



Shoreline Change Along Fire Island National Seashore

Annual Monitoring Report, 2007-2008 (Revised)

Natural Resource Data Series NPS/NCBN/NRDS—2013/450



ON THE COVER

Ongoing mechanical transport of sand to augment dimensions of coastal foredune in Davis Park, Fire Island National Seashore.
Photograph by: Dr. Norbert P. Psuty

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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 Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

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.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Introduction

This version of the FIIS 2007-08 Annual Report is an update of the original, Natural Resource Data Series NPS/NCBN/NRDS—2010/042, that is necessitated because of a transposition of spreadsheet columns in the calculations of shoreline position. The previous version had an incorrect sequence of seasonal shorelines, resulting in incorrect values of shoreline change reported on the shoreline change maps, in the histograms of changes, and in the tables representing changes in the various parks and communities on Fire Island. This version incorporates the correct temporal sequence of shoreline position and the resulting calculations of shoreline position change for the period 2007-08.

This is the first of a series of Annual Reports of the change in shoreline position along the ocean side of Fire Island from inlet to inlet. This first report follows the protocols described in Psuty, et al. (2009) that were applied for the first time on Fire Island in the fall of 2005. Subsequent surveys conducted in the spring of 2007, the fall of 2007, and the spring of 2008 provide the temporal span for this annual report.

The goal of the annual report is to document the collection of the shoreline position data and to describe the short-term variation that has occurred. The changes in position are generally descriptive of the seasonal contrasts (lower energetics in the summer period versus higher energetics in the winter period) that support accumulation during summer and erosion during the winter. However, there are many other variables that affect the gains and losses of sediment and the displacements of the beach, especially along a barrier island, such as Fire Island. Therefore, the short-term annual report is but the first step in the understanding of the conditions that characterize the island and is meant to establish a baseline of information for subsequent characterization and analysis. Discussions and analyses of vectors of shoreline change and likely associations will be the theme of the longer-term (5 years) Trend Reports.

Site and Situation

Fire Island is a barrier island along the southern coast of Long Island (Fig. 1). The barrier is approximately 50 km alongshore from Moriches Inlet to Fire Island Inlet. Each of the inlets is controlled by the presence of jetties bordering federally-maintained navigation channels. Whereas the Moriches Inlet terminus of Fire Island is relatively stable in position because of the pair of jetties defining the channel position, the Fire Island Inlet terminus of Fire Island (Democrat Point) extends considerably beyond the single western jetty and is quite mobile.

The survey of the ocean shoreline position follows the protocols set forward in the NPS Inventory and Monitoring Narrative (Psuty, et al., 2009). Each survey records the position of the shoreline at that time and subsequent surveys compare the changing position through time and space. The resulting data set is a measure of change for specific portions of the island as well as larger groupings of units of the barrier island.

For Fire Island, the area of special interest consists of the holdings of the 17 communities that share presence on the island, as well as the other park jurisdictions (Robert Moses State Park and Smith Point County Park) (Fig. 1). Particular portions of these areas may be designated for special attention at a later time.

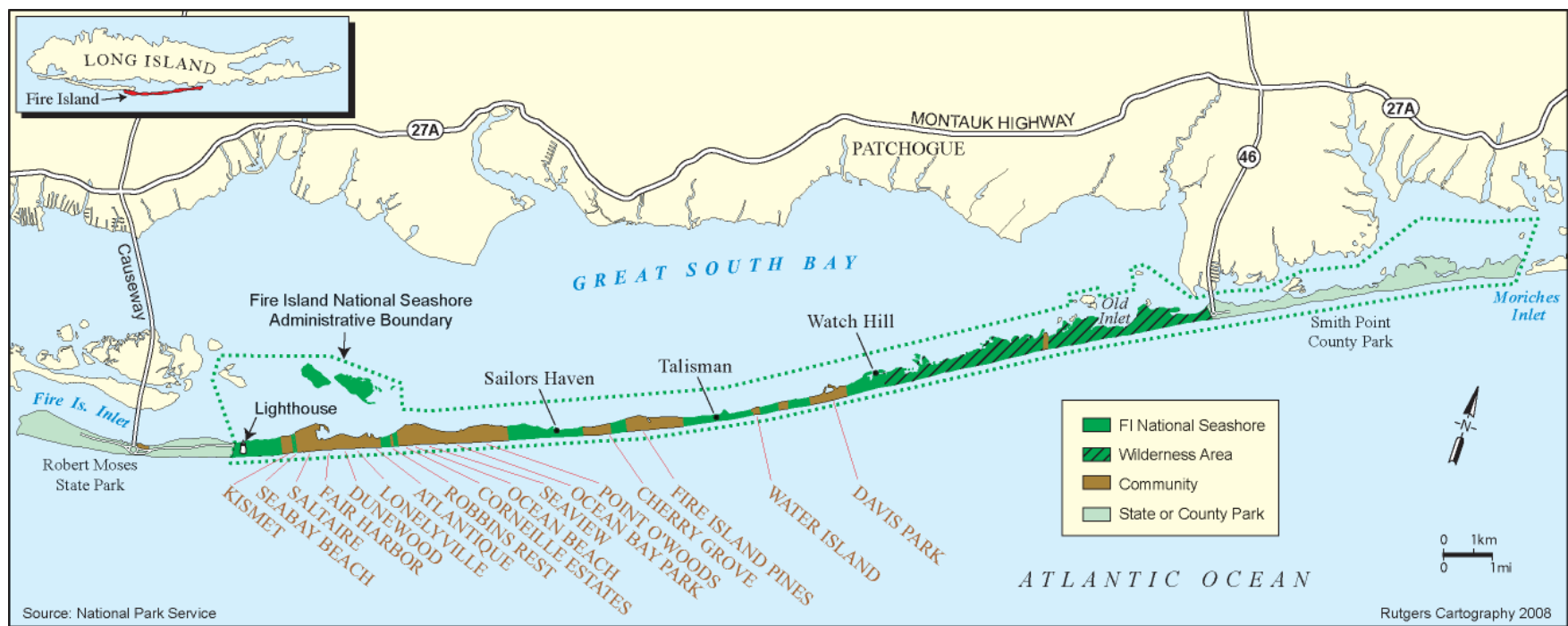


Figure 1. Fire Island, the communities, and the administrative units present on the barrier island.

Timing of Shoreline Position Surveys

Three surveys of the neap-tide, high-tide swash-line are included in this annual report (Table 1). They represent the positions monitored from the Spring of 2007 to the Spring of 2008. The three surveys were run during the predicted neap-tide period and had similar water level elevations.

There is no ocean tide gauge located on Fire Island. There are secondary gauges in Great South Bay and at the inland margins of the two inlets. However, they are in locations of restricted tidal amplitude compared to the ocean tidal range and thus are not good indicators of the water position on the ocean beach, nor the timing of high water at the beach. The nearest gauge that portrays the ocean condition is at the northern end of Sandy Hook, NOAA National Ocean Data Center, Station 8531680 (NOAA, 2009). This gauge is used to reference water level positions and the timing of the water levels in this report. Sandy Hook is also the gauge used to predict water level variation for the general Fire Island area by the NOAA National Ocean Data Center.

Table 1. Date of shoreline survey and elevation of previous high tide.

Season	Date of Survey	Previous High Tide	
		Height* (m)	Time
Spring 2007	14 March 2007	1.350	02:42 AM
Fall 2007	17 March 2007	1.481	11:06 AM
Spring 2008	17 March 2008	1.527	04:06 AM

*Tide heights relative to Mean Lower Low Water, Sandy Hook

Natural and Cultural Events Affecting Shoreline Position

Natural Events

Storms are important elements of the environment that affect shoreline position by mobilizing and transporting beach and dune sediment. The existing protocol for shoreline monitoring is directed at identifying the seasonal, annual, and longer sediment balances at the ocean shoreline by recording changing positions of the water-land contact. Individual storms create short-term variations in the beach position and can be accommodated by judicious planning of survey dates to avoid periods of short-term storm erosion and recovery, and to emphasize neap-tide swash positions independent of specific storms.

Storms are a condition at the ocean beach. They are important drivers of coastal change. However, the absence of an ocean tide gauge at or near Fire Island causes this report to consider other means to identify the temporal distribution and the magnitude of storm events shaping beach position. Whereas the Sandy Hook tide gauge was a good resource for the determination of neap tide occurrence and elevation, it lacked the exposure to respond to the full range of ambient wave directions and storm surges that approach and affect Fire Island. The Sandy Hook tide gauge does provide some insight into storm events from the eastern and southern sectors. However, it does not do justice to waves and surge from the southwest and west. In an effort to

identify the range of coastal storms that affect the Fire Island area, wave data from an offshore buoy have been reviewed to describe conditions of storminess and relative intensity and duration. These wave data are derived from the NOAA National Data Buoy Center and apply to Station 44025 (located about 45 km southeast of Moriches Inlet, NY (NOAA, 2009), supplemented by data from Station 44017 because of gaps in the Station 44025 record.

Wave data are often described by statistical values such as wave height, wave length, wave period, etc. A common wave descriptor is “significant wave height”, which is the mean of the highest one-third of the waves measured during some time interval. In the case of NOAA Station 44025, significant wave heights were determined for successive 20 minute intervals and plotted to describe the sequence of wave conditions during January 2007 through March 2008 (Fig. 2). Periods of large significant wave heights were associated with storm events and the wave data were screened to establish threshold conditions. It was determined that a minimum significant wave height of 3 m would be used to identify the number and the duration of the storm events.

Using this method, 33 storms have been identified as occurring between the beginning of January 2007 and the end of March 2008 (Table 2). Further, durations of the storm events were established by noting consecutive dates with greater than 3 m significant wave height for the 20 minute periods, describing storms of 1-3 days in duration (Table 2). In addition to wave height, the NOAA offshore buoy also records wave direction, in azimuth degrees, from which the waves are arriving (Table 2) (Station 44017 does not record wave direction and thus that variable is absent from Figure 4 if a storm occurred during one of the data gaps).

The combination of data in Figures 2 and Table 2 portrays the winter, spring, and fall seasons as the times of most numerous and most severe storm events, with the December 16-17 storm having a significant wave height of 5.84 m (only slightly greater than the April 15-17 storm significant wave height of 5.46 m that occurred shortly after the Spring 2007 shoreline survey). The late spring and summer period are times of lower waves and presumably lower rates of sediment transport and loss.

Because the shoreline position surveys are scheduled at six-month intervals, they are not meant to represent the outcomes of specific storms, but instead they should provide insight into the comparison of times of high energy levels and considerable sediment transport relative to those times of lower energy levels and more opportunity for sediment retention. Yet, the results may not be so simple. There are other variables at work that affect the outcomes, such as the local sites of sediment accumulation and loss associated with the structures at the inlets and along the shoreline; human manipulation of sediment; inshore circulation cells that add the dimensions of current patterns to the sediment mobility equation, alongshore transfers of pulses of sediment, etc.

