

APPENDIX H

DRAFT PHYSICAL MONITORING PLAN

**St. Lucie County, Florida
South County Beach & Dune Restoration Project
Physical Monitoring Plan**

Project Description

The St. Lucie County South County Beach and Dune Restoration Project area extends for a total of 3.8 miles from FDEP range monuments R-87.7 to R-90.3 and from R-98 to R-115 + 1000 feet south (St. Lucie County/Martin County Line), and proposes approximately 610,000 cubic yards of fill, with an average fill density of 30.5 cy/ft. The proposed project is predicted to impact 1.08 acres of nearshore hardbottom. The purpose of this Project is to abate ongoing and historical beach erosion; specific criteria for plan formulation include:

- optimize project performance and cost effectiveness – generally consistent with USACE planning regulations for Shore Protection Projects, and
- minimize environmental impacts to the extent feasible.

The proposed sand source is from an offshore borrow area, identified as Area 5, located on the southern portion of St. Lucie Shoal which lies within State waters and is located in a sand ridge from 3 to 6 miles offshore of FDEP monuments R-88 to R-115 respectively. The proposed borrow area for the Project:

- contains approximately 1.5 million cubic yards of beach compatible material;
- is located in water depths of approximately -36' to -43' NAVD;
- will have a cut depth of approximately -49' NAVD.

Introduction

Physical monitoring of the St. Lucie County, South County Beach and Dune Restoration Project will accomplish the following objectives:

- 1) Identify erosion and accretion patterns (shoreline and volumetric changes) along the project and adjacent shorelines;
- 2) Provide data to facilitate an engineering evaluation of the beach nourishment performance, based upon pre- and post-construction surveys and subsequent monitoring surveys;
- 3) Identify beach segments that have lost sand in quantities that may require corrective actions;
- 4) Identify location of the equilibrated toe of fill (ETOF); and,
- 5) Determine if the borrow area is experiencing infilling under post-construction conditions.

The physical monitoring data are necessary in order for St. Lucie County and the FDEP to regularly observe and assess, with quantitative measurements, the performance of the project, any adverse impacts due to the project, and the need for any adjustment, modifications, or mitigation of unexpected adverse effects. The primary components of the Physical Monitoring Plan include:

- 1) Beach profile and hydrographic surveys of the Project Area and adjacent beaches (FDEP Reference Monuments R-82 to R-4 Martin County);
- 2) Vertical aerial photography along the limits of the surveyed beach;
- 3) Hydrographic surveys of the borrow area; and,
- 4) Reporting.

These activities will be carried out within the Project Area and along the adjacent shorelines as described in this Plan. Table 1 summarizes the proposed schedule for physical monitoring of the Project.

Table 1 - Monitoring Schedule for the South County Beach and Dune Restoration Project

Monitoring Requirement	Pre-Construction	Post-Construction					
		Immediate	12-Month	24-Month	36-Month	48-Month	5 Years
Beach and Offshore Profiles	X	X	X	X	X		X
Aerial Photography		X	X	X	X		X
Bathymetric Surveys of Borrow Area	X	X			X		
Sand sampling			X	X			
Monitoring Reports		X	X	X	X		X

Each of the above monitoring requirements is described in further detail below:

Beach and Offshore Profile Surveys

All beach and offshore profile survey work performed shall be consistent with the FDEP *Monitoring Standards for Beach Erosion Control Projects* (see Sections 01000 – *Beach Profile Topographic Surveying* and 01100 – *Offshore Profile Surveying*). Beach and offshore profile surveys will be conducted to establish pre- and post-Project conditions within the Project Area and along the adjacent shorelines. Beach profiles will be conducted within 90 days prior to the commencement of construction (pre-construction), and within 60 days following the completion of the construction of the Project (post-construction). Additional monitoring surveys will be performed annually following the post-construction survey for three years following completion of construction. Annual monitoring surveys will be conducted in the months of June, July, or August and shall be repeated, as close as is practical, during that same month of the year.

