



Monitoring Shoreline Position at Gulf Coast Network Parks

Protocol Implementation Plan

Natural Resource Report NPS/GULN/NRR—2017/1501





ON THIS PAGE

Photograph of shoreline surveyor at Horn Island, Gulf Islands National Seashore

ON THE COVER

Photograph of visitor use area at Padre Island National Seashore.

Photograph courtesy of Joe Meiman, National Park Service.

Monitoring Shoreline Position at Gulf Coast Network Parks

Protocol Implementation Plan

Natural Resource Report NPS/GULN/NRR—2017/1501

Jeff Bracewell

National Park Service
646 Cajundome Boulevard
Suite 175
Lafayette, LA 70506

August 2017

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received formal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from [Gulf Coast Network website](#) and the [Natural Resource Publications Management website](#). To receive this report in a format that is optimized to be accessible using screen readers for the visually or cognitively impaired, please email irma@nps.gov.

Please cite this publication as:

Bracewell, J. 2017. Monitoring shoreline position at Gulf Coast Network parks: Protocol implementation plan. Natural Resource Report NPS/GULN/NRR—2017/1501. National Park Service, Fort Collins, Colorado.

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #

Contents

	Page
Figures.....	vi
Tables.....	vi
Abstract.....	vii
Section 1. Introduction / Background	1
The Elements of Monitoring Coastal Shoreline Position:	2
Geographic Extent of the Surveys.....	2
Survey Frequency and Timing	2
Conducting the GPS Shoreline Survey.....	3
Data Analysis and Reports	3
Roles and Responsibilities.....	3
Startup Costs and Budget:	3
Section 2. Conceptual Framework for Monitoring	4
Section 3. Measurable Objectives.....	5
Section 4. What’s Being Measured and How?	6
Overview of Methods.....	7
SOP 3: Survey Timing and GPS Mission Planning	7
SOP 4: Basic GPS Settings for Position Collection	8
SOP 5: Conducting the GPS Shoreline Survey	8
SOP 7: Change Calculation, Data Analysis, and Reporting.....	8
Section 5. Sampling Design and Monitoring Schedule	9
Section 6. Data Management, Analysis, and Reporting	13
Section 7. Budget	17
Section 8. Safety	20
Section 9. Standard Operating Procedures and Deviations from Source Protocols.....	22
Literature Cited	26

Figures

	Page
Figure 1. Shoreline Position monitoring extent—Petit Bois Island.	10
Figure 2. Shoreline Position monitoring extent—Horn Island.	10
Figure 3. Shoreline Position monitoring extent—GUIS Florida.	11
Figure 4. Shoreline Position monitoring extent—PAIS.....	12

Tables

	Page
Table 1. Ecological context for GULN coastal geomorphology vital sign (Adapted from Segura et al. 2007).	4
Table 2a. Field method for geomorphic feature dimensions.....	6
Table 2b. Scale for measuring geomorphic feature dimensions.	6
Table 3. Shoreline monitoring schedule.....	9
Table 4. Data processing and certification matrix for the GULN coastal shoreline monitoring protocol.	14
Table 5. Reporting Schedule.	16
Table 6. Estimated time series and method for conducting shoreline surveys.....	18
Table 7. Estimate of costs for shoreline monitoring including allowance for travel to and from sites.....	19
Table 8a. Standard Operating Procedures required to implement the NCBN Coastal Geomorphology (Shoreline Position) Monitoring Protocol in GULN parks.....	23
Table 8b. Safety related Standard Operating Procedure required to implement the NCBN Coastal Geomorphology (Shoreline Position) Monitoring Protocol in GULN parks.....	25

Abstract

The Gulf Coast Network will follow Northeast Coastal and Barrier Network methods for monitoring coastal geomorphology as documented in Psuty et al. (2010), to monitor shoreline position at Gulf Islands and Padre Island National Seashores. Handheld and utility task vehicle (UTV)-mounted Global Positioning Systems (GPS) or Global Navigation Satellite Systems (GNSS) will be used to record shoreline position by walking or driving the high tide swash line. The implementation of the NCBN Ocean Shoreline Position Protocol in the Gulf Coast Network will require some modifications that are described in this document.

The GULN monitoring objective is to identify the biennial and long-term trends and variability of shoreline position in network parks. This contrasts with NCBN's objective, which includes seasonal surveys in spring and fall to reveal both annual and seasonal variability (Psuty et al. 2010, p. 9). By reducing the survey frequency, the Gulf Coast Network can maintain an achievable long-term workload while still providing meaningful information about geomorphological change on its seashore parks.

Section 1. Introduction / Background

Coastal geomorphology was ranked as one of the top vital signs for monitoring following the Vital Sign prioritization process, which is documented in the *Gulf Coast Network Vital Signs Monitoring Plan* (Segura et al. 2007). The background and justifications for the network to monitor coastal geomorphology align with those documented in Part 1, Ocean Shoreline Position, of the Northeast Coastal and Barrier Network's (NCBN) Coastal Geomorphology protocol, that states:

Changes in shoreline position are recognized as interacting with many other elements of the ocean beach-dune ecosystem and are thus both driving and responding to the variety of natural and cultural factors active at the coast at a variety of temporal and spatial scales. The direction and magnitude of shoreline change can be monitored through the application of a protocol that tracks the spatial position of the neap-tide, high tide swash line under conditions of temporal sampling. Spring and fall surveys conducted in accordance with standard operating procedures will generate consistent and comparable shoreline position data sets that can be incorporated within a data matrix and subsequently analyzed for temporal and spatial variations (Psuty et al. 2010, p. ix).

The Gulf Coast Network will follow Northeast Coastal and Barrier Network methods for monitoring coastal geomorphology as documented in Psuty et al. (2010), to monitor shoreline position at Gulf Islands and Padre Island National Seashores. Handheld and utility task vehicle (UTV)-mounted Global Positioning Systems (GPS) or Global Navigation Satellite Systems (GNSS) will be used to record shoreline position by walking or driving the high tide swash line.

The implementation of the NCBN Ocean Shoreline Position Protocol in the Gulf Coast Network will require some modifications. The most fundamental change among these is related to survey frequency and is revealed in both monitoring objectives and monitoring questions.

Monitoring Objective: The GULN monitoring objective is to identify the biennial and long-term trends and variability of shoreline position in network parks. This contrasts with NCBN's objective, which includes seasonal surveys in spring and fall to reveal both annual and seasonal variability (Psuty et al. 2010, p. 9). By reducing the survey frequency, the Gulf Coast Network can maintain an achievable long-term workload while still providing meaningful information about geomorphological change on its seashore parks.

