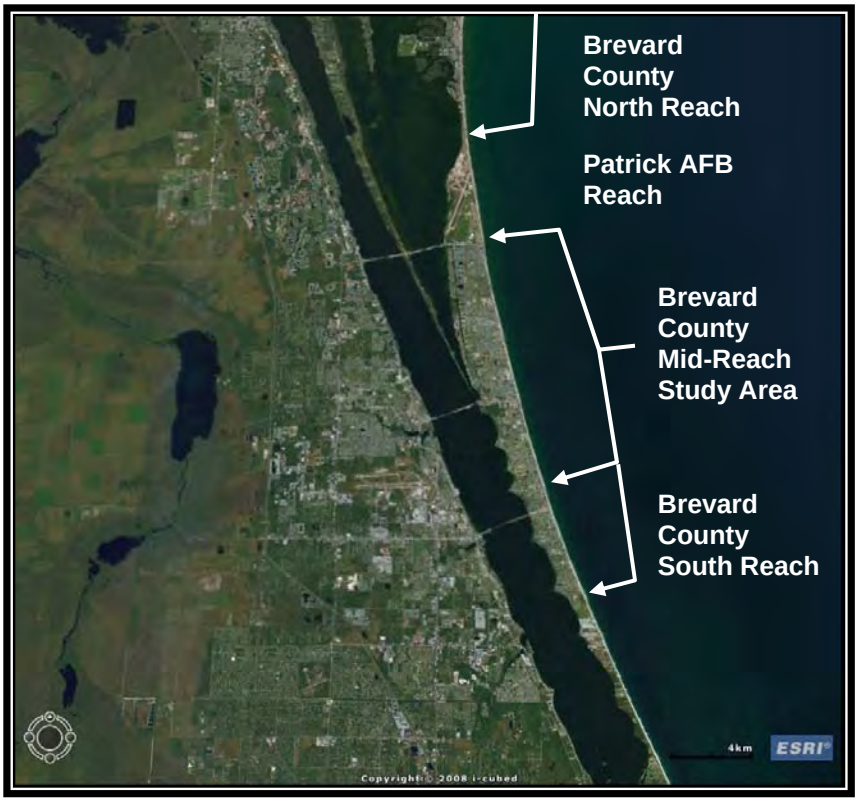
U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

FINAL VALUE ENGINEERING STUDY REPORT FOR

113619 Brevard County Mid-Reach Shore Protection Project, Brevard County, Florida

(Integrated General Reevaluation Report and Supplemental Environmental Impact Statement)



Sponsored By: Brevard County and U.S. Army Engineering District, Jacksonville

Daft Report - September 2006
Revised Final Report - February 2010

DOD SERVICE: USACE **VALUE ENGINEERING OFFICER:** Fred McAuley
CONTROL NO: CESAJ-VE- 10-002C

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(Integrated General Reevaluation Report and Supplemental Environmental Impact Statement)

Draft Report - September 2006
Final Report - February 2010

STUDY SPONSORS: Brevard County and USACE, Jacksonville District

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VALUE ENGINEERING TEAM STUDY

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VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: Brevard County Shore Protection Project - Mid-Reach
PROJECT LOCATION: Brevard County, Florida

The Brevard County Mid-Reach Shore Protection Project is intended to develop and deliver hurricane and storm damage reductions throughout the 7.8 mile Mid-Reach segment of Brevard County, Florida. The Mid-Reach was previously studied in the Feasibility Report with Final Environmental Impact Statement for Brevard County (1996), but the Mid-Reach segment was removed from the recommended plan due to environmental concerns. A General Re-evaluation Report for Brevard County, Florida was authorized by the Water Resources Development Act of 2000 to determine if all or a portion of the Mid-Reach is acceptable for addition into the Brevard County Hurricane and Storm Damage Project.

The project is intended to reduce the damages caused by erosion and coastal storms to shorefront structures along the Mid-Reach study area while maintaining the recreational beach, maintaining opportunities for recreational use of the nearshore areas, and maintaining environmental quality. Accordingly the plan will be constrained by the need to avoid, minimize and mitigate environmental impacts to the nearshore hardbottom which is unique to this region of the State. The two Preferred Plans are identified as the Maximum Benefit Plan and the Compromise Plan and each is described in the following figure (including “Rock Impact” requiring mitigation):

Preferred Plans

The Maximum Benefit Federal Plan

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5A	Reach 5B	Reach 6	Sum
Management Measure	No-Action	30 Ft Beachface Fill	60Ft Conventional Fill	Dune and Vegetation	Seawall	20 Ft Beachface Fill	10 Ft Beachface Fill	
Rock Impact (acres)	0	0.61	2.38	0	0	1.06	0.84	4.89

The Compromise Plan

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5A	Reach 5B	Reach 6	Sum
Management Measure	No-Action	10 Ft Beachface Fill	10 Ft Beachface Fill	Dune and Vegetation	Seawall	10 Ft Beachface Fill	10 Ft Beachface Fill	
Rock Impact (acres)	0	0.35	0.57	0	0	0.61	0.84	2.37

The Maximum Benefits Plan will deliver an estimated Benefit to Cost Ratio of 4.89:1 and the Compromise Plan delivers Benefit to Cost Ratio of 2.37:1. Estimates cost for the two Preferred Plans are $51.1 million and $33.6 million respectively.

VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: Brevard County Shore Protection Project - Mid-Reach
PROJECT LOCATION: Brevard County, Florida

The Supporting Documents Appendices provides the names of Value Engineering Team Members, the Speculation List, Cost Models, and Function Analysis System List (a logic listing identifying project functions), and Supporting Documents identifying the project as developed during the study period.

The following Figures provide project views and supporting details for a quick reference to the project features:

REVISION FOR FINAL REPORT: The Brevard County General Re-evaluation Report, including Supplemental Environmental Impact Statement, presents the results of a hurricane and storm damage reduction study for the 7.8 mile Mid-Reach segment of Brevard County, Florida. The goal of the Brevard County Mid-Reach project is to reduce the damages caused by erosion and coastal storms to shorefront structures along the Mid-Reach study area. The District supports the non-Federal sponsor's locally preferred plan and recommends the plan as the Tentatively Recommended Plan. The plan consists of a small-scale beach fill varying from a 0-foot to 20-foot extension of the mean high water line plus advanced nourishment to maintain the design fill volume. The approximate volume of sand to be placed, as calculated from the 2008 survey, includes an initial design fill of 409,000 cubic yards plus an advanced nourishment fill of 164,000 cubic yards for a total fill of 573,000 cubic yards at initial construction. Placement of the sand is anticipated to impact approximately 3.0 acres of nearshore rock hardbottom by direct and indirect cover of which 1.4 acres is expected to include some temporal variation as the advanced nourishment erodes. The mitigation quantity is calculated from the UMAM ratio of 1.6 mitigation acres required for every acre of natural rock impacted, resulting in a mitigation of 4.8 acres.

The plan is estimated to have an initial construction cost of $29.3 million with annual total benefits of $11.4 million and a Benefit to Cost Ratio of 2.9 to 1.

Refer to the "Summary of Proposals / Recommended Action" for a full list of proposals and potential application to the Brevard County Shore Protection Mid-Reach Project. All recommended proposals follow with detailed revisions from final report and revised potential project savings.

PROJECT TITLE: Brevard County Shore Protection Project - Mid-Reach
PROJECT LOCATION: Brevard County, Florida

FIGURE 1: BREVARD COUNTY SHORE PROTECTION PROJECTPLAN

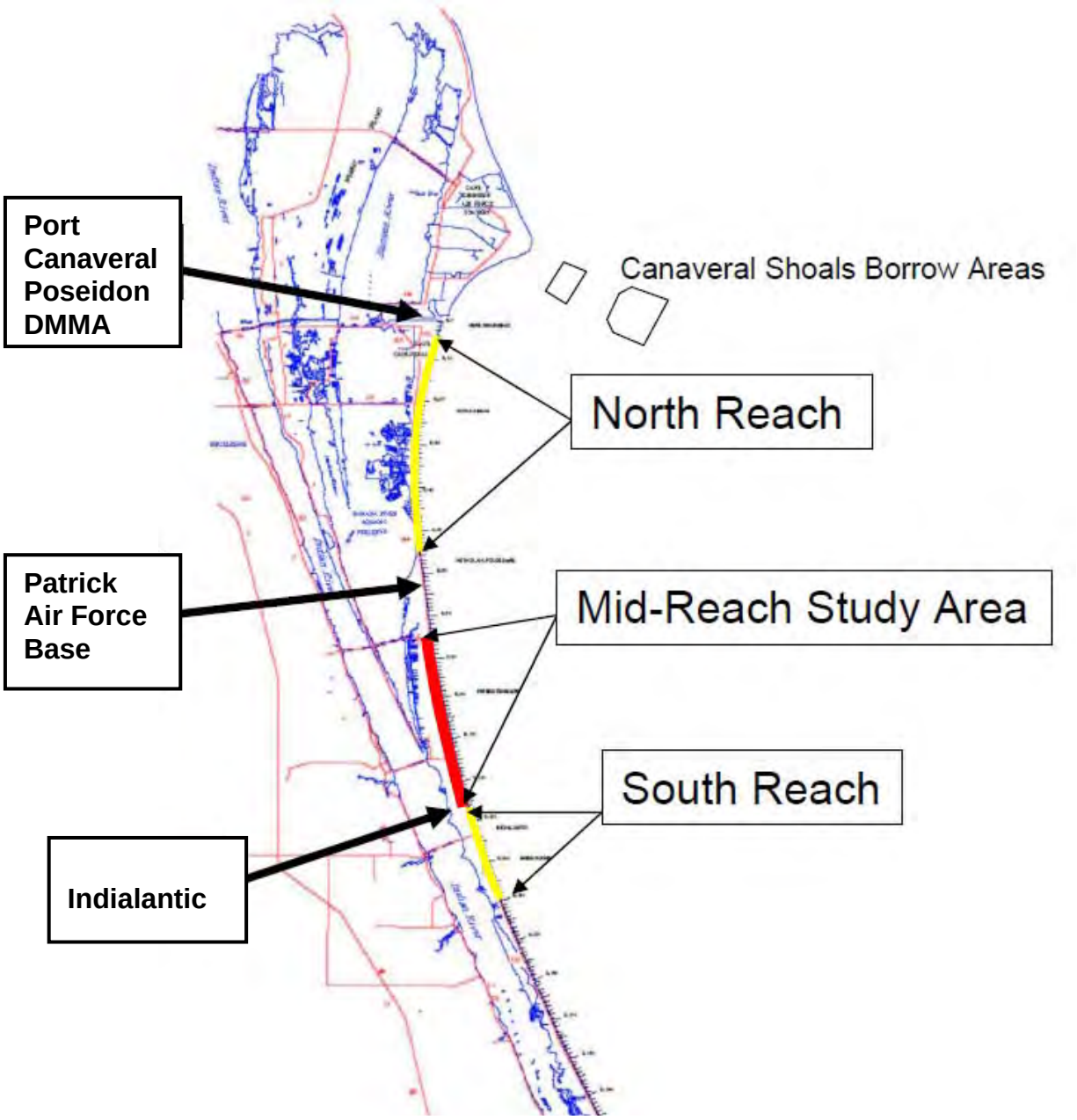
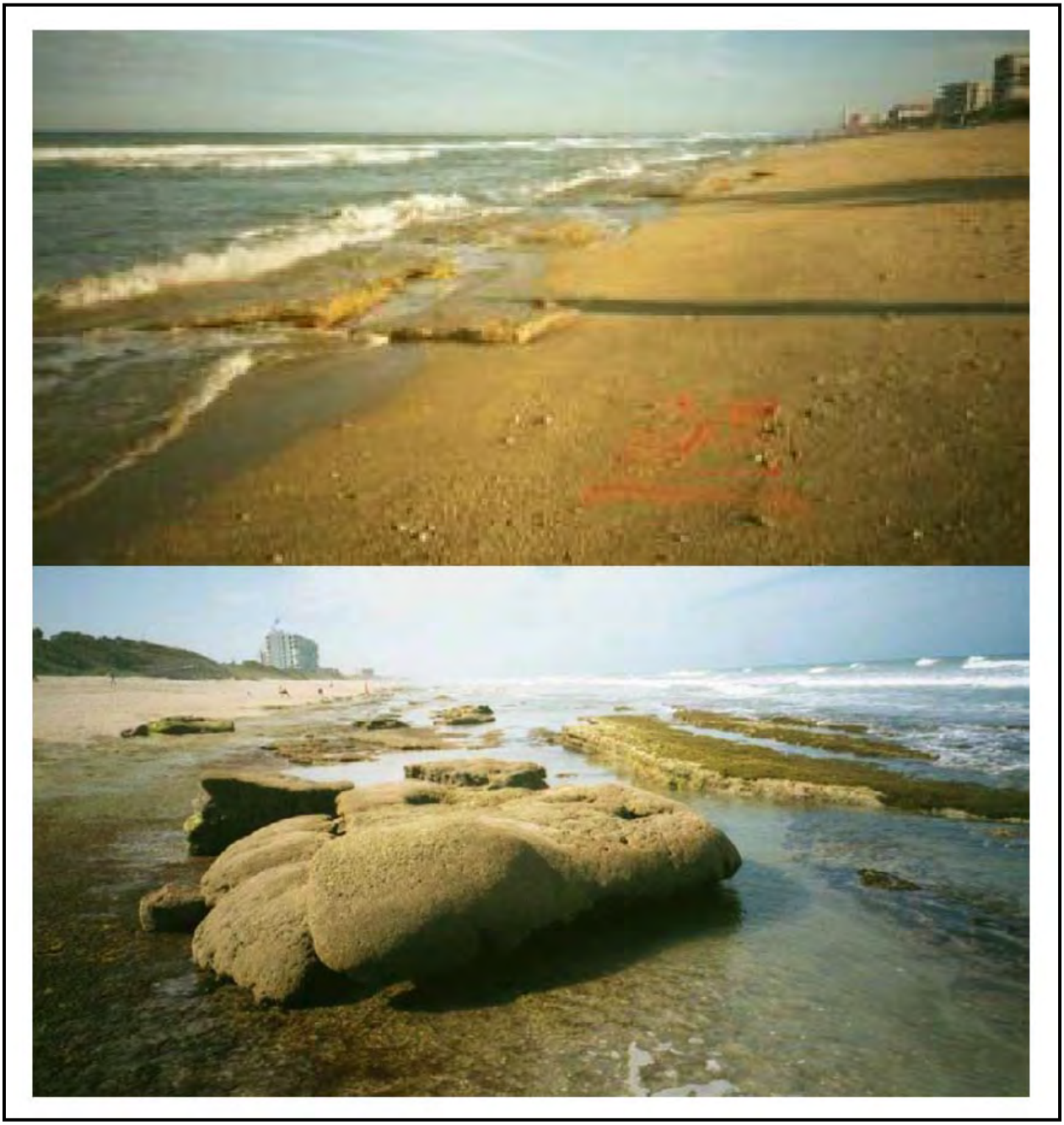


FIGURE 2: BREVARD COUNTY SHORE PROTECTION PROJECT MID-REACH SITE PLAN (SIX SUB-REACH SEGMENTS SHOWN)

FIGURE 3: BREVARD COUNTY SHORELINE NEARSHORE OUTCROPS
Typical Low-Relief Tabular Ledges and
Typical High-Relief Tabular Ledges with
Algae and Sabellariid Tube Worm Structures



VALUE ENGINEERING TEAM STUDY

EXECUTIVE SUMMARY

The formal VE study process was conducted on 1 June 2006. The participants included District Project Development Team (PDT) members and the Non-Federal Sponsor PDT team members as shown in Attachment A.

