

St. Johns County Shore Protection Project 2021 Year 3 Post-Construction Monitoring Report

St. Johns County, FL



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St. Johns County Shore Protection Project
2021 Year 3 Post-Construction Monitoring Report
St. Johns County, Florida

Permit Number 0295429-002-JC

Prepared for
St. Johns County, Florida
and
Florida Department of Environmental Protection

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1.0 INTRODUCTION

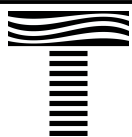
This report presents the latest in a series of annual and semi-annual monitoring reports documenting the evolution of the St. Johns County Shore Protection Project (SPP). Earlier reports (Heckman and Srinivas, 2003; Albada et al., 2005) document the 2002 nourishment project's evolution over time. Albada and Craig (2006), Odroniec and Craig (2007), Odroniec and Krecic (2008), Arnouil and Hodgins (2010), and Arnouil and Trudnak (2011) document the monitoring results of the 2005 nourishment project. Trudnak and Bredesen (2013), Trudnak and Greer (2013, 2014), and Trudnak and Bredesen (2015) document the monitoring results of the 2012 project. Laurent and Trudnak (2019) documented the Year 5 post construction results of the 2012 project as well as the pre- and post-fill conditions of the 2018 project. Laurent and Trudnak (2020) documented the Year 1 post-construction physical monitoring results of the 2018 project while Laurent, Craig, and Lamb (2021) document the Year 2 physical monitoring results. This report documents the Year 3 post-construction physical monitoring results of the 2018 project.

This monitoring report, prepared for St. Johns County, Florida and the Florida Department of Environmental Protection (FDEP), complies with the monitoring requirements specified in FDEP Permit Number 0295429-002-JC. The following sections in this chapter provide the history of the St. Johns County SPP and the report's organization.

1.1 Overview

Originally authorized in WRDA 1986, USACE reauthorized the St. Johns County Erosion Control Project in 1999 after the completion of a detailed General Reevaluation Report (GRR) and final Environmental Assessment (EA) in 1998 (USACE, 2009). These authorizing documents stated two project purposes: (1) to mitigate the down-drift impacts caused by St. Augustine Inlet and its federal navigation channel and (2) to provide storm damage reduction to the St. Augustine Beach upland development (USACE, 1998). To date, the USACE and St. Johns County have nourished the St. Johns County SPP project four times, inclusive of initial nourishment; Section 2.1 further details the project history.

Permit requirements mandate regular beach and borrow area monitoring. The monitoring data documents the effects of the combined nourishment projects on the fill placement area, the control areas to the north and south of the project area, South Ponte Vedra and Vilano Beach (north of St. Augustine Inlet), Porpoise Point (the north shoreline of the inlet), and the borrow areas (Figure 1.1).



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**FIGURE 1.1 ST JOHNS COUNTY SPP
LOCATION MAP
ST. JOHNS COUNTY, FLORIDA**

PROJECT	C2020-069
DRAWN BY	WKL
SHEET	1 OF 1
DATE	FEB 2022

1.2 Report Organization

Following this introduction, Chapter 2.0 summarizes the nourishment history of the project area and provides beach and borrow area survey details. Chapter 3.0 documents the analysis of beach profiles, shoreline positions, beach volumes, and longshore dispersion within the project and control areas and evaluates the overall project performance. Chapter 4.0 discusses the effects of dredging on the borrow area and general changes within the inlet and ebb shoal complex. Chapter 5.0 summarizes the study. A list of references follows Chapter 5.0.

Appendix A summarizes the FDEP reference monument locations and orientations associated with each profile surveyed within the monitoring area. Appendix B contains beach profile plots of monitoring surveys, spanning from R-80 to T-157, used for this report. Appendix C contains 2021 aerial photographs overlaid with surveyed mean high water (MHW) contours for the September 1998/April 1999 baseline, December 2017 pre-fill (denoted 2018 pre-fill), July 2018 post-fill, 2020 year 2 post-fill, and 2021 year 3 post-fill conditions. Appendix D contains year three photographs of the monitoring area.

2.0 BACKGROUND DATA

2.1 Nourishment and Borrow Area History

The initial restoration of the St. Johns County SPP, completed in January 2003, extended 2.8 mi from approximately 600 feet (ft) north of FDEP monument R-137A in Anastasia State Park (2.7 mi south of St. Augustine Inlet) to approximately 600 ft south of FDEP monument R-151 in the City of St. Augustine Beach (Figure 2.1). The State of Florida, piggybacking the federal project, extended the beach restoration project about 0.9 mi north into Anastasia State Park to T-132—permits allowed for the placement of an additional 80,000 cy to be placed in the dunes between T-132 and R-141 and 320,000 cy to be placed on the beach in Anastasia State Park (T-132 through R-137A). The initial restoration (referred to as the 2002 project) occurred in two phases. Between September and October of 2001, the U.S. Army Corps of Engineers (USACE) placed sand from approximately R-145 south to R-151 before funding difficulties interrupted construction. USACE resumed construction in April 2002 and completed the project in January 2003.

The first nourishment, referred to as the 2005 project, occurred before the anticipated nourishment interval due to severe erosion occurring during the 2004 hurricane season. In response to the storms, the U.S. Congress appropriated emergency funds for beach nourishment and Taylor Engineering applied for and received a one-year extension to the existing five-year FDEP permit issued for the initial project. Construction of the first nourishment began in June 2005 and concluded in November 2005. The project encompassed the original 2.8 mi project area, extending from R-137A to R-151.

The second nourishment, known as the 2012 project, extended approximately 1.5 mi from R-139 to R-147. An agreement between USACE and dissenting property owners limited the permitted beach fill volume to approximately 2.1 million cubic yards (mcy); this volume limitation inhibited construction of the full 2.8-mile permitted project. Project construction occurred from February to September of 2012.

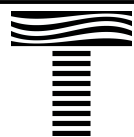
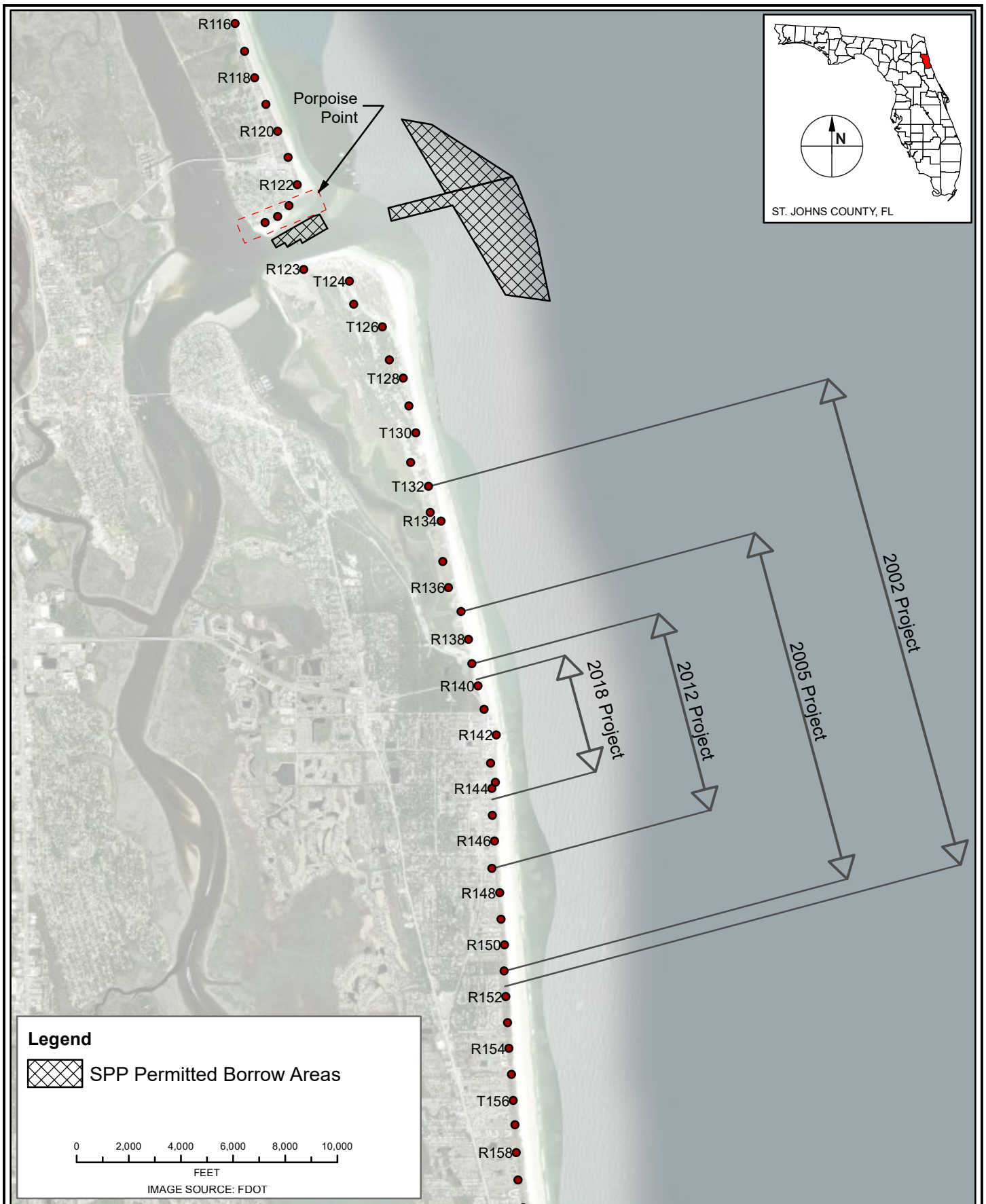
The third nourishment, constructed from January – June 2018, extended approximately 0.9 mi from R-139.7 to R-144.4. The short project length reflects limitations imposed by the St. Augustine Inlet Management Implementation Plan, adopted by FDEP in 2014. The implementation plan limited the project volume to 179,000 cy/yr times the number of years between nourishment events. The

project focused fill placement to the central portion of the project area that experiences the most significant erosion.

All the projects discussed above used portions of the St. Augustine Inlet ebb shoal and navigation channel as the borrow area. The 2012 project used the southern lobe of the ebb shoal (i.e., south of the navigation channel), the inlet's federally authorized navigation channel, a 200-ft widener along the south side of the navigation channel, and the portion of Porpoise Point that encroaches into the navigation easement area (Figure 2.1). The 2018 project used the eastern end of the navigation channel (within the ebb shoal region) in addition to the south end of the permitted borrow area in the southern lobe of the ebb shoal; the project did not dredge any part of the shoals or navigation channel by Porpoise Point. All projects combined have dredged and placed approximately 9.85 mcy within the project area along St. Augustine Beach. Table 2.1 documents the nourishment history.

Of note, various inlet maintenance dredging projects have directly impacted the monitoring area. Immediately after the 2012 nourishment project and again in late 2013/early 2014, USACE practiced regional sediment management strategies and completed a beneficial use placement in Anastasia State Park using materials from maintenance dredging of the inlet interior navigation channels and Intracoastal Waterway. These placement events significantly affected the beach changes in the north control area over the long-term analysis period discussed in previous monitoring reports. USACE also completed two nearshore beneficial use placements at two areas in Vilano Beach (R-114 to R-115 and R-116 to R-117) during summer 2015 (up to 150,000 cy; the exact volume is unavailable). In 2017, USACE beneficially placed maintenance dredging material on Vilano Beach between March and May (137,281 cy reported by USACE).

In addition to inlet maintenance and beneficial use placements, the initial nourishment of the St. Johns County Coastal Storm Risk Management (CSRM) project took place between October 2020 and January 2021, placing 1.3 mcy of material in South Ponte Vedra and Vilano Beach between R-102.5 and R-117.5. This project permitted four borrow areas depicted in Figure 2.1: the Intracoastal Waterway, the St. Augustine Inlet Ebb and Flood Shoal, Davis Shoal, and the St. Augustine Inlet Entrance Channel (with a nine-foot offset to account for material located on channel side slope). Of the permitted borrow areas, the project used the Flood Shoal, IWW widener, and Davis Shoal borrow areas; the USACE did not dredge material from the IWW Borrow Area, located north of the Vilano Beach Bridge, or the Navigation Channel Borrow Area, located in the inlet throat. Chapter 4.0 of this report discusses the changes observed in the inlet complex over the past year including the effects of this project.



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**FIGURE 2.1 ST JOHNS COUNTY SPP
PLACEMENT AND BORROW AREAS
ST. JOHNS COUNTY, FLORIDA**

PROJECT	C2021-050
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SHEET	1 OF 1
DATE	FEB 2022

Table 2.1 St. Johns County SPP Nourishment History

Project	Contractor	Volume Placed (mcy)	Placement Area	Approximate Project Length (mi)	Construction Dates
2002	Great Lakes Dredge and Dock Co.	4.2	R-145 to R-151	3.7 ¹	Sep. 2001 – Oct. 2001
			T-132 to R-151		Apr. 2002 – Jan. 2003
2005	Great Lakes Dredge and Dock Co.	2.8	R-137A to R-151	2.8	Jun. 2005 – Nov. 2005
2012	Marinex Construction, Inc.	2.1	R-139 to R-147	1.5	Feb. 2012 – Sep. 2012
2018	Marinex Construction, Inc.	0.75	R-139.7 to R-144.4	0.9	Jan. 2018 – Jun. 2018

¹Includes the 2.8-mile federal project (R-137 – R-151) plus an additional state-sponsored mile (R-132 – R-137)

2.2 Survey History

2.2.1 Beach Profile Surveys

USACE, FDEP, and St. Johns County have sponsored the collection of beach profile survey data for monitoring purposes. The beach surveys document conditions between R-80 to the north of the inlet and R-157 south of the project area in St. Augustine Beach to document project evolution and effects of borrow area dredging on the beach. Figure 1.1 provides an overview of the monitoring area. From north to south, the beach monitoring area includes South Ponte Vedra Beach and Vilano Beach (R-80 to R-122, extending from St. Augustine Inlet approximately 8.3 mi north), Porpoise Point (within the inlet at monuments R-122A to R-122C), the north control area (extending from St. Augustine Inlet approximately 2.7 mi south from R-123 to R-137A in Anastasia State Park), the project area (R-137A to R-151), and the south control area (extending approximately 1.2 mi from R-152 to T-157). For brevity, the tables and figures in this report refer to the area north of the inlet simply as “Vilano Beach”.

Table 2.2 summarizes the timeline for the beach profile data sets available in the monitoring area. Appendix A lists the FDEP reference monument locations associated with each profile surveyed within the monitoring area. These monuments are part of an extensive network of survey controls that FDEP (formerly the Florida Department of Natural Resources) established in the early 1970s and continues to maintain. These monuments serve as consistent base points for beach profile surveys.

This report compares the 1998/99 baseline (September 1998/April 1999), 2018 pre-fill (December 2017), 2018 post-fill (July 2018), 2020 Year 2 (August 2020), and 2021 Year 3 (September 2021) surveys.

Table 2.2 Beach Profile Survey History

Survey Description		Dates	Profiles	Surveyor
2002 Project	1998/1999 Baseline (2002 Pre-Fill) ¹	Sep. to Dec. 1998	R-123, R-134, R-142T, and R-144	Morgan & Eklund
		Mar. to Apr. 1999	R-117 to T-157	FDEP
	2002 Post-Fill (6-Month Post-Fill)	Mar. to Jun. 2003	R-117 to T-157	Arc Surveying & Mapping
	2004 Pre-Storm (18-Month Post-Fill)	Jul. 2004	R-117 to T-157	Foresight
	2004 Post-Storm	Nov. 2004	R-133 to R-155	Bradley
2005 Project	2005 Pre-Fill	Jun. to Aug. 2005	R-109 to T-157	Arc Surveying & Mapping
	2005 Post-Fill	Dec. 2005	R-109 to T-157	Arc Surveying & Mapping
	6-Month Post-Fill	Apr. to May 2006	R-109 to T-157	Arc Surveying & Mapping
	21-Month Post-Fill	Jul. to Aug. 2007	R-109 to T-157	Morgan & Eklund
	Year 4 Post-Fill	Jun. 2009	T-132 to T-156	USACE
		Oct. 2009	R-116 to T-157	FDEP
		Dec. 2009	R-109 to R-158	Morgan & Eklund
	Year 5 Post-Fill	Oct. 2010	R-72 to R-157	Lowe Engineers
2012 Project	2012 Pre-Fill	Dec. 2011	R-80 to T-157	USACE
	2012 Post-Fill	Dec. 2012	R-80 to T-157	Morgan & Eklund
	Year 1 Post-Fill	Jul. 2013	R-80 to T-157	Morgan & Eklund
	Year 2 Post-Fill	Jul. 2014	R-80 to T-157	Morgan & Eklund
	Year 3 Post-Fill	Aug. 2015	R-80 to T-157	Morgan & Eklund
2018 Project	2018 Pre-Fill ²	Dec. 2017	R-80 to T-157	Seaside Engineering and Surveying
	2018 Post-Fill	Jul. 2018	R-80 to T-157	Seaside Engineering and Surveying
	Year 1 Post-Fill	Aug. 2019	R-80 to T-157	Degrove Surveyors
	Year 2 Post-Fill	Aug. 2020	R-80 to T-157	Degrove Surveyors
	Year 3 Post-Fill	Sep. 2021	R-80 to T-157	Degrove Surveyors

¹ The 1998 survey supplements the 1999 survey at R-123, R-134, R-143T, and R-144

² The 2018 pre-fill survey also satisfies the year 5 post-fill survey requirements for the 2012 project

2.2.2 Ebb Shoal Surveys

USACE, FDEP, and St. Johns County have sponsored the collection of bathymetric surveys of the St. Augustine Inlet ebb shoal complex. The ebb shoal and inlet navigation channel served as the borrow area for the 2002, 2005, 2012, and 2018 nourishment projects. The flood shoal and inlet navigation channel served as the borrow area for the 2020 St. Johns County CSRM project in Vilano Beach. Table 2.3 provides information on the ebb shoal surveys.