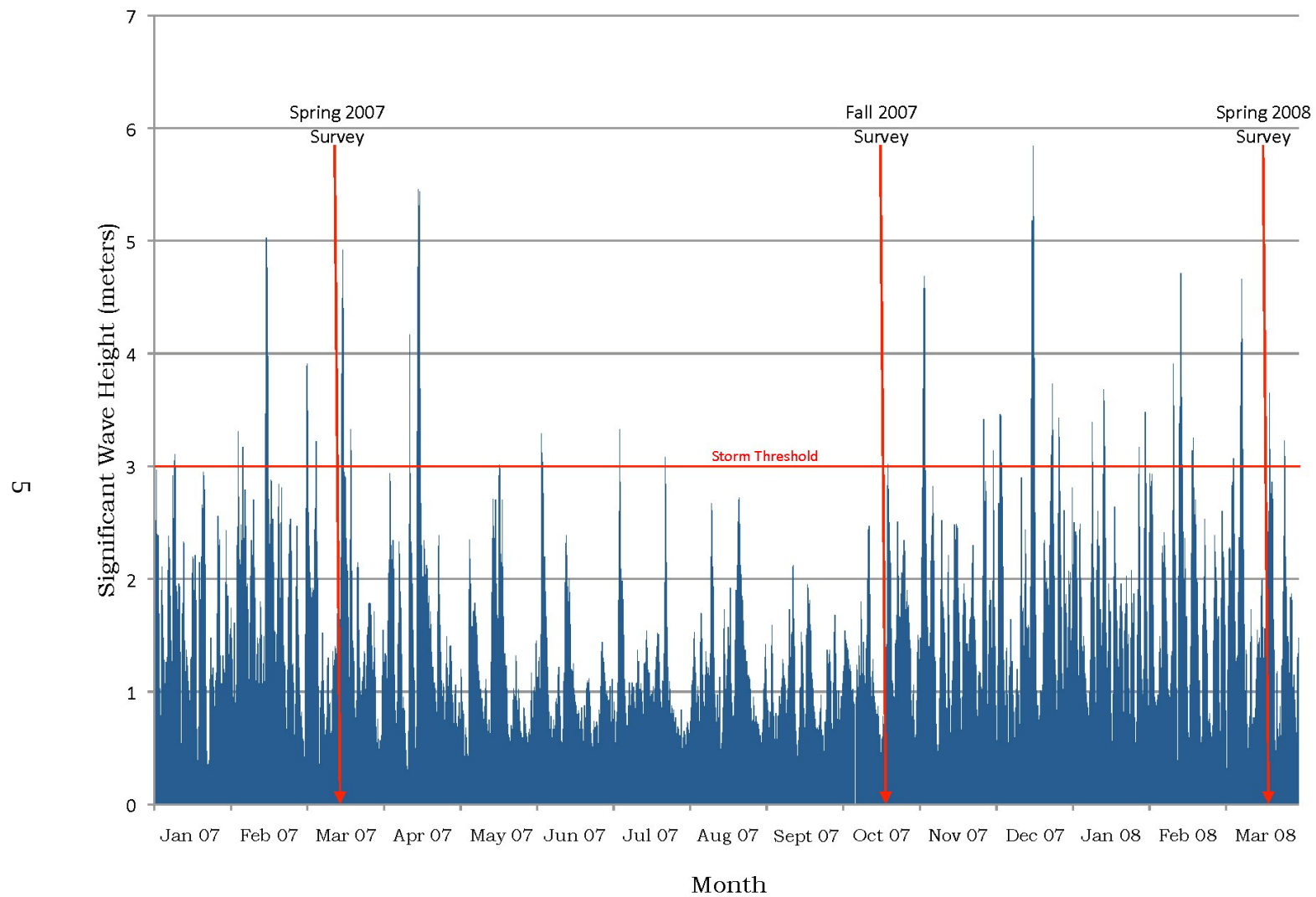


Figure 2. Distribution of significant wave heights from January 2007 through March 2008; establishment of storm threshold and storm events; and timing of shoreline surveys (source: NOAA Ocean Data Center, Buoys 44025 and 44017).

Table 2. Storm events - January 2007 through March 2008 (NOAA, 2009).

Period	Maximum Significant Wave Height (m)	Average Wave Direction (Quadrant)	Duration (Hours)	Number of High Tides
8-9 Jan 2007	3.11	W/NW	3	1
3 Feb 2007	3.31	W	3	0
5 Feb 2007	3.17	NW	2	0
14-15 Feb 2007	5.03	SE	24	2
2-3 Mar 2007	3.91	S	13	1
6 Mar 2007	3.22	NW	1	0
16-17 Mar 2007	4.92	E	19	1
19-20 Mar 2007	3.33	S	4	0
12 Apr 2007	4.17	SE	5	1
15-16 Apr 2007	5.46	SE	32	3
18 May 2007	3.01	E	1	0
4 Jun 2007	3.29	S	4	0
5 Jul 2007	3.33	SW	1	0
23 Jul 2007	3.08	E	2	0
20 Oct 2007	3.02	-unreported-	1	0
3 Nov 2007	4.69	-unreported-	22	2
27 Nov 2007	3.42	-unreported-	2	0
1 Dec 2007	3.14	-unreported-	1	0
3-4 Dec 2007	3.46	-unreported-	14	1
16-17 Dec 2007	5.84	-unreported-	32	3
24 Dec 2007	3.73	-unreported-	10	0
27 Dec 2007	3.43	-unreported-	6	0
9 Jan 2008	3.39	-unreported-	4	0
13-14 Jan 2008	3.68	-unreported-	14	2
28 Jan 2008	3.17	E	2	0
30 Jan 2008	3.48	S	9	1
10-11 Feb 2008	3.91	W	8	1
13-14 Feb 2008	4.71	S	23	1
18 Feb 2008	3.25	SE	5	0
5 Mar 2008	3.07	S	2	0
8-9 Mar 2008	4.66	S	21	2
20 Mar 2008	3.65	S	7	1
26 Mar 2008	3.23	S	4	0

Cultural Events

The period in this report included the emplacement of 21,000 m³ of sediment to the foredune area amongst the houses in Davis Park (during March and April, 2008). The sediment was quarried from outside of the barrier island and thus introduced new sediment to the general sediment supply. However, the sand was placed high on the profile and very late in the survey period. It is unlikely to have caused shoreline displacement. There is no record of beach nourishment in any other portion of Fire Island during the survey period.

Areas of Special Interest

The basic dichotomy of Fire Island is the separation of public land holding from private lands. There are three park entities, Federal, State, and County, on the island as well as seventeen private communities (the basic divisions are depicted on Fig. 1, and each of the individual communities are on Figs. 4–11). Each of the agencies and communities is interested in the conditions that describe its shorefront and the changes that are recorded. Therefore, this report will incorporate the outcomes of shoreline change by landholding and by community as well as the general condition of the barrier island. The intent is to document the changes that occur along the island and to track the dimensions and directions of this change. The consideration of reporting by landholding and community is a means to provide a comparative and geographical perspective to the measures of change.

Changes to the Protocol

No changes to the protocols of data collection were made during the surveys incorporated in this report.

Shoreline Position Data Sets

Following application of the protocol, each surveyed shoreline is registered to a common base and distances are measured from an offshore baseline at 10 m intervals along the baseline (see SOP # 7, Psuty, et al, 2009) Fig. 3, Table 3). The product of the first part of this procedure is a plot of the shoreline positions, the offshore baseline, and transects (Fig. 3). The second part of the procedure is a measure of the distances along the transects to each surveyed shoreline (Table 3). The complete table of measurements of distances from the baseline to the surveyed shoreline, spaced at 10 m intervals, is available on request (see Appendix A).

The change in shoreline position is derived from a comparison of surveyed lines and is conveyed as a measure of differences between distances for each transect location. Although the intent of the survey is to document the change in shoreline position produced by gains or losses in sediment, the shoreline position is also affected by other variables and thus there is a measure of uncertainty, or error, associated with the collected line position. There are four contributors to the uncertainty. Their character and dimension are: 1) the recording instrument is a GPS unit with sub-meter accuracy, its variation is about 0.5 m; there is variation in the wave runup to create the neap high-tide swash line, it is about 3 m; there is some variation in the elevation of the high tide water level on the beach face, it is about 1 m; and there is some small variation in the operator's tracking of the swash line on the beach face. Together, these contributors create an uncertainty in position of ± 5 m. Therefore, any surveyed shoreline has an intrinsic uncertainty of ± 5 m and any comparison between two survey lines, as an example, would have an uncertainty of ± 7 m.

The shoreline position measurements are reported as columns in the spreadsheet (see Appendix A), both as seasonal changes between successive surveys and between surveys at annual

intervals. In addition, the same data sets (differences between surveys) are portrayed spatially in a series of panels (Figs. 4-11). This figure is composed of 8 pages with three panels per page. Each page is a portion of Fire Island, and each page incorporates three panels that depict the seasonal changes from Spring 2007 to Fall 2007, Fall 2007 to Spring 2008, and annual change from Spring 2007 to Spring 2008. The panels include the traces of the surveyed shorelines, a plot of the measured differences between pairs of shorelines, and a depiction of the value of the mean change (solid black line) and an accompanying one standard deviation (dashed black line) for each comparison. Together, these panels incorporate the essential information on the measures and distributions of change through one year, the basis of this annual report.

A running bar graph depicts the relative difference in shoreline position between surveys on each of the panels. Differences of less than 10 m of seaward or inlandward displacement (+ 10 m to - 10 m) are shown as gray, whereas seaward displacement (accretion) greater than 10 m is shown as shades of blue and inland displacement (erosion) in shades of red. The value of each transect, spaced 10 m apart, is represented on Figs. 4-11. The tabular data of seasonal and annual differences are reported (see Appendix A). A composite figure of the totality of Fire Island depicts the seasonal changes as well as the annual change (Fig. 12).

