FINAL

Saco Bay, ME – Shoreline Mapping and Sediment Transport Potential Update PART I

Saco Bay, Maine

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Prepared For:
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New England District
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June 2013

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Table of Contents

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Saco Bay, Maine is a 9-mile long stretch of shoreline that is arcuate in nature and is bound to the south by Fletcher's Neck and the Saco River and to the north by Scarborough River and Prout's Neck (Figure 1). The majority of the coastline in Saco Bay is densely developed, consisting of small beachfront communities. The bay represents the largest sand beach and saltmarsh system in Maine. The Saco River is the primary source for sediment supply to the beaches within the bay (Slovinsky and Dickson 2003). The Saco River estuary is located at the southern end of the embayment, with tidal influence that extends 10 km upstream to the base of two dams at Factory Island. The mouth of the Saco River is shallow (<3.0 m), and is currently stabilized by two jetties. Shoaling between the two jetties and in the harbor landward of the estuary mouth has necessitated a continual maintenance dredging program operated by the United States Army Corps of Engineers (USACE) (Fitzgerald *et al*. 2002).

Figure 1. 1998 aerial photograph identifying important areas within the Saco Bay study area.

In the 19th century navigation at the mouth of the Saco River was noted as difficult due to the presence of tidal deltas (ledges and sandbars) in front of the inlet. In response to increased river traffic in the 19th century, the USACE began altering the inlet in 1827. In 1867, a 1280 m long jetty north of the river mouth was constructed to maintain a clear navigation channel at the inlet. Charts from 1866 depict a large ebb-tidal delta at the mouth of the Saco River, which was destroyed by construction of the north jetty causing the sand to move ashore (Farrell, 1972). This construction also altered the flow out of Saco River from a forked, two-channel morphology to a single channel oriented in an east-west direction. During the period 1885 to 1969 the northern jetty was extended to 2,030 m and heightened to a crest elevation of 1.7m MLW (at its seaward end). In addition to this northern jetty, a second jetty was constructed on the south side of the river entrance in 1894, which was eventually lengthened to 1,463 m and heightened to 1.7 m MLW (at the seaward end). Since the construction of these jetties, accelerated erosion on the order of 2-3 ft/yr has occurred, particularly in the area of Camp Ellis Beach, a small beachfront community located just to the north of the northern most jetty (Slovinsky and Dickson 2003). A more detailed discussion of the history of the jetty construction can be found in Woods Hole Group (2006).

In a physical system like that of Saco Bay, a geologic and historical perspective provides an important understanding about the history of the region, as well as insight into future changes in geomorphology. Aerial photographs, topographic and hydrographic surveys, and recent LiDAR data provide information for quantifying regional geomorphology and change. Coastal shoreline change and digital elevation data for the same region over different time periods provides a method for calculating sediment movement within a region. This report describes an updated shoreline change analysis performed for the entire Saco Bay region using digitized aerial photography. Woods Hole Group completed two prior shoreline change analyses for the Saco Bay area: "Analysis of Shoreline Change for Saco Bay, Maine" (Nov. 2003), which analyzed shoreline positions from 1864 to 1998, and "Analysis of Shoreline Change for Western Beach, Saco Bay, Maine" (Apr. 2004), which analyzed shoreline positions from 1864 to 2003 specifically for the Western Beach area of Saco Bay. In the current study, recent aerial photos through 2010 were combined with past data to obtain a comprehensive understanding of the shoreline change patterns from 1864 to 2010 for the entire bay. In addition, this report discusses the possibility of utilizing LiDAR data in conjunction with historical aerial photography to analyze long term rates of change.

1.1 PROJECT BACKGROUND

The USACE has undertaken a Regional Sediment Management Study (RSM) for Saco Bay, ME. Saco Bay has been studied extensively by USACE due to the Camp Ellis/Saco, ME Section 111 Study, and studies related to the maintenance of Scarborough Inlet. As such, USACE is interested in updating the previous work performed by Woods Hole Group, titled "Analysis of Shoreline Change for Saco Bay, Maine" (Nov. 2003) and "Analysis of Shoreline Change for Western Beach, Saco Bay, Maine" (Apr. 2004).

1.2 GEOGRAPHIC SETTING

1.2.1 Coastal Environment

The study area is located within Saco Bay, which includes approximately 9 miles of arcuate shoreline (a littoral cell) along the southeastern coastline of Maine. This embayment contains the largest sand beach and salt marsh system in Maine. The primary source of sediment to the beaches in the bay is the Saco River (Slovinsky and Dickson 2003). The mean tidal range in Saco Bay is approximately 9 feet, with a spring range of 11.6 feet.

This shoreline reach is classified as a mesotidal shoreline according to the Hayes (1975) tidal classification, which groups coastal areas according to tidal range. The shoreline here is classified as mixed energy (tide-dominated), meaning there are abundant tidal inlets, large ebb tidal deltas, and drumstick barriers present (Hayes, 1975). The coast is characterized by three tidal inlets: Saco River Inlet (primary sediment source for the bay), Goosefare Brook Inlet, and Scarborough Inlet, with sandy pocket beaches which provide economic, environmental, and recreational benefits (Slovinsky and Dickson 2003).

Along this segment of coast, south and southwest winds occur most frequently in summer while northwesterly, westerly, and southwesterly winds prevail in the winter. The strongest winds are from the northeast but are less frequent than the winds coming from the southeast; both have a great influence on the coastline. Predominant seas are more frequently from the southeast and are the driving force behind the northward movement of sediment.

1.2.2 Coastal Geology

The Saco embayment of Maine is considered a riverine-derived sandy shoreline that developed from the onshore reworking of sediment deposited on the inner continental shelf by rivers (Fitzgerald *et al*. 1994). This type of shoreline is mostly comprised of sandy spits that have formed from the reworking of glaciofluvial deposits. The sands are primarily derived from the onshore reworking of sediments during the Holocene transgression (Fitgerald *et al*. 1994).

The Saco embayment is underlain by pre-Quaternary basement igneous and metamorphic rock of the Precambrian and Paleozoic Cape Elizabeth and Kittery Formations (Osberg *et al*. 1985). Tertiary fluvial erosion and Pleistocene glacial scouring has resulted in an irregular upper surface with abundant narrow ridges and pinnacles. These morphological features are responsible for the offshore islands in the bay, including Ram Island and Eagle Island. Most of the bedrock is overlain by late Wisconsinan till and /or glaciomarine silt and clay (Presumpscot Formation; Bloom 1963), which makes up the majority of the Pleistocene material. Local regressive deltaic and outwash plain sand and gravel facies of late Wisconsinan age are abundant along the middle reaches of the Saco River which is the dominant source of sediment to the bay (van Heteren *et al*. 1996).

Observations of coastal geomorphology show that during the latest Holocene period, sand traveled from south to north in Saco Bay. The orientation of paleospits and their continuity with the southern part of the beach are indicative of a significant quantity of sand derived from the Saco River. Ground Penetrating Radar (GPR) observations at Pine Point also depict the northeastward growth of that spit into the Scarborough River Inlet. Fining grain sizes from south to north along both the beach and nearshore are also suggestive of net northerly transport (Kelley et al., 1995).

Grain size data from 140 stations throughout the estuary and nearshore region indicate that the dominant sediment type is medium to coarse sand with finer-grained sediment flanking the wider portions of the river (tidal flats and marshes, long term sediment accumulation areas). Beyond the jetties the sediment is uniformly fine sand (Fitzgerald *et al*. 2002).

Inlets like that of Saco contribute sand to the nearshore zone during periods of high riverine discharge. Sediments in the estuary are medium-coarse grained sand, whereas the region seaward contains fine sands. Velocity measurements confirm the predominance of stronger ebb than flood tidal currents. Bedforms exhibit varying orientations during normal conditions but re-orientate themselves to an ebb direction. These data show that larger spring freshet events overwhelm tidal flow in the estuary and control net sediment transport out of the river. The magnitude, direction, and persistence of the current velocities indicate that freshets are important events in supplying coarse-grained sediment to the estuary mouth, filling harbor regions, and causing shoaling between the Saco jetties (Fitzgerald *et al*. 2002).

2.0 SHORELINE MAPPING

A computer-based shoreline mapping methodology, within a Geographic Information System (GIS) framework, was used to update and analyze changes in historical shoreline position between 1864 and 2010 for Saco Bay, Maine. The purpose of this task was to quantify changes in shoreline position using the most accurate data sources and compilation procedures available, and to characterize areas of erosion and accretion. Because this information is critical to coastal zone management decisions, emphasis has been placed on data accuracy and clear presentation of results. The following sections provide an overview of past analyses, a detailed description of the methods and data sources used, and a summary of the updated analysis results.

2.1 REVIEW OF PREVIOUS STUDIES

2.1.1 "Saco River and Camp Ellis Beach Data Collection and Modeling Report" (Oct. 2006)

An analysis of historical shoreline change was performed for an 8-mile shoreline segment along Saco Bay. Data used to compile the analyses were derived from aerial photography, historical maps, and digital orthophotographic quads. Rates of historical change were calculated at 265 shore-normal transects from Biddeford Pool to Prouts Neck. This report quantified the changes in shoreline position for two (2) specific time periods: 1864-1998 and 1944-1998 (See Appendix C for Figures).

Summary of conclusions from the 2003 study:

- Between 1864 and 1998, the shoreline accreted adjacent to the southern jetty in Saco Bay. Accretion rates along this stretch ranged from +0.74 ft/yr at Transect 32 to +4.3 ft/yr at Transect 38 adjacent to the southern jetty. Between 1944 and 1998 the shoreline accreted more rapidly at rates exceeding +5 ft/yr. There was also a small erosional area that existed on Hills Beach (at approximately Transect 25). Rates of erosion in this region were approximately -1 ft/yr.
- The shoreline adjacent to the northern jetty (Camp Ellis Beach) experienced significant erosion. Between 1864 and 1998, this shoreline eroded at rates between -3.41 ft/yr (at Transect 41) and -0.16 ft/yr (at Transect 53). The more contemporary time period (1944-1998) showed continued erosion, but at a reduced rate (approximately -1.0 ft/yr and less).
- Between Transects 53 and 101, the area between Ferry Beach and Bay View, there was a relatively stable section of shoreline from 1864 to 1998. Here shoreline change rates ranged from -0.16 ft/yr to +0.92 ft/yr. However, in the more contemporary time period, the shoreline became erosive, with rates averaging approximately -1 ft/yr.
- Between 1864 and 1998 there was a seaward growth of the shoreline in the northern portion of the bay, increasing in magnitude towards Scarborough Inlet. This region gained beach throughout the entire 134-year study period, with accretion rates reaching +3.5 ft/yr. For the more recent time period (1944-1998), a similar trend with an increased magnitude was observed.

2.1.2 *"Analysis of Shoreline Change for Western Beach, Saco Bay, Maine" (Apr. 2004)*

An analysis of historical shoreline change was performed for a 3,500-foot shoreline segment along Western Beach in the northeastern portion of Saco Bay. The data used to compile the analyses were derived from aerial photography, historical maps, and digital orthophotographic quads. This report quantified the changes in shoreline position for three (3) specific periods: 1864-1944, 1962-1977, and 1986-2003. (See Appendix C for Figures)

- From 1864 to 1944 the Western Beach shoreline was mostly stable with small amounts of erosion. The shoreline change rates ranged from +0.23 ft/yr to -0.98 ft/yr.
- Between 1962 and 1977, immediately following the widening of the Scarborough channel and jetty construction, the entire Western Beach shoreline was accreting with shoreline growth rates from 1.31 to 10.37 ft/yr. The accretion was greatest along the northwestern portion of Western Beach, adjacent to the river entrance.
- Between 1986 and 2003, moderate erosion was observed, with shoreline change rates ranging from -0.23 to -9.97 ft/yr.
- Over the entire 1864 to 2003 period, the shoreline at Western Beach was relatively stable with periods of accretion and erosion as discussed. Long-term accretionary patterns can be seen near the Scarborough Inlet and Prout's Neck while most of the erosion occurs in the center of this stretch of beach. However, these changes are relatively small (ranging from +1.77 ft/yr near Prouts neck to -0.46 ft/yr near the center of Western Beach) and in general the shoreline has been relatively stable over the long-term.

2.2 UPDATED HISTORICAL SHORELINE CHANGE ANALYSIS

The two previous Woods Hole Group studies (WHG 2006; WHG 2004) on shoreline change in Saco Bay and Western Beach were updated to include more recent shorelines since 1998. Table 1 provides a summary of the shoreline data sources used, including the original datasets between 1864 and 1998 and the newer datasets post 1998.

The time series of photographs selected for this study represents the highest quality and most evenly spaced photographic data available for the Saco Bay area. Additional aerial photographs taken in other years were also available for discrete sections of Saco Bay; however, only data sources covering the entire bay were selected for the current analysis. Details regarding each of the chosen data sources are given in Table 1. This time series of shoreline data provides a high-resolution history of shoreline response along the Saco Bay shoreline.

Table 1. Summary of the Shoreline Data for Saco Bay, Maine

Date	Data Source
1864 (1849-1879)	USC&GS Historical T-sheets with a scale of 1:10,000
1944	USC&GS Historical T-sheet with a scale of 1:20,000
1965	Col-East, Inc. Aerial Survey with a scale of 1:400
1977	James W. Sewall, Co. Aerial Survey, provided by the Maine Geological Survey with a scale of 1:12,000
1986	James W. Sewall, Co. Aerial Survey, provided by the Maine Geological Survey with a scale of 1:6,238
1995	James W. Sewall, Co. Aerial Survey, provided by the Maine Geological Survey with a scale of 1:12,000
1998	USGS DOQ, from the state of Maine GIS website with a scale of 1:40,000
2003	Delorme low tide orthophotography, with a scale of 1:40,000
2004	Maine Geolibrary Orthophotos , from the state of Maine GIS website, with a scale of 1:2,400
2006	Cumberland County, Central Coast Orthophotos, from the state of Maine GIS website, with a scale of 1:1,200
2007	USACE LiDAR Imagery, provided by the USACE NE Division, with a scale of 1:50,000
2009	U.S. Geological Survey, Cumberland County Orthophotos, from the state of Maine GIS website with a scale of 1:4,500
2010	USACE LiDAR Imagery, provided by the USACE NE District, with a scale of 1:9,600

2.2.1 Data Compilation and Analysis Methods

The aerial photographs listed in Table 1 provide a synoptic view of the Saco Bay coastline over time. Most of these data however, were not initially tied to a geographic coordinate system, and thus could not be directly compared with historical map data or with each other without additional processing. Furthermore, the photographs contain a variety of distortions intrinsic to aerial photos such as radial distortion, tilt and pitch of the aircraft, and scale variations. Thus, before shoreline position data from various years can be compared for quantitative analysis of shoreline change, the photographs must be geo-referenced and corrected for distortion. These corrections were accomplished utilizing computer aided cartographic mapping software.

For the current update, shoreline positions from 1998 and earlier were taken directly from the previous Woods Hole Group studies, and no new digitizing was required to capture these shorelines. As described in the previous two studies, the 9x9 inch air photos were scanned to produce a digital raster-based image. The high- resolution images provided greater accuracy in locating control points for geo-referencing the photos and the image contrast could be adjusted to refine the detail of specific features. The initial part of the analysis involved identification of a reference shoreline on each of the digital images. Aerial photo interpretation along a shoreline is an art based on science, supported by familiarity with the area and its processes, and includes a certain amount of error and interpretative subjectivity. Delineation of the reference shoreline is the most important and most subjective part of shoreline change analysis, particularly in areas where relief distortion can compound problems. The horizontal position of the high-water shoreline as recognized on the beach and on photography was determined using a hierarchy of criteria dependent on morphologic features present on the beach. The primary criterion was a well-marked limit of uprush by waves associated with high tide. This was generally recognized as a beach scarp or debris line, marking the upper limit of the foreshore. Lacking this feature, the wet-dry line was digitized. Using this method, the high water line was delineated for each set of aerial photos. These criteria for delineating the high water line are consistent with those used by field topographers and NOS photo interpreters (Shalowitz 1964). For the current update, reference shorelines from the 1998 dataset and earlier were taken from previous studies, however shorelines from the 2003-2010 photographs were captured through heads-up digitizing, and stored digitally in a GIS.

Although photographs from the recent years (1998-2010) were already geo-referenced, all the data from years prior to 1998 were geo-referenced during the previous Woods Hole Group studies. Geo-referencing for the prior analyses was accomplished by identifying a series of evenly spaced control points on the images for which real world x, y coordinates were known. The 1998 USGS digital orthophoto quadrangles were utilized to obtain the ground control. These DOQs contained a variety of features that were easily visible on the scanned images. The DOQs were previously referenced to the UTM (meter) Coordinate System (NAD 1983) Zone 19 by the USGS. Suitable control point positions visible on both the imagery and the DOQ were identified, and marked on the scanned images. Cartographic mapping software was used to georeference the vector data representing the reference shorelines according to the appropriate transformation algorithm (least-squares, affine, or projective). Shorelines from the early USC&GS historical maps were captured using the same technique described above.

Once the shoreline position data were compiled accurately, spatial and temporal changes in the data were quantified. This identification was accomplished by identifying a series of shore-normal transects along Saco Bay where shoreline change could be measured through time, and where rates of shoreline change could be computed. A total of 877 shore normal transects were established at 50 foot evenly spaced intervals (Figure 2). At each transect, distances of shoreline movement were calculated, and annual rates of shoreline change were determined using the various time intervals between shorelines. A matrix of long-term and incremental shoreline change rates was developed using all of the available shoreline data. Appendix B shows the incremental and long-term rates of shoreline change, where positive values indicate accretion, and negative values indicate erosion.

The rates of shoreline change shown in Appendix B were calculated using two different methods. The end-point method uses the distance over which the shoreline position changed (measured along each transect), divided by the number of years during which the change occurred. A different method, the linear regression method, was used to determine the long-term rates of change from 1864 to 2010, 1944 to 2010, and 1998 to 2010. In this method, an average rate of change is based on a best-fit line to a series of points representing shoreline position over a period of time. The linear regression method is the most applicable method when looking at long-term averages in the rates of shoreline change. This method is most often used for planning purposes and for management decisions.

Figure 2. Saco Bay study area showing key Transect locations.

2.2.2 Error Analysis

Available procedures must be used to capture map data as carefully as possible. However, no matter how cautious the approach, a certain amount of error will be retained in all measurements of shoreline position. Potential errors in shoreline change rates can be characterized in three ways: accuracy, precision, and resolution. Accuracy refers to the degree to which a recorded value conforms to a known standard. In the case of mapping, this relates to how well a position on a map is represented relative to actual ground location (e.g., infrastructure, high-water shoreline). Precision, on the other hand, refers to how well a measurement taken from the map or an aerial photograph can be reproduced (Anders and Byrnes 1991). Resolution refers to the ability to distinguish detail in the original data source, and is highly dependent on scale. Higher resolution maps or photos have smaller scales allowing finer and more accurate depiction of the data. All three types of error should be evaluated to gauge the significance of calculated changes relative to inherent inaccuracies. The following discussion addresses these factors in terms of data sources, operator procedures, and equipment limitations.

2.2.2.1 Field Survey Errors

Shoreline measurements obtained from historical maps, such as the USC&GC T-sheets, are only as reliable as the original maps and the survey methods used to compile them. Potential error considerations related to field survey equipment and accurate mapping of high-water shoreline position were addressed by Shalowitz (1964) as follows,

> "With the methods used, and assuming the normal control, it was possible to measure distances with an accuracy of 1 meter while the position of the plan table could be determined within 2 or 3 meters of its true position. To this must be added the error due to the identification of the actual mean high water line on the ground, which may approximate 3 or 4 meters. This is the accuracy of the actual rodded points along the shore and does not include errors resulting from sketching between points. The latter may, in some cases, amount to as much as 10 meters, particularly where small indentations are not visible to the topographer at the plane table."

In the present study, field survey errors pertain only to the 1864 data since all other shorelines were derived from aerial photography and digital orthophotograph quads (DOQs). Using the combination of errors associated with measured distances, location of the plane table, interpretation of the high water shoreline, and sketching between rodded points, the total field survey error for 1864 is ±23.1 ft (Table 2).

2.2.2.2 Cartographic Errors

All maps of shoreline position, whether created from an engineering survey or from aerial photographic sources, have inherent errors. Accuracy depends on the standards to which each original map was made, and on changes which may have occurred to a map since its initial publication. For T-sheets at a 1:10,000 scale, national standards allow up to ±28 ft of error for a stable point, but the location of these points may be more accurate (Shalowitz 1964; Anders and Byrnes 1991; Crowell *et al*. 1991). Non-stable points are located with less accuracy; however, features critical to safe marine navigation are mapped to accuracies stricter than national standards (Ellis, 1978).

Cartographic errors are inherent in both the 1864 and 1944 datasets since the original sources were maps. Three distinct sources of cartographic error result from (i) the position of measured points, (ii) placement of the shoreline on the map, and (iii) the width of the line representing the shoreline. These error sources can be evaluated to provide an estimate of potential inaccuracy for historical maps. Historical T-sheet shorelines are mapped to within ±0.02 inches (at map scale) of true position, which at a 1:10,000 scale is ±16.7 ft on the ground. Line thickness, due to original production and photo-reproduction, is generally no greater than 0.01 in, or ±10 ft ground distance for a map scale of 1:10,000. Furthermore, the precision with which an operator can visualize and move the cursor along a line can lead to additional error (Tanner 1978). Fortunately, improper tracking associated with shoreline digitizing is random and may be dampened when averaged over finite distances of shoreline. Considering the three different sources of cartographic error, total errors for 1864 and 1944 are ±19.9 ft and ±39.7 ft, respectively (Table 2).

Although it can be argued that surveys conducted after 1900 were of higher quality than original mapping operations in the 1840s, an absolute difference cannot be quantified. Consequently, the parameters outlined above are assumed constant for all field surveys and provide a conservative estimate of potential errors.

Table 2. Estimates of Error Associated with Acquiring Shoreline Positions

USC&GS Historical T-Sheet/Survey			
Year	**Scale**	**Field Survey Error**	**Cartographic Error**
1864	1:10,000	± 23.1 ft	± 19.9 ft
1944	1:20,000	NA*	± 39.7 ft
Aerial Survey/Photos			
Year	**Scale**	**Error from position of measured points**	**Error from Delineation of HWL**
1944	1:20,000	± 7.8 ft	± 33.0 ft
1965	1:400	± 1.4 ft	± 2.0 ft
1977	1:12,000	± 2.4 ft	± 4.0 ft
1986	1:6,238	± 1.6 ft	± 5.2 ft
1995	1:12,000	± 0.8 ft	± 10.0 ft
Digital Orthophotograph Quad (DOQ)			
Year	**Scale**	**Error from position of measured points**	**Error from Delineation of HWL**
1998	1:40,000	± 3.6 ft	± 17.0 ft
2003	1:40,000	± 6.7 ft	± 17.0 ft
2004	1:2,400	± 6.7 ft	± 7.0 ft
2006	1:1,200	± 1.0 ft	± 6.0 ft
2007	1:50,000	± 9.8 ft	± 6.0 ft
2009	1:4,500	± 5.5 ft	± 5.0 ft
2010	1:9,600	± 2.5 ft	± 3.0 ft

*The T-sheet for 1944 was created from aerial photos, so there are no field survey errors associated with this dataset.

2.2.2.3 Aerial Survey Errors

Most recent shoreline position data are compiled from aerial photography in two ways. Engineering quality planimetric maps are constructed using stereoplotters and field-tested against surveyed positions. This is the process used to create the most recent T-sheets (1944); however, it is very time consuming and costly. Fortunately, a high-quality alternative approach is available that involves geo-referencing photographs for production of metric-quality photomaps (e.g. image processing/mapping software for geo-referencing photos with ground based horizontal control from DOQs). This alternative approach was used during the two initial Woods Hole Group studies to generate shoreline position data for 1965, 1977, 1986, and 1995. Interpretation of the high-water shoreline position is again the primary factor influencing measurement accuracy. Differences between the position of the measured control points and their true x,y coordinates introduces another source of error; however, with careful selection and distribution of control points, and suitable scale photography (< 1:20,000) the magnitude of these errors can be minimized.

Shoreline position data obtained directly from DOQs contain errors associated with the original geo-referencing, as well as those associated with delineation of the high-water line. The scale of the photography influences the magnitude of these errors, with higher altitude photography creating greater error. Fortunately, the DOQs utilized for the current update from 1998, 2003, 2004, 2006, 2007, 2009, and 2010 had suitable scales and the errors were minimized (Table 2).

2.2.2.4 Total Error

When considering all the potential errors discussed above, it should be recognized that these apply to each individual map or aerial photo. When making comparisons of shoreline position, error is additive because separate maps and air photos are being used. It has been assumed that individual errors represent standard deviations, and thus a root-mean-square (RMS) approach was applied to provide a more realistic assessment of combined potential errors (Merchant 1987; Crowell *et al*. 1991; Byrnes and Hiland 1994). Table 3 summarizes estimates of potential RMS positional error for the data sources used in this study.

Table 3. Estimates of total error associated with shoreline positions

Shoreline Year	Total Error
1864	± 30.5 ft
1944	± 52.2 ft
1965	± 2.4 ft
1977	± 4.7 ft
1986	± 5.4 ft
1995	± 10.0 ft
1998	± 17.4 ft
2003	±18.3 ft
2004	± 9.7 ft
2006	± 6.1 ft
2007	± 11.5 ft
2009	± 7.4 ft
2010	± 3.9 ft

Maximum RMS errors for shoreline change data derived through this updated study are summarized in Table 4. The RMS errors in Table 4 were calculated by taking the square root of the sum of the squares of all potential errors for data of a given source. For any given time period the maximum magnitude of potential error associated with the high-water shoreline position change is provided (top row for each year). Additionally, the rate of potential error associated with the high-water shoreline position change between any two years is also provided (bottom row for each year). For example, when comparing the change in shoreline position between 1986 and 1995, the maximum potential error in the magnitude of change is 11.4 ft, and the error associated with the rate of change between 1986 and 1995 is ± 1.2 ft.

Table 4. Maximum Root-Mean-Square (RMS) potential errors for shoreline change data

Date	1944	1965	1977	1986	1995	1998	2003	2004	2006	2007	2009	2010
1864	60.5*	30.6	30.8	31.0	32.1	35.1	35.5	32.0	31.1	32.6	31.4	30.7
	0.8†	0.3	0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2
1944		52.3	52.4	52.5	53.2	55.0	55.3	53.1	52.6	53.5	52.7	52.4
		2.5	1.6	1.3	1.0	1.0	0.9	0.9	0.8	0.9	0.8	0.8
1965			5.3	6.0	10.3	17.5	18.4	10.0	6.6	11.7	7.8	4.6
			0.4	0.3	0.3	0.5	0.5	0.3	0.2	0.3	0.2	0.1
1977				7.2	11.1	18.0	18.9	10.8	7.7	12.4	8.8	6.1
				0.8	0.6	0.8	0.7	0.4	0.3	0.4	0.3	0.2
1986					11.4	18.2	19.1	11.1	8.2	12.7	9.2	6.7
					1.2	1.5	1.1	0.6	0.4	0.6	0.4	0.3
1995						20.1	20.8	13.9	11.7	15.3	12.5	10.8
						6.3	2.6	1.6	1.1	1.3	0.9	0.7
1998							25.2	19.9	18.4	20.8	18.9	17.8
							5.3	3.6	2.4	2.5	1.7	1.5
2003								20.7	19.3	21.6	19.7	18.7
								24.8	6.7	5.8	3.1	2.7
2004									11.4	15.0	12.2	10.4
									5.6	5.2	2.2	1.7
2006										13.0	9.6	7.2
										14.7	2.7	1.7
2007											13.7	12.1
											5.1	3.7
2009												8.4
												13.7

*Magnitude of potential error associated with high-water shoreline position change (ft)
†Rate of potential error associated with high-water shoreline position change (ft/yr)

The potential RMS errors calculated for the rates of shoreline change shown in Table 4 (denoted with a †) were used to gauge the significance of the magnitude of the computed shoreline change rates. In general, where the RMS errors are greater than or equal to the rates of shoreline change, the uncertainty in the magnitude of the shoreline change is high. This usually occurs in areas where the annual rates of shoreline changes are low. For this study, the RMS errors are limited and the uncertainty in the magnitude of shoreline change is highest for data spans of short time periods (e.g., 2003 to 2004).

2.3 DISCUSSION OF RECENT SHORELINE CHANGE IN SACO BAY

Previous studies of shoreline change in Saco Bay (WHG, 2003; WHG, 2004) have been updated as part of this study by adding six (6) recent shoreline positions since 1998 (Table 1). Results of the analysis are presented in Figures 3, 4, and 5, showing annual rates of shoreline change computed using the linear regression method. Shoreline change during three distinct time periods are discussed in the following sections: 1864 to 1998-2010, 1944 to 1998-2010, and 1998 to 2010. The influence of new data compiled since 1998 on the long- and short-term rates of change are discussed. Appendix A contains a series of maps for the entire study area showing the shoreline positions and annual rates of shoreline change computed for the periods 1864 to 2010 and 1998 to 2010.

2.3.1 1864-1998 and 1864-2010

Updates to the long-term rates of shoreline change in Saco Bay computed for the period 1864 to 2010 are compared with previous rates computed for the period 1864 to 1998 in Figure 3. Shoreline position from south to north is represented on the x-axis in terms of Transect No. and long-term rates of shoreline change in ft/yr are represented on the y-axis. Locations of the Saco River, Goosefare Brook, and Scarborough River are also noted for reference. The 134 to 164 year time interval covered by the data describe the long-term trends in shoreline change, including periods before and after stabilization of the Saco and Scarborough River entrances. Figure 3 shows little variation in the major trends of shoreline change between the two time periods. This is not surprising since the new datasets through 2010 add only twelve (12) years to the already lengthy period of analysis (>100 years). However, areas where differences between the two datasets are present are useful in identifying sections of the coastline where trends in shoreline evolution may be changing. These differences occur in the following areas:

- The area immediately north of the Saco River exhibits a reduced erosion rate due to 1) the lack of available sediment from the depleted Camp Ellis and 2) the recent shoreline stabilization measures that have been installed along the Camp Ellis shoreline,
- The shoreline between Transects 134 and 256, located 0.4 to 1.7 miles north of the Saco River (Ferry Beach to Bay View), shows higher rates of erosion and lower rates of accretion with the updated shorelines through 2010. This corresponds to the recent increased observed erosion occurring in this area likely caused by the reduced sediment influx from the sediment starved area to the south. This region has suffered significant erosion in recent years.
- North and south of the Goosefare Brook inlet the updated long-term rates of change show reduced rates of accretion.
- Further to the north between Transects 600 and 716 (north of Old Orchard Beach to Pine Point) the updated data through 2010 show an increase in the rate of shoreline accretion.
- The shoreline between Transects 750 and 786, located between 0.5 and 0.2 miles west of the Scarborough River entrance, shows lower rates of accretion when using the updated shorelines through 2010.
- Along the Western Beach shoreline the updated data through 2010 show higher rates of erosion, as recent observed along this stretch of beach has been significant.

