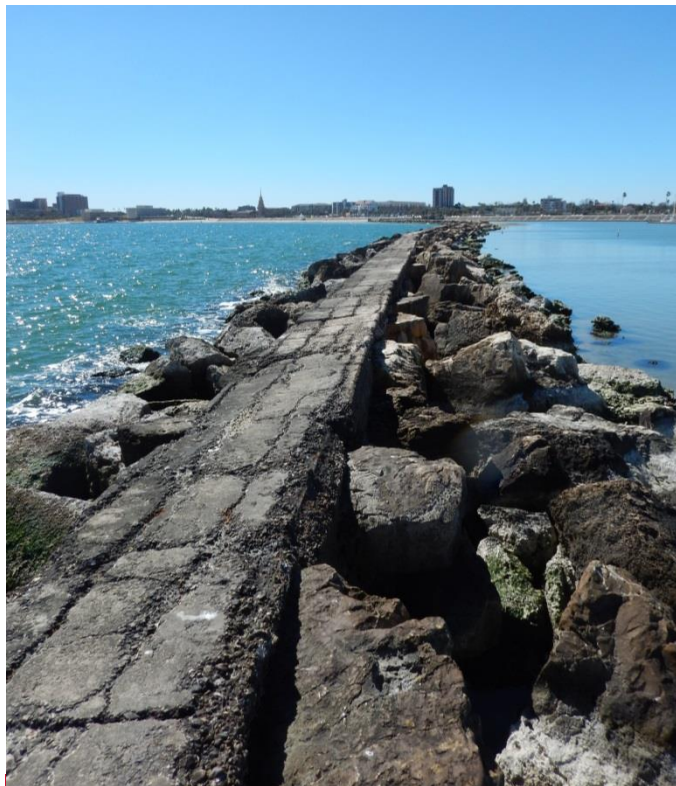




Draft Technical Memorandum

McGee Beach Breakwater
Improvements (E15219)

Seawall Type A Board – Seawall
Maintenance

Corpus Christi, Texas
March 29, 2016

PRELIMINARY DRAFT

THIS DOCUMENT IS RELEASED TO THE
CITY OF CORPUS CHRISTI FOR THE
PURPOSE OF INTERIM REVIEW AND
WAS PREPARED UNDER THE
ENGINEERING SUPERVISION OF:

HDR ENGINEERING, INC.
Texas PE Firm Registration No. F-754

ENGINEER: Daniel J. Heilman, P.E.

LICENSE NO.: 86936

DATE: March 29, 2016

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1.1 Project Description

The City of Corpus Christi is considering repairs and possible improvements to the southern portion of the breakwater adjacent to the downtown marina. As shown in Figure 1, this portion of the breakwater separates the marina from McGee Beach. The initial section of the breakwater extends from the seawall as a concrete foundation supporting a dining concession¹ and restrooms, which transitions to an elevated concrete walkway extending to the armor stone (herein referred to as “rock”) section of the breakwater (Figure 2). The initial approximate 1,800 ft of the rock section is accessible via a concrete walkway that runs along the crest of the breakwater. The overall breakwater system provides wave sheltering for the marina and storm damage protection for the seawall. This report provides a preliminary condition assessment of the southern portion of the breakwater and a conceptual-level opinion of probable cost for associated repairs and/or improvements. This report updates a previous report prepared by HDR for the Seawall 4A Board in 2009.



Figure 1 – Project Location.

¹ The dining concession is currently leased as Seawall Food & Spirits.



Figure 2 – Project Features.

1.2 Existing Site and Facility Conditions

HDR performed a cursory (reconnaissance-level) site condition survey on February 11, 2016. The Seawall dining concession area consists of a small concrete block-wall restaurant, restrooms, and sun terrace (Figure 3) supported by a pile/column-supported concrete foundation. The foundation slab is approximately 4,800 square feet in area.