Table 2.3 Ebb Shoal Survey History

Survey Description		Dates	Surveyor
2002 Project	1998/1999 Baseline (2002 Pre-Dredge)	Sep. to Dec. 1998	Morgan & Eklund
	2002 Post-Dredge (6-Month Post-Dredge)	Mar. to Jun. 2003	Arc Surveying & Mapping
	2004 Post-Storm (Hurricane Monitoring)	Nov. 2004	Bradley
2005 Project	2005 Post-Dredge	Mar. 2006	Arc Surveying & Mapping
	6-Month Post-Dredge	May 2006	Arc Surveying & Mapping
	2007 Year 2 Post-Dredge	Dec. 2007	Morgan & Eklund
	2008 Year 3 Post-Dredge	Dec. 2008 to Jan. 2009	USACE
	2009 Year 4 Post-Dredge	Oct. 2009	FDEP
	2010 Year 5 Post-Dredge	Aug. to Oct. 2010	Lowe Engineers
2012 Project	2012 Pre-Dredge	Dec. 2011	USACE
	2012 Post-Dredge	Nov. 2012 to Feb. 2013	USACE
	2013 Year 1 Post-Dredge	Aug. 2013	Morgan & Eklund
	2014 Year 2 Post-Dredge	Aug. 2014	Morgan & Eklund
	2015 Year 3 Post-Dredge	Aug. 2015	Morgan & Eklund
2018 Project	2018 Pre-Dredge ¹	Oct. 2017	Seaside Engineering and Surveying
	2018 Post-Dredge	Jul. 2018	Seaside Engineering and Surveying
	2019 Year 1 Post-Dredge	Aug. 2019	Degrove Surveyors
	2020 Year 2 Post-Dredge ²	Jul. 2020 to Oct. 2020	USACE
	2021 Year 3 ³	Feb. 2021 to May 2021	USACE

¹ The 2018 pre-dredge survey also satisfies the Year 5 post-dredge requirements for the 2012 project.

² The Year 2 Post-Dredge also satisfies the Pre-Dredge requirement for the St. Johns CSRM project.

³ The Year 3 Post-Dredge was notated as the 2021 Interim survey in the 2020 Monitoring Report (Laurent, Craig, and Lamb).

2.3 Tidal Datums

National Oceanic and Atmospheric Administration (NOAA) tidal datum benchmark station 8720587 at St. Augustine Beach lies within the St. Johns County SPP project area. Benchmark data indicate a 4.6 ft tidal range (tidal epoch 1983–2001) for the semidiurnal tides (two varying high and low tides per day). Table 2.4 presents the NOAA tide data.

Table 2.4 NOAA Tide Data for Station 8720587

Tide Level	NOAA Tide Station 8720587	
	ft-MLLW	ft-NAVD
Mean Higher High Water (MHHW)	5.14	2.01
Mean High Water (MHW)	4.77	1.64
NAVD88 (NAVD)	3.13	0.00
Mean Tide Level (MTL)	2.46	-0.67
Mean Sea Level (MSL)	2.43	-0.70
Mean Low Water (MLW)	0.16	-2.97
Mean Lower Low Water (MLLW)	0.00	-3.13

3.0 BEACH FILL ANALYSIS

3.1 Overview

Project monitoring generally includes analyses to determine the evolution of beach fill over time. Two parameters of particular interest include the shoreline position and fill volume remaining within the project area. Calculating the distance from a given point to a known elevation, in this case Mean High Water (MHW), tracks the change in shoreline position. At St. Augustine Beach, the local MHW elevation is +1.64 ft-NAVD (Table 2.4). Changes to the MHW position between reference monument locations indicate alongshore, gross scale spatial evolution of the nourishment project, while changes to the shoreline position over time determine the cross-shore, temporal evolution of the nourishment project.

Tracking volumes between reference monuments (spatially) and surveys (temporally) provides a historic perspective of the project's evolution and performance. The volume analysis for this report segregates cross-shore volumes into the following compartments: dune to MHW, MHW to -20 ft-NAVD, and below -20 ft-NAVD to the profile extent. Results of additional requested extents are presented in Appendix E. Changes above MHW represent variations to the subaerial, or dry, beach— the area the public typically considers as the beach. Changes below MHW, also called subaqueous changes, indicate the volume remaining below the water surface and within the active profile. The MHW to -20 ft-NAVD compartment represents the most dynamic area with significant changes in the position and elevation of the offshore bar. Below -20 ft-NAVD, bathymetry changes are usually less pronounced and historic profiles typically converge to common elevations.

In addition to the separate shoreline and volume analysis, diffusion analysis combines shoreline position changes and volume changes to determine the temporal evolution of the fill alongshore. Results of such an analysis helps evaluate the performance of each nourishment project.

Notably, specifying a finite depth of closure applicable across the entire monitoring domain proved difficult. The profiles become steeper (deeper offshore depths for a finite distance offshore) as the distance from the ebb shoal increases. Thus, for a set distance offshore, a flatter profile (closer to the ebb shoal) extends to a shallower depth than one further away from the ebb shoal. The profiles at R-123 to T-128, just south of the inlet, do not extend deeper than -20 ft-NAVD, whereas some profiles further to the north and south extended beyond -40 ft-NAVD (see profile plots in Appendix B). The following volume analysis used the full data extents, applying the maximum offshore survey extent at each profile as the offshore limit of volume calculations.

As mentioned, the beach monitoring area consists of five regions: South Ponte Vedra and Vilano Beach (R-80 to R-122), Porpoise Point (R-122A to R-122C), the north control area (R-123 to R-136), the project area (R-137A to R-151), and the south control area (R-152 to T-157). A weighted average procedure incorporates the alongshore (controlling) distance between monuments. This weighted averaging, applied to the MHW and volume analyses, establishes a comparative basis between alongshore segments of beach. In general, a monument's controlling distance extends between the halfway points of adjacent monuments. Although the 2018 project only placed beach fill between R-139.7 and R-144.4, the following analyses consider the authorized project area (R-137A to R-151) as the project area for monitoring purposes.

The following shoreline and beach volume analyses compare the 1998/99 baseline (i.e., pre-construction survey of the 2002 restoration project), 2018-pre-fill, 2018 post-fill, and 2020 year two post-fill conditions to the 2021 year three post-fill condition. The 1998/99 baseline to 2021 year three comparison demonstrates the cumulative effect of the 2002, 2005, 2012, and 2018 nourishment projects as well as the above-mentioned USACE inlet maintenance dredging projects (Section 2.1). The 2018 pre-fill to 2021 year three comparison presents the effect of the 2018 project approximately three years after construction. The 2018 post-fill to 2021 year three comparison details the evolution of the 2018 project since construction. The 2020 year two post-fill to 2021 year three post-fill comparison shows the changes throughout the project monitoring area over the last year. Appendix B contains beach profile plots of the survey data at each monument within the study area.

Several data gaps and errors limit the beach profile comparisons at every monument. The 1998/99 survey at R-123 collected data along a 45° azimuth rather than the 75° azimuth used in later surveys; thus, the shoreline and volume analyses exclude the inconsistent 1998/99 data. In addition, the 1998/99 survey did not include R-80 to R-116. The 2018 pre-fill survey contains an 860-ft long data gap at R-125 due to unnavigable shallow waters for the survey vessel in the ebb shoal vicinity, as well as smaller data gaps at R-90, R-122C, R-128, R-149, and R-151. These offshore data gaps did not affect the shoreline analysis. However, the volume analysis applied a straight line through the gaps at each profile, linearly connecting the survey points on the landward and seaward sides of the gaps. The 2018 post-fill survey contains data gaps, ranging from 260 to 460-ft wide, in the dune and/or berm at R-125, R-127, and R-139 through R-141 due to posted shorebird nesting areas the surveyor could not access. The largest of these gaps occur within the project area at R-139 through R-141. The volume analysis, with the assumption the contractor constructed the authorized berm width and elevation, filled the dune and berm data gaps with the construction template landward to the template's intersection with the pre-fill profile, at which point the data gap was filled with the pre-fill profile data.

3.2 Shoreline Positions and Changes

Analysis of MHW shoreline position changes reveals the alongshore and cross-shore evolution of the beach monitoring area. Table 3.1, Figure 3.1, and Figure 3.2 present the surveyed MHW shoreline position as a function of distance from each monument for the 1998/99 baseline, 2018 pre-fill, 2018 post-fill, 2020 year two, and 2021 year three surveys. Table 3.2, Figure 3.3, and Figure 3.4 present the MHW shoreline position changes at each profile for the previously discussed comparison periods. A positive change in shoreline position indicates shoreline advance or movement offshore while a negative change indicates onshore, shoreline retreat. Appendix C contains plots of the MHW shoreline positions overlaid on 2021 aerial photographs to provide a qualitative comparison of project shoreline evolution.

3.2.1 2018 Pre-Fill (December 2017) – 2021 Year Three Post-Fill (September 2021)

The comparison of 2018 pre-fill and 2021 year three conditions demonstrates the effects of the 2018 nourishment. The project area shoreline (R-137 to R-151) remained seaward (48.1 ft on average) of 2018 pre-fill conditions; the 2021 shoreline position breached the 2018 position to the north of the pier at R-140 and R-141. Within the 2018 placement area (R-140 to R-144) the shoreline advanced 30.3 ft on average, transitioning from retreat at R-141 to the maximum advance of 64.8 ft at R-144. North of the 2018 placement area toward the inlet and into the north control area, the shoreline advances at all monuments with the greatest change occurring at T-126 (267.4 ft). The area south of the inlet is historically known for its dramatic shoreline changes due to inlet effects. The southern portion of the project area experienced shoreline advance throughout, with a maximum advance of 99.4 ft at R-151 and a minimum of 2.0 ft at R-147. This shoreline advancement trend continued into the south control area which experienced an average shoreline advance of 98.5 ft. The moderate to substantial shoreline advance both north and south of the placement area are likely a result of a mild 2021 storm season paired with the dispersion of fill from the placement areas to the north and south.

North of the inlet, the shoreline experienced both shoreline advance and retreat with a weighted average of 10.3 ft. The shoreline changes fluctuated throughout, with larger magnitudes of shoreline advance occurring within the Vilano Beach CSRM placement area (R-102.3 through R-117.5). The shoreline at Porpoise Point retreated -227.3 ft on average, with slight advance occurring at R-122A and significant retreat at R-122B and R-122C.

3.2.2 2018 Post-Fill (July 2018) – 2021 Year Three Post-Fill (September 2021)

The comparison of 2018 post-fill and 2021 year three conditions indicates the performance of the 2018 project for three years following construction. The project area shoreline (R-137 to R-151) retreated -63.8 ft on average; however, this change reflects counter balancing areas of substantial shoreline retreat within the placement area with lesser retreat and moderate advance outside of the placement area. Shoreline retreat averaged -190.0 ft from R-140 to R-144, a result of fill dispersion to the north and south of the 2018 fill placement area. Advance, averaging 31.0 ft, occurred from R-137 to R-139 (the north end of the project area) while minor to moderate retreat dominated from R-145 to R-151 (the south end of the project area), with an average of -15.3 ft.

The north control area experienced shoreline advance of 54.2 ft on average, with advance occurring at most monuments. The largest shoreline changes occurred just south of the inlet at R-123 and T-124 which are within the historically dynamic area largely influenced by the ebb shoal; R-123 experienced -280.4 ft

of shoreline retreat, while T-124 experienced 284.9 ft of shoreline advance during this time period. To the south of this highly dynamic area, between R-127 and R-136, the shoreline positions indicate moderate advance since the 2018 placement; this could be a result of northward dispersion of fill. R-133 and R-134 experienced more significant shoreline advance when compared to the surrounding monuments; the beach profiles in Appendix B indicate continued growth of the subaerial beach and a possible point of inflection along the beach. The south control area experienced shoreline advance at an average of 30.2 ft. Shoreline advance occurred at all monuments with the exception of R-153 (-16.1 ft).

North of the inlet, the shoreline advanced 4.3 ft on average, with a mix of retreat and advance occurring throughout. As expected, significant shoreline advance occurred within the Vilano Beach CSRM project area. North of the inlet, moderate shoreline retreat occurred at sections of beach from R-82 to R-90 and R-96 to R-103. The Porpoise Point shoreline advanced 31.0 ft on average, with significant shoreline advance to the east and moderate retreat in the center and west portions of the point.

3.2.3 2020 Year Two Post-Fill (August 2020) – 2021 Year Three Post-Fill (September 2021)

The comparison of 2020 year two and 2021 year three conditions illustrates the changes that occurred in the project and monitoring areas over the past year. On average, retreat occurred within the project area and at Porpoise Point, while Vilano Beach and the north and south control areas experienced minor to moderate shoreline advance. The project area shoreline (R-137 to R-151) retreated landward -12.6 ft on average, with a mixture of advance and retreat throughout. The 2018 placement area (R-140 to R-144) retreated -47.7 ft on average, with the largest retreat being -114.5 ft at R-141 and smallest being -10.2 ft at R-143T. Minor retreat and advance occurred from R-137A to R-139, with an average advance of 4.0 ft. To the south, retreat occurred adjacent to the placement area (R-145 and R-146) then transitioned to mild shoreline advance through R-151 averaging 5.2 ft of shoreline advance from R-145 to R-151.

The north control area experienced an average shoreline advance of 5.4 ft. The shoreline varied between advance and retreat throughout the control area, the largest shoreline retreat and advance rates were again seen to occur in the dynamic area just south of the inlet at R-123 (-125.8 ft) and R-124 (90.7 ft). Moderate shoreline advance and seaward movement was observed at R-133 and R-134. The south control area experienced an average shoreline advance of 34.5 ft, with mild to moderate advance occurring at all monuments.

North of the inlet, the shoreline advanced 10.3 ft on average, with a mix of advance and retreat throughout. In general, shoreline retreat controlled the northernmost section of the beach before transitioning to mostly shoreline advance near R-91. The CSRM fill area saw the most significant shoreline advance rates over the past year due to the 2020 placement event. The southernmost monuments, outside the CSRM project boundaries and nearest the inlet, experienced increased shoreline recession. Porpoise Point experienced significant shoreline retreat, averaging -234.4 ft. R-122A and R-122B experienced recession rates of -177.7 ft and -381.4 ft, respectively; however, the profile plots indicate that much of the berm elevation at R-122B lies just beneath the MHW contour. R-122C experienced a minor advance of 5.1 ft. The increased shoreline recession may be associated to the large volumetric changes that occurred in the inlet interior as discussed in Section 4.0.

3.2.4 1998/99 Baseline (September 1998-April 1999) – 2021 Year Three Post-Fill (September 2021)

The 1998/99 baseline to 2021 year three post-fill comparison demonstrates the combined effects of the 2002, 2005, 2012, and 2018 nourishment projects in addition to the above-mentioned USACE inlet maintenance dredging projects. The 2021 year three shoreline represents conditions approximately 19 years after the 2002 project, 16 years after the 2005 project, 8 years after the 2012 project, and 3 years after the 2018 project. Since 1998/99 the project area shoreline advanced 321.4 ft on average. The largest shoreline advance occurred at R-138 with R-146 trailing close behind. Regardless of the north and south ends of the project area last receiving fill in 2005, they have advanced substantially indicating the positive net effect of fill on the surrounding beach. The smallest advance rate occurs at R-142 which is located at the center of the project area, near the pier. Moving south from R-146 and into the south control area, the shoreline advance magnitude decreases relatively linearly, suggesting a diminishing effect from fill dispersion. Similarly, the shoreline advance magnitudes generally decrease from R-138 moving north into the north control area.

