Town of Longboat Key, FL

Comprehensive Beach Management Plan: 2019 Update

Submitted to:

Town of Longboat Key, FL

Prepared by:

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(Plan originally submitted to the Town on 1 October 2019)

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EXECUTIVE SUMMARY

This document updates the Town of Longboat Key, FL, Comprehensive Beach Management Plan, first adopted in 1995. The Town actively manages over 10.3 miles of engineered beaches along the Gulf of Mexico. The update builds upon the management objectives of the prior studies, updates the significant level of project work that has occurred since the 2008 BMP update, and provides updated recommendations based upon the condition of the beach as of June/July 2019.

Figure EX-i depicts the existing shoreline conditions as surveyed in 2019, plotted in terms of the position of the Mean High Water Line (MHWL) relative to the design beach width condition and the Town's design baseline[1]. **Figure EX-i** likewise identifies four areas of the Longboat Key shoreline where beach renourishment is needed or is projected to be needed in the near future, to maintain adequate beach width and volume for storm protection and recreational needs. These areas are (A) North End, (B) Gulfside Road, (C) Central Key, and (D) South End. The Town has several options for available sand to renourish these areas, and has budgeted $35M in coming years to construct an expanded groin field for the North End and to place sand in the four areas of need. With the established budget and the sand resources available to the Town, the upcoming renourish project will require a multi-phase effort, combining different dredge/disposal and/or truck haul sand placement.

[1] Survey data are based upon the Florida Department of Environmental Protection R-monument survey system, which provides survey transects every 500 to 1,000 ft along the shoreline.

Near-term action items for beach management are listed below:

- Initiate renewal of sand placement easements islandwide;
- Construct the North End Structural Stabilization Project (2020/2021 beach area A)
- Construct the 2021/2022 multi-phase renourishment project (beach areas B, C, and D)
- Perform geotechnical sand search investigation to seek additional offshore sand sources
- Continue annual physical monitoring surveys and sea turtle nest monitoring
- Continue permit-required hardbottom/reef monitoring as required

The Executive Report and Comprehensive Beach Management Plan document, along with the companion study, provide the background information for these action items and for longer term management items for Town consideration.

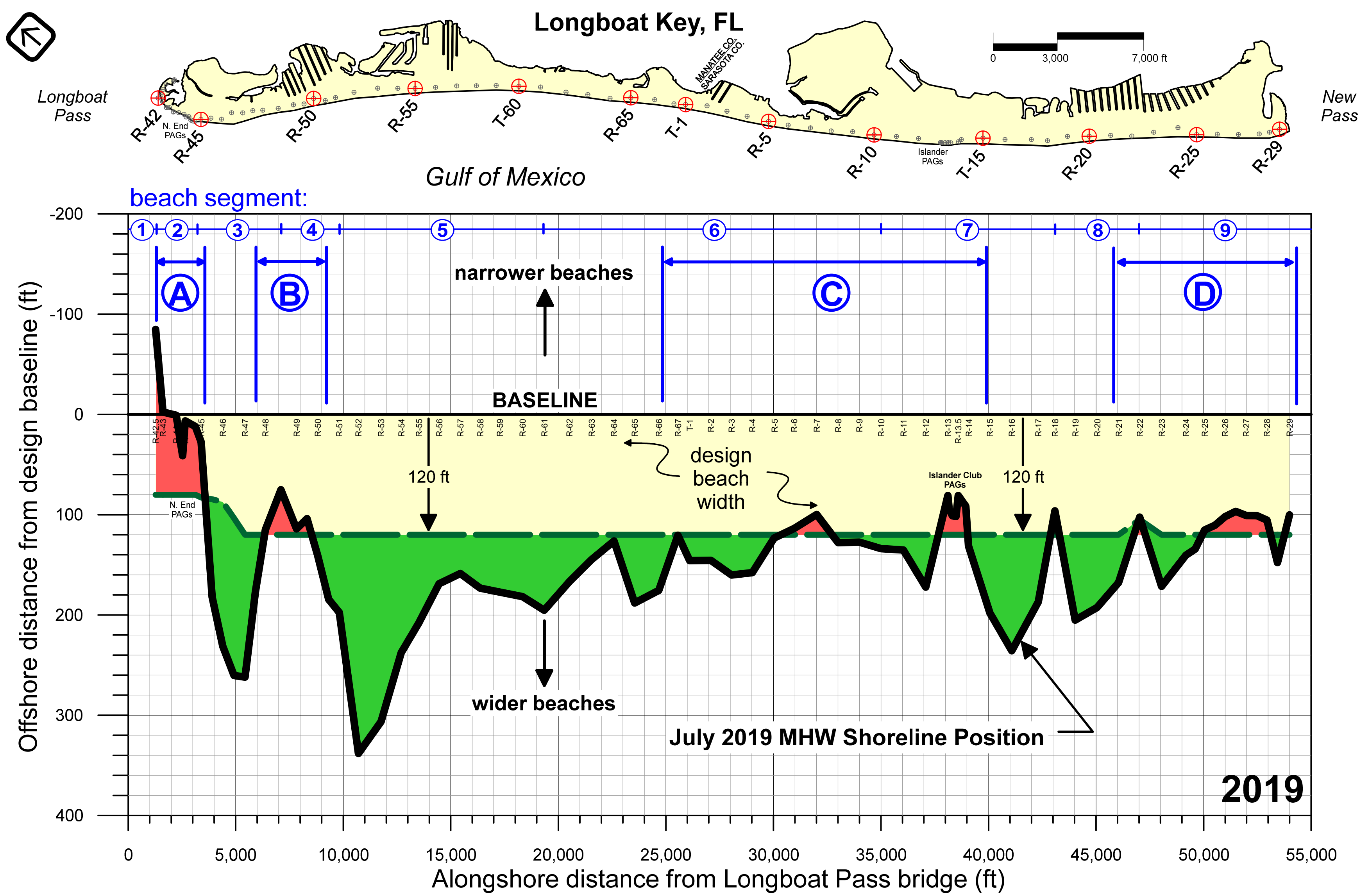

Figure EX-i Position of the June/July 2019 MHWL relative to the updated design beach baseline and beach width, Longboat Key, FL. Labels in blue indicate beach management section numbers 1-9 and proposed beach renourishment areas A-D.

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EXECUTIVE REPORT & PLAN

I INTRODUCTION

The Town of Longboat Key, FL actively manages over 10.3 miles of engineered beaches along the Gulf of Mexico (**Figure EX-1**). These beaches lie in both Manatee County and Sarasota County along the southwest coast of Florida south of the entrance to Tampa Bay. The Town undertook an initial large-scale beach nourishment project in 1993 to address the severely eroded condition of the beach along most of the island shoreline, and to remove numerous derelict coastal structures. In 1995, the Town adopted a comprehensive beach management plan (CPE, 1995), which provided a framework for the Town's decision making for future beach management and served to document the shore protection activities of the Town. The plan was subsequently updated in 1999 (CPE, 1999), and again most recently in 2008 (CPE, 2008). Olsen Associates, Inc. (OAI, 2014) updated numerous management strategies in 2014 and was contracted by the Town to formally update the Comprehensive Beach Management Plan (BMP) in 2019.

The 2019 plan update and study build upon the management objectives of the prior studies, updates the significant level of project work that has occurred since the 2008 BMP update, and provides updated recommendations based upon the condition of the beach as of June/July 2019 (OAI, 2019c, in prep.). The plan focuses on upcoming project work, including the stabilization of the north end of the shoreline and the construction of the next comprehensive renourishment (estimated construction in 2021-2022). The plan likewise describes potential future beach management activities over the next 20 years, approx. Future plans rely significantly on the availability of beach-compatible sand and the corresponding costs associated with obtaining that sand and maintaining it along the Longboat Key shoreline.

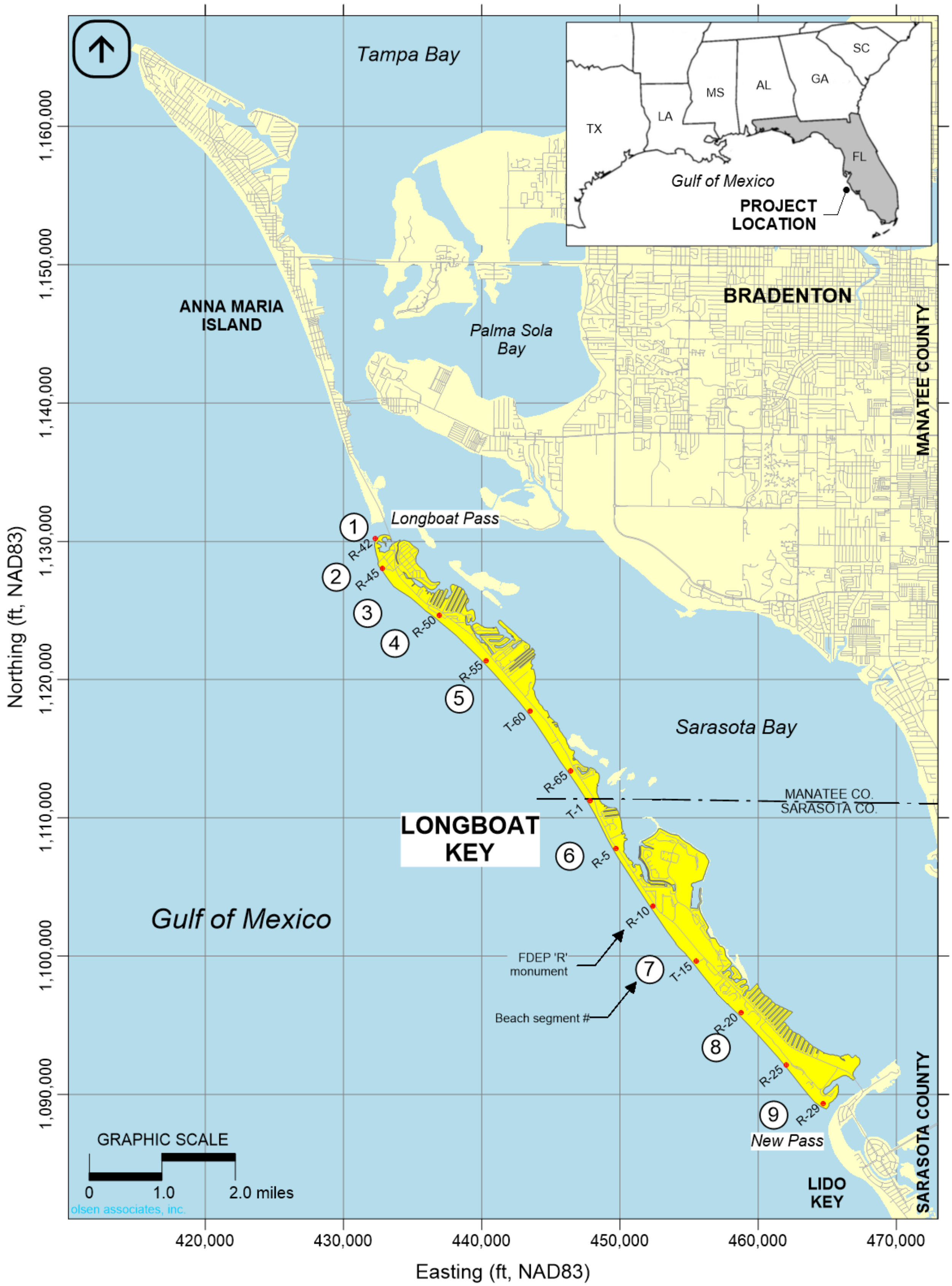

Figure EX-1 Location Map – Longboat Key, FL.

Figure EX-1 depicts the location of Longboat Key. The north end of the island lies roughly 8 miles south of the entrance to Tampa Bay, and is neighbored to the north by Anna Maria Island (Manatee County, FL) and to the south by Lido Key (City of Sarasota, Sarasota County, FL). For management purposes, the island is divided into nine segments, based upon shoreline characteristics and historical performance (**Table EX-1**), and referenced to the FDEP R-monument system. The plan provides site-specific objectives, alternatives, and recommendations for the nine segments.

Table EX-1 Limits of beach management segments, Town of Longboat Key, FL

Beach Segment	Northern Limit	Southern Limit	Segment Length (feet)	Description
#1	Longboat Pass Bridge	R-42.5*	1,300	Greer Island – Longboat Pass shoreline
#2	R-42.5	R-44.9+130’	1,930	Greer Island – Gulf shoreline and Longbeach seawall
#3	R-44.9+130’	R-48.5	3,870	Longbeach seawall to bypass bar attachment area south of Whitney Beach
#4	R-48.5	R-51	2,720	Bypass bar downdrift zone, including 6633 seawall and Gulfside Rd.
#5	R-51	R-61	9,530	S. Gulfside Rd. to Club Longboat
#6	R-61	R-10	15,660	Club Longboat to Neptune Avenue
#7	R-10	R-18	8,090	Neptune Avenue to The Colony, including Islander Club PAGs
#8	R-18	T-22	3,940	The Colony to the Privateer
#9	T-22	New Pass	7,390	Gulf shoreline affected by New Pass ebb shoal (measured to terminal groin)
			54,430 (10.3 miles)	shoreline from Longboat Pass bridge to New Pass terminal groin

*R-xx FDEP survey range monuments

II RECENT BEACH MANAGEMENT HISTORY

Tables EX-2a and **EX-2b** list the beach nourishment and structural stabilization activities undertaken by the Town since the first major beach restoration project in 1993. CPE (2008) describes the history of beach management up through the 2005-2006 major beach renourishment, which spanned the island in multiple segments from R-29 at New Pass northward to R-43 on Greer Island.

II.1 Initiatives from the 2008 Plan Update

CPE (2008) outlined recommendations for all segments of the beach. Most notably these recommendations included three new initiatives. These initiatives, and the subsequent actions taken in relation to them, are:

- Permeable/adjustable groins at the Islander Club condominiums (R-13, Sarasota County).
  - Two concrete Permeable Adjustable Groins (PAGs) were built in 2010.
  - The area south of the southern PAG was renourished in 2016 (see **Section II.5**).
- White sand search
  - Geotechnical investigations were conducted in 2008 and 2010 to develop several borrow areas off Anna Maria Island, including one area on the ebb shoal of Passage Key Inlet (X), one borrow area in Federal waters (F-2), and one in nearby State waters (B-3). These borrow areas hold beach-compatible sands of varying coarseness, shell content, and color (see **Section V**).
  - Geotechnical information has likewise been collected from both Longboat Pass (2010/2014) and New Pass (2014).
- North end structures/inlet evaluations
  - An inlet management study of Longboat Pass was completed in 2011 (CPE, 2011), funded jointly by the Town and Manatee County.
  - An interim beach fill of 139,900 cy, utilizing hopper-dredged sand from Borrow IX at Passage Key, was constructed in 2011 in the vicinity of North Shore Road (R-44.5, Manatee County) to offset the accelerated erosion in that area.
  - A subsequent beach fill of 98,000 cy of sand dredged from the Longboat Pass flood shoal was constructed in the same area in 2014 (see **II.3**).
  - Two concrete Permeable Adjustable Groins (PAGs) were built in 2015 at and just north of North Shore Road to slow the erosion there along. Approximately 9,375 cy of sand were trucked in to supplement the 2014 fill.
  - Permits to dredge the Longboat Pass ebb shoal channel were acquired in 2015. These permits are held jointly by the Town and Manatee County.
  - The Longboat Pass channel borrow area was dredged in late 2016 (see **II.5**).

Table EX-2a History of beach nourishment activities at Longboat Key, FL (1993-2018)

DATE	PROJECT	BEACH SEGMENT	LENGTH PLACEMENT AREA	SAND VOLUME (cy)	
Feb - Aug 1993	Beach Restoration (Longboat Pass/New Pass ebb shoals)	3-9	9.3 miles (49,000 ft), R-47 to R-29	3,336,000	
Oct 1996 - Feb 1997	Mid-Key Interim Nourishment (offshore deposits)	6-7	3.1 miles (17,000 ft), R-65 to R-14	891,000	
July 1997	Longboat Pass Maintenance Dredging	2-4	1.0 mile (5,500 ft) R-44.1 to R-46A & R-48.7 to R-51	109,000	
Aug - Sep 1997	New Pass Maintenance Dredging	9	0.8 miles (4,300 ft), R-22.6 to R-27.4	171,200	
Early 1998	Greer Island Channel Dredging	2	N. of North Shore Rd. (near R-45)	2,000	
Apr - May 2001	Beach Nourishment (offshore deposits)	7	0.7 miles (3,500 ft), R-10.5 to R-14	105,300	
Mar 2003	New Pass Maintenance Dredging	9	1.1 miles (6,000 feet), R-22 to R-28	99,800	
Apr 2005 - Jul 2006	Beach Nourishment (offshore deposits, Passage Key)	2-9	9.8 miles (52,000 ft), R-44 to R-29	1,790,000	
Jan - Feb 2010	North Shore Road (upland sand mines)	2	200 ft, R-44.5 to R-44.7	1,170	
Apr - May 2010	North End Dune Restoration (upland sand mine)	3	0.2 miles (1,140 ft), R-44.9 to R-46A	3,100	
Mar - Jun 2011	North End Nourishment (Passage Key ebb shoal)	2-3	0.5 miles (2,656 ft), R-44 to R-46.5	139,900	
May - Jul 2014	WCIND Project (Longboat Pass flood shoals)	2-3	0.4 miles (2,006 ft), R-44 to R-44.7 & R-44.9 to R-46	98,000	
Dec 2014 - Jun 2015	North End PAGs Sand Placement (upland sand mines)	2	0.1 mile (640 ft), R-44.4 to R-44.9	9,375	
Apr - Jul 2016	Central Key Truck Haul Beach Nourishment (upland sand mines: 307,500 tons)	6-7	2.9 miles (15,500 ft), A: R-62 to R-64 (2,610 ft B: R-67 to R-10.8 (10,630 ft) C: R-13+4 to R-15.7 (2,260 ft)	20,300 139,000 45,700	*2016 Multi-Phase Project: 687,700 cy*
Aug - Sep 2016	New Pass Dredging & Beach Nourishment	9	0.7 miles (3,900 ft) R-24 to R-28	234,000	
Sep - Oct 2016	Longboat Pass – I & II Dredging & Beach Nourishment	2-4	0.8 miles total (4,200 ft) I: R-44.6 to R-45.5 (1,000 ft) II: R-48 to R-50.7 (3,200 ft)	30,200 185,200	
Sep - Oct 2016	South End Emergency Truck Haul (upland sand mines: 50,000)	9	0.2 miles (1,000 ft) R-28 to R-29	33,300	
Sep 2018	North End Interim Nourishment (upland sand mines: 29,361 tons)	2	0.1 miles (600 ft) R-44.2 to R-44.7	22,000	
TOTAL SAND VOLUME PLACED (cubic yards)				**7,465,545**	

Table EX-2b History of coastal structural stabilization activities (1993-2015)
Updated from CPE (2008)

DATE	PROJECT	BEACH SEGMENT
1993	Artificial reef installation (South of Gulfside Road R-52, off Islander Club R-13)	5, 7
Oct 1996 – Feb 1997	Five geotextile-tube groins installed (three from Portobello to Mark III, R-7.5 to R-8.5) (two at Islander Club R-13 to R-13.5)	6-7
Oct 1996 – Feb 1997	Offshore geotextile-tube installed (shore-parallel sill installed off Bayport, R-3 to R-4)	6
Sep 1997 – Jan 1998	New Pass terminal groin reinforced and extended 120 ft Gulfward (R-29.4)	9
Dec 2001 – Jan 2002	Replacement of two geotextile-tube groins (Islander Club R-13 to R-13.5)	7
Jul 2005 – Jul 2006	Artificial reef construction (off Gulfside Road (R-50.5)	4
Nov 2009 – May 2010	Two concrete Permeable Adjustable Groins (PAGs) installed (Islander Club, R-13 to R-13.5, replaced geotubes)	7
Nov 2014 – Jun 2015	Two concrete Permeable Adjustable Groins (PAGs) installed (North Shore Road R-44.4 to R-44.7)	2

- North end structures/inlet evaluations (continued).
  - An update to the Longboat Pass sediment budget (OAI, 2019b) was conducted following the 2016 dredging of Longboat Pass by the Town;
  - Permit applications are in process for the additional structural stabilization of both Greer Island north of the PAGs (3 low-crested rock permeable groins) and the Longbeach seawall and Broadway Street area south of the PAGs (2 low-crested rock permeable groins). Sand for the structural fields may be obtained from upland truck-haul sources or from the Longboat Pass ebb shoal channel borrow area.

Also recommended in the 2008 comprehensive plan was a large-scale renourishment of the engineered beaches, to be constructed in 2014 in keeping with the intended 8-yr beach renourishment interval for the overall project. Following the publication of the 2008 plan, a potential opportunity arose to utilize sand resources lying along a proposed natural gas pipeline corridor that would run into Tampa Bay. Use of the sand, and clearing of the corridor route of beach-compatible sand resources, would potentially receive partial reimbursement from the company proposing the pipeline. The 2010 geotechnical investigation by CPE (2011) identified the F-2 and B-3 borrow areas along the route (see **Figure EX-4**, **Section V**).

In January 2013, the Town advertised an interim beach nourishment project for bids to take advantage of the pipeline corridor sand borrow areas. During the bidding process, members of the dredging industry raised concerns regarding the geometry and volumetric constraints of the proposed borrow areas. Concurrently, the U.S. dredge fleet was anticipating the upcoming restoration work associated with impacts from Hurricane Sandy. The combination of these and other factors resulted in no bids being submitted for the interim nourishment. A subsequent re-bid of the interim project later in 2013 resulted in the receipt of only one bid, which was beyond the target budget for acceptance. From that experience, the Town moved to an incremental approach for its next nourishment project(s), versus the proposed large-scale renourishment.

II.2 2011 North End Beach Renourishment Project

To address accelerated erosion along the North Shore Road area (R-44 to R-46), an interim beach renourishment project was constructed in mid-2011. Approximately 139,900 cy of sand from Borrow Area IX at Passage Key was excavated by a shallow-draft hopper dredge and placed along the shoreline between R-44 on Greer Island and R-46.5 at Broadway Street.

II.3 2014 Longboat Pass Flood Shoal Excavation/Beach Disposal

A 98,000 cubic yard dredging and beach placement project was conducted by the West Coast Inland Navigation District (WCIND) and the Town in 2014 and 2015. The purpose of the project was to remove sand from two flood shoal borrow areas lying north and west of Jewfish Key along the channel from Longboat Pass to the Gulf Intracoastal Waterway. Removal of the sand from the traps was intended to lower shoaling within the navigation channel. Sand from the dredging was placed along the Longboat Key shoreline both north and south of North Shore Road and the Longbeach seawall (R-44 to R-46). Between May-July 2014, the WCIND project placed an estimated 98,000 cy of beach fill.

II.4 2015 North Shore Road Permeable Adjustable Groins

The North Shore Road Permeable Adjustable Groins Project was constructed from 03 November 2014 to 30 June 2015. The project included the construction of two concrete Permeable Adjustable Groins (PAGs), 185 ft and 250 ft in length, near North Shore Road (**Figure EX-2**). In conjunction with PAG construction, a sand volume of 9,375 cy of sand was placed via truck haul. Subsequent monitoring surveys indicated that by mid-2016 only a negligible fraction of the sand volume placed in the WCIND and North End PAG projects remained along that shoreline segment (OAI, 2017c). In December 2016 / January 2017, the southern PAG structure at North Shore Road was partially tightened through the addition of 26 pre-cast concrete elements (both structures remain permeable). It is noted that the shorelines to the north and the south of the structures continue to be highly erosional.

II.5 2016 Multi-Phase Beach Nourishment

Between April and October 2016, an estimated sand volume of 687,700 cubic yards was placed by the Town along seven discrete segments (4.7 miles in total) of Gulf of Mexico shoreline on Longboat Key (OAI, 2017a, b). **Table EX-2a** lists the placement volumes, methods and sand sources used to complete the multi-phase project. The hydraulic dredging component of the 2016 multi-phase beach nourishment consisted of the excavation of two ebb shoal channel borrow areas for placement on Longboat Key. Sand from the New Pass channel (234,000 cy) was placed along 3,900 ft of the southern Longboat Key Gulf of Mexico shoreline between R-24 and R-28 in Sarasota County (**Figure EX-3**). The Longboat Pass sand (205,400 cy) was placed along two segments of shoreline in Manatee County a) Part I: 1,000 ft segment from R-44.7 to R-45.5, in the vicinity of North Shore Road and the Longbeach seawall, and b) Part II: 3,200 ft segment from R-48 to R-50.7, along Gulfside Road. The dredging project construction began on 18 August 2016 and was complete by 21 October 2016.

The truck haul sand placement for the Central Key project was constructed between 6 April 2016 and 13 July 2016, and included the nourishment of three shoreline segments in Manatee and Sarasota Counties and the delivery of 13,768 truck loads of sand (205,000 cy, est.). These segments included portions of Segments #6 and #7, including the area immediately south of the southern PAG at the Islander Club condominium The South End segment in Segment #9, from R-28 to R-29 in Sarasota County was constructed from 26 September 2016 to 07 October 2016, and included the delivery of 2,250 truck loads of sand (33,300 cy, est.).

Figure EX-2 Aerial view of the North Shore Road Permeable Adjustable Groins (PAGs) shortly after completion, and the north end of Longboat Key at Greer Island and Longboat Pass. (6 Aug 2015, Photos from the Air).

Figure EX-3 Dredge excavation of the New Pass ebb shoal channel borrow area, with sand placement to the south end of Longboat Key, (Aerial Innovations, Inc.)

II.6 2018 North Shore Road Emergency Beach Fill

In September-October 2018, approximately 22,000 cubic yards of sand was placed along 600-ft of the shoreline north of North Shore Road, within the concrete PAG cell and northward thereof (OAI, 2018b). The work was performed under an emergency purchase contract by the same truck haul contractor from the 2016 project. Sand was delivered from an upland sand mine via 1,336 truckloads and dumped, spread, and shaped within the fill template (22,000 cy). The project was constructed to address permit-requirements for the PAG structures to maintain certain beach dimensions within the beach cell. The small fill area was significantly impacted by Hurricane Michael (mid-October 2018) shortly after project completion, resulting in the transport of at least 20% to 25% of the placed material northward and offshore of the PAG cell.

In the 1995 Beach Management Plan (BMP), CPE (1995) established a design baseline along the Gulf shoreline of Longboat Key, based approximately on the existing vegetation line in the early 1990s. The baseline also considered the cross-shore siting of several existing condominiums and coastal structures. From the baseline, a design beach template was created to provide a minimum sandy beach width that would provide protection to the upland areas from a 10-yr storm event. This beach width was established at 130 ft from the baseline to the now-superseded NGVD29 vertical datum at elevation 0.0 ft. In an update to the Town's beach activities, OAI (2014) slightly modified the template to reflect recent typical sandy beach conditions and changed the reference of the design width to Mean High Water, based upon the current vertical datum reference of NAVD88. With those updates, the minimum beach width for the design template is now 120 ft, baseline to MHW (**Figure EX-4).** The 120-ft MHW design width is nearly identical to the prior width reference. The slightly steeper Gulfward slope of the new design template better matches the natural sandy slopes of the beaches that have developed since the beaches were restored in the early 1990s. The new template likewise produces a healthier, fuller profile that requires more sand, and thus provides a greater level of storm protection.

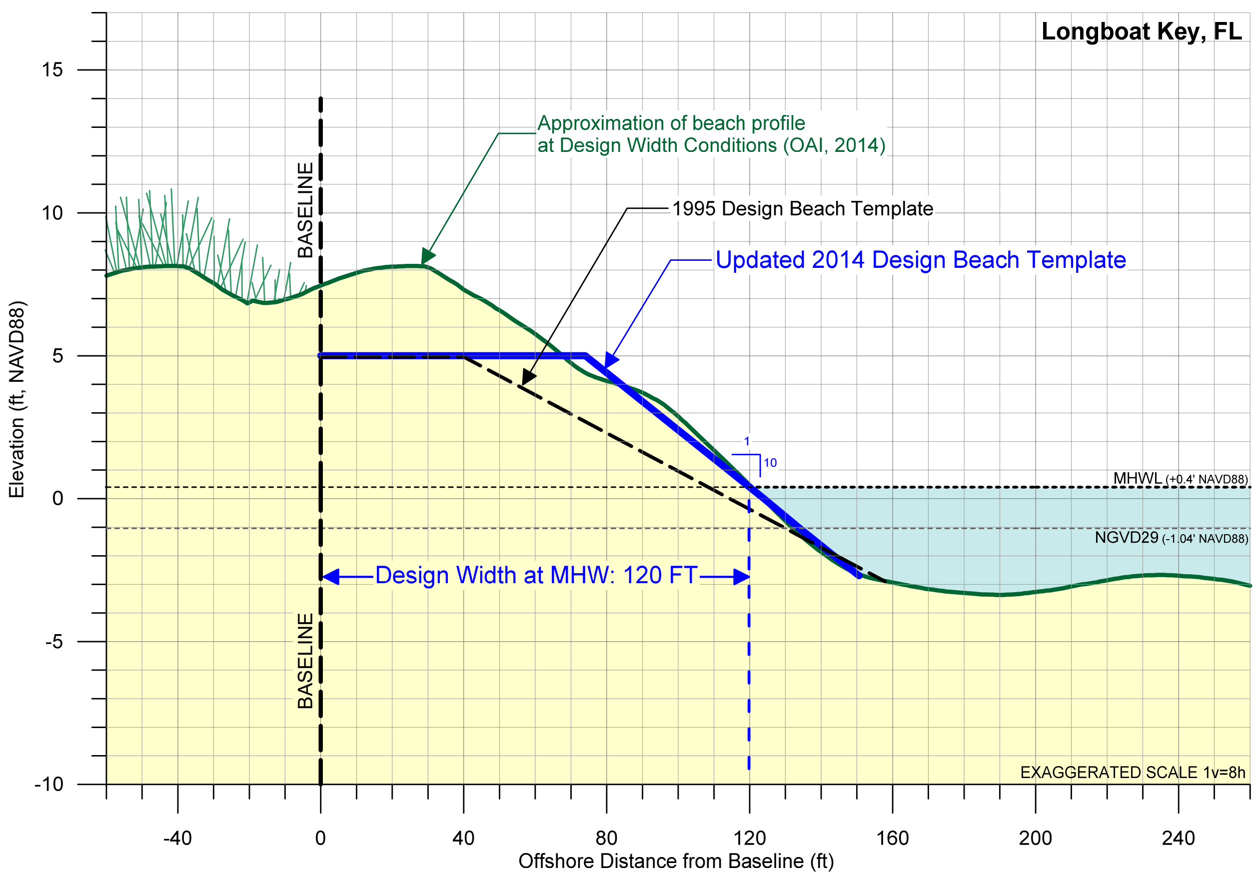

Figure EX-4 Design beach template updated to MHW reference and NAVD88 datum (OAI, 2014).

<u>Baseline Location & Design Width</u> – Since the establishment of the beach baseline, localized adjustments have been implemented in acknowledgment of the infeasibility of maintaining the design beach width in areas where the baseline protrudes too far Gulfward. In some areas, the original baseline was drawn to accommodate structures that were constructed noticeably Gulfward of the overall alongshore trend of development (OAI, 2014). The 2008 BMP summarized several of these adjustments, and the current Plan further edits the location of the design baseline and/or beach width in two critical areas.

(1) North Shore Rd. and Greer Island – The design width north of Whitney Beach at R-47 gradually tapers from the typical 120 ft width to 80 ft at North Shore Road (near R-44.7). This 80 ft width extended to the end of the island, tapering to zero at R-44 (CPE, 2008).
   - 2019 adjustment: With the construction of the proposed North End Structural Stabilization Project, the baseline shall be adjusted landward to follow the current shoreline orientation, which is far landward of the 2008 baseline location. The 80-ft design width carries northward through the proposed structures to R-42.5.

(2) Gulfside Rd. – The originally-established baseline protruded Gulfward along Gulfside Rd., across the large seawall at 6633 Gulf of Mexico Dr., and extended northward toward Whitney Beach. Repeated attempts to maintain sandy beach width along this segment have proven the infeasibility of continuing to try to meet the original design beach shoreline.
   - 2019 Adjustment: The design baseline has been shifted landward to the Gulfward edge of development along Gulfside Rd., without consideration of the seawall. The shift is 100 ft at R-49, landward, while the design width remains at 120 ft. This change does not provide sandy beach width in front the 6633 GMD seawall itself, which is impractical.

Areas of other continuing adjustment from the plan, referencing the standard 120 ft beach width described above, include:

- Islander Club (R-13) – The baseline at Islander Club, Aria, and Villa di Lancia was redrawn to follow the seawalls there along (CPE, 2008). No change in the design beach width was instituted, although the shifted baseline produces an unnatural Gulfward perturbation. With no adjustment in design width, it is noted that the Gulfward baseline shift to the seawalls is approximately 125 ft relative to adjacent properties. The shift and perturbation are greater than the typical design beach width. Thus, holding an additional 120 ft beach, even with the presence of the PAGs, is an unrealistic objective.

- The Colony (R-18, to be renamed St. Regis) – The baseline along the old Colony parcel protrudes Gulfward to accommodate the (previous) siting of the Colony buildings. The parcel has a low-crested adjustable pile/panel groin that stabilizes the shoreline and provides adequate width and shoreline protection thus no adjustments are proposed.

- The Privateer (R-22) – Similarly, the baseline at R-22 originally extended to the center of the Privateer seawall. This resulted in a Gulfward perturbation of the shoreline of over 60 ft. In prior adjustments, the design width was decreased by 15 ft along this short segment of the beach. In the 2008 BMP, it is simply acknowledged that the full design width cannot realistically be maintained in an artificially extended condition at this localized segment. This observation is likewise maintained in the current plan.

IV CURRENT CONDITIONS & SAND NEEDS

Figure EX-5 plots the location of the June/July 2019 Mean High Water Line (MHWL, +0.4 ft NAVD88) relative to the updated design baseline. The figure illustrates the typical 120-ft design beach width, and indicates several areas where the existing beach width has narrowed and the beach width goal is not currently achieved (areas shaded in red). Combining (a) volumetric comparisons of the 2019 survey conditions to the design beach width conditions, (b) projections to 2021 of two years of erosion from recent calculated historical erosion rates, and (c) further advance fill projections of 8 years of erosion along the shoreline, an estimate is computed of the beach fill sand volumes required to bring the various eroded shoreline segments to the design condition *and* to maintain those erosional areas with advance sand fill for an 8-yr renourishment interval. **Table EX-4** lists the expected sand volume needs, 1.421 Mcy, for a 'full' beach nourishment project to occur in 2020/2021 and 2021/2022. As depicted in **Figure EX-5**, the erosion conditions, and hence typical sand placement areas, are typically concentrated in four primary areas, A-D.

Table EX-4 Projected sand volume needs for full design restoration in 2020/2021 and 2021/2022

Project Areas	Segment Length (ft)	Projected Sand Volume Requirement*	Description
NORTH END			
A (segs #2/#3)	3,100 (R-42.5 to R-46)	554,000** (178 cy/ft, avg.)	Greer Island – Gulf shoreline Longbeach seawall to Broadway St.
GULFSIDE ROAD			
B (seg #3)	2,900 (R-47.5 to R-50.5)	330,000 (114 cy/ft, avg.)	South Whitney Beach to Gulfside Rd.
CENTRAL KEY			
C (segs #6/#7)	15,400 (R-66 to R-15)	185,000 (12 cy/ft, avg.)	Longboat Harbour Towers to Sunset Beach
SOUTH END			
D (segs #8/#9)	8,400 (R-21 to New Pass)	352,000 (42 cy/ft, avg.)	Gulf shoreline affected by New Pass ebb shoal (measured to terminal groin)
		1,421,000 cy	Volume needs in 2021/2022*/**

*Values include the volume needed to reach design condition, volume needed for two years of expected erosion to 2021, and advance fill volume needed for subsequent 8 years of erosion during renourishment interval.
** values reflect pre- North End structural stabilization erosion rates; post-stabilization conditions will decrease.

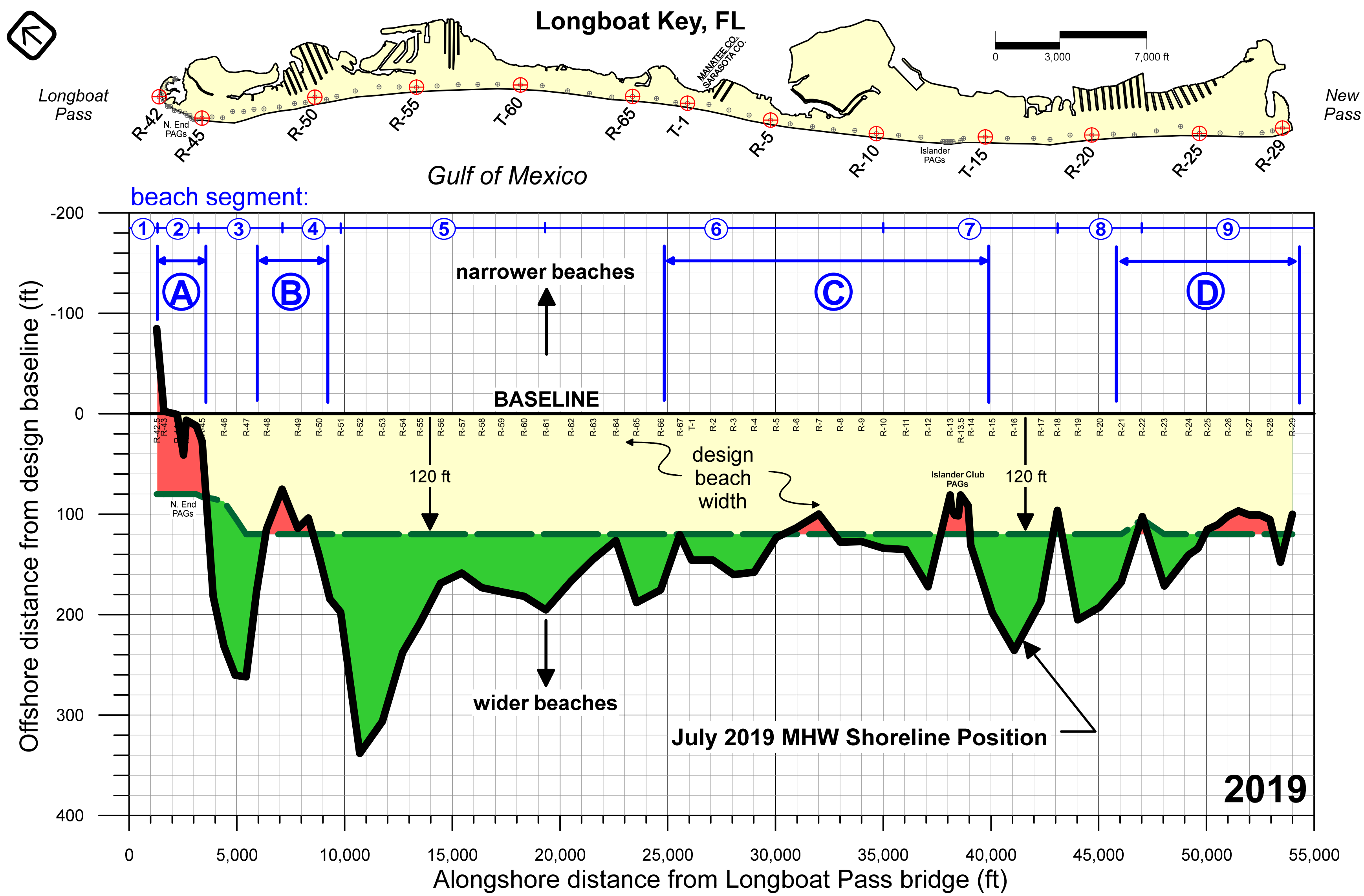

Figure EX-5 Position of the June/July 2019 MHWL relative to the updated design beach baseline and beach width, Longboat Key, FL. Labels in blue indicate beach management section numbers 1-9 and proposed beach renourishment areas A-D.

While **Table EX-4** lists the sand volume needs for the four primary beach areas (**Figure EX-5**), the approaches to be taken to address these needs can reduce the overall volume requirement. Along the North End (Area 'A'), the planned structural stabilization project will place 200,000 cy and significantly reduce the extremely severe erosion rate there along. Hence, the overall need for a 2021/2022 project can be reduced by 354,000 cy. Further, it is judged to be very impractical to continue to try to maintain the design beach width along the seawall at 6633 Gulf of Mexico Drive in Area 'B.' The adjustment to the design baseline in this area reduces the overall need, but the erosion rates that persist around the seawall are significant and require a high volume of sand to address, especially over an 8-yr period. Initial sand placement intended to meet the 8-yr requirement results in wasteful uses of limited sand resources. Herein, the approach is taken is to reduce the sand placement volume to a point that may represent only 3-4 years of advance fill, reducing the need by another 155,000 cy. **Table EX-5** lists the adjusted sand volume needs, 912,000 cy, for beach nourishment projects to occur in 2020/2021 and 2021/2022.

Table EX-5 ADJUSTED projection of sand volume needs for full design restoration in 2020/2021 and 2021/2022

Project Areas	**Segment Length (ft)**	**Projected Sand Volume Requirement***	**Description**
		NORTH END	
A (segs #2/#3)	3,100 (R-42.5 to R-46)	200,000 (65 cy/ft, avg.)	Greer Island – Gulf shoreline Longbeach seawall to Broadway St.
		GULFSIDE ROAD	
B (seg #3)	2,900 (R-47.5 to R-50.5)	175,000 (60 cy/ft, avg., 3-4yr interval)	South Whitney Beach to Gulfside Rd.
		CENTRAL KEY	
C (segs #6/#7)	15,400 (R-66 to R-15)	185,000 (12 cy/ft, avg.)	Longboat Harbour Towers to Sunset Beach
		SOUTH END	
D (segs #8/#9)	8,400 (R-21 to New Pass)	352,000 (42 cy/ft, avg.)	Gulf shoreline affected by New Pass ebb shoal (measured to terminal groin)
		912,000 cy	Volume needs in 2021/2022*/**

*Values include the volume needed to reach design condition, volume needed for two years of expected erosion to 2021, and volume needed for subsequent 8 years of erosion during renourishment interval.

IV.1 Beach Storm Vulnerability

Numerical model simulations of storm recession were performed for existing beach conditions for a range of storm surge and wave cases (**Appendix C**). The model results indicate that the existing beach and dune conditions, for beach segments that are at the design beach width or better (**Figure EX-5**), are typically adequate to provide protection to Gulf-front upland infrastructure from as much as a 6.5-ft to 7.0-ft total storm surge[2]. Such a storm surge approximates a 20-yr storm event (5% chance of occurrence in any given year). Adequate protection refers to the prevention of beach profile erosion and deflation landward of a specified point such as the edge of development, and the prevention of significant wave penetration landward of the primary dunes. In such a storm, the existing primary dunes may be severely damaged or completely eroded away.

For storm events above that surge level, or for beaches that are lower and/or narrower than the design template, the existing beaches provide an incrementally decreasing level of protection as the sustained surge level during a storm overtops the typical beach berm elevations, and the occurrence of overwash, profile deflation or scour increases. Lower areas of the shoreline, such as Greer Island and areas along access corridors and footpaths, will experience overtopping at much lower elevations and smaller storms. Note that the simulations do not address storm-induced flooding along the bay and canal shorelines of Longboat Key.

Along many segments of the shoreline, dunes have grown significantly in the last 15-20 years from all the sand placement efforts. These dune features can limit the overwash and wave intrusion landward of the dune line and increase the overall level of storm protection offered to upland infrastructure. With the substantial dune and dune vegetation growth, the sandy recreational beach berm space has narrowed for some segments as the dry beach berm has gradually eroded landward and the dune vegetation has grown Gulfward. The dune and vegetation are very beneficial to the protection of the beach system and the provision of storm protection benefits. For this reason, FDEP protects the dunes and dune vegetation and limits or prevents any manipulation of these resources that would remove any dune width or trim back any dune vegetation. Any localized proposals for dune enhancement, such as the installation of sand fencing or additional sea oats, etc., should be carefully considered in the context of the degree of vegetation that already exists in a particular location. On the contrary, gaps in the primary dune line should be infilled where practicable and replanted to limit storm overwash and wave intrusion, and dune walkovers should be encouraged.

[2] Total surge refers to the elevation above NAVD88 datum and includes the effects of tide and wave setup.

V SAND RESOURCES

The Town presently holds permits to place beach fill sand from several sources, including upland sand mines, adjacent inlet borrow areas, and offshore borrow areas (see **Section VIII**). These sources are summarized in **Table EX-6**. The locations of these areas are plotted in **Figure EX-6**.

Table EX-6 Currently available sand resources for beach nourishment at Longboat Key, FL

Source	Location/ Volume	General Description of Sediments	Feasibility**
Upland Sources (Truck Haul) (permitted)	110-120 miles* (Lake Wales Ridge) / No practical volume limit	• White (Value 8+) • Coarse, uniform sand • No shell or silts/muds	• Distant source • Community impacts (traffic) • Limited construction access • Cost opinion: $50 - $60/cy
Passage Key Inlet Ebb Shoal (permitted, IX, Xa, Xb)	12 miles* / ~5.5 million cy	• White (Value 7-8) • Fine sand w/ varying shell • Low to no silts/muds	• Distant, shallow source • Rehandling likely required • Screening possibly required • Cost opinion: $45 - $55/cy
Offshore Deposits off Anna Maria I. (permitted, B-3 and F-2***)	15-18 miles* / ~500,000 cy	• Gray/lt. gray (Value ~6) • Fine sand, increased shell • Low silts/muds	• Distant sources • Non-renewable • Screening possibly required • Cost opinion: $25 - $35/cy
Longboat Pass/ New Pass Ebb Shoals (permitted)	~inlet adjacent (2-3 mi) / ~200,000 cy, each inlet	• White sand (Value 7-8) • Fine sand w/ varying shell • Low to no silts/muds	• Local, shared source • Limited volumes • Renewable • Cost opinion: $17 - $22/cy
Inlet Flood Shoal (permitted & unpermitted)	Longboat Pass area / <100,000 cy	• Lt. gray/white (Value 6 -8) • Fine sand w/shell • Increased silt	• Local, shared source • Non-renewable • Cost opinion: $12 - $18/cy
Greer Island Spit (challenging to permit)	Longboat Pass area / <50,000 cy (est.)	• White (Value > 7) • Spit sand: Gulf beaches • Canal sand: fine/silty	• Local source • Limited volumes • Likely non-renewable • Cost opinion: $10 - $15/cy

*distance to Manatee/Sarasota County Line
**cost opinion of all-in unit cost per cubic yard (including mobilization/demobilization). All costs subject to bid.
***BOEM lease renewal required for Borrow Area F-2 in Federal Waters

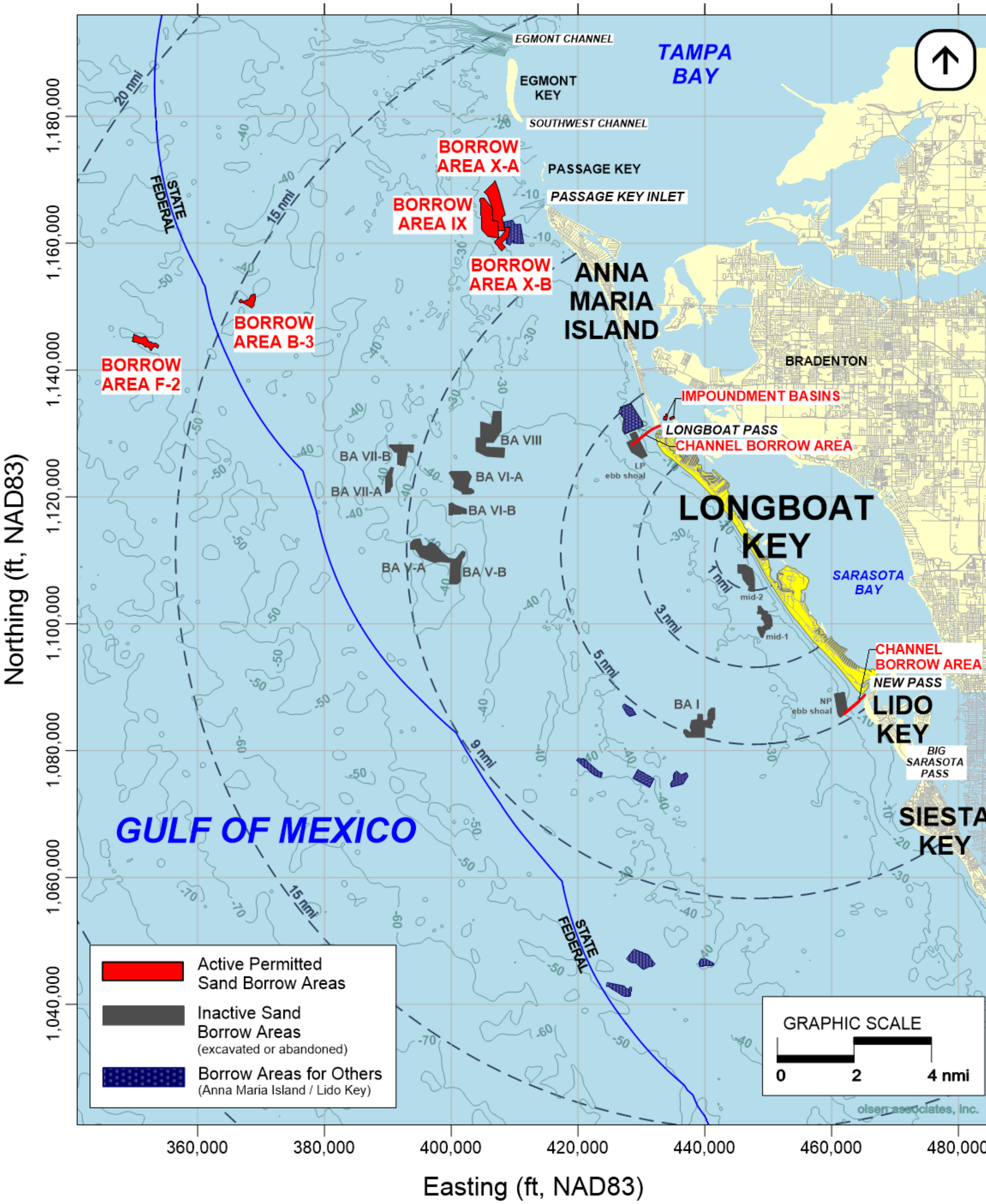

Figure EX-6 Locations of sand sources applicable to the Town of Longboat Key, FL, Beach Management Program (historical and current). Not shown are the locations of upland sources, located along the Lake Wales Ridge roughly 110-120 miles from Longboat Key.

As described in **Table EX-5**, each of the sand sources available to the Town has advantages and disadvantages in regard to sand quality, cost, and constructability. Sands from upland mines are the highest quality materials available, but the high cost and significant community impacts associated with delivery, access, and construction are substantial limiting considerations. Sand from the immediately adjacent ebb shoals is the least-cost option. The sand is highly beach-compatible, but quantities are limited and must be shared with the adjacent islands. Fine white sand from the permitted ebb shoal areas at Passage Key is logistically difficult (and thus expensive) to retrieve. Sand from offshore deposits, while beach-compatible, ranges in color, coarseness, and quality, and the cost varies significantly based on the complexity of excavation and delivery. Sand from the local interior (bay) flood shoals, where permitted, is increasingly fine-grained and of very limited quantity.

This combination of circumstances for sand resources is not projected to change substantially in the future. Previous offshore sand search investigations in 2008 and 2010 identified several candidate borrow areas, but each of these are generally comprised of fine sand with varying levels of shell. The fine sand is expected to limit beach fill longevity. These areas are likewise relatively distant (off Egmont Key and beyond, 12-18 miles or more from the center of Longboat Key). Closer borrow areas, including those utilized in prior nourishment projects, hold coarser, grayer sediments that have in the past been deemed unsuitable for use by the Town. Development of resources in the area is likewise limited by the presence of reef and hardbottom resources.

Given the expected need for sand over the next 20+ years and the particular details of sand resources available to the Town, development of additional offshore sand borrow areas is deemed a critical need for the Town. It is recommended that additional geotechnical investigation work be conducted to seek additional offshore sand sources. In this effort, available deposits of beach-compatible sand, particularly those directly accessible via hopper dredge, should be considered whether they are finer white sands or coarser, grayer sands. Based upon prior investigations, hopper-dredge accessible areas closer to the Longboat Key shoreline are expected to consist of coarser, grayer sediments, while deposits off the Egmont Key and Tampa Bay entrance area may contain fine white sand which is less resistant to erosion. Prior investigations have not revealed borrow sources with the ideal combination of color, grain size, and shell content.

VI OPTIONS FOR UPCOMING & FUTURE NOURISHMENT PROJECTS

The analyses of current shoreline conditions reveals four primary areas of erosional stress, consistent with historical trends for the island. These areas are identified in **Table EX-5**, above, and are illustrated in **Figure EX-7**.

A - North End: To address the severe erosion at the north end of Longboat Key, the proposed 2020/2021 North End Structural Stabilization Project includes the addition of three low-crested permeable rock groins north of the two existing concrete Permeable Adjustable Groins (PAGs) at North Shore Road, and two similar structures south of the PAGs to stabilize the shoreline and lower the currently severe annual erosion rates within the expanded structural field. Sand for the structural field, approximately 180,000 to 200,000 cubic yards (cy), is currently expected to be provided from the dredging of the Longboat Pass ebb shoal borrow area or the delivery of sand from one or more upland sand mines (or a combination of both). Permitting for the project is underway.

B - Gulfside Road: Along the Gulfside Road area (R-47.5 to R-50.5), the severe erosion rate, and thus the significant volumetric requirement, is principally the result of the scouring and downdrift erosive effect of the large seawall at 6633 Gulf of Mexico Drive. As discussed above, the previous untenable Gulfward location of the baseline and design beach condition in this area have been shifted landward in acknowledgement of the infeasibility of maintaining a contiguous sandy shoreline Gulfward of the large seawall. This shift significantly lowers the volumetric need along this beach segment, although erosion rates will remain high and providing sufficient beach width immediately adjacent to the seawall will be difficult. The presence of the seawall and revetment structures that protrude out into the Gulf along this segment complicate the delivery of sand to the area.

C - Central Key: Along a large portion of the center of the island, from the 4400 block of Gulf Mexico Drive (R-66) southward past the Islander Club PAGs to the 2100 block of GMD (R-15), chronic erosion affects the shoreline for approximately four miles, but at significantly lower erosion rates. The resultant low level of required fill placement per foot of shoreline (cy/ft) presents challenges in terms of how the segment can be efficiently and cost-effectively constructed with hydraulically placed sand sources. In 2016, this issue prompted the use of truck-hauled sand delivered from the upland.

D - South End: At the south end, the beaches are strongly affected by the erosional influence of New Pass and the interactions of the shoreline and the ebb shoal. Recent dredging of the ebb shoal channel borrow area in 2016 (placement on Longboat Key) and in 2019 (placement on Lido Key) have limited the formation of any erosive marginal flood channel along the Longboat Key Club and Sands Point shoreline. In concert with any sand placement at the South End, the existing rock terminal groin should be tightened.

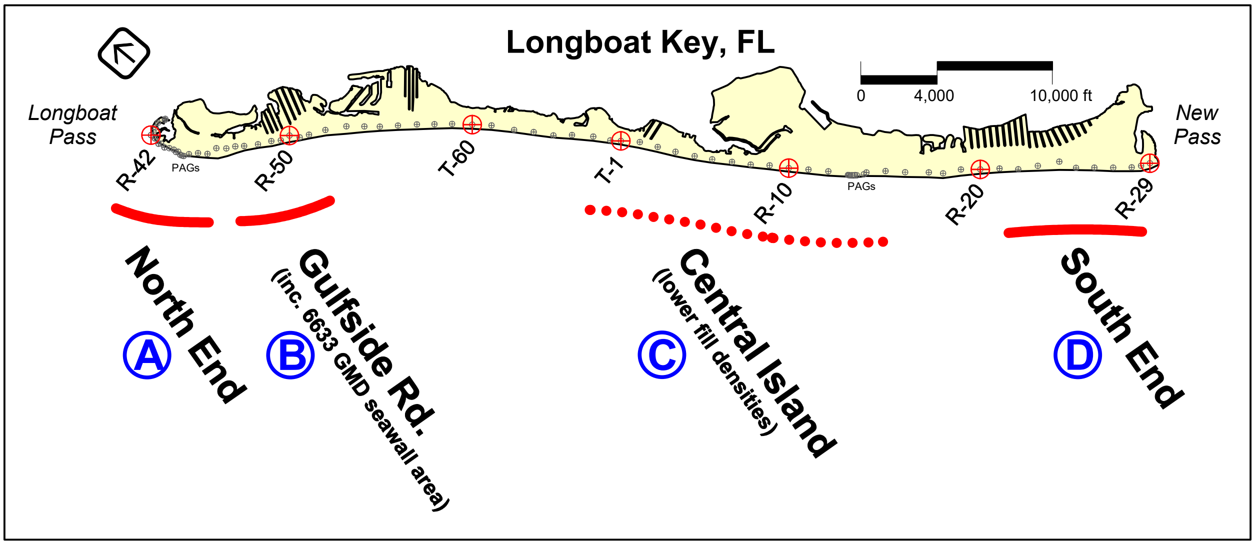

Figure EX-7 General areas in need of beach nourishment and/or stabilization for projects in 2020/2021 and 2021/2022 at Longboat Key, FL.

From **Table EX-5**, the adjusted volumetric need to reach the updated design shoreline and provide for an 8-yr renourishment interval with the 2020/2021 and 2021/2022 projects is approximately 912,000 cubic yards. At this time, the Town has budgeted ~$10M for the North End Structural Stabilization Project (**A**), which proposes the placement of 180,000 cy to 200,000 cy for Area **A**, and the subsequent stabilization of that shoreline via rock groins to greatly lower the annual erosion rate. For the remainder of the shoreline in need of nourishment, the Town has budgeted $25M for a planned 2021/2022 beach fill project.

For the Gulfside Road area (**B**), as discussed it is infeasible to attempt to meet the full needs of this segment identified in **Table EX-4**, due to the high erosion rate and the inability to maintain the full beach design width there along. Erosion rates shortly after sand placement will be extremely high, after which annual losses are expected to lessen dramatically, but at much narrower beach widths adjacent to the seawall. Herein, the approach is adopted of placing a smaller volume, 175,000 cy, that restores the beach width in 2021/2022 but that only provides a renourishment period of 3-4 years. This concession further lowers the overall sand volume requirement to 912,000 cy.

To best address the beach fill volumetric needs listed in **Table EX-4** within the given budget, several scenarios for beach nourishment were evaluated, with consideration for the available sand sources and the fill volumes, fill volume densities, and placement locations required. Given the proximity of the North End Structural Stabilization Project to Longboat Pass, it is assumed that the beach fill for that project segment (**A**) will come from an excavation of the Longboat Pass borrow area channel. This would take advantage of the least costly sand for that project.

Given that Longboat Pass sand will be used for the North End, the available sand sources for the Gulfside Road segment (**B**) are either upland sand sources delivered via truck haul, or sand delivered from offshore via hopper dredge or some other form of hydraulic pumpout from the Gulf directly to the shoreline. These offshore sources are the Passage Key ebb shoal or the more distant offshore borrow areas (**Table EX-6**).

For the Central Key segment (**C**), the remaining available sand resources likewise are upland truck-hauled sand sources or offshore dredge sand.

For the South End (**D**), it is assumed that sand from the New Pass channel borrow area would be utilized to meet the needs for a portion of the southern segment of the beaches from R-29 northward. This would again take advantage of the least-costly acceptable sand available to the Town. From **Table EX-5**, the south end segment requires roughly 152,000 cy more than what is available from New Pass (200,000 cy). Thus, the balance of that volume would require sand from either an upland source or one of the offshore dredge options.

These choices and constraints raise the question of sand quality and community/traffic impacts. Sand from the upland sources is the most costly, but it is also the highest quality material available. Sand obtained from Borrow Area X at Passage Key is light gray to white fine sand with varying levels of shell, but is located in very shallow waters on the ebb shoal there, which lies roughly 12 miles from the center of the island. Obtaining that sand will require some form of rehandling, and possibly screening, thus the sand is relatively costly. Sand available from other offshore sources that don't require rehandling is accordingly less costly, but the sediments are generally grayer and shellier than the other sources.

Based on these inputs, the following scenarios for beach nourishment/stabilization in 2020/2021 and 2021/2022 are proposed in **Tables EX-7, EX-8,** and **EX-9**. Unit cost opinions for the tables are derived from recent bid tabulation information from local dredge projects at New Pass, Longboat Pass, and Pinellas County.

To begin, the volume requirements listed in **Table EX-5** can be met utilizing the two local inlet sources and the more distant offshore sand sources F-2 in Federal waters and B-3 in State waters near the State/Federal boundary off Passage Key (see **Figure EX-6**). These borrow areas have noticeably grayer, shellier sediments but are permitted beach-compatible sand sources. The depths at the borrow areas are sufficient to eliminate the need for rehandling, but the small overall fill volume and the thin fill densities required over three miles of the Central Key and South End segments generally decrease the efficiency of a hopper dredge project. Nonetheless, for **Scenario #1** the relatively traditional construction techniques produce lower unit prices ($25 to $35/cy for the hopper dredge operation) than the white sand sources. As detailed in **Table EX-7**, use of these borrow areas would allow for the full construction of the project, although very little sand volume, if any, would remain in the offshore borrow areas. It is noted that use of these offshore borrow areas would provide sand that is grayer and shellier than the Passage Key, inlet ebb shoal, and upland sands, and closer in composition and color to the coarse sands used in the 2005/2006 layered beach project. **Scenario #1** would place the target required volume (**Table EX-5**), suggesting that the overall renourishment interval for the North End, Central Key, and South End areas would be met for 8 years, and the Gulfside Road segment needs would be met for 3-4 years.

Table EX-7 Project Construction **Scenario #1** - 2020/2021 and 2021/2022

Description/ Method	**Sand Volume (cy)**	**Opinion of Unit Cost ($/cy)**	**Opinion of Segment Cost**
A* - *NORTH END *Dredge sand from Longboat Pass (w/ structural stabilization)*	*~200,000 cy*	*$22/cy*	*$10M budgeted 2020/2021* *Longboat Pass sand: $4.400M.(+strux)*
***B* - Gulfside Road** Dredge sand from offshore	175,000 cy	$30/cy	$5.25M
***C* - Central Key** Dredge sand from offshore	185,000 cy	$30/cy	$5.55M
***D* - South End** Dredge Sand from offshore & Dredge sand from New Pass	152,000 cy	$30/cy	$4.56M
	200,000 cy	$22/cy	$4.40M
TOTAL	912,000 cy		$10M: 2020/2021 project $19.76: 2021/2022 project

In **Scenario #2**, the Gulfside Road and Central Key portions of the beach are filled via truck haul, while the ends of the island are served by dredging from the respective ebb shoal channel borrow areas. For the given budget, it is estimated that 374,500 cubic yards of sand could be placed by truck. This would require almost 25,0000 dump truck loads of sand to be delivered to the island, nearly 57% more loads than were delivered in the 2016 projects. Balanced against that upland impact is the white, uniform, medium-grained sand consistency of the material that would be delivered from the upland sand mines. With the project assumptions as stated above, **Scenario #2** would provide nearly 85% of the target required volume (as adjusted in this discussion), suggesting that the overall renourishment interval for the North End and Central Key areas would be met for 8 years, the South End segment needs would be met for approximately 6 years, and the Gulfside Road segment needs would be met for 1 year.

Table EX-8 Project Construction **Scenario #2** - 2020/2021 and 2021/2022

Description/ Method	**Sand Volume (cy)**	**Opinion of Unit Cost ($/cy)**	**Opinion of Segment Cost**
A* - *NORTH END *Dredge sand from Longboat Pass (w/ structural stabilization)*	*~200,000 cy*	*$22/cy*	*$10M budgeted 2020/2021* *Longboat Pass sand: $4.400M.(+strux)*
***B* - Gulfside Road** Truck Haul Beach Fill	113,000 cy	$55/cy	$6.21M
***C* - Central Key** Truck Haul Beach Fill	185,000 cy	$55/cy	$10.18M
***D* - South End** Truck Haul Beach Fill & Dredge sand from New Pass	76,500 cy	$55/cy	$4.21M
	200,000 cy	$22/cy	$4.40M
TOTAL	774,500 cy		$10M: 2020/2021 project $25M: 2021/2022 project

For **Scenario #3,** the truck haul components of the project are replaced with a sand dredging project from Borrow Area X on the ebb shoal at Passage Key (**Table EX-9**). The shallow depths of the borrow area, the small overall fill volume, and the thin fill densities required over three miles of the Central Key segment require an expensive, equipment-intensive rehandling of the material to deliver it to Longboat Key. These factors serve to increase the price of dredged sand substantially. Despite those factors, the placement of dredged sand is opined to be less per cubic yard, overall, than using the truck haul sand. The sand from the Passage Key borrow area is light gray to white fine sand with varying levels of shell fragments (finer and shellier than the available truck haul sand, and thus may be somewhat less resistant to erosion). With the less costly unit price for the Passage Key sand and the assumptions stated above, **Scenario #3** would provide over 89% of the target required volume, suggesting that the overall renourishment interval for the North End and Central Key areas would be met for 8 years, the South End segment needs would be met for approximately 7 years, and the Gulfside Road segment needs would be met for 1 year.

Table EX-9 Project Construction **Scenario #3** - 2020/2021 and 2021/2022

Description/ Method	**Sand Volume (cy)**	**Opinion of Unit Cost ($/cy)**	**Opinion of Segment Cost**
***A* - <u>NORTH END</u>** *Dredge sand from Longboat Pass (w/ structural stabilization)*	*~200,000 cy*	*$22/cy*	*<u>$10M budgeted 2020/2021</u>* *Longboat Pass sand: $4.40M.(+strux)*
B **- <u>Gulfside Road</u>** Dredge Sand from Passage Key	113,000 cy	$50/cy	$5.65M
C **- <u>Central Key</u>** Dredge Sand from Passage Key	185,000 cy	$50/cy	$9.25M
D **- <u>South End</u>** Dredge Sand from Passage Key & Dredge sand from New Pass	114,000 cy	$50/cy	$5.70M
	200,000 cy	$22/cy	$4.40M
TOTAL	812,000 cy		$10M: 2020/2021 project $25M: 2021/2022 project

Sand for Future Projects – As stated above, the sand volumes provided in the project scenarios are intended to provide for up to an 8-yr renourishment interval within the allotted budget. At the time of the subsequent renourishment (e.g. 2029), the choices for project renourishment sand are expected to be very similar to the present scenarios. Sand dredged from the adjacent inlet ebb shoals is likely to remain the least-cost source well into the future, but the available volumes are limited. This combination of circumstances will continue to lead to multi-phase renourishment projects. Construction of the North End Structural Stabilization Project is intended to reduce the total demand for sand, which may allow for more sand from Longboat Pass to be placed elsewhere, such as along the Gulfside Road area. This leaves the other areas of the Central Key shoreline to be served by the same truck haul and/or offshore sand resources, and some of the currently available offshore sources may be expended in the upcoming 2021/2022 project. This projection highlights the need to seek additional offshore sand sources.

VII PROJECT FUNDING & COST-SHARING

The Town is eligible to receive cost-sharing assistance from different sources to defray and/or reimburse the cost of beach management activities.

- State of Florida FDEP Beach Management Funding Assistance Program – The entirety of the Longboat Key Gulf shoreline is designated by the Florida Department of Environmental Protection as a Critically Eroded Shoreline (per F.S. 161.101). As a result, the Town is eligible to receive cost-sharing assistance for eligible design, construction, and monitoring tasks associated with the restoration and maintenance of the Gulf beaches. The cost-sharing percentage is half the percentage of the Critically-Eroded shoreline length that is publicly accessible as defined by the FDEP (Rule 62B-36, F.A.C). For the Local Government Funding Request prepared in 2019 for the upcoming construction tasks, almost 54% of the Longboat Key shoreline was calculated to be publicly accessible, thus the Department cost-share request is for a share that is half that amount (26.94% applied for in 2019). The publicly-accessible shoreline percentage is determined from public parking areas, hotels, and State-licensed vacation/resort condominium units. Any increase in the future State cost-sharing would require significant additions of public parking or significant increases in the numbers of licensed vacation/resort condominiums in currently low-access areas. **Funds from this FDEP program are limited and are subject to project ranking criteria and to the Legislative appropriation process.**

- Federal Emergency Management Agency (FEMA) Post-Disaster Funding –The nourished beaches of Longboat Key qualify under FEMA guidelines as engineered beaches, and as such are eligible for post-disaster funding assistance in the event the beaches are damaged in a declared storm event. FEMA eligibility requires that
  a) the beach is not a federally constructed shoreline under the specific authority of the U.S. Army Corps of Engineers (USACE);
  b) the beach was constructed by the placement of imported sand—of proper grain size—to a designed elevation, width, and slope; and
  c) the Town has established and adhered to a maintenance program involving periodic renourishment with imported sand to preserve the original design.

  The Town has received FEMA funding from numerous declared disasters in the past, dating back to 1993 following completion of the original beach restoration project. Most recently, a portion (>$7M) of the costs of the 2016 Multi-Phase Beach Nourishment Project were reimbursed to the Town by FEMA and the Florida Department of Emergency Management (FL DEM) for beach damages (measured sand losses) incurred during Tropical Storm Fay (2008), Hurricane Debby (2012), and Hurricane Hermine (2016). FEMA reimbursements typically amount to 75% of the costs to repair eligible storm-related damages (including associated engineering permitting costs). The Florida DEM likewise provides up to 12.5% of those same eligible costs. Through this Beach Management Plan Update, the Town will continue to diligently pursue storm damage claims when such events impact the engineered beaches. For the upcoming North End and 2021/2022, no FEMA/FL DEM funds are expected to be available at this time.

- <u>Potential Federal Funding for Hurricane/Storm-Damage Reduction Project (Shore Protection Project)</u> – The Town has expressed interest to participate with the USACE in a feasibility study to evaluate the Longboat Key Gulf shoreline for Federal participation in maintaining portions of the beaches. The Longboat Key shoreline in both Manatee and Sarasota Counties was evaluated for Federal participation in the 1970s and 1980s. A portion of the shoreline in Sarasota County was previously authorized for Federal participation in the early 1980s but the Town elected not to pursue the project, due to the low Federal participation percentage, the necessity for additional studies, and the need for perpetual easements. At this time, the USACE has requested Federal funding to initiate a feasibility study. The approval and eventual construction of a Federal project is contingent upon numerous factors, including the Federal appropriations process, the level of public beach access under Federal rules, and the degree to which a project could reduce storm damages beyond existing conditions. Such studies, and eventual construction if approved, take many years to complete (on the order of 8 to 15+ years).

- <u>Federal Navigation Project Maintenance at Longboat Pass and New Pass</u> – At this time, no Federal funding is authorized for the maintenance of the navigation channels at either inlet. As described previously, the Town has acquired permits to perform periodic dredging and beach disposal of both channel borrow areas, without Federal funding assistance.

- <u>County Funding</u> - The Town has interlocal agreements with Manatee County and Sarasota County, both of which provide Longboat Key with a share of the Tourist Development Tax. These funds are earmarked for beach nourishment costs. The Town is projecting a total of $725,000.00 for FY19 from Tourist Development Taxes. Recently, roughly 40% of these funds were from Manatee County and 60% were from Sarasota County.

- <u>Local Funding</u> - In 2014, the Town redefined and reestablished by ordinance the two long-standing taxing districts on the island (A-Gulfside and B-Bayside) that provide dedicated funding for beach nourishment and maintenance projects. The Town levies ad valorem taxes to fund beach renourishment, protection, erosion prevention, operation, maintenance, and administrative support. The Gulfside District includes all properties that lie on the west side of Gulf of Mexico Drive. The Gulfside District is responsible for 80 percent of the combined millage rate for the districts. All other properties on the island are part of the Bayside District, which is responsible for the remaining 20 percent.

VIII PERMITS & MONITORING

As mentioned above, the Town holds numerous permits for beach nourishment activities. These permits allow for sand placement along the entire Gulf shoreline, and allow for dredging of the Longboat Pass and New Pass ebb shoal channels with sand placement along the adjacent Longboat Key shoreline. The Town likewise holds permits for the ongoing maintenance and monitoring of the Islander Club and North Shore Road PAGs, and is in the process of acquiring permits for the construction of the proposed North End Structural Stabilization Project. The permits that allow for significant sand placement include:

- Islandwide sand placement (R-42 to R-29)
    - FDEP Joint Coastal Permit (JCP) #0296464-001, -008, -010
        - Expires October 2026
    - USACE Department of the Army (DA) #2009-03350
        - Expires January 2023
- Longboat Pass ebb shoal channel dredging and sand placement (R-43 to R-50.5)
    - FDEP Joint Coastal Permit (JCP) #0298107-004 (and mods)
        - Expires March 2030
    - USACE Department of the Army (DA) #2014-00606
        - Expires March 2031
- New Pass ebb shoal channel dredging and sand placement (R-20 to R-29)
    - FDEP Joint Coastal Permit (JCP) #0039755-003 (and mods)
        - Expires July 2030
    - USACE Department of the Army (DA) #SAJ-2014-02347
        - Expires February 2031

Easements – In association with the nourishment permits, the Town holds long-term easements over the Gulf-front placement areas. These easements typically expire in late 2021. **Renewal of the easements is a priority for the Town to continue the beach management program.**

Monitoring – Each of the FDEP permits listed above contains requirements for monitoring of physical beach conditions to track the condition of the beach and the performance of the various sand placement and structural stabilization projects. In 2016, the Town merged many of the physical monitoring requirements into a Comprehensive Physical Monitoring Program that seeks to perform annual beach profile surveys of the Gulf shorelines, with biennial detailed analyses of beach performance, consistent with project permits. Other localized requirements for MHWL surveys, aerial photography, etc., are incorporated into the Comprehensive plan as needed. The permits also carry ongoing environmental monitoring requirements to track sea turtle nesting, shorebird activity, and the performance of hardbottom and artificial reef areas. Many of these requirements terminate after three years following construction activities.

IX RECOMMENDATIONS

Tables EX-10 and **EX-11** summarize the recommendations of the 2019 Comprehensive Beach Management Plan Update for the Gulf of Mexico shoreline of Longboat Key, FL. **Table EX-10** describes islandwide activities to be undertaken by the Town to provide continuing permit compliance and funding eligibility from the FDEP, FEMA, and FL DEM for current and future project work. **Table EX-10** details specific recommendations for actions to be taken in each beach segment along the shoreline.

Near-term action items for beach management, summarized from **Tables EX-10** and **EX-11**, are listed below:

- Initiate renewal of sand placement easements islandwide;
- Construct the North End Structural Stabilization Project (2020/2021 beach area **A**)
- Construct the 2021/2022 multi-phase renourishment project (beach areas **B**, **C**, and **D**)
- Perform geotechnical sand search investigation to seek additional offshore sand sources
- Continue annual physical monitoring surveys and sea turtle nest monitoring
  - Continue any permit-required hardbottom/reef monitoring

Table EX-10 2019 Islandwide Beach Management Plan Recommendations
Town of Longboat Key, FL

Islandwide	Recommended Actions

All Segments	• Continue islandwide physical monitoring
	  • (annual beach profile surveys)
	• Continue annual islandwide sea turtle nest monitoring
	  • Perform reef/hardbottom monitoring and shorebird monitoring as required by permit for upcoming construction activities
	• Renew sand placement easements along the Gulf-front
	• Conduct geotechnical sand search investigation

Table EX-11 2019 Segment-specific Beach Management Plan Recommendations
Town of Longboat Key, FL

Beach Segment	Northern Limit	Southern Limit	Recommended Actions and Plan
1	Longboat Pass Bridge	R-42.5	• Greer Island/ lagoon: Evaluate options for Canal 1A and spit shoaling • Place excavated beach-compatible material in stabilized areas of the Gulf shoreline

2	R-42.5	R-44.9	• Construct Greer Island / North End Structural Stabilization:
			    • Three permeable rock groins and beach fill
			    • Sand fill from Longboat Pass or upland sand (truck haul)
			• Adjust the permeability of PAGs and rock groins as needed
			• Periodic maintenance fill every 8 years of the groin field concurrent with comprehensive Longboat Key renourishment
			• Adjust the baseline landward to reflect realistic shoreline position following groin field expansion

3	R-44.9	R-48.5	• Construct Longbeach / Broadway Structural Stabilization:
			    • Two permeable rock groins and beach fill
			    • Sand fill from offshore or upland sand (truck haul)
			• Periodic maintenance fill every 8 years of the groin field concurrent with comprehensive Longboat Key renourishment

4	R-48.5	R-51	• Gulfside Road renourishment in 2021/2022 • Sand fill from offshore or upland sand (truck haul) • Periodic maintenance nourishment every ~3-4 years, concurrent with comprehensive Longboat Key renourishment when possible • Adjust the baseline landward to reflect realistic shoreline position
5	R-51	R-61	• No immediate action, continue monitoring
6 / 7	R-61	R-18	• Central Key renourishment in 2021/2022 (R-66 to R-15) • Sand fill from offshore or upland sand (truck haul) • Periodic nourishment (~8 year renourishment interval)
8 / 9	R-18	New Pass	• New Pass renourishment in 2021/2022 or earlier (R-21 to R-29) • Periodic nourishment (~6-8 year renourishment interval) • Tighten terminal groin

Longboat Key, FL
2019 Beach Management Plan Update

February 2020

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Longboat Key, FL
Comprehensive Beach Management Plan: 2019 Update

February 2020

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1.0 INTRODUCTION

This report updates the Town of Longboat Key, FL, Comprehensive Beach Management Plan, first adopted in 1995. The Town actively manages over 10.3 miles of engineered beaches along the Gulf of Mexico. The update builds upon the management objectives of prior studies, summarizes the recent beach management activities since the 2008 Beach Management Plan Update, and provides updated recommendations based upon the condition of the beach as of June/July 2019. OAI was contracted by the Town to formally update the Comprehensive Beach Management Plan (BMP) in 2019.

1.1 Location

Longboat Key, FL, is located in southwest Florida, approximately eight miles south of Tampa Bay. The island includes approximately 10.3 miles of Gulf of Mexico shoreline, divided nearly equally between Manatee and Sarasota counties. A location map of the island and surrounding areas is provided in **Figure 1.1**.

Figure 1.1 Location Map -- Longboat Key, FL.

1.2 Survey Datums and Layout

Herein, the performance of the Gulf shoreline is evaluated using beach profile survey data which references the same datums and survey origin points from the Town's historical coastal monitoring program (e.g. OAI, 2017). These surveys are based upon the FDEP R-monuments at 500 ft to 1,000 ft intervals. Elevations are referenced in feet to the North American Vertical Datum of 1988 (NAVD88). The horizontal coordinates are referenced in feet to the North American Datum of 1983, expressed in State Plane Coordinates, Florida West Zone (0902), (ft NAD83).

The vertical datums for the open coast FDEP LABINS tidal interpolation point 100146 and the interior waterway stations at Cortez (east of Bradenton Beach and the GIWW at Cortez Marina) and at Longboat Key (south end at the Longboat Key Marina at Channel Lane) are tabulated in **Table 1.1**. Along the shoreline, Mean High Water is taken to be 0.4 ft above NAVD88.

The survey origin data for the island-wide beach profile surveys are listed in **Table 1.2a** and **Table 1.2b**. The analysis herein utilizes the June/July 2019 dataset to assess the current conditions. The beach profiles were collected in compliance with the FDEP guidelines for the collection of data for the post-construction monitoring of beach nourishment projects.

Table 1.1 Tidal datums in the vicinity of Longboat Key, FL (all relative to NAVD88, units in feet).

Tidal Datum	**LABINS Tide Point 100146** (off LBK R-27)	**Cortez NOAA Station 872-6217** Cortez Marina (27°28.0' N / 82°41.2 W)	**Longboat Key NOAA Station 872-6089** Sarasota Bay –LBK Marina (27°20.4' N / 82°35.4' W)
Mean Higher High Water (MHHW)	--	+0.53	+0.57
Mean High Water (MHW)	+0.40	+0.24	+0.20
NAVD88	0.00	0.00	0.00
Mean Tide Level (MTL)	--	-0.49	-0.44
Mean Low Water (MLW)	-1.01	-1.22	-1.08
NGVD29	-1.04	-0.99	-1.04
Mean Lower Low Water (MLLW)	--	-1.56	-1.50
Mean Tide Range	1.41	1.46	1.28

Source: *http://data.labins.org/2003/index.cfm and linked NOAA station reports*

Table 1.2a Beach profile origin tabulation for the June/July 2019 survey in Longboat Key, FL (Manatee County).

Mon.	Easting (ft-NAD83)	Northing (ft-NAD83)	Elevation (ft-NAVD)	Azimuth (deg,true)
GR-A	433,430.00	1,130,190.00	-	340
Greer	433,363.31	1,130,168.75	-	340
GR-B	433,030.00	1,130,350.00	-	340
GR-C	432,750.00	1,130,300.00	-	340
GR-D	432,505.00	1,130,215.00	-	310
R-42	432,299.60	1,130,215.20	3.71	220
R-42	432,299.60	1,130,215.20	3.71	240
R-42.5	432,303.90	1,129,945.83	-	220
R-42.5B	432,303.90	1,129,945.83	-	290
R-43	432,209.51	1,129,633.40	3.97	220
R-43B	432,209.51	1,129,633.40	3.97	270
R-43.5	432,295.10	1,129,529.45	-	220
R-44	432,262.33	1,129,262.43	4.61	220
R-44B	432,262.33	1,129,262.43	4.61	250
R-44Z	432,262.33	1129262.43	4.61	265
R-44.2	432,395.00	1,129,045.00	-	250
R-44.2B	432,395.00	1,129,045.00	-	260
R-44+480'	432,480.31	1,128,823.70	-	255
R-44.4	432,485.00	1,128,810.00	-	250
R-44+520'	432,490.64	1,128,785.05	-	255
R-44.5	432,464.80	1,128,655.35	-	220
R-44.5B	432,464.80	1,128,655.35	-	250
R-44.6	432,550.00	1,128,565.00	-	250
R-44+842'	432,476.54	1,128,450.13	-	244
R-44+882'	432,493.88	1,128,414.09	-	244
R-44.7	432,492.81	1,128,394.58	-	220
R-44.8	432,518.17	1,128,297.85	-	220
R-44.9B	432,563.02	1,128,208.26	-	235
R-44.9C	432,563.02	1,128,208.26	-	245
R-45	432,814.34	1,128,057.59	6.13	220
R-45B	432,814.34	1,128,057.59	6.13	235
R-45.5	433,157.00	1,127,733.99	-	220
R-46A	433,443.12	1,127,329.03	5.83	220
R-46.5	433,967.00	1,127,162.00	-	220
R-47	434,296.02	1,126,761.97	5.82	220
R-47.5	434,681.00	1,126,469.00	-	220
R-48	434,990.37	1,126,130.11	4.94	220
R-48.5	435,519.00	1,125,635.00	-	220
R-49	436,099.67	1,125,200.34	4.12	220
R-49.5	436,448.00	1,124,845.00	-	220
R-50	436,929.24	1,124,665.36	3.53	220
R-50.5	437,201.01	1,124,191.83	-	220
R-51	437,617.97	1,123,910.91	4.1	220
R-52	438,353.07	1,123,412.82	6	220
R-53	439,211.16	1,122,696.49	4.84	230
R-54A	439,804.26	1,121,973.33	5.05	230
R-55	440,316.76	1,121,352.31	5.72	230
R-56	440,975.50	1,120,659.49	7.3	230
R-57	441,649.39	1,119,945.54	6.88	230
R-58	442,248.26	1,119,249.07	7.43	230
R-59	442,848.31	1,118,552.52	6.98	230
T-60	443,498.17	1,117,717.78	8.3	230
R-61	444,117.01	1,116,926.06	6.99	230
R-62A	444,698.30	1,115,871.14	7.81	235
R-63	445,263.74	1,115,019.40	7.95	235
R-64	445,792.95	1,114,116.27	5.99	235
R-65	446,433.18	1,113,391.50	6.93	235
R-66	447,083.15	1,112,482.98	6.68	235
R-67	447,506.37	1,111,676.97	9.79	240

Table 1.2b Beach profile origin tabulation for the June/July 2019 survey in Longboat Key, FL (Sarasota County).

Mon.	Easting	Northing	Elevation	Azimuth
	(ft-NAD83)	(ft-NAD83)	(ft-NAVD)	(deg,true)
T-1	447,835.00	1,111,237.00	8.46	240
R-2	448,426.25	1,110,437.68	7.6	240
R-3A	448,826.16	1,109,558.12	9.03	240
R-4	449,242.95	1,108,692.34	10	240
R-5	449,709.00	1,107,780.00	6.11	240
T-6	450,164.00	1,106,971.00	8.19	240
R-7	450,724.49	1,106,089.46	3.48	240
R-8	451,242.14	1,105,254.14	7.46	235
R-9	451,854.96	1,104,475.16	6.75	235
R-10	452,383.37	1,103,616.91	3.25	235
R-11	452,990.85	1,102,773.06	7.01	235
R-12	453,585.12	1,101,924.67	6.51	235
R-13	454,089.57	1,101,017.86	7.91	235
R-13+53'	454,119.80	1,100,975.90	-	231
R-13+68'	454,129.50	1,100,962.10	-	231
R-13+200'	454,222.30	1,100,852.10	-	235
R-13+358'	454,315.90	1,100,741.80	-	227
R-13+372'	454,325.50	1,100,729.00	-	227
R-13+500'	454,389.06	1,100,647.59	7.96	235
R-13+900'	454,657.41	1,100,405.68	-	235
R-14	454,817.96	1,100,367.25	6.06	235
T-15	455,515.11	1,099,640.19	6.53	235
R-16	456,123.11	1,098,817.70	7.14	235
R-17	456,914.10	1,097,874.20	7.24	235
R-18	457,353.60	1,097,265.71	4.95	230
R-19	458,108.59	1,096,683.22	3.01	230
R-20	458,762.17	1,095,913.96	5.67	230
R-21	459,438.09	1,095,173.23	6.11	230
T-22	460,036.04	1,094,398.27	7.43	230
T-23	460,835.08	1,093,734.74	3.44	230
R-24	461,722.57	1,093,012.75	7.83	230
R-24.5	461,753.00	1,092,478.00	-	230
R-25	462,030.07	1,092,131.26	7.98	230
R-25.5	462,344.00	1,091,711.00	-	230
R-26	462,657.57	1,091,409.76	8.43	230
R-26.5	462,940.00	1,091,009.00	-	230
R-27	463,283.56	1,090,659.27	6.34	230
R-27.5	463,548.00	1,090,248.00	-	230
R-28	463,920.06	1,089,926.78	5.55	230
R-28.5	464,295.96	1,089,609.78	-	230
R-29	464,696.55	1,089,339.28	3.7	215
R-28.5	464,295.96	1,089,609.78	-	230
R-29	464,696.55	1,089,339.28	3.7	215

1.3 Beach Management Segments

The Beach Management Segments tabulated in **Table 1.3** and depicted in **Figure 1.2** (OAI, 2015a) divide the Longboat Key Gulf of Mexico shoreline into nine segments based on the location of structures, physical processes, and project limits. The table includes a description of the segment boundaries, including landmarks and FDEP R-monuments (see **Table 1.2a** and **Table 1.2b** for R-monument coordinates). Herein, site-specific objectives, alternatives, and recommendations are provided for each management segment.

Table 1.3 Limits of beach management segments, Town of Longboat Key, FL

Beach Segment	Northern Limit	Southern Limit	Segment Length[1] (feet)	Description
#1	Longboat Pass Bridge	R-42.5	1,300	Greer Island – Longboat Pass shoreline
#2	R-42.5	R-44.9+130’	1,930	Greer Island – Gulf shoreline and Longbeach seawall
#3	R-44.9+130’	R-48.5	3,870	Longbeach seawall to bypass bar attachment area south of Whitney Beach
#4	R-48.5	R-51	2,720	Bypass bar downdrift zone, including 6633 seawall and Gulfside Rd.
#5	R-51	R-61	9,530	S. Gulfside Rd. to Club Longboat
#6	R-61	R-10	15,660	Club Longboat to Neptune Avenue
#7	R-10	R-18	8,090	Neptune Avenue to The Colony, including Islander Club PAGs
#8	R-18	T-22	3,940	The Colony to the Privateer
#9	T-22	New Pass	7,390	Gulf shoreline affected by New Pass ebb shoal (measured to terminal groin)
Town of Longboat Key Monitored Shoreline			54,430 (10.3 miles)	Longboat Pass bridge to New Pass terminal groin

[1] Segment lengths based on the 2015 MHW shoreline

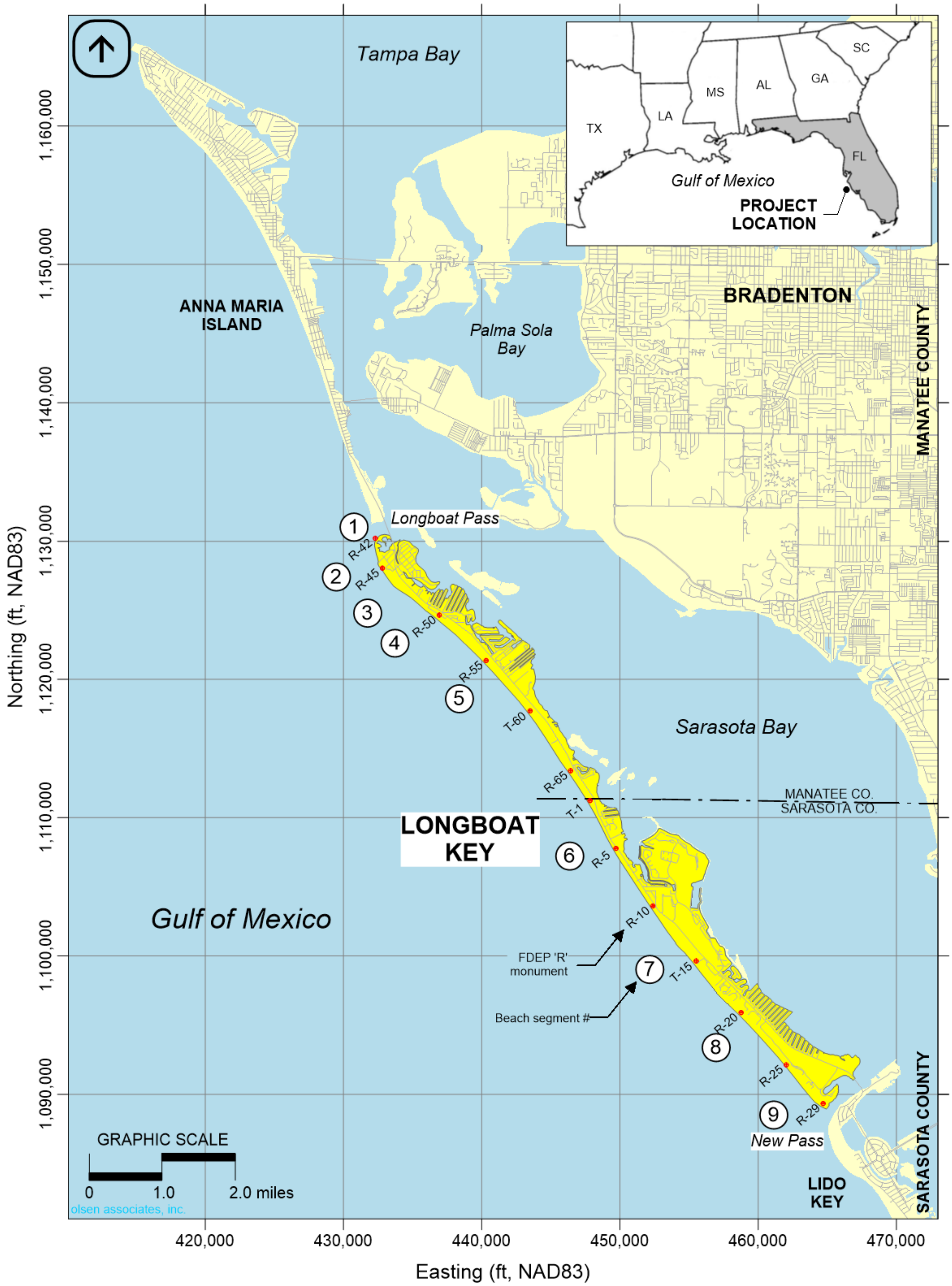


Figure 1.2 Beach management segments along the Longboat Key, FL, Gulf of Mexico shoreline.

2.0 RECENT BEACH MANAGEMENT HISTORY

2.1 Project Construction History

Since the 1990s, the Town of Longboat Key has administered a beach management program along the Town's Gulf of Mexico shoreline. CPE (2008) describes the history of beach management up through the 2005-2006 major beach renourishment. The primary means of beach maintenance since the 1992-1993 island-wide restoration has been renourishment. However, structural stabilization has been implemented to address shoreline segments with higher than average erosion rates.

2.1.1 Beach Nourishment

Table 2.1 summarizes the beach nourishment and other sand placement activities that have occurred along the Longboat Key shoreline since the first major restoration project in 1992-1993 (updated from CPE, 2012). In 1992-1993, a sand volume of 3.3 Mcy was placed along the Gulf shoreline. Over the next ten years, another 1.4 Mcy were added to the project shoreline through various small-scale projects. The second comprehensive nourishment was constructed in 2005-2006, which included the placement of 1.8 Mcy of sand. Between 2006 and 2016, several small-scale projects placed a combined volume of 251,500 cy to address the extreme erosion on the north end of the island, including the 2011 North End Nourishment, the 2014 Longboat Pass Flood Shoal Disposal, and the 2015 North End PAG fill.

<u>2011 North End Beach Renourishment Project</u>

To address accelerated erosion along the North Shore Road area (R-44 to R-46), an interim beach renourishment project was constructed in mid-2011. Approximately 139,900 cy of sand from Borrow Area IX at Passage Key was excavated by a shallow-draft hopper dredge and placed along the shoreline between R-44 on Greer Island and R-46.5 at Broadway Street.

<u>2014 Longboat Pass Flood Shoal/Excavation/Beach Disposal Project</u>

A 98,000 cubic yard dredging and beach placement project was conducted by the West Coast Inland Navigation District (WCIND) and the Town in 2014. The purpose of the project was to remove sand from two flood shoal borrow areas lying north and west of Jewfish Key along the channel from Longboat Pass to the Gulf Intracoastal Waterway. Creation of the traps was intended to reduce shoaling within the navigation channel. Sand from the dredging was placed along the Longboat Key shoreline in the vicinity of North Shore Road and the Longbeach seawall (R-44 to R-46). Between May-July 2014, the WCIND project placed an estimated 98,000 cy of beach fill.

Table 2.1 History of beach nourishment activities at Longboat Key, FL (1993-2018)

DATE	PROJECT	BEACH SEGMENT	LENGTH PLACEMENT AREA	SAND VOLUME (cy)	
Feb - Aug 1993	Beach Restoration (Longboat Pass/New Pass ebb shoals)	3-9	9.3 miles (49,000 ft), R-47 to R-29	3,336,000	
Oct 1996 - Feb 1997	Mid-Key Interim Nourishment (offshore deposits)	6-7	3.1 miles (17,000 ft), R-65 to R-14	891,000	
July 1997	Longboat Pass Maintenance Dredging	2-4	1.0 mile (5,500 ft) R-44.1 to R-46A & R-48.7 to R-51	109,000	
Aug - Sep 1997	New Pass Maintenance Dredging	9	0.8 miles (4,300 ft), R-22.6 to R-27.4	171,200	
Early 1998	Greer Island Channel Dredging	2	N. of North Shore Rd. (near R-45)	2,000	
Apr - May 2001	Beach Nourishment (offshore deposits)	7	0.7 miles (3,500 ft), R-10.5 to R-14	105,300	
Mar 2003	New Pass Maintenance Dredging	9	1.1 miles (6,000 feet), R-22 to R-28	99,800	
Apr 2005 - Jul 2006	Beach Nourishment (offshore deposits, Passage Key)	2-9	9.8 miles (52,000 ft), R-44 to R-29	1,790,000	
Jan - Feb 2010	North Shore Road (upland sand mines)	2	200 ft, R-44.5 to R-44.7	1,170	
Apr - May 2010	North End Dune Restoration (upland sand mine)	3	0.2 miles (1,140 ft), R-44.9 to R-46A	3,100	
Mar - Jun 2011	North End Nourishment (Passage Key ebb shoal)	2-3	0.5 miles (2,656 ft), R-44 to R-46.5	139,900	
May - Jul 2014	WCIND Project (Longboat Pass flood shoals)	2-3	0.4 miles (2,006 ft), R-44 to R-44.7 & R-44.9 to R-46	98,000	
Dec 2014 - Jun 2015	North End PAGs Sand Placement (upland sand mines)	2	0.1 mile (640 ft), R-44.4 to R-44.9	9,375	
Apr - Jul 2016	Central Key Truck Haul Beach Nourishment (upland sand mines: 307,500 tons)	6-7	2.9 miles (15,500 ft), A: R-62 to R-64 (2,610 ft B: R-67 to R-10.8 (10,630 ft) C: R-13+372' to R-15.7 (2,260 ft)	20,300 139,000 45,700	*2016 Multi-Phase Project: 687,700 cy*
Aug - Sep 2016	New Pass Dredging & Beach Nourishment	9	0.7 miles (3,900 ft) R-24 to R-28	234,000	
Sep - Oct 2016	Longboat Pass – I & II Dredging & Beach Nourishment	2-4	0.8 miles total (4,200 ft) I: R-44+882' to R-45.5 (1,000 ft) II: R-48 to R-50.7 (3,200 ft)	30,200 185,200	
Sep - Oct 2016	South End Emergency Truck Haul (upland sand mines: 50,000)	9	0.2 miles (1,000 ft) R-28 to R-29	33,300	
Sep 2018	North End Interim Nourishment (upland sand mines: 29,361 tons)	2	0.1 miles (600 ft) R-44.2 to R-44.7	22,000	
TOTAL SAND VOLUME PLACED (cubic yards)				**7,465,545**	

2015 North Shore Road Permeable Adjustable Groin Beach Fill

The North Shore Road Permeable Adjustable Groins Project was constructed from 03 November 2014 to 30 June 2015. In conjunction with PAG construction, a sand volume of 9,375 cy of sand was placed via truck haul to supplement the WCIND beach fill placed the year before. Subsequent monitoring surveys indicated that by mid-2016 only a negligible fraction of the sand volume placed in the WCIND and North End PAG projects remained along that shoreline segment (OAI, 2017c).

2016 Multi-Phase Beach Nourishment

Between April and October 2016, an estimated sand volume of 687,700 cubic yards was placed by the Town along seven discrete segments (4.7 miles in total) of Gulf of Mexico shoreline on Longboat Key (OAI, 2017a, b, **Figure 2.1**). **Table 2.1** lists the placement volumes, methods and sand sources used to complete the multi-phase project. The hydraulic dredging component of the 2016 multi-phase beach nourishment consisted of the excavation of two ebb shoal channel borrow areas for placement on Longboat Key. Sand from the New Pass channel (234,000 cy) was placed along 3,900 ft of the southern Longboat Key Gulf of Mexico shoreline between R-24 and R-28 in Sarasota County (Figure 3). The Longboat Pass sand (205,400 cy) was placed along two segments of shoreline in Manatee County a) Part I: 1,000 ft segment from R-44.7 to R-45.5, in the vicinity of North Shore Road and the Longbeach seawall, and b) Part II: 3,200 ft segment from R-48 to R-50.7, along Gulfside Road. The dredging project construction began on 18 August 2016 and was complete by 21 October 2016.

The truck haul sand placement for the Central Key project was constructed between 6 April 2016 and 13 July 2016, and included the nourishment of three shoreline segments in Manatee and Sarasota Counties and the delivery of 13,768 truck loads of sand (205,000 cy, est.). These segments included portions of Segments #6 and #7, including the area immediately south of the southern PAG at the Islander Club condominium The South End segment in Segment #9, from R-28 to R-29 in Sarasota County was constructed from 26 September 2016 to 07 October 2016, and included the delivery of 2,250 truck loads of sand (33,300 cy, est.).

2018 North End Interim Nourishment Project

In September-October 2018, approximately 22,000 cubic yards of sand was placed along 600-ft of the shoreline north of North Shore Road, within the concrete PAG cell and northward thereof (OAI, 2018b). The work was performed under an emergency purchase contract by the same truck haul contractor from the 2016 project. Sand was delivered from an upland sand mine via 1,336 truckloads and dumped, spread, and shaped within the fill template (22,000 cy). The project was constructed to address permit-requirements for the PAG structures to maintain certain beach dimensions within the beach cell. The small fill area was significantly impacted by Hurricane Michael (mid-October 2018) shortly after project completion, resulting in the transport of at least 20% to 25% of the placed material northward and offshore of the PAG cell. **Figure 2.1** depicts the location of the recent 2016 and 2018 projects.

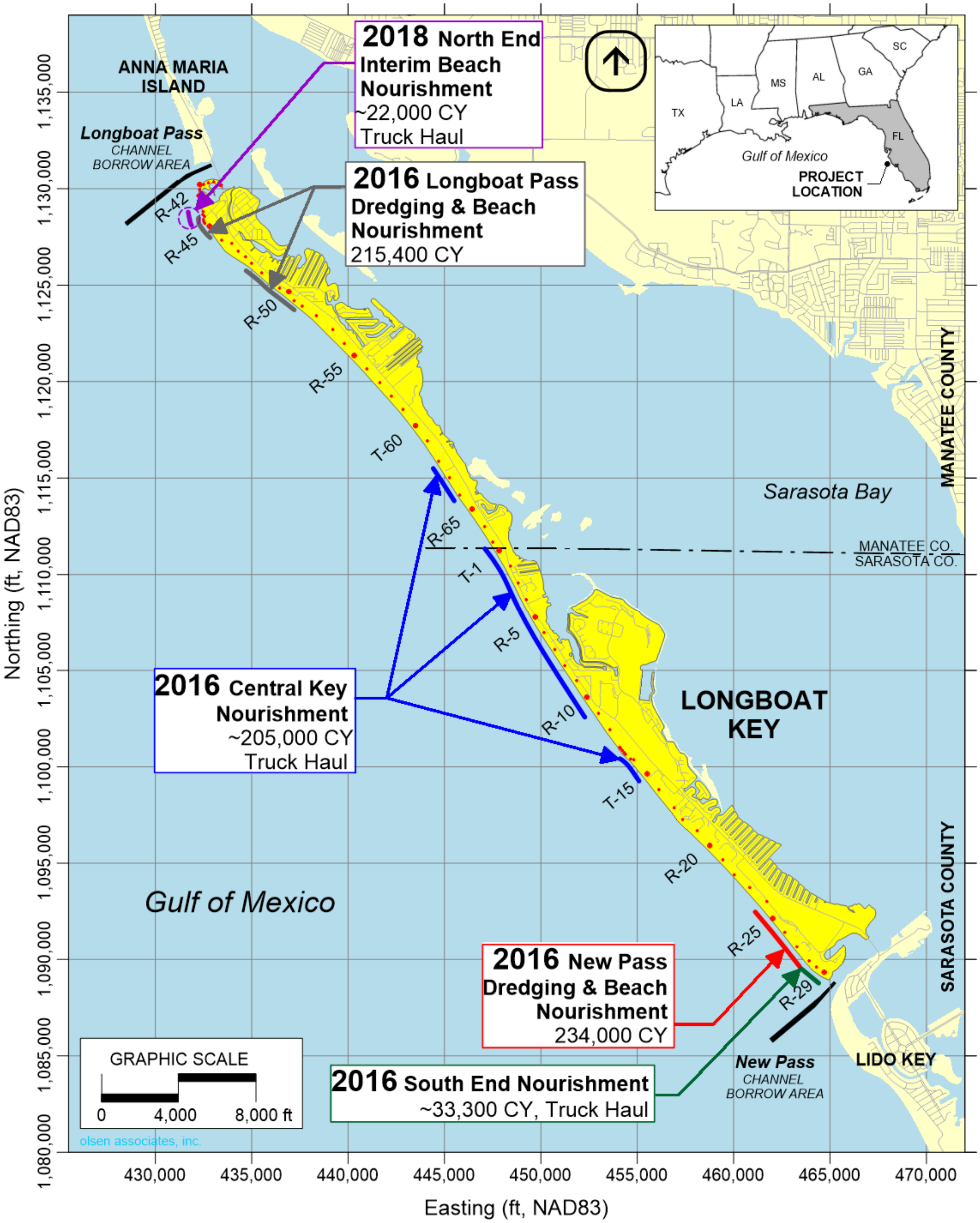


Figure 2.1 Recent beach nourishment construction on Longboat Key (2016 and 2018)

2.1.2 Structural Stabilization

Prior to the 1992-1993 restoration project, seawalls, revetments, and groins were plentiful along the Longboat Key Gulf shoreline. Many of these structures were removed as a part of the beach restoration project, but a handful of exposed seawalls and two rock groins remain. These structures include a seawall and revetment at Longbeach (~R-45), a 200-ft seawall at 6633 Gulf of Mexico Drive (~R-48.5), a seawall at 6541 Gulfside Road (~R-49.5), a concrete panel Makepeace groin at the site of the old Colony development (R-18), and a terminal groin at New Pass (~R-29). Additionally, the following properties have seawalls that are currently located landward of the Mean High Water shoreline: Aria/Villa di Lancia (R-14), Privateer (R-22), and Longboat Key Towers (R-25). Recently, groin structures have been re-introduced in limited areas to combat erosional hotspots. Structural construction activities post-1993 are summarized in **Table 2.2** (updated from CPE, 2008).

Table 2.2 Coastal structure construction along the Longboat Key Gulf of Mexico shoreline 1993-2015 (updated from CPE, 2008)

DATE	PROJECT	BEACH SEGMENT
Oct 1996 – Feb 1997	5 geotextile-tube groins (3 from Portobello to Mark III, R-7.5 to R-8.5) (2 at Islander Club R-13 to R-13.5)	6-7
Oct 1996 – Feb 1997	Offshore geotextile-tube (shore-parallel sill) Bayport, R-3 to R-4	6
Sep 1997 – Jan 1998	New Pass terminal groin reinforced and extended 120 ft Gulfward (R-29.4)	9
Dec 2001 – Jan 2002	Replacement of two geotextile-tube groins (Islander Club Between R-13 & R-13.5)	7
2009 Nov - 2010 May	Islander Club Permeable Adjustable Groins (PAGs) 2 PAGs Between R-13 & R-13.5	7
2014 Dec - 2015 June	North End Structural Stabilization Project 2 PAGs R-44.4 & R-44.7 North Shore Road	2

2009/2010 Islander Club Permeable Adjustable Groins

The Islander Club Permeable Adjustable Groins (PAGs) were installed in the winter of 2009/2010 between R-13 and R-13.5 on Longboat Key. The 252-ft long structures were designed by Coastal Planning and Engineering of Boca Raton, FL, to address a persistent erosional hotspot. Following the installation of the PAGs, the shoreline immediately south of the structures experienced increased erosion and it was recommended that the groins be adjusted in order to increase the permeability and thereby reduce erosion to the south. In May 2012, the groins were adjusted by removing 120 pre-cast concrete elements from the Gulfward end of the northern groin and 90 elements from the southern groin.

2015 North Shore Road Permeable Adjustable Groins

The North Shore Road Permeable Adjustable Groins Project was constructed from 03 November 2014 to 30 June 2015. The project included the construction of two concrete Permeable Adjustable Groins (PAGs), 185 ft and 250 ft in length, near North Shore Road.

In December 2016 / January 2017, the southern PAG structure at North Shore Road was partially tightened through the addition of 26 pre-cast concrete elements, although both structures remain permeable. It is noted that the shorelines to the north and the south of the structures continue to be highly erosional. The proposed North End Stabilization Project discussed in **Section 7.2** is intended to address the chronic erosion that persists in these areas.

2.2 Baseline and Design Template

In the 1995 Beach Management Plan (BMP), CPE (1995) established a design baseline along the Gulf shoreline of Longboat Key, based approximately on the vegetation line existing in the early 1990s. The baseline also considered the cross-shore siting of several existing condominiums and coastal structures. From the baseline, a design beach template was created to provide a minimum sandy beach width that would provide protection to the upland areas from a 10-yr storm event (approx.). This beach width was established at 130 ft from the baseline to the now-superseded NGVD29 vertical datum at elevation 0.0 ft.

In an update to the Town's beach activities, OAI (2014) slightly modified the design template to reflect recent typical sandy beach conditions and changed the reference of the design width to the Mean High Water (MHW = +0.4 ft NAVD88) contour, based upon the current vertical datum reference of NAVD88. With those updates, the minimum beach width for the design template is now 120 ft, from the baseline Gulfward to MHW. **Figure 2.2** compares the 1995 design beach profile template with the 2014 update. Note the effective design recreational beach width remains unchanged. The new template likewise produces a healthier, fuller profile that requires more sand, and thus provides a greater level of storm protection.

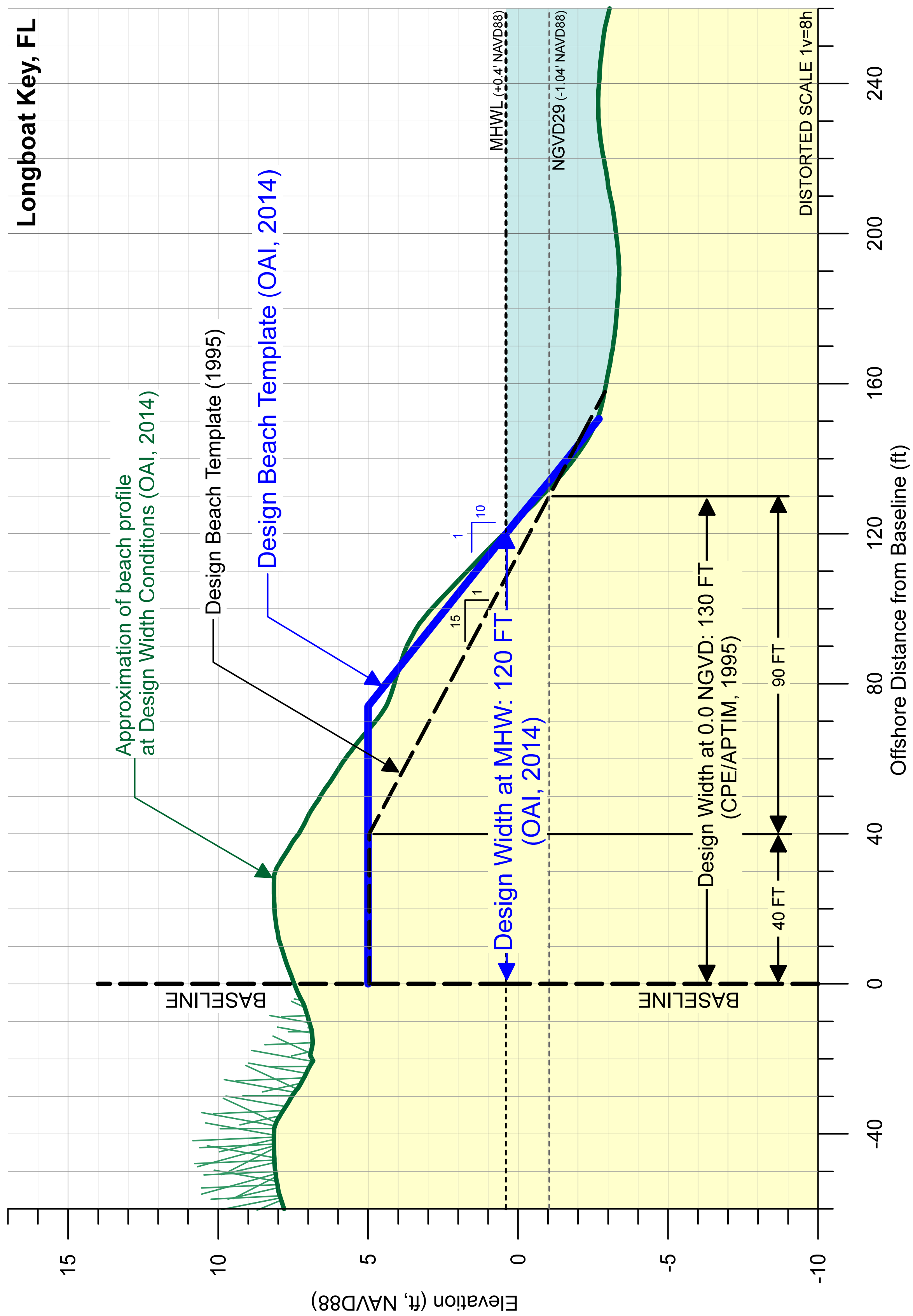


Figure 2.2 Design beach template for the Longboat Key, FL, Gulf of Mexico shoreline (updated in OAI, 2014)

Baseline Location & Design Width

In some areas, the original baseline was drawn to accommodate structures that were constructed noticeably Gulfward of the overall alongshore trend of development (OAI, 2014). This has often resulted in an unreasonable design MHW location in those areas. Additionally, some segments of the Longboat Key shoreline exhibit severe erosion relative to the rest of the island. In these areas, the design shoreline is violated more rapidly, prompting a premature need for renourishment relative to the rest of the island. The northern shoreline is a prime example.

Since the establishment of the beach baseline, localized adjustments have been implemented in acknowledgment of the infeasibility of maintaining the design beach width in (a) areas where the baseline protrudes too far Gulfward or (b) in areas of extreme erosional stress. The 2008 Beach Management Plan Update recommended the following adjustments:

1. North End -- To account for the highly erosional shoreline conditions at the north end, a reduction in beach width was introduced. The beach width fronting the Longbeach seawall was set at 80 ft to the design MHW shoreline. The design beach width gradually increases from 80 ft at Longbeach (~R-44.7) southward to 120 ft at Whitney Beach (R-47).

2. Islander Club -- The baseline at Islander Club, Aria, and Villa di Lancia was redrawn to follow the seawalls there along (CPE, 2008).

3. Privateer Condominium -- The baseline at R-22 originally extended to the center of the Privateer seawall. This resulted in a Gulfward perturbation of the shoreline of over 60 ft. In 2008, the design width was decreased by 15 ft along this short segment of the beach. It is acknowledged that the full design width cannot realistically be maintained in an artificially extended condition at this localized segment (CPE, 2008).

Recent physical monitoring indicates similar management difficulties in other areas. Herein, two further modifications to the baseline are applied. **Appendix A** plots the current (2019) version of the baseline and design Mean High Water (MHW) shoreline.

1. North End -- With the construction of the proposed North End Structural Stabilization Project, the baseline shall be adjusted landward to follow the current shoreline orientation, which is far landward of the 2008 baseline location. The 80-ft design width carries northward through the proposed structures to R-42.5. **Figure 2.3** depicts the updated location of the baseline along the northernmost segment of Gulf shoreline.