Monitoring Questions: The Gulf Coast Network's monitoring questions are: (1) What is the displacement of the shoreline? (2) What are the biennial dimensions of the displacement? (3) What are the long-term dimensions of the displacement? (4) What are the spatial and temporal trends in the shoreline displacement? These questions differ from the Northeast Coastal and Barrier Network in excluding seasonal variation and looking at biennial rather than seasonal and annual dimensions of displacement (Psuty et al. 2010, p. 9)

Despite the difference in temporal scale, the Gulf Coast Network can implement the NCBN shoreline position protocol standard operating procedures (SOPs) with minor changes. The changes generally

concern: adding detail for specific equipment and software, updating verbiage and processing steps for more contemporary GPS and GNSS equipment, changing the survey and reporting frequency, and changing the survey timing for work on the Gulf Coast. By adapting the NCBN's established SOPs with minor modifications, the Gulf Coast Network will collect accurate positional data using repeatable methods that will allow for scientifically rigorous comparisons across time.

The Gulf Coast Network's adaptation of Psuty et al. (2010) will incorporate the modifications outlined below. Modifications are organized using the same section headings as those used in Psuty et al. (2010) so that points can easily be referenced in the source document.

The Elements of Monitoring Coastal Shoreline Position:

- The Gulf Coast Network will conduct surveys biennially (every other year), focusing on long-term trends (not on seasonal variation) as outlined in bullet 2 (Psuty et al. 2010, p. 9).
- Annual dimensions as outlined in bullet 3 (Psuty et al. 2010, p. 9), will be on a biennial basis

Geographic Extent of the Surveys

- The Northeast Coastal and Barrier Network monitors the entire length of the ocean beach at network parks (Psuty et al. 2010, p. 17). The Gulf Coast Network will monitor both Gulf and sound sides of Mississippi Barrier Islands.

Survey Frequency and Timing

In NCBN ocean parks, GPS surveys are conducted in early spring (mid-March to late April) and early fall (mid-September to late October), a period that coincides with the peak expression of seasonal beach variability (Psuty et al. 2010, p. 28). The peak summer expression at Gulf Islands (GUIS) and Padre Island (PAIS) National Seashores occurs in late summer (August to mid-September), before passages of northerlies begin to deflate dunes, widen beach profiles and create less discrete primary dune and shoreline features. Unfortunately, the Atlantic hurricane season, which extends into the Gulf of Mexico, coincidentally peaks in the summer (June through November) and produces stochastic storm events that can dramatically alter typical geomorphological form. Comparing storm-impacted shoreline data sets with non-storm-impacted shoreline datasets will highlight short term change.

As the GULN focus is on long-term trends, shoreline surveys will be conducted only once every two years. Surveys will occur in the spring, avoiding the deflated winter season expression, but also avoiding the potential onset of tropical storms. April and May emerge as the ideal months to survey GULN coastal parks as this timeframe is between the winter season, characterized by dominant north winds, and the Atlantic hurricane season. The spring season also coincides with GULN vegetation monitoring efforts. Overlapping these monitoring projects in space and time will allow for logistical advantages for conducting field work and the potential for the shoreline data set to inform the vegetation dataset, and vice versa. A maximum two-month survey window at each park will allow for flexible scheduling in case of unforeseen interferences. May is the preferred survey month because the beach-dune system is becoming more stable in the absence of northerlies. If possible,

Padre Island NS should be surveyed in May. To avoid disturbing nesting shorebirds, GUIS biologists prefer that the Gulf Coast Network conduct shoreline surveys in April at Gulf Islands NS.

Conducting the GPS Shoreline Survey

NCBN shoreline surveys are conducted mostly with four wheel drive vehicles or Utility Task Vehicles (UTVs) whereas limited access areas are walked (Psuty et al. 2010, pp. 29, 79). Given the GUIS island units can only be accessed with small boats and shorelines cannot be surveyed with vehicles, the network will conduct shoreline surveys at Horn and Petit Bois Islands by walking.

Data Analysis and Reports

- NCBN annual reports include a seasonal comparison (Psuty et al. 2010, p. 33). Seasonal comparisons will not be reported because the Gulf Coast Network will only capture the biennial period.
- The Northeast Coastal and Barrier Network produces annual reports to describe within season, year-to-year variation (Psuty et al. 2010, p. 33). The Gulf Coast Network will produce similar reports, comparing the current year's survey with the previous. Following the two-year survey cycle, the Gulf Coast Network will produce biennial reports.
- The Northeast Coastal and Barrier Network produces shoreline displacement trend reports after five survey events or every five years (Psuty et al. 2010, p. 33). Similarly, the Gulf Coast Network will generate a shoreline displacement trend report after five survey events. However, in contrast to the Northeast Coastal and Barrier Network, the GULN reports will occur on a ten -year cycle, because surveys will be conducted every other year. Trend reports will be produced in consultation with locally knowledgeable coastal geology experts.

Roles and Responsibilities

- Gulf Coast Network staff or local cooperators will conduct the survey rather than park staff. Logistical support from parks will be necessary to access survey locations (Psuty et al. 2010, p. 35).
- The Gulf Coast Network will be responsible for procuring the GPS/GNSS equipment and software necessary for performing the survey, post-processing results, and conducting basic change analysis. This is similar to the NCBN approach, except that the NCBN parks and cooperators provide their own GPS/GNSS equipment for the monitoring effort (Psuty et al. 2010, p. 37).

Startup Costs and Budget:

Startup costs for the NCBN shoreline monitoring effort considers the purchase of an ATV (Psuty et al. 2010, p. 37). The Gulf Coast Network will not purchase an ATV to implement this protocol as GUIS and PAIS will make their UTV fleets available to conduct surveys.

Section 2. Conceptual Framework for Monitoring

Barrier islands are geologically young features; the vast majority are less than 7,000 years in age, and most are probably less than 3,000 years old. Barrier-island formation is dependent upon the complex interaction between waves, sea-level change, and the availability of sediment. They are a vital part of the coastal and estuarine habitats found in Gulf Coast Network parks. Barrier islands are composed of three general zones: beach, dune, and back dune. Each zone provides critical habitat for several state- and federally- listed species. These systems serve as key stopover areas for migratory birds, nesting sites for sea turtles, year-round habitat for the Perdido Key beach mouse, and nesting and wintering habitat for shorebirds (Segura et al. 2007). Ecological stressors affecting geomorphic processes in GULN barrier island parks are documented in Table 1.