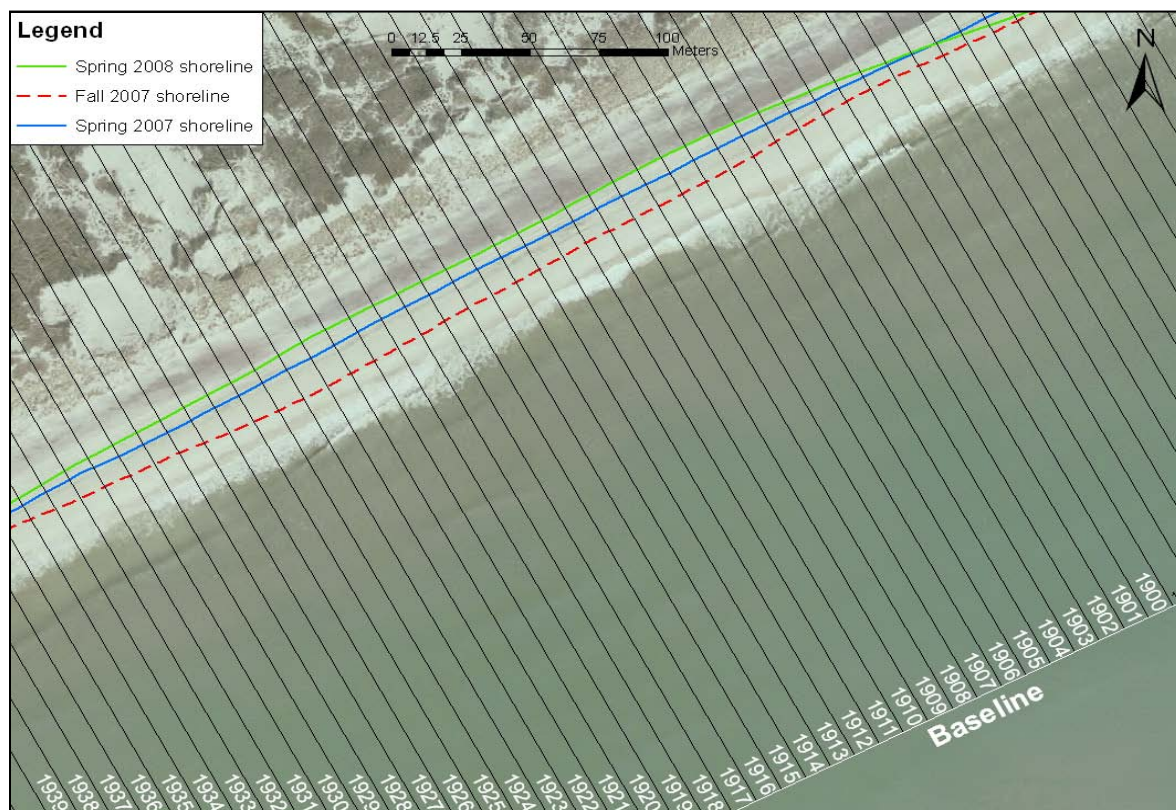


Figure 3. A sampling of surveyed shorelines intersecting with transects, and producing measures of distances from the baseline along each transect.

Table 3. A sampling of a table of measured distances from the baseline for each transect on each survey, and comparative displacements of the shoreline between surveys.

Transect Numbers	Spring 2007	Fall 2007	Spring 2008	Changes (m) (± 10 m)		
				Spring 2007 - Fall 2007	Fall 2007 - Spring 2008	Spring 2007 - Spring 2008
1900	241.78	235.92	244.99	5.86	-9.07	-3.22
1901	241.61	234.94	245.69	6.67	-10.75	-4.08
1902	241.39	234.07	246.34	7.32	-12.27	-4.95
1903	241.21	233.11	246.83	8.11	-13.72	-5.62
1904	241.03	231.96	247.05	9.07	-15.09	-6.02
1905	240.89	231.16	247.10	9.73	-15.94	-6.21
1906	240.43	230.50	247.12	9.94	-16.63	-6.69
1907	240.05	230.22	247.04	9.83	-16.82	-6.99
1908	239.78	229.77	246.78	10.01	-17.01	-7.00
1909	239.74	229.42	246.36	10.32	-16.93	-6.61
1910	239.32	229.10	245.76	10.22	-16.66	-6.44

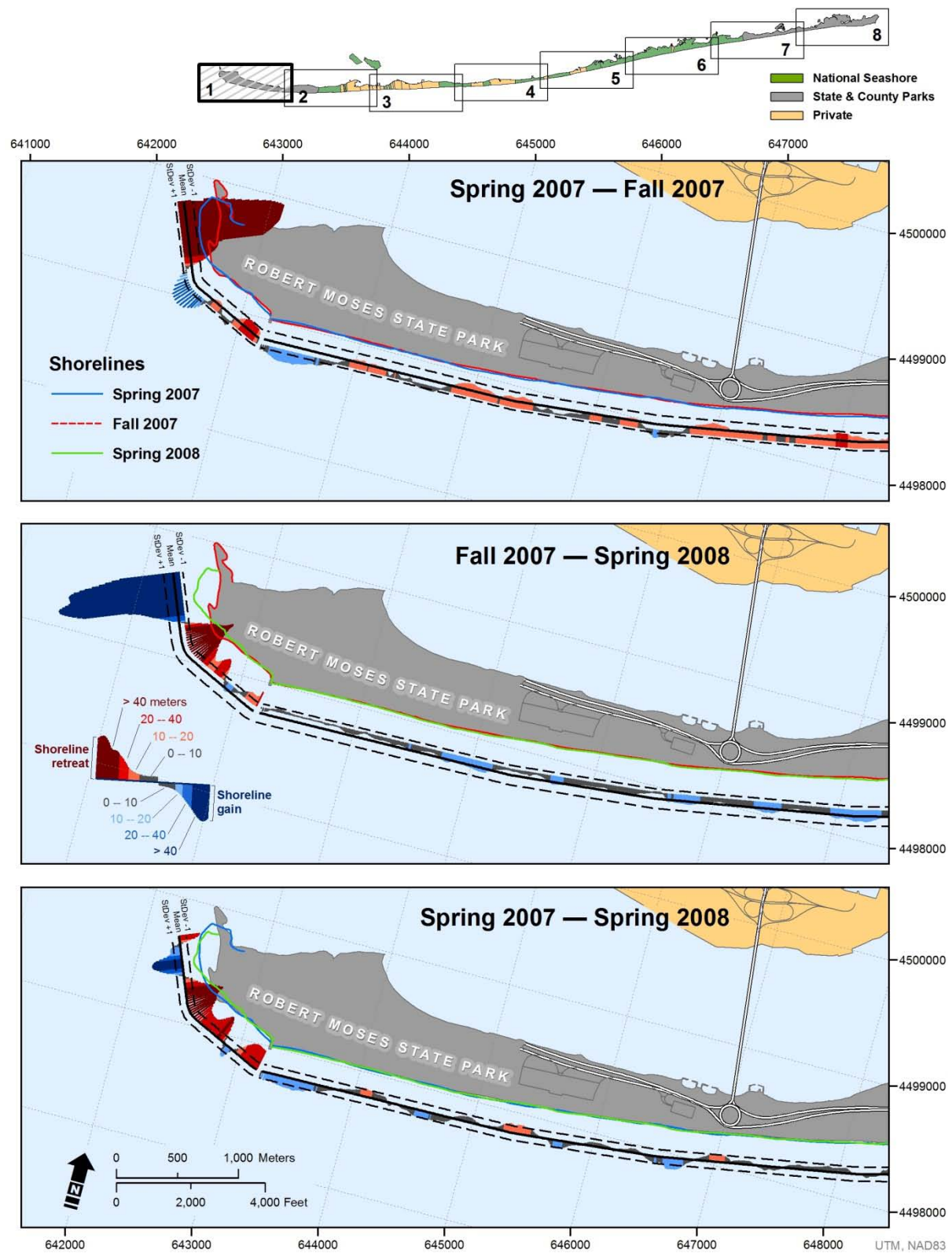


Figure 4. Distribution of seasonal and annual shoreline change values, Compartment 1, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

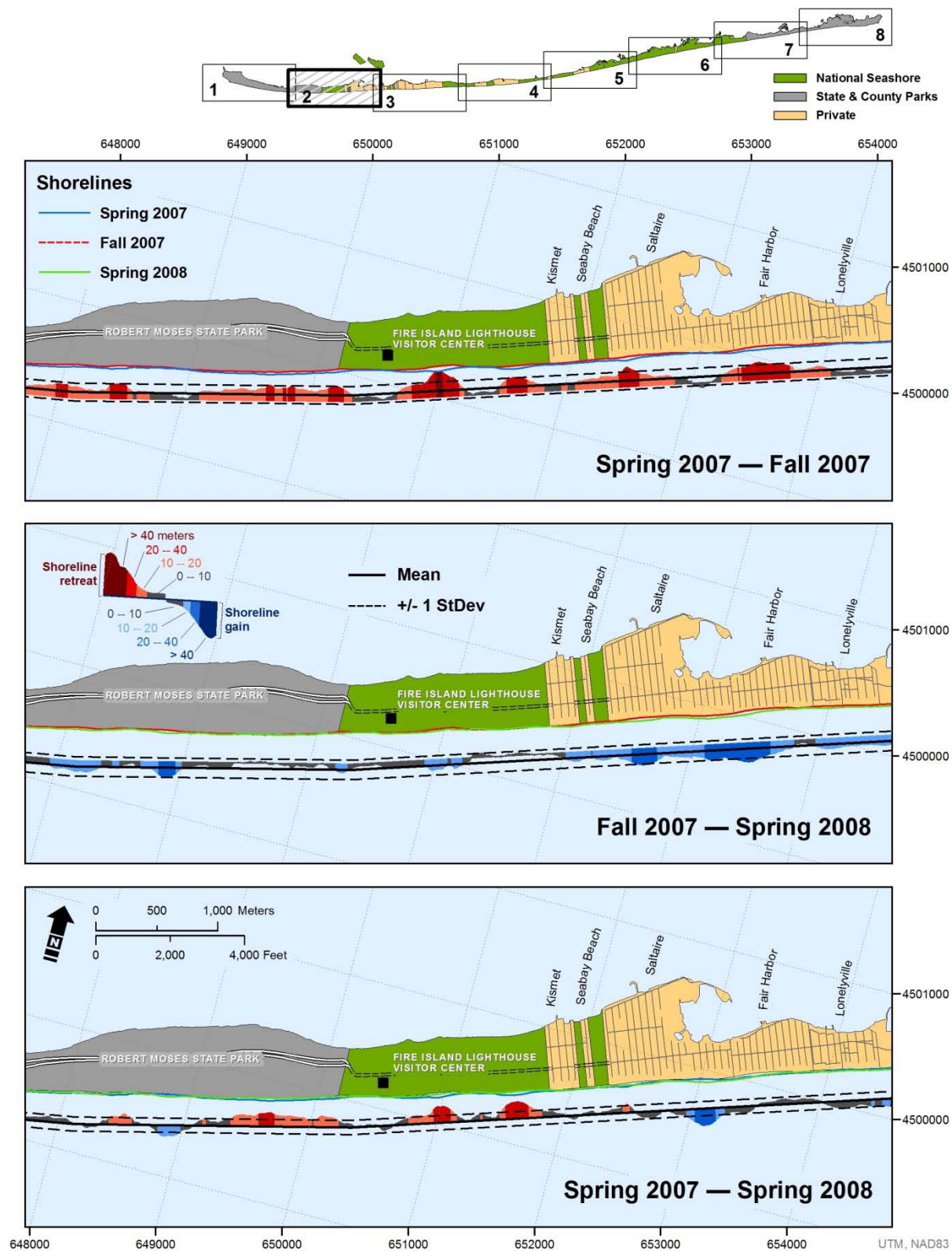


Figure 5. Distribution of seasonal and annual shoreline change values, Compartment 2, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

