Shoreline Change Rate Estimates

St. Johns County
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Prepared by:
Emmett R. Foster[1]
Darren L. Spurgeon[2] and Jenny Cheng[2]

[1] *Office of Beaches & Coastal Systems*
Florida Dept. of Environmental Protection
Tallahassee, FL

[2] *Beaches & Shores Resource Center*
Florida State University
Tallahassee, FL

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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 Darren Spurgeon and Jenny Cheng of the Beaches and Shores Resource Center. 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
Office of Beaches and Coastal Systems

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1 EXECUTIVE SUMMARY

St. Johns is a large coastal county that encompasses a full spectrum of beach conditions. There are beaches that are eroding, beaches that are accreting, and beaches that are relatively stable. A variety of sand types are present throughout the county.

The largest problem area is centered around the St. Augustine Beach revetment. Beaches to both sides are highly erosive, and the revetment itself is frequently damaged by storms. A major change in the form of a large scale beach nourishment is planned. The Corps of Engineer's estimated project nourishment interval is five years.

Shoreline change rate estimates have been relatively low in the region north of St. Augustine Inlet. The beaches there are generally steep with a high broken shell content. The inlet strongly influences the beaches on both sides. South of the inlet, the beach material is primarily fine grain quartz sand, resulting in a relatively flat active beach profile, with significant dunes where conditions are favorable. There is a high erosion zone extending from about R-131 to about R-150, which may expand over time. Beyond this zone, the beaches have generally been accretionary southward to Matanzas Inlet, with the exception of a small adjacent area of fluctuations. From Matanzas Inlet to the St. Johns-Flagler county line, there is a zone of significant armoring followed by a moderately erosive pocket beach subject to breaching and overwash during storms.

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 beach 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

St. Johns County is located in northeast Florida, spanning approximately 41.3 mi (66.5 km) of coastline (Figure 1). Two inlets exist along the Atlantic coast of this county: St Augustine and Matanzas. The former is maintained by the U. S. Army Corps of Engineers and has north and south jetties. Matanzas Inlet is not a maintained navigational inlet and has no jetties.

Many small communities lie along the St. Johns County's coast. They are primarily residential with St. Augustine Beach being the largest and most commercial. There are three main public park segments: Guana River State Park in the north central portion of the county, Anastasia State Recreational Area on the south side of St. Augustine Inlet, and Ft. Matanzas National Monument along the north shore of Matanzas Inlet.

There are 209 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.

3.2 Coastal Setting

3.2.1 Waves and Tides

Tides for this area are semidiurnal. The mean tide range is 4.6 ft (1.4 m), with a spring tide range of 5.2 ft (1.6 m) (National Ocean Service–NOAA, 1988).

The mean significant wave height for 59 ft (18 m) depth offshore of St. Johns County is 3.5-4.0 ft (1.1-1.2 m) (USACE, 1998). The dominant wave direction is out of the northeast, which corresponds to the dominant winter wind direction.

During the winter months, waves for north Florida have a dominant direction out of the northeast with higher wave heights and longer wave periods. In the summer months, however, waves approach mainly from the southeast, having relatively smaller wave heights and a combination of shorter and longer periods, except during periods of hurricane activity. Wave energy in the St. Johns County area is moderate.

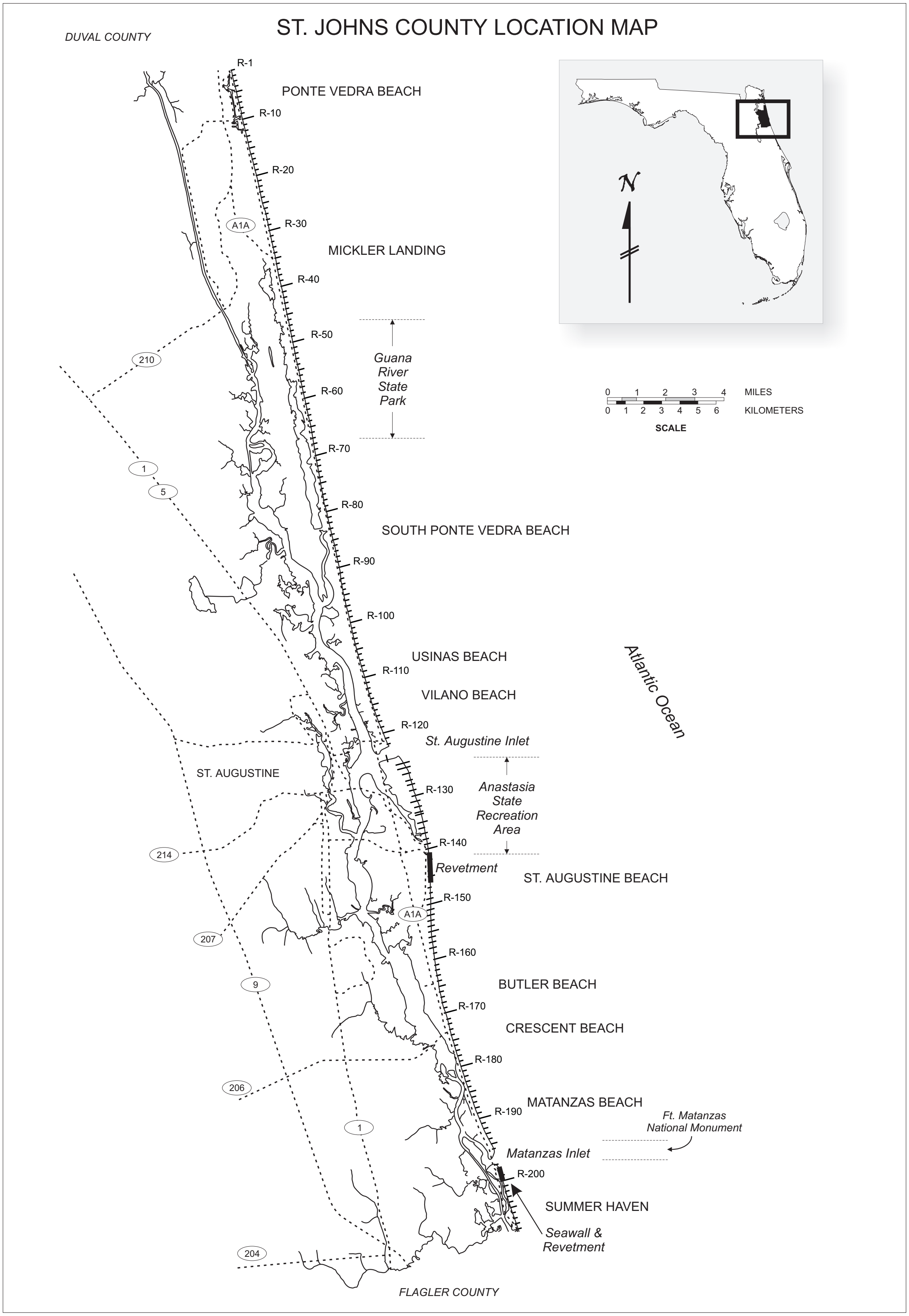

Figure 1. Study area showing St. Johns County, Florida.

3.2.2 Longshore Transport

The direction of net littoral transport is from north to south. Strong evidence for this exists in the north shore deposition patterns inside the inlets and the ebb shoal patterns outside the two inlets. There are several widely differing estimates of net longshore sediment transport, ranging from about 147,000 yd^3/yr (112,000 m^3/yr) to 440,000 yd^3/yr (336,000 m^3/yr) (USACE, 1990; Dean and O'Brien, 1987).

It is notable that there are distinct and important variations in sand type across St. Johns County. At the north end, the sediment transitions from the finer and whiter, predominantly quartz sand of Duval County, at least in part a result of decades of large scale nourishment projects, to a much coarser mixture of crushed shell hash and quartz sand, which continues south to St. Augustine Inlet. Between St. Augustine Inlet and Matanzas Inlet, fine white quartz dominates again, absent of any significant shell hash component. The sand on this island is fine enough to have established a long tradition of beach driving. South of Matanzas Inlet, there is a rapid transition from the material naturally bypassed across the inlet's ebb tidal shoal and deposited on the immediately adjacent south shoreline to a much coarser shell hash which continues through all of Flagler County into northern Volusia County.

In the described locations where the sand is mostly composed of fine quartz, the beach profile shape is very flat. In contrast, in locations where the sand is a mixture of quartz and shell hash, the profile is relatively steep. Evidence for preferential transport of the finer materials across the county from north to south is considerable and can be seen in northern St. Johns County's dunes formed by the wind, in the sand that has accumulated within, and on the north side of St. Augustine Inlet (to be discussed later), and where the outside bypassing shoals of both inlets deposit fine sand back onto the beach on the southern adjacent shores. It is believed that both a high degree of biological activity and the breakdown of extensive nearshore coquina and beachrock outcrops are contributing to the abundant shell supply in the shelly areas.

3.2.3 Storms

There have been numerous hurricanes and northeaster storms that have affected northeast Florida (USACE, 1998). A total of eleven hurricanes have passed through the St. Johns County area over the last century, along with numerous northeasters. Hurricane Dora in 1964, and northeasters in the 1960's and in November 1984 were probably the most intense in recent history. In general, winter storms or northeasters are thought to have a greater impact on shoreline change than hurricanes in this county because these winter storms occur with greater frequency and can remain in the area for longer periods of time. This could change during periods of intense Atlantic hurricane activity, such as occurred in the 1999 season. 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, the coastal process and erosion pattern can be permanently changed by a storm.

3.3 Inlets

3.3.1 St. Augustine Inlet

In its natural state, St. Augustine Inlet was at times over two miles wide, having several primary channels (USACE, 1990; FDEP Historic Shoreline Database). There was apparently frequent shifting and shoaling of its channels. In order to improve navigability, a new inlet was dredged through the southern tip of Vilano Beach in 1940. Stabilization was effected with the construction of the north and south jetties in 1941 and 1957, respectively.

The repositioning and stabilization of the inlet forced other, less efficient channels to shoal and eventually close. Waves soon dominated the once tidally influenced channels, and the resultant shoals that had been forming were pushed shoreward (USACE, 1990). This, in conjunction with sediment derived from erosion of adjacent beaches, led to the formation of Conch Island. A large ebb-tidal delta has developed at the mouth of the new channel. The north jetty has become very porous, allowing a large accumulation of sand to gradually build up along the north interior shoreline of the inlet from west to east. Houses have been constructed along the westernmost portion of this accretion zone. Hurricane Dora in 1964 washed out much of the accumulation present at that time. One of the authors (Foster) suggests that this accumulation is a result of the inlet's attempt to migrate southward while contending with the porous north jetty.

As noted previously, prior to stabilization, old St. Augustine Inlet had a large dynamic and complex shoal and channel system. It also had a southeasterly trending ebb channel, which together with natural sand bypassing towards the south formed a succession of moving, shoal-sheltered cape-like features along the adjacent southern shoreline. One of these features is now the heavily armored St. Augustine Beach area. Since armoring began in the 1930s (USACE, 1990) and before the new inlet was cut in 1940, armoring was probably initially constructed in response to the movements of the old inlet. However, armoring (or retreat) would have been inevitable with the relocation of the inlet much farther northward.

3.3.2 Matanzas Inlet

It appears from the historic information that this inlet had a tendency to migrate southward. However, the construction of a bridge with a concrete abutment in 1925 has apparently prevented further migration in that direction (Dean and O'Brien, 1987). The bridge has been replaced at least twice since that time. There are significant beachrock exposures along the inlet's southern shoreline in the vicinity of T-197A, which may also help limit southward movement. FDEP aerial photographs clearly show sand being naturally bypassed across the inlet and southward. However, sand supply to the south has apparently been insufficient to prevent armoring along the first 4,000 feet south of the inlet.

3.4 Engineering Projects

3.4.1 Beach Nourishment

In the 1990s, there have been several relatively small beach nourishments in Anastasia State Recreational Area. In 2-6/1996, approximately 26,000 yd^3 of fill were placed between R-132 and R-141. Other fills, though not well documented, occurred between R-132 and R-141 in 1997, 1998, and 1999, with considerably larger volumes of sand. Also, in 2-6/1996, approximately 144,000 yd^3 of fill were placed between R-145 and R-149. There is a large nourishment project planned for St. Augustine Beach, from R-137 to R-150, which will span across the revetment.

In 7-8/1999, approximately 212,000 yd^3 of fill from ICW dredging were placed between R-200 and R-208, south of Matanzas Inlet, although it was barely evident any filling had occurred when inspected by the authors in March 2000.

3.4.2 Structures

The most prominent and influential coastal structure is the jetty system at St. Augustine Inlet. The north jetty was built in 1941, a year after the inlet was cut (USACE, 1990, 1979). The structure's present length is about 1,580 ft (482 m). The south jetty was completed in 1957 and is about 3,695 ft (1,126 m) in length. The north jetty has impounded a portion of the southerly littoral drift, but because both jetties are relatively short and porous, a significant amount of littoral sediment also travels around and through the jetties.

At St. Augustine Beach, seawall armoring began in the 1930s and revetment armoring continued until the mid-1970s (USACE, 1990). FDEP aerial photographs of 1986 show approximately 4,900 feet of massive granite revetment between R-141 and R-145.5, and approximately another 800 feet of lower, more porous revetment between R-145.5 and R-146.5. The exact timing and sequencing of the various armoring additions is unclear. Major additions and repairs did occur after 1962 and 1964 storms, and in 1973. It is apparent that armoring spread southward over time, as would be expected, and that repairs were needed after all major storms.

In the north corner of the St. Augustine Beach revetment, between R-139 and R-141, there have been several mostly unsuccessful attempts to use various types of armoring and debris placements to control the erosion problem. Consequently, Highway A1A had to be re-routed away from this area.

Along Ponte Vedra Beach, to the north of St. Augustine Inlet, seawall armoring also began in the 1930s, with miscellaneous additions including revetments through at least the early 1970s. Almost all of this is normally buried but parts are occassionally exposed during periods of severe storms.

Approximately 1,800 feet of granite revetment was built in 1963 between R-198 and R-200 in Summer Haven, and has been repaired numerous times. The shoreline between R-197 and R-198 contains miscellaneous armoring of uncertain date, normally fronted by a beach deposited by the Matanzas Inlet bypassing ebb shoal system.

3.4.3 Dredging

St. Augustine Inlet was dredged almost annually in the 1970s, but only once in the 1980s, in 1986 (USACE, 1990). Through 1976 the sand was sidecast or disposed of offshore. From 1978 to 1986, there was nearshore disposal via hopper dredge in sites opposite the St. Augustine Beach revetment. As of March 1990, 1.3 million yd^3 have been dredged from the inlet channel. Approximately 480,000 yd^3 of this were placed in the nearshore zones. Dredging also occurred from 1996 to 1999, with disposal primarily in Anastasia State Recreational Area, and also south of the revetment in 1996.

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

Shoreline (MHW) change rate estimates are provided in Figures 2 and 4 and Table A-1 (Appendix A). These estimates are intended to reflect pre-nourishment conditions where such projects exist and otherwise reflect current averaged conditions. For each area, approximately linear time segments were identified in the distance versus time "stack" plots, as shown in Appendix B, consistent with observed primary coastal processes. Rate estimates were calculated for the selected, approximately linear time segments.

5.1 Northern Area

The northern part of St. Johns County is dominated by the presence of St. Augustine Inlet at the southern end and a long and relatively significant headland feature extending from about R-15 to R-75, as can be seen in Figures 2 and 3. The latter is associated with submerged coquina and/or beachrock outcrops in the nearshore zone, which are believed to provide at least a portion of the shell hash observed in the beach sediment throughout the entire area. A fresher shell component may derive from active shellfish populations possibly associated with the outcrops habitat. The shoreline along the headland feature has been relatively stable.

The zone between the inlet and the headland has been progressively erosive from south to north, with the highest erosion at -1.5 ft/yr. It is believed by one of the authors (Foster) that this pattern is a response to the refraction of waves from the southeast around the inlet ebb shoals. It is not clear at this time what effect mining the ebb shoals for a renourishment project may have on the wave refraction pattern and the corresponding erosion pattern.

There is a small magnitude erosion zone, averaging -0.5 to -1.0 ft/yr, along the northern face of the headland feature. Although the cause of this is as yet unknown, it does not appear to be a serious problem, given the abundance of sand supply drifting south from nourishment projects in adjacent Duval County. Figure 2 contains a fitted curve to the rate data to help clarify this erosion pattern.

5.2 Central and Southern Areas

The shoreline change rates for this portion of St. Johns County are plotted in Figure 4 and a plan view map is shown in Figure 5. The dominant features of note are the two inlets, St. Augustine and Matanzas, and the major armored area on St. Augustine Beach.

Starting from the north and progressing southward, there is first a zone (R-124 to R-126) adjacent to St. Augustine Inlet that has been experiencing fairly extreme fluctuations over the past two decades. Rate estimates in this area simply represent the trend of the fluctuations in recent times. A bulbous shape has built up over time in this area but now fluctuates because it is in the shelter of randomly changing ebb shoals (Figure 5).

From R-127 to R-140, there is a pocket beach between the bulbous shoal protected area and the heavily armored and seaward protruding area to the south. This pocket has experienced over the last three decades an accretion trend in its northern reaches (R-127 to R-130) and erosion to the south (R-130 to R-140). The latter erosional area averages as high as -12 ft/yr but at individual locations is as high as -17 ft/yr.

Across the St. Augustine Beach revetment there has been negligible MHW change since it was built because the MHW is at the base of the rocks. Instead, the rates given for this area (R-141 to R-145) are estimates of the erosion prior to the armoring construction. Since available data is very limited and is affected by armoring anyway (by the use of 1972 data), these rates are most likely too small, even though they range between -24.0 and -8.0 ft/yr. As this armored area has become increasingly exposed to wave energy over the years while adjacent beaches have retreated and evolved, the erosion potential is probably several times greater now.

South of the revetment (R-146 to R-150) erosion has developed as would be expected downdrift of a partial littoral barrier, with rates of -6.5 to -1.0 ft/yr. Left unmanaged, this problem area will expand and worsen over time. At least one significant renourishment occurred here in 1996.

South of the current revetment's zone of influence, it has been all accretionary south to the vicinity of Matanzas Inlet. At R-195 and R-196, there have been significant fluctuations most likely associated with inlet shoaling changes. The most recent trend at R-195 has been erosive, with rate estimates approximating -5.0 ft/yr.

It was previously mentioned that armoring and shoal bypassing zones currently exist on the south side of Matanzas Inlet. In the zone where shoaling deposits material onto the beach, between R-197, T-197A, and R-198, there are large beach width fluctuations. The rates for these reference points reflect the trend of the fluctuations over the past three decades. At R-199, there is a large rock revetment which ends at R-200. MHW erosion here has been halted by the revetment, and the rate given for R-199 is a pre-armoring estimate.

Rates on the order of -1.5 to -2.0 ft/yr in the pocket beach between two armored areas (R-200 and R-209) represent that trend over the past three decades. The area between R-200 and R-202 has a tendency to be overwashed and breached during storms. There have been several relatively small-volume sand fill placements to restore pre-storm elevations. As previously mentioned, a large beach fill in 7-8/1999, using sand from ICW dredging, eroded rapidly, probably as a result of fall and winter storms.

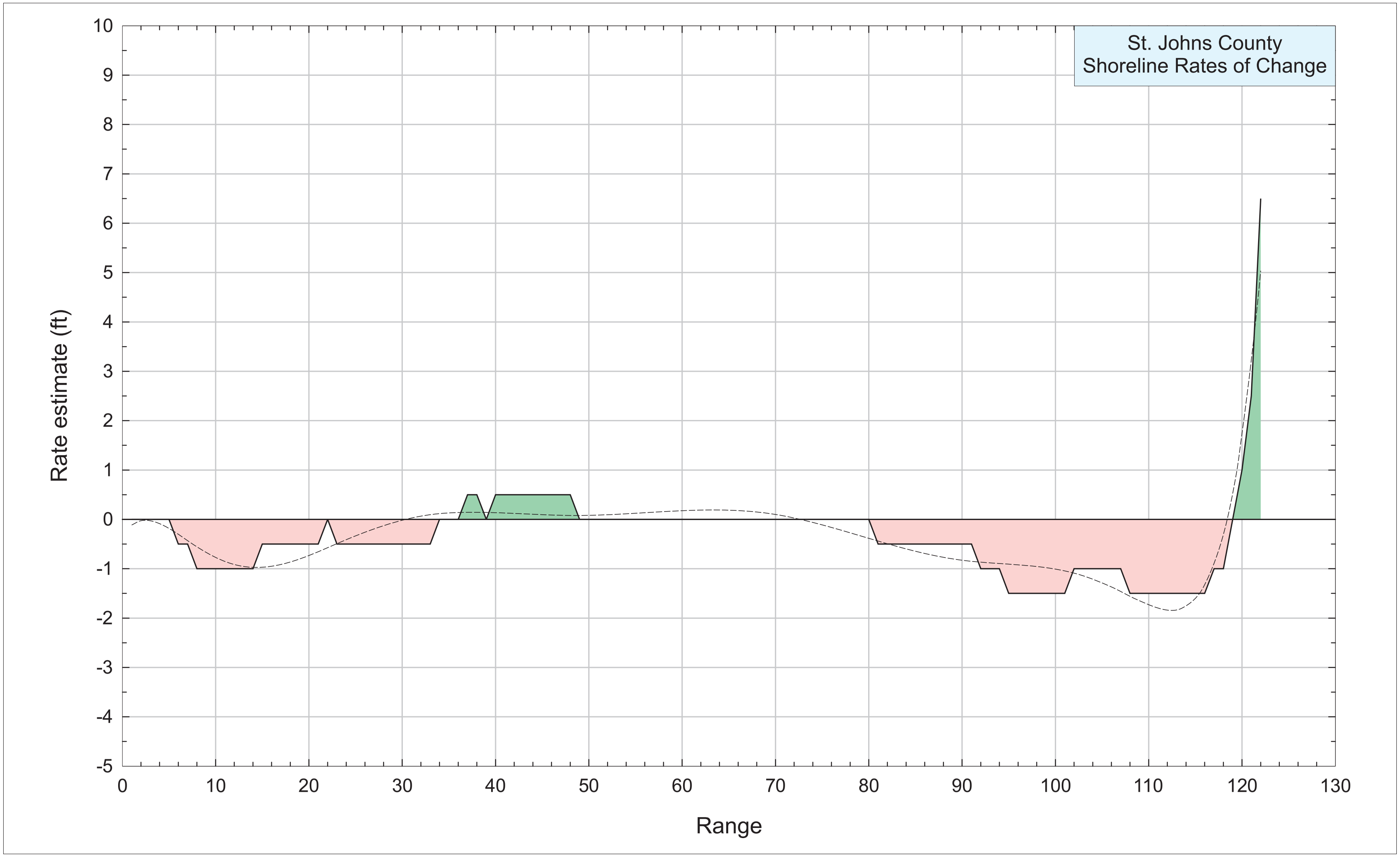

Figure 2. Shoreline rate of change estimates for St. Johns County, Florida (north).

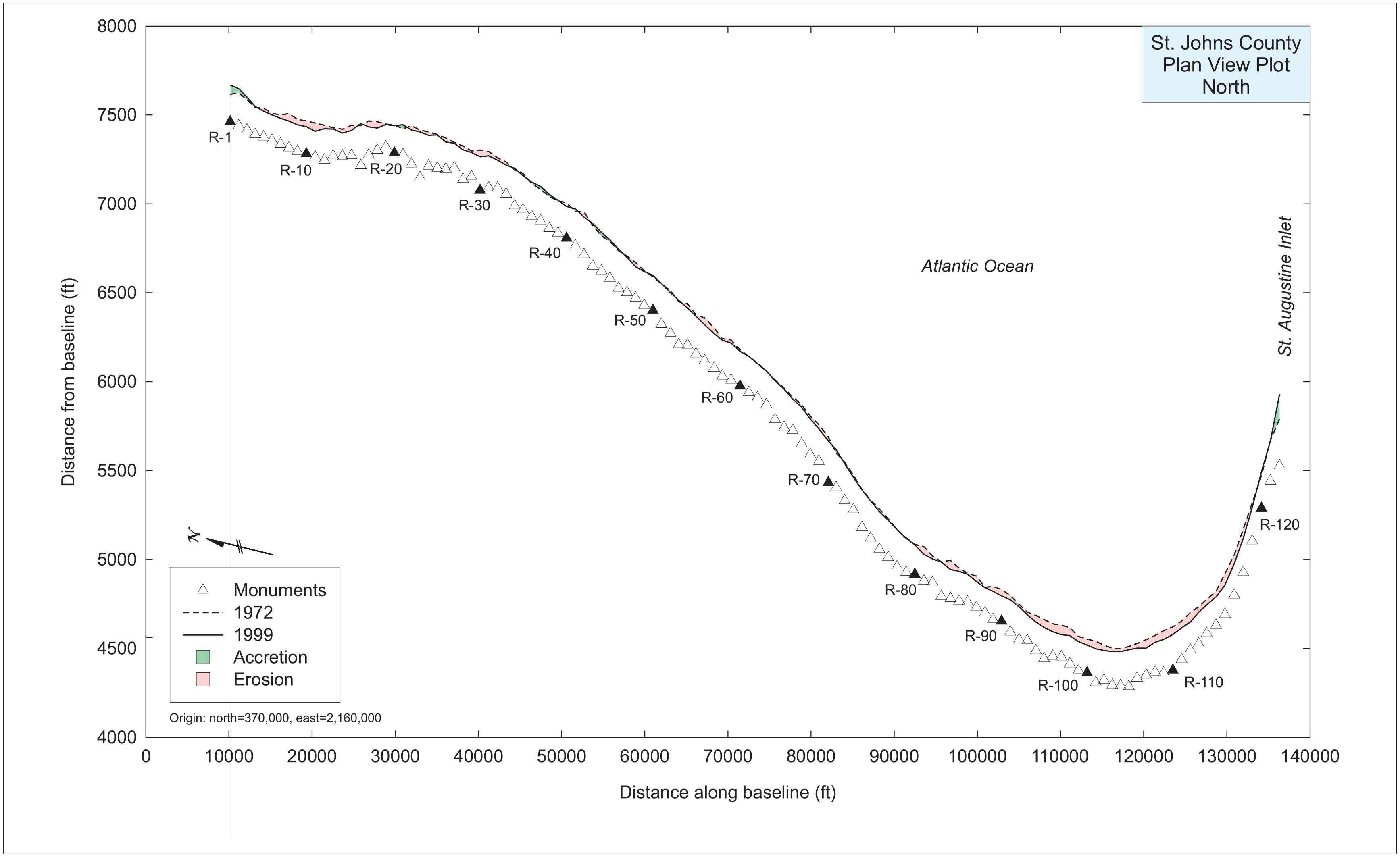

Figure 3. Plan view map of St. Johns County, Florida (north), comparing years 1972, and 1999.

