ATTACHMENT 23C
OPERATIONS, MONITORING, AND MAINTENANCE PLAN

I. INTRODUCTION

Initial Construction: restoring critically eroding beaches on Manasota Key (Updrift Beach Fill-UBF), Palm Island (North Beach Fill-NBF), and Knight-Don Pedro Islands (South Beach Fill-SBF) utilizing offshore sand resources and inlet channel bypassing; and installing a stabilizing structure, specifically a low-crested permeable terminal groin, on the south end of the Stump Pass Beach State Park on Manasota Key.

Operation, Monitoring and Maintenance (OM&M) Plan: maintenance dredging of Stump Pass for navigation purposes; bypassing sand from maintenance dredging onto the NBF and backpassing available sand from maintenance dredging to the UBF; placing sediment on the ebb shoal in the event the physical monitoring results determine additional sediment will contribute its reformation; adaptive management activities including adjusting permeability of stabilizing structure on the UBF, sand sharing (transferring sand from accretional areas to erosional areas), and maintaining water quality in Rum Cove lagoon through introduction of tidal exchange; and maintaining the UBF including an extension to the north project boundary, NBF including an extension to the south to match the northern terminus of the SBF, and SBF through renourishment using offshore sand sources.

II. BEACH NOURISHMENT AND INLET MAINTENANCE DREDGING PLAN

15-year Beach Nourishment Summary: 420,000 cubic yards (CY) – initial; 330,000 CY per nourishment event * 2 events = 660,000 CY; factor for storm impacts = 120,000 CY; total = approximately 1.2 million cubic yards (MCY). Sand will be placed on the UBF (R14.5 to terminal structure) and extension of UBF to the north (R9 to R14.5), extension of NBF to the south (R26 to R29), and SBF (R29 to R40.5) from offshore sand sources.

15-year Maintenance Dredging Summary: 85,000 CY per event * 4 events = 340,000 CY; factor for storm impacts = 100,000 CY; total = approximately 440,000 CY. Sand will be bypassed to NBF (1,200 ft northeast of R22 to R26) and backpassed to UBF (R14.5 to terminal structure).

III. BORROW AREA UTILIZATION PLAN

A. VOLUME SUMMARY

1. Borrow Area A is comprised of three sub-areas with a total volume of approximately 1.15 MCY:

Sub-area A1 contains approximately 550,000 CY
Sub-area A2 contains approximately 360,000 CY
Sub-area A3 contains approximately 240,000 CY

2. Borrow Area B is comprised of two sub-areas with a total volume of approximately 395,000 CY:

Sub-area B1 contains approximately 205,000 CY

Sub-area B2 contains approximately 190,000 CY

3. Channel Borrow Area: 85,000 CY per event * 4 events = 340,000 CY; factor for storm impacts = 100,000 CY; total = approximately 440,000 CY.

B. SEQUENCE

Initial: Accounting for a 25% cut-to-fill ratio to include losses and construction inaccuracies, the volume required for initial nourishment equals 420,000 CY * 1.25 = 525,000 CY.

For the initial nourishment event, Offshore Borrow Sub-area A1 will be designated as the primary source and Sub-area A2 as the secondary source to yield the necessary beach fill for the SBF and UBF segments. The Channel Borrow Area will be designated as the primary source to yield the necessary beach fill for the NBF. Additional sediment from the Channel Borrow Area may be placed on the UBF.

Renourishment: Accounting for the 25% cut-to-fill ratio, the volume required for two renourishment events equals 2 * 330,000 CY * 1.25 = approximately 825,000 CY.

For the first renourishment event, Offshore Borrow Sub-area A2 will be designated as the primary source and Sub-area A3 as the secondary source to yield the necessary beach fill for the SBF and UBF segments. The Channel Borrow Area will be designated as the primary source to yield the necessary beach fill for the NBF. Additional sediment from the Channel Borrow Area may be placed on the UBF. For the second renourishment event, Offshore Borrow Sub-area B1 will be designated as the primary source and Sub-area B2 as the secondary source to yield the necessary beach fill for the SBF and UBF segments. The Channel Borrow Area will be designated as the primary source to yield the necessary beach fill for the NBF. Additional sediment from the Channel Borrow Area may be placed on the UBF.