2. Gulfside Road -- The originally-established baseline protruded Gulfward along Gulfside Road, across the large seawall at 6633 Gulf of Mexico Drive, and extended northward toward Whitney Beach. Repeated attempts to maintain sandy lateral access along this segment have proven the infeasibility of continuing to try to meet the original design beach shoreline in that location. Thus, the design baseline depicted in **Figure 2.4** has been shifted landward to the existing vegetation line and the Gulfward edge of development along Gulfside Rd., without consideration of the seawall. The shift is 100 ft at R-49, landward, while the design width remains at 120 ft. This change does not provide sandy beach width in front the 6633 GMD seawall itself, which is impractical.

Although no further adjustments are proposed at this time, the following areas are noted as potentially difficult to maintain and/or as deviating from the typical alongshore design:

- Islander Club -- No change in the design beach width was instituted with the 2008 seaward adjustment that follows the seawalls. The shifted baseline produces an unnatural Gulfward perturbation and with no corresponding adjustment in design width, it is noted that the Gulfward shift of the baseline to the seawalls is approximately 125 ft relative to adjacent properties. The shift and perturbation are greater than the typical design beach width. Holding a beach width greater than 120 ft, even with the presence of the PAGs, is an unrealistic objective.

- The old Colony property (to be redeveloped with St. Regis hotel and resort) – The baseline along the old Colony parcel protrudes Gulfward to accommodate the previous siting of the Colony buildings. Maintaining the full 120-ft design width at this location would result in a Gulfward shoreline perturbation relative to the adjacent properties. It is noted that the parcel has a low-crested adjustable pile/panel 'Makepeace' groin that stabilizes the shoreline, providing adequate beach width and protection to the upland.

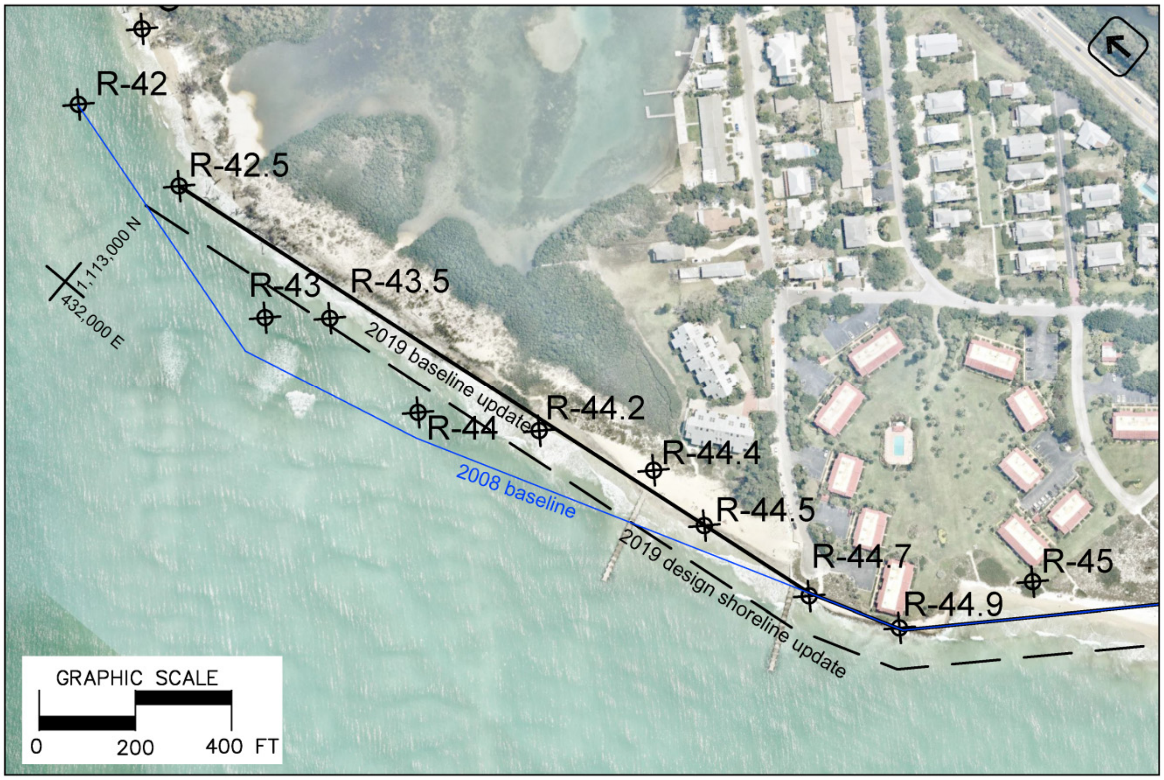


Figure 2.3 Updated baseline location at the north end of Longboat Key, FL.

Figure 2.4 Updated baseline location in the vicinity of the 6633 Gulf of Mexico Drive seawall in Longboat Key, FL. The baseline was shifted 100 ft landward at R-49 in Manatee County.

2.3 Recommendations from Prior Beach Management Plan (2008 Update)

The 2008 Beach Management Plan Update (CPE, 2008) stressed the importance of continued islandwide physical and biological monitoring. Detailed, site-specific recommendations from that report are summarized by management segment in **Table 2.3**. CPE (2008) also recommended three new initiatives:

1. Permeable/adjustable groins at the Islander Club condominiums (R-13, Sarasota County).
   - Two concrete Permeable Adjustable Groins (PAGs) were built in 2010.
   - The area south of the southern PAG was renourished in 2016.

2. White sand search
   - Geotechnical investigations were conducted in 2008 and 2010 to develop several borrow areas off Anna Maria Island, including one area on the ebb shoal of Passage Key Inlet (X), one borrow area in Federal waters (F-2), and one in nearby State waters (B-3). These borrow areas hold beach-compatible sands of varying coarseness, shell content, and color.

3. North end structures/inlet evaluations
   - An inlet management study of Longboat Pass was completed in 2011 (CPE, 2011), funded jointly by the Town and Manatee County.
   - An interim beach fill of 139,900 cy, utilizing hopper-dredged sand from Borrow IX at Passage Key, was constructed in 2011 in the vicinity of North Shore Road (R-44.5, Manatee County) to offset the accelerated erosion in that area.
   - A subsequent beach fill of 98,000 cy of sand dredged from the Longboat Pass flood shoal was constructed in the same area in 2014.
   - Two concrete Permeable Adjustable Groins (PAGs) were built in 2015 at and just north of North Shore Road to slow the erosion there along. Approximately 9,375 cy of sand were trucked in to supplement the 2014 WCIND fill.
   - Permits to dredge the Longboat Pass ebb shoal channel were acquired in 2015.
   - The Longboat Pass channel borrow area was dredged for beach nourishment along Longbeach and Gulfside Road in late 2016.
   - An update to the Longboat Pass sediment budget (OAI, 2019a) was conducted following the 2016 dredging of Longboat Pass by the Town.
   - At the time of this writing, permit applications are under review for the additional structural stabilization of both Greer Island north of the PAGs (3 low-crested rock permeable groins) and the Longbeach / Broadway Street area south of the PAGs (2 low-crested rock permeable groins).

Table 2.3 Recommendations of the 2008 Beach Management Plan Update by shoreline segment, Longboat Key, FL (CPE, 2008)

<table>
<tr><th>Segment*</th><th>Northern Limit</th><th>Southern Limit</th><th>2008 Recommendations</th></tr>
<tr><td>1</td><td>Longboat Pass Bridge</td><td>R-42.5</td><td>• Australian pine removal
• Stabilizing structures
• Longboat Pass sand placement
• Periodic nourishment
• Physical and biological monitoring</td></tr>
<tr><td>2</td><td>R-42.5</td><td>R-44.9+130’</td><td>• Stabilizing structures
• Longboat Pass sand placement
• Periodic nourishment
• Physical and biological monitoring</td></tr>
<tr><td>3</td><td>R-44.9+130’</td><td>R-48.5</td><td>• Longboat Pass sand placement
• Periodic nourishment
• Physical and biological monitoring</td></tr>
<tr><td>4</td><td>R-48.5</td><td>R-51</td><td rowspan="3">• Periodic nourishment
• Physical and biological monitoring</td></tr>
<tr><td>5</td><td>R-51</td><td>R-61</td></tr>
<tr><td>6</td><td>R-61</td><td>R-10</td></tr>
<tr><td>7</td><td>R-10</td><td>R-18</td><td>• Two Permeable Adjustable Groins (PAGs) in the vicinity of the Islander Club
• Periodic nourishment
• Physical and biological monitoring</td></tr>
<tr><td>8</td><td>R-18</td><td>T-22</td><td>• Periodic nourishment
• Physical and biological monitoring</td></tr>
<tr><td>9</td><td>T-22</td><td>New Pass</td><td>• New Pass sand placement
• Periodic nourishment
• Physical and biological monitoring</td></tr>
</table>

*Analysis segment limits updated to reflect those described in OAI (2015a)

Also recommended in the 2008 comprehensive plan was a large-scale renourishment of the engineered beaches, to be constructed in 2014 in keeping with the intended 8-yr beach renourishment interval for the overall project. Following the publication of the 2008 plan, a potential opportunity arose to utilize sand resources lying along a proposed natural gas pipeline corridor that would run into Tampa Bay. Use of the sand, and clearing of the corridor route of beach-compatible sand resources, would potentially receive partial reimbursement from the company proposing the pipeline. The 2010 geotechnical investigation by CPE (2011) identified the F-2 and B-3 borrow areas along the route.

In January 2013, the Town advertised a beach nourishment project for bids to take advantage of the pipeline corridor sand borrow areas. During the bidding process, members of the dredging industry raised concerns regarding the geometry and volumetric constraints of the proposed borrow areas. Concurrently, the U.S. dredge fleet was anticipating the upcoming restoration work associated with impacts from Hurricane Sandy. The combination of these and other factors resulted in no bids being submitted for the interim nourishment. A subsequent re-bid of the interim project later in 2013 resulted in the receipt of only one bid, which exceeded the target budget for acceptance. From that experience, the Town moved to an incremental approach to address areas of need, versus the proposed large-scale renourishment.

3.0 BEACH CONDITIONS & FUTURE SAND NEEDS

The condition and ongoing evolution of the Longboat Key, FL, Gulf of Mexico shoreline has been documented in numerous recent reports (OAI, 2018a; 2017c, etc.). **Appendix B** plots historical beach profiles along the shoreline, documenting the variability in shoreline position and beach volume since the last major restoration of 2005-2006. The current condition of the beach is evaluated herein with respect to the design Mean High Water (MHW) shoreline and storm vulnerability. **Appendix A** provides an aerial-based depiction of the location of the 2019 baseline and design shoreline, applying the updates from **Section 2.2**. The level of storm vulnerability was assessed through numerical SBEACH modeling; a detailed account of which is provided in **Appendix C**. These factors are combined with historical erosion rates to determine sand volume needs for the next comprehensive nourishment of the Gulf shoreline.

3.1 Beach Width & the Design Shoreline

Figure 3.1 plots the location of the MHWL from the most recent monitoring survey of June/July 2019, plotted with respect to the updated design baseline and target beach width. The design MHWL prescribes the minimum desired beach width to be maintained along the island and is generally located 120 ft (typ.) Gulfward of the baseline. As shown in **Figure 3.1**, the design beach width is narrowed to 80 ft along the northernmost shoreline.

Overall, the 2019 survey indicates that the design condition is achieved along the majority of the Gulf shoreline (areas depicted in green). However, the figure depicts several areas in red where the existing beach has narrowed to the point that the minimum design beach width is not achieved. Four primary areas of concern, labeled 'A' through 'D,' are denoted in blue, including the North End, from Greer Island to Longbeach/Broadway (R-42.5 to R-45); Gulfside Road (R-48 to R-49.5); Central Key (R-6, R-7, and R-13.5); and the South End, from Longboat Key Towers to New Pass (R-25 to R-29). These areas were nourished during the 2016 Multi-Phase Renourishment and will likely continue to be the focus of the next nourishment of 2021/2022 as well as future renourishment efforts.

Figure 3.1 also shows two other locations where the 2019 MHWL is located landward of the design, at R-18 (St. Regis) and T-22 (Privateer). The baseline at these locations is sited Gulfward of the adjacent properties, leading to a similar Gulfward perturbation in the design shoreline. Although the design shoreline is not achieved, these areas have adequate beach width and protection to the upland.

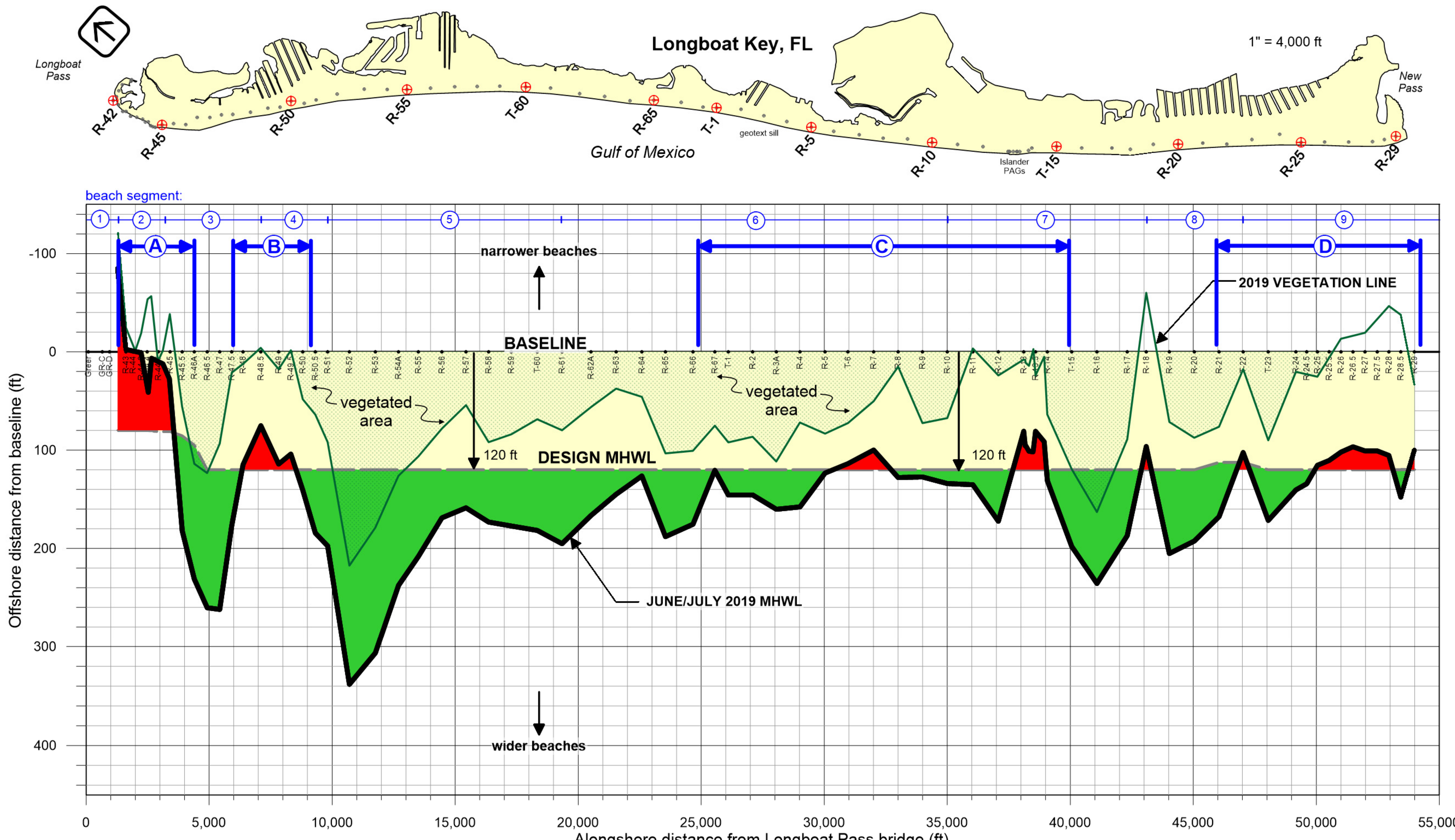


Figure 3.1 Position of the June/July 2019 MHWL relative to the updated design beach baseline and beach width in Longboat Key, FL. The Gulfward extent of vegetation was estimated from aerial photography dated 7 May 2019 (Nearmap).

Vegetation growth and recreational space – As of June/July 2019, the MHWL position results in 189 acres of dry beach space Gulfward of the baseline, from R-42.5 to the terminal groin. However, not all of the dry beach is available for recreation, as a significant portion is covered by vegetation. **Figure 3.1** plots the Gulfward extent of vegetation, as determined through examination of aerial photography (7 May 2019, Nearmap). The 2019 edge of vegetation extends Gulfward into the design width, and in some cases, beyond the design MHW shoreline. In the most extreme case, the vegetation extends nearly 100 ft Gulfward of the design MHWL along the residential shoreline from 6300 to 5800 Gulf of Mexico Drive (R-51 to R-55). In other areas, such as Sunset Beach (T-15) and Seaplace (R-16), the vegetation line extends roughly 40 ft beyond the design MHWL. Overall, the vegetated areas currently occupy approximately 72 acres (38%) of the beach area Gulfward of the baseline. As the beach narrows over time, the percentage of the beach occupied by vegetation will grow, since the loss of beach area will occur first along the open sandy shoreline.

3.2 Performance by Beach Management Segment

Segment #1 - Segment #1 is the Pass-facing spit shoreline of Greer Island, much of which has grown in the last 15-20 years. Presently, the shoreline segment has migrated eastward to and beyond the GMD bridge and is vegetated with mangroves, invasive Australian pines, and sea oats. **Figure 3.2** displays the November 2019 condition of the Greer Island Longboat Pass shoreline.

Figure 3.2 November 2019 condition of the Greer Island Longboat Pass shoreline.

This low-lying, undeveloped area has never received direct sand placement and is not part of the engineered beach project, although it has grown significantly since the early 2000's. The sand spit typically migrates eastward, receiving sand that has eroded from the northern Gulf shoreline. The Town is currently developing alternatives for management of the Greer Island sand spit at the northern terminus of Longboat Key.

Segment #2 - Segment #2 includes the Greer Island Gulf shoreline, beginning at R-42.5 in Manatee County and extending southward to the southern terminus of the Longbeach seawall (nearly to R-45). The northern Segment #2 shoreline is also undeveloped, while the southern portion includes two condominiums and the North Shore Road public beach access. Historically, this segment has exhibited large fluctuations in beach width and sand volume, related directly to sand placement efforts and the immediate and severe erosion of that sand. In recent years, Segment #2 has experienced some of the highest average erosion rates on the island.

Several recent beach fill projects, including the 2011 North End Nourishment, 2014 Longboat Pass Flood Shoal Excavation and Beach Disposal Project (WCIND), 2016 Longboat Pass Dredging and Beach Nourishment Project, and 2018 North End Interim Nourishment, have attempted to replace sand losses and re-establish sandy lateral access along this shoreline. In addition, two Permeable Adjustable Groins (PAGs) were constructed in 2015 to lower the erosion rate in the vicinity of the North Shore Road beach access. Despite the presence of the structures, severe erosion rates persist in this area. **Figure 3.3** depicts the shoreline conditions in the vicinity of the PAGs (~R-44) as of October 2019.

As illustrated **Figure 3.1**, the engineered design width is narrower in this segment at 80 ft relative to the rest of the island, which maintains 120 ft. This concession was made in the 2008 Beach Management Plan Update (CPE, 2008) to account for the impracticality of maintaining a wider beach along this highly erosional area. As of June/July 2019, the entire Segment #2 shoreline is landward of the design MHW shoreline. **Figure 3.3** depicts the eroded condition of the shoreline in the vicinity of R-44, at the northernmost PAG.

Figure 3.3 October 2019 eroded beach conditions in the vicinity of the North End Permeable Adjustable Groins (R-44 in Manatee County) on Longboat Key. The northern PAG is shown in the foreground.

Segment #3 - Southward thereof, the shoreline fronting Broadway St. and the Sea Pines, Beachwalk, and Whitney Beach Condominiums (R-45 to R-48.5) includes the attachment zone of the Longboat Pass ebb shoal bypass bar. The engineered design beach width transitions from 80 ft to 120 ft in this area. Recent physical monitoring data indicates that the central portion of this segment is stable to accretional, while the northern and southern portions are erosional. The June/July survey of 2019 indicates the MHWL is over 140 ft *Gulfward* of the design condition in the vicinity of R-46.5 (across from Whitney Plaza). Along the segment ends, the MHW shoreline is roughly 50 ft *landward* of the design. In 2016, the Longboat Pass Dredging and Beach Nourishment Project included sand placement in this segment along both ends. Other recent sand placement efforts in Segment #3 include the 2011 North End Nourishment and the 2014 Longboat Pass Flood Shoal/Excavation/Beach Disposal Project (WCIND).

Segment #4 - Segment #4 primarily includes residential shoreline fronting Gulfside Road from R-48.5 to R-51 in Manatee County. The location of the shoreline relative to the Longboat Pass ebb shoal has historically led to shoreline recession and erosion, as evidenced by several buried and exposed erosion control structures. The presence of the large seawall at 6633 Gulf of Mexico Drive greatly exacerbates the erosional stress, creating a scouring effect in this area. Along with severe erosion rates, beach nourishment is further complicated, and limited, by the presence of hardbottom and artificial reef resources located off the southern end of this segment.

The design beach width in this segment is 120 ft. The historical location of the baseline extended Gulfward to accommodate the large seawall at 6633 GMD (CPE, 2008). Recent attempts at maintaining sandy lateral access in front of the wall for any reasonable length of time have been unsuccessful. In 2016, the Longboat Pass Dredging and Beach Nourishment Project placed 185,200 cy along Gulfside Road (OAI, 2017a, b). From the time of the post-construction survey in October 2016 to the year-1 physical monitoring survey of July 2017, the design shoreline had already been violated in this area (OAI, 2017c). **Figure 3.4** compares the post-construction and year-1 monitoring conditions of the beach in the vicinity of the seawall. In order to create a more manageable design shoreline, the location of the baseline is moved 100 ft landward at R-49 (see **Section 2.2** and **Appendix A**).

Figure 3.4 A comparison of beach conditions in the vicinity of the 6633 Gulf of Mexico Drive seawall immediately post-construction (top frame) and nearly one year (bottom frame) following the 2016 Longboat Pass Dredging and Beach Nourishment Project. Maintaining the design MHW shoreline that was located 120 ft Gulfward of the seawall (CPE, 2008) has proven to be infeasible.

Segment #5 - Segment #5 includes the historically stable to accretional shoreline from R-51 to R-61 in Manatee County, from Gulfside Road southward to the Club Longboat area. The upland development consists of private residences along the northern portion of the segment and condominiums and public lodging establishments southward thereof. The June/July 2019 MHWL lies well Gulfward of the 120 ft design shoreline throughout Segment #5. Because this shoreline has been stable to accretional, no sand placement has occurred since the last large-scale renourishment of 2005-2006.

Segment #6 - Southward thereof, Segment #6 spans the shoreline from R-61 in Manatee County across the County line and southward to R-10 in Sarasota County near Neptune Avenue. Roughly two-thirds of the 3-mile-long Segment #6 is developed with private condominiums and public lodging establishments. The central portion of the segment from R-2 to T-6 in Sarasota County is an undeveloped private beach fronting the Bayport, Beach Harbor, Twin Shores, and Buttonwood Cove neighborhoods. As illustrated in **Figure 3.1**, the June/July 2019 MHWL indicates beach widths near or just Gulfward of the design condition. As of 2019, the vegetated area occupies a significant portion of the design beach.

The shoreline in this area is historically mildly erosional. Relatively thin beach fill densities are required to maintain the desired beach width in this area. Such conditions prompted the truck haul component of the 2016 Multi-Phase Beach Nourishment, which placed sand in the sub-segment at Atlas Street from R-62 to R-64 in Manatee County and from R-67 (Turtle Crawl Inn in Manatee County) through R-10 (Sarasota County). Previous structural stabilization along the shoreline includes the installation of a shore-parallel geotextile sill in the vicinity of R-3 and three geotextile tube groins near the Portobello and the Diplomat (R-7.5 to R-8.5).

Segment #7 - The Segment #7 shoreline spans from R-10 to R-18 (Neptune Avenue to the St. Regis site) and is largely developed with condominiums. Locally, the shoreline has historically been recessional in the vicinity of the Islander Club (~R-13). Physical monitoring data indicates that the installation of the PAG structures in 2010/2011 has reduced the overall erosional signal within this overall segment. The structural field does, however, produce a locally narrower downdrift shadow zone to the south, fronting the Aria and Villa di Lancia condominiums. In 2016, the Central Key Beach Nourishment Project placed roughly 45,700 cy in this area (OAI, 2017a).

Segment #8 - Segment #8 extends from R-18 (the Colony/St. Regis) to T-22 (the Privateer) in Sarasota County. The upland development predominately consists of private condominiums. A concrete panel 'Makepeace' groin is located at the northern boundary at R-18, associated with the old Colony property. The majority of the June/July 2019 MHW shoreline in this segment is located well *Gulfward* of the 120-ft design, excepting the segment ends in the vicinity of the proposed St. Regis Resort (R-18) and the Privateer Condominium (T-22). As discussed previously, the design shoreline in the vicinity of T-22 is locally reduced to 105-ft to account for the Gulfward perturbation in the baseline (CPE, 2008). Even with this slight adjustment in the design shoreline, the target beach width has been difficult to maintain in this area. Overall, while the shoreline lies substantially Gulfward of the design condition, the Segment #8 shoreline is mildly erosional. No sand placement has occurred in this area since the 2005-2006 renourishment.

Segment #9 - The southernmost segment of Gulf shoreline, from T-22 at the Privateer to the terminal groin at New Pass, lies along Longboat Club Road. The upland development consists of private residences and condominiums. This segment has historically been erosional, and maintaining the 120-ft design beach width in the area has been challenging due to the variable erosional effects of the New Pass ebb shoal and the inlet. As of the June/July 2019 survey, the majority of the Segment #9 MHW shoreline is landward of the design condition. Sand was last placed in this segment in 2016, when the Multi-Phase nourishment placed approximately 267,300 cy of upland and New Pass sand to address the erosion from R-24 to R-29. **Figure 3.5** depicts the condition of the shoreline as of 13 July 2019.

Figure 3.5 Condition of the Gulf shoreline from the Sanctuary Condominium (R-25) to New Pass (R-29) in Beach Segment #9 in Longboat Key, FL.

At the southern end of Segment #9 is the New Pass terminal groin, sited approximately 430 ft south of R-29 in Sarasota County. The structure is comprised of limestone boulders, roughly 3 to 5 ft in diameter, and reaches an elevation of +4 ft NAVD. The most recent rehabilitation of the structure was conducted in 1998. At that time, the structure was tightened and extended by 120 ft to reach its present length of approximately 315 ft. Since 1998, the stones comprising the structure have shifted and settled. The current condition of the structure is low and porous, allowing sand to be transported over and through the terminal structure into New Pass.

3.3 Current Storm Vulnerability

A storm recession analysis was performed along the Longboat Key project shoreline using the numerical model SBEACH. The study area included 9.8 miles of the Gulf of Mexico shoreline from R-44.6 in Manatee County to R-29 in Sarasota County. A detailed account of the setup, calibration, validation, and results is included in **Appendix C**. The purpose of the analysis was to describe the performance of the existing beach and the vulnerability of the upland development under various storm conditions.

Eight return-period storm surge levels were modeled on the May 2018 Longboat Key shoreline, including: 5-year (20% chance of annual occurrence), 10-year (10%), 15-year (7%), 20-year (5%), 25-year (4%), 30-year (3%), 50-year (2%), and 100-year (1%). The simulated post-storm profiles were examined to determine the horizontal retreat of the beach face at specific elevations, to estimate the surge level at which the primary dune features would be lost, and to assess the landward limit of erosion, indicated by the landward-most occurrence of a six-inch deflation in profile elevation.

Figures 3.6 through **3.8** depict typical example profiles with select storm simulation results for the north, central, and south island, respectively. In each figure, the progression of beach erosion can be tracked from the 5-year storm to the 100-year storm as the predicted storm surge levels increase. In particular, the figures indicate that damage from a 5-year storm event would be contained to the sandy beach, with little or no impact to the dunes and upland areas. As the storm surge rises, the frontal dunes are increasingly impacted and eventually lost in storms reaching 10-year to 25-year surge levels (typical). With the loss of the frontal dunes, overwash and storm inundation becomes increasingly common and more severe. **Appendix C** catalogs the predicted retreat of the sandy beach for all simulations. Comparison of the figures highlights the significant increase in protection afforded by a healthy, elevated dune feature. Such features have been commonly established along the central portions of the island, while maintaining dunes in the higher-erosion areas continues to be a challenge.

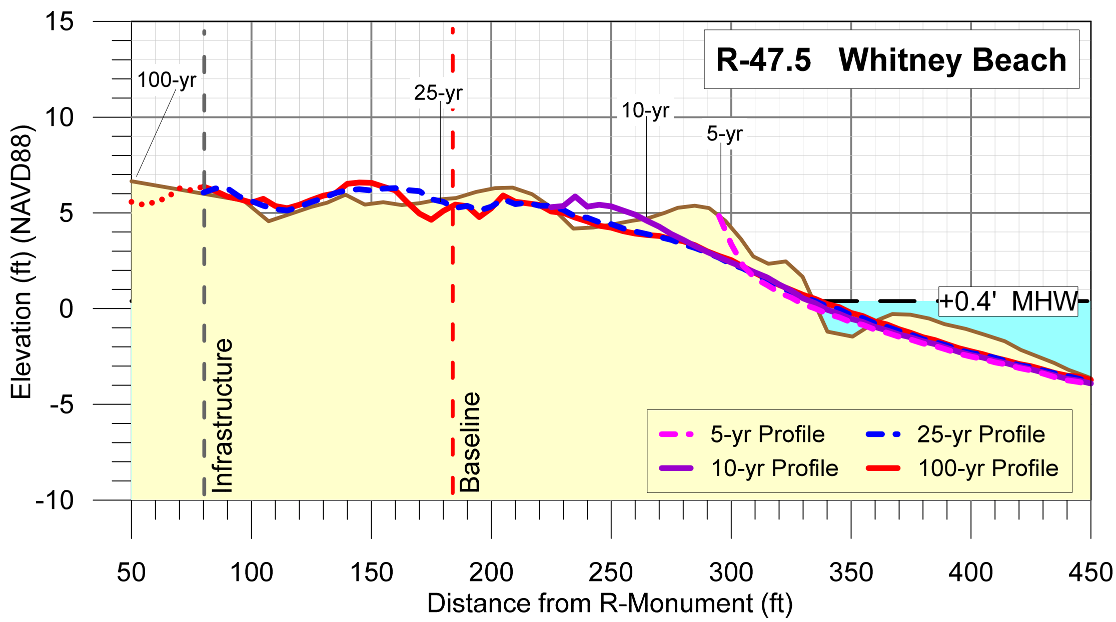


Figure 3.6 Typical storm response profiles along the north end of Longboat Key, FL.

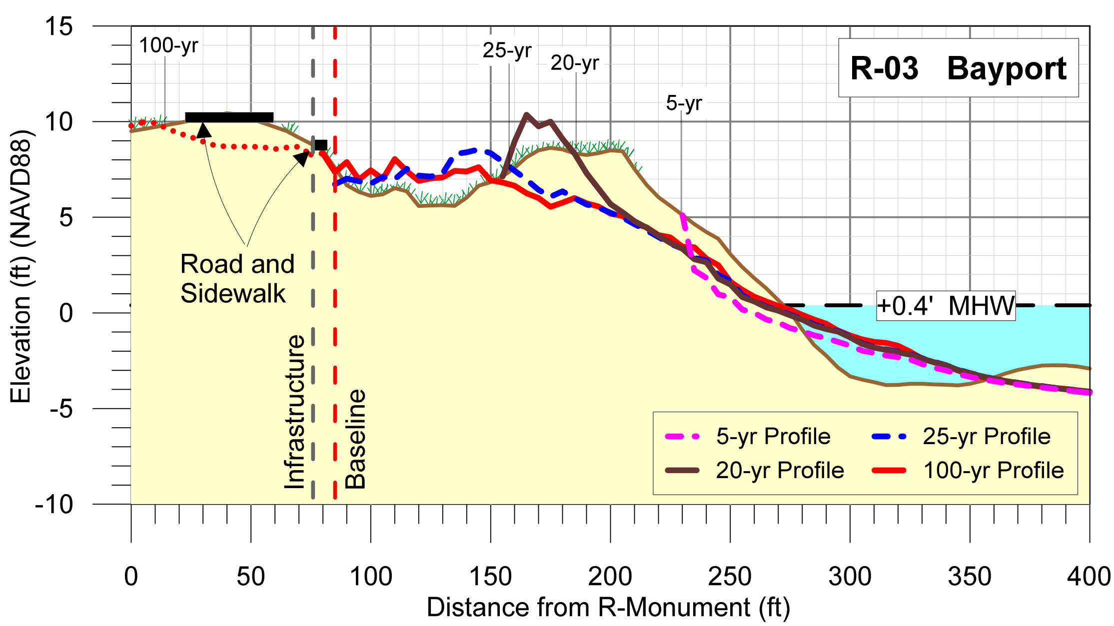


Figure 3.7 Typical storm response profiles along the central portion of Longboat Key, FL.

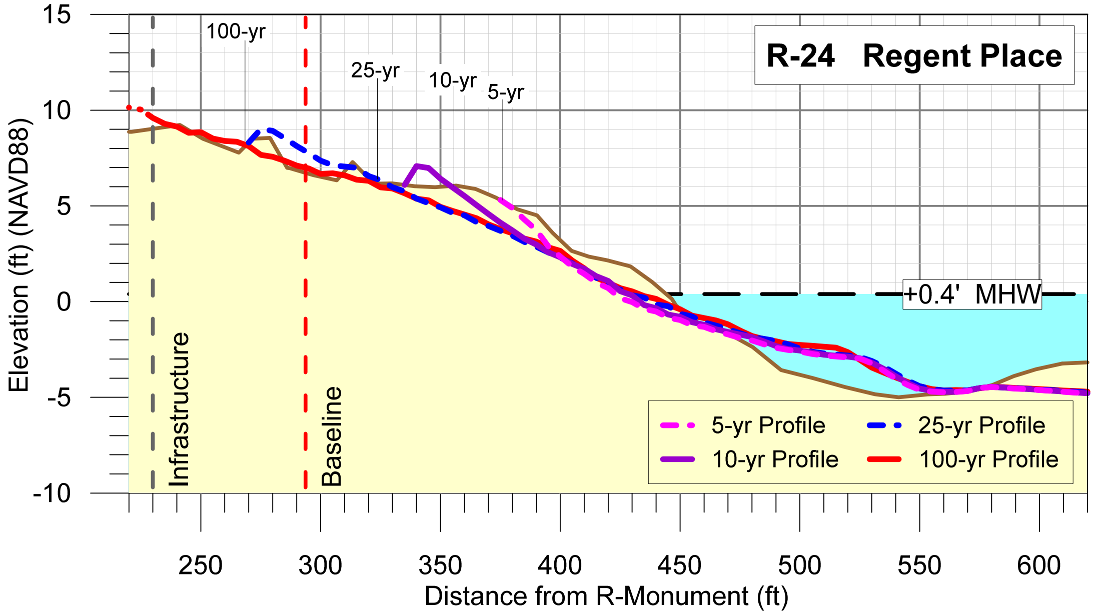


Figure 3.8 Typical storm response profiles along the south end of Longboat Key, FL.

Landward Limit of Erosion

For a 5-year storm (20% chance of annual occurrence), storm impacts extended an average of 49 ft landward of the existing Mean High Water Line, across all profiles. Such a storm would cause significant erosion and scarping of the upper beach berm, as evidenced in the results typified above. Of particular interest is the 25-year event because it is used by FDEP to assess the level of vulnerability to upland infrastructure. The 25-year storm simulation (4% chance of annual occurrence) indicated storm-induced erosion would extend 137 ft (average) landward of the existing May 2018 MHWL. At this distance, significant loss of the primary frontal dunes, impacts to dune vegetation landward thereof, and some impacts to infrastructure are expected to occur. Toward the ends of the island, impacts would be significantly more severe, as many of the profiles are not of sufficient elevation along the dunes or in the upland to protect against overtopping. Such is the case at Whitney Beach (R-47.5), depicted in **Figure 3.6**.

The model clearly demonstrates the importance a healthy beach berm and the additional benefit of a dune feature to prevent overtopping. Once overtopping occurs, as evidenced by the more extreme storm results (30-, 50-, and 100-year), flooding, inundation, and potential damage to upland infrastructure is increasingly likely. At this point, it is expected that inundation of upland parcels and wave impacts to structures would occur along the island.

Overall, the SBEACH predictions suggest that the existing engineered beach provides a robust level of storm protection for the upland infrastructure. The beach generally provides protection for a 20-year storm event, which has an expected total surge level of +7.0 ft NAVD and a 5% chance of occurrence in any given year. Such a storm would overtop the beach and significantly impact the frontal dunes, leaving the shoreline vulnerable to a subsequent storm impact. Lower areas of the shoreline, such as Greer Island, or areas along access corridors and footpaths, will experience overtopping and upland inundation during smaller storm events. Additionally, structures that are sited far Gulfward of the typical line of development are increasingly vulnerable to storm damages. It is noted that the model simulations do not address storm-induced flooding along the bay and canal shorelines of Longboat Key.

3.4 Sand Needs

In order to restore and maintain the design beach width and storm protection function of the Gulf shoreline, a comprehensive renourishment is planned for 2021/2022. Three components of sand volumes are combined to determine the project sand needs. First, from **Figure 3.1,** the 2019 beach profile conditions were compared to the target design template to identify existing volume deficits (expressed in cubic yards per foot of shoreline). Second, from the historical monitoring data, representative annualized erosion rates are computed at each survey monument. These rates are used to estimate the volume deficit at the time of planned construction in 2021, thus adding two years of erosion. Third, an additional eight years of erosion are included to provide advance fill for the target renourishment interval. As will be discussed, it is desirable to return to the intended longer, more economical nourishment interval of eight years, which is more cost-effective and typical for projects in the State of Florida. **Figure 3.9** depicts the projected sand needs for the next renourishment. **Table 3.1** lists the expected sand volume needs, 1.421 Mcy, for a beach nourishment project to occur in 2020/2021 and 2021/2022.

Table 3.1 Projected sand volume needs for full design restoration in 2020/2021 and 2021/2022

Project Areas	Segment Length (ft)	Projected Sand Volume Requirement*	Description
NORTH END			
A (segs #2/#3)	3,100 (R-42.5 to R-46)	554,000** (178 cy/ft, avg.)	Greer Island – Gulf shoreline Longbeach seawall to Broadway St.
GULFSIDE ROAD			
B (seg #3)	2,900 (R-47.5 to R-50.5)	330,000 (114 cy/ft, avg.)	South Whitney Beach to Gulfside Rd.
CENTRAL KEY			
C (segs #6/#7)	15,400 (R-66 to R-15)	185,000 (12 cy/ft, avg.)	Longboat Harbour Towers to Sunset Beach
SOUTH END			
D (segs #8/#9)	8,400 (R-21 to New Pass)	352,000 (42 cy/ft, avg.)	Gulf shoreline affected by New Pass ebb shoal (measured to terminal groin)
		1,421,000 cy	Volume needs in 2021/2022*/**

*Values include the volume needed to reach design condition, volume needed for two years of expected erosion to 2021, and advance fill volume needed for subsequent 8 years of erosion during renourishment interval.

**Values reflect pre- North End structural stabilization erosion rates; post-stabilization conditions will decrease.

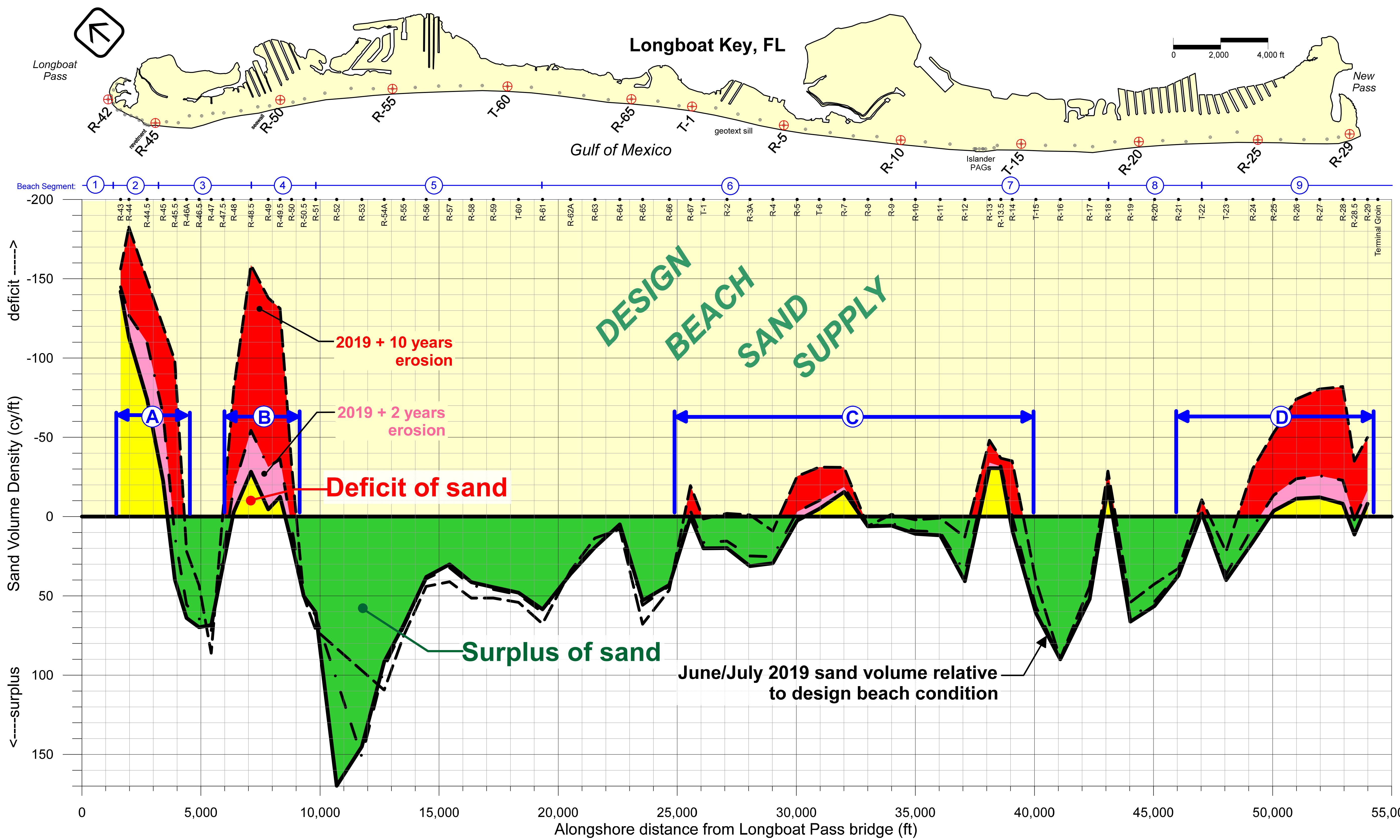


Figure 3.9 Volume density needs as of June/July 2019 for the planned renourishment of the Longboat Key, FL, Gulf shoreline.

Section 2.1.1 chronicles the repeated sand placement along the mostly unstabilized north end shoreline. As will be discussed, a structural stabilization project is planned to reduce ongoing erosion in **Beach Area A**. Additional structural stabilization of this shoreline will lower the average annual erosion rate and thereby lower the projected sand need. It is anticipated that the projected need for **Beach Area A** will be approximately 200,000 cy. This sand volume is expected to fill the groin cells and address the need over an 8-year time interval. Hence, the overall volume need from **Table 3.1** is reduced by 354,000 cy in Area A.

Further, it is judged to be very impractical to continue to try to maintain the design beach width along the seawall at 6633 Gulf of Mexico Drive in Area 'B'. The erosion rates that persist around the seawall are significant and would require a high volume of sand, especially over an 8-yr period. Placement of that much material Gulfward of the seawall is observed to actually. Initial sand placement intended to meet an 8-yr renourishment interval increases the rate of erosion due to the significant perturbation caused by the extended fill and results in the wasted use of limited sand resources. Herein, the approach is taken is to reduce the sand placement volume to represent only 3-4 years of advance fill. At this reduced interval, the overall placement volume is reduced by 155,000 cy. It is noted that **Area B** will need to be renourished at a more frequent interval relative to **Areas A**, **C**, and **D** to maintain the design beach.

Taking into account the volume adjustments in **Beach Areas A** and **B** noted above, the resulting projected sand volume needs are summarized in **Table 3.2**. In total, a quantity of 912,000 cy is suggested for beach nourishment in 2020/2021 and 2021/2022.

<u>Future Nourishment</u> - In order to maintain the Longboat Key Gulf shoreline over a 25-year time horizon (to 2046), it is estimated that the Town may need to place an additional 2,500,000 cy of sand, at a minimum. This estimate applies an islandwide erosion rate of -100,000 cy/yr over a 25-year period. Recent monitoring reports indicate a higher overall average erosion rate of -125,000 cy/yr since 2006. However, much of the sand loss currently occurs along the northern shoreline, as a result of interactions with Longboat Pass. The North End Structural Stabilization Project will address some of the severe erosional stress and thereby reduce the overall erosion rate. It is estimated that this stabilization could reduce the erosion rate by as much as -25,000 cy/yr, yielding an overall islandwide erosion rate of -100,000 cy/yr, to be applied over the timeframe of 2021-2046. Actual volume requirements will be determined through project monitoring and are highly dependent on the storm climate over that timeframe.

Table 3.2 ADJUSTED projection of sand volume needs for full design restoration in 2020/2021 and 2021/2022

Project Areas	Segment Length (ft)	Projected Sand Volume Requirement*	Description
		NORTH END	
A (segs #2/#3)	3,100 (R-42.5 to R-46)	200,000 (65 cy/ft, avg.)	Greer Island – Gulf shoreline Longbeach seawall to Broadway St.
		GULFSIDE ROAD	
B (seg #3)	2,900 (R-47.5 to R-50.5)	175,000 (60 cy/ft, avg., 3-4yr interval)	South Whitney Beach to Gulfside Rd.
		CENTRAL KEY	
C (segs #6/#7)	15,400 (R-66 to R-15)	185,000 (12 cy/ft, avg.)	Longboat Harbour Towers to Sunset Beach
		SOUTH END	
D (segs #8/#9)	8,400 (R-21 to New Pass)	352,000 (42 cy/ft, avg.)	Gulf shoreline affected by New Pass ebb shoal (measured to terminal groin)
		912,000 cy	Volume needs in 2021/2022*/**

*Values include the volume needed to reach design condition, volume needed for two years of expected erosion to 2021, and volume needed for subsequent 8 years of erosion during renourishment interval.

4.0 SAND RESOURCES

The Town currently holds permits that allow for beach nourishment from a variety of sand sources, including tidal inlets, offshore borrow areas, and upland sand mines. Herein, each of the permitted sand sources is discussed in terms of sand quality and compatibility with the native/existing beach. In addition, certain unpermitted sand resources, such as the Greer Island sand spit, are also included in this evaluation.

4.1 Sediment Compatibility

Table 4.1 summarizes the composite sediment characteristics of the "native" sediments (ATM, 1989), pre-beach nourishment, as well as the various sand resources available to the Town. All of the sediment sources in the table have been deemed beach compatible and acceptable for placement along the Gulf shoreline of Longboat Key, but slight variations in composition, color, and grain size will affect the longevity and presentation on the beach. The sediment characteristics in the table are computed from an average of borrow area Vibracore samples, post-construction beach berm samples, and/or upland sand mine samples, as applicable.

The mean grain size and sorting were computed using the method of moments. Higher sorting values indicate a wider range of sediment sizes. The sorting value can also be an indicator of relative shell content. For example, sediments with a larger sorting value (see **Table 4.1**) generally include more shell material.

The shell content is determined through carbonate content testing, when available. In several cases, this laboratory test was not performed (particularly for historical samples). For these samples, either visual shell (performed by a geologist) or 'cumulative percent retained on the No. 4 sieve' are provided. The cumulative material retained on the No. 4 sieve indicates the percentage of large shell fragments in a sample and is frequently utilized as a criterion in FDEP Sediment Quality Assurance / Quality Control (QA/QC) Plans. In contrast, the visual shell and carbonate content metrics include shell material of a larger variety of sizes.

The fines content represents the percentage passing the No. 230 sieve, those sediments that are finer than 0.063 mm in diameter. Borrow areas with a relatively high percent fines can lead to turbidity (water quality) issues during construction and decreased beach fill performance. A fraction of these fine sediments are typically winnowed out during the dredging process. As such, the in-situ fines content determined from an analysis of Vibracore samples will typically be greater than the fines content of post-construction beach berm samples.

Table 4.1 Summary of sediment characteristics of the various sand borrow areas and authorized upland sand sources for the Town of Longboat Key.

	SAND SOURCE	MEAN (mm)	MEDIAN (mm)	SORTING (ϕ)	SHELL CONTENT	FINES (%)	MUNSELL COLOR
Neighboring Ebb Shoals	New Pass	0.23	0.15	1.52	30%	≤1%	≥7
	Longboat Pass	0.34	0.21	1.65	30%	≤1%	≥7
Longboat Pass Flood Shoal	WCIND Sand Traps (pre-excavation)	0.24	0.17	1.42	20%	≤1%	8
Passage Key	IX	0.21	0.17	1.08	16%	≤6%	8
	X-A	0.23	0.17	1.18	20%	≤2%	≥7
	X-B	0.22	0.17	1.08	18%	≤2%	≥7
Offshore	B-3	0.28	0.22	1.12	41%	≤2%	6
	F-2	0.24	0.19	1.14	38%	≤2%	6
Upland	Stewart Materials Immokalee	0.34	0.32	0.85	0%	≤2%	8
	E.R. Jahna Green Bay	0.32	0.32	0.95	0%	0%	7
	CEMEX Davenport	0.35	0.36	0.51	<1%	0%	8
	CEMEX Lake Wales	0.43	0.44	0.88	0%	0%	7
Native / Existing	**Longboat Key** (ATM, 1989)	**0.22**	**0.16**	**1.38**	**0.78%**[1]	**0%**	**7.5-8**[2]

[1] Cumulative percent retained on the No. 4 Sieve
[2] OAI opinion. Not tested.

The average or typical color of the sediments is described via the Munsell Value. White sand has a Munsell Value of 7-8 or higher. Lower color values indicate darker (grayer) material. In-situ borrow area sediments with Munsell Values of less than 8 can improve in color over time with solar exposure, but may not ultimately achieve a final value of 8 or better. Typical improvement in color might be 1 or 2 Value points.

In general, the borrow areas contain a mixture of fine quartz sands and varying levels of shell hash, shell fragments, and other carbonate material. The clean quartz sand fraction generally produces the lighter color Values, thus, the lightest and whitest sediments are typically extremely fine, both in terms of the mean and median grain size values.

4.2 Native/Existing Beach

The "native" sand characteristics for the beaches of Longboat Key are based on historical data described by Applied Technology Management (ATM, 1989). From that source, CPE (2011a) opined that the samples collected along the southern end of the island are most representative of the native sediments because they are less affected by coastal armoring present along the northern shoreline at the time of the study.

Figure 4.1 plots the grain size distribution of the native composite of the sand samples collected on the southern end of the island (ATM, 1989). The composite sample indicates a mean grain size of 0.22mm and a median grain size (d_{50}) of 0.16mm with a sorting of 1.38 ϕ. The shape of the suggested native cumulative distribution reveals that the finer half of the sample, by weight, lies in a narrow range of grain sizes from 0.06 mm to 0.16 mm (very fine to fine sand). Conversely, the coarser half of the sample, by weight, is distributed across a broader range of sizes, from 0.16 mm up to approximately 8.00 mm in size (fine sand to gravel or pebble size). This pattern of grain size distribution produces the increased mean grain size (0.22 mm) compared to the median (0.16 mm) and arises from the combination of fine quartz grains and coarser shell hash or shell fragments (carbonate materials). The overall range of grain sizes across the native beach distribution also contributes to a higher composite sorting, ϕ. The suggested southern native beach distribution has a sorting value of 1.38ϕ, considered to be a poorly-sorted (or well-graded) sample. As noted, the increased range of grain sizes is principally skewed by the coarser half of the distribution.

No specific Munsell color or percent carbonate information is available from the 1980s data collection. Inspection of the area beaches, historically and currently, suggests that the Munsell color Value of native beach sediments should be between 7.5 and 8.5 (the Value scale reaches to 10). Although no carbonate content testing was performed on these historical samples, the grain size distribution clearly suggests the presence of shell fragments.

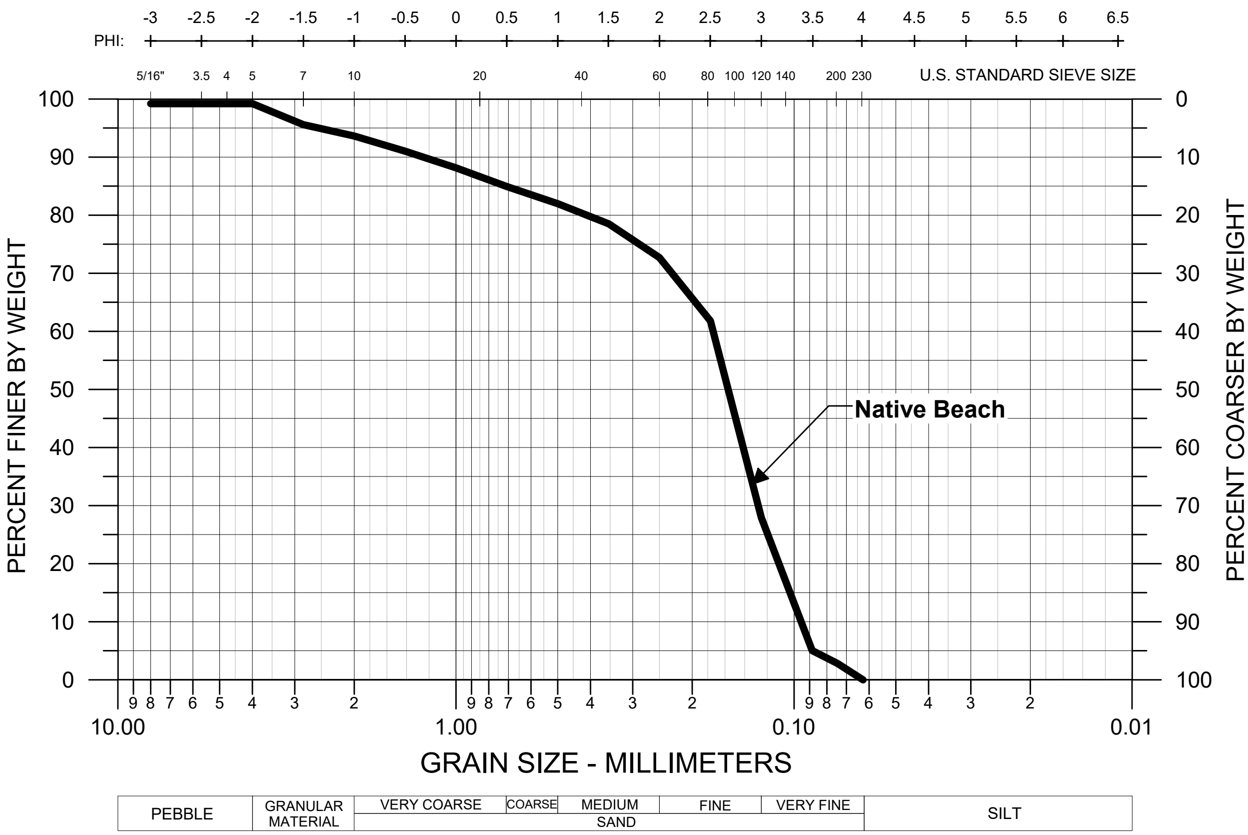


Figure 4.1 Grain size distribution of the suggested native beach on Longboat Key, FL (CPE, 2011a).

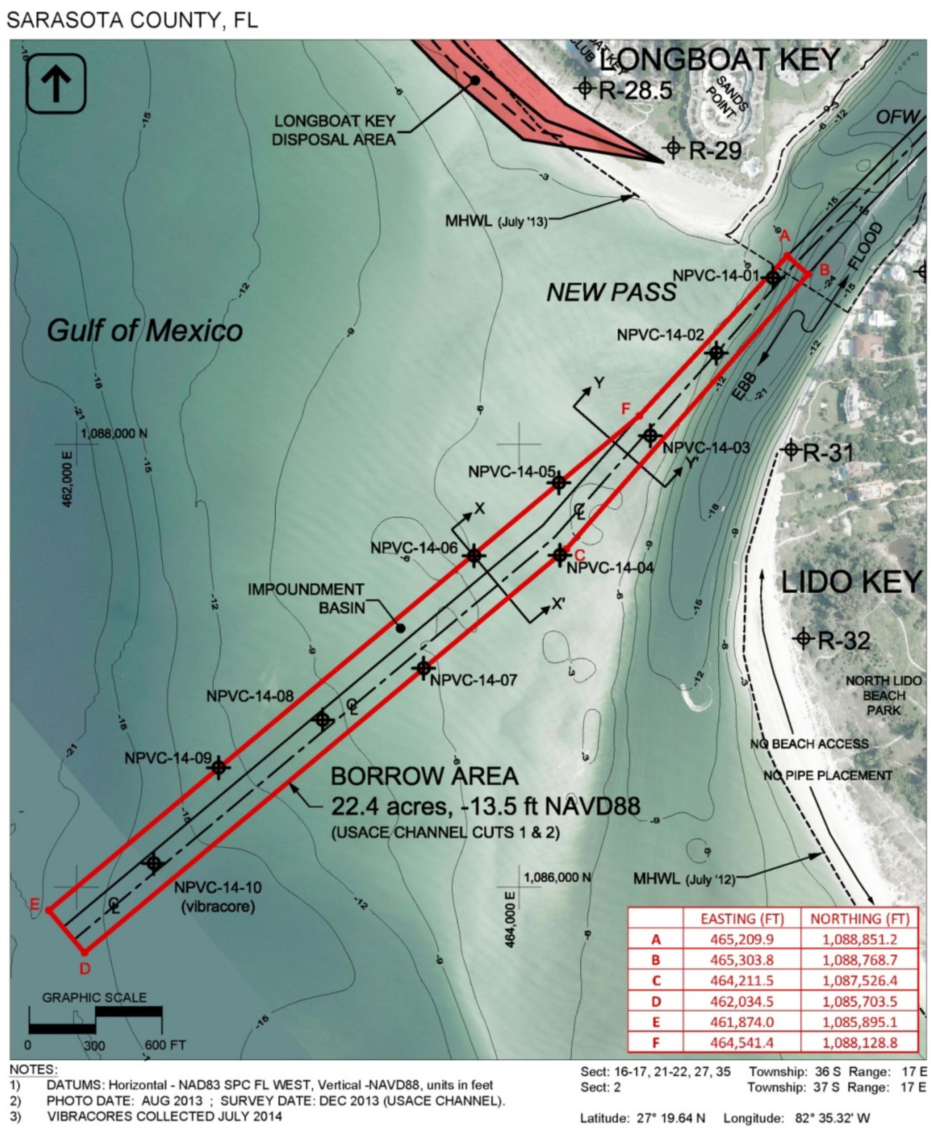
4.3 Tidal Inlet Sources

Figure 4.2 displays the tidal inlet borrow areas permitted for excavation for Longboat Key beach nourishment. Immediately adjacent to Longboat Key are two ebb channel borrow areas, New Pass and Longboat Pass. Longboat Pass also includes two flood shoal impoundment basin borrow areas, permitted by the West Coast Inland Navigation District (WCIND). North of Anna Maria Island, the Passage Key Inlet ebb shoal includes three permitted borrow areas for the Town: Borrow Areas IX, X-A, and X-B.

Figure 4.2 Location map of permitted inlet borrow areas for Longboat Key beach nourishment

4.3.1 New Pass

New Pass lies immediately south of Longboat Key and north of the neighboring island of Lido Key (**Figure 4.3**). The Town holds joint permits with the City of Sarasota to dredge the ebb shoal portion of the Federal navigation channel (previously maintained by the USACE) for beach nourishment. Typical excavation volumes from the channel borrow area are on the order of 200,000 cy. Under the current permits (issued in 2015), the borrow area has been dredged twice -- first in 2016 for placement along southern Longboat Key and most recently in early 2019 for placement along southern Lido Key. The Town should be able to utilize this sand source at least once more for nourishment of the southern shoreline before the permits expire in 2030.



	EASTING (FT)	NORTHING (FT)
A	465,209.9	1,088,851.2
B	465,303.8	1,088,768.7
C	464,211.5	1,087,526.4
D	462,034.5	1,085,703.5
E	461,874.0	1,085,895.1
F	464,541.4	1,088,128.8

Figure 4.3 Location map of the New Pass channel borrow area (OAI, 2014).

4.3.2 Longboat Pass

Similar to New Pass, the Town holds joint permits with Manatee County (for Anna Maria Island) to dredge the ebb shoal portion of the Federal navigation channel (previously maintained by the USACE) for beach nourishment (**Figure 4.4**). The Town was the first to utilize the borrow area after the current permits were issued in 2015. A cutterhead suction dredge excavated over 200,000 cy for placement along two segments of northern Longboat Key shoreline (summer 2016). At the time of this writing, Manatee County is planning to utilize some portion of the channel borrow area for beach fill, planned for some time in 2020 or 2021. The Town may be able to use any excess sand volume in the channel borrow area at that time. According to an April 2018 survey, between 90,000 cy and 160,000 cy of sand are available for excavation. The Town should be able to utilize this borrow area for one to two more placement events over the life of the permits.

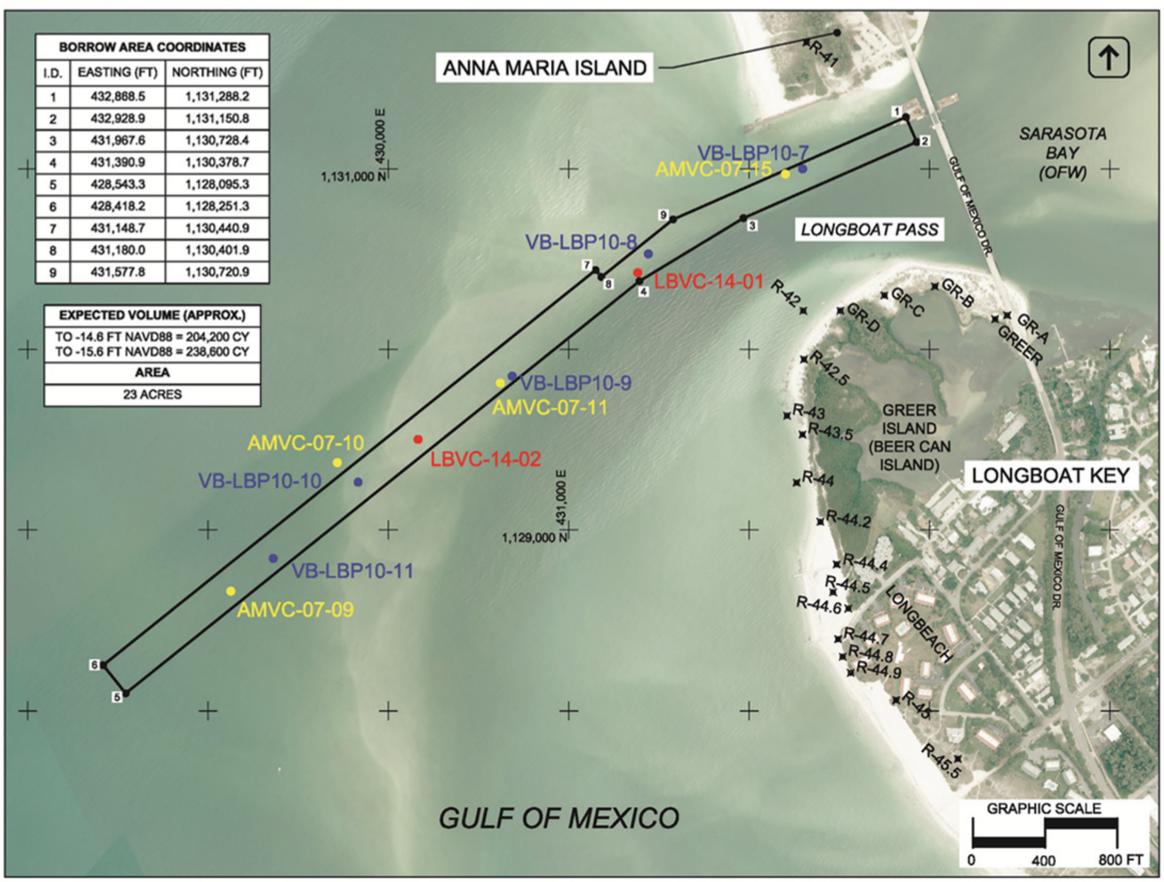


Figure 4.4 Location map of the Longboat Pass channel borrow area (OAI, 2015b). Volume estimates are pre-2016 dredging operations.

4.3.3 WCIND Sand Traps

The West Coast Inland Navigation District (WCIND) permitted the excavation of two flood shoal sand traps lying between the Gulf of Mexico Drive bridge and the Gulf Intracoastal Waterway (GIWW) in Longboat Pass. Excavation and maintenance of the traps was intended to relieve shoaling within the channel limits of the GIWW in the vicinity. In 2014, 98,000 cy of fine-grained sand was excavated for placement on the northern Longboat Key shoreline in conjunction with, and prior to, the construction of the two concrete groin structures at North Shore Road.

Two years of post-construction monitoring data indicated refilling rates of 300 cy/yr (Cut 1) and 5,000 cy/yr (Cut 2) (H&M, 2016). As of the 2016 survey, the sand traps had not refilled substantially to make them a viable sand source in the near future. The permits, which also allow for nourishment of the Anna Maria Island shoreline, expire in 2027.

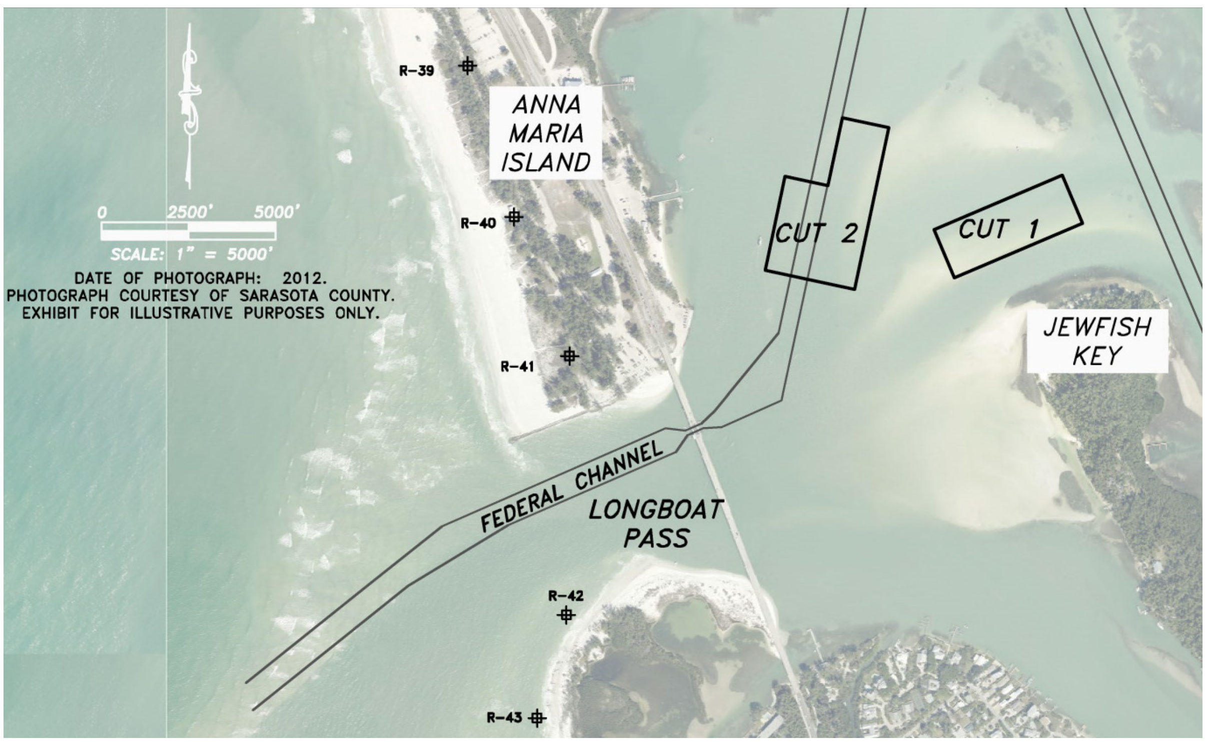


Figure 4.5 Location of the WCIND Longboat Pass sand traps (H&M, 2014).

New Pass / Longboat Pass Compatibility

Figure 4.6 plots the cumulative grain size distributions from the neighboring inlet shoals of New Pass and Longboat Pass, including the two ebb channel borrow areas and the Longboat Pass flood shoal impoundment basins. No geotechnical information was available for the Greer Island sand spit at the time of this writing (although the sand derives from the Gulf shoreline). The ebb channel borrow area composites plotted in the figure were derived from Vibracores collected prior to the 2016 New Pass / Longboat Pass Beach Nourishment Project, but it is anticipated that the channels will refill with fairly similar (though somewhat finer) sediment.

The ebb channel borrow areas include a mixture of coarse, shelly material located in the highly-energetic inlet throat and fine quartz sand located in the offshore portions of the channels, as evidenced by the shape of the distributions in **Figure 4.6**. This variability in sediment characteristics is apparent during construction. As the dredge moves offshore from the inlet throat, the beach fill material becomes increasingly finer.

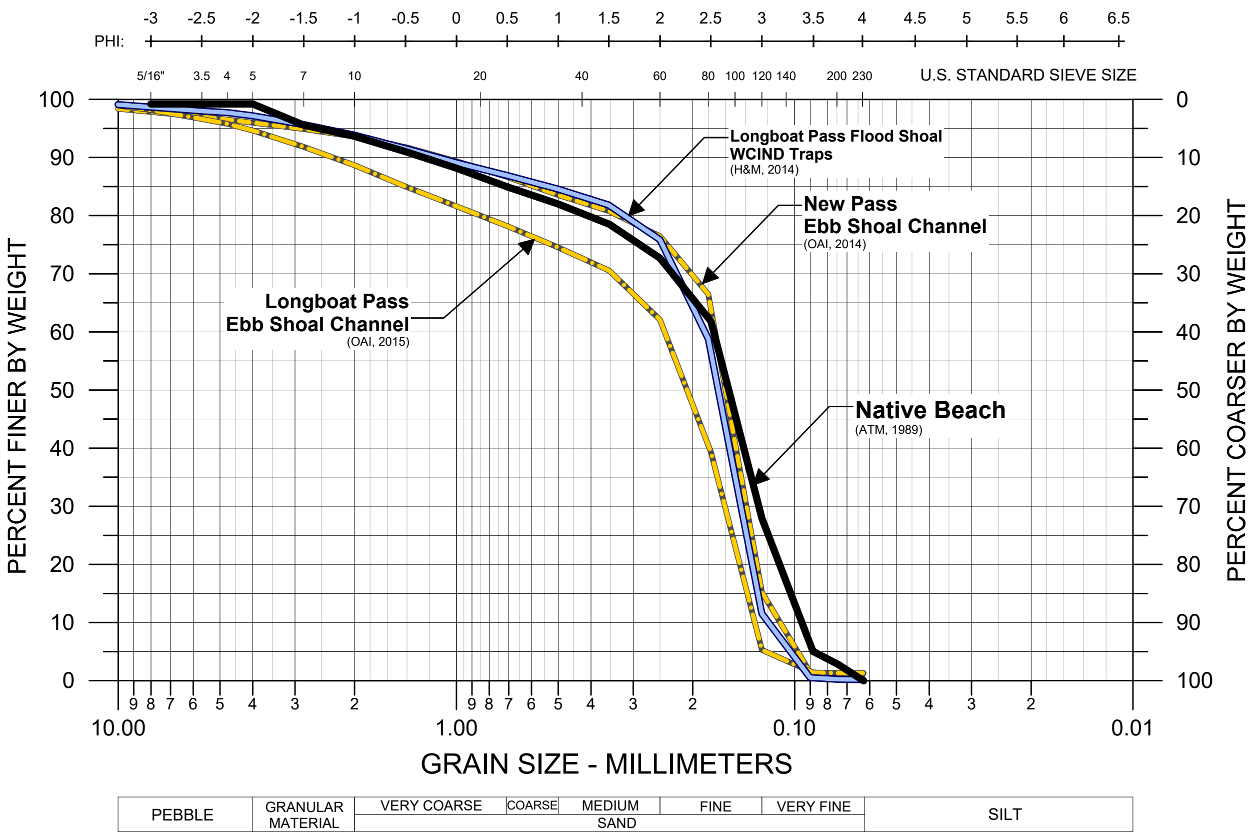


Figure 4.6 Grain size distribution of sediments from the nearby New Pass and Longboat Pass shoals. The native / existing Longboat Key beach is also plotted for reference.

The mean grain size of individual samples ranges from 0.14 mm to 0.59 mm for New Pass and 0.19 mm to 0.79 mm for Longboat Pass, depending on the location of the Vibracore. Overall, the composites indicate a mean of 0.23 mm for New Pass and 0.34 mm for Longboat Pass. Similarly, the shell content varies widely between samples, with negligible carbonate material to upwards of 70%. Overall, both channel borrow areas contain roughly 30% carbonate material. The carbonate fraction is primarily comprised of smaller, sand-sized shell to shell hash. Overall, the sediments in the ebb shoal borrow areas are highly beach compatible with a Munsell Value of 7 or lighter.

Also plotted for reference in **Figure 4.6** is the average cumulative grain size distribution from the 2014 WCIND project. The 2014 nourishment included the excavation of two sand traps located on the Longboat Pass flood shoal for placement along northern Longboat Key. The sand excavated from the Longboat Pass flood shoal was similar in size to the New Pass ebb channel borrow area, with a mean of 0.24 mm and a median of 0.17 mm. The carbonate content was roughly 20% and the sand was relatively white, with a Munsell Value of 8. Unlike the ebb channel borrow areas, however, the sand traps have not refilled in a timely manner, precluding this source for beach nourishment in the near term.

4.3.4 Greer Island Sand Spit

The Town is currently developing alternatives for management of the Greer Island sand spit at the northern terminus of Longboat Key. Sand transported eastward from the eroding Gulf shoreline has resulted in the growth of the spit feature and concurrent shoaling of the entrance of the interior lagoon of Greer Island (see **Figure 4.7**). One of the management alternatives may involve the excavation of the eastward portion of the spit for placement along the Gulf of Mexico shoreline. The scope and timing of any excavation is to be determined. Should excavation occur, it may be a one-time event, assuming the structural stabilization project along the Gulf shoreline is constructed. Material obtained from the upper beach would be highly compatible to the existing Gulf shoreline. Sand dredged from the submerged area and the adjacent Greer Island lagoon would likely be finer and darker in color.

Figure 4.7 Greer Island sand spit and interior lagoon at the northern end of Longboat Key, FL, looking offshore from Longboat Pass (right) toward the Gulf of Mexico.

4.3.5 Passage Key Inlet Ebb Shoal Borrow Areas

The Town has three permitted borrow areas sited on the Passage Key ebb shoal, offshore of the north tip of Anna Maria Island (Borrow Areas IX, X-A, and X-B). In total, the borrow areas contain up to 5.5M cy of sand. Borrow Area IX contains roughly 2.0 M cy. Borrow Areas X-A and X-B, contain 2.8 M cy and 0.70 M cy, respectively. The offshore portions of Borrow Area IX were dredged previously for the 2005-2006 beach nourishment and the 2011 North End Nourishment. Prior to the 2011 construction, Vibracore samples indicated up to 6% fines (CPE, 2011a). However, finer sediments were likely winnowed out during the dredging process, as post-construction berm samples indicated less than 1% fines (CPE, 2011g).

Figure 4.8 plots the cumulative grain size distribution of the borrow area composites for IX, X-A, and X-B that lie along the Passage Key ebb shoal. As suggested by the shape of the grain size distributions, these borrow areas contain mostly fine sand with relatively low percentages of shell material (< 20%). Due to the high quartz fraction, the color of the borrow area sediment is white, with a Munsell Value of 7-8. The mean grain size ranges from 0.21 mm to 0.23 mm, which is similar to the native / existing Longboat Key beach, but relatively fine in comparison with other available sources. The fine nature of the sediments may lead to reduced beach fill performance, or increased overfill requirements.

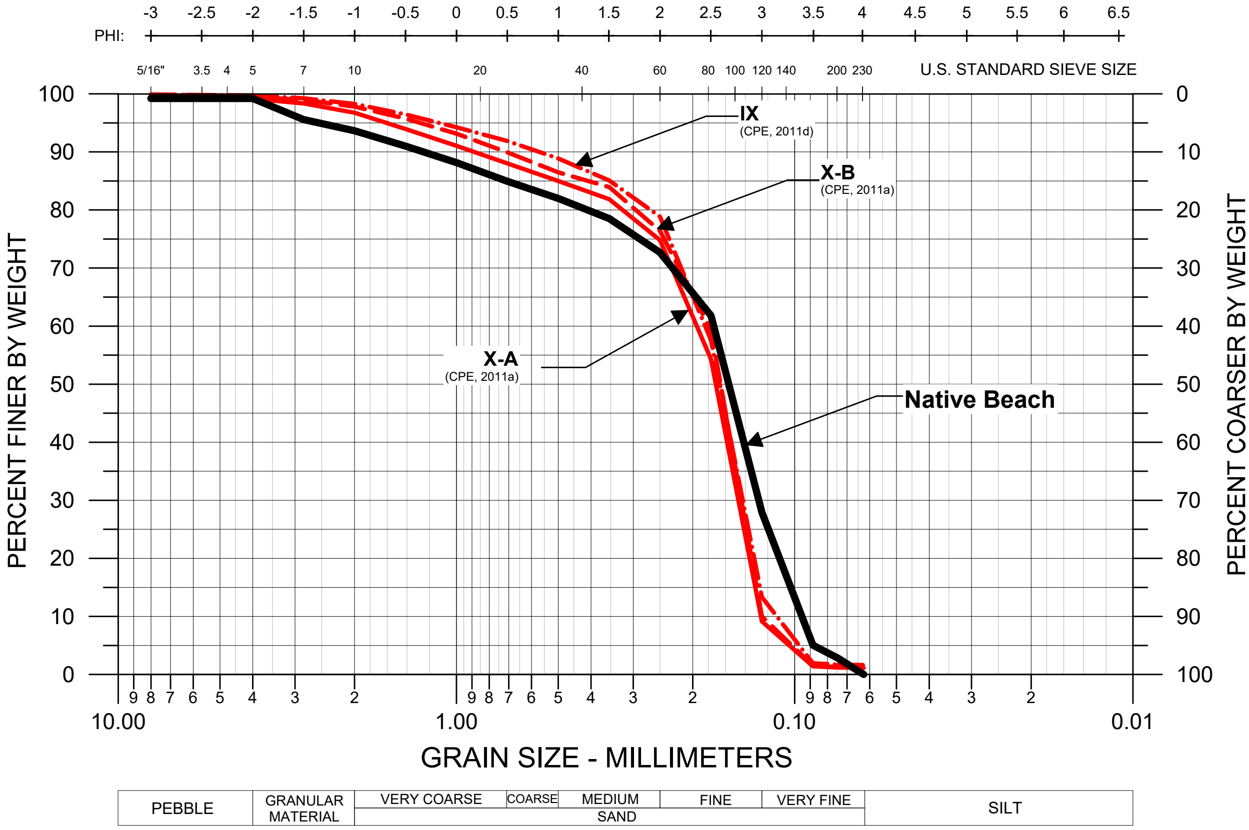


Figure 4.8 Cumulative grain size distributions of the borrow area composites for IX, X-A, and X-B, sites that lie along the Passage Key ebb shoal. The native / existing Longboat Key beach is also plotted for reference.

4.4 Offshore Sand

The Town has two permitted offshore borrow areas, B-3 and F-2, located roughly 15+ nautical miles northwest from the project area. These sites were developed along the Gulfstream pipeline corridor (a proposed project that was later abandoned). **Figure 4.10** plots the location of the offshore borrow areas relative to Longboat Key and the inlet sources discussed previously. Borrow Area B-3 is located in about 40 ft of water and contains an estimated 131,500 cy of sand (CPE, 2011b). Farther west, in Federal waters, is Borrow Area F-2. This borrow area contains about 466,500 cy of gray sand (CPE, 2011b). While Area F-2 is permitted for use, the lease agreement with the Bureau of Ocean Energy Management has expired and would need renewal.

Figure 4.9 compares the grain size distributions of the offshore borrow area composites with the native / existing sediment on Longboat Key. The offshore borrow areas B-3 and F-2 contain relatively coarse beach fill material, with mean grain sizes of 0.28 mm and 0.24 mm, respectively. As such, this material may result in greater longevity than some of the other sources available to the Town for nourishment. However, the material within these borrow areas is also darker in color (Munsell Value of 6). The darker color is partly attributed to the larger shell fraction of roughly 40%.

Figure 4.9 Cumulative grain size distributions for the borrow area composites of B-3 and F-2, located 15+ nmi offshore of Longboat Key, and the native / existing Longboat Key beach sediments.

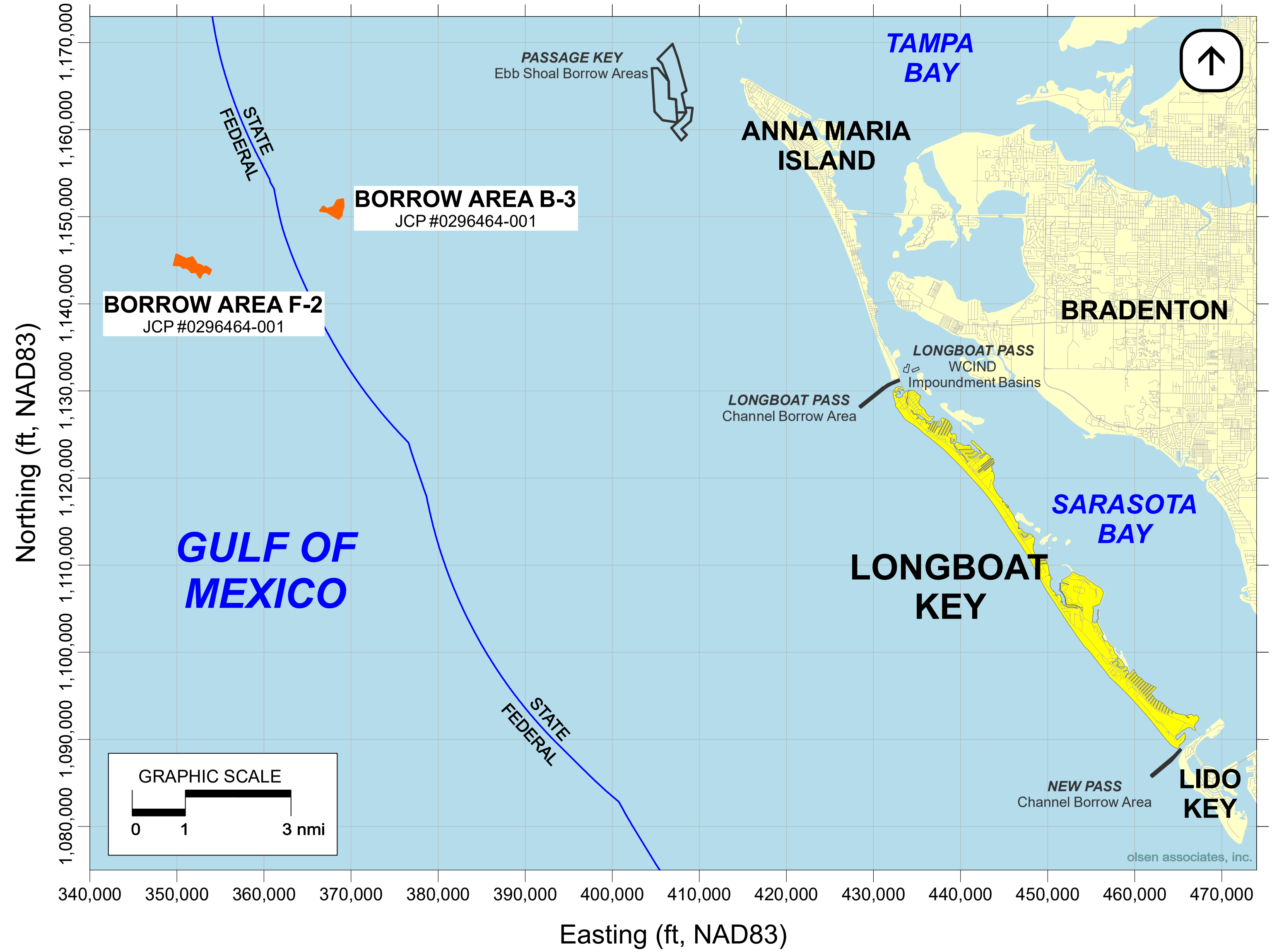


Figure 4.10 Location map of the currently permitted offshore borrow areas relative to the Longboat Key project shoreline and the inlet borrow areas (F-2 requires BOEM lease renewal).

4.5 Upland Truck Haul Sand

The Town currently holds permits to nourish the Gulf of Mexico shoreline with upland sand from four previously authorized sources: Stewart Materials in Immokalee, E.R. Jahna in Green Bay, CEMEX in Davenport, and CEMEX in Lake Wales. **Figure 4.12**depicts the location of these sources relative to the Longboat Key project shoreline. All of the authorized upland sand sources are about 2-2.5 hours from central Longboat Key.

The upland sediment is coarse white sand with little or no shell. **Figure 4.11** plots the representative grain size distributions of material from the four upland mines. This material is more uniform in size compared to the other sources, due to the controlled sorting process at the mines. The mean grain size is very similar to the median for all four sources. The mean grain sizes of Stewart Materials Immokalee, Jahna Green Bay, and CEMEX Davenport are 0.34 mm, 0.32 mm, and 0.35 mm, respectively. As shown in **Figure 4.11**, the material from CEMEX Lake Wales is coarser than that of the other mines, with a mean of 0.43 mm. It is noted that sediment characteristics from the mines do change over time as different mine areas are excavated.

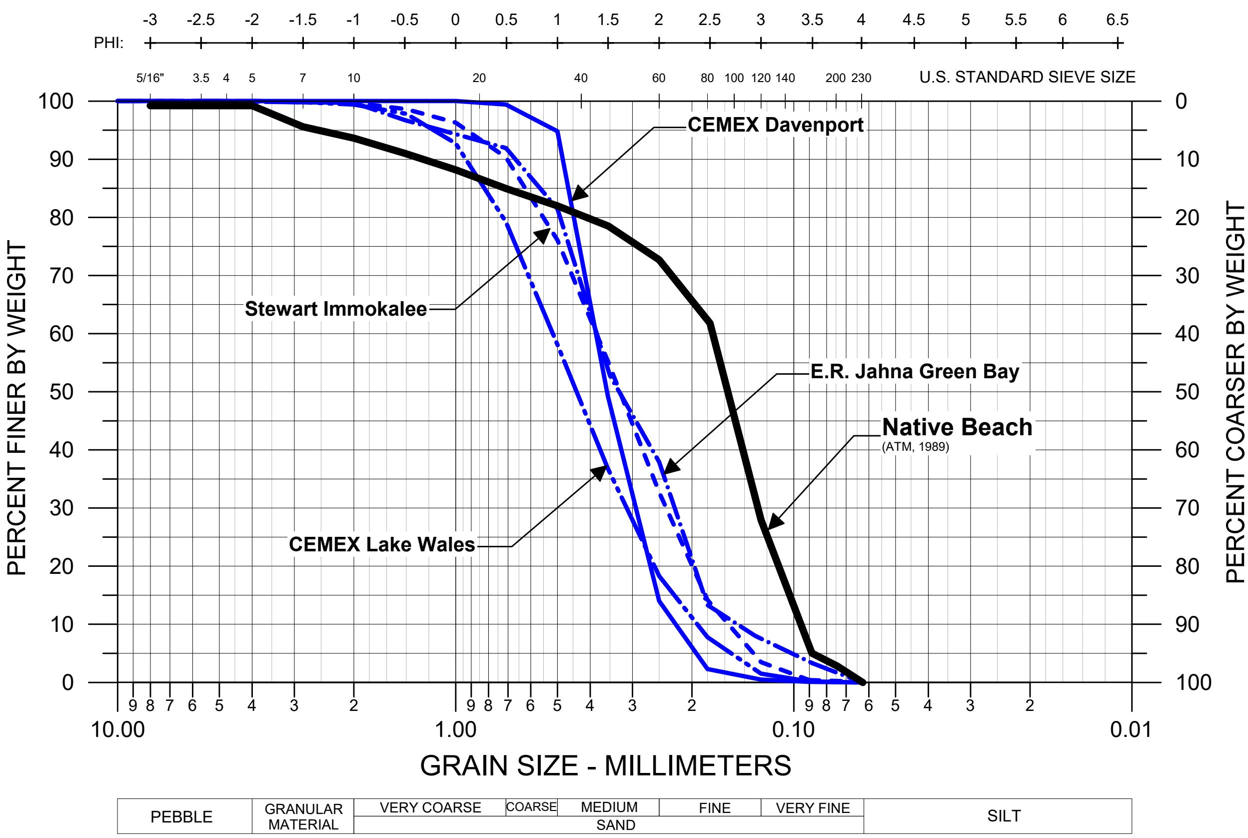


Figure 4.11 Cumulative grain size distributions for the four upland sand sources authorized for nourishment of the Longboat Key Gulf of Mexico shoreline. The native / existing Longboat Key beach is also plotted for reference.

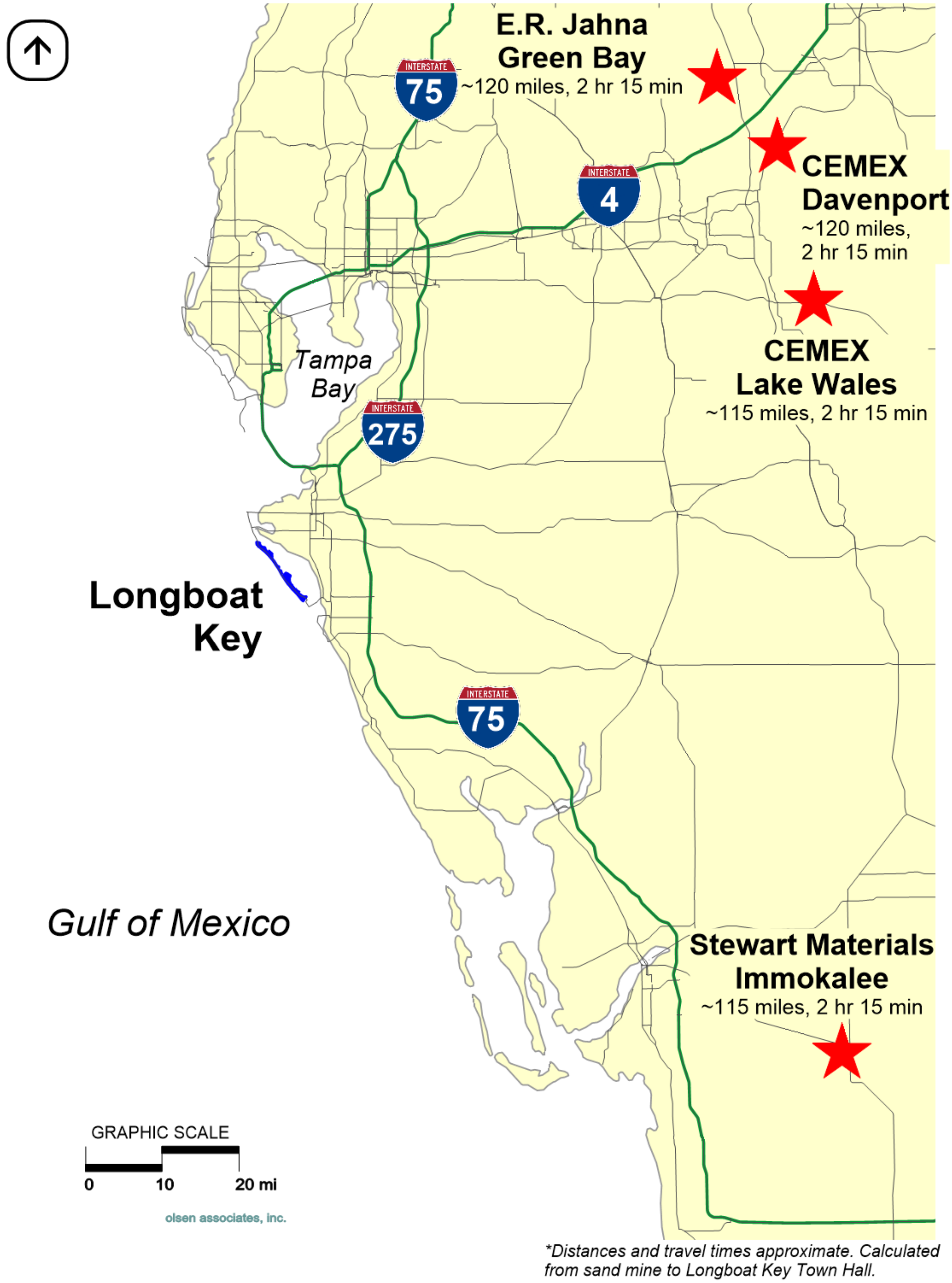


Figure 4.12 Location map of authorized upland sand sources for nourishment of the Longboat Key, FL, Gulf of Mexico shoreline (ref. FDEP JCP #0296464 and #0300119).

4.6 Summary of Permitted Sources

Figure 4.13 combines the grain size distributions for all of the available sources into one plot for comparison. As indicated in the figure, the upland sand sources (blue curves) are significantly coarser and more uniform in size than the in-water borrow areas. The Passage Key ebb shoal borrow areas (red curves) contain the finest material. The Passage Key borrow areas also have a smaller coarse shell fraction than B-3, F-2, New Pass, and Longboat Pass.

4.7 Other Potential Sources

Figure 4.14 depicts the local bathymetry offshore of Longboat Key, from the Tampa Bay entrance southward to Siesta Key. Inspection of the large-scale bathymetry reveals generally straight and parallel contours of the Gulfward-sloping seabed offshore of Longboat Key, reaching approximately 45- to 50-ft depths at the 9-nautical mile offshore boundary between State and Federal Waters. Also evident in the figure are smaller-scale irregularities indicative of hardbottom features and sand waves of varying sizes.

Figure 4.14 also includes the various active and relict sand borrow areas utilized by the Town and the neighboring islands. The currently permitted borrow areas for the Town are depicted in red. The figure likewise plots the locations of borrow areas previously developed for Longboat Key, including the Longboat Pass and New Pass ebb shoal borrow areas excavated for the 1992-1993 initial beach restoration project, the 1997 and 2001 interim nourishment projects (Borrow Area V-A) and the 2005-2006 renourishment (Borrow Area IV-A and Borrow Area IX). The 2005-2006 nourishment project design included a coarse, gray base (Borrow Area IV-A) and a fine, white cap (Borrow Area IX). The other borrow areas depicted in grey were abandoned due to sediment quality concerns and have not been excavated.

Numerous field investigations have occurred on behalf of the Town of Longboat Key to develop sand sources for beach nourishment along the island. **Figure 4.15** maps the locations of Vibracores collected by the Town and others atop the local bathymetry and developed borrow areas. The historical Vibracore data were obtained from the FDEP Regional Offshore Sand Source Inventory (ROSSI) database.

Vibracores collected on the neighboring flood shoals suggest the presence of beach compatible sand (generally fine sand); however, environmental permitting challenges could impede the use of these sources. For example, Submerged Aquatic Vegetation (SAV) is abundant over the flood shoal of New Pass. Any impacts to SAV would require costly mitigation and monitoring. Similarly, permitting any portion of the Jewfish Key shoal in Longboat Pass for excavation would present significant obstacles. Regulatory agencies may require numerical modeling studies to assess potential adverse impacts to the adjacent shoals and shorelines.

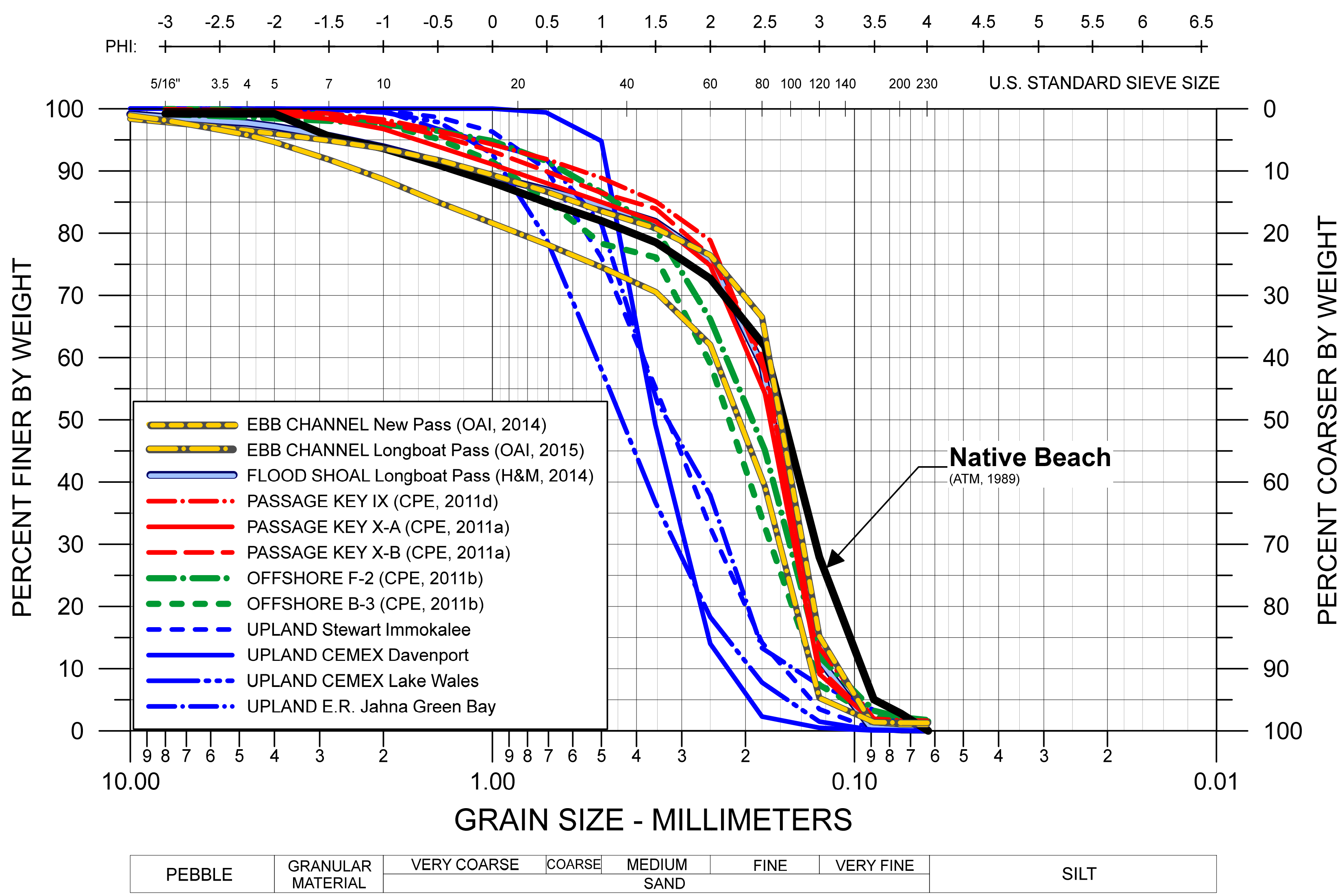


Figure 4.13 Cumulative grain size distributions for the permitted sand sources authorized for nourishment of the Longboat Key Gulf of Mexico shoreline. The distribution for the native / existing Longboat Key beach is also plotted for reference.

Figure 4.14 Location map of borrow areas in the vicinity of the Longboat Key. Radial distances are shown from the central project area for reference.

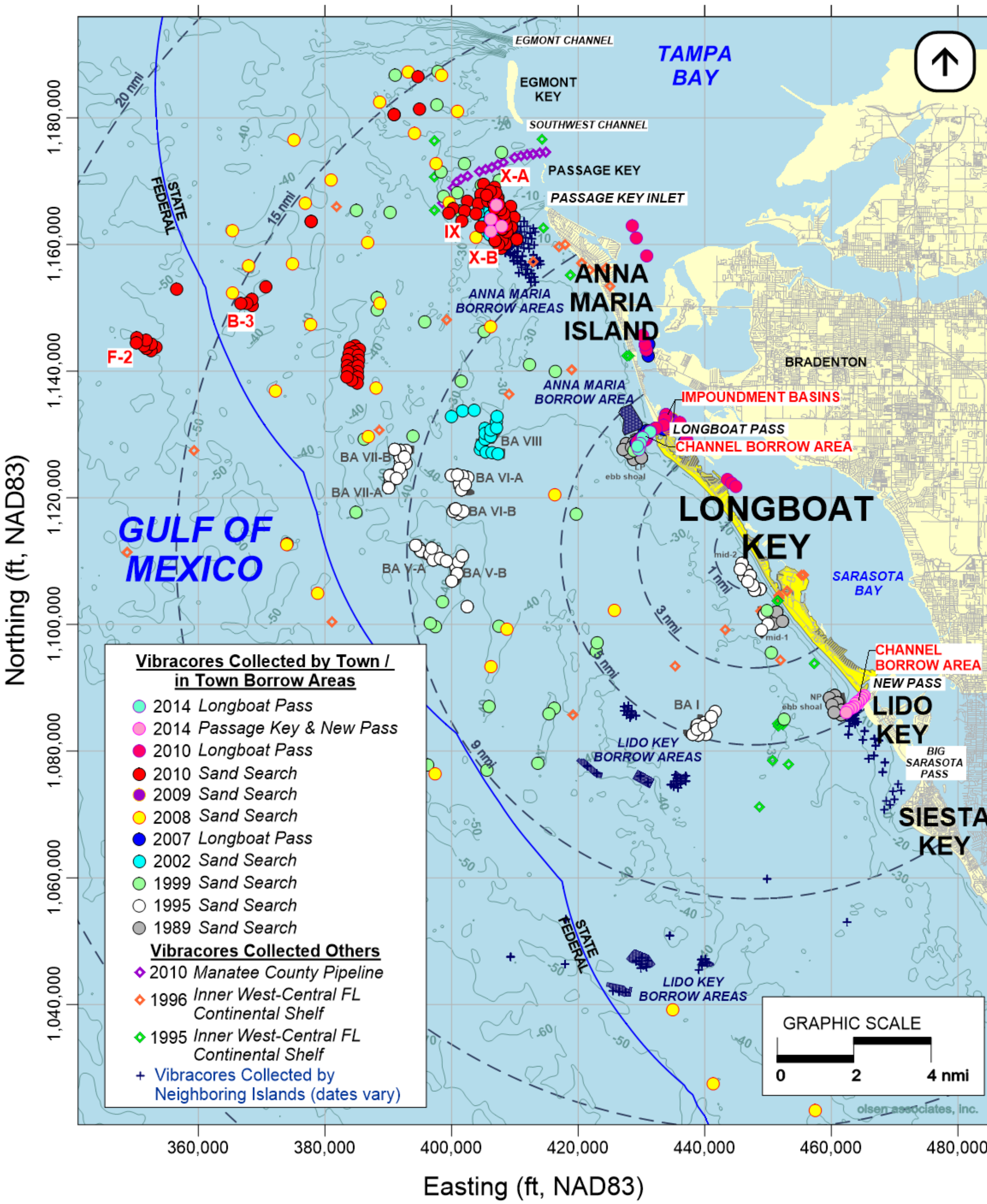


Figure 4.15 Map of Vibracore investigations conducted in the vicinity of Longboat Key, FL.

Available Vibracore data indicates small deposits of beach compatible material amongst scattered hardbottom offshore of Longboat Key. Generally, the material located nearby tends to be grayer (Munsell color Values of about 6) than the white sand with Munsell Values of 8+ desired by the Town. Previous explorations also suggest that the offshore material contains shell fragments of varying sizes.

Farther afield, sand search investigations in 2008 and 2010 identified relatively distant candidate borrow areas located off of Egmont Key and beyond, 12-18 miles from the center of Longboat Key. Each of these are generally comprised of fine sand with varying levels of shell. It is noted that finer sediment is generally less resistant to erosion, limiting beach fill longevity.

Given the expected need for sand over the next 25+ years and the particular details of sand resources available to the Town, development of additional offshore sand borrow areas is deemed a critical need. It is recommended that additional geotechnical investigation work be conducted to seek additional offshore sand sources. In this effort, available deposits of beach-compatible sand, particularly those directly accessible via hopper dredge, should be targeted. It is recognized that any offshore sand resources will likely contain materials that are either finer or grayer than the ideal beach fill sediments.

5.0 FUTURE PROJECT PLANNING

The following section discusses project approaches for each of the four eroded beach segments discussed above, and develops three primary scenarios for the construction of the 2021/2022 comprehensive renourishment of the Gulf shoreline, guided by an allotted budget of $35M. Various combinations of the available sand sources from **Section 4.0** are analyzed to meet the projected volumetric needs developed in **Section 3.0**. Probable costs for each sand source are estimated using data from recently constructed local projects. The estimated costs include considerations for constructability of the anticipated fill segments.

5.1 Construction Areas

The analyses of current shoreline conditions described in **Section 3.0** revealed four primary areas of erosional stress, consistent with historical trends for the island. These areas are illustrated in **Figure 5.1** At a minimum, the Town should plan to perform periodic maintenance nourishment in these four areas at an approximate 8-year nourishment interval (at most) over the 25-year time horizon. Although the remaining areas of the Gulf shoreline do not present a need for nourishment at this time, additional needs may arise over time (due to storm impacts, for example). Each of the four areas has unique construction considerations based on the anticipated fill densities, access points, and condition of the shoreline.

A - North End: To address the severe erosion at the north end of Longboat Key, the Town plans to construct a North End Structural Stabilization Project in 2020/2021. The proposed project includes the addition of three low-crested permeable rock groins north of the two existing concrete Permeable Adjustable Groins (PAGs) at North Shore Road, and two similar structures south of the PAGs to stabilize the shoreline and lower the currently severe annual erosion rates within the expanded structural field (R-42.5 to R-46). An initial beach fill and periodic maintenance renourishment will be required to fill the groin cells. Permitting for the project is underway. **Figures 5.2 and 5.3** depict the proposed structures and beach fill. The sand would ideally be sourced from the adjacent Longboat Pass channel borrow area. Should this sand source not be available at the time of construction, other sources, including upland sand or offshore borrow areas may be used. A projected need of 65 cy/ft is estimated by the time of construction (**Table 3.2**).

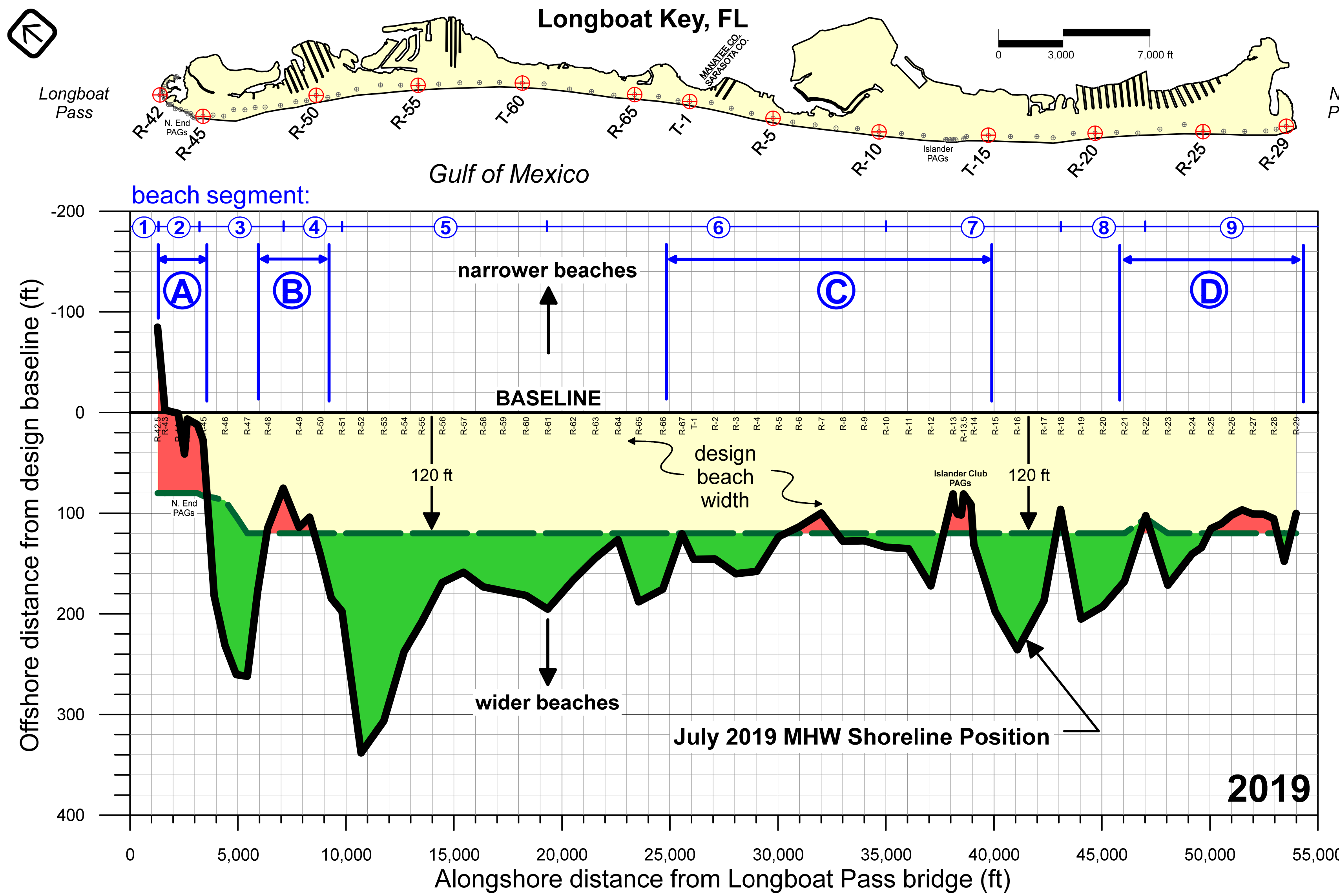


Figure 5.1 Position of the June/July 2019 MHWL relative to the updated design beach baseline and beach width, Longbaot Key, FL. Labels in blue indicate beach management segments 1-9 and proposed beach renourishment areas A-d.

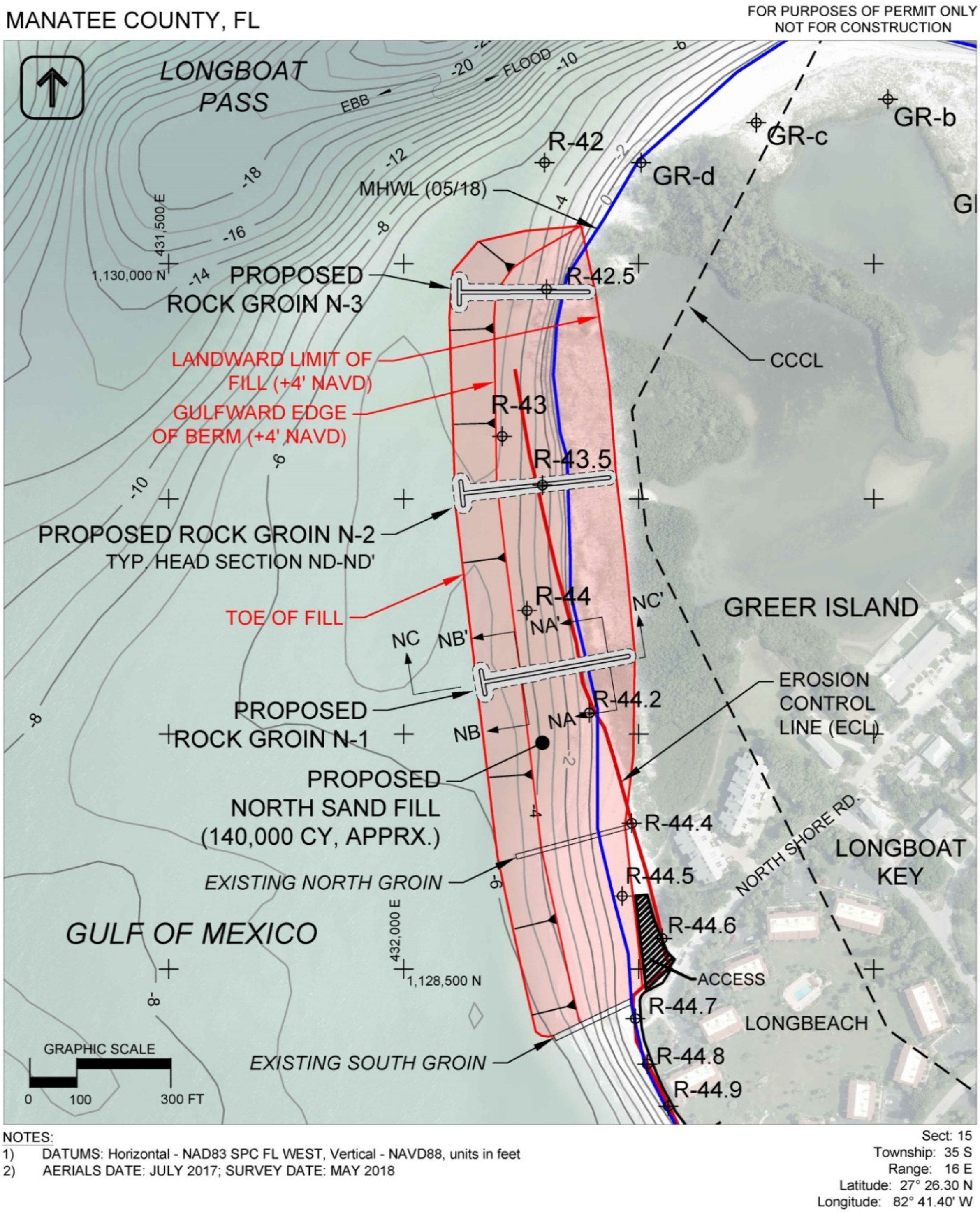


Figure 5.2 Proposed permeable rock groin structures north of the existing North End PAGs on Longboat Key (from permit drawings JCP 0300119-007).