Figure 3 – Seawall Dining Concession and ADA Ramp

The condition survey included the building foundation from the top of the concrete floor slab down to the sand for the portions visible from the outside of the structure. The north row of piles/columns supporting the foundation slab is an extension of the breakwater to the seawall. Observations of the underside of the foundation slab were done from the edge of the slab; the space underneath the foundation between the sand and the slab was not accessed. An inspection of the building supported by the foundation slab was not within the scope of this condition survey. A concrete ADA ramp extends from the top of the seawall to the sand at McGee Beach and is newer than the building; this ramp was also not within the scope of this condition survey.

The foundation slab appears to be in good condition when observed from the top outside of the building. Few cracks were observed on the top of the slab. The top side of the slab was not sounded. The drainage grate and frame in the slab are severely corroded and there are cracks in the slab radiating from the grate frame (Figure 4). It appears that the grate drains water through the slab and into the sand. The drawings show no piping from the drain. There is a lift station beneath the slab for the pumping of sewage. The hatch for the pump station was not opened and the pump station condition was not observed.



Figure 4 – Top View of Foundation Slab

Although at first glance the underside of the slab also appeared to be in good condition, there is at least one large area (approximated at 8 to 10 feet in diameter) of spalling concrete. The spalled concrete has not fallen from the slab, but is loose, and the edge of the spalled concrete appears to be hanging 2 or 3 inches from the slab (Figure 5).



Figure 5 – View of Underside of Slab

Viewed from the edge of the foundation, it was difficult to see if there were any other spalled areas. The underside of the slab was not sounded. Based on the portions of the foundation that were observed, it was estimated that approximately 30% of the overall underneath side of the slab may have areas that are spalling (not all of the slab was visible at the time of this survey).

The foundation slab to column/pile connection consists of a 4-inch thick by 3-foot square drop panel at the top of each pile/column (Figure 6).



Figure 6 – View of Column/Pile Connection Under Slab

Of those panels that were visible, no corrosion was observed. The tops of the column/piles that were visible appeared to be in good condition with the exception of one. The portion visible (top 2 feet) was observed to be in poor condition, exhibiting severe cracking (Figures 7 and 8).



Figure 7 – Column/Pile with Severe Cracking



Figure 8 –Column/Pile with Severe Cracking

A PVC water pipe under the slab was observed to have a leak at a 90 degree joint. Water was flowing from the leak and draining into the sand at the time of the site visit (Figure 9). It appeared that the line was for supply water. No apparent structural damage was observed associated with the leak.



Figure 9 – Water leaking from Pipe Under Slab

The foundation slab is connected to an elevated concrete walkway that extends to the rock section of the breakwater. As previously observed during the 2009 survey, the walkway structure shows signs of severe deterioration, including spalled concrete and exposed rebar, large cracks, damaged stairs and handrails (Figure 10).



Figure 10 – Damage along elevated walkway extending to the rock breakwater. Also note the gap below the walkway, which allows sand to be blown from McGee Beach into the marina.

In addition the lighting, lighting poles and electrical conduit is missing, as are sections of handrail and the previous fish-cleaning stand. Continued degradation of the concrete deck and foundation will eventually lead to more significant structural damage, creating a gap in the breakwater that would leave a portion of the seawall more susceptible to potential wave damage during severe storms. In addition, collapse of the walkway could occur during a severe storm, causing structural debris to damage the seawall, marina, boats, and landward infrastructure.

As a secondary concern, the opening under the walkway allows sand from McGee Beach to be blown into the marina. Loss of sand from McGee Beach increases exposure of the adjacent seawall (south of the breakwater) to wave impacts, increasing potential for undermining and/or damage during severe storms. In addition, loss of wind-blown sand under the walkway increases the requirements for periodic renourishment of McGee Beach.

The rock breakwater extends northward from the elevated concrete walkway and around the City marina. The breakwater is approximately 5,800 ft long, with the southern approximate 1,800 ft having a 4-ft wide concrete cap (walkway) for pedestrian access. Deterioration of the walkway has progressed since the 2009 survey, with severe spalling, cracking, and rebar exposure over its entire length, and some sections of the cap completely missing (Figure 11). The handrails, lighting, and electrical conduit are gone, and the walkway is frequently subjected to wave spray and overtopping, which can create a slippery walking surface