Table 1. Ecological context for GULN coastal geomorphology vital sign (Adapted from Segura et al. 2007).

Vital sign	Management issues informed by monitoring	Potential measures
Coastal geomorphology	Dredge-and-spoil operations, coastal armoring, hydrologic modification, beach nourishment affecting sediment supply and transport Water, oil, and gas extraction affecting subsidence Recreation (driving, foot-traffic) affecting erosion and altering geomorphic processes Climate change and increased storm frequency altering geomorphic processes	Geomorphic dimension and properties

Measuring shoreline displacement is an established method for assessing geomorphic dimension and properties as presented in Table 1. Measuring the change in shoreline position will yield spatially explicit information about the rates of erosion or accretion along a park shoreline.

The methods outlined in Psuty et al. (2010) will be implemented by the Gulf Coast Network with minor modifications to document shoreline position by recording the position of the swash line. These data will allow for the comparison of shorelines across time, addressing an array of park management interests primarily related to the loss or gain of sediment. Other GULN monitoring efforts at seashore parks that might be informed by monitoring coastal geomorphology include: Land Birds, Terrestrial Vegetation, Seagrasses, and Water Quality. As the islands of Gulf Islands and Padre Island National Seashores provide the foundation for almost all park natural and cultural resources, a better understanding of the geomorphic change patterns through space and time will help park managers to understand and explain changes in biological communities, habitat availability, and threats to infrastructure.

Section 3. Measurable Objectives

The measurable objectives stated in Psuty et al. (2010) focus on identification of the seasonal, annual, and long-term trends and variability of shoreline position in the network parks. The protocol is written to address the following questions:

- What is the displacement of the shoreline?
- What are the seasonal dimensions of the displacement?
- What are the annual dimensions of the displacement?
- What are the long-term dimensions of the displacement?
- What are the spatial and temporal trends in the shoreline displacement?

Gulf Coast Network will adopt a similar objective and set of monitoring questions:

- GULN's monitoring objective is to identify the biennial and long-term trends and variability of shoreline position in network parks.
- GULN's monitoring questions are:
 - o What is the displacement of the shoreline?
 - o What are the biennial dimensions of the displacement?
 - o What are the long-term dimensions of the displacement?
 - o What are the spatial and temporal trends in the shoreline displacement?

By focusing on long-term trends rather than seasonal variation and annual comparisons, the network will establish an achievable workload that is sustainable in the context of executing all Gulf Coast Network protocols. Routinely collecting shoreline position every other year will address the Gulf Coast Network's stated monitoring objective to "establish a current baseline condition and document changes in coastal barrier-island morphology, both gradual and storm-induced" (Segura et al. 2007).

Section 4. What's Being Measured and How?

The Gulf Coast Network will monitor shoreline position using the same methods developed and approved for implementation in the Northeast Coastal and Barrier Network (Psuty et al. 2010) using Differentially Corrected Global Navigation Satellite Systems (DGNSS). This system combines the U.S. Global Positioning System (GPS) and other satellite-based positioning systems for the collection of accurate geographic information in a variety of environments. DGNSS units will be carried on foot or mounted to a UTV to traverse and document neap tide, high tide swash line position. Shoreline position data will be stored in an ArcGIS platform and analyzed using the USGS/NOAA Digital Shoreline Assessment System (DSAS) (Thieler et al. 2008). DSAS is capable of generating a suite of summary statistics used to assess distance and rates of shoreline change. Selection of survey areas was done in consultation with park staff (Table 2b).

Table 2a. Field method for geomorphic feature dimensions.

Objective	Sampling Method	Data Collected	Analysis Tool	Derived Data
Shoreline Position	Handheld, or vehicle mounted GNSS units will be used to record the shoreline position.	Geographic location of shoreline position (swash line)	USGS Digital Shoreline Analysis System	Net shoreline movement, linear regression rate of change

Table 2b. Scale for measuring geomorphic feature dimensions.

Area Sampled	Spatial Design	Temporal Design	Scale of Analysis
GUIS: Horn Island, Petit Bois Island	Whole island	Every two years	Whole island
GUIS: west Santa Rosa Island and east Perdido Key	Gulf/Pensacola Pass shorelines	Every two years	Park unit (Gulf-side)
PAIS	Entire Gulf shoreline	Every two years	Whole park (Gulf-side)

Overview of Methods

Psuty et al. (2010) provides detailed SOPs to guide personnel through all aspects of monitoring and reporting changes in shoreline position. Specific protocol SOPs include:

1. Equipment and Supplies;
2. Training for Field Data Collection;
3. Survey Timing and GPS Mission Planning;
4. Basic GPS Settings for Position Collection;
5. Conducting the GPS Shoreline Survey;
6. Initial Post-Survey Processing;
7. Change Calculation, Data Analysis, and Reporting;
8. Data Management;
9. Revising the Protocol; and
10. Field Safety for the Ocean Shoreline Position Monitoring Protocol (created after the protocol was published).

The Gulf Coast Network will follow all SOPs documented in Psuty et al. (2010) with the following exceptions:

SOP 3: Survey Timing and GPS Mission Planning

Northeast Coastal and Barrier Network targets a six-week period from mid-March to late April for peak winter expression. Since the Gulf Coast Network's focus is on long-term monitoring, not on seasonal comparisons, a pre-hurricane season condition will be targeted to avoid surveying after tropical storms. If possible, surveys should be planned to coincide with the first neap tide in the preferred sampling month (April at Gulf Islands NS and May at Padre Island NS). If it is not possible to conduct the survey during the overall April/May sample period, the next neap tide period will be chosen in consultation with the park. It is preferable to collect data outside of the prescribed survey period rather than not collect data.

SOP 4: Basic GPS Settings for Position Collection

- A statement will be added to ensure that accuracy-based settings are used to warn the surveyor when post-processed horizontal exceeds 1 meter (3.2 feet [ft]). It may be acceptable to collect data over a 1-meter (3.2 ft) accuracy threshold given survey constraints, but the surveyor should be made aware if accuracy decays.
- Logging settings for shorelines should be set to a 3-meter (9.8 ft) interval rather than 5 meters (16.4 ft) following advances in technology and the desire by park managers to acquire more detailed variation in the shoreline position.
- Following technological changes in instrumentation, Trimble TerraSync's "GNSS Settings" should be set to "Productivity" (GeoXH or GeoXT) or "Use Smart Settings" (Geo6000 or Geo7x). These settings allow the receiver to select the best satellites to provide the most accurate solution.
- Coordinate system should be set to NAD 83, UTM (Meters)—Zone 14 for Padre Island NS and Zone 16 for Gulf Islands NS.