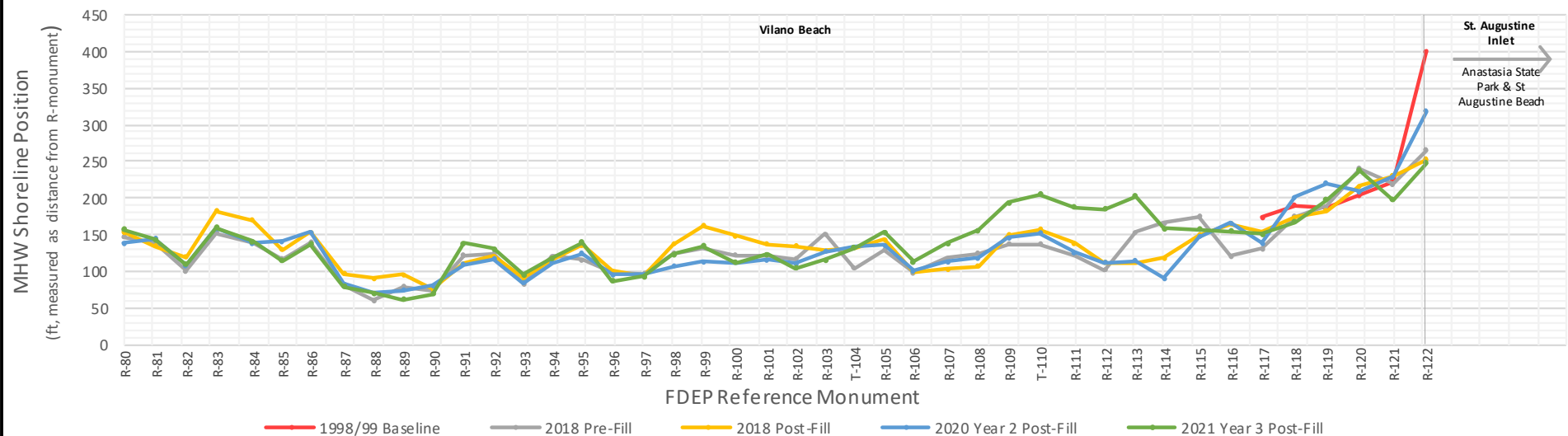
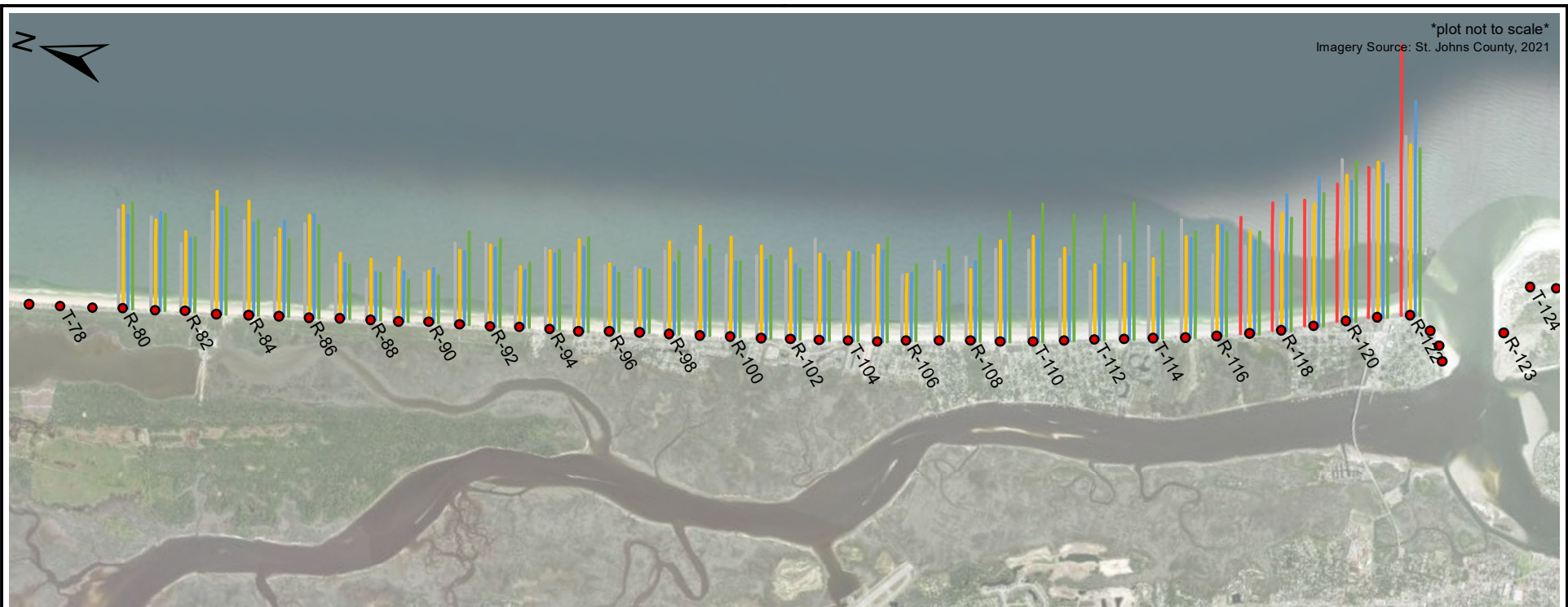
On average, the north control area shoreline advanced 64.9 ft. However, this relatively moderate change reflects the net difference between severe recession magnitudes (maximum recession of -245.0 ft at R-127) in the northern half of the control area and substantial advance magnitudes (maximum of 334.6 ft at R-136) in the southern half. The south control area shoreline advanced 212.8 ft on average, with a generally decreasing trend from north to south.

The 1998/99 baseline survey north of the inlet only included R-117 through R-122 and did not include Porpoise Point. Within this small stretch of Vilano Beach, the shoreline experienced an average recession of -2.5 ft. Except for significant shoreline recession of -152.8 ft at R-122, mild to moderate shoreline changes ranging from -22.6 ft to 33.7 ft occurred.

Table 3.1 MHW Shoreline Positions

Area Details	FDEP Reference Monument	Controlling Distance (ft)	MHW Shoreline Position (ft from Monument)				
			1998/99 Baseline (Sept 98 – Apr 99)	2018 Pre-Fill (Dec 17)	2018 Post-Fill (Jul 18)	2020 Year 2 (Aug 20)	2021 Year 3 (Sept 21)
Vilano Beach	R-80	1,066	-	146.9	153.8	150.1	157.4
	R-81	1,064	-	138.8	134.2	147.3	142.7
	R-82	1,042	-	100.5	118.8	126.3	109.1
	R-83	1,077	-	152.2	182.1	169.2	159.2
	R-84	1,068	-	140.0	169.1	147.9	140.4
	R-85	1,032	-	116.7	129.9	134.5	113.6
	R-86	1,037	-	139.8	152.9	147.3	137.4
	R-87	1,049	-	80.2	96.8	96.9	79.4
	R-88	999	-	60.7	89.9	79.4	69.7
	R-89	991	-	79.5	94.8	81.7	61.0
	R-90	1,036	-	74.1	75.8	89.4	69.4
	R-91	1,049	-	121.6	110.9	103.3	137.5
	R-92	1,028	-	123.7	121.1	122.9	130.7
	R-93	1,010	-	82.9	90.7	101.6	95.8
	R-94	1,005	-	120.5	117.2	137.3	117.8
	R-95	1,016	-	115.7	135.9	143.6	139.2
	R-96	1,034	-	97.8	100.6	102.9	87.0
	R-97	1,019	-	96.4	92.8	96.8	92.3
	R-98	1,032	-	124.0	137.4	138.0	122.7
	R-99	1,046	-	132.0	162.5	153.6	134.7
	R-100	1,039	-	121.3	148.0	165.1	111.4
	R-101	1,019	-	121.8	136.5	174.1	122.6
	R-102	996	-	117.0	134.8	163.1	104.2
	R-103	990	-	150.6	128.5	170.1	116.1
	T-104	992	-	103.6	131.9	165.9	131.6
	R-105	988	-	128.7	143.7	172.7	153.9
	R-106	1,048	-	97.4	98.6	151.8	113.1
	R-107	1,089	-	118.4	103.1	150.5	138.5
	R-108	1,038	-	124.5	106.2	156.9	156.0
	R-109	1,068	-	137.4	149.6	177.8	193.2
	T-110	1,093	-	136.9	157.2	184.1	205.3
	R-111	1,051	-	121.3	137.9	151.5	187.5
	R-112	1,024	-	101.0	111.6	137.7	184.5
	R-113	992	-	153.3	112.2	156.6	201.9
	R-114	1,043	-	166.2	118.4	152.7	158.7
	R-115	1,091	-	175.2	149.5	184.1	156.7
	R-116	1,090	-	120.4	164.0	196.7	153.9
	R-117	1,101	172.8	130.5	152.6	193.8	151.0
	R-118	1,093	189.8	174.9	174.0	221.9	167.2
	R-119	1,103	186.7	188.2	181.7	243.2	197.0
	R-120	1,090	203.6	239.7	216.6	263.6	237.3
	R-121	1,089	222.4	218.5	230.2	224.1	197.4
	R-122	553	400.5	265.1	253.2	289.4	247.7
	R-122A	279	-	293.5	19.6	-56.4	326.2

Area Details	FDEP Reference Monument	Controlling Distance (ft)	MHW Shoreline Position (ft from Monument)				
			1998/99 Baseline (Sept 98 – Apr 99)	2018 Pre-Fill (Dec 17)	2018 Post-Fill (Jul 18)	2020 Year 2 (Aug 20)	2021 Year 3 (Sept 21)
Porpoise Point	R-122B	551	-	404.8	96.8	410.1	28.7
	R-122C	272	-	386.2	249.7	122.0	198.9
North Control Area (Anastasia State Park)	R-123	451	-	2,084.3	2,417.0	2449.3	2,136.7
	T-124	895	1,699.2	1,590.6	1,488.1	1,702.2	1,773.0
	R-125	1,007	1,804.5	1,723.4	2,008.8	1,961.1	1,953.2
	T-126	1,205	1,118.3	746.0	854.3	1,010.9	1,013.4
	R-127	1,052	1,128.4	760.0	840.6	922.5	883.4
	T-128	952	620.9	363.4	441.0	502.4	479.9
	T-129	1,076	489.6	350.6	415.3	468.9	433.3
	T-130	1,052	356.6	307.1	416.4	423.9	457.6
	R-131A	1,048	771.7	777.1	816.3	871.5	852.6
	T-132	1,026	346.2	326.9	390.0	448.3	408.7
	R-133	714	518.5	571.7	582.3	636.5	689.1
	R-134	969	153.9	225.6	272.3	366.1	400.1
	R-135	1,266	462.1	602.8	702.7	737.8	698.0
	R-136	1,020	457.7	651.6	709.3	779.3	792.3
Project Area	R-137A	1,044	192.9	434.7	472.5	553.3	538.3
	R-138	1,016	94.1	424.0	508.8	541.3	510.7
	R-139	921	187.2	542.6	560.0	660.7	583.6
	R-140	911	167.0	501.5	698.0	642.4	497.5
	R-141	1,003	163.9	381.6	670.3	582.6	358.4
	R-142	1,029	69.1	96.1	409.7	261.4	146.1
	R-143T	966	273.7	459.2	633.0	601.7	521.9
	R-144	972	192.9	463.2	582.7	600.6	528.0
	R-145	989	201.2	540.5	582.1	626.5	600.8
	R-146	982	174.0	551.8	618.2	611.8	585.2
	R-147	984	395.3	786.0	794.3	787.7	787.9
	R-148	985	166.0	520.9	554.6	544.8	526.0
	R-149	984	189.4	458.9	573.5	555.3	527.2
	R-150	973	167.1	391.7	470.4	472.6	457.1
	R-151	967	263.3	461.8	559.8	574.0	561.2
South Control Area	R-152	979	295.4	464.8	538.3	585.1	546.9
	R-153	977	303.6	439.8	543.7	594.8	527.6
	R-154	979	353.3	477.8	537.1	584.2	590.3
	R-155	988	345.2	423.5	493.5	518.4	550.3
	T-156	952	343.6	446.5	477.3	559.1	516.3
	T-157	976	362.5	437.2	508.4	569.0	547.9



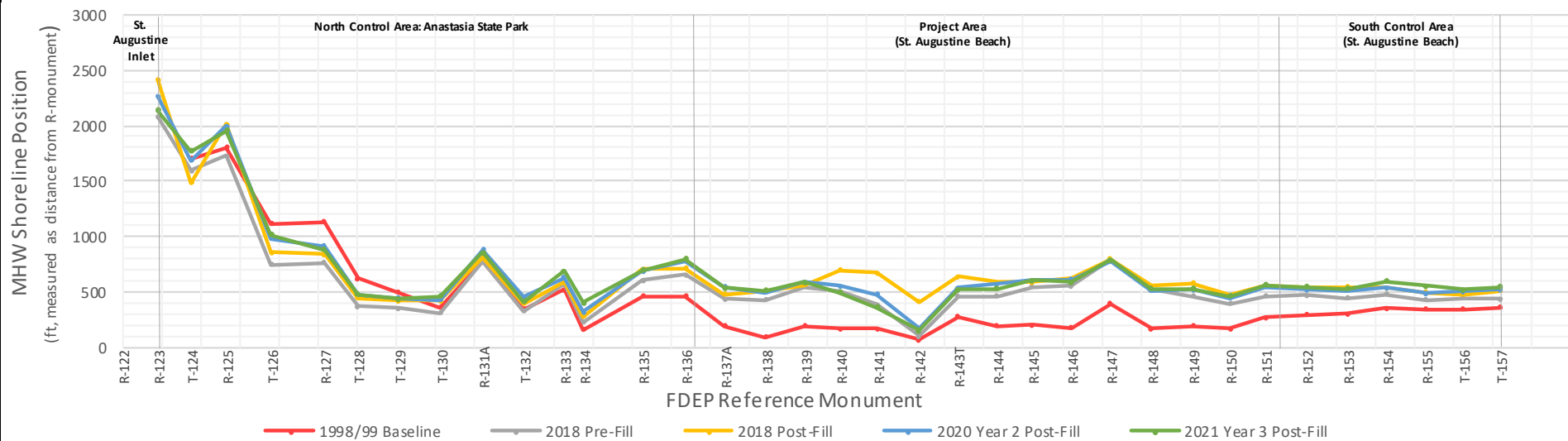
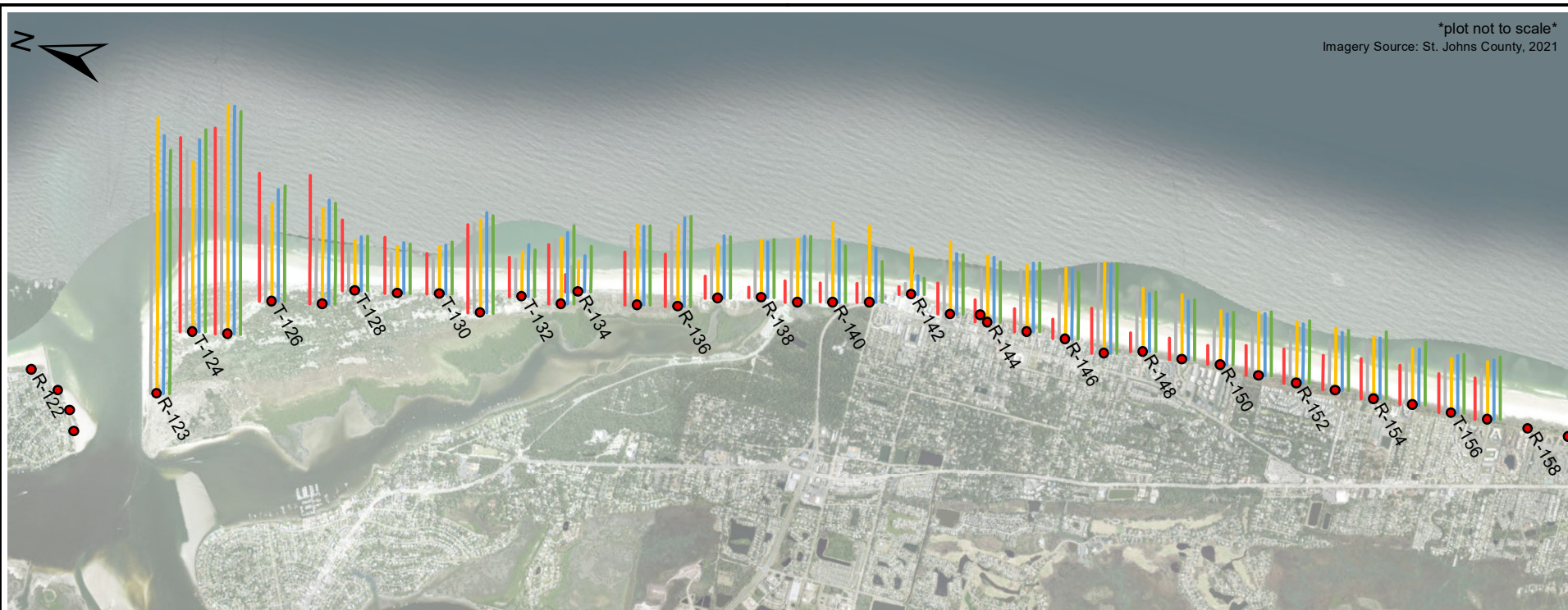
TAYLOR ENGINEERING INC.
 10199 SOUTHSIDE BLVD.
 SUITE 310
 JACKSONVILLE, FL 32256
 CERTIFICATE OF AUTHORIZATION # 4815

**FIGURE 3.1: MHW SHORELINE POSITIONS
 NORTH OF ST. AUGUSTINE INLET
 ST. JOHNS COUNTY SPP MONITORING
 ST. JOHNS COUNTY, FL**



ST. JOHNS COUNTY, FL

PROJECT	C2021-050
DRAWN BY	PL
SHEET	1 OF 1
DATE	JAN 2022



TAYLOR ENGINEERING INC.
10199 SOUTHSIDE BLVD.
SUITE 310
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

**FIGURE 3.2: MHW SHORELINE POSITIONS
SOUTH OF ST. AUGUSTINE INLET
ST. JOHNS COUNTY SPP MONITORING
ST. JOHNS COUNTY, FL**