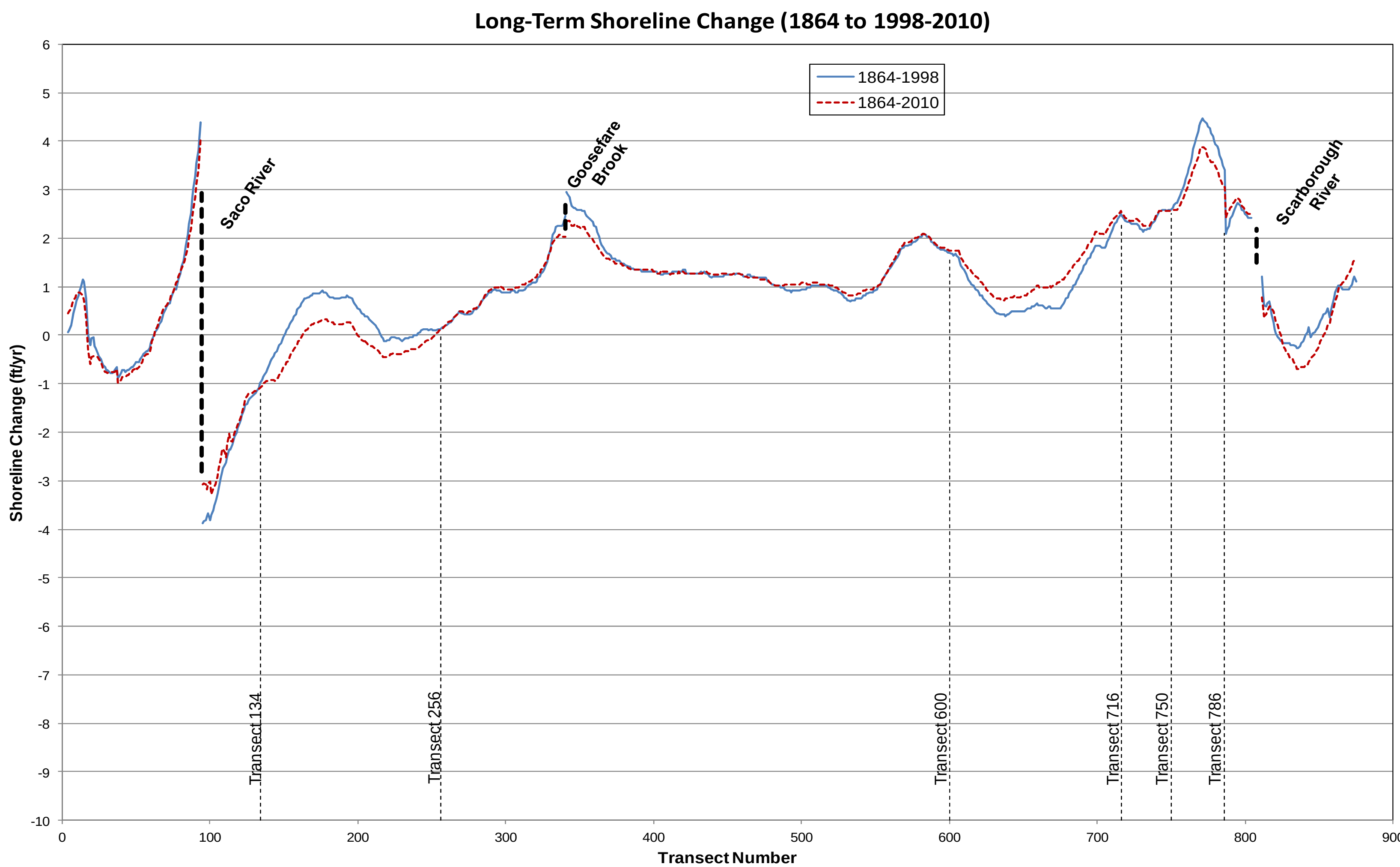

Figure 3. Comparison between long-term rates of shoreline change computed from 1864-1998 and 1864-2010.

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2.3.2 1944-1998 and 1944-2010

Updates to the long-term rates of shoreline change in Saco Bay computed for the period 1944 to 2010 are compared with previous rates computed for the period 1944 to 1998 in Figure 4. These data compare rates of shoreline change over the most recent 54 to 66 year time period, reflecting changes after stabilization of the Saco River entrance. This time period also covers shoreline change at the Scarborough River entrance, both before and after jetty construction at the southern edge of the river mouth. General trends in shoreline change are essentially the same for the two time periods (Figure 4), with the following exceptions:

- For the more recent time period, the data show lower rates of shoreline accretion south of the Saco River between Transect 38 and the southern jetty. Over time the inlet has adjusted to the structuring and has reached a more stable equilibrium, the accretion rate has slowed.
- Increased erosion north of the Saco River entrance between Transects 128 and 250, located 0.3 to 1.5 miles north of the river, corresponding to the lack of sediment arriving in this area.
- Increased rates of accretion south of Goosefare Brook and further north between Transects 515 and 700.
- Lower rates of shoreline accretion between Transects 700 and 786, located 0.2 to 1.0 miles west of the Scarborough River entrance.
- Along the Western Beach shoreline the updated data through 2010 show higher rates of erosion.

2.3.3 1998-2010

The influence of recent trends in shoreline change over the 12 year period between 1998 and 2010 on the long-term rates of change is illustrated in Figure 5. The higher degree of variability in the short-term data is seen by the increased magnitudes of erosion and accretion and the rapid variations in rates of change in the alongshore direction. Long-term rates of change are typically much smoother and show less variability than short-term rates because the changes are averaged over a greater number of years and perturbations in shoreline position are smoothed out. Comparison of the short-term data with the longer-term rates of shoreline change reveals the following differences:

- South of the Saco River between Transect 39 and the south jetty, the recent data since 1998 show significant erosion, with rates ranging from -0.5 to -5.5 ft/yr. This finding is opposite the trend shown in the long-term data, which shows increasing accretion from south to north along this stretch of shoreline.
- The short-term data show shoreline accretion north of the Saco River entrance for approximately 0.2 miles. This accretion is likely due to the recent stabilization efforts and nourishment in this area. Temporary geotubes in the area are required to be continually covered with sediment, which adds a source of material. Long-term data for this same area show significant erosion.
- The short-term data since 1998 show that the majority of the shoreline between Saco River and Goosefare Brook is eroding, with rates gradually decreasing from

south to north. A dramatic increase in the rate of erosion takes place just north of Transect 134 and then gradually decreases towards Goosefare Brook. This area corresponds to recent observed erosion that has threatened local infrastructure. This same general trend is reflected in the long-term data.

- North of Goosefare Brook to approximately Transect 564 the short-term data reflect erosion on the order of -1.0 to -2.0 ft/yr. This finding is opposite the trend shown in the long-term data, which shows a nearly consistent rate of accretion of +1.0 ft/yr.
- The 1.3 mile stretch of shoreline between Transects 564 and 696 reflects significant accretion over the recent time period since 1998. Rates vary from +1.3 to +5.4 ft/yr. The long-term data also shows accretion in this area.
- The short-term data for the shoreline between Transect 696 and the west side of the Scarborough River shows erosion, with average annual rates of approximately -0.5 to -2.5 ft/yr. The longer-term data reflects a trend of increasing shoreline accretion from west to east in this same area.
- Western Beach shows the magnitudes of erosion increasing from north to south, with the greatest average annual rates on the order of -3.0 ft/yr along the southeast portion of the beach.

2.3.4 Analysis of Error Associated with Recent Shoreline Change

Room mean square potential errors associated with the short-term rates of shoreline change between 1998 and 2010 are presented in Figure 6. The solid blue line represents the short-term rates of shoreline change computed using the end point methodology. This method uses the distance of shoreline movement between the 1998 and 2010 shorelines, divided by the 12 years between the two data sets to arrive at a change rate in ft/yr. The rate of potential error associated with the high-water shoreline position change for these two data sets was taken from Table 4 and used to represent the range of possible shoreline change rates for any given location along the shoreline (light blue dashed lines). The error bars can be used to help gauge the significant of the magnitude of shoreline change. In general, where RMS errors are greater than or equal to the rates of shoreline change, the uncertainty in the magnitude of shoreline change is high. This usually occurs in areas where the annual rates of shoreline change are low. Although the error bands show the uncertainty in the magnitude of shoreline change, the trends in shoreline position can be considered accurate.

RMS errors for the short-term rates of shoreline change between 1998 and 2010 were calculated to be +/- 1.5 ft/yr. As a result, any rates of change computed within +/- 1.5 ft/yr are within the error bounds of the analysis, and uncertainty exists about actual erosion or accretion. Fortunately this occurs in only two places where the rates of shoreline change are relatively low; between Transects 463 and 560, and between Transects 692 and 773 (Figure 6). Based on the error analysis there is uncertainty as to whether these sections of the shoreline experienced erosion or accretion over the 12 year period between 1998 and 2010. All other sections of the coastline show clear trends of erosion or accretion.

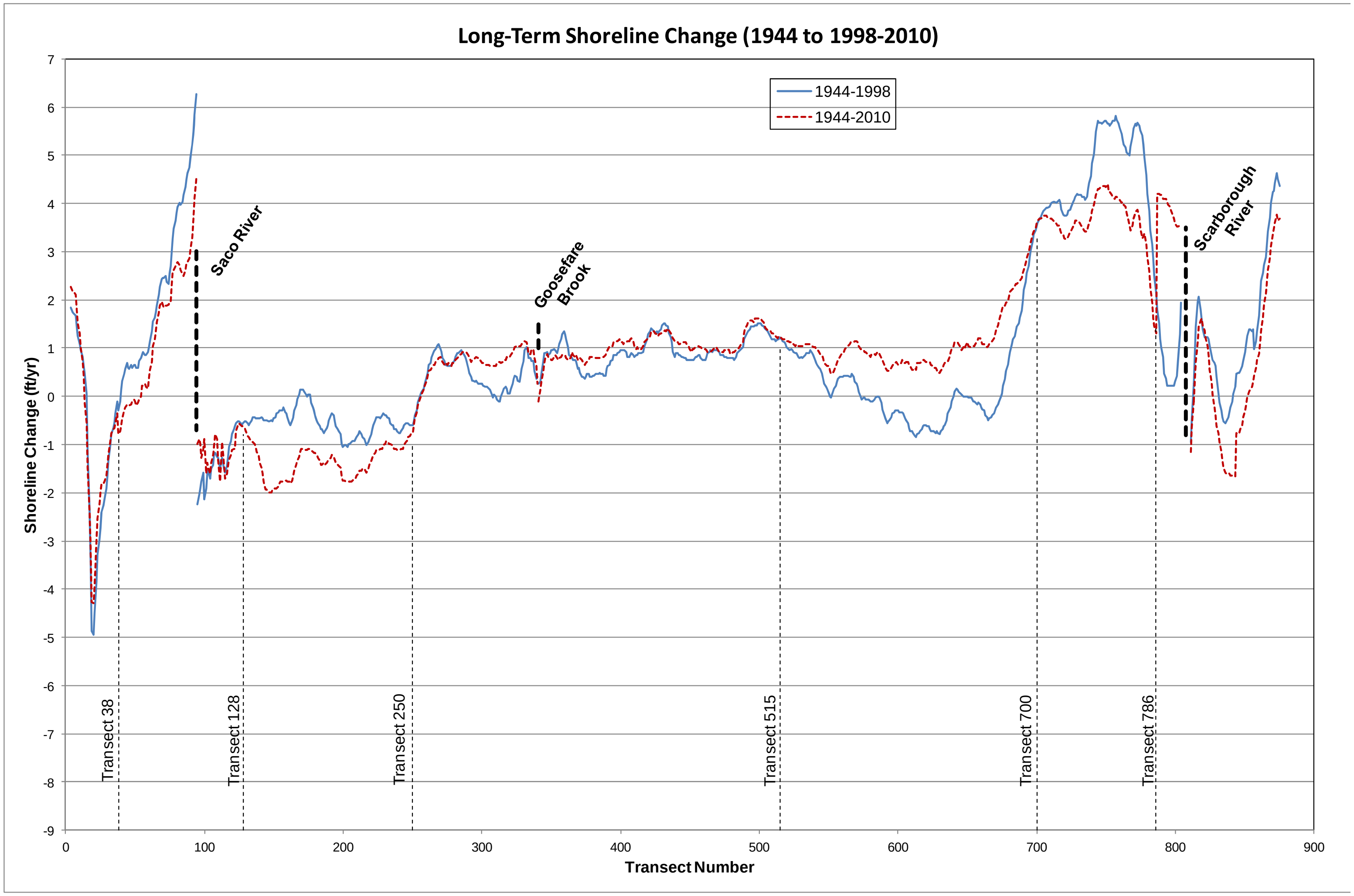

Figure 4. Comparison between long-term rates of shoreline change computed from 1944-1998 and 1944-2010.

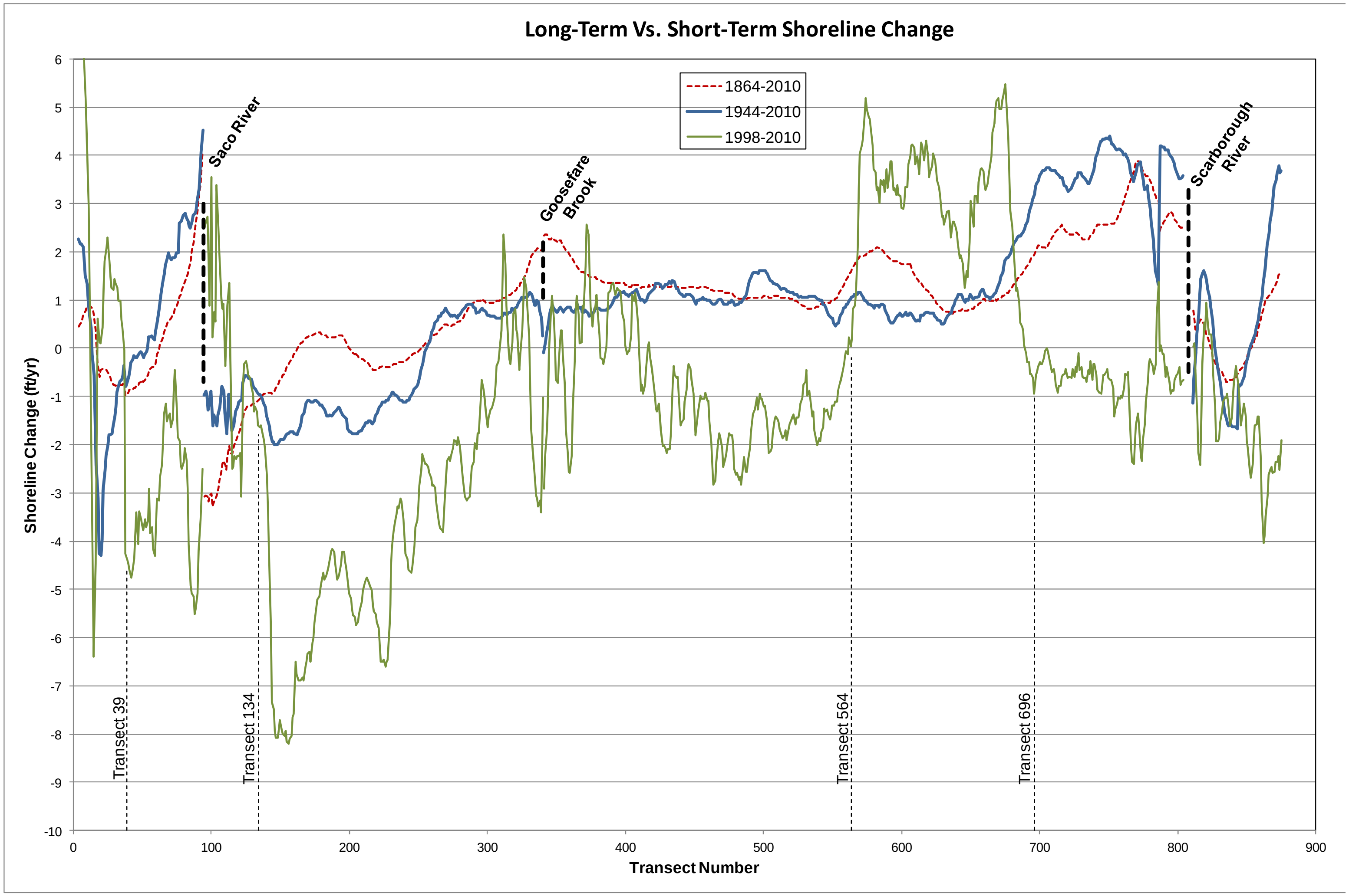

Figure 5. **Comparison between long-term (1864-2010; 1944-2010) and short-term (1998-2010) shoreline change.**

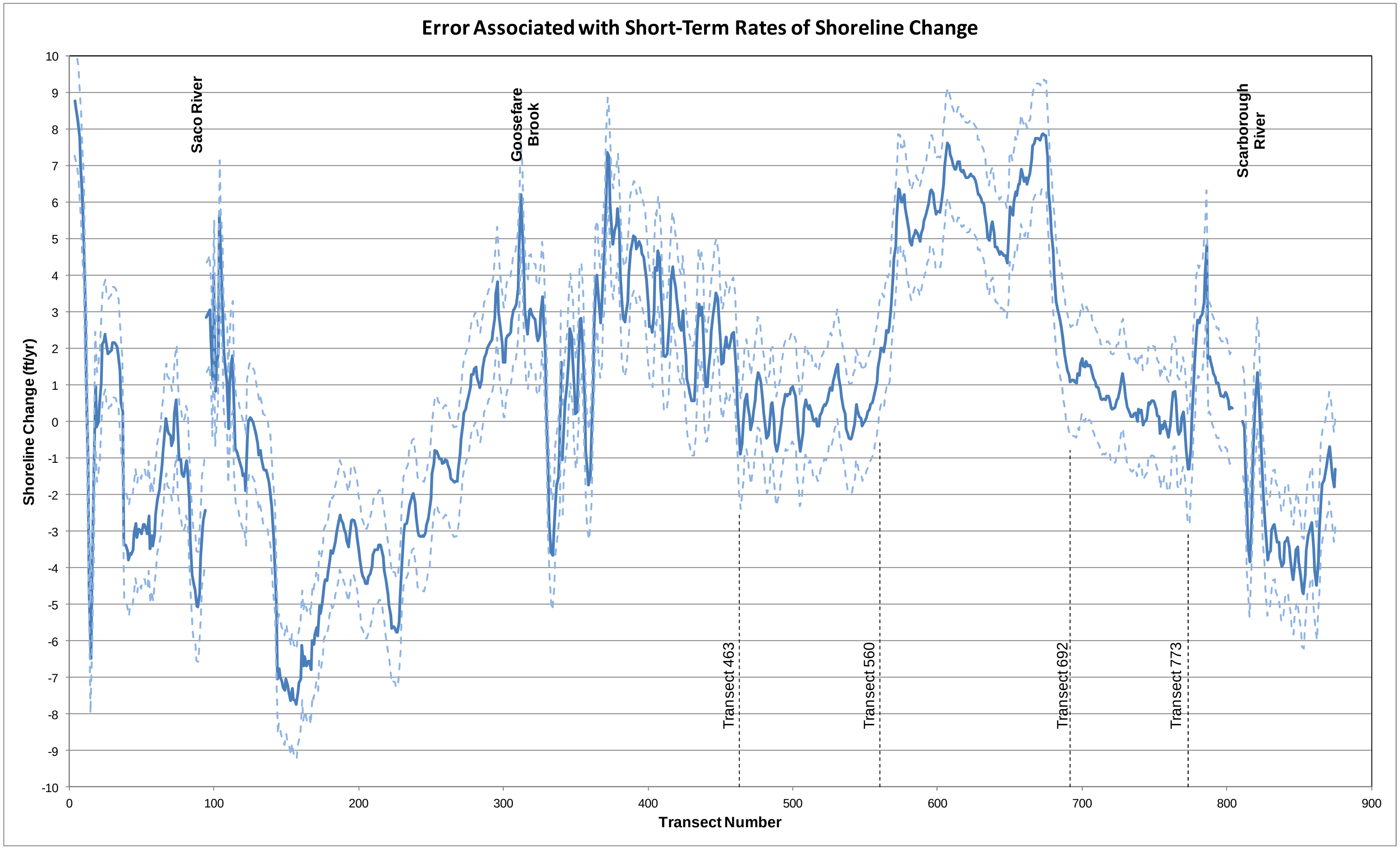

Figure 6. Root mean square potential error associated with short-term rates of change between 1998 and 2010.

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2.4 LIDAR BASED SHORELINE CHANGE ANALYSIS

In addition to updating the previous shoreline change analyses performed for Saco Bay, Light Detection and Ranging (LiDAR) data were also used to evaluate recent shoreline change along the 9-mile shoreline of Saco Bay, Maine. LiDAR data were collected by NOAA in 2000 and by the USACE in 2007 and 2010. The purpose of this task was to determine whether LiDAR data can be utilized in conjunction with traditional shoreline position data derived from aerial photos and historical surveys to obtain reliable shoreline change estimates. While techniques for digitizing the high water line (HWL) from aerial photography have improved over the years, and can continue to be used when incorporating shoreline information from additional years, capturing the HWL can be labor intensive and is subject to interpretation. One possibility to streamline the process going forward is to utilize LiDAR data.

Airborne LiDAR is an active remote sensing technology capable of producing high resolution and accurate elevation data for large areas in a short amount of time. To utilize LiDAR data for shoreline mapping, and specifically to combine LiDAR data with more traditional forms of shoreline mapping where the HWL is used as the shoreline indicator, it is necessary to develop simple relationships between LiDAR elevations and the position of the HWL. Studies conducted by Robertson et al. (2004) and Harris et al. (2006) suggest that it is possible to utilize recently acquired LiDAR data in conjunction with historic aerial photos to develop reliable shoreline change data. The following sections provide a detailed description of the data sources and methods utilized to derive a comparable shoreline indicator from the available LiDAR datasets for the Saco Bay area. Additionally, results from the LiDAR data analysis are compared with the 1998 to 2010 shoreline change data derived solely from the aerial photographs.

2.4.1 Data sources

LiDAR data was collected by NOAA in 2000 and by USACE in 2007 and 2010. These three available LiDAR data sets for the Saco Bay, Maine region are detailed here:

- 1996-2000 NOAA/USGS/NASA Airborne LiDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline (2000);
- 2005-2007 United States Army Corps of Engineers (USACE) Topo-Bathy LiDAR: Maine, Massachusetts, and Rhode Island (2007);
- 2010 United States Army Corps of Engineers (USACE) Joint Airborne LiDAR Bathymetry Technical Center of eXpertise (JALBTCX) LiDAR: Northeast (Topo) (2010).

Errors associated with each of these data sources are noted in Table 5. Of the three LiDAR datasets mentioned above, two were collected concurrently with aerial photography: 2007 and 2010. The combination of these two data types allowed the determination of a LiDAR derived contour line that would be comparable to the HWL derived from past aerial photographs. For information about the source and potential errors associated with the 2007 and 2010 aerial photographs see Table 1.

Table 5. Potential Errors Associated with LiDAR Data Sources

Year	Source	Horizontal Accuracy	Vertical Accuracy	Pixel Size
2000	NOAA	80 cm	15 cm	3 m
2007	USACE	75 cm	20 cm	2 m
2010	USACE	75 cm	20 cm	1 m

2.4.2 Data Compilation and Analysis Methods

Previous studies have analyzed the feasibility of using LiDAR surveys to update historical shoreline datasets for analysis of shoreline change rates (Robertson, et al. 2004; Harris, et al. 2006). Robertson et al. (2004) compared LiDAR-derived contour shorelines and the HWL at multiple study locations using airborne LiDAR topography and orthoimagery that were collected simultaneously. The HWL was digitized from the orthoimagery based on the wet-dry line. This digitized line was then compared with contours derived from LiDAR associated with the previous high tide (HW), the mean high water datum (MHW), and the mean higher high water datum (MHHW) from nearby tide gages. For his study area, Robertson et al. (2004) found the MHHW contour from the LiDAR data most closely matched the HWL digitized from the photography.

In a similar method, Harris et al. (2006) utilized LiDAR survey data taken within a few weeks of on-the-ground GPS shoreline surveys to determine the comparability between the two methods of capturing a shoreline indicator. Shoreline vectors created from GPS surveys were converted to points. Point layers were then overlain onto concurrent LiDAR-derived DEMs and the elevation of each point was extracted. The elevation values attached to the points for each shoreline/DEM pair were averaged to obtain a contour elevation that could be generated from the DEMs. Ultimately, Harris et al. (2006) averaged the resulting elevations from each shoreline/DEM comparison, and used the single averaged elevation to derive a shoreline from all LiDAR DEMs available.

For this study, a method similar to the one described in Harris et al. (2006) was utilized. The shorelines digitized from the 2007 and 2010 LiDAR associated aerial photography were converted to a series of points, with spacing comparable to the LiDAR DEM pixel size. For example, points were created every 1-meter for the 2010 shoreline and every 2-meters for the 2007 shoreline. These point layers were then overlain onto the concurrent LiDAR derived DEMs, and the elevation under each point was extracted. Simple statistical analyses were performed on the resulting elevation data to determine the range and mean of the extracted elevations. This type of analysis was then used to determine the contour elevation from the LiDAR DEM that most closely matched the digitized shoreline from the photograph.

Frequency distribution plots of the elevation values extracted from the 2007 and 2010 shorelines are displayed in Figure 7 and 8, respectively. The range of elevations captured by the digitized shorelines is plotted along the x-axis, and the frequency of occurrence is plotted on the y-axis. Ideally, the range of elevation values would be relatively small, indicating that the aerial photo analyst is able to identify and follow the shoreline indicator along a consistent elevation. However, the range of elevations captured by the digitized shorelines in this study was relatively high. Elevations along the 2007 shoreline ranged from 0.18 ft to 10.63 ft (a 10.45 ft range), while elevations along the 2010 shoreline ranged from -1.67 ft to 9.21 ft (a 10.88 ft range). These ranges however, are comparable to the differences between LiDAR and aerial photograph derived shorelines observed in previous studies (Harris et al., 2006), whose differences ranged from approximately 7 to 15 ft.

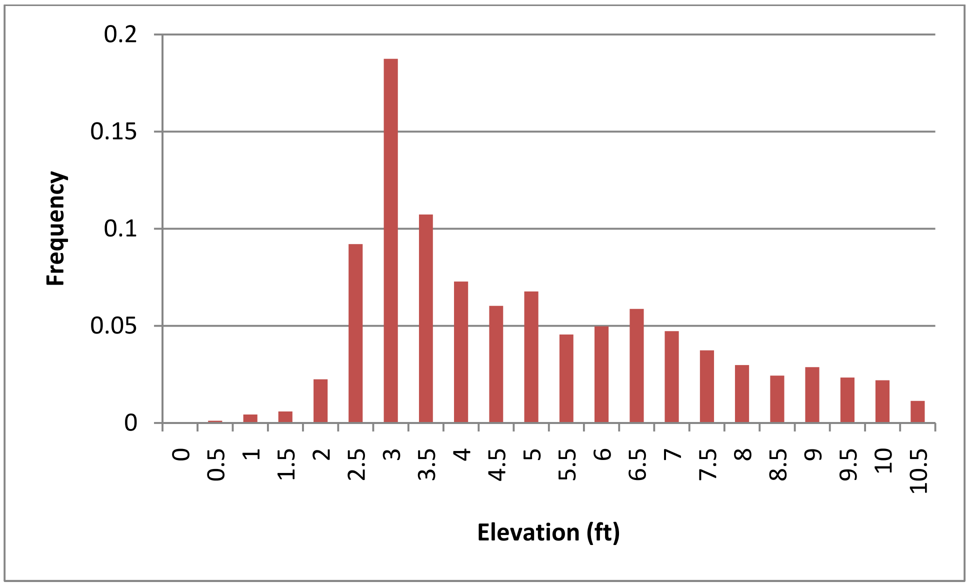

Figure 7. Frequency distribution plot for elevation values extracted from the 2007 shoreline.

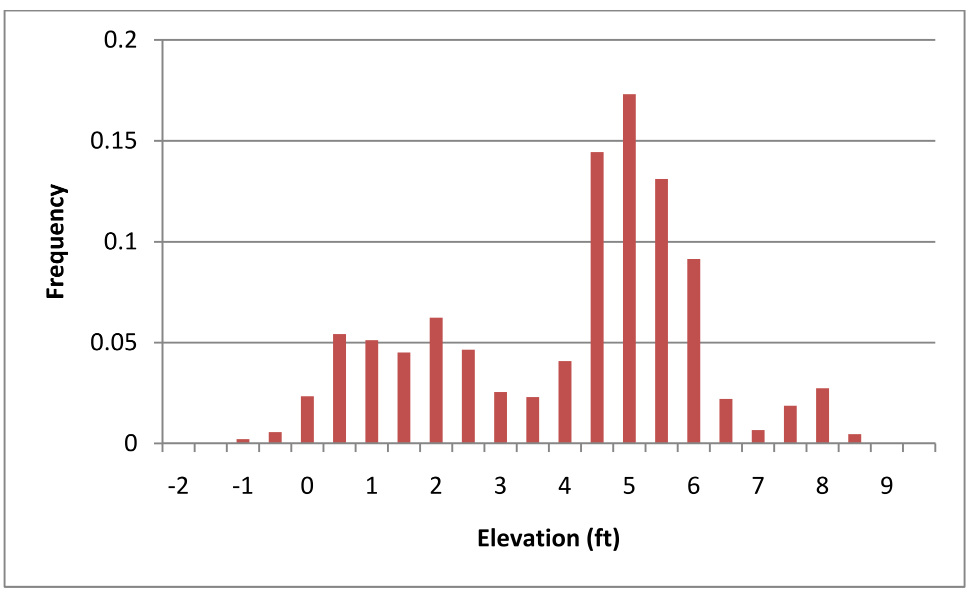

Figure 8. Frequency distribution plot for elevation values extracted from the 2010 shoreline.

A summary of point density, minimum and maximum elevations, as well as the mean and standard deviations is provided in Table 6. Following the methods used in Harris et al. (2006), an average of the mean elevation values for 2007 and 2010 was calculated to be 4.26 ft (NAVD88). Tidal data from the Portland, ME National Ocean Service (NOS) tide gage (Station ID: 8418150) was adjusted for the Saco Bay study area and used to identify elevations for common tidal datums: MHHW, MHW, and MTL (Table 7). Comparison of the tidal datums with the 4.26 ft NAVD88 average elevation of the 2007 and 2010 digitized shorelines shows a close match with MHW. Based on this finding, the 4.22 ft NAVD88 contour (MHW) was chosen as the shoreline indicator for the 2000, 2007, and 2010 LiDAR datasets. Use of a tidal benchmark to extract shorelines from LiDAR data for shoreline change analyses has been tested successfully by Robertson et al. (2004).

Table 6. Summary Statistics for Elevations Extracted from the 2007 and 2010 Shorelines.

Parameter	2007	2010
Count	6241	12838
Minimum	0.18	-1.67
Maximum	10.63	9.21
Mean Elevation (NAVD88)	4.69	3.83
Standard Deviation	2.25	2.04

Table 7. Tidal Datum Elevations for Saco Bay.

Tidal Benchmark	Elevation in feet (NAVD88)
Mean Higher High Water (MHHW)	4.65
Mean High Water (MHW)	4.22
Mean Tide Level (MTL)	0.35

Results from analysis of the LiDAR data were used to evaluate the possibility of combining LiDAR extracted shorelines with traditional data from historical surveys and aerial photographs for analysis of long-term shoreline change. Two different analyses were performed to assess the comparability of the various data sources and the impacts on rates of shoreline change. The analyses were completed using data from 1998 to 2010. The first analysis included a 1998 shoreline digitized from aerial photography in combination with the MHW derived contour line at 4.22 ft NAVD88 from the 2000, 2007, and 2010 LiDAR data. Results from this analysis were then compared to a second analysis which used digitized shorelines from the 1998, 2003, 2006, 2007, 2009, and 2010 aerial photographs. A comparison of the two analyses is provided in Figure 9. The red line presents the calculated shoreline change rates using the digitized shorelines, while the blue line presents the calculated shoreline change rates using the LiDAR derived shorelines. The dashed red lines and red zone area also provide the error bounds associated with the digitized shorelines between 1998 and 2010, as presented in Table 4 (± 1.5 ft/yr). In some cases, the differences between the two methods may be due to the errors associated with the digitization approach.