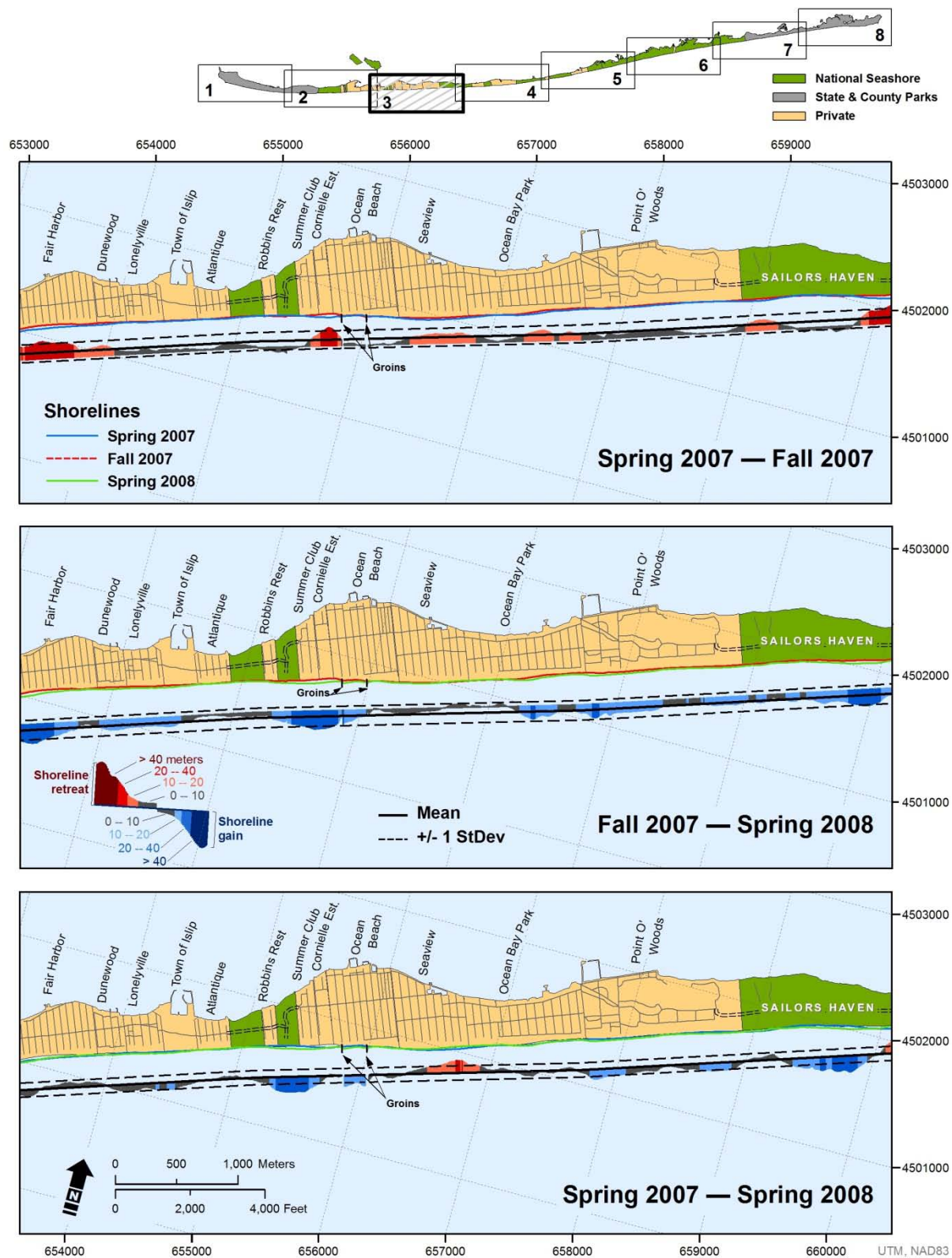


Figure 6. Distribution of seasonal and annual shoreline change values, Compartment 3, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

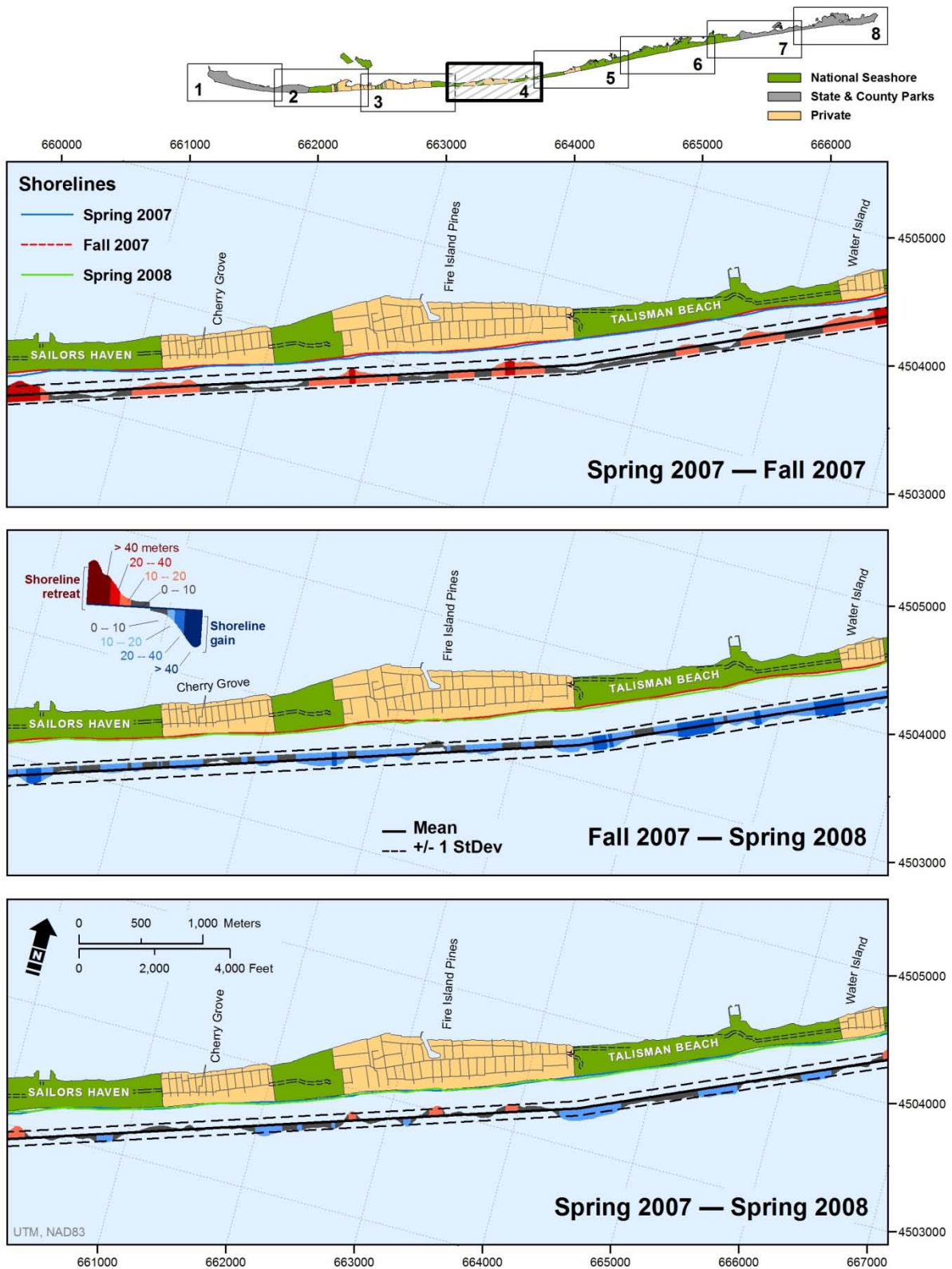


Figure 7. Distribution of seasonal and annual shoreline change values, Compartment 4, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