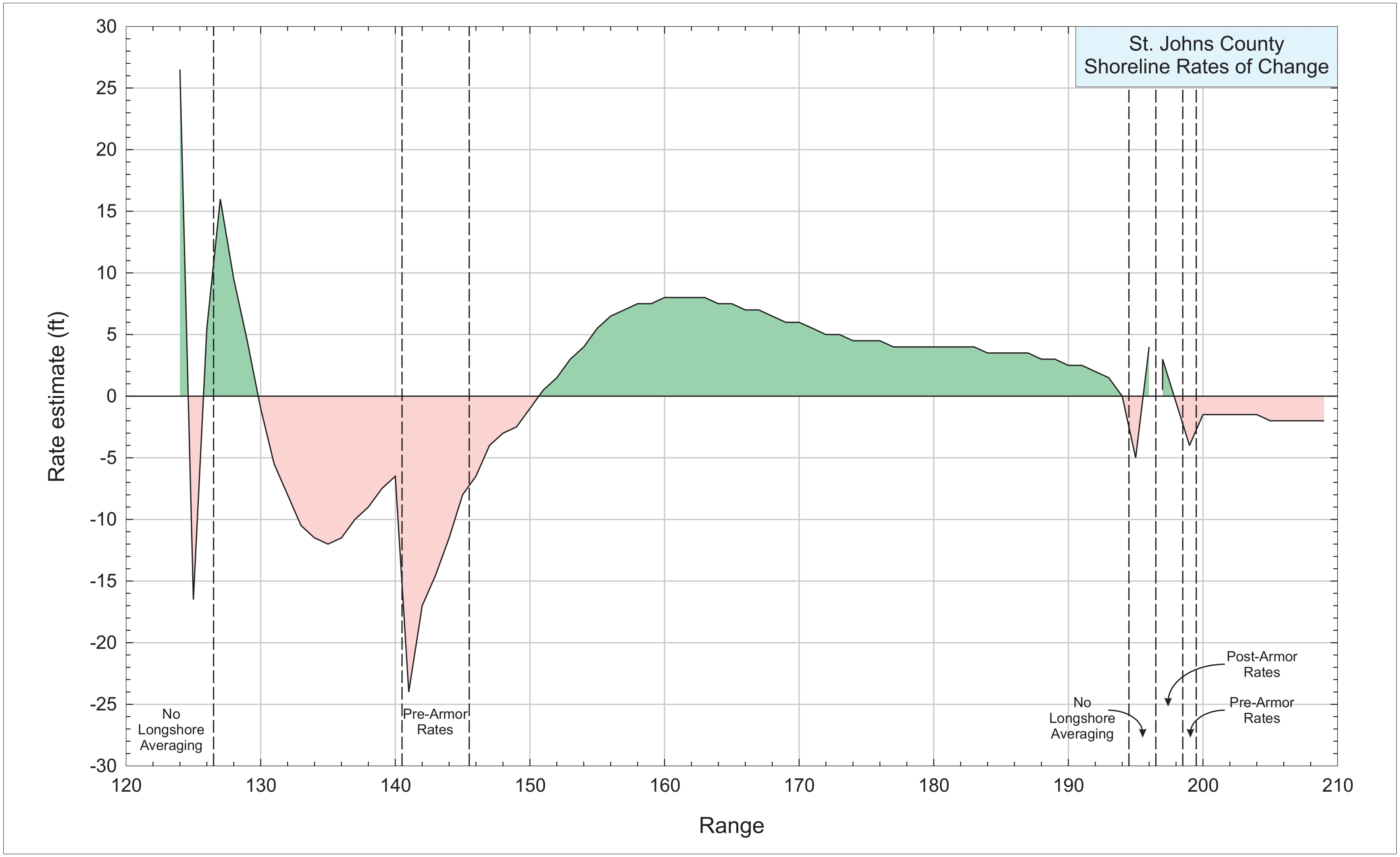

Figure 4. Shoreline rate of change estimates for St. Johns County, Florida (south).

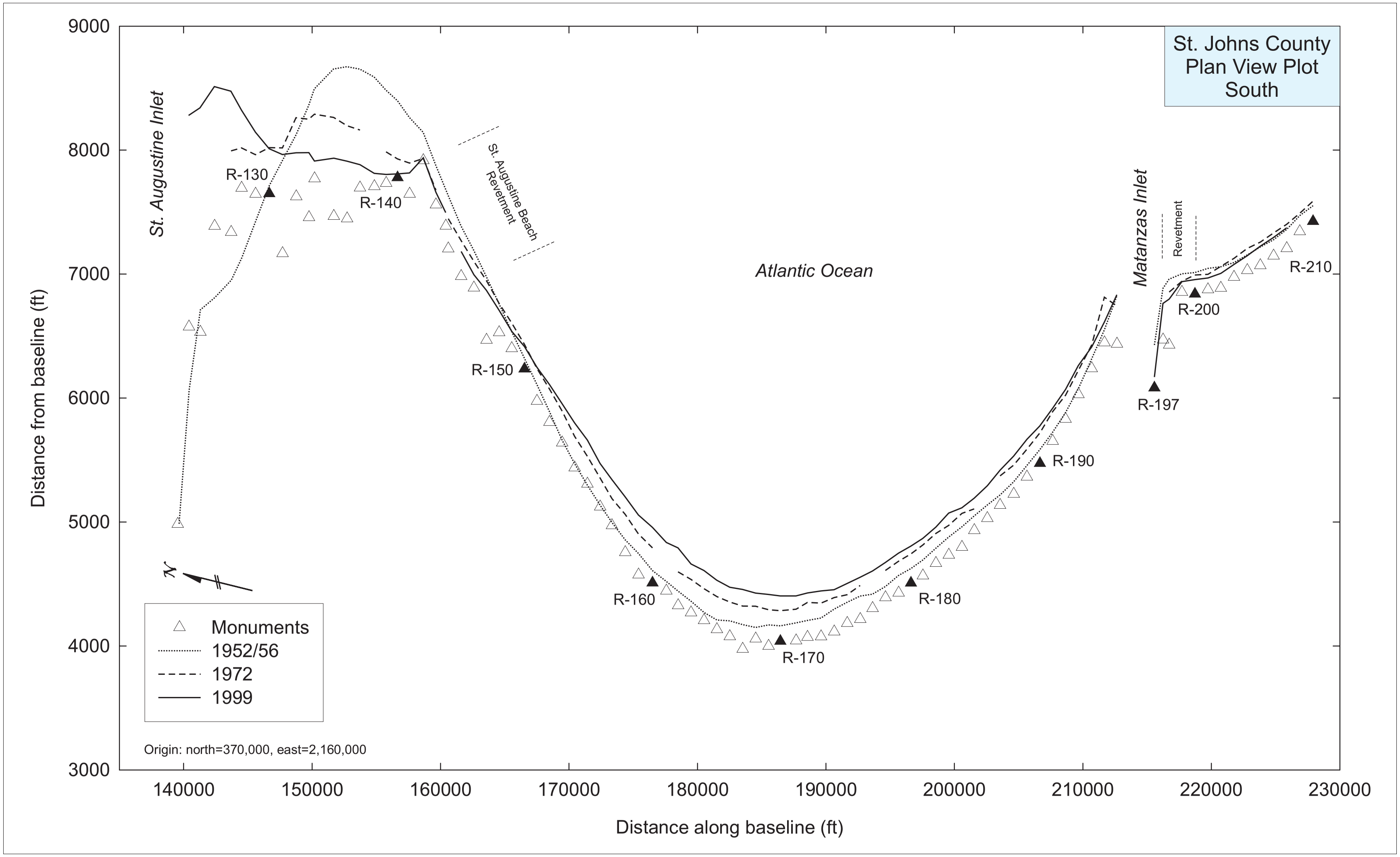

Figure 5. Plan view map of St. Johns County, Florida (south), comparing years 1952/56, 1972, and 1999.

6 SUMMARY

The shoreline north of St. Augustine Inlet can be characterized as midly erosional to stable, with rates of -1.5 to +0.5 ft/yr. South of St. Augustine Inlet, rates of erosion are higher, reaching -24 ft/yr. Erosive conditions extend from the inlet to approximately R-151; however, the erosional limit appears to have progressed southward historically and may continue to do so into the foreseeable future. From approximately R-151 to just north of Matanzas Inlet, conditions are largely accretional with rates between 0.0 and 8.0 ft/yr. However, nearest the north side of the inlet and south of the inlet, there is a significant amount of erosion, with rates between -5.0 and -1.5 ft/yr.

It is recommended for planning purposes that a minimum level of erosion of -1 ft/yr be assumed for all stable, accreting, or lesser eroding areas, as a conservative practice. There are simply too many unknowns about future conditions, such as sea level rise, to assume otherwise.

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8 APPENDICES

8.1 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 St. Johns County, Florida.

Range	Time span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
1	1858-1958	0.0	-0.5	0.0	0.0	
2	1858-1958	0.0	-0.3	0.0	0.0	3 pt average
3	1858-1963/64	0.2	0.1	0.2	0.0	5 pt average
4	1972-1999	0.2	1.0	0.2	0.0	7 pt average
5	1972-1999	-0.6	0.3	-0.6	0.0	↓
6	1972-1999	-0.3	0.0	-0.3	-0.5	
7	1972-1999	-0.7	0.3	-0.7	-0.5	
8	1972-1999	-1.5	-0.8	-1.6	-1.0	
9	1972-1999	-1.0	-0.4	-1.1	-1.0	
10	1972-1999	-1.2	-1.0	-1.2	-1.0	
11	1972-1999	-1.9	-2.1	-1.7	-1.0	
12	1972-1999	-0.9	-0.8	-0.8	-1.0	
13	1972-1999	-0.3	-0.2	-0.3	-1.0	
14	1972-1999	-0.9	-0.6	-0.9	-1.0	
15	1972-1999	-0.8	-0.4	-1.1	-0.5	
16	1972-1999	0.4	0.4	0.4	-0.5	
17	1972-1999	-1.2	-1.2	-1.2	-0.5	
18	1972-1999	-1.0	-0.5	-1.3	-0.5	
19	1972-1999	-0.1	-0.5	-0.1	-0.5	
20	1972-1999	-0.2	-0.5	-0.2	-0.5	
21	1972-1999	1.2	0.5	0.9	-0.5	
22	1972-1999	-0.9	-1.2	-0.9	0.0	
23	1972-1999	-0.4	-0.5	-0.4	-0.5	
24	1972-1999	-0.1	-0.5	-0.7	-0.5	
25	1972-1999	-0.1	0.3	-0.1	-0.5	
26	1972-1999	-0.8	-0.8	-0.8	-0.5	
27	1972-1999	-0.2	-0.4	-0.2	-0.5	
28	1972-1999	-0.8	-1.1	-0.8	-0.5	
29	1972-1999	-0.3	-0.2	-0.3	-0.5	
30	1972-1999	-1.4	-1.2	-1.4	-0.5	
31	1972-1999	-0.9	-1.2	-0.9	-0.5	
32	1972-1999	-0.5	0.0	-0.5	-0.5	
33	1972-1999	-0.7	-0.2	-0.7	-0.5	
34	1972-1999	0.3	0.2	0.3	0.0	
35	1972-1999	-0.5	-0.1	-0.5	0.0	
36	1972-1999	0.3	0.8	0.3	0.0	

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

Range	Time span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
37	1972-1999	0.6	1.3	0.6	0.5	
38	1972-1999	0.4	0.8	0.4	0.5	
39	1972-1999	0.1	0.9	0.1	0.0	
40	1972-1999	-0.8	0.6	-0.8	0.5	
41	1972-1999	0.6	0.4	0.6	0.5	
42	1972-1999	-1.2	-0.1	-1.1	0.5	
43	1972-1999	0.4	1.4	0.4	0.5	
44	1972-1999	0.7	1.6	0.7	0.5	
45	1972-1999	0.4	1.5	0.4	0.5	
46	1972-1999	0.4	0.5	0.4	0.5	
47	1972-1999	-0.3	0.6	-0.3	0.5	
48	1972-1999	-0.2	0.7	-0.9	0.5	
49	1972-1999	-0.2	0.4	-0.2	0.0	
50	1972-1999	0.3	1.5	0.3	0.0	
51	1972-1999	0.1	1.0	0.1	0.0	
52	1972-1999	-0.4	0.1	-0.4	0.0	
53	1972-1999	0.3	0.2	0.3	0.0	
54	1972-1999	-0.4	0.8	-0.9	0.0	
55	1972-1999	-0.3	0.7	-0.3	0.0	
56	1972-1999	-1.3	-0.3	-1.4	0.0	
57	1972-1999	-0.9	0.5	-1.2	0.0	
58	1972-1999	-0.3	0.7	-0.3	0.0	
59	1972-1999	-0.7	0.7	-0.7	0.0	
60	1972-1999	-0.3	1.7	-0.3	0.0	
61	1972-1999	0.1	1.0	0.1	0.0	
62	1972-1999	-0.1	0.8	-0.1	0.0	
63	1972-1999	0.0	1.6	0.0	0.0	
64	1972-1999	-0.2	1.3	-0.2	0.0	
65	1972-1999	-0.2	0.7	-0.2	0.0	
66	1972-1999	-0.5	0.4	-0.5	0.0	
67	1972-1999	-0.5	0.1	-0.5	0.0	
68	1972-1999	-0.6	-0.4	-0.6	0.0	
69	1972-1999	-0.8	-0.4	-0.8	0.0	
70	1972-1999	-0.9	0.1	-0.9	0.0	
71	1972-1999	0.7	1.0	0.7	0.0	
72	1972-1999	-0.3	0.7	-0.3	0.0	

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

Range	Time span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
73	1972-1999	-0.5	0.3	-0.5	0.0	
74	1972-1999	-0.1	0.7	-0.1	0.0	
75	1972-1999	-0.1	0.9	-0.1	0.0	
76	1972-1999	-0.5	0.5	-0.5	0.0	
77	1972-1999	-0.3	0.6	-0.3	0.0	
78	1972-1999	0.0	1.4	0.0	0.0	
79	1972-1999	-0.1	0.7	-0.1	0.0	
80	1972-1999	-0.1	0.4	-0.1	0.0	
81	1972-1999	-1.4	-0.8	-1.6	-0.5	
82	1972-1999	-0.6	-0.4	-0.6	-0.5	
83	1972-1999	0.0	-0.1	0.0	-0.5	
84	1972-1999	0.1	-0.3	-1.9	-0.5	
85	1972-1999	-0.7	-0.8	-0.7	-0.5	
86	1972-1999	-0.2	-0.3	-0.2	-0.5	
87	1972-1999	-0.8	-0.7	-1.1	-0.5	
88	1972-1999	-0.1	-0.1	-0.1	-0.5	
89	1972-1999	-0.4	-0.9	-1.0	-0.5	
90	1972-1999	-1.3	-1.1	-1.3	-0.5	
91	1972-1999	-0.9	-0.6	-0.9	-0.5	
92	1972-1999	-0.5	0.1	-0.5	-1.0	
93	1972-1999	-0.5	-0.7	-0.5	-1.0	
94	1972-1999	-1.4	-1.0	-1.4	-1.0	
95	1972-1999	-1.3	-1.6	-1.7	-1.5	
96	1972-1999	-1.2	-1.3	-1.6	-1.5	
97	1972-1999	-1.9	-2.5	-2.0	-1.5	
98	1972-1999	-1.9	-2.0	-1.6	-1.5	
99	1972-1999	-1.1	-1.4	-1.1	-1.5	
100	1972-1999	-1.2	-2.1	-1.2	-1.5	
101	1972-1999	-2.1	-2.6	-1.6	-1.5	
102	1972-1999	-0.9	-0.5	-1.1	-1.0	
103	1972-1999	-1.1	-1.2	-0.7	-1.0	
104	1972-1999	-0.5	-0.8	-0.5	-1.0	
105	1972-1999	-0.7	-0.5	-0.7	-1.0	
106	1972-1999	-0.6	0.1	-0.9	-1.0	
107	1972-1999	-1.3	-1.5	-1.8	-1.0	
108	1972-1999	-1.3	-1.0	-1.4	-1.5	

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

Range	Time span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
109	1972-1999	-1.2	-1.4	-1.8	-1.5	
110	1972-1999	-1.9	-1.5	-1.6	-1.5	
111	1972-1999	-1.9	-2.0	-1.4	-1.5	
112	1972-1999	-2.0	-1.8	-2.0	-1.5	
113	1972-1999	-1.1	-1.0	-1.1	-1.5	
114	1972-1999	-1.0	-0.9	-1.2	-1.5	
115	1972-1999	-1.2	-1.5	-1.2	-1.5	
116	1972-1999	-2.0	-2.2	-2.4	-1.5	
117	1972-1999	-2.1	-1.7	-1.9	-1.0	
118	1972-1999	-2.1	-1.8	-1.9	-1.0	↑
119	1972-1999	-1.2	0.2	-0.9	0.0	7 pt average
120	1972-1999	2.1	1.1	0.8	1.0	5 pt average
121	1972-1999	-0.1	-0.2	-0.1	2.5	3 pt average
122	1972-1999	7.6	6.9	5.2	6.5	
St. Augustine Inlet						
124	1984-1999	N/A	34.8	18.3	26.5	no RA used
125	1984-1999	N/A	-11.2	-21.5	-16.5	no RA used
126	1984-1999	N/A	5.3	5.2	5.5	no RA used
127	1972-1995	17.1	17.3	14.3	16.0	
128	1972-1995	8.3	7.5	5.9	9.5	3 pt average
129	1972-1995	6.4	5.7	3.0	4.5	5 pt average
130	1972-1995	-1.9	-2.1	-3.4	-1.0	7 pt average
131	1972-1995	-3.7	-3.3	-3.3	-5.5	↓
132	1972-1995	-11.5	-11.6	-14.1	-8.0	
133	1972-1995	-17.1	-16.1	-14.7	-10.5	
134	1972-1995	-16.1	-15.9	-15.9	-11.5	
135	1972-1995	-9.4	-9.2	-10.2	-12.0	
136	1972-1995	-11.8	-12.2	-12.8	-11.5	↑
137	1972-1995	-9.8	-10.6	-12.4	-10.0	7 pt average
138	1973/75-1995	-5.0	-6.7	-10.7	-9.0	5 pt average
139	1972-1995	-8.4	-8.2	-8.4	-7.5	3 pt average
140	1972-1995	-6.7	-6.8	-6.5	-6.5	
141	1952/56-1972	-24.6	-24.4	-23.0	-24.0	Begin pre-armor rates
142	1952/56-1972	-14.3	-14.2	-13.1	-17.0	3 pt average
143	1952/56-1972	-14.2	-14.0	-12.5	-14.5	5 pt average

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

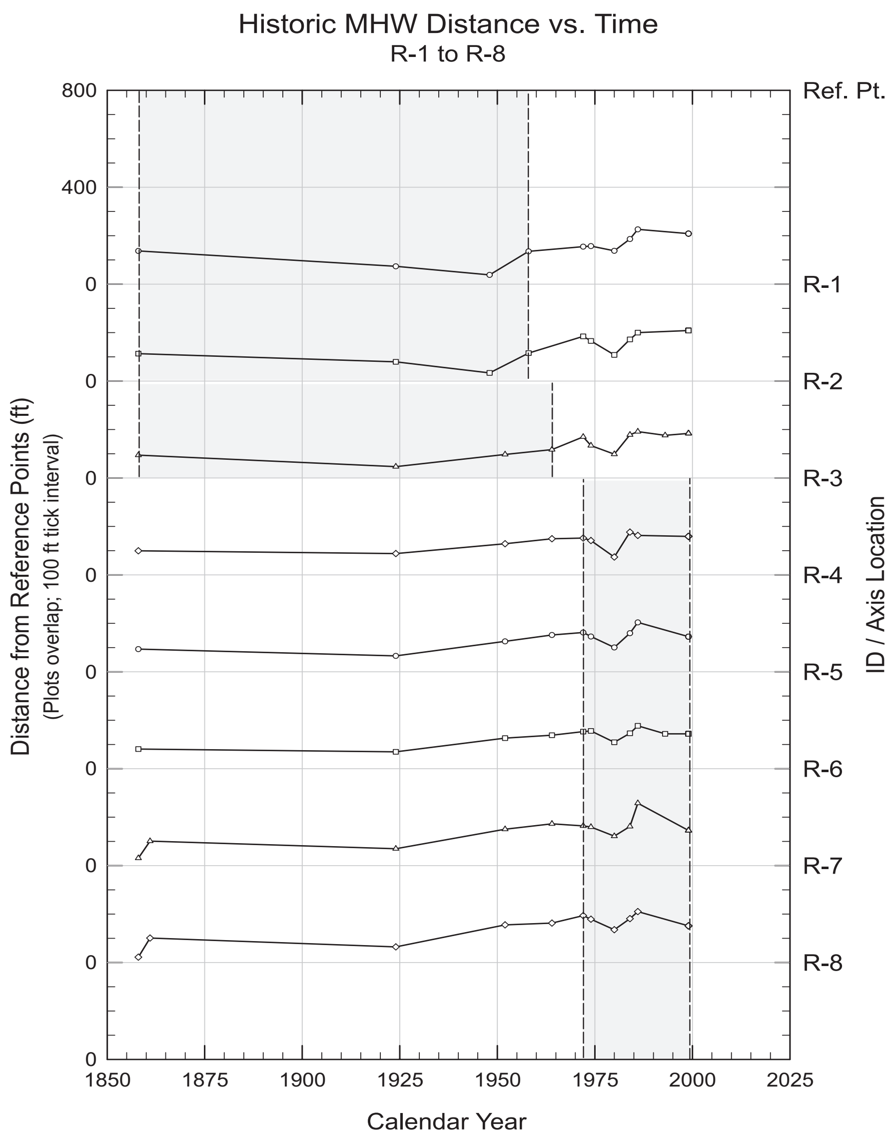
Range	Time span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
144	1952/56-1972	-12.6	-12.5	-11.7	-11.5	3 pt average
145	1952/56-1972	-8.8	-8.6	-7.3	-8.0	End pre-armor rates
146	1952/56-1995	-5.9	-6.2	-6.8	-6.5	
147	1952/56-1995	-4.0	-3.9	-5.0	-4.0	3 pt average
148	1952/56-1995	-1.7	-1.6	-1.2	-3.0	5 pt average
149	1972-1995	-2.1	-1.9	-3.2	-2.5	7 pt average
150	1972-1995	-0.1	-0.4	-3.6	-1.0	↓
151	1972-1995	-2.4	0.7	-2.6	0.5	
152	1972-1995	-0.1	1.7	-0.1	1.5	
153	1972-1999	4.9	5.1	2.2	3.0	
154	1972-1999	5.7	5.8	4.0	4.0	
155	1972-1999	7.5	7.8	4.8	5.5	
156	1972-1999	7.1	7.8	4.3	6.5	
157	1972-1999	9.7	8.2	5.7	7.0	
158	1972-1999	7.5	7.4	5.2	7.5	
159	1952/56-1999	8.4	8.1	7.2	7.5	
160	1952/56-1999	9.3	8.6	8.1	8.0	
161	1952/56-1999	8.9	7.7	7.3	8.0	
162	1952/56-1999	8.9	8.6	8.1	8.0	
163	1952/56-1999	8.5	7.8	7.0	8.0	
164	1952/56-1999	8.5	8.1	7.9	7.5	
165	1952/56-1999	7.7	8.2	7.5	7.5	
166	1952/56-1999	7.3	6.7	6.3	7.0	
167	1952/56-1999	7.5	7.0	6.6	7.0	
168	1952/56-1999	6.9	7.1	6.4	6.5	
169	1952/56-1999	6.3	5.9	5.7	6.0	
170	1952/56-1999	6.5	6.0	5.6	6.0	
171	1952/56-1999	5.4	5.6	5.1	5.5	
172	1952/56-1999	4.8	5.1	5.2	5.0	
173	1952/56-1999	5.6	5.6	5.1	5.0	
174	1952/56-1999	4.3	3.9	3.6	4.5	
175	1952/56-1999	4.5	4.4	3.5	4.5	
176	1952/56-1999	4.3	3.9	3.5	4.5	
177	1952/56-1999	4.7	4.9	4.3	4.0	
178	1952/56-1999	4.3	4.5	4.5	4.0	

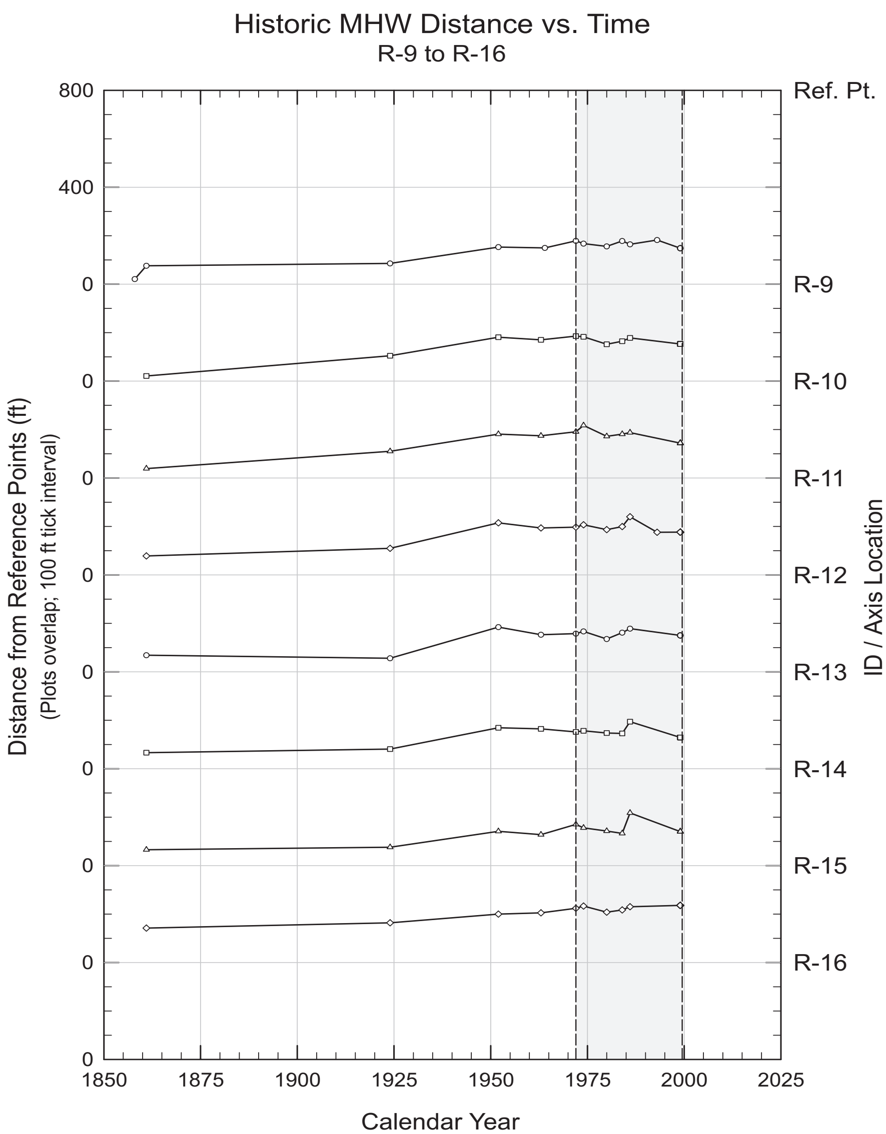
Table A-1. Shoreline change rate estimates for St. Johns County, Florida.