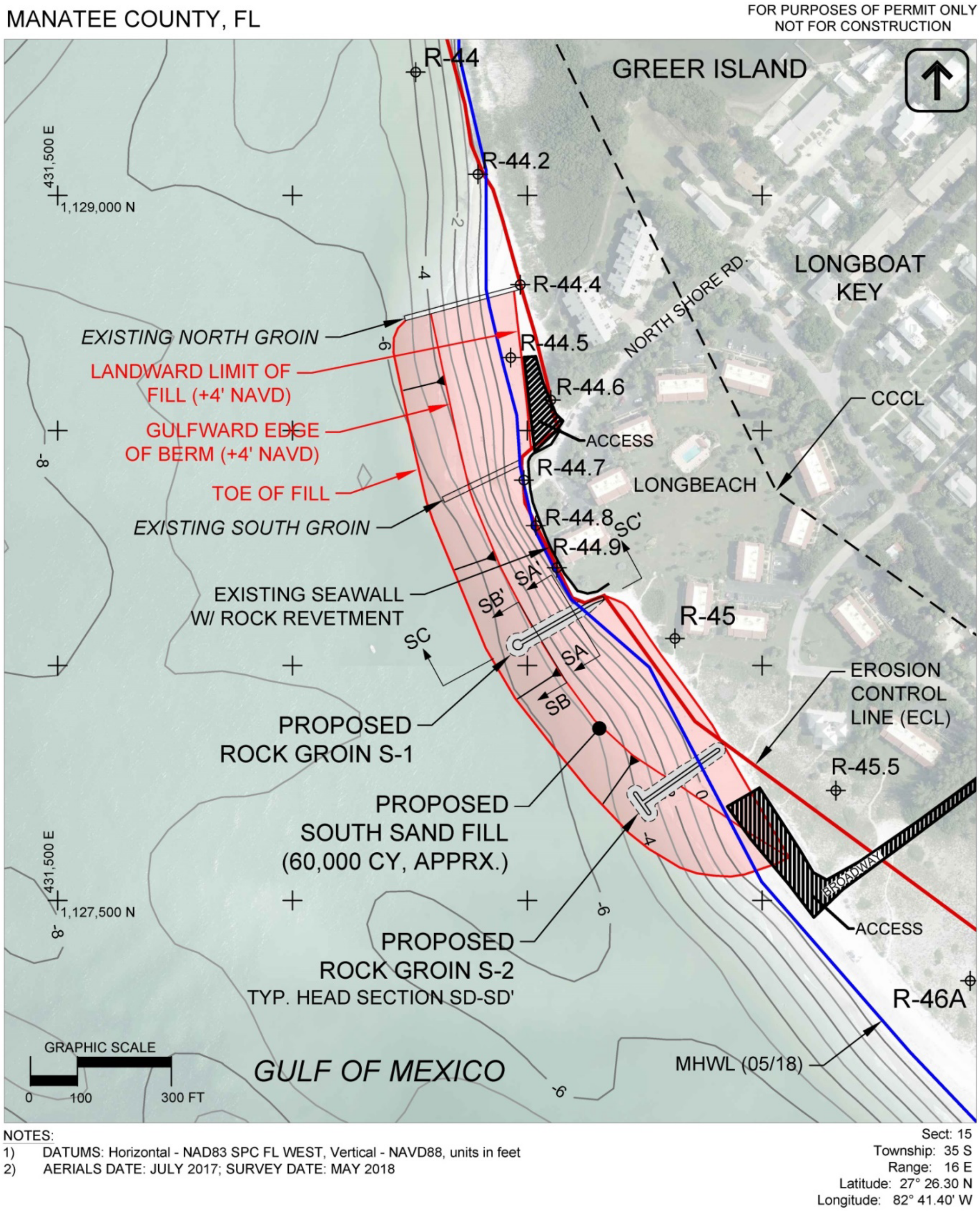


Figure 5.3 Proposed permeable rock groin structures south of the existing North End PAGs on Longboat Key (from permit drawings JCP 0300119-008).

B - Gulfside Road: Along the Gulfside Road area (R-47.5 to R-50.5), the severe erosion rate, and thus the significant volumetric requirement, is principally the result of the scouring and downdrift erosive effect of the large seawall at 6633 Gulf of Mexico Drive. As discussed above, the previous untenable Gulfward location of the baseline and design beach condition in this area have been shifted landward in acknowledgement of the infeasibility of maintaining a contiguous sandy shoreline Gulfward of the large seawall. This shift significantly lowers the volumetric need along this beach segment, although erosion rates will remain high and providing sufficient beach width immediately adjacent to the seawall will be difficult. As discussed previously, a reduced renourishment interval of 3-4 years is proposed for Gulfside Road. The projected volumetric need is anticipated to be 60 cy/ft in 2021/2022 (**Table 3.2**). The presence of the seawall and revetment structures that protrude out into the Gulf along this segment block lateral access and complicate the delivery of sand to the area. In addition, nearshore hardbottom and artificial reef resources are located offshore of the fill area. Special considerations for these resources may require the use of coarser sand and limits on the width of the fill template.

C - Central Key: Along a large portion of the center of the island, from the 4400 block of Gulf Mexico Drive (R-66) southward past the Islander Club PAGs to the 2100 block of GMD (R-15), chronic erosion affects the shoreline for approximately four miles, but at significantly lower erosion rates compared to the other areas of need. The resultant low level of required fill placement per foot of shoreline (roughly 12 cy/ft from **Table 3.2**) presents challenges in terms of how the segment can be efficiently and cost-effectively constructed.

At these fill densities, the footprint of the design template narrows substantially and the rate of fill progress along the shoreline increases. These factors increase the difficulty for the shore crew to manage the high volume output from the dredge discharge pipe. As the fill density decreases, the percentage of sand placed outside the paid construction template increases, leading to production inefficiency. Contractors account for areas of small fill density by factoring in these losses and by adding shore crew and equipment to balance productivity. All these issues contribute to increased costs for hydraulically placed sources. Small fill densities are generally simpler to construct with upland sand. In 2016, three segments of the central island were nourished with truck-hauled sand delivered from the upland.

D - South End: At the south end, the shoreline from R-21 to R-29.4 in Sarasota County is strongly affected by the erosional influence of New Pass and the interactions of the shoreline and the ebb shoal. For the 2021/2022 renourishment, projected fill densities along this shoreline are 42 cy/ft (**Table 3.2**). This shoreline segment is most easily nourished with sand from the nearby New Pass ebb shoal channel borrow area, if available. It is noted that limited access along the shoreline may complicate construction. In the 2016 Multi-Phase Beach Nourishment, the private L'Ambiance and Longboat Key Club properties were used to access the beach. In addition, it is recommended that the terminal structure be tightened to reduce the amount of sand lost through and over the structure into New Pass.

5.2 Sand Source Considerations

The sand resources currently or potentially available to the Town have been described in **Section 4.0**. Multiple factors affect beach nourishment construction from these sources. Foremost among these factors is the location of the source relative to the disposal shoreline. Generally, production decreases as the distance to the project shoreline increases. For hydraulically dredged sand, the ambient water depths in the borrow areas affect the type of equipment that can be used for construction. If rehandling or screening of the material is required, additional equipment will be necessary.

<u>New Pass / Longboat Pass</u>

For the local inlet sources of New Pass and Longboat Pass, a cutterhead suction/pipeline dredge can operate most efficiently in the shallow depths of the excavation areas and be able to pump the sand slurry the relatively short distances from the borrow area to the beach fill segments near the ends of the island. In 2016, the Town excavated New Pass to nourish the southern mile of shoreline (R-24 to R-28). Under the same contract, the Longboat Pass channel borrow area was excavated to nourish two segments of northern shoreline, including North Shore Road/Longbeach to Broadway Street (R-44.7 to R-45.5) and Gulfside Road (R-48 to R-50.5). The farthest pumping distance for the 2016 nourishment was roughly 1.5 miles from the channel borrow area. No booster pump was used in the operations. Given the typically available sand volumes from the New Pass and Longboat Pass ebb shoal channel borrow areas and the erosional conditions of the beach segments immediately adjacent to these borrow areas, it is unlikely that the sand from these areas would be transported any farther toward the center of the island.

Passage Key Inlet Borrow Areas

Borrow Areas IX, X-A, and X-B are much farther from Longboat Key, roughly 11 nmi from the center of the island. The shallow water depths on the ebb shoal at Passage Key greatly complicate the excavation and use of the beach fill sand for Longboat Key. The depths in most of these areas are too shallow to be accessed by hopper dredge, while the long distance to the beach fill site makes the direct use of a cutterhead dredge very inefficient, requiring booster pumps and miles of pipeline across an area containing hardbottom in numerous places. These factors promote the rehandling of dredged material. The existing permits for the Passage Key borrow areas include two rehandling areas, as shown in **Figure 5.4**. Multiple options could be considered for construction. Similar to recent efforts in Pinellas County, excavation could be performed by cutterhead dredge, with the material pumped to a loading barge for scow transport to Longboat Key. Another (less efficient) option could involve depositing the sand into deeper waters, within the permitted rehandling areas, for subsequent re-excavation and transport by a larger hopper dredge. Other construction considerations include the possibility of relatively large shell fragments. The Town may elect to have the contractor screen the material prior to beach disposal in order to remove this shell fraction.

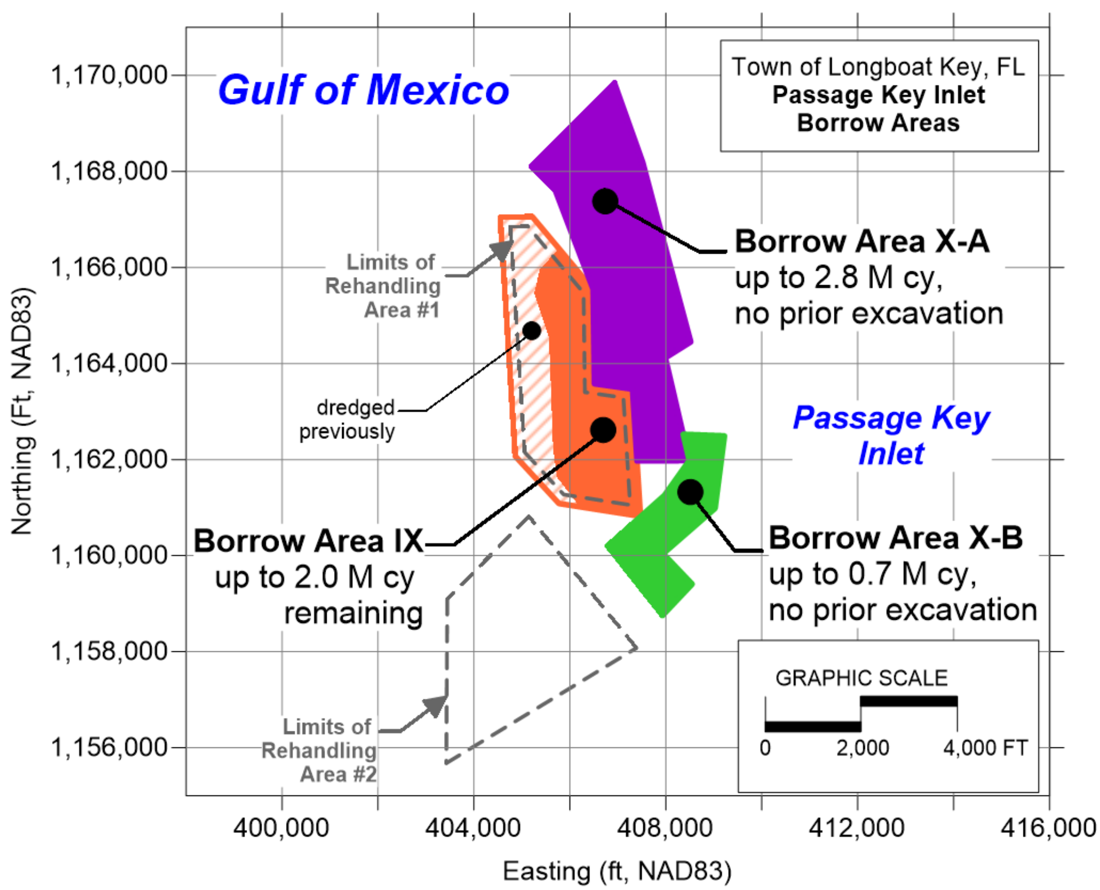


Figure 5.4 Borrow Areas IX, X-A, and X-B and two rehandling areas along the ebb shoal of Passage Key Inlet.

Offshore Sand

The distant offshore locations and deeper water depths of offshore borrow areas B-3 and F-2 lend themselves to hopper dredge construction. These areas contain beach compatible sand underlain by shelly sand and rock. Likewise, the borrow areas lie adjacent to areas of exposed hardbottom. As such, screening may be necessary to remove rocks or large shell. The presence of the rock and hardbottom results in irregularly-shaped borrow area limits, both in planform and in design cut elevation. For that reason, the reported available sand volumes represent the maximum, or neat, volumes available. In reality, the efficiencies of the offshore dredging process restrict how close to the permitted boundaries a dredge can conservatively operate, especially the vertical limits. As discussed in **Section 2**, such issues were raised by the dredge industry during the bid process for a 2013-2014 project. For this and other reasons (competition with other Hurricane Sandy project work), no bids were submitted for the interim nourishment. A subsequent re-bid of the interim project later in 2013 resulted in the receipt of only one bid, which exceeded the target budget for acceptance.

The Federal BOEM lease required for use of the Borrow Area F-2 sand expired in October 2019, but the Town may apply for a new lease. If the Town elects to use this borrow area, they must provide a letter of interest to the BOEM Gulf of Mexico Office in New Orleans. This submittal would include a specific plan for use of the material, the project permits, the expired BOEM lease, and any environmental documentation. In addition, an updated Environmental Assessment must be prepared prior to the issuance of a new lease. Upon receipt of the necessary documentation, a new lease could be issued in roughly 90 days[3].

Truck Haul

The Town has permits to source from upland sand mines. In this case, the sand would be transported from upland mines by a combination of over-the-road and off-road dump trucks. Although the quality of upland sand is generally superior to the sand deposits offshore of Longboat Key, there are significant community impacts to consider, traffic impacts being the largest of those. The construction access requirements are also considerably more involved for a trucking project, as will be discussed in **Section 5.5**.

Since 2015, the Town has constructed four truck haul beach nourishment projects, ranging in size from 13,000 tons to 300,000+ tons. Each dump truck has a carrying capacity of approximately 22 tons, so a project of 300,000 tons (~200,000 cy) requires 13,600+ truck loads. The Town has previously utilized material from three of the currently permitted mines: Stewart Immokalee (2016 Central Key and South End), CEMEX Davenport (2018 North End), and E.R. Jahna Greenbay (2015 North End PAG Fill). **Figure 5.6** through **5.8** show examples from recent upland truck haul construction projects.

[3] Personal communication -- 14 June 2019 with J. Mallindine of the BOEM Gulf of Mexico Office in New Orleans.

Figure 5.5 Sand from the Stewart Materials mine in Immokalee, FL, used for the 2016 Central Key Beach Nourishment Project.

Figure 5.6 Construction operations in the vicinity of the Seahorse Resort (R-6) during the 2016 Central Key Beach Nourishment Project.

Figure 5.7 The condition of the beach immediately following the 2018 North End Interim Beach Nourishment Project at North Shore Road in Longboat Key, FL. Sand for the project was sourced from CEMEX Davenport.

Figure 5.8 Beach fill operations following the construction of the North End Permeable Adjustable Groins at North Shore Road in Longboat Key, FL. Sand was sourced from E.R. Jahna Greenbay.

5.3 Cost Estimates

Table 5.1 summarizes the sediment characteristics from **Section 4.0**, construction considerations discussed above, and the probable cost associated with each of the sand sources available to the Town for renourishment.

New Pass & Longboat Pass - The New Pass channel borrow area has been excavated twice recently -- in 2019 by the City of Sarasota for nourishment of the Lido Key shoreline and in 2016 by the Town for nourishment of the South End. For the 2016 project, the Town also conducted excavation and nourishment from the Longboat Pass channel borrow area under the same contract. Data from recent projects suggests that the near-term unit price for sand from the New Pass and Longboat Pass channel borrow areas could range from \$17 to \$22 per cubic yard[4]. Prices near the lower end of the range would be achieved with a larger project, potentially one combining excavation of both Pass borrow areas, similar to the 2016 project.

Other options for nourishment sand in the vicinity of Longboat Pass include the flood shoal impoundment basins and the Greer Island sand spit. Excavation of the Longboat Pass flood shoal impoundment basins is not likely to be a viable option in the near future due to the lack of available sand volume. In 2014, the impoundment basins were excavated by the West Coast Inland Navigation District for just under \$10/cy (H&M, 2014). The nearby Greer Island sand spit may be excavated for \$12 to \$18 per cubic yard (opinion only, subject to bid).

Passage Key Inlet Borrow Areas - Excavation of any of the Passage Key Inlet borrow areas (IX, X-A, or X-B) will likely require some form of rehandling. The increased handling effort and time will in turn affect construction costs. In addition, the material may need to be screened before it is deposited onto the beach. If screening is required, construction costs will be slightly higher. Based upon pricing data from the 2018 Pinellas County Shore Protection Project, it is opined that sand dredged, transported, and placed from the Passage Key borrow areas would be on the order of \$45 to \$55/cy.

Offshore Sand - Estimated construction costs for sand from Borrow Areas B-3 and F-2 are expected to range from \$25 to \$35/cy. This estimate is based on previously constructed hopper dredge projects of similar scope. Similar to the Passage Key borrow area sand, this material may necessitate screening prior to disposal on the beach.

[4] Estimated "all-in" construction cost -- the total contract amount (including mobilization/demobilization) divided by the quantity of sand. All costs are subject to bid.

Truck Haul - Project costs for sand delivered from upland sources depend on the daily production rate of the sand mine(s), the overall distance and complexity of the haul route, and the locations and logistics of any intermediate sand stockpiling and rehandling areas and individual beach access points. For Longboat Key, the hauling distance is the primary driver of the cost. Based upon recent project experience at Longboat Key, costs for sand trucked from the available mines and placed and shaped on the beach is opined to total $50 to $60/cy.

Table 5.1 Currently available sand resources for beach nourishment at Longboat Key, FL

Source	Location/ Volume	General Description of Sediments	Feasibility**
Upland Sources (Truck Haul) (permitted)	110-120 miles* (Lake Wales Ridge) / No practical volume limit	• White (Value 8+) • Coarse, uniform sand • No shell or silts/muds	• Distant source • Community impacts (traffic) • Limited construction access • Cost opinion: $50 - $60/cy
Passage Key Inlet Ebb Shoal (permitted, IX, Xa, Xb)	12 miles* / ~5.5 million cy	• White (Value 7-8) • Fine sand w/ varying shell • Low to no silts/muds	• Distant, shallow source • Rehandling likely required • Screening possibly required • Cost opinion: $45 - $55/cy
Offshore Deposits off Anna Maria I. (permitted, B-3 and F-2***)	15-18 miles* / ~500,000 cy	• Gray/lt. gray (Value ~6) • Fine sand, increased shell • Low silts/muds	• Distant sources • Non-renewable • Screening possibly required • Cost opinion: $25 - $35/cy
Longboat Pass/ New Pass Ebb Shoals (permitted)	~inlet adjacent (2-3 mi) / ~200,000 cy, each inlet	• White sand (Value 7-8) • Fine sand w/ varying shell • Low to no silts/muds	• Local, shared source • Limited volumes • Renewable • Cost opinion: $17 - $22/cy
Inlet Flood Shoal (permitted & unpermitted)	Longboat Pass area / <100,000 cy	• Lt. gray/white (Value 6 -8) • Fine sand w/shell • Increased silt	• Local, shared source • Non-renewable • Cost opinion: $12 - $18/cy
Greer Island Spit (challenging to permit)	Longboat Pass area / <50,000 cy (est.)	• White (Value > 7) • Spit sand: Gulf beaches • Canal sand: fine/silty	• Local source • Limited volumes • Likely non-renewable • Cost opinion: $10 - $15/cy

*distance to Manatee/Sarasota County Line

**cost opinion of all-in unit cost per cubic yard (including mobilization/demobilization). All costs subject to bid.

***BOEM lease renewal required for Borrow Area F-2 in Federal Waters

5.4 Construction Scenarios 2021/2022

Each of the scenarios presented herein address the four areas of need depicted in **Figure 5.9**. For purposes of the following discussion, it is assumed that the combined budget for the North End Structural Stabilization Project and the comprehensive nourishment of 2021/2022 is $35M (initially set at $10M and $25M, respectively, including the groin structures). In these scenarios, it was assumed that roughly 200,000 cy of sand from Longboat Pass will be available to fill the north end groin field at the time of construction.

Additionally, each of the scenarios include the excavation of 200,000 cy from the New Pass ebb channel borrow area to partially fulfill the volume needs on the south end of the island. Herein, the estimated cost for the New Pass dredging and beach nourishment is $4.40M. Subtracting the estimated cost for New Pass sand leaves $20.6M to nourish Area B, Area C, and the remaining volume requirement for Area D. The New Pass and Longboat Pass ebb channel borrow areas are the most cost effective options for beach nourishment. If these sources are not available at the time of construction, then the total cost will increase. Otherwise, the total sand volume must decrease if the $25M budget is to be maintained. A decrease in sand volume results in a lower renourishment interval.

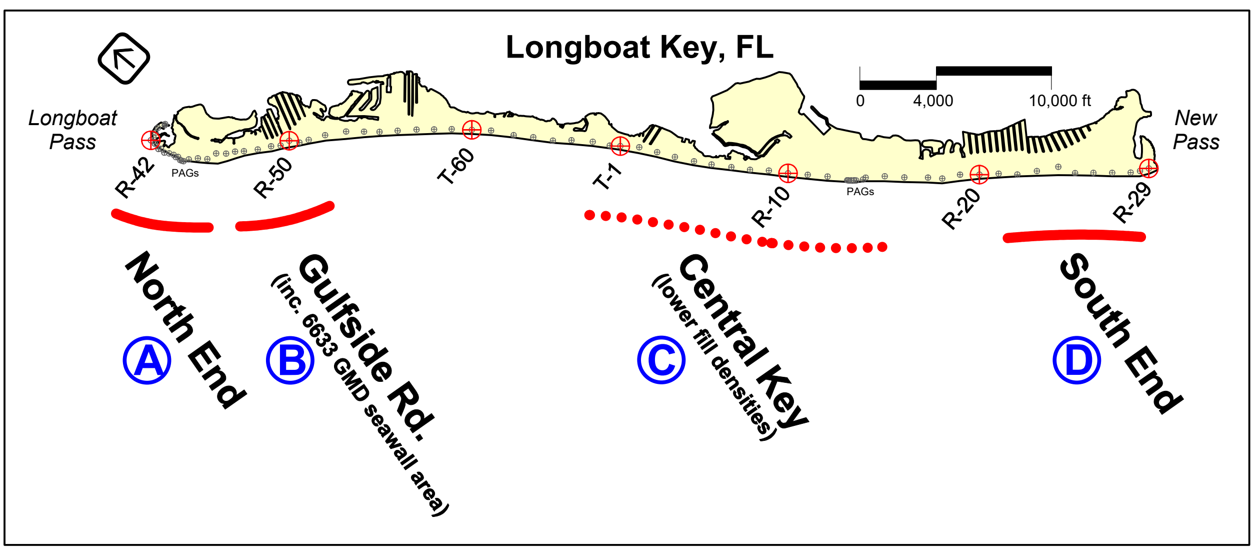


Figure 5.9 General areas in need of beach nourishment and/or structural stabilization for projects in 2020/2021 and 2021/20222 at Longboat Key, FL.

Scenario #1

Figure 5.10 depicts Scenario #1, in which the volume requirements listed in **Table 3.2** can be met utilizing the two local inlet sources (400,000 cy) and the offshore sand sources F-2 and B-3 (512,000 cy). As noted in the figure, the volume requirement at the south end exceeds the estimated volume available from New Pass. Sand excavated from the offshore borrow areas would supplement the sand volume from New Pass. The inlet dredging component of this project (common to all three scenarios) would closely resemble the 2016 New Pass / Longboat Pass Dredging and Beach Nourishment Project. Sand dredged from the offshore borrow areas would be transported to specified areas just offshore of Longboat Key and subsequently pumped ashore through submerged pipelines. The corridors for the pipelines would be pre-determined in order to avoid hardbottom/reef resources in the nearshore. **Table 5.2** details the estimated costs and construction methods associated with Scenario #1. Primary advantages and disadvantages of this scenario are:

Advantages:

- Sand obtained for relatively low unit prices ($25 to $35/cy or less)
- Target renourishment interval of 8 years met for Areas A (North End), C (Central Key), and D (South End). Target interval met for Area B (Gulfside Road) (~3-4 years)

Disadvantages:

- Requires renewal of Borrow Area F-2 BOEM lease
- Utilizes shellier, grayer sand from offshore
- Exhausts offshore borrow areas B-3 and F-2

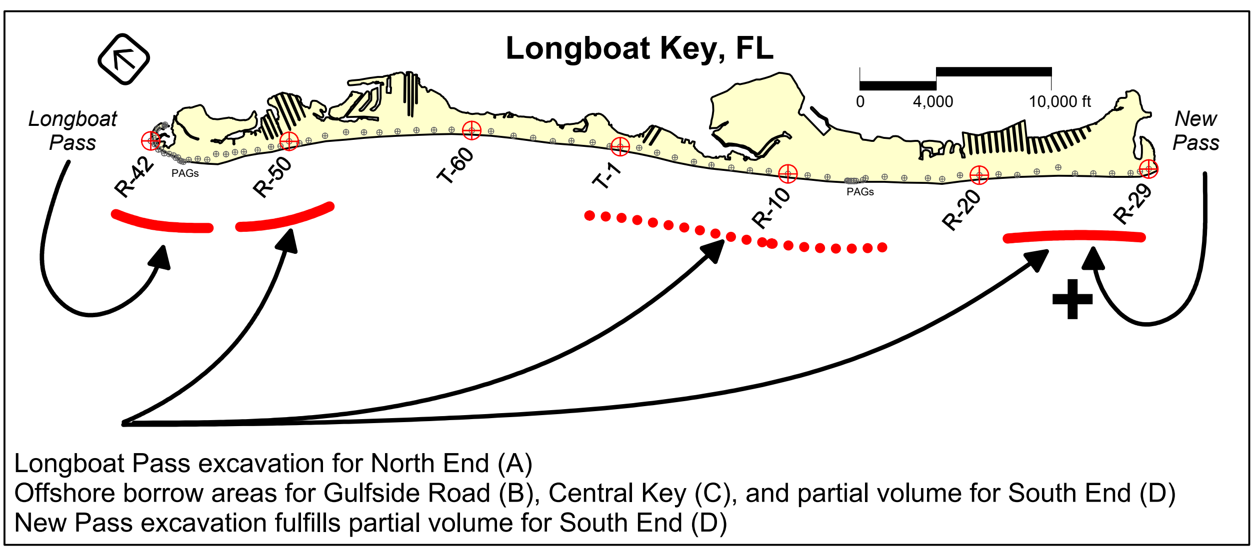


Figure 5.10 Construction Scenario 1 for the 2020/2021, 2021/2022 nourishment of Longboat Key, FL.

Table 5.2 Project Construction **Scenario #1 -** 2020/2021 and 2021/2022

Description/ Method	**Sand Volume (cy)**	**Opinion of Unit Cost ($/cy)**	**Opinion of Segment Cost**
A - ***NORTH END*** *Dredge sand from Longboat Pass (w/ structural stabilization)*	*~200,000 cy*	*$22/cy*	*$10M budgeted 2020/2021* *Longboat Pass sand: $4.40M.(+strux)*
B - **Gulfside Road** Dredge sand from offshore	175,000 cy	$30/cy	$5.25M
C - **Central Key** Dredge sand from offshore	185,000 cy	$30/cy	$5.55M
D - **South End** Dredge Sand from offshore & Dredge sand from New Pass	152,000 cy	$30/cy	$4.56M
	200,000 cy	$22/cy	$4.40M
TOTAL	912,000 cy (100% of target)		*$10M: 2020/2021 project (Area A)* $19.76: 2021/2022 project (Areas B, C, D)

Scenario #2

Scenario #2 incorporates a truck haul component, where sand is delivered from upland mines (**Figure 5.11**). With $20.6M available ($25M less $4.4M for New Pass), it is estimated that a total of 774,500 cy of sand could be placed along the island, including 400,000 cubic yards of sand from the local inlet sources and 374,500 cubic yards of sand from upland sources. The truck haul component of the project would resemble the 2016 Central Key / South End Truck Haul Beach Nourishment Project, but on a larger scale. This upland sand volume would result in almost 25,000 dump truck loads to be delivered to the island, nearly 57% more loads than were delivered in the 2016 projects. **Table 5.3** details the estimated costs and construction methods associated with Scenario #2. The primary advantages and disadvantages of this scenario are:

Advantages:

- White, coarse sand
- Less downtime associated with severe weather events compared to dredging operations

Disadvantages:

- Sand obtained for high unit prices ($50 to $60/cy)
- Lower renourishment interval for Area D (~6-year) and Area B (~1-year)
- Challenge of truck haul construction and access along Gulfside Road
- Community impacts from trucking operations

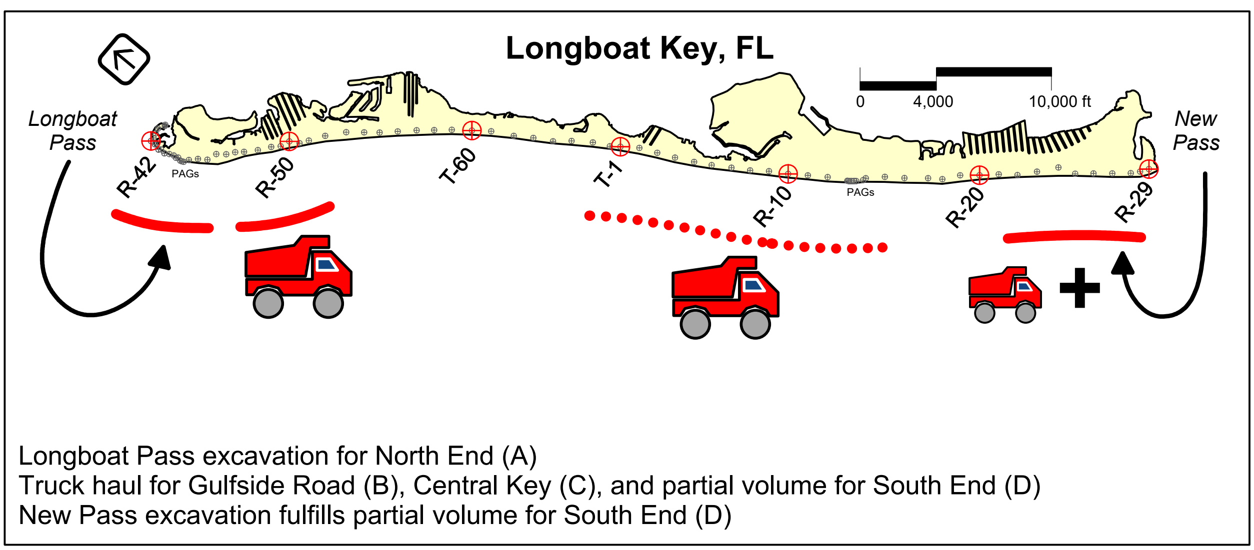


Figure 5.11 Construction Scenario 2 for the 2020/2021, 2021/2022 nourishment of Longboat Key, FL.

Table 5.3 Project Construction **Scenario #2 -** 2020/2021 and 2021/2022

Description/ Method	**Sand Volume (cy)**	**Opinion of Unit Cost ($/cy)**	**Opinion of Segment Cost**
A* - *NORTH END *Dredge sand from Longboat Pass (w/ structural stabilization)*	*~200,000 cy*	*$22/cy*	*$10M budgeted 2020/2021* *Longboat Pass sand: $4.40M.(+strux)*
***B* - Gulfside Road** Truck Haul Beach Fill	113,000 cy	$55/cy	$6.21M
***C* - Central Key** Truck Haul Beach Fill	185,000 cy	$55/cy	$10.18M
***D* - South End** Truck Haul Beach Fill & Dredge sand from New Pass	76,500 cy	$55/cy	$4.21M
	200,000 cy	$22/cy	$4.40M
TOTAL	774,500 cy (85% of target)		*$10M: 2020/2021 project (Area A)* $25M: 2021/2022 project (Areas B, C, D)

For **Scenario #3,** the truck haul components of the project are replaced with a dredging project from Borrow Area X on the ebb shoal at Passage Key (**Figure 5.12**). The shallow depths of the borrow area, the small overall fill volume, and the thin fill densities required over three miles of the Central Key segment require an expensive, equipment-intensive rehandling of the material to deliver it to Longboat Key. These factors serve to increase the price of dredged sand substantially. Despite those factors, the placement of dredged sand is opined to be less per cubic yard, overall, than using the truck haul sand. The sand from the Passage Key borrow area is light gray to white fine sand with varying levels of shell fragments (finer and somewhat shellier than the available truck haul sand, and thus may be somewhat less resistant to erosion). With the less costly unit price for the Passage Key sand and the assumptions stated above, **Scenario #3** would provide over 89% of the target required volume (**Table 5.4**).

Advantages:

- White to light gray sand

Disadvantages:

- Sand obtained for relatively high unit prices ($45 to $55/cy)
- Lower renourishment interval for Area D (~7-year) and Area B (~1-year)
- Fine sand may be less resistant to erosion

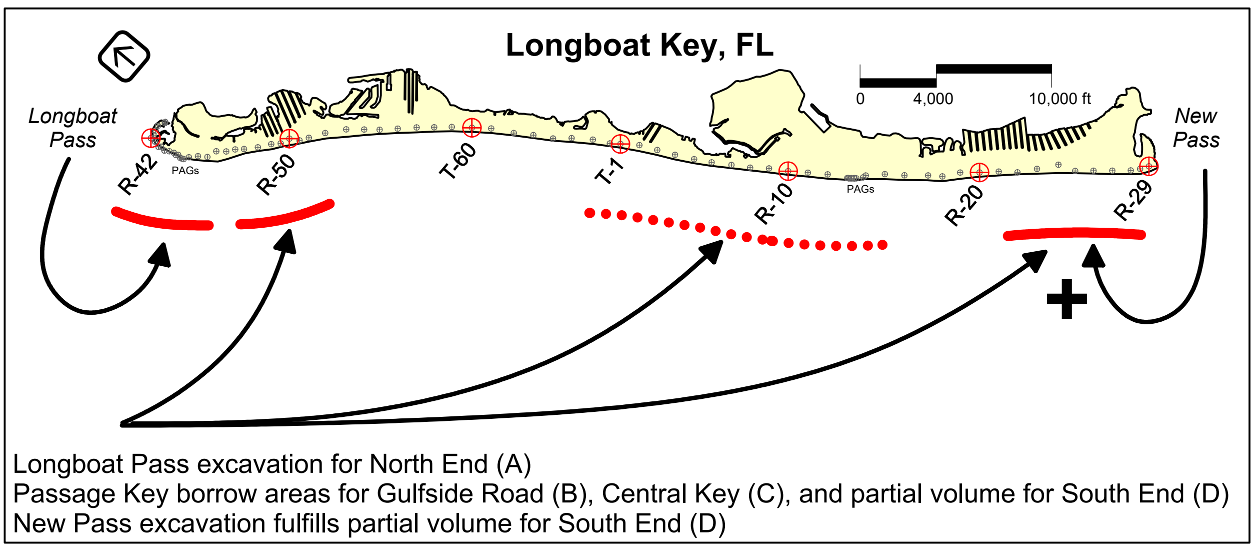


Figure 5.12 Construction Scenario 3 for the 2020/2021, 2021/2022 nourishment of Longboat Key, FL.

Table 5.4 Project Construction **Scenario #3** - 2020/2021 and 2021/2022

Description/ Method	**Sand Volume (cy)**	**Opinion of Unit Cost ($/cy)**	**Opinion of Segment Cost**
A* - *NORTH END *Dredge sand from Longboat Pass (w/ structural stabilization)*	*~200,000 cy*	*$22/cy*	*$10M budgeted 2020/2021* *Longboat Pass sand: $4.40M.(+strux)*
B **- Gulfside Road** Dredge Sand from Passage Key	113,000 cy	$50/cy	$5.65M
C **- Central Key** Dredge Sand from Passage Key	185,000 cy	$50/cy	$9.25M
D **- South End** Dredge Sand from Passage Key & Dredge sand from New Pass	114,000 cy	$50/cy	$5.70M
	200,000 cy	$22/cy	$4.40M
TOTAL	812,000 cy (89% of target)		*$10M: 2020/2021 project (Area A)* $25M: 2021/2022 project (Areas B, C, D)

Ultimately the selection of a construction scenario by the Town will be dependent upon numerous factors, including but not limited to the desire (or lack thereof) for employing upland truck haul delivery, the timing and availability of sediments from the two adjacent tidal inlets, and the ultimate budget figure provided for the project(s).

5.5 Construction Access

In all of the construction scenarios, access points are required for the transport of equipment to the project area. Limited access decreases project efficiency and can increase project cost. Overall, the Town has limited options for construction access along the Gulf shoreline. The following areas have been utilized for construction access to varying degrees in recent nourishment projects on Longboat Key:

- North Shore Road (~R-44.5),
- Broadway Street (R-45.5),
- Gulfside Road (R-50.5),
- Atlas Street (R-62.5),
- Buttonwood Cove (R-5),
- Longview Drive (T-6),
- Monroe Street (R-8),
- Seaplace (T-15),
- Colony/St. Regis (R-18),
- Beachplace (R-21),
- L'Ambiance (R-27), and
- Longboat Key Club Resort (R-28.5).

Several of these access points lie on private property and have been closed (to one degree or another). Sizable alongshore gaps exist between these access points. For examples, the gap between Gulfside Road and Atlas Street is 2¼ miles and the distance from Atlas Street to Buttonwood Cove is over 1½ miles. Recent development has also disqualified some of these areas for future construction access. For example, in 2016, the Colony property (R-18) provided an ideal access point for trucks, with sufficient space for queuing and two-way traffic. Since that time, the Colony infrastructure has been demolished and cleared and the St. Regis Hotel and Condominiums is under development.

Any access point that contains significant vegetation structures, utilities, etc., will decrease its practicality and increase the cost of post-construction restoration. Additionally, any future access on private property is not guaranteed. The Town is encouraged to identify potential areas for access and staging, particularly for the upcoming nourishment planned for 2021/2022.

<u>Trucking Considerations</u>

Construction access becomes particularly important for upland truck haul projects or dredging projects that incorporate a stockpile and trucking component. Efficiencies of truck haul projects are dependent upon the on-beach travel distance from access points and the resultant number of off-road vehicles needed to efficiently utilize the sand stockpile sites. The ideal spacing between access points will vary with truck cycle times, fill template densities, upland mine production, and contractor preferences.

The total area and width of an access point are likewise important factors for determining the utility of an access point. Sufficient acreage is needed to allow for equipment storage and/or truck queuing. Ideally, trucks would have an additional on-island waiting area so that the contractor could closely coordinate their arrival at the immediate stockpile area. Without sufficient space for queuing and truck arrival control, local traffic will be increasingly affected. Trucking projects may employ mats or conveyor systems to transport sand from an access point onto the beach.

6.0 FUNDING

Maintenance and monitoring of the Longboat Key beach projects are funded through a combination of local, State, and Federal sources. The amount of funding available from each entity depends on the project scope, economic efficiency, project beneficiaries, public access, and overall availability of funds.

6.1 Local Funding

Town of Longboat Key

In 2014, the Town redefined and reestablished by ordinance the two long-standing taxing districts on the island (A-Gulfside and B-Bayside) that provide dedicated funding for beach nourishment and maintenance projects. The Town levies ad valorem taxes to fund beach renourishment, protection, erosion prevention, operation, maintenance, and administrative support. The Gulfside District includes all properties that lie on the west side of Gulf of Mexico Drive. The Gulfside District is responsible for 80 percent of the combined millage rate for the districts. All other properties on the island are part of the Bayside District, which is responsible for the remaining 20 percent.

Manatee and Sarasota Counties

The Town has interlocal agreements with Manatee and Sarasota Counties, which provide Longboat Key with a share of the Tourist Development Tax. These funds are earmarked for beach nourishment costs. Recently, the Town has received an estimated annual contribution of $725,000.00 from Tourist Development Taxes. Of which, roughly 40% were from Manatee County and 60% were from Sarasota County.

6.2 State Cost-Sharing (FDEP)

State funds are available from the Florida Department of Environmental Protection Beach Management Funding Assistance Program. **Funds from this FDEP program are limited, subject to project ranking criteria, and to the Legislative appropriation process.** To be eligible for the program, a project must be designated by FDEP as a Critically Eroded Shoreline (per F.S. 161.101); located on the Gulf of Mexico, Atlantic Ocean, or Straits of Florida; and consistent with the Strategic Beach Management Plan. Eligible local governments apply annually for funding and are ranked in accordance with Rule 62B-36, F.A.C. Once the funds are appropriated from the Legislature, the State distributes the available funds to the top-ranked projects by entering into cost-sharing agreements with the local governments.

The entirety of the Longboat Key Gulf shoreline is designated as Critically Eroded and the monitoring and maintenance of the engineered beach is consistent with the Strategic Beach Management Plan. As such, the Town is eligible to receive cost-sharing assistance for design, construction, and monitoring tasks associated with beach restoration and maintenance. If the Town project(s) rank high enough to receive funding assistance, the level of cost-sharing assistance is determined to be half of the publicly-accessible shoreline length that meets the criteria above (calculated on a percentage basis from the overall project shoreline length). Publicly-accessible shoreline credits are generated from public parking areas, hotels, and State-licensed vacation/resort condominium units. In 2019, the calculation was revisited and roughly 54% of the project shoreline was determined to be publicly accessible. This update increased the State cost-sharing percentage from 22.79% to 26.94%. **Appendix D** displays the updated public access points and associated eligible shoreline lengths. Any increase in the future State cost-sharing percentage would require significant additions of public parking or significant increases in the numbers of licensed vacation/resort condominiums in currently low-access areas.

6.3 Federal Funding

Potential Federal funding mechanisms for the maintenance and management of the Town's Gulf beaches include those administered by the U.S. Army Corps of Engineers (USACE) and the Federal Emergency Management Agency (FEMA). The two funding sources are mutually exclusive. FEMA reimbursement funds may be available when the Town has incurred costs to repair storm damages, as outlined below. In general, USACE funds two types of beach nourishment projects (a) Hurricane / Storm Damage Reduction Projects (Shore Protection Projects) and/or (b) maintenance dredging of Federal navigation channels.

6.3.1 USACE

Federal Shore Protection Project

The Town has expressed interest to partner with the USACE in a feasibility study to evaluate the Longboat Key Gulf shoreline for Federal participation in maintaining portions of the beaches through a Federal Shore Protection Project. At the time of this writing, the USACE has requested Federal funding for the feasibility study. The entire Longboat Key shoreline was evaluated for Federal participation in the 1970s and 1980s. A portion of the shoreline in Sarasota County was previously authorized for Federal participation in the early 1980s but the Town elected not to pursue the project, due to the low Federal cost-share percentage, the necessity for additional studies, and the need for perpetual easements.

The approval and eventual construction of a Federal project is contingent upon numerous factors, including the Federal appropriations process, the level of public beach access under Federal rules, and the degree to which a project could reduce storm damages beyond existing conditions. Such studies, and eventual construction (if approved), take many years to complete (on the order of 8 to 15+ years). Based on the current land use and level of public access along the Longboat Key Gulf shoreline, it is opined that the probable cost-share percentage would be up to 23%. This estimate is consistent with previous reports by CPE (2011f). **Appendix E** provides a preliminary listing of the Gulf shoreline that could potentially qualify as publicly accessible by the USACE. If the project were to be funded by the USACE, the Town would forfeit FEMA disaster reimbursement funding, but gain eligibility for USACE Public Law 84-99 funding, which aides in post-storm rehabilitation of Federal projects.

Federally Authorized Navigation Channels

New Pass and Longboat Pass became Federally authorized navigation channels in 1964 and 1975, respectively. Between 1964 and 2002, the USACE financed the dredging of New Pass on eight occasions. Sand was deposited on the adjacent beaches of Lido Key and Longboat Key. Federal funding for the project ended in 2003. Similarly, the Corps conducted navigational maintenance dredging in Longboat Pass with Longboat Key and Anna Maria Island as the beneficiaries of the beach compatible dredge spoil. Longboat Pass was excavated by the Corps five times between 1977 and 1997. Federal funding has not been available for the project since the late 1990s. Today, the Town shares permits with Manatee County and the City of Sarasota (for the neighboring islands of Anna Maria Island and Lido Key, respectively) to utilize the passes as economical sources for beach nourishment sand, without Federal funding assistance. It is not anticipated that Federal funding will be available for navigational maintenance dredging and beach disposal in the future.

6.3.2 FEMA Post-Disaster Reimbursement

Eligibility

The Stafford Act and Title 44 of the Code of Federal Regulations (CFR) outline the requirements for Federal disaster assistance through FEMA. FEMA reimbursements typically amount to 75% of the costs to repair eligible storm-related damages (including associated engineering permitting costs). The Florida DEM likewise provides up to 12.5% of those same eligible costs[5]. The nourished beaches of Longboat Key currently qualify under FEMA guidelines as engineered beaches, and as such, are eligible for post-disaster funding assistance in the event the beaches are damaged in a declared storm event.

[5] It is common for local sponsors to construct a larger project that restores the storm damages plus places advance fill to account for typical background erosion. For example, storm damages on a given project shoreline may amount to 20% of the total desired sand volume. Frequently, FEMA provides reimbursement for this type of project on a pro-rated basis, where they cover 20% of the total cost (including 20% of the mobilization/demobilization fee).

FEMA eligibility requires that:

a) the beach is not a federally constructed shoreline under the specific authority of the U.S. Army Corps of Engineers (USACE);
b) the beach was constructed by the placement of imported sand—of proper grain size—to a designed elevation, width, and slope; and
c) the Town has established and adhered to a maintenance program involving periodic renourishment with imported sand to preserve the original design.

It is also noted that FEMA reimbursement assistance is only available when a disaster is declared in Manatee and/or Sarasota Counties.

Claims Process

In order to submit a FEMA claim for storm damages, the sand volume loss and cost of storm repairs must first be estimated by the Engineer. Sand volume losses are typically estimated by comparing beach profile surveys conducted pre- and post-storm (as close in time to the event as possible). The Town conducts annual profile surveys of the engineered beaches prior to hurricane season for this reason. After a storm hits and beach damage is perceived, rapid acquisition of post-storm surveys provides the best estimate of sand volume losses from the engineered beach limits[6]. For this reason, it is suggested that the Town consider contingency budgeting for a post-storm survey and analysis

Upon determination of the sand volume losses, an opinion of probable cost to repair the damages is prepared. Using the information provided in the Engineer's report, FEMA verifies the claim and creates a Project Worksheet (PW). The PW must then be approved at higher administration levels, and funds must be ultimately be obligated by FEMA. Once the Federal funds for the project have been obligated, FEMA sends the money to the Florida Department of Emergency Management (FL DEM, the State is considered to be the Grantee of these funds). The local sponsor (the Town), as subgrantee, then submits documentation of the expenses incurred for eligible storm repairs for review and eventual reimbursement.

[6] Note that FEMA considers the entire active beach profile to the depth of closure (including the submerged areas) when estimating volume losses. This is because sand deposited in the active profile may eventually migrate back onshore naturally. Frequently, storm-induced erosion of the upper beach is accompanied by deposition in the submerged profile. As such, the calculated net volume change eligible for a FEMA claim can be much less than what is measured or observed on the upper, visible portions of the beach.

Previous Funding

The Town has received FEMA funding from numerous declared disasters in the past, dating back to 1993 following completion of the original beach restoration project. Most recently, more than $7M of the costs of the 2016 Multi-Phase Beach Nourishment Project were reimbursed to the Town by FEMA and FL DEM for beach damages incurred during Tropical Storm Fay (2008), Hurricane Debby (2012), and Hurricane Hermine (2016). Through this Beach Management Plan Update, the Town will continue to diligently pursue storm damage claims when such events impact the engineered beaches. It is noted that no FEMA/FL DEM funds are anticipated to help finance the upcoming North End Structural Stabilization or the 2021/2022 renourishment project.

7.0 PERMITS

Table 7.1 summarizes the Joint Coastal Permits (JCPs) for construction along the Longboat Key Gulf of Mexico shoreline. The JCPs issued by the Florida Department of Environmental Protection each have corresponding Federal permits issued by the U.S. Army Corps of Engineers.

7.1 Active Permits

At present, the Town of Longboat Key holds several permits that allow for sand placement from the northern limit of the Gulf shoreline (~R-42 in Manatee County) to the southern limit at the New Pass terminal groin (~R-29 in Sarasota County). The permits allow for nourishment sand from several sources, including approved upland mines, inlet shoal borrow areas, and offshore borrow areas (see **Section 4**). Generally, the permitted beach fill templates include sand placement between the elevations of +6 ft NAVD88 and -6 ft NAVD88. In some segments of the shoreline, the toe of fill may reach elevations of -15 ft NAVD88 or deeper. No dune construction is currently authorized by the permits. Of the available sand placement permits, only one (JCP #0298107-002-JC) allows for nearshore disposal of sand, that being from the WCIND Longboat Pass flood shoal sand traps. The Town also holds permits #0300119-004-JC and #0255697-002-JC that allow for modification of the Permeable Adjustable Groin (PAG) structures at the North Shore Road and Islander Club sites, respectively.

The Town recently received a 5-year time extension of the Longboat Key Nourishment permit (JCP #0296464-010-JN), which now permits construction up to 26 October 2026. The corresponding Department of Army Permit #SAJ-2009-03350 (IP-MEP) expires in 2023. The Town is currently seeking a similar time extension of the Federal permit to 2026.

Table 7.1 Active Joint Coastal Permits for sand placement along Longboat Key, FL

ID Number	Name	Permittee(s)	Issue Date	Expiration Date	Description
0296464-001 (as modified) [SAJ-2009-03350 (IP-MEP)]	Longboat Key Nourishment	Town of Longboat Key	26 OCT 2011	26 OCT 2026	Sand placement from borrow areas F2, B3, IX, and X, and upland sources between R-42 in Manatee County to R-29 in Sarasota County
0300119-001 [SAJ-2010-01056 (IP-MEP)]	Longboat Key North End Nourishment	Town of Longboat Key	13 SEP 2010	13 SEP 2020	Sand placement along the shoreline from R-44 to R-47.5 in Manatee County from Borrow Area IX
0300119-004 [SAJ-2012-01018 (SP-MEP)]	Longboat Key North End Structural Stabilization	Town of Longboat Key	31 JAN 2014	31 JAN 2024	Construction of two concrete Permeable Adjustable Groins (PAGs) and sand placement as needed from previously authorized upland sources between R-42 and R-45 in Manatee County
0300119-007 [USACE DA pending]	Longboat Key North End / Greer Island Structural Stabilization	Town of Longboat Key	30 AUG 2019	30 AUG 2034	Will allow for the construction of three permeable rock groins and sand placement between R-42 and R-44.7 in Manatee County (north of the existing PAGs). Sand sources include previously authorized upland sand and the Longboat Pass borrow area.
0300119-008 [USACE DA pending]	Longboat Key Longbeach / Broadway Structural Stabilization	Town of Longboat Key	30 AUG 2019	30 AUG 2034	Will allow for the construction of two permeable rock groins and sand placement between R-44.4 and R-46 in Manatee County (south of the existing PAGs). Sand sources include previously authorized upland sand and the Longboat Pass borrow area.
0298107-002 (modification -008-JN) [SAJ-2011-02907 (SP-MEP)]	Longboat Pass Flood Shoal Impoundment Basins	West Coast Inland Navigation District*	5 DEC 2012	5 DEC 2027	Excavation of two “sand trap” areas of the Longboat Pass flood shoal with sand placement on the beach and/or a nearshore disposal site at Longboat Key between R-44 and R-48 in Manatee County
0298107-004 [SAJ-2014-00606 (SP-CSH)]	Longboat Pass Navigational Maintenance Dredging & Beach Nourishment	Town of Longboat Key & Manatee County*	19 MAR 2015	19 MAR 2030	Dredging of the Longboat Pass channel for placement along the northern shoreline of Longboat Key between R-43.5 and R-50.5 in Manatee County
0255697-002 (as modified) [SAJ-2005-9068 (IP-MFN)]	Longboat Key Permeable Adjustable Groins	Town of Longboat Key	18 FEB 2009	Maintenance phase does not expire	Construction of two concrete Permeable Adjustable Groins (PAGs) at the Islander Club Condominium at R-13 to R-13.5 (approx.) in Sarasota County. The maintenance phase allows for monitoring and adjustment of the groins as necessary.
0039755-003 [SAJ-2009-03350 (IP-MEP)]	Longboat Key and Lido Key Beach Nourishment	Town of Longboat Key & City of Sarasota*	2 JULY 2015	2 JULY 2030	Beach nourishment from excavation of the New Pass ebb shoal, within and adjacent to the federally-authorized navigation channel. Alongshore placement limits on Longboat Key are between R-20 and R-29 in Sarasota County

*Sand placement shared with adjacent shoreline

7.2 Pending Applications

At present, the Town of Longboat Key is pursuing two permit modifications that would allow sand placement and the construction of three permeable rock groin structures between R-42 and R-44.7 (North End / Greer Island Structural Stabilization) and two structures between R-44.4 and R-46 in Manatee County (Longbeach / Broadway Structural Stabilization). The proposed extension of the north end groin field and corresponding beach fill are intended to reduce the ongoing severe erosional stress experienced along the North End of Longboat Key. The permeable rock groin structures will protect upland infrastructure and natural resources in the area and reduce the demand for beach nourishment sand.

Permit modifications from FDEP have been received for JCP #0300119 (-007-JM) and (-008-JM), while corresponding modifications to the USACE Department of Army Permit #SAJ-2012-01018-CSH are still pending. FDEP permit modification 0300119-007-JM includes the three northern structures, while 0300119-008-JM includes the structures south of the existing PAGs.

7.3 Future Permitting

Prior to the expiration of JCP #0296464 (October 2026), it is advised that the Town seek a similar permit (or major permit modification) to continue to perform periodic maintenance nourishment of the Gulf of Mexico shoreline from R-42.5 in Manatee County to R-29 in Sarasota County. The acquisition of a new island wide permit may take 2-3 years.

As mentioned previously, the Town plans to rehabilitate the terminal groin at New Pass in the near future. Tightening the structure will require approval from the regulatory agencies. However, if the footprint of the structure is not expanded and construction operations do not negatively impact endangered species, permitting may be relatively expedient.

Acquiring permits to remove dune vegetation to gain beach width, perhaps through a Coastal Control Line Permit, is not likely to be successful and is not recommended. Vegetated dunes offer a significant level of protection to the upland infrastructure. For this reason, FDEP protects and limits manipulation of these resources. Any local proposals for dune enhancement, such as the installation of sand fencing or additional sea oats, etc., should be carefully considered in the context of the degree of vegetation that already exists in a particular location. On the contrary, it is recommended that gaps in the primary dune line should be infilled where practicable and replanted to limit storm overwash and wave intrusion. Additionally, the construction of dune walkovers is encouraged to limit damage to the dunes via pedestrian traffic.

7.4 Easements for Beach Nourishment Activities

In association with the nourishment permits, the Town holds long-term easements over the Gulf-front placement areas. The majority of the current easements expire in late 2021. **Renewal of the easements is a priority for the Town to continue the beach management program.** While the original easements obtained in 2011 implemented a 10-yr term, it is recommended that language be considered that would allow the easements to run for the life of actively held beach nourishment permits.

8.0 PHYSICAL & ENVIRONMENTAL MONITORING REQUIREMENTS

Each of the permits in the previous section contains requirements for beach monitoring to track the physical performance of various sand placement and structural stabilization projects. The Town of Longboat Key merged the physical monitoring requirements of the various beach project segments into one comprehensive plan in 2016, prior to the construction of the multi-phase renourishment. The State-approved plan allows data collection, analysis, and reporting to occur island-wide, rather than in a fragmented manner with multiple project segments on varying schedules. The current plan calls for annual beach profile surveys of the Gulf shorelines, with biennial detailed analyses of beach performance, consistent with project permits. Other localized requirements for MHWL surveys, aerial photography, etc., are incorporated into the Comprehensive plan as needed. In addition, the permits include ongoing environmental monitoring requirements to track sea turtle nesting, shorebird activity, and the condition of hardbottom and artificial reef areas. Many of these requirements terminate two to three years following construction activities.

8.1 Physical Monitoring

The current physical monitoring requirements for the Gulf of Mexico shoreline are enumerated in the Comprehensive Physical Monitoring Plan for the Town of Longboat Key, dated 25 February 2019. **Figure 8.1** shows the location of the various projects with ongoing physical monitoring requirements that are included in the comprehensive plan. As future projects are constructed, the State may require minor updates to the plan. The purpose of the physical monitoring plan is to:

- meet the regulatory requirements of the permits,
- evaluate the post-construction performance of the beach and borrow area(s) (as applicable),
- function as an important database for purposes of future beachfront development, planning, or management activities,
- fulfill the requirements of FEMA with respect to Category 'G' disaster relief eligibility by documenting both the construction of the engineered beach renourishment projects and the condition of the beach prior to a future major storm event, and
- provide design guidance for future beach maintenance activities along the Gulf of Mexico shorefront in Manatee and Sarasota Counties.

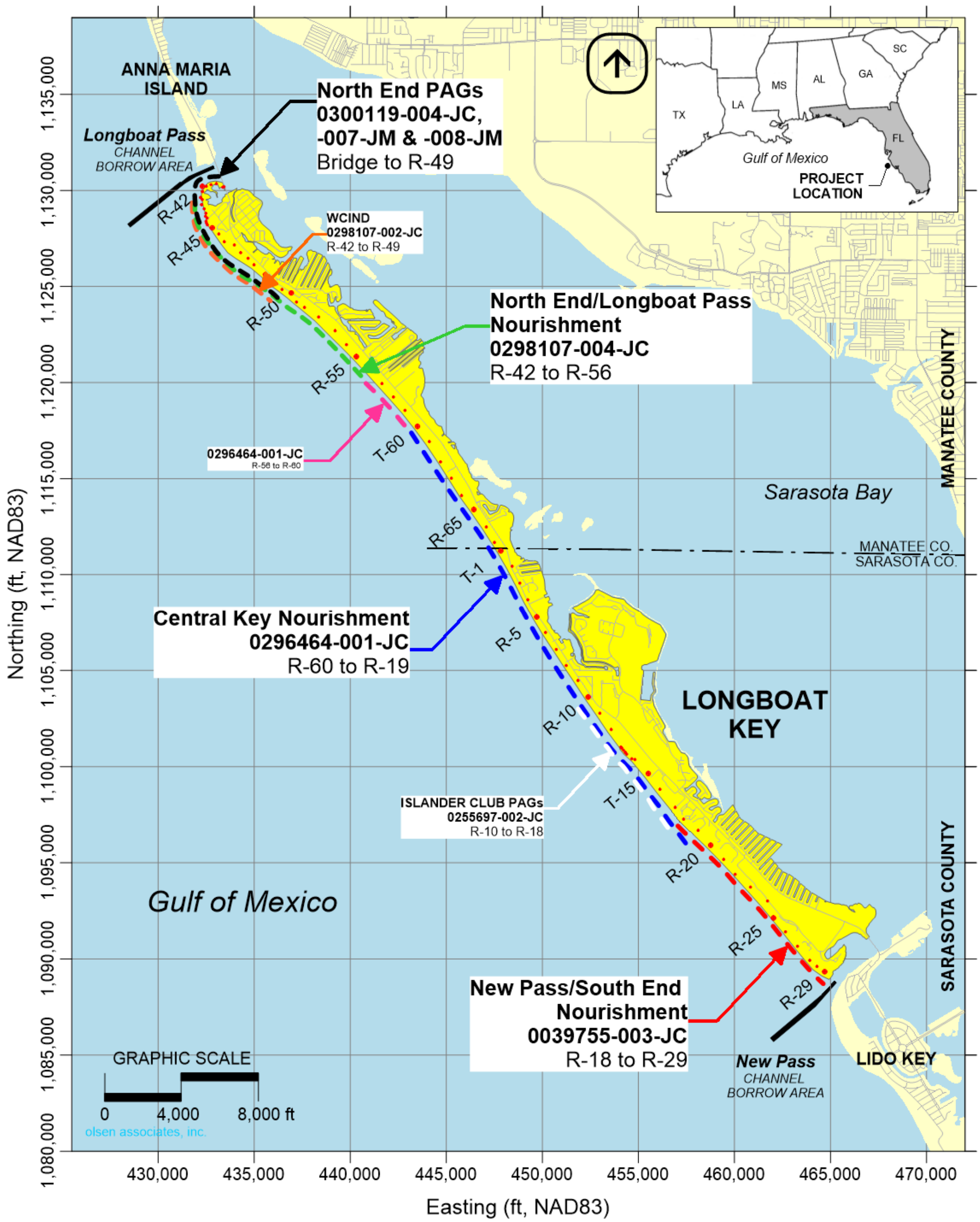


Figure 8.1 Active monitoring limits for the various projects constructed (or planned) along the Longboat Key, FL, Gulf of Mexico shoreline.

The monitoring plan includes five basic elements:

- comprehensive surveys of the beaches and borrow area (if applicable) by a qualified hydrographic surveyor,
- controlled digital aerial orthoimagery,
- survey of the Mean High Water Line (MHWL) in the vicinity of the existing North End structures and recommendations on structural adjustments,
- analysis of annual beach changes and maintenance of the cumulative comparative database, and
- formulation of a detailed *Biennial Report of Findings* for consideration by the Town of Longboat Key, State and Federal agencies, and the general public.

Beach Profile Surveys

The comprehensive plan typically requires the collection of beach profile surveys immediately before and after construction, one year following construction, and on a biennial post-construction basis throughout the life of the projects. In order to effectively consolidate the monitoring requirements, island-wide surveys of the Longboat Key Gulf shoreline are sometimes shifted slightly from the strict annual/biennial schedule. It is recommended that the Town perform a comprehensive beach profile survey in late spring/early summer each year, to document the condition of the shoreline prior to tropical storm season. At present, the monitoring program includes the collection of at least 85 shore-perpendicular beach profiles along the island, including intermediate surveys near the concrete groin structures.

Borrow Area Surveys

Surveys of project borrow areas are typically required pre-construction, post-construction, and three years post-construction. For the New Pass and Longboat Pass channel borrow areas, a pre-construction survey of the entire inlet system is also required per the comprehensive plan. The Town recently utilized the New Pass and Longboat Pass channel borrow areas for construction in 2016 and acquired pre- and post-construction surveys at that time. The year-3 post-construction (2019) surveys were performed by the neighboring project sponsors for Lido Key (New Pass) and Anna Maria Island (Longboat Pass). The Town is not required to perform further survey of any borrow area until the next construction project.

Aerial Imagery

Aerial orthoimagery is generally only required in the areas of newly constructed structures. The Town may choose to collect controlled aerial imagery of the entire island for physical monitoring as deemed useful.

MHWL Surveys

Mean High Water Line (MHWL) surveys are required on the north end of the island to monitor the performance of the North Shore Road structures. These surveys occur on the same annual/biennial schedule as the beach profile surveys. The project-specific physical monitoring plan for the Islander Club PAGs was superseded by the Comprehensive Physical Monitoring Plan, thereby eliminating the requirement to perform a detailed MHWL survey in the vicinity of those structures.

8.2 Biological Monitoring

The beaches of Longboat Key are important habitat for several endangered / threatened species of shorebirds and sea turtles. As such, island-wide surveys of shorebirds and nesting sea turtles are collected to document the presence and numbers of these species, and to monitor any adverse impacts due to beach nourishment and coastal structure construction. **Table 8.1** summarizes the environmental monitoring requirements from the active permits in **Section 7.0**.

Shorebirds

The breeding season for Longboat Key is February 15 to September 1. Any construction project that occurs during this time requires daily shorebird surveys along the project length. In addition, the USFWS Piping Plover Programmatic Biological Opinion (P3BO) mandates bimonthly surveys of the project shoreline during the migration and wintering season from July 15 through May 15. These surveys are required for two years following the construction of a beach nourishment project.

Sea Turtles

Due to the high density of sea turtle nests on the island, the Town conducts sea turtle nest monitoring along the Gulf shoreline every year. When a project is constructed, typical requirements for the protection of sea turtles include: daily clearance for construction operations (if construction occurs during nesting season) with nest relocation where required, post-construction compaction sampling and/or beach tilling, escarpment surveys along the length of the project, and post-construction lighting surveys. Sea turtle nest monitoring is performed daily from April 15 through November 15 (or the end of nesting/hatching activities). Post-construction monitoring is typically required by permit for 2 years following a nourishment event. Year-3 post-construction sea turtle nest monitoring may be required if the target criteria enumerated in the permits are not met.

Hardbottom / Reef Resources

Hardbottom features exist in the nearshore areas along the Longboat Key shoreline. In particular, an area of both natural hardbottom and artificial reef resources is located offshore of the north end of Longboat Key, in the vicinity of Gulfside Road (R-48.5 to R-52 in Manatee County). From the permitting process for multiple projects (see above), hardbottom/reef monitoring is required when sand is placed between R-45.5 and R-55. The monitoring is required pre-construction, post-construction and for three subsequent years after every nourishment event. The most recent sand placement in this area occurred during the 2016 Longboat Pass Dredging and Beach Nourishment Project. The Town is currently committed to one more year (2020) of post-construction hardbottom monitoring for that project. The 2020 survey will likely also serve as a pre-construction survey for future work. A detailed description of the required surveys and methods are included in the Hardbottom Monitoring Plan for the Town of Longboat Key (CPE, 2011e, Rev. 2019).

Table 8.1 Biological monitoring requirements associated with sand placement along Longboat Key, FL

Requirement	**Monitoring Schedule**	**Season / Date**	**Permit(s)**	**Notes**
Hardbottom Monitoring	Pre-Construction Yr-1 Post-Construction Yr-2 Post-Construction Yr-3 Post-Construction	Late Summer	0298107-004-JC 0296464-001-JC	Triggered by and placement between R-45.5 and R-55 in Manatee County
Sea Turtle Nest Monitoring	Construction Post-Construction Yr-1 Post-Construction Yr-2 Post-Construction	Apr 15 to Nov 15	all	Daily If construction occurs during nesting season, daily clearance is required from sea turtle nest monitor Town historically performs annual monitoring
Shorebird Monitoring	Pre-Construction (if in season) Yr-1 Post-Construction Yr-2 Post-Construction	Feb 15 to Sep 1 (breeding) July 15 to May 15 (wintering)	all	Bimonthly post-construction wintering surveys If construction occurs during breeding season, **daily** surveys should be performed, commencing 10 days prior to construction
Lighting Surveys	Construction Post-Construction Yr-1 Post-Construction Yr-2 Post-Construction	May 1 to Aug 1	all	Two surveys are required (1) between May 1 and May 15 (2) between July 15 and Aug 1
Escarpment Surveys	Post-Construction Yr-1 Post-Construction Yr-2 Post-Construction Yr-3 Post-Construction	Mar 15 to Apr 15; Feb 15 to Nov 15	all	Visual survey and scarp removal Weekly visual surveys during sea turtle nesting and shorebird seasons
Compaction Sampling and/or Beach Tilling	Post-Construction Yr-1 Post-Construction Yr-2 Post-Construction Yr-3 Post-Construction	Prior to Apr 15	all	If compaction exceeds threshold values, tilling is required. Compaction measurements can be waived if tilling is performed.

9.0 RECOMMENDATIONS

Based upon the analyses and information provided herein, the following observations and recommendations are provided for consideration by the Town for continued maintenance of its engineered beach resources.

- Maintain funding eligibility from FDEP, FEMA, and FL DEM, and ensure permit compliance by continuing physical monitoring, biological monitoring, and maintenance renourishment. Thoroughly document all construction activities.

- Construct the North End Structural Stabilization Project and a comprehensive renourishment project, in 2020/2021 and 2021/2022, to maintain the Gulf beaches and address segments of shoreline located landward of the Town's design MHWL, as of the most recent 2019 survey. **Figure 9.1** depicts the 2019 MHWL relative to the Town's baseline (updated herein) and design MHW shoreline. The figure denotes four key areas of need, where the design beach width is currently not achieved (areas in red):
    - Beach Area A (Northern shoreline from Greer Island to Broadway Street)
    - Beach Area B (Gulfside Road)
    - Beach Area C (Central Key)
    - Beach Area D (South End)

- Initiate renewal of sand placement easements along the entire Gulf shoreline. Most of the current easements will expire in 2021. It is also recommended that the Town identify and secure potential construction access points.

- Future beach renourishment of the Longboat Key project shoreline will require additional sand resources. As such, the development of offshore borrow area(s) is deemed a critical need. Examination of the existing geotechnical data collected offshore of Longboat Key does not reveal an ideal combination of color, grain size, and sediment composition. It is recommended that the Town initiate the collection of additional data to locate a suitable sand resource.

<u>Recommendations by Beach Management Segment</u> - Recommendations for each of the nine beach management segments depicted in **Figure 9.2** are provided in **Table 9.1.** These recommendations are tailored to each segment's unique physical processes, historical trends in shoreline and volume change, upland development, and management objectives.

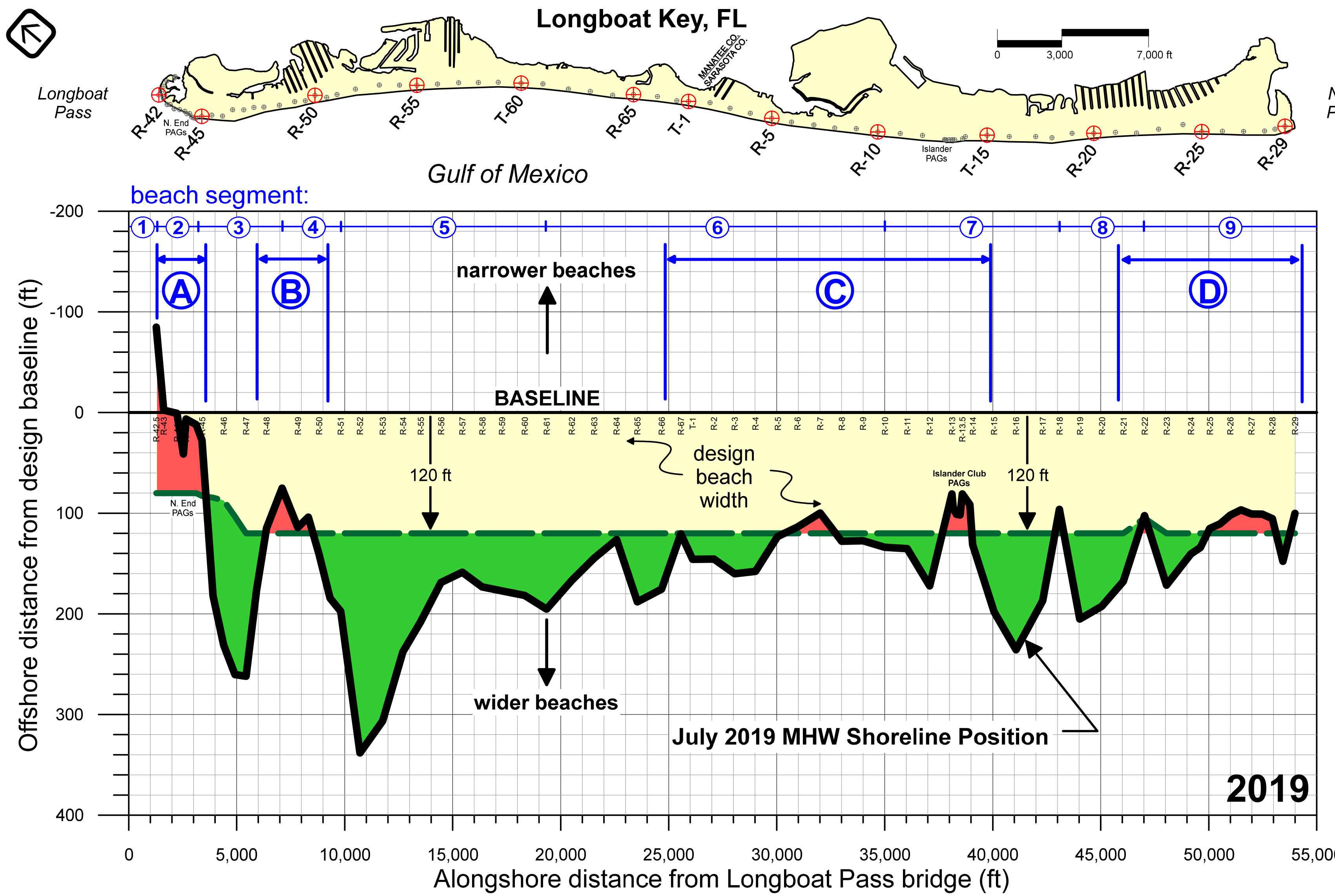


Figure 9.1 Position of the June/July 2019 MHWL relative to the updated design beach baseline and beach width, Longboat Key, FL. Labels in blue indicate beach management section numbers 1-9 and proposed beach renourishment areas A-D, planned for construction in 2021/2022.

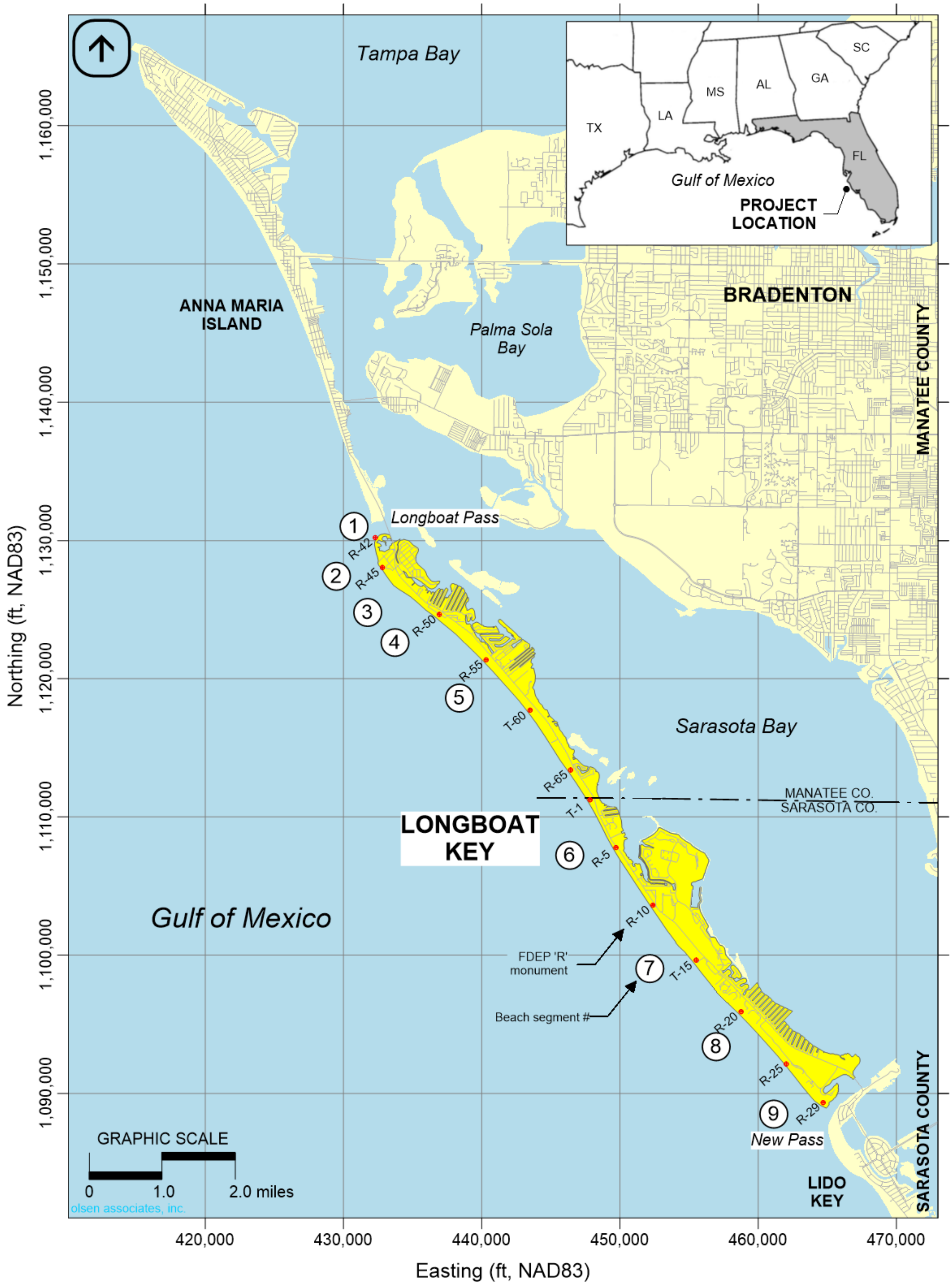


Figure 9.2 Location map of the nine beach management segments along Longboat Key, FL.

Table 9.1 2019 Segment-specific Beach Management Plan Recommendations
Town of Longboat Key, FL

Beach Segment	Northern Limit	Southern Limit	Recommended Actions and Plan
1	Longboat Pass Bridge	R-42.5	• Greer Island/ lagoon: Evaluate options for Canal 1A and spit shoaling • Place excavated beach-compatible material in stabilized areas of the Gulf shoreline

2	R-42.5	R-44.9	• Construct Greer Island / North End Structural Stabilization:
			    • Three permeable rock groins and beach fill
			    • Sand fill from Longboat Pass or upland sand (truck haul)
			• Adjust the permeability of PAGs and rock groins as needed
			• Periodic maintenance fill every 8 years of the groin field concurrent with comprehensive Longboat Key renourishment
			• Adjust the baseline landward to reflect realistic shoreline position following groin field expansion

3	R-44.9	R-48.5	• Construct Longbeach / Broadway Structural Stabilization:
			    • Two permeable rock groins and beach fill
			    • Sand fill from offshore or upland sand (truck haul)
			• Periodic maintenance fill every 8 years of the groin field concurrent with comprehensive Longboat Key renourishment

4	R-48.5	R-51	• Gulfside Road renourishment in 2021/2022 • Sand fill from offshore or upland sand (truck haul) • Periodic maintenance nourishment every ~3-4 years, concurrent with comprehensive Longboat Key renourishment when possible • Adjust the baseline landward to reflect realistic shoreline position
5	R-51	R-61	• No immediate action, continue monitoring
6 / 7	R-61	R-18	• Central Key renourishment in 2021/2022 (R-66 to R-15) • Sand fill from offshore or upland sand (truck haul) • Periodic nourishment (~8 year renourishment interval)
8 / 9	R-18	New Pass	• New Pass renourishment in 2021/2022 or earlier (R-21 to R-29) • Periodic nourishment (~6-8 year renourishment interval) • Tighten terminal groin

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The baseline and design shoreline of CPE (2008) were updated to reflect the current shoreline orientation of the north end of the island and create a more realistic design target in the vicinity of the 6633 Gulf of Mexico Drive seawall. **Table A-1** lists the coordinates of the updated baseline. The design Mean High Water (MHW) shoreline is located 80 to 120 ft Gulfward of the baseline. The narrower design width of 80 ft is exclusive to the north end of the island, where erosion rates are very high relative to the rest of the Longboat Key shoreline.

Table A-1 Coordinates of the baseline along the Longboat Key Gulf of Mexico shoreline from R-42.5 in Manatee County to the terminal groin at New Pass in Sarasota County.

	Easting (ft, NAD83)	Northing (ft, NAD83)		Easting (ft, NAD83)	Northing (ft, NAD83)
1	432,303.90	1,129,945.83	**32**	451,238.00	1,105,251.00
2	432,497.95	1,128,397.37	**33**	451,793.00	1,104,431.00
3	432,564.00	1,128,200.00	**34**	452,358.00	1,103,599.00
4	433,448.00	1,127,337.00	**35**	452,928.00	1,102,729.00
5	434,214.00	1,126,627.00	**36**	453,549.00	1,101,900.00
6	434,906.90	1,126,030.64	**37**	454,084.00	1,101,016.00
7	436,004.04	1,125,086.37	**38**	454,223.33	1,100,852.82
8	436,790.56	1,124,500.09	**39**	454,386.73	1,100,645.96
9	437,605.00	1,123,893.00	**40**	454,509.00	1,100,518.00
10	438,380.00	1,123,445.00	**41**	454,580.00	1,100,463.00
11	439,143.00	1,122,639.00	**42**	454,698.00	1,100,386.00
12	440,316.00	1,121,352.00	**43**	454,769.00	1,100,371.00
13	440,936.00	1,120,626.00	**44**	454,792.00	1,100,349.00
14	441,582.00	1,119,889.00	**45**	455,469.00	1,099,608.00
15	442,199.00	1,119,208.00	**46**	456,124.00	1,098,818.00
16	442,800.00	1,118,495.00	**47**	456,876.00	1,097,847.00
17	443,445.00	1,117,673.00	**48**	457,298.00	1,097,200.00
18	444,051.00	1,116,860.00	**49**	458,043.00	1,096,628.00
19	444,696.00	1,115,870.00	**50**	458,735.00	1,095,891.00
20	445,242.00	1,115,001.00	**51**	459,410.00	1,095,145.00
21	445,788.00	1,114,113.00	**52**	460,033.00	1,094,396.00
22	446,403.00	1,113,370.00	**53**	460,774.00	1,093,692.00
23	447,031.00	1,112,446.00	**54**	461,483.00	1,092,845.00
24	447,488.00	1,111,666.00	**55**	462,022.00	1,092,130.00
25	447,797.00	1,111,215.00	**56**	462,025.00	1,092,127.00
26	448,269.00	1,110,364.00	**57**	462,614.00	1,091,373.00
27	448,747.00	1,109,521.00	**58**	463,219.00	1,090,605.00
28	449,152.00	1,108,650.00	**59**	463,863.00	1,089,879.00
29	449,654.00	1,107,741.00	**60**	464,656.00	1,089,282.00
30	450,127.00	1,106,950.00	**61**	465,042.00	1,089,105.00
31	450,682.00	1,106,065.00			

