II Underwater Inspection. It is quite possible there are areas on each of the 14 piles beneath the marine growth that was not removed where pitting greater than 3/4-inch deep exists. The only way to be completely certain of the depths and frequency of the pitting is to remove 100 percent of the marine growth from all 14 piles.

The topside condition of the structural components, primarily the above-water section of the precast concrete piles and the cast-in-place concrete pile caps, are in "Good Condition", with a Condition Rating of 6. There are however, a few items that require repairs, to stop further deterioration and extend service life. Considering the nature of the recommended repairs, there is no urgency to implement these repair efforts, at this time. But the sooner the repairs are implemented, the less deterioration that has to be repaired.

Table 4 below provides a summary of the topside items that require repairs. Of the seven cast-in-place concrete pile caps, only three (Pile Caps 3-4, 12-13, and 14-15) require repairs. The concrete repairs are recommended to remove the deteriorated concrete areas and to replace them with modified-polymer cementitious mortar repairs, thereby improving corrosion protection to the steel reinforcing bars and extending the service life of the pile caps. These repairs are not being recommended, because of structural capacity issues with the pile caps, but for the sole purpose to extend the service life of the pile caps.

TABLE 4

Summary of Recommended Topside Repairs

Pile Cap No.	Recommended Repairs
12-13	Repair 8-in. x 48-in. x 54-in. spalled concrete pile cap soffit = 14 cf Repair cracked east bottom edge of pile cap 12-in. x 12-in. x 54-in. = 5 cf
1-2	None
3-4	Repair 8-in. x 18-in. x 36-in. cracked and delaminating concrete on north side of pipe support = 4 cf
5-6-7	None
8-9	None
10-11	None
14-15	Repair 8-in. x 18-in. x 54-in. cracked and delaminating concrete pile cap soffit = 5 cf Repair 8-in. x 18-in. x 36-in. spalled concrete on south side of pipe support pile cap = 4 cf
	Total Repair Quantity = 32 cubic feet of Polymer-Modified Cementitious Mortar

The final recommendation of the 2003 Seamar Divers' Report was to "…establish a more effective fendering system to prevent any further damage due to collision with vessels or other floating debris." The recommendation to provide "a more effective fender system" to protect the piling is a prudent recommendation. However, at this time it is not known if the current timber pile dolphin fenders were in place at the time of the 2003 Seamar Divers' underwater inspection, or if the timber dolphins were added after the Seamar Report was issued. Neither is

it known if the current timber pile dolphin fenders were in place in the mid-1990s, at the time the boat impact caused the structural damage to Pile 5.

If the current timber pile dolphin fenders, as may be seen in Photo No. 48: Existing Timber Pile Dolphin Fender, were not added as the result of the Seamar Divers' Report's recommendation, this PDM recommends that the City take into consideration the Seamar recommendation and act accordingly.

Photo No. 48: Existing Timber Pile Dolphin Fender

9 Estimated Probable Repairs Cost

The CH2M HILL 2009 Technical Memorandum presented an Estimated Probable Cost, for the recommended repairs, which was up dated in 2010 and entitled, "Updated Conceptual Budgetary Cost Estimate" for Precast Concrete Pile Jacket Repairs, dated December 03, 2010. The 2010 Cost Estimate for the Pipe Support Piling Repairs was the last estimate prepared prior to the 2012 pile inspections. This cost estimate, other than being two-years old and prepared before the most recent Topside and Underwater Dive Inspections were undertaken, is based on the reported findings and recommendations of the 2003 Seamar Divers' Report. The Seamar Divers' Report recommended that pile jackets be provided to encapsulate all 15 precast concrete piles, and not just Pile 5. A copy of the 2010 Cost Estimate is presented in Appendix E.

The 2010 Cost Estimate for jacketing all 15 precast concrete piles was escalated from the December 2010 date, to the then estimated mid-point of construction date of July 01, 2011, using a 4 percent annual escalation rate. This yielded the Estimated Rounded Total of $773,000. To provide a point of reference in today's dollars, the 2010 cost estimate has been escalated, using the annual rates of inflation, or the Current Consumer Price Index (CPI), published by the United States Bureau of Labor Statistics, from the December 03, 2010 date, to the new estimated mid-point of construction date of December 03, 2013. The resulting compounded escalation rate is 7.89 percent over the 3-year period. The application of this escalation rate to the December 2010 estimated costs results in a Rounded Total Conceptual Budgetary Cost Estimate of $800,000, for providing pile jackets for all 15 piles.

However, this Preliminary Design Memorandum (PDM) recommends that only Pile 5 be encapsulated, with a pile jacket and not all 15 of the precast concrete piling.

2012 Cost Estimate

The recommendations of this PDM, based on the 2012 Topside and Underwater Dive Inspections, are of limited scope. Considering the piping support piles were completed in June-1990, based on the date of the "As-Built" drawings, they have been in service for roughly 22 years. The current condition of the precast concrete piles and the existing cast-in-place concrete pile caps has been classified as "Good Condition", with an ASCE Manual Condition Rating of 6. However, considering they have been exposed to the harsh, salt-laden marine environment of Key West, Florida for 22 years, their condition is felt to be in "very good" condition.

This PDM recommends providing a pile jacket to encapsulate only Pile 5, the pile damaged by boat impact in the mid-1990s, and accomplishing the minor repairs to three of the seven cast-in-place concrete pile caps, replacing areas of deteriorated concrete with a modified polymer cementations mortar repairs.

Based on the 2010 cost estimate's unit costs for encapsulating all 15 of the precast concrete piles, the 2010 estimate was adjusted downward to provide only one pile jacket to encapsulate Pile 5. The rounded estimated December 2013 probable cost for the Pile 5 pile jackets, including engineering and underwater diver inspections, totals $80,000.

This PDM also recommends the minor repairs to three of the seven cast-in-place concrete pile caps. Table 4: Summary of Recommended Topside Repairs tabulates the recommended repairs, which total approximately 32 cubic feet. Based on an approximate 2010 unit price for the polymer-modified cementitious mortar (P-MCM) repairs, the escalated 2013 unit price for the P-MCM repairs is estimated at $1000.00 per cubic foot, including a 20% Contingency Factor, a 20% Key West Factor, and Engineering. Based on this quantity and unit cost, the December 2013 estimated rounded cost for 32 cubic feet of P-MCM repairs, to three pile caps, is $32,000.

Therefore, the December-2013 estimated repair cost totals $121,000. The December 2013 Rounded Estimated Probable Cost of Repairs is $125,000.

Appendix A
Seamar Divers, Inc.'s Report, "Underwater Substructure Evaluations Fleming Key Force Mains Bridge Concrete Support Pilings", dated August 2003

CITY OF KEY WEST, FLORIDA
UTILITIES DEPT.

UNDERWATER SUBSTRUCTURE EVALUATION:

FLEMINGS KEY FORCE MAINS BRIDGE

CONCRETE SUPPORT PILINGS

Houston, TX (281) 208-2522 - New Orleans, LA (504) 433-2513 Miami, FL (305) 365-3865

SEAMAR DIVERS, INC.
DIVING & SALVAGE

INTRODUCTION

On August 9th, 2003 Seamar Divers, Inc. completed an underwater evaluation of the substructure of the Fleming Key Force Mains Bridge for Mr. David Fernandez with the City of Key West Utilities Department. The dive team overcame some adverse conditions to conduct the inspection as per attached scope of work.

Fifteen concrete pilings were inspected for deficiencies as; pitting, spalling, exposed rebar, stress cracks, or any other damages that may affect the structural properties of the pilings, as well as the condition of the surrounding seabed. See attached report, digital stills and CD ROMs for deficiencies that were noted to pilings above and below surface.

The following Seamar Divers, Inc. personnel on this project were as follows:

Francisco Cano	Supervisor/Diver
David Heinrich	Inspection Diver
Shay Files	Stand-by Diver/Tender

The following City of Key West personnel were on board to witness the inspection procedure:

Robert Andrews	Mooring Field Manager/Boat Operator

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P.O. Box 740976 – Houston, TX 77274

SEAMAR DIVERS, INC.
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Underwater Substructure Evaluation: Concrete Support Pilings of Fleming Key Force Mains Bridge for the City of Key West Utilities Department

Scope of Work:

The scopes of services to be provided by Seamar Divers, Inc. for this project are as follows:

Determine the condition of existing concrete pilings from waterline to seabed; presence of pitting, spalling, exposed rebar, stress cracks or any other damages that may affect the structural properties of the pilings.

Determine the condition of surrounding seabed; type of channel bottom, profile, debris accumulations at or near pilings, scour and/or undermining of footings (if applicable).

The method for acquiring data will be via underwater inspection commercial dive operations utilizing surface supplied air with two way communications by a 3-man team consisting of a Designated-Person-in-Charge, Inspection Diver and Stand-by Diver/Tender. Due to the amount of tidal current and M/V traffic in the area a boat (dive platform) will be necessary. Divers will utilize hand tools to remove marine growth in order to conduct visual and tactile examination, documenting all conditions with underwater color video camera. Profile and sounding information will be acquired with diver's pneumo-fathometer and verified by boat fathometer (if equipped).

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Report of Conditions

The underwater video inspection of Fleming Key Force Mains Bridge's 15 concrete pilings was performed on August 9th, 2003 at "slack" low since there were substantial currents during tidal transitions. The previous three days were utilized to remove a substantial amount of marine biofouling that encrusts all submerged areas of pilings to reveal the prestressed concrete underneath and to pinpoint deficiencies for the inspection video. Results are enclosed below and detailed in video, drawings and stills. All piling numbers referenced correspond with video and drawings.

Piling #1: Minor pitting was encountered up to 1/3" deep on all four faces at the water line. Both northeast and northwest corners show evidence of spalling. Minor pitting was also encountered up to 1/3" deep on all four faces at natural bottom. The southeast corner has been chipped from 4' below surface continuing 10' above surface; affected area is 1/2" to 2" wide.