Range	Time span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
179	1952/56-1999	3.5	4.0	4.2	4.0	
180	1952/56-1999	4.0	4.3	4.2	4.0	
181	1952/56-1999	3.7	4.0	4.0	4.0	
182	1952/56-1999	3.2	3.7	4.0	4.0	
183	1952/56-1999	4.0	4.2	4.5	4.0	
184	1952/56-1999	3.4	3.3	3.6	3.5	
185	1952/56-1999	3.6	3.5	3.3	3.5	
186	1952/56-1999	4.2	4.3	3.6	3.5	
187	1972-1999	3.0	3.6	1.7	3.5	
188	1972-1999	3.6	3.5	2.7	3.0	
189	1972-1999	4.4	4.5	2.9	3.0	
190	1972-1999	2.2	2.8	2.1	2.5	↑
191	1972-1999	2.1	3.1	1.0	2.5	7 pt average
192	1972-1999	2.9	4.1	1.8	2.0	5 pt average
193	1972-1999	0.7	2.6	1.4	1.5	3 pt average
194	1972-1999	0.0	0.3	-0.6	0.0	
195	1972-1999	N/A	-2.1	-7.4	-5.0	no RA used
196	1972-1999	N/A	4.4	3.3	4.0	no RA used
Matanzas Inlet						
197	1973/75-1999	N/A	-0.7	1.7	0.5	no RA used
197A	1973/75-1999	N/A	2.8	3.4	3.0	no RA used
198	1972-1999	N/A	0.8	-2.1	-0.5	no RA used
199	1952/56-1972	-3.6	-3.7	-3.7	-3.5	Pre-armor rate
200	1972-1999	-1.7	-1.2	-1.4	-1.5	
201	1972-1999	-1.0	-1.0	-1.1	-1.5	3 pt average
202	1972-1999	-1.4	-1.8	-2.1	-1.5	5 pt average
203	1972-1999	-1.6	-2.1	-1.8	-1.5	7 pt average
204	1972-1999	-2.2	-2.2	-2.2	-1.5	↓
205	1972-1999	-1.8	-1.7	-1.2	-2.0	↑
206	1972-1999	-2.4	-2.1	-1.3	-2.0	7 pt average
207	1972-1999	-1.6	-2.2	-1.0	-2.0	5 pt average
208	1972-1999	-1.7	-1.5	-2.5	-2.0	3 pt average
209	1972-1999	-1.5	-2.0	-1.9	-2.0	

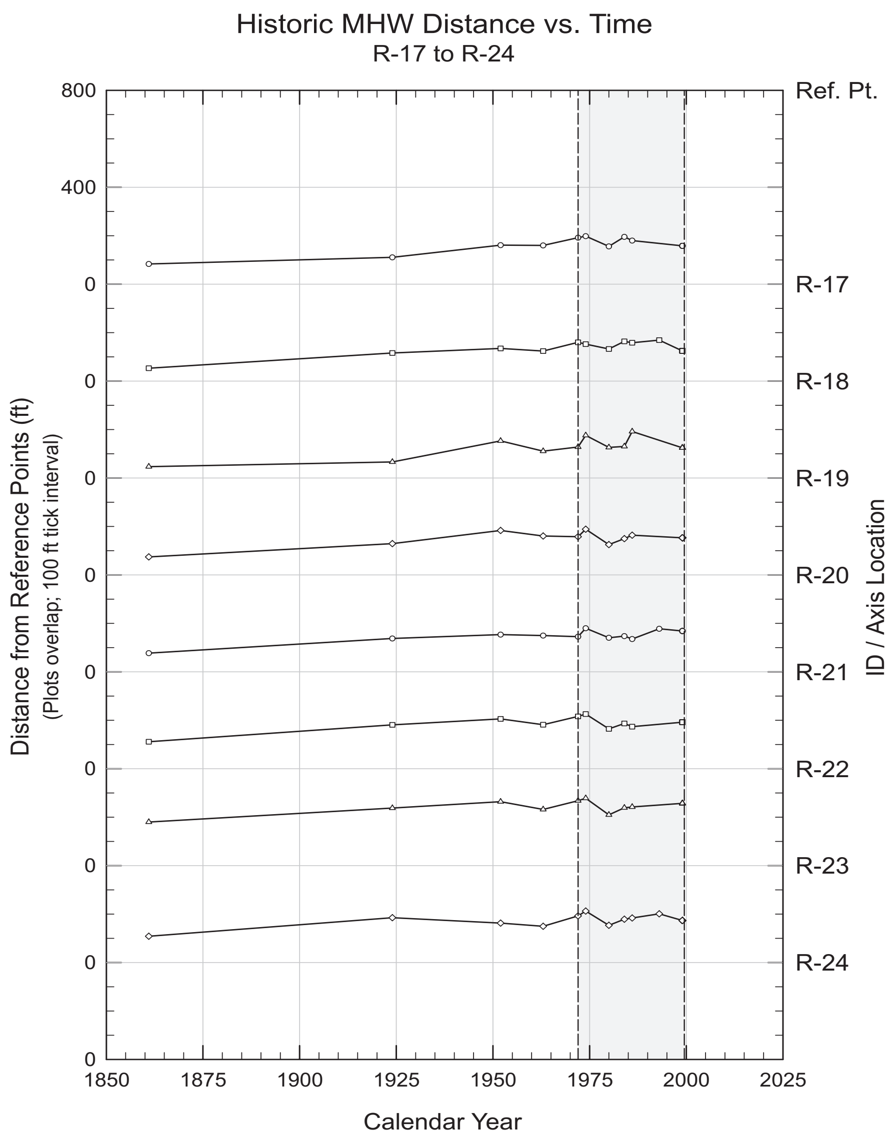
8.2 Appendix B: Stack Plots

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

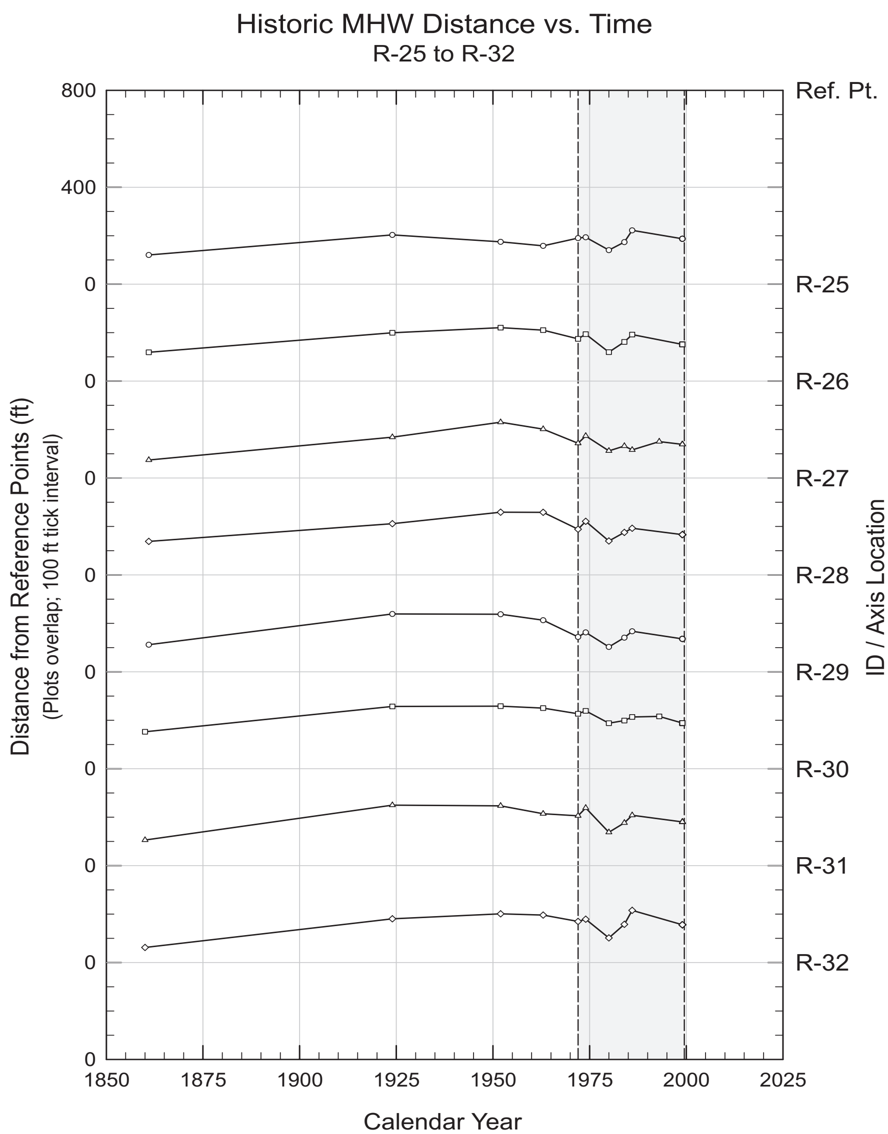

Historic MHW Distance vs. Time
R-1 to R-8
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

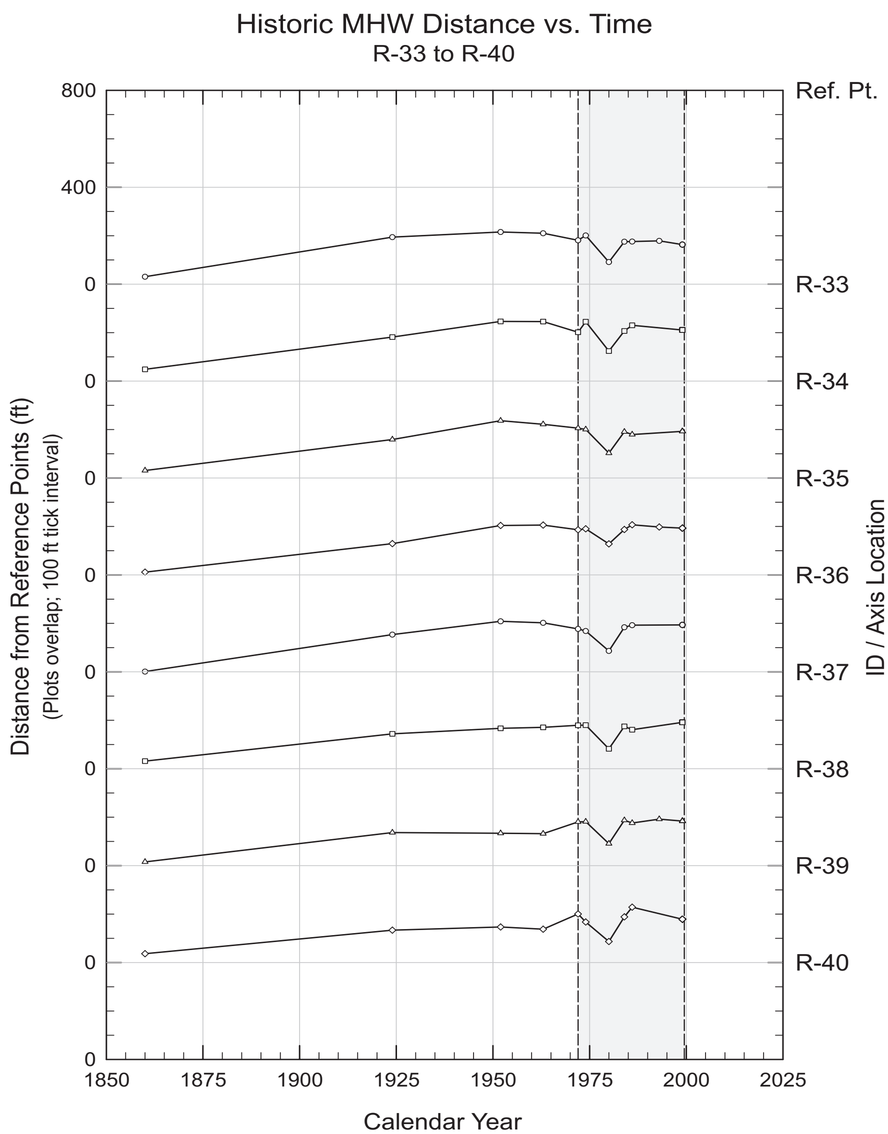


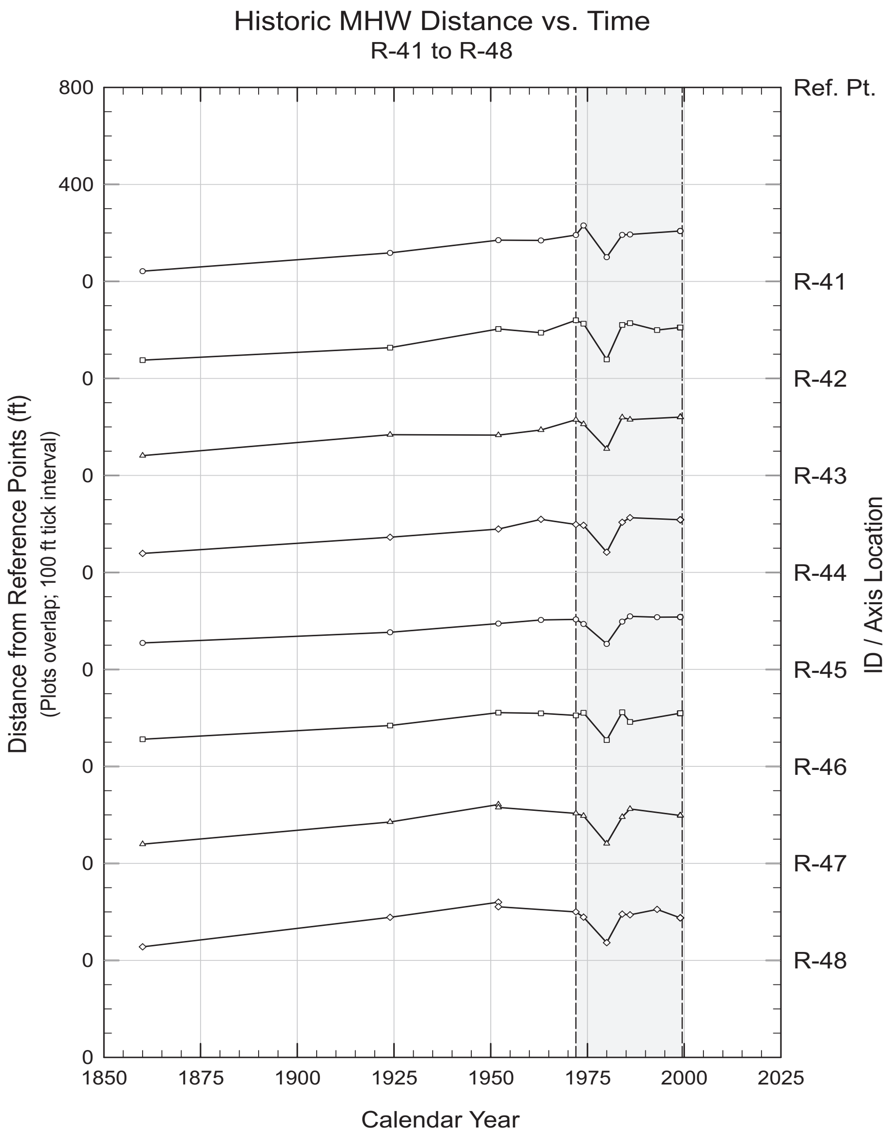
Historic MHW Distance vs. Time
R-9 to R-16
800
400
0
0
0
0
0
0
0
0
0
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. Pt.
R-9
R-10
R-11
R-12
R-13
R-14
R-15
R-16
ID / Axis Location

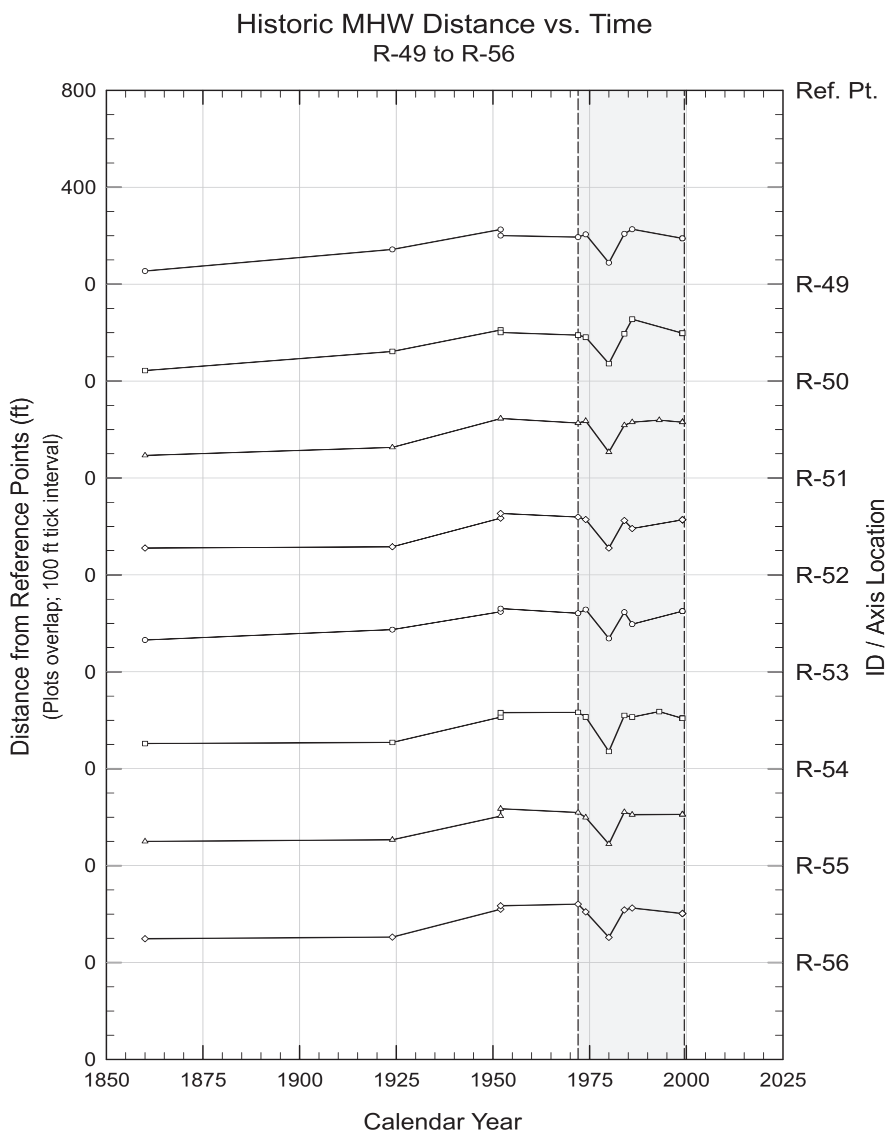


Historic MHW Distance vs. Time
R-17 to R-24
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-17
R-18
R-19
R-20
R-21
R-22
R-23
R-24
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location

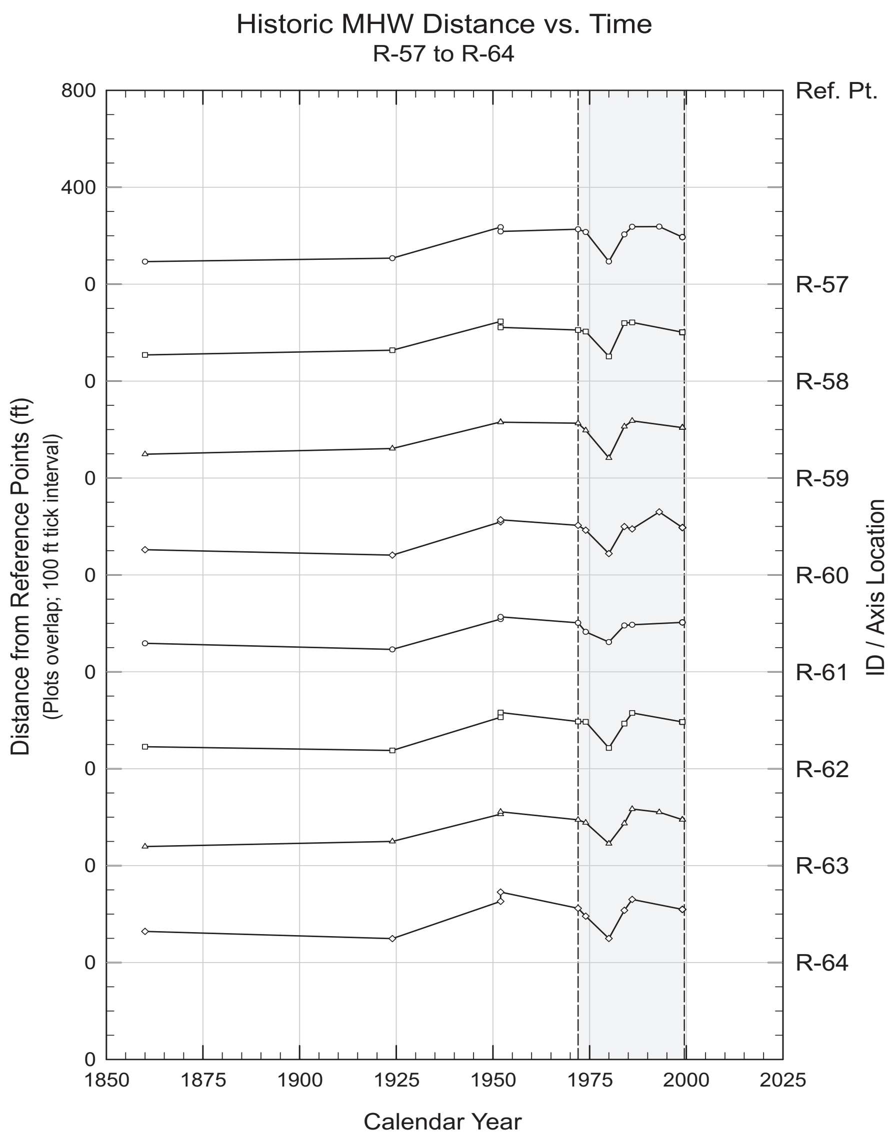

Historic MHW Distance vs. Time
R-25 to R-32
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-25
R-26
R-27
R-28
R-29
R-30
R-31
R-32
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location

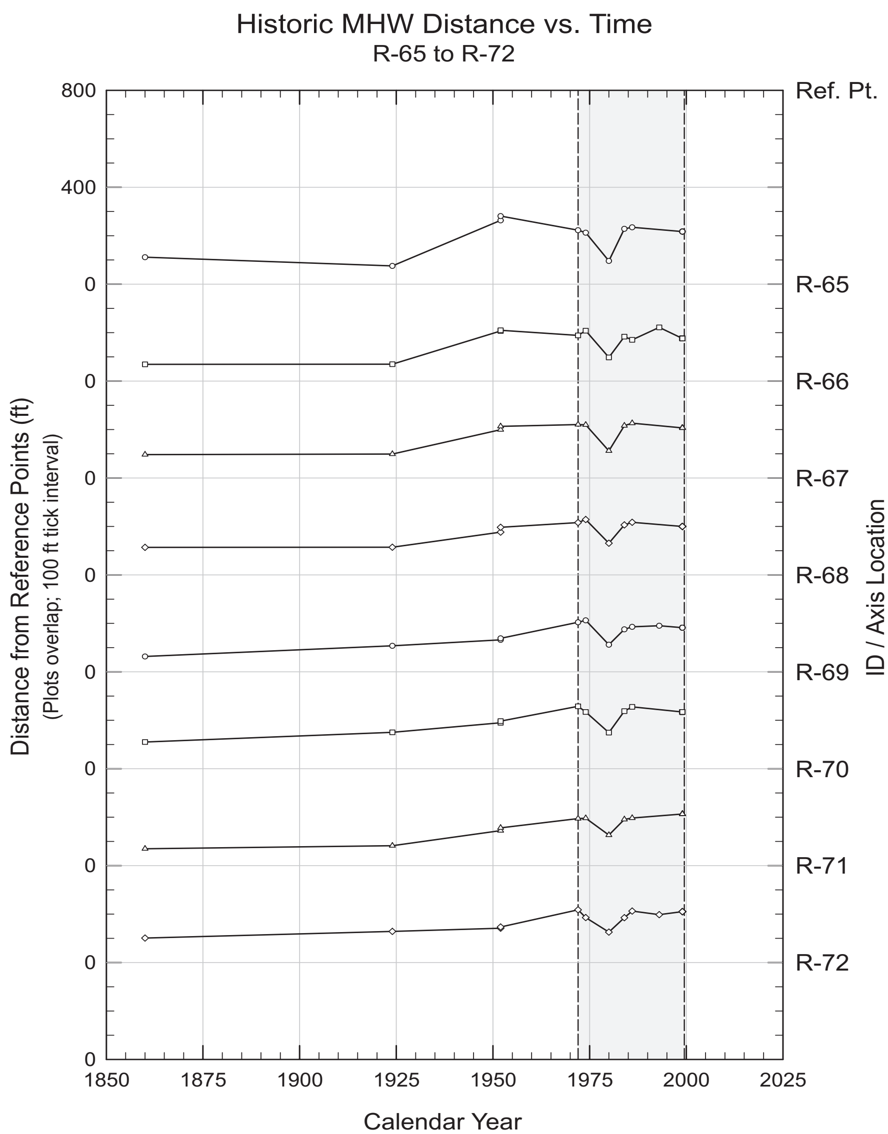

Historic MHW Distance vs. Time
R-33 to R-40
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-33
R-34
R-35
R-36
R-37
R-38
R-39
R-40
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

