# Shoreline Change Rate Estimates

## Bay County

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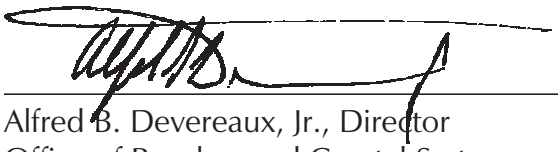
# FOREWORD

This report was prepared to provide shoreline change rate estimates to assist in regulatory programs and beach management planning efforts. In particular, there is a need to assist project managers within the Office of Beaches and Coastal Systems in ranking proposed beach management projects for State of Florida funding support. Efforts were made in developing the rate estimates to consider and take into account the influences of coastal structures and sand fill placements on shoreline change. However, these influences can be very complex and extensive analysis and consideration of such influences was beyond the scope of this work.

Shoreline change analyses performed for other specific purposes, such as for establishing 30-year erosion projections pursuant to paragraph 161.053(6), F.S., should be developed in accordance with appropriate and applicable procedures for that specific purpose, although these reports may be relevant in that regard.

This report was prepared by Emmett Foster, P. E., of the Office of Beaches and Coastal Systems, and Jenny Cheng of the Beaches and Shores Resource Center. Mr. Foster is the author and editor of the text, calculations, and base graphics. Ms. Cheng formatted and assembled the report, detailed the graphics, plotted the profiles, and assisted with outlining and referencing. The shoreline change rate estimates are based on the best available data at the time of report preparation. Updates to the report will be performed as new data becomes available and as staff workload allows.

APPROVED BY



Alfred B. Devereaux, Jr., Director
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# 1 EXECUTIVE SUMMARY

Bay County, except for Shell Island and the federal Crooked Islands, may be considered to be highly developed. In the zone extending from the Walton County line eastward to near St. Andrews State Recreation Area, the estimated shoreline (MHW) change rates hovered between -0.5 and +0.5 ft/yr during the modern period, 1934-1997, prior to the Panama City Beach Nourishment Project of 1999. However, the area adjacent to St. Andrews Bay Entrance Channel (Panama City), FDEP reference points R-80 to R-97, experienced a classic downdrift-from-an-inlet erosion pattern during the period 1934-1971, averaging -6 ft/yr at the inlet, R-97, and tapering down to -1 ft/yr at R-80. Erosion in this area has since been abated and arguably controlled for the most part by numerous beach nourishments in St. Andrews State Recreation Area using sand from inlet maintenance dredging projects in the period 1971-2000.

Shell Island, mostly state-owned, is monitored only in part, from R-98 to R-121. That zone is difficult to reliably estimate due to a high level of beach width fluctuations, probably caused by storms and large scale beach cusps. The data do not suggest high erosion but do suggest relatively recent trends of mild erosion at the ends. The eastern end of the island (outside the R-monument zone) has in recent years joined with the Crooked Islands, closing off St. Andrews Bay East Pass.

The Mexico Beach area, R-122 to R-144, is experiencing moderate levels of accretion, tapering towards stability, west to east. However, since the sand supply is from the erosion of the Crooked Islands, there is a concern over what may happen when these islands eventually erode away and/or merge with the mainland.

# 2 INTRODUCTION

This work is part of an ongoing project to develop up-to-date shoreline erosion rate estimates for the Florida sandy beach coastline. The shoreline referred to is the approximate Mean High Water (MHW) elevation contour. The information compiled and analyses conducted are intended to provide quantitative and qualitative information on a county-by-county basis that may be used to assist in beach management planning, coastal regulation, and general shoreline analysis work.

Quantitative erosion information will be focused on providing erosion estimates relative to currently active coastal processes in those places where no renourishment projects exist. Where renourishment or other similar sand fill projects of size exist, erosion rate estimates for the pre-project conditions will be attempted where possible. It is beyond the scope of these reports to analyze renourishment project performance. In such cases, erosion is a combination of initial onshore-offshore adjustments, lateral diffusion, structural interaction, and the "background erosion" process. Because the conditions that affect erosion are being frequently altered (e.g. inlets, shoals, and armoring additions/subtractions), pre-project erosion estimates are useful primarily in a historical sense and in showing what led to the need for the artificial nourishment.

The data used for this analysis is from the Office of Beaches and Coastal Systems Historic Shoreline Database. The database includes beach and offshore profile field surveys, digitized historical shoreline and bathymetric maps, aerial photographs from the Office files, and numerous graphical representations of the data, all within a common set of horizontal and vertical controls. This database was developed and quality controlled by engineers in the Research, Analysis and Policy Section and is continually updated as time and workload allows. Beach profiles were surveyed by the Coastal Data Acquisition Section and, in some cases, by private firms, the latter usually related to the monitoring of coastal erosion control projects.

It is beyond the scope of this report to investigate possible actions that may be necessary to prevent or curb shoreline erosion. Where appropriate, however, recommended actions may be suggested or previous, unsuccessful attempts may be pointed out in an effort to help guide the reader towards a better understanding of the dynamics of the coastline and future trends in shoreline change.

# 3 REGIONAL SETTING

## 3.1 Study Area

Bay County is located in the Panhandle of west Florida (Figure 1). The length of the ocean shoreline is approximately 42 miles, of which 12 miles, including the Crooked Island segment and the eastern end of Shell Island, is Federally owned and not under State jurisdiction. In our study area, exclusive of the Crooked Islands area, there are four inlets or passes: Philips Inlet, St. Andrews Bay Entrance Channel (Panama City), St. Andrews Bay East Pass, and Mexico Beach Inlet. Philips Inlet at the Walton/Bay County line drains a lake, and may better be defined as a lake outlet similar to those in Walton County. St. Andrews Bay East Pass has been closed by littoral drift, as observed in FDEP January 8, 2000 aerial videos. Both St. Andrews Bay Entrance Channel and Mexico Beach Inlet are frequently dredged. The former is a federally maintained navigational channel. As of January 8, 2000 there were also two inlets through the Crooked Islands.

There are 144 sequentially numbered DEP survey reference points, generally referred to as "R" monuments, spaced approximately 1,000 ft (300 m) apart. This report uses these reference points to locate various items within the study area.

Bay County is considered to be highly developed between R-1 and R-92, and between R-127 and R-138. Many buildings in the R-1 to R-92 zone are fronted by seawalls or bulkheads. Since many buildings in both highly developed zones were located relatively far seaward, where dunes were previously located, widespread damage occurred when major storms struck in 1975 (Hurricane Eloise) and 1995 (Hurricane Opal). In 1999 the longest nourishment project in Florida was completed between R-1 and R-93, primarily as a response to Hurricane Opal damages.

There are several small public park areas along this coast, and one relatively large state park, St. Andrews State Recreation Area, which extends from approximately R-92 to R-118. It includes both sides of St. Andrews Bay Entrance Channel and a large portion of Shell Island. Shell Island is essentially undeveloped, with primarily state ownership.

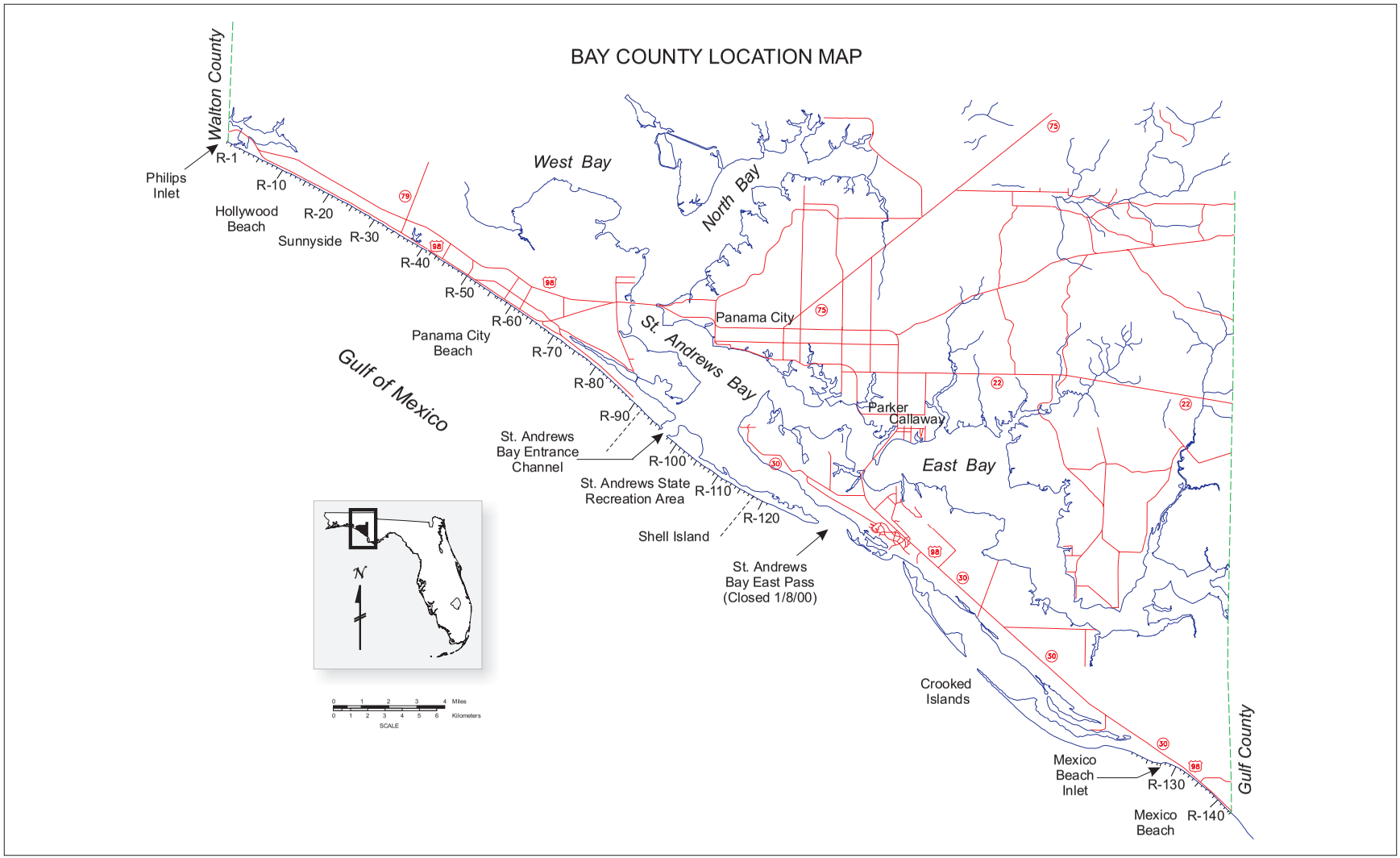


Figure 1. Study area showing Bay County, Florida.

## 3.2 Coastal Setting

### *3.2.1 Waves and Tides*

Tide gauges exist at two fishing piers in the Panama City Beach area, between R-40 and R-41 and between R-57 and R-58, NOS stations 8729210 and 8729189, respectively. According to these gauges, tides are diurnal with a mean tidal range of 1.25 to 1.27 ft (.381 to .387 m) (NOS 1988).

Another gauge (NOS Station 8728995) exists on the pier in Mexico Beach, between R-129 and R-130. Tides here are very similar, with a mean tide range of 1.19 ft (.363 m).

According to the Wave Information Study (WIS) of the Waterways Experiment Station, U.S. Army Corps of Engineers, the mean significant wave height for offshore Bay County (WIS station G1038, 62 ft (19m) depth) is 2.0 ft (0.6 m) and the mean wave period is 4.0 seconds. The most frequent wave direction is out of the south-southeast.

### *3.2.2 Longshore Transport*

The direction of net littoral transport in the Panama City Beach area is from east to west, as evidenced by the recurring erosion problem west of the jetties of the St. Andrews Bay Entrance Channel. This is also consistent with the wave information previously noted. There are several widely differing estimates of net longshore transport. Recent estimates by the USACOE Mobile District (1994) yielded 79,000 cy/yr to 91,000 cy/yr. This is consistent with records of dredging and sand placement for the inlet, which yield approximately 82,000 cy/yr to 103,000 cy/yr, 1971 - 1990, assuming the filling essentially maintained a condition of shoreline stability or a low level of net losses. The beach fills will be discussed in a later section. Another recent estimate of approximately 70,000 cy/yr westward was determined by Coastal Tech (2000).

In the Mexico Beach area, net littoral transport is from northwest to southeast, as evidenced by shoreline changes adjacent to Mexico Beach Inlet. The shoreline is oriented much differently in this area than in the Panama City Beach area, which accounts for the change in net sand transport direction. Dean and O'Brien (1987) reference a net transport estimate of 140,000 cy/yr. A more recent estimate of 50,800 cy/yr net transport southeastward across Mexico Beach Inlet was provided by Craig and Taylor (1999).

### *3.2.3 Storms*

Hurricanes in this area occur frequently and both the storms and their effects can remain in the area for long periods of time. However, storms are just peaks in the total normal wind and wave climate record. Experience and observations indicate that severe storms can temporarily disrupt or obscure the longer term erosion pattern, perhaps for up to a decade. In some situations, if a major factor such as the sand supply is altered, or if an inlet is significantly changed, coastal processes can be permanently affected by a storm. Two major storms in recent history were Hurricane Eloise in 1975 and Hurricane Opal in 1995. Both caused extensive property damage, dune erosion, and deposition of sand in deeper water offshore. The regional effects of recent hurricanes have been discussed by Leadon (1999) and Leadon et al (1998). The Panama City Beach Nourishment Project, which was completed in 4/99 and extends from R-1 to R-93, was constructed to recover quickly from Hurricane Opal effects and to reduce future damages from storms.

## 3.3 Inlets

### *3.3.1 Philips Inlet*

Philips Inlet is a small outlet channel connecting Lake Powell to the gulf. This channel is not protected by jetties and tended to migrate over time.

The channel was maintained artificially open by dredging for a number of years by private interests. When abandoned it closed. It has only been open by intervention since. The state has owned the inlet since 1995/96. (Personal Communication, A. Devereaux, FDEP/OBCS Director, 12/00).

A permit exists to allow the FDEP Division of Recreation and Parks to open Philips Inlet via mechanical excavation when needed, e.g. to relieve high water levels in the lake (JC 0141770-001; issued 9/98; expires 9/08). At least one inlet re-opening has occurred under this permit.

### *3.3.2 St. Andrews Bay Entrance Channel (Panama City)*

This inlet, which is located between DNR reference monuments R-97 and R-98, is man-made and federally maintained. The entrance was cut through the barrier island in 1934 and two jetties were constructed to stabilize the channel in the same year (Dean and O'Brien, 1987). The jetties have been modified at least twice since then.

In the post inlet construction period of 1935 through 1990, in excess of 9 million cubic yards of maintenance dredging material had been disposed of in deep water. Approximately 1.5 million cubic yards had been placed on the beach west of the inlet in the time period 1971-1990 (USACE, 1994). A list of beach nourishment quantities will be given in a later section.

### *3.3.3 St. Andrews Bay East Pass*

St. Andrews Bay East Pass , located at the eastern end of Shell Island, was a natural inlet, formerly the navigation channel to St. Andrews Bay, which was maintained by the Army Corps of Engineers until 1934.

The total volume of dredged material from the inlet from 1911 to 1934 was 6.1 million cubic yards. The disposal area was open water (Dean and O'Brien, 1987).

This inlet was observed to be closed by littoral drift as witnessed in January 8, 2000, DEP aerial video photography.

### *3.3.4 Mexico Beach Inlet*

Mexico Beach Inlet, a small navigation channel which lies between reference monuments R-127 and R-128, was originally a small creek. When interior lowland was developed into a canal system in the late 1950's, two jetties were constructed to stabilize the inlet, probably in the late 1950's or early 1960's.

Three methods have been used to maintain Mexico Beach Inlet: a drag line was used between 1971 to 1975; jet pump systems were used from 1973 to 1974 and 1976; a small floating dredge is being used at present (Dean and O'Brien, 1987, and Craig and Taylor, 1999). Sand from dredging has primarily been placed on the adjacent beach to the east.

## 3.4 Engineering Projects

### *3.4.1 Beach Nourishments*

Beach nourishments in Bay County have either been concurrent with the dredging of St. Andrews Bay Entrance Channel or in response to major hurricanes. The dredging related placements were localized to adjacent beaches west of the inlet, both on the gulf beaches and within the inlet. The storm related placements were across a very broad area, from Philips Inlet to St. Andrews Park. Nourishment events since 1971

Table 1. List of nourishment events in Bay County

| Date | Volume (yd3) | Placement | | References |
|---|---|---|---|---|
| 12/71 | 486500 | St. Andrews State Rec. Area Beach | | USACE 1994 |
| 1976 | 232000 | Various Locations between Philips Inlet and the St. Andrews Bay Entrance Channel | | ,, |
| 6/82 | 270500 | St. Andrews State Rec. Area Beach | | ,, |
| 10/84 | 188100 | Inner West Side of the Inlet 50000 | St. Andrews State Rec. Area Beach 138100 | ,, |
| 5/86 | 220650 | Inner West Side of the Inlet 20000 | St. Andrews State Rec. Area Beach 200650 | ,, |
| 3/88 | 205500 | Inner West Side of the Inlet 15000 | St. Andrews State Rec. Area Beach 190000 | ,, |
| 11/90 | 312907 | Inner West Side of the Inlet 45000 | St. Andrews State Rec. Area Beach 267907 | ,, |
| 4/93 | 111,500 | Uncertain | | USACE 4/99 Correspondence |
| 1/96 | 31,700 | Inner West Side of Inlet | | ,, |
| 2-5/96 | 177,900 | Inner West Side of the Inlet 9,600 | St. Andrews State Rec. Area Beach 168,300 | ,, |
| 8/98-4/99 | 9.1 M | R-1 to R-92.5 | | CPE 2000 |
| 4-5/99 | 210000 | Beach and Inner West Side of Inlet | | USACE 11/00 Correspondence |

are listed in the following Table 1. There were probably earlier sand placements west of the inlet, soon after the time of inlet construction, that are not well documented.

The Panama City Beach Nourishment Project of 1998-1999 was permitted in 4/98 (JC 0128852-001). The permit allows for periodic renourishments through 4/13.

In addition to the above listed beach nourishments, sand from dredging Mexico Beach Inlet has been irregularly placed on the adjacent beach to the east, probably since at least the 1960's. Quantities are unknown, but the sand appears to be helpful in stabilizing the Mexico Beach shoreline, as will be discussed in a later section. Mexico Beach Inlet is maintained by local interests.

### *3.4.2 Structures*

The two jetties along the Panama City Harbor Entrance Channel were completed in 1934 and have since been modified. The Mexico Beach Inlet jetties were probably built in the mid to late 1950's. There are five gulf piers: between R-40 and R-41, between R-57 and R-58, between R-67 and R-68 (a short pier), between R-92 and R-93, and between R-129 and R-130. There are many seawalls and bulkheads between R-1 and R-92; almost all have normally had some beach width in front of them.

# 4 METHODS

A shoreline change analysis to satisfy the report objectives was performed using the methodology initially developed by Foster and Savage (1989) and Foster (1992). In brief, within the often nonlinear record of shoreline change versus time by reference points, segments are identified, consistent with observed coastal processes, in which the erosion is relatively constant or can reasonably be approximated as such. Three different rate calculation methods are applied to these approximately linear shoreline change versus time segments: the rate averaging, least squares, and end-point methods. These results are first averaged alongshore and then averaged across the three calculation methods to achieve a consensus average, not dependent on any single rate calculation method. This is because each calculation method has relative advantages and disadvantages. If time segments are selected reasonably well, the differences between rate methods will be minimal. In certain simplified situations it may be better to use a single rate calculation method, such as the end-point method, as necessity and reason dictate. If the averaging is done properly it will achieve results representative of the unaveraged data but will not be overly affected by individual point variability.

In many cases, rates from longer and shorter time periods are calculated for comparison purposes (e.g., to show possible progression of an erosion pattern over time or to show that the use of more recent data, which is generally of higher accuracy, yields essentially the same results as the data in a comparative longer time period).

Visual tools used for analysis generally include plan views of shorelines oriented and scaled to emphasize shoreline width changes as well as sometimes subtle but important shoreline orientation differences or geologic features within a county or reach. This analysis is also dependent on the shoreline location versus time plots with overlapping axes, known as "stack plots" because several data plots are stacked in sequence to better see a pattern in the data (Appendix B). There are also representative beach profile plots (Appendix C).