Piling #2: Minor pitting was encountered 1/4" to 1/2" deep on all four faces water line and at natural bottom with evidence of spalling at the southeast corner in the water line area.

Piling #3: Minor pitting was encountered up to 1/2" deep on all four faces water line, mid water and at natural bottom with evidence of spalling at the northeast corner in the water line area and at the mid water area (6"long X 2" wide).

Piling #4: Minor pitting was encountered 1/16" to 1/8" deep on all four faces water line, mid water and at natural bottom with chipped area 1' long x 1/4" wide at the northeast corner in the water line area.

Piling #5: Minor pitting was encountered 1/16" to 1/4" deep on north, east and west faces in the water line area with a 2" chip in the southeast corner. Minor pitting was also encountered 1/16" to1/2" deep on north, east, south faces in the mid water area. Natural bottom area pitting was 1/16" deep concentrated on north and east faces.

Piling #6: A stress crack 5-1/2" long was observed running horizontal adjacent to and transversing the northwest corner and terminating in a spalled area. Minor pitting up to 1/4" deep was also observed as well as evidence of spalling of corners at water line, mid water and natural bottom. This piling has had repairs above water line.

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Report of Conditions (continued)

Piling #7: Minor to major pitting was encountered from 1/16" to 3/4" deep on several faces at all three levels as well as evidence of spalling at several corners.

Piling #8: Minor pitting up to 1/2" deep as well as evidence of spalling was encountered on several faces and corners at all three levels.

Piling #9: No apparent damages were observed in the waterline area. In the mid water area pitting was encountered 1/4" to 3/4" deep with evidence of spalling. At the natural bottom area minor pitting was encountered 1/16" to 1/4" deep.

Piling #10: Minor pitting 1/16" deep was observed on the west face and evidence of spalling was present at the southeast corner in the water line area. Minor pitting was encountered on all four faces at the natural bottom area with evidence of spalling at all four corners.

Piling #11: Minor pitting was observed in the water line area on the north face with evidence of slight spalling at the east and west corners. At the natural bottom area slight spalling was observed at the northeast corner.

Piling #12: No apparent damage was observed other than minor pitting that may be attributed to loss of aggregate during the forming phase of the piling.

Piling #13: Same conditions as Piling #12.

Piling #14: Minor pitting 1/4" deep was observed on west and east faces in the water line area as well as evidence of spalling at east corner.

Piling #15: No apparent damage was observed other than minor pitting that may be attributed to loss of aggregate during the forming phase of piling.

Surrounding Seabed: No serious accumulations of debris were found in contact or adjacent to the inspected pilings, however several structures were located protruding from the seafloor: (2) wood pile stubs extending 2' above natural bottom in the vicinity of piling #8 and (1) H-beam extending 6' above natural bottom between pilings #1 and #3. Seabed consists primarily of rock, coral with minimal signs of scour around the deeper pilings.

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SEAMAR DIVERS, INC.
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RECOMMENDATIONS

Upon reviewing all collected data with no previous inspection report made available; several items should be addressed. The structures protruding from the seabed in the vicinity of the pilings should be removed to prevent future accumulations of debris that could be detrimental to the pilings. Encapsulation of the pilings to prevent any further deterioration of the substructures surfaces due to the substantial currents experienced during tidal transitions. Type of encapsulation utilized should be similar as to what is in effect at the adjacent roadway bridge from well above mean tide to natural bottom. Serving multipurpose, increasing structural integrity as well as providing less resistance to the tidal fluctuations that were evident throughout the cleaning and inspection process. It would also be beneficial to establish a more effective fendering system to prevent any further damage due to collision with vessels or other floating debris.

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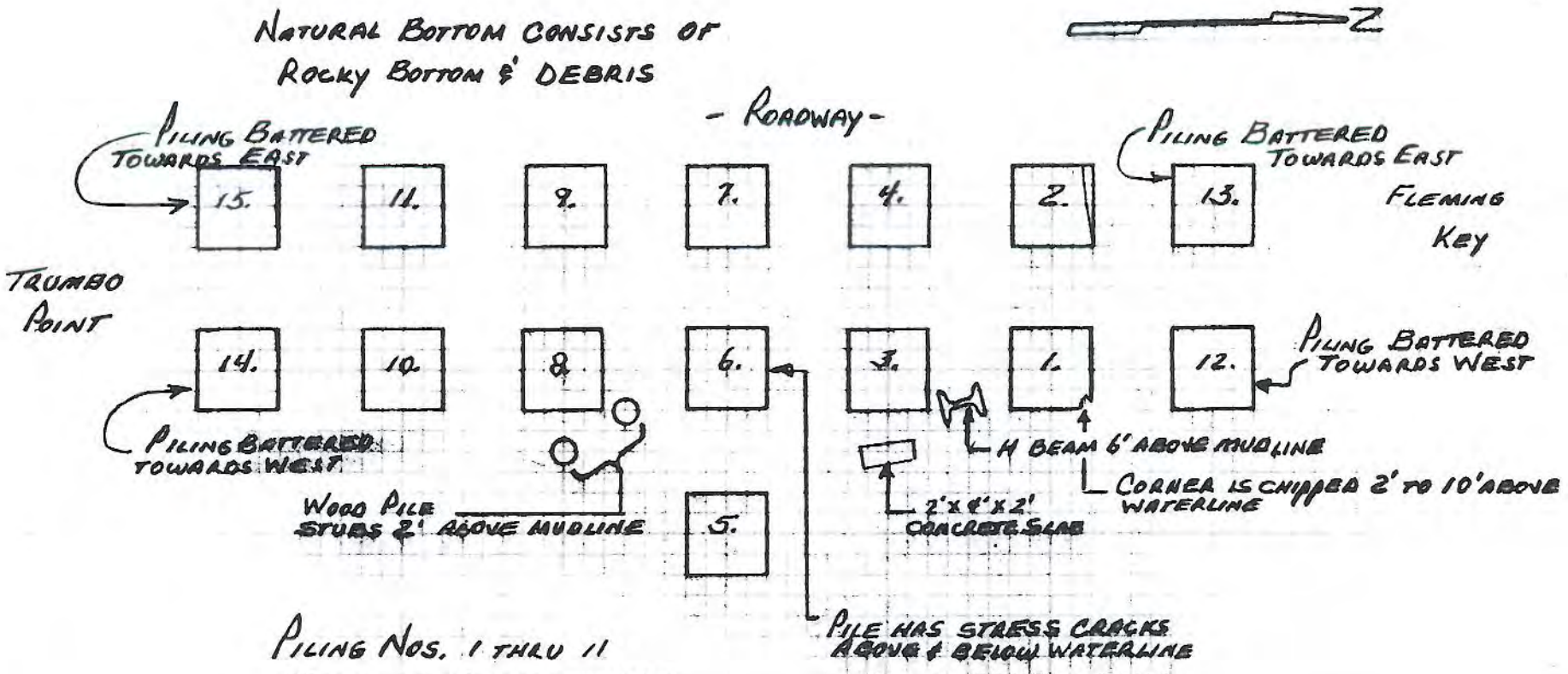
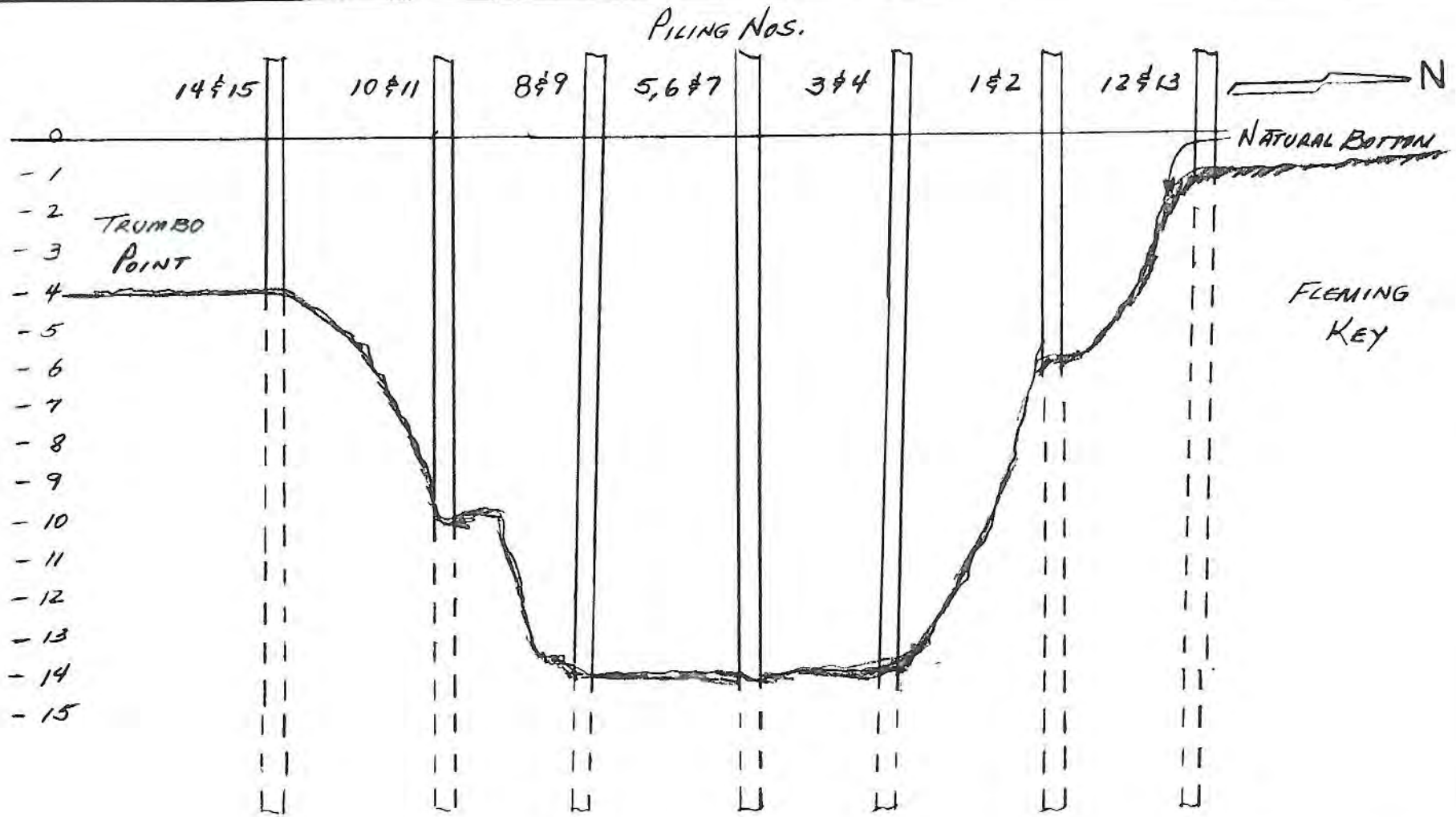


SEAMAR DIVERS, INC.		
SCALE: NIA	APPROVED BY:	DRAWN BY
DATE: 8-25-03		REVISED
KEY WEST - FLEMMING KEY BRIDGE		
TOP VIEW PIPE PILE RACK		DRAWING NUMBER 1.