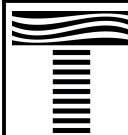
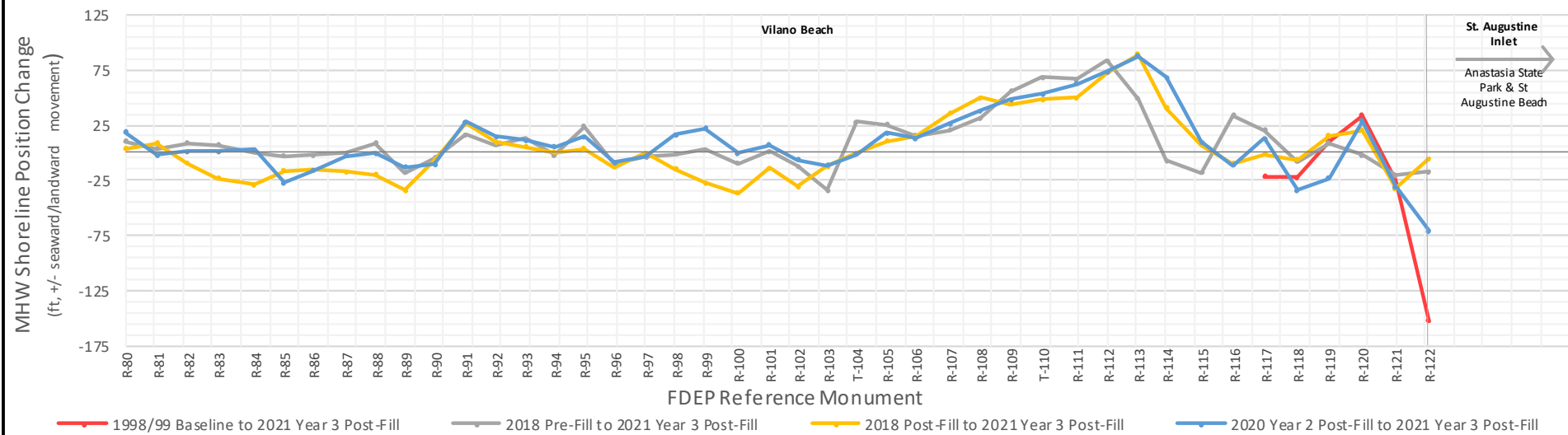
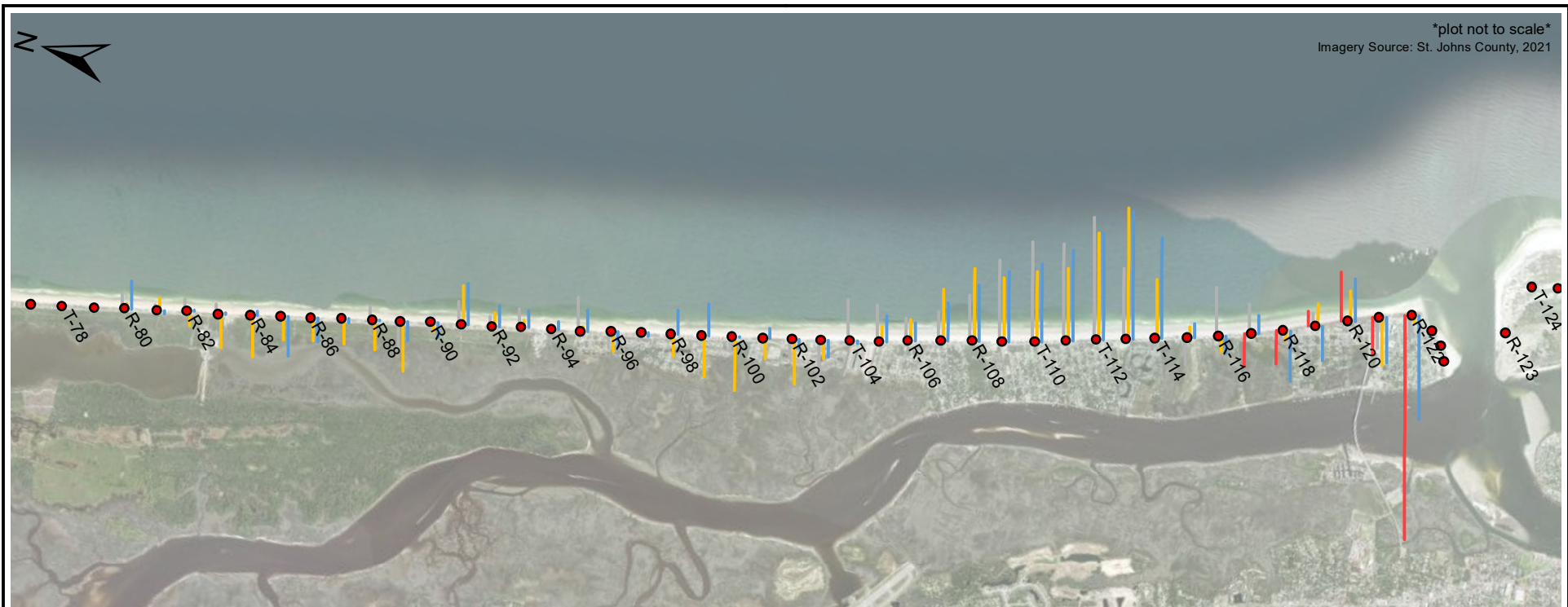
PROJECT	C2021-050
DRAWN BY	PL
SHEET	1 OF 1
DATE	JAN 2022

Table 3.2 MHW Shoreline Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	MHW Shoreline Change (ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20–Sep '21)
Vilano Beach	R-80	1,066	-	10.5	3.6	18.9
	R-81	1,064	-	3.9	8.5	-2.4
	R-82	1,042	-	8.6	-9.7	0.9
	R-83	1,077	-	7.0	-22.9	1.1
	R-84	1,068	-	0.4	-28.8	2.6
	R-85	1,032	-	-3.0	-16.2	-27.3
	R-86	1,037	-	-2.4	-15.5	-16.2
	R-87	1,049	-	-0.8	-17.4	-2.8
	R-88	999	-	9.0	-20.2	-0.5
	R-89	991	-	-18.5	-33.8	-12.9
	R-90	1,036	-	-4.7	-6.3	-10.3
	R-91	1,049	-	15.9	26.6	28.3
	R-92	1,028	-	7.1	9.6	14.4
	R-93	1,010	-	12.9	5.1	11.4
	R-94	1,005	-	-2.7	0.6	5.5
	R-95	1,016	-	23.5	3.2	14.7
	R-96	1,034	-	-10.9	-13.6	-8.7
	R-97	1,019	-	-4.1	-0.4	-2.7
	R-98	1,032	-	-1.3	-14.8	16.5
	R-99	1,046	-	2.7	-27.8	21.7
	R-100	1,039	-	-9.9	-36.6	-0.3
	R-101	1,019	-	0.8	-13.9	6.8
	R-102	996	-	-12.7	-30.6	-6.1
	R-103	990	-	-34.5	-12.4	-11.2
	T-104	992	-	28.0	-0.2	-1.6
	R-105	988	-	25.1	10.2	17.9
	R-106	1,048	-	15.7	14.5	12.6
	R-107	1,089	-	20.1	35.4	26.0
	R-108	1,038	-	31.5	49.8	38.2
	R-109	1,068	-	55.8	43.7	48.1
	T-110	1,093	-	68.4	48.1	53.6
	R-111	1,051	-	66.2	49.6	62.0
	R-112	1,024	-	83.5	72.9	73.2
	R-113	992	-	48.6	89.7	87.5
	R-114	1,043	-	-7.5	40.3	68.6
	R-115	1,091	-	-18.5	7.2	9.4
	R-116	1,090	-	33.5	-10.1	-11.4
	R-117	1,101	-21.8	20.5	-1.6	12.7
	R-118	1,093	-22.6	-7.8	-6.9	-34.3
	R-119	1,103	10.3	8.8	15.3	-23.6
	R-120	1,090	33.7	-2.4	20.7	29.2

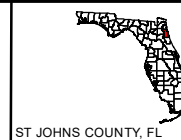
Area Details	FDEP Reference Monument	Controlling Distance (ft)	MHW Shoreline Change (ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20–Sep '21)
Porpoise Point	R-121	1,089	-24.9	-21.0	-32.8	-30.9
	R-122	553	-152.8	-17.5	-5.5	-70.8
	R-122A	279	-	32.7	306.6	-177.7
	R-122B	551	-	-376.1	-68.1	-381.4
	R-122C	272	-	-192.5	-50.9	5.1
North Control Area (Anastasia State Park)	R-123	451	-	52.4	-280.4	-125.8
	T-124	895	73.9	182.4	284.9	90.7
	R-125	1,007	148.8	229.9	-55.6	-45.6
	T-126	1,205	-104.9	267.4	159.1	34.3
	R-127	1,052	-245.0	123.4	42.8	-29.0
	T-128	952	-141.1	116.5	38.9	6.9
	T-129	1,076	-56.3	82.7	17.9	-13.6
	T-130	1,052	101.0	150.5	41.2	27.7
	R-131A	1,048	80.9	75.5	36.3	-29.4
	T-132	1,026	62.4	81.7	18.6	-46.7
	R-133	714	170.6	117.5	106.8	60.2
	R-134	969	246.1	174.5	127.7	81.0
	R-135	1,266	235.9	95.1	-4.7	7.5
	R-136	1,020	334.6	140.7	83.0	11.7
Project Area	R-137A	1,044	345.4	103.6	65.7	-8.0
	R-138	1,016	416.6	86.7	1.9	19.6
	R-139	921	396.4	41.0	23.7	0.6
	R-140	911	330.4	-4.0	-200.5	-54.0
	R-141	1,003	194.5	-23.2	-311.9	-114.5
	R-142	1,029	76.9	50.0	-263.6	-19.1
	R-143T	966	248.2	62.7	-111.0	-10.2
	R-144	972	335.2	64.8	-54.7	-40.7
	R-145	989	399.6	60.3	18.7	-3.2
	R-146	982	411.2	33.4	-33.0	-24.7
	R-147	984	392.6	2.0	-6.3	8.0
	R-148	985	360.0	5.1	-28.6	16.6
	R-149	984	337.8	68.3	-46.3	10.8
	R-150	973	290.0	65.4	-13.3	12.9
	R-151	967	298.0	99.4	1.4	16.1
South Control Area	R-152	979	251.4	82.1	8.5	29.5
	R-153	977	224.0	87.9	-16.1	16.9
	R-154	979	237.0	112.4	53.2	57.4
	R-155	988	205.1	126.8	56.9	62.3
	T-156	952	172.7	69.8	39.0	13.4
	T-157	976	185.4	110.7	39.5	26.6

Area Details	FDEP Reference Monument	Controlling Distance (ft)	MHW Shoreline Change (ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20–Sep '21)
Vilano Beach Weighted Average	R-80 to R-122	44,384	-2.5	10.3	4.3	10.3
Porpoise Point Weighted Average	R-122A to R-122C	1,102	-	-227.3	31.0	-234.4
North Control Area Weighted Average	R-123 to R-136	13,734	64.9	139.0	54.2	5.4
Project Area Weighted Average	R-137A to R-151	14,727	321.4	48.1	-63.8	-12.6
South Control Area Weighted Average	R-152 to T-157	5,850	212.8	98.5	30.2	34.5

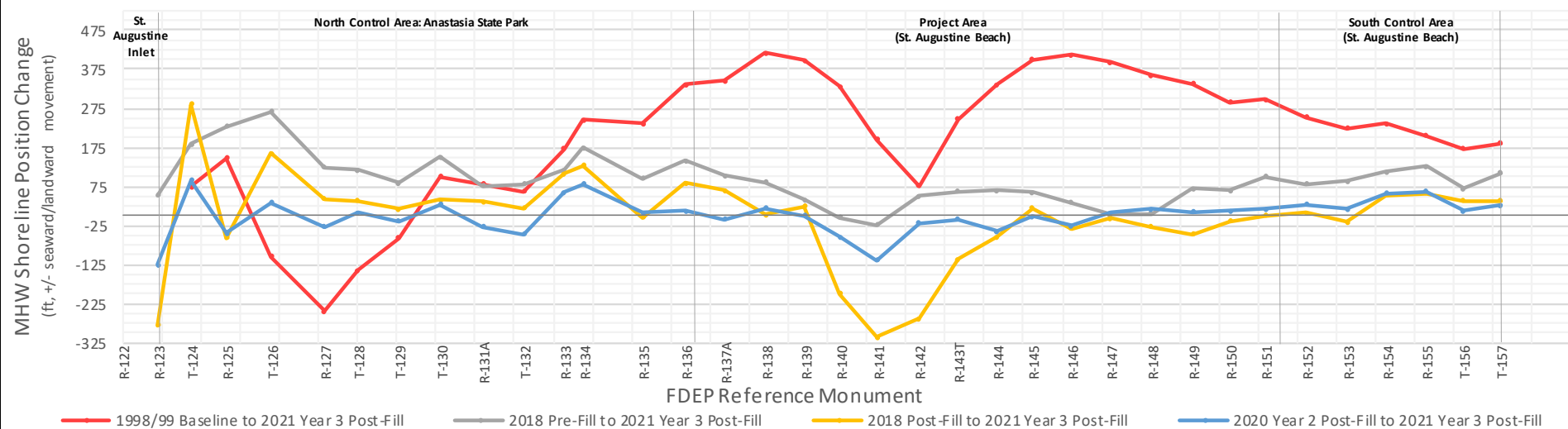
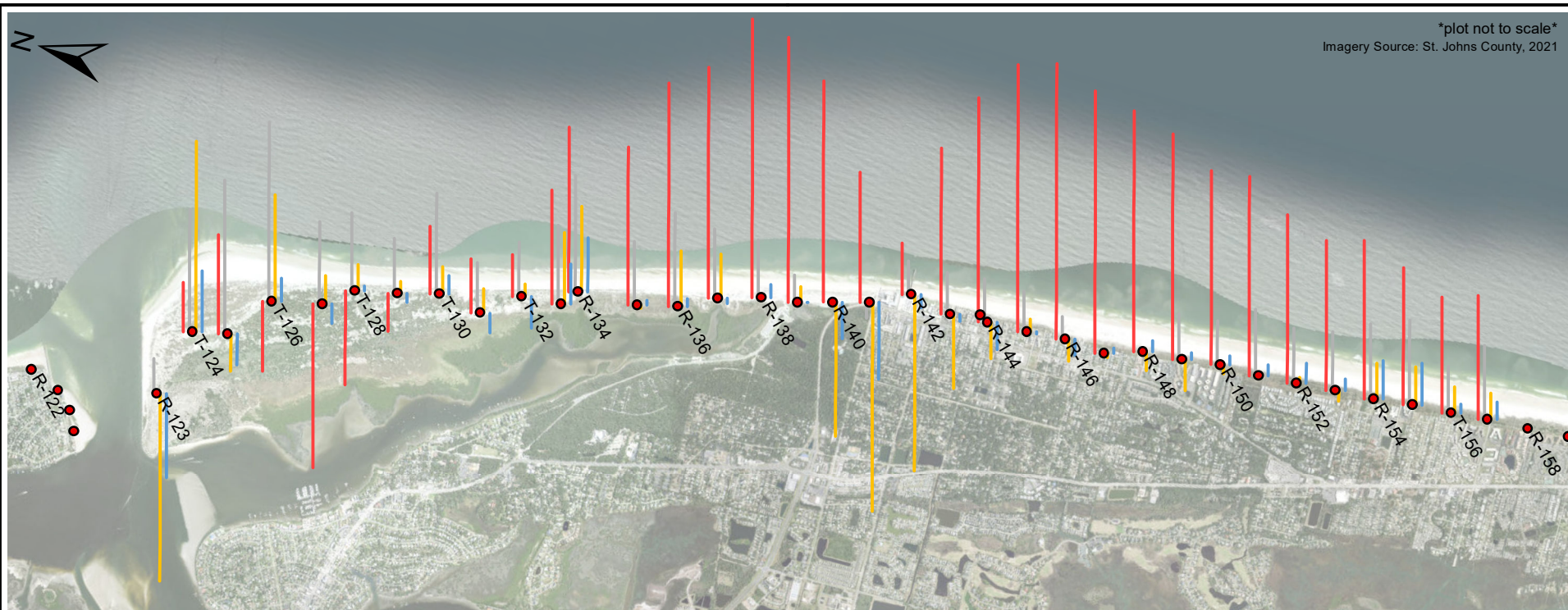


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10199 SOUTHSIDE BLVD.
SUITE 310
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

**FIGURE 3.3: MHW SHORELINE POSITION CHANGES
NORTH OF ST. AUGUSTINE INLET
ST. JOHNS COUNTY SPP MONITORING
ST. JOHNS COUNTY, FL**



PROJECT	C2021-050
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DATE	JAN 2022



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**FIGURE 3.4: MHW SHORELINE POSITION CHANGES
SOUTH OF ST. AUGUSTINE INLET
ST. JOHNS COUNTY SPP MONITORING
ST. JOHNS COUNTY, FL**



ST. JOHNS COUNTY, FL

PROJECT	C2021-050
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SHEET	1 OF 1
DATE	JAN 2022

3.3 Beach Volume Changes

As discussed in Section 3.1, beach volume changes indicate monitoring area evolution and project performance. Taylor Engineering calculated volume changes at each monument location within the following vertical compartments: dune to MHW, MHW to -20 ft-NAVD, and below -20 ft-NAVD (extending offshore to the maximum common survey extent at each monument for each survey comparison). The total volume above MHW represents the subaerial or dry beach, while below MHW changes represent the subaqueous portion of the beach. Table 3.3 to Table 3.5 and Figure 3.5 to Figure 3.9 present beach volume changes (presented in cy/ft units) on a monument-by-monument basis for each volume compartment. Figure 3.10 and Figure 3.11 present the total volume changes over the entire profile. Table 3.7 and Table 3.8 provide a total volume change summary presented in cy/ft and cy units. Of note, extending the volume calculations offshore to the maximum common survey extent at each monument for each survey comparison, as opposed to limiting the calculations to a consistent distance offshore (e.g., 3,000 ft offshore), results in volume changes that reflect the available data to the greatest degree possible. However, this methodology may apply different offshore extents than used in previous monitoring reports, resulting in additive volumes that may not match previously reported volumes.

3.3.1 2018 Pre-Fill (December 2017) – 2021 Year Three Post-Fill (September 2021)

The comparison of 2018 pre-fill and 2021 year three conditions reveals the effects of the 2018 nourishment. The project area (R-137 to R-151) gained 63.6 cy/ft on average (967,282 cy total), with accretion occurring above MHW (26.6 cy/ft on average, 404,438.5 cy total), between MHW and -20 ft-NAVD (4.7 cy/ft on average, 71,519.7 cy total), and below -20 ft-NAVD (32.3 cy/ft on average, 491,324 cy total). Accretion was consistent across the 2018 placement area (R-140 to R-144), the area to the north (R-137 to R-139), and the area to the south (R-145 to R-151) with 62.5 cy/ft (334,833 cy) in the placement area, 59.0 cy/ft (175,772 cy) to the north, and 66.5 cy/ft (456,677 cy) to the south. All the project's subareas gained sand above MHW, between MHW and -20 ft-NAVD, and below -20 ft-NAVD. The overall volume accumulated is approximately 215,000 cy greater than that of the 2018 renourishment suggesting that the nourishment of the beach could be paired with natural recovery of the beach following the severe storm seasons of 2016 and 2017; however, approximately half of the accretion occurs above the -20 ft-NAVD contour and half below the -20 ft-NAVD contour indicating much of the sand is located offshore of the sub-aerial beach.