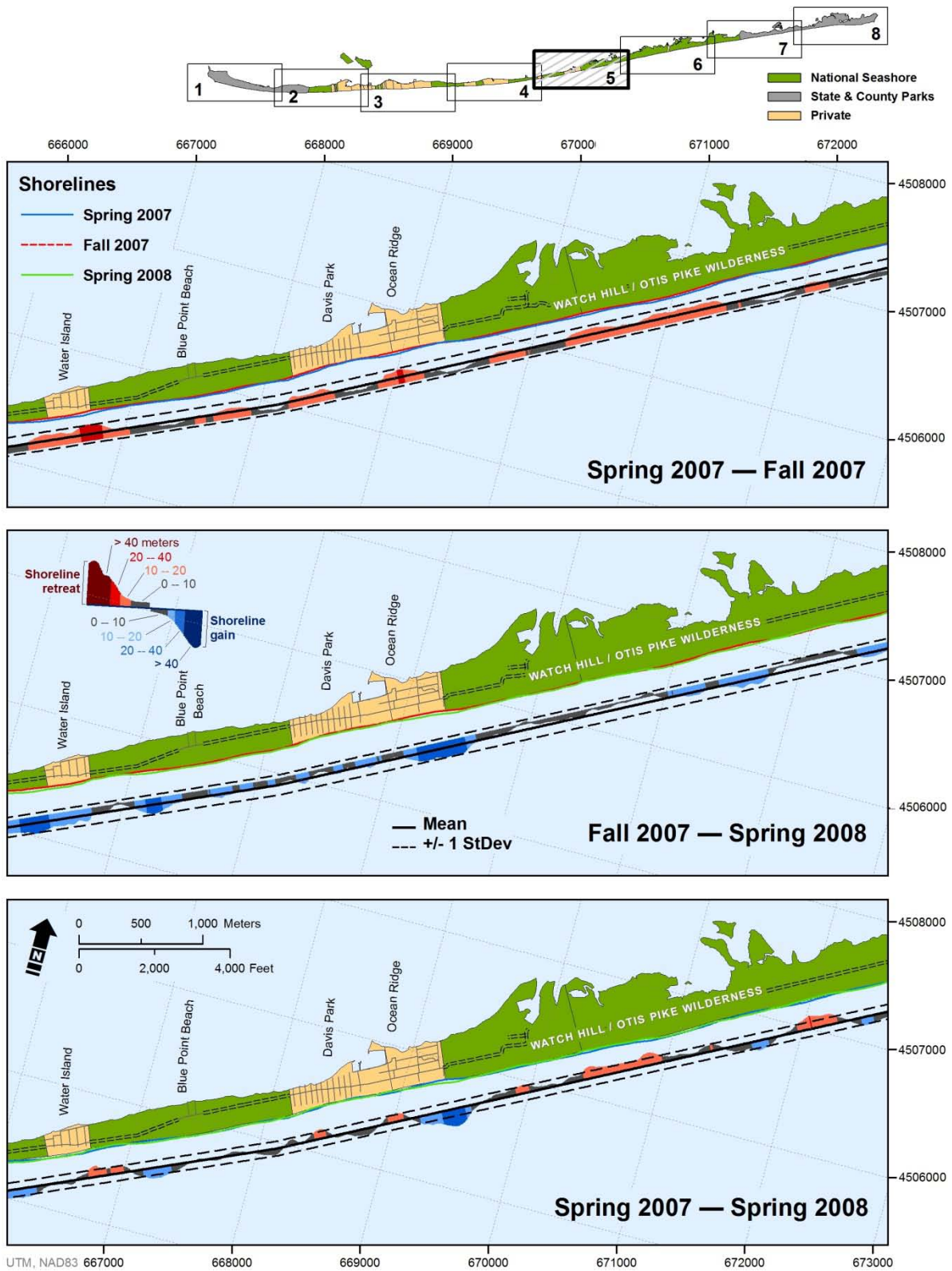


Figure 8. Distribution of seasonal and annual shoreline change values, Compartment 5, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

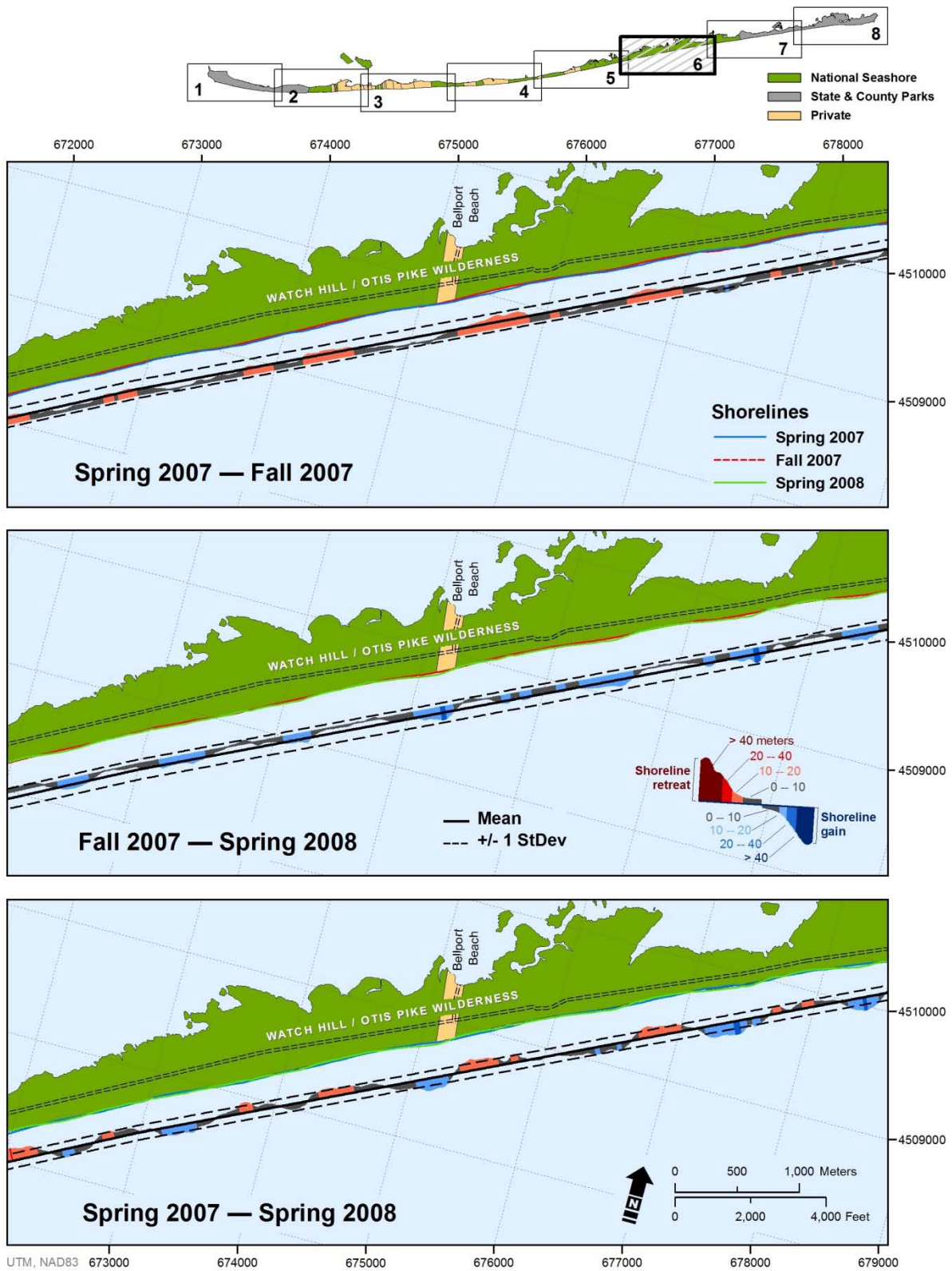


Figure 9. Distribution of seasonal and annual shoreline change values, Compartment 6, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

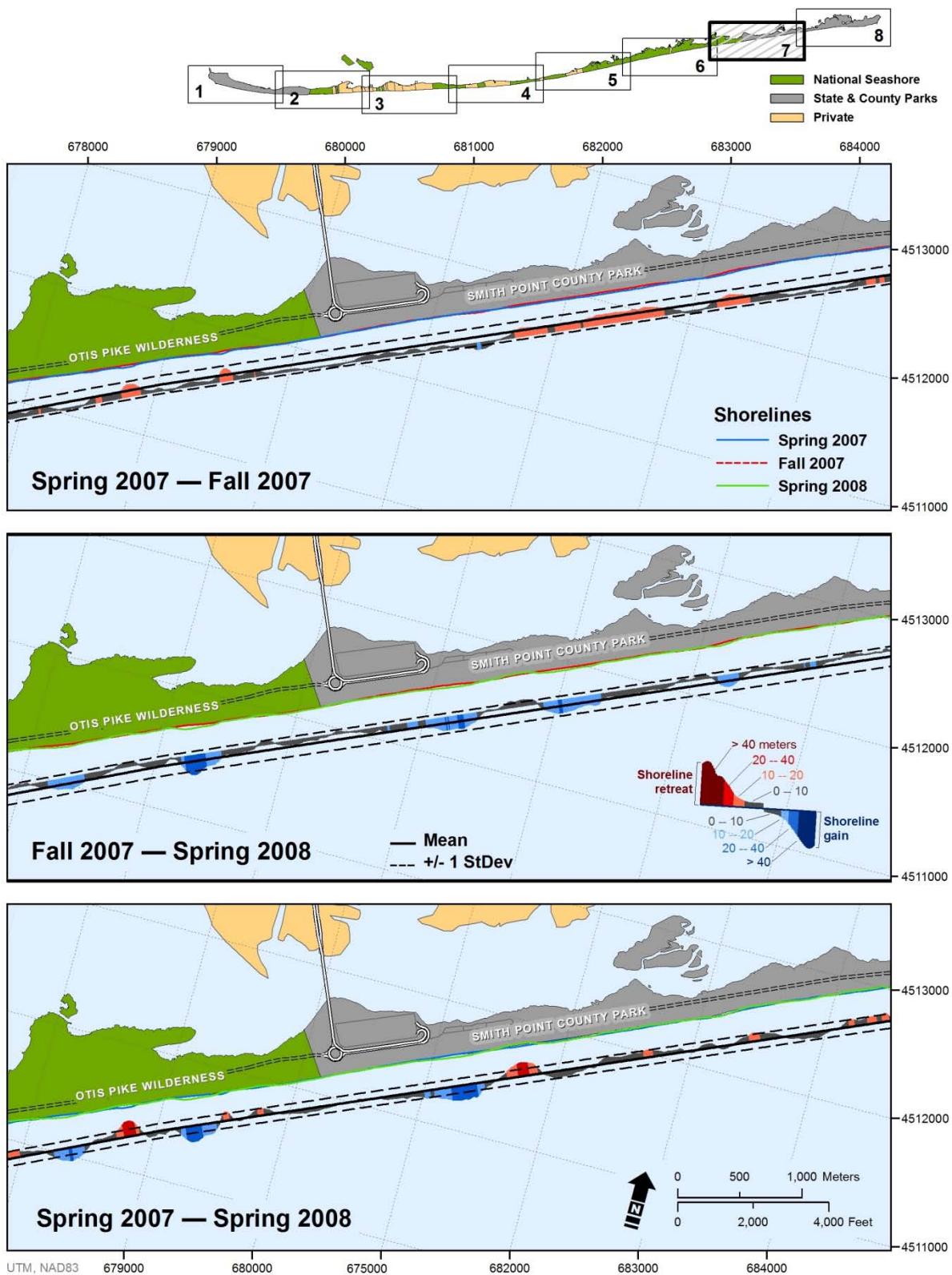


Figure 10. Distribution of seasonal and annual shoreline change values, Compartment 7, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