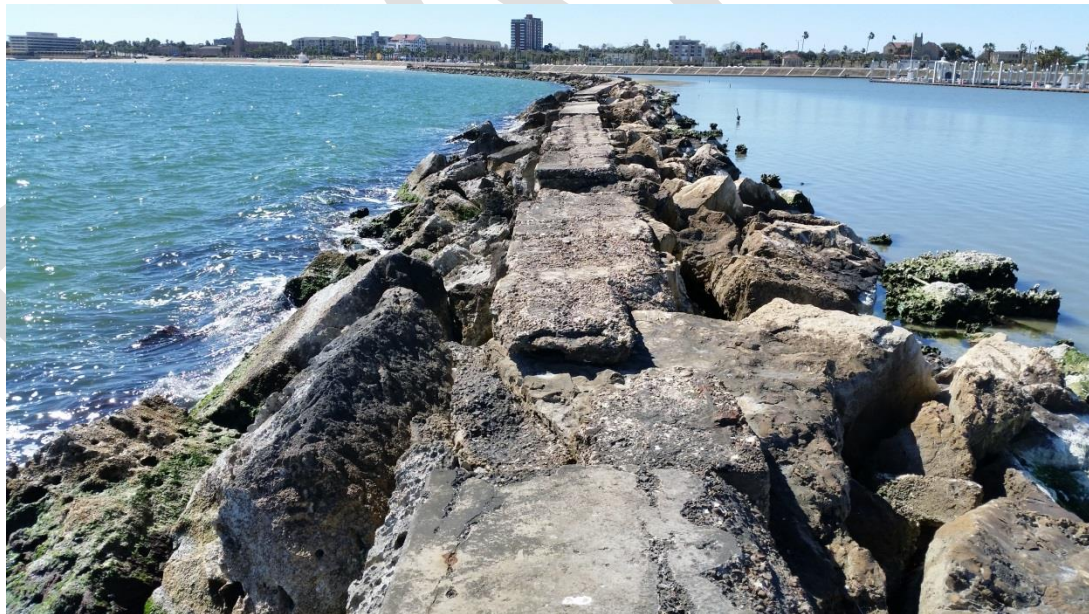


Figure 11 - Missing sections of concrete breakwater cap.

1.3 Proposed Improvement and Description

The proposed improvements consist of the following primary elements.

- **Building Foundation:** The bottom of the building foundation should be sounded to determine the limits of the deteriorated spalling concrete; these areas should be repaired.

- Breakwater Extension: The existing elevated walkway is recommended to be demolished and replaced with a new rock breakwater and walkway (concrete cap).
- Breakwater Walkway: The concrete walkway along the existing rock breakwater is recommended to be repaired/replaced, and possibly raised.

These improvements will help fortify the seawall against wave attack by preventing failure of the breakwater and reducing erosion at McGee Beach. Figure 12 shows the locations of the proposed improvements.

