Shoreline Change Rate Estimates

Volusia 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. 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

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1 EXECUTIVE SUMMARY

Most of the Atlantic coast of Volusia County is characterized by flat, fine grain sand beaches, although there are transitions to coarser grain beaches at both ends. The county is highly developed and heavily armored. The jetties at Ponce de Leon Inlet were constructed 1968-1971, and have been and continue to be modified through the present.

An analysis was performed of the best data available, from DEP field surveys of 1972, 1987-8, 1993, and 1997. These data indicate either stable or accretionary MHW conditions in all areas north of Ponce de Leon Inlet, a shoal-influenced, fluctuating and relatively unpredictable zone immediately south of the inlet, and then a progressive but so far mild erosion pattern southward through the end of the developed coastline. This latter erosion pattern may get worse in the future.

Since future climatic conditions such as sea level rise are uncertain, it is recommended for planning purposes that an erosion rate estimate of -1 ft/yr be considered for use in all stable or accretionary areas.

Because of the extensive armoring and very seaward construction typical in the county, storms and high tide winter waves lower the already low and flat beach profile and impact against the armoring on a frequent basis. It is unknown how effective the armoring will be against one or more major storms. Certainly there is the potential for serious storm damage throughout the county.

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

Volusia County is located in northeast Florida, just north of Cape Canaveral (Figure 1). The coastline exists as two barrier islands separated by Ponce de Leon Inlet. Behind the barrier islands is the Intracoastal Waterway, which includes Halifax River and Indian River.

Volusia County contains 234 DEP survey reference points, generally designated as "R" monuments, spaced approximately 1000 ft (300m) apart. This report uses these reference points to locate various items within the county.

Volusia County is considered to be highly developed with a combination of multifamily and single family dwellings. The majority of these are fronted by seawalls or rock revetments.

There are three significant public park areas along this coast. In the north, R-1 to R-16, is the North Peninsula State recreation Area. On both sides of Ponce Inlet, R-146 to R-153, there is a county-administered park. From R-208 southward is the northern part of Canaveral National Seashore.

3.2 Coastal Setting

The beach ridge varies in width from 300-3,000 feet. The type of sand in the central part of the county (approximately R-57 to R-195) is primarily fine grain quartz, resulting in low, flat beaches with a large horizontal tide range. There is a long time tradition of beach driving. In the few locations where buildings do not exist, there are extensive dunes. In the northern and southern parts of the county, there are transitions to beaches composed of a shell-quartz mixture, with steeper beach slopes and lower dunes. The north and south park zones have beaches of the mixed sand type.

3.2.1 Waves and Tides

The mean tidal range is about 2.8 ft at Ponce de Leon Inlet and spring tides can reach 3.2 ft (National Ocean Service, 1988). The tides are semidiurnal.

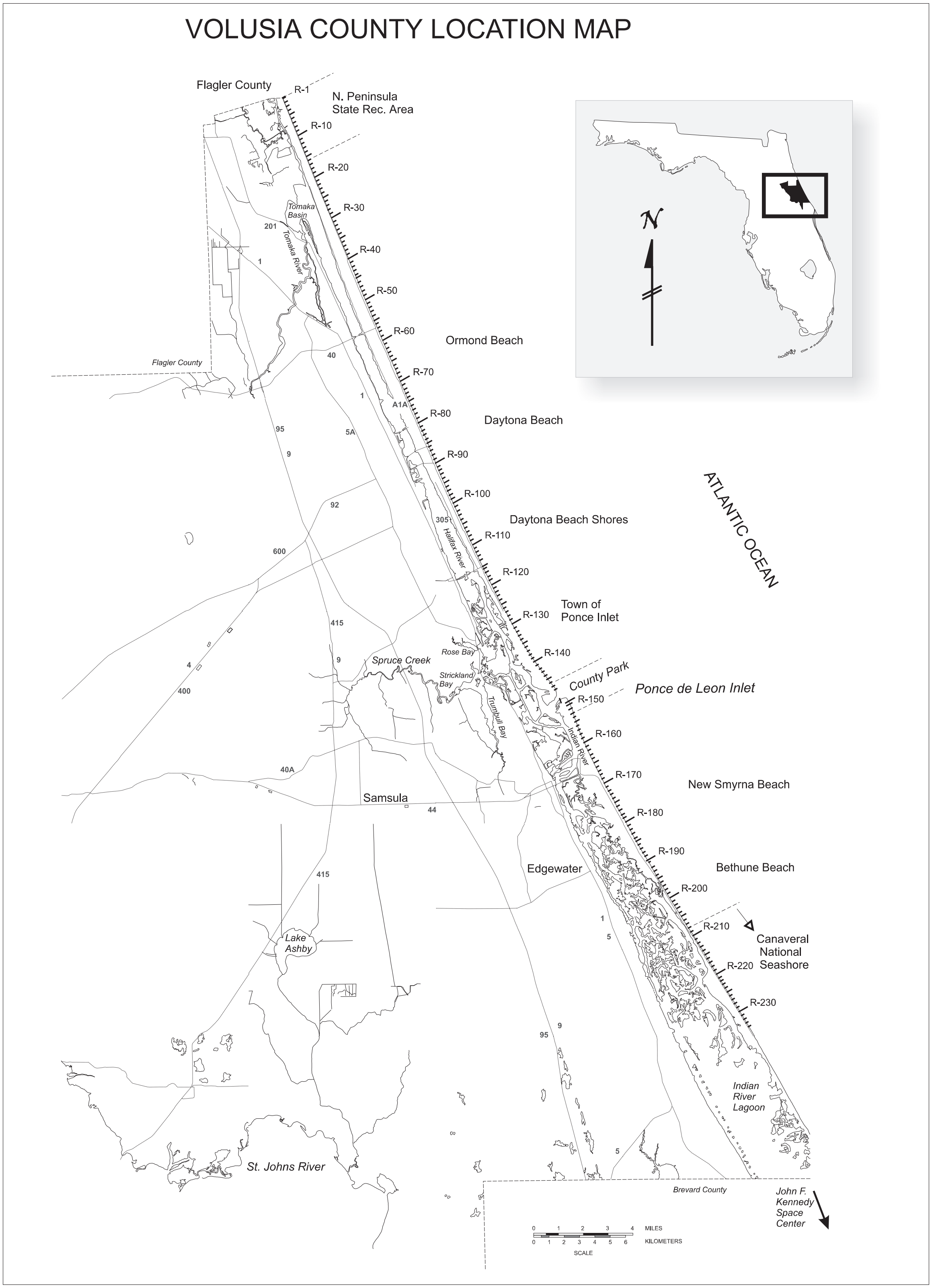

Figure 1. Study area showing Volusia County, Florida.

The average annual wave height for the county is about 2.1 ft with periods of between 6.2 and 7.3 seconds. The majority of waves approach from the north and east, while most of the largest waves arrive out of the northeast (USACE, 1983).

3.2.2 Longshore Transport

The net annual littoral drift in the county is to the south, based on the accretion and erosion patterns that have eventually developed north and south of Ponce Inlet, respectively. There is wide variation in the estimates of the magnitude of sediment transport. The U.S. Army Corps of Engineers estimated the net volume of sediment transport as 500,000 yd^3 to the south (USACE, 1983 and Dean and O'Brien, 1987). However, Walton (1976) provided an estimate of only 77,000 yd^3 to the south. There is a large amount of sand in this coast's nearshore bar formations and inlet shoals. It is difficult to ascertain how much sand is bypassed south of Ponce Inlet, but it will be seen that only a relatively mild erosion pattern has formed southward of the inlet thus far.

3.2.3 Storms

There have been numerous hurricanes and northeaster storms that have affected northeast Florida. Of note is the 1984 Thanksgiving Day northeaster storm, which lasted several days and was therefore particularly erosive. 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. 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. There is no evidence that the beaches of Volusia County have been so affected, except perhaps by the proliferation of coastal armoring.

3.3 Inlets

3.3.1 Ponce de Leon

Ponce de Leon Inlet was a large natural inlet which has only in recent times been stabilized and maintained by jetties and dredging. There were largely unsuccessful dredging operations in the mid 1930's and 1940's.

Construction began on the north and south jetties in 1968 and both were finished by 1971, with the interior and entrance channels dredged later that same year and through July 1972. Presently, the north and south jetties are about 4,200 ft and 2,700 ft long, respectively, although only a small portion of the south jetty extends into the Atlantic. A weir was included in the original north jetty design to allow southward littoral drift to accumulate in an impoundment basin inside the inlet adjacent to the north jetty.

The beaches to the north and the inside area west of the north jetty became erosional after construction of the jetty (UF/COEL, 1973, and Purpura and Chiu, 1977, and Jones and Mehta, 1977).

The north jetty weir was closed in late 1984 or early 1985, and the north jetty was tightened and repaired. Since then, the area west of the north jetty, inside the inlet, has become increasingly erosional, and the beaches to the north have apparently stabilized and may be accretional. This latter pattern has been obscured by the two major renourishments of 1985 and 1989, discussed in later sections.

Since 1972, the area inside the inlet adjacent to the south jetty has been accretional (UF/COEL 1973, Purpura and Chiu 1977, and DEP aerial photos). Also, the main channel has aligned itself along the interior side of the north jetty, despite numerous dredging attempts to center the channel within the jetties.

In hindsight it is not surprising that these problems have occurred. The short and porous south jetty combined with a large, wave refracting, south side ebb shoal and immediate post-construction south side beach nourishment, should indeed have led to significant accretion within the inlet from the south, pressuring the channel northward. Also the jetties are oriented such that the flood tidal flow enters from the east with a westward flow momentum. This directional momentum, coupled with waves entering the inlet between the jetties, should indeed have led to significant erosion of the southwesterly-oriented interior shoreline on the north side of the inlet. There is currently a proposal to extend the south jetty 1000 feet seaward, and a revetment along the north side interior shoreline is currently being extended approximately 900 feet.

3.4 Engineering Projects

3.4.1 Beach Nourishments

Beach nourishment in Volusia County has been concurrent with the dredging of Ponce de Leon Inlet and localized to adjacent beaches.

Table 1 lists inlet maintenance dredging and nourishment events based on information from USACE (1998) and on information received from USACE in 4/2000.

Table 1. List of inlet maintenance dredging and nourishment events

Date	Contract Quantity (yd^3)	Disposal Area
7/71 - 2/72	178,000	Beach south of south jetty
8/71 - 8/72	400,000	`` `` `` `` ``
3 - 4/73	120,000	Open water offshore
4 - 8/74	89,000	Beach north of north jetty
4 - 8/74	434,000	Beach west of north jetty, breach closure within inlet
5 - 6/75	138,000	North offshore
3/76	13,000	North offshore
8 - 9/76	38,000	Open water offshore
11/77 - 7/78	435,000	Beach north of north jetty
11/78 - 3/79	41,000	North offshore
5 - 8/84	82,000	Beach north of north jetty
4 - 5/85	887,000	`` `` `` `` ``
3 - 12/89	869,000	`` `` `` `` ``
1994	215,000	Beach west of north jetty, within inlet

3.4.2 Structures

In addition to having the Ponce de Leon Inlet jetties, previously described, Volusia County is heavily armored, especially within the cities of Ormond Beach, Daytona Beach, Daytona Beach Shores, New Smyrna Beach and Bethune Beach. There are also ocean piers between R-83 and R-84, and between R-117 and R-118. Ocean piers generally act as permeable groins.

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).

Volusia County has been found to be a special case in which normal methodology procedures had to be modified by limiting the data used in rate calculations only to the highest accuracy, quality-controlled data from DEP field surveys. The reason for this is that the majority of this county has flat, fine grain sand beaches. It is difficult to locate the MHW elevation contour accurately except via field survey. The following factors are involved: a large horizontal tide range, large seasonal beach width changes, frequent high wave conditions causing runup on the flat beaches, and high reflectivity white sand affecting sun glare in aerial photos. All these factors make

MHW location via aerial photos, the primary method employed in modern U. S. Government topographic maps, problematic. Those sources tend to show a great deal of noise in the shoreline location. Still earlier surveying by planetable methods and first generation aerial photography probably have similar problems, in addition to possible horizontal and vertical control difficulties. Outside of the vicinity of relatively recent inlet and beach nourishment effects, it will be seen that the most accurate data from 1972 to 1993/1997 show only very subtle shoreline changes. To capture that type of low level change essentially limits the quantitative analysis to the best available data, remaining mindful of seasonal fluctuations.

It is worth noting that the earliest data for this county from the 1800's suggest overall accretion, almost county-wide , since that time (see stack plots of Appendix B). It simply isn't known if this is correct or realistic, given the general lack of such accretion in our modern most accurate data. However, it will be seen that there is indeed an accretionary pattern occurring in the northern part of the county that has been progressing southward. Whether this has any significance relative to the suggestion offered by the earliest data is unknown. It will be interesting to see how this accretionary pattern evolves over the next few decades.

5 SHORELINE CHANGE

For the purposes of this discussion, it is helpful to divide coastal Volusia County into three zones, from north to south. Effects related to Ponce de Leon Inlet define the boundaries of these divisions. Shoreline (MHW) change rate estimates are provided in Figures 2 and 6 and Table A-1 (Appendix A).

5.1 North Zone, R-1 to R-120

Figure 3 shows in plan view the majority of this zone. Notable are two features: a minor headland between approximately R-25 and R-45, and a seaward point between R-83 and R-84 associated with a large ocean pier. The area between about R-65 and R-89 in general is slightly seaward and may possibly be considered a minor headland feature as well. These minor headland features could be a result of subsurface hard features and / or low wave refraction patterns caused by offshore topography. There is also a progressively seaward offset to the seawalls north of the pier which may add to the pier's effect.

The reach from R-1 to approximately R-38 is essentially identical in sand type and beach characteristics to the beaches of Flagler County to the north. The sand is a broken shell and fine quartz mixture, the beaches are relatively steep in profile, and there has been no measurable MHW erosion from 1972 to 1987-8/1989. There is no 1997 data through R-56. The calculated erosion rates are all positive, between +0.5 and +1.5 ft/yr. The subreach between R-1 and R-16 is state owned parkland.

The reach between about R-18 and R-57 is more closely examined in the slightly enlarged plan view of Figure 4 which includes 1989 data. This shows that an accretion pattern has grown and spread southward across and beyond the minor headland feature in that area. Data from 1993, not included in the figure for clarity reasons, shows the accretion still in place at that time. A field inspection by the authors in April 2000 confirmed its' continued existence through about R-57. The accreted sand appears to be composed of transitional material, i.e. a mixture of the shell hash of the north and the fine sand of the south.

The cause is as yet unknown, but the timing of most of the buildup is in the five years after the major 1984 northeaster storm. It remains unknown whether the accretion will continue and spread further southward.

The MHW shoreline in the remainder of this first zone, from R-57 to R-120, has remained relatively stable, with rates of zero to +0.5 ft/yr. Over the 25 year time period considered, and recalling the flatness of the beach and observed large seasonal changes, these MHW changes are most likely insignificant.

5.2 North Side of Inlet Zone, R-120 to R-148

The plan view shoreline map of Figure 5 shows net accretion throughout this zone since 1972. It also apparently shows one of the nourishment projects which occurred in this area, visible in the 1987-8 shoreline. Recall that there were two large nourishments (in 1985 and 1989) following the north jetty weir closure and repairs of 1984/85.

Our data in this zone is very limited and randomly spaced in time relative to events which had controlling effects on the coastal processes. As previously mentioned, when the north jetty was originally constructed (1968-71) it had a large weir section. The shoreline north of the inlet became erosive, as reported by UF/COEL (1973) and Purpura and Chiu (1977), and as is evident in DEP aerial photography of 1978. Nourishment projects along the north beaches became necessary. The largest of these was in 1977-78 (see Table 1 in previous section).

Finally the weir section was closed in 1984-85, which occurred coincident with a major northeaster storm in November 1984, and was followed by the two large nourishment projects along the northern beaches. It is difficult to say what proportion of the net accretion of the MHW shoreline since 1972, as shown in Figure 5, is due to the nourishments and which is due to transport into the area from further north. It is noted that the one nourishment captured in part by the 1987-88 survey, as shown in Figure 5, is a significant fraction of the net gain. Two such projects of similar size did occur, so probably a large percentage of the net accretion 1972-1997 is due to the nourishments. The fact that those fills have remained in the area and the shoreline in this zone has achieved an orientation expected by theory, indicates that the weir closure was successful in stabilizing the northern shoreline.

Trying to calculate meaningful shoreline change rates with the available data is a problem. The starting point would have to be early 1985 and there would have to have been no large beach nourishments. In other words, the data doesn't exist to make rate calculations that represent normal conditions or can lead to usable predictions. Essentially all that can be said is that, provided the north jetty remains intact, there should be a mildly stable or accreting shoreline in the second zone of Volusia County. The MHW shoreline change rates given in Figure 2 and Table A-1 for this zone are simply net changes expressed as a rate, and are strongly affected by the nourishments.

5.3 South of the Inlet Zone, R-149 to R-234

MHW shoreline change rates for this portion of Volusia County are plotted in Figure 6, and a plan view map is shown in Figure 7. A slightly enlarged plan view is given in Figure 8, to show in clearer detail the net changes closer to the inlet.

Immediately south of the inlet, R-149 to about R-167, there has been a cycle first of erosion, then of accretion, 1972-1997. This area is affected by the large ebb shoal offshore, which changes both randomly and as a result of the inlet stabilization and dredging activities. It is uncertain what effect the expected south jetty extension will have on either the shoreline or the ebb shoals. The rate calculations for the R-149 to R-155 area merely indicate the net trend over the given time period, and are not considered to be reasonable indications of the present or future in this area.

From R-162 southward, the data suggest the gradual development of a progressive, southward-spreading erosion pattern commonly found downdrift of ebb-shoal sheltered areas and inlets. This type of pattern was discussed by Foster (1995). The calculated rates are highest in the northern part of the erosion zone, at -1.5 ft/yr, and taper off gradually southward. It is observed that these rates are not nearly as high as experienced downdrift of many other inlets. Most likely this is because there is enough natural bypassing around the inlet and through the ebb shoals to prevent extreme erosion so far. It is also noted that there is considerable uncertainty in the magnitude of net transport southward.

As mentioned previously, most of the R-161 to R-208 area is armored with seawalls or revetments. Since the data indicates there has been a relatively low level of ongoing erosion, the armoring has primarily been a response to building too close to the ocean with subsequent storm damages, especially in the southernmost zones which were the last to armor. Other researchers, notably Hine (1989) and Allan (1991), have reached similar conclusions about the armoring, low level erosion, and building too close to the sea in that area.

However, if the erosion pattern from R-162 southward gets worse, as it can and very possibly will do, given the uncertain sand supply, then beach nourishments may become necessary to maintain any beach seaward of the armoring along this active zone. It is noted that there is now an approved disposal zone for dredged sand between approximately R-159 and R-161.

Please refer to the executive summary at the beginning of this report for a brief synopsis of these findings.

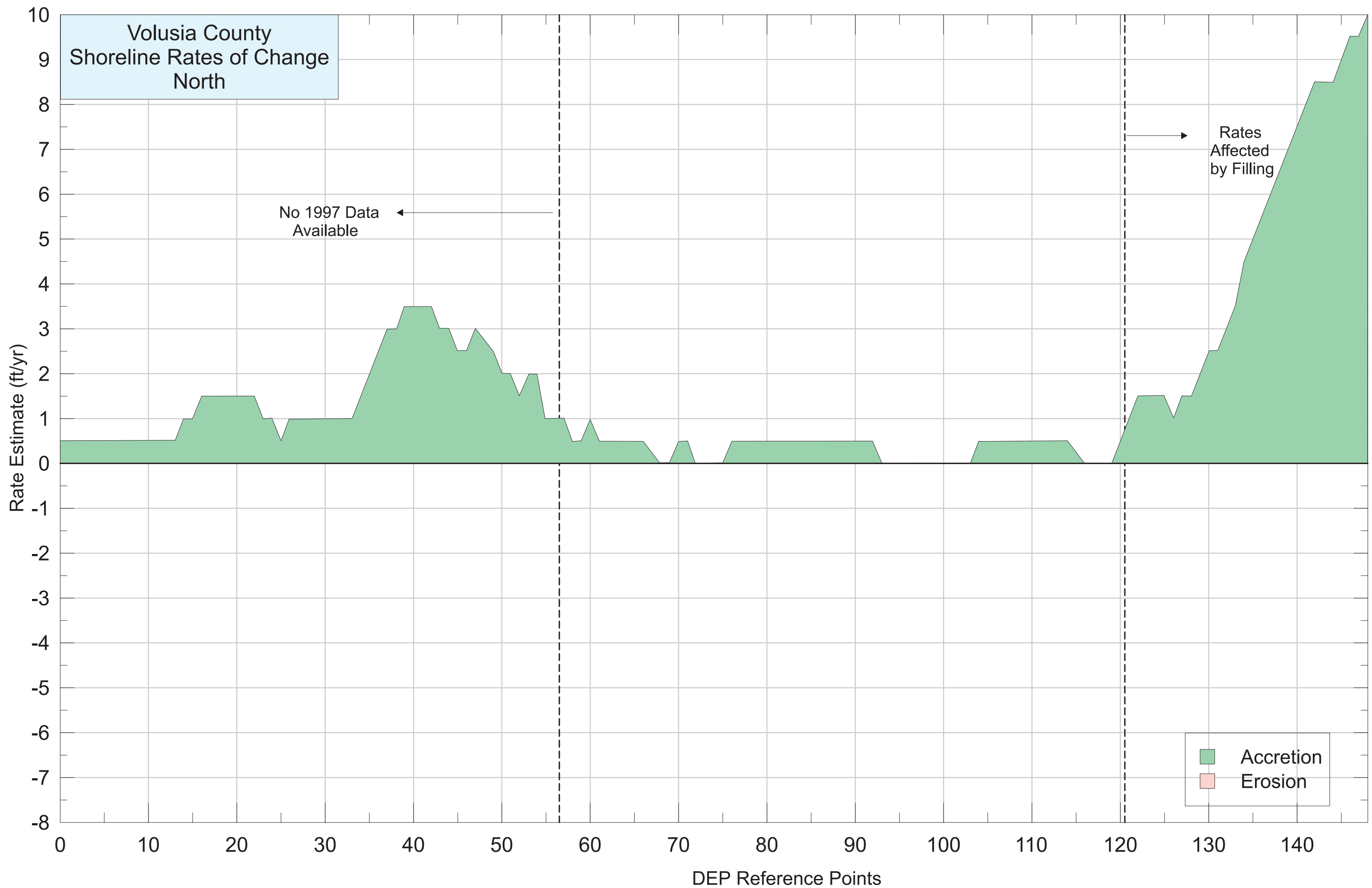

Figure 2. Shoreline rate of change estimates for Volusia County, Florida (north).

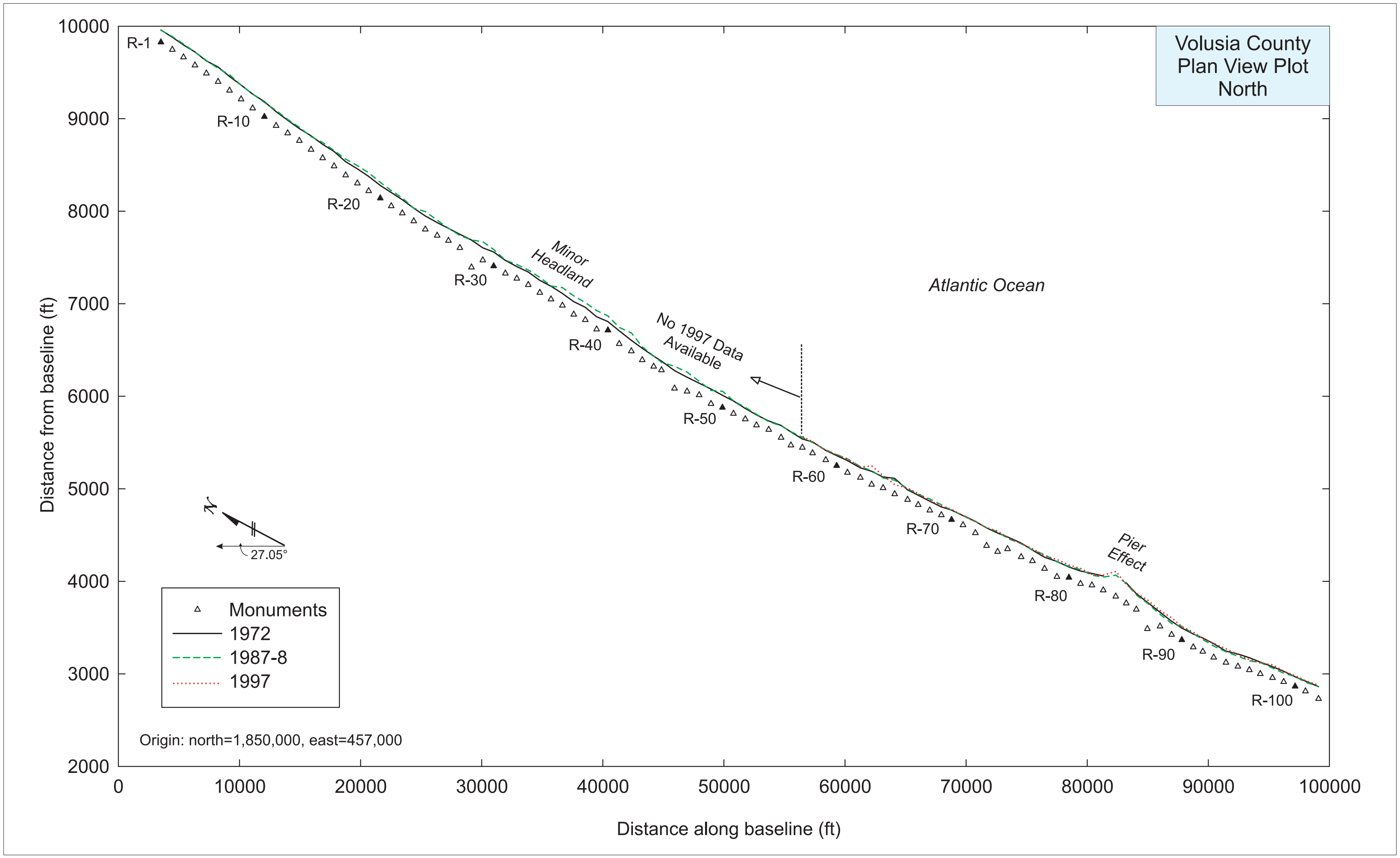

Figure 3. Plan view map of Volusia County, Florida (from R-1 to R-102), comparing years 1972, 1987-8, and 1997.

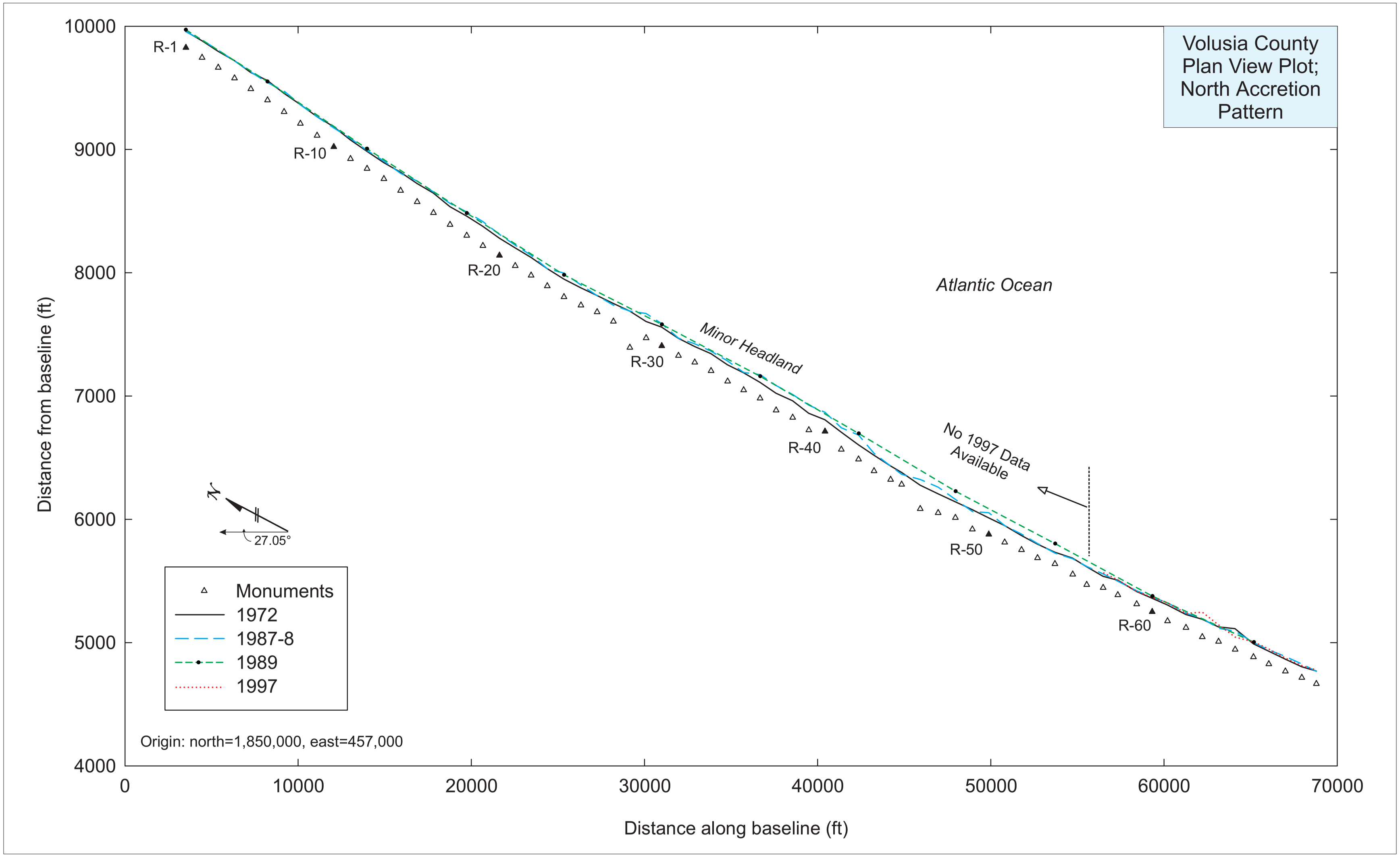

Figure 4. Plan view map of Volusia County, Florida (from R-1 to R-70), comparing years 1972, 1987-8, 1989, and 1997.