The monitoring area includes FDEP range monuments within the bounds of the beach fill area (R-87.7 to R-90.3 and from R-98 to R-115 + 1000 ft south) and at least 5,000 feet of the adjacent shoreline on both sides of the beach fill area. Beach and offshore profile surveys will extend from each St. Lucie County FDEP range monuments R-82 through R-115 and will also include range monuments R-1 through R-4 in Martin County. Traditional beach and hydrographic survey methods will be used to collect beach profile data per FDEP monitoring standards. Wading beach profile portions will be conducted using standard techniques from the dune across the beach and seaward to a depth of approximately -4 ft NAVD. The offshore, hydrographic portions of the profiles will be conducted utilizing a survey vessel outfitted with a digital fathometer, a Differential Global Positioning System (DGPS), and navigational software. Offshore portions will extend from the nearshore to approximately 2,000 feet seaward of profile origin or to a depth of approximately -30-feet NAVD, whichever is further offshore. Overlap will occur between the seaward terminus of the beach profiles and the landward origination of the hydrographic profiles in order to verify correct equipment operations. Fathometer calibrations via ‘bar checks’ will be performed periodically during surveys. Tidal corrections for vessel surveys will be performed using a digital recording tide gage or tide staff, which will be referenced to known vertical benchmarks. Tidal data will be recorded for the duration of the vessel surveys and applied during data reduction to achieve elevations referenced to NAVD.

Elevations of the beach profiles will be obtained at appropriate intervals and at all noticeable breaks in grade (greater than 1 foot vertically). Soundings from offshore portions of beach profiles will be obtained at appropriate intervals. Survey transects will originate at stations in the upland area of the beach at approximately 1,000 foot intervals along the shoreline as denoted by FDEP range monuments and extend offshore along the appropriate azimuth (degrees clockwise from magnetic north).

Aerial Photography

All aerial photography work is to be performed consistent with the FDEP *Monitoring Standards for Beach Erosion Control Projects* (see Section 02100 – *Environmental Aerial Photography Acquisition*) with the exception of:

- 1) Part II – Execution, Section B. Flight 16 - To provide for adequate visibility, the photography will be taken during a period of incoming tide.
- 2) Part II – Execution, Section B. Flight 17 – The work is to be conducted during one (1) flight; a “schedule” is not warranted.

Aerial photography of the beach shall be taken concurrently with the post-construction surveys and each subsequent monitoring survey as identified in Table 1, as close to the time of the beach profile surveys as reasonably possible. Controlled, flight-dated, color vertical aerial photographs of the study area will be taken for the purpose of documenting consistency between surveyed profile lines and the delineation of the exposed nearshore hardbottom. Aerial photography shall include the beach and nearshore region from St. Lucie County FDEP range monuments R-82 through R-4 (Martin County) inclusive. Specifically, the flight and the photography will be accomplished during a period of incoming tide during one flight.

This task will produce controlled, vertical, color, aerial photography along the coastline of St. Lucie County for the primary purpose of mapping and quantifying exposed nearshore hardbottom and natural/artificial reefs. Toward that end, the flight day shall be selected such that there is sufficient visibility in coastal waters and that the film selected is of type and quality to provide the best possible images in the greatest possible water depths. Photography shall be obtained during morning hours with cloud cover at less than 10%, and in order to minimize glint, the flight window shall occur when the sun angle is between 15 to 30 degrees to the horizon. If, during the flight, weather conditions deteriorate to the point that the purposes of the flight can not be met, or the five flight conditions specified above cannot be met, it is the responsibility of the photographer to determine whether or not to terminate the flight and complete the scope of work on another day.

It is the responsibility of the photographer to determine the best color film available to meet the above-stated objectives. The photography shall employ the use of a precision Zeiss RMK/A cartographic camera (or equal) calibrated by the US Geological Survey. The camera will be equipped with a data block, which will record the lens number, calibration, focal length of the lens, altitude, date, and time. The photographs will be color aerial photography and geo-referenced digital imagery with the following specifications:

- a. A minimum 60% overlap with each adjacent photograph and a ratio of 50% land and 50% ocean (2000' and 2000') on the horizontal.
- b. The image will be clear and sharp in detail, free from clouds, shadows or any other blemishes that would render the image as uncertain for mapping rock and reef features as far offshore as possible and no less than -15 feet NAVD.
- c. Each frame must contain:

- i. time of day clock in standard time,
- ii. altimeter reading,
- iii. exposure counter,
- iv. camera identification number,
- v. lens focal length in mm, and
- vi. the plate ID number.

Necessary ground control will be extracted from existing imagery sources and used in combination with collected ABGPS to rectify this imagery.

Bathymetric Surveys of Borrow Area

If the offshore sand source is used, the hydrographic survey of the borrow area is to be consistent with the FDEP *Monitoring Standards for Beach Erosion Control Projects* (see Section 01200 – *Borrow Site, Shoal and Other Bathymetric Surveying*). Hydrographic surveys of the borrow area shall be conducted within 90 days prior to the commencement of construction (pre-construction), within 60 days following the completion of construction of the Project (post-construction), and concurrent with the 36-month post-construction monitoring event – as summarized in Table 1. These data will be used to assess the infilling rate of the offshore borrow area.