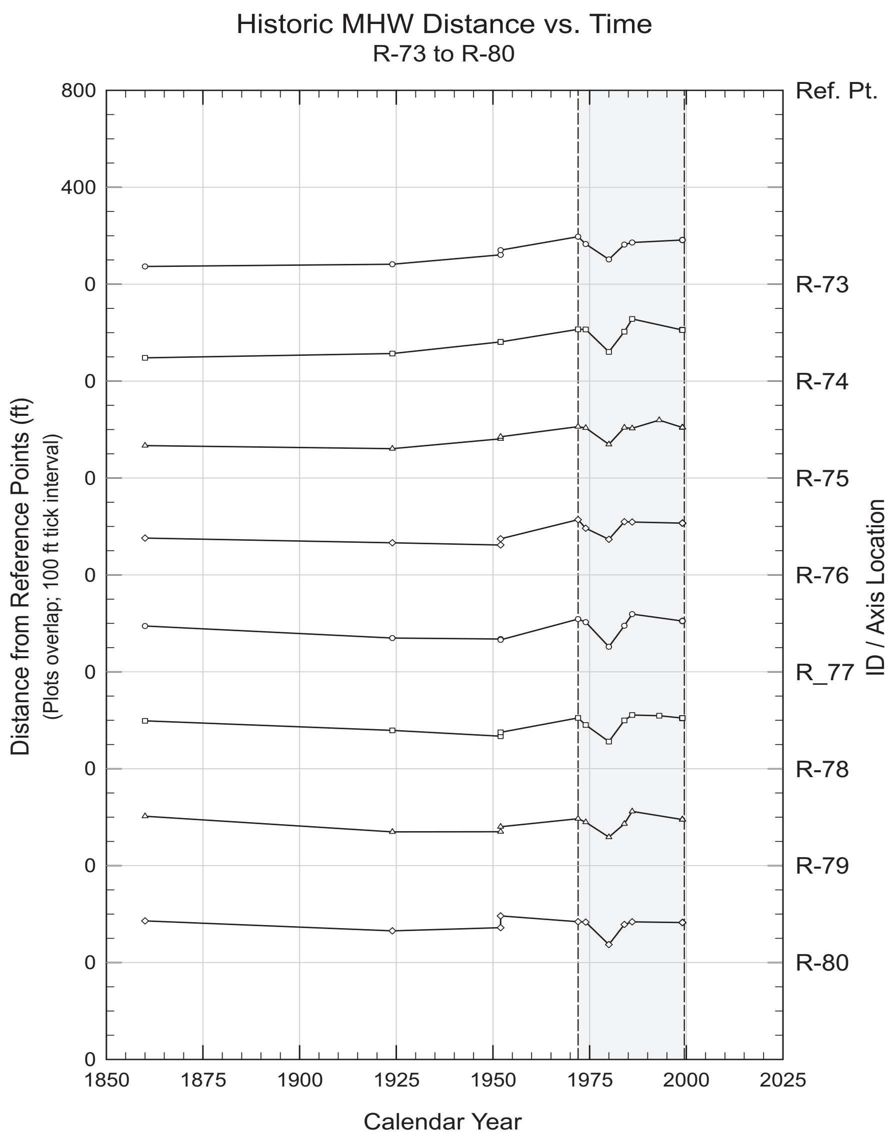

Historic MHW Distance vs. Time
R-41 to R-48
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-41
R-42
R-43
R-44
R-45
R-46
R-47
R-48
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

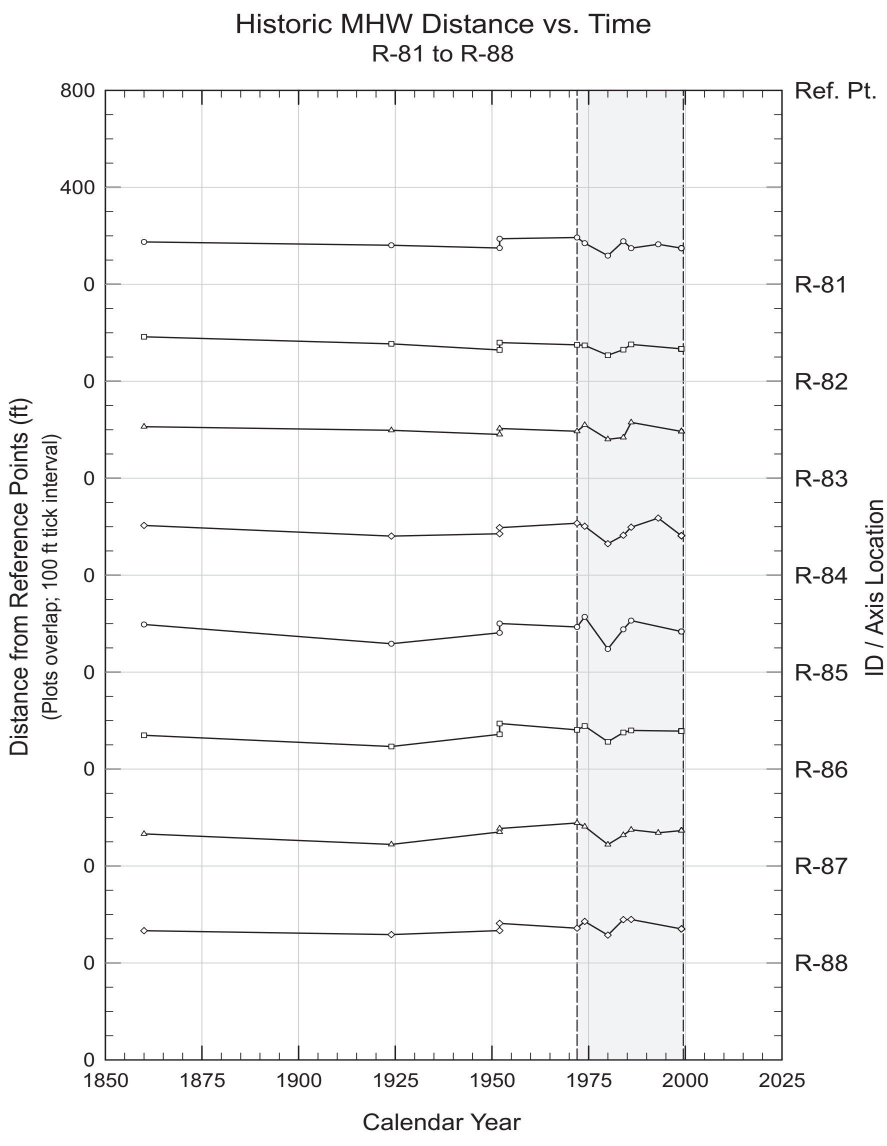


Historic MHW Distance vs. Time
R-49 to R-56
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-49
R-50
R-51
R-52
R-53
R-54
R-55
R-56
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year


Historic MHW Distance vs. Time
R-57 to R-64
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-57
R-58
R-59
R-60
R-61
R-62
R-63
R-64
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location

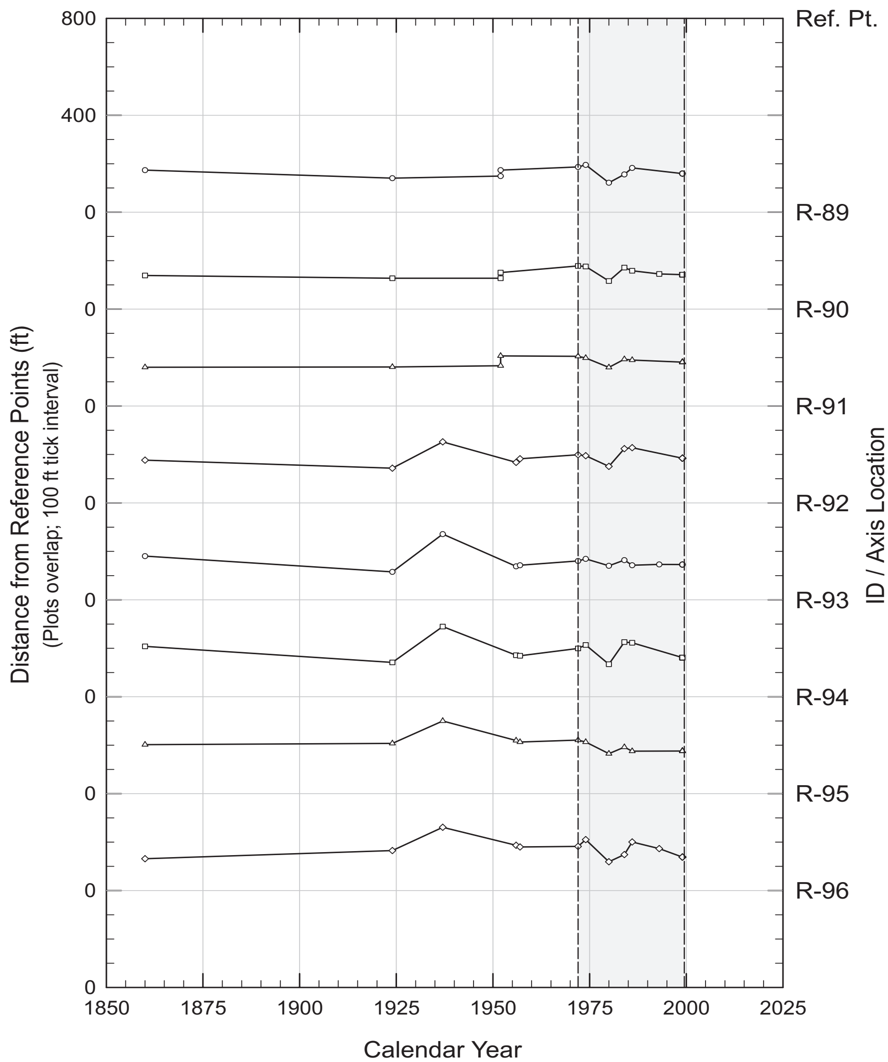

Historic MHW Distance vs. Time
R-65 to R-72
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-65
R-66
R-67
R-68
R-69
R-70
R-71
R-72
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

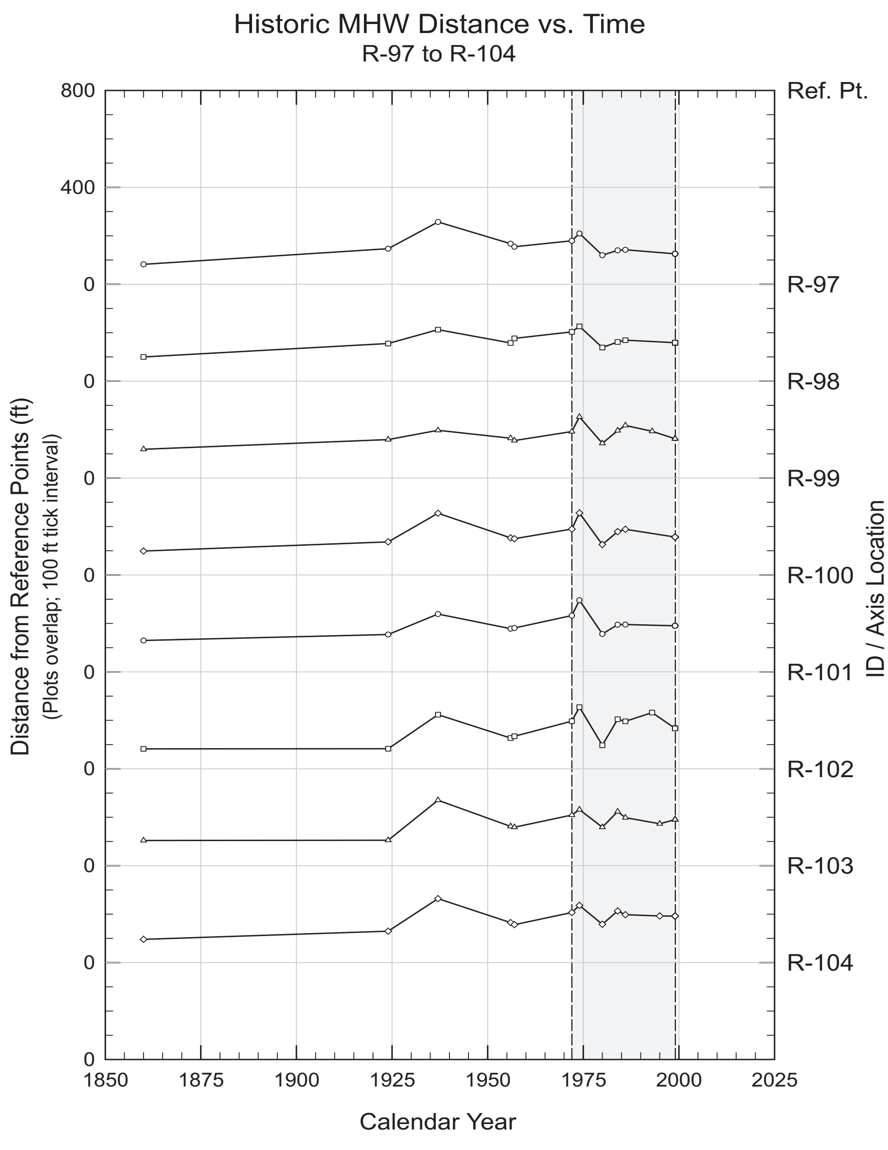

Historic MHW Distance vs. Time
R-73 to R-80
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-73
R-74
R-75
R-76
R_77
R-78
R-79
R-80
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

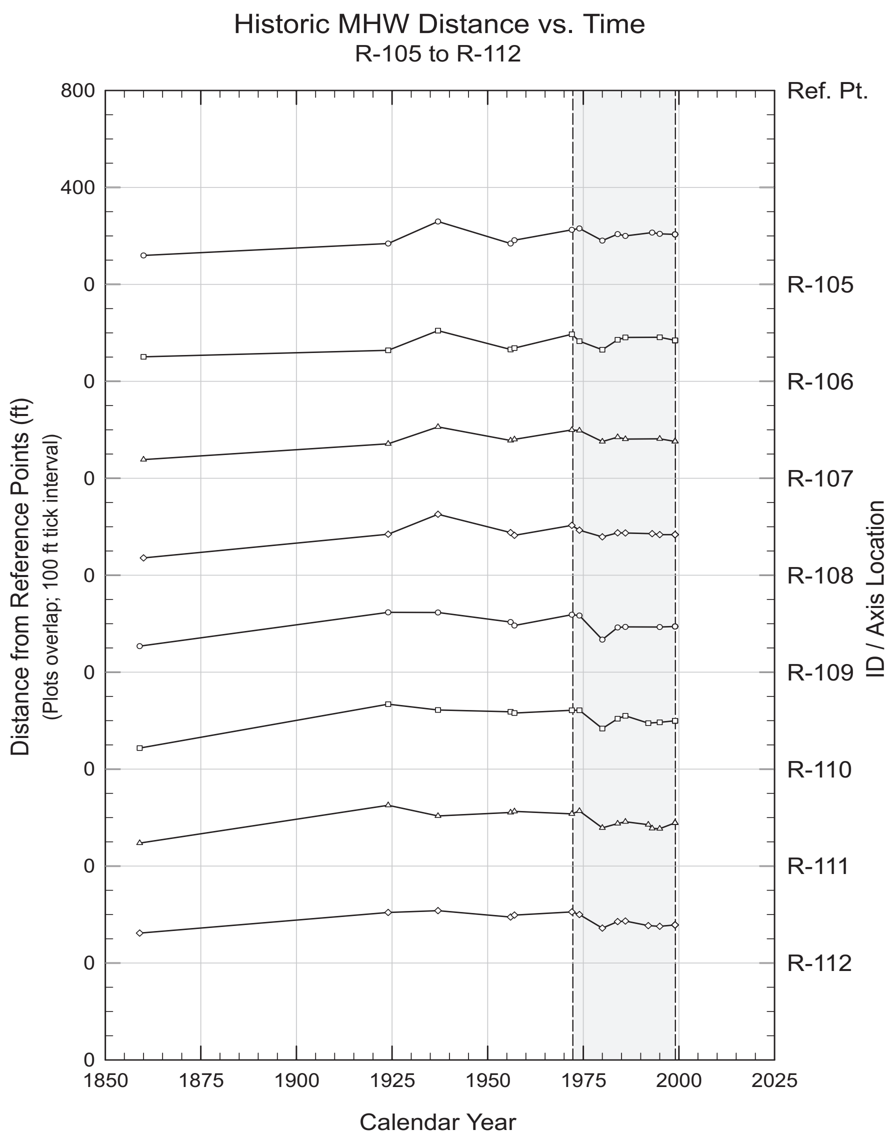

Historic MHW Distance vs. Time
R-81 to R-88
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-81
R-82
R-83
R-84
R-85
R-86
R-87
R-88
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location

Historic MHW Distance vs. Time

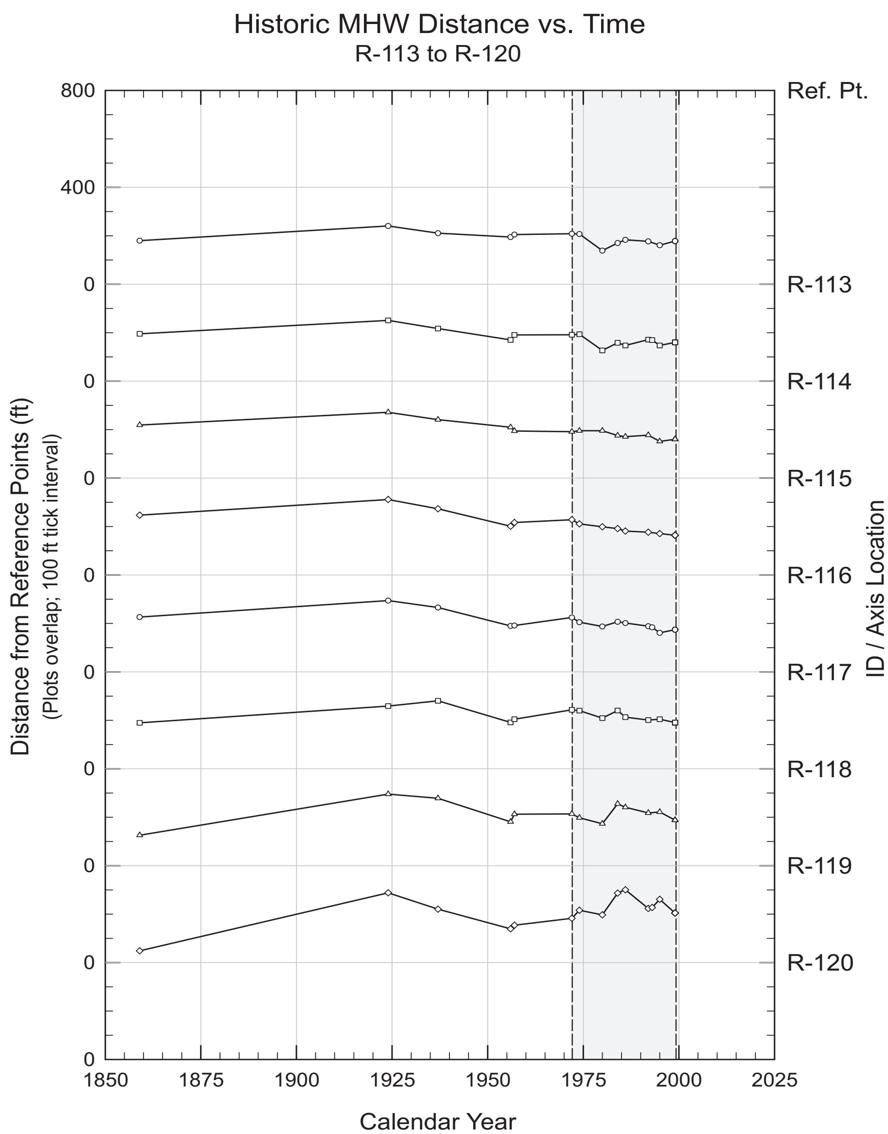
R-89 to R-96



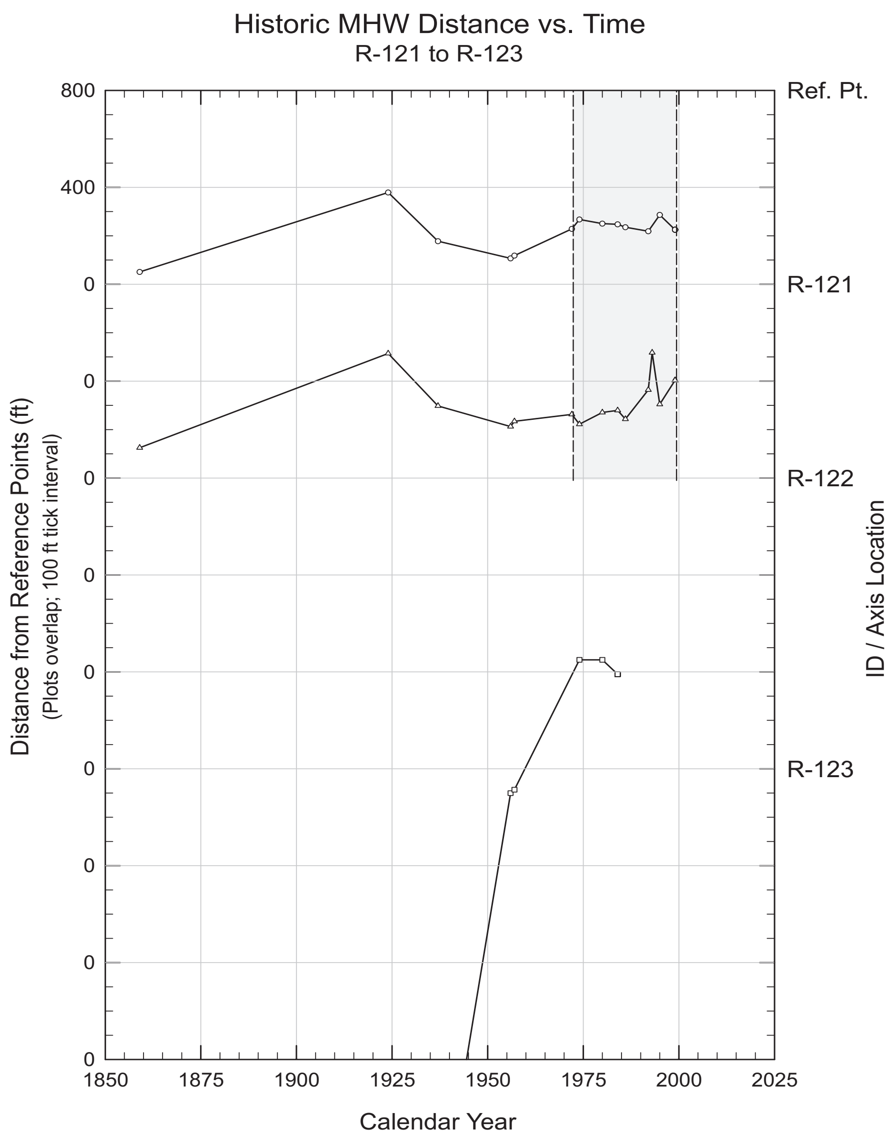

Historic MHW Distance vs. Time
R-97 to R-104
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-97
R-98
R-99
R-100
R-101
R-102
R-103
R-104
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year



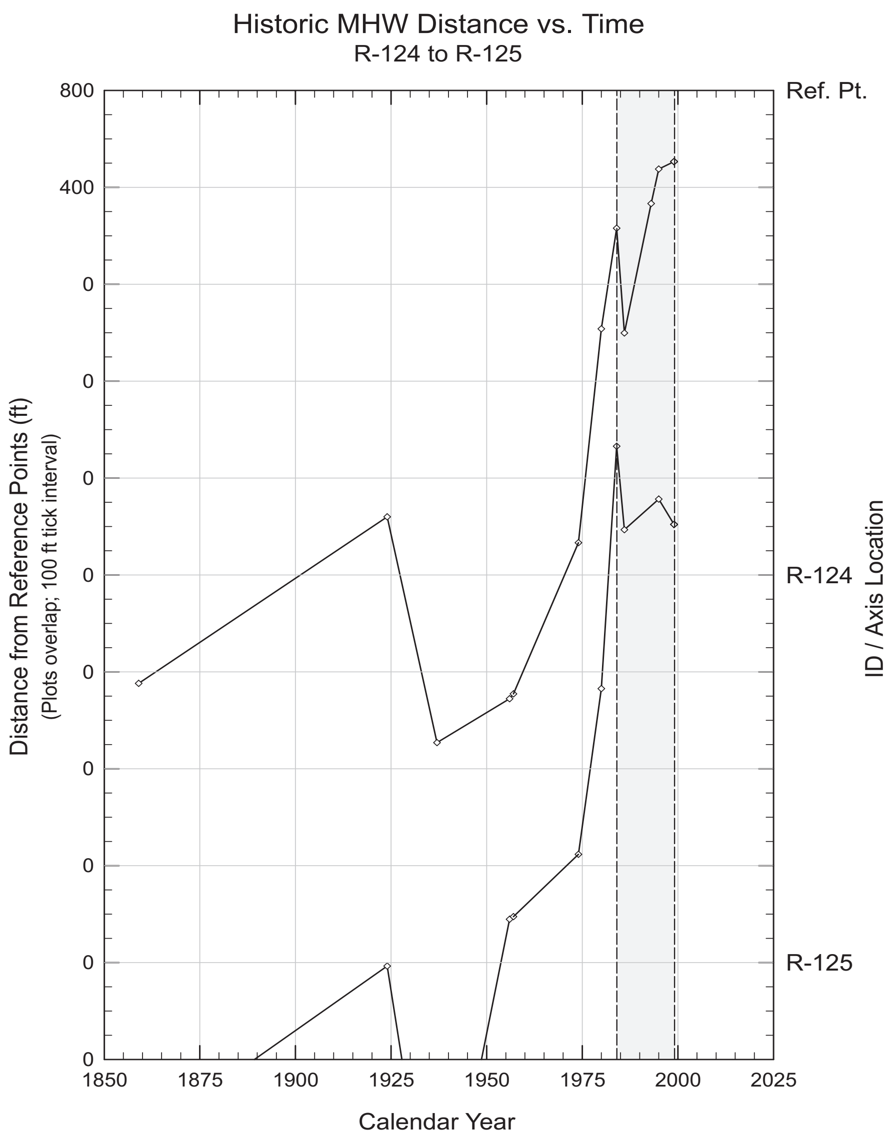
Historic MHW Distance vs. Time
R-105 to R-112
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-105
R-106
R-107
R-108
R-109
R-110
R-111
R-112
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year