SOP 5: Conducting the GPS Shoreline Survey

The GPS survey will be conducted every other year during neap tide periods in April or May.

SOP 7: Change Calculation, Data Analysis, and Reporting

Biennial comparisons will be made because GULN shoreline surveys will only occur in the spring, every other year.

Section 5. Sampling Design and Monitoring Schedule

Monitoring site selections were made in collaboration with subject matter experts, along with park staff. The selections consider the following: distributing effort for long-term monitoring goals, logistical constraints, and a reasonable workload for implementation by GULN staff. Approximately 206 kilometers (128 miles [mi]) of shoreline in GULN coastal parks will be monitored over a two year cycle, 101 kilometer (62.8 mi) at Gulf Islands NS in odd numbered years, and 105 kilometers (65.2 mi) at Padre Island NS in even numbered years (Table 3). Both Gulf- and Sound-side shorelines will be surveyed at Horn and Petit Bois Islands of Gulf Islands NS in Mississippi, because both shorelines are dynamic and are priority interests for the park (Figures 1 and 2). In the Gulf Islands NS Florida units, monitoring efforts will focus on the Gulf shorelines and extend through Pensacola Pass at Perdido Key and Fort Pickens (Figure 3). The north shores of these units are frequently inaccessible to UTVs and will not be routinely surveyed as part of this monitoring effort. At Padre Island NS, monitoring efforts will be focused on the more dynamic Gulf shoreline and extend the entire length of the seashore within the park boundary (Figure 4).

Table 3. Shoreline monitoring schedule.

Unit	Approximate length of shoreline (km)	Description	Schedule
Horn Island	50	All Gulf and sound shorelines	Even numbered years
Petit Bois Island	22	All Gulf and sound shorelines	Even numbered years
West End Santa Rosa (Ft Pickens)	15	Gulf and Pensacola Pass shoreline	Even numbered years
East End Perdido Key	14	Gulf and Pensacola Pass shoreline	Even numbered years
Padre Island NS	105	All Gulf shorelines	Odd numbered years

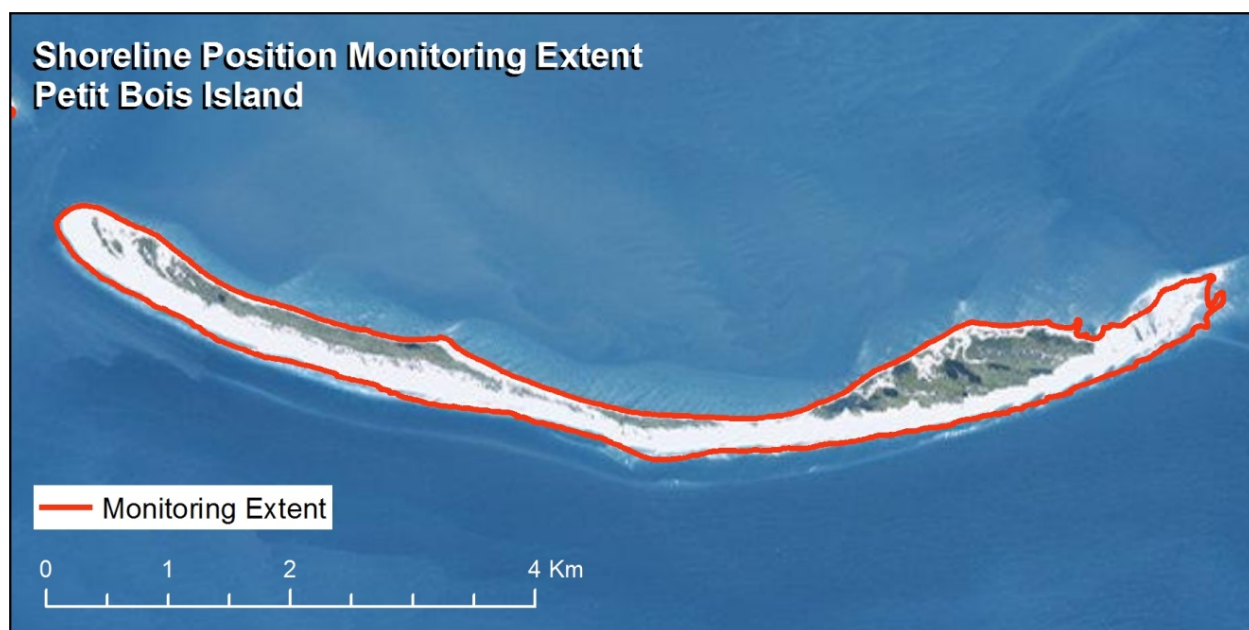


Figure 1. Shoreline Position monitoring extent—Petit Bois Island.