Value Engineering (VE) is a process used to study the functions a project is to accomplish. As a result, the VE team takes a critical look at how these functions are being met, and it identifies alternative ways to achieve the equivalent function while increasing the value, and the cost ratio of the project. The project was studied using the Corps of Engineers standard Value Engineering (VE) methodology, consisting of five phases:

Information Phase: The Team was presented figures, descriptions of project work, and cost estimates to fully understand the work to be performed and the functions to be achieved. Cost Models (see Appendix C) were compared to determine areas of relative high cost to ensure that the team focused on those parts of the project that offered the most potential for cost savings.

Speculation Phase: The Team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged (see Appendix B).

Analysis Phase: Evaluation, testing and critical analysis of all ideas generated during speculation was performed to determine potential for savings and possibilities for risk. Ideas were ranked by priority for development. Ideas that did not survive critical analysis were deleted.

Development Phase: VE team members developed the selected priority ideas identified during analysis into written proposals. Proposal descriptions and possible impacts to schedule and funding were identified for each item discussed. Savings were estimated where realized.

Presentation Phase: Presentation is a two-step process. First, the VE Study Report is distributed for review (by the full PDT and all appropriate project supporters and decision-makers). Review comments are to be coordinated for decision on any proposals recommended by the study report. Final coordination will include a formal Presentation conference for recommendation of actions to be taken on specific VE proposals. Actions reflecting each proposal are to be annotated on Summary of Proposals / Recommended Action. Further formal coordination of VE action items will be through the PDT and VEO to document cost saving realized in the course of the VE study. A revised Final report is being issued documenting VE actions implemented into the project. The Revised Final Report incorporated implemented VE actions as documented in the GRR Recommended Plan (Locally Preferred Plan). Revised estimated savings are shown in the Summary of Proposals. Each proposal is updated with information reflecting the GRR Recommended Plan also.

VALUE ENGINEERING TEAM STUDY

SUMMARY OF PROPOSALS / RECOMMENDED ACTION

PROPOSAL NUMBER	DESCRIPTION	POTENTIAL SAVINGS	RECOMMENED ACTION
C-1	Develop Coquina Stone Articulated Concrete Mat Mitigation Reef		Proposal To Be Developed
C-1A	(Impact Assumed - 5 Acre Reef 85% Functional Ratio, or 3.00:1)	$3,500,000	
C-1B	(Impact Assumed - 5 Acre Reef 100% Functional Ratio, or 2.72:1)	$5,250,000	
C-1C*	**GRR Recommended Plan – Impact Determined - 3 Acre Reef 100% Functional Ratio, or 1.6:1**	**$7,766,000**	**Proposal as Implemented**
C-2	Develop an Optimized Beach Nourishment Plan for Individual Mid-Reach Shoreline Segments (C-2A: Maximum Benefit Federal Plan vs C-2B: The Compromise Plan)		Proposal To Be Developed
C-2A	The Maximum Benefit Federal Plan by Truck Haul ($9,124,000)		
C-2B	The Compromise Plan by Truck Haul	$12,436,000	
C-2C	**GRR Recommended Plan – Locally Preferred Plan**	**$24,198,000**	**Proposal as Implemented**
***Estimated Total First Cost Savings**		**$24,198,000**	

Two Value Engineering Program measurement matrix criteria are tracked and reported for higher Headquarters through VE program execution by regional District offices. Cost avoidance (also known as savings) is the traditionally recognized measurement matrix for VE studies reflecting efficiencies and cost reduction realized from implementation of VE ideas. These VE proposals are know as “Quantitative” proposals.

The second program measurement matrix is value added ideas that improve the project, or solve associated problems with plan execution that may result in additional expenditures to deliver a successful project and related benefits. These VE proposals are know as “Qualitative” proposals. No penalty for adding “Qualitative” proposals is applied to reduce cost avoidance or savings. Typically the Value Engineering Comments which are provided with limited or no cost determined are considered Qualitative”. Ten Qualitative Proposal Comments are proved with the VE report.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-1 PAGE NO: 1 OF 5

DESCRIPTION: Develop Coquina Stone Articulated Concrete Mat Mitigation Reef

ORIGINAL DESIGN: The planned mitigation reef combines limestone boulders with a foundation mattress constructed of plastic geogrid material filled with small gravel sized limestone rock. The mattress provides support for the limestone and prevents subsidence into the sand. Construction of units would take place on land with placement from ocean going barges by crane. Placement depths are from 14 to 16 feet. The limestone boulders are sized from 2 to 6 feet in diameter. Alternative shoreline plans for the 6 Mid-Reach segments include a 10 FT + 10 FT advance maintenance plan, 20 FT + 10 FT advance maintenance plan, and 30 FT + 10 FT advance maintenance plan. Total estimated impact for respective plans ranges from 3.5 to 5.7 to 8.1 acres, and averages about 5 acres over the 6 segment reaches.

PROPOSED DESIGN: The proposed alternative mitigation reef is a formed articulated concrete mat with coquina stone imbedded in the top surface. Individual panels can be interconnected to create a large and less moveable reef. Construction of units would take place on land with placement from ocean going barges by crane. Placement depths are from 14 to 16 feet.

ADVANTAGES:

- Less acreage required as whole surface counts toward mitigation.
- Easier installation using one system.
- More closely approximates the flat tabular relief of the natural rock.
- May produce improved mitigation ratio – better than rock filled marine mat.

DISADVANTAGES:

- Still does not meet optimal mitigation reef depth of 0 to 10 feet.

JUSTIFICATION: The proposed mitigation reef is an improvement over the original design. It may have environmental and cost advantages by more closely matching the natural rock. The cost advantage would result from a change in the mitigation ratio and may result in a cost savings of several million dollars, depending on the numbers of acres of mitigation constructed. This mitigation reef still does not meet every requirement of mitigation, so alternatives should continue to be considered.

Current cost estimates of the original mitigation reef were calculated for a range of sizes from 1 acre to 15 acres. Costs not including engineering, design, contracting and permitting, range from $1.3 million to $1.4 million. Construction cost estimates for the proposed mitigation reef based on input from a design consultant will also be in the $1.4 million range. So there are no cost savings in changing materials if the same number of acres is required.

The proposed design may more closely mimic the natural rock formation in its low tabular structure. As such, it is possible that environmental evaluation will yield a change in the mitigation ratio. The original design requires a mitigation ratio of 3.34:1.

A quick inspection of the UMAM computation sheets shows that only one of three criteria would possibly change; that being the functionality of the mitigation reef. The reef evaluated at 3.34:1 was given a functionality of 70-75% compared to the natural reef. A modest increase to 85% would result in a change in mitigation ratio to 3.0:1. The extreme value if the functionality of the mitigation reef were assigned 100% would result in a mitigation ratio of 2.72:1. The change in construction cost with the different mitigation ratios is shown in the Cost Estimate Worksheet for this proposal.

Potential saving for the proposed formed articulated concrete mat with imbedded coquina stone (Proposals C-1A and C-1B) ranges from $3.5 to $5.25 million for each 5 acres of mitigation if improved mitigation ratios are realized.

REVISION FOR FINAL REPORT: The Recommended Plan will develop articulated concrete mats with imbedded coquina stone as the mitigation system for impacted hard ground rock. Adverse impacts to hard ground rock areas will be limited to approximately 3 acres including initial direct placement and subsequent cross-shore equilibration and long-shore diffusion.

Final details and dimensions will change with detailed design. Each articulated reef mat will contain 18 cable-connected concrete blocks with coquina surface. Mats will be about 8 FT by 15 FT by 1 FT and comprise 90 lineal feet of valleys or ridges. Approximately 42 mats will be places adjacently with two additional top layer mats landward forming an overhang ledge. The reef mat set consists of 44 total mats to constitute 0.15- to 0.16 acres of hard bottom structure. Mitigation sites will be typically set 800 FT from existing rocks, to 1,000 FT seaward of MLW shoreline, and results in about -12 to -14 FT (MLW) water depths. Three to five mat sets spaced 50- to 60 FT apart along the -15 FT (MLW) contour will form a reef-group (0.45- to 0.75 Acres). Reef-groups would be spaced 400- to 9,000 FT apart to create the total shoreline reef mitigation.

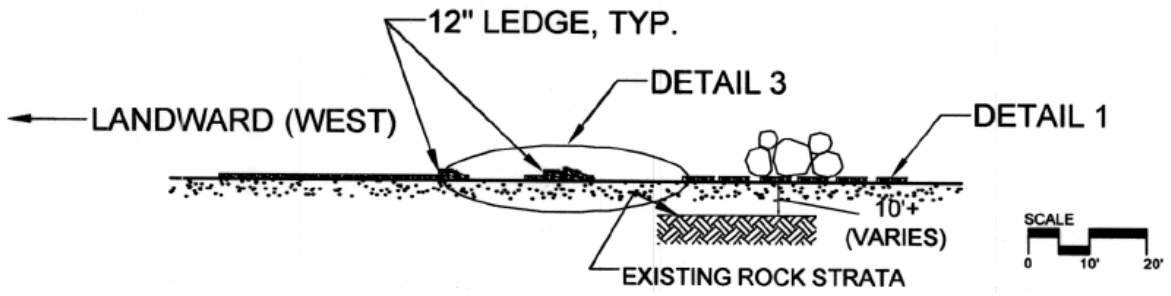
Adjusted savings for the use of articulated concrete mat with imbedded coquina stone for reduced rock impact limited to approximately 4.8 acres (3 Acres impacted at 1.6:1 Mitigation Ratio) with the GRR Recommended Plan. The corresponding areas and cost savings are adjusted accordingly as follows:

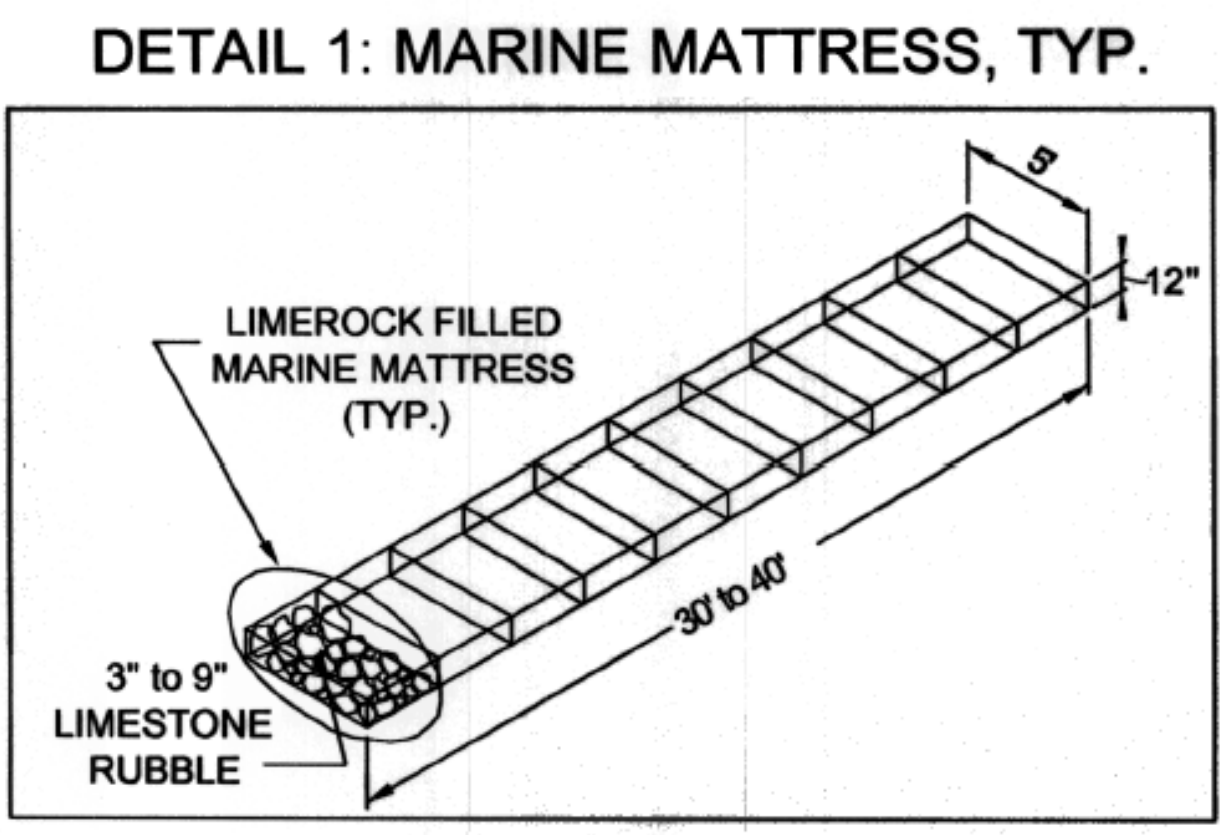
Original Plan: 3 Acres Rock Filled Marine Mat Mitigation X (3.34:1 Ratio) X $1,209,509/Acre + 23% Contingency = $14,907,000