Soundings for the bathymetric survey will be taken at no greater than 25-foot intervals along sounding lines no more than 200 feet apart. The surveys will extend approximately 500 feet beyond the limits of the borrow site.

Monitoring Reports

Monitoring reports will be written following each survey, commencing with the 12-month post-construction survey. The report shall summarize and discuss the data and analyses conducted each year for the 12, 24, and 36-month post-construction time period. In general, the monitoring reports will include:

- **Beach and Offshore Profile Surveys:** Each monitoring report shall include:
 - signed and sealed survey,
 - an analysis of the observed toe of fill position relative to the nearshore hardbottom,
 - analysis for patterns, trends, or changes between annual surveys and for cumulative changes over time,
 - an evaluation of the erosion and accretion rates occurring between the initial post-construction survey and the annual monitoring surveys, and an assessment of the volume of fill remaining within the Project area, and
 - an evaluation of the adjustment of the beach fill and volume accumulations outside of the Project area, and an assessment of alongshore and cross-shore fill movement.
- **Bathymetric Surveys of the Borrow Area:** If the offshore sand source is used, the offshore borrow area surveys (signed and sealed) shall be analyzed and compared to the post-construction conditions to determine the infilling rate, if any, of the borrow area..
- **Aerial Photography:** The aerial photographs will be included in the monitoring report as an appendix. Under this plan, the aerial photography obtained will be analyzed to assess

the extent of hardbottom (acres) physically impacted by direct burial associated with adjustment of the placed fill determined by:

- comparison of the predicted Equilibrated Toe of Fill (ETOF) with the measured ETOF reflected in: (i) the profile surveys (obtained under this plan) and (ii) the “Nearshore Hardbottom Edge Mapping” and the “Video Transects” (obtained from the Biological Monitoring Plan), and
- comparison of the digitized hardbottom maps for the existing baseline condition with post-construction maps (obtained from the Biological Monitoring Plan).
- **Appendices:** The report appendices shall include:
 - cross sections of the beach and offshore profiles and a graphical representation of volumetric and shoreline position changes throughout the monitoring area, and
 - reduced data (in digital format) from the survey of the offshore borrow area (if used), along with a contour plot of the borrow area survey results.

Attachment B

FDEP File No. 0154626-001-JC

St. Lucie County, Florida

South County Beach & Dune Restoration Project

During-Construction Turbidity Monitoring Plan

Project Description

The St. Lucie County South County Beach and Dune Restoration Project area extends over a total shoreline length of 3.8 miles from Florida Department of Environmental Protection (FDEP) range monuments R-87.7 to R-90.3 and R-98 to 1000 feet south of R-115 (St. Lucie County/Martin County Line). The Project entails placement of approximately 610,000 cubic yards of sand fill, with an average fill density of 30.5 cubic yards per linear foot. The proposed Project is predicted to impact 1.08 acres of nearshore hardbottom via direct burial; secondary impacts due to temporary increases in turbidity are expected to affect an additional 0.79 acres of nearshore hardbottom.

The proposed sand source is an offshore borrow area, identified as Area 5, located on the southern portion of St. Lucie Shoal within State waters. Area 5 is located in a sand ridge from 3 to 6 miles offshore of FDEP monuments R-88 to R-115 respectively. The proposed offshore borrow area for the Project contains approximately 1.3 million cubic yards of beach compatible sand. Alternately, sand fill – comparable to that available from the offshore sand source - may be obtained from an upland sand source.

Introduction

Turbidity monitoring in the vicinity of the Project Area shall be conducted during construction by the CONTRACTOR both at the beach fill site and at the offshore borrow area (if the offshore option is used). The CONTRACTOR shall be bound and obligated to maintain the quality of the State's waters as stipulated in Project permits and in applicable provisions of Florida Administrative Code [Sections 62-4 .244(5)(c) and 62-110.104]. The CONTRACTOR will be required to make inspections, measurements and observations required by those regulations and the FDEP permit in the vicinity of the dredge and at the sand fill placement area along the beach. This includes, but is not limited to, periodic turbidity sampling with reports to the ENGINEER, following the procedures and frequencies stated below and identified in the FDEP Permit. The proposed turbidity monitoring described herein is based upon the "Turbidity and Mixing Zone Analysis" dated July 8, 2010 by Coastal Tech which proposes:

- for the offshore sand source, a Mixing Zone extending 65m seaward of the proposed shoreline and 150m down-current of the discharge point, and
- for the upland sand source, a Mixing Zone extending 65m seaward of the proposed shoreline and 500m down-current of "fill-placement-activities".