SEAMAR DIVERS, INC.

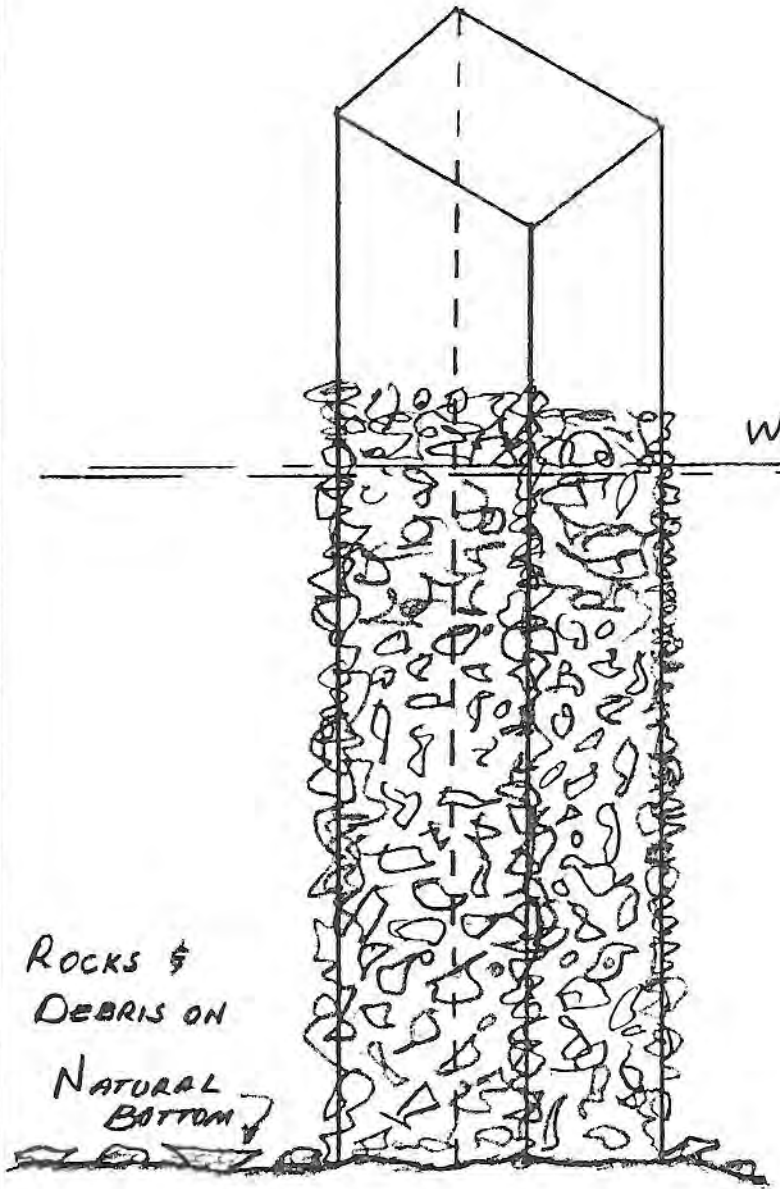
SCALE: N/A	APPROVED BY:	DRAWN BY
DATE: 8-25-03		REVISED

DEPTH PROFILE

KEY WEST - FLEMMING KEY BRIDGE

DRAWING NUMBER 2.

-See enclosed photos for more detail -

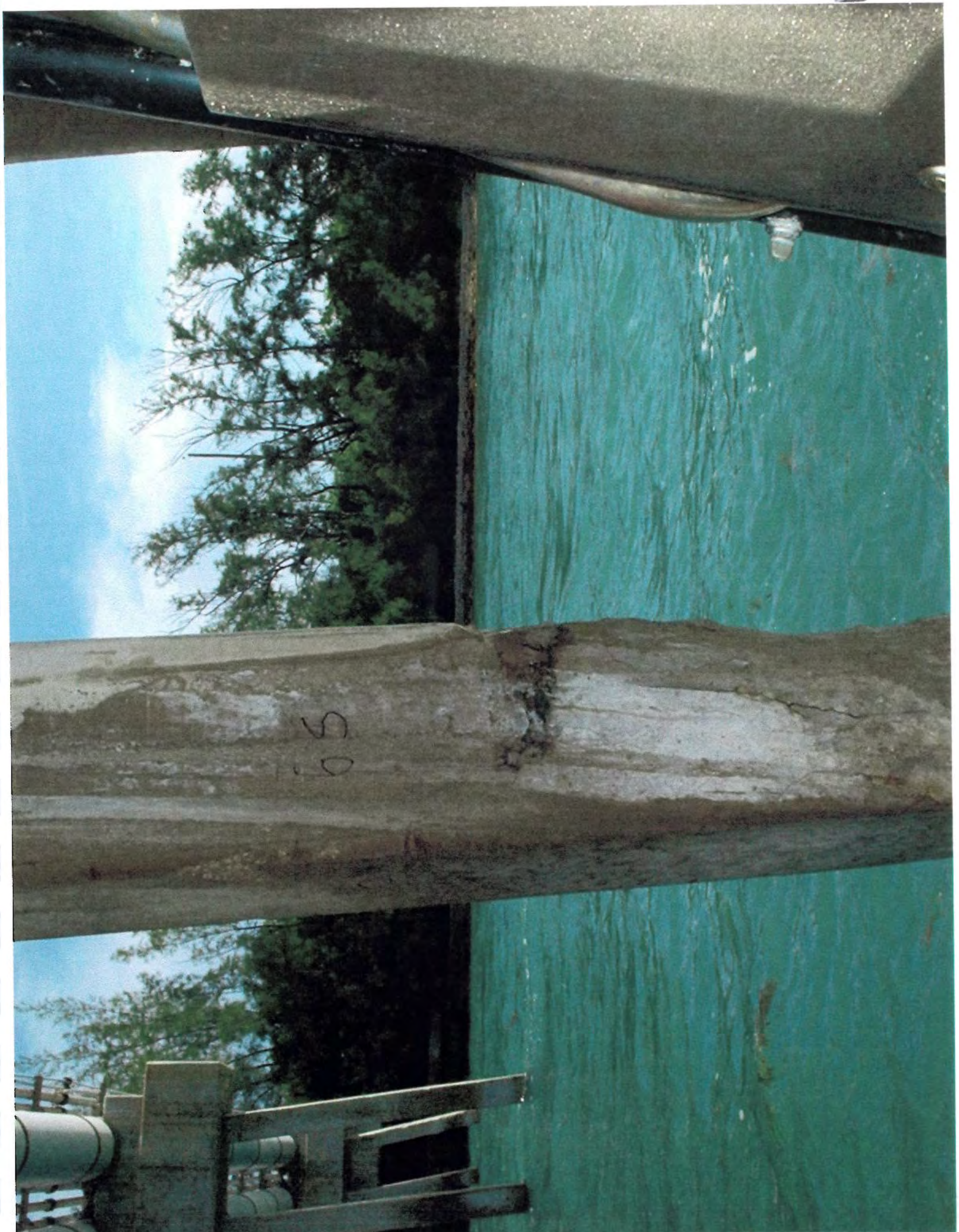


Note *
On Piling No. 6 East face there appears to be major repair above the waterline of the pile

100% marine growth 3' above waterline to natural bottom

Seamar Divers, Inc.		
SCALE: N/A	APPROVED BY:	DRAWN BY
DATE: 8-25-03		REVISED
Key West - Flemming Key Bridge		
A Typical Piling		DRAWING NUMBER 3.

1D



11

SEAMAR DIVERS, INC.
DIVING & SALVAGE

Date: 08/06/03 **Customer:** City of Key West Utilities

Job # 03-079 **Dive Supervisor:** Francisco Cano

Location:	City of Key West, Florida		
Vessel:	City Marina Pump-out Boat	**Customer Rep.:**	Mr. David Fernandez/Mr. Robert Andrews
Structure	Fleming Key Force Mains Bridge	**Client P.O.#:**	041020
		Day One	

Time:	Description of Work
0915	Dive team arrives at City of Key West Marina as requested by Robert Andrews (Boat operator)
0930	Dive team loads equipment to Pump/out Boat.
0948	Dive team departs Marina en route to Fleming Key Bridge.
1020	Dive station is set up and checked, pre-dive safety meeting is conducted. Current is running at 8 knots. Dive Supervisor reports to Seamar Divers, Inc. office that there are 15 pilings total to be inspected and not 5 as originally quoted.
1025	Diver #1 L/S (Left/Surface) reports pilings are 100% encrusted with both hard and soft marine growth. At this time the pilings are numbered in the order that they are cleaned. (see attached drawings) Shallow pilings will only have two 1' bands cleaned (waterline and bottom)
1030	Diver #1 begins removing marine growth.
1140	Diver finished cleaning bottom band on piling #1, moving to piling #2 bottom. Piling #2 penetrates natural bottom at -6' below surface.
1228	Diver #1 completes cleaning of bottom band on #2 piling.
1235	Diver #1 R/S (Reaches/Surface) to return to dock for more air and to allow tide to slow down.
1423	Dive team back on job site, current running at 2 knots.
1425	Diver #1 L/S to begin removing marine growth from pilings #5, #6, & #7. Three 1' bands will be removed of marine growth on these pilings (waterline, midway and bottom).
1555	Diver completes bottom bands moving to midway areas.
1556	Tender in water to clean waterline bands.
1730	Tender completes waterline bands on all three pilings and returns to boat.
1739	Diver #2 L/S to assist Diver #1 with midway bands.
1800	Diver #1 and #2 R/S. City of Key West rep. calls end to diving day due to M/V traffic.
1825	Dive team returns to Marina, unloading personal dive gear and U/W video package.
1840	Dive team departs Marina to return at 0800 on August 7th, 2003.