# 5 SHORELINE CHANGE

For the purpose of this discussion, it is helpful to divide coastal Bay County into three zones, west to east. The first two zones are separated by St. Andrews Bay Entrance Channel. The third zone is the Mexico Beach area, south and east of the federally-owned Crooked Islands.

## 5.1 West Zone, R-1 to R-97

Figure 2 shows this zone in plan view. Shoreline (MHW) change rate estimates are provided in Figure 3 and Table A-1 (Appendix A). Other than being the eastern portion of a very long, concave-shaped shoreline extending all the way eastward from Pensacola and the Alabama border, the most notable shoreline feature here is the erosion zone extending westward from St. Andrews Bay Entrance Channel. Recall that the inlet was cut in 1934. The erosion pattern spread westward from R-97 to approximately R-80 over the years between 1934 and 1971. From 1972 to 1997, numerous maintenance dredging operations placed sand between R-97 and R-92, which essentially kept the erosion pattern from getting worse, as far as can be determined from the data. The type of inlet-induced erosion pattern found here was discussed by Foster (1995) with examples of similar situations. The rate estimates provided for the R-97 to R-80 zone are for the pre-nourishment period 1934-1971, and range from -7 ft/yr next to the inlet to -0.5 ft/yr at R-80. The rate estimates westward, from R-79 to R-1, appear to fluctuate randomly between +0.5 and -0.5 ft/yr over the 1934-1997 period. Essentially this is an indication of a relatively stable to mildly eroding situation, at the edge of the ability of our data to measure it. The results of using a more recent time period, such as 1971 to 1997, were compared, although not shown here. These rates were not considered to be contradictory but did contain a lot more of what is believed to be noise in the data, due to there having been many major storms during that time period, including a significant 1970 storm, Hurricane Eloise in 1975, and Hurricane Opal in 1995. Another source of noise in the data is the large scale beach cusps common to this area. Conservatively it is recommended that -1 ft/yr be used for planning and regulatory purposes in the R-1 to R-80 portion of Zone 1.

As previously discussed (see Section 3.4.1), a major beach restoration project was completed in 1999, extending from R-1 to R-92. Nourishments in the R-92 to R-97 reach in St. Andrews State Recreation Area are expected to continue using sand from maintenance dredging operations. The Panama City Restoration Project was undertaken primarily for storm protection purposes, very much in response to

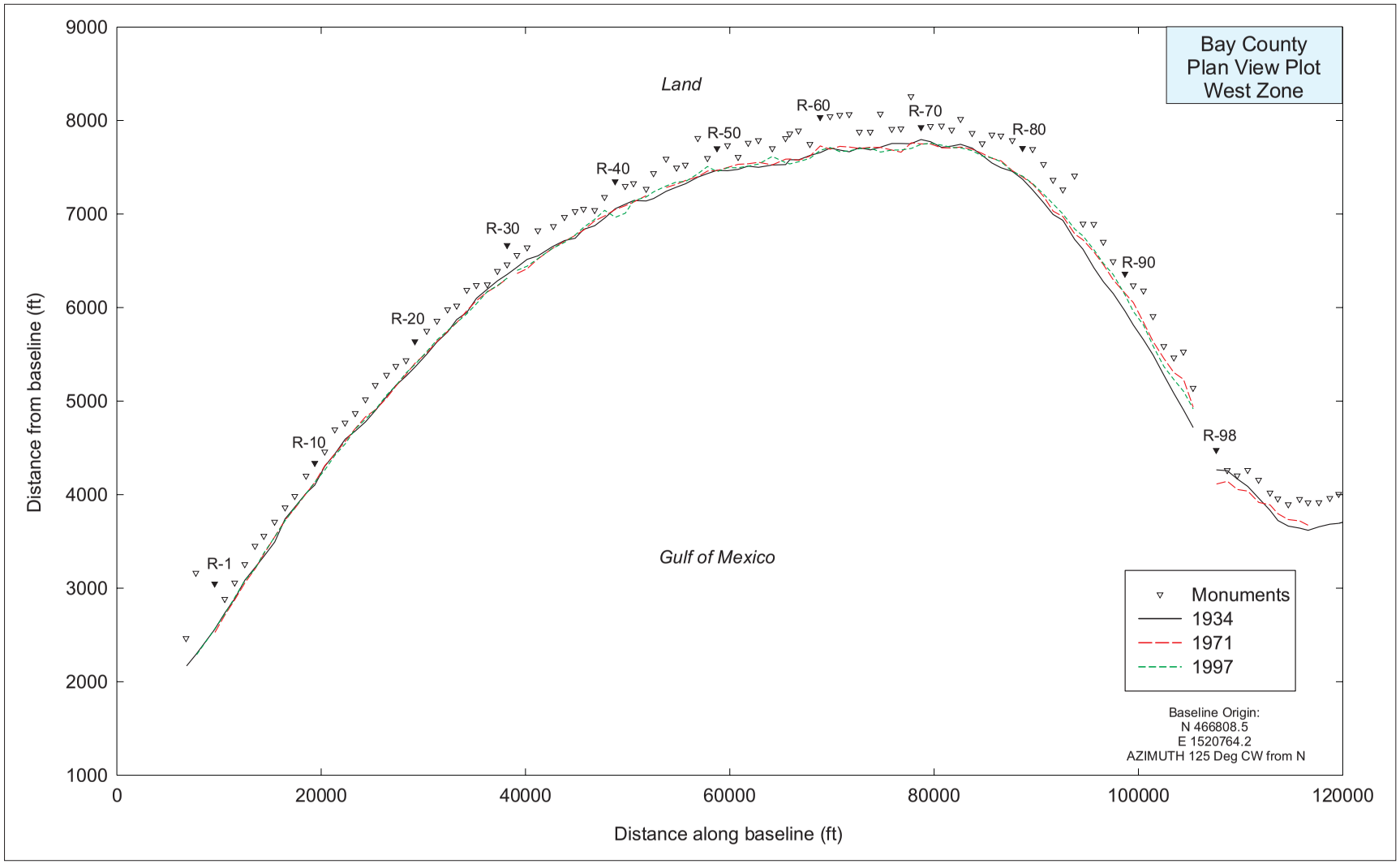


Figure 2. Plan view map of Bay County, Florida (from R-1 to R-110), comparing years 1934, 1971, and 1997.

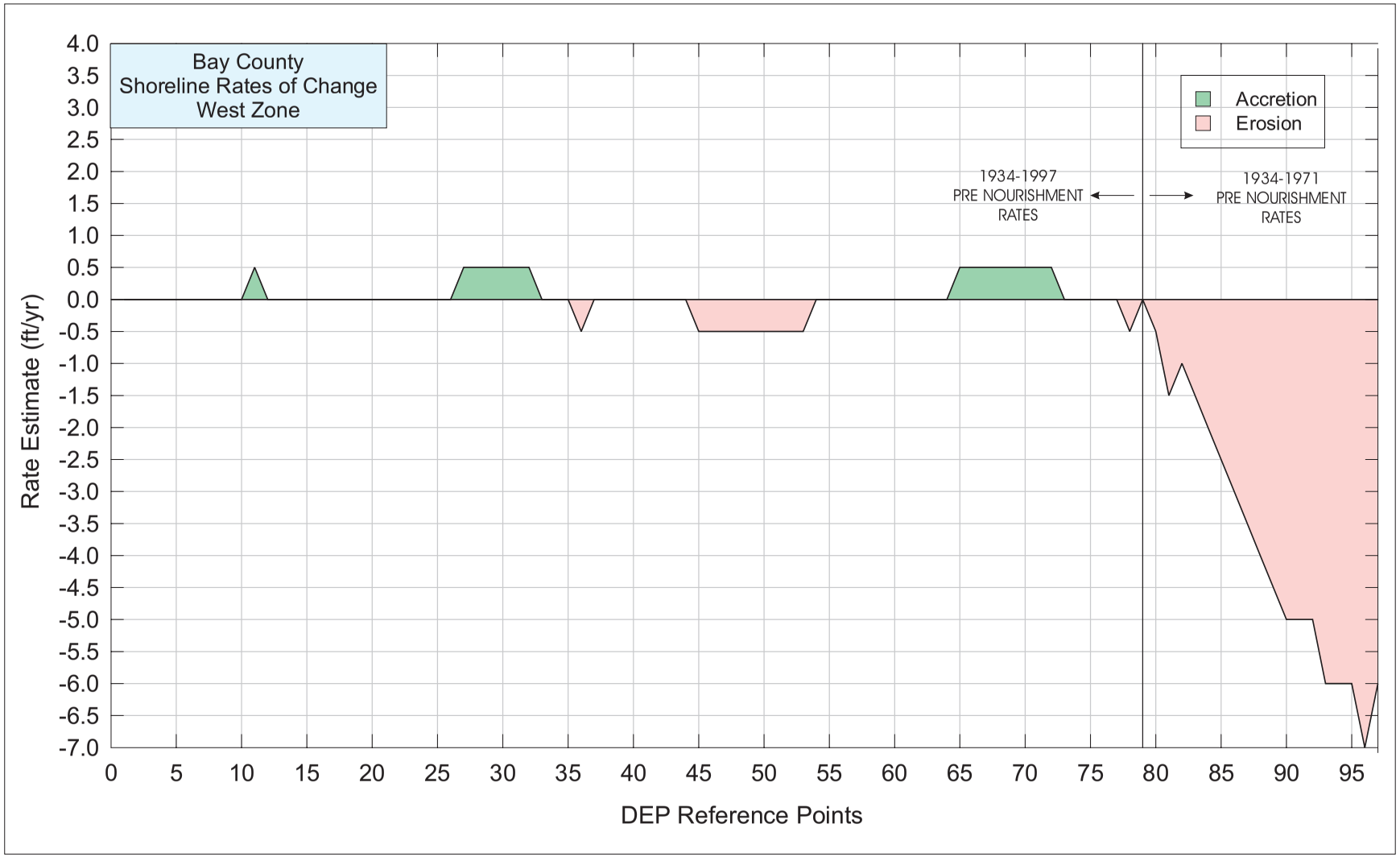


Figure 3. Shoreline rate of change estimates for Bay County, Florida (from R-1 to R-97).

Hurricane Opal, since many buildings were damaged due to very seaward locations. The beach profile was also noticeably lowered by the storm, and there was uncertainty as to eventual recovery.

### 5.2 Shell Island Zone, R-98 to R-121

This portion of Shell Island is mostly state-owned. Figure 4 shows in plan view historic shorelines from 1934, 1971, 1972, 1973, 1995 (pre-H. Opal), and 1996. This view shows a relatively large amount of beach width fluctuations, which can be attributed both to major storms and the large scale beach cusps commonly found in both Zones 1 and 2. The earliest reliable shoreline on both sides of the inlet is 1934, shown here as significantly different from the later shorelines. Essentially there was an adjustment from the 1934 orientation to that found in 1971-72-73, with probably random fluctuations from then on. The shoreline change rates given in Figure 5 and Table A-1 are therefore given with a strong caution: they may really only indicate random fluctuations, especially the centermost accretionary rates. It is possible there is a small amount of real erosion on the east next to the St. Andrews Pass jetty, resulting from jetty porosity and landward overtopping of the jetty. There was also considerable landward overwash across the entire island during Hurricane Opal. It is also quite possible that there is a real amount of erosion on the western end of this zone since Shell Island in recent years has connected with one of the Crooked Islands, closing St. Andrews East Pass, and is continuing to change in a large scale process. Briefly, the essential coastal process occurring in the Crooked Islands is rapid island retreat via landward overwash and lateral erosion east and west. Islands here are breaking up in the eastern zone and have joined with each other and the mainland in the western zone, when last observed in the DEP aerial video of January 2000. The lateral erosional process has been supplying sand to the third DEP monitored zone, the Mexico Beach area.

It is worth noting that the possibly stable to mildly erosive Shell Island Zone, R-98 to R-121, appears to be sheltered by nearshore relic shoal deposits, possibly from an earlier inlet location.

### 5.3 Mexico Beach Zone, R-122 to R-144

Figure 6 shows this zone in plan view, with shoreline selections from 1869 to 1996. Sand supplied from the erosion of the Crooked Islands has built up this area over time. When the Mexico Beach Inlet jetties were built, post 1956, there was an initial sand buildup on the west side due to the jetty acting as a littoral barrier, and accompanying erosion on the east side. After this process was completed, bypassing increased and may have accelerated over time. Whereas initially the placement of dredged material to the east was probably essential in maintaining the eastern

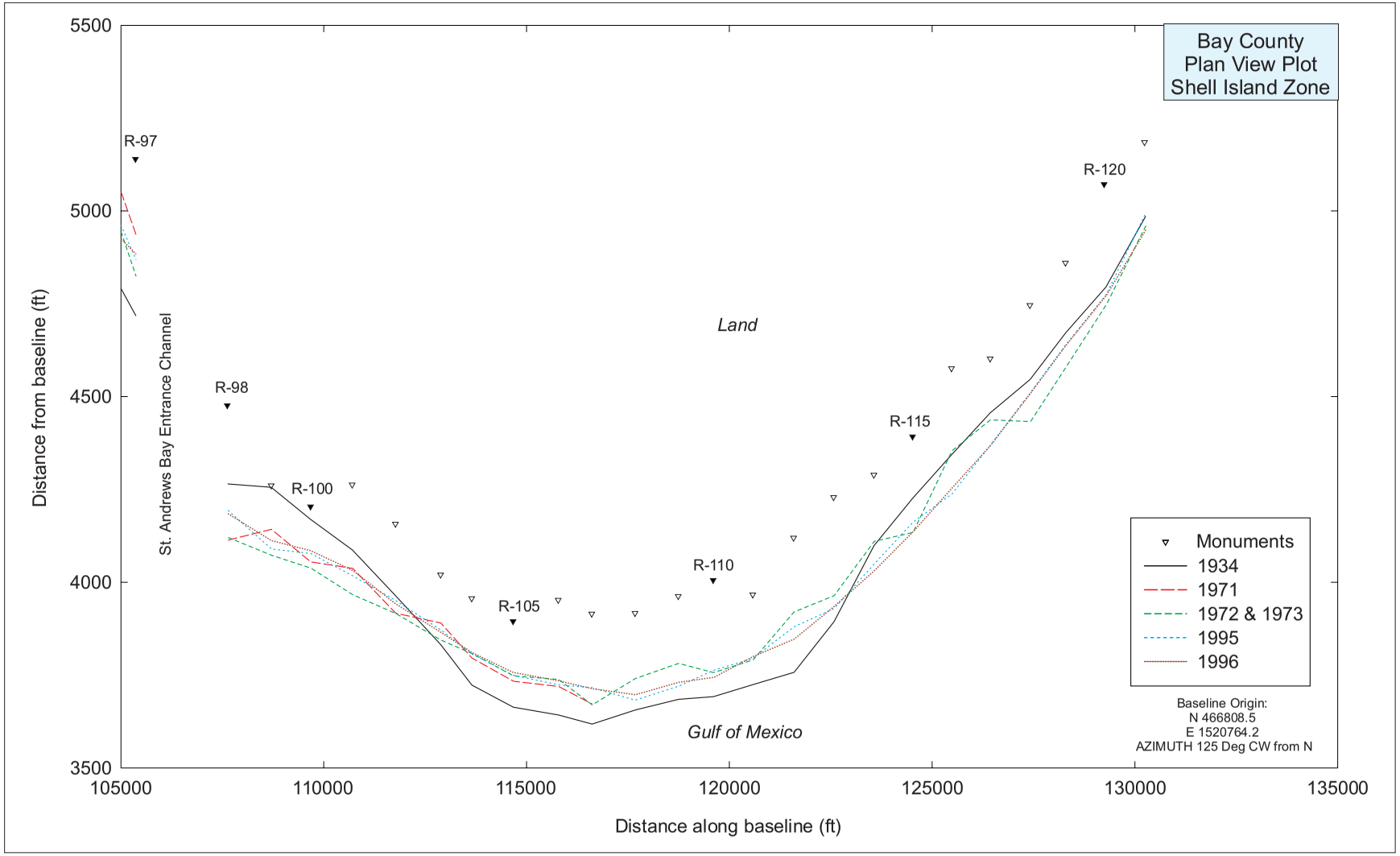


Figure 4. Plan view map of Bay County, Florida (from R-96 to R-121), comparing years 1934, 1971, 1973, 1995, and 1996.

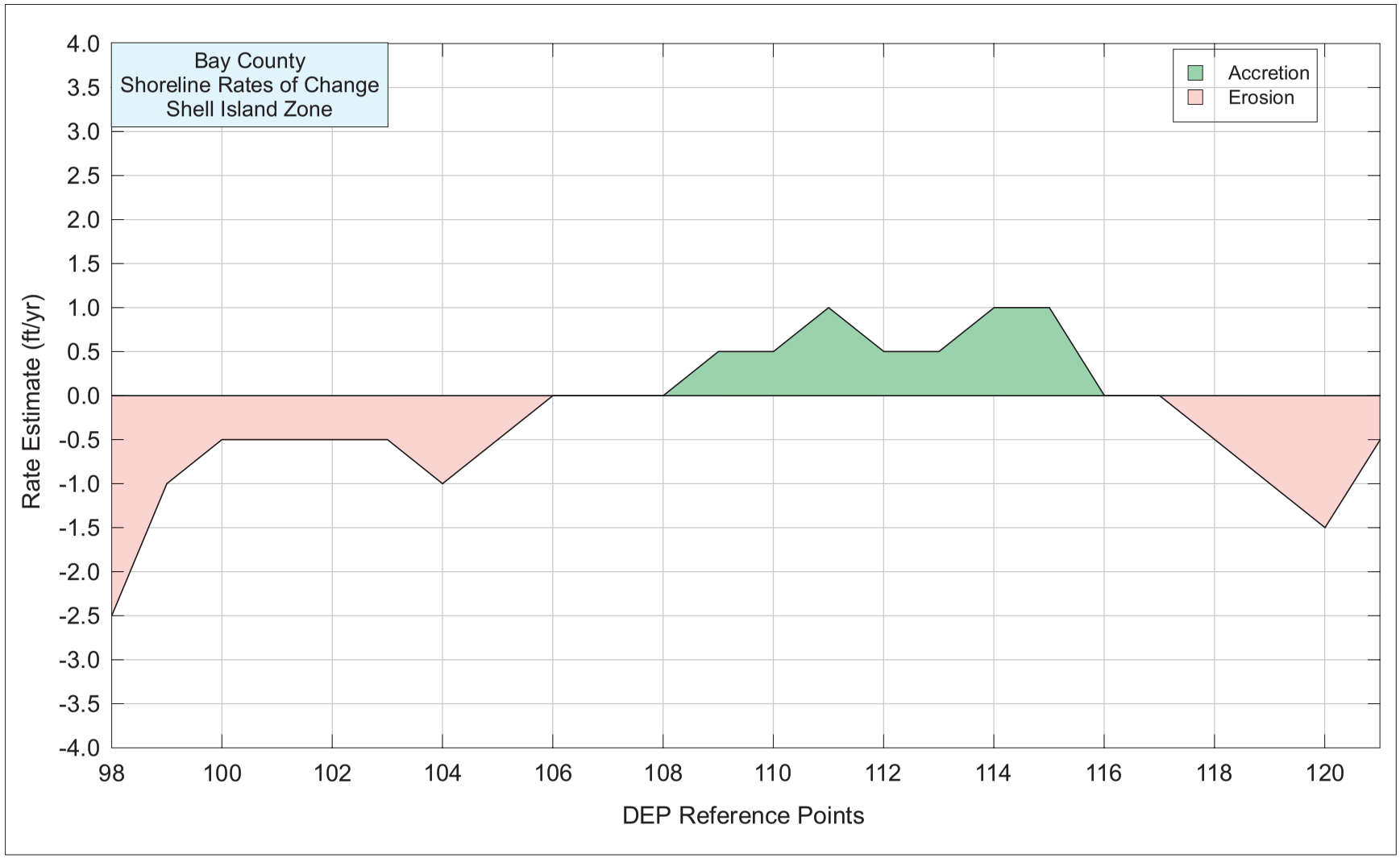


Figure 5. Shoreline rate of change estimates for Bay County, Florida (from R-98 to R-121).