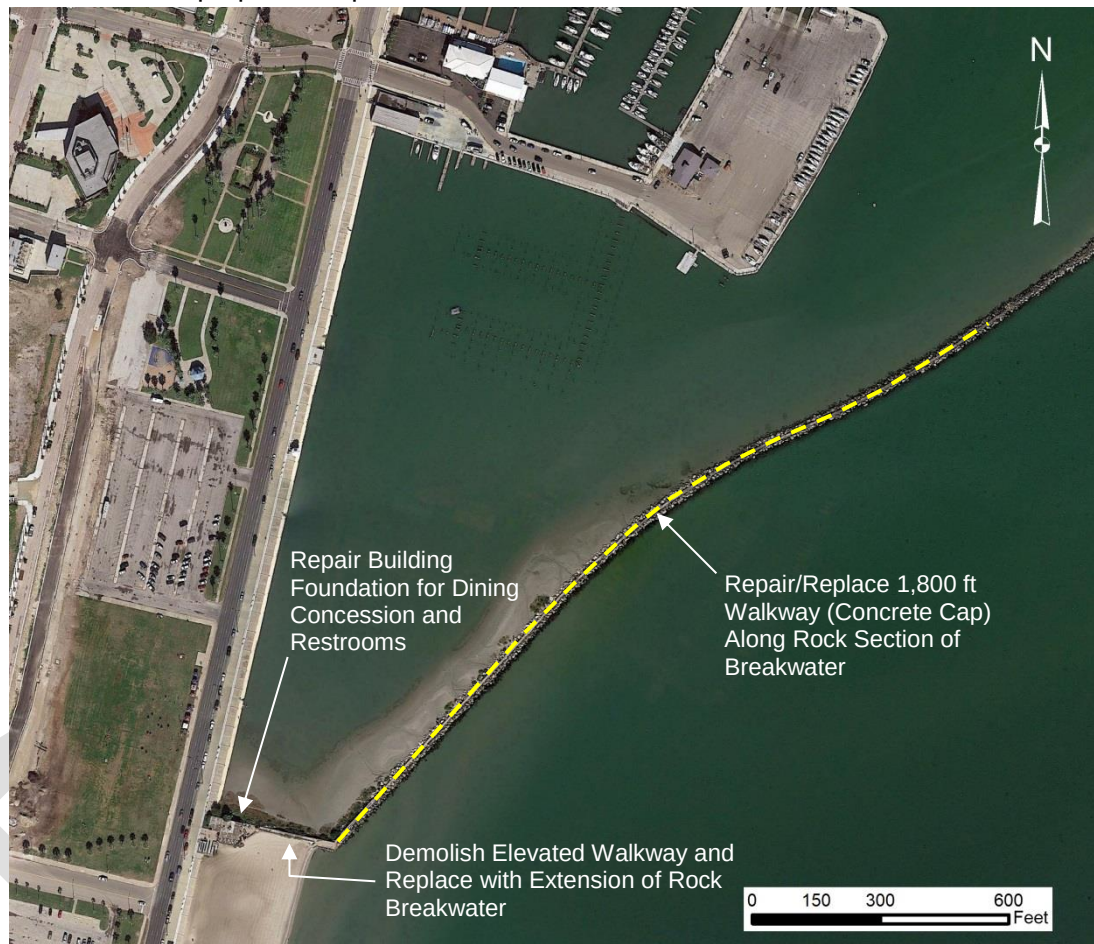


Figure 12 – Locations of Proposed Improvements

Detailed features of the proposed improvements consist of the following:

- Building Foundation
 - Repair the underside of the foundation slab by removing the deteriorated concrete and replacing with a corrosion resistant concrete patching material.
 - Remove deteriorated column/pile concrete top and replace with a corrosion resistant concrete patching material.
 - Replace concrete drainage grate. Further examine grate frame and, if required, remove by saw cutting the cracked concrete around the frame and replace the frame and concrete.

- Provide a wall on the south side of the foundation slab to lessen blowing sea air and sand from further deteriorate the underside of the foundation slab.
- Repair plumbing and electrical lines as required.
- Breakwater Extension
 - Demolish the elevated walkway and concrete sheet pile from the damaged steps seaward of the building foundation to the existing breakwater.
 - Extend the existing breakwater approximately 200 ft landward to the building foundation.
 - Construct a 6-ft wide, 200-ft long concrete walkway along the crest of the new breakwater.
 - Replace the steps between the breakwater and McGee Beach.
- Breakwater Walkway
 - Repair/replace entire 1,800-ft concrete walkway (concrete cap) along existing rock breakwater.
 - All of the existing walkway is recommended to be either partially or fully replaced. Broken sections of walkway surface should be removed. Because it is recommended that the new walkway be constructed higher and wider than the existing walkway, the sound portions of the existing walkway could possibly be left in place with the new sections cast over the existing sections. The viability of leaving sections of the existing walkway in place depends on how soon the repairs are performed.
 - Construct/place rock ballast (smaller stones) to fill gaps between larger stone and provide a base for the new concrete walkway.
 - Build new walkway wider (assumed here to be 2 ft wider) and higher (assumed here to be 1 ft higher) than original. This would make the new walkway approximately 6 ft wide.
- Install additional amenities along the breakwater walkway
 - Install electrical utilities and lighting along the length of the breakwater.
 - Install signage, trash receptacles, a fish cleaning station, handrails, and other possible amenities.