IV. FILL EXTENSIONS

A. UPDRIFT BEACH FILL EXTENSION (R9 TO R14.5)

Appendix A includes the 2013 Aerial Photographs at 1”=200’. Superimposed on these photos are the Storm Erosion Analysis results of the Sarasota County and Charlotte County Beach Erosion Study completed by the Consulting Team in 2003. Using the results of the storm impact assessment completed as part of that study, the projected 25-year return interval storm erosion event can be viewed as bounded by the 10-year and 50-year return interval storm erosion events. The properties north of the prior project UBF fill limits, that is, north of R14.5, all lie seaward of the storm erosion line and are threatened by a 25-year return interval storm. CEC recently measured the dimensions of shoreline armoring for Manasota Key (Attachment 22). Those properties that have shoreline armoring were excluded from the measurements. A total of 4,070 feet of shoreline has properties that are not armored and lie seaward of the 25-year return interval storm erosion line on Manasota Key between R9.1 and R17.

B. NORTH BEACH FILL EXTENSION (R26 TO R29)

The downdrift shoreline of Stump Pass is subject to natural and anthropogenic activities. The shoreline reach between the southern limits of the 2003 project's fill placement along the inlet shoreline at R-26 and northern limits of the 2003 project's fill placement along the gulf-front shoreline at R-29 while experiencing some dynamic changes ranging from -41 ft per year of erosion to +18 ft per year of accretion, has overall exhibited general stability since the 2003 project equal to an average of +2 ft per year of accretion (Table 1). It is noted the collapse of the former ebb shoal due to the channel realignment in the 2003 project has served as a feeder system to nourish segments of the downdrift shoreline along the gulf-front beaches. While it is not anticipated the shoreline reach between R-26 and R-29 will require nourishment in the near future, it is the County and residents' desire to include it in the new long-term permit in the event significant storms impact the Project area or anthropogenic activities (e.g., maintenance dredging or terminal structure) cause adverse impacts to this shoreline reach.

Table 1. MHW Shoreline Changes for North Beach Fill Extension

R-mon	2003-Pre (Ft)	2003-Post (Ft)	Fill Width (Ft) *	2013 (Ft)	2003 Post-2013 (Ft)	Average Change (Ft/Yr)
R-26	485.5	512.4	26.9	690.8	178.4	18
R-27	1073.7	1094.8	N. F.	683.6	-411.2	-41
R-28	486.6	488.5	N. F.	666.4	177.9	18
R-29	288.5	359.5	71.0	503.3	143.8	14
Average					22.2	2

* N. F. denotes No Fill was placed in 2003 Project

V. RENOURISHMENT CRITERIA

The criteria for scheduling the renourishment of the beach fill segments include the following:

- Catastrophic event impacts Project area;
- Significant loss of environmental habitats (e.g., sea turtle nesting, shorebird nesting);
- 50% of Design Template is eroded along majority of individual beach fill segment; or
- Storm erosion modeling utilizing current profile data is completed and demonstrates majority of development is threatened from 25-year storm event within a given shoreline reach.

VI. MAINTENANCE DREDGING CRITERIA

A. NAVIGATION

The West Coast Inland Navigation District, Florida Sea Grant (FSG), and Charlotte County recently completed a Regional Waterway Management System Report providing boating data for the County's waterways. Utilizing the traffic sheds within the Stump Pass area, 94% of the vessels ranged in size up to 40 feet in length with drafts ranging from less than 1.0 foot to 6.0

feet. The design vessel draft was chosen as three (3) feet based on an analysis of this data and consistency with the Stump Pass Inlet Management Study. The navigation criteria is established as the design vessel draft plus squat, under keel clearance, and wave allowance equal to -7 ft MLLW, which is -9 ft NAVD88.

Applying the navigation criteria and advanced maintenance parameter, the recommended construction depth was determined to be -11 feet MLLW (Table 2). This equates to approximately -13 feet North American Vertical Datum of 1988 (NAVD88) based on interpolation between tidal stations 8725858 at Venice and 8725110 at Naples. It is noted that the wave allowance parameter is excluded on the approach channel (landward of the bayside shorelines of Manasota Key and Palm Island reducing the design depth to -9 feet NAVD88 and construction depth to -11 feet NAVD88.