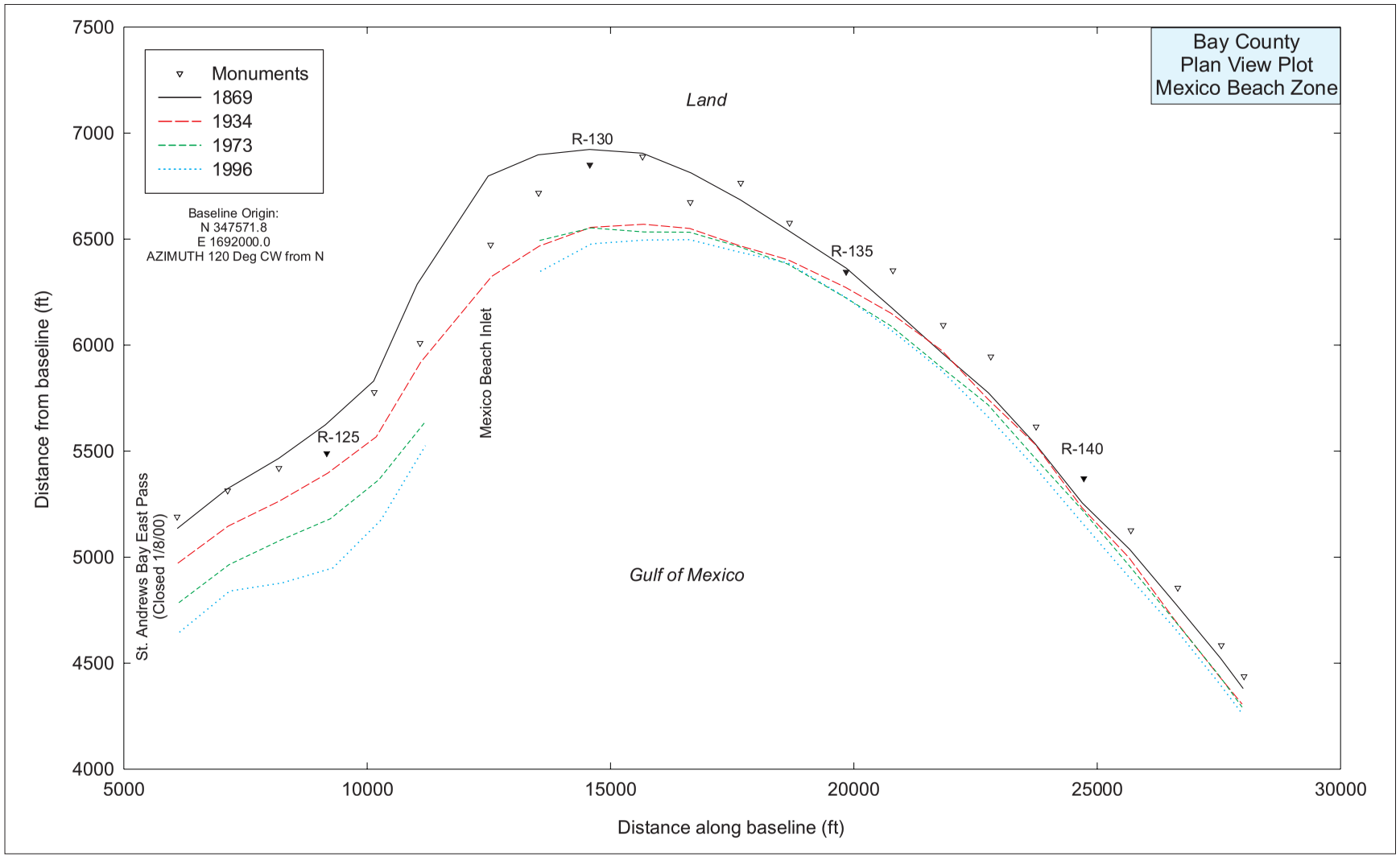


Figure 6. Plan view map of Bay County, Florida (from R-122 to R-144), comparing years 1869, 1934, 1973, and 1996.

shoreline, now it probably is less so. However, the shoreline immediately southeast of the inlet and the associated building line are probably still dependent to a "not safe to change it" degree on continuing maintenance dredging fill placement. This is a local dredging operation, as noted previously.

The shoreline change rate estimates provided in Figure 7 and Table A-1 reflect the overall accretionary trend described above. The rates are calculated using data from 1971 to 1998, since this is a period of time having relatively linear change rates and reliable accurate data. It is important to make it clear that the sand supply from the erosion of the Crooked Islands will not last forever. Eventually the islands will merge with the mainland, although it may take many decades (or not). When that happens, the sand supply may be less, perhaps much less, and the Mexico Beach situation will change. No time line is reliable here as the Crooked Island changes have not been reliably monitored, quantitatively, by DEP surveys and a quantitative study has not been undertaken.

It is further noted that there are relic shoals offshore the western portion of this Mexico Beach zone and the eastern portion of the Crooked Islands. These shoals are significant in affecting the wave climate and causing some "bumps" in the shoreline orientation. The sand transport direction is from the northwest to the southeast here, since the area is relatively sheltered from the predominant easterly winds, unlike the previous Zones 1 and 2.

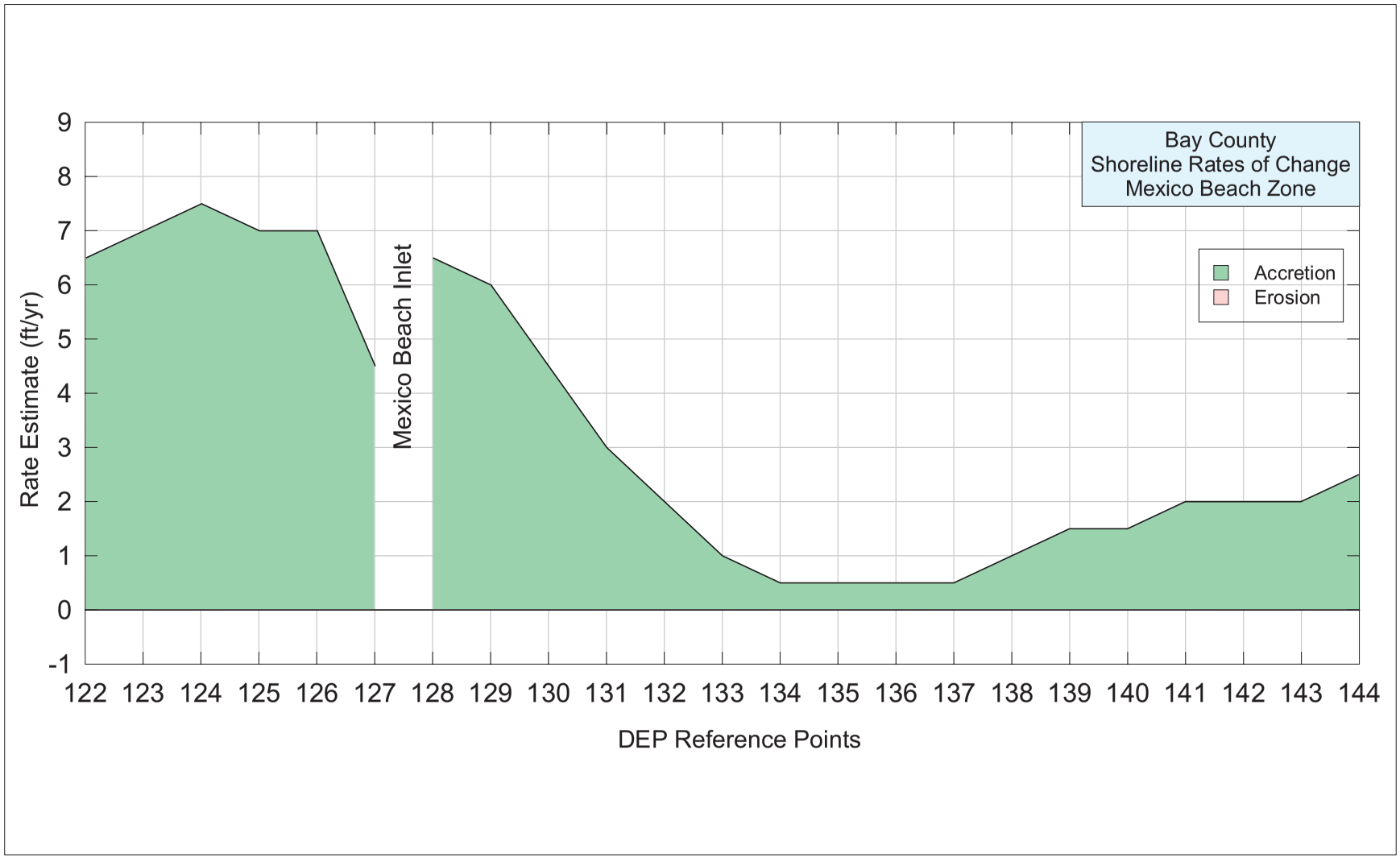


Figure 7. Shoreline rate of change estimates for Bay County, Florida (from R-122 to R-144).

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# 7 APPENDICES

## 7.1 Appendix A: Shoreline Change Rate Estimates

Table A-1: This table and accompanying figure provide rates based on the method described in Section 4.

Table A-1. Shoreline change rate estimates for Bay County, Florida.

| Range | Time Span | Method | | | Rounded Concensus Average | Comments |
|---|---|---|---|---|---|---|
| | | RA | LS | EP | | |
| 1 | 1934-1997 | -0.1 | 0 | -0.1 | 0 | |
| 2 | 1934-1997 | 0.2 | 0.7 | 0.2 | 0 | 3 pt average |
| 3 | 1934-1997 | -0.2 | 0.3 | -0.2 | 0 | 5 pt average |
| 4 | 1934-1997 | 0.1 | 0.4 | 0.1 | 0 | 7 pt average |
| 5 | 1934-1997 | 0.2 | -0.3 | 0.2 | 0 | ↓ |
| 6 | 1934-1997 | -0.2 | -0.5 | -0.6 | 0 | |
| 7 | 1934-1997 | 0.4 | -0.4 | -0.9 | 0 | |
| 8 | 1934-1997 | 0.3 | 0.7 | 0.3 | 0 | |
| 9 | 1934-1997 | 0.1 | 0.1 | 0.1 | 0 | |
| 10 | 1934-1997 | 0.1 | 0 | 0.1 | 0 | |
| 11 | 1934-1997 | -0.5 | -0.3 | -0.5 | 0.5 | |
| 12 | 1934-1997 | 0.7 | 0.4 | 0.7 | 0 | |
| 13 | 1934-1997 | 0.2 | 0.3 | 0.2 | 0 | |
| 14 | 1934-1997 | 1.1 | 0.9 | 0.8 | 0 | |
| 15 | 1934-1997 | -0.3 | 0 | -0.3 | 0 | |
| 16 | 1934-1997 | -0.5 | -0.3 | -0.5 | 0 | |
| 17 | 1934-1997 | -0.1 | 0.1 | -0.1 | 0 | |
| 18 | 1934-1997 | -0.3 | 0.2 | -0.3 | 0 | |
| 19 | 1934-1997 | 0.1 | 0.6 | 0.1 | 0 | |
| 20 | 1934-1997 | -0.4 | -0.4 | -0.5 | 0 | |
| 21 | 1934-1997 | -0.4 | -0.4 | -0.4 | 0 | |
| 22 | 1934-1997 | -0.5 | -0.4 | -0.5 | 0 | |
| 23 | 1934-1997 | -0.3 | -0.1 | -0.3 | 0 | |
| 24 | 1934-1997 | -0.2 | -0.3 | -0.2 | 0 | |
| 25 | 1934-1997 | 0.5 | 0.2 | 0.5 | 0 | |
| 26 | 1934-1997 | 0.2 | 0 | 0.2 | 0 | |
| 27 | 1934-1997 | 1 | 0.9 | 0.9 | 0.5 | |
| 28 | 1934-1997 | 0.4 | 0.4 | 0.4 | 0.5 | |
| 29 | 1934-1997 | -0.1 | 0.4 | 0.8 | 0.5 | |
| 30 | 1934-1997 | 0.5 | 0.8 | 0.6 | 0.5 | |
| 31 | 1934-1997 | 0.5 | 0.4 | 0.5 | 0.5 | |
| 32 | 1934-1997 | 0.7 | 0.9 | 1.2 | 0.5 | |

Table A-1. Shoreline change rate estimates for Bay County, Florida.

| Range | Time Span | Method | | | Rounded Concensus Average | Comments |
|---|---|---|---|---|---|---|
| | | RA | LS | EP | | |
| 33 | 1934-1997 | 0.5 | -0.5 | 0.5 | 0 | |
| 34 | 1934-1997 | 0.3 | -0.4 | 0.3 | 0 | |
| 35 | 1934-1997 | 0.3 | -0.4 | 0.3 | 0 | |
| 36 | 1934-1997 | -0.6 | -0.7 | -0.5 | -0.5 | |
| 37 | 1934-1997 | -0.3 | -0.4 | -0.3 | 0 | |
| 38 | 1934-1997 | -1 | -1.4 | -1.1 | 0 | |
| 39 | 1934-1997 | -0.5 | -0.8 | -1.3 | 0 | |
| 40 | 1934-1997 | 2.4 | 1.7 | 1.5 | 0 | |
| 41 | 1934-1997 | 1.9 | 1.2 | 1.5 | 0 | |
| 42 | 1934-1997 | 0 | 0.6 | 0 | 0 | |
| 43 | 1934-1997 | 0.1 | -0.7 | -0.7 | 0 | |
| 44 | 1934-1997 | -0.3 | -1.1 | -1.1 | 0 | |
| 45 | 1934-1997 | -0.3 | -0.4 | -0.9 | -0.5 | |
| 46 | 1934-1997 | 0 | -0.3 | -0.9 | -0.5 | |
| 47 | 1934-1997 | -0.4 | -0.4 | -0.4 | -0.5 | |
| 48 | 1934-1997 | -0.1 | 0 | -0.6 | -0.5 | |
| 49 | 1934-1997 | -0.5 | -0.6 | -1.2 | -0.5 | |
| 50 | 1934-1997 | 0.2 | 0 | 0.2 | -0.5 | |
| 51 | 1934-1997 | -0.6 | -0.2 | -0.5 | -0.5 | |
| 52 | 1934-1997 | -0.3 | -0.3 | -0.3 | -0.5 | |
| 53 | 1934-1997 | 0 | 0 | 0 | -0.5 | |
| 54 | 1934-1997 | -0.5 | -0.6 | -0.6 | 0 | |
| 55 | 1934-1997 | -0.7 | -0.8 | -1.5 | 0 | |
| 56 | 1934-1997 | -0.3 | 0.3 | -0.3 | 0 | |
| 57 | 1934-1997 | 1.7 | 1.2 | 0.7 | 0 | |
| 58 | 1934-1997 | 0.3 | 0.3 | 0.3 | 0 | |
| 59 | 1934-1997 | 0.5 | 0.4 | 0.5 | 0 | |
| 60 | 1934-1997 | -0.4 | -0.1 | -0.4 | 0 | |
| 61 | 1934-1997 | -0.1 | -0.2 | -0.1 | 0 | |
| 62 | 1934-1997 | 0.3 | 0.1 | 0.3 | 0 | |
| 63 | 1934-1997 | -0.2 | -0.4 | -0.2 | 0 | |
| 64 | 1934-1997 | 0.2 | -0.1 | 0.2 | 0 | |

Table A-1. Shoreline change rate estimates for Bay County, Florida.

| Range | Time Span | Method | | | Rounded Concensus Average | Comments |
|---|---|---|---|---|---|---|
| | | RA | LS | EP | | |
| 65 | 1934-1997 | -0.3 | -0.3 | -0.3 | 0.5 | |
| 66 | 1934-1997 | 1.4 | 1 | 0.8 | 0.5 | |
| 67 | 1934-1997 | 0.3 | 0.9 | 1.1 | 0.5 | |
| 68 | 1934-1997 | 0 | 0.7 | 1.1 | 0.5 | |
| 69 | 1934-1997 | 0.3 | 0.6 | 0.8 | 0.5 | |
| 70 | 1934-1997 | 0.6 | 0.7 | 0.8 | 0.5 | |
| 71 | 1934-1997 | 0.2 | 0.1 | 0.2 | 0.5 | |
| 72 | 1934-1997 | -0.4 | -0.4 | -0.4 | 0.5 | |
| 73 | 1934-1997 | 0.2 | 0.1 | 0.2 | 0 | |
| 74 | 1934-1997 | -0.2 | 0.2 | 0.6 | 0 | |
| 75 | 1934-1997 | 0.4 | 0.5 | 0.4 | 0 | ↑ |
| 76 | 1934-1997 | 0.1 | -0.3 | 0.1 | 0 | 7 pt average |
| 77 | 1934-1997 | -0.3 | -0.7 | -0.8 | 0 | 5 pt average |
| 78 | 1934-1997 | -0.4 | -0.9 | -1 | -0.5 | 3 pt average |
| 79 | 1934-1997 | 0 | -0.2 | 0 | 0 | |
| Begin Inlet-Induced Erosion Pattern | | | | | | |
| 80 | 1934-1971 | N/A | N/A | -0.6 | -0.5 | EP only |
| 81 | 1934-1971 | N/A | N/A | -1.7 | -1.5 | 3 pt average |
| 82 | 1934-1971 | N/A | N/A | -1.7 | -1 | 5 pt average |
| 83 | 1934-1971 | N/A | N/A | -1 | -1.5 | 7 pt average |
| 84 | 1934-1971 | N/A | N/A | -1.1 | -2 | ↓ |
| 85 | 1934-1971 | N/A | N/A | -1.5 | -2.5 | |
| 86 | 1934-1971 | N/A | N/A | -2.7 | -3 | |
| 87 | 1934-1971 | N/A | N/A | -4.6 | -3.5 | |
| 88 | 1934-1971 | N/A | N/A | -4.9 | -4 | |
| 89 | 1934-1971 | N/A | N/A | -4 | -4.5 | |
| 90 | 1934-1971 | N/A | N/A | -5.2 | -5 | |
| 91 | 1934-1971 | N/A | N/A | -6.5 | -5 | |
| 92 | 1934-1971 | N/A | N/A | -5.1 | -5 | |
| 93 | 1934-1971 | N/A | N/A | -3.9 | -6 | ↑ |
| 94 | 1934-1971 | N/A | N/A | -4.8 | -6 | 7 pt average |
| 95 | 1934-1971 | N/A | N/A | -6 | -6 | 5 pt average |

Table A-1. Shoreline change rate estimates for Bay County, Florida.