C-1C: GRR Recommended Plan: 3 Acres Coquina-ACM Mitigation X (1.6:1 Ratio) X $1,209,509/Acre + 23% Contingency = $7,141,000

Final Estimated Savings: $7,766,000

Current Stone Filled Marine Mattress
(Mitigation Ratio 3.34:1)





Proposed Coquina Stone Articulated Concrete Mat
(Mitigation Ratio 1.6:1)

Capacities for Concrete Mattress on Handling Frame
(Below Water Installation Techniques)

- Dimensions: 8' X 20' X 9" (10,500 Lbs
- Mattress Weight Submerged: 6,000 lbs. (approx.)
- Concrete Density: 145 lbs. per cu. ft., 4,000 psi
- 160 elements: 5/8" ultra violet stabilized copolymer extruded fiber rope, minimum tensile strength 9,500 lbs

COST ESTIMATE WORKSHEET

C-1 PROPOSAL DESCRIPTION: Develop Coquina Stone Articulated Concrete Mat

DELETIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-1	Current Completed Mitigation Reef:				
	5 Acres impact X 3.34 ratio	Ac	17	$1,400,000.00	$23,800,000
			Total Deletions		$23,800,000

ADDITIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-1A	Stone ACM Completed Mitigation Reef:				
	5 Acres impact X 3.00 ratio	Ac	15	$1,400,000.00	$21,000,000
			Total Additions		$21,000,000
		Net Cost Decrease/Increase			$2,800,000
	*	Mark-ups	25.00%		$700,000
		Total Cost Decrease/Increase			$3,500,000

ADDITIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-1B	Stone ACM Completed Mitigation Reef:				
	5 Acres impact X 2.72 ratio	Ac	14	$1,400,000.00	$19,600,000
			Total Additions		$19,600,000
		Net Cost Decrease/Increase			$4,200,000
	*	Mark-ups	25.00%		$1,050,000
		Total Cost Decrease/Increase			$5,250,000

Mark-ups: Gen. Contractor Mark-up - Included in Unit Prices (Field Office/Home Office/Profit/Bond); Contingencies - 25.0%

REVISED FINAL COST ESTIMATE WORKSHEET

C-1 PROPOSAL DESCRIPTION: Develop Coquina Stone Articulated Concrete Mat (GRR Recommended Locally Preferred Plan)

DELETIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-1	Current Completed Mitigation Reef:				
	3 Acres impact X 3.34 ratio	Ac	10.0	$1,209,509.03	$12,119,280
			Total Deletions		$12,119,280

ADDITIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-1C	Stone ACM Completed Mitigation Reef:				
	3 Acres impact X 1.60 ratio	Ac	4.8	$1,209,509.03	$5,805,643
			Total Additions		$5,805,643
		Net Cost Decrease/Increase			$6,313,637
	*	Mark-ups	23.00%		$1,452,137
		Total Cost Decrease/Increase			$7,765,774

Mark-ups: Gen. Contractor Mark-up - Included in Unit Prices (Field Office/Home Office/Profit/Bond); Contingencies - 23.0%

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-2 PAGE NO: 1 OF 9

DESCRIPTION: Develop an Optimized Beach Nourishment Plan for Individual Mid-Reach Shoreline Segments (C-2: Maximum Benefit Federal Plan vs C-2A: The Compromise Plan)

ORIGINAL DESIGN: The Brevard County Mid-Reach segment is under study for the development of an effective shore protection plan to reduce storm damages that can meet the federal and local objectives, and the selected plan must meet economic requirements for benefits vs cost to construct (>1:1 Benefit/Cost). One initial plan under consideration is the Maximum Benefit Federal Plan that typically consists of dredge placement of a beach profile identified for each sub-reach segment. The plan places a combination conventional fill and beachface fill on selected sub-reach segments and reduces portions of the Mid-Reach project to a dune fill only in two reaches. One segment in Reach 5A is identified for a revetment structure to be covered with sand. One reach is identified for no work as the Benefit: Cost ratio does not justify improvements to that segment of the project. Annualized benefits are estimated as $6.1 million.

The nearshore hardbottom rock areas (consisting of coquina outcrops formed from lithified shell fragments, quarts sand and calcium carbonate) are unique to the Mid-Reach project area and they provide diverse habit for shallow marine flora and fauna and are identified as Habitat Areas of Particular Concern (HAPC). Any rock areas covered by sand placement must be mitigated for using a mitigation feature consisting of .rock filled marine mat and larger stone arrangements to be placed in 10 to 14 foot water depths. An estimated ratio of mitigation for this system is identified as 3.34 to 1 for each acre impacted. The Maximum Benefit Federal Plan is estimated to impact 4.89 acres of rock and the mitigation requirement is 16.3 acres.

See Figure 1- Brevard County Mid-Reach Alternative Matrix for issues effecting alternative plans, and Figure 2 – Preferred Plans for further description of the Maximum Benefit Federal Plan.

PROPOSED DESIGN: It is recommended that an optimal beach nourishment plan be developed to assure an efficient level of shore protection can be delivered, and that the plan will reduce hardbottom rock impact. The alternative will likely be less than the Maximum Benefit plan, but it may offer the Mid-Reach area effective storm damage protection while allowing other means of sand delivery such as truck haul. A minimum beachface fill section of 10’ is proposed for segments with beach fill. All segments get a dune feature and one segment only get the dune fill with vegetation. A revetment structure is also proposed in Reach 5A. The truck haul method and reduced beachface fill sections may offer further improvements to the Compromise Plan shown in Figure 2. The more careful sand placement for a reduced beachface fill and dune system resulting by truck haul will also reduce the impact to hardbottom areas. The Compromise Plan is estimated to impact 2.37 acres of rock and the mitigation requirement is 7.9 acres. Estimates are provided for truck haul beach fill placement for both the Maximum Benefit Federal Plan and Compromise Plan for pricing comparison. Annualized benefits are estimated as $5.1 million for the Compromise Plan.

ADVANTAGES:
- A modified plan with reduced beachface fill quantities introduces a less intrusive profile and sand delivery method using truck haul.
- The Compromise Plan delivers protection with benefit and is an executable plan.
- Reduced hardbottom rock impact results from reduced sections and truck haul plan.

DISADVANTAGES:
- A 20% reduction in benefits is realized with the Compromise Plan.
- Stockpiling and rehandling sand is required with truck haul – this required further development.
- An increase in cost is incurred with the more expensive truck haul method if the Maximum Benefits Plan is selected.

JUSTIFICATION: The Compromise Plan represents a starting point for development of an optimized plan that can deliver the maximum level of storm damage protection and an economical means of executing the plan. Beach fill placement by truck haul and more localized grading will assure hardbottom areas are avoided. It improves impact to critical Habitat Areas of Particular Concern with a reduction of hardbottom areas being covered by sand. Each sub-reach segment can be optimized, and can consider a specific level of protection and the means of achieving it. While the reduced annual benefits for the Compromise Plan is approximately $1 million, this can be refined by further development and optimization to offer a better level of protection may be deliver with refinement of the plan.

Beach fill quantities for respective alternative plans are approximately 988,000 CY vs 676,000 CY. For pricing comparison, both plans were estimated for truck haul and the Maximum Benefits plan would cost approximately $9 million more than construction by dredge placement. It remains questionable that any level of reduced rock impact could be realized for that plan. The Compromise Plan realized approximately $12 million in reduced construction cost when compared to the Maximum Benefits Plan. This truck haul Compromise Plan is somewhat underdeveloped with regard to stock-piling and rehandling site acquisition and development. Estimating Worksheets are developed for each plan identifying C-2 as the Maximum Benefits Plan (Dredge), C-2A as the Maximum Benefits Plan (Truck Haul), and C-2B as the Compromise Plan (Truck Haul).

Truck haul routes and stockpiling /rehandling sites will require careful coordination. See comments 1 through 6 for more information of alternatives to be coordinated.

REVISION FOR FINAL REPORT: The developing plan has been greatly optimized with the development of the GRR. The Recommended Plan is the Locally Preferred Plan (LPP) which closely follows the GRR NED Plan. The difference between the two plans are changes in Reach 4 - changed from dune and vegetation only to a 10 foot beachface fill, and Reach 3 - changed from a 30 foot beachface fill to a 20 foot beachface fill with the LPP. Total sand placement is increased from 684,000 CY to 737,000 CY with the LPP. Rock impact is unchanged for the LPP.

Figure 3 presents NED and LPP plan details for optimal beach nourishment for individual Mid-Reach shoreline segments progressing from the initial VE effort to a more fully developed GRR level. The typical sections for the recommended plan are shown as Drawing 1, Mid-Reach Recommended LPP and Drawing 2, presenting respective Mid-Reach beach fill and dune fill cross sections.

Protection ranges from a 5 year to a 75 year storm level and varies along the Mid-Reach segments. Updated annual benefits are identified as $11.4 million and Benefits to Cost Ratio is 3.74 to 1. The plan offers the maximum storm damage reduction while minimizing environmental impacts to near shore rock. The Mid-Reach contains approximately 31.3 acres of near shore rock and only 4 acres will be impacted. The development of the coquina articulated mat systems will be recognized as having a 1.6 to 1 UMAM ratio resulting in mitigation of 4.8 acres.

The dredge placement site has been determined to be the Poseidon DMMA which will serve for both the initial construction and future renourishment cycles estimated to occur at three year intervals. Mid-Reach construction and future renourishment sand placement will be by truck haul with an average haul distance to the mid-construction point of approximately 20 miles. The DMMA is approximately 4 to 8 miles from the Canaveral Shoals Sand Borrow Areas. Hydraulic dredge placement for maintenance will be coordinated with North and South Reach portions of the federal shore protection project. This coordination allows sharing costs of mob/demob and prep with all three reached even though the North and South Reaches are on a 6 year cycle.

The current GRR level project plan has been compared to the initial Maximum Benefits Federal Plan for cost analysis and determining the cost avoidance through further plan development and optimization. The GRR plan minimizes sand placement and potential impacts to rock areas requiring mitigation. The greatly reduced quantities in these two features allow substantial reduction in construction cost for the project. The original Maximum Benefits Plan has been updated to FY2010 dollars and applicable markups are incorporated into unit cost so that the GRR contingency can be evenly applied to both alternatives. The optimized or LPP plan is identified as C-2C and the adjusted net savings are recognized as $24,198,000.

Figure 1- Brevard County Mid-Reach Alternative Matrix

Alternative Matrix

Management Measure	Number	Alternatives	Mitigation	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5A	Reach 5B	Reach 6
NS-1 No-Action	NS-1	future without project	No							
NS-7 Condemnation and Acquistion	NS-7A	100 feet of recession	No							
	NS-7B	134 feet of recession	No							
	NS-7C	170 feet of recession	No							
S-2 Revetment	S-2	50-year protection level	No							
S-3A Beachface Fill	S-3A(1)	10 foot exten. of MHW /1	Yes							
	S-3A(2)	20 foot exten. of MHW	Yes							
	S-3A(3)	30 foot exten. of MHW	Yes							
S-3B Conventional Fill Cumulative Reach 1 alone, then Reach 1 +2, then Reach 1+2 +3, etc	S-3B(1)	20 foot exten. of MHW	Yes							
	S-3B(2)	40 foot exten. of MHW	Yes							
	S-3B(3)	60 foot exten. of MHW	Yes							
	S-3B(4)	80 foot exten. of MHW	Yes							
	S-3B(5)	100 foot exten. of MHW	Yes							
	S-3B(6)	120 foot exten. of MHW	Yes							
	S-3B(7)	140 foot exten. of MHW	Yes							
	S-3B(8)	160 foot exten. of MHW	Yes							
S-3B Conventional Fill NOT Cumulative	S-3B(1)	20 foot exten. of MHW	Yes							
	S-3B(2)	40 foot exten. of MHW	Yes							
	S-3B(3)	60 foot exten. of MHW	Yes							
	S-3B(4)	80 foot exten. of MHW	Yes							
	S-3B(5)	100 foot exten. of MHW	Yes							
	S-3B(6)	120 foot exten. of MHW	Yes							
	S-3B(7)	140 foot exten. of MHW	Yes							
	S-3B(8)	160 foot exten. of MHW	Yes							
S-8 Dune and Vegetation	S-8	1 foot exten. of MHW	No							
Combination	C-1	Revetment plus Dune S-8	No							
	C-2	Revetment plus Dune S-8 plus Fill S-3A(1)	Yes							
	C-3	Dune plus Fill S-3A(1)	Yes							
	C-4	Revetment plus Dune S-8 plus Fill S-3A(2)	Yes							
	C-5	Revetment plus Dune S-8 plus Fill S-3A(3)	Yes							

Figure 2- Initial Preferred Plans

Preferred Plans

The Maximum Benefit Federal Plan

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5A	Reach 5B	Reach 6	Sum
Management Measure	No-Action	30 Ft Beachface Fill	60Ft Conventional Fill	Dune and Vegetation	Seawall	20 Ft Beachface Fill	10 Ft Beachface Fill	
Rock Impact (acres)	0	0.61	2.38	0	0	1.06	0.84	4.89

The Compromise Plan

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5A	Reach 5B	Reach 6	Sum
Management Measure	No-Action	10 Ft Beachface Fill	10 Ft Beachface Fill	Dune and Vegetation	Seawall	10 Ft Beachface Fill	10 Ft Beachface Fill	
Rock Impact (acres)	0	0.35	0.57	0	0	0.61	0.84	2.37

Figure 3 – GRR Recommended Plan

NED Plan (Optimized Benefit Plan)