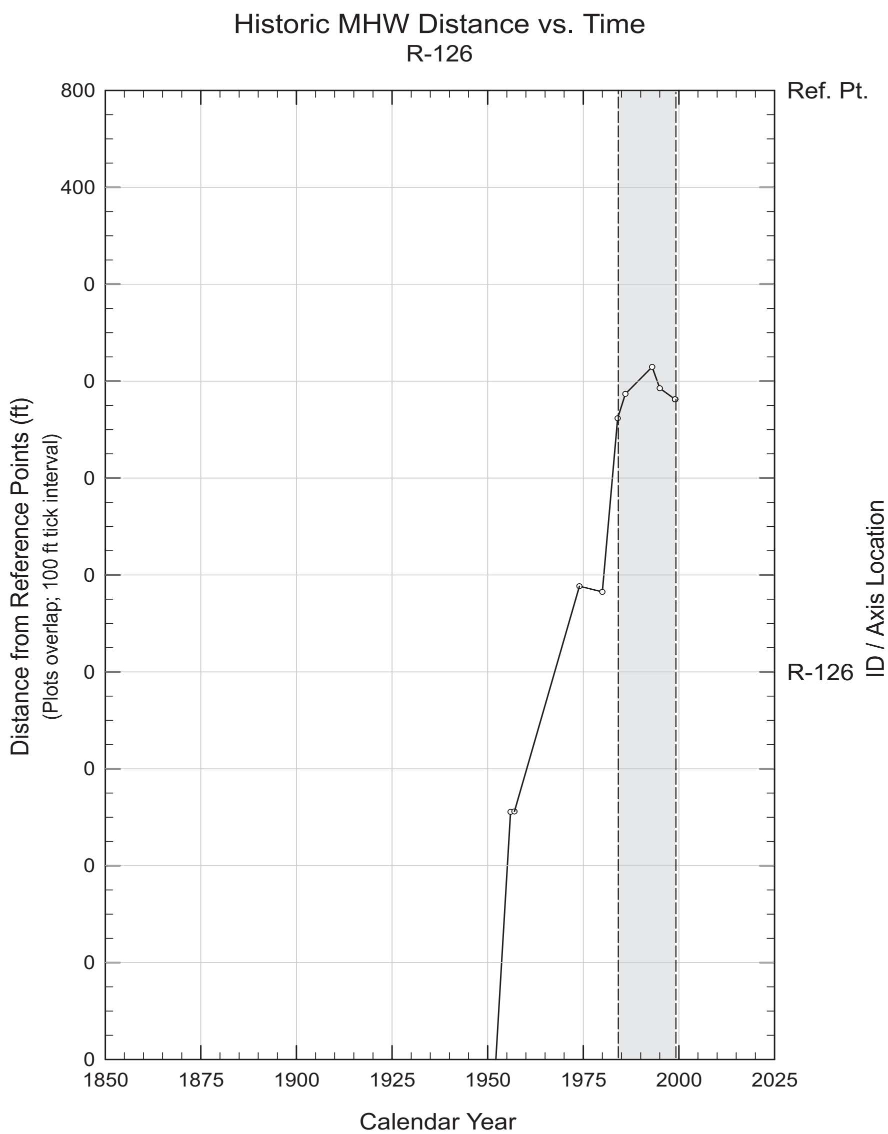
Historic MHW Distance vs. Time
R-113 to R-120
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-113
R-114
R-115
R-116
R-117
R-118
R-119
R-120
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

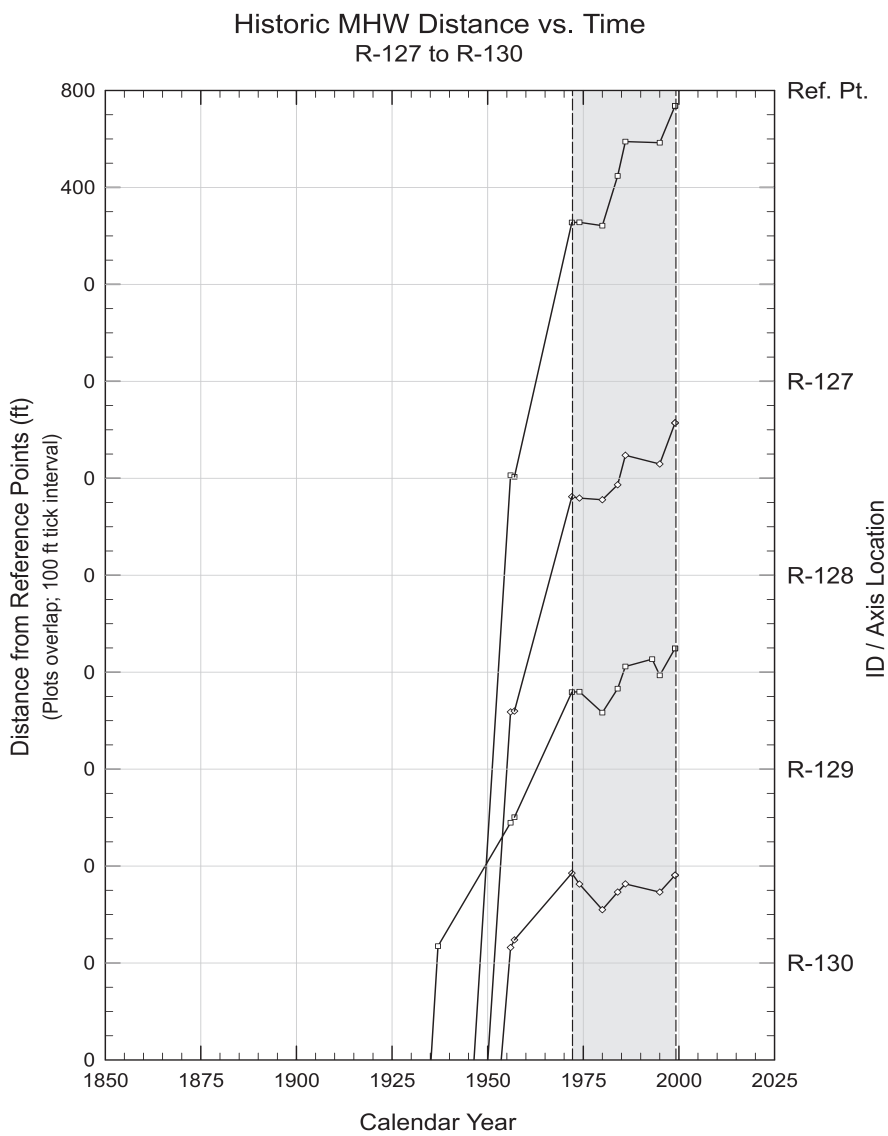


Historic MHW Distance vs. Time
R-121 to R-123
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-121
R-122
R-123
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

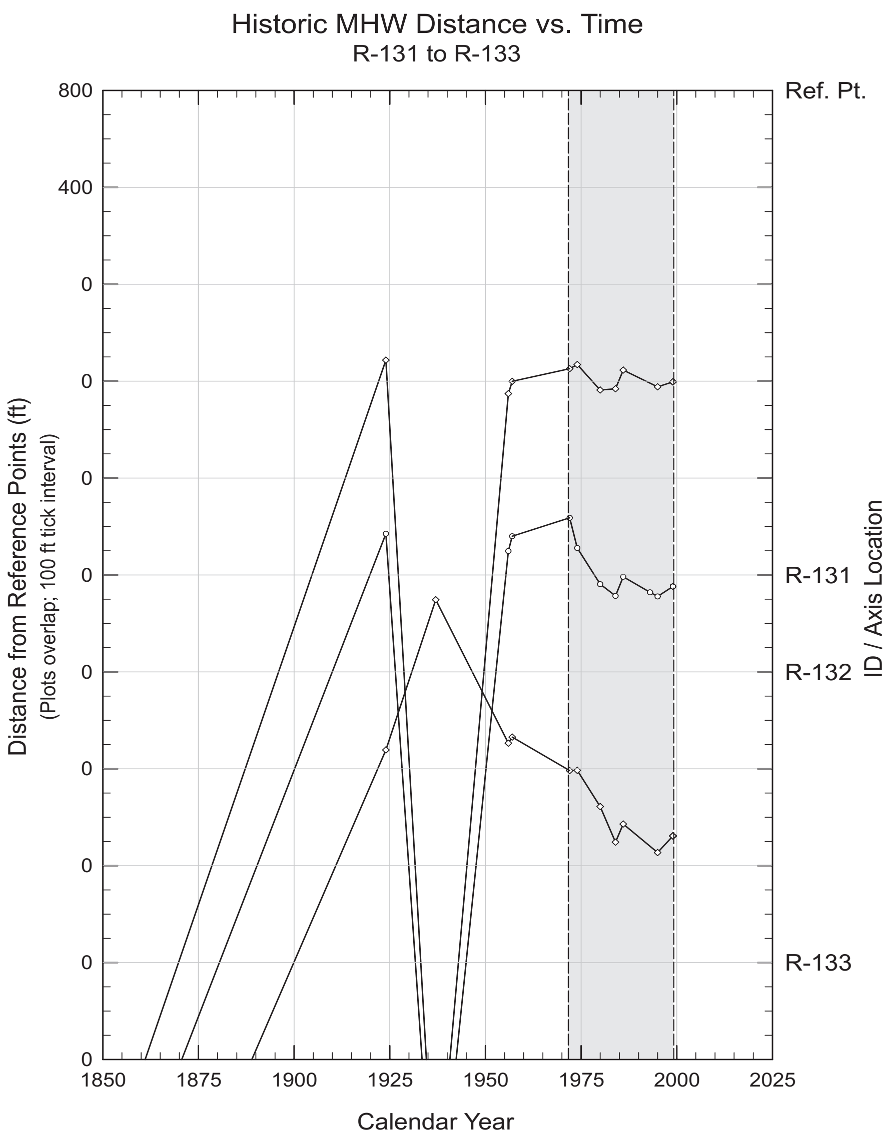


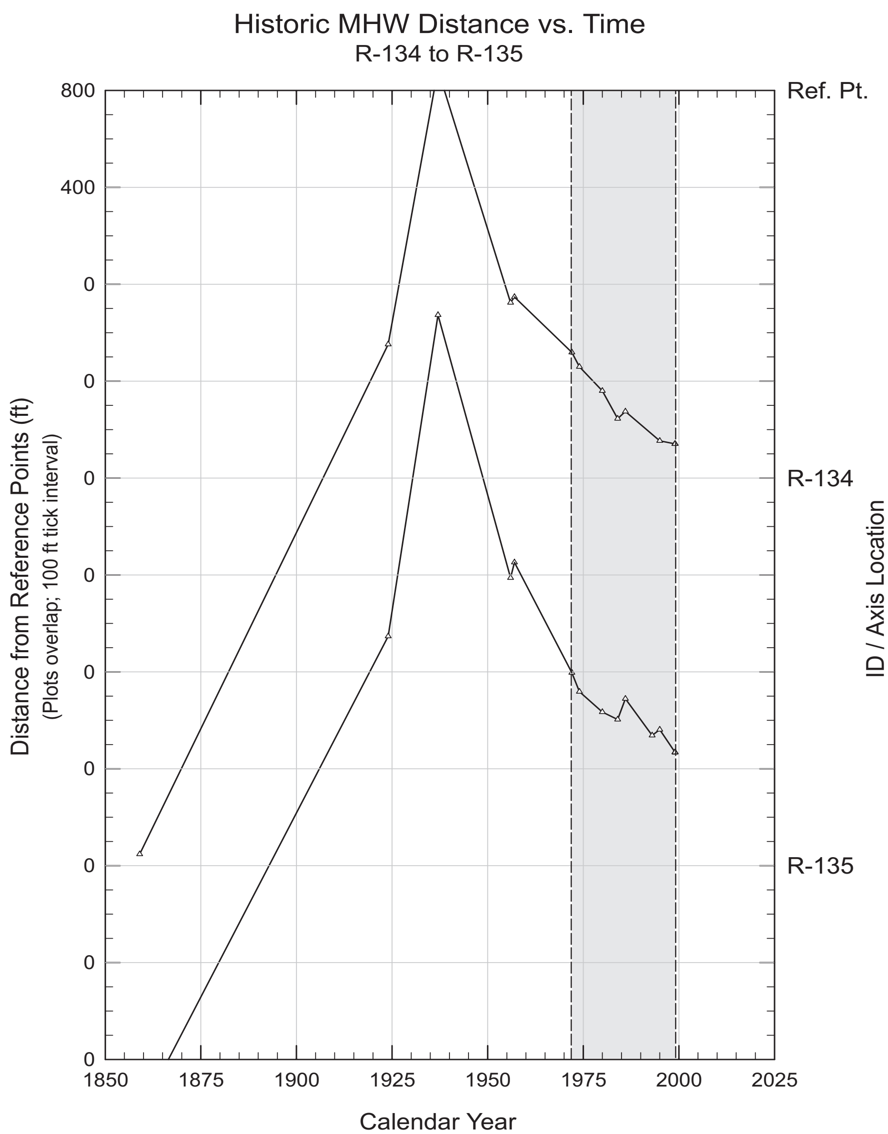
Historic MHW Distance vs. Time
R-124 to R-125
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-124
R-125
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

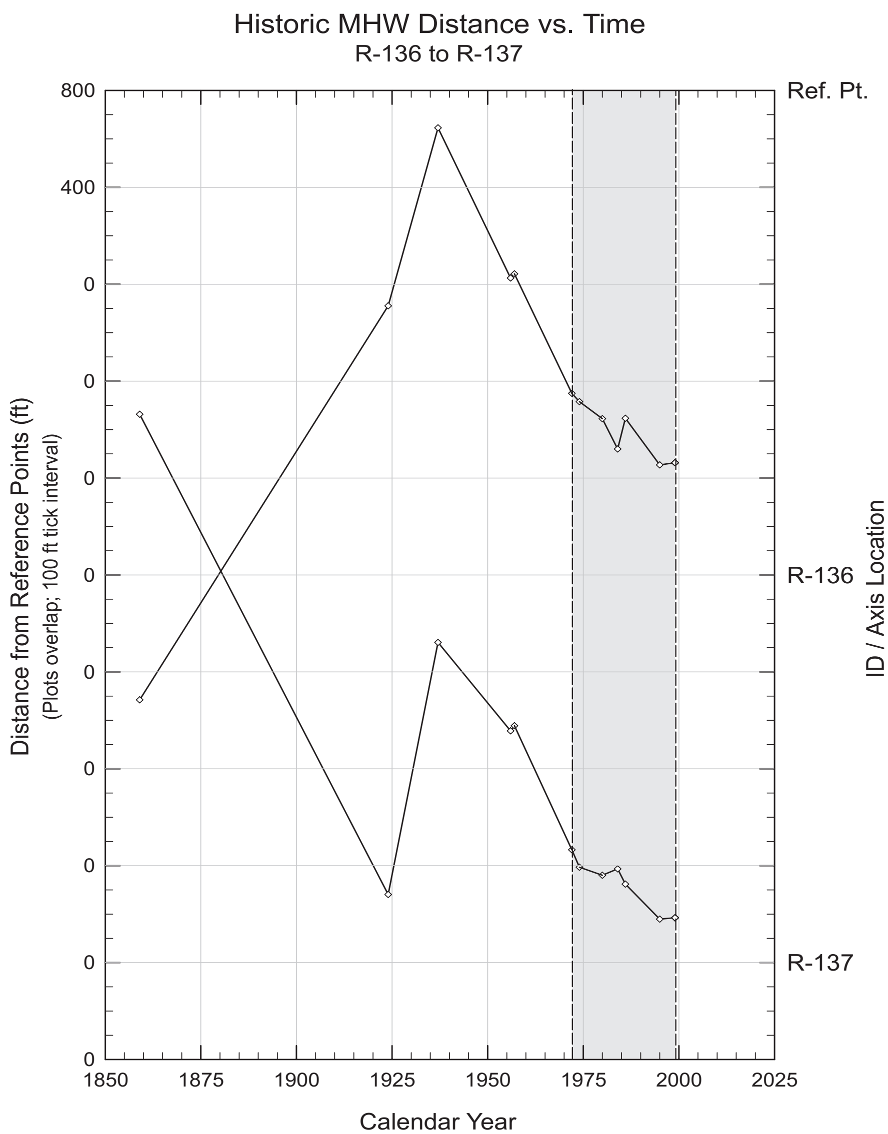

Historic MHW Distance vs. Time
R-126
800
400
0
0
0
0
0
0
0
0
0
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. Pt.
R-126
ID / Axis Location



Historic MHW Distance vs. Time
R-127 to R-130
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
Ref. Pt.
R-127
R-128
R-129
R-130
ID / Axis Location

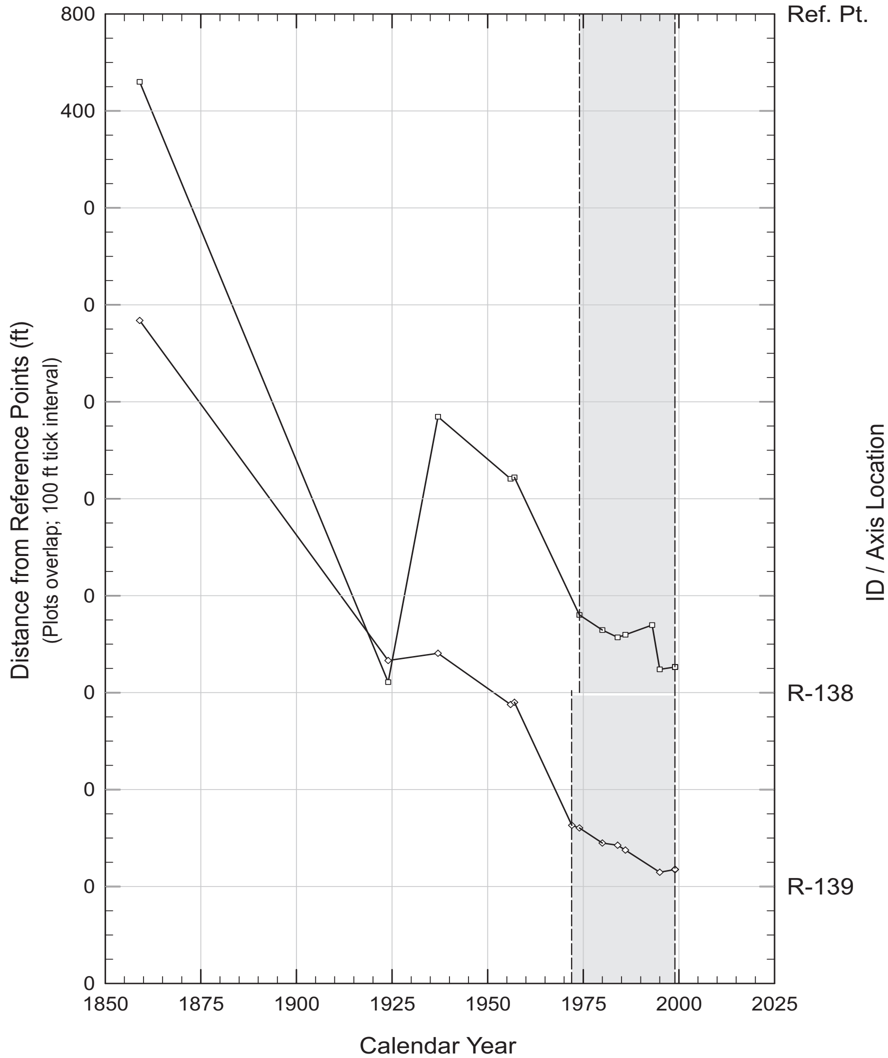

Historic MHW Distance vs. Time
R-131 to R-133
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. Pt.
R-131
R-132
R-133
ID / Axis Location

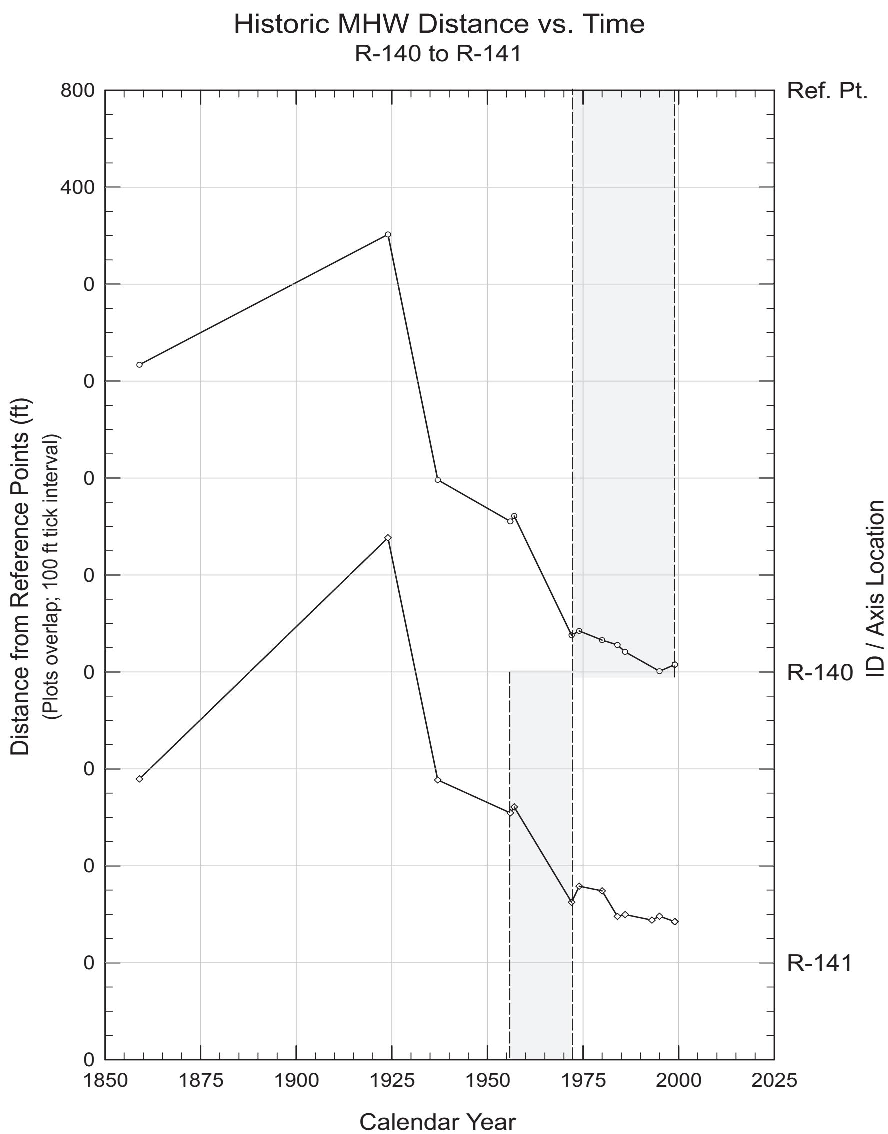

Historic MHW Distance vs. Time
R-134 to R-135
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
Ref. Pt.
R-134
R-135
ID / Axis Location



Historic MHW Distance vs. Time
R-136 to R-137
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-136
R-137
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