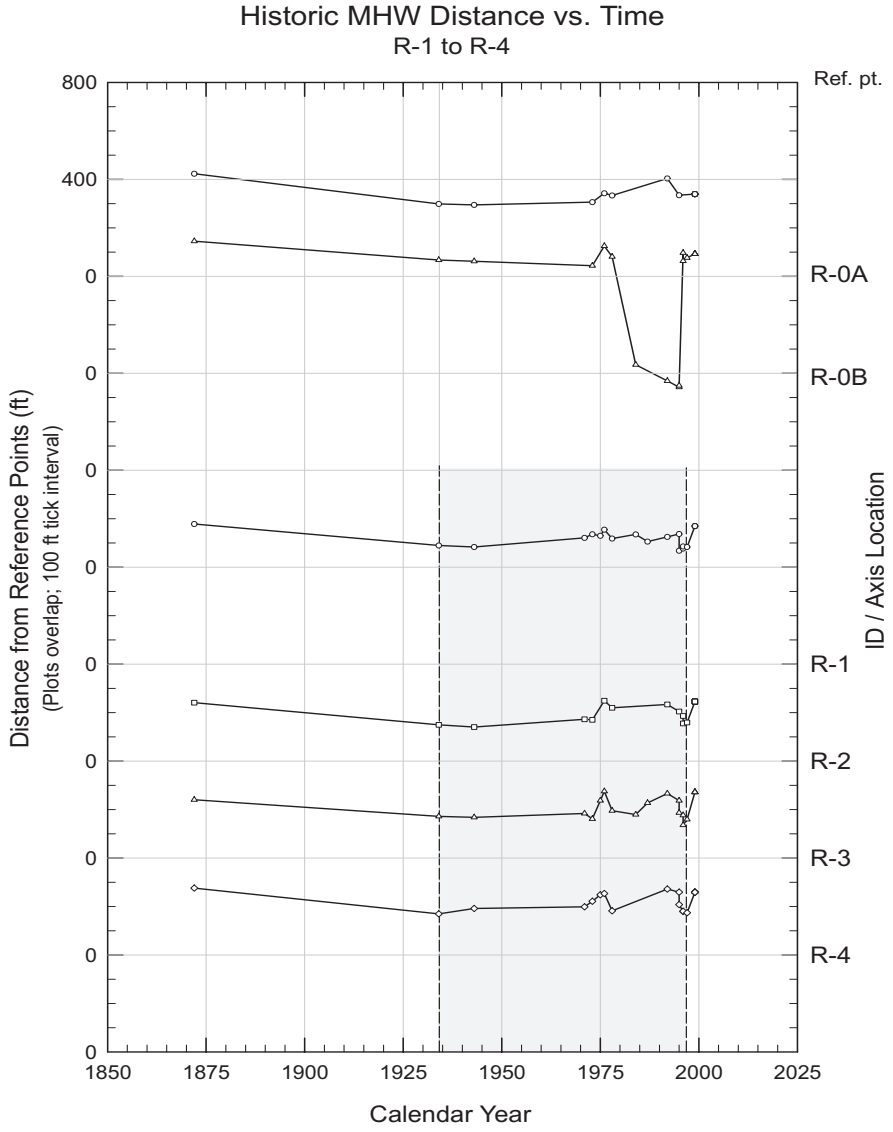
| Range | Time Span | Method | | | Rounded Concensus Average | Comments |
|---|---|---|---|---|---|---|
| | | RA | LS | EP | | |
| 96 | 1934-1971 | N/A | N/A | -8.9 | -7 | 3 pt average |
| 97 | 1934-1971 | N/A | N/A | -5.9 | -6 | |
| St. Andrews Bay Entrance Channel | | | | | | |
| 98 | 1971-1996 | -1.5 | -2.7 | -2.9 | -2.5 | |
| 99 | 1971-1996 | 0.5 | 1.4 | 1.2 | -1 | 3 pt average |
| 100 | 1971-1996 | -0.9 | -1 | -1.2 | -0.5 | 5 pt average |
| 101 | 1971-1996 | 0.2 | -0.3 | 0.2 | -0.5 | 7 pt average |
| 102 | 1971-1996 | -1.5 | -1.6 | -1 | -0.5 | ↓ |
| 103 | 1971-1996 | 0.5 | -0.5 | 1 | -0.5 | |
| 104 | 1971-1996 | -0.6 | -1.1 | -0.6 | -1 | |
| 105 | 1971-1996 | -2 | -2 | -0.9 | -0.5 | |
| 106 | 1971-1996 | -0.2 | 0.6 | -0.6 | 0 | |
| 107 | 1971-1996 | -2 | -2.2 | -1.7 | 0 | |
| 108 | 1972-1996 | 2.3 | 4 | 1.8 | 0 | |
| 109 | 1972-1996 | 2.1 | 2.1 | 2.1 | 0.5 | |
| 110 | 1972-1996 | 0.6 | -2 | 0.6 | 0.5 | |
| 111 | 1972-1996 | -0.4 | -0.9 | -0.4 | 1 | |
| 112 | 1972-1996 | -0.3 | 0.2 | 3.1 | 0.5 | |
| 113 | 1972-1996 | 1 | 1.4 | 1.2 | 0.5 | |
| 114 | 1972-1996 | -0.8 | -0.3 | 3.3 | 1 | |
| 115 | 1972-1996 | -0.1 | -0.7 | -0.1 | 1 | |
| 116 | 1973-1996 | 1.8 | 2.2 | 4.3 | 0 | |
| 117 | 1973-1996 | 2.9 | 2.3 | 3 | 0 | ↑ |
| 118 | 1973-1996 | -1.6 | -2.2 | -3.3 | -0.5 | 7 pt average |
| 119 | 1973-1996 | -3.8 | -3.3 | -2.5 | -1 | 5 pt average |
| 120 | 1973-1996 | -0.7 | -3.2 | -1.1 | -1.5 | 3 pt average |
| 121 | 1973-1996 | 0.5 | -2.1 | 0.5 | -0.5 | |
| End of Monitored Part of Shell Island /Beginning of Mexico Beach | | | | | | |
| 122 | 1973-1996 | 6.2 | 6.8 | 6.1 | 6.5 | |
| 123 | 1973-1996 | 6.7 | 6.9 | 5.5 | 7 | 3 pt average |
| 124 | 1973-1996 | 8.4 | 8.3 | 8.9 | 7.5 | 5 pt average |
| 125 | 1973-1996 | 8.1 | 7.5 | 10.3 | 7 | 5 pt average |

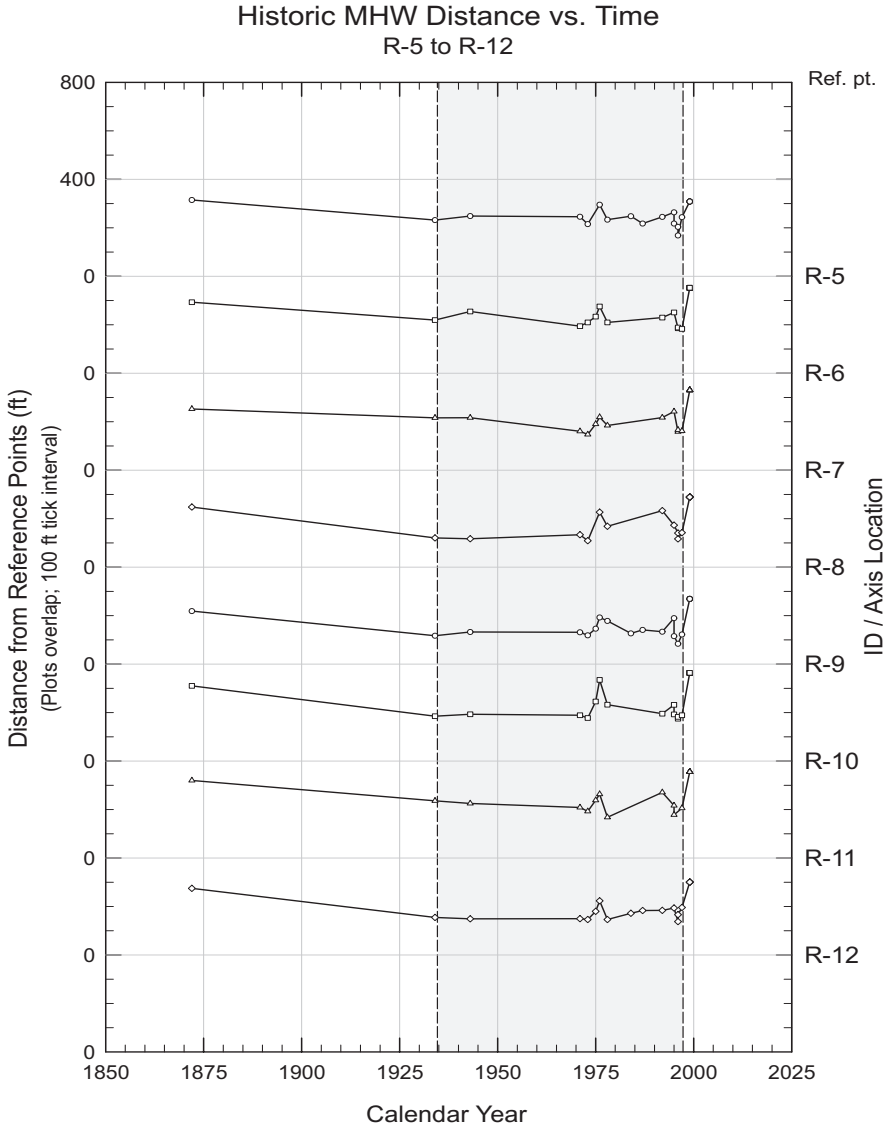
Table A-1. Shoreline change rate estimates for Bay County, Florida.

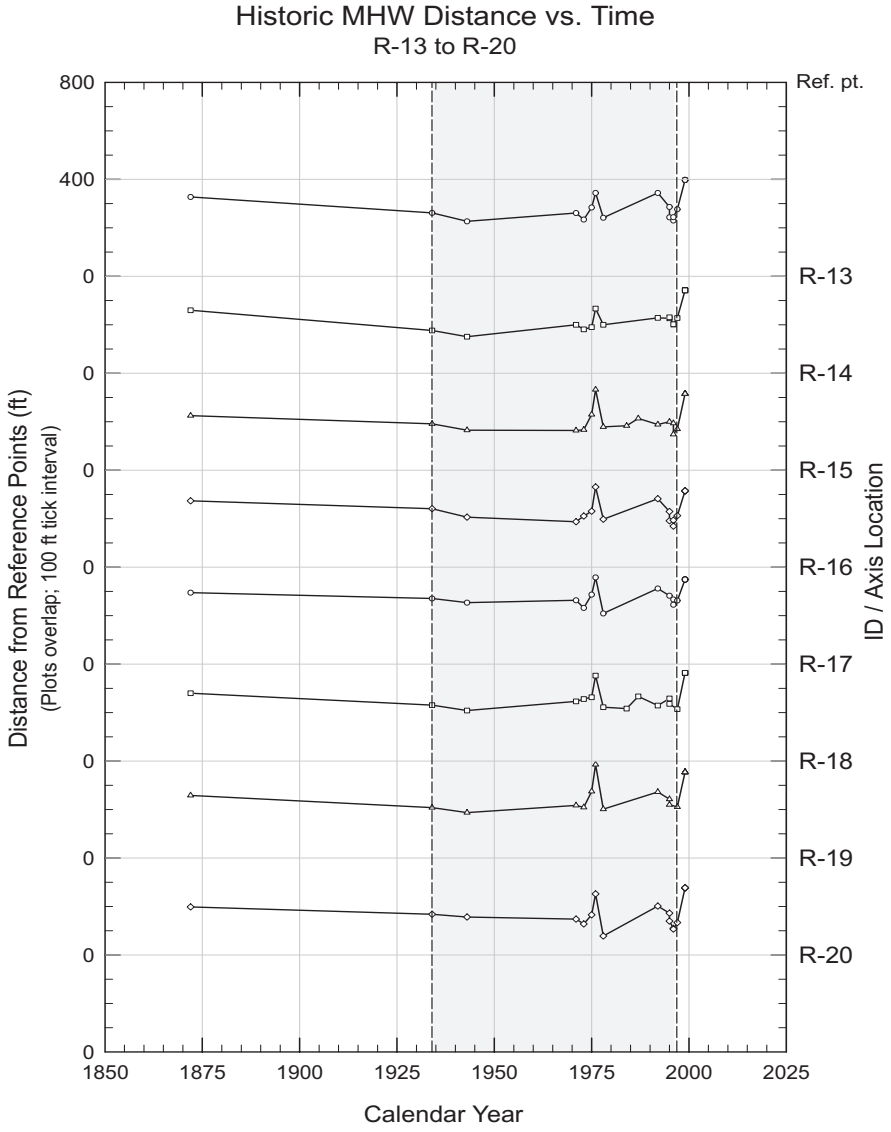
| Range | Time Span | Method | | | Rounded Concensus Average | Comments |
|---|---|---|---|---|---|---|
| | | RA | LS | EP | | |
| 126 | 1973-1996 | 7 | 6.9 | 8.5 | 7 | 3 pt average |
| 127 | 1973-1996 | 4.9 | 4.3 | 4.8 | 4.5 | |
| Mexico Beach Inlet | | | | | | |
| 128 | 1973-1998 | 6.6 | 6.2 | 6.2 | 6.5 | |
| 129 | 1973-1996 | 6.7 | 6.7 | 6.3 | 6 | 3 pt average |
| 130 | 1973-1998 | 4.9 | 4.8 | 4.3 | 4.5 | 5 pt average |
| 131 | 1973-1998 | 2.6 | 2.3 | 2.8 | 3 | 7 pt average |
| 132 | 1973-1998 | 1.3 | 1.3 | 1.5 | 2 | ↓ |
| 133 | 1973-1998 | 0.2 | 1 | 0.2 | 1 | |
| 134 | 1973-1998 | -0.6 | -0.2 | -0.9 | 0.5 | |
| 135 | 1973-1998 | -0.6 | 0 | -1 | 0.5 | |
| 136 | 1973-1998 | 0.2 | 0.5 | 0.2 | 0.5 | |
| 137 | 1973-1998 | -0.1 | 0.4 | 0.9 | 0.5 | |
| 138 | 1973-1998 | 2.4 | 2.5 | 1.9 | 1 | |
| 139 | 1973-1998 | 0.9 | 1 | 1.4 | 1.5 | |
| 140 | 1973-1996 | 1.6 | 1.9 | 2.6 | 1.5 | ↑ |
| 141 | 1973-1998 | 2.4 | 2.8 | 1.7 | 2 | 7 pt average |
| 142 | 1973-1996 | 1.6 | 2 | 1.4 | 2 | 5 pt average |
| 143 | 1973-1996 | 1.6 | 1.8 | 1.6 | 2 | 3 pt average |
| 144 | 1973-1998 | 2.2 | 2.3 | 2.3 | 2.5 | |

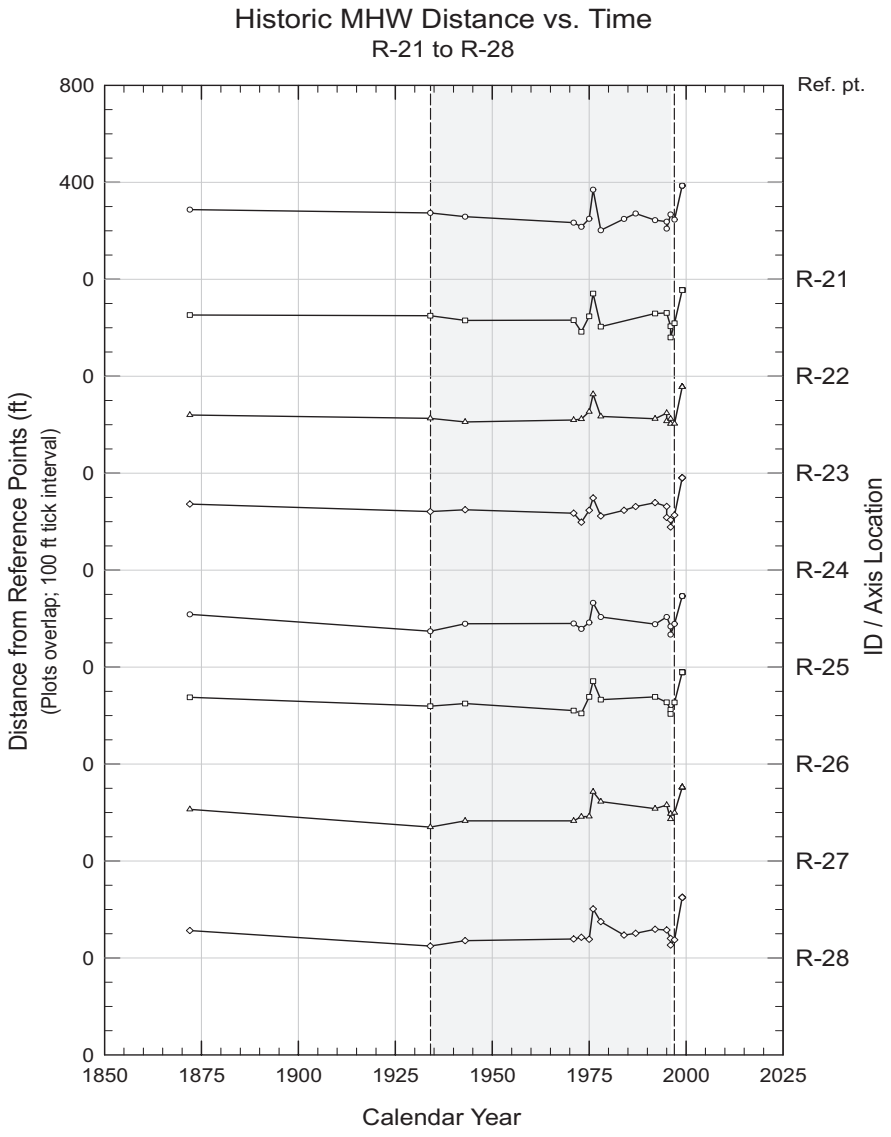
## 7.2 Appendix B: Stack Plots

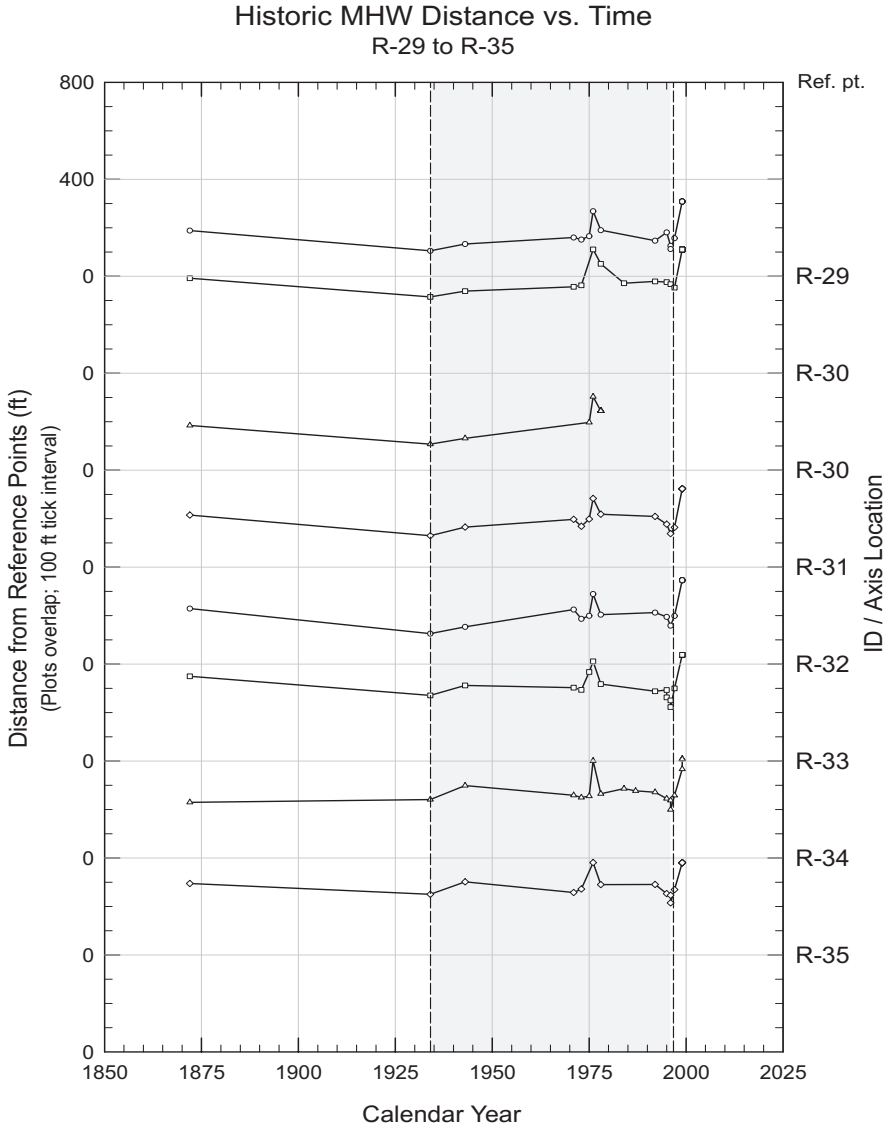
Stack plots from Historic Shoreline Database, Florida Department of Environmental Protection, Office of Beaches and Coastal Systems; slightly modified by authors.