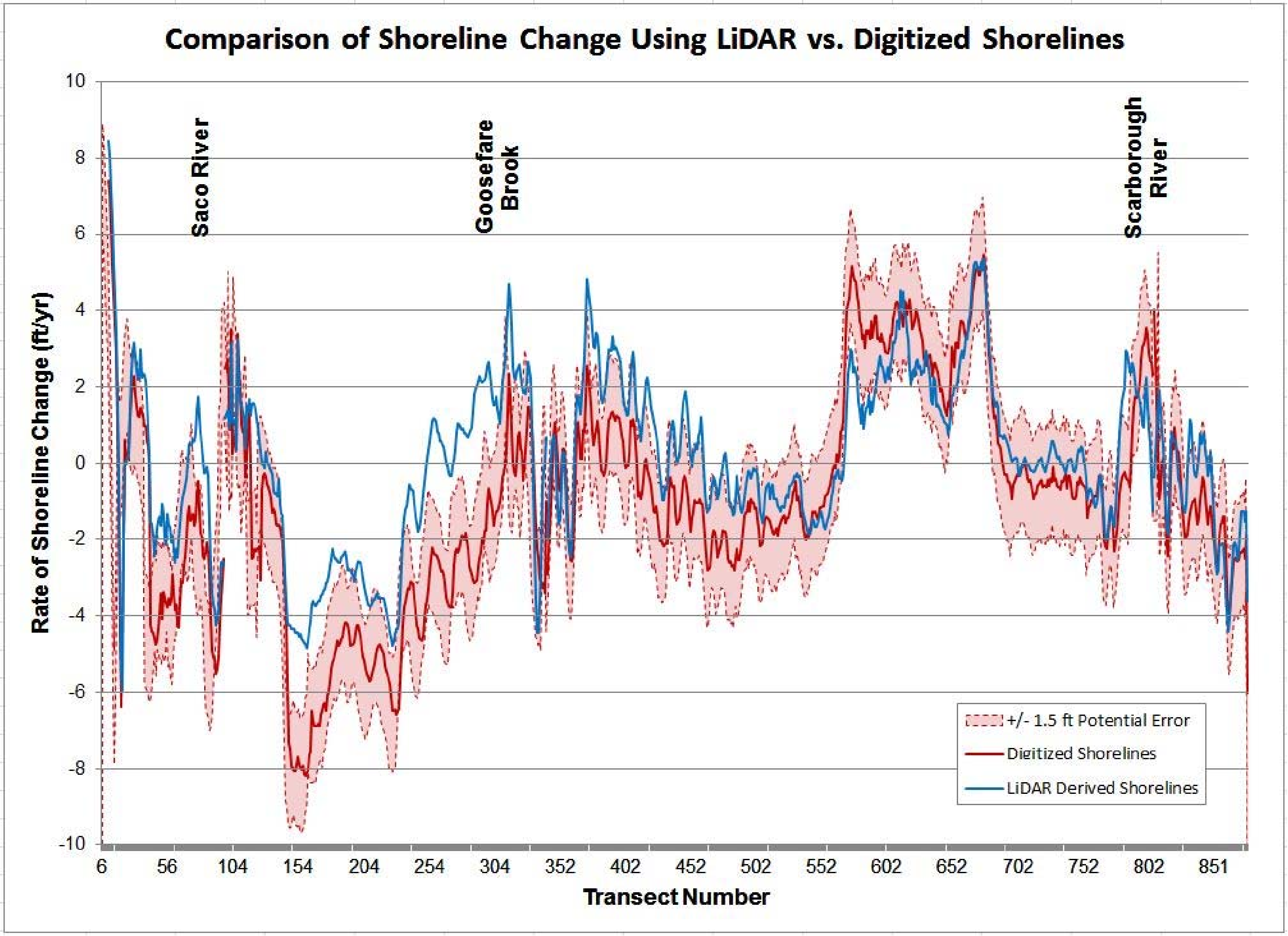

Figure 9. Comparison of LiDAR and aerial photo based inputs for shoreline change analyses from 1998 to 2010.

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Although differences between the two methods are evident, the trends in shoreline change are comparable. For example, both methods show similar trends of shoreline change to the south and north of Goosefare Brook, although the rates of change computed using the LiDAR derived shorelines indicate less erosion and greater accretion. The closest agreement between the two methods occurs along the northern portion of the study area starting around Transect 650 and extending across the Scarborough River to Western Beach.

Differences between shoreline change rates computed using shorelines digitized from aerial photographs and LiDAR derived contours are potentially due to interpretation errors associated with identifying the HWL on the aerial photography. This can occur when beach slopes vary along the study area or when the color of the wet dry line changes due to variations in sediment characteristics (Robertson, et al. 2004). Tonal changes caused by other features in the imagery such as debris lines, previous HWL marks, and instant swash lines can occasionally smear the HWL on the photographs as well. Finally, on highly reflective beaches consisting of white or light colored sand, discerning HWL can be very difficult, often leading to interpretation errors.

2.4.3 Discussion of using LIDAR Data for shoreline change

Although use of LiDAR data alone eliminates errors associated with interpretation of the HWL on aerial photographs, it cannot be used for the evaluation of historical rates of shoreline change since it is a relatively new survey technique that has become common in the last two decades. Therefore, historical shoreline position information can only be obtained through the combined interpretation of historical T-sheets, surveys, and aerial photography. When LiDAR is combined with other sources of data as in this analysis, attention must be given to potential discrepancies between the digitized high water line and any chosen elevation to extract a shoreline from recent LiDAR data.

Results of this evaluation confirm the findings of Robertson et al. (2004), who determined that water levels and tidal datums can be used to extract shorelines from LiDAR data for comparison with historical shoreline data. These contour shorelines can approximate the high water line with reasonable accuracy, allowing historical shoreline change analyses to incorporate various data sources.

Although there are inconsistencies with combining aerial photography and historical survey data with LiDAR data, there are also benefits. Difficulties associated with identifying the HWL from aerial photographs (reflective beaches, multiple rack lines, etc.) do not affect contour shorelines derived from LiDAR data, producing a more reliable shoreline indicator, and LiDAR derived contours can be extracted much more quickly and efficiently than digitizing the HWL from other sources. For this reason, utilization of LiDAR derived shorelines should be considered when planning future shoreline change analyses.

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3.0 CONCLUSION

This report updates two previous Woods Hole Group studies (WHG 2006; WHG 2004) on shoreline change in Saco Bay and Western Beach. The previous studies were updated by adding new shoreline position information since 1998. A total of six (6) new shorelines were added to the analysis for the years 2003, 2004, 2006, 2007, 2009, and 2010.

The following conclusions were drawn from the shoreline change update:

- Trends in long-term shoreline change from 1864 to 2010 showed little change from the previous studies. The data show high rates of erosion immediately north of the Saco River entrance, which gradually decrease to the north and eventually change over to accretion south of Goosefare Brook. Varying rates of shoreline accretion occur between Goosefare Brook and the Scarborough River. Long-term change at Western Beach shows mile accretion at the ends of the beach and more significant erosion near the center.
- Short-term shoreline change from 1998 to 2010 shows similar trends to the long-term data. Specifically, the short-term data show shoreline erosion south of the Saco River entrance. Accretion occurs immediately north of the Saco River likely due to recent stabilization efforts. Starting around Transect 134 the data show erosion rates on the order of -8.0 ft/yr. These rates taper off towards the north and eventually change to slight accretion in the vicinity of Goosefare Brook. With one exception the shoreline between Goosefare Brook and the Scarborough River is primarily erosional with average rates between -0.5 and -1.5 ft/yr. The exception occurs between Transects 564 and 696 where significant shoreline accretion takes place. Short-term data from Western Beach show a trend of increasing erosion from west to east.

The use of LiDAR data was found to be a viable approach to supplement analyses of historical shoreline change based on more traditional maps and aerial photographs. It was determined that water levels and tidal datums can be used to extract shorelines from LiDAR data for comparison with historical shoreline data.

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APPENDIX A: SHORELINE CHANGE MAPS (1864-2010)

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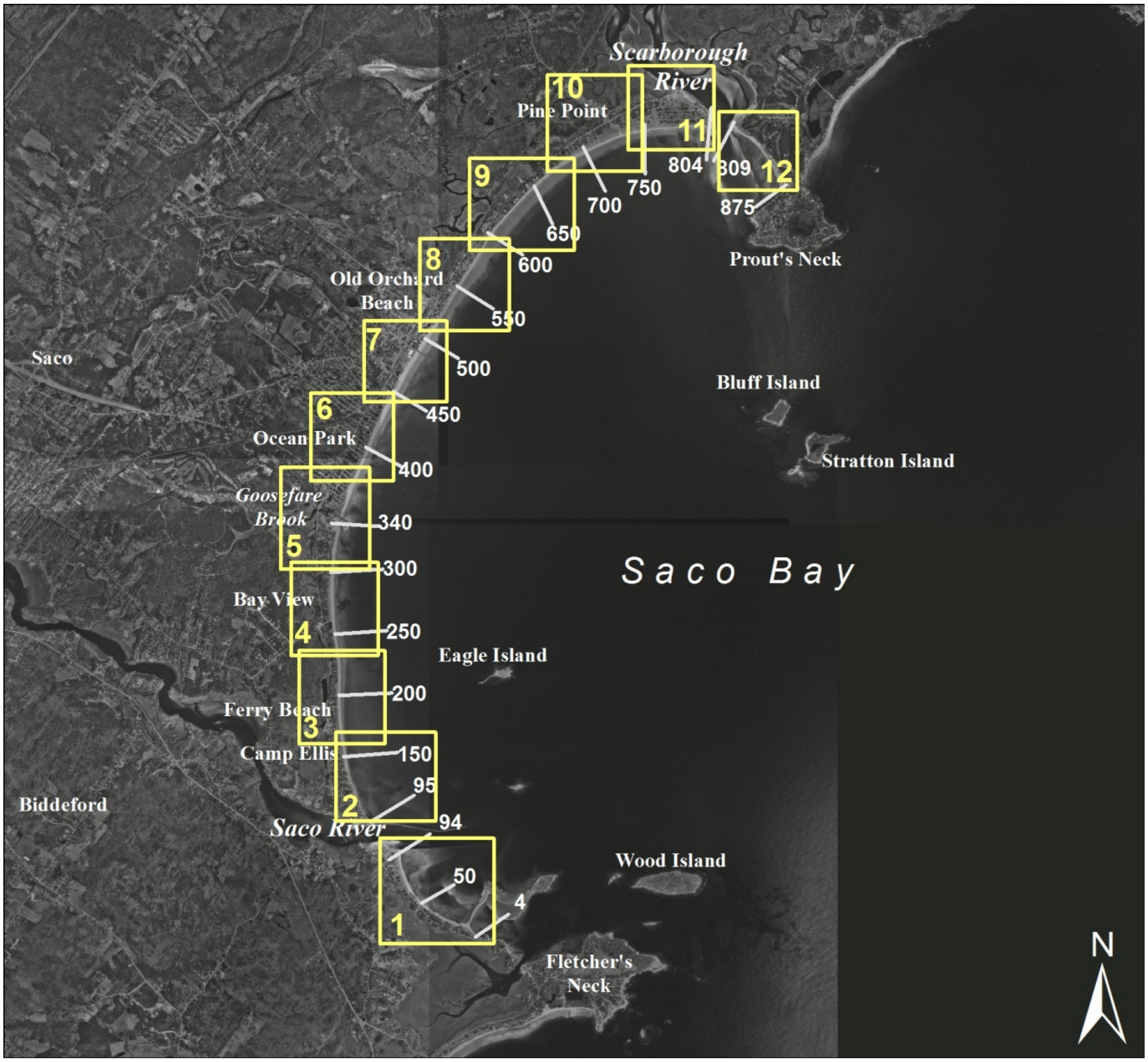
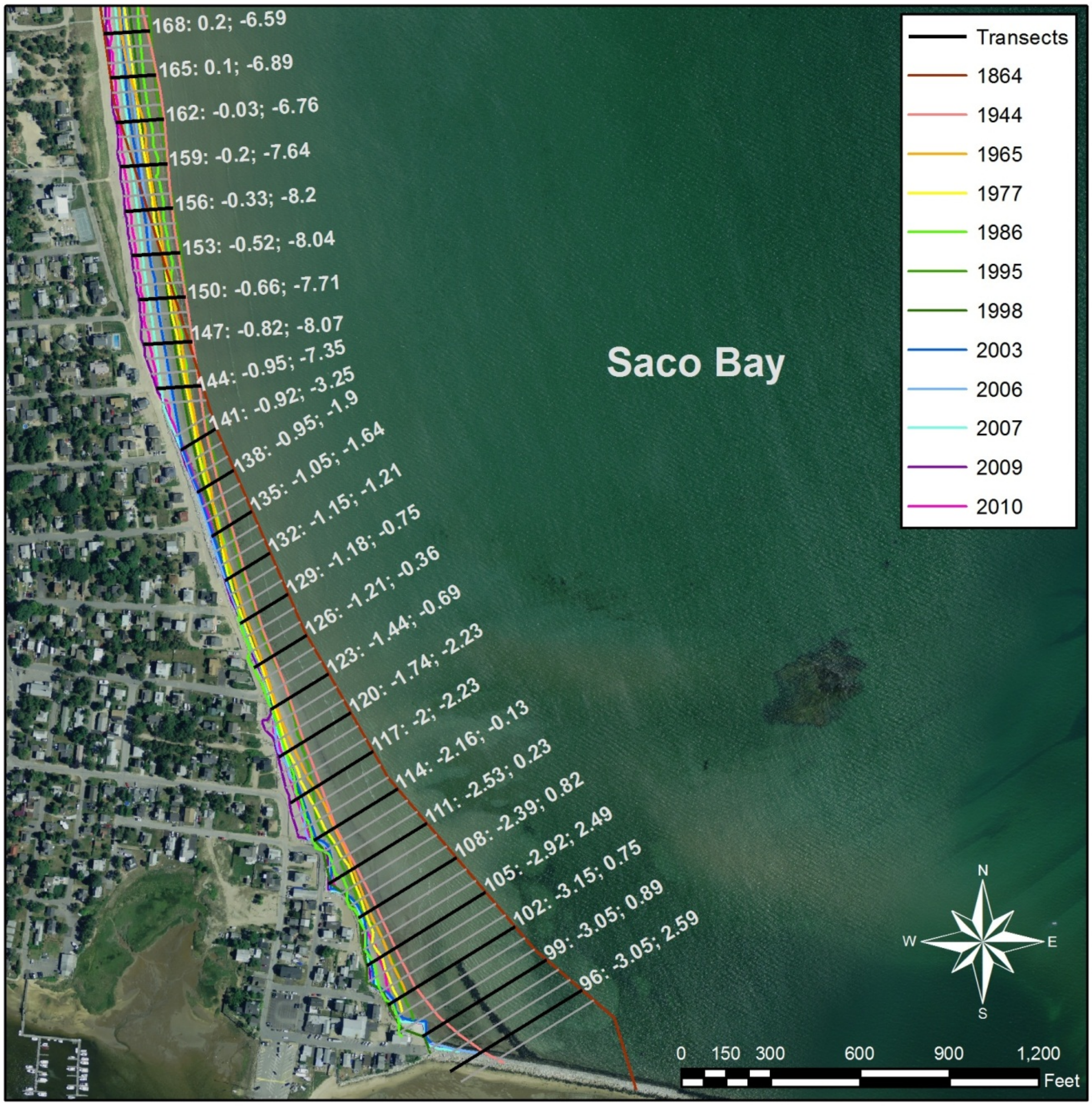
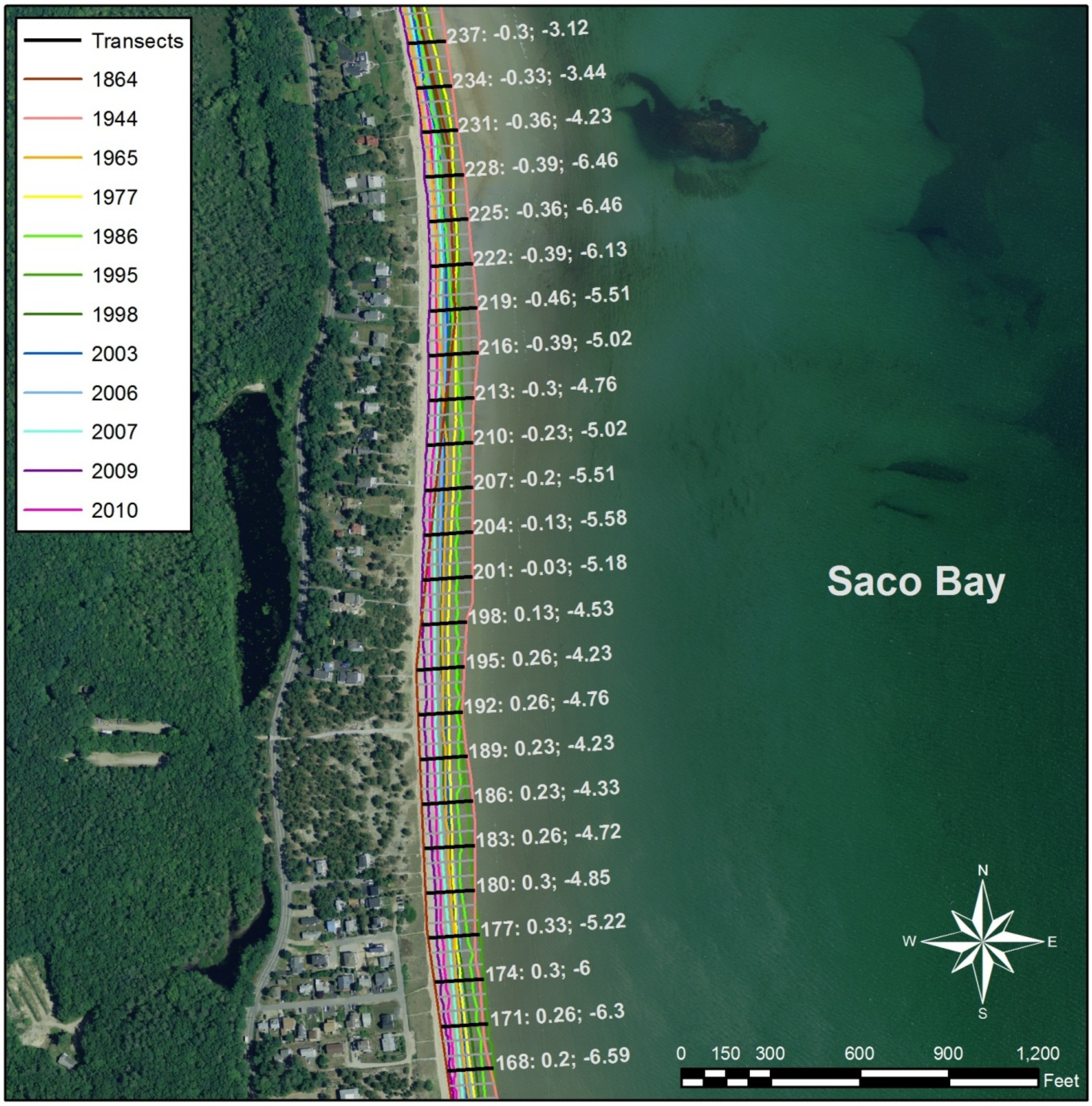


Figure A-1. Shoreline change map locator. Numbered boxes indicate the map number, which corresponds to one of the series of regional maps presented below.

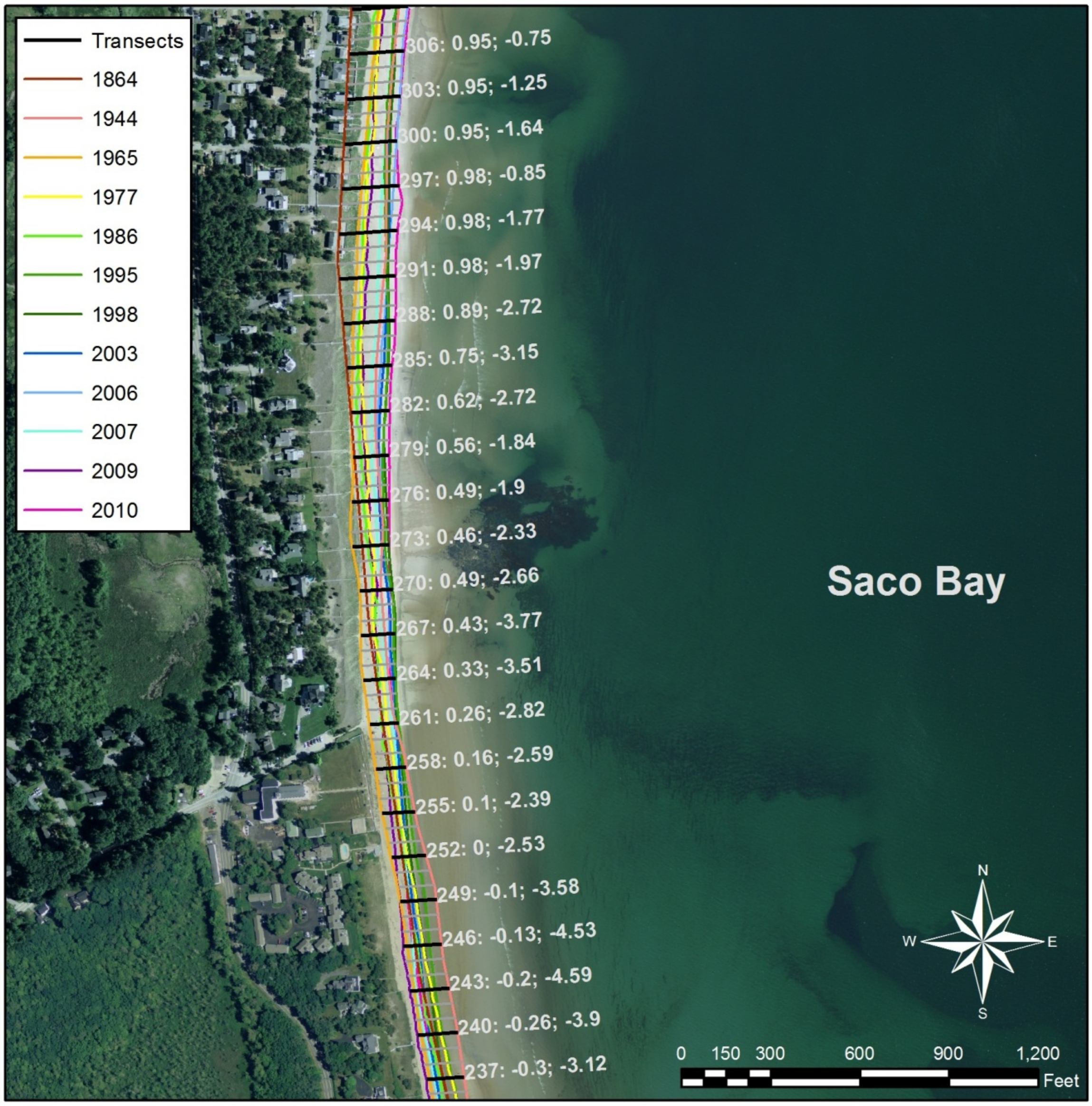
Map 1. **Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.**



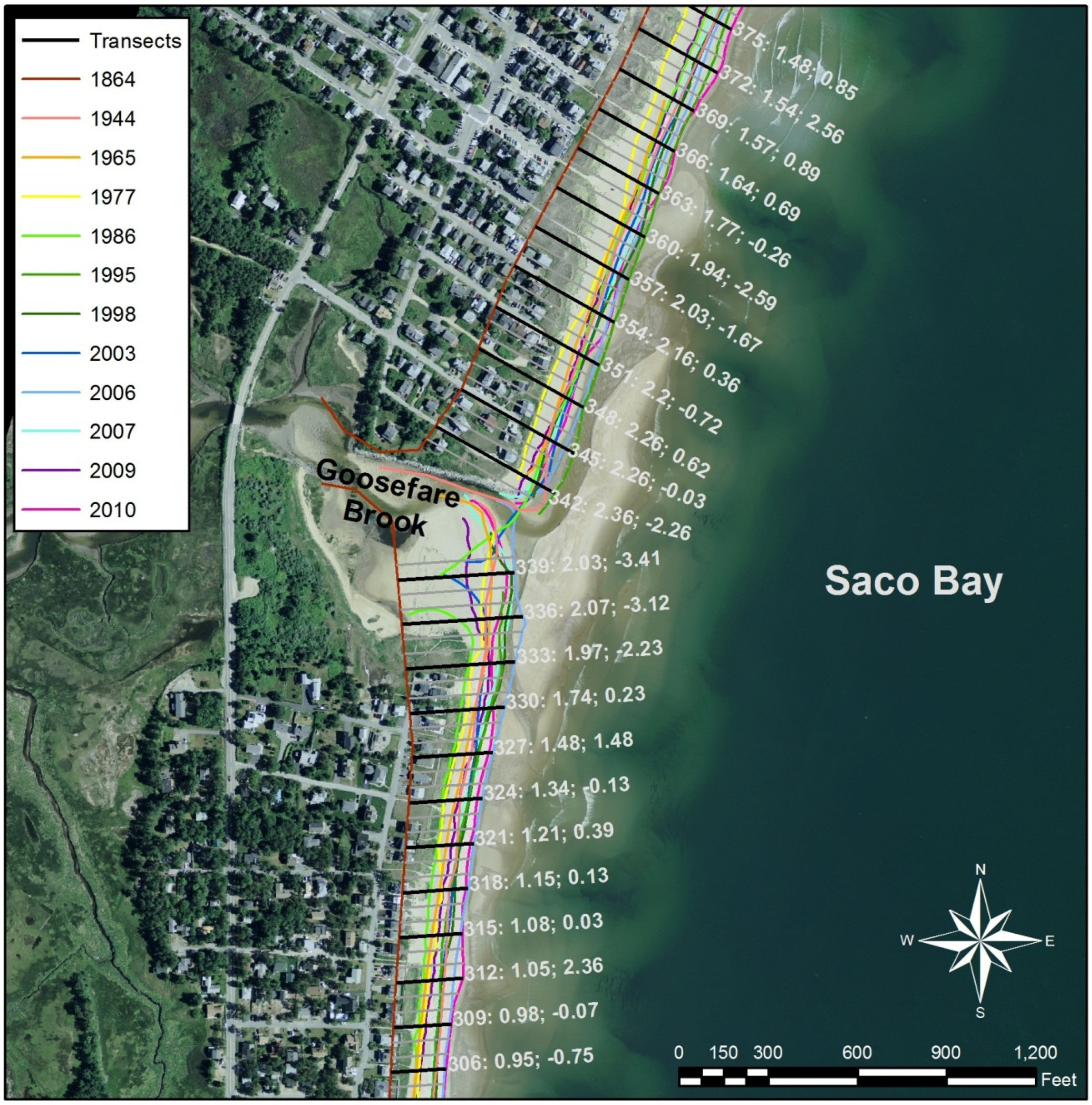
Map 2. **Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.**



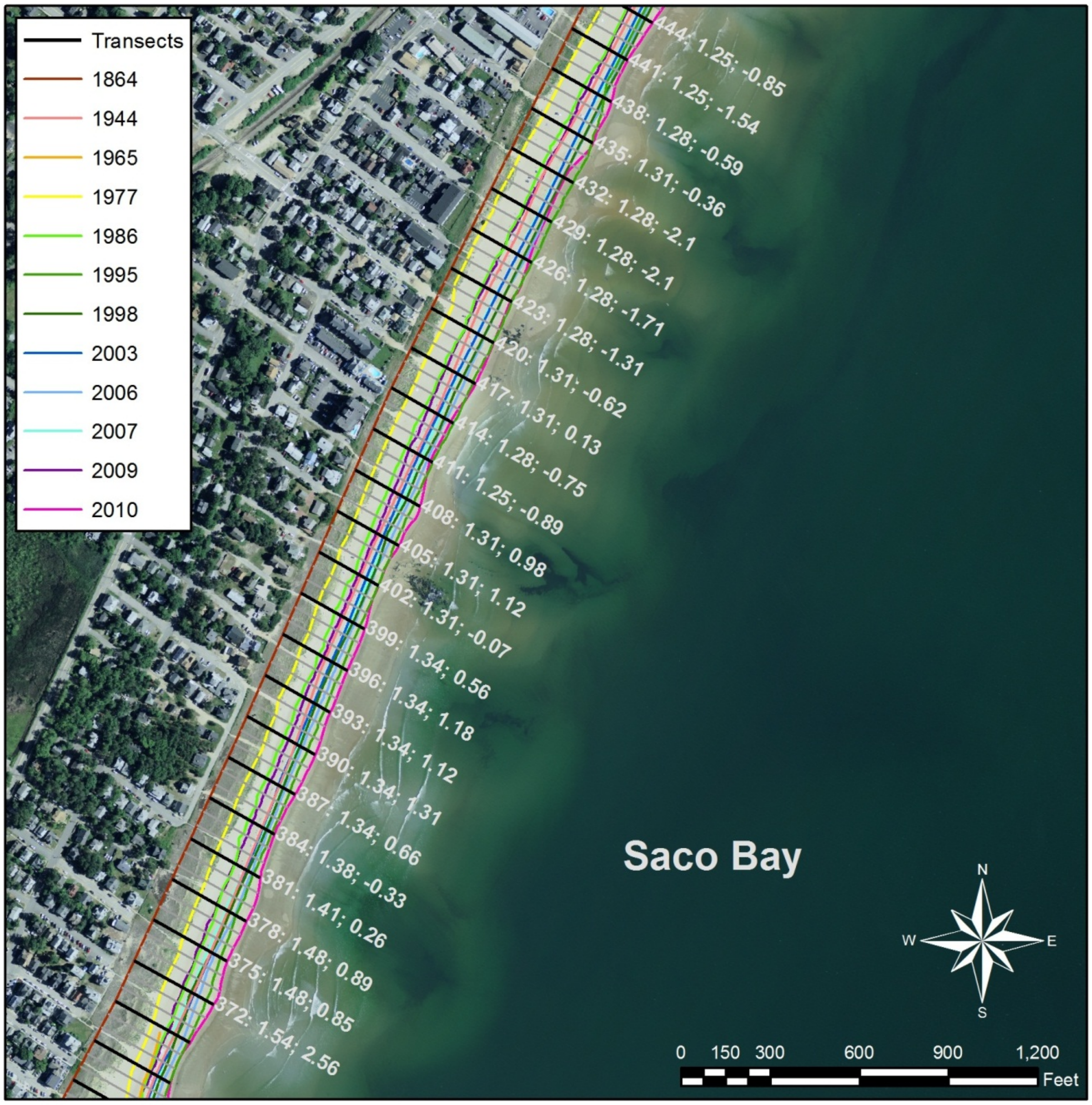
Map 3. **Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.**



Map 4. Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.

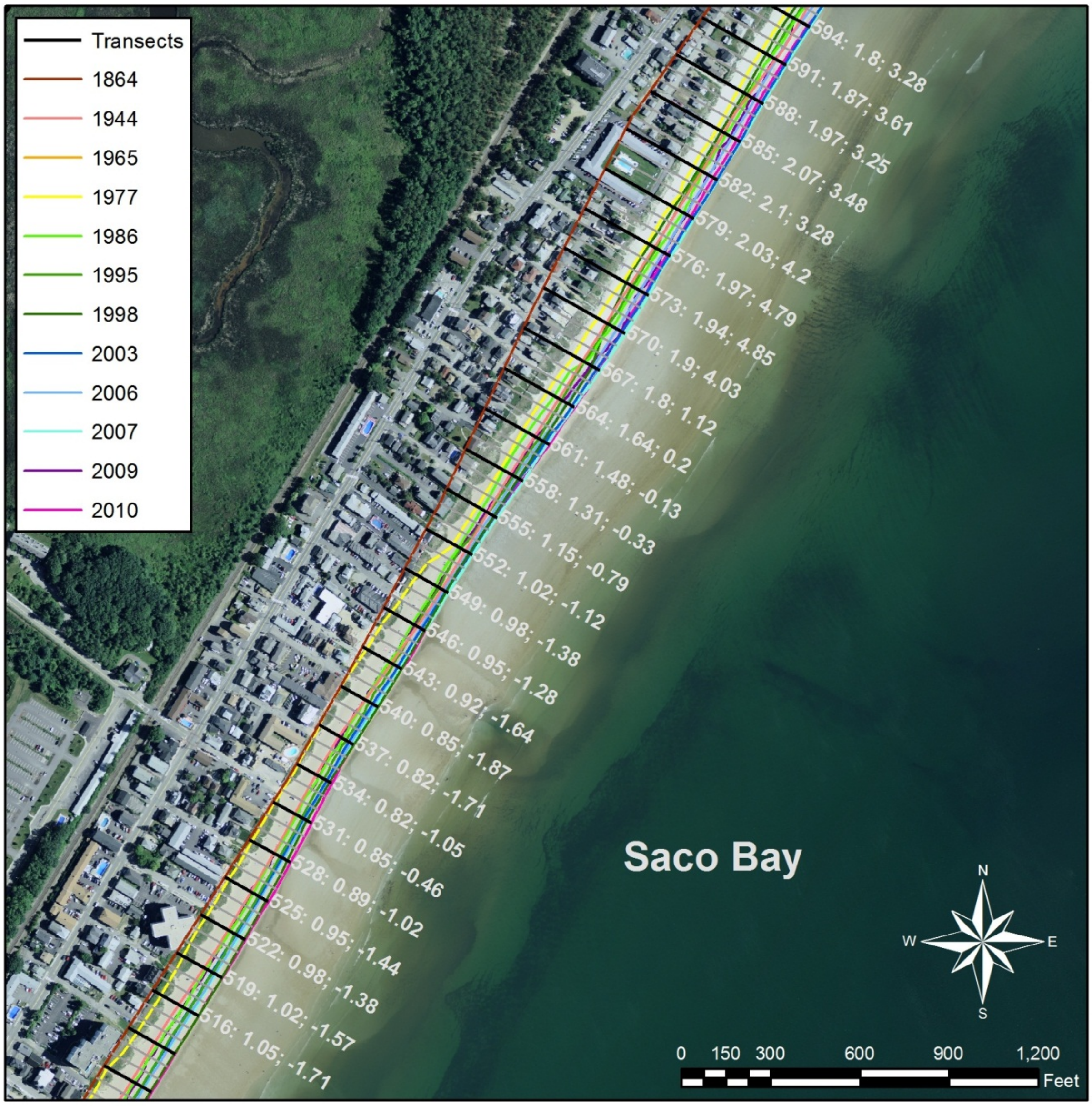


Map 5. Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.