1.4 Opinion of Probable Project Cost

Table 1 provides a conceptual level opinion of cost (cost) that was developed using conceptual level planning and estimating. As details of the project are developed and identified, more accurate costs can be established. The cost is estimated to be approximately \$3,861,000. However, this cost can vary depending on items including, but not limited to:

- Material availability and fluctuations in raw material, fuel and transportation costs.
- Construction schedules and working restraints.
- General conditions requested of the contractor / professional services by the owner.

- Economic climate at the time of bidding. Typically, when contractors are not busy, one can expect lower prices for construction projects.
- Existing conditions of the facility or location discovered during subsequent field investigations and/or engineering evaluations.

The number reflected above includes a 25% contingency. It is recommended that contingencies not be deducted or reduced at this planning stage of the project. Key assumptions or clarifications of the cost opinion include:

1. The entire breakwater walkway will need to be replaced.
2. Dining concession and restroom building does not have to be demolished.
3. Quantity take-offs based on limited available data. Accurate topographic and bathymetric data may result in substantial quantity changes.
4. Americans with Disabilities Act (ADA) compliance can be difficult to obtain for marine structures and may not be feasible for the breakwater walkway and steps from the beach. Limited contingency is included for design and construction of improvements necessary to comply with ADA standards.

**TABLE 1: OPINION OF PROBABLE PROJECT COST
McGee Beach Breakwater Improvements (E15219)**

Estimated By: SA McCoy
Checked By: C. LaPann-Johannessen
QA/QC By: M Kreiber
Date: 3/29/2016

Item Description	Quantity		Unit Cost	Minor Work Item Subtotals	Major Work Item Subtotals	Extended Total
	QTY	Unit				
Item No. 1 - Mobilization/Demobilization						\$120,000
Mobilization	1	LS	\$70,000	\$70,000	\$70,000	
Demobilization	1	LS	\$50,000	\$50,000	\$50,000	
Item No. 2 - Breakwater Extension (Replace Elevated Walkway)						\$564,000
Component Description					\$564,000	
Demolish elevated walkway	1	LS	\$115,000	\$115,000		
Foundation preparation	1	LS	\$12,000	\$12,000		
Geotextile fabric	900	SY	\$7	\$6,300		
Graded Riprap	1,700	TON	\$170	\$289,000		
Place Stone to Fill Armor Stone Voids Under Walkway	200	LF	\$240	\$48,000		
Breakwater Walkway	200	LF	\$425	\$85,000		
Concrete Transition	1	LS	\$9,000	\$9,000		
Item No. 3 - Improve Walkway Along Existing Breakwater						\$1,355,000
Component Description					\$1,260,000	
Demolish unsalvageable walkway	1,800	LF	\$75	\$135,000		
Improve Breakwater Walkway	1,800	LF	\$425	\$765,000		
Place Stone to Fill Voids Under Walkway	1,800	LF	\$200	\$360,000	\$95,000	
Component Description						
Electrical Line/Lighting Breakwater Walkway	2,000	LF	\$35	\$70,000		
Trash receptacles, signage, etc	1	LS	\$25,000	\$25,000		
Item No. 4 - Repair Building Foundation						\$272,000
Component Description					\$272,000	
Building Demo (as required)	1	LS	\$50,000	\$50,000		
Repair underside of foundation slab	1,440	SF	\$150	\$216,000		
Repair Pile/Column	10	LF	\$600	\$6,000		
SUBTOTAL (Work Items):						\$2,311,000
25% Project Contingency:						\$578,000
SUBTOTAL (Work Items Plus Contingency):						\$2,889,000
Other Project Related Costs						\$972,000
Surveys	1	LS	\$20,000	NA	\$20,000	
Geotechnical Investigation	NA	5.0%	NA	NA	\$144,000	
Engineering	NA	12.0%	NA	NA	\$347,000	
Permitting	NA	5.0%	NA	NA	\$144,000	
Construction Administration	NA	5.0%	NA	NA	\$144,000	
Materials Testing	NA	1.0%	NA	NA	\$29,000	
Engineering Services (City of CC)	NA	3.5%	NA	NA	\$101,000	
Bond Issuance (City of CC)	NA	1.0%	NA	NA	\$29,000	
Miscellaneous (Printing, Advertising, Etc.)	NA	0.5%	NA	NA	\$14,000	
PROJECT GRAND TOTAL:						\$3,861,000