The north control area gained an average of 94.5 cy/ft (1,297,551 cy total). Significant accretion occurred above MHW (38.1 cy/ft or 522,802 cy) and between MHW and -20 ft-NAVD (41.0 cy/ft or 563,669 cy) while moderate accretion occurred below -20 ft-NAVD (15.4 cy/ft or 211,079 cy). The north control area experienced the most significant total volume changes at R-125 and T-126 (212.3 cy/ft and 247.3 cy/ft, respectively) where the beach berm increased in elevation significantly. Overall, accretion occurred at all monuments except for R-123, which experienced moderate erosion likely due to its proximity to the inlet. The south control area experienced an average accretion of 118.4 cy/ft (692,672 total). Consistent accretion is observed on a monument-by-monument basis with averages of 24.7 cy/ft (144,638 cy) above MHW, 59.9 cy/ft (350,650 cy) between MHW and -20 ft-NAVD, and 33.7 cy/ft (197,384 cy) below -20 ft-NAVD. The volume gains in the north and south reference areas indicate the positive impact of fill and a relatively calm wave climate allowing for beach recovery.

North of the inlet, accretion occurred at all monuments except for R-85 and R-121. The most significant volumes changes occurred surrounding the CSRM project. The area north of the inlet gained 95.6 cy/ft on average, or 4,242,377 cy in total, with 14.0 cy/ft (623,433 cy) of accretion occurring above MHW, 49.2

cy/ft (2,183,348 cy) of accretion between MHW and -20 ft-NAVD, and 32.3 cy/ft (1,435,597 cy) accretion below -20 ft-NAVD. Although variable, the volumes below -20 ft-NAVD generally increase with southern movement toward the inlet.

On average, Porpoise Point experienced moderate erosion (-49.6 cy/ft or -3,737 cy), with erosion occurring above -20 ft-NAVD and minimal accretion below -20 ft-NAVD. The west and center end of the point both experienced erosion, with a total of -81.7 cy/ft (-22,220 cy) at R-122 C and -103.4 cy/ft at R-122B. The east end eroded slightly above MHW, but gained sediment below MHW, which led to a total volume gain of 88.0 cy/ft or 20,577 cy.

3.3.2 2018 Post-Fill (July 2018) – 2021 Year Three Post-Fill (September 2021)

The 2018 post-fill and 2021 year three survey comparison demonstrates the performance of the 2018 nourishment over the three years following construction. The project area (R-137 to R-151) eroded a total of -235,222 cy (-15.5 cy/ft on average). In this area, the subaerial beach and nearshore above the -20 ft-NAVD contour lost -522,987 cy of sediment while the area below -20 ft-NAVD gained 287,765 cy. Within the 2018 placement area (R-140 to R-144), erosion occurred at all monuments, with the most significant losses at R-141 and R-142. Losses in the placement area occurred above the -20 ft-NAVD contour and decreased with movement away from the placement area. The total volume change indicates both areas to the north and south of the fill placement experienced accretion at all monuments except for R-139. Magnitudes of accretion generally increase as you move away from the placement area, suggesting the outward dispersion of fill. This pattern occurs in the total volume change, the change above MHW, and the change above -20 ft-NAVD.

The north control area gained 61.4 cy/ft on average (843,354 cy total). Mild to moderate accretion occurred above MHW (20.9 cy/ft, 287,502 cy) and between MHW and -20 ft (33.1 cy/ft, 454,786 cy) with more significant gains occurring near St. Augustine Inlet. Variable erosion and accretion occurred below -20 ft-NAVD (averaging 7.4 cy/ft or 101,067 cy). The south control area gained 77.5 cy/ft on average (453,183 cy total), with relatively uniform accretion occurring across all subsets; above MHW and below -20 ft-NAVD mild accretion occurred (averaging 9.5 cy/ft and 19.8 cy/ft, respectively) while between MHW and -20 ft-NAVD moderate accretion occurred at all monuments (averaging 40.6 cy/ft).

North of the inlet, moderate to substantial erosion controlled the north portion of the monitoring area while substantial accretion occurred in the southern portion fueled by the CSRSM placement event. Overall, minor accretion occurred above MHW (averaging 5.7 cy/ft or 253,472 cy), moderate accretion between MHW and -20 ft-NAVD (averaging 35.2 cy/ft or 1,561,643 cy), and minor erosion occurred below -20 ft-NAVD (averaging -6.7 cy/ft or -299,035 cy). On a monument-by-monument basis, changes above MHW varied between minor to moderate erosion with minimal accretion until the significant accretion associated with the CSRSM project. The area between MHW and -20 ft-NAVD primarily experienced accretion with minor erosion at a few monuments with increasing accretion rates within the CSRSM project area. Below -20 ft-NAVD, moderate erosion occurred from R-80 to R-97 followed by moderate accretion with minimal erosion until the inlet.

Since the 2018 project, Porpoise Point experienced accretion across the profiles (40.5 cy/ft, 44,685 cy) with the majority of the sediment gains occurring between the MHW and -20 ft-NAVD contours. Above MHW mild erosion occurred averaging -4.7 cy/ft (-5,231 cy). Below MHW and above -20 ft-NAVD, moderate accretion transitions to erosion with westward movement across the point, averaging 36.2 cy/ft

(39,898 cy). Below -20 ft-NAVD, similar to above MHW, moderate accretion transitions to moderate erosion with westward movement averaging 9.1 cy/ft (10,018 cy).

3.3.3 2020 Year Two Post-Fill (August 2020) – 2021 Year Three Post-Fill (September 2021)

The 2020 year two post-fill and 2021 year three post-fill survey comparison demonstrates the performance of the project and control areas over the past year. The project area (R-137 to R-151) experienced an average loss of -23.4 cy/ft (-338,073 cy), with the most significant losses occurring below the -20 ft-NAVD contour. Above MHW, the project area eroded an average of -1.8 cy/ft (-24,279 cy); the majority of the erosion occurred in the 2018 placement area (R-140 to R-144), where -71,375 cy eroded over the past year. The remainder of the project area above MHW experienced minimal losses and gains. The area below MHW and above -20 ft-NAVD fluctuated between minor losses and gains throughout, averaging -7.2 cy/ft (-102,336.5 cy total). Below -20 ft-NAVD all profiles except for R-147 lost sediment, averaging -14.4 cy/ft (-211,458 cy total), however these erosion losses offshore appear to result from minor elevation changes spread across a large area rather than any significant morphologic changes in the profile.

The north control area experienced a mix of erosion and accretion, with an average gain of 1.7 cy/ft (22,907 cy). Mild accretion occurred at all monuments above MHW, except for R-123 which experienced -11.3 cy/ft of erosion. Overall, the area above MHW gained an average of 6.0 cy/ft of sediment, or 82,748 cy in total. Between MHW and -20 ft-NAVD mild to moderate erosion and accretion occurred averaging -0.1 cy/ft (-1,400 cy). The largest erosion and accretion magnitudes occurred near the inlet in the dynamic ebb shoal region. Below the -20 ft-NAVD contour, the control area had minimal accretion from R-123 to T-129 due to the survey not extending much beyond the -20 ft-NAVD contour. Moderate erosion and slight accretion occurred in the remainder of the north control area below the -20 ft-NAVD contour. The south control area experienced an average erosion loss of -14.6 cy/ft, or -85,163 cy in total. The erosion was fairly consistent throughout the control area above MHW with all monuments experiencing mild accretion averaging 7.8 cy/ft (45,641 cy); between MHW and -20 ft-NAVD mild erosion and accretion occurred; and moderate erosion occurred at all monuments below -20 ft-NAVD averaging -20.4 cy/ft.

The area north of the inlet experienced significant accretion averaging 50.6 cy/ft (2,245,923 cy total). The largest gains occurred within the CSRM project boundaries while the areas to the north and south generally experienced more mild accretion. Similar patterns are observed in the areas above MHW and between MHW and -20 ft-NAVD with variable erosion and accretion occurring north of the CSRM project and significant accretion occurring in the region of the project. Between MHW and -20 ft-NAVD, mild accretion did occur in the northern half of Vilano Beach with the apparent growth of a nearshore sand bar near the -10 ft-NAVD contour along the beach. Below MHW variable erosion and accretion occurred, averaging 8.0 cy/ft (355,592 cy); generally, accretion occurred offshore the northern section of Vilano Beach, while erosion occurred offshore of the southern portion of Vilano Beach.

As a whole, Porpoise Point experienced moderate erosion averaging -43.2 cy/ft (-47,632 cy), with the majority of the losses occurring below -20 ft-NAVD (-41.7 cy/ft). Minor erosion occurred above MHW (-3.0 cy/ft or -3,342 cy total) and minor accretion occurred between MHW and -20 ft-NAVD (1.5 cy/ft or 1,657 cy total). Above MHW mild erosion transitioned to mild accretion with westward movement across the point. Between MHW and -20 ft-NAVD, R-122A experienced significant gains at the -15 ft-NAVD contour and R-122B and R-122C both experienced gains between the -5 ft-NAVD and -15 ft-NAVD contours and significant losses on the channel slope beneath the -15 ft-NAVD contour. Below -20 ft-NAVD mild accretion transitioned into significant erosion with westward movement.

3.3.4 1998/99 Baseline (September 1998-April 1999) – 2021 Year Three Post-Fill (September 2021)

Comparing the baseline survey to the 2021 year three post-fill survey determines the combined effects of the 2002, 2005, 2012, and 2018 nourishment projects and the inlet maintenance dredging projects. Overall, the project area gained 4,664,277 cy (306.9 cy/ft), equal to roughly 47% of the combined placement volume (9.85 mcy) of the four projects. Above the -20 ft-NAVD contour, accretion occurred at every monument throughout the project area averaging 109.4 cy/ft (1,662,639 cy) above MHW and 210.9 cy/ft between MHW and -20 ft-NAVD (3,205,321 cy). Despite the shortened length of the 2012 and 2018 projects, the north and south ends of the project area gained a relatively consistent and substantial volume. Meanwhile the central region of the project area, where recent placement events occurred, had the smallest gains focused near R-142. Net erosion (averaging -13.4 cy/ft, -203,882 cy) occurred below the -20 ft-NAVD contour, with the most significant losses from R-137A to R-139; south of R-144 experienced varying erosion and accretion.

The north control area eroded -45.4 cy/ft on average (-623,577 cy total). Significant erosion occurred from T-126 to T-129, while the remainder of the area's trends ranged from minor erosion to significant accretion. Above MHW and between MHW and -20 ft NAVD, the northern portion of the control area, except for T-124 and R-125, experienced erosion, while south of R-129/R-130 experienced accretion. Below -20 ft-NAVD, minor to moderate erosion occurred at most monuments, with a few areas of minor accretion or no change due to limited data located below the -20 ft-NAVD contour. Overall, the largest changes in the northern control area occurred in the sub-aqueous profile due to changes across the ebb shoal. Fill dispersion is observed in the increasing accretion trend with proximity to the project area.

The southern control area gained a significant volume of sediment (averaging 321.6 cy/ft, 1,881,299 cy), with accretion occurring in all volume compartments at all monuments. Above MHW the accretion magnitude generally decreases southwards, indicating a diminishing effect from fill dispersion. However, below -20 ft-NAVD, the accretion magnitude increases southwards. Accretion in the area between MHW and -20 ft-NAVD is relatively consistent throughout the control area. The combined trends within all three compartments resulted in similar accretion magnitudes at each monument.

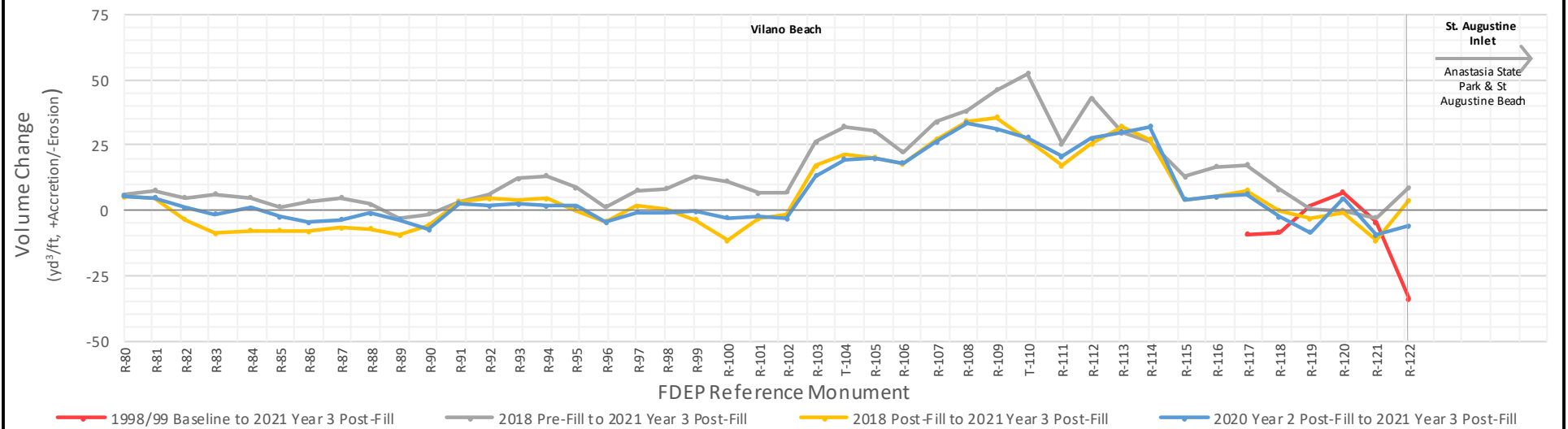
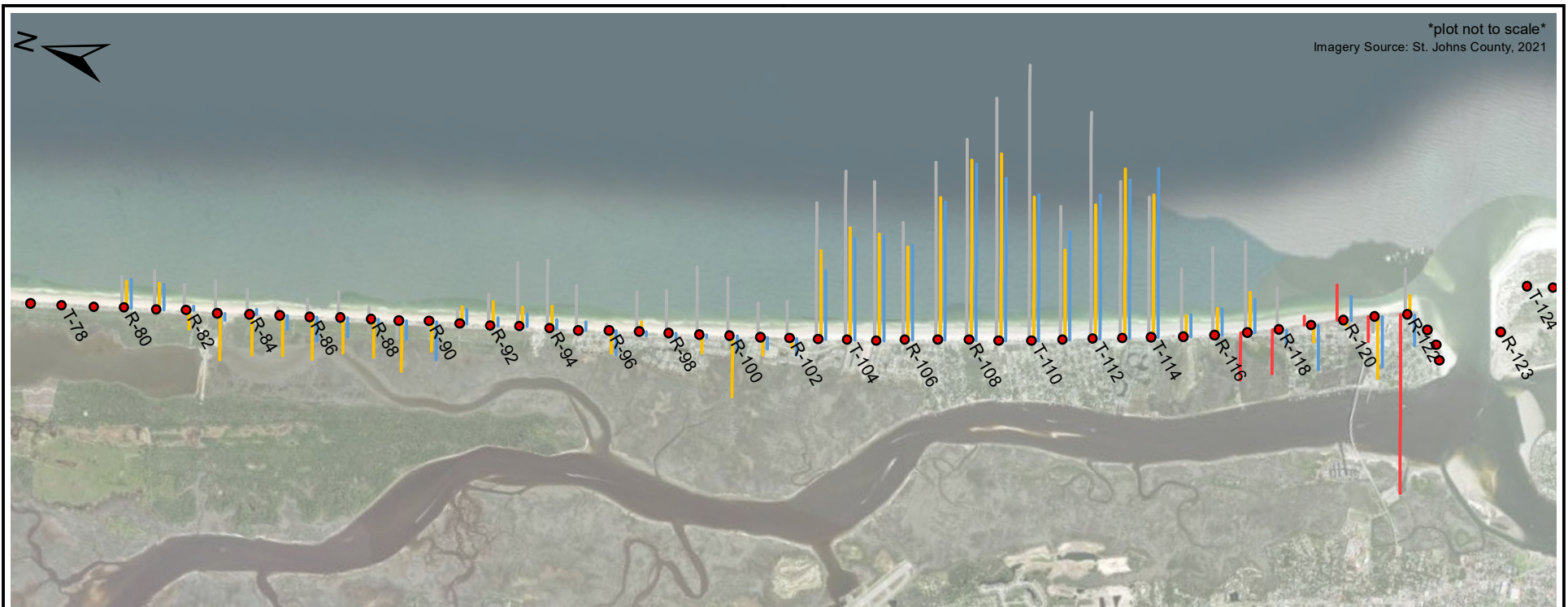
1998/99 survey data north of the inlet were only collected at R-117 to R-122 in Vilano Beach. This segment adjacent to the inlet gained a total of 141,357 cy (23.4 cy/ft on average), as opposed to the 1998/99 to 2020 year two comparison, which indicated a loss of -44.2 cy/ft (Laurent, Lamb, Craig, 2021). A mix of mild erosion and accretion occurred above MHW. Between MHW and -20 ft-NAVD, moderate accretion transitioned to moderate erosion as proximity to the inlet increased. Below -20 ft-NAVD, minor erosion transitioned to moderate accretion from R-117 to R-119, while R-120 to R-122 showed no change in volume due to lack of data beneath the -20 ft-NAVD contour. Overall, mild accretion transitioned to erosion with southward movement along the beach. Porpoise Point survey data was not collected in 1998/99.