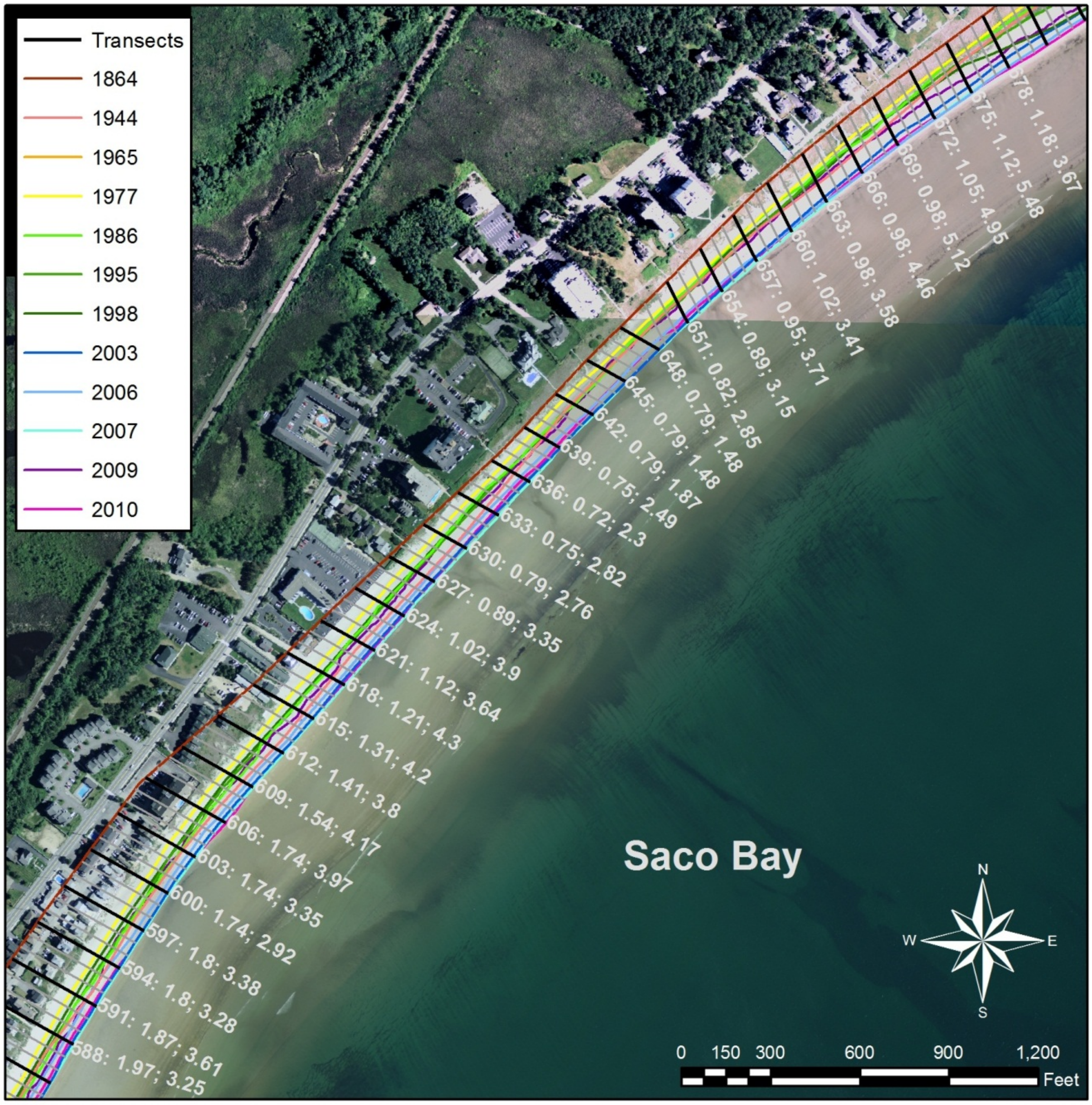


Map 6. **Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.**

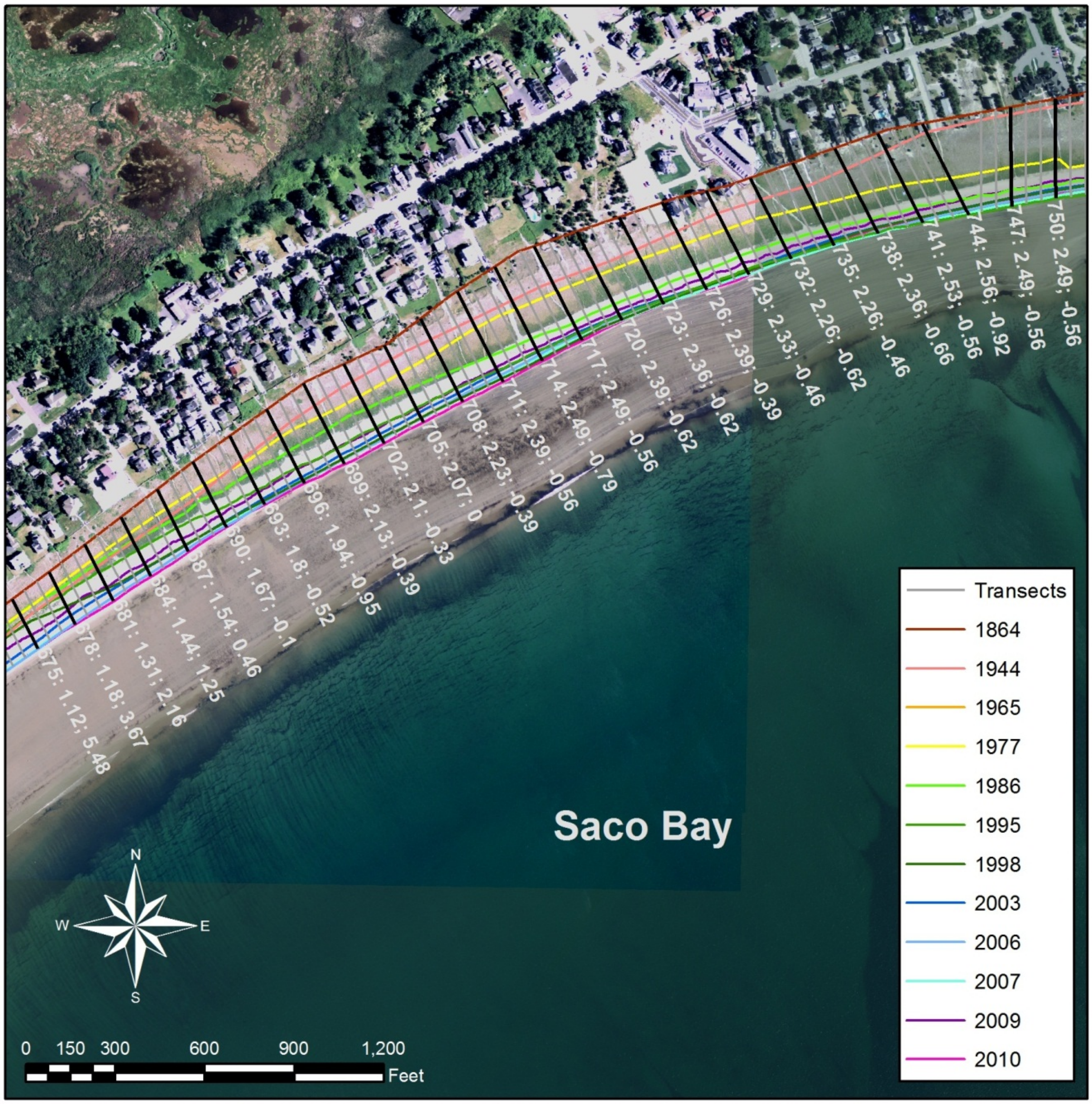
Map 7. **Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.**



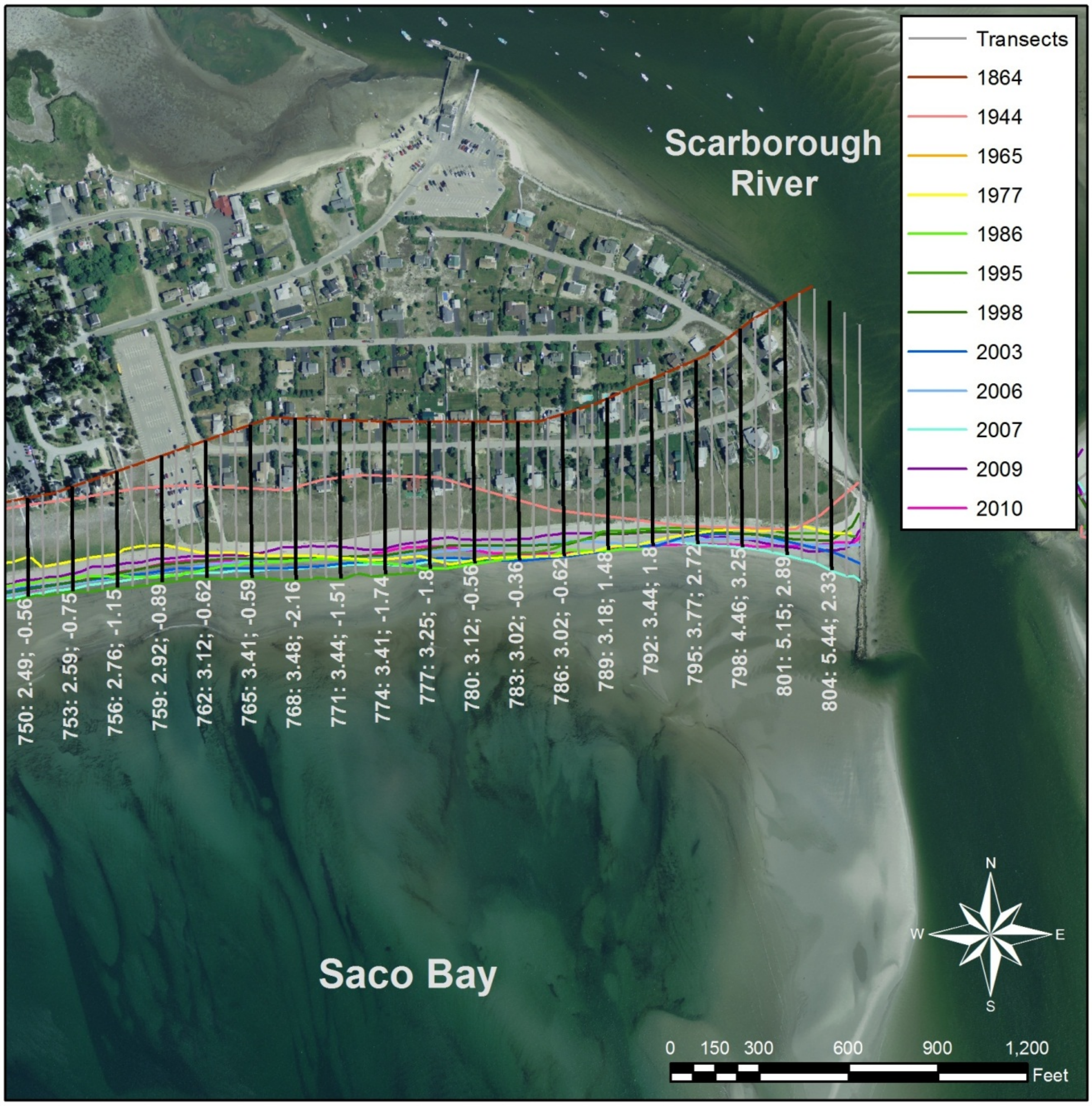
Map 8. Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.



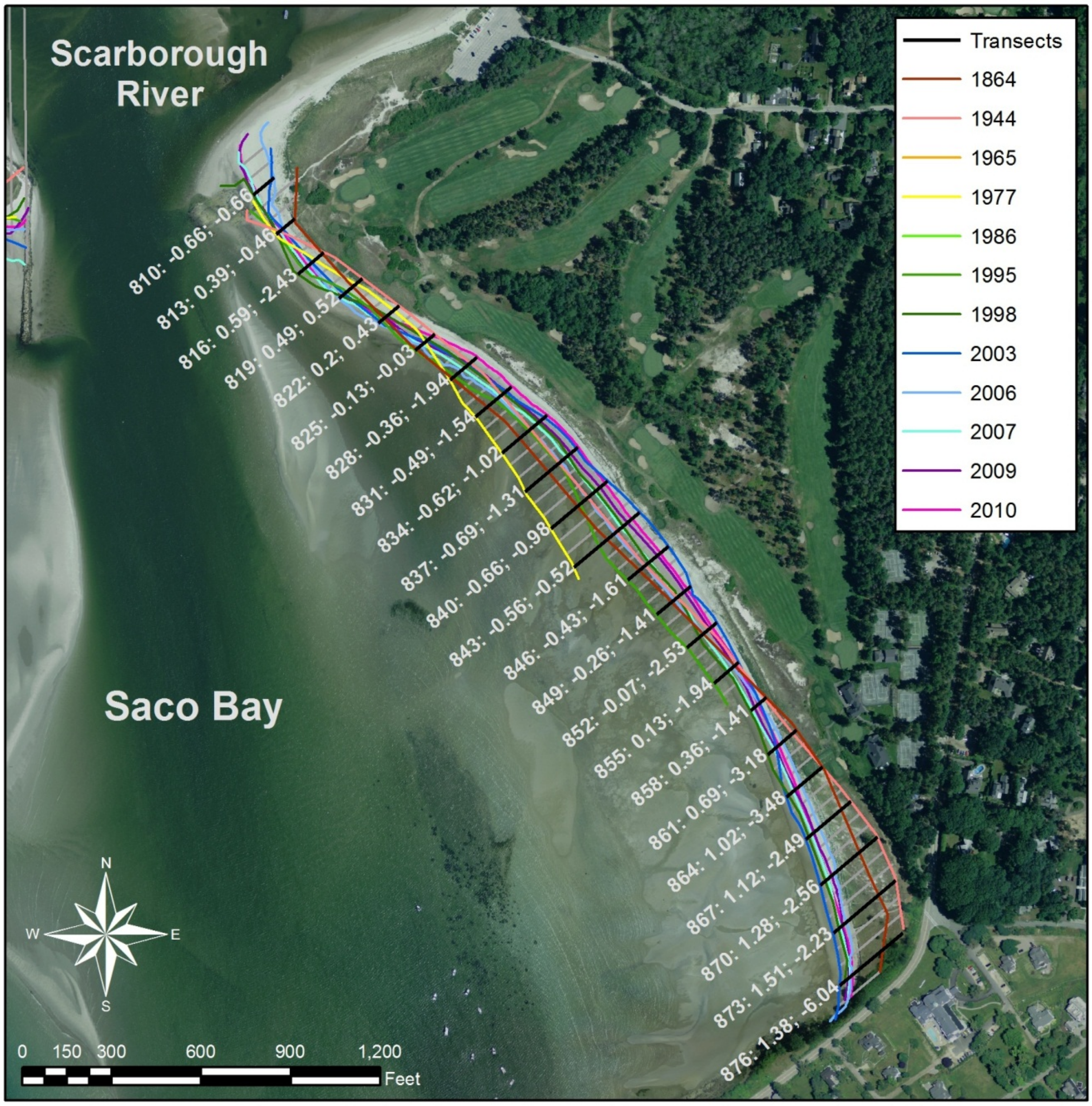
Map 9. Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.



Map 101. Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.



Map 11. **Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.**



Map 12. **Historical shoreline positions and change rates (linear regression) from 1864-2010 and 1998-2010 displayed in feet/year.**

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APPENDIX B: RATES OF SHORELINE CHANGE (1864-2010)

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	End Point Analysis						Linear Regression Analysis					
Transect	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998
4	-1.21	-0.20	0.52	2.66	8.76	1.31	-1.21	0.07	0.46	2.26	7.58	1.84
5	-1.05	-0.13	0.56	2.53	8.56	1.21	-1.05	0.10	0.49	2.16	7.51	1.74
6	-0.89	-0.03	0.62	2.46	8.23	1.21	-0.89	0.20	0.56	2.16	7.41	1.71
7	-0.66	0.10	0.72	2.36	7.77	1.18	-0.66	0.33	0.66	2.10	7.08	1.67
8	-0.26	0.26	0.79	2.07	6.95	1.02	-0.26	0.46	0.72	1.80	6.10	1.44
9	0.13	0.43	0.89	1.80	6.13	0.89	0.13	0.62	0.79	1.51	5.15	1.25
10	0.46	0.59	0.95	1.51	5.15	0.72	0.46	0.72	0.85	1.31	4.40	1.08
11	0.72	0.69	0.92	1.12	3.25	0.66	0.72	0.82	0.89	1.02	2.89	0.95
12	0.98	0.85	0.89	0.72	1.18	0.62	0.98	0.92	0.89	0.72	1.05	0.82
13	1.25	1.02	0.82	0.33	-1.12	0.62	1.25	0.98	0.85	0.43	-0.95	0.62
14	1.61	1.18	0.72	-0.33	-4.62	0.62	1.61	1.15	0.82	-0.13	-4.46	0.49
15	1.84	1.18	0.56	-1.02	-6.49	0.16	1.84	1.12	0.72	-0.56	-6.40	0.07
16	2.10	0.79	0.36	-1.74	-4.36	-1.15	2.10	0.75	0.36	-1.48	-4.46	-1.12
17	2.33	0.33	0.16	-2.43	-1.48	-2.62	2.33	0.39	0.00	-2.43	-1.84	-2.40
18	2.46	-0.10	-0.03	-3.02	0.95	-3.87	2.46	0.00	-0.33	-3.12	0.62	-3.48
19	3.08	-0.26	-0.26	-4.26	-0.16	-5.18	3.08	-0.20	-0.59	-4.26	0.13	-4.86
20	3.41	-0.07	-0.07	-4.26	-0.03	-5.15	3.41	-0.07	-0.46	-4.30	0.10	-4.95
21	3.12	-0.10	-0.03	-3.87	0.43	-4.82	3.12	-0.03	-0.43	-3.97	0.43	-4.49
22	2.62	-0.20	-0.10	-3.41	1.05	-4.36	2.62	-0.23	-0.43	-2.95	1.21	-3.84
23	2.13	-0.33	-0.13	-2.89	2.10	-3.97	2.13	-0.26	-0.43	-2.53	1.80	-3.28
24	1.80	-0.39	-0.20	-2.59	2.20	-3.64	1.80	-0.36	-0.46	-2.23	2.10	-2.99
25	1.44	-0.49	-0.26	-2.33	2.39	-3.35	1.44	-0.43	-0.49	-2.00	2.30	-2.72
26	1.05	-0.56	-0.36	-2.07	2.03	-2.95	1.05	-0.49	-0.56	-1.80	1.80	-2.40
27	0.85	-0.62	-0.43	-1.97	1.84	-2.79	0.85	-0.56	-0.62	-1.80	1.48	-2.26
28	0.62	-0.69	-0.49	-1.84	1.90	-2.66	0.62	-0.62	-0.69	-1.77	1.25	-2.13
29	0.33	-0.79	-0.56	-1.64	1.94	-2.40	0.33	-0.66	-0.75	-1.64	1.21	-1.90
30	0.07	-0.85	-0.59	-1.41	2.16	-2.17	0.07	-0.72	-0.75	-1.41	1.44	-1.67
31	-0.23	-0.89	-0.62	-1.12	2.16	-1.84	-0.23	-0.72	-0.79	-1.21	1.34	-1.35
32	-0.52	-0.89	-0.66	-0.82	2.13	-1.48	-0.52	-0.75	-0.75	-0.92	1.25	-1.02
33	-0.69	-0.92	-0.69	-0.69	2.03	-1.28	-0.69	-0.79	-0.75	-0.75	0.98	-0.79
34	-0.75	-0.92	-0.69	-0.62	1.84	-1.15	-0.75	-0.79	-0.75	-0.69	0.98	-0.66
35	-0.85	-0.92	-0.72	-0.56	1.38	-0.98	-0.85	-0.75	-0.75	-0.66	0.59	-0.56
36	-0.95	-0.89	-0.75	-0.52	0.52	-0.75	-0.95	-0.72	-0.75	-0.56	0.43	-0.36
37	-1.05	-0.82	-0.72	-0.33	0.26	-0.43	-1.05	-0.66	-0.69	-0.36	-0.03	-0.10
38	-1.15	-0.82	-1.02	-0.85	-3.38	-0.30	-1.15	-0.89	-0.98	-0.79	-4.26	-0.30
39	-1.21	-0.79	-0.98	-0.69	-3.38	-0.13	-1.21	-0.82	-0.95	-0.72	-4.40	-0.10
40	-1.28	-0.72	-0.95	-0.56	-3.54	0.07	-1.28	-0.79	-0.92	-0.59	-4.46	0.13
41	-1.31	-0.69	-0.92	-0.46	-3.80	0.30	-1.31	-0.72	-0.85	-0.46	-4.59	0.33
42	-1.41	-0.69	-0.92	-0.33	-3.61	0.36	-1.41	-0.72	-0.85	-0.30	-4.76	0.46
43	-1.51	-0.72	-0.95	-0.26	-3.64	0.49	-1.51	-0.75	-0.85	-0.23	-4.66	0.56
44	-1.61	-0.72	-0.95	-0.16	-3.51	0.56	-1.61	-0.72	-0.82	-0.16	-4.36	0.69
45	-1.57	-0.75	-0.95	-0.16	-3.05	0.46	-1.57	-0.72	-0.82	-0.20	-3.90	0.59
46	-1.54	-0.75	-0.92	-0.16	-2.79	0.43	-1.54	-0.69	-0.79	-0.20	-3.41	0.56
47	-1.48	-0.69	-0.89	-0.16	-3.18	0.49	-1.48	-0.66	-0.79	-0.16	-4.07	0.66
48	-1.44	-0.69	-0.85	-0.16	-2.95	0.46	-1.44	-0.66	-0.72	-0.10	-3.38	0.59
49	-1.41	-0.62	-0.79	-0.07	-2.98	0.56	-1.41	-0.59	-0.69	-0.07	-3.54	0.66
50	-1.34	-0.56	-0.75	-0.07	-3.08	0.59	-1.34	-0.56	-0.66	-0.10	-3.67	0.66
51	-1.31	-0.59	-0.79	-0.13	-2.82	0.46	-1.31	-0.56	-0.69	-0.20	-3.77	0.59
52	-1.28	-0.59	-0.75	-0.13	-2.82	0.46	-1.28	-0.56	-0.66	-0.13	-3.54	0.59
53	-1.28	-0.52	-0.72	-0.07	-2.98	0.59	-1.28	-0.49	-0.62	-0.07	-3.71	0.72
54	-1.25	-0.46	-0.69	0.00	-3.08	0.69	-1.25	-0.43	-0.56	0.00	-3.58	0.79
55	-1.25	-0.39	-0.56	0.23	-2.59	0.85	-1.25	-0.39	-0.46	0.23	-2.92	0.85
56	-1.18	-0.30	-0.56	0.20	-3.48	1.02	-1.18	-0.36	-0.43	0.23	-3.84	0.92
57	-1.12	-0.26	-0.49	0.26	-3.12	0.98	-1.12	-0.33	-0.39	0.26	-3.71	0.85
58	-1.02	-0.23	-0.46	0.20	-3.41	0.98	-1.02	-0.33	-0.39	0.20	-4.17	0.85
59	-0.95	-0.16	-0.39	0.26	-3.08	0.98	-0.95	-0.26	-0.36	0.16	-4.30	0.92
60	-0.89	-0.10	-0.30	0.39	-2.53	1.02	-0.89	-0.16	-0.26	0.36	-3.64	1.02
61	-0.79	0.00	-0.20	0.56	-2.13	1.12	-0.79	-0.10	-0.13	0.56	-3.12	1.15
62	-0.72	0.10	-0.07	0.72	-1.90	1.31	-0.72	0.00	-0.03	0.72	-3.15	1.35
63	-0.66	0.20	0.03	0.92	-1.64	1.48	-0.66	0.07	0.10	1.05	-2.66	1.54
64	-0.69	0.23	0.13	1.08	-1.18	1.57	-0.69	0.13	0.16	1.18	-2.43	1.64
65	-0.69	0.30	0.20	1.25	-0.79	1.71	-0.69	0.16	0.23	1.34	-1.97	1.74
66	-0.69	0.33	0.30	1.48	-0.23	1.84	-0.69	0.23	0.33	1.54	-1.38	1.87

	End Point Analysis						Linear Regression Analysis					
Transect	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**
67	-0.69	0.43	0.39	1.67	0.07	2.03	-0.69	0.30	0.43	1.74	-1.15	2.10
68	-0.69	0.49	0.43	1.77	-0.26	2.20	-0.69	0.36	0.49	1.87	-1.51	2.26
69	-0.69	0.52	0.46	1.87	-0.33	2.33	-0.69	0.46	0.56	1.97	-1.44	2.43
70	-0.59	0.56	0.46	1.77	-0.39	2.23	-0.59	0.52	0.59	1.90	-1.34	2.46
71	-0.49	0.62	0.49	1.74	-0.66	2.23	-0.49	0.59	0.62	1.84	-1.64	2.46
72	-0.39	0.69	0.59	1.77	-0.49	2.23	-0.39	0.66	0.69	1.87	-1.48	2.49
73	-0.30	0.69	0.66	1.80	0.23	2.17	-0.30	0.66	0.72	1.87	-0.85	2.36
74	-0.20	0.75	0.75	1.87	0.59	2.17	-0.20	0.75	0.82	1.90	-0.46	2.33
75	-0.16	0.89	0.79	1.94	-0.39	2.43	-0.16	0.89	0.89	1.97	-1.25	2.56
76	-0.13	0.98	0.82	1.94	-1.05	2.59	-0.13	0.95	0.95	1.97	-1.84	2.69
77	-0.10	1.02	0.85	2.00	-1.05	2.66	-0.10	0.95	1.08	2.59	-1.94	3.28
78	-0.03	1.12	0.92	2.07	-1.44	2.82	-0.03	1.05	1.12	2.62	-2.43	3.48
79	0.00	1.18	0.98	2.13	-1.51	2.92	0.00	1.15	1.21	2.69	-2.49	3.64
80	0.07	1.28	1.05	2.26	-1.38	3.05	0.07	1.28	1.31	2.76	-2.36	3.81
81	0.10	1.34	1.15	2.43	-1.08	3.18	0.10	1.41	1.38	2.79	-2.07	3.94
82	0.16	1.44	1.21	2.49	-1.28	3.31	0.16	1.54	1.48	2.72	-2.33	4.00
83	0.36	1.57	1.28	2.39	-2.16	3.38	0.36	1.67	1.54	2.62	-2.92	3.97
84	0.62	1.77	1.38	2.26	-3.25	3.44	0.62	1.84	1.64	2.53	-4.07	4.04
85	0.92	2.00	1.51	2.20	-4.20	3.61	0.92	2.07	1.80	2.49	-4.92	4.17
86	1.21	2.23	1.71	2.26	-4.49	3.74	1.21	2.30	2.00	2.62	-5.08	4.33
87	1.51	2.46	1.90	2.36	-4.59	3.87	1.51	2.53	2.20	2.76	-5.15	4.49
88	1.80	2.72	2.10	2.43	-5.05	4.07	1.80	2.79	2.39	2.79	-5.51	4.63
89	2.10	2.95	2.33	2.56	-5.08	4.23	2.10	3.02	2.59	2.85	-5.41	4.76
90	2.43	3.21	2.56	2.76	-4.72	4.36	2.43	3.28	2.85	3.05	-5.08	4.95
91	2.72	3.44	2.89	3.05	-3.71	4.53	2.72	3.54	3.12	3.31	-4.20	5.22
92	2.98	3.71	3.18	3.41	-2.98	4.79	2.98	3.80	3.41	3.67	-3.54	5.48
93	3.18	4.00	3.48	3.80	-2.69	5.22	3.18	4.10	3.74	4.07	-3.05	5.84
94	3.38	4.30	3.74	4.23	-2.43	5.64	3.38	4.40	4.07	4.53	-2.49	6.27
95	-4.76	-3.90	-3.35	-1.67	2.85	-2.66	-4.76	-3.87	-3.08	-0.98	2.49	-2.23
96	-4.89	-3.87	-3.35	-1.44	2.95	-2.40	-4.89	-3.84	-3.05	-0.89	2.59	-2.03
97	-4.95	-3.87	-3.31	-1.31	3.05	-2.26	-4.95	-3.80	-3.08	-0.98	2.72	-1.90
98	-5.02	-3.80	-3.31	-1.28	2.20	-2.03	-5.02	-3.74	-3.18	-1.28	1.84	-1.77
99	-5.02	-3.67	-3.28	-1.18	1.12	-1.67	-5.02	-3.67	-3.05	-1.08	0.89	-1.57
100	-4.95	-3.84	-3.21	-1.08	4.00	-2.20	-4.95	-3.80	-3.02	-0.89	3.54	-2.13
101	-4.92	-3.80	-3.44	-1.64	0.82	-2.17	-4.92	-3.71	-3.28	-1.61	0.23	-1.90
102	-4.92	-3.74	-3.31	-1.38	1.57	-2.03	-4.92	-3.61	-3.15	-1.38	0.75	-1.61
103	-4.79	-3.61	-3.18	-1.25	1.84	-1.90	-4.79	-3.51	-3.12	-1.48	0.56	-1.54
104	-4.62	-3.77	-2.98	-1.02	5.64	-2.46	-4.62	-3.44	-3.08	-1.61	3.38	-1.71
105	-4.46	-3.51	-2.89	-0.95	4.26	-2.07	-4.46	-3.28	-2.92	-1.38	2.49	-1.51
106	-4.30	-3.31	-2.76	-0.92	3.44	-1.84	-4.30	-3.15	-2.76	-1.21	1.97	-1.41
107	-4.13	-3.08	-2.69	-0.95	1.87	-1.54	-4.13	-2.95	-2.56	-1.02	1.02	-1.18
108	-3.97	-2.89	-2.56	-0.82	1.31	-1.28	-3.97	-2.85	-2.39	-0.79	0.82	-1.18
109	-3.80	-2.79	-2.49	-0.89	1.12	-1.31	-3.80	-2.76	-2.33	-0.89	0.92	-1.25
110	-3.64	-2.76	-2.56	-1.25	-0.20	-1.44	-3.64	-2.66	-2.43	-1.34	-0.36	-1.28
111	-3.51	-2.85	-2.53	-1.38	1.02	-1.87	-3.51	-2.62	-2.53	-1.77	0.23	-1.51
112	-3.38	-2.66	-2.33	-1.05	1.61	-1.64	-3.38	-2.49	-2.26	-1.34	0.89	-1.38
113	-3.21	-2.49	-2.13	-0.82	1.80	-1.41	-3.21	-2.36	-2.03	-0.95	1.34	-1.28
114	-3.08	-2.46	-2.23	-1.21	0.16	-1.54	-3.08	-2.36	-2.16	-1.41	-0.13	-1.51
115	-2.85	-2.33	-2.20	-1.44	-0.75	-1.57	-2.85	-2.26	-2.20	-1.71	-2.49	-1.57
116	-2.72	-2.26	-2.13	-1.41	-0.85	-1.54	-2.72	-2.16	-2.10	-1.61	-2.46	-1.44
117	-2.62	-2.16	-2.07	-1.41	-0.95	-1.51	-2.62	-2.10	-2.00	-1.44	-2.23	-1.25
118	-2.53	-2.07	-2.00	-1.38	-1.12	-1.44	-2.53	-2.00	-1.90	-1.31	-2.30	-1.05
119	-2.43	-1.97	-1.94	-1.34	-1.31	-1.35	-2.43	-1.90	-1.84	-1.21	-2.23	-0.92
120	-2.33	-1.90	-1.84	-1.28	-1.48	-1.25	-2.33	-1.80	-1.74	-1.12	-2.23	-0.79
121	-2.20	-1.80	-1.77	-1.21	-1.44	-1.18	-2.20	-1.74	-1.67	-1.08	-2.16	-0.69
122	-2.07	-1.71	-1.71	-1.28	-1.90	-1.12	-2.07	-1.64	-1.61	-1.08	-3.08	-0.62
123	-1.97	-1.61	-1.51	-0.95	-0.39	-1.08	-1.97	-1.54	-1.44	-0.72	-0.69	-0.56
124	-1.84	-1.51	-1.38	-0.85	0.00	-1.02	-1.84	-1.44	-1.31	-0.59	-0.33	-0.52
125	-1.74	-1.44	-1.31	-0.79	0.10	-0.98	-1.74	-1.41	-1.25	-0.56	-0.26	-0.52
126	-1.67	-1.38	-1.25	-0.75	0.07	-0.95	-1.67	-1.34	-1.21	-0.59	-0.36	-0.56
127	-1.64	-1.34	-1.21	-0.75	-0.03	-0.92	-1.64	-1.31	-1.21	-0.62	-0.56	-0.59
128	-1.61	-1.31	-1.21	-0.75	-0.13	-0.89	-1.61	-1.28	-1.18	-0.62	-0.62	-0.56
129	-1.51	-1.28	-1.21	-0.82	-0.33	-0.95	-1.51	-1.25	-1.18	-0.66	-0.75	-0.52