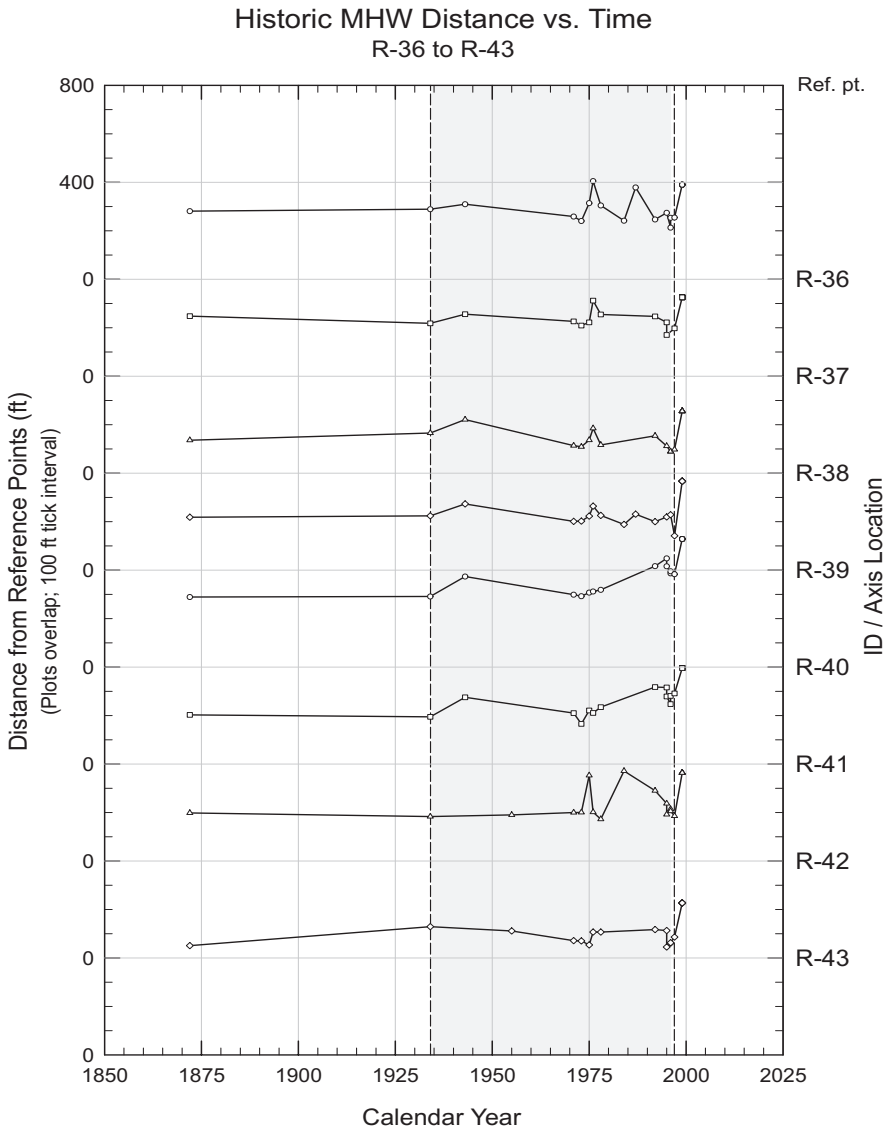

Historic MHW Distance vs. Time
R-1 to R-4
Ref. pt.
800
400
0
0
0
0
0
0
0
0
R-0A
R-0B
R-1
R-2
R-3
R-4
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

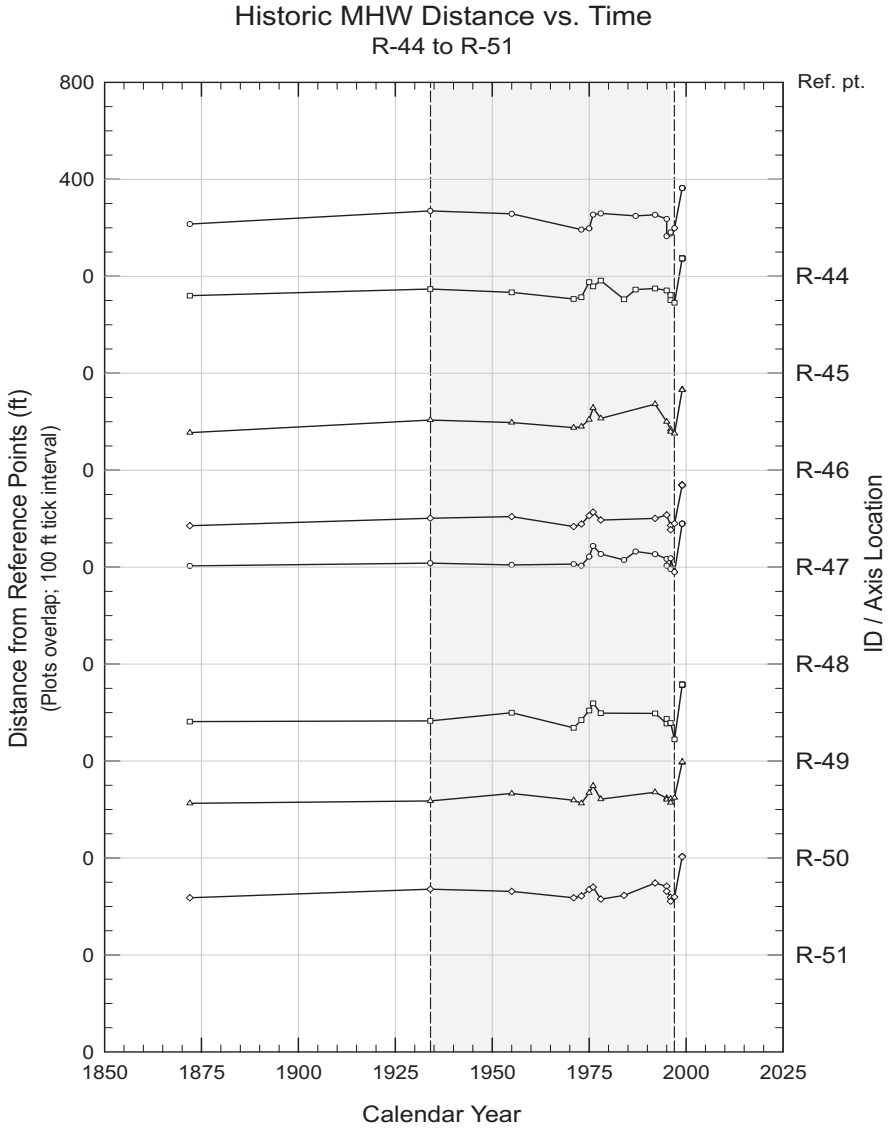

Historic MHW Distance vs. Time
R-5 to R-12
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
ID / Axis Location

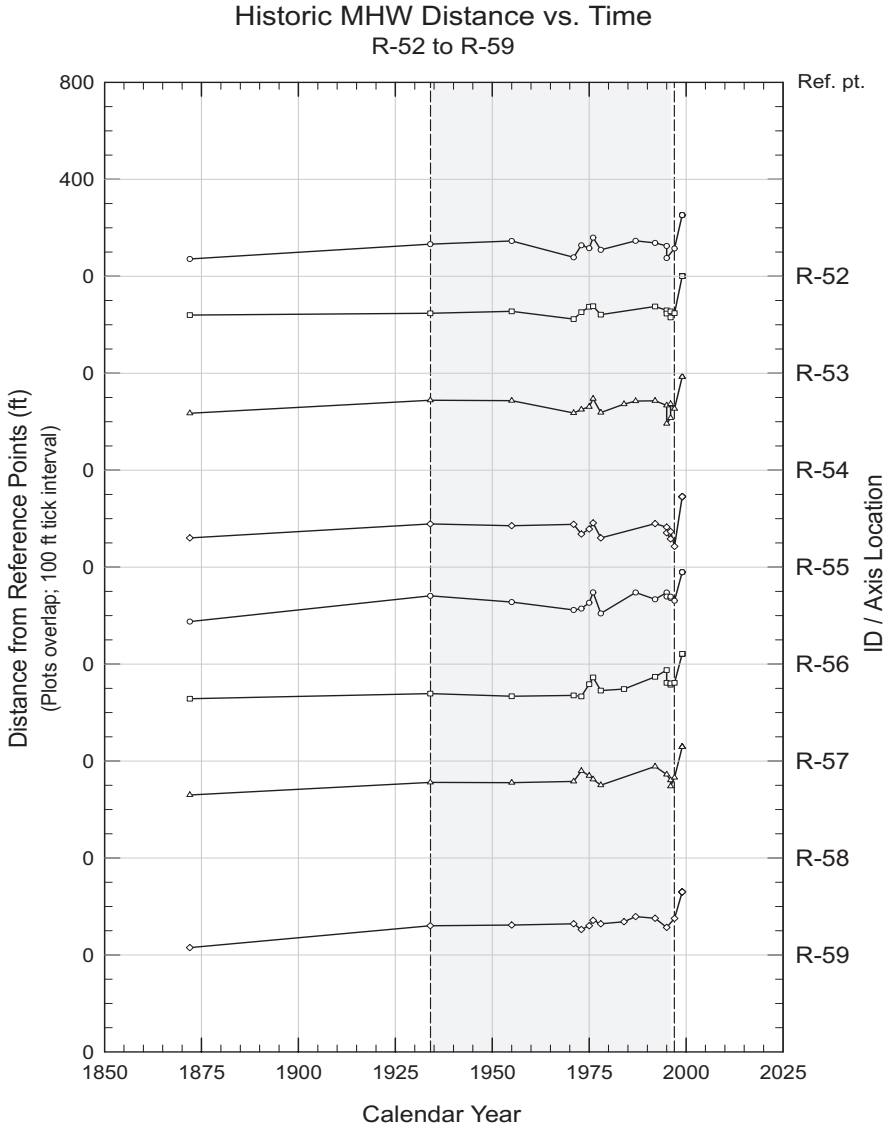

Historic MHW Distance vs. Time
R-13 to R-20
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-13
R-14
R-15
R-16
R-17
R-18
R-19
R-20
ID / Axis Location

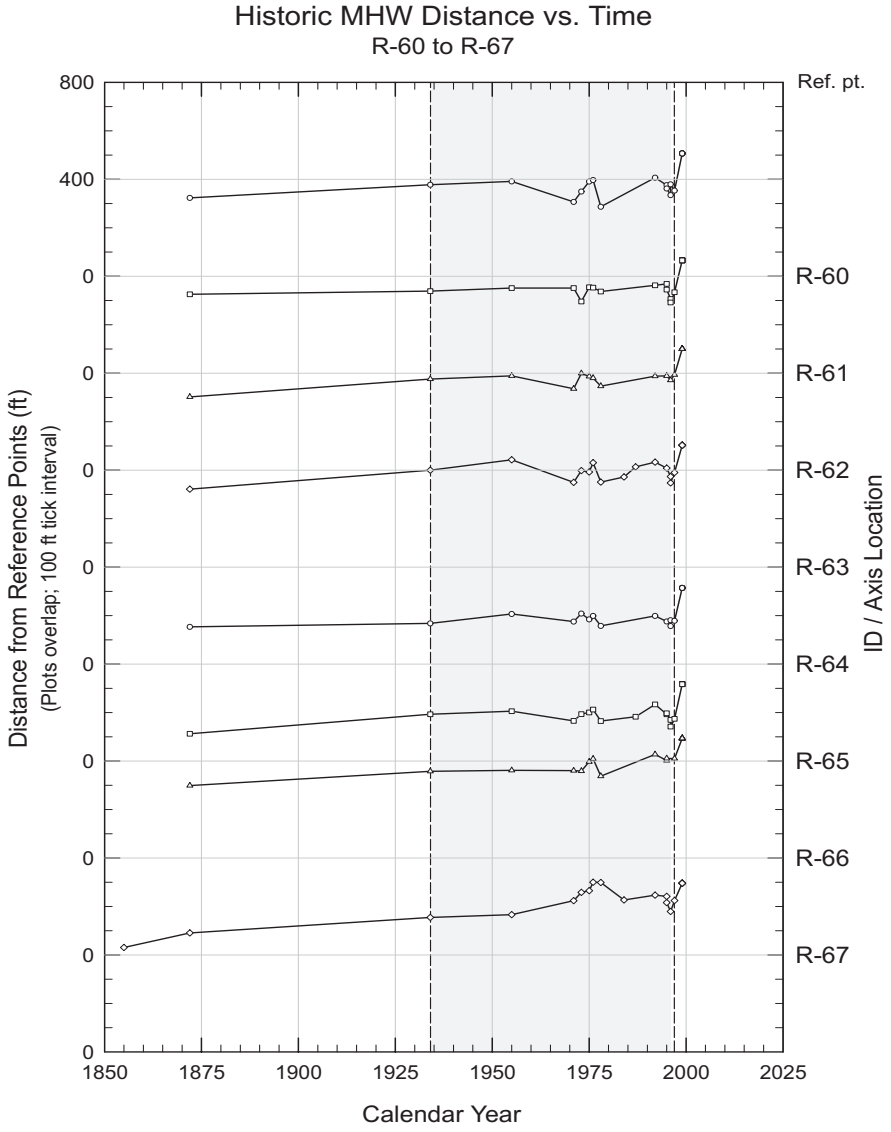

Historic MHW Distance vs. Time
R-21 to R-28
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-21
R-22
R-23
R-24
R-25
R-26
R-27
R-28
ID / Axis Location

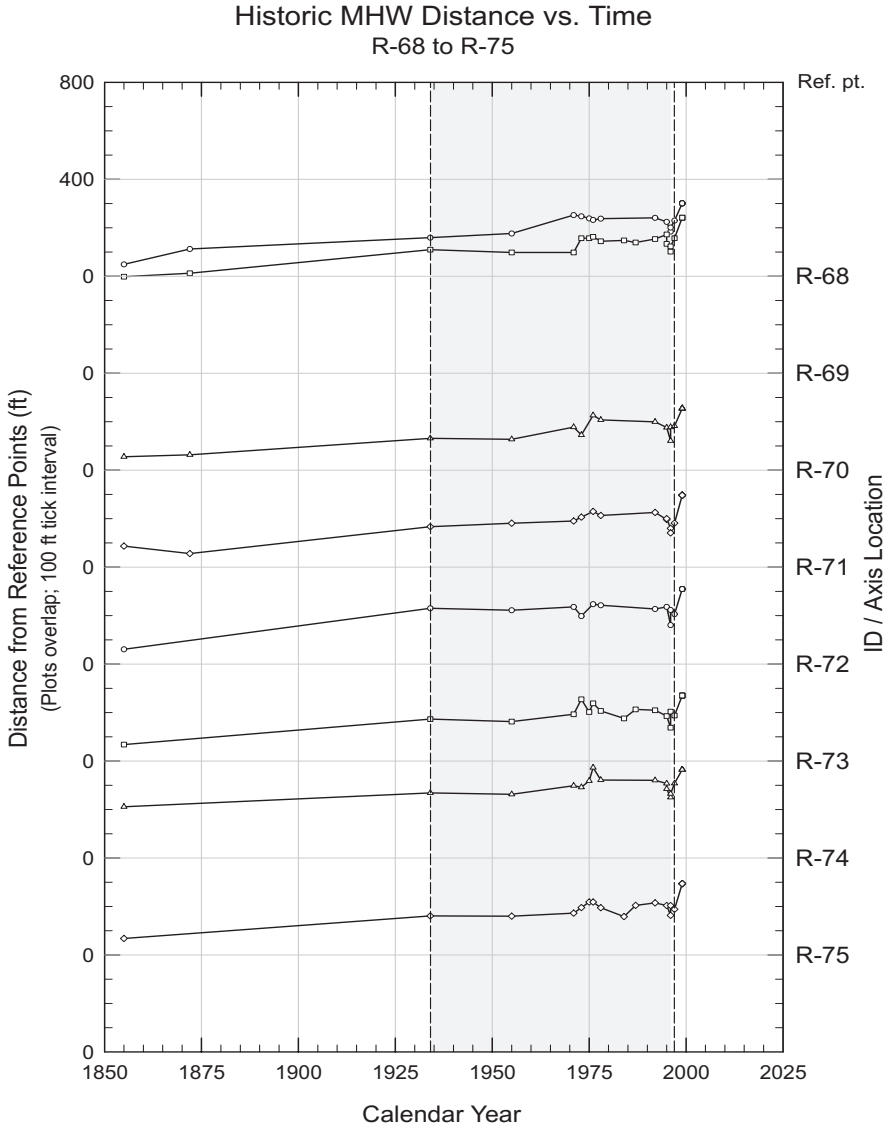

Historic MHW Distance vs. Time
R-29 to R-35
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-29
R-30
R-30
R-31
R-32
R-33
R-34
R-35
ID / Axis Location

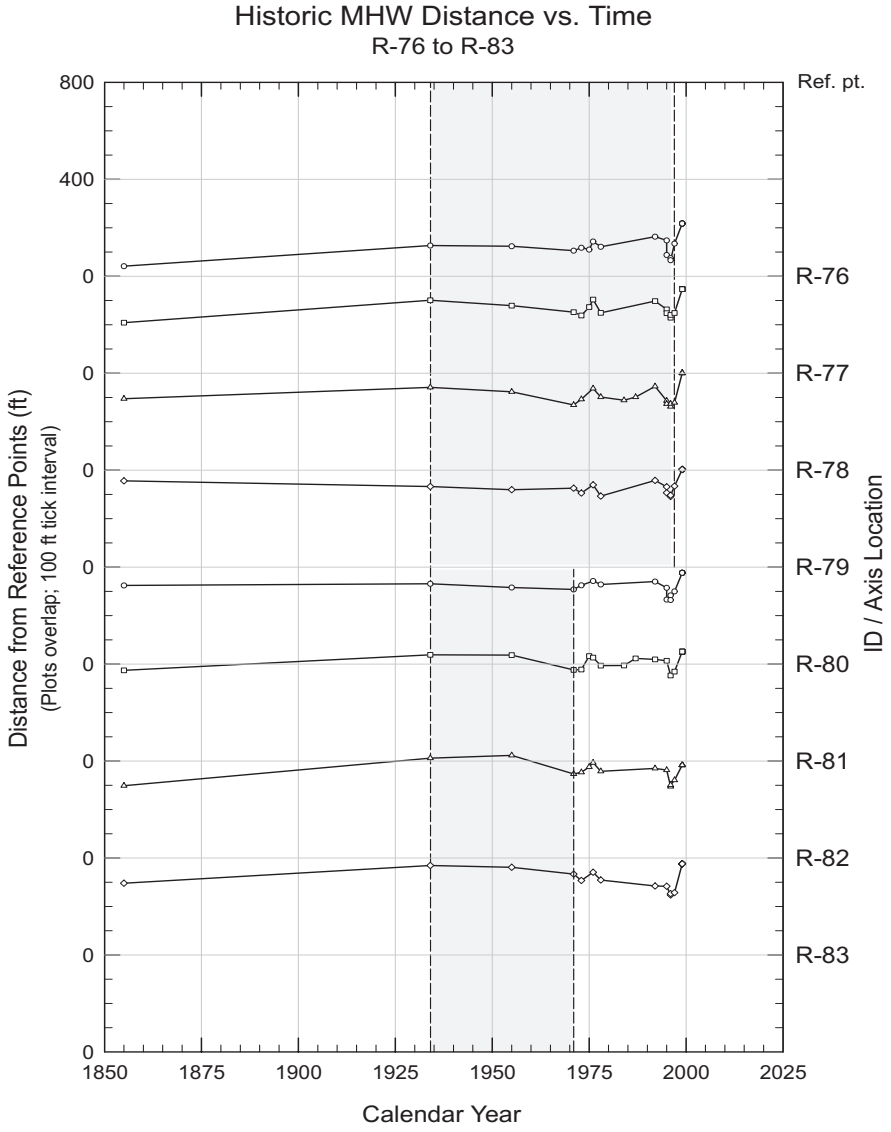

Historic MHW Distance vs. Time
R-36 to R-43
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-36
R-37
R-38
R-39
R-40
R-41
R-42
R-43
ID / Axis Location