SEAMAR DIVERS, INC.
DIVING & SALVAGE

Date: 08/07/03 **Customer:** City of Key West Utilities

Job # 03-079 **Dive Supervisor:** Francisco Cano

Location:	City of Key West, Florida		
Vessel:	City Marina Pump-out Boat	**Customer Rep.:**	Mr. David Fernandez/Mr. Robert Andrews
Structure	Fleming Key Force Mains Bridge	**Client P.O.#:**	041020
		Day Two	

Time:	Description of Work
0745	Dive team arrives at City of Key West Marina.
0810	Dive team departs with Robert Andrews to fill HP Breathing Air cylinders.
0945	Dive team returns to Marina and loads gear and cylinders for the days work.
1015	Dive team at jobsite. Current running at 6 knots.
1020	Diver #1 and #2 L/S to remove marine growth from waterline areas of pilings #1, #2, #12 & #13.
1100	Diver #2 R/S. Waterline bands completed on pilings #12 & #13.
1230	Diver #1 completes waterline bands on pilings #1 & #2.
1300	Diver #3 L/S to clean bottom band on piling #3. Diver #1 cleaning waterline on pilings #3 & #4.
1343	Diver #3 R/S. Bottom band completed on piling #3.
1425	Diver #1 completes cleaning waterline bands on pilings #1 & #2.
1449	Diver #2 L/S to clean midway band on piling #3.
1511	Diver #1 moves to piling #4 to clean midway band.
1530	Diver #1 R/S. Midway band on piling #4 completed.
1535	Diver #3 L/S to clean midway band on piling #6. Diver #1 L/S to clean waterline bands on pilings #10, #11, #14 & #15.
1642	Diver #3 R/S. Midway band on piling #6 completed.
1700	Diver #1 R/S. Waterline bands on pilings #10, #11, #14 & #15 completed.
1718	Dive team departs job site en route to Marina.
1738	Dive team at Marina to offload personal gear.
1800	Dive team departs Marina to return 0830 on August 8th, 2003.

SEAMAR DIVERS, INC.
DIVING & SALVAGE

Date: 08/08/03 **Customer:** City of Key West Utilities

Job # 03-079 **Dive Supervisor:** Francisco Cano

Location:	City of Key West, Florida		
Vessel:	City Marina Pump-out Boat	**Customer Rep.:**	Mr. David Fernandez/Mr. Robert Andrews
Structure	Fleming Key Force Mains Bridge	**Client P.O.#:**	041020
		Day Three	

Time:	Description of Work
0830	Dive team arrives at City of Key West Marina. Loading gear to boat.
0855	Dive team departs Marina en route to jobsite.
0920	Dive team arrives at Fleming Key Bridge and is informed that no escort boat will available to slow down M/V traffic. Mr. Robert Andrews makes calls to find an escort.
1018	Diver #1 L/S to clean bottom of piling #10, current running at 7 knots. Dive supervisor calls Mr. David Fernandez to request escort boat.
1128	Diver #1 R/S completes cleaning of 2 sides of piling #10. Dive supervisor calls the dive because of too much M/V traffic and current making it unsafe. Escort did not arrive.
1141	Dive team returns to Marina to let tide pass and wait on escort.
1320	Dive team back on jobsite.
1337	Boat secure to piling #10 & #11. Current running at 5 knots and no escort boat. Standing by for escort to arrive.
1500	Diver #1 L/S to resume cleaning of piling #10.
1524	Diver #1 completed bottom band on piling #10 moving to #11.
1528	Diver #2 L/S to help clean on piling #11.
1611	Diver #1 & #2 R/S. Completed cleaning on piling #11.
1620	Diver #1 L/S to clean waterline bands on pilings #8 & #9.
1800	Diver #1 R/S. Completed cleaning waterline bands on pilings #8 & #9.
1802	Dive team en route to Marina.
1818	Dive team unloading gear.
1830	Dive team departs Marina to return at 1300 on August 9th, 2003. Start time changed on final day to be able to take advantage of slack tide for U/W video inspection.

SEAMAR DIVERS, INC.
DIVING & SALVAGE

Date: 08/09/03 **Customer:** City of Key West Utilities

Job # 03-079 **Dive Supervisor:** Francisco Cano

Location:	City of Key West, Florida		
Vessel:	City Marina Pump-out Boat	**Customer Rep.:**	Mr. David Fernandez/Mr. Robert Andrews
Structure	Fleming Key Force Mains Bridge	**Client P.O.#:**	041020
		Day Four	

Time:	Description of Work
1300	Dive team arrives at City of Key West Marina.
1310	Loading gear to boat.
1330	Dive team arrives at jobsite. Current running at 6 knots.
1350	Diver #1 L/S to conduct U/W video inspection of pilings #12 & #13.
1410	Diver #1 R/S completes inspection of pilings #12 & #13.
1416	Diver #1 L/S to conduct U/W video inspection of pilings #1 & #2, but current is running too strong. Will do shallower pilings first where there is less current.
1430	Diver #1 R/S to move to pilings #14 & #15.
1440	Diver #1 L/S to conduct U/W video inspection of pilings #14 & #15.
1458	Diver #1 R/S completes inspection of pilings #14 & #15. Boat moving to pilings #10 & #11.
1509	Diver #1 L/S to conduct U/W video inspection of pilings #10 & #11.
1530	Diver #1 R/S completes inspection of pilings #10 & #11. Boat moving to pilings #8 & #9.
1550	Diver #1 L/S to conduct U/W video inspection of pilings #8 & #9.
1630	Diver #1 R/S completes inspection of pilings #8 & #9. Moving boat to pilings #5, #6 & #7.
1650	Diver #1 L/S to conduct U/W video inspection of pilings #5, #6 & #7.
1745	Diver #1 R/S completes inspection of pilings #5, #6 & #7. Moving boat to pilings #3 & #4.
1808	Diver #2 L/S to conduct U/W video inspection of pilings #3 & #4.
1828	Diver #2 R/S completes inspection of pilings #3 & #4. Moving boat to pilings #1 & #2.
1835	Diver #2 L/S to conduct U/W video inspection of pilings #1 & #2.
1853	Diver #2 R/S. U/W video inspection of 15 concrete pilings of Fleming Key Force Mains Bridge for the City of Key West Utilities Department is completed. (please refer to conditions report, video and drawings for details)
1945	Dive team departs City of Key West Marina with all gear.
	THANKS FOR THE WORK!

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SEAMAR DIVERS, INC.
DAILY TIME SHEET

Phone: (281) 208-2522
Fax: (281) 208-2524

CUSTOMER: City of Key West Utilities Dept
MAILING ADDRESS:
ATTENTION: David Fernandez PHONE # ( )
CUSTOMER S.O #:
JOB DESCRIPTION AND/OR WORK PERFORMED: Diving Evaluation & Bottom Profile Bottom Survey for Debris & Bottom Conditions

DATE: 8/6/03 Wed
JOB NUMBER: 03-079
JOB LOCATION:
CUSTOMER JOB #:

PERSONNEL AND DEPTH:

Mileage	Hours	Divers	Depth	Hours	Tenders
	10	F. DANO		10	S. Fikes
	10	D. Howard			

ACCIDENTS REPORTED: None

TRUCKING:

CONSUMABLES:

Oxygen	
Compressed Air	11 7/12
H_2O_2	
Nitrox	
Battery	
Manila Rope	
Poly Rope	1/2 (±)
Burning Rods	
Welding Rods	
Bottle Buoy	
Styrofoam Buoy	
35 mm Film	
Video Tapes	
Duct Tape	1

EQUIPMENT:

SHALLOW AIR PKG.		JETTING EQUIPMENT		BURNING EQUIPMENT	
216 Compressor	1	300' Burning Lead w/Torch		300' Burn Rig	
325 Compressor		Jet Pump #		600' Burn Rig	
Filter System	1/2	Jet Hose		Bottle Rack	
#10 Whip		Jet Nozzle		Oxygen	
300' Dive Hose	2	CP Hose		Acetyline	
Volume Tank				Knife Switch	
Ladder	1			O_2 Regulator	
				Burning Box	
		AIR LIFT EQUIPMENT		Welding Mach.	
		4" Air Lift		U/W Burn Leads	
DEEP AIR PKG.		6" Air Lift		U/W Weld Leads	
D/L Chamber		Extension		Weld Electrodes	
____ Compressor		____ Compressor			
____ Compressor		CP Hose		CAMERA EQUIPMENT	
Volume Tank				35 MM Camera	
Filter System				U/W Strobe	
300' Dive Hose				U/W Video/Audio	1
600' Dive Hose		HYDRAULIC EQUIPMENT		Video Tapes	
Bottle Rack		1" Impact Wrench			
Oxygen Bottle		1-1/2" Impact Wrench			
Compressed Air Bottle		Hydraulic Unit		MISCELLANEOUS EQUIPMENT	
O_2 Regulator		Twin Hose On Reel		10' Probe	
Compressed Air Regulator		Sockets		Potentiometer/Probe	
Pneumo Gauge				Open Bottom Bell	
Ladder		Back Up Wrenches		Launching System	
Manual				8' x 10' H_2O_2 House	
Decompression Tables		3/4" Air Hose		Tool Box	1
				Diva Radio	

THIRD PARTY EQUIPMENT AND/OR SERVICES:

Frank Dano — SEAMAR REPRESENTATIVE — SIGNATURE REQUIRED

CUSTOMER REPRESENTATIVE — SIGNATURE REQUIRED

REMINDER — ATTACH COMPLETED DAILY DIVE LOGS

P.O. Box 740976
Houston, TX 77274

SEAMAR DIVERS, INC.