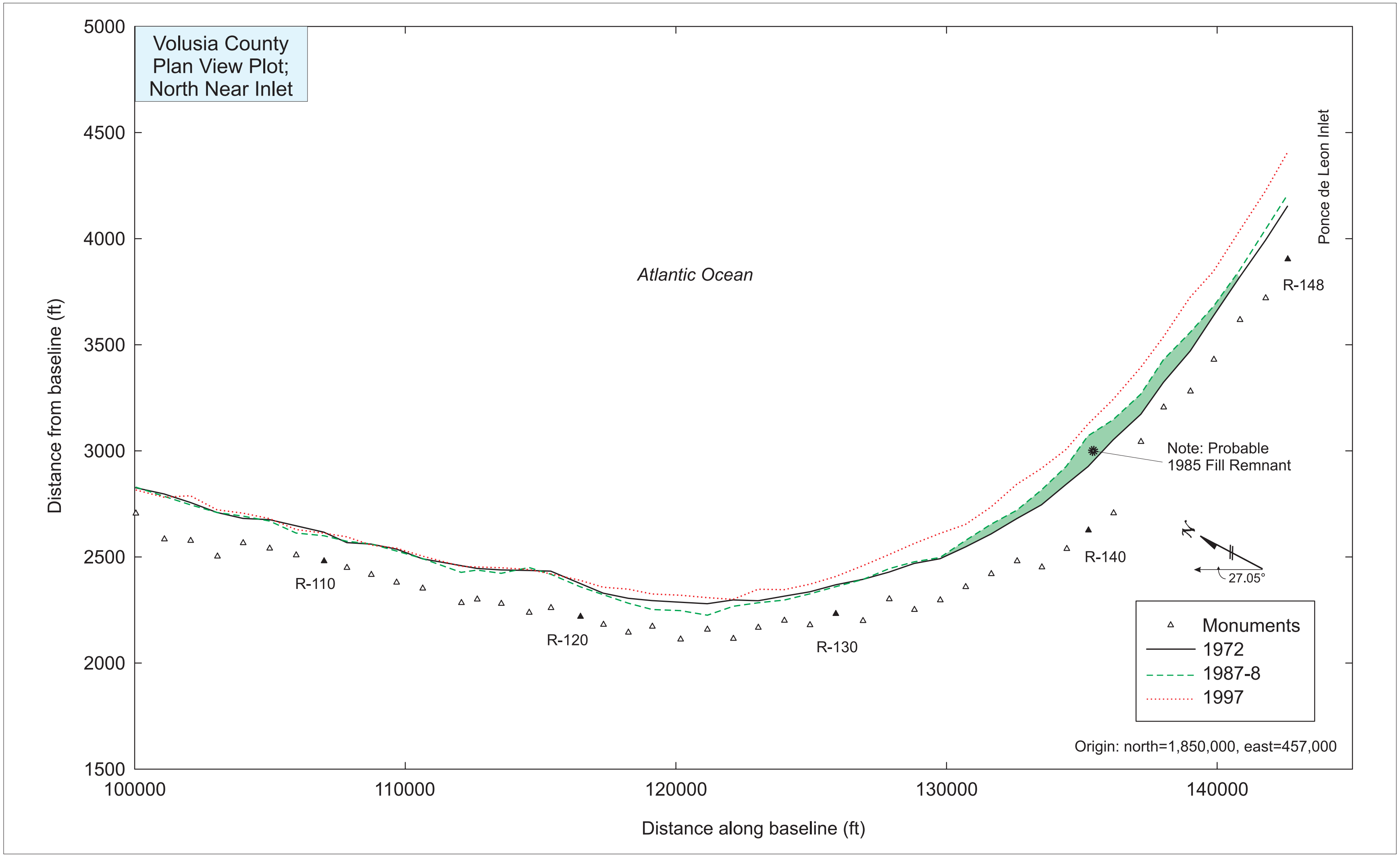

Figure 5. Plan view map of Volusia County, Florida (from R-103 to R-148), comparing years 1972, 1987-8, and 1997.

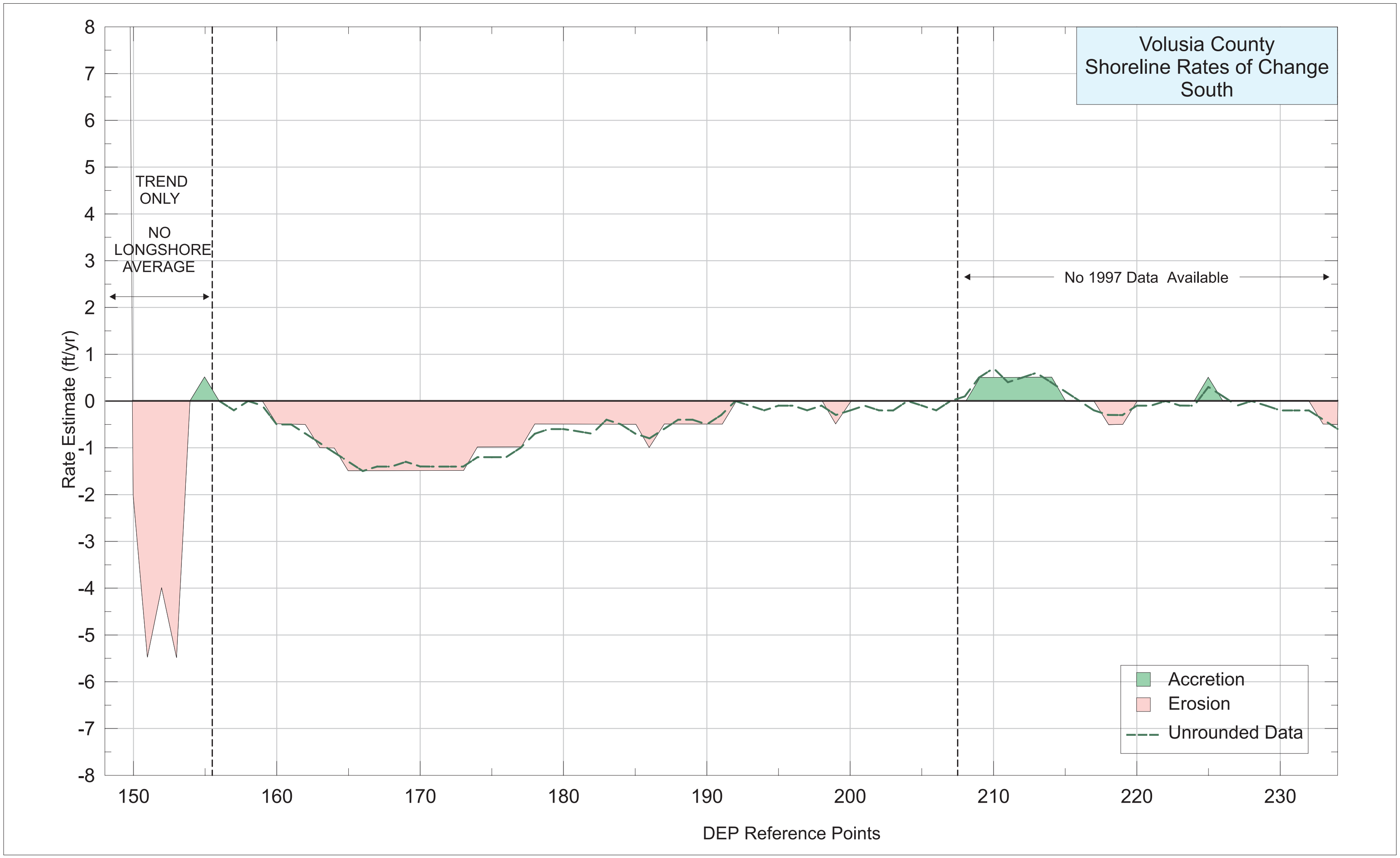

Figure 6. Shoreline rate of change estimates for Volusia County, Florida (south).

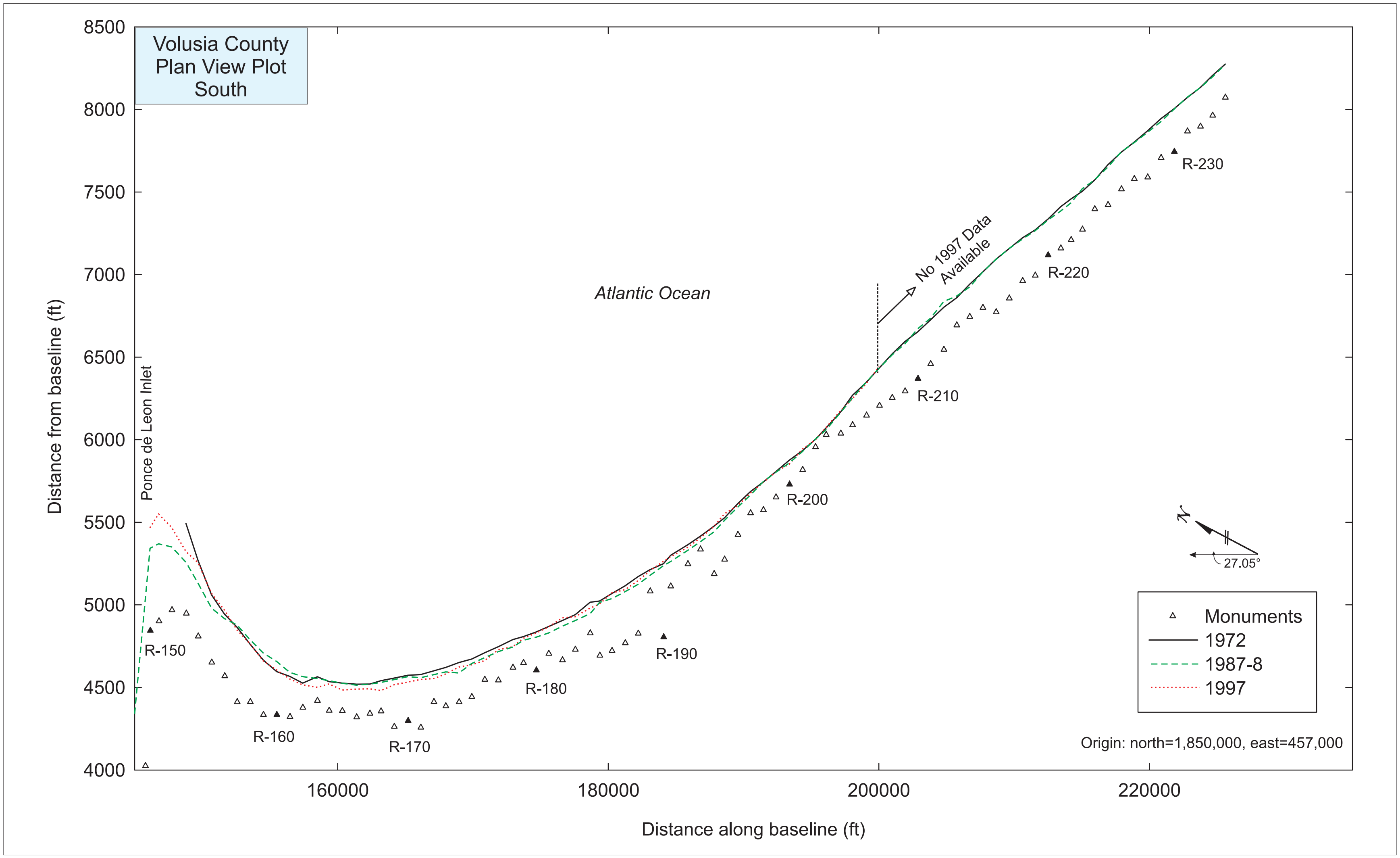

Figure 7. Plan view map of Volusia County, Florida (from R-150 to R-234), comparing years 1972, 1987-8, and 1997.

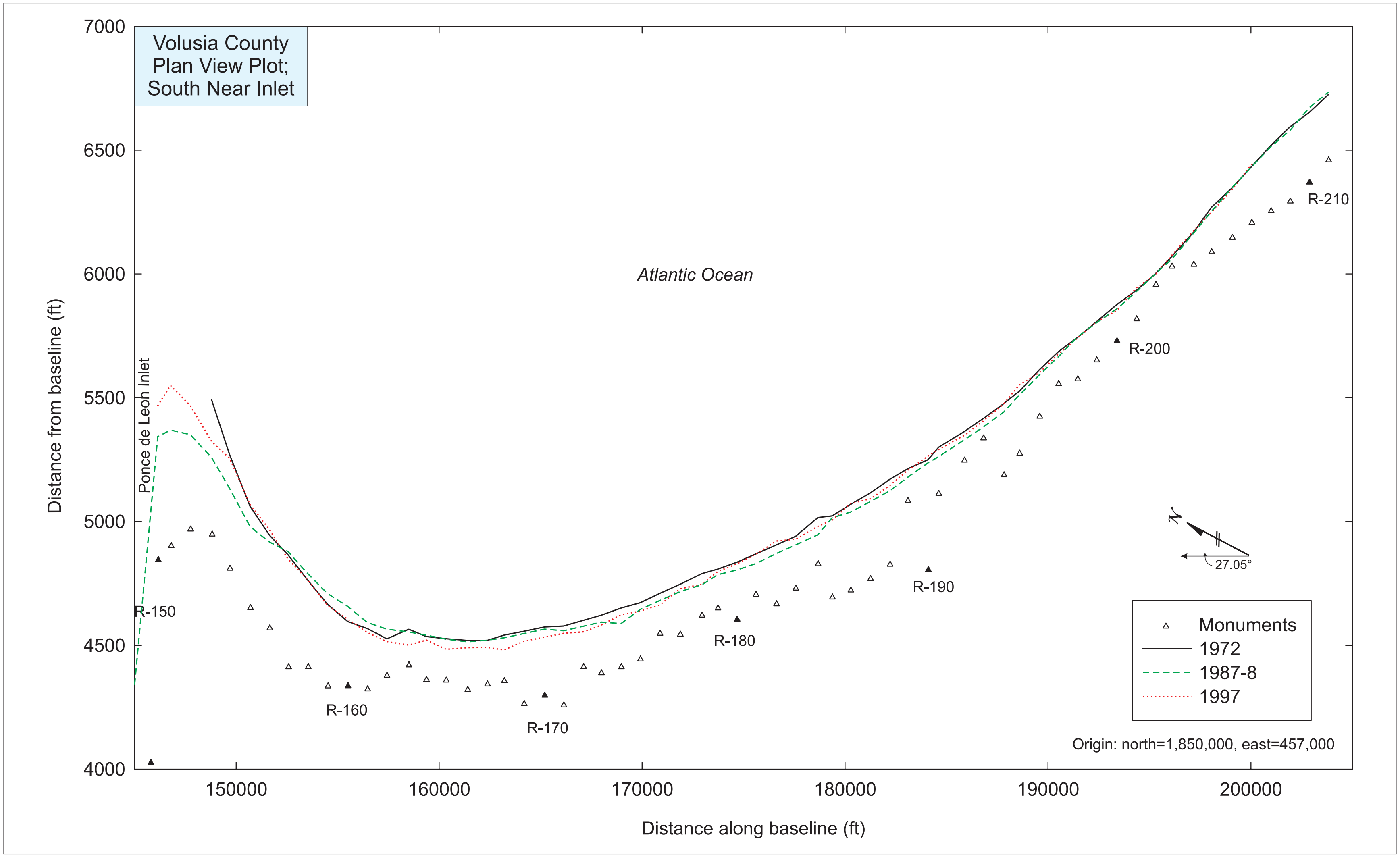

Figure 8. Plan view map of Volusia County, Florida (from R-150 to R-211), comparing years 1972, 1987-8, and 1997.

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7 APPENDICES

7.1 Appendix A: Shoreline Change Rate Estimates

Table A-1: This table provides rates based on the method described in Section 4.

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

Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
1	1972-1993	0.8	0.7	0.9	0.5	7 pt avg
2	1972-1987	0.4	0.4	0.4	0.5	↓
3	1972-1993	0.2	0.3	0.2	0.5	
4	1972-1987	-0.2	-0.2	-0.2	0.5	
5	1972-1987	0.2	0.2	0.2	0.5	
6	1972-1993	0.2	0.3	0.9	0.5	
7	1972-1987	1.2	1.2	1.2	0.5	
8	1972-1987	-0.1	-0.1	-0.1	0.5	
9	1972-1993	0.8	1.5	1.4	0.5	
10	1972-1987	-0.7	-0.7	-0.7	0.5	
11	1972-1987	0.8	0.8	0.8	0.5	
12	1972-1993	0.4	0.8	0.4	0.5	
13	1972-1987	0.9	0.9	0.9	0.5	
14	1972-1987	-0.6	-0.6	-0.6	1.0	
15	1972-1993	1.7	1.7	1.7	1.0	
16	1972-1987	0.6	0.6	0.6	1.5	
17	1972-1987	1.7	1.7	1.7	1.5	
18	1972-1993	2.1	2.0	1.8	1.5	
19	1972-1987	2.6	2.6	2.6	1.5	
20	1972-1987	2.1	2.1	2.1	1.5	
21	1972-1993	0.8	1.3	0.8	1.5	
22	1972-1987	1.2	1.2	1.2	1.5	
23	1972-1987	-0.1	-0.1	-0.1	1.0	
24	1972-1993	1.8	1.7	1.7	1.0	
25	1972-1987	1.6	1.6	1.6	0.5	
26	1972-1987	-0.1	-0.1	-0.1	1.0	
27	1972-1993	0.7	1.0	1.4	1.0	
28	1972-1987	-0.1	-0.1	-0.1	1.0	
29	1972-1987	4.3	4.3	4.3	1.0	
30	1972-1993	-0.1	-0.3	-1.6	1.0	
31	1972-1987	0.1	0.1	0.1	1.0	
32	1972-1987	1.4	1.4	1.4	1.0	

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

Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
33	1972-1993	1.2	1.5	1.3	1.0	
34	1972-1987	2.0	2.0	2.0	1.5	
35	1972-1987	0.1	0.1	0.1	2.0	
36	1972-1993	2.7	2.5	1.9	2.5	
37	1972-1987	4.1	4.1	4.1	3.0	
38	1972-1987	3.3	3.3	3.3	3.0	
39	1972-1993	4.8	4.9	4.9	3.5	
40	1972-1987	3.9	3.9	3.9	3.5	
41	1972-1987	2.3	2.3	2.3	3.5	
42	1972-1993	5.3	4.9	4.5	3.5	
43	1972-1987	1.0	1.0	1.0	3.0	
44	1972-1988	4.4	4.4	4.4	3.0	
45	1972-1993	4.1	2.8	2.8	2.5	
46	1972-1987	3.0	3.0	3.0	2.5	
47	1972-1987	3.6	3.6	3.6	3.0	
49	1972-1987	-1.1	-1.1	-1.1	2.5	
50	1972-1987	2.7	2.7	2.7	2.0	
51	1972-1993	5.5	.1	4.8	2.0	
52	1972-1987	0.7	0.7	0.7	1.5	
53	1972-1987	0.3	0.3	0.3	2.0	
54	1972-1989	2.2	2.7	4.1	2.0	
55	1972-1993	1.4	1.6	2.0	1.0	
56	1972-1987	0.1	0.1	0.1	1.0	
57	1972-1997	1.6	2.1	1.2	1.0	
58	1972-1997	0.1	0.0	0.1	0.5	
59	1972-1997	0.0	-0.1	0.0	0.5	
60	1972-1997	0.3	1.7	0.3	1.0	
61	1972-1997	0.7	0.7	0.7	0.5	
62	1972-1997	0.4	0.4	0.4	0.5	
63	1972-1997	2.4	2.1	2.3	0.5	
64	1972-1997	0.6	1.5	0.6	0.5	
65	1972-1997	-3.0	-2.7	-2.8	0.5	

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

Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
66	1972-1997	2.1	1.4	0.7	0.5	
68	1972-1997	0.3	0.4	0.3	0.0	
69	1972-1997	0.4	1.4	0.4	0.0	
70	1972-1997	0.3	0.3	0.3	0.5	
71	1972-1997	-0.1	-0.1	-0.1	0.5	
72	1972-1997	-0.3	0.4	-0.3	0.0	
73	1972-1997	0.0	0.0	0.0	0.0	
74	1972-1997	0.8	0.8	0.8	0.0	
75	1972-1997	-0.3	0.8	-0.3	0.0	
76	1972-1997	-0.4	-0.4	-0.4	0.5	
77	1972-1997	0.6	0.5	0.6	0.5	
78	1972-1997	0.6	0.8	0.6	0.5	
79	1972-1997	1.6	1.4	0.8	0.5	
80	1972-1997	0.8	0.8	0.8	0.5	
81	1972-1997	2.1	1.8	1.1	0.5	
82	1972-1997	-0.5	-0.6	-0.5	0.5	
83	1972-1997	0.4	0.3	0.4	0.5	
85	1972-1997	-0.8	-0.8	-0.8	0.5	
86	1972-1997	0.2	-0.1	0.2	0.5	
89	1972-1997	1.9	1.2	1.4	0.5	
90	1972-1997	0.6	0.9	0.6	0.5	
91	1972-1997	0.8	0.7	0.8	0.5	
92	1972-1997	-0.4	-0.5	-0.4	0.5	
93	1972-1997	0.1	0.8	0.1	0.0	
94	1972-1997	0.9	0.6	0.9	0.0	
95	1972-1997	-0.4	-0.5	-0.4	0.0	
96	1972-1997	-0.6	-0.4	-0.9	0.0	
97	1972-1997	-0.4	-0.4	-0.4	0.0	
98	1972-1997	0.9	0.7	0.9	0.0	
99	1972-1997	0.0	0.9	0.0	0.0	
100	1972-1997	0.4	0.4	0.4	0.0	
101	1972-1997	0.1	0.0	0.1	0.0	

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

Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
102	1972-1997	0.6	0.2	0.6	0.0	
103	1972-1997	-0.4	0.1	-0.4	0.0	
104	1972-1997	-0.5	-0.5	-0.5	0.5	
105	1972-1997	0.9	1.0	1.3	0.5	
106	1972-1997	0.5	0.5	0.5	0.5	
107	1972-1997	0.8	0.8	1.0	0.5	
108	1972-1997	0.2	1.1	0.2	0.5	
110	1972-1997	-0.2	-0.3	-0.2	0.5	
111	1972-1997	1.5	1.8	1.1	0.5	
112	1972-1997	-0.2	-0.1	-0.2	0.5	
113	1972-1997	0.2	0.1	0.2	0.5	
114	1972-1997	0.5	0.1	0.5	0.5	
116	1972-1997	0.3	0.2	0.3	0.0	
117	1972-1997	0.4	0.6	0.4	0.0	↑
118	1972-1997	0.2	0.1	0.2	0.0	5 pt avg
119	1972-1997	-0.5	-0.5	-0.5	0.0	3 pt avg
120	1972-1997	0.6	0.6	0.6	0.5	1 pt avg
BEGIN FILL AND INLET INFLUENCED ZONE, EP ONLY						
121	1972-1997			1.1	1.0	1 pt avg
122	1972-1997			1.7	1.5	3 pt avg
123	1972-1997			1.2	1.5	5 pt avg
124	1972-1997			1.3	1.5	7 pt avg
125	1972-1997			1.2	1.5	↓
126	1972-1997			0.1	1.0	
127	1972-1997			2.2	1.5	
128	1972-1997			1.2	1.5	
129	1972-1997			1.4	2.0	
130	1972-1997			1.6	2.5	
131	1972-1997			2.6	2.5	
132	1972-1997			3.3	3.0	
133	1972-1997			3.8	3.5	
134	1972-1997			4.8	4.5	

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

Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
135	1972-1997			4.3	5.0	
136	1972-1997			5.1	5.5	
137	1972-1997			6.5	6.0	
138	1972-1997			6.8	6.5	
139	1972-1997			6.6	7.0	
140	1972-1997			8.0	7.5	
141	1972-1997			7.6	8.0	
142	1972-1997			8.8	8.5	
143	1972-1997			8.5	8.5	
144	1972-1997			10.1	8.5	↑
145	1972-1997			8.3	9.0	7 pt avg
146	1972-1997			8.7	9.5	5 pt avg
147	1972-1997			9.2	9.5	3 pt avg
148	1972-1997			10.0	10.0	1 pt avg
Ponce de Leon Inlet						
149	1973/75-1987	48.8	42.8	45.2	45.5	
150	1973/75-1997	N/A	0.2	-4.2	-2.0	No RA used
151	1973/75-1997	N/A	-3.4	-7.5	-5.5	No RA used
152	1973/75-1997	N/A	-2.6	-5.6	-4.0	No RA used
153	1972-1997	N/A	-4.5	-6.9	-5.5	No RA used
154	1972-1997	N/A	1.0	-0.6	0.0	No RA used
155	1972-1997	N/A	0.7	0.4	0.5	No RA used
156	1972-1997	-0.9	-0.1	0.9	0.0	1 pt avg
157	1972-1997	-0.7	-0.5	-0.7	0.0	3 pt avg
158	1972-1997	0.0	0.2	0.0	0.0	5 pt avg
159	1972-1997	-0.2	0.6	-0.2	0.0	7 pt avg
160	1972-1997	0.4	0.7	0.4	-0.5	↓
161	1972-1997	-0.6	-0.4	-0.6	-0.5	
162	1972-1997	-0.4	0.1	-0.4	-0.5	
163	1972-1997	-3.1	-2.2	-2.5	-1.0	
164	1972-1997	-0.6	-0.5	-0.6	-1.0	
165	1972-1997	-2.0	-1.4	-1.7	-1.5	

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

Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
166	1972-1997	-0.8	-1.1	-1.2	-1.5	
167	1972-1997	-0.6	-1.1	-1.1	-1.5	
168	1972-1997	-1.9	-1.9	-2.4	-1.5	
169	1972-1997	-1.6	-1.6	-1.6	-1.5	
170	1972-1997	-1.8	-1.6	-1.6	-1.5	
171	1972-1997	-0.2	-0.5	-1.2	-1.5	
173	1972-1997	-1.6	-1.6	-1.6	-1.5	
174	1972-1997	-1.3	-0.8	-1.1	-1.0	
175	1972-1997	-1.6	-1.4	-1.4	-1.0	
176	1972-1997	-1.9	-1.9	-1.9	-1.0	
177	1972-1997	0.5	0.0	-0.7	-1.0	
178	1972-1997	-1.5	-1.8	-1.7	-0.5	
179	1972-1997	-0.4	-0.5	-0.4	-0.5	
180	1972-1997	-0.2	-0.5	-0.2	-0.5	
182	1972-1997	0.6	0.4	0.6	-0.5	
183	1972-1997	-0.5	-0.3	-0.5	-0.5	
184	1972-1997	-3.0	-1.7	-1.4	-0.5	
185	1972-1997	-0.7	-0.7	-0.7	-0.5	
186	1972-1997	0.2	0.2	0.2	-1.0	
187	1972-1997	-0.9	-1.0	-0.9	-0.5	
188	1972-1997	-2.0	-1.2	-1.0	-0.5	
189	1972-1997	-0.3	0.1	-0.3	-0.5	
190	1972-1997	0.6	0.5	0.6	-0.5	
191	1972-1997	-0.4	-0.6	-0.4	-0.5	
192	1972-1997	-0.6	0.0	-0.6	0.0	
193	1972-1997	-0.4	-0.6	-0.4	0.0	
194	1972-1997	0.0	-0.2	0.0	0.0	
195	1972-1997	0.5	0.9	1.0	0.0	
196	1972-1997	-0.5	-0.6	-0.5	0.0	
197	1972-1997	-0.4	-0.4	-0.4	0.0	
198	1972-1997	-0.1	0.2	-0.1	0.0	
199	1972-1997	-0.1	-0.1	-0.1	-0.5	