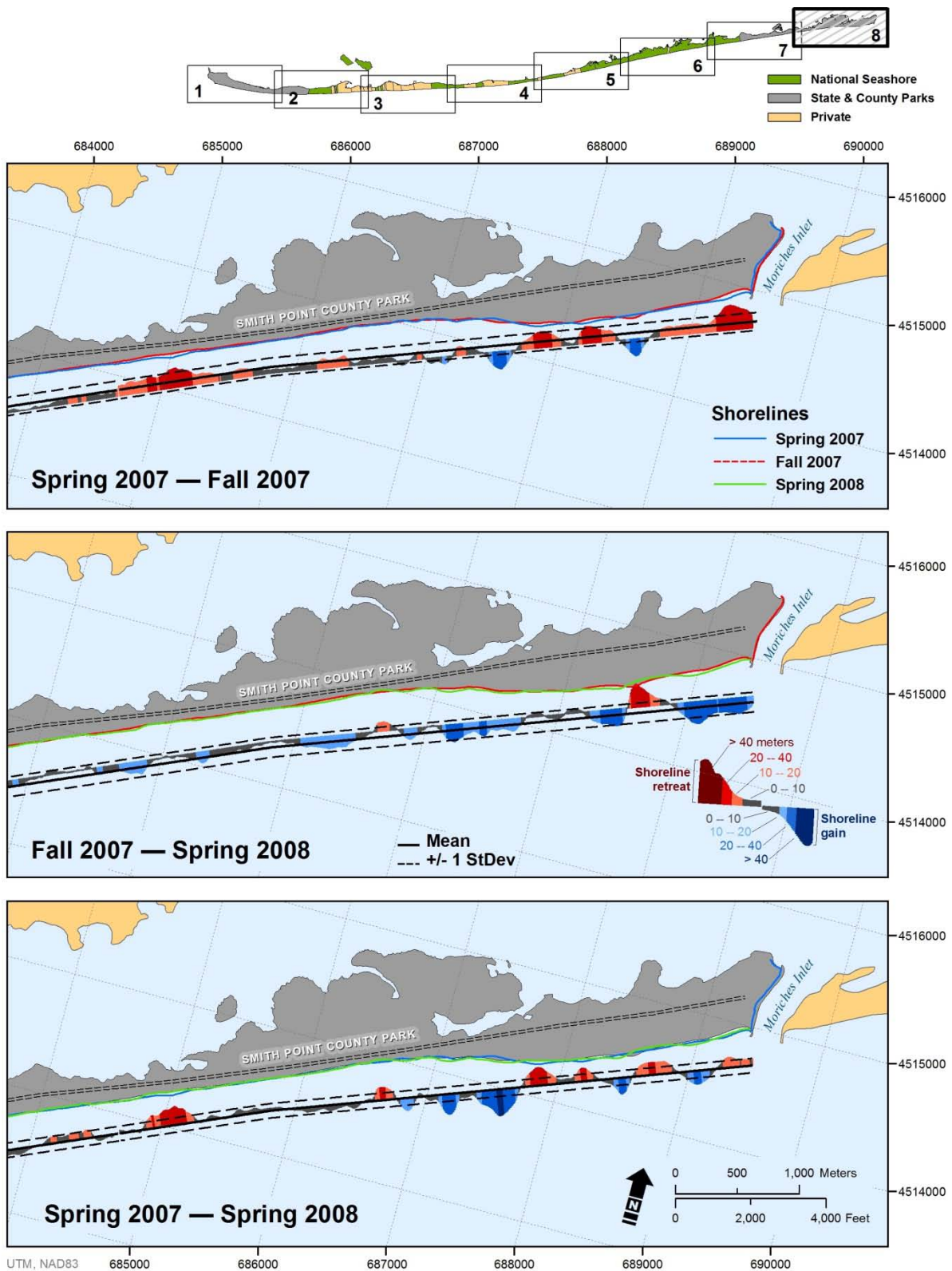


Figure 11. Distribution of seasonal and annual shoreline change values, Compartment 8, Fire Island; portrayal of magnitudes of change, mean changes, and standard deviations per temporal unit.

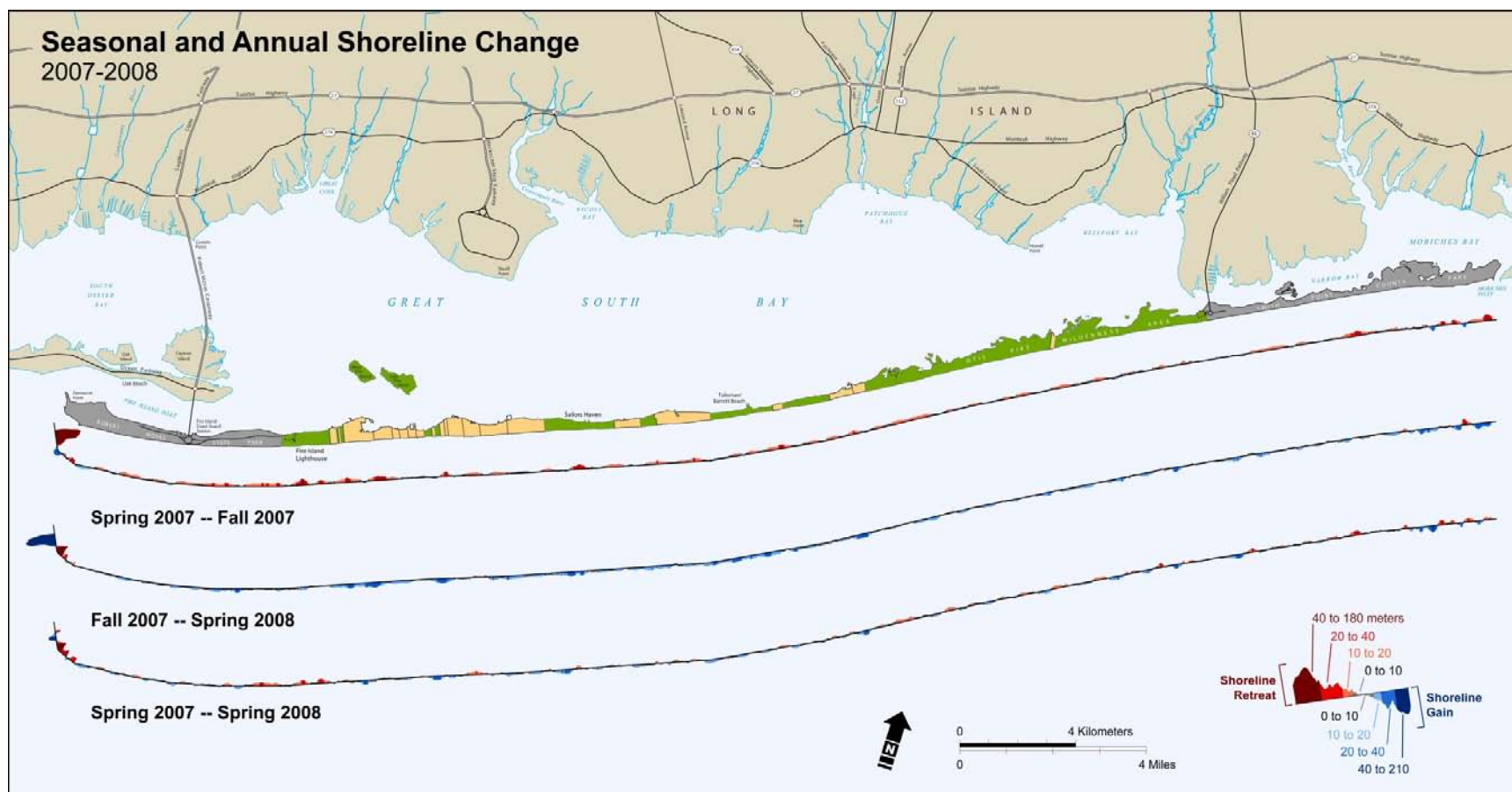


Figure 12. Alongshore distribution of changes, Spring 2007-Spring 2008.

Summary Statistics and Tables of Change

The totality of the difference measurements is also subjected to statistical analysis to determine the mean and standard deviation values for the seasonal and annual comparisons. These outcomes are represented on a summary map portraying the spatial distribution of the displacements (Fig. 12), as histograms of the frequency of changes for the entire island (Figs. 13-15), and in summary tables for areas of interest (Tables 4-7).

A general perspective of the seasonal and annual change is presented in Fig. 14. It consists of three bar charts that depict the shoreline displacements in a geographical array. In addition, the differences in shoreline position are plotted in a histogram format to portray the range of the values of change (Figs. 13-15). In the instances of the seasonal comparisons as well as the annual change, there is a near normal distribution that depicts a marked central tendency in the assembled measurements and a general decline of frequency of change away from the mean values. The Spring 2007-Fall 2007 histogram is a bit different because it has a few measurements that are very large negative changes downdrift of the Fire Island Inlet jetty (Democrat Point). However, the remainder of the island is tightly grouped around a central tendency. The Fall 2007–Spring 2008 data distribution are somewhat the opposite extremes with a large accumulation at Democrat Point. The data are grouped in bins of 5 m; that is, each of the bars in the histograms incorporate a range of 5 m. Each histogram (Figs. 13-15) incorporates a visual portrayal of the mean value, one $\pm$ standard deviation, and the minimum and maximum values for the survey period. The Spring 2007–Fall 2007 changes span the summer period and have the largest negative mean value (-9.78 m), whereas the Fall 2007-Spring 2008 changes have a positive mean value (9.51 m). Over the annual period, the mean displacement is -0.18 m. Each of the seasonal changes as well as the annual change has similar and small standard deviations, ranging from 11.65 to 15.95. In each of the comparisons, the largest displacements tend to be associated with the structures at the inlets and their downdrift influences.

Areas of Interest

The variety of jurisdictions and land holding on Fire Island raise interest in the rates and magnitudes of displacement along the barrier island. An initial separation of the island into Federal, State, and County holdings, plus the areas occupied by the communities reveals the similarity of shoreline displacement (Tables 4-5), except for locations near the jettied inlets. In Tables 4 and 5, the subdivisions at the inlet are arranged from west to east. Thus, the shoreline length downdrift of the jetty at Fire Island Inlet extends 1490 m, the shoreline updrift of the jetty that is affected by the structure extends for 2560 m, and the alongshore distance in Robert Moses State Park not influenced by the jetty extends for 4580 m before reaching the border of Fire Island National Seashore. Likewise, the portion of Smith Point County Park having a positive influence extends downdrift for 2660 m, the negative influence extends alongshore for 2300 m, and the portion uninfluenced by the jetty extends for 5190 m to the border with the Fire Island National Seashore. Within the zone of jetty influence, there is considerable local variation, and there is both greater positive displacement (+202 m) and greater negative displacement (-80 m) than any other place on the barrier island. By contrast, for this short time period, each of the jurisdictions records a modest positive annual displacement that varies from 7.1 to 12.3 m.