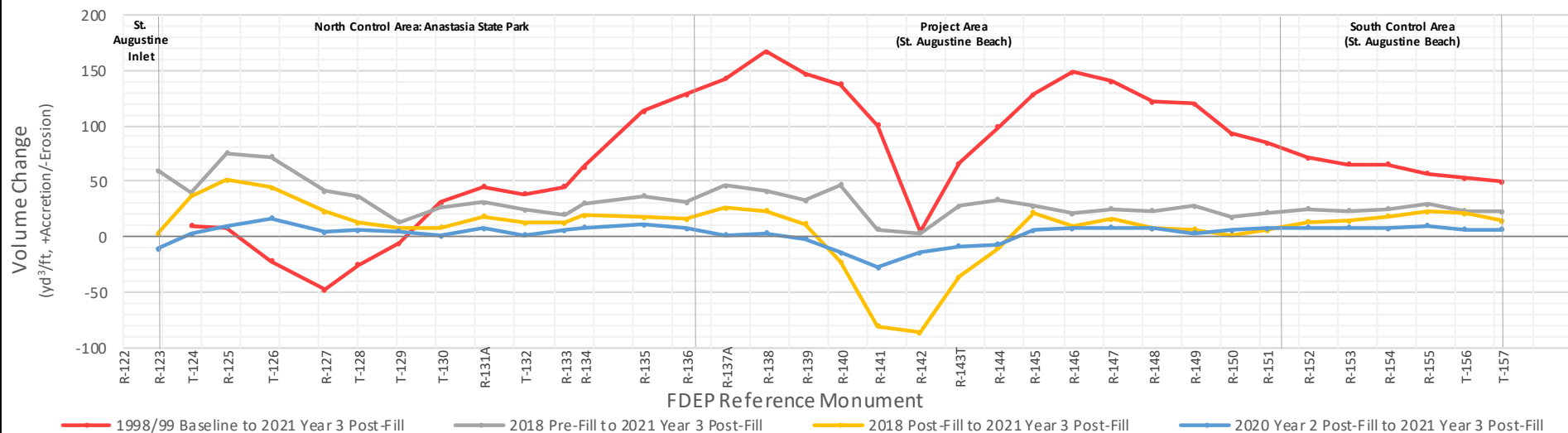
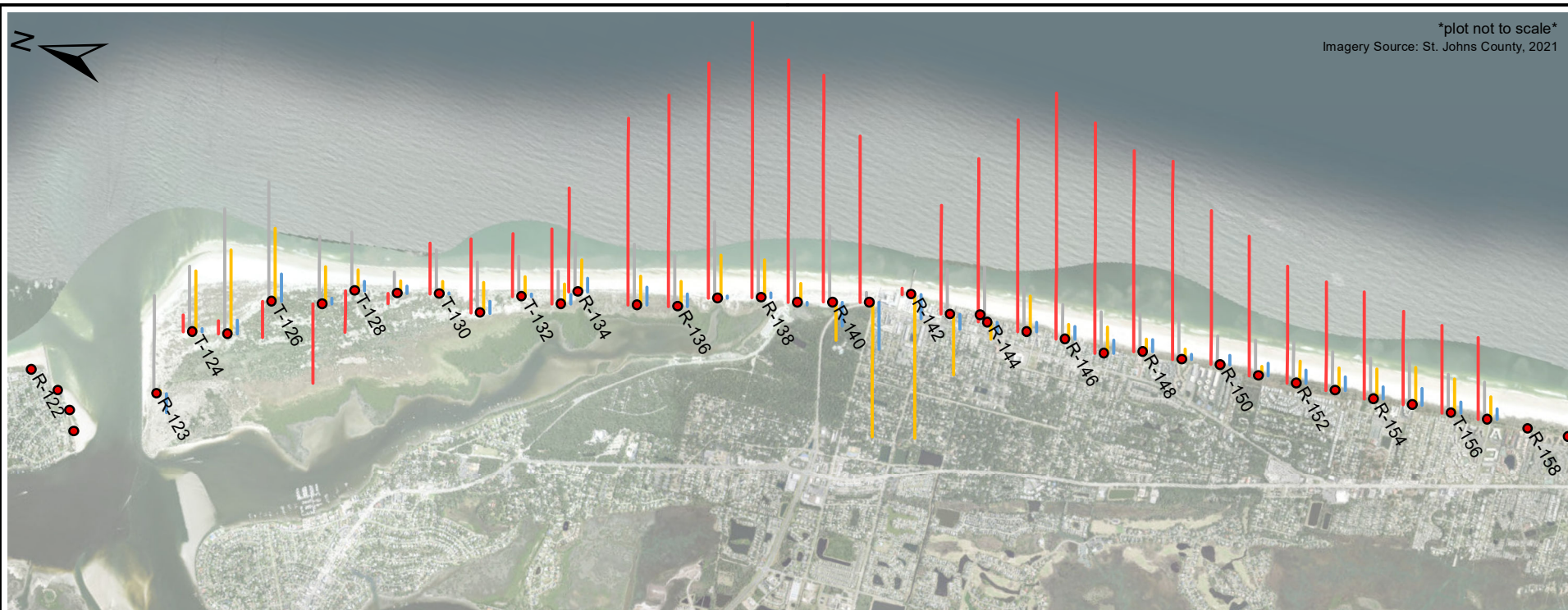
Table 3.3 Dune to MHW Beach Volume Change

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr 99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066	-	6.0	5.1	5.4
	R-81	1,064	-	7.5	5.0	4.8
	R-82	1,042	-	4.9	-3.5	0.8
	R-83	1,077	-	6.2	-8.8	-1.3
	R-84	1,068	-	4.8	-7.7	1.0
	R-85	1,032	-	1.4	-7.7	-2.6
	R-86	1,037	-	3.5	-8.0	-4.5
	R-87	1,049	-	4.9	-6.7	-3.7
	R-88	999	-	2.4	-7.2	-1.2
	R-89	991	-	-3.4	-9.6	-3.5
	R-90	1,036	-	-1.4	-5.6	-7.3
	R-91	1,049	-	3.0	3.3	2.7
	R-92	1,028	-	6.0	4.6	1.5
	R-93	1,010	-	12.1	3.6	2.4
	R-94	1,005	-	13.1	4.3	1.7
	R-95	1,016	-	8.6	-0.2	1.7
	R-96	1,034	-	1.2	-4.2	-4.5
	R-97	1,019	-	7.5	1.8	-0.8
	R-98	1,032	-	8.3	0.3	-0.8
	R-99	1,046	-	12.9	-3.4	-0.6
	R-100	1,039	-	11.0	-11.6	-2.7
	R-101	1,019	-	6.5	-3.4	-2.1
	R-102	996	-	7.1	-1.8	-3.2
	R-103	990	-	26.0	16.9	13.1
	T-104	992	-	32.1	21.4	19.4
	R-105	988	-	30.3	20.3	20.0
	R-106	1,048	-	22.3	17.7	18.0
	R-107	1,089	-	33.8	27.1	26.3
	R-108	1,038	-	38.2	34.2	33.6
	R-109	1,068	-	46.1	35.5	30.9
	T-110	1,093	-	52.5	27.4	27.9
	R-111	1,051	-	25.4	17.1	20.6
	R-112	1,024	-	43.1	25.5	27.4
	R-113	992	-	29.8	32.2	30.1
	R-114	1,043	-	26.7	27.0	32.1
	R-115	1,091	-	12.9	4.0	4.2
	R-116	1,090	-	16.7	5.1	5.1
	R-117	1,101	-9.0	17.4	7.7	6.4
	R-118	1,093	-8.4	8.0	0.0	-2.4
	R-119	1,103	1.7	0.6	-3.2	-8.4

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr 99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-120	1,090	6.8	0.0	-0.9	4.6
	R-121	1,089	-4.8	-2.9	-11.8	-9.4
	R-122	553	-33.9	8.7	3.7	-5.9
Porpoise Point	R-122A	279	-	-35.5	4.3	-12.6
	R-122B	551	-	-39.4	-7.4	-5.4
	R-122C	272	-	-17.0	-8.6	11.6
North Control Area (Anastasia State Park)	R-123	451	-	59.2	1.8	-11.3
	T-124	895	10.1	39.5	36.8	2.0
	R-125	1,007	7.9	75.6	50.8	8.5
	T-126	1,205	-21.9	71.9	44.0	16.5
	R-127	1,052	-47.9	41.0	22.7	3.7
	T-128	952	-25.2	35.6	12.7	5.6
	T-129	1,076	-6.1	13.0	7.7	4.6
	T-130	1,052	30.9	26.9	7.9	0.9
	R-131A	1,048	44.8	30.8	18.5	7.1
	T-132	1,026	38.0	24.4	12.0	1.5
	R-133	714	45.5	19.7	12.1	5.7
	R-134	969	63.0	30.3	19.4	8.2
	R-135	1,266	113.1	36.8	17.6	10.8
	R-136	1,020	128.0	30.8	15.3	7.6
Project Area	R-137A	1,044	142.3	46.2	26.0	1.2
	R-138	1,016	166.5	40.5	23.0	3.1
	R-139	921	146.8	32.2	11.5	-1.6
	R-140	911	137.3	46.4	-23.0	-14.3
	R-141	1,003	100.8	6.1	-81.3	-28.2
	R-142	1,029	3.6	2.7	-86.8	-14.5
	R-143T	966	65.9	27.3	-36.6	-9.0
	R-144	972	98.8	33.2	-10.4	-6.7
	R-145	989	128.1	27.0	21.7	5.8
	R-146	982	148.7	20.8	9.0	7.5
	R-147	984	139.5	25.3	15.9	8.0
	R-148	985	121.5	22.9	7.5	7.2
	R-149	984	120.0	27.1	6.3	3.5
	R-150	973	93.3	17.4	1.2	5.6
	R-151	967	84.3	21.6	5.7	7.5
South Control Area	R-152	979	70.8	24.9	13.3	8.0
	R-153	977	65.6	23.4	13.7	8.3
	R-154	979	64.9	24.7	18.0	7.4
	R-155	988	56.6	29.1	22.8	10.1
	T-156	952	52.8	23.4	20.5	6.5
	T-157	976	49.6	22.7	13.8	6.4

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr 99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach Weighted Average	R-80 to R-122	44,384	-5.6	14.0	5.7	6.5
Porpoise Point Weighted Average	R-122A to R-122C	1,102	-	-32.9	-4.7	-3.0
North Control Area Weighted Average	R-123 to R-136	13,734	28.8	38.1	20.9	6.0
Project Area Weighted Average	R-137A to R-151	14,727	109.4	26.6	-7.6	-1.8
South Control Area Weighted Average	R-152 to T-157	5,850	60.1	24.7	17.0	7.8





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CERTIFICATE OF AUTHORIZATION # 4815

**FIGURE 3.6: DUNE TO MHW BEACH VOLUME CHANGES
SOUTH OF ST. AUGUSTINE INLET
ST. JOHNS COUNTY SPP MONITORING
ST. JOHNS COUNTY, FL**



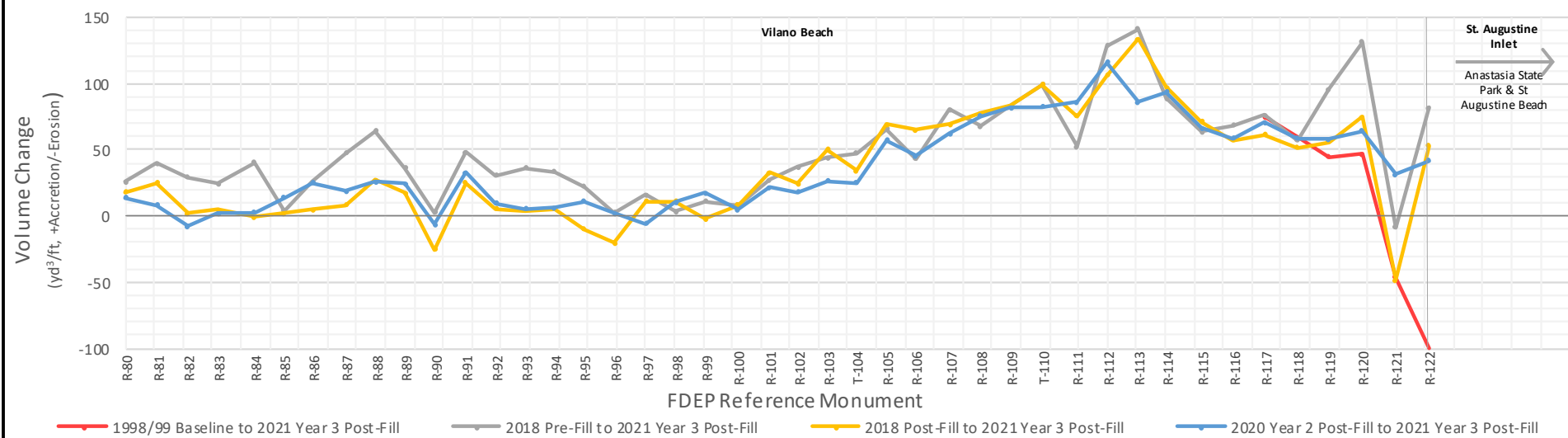
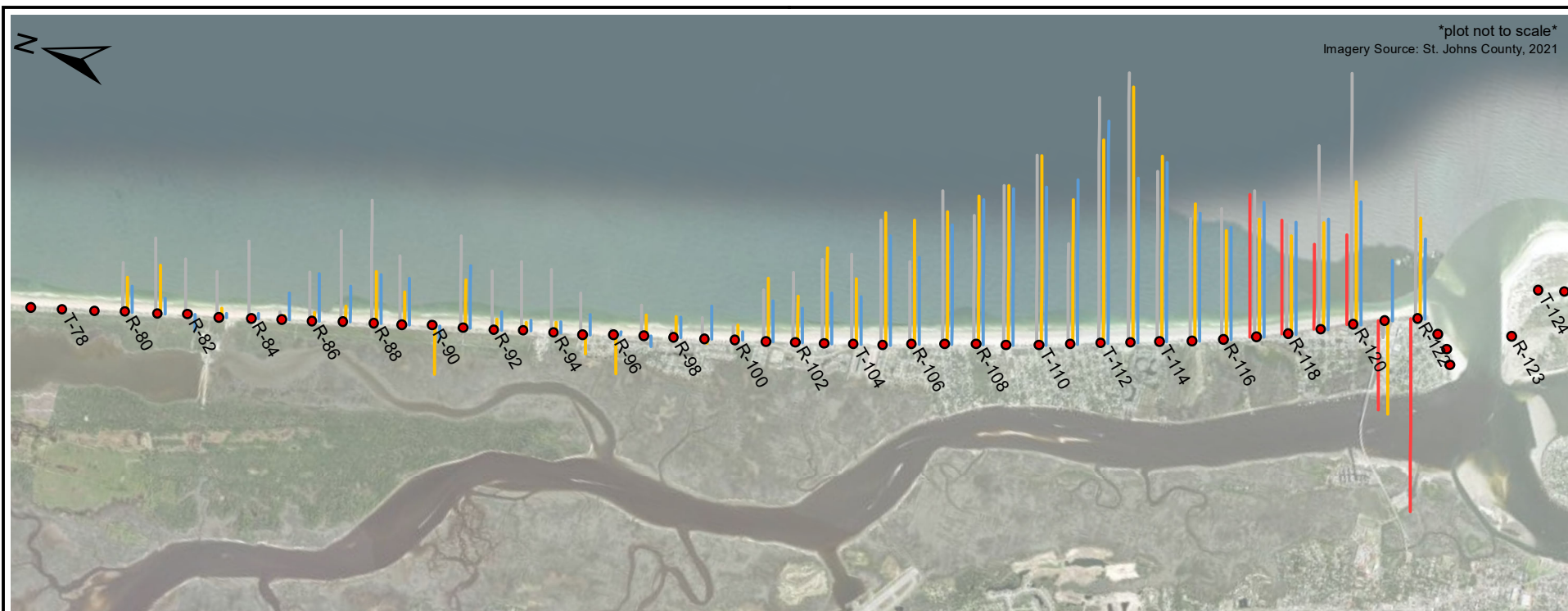
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DATE	JAN 2022

Table 3.4 MHW to -20 ft-NAVD88 Beach Volume Change

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr 99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066	-	25.9	18.3	13.5
	R-81	1,064	-	39.7	25.3	8.3
	R-82	1,042	-	29.1	1.9	-8.0
	R-83	1,077	-	24.1	4.9	2.3
	R-84	1,068	-	40.3	-0.9	2.8
	R-85	1,032	-	3.9	2.2	13.9
	R-86	1,037	-	25.7	4.7	24.9
	R-87	1,049	-	47.5	8.3	18.5
	R-88	999	-	64.2	27.0	25.4
	R-89	991	-	36.1	17.1	24.2
	R-90	1,036	-	2.9	-25.4	-6.7
	R-91	1,049	-	48.1	25.3	32.5
	R-92	1,028	-	30.9	5.7	9.6
	R-93	1,010	-	36.0	4.4	5.4
	R-94	1,005	-	33.2	5.6	6.0
	R-95	1,016	-	21.9	-9.9	10.8
	R-96	1,034	-	2.8	-20.1	1.8
	R-97	1,019	-	15.9	10.8	-5.6
	R-98	1,032	-	3.5	10.9	10.7
	R-99	1,046	-	11.1	-2.2	17.4
	R-100	1,039	-	7.9	7.9	4.4
	R-101	1,019	-	27.0	33.1	21.3
	R-102	996	-	36.7	24.2	18.0
	R-103	990	-	44.0	50.1	26.7
	T-104	992	-	47.3	34.4	25.1
	R-105	988	-	65.4	69.1	57.2
	R-106	1,048	-	43.2	64.7	45.6
	R-107	1,089	-	80.2	69.2	62.4
	R-108	1,038	-	67.5	77.5	75.7
	R-109	1,068	-	83.4	83.3	81.8
	T-110	1,093	-	99.3	99.1	82.6
	R-111	1,051	-	52.4	75.5	85.8
	R-112	1,024	-	128.4	106.2	116.0
	R-113	992	-	140.9	133.7	86.1
	R-114	1,043	-	88.8	96.8	93.6
	R-115	1,091	-	63.8	71.5	66.6
	R-116	1,090	-	68.4	56.9	58.7
	R-117	1,101	74.4	76.4	61.6	70.5
	R-118	1,093	59.4	57.3	51.4	58.5
	R-119	1,103	44.4	95.8	55.7	57.6