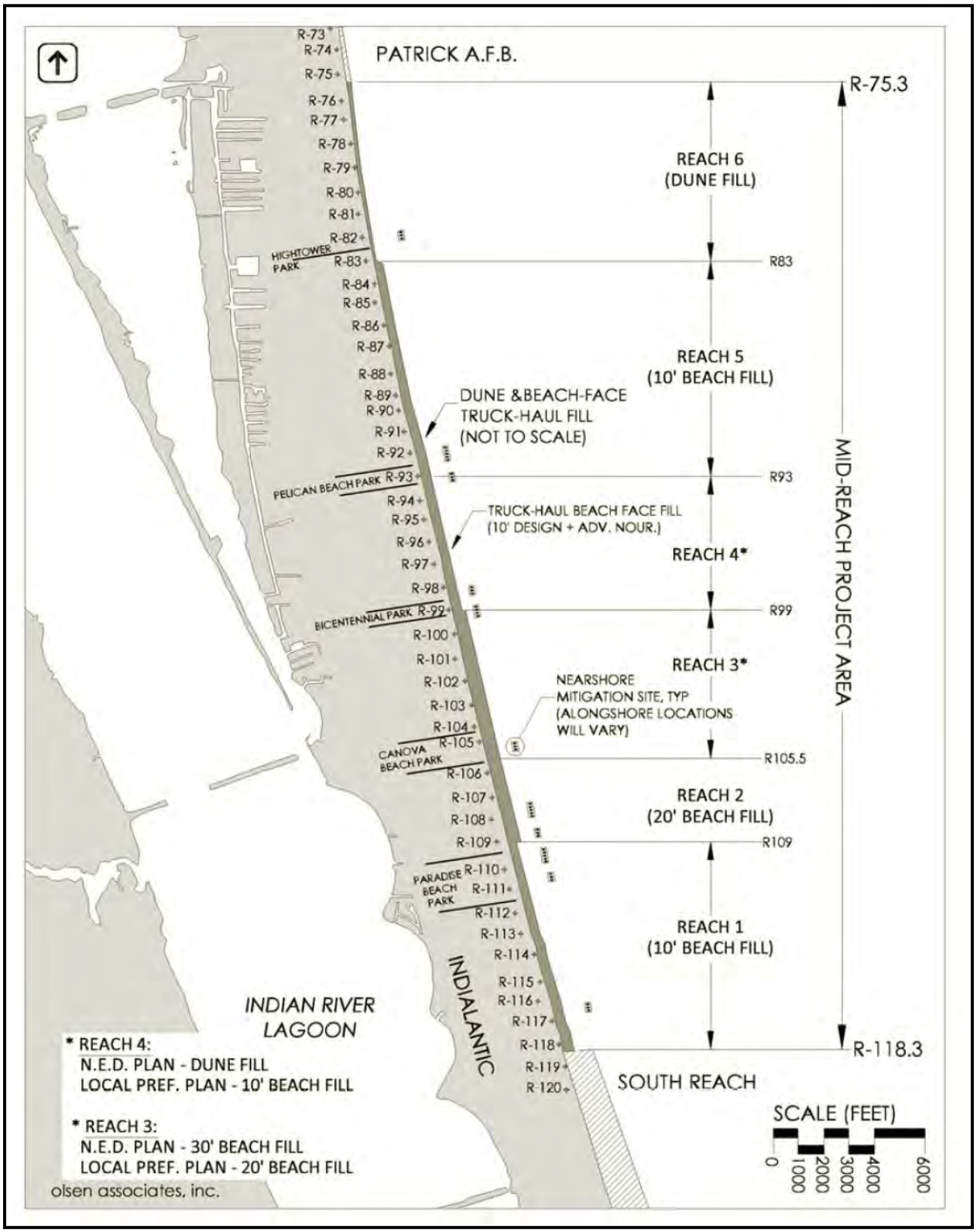
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5*	Reach 6	Sum
	10” Beach-face Fill	20” Beach-face Fill	30” Beach-face Fill	Dune Fill Only	10” Beach-face Fill	Dune Fill Only	
Rock Impact (Acres)	0.3 0.5		1.1	0.2 0.9		0.1	3.1

Locally Preferred Plan (Optimized Benefit Plan) Recommended

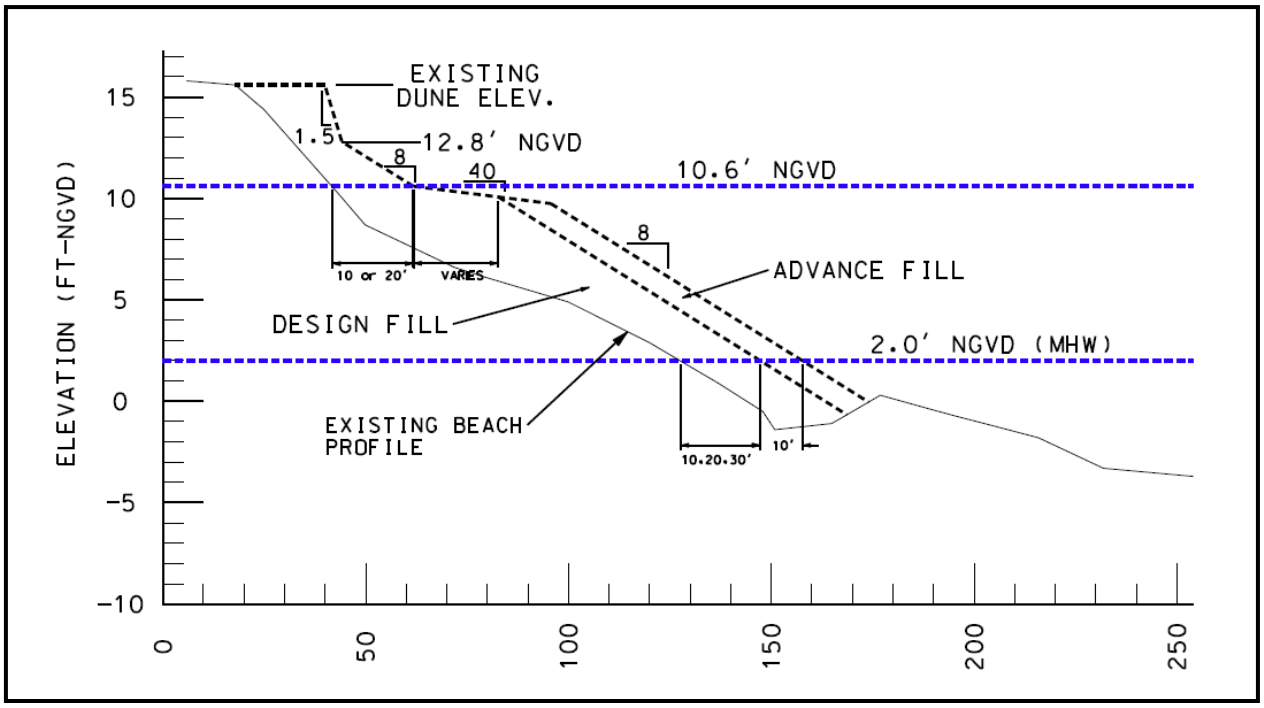
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5*	Reach 6	Sum
	10” Beach-face Fill	20” Beach-face Fill	20” Beach-face Fill	10” Beach-face Fill	10” Beach-face Fill	Dune Fill Only	
Rock Impact (Acres)	0.3 0.4		0.8	0.5 0.9		0.1	3.0

*Reach 5A and 5B are merged w/ NED and LPP

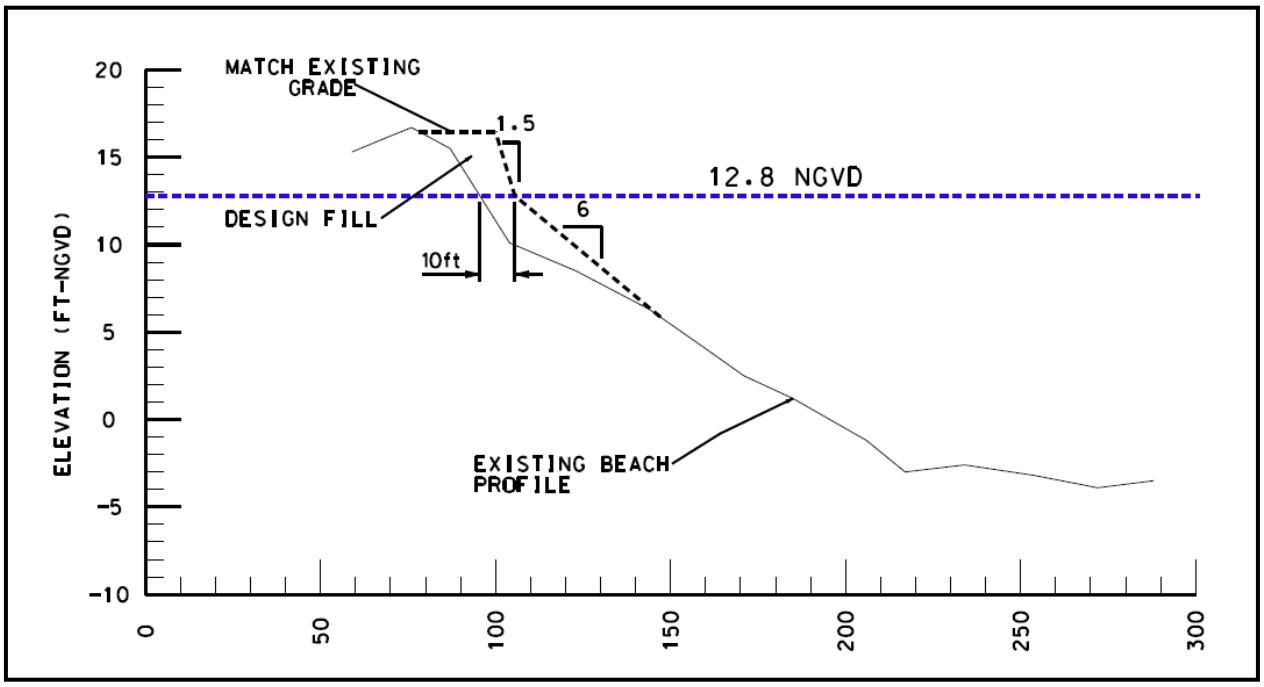
Drawing 1 - Brevard County Mid-Reach LPP Plan
(GRR Recommended Plan with Beachfill Profile and Mitigation Site Shown)



Drawing 2 - Brevard County Mid-Reach LPP Profile Sections
(GRR Recommended Plan)
10- and 20-Foot Beach Fill Cross Sections



Dune Fill Cross Section



	COST ESTIMATE WORKSHEET				
C-2	PROPOSAL DESCRIPTION: Develop an Optimal Beach Nourishment Plan for Individual Mid-Reach Shoreline Segments (C-2 Maximum Benefit Federal Plan vs C-2A MBFP Truck Haul)				
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-2	Mob/Demob/Prep Using Hopper Dredge:				
	Reach 1 No Action (B/C <1)	LS	0	$14.75	$0
	Reach 2 30' Beachface Fill	CY	162,000	$14.75	$2,389,500
	Reach 3 60' Conventional Fill	CY	323,000	$14.75	$4,764,250
	Reach 4 Dune Fill	CY	59,000	$14.75	$870,250
	Reach 5A & B Dune/20' Beachface Fill	CY	264,000	$14.75	$3,894,000
	Reach 5A Revetment	LS	1	$4,531,821.86	$4,531,822
	Reach 6 10' Beachface Fill	CY	180,000	$14.75	$2,655,000
	Offshore Mitigation - (3.34:1)	Ac	16.3	$1,054,000.00	$17,222,360
					$0
					$0
					$0
					$0
			Total Deletions		$36,327,182
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-2A	Mob/Demob/Prep DMMA TBD/Truck Haul:				
	Reach 1 (No Action B/C <1)	CY	0	$20.60	$0
	Reach 2 30' Beachface Fill (Truck Haul)	CY	162,000	$20.60	$3,337,200
	Reach 3 60' Beachface Fill (Truck Haul)	CY	323,000	$20.60	$6,653,800
	Reach 4 Dune Fill (Truck Haul)	CY	59,000	$20.60	$1,215,400
	Reach 5A & B Dune/20' Beachface Fill (Truck Haul)	CY	264,000	$20.60	$5,438,400
	Reach 5A Revetment	LS	1	$4,531,821.86	$4,531,822
	Reach 6 10' Beachface Fill (Truck Haul)	CY	180,000	$20.60	$3,708,000
	Offshore Mitigation - (3.34:1)	Ac	16.3	$1,093,000.00	$17,859,620
					$0
					$0
					$0
					$0
					$0
			Total Additions		$42,744,242
		Net Cost Increase			-$6,417,060
*		Mark-ups	42.19%		-$2,707,358
		Total Cost Increase			-$9,124,418
	Quantities were estimated from planning level cost sub-reach estimates using a unit cost average for sand placement by dredge ($14.75/CY) or truck haul ($20.60/CY) dated 13 July 2006.				
*	Mark-ups: Gen. Contractor Mark-up - Included in Unit Prices (Field Office/Home Office/Profit/Bond);				
	PED - 10%; S&A - 8.5%; Contingencies -15.0% and Escalation to FY06 - 3.6% =				42.19%

COST ESTIMATE WORKSHEET

C-2 PROPOSAL DESCRIPTION: Develop an Optimal Beach Nourishment Plan for Individual Mid-Reach Shoreline Segments (C-2 Maximum Benefit Federal Plan vs C-2B The Comprise Plan)

DELETIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-2	Mob/Demob/Prep Using Hopper Dredge:				
	Reach 1 No Action (B/C <1)	LS	0	$14.75	$0
	Reach 2 30' Beachface Fill	CY	162,000	$14.75	$2,389,500
	Reach 3 60' Conventional Fill	CY	323,000	$14.75	$4,764,250
	Reach 4 Dune Fill	CY	59,000	$14.75	$870,250
	Reach 5A & B Dune/20' Beachface Fill	CY	264,000	$14.75	$3,894,000
	Reach 5A Revetment	LS	1	$4,531,821.86	$4,531,822
	Reach 6 10' Beachface Fill	CY	180,000	$14.75	$2,655,000
	Offshore Mitigation - (3.34:1)	Ac	16.3	$1,054,000.00	$17,222,360
					$0
					$0
					$0
					$0
			Total Deletions		$36,327,182

ADDITIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-2B	Mob/Demob/Prep DMMA TBD/Truck Haul:				
	Reach 1 (No Action B/C <1)	CY	0	$20.60	$0
	Reach 2 10' Beachface Fill (Truck Haul)	CY	102,000	$20.60	$2,101,200
	Reach 3 10' Beachface Fill (Truck Haul)	CY	134,000	$20.60	$2,760,400
	Reach 4 Dune Fill (Truck Haul)	CY	59,000	$20.60	$1,215,400
	Reach 5A & B Dune/10' Beachface Fill (Truck Haul)	CY	201,000	$20.60	$4,140,600
	Reach 5A Revetment	LS	1	$4,531,821.86	$4,531,822
	Reach 6 10' Beachface Fill (Truck Haul)	CY	180,000	$20.60	$3,708,000
	Offshore Mitigation - (3.34:1)	Ac	7.9	$1,152,000.00	$9,123,840
					$0
					$0
					$0
					$0
					$0
			Total Additions		$27,581,262
		Net Cost Increase			$8,745,920
*		Mark-ups	42.19%		$3,689,904
		Total Cost Increase			$12,435,824

Quantities were estimated from planning level cost sub-reach estimates using a unit cost average for sand placement by dredge ($14.75/CY) or truck haul ($20.60/CY) dated 13 July 2006.