DAILY TIME SHEET

Phone: (281) 208-2522
Fax: (281) 208-2524

CUSTOMER: City of Key West Utilities

MAILING ADDRESS:

ATTENTION: D. Fernandez PHONE # ( )

CUSTOMER S.O.#:

DATE: 8/7/03 Thurs.

JOB NUMBER: 03-C-22

JOB LOCATION: Key West FL

CUSTOMER JOB #:

JOB DESCRIPTION AND/OR WORK PERFORMED: Diving Evaluation & Bottle Replacement Fisher Survey for Debris & Bottom Conditions

PERSONNEL AND DEPTH:

Mileage	Hours	Divers	Depth	Hours	Tenders
	10	P. CANO		10	S. Fikes
	10	D. Heinrich			

ACCIDENTS REPORTED: None.

TRUCKING:

CONSUMABLES:

Oxygen	
Compressed Air	1" 25 Min.
H_2O_2	
Nitrox	
Battery	
Manila Rope	
Poly Rope	
Burning Rods	
Welding Rods	
Bottle Buoy	
Styrofoam Buoy	
35 mm Film	
Video Tapes	
Duct Tape	

EQUIPMENT:

SHALLOW AIR PKG.		JETTING EQUIPMENT		BURNING EQUIPMENT	
216 Compressor		300' Burning Lead w/Torch		300' Burn Rig	
325 Compressor	1	Jet Pump #		600' Burn Rig	
Filter System		Jet Hose		Bottle Rack	
#10 Whip	3	Jet Nozzle		Oxygen	
300' Dive Hose	2	CP Hose		Acetyline	
Volume Tank				Knife Switch	
Ladder	1			O_2 Regulator	
				Burning Box	
		AIR LIFT EQUIPMENT		Welding Mach.	
		4" Air Lift		U/W Burn Leads	
DEEP AIR PKG.		8" Air Lift		U/W Weld Leads	
DA Chamber		Extension		Weld Electrodes	
____ Compressor		____ Compressor			
____ Compressor		CP Hose			
Volume Tank				CAMERA EQUIPMENT	
Filter System				35 MM Camera	
300' Dive Hose				U/W Strobe	
600' Dive Hose		HYDRAULIC EQUIPMENT		U/W Video/Audio	1
Bottle Rack		1" Impact Wrench		Video Tapes	1
Oxygen Bottle		1-1/2" Impact Wrench			
Compressed Air Bottle		Hydraulic Unit			
O_2 Regulator		Twin Hose On Reel		MISCELLANEOUS EQUIPMENT	
Compressed Air Regulator		Sockets ____		10' Probe	
Pneumo Gauge				Potentiometer/Probe	
Ladder		Back Up Wrenches		Open Bottom Bell	
Manual				Launching System	
Decompression Tables		3/4" Air Hose		8' x 10' H_2O_2 House	
				Tool Box	
				Dive Radio	2

THIRD PARTY EQUIPMENT AND/OR SERVICES:

Francisco (Paco) — SEAMAR REPRESENTATIVE SIGNATURE REQUIRED

CUSTOMER REPRESENTATIVE SIGNATURE REQUIRED

REMINDER — ATTACH COMPLETED DAILY DIVE LOGS

P.O. Box 740976
Houston, TX 77274

SEAMAR DIVERS, INC.

DAILY TIME SHEET

Phone: (281) 208-2522
Fax: (281) 208-2524

CUSTOMER: City of Key West Utilities Dept
MAILING ADDRESS:
ATTENTION: D. Fernandez PHONE # ( )
CUSTOMER S.O.#:

DATE: 8/8/03 F.E.
JOB NUMBER: 03-079
JOB LOCATION: Key West FL.
CUSTOMER JOB #:

JOB DESCRIPTION AND/OR WORK PERFORMED: Piling Evaluation & Bottom Photos
Bottom Survey For Debris & Bottom Composition

PERSONNEL AND DEPTH:

Mileage	Hours	Divers	Depth	Hours	Tenders
	10	I CANO		10	J. Ellis
	10	D. Hernandez			

ACCIDENTS REPORTED: None

TRUCKING:

CONSUMABLES:

Oxygen	
Compressed Air	
H_2O_2	
Nitrox	
Battery	
Manila Rope	
Poly Rope	
Burning Rods	
Welding Rods	
Bottle Buoy	
Styrofoam Buoy	
35 mm Film	
Video Tapes	
Duct Tape	

EQUIPMENT:

SHALLOW AIR PKG.		JETTING EQUIPMENT		BURNING EQUIPMENT	
216 Compressor	1	300' Burning Lead w/ torch		300' Burn Rig	
325 Compressor		Jet Pump #		600' Burn Rig	
Filter System	1	Jet Hose		Bottle Rack	
#10 Whip	3	Jet Nozzle		Oxygen	
300' Dive Hose	2	CP Hose		Acetylene	
Volume Tank				Knife Switch	
Ladder	1			O_2 Regulator	
				Burning Box	
		AIR LIFT EQUIPMENT		Welding Mach.	
		4" Air Lift		U/W Burn Leads	
DEEP AIR PKG.		6" Air Lift		U/W Weld Leads	
DVL Chamber		Extension		Weld Electrodes	
____ Compressor		____ Compressor			
____ Compressor		CP Hose			
Volume Tank				CAMERA EQUIPMENT	
Filter System				35 MM Camera	
300' Dive Hose				U/W Strobe	
600' Dive Hose		HYDRAULIC EQUIPMENT		U/W Video/Audio	
Bottle Rack		1" Impact Wrench		Video Tapes	
Oxygen Bottle		1-1/2" Impact Wrench			
Compressed Air Bottle		Hydraulic Unit			
O_2 Regulator		Twin Hose On Reel		MISCELLANEOUS EQUIPMENT	
Compressed Air Regulator		Sockets ____		10' Probe	
Pneumo Gauge		____		Potentiometer/Probe	
Ladder		Back Up Wrenches		Open Bottom Bell	
Manual		____		Launching System	
Decompression Tables		3/4" Air Hose		8' x 10' H_2O_2 House	
				Tool Box	
				Dive Radio	2

THIRD PARTY EQUIPMENT AND/OR SERVICES:

Francisco Cano
SEAMAR REPRESENTATIVE SIGNATURE REQUIRED

CUSTOMER REPRESENTATIVE SIGNATURE REQUIRED

REMINDER — ATTACH COMPLETED DAILY DIVE LOGS

P.O. Box 740976
Houston, TX 77274

SEAMAR DIVERS, INC.

Phone: (281) 208-2522
Fax: (281) 208-2524

DAILY TIME SHEET

CUSTOMER: City of Key West Utilities Dept.
MAILING ADDRESS:
ATTENTION: David Fernandez PHONE # ( )
CUSTOMER S.O.#:

DATE: ~~03-075~~ 8/1/03 SR
JOB NUMBER: 03-075
JOB LOCATION: Flemming Key
CUSTOMER JOB #:

JOB DESCRIPTION AND/OR WORK PERFORMED: Piling Evaluation & Bottom Profile
Bottom Survey for Debris & Bottom Consistency

ACCIDENTS REPORTED:

TRUCKING:

PERSONNEL AND DEPTH:

Mileage	Hours	Divers	Depth	Hours	Tenders
	8	F. CANO		8	S. Files
	8	D. Hedrich			

CONSUMABLES:

Oxygen	
Compressed Air	2
H_2O_2	
Nitrox	
Battery	
Manila Rope	
Poly Rope	
Burning Rods	
Welding Rods	
Bottle Buoy	
Styrofoam Buoy	
35 mm Film	
Video Tapes	1
Duct Tape	

EQUIPMENT:

SHALLOW AIR PKG.		JETTING EQUIPMENT		BURNING EQUIPMENT	
216 Compressor	1	300' Burning Lead w/Torch		300' Burn Rig	
325 Compressor		Jet Pump #		600' Burn Rig	
Filter System	1	Jet Hose		Bottle Rack	
#10 Whip	3	Jet Nozzle		Oxygen	
300' Dive Hose	4	CP Hose		Acetyline	
Volume Tank				Knife Switch	
Ladder	1			O_2 Regulator	
		AIR LIFT EQUIPMENT		Burning Box	
		4" Air Lift		Welding Mach.	
DEEP AIR PKG.		6" Air Lift		U/W Burn Leads	
D/L Chamber		Extension		U/W Weld Leads	
____ Compressor		____ Compressor		Weld Electrodes	
____ Compressor		CP Hose			
Volume Tank				CAMERA EQUIPMENT	
Filter System				35 MM Camera	
300' Dive Hose				U/W Strobe	
600' Dive Hose		HYDRAULIC EQUIPMENT		U/W Video/Audio	1
Bottle Rack		1" Impact Wrench		Video Tapes	
Oxygen Bottle		1-1/2" Impact Wrench			
Compressed Air Bottle		Hydraulic Unit			
O_2 Regulator		Twin Hose On Reel		MISCELLANEOUS EQUIPMENT	
Compressed Air Regulator		Sockets ____		10' Probe	
Pneumo Gauge		____		Potentiometer/Probe	
Ladder		Back Up Wrenches		Open Bottom Bell	
Manual		____		Launching System	
Decompression Tables		3/4" Air Hose		8' x 10' H_2O_2 House	
				Tool Box	
				Dive Radio	2

THIRD PARTY EQUIPMENT AND/OR SERVICES:

Francisco Cano
SEAMAR REPRESENTATIVE SIGNATURE REQUIRED

CUSTOMER REPRESENTATIVE SIGNATURE REQUIRED

REMINDER — ATTACH COMPLETED DAILY DIVE LOGS

Appendix B
CH2M HILL Technical Memorandum: "Structural Evaluation of the Fleming Key Bridge Pipe Crossing Support Pilings", dated July 17, 2009

Structural Evaluation of the Fleming Key Bridge Pipe Crossing Support Pilings, City of Key West, Florida, Work Order F-09 SWR

PREPARED FOR: City of Key West, Florida, Utilities Department

PREPARED BY: Rohan Sybron, P.E. (FL), CH2M HILL

CHECKED BY: Gary R. Dupere, P.E., CH2MHILL

DATE: July 17, 2009

PROJECT NUMBER: 390490

Project Description

The City of Key West (the City) is looking into the potential of implementing reclaimed water for irrigation in certain areas of Key West. To supply reclaimed water to the City, a new pipeline will need to be installed on the Fleming Key Bridge pipe support pilings. Currently, there is a pile and pile cap support system for the two existing 30-inch-diameter steel pipes that convey sewage to the Richard A. Heyman Environmental Protection Facility (Wastewater Treatment Plant). The City is proposing the installation of an additional steel pipe of up to 18 inches in diameter for a reclaimed water main to be superimposed on the existing pipe support system.