Figure A.1 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

Figure A.2 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

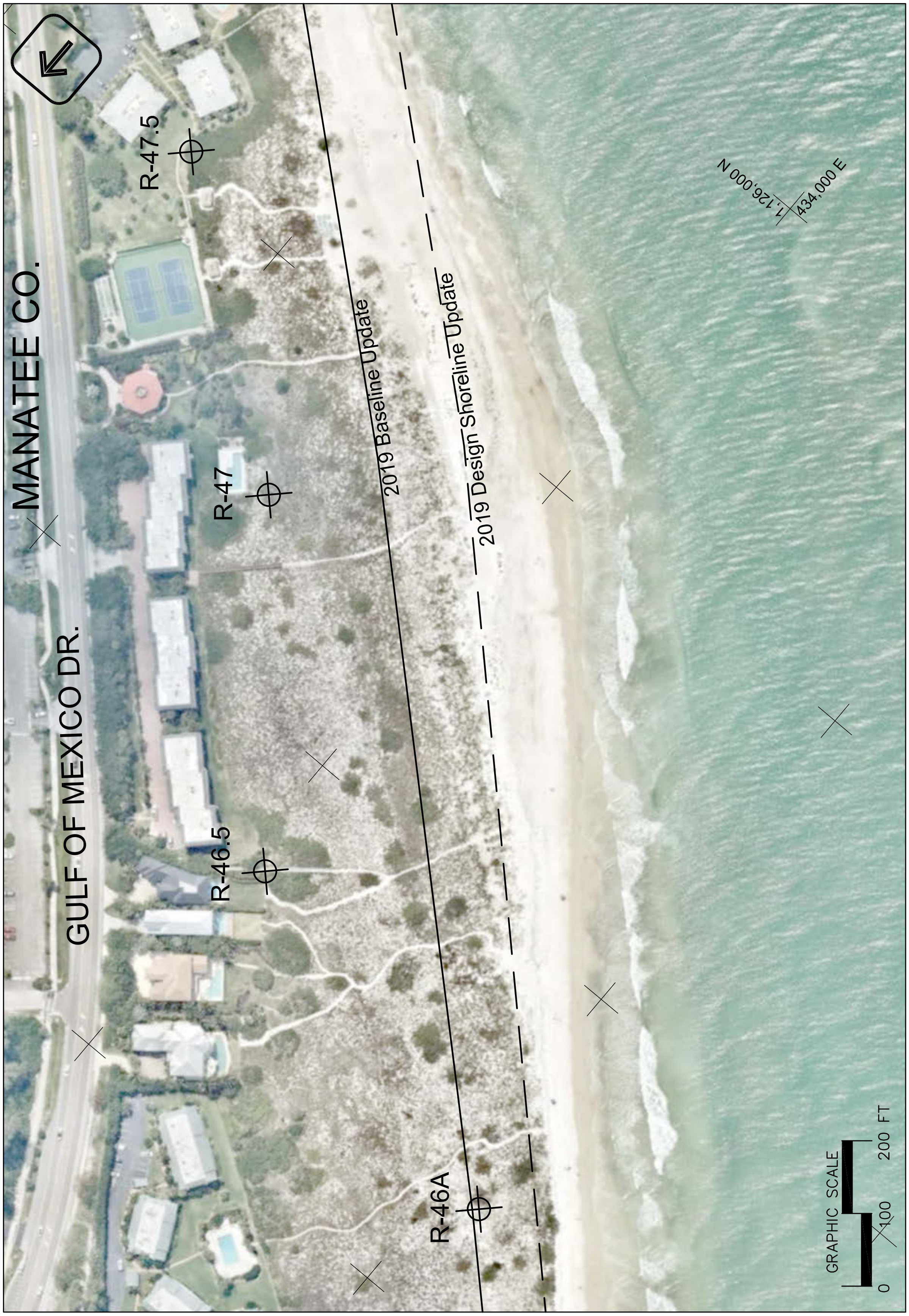

Figure A.3 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

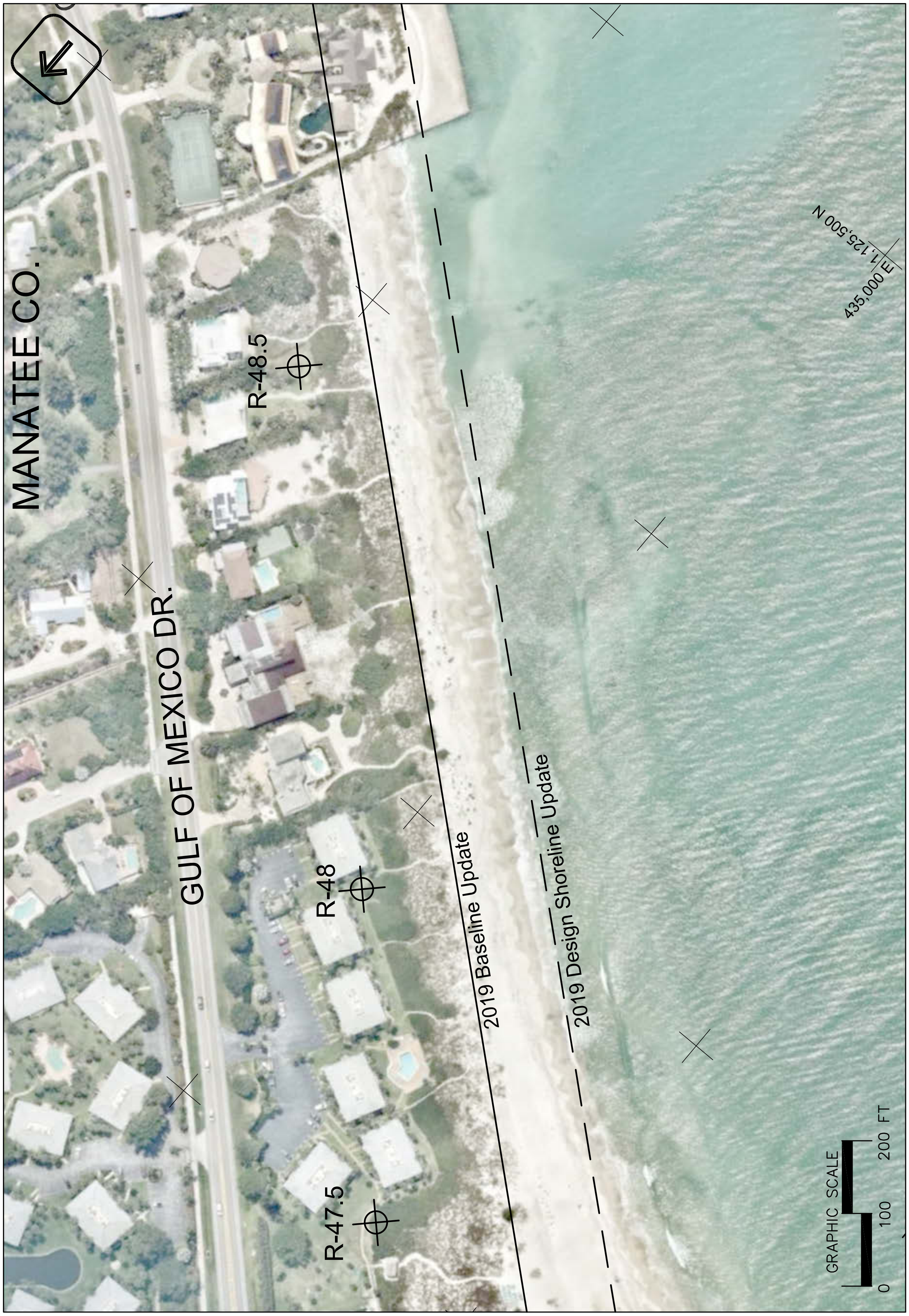

Figure A.4 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

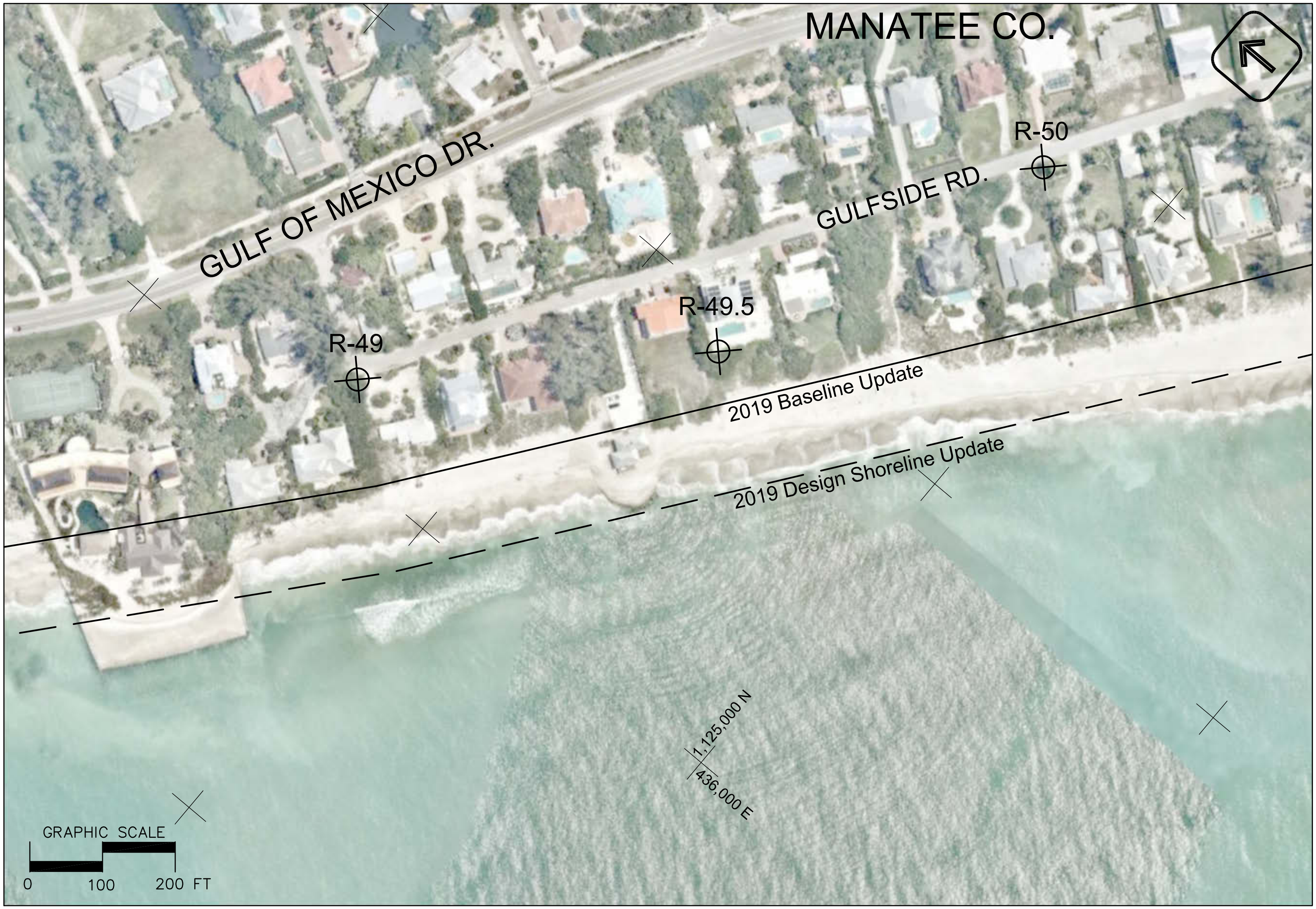

Figure A.5 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

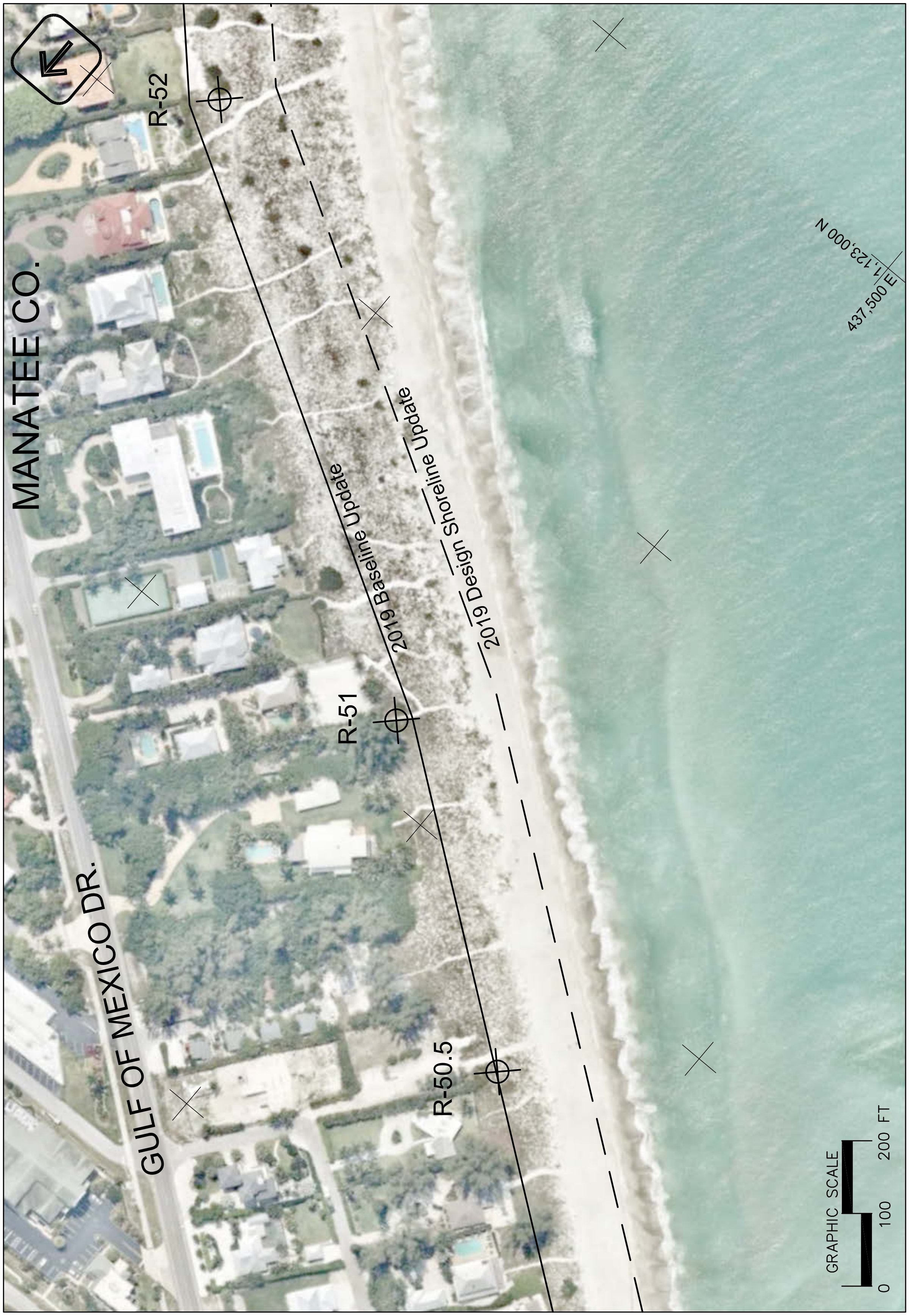

Figure A.6 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

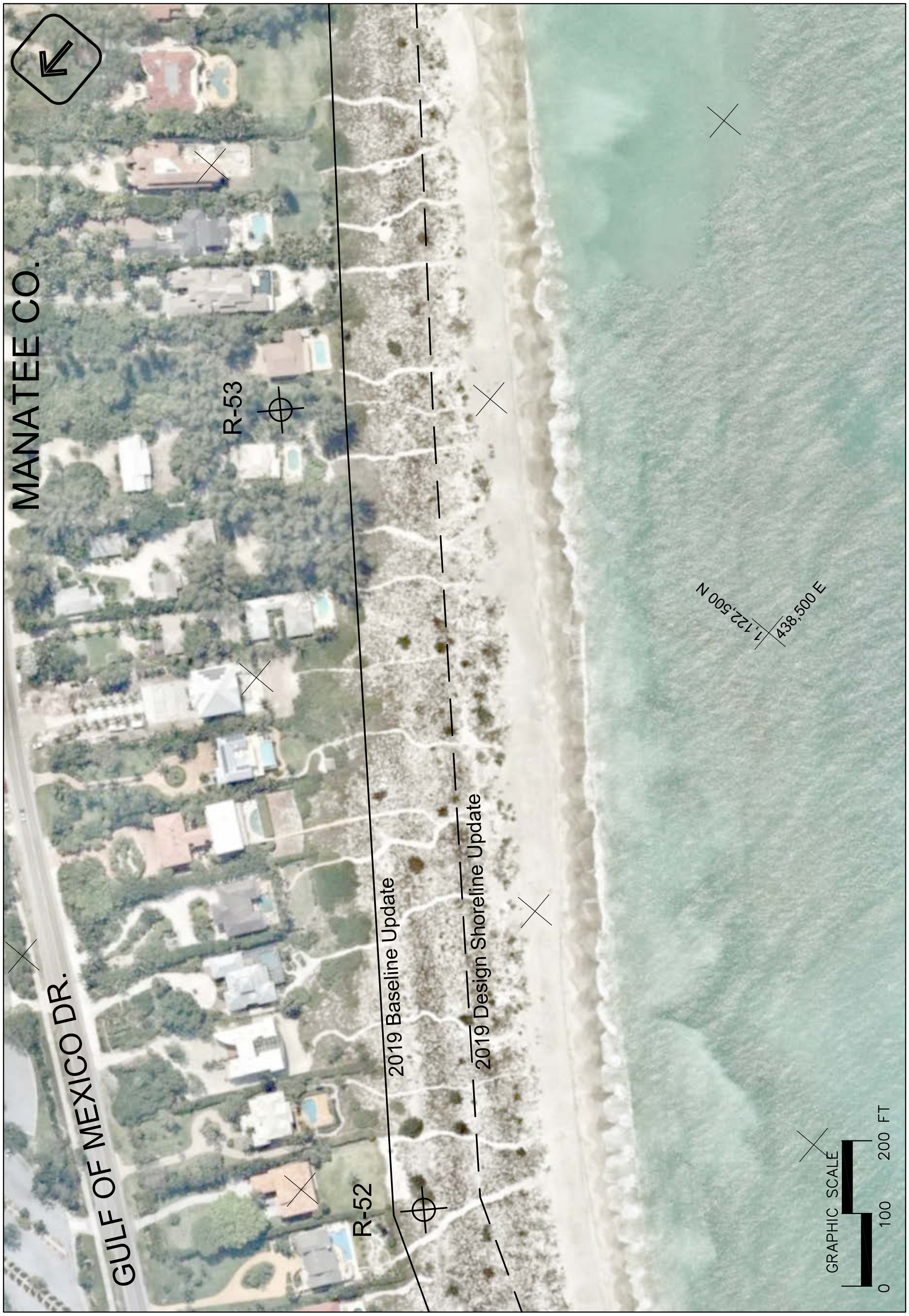

Figure A.7 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

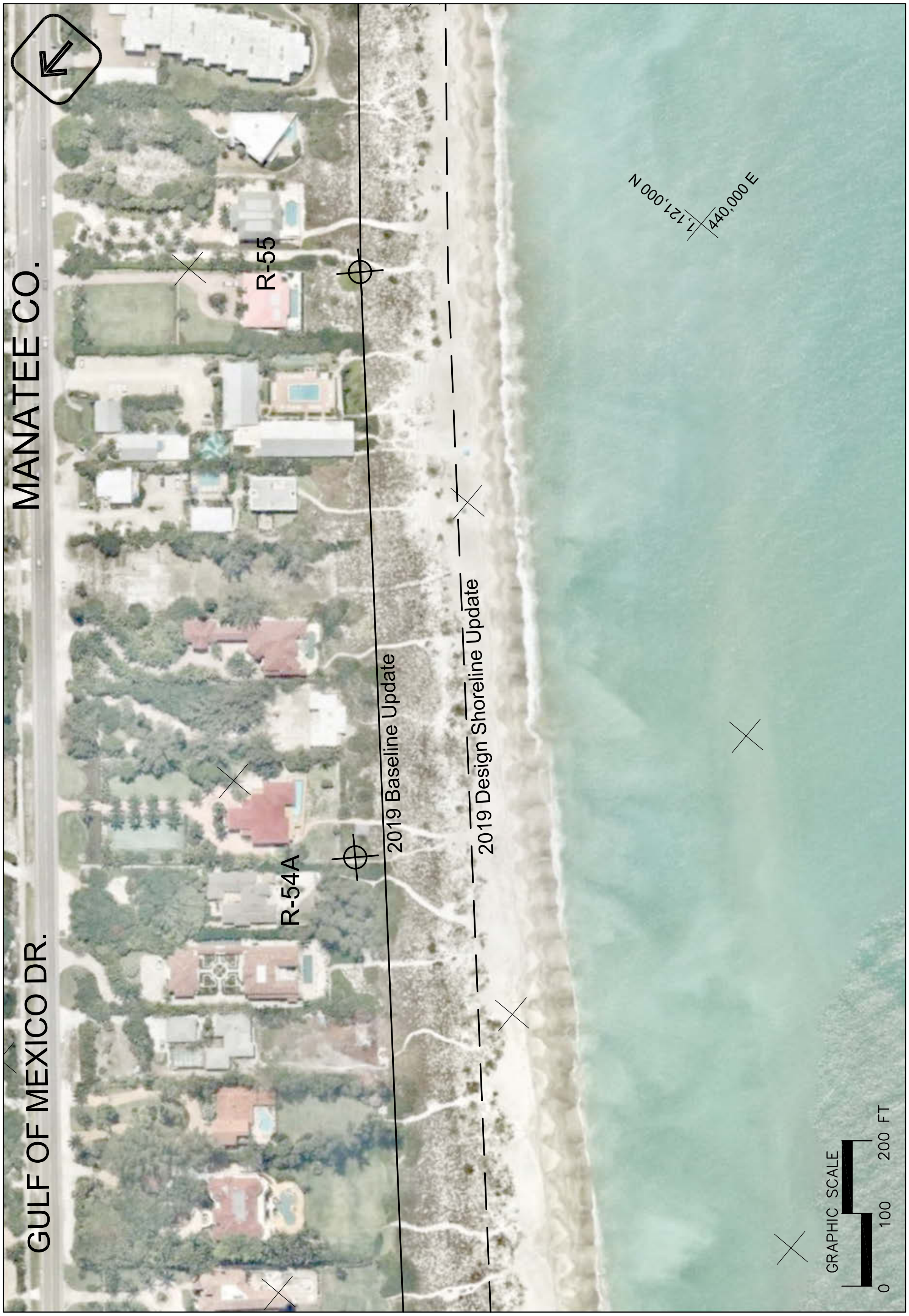

Figure A.8 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

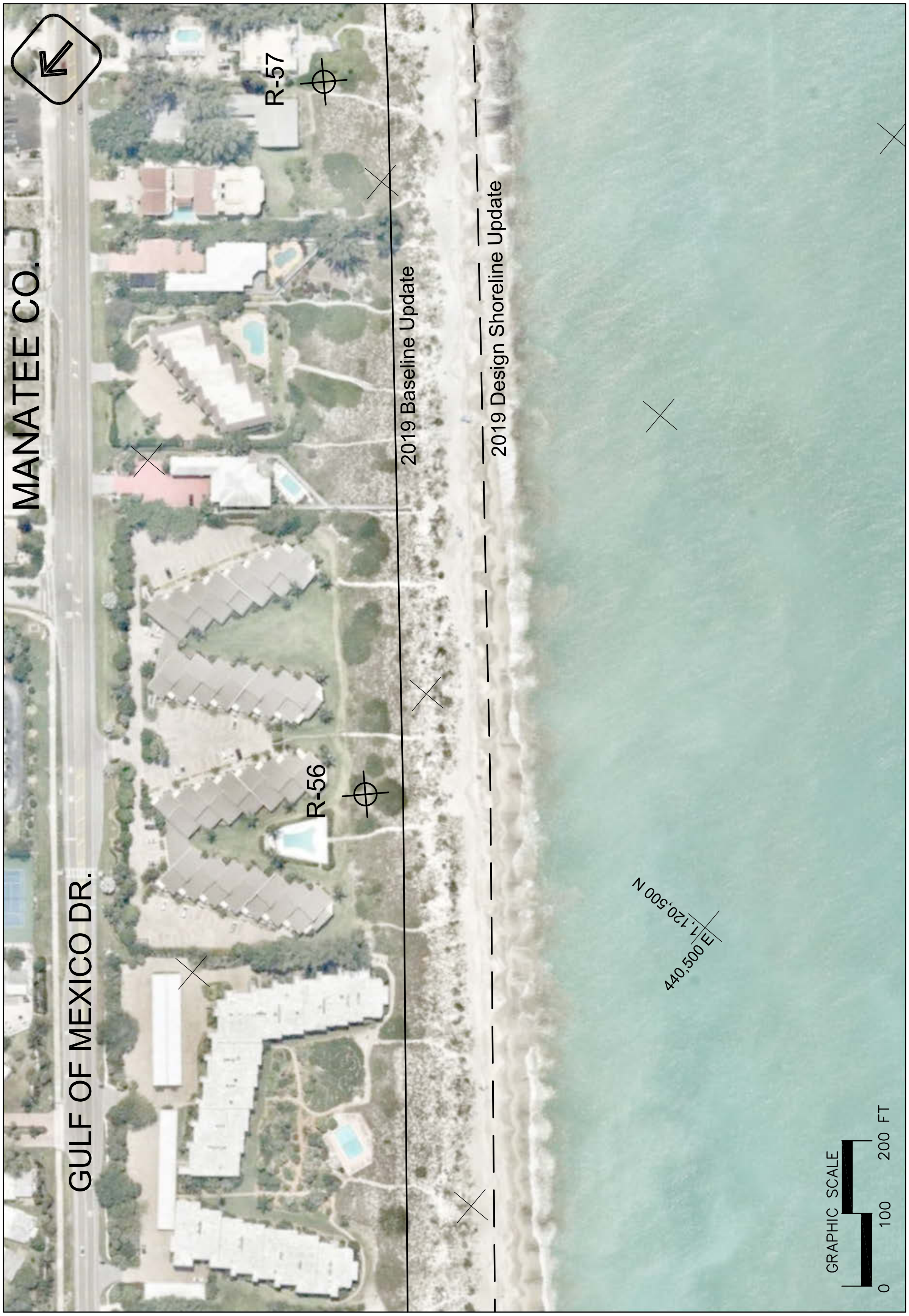

Figure A.9 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

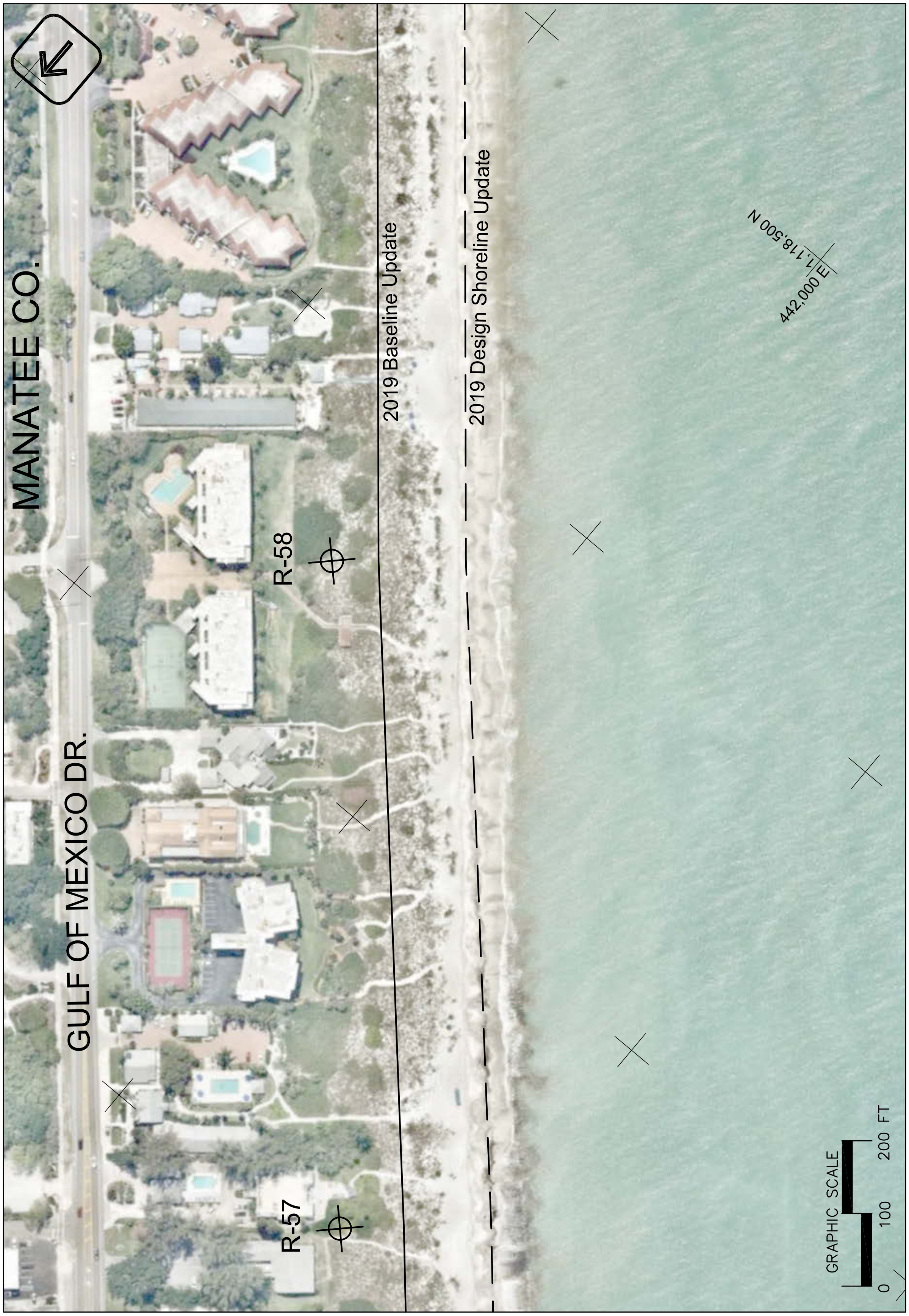

Figure A.10 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

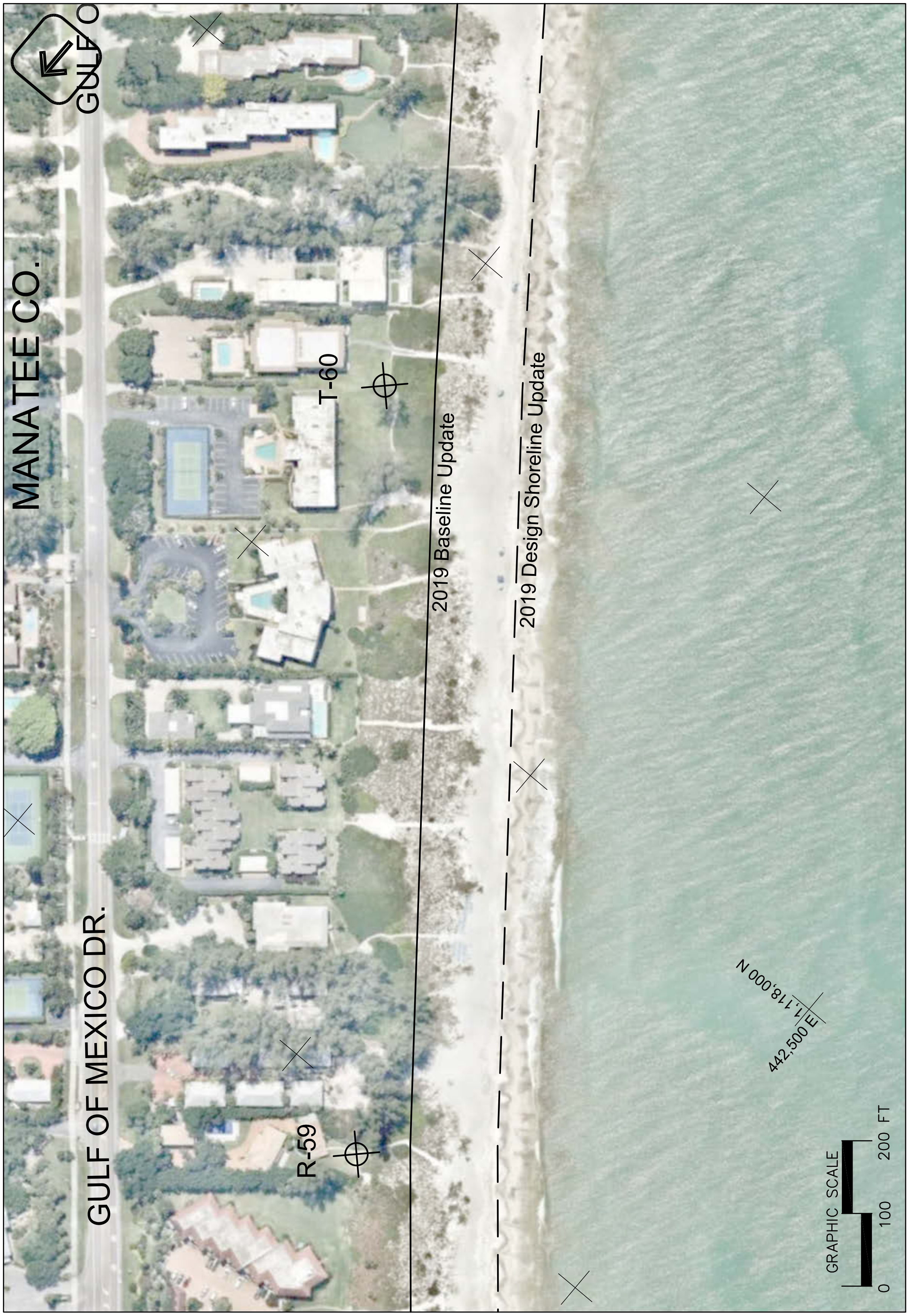

Figure A.11 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

Figure A.12 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

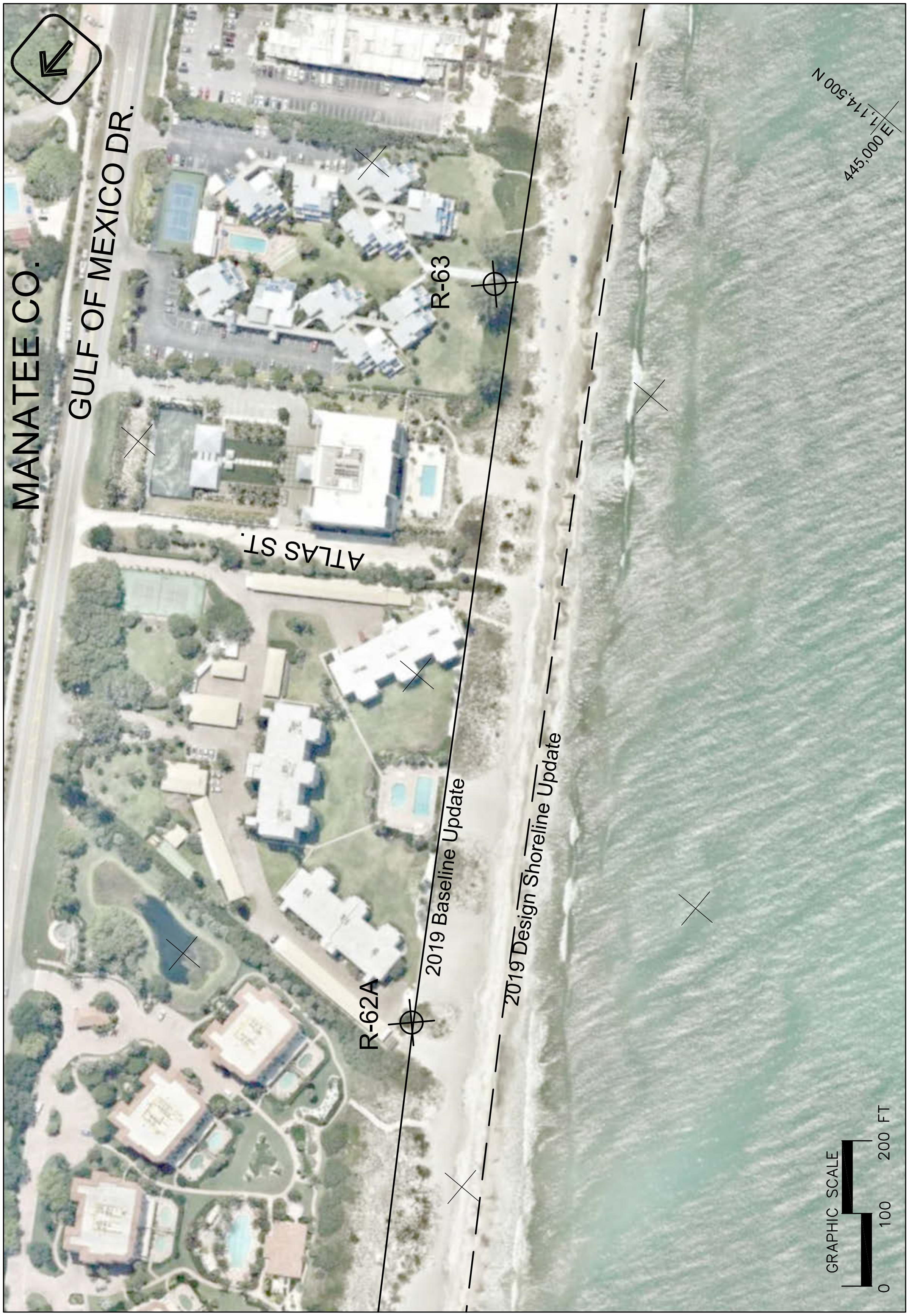

Figure A.13 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

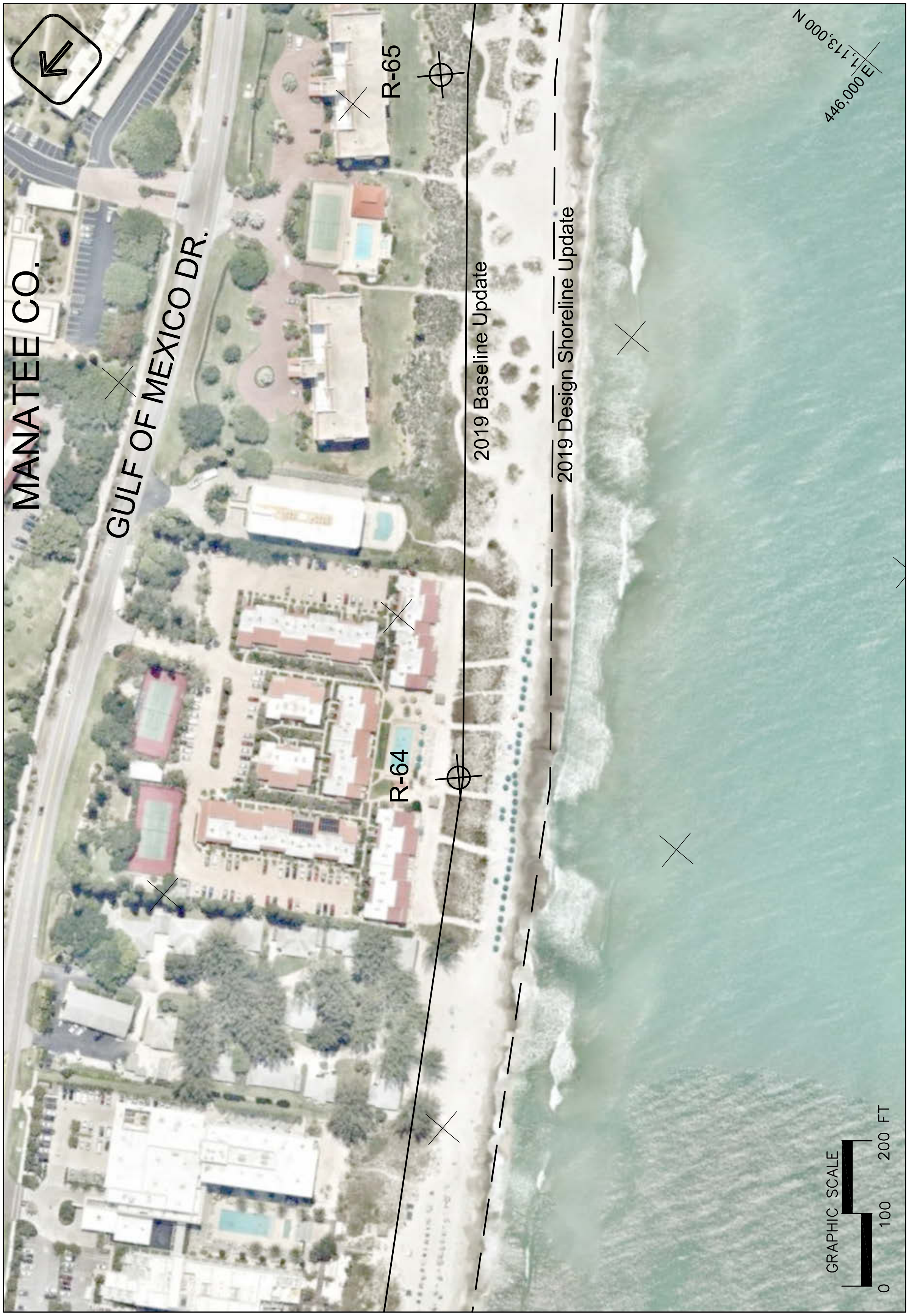

Figure A.14 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

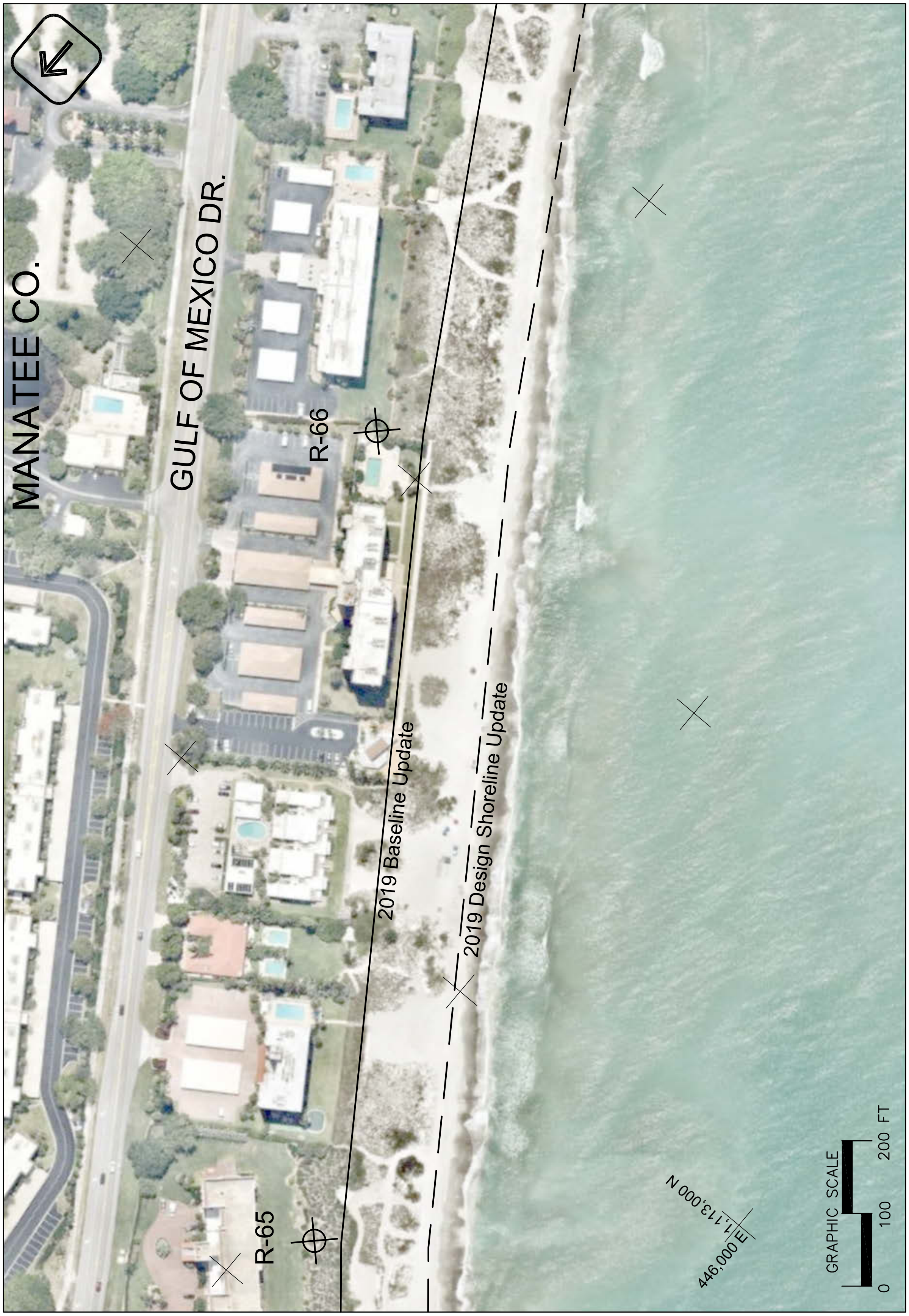

Figure A.15 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

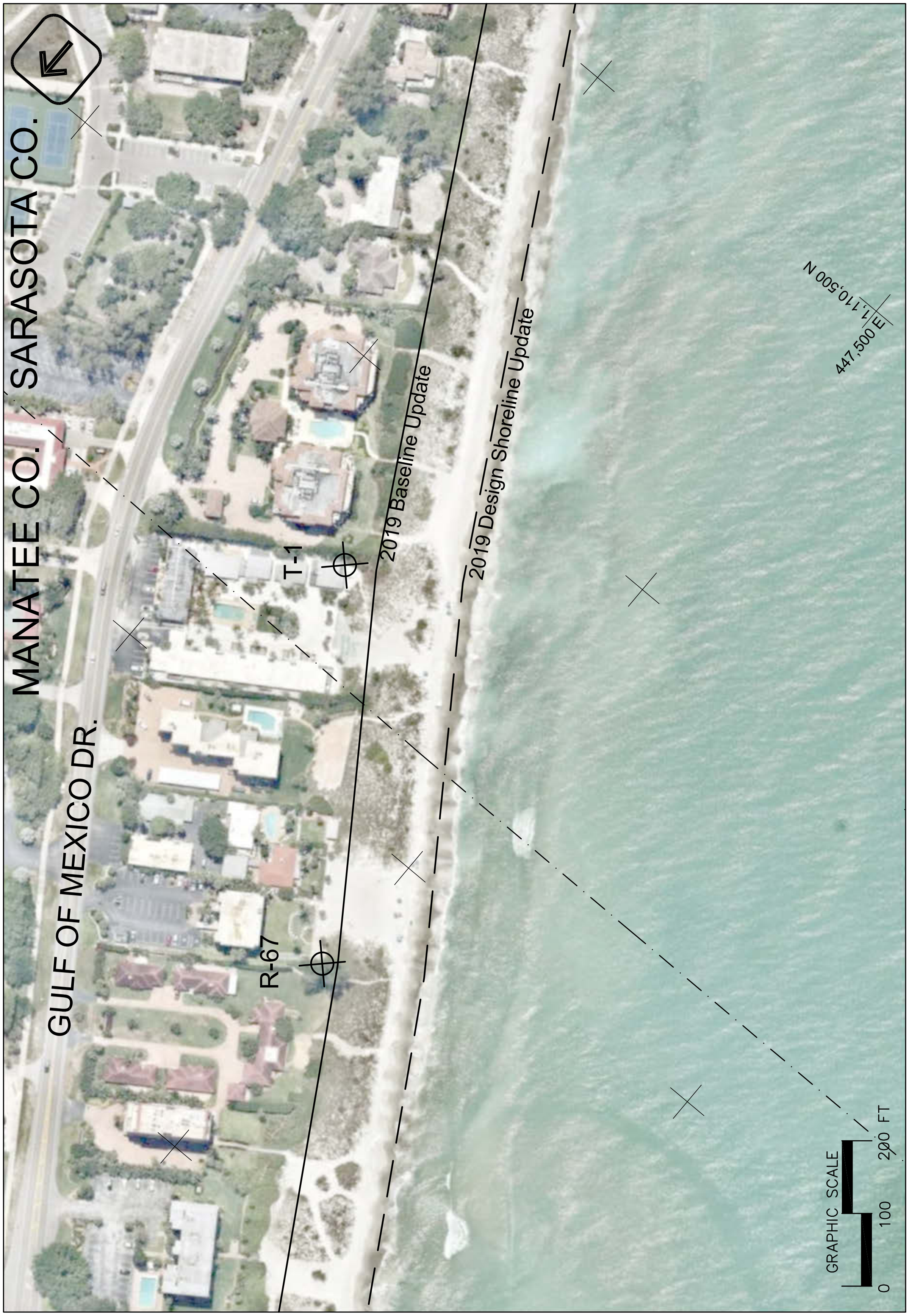

Figure A.16 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

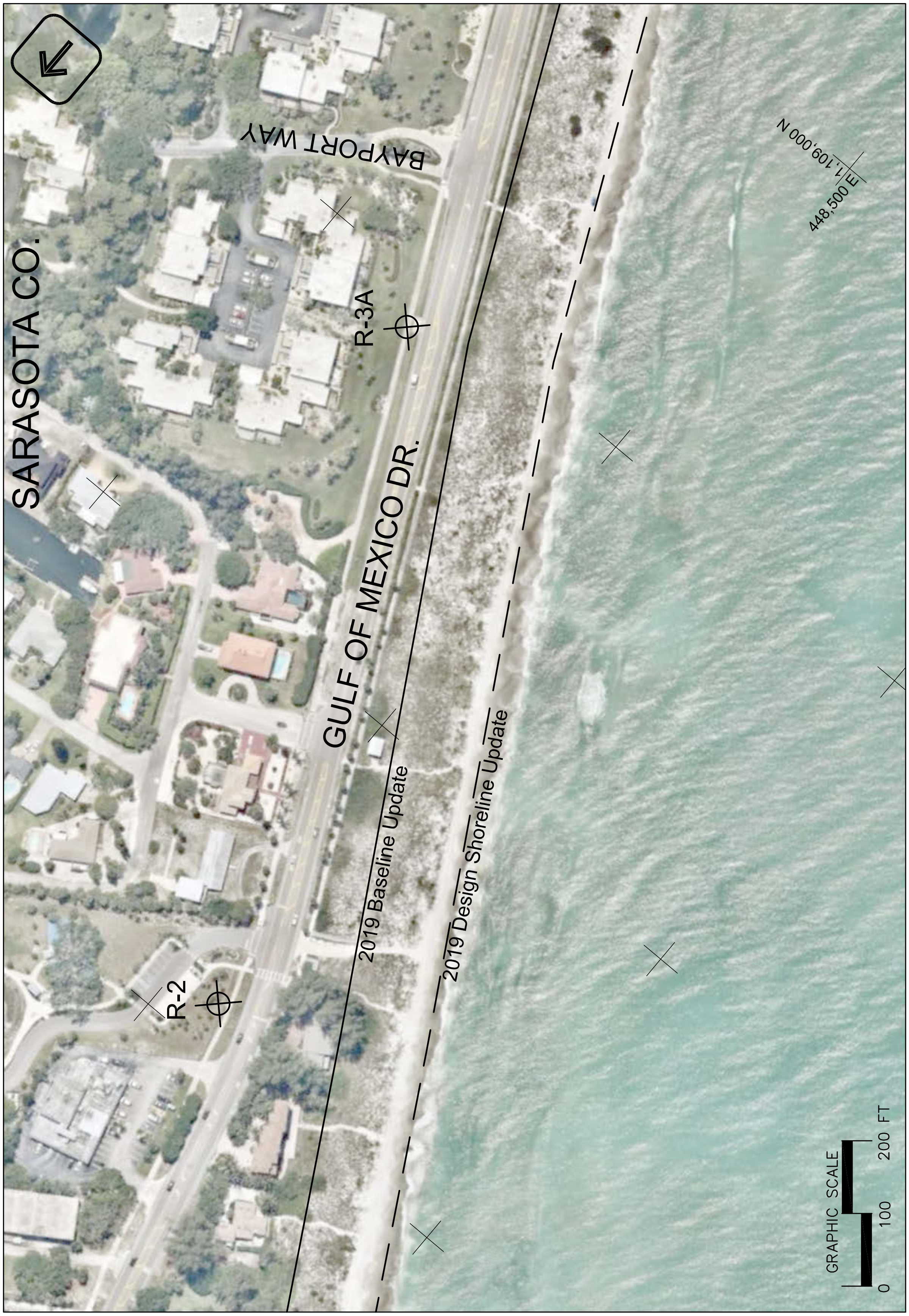

Figure A.17 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

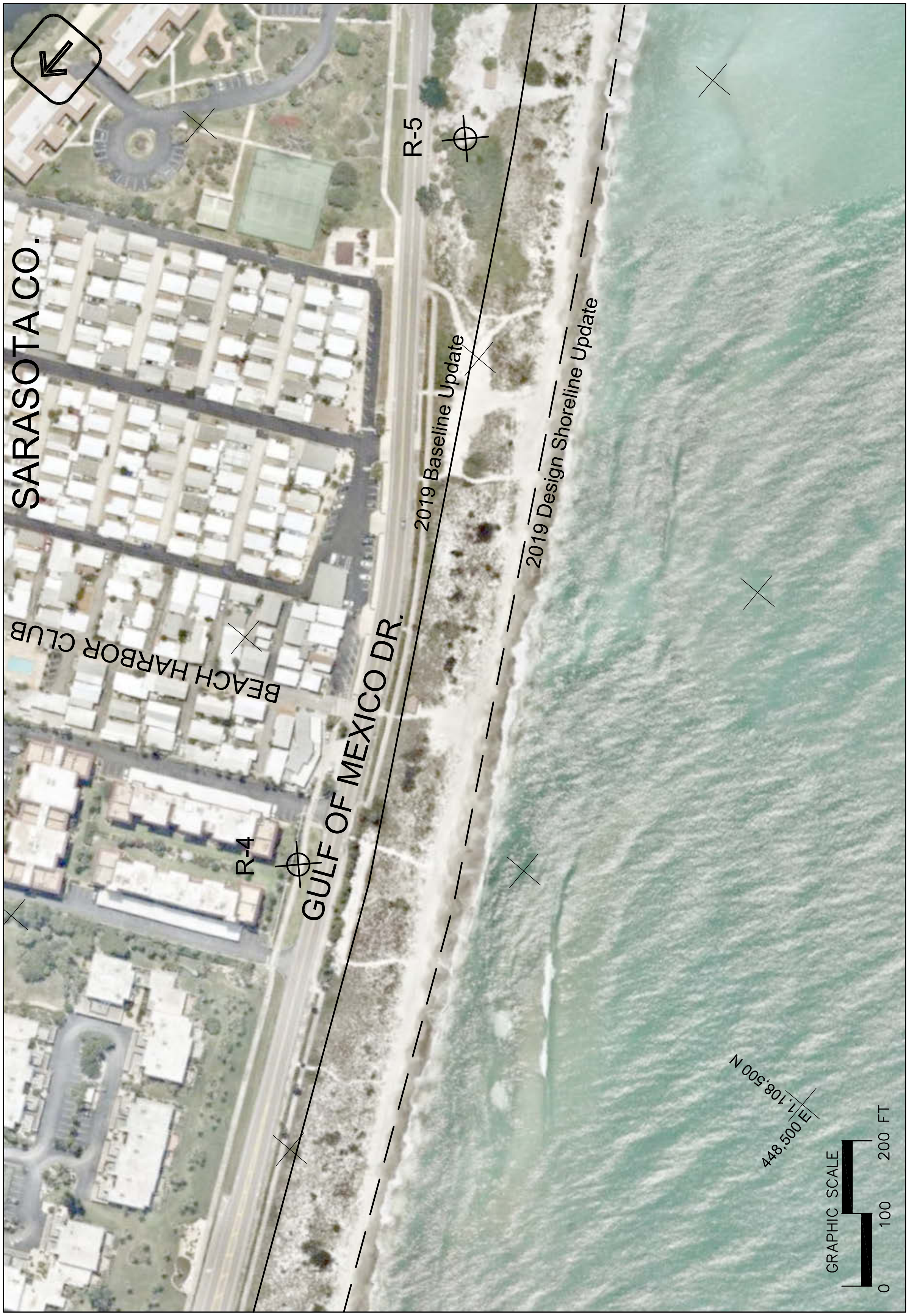

Figure A.18 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

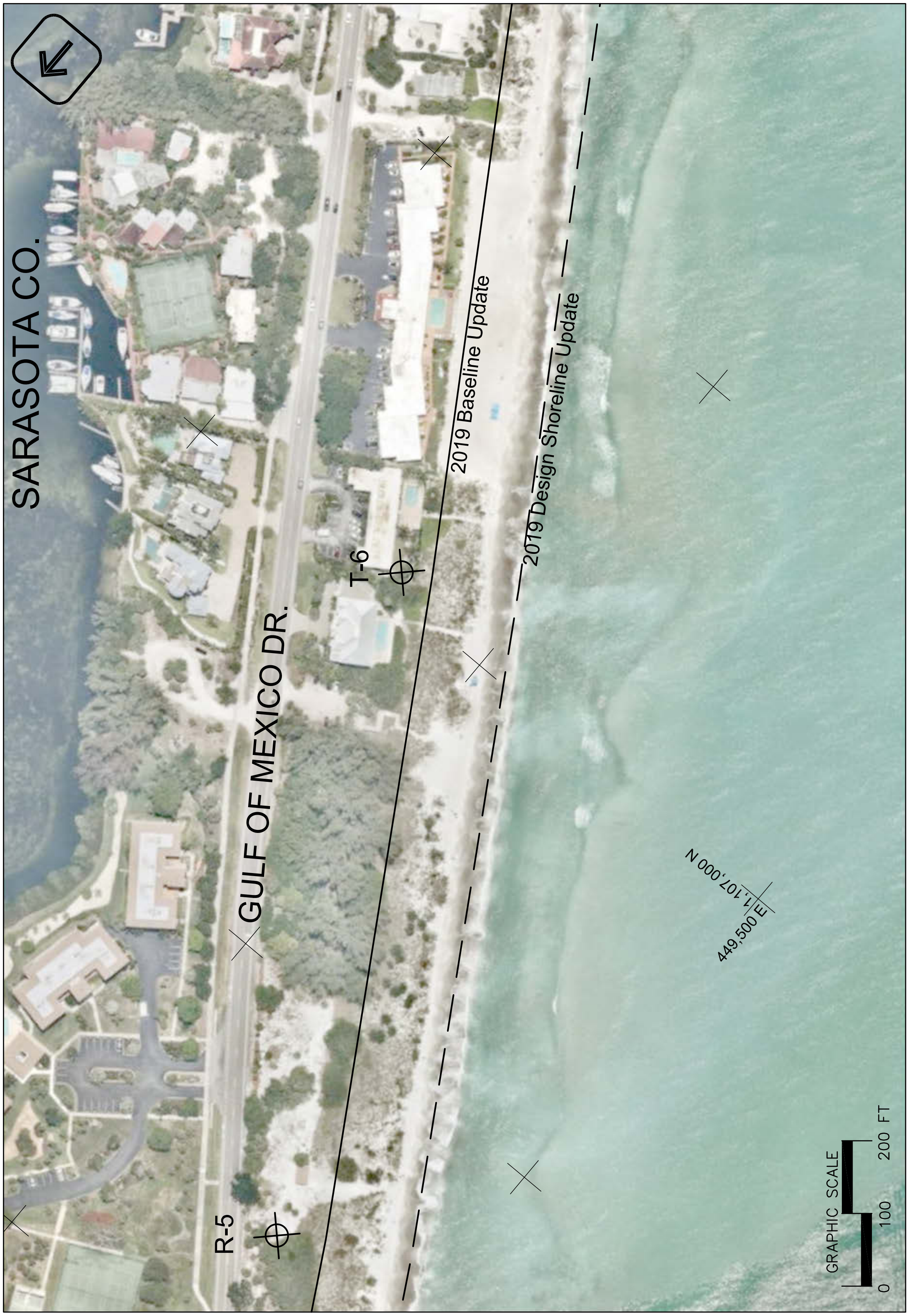

Figure A.19 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

Figure A.20 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

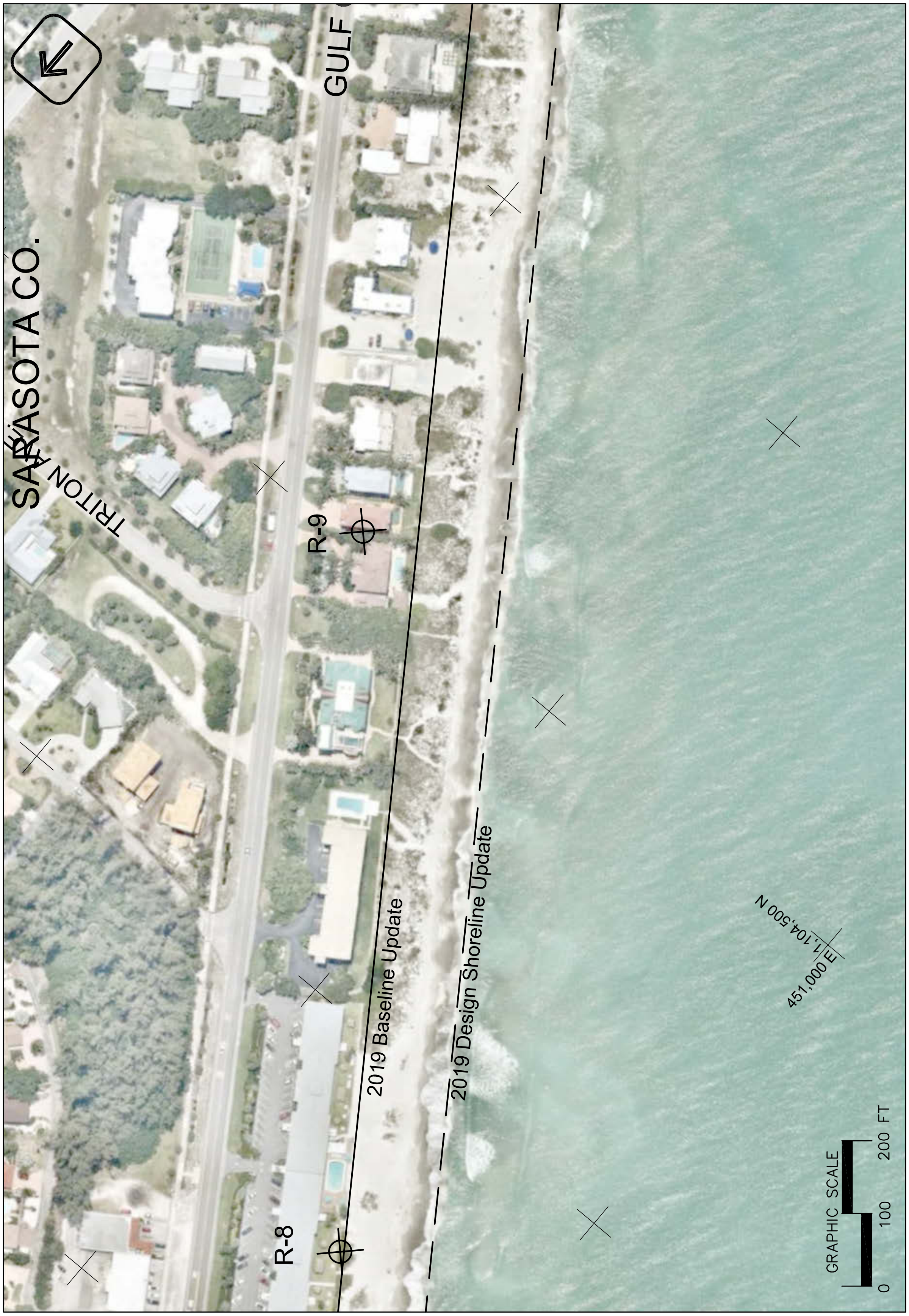

Figure A.21 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

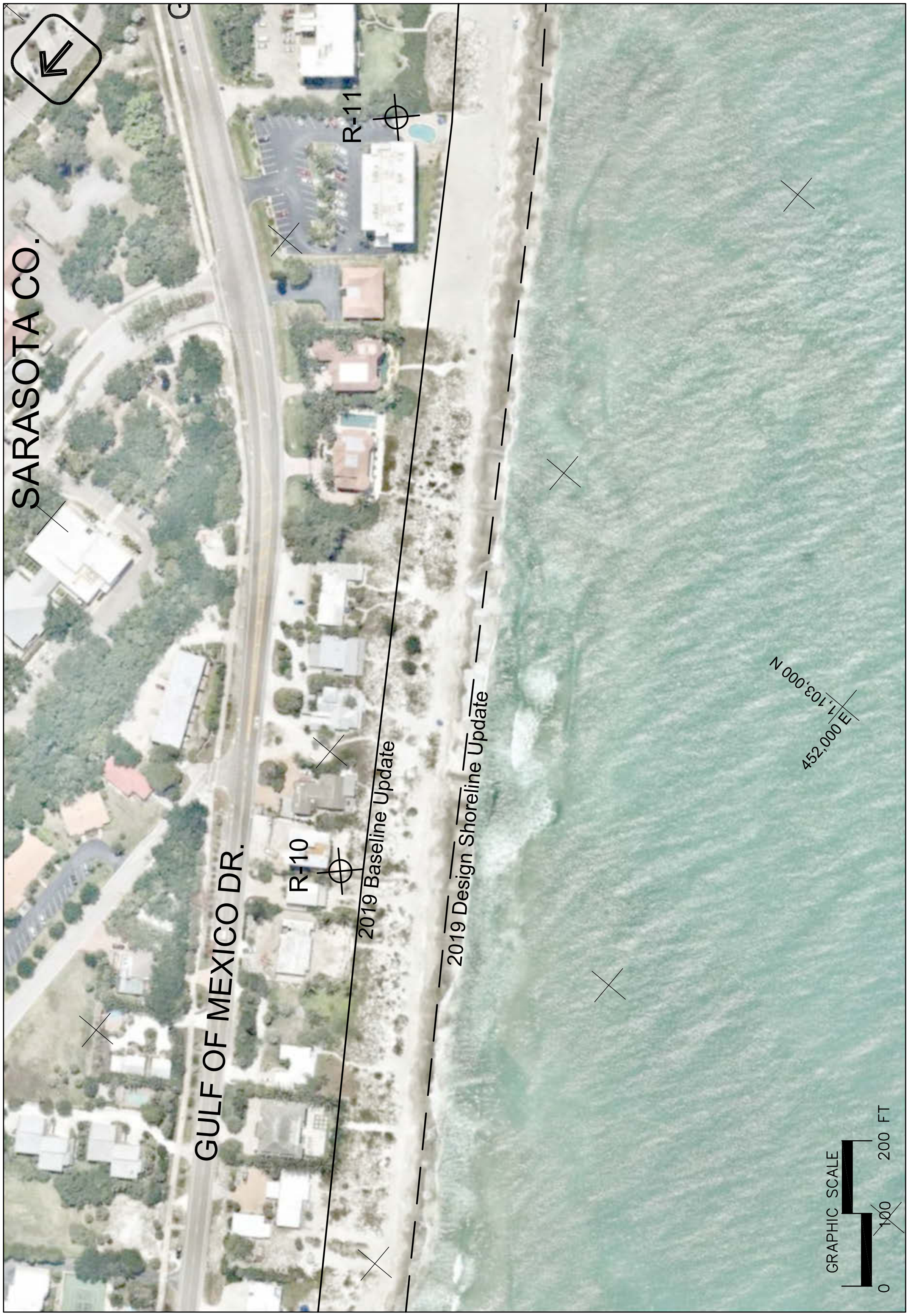

Figure A.22 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

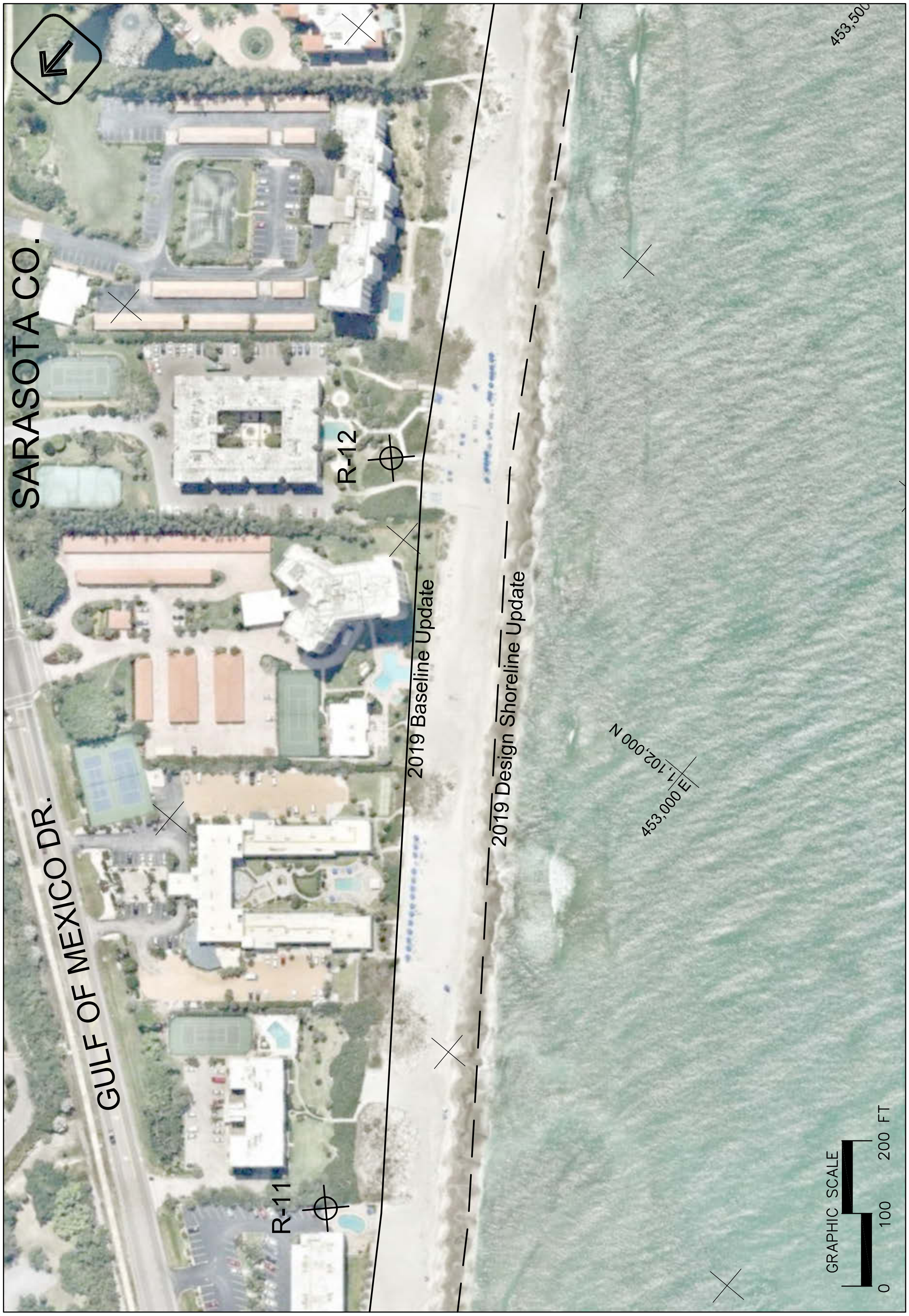

Figure A.23 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

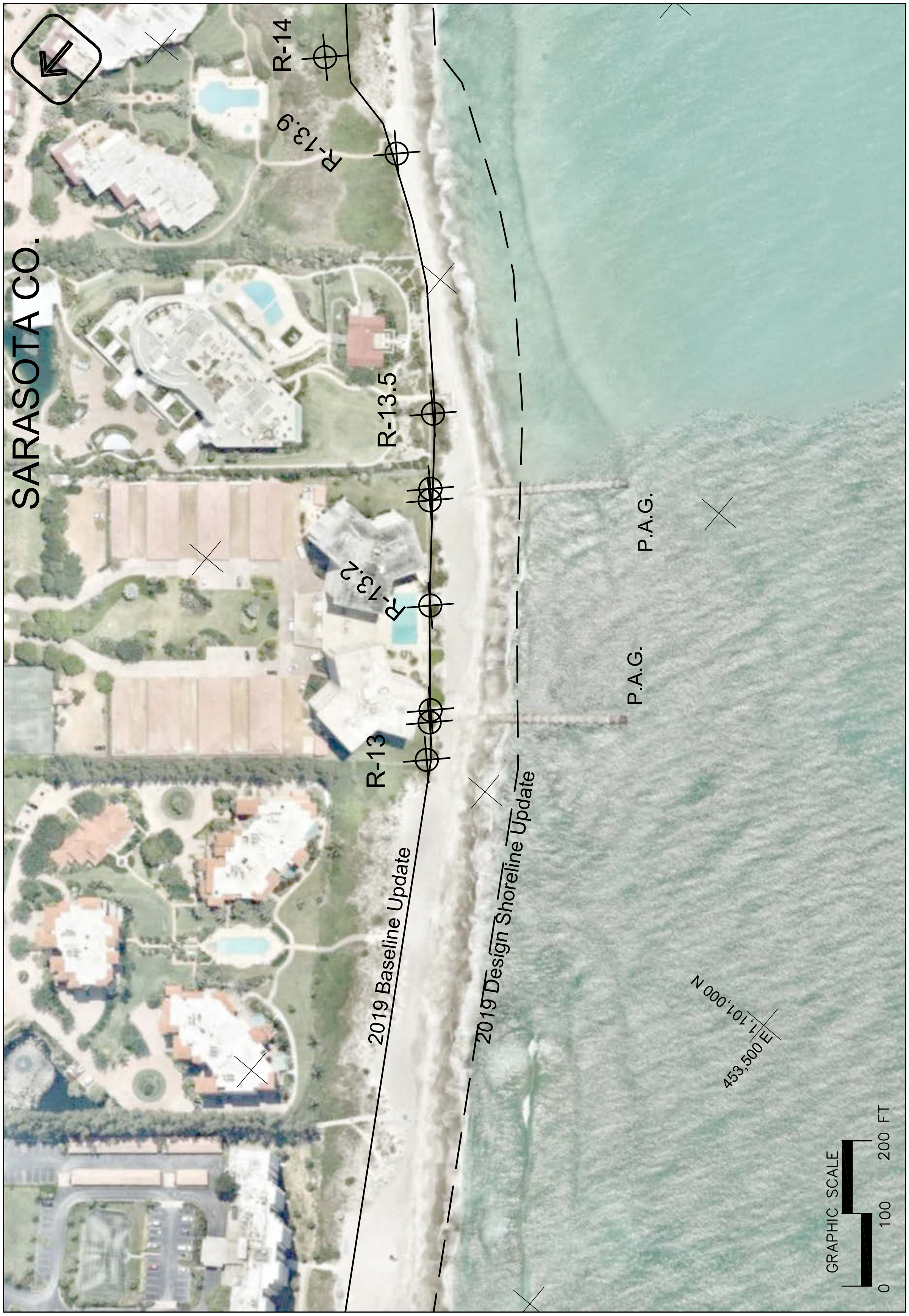

Figure A.24 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

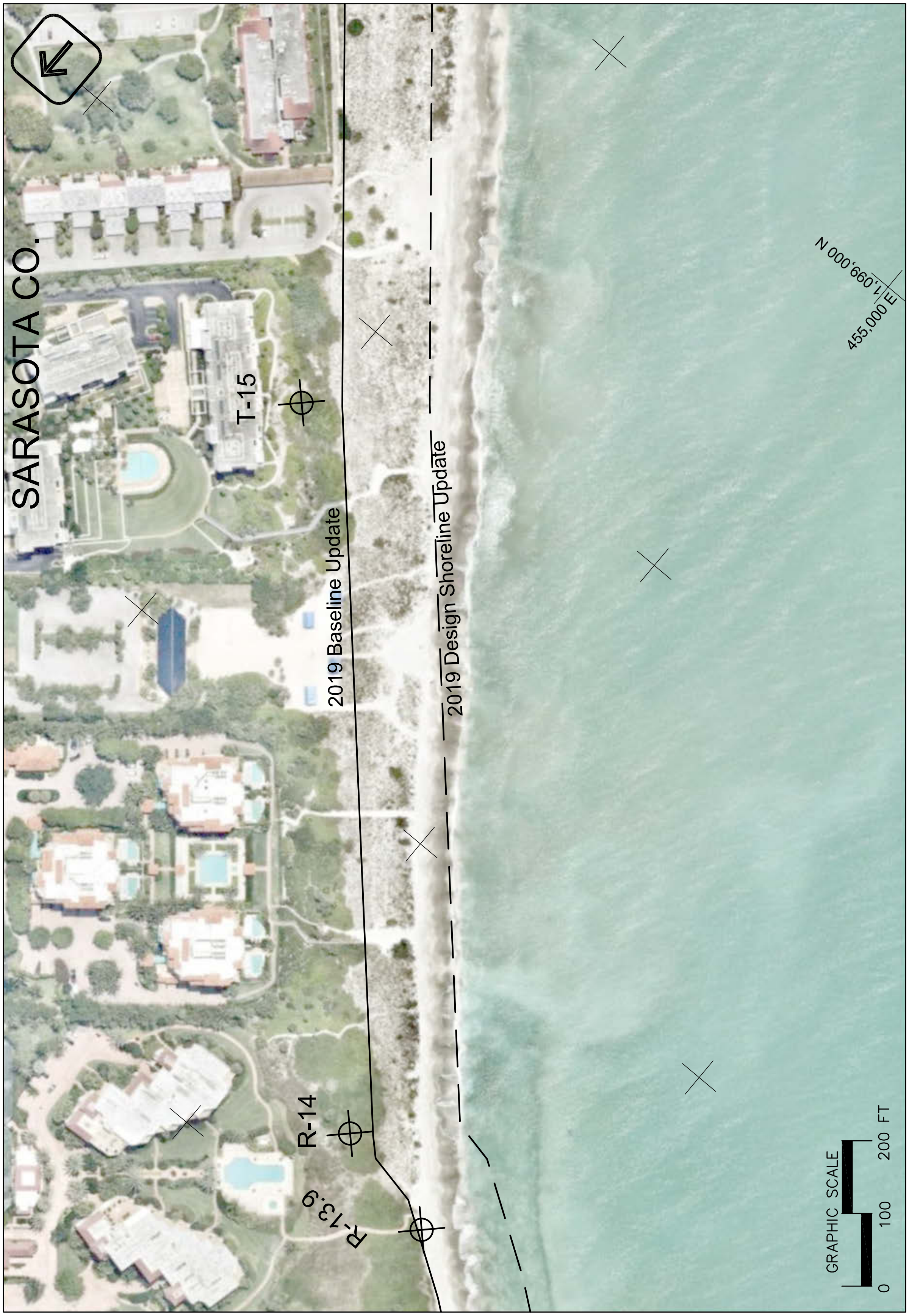

Figure A.25 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

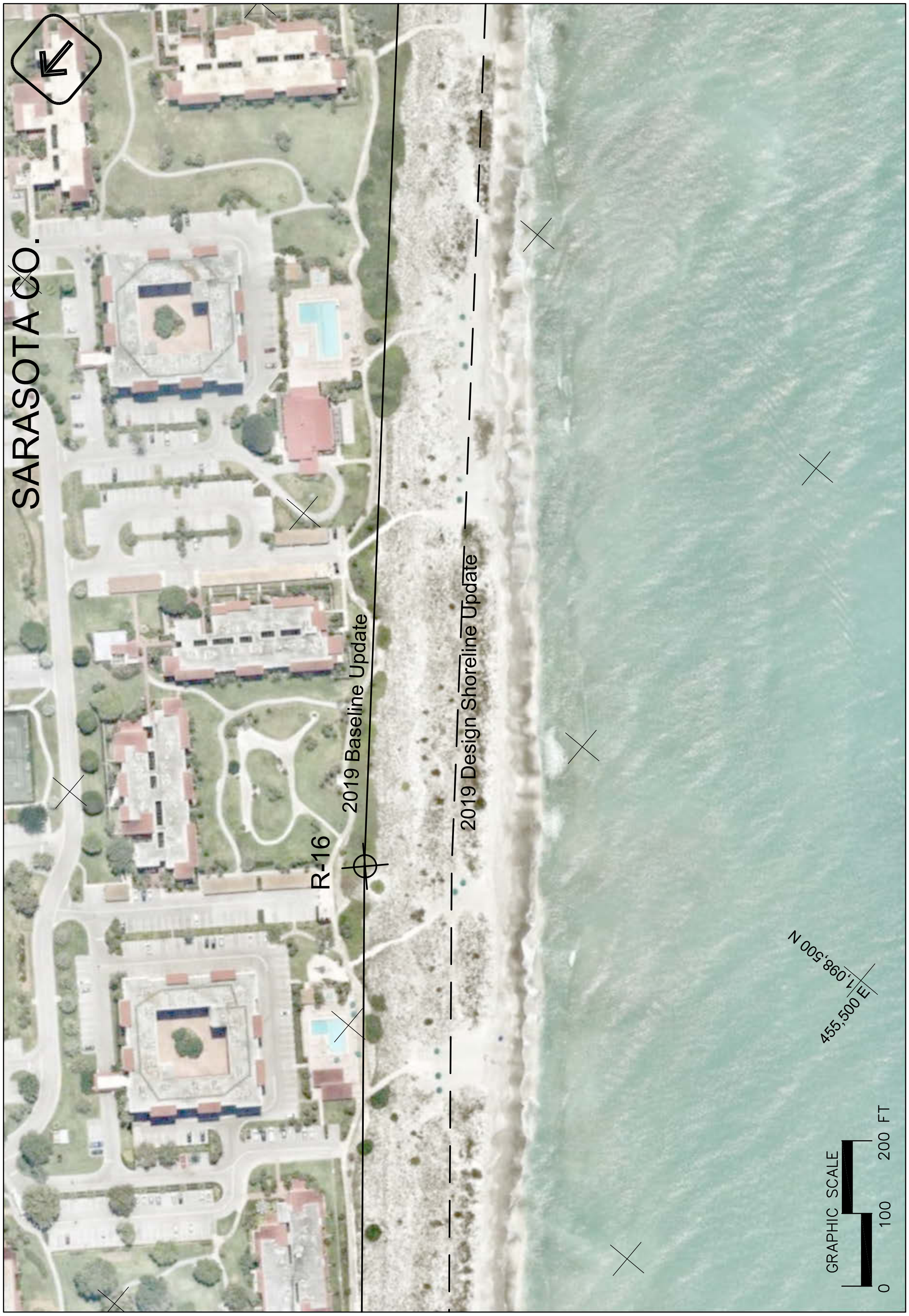

Figure A.26 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

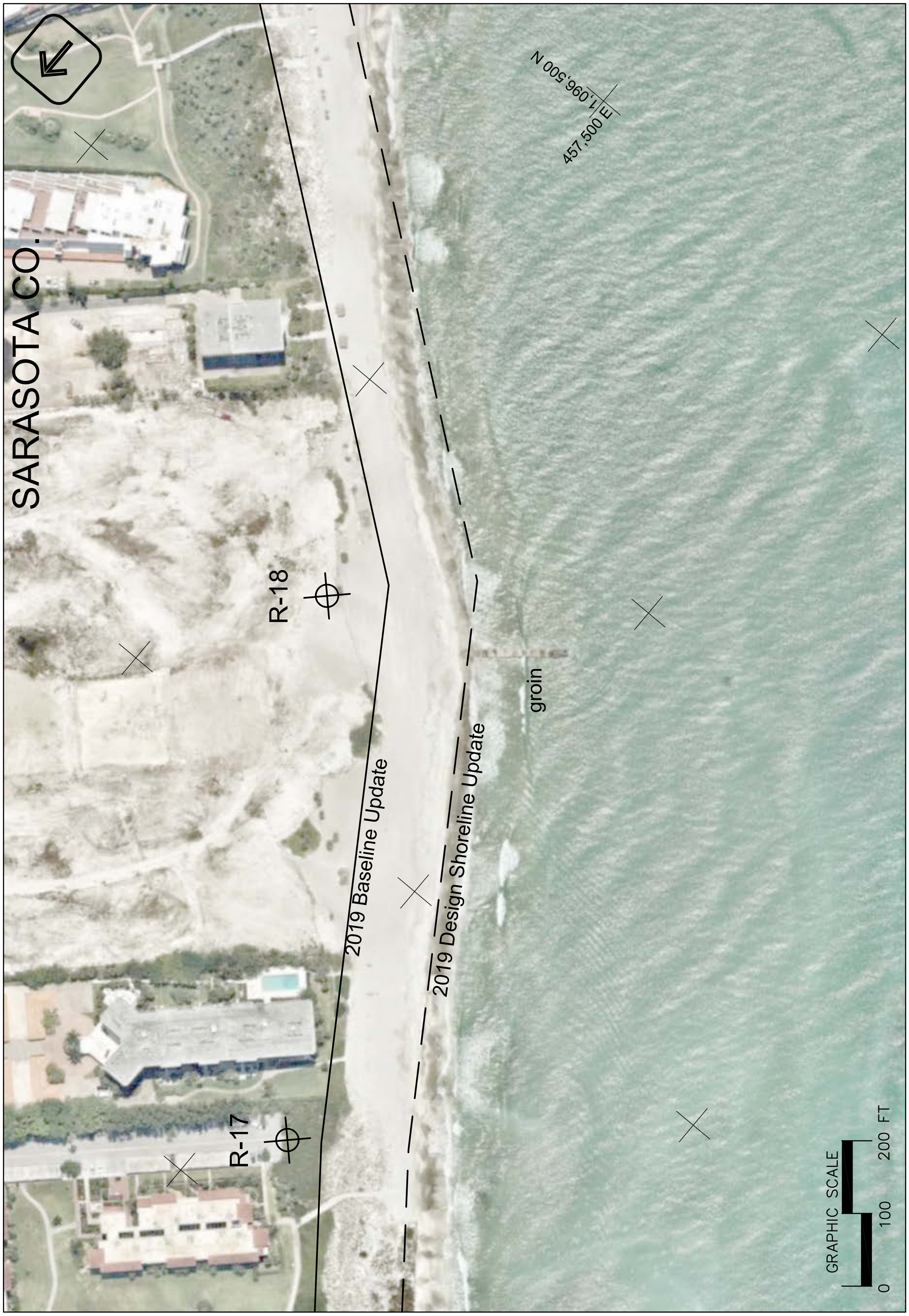

Figure A.27 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

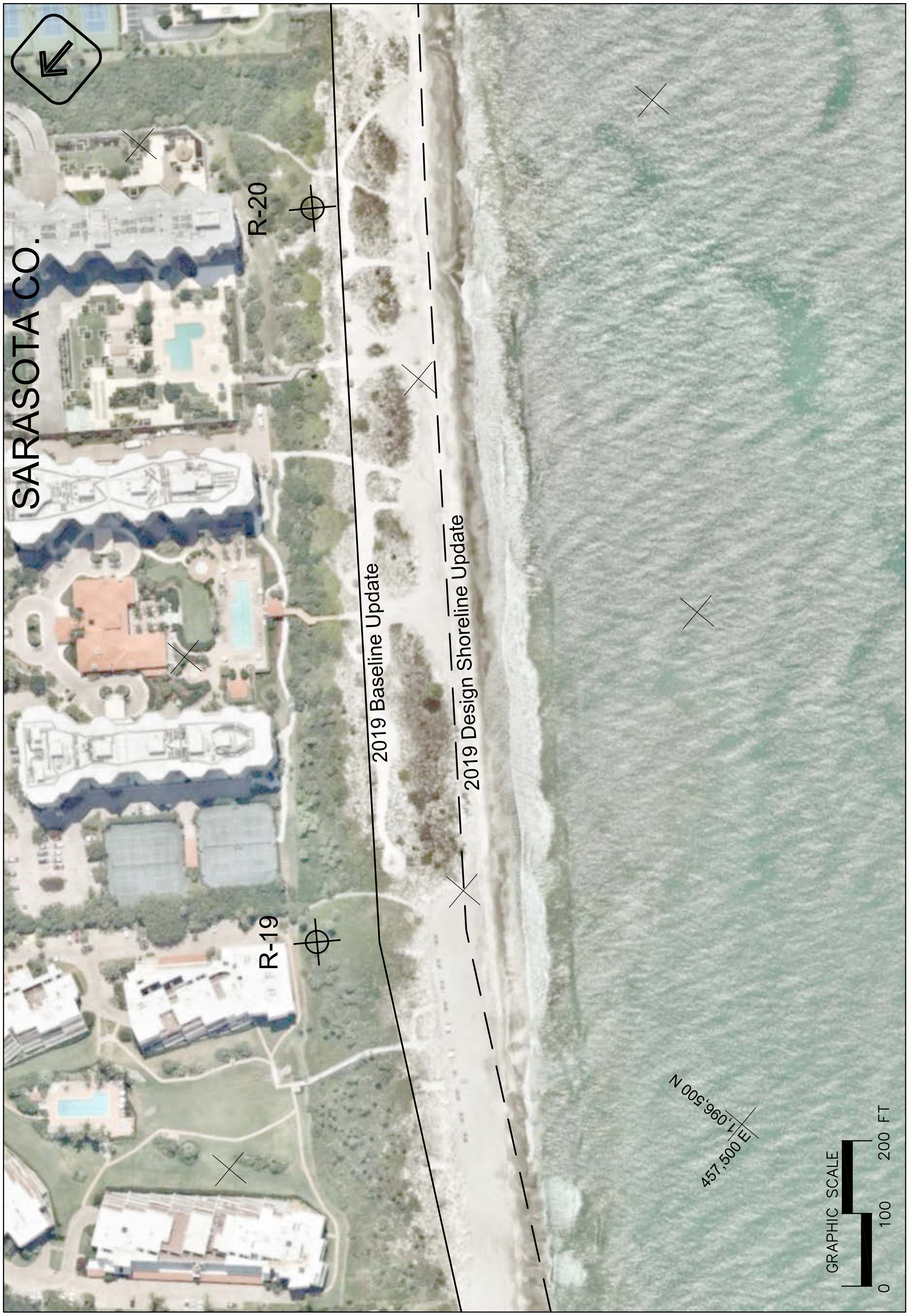

Figure A.28 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

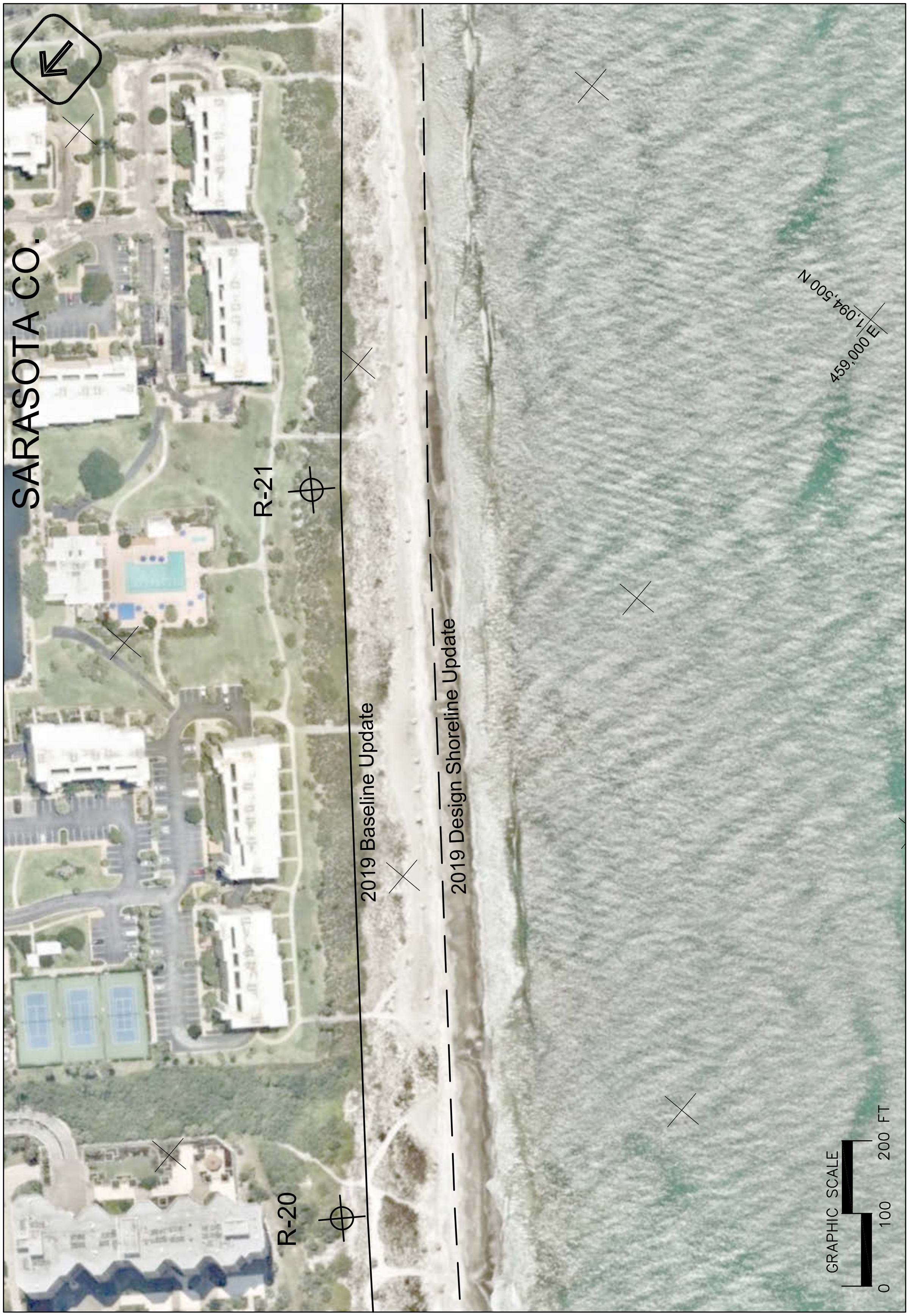

Figure A.29 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

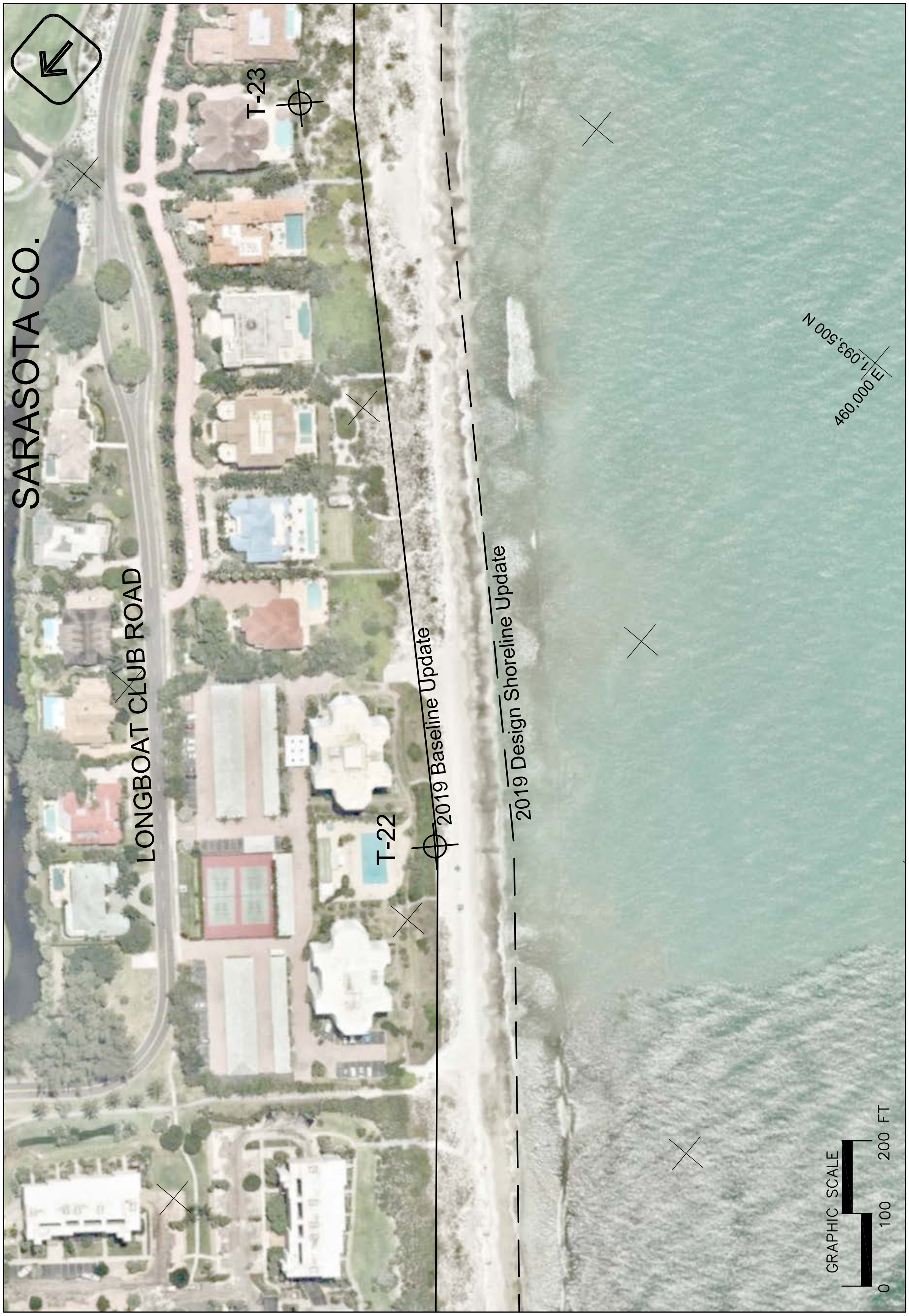

Figure A.30 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

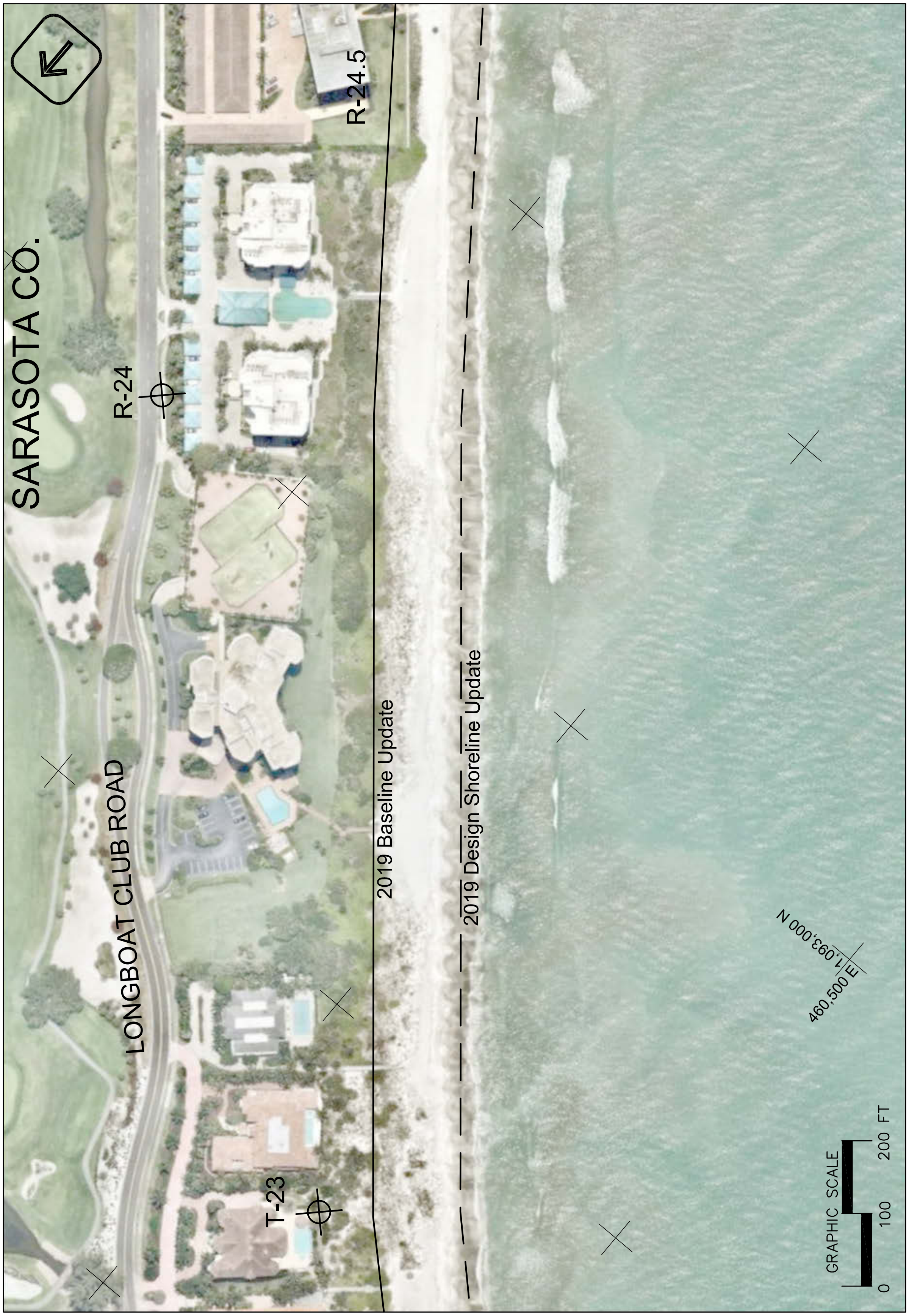

Figure A.31 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

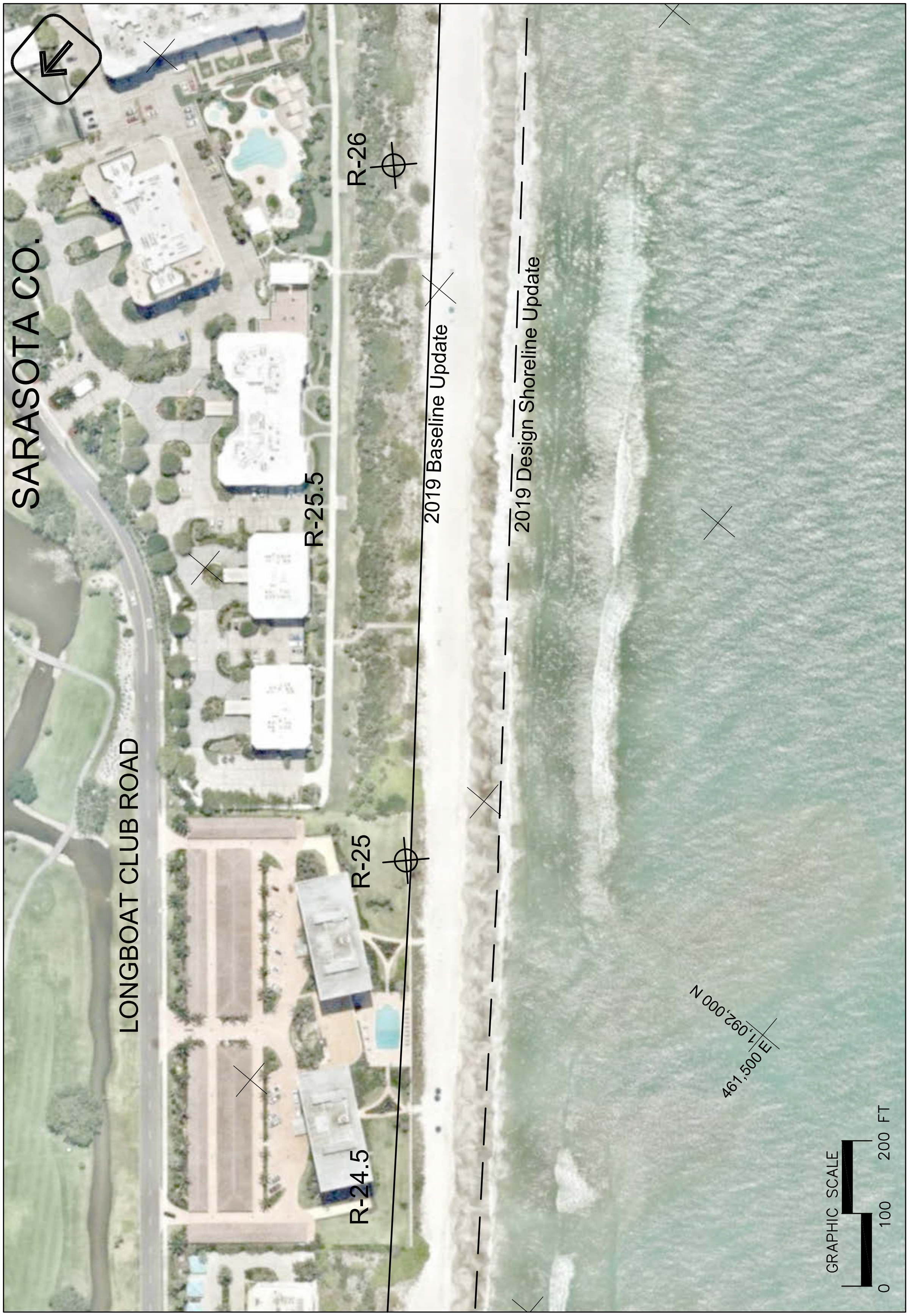

Figure A.32 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

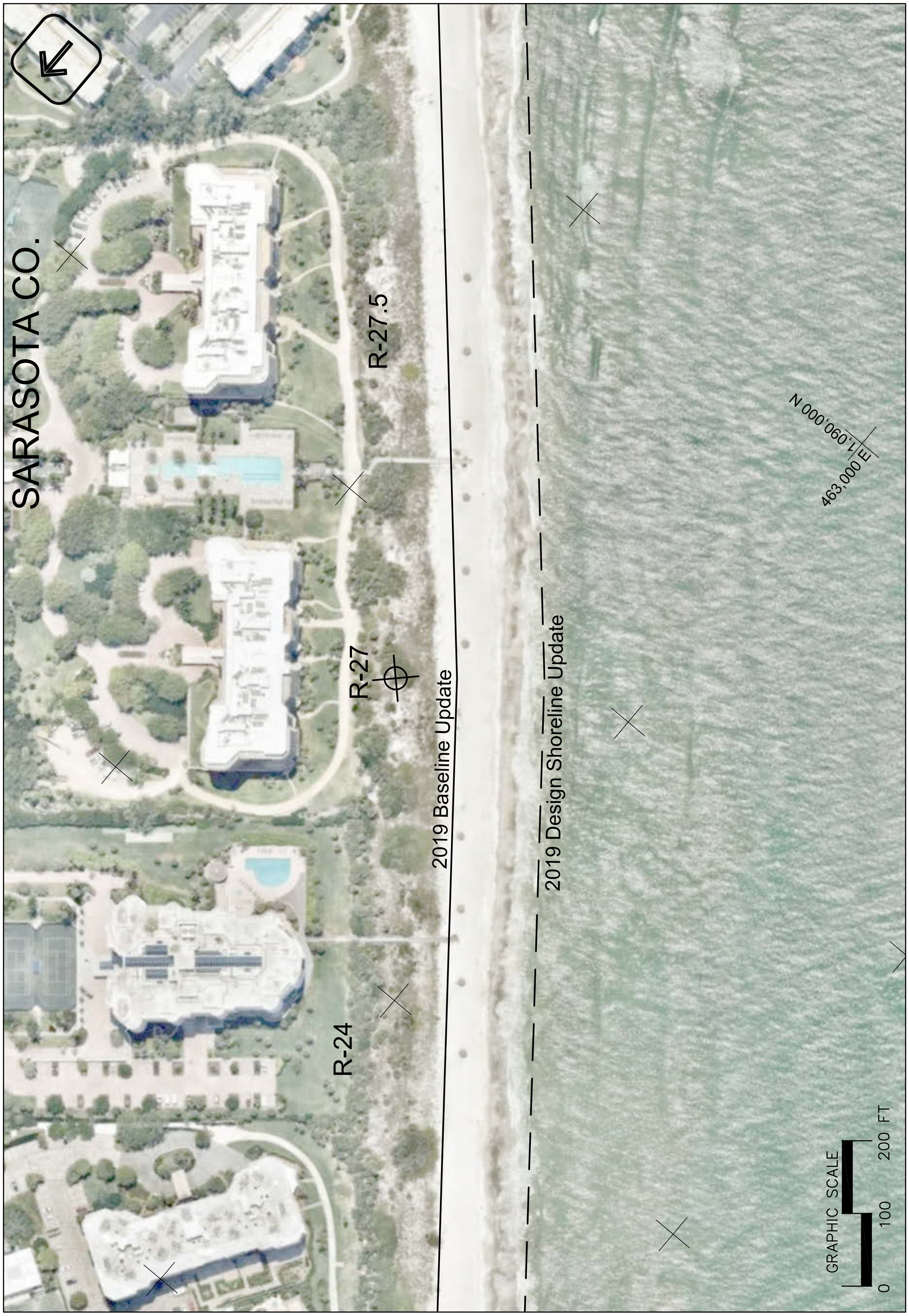

Figure A.33 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

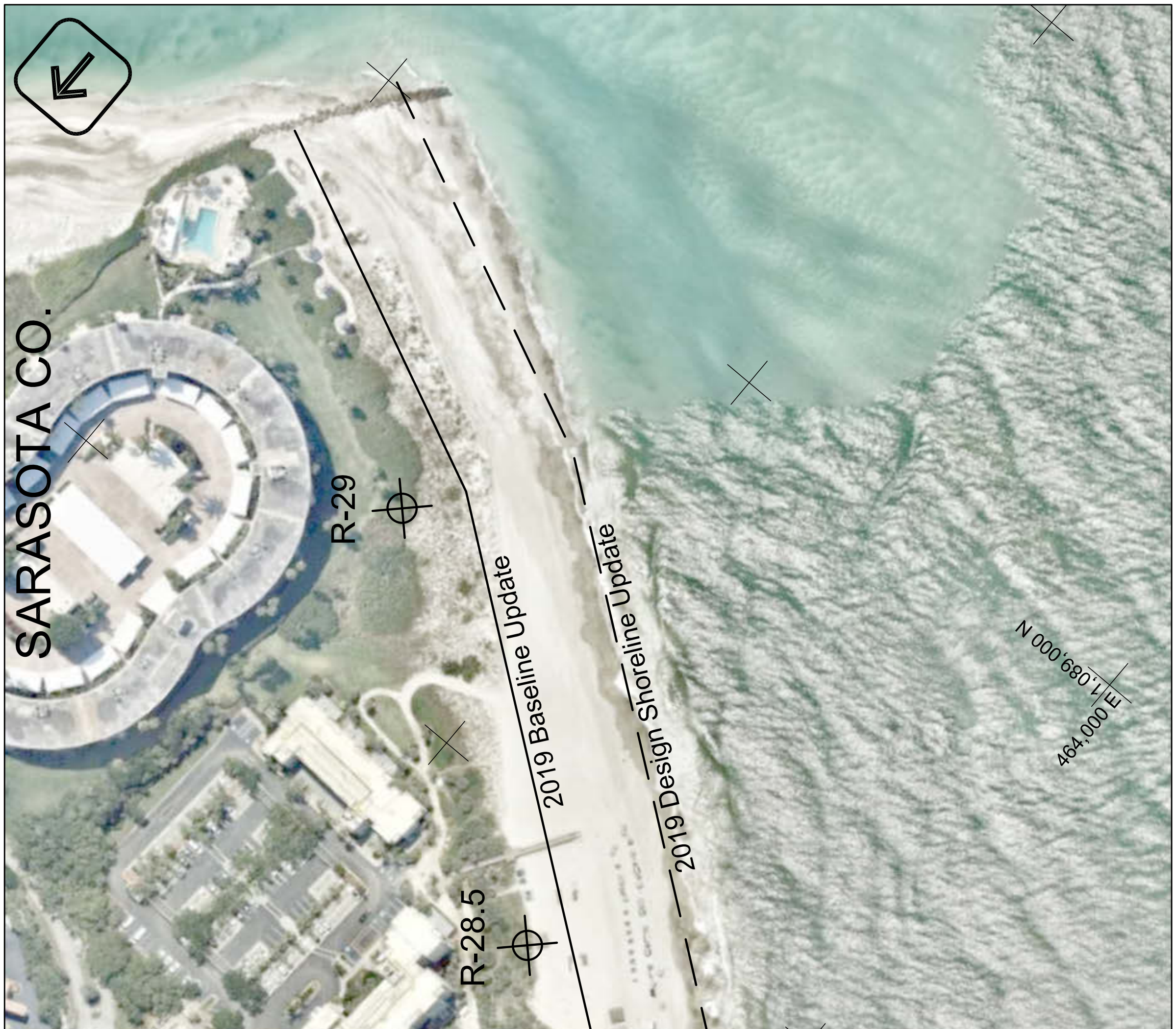

Figure A.34 2019 update to the baseline and design shoreline along the Longboat Key, FL, Gulf of Mexico shoreline (Photo Date: 7 May 2019).

APPENDIX B – HISTORICAL BEACH PROFILE PLOTS

The following plots of historical beach profiles were compiled from three primary sources, A) the database maintained by the FDEP Beaches, Ports, and Inlets Program (July 2006, collected by Coastal Planning & Engineering, Inc. and submitted to FDEP), B) beach profile survey data collected by ARC Surveying and Mapping, Inc., of Jacksonville, FL, (July 2012, June 2015, and October 2016 data), and C) beach profile survey data collected by Hyatt Survey Services, Inc., of Bradenton, FL, (August 2016, May 2018 and June/July 2019 data).

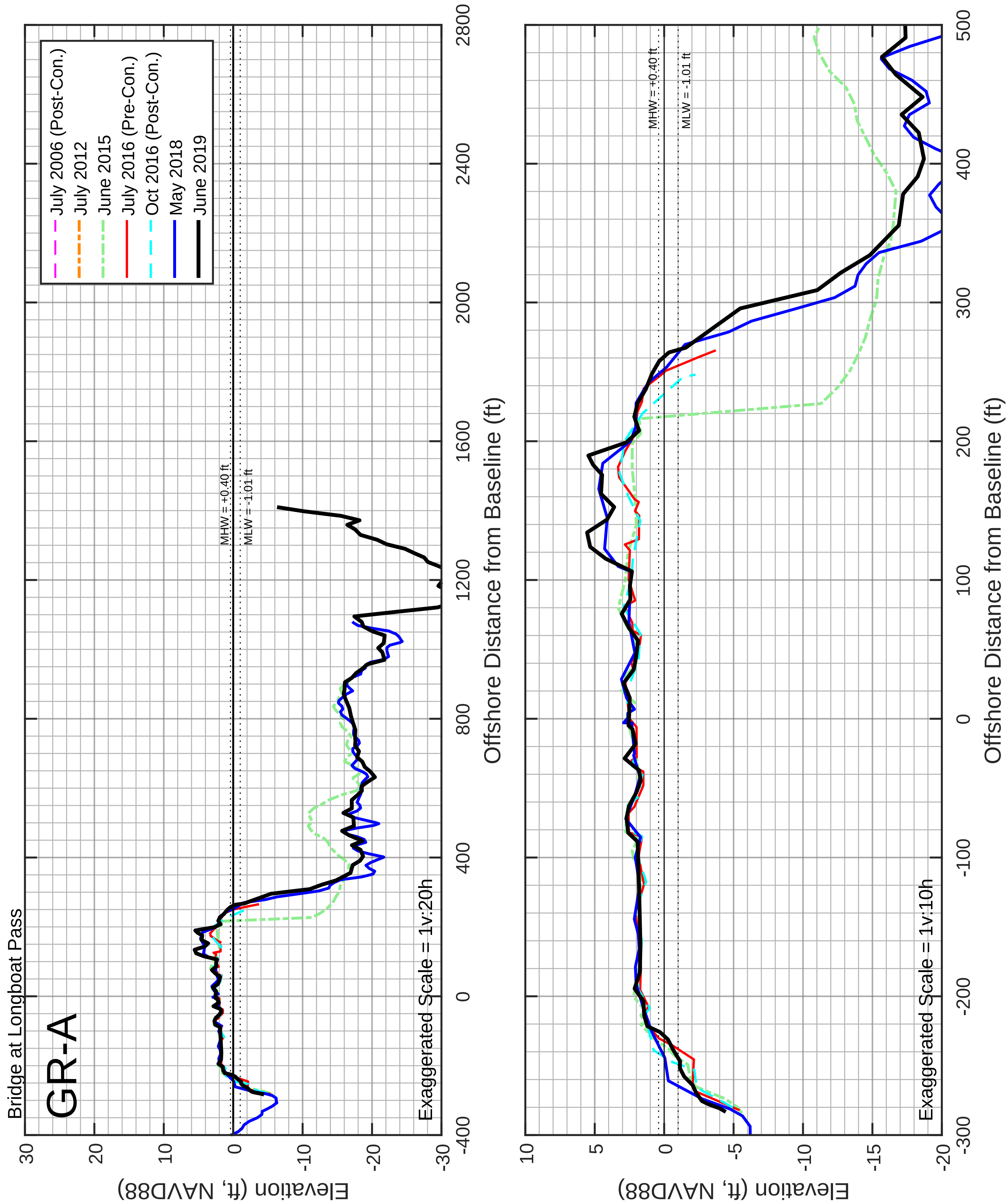

Figure B-001: Measured beach profiles at monument GR-A Longboat Key, Florida.

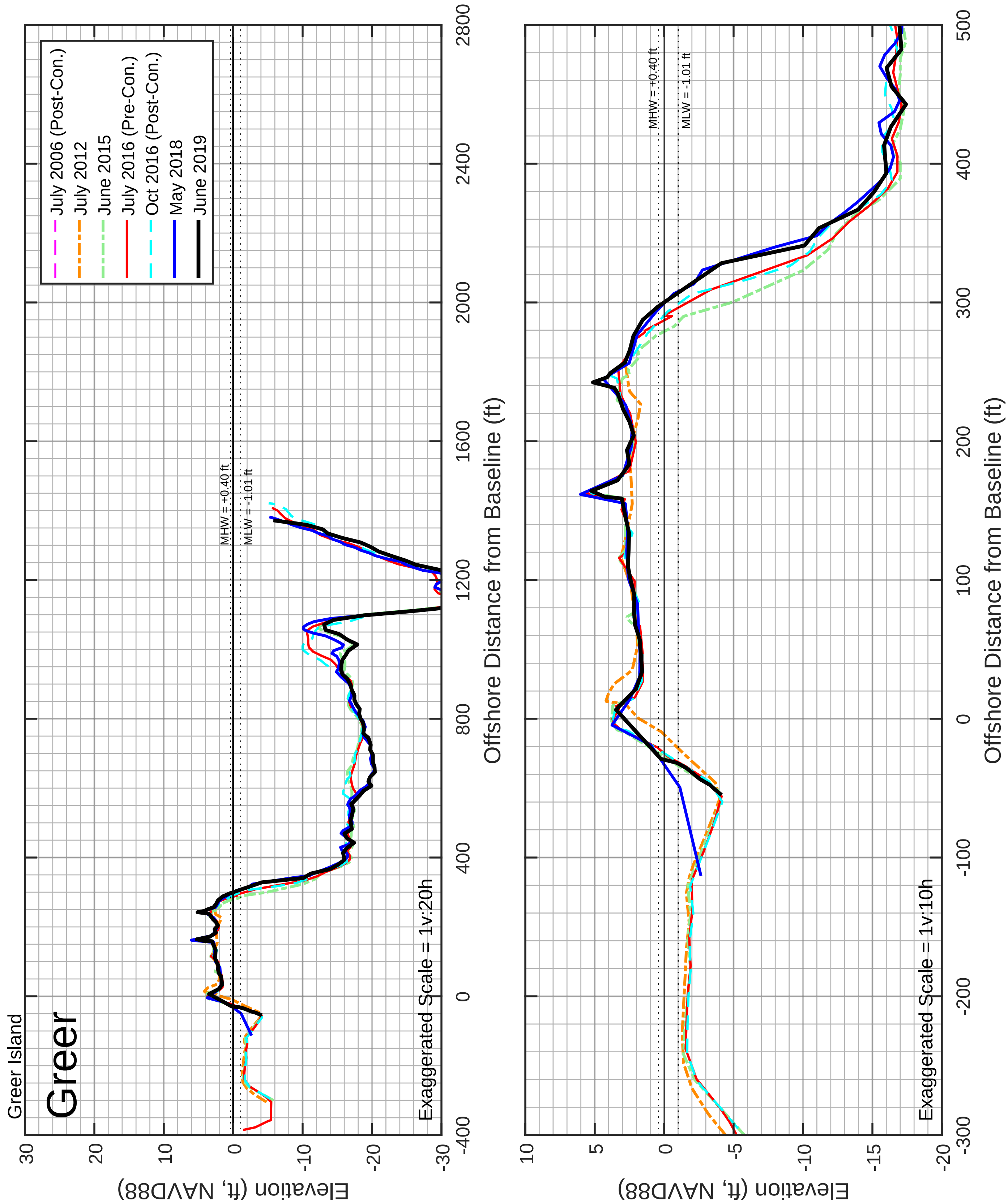

Figure B-002: Measured beach profiles at monument Greer Longboat Key, Florida.

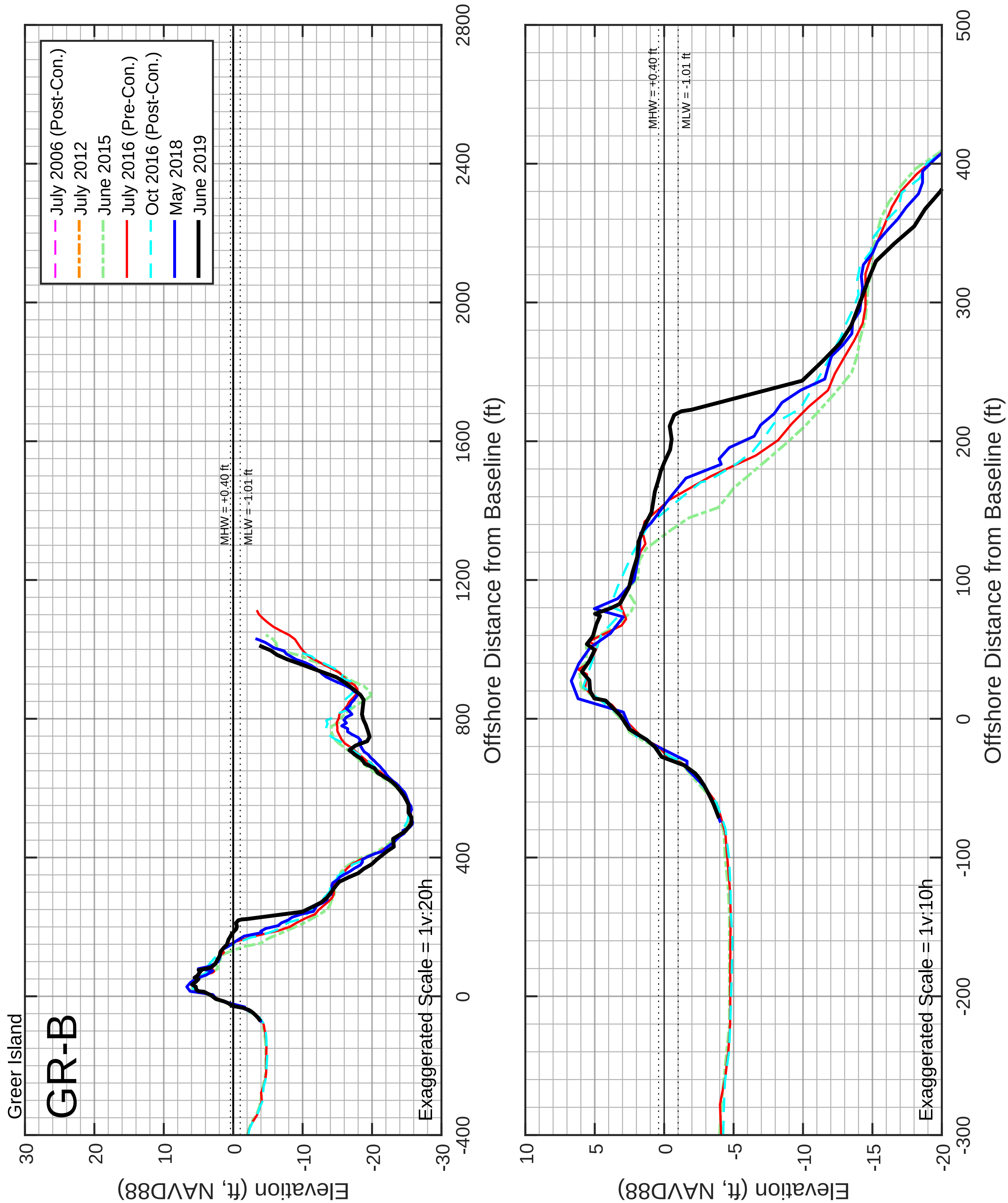

Figure B-003: Measured beach profiles at monument GR-B Longboat Key, Florida.

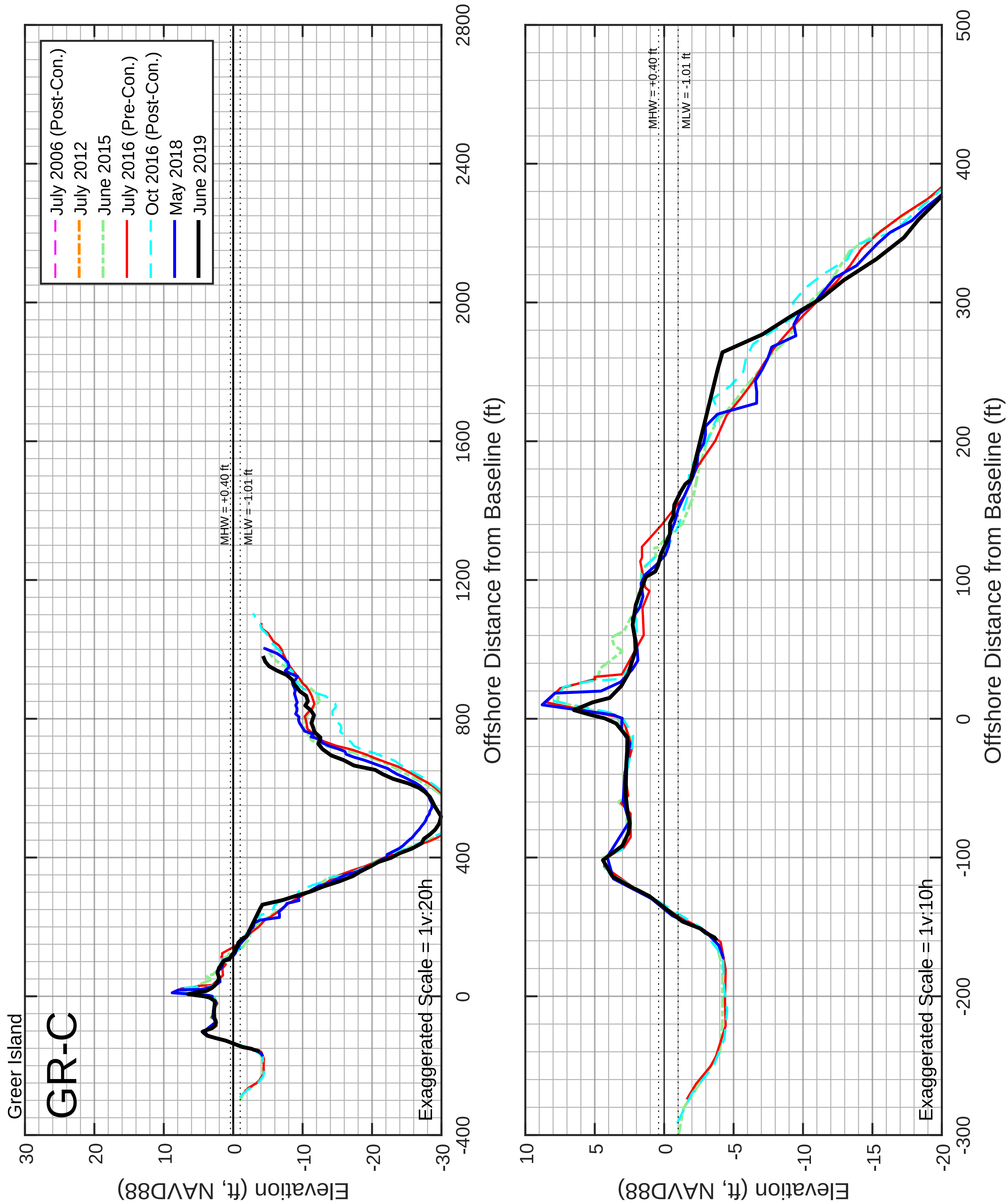

Figure B-004: Measured beach profiles at monument GR-C Longboat Key, Florida.

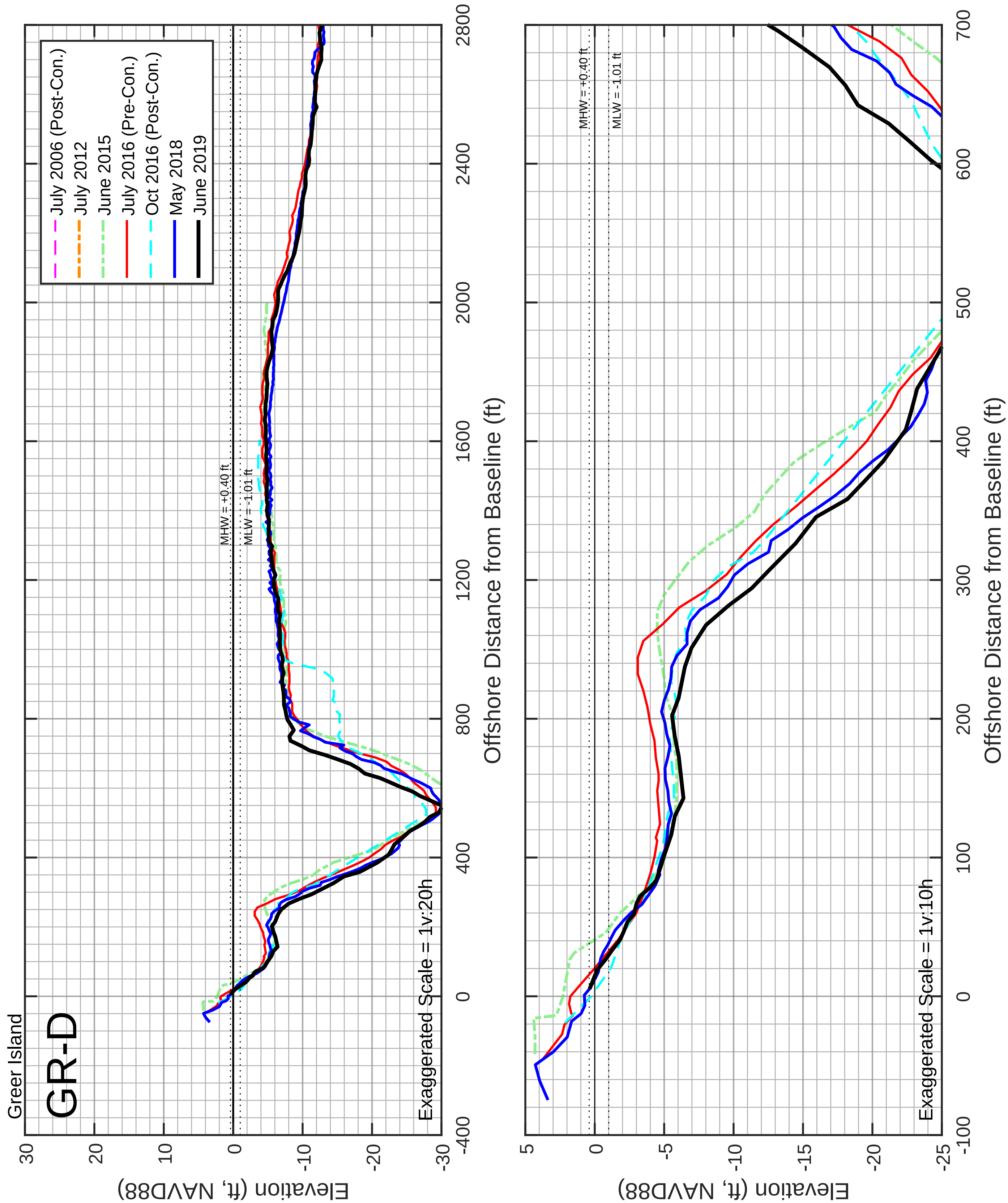

Figure B-005: Measured beach profiles at monument GR-D Longboat Key, Florida.

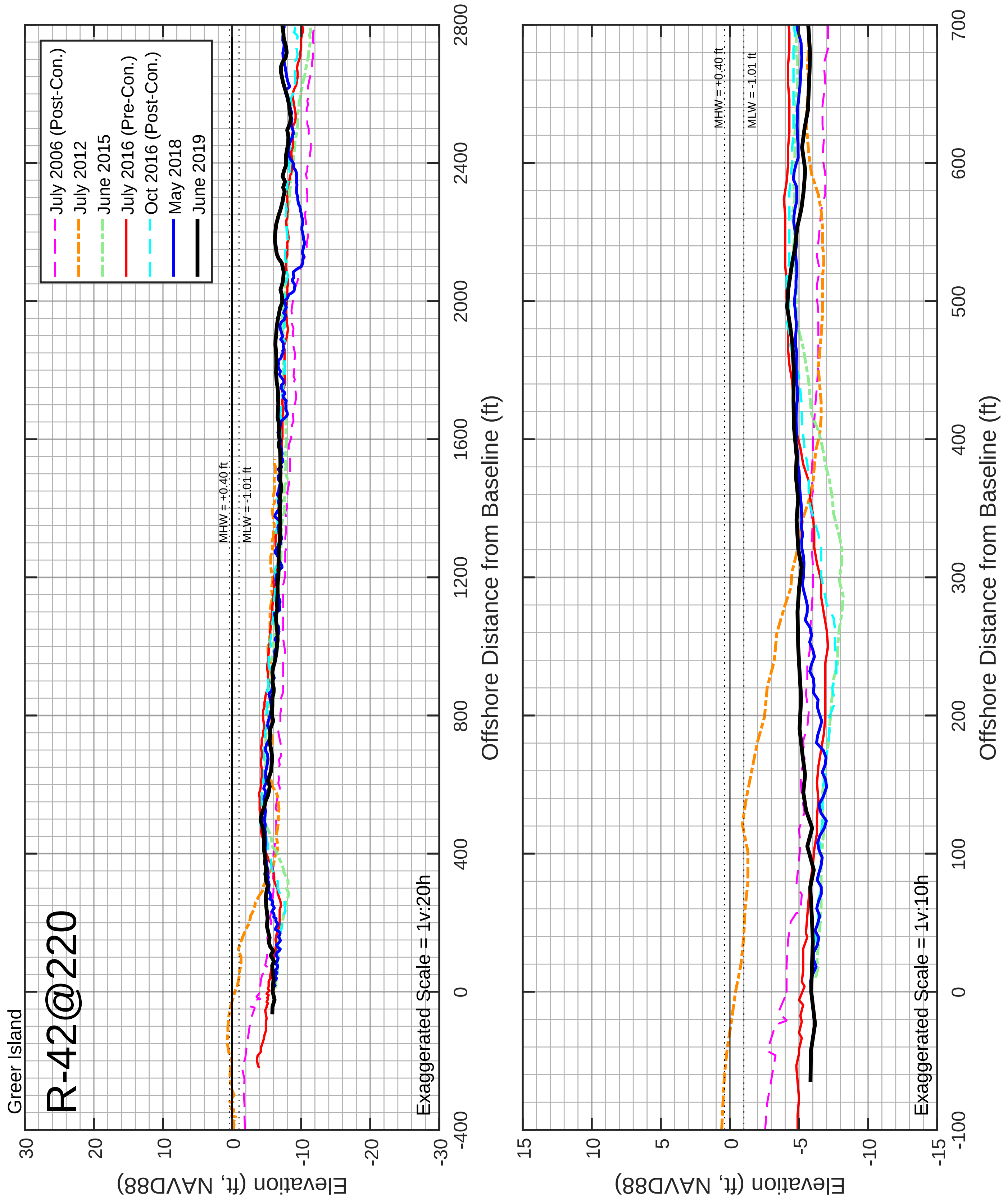

Figure B-006: Measured beach profiles at monument R-42@220 Longboat Key, Florida.

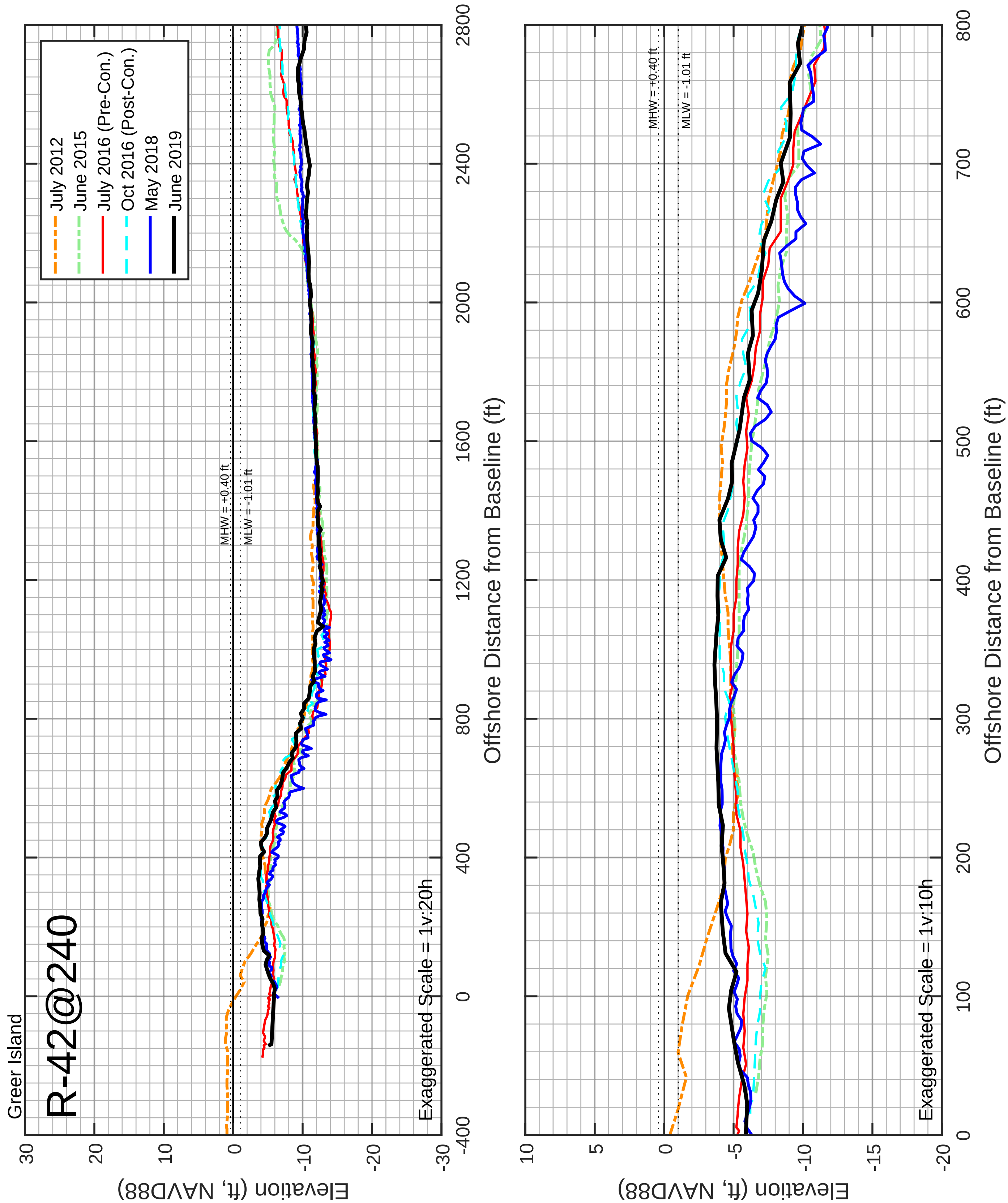

Figure B-007: Measured beach profiles at monument R-42@240 Longboat Key, Florida.

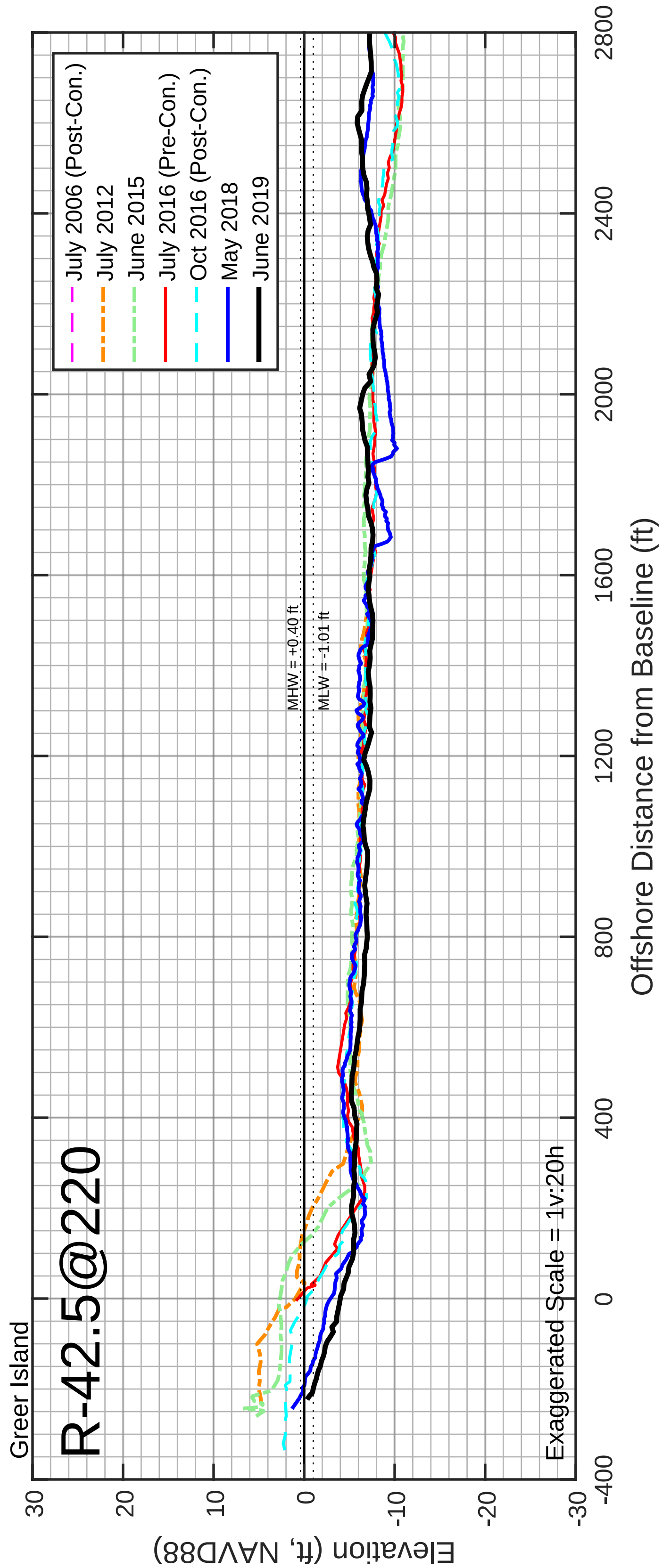

Figure B-008: Measured beach profiles at monument R-42.5@220 Longboat Key, Florida.

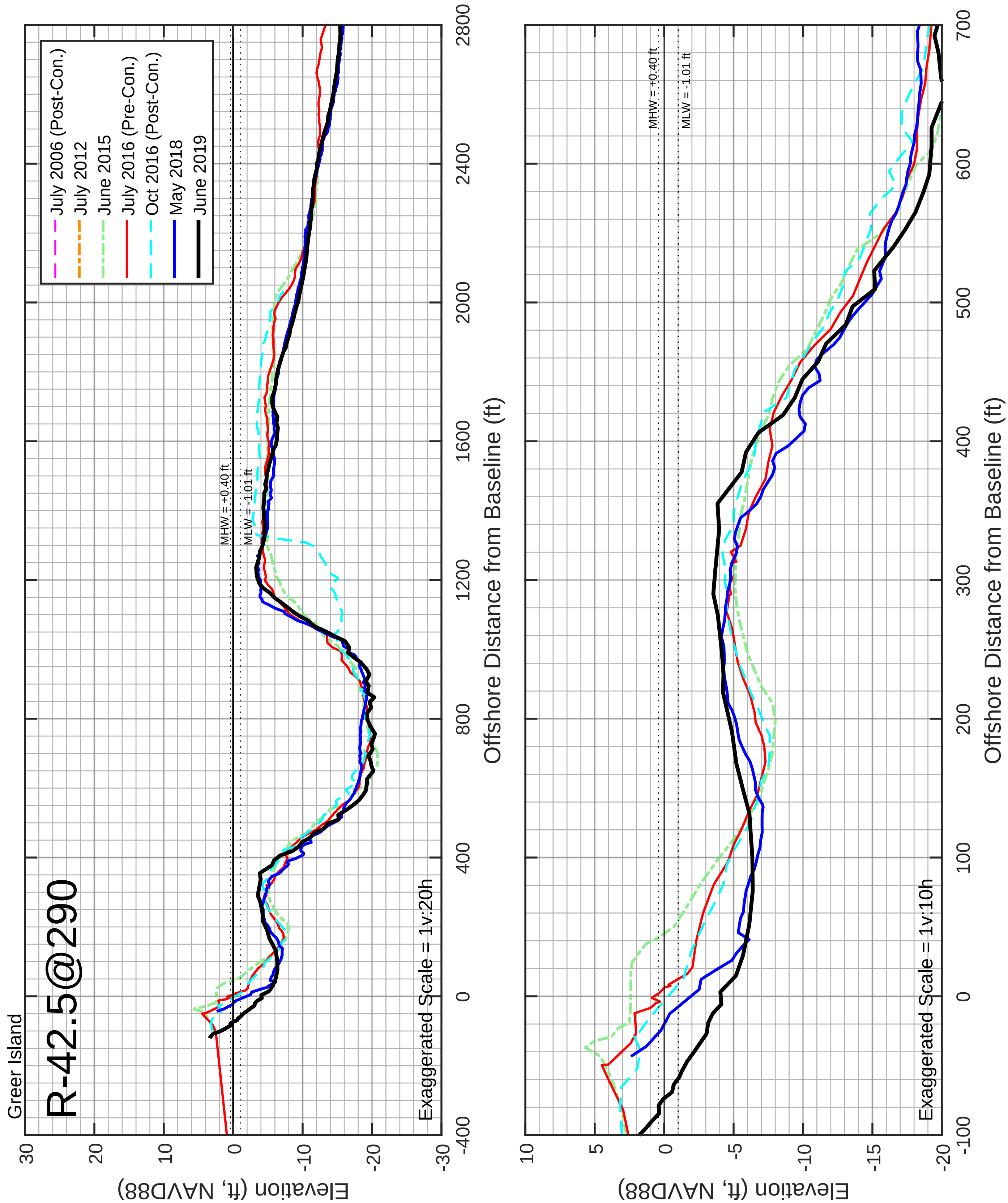

Figure B-009: Measured beach profiles at monument R-42.5@290 Longboat Key, Florida.