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

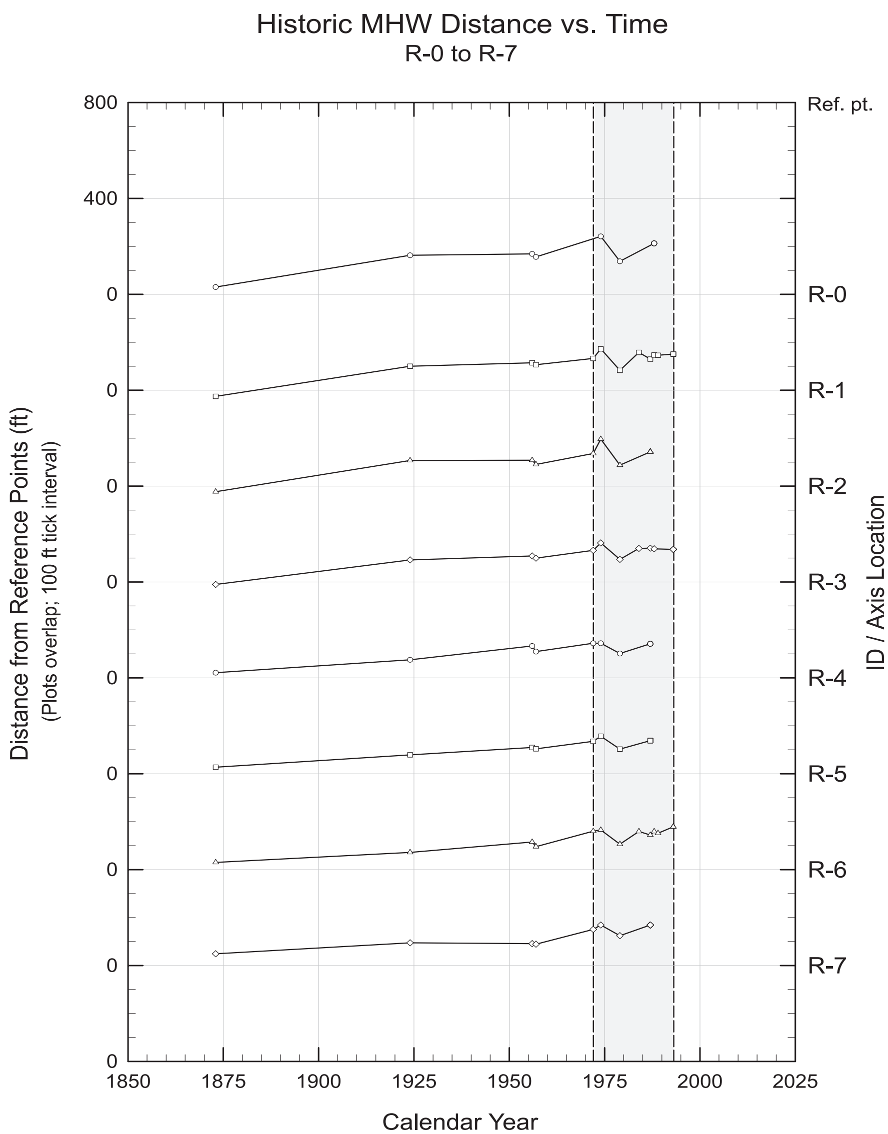
Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
200	1972-1997	-1.1	-1.0	-1.0	0.0	
201	1972-1997	0.4	0.3	0.4	0.0	
202	1972-1997	-0.2	-0.1	-0.2	0.0	
203	1972-1997	0.1	0.1	0.1	0.0	
204	1972-1997	0.3	0.3	0.3	0.0	
205	1972-1997	-0.8	-0.8	-0.8	0.0	
206	1972-1997	-0.2	-0.2	-0.2	0.0	
207	1972-1997	0.4	0.7	0.4	0.0	
208	1972-1988	-0.4	-0.4	-0.4	0.0	
209	1972-1988	-0.9	-0.9	-0.9	0.5	
210	1972-1993	1.6	1.6	2.3	0.5	
211	1972-1988	0.6	0.6	0.6	0.5	
212	1972-1988	2.2	2.2	2.2	0.5	
213	1972-1993	0.8	0.9	0.8	0.5	
214	1972-1988	-1.0	-1.0	-1.0	0.5	
215	1972-1988	0.0	0.0	0.0	0.0	
216	1972-1993	0.2	-0.1	0.2	0.0	
217	1972-1988	0.0	0.0	0.0	0.0	
218	1972-1988	-0.5	-0.5	-0.5	-0.5	
219	1972-1993	0.5	0.1	0.5	-0.5	
220	1972-1988	-0.4	-0.4	-0.4	0.0	
221	1972-1988	-1.6	-1.6	-1.6	0.0	
222	1972-1993	0.0	-0.2	0.0	0.0	
223	1972-1988	1.0	1.0	1.0	0.0	
224	1972-1988	0.1	0.4	0.1	0.0	
225	1972-1993	0.3	-0.1	0.3	0.5	
226	1972-1988	0.2	0.2	0.2	0.0	
227	1972-1988	-0.4	-0.4	-0.4	0.0	
228	1972-1993	0.6	0.6	0.6	0.0	
229	1972-1988	-1.1	-0.2	-1.1	0.0	
230	1972-1988	-0.2	-0.2	-0.2	0.0	↑

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

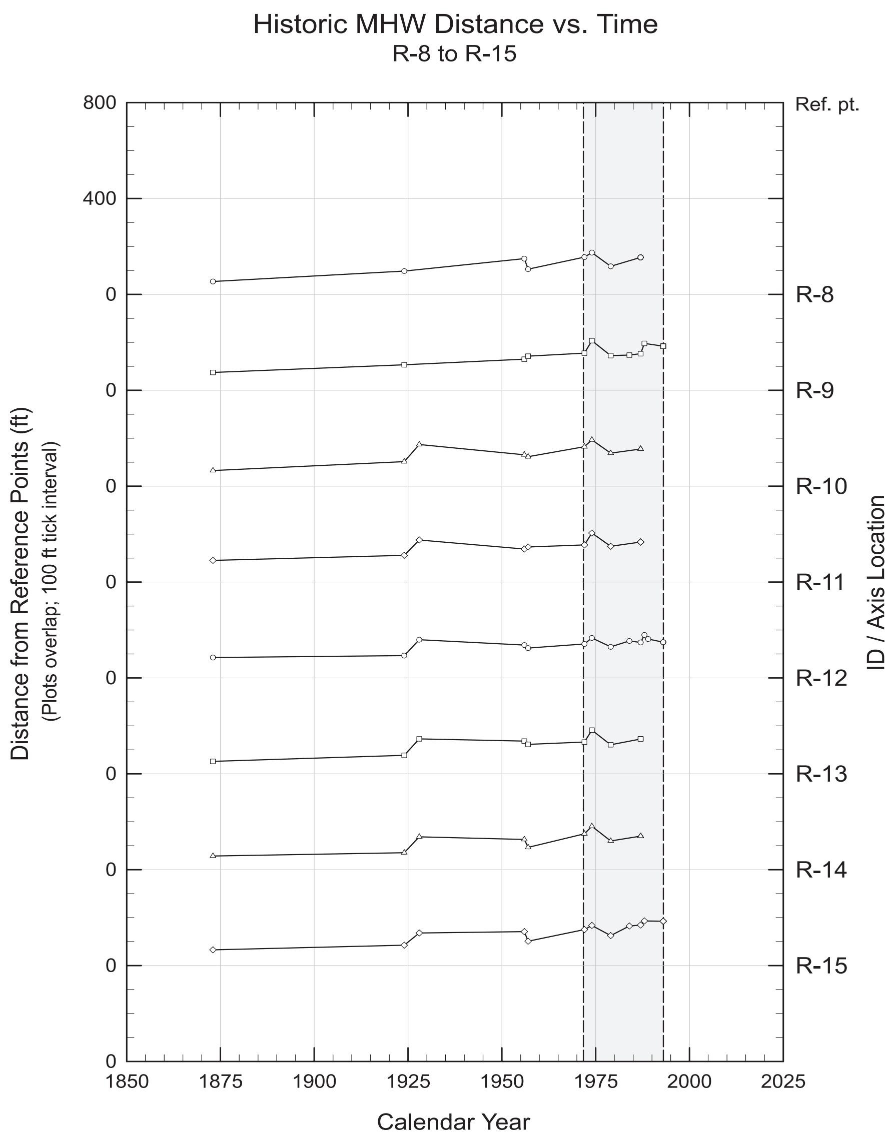
Range	Time Span	Method			Rounded Concensus Average	Comments
		RA	LS	EP		
231	1972-1993	0.5	0.2	0.5	0.0	7 pt avg
232	1972-1988	0.0	0.0	0.0	0.0	5 pt avg
233	1972-1988	-0.5	-0.5	-0.5	-0.5	3 pt avg
234	1972-1993	-0.5	-0.9	-0.5	-0.5	

7.2 Appendix B: Stack Plots

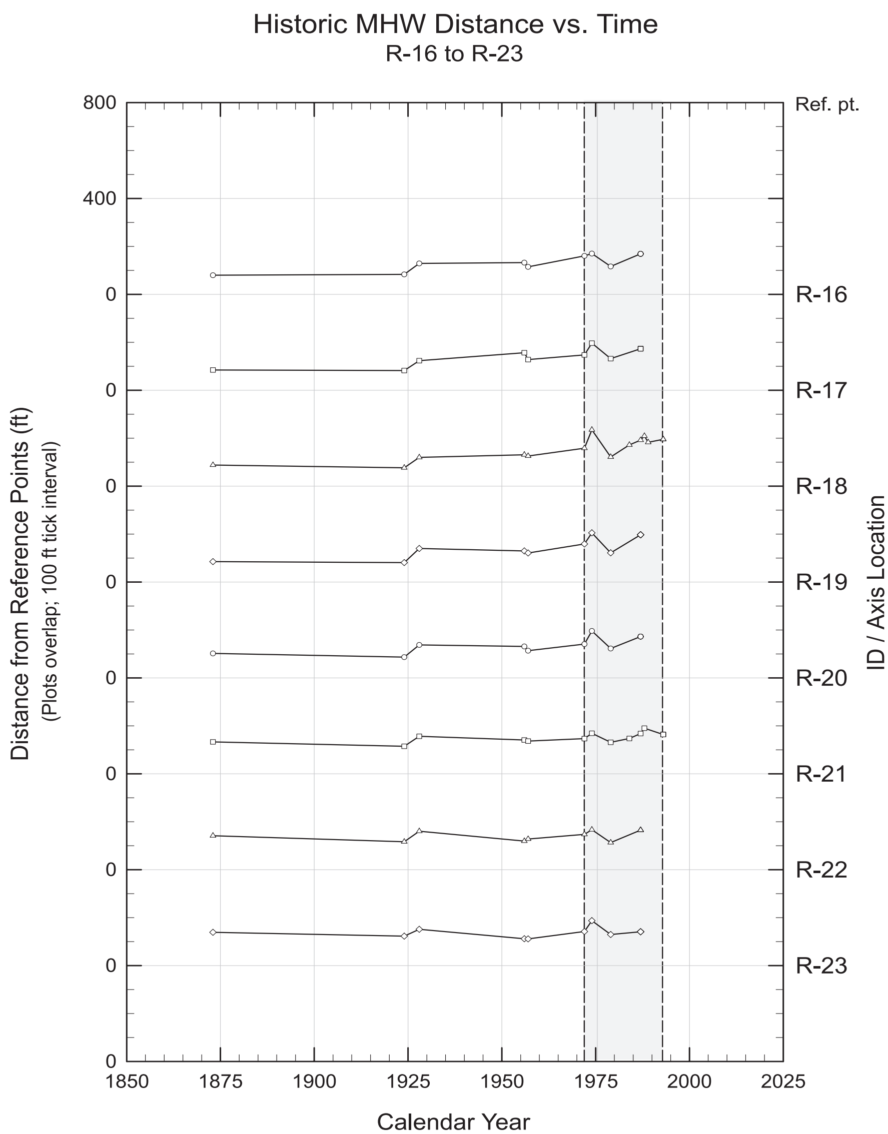
Stack plots from Historic Shoreline Database, Florida Department of Environmental Protection, Office of Beaches and Coastal Systems; slightly modified by authors.



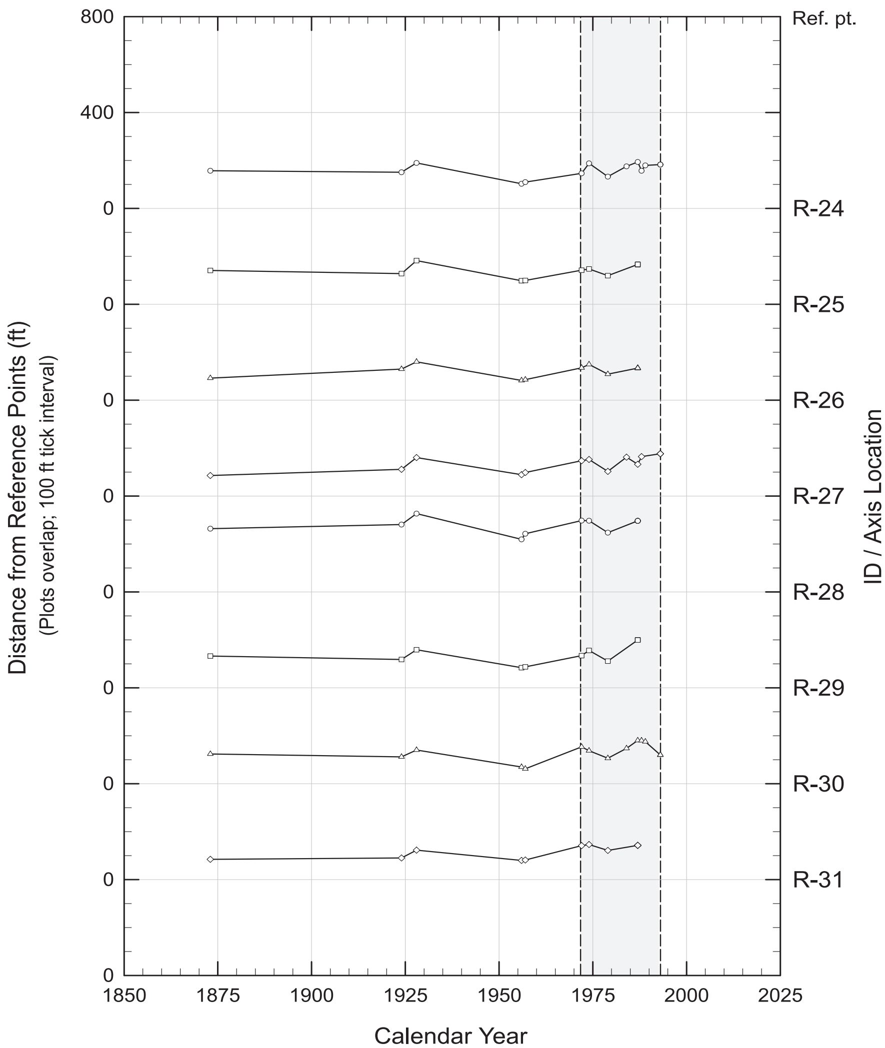
Historic MHW Distance vs. Time
R-0 to R-7
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-0
R-1
R-2
R-3
R-4
R-5
R-6
R-7
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location

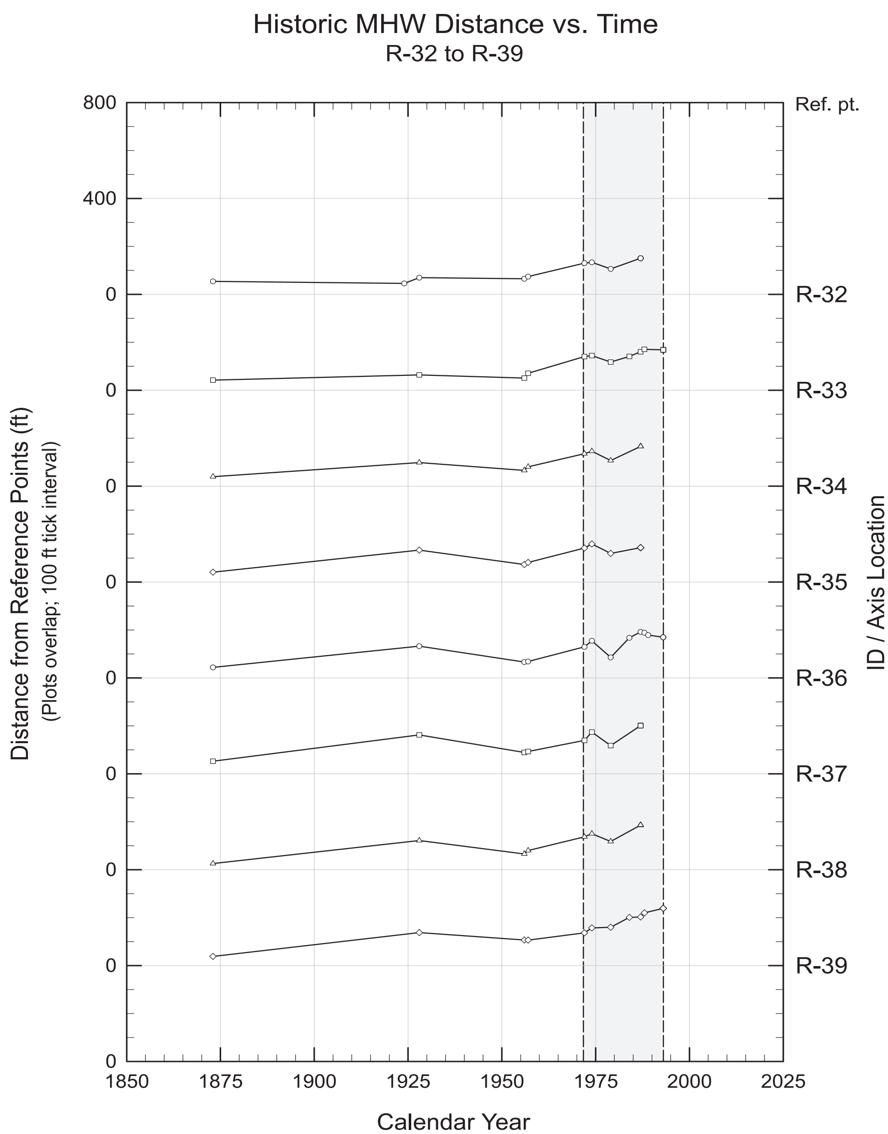


Historic MHW Distance vs. Time
R-8 to R-15
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
Ref. pt.
R-8
R-9
R-10
R-11
R-12
R-13
R-14
R-15
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

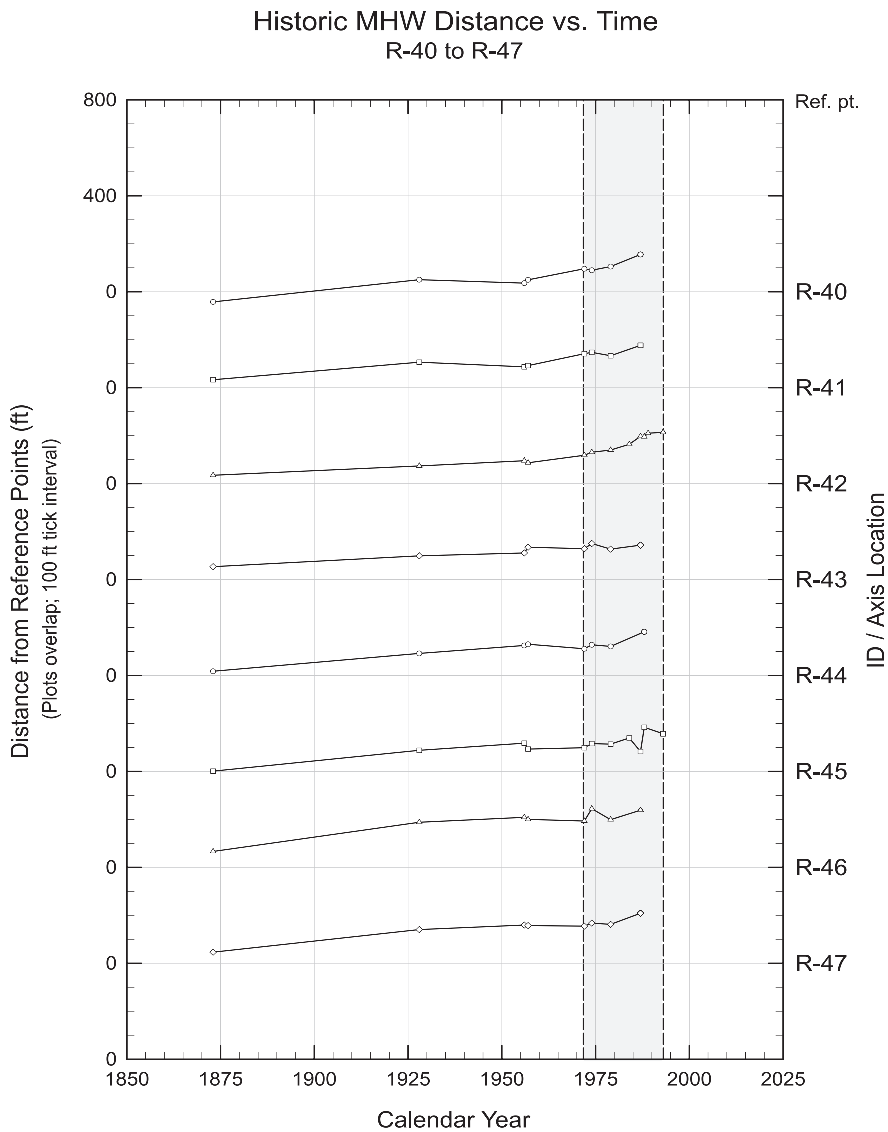

Historic MHW Distance vs. Time
R-16 to R-23
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-16
R-17
R-18
R-19
R-20
R-21
R-22
R-23
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location

Historic MHW Distance vs. Time
R-24 to R-31

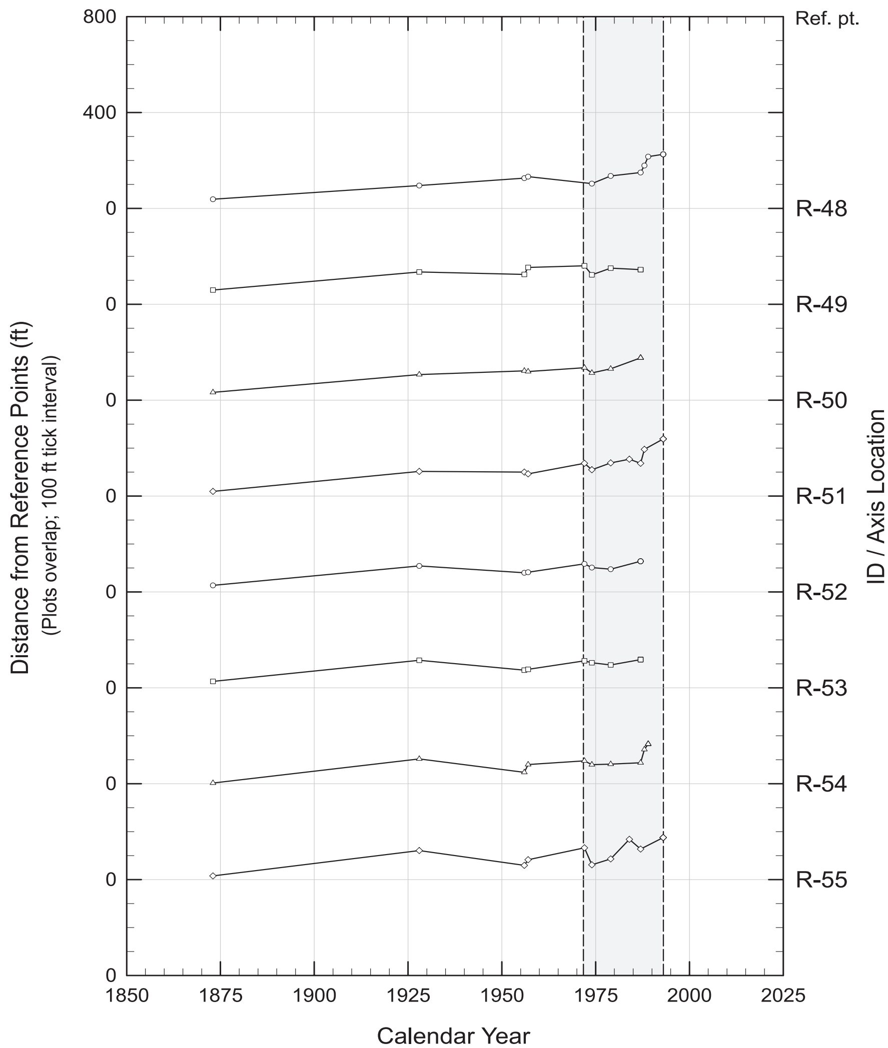


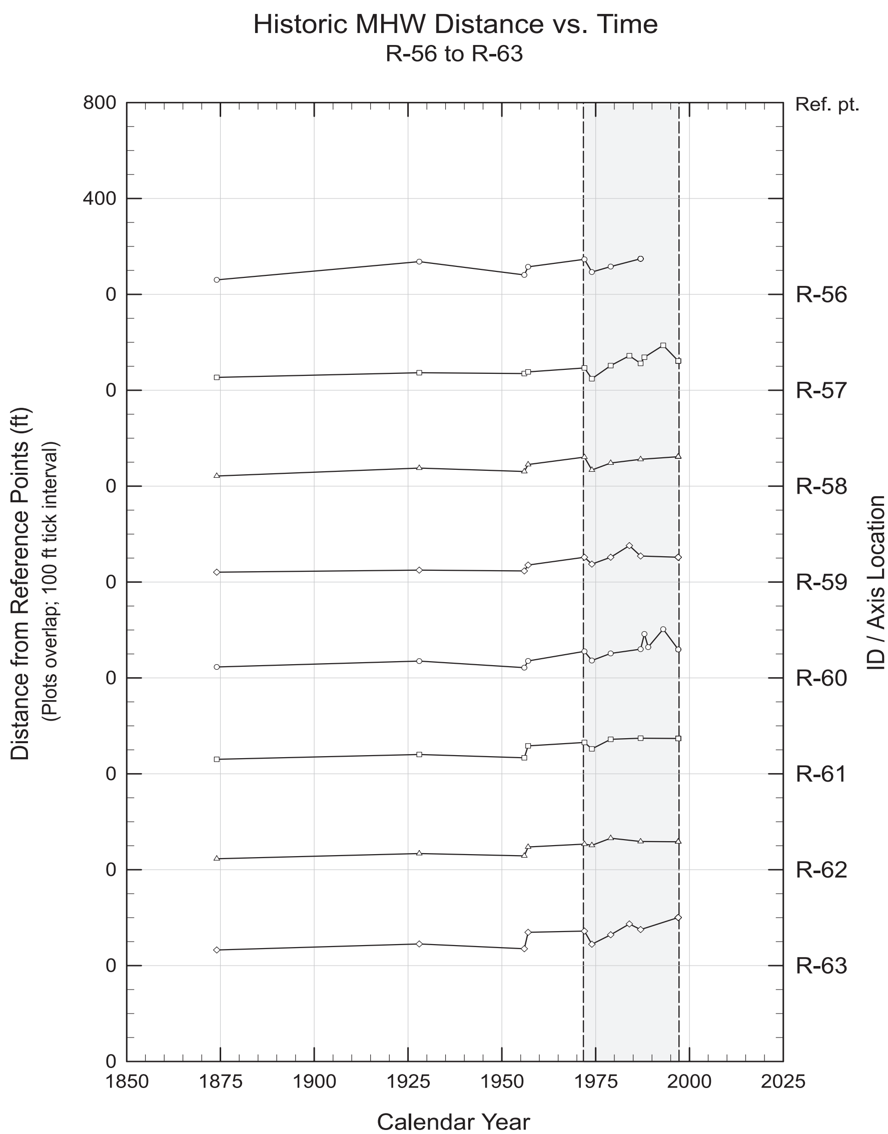


Historic MHW Distance vs. Time
R-32 to R-39
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-32
R-33
R-34
R-35
R-36
R-37
R-38
R-39
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