Table 2. Navigation Channel Depth Requirements

Design Criteria	Depth (FT, MLLW)
Design Vessel Draft	3.0
Squat	1.0
Under Keel Clearance	1.0
Wave Allowance	2.0
Advanced Maintenance	2.0
Recommended Channel Depth	9.0
Dredge Tolerance	2.0
Construction Depth	11.0

When the alignment of the Primary Borrow Area shifted from the original 1980 channel to a modified channel in response to Division of State Lands concerns, the borrow area width was increased from 300 feet to 600 feet to provide the volume of sand needed for the proposed storm damage reduction project. As this Project proposes to dredge Stump Pass for navigation purposes, the original 300-foot wide channel was chosen as the design channel width which is set as the navigation criteria. The full channel is recommended for permitting to allow for flexibility at the time of construction to shift the dredge cut within the channel to yield the optimal design plan per event.

B. HYDRAULIC STABILITY

The channel width to the proposed channel depth yields a cross-sectional area that closely matches the historically hydraulic efficient channel measured during the 1980's. As one purpose of the channel dredging includes maintaining hydraulic stability in addition to improved navigation, the historical hydraulic parameters were tabulated including historic measurements of the 1980's conditions as well as the annual monitoring measurements (Table 3). Eliminating the high and low values, the recommended range of hydraulic parameters for use in evaluating maintenance dredging needs and sustaining hydraulic stability are presented.

Table 3. Inlet Stability Hydraulic Parameters

Project	Monitoring Period	Tidal Range (ft)	Peak Current Velocity (ft/s)	Cross-sectional Area^2 (ft^2)	Tidal Prism (ft^3)
1983	1980s Condition	N. M. *	5.0	5,244	4.3E+08
2003	Post-Con	2.2	4.9	7,613	6.2E+08
	1-Year	2.6	5.2	5,532	4.6E+08
	2-Year	3.2	6.1	5,474	5.3E+08
2006	Post-Con	2.6	4.5	8,147	6.1E+08
	1-Year	3.3	4.9	5,647	4.6E+08
	2-Year	2.5	4.8	4,382	3.5E+08
	3-Year	2.7	4.9	4,706	3.8E+08
2011	Post-Con	2.5	5.4	5,820	5.2E+08
	1-Year	2.9	5.2	5,324	4.6E+08
	2-Year	2.7	5.5	4,916	4.5E+08
Recommended Hydraulic Parameters for Inlet Stability		2.5 – 3.2	4.8 – 5.5	4,700 – 7,600	3.8E+08 - 6.1E+08

N. M. denotes Not Measured

VII. INLET BYPASSING OBJECTIVES

As part of the Sarasota County and Charlotte County Beach Erosion Study, the Knight Island complex sediment budget determined that the Stump Pass inlet impact to the downdrift beaches was severe. The adjacent beaches experienced a net erosion rate of over 40,000 (inlet shoreline) and 80,000 (gulf front) cubic yards per year prior to the initial restoration in 2003. The quantity of sand that was bypassed around the inlet was less than 5,000 cubic yards per year. The inlet impacts on the adjacent beaches including Manasota Key spit growth, and deposition on the ebb and flood shoals, was over 58,000 cubic yards per year.

As part of the 2001 Inlet Management Study, the area of inlet influence of Stump Pass was derived as follows. The existing area of inlet influence was examined using historical shoreline change rates, aerial photographs, and bathymetric surveys. Based on the historic shoreline change rates, the radius of inlet influence was determined to be approximately 9,900 feet and 17,100 feet north and south of Stump Pass respectively. These updrift and downdrift limits of inlet influence were defined as points where the perturbations in long-term averaged shoreline change begin tapering off at a distance away from the inlet. A review of the September 1999 bathymetric survey indicated the nearshore straight and parallel contours diverge at approximately 6,000 feet north of and 15,000 feet south of Stump Pass. Defining the northern boundary was complicated by the impacts of the coastal armoring along this shoreline. Defining the southern boundary was complicated by the impacts of the multiple dredge and fill projects conducted. Using the more conservative boundaries defined by the historical shoreline change rates, the area of inlet influence was defined as 9,900 feet north of and 17,100 feet south of Stump Pass. Those boundaries correspond to the approximate locations of monuments R12 to R21 on Manasota Key and R22 to R39 on Knight Island-Don Pedro Island.