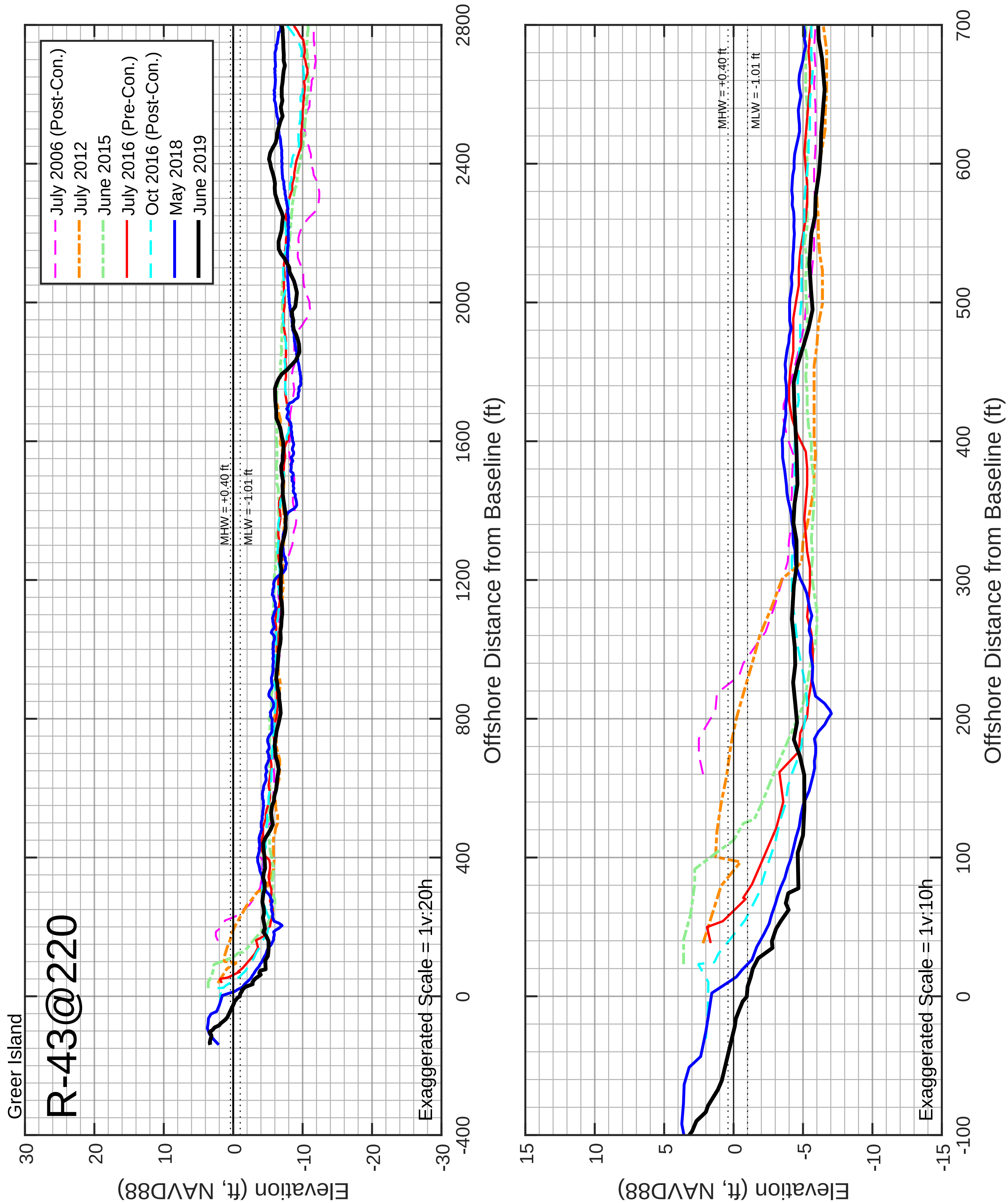

Figure B-010: Measured beach profiles at monument R-43@220 Longboat Key, Florida.

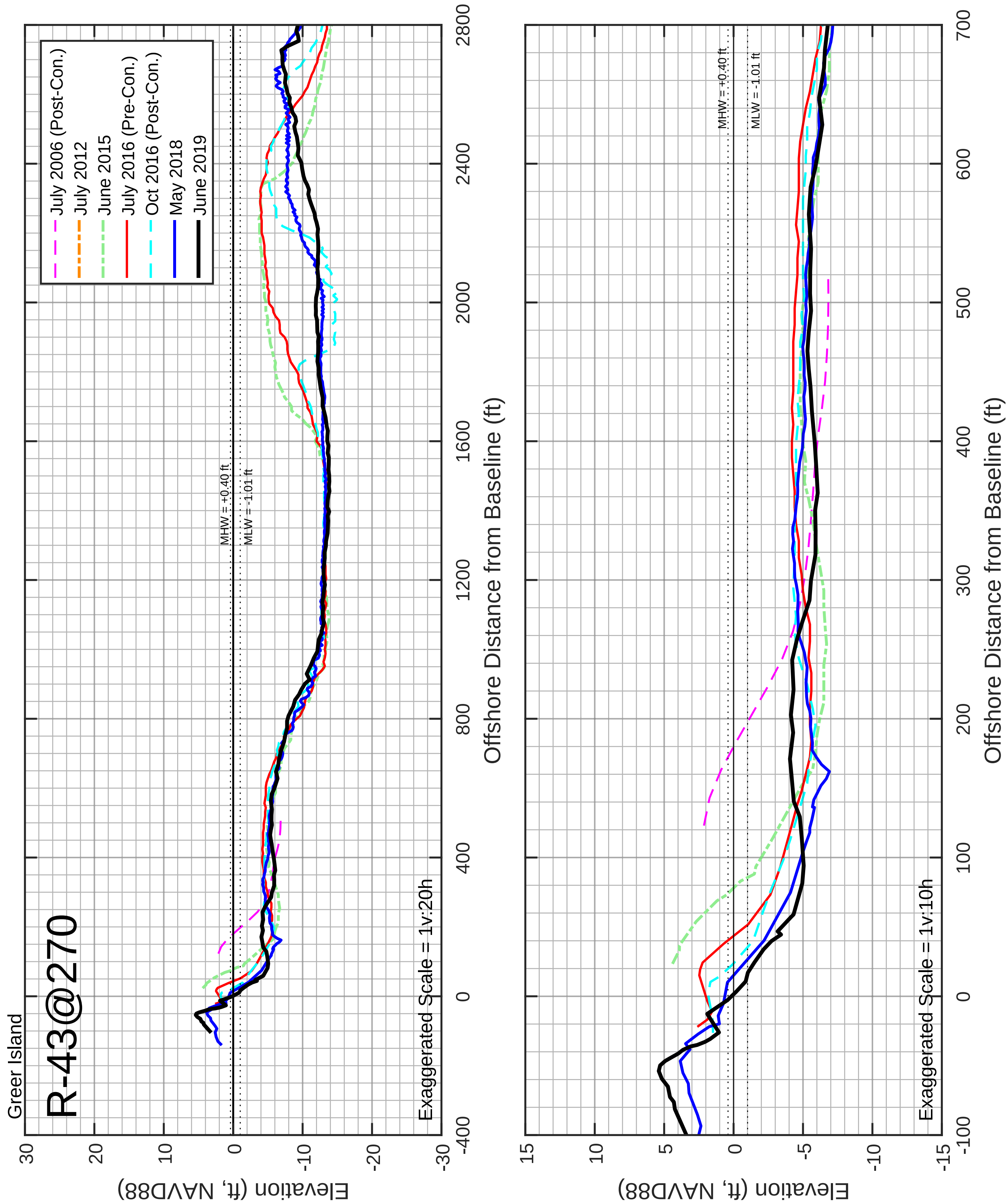

Figure B-011: Measured beach profiles at monument R-43@270 Longboat Key, Florida.

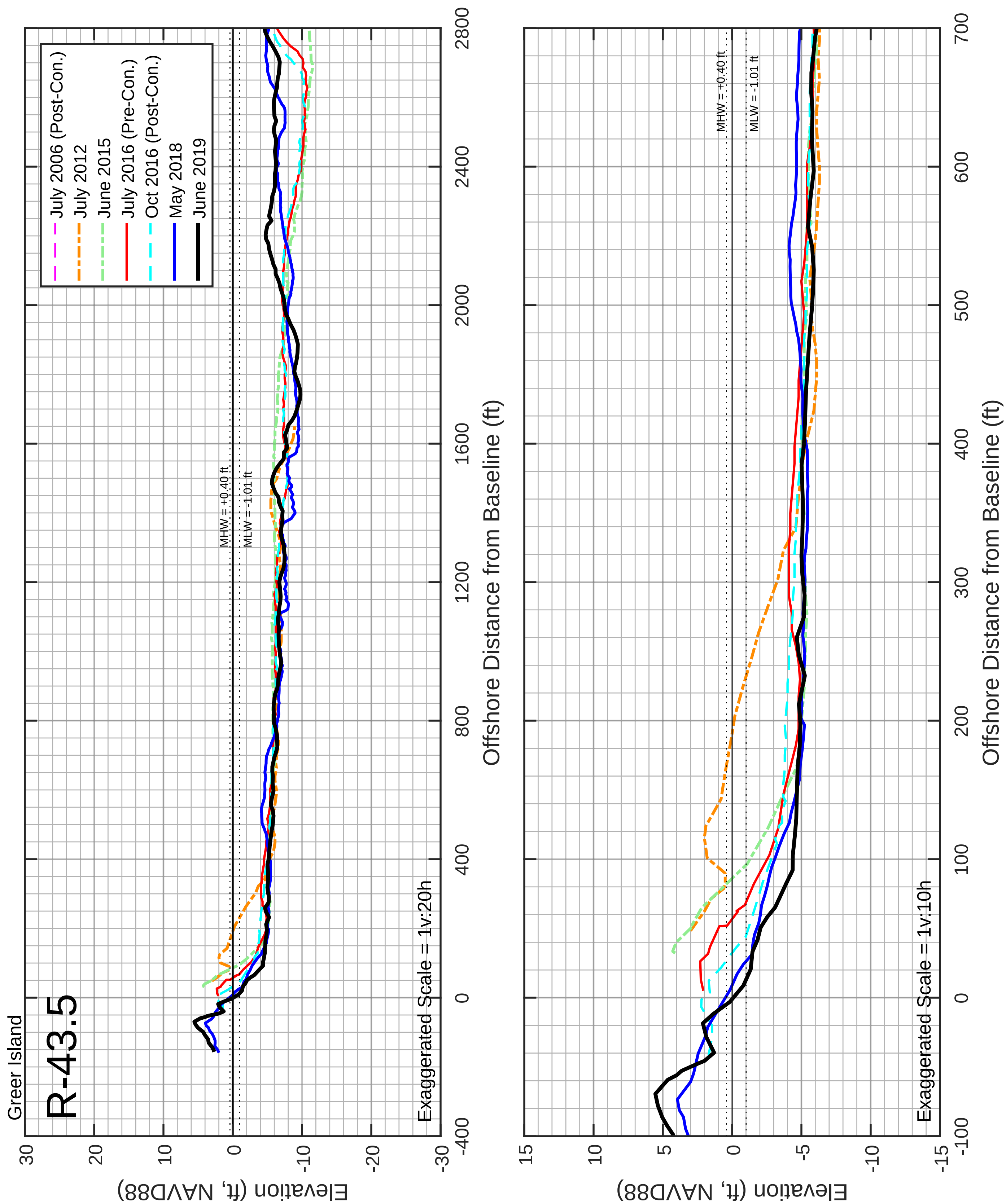

Figure B-012: Measured beach profiles at monument R-43.5 Longboat Key, Florida.

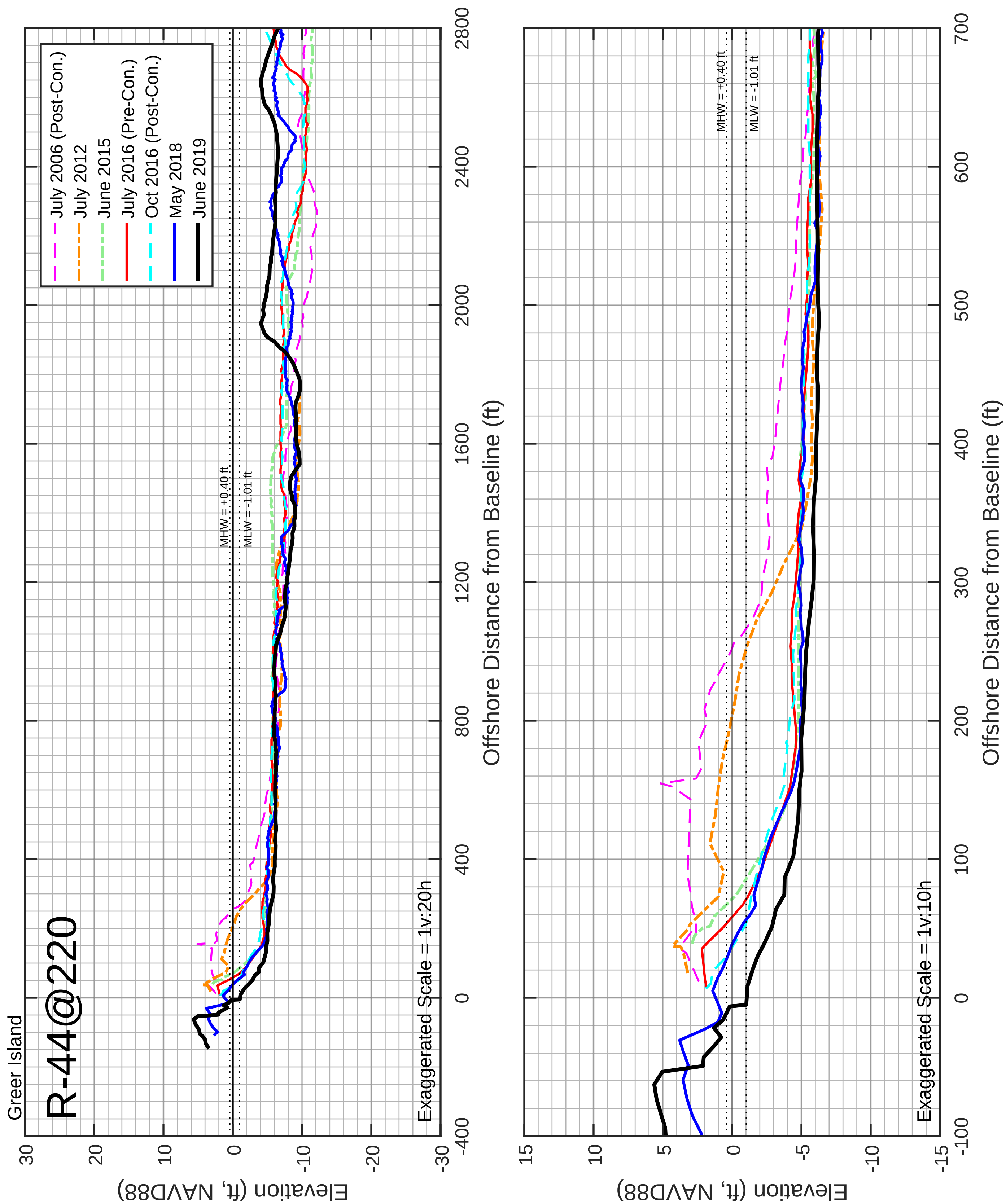

Figure B-013: Measured beach profiles at monument R-44@220 Longboat Key, Florida.

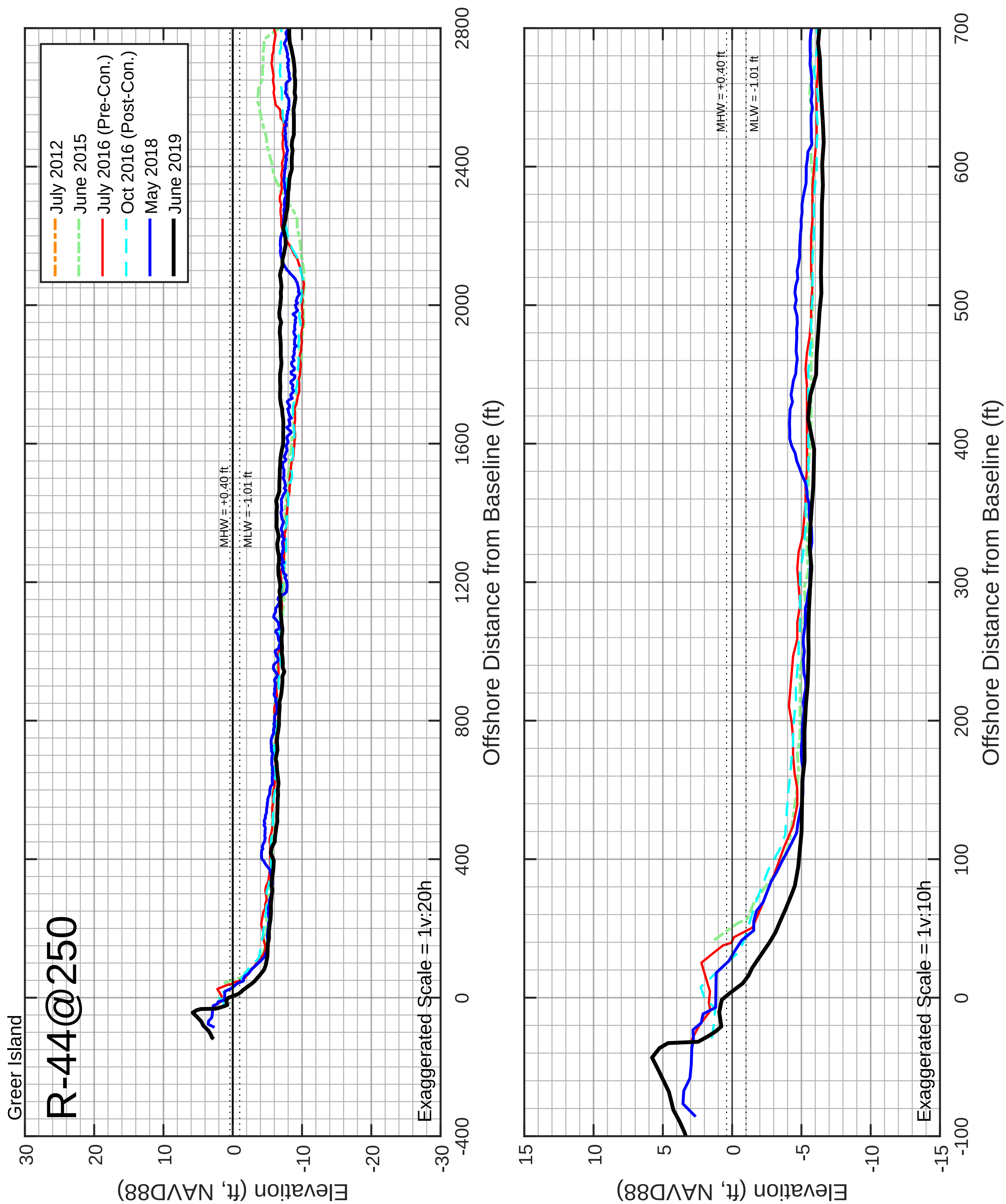

Figure B-014: Measured beach profiles at monument R-44@250 Longboat Key, Florida.

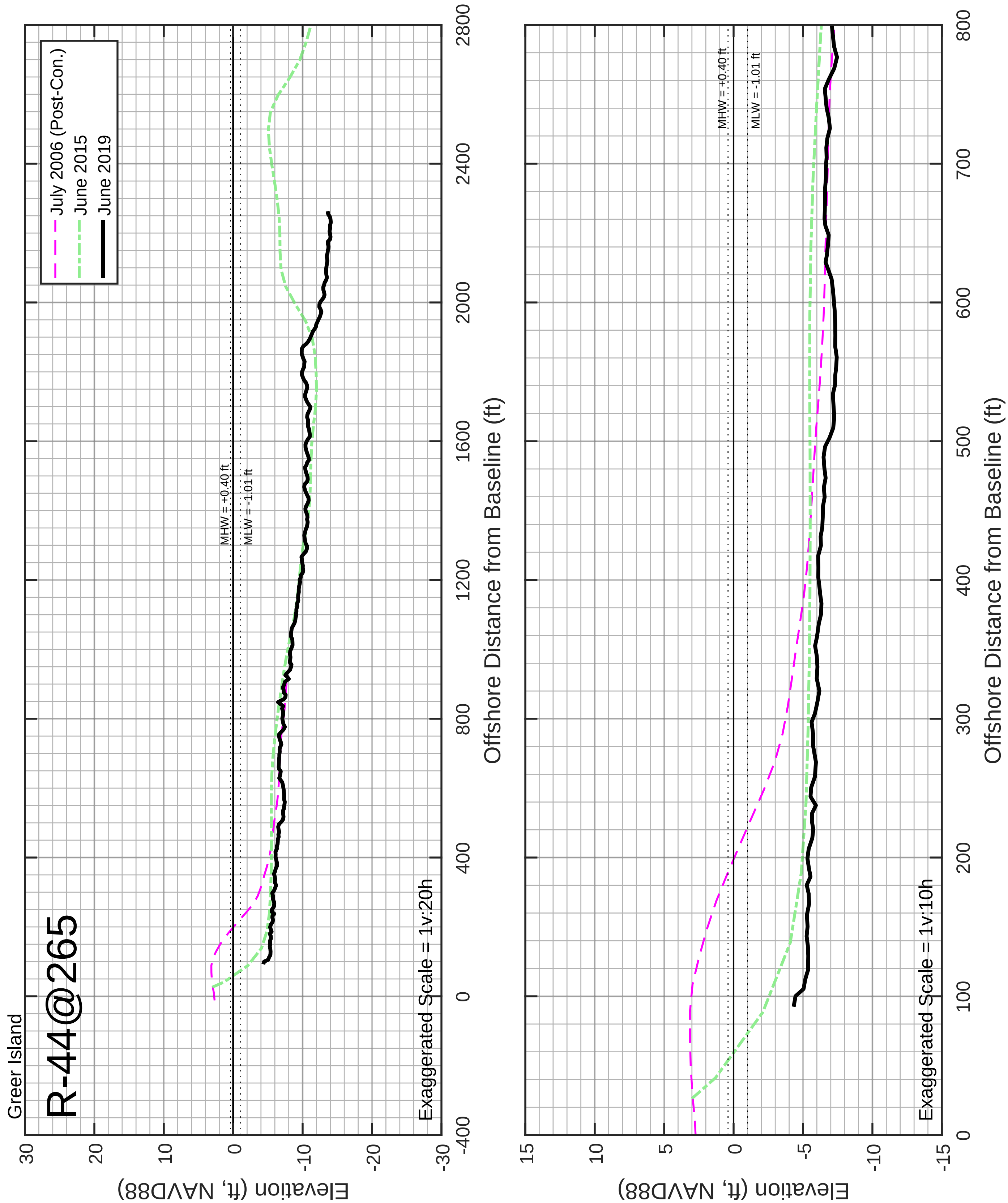

Figure B-015: Measured beach profiles at monument R-44@265 Longboat Key, Florida.

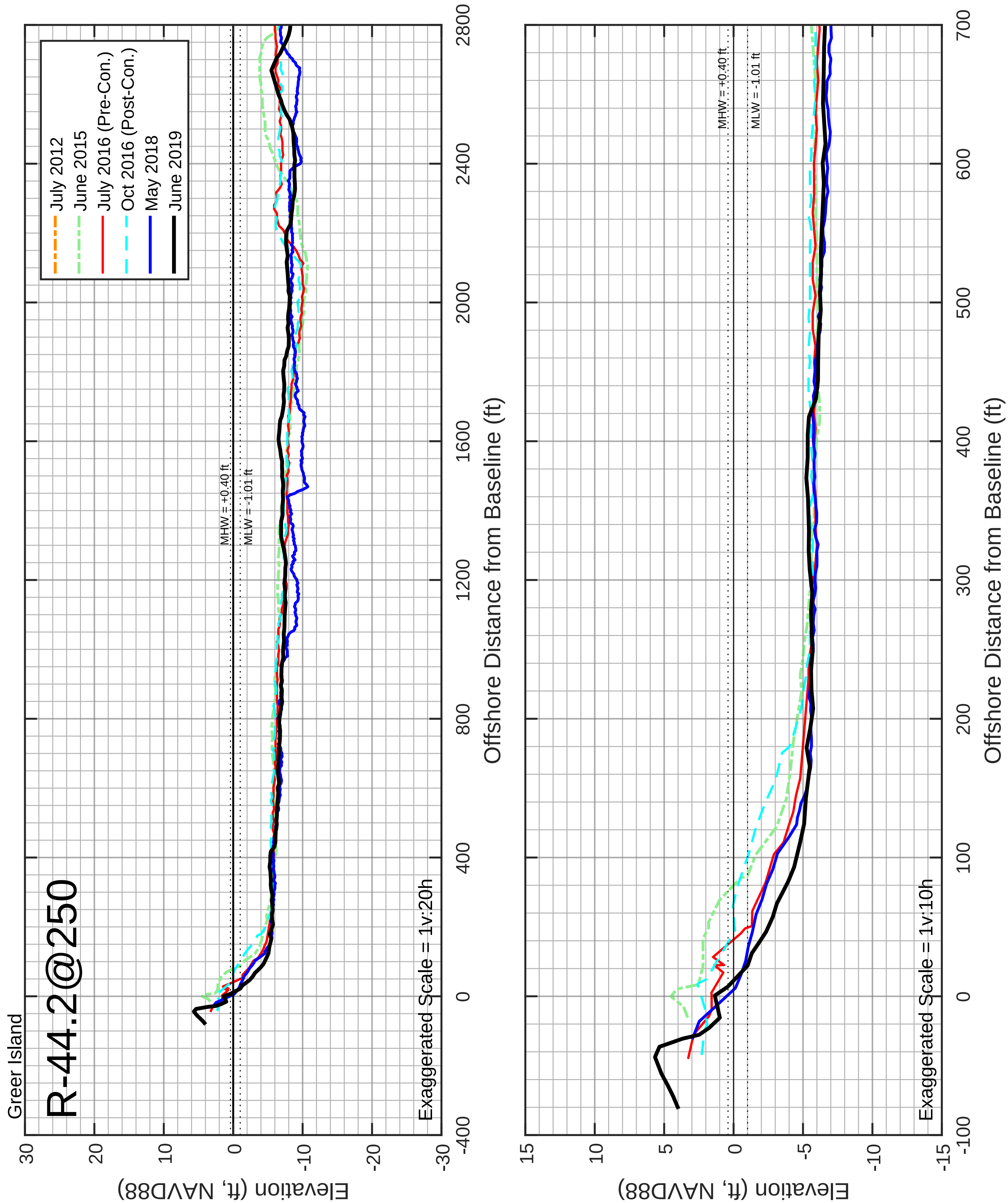

Figure B-016: Measured beach profiles at monument R-44.2@250 Longboat Key, Florida.

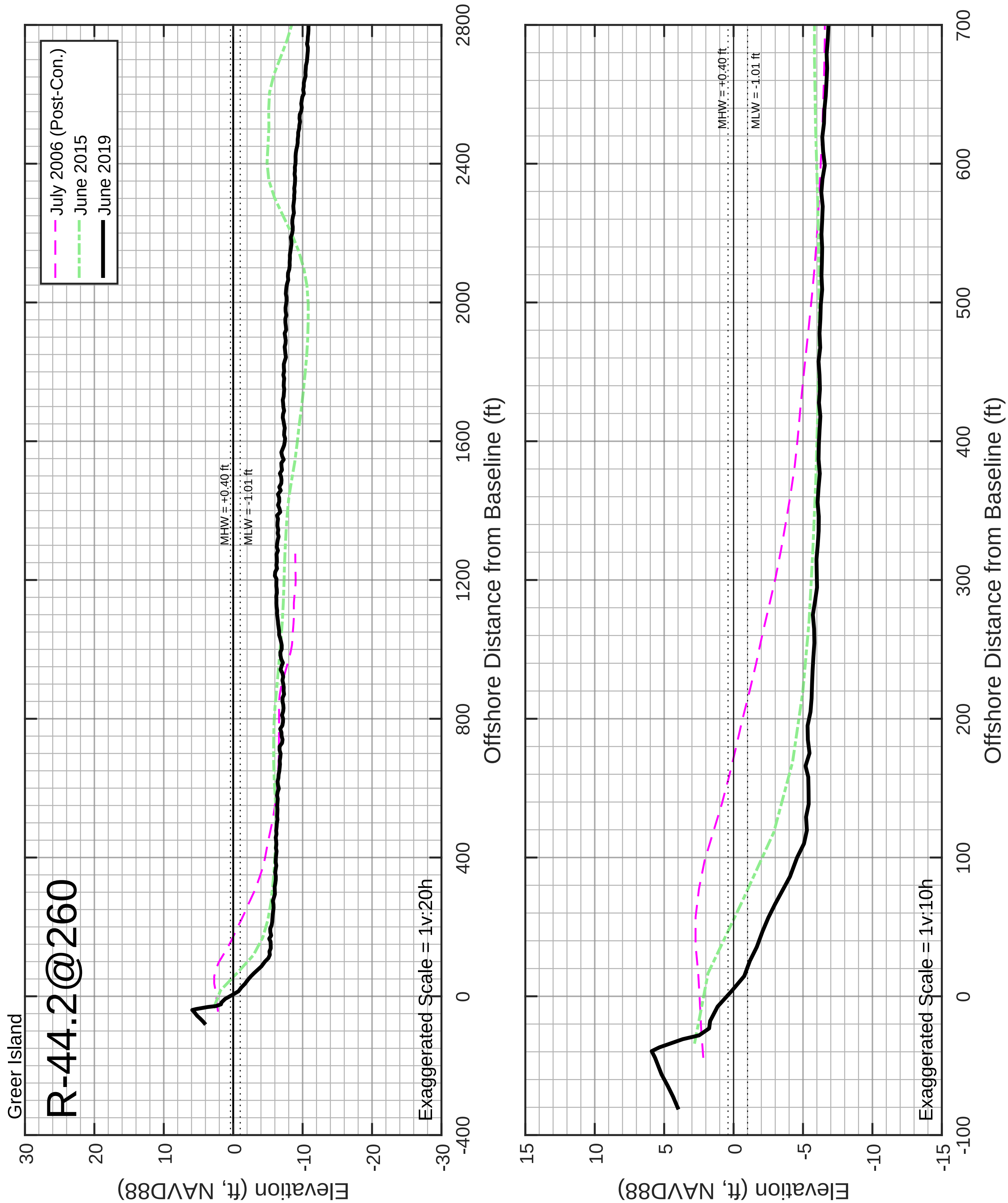

Figure B-017: Measured beach profiles at monument R-44.2@260 Longboat Key, Florida.

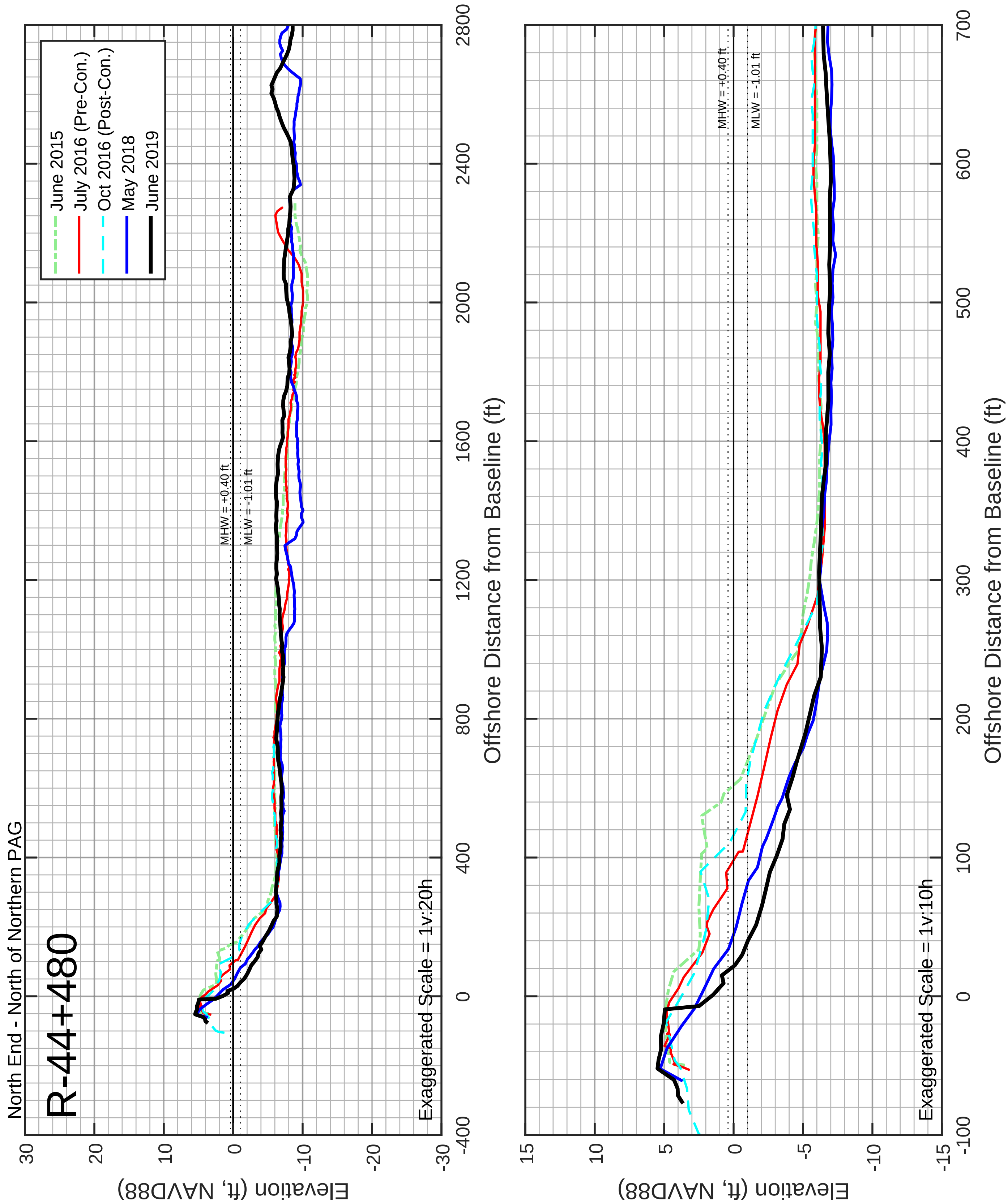

Figure B-018: Measured beach profiles at monument R-44+480 Longboat Key, Florida.

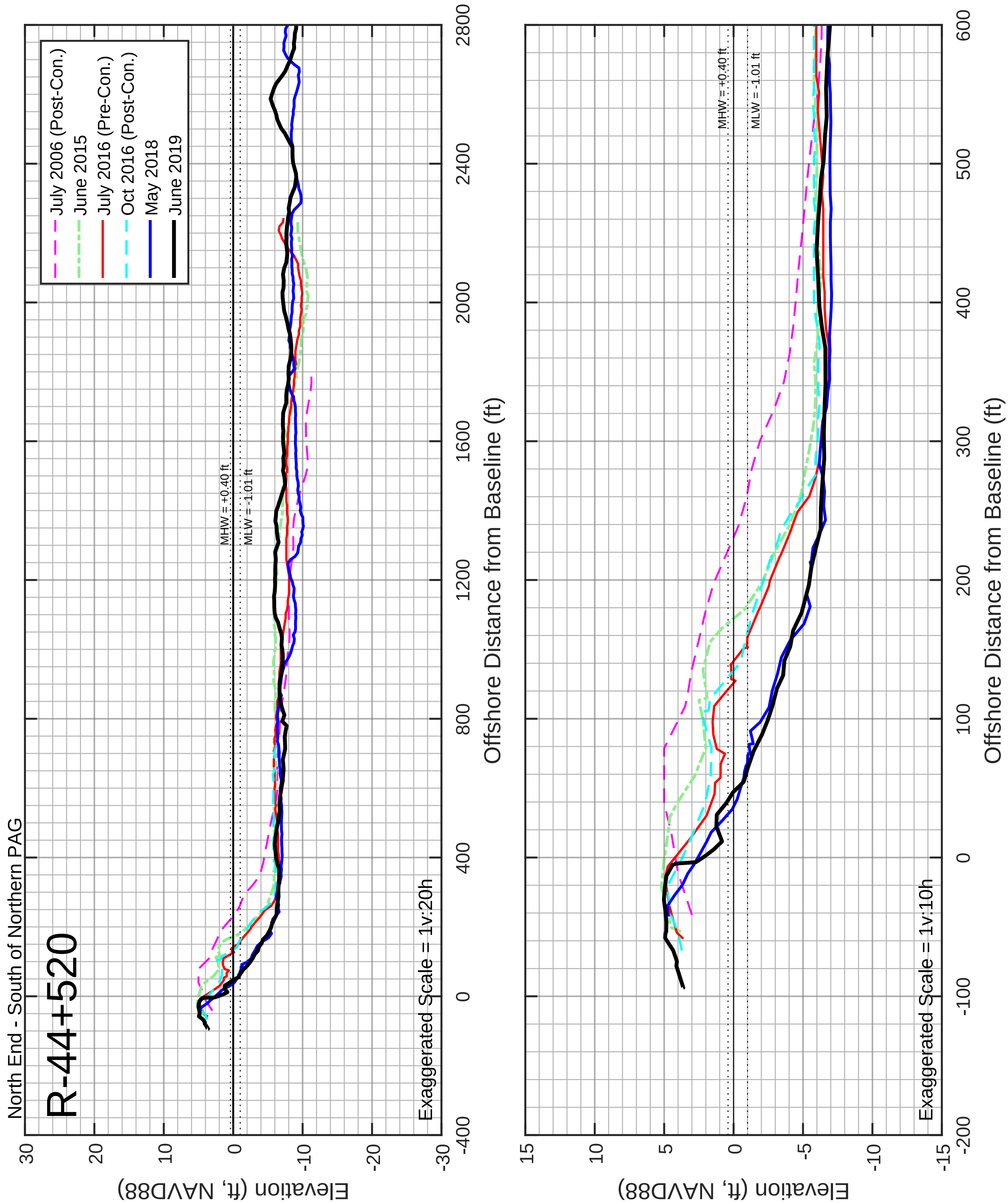

Figure B-019: Measured beach profiles at monument R-44+520 Longboat Key, Florida.

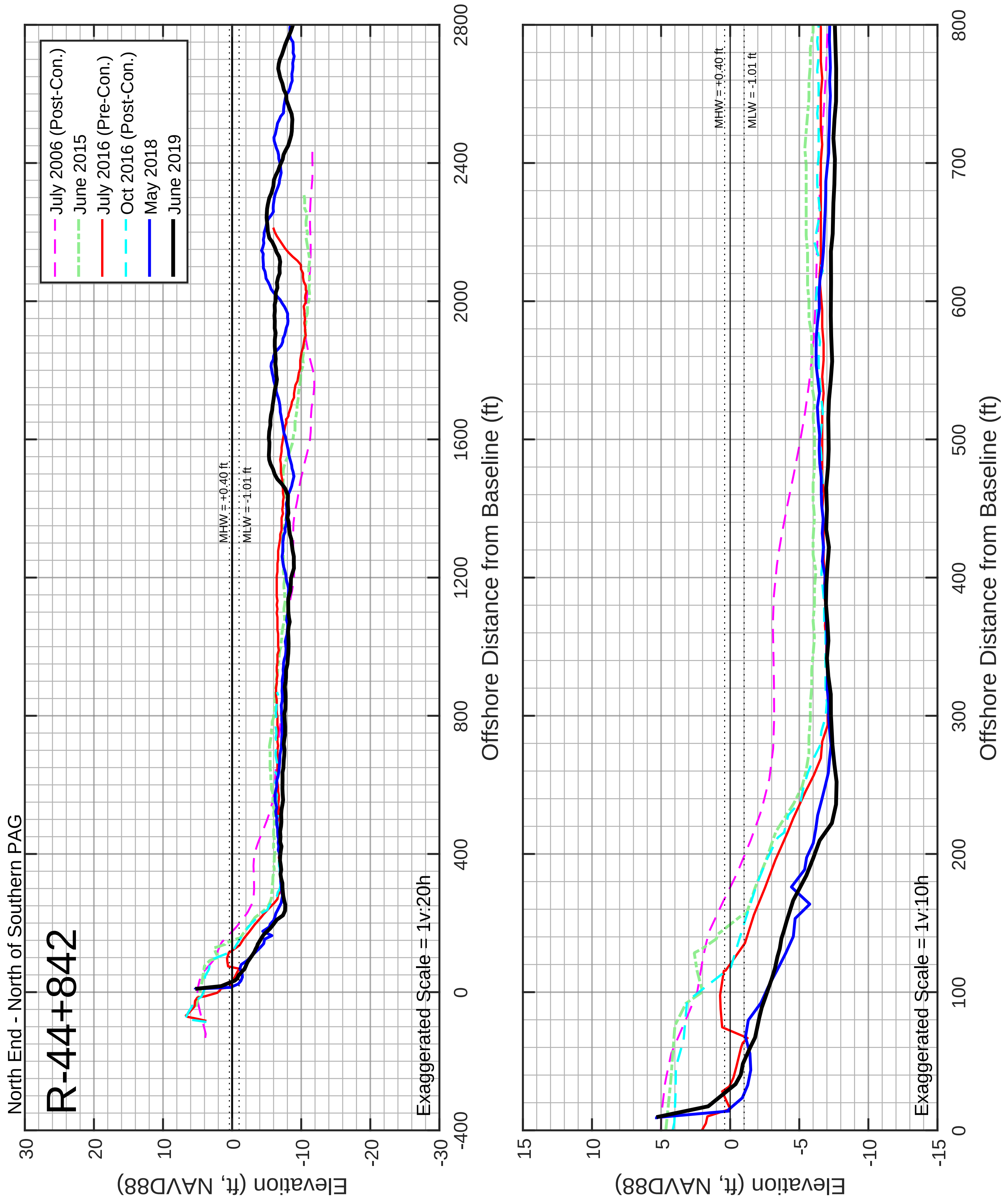

Figure B-020: Measured beach profiles at monument R-44+842 Longboat Key, Florida.

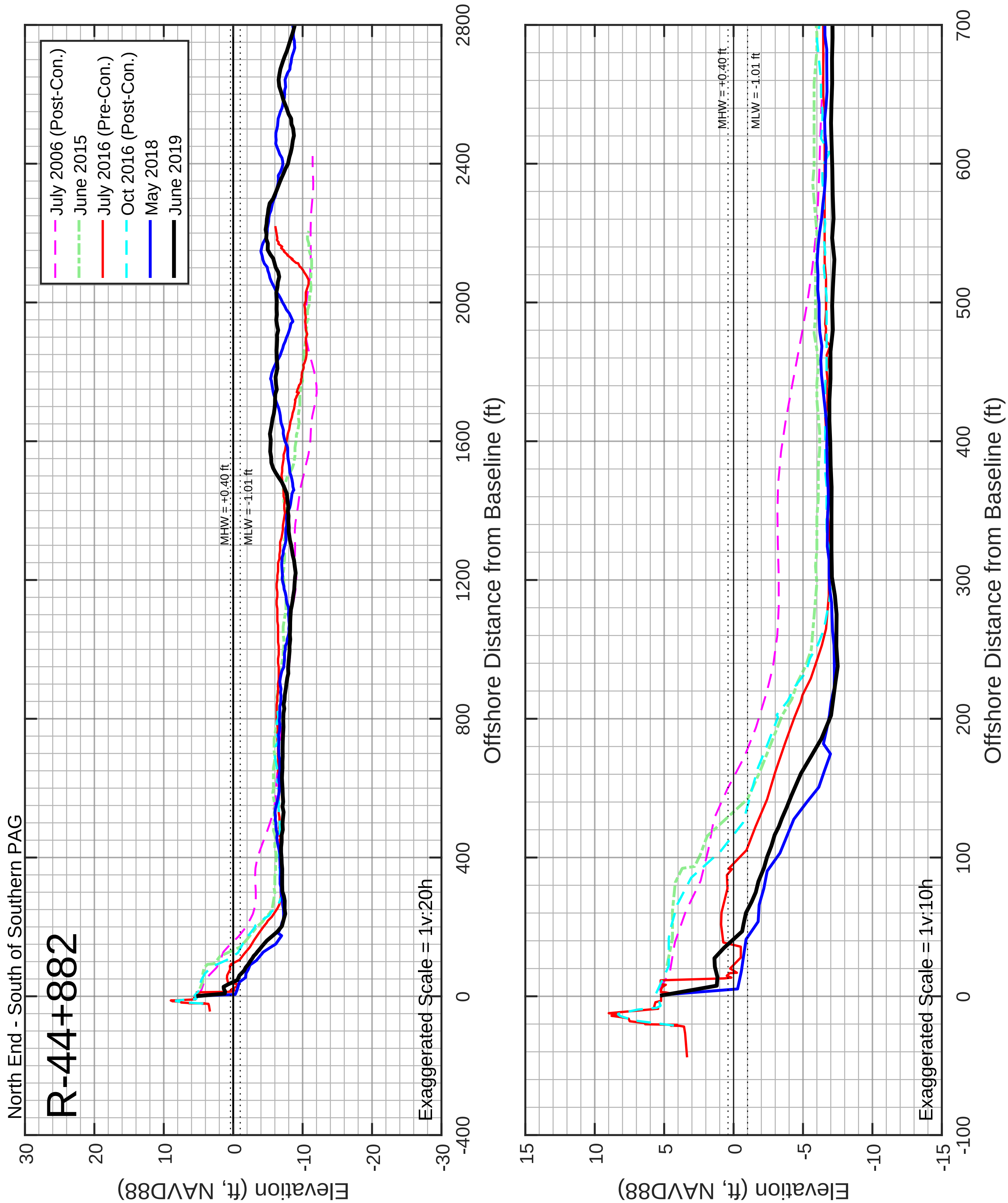

Figure B-021: Measured beach profiles at monument R-44+882 Longboat Key, Florida.

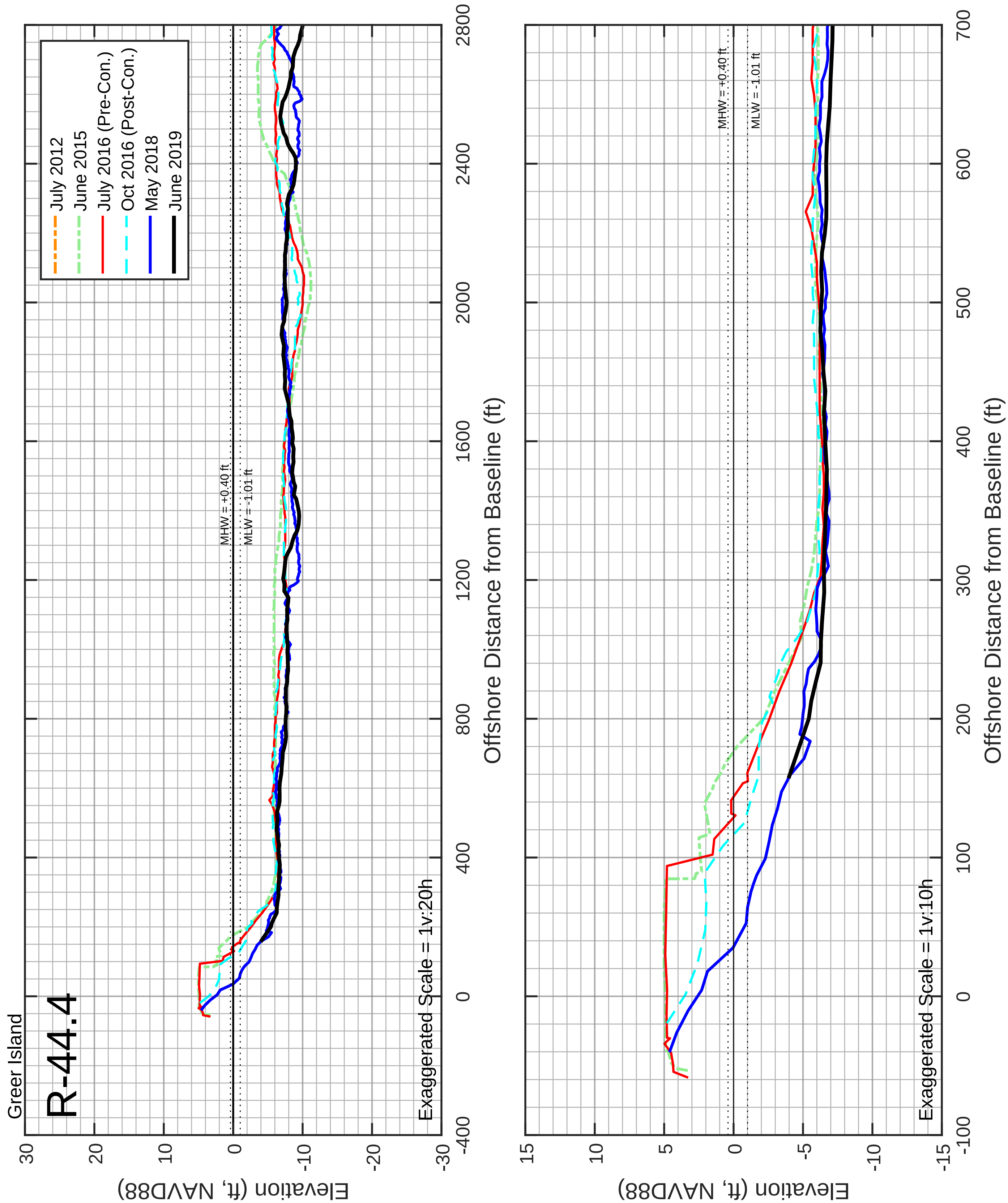

Figure B-022: Measured beach profiles at monument R-44.4 Longboat Key, Florida.

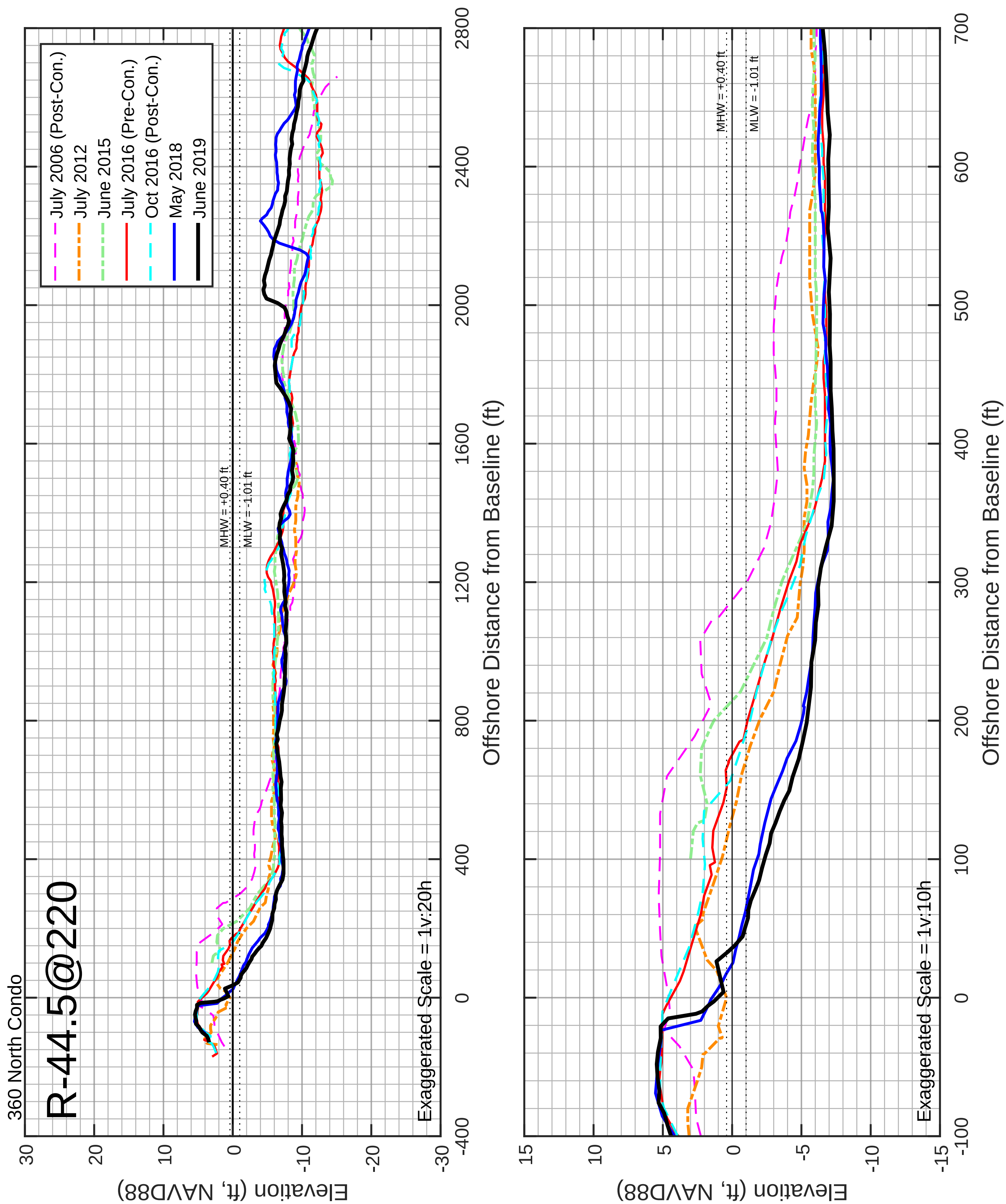

Figure B-023: Measured beach profiles at monument R-44.5@220 Longboat Key, Florida.

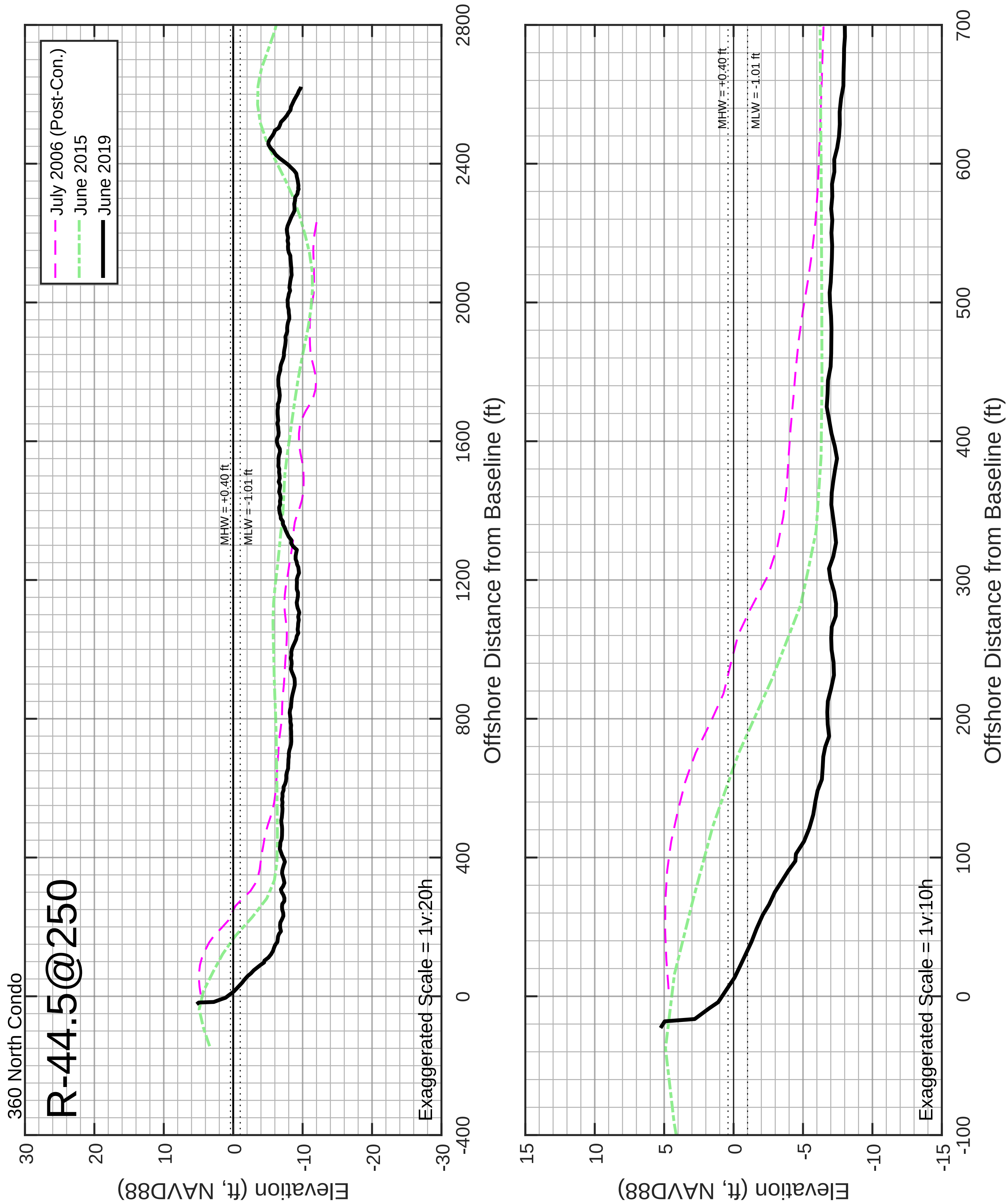

Figure B-024: Measured beach profiles at monument R-44.5@250 Longboat Key, Florida.

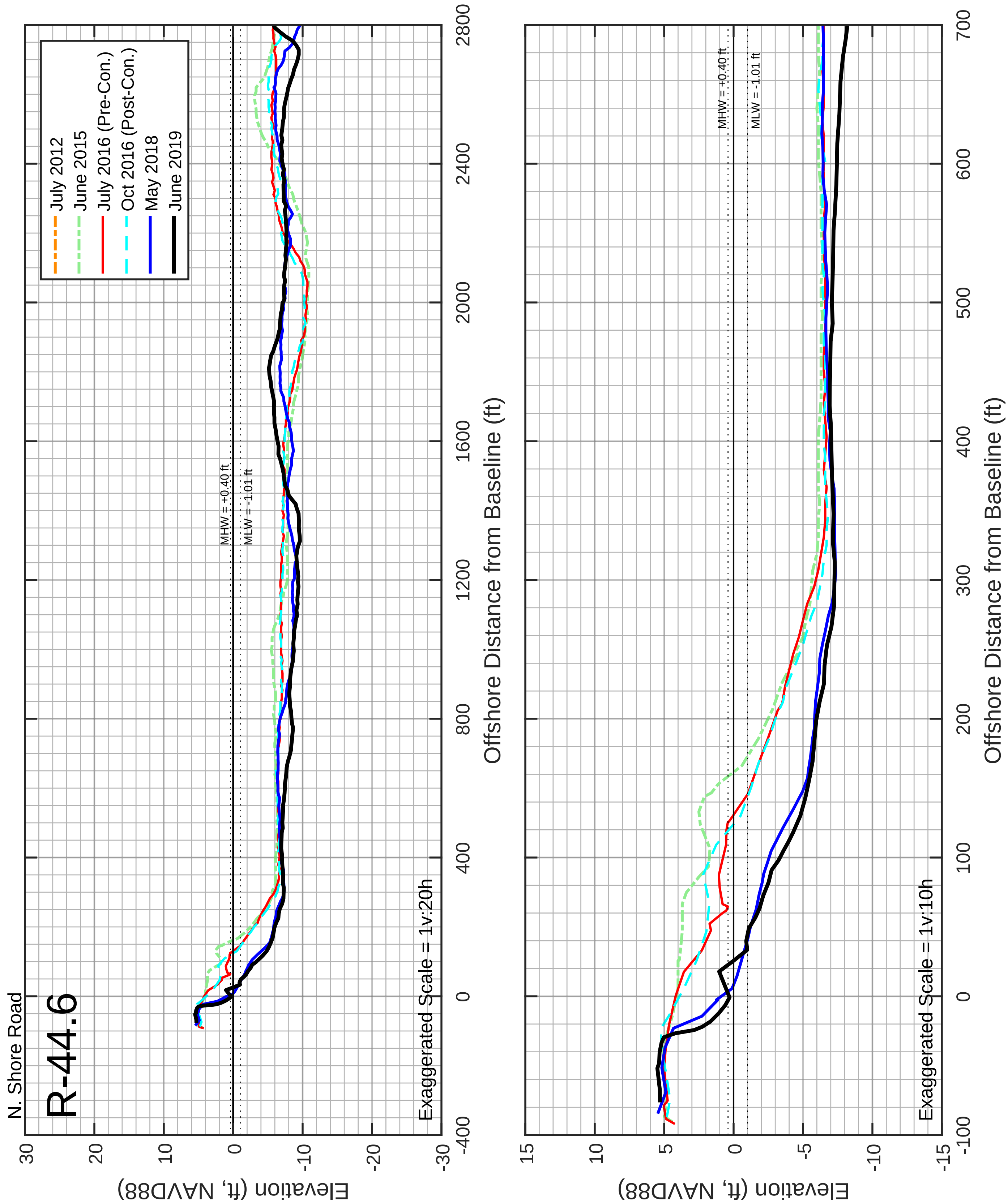

Figure B-025: Measured beach profiles at monument R-44.6 Longboat Key, Florida.

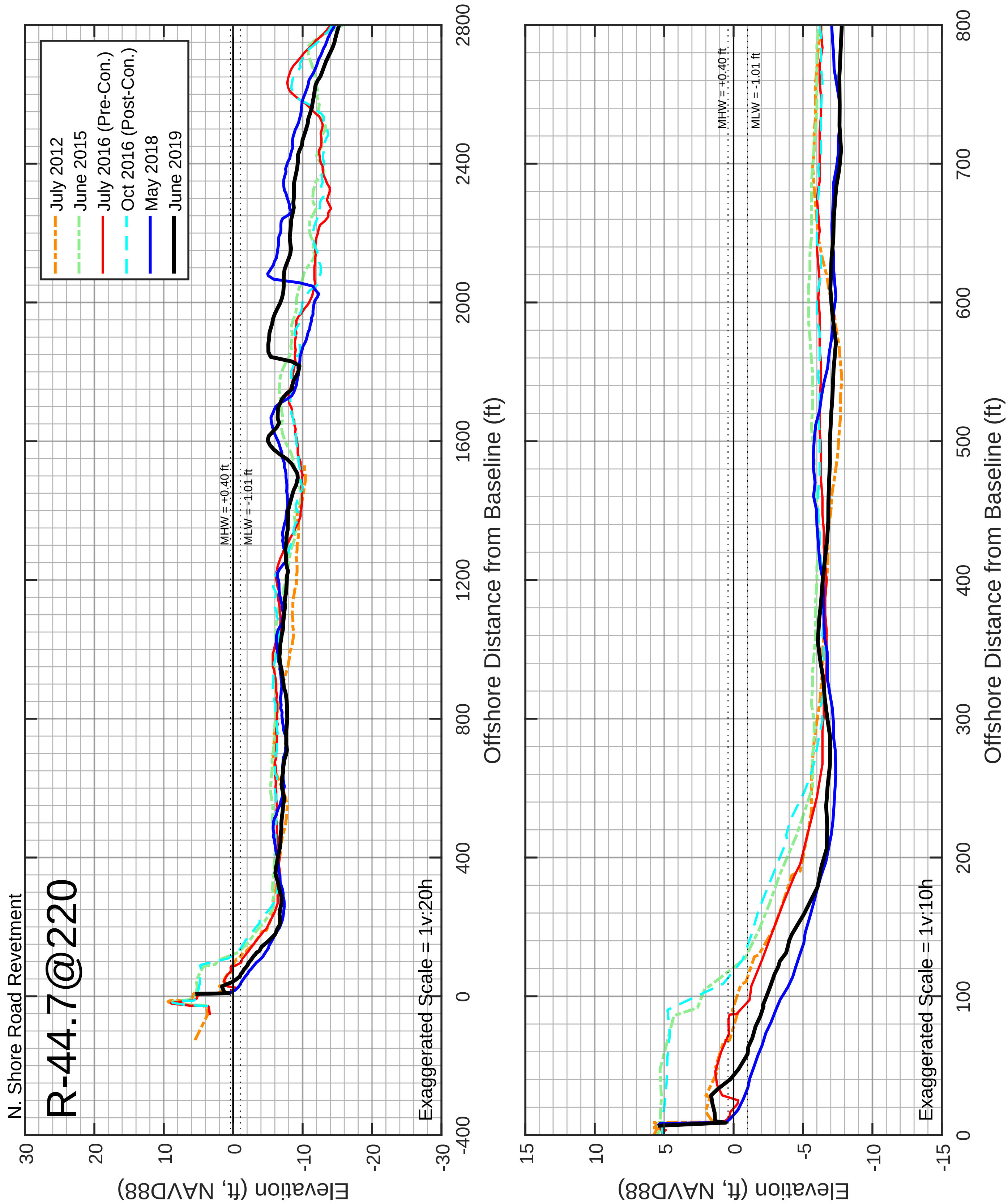

Figure B-026: Measured beach profiles at monument R-44.7@220 Longboat Key, Florida.

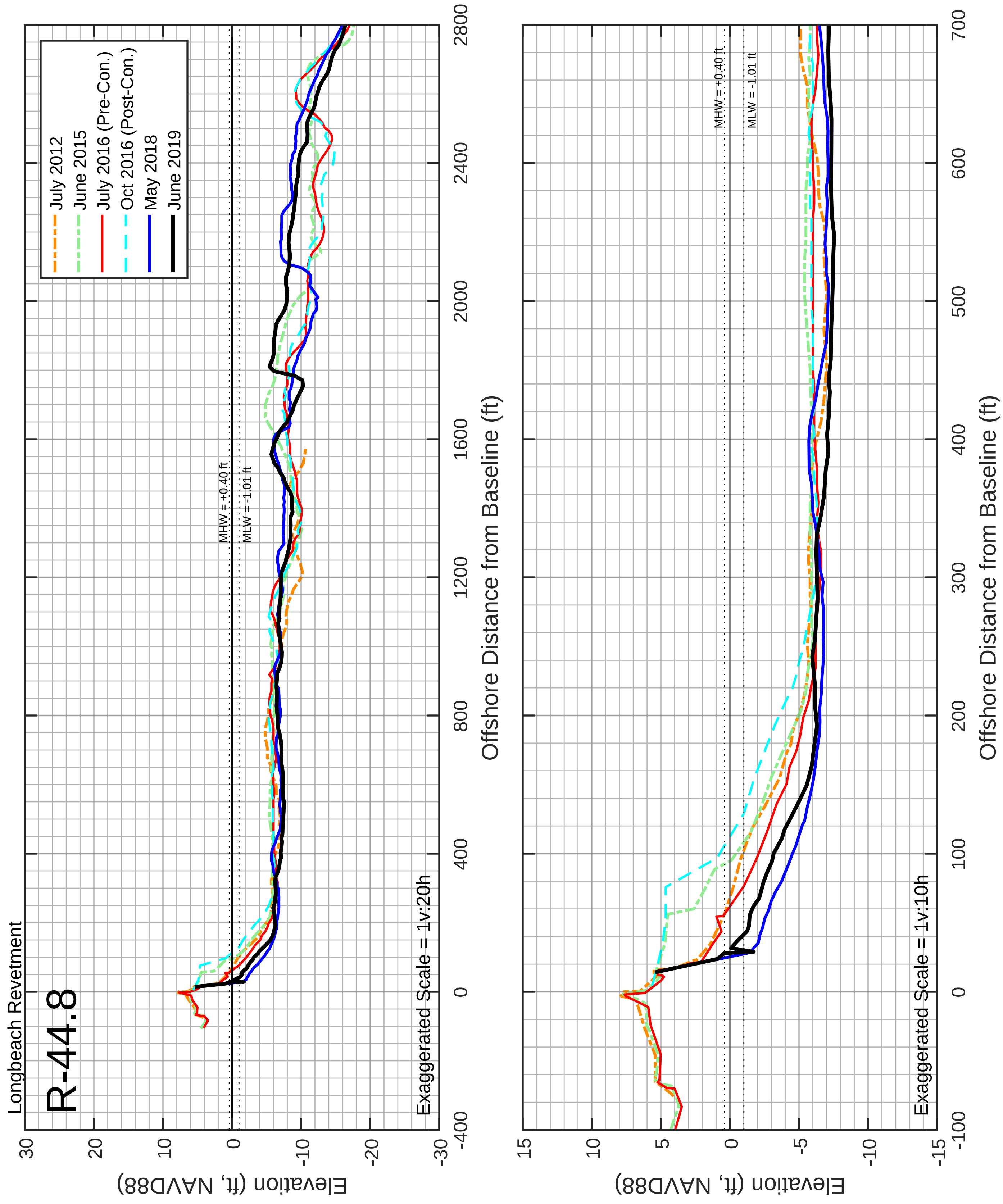

Figure B-027: Measured beach profiles at monument R-44.8 Longboat Key, Florida.

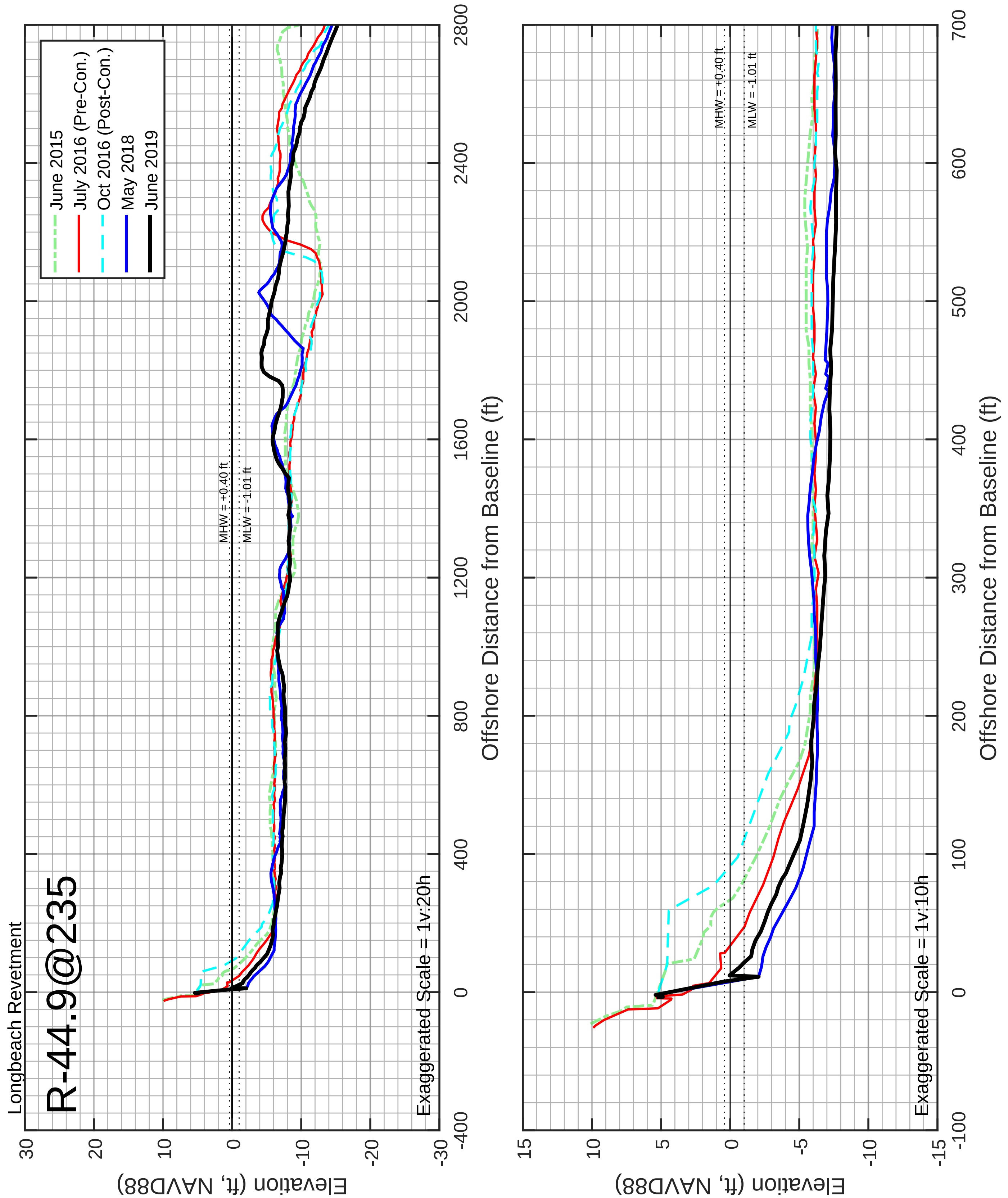

Figure B-028: Measured beach profiles at monument R-44.9@235 Longboat Key, Florida.

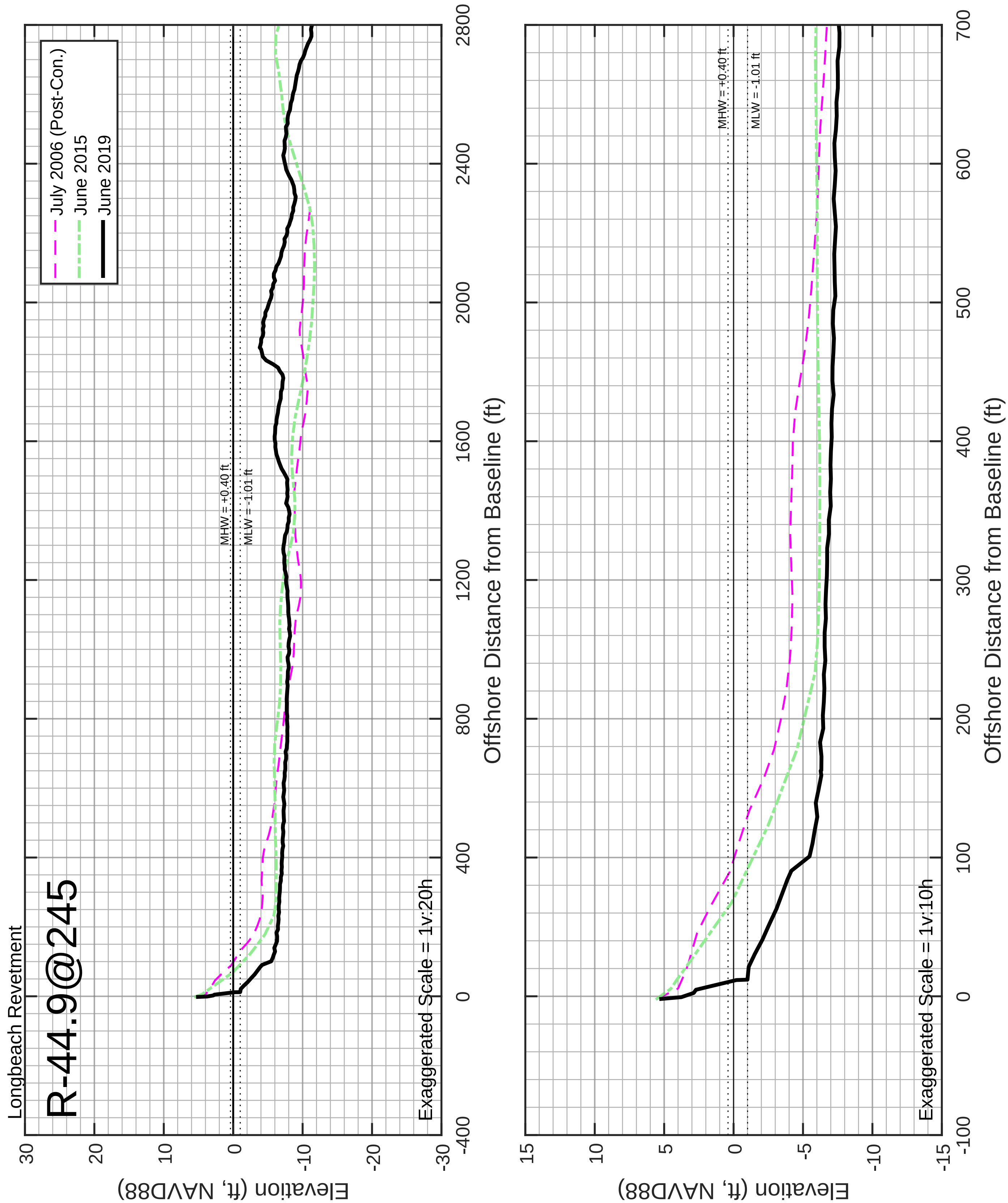

Figure B-029: Measured beach profiles at monument R-44.9@245 Longboat Key, Florida.

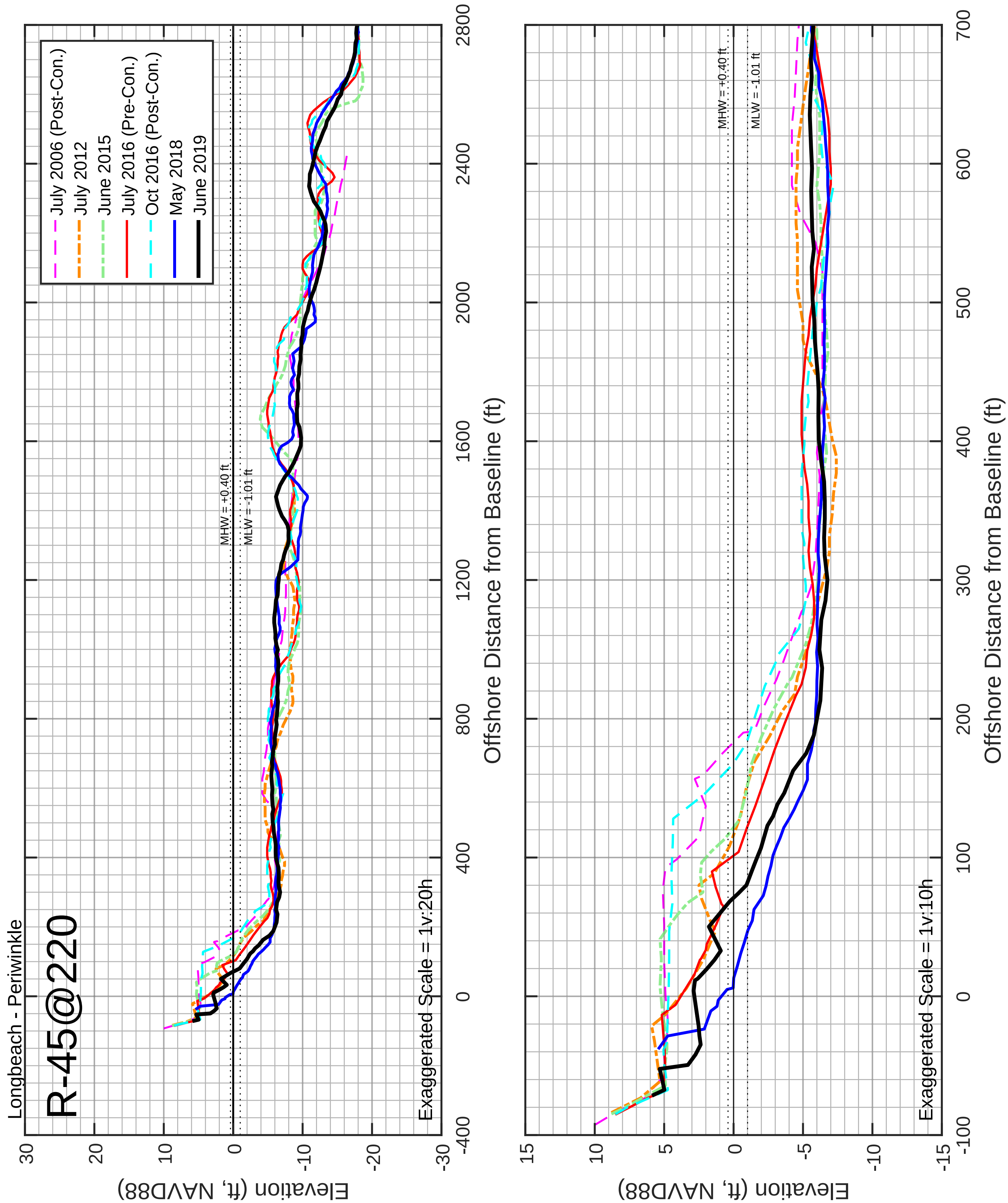

Figure B-030: Measured beach profiles at monument R-45@220 Longboat Key, Florida.

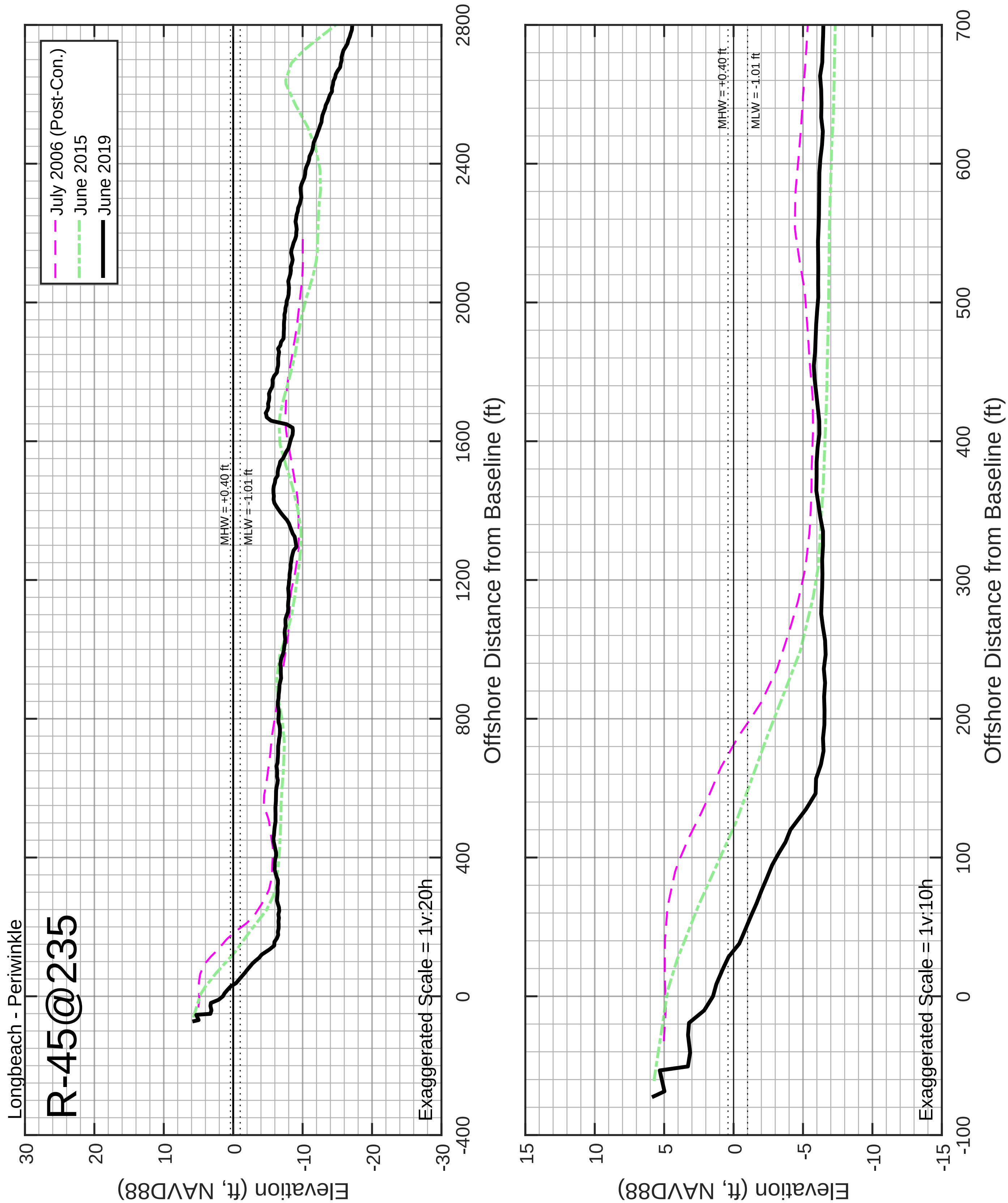

Figure B-031: Measured beach profiles at monument R-45@235 Longboat Key, Florida.

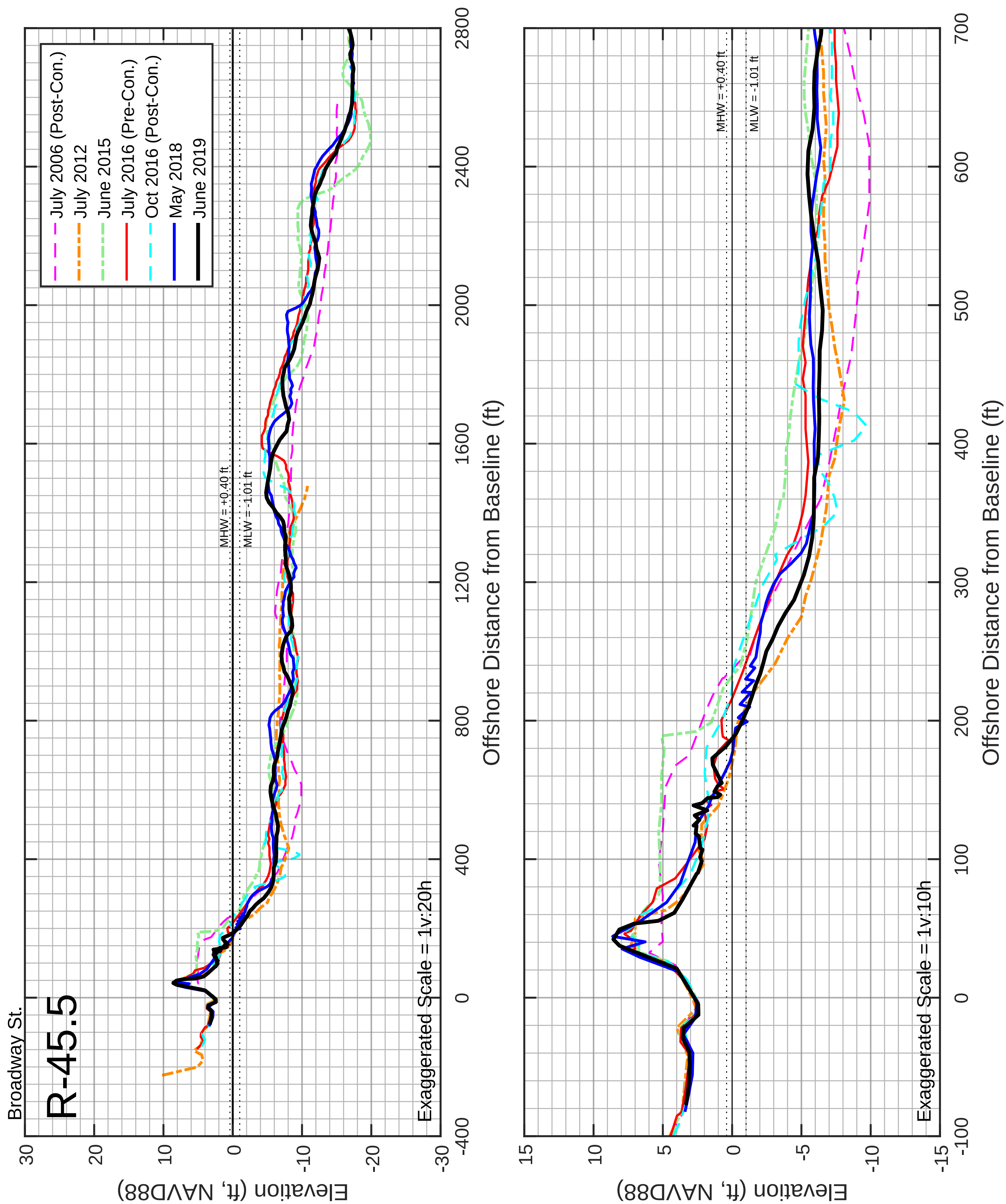

Figure B-032: Measured beach profiles at monument R-45.5 Longboat Key, Florida.

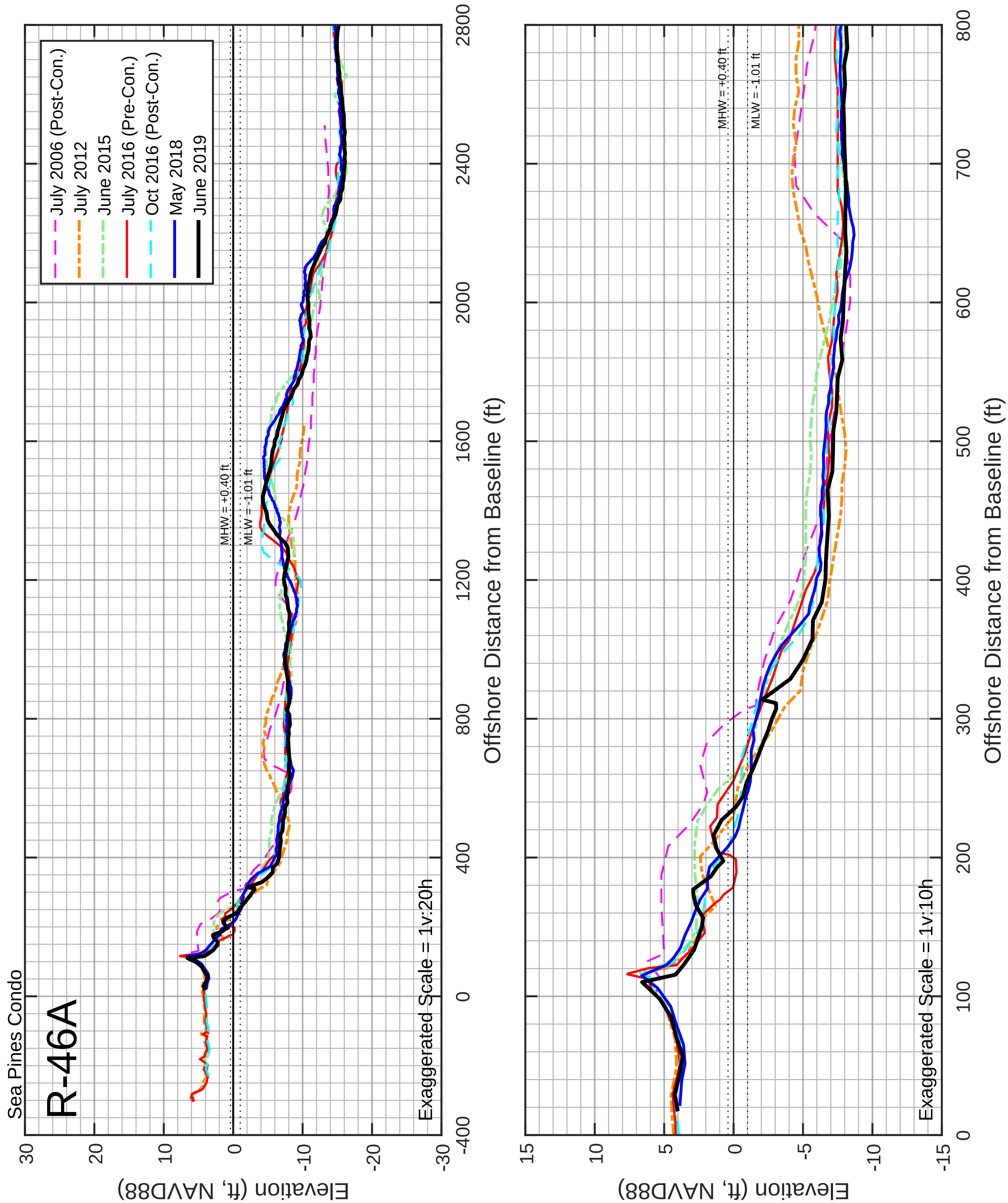

Figure B-033: Measured beach profiles at monument R-46A Longboat Key, Florida.

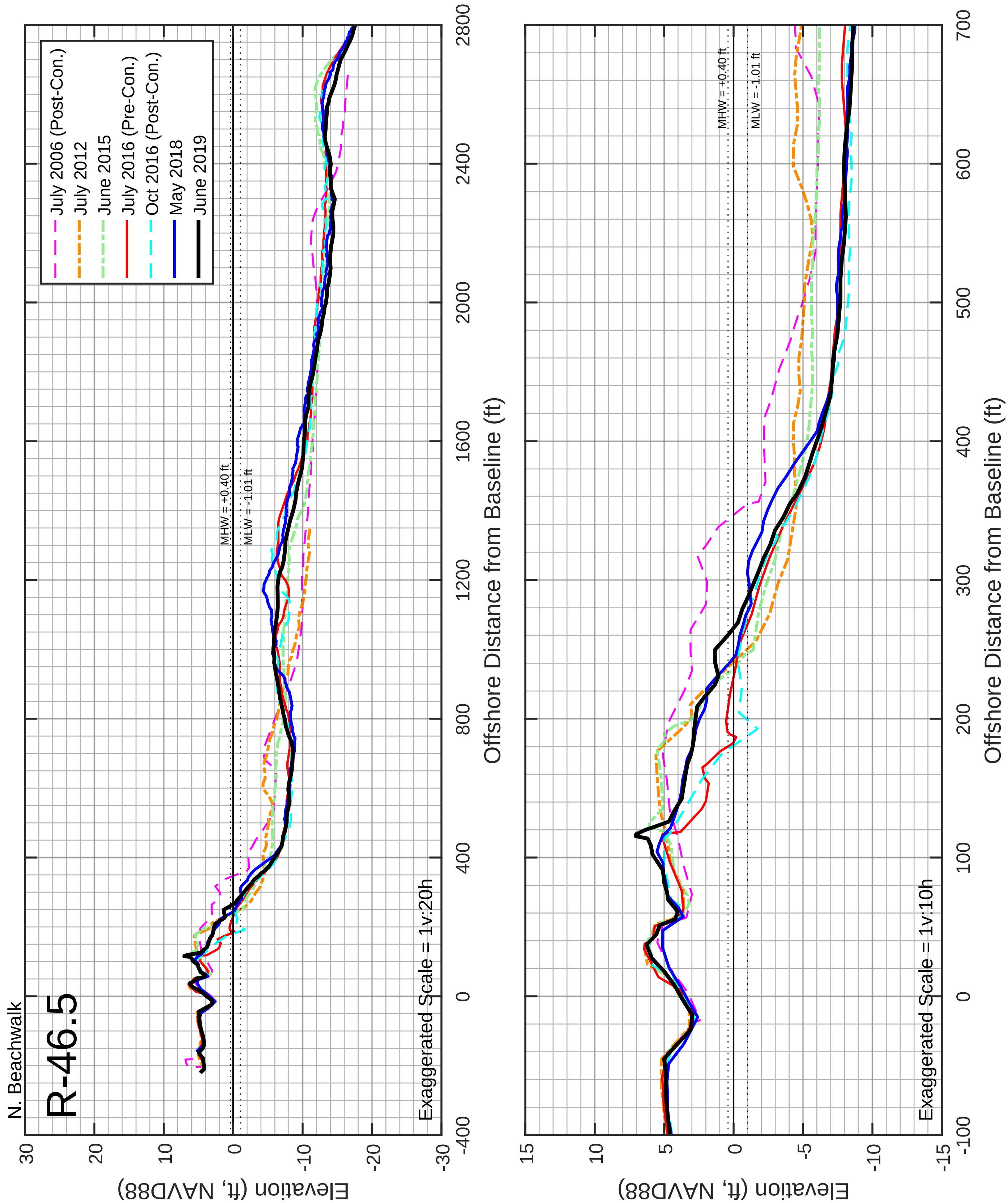

Figure B-034: Measured beach profiles at monument R-46.5 Longboat Key, Florida.

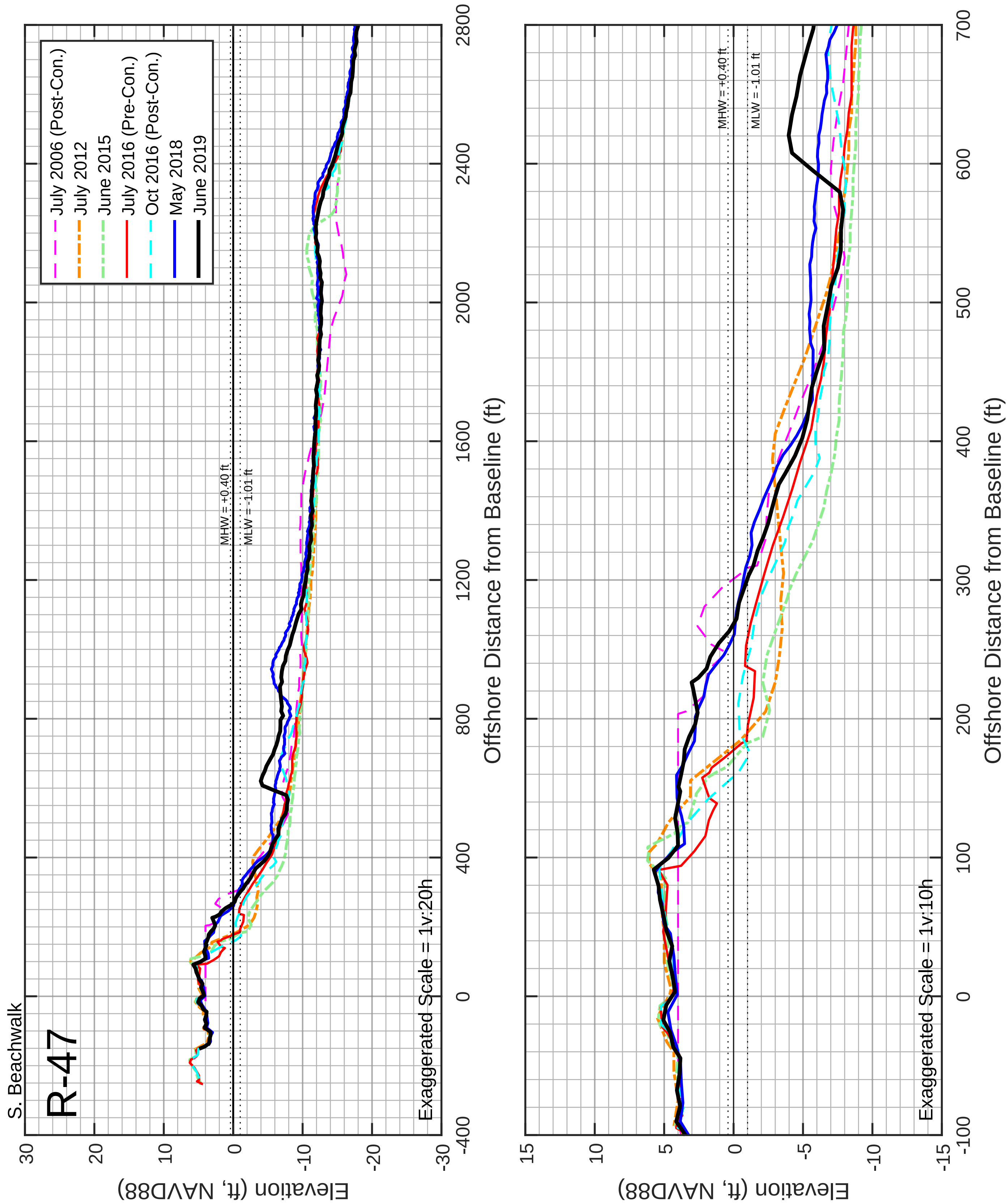

Figure B-035: Measured beach profiles at monument R-47 Longboat Key, Florida.

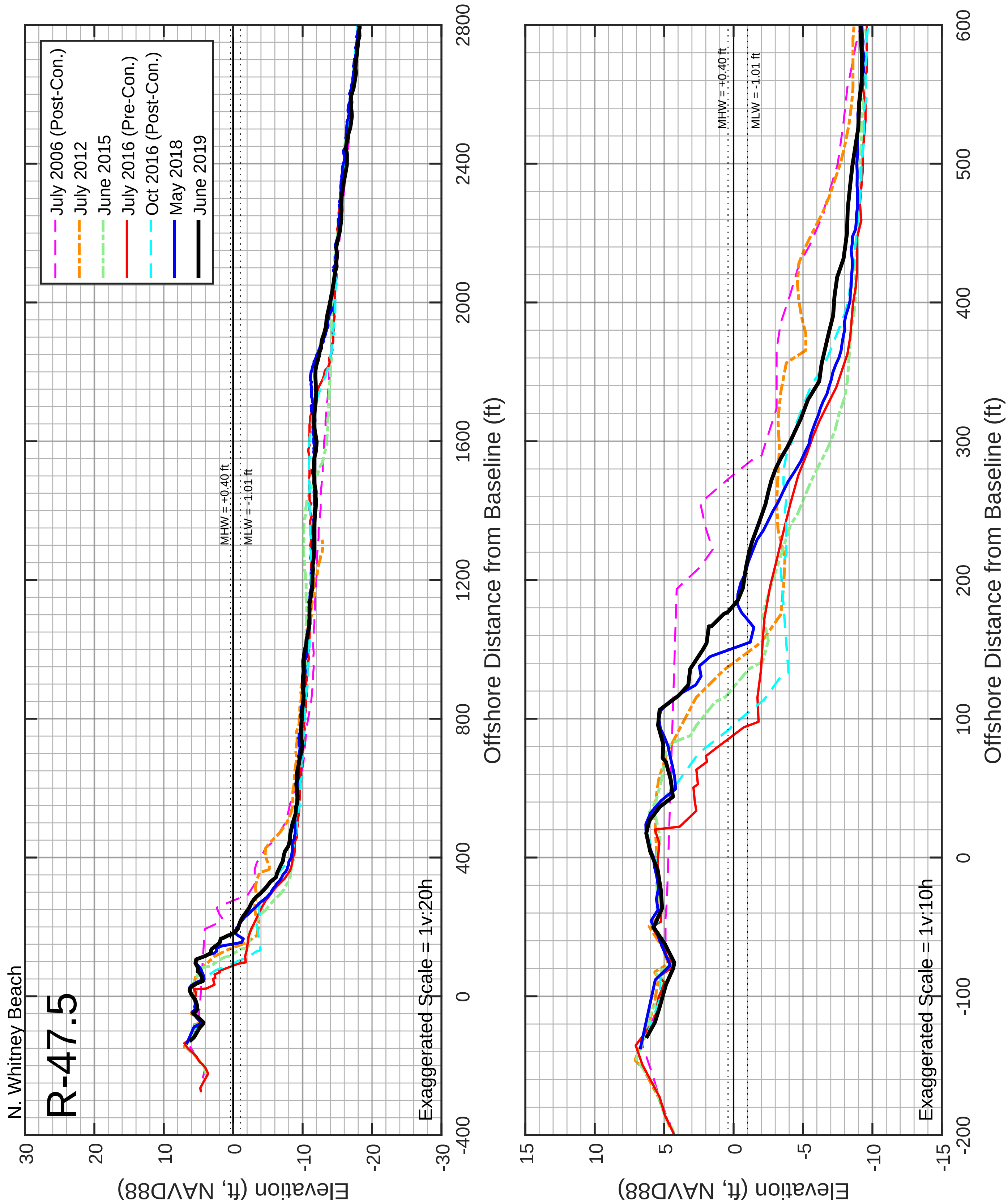

Figure B-036: Measured beach profiles at monument R-47.5 Longboat Key, Florida.

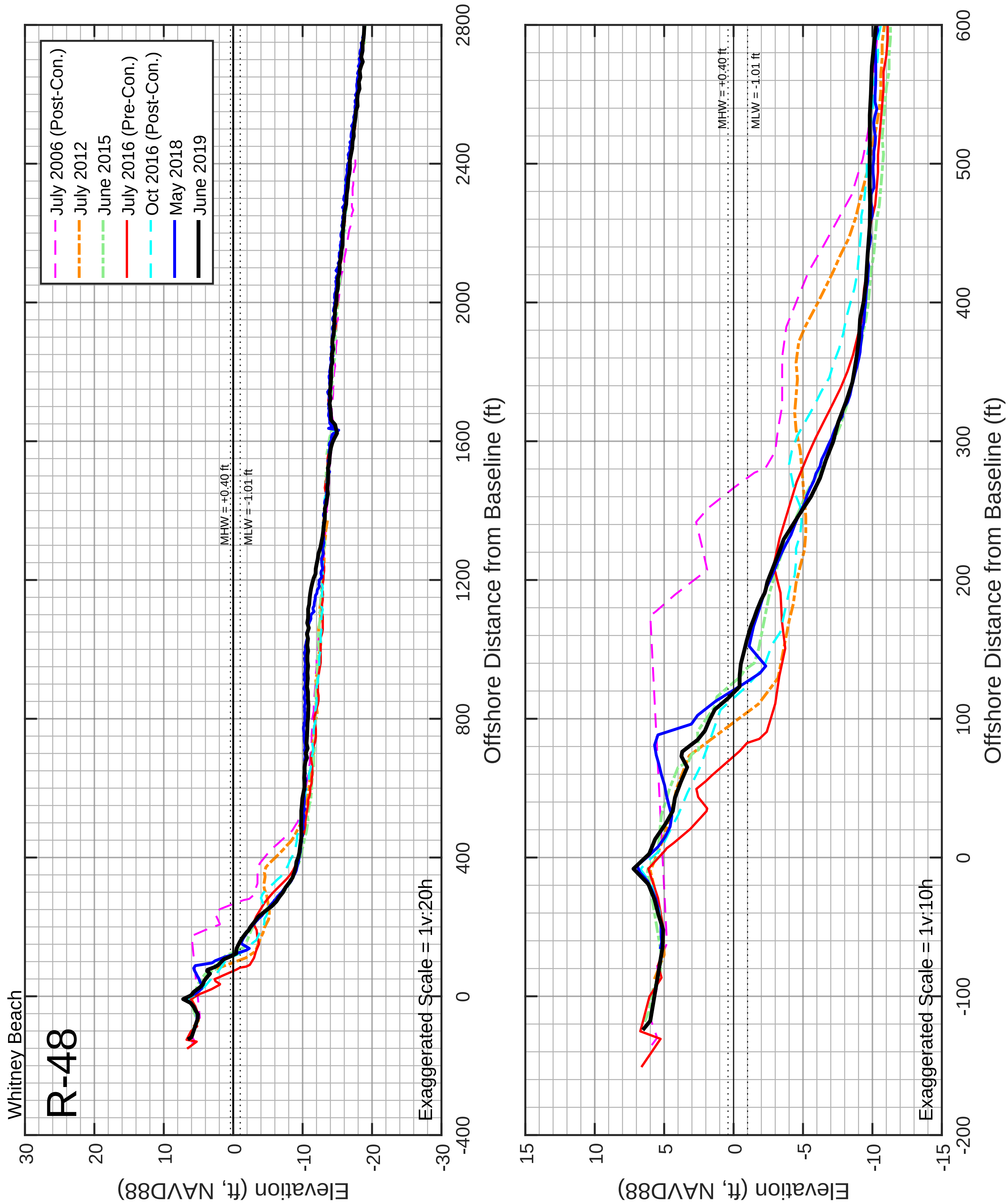

Figure B-037: Measured beach profiles at monument R-48 Longboat Key, Florida.

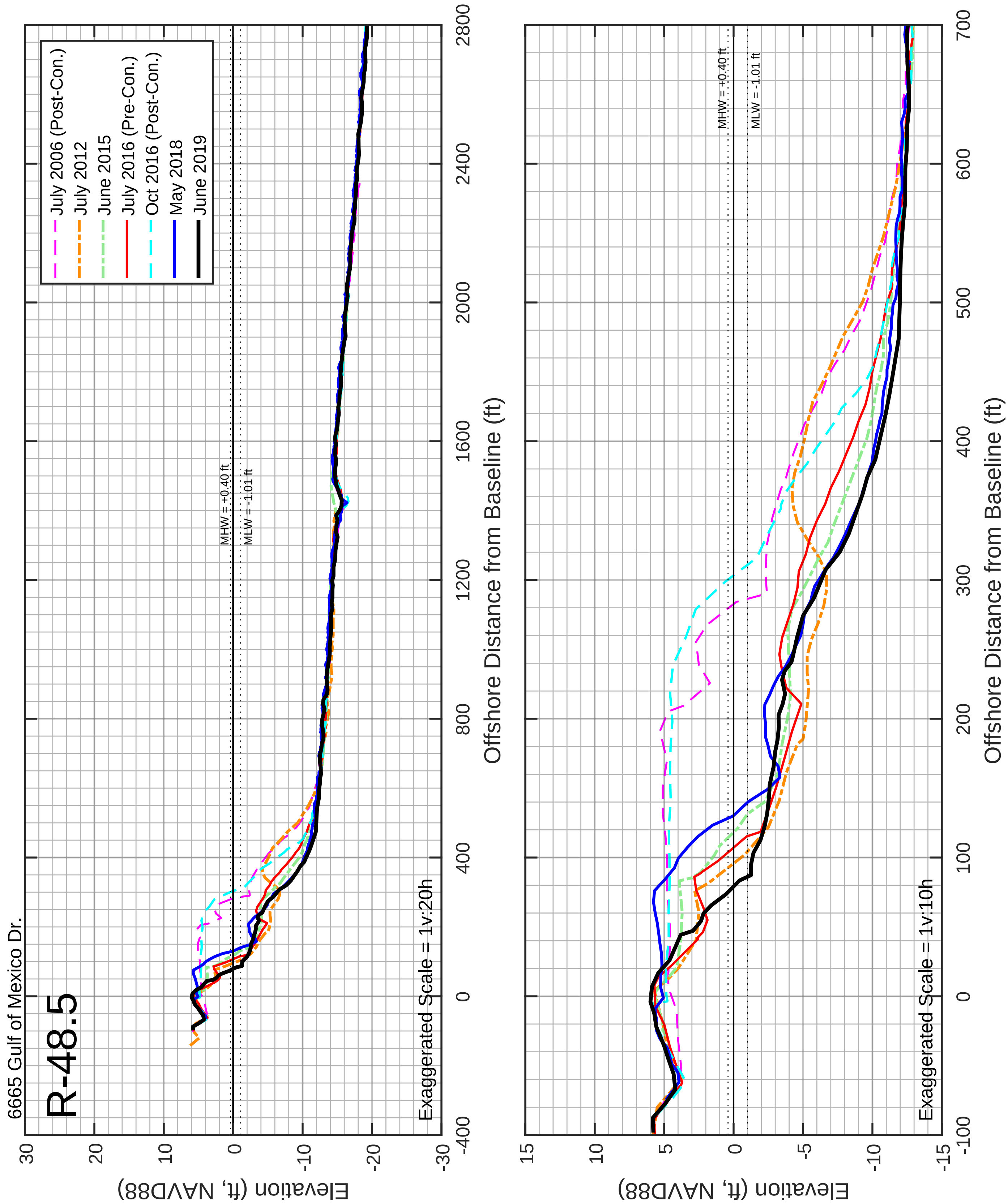

Figure B-038: Measured beach profiles at monument R-48.5 Longboat Key, Florida.

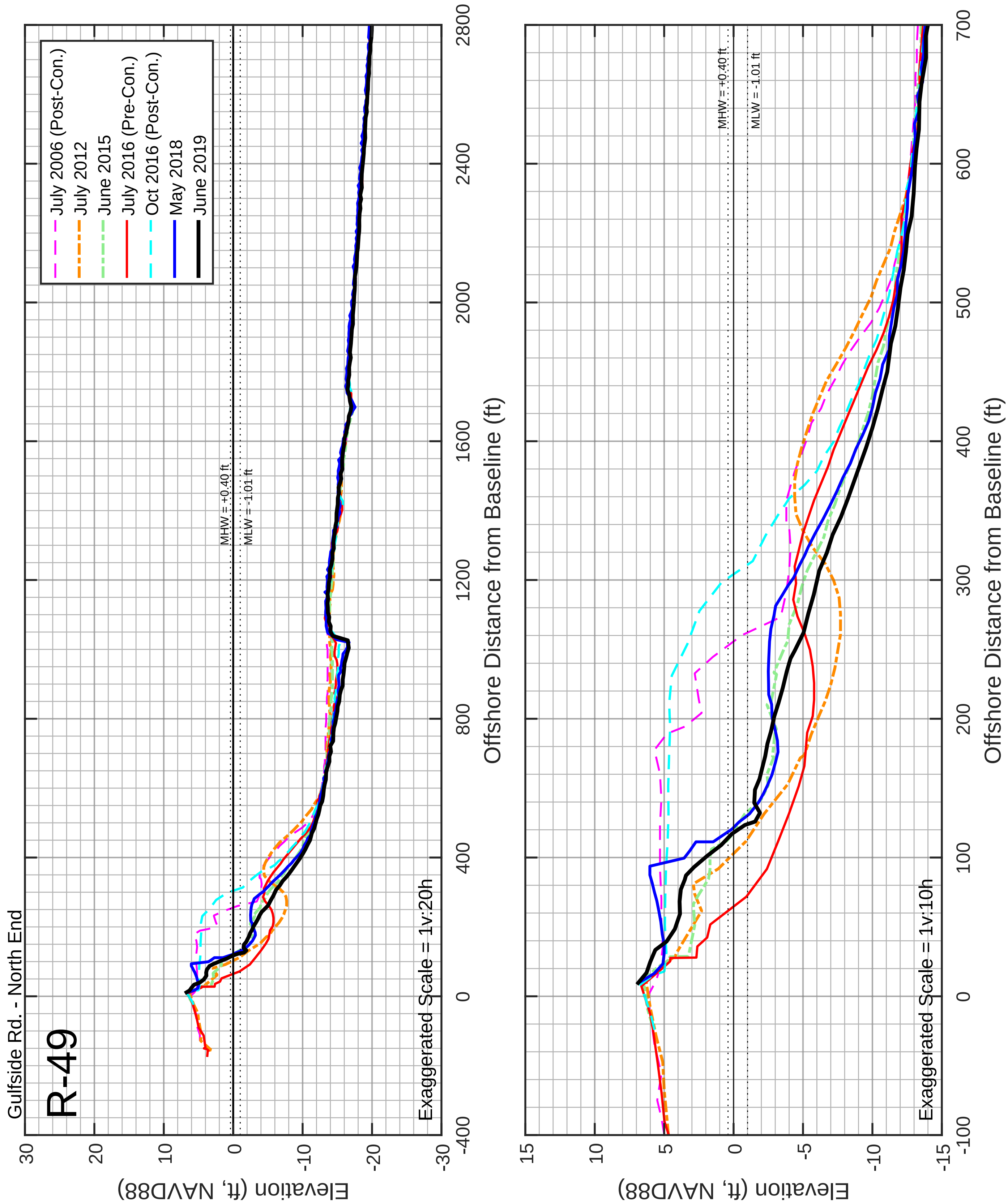

Figure B-039: Measured beach profiles at monument R-49 Longboat Key, Florida.