Sampling Methods

Water samples shall be obtained and analyzed for turbidity. Samples obtained for turbidity analysis shall be kept in the dark and analyzed within 2 hours of collection. Water samples shall be obtained at mid-depth of the water column at the sampling location and shall be taken with a sampling device demonstrated to be capable to collecting a discrete water sample, uncontaminated by water from any other depth. The turbidity in the water samples subsequently shall be measured in Nephelometric Turbidity Units (NTU) using a standard Nephelometer. At each sample location, the CONTRACTOR shall obtain and test 2 water samples; the average

turbidity level of the two samples shall be the basis for compliance with FDEP permit conditions.

Sampling Frequency and Location

Turbidity samples shall be taken by the CONTRACTOR at the locations indicated below:

- (A) Beach Disposal Site(s).
- (1) Frequency: At least every four hours during beach fill placement activities.
 - (2) Background Reading: At a point approximately 65 meters offshore and at least 150 meters up-current from the fill discharge point or fill placement activities, outside of any visible turbidity plume, at mid-depth.
 - (3) Compliance Reading: No more than 65 meters offshore within the densest portion of any visible turbidity plume, at mid-depth of the water column and at no more than:
 - 150 meters down-current of the discharge point for use of the offshore borrow area, or
 - 500 meters down-current of fill placement activities for use of the upland sand source.

For Compliance samples, the CONTRACTOR shall include the distance from the shoreline (in meters) to the location of samples.

- (4) Intermediate Reading: For use of either the offshore borrow area or the upland sand source, additional compliance samples shall be also be collected no more than 65 meters offshore within the densest portion of any visible turbidity plume generated by this Project, at mid-depth of the water column and at the following intermediate locations:
 - as near as practical and safe to area of fill placement activities,
 - at 150 meters,
 - at 300 meters, and
 - at 400 meters.

Intermediate sample locations may be modified during construction with the concurrence of FDEP. For Intermediate samples, the CONTRACTOR shall include the actual distance from the existing or proposed shoreline (in meters) to the location of samples.

- (B) Offshore Borrow Site – if used.
- (1) Frequency: At least every four hours during dredging.
 - (2) Background Reading: At 150 meters, but no more than 500 meters, up-current from the dredge, outside of any visible turbidity plume, at mid-depth.
 - (3) Compliance Reading: No more than 150 meters down-current from the dredge, in the densest portion of any visible turbidity plume, at mid-depth.

Compliance

The compliance locations given above shall be considered the limits of the temporary mixing zone for turbidity allowed during construction. If monitoring reveals turbidity levels at the beach compliance site greater than 29 NTUs above the associated background turbidity levels, construction activities shall **cease immediately** and not resume until corrective measures have been taken and turbidity has returned to acceptable levels. If measured turbidity exceeds the allowable values, and following cessation of work, the CONTRACTOR shall immediately notify the COUNTY and ENGINEER (on the morning of the following work day if the excess turbidity it occurs after normal work hours). Delays in work due to the fault or negligence of the CONTRACTOR or the CONTRACTOR's failure to comply with this Specification shall not be compensated. Corrective measures may require temporary longitudinal dikes to retain the fill on

the beach within the limits of the fill template, and to control ambient water turbidity.

Testing

The CONTRACTOR shall provide the COUNTY and ENGINEER with a certification, attesting to and including:

- (1) a statement describing the procedures used in collection, handling, storage and analysis of the samples;
- (2) the accuracy of his testing equipment,
- (3) the procedures for calibration and measurement.

The CONTRACTOR will maintain the calibration of the equipment and apply these procedures throughout the Project construction. Whenever there is doubt as to the adequacy of the testing or validity of the results, the ENGINEER may direct that additional tests be performed.

Reports

During dredging operations and/or fill placement activities, the CONTRACTOR shall prepare daily turbidity monitoring reports with a title referencing "Permit Number 0154626-001-JC, St. Lucie County South County Beach and Dune Restoration Project" and containing the following information:

- (1) time of day and date samples were obtained and analyzed
- (2) water temperature (°C)
- (3) depth of water body where sample was obtained
- (4) depth of sample
- (5) antecedent weather conditions – including:
 - wind direction and velocity
 - wave heights and period
- (6) tidal stage and direction of flow
- (7) map indicating the sampling locations
- (8) A statement by the individual responsible for implementation of the sampling program concerning:
 - the authenticity, precision, limits of detection and accuracy of the data; and,
 - a description of any factors influencing construction or the sampling program.

Submittal of Reports

Daily monitoring reports shall be submitted by the CONTRACTOR to the COUNTY, and ENGINEER on a daily basis within 24 hours of analysis.