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr 99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-120	1,090	46.9	131.3	74.6	64.2
	R-121	1,089	-46.4	-8.8	-48.8	31.4
	R-122	553	-100.5	81.8	52.7	41.6
Porpoise Point	R-122A	279	-	49.8	90.6	18.0
	R-122B	551	-	-32.5	49.6	-37.2
	R-122C	272	-	-60.6	-46.8	63.0
North Control Area (Anastasia State Park)	R-123	451	-	-96.8	8.4	-49.9
	T-124	895	42.5	6.1	-9.8	-58.7
	R-125	1,007	9.9	133.9	3.2	-36.1
	T-126	1,205	-420.3	173.7	182.1	52.2
	R-127	1,052	-312.6	78.7	101.1	57.0
	T-128	952	-239.7	64.2	48.0	11.1
	T-129	1,076	-114.0	25.1	29.0	9.3
	T-130	1,052	-33.4	45.3	0.4	1.6
	R-131A	1,048	-4.3	-14.3	-0.5	-11.0
	T-132	1,026	25.6	35.0	8.6	-8.1
	R-133	714	80.6	2.4	42.9	13.0
	R-134	969	105.1	25.0	27.3	-1.3
	R-135	1,266	98.2	-15.3	-13.4	-17.5
	R-136	1,020	123.0	11.5	4.7	-1.2
Project Area	R-137A	1,044	158.3	7.0	11.8	-2.0
	R-138	1,016	225.8	-7.8	-9.8	-3.0
	R-139	921	249.1	-13.2	-32.1	-6.3
	R-140	911	229.6	-9.8	-66.7	-22.7
	R-141	1,003	157.3	2.3	-107.4	-26.9
	R-142	1,029	116.6	34.3	-124.9	1.7
	R-143T	966	189.1	-4.6	-69.0	-14.0
	R-144	972	299.8	-0.2	-31.6	-7.6
	R-145	989	278.5	4.8	-20.7	11.2
	R-146	982	279.6	-16.0	-6.7	-8.8
	R-147	984	241.4	-7.2	-9.1	-4.1
	R-148	985	216.7	-10.4	11.8	-13.6
	R-149	984	240.8	16.3	11.1	3.5
	R-150	973	191.6	29.6	21.6	-16.3
	R-151	967	202.2	38.1	26.6	3.0
South Control Area	R-152	979	172.6	27.1	21.4	-18.4
	R-153	977	176.6	62.4	38.7	11.5
	R-154	979	161.9	56.9	31.4	-4.5
	R-155	988	142.9	82.2	33.8	6.2
	T-156	952	160.6	53.6	50.1	1.9
	T-157	976	157.1	77.2	68.8	-8.7

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr 99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach Weighted Average	R-80 to R-122	44,384	23.4	49.2	35.2	36.0
Porpoise Point Weighted Average	R-122A to R-122C	1,102	-	-18.6	36.2	1.5
North Control Area Weighted Average	R-123 to R-136	13,734	-54.1	41.0	33.1	-0.1
Project Area Weighted Average	R-137A to R-151	14,727	210.9	4.7	-26.8	-7.2
South Control Area Weighted Average	R-152 to T-157	5,850	161.9	59.9	40.6	-2.0

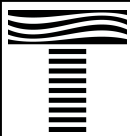
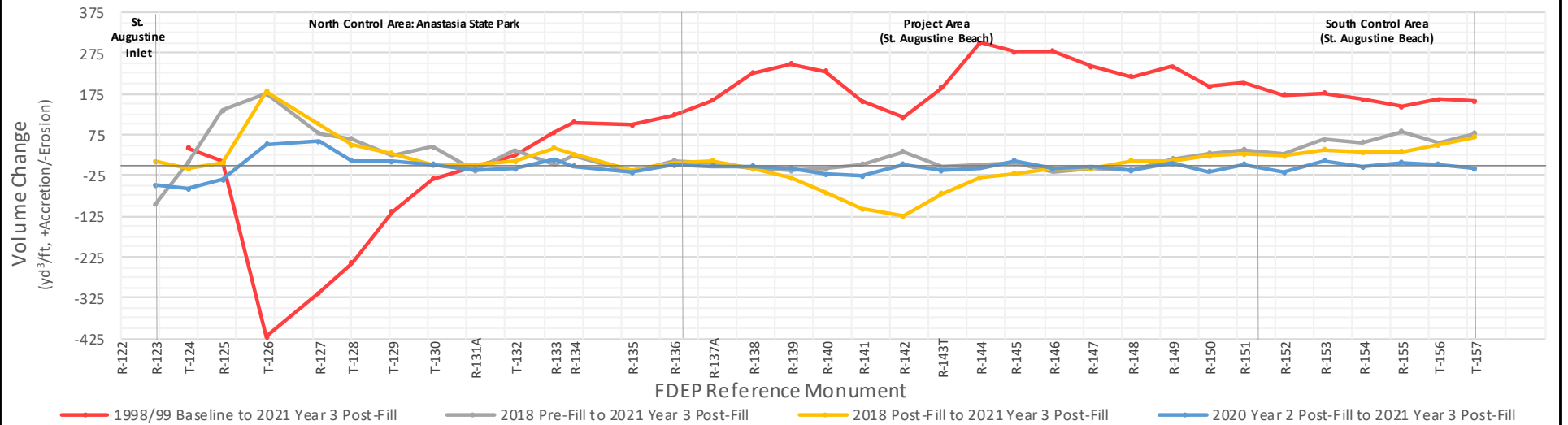
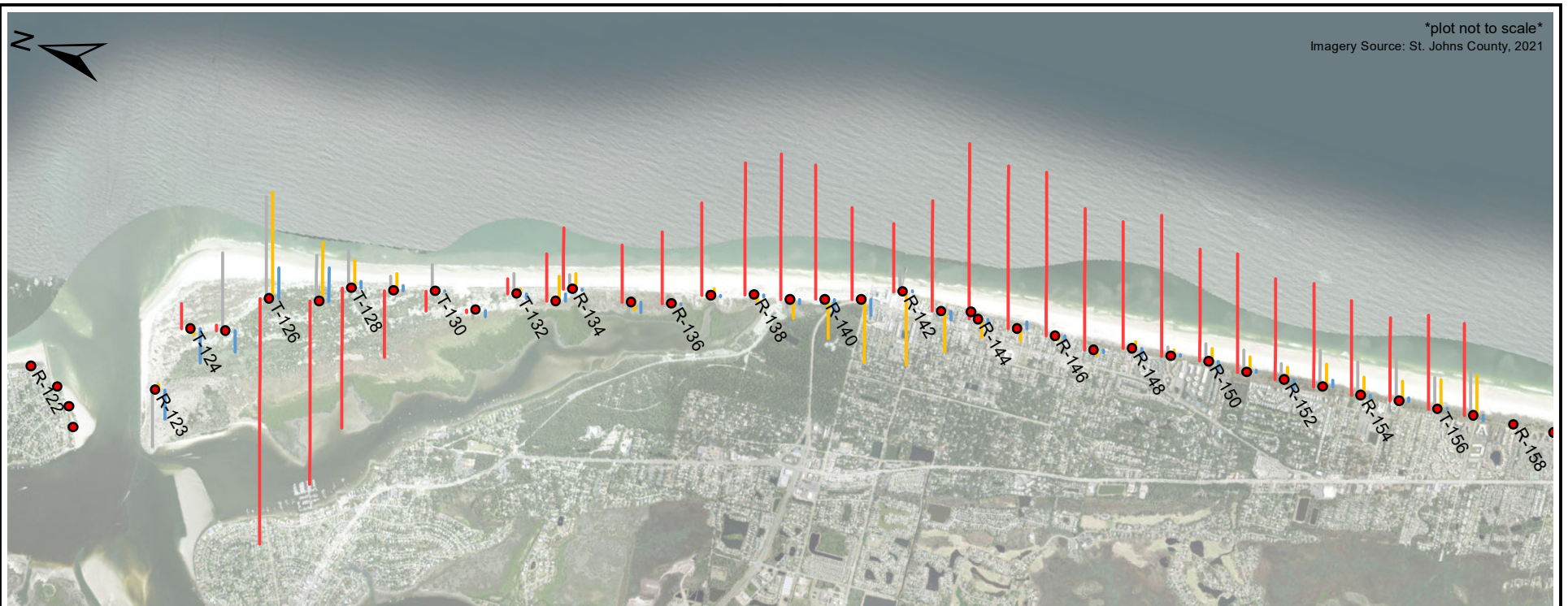


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**FIGURE 3.7: MHW TO -20 FT-NAVD BEACH VOLUME CHANGES
 NORTH OF ST. AUGUSTINE INLET
 ST. JOHNS COUNTY SPP MONITORING
 ST. JOHNS COUNTY, FL**

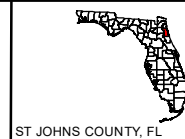


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**FIGURE 3.8: MHW TO -20 FT-NAVD BEACH VOLUME CHANGES
SOUTH OF ST. AUGUSTINE INLET
ST. JOHNS COUNTY SPP MONITORING
ST. JOHNS COUNTY, FL**



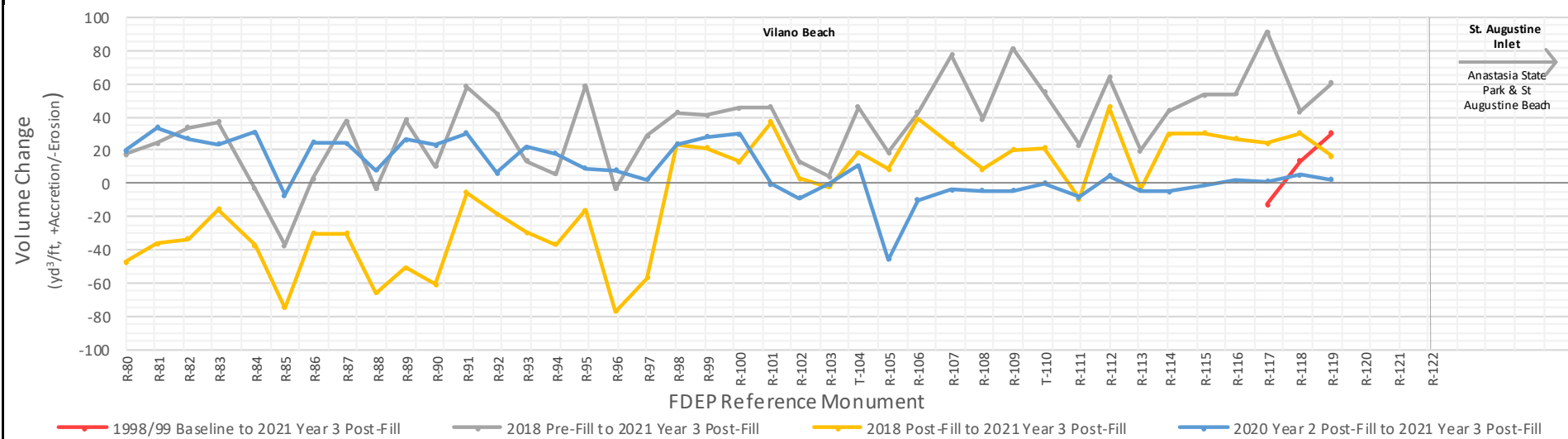
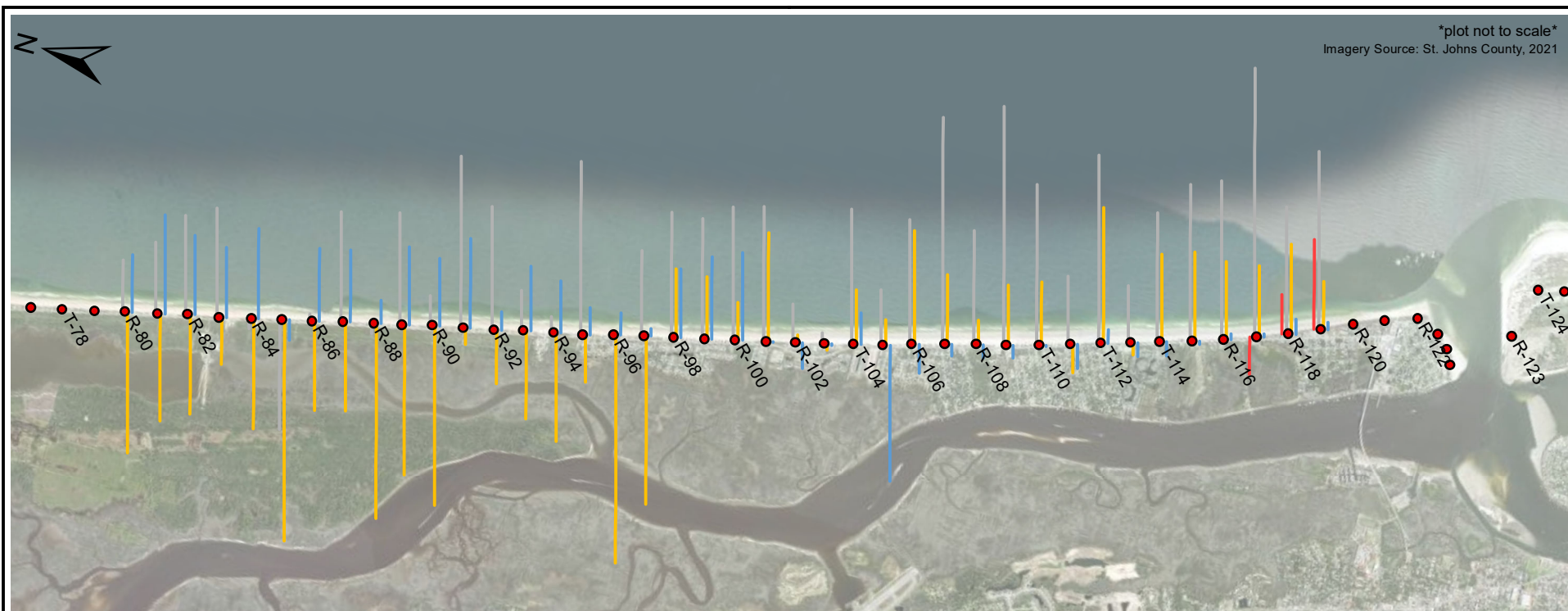
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Table 3.5 Below -20 ft-NAVD88 Volume Change

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066	-	17.6	-47.7	19.5
	R-81	1,064	-	24.3	-36.3	33.5
	R-82	1,042	-	33.7	-33.8	27.0
	R-83	1,077	-	37.1	-15.8	23.8
	R-84	1,068	-	-3.4	-37.4	30.6
	R-85	1,032	-	-37.2	-75.1	-7.0
	R-86	1,037	-	2.6	-30.1	24.9
	R-87	1,049	-	37.4	-30.2	24.3
	R-88	999	-	-3.5	-66.3	7.7
	R-89	991	-	38.1	-51.0	26.4
	R-90	1,036	-	10.1	-60.9	23.0
	R-91	1,049	-	58.3	-5.5	30.5
	R-92	1,028	-	41.8	-18.2	6.2
	R-93	1,010	-	13.7	-29.9	21.9
	R-94	1,005	-	5.5	-36.8	17.7
	R-95	1,016	-	58.9	-16.1	9.3
	R-96	1,034	-	-3.4	-77.3	7.6
	R-97	1,019	-	28.8	-57.2	2.5
	R-98	1,032	-	42.6	23.3	23.3
	R-99	1,046	-	40.9	21.1	28.0
	R-100	1,039	-	45.2	12.8	29.8
	R-101	1,019	-	45.8	37.0	-0.3
	R-102	996	-	13.1	2.6	-8.7
	R-103	990	-	3.7	-2.1	-0.6
	T-104	992	-	46.0	18.5	10.7
	R-105	988	-	18.8	8.6	-46.1
	R-106	1,048	-	42.4	38.5	-9.8
	R-107	1,089	-	77.0	23.8	-3.8
	R-108	1,038	-	38.7	8.3	-4.6
	R-109	1,068	-	81.1	20.5	-4.4
	T-110	1,093	-	54.7	21.5	-0.2
	R-111	1,051	-	23.1	-9.5	-8.2
	R-112	1,024	-	63.9	46.1	4.7
	R-113	992	-	19.4	-4.1	-4.6
	R-114	1,043	-	43.7	29.7	-4.7
	R-115	1,091	-	53.1	30.2	-1.2
	R-116	1,090	-	54.0	26.6	2.0
	R-117	1,101	-12.7	91.3	24.2	1.2
	R-118	1,093	13.4	43.2	30.4	5.1
	R-119	1,103	30.4	60.5	16.3	2.5