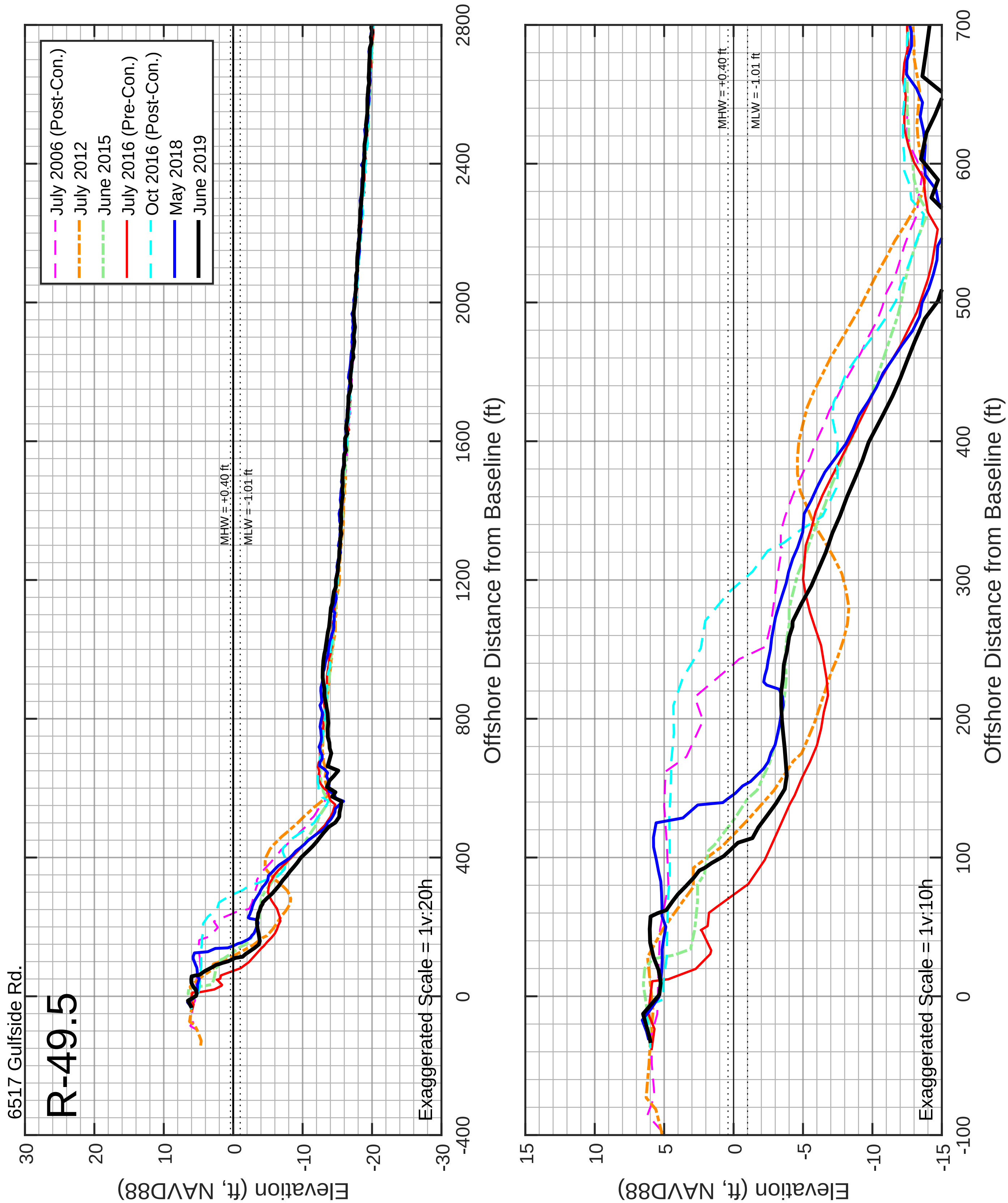

Figure B-040: Measured beach profiles at monument R-49.5 Longboat Key, Florida.

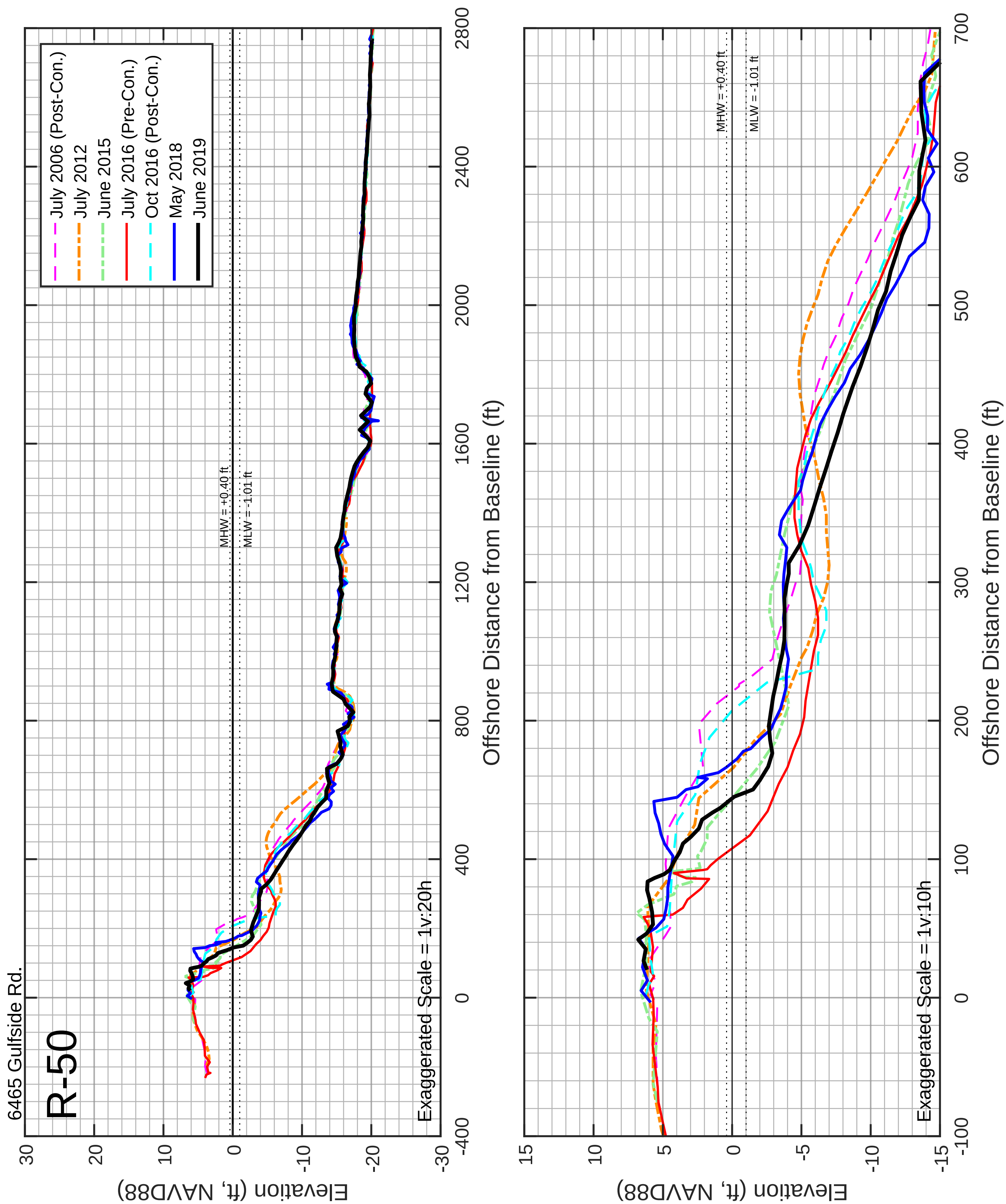

Figure B-041: Measured beach profiles at monument R-50 Longboat Key, Florida.

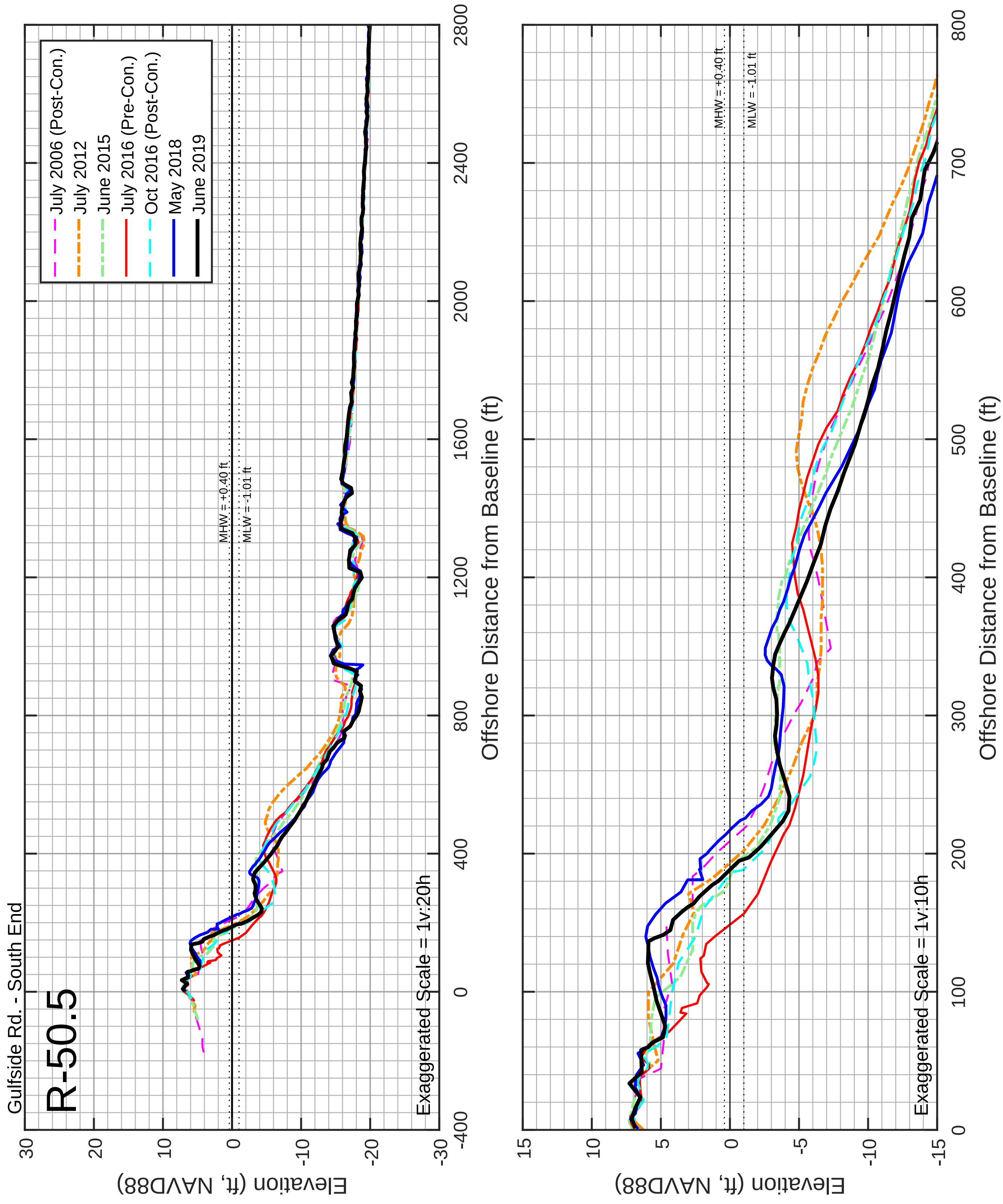

Figure B-042: Measured beach profiles at monument R-50.5 Longboat Key, Florida.

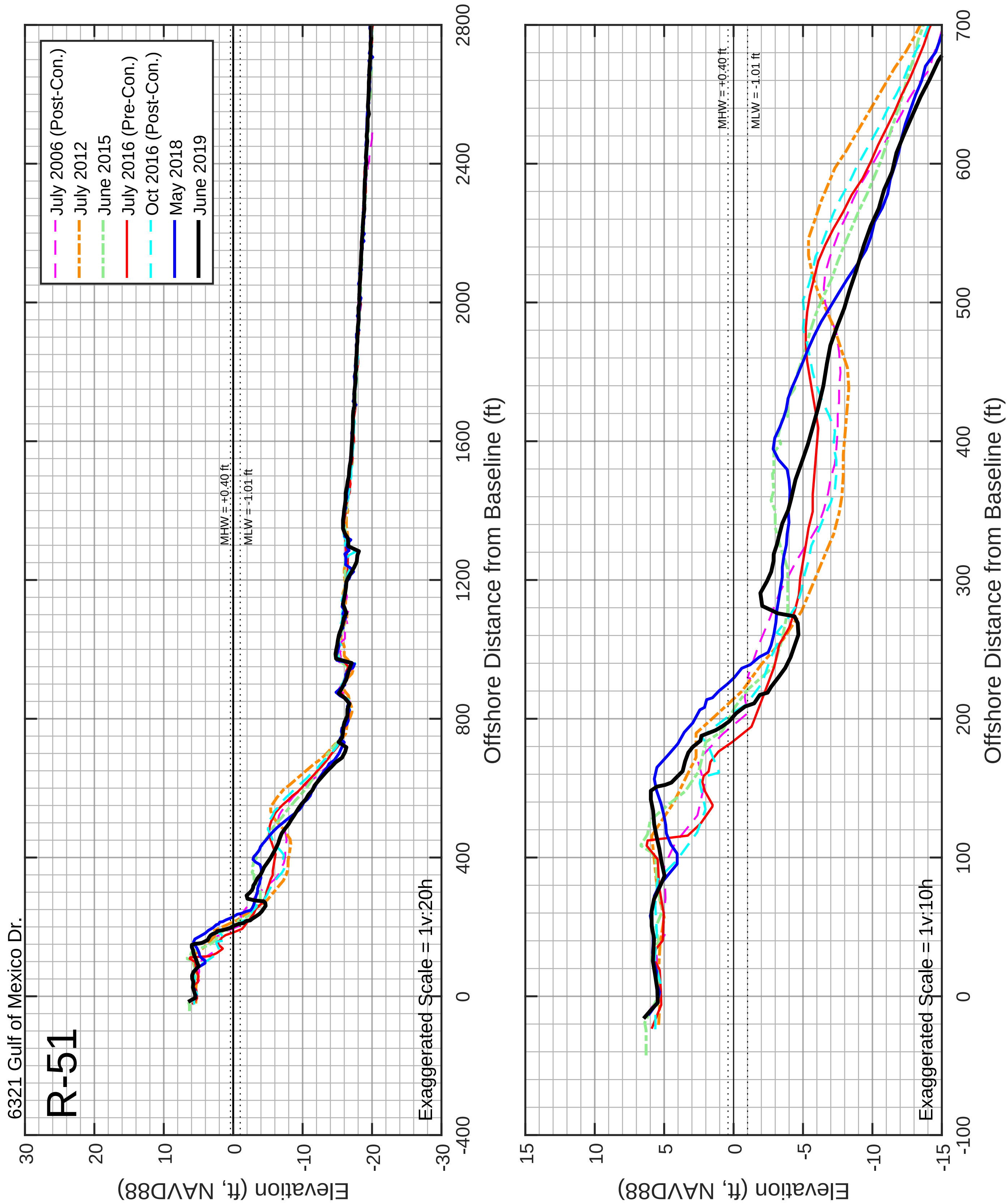

Figure B-043: Measured beach profiles at monument R-51 Longboat Key, Florida.

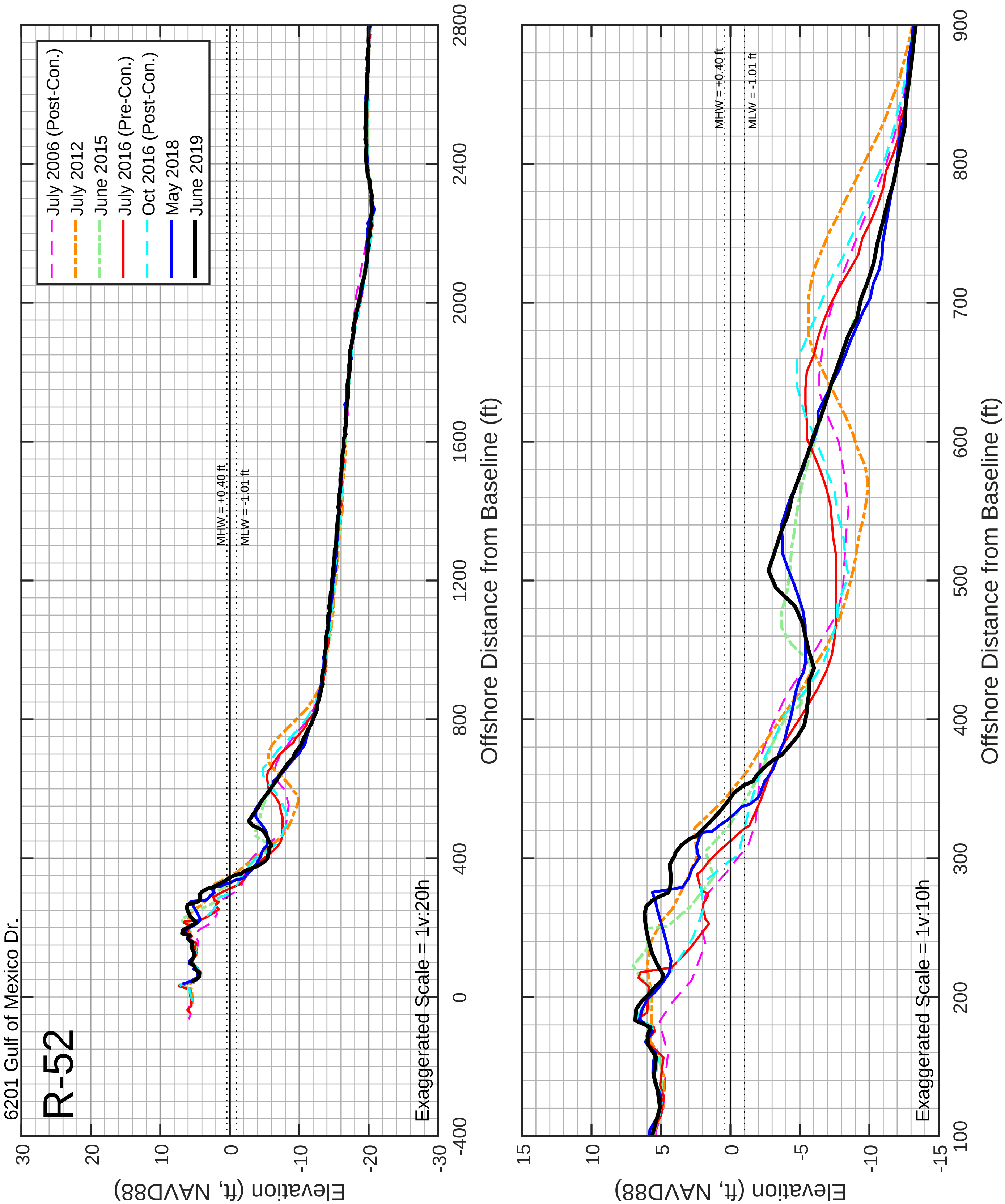

Figure B-044: Measured beach profiles at monument R-52 Longboat Key, Florida.

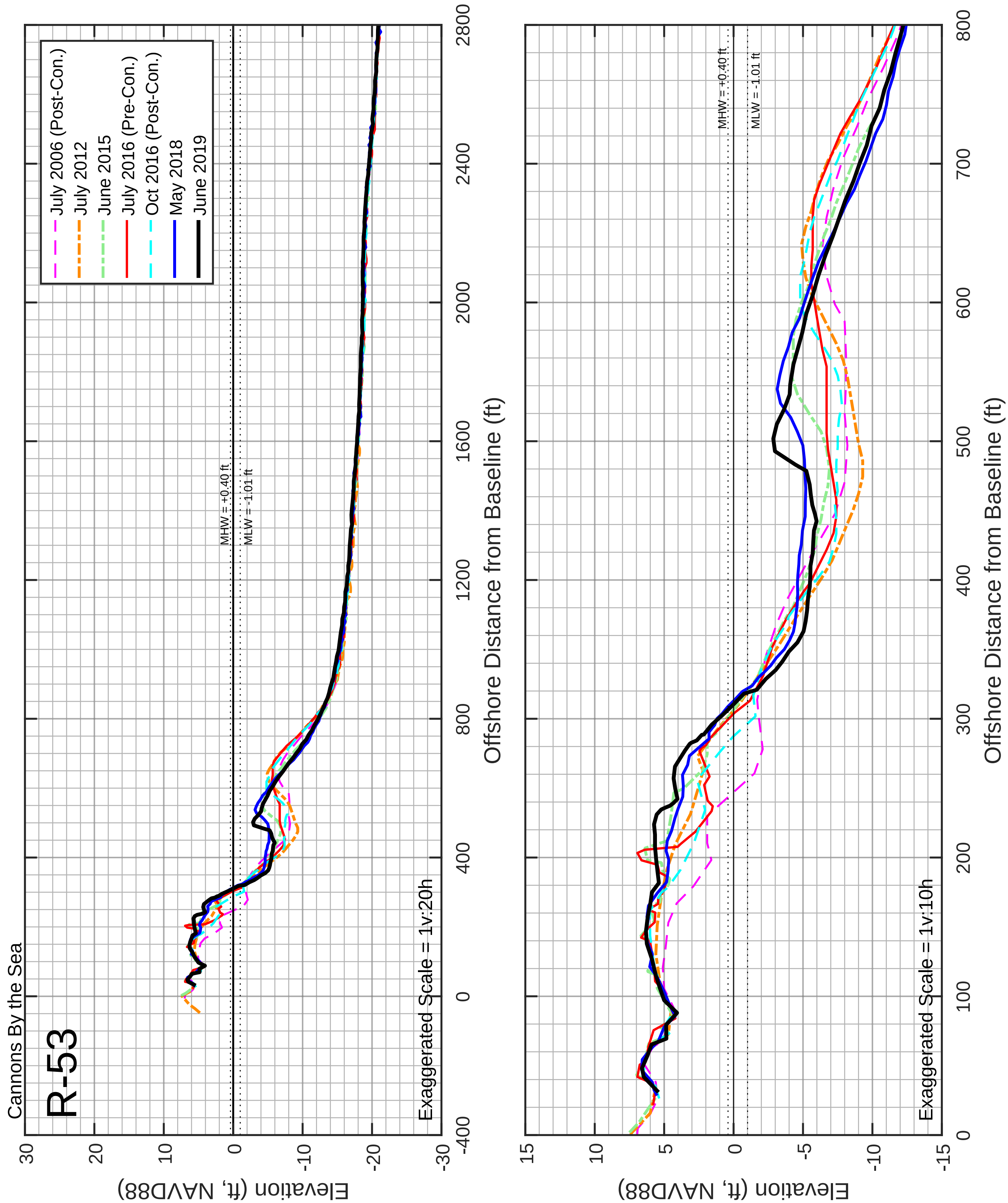

Figure B-045: Measured beach profiles at monument R-53 Longboat Key, Florida.

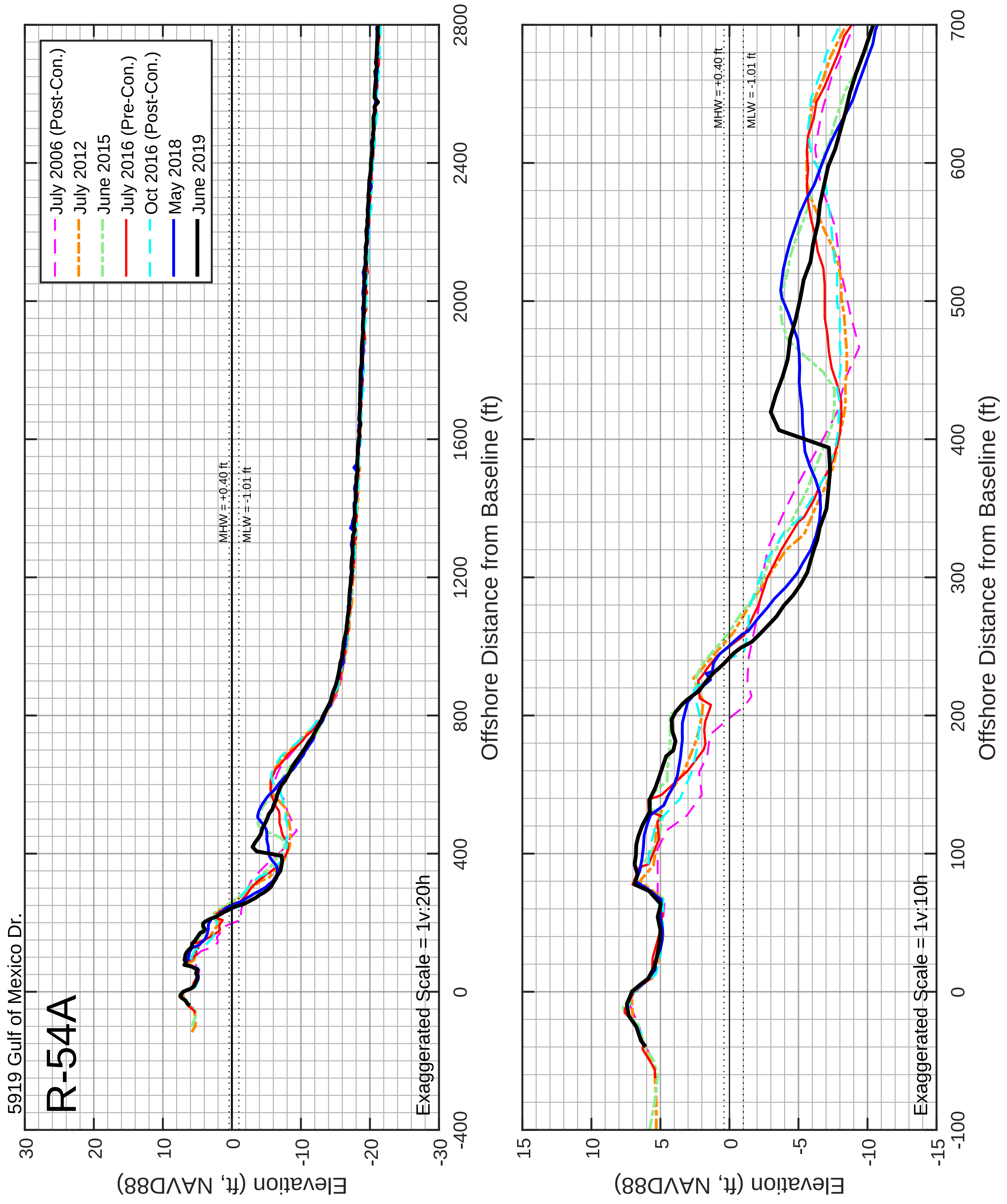

Figure B-046: Measured beach profiles at monument R-54A Longboat Key, Florida.

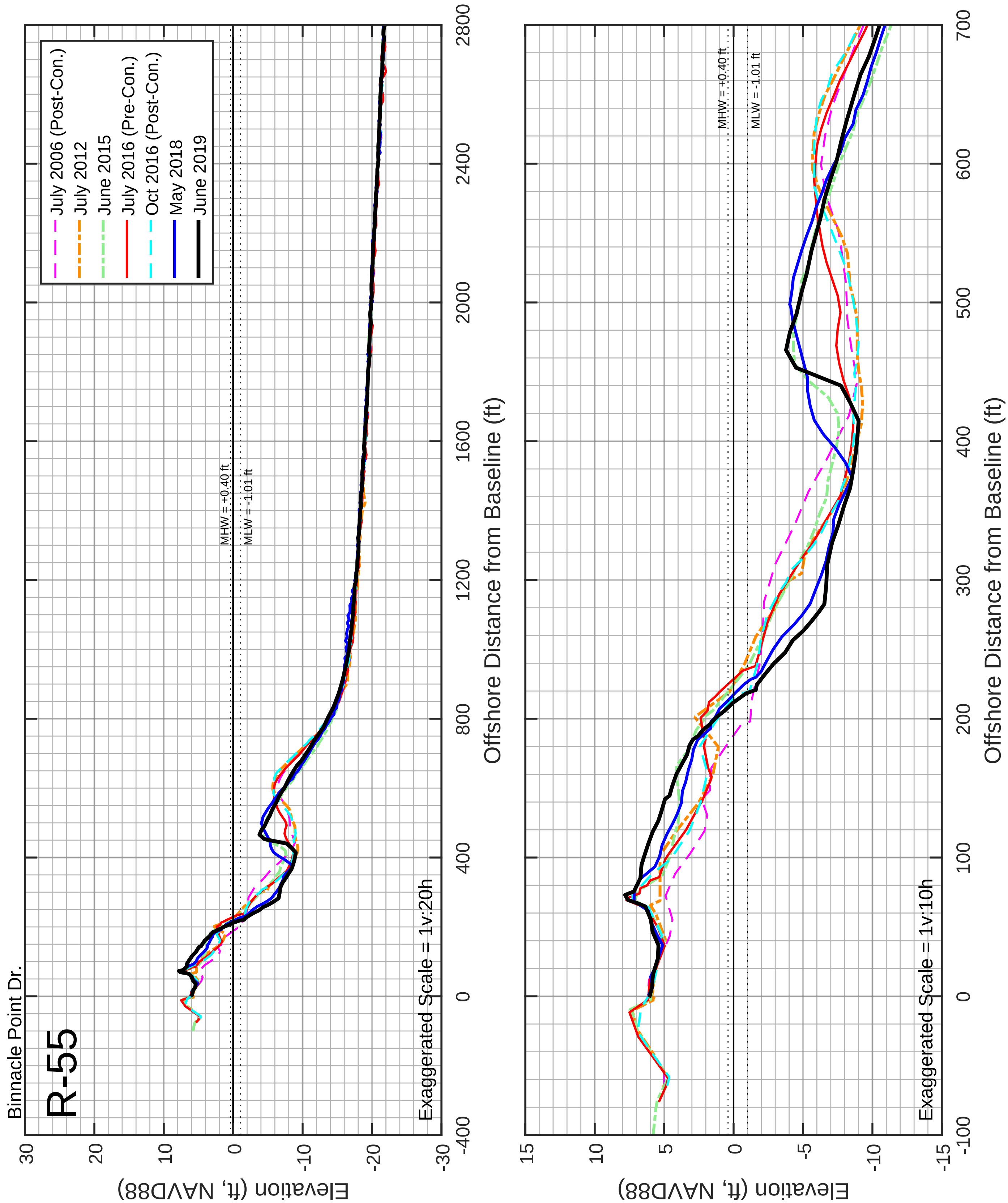

Figure B-047: Measured beach profiles at monument R-55 Longboat Key, Florida.

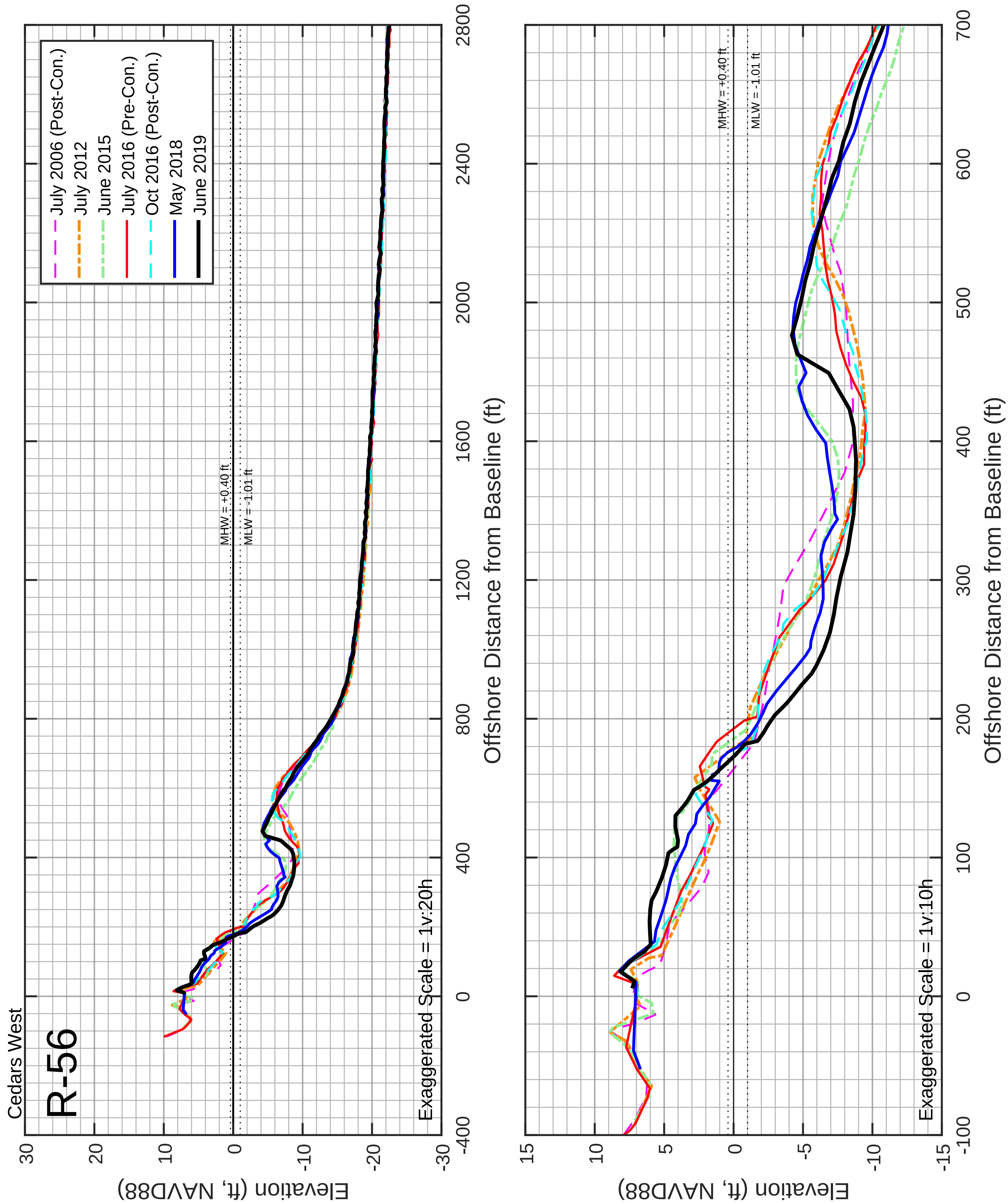

Figure B-048: Measured beach profiles at monument R-56 Longboat Key, Florida.

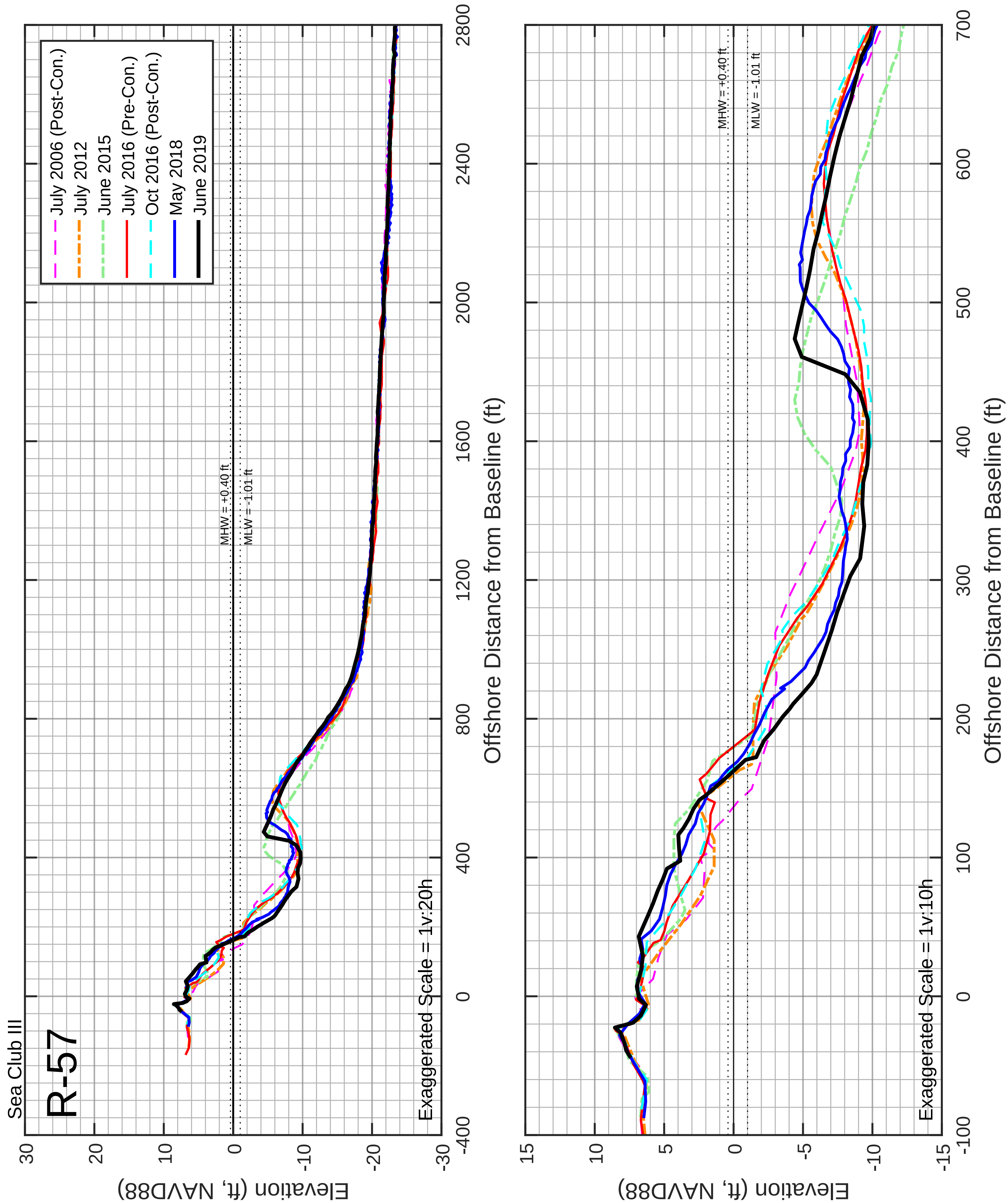

Figure B-049: Measured beach profiles at monument R-57 Longboat Key, Florida.

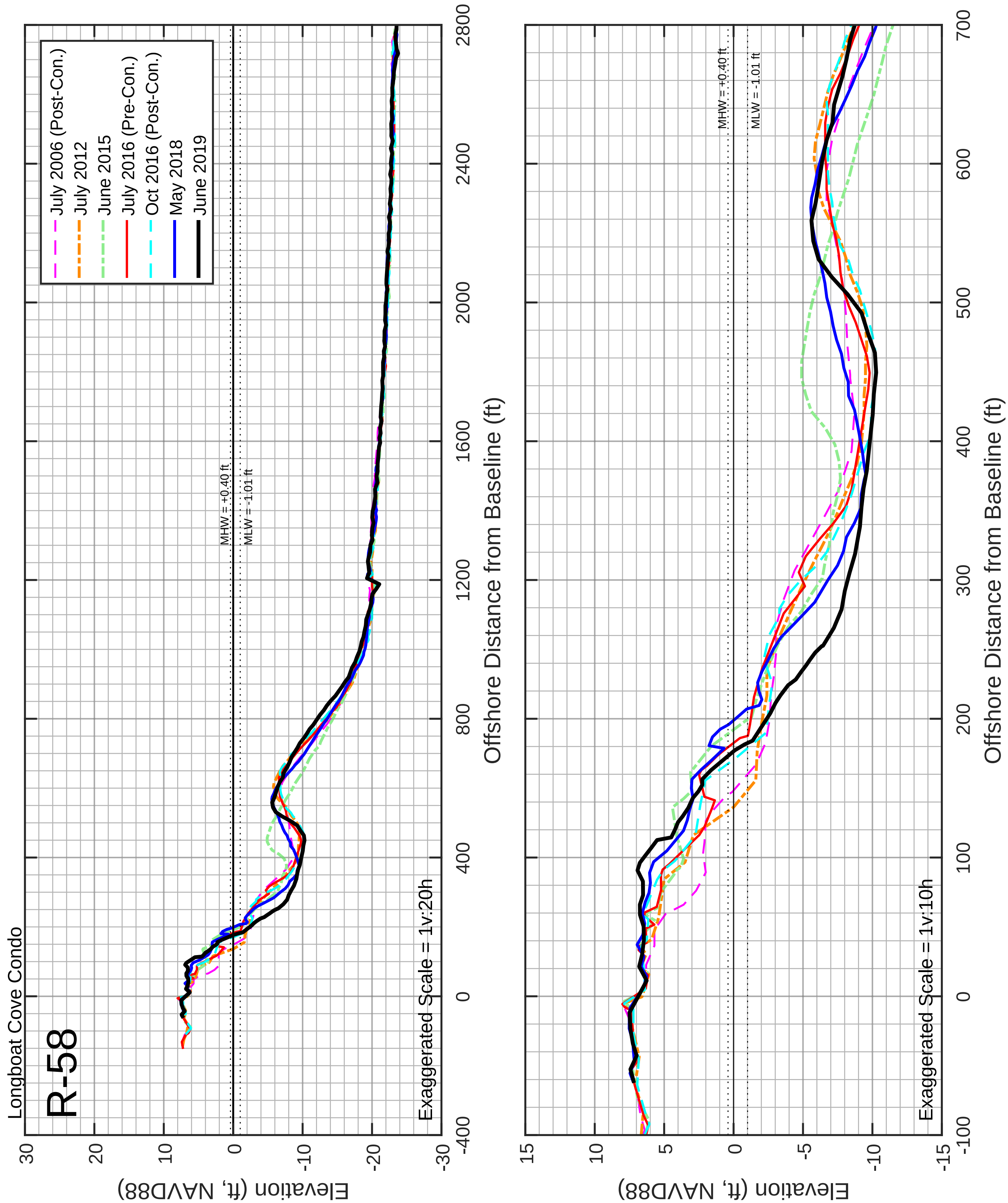

Figure B-050: Measured beach profiles at monument R-58 Longboat Key, Florida.

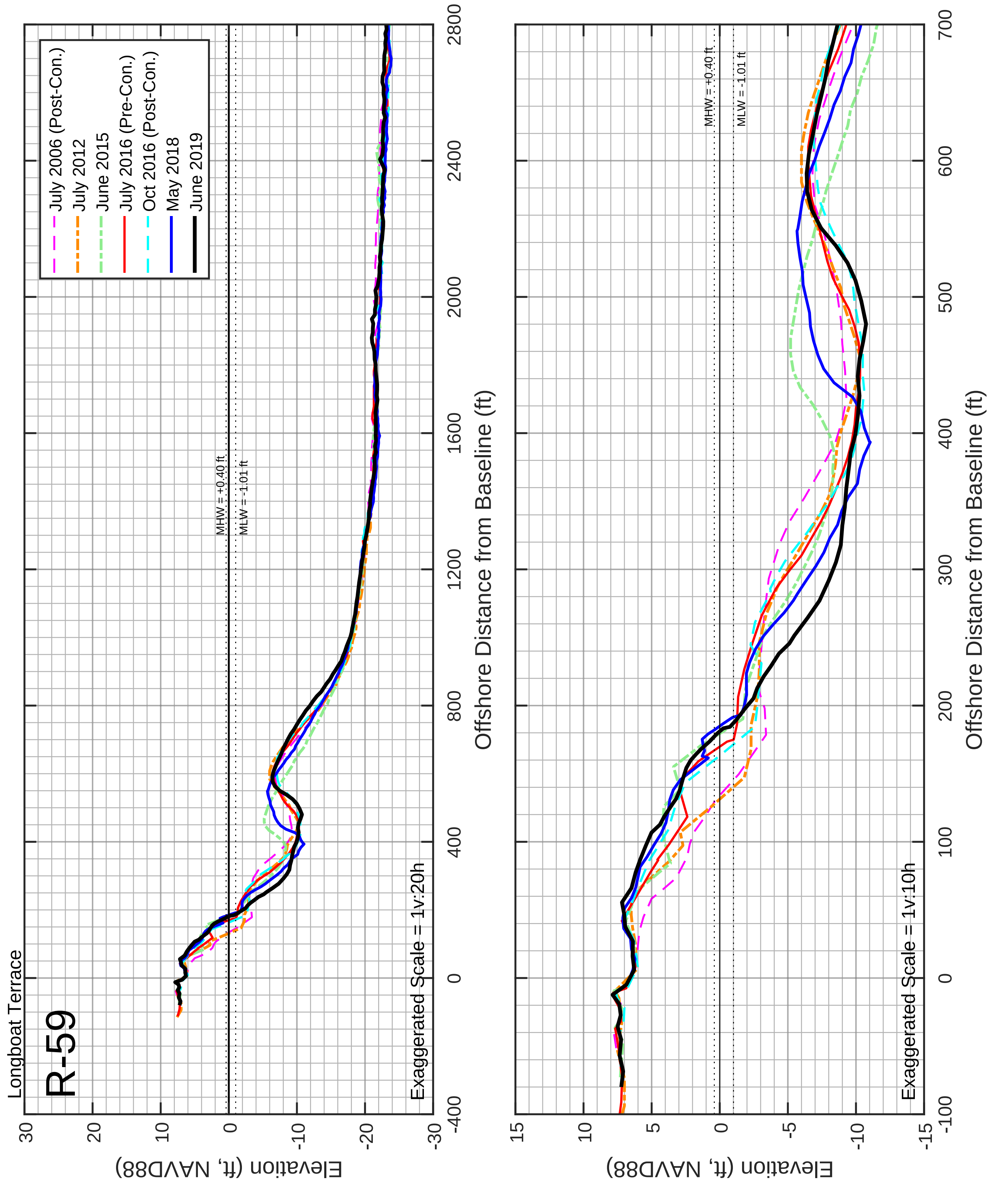

Figure B-051: Measured beach profiles at monument R-59 Longboat Key, Florida.

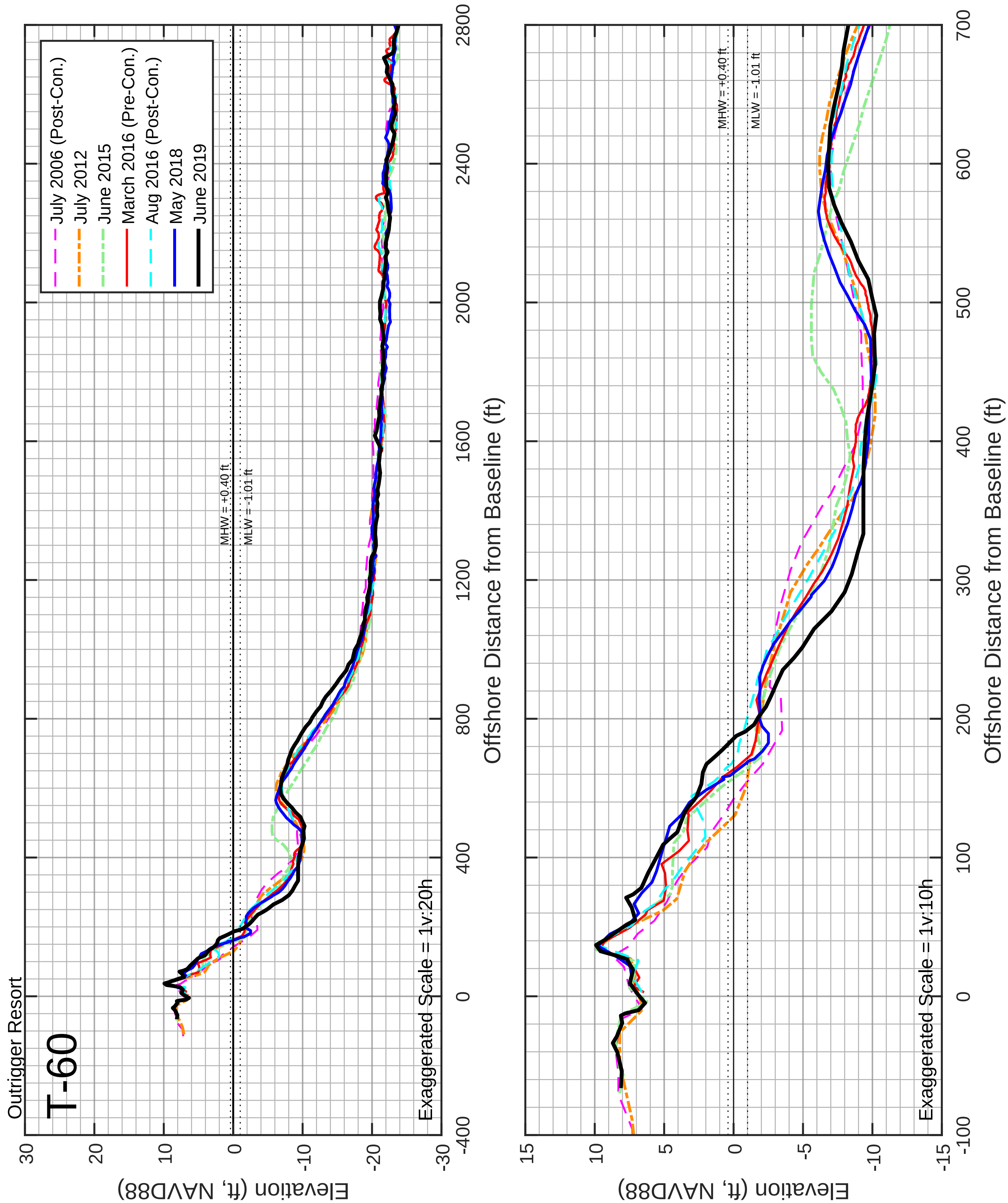

Figure B-052: Measured beach profiles at monument T-60 Longboat Key, Florida.

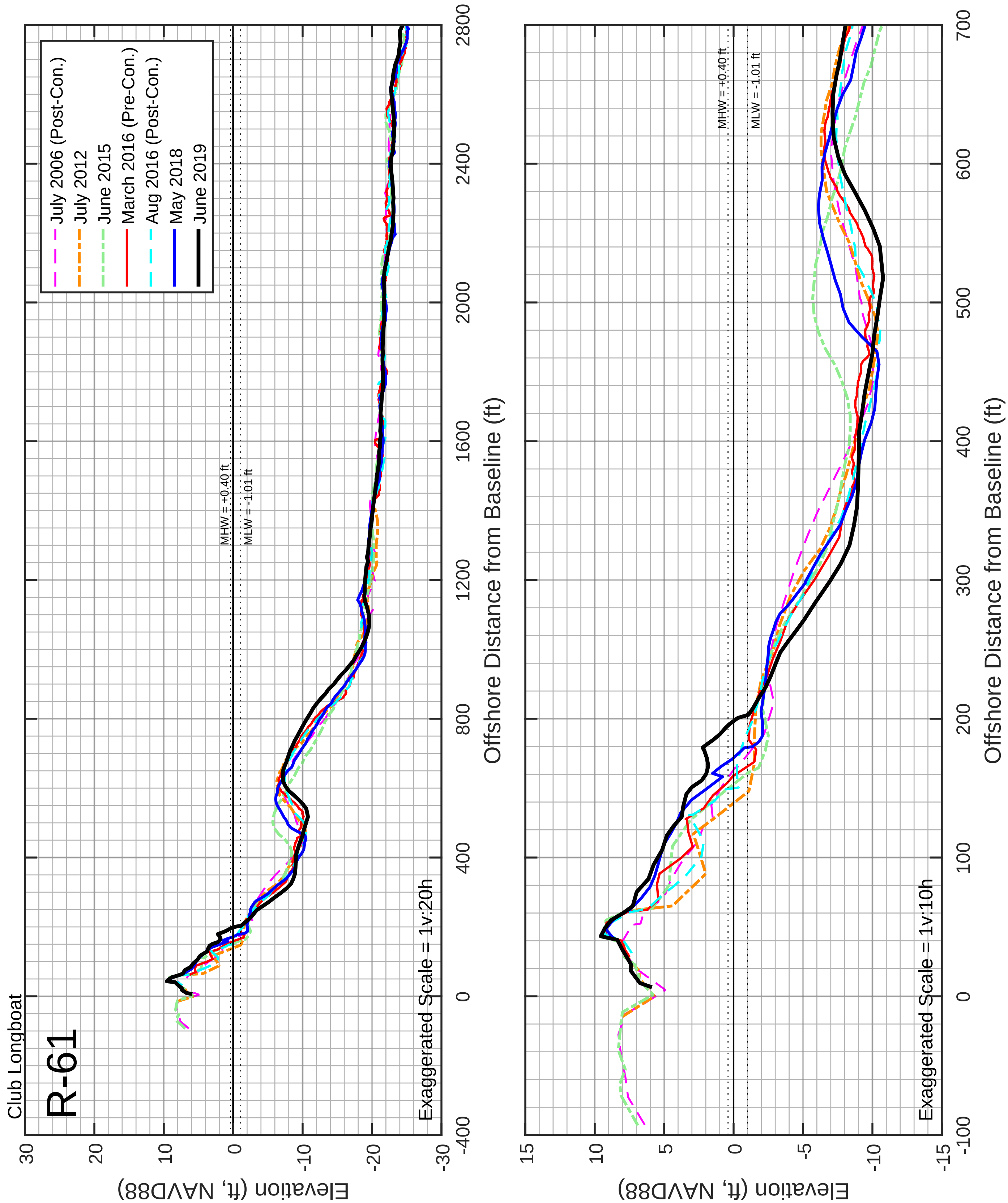

Figure B-053: Measured beach profiles at monument R-61 Longboat Key, Florida.

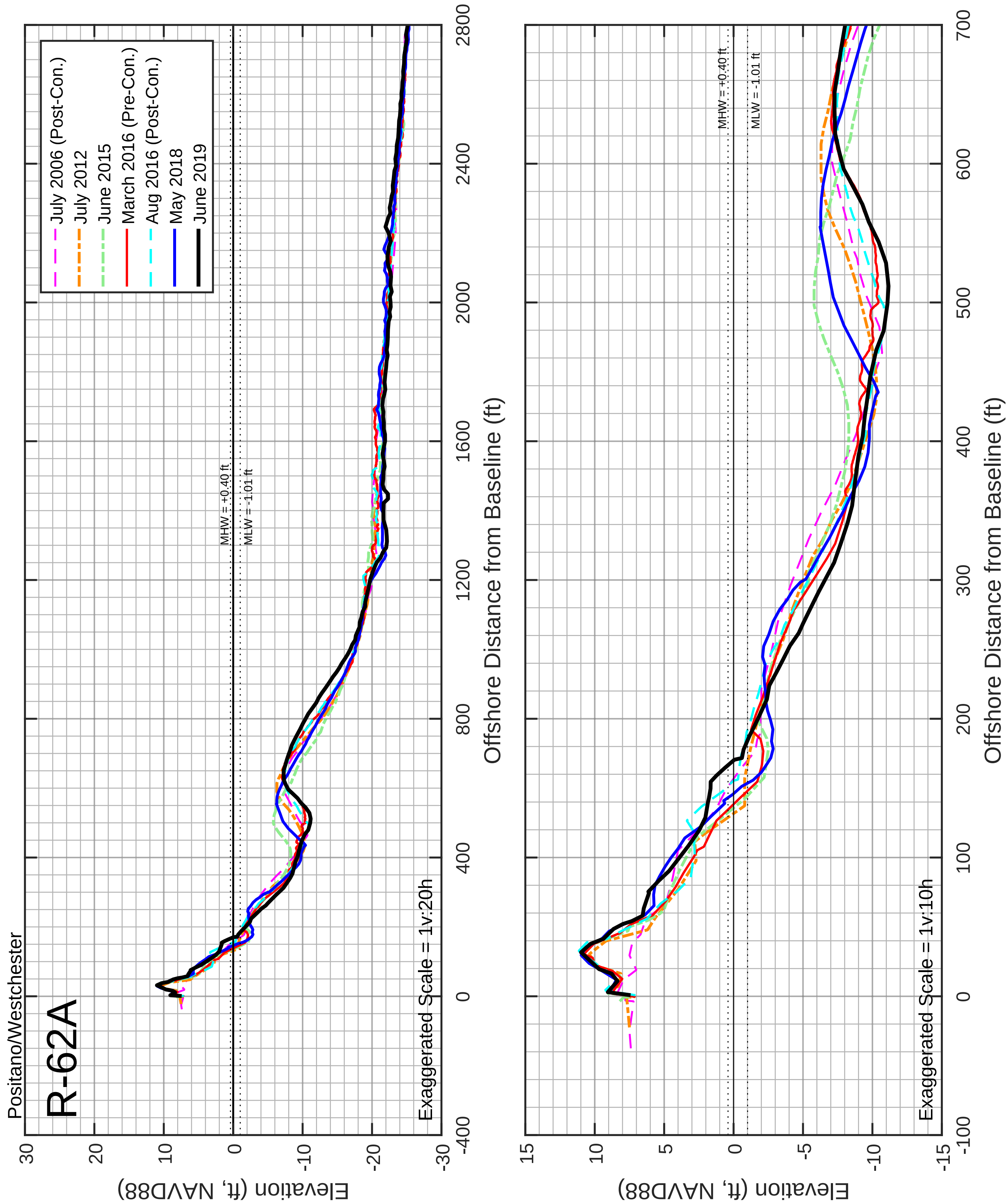

Figure B-054: Measured beach profiles at monument R-62A Longboat Key, Florida.

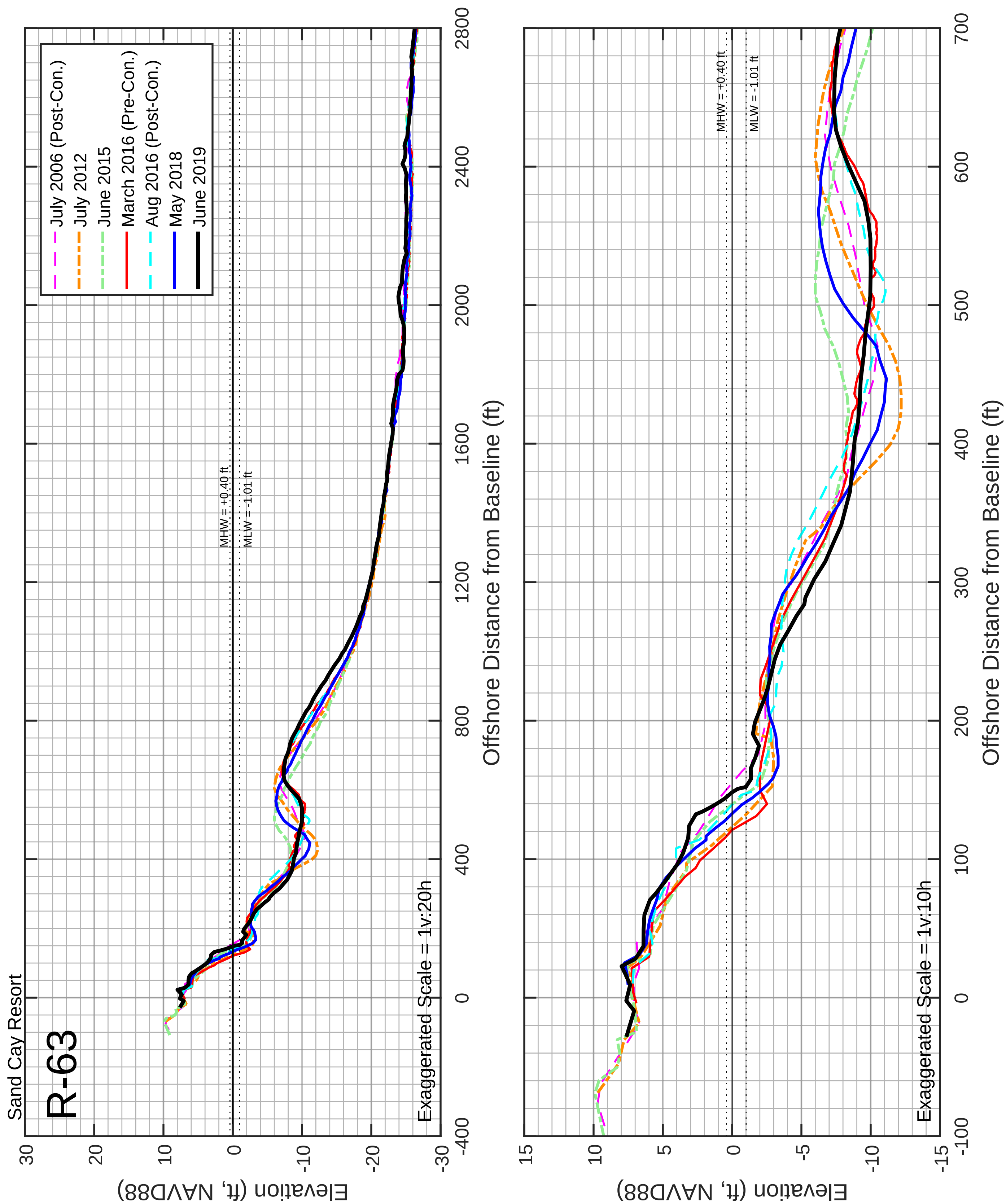

Figure B-055: Measured beach profiles at monument R-63 Longboat Key, Florida.

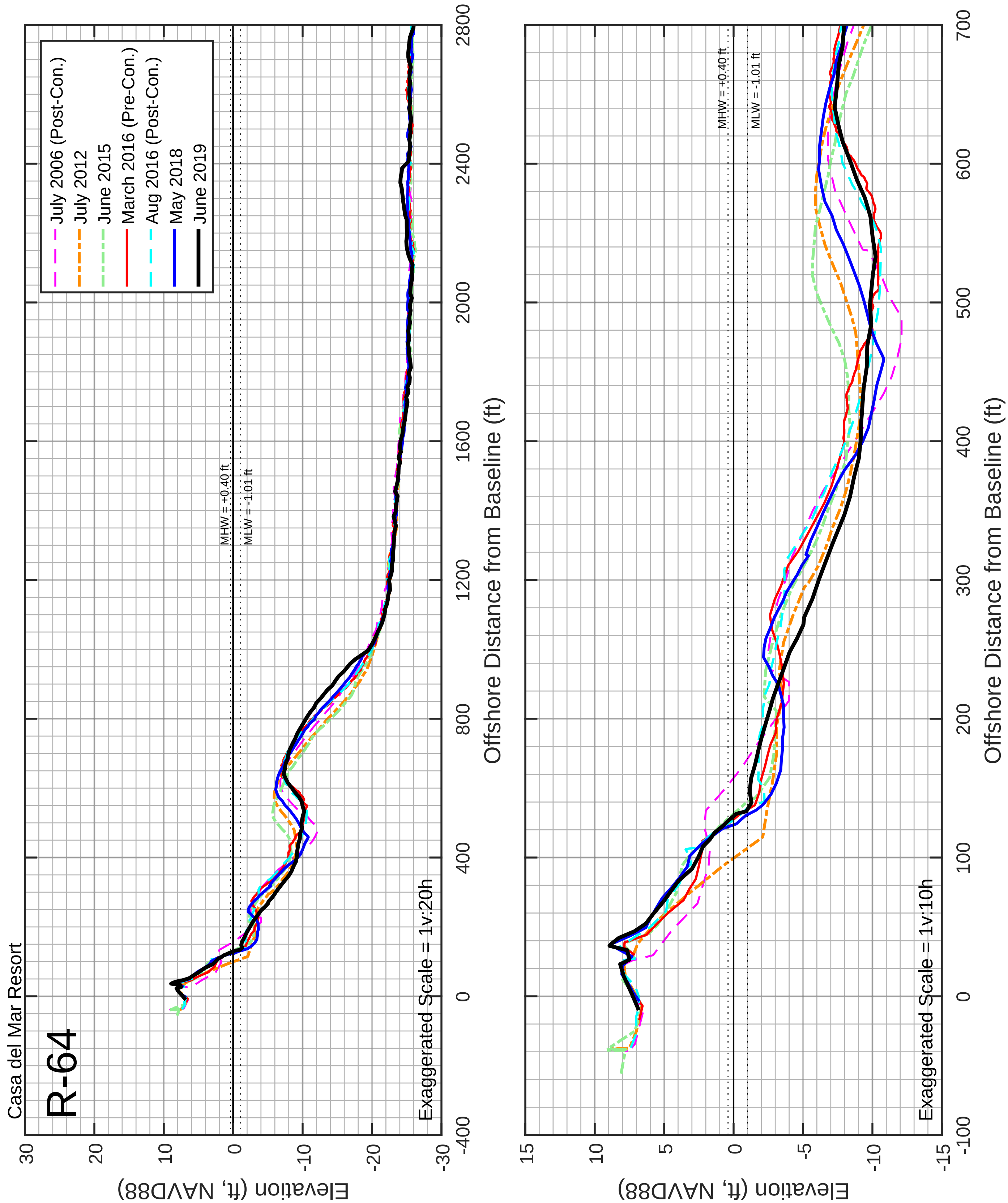

Figure B-056: Measured beach profiles at monument R-64 Longboat Key, Florida.

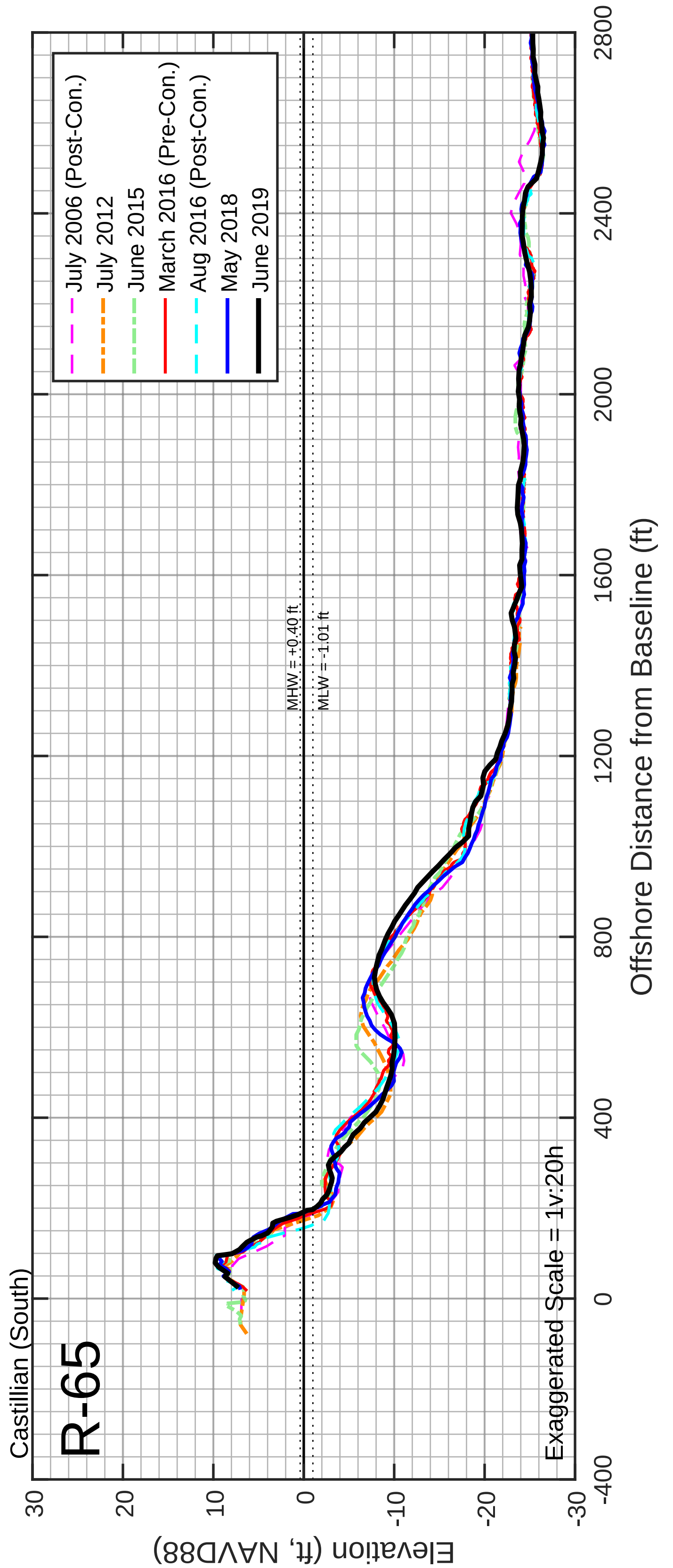

Figure B-057: Measured beach profiles at monument R-65 Longboat Key, Florida.

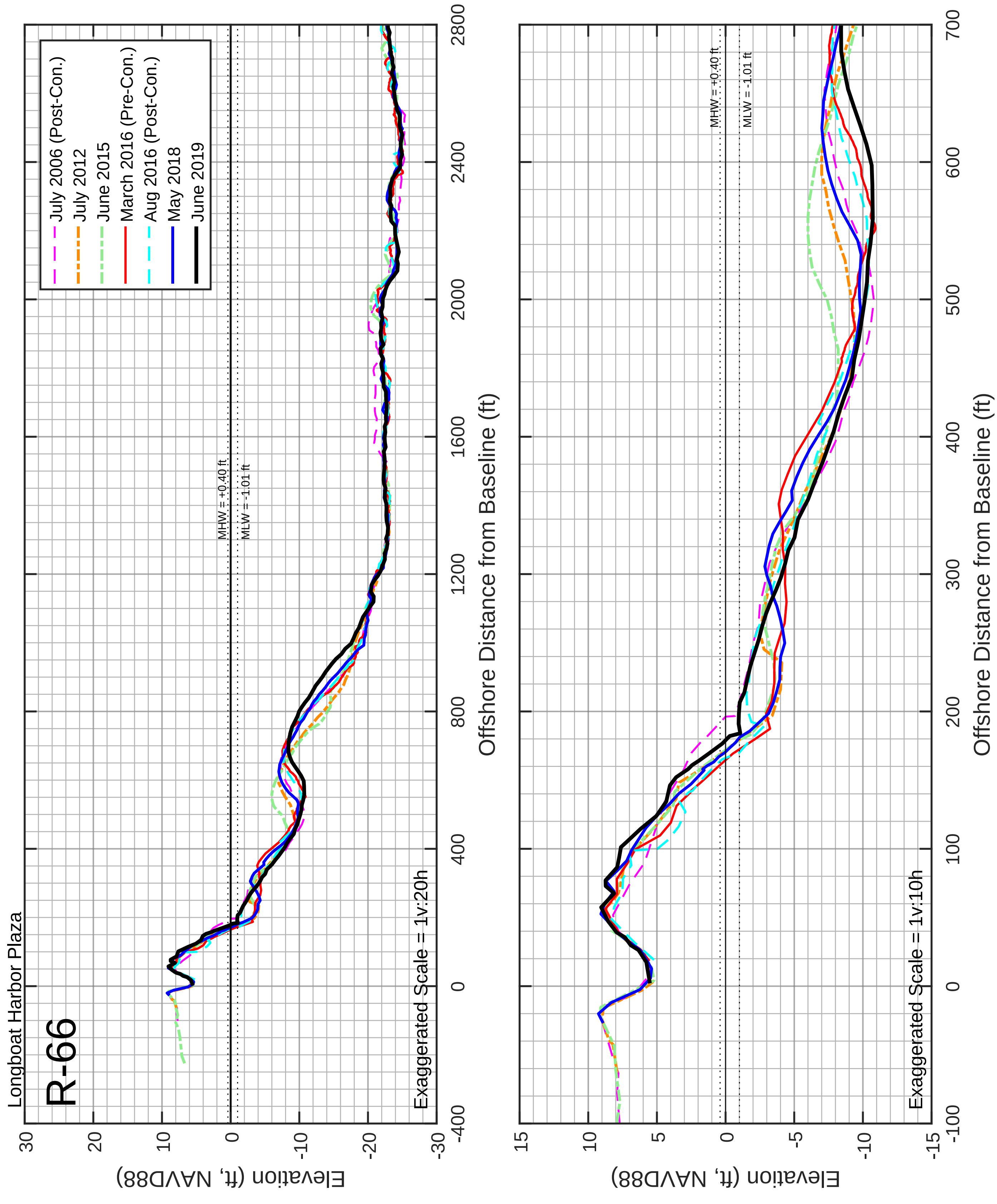

Figure B-058: Measured beach profiles at monument R-66 Longboat Key, Florida.

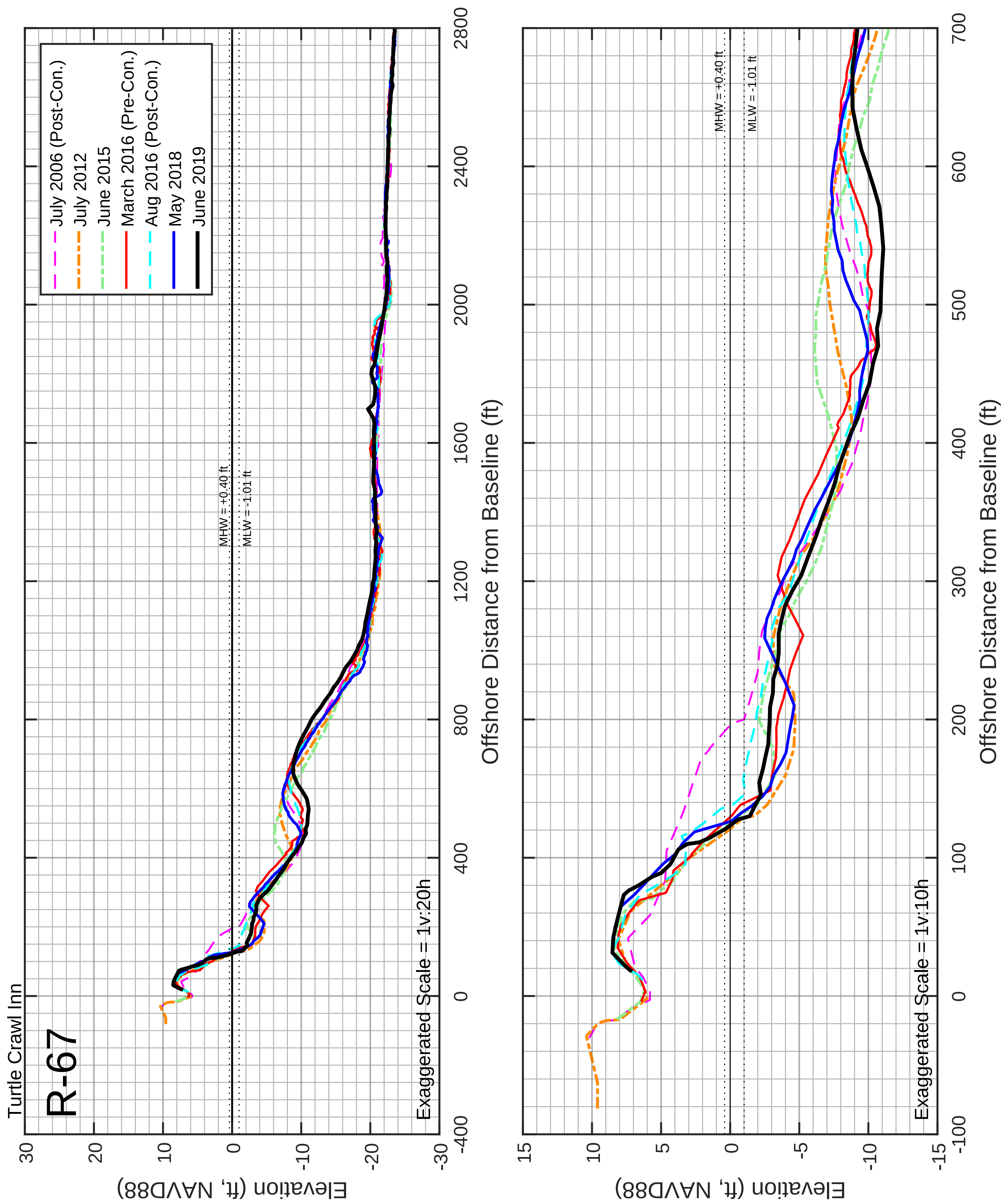

Figure B-059: Measured beach profiles at monument R-67 Longboat Key, Florida.

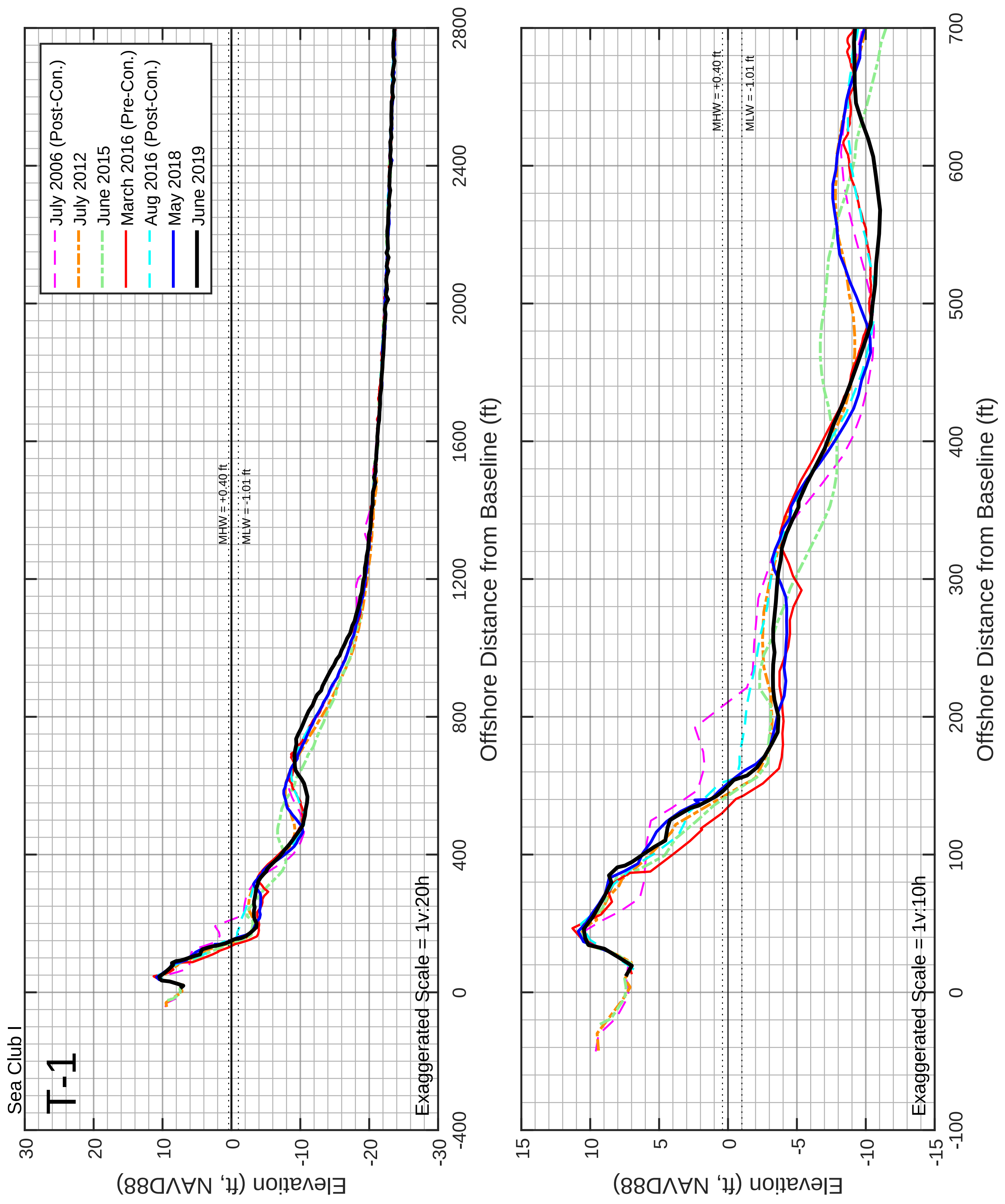

Figure B-060: Measured beach profiles at monument T-1 Longboat Key, Florida.

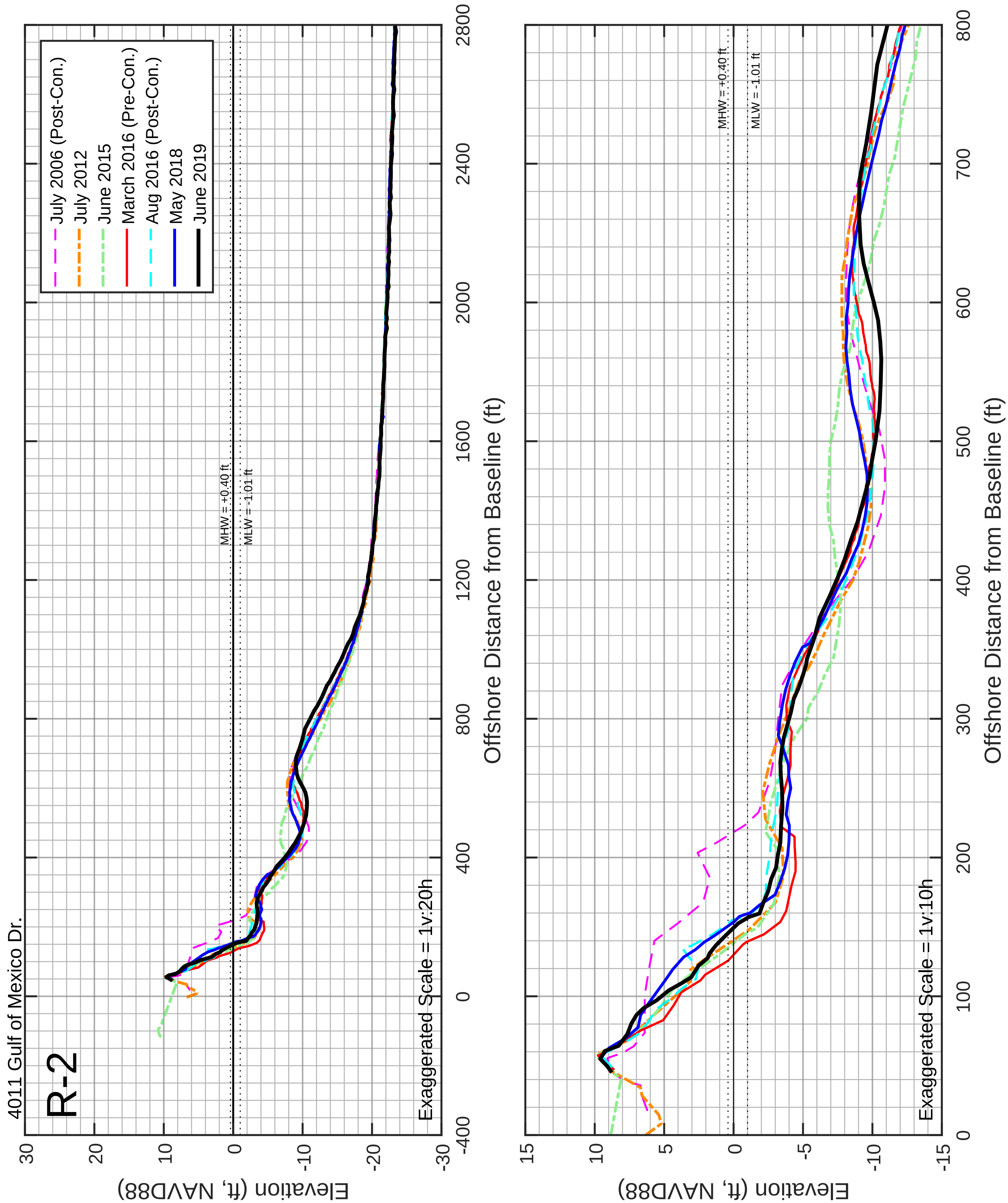

Figure B-061: Measured beach profiles at monument R-2 Longboat Key, Florida.

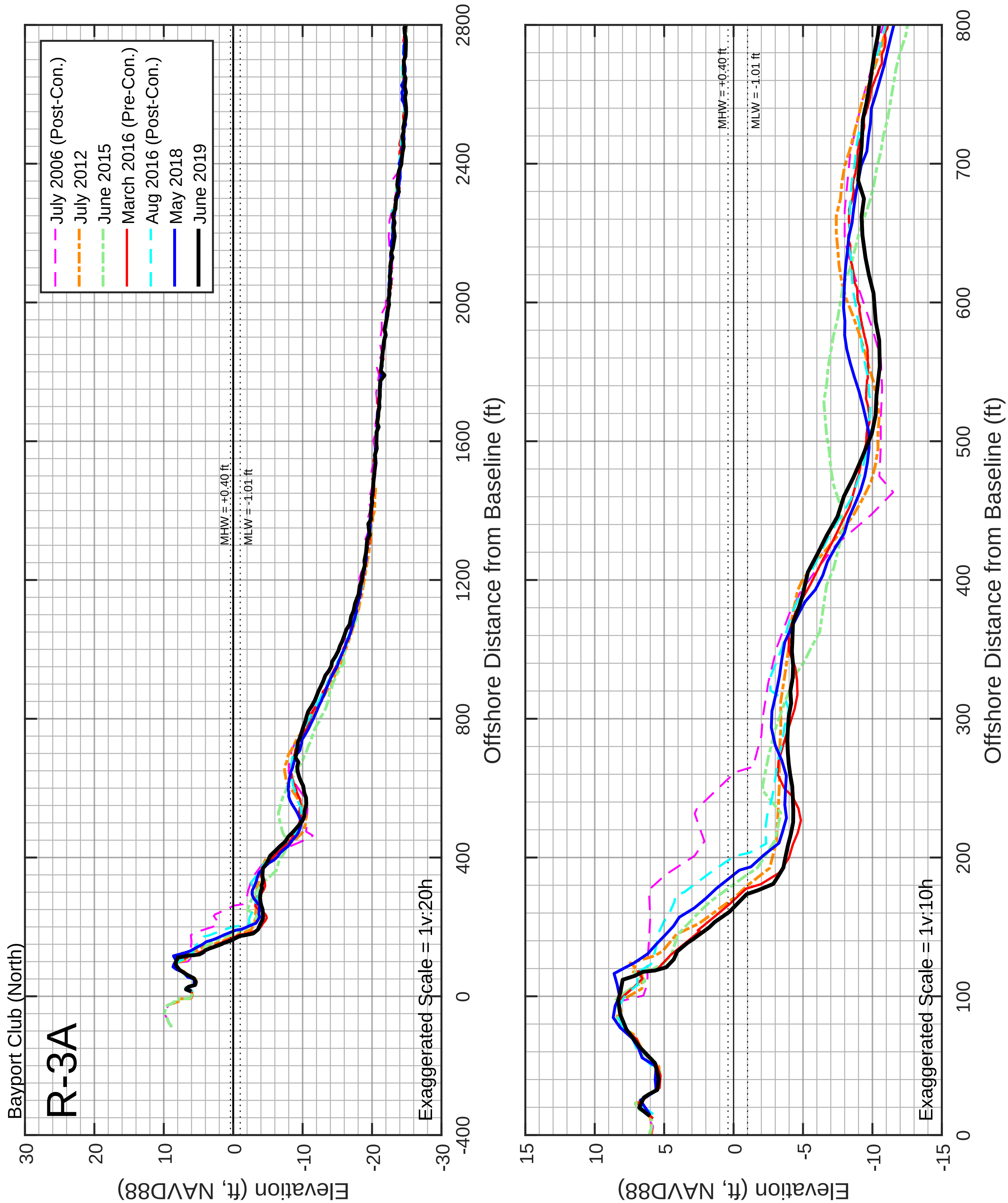

Figure B-062: Measured beach profiles at monument R-3A Longboat Key, Florida.

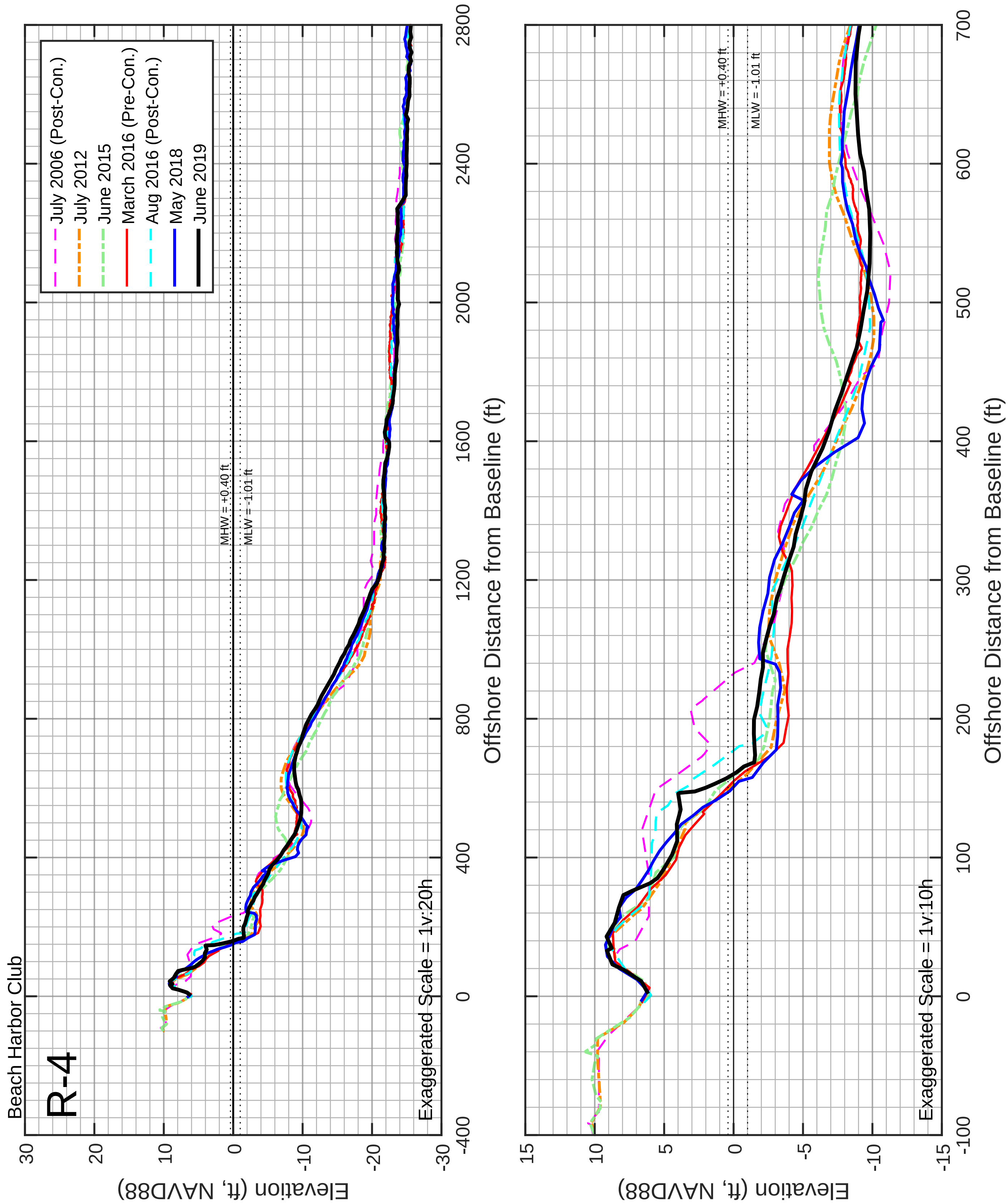

Figure B-063: Measured beach profiles at monument R-4 Longboat Key, Florida.

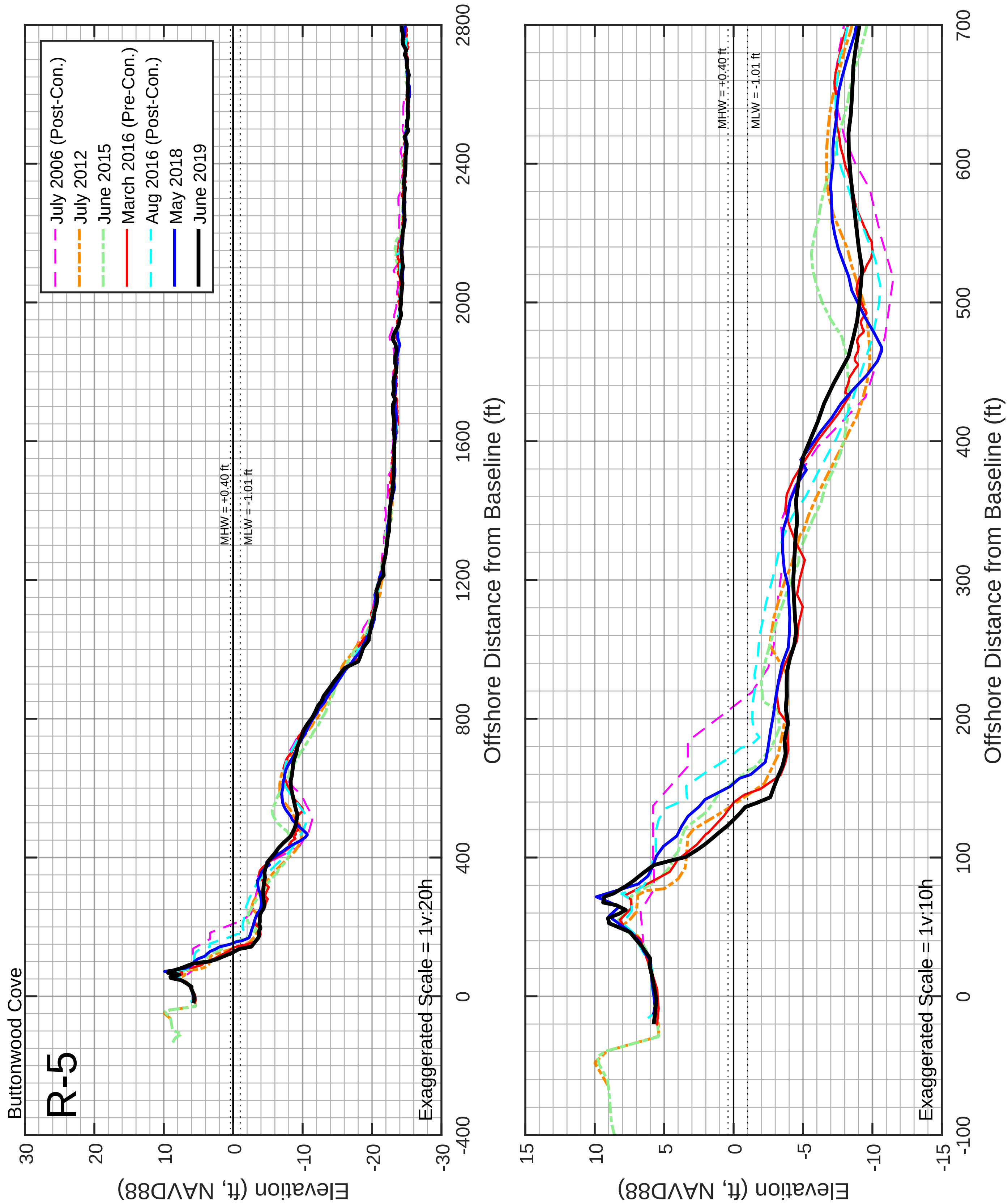

Figure B-064: Measured beach profiles at monument R-5 Longboat Key, Florida.

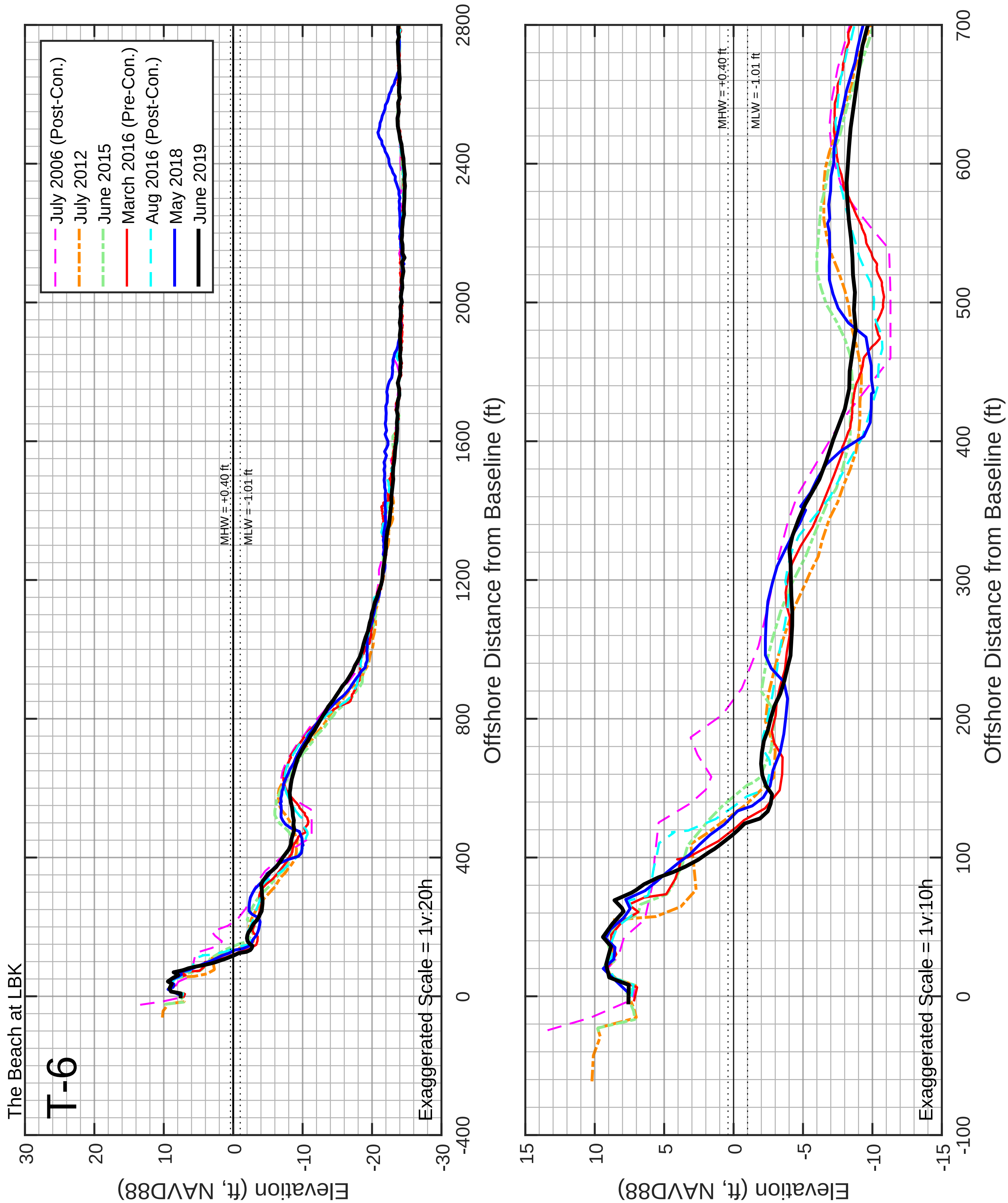

Figure B-065: Measured beach profiles at monument T-6 Longboat Key, Florida.

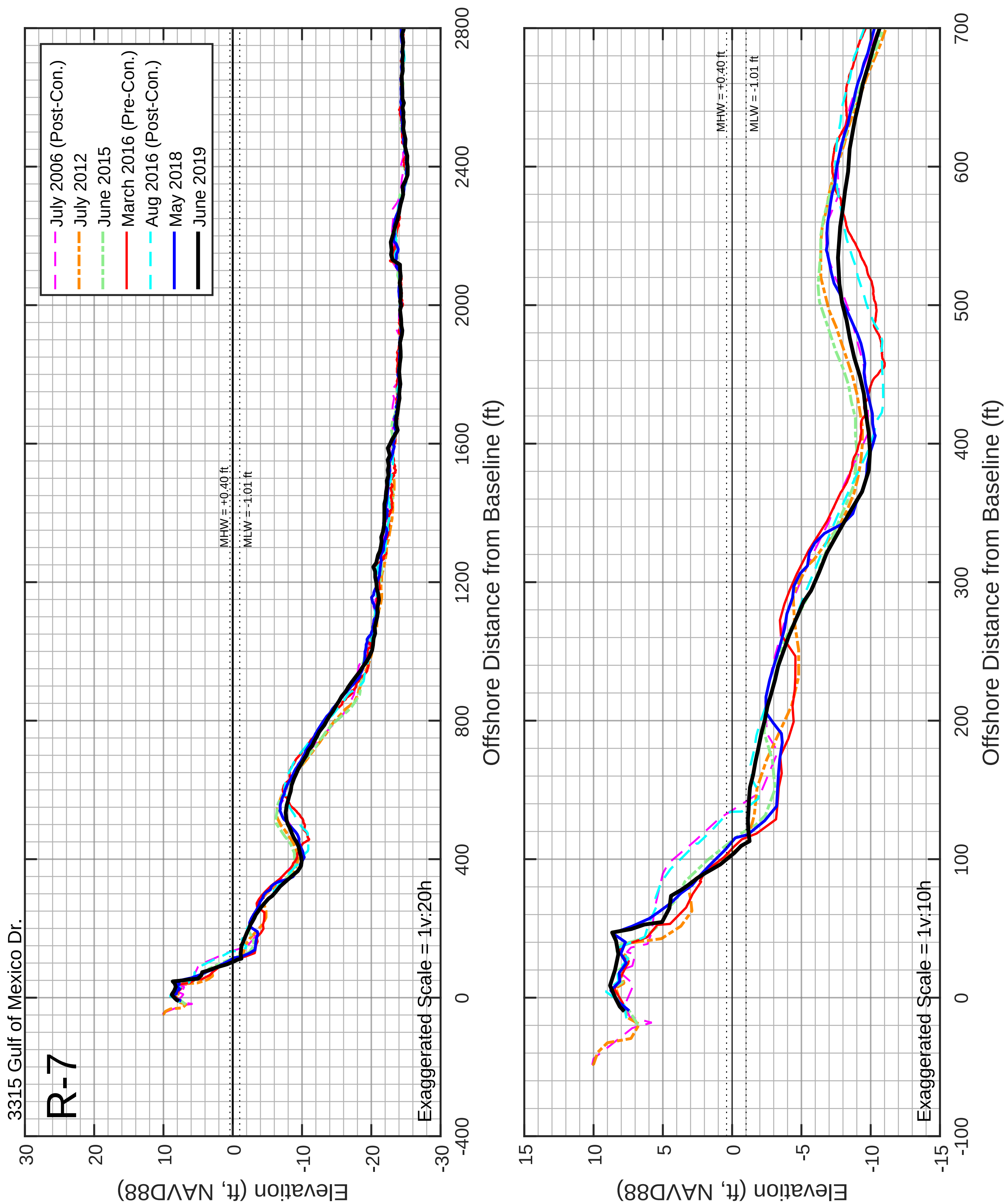

Figure B-066: Measured beach profiles at monument R-7 Longboat Key, Florida.

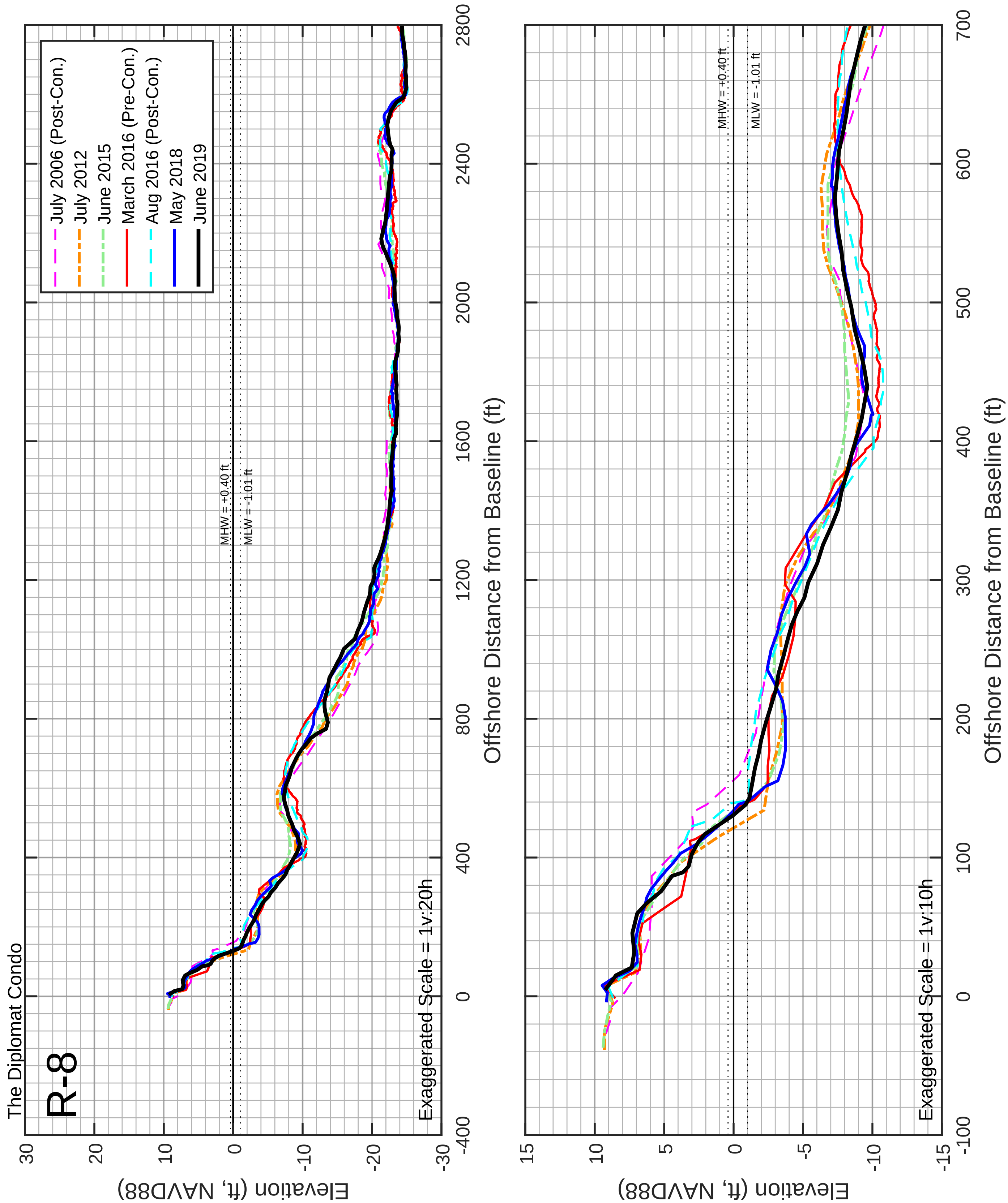

Figure B-067: Measured beach profiles at monument R-8 Longboat Key, Florida.

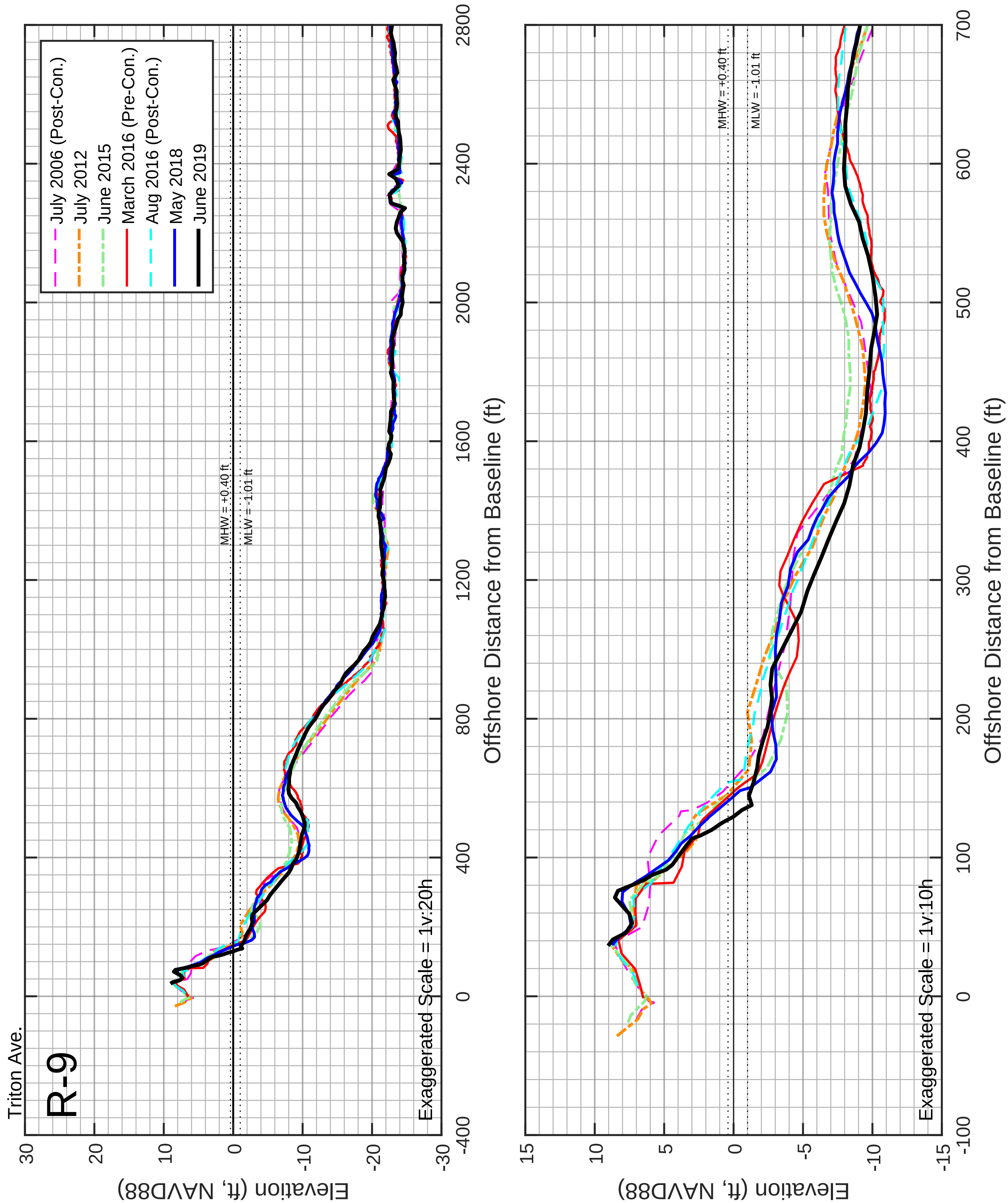

Figure B-068: Measured beach profiles at monument R-9 Longboat Key, Florida.

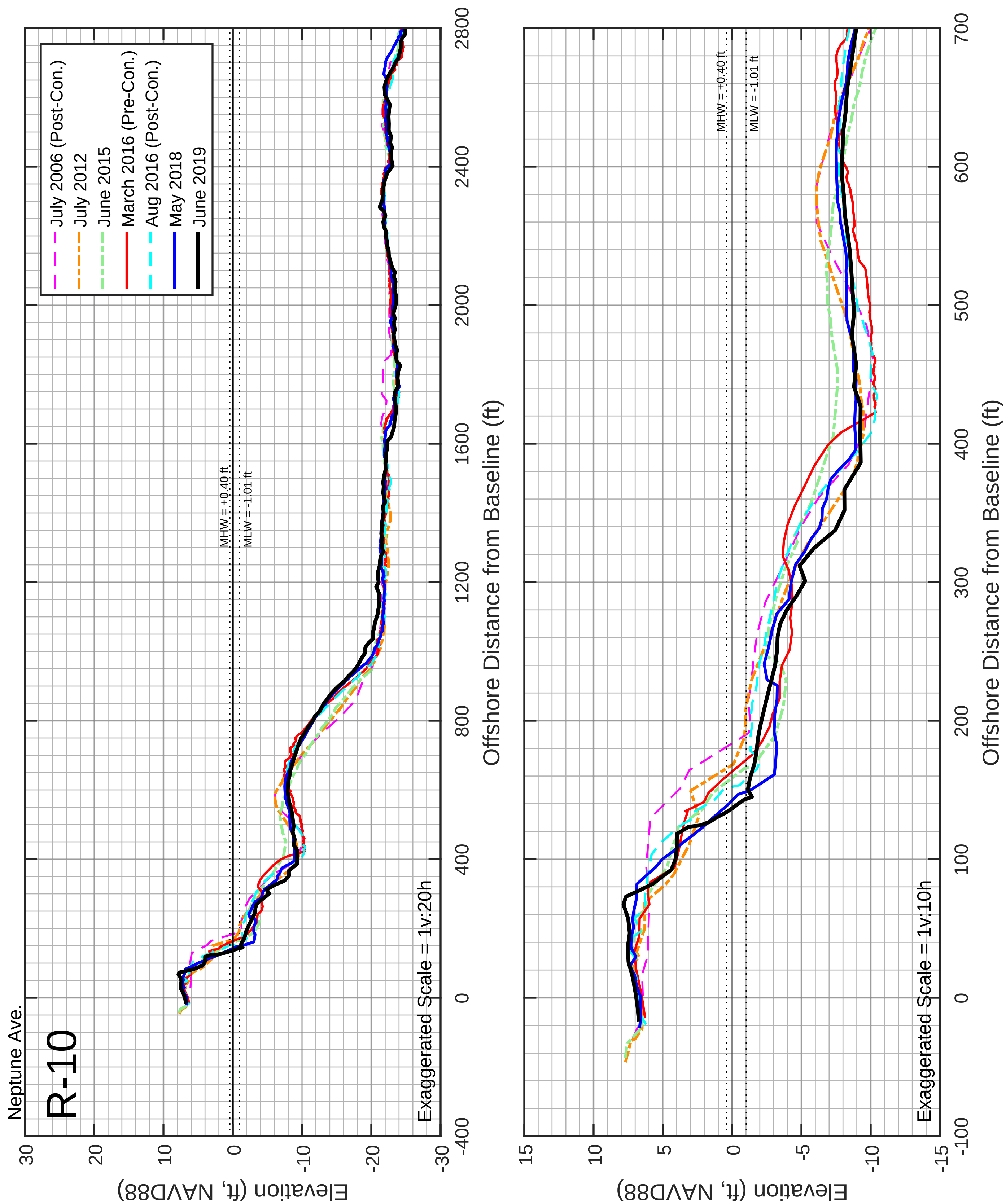

Figure B-069: Measured beach profiles at monument R-10 Longboat Key, Florida.