* Mark-ups: Gen. Contractor Mark-up - Included in Unit Prices (Field Office/Home Office/Profit/Bond); PED - 10%; S&A - 8.5%; Contingencies -15.0% and Escalation to FY06 - 3.6% = 42.19%

REVISED FINAL COST ESTIMATE WORKSHEET

C-2 PROPOSAL DESCRIPTION: Develop an Optimal Beach Nourishment Plan for Individual Mid-Reach Shoreline Segments (C-2 Maximum Benefit Federal Plan in FY2010 $'s vs C-2C GRR Recommended Locally Preferred Plan)

DELETIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-2	Mob/Demob/Prep Using Hopper Dredge:				
	Reach 1 No Action (B/C <1)	LS	0	$20.21	$0
	Reach 2 30' Beachface Fill	CY	162,000	$20.21	$3,274,020
	Reach 3 60' Conventional Fill	CY	323,000	$20.21	$6,527,830
	Reach 4 Dune Fill	CY	59,000	$20.21	$1,192,390
	Reach 5A & B Dune/20' Beachface Fill	CY	264,000	$20.21	$5,335,440
	Reach 5A Revetment	LS	1	$5,211,595.14	$5,211,595
	Reach 6 10' Beachface Fill	CY	180,000	$20.21	$3,637,800
	Offshore Mitigation - (3.34:1)	Ac	16.3	$1,212,100.00	$19,805,714
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Deletions		$44,984,789

ADDITIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
C-2C	GRR Plan: Mob/Demob/Prep Poseidon DMMA	LS	1	$1,626,444.00	$1,626,444
	Reach 1 10' Beachface Fill (Truck Haul)	CY	147,972	$25.08	$3,711,138
	Reach 2 20' Beachface Fill (Truck Haul)	CY	84,068	$25.09	$2,109,266
	Reach 3 20' Beachface Fill (Truck Haul)	CY	135,189	$24.99	$3,378,373
	Reach 4 10' Beachface Fill (Truck Haul)	CY	84,502	$24.60	$2,078,749
	Reach 5 10' Beachface Fill (Truck Haul)	CY	103,220	$25.03	$2,583,597
	Reach 6 Dune Fill (Truck Haul)	CY	17,877	$25.39	$453,897
	Offshore Mitigation - 4.8 Acres	Ac	4.8	$1,209,509.03	$5,805,643
	Non-Construction	LS	1	$2,751,485.00	$2,751,485
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Additions		$24,498,592

		Net Cost Increase			$20,486,197
	*	Mark-ups	23.00%		$4,711,825
		Total Cost Increase			$25,198,022

FY09 GRR Quantities and Unit Cost used for truck haul and CWCCIS indexed w/ estimated markup for dredge placement ($20.21/CY)

* Mark-ups: Gen. Contractor Mark-up - Included in Unit Prices (Field Office/Home Office/Profit/Bond); Non Construction (PED/S&I/LD) shown as line item; Contingencies - 23.0%

1. <u>Identify Alternative Out-of-Kind Mitigation Reef Locations (Speculation Item 21):</u> The speculation mitigation reef is of the same or similar construction technique as the original mitigation reef but varies from the original in placement location. Placement in water depth from 0 to 10 feet is desired to mimic the natural reef to be impacted. To achieve this, a location with reduced wave action is needed. The area must provide approximately 20 acres of area for reef placement. Potential locations include Canaveral Inlet and Sebastian Inlet.

Canaveral Inlet is a fully developed port, such that placement of reefs within the inlet interior would obstruct navigation and would be prohibited. Canaveral Inlet is connected to the Indian River by locks, such that on the west side of the locks any reef would be cut off from the ocean and would not be advantageous. Placement next to the Canaveral jetties would be possible in the lee of the waves, but does not offer much acreage for placement.

Sebastian Inlet is a smaller inlet, used mostly by recreational boaters. Placement at Sebastian Inlet is not restricted by location, making placements next to the jetties, inside the inlet and in the Indian River near the inlet possible. The wave climate would be minimal, allowing placement at shallow depths. Cost savings may be realized from smaller equipment in the protected environment and less acreage if the mitigation ratio is reduced. The mitigation ratio is questionable, though, as any gain in habitat function due to the shallow depth may be counteracted by loss from the inshore location and less mixing of the water from the waves. Sebastian Inlet is 18 to 25.6 miles south of the Mid-Reach south and north end of the study area, respectively, which may mean different species. It is doubtful 20 acres of reef could be placed looking at the aerial photographs and seagrass mapping. Impacts to seagrass would be undesirable. Therefore, Sebastian Inlet is not a viable placement location. This speculation idea is removed from further consideration.

Brevard County SSP, Canaveral Inlet and Sebastian Inlet Location Map

Brevard County SSP, Canaveral Inlet Location Map

Sebastian Inlet Map with Seagrasses

2. Place conventional fill in Reach 3, stockpile on the beach for truck haul north and south, and mitigate 3 acres of rock offshore (Speculation Item 22): This combination of alternatives was presented by the Sponsor's representative for consideration. The conventional fill, stockpile and mitigation elements are included in the separable elements of alternatives under consideration. Combining these elements is possible and is within the scope of alternatives already included. This speculation idea is noted for the study, but is not developed further at this time.

3. Conventional fill Reach 3 and local preferred plan for other Reaches (Speculation Item 23): This combination of alternatives was presented by the Sponsor's representative for consideration. The conventional fill is included in the separable elements of alternatives under consideration. The sponsor alluded that if the Federal selected plan is not desirable to the sponsor, they would be willing to back a locally preferred plan with some change in cost sharing. The locally preferred plan is agreed upon following identification of the Federal selected plan, still to be determined. This speculation idea is noted for the study, but is not developed further at this time.

4. Conventional fill in Reaches 1 and 2 as the locally preferred plan and dune truck haul fill in Reaches 3 thru 6 as the Federal plan (Speculation Item 24): This combination of alternatives was presented by the Sponsor's representative for consideration. The conventional fill and dune fill are included in the separable elements of alternatives under consideration. The sponsor alluded that if the Federal selected plan is not desirable to the sponsor, they would be willing to back a locally preferred plan with some change in cost sharing. The locally preferred plan is agreed upon following identification of the Federal selected plan, still to be determined. This speculation idea is based upon the idea that the Federal selected plan may be dune fill for Reaches 3 thru 6, but this has not been finalized. This speculation idea is noted for the study, but is not developed further at this time.

5. Vertical Seawall Alternative (Speculation Item 26): This alternative involves placing a vertical seawall structure parallel to the mean high water line at the foot of the existing bluff. The seawall would be designed to protect against the 50-year storm level. During the course of the study, a part of Reach 5 was identified as meeting the criteria for eligibility set forth in the State's Coastal Zone Management Program which must be abided by per the Federal Coastal Zone Management Act. Two areas, 2,760 feet and 560 feet in length, have been identified for construction of the seawall.

Discussion of the environmental permitting process led to the conclusion that it would be likely that a seawall would have some permitting conditions regarding sea turtle nesting. This could include up to a 5-foot sand cover vertically over any portions of the seawall. Internal discussion between Planning Division, Project Management, and Office of Counsel led to an agreement that the sand cover was a reasonable and integral part of the design.

As such the sand cover would be included as a required part of the alternative in all documentation and included in the construction costs. It was suggested that initial construction of the seawall and sand cover be a cost-sharing item, and continued maintenance of the sand cover should be an item of local cooperation.

It is anticipated that the local sponsor may not agree to an item of local cooperation including maintenance of the sand cover. However, the plan must be fully developed to present to the local sponsor. This speculation idea should be carried forward in the planning process.

6. Several dredge storage and rehandling sites were recommended to be investigated (Speculation Items 1, 2, 4, 11, 12, 14): This is an update to the discussion with David Roach, director of FIND and the status of the 8 FIND placement sites that are planned for or in place in Brevard County.

Essentially FIND would welcome a partnership to speed development and construction of their unconstructed sites and would cooperate with us in using certain existing sites to temporarily stockpile offshore sand. It would require written agreements regarding the joint use and management of sediment to ensure adequate capacity for both parties, but if it were cost effective (see below) it appears that FIND would be a willing partner.

The main road block to the use of FIND sites is the high costs to transport and rehandle sand into the site, and back out of the site for beach placement. In talking with Brian Blake and Phil Bates after the meeting (along with input from David Roach during the call) it looks prohibitively expensive to barge the material to these sites. The process of moving sand from the borrow site to the FIND sites would involve:

1) Hydraulic dredging at Canaveral Shoals into seagoing barges/scows.
2) Rehandling of material into smaller, scows for use in the IWW (only hold 1000 to 1500 CY each).
3) Transport of scows through the barge canal to the IWW, then North or South to the FIND site.
3) Resuspension of sand into slurry to hydraulically pump out small scows into placement site.
4) Truck haul to Mid Reach.

The approximate cost for this at ~$100/cy due primarily to the rehandling operations (present cost estimate for truck haul from existing upland borrow is ~$30/cy). This does NOT include any costs for development/modification of the sites themselves. It is a consensus option that this cost is far too high vs. the benefit of dune fill. It is recommended to abandon this alternative and identify other alternatives with better opportunities for innovative ways to reduce cost.

One alternative that holds some possibility is to stockpile on Patrick AFB while the offshore dredge is mobilized by putting a pipeline under A1A and pumping directly out of the seagoing barge or dredge into the stockpile area, thus eliminating one portion of rehandling and making truck haul distances much shorter than the FIND sites would be. I will talk with the AFB engineer re this. This alternative requires development of an entirely new site with all the attendant environmental challenges and logistical issues that that poses. Considerable cost would be required for development of a new DMMA site. Identifying an existing DMMA site with minimal requirements for use as a storage and rehandling site would be a better alternative

Perhaps the best alternative still seems to be the Port West Disposal site near the Navy docks with it's deep draft access and relatively short haul distances. A planned meeting with AF/Navy/Port on August 17, 2006, will address each of these remaining alternatives.

7. Develop artificial reefs (Speculation Item 16):. Develop artificial reefs-reef balls on mats (see low-crested breakwater reef – Dade County 1,800 LF for $2 million)

The low-crested breakwater reef, or Submerged Artificial Reef Training Structure (SMART), proposed in Dade County was to consist of various sized reef balls mounted on concrete slabs which in turn would be cabled to ARMORTEC Armorflex Concrete Block Mats. It was to be placed in an average depth of 7-feet below MLW. The draft Environmental Assessment for this project, with detailed information, can be found at: http://planning.saj.usace.army.mil/envdocs_A-D/Dade_Co/Section227/MIAMI-DADE-COUNTY.pdf

EN-HC stated that the SMART should be stable in the Dade County wave climate, and may be stable in the Mid-Reach wave climate if designed correctly. Anchoring or pinning the structure would probably be necessary if placed in the intertidal zone or just beyond. Getting the SMART deployed in shallow water, e.g. 7-feet below MLW, would be problematic in the Mid-Reach. The SMART could possibly be towed or floated in.

The National Marine Fisheries Service and Florida Fish and Wildlife Conservation Commission raised concerns regarding sea turtle passage over the SMART and increased fish predation of hatchling sea turtles. The US Fish and Wildlife Service stated that if the SMART caused increased beach erosion resulting in loss of sea turtle nests or nesting habitat, then the structure should be removed.

From an ecological function standpoint, there is very little difference between the proposed articulated mattresses embedded with boulders versus the SMART. It is suggested that economic and engineering criteria be used to choose the type of structure. The real problem is placement of a mitigation structure in shallow water, which has stability, accessibility, and liability issues.

8. Use literature search, case studies other resource (Speculation Item 20): Electronic library was used to search 14+ journals, including (or within the following professional organizations): American Fisheries Society, Applied Ocean Research, Biological Conservation, Biosystems Engineering, Coastal Management, Conservation Biology, Ecological Engineering, Estuarine Coastal and Shelf Science, Fisheries Research, Journal of Applied Ecology, Journal of Ecology, Journal of Experimental Marine Biology and Ecology, Journal of Marine Systems, and Marine Environmental Systems. Searches were conducted for information on artificial reefs (AR), and refined searches were performed on intertidal AR, shallow water AR, and construction of AR. Although there is a large volume of information in the literature on AR, no useful information or ideas which appear to be better than the proposed articulated mattress embedded with boulders were found.

9. Develop geo-tube core dune system (Speculation Item 25): Develop geo-tube core dune system – select locations and leave gaps for sea turtle nesting (ask USFWS).