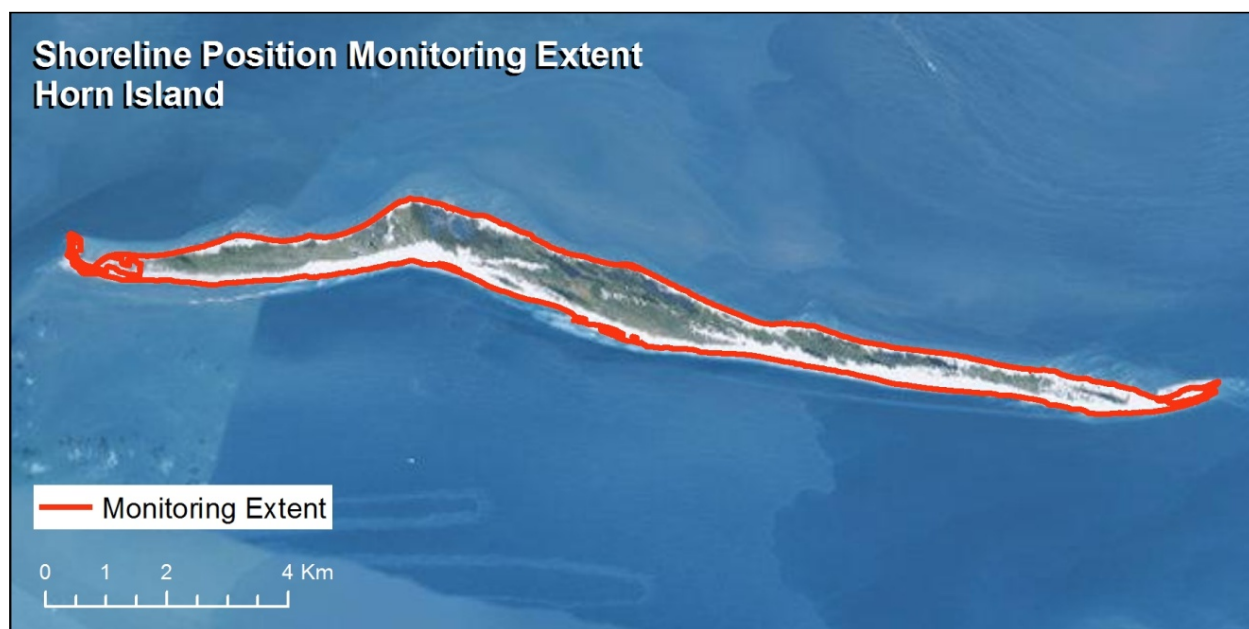


Figure 2. Shoreline Position monitoring extent—Horn Island.

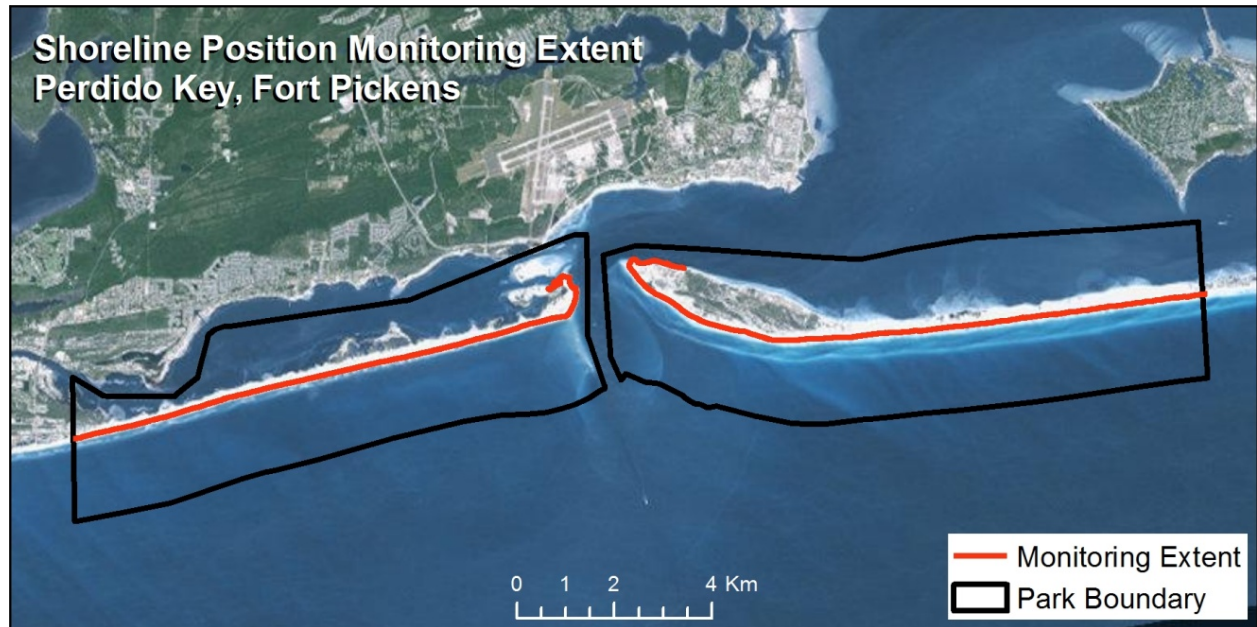


Figure 3. Shoreline Position monitoring extent—GUIS Florida.

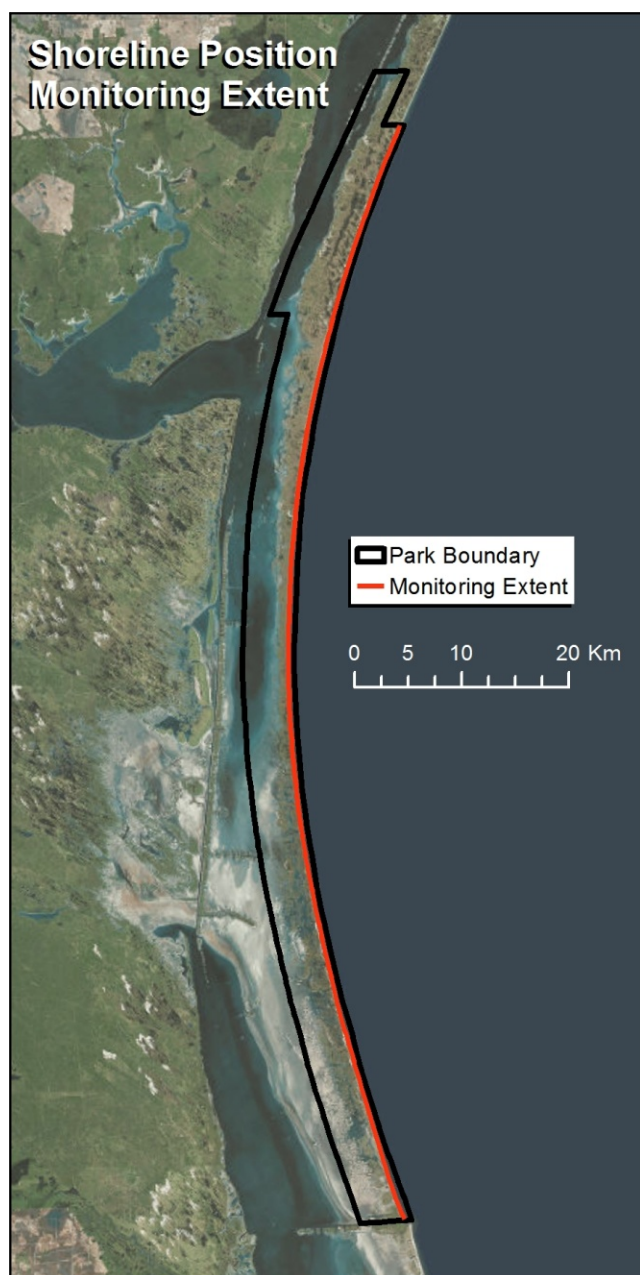


Figure 4. Shoreline Position monitoring extent—PAIS.