	End Point Analysis						Linear Regression Analysis					
Transect	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998
130	-1.44	-1.25	-1.21	-0.92	-0.62	-0.98	-1.44	-1.21	-1.15	-0.72	-0.95	-0.52
131	-1.38	-1.21	-1.18	-0.95	-0.92	-0.98	-1.38	-1.18	-1.15	-0.82	-1.31	-0.56
132	-1.28	-1.18	-1.15	-0.98	-0.79	-1.02	-1.28	-1.15	-1.15	-0.85	-1.21	-0.59
133	-1.21	-1.15	-1.12	-1.05	-1.02	-1.05	-1.21	-1.08	-1.12	-0.89	-1.31	-0.56
134	-1.12	-1.08	-1.08	-1.05	-1.28	-1.02	-1.12	-0.98	-1.08	-0.95	-1.61	-0.49
135	-1.02	-1.02	-1.05	-1.05	-1.34	-0.98	-1.02	-0.92	-1.05	-0.95	-1.64	-0.43
136	-0.95	-0.95	-0.98	-1.02	-1.34	-0.95	-0.95	-0.85	-0.98	-0.98	-1.61	-0.43
137	-0.89	-0.92	-0.95	-1.05	-1.44	-0.95	-0.89	-0.82	-0.98	-1.05	-1.71	-0.46
138	-0.79	-0.89	-0.95	-1.12	-1.67	-0.98	-0.79	-0.75	-0.95	-1.15	-1.90	-0.46
139	-0.69	-0.82	-0.92	-1.18	-1.87	-1.05	-0.69	-0.69	-0.95	-1.21	-2.07	-0.46
140	-0.59	-0.75	-0.89	-1.25	-2.33	-1.02	-0.59	-0.59	-0.92	-1.38	-2.62	-0.46
141	-0.46	-0.69	-0.89	-1.38	-3.18	-1.02	-0.46	-0.52	-0.92	-1.48	-3.25	-0.43
142	-0.36	-0.66	-0.89	-1.54	-3.77	-1.08	-0.36	-0.49	-0.92	-1.61	-4.10	-0.46
143	-0.23	-0.56	-0.92	-1.74	-5.02	-1.05	-0.23	-0.43	-0.92	-1.77	-5.74	-0.49
144	-0.13	-0.49	-1.02	-2.13	-7.05	-1.08	-0.13	-0.36	-0.95	-1.94	-7.35	-0.49
145	-0.03	-0.46	-0.95	-2.10	-6.76	-1.12	-0.03	-0.33	-0.89	-1.94	-7.48	-0.49
146	0.07	-0.39	-0.95	-2.16	-6.99	-1.12	0.07	-0.26	-0.89	-2.00	-7.94	-0.52
147	0.20	-0.36	-0.89	-2.20	-7.12	-1.15	0.20	-0.20	-0.82	-2.00	-8.07	-0.52
148	0.30	-0.30	-0.85	-2.23	-7.28	-1.15	0.30	-0.16	-0.79	-2.00	-8.07	-0.49
149	0.39	-0.23	-0.79	-2.23	-7.35	-1.15	0.39	-0.10	-0.72	-1.94	-7.90	-0.52
150	0.49	-0.16	-0.72	-2.16	-7.05	-1.12	0.49	-0.03	-0.66	-1.90	-7.71	-0.46
151	0.56	-0.10	-0.69	-2.16	-7.22	-1.08	0.56	0.03	-0.62	-1.90	-7.90	-0.43
152	0.66	-0.03	-0.62	-2.20	-7.38	-1.05	0.66	0.10	-0.56	-1.90	-8.00	-0.36
153	0.75	0.03	-0.59	-2.20	-7.64	-1.05	0.75	0.16	-0.52	-1.87	-8.04	-0.33
154	0.82	0.10	-0.49	-2.13	-7.31	-1.02	0.82	0.23	-0.46	-1.80	-7.94	-0.30
155	0.95	0.16	-0.46	-2.16	-7.61	-0.98	0.95	0.26	-0.39	-1.77	-8.17	-0.30
156	1.05	0.23	-0.39	-2.16	-7.64	-0.95	1.05	0.33	-0.33	-1.77	-8.20	-0.30
157	1.15	0.30	-0.33	-2.16	-7.74	-0.95	1.15	0.39	-0.30	-1.74	-8.10	-0.23
158	1.28	0.36	-0.26	-2.16	-7.41	-1.02	1.28	0.43	-0.23	-1.74	-8.04	-0.33
159	1.44	0.39	-0.20	-2.20	-7.15	-1.12	1.44	0.52	-0.20	-1.74	-7.64	-0.36
160	1.57	0.46	-0.16	-2.26	-7.05	-1.21	1.57	0.56	-0.13	-1.77	-7.58	-0.43
161	1.71	0.46	-0.07	-2.23	-6.13	-1.38	1.71	0.59	-0.10	-1.77	-6.49	-0.56
162	1.87	0.56	-0.03	-2.33	-6.69	-1.41	1.87	0.66	-0.03	-1.80	-6.76	-0.59
163	1.97	0.62	0.07	-2.23	-6.43	-1.35	1.97	0.72	0.03	-1.74	-6.89	-0.49
164	2.00	0.66	0.07	-2.23	-6.69	-1.28	2.00	0.75	0.07	-1.64	-6.89	-0.43
165	1.94	0.69	0.10	-2.13	-6.56	-1.18	1.94	0.75	0.10	-1.54	-6.89	-0.30
166	1.90	0.69	0.10	-2.07	-6.56	-1.08	1.90	0.79	0.13	-1.41	-6.82	-0.20
167	1.87	0.69	0.10	-2.03	-6.79	-1.02	1.87	0.79	0.16	-1.34	-6.89	-0.07
168	1.80	0.72	0.16	-1.80	-6.00	-0.92	1.80	0.82	0.20	-1.25	-6.59	0.03
169	1.77	0.72	0.16	-1.77	-6.10	-0.82	1.77	0.82	0.23	-1.15	-6.49	0.13
170	1.74	0.72	0.20	-1.64	-5.81	-0.75	1.74	0.85	0.23	-1.08	-6.33	0.13
171	1.77	0.72	0.23	-1.67	-5.64	-0.79	1.77	0.85	0.26	-1.08	-6.30	0.13
172	1.80	0.75	0.20	-1.74	-5.87	-0.85	1.80	0.85	0.26	-1.12	-6.49	0.10
173	1.84	0.75	0.26	-1.64	-5.05	-0.89	1.84	0.85	0.26	-1.12	-6.10	0.03
174	1.90	0.72	0.26	-1.74	-5.25	-0.95	1.90	0.85	0.30	-1.12	-6.00	0.00
175	1.84	0.72	0.26	-1.64	-4.95	-0.92	1.84	0.89	0.30	-1.08	-5.71	0.03
176	1.87	0.72	0.30	-1.61	-4.46	-0.98	1.87	0.92	0.33	-1.08	-5.38	0.03
177	1.97	0.72	0.33	-1.67	-4.33	-1.12	1.97	0.89	0.33	-1.12	-5.22	-0.13
178	2.03	0.72	0.33	-1.74	-4.36	-1.18	2.03	0.89	0.33	-1.15	-5.15	-0.23
179	2.03	0.72	0.33	-1.77	-4.13	-1.25	2.03	0.85	0.33	-1.18	-4.99	-0.30
180	2.07	0.69	0.33	-1.77	-3.80	-1.35	2.07	0.82	0.30	-1.18	-4.85	-0.39
181	2.10	0.69	0.33	-1.77	-3.54	-1.41	2.10	0.79	0.30	-1.21	-4.66	-0.52
182	2.13	0.66	0.33	-1.87	-3.61	-1.48	2.13	0.79	0.26	-1.28	-4.79	-0.56
183	2.13	0.66	0.30	-1.90	-3.51	-1.57	2.13	0.79	0.26	-1.34	-4.72	-0.62
184	2.16	0.62	0.30	-1.94	-3.28	-1.64	2.16	0.75	0.23	-1.41	-4.62	-0.69
185	2.16	0.59	0.30	-1.94	-3.08	-1.71	2.16	0.75	0.23	-1.41	-4.56	-0.69
186	2.16	0.59	0.33	-1.90	-2.79	-1.71	2.16	0.75	0.23	-1.38	-4.33	-0.75
187	2.13	0.56	0.33	-1.87	-2.56	-1.71	2.13	0.75	0.23	-1.41	-4.20	-0.72
188	2.07	0.59	0.33	-1.80	-2.69	-1.61	2.07	0.75	0.23	-1.38	-4.17	-0.66
189	2.00	0.59	0.33	-1.71	-2.79	-1.48	2.00	0.79	0.23	-1.34	-4.23	-0.59
190	1.94	0.59	0.33	-1.64	-2.92	-1.35	1.94	0.79	0.23	-1.31	-4.46	-0.49
191	1.90	0.62	0.33	-1.57	-3.08	-1.28	1.90	0.79	0.26	-1.28	-4.79	-0.39
192	1.87	0.66	0.33	-1.54	-3.28	-1.18	1.87	0.79	0.26	-1.21	-4.76	-0.36

	End Point Analysis						Linear Regression Analysis					
Transect	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**
193	1.94	0.66	0.33	-1.61	-3.44	-1.18	1.94	0.82	0.26	-1.25	-4.69	-0.39
194	1.97	0.66	0.36	-1.64	-3.15	-1.31	1.97	0.79	0.26	-1.31	-4.46	-0.52
195	2.03	0.62	0.36	-1.67	-2.72	-1.44	2.03	0.79	0.26	-1.38	-4.23	-0.62
196	2.00	0.59	0.33	-1.74	-2.69	-1.54	2.00	0.75	0.20	-1.41	-4.23	-0.69
197	1.97	0.52	0.26	-1.77	-2.72	-1.57	1.97	0.69	0.16	-1.44	-4.43	-0.72
198	1.94	0.49	0.23	-1.87	-2.92	-1.61	1.94	0.66	0.13	-1.48	-4.53	-0.79
199	2.03	0.46	0.16	-2.07	-3.18	-1.84	2.03	0.59	0.03	-1.67	-4.89	-0.98
200	2.03	0.46	0.13	-2.16	-3.54	-1.90	2.03	0.56	0.00	-1.74	-5.08	-1.05
201	1.97	0.43	0.10	-2.20	-3.77	-1.84	1.97	0.52	-0.03	-1.74	-5.18	-1.02
202	1.90	0.39	0.03	-2.23	-4.13	-1.80	1.90	0.49	-0.07	-1.77	-5.41	-1.02
203	1.84	0.36	0.00	-2.23	-4.23	-1.77	1.84	0.46	-0.10	-1.77	-5.54	-1.05
204	1.77	0.33	-0.03	-2.23	-4.33	-1.77	1.77	0.43	-0.13	-1.77	-5.58	-0.98
205	1.71	0.30	-0.07	-2.20	-4.43	-1.74	1.71	0.39	-0.13	-1.77	-5.74	-0.98
206	1.64	0.26	-0.10	-2.20	-4.43	-1.71	1.64	0.39	-0.16	-1.77	-5.67	-0.95
207	1.57	0.26	-0.13	-2.16	-4.26	-1.71	1.57	0.36	-0.20	-1.74	-5.51	-0.92
208	1.51	0.23	-0.13	-2.13	-4.17	-1.67	1.51	0.33	-0.20	-1.71	-5.41	-0.92
209	1.41	0.20	-0.16	-2.07	-3.97	-1.64	1.41	0.30	-0.23	-1.71	-5.25	-0.89
210	1.34	0.16	-0.16	-2.00	-3.64	-1.64	1.34	0.26	-0.23	-1.64	-5.02	-0.85
211	1.28	0.10	-0.16	-1.94	-3.51	-1.61	1.28	0.23	-0.26	-1.61	-4.85	-0.79
212	1.21	0.07	-0.20	-1.94	-3.51	-1.61	1.21	0.20	-0.26	-1.54	-4.79	-0.72
213	1.18	0.03	-0.23	-1.97	-3.51	-1.64	1.18	0.16	-0.30	-1.54	-4.76	-0.79
214	1.18	0.00	-0.26	-2.00	-3.38	-1.71	1.18	0.10	-0.33	-1.51	-4.85	-0.85
215	1.15	-0.03	-0.30	-2.07	-3.38	-1.77	1.15	0.03	-0.36	-1.51	-4.92	-0.89
216	1.12	-0.07	-0.33	-2.13	-3.48	-1.84	1.12	-0.03	-0.39	-1.54	-5.02	-0.95
217	1.12	-0.10	-0.39	-2.20	-3.71	-1.87	1.12	-0.07	-0.46	-1.57	-5.31	-1.02
218	0.98	-0.10	-0.43	-2.13	-4.07	-1.74	0.98	-0.13	-0.46	-1.51	-5.44	-0.95
219	0.92	-0.10	-0.43	-2.07	-4.36	-1.57	0.92	-0.13	-0.46	-1.41	-5.51	-0.89
220	0.89	-0.07	-0.43	-2.03	-4.72	-1.44	0.89	-0.10	-0.46	-1.34	-5.67	-0.79
221	0.85	0.00	-0.43	-1.97	-5.02	-1.28	0.85	-0.10	-0.43	-1.28	-5.81	-0.69
222	0.82	0.03	-0.39	-1.87	-5.31	-1.12	0.82	-0.07	-0.39	-1.21	-6.13	-0.59
223	0.79	0.07	-0.39	-1.80	-5.67	-0.95	0.79	-0.03	-0.39	-1.18	-6.49	-0.49
224	0.75	0.10	-0.36	-1.71	-5.61	-0.85	0.75	-0.03	-0.36	-1.12	-6.49	-0.43
225	0.72	0.10	-0.36	-1.67	-5.64	-0.82	0.72	-0.03	-0.36	-1.12	-6.46	-0.43
226	0.69	0.10	-0.39	-1.67	-5.77	-0.79	0.69	-0.07	-0.39	-1.12	-6.59	-0.43
227	0.66	0.07	-0.39	-1.67	-5.77	-0.79	0.66	-0.07	-0.39	-1.08	-6.49	-0.46
228	0.62	0.03	-0.39	-1.64	-5.48	-0.79	0.62	-0.07	-0.39	-1.08	-6.46	-0.39
229	0.56	0.00	-0.39	-1.54	-4.76	-0.85	0.56	-0.10	-0.39	-1.02	-5.74	-0.36
230	0.49	-0.10	-0.39	-1.44	-3.84	-0.95	0.49	-0.13	-0.39	-0.98	-4.95	-0.39
231	0.52	-0.10	-0.33	-1.34	-3.02	-0.98	0.52	-0.10	-0.36	-0.92	-4.23	-0.39
232	0.59	-0.07	-0.30	-1.34	-2.82	-1.05	0.59	-0.07	-0.33	-0.92	-3.80	-0.43
233	0.66	-0.07	-0.26	-1.38	-2.79	-1.08	0.66	-0.07	-0.33	-0.98	-3.64	-0.46
234	0.69	-0.03	-0.26	-1.41	-2.66	-1.15	0.69	-0.07	-0.33	-0.98	-3.44	-0.56
235	0.75	-0.03	-0.20	-1.41	-2.30	-1.21	0.75	-0.03	-0.33	-1.02	-3.28	-0.59
236	0.82	-0.03	-0.20	-1.44	-2.20	-1.28	0.82	-0.03	-0.30	-1.05	-3.31	-0.59
237	0.89	0.00	-0.16	-1.44	-2.03	-1.35	0.89	-0.03	-0.30	-1.08	-3.12	-0.69
238	0.92	0.00	-0.16	-1.48	-1.97	-1.35	0.92	0.00	-0.30	-1.08	-3.18	-0.69
239	0.98	0.03	-0.13	-1.51	-2.23	-1.35	0.98	0.00	-0.30	-1.12	-3.54	-0.72
240	1.05	0.07	-0.13	-1.54	-2.59	-1.35	1.05	0.00	-0.26	-1.12	-3.90	-0.75
241	1.08	0.13	-0.13	-1.61	-3.02	-1.31	1.08	0.03	-0.26	-1.12	-4.26	-0.75
242	1.08	0.16	-0.10	-1.57	-3.12	-1.21	1.08	0.07	-0.23	-1.08	-4.36	-0.72
243	1.12	0.20	-0.07	-1.51	-3.15	-1.15	1.12	0.10	-0.20	-1.08	-4.59	-0.66
244	1.12	0.23	-0.07	-1.48	-3.12	-1.12	1.12	0.13	-0.16	-1.02	-4.62	-0.59
245	1.08	0.20	-0.07	-1.44	-3.15	-1.08	1.08	0.13	-0.16	-0.95	-4.66	-0.56
246	1.12	0.20	-0.07	-1.44	-3.05	-1.12	1.12	0.13	-0.13	-0.92	-4.53	-0.56
247	1.12	0.20	-0.03	-1.44	-2.85	-1.15	1.12	0.13	-0.10	-0.85	-4.10	-0.56
248	1.15	0.20	-0.03	-1.44	-2.66	-1.18	1.15	0.10	-0.10	-0.82	-3.71	-0.59
249	1.18	0.20	0.00	-1.44	-2.49	-1.21	1.18	0.13	-0.10	-0.79	-3.58	-0.59
250	1.18	0.20	0.03	-1.38	-2.10	-1.21	1.18	0.13	-0.07	-0.75	-3.28	-0.59
251	1.08	0.20	0.07	-1.15	-1.44	-1.12	1.08	0.10	-0.03	-0.59	-2.85	-0.52
252	0.98	0.20	0.10	-1.02	-1.15	-0.98	0.98	0.10	0.00	-0.46	-2.53	-0.39
253	0.92	0.20	0.13	-0.85	-0.79	-0.85	0.92	0.10	0.03	-0.33	-2.20	-0.30
254	0.82	0.23	0.13	-0.69	-0.82	-0.66	0.82	0.13	0.07	-0.20	-2.33	-0.13
255	0.79	0.26	0.16	-0.62	-0.95	-0.56	0.79	0.13	0.10	-0.07	-2.39	0.00

	End Point Analysis						Linear Regression Analysis					
Transect	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998
256	0.75	0.26	0.16	-0.56	-1.02	-0.46	0.75	0.13	0.10	0.00	-2.39	0.07
257	0.72	0.30	0.20	-0.46	-1.02	-0.36	0.72	0.16	0.13	0.07	-2.46	0.10
258	0.69	0.33	0.20	-0.39	-1.15	-0.26	0.69	0.16	0.16	0.13	-2.59	0.16
259	0.66	0.33	0.23	-0.33	-1.12	-0.13	0.66	0.20	0.20	0.23	-2.69	0.26
260	0.59	0.36	0.23	-0.20	-1.05	0.00	0.59	0.20	0.23	0.33	-2.85	0.39
261	0.52	0.36	0.26	-0.10	-1.08	0.13	0.52	0.23	0.26	0.43	-2.82	0.49
262	0.49	0.39	0.26	0.00	-1.21	0.23	0.49	0.26	0.30	0.52	-2.89	0.66
263	0.49	0.43	0.30	0.03	-1.34	0.33	0.49	0.26	0.30	0.56	-3.18	0.69
264	0.52	0.49	0.33	0.10	-1.57	0.46	0.52	0.33	0.33	0.59	-3.51	0.82
265	0.52	0.52	0.36	0.16	-1.61	0.56	0.52	0.36	0.36	0.66	-3.64	0.92
266	0.56	0.59	0.39	0.20	-1.67	0.59	0.56	0.39	0.39	0.66	-3.74	0.95
267	0.62	0.62	0.46	0.26	-1.64	0.66	0.62	0.43	0.43	0.72	-3.77	0.98
268	0.62	0.66	0.49	0.30	-1.64	0.72	0.62	0.46	0.46	0.75	-3.80	1.05
269	0.62	0.66	0.49	0.36	-1.31	0.72	0.62	0.49	0.49	0.79	-3.41	1.08
270	0.62	0.66	0.52	0.43	-0.89	0.69	0.62	0.46	0.49	0.82	-2.66	0.98
271	0.69	0.66	0.56	0.43	-0.49	0.62	0.69	0.46	0.49	0.75	-2.33	0.92
272	0.75	0.66	0.59	0.39	-0.07	0.49	0.75	0.43	0.46	0.72	-2.26	0.79
273	0.82	0.66	0.62	0.36	0.23	0.39	0.82	0.43	0.46	0.66	-2.33	0.72
274	0.92	0.66	0.66	0.33	0.33	0.33	0.92	0.43	0.46	0.69	-2.23	0.66
275	0.95	0.69	0.66	0.36	0.49	0.33	0.95	0.43	0.49	0.66	-2.07	0.62
276	0.95	0.69	0.69	0.39	0.69	0.36	0.95	0.43	0.49	0.69	-1.90	0.62
277	0.95	0.72	0.72	0.49	0.92	0.39	0.95	0.46	0.49	0.66	-1.94	0.62
278	0.95	0.72	0.79	0.56	1.28	0.43	0.95	0.49	0.52	0.62	-2.00	0.66
279	0.95	0.75	0.79	0.59	1.28	0.46	0.95	0.52	0.56	0.69	-1.84	0.69
280	0.98	0.75	0.82	0.66	1.44	0.46	0.98	0.52	0.56	0.69	-2.03	0.72
281	0.98	0.82	0.85	0.72	1.48	0.56	0.98	0.56	0.59	0.75	-2.26	0.82
282	1.05	0.85	0.89	0.72	1.21	0.62	1.05	0.62	0.62	0.79	-2.72	0.89
283	1.12	0.92	0.92	0.72	1.02	0.66	1.12	0.66	0.66	0.82	-2.89	0.89
284	1.18	0.98	0.98	0.72	0.92	0.69	1.18	0.69	0.72	0.85	-3.08	0.92
285	1.25	1.05	1.05	0.79	1.12	0.72	1.25	0.75	0.75	0.89	-3.15	0.95
286	1.34	1.08	1.12	0.82	1.44	0.69	1.34	0.79	0.82	0.92	-3.12	0.92
287	1.44	1.12	1.18	0.82	1.74	0.62	1.44	0.82	0.85	0.92	-3.08	0.85
288	1.54	1.15	1.21	0.79	1.87	0.56	1.54	0.85	0.89	0.92	-2.72	0.82
289	1.64	1.18	1.25	0.72	2.00	0.46	1.64	0.89	0.92	0.92	-2.46	0.75
290	1.77	1.21	1.28	0.66	2.10	0.36	1.77	0.89	0.95	0.85	-2.36	0.59
291	1.90	1.21	1.31	0.59	2.16	0.23	1.90	0.92	0.98	0.82	-1.97	0.49
292	2.00	1.25	1.34	0.52	2.23	0.13	2.00	0.95	0.98	0.72	-2.10	0.39
293	2.00	1.25	1.34	0.52	2.46	0.10	2.00	0.95	0.98	0.75	-1.77	0.33
294	2.00	1.21	1.34	0.59	2.82	0.10	2.00	0.92	0.98	0.75	-1.77	0.33
295	1.97	1.21	1.38	0.69	3.48	0.10	1.97	0.92	0.98	0.79	-1.08	0.30
296	1.94	1.18	1.41	0.75	3.80	0.10	1.94	0.92	1.02	0.82	-0.66	0.33
297	1.90	1.18	1.31	0.62	2.98	0.13	1.90	0.89	0.98	0.79	-0.85	0.26
298	1.87	1.18	1.28	0.56	2.56	0.13	1.87	0.89	0.98	0.79	-1.05	0.26
299	1.84	1.15	1.25	0.52	2.13	0.16	1.84	0.89	0.95	0.75	-1.28	0.26
300	1.80	1.15	1.18	0.46	1.61	0.20	1.80	0.89	0.95	0.69	-1.64	0.26
301	1.80	1.15	1.18	0.43	1.61	0.20	1.80	0.89	0.95	0.69	-1.44	0.23
302	1.84	1.15	1.25	0.52	2.26	0.13	1.84	0.89	0.95	0.66	-1.28	0.20
303	1.84	1.15	1.25	0.52	2.36	0.13	1.84	0.89	0.95	0.66	-1.25	0.20
304	1.87	1.15	1.25	0.52	2.36	0.13	1.87	0.92	0.95	0.66	-1.18	0.20
305	1.87	1.15	1.28	0.52	2.43	0.10	1.87	0.92	0.95	0.66	-1.02	0.16
306	1.90	1.15	1.28	0.52	2.76	0.03	1.90	0.92	0.95	0.62	-0.75	0.13
307	1.94	1.15	1.31	0.52	3.05	-0.03	1.94	0.89	0.98	0.62	-0.36	0.03
308	1.97	1.15	1.31	0.52	3.08	-0.03	1.97	0.89	0.98	0.62	-0.26	-0.03
309	2.00	1.18	1.34	0.56	3.21	-0.03	2.00	0.92	0.98	0.62	-0.07	0.03
310	2.00	1.18	1.38	0.59	3.64	-0.07	2.00	0.92	1.02	0.62	0.36	0.00
311	2.03	1.15	1.44	0.75	4.82	-0.13	2.03	0.92	1.05	0.69	1.38	-0.07
312	2.03	1.15	1.54	0.95	6.20	-0.16	2.03	0.92	1.05	0.72	2.36	-0.10
313	2.03	1.18	1.54	0.92	5.48	-0.07	2.03	0.95	1.05	0.72	1.74	-0.10
314	2.03	1.25	1.48	0.82	4.26	0.10	2.03	0.98	1.08	0.69	0.89	0.00
315	2.00	1.31	1.44	0.79	3.02	0.30	2.00	1.02	1.08	0.72	0.03	0.10
316	2.00	1.34	1.44	0.75	2.59	0.33	2.00	1.05	1.12	0.75	-0.23	0.16
317	1.97	1.34	1.41	0.75	2.39	0.39	1.97	1.05	1.12	0.75	-0.33	0.20
318	1.97	1.31	1.44	0.85	3.02	0.39	1.97	1.08	1.15	0.82	0.13	0.16

	End Point Analysis						Linear Regression Analysis					
Transect	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998
319	2.10	1.31	1.44	0.69	3.08	0.20	2.10	1.08	1.18	0.79	0.72	0.07
320	2.16	1.34	1.48	0.62	2.89	0.13	2.16	1.08	1.18	0.82	0.82	0.07
321	2.16	1.38	1.48	0.66	2.82	0.20	2.16	1.12	1.21	0.85	0.39	0.13
322	2.16	1.44	1.54	0.79	2.79	0.36	2.16	1.18	1.28	0.92	0.30	0.26
323	2.16	1.48	1.54	0.82	2.33	0.49	2.16	1.21	1.28	0.95	-0.46	0.36
324	2.16	1.54	1.57	0.89	2.20	0.59	2.16	1.28	1.34	1.02	-0.13	0.43
325	2.23	1.57	1.61	0.89	2.36	0.56	2.23	1.31	1.38	1.05	0.36	0.39
326	2.36	1.57	1.67	0.89	2.95	0.43	2.36	1.34	1.44	1.02	0.89	0.33
327	2.46	1.61	1.77	0.92	3.41	0.36	2.46	1.41	1.48	1.05	1.48	0.30
328	2.53	1.74	1.80	0.95	2.82	0.56	2.53	1.51	1.54	1.05	1.25	0.43
329	2.66	1.90	1.87	0.95	1.84	0.75	2.66	1.64	1.64	1.08	0.89	0.56
330	2.79	2.07	1.90	0.85	0.33	0.95	2.79	1.77	1.74	1.12	0.23	0.72
331	2.92	2.23	1.94	0.72	-1.44	1.18	2.92	1.94	1.84	1.15	-0.79	0.95
332	3.08	2.36	1.94	0.56	-2.76	1.28	3.08	2.07	1.90	1.12	-1.67	1.02
333	3.28	2.46	1.97	0.39	-3.58	1.25	3.28	2.13	1.97	1.05	-2.23	0.95
334	3.44	2.53	2.00	0.30	-3.67	1.15	3.44	2.23	2.00	0.89	-2.49	0.79
335	3.48	2.56	2.10	0.43	-3.05	1.18	3.48	2.26	2.03	0.89	-3.05	0.79
336	3.54	2.62	2.23	0.69	-2.16	1.31	3.54	2.26	2.07	0.98	-3.12	0.72
337	3.58	2.76	2.39	0.92	-1.74	1.48	3.58	2.26	2.07	0.95	-3.28	0.72
338	3.80	2.82	2.49	0.89	-1.54	1.41	3.80	2.26	2.03	0.79	-3.15	0.52
339	4.00	2.82	2.53	0.72	-0.89	1.05	4.00	2.30	2.03	0.62	-3.41	0.36
340	4.20	2.59	2.49	0.46	1.61	0.20	4.20	2.46	2.03	0.26	-1.02	0.39
341	5.58	3.05	2.72	-0.72	-1.05	-0.66	5.58	2.95	2.33	-0.10	-2.92	0.26
342	5.31	2.92	2.69	-0.49	-0.03	-0.59	5.31	2.92	2.36	0.13	-2.26	0.30
343	4.92	2.79	2.59	-0.23	0.52	-0.39	4.92	2.85	2.36	0.30	-1.71	0.46
344	4.53	2.66	2.53	0.07	0.98	-0.13	4.53	2.76	2.30	0.52	-1.05	0.72
345	4.20	2.53	2.46	0.36	1.74	0.07	4.20	2.66	2.26	0.69	-0.03	0.89
346	4.13	2.49	2.49	0.52	2.53	0.10	4.13	2.62	2.26	0.79	0.75	0.89
347	4.07	2.49	2.49	0.56	2.33	0.20	4.07	2.62	2.30	0.89	1.08	0.92
348	4.10	2.53	2.46	0.43	1.77	0.16	4.10	2.59	2.26	0.82	0.62	0.85
349	4.13	2.53	2.39	0.30	0.85	0.16	4.13	2.59	2.23	0.79	0.10	0.89
350	4.10	2.56	2.36	0.26	0.20	0.26	4.10	2.59	2.23	0.75	-0.66	0.95
351	4.10	2.56	2.36	0.30	0.26	0.30	4.10	2.59	2.20	0.75	-0.72	0.95
352	4.07	2.56	2.46	0.52	1.51	0.33	4.07	2.56	2.23	0.82	-0.23	0.98
353	4.03	2.53	2.56	0.79	2.79	0.33	4.03	2.56	2.23	0.85	0.36	0.95
354	3.94	2.49	2.53	0.82	2.82	0.36	3.94	2.49	2.16	0.79	0.36	0.89
355	3.87	2.46	2.43	0.69	1.94	0.43	3.87	2.46	2.13	0.75	-0.13	0.98
356	3.74	2.46	2.33	0.62	0.69	0.59	3.74	2.43	2.07	0.79	-0.75	1.08
357	3.61	2.46	2.20	0.52	-0.79	0.82	3.61	2.39	2.03	0.82	-1.67	1.18
358	3.44	2.46	2.16	0.56	-1.38	0.98	3.44	2.36	2.00	0.85	-2.16	1.28
359	3.38	2.46	2.10	0.59	-1.74	1.08	3.38	2.33	1.97	0.85	-2.56	1.35
360	3.35	2.39	2.10	0.59	-1.48	1.05	3.35	2.26	1.94	0.85	-2.59	1.28
361	3.31	2.33	2.10	0.62	-0.62	0.92	3.31	2.23	1.87	0.79	-2.23	1.18
362	3.25	2.23	2.13	0.72	0.92	0.69	3.25	2.13	1.84	0.75	-1.28	1.02
363	3.21	2.10	2.16	0.89	2.59	0.52	3.21	2.03	1.77	0.75	-0.26	0.85
364	3.12	2.03	2.16	1.02	3.80	0.43	3.12	1.94	1.74	0.82	0.79	0.82
365	3.05	1.97	2.13	1.02	4.00	0.36	3.05	1.87	1.71	0.92	1.08	0.79
366	2.95	1.90	2.00	0.89	3.28	0.36	2.95	1.80	1.64	0.85	0.69	0.75
367	2.92	1.87	1.94	0.79	2.69	0.36	2.92	1.77	1.61	0.82	0.10	0.75
368	2.89	1.84	1.94	0.79	3.05	0.26	2.89	1.71	1.57	0.85	0.13	0.72
369	2.85	1.77	1.97	0.92	4.23	0.20	2.85	1.67	1.57	0.75	0.89	0.56
370	2.82	1.77	2.00	0.98	4.62	0.23	2.82	1.67	1.57	0.75	0.82	0.59
371	2.82	1.71	2.07	1.12	6.20	0.03	2.82	1.64	1.54	0.79	1.71	0.49
372	2.82	1.64	2.10	1.21	7.35	-0.13	2.82	1.57	1.54	0.75	2.56	0.39
373	2.82	1.64	2.10	1.18	7.22	-0.10	2.82	1.57	1.51	0.72	2.36	0.39
374	2.79	1.64	2.00	1.02	5.97	-0.03	2.79	1.57	1.48	0.66	1.54	0.36
375	2.79	1.67	1.97	0.95	5.15	0.07	2.79	1.54	1.48	0.69	0.85	0.39
376	2.76	1.71	1.97	0.98	4.85	0.16	2.76	1.54	1.48	0.72	0.46	0.46
377	2.72	1.67	1.97	1.05	5.22	0.16	2.72	1.54	1.48	0.75	0.72	0.46
378	2.69	1.67	1.97	1.08	5.41	0.16	2.69	1.48	1.48	0.82	0.89	0.39
379	2.66	1.64	2.00	1.15	5.81	0.16	2.66	1.48	1.44	0.82	1.12	0.39
380	2.66	1.64	1.94	1.08	5.18	0.20	2.66	1.48	1.44	0.82	0.79	0.43
381	2.62	1.64	1.84	0.89	4.00	0.23	2.62	1.44	1.41	0.82	0.26	0.43