PD-E discussed the use of geo-tubes along the Mid-Reach with the US Fish and Wildlife Service. The Service stated that permittees in Brevard County have not maintained sufficient sand coverage over installed geo-tubes for the last two sea turtle nesting seasons. This gave the impression that the Service would not look favorably upon the use of geo-tubes or any armor within the Mid-Reach. However, in areas that are vulnerable to erosion and no other options were available, vertical structures such as seawalls would be preferred by the Service over geo-tubes or sloped revetments. The Service also stated that leaving gaps between geo-tubes would probably not be beneficial. There would still be a liability in maintaining sufficient sand coverage over tubes, and the gaps would only be utilized by sea turtles by chance.

Since some areas of the project may have minimal protection provided, such as dune only, or a 10 foot beachface fill, the possible use of a geo-tube core with gaps should be restudied during the PED P&S phase to improve damage recovery and allow a gap for natural sand should nesting and storm damage activities overlap. A typical arrangement may be 60 foot of geo-tube and 60 foot gap continuously for applicable sub-reaches.

10. Design turtle friendly dune with flat slopes (Speculation Item 27): After some discussion among PD-E staff, the approved slope of the recently constructed dune through the Mid-Reach should be recommended.

SUPPORTING DOCUMENTS

CONTACT DIRECTORY

Brevard County Shore Protection Project
Mid-Reach Segment
Value Engineering Team

1 June 2006

	Name	Organization	Telephone
1.	Oz Rodriguez	SAJ-DP-C	904-232-2909
2.	Candida Bronson	SAJ-PD-PN	904-232-3873
3.	Jason Engle	SAJ-EN-HC	904-232-2230
4.	Eric Roasch	SAJ-PD-D	904-232-3680
5.	Phill Bates	SAJ-CO-OM	904-232-1196
6.	Mark Clark	SAJ-CO-CS	904-232-1433
7.	Matt Schrader	SAJ-EN-HC	904-232-2043
8.	Tom Martin	SAJ-EN-HC	904-232-2043
9.	Paul Strodola	SAJ-PD-EA	904-232-3271
10.	Brian Blake	SAJ-EN-C	904-232-1003
11.	Kevin Bodge	Olsen Assc, Inc.	904-387-6114
12.	Steve Howard	Olsen Assc, Inc.	904-387-6114
13.	Virginia Barker	Brevard County	
14.	Mike McGarry	Brevard County	

SPECULATION LIST

Brevard County Mid-Reach Speculation List 1-Jun-06

D= Develop Idea; C = Comment on Idea; X= Deleted Idea

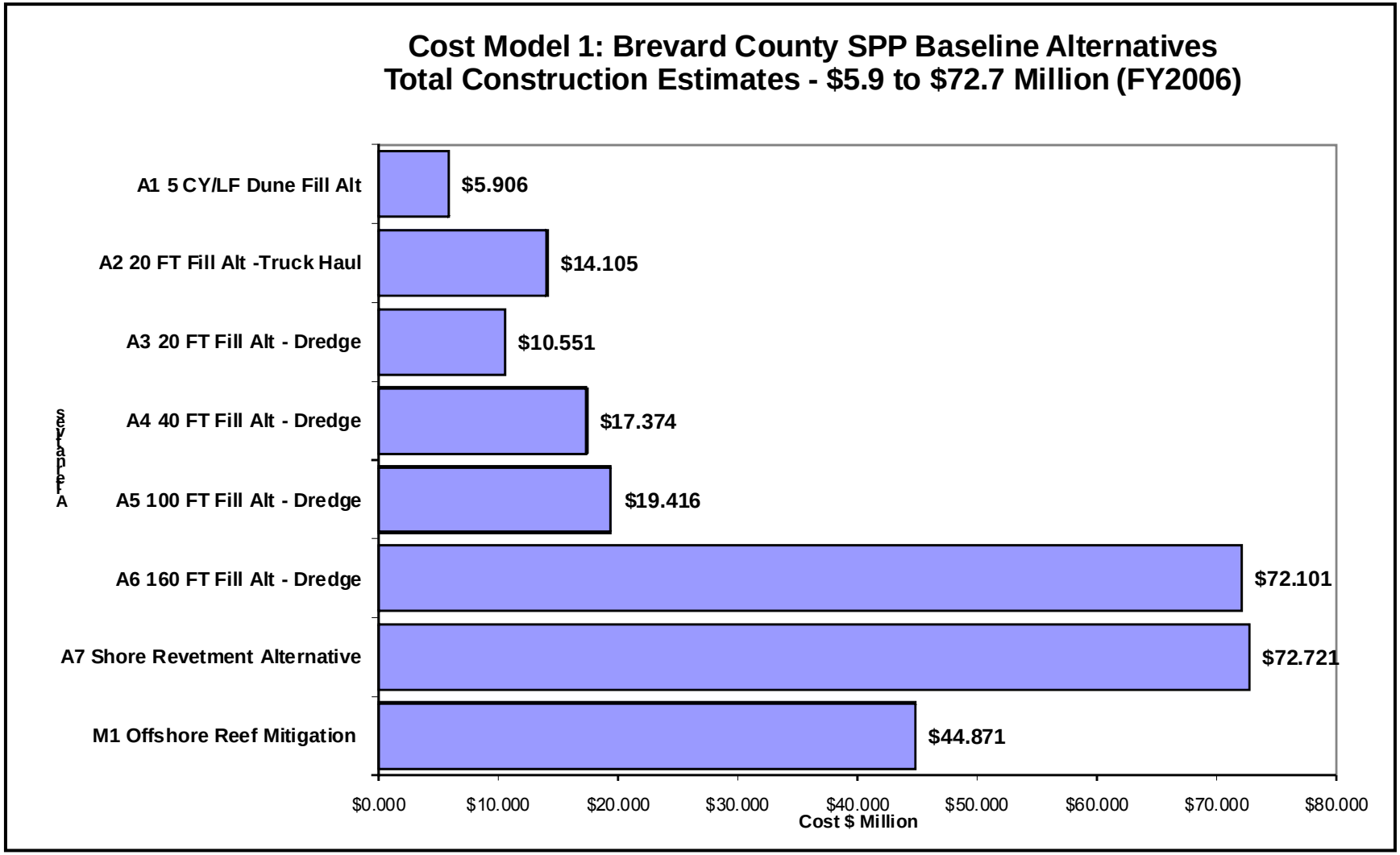
1	C	Upland sand sources for truck hauling	See below
2	C	Research available upland sources – borrow sites identified (FIND sites: BV-2C [3.2 MCY - road issues – hydraulic to barge/rehandle]; CBC barge canal [full, unknown quantity - beach quality?]; BV-52 [216,000 CY small quantity – free - beach quality?]; 2 e	OR/IWW/PM/CO
3	C	Dredging Canaveral Shoals and stockpile in mid-reach or north inlet (Beach stockpile issues)	See 24
4	C	Dredging Canaveral Shoals and stockpile in port (West preferred) disposal area	JE/KB
5	X	Improve road to BV-2C as mitigation access to borrow	OR/IWW/PM/CO County
6	X	Identify commercial borrow sites (quantities, cost) - Comment not preferred option	FM
7	X	Sample and research borings for IWW to determine sand quality - Comment not preferred option	FM
8	X	Develop sources to cover shortfall in quantities or unsuitable material quantities (contingency) - Not required	FM
9	X	Upper St. Johns River restoration project as borrow source	PS
10	X	St. Lucie shoal (millions CY – environmental issues)	
11	C	Develop new FIND receiving sites for stockpiling hydraulic dredged sands	See #2
12	C	Use barges from CS2 to deliver new FIND – truck haul to site	See #2
13	X	Place Canaveral by-pass sand in mid-reach	
14	C	Stockpile on Patrick AFB – truck haul	JE/KB
15	X	Relocate the rock	
16	C	Develop artificial reefs – reef balls on mats (See low-crested breakwater reef – Dade County 1,800 LF for $2 million)	PS
17	D	Use Coquina-concrete mats - deep 14' to 16' depth	CB
18	X	Build Geotube off-shore breakwater – recreation and habitat	
19	*	Poly-marine mat with limestone placed on top in 12' to 16' water	*Current Plan
20	C	Use Literature search, case studies other resource	PS
21	C	Consider out-of-kind mitigation (Inlet a possibility)	CB
22	C	Conventional fill in reach 3 , stockpile for truck haul north and south, and mitigate 3 acres rock 3:1 offshore	KB/VB
23	C	Conventional fill reach 3 and local for other reaches	KB/VB
24	C	Conventional fill reach 1 and 2 as local and dune truck haul fill 3 thru 6	KB/VB
25	C	Develop Geotube core dune system – select locations and leave gaps for nesting	PS
26	C	Vertical seawall reach 5 (4,000 LF)	CB/CC
27	C	Design turtle friendly dune with flat slopes	PS
28	D	Develop optimized nourishment plan as a betterment to the compromise plan	CB/JE/TM/PS