Turbidity monitoring reports shall be submitted by the COUNTY to FDEP on a weekly basis within seven (7) days of collection via a cover letter containing the following statement:

"This information is provided in partial fulfillment of the monitoring requirements in Permit No. , 0154626-001-JC, St. Lucie County South County Beach and Dune Restoration Project."

Post-Construction Analysis

In general, the data shall be analyzed by the ENGINEER after construction to assess the efficacy of the FDEP approved Mixing Zone and the likely Mixing Zone needed for future nourishment employing a similar sand source.

FDEP File No. 0154626-001-JC
St. Lucie County, Florida
South County Beach & Dune Restoration Project
Post-Construction Turbidity Monitoring Plan

Project Description

The St. Lucie County South County Beach and Dune Restoration Project area extends over a total shoreline length of 3.8 miles from Florida Department of Environmental Protection (FDEP) range monuments R-87.7 to R-90.3 and R-98 to 1000 feet south of R-115 (St. Lucie County/Martin County Line). The Project entails placement of approximately 610,000 cubic yards of sand fill, with an average fill density of 30.5 cubic yards per linear foot. The proposed Project is predicted to impact 1.08 acres of nearshore hardbottom via direct burial; secondary impacts due to temporary increases in turbidity are expected to affect an additional 0.69 acres of nearshore hardbottom.

The proposed sand source is an offshore borrow area, identified as Area 5, located on the southern portion of St. Lucie Shoal within State waters. Area 5 is located in a sand ridge from 3 to 6 miles offshore of FDEP monuments R-88 to R-115 respectively. The proposed offshore borrow area for the Project contains approximately 1.3 million cubic yards of beach compatible sand. Alternately, sand fill – comparable to that available from the offshore sand source – may be obtained from an upland sand source.

Introduction

Turbidity monitoring in the vicinity of the Project Fill Area shall be conducted by a licensed ENGINEER following completion of construction of the Project. This monitoring is to provide a basis for assessment of Project turbidity effects “post-construction and during a storm event”. Monitoring events are to occur:

- at 3, 6, 9, and 12-months after the completion of construction, and
- during up to 2 storm events when breaking wave heights exceed 4 feet.

Post-construction turbidity monitoring shall comply with the procedures stated below and as identified in the FDEP Permit.

Sampling Methods

Water samples shall be obtained and analyzed for turbidity. Samples obtained for turbidity analysis shall be kept in the dark and analyzed within 2 hours of collection. Water samples shall be obtained at mid-depth of the water column at the sampling location and shall be taken with a sampling device demonstrated to be capable of collecting a discrete water sample, uncontaminated by water from any other depth. The turbidity in the water samples subsequently shall be measured in Nephelometric Turbidity Units (NTU) using a standard Nephelometer. At each sample location, the COUNTY or ENGINEER shall obtain and test 2 water samples; the average turbidity level of the two samples shall be the basis for compliance with FDEP permit conditions

Sampling Frequency and Location

For all sampling events, turbidity samples shall be taken at 2-hour intervals over an 8-hour period at the locations as indicated below:

- Background Reading: At a point approximately 65 meters offshore and at least 500 meters up-current from the Project Fill Area boundaries, at mid-depth of the water column.
- Compliance Reading: No more than 65 meters offshore and at 150 meters down-current of the Project Fill Area boundary, at mid-depth of the water column.

Testing

The COUNTY shall provide a certification, attesting to and including:

- (1) a statement describing the procedures used in collection, handling, storage and analysis of the samples;
- (2) the accuracy of all testing equipment,
- (3) the procedures for calibration and measurement.

The COUNTY will maintain the calibration of the equipment and apply these procedures throughout the monitoring.

Reports

The COUNTY shall prepare and submit to FDEP a summary report of all post-construction monitoring data within 90 days of the 12-month post-construction turbidity sampling event; the report shall include a title referencing "Permit Number 0154626-001-JC, St. Lucie County South County Beach and Dune Restoration Project" and shall contain the following information:

- (1) time of day and date samples were obtained and analyzed.
- (2) water temperature (°C).
- (3) depth of water body where sample was obtained.
- (4) depth of sample.
- (5) antecedent weather conditions – including:
 - wind direction and velocity,
 - wave heights and period.
- (6) tidal stage and direction of flow.
- (7) map indicating the sampling locations
- (8) a statement by the individual responsible for implementation of the sampling program concerning:
 - the authenticity, precision, limits of detection and accuracy of the data, and
 - a description of any factors influencing construction or the sampling program.
- (9) an analysis of the measured data for compliance with State Water Quality Standards and an assessment of the post-construction turbidity effects associated with the Project.