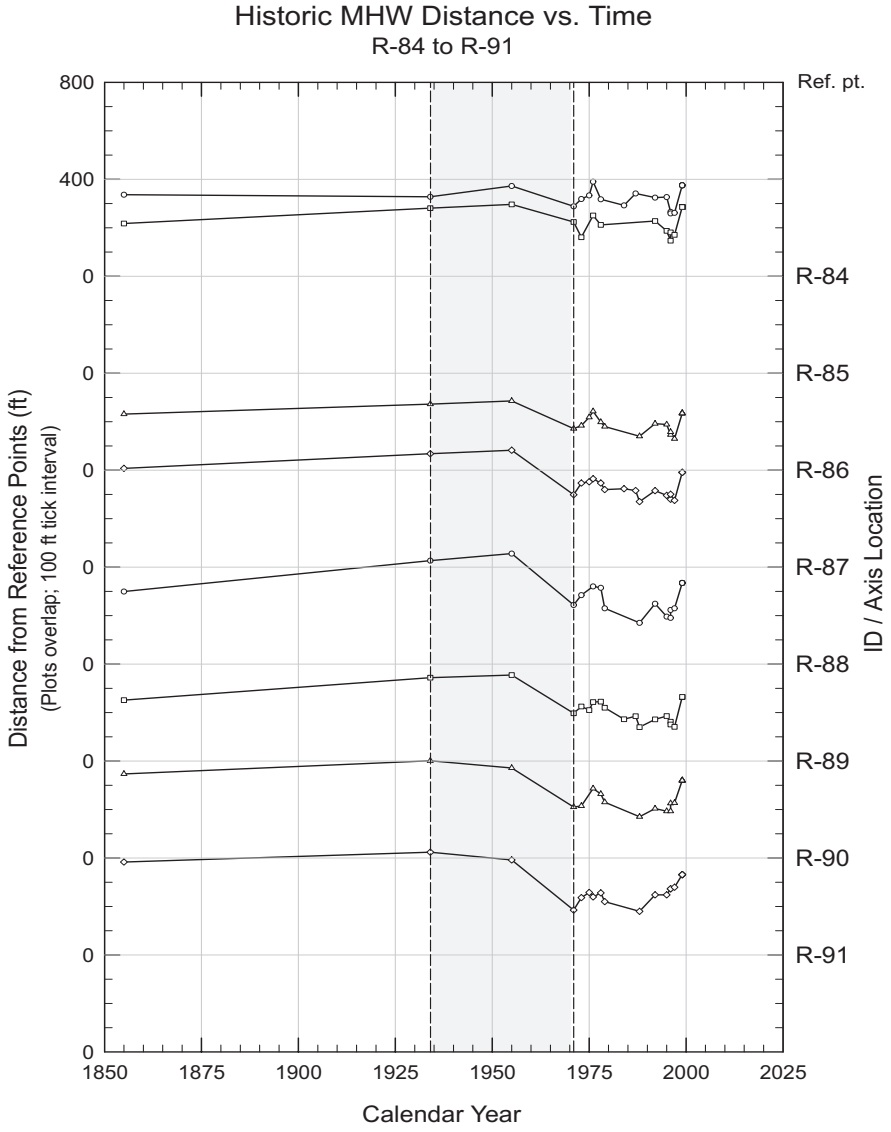

Historic MHW Distance vs. Time
R-44 to R-51
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-44
R-45
R-46
R-47
R-48
R-49
R-50
R-51
ID / Axis Location

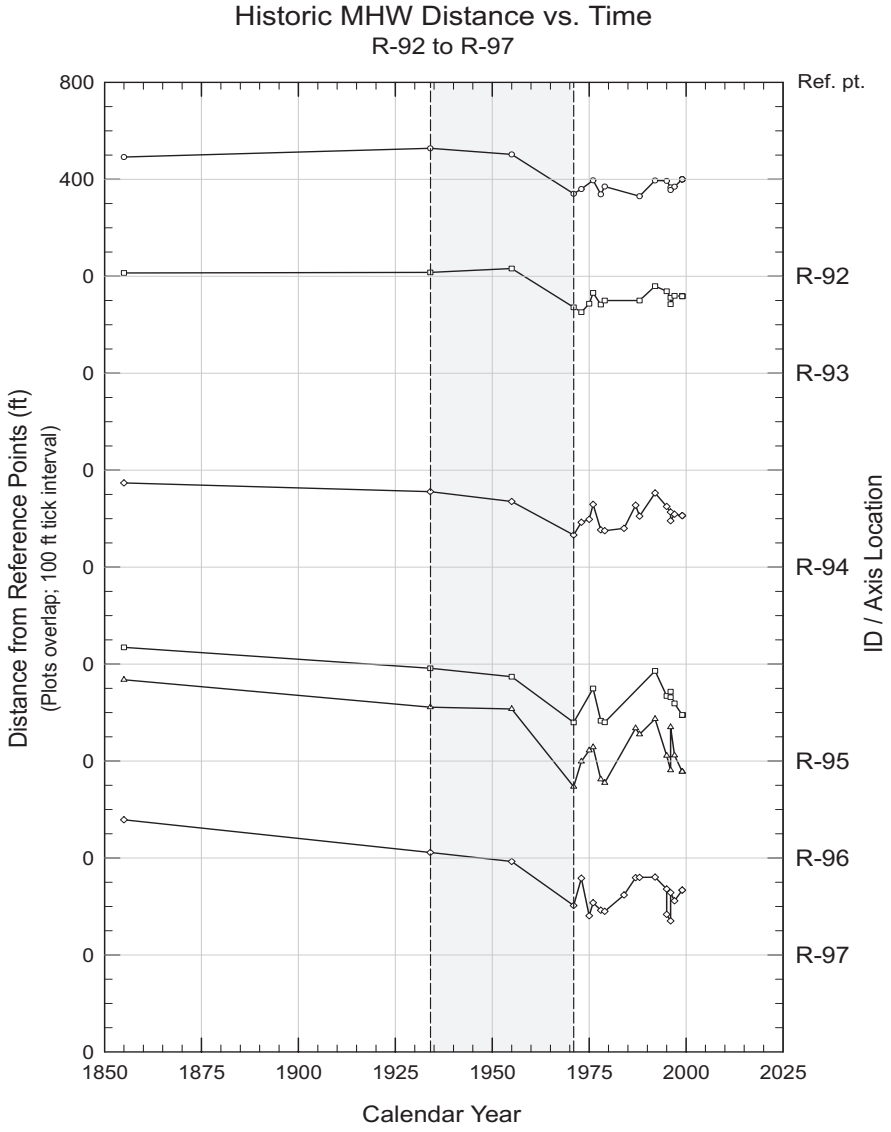

Historic MHW Distance vs. Time
R-52 to R-59
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-52
R-53
R-54
R-55
R-56
R-57
R-58
R-59
ID / Axis Location

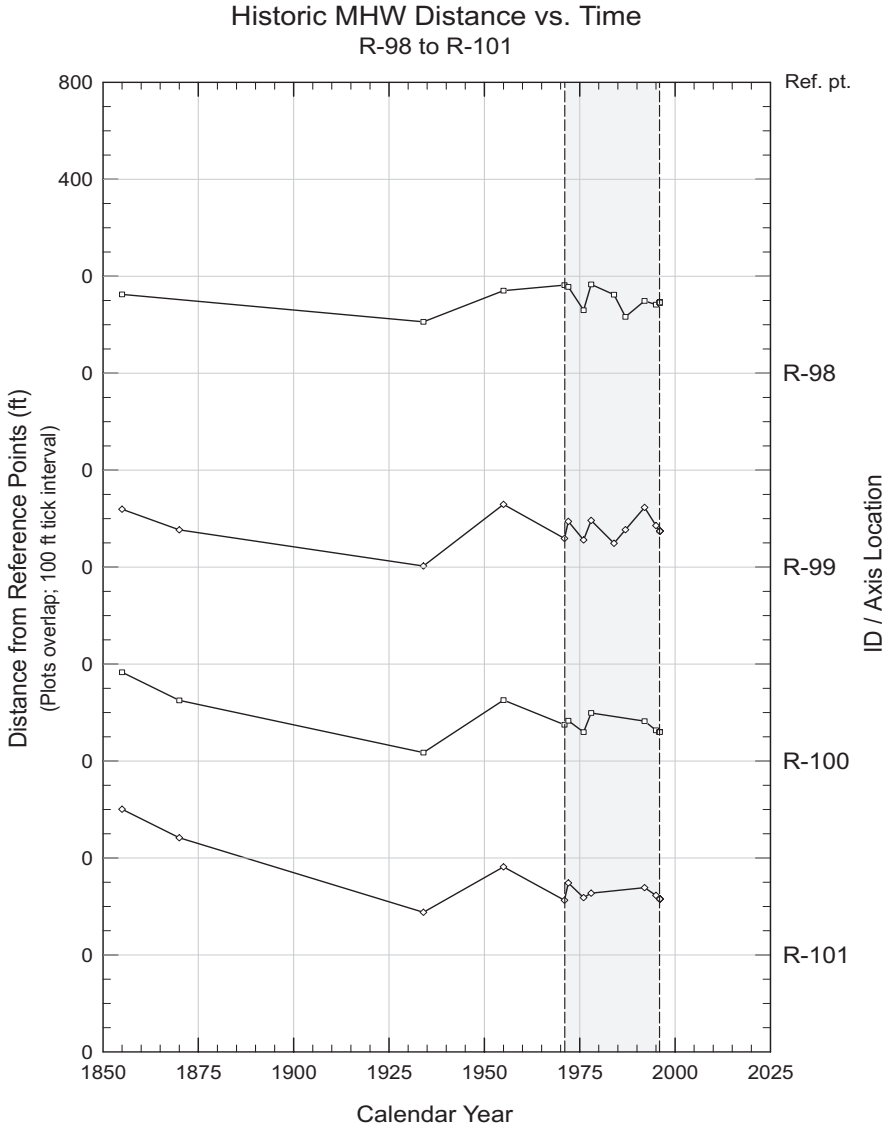

Historic MHW Distance vs. Time
R-60 to R-67
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-60
R-61
R-62
R-63
R-64
R-65
R-66
R-67
ID / Axis Location

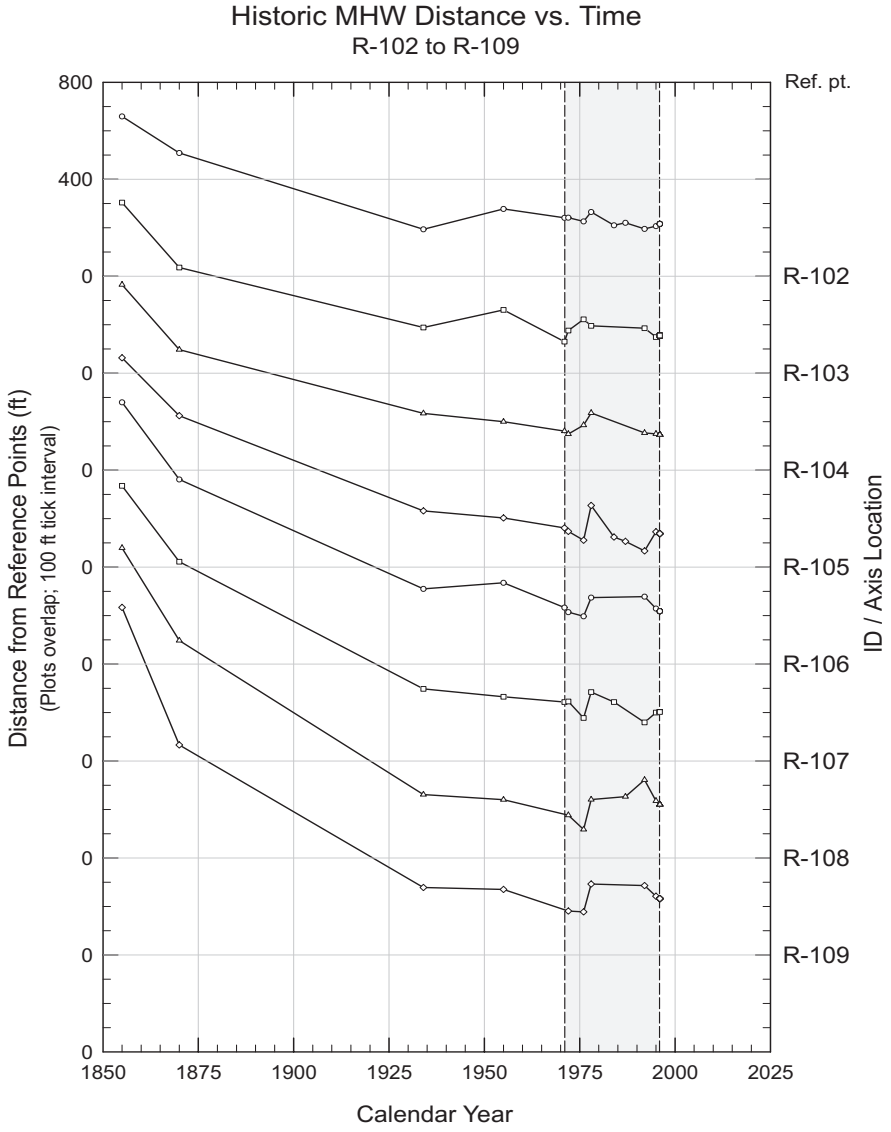

Historic MHW Distance vs. Time
R-68 to R-75
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-68
R-69
R-70
R-71
R-72
R-73
R-74
R-75
ID / Axis Location

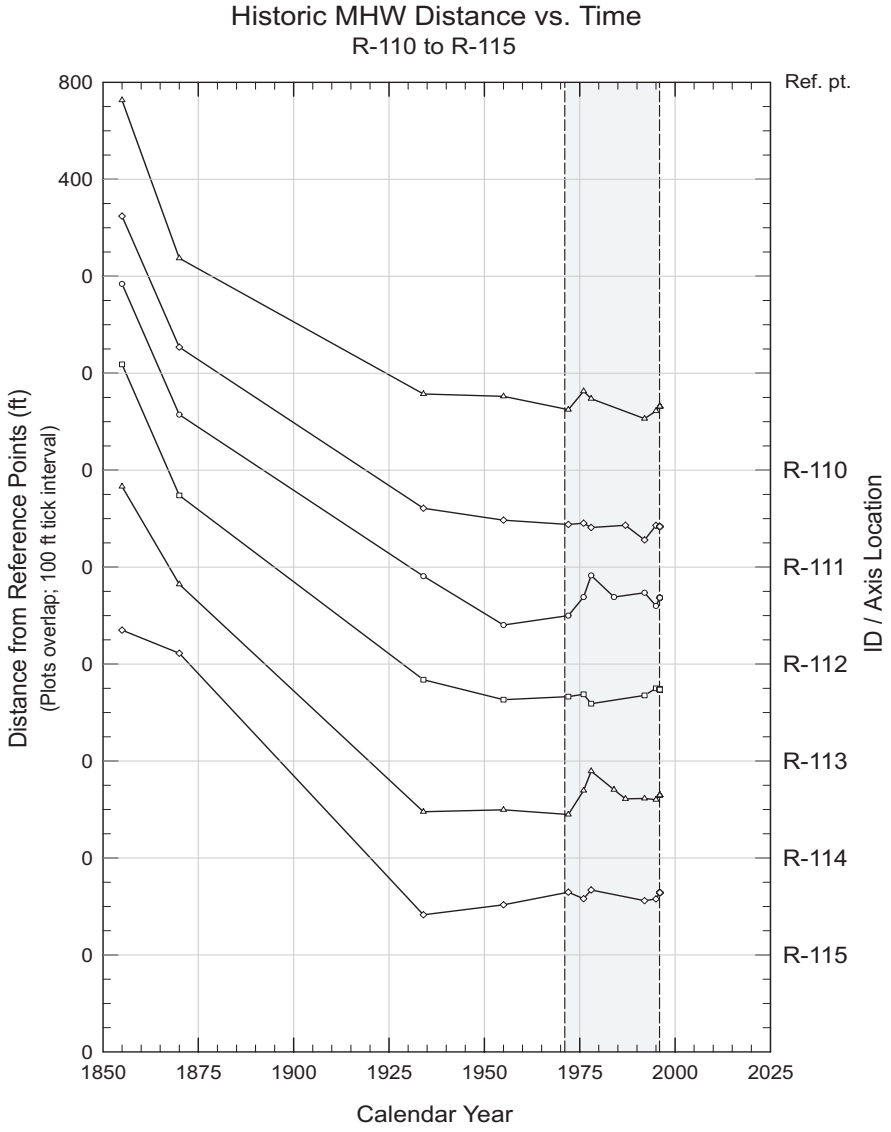

Historic MHW Distance vs. Time
R-76 to R-83
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-76
R-77
R-78
R-79
R-80
R-81
R-82
R-83
ID / Axis Location

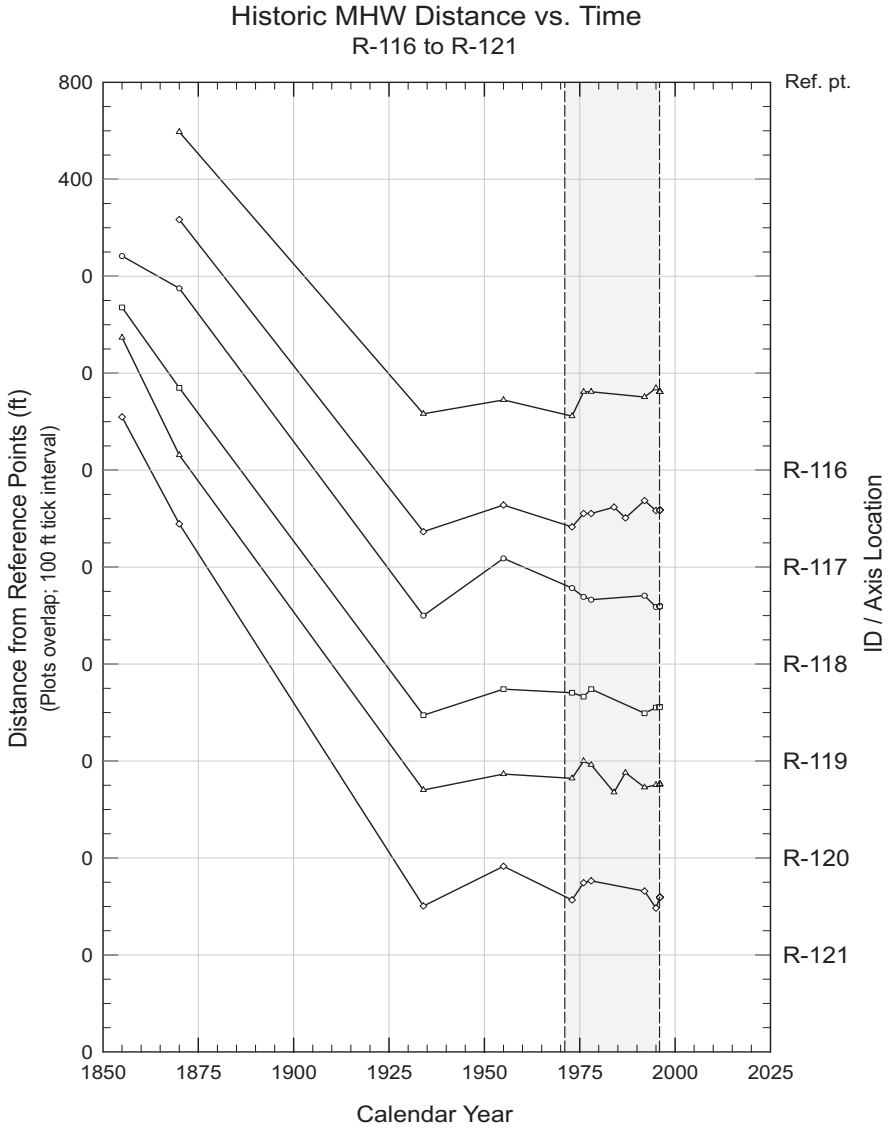

Historic MHW Distance vs. Time
R-84 to R-91
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-84
R-85
R-86
R-87
R-88
R-89
R-90
R-91
ID / Axis Location

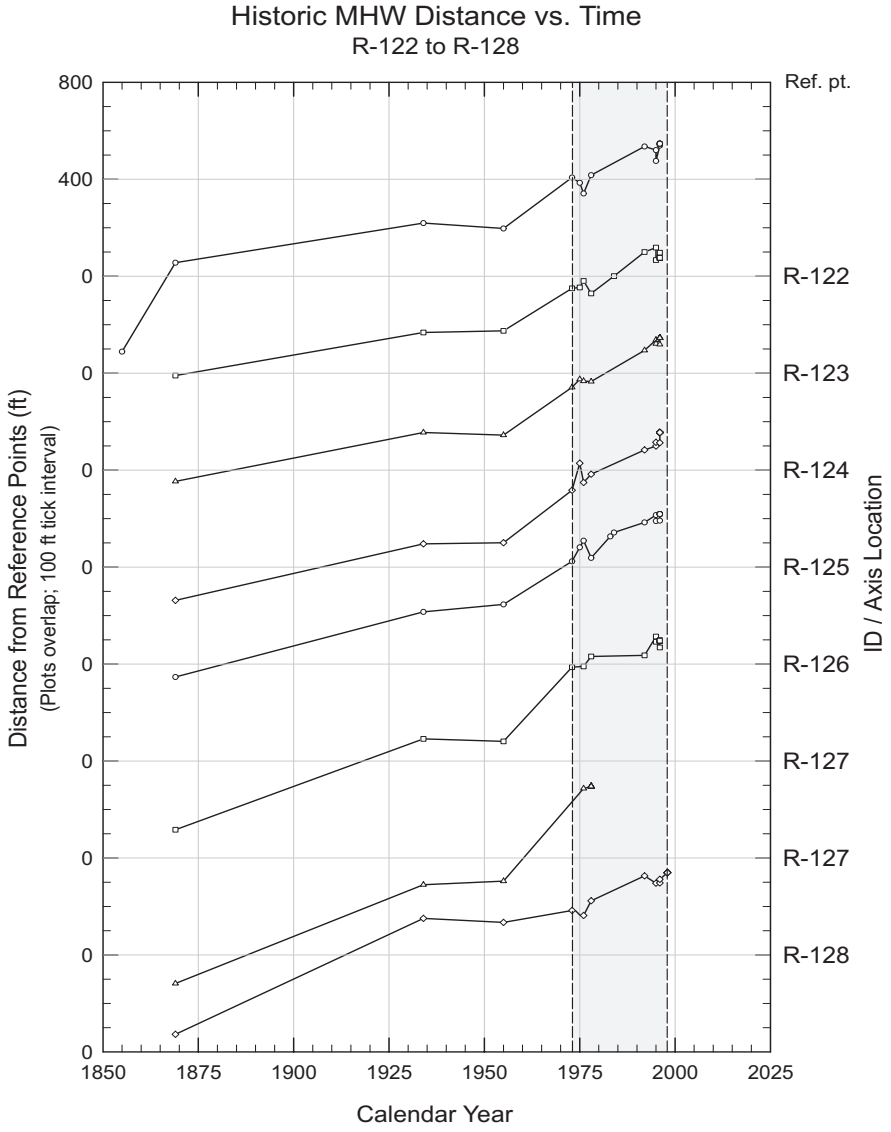

Historic MHW Distance vs. Time
R-92 to R-97
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-92
R-93
R-94
R-95
R-96
R-97
ID / Axis Location