Notes and Assumptions:

- Opinion of probable project cost (OPPC) is based on HDR's understanding of current labor and material costs and reasonable estimates of construction activity duration. Costs shown are based on 2016 pricing without consideration for future cost escalation.
- ADA compliance can be difficult to obtain for marine structures and may not be feasible for the breakwater walkway and steps from the beach. Limited contingency is included for design and construction of improvements necessary to comply with ADA standards.
- Cost for new walkway is based on 6 ft wide by 12 inches thick concrete cap along breakwater. It was assumed that 100% (1,800 LF) of walkway will be replaced.
- Walkway and breakwater volumes based on limited field data. Detailed survey will be required during detailed design.
- Cost based on assumption that concession building will be demolished down to the foundation slab and that the foundation slab will require some repair. Rigorous structural investigation should be performed during detailed design.
- Connection from the breakwater extension to the concession area will include concrete transition.
- Breakwater walkway will consist of small stone (approx 3 to 12 in dia) to reduce voids between armor stone, 3000 psi concrete filler with RC placed for the walkway cap.
- Lengths are approximate based on aerial photo and limited ground measurements.
- Construction methods may employ the optional flotation channel at the Contractor's preference. Regulatory coordination is required to determine feasibility of flotation channel.
- Cost for improved walkway based on \$1,500/CY concrete.
- It is assumed that the soils are not contaminated. Material testing during the design phase will determine the suitability of the soil to be used as backfill.

1.5 Opinion of Project Schedule

An opinion of project schedule was developed using conceptual level planning and is provided to illustrate only the anticipated duration of the project from a start date which has not yet been determined. As details of the project are developed and identified, a more accurate schedule can be established. The duration of the project schedule is estimated to be approximately 16 months. However, this schedule can vary depending on items including, but not limited to:

- Material availability at the time of construction
- Contractor and equipment backlog and availability
- Weather conditions
- Construction schedules and working restraints
- General conditions requested of the contractor / professional services by the owner.

1.6 Key Project Considerations

The following key considerations were taken into account during this conceptual level study which will need to be addressed as the project develops:

- The building foundation supporting the restrooms and restaurant concession building does not have to be demolished.
- Limited topographic/bathymetric data were available for developing the project concept. Obtaining and analysis of more detailed site data may result in different requirements for the project.
- The envisioned walkway would be 6 ft wide and constructed over the existing walkway where possible. More rigorous assessment may result in different dimensional requirements and/or identification of additional necessary work.
- An opportunity to improve water quality within the marina may be created by this project. Water quality may be improved by installing culverts through the breakwater and/or improving existing water exchange. Water quality improvement opportunities should be investigated during preliminary design.

In addition, the following are key considerations which will need to be addressed as the project develops:

- The length of the walkway (1,800 ft) in this proposed layout matches that of the existing walkway. Depending on available funding, a longer or shorter walkway may be opted for.

The overall breakwater system, for the purposes of this analysis, was primarily considered for its ability to provide increased storm damage protection to the seawall. This structure has obvious recreational benefits as well. Amenities can be added or modified to tailor the structure to the City's needs.

1.7 Seawall Enhancement Explanation

In this study, improvements to the seawall and flood protection system have been limited to structural strengthening or enhancements which provide additional protection to individual components of the flood protection system. This project will enhance the flood protection function of the seawall by:

1. Maintaining components of the breakwater and elevated approach walkway that, if otherwise left to continue deteriorating, may result in more significant structural damage and potential failure during a severe storm. Such structural failure would essentially create a gap in the breakwater, resulting in greater exposure of the seawall to storm damage.
2. Sealing the opening under the elevated approach walkway to reduce wind-blown sand transport from McGee Beach into the marina. Loss of sand at McGee Beach increases exposure of the southern portion of the seawall to undermining and wave impacts during severe storms.
3. Raising the existing breakwater crest by approximately 1 ft over the length of the walkway may help improve wave attenuation during storm surges. Increasing the breakwater's ability to attenuate waves would reduce wave impacts to the seawall.