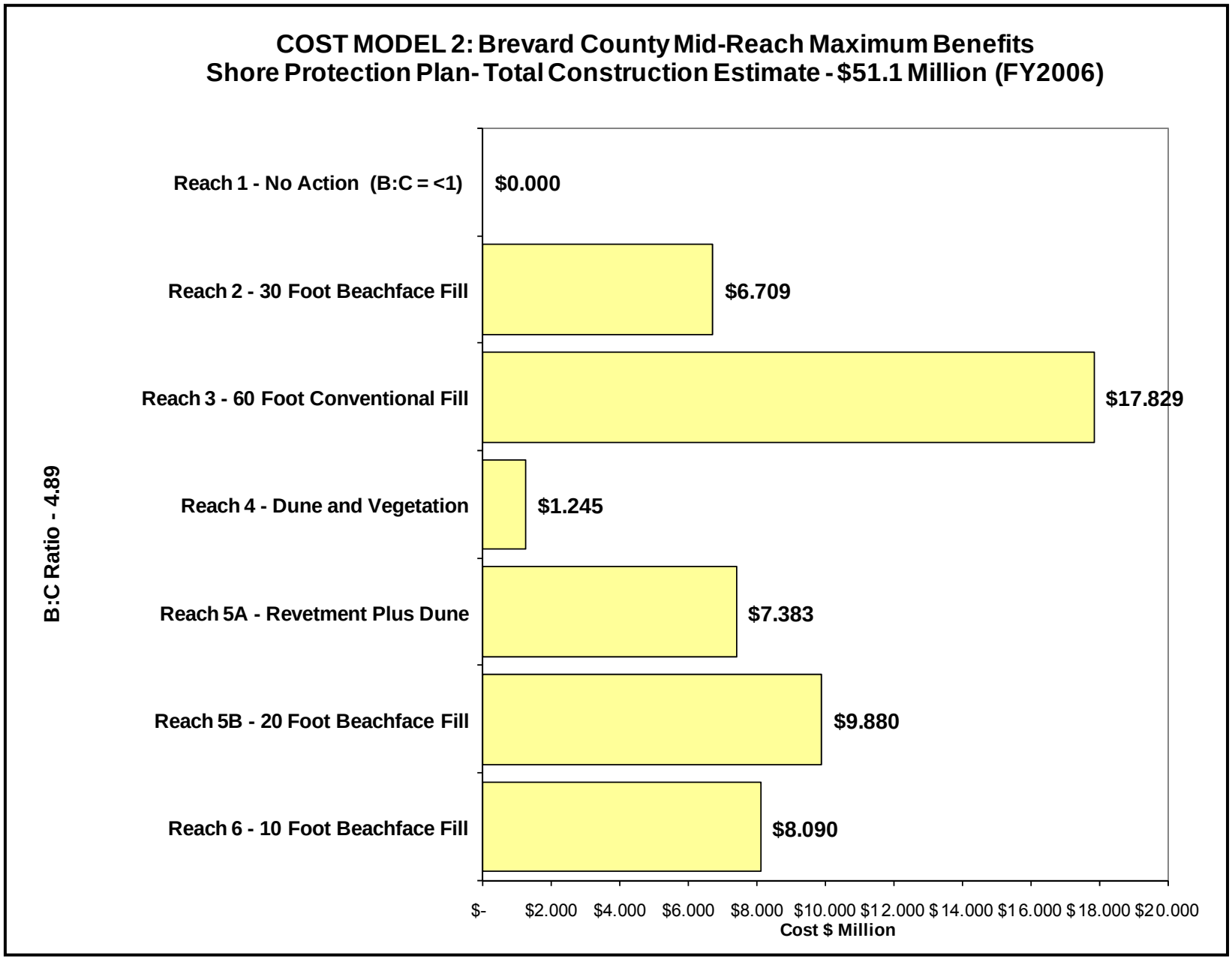
COST MODEL

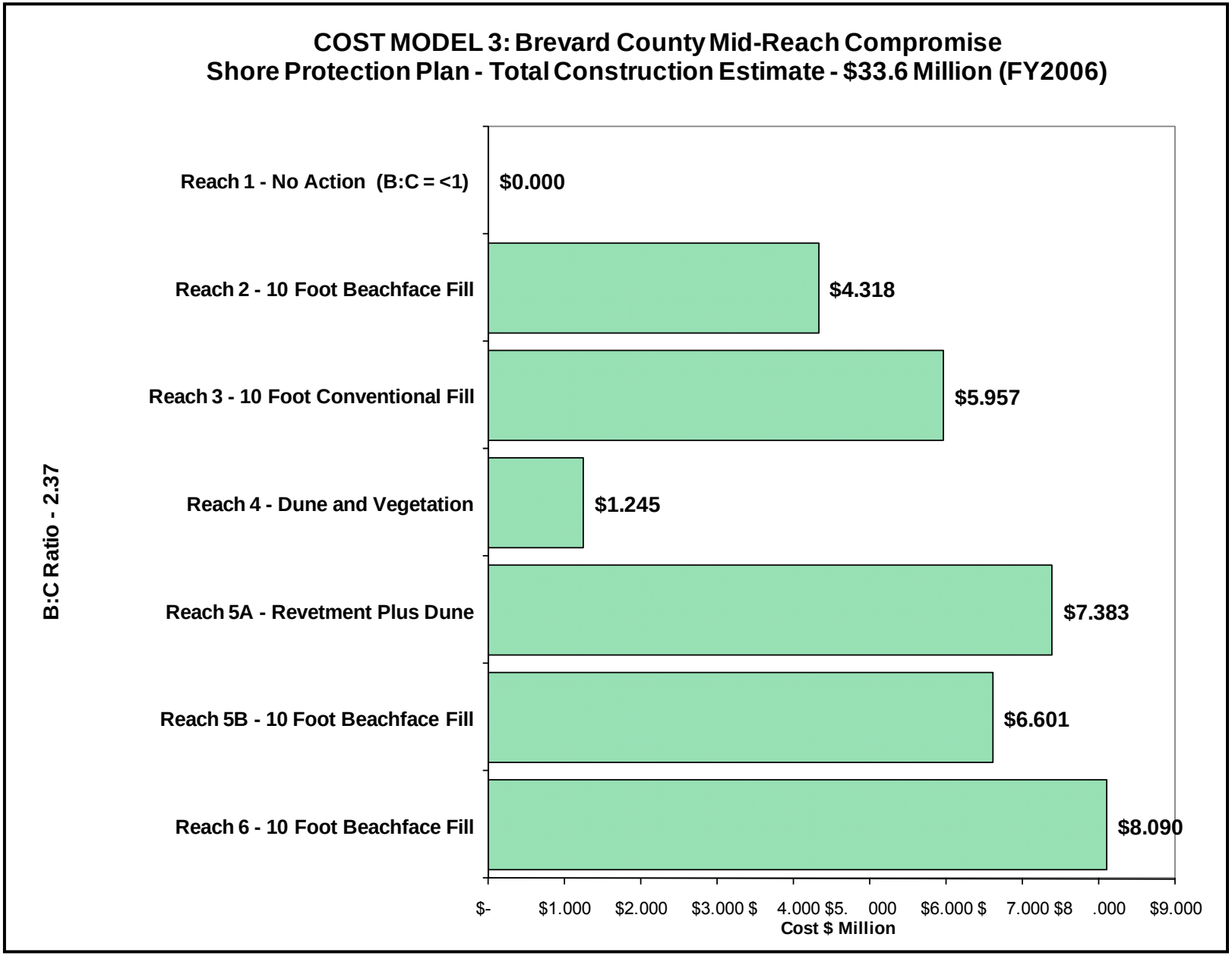
Cost Model 1: Brevard County Mid-Reach Segment
Baseline Estimates for Alternatives – Dune Fill, Truck and Dredge Beach Nourishment, Shore Revetment and Off Shore Reef Mitigation

Cost Model 2: Brevard County Mid-Reach Segment -
Maximum Benefits Plan

Cost Model 3: Brevard County Mid-Reach Segment -
Compromise Plan


Cost Model 1: Brevard County SPP Baseline Alternatives
Total Construction Estimates - $5.9 to $72.7 Million (FY2006)
A1 5 CY/LF Dune Fill Alt
$5.906
A2 20 FT Fill Alt -Truck Haul
$14.105
A3 20 FT Fill Alt - Dredge
$10.551
A4 40 FT Fill Alt - Dredge
$17.374
A5 100 FT Fill Alt - Dredge
$19.416
A6 160 FT Fill Alt - Dredge
$72.101
A7 Shore Revetment Alternative
$72.721
M1 Offshore Reef Mitigation
$44.871
$0.000
$10.000
$20.000
$30.000
$40.000
$50.000
$60.000
$70.000
$80.000
Cost $ Million


COST MODEL 2: Brevard County Mid-Reach Maximum Benefits
Shore Protection Plan- Total Construction Estimate - $51.1 Million (FY2006)
Reach 1 - No Action (B:C = <1)
$0.000
Reach 2 - 30 Foot Beachface Fill
$6.709
Reach 3 - 60 Foot Conventional Fill
$17.829
Reach 4 - Dune and Vegetation
$1.245
Reach 5A - Revetment Plus Dune
$7.383
Reach 5B - 20 Foot Beachface Fill
$9.880
Reach 6 - 10 Foot Beachface Fill
$8.090
B:C Ratio - 4.89
$- $2.000 $4.000 $6.000 $8.000 $10.000 $12.000 $14.000 $16.000 $18.000 $20.000
Cost $ Million


COST MODEL 3: Brevard County Mid-Reach Compromise
Shore Protection Plan - Total Construction Estimate - $33.6 Million (FY2006)
Reach 1 - No Action (B:C = <1)
$0.000
Reach 2 - 10 Foot Beachface Fill
$4.318
Reach 3 - 10 Foot Conventional Fill
$5.957
Reach 4 - Dune and Vegetation
$1.245
Reach 5A - Revetment Plus Dune
$7.383
Reach 5B - 10 Foot Beachface Fill
$6.601
Reach 6 - 10 Foot Beachface Fill
$8.090
B:C Ratio - 2.37
$-
$1.000
$2.000
$3.000
$4.000
$5.000
$6.000
$7.000
$8.000
$9.000
Cost $ Million

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM – Project Function List

Function Analysis System Technique (FAST) - Brevard County SSP Mid-Reach Project Function List

Achieved By Plan (Y/N)	Verb-Noun Function:
Y	Reduce Storm/Hurricane Damage
Y	Protect Property/Infrastructure
Y	Minimize Erosion Impacts
Y	Enhance Beach/Shoreline
Y	Contour Dune Fill/Beach Extension
Y	Widen Advanced Sand Nourishment
Y	Develop Sand Delivery/Placement Options
Y	Identify/Distribute Sand Sources
Y	Distribute Sand (Pipe/Truck)
Y	Execute Shoreline Protection Plan
Y	Modify Beach/Shoreline
Y	Minimize Environmental Impacts
Y	Protect Environmental Habitat Areas
Y	Protect Nearshore Rock/Turtle Nesting Habitat
Y	Monitor Sea Turtle Impacts
Y	Protect Nesting Habitat
Y	Monitor Rock Impacts
Y	Mitigate Rock Resources
Y	Execute Selected Plan
Y	Maximize Economic Deliveries
Y	Optimize Shoreline Recreation
Y	Optimize Future Shoreline Maintenance

Appendix E:
Supporting Documents
Project Alternative Matrix and
Costs vs. Benefits for All Reaches and Plans
13 July 2006

VALUE ENGINEERING TEAM STUDY

APPENDIX E:

BREVARD MID-REACH
COSTS VS. BENEFITS

THIS IS FOR MITIGATION RATIO 1:3.34

				REACH 1								REACH 2							
Management Measure	Number	Alternatives	Mitigation	Construction Cost	Acres (3.34:1)	Mitigation Cost	Total First Cost	AAEQ Cost	AAEQ Benefit	Net Benefits	Benefit-Cost Ratio	Construction Cost	Acres (3.34:1)	Mitigation Cost	Total First Cost	AAEQ Cost	AAEQ Benefit	Net Benefits	Benefit-Cost Ratio
NS-1 No-Action	NS-1	future without project	No	$0		$0	$0	$0	$0	$0	0.00			$0	$0		$0	$0	0.00
NS-7 Condemnation and Acquistion	NS-7A	100 feet of recession	No																
	NS-7B	134 feet of recession	No																
	NS-7C	170 feet of recession	No																
S-2 Revetment	S-2	50-year protection level	No																
S-3A Beachface Fill	S-3A(1)	10 foot exten. of MHW /1	Yes	$5,837,677	0.97	$1,922,041	$7,759,718	$1,048,587	$755,391	($293,196)	0.72	$2,134,285	1.17	$2,183,963	$4,318,248	$524,737	$550,507	$25,770	1.05
	S-3A(2)	20 foot exten. of MHW	Yes	$7,829,229	1.50	$2,620,500	$10,449,729	$1,161,171	$824,191	($336,980)	0.71	$2,762,297	1.70	$2,882,423	$5,644,720	$570,511	$633,683	$63,172	1.11
	S-3A(3)	30 foot exten. of MHW	Yes	$9,840,333	1.90	$3,144,346	$12,984,679	$1,268,711	$867,838	($400,873)	0.68	$3,390,125	2.04	$3,318,962	$6,709,087	$606,493	$687,439	$80,946	1.13
S-3B Conventional Fill	S-3B(1)	20 foot exten. of MHW	Yes	$3,937,169	6.38	$8,994,056	$12,931,225	$1,459,111	$824,191	($634,920)	0.56	$4,834,815	10.99	$15,018,450	$19,853,265	$2,089,634	$1,171,274	($918,360)	0.56
Cumulative	S-3B(2)	40 foot exten. of MHW	Yes	$6,151,144	6.38	$8,994,056	$15,145,200	$1,582,735	$897,933	($684,802)	0.57	$7,566,725	10.99	$15,018,450	$22,585,175	$2,242,179	$1,338,798	($903,381)	0.60
Reach 1 alone, then	S-3B(3)	60 foot exten. of MHW	Yes	$8,163,510	6.38	$8,994,056	$17,157,566	$1,695,101	$933,376	($761,725)	0.55	$10,343,088	10.99	$15,018,450	$25,361,538	$2,397,205	$1,425,963	($971,242)	0.59
Reach 1 +2, then	S-3B(4)	80 foot exten. of MHW	Yes	$10,135,514	6.38	$8,994,056	$19,129,570	$1,805,214	$947,517	($857,697)	0.52	$13,059,816	10.99	$15,018,450	$28,078,266	$2,548,902	$1,463,324	($1,085,578)	0.57
Reach 1+2 +3, etc	S-3B(5)	100 foot exten. of MHW	Yes	$12,067,155	6.38	$8,994,056	$21,061,211	$1,913,073	$951,656	($961,417)	0.50	$15,716,909	10.99	$15,018,450	$30,735,359	$2,697,269	$1,473,647	($1,223,622)	0.55
	S-3B(6)	120 foot exten. of MHW	Yes	$14,584,062	6.38	$8,994,056	$23,578,118	$2,053,613	$952,546	($1,101,067)	0.46	$19,196,142	10.99	$15,018,450	$34,214,592	$2,891,543	$1,475,501	($1,416,042)	0.51
	S-3B(7)	140 foot exten. of MHW	Yes	$16,989,871	6.38	$8,994,056	$25,983,927	$2,187,948	$952,929	($1,235,019)	0.44	$22,568,183	10.99	$15,018,450	$37,586,633	$3,079,831	$1,475,997	($1,603,834)	0.48
	S-3B(8)	160 foot exten. of MHW	Yes	$18,827,890	6.38	$8,994,056	$27,821,946	$2,290,580	$953,878	($1,336,702)	0.42	$25,370,530	10.99	$15,018,450	$40,388,980	$3,236,309	$1,477,218	($1,759,091)	0.46
S-3B Conventional Fill	S-3B(1)	20 foot exten. of MHW	Yes	$3,789,649	6.38	$8,994,056	$12,783,705	$1,450,873	$824,191	($626,682)	0.57	$2,342,606	4.61	$6,680,349	$9,022,955	$794,800	$633,683	($161,117)	0.80
NOT Cumulative	S-3B(2)	40 foot exten. of MHW	Yes	$6,007,803	6.38	$8,994,056	$15,001,859	$1,574,731	$897,933	($676,798)	0.57	$3,819,166	4.61	$6,680,349	$10,499,515	$877,248	$727,465	($149,783)	0.83
	S-3B(3)	60 foot exten. of MHW	Yes	$8,021,554	6.38	$8,994,056	$17,015,610	$1,687,175	$933,376	($753,799)	0.55	$5,538,239	4.61	$6,680,349	$12,218,588	$973,238	$779,187	($194,051)	0.80
	S-3B(4)	80 foot exten. of MHW	Yes	$9,994,942	6.38	$8,994,056	$18,988,998	$1,797,365	$947,517	($849,848)	0.53	$7,217,084	4.61	$6,680,349	$13,897,433	$1,066,981	$802,407	($264,574)	0.75
	S-3B(5)	100 foot exten. of MHW	Yes	$11,927,968	6.38	$8,994,056	$20,922,025	$1,905,301	$951,656	($953,645)	0.50	$8,855,701	4.61	$6,680,349	$15,536,050	$1,158,478	$808,591	($349,887)	0.70
	S-3B(6)	120 foot exten. of MHW	Yes	$14,447,631	6.38	$8,994,056	$23,441,687	$2,045,995	$952,546	($1,093,449)	0.47	$10,755,599	4.61	$6,680,349	$17,435,948	$1,264,565	$809,555	($455,010)	0.64
	S-3B(7)	140 foot exten. of MHW	Yes	$16,856,196	6.38	$8,994,056	$25,850,252	$2,180,484	$952,929	($1,227,555)	0.44	$12,653,931	4.61	$6,680,349	$19,334,280	$1,370,564	$809,668	($560,896)	0.59
	S-3B(8)	160 foot exten. of MHW	Yes	$19,153,663	6.38	$8,994,056	$28,147,719	$2,308,770	$953,878	($1,354,892)	0.41	$14,550,696	4.61	$6,680,349	$21,231,045	$1,476,476	$809,940	($666,536)	0.55
S-8 Dune and Vegetation	S-8	1 foot exten. of MHW	No	$1,776,705	0.00	$0	$1,776,705	$961,919	$658,619	($303,300)	0.68	$951,512	0.00	$0	$951,512	$514,315	$434,133	($80,182)	0.84
Combination	C-1	Revetment plus Dune S-8	No																
	C-2	Revetment plus Dune S-8 plus Fill S-3A(1)	Yes																
	C-3	Dune plus Fill S-3A(1)	Yes	$7,614,382	0.97	$1,922,041	$9,536,423	$2,010,506	$755,391	($1,255,115)	0.38	$3,085,797	1.17	$2,183,963	$5,269,760	$1,039,052	$550,507	($488,545)	0.53
	C-4	Revetment plus Dune S-8 plus Fill S-3A(2)	Yes																
	C-5	Revetment plus Dune S-8 plus Fill S-3A(3)	Yes																