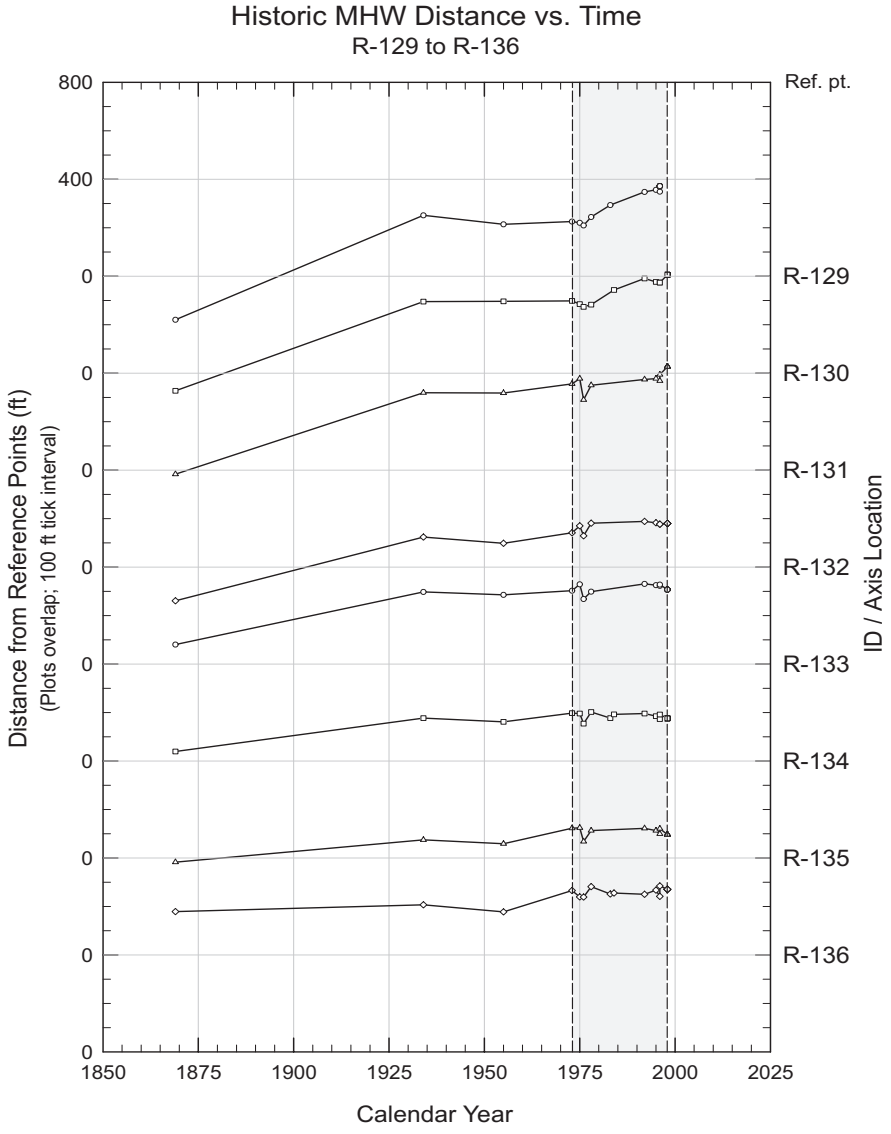

Historic MHW Distance vs. Time
R-98 to R-101
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-98
R-99
R-100
R-101
ID / Axis Location

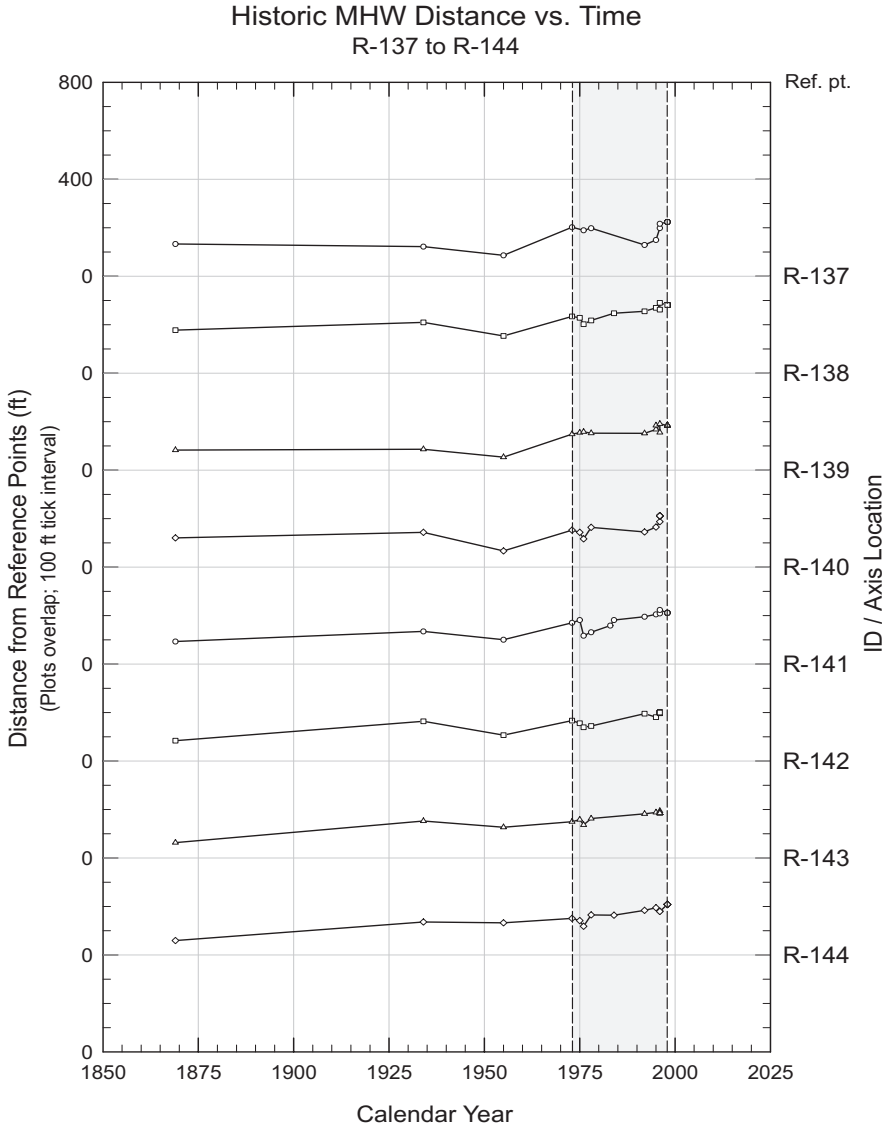

Historic MHW Distance vs. Time
R-102 to R-109
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-102
R-103
R-104
R-105
R-106
R-107
R-108
R-109
ID / Axis Location


Historic MHW Distance vs. Time
R-110 to R-115
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-110
R-111
R-112
R-113
R-114
R-115
ID / Axis Location

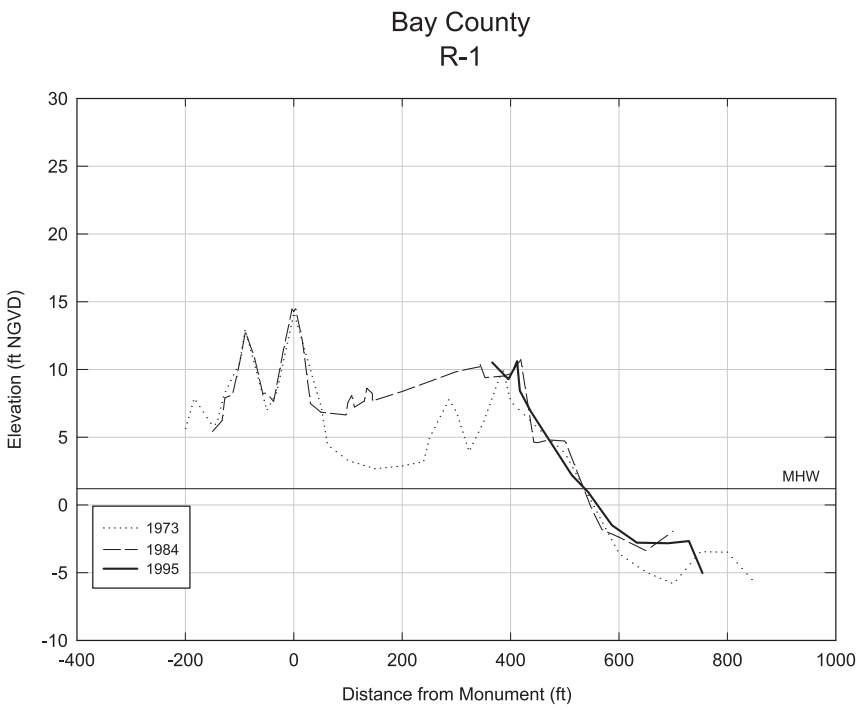

Historic MHW Distance vs. Time
R-116 to R-121
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-116
R-117
R-118
R-119
R-120
R-121
ID / Axis Location

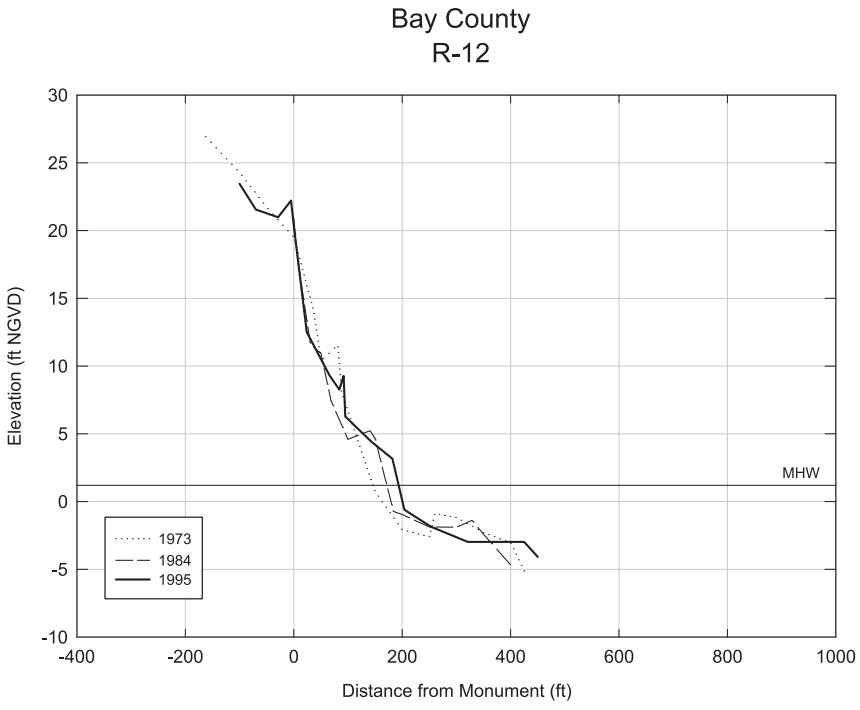

Historic MHW Distance vs. Time
R-122 to R-128
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-122
R-123
R-124
R-125
R-126
R-127
R-127
R-128
ID / Axis Location

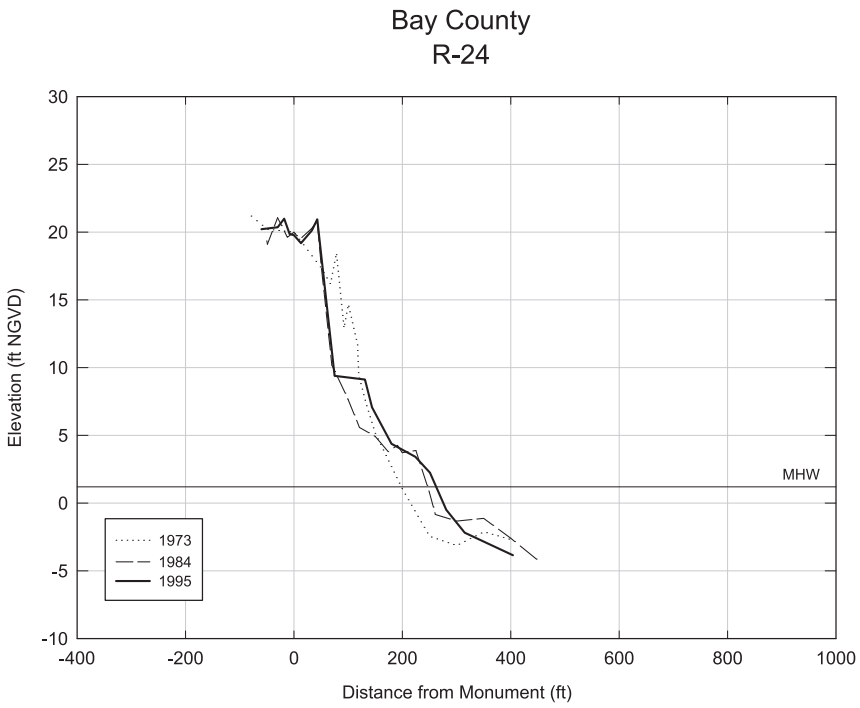

Historic MHW Distance vs. Time
R-129 to R-136
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-129
R-130
R-131
R-132
R-133
R-134
R-135
R-136
ID / Axis Location

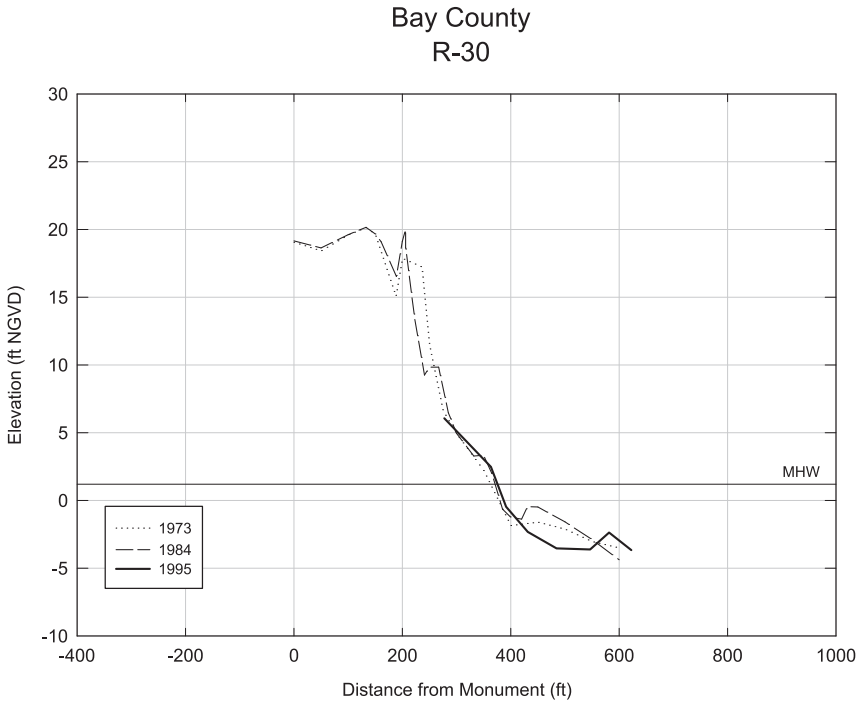

Historic MHW Distance vs. Time
R-137 to R-144
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-137
R-138
R-139
R-140
R-141
R-142
R-143
R-144
ID / Axis Location