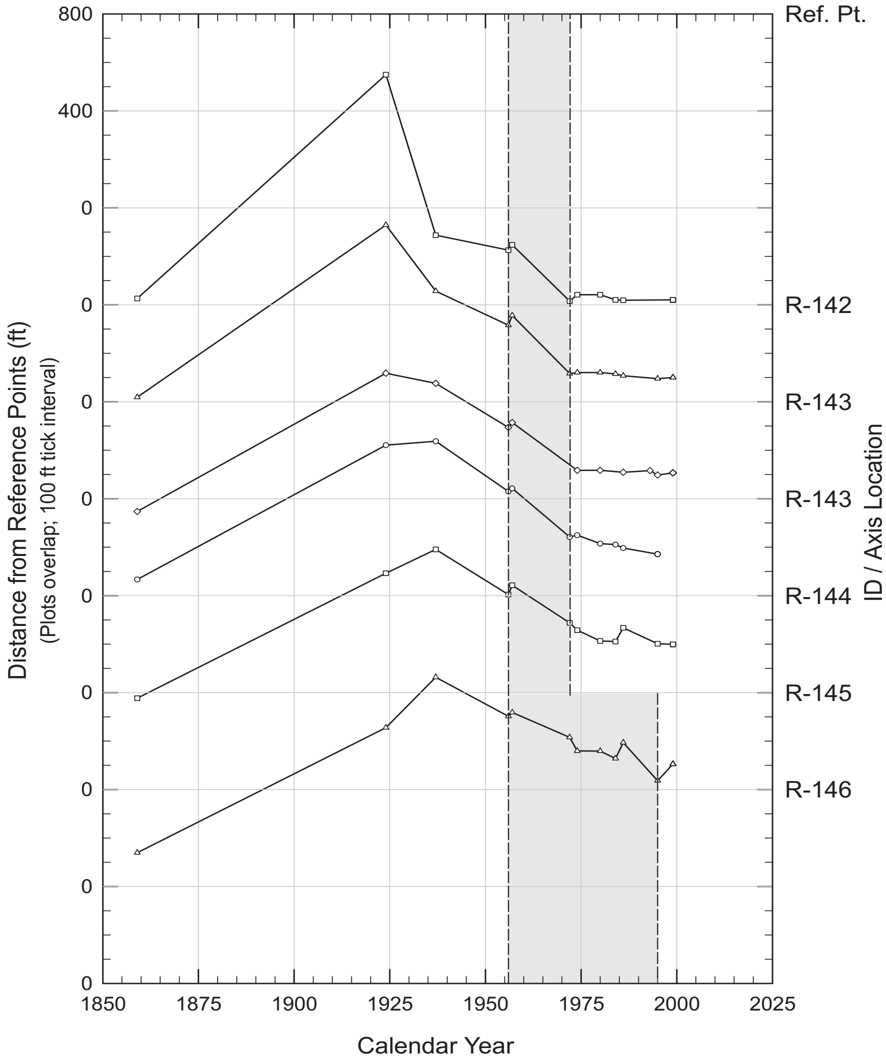
Historic MHW Distance vs. Time
R-138 to R-139

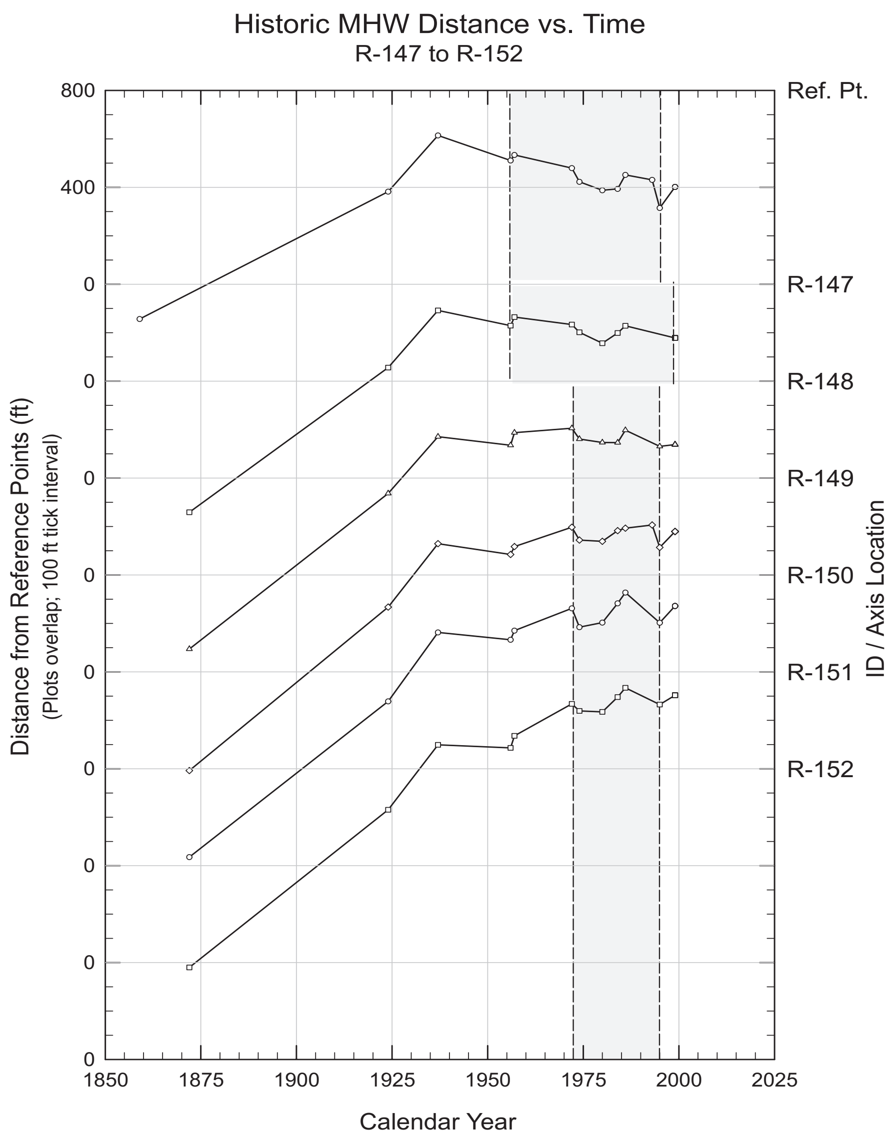




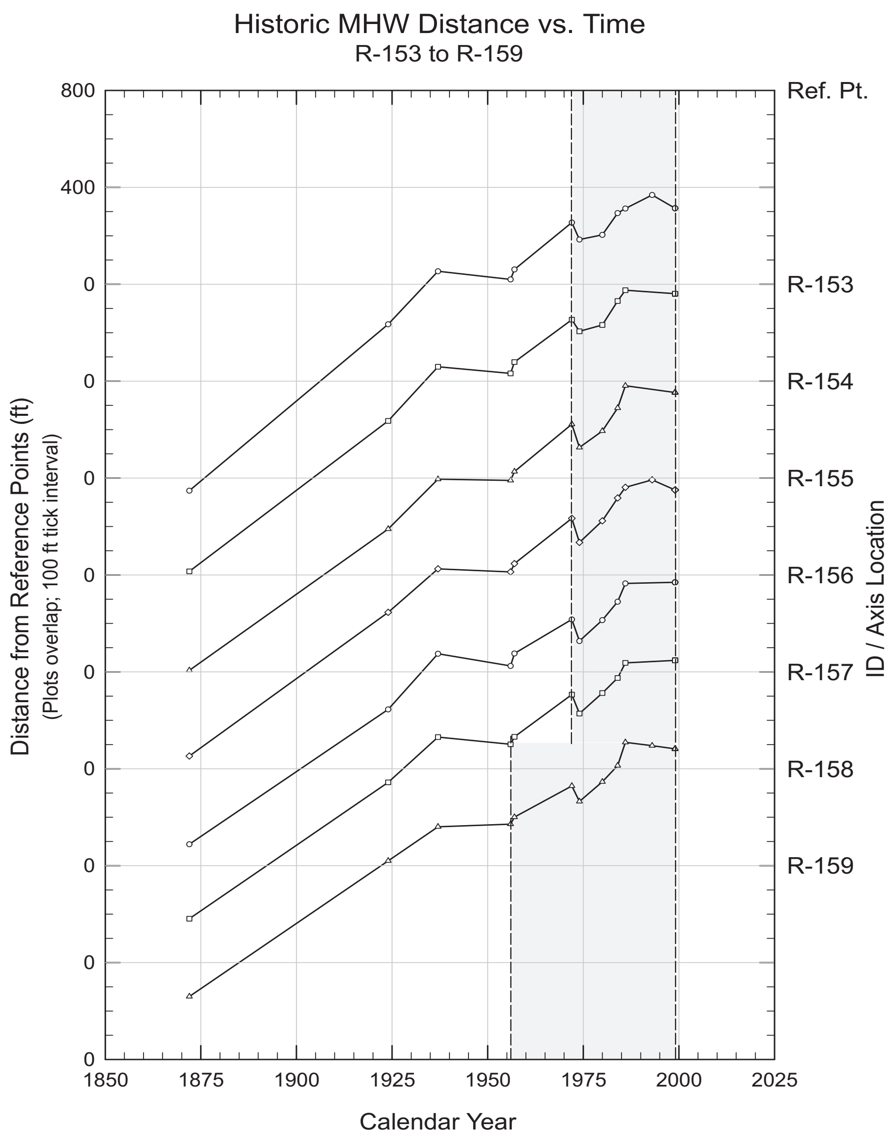
Historic MHW Distance vs. Time
R-140 to R-141
800
400
0
0
0
0
0
0
0
0
Ref. Pt.
R-140
R-141
ID / Axis Location
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

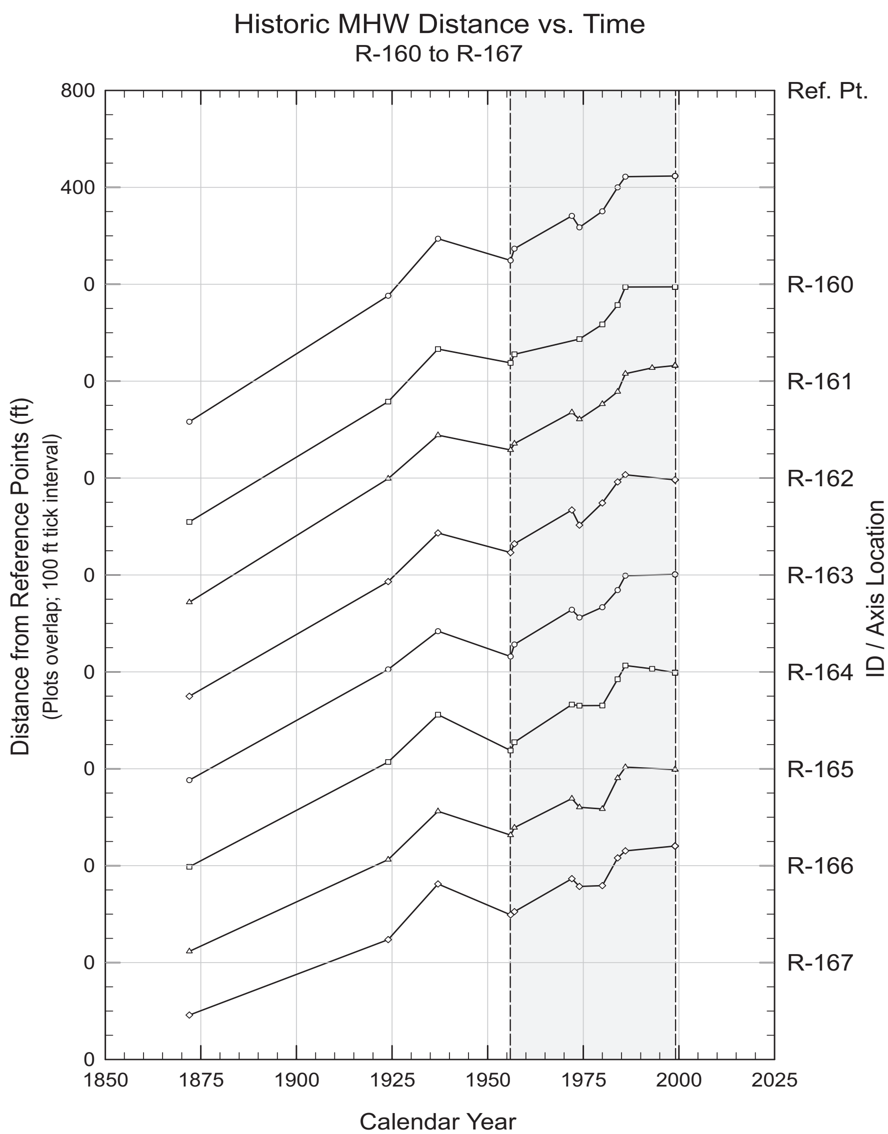
Historic MHW Distance vs. Time
R-142 to R-146

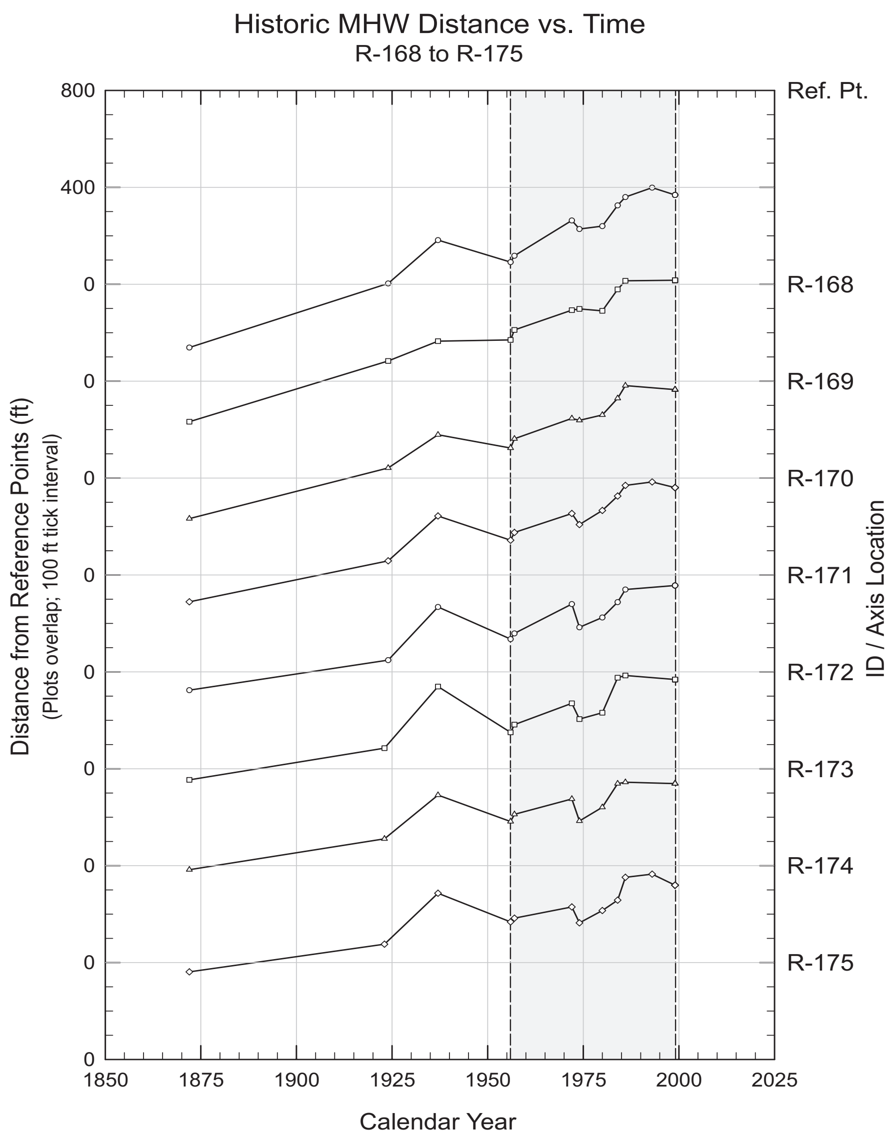




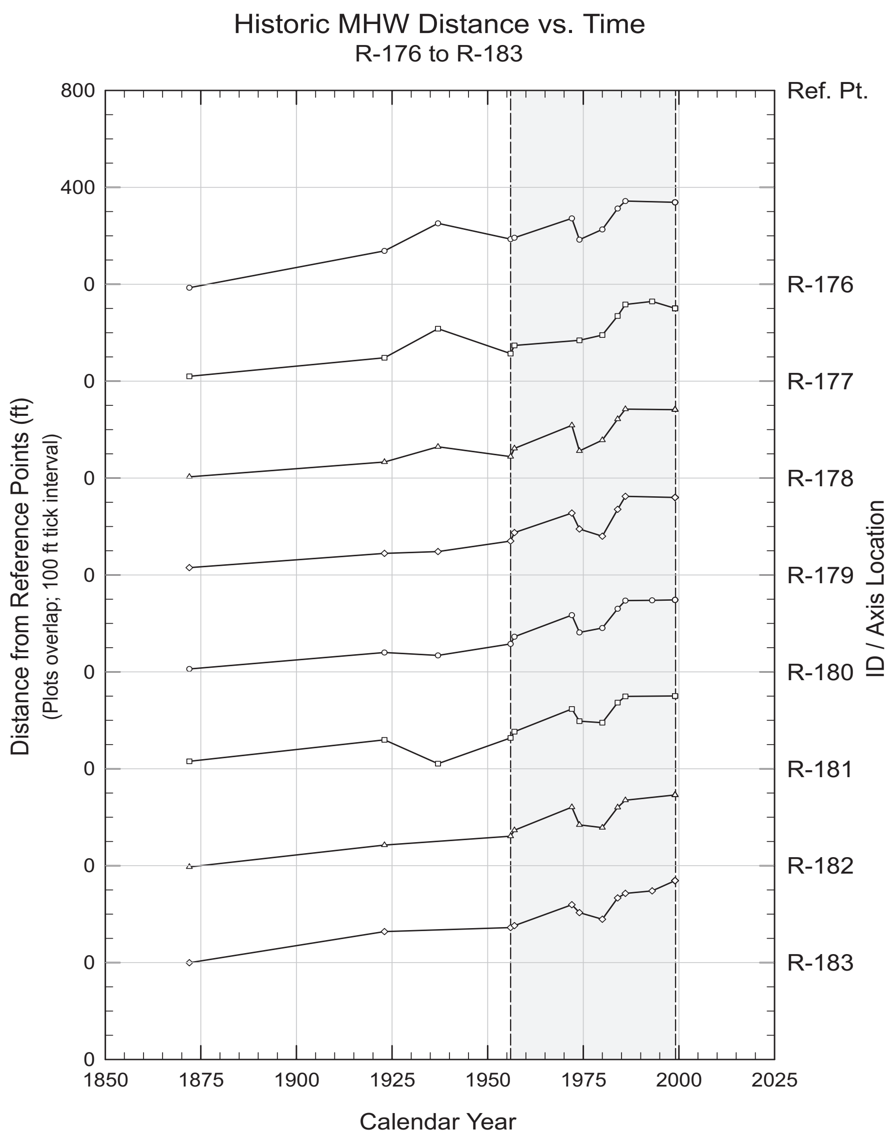
Historic MHW Distance vs. Time
R-147 to R-152
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
Ref. Pt.
R-147
R-148
R-149
R-150
R-151
R-152
ID / Axis Location

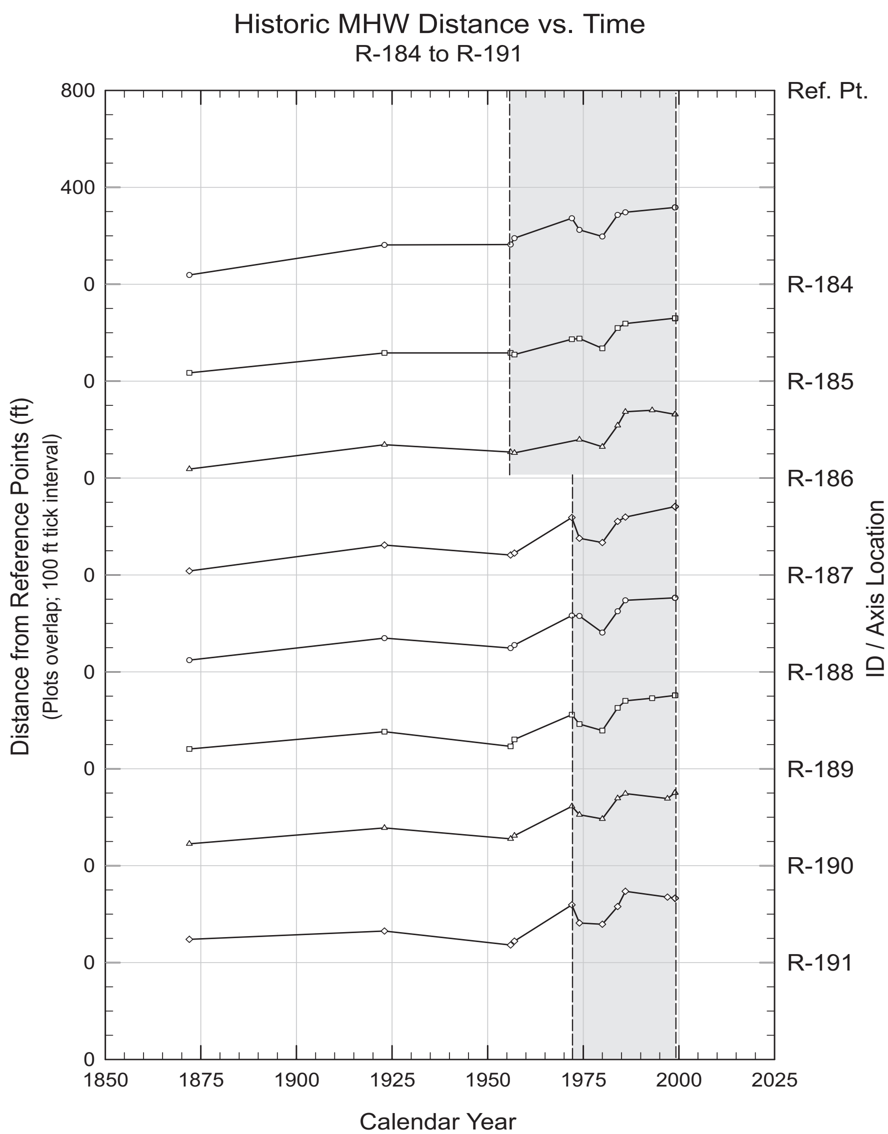

Historic MHW Distance vs. Time
R-153 to R-159
800
400
0
0
0
0
0
0
0
0
0
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. Pt.
R-153
R-154
R-155
R-156
R-157
R-158
R-159
ID / Axis Location


Historic MHW Distance vs. Time
R-160 to R-167
Ref. Pt.
R-160
R-161
R-162
R-163
R-164
R-165
R-166
R-167
800
400
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location



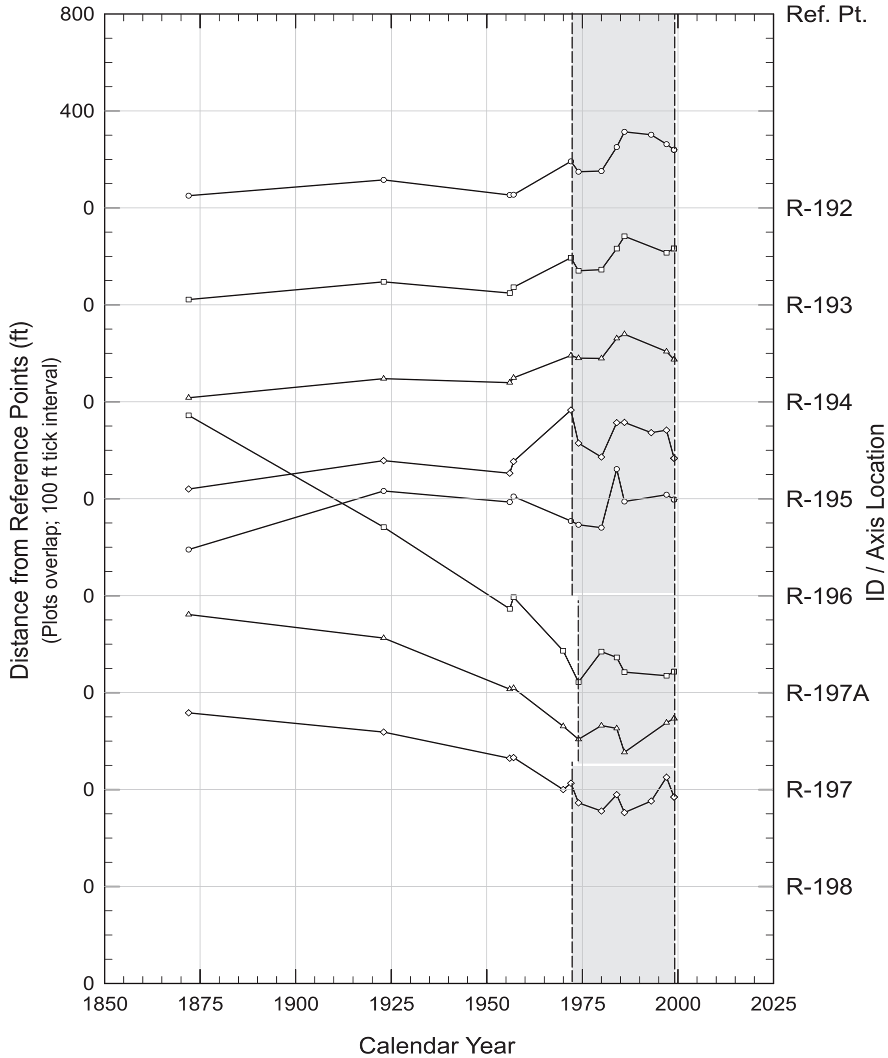
Historic MHW Distance vs. Time
R-168 to R-175
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-168
R-169
R-170
R-171
R-172
R-173
R-174
R-175
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