BREVARD MID-REACH
COSTS VS. BENEFITS

THIS IS FOR MITIGATION RATIO 1:3.34

				REACH 3								REACH 4							
Management Measure	Number	Alternatives	Mitigation	Construction Cost	Acres (3.34:1)	Mitigation Cost	Total First Cost	AAEQ Cost	AAEQ Benefit	Net Benefits	Benefit-Cost Ratio	Construction Cost	Acres (3.34:1)	Mitigation Cost	Total First Cost	AAEQ Cost	AAEQ Benefit	Net Benefits	Benefit-Cost Ratio
NS-1 No-Action	NS-1	future without project	No			$0	$0		$0	$0	0.00			$0	$0		$0	$0	0.00
NS-7 Condemnation and Acquistion	NS-7A	100 feet of recession	No																
	NS-7B	134 feet of recession	No																
	NS-7C	170 feet of recession	No																
S-2 Revetment	S-2	50-year protection level	No																
S-3A Beachface Fill	S-3A(1)	10 foot exten. of MHW /1	Yes	$2,812,973	1.90	$3,144,346	$5,957,319	$852,311	$3,228,538	$2,376,227	3.79	$3,863,069	1.67	$2,838,769	$6,701,838	$995,359	$1,147,407	$152,048	1.15
	S-3A(2)	20 foot exten. of MHW	Yes	$4,125,436	2.91	$4,453,970	$8,579,405	$964,269	$3,861,248	$2,896,979	4.00	$5,167,143	2.77	$4,279,353	$9,446,496	$1,111,417	$1,290,058	$178,641	1.16
	S-3A(3)	30 foot exten. of MHW	Yes	$5,436,877	3.87	$5,719,947	$11,156,824	$1,076,665	$4,303,044	$3,226,379	4.00	$6,470,941	4.07	$5,981,875	$12,452,816	$1,244,296	$1,423,011	$178,715	1.14
S-3B Conventional Fill Cumulative Reach 1 alone, then Reach 1 +2, then Reach 1+2 +3, etc	S-3B(1)	20 foot exten. of MHW	Yes	$5,820,943	18.94	$25,408,038	$31,228,982	$3,174,725	$5,013,622	$1,838,897	1.58								
	S-3B(2)	40 foot exten. of MHW	Yes	$9,562,910	18.94	$25,408,038	$34,970,948	$3,383,670	$5,850,057	$2,466,387	1.73								
	S-3B(3)	60 foot exten. of MHW	Yes	$13,298,168	18.94	$25,408,038	$38,706,206	$3,592,239	$6,139,014	$2,546,775	1.71								
	S-3B(4)	80 foot exten. of MHW	Yes	$16,950,108	18.94	$25,408,038	$42,358,146	$3,796,157	$6,254,943	$2,458,786	1.65								
	S-3B(5)	100 foot exten. of MHW	Yes	$20,518,732	18.94	$25,408,038	$45,926,771	$3,995,422	$6,300,173	$2,304,751	1.58								
	S-3B(6)	120 foot exten. of MHW	Yes	$25,702,978	18.94	$25,408,038	$51,111,017	$4,284,900	$6,315,942	$2,031,042	1.47								
	S-3B(7)	140 foot exten. of MHW	Yes	$30,776,134	18.94	$25,408,038	$56,184,172	$4,568,175	$6,320,490	$1,752,315	1.38								
	S-3B(8)	160 foot exten. of MHW	Yes	$35,273,291	18.94	$25,408,038	$60,681,329	$4,819,288	$6,322,586	$1,503,298	1.31								
S-3B Conventional Fill NOT Cumulative	S-3B(1)	20 foot exten. of MHW	Yes	$2,967,102	7.95	$11,045,843	$14,012,945	$1,275,502	$3,861,248	$2,585,746	3.03	$3,392,448	13.53	$18,336,203	$21,728,651	$1,660,580	$1,290,058	($370,522)	0.78
	S-3B(2)	40 foot exten. of MHW	Yes	$4,889,413	7.95	$11,045,843	$15,935,256	$1,382,840	$4,530,159	$3,147,319	3.28	$5,113,144	13.53	$18,336,203	$23,449,347	$1,756,660	$1,541,541	($215,119)	0.88
	S-3B(3)	60 foot exten. of MHW	Yes	$6,783,418	7.95	$11,045,843	$17,829,261	$1,488,598	$4,731,951	$3,243,353	3.18	$6,978,657	13.53	$18,336,203	$25,314,860	$1,860,827	$1,661,969	($198,858)	0.89
	S-3B(4)	80 foot exten. of MHW	Yes	$8,634,719	7.95	$11,045,843	$19,680,562	$1,591,971	$4,810,519	$3,218,548	3.02	$8,805,700	13.53	$18,336,203	$27,141,903	$1,962,846	$1,719,821	($243,025)	0.88
	S-3B(5)	100 foot exten. of MHW	Yes	$10,443,316	7.95	$11,045,843	$21,489,158	$1,692,959	$4,845,426	$3,152,467	2.86	$10,594,273	13.53	$18,336,203	$28,930,476	$2,062,716	$1,734,493	($328,223)	0.84
	S-3B(6)	120 foot exten. of MHW	Yes	$13,072,762	7.95	$11,045,843	$24,118,605	$1,839,782	$4,859,341	$3,019,559	2.64	$12,866,908	13.53	$18,336,203	$31,203,111	$2,189,616	$1,739,122	($450,494)	0.79
	S-3B(7)	140 foot exten. of MHW	Yes	$15,703,196	7.95	$11,045,843	$26,749,039	$1,986,661	$4,863,393	$2,876,732	2.45	$15,137,432	13.53	$18,336,203	$33,473,635	$2,316,397	$1,741,220	($575,177)	0.75
	S-3B(8)	160 foot exten. of MHW	Yes	$18,334,617	7.95	$11,045,843	$29,380,459	$2,133,594	$4,864,268	$2,730,674	2.28	$17,405,845	13.53	$18,336,203	$35,742,048	$2,443,061	$1,742,153	($700,908)	0.71
S-8 Dune and Vegetation	S-8	1 foot exten. of MHW	No	$1,330,236	0.00	$0	$1,330,236	$719,726	$2,419,456	$1,699,730	3.36	$1,245,234	0.00	$0	$1,245,234	$673,620	$932,196	$258,576	1.38
Combination	C-1	Revetment plus Dune S-8	No																
	C-2	Revetment plus Dune S-8 plus Fill S-3A(1)	Yes																
	C-3	Dune plus Fill S-3A(1)	Yes	$4,143,209	1.90	$3,144,346	$7,287,555	$1,572,036	$3,228,538	$1,656,502	2.05	$5,108,303	1.67	$2,838,769	$7,947,072	$1,668,978	$1,147,407	($521,571)	0.69
	C-4	Revetment plus Dune S-8 plus Fill S-3A(2)	Yes																
	C-5	Revetment plus Dune S-8 plus Fill S-3A(3)	Yes																

BREVARD MID-REACH
COSTS VS. BENEFITS

THIS IS FOR MITIGATION RATIO 1:3.34

				REACH 5A								REACH 5B							
Management Measure	Number	Alternatives	Mitigation	Construction Cost	Acres (3.34:1)	Mitigation Cost	Total First Cost	AAEQ Cost	AAEQ Benefit	Net Benefits	Benefit-Cost Ratio	Construction Cost	Acres (3.34:1)	Mitigation Cost	Total First Cost	AAEQ Cost	AAEQ Benefit	Net Benefits	Benefit-Cost Ratio
NS-1 No-Action	NS-1	future without project	No			$0	$0		$0	$0	0.00			$0	$0		$0	$0	0.00
NS-7 Condemnation and Acquistion	NS-7A	100 feet of recession	No																
	NS-7B	134 feet of recession	No																
	NS-7C	170 feet of recession	No																
S-2 Revetment	S-2	50-year protection level	No																
S-3A Beachface Fill	S-3A(1)	10 foot exten. of MHW /1	Yes	$2,111,806	1.20	$2,227,616	$4,339,423	$583,057	$1,990,412	$1,407,354	3.41	$3,281,676	2.04	$3,318,962	$6,600,638	$874,837	$1,377,708	$502,872	1.57
	S-3A(2)	20 foot exten. of MHW	Yes	$2,880,669	2.00	$3,275,308	$6,155,978	$654,396	$2,302,489	$1,648,092	3.52	$4,596,852	3.54	$5,283,402	$9,880,255	$1,023,735	$1,536,098	$512,363	1.50
	S-3A(3)	30 foot exten. of MHW	Yes	$3,644,983	2.97	$4,541,278	$8,186,261	$742,283	$2,509,625	$1,767,342	3.38	$5,911,475	5.14	$7,378,825	$13,290,300	$1,182,989	$1,630,758	$447,770	1.38
S-3B Conventional Fill Cumulative	S-3B(1)	20 foot exten. of MHW	Yes																
Reach 1 alone, then	S-3B(2)	40 foot exten. of MHW	Yes																
Reach 1 +2, then	S-3B(3)	60 foot exten. of MHW	Yes																
Reach 1+2 +3, etc	S-3B(4)	80 foot exten. of MHW	Yes																
	S-3B(5)	100 foot exten. of MHW	Yes																
	S-3B(6)	120 foot exten. of MHW	Yes																
	S-3B(7)	140 foot exten. of MHW	Yes																
	S-3B(8)	160 foot exten. of MHW	Yes																
S-3B Conventional Fill NOT Cumulative	S-3B(1)	20 foot exten. of MHW	Yes																
	S-3B(2)	40 foot exten. of MHW	Yes																
	S-3B(3)	60 foot exten. of MHW	Yes																
	S-3B(4)	80 foot exten. of MHW	Yes																
	S-3B(5)	100 foot exten. of MHW	Yes																
	S-3B(6)	120 foot exten. of MHW	Yes																
	S-3B(7)	140 foot exten. of MHW	Yes																
	S-3B(8)	160 foot exten. of MHW	Yes																
S-8 Dune and Vegetation	S-8	1 foot exten. of MHW	No	$939,579	0.00	$0	$939,579	$507,831	$1,529,374	$1,021,543	3.01	$1,258,764	0.00	$0	$1,258,764	$680,964	$1,145,541	$464,577	1.68
Combination	C-1	Revetment plus Dune S-8	No	$7,383,233	0.00	$0	$7,383,233	$921,547	$2,802,823	$1,881,275	3.04								
	C-2	Revetment plus Dune S-8 plus Fill S-3A(1)	Yes	$9,495,039	1.20	$2,227,616	$11,722,655	$1,504,605	$2,814,417	$1,309,812	1.87								
	C-3	Dune plus Fill S-3A(1)	Yes	$3,051,385	1.20	$2,227,616	$5,279,001	$1,090,888	$1,990,412	$899,524	1.82	$4,540,440	2.04	$3,318,962	$7,859,402	$1,555,801	$1,377,708	($178,093)	0.89
	C-4	Revetment plus Dune S-8 plus Fill S-3A(2)	Yes	$10,263,902	2.00	$3,275,308	$13,539,210	$1,575,944	$2,823,040	$1,247,096	1.79								
	C-5	Revetment plus Dune S-8 plus Fill S-3A(3)	Yes	$11,028,216	2.97	$4,541,278	$15,569,494	$1,663,830	$2,828,232	$1,164,401	1.70								

BREVARD MID-REACH
COSTS VS. BENEFITS

THIS IS FOR MITIGATION RATIO 1:3.34

				REACH 6							
Management Measure	Number	Alternatives	Mitigation	Construction Cost	Acres (3.34:1)	Mitigation Cost	Total First Cost	AAEQ Cost	AAEQ Benefit	Net Benefits	Benefit-Cost Ratio
NS-1 No-Action	NS-1	future without project	No			$0	$0		$0	$0	0.00
NS-7 Condemnation and Acquistion	NS-7A	100 feet of recession	No								
	NS-7B	134 feet of recession	No								
	NS-7C	170 feet of recession	No								
S-2 Revetment	S-2	50-year protection level	No								
S-3A Beachface Fill	S-3A(1)	10 foot exten. of MHW /1	Yes	$3,766,877	2.81	$4,323,007	$8,089,884	$1,052,520	$1,207,558	$155,038	1.15
	S-3A(2)	20 foot exten. of MHW	Yes	$5,447,067	4.81	$6,942,277	$12,389,344	$1,255,903	$1,383,478	$127,575	1.10
	S-3A(3)	30 foot exten. of MHW	Yes	$7,128,253	7.18	$10,041,776	$17,170,029	$1,488,670	$1,488,372	($298)	1.00
S-3B Conventional Fill Cumulative Reach 1 alone, then Reach 1 +2, then Reach 1+2 +3, etc	S-3B(1)	20 foot exten. of MHW	Yes								
	S-3B(2)	40 foot exten. of MHW	Yes								
	S-3B(3)	60 foot exten. of MHW	Yes								
	S-3B(4)	80 foot exten. of MHW	Yes								
	S-3B(5)	100 foot exten. of MHW	Yes								
	S-3B(6)	120 foot exten. of MHW	Yes								
	S-3B(7)	140 foot exten. of MHW	Yes								
	S-3B(8)	160 foot exten. of MHW	Yes								
S-3B Conventional Fill NOT Cumulative	S-3B(1)	20 foot exten. of MHW	Yes								
	S-3B(2)	40 foot exten. of MHW	Yes								
	S-3B(3)	60 foot exten. of MHW	Yes								
	S-3B(4)	80 foot exten. of MHW	Yes								
	S-3B(5)	100 foot exten. of MHW	Yes								
	S-3B(6)	120 foot exten. of MHW	Yes								
	S-3B(7)	140 foot exten. of MHW	Yes								
	S-3B(8)	160 foot exten. of MHW	Yes								
S-8 Dune and Vegetation	S-8	1 foot exten. of MHW	No	$1,459,565		$0	$1,459,565	$789,868	$920,115	$130,247	1.16
Combination	C-1	Revetment plus Dune S-8	No								
	C-2	Revetment plus Dune S-8 plus Fill S-3A(1)	Yes								
	C-3	Dune plus Fill S-3A(1)	Yes	$5,226,442	2.81	$4,323,007	$9,549,449	$1,842,388	$1,207,558	($634,830)	0.66
	C-4	Revetment plus Dune S-8 plus Fill S-3A(2)	Yes								
	C-5	Revetment plus Dune S-8 plus Fill S-3A(3)	Yes								