As part of the City's due diligence effort, the impacts on the existing pipe support system from the additional pipeline weight must be determined.

Assumptions

The following assumptions were used in the analysis of the adequacy of the existing pipe crossing piling system to support the new 18-inch-diameter pipe:

- The existing pipe support system drawings (Sheets 328 and 330)[1], Seamar report[2], and precast concrete pile installation specifications[3] are correct and valid. Specifically that the piles: are driven to a tip elevation of at least -35.0 mean low water (MLW), can develop an ultimate axial capacity of 100 tons, have concrete compressive strength of 5,500 pounds per square inch (psi), and are square with 14-inch sides.

[1]CH2M HILL 1986. Key West Wastewater Treatment Plant, Force Mains Channel Crossing Plan and Profile. CH2M HILL Project Number FC20064.G1. May 1986.

[2]Seamar Divers, Inc. Diving and Salvage. 2003. Underwater Substructure Evaluation: Flemings Key Force Mains Bridge, Concrete Support Pilings. Prepared for the City of Key West, Utilities Department. August 9, 2003.

[3]CH2M HILL. 1986. Specification Section 02312, Prestressed, Precast Concrete Piling. CH2M HILL Project Number FC20064C-CVOM. May 1986.

- Total loading to be added is limited to an 18-inch-diameter steel pipe filled with reclaimed water.
- This Technical Memorandum (TM) is limited to the determination of the capability of the existing pipe crossing piling system to support an 18-inch-diameter steel reclaimed water pipeline. The provision of mounting details is outside the scope of this TM. Pipe installation will be above and centered between the two existing 30-inch steel pipes.
- The structural analysis and results are based on "*as-built*" or "*new*" conditions of the existing precast concrete piles and cast-in-place concrete bent caps because their existing structural conditions are unknown.
- The recommendations for repair from the 2003 Seamar inspection report of the support piers have not been implemented based on correspondence from David Fernandez to Andrew Smyth.[4] Based on this email, it will be assumed that no repairs were required.
- The existing Fleming Key Bridge structure provides lateral restraint for horizontal loads applied to the existing pipe crossing piling system in a direction that causes the existing pipe crossing piling system to move toward the bridge. The existing pipe crossing piling system are battered or installed at an angle, to provide lateral restraint for horizontal loads applied in the opposite direction to the batter.

Existing Conditions

An underwater substructure evaluation was completed by Seamar Divers in 2003, 17 years after original construction. The Seamar report findings were that at least 10 of the 15 precast piles were exhibiting signs of concrete spalling and cracking. It is now 23 years since the original construction, and it is reasonable to assume that the piles have deteriorated even more since the Seamar report, as a result of the severe marine environment. Visible signs of concrete deterioration, attributed to corrosion of the steel reinforcement during the past 6 years, will most likely be more pronounced than those visible in 2003.

Pile No. 6 from the Seamar report was damaged during a boating accident, and showed signs of stress cracks in 2003. A new pile (No. 5) was installed to augment the capacity of the damaged pile. There was no information available on Pile No. 5, such as size, length, embedment depth, concrete strength, or date installed.

Analysis

Based on the assumption of the piles being in "*as-built*" or "*new*" condition, the existing piles and bents were evaluated for existing loads and the future load of an 18-inch-diameter steel pipe filled with reclaimed water by comparing applied design loads to calculated capacities.

Three design checks were performed:

- The first check determined the actual load at the bottom of the pile and compared this load with the allowable pile compressive capacity.

[4]Fernandez, David/City of Key West. 2009. Personal communication with Andrew Smyth/CH2M HILL. May 18.

- The second check determined the actual bending moment in the pile bent and compared this moment with the ultimate bending moment.
- The third check determined the actual pile axial load and compared this load with the ultimate pile capacity [3] from design tables. [5]

Results

Results of the analysis are shown in Exhibit 1.

EXHIBIT 1
Structural Analysis Results

Design Check No.	Applied	Capacity	Results
1. Pile/Soil Axial Compressive Capacity	Axial load applied to each pile (including pile weight, concrete bent cap, pipes, fluids, conduits, plus new 18" steel pipe, live load of 50 lbs/ft along pipe length): 78.4 kips (unfactored)	Pile driving resistance (Ultimate pile capacity of 100 tons with Factor of Safety of 2.25): 88.9 kips (Allowable)	78.4 kips<88.9 kips (OK)
2. Pile Bent Bending Moment	Design bending moment (including pipes, fluid, conduits, bent, new 18" steel pipe): 38.1 kip-ft (factored)	Ultimate bending capacity: 691 kip-ft	38.1 kip-ft<691 kip-ft (OK)
3. Concrete Pile Axial Capacity	Design concrete axial load (including pile weight, bent, pipes, fluid, conduits, new 18" steel pipe, live load of 50 lbs/ft along pipe length): 110.5 kips (factored)	Ultimate concrete pile axial capacity from precast tables (14-in square precast pile, 40ft unbraced length, 5000 psi concrete, 700psi prestress): 125 kips.	110.5 kips<125 kips (OK)

Notes:
1 kip=1,000 pounds
1 ton=2,000 pounds=2.0 kips

Comparing the applied loads to the "*as-built*" or "*new*" condition member capacities tabulated above, the piles and concrete bent caps appear to be adequate to resist the new applied dead and live loads from the 18-inch-diameter steel pipe, based on the previously stated assumptions being correct.

Recommendations

The Fleming Key Bridge pipe crossing piling system is not in an "*as-built*" or "*new*" condition, as has been assumed in this analysis. In fact, the repair recommendations of the 2003 Seamar inspection report were *not* accomplished, and the structural condition of the precast concrete support pilings has most likely deteriorated further during the last 6 years. Accordingly, it is recommended that a new, more comprehensive topside and underwater structural evaluation be performed to determine the current condition of the structural

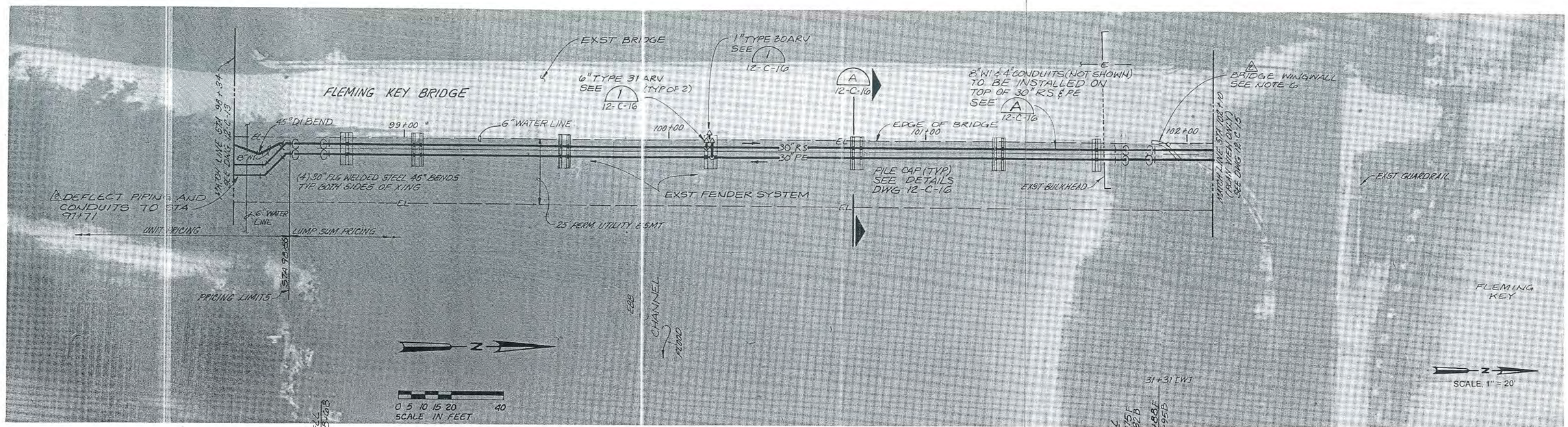
[5]Prestressed Concrete Institute. 1977. "Recommended Practice for Design, Manufacture and Installation of Prestressed Concrete Piling". *PCI Journal.* Vol. 22, No. 2. March/April 1977.