	End Point Analysis						Linear Regression Analysis					
Transect	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998
382	2.59	1.64	1.77	0.79	3.18	0.26	2.59	1.44	1.41	0.79	-0.20	0.46
383	2.56	1.64	1.74	0.72	2.82	0.26	2.56	1.41	1.38	0.79	-0.23	0.46
384	2.53	1.64	1.71	0.72	2.72	0.30	2.53	1.41	1.38	0.79	-0.33	0.46
385	2.53	1.61	1.71	0.75	2.95	0.26	2.53	1.38	1.34	0.79	-0.23	0.49
386	2.49	1.57	1.71	0.79	3.28	0.26	2.49	1.38	1.34	0.79	0.03	0.46
387	2.46	1.57	1.77	0.92	4.00	0.23	2.46	1.34	1.34	0.82	0.66	0.46
388	2.43	1.54	1.77	0.98	4.66	0.20	2.43	1.34	1.34	0.82	1.15	0.43
389	2.39	1.51	1.80	1.05	4.92	0.23	2.39	1.34	1.34	0.85	1.18	0.43
390	2.36	1.51	1.80	1.15	5.08	0.30	2.36	1.34	1.34	0.92	1.31	0.56
391	2.30	1.51	1.77	1.18	5.02	0.33	2.30	1.34	1.34	0.95	1.34	0.62
392	2.23	1.48	1.74	1.15	4.72	0.36	2.23	1.31	1.34	1.05	1.21	0.66
393	2.20	1.48	1.74	1.18	4.82	0.39	2.20	1.31	1.34	1.05	1.12	0.72
394	2.13	1.44	1.74	1.21	4.92	0.43	2.13	1.31	1.34	1.05	1.25	0.75
395	2.07	1.44	1.71	1.28	4.79	0.52	2.07	1.31	1.34	1.12	1.21	0.85
396	2.07	1.44	1.71	1.28	4.59	0.56	2.07	1.31	1.34	1.15	1.18	0.85
397	2.07	1.48	1.71	1.28	4.49	0.59	2.07	1.31	1.34	1.15	0.98	0.85
398	2.07	1.48	1.71	1.28	4.26	0.62	2.07	1.31	1.34	1.15	0.72	0.89
399	2.03	1.51	1.67	1.25	3.87	0.69	2.03	1.31	1.34	1.18	0.56	0.92
400	2.03	1.48	1.61	1.12	3.12	0.69	2.03	1.31	1.31	1.12	0.07	0.95
401	2.03	1.48	1.57	1.02	2.59	0.69	2.03	1.31	1.31	1.12	-0.13	0.95
402	2.03	1.48	1.57	1.02	2.59	0.69	2.03	1.31	1.31	1.08	-0.07	0.95
403	2.03	1.48	1.54	0.98	2.43	0.69	2.03	1.28	1.28	1.12	-0.07	0.95
404	2.00	1.44	1.57	1.05	2.95	0.62	2.00	1.28	1.28	1.12	0.26	0.92
405	2.00	1.41	1.64	1.18	4.20	0.52	2.00	1.25	1.31	1.15	1.12	0.82
406	2.03	1.41	1.64	1.15	4.13	0.52	2.03	1.25	1.31	1.15	0.98	0.82
407	2.03	1.44	1.71	1.31	4.66	0.59	2.03	1.28	1.31	1.18	1.15	0.85
408	2.07	1.48	1.71	1.31	4.46	0.62	2.07	1.28	1.31	1.21	0.98	0.89
409	2.07	1.48	1.64	1.15	3.67	0.59	2.07	1.28	1.31	1.15	0.49	0.85
410	2.07	1.44	1.57	0.95	2.79	0.56	2.07	1.28	1.28	1.05	-0.07	0.82
411	2.10	1.48	1.51	0.79	1.80	0.56	2.10	1.28	1.25	0.98	-0.89	0.85
412	2.13	1.51	1.54	0.82	1.77	0.59	2.13	1.28	1.28	1.02	-0.75	0.85
413	2.16	1.54	1.54	0.85	1.84	0.62	2.16	1.31	1.28	0.98	-0.95	0.89
414	2.16	1.51	1.57	0.85	2.20	0.56	2.16	1.31	1.28	0.95	-0.75	0.89
415	2.13	1.48	1.61	0.98	2.95	0.56	2.13	1.31	1.28	0.98	-0.43	0.89
416	2.07	1.48	1.67	1.15	3.84	0.56	2.07	1.31	1.28	1.05	0.03	0.92
417	2.03	1.48	1.71	1.31	4.23	0.66	2.03	1.31	1.31	1.12	0.13	1.02
418	1.97	1.48	1.67	1.31	3.94	0.75	1.97	1.31	1.28	1.15	-0.16	1.08
419	1.94	1.51	1.67	1.34	3.67	0.85	1.94	1.31	1.31	1.18	-0.43	1.18
420	1.87	1.51	1.64	1.38	3.38	0.95	1.87	1.34	1.31	1.21	-0.62	1.28
421	1.84	1.51	1.61	1.38	2.95	1.02	1.84	1.34	1.28	1.25	-0.98	1.35
422	1.77	1.51	1.57	1.34	2.62	1.08	1.77	1.28	1.28	1.34	-1.25	1.41
423	1.80	1.51	1.57	1.31	2.49	1.05	1.80	1.28	1.28	1.34	-1.31	1.38
424	1.80	1.51	1.61	1.38	3.02	1.05	1.80	1.28	1.28	1.34	-1.15	1.35
425	1.84	1.51	1.57	1.25	2.39	1.02	1.84	1.28	1.28	1.31	-1.41	1.31
426	1.84	1.51	1.51	1.12	1.80	0.98	1.84	1.28	1.28	1.28	-1.71	1.35
427	1.87	1.51	1.48	0.98	1.15	0.95	1.87	1.28	1.28	1.25	-2.03	1.31
428	1.84	1.51	1.44	0.98	0.95	1.02	1.84	1.28	1.28	1.28	-2.00	1.35
429	1.77	1.48	1.44	1.02	0.79	1.05	1.77	1.28	1.28	1.31	-2.10	1.38
430	1.74	1.48	1.41	1.02	0.56	1.12	1.74	1.28	1.28	1.31	-2.16	1.48
431	1.71	1.48	1.41	1.05	0.56	1.15	1.71	1.28	1.28	1.34	-2.10	1.51
432	1.71	1.48	1.41	1.05	0.56	1.15	1.71	1.31	1.28	1.38	-2.10	1.51
433	1.74	1.48	1.44	1.08	1.08	1.12	1.74	1.28	1.28	1.34	-1.80	1.48
434	1.77	1.48	1.57	1.31	2.49	1.05	1.77	1.31	1.31	1.41	-0.75	1.44
435	1.80	1.48	1.64	1.41	3.21	1.02	1.80	1.28	1.31	1.38	-0.36	1.31
436	1.84	1.48	1.61	1.31	2.89	0.95	1.84	1.28	1.31	1.31	-0.56	1.21
437	1.87	1.48	1.61	1.31	3.12	0.92	1.87	1.25	1.28	1.25	-0.62	1.12
438	1.90	1.48	1.57	1.18	2.69	0.85	1.90	1.21	1.28	1.21	-0.59	0.92
439	1.90	1.51	1.51	0.98	1.44	0.89	1.90	1.18	1.25	1.15	-1.31	0.82
440	1.90	1.51	1.48	0.95	0.95	0.92	1.90	1.21	1.25	1.12	-1.61	0.89
441	1.94	1.54	1.48	0.92	0.95	0.92	1.94	1.21	1.25	1.12	-1.54	0.89
442	1.94	1.54	1.51	1.02	1.41	0.92	1.94	1.21	1.25	1.08	-1.48	0.85
443	1.94	1.54	1.54	1.08	1.90	0.92	1.94	1.21	1.25	1.08	-1.12	0.85
444	1.97	1.54	1.61	1.18	2.46	0.89	1.97	1.21	1.25	1.12	-0.85	0.82

	End Point Analysis						Linear Regression Analysis					
Transect	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**
445	1.97	1.54	1.64	1.25	2.92	0.89	1.97	1.21	1.28	1.12	-0.46	0.82
446	2.00	1.54	1.67	1.31	3.28	0.89	2.00	1.21	1.28	1.12	-0.33	0.79
447	2.00	1.54	1.71	1.34	3.51	0.89	2.00	1.21	1.28	1.12	-0.43	0.79
448	2.00	1.57	1.71	1.34	3.35	0.92	2.00	1.25	1.28	1.08	-0.66	0.75
449	2.03	1.57	1.67	1.28	2.92	0.92	2.03	1.25	1.28	1.05	-0.95	0.75
450	2.03	1.57	1.64	1.15	2.16	0.92	2.03	1.25	1.25	0.98	-1.38	0.75
451	2.03	1.57	1.57	1.05	1.57	0.92	2.03	1.25	1.25	0.92	-1.80	0.75
452	2.03	1.57	1.57	1.02	1.61	0.92	2.03	1.25	1.25	0.98	-1.44	0.75
453	2.03	1.57	1.61	1.08	1.97	0.89	2.03	1.25	1.25	0.98	-1.28	0.75
454	2.03	1.57	1.61	1.12	2.30	0.89	2.03	1.28	1.28	1.02	-0.98	0.82
455	2.00	1.57	1.61	1.08	2.03	0.89	2.00	1.25	1.28	1.02	-1.05	0.82
456	2.00	1.57	1.61	1.08	2.00	0.89	2.00	1.28	1.28	1.05	-1.05	0.85
457	2.00	1.57	1.61	1.15	2.23	0.92	2.00	1.28	1.28	1.02	-1.05	0.85
458	2.03	1.54	1.61	1.12	2.39	0.85	2.03	1.28	1.28	1.02	-0.92	0.79
459	2.03	1.54	1.61	1.08	2.43	0.82	2.03	1.25	1.25	0.98	-1.08	0.75
460	1.97	1.51	1.54	1.02	2.03	0.82	1.97	1.25	1.25	0.98	-1.08	0.75
461	1.94	1.51	1.48	0.92	1.28	0.85	1.94	1.21	1.21	0.98	-1.51	0.75
462	1.90	1.51	1.41	0.82	0.39	0.92	1.90	1.21	1.21	0.95	-1.97	0.82
463	1.87	1.51	1.34	0.72	-0.43	0.98	1.87	1.21	1.21	0.92	-2.43	0.89
464	1.84	1.51	1.31	0.69	-0.89	1.02	1.84	1.25	1.18	0.92	-2.82	0.92
465	1.80	1.51	1.34	0.75	-0.62	1.05	1.80	1.25	1.18	0.92	-2.76	0.95
466	1.77	1.48	1.38	0.85	-0.10	1.05	1.77	1.21	1.18	0.95	-2.36	0.92
467	1.77	1.48	1.41	0.98	0.56	1.05	1.77	1.21	1.18	0.98	-1.90	0.95
468	1.74	1.48	1.41	1.02	0.75	1.05	1.74	1.21	1.18	1.02	-1.77	0.95
469	1.71	1.48	1.38	0.98	0.43	1.08	1.71	1.18	1.18	1.02	-1.84	0.95
470	1.74	1.48	1.34	0.89	0.13	1.08	1.74	1.18	1.18	0.98	-2.07	0.95
471	1.77	1.48	1.31	0.82	-0.23	1.05	1.77	1.18	1.15	0.92	-2.46	0.92
472	1.77	1.48	1.34	0.85	0.00	1.02	1.77	1.18	1.15	0.92	-2.30	0.85
473	1.77	1.48	1.38	0.89	0.23	1.02	1.77	1.18	1.15	0.92	-2.20	0.85
474	1.77	1.48	1.41	0.92	0.59	1.02	1.77	1.18	1.15	0.92	-2.03	0.85
475	1.80	1.48	1.44	0.98	0.98	1.02	1.80	1.18	1.15	0.95	-1.77	0.82
476	1.77	1.48	1.44	1.05	1.34	0.98	1.77	1.18	1.15	0.95	-1.80	0.82
477	1.74	1.44	1.44	1.05	1.28	0.98	1.74	1.12	1.15	0.98	-1.80	0.79
478	1.71	1.41	1.38	1.02	1.08	0.98	1.71	1.12	1.12	0.95	-2.00	0.79
479	1.67	1.41	1.34	0.92	0.56	0.98	1.67	1.08	1.08	0.89	-2.49	0.79
480	1.64	1.38	1.28	0.85	0.23	0.98	1.64	1.05	1.05	0.89	-2.62	0.79
481	1.61	1.34	1.25	0.79	-0.20	0.98	1.61	1.05	1.05	0.92	-2.59	0.79
482	1.57	1.34	1.18	0.72	-0.46	0.98	1.57	1.02	1.02	0.92	-2.72	0.75
483	1.54	1.31	1.18	0.75	-0.39	1.02	1.54	1.02	1.02	0.95	-2.66	0.82
484	1.51	1.31	1.21	0.85	-0.16	1.05	1.51	1.02	1.02	0.95	-2.82	0.89
485	1.48	1.31	1.25	0.98	0.46	1.12	1.48	1.02	1.02	0.98	-2.46	0.92
486	1.44	1.31	1.25	1.05	0.52	1.15	1.44	0.98	1.02	1.05	-2.26	0.95
487	1.38	1.31	1.21	0.98	0.03	1.18	1.38	0.98	1.02	1.08	-2.56	0.98
488	1.38	1.31	1.15	0.92	-0.59	1.21	1.38	0.98	1.02	1.12	-2.56	1.02
489	1.28	1.31	1.15	0.95	-0.82	1.35	1.28	0.95	1.05	1.31	-2.33	1.18
490	1.21	1.28	1.15	1.02	-0.59	1.38	1.21	0.92	1.05	1.41	-2.07	1.21
491	1.15	1.25	1.15	1.08	-0.36	1.41	1.15	0.92	1.05	1.48	-1.74	1.31
492	1.12	1.25	1.15	1.18	0.00	1.44	1.12	0.92	1.05	1.54	-1.38	1.35
493	1.05	1.25	1.15	1.31	0.33	1.51	1.05	0.89	1.05	1.57	-1.31	1.38
494	0.98	1.25	1.18	1.41	0.56	1.57	0.98	0.92	1.05	1.57	-1.28	1.44
495	0.98	1.21	1.18	1.44	0.75	1.61	0.98	0.92	1.05	1.57	-1.02	1.44
496	0.95	1.21	1.18	1.44	0.69	1.61	0.95	0.92	1.05	1.54	-1.28	1.44
497	0.95	1.21	1.18	1.48	0.75	1.61	0.95	0.92	1.05	1.61	-0.95	1.48
498	0.98	1.25	1.21	1.48	0.75	1.64	0.98	0.92	1.05	1.61	-1.05	1.48
499	0.98	1.25	1.21	1.51	0.89	1.67	0.98	0.92	1.05	1.61	-1.05	1.51
500	0.98	1.28	1.25	1.54	0.95	1.67	0.98	0.95	1.08	1.61	-1.21	1.51
501	1.02	1.28	1.25	1.54	0.85	1.67	1.02	0.95	1.08	1.61	-1.18	1.51
502	1.05	1.28	1.25	1.48	0.69	1.64	1.05	0.95	1.08	1.57	-1.48	1.48
503	1.08	1.31	1.21	1.34	0.00	1.61	1.08	0.95	1.08	1.54	-1.74	1.44
504	1.12	1.31	1.18	1.25	-0.36	1.57	1.12	0.98	1.05	1.44	-2.16	1.41
505	1.15	1.31	1.15	1.12	-0.82	1.54	1.15	0.98	1.05	1.41	-2.13	1.38
506	1.18	1.31	1.15	1.12	-0.66	1.51	1.18	0.98	1.05	1.38	-2.07	1.35
507	1.25	1.31	1.18	1.15	-0.30	1.48	1.25	1.02	1.08	1.34	-1.77	1.31

	End Point Analysis						Linear Regression Analysis					
Transect	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998
508	1.28	1.34	1.25	1.21	0.33	1.41	1.28	1.02	1.08	1.34	-1.48	1.21
509	1.34	1.34	1.28	1.21	0.59	1.35	1.34	1.02	1.08	1.31	-1.41	1.18
510	1.31	1.34	1.25	1.18	0.46	1.35	1.31	1.02	1.08	1.31	-1.48	1.18
511	1.31	1.31	1.25	1.18	0.33	1.35	1.31	1.02	1.08	1.28	-1.54	1.18
512	1.28	1.31	1.25	1.18	0.43	1.35	1.28	1.02	1.05	1.25	-1.67	1.15
513	1.28	1.31	1.25	1.18	0.26	1.38	1.28	1.02	1.05	1.21	-1.80	1.18
514	1.28	1.34	1.21	1.18	0.03	1.41	1.28	1.02	1.05	1.25	-1.87	1.18
515	1.25	1.31	1.21	1.18	0.00	1.44	1.25	1.02	1.05	1.25	-1.80	1.21
516	1.28	1.31	1.21	1.15	0.07	1.38	1.28	1.02	1.05	1.21	-1.71	1.18
517	1.28	1.31	1.21	1.08	-0.13	1.35	1.28	1.02	1.05	1.18	-1.90	1.15
518	1.31	1.31	1.18	1.05	-0.13	1.31	1.31	0.98	1.05	1.18	-1.67	1.12
519	1.31	1.31	1.21	1.05	0.16	1.25	1.31	0.98	1.02	1.15	-1.57	1.08
520	1.34	1.28	1.21	1.02	0.26	1.18	1.34	0.95	1.02	1.15	-1.48	1.02
521	1.34	1.25	1.18	1.02	0.36	1.15	1.34	0.95	1.02	1.15	-1.41	0.98
522	1.31	1.25	1.18	1.02	0.46	1.12	1.31	0.92	0.98	1.12	-1.38	0.95
523	1.31	1.21	1.15	0.98	0.43	1.12	1.31	0.92	0.98	1.12	-1.57	0.98
524	1.28	1.21	1.15	0.98	0.56	1.08	1.28	0.92	0.98	1.12	-1.44	0.95
525	1.28	1.18	1.15	1.02	0.82	1.05	1.28	0.89	0.95	1.08	-1.44	0.92
526	1.25	1.15	1.15	1.02	0.92	1.05	1.25	0.89	0.95	1.05	-1.31	0.89
527	1.21	1.15	1.12	0.98	0.85	1.02	1.21	0.85	0.92	1.08	-1.15	0.89
528	1.18	1.08	1.08	0.95	1.08	0.95	1.18	0.82	0.89	1.05	-1.02	0.82
529	1.15	1.05	1.05	0.95	1.28	0.89	1.15	0.79	0.89	1.05	-0.75	0.79
530	1.12	0.98	1.02	0.95	1.41	0.85	1.12	0.75	0.85	1.05	-0.69	0.82
531	1.05	0.95	1.02	0.95	1.57	0.82	1.05	0.72	0.85	1.05	-0.46	0.79
532	0.98	0.95	0.98	0.95	1.21	0.89	0.98	0.72	0.82	1.05	-0.98	0.82
533	0.92	0.95	0.95	0.95	0.92	0.95	0.92	0.69	0.82	1.08	-0.89	0.85
534	0.95	0.95	0.92	0.92	0.66	0.95	0.95	0.72	0.82	1.08	-1.05	0.89
535	0.95	0.95	0.92	0.89	0.36	0.98	0.95	0.72	0.82	1.08	-1.41	0.89
536	0.95	0.98	0.92	0.89	0.20	1.02	0.95	0.72	0.82	1.08	-1.31	0.89
537	0.98	1.02	0.92	0.82	-0.20	1.05	0.98	0.75	0.82	1.08	-1.71	0.95
538	1.05	1.02	0.92	0.75	-0.36	0.98	1.05	0.75	0.85	1.05	-1.90	0.89
539	1.12	1.05	0.92	0.72	-0.46	0.98	1.12	0.75	0.85	1.02	-2.00	0.85
540	1.18	1.08	0.95	0.69	-0.49	0.92	1.18	0.75	0.85	1.02	-1.87	0.75
541	1.25	1.12	0.98	0.66	-0.43	0.89	1.25	0.79	0.89	0.98	-1.94	0.69
542	1.31	1.12	1.02	0.66	-0.20	0.82	1.31	0.82	0.92	0.98	-1.74	0.66
543	1.41	1.15	1.05	0.59	-0.07	0.75	1.41	0.82	0.92	0.92	-1.64	0.59
544	1.48	1.15	1.08	0.66	0.46	0.69	1.48	0.85	0.95	0.89	-1.25	0.56
545	1.54	1.18	1.08	0.56	0.30	0.62	1.54	0.85	0.95	0.85	-1.31	0.46
546	1.61	1.18	1.08	0.46	0.13	0.52	1.61	0.89	0.95	0.79	-1.28	0.36
547	1.71	1.18	1.08	0.36	0.07	0.43	1.71	0.89	0.95	0.69	-1.38	0.26
548	1.74	1.18	1.08	0.26	-0.13	0.36	1.74	0.89	0.95	0.66	-1.48	0.20
549	1.80	1.18	1.08	0.26	-0.03	0.33	1.80	0.92	0.98	0.62	-1.38	0.16
550	1.84	1.21	1.12	0.23	0.00	0.26	1.84	0.92	0.98	0.62	-1.18	0.07
551	1.87	1.21	1.12	0.23	0.13	0.26	1.87	0.95	0.98	0.52	-1.18	0.00
552	1.90	1.25	1.18	0.30	0.26	0.30	1.90	1.02	1.02	0.46	-1.12	-0.03
553	1.94	1.28	1.21	0.33	0.33	0.33	1.94	1.05	1.05	0.49	-1.12	0.10
554	1.94	1.31	1.25	0.39	0.46	0.39	1.94	1.08	1.08	0.52	-0.89	0.16
555	2.00	1.38	1.31	0.46	0.52	0.43	2.00	1.15	1.15	0.62	-0.79	0.23
556	2.03	1.41	1.34	0.52	0.62	0.49	2.03	1.21	1.21	0.69	-0.66	0.30
557	2.10	1.48	1.41	0.59	0.85	0.56	2.10	1.25	1.25	0.75	-0.56	0.36
558	2.13	1.51	1.48	0.69	1.08	0.59	2.13	1.31	1.31	0.82	-0.33	0.39
559	2.23	1.57	1.57	0.75	1.48	0.59	2.23	1.34	1.38	0.85	-0.16	0.39
560	2.30	1.61	1.64	0.82	1.77	0.62	2.30	1.38	1.41	0.92	-0.07	0.39
561	2.39	1.67	1.71	0.85	2.00	0.62	2.39	1.44	1.48	0.92	-0.13	0.43
562	2.46	1.74	1.74	0.85	2.00	0.62	2.46	1.48	1.54	0.98	0.23	0.43
563	2.56	1.77	1.77	0.85	1.90	0.62	2.56	1.54	1.57	1.02	0.03	0.43
564	2.62	1.84	1.87	0.92	2.20	0.66	2.62	1.57	1.64	1.05	0.20	0.43
565	2.69	1.87	1.90	0.95	2.49	0.62	2.69	1.61	1.67	1.08	0.82	0.39
566	2.76	1.90	1.97	0.95	2.43	0.66	2.76	1.67	1.74	1.12	0.89	0.39
567	2.85	1.97	2.00	0.98	2.59	0.62	2.85	1.77	1.80	1.12	1.12	0.46
568	2.92	1.90	2.00	0.92	3.15	0.43	2.92	1.80	1.84	1.12	2.10	0.39
569	2.98	1.87	2.03	0.89	3.94	0.23	2.98	1.80	1.87	1.15	3.31	0.30
570	3.02	1.84	2.03	0.85	4.46	0.07	3.02	1.84	1.90	1.15	4.03	0.26

	End Point Analysis						Linear Regression Analysis					
Transect	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**
571	3.08	1.80	2.03	0.82	4.79	-0.03	3.08	1.84	1.90	1.12	4.20	0.20
572	3.12	1.80	2.10	0.85	5.61	-0.16	3.12	1.84	1.90	1.05	4.33	0.10
573	3.18	1.77	2.13	0.89	6.36	-0.30	3.18	1.87	1.94	0.98	4.85	0.00
574	3.25	1.77	2.13	0.82	6.33	-0.39	3.25	1.87	1.94	0.98	5.18	-0.07
575	3.28	1.80	2.13	0.75	6.00	-0.36	3.28	1.90	1.97	0.95	4.95	-0.03
576	3.35	1.84	2.20	0.79	6.00	-0.36	3.35	1.94	1.97	0.92	4.79	-0.03
577	3.41	1.90	2.23	0.82	6.20	-0.33	3.41	1.94	2.00	0.92	4.76	-0.07
578	3.44	1.94	2.23	0.79	5.84	-0.33	3.44	1.97	2.00	0.89	4.40	-0.07
579	3.51	1.97	2.26	0.75	5.54	-0.30	3.51	2.00	2.03	0.89	4.20	-0.07
580	3.54	2.00	2.26	0.69	5.22	-0.26	3.54	2.03	2.03	0.82	3.71	-0.10
581	3.61	2.03	2.26	0.69	4.92	-0.23	3.61	2.03	2.07	0.89	3.64	-0.10
582	3.64	2.07	2.30	0.69	4.82	-0.23	3.64	2.07	2.10	0.89	3.28	-0.10
583	3.67	2.10	2.33	0.72	4.99	-0.23	3.67	2.10	2.10	0.89	3.35	-0.07
584	3.61	2.07	2.30	0.75	5.12	-0.20	3.61	2.07	2.07	0.85	3.02	-0.03
585	3.54	2.03	2.30	0.79	5.22	-0.16	3.54	2.03	2.07	0.92	3.48	0.00
586	3.48	2.00	2.26	0.79	5.15	-0.16	3.48	2.03	2.03	0.92	3.38	0.00
587	3.44	1.97	2.23	0.72	5.08	-0.20	3.44	2.00	2.00	0.89	3.48	-0.03
588	3.48	1.94	2.20	0.62	4.92	-0.33	3.48	1.94	1.97	0.79	3.25	-0.13
589	3.51	1.90	2.16	0.56	5.12	-0.43	3.51	1.90	1.94	0.75	3.71	-0.26
590	3.54	1.87	2.16	0.49	5.28	-0.56	3.54	1.87	1.90	0.66	3.31	-0.39
591	3.54	1.84	2.13	0.43	5.48	-0.69	3.54	1.84	1.87	0.59	3.61	-0.46
592	3.58	1.80	2.13	0.36	5.64	-0.79	3.58	1.80	1.84	0.52	3.87	-0.56
593	3.51	1.80	2.13	0.43	5.84	-0.75	3.51	1.80	1.84	0.52	3.87	-0.52
594	3.48	1.77	2.10	0.49	5.94	-0.69	3.48	1.77	1.80	0.52	3.28	-0.49
595	3.41	1.77	2.13	0.59	6.30	-0.66	3.41	1.77	1.80	0.59	3.31	-0.43
596	3.35	1.74	2.13	0.62	6.33	-0.59	3.35	1.77	1.80	0.62	3.18	-0.36
597	3.28	1.74	2.10	0.66	6.23	-0.56	3.28	1.74	1.80	0.69	3.38	-0.33
598	3.25	1.74	2.07	0.66	5.97	-0.49	3.25	1.74	1.77	0.69	3.18	-0.30
599	3.21	1.74	2.03	0.62	5.67	-0.49	3.21	1.71	1.77	0.72	3.15	-0.30
600	3.18	1.71	2.03	0.66	5.74	-0.46	3.18	1.71	1.74	0.66	2.92	-0.30
601	3.18	1.71	2.03	0.66	5.74	-0.46	3.18	1.67	1.74	0.66	2.89	-0.33
602	3.15	1.71	2.03	0.66	5.71	-0.43	3.15	1.67	1.74	0.69	3.02	-0.33
603	3.15	1.71	2.03	0.72	6.04	-0.43	3.15	1.64	1.74	0.75	3.35	-0.33
604	3.18	1.71	2.07	0.75	6.49	-0.49	3.18	1.67	1.74	0.69	3.35	-0.36
605	3.21	1.71	2.13	0.79	6.95	-0.56	3.21	1.64	1.74	0.69	3.80	-0.46
606	3.18	1.64	2.10	0.82	7.41	-0.62	3.18	1.61	1.74	0.72	3.97	-0.49
607	3.12	1.57	2.07	0.79	7.61	-0.69	3.12	1.51	1.67	0.72	4.20	-0.56
608	3.05	1.48	1.97	0.69	7.54	-0.82	3.05	1.44	1.61	0.66	4.23	-0.66
609	2.95	1.41	1.90	0.59	7.31	-0.85	2.95	1.38	1.54	0.62	4.17	-0.72
610	2.89	1.38	1.84	0.52	7.15	-0.89	2.89	1.34	1.48	0.56	3.80	-0.72
611	2.82	1.31	1.77	0.49	7.02	-0.92	2.82	1.28	1.44	0.56	3.97	-0.75
612	2.76	1.28	1.71	0.46	6.89	-0.95	2.76	1.21	1.41	0.59	3.80	-0.82
613	2.69	1.21	1.67	0.46	6.89	-0.95	2.69	1.15	1.34	0.56	3.61	-0.85
614	2.56	1.18	1.64	0.52	7.08	-0.89	2.56	1.08	1.34	0.69	4.26	-0.79
615	2.46	1.12	1.61	0.56	7.08	-0.85	2.46	1.05	1.31	0.69	4.20	-0.75
616	2.36	1.08	1.54	0.56	6.86	-0.82	2.36	1.02	1.25	0.69	3.90	-0.72
617	2.26	1.05	1.51	0.59	6.82	-0.75	2.26	0.98	1.25	0.72	4.13	-0.69
618	2.20	1.02	1.48	0.62	6.86	-0.72	2.20	0.95	1.21	0.75	4.30	-0.62
619	2.10	0.98	1.44	0.62	6.72	-0.69	2.10	0.92	1.18	0.75	3.97	-0.59
620	2.03	0.95	1.41	0.66	6.66	-0.62	2.03	0.89	1.15	0.72	3.54	-0.59
621	1.97	0.92	1.38	0.62	6.66	-0.66	1.97	0.82	1.12	0.72	3.64	-0.62
622	1.94	0.89	1.34	0.59	6.69	-0.72	1.94	0.82	1.08	0.72	3.77	-0.62
623	1.90	0.82	1.31	0.59	6.76	-0.75	1.90	0.75	1.05	0.72	4.03	-0.69
624	1.87	0.79	1.28	0.52	6.72	-0.79	1.87	0.72	1.02	0.66	3.90	-0.72
625	1.84	0.75	1.21	0.49	6.69	-0.82	1.84	0.69	0.95	0.62	3.74	-0.72
626	1.77	0.72	1.21	0.49	6.59	-0.82	1.77	0.66	0.92	0.59	3.48	-0.72
627	1.74	0.72	1.18	0.49	6.49	-0.82	1.74	0.62	0.89	0.59	3.35	-0.75
628	1.71	0.69	1.12	0.43	6.20	-0.82	1.71	0.59	0.85	0.56	3.18	-0.72
629	1.64	0.66	1.08	0.43	6.20	-0.82	1.64	0.56	0.82	0.49	2.72	-0.75
630	1.61	0.62	1.05	0.39	6.10	-0.85	1.61	0.52	0.79	0.49	2.76	-0.79
631	1.51	0.56	1.02	0.39	6.00	-0.82	1.51	0.49	0.79	0.52	2.56	-0.72
632	1.44	0.56	0.98	0.43	5.94	-0.75	1.44	0.46	0.75	0.59	2.72	-0.69
633	1.34	0.52	0.95	0.46	5.71	-0.69	1.34	0.46	0.75	0.66	2.82	-0.62