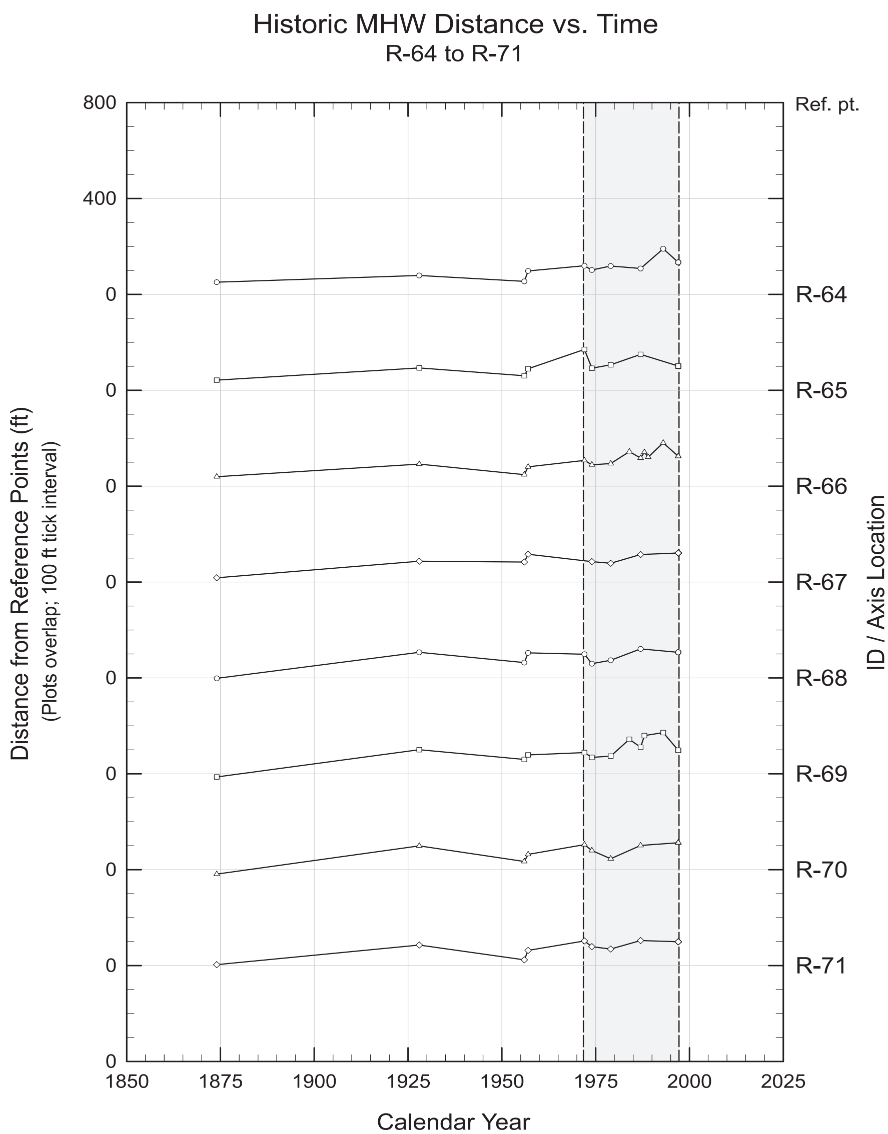

Historic MHW Distance vs. Time
R-40 to R-47
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-40
R-41
R-42
R-43
R-44
R-45
R-46
R-47
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

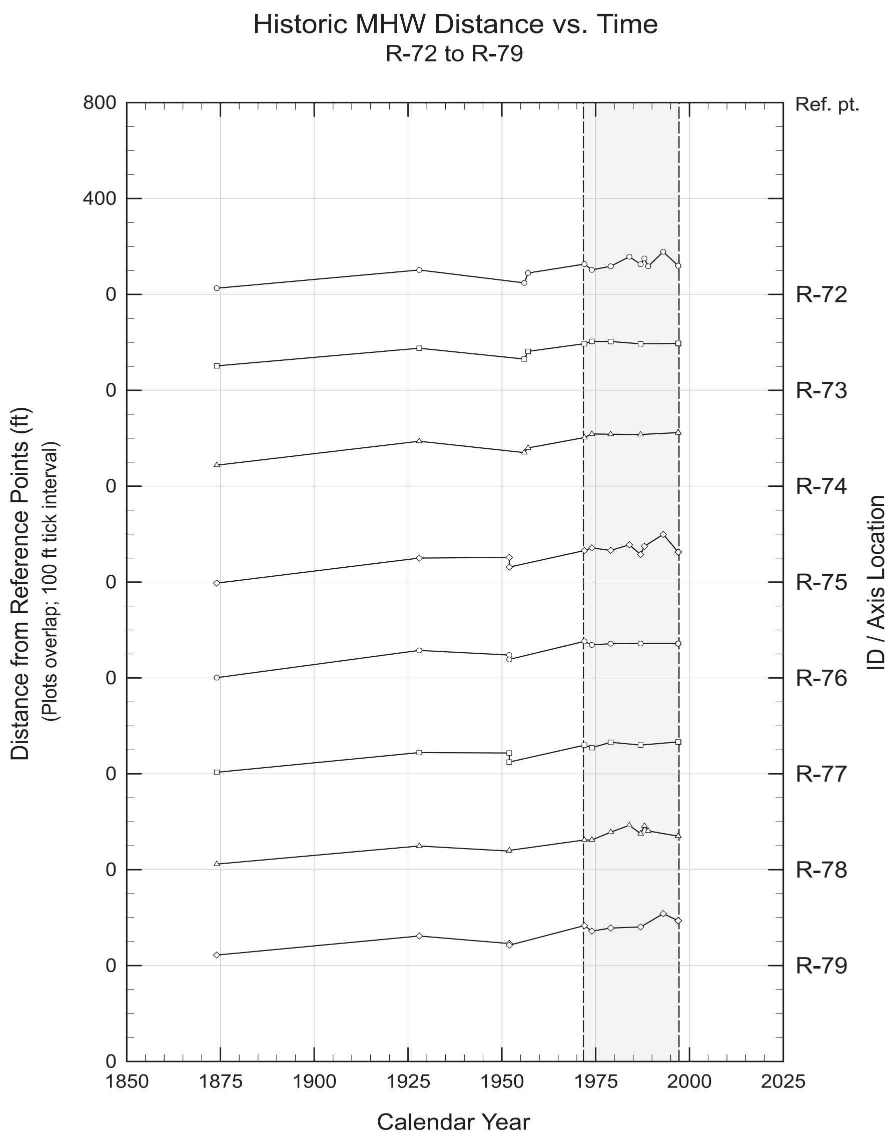
Historic MHW Distance vs. Time
R-48 to R-55





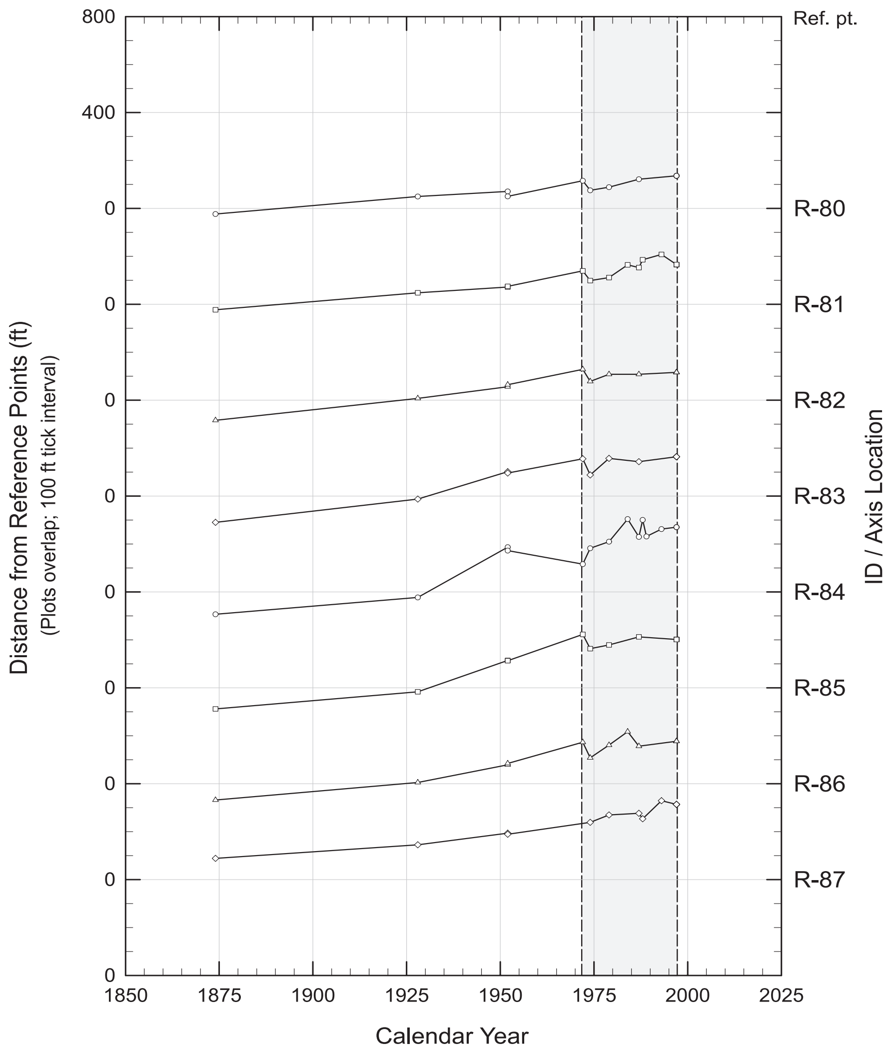
Historic MHW Distance vs. Time
R-56 to R-63
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-56
R-57
R-58
R-59
R-60
R-61
R-62
R-63
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

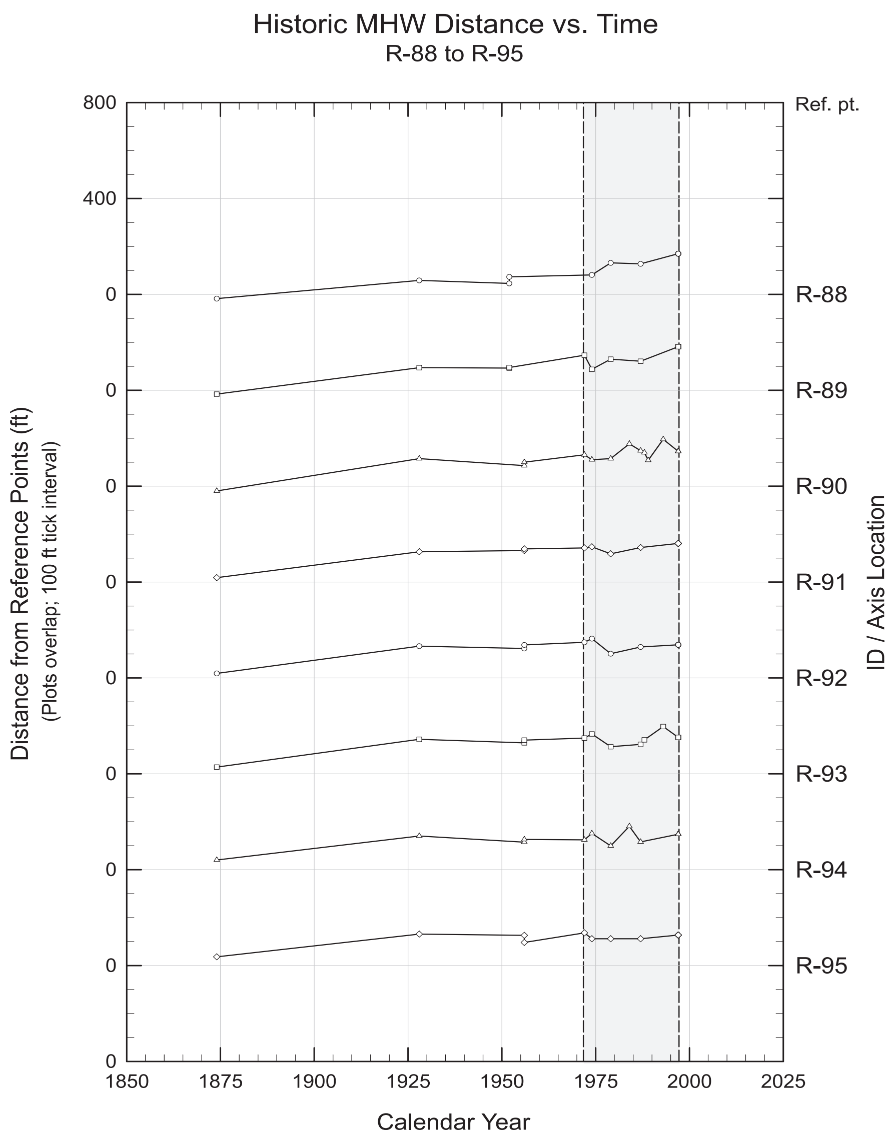

Historic MHW Distance vs. Time
R-64 to R-71
800
400
0
Ref. pt.
R-64
R-65
R-66
R-67
R-68
R-69
R-70
R-71
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year



Historic MHW Distance vs. Time
R-72 to R-79
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-72
R-73
R-74
R-75
R-76
R-77
R-78
R-79
ID / Axis Location

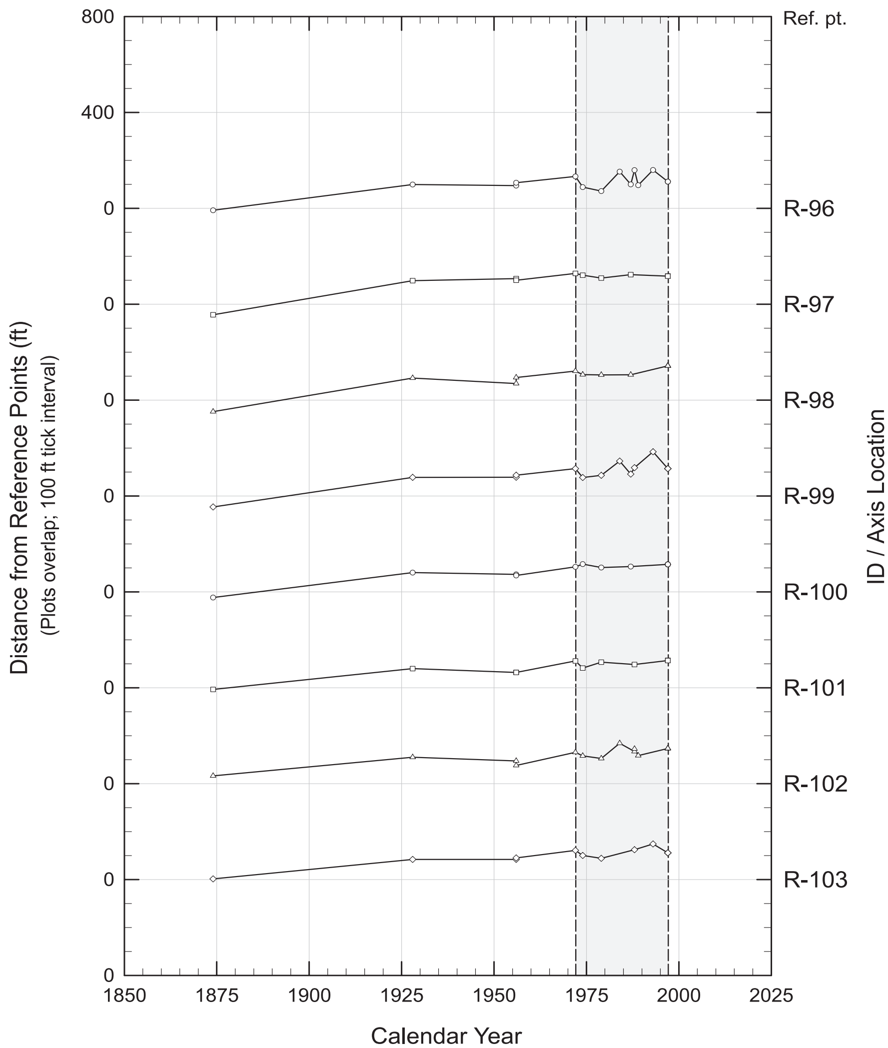
Historic MHW Distance vs. Time
R-80 to R-87

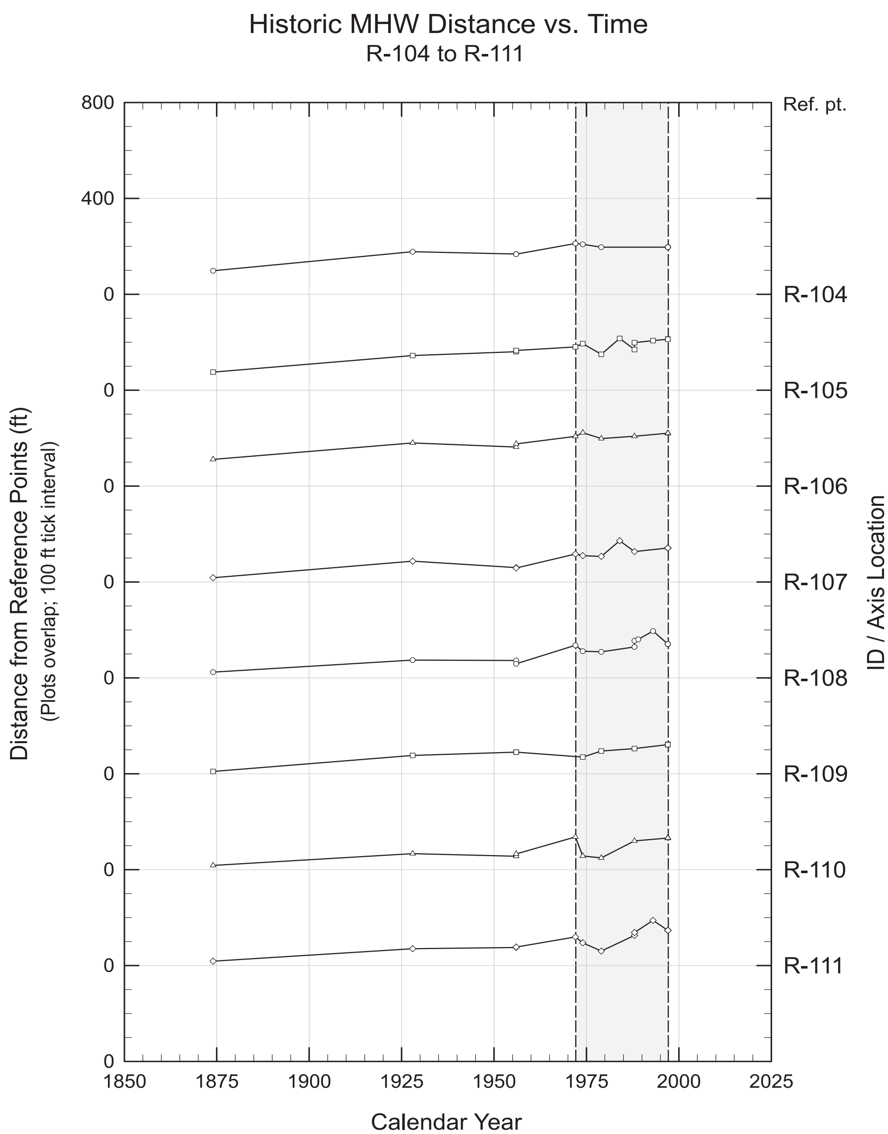




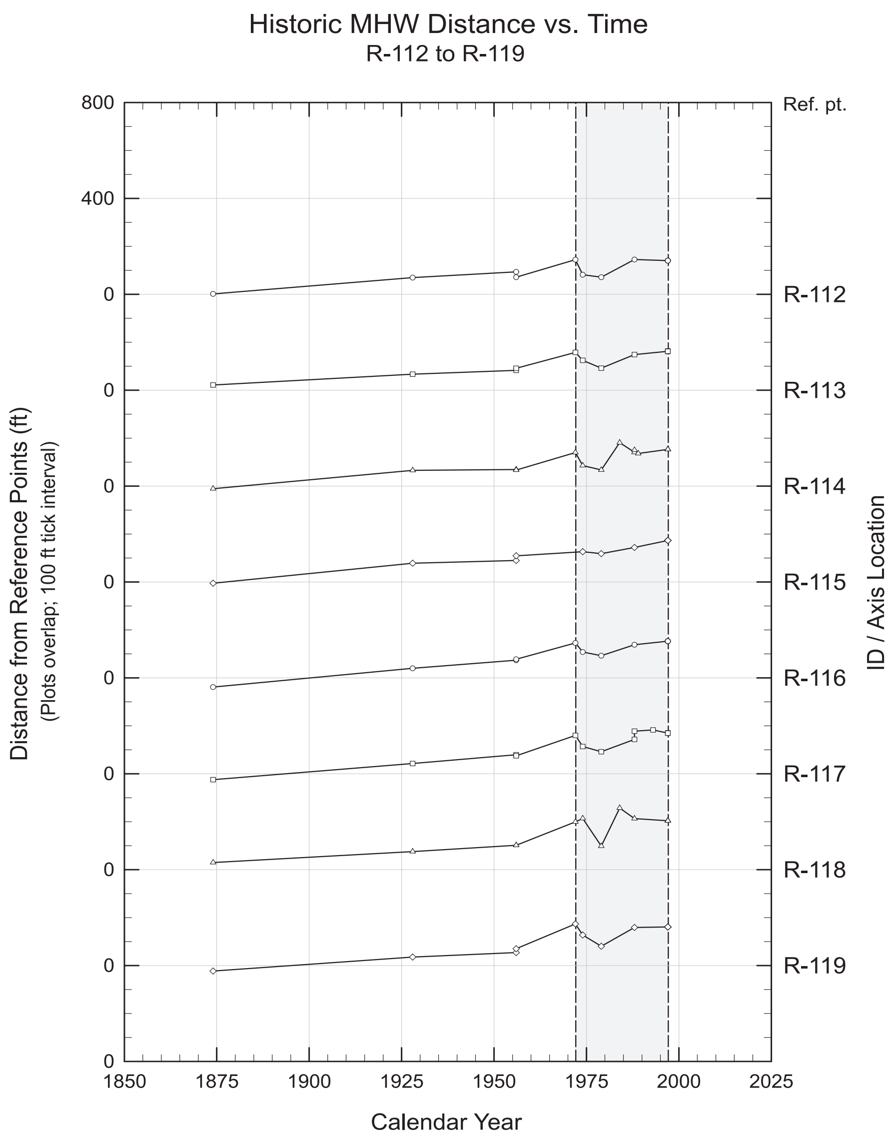
Historic MHW Distance vs. Time
R-88 to R-95
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-88
R-89
R-90
R-91
R-92
R-93
R-94
R-95
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

Historic MHW Distance vs. Time
R-96 to R-103

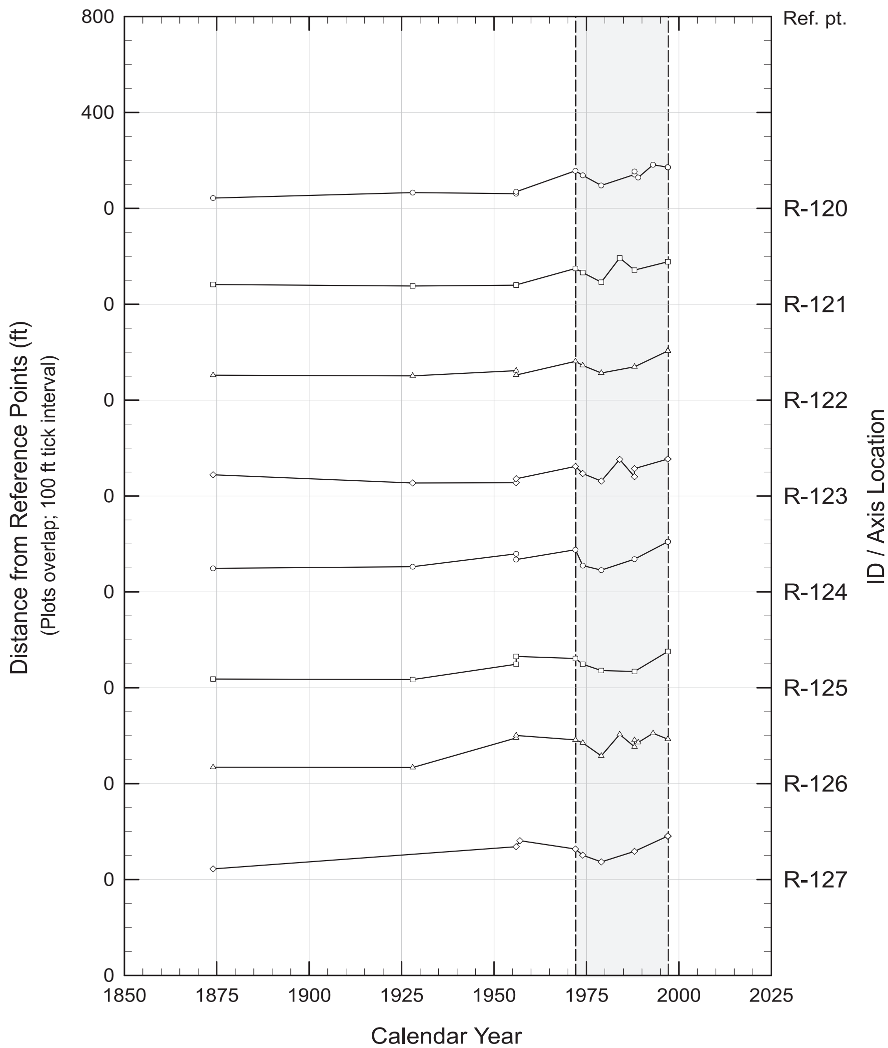


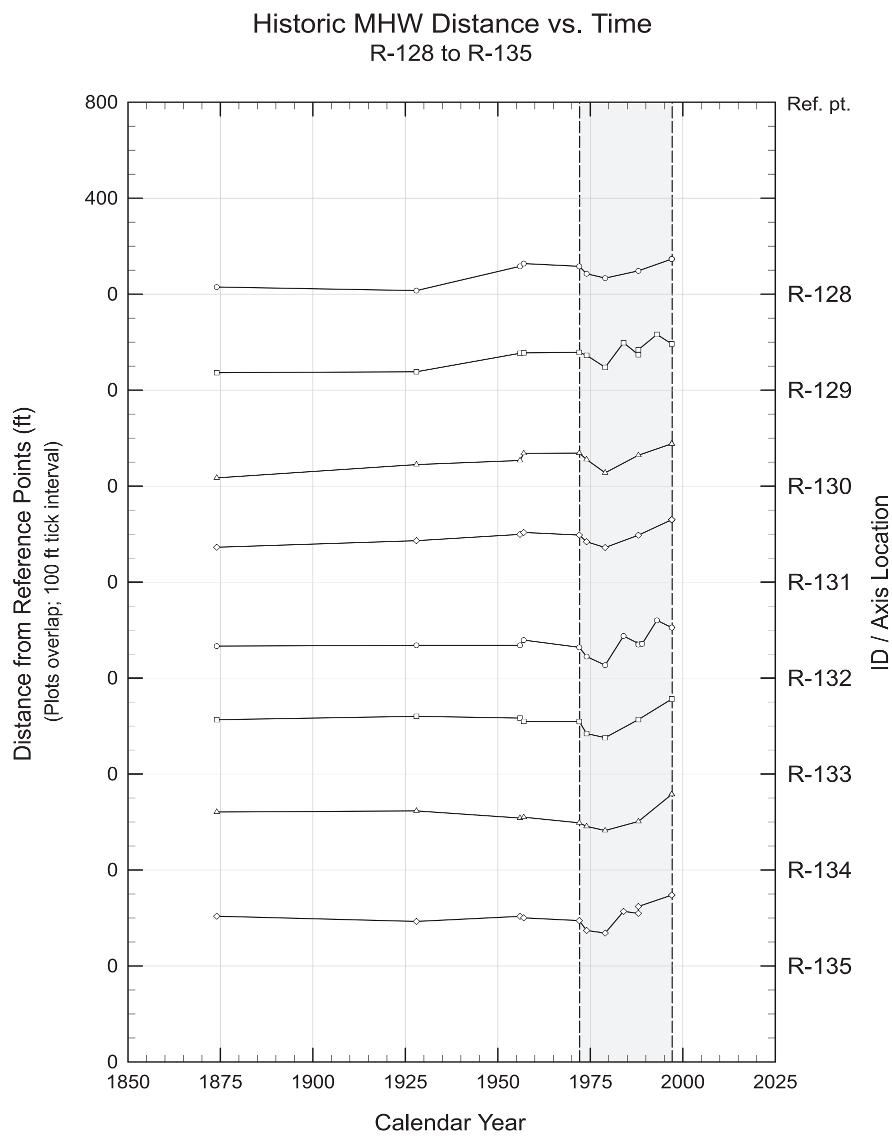


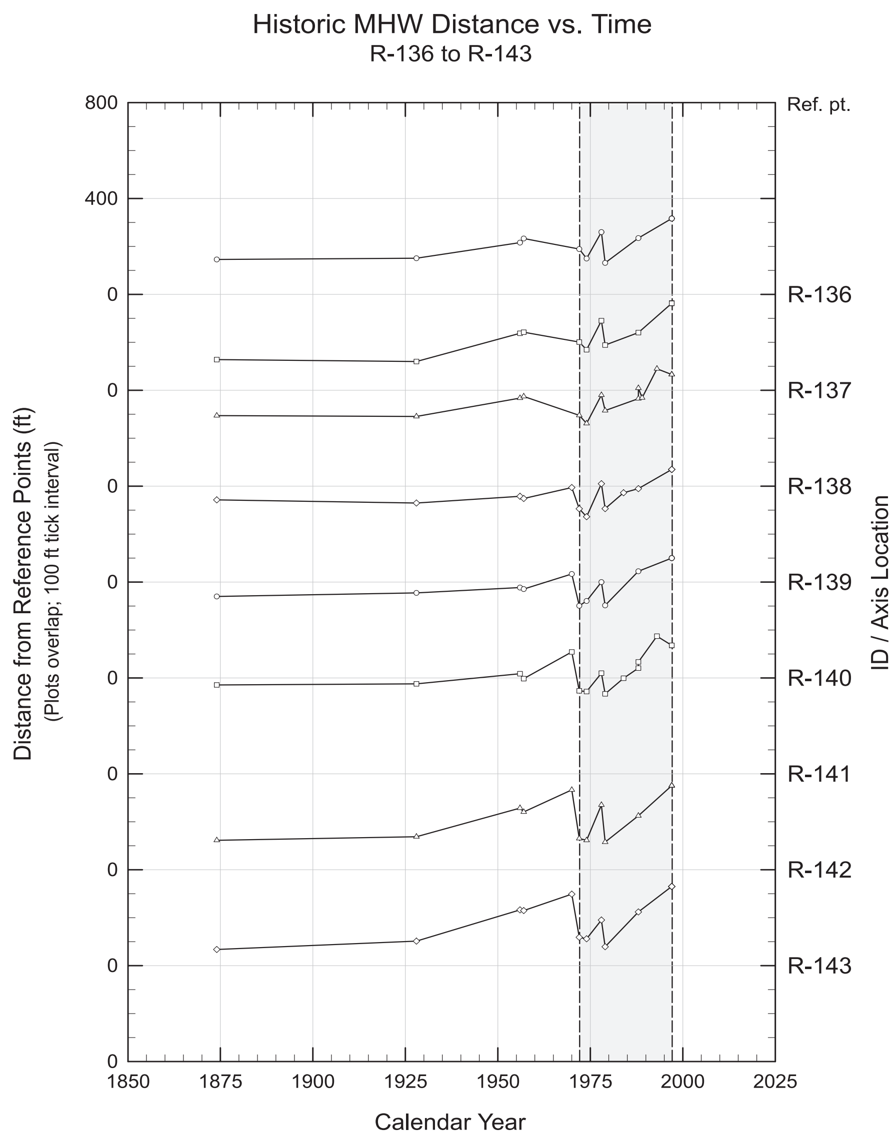
Historic MHW Distance vs. Time
R-104 to R-111
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-104
R-105
R-106
R-107
R-108
R-109
R-110
R-111
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location