As part of permitting the new Project, a detailed sediment budget was derived from 2003 pre-construction through the most recent monitoring survey in 2013 equal to a 10-Year period **(Attachment 5 – Project Description)**. Based on the analysis, approximately 33,000 CY/YR bypassed Stump Pass from north to south, inclusive of the volumes excavated from the channel and volumes placed on the beaches during nourishment events. This is the recommended target bypassing objective to the downdrift beaches of Stump Pass for the new Project.

VIII. PHYSICAL MONITORING PLAN

Physical monitoring of the Project is performed through acquisition of Project-specific data to include, at a minimum, topographic and bathymetric surveys of the beach, offshore, and borrow site areas, aerial photography, and engineering analysis. The monitoring data is necessary in order to regularly observe and assess, with quantitative measurements, the performance of the Project, any adverse effects which have occurred, and the need for any adjustments, modifications, or mitigative response to the Project. The physical monitoring plan dated September 17, 2014 is presented in Appendix 2.

IX. ADAPTIVE MANAGEMENT PLAN

A. NAVIGATION CHANNEL DREDGING

If channel dredging results in accelerated erosion of the adjacent shorelines as documented by the performance assessment, OM&M activities shall be implemented by the County to reduce impacts on areas of high vulnerability. These activities may include but not be limited to adjusting the frequency of dredging, adjusting the channel alignment, placing advanced nourishment on the shoreline along the hot spot area, or using offshore sand to supplement the maintenance dredge fill placement on the shoreline along the hot spot area in a future renourishment event. These adaptive management activities shall be determined by the physical monitoring and performance assessment.

B. EBB SHOAL REFORMATION

The Consulting Team conducted an ebb shoal analysis as part of the Plan Formulation Phase of the County's 10-Year Program. This analysis determined that the ebb shoal experienced a net growth rate rate of over 20,000 CY per year between 2003 and 2011 accounting for the sand mining that occurred during the 2003 and 2006 projects. Further, the analysis determined that approximately 500,000 CY were needed to restore the ebb shoal to its quasi-stable 1980's condition. In the event physical monitoring indicates the ebb shoal growth rate is not maintained at the current rate, then the adaptive management activities include sediment placement on the ebb shoal from the offshore borrow areas to provide additional sediment to enable shoal reformation.

C. TERMINAL GROIN ADJUSTMENTS

Adaptive management activities include minor maintenance and repair of the terminal groin, filling scour holes adjacent to the groin and adjusting permeability of the structure. The Terminal Groin Design Report is included in Attachment 33A-2. If physical monitoring indicates too much sand is bypassing the structure resulting in significant channel infilling and / or channel deflection:

- raise crest elevation to +4 ft NAVD88, or
- place stone to fill in seaward slope to 1V:5H, or
- install chinking stone within seaward section.

If physical monitoring indicates not enough sand is bypassing structure to support dry recreational beach and environmental habitat south of the structure:

- remove chinking stone from landward section.

If physical monitoring indicates terminal groin results in accelerated erosion:

- place advanced nourishment on the shoreline along the hot spot area to offset the impacts, or using offshore sand supplement the maintenance dredge fill placement on the shoreline along the hot spot area in a future renourishment event.

D. SAND SHARING

Adaptive management activities include hot-spot maintenance through sand transfer. Sand may be transferred from accretional areas to areas of need within the Project boundary (sand transfer); as long as the overall Project performance is maintained and the sand transfer action is justified. The physical monitoring data must demonstrate that the sand removal areas have been accreting and the sand removal design elevations will not be below the Design Template.

E. RUM COVE WATER QUALITY

In the event Project construction or OM&M activities prevent the exchange of water between the Gulf of Mexico and the Rum Cove lagoon located adjacent to the NBF (bay side), an adaptive management strategy is included in the OM&M Program to maintain water quality in the Rum Cove lagoon through introduction of tidal exchange. Water quality monitoring must demonstrate water quality in the lagoon has deteriorated as a result of sand placement, structural installation and / or dredging.