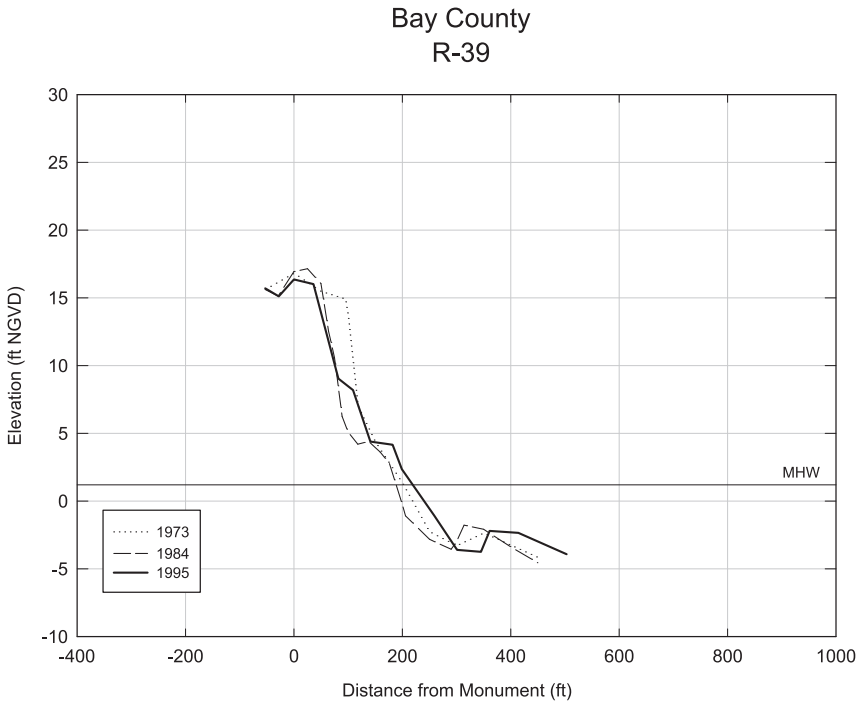
## 7.3 Appendix C: Profile Plots

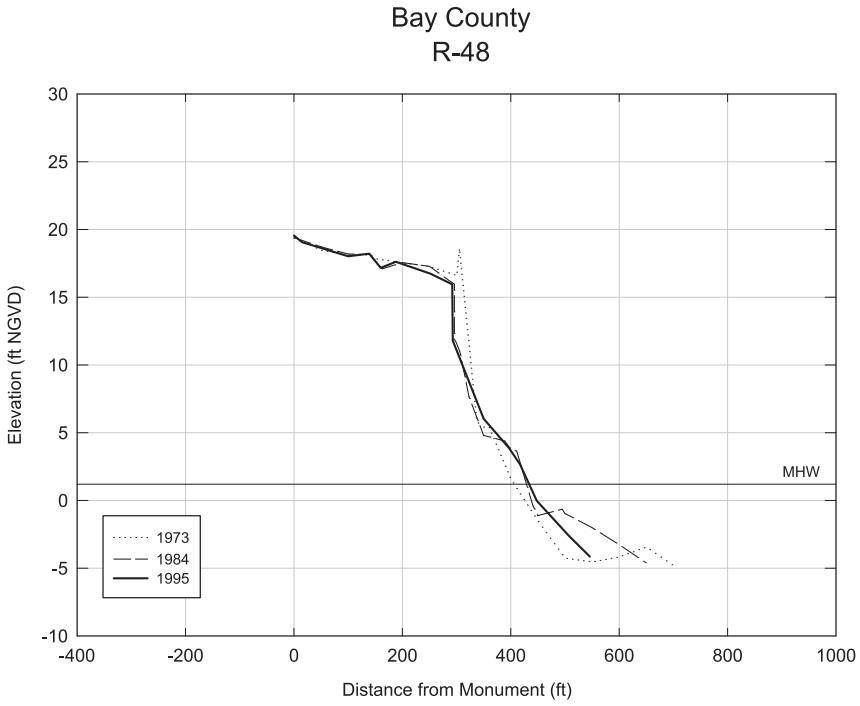

Bay County
R-1
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

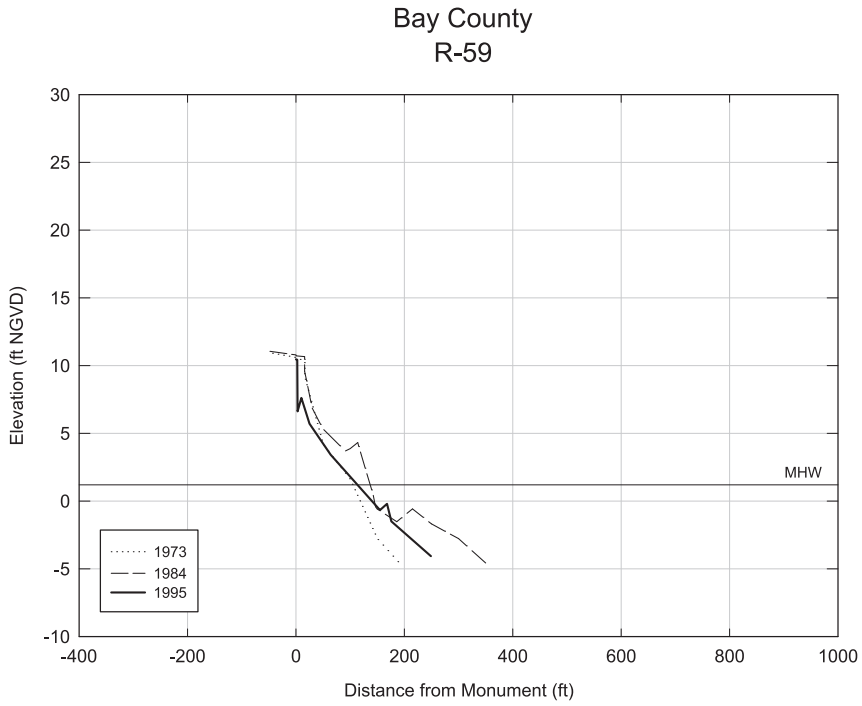

Bay County
R-12
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

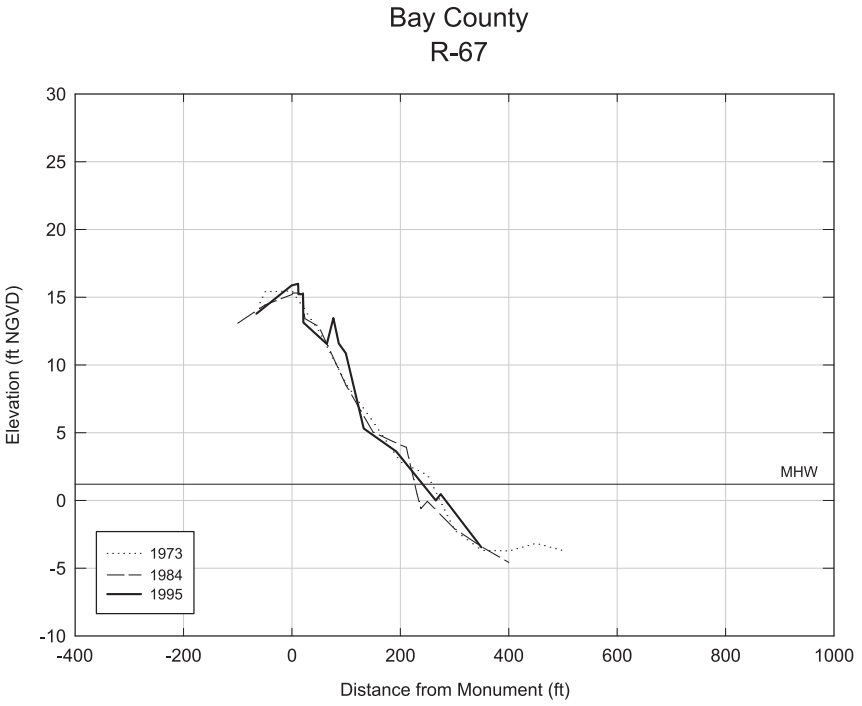

Bay County
R-24
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

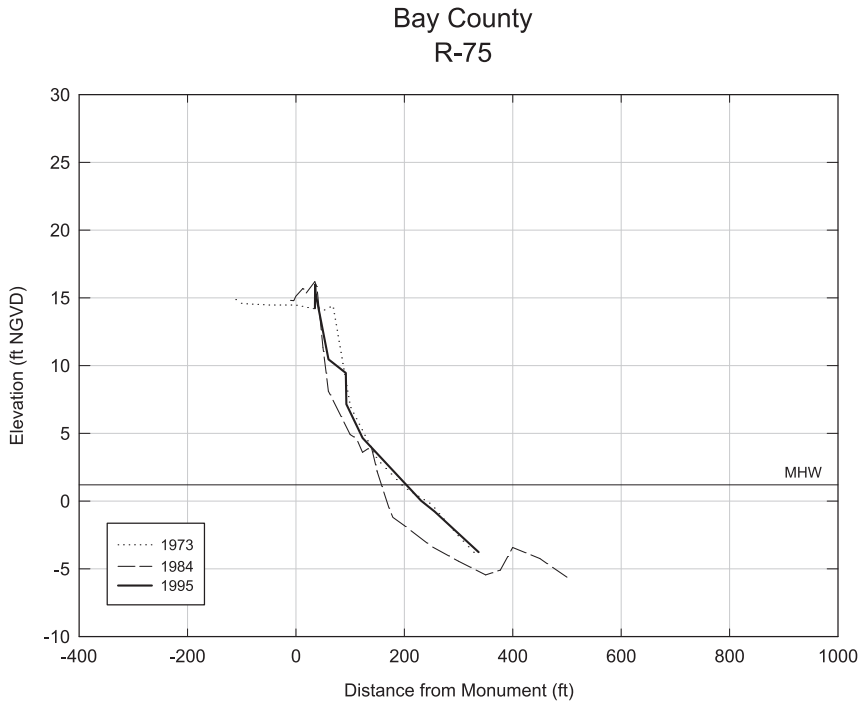

Bay County
R-30
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

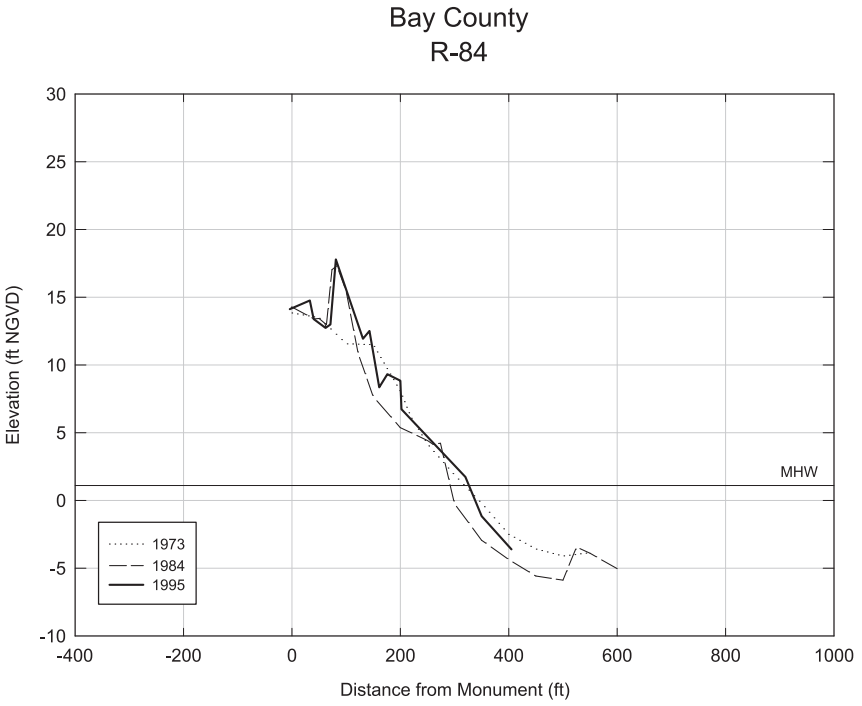

Bay County
R-39
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

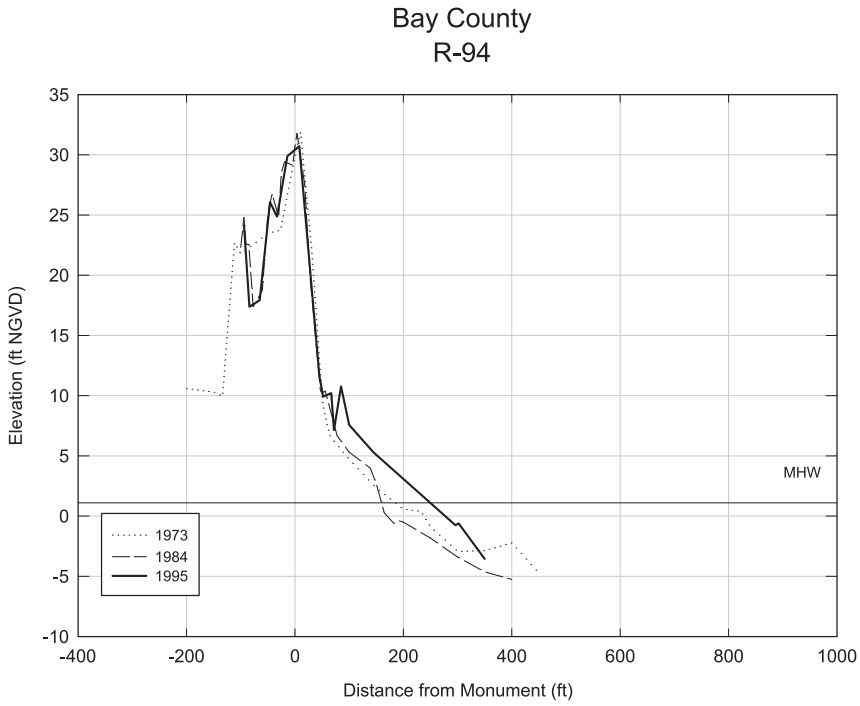

Bay County
R-48
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

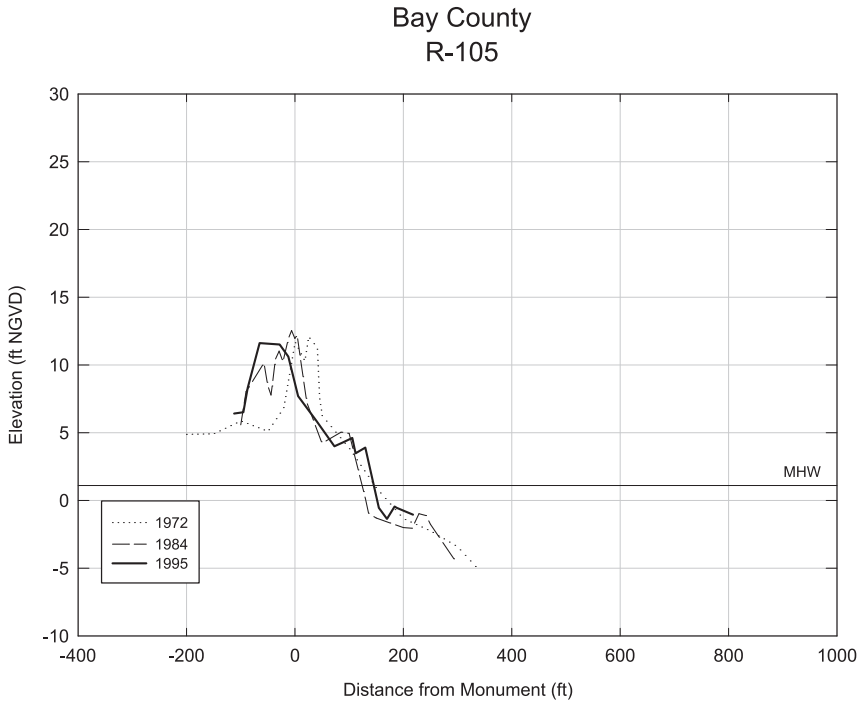

Bay County
R-59
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

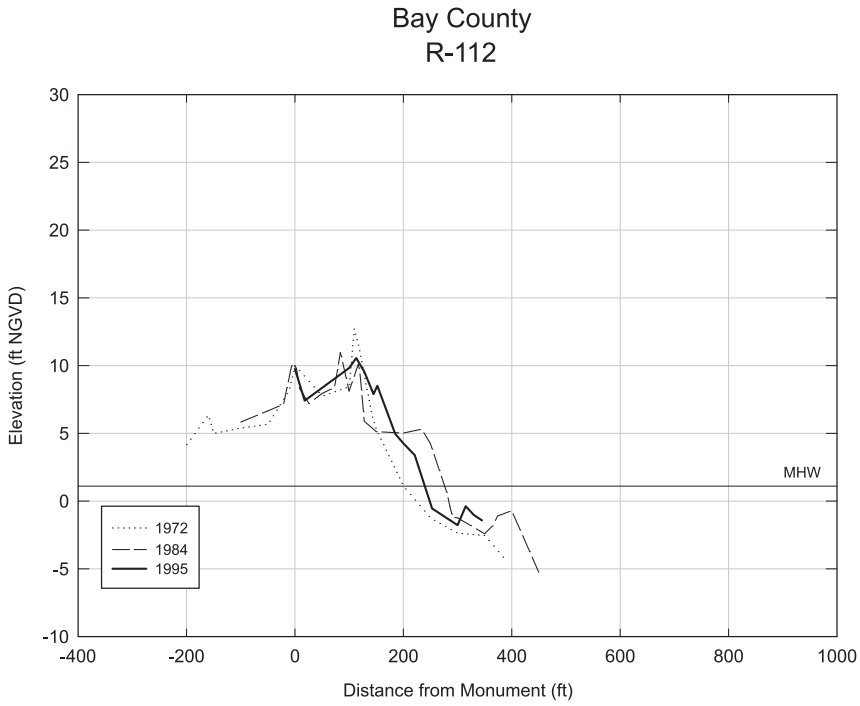

Bay County
R-67
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

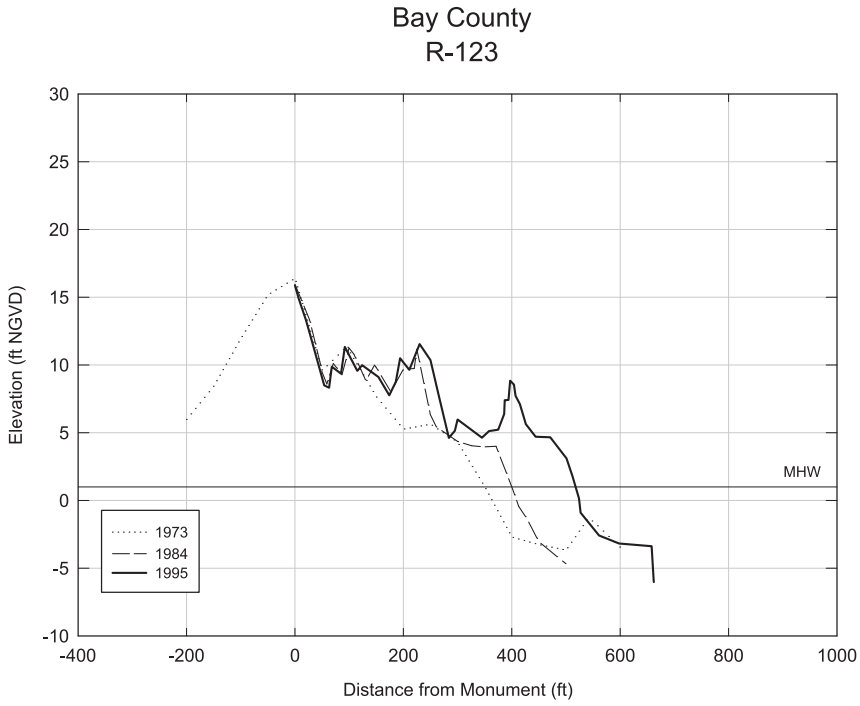

Bay County
R-75
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

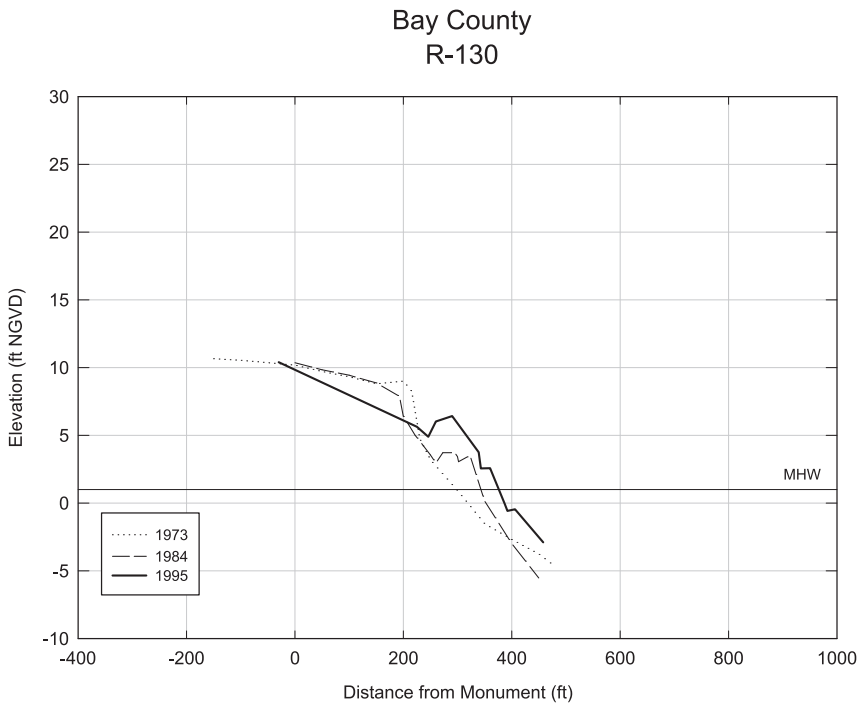

Bay County
R-84
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000

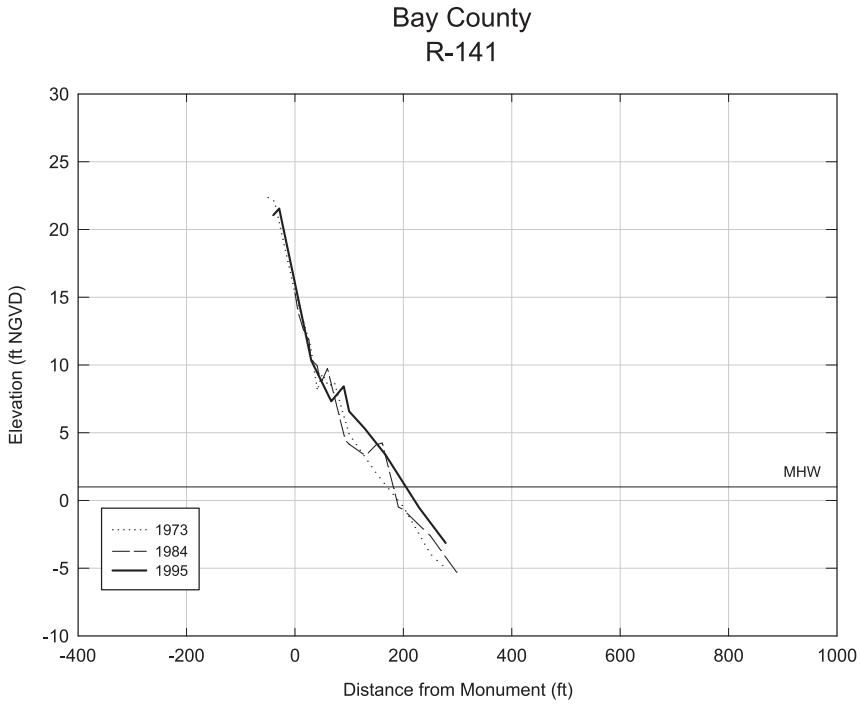

Bay County
R-94
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
35
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000


Bay County
R-105
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1972
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000


Bay County
R-112
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1972
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000


Bay County
R-123
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000


Bay County
R-130
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000


Bay County
R-141
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1973
1984
1995
30
25
20
15
10
5
0
-5
-10
-400
-200
0
200
400
600
800
1000