Section 6. Data Management, Analysis, and Reporting

Psuty et al. (2010) includes detailed SOPs to handle all aspects of data management. The eight principal data management elements are: field preparation: conducting the survey, post-processing, GIS editing, data entry, metadata creation, file management and archiving, and reporting procedures. DSAS will be used by the Gulf Coast Network for storage and analysis of the final shoreline feature. All other data elements will follow naming and storage guidance set forth in Psuty et al. (2010). The Northeast Coastal and Barrier Network shoreline database will be adapted for Gulf Coast Network parks to capture field form data and link all project elements. The following workflow describes the core data management steps needed to implement this protocol:

1. Raw GPS data are post-processed and exported to Environmental Systems Research Institute (ESRI) shapefile.
2. Shoreline position is verified and edited as needed using Geographic Information Systems.
3. Federal Geographic Data Committee (FGDC) compliant metadata is created for (ESRI) shapefile.
4. Edited/Corrected shoreline shapefiles are imported into the final shoreline geodatabase as an ESRI Feature Class for analysis in DSAS.
5. Field data forms are scanned and entered into shoreline monitoring database. A third party will perform 100% check to verify data entry accuracy.
6. Photos are downloaded, renamed, and linked to the shoreline monitoring database.
7. Distances from the baseline to the shoreline are calculated along transects in DSAS. Distance matrices will be exported from DSAS as Microsoft Excel spreadsheets.
8. Related files are archived annually and include: The shoreline monitoring database (.mdb), spatial datasets (.ssf, .cor, .shp, .mdb), photos (.jpeg), field forms (.pdf), a distance matrix (.csv and xls), an biennial report (.pdf), and a trend report (.pdf, after five survey events).

The types and requisite processing steps for data to be collected as a part of the Gulf Coast Network Shoreline Position monitoring protocol implementation plan have been documented in Table 4. Additionally, the Protocol Implementation Plan (PIP; this document), along with related SOPs and appendix items will be managed locally as long-term records and also posted to the NPS Integrated Resource Management Application (IRMA). Other ancillary documents and data sets associated with the PIP such as those downloaded for trip planning, e.g., tide predictions and weather data, will be managed locally as long-term records. Details about managing these and all associated PIP records can be found in SOP SHRO8—*Data Management* (Bracewell 2017). Data quality standards applied to the collection, processing, storage, analysis, and publication of monitoring data described in this PIP are found in *Monitoring Shoreline Position at Gulf Coast Network Parks: Data Quality Standards* (Bracewell 2017)

Table 4. Data processing and certification matrix for the GULN coastal shoreline monitoring protocol.

Data Type	Process Step	Product Description	Product Type
Raw Data	Download digital data and organize field forms	Trimble GPS/GNSS field data (topographic points, benchmarks)	.ssf files
Raw Data	Download digital data and organize field forms	Field forms	Paper field sheets
Raw Data	Download digital data and organize field forms	Digital photos	.jpg files
Provisional Data	Post-processing and data entry	GNSS differential corrections performed in Trimble Pathfinder Office	.cor files
Provisional Data	Post-processing and data entry	Differentially corrected files exported to ESRI Shapefile	.shp (1 of 2)
Accepted Data	Post-processing and data entry	Photos renamed	.jpg
Provisional Data	Post-processing and data entry	Field form data are verified and entered into database	.mdb file
Accepted Data	Data validation	100% cross-check between database and field forms performed	.mdb file
Accepted Data	Post-processing and data entry	Verified field forms are scanned	.pdf (1 of 2)
Accepted Data	Data validation	Corrected GPS/GNSS data (shapefiles) edited and verified in GIS. Errors/outliers flagged and notation to explain error added to shapefile	.shp (2 of 2)
Accepted Data	Data validation	Shapefile features meeting quality standards are imported to DSAS geodatabase with historical shoreline library	.gdb
Accepted Data	Value added	Distances from baseline calculated and exported	.csv
Accepted Data	Value added	Current distance table (.csv) appended to master distance matrix	.xls
Accepted Data	Local archive	Field forms managed as long-term records	Paper field sheets

Table 4 (continued). Data processing and certification matrix for the GULN coastal shoreline monitoring protocol.

Data Type	Process Step	Product Description	Product Type
Raw & Provisional Data	Offsite archive and publication	Raw and provisional datasets are published to IRMA. Includes: Raw and corrected GPS/GNSS files, Exported shapefile, Edited shapefile	.zip (1 of 2)
Accepted Data	Offsite archive and publication	Accepted data published to IRMA. Includes: Renamed photos, Verified field forms, QA/QCed database, Appended DSAS geodatabase, Exported distance table, and Master distance matrix	.zip (2 of 2)
Accepted Data	Offsite archive and publication	Biennial and trend reports published to IRMA	.pdf (2 of 2)

Gulf Coast Network will also follow procedures for change calculation, analysis, and reporting as outlined in SOP 7 of Psuty et al. (2010) with the following exceptions:

- Gulf Coast Network will not report on seasonal changes
- Biennial event-based data summary reports will be generated in the fall of a survey year, occurring every other year for a given park (Table 5).

Consistent with Psuty et al. (2010), long-term trend reports will be done in consultation with subject matter experts after five survey events (Table 5).

Table 5. Reporting Schedule.

Monitoring Year	1	2	3	4	5	6	7	8	9	10	11	12
Park Surveyed	GUIS	PAIS	GUIS	PAIS	GUIS	PAIS	GUIS	PAIS	GUIS	PAIS	GUIS	PAIS
Biennial Report	GUIS	PAIS	GUIS	PAIS	GUIS	PAIS	GUIS	PAIS	--	--	GUIS	PAIS
Long-Term Report	--	--	--	--	--	--	--	--	GUIS	PAIS	--	--

Section 7. Budget

The estimated annual cost (based on FY2015 dollars) of implementation of the Gulf Coast Network Shoreline Position Protocol (this document) is presented in Table 7. The minimum cost of a field day includes team cost, travel cost, field supplies and fuel cost. Consumable field supplies cost approximately \$5 per day and include items such as baggies, flagging, hand cleaners, bug spray, sunblock, and batteries.

The estimated team cost will be based on using a GS-11 (step 5) GIS Specialist and GS-07 (step 5) biologist/tech scale using a 40% fringe benefits cost. This will be a mid-range estimate, as personnel may cost more or less due to step in grade. We will assume this team of two for conducting all shoreline surveys.

Much of the project equipment (including communications radios and cameras) may be shared among multiple projects and constitute a separate network cost not apportioned here.