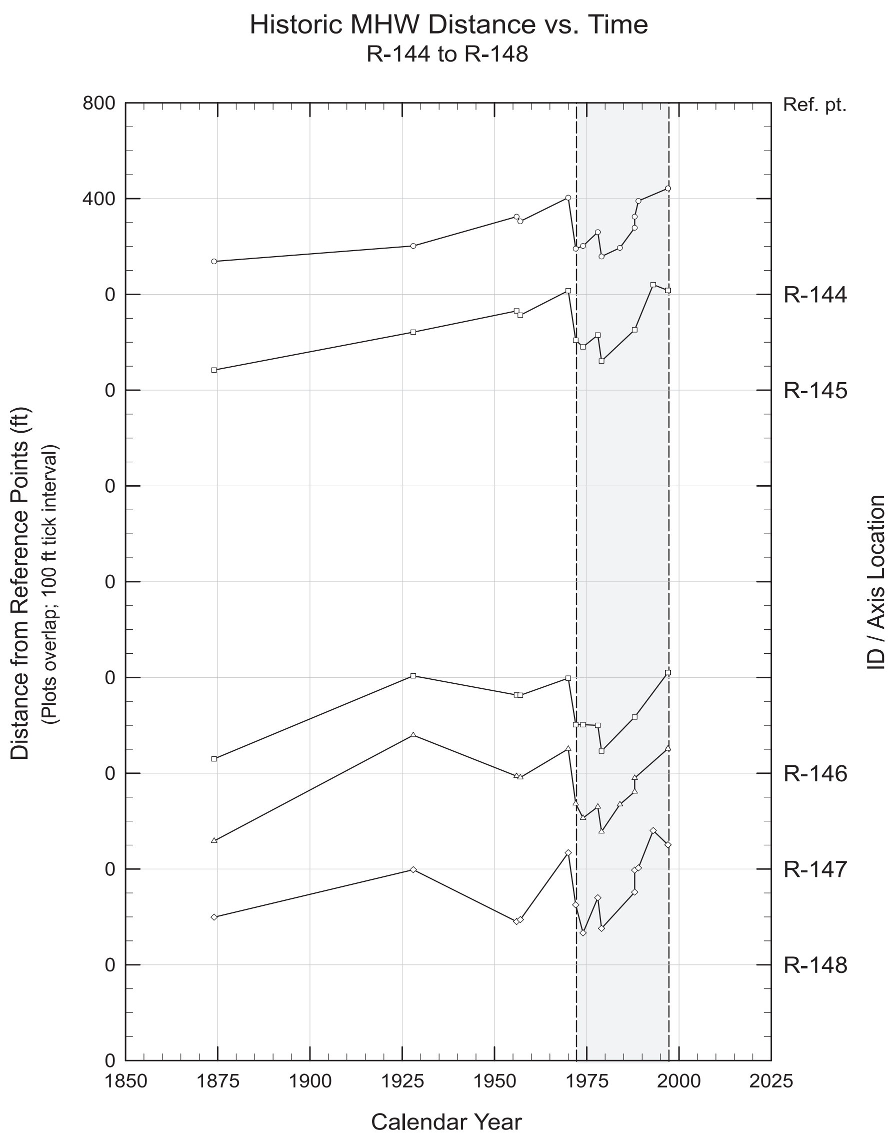

Historic MHW Distance vs. Time
R-112 to R-119
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
Calendar Year
ID / Axis Location
Ref. pt.
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
R-112
R-113
R-114
R-115
R-116
R-117
R-118
R-119

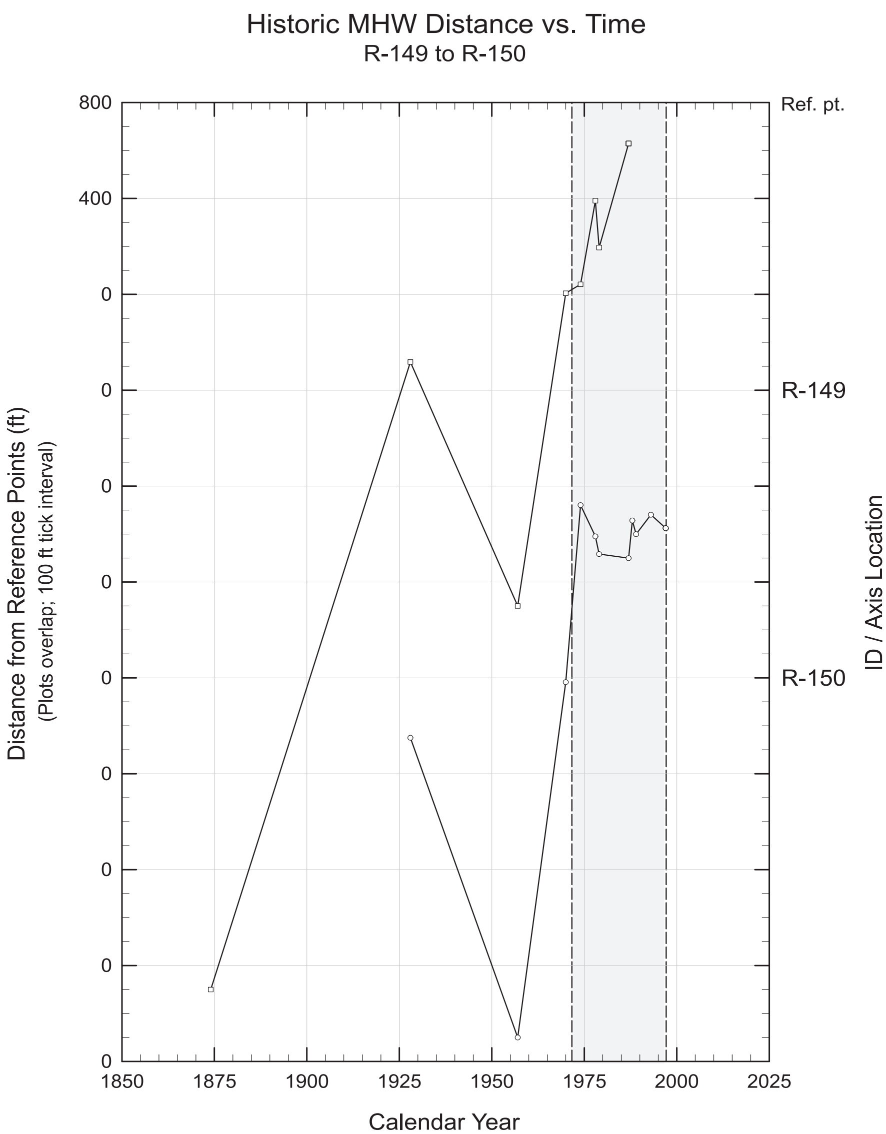
Historic MHW Distance vs. Time
R-120 to R-127

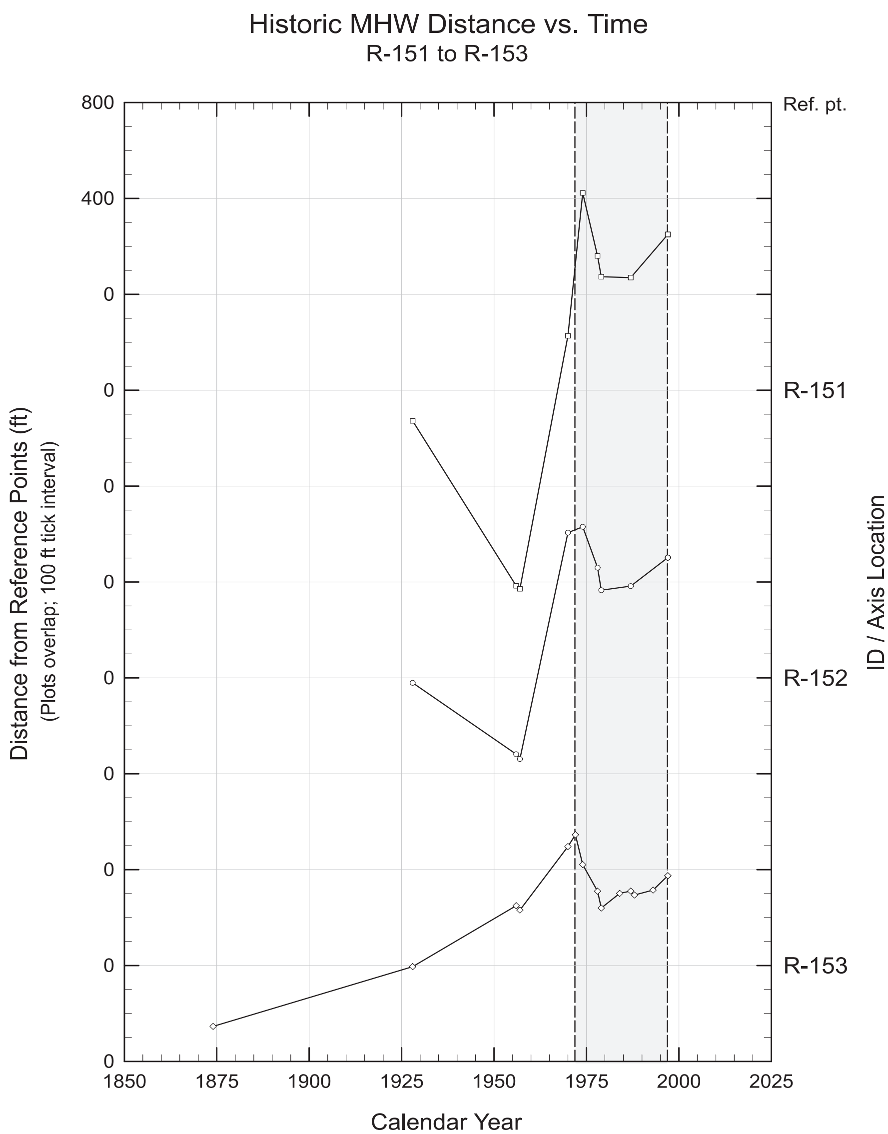



Historic MHW Distance vs. Time
R-128 to R-135
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
Ref. pt.
800
400
0
R-128
R-129
R-130
R-131
R-132
R-133
R-134
R-135
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

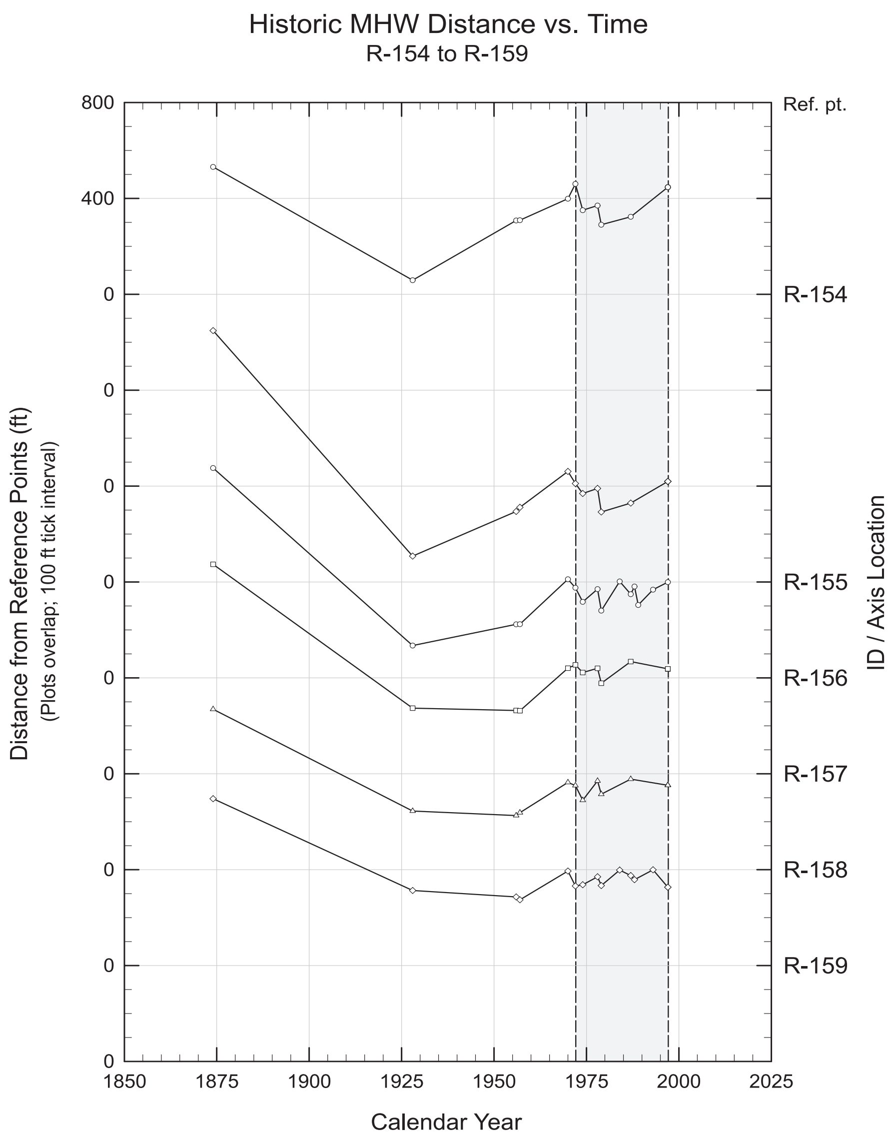

Historic MHW Distance vs. Time
R-136 to R-143
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-136
R-137
R-138
R-139
R-140
R-141
R-142
R-143
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

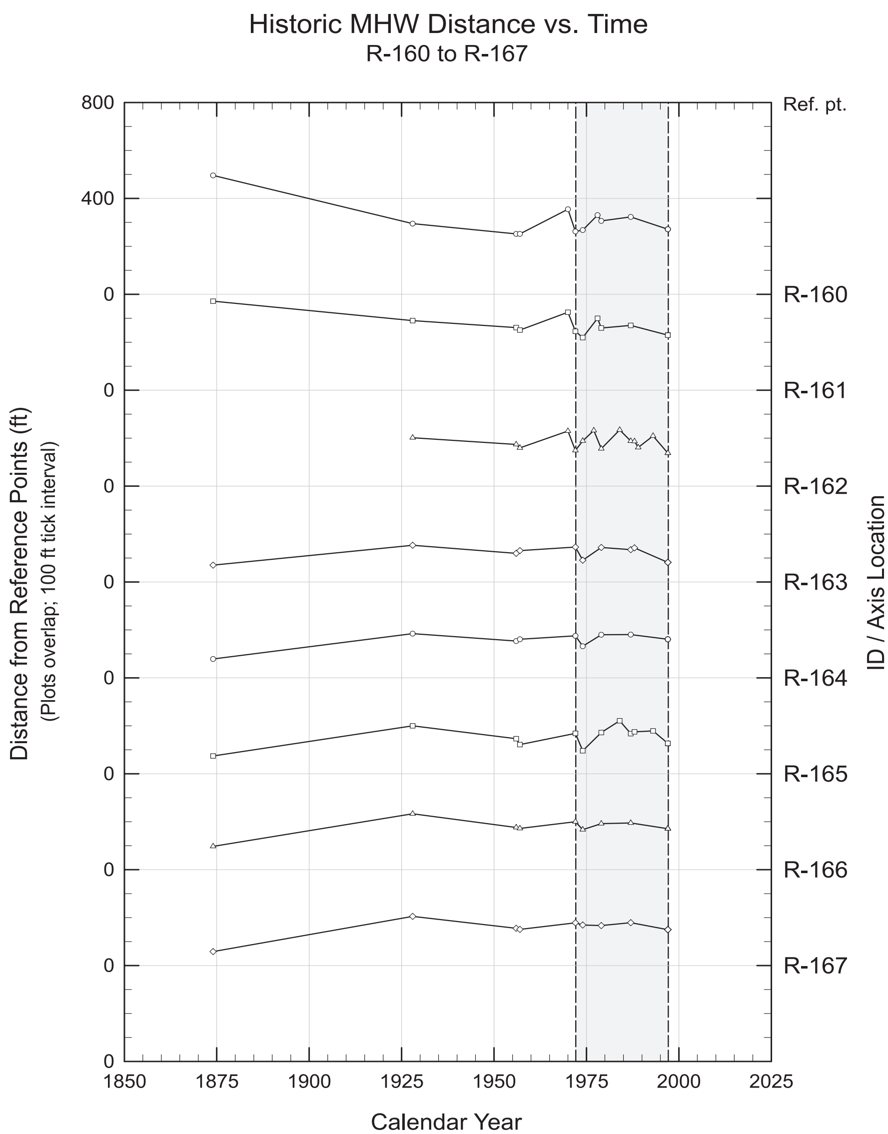

Historic MHW Distance vs. Time
R-144 to R-148
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-144
R-145
R-146
R-147
R-148
ID / Axis Location

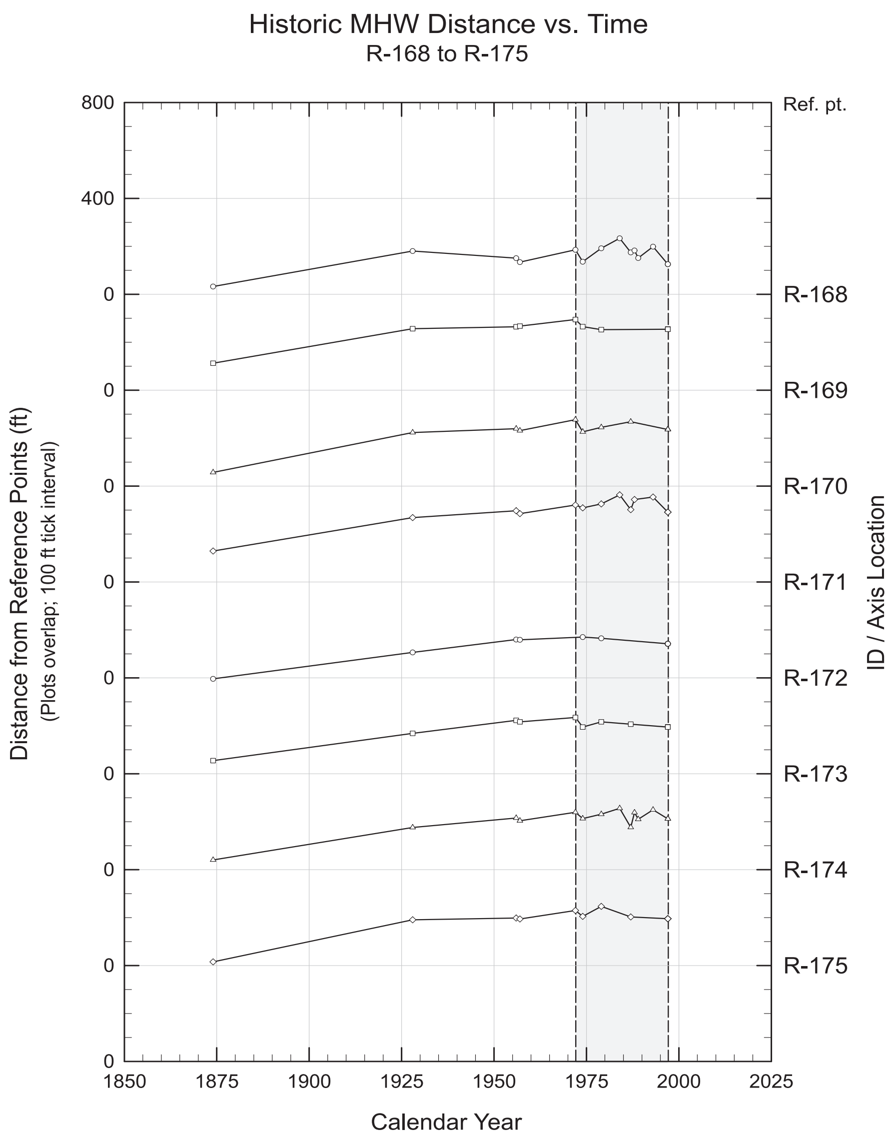

Historic MHW Distance vs. Time
R-149 to R-150
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
Ref. pt.
R-149
R-150
ID / Axis Location



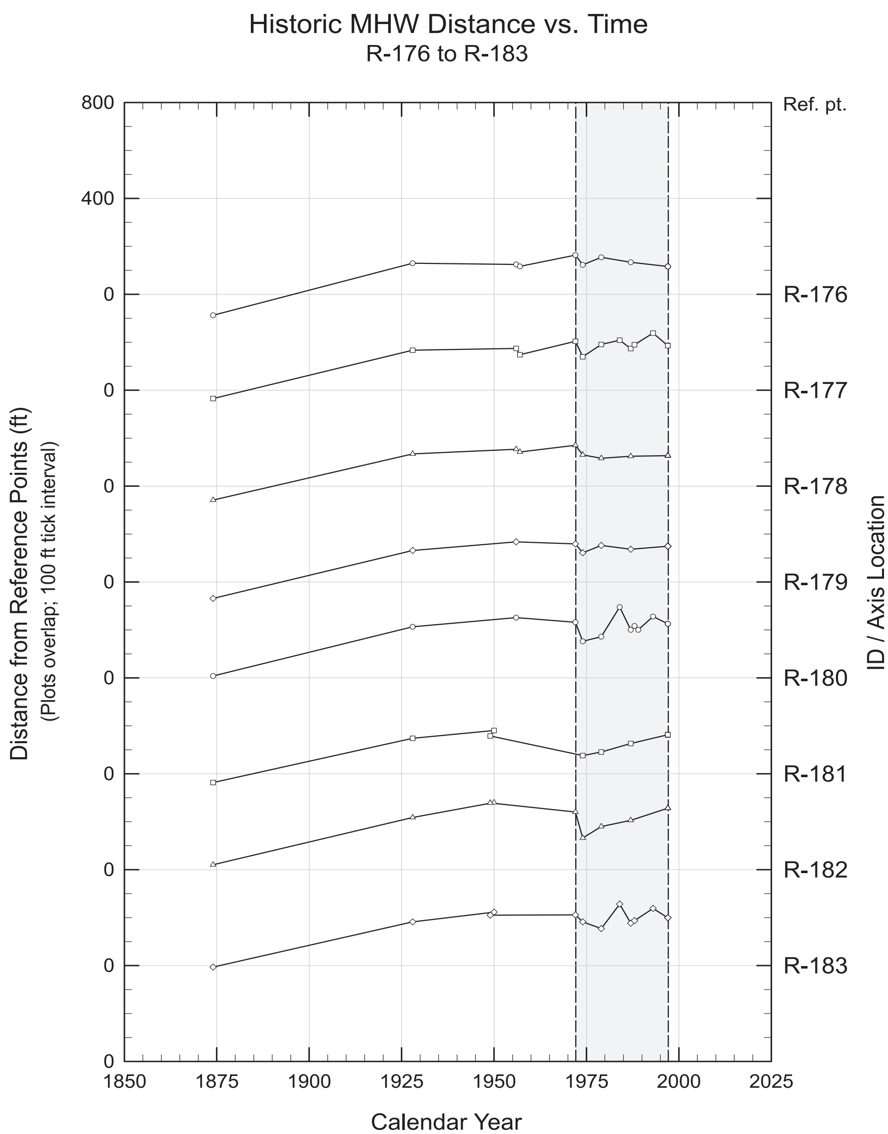
Historic MHW Distance vs. Time
R-151 to R-153
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
0
0
0
0
0
0
0
0
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Ref. pt.
R-151
R-152
R-153
ID / Axis Location


Historic MHW Distance vs. Time
R-154 to R-159
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-154
R-155
R-156
R-157
R-158
R-159
ID / Axis Location

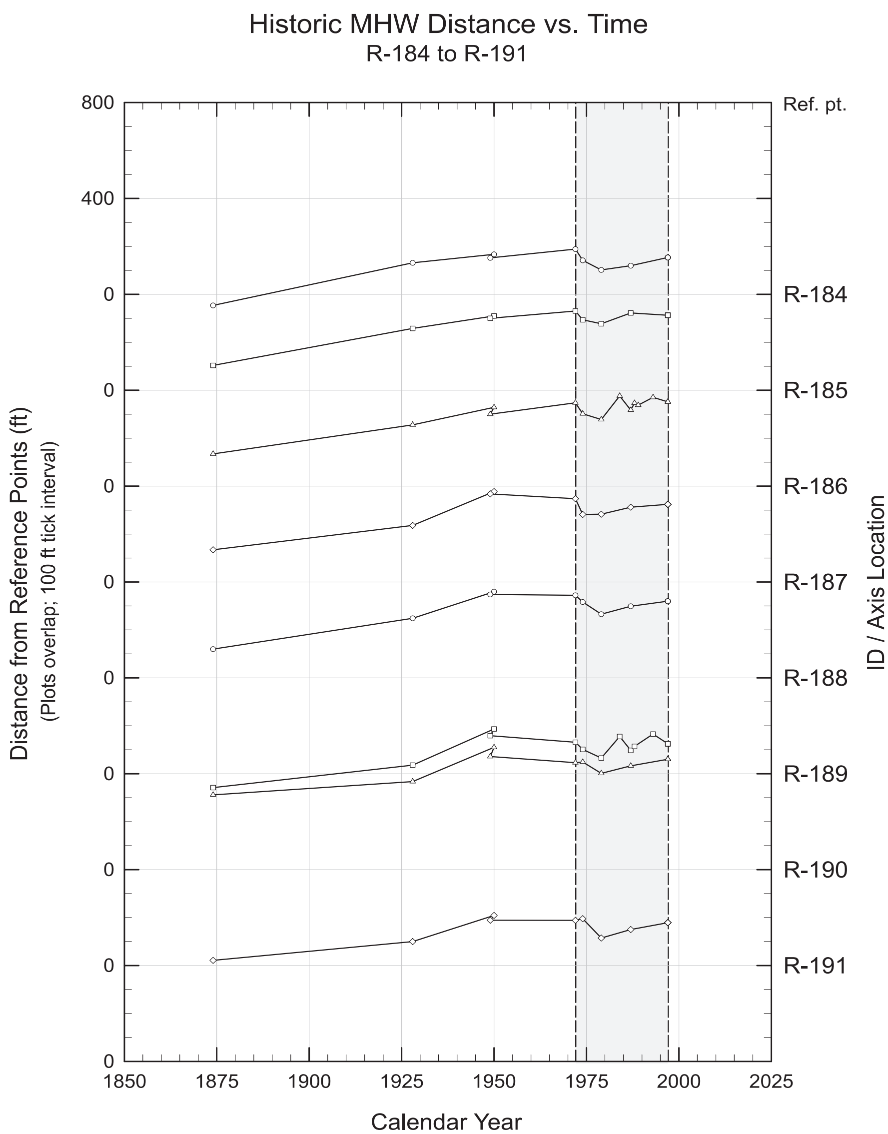

Historic MHW Distance vs. Time
R-160 to R-167
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-160
R-161
R-162
R-163
R-164
R-165
R-166
R-167
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location