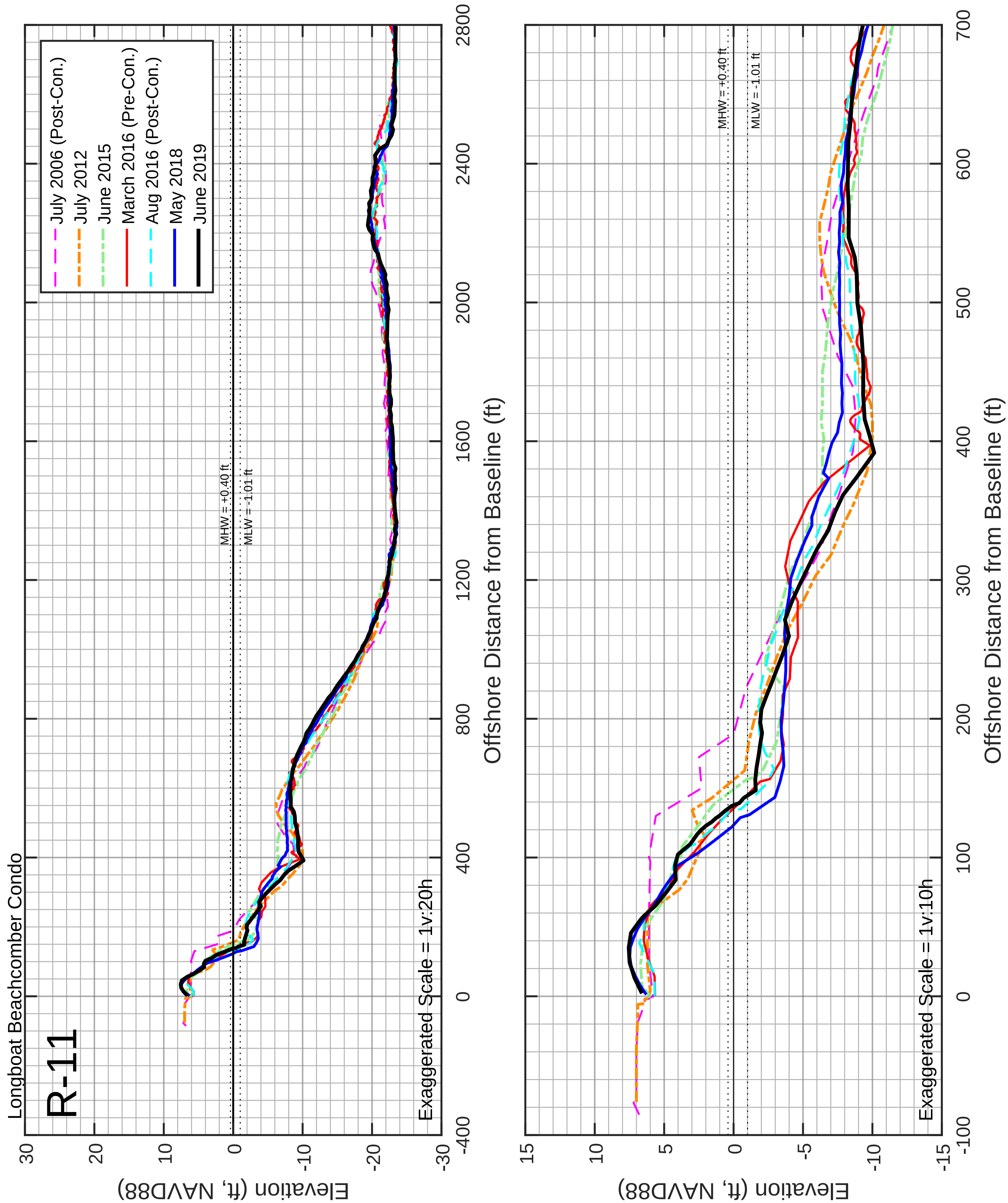

Figure B-070: Measured beach profiles at monument R-11 Longboat Key, Florida.

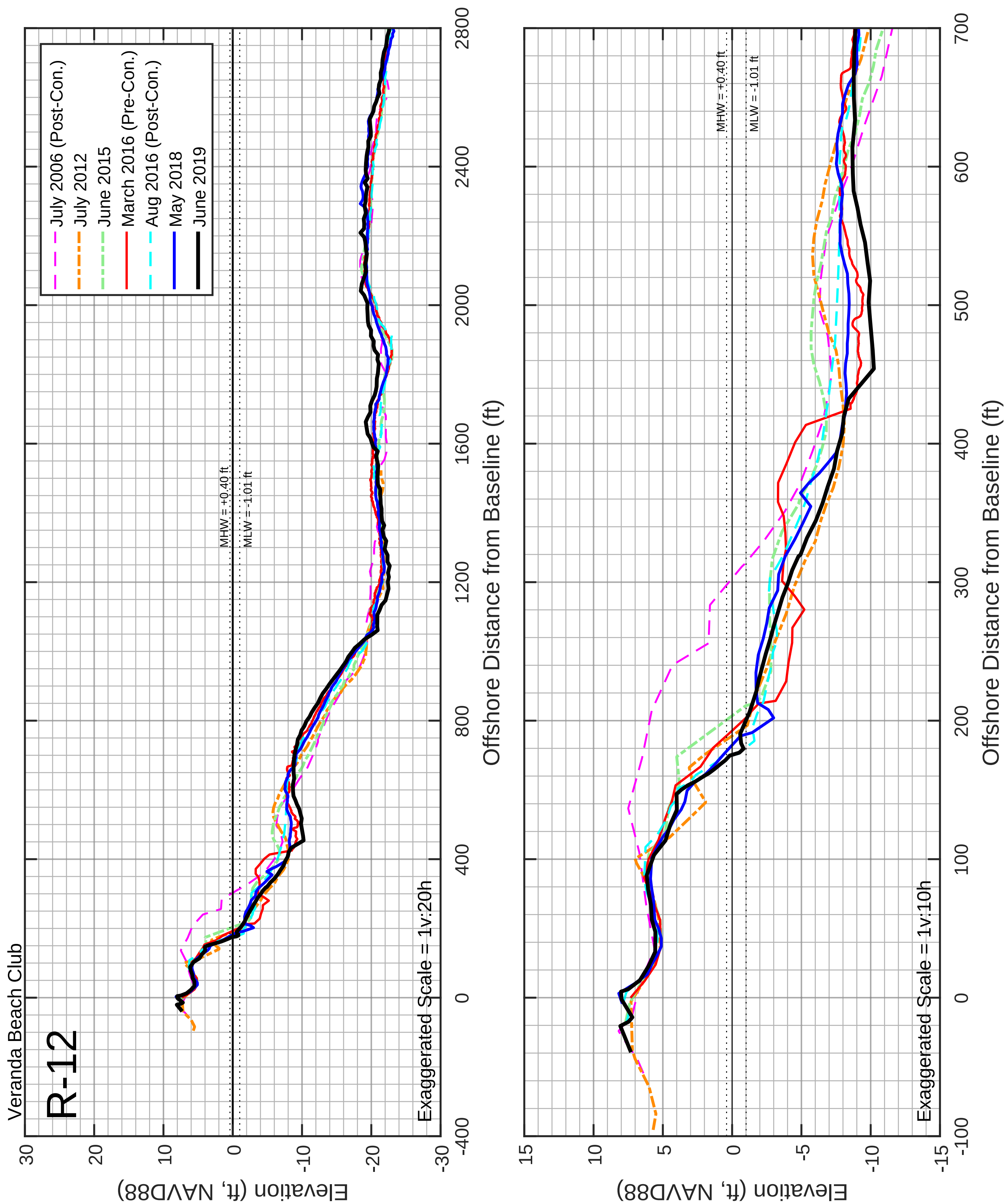

Figure B-071: Measured beach profiles at monument R-12 Longboat Key, Florida.

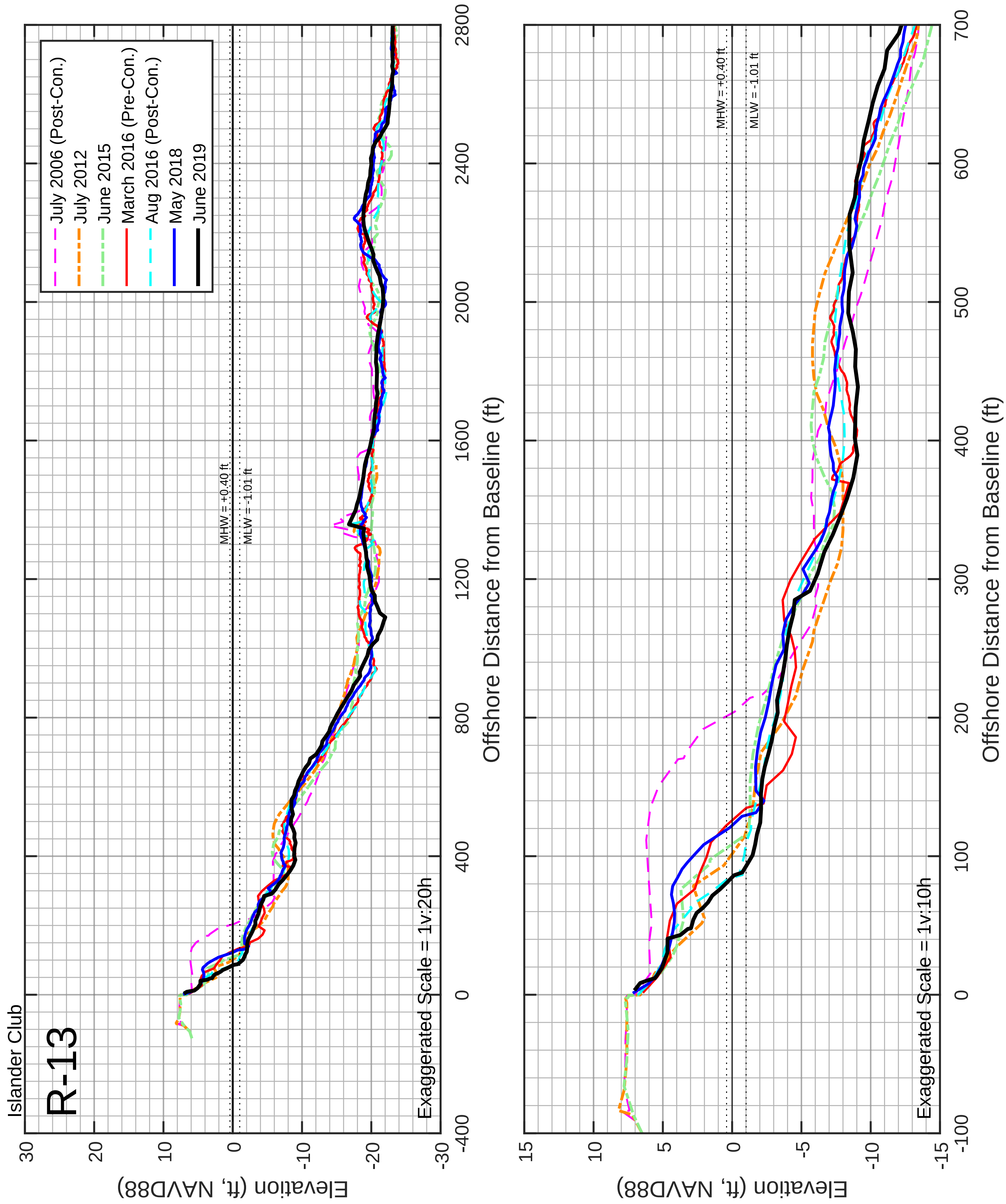

Figure B-072: Measured beach profiles at monument R-13 Longboat Key, Florida.

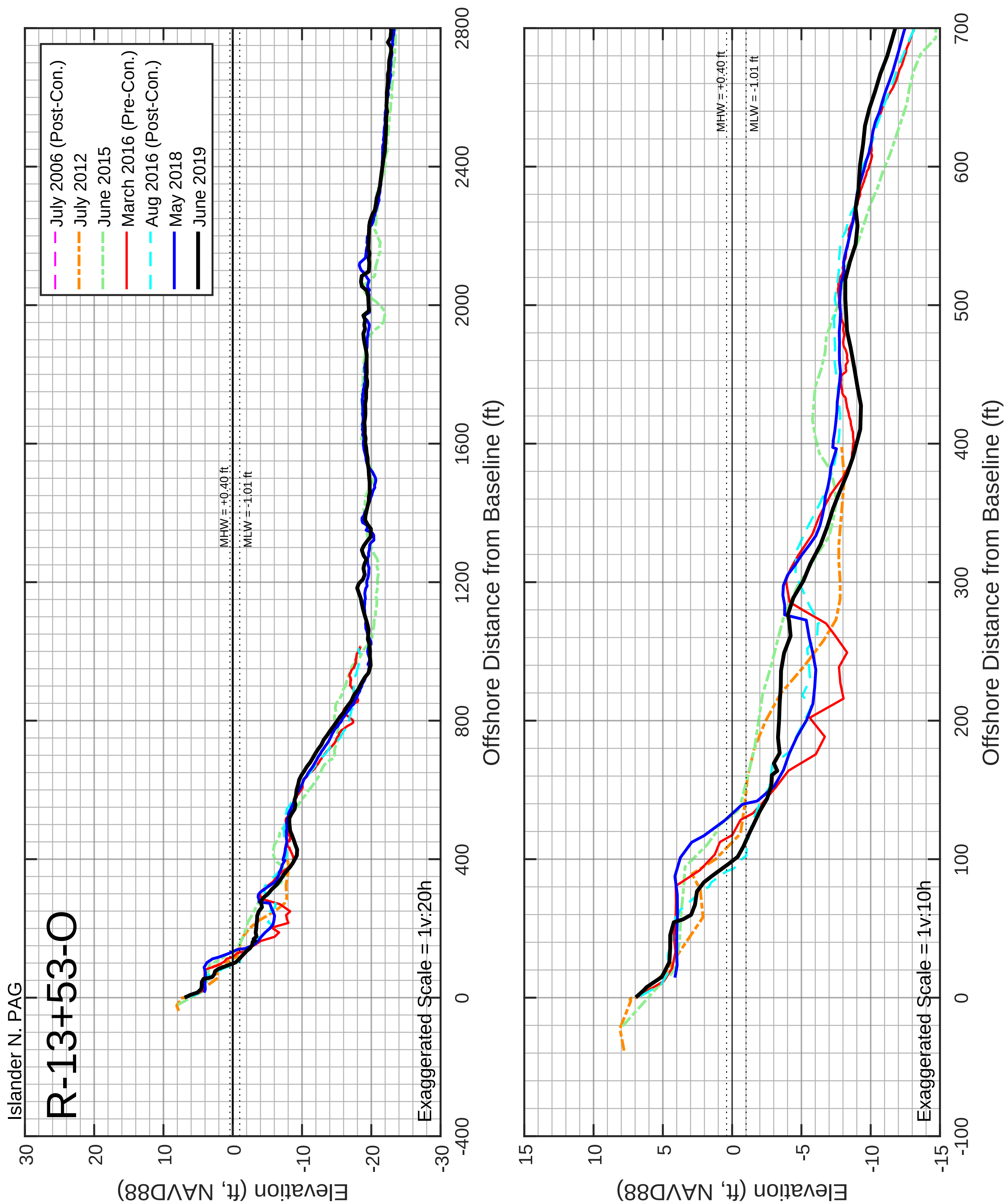

Figure B-073: Measured beach profiles at monument R-13+53-O Longboat Key, Florida.

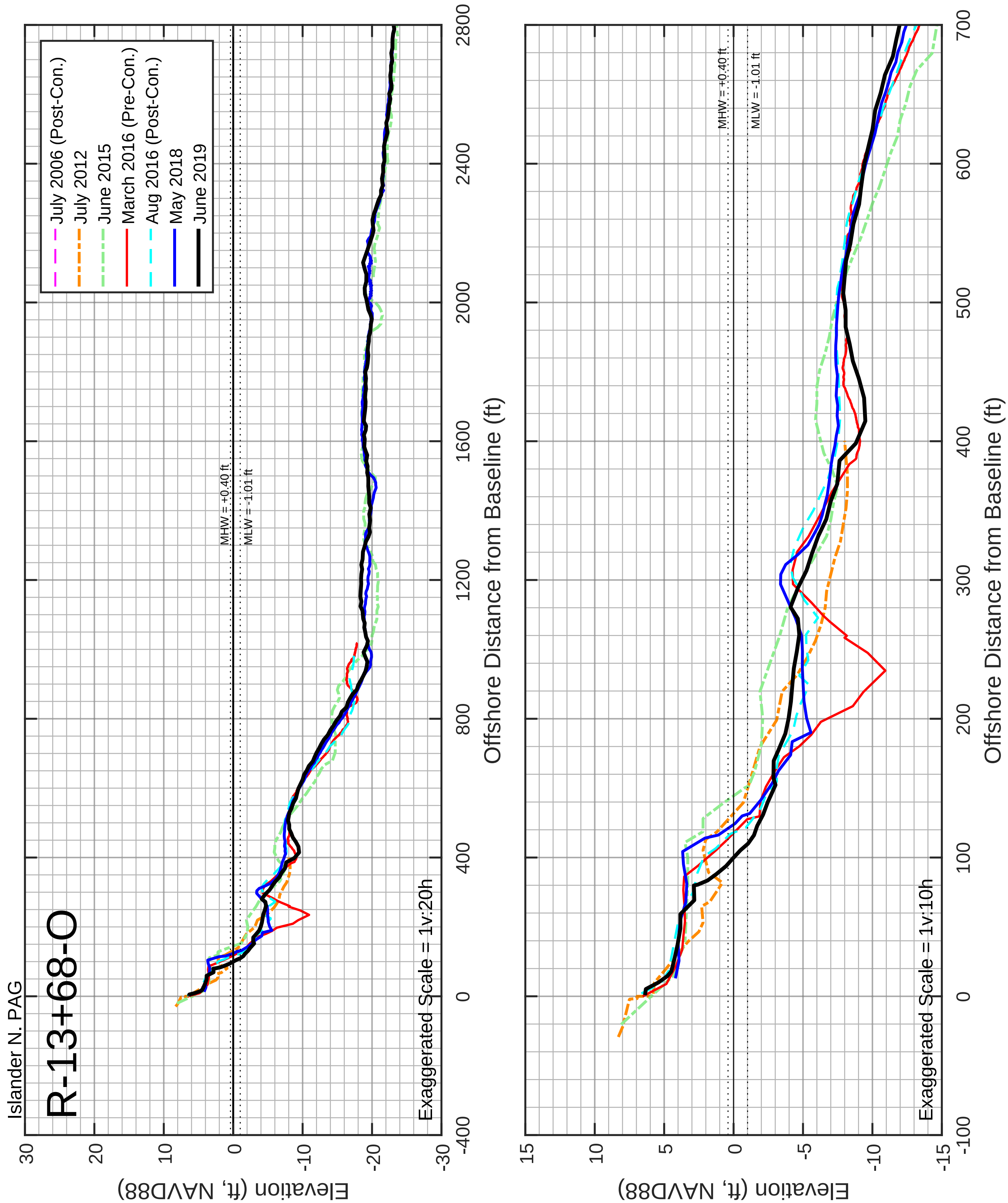

Figure B-074: Measured beach profiles at monument R-13+68-O Longboat Key, Florida.

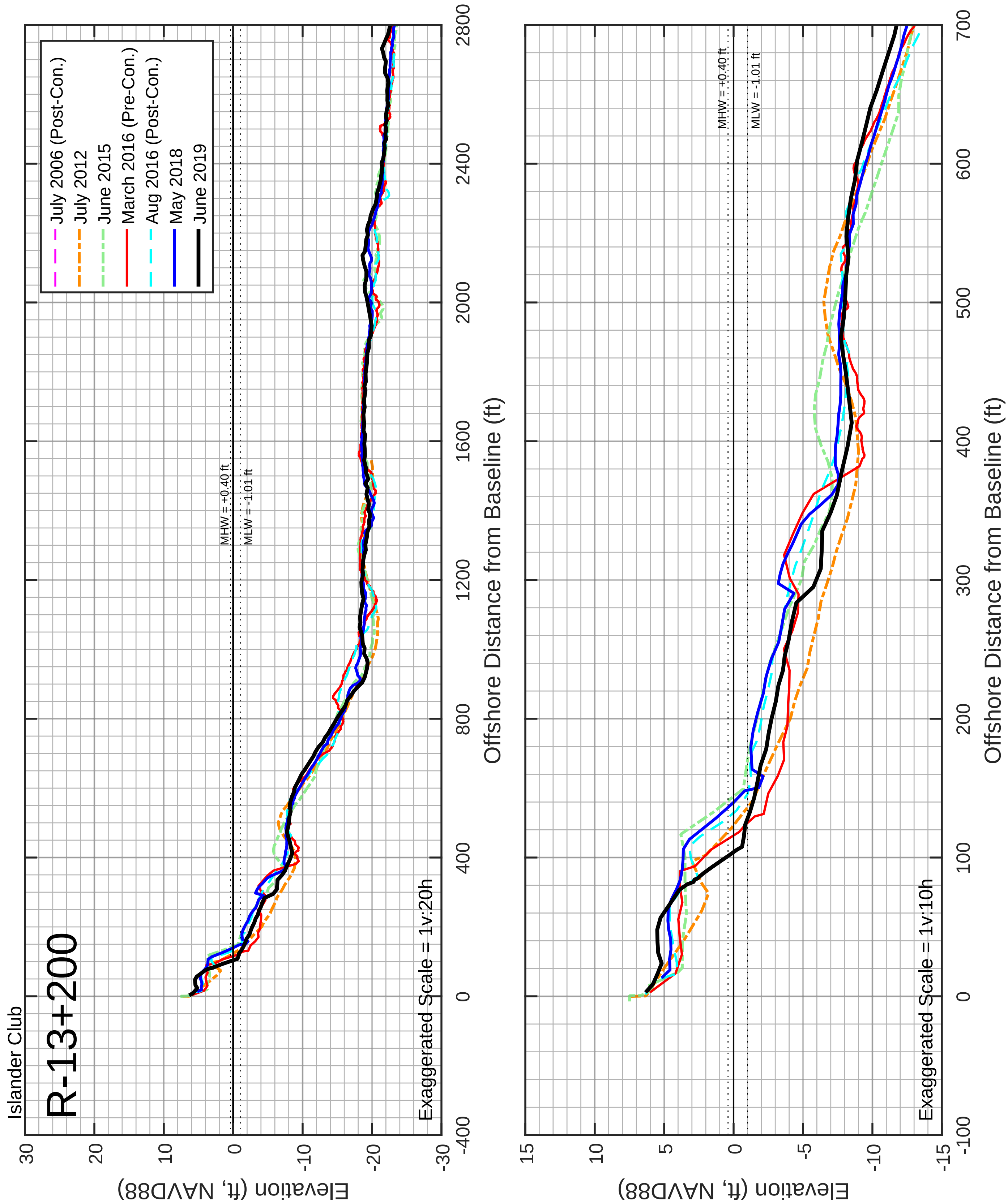

Figure B-075: Measured beach profiles at monument R-13+200 Longboat Key, Florida.

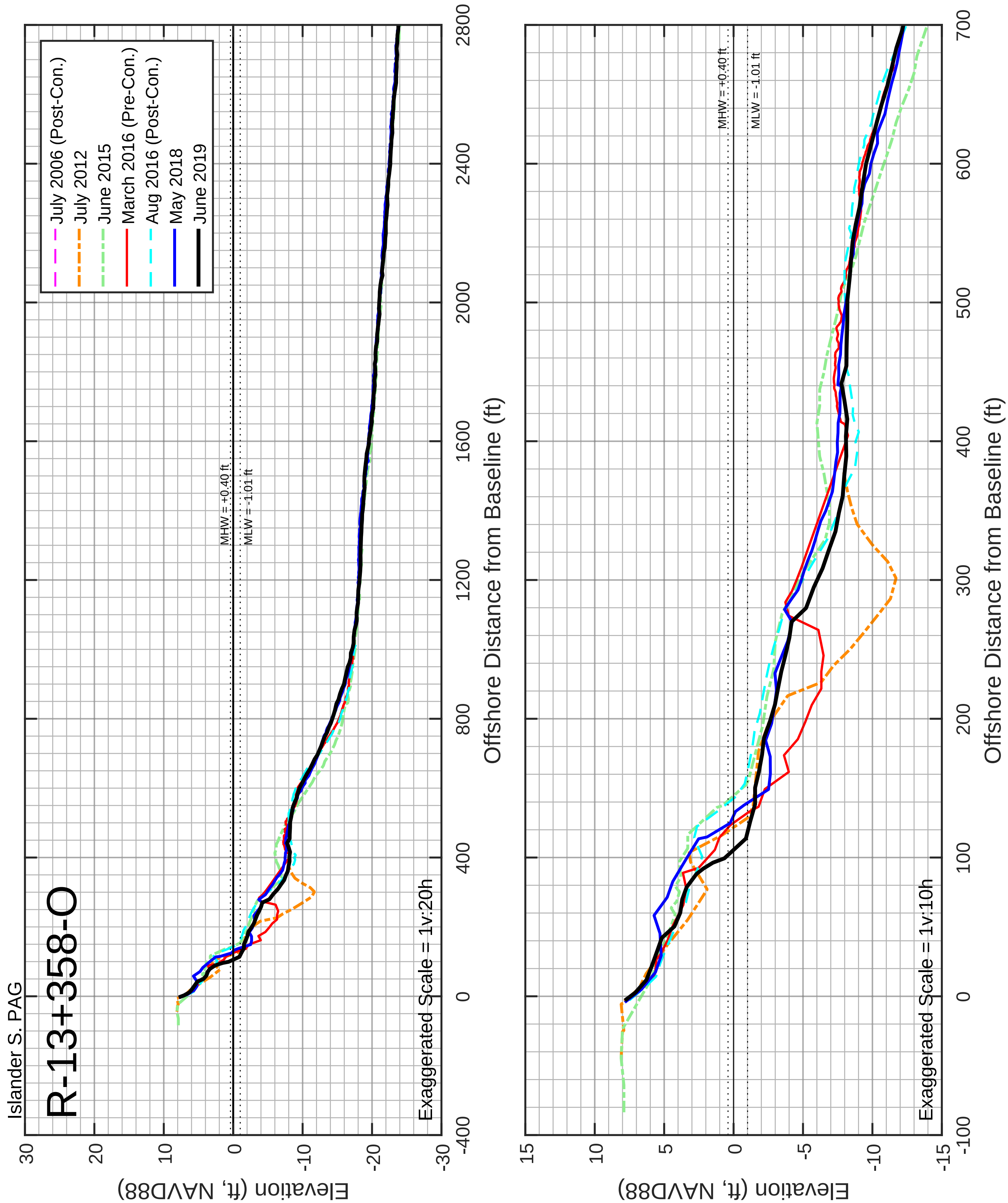

Figure B-076: Measured beach profiles at monument R-13+358-O Longboat Key, Florida.

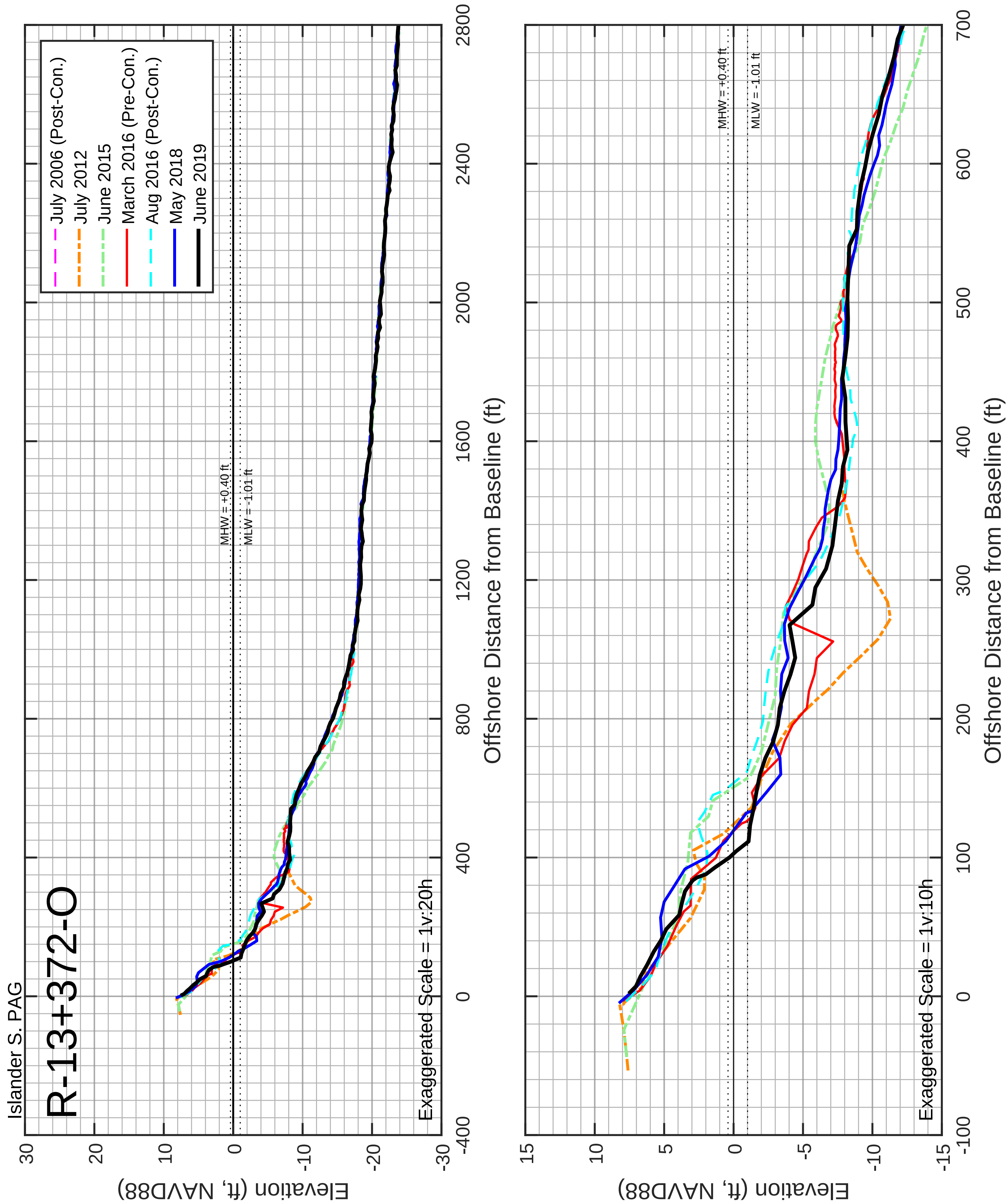

Figure B-077: Measured beach profiles at monument R-13+372-O Longboat Key, Florida.

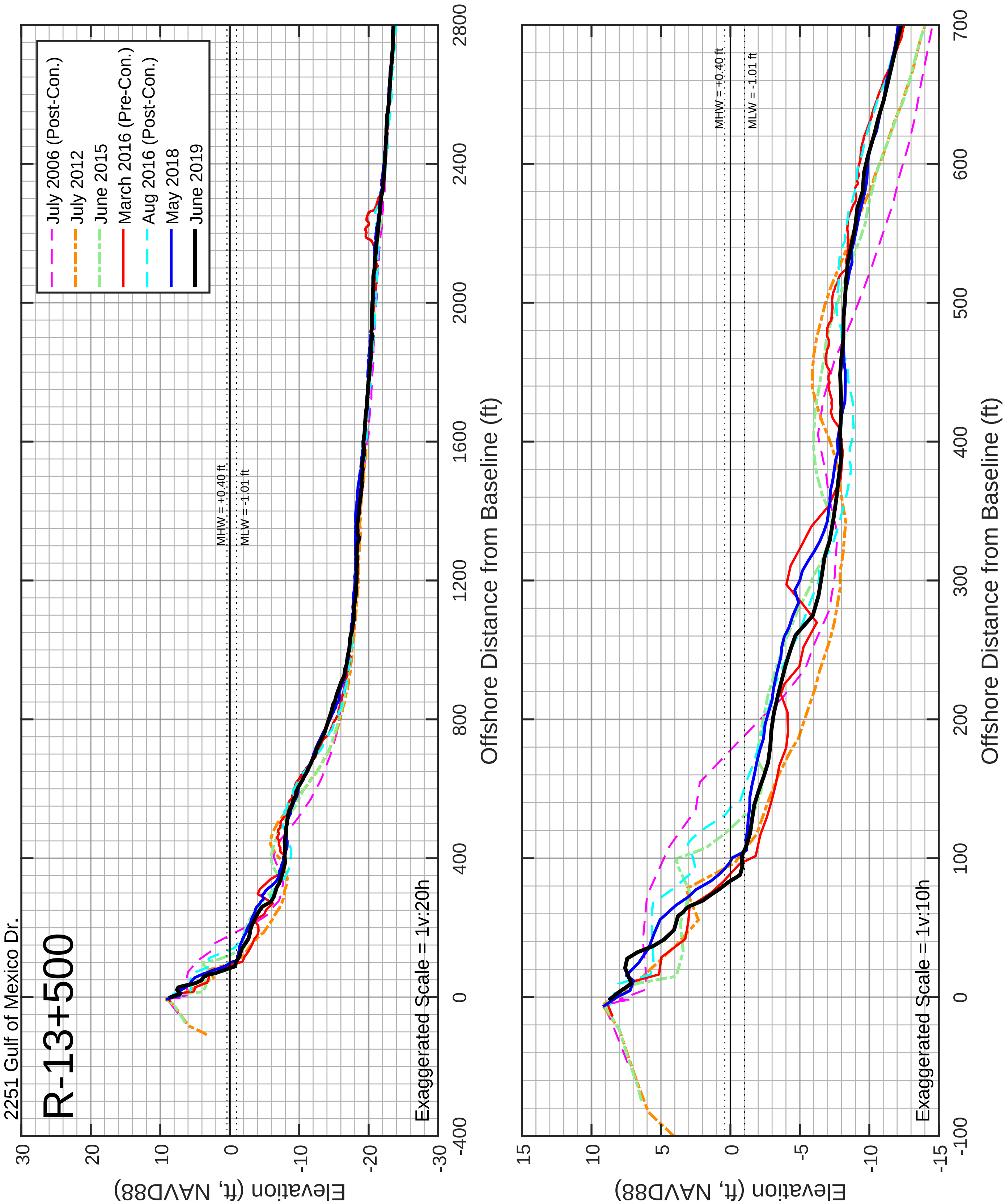

Figure B-078: Measured beach profiles at monument R-13+500 Longboat Key, Florida.

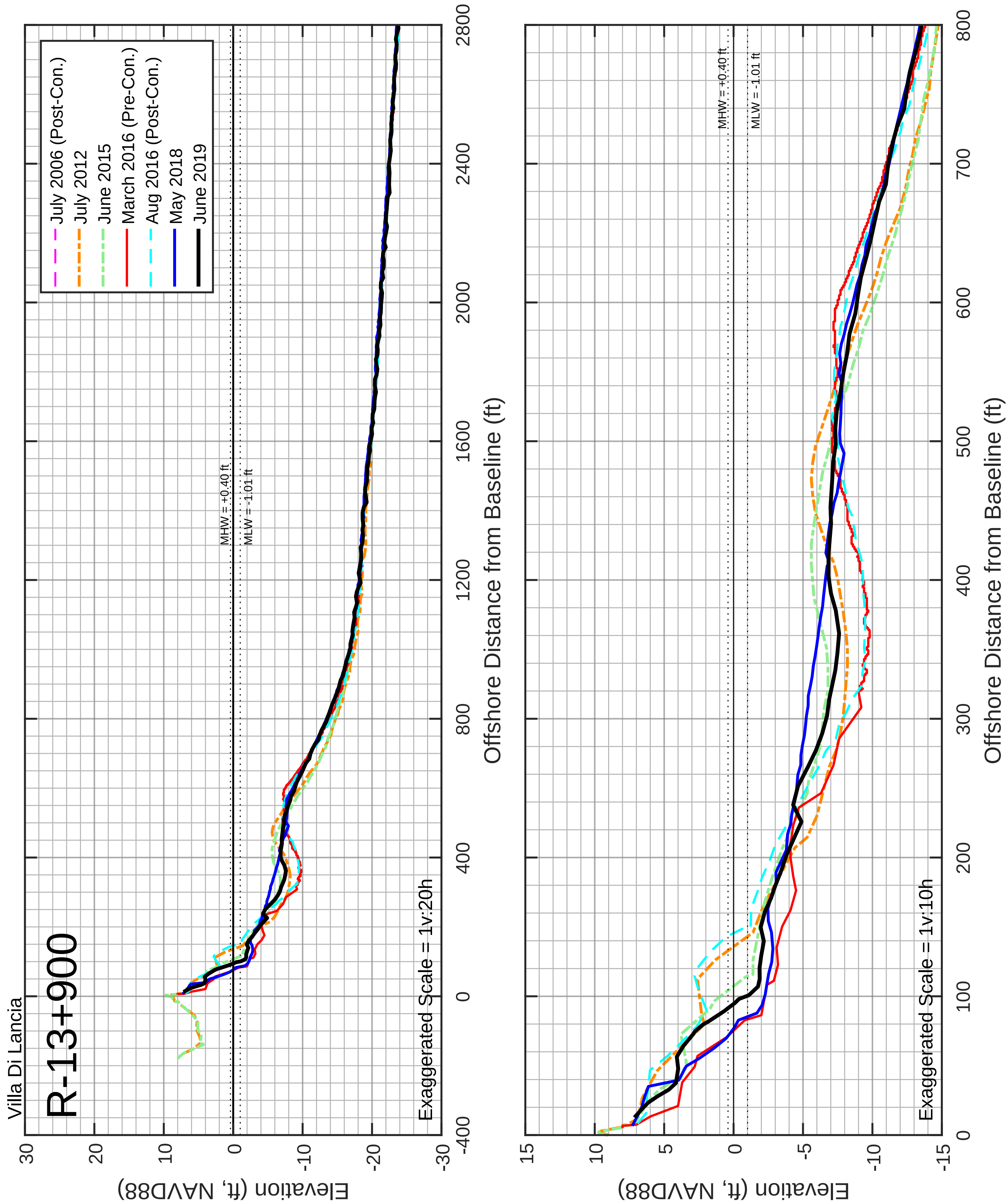

Figure B-079: Measured beach profiles at monument R-13+900 Longboat Key, Florida.

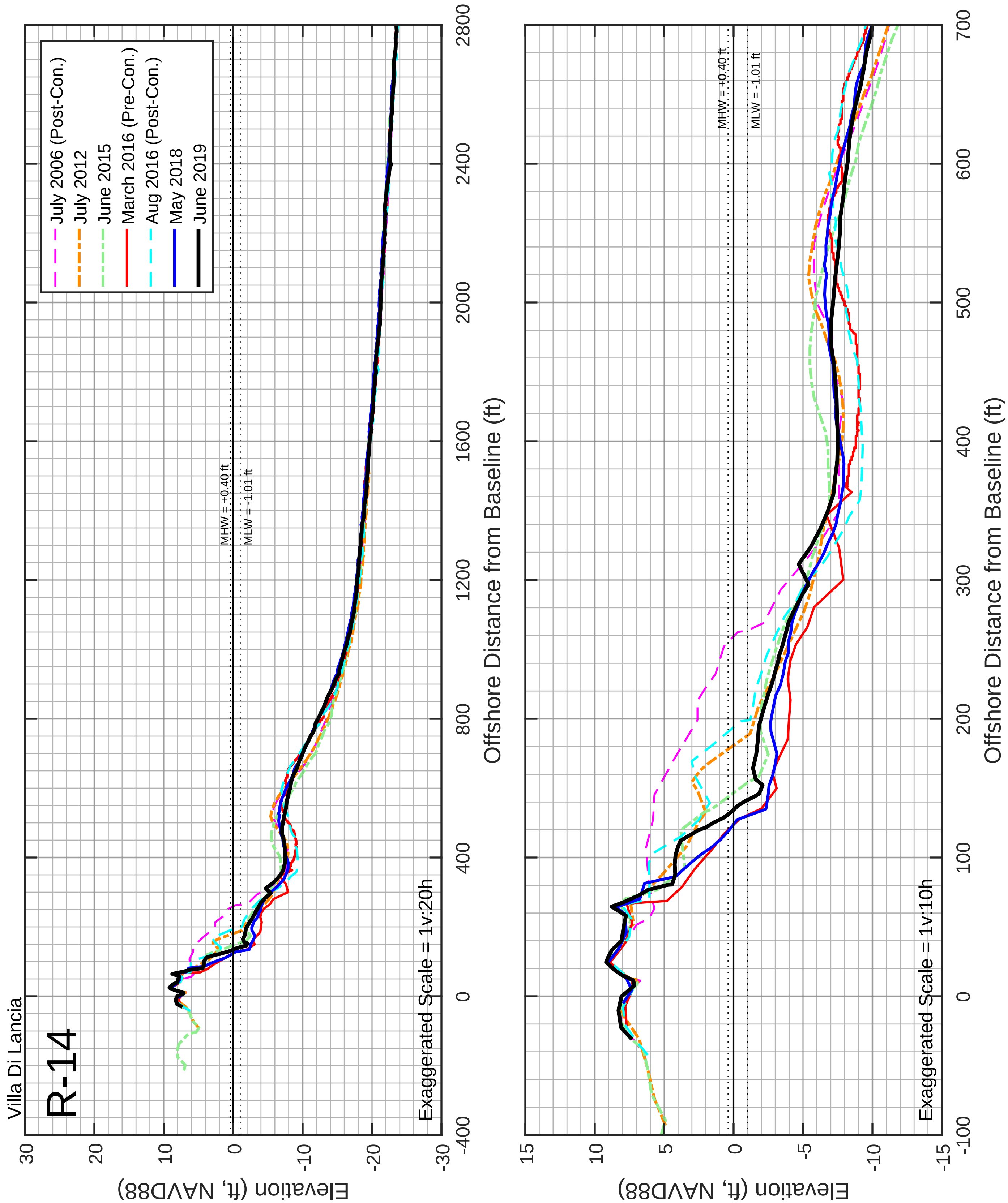

Figure B-080: Measured beach profiles at monument R-14 Longboat Key, Florida.

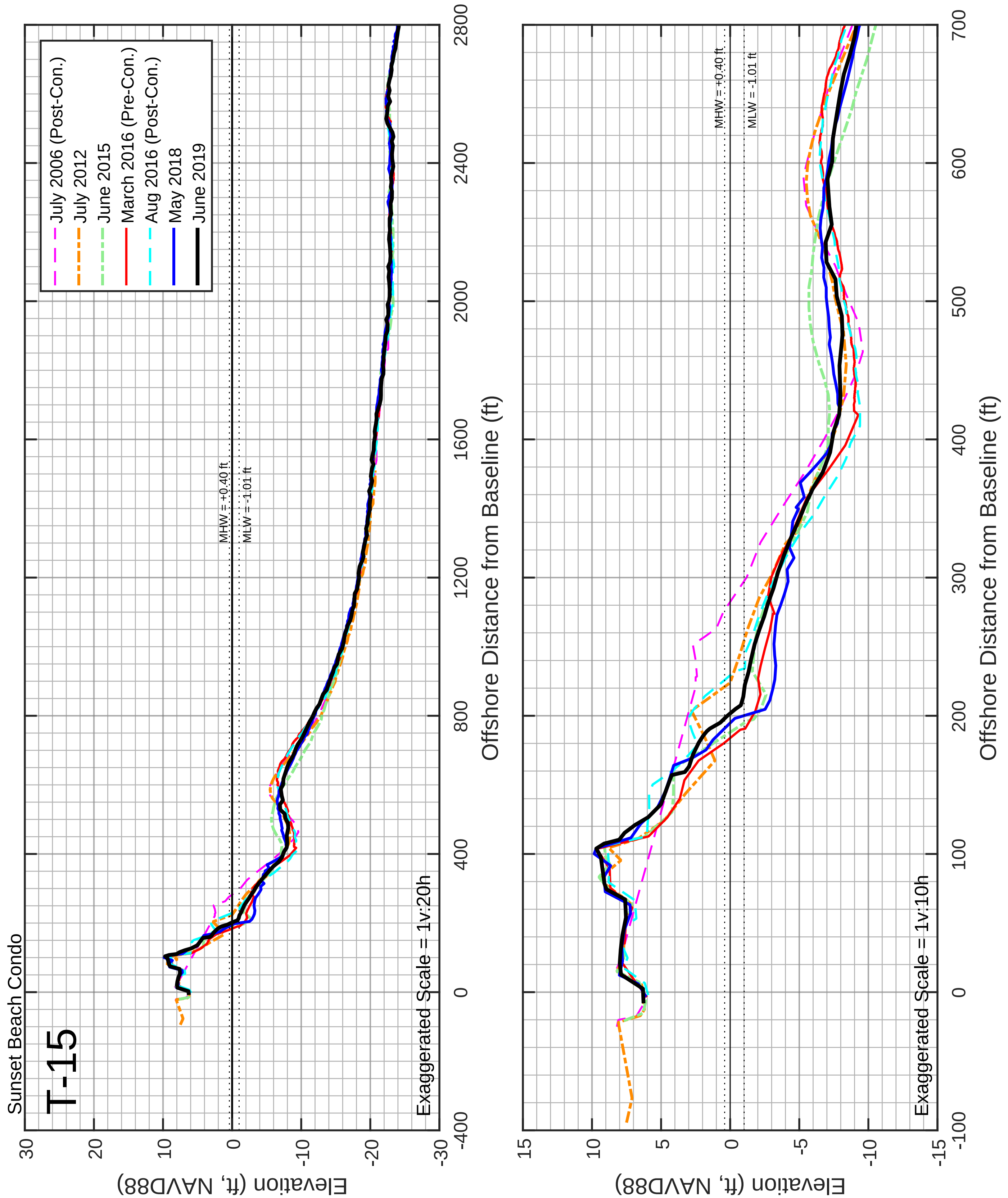

Figure B-081: Measured beach profiles at monument T-15 Longboat Key, Florida.

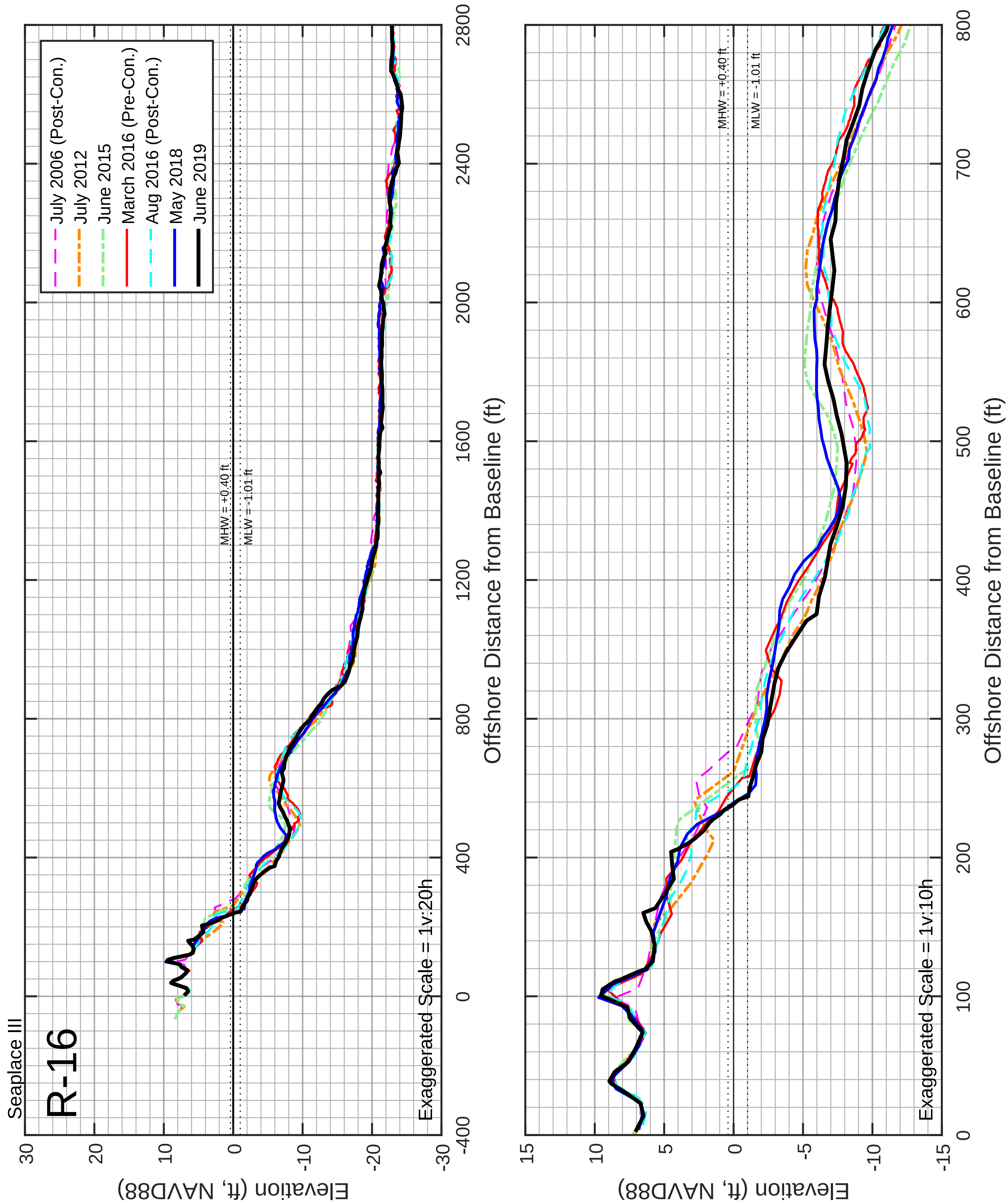

Figure B-082: Measured beach profiles at monument R-16 Longboat Key, Florida.

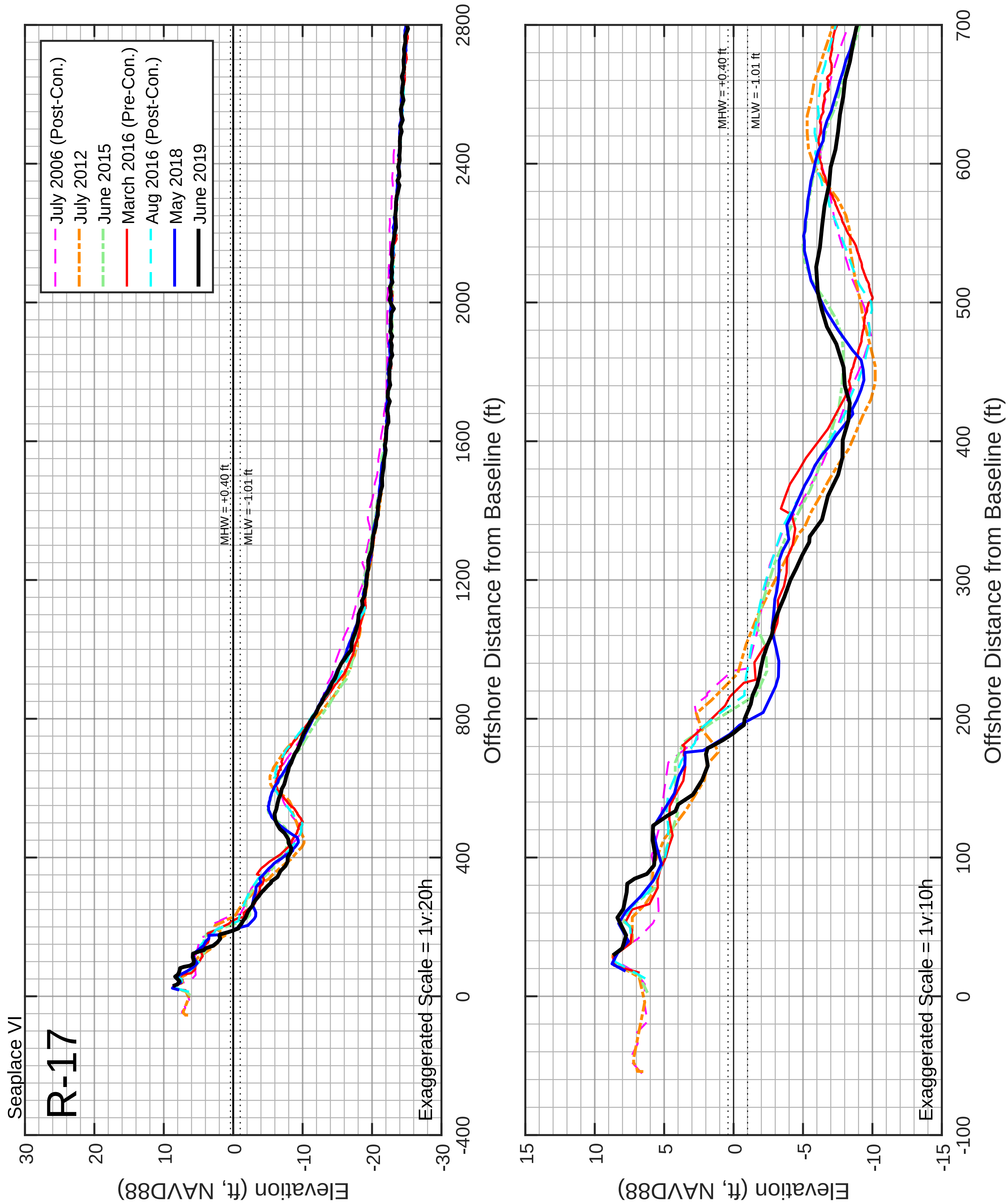

Figure B-083: Measured beach profiles at monument R-17 Longboat Key, Florida.

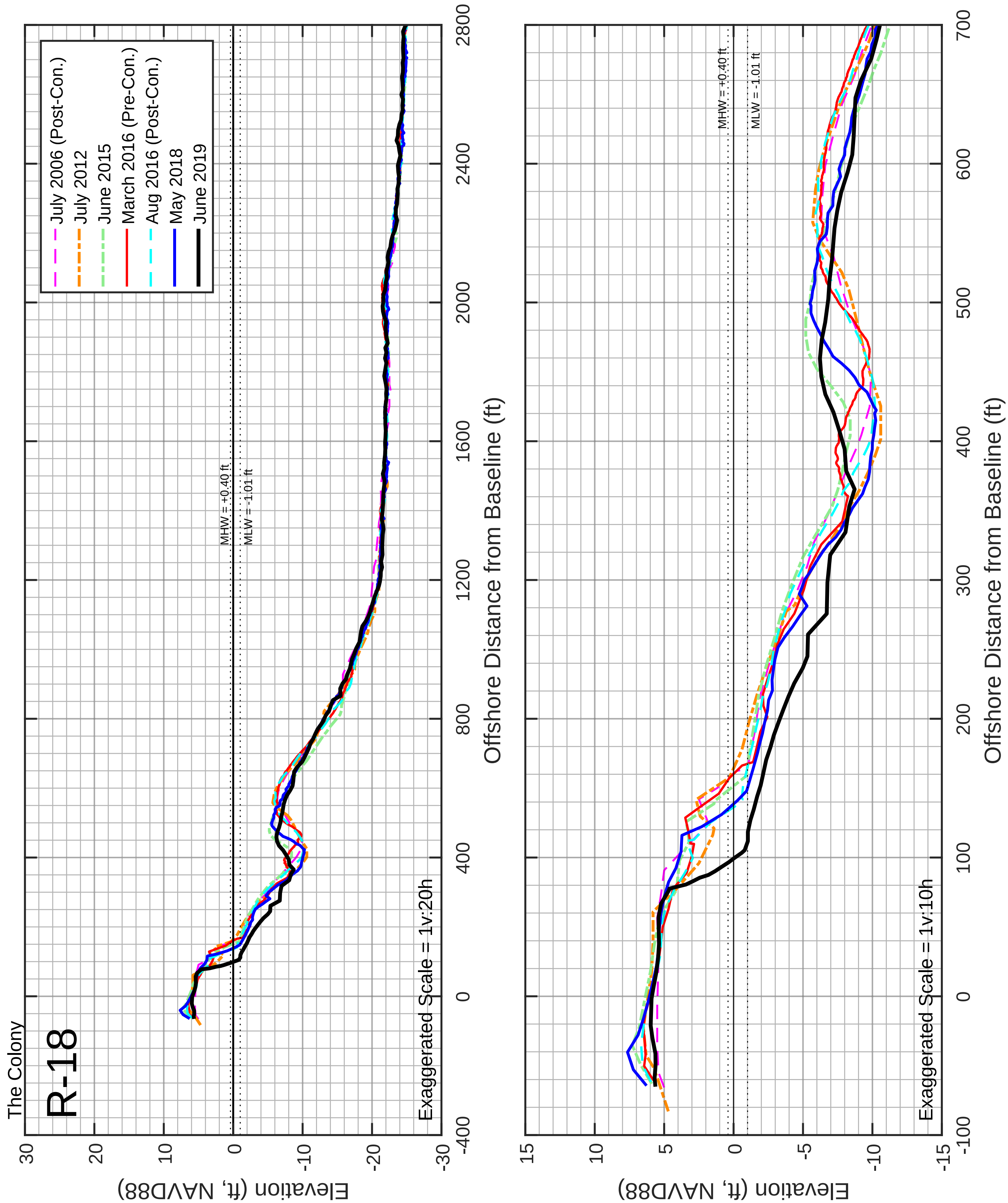

Figure B-084: Measured beach profiles at monument R-18 Longboat Key, Florida.

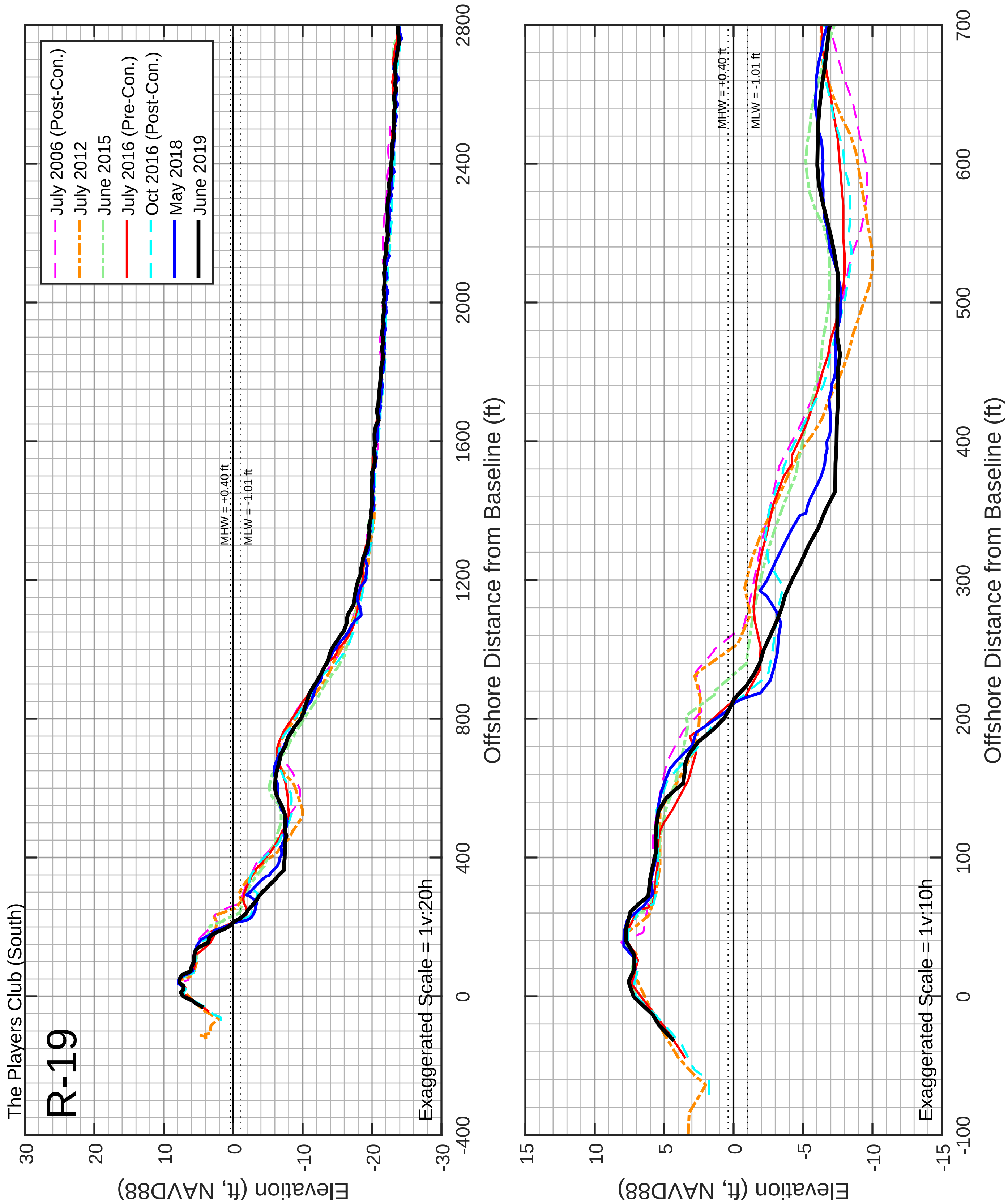

Figure B-085: Measured beach profiles at monument R-19 Longboat Key, Florida.

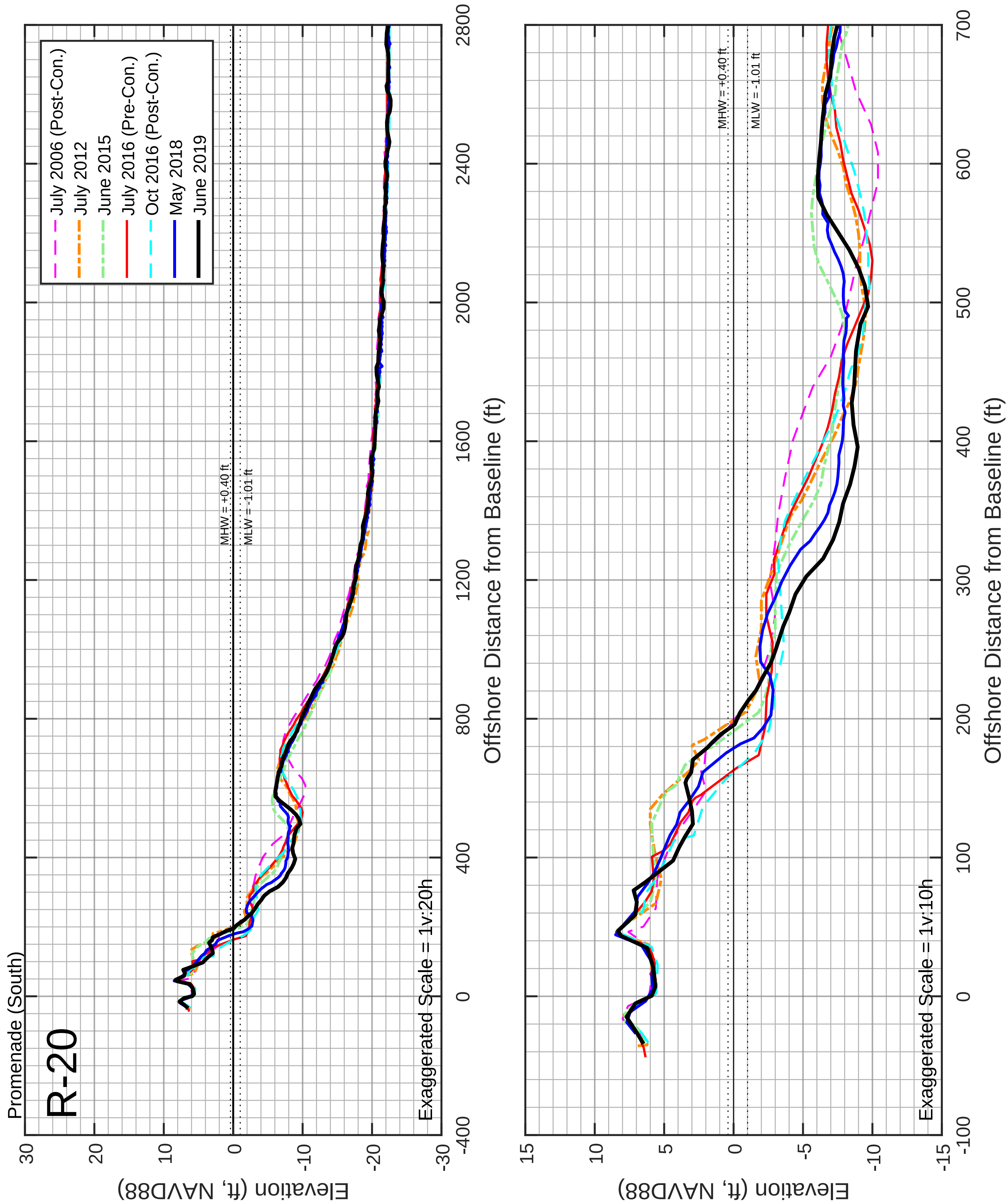

Figure B-086: Measured beach profiles at monument R-20 Longboat Key, Florida.

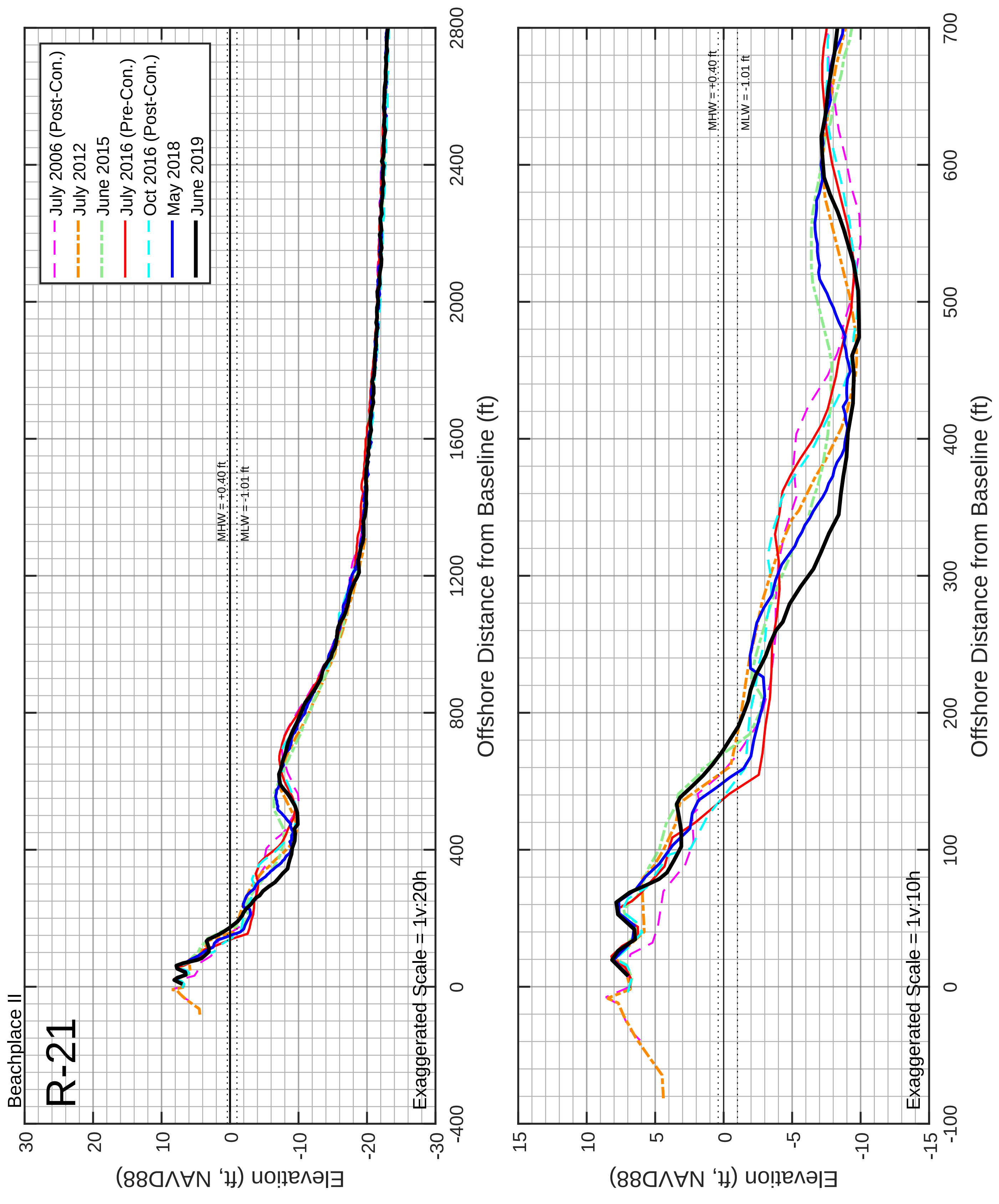

Figure B-087: Measured beach profiles at monument R-21 Longboat Key, Florida.

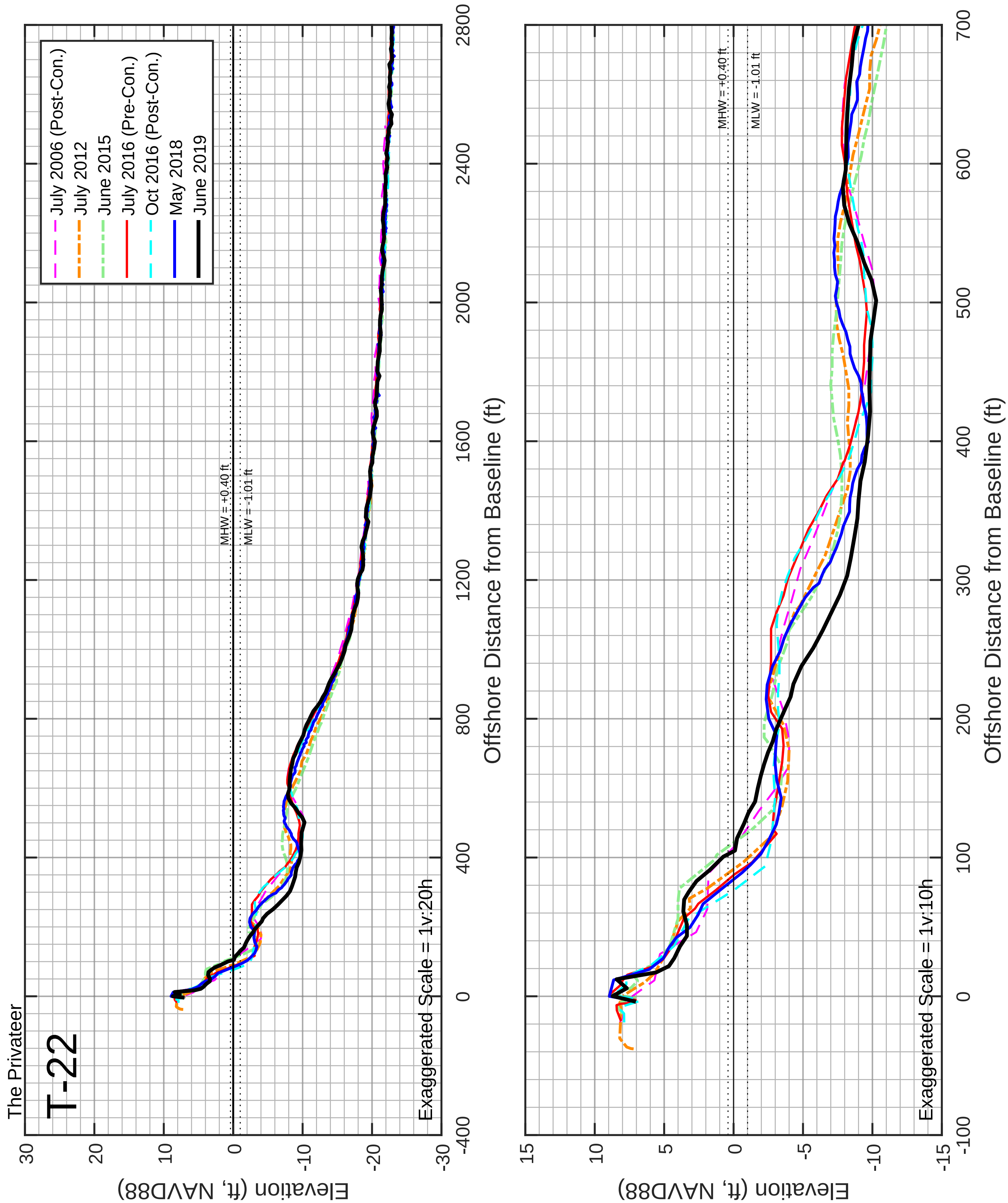

Figure B-088: Measured beach profiles at monument T-22 Longboat Key, Florida.

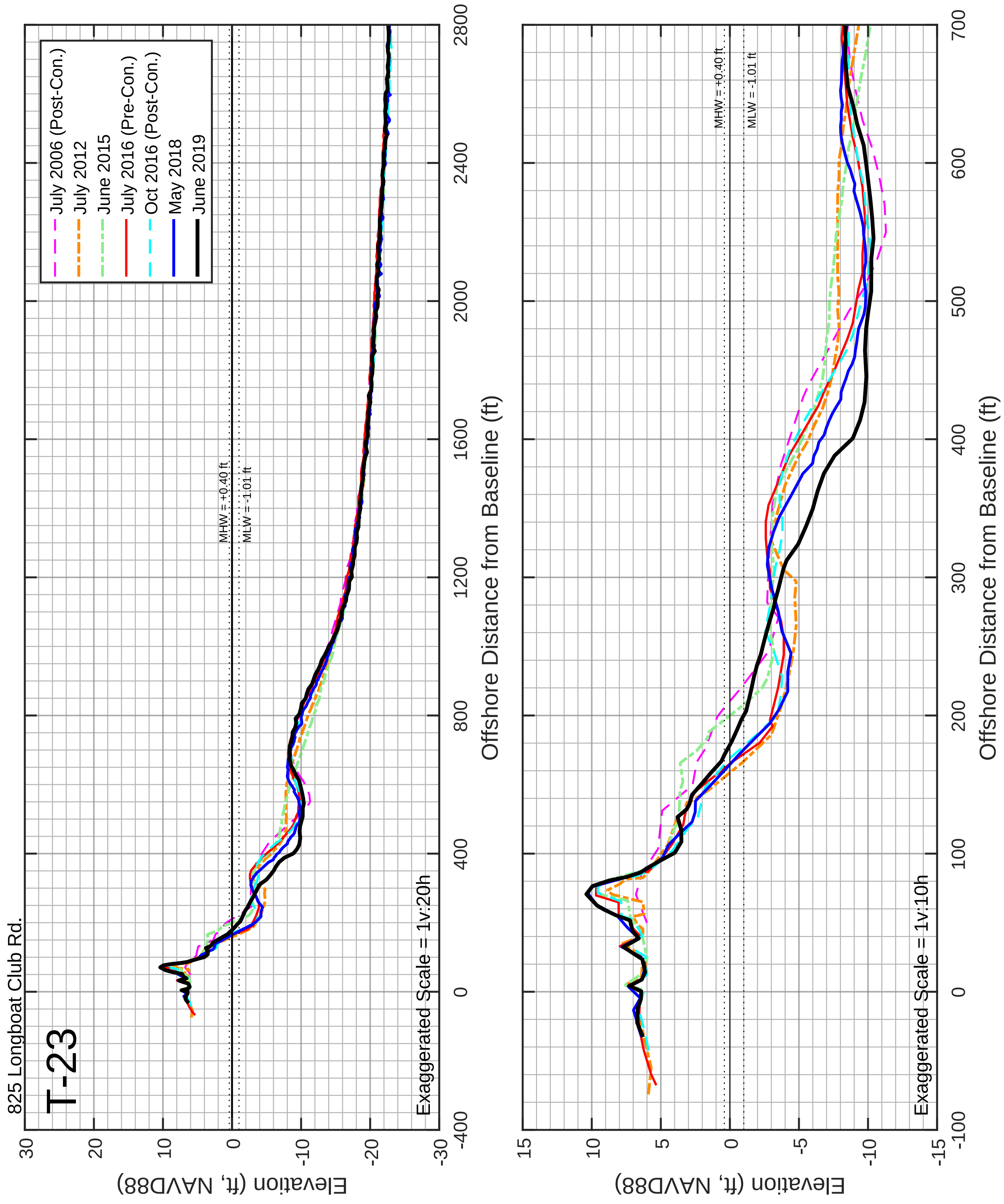

Figure B-089: Measured beach profiles at monument T-23 Longboat Key, Florida.

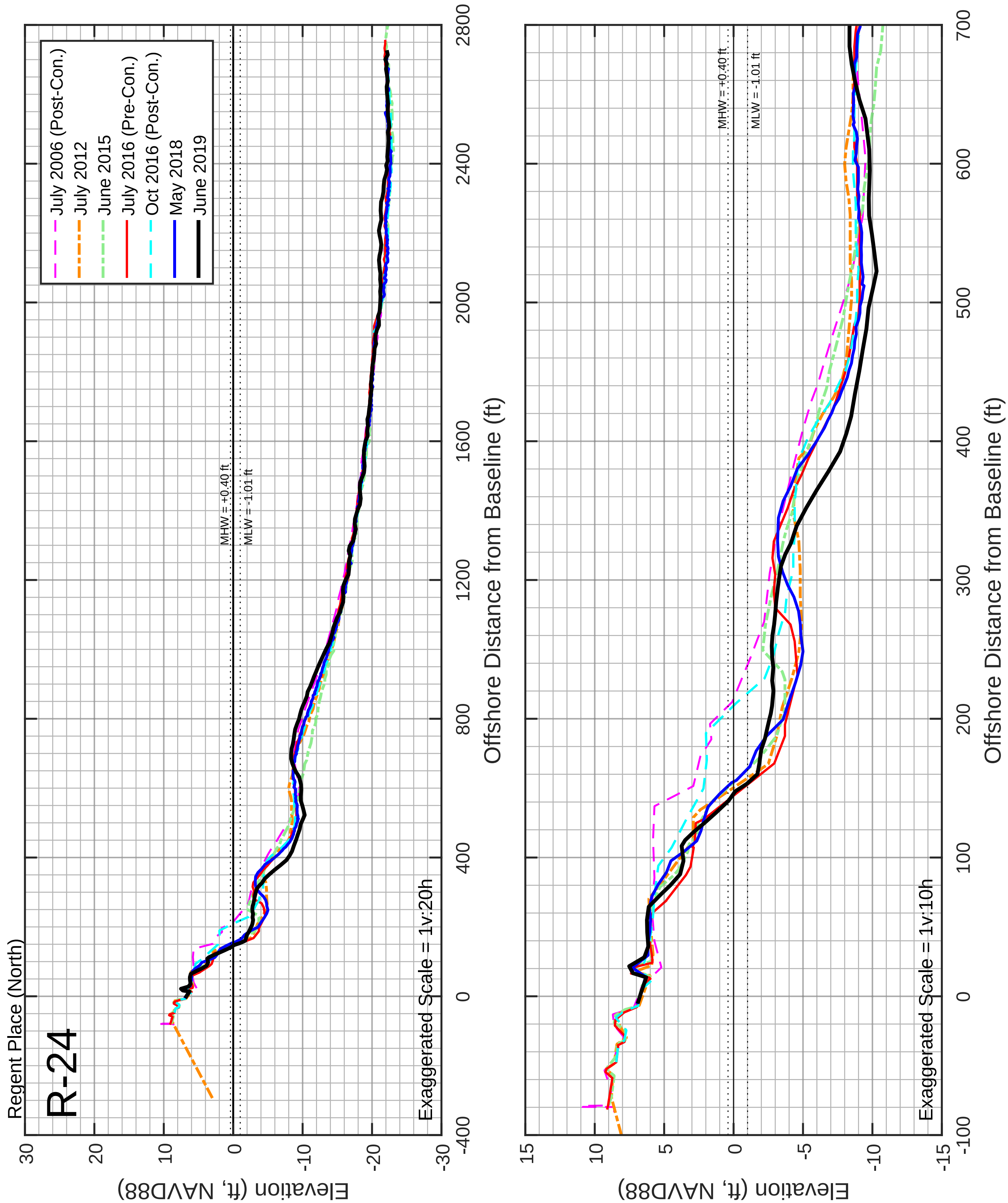

Figure B-090: Measured beach profiles at monument R-24 Longboat Key, Florida.

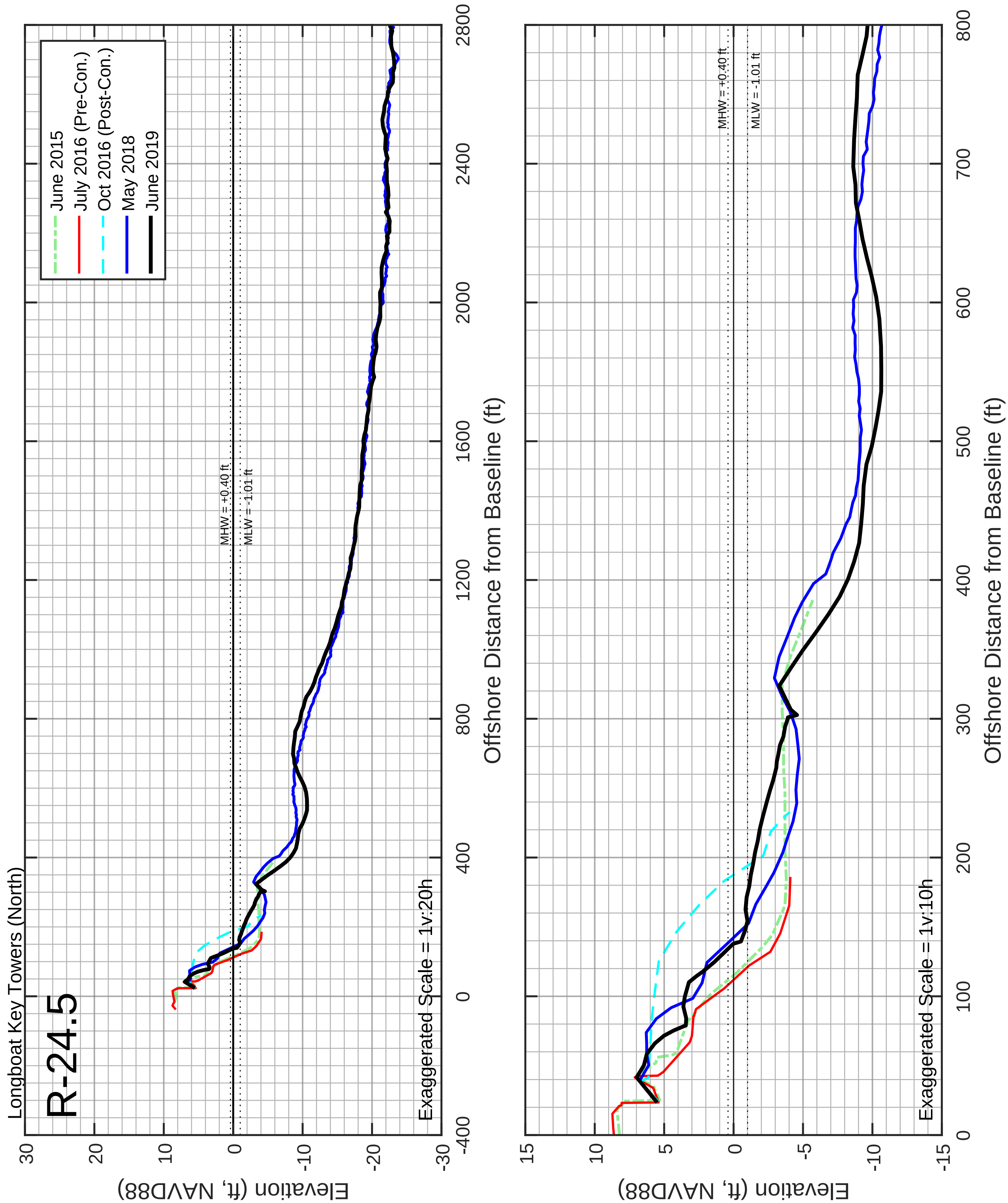

Figure B-091: Measured beach profiles at monument R-24.5 Longboat Key, Florida.

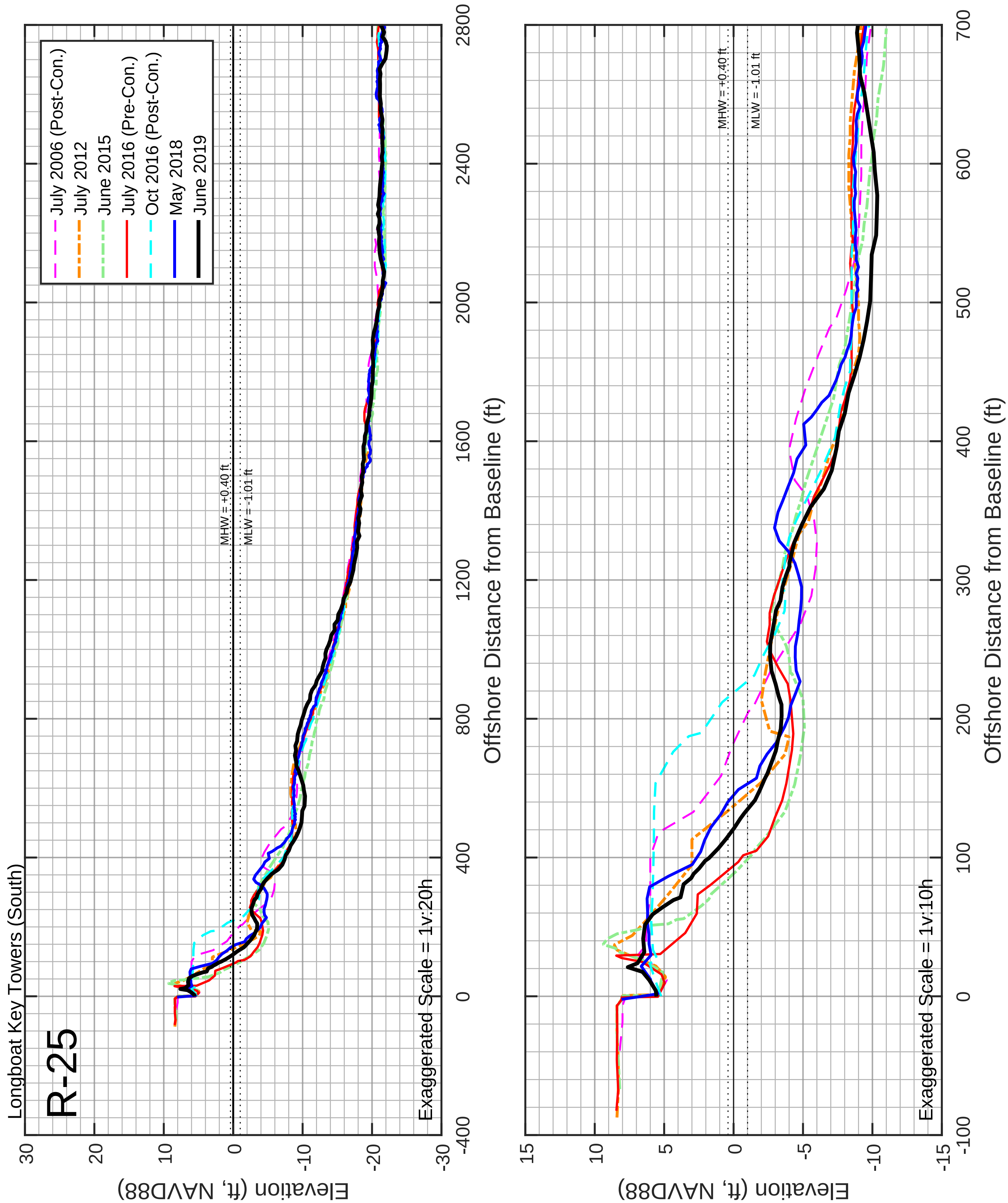

Figure B-092: Measured beach profiles at monument R-25 Longboat Key, Florida.

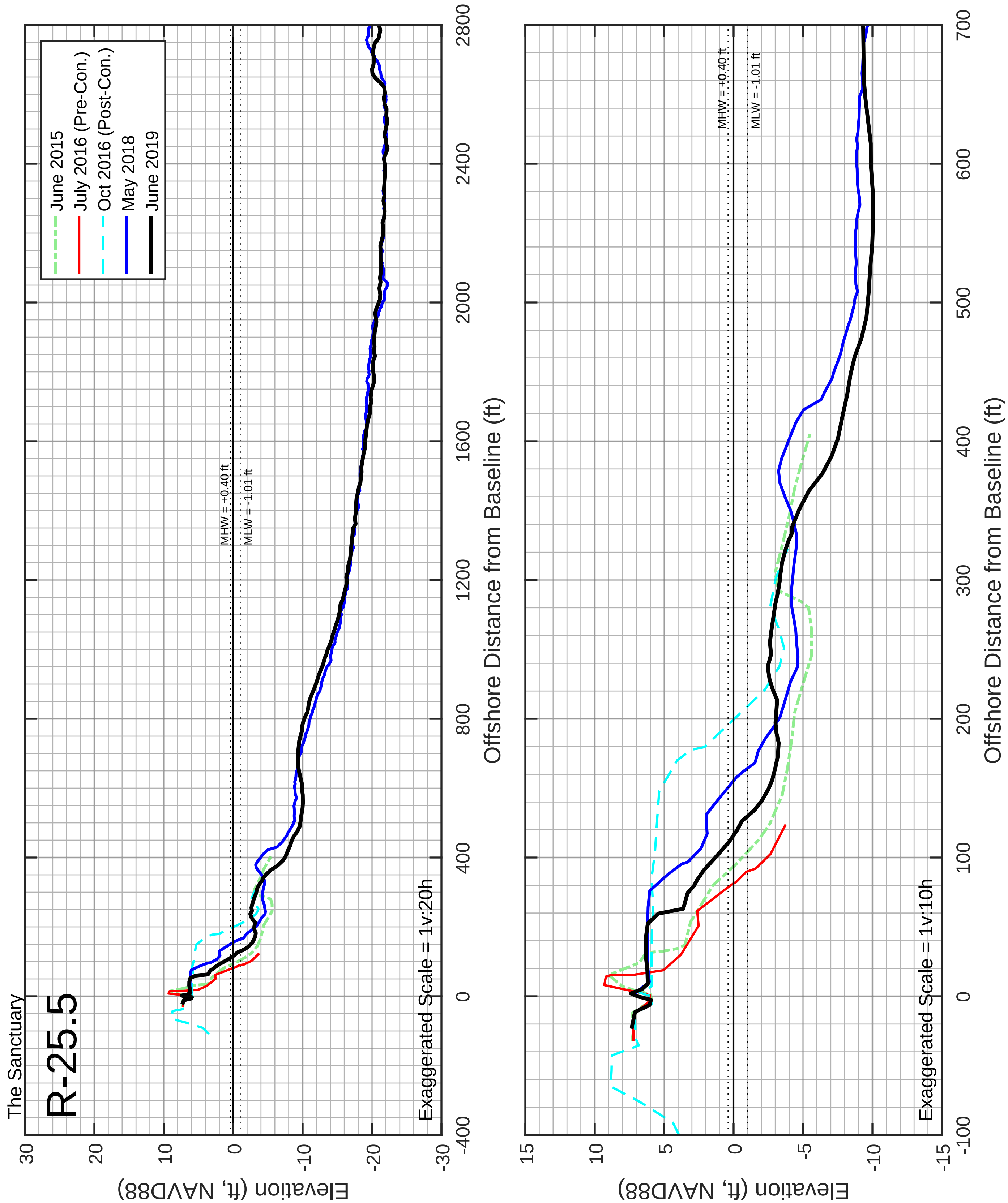

Figure B-093: Measured beach profiles at monument R-25.5 Longboat Key, Florida.

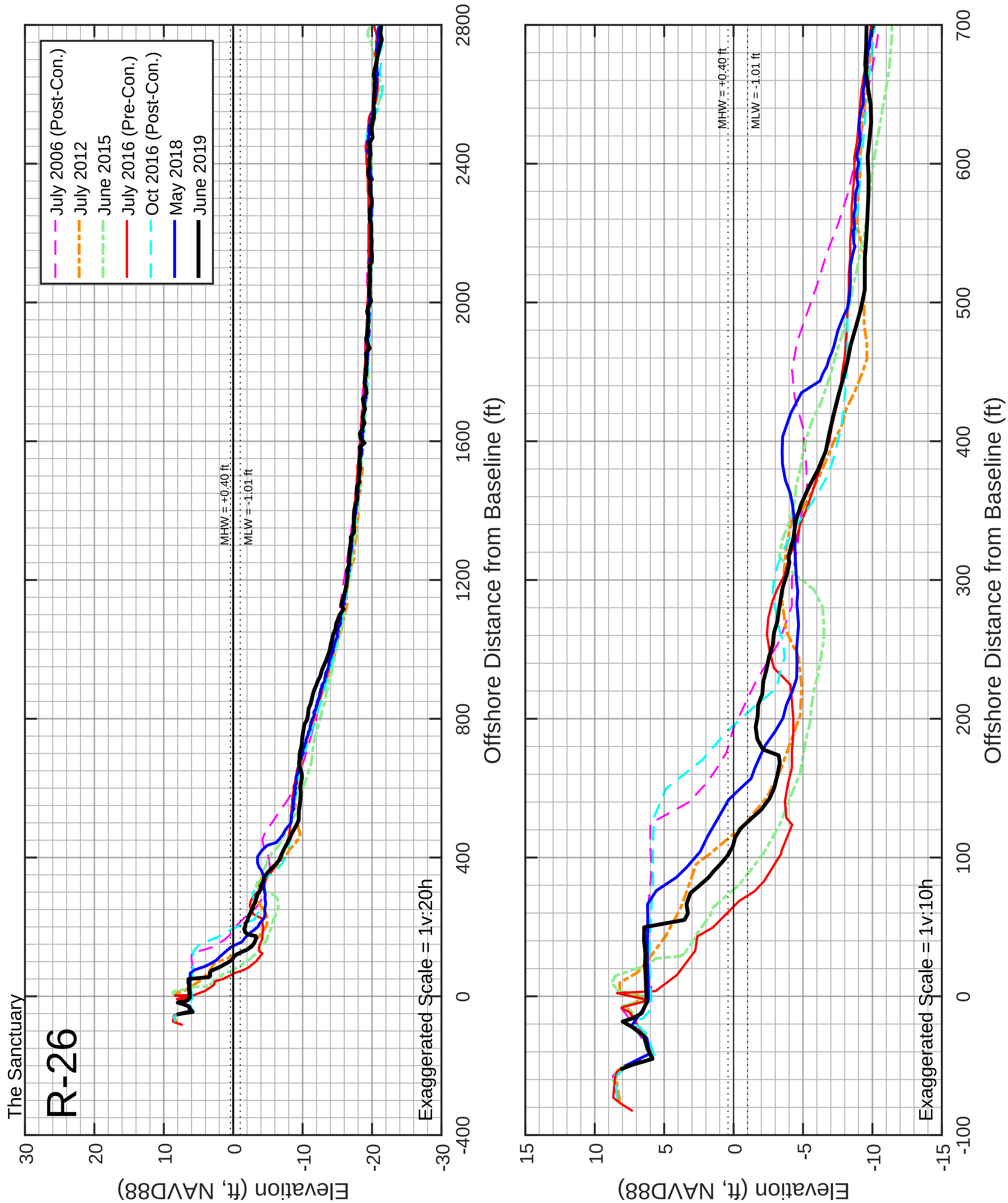

Figure B-094: Measured beach profiles at monument R-26 Longboat Key, Florida.

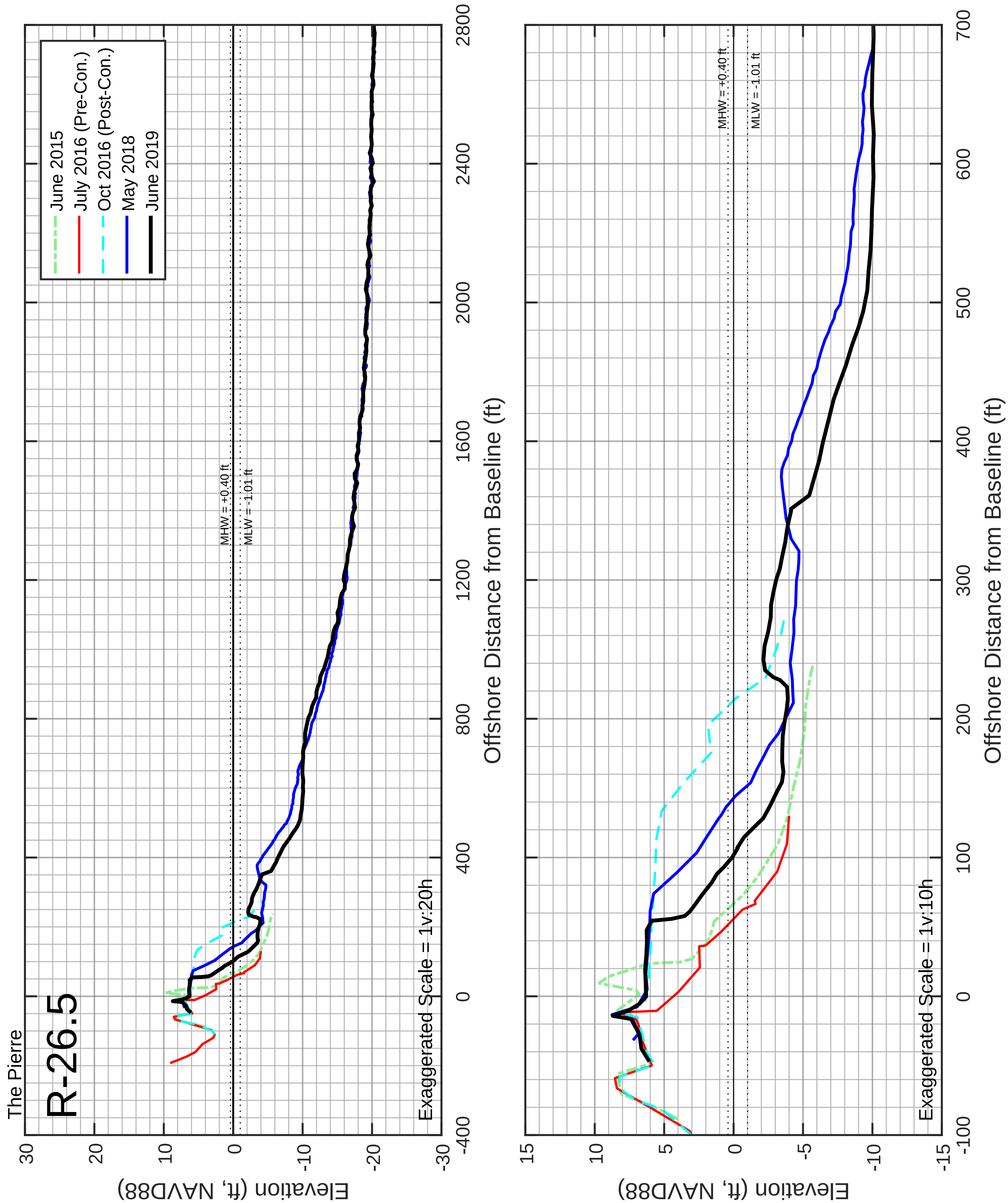

Figure B-095: Measured beach profiles at monument R-26.5 Longboat Key, Florida.

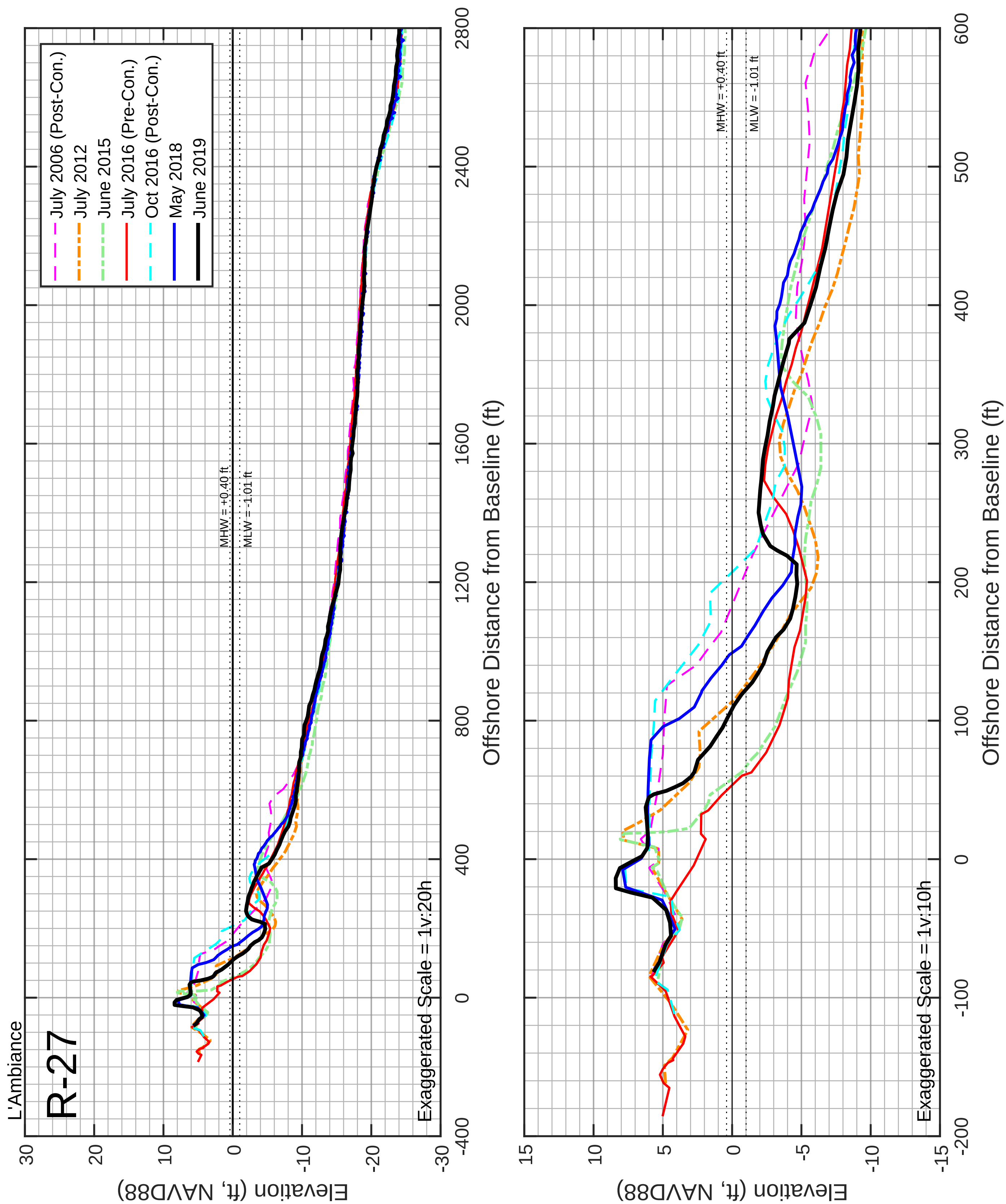

Figure B-096: Measured beach profiles at monument R-27 Longboat Key, Florida.

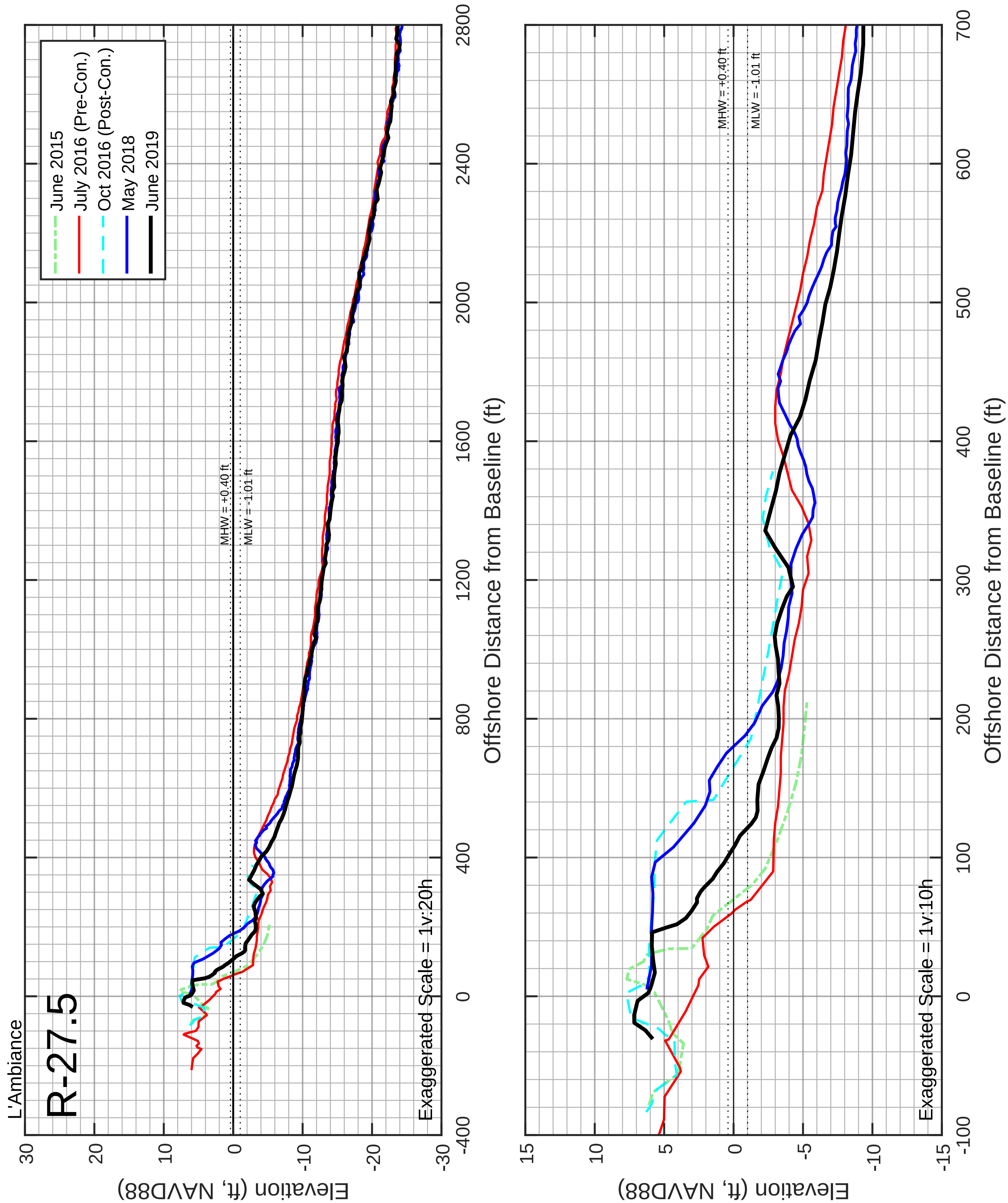

Figure B-097: Measured beach profiles at monument R-27.5 Longboat Key, Florida.

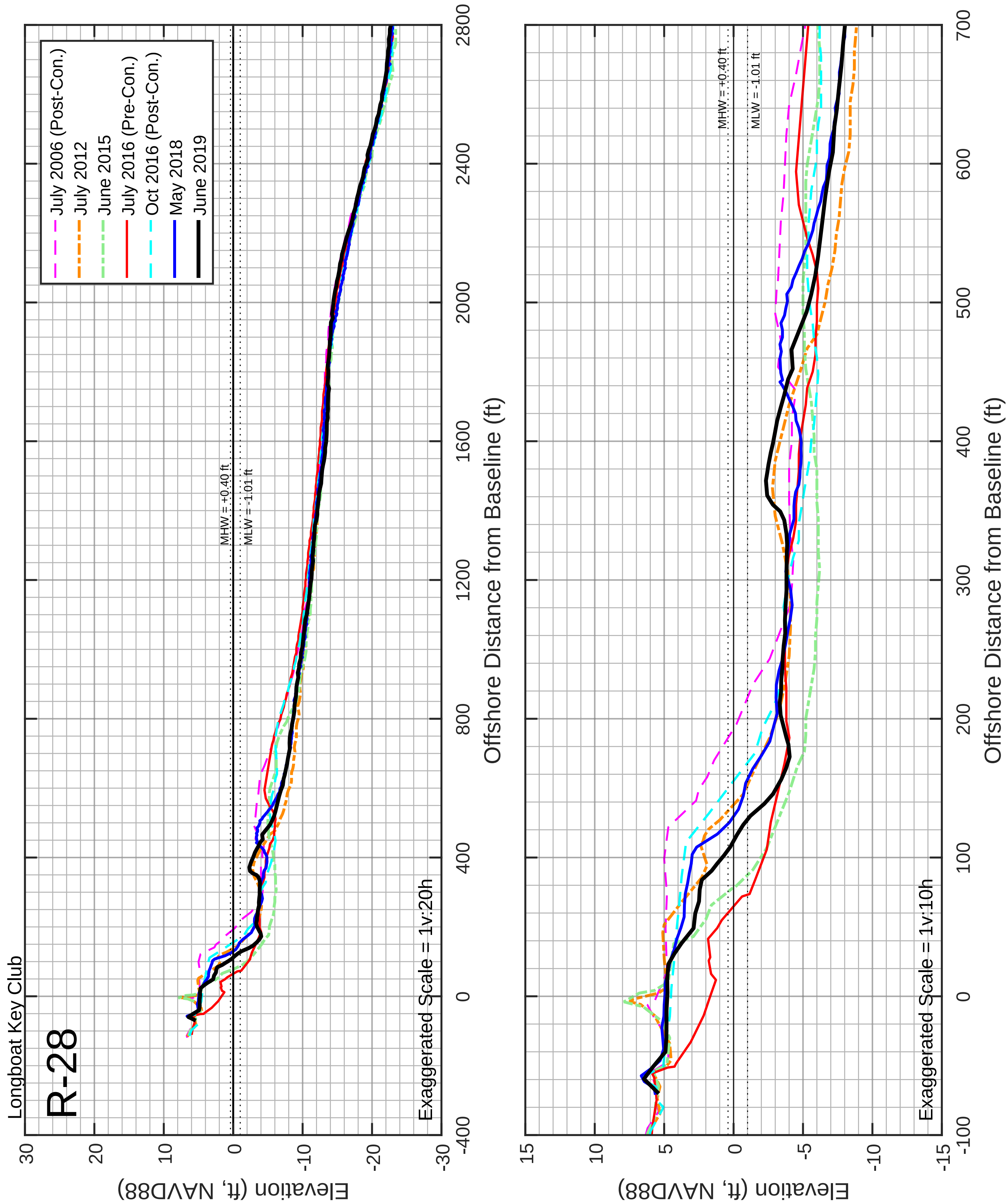

Figure B-098: Measured beach profiles at monument R-28 Longboat Key, Florida.

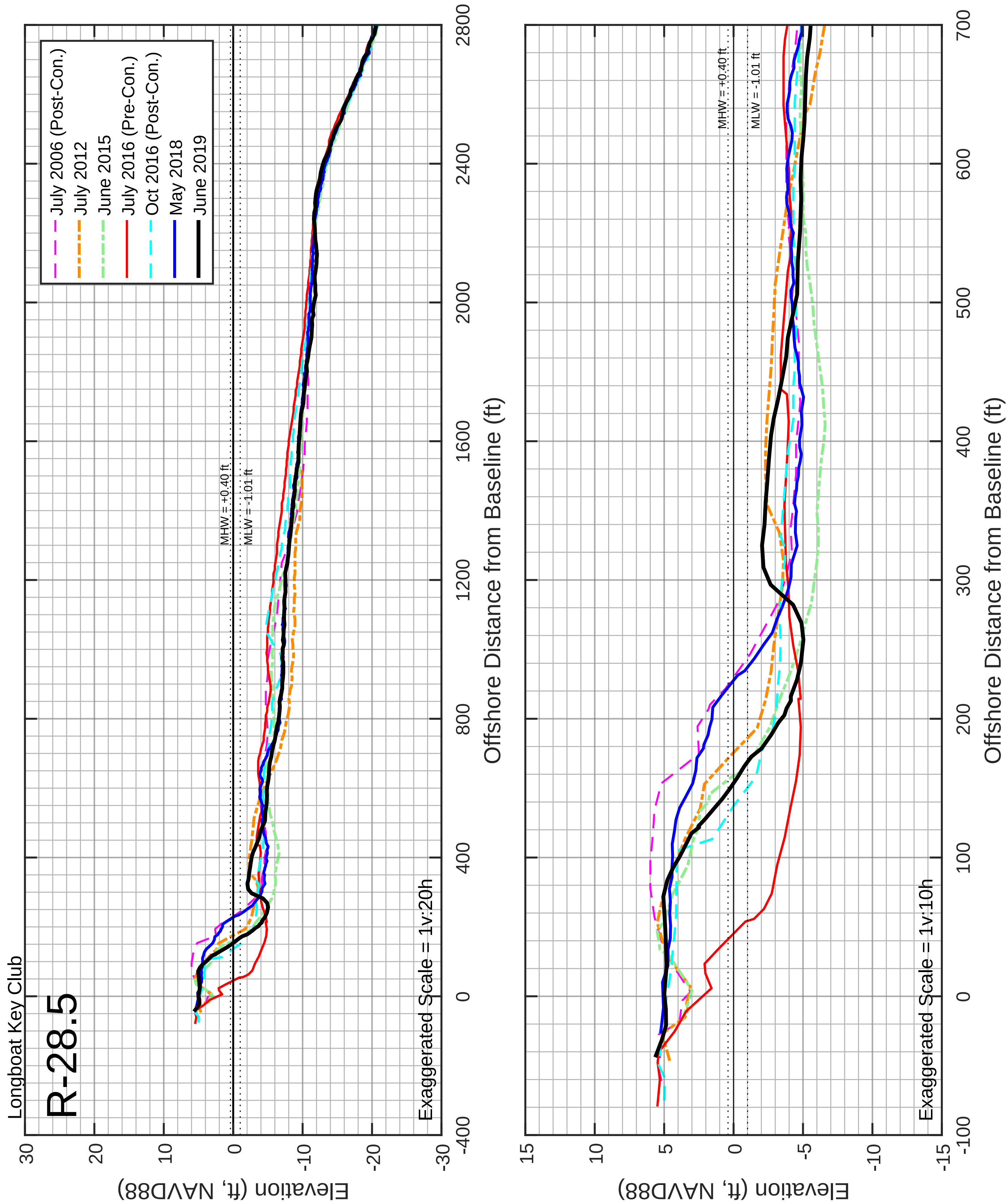

Figure B-099: Measured beach profiles at monument R-28.5 Longboat Key, Florida.