For every field day, there will be team prep time at the vehicle before heading out to the survey locations, field travel time to the survey location, and field travel time back, followed by team stand-down and stowage time. Travel time to and between sites will vary and will be affected by distance and by conditions. This variation in travel time is accounted for resulting in an anticipated four survey days at Gulf Islands NS and two survey days at Padre Island NS.

All projects involve data management. We will assume one GS-11 at \$360.30 per day for data management cost. In general, we should assume that data management will be a relatively fixed cost regardless of miles of shoreline surveyed. Survey preparation, data download, QA/QC, and basic reporting don't fluctuate much based on the amount of data collected. We initially assume that about ten days of data management will be required per survey event regardless of the park and how many miles of shoreline are surveyed.

Logistical support and site access assistance from parks is assumed in budget planning and includes transport by boat (GUIS), and UTV and / or other vehicles (GUIS and PAIS).

Each GULN coastal park will have a little over 100 kilometers (62.1 mi) of shoreline to survey. Table 6 presents the expected workload for conducting shoreline surveys at GULN seashore parks as a time series. The estimated workloads are based on consultation with network parks and consider logistics, terrain and survey method (walking vs. driving).

Table 6. Estimated time series and method for conducting shoreline surveys.

Park	Day	Survey Area	Method
GUIS	Day 1	Horn Island	Walking
	Day 2	Petit Bois Island	Walking
	Day 3	Perdido Key	UTV
	Day 4	Fort Pickens	UTV
PAIS	Day 1	0 To 70 Km	UTV
	Day 2	70 To 105 Km	UTV

Table 7 presents project cost estimations based on implementation using one field team plus standard data management support at the office and assumes a workload of about 100 kilometers (62.1 mi) of shoreline. The estimations are based on the costs and assumptions presented above and include:

1. Data management cost based on \$360.30/day;
2. A field team of two costing approximately \$603.84/day;
3. Field consumables at \$20.00/day;
4. Travel and lodging costs for the field team at a lodging rate of \$114 per night, and a per diem rate of \$59 per day totaling \$346/day per team; and
5. A government vehicle fuel estimate of \$40 per day.

Table 7. Estimate of costs for shoreline monitoring including allowance for travel to and from sites.

Expense	Estimated Unit cost	Cost GUIS	Cost PAIS
Team cost	\$603.84 / day	\$ 2,415.36	\$ 1,207.68
Data management 10 days	\$360.30 / day	\$ 3,603.20	\$ 3,603.20
Travel cost (lodging, M&IE—survey days) ¹	\$346 / day (Team)	\$ 1,384.00	\$ 692.00
Travel cost (Lodging, M&IE, salary - to and from park) ²	M&IE of \$177 + 1 night lodging (Team)	\$ 523.00	\$ 523.00
Field supplies	\$20 / day	\$ 80.00	\$ 40.00
Fuel cost	\$40 / day	\$ 240.00	\$ 160.00
Total Project cost	—	\$ 8,245.56	\$ 6,225.88

¹Lodging and meals and incidental expenses (M&IE) costs are added as \$346.00/day for two people based on summer rate in Florida.

²Includes one day lodging for travel to the park, 0.75% M&IE and Salary for travel to and from the park.

Section 8. Safety

Implementation of this protocol has multiple complex risks. Staff will continuously evaluate all risks at the programmatic, personnel, and site level. Programmatic-level safety information is presented here and procedures to mitigate risks associated with specific activities related to protocol implementation (such as safe operations of UTVs, vehicle use and operation, injury reporting and accident reporting) are addressed in standard operating procedures below.

Job hazard analyses (JHAs) were completed for all personnel who implement portions of the protocol in which risks and risk abatement strategies (including training needs) were identified. Risks and abatement strategies for all staff were synthesized to develop a protocol-level JHA. The protocol JHA was then used to perform a programmatic-level Green-Amber-Red (GAR) risk analysis to assess whether implementation of this protocol could be accomplished within an acceptable level of risk.

Specific safety concerns include:

- Crew members will spend many hours (and miles) driving to, between, and from survey locations to conduct the requisite fieldwork.
- Crew members may be working in park areas outside of communications range (either by park radio or by cell phone).
- Crew members will frequently be exposed to extreme heat and humidity and will be working for extended periods of time in remote areas with potentially rapidly-changing and severe weather conditions.
- Crew members will be frequently exposed to toxic and thorny plants, stinging and biting insects, treacherous terrain, venomous and other hazardous animals, and potentially hazardous materials and debris left from pre-park land usage, such as old drilling and range equipment, fencing and piping, contaminated soils, and waste materials.
- In specific cases, crew members will be utilizing watercraft and UTV / ATV for site-access, and will be exposed to increased risks associated with use of this equipment.

Injury or loss of life while in transit to and from field sites and during survey activities within sites—as well as while in transit to or from survey sites via watercraft and UTV / ATV—are the most significant risks encountered when conducting this activity.

Based on the JHA and associated risk abatement measures it was determined that this protocol can be safely implemented provided that the Gulf Coast Network and partner staff implement it in accordance with the referenced SOPs and recommended risk abatement strategies. In addition to SOPs that have been developed to safely implement this protocol, specific training needs for all staff have been identified including certification in basic first aid. To increase the overall level of safety and awareness, obtaining additional levels of training beyond basic certifications will be encouraged.

Safety procedures will be routinely reviewed with network staff and partners before field operations as prescribed in SOPs. Safety SOPs are reviewed at least annually and updated as necessary to ensure that they adequately mitigate risks to personnel, property, and the public.

In addition to protocol-specific safety procedures and guidelines, Gulf Coast Network staff will follow the general guidelines set forth in the National Park Service (NPS) Occupational Safety and Health Program (NPS 2008).

Section 9. Standard Operating Procedures and Deviations from Source Protocols

To ensure consistent implementation of this protocol over time, standard operating procedures (SOPs) have been adapted from other networks, or developed as needed by the Gulf Coast Network (Table 8a and 8b). Technical aspects of the Gulf Coast Network's shoreline position monitoring will be primarily adapted from Psuty et al. (2010). The Southeast Coast Network has provided some additional detail to the Psuty et al. (2010) post processing SOP in Baron (2017). These post-processing details have been adapted in this Protocol Implementation Plan. Logistical challenges and worksite conditions are similar to those encountered in NCBN parks. Accordingly, guiding safety procedures are adapted from *Field Safety for the Ocean Shoreline Position Monitoring Protocol* (Skidds 2013). All SOPs are adapted from procedures approved and implemented programmatically through other monitoring efforts to the greatest extent possible. Project SOPs are available for download at the NPS Integrated Resource Management Applications portal at <https://irma.nps.gov/DataStore/Reference/Profile/2237508> (NPS 2017).