Historic MHW Distance vs. Time
R-168 to R-175
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
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

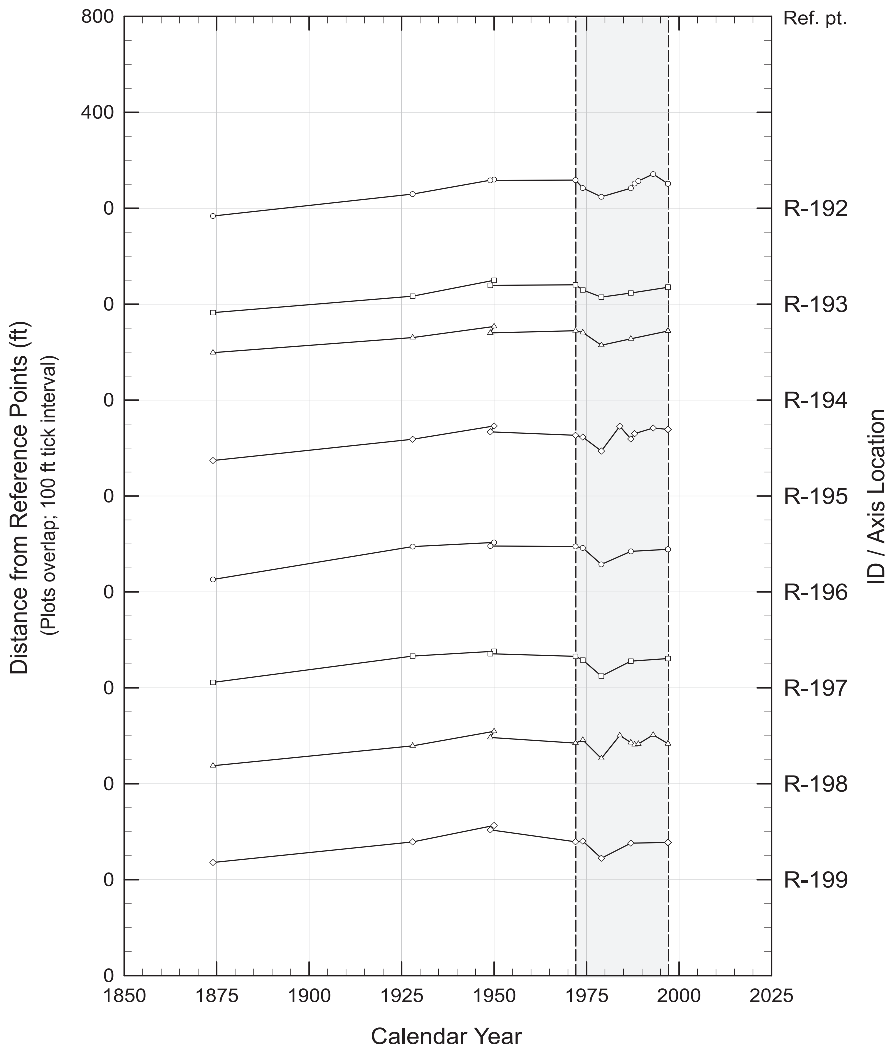


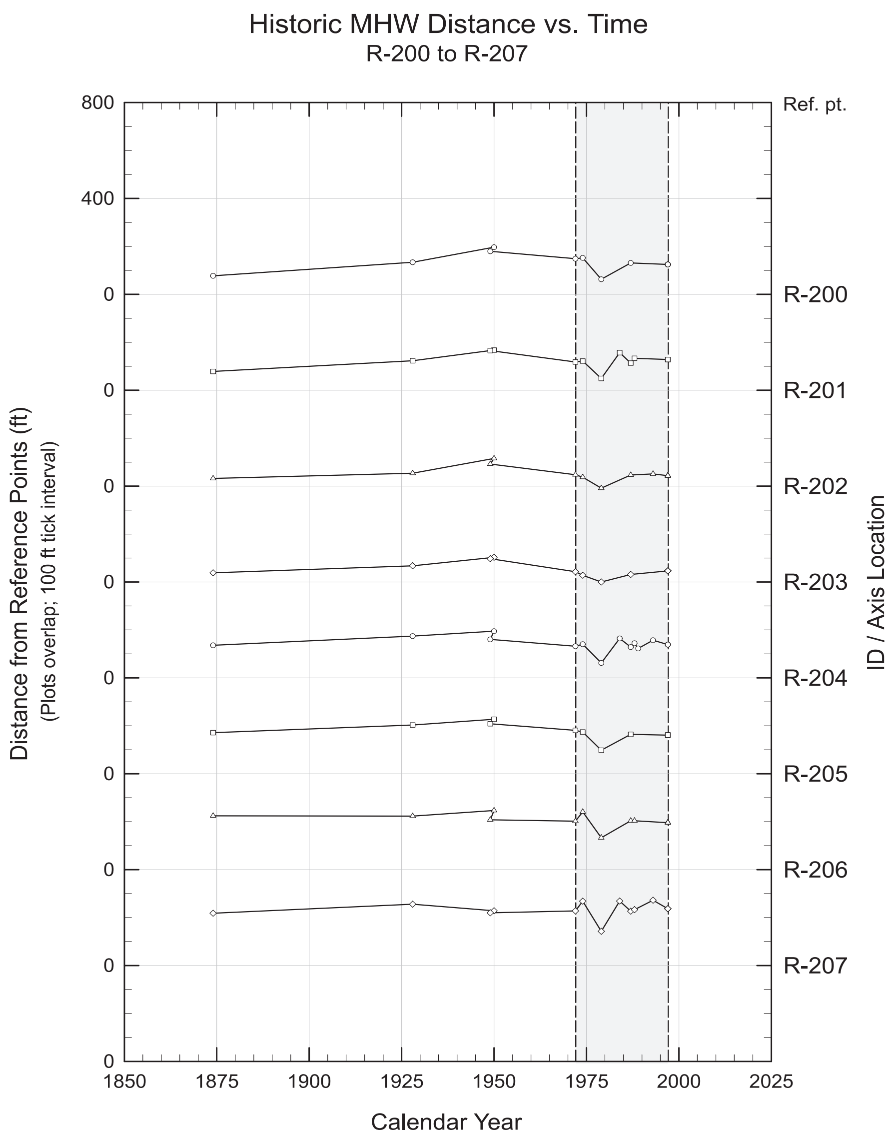
Historic MHW Distance vs. Time
R-176 to R-183
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-176
R-177
R-178
R-179
R-180
R-181
R-182
R-183
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year



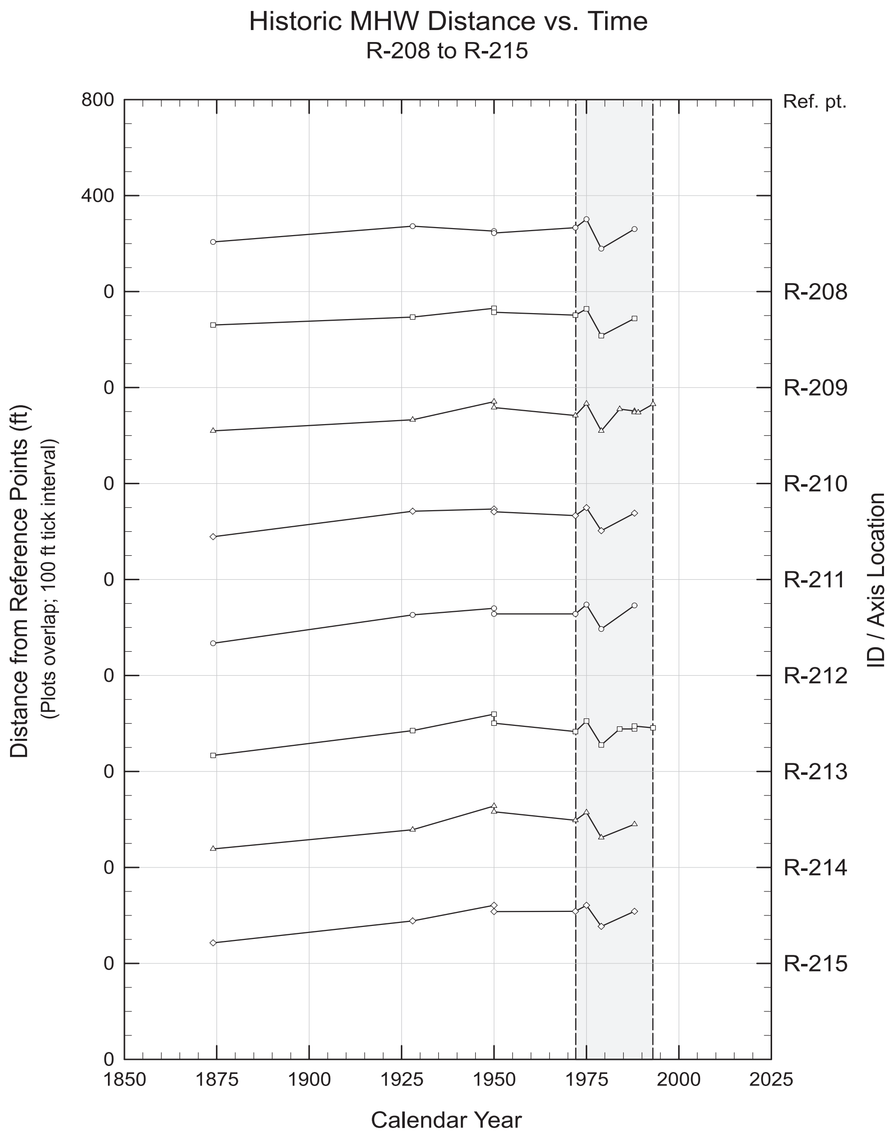
Historic MHW Distance vs. Time
R-184 to R-191
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-184
R-185
R-186
R-187
R-188
R-189
R-190
R-191
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

Historic MHW Distance vs. Time
R-192 to R-199

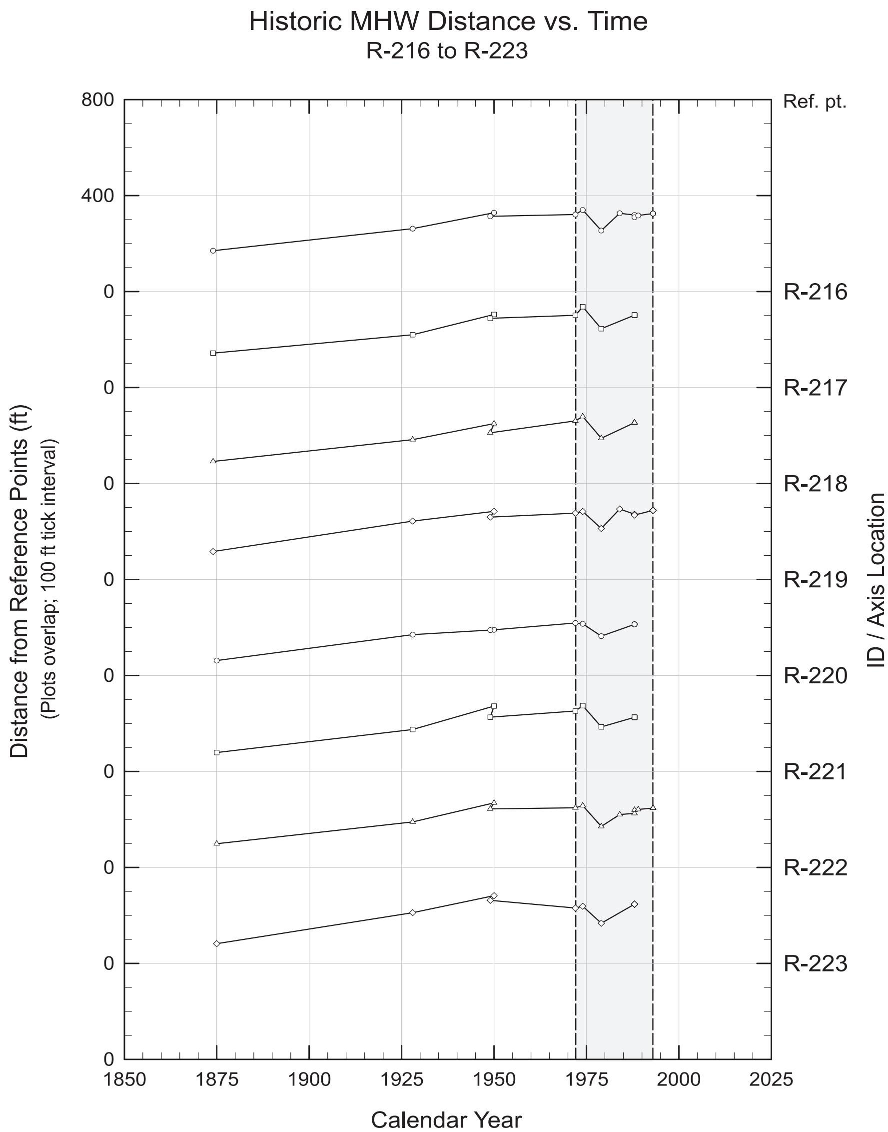




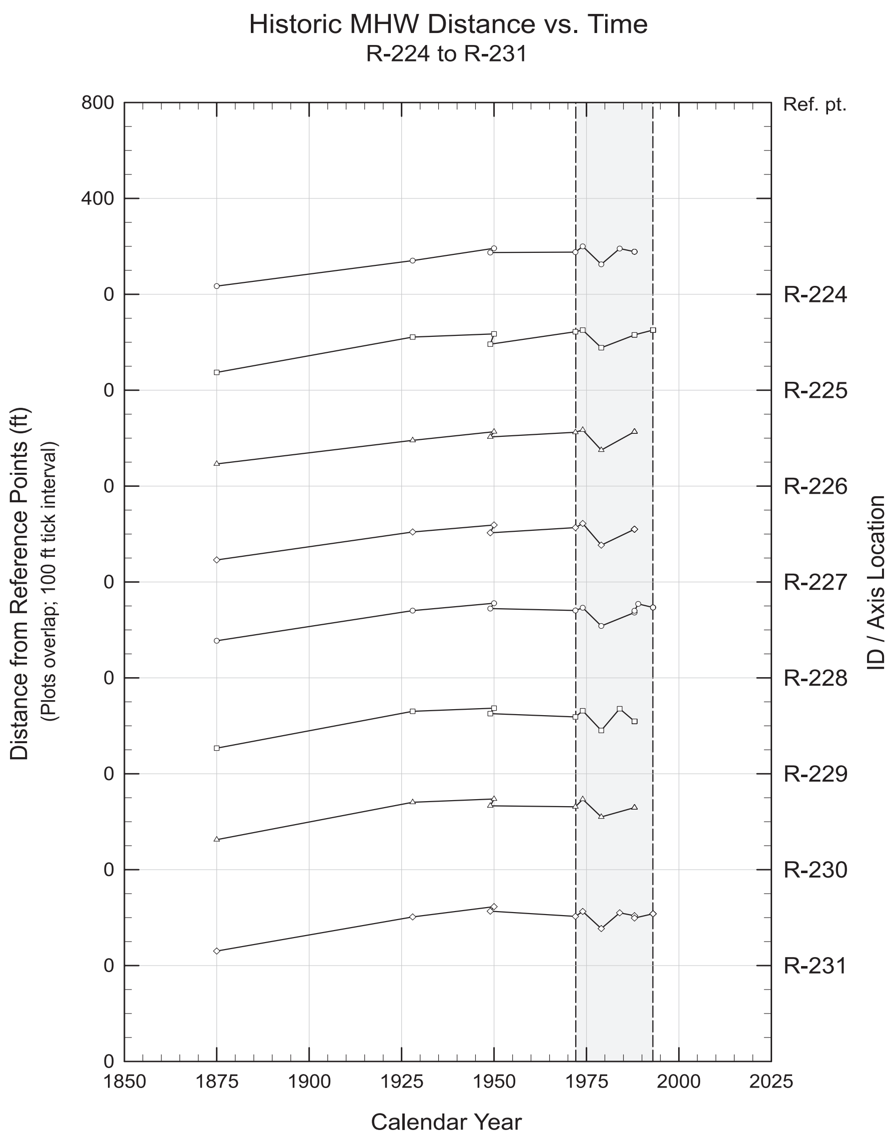
Historic MHW Distance vs. Time
R-200 to R-207
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-200
R-201
R-202
R-203
R-204
R-205
R-206
R-207
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year



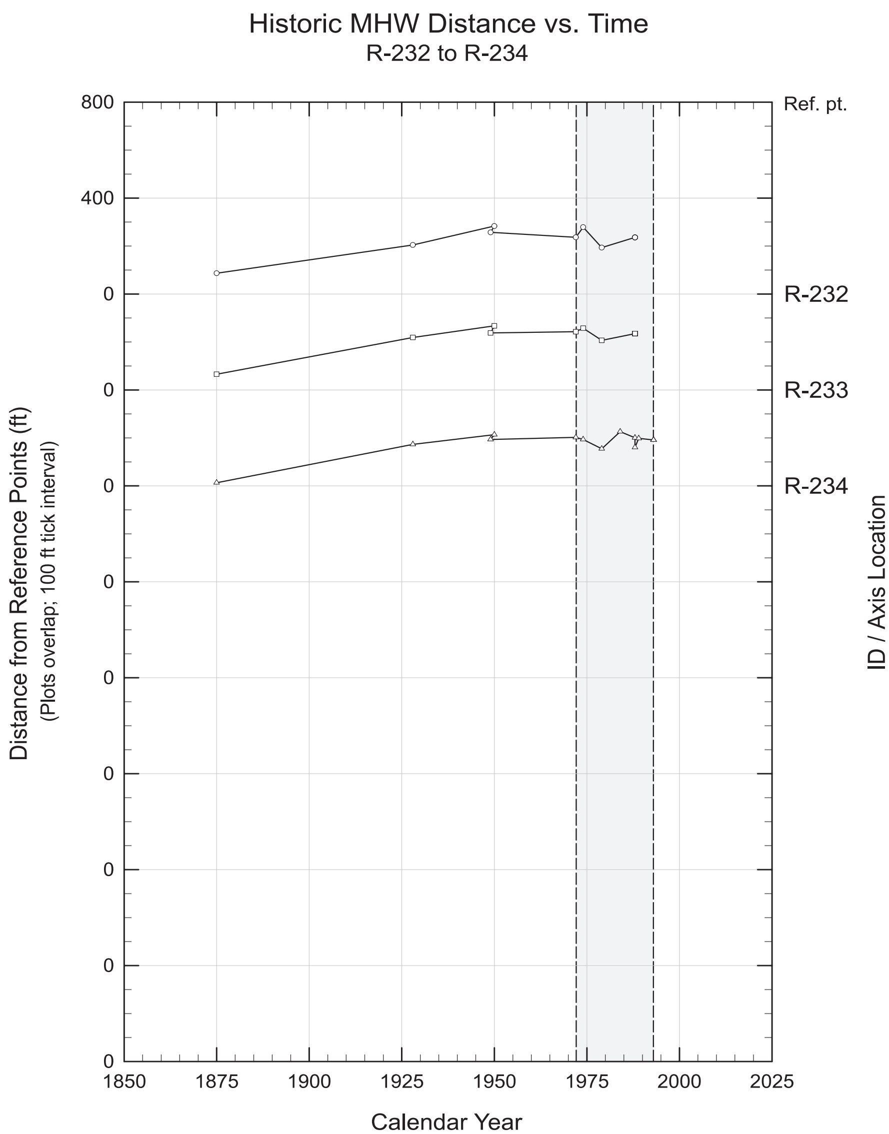
Historic MHW Distance vs. Time
R-208 to R-215
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-208
R-209
R-210
R-211
R-212
R-213
R-214
R-215
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year



Historic MHW Distance vs. Time
R-216 to R-223
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
800
400
0
Ref. pt.
R-216
R-217
R-218
R-219
R-220
R-221
R-222
R-223
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

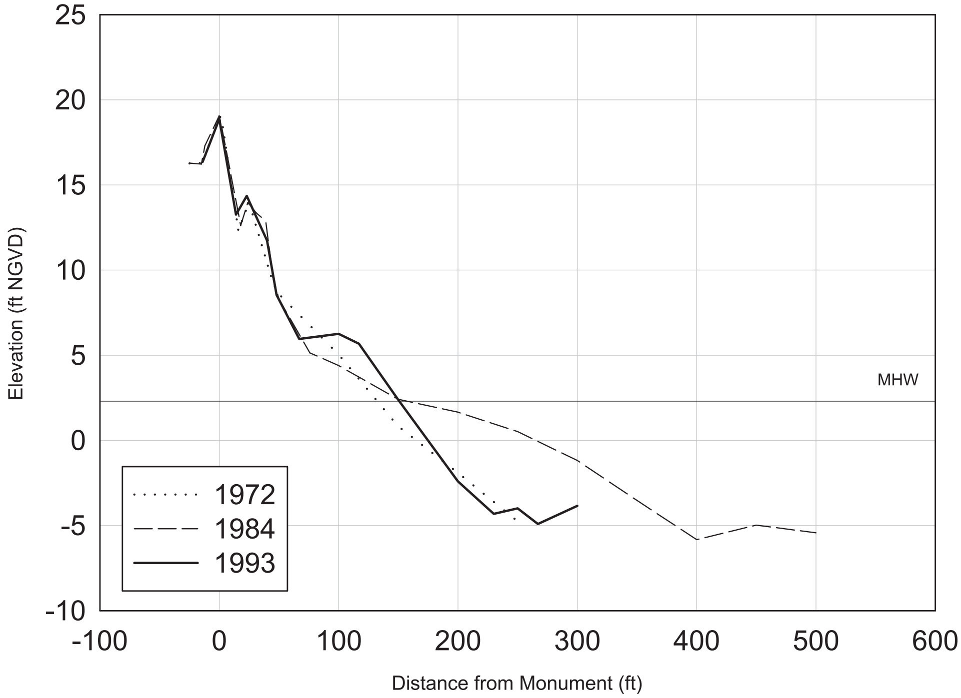


Historic MHW Distance vs. Time
R-224 to R-231
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-224
R-225
R-226
R-227
R-228
R-229
R-230
R-231
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

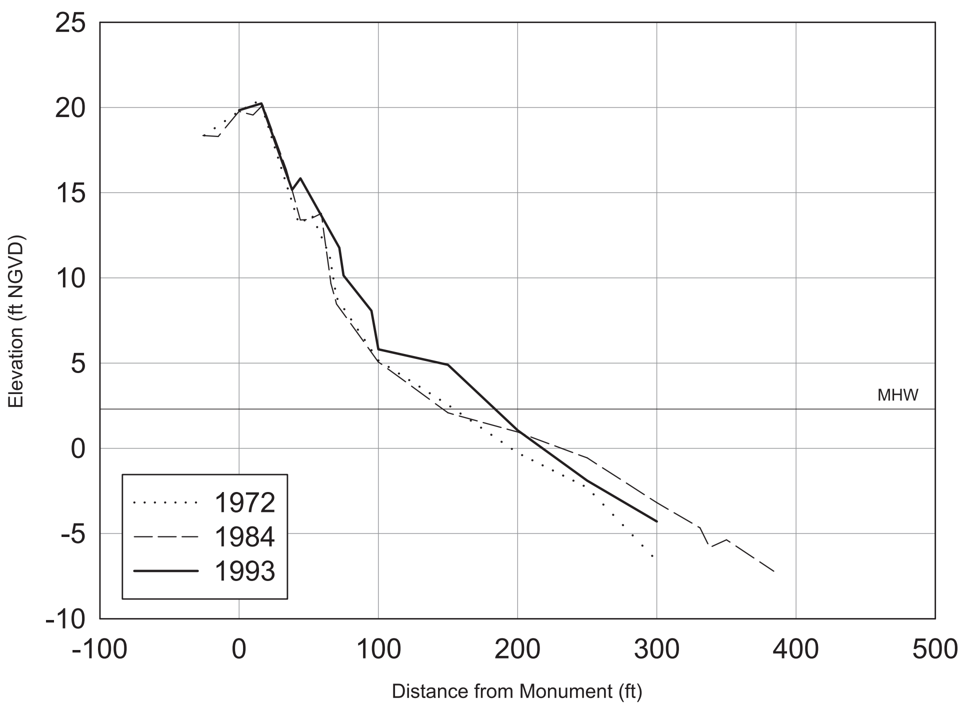

Historic MHW Distance vs. Time
R-232 to R-234
800
400
0
0
0
0
0
0
0
0
0
Ref. pt.
R-232
R-233
R-234
Distance from Reference Points (ft)
(Plots overlap; 100 ft tick interval)
ID / Axis Location
1850
1875
1900
1925
1950
1975
2000
2025
Calendar Year