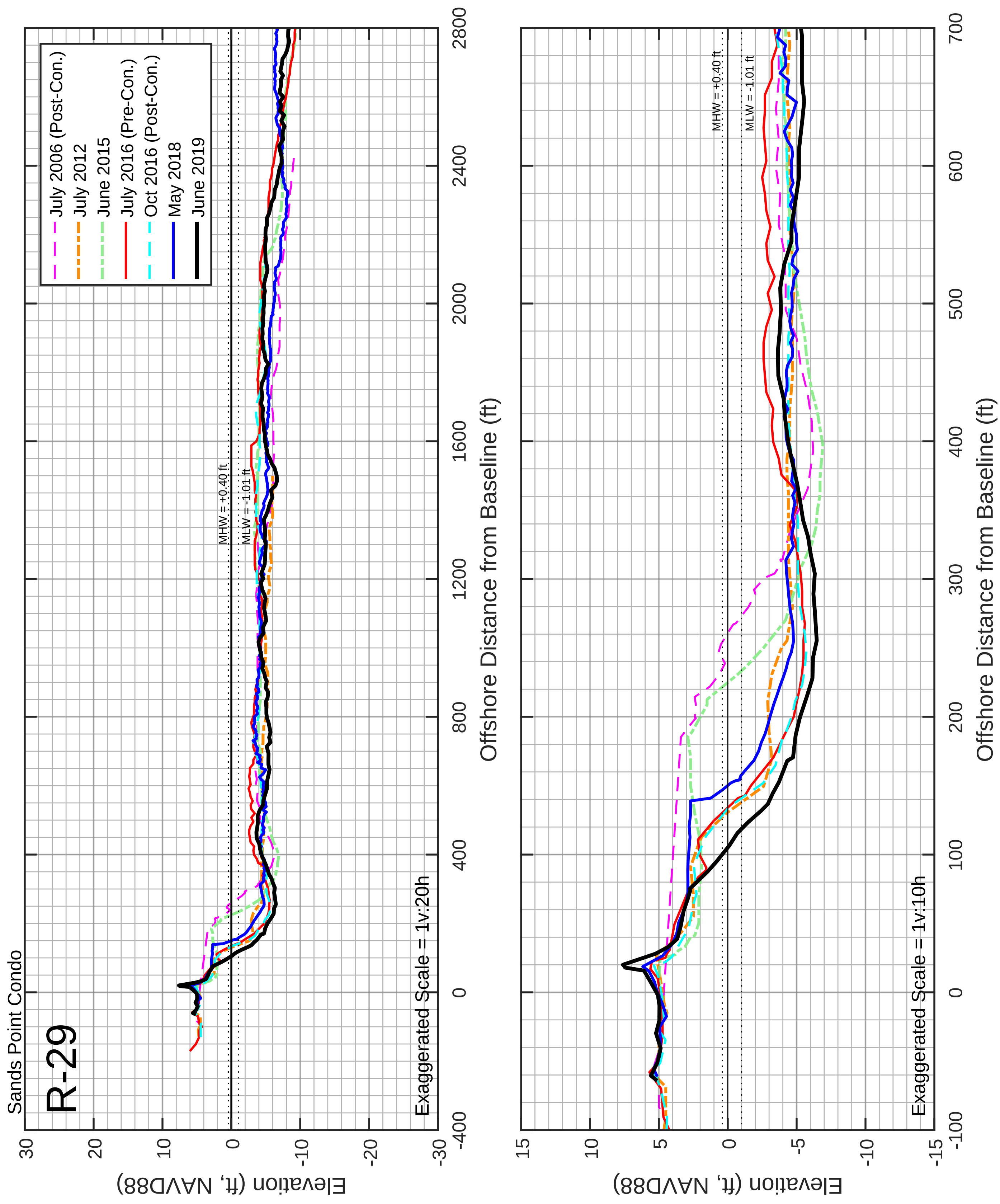

Figure B-100: Measured beach profiles at monument R-29 Longboat Key, Florida.

The following report details the setup, calibration, validation, and results of SBEACH modeling to assess the current level of storm vulnerability along the Longboat Key Gulf of Mexico shoreline.

SBEACH Storm Recession & Vulnerability Analysis

in support of the

2019 Beach Management Plan Update

Town of Longboat Key, FL

February 2020

1.0 INTRODUCTION

1.1 Background

This engineering report summarizes the setup, calibration, validation, and results of an SBEACH (Storm-induced BEAch Change) model for the Gulf of Mexico shoreline of Longboat Key, FL. The model was developed by the US Army Corps of Engineers to calculate beach and dune erosion under storm wave action (Sommerfeld, Kraus, & Larson, 1996). The model simulates beach profile change, including the formation and movement of major morphologic features such as longshore bars, troughs, and berms, under varying storm waves and water levels (Rosati, Wise, Kraus, & Larson, 1993). Herein, the model is applied to Longboat Key to assess the level of storm vulnerability along the existing shoreline and support the recommendations proposed in the 2019 Beach Management Plan Update for the Town of Longboat Key.

1.2 Project Location & Physical Setting

Longboat Key is located in southwest Florida, approximately eight miles south of Tampa Bay. The barrier island includes approximately 10.1 miles of Gulf of Mexico shoreline, divided nearly equally between Manatee and Sarasota counties (**Figure 1.1**). Florida Department of Environmental Protection (FDEP) survey range monuments (R-monuments) on the island range from R-42 to R-67 in Manatee County and from T-1 to R-29 in Sarasota County. Control information for these monuments is presented in **Table 1.1**. The island is bounded by tidal inlets to the north and south. On the northern end, Longboat Pass separates Longboat Key from Anna Maria Island. The inlet shoreline consists of a sandy ephemeral spit at the north end of Longboat Key. On the southern end, New Pass separates the island with Lido Key. The south end of Longboat Key is stabilized by a permeable terminal groin.

Figure 1.1: Location Map – Longboat Key, Manatee/Sarasota Counties, FL

Table 1.1: Control Table of R-Monuments. Locations are in feet relative to NAD83 State Plane, FL West Zone. Azimuths are in degrees from true north.

Monument Name	Easting	Northing	Azimuth	Monument Name	Easting	Northing	Azimuth
R-44.6	432,550.00	1,128,565.00	250	T-1	447,835.00	1,111,237.00	240
R-45	432,814.30	1,128,057.60	220	R-2	448,426.25	1,110,437.68	240
R-45.5	433,157.00	1,127,734.00	220	R-3A	448,826.16	1,109,558.12	240
R-46A	433,443.10	1,127,329.00	220	R-4	449,242.95	1,108,692.34	240
R-46.5	433,967.00	1,127,162.00	220	R-5	449,709.00	1,107,780.00	240
R-47	434,296.00	1,126,762.00	220	T-6	450,164.00	1,106,971.00	240
R-47.5	434,681.00	1,126,469.00	220	R-7	450,724.49	1,106,089.46	240
R-48	434,990.40	1,126,130.10	220	R-8	451,242.14	1,105,254.14	235
R-48.5	435,519.00	1,125,635.00	220	R-9	451,854.96	1,104,475.16	235
R-49	436,099.67	1,125,200.34	220	R-10	452,383.37	1,103,616.91	235
R-49.5	436,448.00	1,124,845.00	220	R-11	452,990.85	1,102,773.06	235
R-50	436,929.24	1,124,665.36	220	R-12	453,585.12	1,101,924.67	235
R-50.5	437,201.01	1,124,191.83	220	R-13	454,089.57	1,101,017.86	235
R-51	437,617.97	1,123,910.91	220	R-13+200	454,222.30	1,100,852.10	235
R-52	438,353.07	1,123,412.82	220	R-13+500	454,389.06	1,100,647.59	235
R-53	439,211.16	1,122,696.49	230	R-13+900	454,657.41	1,100,405.68	235
R-54A	439,804.26	1,121,973.33	230	R-14	454,817.96	1,100,367.25	235
R-55	440,316.76	1,121,352.31	230	T-15	455,515.11	1,099,640.19	235
R-56	440,975.50	1,120,659.49	230	R-16	456,123.11	1,098,817.70	235
R-57	441,649.39	1,119,945.54	230	R-17	456,914.10	1,097,874.20	235
R-58	442,248.26	1,119,249.07	230	R-18	457,353.60	1,097,265.71	230
R-59	442,848.31	1,118,552.52	230	R-19	458,108.59	1,096,683.22	230
T-60	443,498.17	1,117,717.78	230	R-20	458,762.17	1,095,913.96	230
R-61	444,117.01	1,116,926.06	230	R-21	459,438.09	1,095,173.23	230
R-62A	444,698.30	1,115,871.14	235	T-22	460,036.04	1,094,398.27	230
R-63	445,263.74	1,115,019.40	235	T-23	460,835.08	1,093,734.74	230
R-64	445,792.95	1,114,116.27	235	R-24	461,722.57	1,093,012.75	230
R-65	446,433.18	1,113,391.50	235	R-24.5	461,753.00	1,092,478.00	230
R-66	447,083.15	1,112,482.98	235	R-25	462,030.07	1,092,131.26	230
R-67	447,506.37	1,111,676.97	240	R-25.5	462,344.00	1,091,711.00	230
				R-26	462,657.57	1,091,409.76	230
				R-26.5	462,940.00	1,091,009.00	230
				R-27	463,283.56	1,090,659.27	230
				R-27.5	463,548.00	1,090,248.00	230
				R-28	463,920.06	1,089,926.78	230
				R-28.5	464,295.96	1,089,609.78	230
				R-29	464,696.55	1,089,339.28	215

The majority of the Longboat Key shoreline is developed with hotels, condominiums, and private residences. State Road 789 (Gulf of Mexico Drive) runs the length of the island and serves as a hurricane evacuation route. An engineered beach and natural dune feature provide storm protection for the upland infrastructure. Since the first major beach restoration project of 1993, the Gulf shoreline is predominately sandy in nature, but a handful of hard structures exist to protect upland property and provide erosion control, including:

- Pair of Permeable Adjustable Groin (PAGs) centered just north of North Shore Road, between R-44 and R-45 in Manatee County
- Seawall at the Longbeach Condominiums near R-45 in Manatee County
- Seawall at 6633 Gulf of Mexico Drive north of R-49 in Manatee County
- Seawall at Gulfside Road, south of R-49 in Manatee County
- Shore-parallel geotextile sill near Bayport, R-3 to R-4 in Sarasota County
- Pair of PAGs and seawall at the Islander Club Condominiums, south of R-13 in Sarasota County
- Groin at R-18 in Sarasota County (formerly known as The Colony)
- Terminal groin at New Pass ~400 feet southeast of R-29 in Sarasota County

Longboat Key is fairly low-lying, with typical upland elevations between +5 and +10 ft NAVD88[1]. Beach profiles along the shore vary from north to south with the highest dune features lying in the center of the island. The three sections of the island discussed herein are defined as the northern end (R-44.6 – R-54), the central portion (R-55 – R-18), and the southern end (R-19 – R-29). At the northern end (**Figure 1.2**) upland elevations reach approximately +6 ft and the typical beach profile does not have a very pronounced dune feature. Gulfward thereof, the beach berm reaches elevations of +4 to +5 ft and the beach face has a relatively steep 1V:6H slope. The central portion of the island has a more defined dune feature that ranges between +7 and +10 ft in elevation (**Figure 1.3**). Berm elevations range between +4 and +7 ft and the slopes at the beach face are approximately 1V:7H. On the southern end of the island, the dune feature is generally between +6 and +9 ft in elevation, with berm elevations range between +4 and +6 ft and the slope of the beach face is approximately 1V:10H (**Figure 1.4**).

[1] NAVD88: North American Vertical Datum of 1988. All elevations in this report are relative to NAVD88 unless otherwise noted. Horizontal coordinates are referenced in US Survey Feet relative to the Florida State Plane Coordinate System, West Zone, North American Datum of 1983 (NAD83). See **Table 1.2** for tidal datum information.

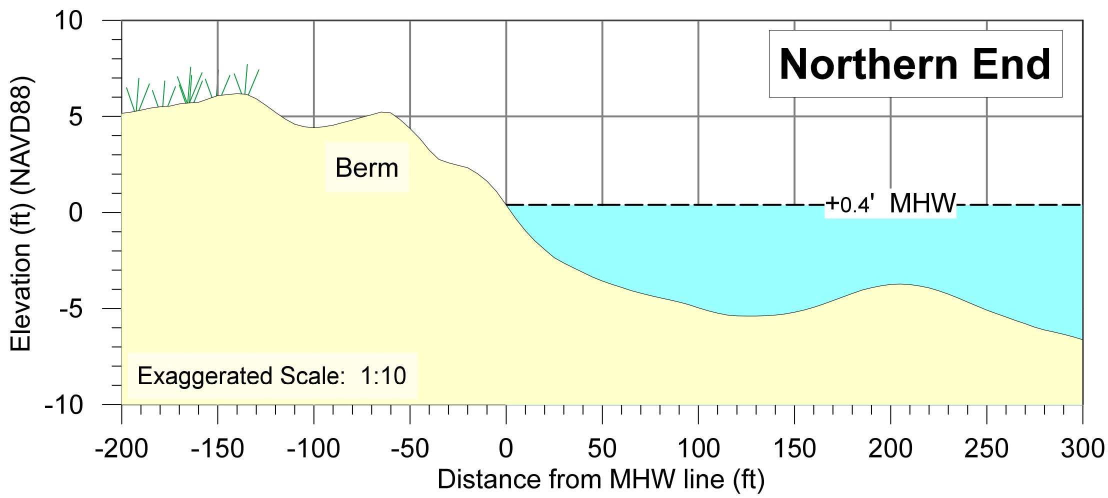

Figure 1.2: Typical beach profile along the northern end of Longboat Key. (R-44.6 – R-54)

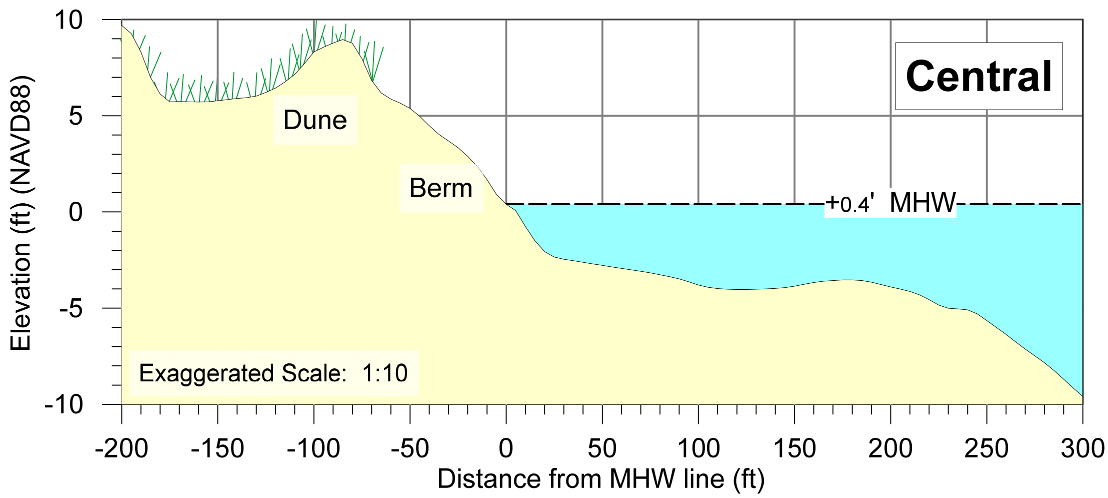

Figure 1.3: Typical beach profile along the central portion of Longboat Key. (R-55 – R-18)

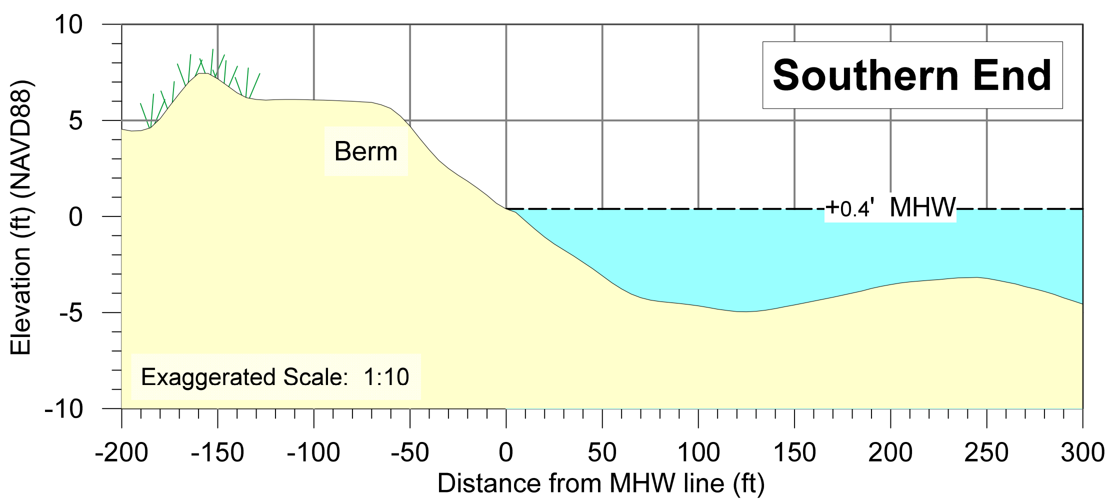

Figure 1.4: Typical beach profile along the southern end of Longboat Key. (R-19 – R-29)

The published tidal datums in the vicinity of Longboat Key are listed in **Table 1.2**, relative to NAVD88. The different locations are presented because there are no physical tide stations at the study site. The tide range and Mean High Water elevation at Longboat Key are best described by the LABINS tide point. The project shoreline exhibits mixed tides with a mean range of 1.4 ft. In **Table 1.2**, various other tidal datums are provided from nearby NOAA stations for comparison. Stations denoted with an asterisk are "virtual" stations, meaning there is no active tide gauge to measure water levels on site. The nearest NOAA Gulf tide station is located approximately 38 miles north of Longboat Pass in Clearwater Beach. The next closest active, open coast station is located in Naples, FL, 100 miles southeast of the project area. The closest Gulf of Mexico virtual station that provides only predicted tides is located at Anna Maria Island, approximately 8 miles north of the Manatee/Sarasota county line. Data from Clearwater Beach and Anna Maria Island are used herein to validate the SBEACH model.

Table 1.2: Tidal datums at several stations near Longboat Key.

Tidal Datum	**LABINS Tide Point 100146** (offshore R-27 Sarasota County) **Gulf**	**NOAA 8726217** Cortez Marina **Interior***	**NOAA 8726089** Sarasota Bay Longboat Key Marina **Interior***	**NOAA 8726384** Port Manatee **Interior**	**NOAA 8726243** Anna Maria Island **Gulf***	**NOAA 8726724** Clearwater Beach **Gulf**
Mean Higher High Water (MHHW)	--	+0.53	+0.57	0.64	0.64	+0.99
Mean High Water (MHW)	+0.40	+0.24	+0.20	0.37	0.34	+0.65
NAVD88	0.00	0.00	0.00	0.00	0.00	0.00
Mean Tide Level (MTL)	--	-0.49	-0.44	-0.45	-0.49	-0.39
Mean Low Water (MLW)	-1.01	-1.22	-1.08	-1.17	-1.24	-1.26
NGVD29	-1.04	-0.99	-1.04	-0.95	-0.99	-0.86
Mean Lower Low Water (MLLW)	--	-1.56	-1.50	-1.54	-1.62	-1.77
Mean Tide Range	1.41	1.46	1.28	1.54	1.58	1.91

Source: LABINS (https://www.labins.org/survey_data/water/water.cfm) and NOAA
*Virtual station

1.3 Storm History

Longboat Key beaches have been affected by a number of damaging storms/hurricanes in the past. **Table 1.3** provides a detail listing of these storms. Over the 168-year period of record (1851-2019), 17 cyclonic storms of tropical storm force or greater have passed within 25 nautical miles of the center of Longboat Key and 86 storms have passed within 100 nautical miles. **Figure 1.5** depicts the cyclonic storm tracks since 1851 in the vicinity of the island. **Table 1.4** summarizes the number storms passing with 25 and 100 nautical miles[2] of the study area since 1851.

Recent storms of note, including Tropical Strom Debby (2012), Hurricane Hermine (2016) and Hurricane Michael (2018) are not included in **Table 1.3** or **Table 1.4** because their respective tracks do not fall within the 25- and 100-mile radii. However, because of their size, track direction, and intensity, these storms had notable effects on the shoreline. **Figure 1.6** illustrates the storm tracks of these three storms. At their closest proximity to the island, Debby, Hermine and Michael were approximately 135 miles, 170 miles, and 245 miles away from the center of the island, respectively. Hurricane Hermine was used in the validation process for the SBEACH model parameters and is discussed further in the following section.

[2] Passing within the defined distance (25 & 100 nautical miles) from the midpoint of the island (~R-01).

Table 1.3: Hurricane and tropical storm history in the vicinity of Longboat Key (1851-2019).

Storm	Intensity Passing Within Specified Radius		Storm	Intensity Passing Within Specified Radius	
	100-miles	25-miles		100-miles	25-miles
Gordon (2018)	TS	-	Unnamed (1937)	TS	-
Irma (2017)	H3	-	Unnamed (1935)	H5	H4
Emily (2017)	TS	TS	Unnamed (1933)	H3	-
Fay (2008)	TS	-	Unnamed (1932)	H1	-
Barry (2007)	TS	TS	Unnamed (1930)	TS	TS
Frances (2004)	H1	-	Unnamed (1929)	H2	-
Jeanne (2004)	H2	-	Unnamed (1928)	H4	TS
Charley (2004)	H4	-	Unnamed (1926)	H3	-
Erika (2003)	TS	-	Unnamed (1925)	TS	-
Henri (2003)	TS	-	Unnamed (1921)	H4	-
Gabrielle (2001)	TS	TS	Unnamed (1920)	TS	-
Gordon (2000)	H1	-	Unnamed (1916)	TS	-
Harvey (1999)	TS	-	Unnamed (1911)	TS	-
Mitch (1998)	TS	-	Unnamed (1910)	H3	-
Erin (1995)	H1	-	Unnamed (1907)	TS	-
Jerry (1995)	TS	-	Unnamed (1906)	TS	-
Gordon (1994)	TS	-	Unnamed (1904)	TS	-
Marco (1990)	TS	TS	Unnamed (1903)	H1	TS
Keith (1988)	TS	TS	Unnamed (1902)	TS	-
Bob (1985)	TS	-	Unnamed (1901)	H1	-
Isidore (1984)	TS	-	Unnamed (1899)	H1	-
Unnamed (1982)	TS	-	Unnamed (1898)	TS	-
Dennis (1981)	TS	-	Unnamed (1896)	H3	-
Unnamed (1974)	TS	-	Unnamed (1894)	H2	-
Jenny (1969)	TS	-	Unnamed (1892)	TS	TS
Gladys (1968)	H1	-	Unnamed (1891)	TS	-
Abby (1968)	TS	-	Unnamed (1889)	TS	-
Alma (1966)	H3	-	Unnamed (1888)	H2	-
Donna (1960)	H3	-	Unnamed (1887)	TS	-
Florence (1960)	TS	-	Unnamed (1886)	H2	-
Unnamed (1959)	TS	-	Unnamed (1885)	TS	-
Judith (1959)	TS	-	Unnamed (1882)	H1	-
Hazel (1953)	H1	-	Unnamed (1879)	TS	-
How (1951)	TS	-	Unnamed (1878)	H2	TS
King (1950)	H1	-	Unnamed (1874)	H1	-
Easy (1950)	H3	-	Unnamed (1873)	H3	TS
Unnamed (1949)	H4	-	Unnamed (1872)	TS	-
Unnamed (1947)	H2	-	Unnamed (1871)	H2	-
Unnamed (1946)	H1	H1	Unnamed (1861)	TS	-
Unnamed (1945)	H3	-	Unnamed (1860)	TS	-
Unnamed (1944)	H3	H2	Unnamed (1859)	H1	H1
Unnamed (1941)	H1	TS	Unnamed (1858)	TS	TS
Unnamed (1939)	H1	-	Unnamed (1852)	H1	-

Source: National Hurricane Center tropical cyclone database (https://www.nhc.noaa.gov/data/).

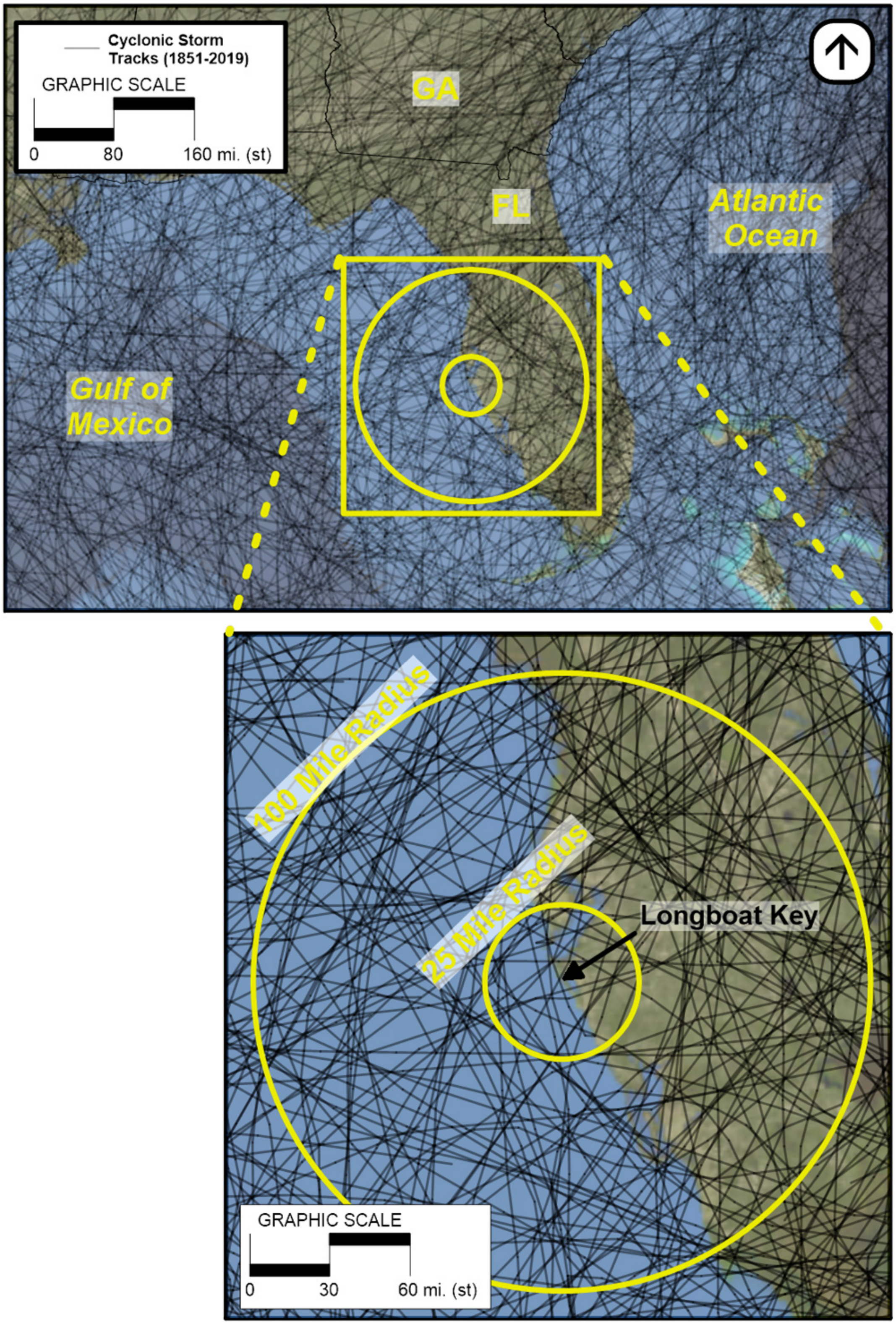

Figure 1.5: Cyclonic storm activity in the vicinity of Longboat Key, FL (1851-2019).

Table 1.4: Hurricane and tropical storm summary in the vicinity of the beaches at Longboat Key (1851-2019)[3].

Category (Saffir-Simpson Scale)	No. of Storms Passing within 100 nautical miles	No. of Storms Passing within 25 nautical miles
Tropical Storm (39-73 mph winds)	45	13
Category 1 (74-95 mph winds)	17	2
Category 2 (76-110 mph winds)	8	1
Category 3 (111-129 mph winds)	11	0
Category 4 (130-156 mph winds)	4	1
Category 5 (157 mph or greater winds)	1	0
Total	**86**	**17**

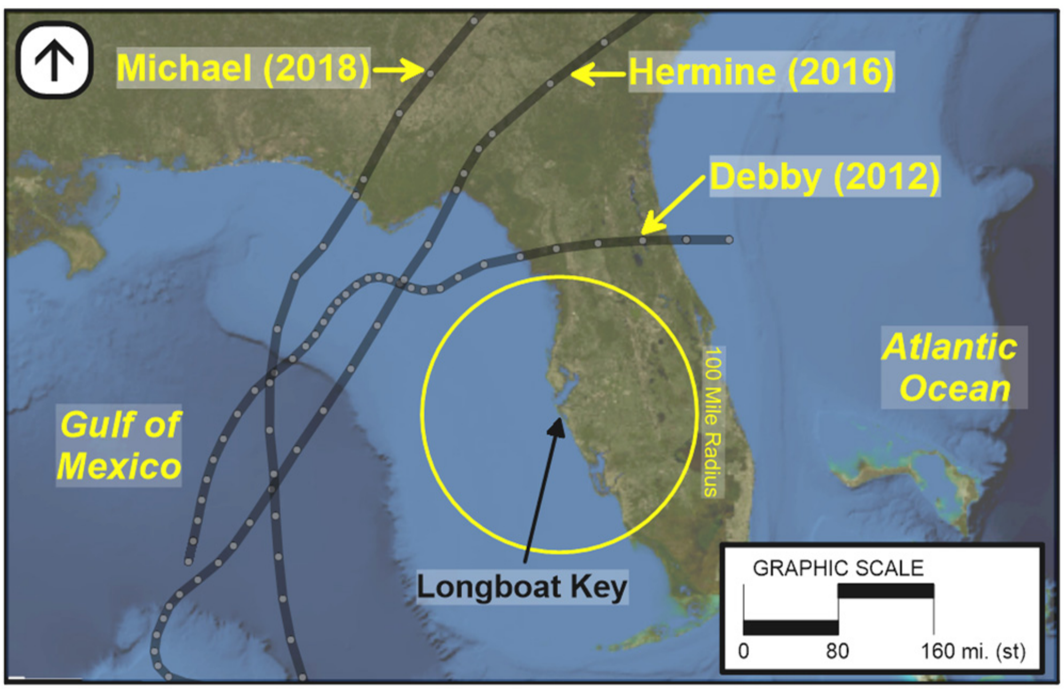

Figure 1.6: Storm tracks for Debby, Hermine and Michael.

[3] Historical cyclonic data from the NOAA National Center for Environmental Information (https://coast.noaa.gov/hurricanes)

2.0 STORM SURGE LEVELS, WAVE SETUP & WAVE HEIGHT

This chapter presents results of analyses employed to predict combined total storm water levels along the Longboat Key shoreline. Combined total storm water levels include the effects of storm surge, wave setup, and wave height (crest elevation). Storm surge is defined as the superelevation of the mean water level during a storm event and is caused by wind shear stress, barometric pressure anomalies, astronomical tides, shoreline configuration, local bathymetry, and Coriolis contributions. Wave setup is the short-term but sustained increase in water level due to the presence of waves breaking across the beach.

Herein, the storm water levels for Longboat Key were estimated using published values from FDEP (2011) and FEMA (2014). These studies analyzed hundreds of storm simulations to determine the storm water levels corresponding to various return periods presented in **Table 2.1**. Note that the FDEP (2014) storm water levels include the effects of wave setup whereas the FEMA (2011) values do not. Neither the FDEP nor FEMA values include the effects of the passage of individual waves atop the storm surge. The crests of single waves can reach elevations several feet higher than the "still-water" surge levels.

Table 2.1: Predicted storm water level elevations along the project area for various return periods (FDEP, 2011 and FEMA, 2014).

Return Period (Years)	Probability of Occurrence *in any given year*	FDEP Predicted Storm Water Level Elevation *Including wave setup** (ft-NAVD)	FEMA Predicted Storm Water Level Elevation *NOT including wave setup* (ft-NAVD)
5	20%	3.3	-
10	10%	5.3	3.7
15	7%	6.4	-
20	5%	7.0	-
25	4%	7.5	-
30	3%	8.2	-
50	2%	9.5	7.8
100	1%	-	9.3

*includes wave setup, but not individual wave effects

The frequency of occurrence of various storm surges at a given location is expressed as the "return period" (T_R). The return period has an inverse relationship with the probability that the event will be exceeded in any one year. For example, a 100-year surge level has a 0.01 or 1% chance of being experienced or exceeded in any one year. The probability of occurrence is also included in **Table 2.1** for reference.

Table 2.2 presents the maximum recorded water levels for several recent storms of note at nearby tide gauge stations, including the open coast Clearwater Beach tide gauge (NOS station 8726724) and the interior Port Manatee tide gauge (NOS station 8726384), located 38 miles and 18 miles north of Longboat Key, respectively. As shown in the table, the measured water levels are lower at Port Manatee because it is a relatively sheltered interior gauge. The next closest open coast NOAA tide gauge is located 100 miles south of the project area, in Naples.

Comparing the maximum water level observed during Hurricane Hermine from **Table 2.2** with the published storm water levels from **Table 2.1** indicates a suggested return period of 6-13 years, meaning there is a 7% to 17% chance that the same water levels observed near the project area during Hurricane Hermine will be met or exceeded in any given year.

Table 2.2: Measured maximum water elevations for selected recent storm events, at NOAA Tide Stations 8726724 (Clearwater, FL) and 8726384 (Port Manatee, FL)

Storm Event	Max. Recorded Water Level (ft-NAVD)	
	Clearwater Beach NOAA 8726724	Port Manatee NOAA 8726384
Hurricane Irma (2017)	+1.90	+1.90
Hurricane Michael (2018)	+3.33	+2.66
Tropical Storm Debby (2012)	+3.60	+2.83
Hurricane Hermine (2016)	+3.88	+2.98
Tropical Storm Josephine (1996)	+4.11	-
Hurricane Elena (1985)	+4.14	-
"North American Blizzard of 1999"	+4.29	+2.61
"Nor'easter of 1993"	+4.99	-

3.0 SBEACH MODEL SETUP & CALIBRATION

3.1 Background

The SBEACH model must first be set up and calibrated in order to predict the storm-induced beach profile change in the study area. Calibration is the process of using the SBEACH model to reproduce observed beach profile changes caused by a storm. A calibrated model is then verified with data from another storm that impacted the study area (Rosati et al., 1993). In the case of Longboat Key, a review of the available topographic/bathymetric survey data indicates a lack of coinciding oceanographic data with locally damaging storms. As a result, this analysis relies on FDEP calibrated model input values for Sarasota County (Wang and Manausa, 2013). Wang and Manausa (2013) divided the Sarasota County shoreline into four segments in order to provide site-specific recommended model input. The recommended values for Segment 1 (R-1 to R-44) are adapted herein for Longboat Key. The calibration study used data from Tropical Storm Gabrielle, which made landfall on September 11, 2001 as a strong Tropical Storm near Venice, FL.

3.2 SBEACH Calibration (Sarasota County)

SBEACH requires a beach profile, mean water elevation time series, and incident wave characteristics as input. The pre-storm beach profile input included June 2001 beach profiles from South Venice, FL. Model calibration was performed so that the simulated SBEACH post-storm profiles agreed well with the May 2002 beach profiles, surveyed 7 months after Tropical Strom Gabrielle made landfall in Sarasota County. Wang and Manausa (2013) utilized a 2-D storm surge model to generate input water levels for Tropical Storm Gabrielle. There was insufficient measured wave data in the study area for Tropical Storm Gabrielle. As a result, the investigators calculated the significant wave height and dominant wave period time series using the maximum wind speeds for Tropical Storm Gabrielle, published by the National Hurricane Center.

In general, the SBEACH model is calibrated through the adjustment of two parameters, the transport rate coefficient, K, and the coefficient for the slope dependent term, ε. Generally, larger K values generate greater sand transport and more prominent bar features while smaller values tend to yield a more subdued bar (USACE 1996). Conversely, larger ε values tend to produce less prominent bars. Additional model parameters that are established from environmental or physical conditions include the transport rate decay coefficient multiplier, λ, water temperature, the median grain size (d_{50}) of the beach sediments, typical maximum slope prior to avalanching of sediment during the erosion process and the landward surf zone depth. **Table 3.1** compares the recommended values from the calibration study (Wang and Manausa, 2013, Sarasota County R-1 to R-44) with the default values for the SBEACH model parameters (Sommerfeld, Kraus and Larson, 1996).

Table 3.1: Recommended SBEACH model input parameters for R-1 to R-44 in Sarasota County compared to the SBEACH default values.

Parameter	Units	Range of Recommended Values	Default Value	Calibrated Value (Wang and Manausa, 2013)
Transport rate coefficient, K	m^4/N	$0.25e^{-6} – 2.5e^{-6}$	$1.75e^{-6}$	$0.50e^{-6}$
Slope dependent term, ε	m^2/S	0.001 – 0.005	0.002	0.005
Transport rate decay coefficient multiplier, λ	m^{-1}	0.1 – 0.5	0.5	0.5
Overwash transport parameter	-	0.002 – 0.008	0.005	0.002
Landward Surf zone Depth	ft	0.5 – 1.6	1.0	1.0
Maximum Slope Prior to Avalanching	deg.	15 – 90	45	15
Median Grain Size (d_{50})	mm	0.15 – 1.0	0.35	0.35
Water Temperature	deg. C	0 – 40	24	28

Wang and Manausa (2013) provided 15-year and 25-year hydrographs, with- and without-wave setup, for R-1 to R-44 in Sarasota County (**Figure 3.1**). The peak water levels from the with-setup hydrographs match the published values from FDEP (2011). As suggested by **Figure 3.1**, the SBEACH model typically computes and adds between one and two feet of wave-induced setup across the simulated profiles. Only the without-setup hydrographs were utilized as SBEACH input, since the model calculates and adds these effects internally. The hydrographs represent a 36-hour storm duration. It is noted that these hydrographs represent relatively short-term storm water level conditions. Storms affecting the Longboat Key shoreline may cause elevated water levels for much longer time periods than depicted in **Figure 3.1**.

Wang and Manausa (2013) found that the inclusion of variable input wave characteristics produced similar results to a constant wave height and period input. For county-wide application of the calibrated model, Wang and Manausa (2013) recommended an input wave height and period of 7 ft and 7 seconds, respectively, for high frequency storm events.

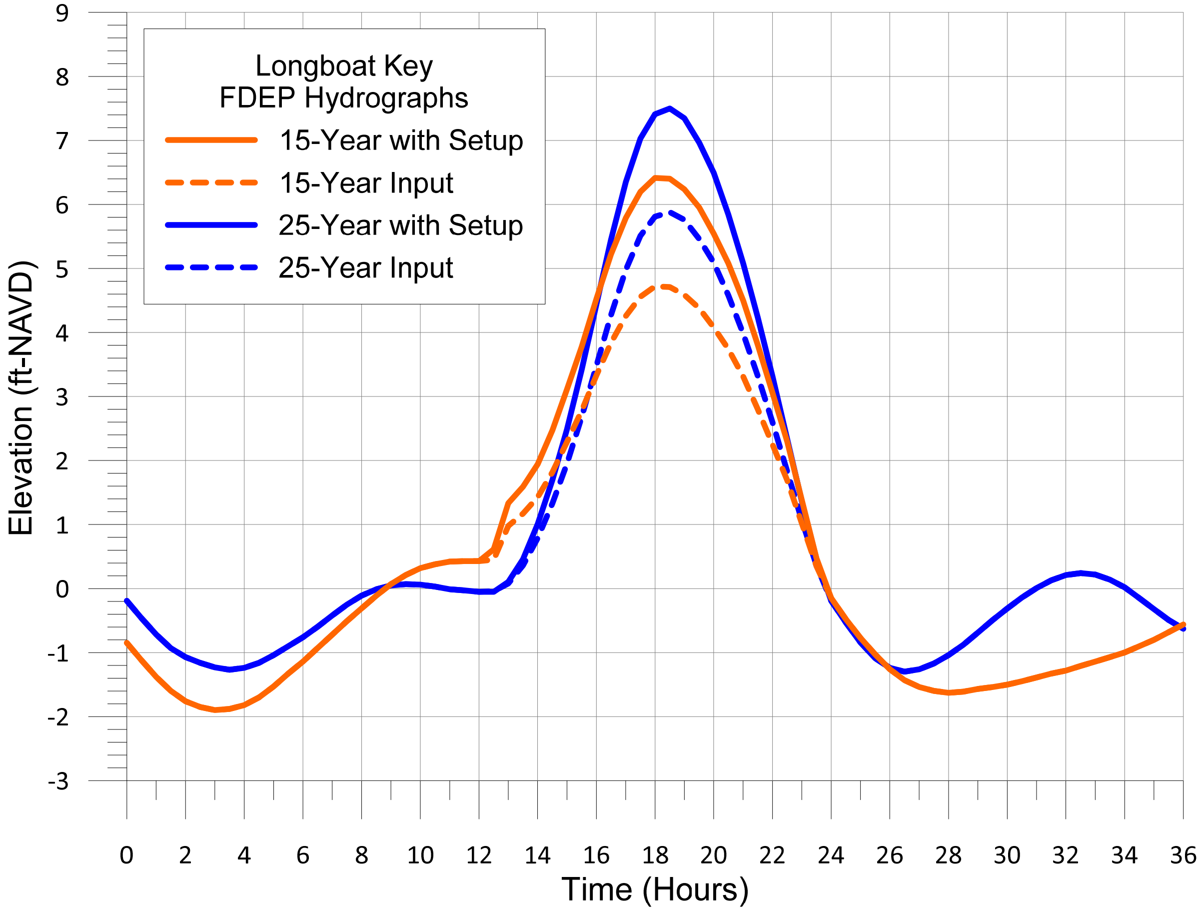

Figure 3.1 Published storm hydrographs for R-1 to R-44 in Sarasota County (Wang and Manausa, 2013). SBEACH model simulations utilize the input curves that do not include the effects of wave setup.

3.3 Application to Longboat Key

In the application of the model to Longboat Key, minor adjustments were made to the recommendations of Wang and Manausa (2013). For the grain size parameter, a median (d_{50}) grain size of 0.25 mm is more appropriate for Longboat Key. The county-wide average d_{50} of 0.35 mm would produce an optimistic scenario, reducing the level of erosion simulated on the Longboat Key shoreline. Similarly, the 'maximum slope prior to avalanching' parameter was adjusted from 15 degrees to 30 degrees produce a more realistic post-storm profile shape on Longboat Key. Model simulations with 15 degrees caused unrealistic deflation of the profile, and lacked the scarping behavior that typifies post-storm profiles. The 30-degree avalanching angle matches the angle of repose for granular materials (Al-Hashemi & Al-Amoudi, 2018). This value thus falls between the USACE default value and the recommended value from Wang and Manausa (2013).

4.0 SBEACH MODEL VALIDATION

4.1 Background (Hurricane Hermine)

As mentioned previously, a lack of specific pre- and post-storm data on Longboat Key hinders the ability to perform a rigorous SBEACH model validation. However, limited pre- and post-storm beach profile data exists for Hurricane Hermine. In addition, the corresponding storm water levels and wave characteristics can be estimated for model input.

Figure 4.1 plots the track of Hurricane Hermine, which made landfall in St. Marks, FL, on 2 September 2016. At its strongest, Hurricane Hermine was classified as a Category 1 storm. Hurricane Hermine generated elevated water levels in the vicinity of Longboat Key that persisted for 3 days. Peak sustained wind speeds of 31 mph, with gusts up to 40 mph, were measured near the project shoreline at the Sarasota-Bradenton International Airport (Berg, 2017). Offshore wave data from NOAA Buoy 42099 indicates that wave heights reached a maximum of 24 ft, with heights above 10 ft persisting for about 10 hours. The southern end of the project area lost a sand volume of roughly 56,000 cy as a direct result of the storm (OAI, 2016).

Figure 4.1: Storm track of Hurricane Hermine (2016). (National Hurricane Center, NOAA)

4.2 Beach Profiles

The beach erosion caused by Hurricane Hermine was captured in the before- and after-placement beach profile surveys collected for the 2016 New Pass Dredging and Beach Nourishment Project. Herein, the model is validated using data collected on 31 August 2016 (pre-storm) and 4 September 2016 (post-storm) at R-25.5 in Sarasota County, near the Sanctuary condominium (OAI, 2016).

4.3 Storm Water Levels

As mentioned previously, the closest available open coast tide station with measured water level data is Clearwater Beach (NOAA 8726724). NOAA also provides predicted tides at various other virtual stations closer to the project area. The closest open coast virtual station is Anna Maria Island (NOAA 8726243), 8 miles north of the project area. Given the proximity of the Anna Maria Island station to Longboat Key, it is opined that the predicted tides at that station more closely match those of the project shoreline.

Figure 4.2 (top panel) compares the predicted tide of Clearwater Beach (38 miles away) to that of Anna Maria Island (8726243) during the passage of Hurricane Hermine. Inspection of the predicted tides indicates a fairly small, but significant difference in the water levels of approximately 0.6 ft at high tide. In order to remove this effect and obtain estimated input storm water levels for Longboat Key, the storm surge observed during Hurricane Hermine was first extracted from the Clearwater Beach data by subtracting the predicted tide from the measured water level (**Figure 4.2**, middle panel). Second, the estimated Hurricane Hermine surge was added to the predicted tide at Anna Maria Island. The resulting bold black line in the bottom panel of **Figure 4.2** shows the estimated storm water levels at Longboat Key used for model input.

In the course of the simulations, the SBEACH model adds the effects of wave setup to the input water levels. Consequently, it is important that the input storm water levels do not include the effects of wave setup. The Clearwater Beach tide gauge, from which the storm surge was derived, is located on the Gulfward end of a pier, roughly 650 ft offshore. It was thus assumed that the estimated storm water levels on Longboat Key, plotted in **Figure 4.2** (bottom panel) and derived from the Clearwater Beach and Anna Maria Island stations, are appropriate for SBEACH model input.

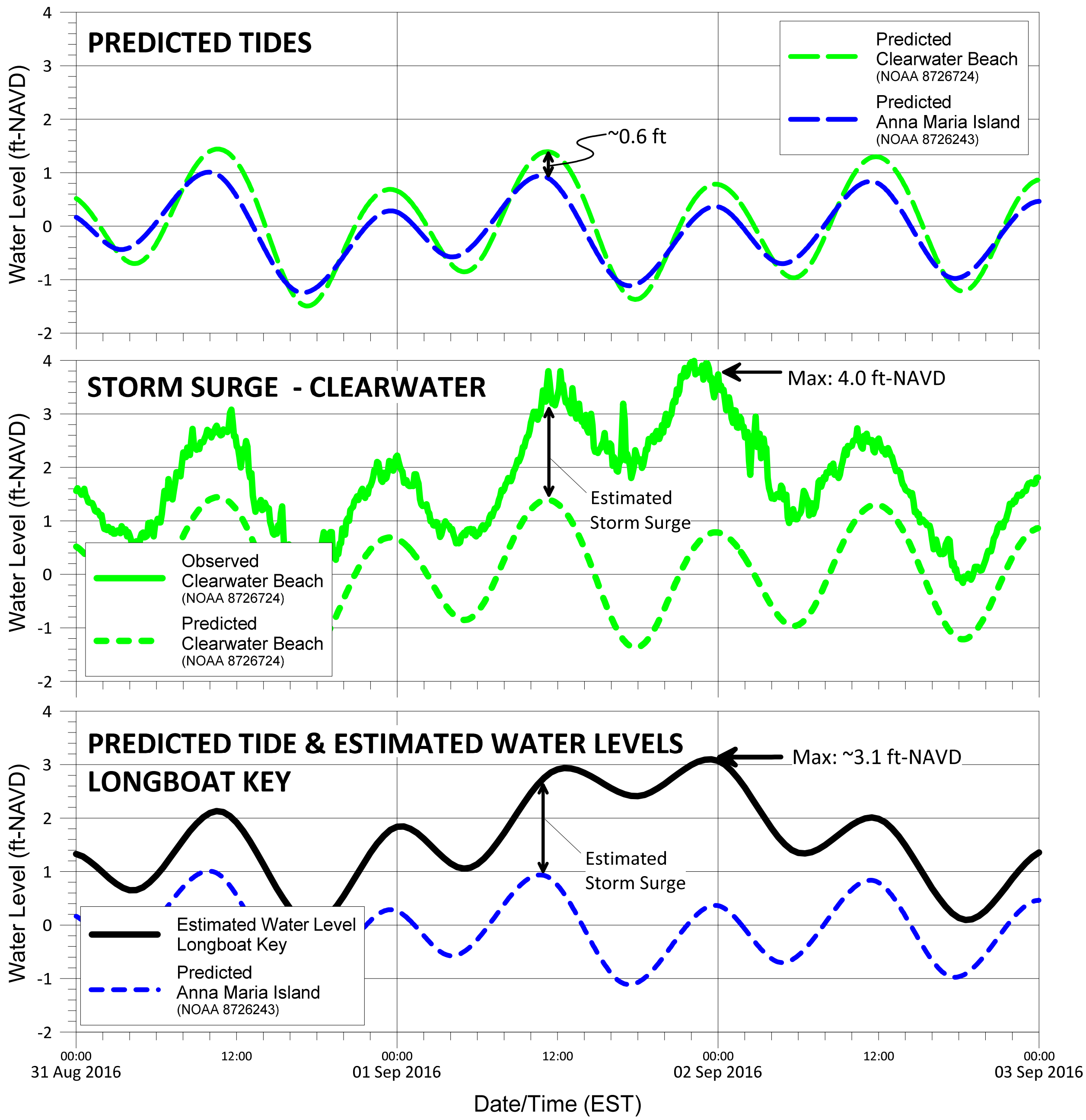

Figure 4.2 Development of predicted storm water level time series from Hurricane Hermine at Longboat Key, FL. Discrepancy between predicted tides (Top Panel) is considered along with measured storm surge (Middle Panel) to produce the estimated water level time series (Bottom Panel).

Figure 4.3 compares the time series of the predicted storm water level input for Hurricane Hermine with that of the FDEP 10-year input hydrograph (Wang and Manausa, 2013). Inspection of **Figure 4.3** suggests that the water levels for this particular storm are much different from the FDEP curves (Wang and Manausa, 2013). The maximum water levels are similar, but the Hermine water levels represent a storm with a much longer duration. The FDEP hydrograph represents a relatively short storm that results in elevated water levels for roughly half a day. This comparison suggests that the erosion induced by the Wang and Manausa (2013) storm water levels may be overly optimistic (minimized). It is noted that the damage from actual storms may exceed the model results, particularly if the storm is slow-moving, generating elevated water levels for an extended period of time.

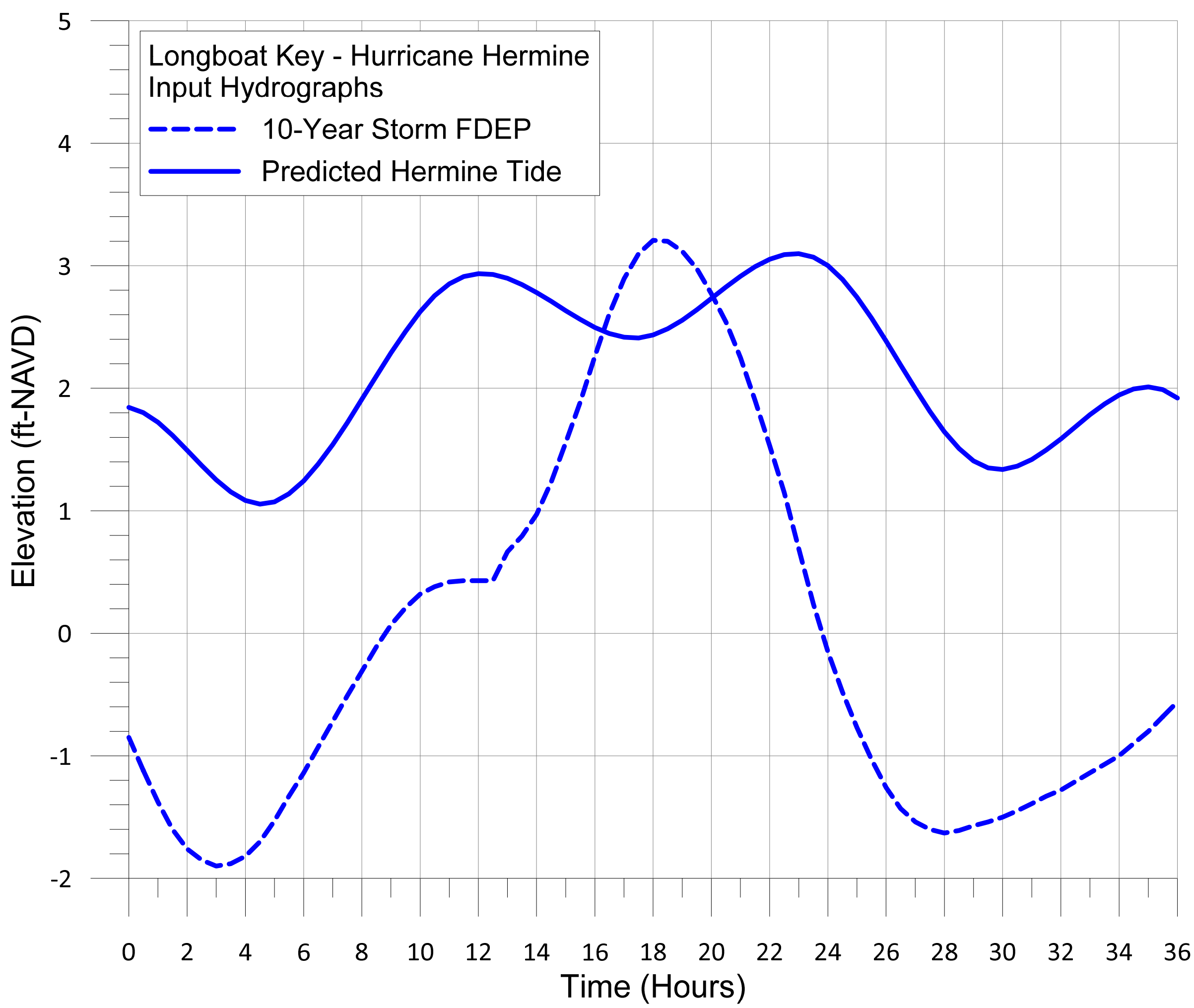

Figure 4.3 Comparison of predicted Hurricane Hermine storm water levels versus the 10-year FDEP storm hydrograph (Wang and Manausa, 2013).

4.4 Wave Characteristics

The closest available wave data is measured at NOAA Buoy 42099, which is located 90 nautical miles west of Longboat Key in 308 ft of water. Waves measured at this location reached a maximum height of 24 ft and wave heights exceeding 10 ft persisted for 30 hours. The waves experienced on the Longboat Key Gulf shoreline are typically smaller than the deep-water measurements due to wave breaking and other dissipation mechanisms. For the present analysis, a constant significant wave height of 7 ft and a wave period of 7 seconds were utilized, as recommended by Wang and Manausa (2013).

4.5 Input Model Parameters

The validation run utilized the model parameters recommended by Wang and Manausa (2013) for Sarasota County with minor adjustments for sediment diameter and angle of repose, as discussed previously. A summary of the input parameters is provided in **Table 4.1**.

Table 4.1: SBEACH model input parameters for Longboat Key (adapted from Wang and Manausa, 2013)

Parameter	Units	Input Value (adapted from Wang and Manausa, 2013)
transport rate coefficient, K	m^4/N	$0.50e^{-6}$
slope dependent term, ε	m^2/S	0.005
transport rate decay coefficient multiplier, λ	m^{-1}	0.5
Overwash transport parameter	-	0.002
Landward Surf zone Depth	ft	1.0
Maximum Slope Prior to Avalanching	deg.	30
Median Grain Size (d_{50})	mm	0.25
Water Temperature	deg. C	28

4.6 Validation Results

The measured and simulated post-Hermine profiles are plotted with the pre-storm (input) profile in **Figure 4.4**. As illustrated in the figure, there is relatively good agreement between the measured and the simulated post-Hermine profiles. The model accurately depicts the loss of the primary dune feature, as the maximum storm surge level reached over +4.9 ft during the storm, overtopping the berm and impacting the dune for several hours. The observed landward limit of erosion was 113 ft Gulfward of the construction baseline. The predicted limit of erosion from the SBEACH simulation was within 3 ft of the observed, at 110 ft Gulfward of the baseline. The modeled recession of the MHW shoreline also closely matches that of the observed (within 5 ft). Based on these limited data, the selected calibration parameters appear appropriate for estimating storm-induced erosion along the Longboat Key shoreline.

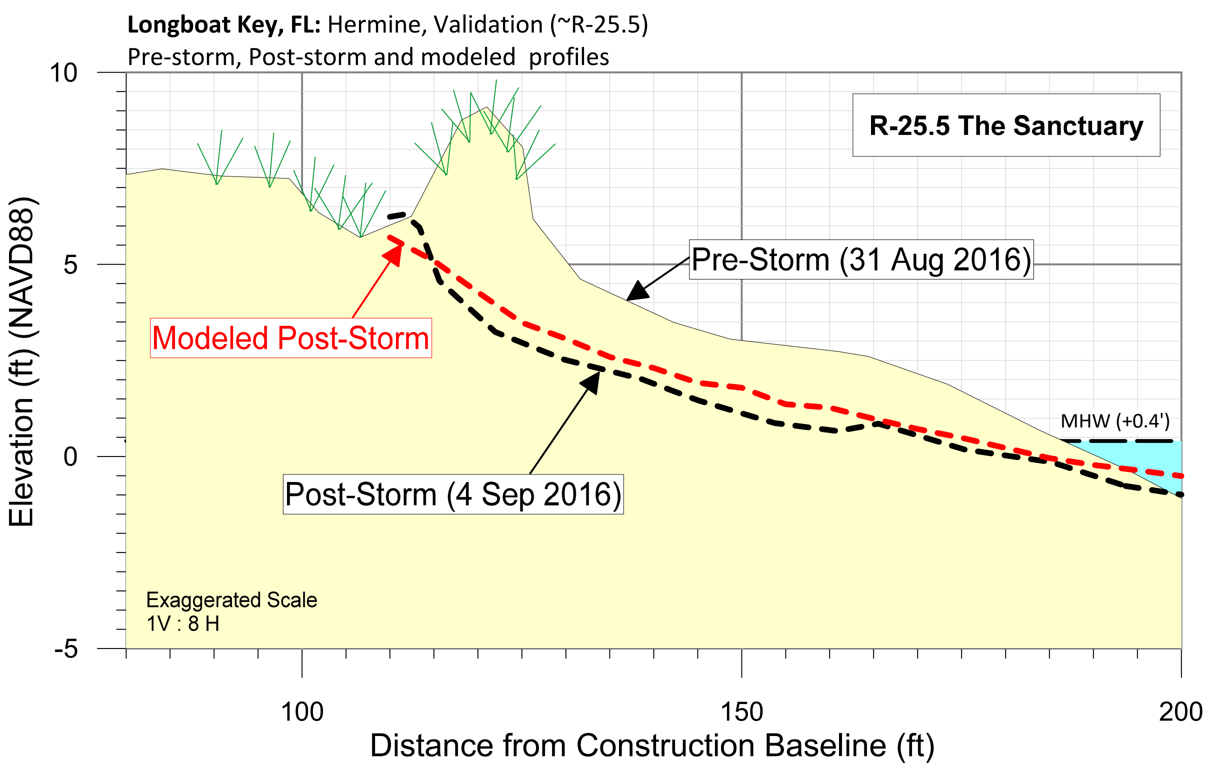

Figure 4.4 Measured and simulated effects of Hurricane Hermine on the beach profile near R-25.5 on Longboat Key. Simulations of storm-induced erosion were estimated using the SBEACH model.

5.0 PREDICTIONS OF FUTURE STORM RECESSION

5.1 Background

Using the calibration parameters established in **Section 3,** a range of storms were modeled on the existing (May 2018) Longboat Key shoreline. The range of modeled storm water levels and their respective annual probability of occurrence was as follows:

- 5 Year (20%)
- 10 Year (10%)
- 15 Year (7%)
- 20 Year (5%)
- 25 Year (4%)
- 30 Year (3%)
- 50 Year (2%)
- 100 Year (1%)

Of particular interest in the analyses are the higher-frequency (i.e. more likely to occur in a given year) events. The FDEP uses the 25-year event as a benchmark to determine the level of vulnerability of upland infrastructure.

5.2 SBEACH Input Data

Beach Profile Data The project shoreline was surveyed in May 2018 by Hyatt Survey Services, Inc., of Bradenton, FL. Beach profiles are available at each of the 67 FDEP survey R-Monuments located within the project area (R-44.6 to R-29). The profiles typically extend from the landward side of the dune seaward to a distance of approximately 2,500 to 3,000 feet offshore. Depending upon the location of the survey profile, this distance corresponds to offshore waters depths of -6 to -20 ft relative to NAVD.

Storm Hydrographs The FDEP storm hydrographs (Wang and Manausa, 2013) were used as input for the return period storm model runs for Longboat Key. The published 15- and 25-year storm hydrographs were scaled to create the range of hydrographs for the different return period storm events by matching the peak tide levels for those respective curves to match the published peak storm tide levels (**Table 2.1**). Since the FDEP (2011) peak storm tide levels include dynamic wave setup, the storm hydrographs were adjusted downward to account for the wave setup calculated within the SBEACH model. Through an iterative process, the FDEP input hydrographs were proportionally reduced based upon the average SBEACH-generated setup. This resulted in a set of final average maximum water elevations for all of the profiles that approximately matches the FDEP peak storm tide levels listed in **Table 2.1**. **Figure 5.1** presents the published storm hydrographs for the 15-year and 25-year storms (Wang and Manausa, 2013), and the scaled hydrographs for the modeled return period storms based on the values in **Table 2.1**.

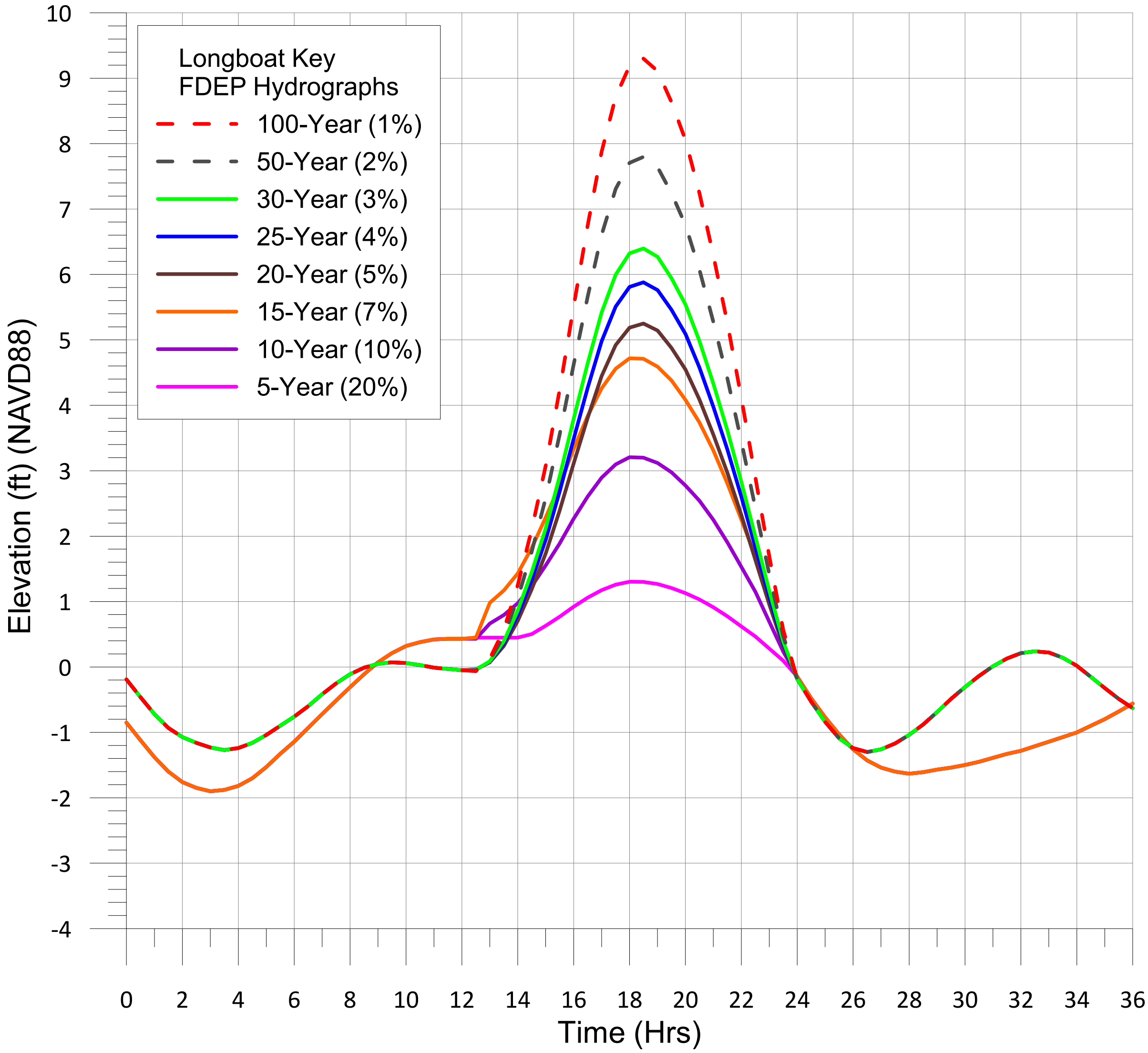

Figure 5.1: Published (Wang and Manausa, 2013) storm hydrographs and scaled hydrographs used for SBEACH input, Longboat Key, FL. Hydrographs were scaled to match storm water levels in FDEP (2011) and FEMA (2014). The plotted curves represent the input surge levels at the offshore ends of the beach profiles, and as such do not include wave setup effects at the beach.

Wave Characteristics No measured wave information was available for the various return period storms. However, Wang and Manausa (2013) demonstrated that a constant wave condition can provide a reasonable proxy for measured time series wave data. As recommended in Wang and Manausa (2013), the input wave conditions for most of the storm events modeled were assumed to be constant, with H_s= 7.0 ft and T_p=7.0 s. For the largest storm (100-year return period), the wave height was increased to 9 ft, but the period was kept at 7 seconds.

5.3 SBEACH Model Results

Plots of the predicted 5-, 10-, 15-, 20-, 25-, 30-, and 100-year storm response profiles at each of the 67 beach profiles analyzed are provided in **Appendix A**. The Town's design beach baseline and seaward edge of infrastructure are included in the plots for reference. The approximate seaward edge of infrastructure (structures, parking areas, roads, etc.) at each profile was determined from aerial photography. The design beach baseline, established in 1995, generally follows the early 1990s pre-restoration edge of vegetation along the shoreline.

Predicted results are discussed for the north, central, and south sections of the island, as previously defined in the text. Each profile type has a different response to the simulated storms. To demonstrate the differences, the figures that follow plot representative profiles from each section, with selected storm response profiles. These figures depict the progressing storm intensity levels at which the beach berm and dunes are eroded and eventually overtopped. One metric of the storm damage is the landward limit of erosion, defined herein as the landwardmost point that experiences at least six inches of profile deflation. Locations of the predicted landward limit of erosion for representative storms are mapped in aerial-based plan-view in **Appendix B**. It is noted that the storms simulated produce general conditions that are predicted by the model to be experienced during the respective type of surge levels. The SBEACH model does not take into consideration the level of vegetation or effects of infrastructure on the erosion simulation, therefore the erosion limits presented should be considered as guidance of what may occur at each level of storm exposure.

Figure 5.2 through **Figure 5.4** depict a representative beach profile for the north, central, and south sections, respectively, and model results for selected storms. The 25-year storm response is included on all three figures; this storm level is evaluated by the FDEP to assess the potential vulnerability of upland infrastructure. These figures also include the location of the design beach baseline, the approximate location of the edge of infrastructure, as well as the Mean High Water (MHW) elevation. The landward limits of erosion for each of the response profiles are marked for each storm profile.

Figure 5.2 illustrates a representative beach profile for the north section of the island, at Whitney Beach (R-47.5). The plot includes predicted profile responses for the 5-, 10-, 25-, and 100-year storms and indicates the relative location of the design beach baseline and the Gulfward limit of infrastructure. At this location, the beach berm is relatively low and flat, with no distinct primary dune feature, with a low vegetated upland beach area extending roughly 250 ft from MHW to the Gulfward edge of development. As plotted in **Figure 5.2**, all storms produce only a minor level of shoreline retreat at MHW, with an increasing level of upper beach berm erosion. The 5-year storm is predicted to produce 20 to 30 ft of erosion along the dry recreational beach and to leave a minor level of scarping along the low dune face. With a 10-year storm impact, the beach berm and low dune are expected to experience significant erosion and overtopping. Above the 10-yr storm, the recreational beach berm and dune are planed off and wide expanses of the low back beach area becomes progressively overwashed as the total surge levels exceed +6 to +7 ft and the landward limit of erosion extends well landward. For the 25-yr to 30-yr events and higher, most of the profile will be submerged in the storm surge (as will many areas of the island). Due to the low back beach elevations along this profile, the model predicts that the landward limit of erosion will extend well inland by 200 to 250 ft or more in the 25-yr to 100-yr storm events, although the total volumetric erosion associated with the storm overwash is predicted to be relatively small in this instance[4].

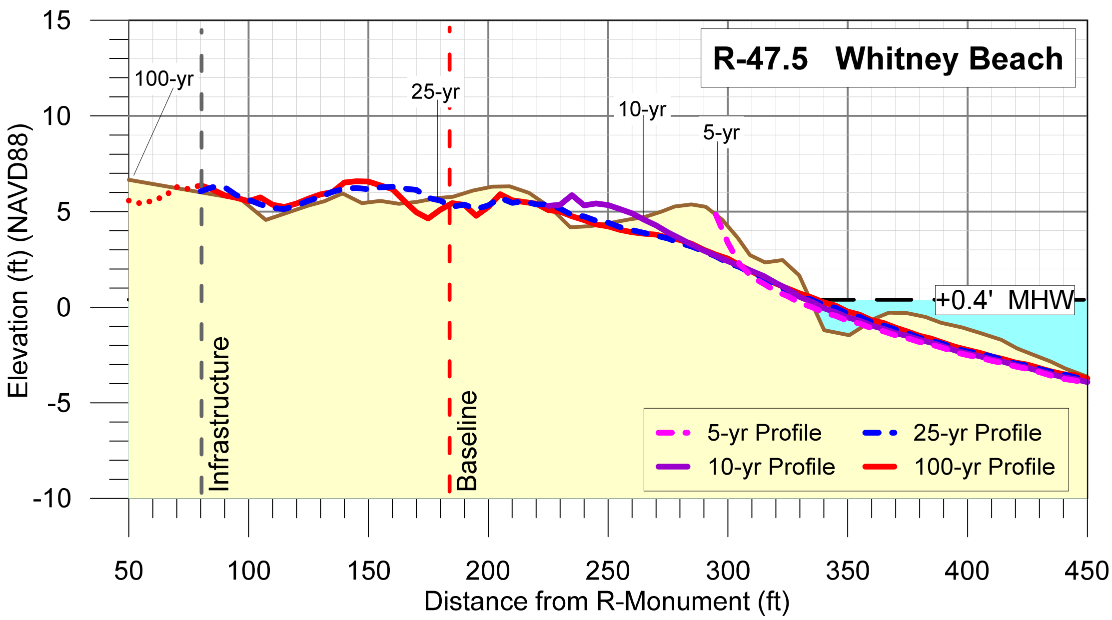

Figure 5.2: Storm response profiles predicted for a representative north profile at Whitney Beach (R-47.5) for the 5-, 10-, 25-, and 100-year storms. The landward limit of erosion/deflation for each storm is identified by return period label.

[4] The maximum water levels expected for the 100-year storm of ~11ft NAVD (w/setup) would greatly exceed not only the elevation of the berm and dune, but also many areas of the island.

Both the Gulfward edge of infrastructure and the landward limits of erosion vary widely along the north end of the island, and the predicted erosion and retreat at each profile is strongly influenced by the elevations and volume of sand in the dunes. The larger, higher elevation dunes limit overtopping and overwash for higher return-period storms (see Appendices A and B for individual results). Once the dune is overtopped and planed off, the general low elevation of the back beach allows for storm impacts to extend well landward of the MHWL.

Figure 5.3 depicts the modeled profile at Bayport (R-03) in the central portion of the island. This profile has a more prominent primary dune at a higher elevation. **Figure 5.3** illustrates the storm response profiles for the 5-, 20-, 25-, and 100-year storms, the design beach baseline, and the limit of infrastructure. The corresponding landward limits of erosion are labeled at their respective locations. In the case of the beach at Bayport (R-03) the 5-year storm response is similar to the north end profile, with 20- to 30-ft of retreat of the recreational beach berm and some minor scarping of the profile. With the higher dune elevation, the profile is predicted to be able to resist significant overtopping in a 20-yr event (vs. 10-yr), although the profile does experience overwash and landward dune retreat. Above the 20-yr event, the 25-yr storm is predicted to result in the loss of the primary dune feature, with overwash depositing on the landward side of the dune. In a 100-yr event, again, the profile will be inundated with the storm surge, and the model predicts the landward limit of erosion/deflation will extend landward to the sidewalk and road along Gulf of Mexico Drive. The effects of these hard structures are not included in this analysis.

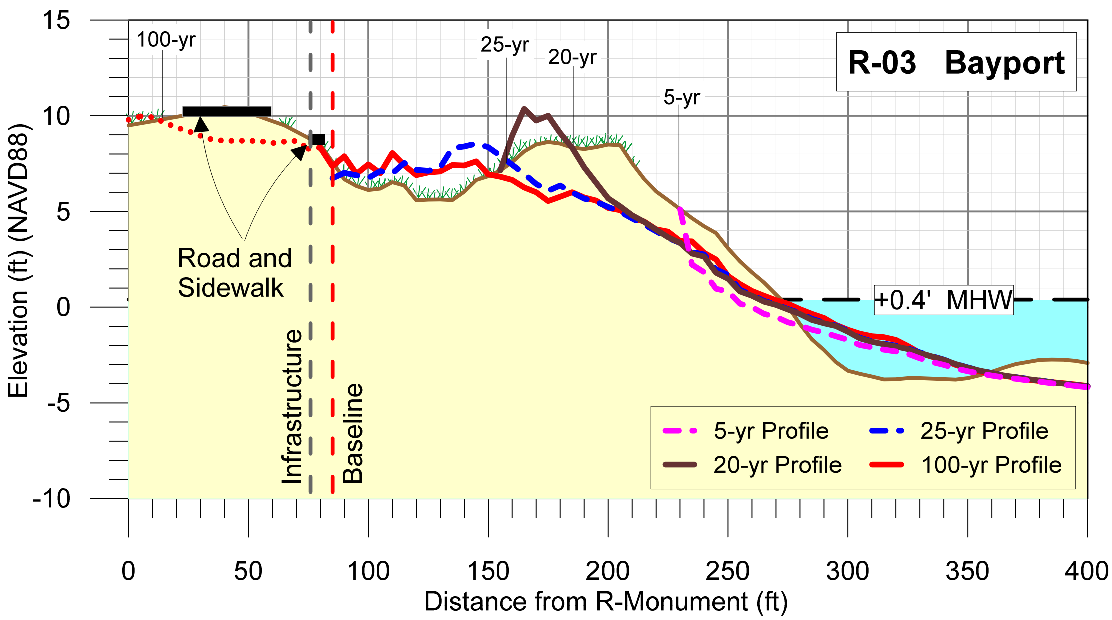

Figure 5.3: Storm response profiles on the representative central profile at Bayport (R-03) for the 5-, 20-, 25- and 100-year storms. The landward limit of erosion/deflation for each storm is identified by return period label.

Figure 5.4 depicts the predicted storm recession profiles at Regent Place (R-24), along the southern portion of the island. This profile has a wider berm compared to the rest of the island, although the profile exhibits only a minor dune feature and the back beach elevations are similar to or lower than the central portion of the island. **Figure 5.4** depicts the predicted storm response profiles for the 5-, 10-, 25-, and 100-year storms, along with the design beach baseline, and the Gulfward edge infrastructure. The landward limits of erosion for each storm are noted with their corresponding labels. Similar to the majority of profiles, the 5-year storm is predicted to result in only 20-30 ft of retreat of the dry recreational beach berm and cause only minor scarping of the upper berm. The 10-yr storm extends the erosion to the upper recreational beach, and suggests some deposition along the berm as sand eroded from the beach face is pushed landward. Above the 10-yr (10%) storm event, the beach becomes increasing planed off and overwash begins to extend landward of the baseline as more of the beach becomes submerged at higher storm surge levels. While no deflation is observed at the Gulfward edge of infrastructure for the 100-yr event, the area will still experience storm flooding in this location. Additionally, it should be noted, for all areas, that the edge of infrastructure varies significantly alongshore, and the transects only present predictions at their specific alongshore transects.

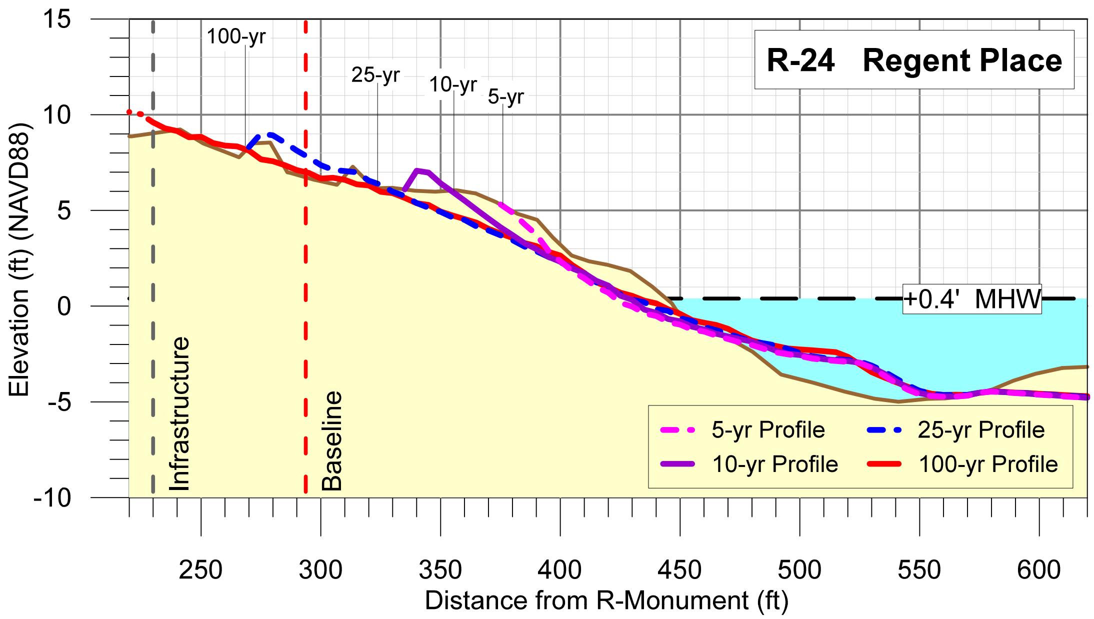

Figure 5.4: Predicted storm response profiles on the representative southern profile at Regent Place (R-24) for the 5-, 10-, 25- and 100-year storms. The predicted landward limit of erosion/deflation for each storm is identified by return period label.

Table 5.1 summarizes the predicted islandwide average retreat distance of the MHW, berm (+4ft NAVD), and toe of dune (+6ft NAVD) contours for the 5-, 15-, 25-, and 100-year storm simulations. Averages for the north, central and southern island sections are also presented. The table also includes the average landward limit of erosion relative to the pre-storm MHWL (the landwardmost point where the profile exhibits at least 0.5 ft of deflation). Model results indicate that the MHWL experiences a relatively small retreat for all storms. As evident from the simulation profiles plotted in **Appendix A**, the MHW elevation lies near a typical transition point between erosion of the upper beach and deposition in the shallow nearshore area. Above the MHW line, post-storm profiles increasingly exhibit a very planar shape as the upper beach and dunes are eroded. Some portion of the eroded sand from the upper beaches is transported Gulfward into the submerged portions of the profile. This process typically limits the MHW retreat. The greatest retreat of the MHWL is experienced at the 5-year (20%) storm because wave impacts more closely affect the intertidal zone and beach face.

The average retreat at the +4ft NAVD berm elevation exhibits a progression of erosion with increasing storm intensity. The 5-year storm produced an average retreat of -6ft at the berm. In a 15-year (7%) storm, the beach is predicted to experience an average retreat of -24 ft as the increased surge level results in wave impacts that affect a higher elevation along the profile. Beyond the 15-year storm the berm only exhibited an additional -2ft of predicted retreat for a total average retreat of -26ft as the higher surge level allows waves to pass over the beach face and affect the upper berm and dunes.

At an elevation typical of the top of berm or seaward toe of dune (+6ft NAVD), model predictions indicate no retreat during a 5-year storm event (on average). For the surge levels of a 15-year storm event, the dune face experiences an average landward retreat of -8 ft, although some profiles do exhibit accretion as the berm erodes and sand can be overwashed landward, creating small accumulations along the profile. At higher surge levels, most dune features along the shoreline are predicted to be severely or completely eroded away and the +6ft contour is predicted to consistently retreat with the increasing storm intensity. In general, the existing beach and dunes may provide protection to upland infrastructure from a 20-yr storm event, but in the process the dunes would be severely eroded or lost, providing no additional protection for a subsequent storm event. Recession predictions from a 25-year (4%) storm event suggest retreat of the +6 ft contour of -27 ft on average, and retreat during a 100-year (1%) storm average -45 ft. It is noted that for the 100-yr event, the combined total water level is expect to fully inundate the beach with several feet of water, which will allow large waves to pass over the beach itself and interact directly with the upland infrastructure.

Table 5.1 Average retreat of the MHW, berm (+4ft NAVD), and toe of dune (+6ft NAVD) contours for each of the 5-, 15-, 25-, and 100-year storms simulated at each section of the shoreline, Longboat Key, FL. The Landward Limit of Erosion (LLE) is relative to the MHW position of the pre-storm input profile.

5-year storm (20%)				
Shoreline section	MHW	Berm (+4ft NAVD)	Toe of Dune (+6ft NAVD)	LLE*
Average	**-15**	**-6**	**0**	**-49**
North R-44.6 – R-54	-11	-4	-1	-47
Central R-55 – R-19	-15	-8	0	-48
South R-20 – R-29	-19	-1	0	-55
15-year storm (7%)				
Shoreline section	MHW	Berm (+4ft NAVD)	Toe of Dune (+6ft NAVD)	LLE*
Average	**-7**	**-24**	**-8**	**-100**
North R-44.6 – R-54	-6	-36	7	-111
Central R-55 – R-19	-6	-21	-10	-92
South R-20 – R-29	-11	-18	-16	-106
25-year storm (4%)				
Shoreline section	MHW	Berm (+4ft NAVD)	Toe of Dune (+6ft NAVD)	LLE*
Average	**-8**	**-26**	**-27**	**-137**
North R-44.6 – R-54	-6	-42	-40	-181
Central R-55 – R-19	-7	-22	-22	-116
South R-20 – R-29	-14	-19	-30	-137
100-year storm (1%)				
Shoreline section	MHW	Berm (+4ft NAVD)	Toe of Dune (+6ft NAVD)	LLE*
Average	**-4**	**-26**	**-45**	**-204**
North R-44.6 – R-54	-3	-40	-82	-284
Central R-55 – R-19	-3	-22	-31	-172
South R-20 – R-29	-10	-18	-44	-185

*Landward Limit of Erosion with respect to pre-storm MHWL.

Table 5.1 also summarizes the predictions of the average landward limit of erosion relative to the pre-storm MHWL, where negative values represent distances in a landward direction. This limit is relevant to infrastructure and buildings in close proximity to the beach. Similar to the contour retreat, the northern and southern sections of the shoreline are predicted to experience deflation farther landward along the profile than the central portion of the island, where the beach typical exhibits higher dune and berm elevations.

Figure 5.5 plots the landward limit of erosion relative to the pre-storm MHWL for all simulated storms. The black curve represents the total average for the shoreline. Each colored curve represents average limits of erosion for each of the three shoreline sections. For a 5-yr storm impact, the landwardmost limit of profile deflation occurs only 50 ft landward of the pre-storm MHWL (a point that lies along the sandy beach berm or at the Gulfward dune face, typically). As the storm intensity increases, the landward limit of deflation predictably moves landward, extending roughly 100 ft landward of the pre-project MHWL as the dune features begin to erode for a 15-yr event (7% chance of annual occurrence). At the 20-yr (5%) storm surge level, the dunes are severely impacted and the landward limit of erosion begins to progress landward of the dunes. At this level the limits begin to differ between the various segments of the beach. Areas with bigger and taller dunes in the central portion of Longboat Key can better resist overtopping, limiting the landward profile changes, whereas the lower profiles along the northern portion of the Key will experience more deflation well landward of the dunes. These differences grow with storm intensity, especially for the northern shoreline section.

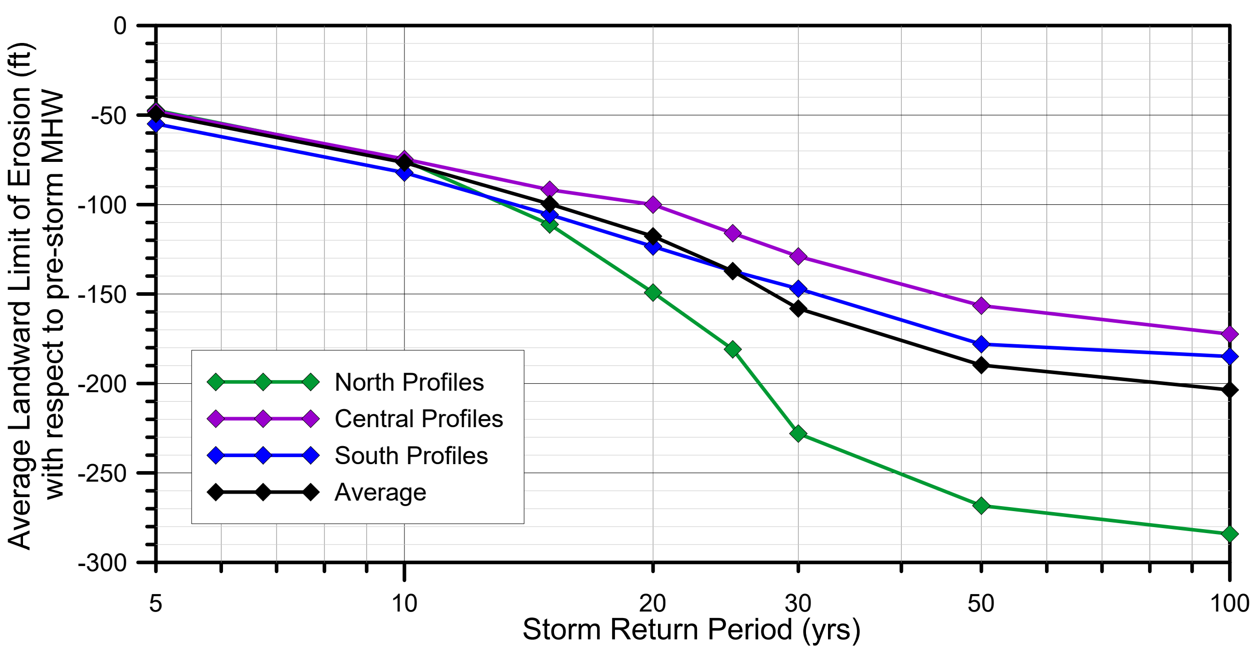

Figure 5.5: Average landward limit of erosion for each section of the shoreline at different level storms.

The following three figures illustrate in sequential plan view the predicted landward limit of erosion for the 5-, 15-, 25-, and 100-year storm events. The results are plotted relative to the Town of Longboat Key design beach baseline. As described above, the baseline was established in the mid-1990s, based upon the existing vegetation line prior to beach restoration. From the design baseline, the Town established a minimum design beach width, between 80 and 120 ft from the baseline to MHW. The sequence of figures illustrates how the landward limit of erosion/deflation increasingly impacts the beach, the vegetated areas, and the developed upland areas. In some locations, such as the 6633 GMD seawall, the siting of structures narrows the beach width; these areas will experience storm impacts at much lower storm intensities.

Figure 5.6A plots the design beach width (80-120ft) and the pre-storm MHWL utilized in the present study. The plot likewise depicts the current vegetation line and the Gulfward edge of development along the shoreline (determined from current aerial photography). Note that in the 25+ years since the baseline was established, both the MHWL and the vegetation line have changed considerably, and the changes do not parallel the baseline. Similarly, the Gulfward edge of development (roads, buildings, pool decks, etc.) is highly irregular relative to the baseline location, as different parcels have different setbacks. This irregularity is exaggerated in the figures due to the differences in horizontal and vertical scales. Greer Island was not modeled in this analysis because of its overall low elevation and its proximity to the inlet.

Figure 5.6B includes the landward limit of erosion for the 5-year and 15-year storms along the shoreline. As discussed above, erosion from the 5-year storm (20%) is generally limited to the sandy beach berm and the Gulfward dune face. For the 15-year storm (7%), most beach profiles experience at least some erosion of the dunes and retreat into the existing vegetation. In some areas the limit of erosion is predicted to reach the seawalls for the Islander Club, the Privateer Condominiums, and the seawalls in the north section of the island. [5]

Figure 5.6C introduces the predicted landward limit of erosion for the 25-year and 100-year storms. As discussed, the 25-year storm is predicted to erode most if not all of the dunes along the shoreline, allowing the erosion signal to extend much farther landward. As shown, predicted 25-yr storm impacts have a widespread impact to upland vegetation and increasing impacts to additional upland infrastructure, especially structures sited Gulfward of the average line of development (e.g. the Islands West seawall, the Longboat Key Towers seawall, and the Gulfside Road area south of the 6633 GMD seawall). By the 100-year storm the landward limit of erosion reaches much farther landward and suggests there likely will be erosional impacts to a major portion of structures along the shoreline (which will experience significant flooding, if not erosion). **Appendix B** depicts aerial plan views of the predicted erosion limits.

[5] The Gulfward edge of infrastructure is defined at a much higher alongshore resolution versus the modeled beach profiles. Intersections between the predicted landward limit of erosion and edge of infrastructure is only a suggestion of possible impacts.

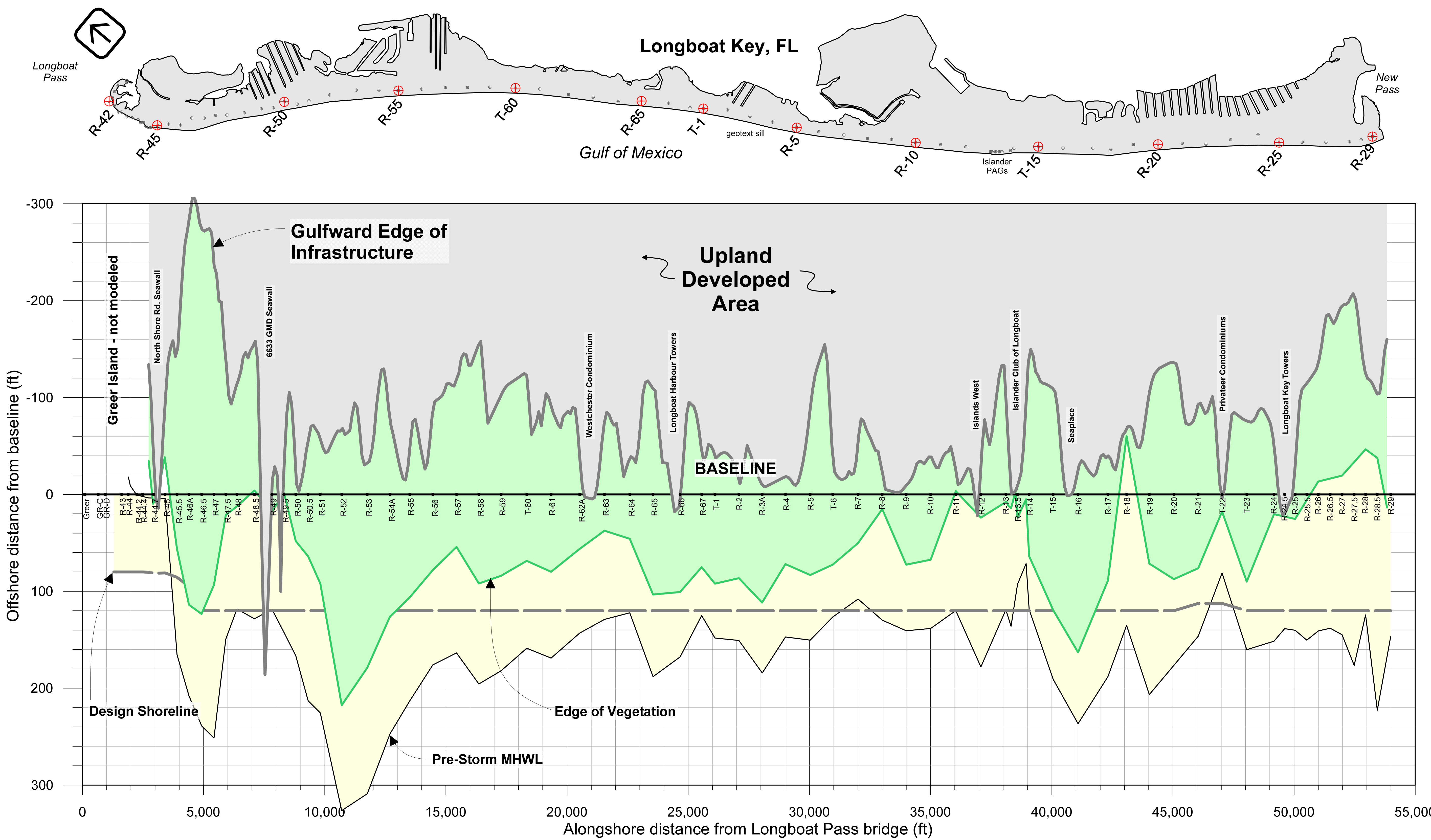

Figure 5.6A: Pre-storm conditions of the edge of infrastructure, edge of vegetation and Mean High Water Line (MHWL, May 2018) along the project baseline in Longboat Key, FL.

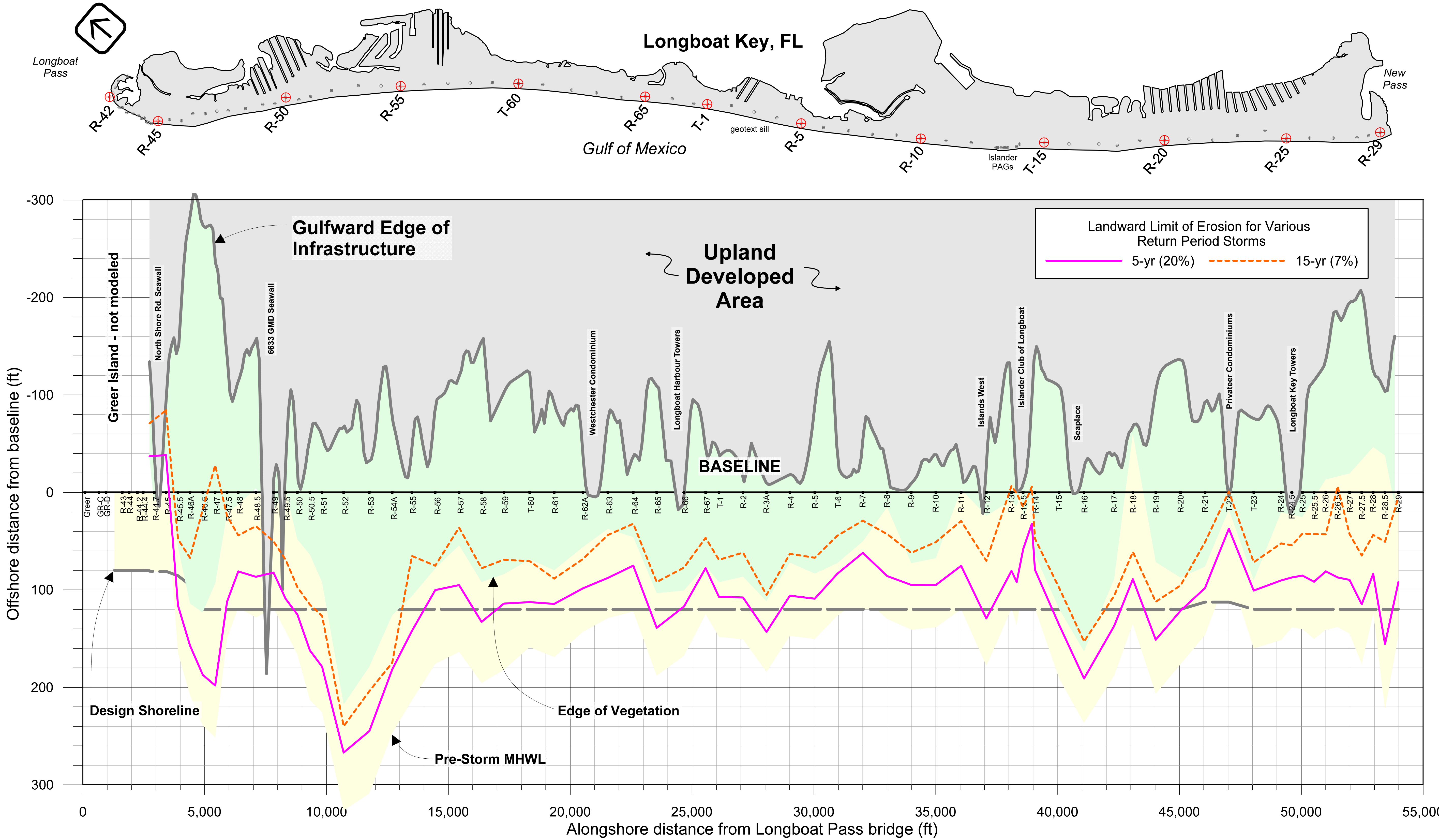

Figure 5.6B: Predictions of post-storm landward limits of erosion for the 5-year and 15-year storms relative to the "current conditions" (May 2018) and the project baseline along the shoreline in Longboat Key, FL.

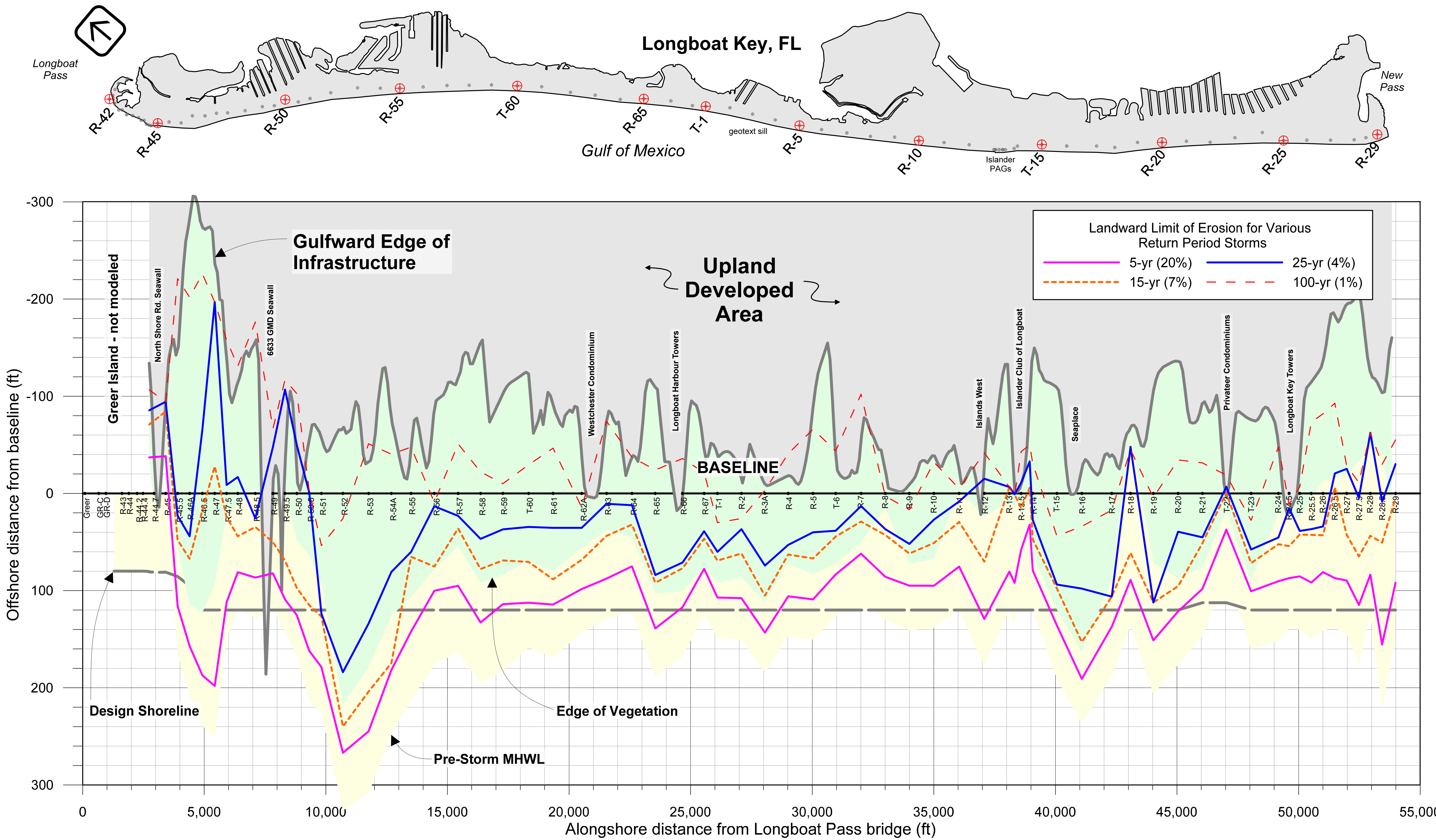

Figure 5.6C: Predictions of post-storm landward limits of erosion for various return period storms relative to the "current conditions" (May 2018) and the project baseline along the shoreline in Longboat Key, FL.

6.0 SUMMARY & CONCLUSIONS

Numerical model simulations of beach profile storm recession were performed for a range of storm surge levels and wave cases impacting existing beach conditions along the Longboat Key, FL, shoreline, using the model SBEACH (Storm-induced BEAch Change, Rosati, et al., 1993). The modeling analysis was conducted to assess the level of storm vulnerability along the existing shoreline to support the recommendations proposed in the 2019 Beach Management Plan Update for the Town of Longboat Key. Calibration parameters for the SBEACH model were established from the Florida Department of Environmental Protection SBEACH report by Wang and Manausa (2013) for Sarasota County, FL. A limited validation assessment of the calibration parameters was conducted using a small dataset from impacts of Hurricane Hermine in September 2016.

The SBEACH modeling results were used to compile predictions of shoreline recession at Mean High Water (MHW) and along higher berm elevation contours along the beach for each FDEP R-monument transect for a range of return period storms. These storms include return periods of 5-yr (20%), 10-yr (10%), 15-yr (7%), 20-yr (5%), 25-yr (4%), 30-yr (3%), 50-yr (2%), and 100-yr (1%). The percentage listed for each return period storm represents the likelihood of occurrence of that storm in a given year. By example for Longboat Key, there is a 5% chance in any given year that a storm with a 20-yr return period surge elevation of nearly +7ft NAVD, including setup, will impact the island. The modeling results also include predictions of the landward limit of erosion, defined as the landwardmost occurrence of vertical deflation of the existing beach profile by at least six inches. These results are presented in relation to the relative positions of the existing pre-storm Mean High Water Line (MHWL), the Town's design beach baseline and design beach width, and the Gulfward edge of development along the shoreline.

The model results indicate that the existing beach and dune conditions, for beach segments that are at the design beach width or better, are typically adequate to provide protection to Gulf-front upland infrastructure from as much as a 6.5-ft to 7.0-ft total storm surge[6]. Such a storm surge approximates a ~20-yr storm event (5% chance of occurrence in any given year). Adequate protection refers to the prevention of beach profile erosion and deflation landward of a specified point such as the edge of development, and the prevention of significant wave

[6] Total surge refers to the elevation above NAVD88 datum and includes the effects of tide and wave setup.

penetration landward of the primary dunes. In such a storm, the existing primary dunes may be severely damaged or completely eroded away, leaving only minimal protection for a subsequent storm impact.

For storm events above that surge level, or for beaches that are lower and/or narrower than the design template, the existing beaches provide an incrementally decreasing level of protection as the sustained surge level during a storm overtops the typical beach berm elevations, and the occurrence of overwash, profile deflation or scour increases. Lower areas of the shoreline, such as Greer Island and areas along access corridors and footpaths, will experience overtopping at much lower elevations and smaller storms. Note that the simulations do not address storm-induced flooding along the bay and canal shorelines of Longboat Key.

Along many segments of the shoreline, dunes have grown significantly in the last 15-20 years from all the sand placement efforts. These dune features can limit the overwash and wave intrusion landward of the dune line and increase the overall level of storm protection offered to upland infrastructure. With the substantial dune and dune vegetation growth, the sandy recreational beach berm space has narrowed for some segments as the dry beach berm has gradually eroded landward and the dune vegetation has grown Gulfward. The dune and vegetation are very beneficial to the protection of the beach system and the provision of storm protection benefits. For this reason, FDEP protects the dunes and dune vegetation and limits or prevents any manipulation of these resources that would remove any dune width or trim back any dune vegetation.

7.0 REFERENCES

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APPENDIX D – STATE COST-SHARING -- PUBLIC ACCESS (APPROVED)

The following table listing the public access points was submitted and approved for the FY 2020/2021 State Local Government Funding Request (LGFR). The updated assessment of the public access along Longboat Key resulted in increasing the State cost-share percentage to 26.94%.

					Units for Access Credit					
Site Name	**Site Address**	**Nearest R-Monument**	**Access Type**	**Shore Frontage of Parcel (ft)**	**# Parking Spots** *1 unit*	**# Bus Stops** *1 unit*	**# Bike Parking** *1/4 unit*	**# Vacation Rental Units** *1 unit*	**# Total Units**	**Eligible Shoreline** *(ft, no overlap)*
N. SHORE RD	100 North Shore Road	R-44	Secondary	70	30	0	6	0	25	1,390
SEABREEZE AVE	7055 Seabreeze Avenue	R-45	Secondary	10	19	2	0	0	21	1,060
BROADWAY ST	100 Broadway Street	R-46	Secondary	70	30	0	0	0	25	1,390
BEACHWALK	6847 Gulf of Mexico Drive	R-46.5	Secondary	30	0	0	0	0	0	0
WHITNEY BEACH	6701 Gulf of Mexico Drive	R-48	Condo	850	N/A	N/A	N/A	8	8	420
GULFSIDE RD	6399 Gulfside Road	R-50.5	Secondary	100	52	0	0	0	50	2,740
ROLLING WAVES	6351 Gulf of Mexico Drive	R-50.5	Condo	100	N/A	N/A	N/A	8	2	0
SILVER SANDS	5841 Gulf of Mexico Drive	R-55	Condo	160	N/A	N/A	N/A	44	3	160
CEDAR'S WEST & EAST (ACROSS THE STREET)	5655 Gulf of Mexico Drive	R-56	Condo	610	N/A	N/A	N/A	21	12	610
WICKER INN	5581 Gulf of Mexico Drive	R-57	Motel	170	N/A	N/A	N/A	11	6	170
SANDPIPER INN	5451 Gulf of Mexico Drive	R-58	Motel	100	N/A	N/A	N/A	11	6	100
ARBORS BY THE SEA	5441 Gulf of Mexico Drive	R-58	Motel	100	N/A	N/A	N/A	11	6	100
LITTLE GULL	5331 Gulf of Mexico Drive	R-59	Condo	100	N/A	N/A	N/A	16	2	100
BEACH CASTLE	5310 Gulf of Mexico Drive	R-59	Condo	100	N/A	N/A	N/A	18	2	100
SEA GRAPE INN	5125 Gulf of Mexico Drive	T-60	Condo	100	N/A	N/A	N/A	8	2	100

					Units for Access Credit					
Site Name	**Site Address**	**Nearest R-Monument**	**Access Type**	**Shore Frontage of Parcel (ft)**	**# Parking Spots** *1 unit*	**# Bus Stops** *1 unit*	**# Bike Parking** *1/4 unit*	**# Vacation Rental Units** *1 unit*	**# Total Units**	**Eligible Shoreline** *(ft, no overlap)*
WHITE SANDS	5113 Gulf of Mexico Drive	T-60	Condo	100	N/A	N/A	N/A	30	2	100
ATLAS ST	4795 Gulf of Mexico Drive	R-63	Secondary	40	30	2	6	0	34	1,560
SAND CAY	4725 Gulf of Mexico Drive	R-63	Condo	350	N/A	N/A	N/A	60	7	350
ZOTA RESORT	4711 Gulf of Mexico Drive	R-63	Hotel	390	N/A	N/A	N/A	186	7	390
CASA DEL MAR	4621 Gulf of Mexico Drive	R-64	Condo	520	N/A	N/A	N/A	103	10	520
LA PLAYA	4425 Gulf of Mexico Drive	R-66	Condo	200	N/A	N/A	N/A	21	4	200
SEA CLUB I	4141 Gulf of Mexico Drive	T-1	Condo	200	N/A	N/A	N/A	24	4	0
BAYFRONT PARK	4001 Gulf of Mexico Drive	R-2	Primary	100	96	3	6	0	100	5,380
BUTTONWOOD / LONGVIEW	3495 Gulf of Mexico Drive	T-6	Secondary	60	30	0	0	0	30	1,240
THE BEACH ON LONGBOAT KEY	3466 Gulf of Mexico Drive	T-6	Condo	150	N/A	N/A	N/A	10	6	0
SEAHORSE RESORT	3485 Gulf of Mexico Drive	T-6	Condo	450	N/A	N/A	N/A	36	9	450
WESTFIELD ST	3355 Gulf of Mexico Drive	R-7	Secondary / Condo	60	12	2	0	7	21	1,170
MONROE ST / MAYFIELD ST	3175 Gulf of Mexico Drive	R-8	Secondary / Condo	60 (250 ft condo)	20	1	0	15	21	1,420
TRITON AVE	3055 Gulf of Mexico Drive	R-9	Secondary	50	0	0	0	0	0	0
GULF TIDES	3005 Gulf of Mexico Drive	R-9	Condo	200	N/A	N/A	N/A	21	4	0
NEPTUNE AVE/TOWN HALL	2900 Gulf of Mexico Drive	R-10	Secondary	50	48	2	0	0	50	2,160
THE BEACHCOMBER	2721 Gulf of Mexico Drive	R-11	Condo	200	N/A	N/A	N/A	34	4	0
FOUR WINDS RESORT	2605 Gulf of Mexico Drive	R-12	Condo	330	N/A	N/A	N/A	45	6	330
VERANDA BEACH CLUB	2509 Gulf of Mexico Drive	R-12	Condo	250	N/A	N/A	N/A	40	5	250

Site Name	Site Address	Nearest R-Monument	Access Type	Shore Frontage of Parcel (ft)	Units for Access Credit				# Total Units	Eligible Shoreline *(ft, no overlap)*
					# Parking Spots *1 unit*	# Bus Stops *1 unit*	# Bike Parking *1/4 unit*	# Vacation Rental Units *1 unit*		
SEAPLACE	2045 Gulf of Mexico Drive	R-16	Condo	2,120	N/A	N/A	N/A	33	33	1,740
BEACHPLACE	1109 Gulf of Mexico Drive	R-21	Condo	1,440	N/A	N/A	N/A	35	27	1,440
LONGBOAT CLUB RD	Intersection of Longboat Club Rd / Gulf of Mexico Dr.	R-21	Secondary	10	0	2	0	0	2	110
LONGBOAT KEY CLUB INN ON THE BEACH	250 Sands Point Road	R-28	Condo	1,310	N/A	N/A	N/A	226	25	1,310

TOTAL	28,560
Cost Share Percentage	26.94%

APPENDIX E – FEDERAL COST-SHARING -- INITIAL EVALUATION

Table E-1 summarizes the eligibility of Longboat Key shoreline for potential Federal cost-sharing based strictly on public access. To be eligible for Federal cost-sharing, the shoreline must be publicly accessible and have public benefit. To be deemed publicly accessible, the shoreline must be located within ¼ mile of a public beach access point and have sufficient parking and/or public transportation. Additionally, the Gulf-front property owners must sign a Federal easement in order for each parcel to be eligible for cost-sharing. Any properties that do not have Federal easements will have a 0% Federal cost-share. Further, privately-owned properties must be developed to qualify. Undeveloped privately-owned properties will receive 0% cost-sharing.

Table E-1 Initial estimate of potential Federal cost-sharing based on public access points located along the Longboat Key Gulf of Mexico shoreline from R-42.5 in Manatee County to R-29 in Sarasota County.

Shoreline Description	Approximate R-monument Limits	Segment Length (ft)	Within 1/4 mile of Public Access (Y/N)	Eligible for Federal Cost-Sharing (Y/N)	Segment of Eligible Shoreline (ft)	Notes
Greer Island	R-42.5 to R-44.4	1,000	Y	N	0	project taper area, undeveloped barrier island
North Shore Road to Whitney Beach	R-44.4 to R-48	3,580	Y	Y	2,330	North Shore Rd. / Broadway St. / Beachwalk access points
Whitney Beach to Gulfside Road	R-48 to R-49.5	1,790	N	N	0	
Gulfside Road	R-49.5 to R-52	2,740	Y	Y	1,780	Gulfside Rd. access
Cannon's By the Sea to Longboat Beach & Tennis Club	R-52 to R-61.5	9,040	N	N	0	
Positano to Casa Del Mar	R-61.5 to R-64	2,740	Y	Y	1,780	Atlas St. access
Casa Del Mar to Mark II	R-64 to R-67.5	3,300	N	N	0	
Mark II to Bayfront Park	R-67.5 to R-2	1,420	Y	Y	920	Bayfront Park access
Bayport	R-2 to R-3	1,320	Y	N	0	Undeveloped private
Beach Harbor	R-3 to R-5	1,150	N	N	0	
Twin Shores/Buttonwood	R-5 to T-6	1,320	Y	N	0	Undeveloped private
Longview Drive to The Beachcomber	T-6 to R-11	5,750	Y	Y	3,740	Longview Dr. / Westfield St. / Mayfield St. / Neptune Town Hall access points
Four Winds to Promenade	R-11 to R-20	8,850	N	N	0	
Beachplace to Privateer	R-20 to T-23	2,640	Y	Y	1,720	Gulf of Mexico Dr. / Longboat Club Rd. access
Longboat Club Rd.	T-23 to R-29 (terminal groin)	6,360	N	N	0	
TOTAL	**R-42.5 to R-29 (terminal groin)**	**53,000**			**12,270**	
					23%	**Estimated Potential Federal Cost-Share Percentage**

*A 65% Federal cost-share is applied for all eligible shoreline lengths (Ref: USACE ER 1105-2-100). The above estimate is opined to be the upper limit of Federal cost-sharing. This estimate assumes all access points have sufficient public parking and all easements are obtained.