	End Point Analysis						Linear Regression Analysis					
Transect	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998	1864-1944	1864-1998	1864-2010	1944-2010	1998-2010	1944-1998
634	1.28	0.52	0.89	0.46	5.35	-0.59	1.28	0.43	0.75	0.69	2.85	-0.59
635	1.18	0.49	0.85	0.46	5.02	-0.52	1.18	0.43	0.72	0.72	2.59	-0.49
636	1.08	0.49	0.85	0.52	4.95	-0.43	1.08	0.43	0.72	0.72	2.30	-0.36
637	1.02	0.46	0.85	0.69	5.35	-0.33	1.02	0.43	0.72	0.82	2.62	-0.26
638	0.95	0.49	0.89	0.79	5.44	-0.23	0.95	0.39	0.75	0.92	2.62	-0.23
639	0.92	0.49	0.89	0.82	5.15	-0.10	0.92	0.43	0.75	0.98	2.49	-0.10
640	0.85	0.52	0.85	0.85	4.76	0.00	0.85	0.43	0.75	1.05	2.39	0.00
641	0.82	0.52	0.85	0.92	4.76	0.10	0.82	0.46	0.79	1.12	2.16	0.10
642	0.82	0.52	0.85	0.95	4.69	0.13	0.82	0.49	0.79	1.12	1.87	0.16
643	0.82	0.52	0.85	0.89	4.56	0.10	0.82	0.49	0.79	1.12	1.94	0.13
644	0.85	0.56	0.89	0.89	4.62	0.07	0.85	0.49	0.82	1.08	1.77	0.10
645	0.89	0.56	0.89	0.85	4.59	0.03	0.89	0.49	0.79	1.02	1.48	0.07
646	0.89	0.56	0.85	0.82	4.53	0.00	0.89	0.49	0.79	0.95	1.25	0.03
647	0.89	0.52	0.85	0.79	4.53	0.00	0.89	0.49	0.79	1.02	1.61	0.00
648	0.89	0.52	0.82	0.75	4.33	-0.03	0.89	0.49	0.79	0.98	1.48	0.00
649	0.92	0.52	0.85	0.82	4.82	-0.07	0.92	0.49	0.82	1.05	2.20	0.00
650	0.92	0.52	0.95	0.98	5.87	-0.07	0.92	0.49	0.82	1.12	3.05	0.00
651	0.95	0.52	0.95	0.95	5.77	-0.10	0.95	0.49	0.82	1.05	2.85	-0.03
652	0.98	0.52	0.95	0.92	5.64	-0.13	0.98	0.52	0.82	1.02	2.53	-0.03
653	1.02	0.56	0.98	0.95	6.00	-0.13	1.02	0.56	0.85	1.05	3.15	-0.03
654	1.05	0.56	1.02	0.98	6.26	-0.16	1.05	0.56	0.89	1.05	3.15	-0.10
655	1.12	0.59	1.05	0.95	6.17	-0.16	1.12	0.56	0.89	1.05	3.02	-0.10
656	1.15	0.62	1.08	0.98	6.49	-0.20	1.15	0.59	0.92	1.08	3.44	-0.13
657	1.18	0.62	1.12	0.98	6.49	-0.20	1.18	0.59	0.95	1.15	3.71	-0.16
658	1.25	0.69	1.18	1.12	6.89	-0.13	1.25	0.62	0.98	1.21	3.74	-0.13
659	1.31	0.72	1.21	1.08	6.69	-0.13	1.31	0.66	1.02	1.21	3.67	-0.16
660	1.34	0.72	1.21	1.02	6.56	-0.16	1.34	0.62	1.02	1.15	3.41	-0.23
661	1.38	0.75	1.21	1.02	6.66	-0.20	1.38	0.62	0.98	1.08	3.28	-0.26
662	1.41	0.75	1.21	0.98	6.49	-0.23	1.41	0.62	0.98	1.08	3.41	-0.30
663	1.41	0.72	1.21	0.92	6.69	-0.33	1.41	0.62	0.98	1.05	3.58	-0.39
664	1.44	0.69	1.18	0.89	6.76	-0.39	1.44	0.59	0.98	1.02	3.71	-0.43
665	1.41	0.69	1.18	0.92	7.15	-0.43	1.41	0.56	0.98	1.05	3.97	-0.49
666	1.41	0.66	1.21	0.95	7.54	-0.46	1.41	0.56	0.98	1.08	4.46	-0.46
667	1.38	0.66	1.21	0.98	7.61	-0.46	1.38	0.59	0.98	1.12	4.66	-0.43
668	1.34	0.62	1.21	1.02	7.74	-0.43	1.34	0.59	1.02	1.15	4.99	-0.39
669	1.31	0.62	1.18	1.05	7.74	-0.39	1.31	0.56	0.98	1.21	5.12	-0.36
670	1.25	0.62	1.21	1.12	7.74	-0.33	1.25	0.56	1.02	1.28	5.18	-0.30
671	1.21	0.66	1.21	1.21	7.68	-0.20	1.21	0.56	1.02	1.38	4.95	-0.23
672	1.18	0.66	1.25	1.31	7.84	-0.10	1.18	0.56	1.05	1.48	4.95	-0.16
673	1.12	0.69	1.25	1.41	7.87	0.03	1.12	0.56	1.08	1.57	5.15	-0.10
674	1.08	0.69	1.28	1.51	7.81	0.13	1.08	0.56	1.08	1.71	5.25	0.00
675	1.02	0.72	1.28	1.61	7.81	0.26	1.02	0.56	1.12	1.80	5.48	0.07
676	1.02	0.79	1.31	1.64	7.22	0.43	1.02	0.59	1.15	1.87	5.12	0.23
677	1.02	0.89	1.31	1.67	6.26	0.69	1.02	0.66	1.15	1.87	4.36	0.36
678	1.02	0.98	1.34	1.74	5.71	0.89	1.02	0.69	1.18	1.94	3.67	0.52
679	1.05	1.05	1.38	1.80	5.18	1.08	1.05	0.75	1.21	1.97	2.85	0.66
680	1.05	1.15	1.44	1.87	4.66	1.28	1.05	0.79	1.28	2.07	2.53	0.79
681	1.08	1.25	1.48	1.94	4.03	1.48	1.08	0.85	1.31	2.16	2.16	0.92
682	1.08	1.31	1.48	1.97	3.28	1.67	1.08	0.92	1.34	2.20	1.51	1.08
683	1.12	1.38	1.51	1.97	3.02	1.74	1.12	0.95	1.38	2.23	1.18	1.18
684	1.15	1.41	1.54	2.00	2.92	1.80	1.15	1.02	1.44	2.30	1.25	1.25
685	1.18	1.48	1.57	2.03	2.69	1.90	1.18	1.05	1.48	2.33	0.95	1.35
686	1.21	1.51	1.61	2.07	2.49	1.97	1.21	1.12	1.51	2.33	0.52	1.44
687	1.25	1.57	1.61	2.07	2.13	2.03	1.25	1.18	1.54	2.36	0.46	1.51
688	1.28	1.61	1.64	2.07	1.84	2.10	1.28	1.25	1.57	2.39	0.36	1.64
689	1.31	1.67	1.67	2.10	1.57	2.23	1.31	1.28	1.61	2.46	0.07	1.77
690	1.28	1.71	1.71	2.20	1.41	2.36	1.28	1.34	1.67	2.56	-0.10	1.97
691	1.21	1.74	1.71	2.30	1.25	2.53	1.21	1.44	1.71	2.62	-0.30	2.20
692	1.18	1.80	1.74	2.43	1.08	2.69	1.18	1.48	1.77	2.76	-0.30	2.36
693	1.12	1.84	1.77	2.59	1.12	2.89	1.12	1.54	1.80	2.85	-0.52	2.56
694	1.08	1.90	1.84	2.72	1.12	3.05	1.08	1.57	1.87	2.98	-0.52	2.69
695	1.08	1.94	1.87	2.82	1.08	3.22	1.08	1.61	1.90	3.08	-0.62	2.89
696	1.05	2.00	1.90	2.95	1.05	3.38	1.05	1.67	1.94	3.18	-0.95	3.02

	End Point Analysis						Linear Regression Analysis					
Transect	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**
697	1.02	2.03	1.97	3.12	1.31	3.51	1.02	1.74	2.03	3.35	-0.56	3.22
698	1.02	2.10	2.03	3.21	1.25	3.64	1.02	1.80	2.07	3.41	-0.49	3.35
699	1.05	2.13	2.10	3.35	1.57	3.74	1.05	1.84	2.13	3.48	-0.39	3.44
700	0.98	2.13	2.10	3.48	1.71	3.84	0.98	1.84	2.13	3.58	-0.30	3.51
701	0.89	2.13	2.07	3.51	1.51	3.94	0.89	1.84	2.13	3.64	-0.33	3.61
702	0.82	2.10	2.03	3.54	1.48	4.00	0.82	1.84	2.10	3.67	-0.33	3.67
703	0.75	2.07	2.03	3.54	1.64	3.97	0.75	1.80	2.10	3.67	-0.20	3.71
704	0.72	2.03	2.00	3.54	1.51	4.00	0.72	1.80	2.10	3.71	-0.07	3.81
705	0.66	2.03	1.97	3.61	1.54	4.04	0.66	1.80	2.07	3.74	0.00	3.84
706	0.72	2.07	2.03	3.61	1.48	4.10	0.72	1.84	2.13	3.74	-0.07	3.87
707	0.85	2.16	2.10	3.58	1.28	4.10	0.85	1.94	2.16	3.74	-0.16	3.90
708	0.98	2.23	2.13	3.58	1.18	4.10	0.98	2.00	2.23	3.71	-0.39	3.90
709	1.12	2.30	2.20	3.54	1.08	4.10	1.12	2.07	2.30	3.67	-0.49	3.94
710	1.25	2.39	2.26	3.54	0.95	4.07	1.25	2.16	2.33	3.67	-0.43	3.97
711	1.34	2.46	2.33	3.51	0.92	4.07	1.34	2.23	2.39	3.67	-0.56	4.00
712	1.41	2.49	2.36	3.51	0.82	4.10	1.41	2.30	2.43	3.64	-0.75	4.04
713	1.51	2.56	2.39	3.48	0.62	4.10	1.51	2.33	2.46	3.61	-0.92	4.04
714	1.57	2.59	2.43	3.44	0.59	4.07	1.57	2.39	2.49	3.58	-0.79	4.00
715	1.67	2.62	2.46	3.44	0.62	4.04	1.67	2.46	2.53	3.54	-0.79	4.04
716	1.71	2.66	2.49	3.41	0.59	4.00	1.71	2.49	2.56	3.54	-0.59	4.07
717	1.71	2.59	2.43	3.35	0.69	3.90	1.71	2.46	2.49	3.44	-0.56	4.00
718	1.67	2.53	2.39	3.21	0.69	3.77	1.67	2.39	2.46	3.38	-0.52	3.87
719	1.67	2.49	2.33	3.15	0.62	3.71	1.67	2.36	2.43	3.35	-0.43	3.77
720	1.67	2.46	2.30	3.08	0.36	3.67	1.67	2.33	2.39	3.28	-0.62	3.74
721	1.64	2.46	2.26	3.05	0.33	3.64	1.64	2.33	2.39	3.25	-0.59	3.74
722	1.61	2.43	2.26	3.08	0.36	3.64	1.61	2.33	2.36	3.28	-0.59	3.77
723	1.54	2.39	2.23	3.12	0.39	3.67	1.54	2.30	2.36	3.31	-0.62	3.84
724	1.48	2.39	2.23	3.18	0.59	3.71	1.48	2.30	2.36	3.41	-0.43	3.87
725	1.41	2.39	2.23	3.21	0.62	3.77	1.41	2.30	2.36	3.44	-0.59	3.94
726	1.38	2.36	2.26	3.31	0.85	3.84	1.38	2.30	2.39	3.51	-0.39	4.04
727	1.31	2.36	2.26	3.44	1.18	3.90	1.31	2.30	2.39	3.54	-0.49	4.07
728	1.18	2.33	2.23	3.51	1.31	4.00	1.18	2.26	2.36	3.64	-0.10	4.13
729	1.05	2.26	2.16	3.51	0.98	4.07	1.05	2.20	2.33	3.64	-0.46	4.20
730	0.98	2.23	2.10	3.44	0.69	4.04	0.98	2.16	2.30	3.64	-0.39	4.17
731	0.98	2.20	2.07	3.35	0.39	4.00	0.98	2.13	2.26	3.58	-0.59	4.17
732	1.02	2.20	2.07	3.31	0.33	3.97	1.02	2.16	2.26	3.54	-0.62	4.17
733	1.05	2.20	2.03	3.28	0.20	3.94	1.05	2.16	2.26	3.51	-0.62	4.13
734	1.08	2.20	2.03	3.21	0.13	3.87	1.08	2.20	2.26	3.44	-0.69	4.13
735	1.12	2.20	2.03	3.18	0.13	3.84	1.12	2.20	2.26	3.41	-0.46	4.07
736	1.08	2.20	2.03	3.21	0.20	3.87	1.08	2.23	2.30	3.41	-0.52	4.13
737	1.05	2.23	2.07	3.28	0.23	3.97	1.05	2.30	2.33	3.51	-0.26	4.30
738	0.98	2.23	2.07	3.35	0.00	4.10	0.98	2.33	2.36	3.58	-0.66	4.43
739	0.95	2.26	2.10	3.54	0.33	4.23	0.95	2.36	2.39	3.71	-0.33	4.56
740	0.89	2.33	2.16	3.67	0.23	4.43	0.89	2.43	2.46	3.84	-0.33	4.82
741	0.82	2.36	2.20	3.87	0.30	4.66	0.82	2.49	2.53	3.97	-0.56	5.02
742	0.72	2.39	2.20	3.97	-0.10	4.86	0.72	2.56	2.56	4.07	-0.85	5.25
743	0.56	2.39	2.20	4.13	-0.03	5.05	0.56	2.56	2.56	4.17	-0.92	5.48
744	0.43	2.36	2.20	4.33	0.03	5.25	0.43	2.59	2.56	4.30	-0.92	5.71
745	0.39	2.36	2.16	4.33	0.10	5.25	0.39	2.59	2.56	4.30	-0.95	5.68
746	0.36	2.33	2.20	4.43	0.52	5.28	0.36	2.59	2.56	4.33	-0.56	5.68
747	0.33	2.33	2.16	4.43	0.46	5.28	0.33	2.56	2.56	4.33	-0.56	5.64
748	0.30	2.33	2.20	4.49	0.56	5.35	0.30	2.59	2.56	4.36	-0.49	5.68
749	0.30	2.33	2.20	4.53	0.56	5.35	0.30	2.59	2.56	4.36	-0.43	5.71
750	0.30	2.36	2.20	4.53	0.52	5.38	0.30	2.59	2.56	4.33	-0.62	5.71
751	0.30	2.36	2.20	4.49	0.33	5.41	0.30	2.62	2.59	4.40	-0.66	5.64
752	0.30	2.36	2.20	4.49	0.16	5.45	0.30	2.69	2.59	4.23	-0.66	5.64
753	0.33	2.36	2.20	4.46	0.13	5.41	0.33	2.72	2.59	4.23	-0.82	5.61
754	0.36	2.39	2.16	4.36	-0.33	5.38	0.36	2.72	2.59	4.17	-1.41	5.68
755	0.43	2.39	2.20	4.33	-0.10	5.31	0.43	2.79	2.62	4.13	-1.28	5.71
756	0.56	2.46	2.23	4.26	-0.20	5.25	0.56	2.89	2.69	4.10	-1.15	5.71
757	0.69	2.53	2.30	4.26	0.00	5.22	0.69	2.95	2.76	4.13	-1.02	5.81
758	0.79	2.56	2.36	4.23	-0.10	5.18	0.79	3.05	2.82	4.13	-1.05	5.74
759	0.92	2.62	2.39	4.17	-0.33	5.15	0.92	3.12	2.89	4.10	-0.98	5.64

	End Point Analysis						Linear Regression Analysis					
Transect	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**
760	1.05	2.72	2.46	4.17	-0.43	5.18	1.05	3.21	2.95	4.07	-1.02	5.58
761	1.25	2.82	2.59	4.20	-0.10	5.15	1.25	3.35	3.05	4.00	-0.82	5.45
762	1.44	2.92	2.72	4.30	0.56	5.12	1.44	3.44	3.15	4.03	-0.52	5.31
763	1.67	3.05	2.85	4.30	0.79	5.05	1.67	3.58	3.25	3.97	-0.56	5.22
764	1.94	3.18	2.98	4.26	0.82	4.99	1.94	3.67	3.35	3.94	-0.49	5.15
765	2.20	3.31	3.08	4.17	0.59	4.95	2.20	3.84	3.41	3.80	-1.05	5.05
766	2.46	3.44	3.15	3.97	-0.26	4.89	2.46	3.97	3.51	3.64	-2.07	5.02
767	2.72	3.58	3.28	3.94	-0.36	4.86	2.72	4.07	3.58	3.54	-2.36	4.99
768	2.98	3.71	3.38	3.87	-0.26	4.76	2.98	4.20	3.67	3.44	-2.39	5.18
769	3.12	3.84	3.54	4.03	0.10	4.89	3.12	4.33	3.77	3.54	-1.94	5.38
770	3.08	3.90	3.61	4.26	0.26	5.12	3.08	4.40	3.87	3.67	-1.57	5.54
771	2.89	3.87	3.54	4.36	-0.03	5.35	2.89	4.46	3.87	3.80	-1.34	5.64
772	2.76	3.84	3.44	4.30	-0.82	5.41	2.76	4.43	3.87	3.84	-1.61	5.61
773	2.66	3.77	3.38	4.23	-1.31	5.41	2.66	4.40	3.84	3.87	-2.26	5.68
774	2.62	3.67	3.28	4.10	-1.31	5.25	2.62	4.36	3.74	3.71	-2.33	5.61
775	2.62	3.61	3.25	4.03	-0.69	5.05	2.62	4.30	3.67	3.48	-1.90	5.51
776	2.62	3.51	3.25	4.00	0.10	4.86	2.62	4.26	3.61	3.28	-1.57	5.41
777	2.66	3.48	3.31	4.10	1.08	4.76	2.66	4.17	3.58	3.31	-1.12	5.22
778	2.69	3.48	3.35	4.13	1.67	4.66	2.69	4.10	3.58	3.38	-0.69	4.95
779	2.95	3.48	3.41	3.97	2.43	4.30	2.95	4.00	3.54	3.15	-0.33	4.59
780	3.18	3.48	3.41	3.71	2.76	3.90	3.18	3.94	3.48	2.89	-0.23	4.20
781	3.44	3.48	3.41	3.38	2.69	3.54	3.44	3.90	3.41	2.59	-0.33	3.84
782	3.71	3.44	3.41	3.05	2.85	3.12	3.71	3.84	3.35	2.26	-0.36	3.44
783	3.94	3.44	3.38	2.72	2.92	2.69	3.94	3.71	3.25	1.94	-0.52	3.15
784	4.17	3.38	3.38	2.39	3.25	2.23	4.17	3.61	3.15	1.61	-0.33	2.85
785	4.26	3.25	3.31	2.20	4.03	1.80	4.26	3.51	3.08	1.44	0.69	2.49
786	4.40	3.18	3.31	2.03	4.82	1.44	4.40	3.41	3.05	1.31	1.38	2.13
787	0.85	2.36	2.30	4.03	1.71	4.56	0.85	2.10	2.43	4.20	-0.07	1.80
788	1.02	2.46	2.39	4.03	1.77	4.53	1.02	2.16	2.49	4.20	0.07	1.51
789	1.21	2.53	2.46	4.00	1.64	4.49	1.21	2.26	2.56	4.17	-0.13	1.18
790	1.38	2.66	2.56	3.97	1.44	4.49	1.38	2.39	2.62	4.17	-0.13	1.02
791	1.51	2.72	2.62	3.94	1.31	4.49	1.51	2.46	2.66	4.10	-0.59	0.82
792	1.64	2.79	2.66	3.90	1.21	4.49	1.64	2.53	2.72	4.10	-0.39	0.46
793	1.74	2.85	2.72	3.90	1.05	4.53	1.74	2.59	2.76	4.10	-0.49	0.36
794	1.84	2.92	2.76	3.90	1.05	4.53	1.84	2.69	2.82	4.03	-0.72	0.23
795	1.90	2.95	2.79	3.87	0.79	4.53	1.90	2.72	2.82	3.97	-0.95	0.23
796	1.80	2.89	2.72	3.84	0.69	4.49	1.80	2.69	2.79	3.94	-0.85	0.23
797	1.77	2.82	2.66	3.74	0.69	4.40	1.77	2.66	2.72	3.84	-0.89	0.23
798	1.74	2.76	2.59	3.61	0.66	4.27	1.74	2.59	2.66	3.74	-0.66	0.23
799	1.74	2.69	2.56	3.51	0.79	4.10	1.74	2.56	2.62	3.67	-0.56	0.23
800	1.74	2.62	2.49	3.41	0.75	3.97	1.74	2.49	2.56	3.58	-0.52	0.30
801	1.71	2.59	2.43	3.28	0.56	3.87	1.71	2.46	2.53	3.51	-0.39	0.43
802	1.64	2.56	2.39	3.28	0.33	3.90	1.64	2.43	2.49	3.51	-0.75	0.72
803	1.57	2.56	2.36	3.31	0.39	3.97	1.57	2.43	2.49	3.54	-0.69	1.28
804	1.54	2.53	2.36	3.35	0.36	4.00	1.54	2.43	2.49	3.58	-0.66	1.94
811	2.76	1.15	1.05	-0.98	0.00	-1.21	2.76	1.21	0.79	-1.15	0.03	-0.95
812	1.80	0.85	0.75	-0.49	-0.16	-0.56	1.80	0.89	0.59	-0.62	0.10	-0.43
813	0.82	0.59	0.43	-0.03	-1.18	0.23	0.82	0.62	0.39	-0.10	-0.46	0.26
814	0.43	0.62	0.36	0.30	-2.56	0.92	0.43	0.59	0.43	0.30	-1.41	0.85
815	0.16	0.75	0.43	0.69	-3.44	1.57	0.16	0.66	0.49	0.72	-2.16	1.44
816	-0.10	0.79	0.43	1.05	-3.84	2.10	-0.10	0.69	0.59	1.12	-2.43	1.97
817	-0.33	0.69	0.43	1.34	-2.56	2.20	-0.33	0.59	0.59	1.44	-1.44	2.07
818	-0.46	0.56	0.43	1.48	-1.02	2.00	-0.46	0.43	0.56	1.57	-0.33	1.80
819	-0.52	0.36	0.36	1.44	0.20	1.71	-0.52	0.26	0.49	1.61	0.52	1.57
820	-0.62	0.20	0.23	1.25	0.66	1.38	-0.62	0.13	0.39	1.48	0.39	1.38
821	-0.72	0.00	0.10	1.12	1.34	1.08	-0.72	0.03	0.30	1.38	0.95	1.21
822	-0.82	-0.10	-0.03	0.95	0.89	0.95	-0.82	-0.03	0.20	1.21	0.43	1.21
823	-0.92	-0.20	-0.20	0.69	-0.07	0.85	-0.92	-0.07	0.10	1.05	0.30	1.21
824	-0.98	-0.30	-0.36	0.43	-0.85	0.69	-0.98	-0.13	0.00	0.85	0.30	1.18
825	-0.98	-0.36	-0.49	0.13	-1.77	0.56	-0.98	-0.13	-0.13	0.56	-0.03	1.05
826	-0.98	-0.43	-0.59	-0.10	-2.39	0.39	-0.98	-0.16	-0.23	0.30	-0.56	0.85
827	-0.98	-0.46	-0.69	-0.30	-3.08	0.30	-0.98	-0.16	-0.30	0.03	-1.21	0.75
828	-0.98	-0.49	-0.75	-0.46	-3.80	0.26	-0.98	-0.16	-0.36	-0.23	-1.94	0.69

	End Point Analysis						Linear Regression Analysis					
Transect	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**	**1864-1944**	**1864-1998**	**1864-2010**	**1944-2010**	**1998-2010**	**1944-1998**
829	-0.98	-0.49	-0.75	-0.46	-3.61	0.23	-0.98	-0.16	-0.39	-0.39	-1.94	0.62
830	-0.92	-0.52	-0.75	-0.59	-3.54	0.03	-0.92	-0.16	-0.46	-0.62	-1.87	0.39
831	-0.79	-0.52	-0.72	-0.66	-2.98	-0.16	-0.79	-0.20	-0.49	-0.75	-1.54	0.07
832	-0.66	-0.52	-0.72	-0.79	-2.85	-0.33	-0.66	-0.20	-0.49	-0.95	-1.31	-0.13
833	-0.59	-0.56	-0.75	-0.92	-2.82	-0.52	-0.59	-0.20	-0.56	-1.15	-1.12	-0.30
834	-0.59	-0.62	-0.82	-1.12	-3.15	-0.66	-0.59	-0.23	-0.62	-1.34	-1.02	-0.43
835	-0.59	-0.66	-0.89	-1.21	-3.31	-0.79	-0.59	-0.26	-0.69	-1.48	-1.02	-0.52
836	-0.59	-0.69	-0.89	-1.28	-3.31	-0.85	-0.59	-0.26	-0.69	-1.57	-0.95	-0.56
837	-0.59	-0.62	-0.89	-1.28	-3.74	-0.72	-0.59	-0.23	-0.69	-1.61	-1.31	-0.52
838	-0.56	-0.59	-0.85	-1.21	-3.97	-0.62	-0.56	-0.16	-0.66	-1.57	-1.61	-0.43
839	-0.56	-0.59	-0.85	-1.18	-3.87	-0.59	-0.56	-0.13	-0.66	-1.61	-1.44	-0.33
840	-0.56	-0.59	-0.82	-1.12	-3.31	-0.66	-0.56	-0.07	-0.66	-1.64	-0.98	-0.23
841	-0.56	-0.59	-0.79	-1.08	-3.25	-0.62	-0.56	0.00	-0.62	-1.64	-0.69	-0.10
842	-0.56	-0.56	-0.79	-1.05	-3.18	-0.59	-0.56	0.07	-0.62	-1.64	-0.36	0.07
843	-0.49	-0.49	-0.72	-1.02	-3.44	-0.52	-0.49	0.16	-0.56	-1.67	-0.52	0.20
844	-0.43	-0.43	-0.69	-1.02	-3.74	-0.43	-0.43	-0.03	-0.49	-0.75	-0.85	0.46
845	-0.36	-0.36	-0.66	-1.05	-4.17	-0.36	-0.36	0.00	-0.46	-0.79	-1.25	0.49
846	-0.30	-0.30	-0.62	-1.02	-4.33	-0.30	-0.30	0.03	-0.43	-0.75	-1.61	0.49
847	-0.30	-0.30	-0.56	-0.89	-3.87	-0.26	-0.30	0.07	-0.39	-0.69	-1.31	0.52
848	-0.30	-0.26	-0.52	-0.82	-3.51	-0.23	-0.30	0.10	-0.33	-0.59	-1.15	0.62
849	-0.30	-0.20	-0.46	-0.69	-3.44	-0.10	-0.30	0.16	-0.26	-0.43	-1.41	0.72
850	-0.30	-0.10	-0.39	-0.56	-3.84	0.16	-0.30	0.23	-0.20	-0.30	-1.94	0.92
851	-0.30	0.00	-0.33	-0.39	-4.20	0.46	-0.30	0.30	-0.13	-0.16	-2.07	1.08
852	-0.30	0.13	-0.26	-0.23	-4.66	0.75	-0.30	0.36	-0.07	-0.03	-2.53	1.25
853	-0.30	0.20	-0.20	-0.10	-4.72	0.92	-0.30	0.43	0.00	0.10	-2.69	1.38
854	-0.23	0.23	-0.13	-0.03	-4.20	0.85	-0.23	0.46	0.07	0.13	-2.39	1.38
855	-0.13	0.23	-0.07	0.03	-3.54	0.79	-0.13	0.49	0.13	0.20	-1.94	1.35
856	-0.07	0.30	0.03	0.13	-3.12	0.82	-0.07	0.56	0.20	0.30	-1.61	1.38
857	0.00	0.39	0.13	0.26	-3.05	0.98	0.00	0.36	0.23	0.43	-1.57	0.98
858	0.07	0.52	0.23	0.46	-2.85	1.15	0.07	0.49	0.36	0.59	-1.41	1.15
859	0.13	0.62	0.36	0.62	-2.76	1.35	0.13	0.59	0.46	0.75	-1.41	1.35
860	0.20	0.79	0.46	0.75	-3.48	1.67	0.20	0.75	0.59	0.89	-2.23	1.67
861	0.23	0.95	0.52	0.95	-4.07	2.03	0.23	0.89	0.69	1.08	-3.18	2.03
862	0.13	1.05	0.62	1.18	-4.49	2.40	0.13	0.98	0.82	1.34	-4.03	2.40
863	0.07	1.08	0.69	1.44	-3.84	2.56	0.07	1.02	0.92	1.64	-3.90	2.56
864	0.00	1.12	0.79	1.71	-2.98	2.72	0.00	1.02	1.02	1.90	-3.48	2.72
865	-0.16	1.08	0.82	2.00	-2.10	2.89	-0.16	0.98	1.05	2.13	-3.05	2.89
866	-0.36	1.05	0.82	2.26	-1.71	3.15	-0.36	0.95	1.08	2.39	-2.62	3.15
867	-0.52	1.08	0.85	2.53	-1.61	3.41	-0.52	0.95	1.12	2.62	-2.49	3.41
868	-0.69	1.08	0.89	2.79	-1.48	3.71	-0.69	0.95	1.15	2.85	-2.46	3.71
869	-0.85	1.12	0.92	3.08	-1.18	4.00	-0.85	0.95	1.21	3.12	-2.59	4.00
870	-0.98	1.12	0.95	3.31	-0.98	4.23	-0.98	0.95	1.28	3.35	-2.56	4.23
871	-0.98	1.15	0.98	3.41	-0.69	4.27	-0.98	0.98	1.31	3.48	-2.36	4.27
872	-0.98	1.21	1.02	3.48	-0.95	4.43	-0.98	1.05	1.41	3.61	-2.36	4.43
873	-0.95	1.31	1.08	3.54	-1.51	4.63	-0.95	1.15	1.51	3.77	-2.23	4.63
874	-0.72	1.38	1.15	3.38	-1.80	4.49	-0.72	1.21	1.54	3.64	-2.53	4.49
875	-0.82	1.28	1.05	3.35	-1.31	4.36	-0.82	1.12	1.51	3.67	-1.90	4.36

APPENDIX C: SHORELINE CHANGE MAPS (WHG, 2006; WHG, 2004)

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C-1. SHORELINE CHANGE ANALYSIS RESULTS FROM SACO RIVER AND CAMP ELLIS BEACH DATA COLLECTION AND MODELING REPORT, OCTOBER 2006

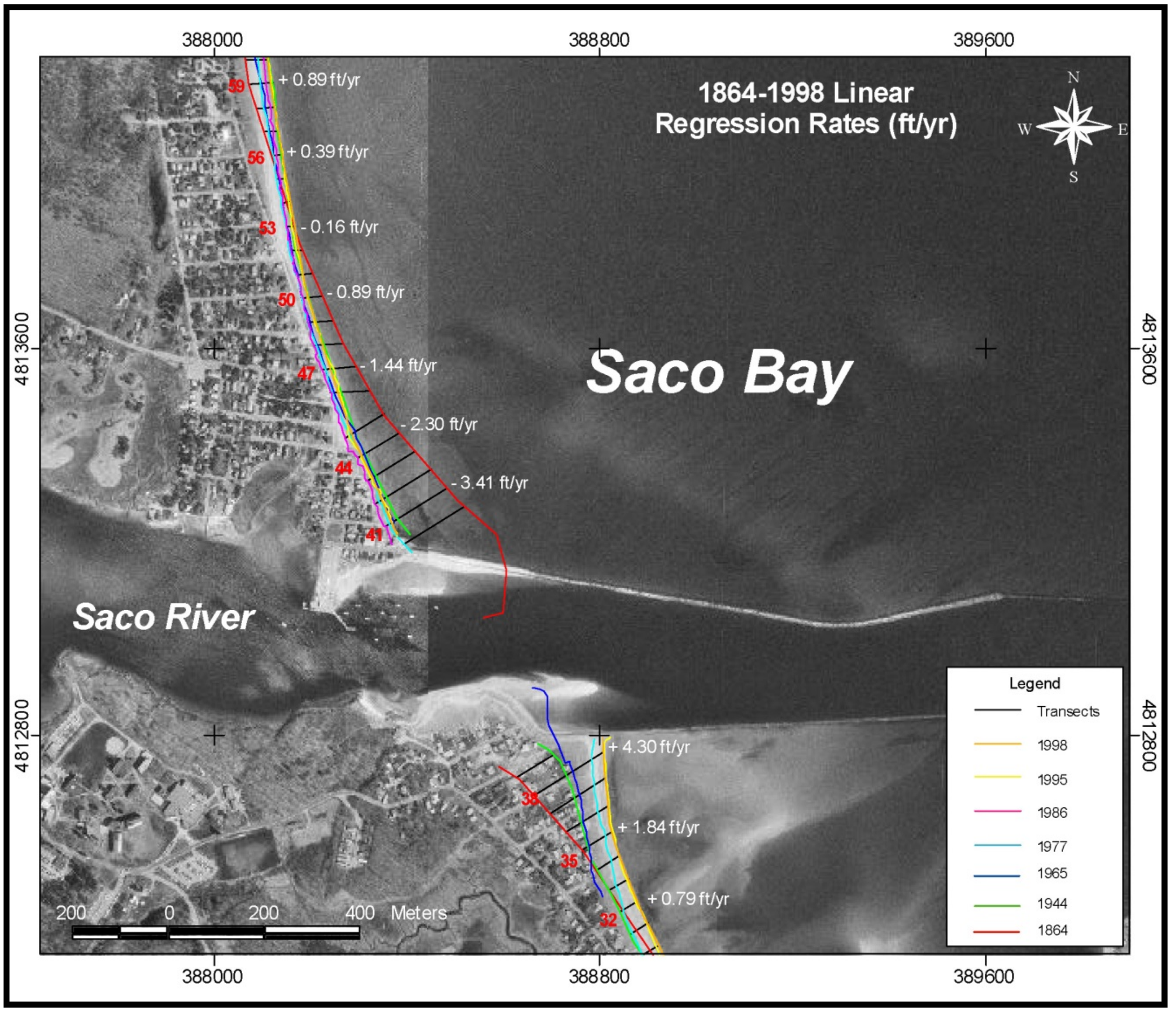


Figure C-1.1 Historical shoreline positions and change rates (linear regression) from 1864-1998 for the region near the Saco River.