7.3 Appendix C: Profile Plots

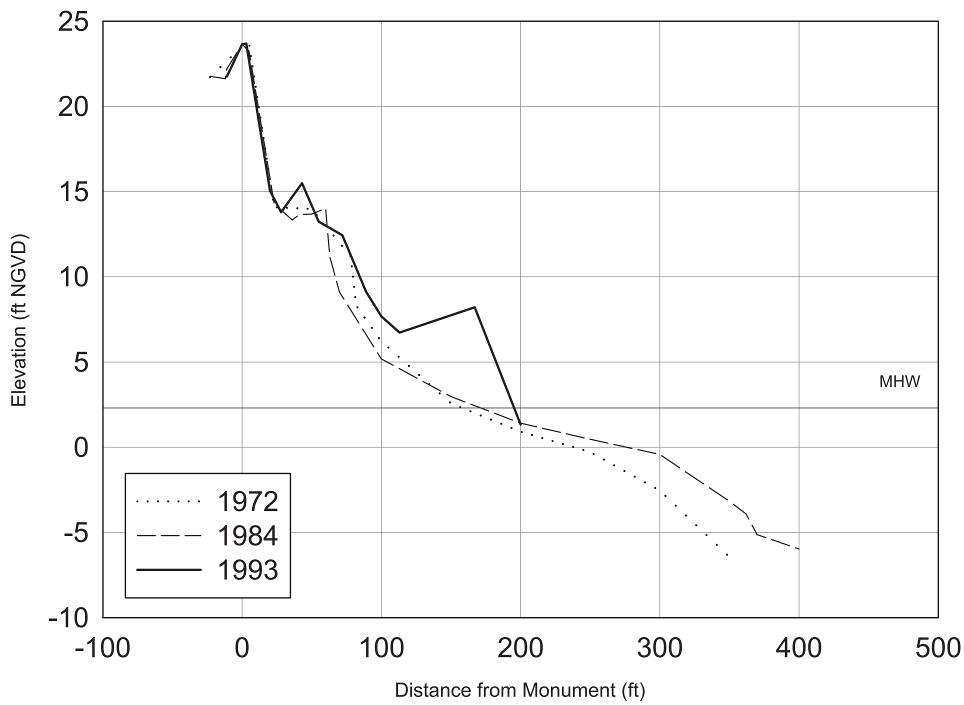
Volusia County
R-1



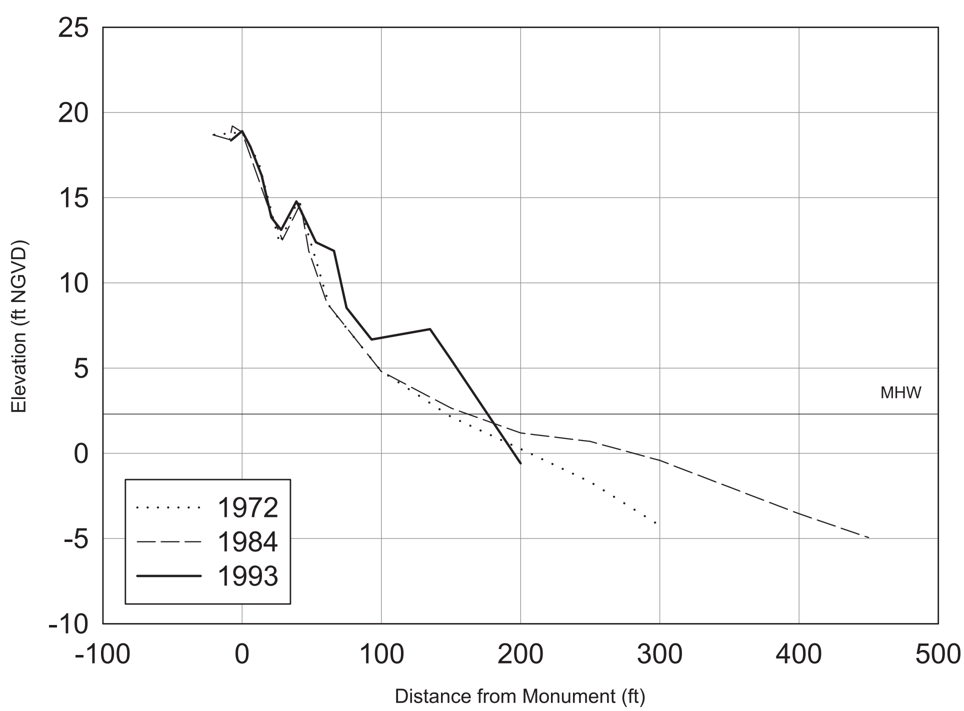
Volusia County
R-9



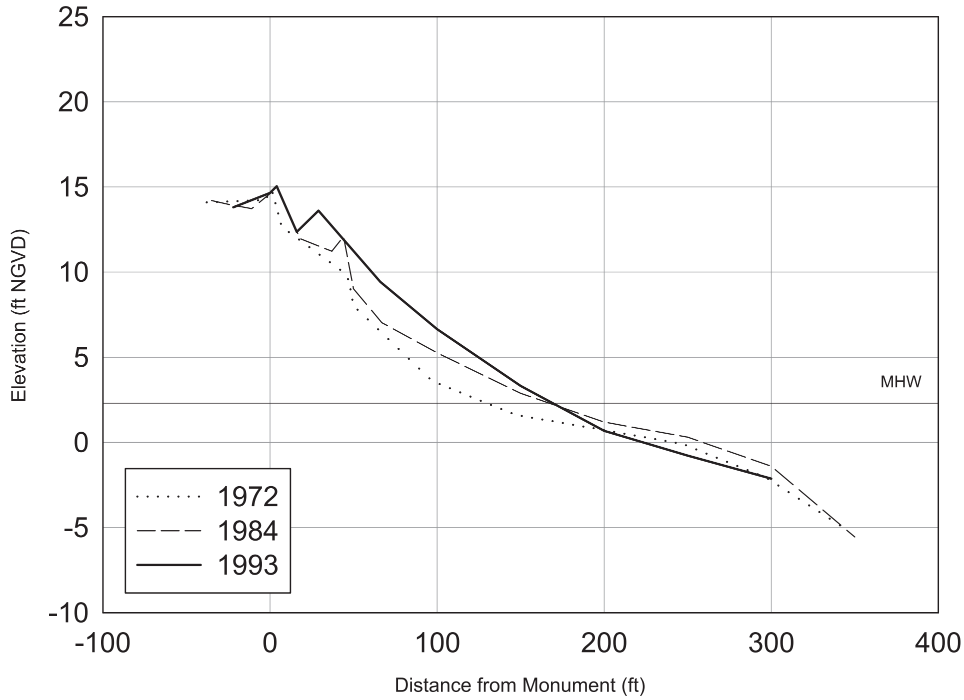
Volusia County
R-18



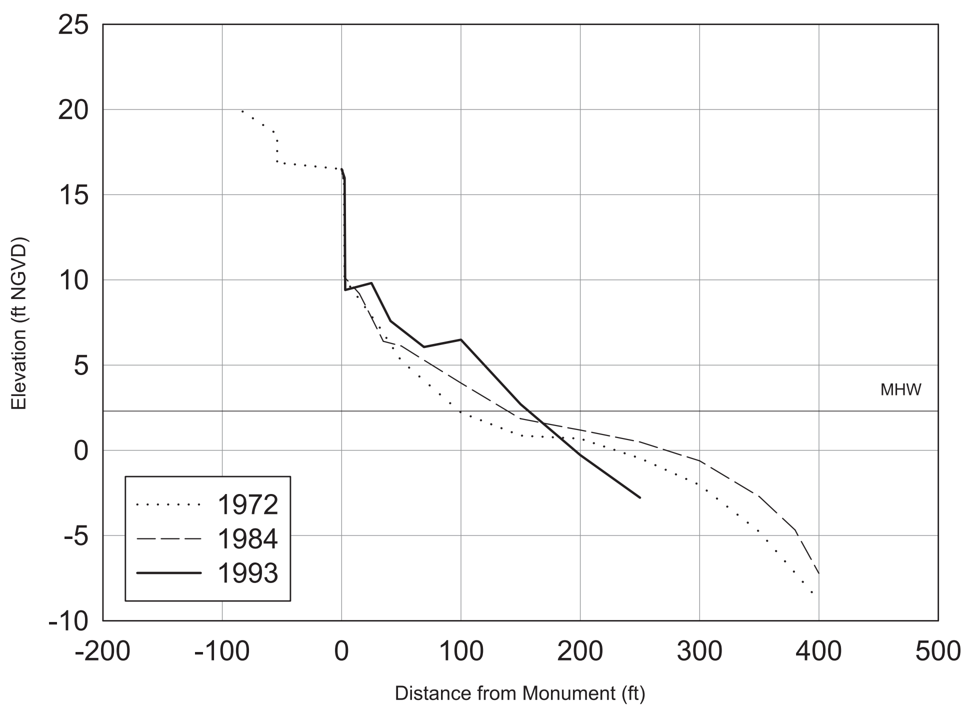
Volusia County
R-27



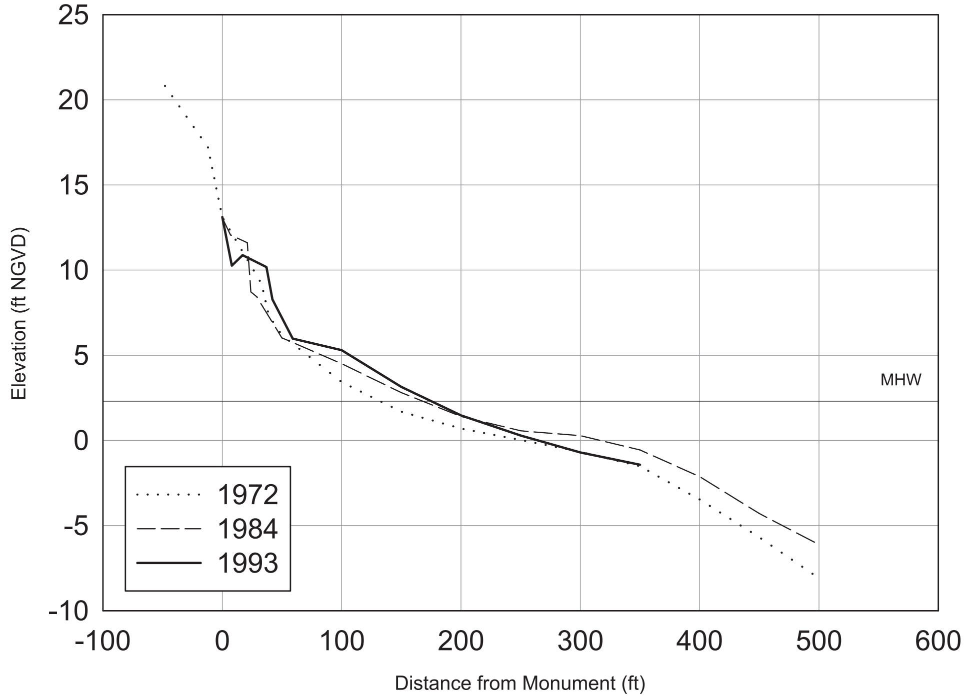
Volusia County
R-36



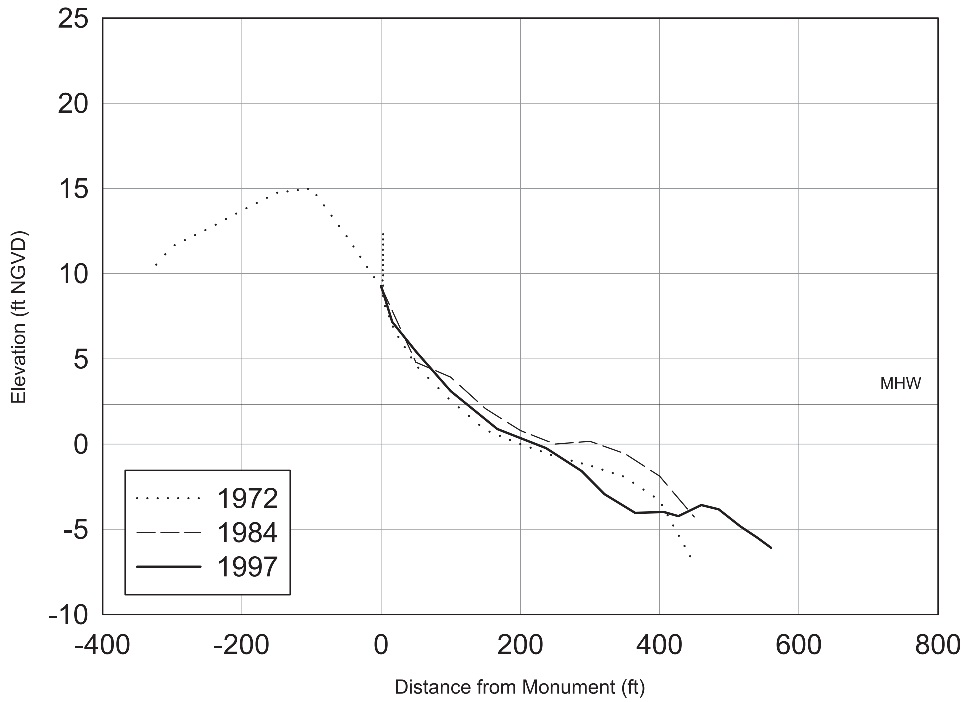
Volusia County
R-45



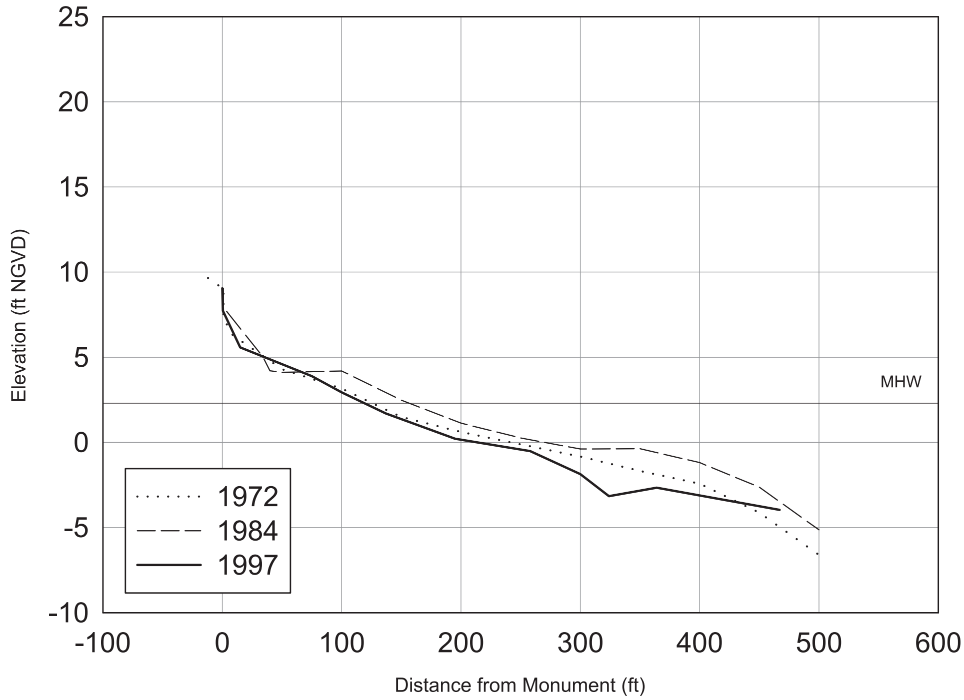
Volusia County
R-55



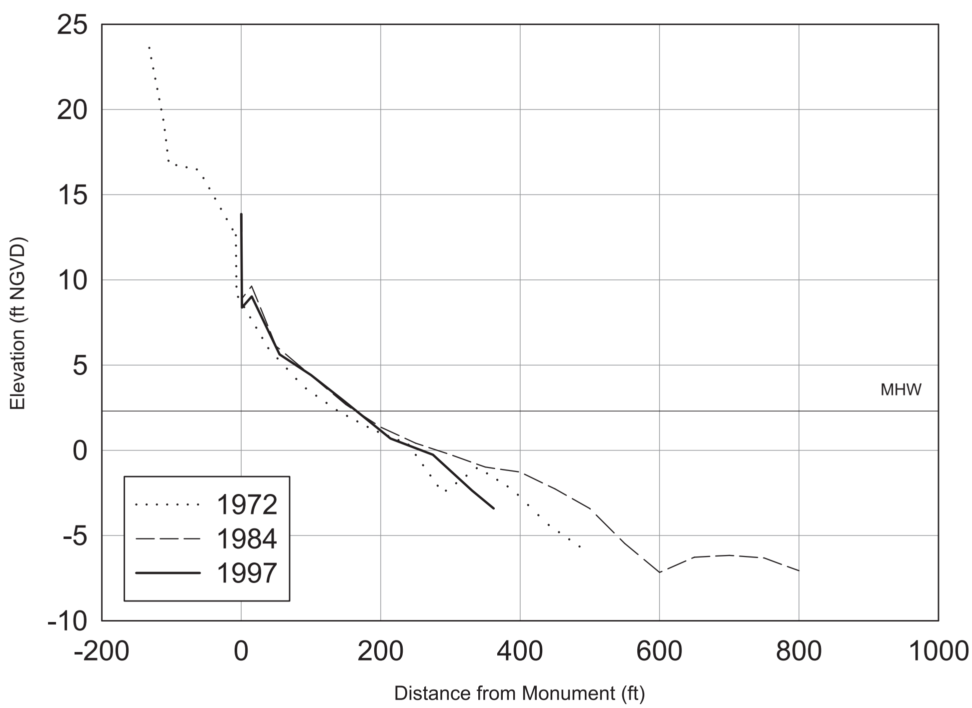
Volusia County
R-66



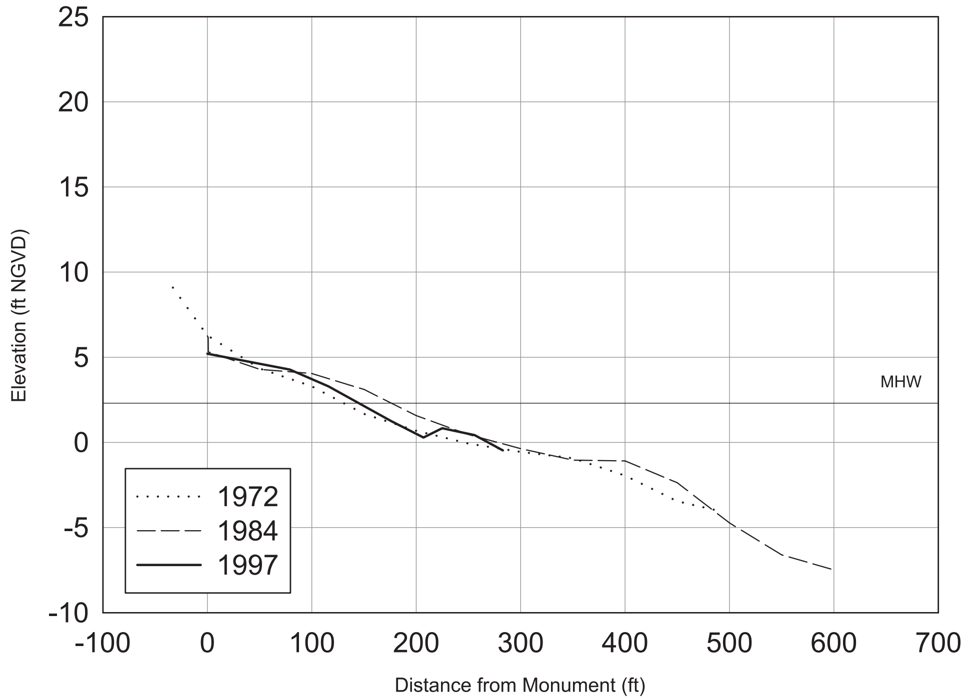
Volusia County
R-72



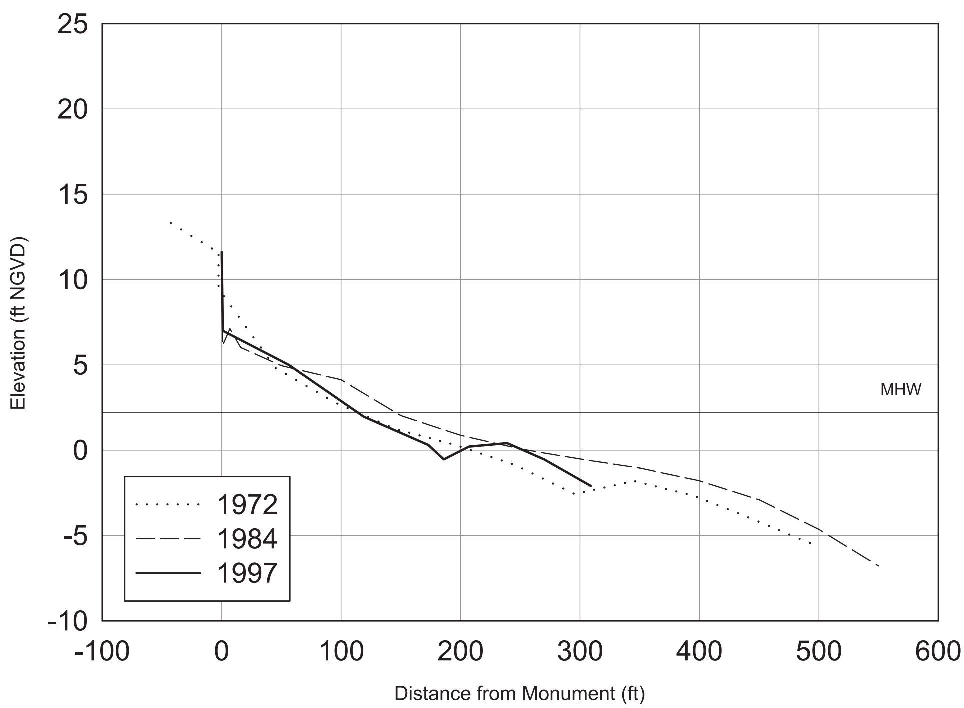
Volusia County
R-81



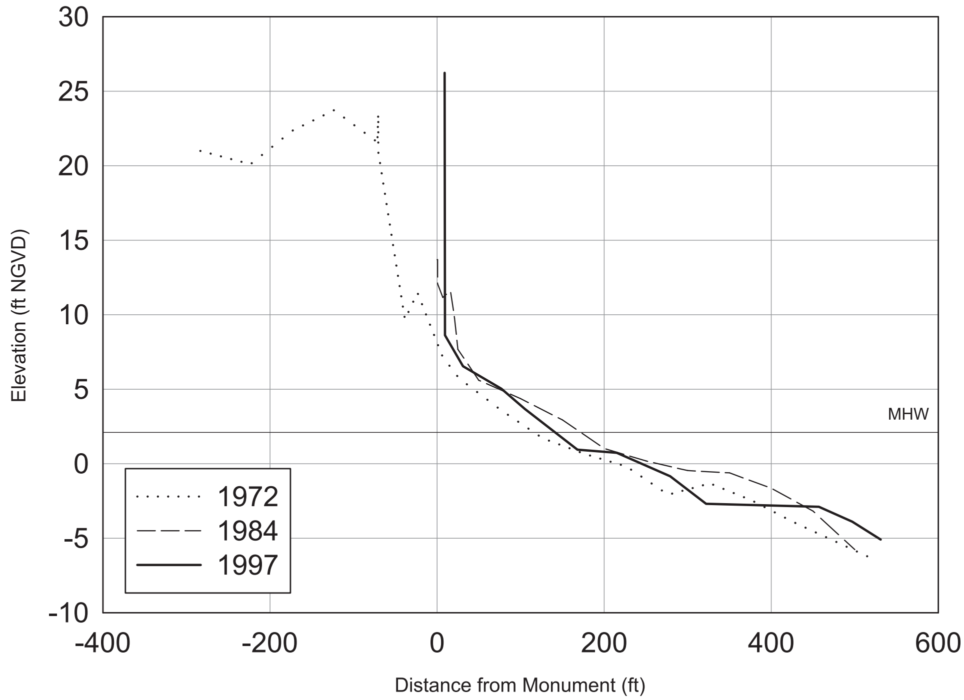
Volusia County
R-90



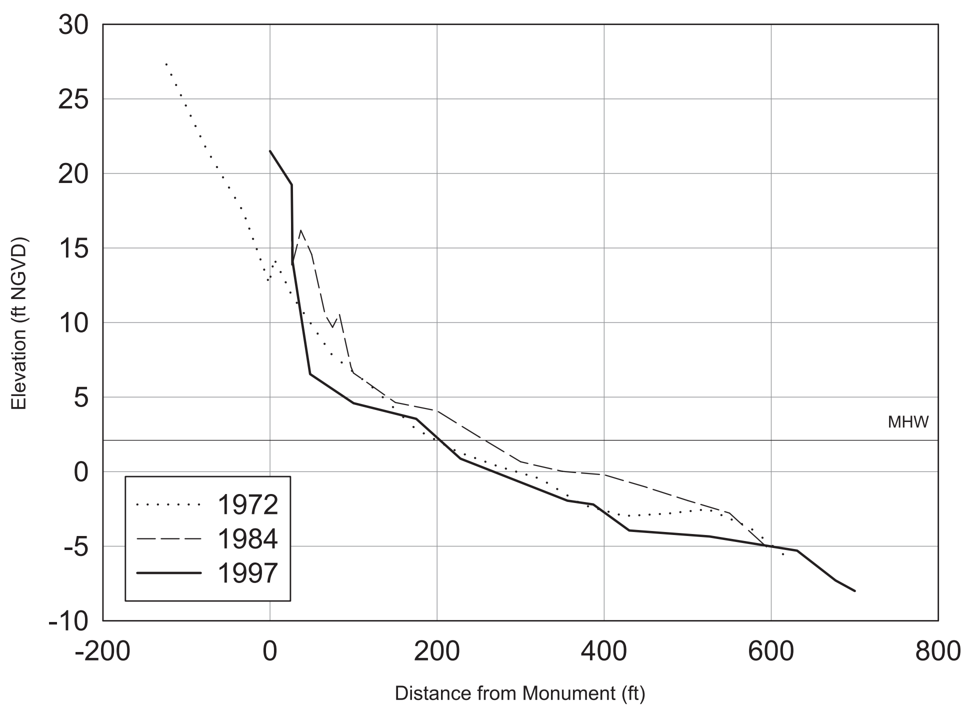
Volusia County
R-99



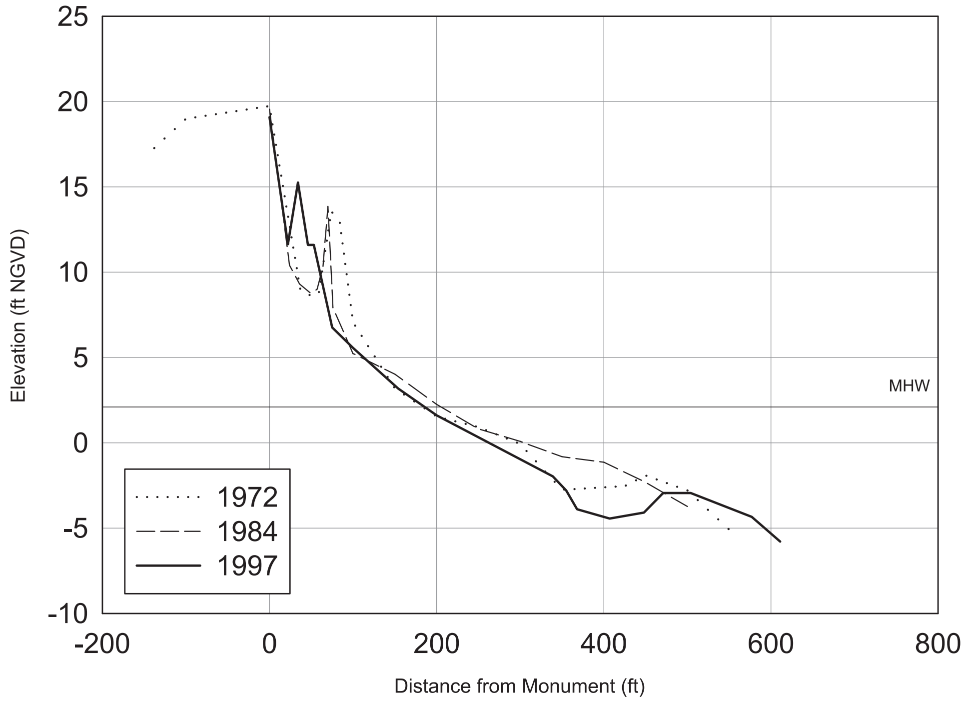
Volusia County
R-107



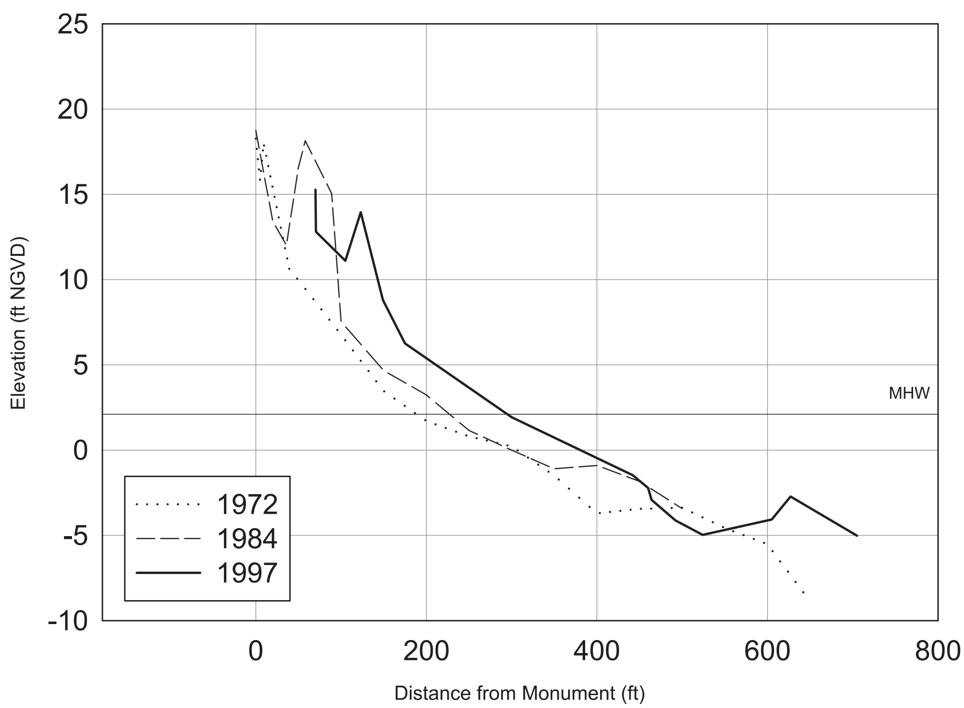
Volusia County
R-118



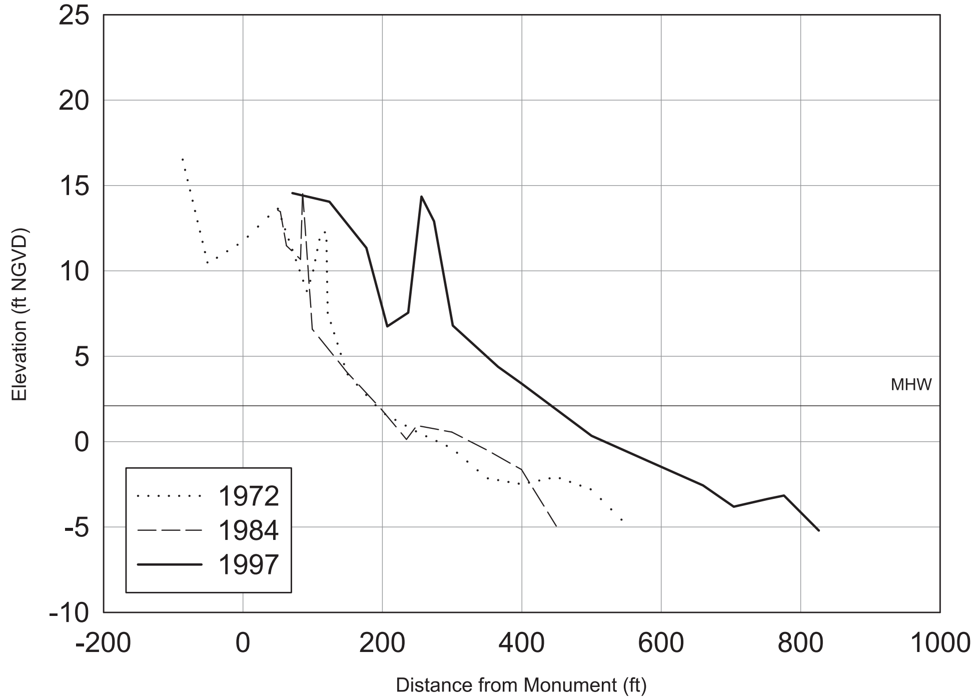
Volusia County
R-126



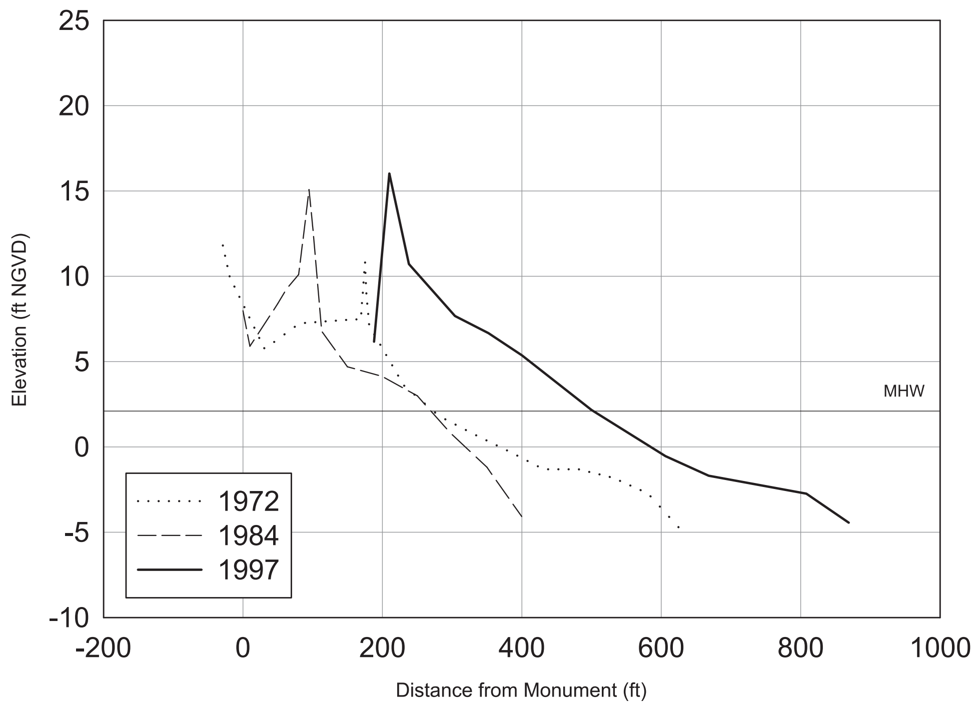