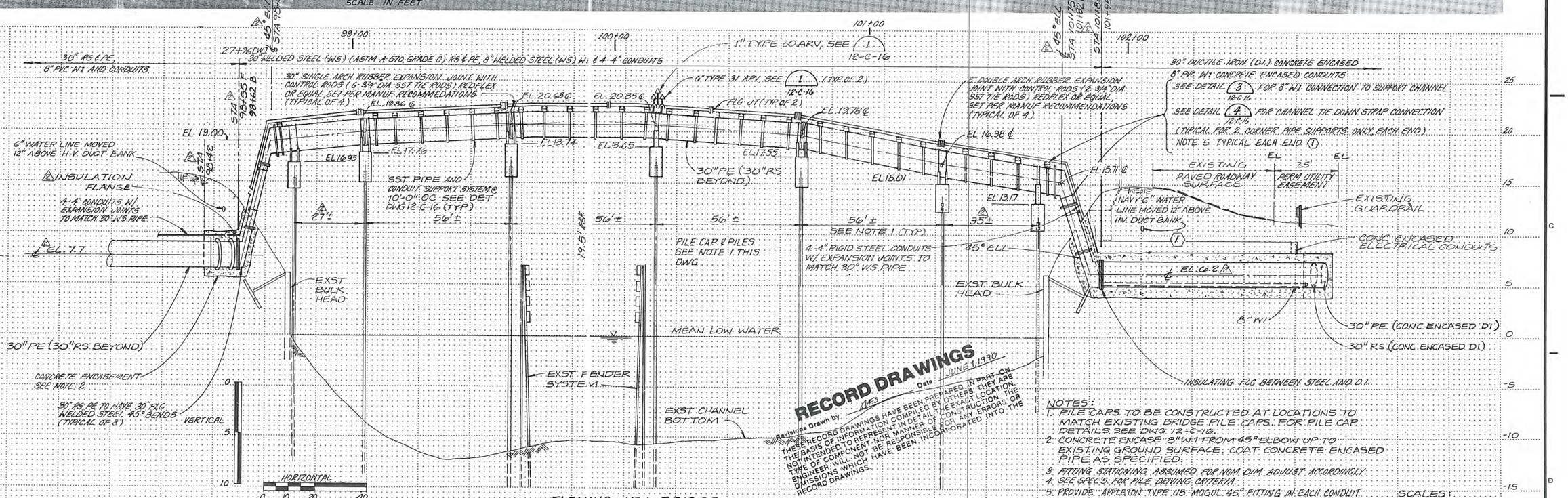
elements. In addition, it is recommended the repairs from this more comprehensive inspection and evaluation be accomplished to bring the existing structure up to or exceeding its original "*as-built*" or "*new*" condition.

Conclusion

The new 18-inch-diameter steel pipe carrying reclaimed water may be supported by the existing Fleming Key Bridge pipe crossing piling system, provided the current condition of the existing structural elements is upgraded to at least an "*as-built*" or "*new*" condition. However, with the pipe crossing piling system not being in an "*as-built*" or "*new*" condition, it is not possible to conclude that the existing structure is adequate at this time.

Appendix C
Original Fleming Key Bridge Pipe Supports Construction Drawings: Key West Wastewater Treatment Plant, Key West, Florida, Project No. FC20064G1, dated May 1986





RECORD DRAWINGS

Revisions Drawn by: NKS Date: JUNE 1, 1990

THESE RECORD DRAWINGS HAVE BEEN PREPARED IN PART ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT, NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO RECORD DRAWINGS.

FLEMING KEY BRIDGE
ELEVATION
VIEW LOOKING WEST

NOTES:
1. PILE CAPS TO BE CONSTRUCTED AT LOCATIONS TO MATCH EXISTING BRIDGE PILE CAPS. FOR PILE CAP DETAILS SEE DWG 12-C-16.
2. CONCRETE ENCASE 8" W1 FROM 45° ELBOW UP TO EXISTING GROUND SURFACE; COAT CONCRETE ENCASED PIPE AS SPECIFIED.
3. FITTING STATIONING ASSUMED FOR NOM DIM. ADJUST ACCORDINGLY.
4. SEE SPEC 5 FOR PILE DRIVING CRITERIA.
5. PROVIDE APPLETON TYPE UB MOGUL 45° FITTING IN EACH CONDUIT.
6. CONTRACTOR MAY REMOVE A PORTION OF THE EXISTING BRIDGE WINGWALL IF REQ'D. DEFLECT 30" RS IF NECESSARY TO CLEAR BRIDGE PILE FOR STRUCTURE REPLACEMENT. SEE U.S. NAVY DWG. 966038 FOR DETAILS.

SCALES:
1" = 5' VERT
1" = 20' HORIZ

CH2M HILL

DSGN	L.J. POWELL, J. WORCESTER
DR	A.L. ROGERS
CHK	H.H. MEJDELL
APVD	K.A. COPI

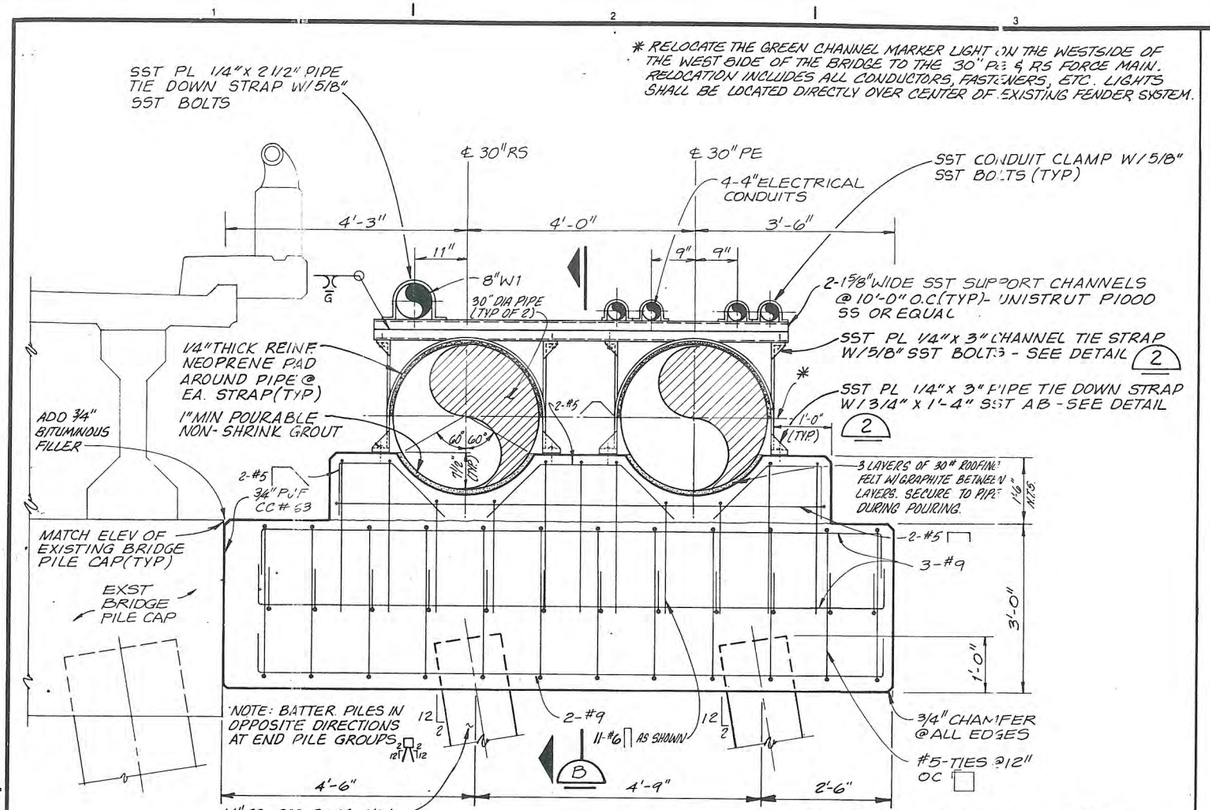
NO.	DATE	REVISION	DR'S	CHK
	6/11/90	RECORD DRAWING	GE	JPC
2	22 OCT 87	REVISED WS PIPE LENGTH & ALIGNMENT	PK'S	RN
1	24 JUL 86	ADDED 45° FITTINGS, RS CONDUIT	BY	APVD

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 ——— 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