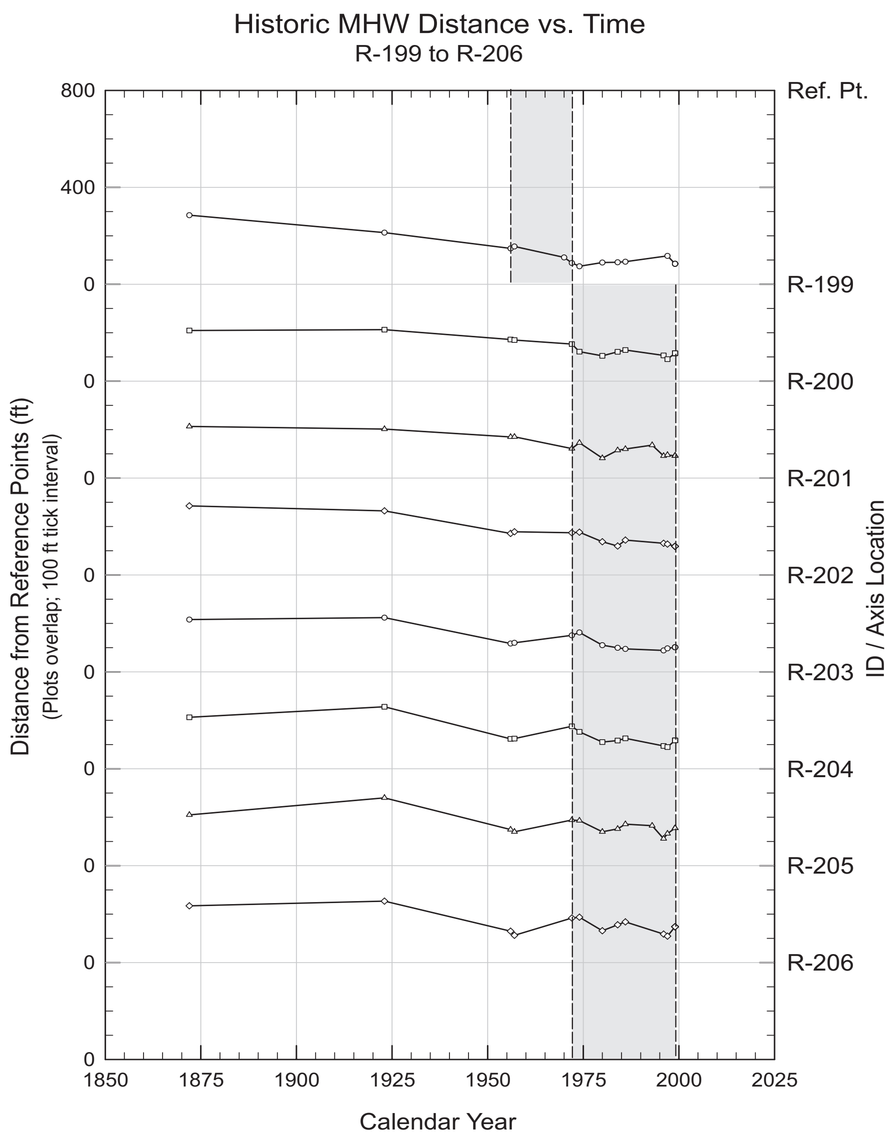

Historic MHW Distance vs. Time
R-176 to R-183
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. Pt.
R-176
R-177
R-178
R-179
R-180
R-181
R-182
R-183
ID / Axis Location



Historic MHW Distance vs. Time
R-184 to R-191
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-184
R-185
R-186
R-187
R-188
R-189
R-190
R-191
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

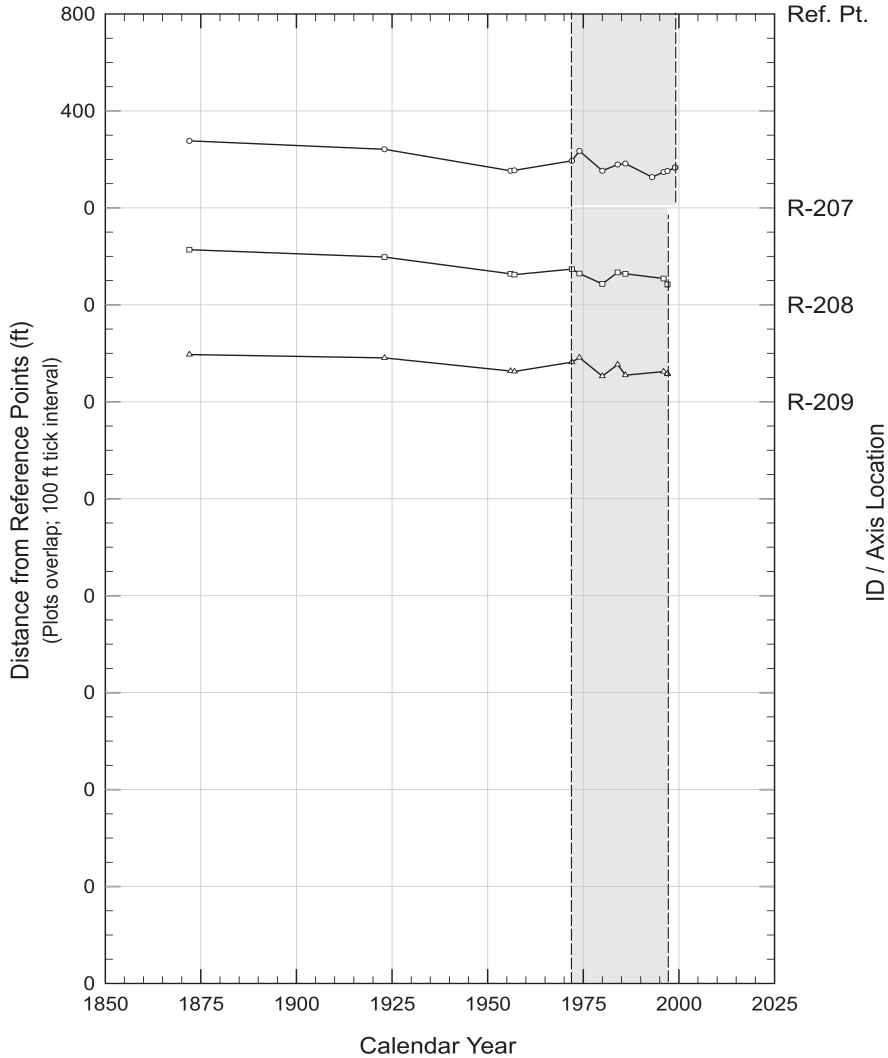
Historic MHW Distance vs. Time
R-192 to R-198





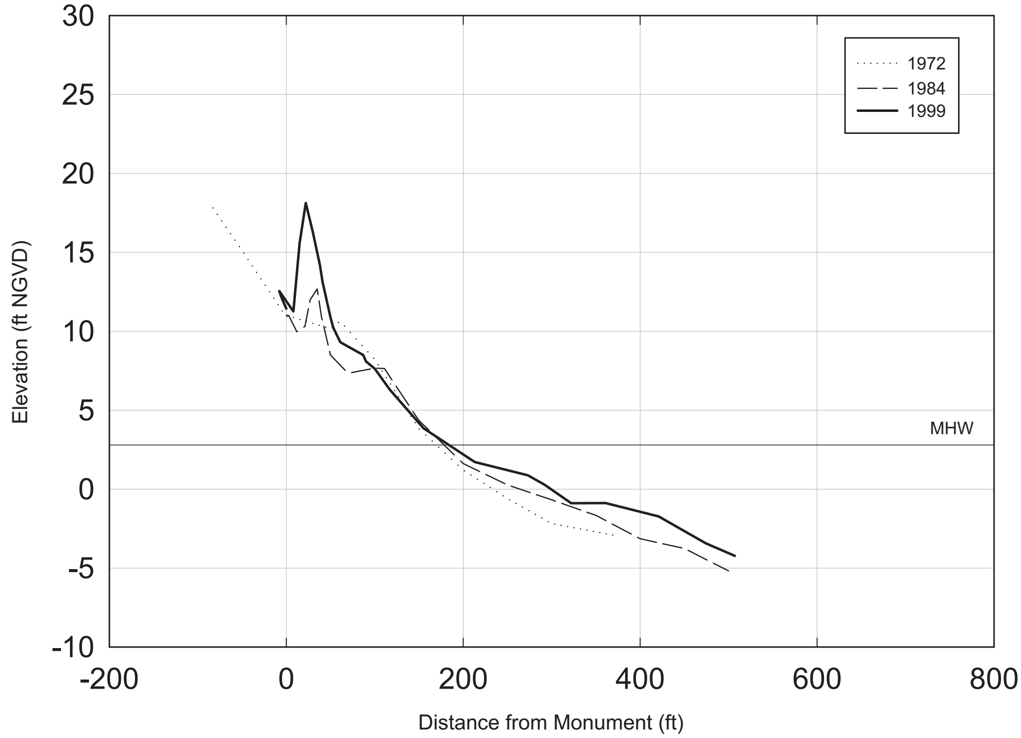
Historic MHW Distance vs. Time
R-199 to R-206
800
400
0
0
0
0
0
0
0
0
0
Ref. Pt.
R-199
R-200
R-201
R-202
R-203
R-204
R-205
R-206
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