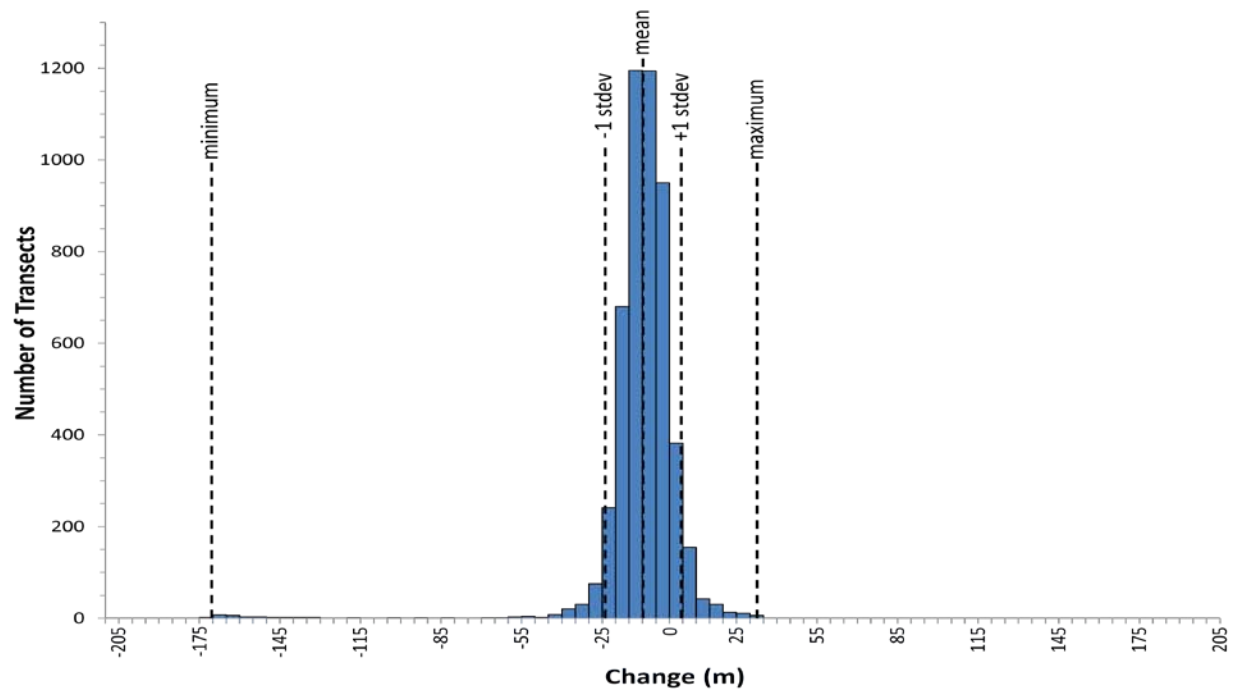


Figure 13. Distribution of difference measurements for the seasonal shoreline change between Spring 2007 and Fall 2007, incorporating the mean change value, standard deviation, maximum and minimum.

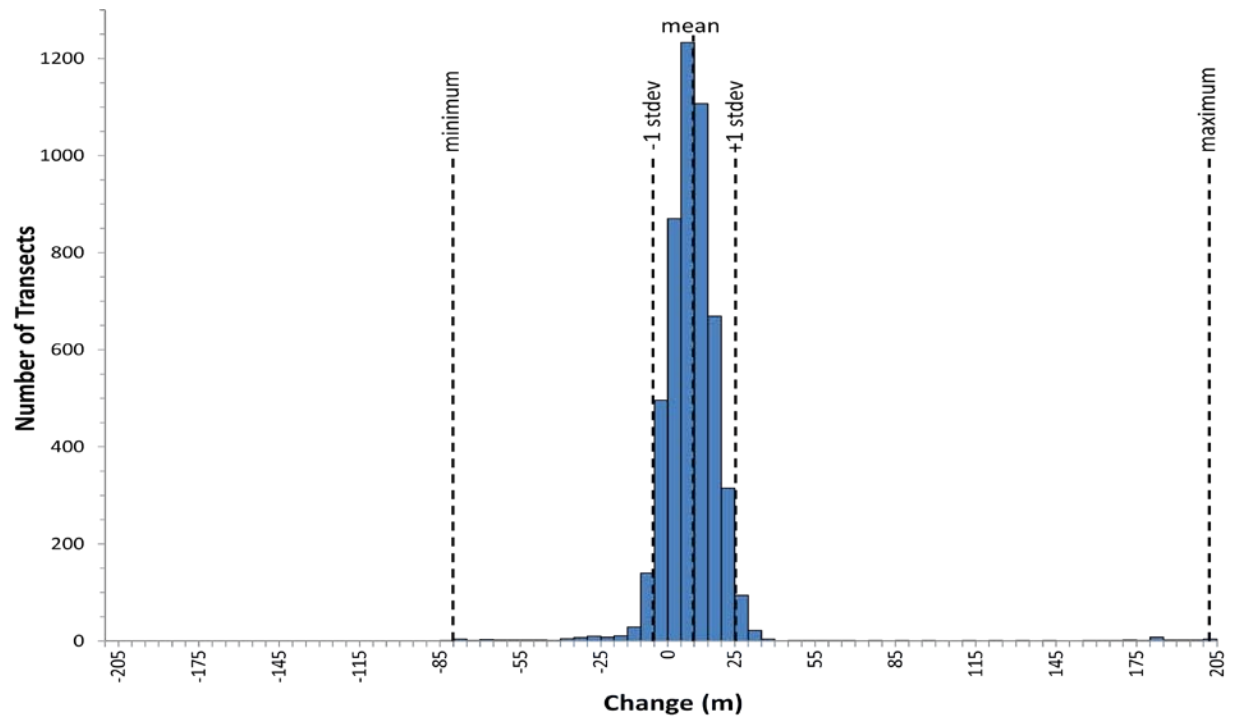


Figure 14. Distribution of difference measurements for the seasonal shoreline change between Fall 2007 and Spring 2008, incorporating the mean change value, standard deviation, maximum and minimum.

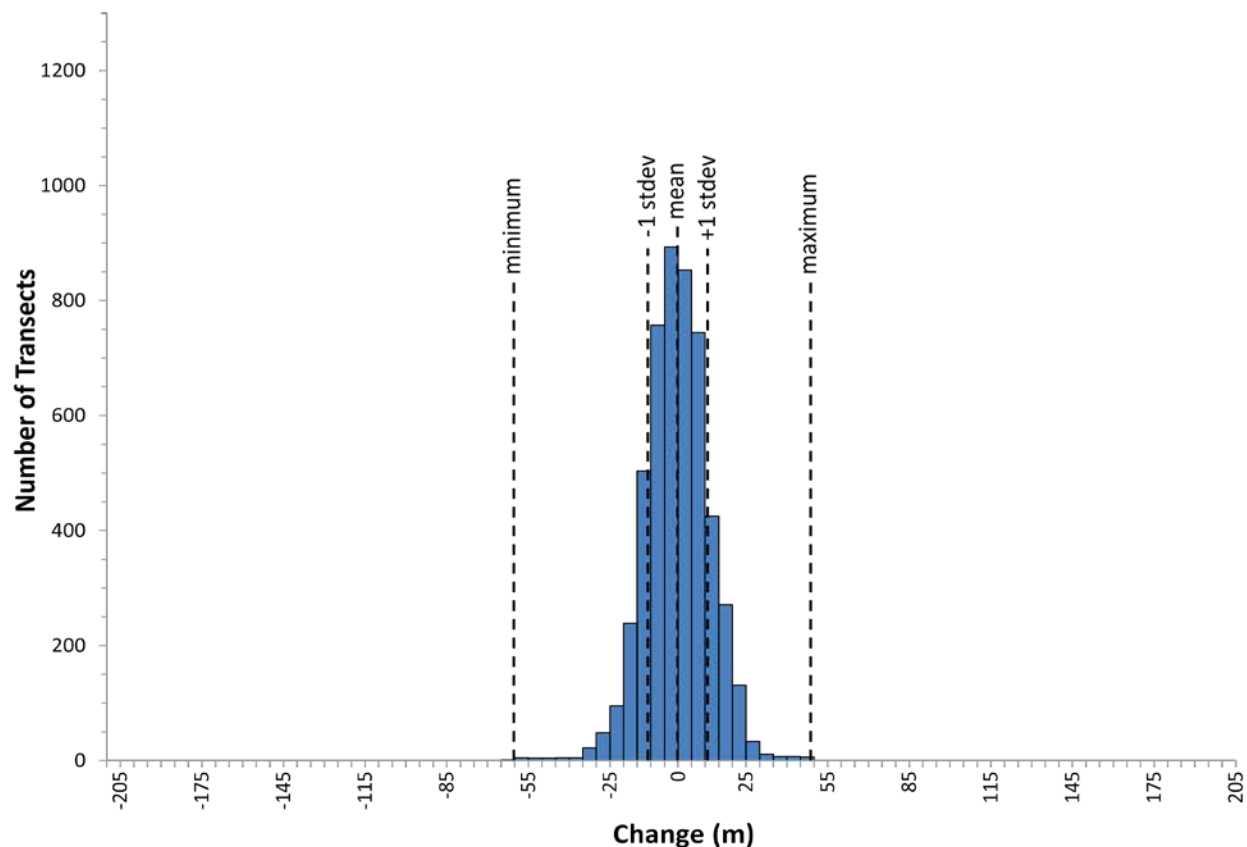


Figure 15. Distribution of difference measurements for the annual shoreline change between Spring 2007 and Spring 2008, incorporating the mean change value, standard deviation, maximum and minimum.

Further division of the developed area into its community compartments interspersed with public land offers another view of the comparison of rates and magnitudes of change on more local scales (Tables 6-7). Although there is a general consistency of change in adjacent communities, there are several trends present seasonally as well as on the annual scale. It is impossible to extend the information beyond this one year, but there are observations related to the great range of shore position change as noted by the large standard deviations relative to the mean values (near the inlets), and the areas of very low standard deviations (less than 1.0 m in three NPS parcels and in one community). The history of shoreline change on Fire Island incorporates substantial alongshore variation (Allen, et al., 2002) and this data set maintains that variation. However, this is one year and it is not prudent to ascribe longer-term changes based on this limited data set.

Table 4. Descriptive statistics of seasonal shoreline change of entire Fire Island and its major components, Spring 2007 - Fall 2007 and Fall 2007 - Spring 2008 (negative values in red).