Volusia County
R-135

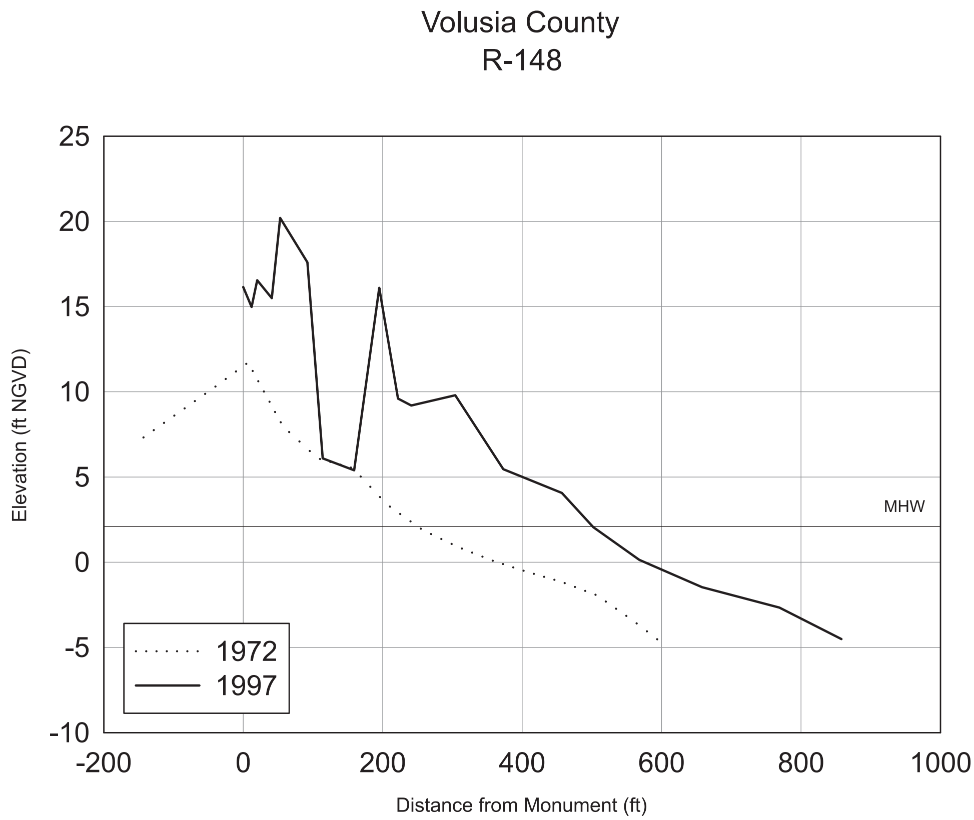


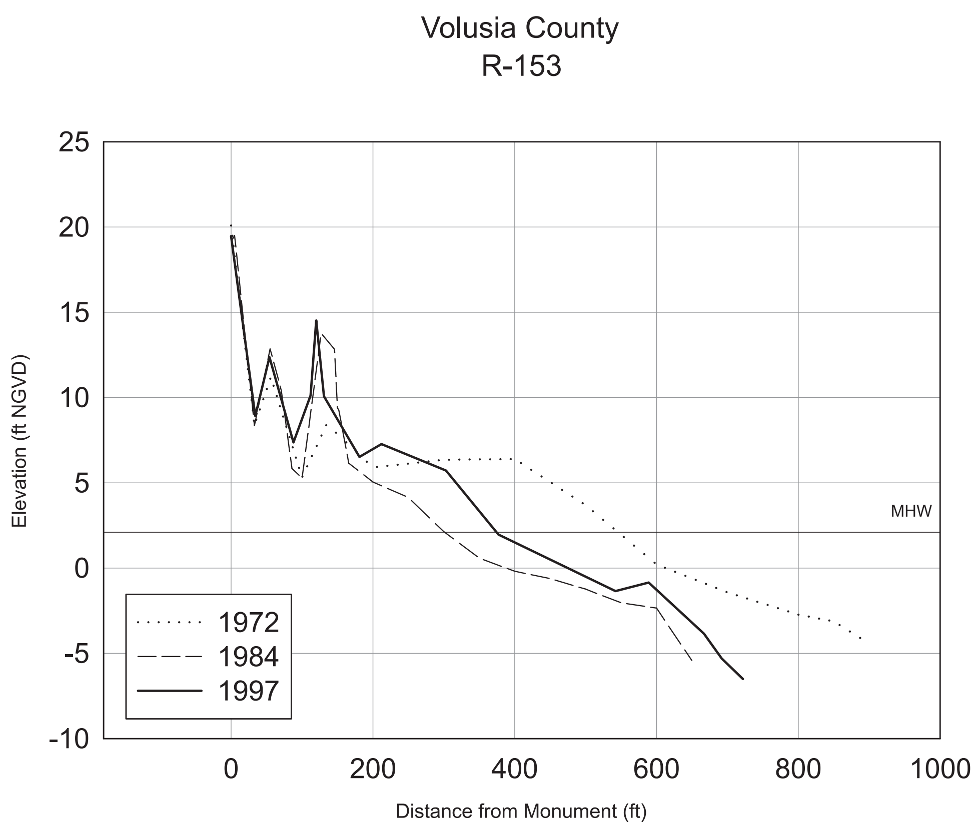
Volusia County
R-144



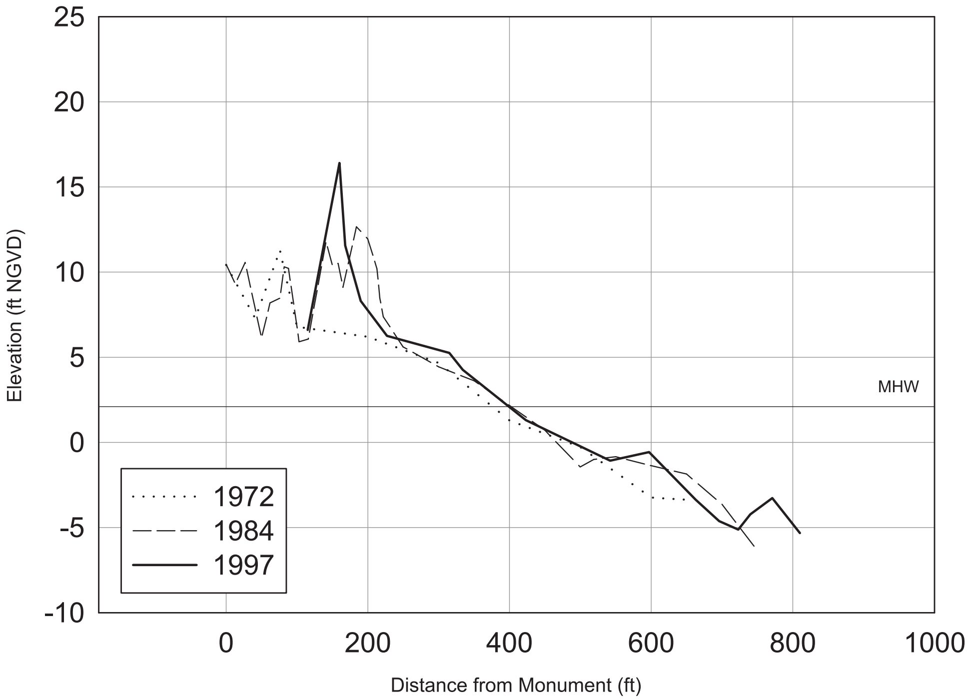
Volusia County
R-147



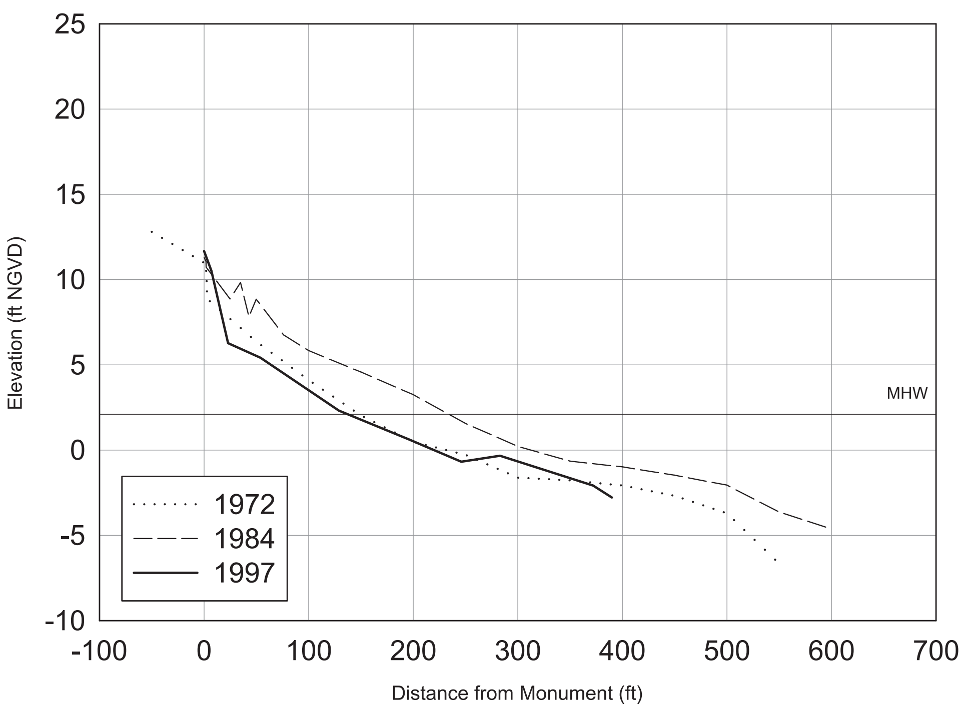

Volusia County
R-148
25
20
15
10
5
0
-5
-10
-200
0
200
400
600
800
1000
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1972
1997


Volusia County
R-153
25
20
15
10
5
0
-5
-10
0
200
400
600
800
1000
Elevation (ft NGVD)
Distance from Monument (ft)
MHW
1972
1984
1997

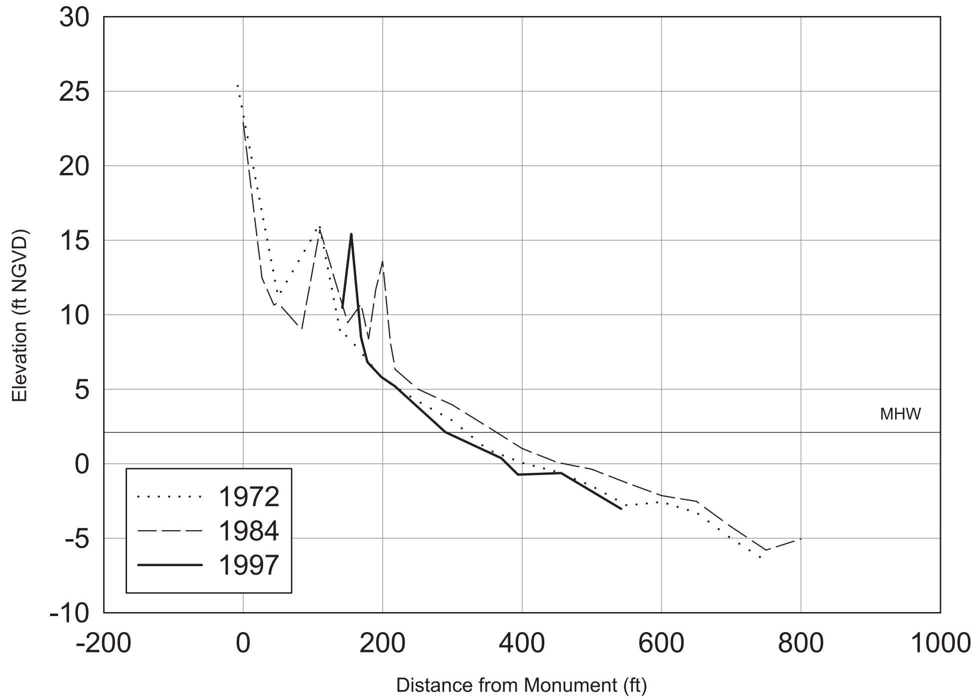
Volusia County
R-156



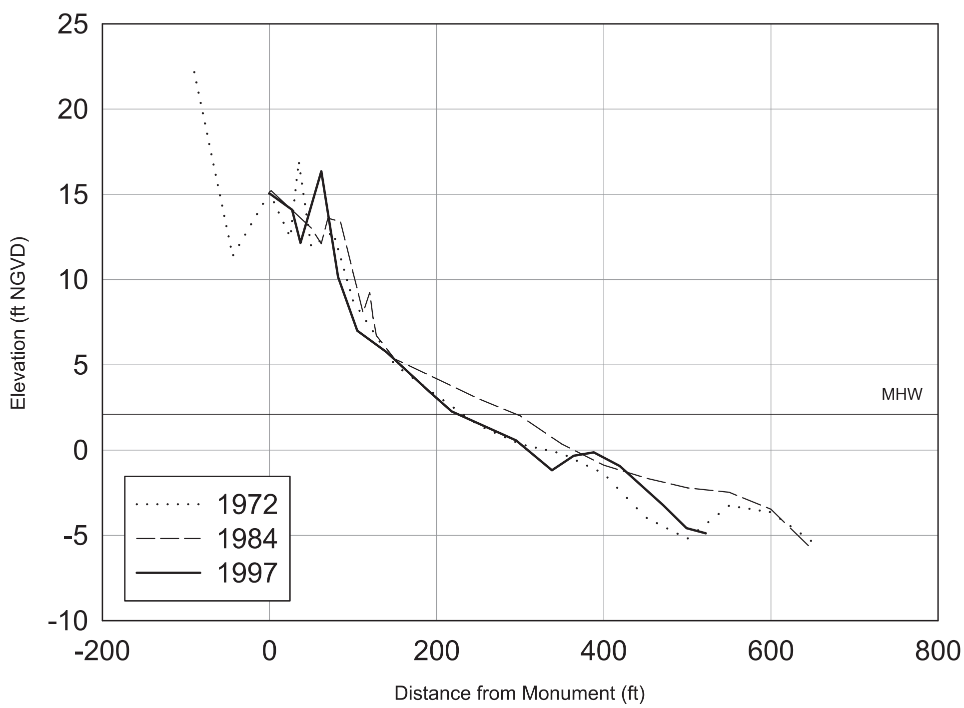
Volusia County
R-162



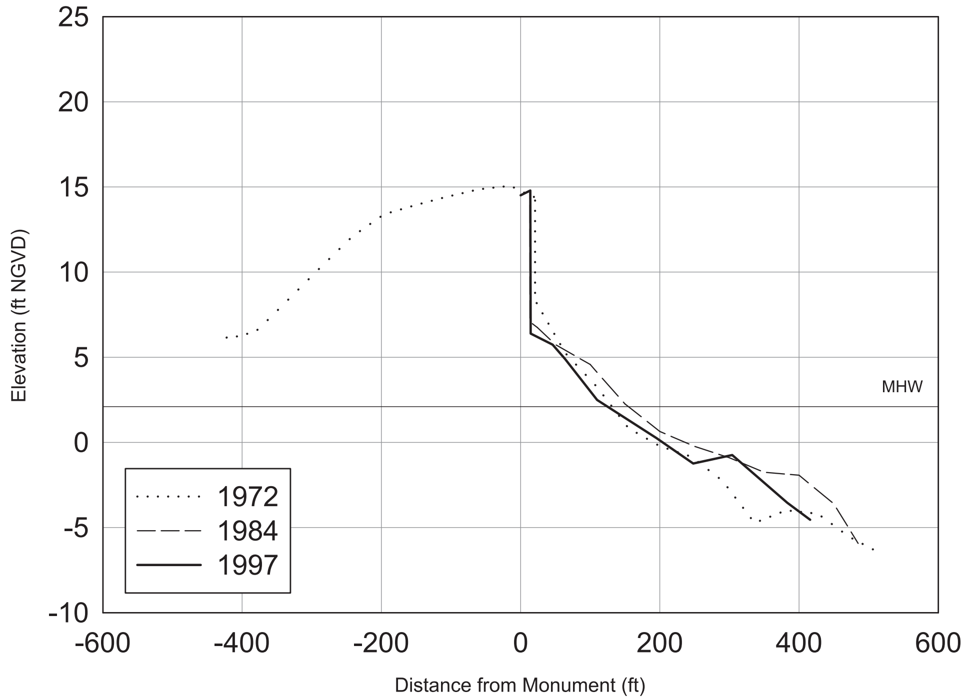
Volusia County
R-171



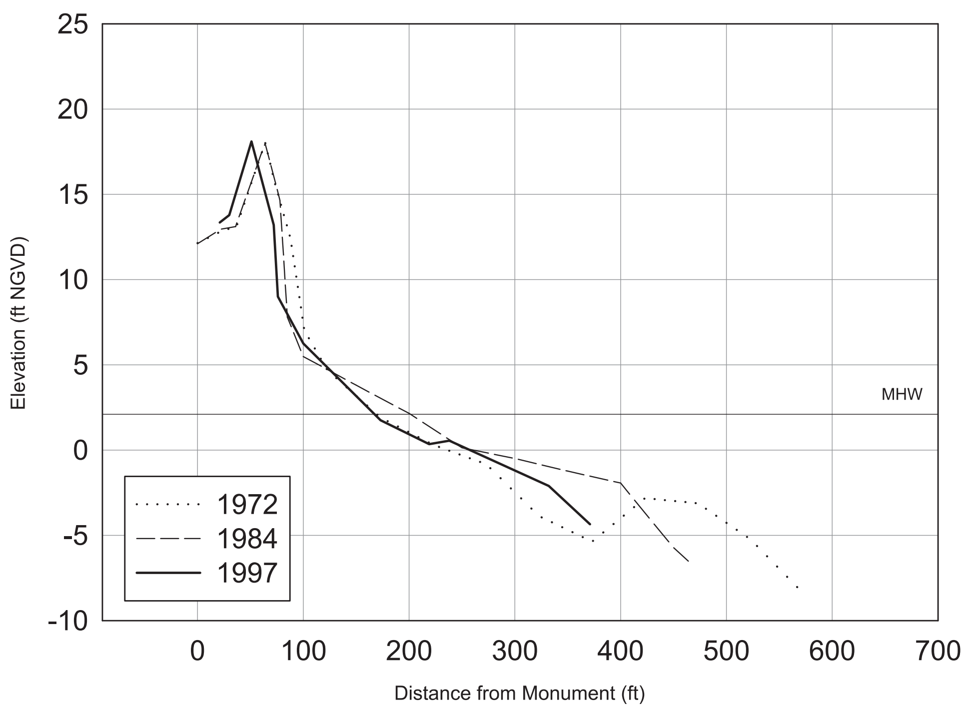
Volusia County
R-180



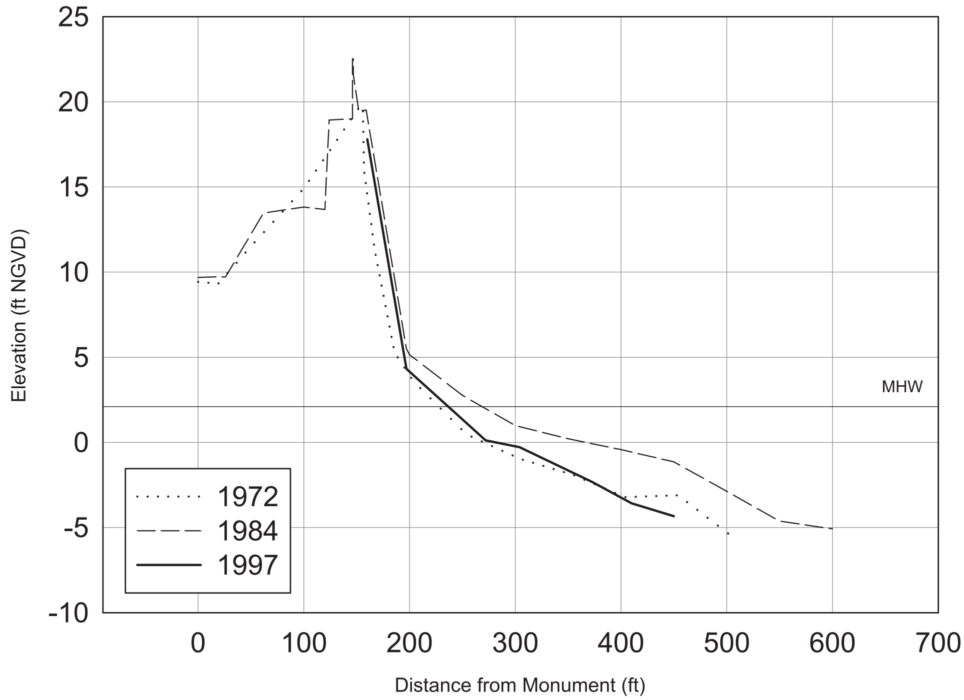
Volusia County
R-189



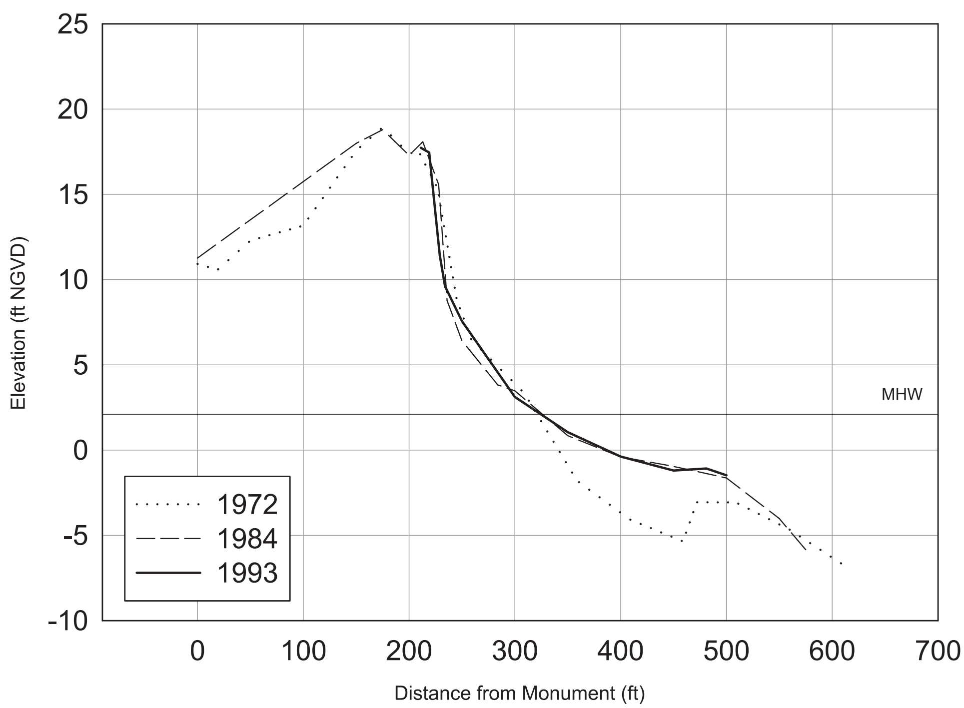
Volusia County
R-198



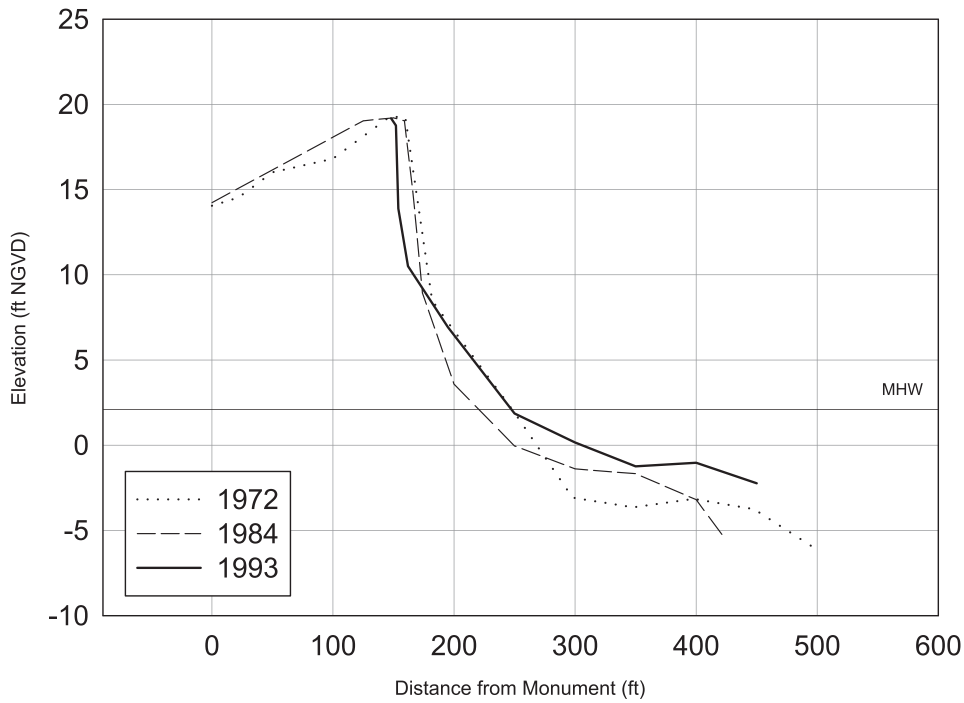
Volusia County
R-207



Volusia County
R-216



Volusia County
R-222



Volusia County
R-234