Historic MHW Distance vs. Time
R-207 to R-209

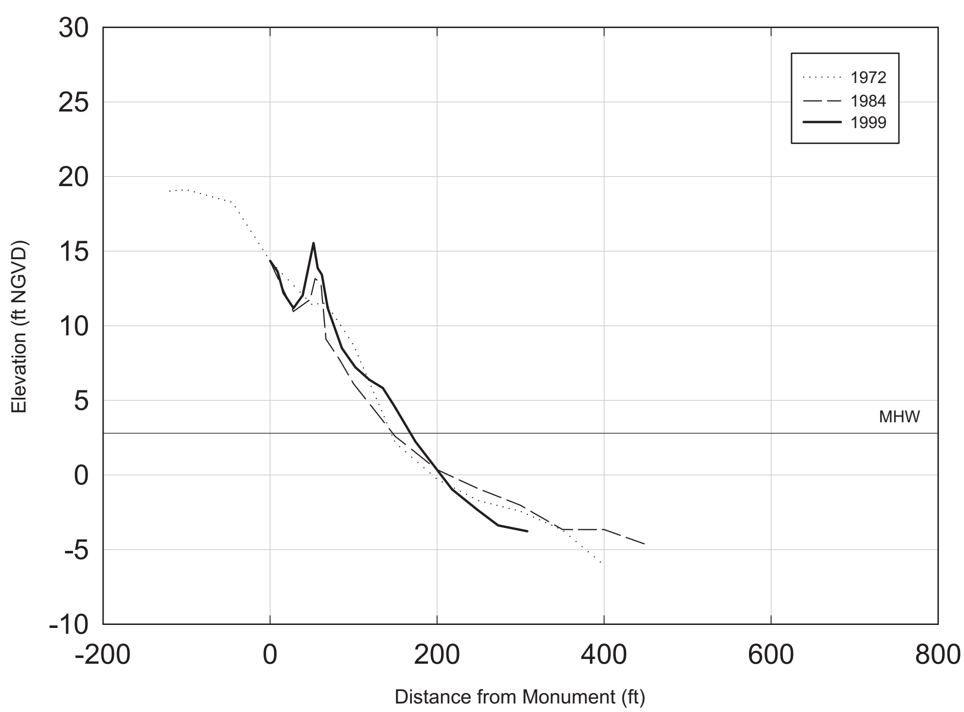


8.3 Appendix C: Profile Plots

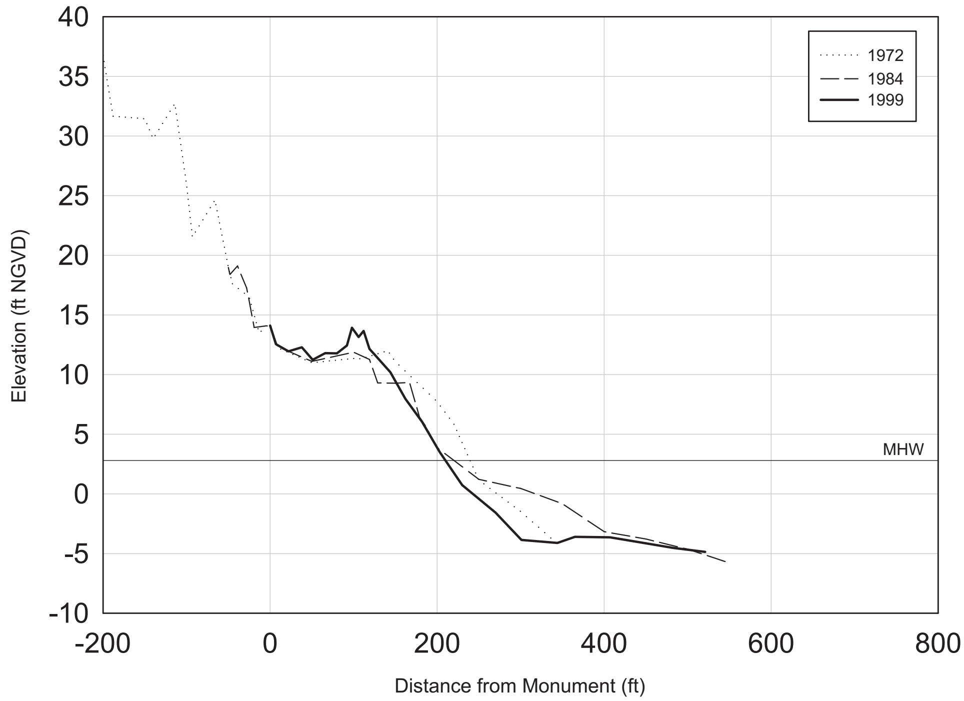
St. Johns County
R-3



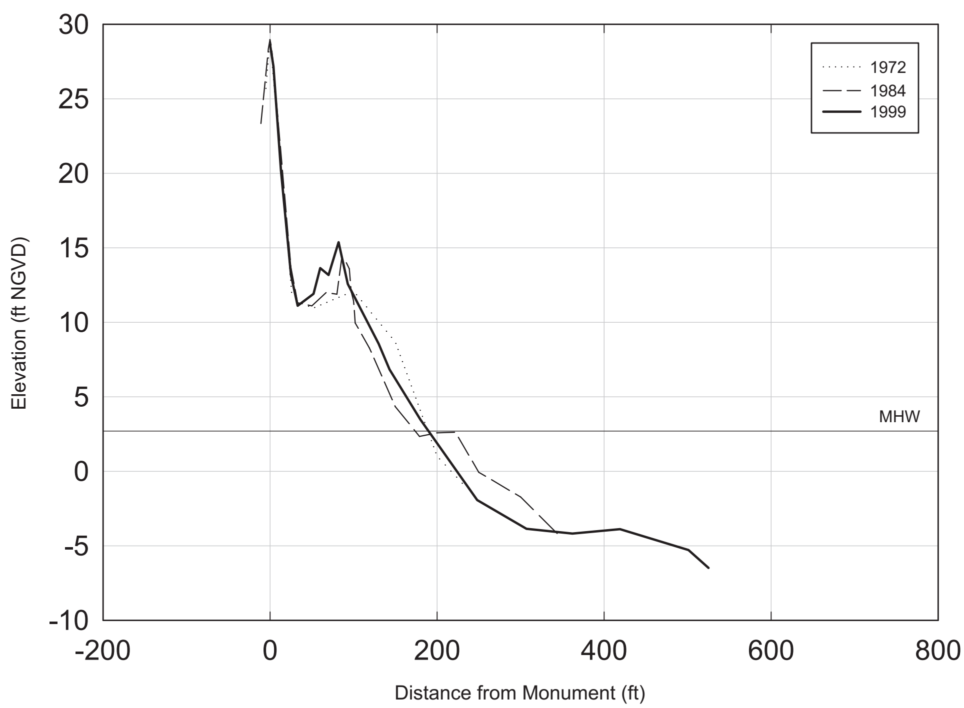
St. Johns County
R-21



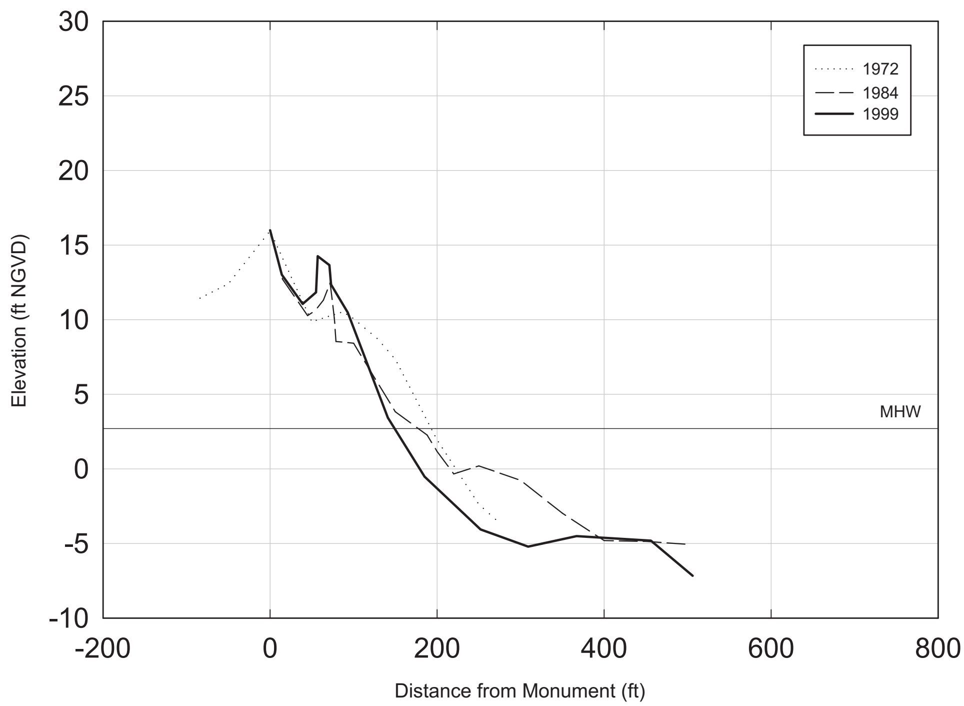
St. Johns County
R-42



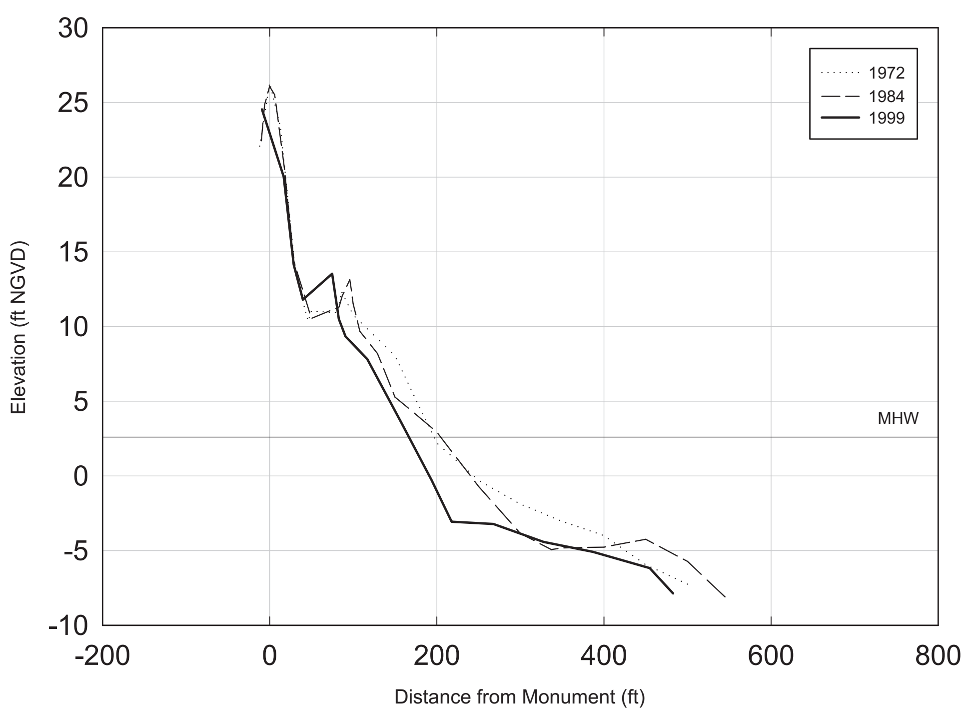
St. Johns County
R-63



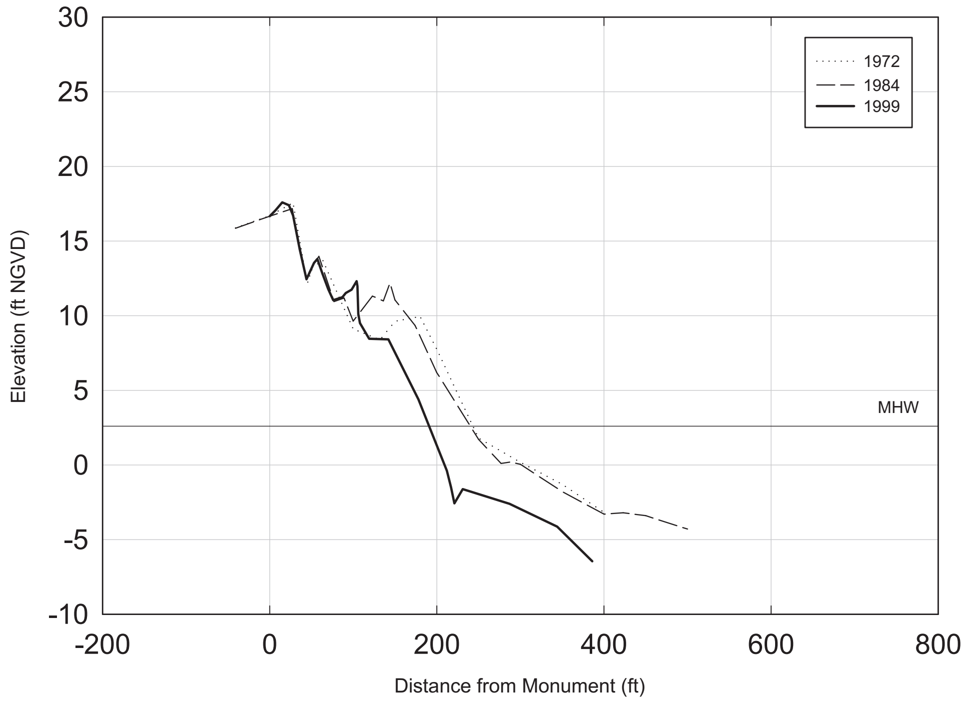
St. Johns County
R-81



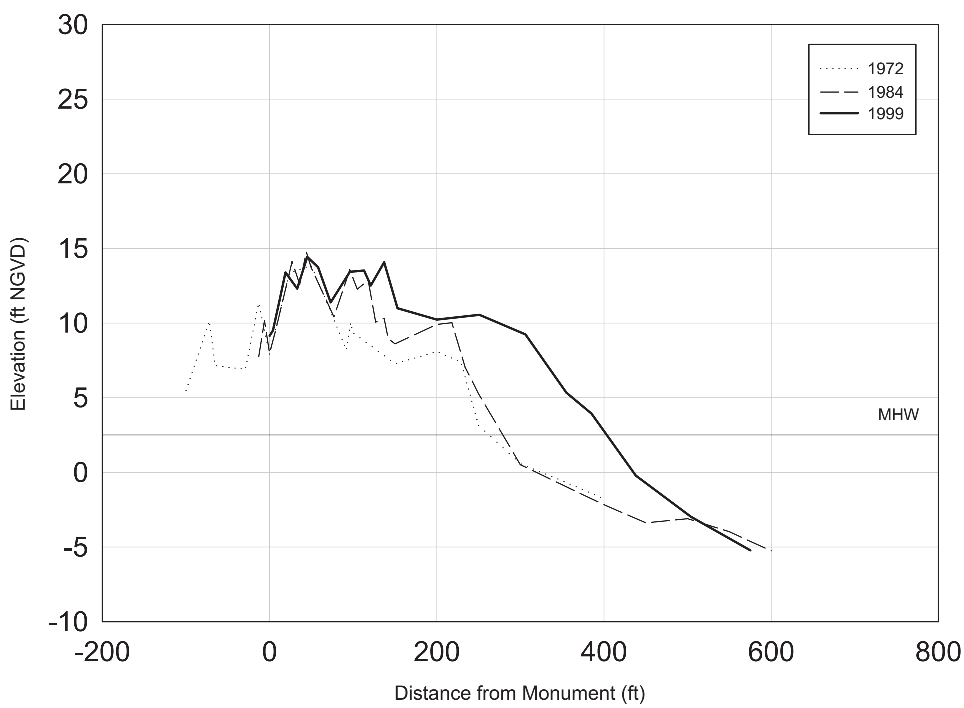
St. Johns County
R-102



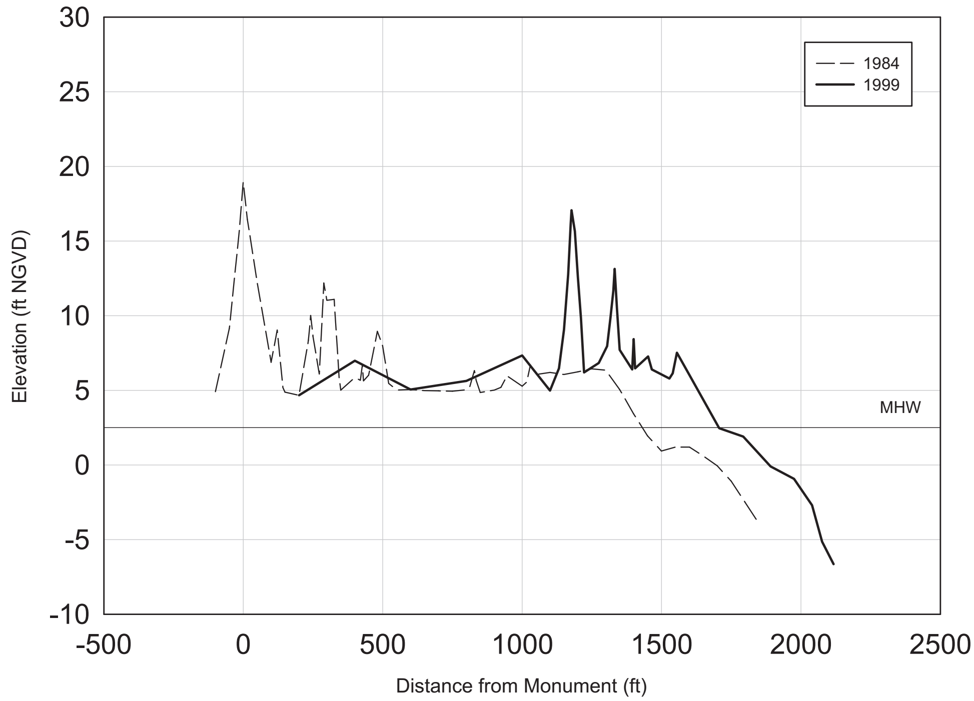
St. Johns County
R-118



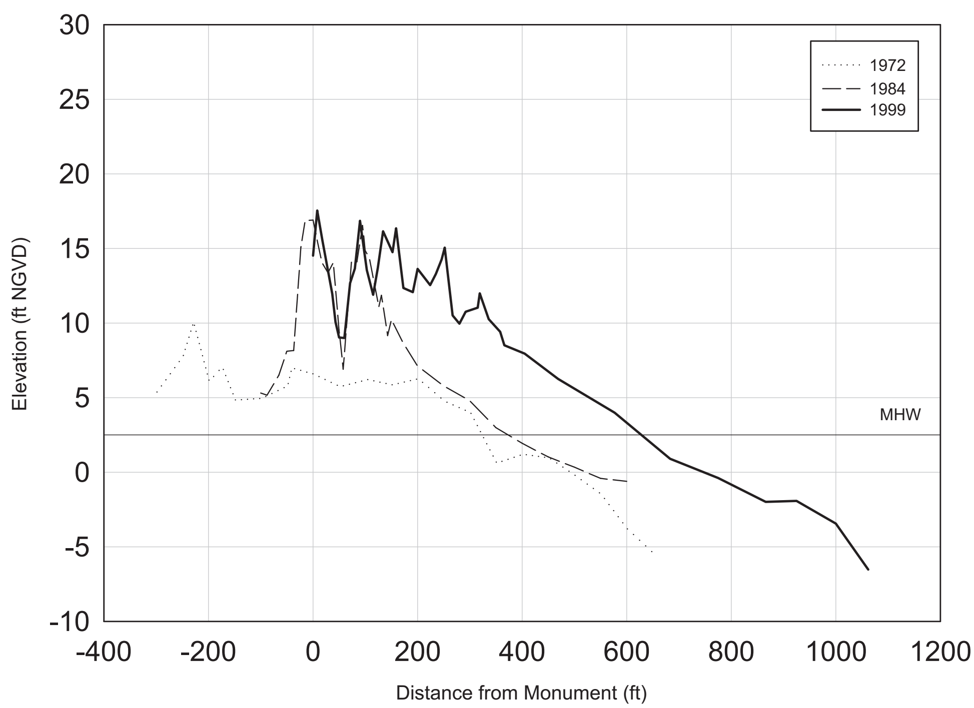
St. Johns County
R-122

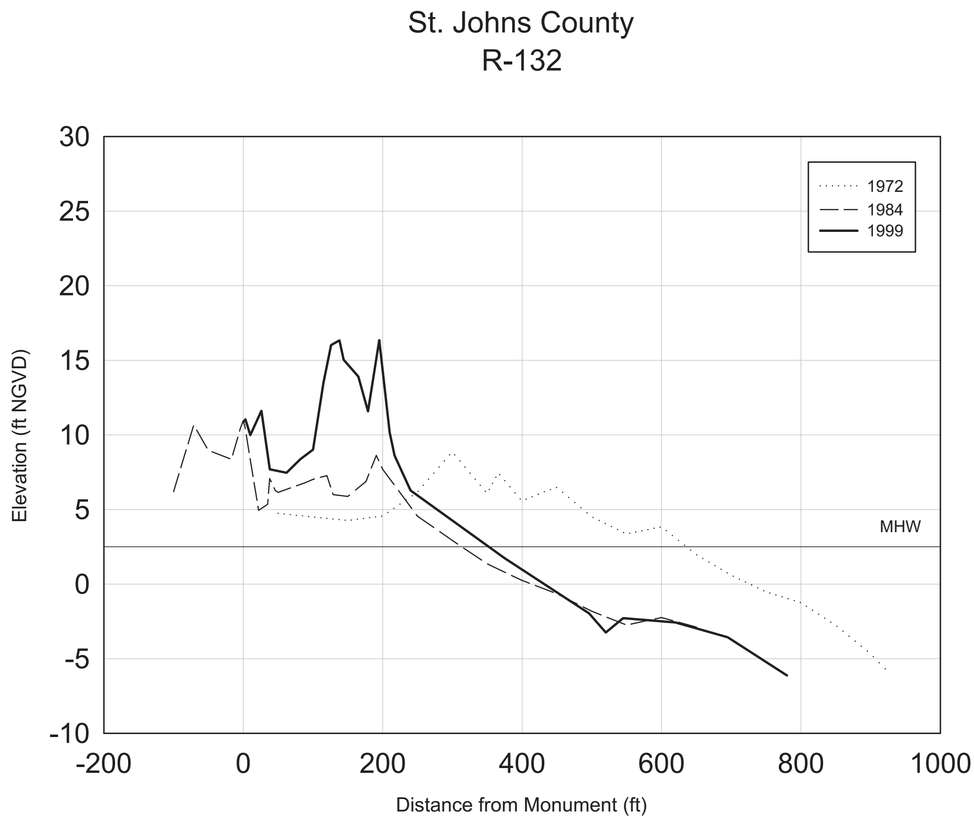


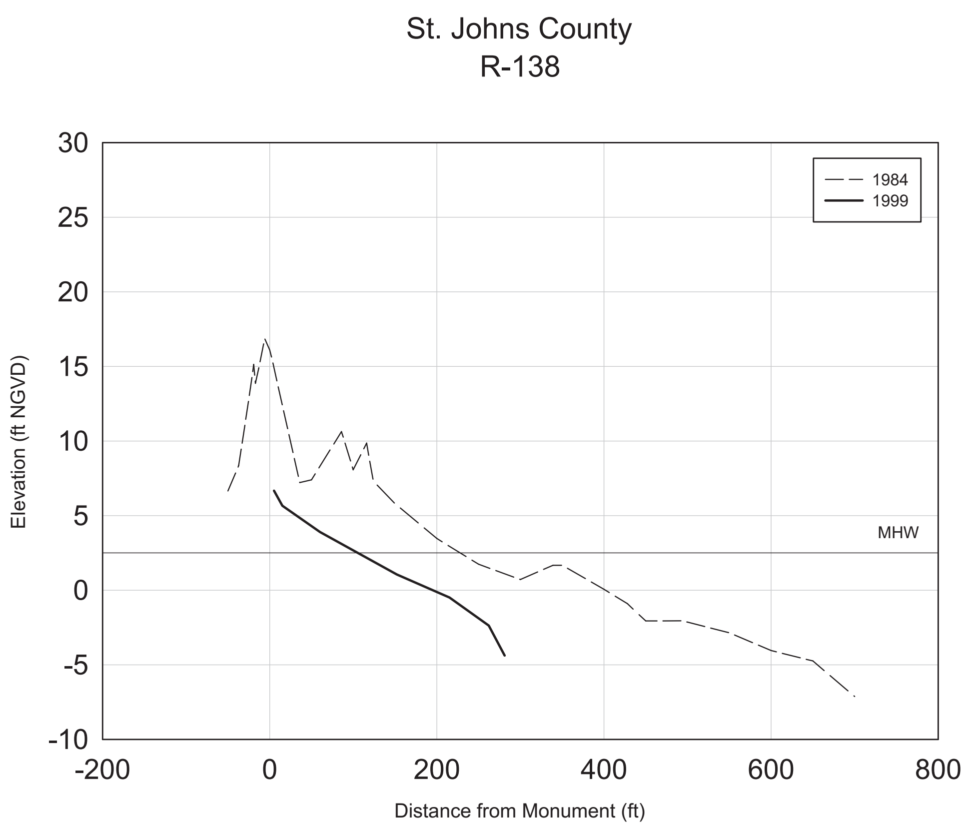
St. Johns County
R-124



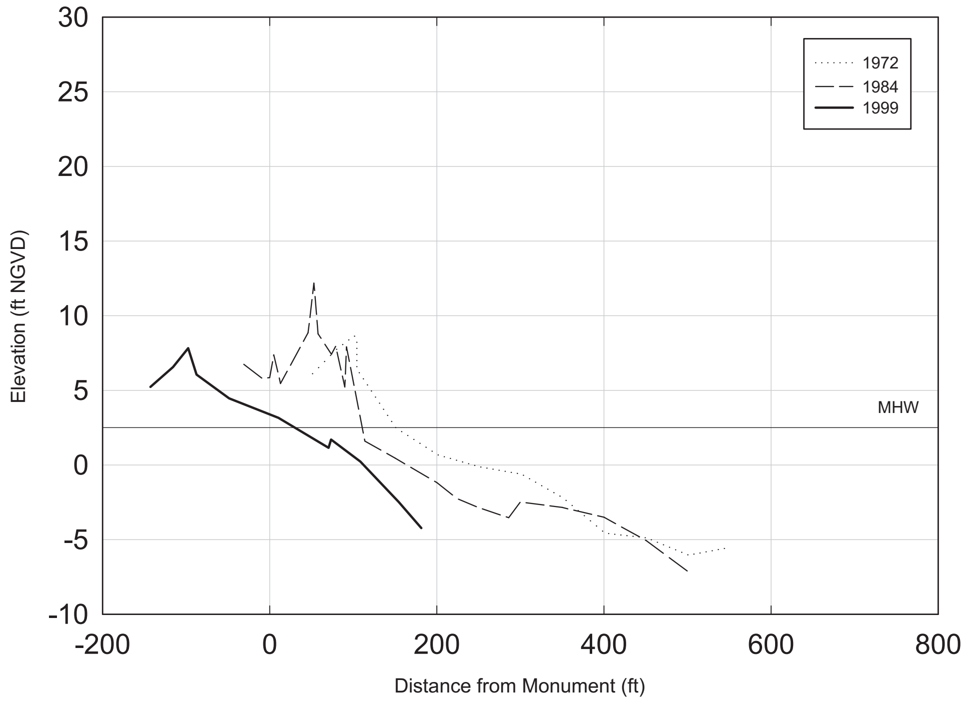
St. Johns County
R-128



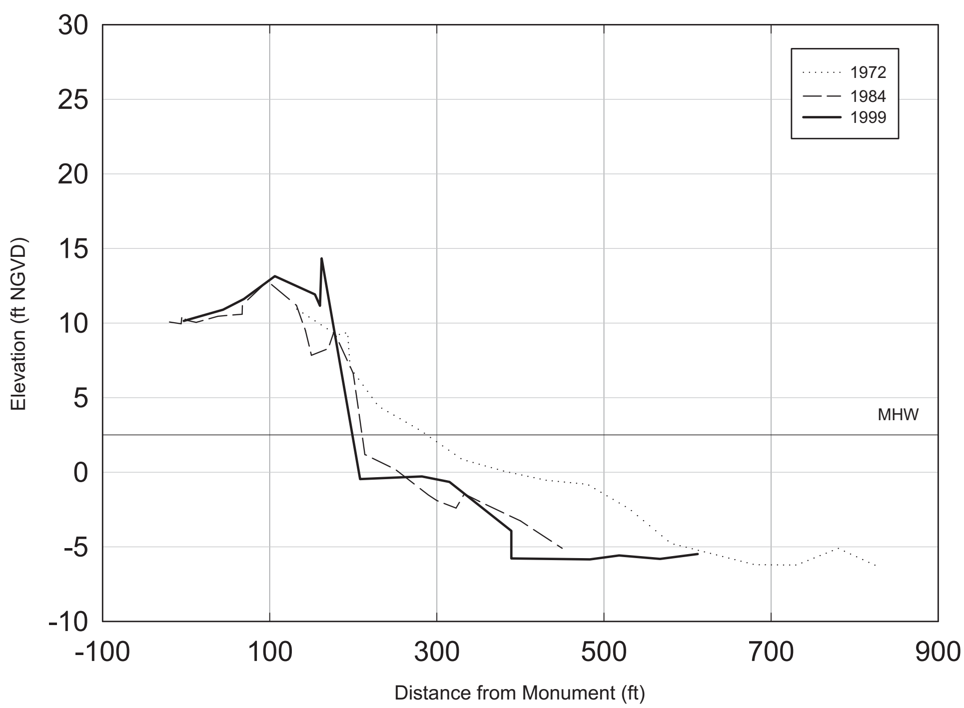

St. Johns County
R-132
1972
1984
1999
MHW
Elevation (ft NGVD)
Distance from Monument (ft)
30
25
20
15
10
5
0
-5
-10
-200
0
200
400
600
800
1000


St. Johns County
R-138
1984
1999
MHW
Elevation (ft NGVD)
Distance from Monument (ft)
30
25
20
15
10
5
0
-5
-10
-200
0
200
400
600
800

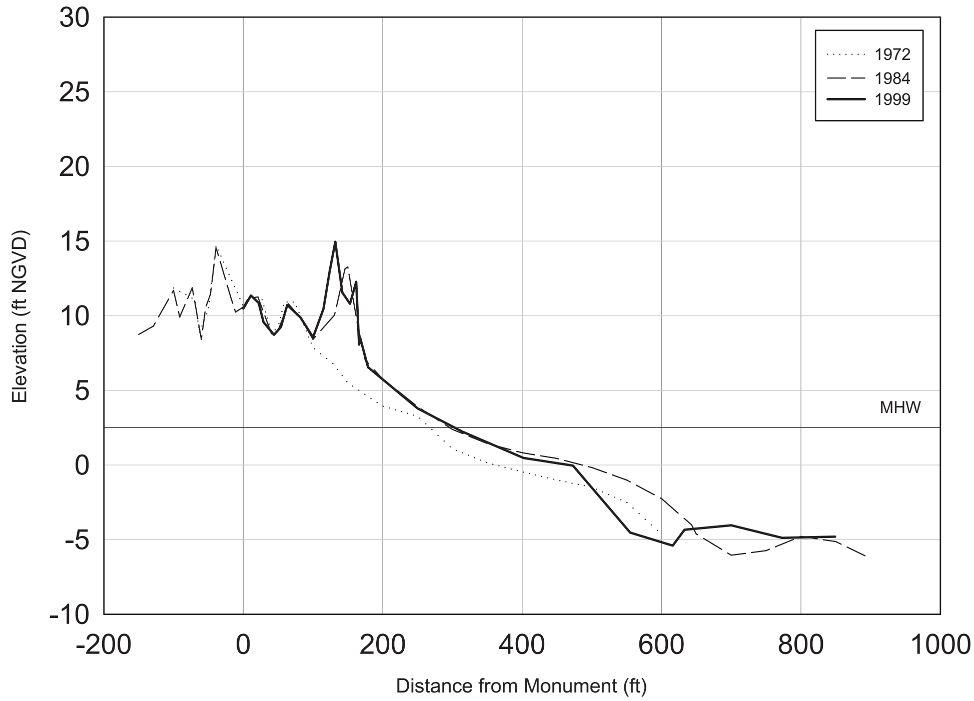
St. Johns County
R-140



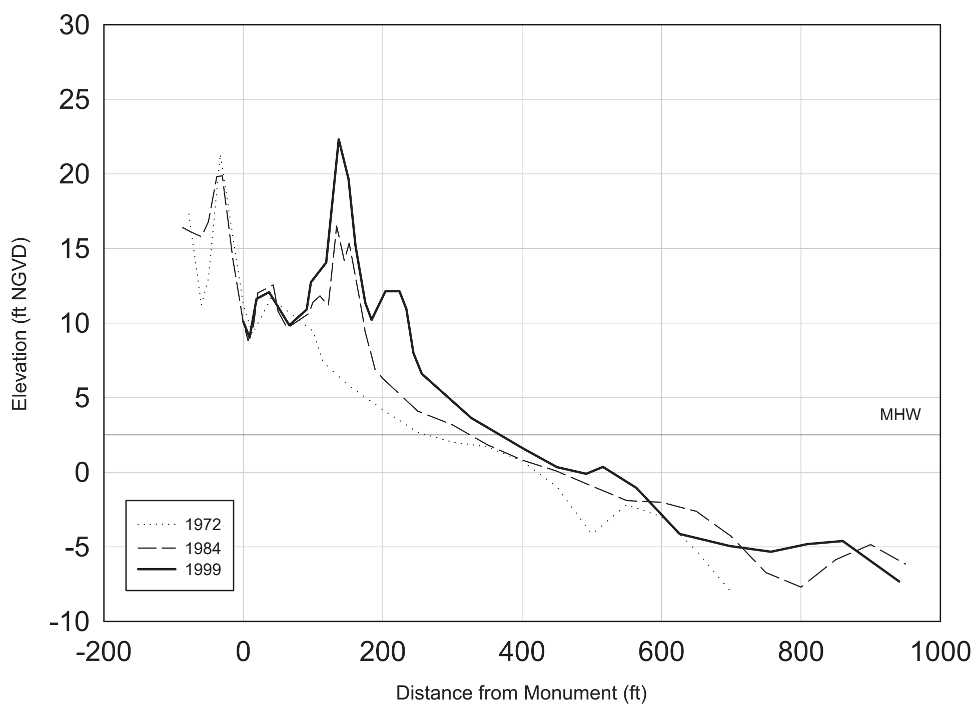
St. Johns County
R-145



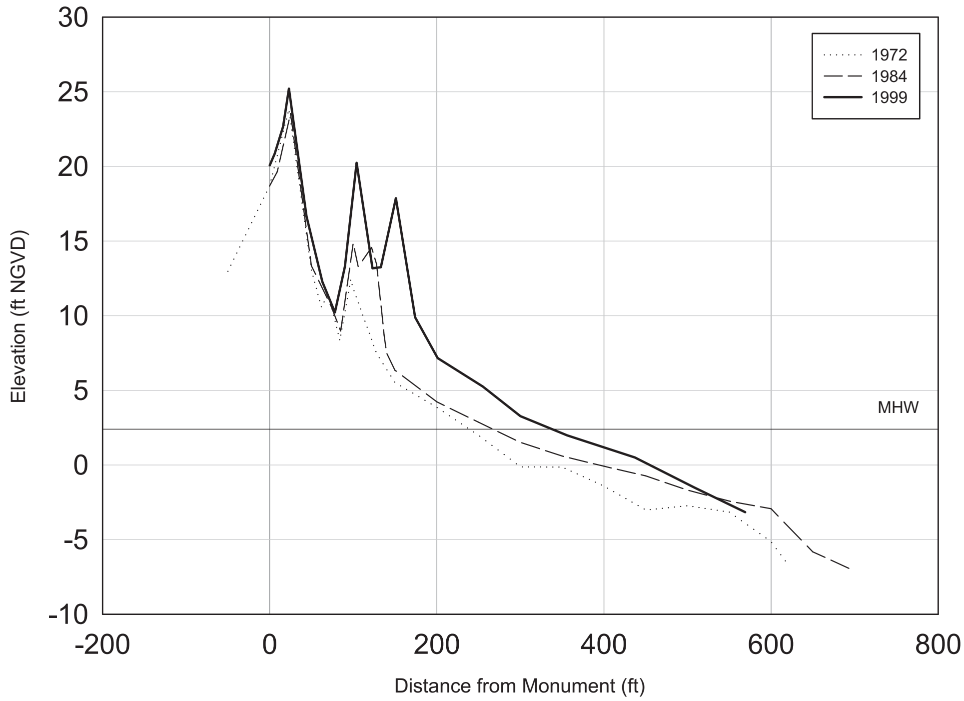
St. Johns County
R-152



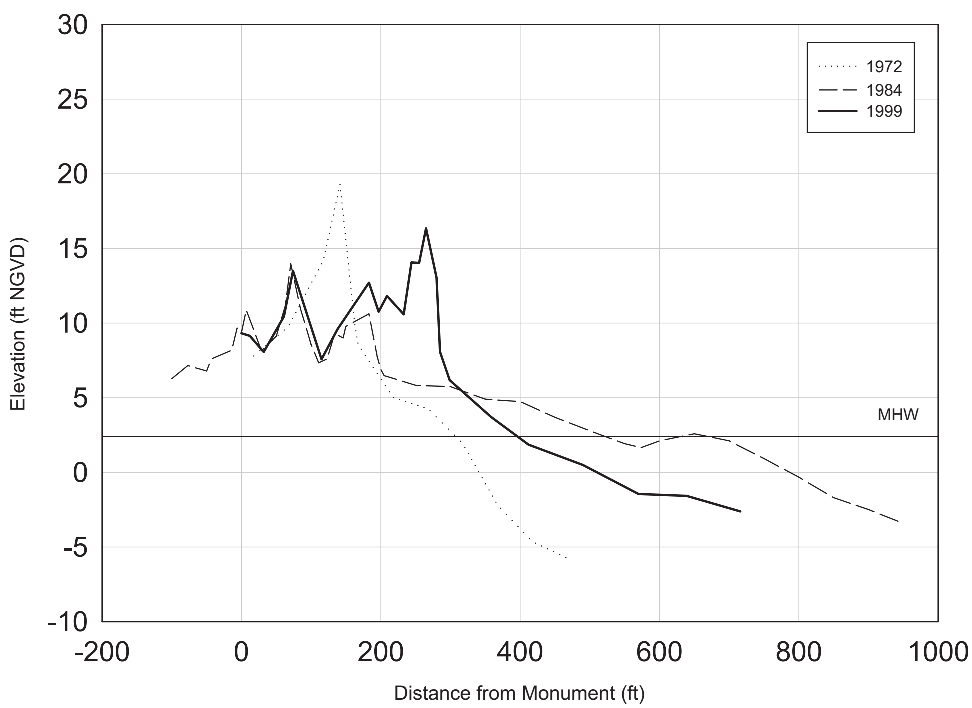
St. Johns County
R-168

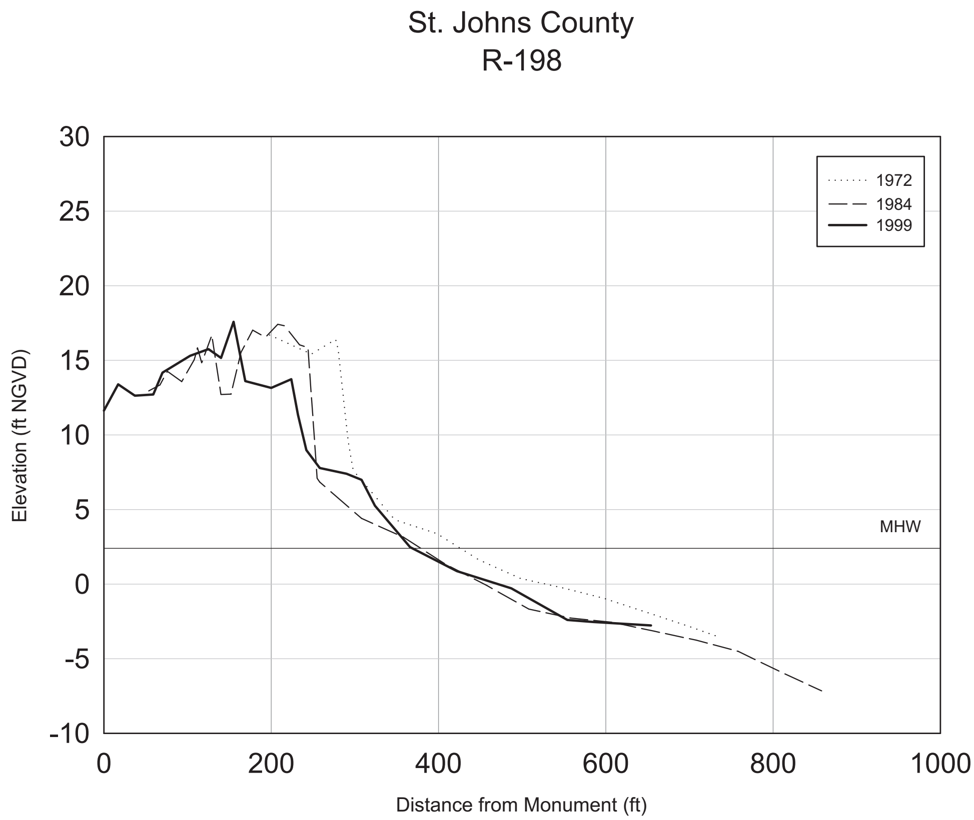


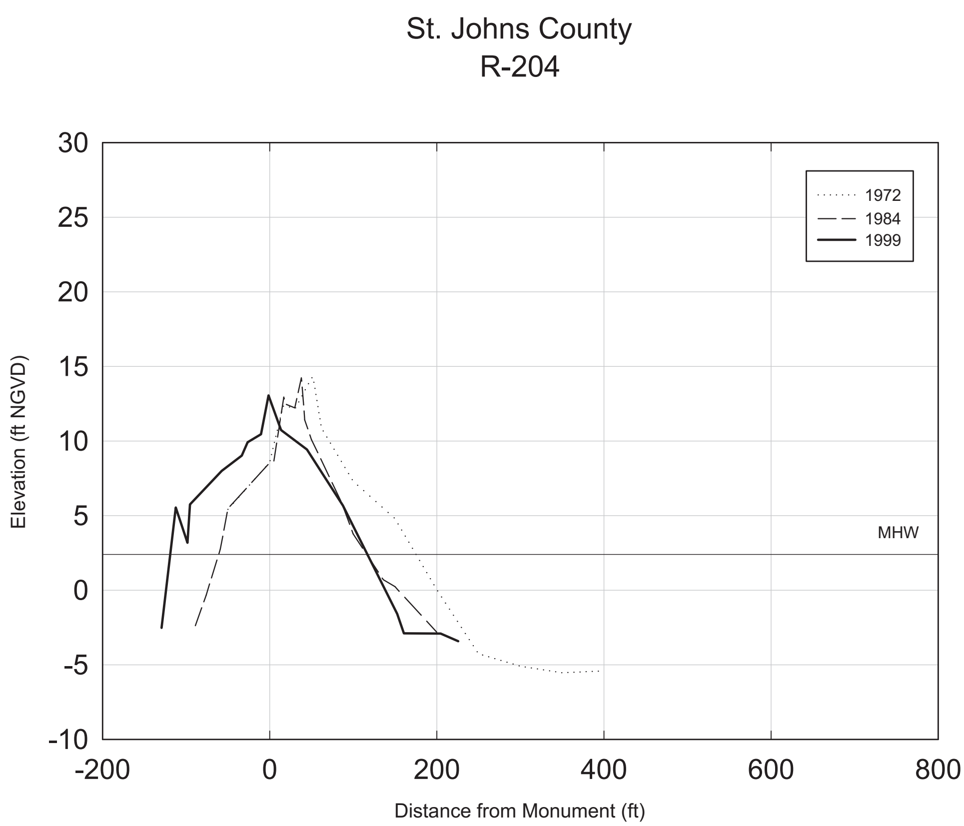
St. Johns County
R-183



St. Johns County
R-196




St. Johns County
R-198
1972
1984
1999
MHW
Elevation (ft NGVD)
Distance from Monument (ft)
30
25
20
15
10
5
0
-5
-10
0
200
400
600
800
1000


St. Johns County
R-204
1972
1984
1999
MHW
Elevation (ft NGVD)
Distance from Monument (ft)
30
25
20
15
10
5
0
-5
-10
-200
0
200
400
600
800