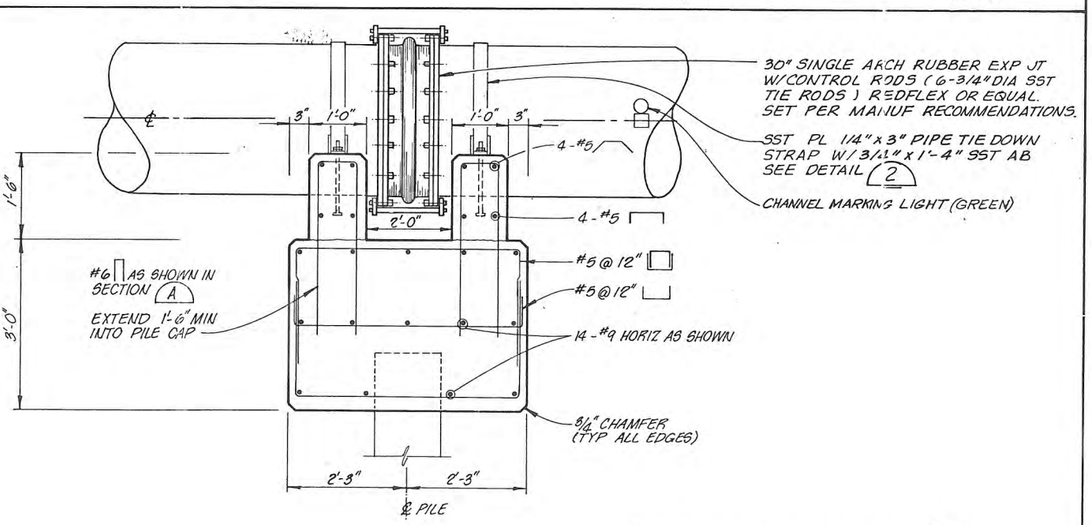
KEY WEST WASTEWATER TREATMENT PLANT
KEY WEST, FLORIDA

FORCE MAINS
CHANNEL CROSSING PLAN & PROFILE
STA 99+00 TO 102+00

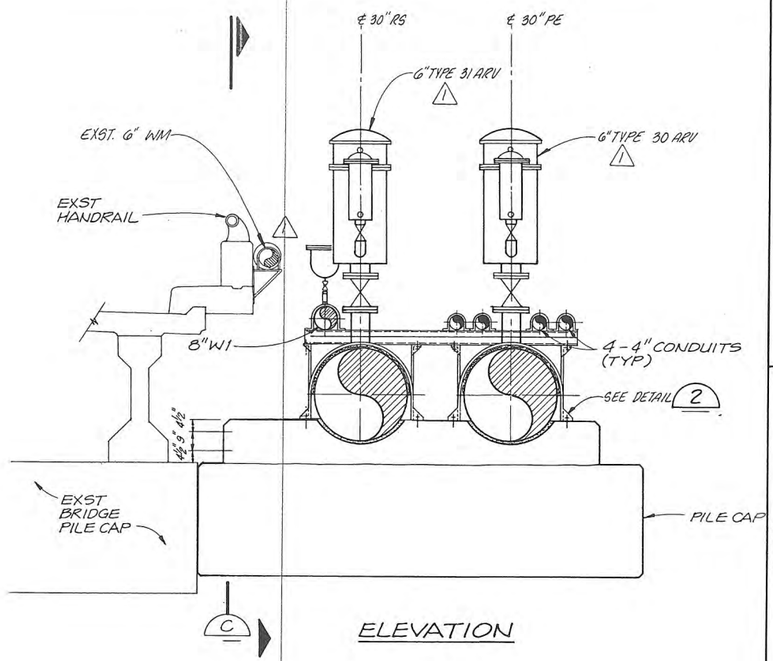
SHEET	328
DWG NO.	12-C-14
DATE	MAY 1986
PROJ NO.	FC20064.G1



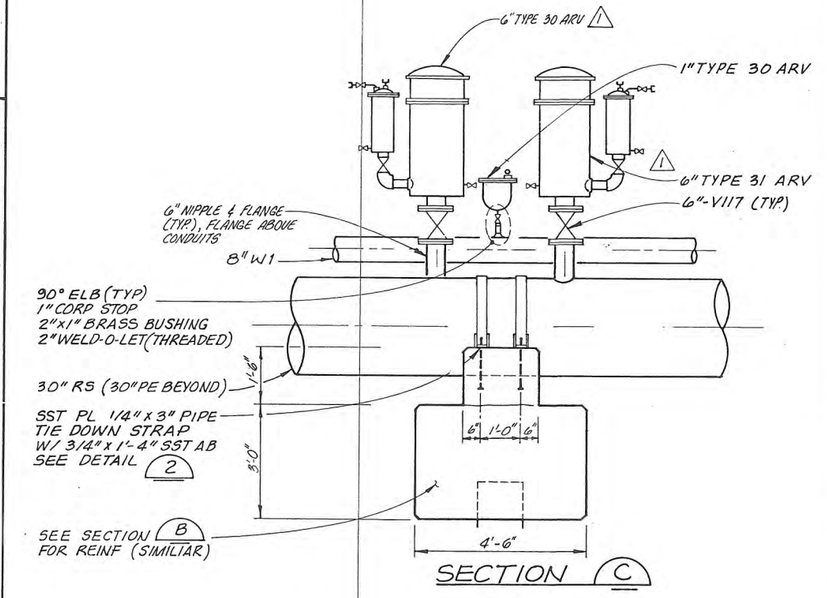
PILE CAP SECTION (A)
N.T.S. 12-C-14



PILE CAP SECTION (B)
N.T.S.

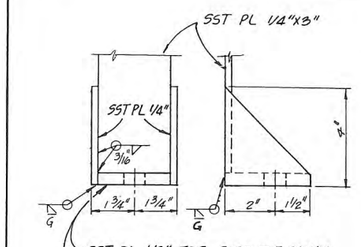


ELEVATION

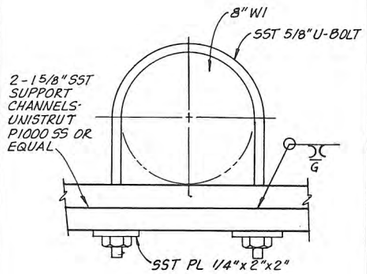


SECTION (C)

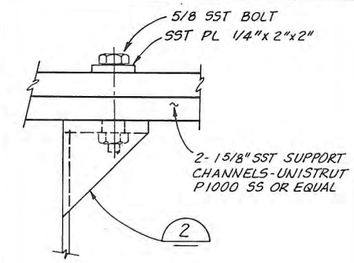
AIR RELEASE VALVE DETAIL (1) AND (C)
NTS 12-C-14 12-C-14



DETAIL (2) N.T.S.



DETAIL (3) 12-C-14 N.T.S.



DETAIL (4) 12-C-14 N.T.S.

RECORD DRAWINGS
Revisions Drawn by DFS Date JUNE 1, 1990
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CH2M HILL

DSGN L.J POWELL, J. WORCESTER		6/1/90	RECORD DRAWING	DFS	AWW
DR A.L. ROGERS					
CHK E. SEEGMUELLER	1	2-10-87	REVISED LOCATION OF ARV'S PER CONFLICT W/EXST. 6" WATER MAIN	NSF	JPC
APVD K. CORI	NO.	DATE	REVISION	BY	APVD

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VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

KEY WEST WASTEWATER TREATMENT PLANT
KEY WEST, FLORIDA

FORCE MAINS CHANNEL CROSSING - DETAILS

SHEET	330
DWG NO.	12-C-16
DATE	MAY 1986
PROJ NO.	FC20064.G1

Appendix D
Updated Conceptual Budgetary Cost Estimate for "Precast Concrete Pile Jacket Repairs—Fleming Key Bridge Pipe Support Piling", dated December 03, 2010

UPDATED CONCEPTUAL BUDGETARY COST ESTIMATE

1 2

CH2MHILL
3001 PGA Blvd
Suite 300
Palm Beach Gardens
Florida 33410

Precast Concrete Pile Jacket Repairs
Wastewater and Water Pipe Support Pile Bents
Fleming Key Bridge
City of Key West, Florida

Sheet__ of __
Job No. 390490
By_grd_06-11-09
Rev_grd_12-03-10
Rev_#07

ITEM	DESCRIPTION	QTY	UNITS	UNIT COST	EST'D COST	Subtotals
1	**Mobilization and General Conditions**					
	Mobilization/Demobilization to Key West, FL.	1	LS	$50,000	50,000	
	General Conditions, Bonds, Permits, Insurance, etc.	1	LS	$5,000	5,000	$55,000
2	**Concrete Pile Repair w/ Epoxy Crack Injection**					
	SikaDur 31 Hi-Mod Gel Crack Sealing Grade Epoxy	10	Gal	$225.00	2,250	
	SikaDur 35 Hi-Mod LV Injection Grade Epoxy	10	Gal	$280.00	2,800	
	2-Man Repair Crew - 15 - 10 Hr Days	150	Hrs	$195.00	29,250	
	Temporary Shoring & Work Platform	150	Hrs	$30.00	4,500	
	Boat & Equipment	150	Hrs	$35.00	5,250	$44,050
3	**Supplemental Reinforcing Steel**					
	ASTM A615, Gr 60 - #4 Ties & #4 Vertical Rebar	3,500	LB	$3.00	10,500	
	Sika Armatec 110 Rebar Coating System	55	Gal	$105.00	5,775	
	2-Man Repair Crew - 15 - 10 Hr Days	150	Hrs	$195.00	29,250	
	Temporary Shoring & Work Platform	150	Hrs	$30.00	4,500	
	Boat & Equipment	150	Hrs	$35.00	5,250	$55,275
4	**Concrete Pile Repairs - 15 - 20-ft Sleeves**					
	FRP 20-ft Repair Sleeves to 5-ft Above Waterline	300	LF	$70.00	21,000	
	SikaDur 35 Hi-Mod LV LPL Injection Grade Epoxy	300	Gal	$280.00	84,000	
	Oven-Dried Silica Sand	300	CF	$25.00	7,500	
	3-Man Underwater Dive Team - 23 - 10 Hr Days	230	Hrs	$270.00	62,100	
	Dive Equipment	230	Hrs	$105.00	24,150	
	3-Man Repair Crew - 23 - 10 Hr Days	230	Hrs	$270.00	62,100	
	Temporary Shoring & Work Platform	230	Hrs	$30.00	6,900	
	Boat & Equipment	230	Hrs	$105.00	24,150	$291,900
	SUBTOTAL Probable Construction Cost Estimate				**446,225**	$446,225
	Contingency Allowance		20%		89,245	
	Escalation (estimated to July 01, 2011)		4%		21,419	
	Key West Factor		20%		111,378	
	TOTAL Probable Construction Cost Estimate				**668,267**	

UPDATED CONCEPTUAL BUDGETARY COST ESTIMATE 2

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Wastewater and Water Pipe Support Pile Bents
Fleming Key Bridge
City of Key West, Florida

Sheet__ of __
Job No. 390490
By_grd_06-11-09
Rev_grd_12-03-10
Rev_#07

ITEM	DESCRIPTION	QTY	UNITS	UNIT COST	EST'D COST	Subtotals
	Engineering Design Services				87,000	
	Subwater Inspection (by Diving Subcontractor)				17,000	
	TOTAL Conceptual Budgetary Cost Estimate				**$772,267**	
Total Conceptual Budgetary Cost Estimate (Rounded)					$773,000	

This Conceptual Budgetary Cost Estimate has been prepared for guidance in project budgeting, planning, evaluation and implementation, from the best information available at the time the estimate was prepared. Escalation of costs presented herein has been projected to July 01, 2011, the estimated mid-point of construction, at an annual percentage rate of 4.0%. The final cost of the work will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variables, at the specific time the project is bid. As a result, the final project cost will most proably vary from the estimated cost presented herein. For these reasons, project funding needs must be carefully reviewed, prior to making specific financial decisions, to help ensure proper project evaluation and adequate funding. It is recommended that the City of Key West take these points into consideration, when making financial decisions and commitments.