Spatial Component	Length (m)	Spring 2007 – Fall 2007 (m)				Fall 2007 – Spring 2008 (m)			
		Mean	Stdev	Max	Min	Mean	Stdev	Max	Min
NPS land	20050	-8.55	7.45	10.63	-41.85	11.02	2.31	30.54	-7.14
Robert Moses State Park	8630	-14.87	30.13	33.28	-171.13	10.36	34.47	202.10	-80.52
<i>Area downdrift of jetty</i>	1490	-48.44	65.17	33.28	-171.13	32.34	87.33	202.10	-80.52
<i>Area updrift and influenced by jetty</i>	2560	-3.31	11.00	18.24	-19.87	4.77	4.81	15.08	-3.97
<i>Updrift, not influenced by jetty</i>	4580	-12.14	7.29	12.05	-24.37	7.76	5.40	25.20	-2.50
Smith Point County Park	10150	-7.94	10.25	27.56	-39.56	7.10	10.50	35.49	-36.90
<i>Area of negative inlet influence</i>	2300	-8.93	8.54	10.90	-30.93	6.52	7.70	19.78	-14.28
<i>Area of positive inlet influence</i>	2660	-9.52	15.87	27.56	-39.56	10.31	15.81	35.49	-36.90
<i>Downdrift, not influenced by inlet</i>	5190	-6.74	6.76	10.39	-22.15	5.81	7.72	21.17	-9.35
All developed areas	12380	-9.80	7.09	7.98	-31.56	12.25	7.56	31.36	-9.22
<i>West of Ocean Beach groins</i>	3420	-11.40	9.14	7.98	-31.56	15.72	7.94	31.36	0.62
<i>East of Ocean Beach groins</i>	8960	-9.19	6.02	6.29	-25.29	10.93	6.97	25.62	-9.22
Total Ocean Shoreline	51210	-9.78	14.49	33.28	-171.13	9.51	15.95	202.10	-80.52

Table 5. Descriptive statistics of annual shoreline change of entire Fire Island and its major components, Spring 2007 – Spring 2008 (negative values in red).

Spatial Component	Length (m)	Spring 2007 – Spring 2008 (m)			
		Mean	Stdev	Max	Min
NPS land	20050	1.53	3.75	27.40	-27.85
Robert Moses State Park	8630	-4.00	14.58	48.95	-60.84
<i>Downdrift of jetty</i>	1490	-14.23	28.51	48.95	-60.84
<i>Updrift, influenced by jetty</i>	2560	1.46	9.12	17.70	-14.54
<i>Updrift, not influenced by jetty</i>	4580	-4.38	9.31	17.58	-22.71
Smith Point County Park	10150	-0.84	12.49	42.12	-30.07
<i>Area of negative inlet influence</i>	2300	-2.41	11.06	28.83	-30.07
<i>Area of positive inlet influence</i>	2660	0.79	18.12	42.12	-29.20
<i>Downdrift, not influenced by inlet</i>	5190	-0.93	9.29	23.18	-21.85
All developed areas	12380	2.45	8.91	27.06	-20.59
<i>West of Ocean Beach groins</i>	3420	4.32	8.96	27.06	-13.96
<i>East of Ocean Beach groins</i>	8960	1.74	8.79	26.04	-20.59
Total Ocean Shoreline	51210	-0.18	11.65	48.95	-60.84

Table 6. Descriptive statistics of seasonal shoreline change, by NPS land (shaded) and non-NPS land (unshaded), Spring 2007 – Fall 2007 and Fall 2007 – Spring 2008 (negative values in red). List reflects geographic progression along Fire Island from west to east (see Fig. 1).

Spatial Component	Length (m)	Spring 2007 - Fall 2007 (m)				Fall 2007 - Spring 2008 (m)			
		Mean	Stdev	Max	Min	Mean	Stdev	Max	Min
Robert Moses State Park	8630	-14.87	30.13	33.28	171.13	-4.04	14.59	48.95	-60.84
NPS - Lighthouse	1720	-14.98	10.91	-0.43	-41.85	-10.41	9.00	7.26	-27.85
Kismet	240	-10.30	1.30	-8.44	-13.44	-1.09	4.30	5.03	-8.94
NPS	60	-13.76	0.68	-12.64	-14.64	-2.93	1.08	-1.10	-4.26
Seabay Beach	60	-15.46	0.29	-14.97	-15.72	-4.80	0.98	-2.94	-5.59
NPS	120	-17.14	1.52	-14.56	-18.39	-3.04	1.21	-1.41	-4.85
Saltaire	1030	-12.18	9.66	7.49	-31.56	7.22	10.74	27.06	-13.96
Fair Harbor	660	-20.37	5.43	-10.85	-28.28	-2.48	6.03	9.49	-8.74
Dunewood	230	-10.49	4.32	-4.76	-16.17	4.36	4.77	9.41	-3.97
Lonelyville	310	-4.77	1.23	-2.52	-6.93	8.55	1.44	10.86	5.76
Town of Islip	270	-3.45	0.81	-1.59	-4.93	6.38	3.59	11.59	0.42
Atlantique	250	-3.65	2.77	-0.94	-8.72	-1.77	1.82	0.50	-4.55
NPS	300	-3.49	3.75	2.99	-8.67	1.59	4.25	8.15	-4.52
Robbins Rest	100	5.40	1.98	7.98	2.63	15.80	4.88	21.37	8.23
NPS	180	4.93	2.81	9.83	0.40	23.81	0.57	24.39	22.23
Summer Club	160	-9.37	7.15	0.41	-19.82	17.97	4.96	24.17	9.20
Cornielle Estates	110	-26.44	2.72	-21.36	-29.54	1.22	3.84	7.76	-2.84
Ocean Beach	530	-2.97	6.85	6.29	-25.29	6.69	6.71	17.71	-2.10
Seaview	570	-12.72	2.97	-4.07	-15.57	-11.01	6.64	2.17	-20.59
Ocean Bay Park	970	-9.20	4.55	-0.29	-17.02	-1.48	5.34	7.26	-13.47
Point O'Woods	1280	-4.72	3.33	1.70	-9.78	8.52	3.80	15.76	0.44
NPS - Sailors Haven	2410	-8.92	9.99	8.29	-31.58	4.29	10.59	26.15	-19.69
Cherry Grove	900	-7.22	6.48	2.40	-18.96	2.44	6.59	16.01	-7.26
NPS	560	-6.85	5.58	1.54	-14.29	8.23	2.10	11.98	-0.49
Fire Island Pines	1880	-11.03	5.54	-0.12	-22.44	-0.83	8.18	18.75	-15.57
NPS - Talisman	1780	-7.46	5.55	6.10	-18.61	8.74	5.52	18.90	-2.27
Water Island	770	-14.98	5.71	-6.56	-24.82	4.23	7.64	14.14	-16.08
NPS	140	-19.44	3.63	-13.15	-23.94	-12.58	2.86	-9.64	-17.49
Blue Point Beach	800	-7.83	2.76	-2.87	-12.00	3.61	8.72	15.77	-13.03
NPS	730	-9.53	4.85	-1.28	-16.43	0.17	4.56	8.22	-8.35
Davis Park	830	-10.78	5.34	-2.23	-19.79	-2.01	7.47	9.83	-14.31
Ocean Ridge	430	-10.18	7.11	2.93	-21.08	9.61	11.32	26.04	-12.07
NPS Watch Hill/Wilderness	12050	-7.82	5.93	10.63	-19.57	-1.06	10.54	27.40	-24.70
Smith Point County Park	10150	-7.94	10.25	27.56	-39.56	-0.8	12.48	42.12	-30.06

Table 7. Descriptive statistics of annual shoreline change, Descriptive statistics of annual shoreline change, by NPS land (shaded) and non-NPS land (unshaded), 2007 – Spring 2008 (negative values in red). List reflects geographic progression along Fire Island from west to east (see Fig. 1).

Spatial Component	Length (m)	Spring 2007 – Spring 2008 ($\pm 10m$)			
		Mean	Stdev	Max	Min
Robert Moses State Park	8630	-4.00	14.58	48.95	-60.84
NPS - Lighthouse	1720	-10.42	9.01	7.26	-27.85
Kismet	240	-1.09	4.30	5.03	-8.94
NPS	60	-2.93	1.08	-1.10	-4.26
Seabay Beach	60	-4.80	0.98	-2.94	-5.59
NPS	120	-3.04	1.21	-1.41	-4.85
Saltaire	1030	7.22	10.74	27.06	-13.96
Fair Harbor	660	-2.48	6.03	9.49	-8.74
Dunewood	230	4.36	4.77	9.41	-3.97
Lonelyville	310	8.55	1.44	10.86	5.76
Town of Islip	270	6.38	3.59	11.59	0.42
Atlantique	250	-1.77	1.82	0.50	-4.55
NPS	300	1.59	4.25	8.15	-4.52
Robbins Rest	100	15.80	4.88	21.37	8.23
NPS	180	23.81	0.57	24.39	22.23
Summer Club	160	17.97	4.96	24.17	9.20
Cornielle Estates	110	1.22	3.84	7.76	-2.84
Ocean Beach	530	6.19	6.55	17.15	-2.10
Seaview	570	-11.01	6.64	2.17	-20.59
Ocean Bay Park	970	-1.48	5.34	7.26	-13.47
Point O'Woods	1280	8.52	3.80	15.76	0.44
NPS - Sailors Haven	2410	4.29	10.59	26.15	-19.69
Cherry Grove	900	2.44	6.59	16.01	-7.26
NPS	560	8.23	2.10	11.98	-0.49
Fire Island Pines	1880	-0.83	8.18	18.75	-15.57
NPS - Talisman	1780	8.74	5.52	18.90	-2.27
Water Island	770	4.23	7.64	14.14	-16.08
NPS	140	-12.58	2.86	-9.64	-17.49
Blue Point Beach	800	3.61	8.72	15.77	-13.03
NPS	730	0.17	4.56	8.22	-8.35
Davis Park	830	-2.01	7.47	9.83	-14.31
Ocean Ridge	430	9.61	11.32	26.04	-12.07
NPS Watch Hill/Wilderness	12050	-1.06	10.54	27.40	-24.70
Smith Point County Park	10150	-0.84	12.49	42.12	-30.07

Information for Management

With the caveat that the data presented only apply to a one-year period, there are many locations that have changes greater than ± 7 m measure of uncertainty and some that are greater than the one-standard-deviation. Both inlet areas, at the margins of Robert Moses State Park and Smith Point County Park, have large inland displacements. Also, portions of Fire Island Pines, the NPS Wilderness Area, and the NPS Lighthouse area each have inland displacements greater than one-standard-deviation. It is not possible to determine if these changes are local perturbations or some larger negative displacement with this limited data set. Longer term tendencies of shoreline change will be analyzed through the 5-years Trend Reports.

Problems/Concerns

There were no issues that arose in this period that constituted problems or concerns in the application of the protocol. One small matter was the potential for loss of satellite communication during the survey, especially from around noon to 1 pm. It is necessary to check the GPS unit regularly to determine the efficacy of the connection and the collection of shoreline position, as per the protocol.

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Appendix A. Shoreline Position Data

The lines that represent the shoreline position for each of the surveyed periods are stored as shapefiles in a Geodatabase along with the Transects, the Baseline used in the shoreline change analysis, and the spreadsheet with the results from the DSAS analysis. This information and data are available from the Data Manager for the National Park Service, Northeast Coastal and Barrier Network, Inventory and Monitoring Program:

Data Manager
National Park Service
Northeast Coastal and Barrier Network
URI Dept. Natural Resources Science
1 Greenhouse Rd
Kingston, RI 02881