Table 8a. Standard Operating Procedures required to implement the NCBN Coastal Geomorphology (Shoreline Position) Monitoring Protocol in GULN parks.

Monitoring SOP and data store record	Citation	Explanation of Differences	GULN updated SOP	Link to Published Document IRMA record
SOP 1. Equipment and Supplies 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	Modified to include additional safety items and the use of UTV, rather than ATV	GULN SOP SHR01— Equipment and supplies	2242633
SOP 2. Training for Field Data Collection 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	No modifications.	GULN SOPSHR02— Training for field data collection	22426334
SOP 3. Survey Timing and Mission Planning 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	Modification in survey timing to target pre-hurricane season condition. Updated sources for local tidal predictions and weather. Reduced survey window from 6 weeks to one month.	GULN SOP SHR03— Survey timing and mission planning	22426335
SOP 4. Basic GPS Settings for Position Collection 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	Modifications to GPS/GNSS settings to be consistent with current GNSS best-practices. Added detailed procedures to access and confirm critical data logger settings using Trimble Terrasync software. Changed vertex logging interval from 5 meters to 3 meters.	GULN SOP SHR04— Basic GPS settings for position collection	22426336
SOP 5. Conducting the GPS Shoreline Survey 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	Clarification statement added stating that surveys will be conducted every other year in the Spring. Statements added about expected GPS accuracy and warnings when accuracy threshold is exceeded. Statement added about recording locations for photo points.	GULN SOP SHR05— Conducting the GPS shoreline survey	22426337

Table 8a (continued). Standard Operating Procedures required to implement the NCBN Coastal Geomorphology (Shoreline Position) Monitoring Protocol in GULN parks.

Monitoring SOP and data store record	Citation	Explanation of Differences	GULN updated SOP	Link to Published Document IRMA record
SOP 6. Initial Post-Survey Processing 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	GPS Post Processing details added based on 'SECN Standard Operating Procedure (SOP) # 1.3.23, Coastal Shoreline Monitoring Annual Analysis Protocol'. Added detail for QA/QC procedures. Deleted section on converting points to lines as this will not be part of the GULN workflow. Added section about handling digital photos.	GULN SOP SHR06—Initial post-survey processing	2242638
SOP 7. Change Calculation, Data Analysis, and Reporting 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	Modification to clarify spring only surveys will be conducted for change analysis. Seasonal change analysis will not be addressed in this protocol. Changes to clarify that biennial comparisons will be made rather than annual comparisons; therefore reports will be generated every two years. Following the biennial survey schedule, trend reports will be generated after five survey events, or once every 10 years.	GULN SOP SHR07—Change calculation, data analysis, and reporting	2242639
SOP 8. Data Management 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	Modifications to reflect differences in archiving procedures and off-site data backup systems. Clarification added to state that GULN will not perform annual comparisons. Removed section regarding converting points to lines (n/a for our workflow). Removed export to ascii step as this is not currently practiced with other GULN protocols. File types generated from this protocol are widely accessible through common software platforms. Removed references to contractors performing monitoring. GULN will perform shoreline monitoring.	GULN SOP SHR08—Data management	2242640
SOP 9. Revising the Protocol 664308	Psuty et al. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I - Ocean Shoreline Position. National Park Service. Fort Collins, Colorado	Changed minor revision numbers from hundredths to tenths (e.g., 1.01 to 1.1). Updated 'communicating changes to protocol' weblink from Network website to IRMA	GULN SOP SHR09—Revising the protocol	2242641

Table 8b. Safety related Standard Operating Procedure required to implement the NCBN Coastal Geomorphology (Shoreline Position) Monitoring Protocol in GULN parks.

SOP topic	Citation	Explanation of Differences	GULN updated SOPs	Link to Published Document IRMA record
Safety plan	Skidde, D. 2013. Field Safety for the Ocean Shoreline Position Monitoring Protocol	Added a note about GULN JHA for motorboat operation. Deleted part about MOU between network and park for designating POC. Replaced NCBN POC roles and procedures with GULN-specific procedures. Replaced NCBN accident reporting procedures with SER procedures. Added note about Zika virus.	GULN SOP SHR10—Field Safety for Monitoring Shoreline Position at Gulf Coast Network Parks Protocol Implementation Plan	2242642

Literature Cited

- Baron, L. C. 2017. Post-survey GPS data processing. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP—2.3.10. Southeast Coast Network, Athens, Georgia.
- Bracewell, J. 2017. Monitoring shoreline position at Gulf Coast Network parks: data quality standards. Natural Resource Report NPS/GULN/NRR—2017/1502. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2243713> (last accessed August 2017).
- Bracewell, J., and W. Granger. 2017. Data Management—Version 1.0. Gulf Coast Network Standard Operating Procedure NPS/GULN/SOP—SHR08. Gulf Coast Network, Lafayette, Louisiana. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2242640> (last accessed August 2017).
- National Park Service (NPS). 2008. Safety and Health for Field Operations, Reference Guide 50B. Available at: <http://www.nps.gov/policy/RM50Bdoclist.htm> (last accessed July 2017).
- National Park Service (NPS). 2017. Integrated Resource Management Applications. Gulf Coast Network Shoreline Monitoring Project. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2237508> (last accessed February 2017).
- Psuty, N., T. Silveira, A. Spahn, and D. Skidds. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol, Part 1—Ocean shoreline position. Natural Resource Report NPS/NCBN/NRR—2010/185. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/664308> (last accessed July 2017).
- Segura, M., R. Woodman, J. Meiman, W. Granger, and J. Bracewell. 2007. Gulf Coast Network Vital Signs Monitoring Plan. Natural Resource Report NPS/GULN/NRR—2007/015. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/661666> (last accessed July 2017).
- Skidds, D. 2013. Field Safety for the Ocean Shoreline Position Monitoring Protocol. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2242785> (last accessed September 2017).
- Thieler, E. R., E. A. Himmelstoss, J. L. Zichichi, and A. Ergul. 2008. The digital shoreline analysis system (DSAS) version 4.0—an ArcGIS extension for calculating shoreline change. Open-File Report 2008-1278. U.S. Geological Survey. Available at: <http://woodshole.er.usgs.gov/project-pages/DSAS/> (last accessed July 2017).

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 635/139872, 613/139872, August 2017

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

EXPERIENCE YOUR AMERICA™