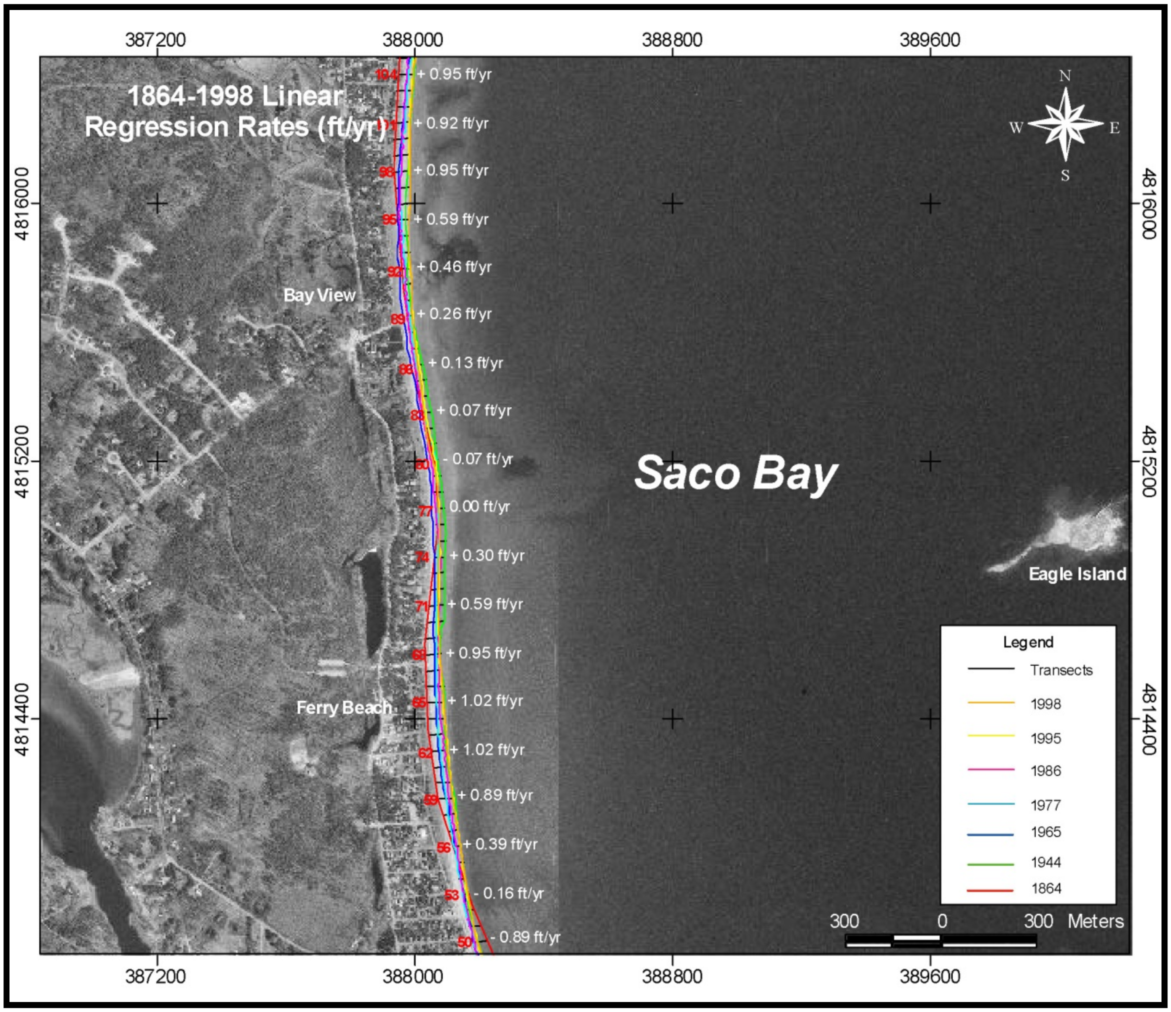


Figure C-1.2 Historical shoreline positions and change rates (linear regression) from 1864-1998 for the region near Ferry Beach and Bay View in Saco Bay.

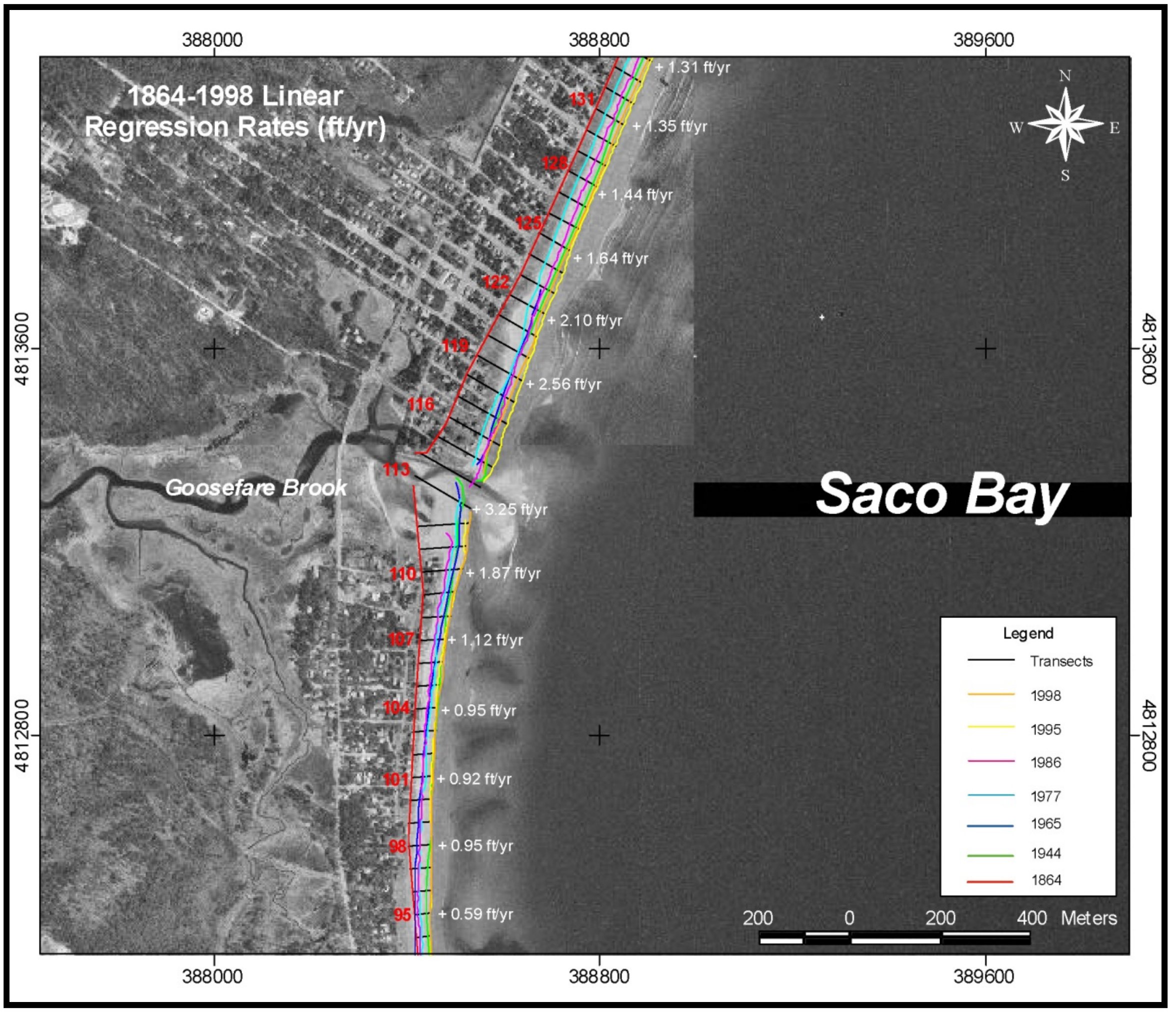


Figure C-1.3 Historical shoreline positions and change rates (linear regression) from 1864-1998 for the region near Goosefare Brook in Saco Bay.

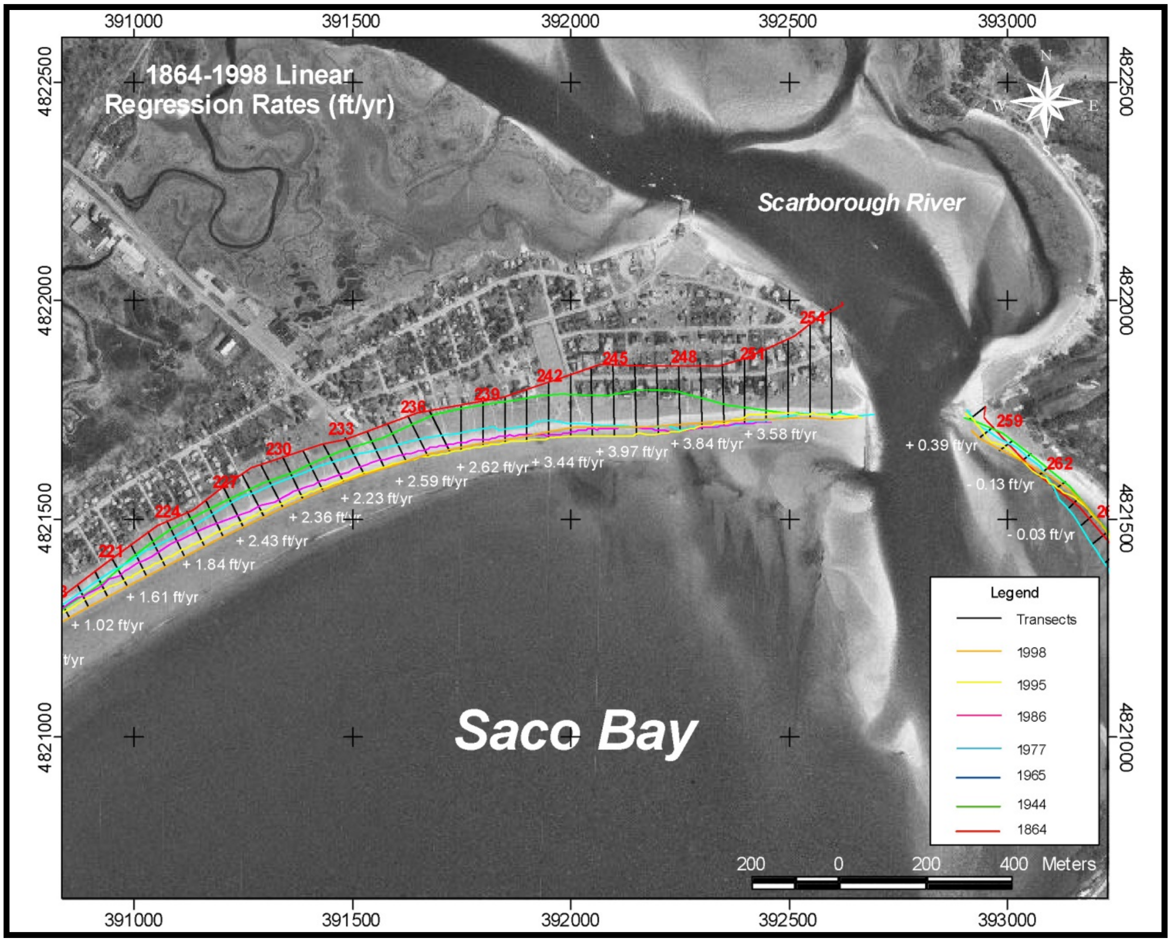


Figure C-1.4 Historical shoreline positions and change rates (linear regression) from 1864-1998 for the region near Scarborough River in Saco Bay.

C-2. SHORELINE CHANGE ANALYSIS RESULTS FROM ANALYSIS OF SHORELINE CHANGE FOR WESTERN BEACH, SACO BAY, MAINE, APRIL 2004

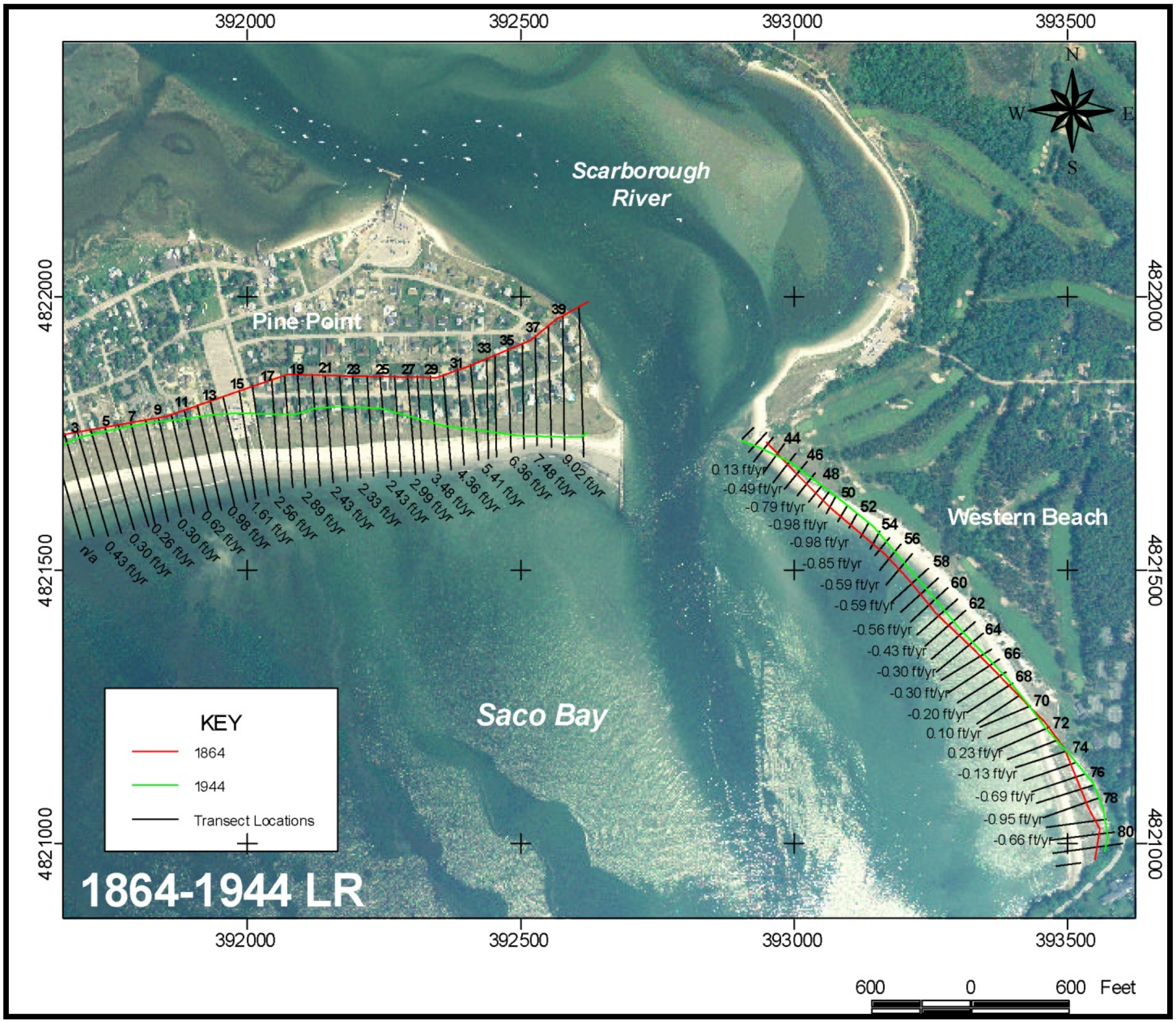


Figure C-2.1 Map showing transect locations along with shoreline movement rates from 1864-1944 for Pine Point and Western Beach, ME (overlaid on the 2003 aerial). Along Western beach, linear regression rates display a pattern of relatively stable shoreline with some minor erosion.

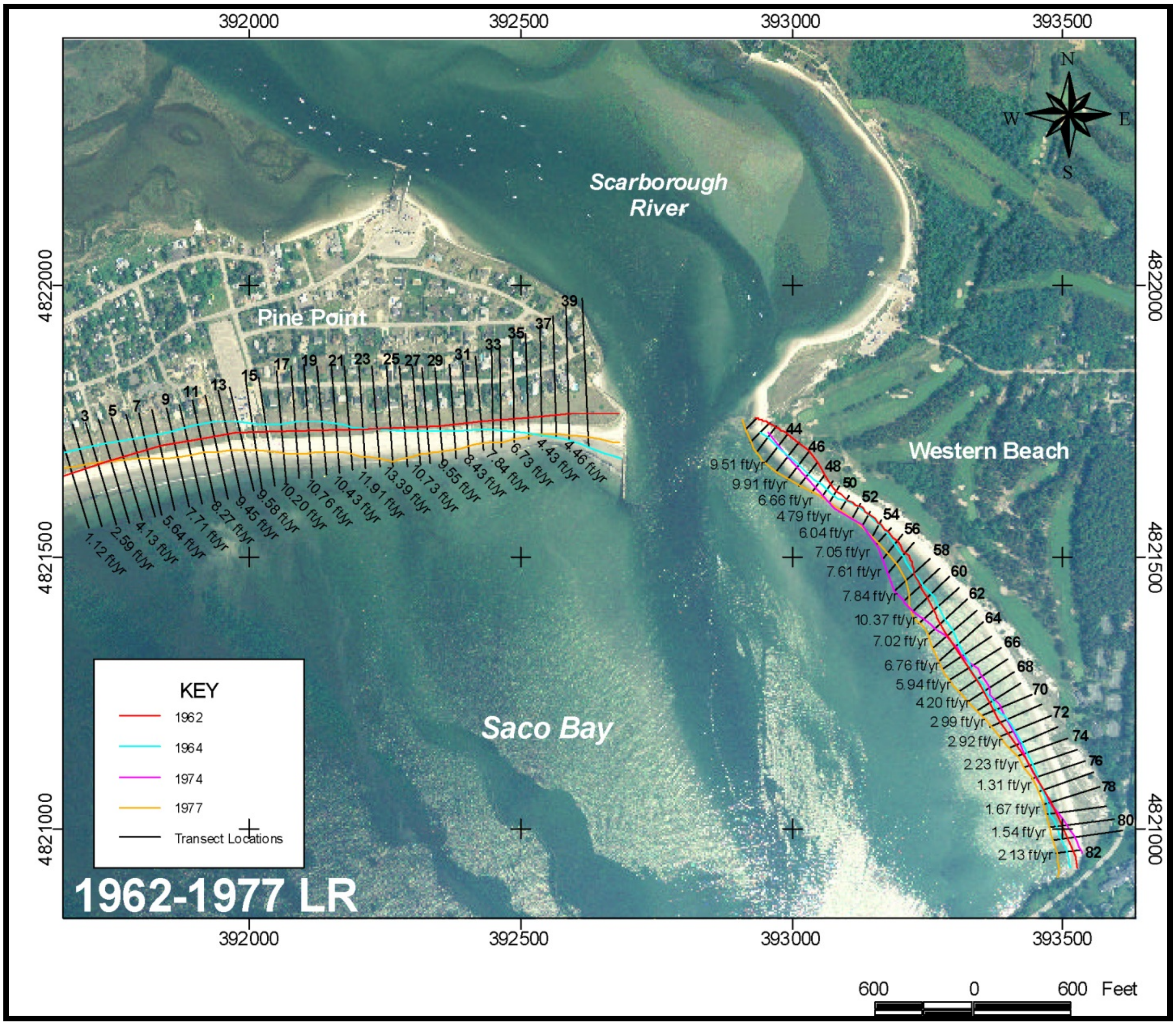


Figure C-2.2 Map of transect locations and shoreline movement rates from 1962-1977 for Pine Point and Western Beach, ME. Linear regression rates display a pattern of mild to moderate rates of shoreline accretion.

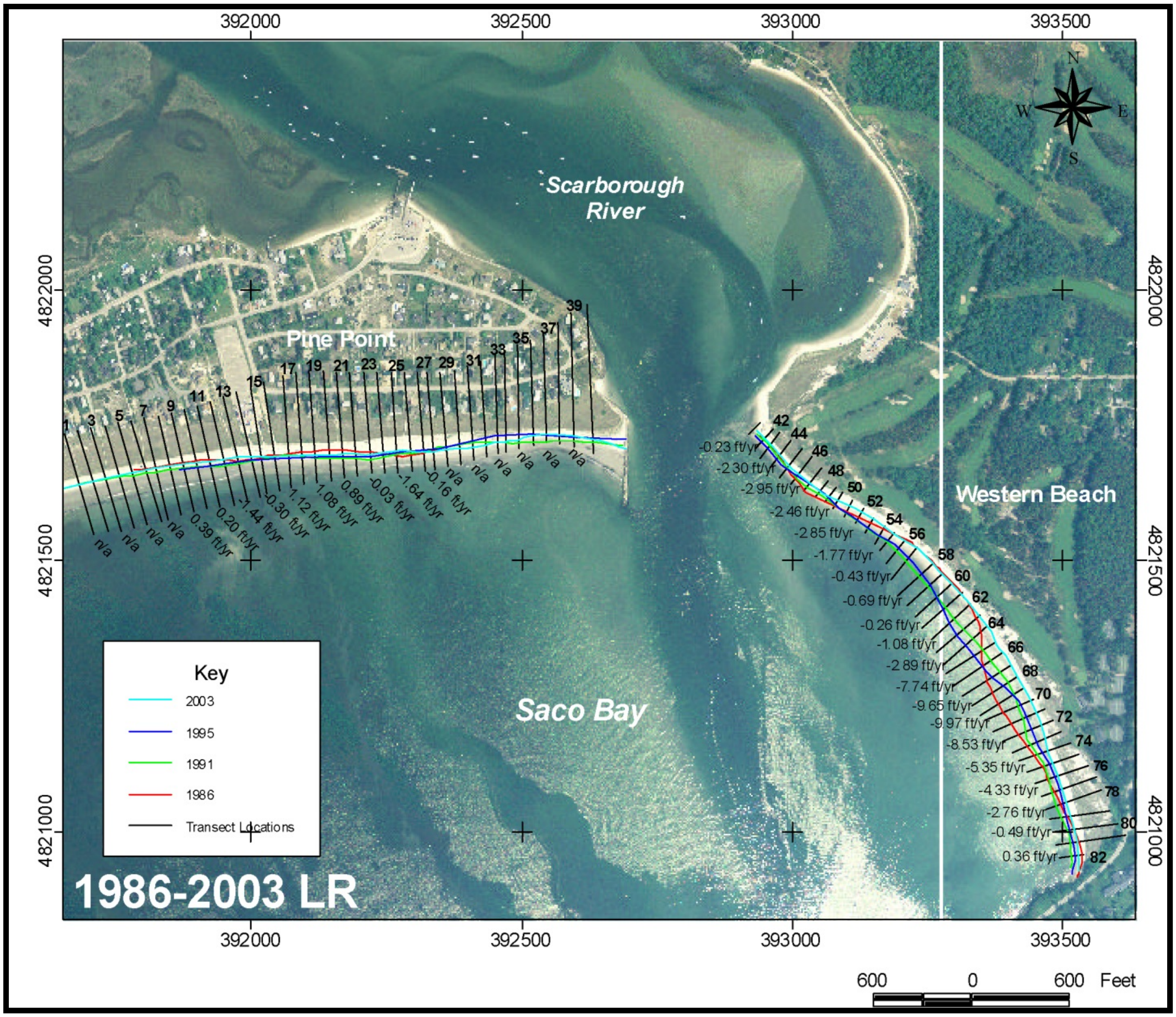
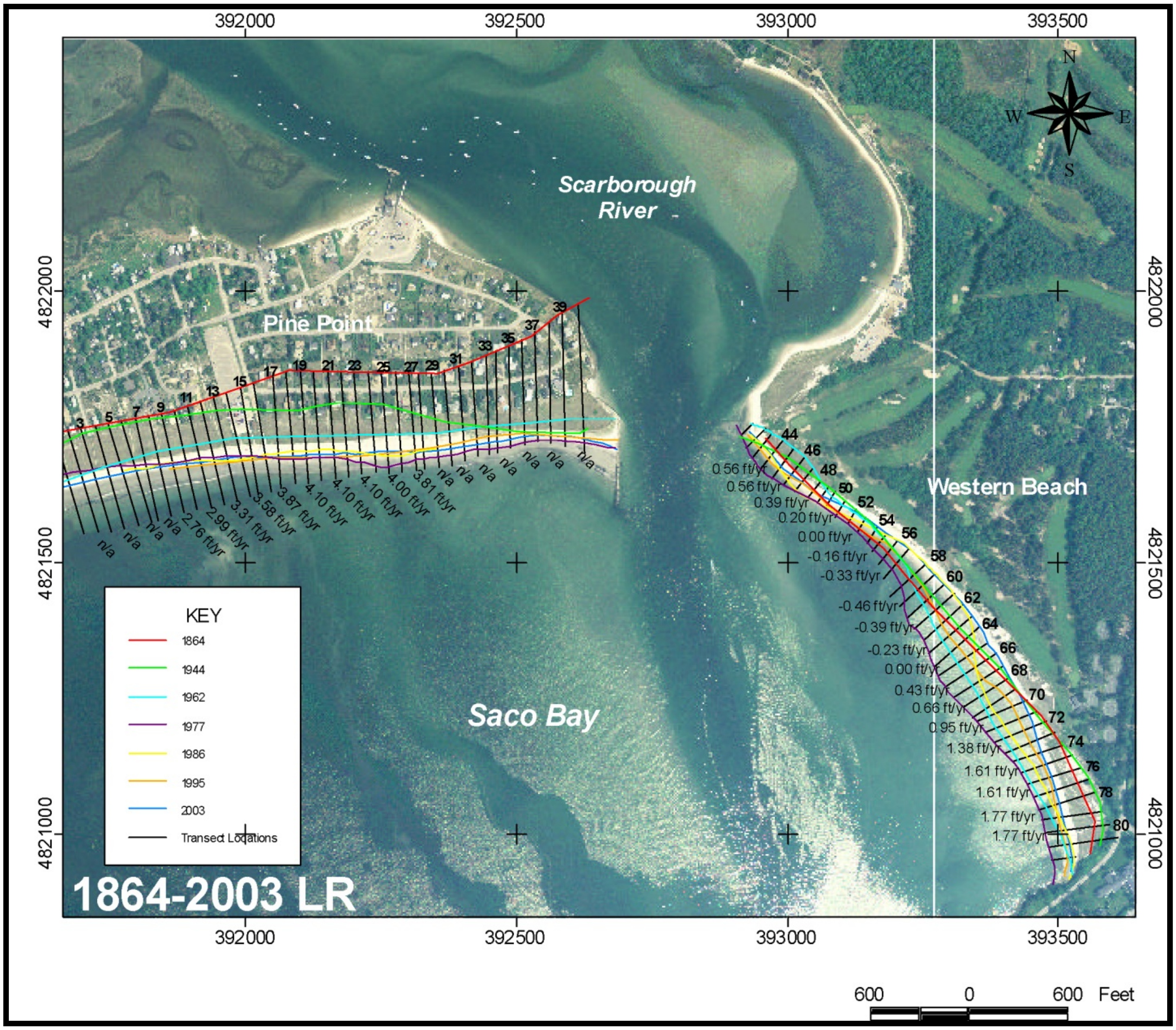


Figure C-2.3 Map of transect locations and shoreline movement rates from 1986-2003 for Pine Point and Western Beach, ME (overlaid on the 2003 aerial). Along Western Beach, linear regression rates display a pattern of moderate shoreline erosion.



FigureC-2.4 Map displaying transect locations and the overall shoreline movement from 1864-2003 for Pine Point and Western Beach, ME. Along Western Beach, linear regression rates display a pattern of relatively stable shoreline with some minor erosion and accretive hot spots.