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-120	1,090	-	-	-	-
	R-121	1,089	-	-	-	-
	R-122	553	-	-	-	-
Porpoise Point	R-122A	279	-	73.7	42.6	16.2
	R-122B	551	-	-31.5	13.1	-34.0
	R-122C	272	-	-4.1	-33.4	-116.6
North Control Area (Anastasia State Park)	R-123	451	-	-	-	-
	T-124	895	-	-	-	-
	R-125	1,007	-	2.8	1.9	0.5
	T-126	1,205	-0.1	1.6	0.4	2.1
	R-127	1,052	-0.4	1.7	2.2	0.7
	T-128	952	0.0	6.1	0.7	0.3
	T-129	1,076	12.9	28.7	18.2	3.2
	T-130	1,052	-17.0	25.8	9.6	-10.8
	R-131A	1,048	-44.7	31.8	19.7	1.8
	T-132	1,026	-0.1	-14.4	-31.7	-17.6
	R-133	714	-112.8	33.2	26.1	-30.3
	R-134	969	-49.7	46.7	34.6	15.8
	R-135	1,266	-30.6	8.7	-8.3	-17.6
	R-136	1,020	-56.2	41.3	35.6	-9.6
Project Area	R-137A	1,044	-76.5	14.4	5.0	-18.1
	R-138	1,016	-73.9	37.2	27.7	-17.6
	R-139	921	-84.9	18.1	9.9	-13.3
	R-140	911	-34.7	32.6	20.1	-11.7
	R-141	1,003	-14.8	39.1	27.6	-8.7
	R-142	1,029	-38.4	42.7	23.7	-24.6
	R-143T	966	-42.3	24.3	20.8	-16.6
	R-144	972	44.9	23.6	15.2	-23.7
	R-145	989	-48.9	44.3	8.7	-18.0
	R-146	982	27.5	28.8	18.1	-5.8
	R-147	984	-19.2	48.6	27.3	0.6
	R-148	985	52.5	21.0	25.2	-5.3
	R-149	984	13.1	41.7	21.8	-12.1
	R-150	973	28.6	20.2	17.0	-19.2
	R-151	967	62.4	44.3	15.9	-20.7
South Control Area	R-152	979	60.1	14.1	16.7	-26.9
	R-153	977	93.9	40.9	22.9	-4.6
	R-154	979	88.6	34.8	19.9	-19.9
	R-155	988	113.7	45.8	18.3	-13.4
	T-156	952	112.6	36.0	29.4	-21.8
	T-157	976	128.9	30.8	12.1	-35.7

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach Weighted Average	R-80 to R-122	44,384	5.7	32.3	-6.7	8.0
Porpoise Point Weighted Average	R-122A to R-122C	1,102	-	1.9	9.1	-41.7
North Control Area Weighted Average	R-123 to R-136	13,734	-20.1	15.4	7.4	-4.3
Project Area Weighted Average	R-137A to R-151	14,727	-13.4	32.3	18.9	-14.4
South Control Area Weighted Average	R-152 to T-157	5,850	99.6	33.7	19.8	-20.4



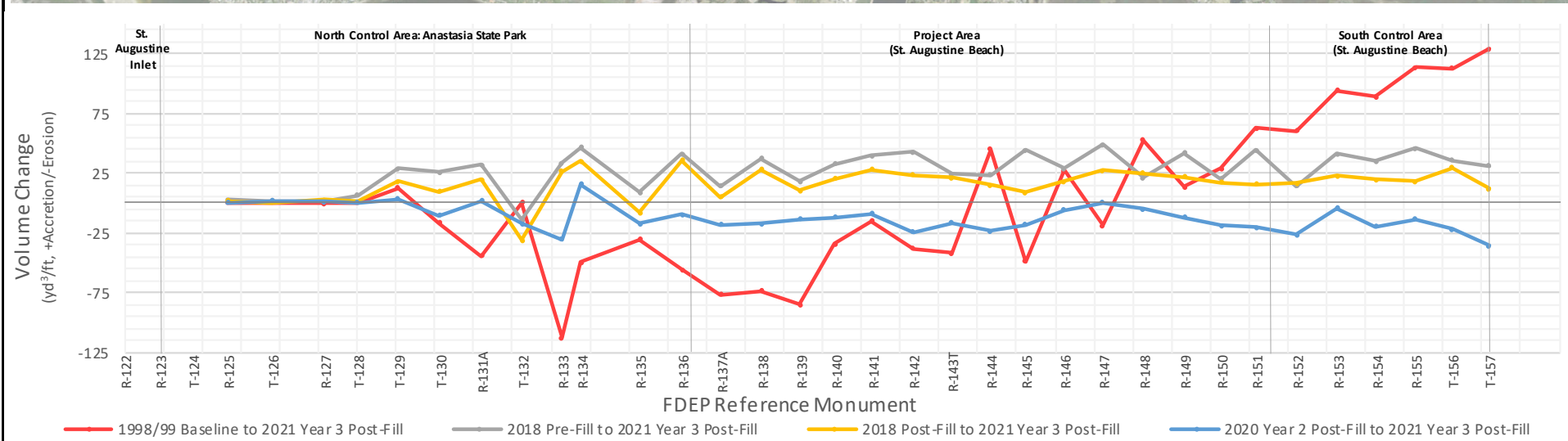
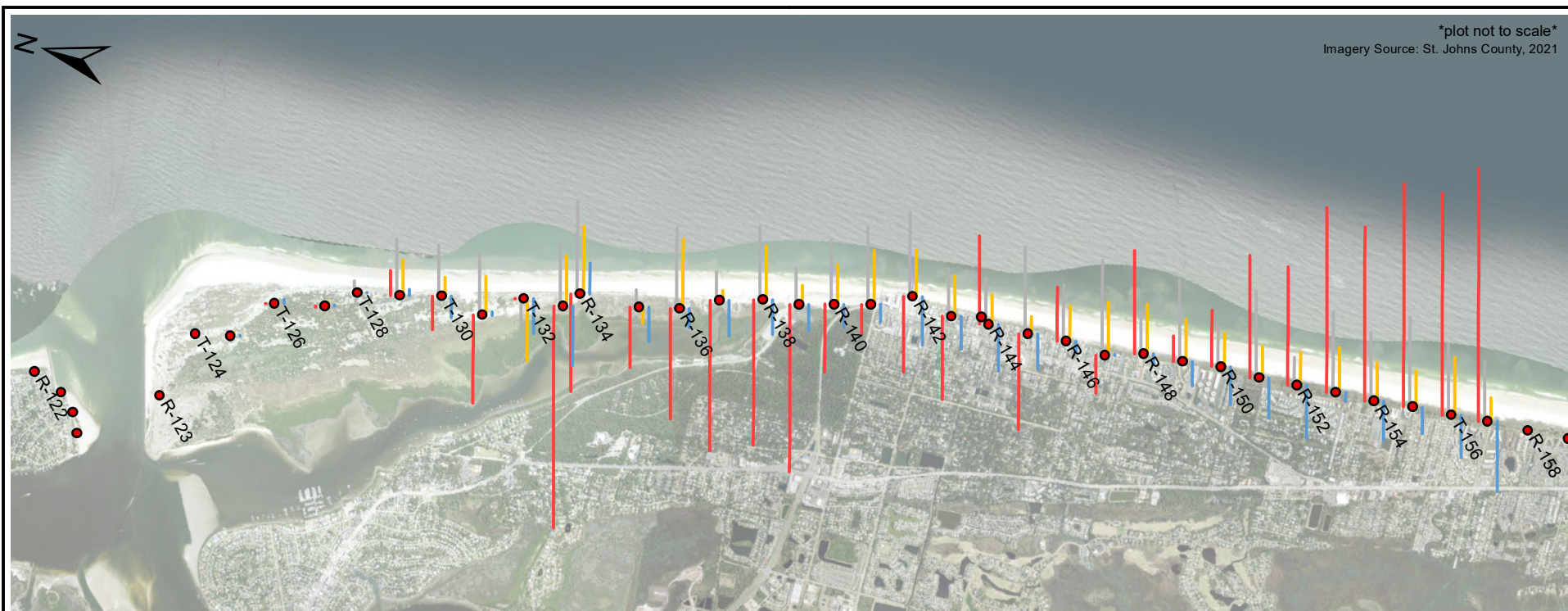
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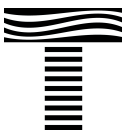
**FIGURE 3.9: BELOW -20 FT-NAVD BEACH VOLUME CHANGES
NORTH OF ST. AUGUSTINE INLET
ST. JOHNS COUNTY SPP MONITORING
ST. JOHNS COUNTY, FL**



ST. JOHNS COUNTY, FL

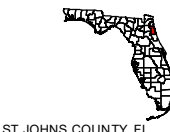
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FIGURE 3.10: BELOW -20 FT-NAVD BEACH VOLUME CHANGES
 SOUTH OF ST. AUGUSTINE INLET
 ST. JOHNS COUNTY SPP MONITORING
 ST. JOHNS COUNTY, FL



ST. JOHNS COUNTY, FL

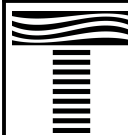
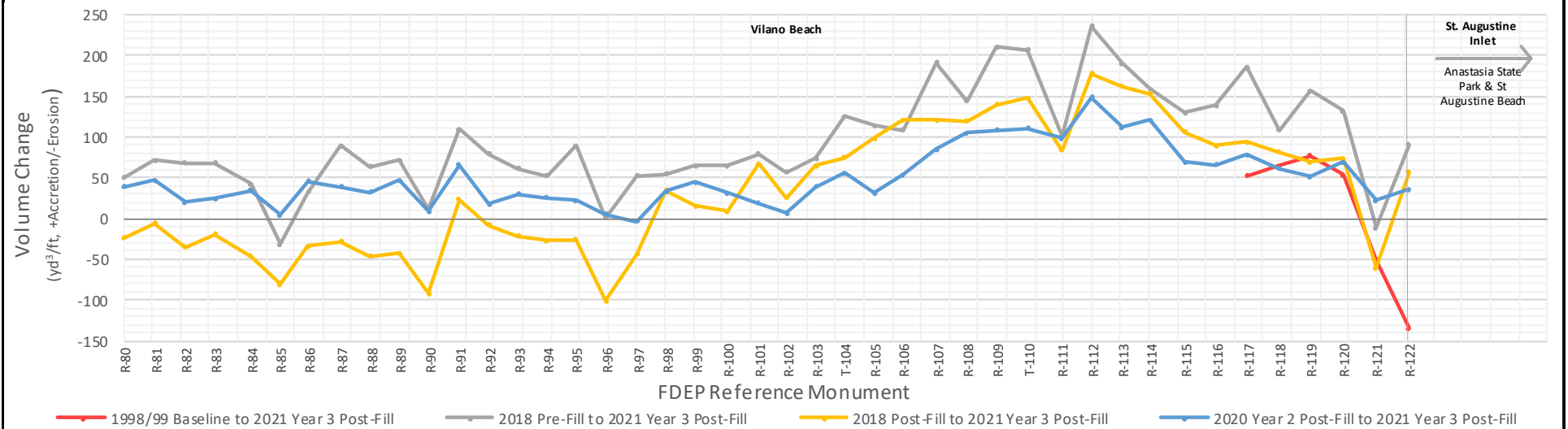
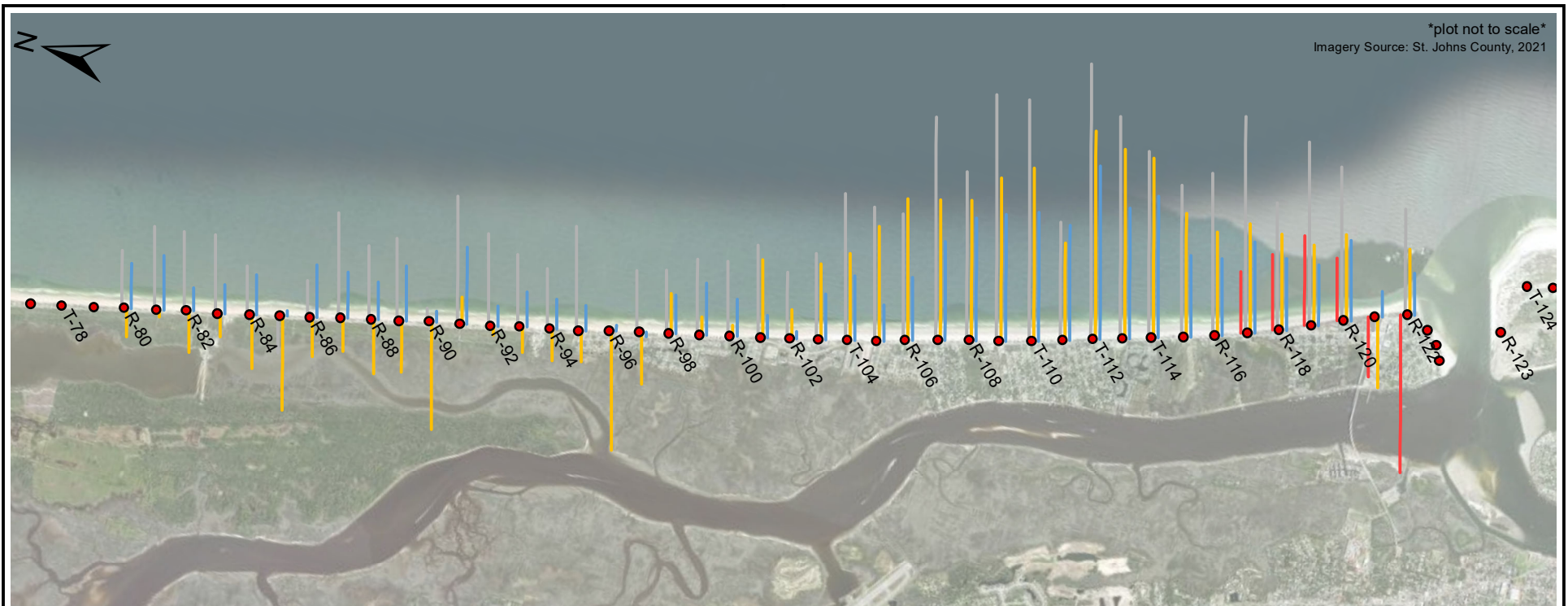
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Table 3.6 Total Volume Change

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066	-	49.6	-24.3	38.5
	R-81	1,064	-	71.6	-6.0	46.6
	R-82	1,042	-	67.7	-35.4	19.8
	R-83	1,077	-	67.4	-19.8	24.8
	R-84	1,068	-	41.7	-46.0	34.3
	R-85	1,032	-	-31.9	-80.6	4.3
	R-86	1,037	-	31.8	-33.4	45.2
	R-87	1,049	-	89.8	-28.7	39.1
	R-88	999	-	63.1	-46.5	31.9
	R-89	991	-	70.8	-43.4	47.2
	R-90	1,036	-	11.6	-91.9	9.0
	R-91	1,049	-	109.3	23.0	65.8
	R-92	1,028	-	78.7	-7.8	17.3
	R-93	1,010	-	61.7	-21.9	29.7
	R-94	1,005	-	51.8	-26.9	25.4
	R-95	1,016	-	89.4	-26.2	21.7
	R-96	1,034	-	0.6	-101.6	4.9
	R-97	1,019	-	52.3	-44.5	-4.0
	R-98	1,032	-	54.4	34.5	33.2
	R-99	1,046	-	64.9	15.5	44.7
	R-100	1,039	-	64.2	9.2	31.5
	R-101	1,019	-	79.3	66.7	18.9
	R-102	996	-	56.9	25.0	6.1
	R-103	990	-	73.8	65.0	39.3
	T-104	992	-	125.4	74.2	55.2
	R-105	988	-	114.4	98.1	31.1
	R-106	1,048	-	107.9	121.0	53.7
	R-107	1,089	-	191.1	120.2	84.9
	R-108	1,038	-	144.4	120.0	104.7
	R-109	1,068	-	210.7	139.3	108.4
	T-110	1,093	-	206.6	148.0	110.3
	R-111	1,051	-	100.9	83.1	98.2
	R-112	1,024	-	235.4	177.8	148.1
	R-113	992	-	190.1	161.8	111.7
	R-114	1,043	-	159.2	153.5	120.9
	R-115	1,091	-	129.8	105.7	69.6
	R-116	1,090	-	139.1	88.7	65.8
	R-117	1,101	52.7	185.0	93.6	78.1
	R-118	1,093	64.4	108.5	81.8	61.1
	R-119	1,103	76.5	156.9	68.8	51.7

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-120	1,090	53.7	131.3	73.7	68.8
	R-121	1,089	-51.2	-11.8	-60.5	22.0
	R-122	553	-134.5	90.5	56.4	35.7
Porpoise Point	R-122A	279	-	88.0	137.4	21.6
	R-122B	551	-	-103.4	55.3	-76.6
	R-122C	272	-	-81.7	-88.8	-42.0
North Control Area (Anastasia State Park)	R-123	451	-	-37.6	10.2	-61.3
	T-124	895	52.6	45.6	27.0	-56.8
	R-125	1,007	17.8	212.3	55.9	-27.1
	T-126	1,205	-442.3	247.3	226.5	70.9
	R-127	1,052	-360.9	121.3	126.1	61.4
	T-128	952	-264.9	105.9	61.4	17.0
	T-129	1,076	-107.2	66.8	54.9	17.1
	T-130	1,052	-19.5	98.0	17.9	-8.2
	R-131A	1,048	-4.2	48.3	37.7	-2.1
	T-132	1,026	63.5	45.0	-11.1	-24.2
	R-133	714	13.2	55.3	81.0	-11.6
	R-134	969	118.3	102.0	81.3	22.7
	R-135	1,266	180.7	30.1	-4.1	-24.3
	R-136	1,020	194.8	83.5	55.6	-3.1
Project Area	R-137A	1,044	224.1	67.6	42.8	-18.9
	R-138	1,016	318.5	69.9	40.9	-17.6
	R-139	921	311.0	37.1	-10.6	-21.2
	R-140	911	332.3	69.3	-69.6	-48.8
	R-141	1,003	243.3	47.5	-161.0	-63.7
	R-142	1,029	81.9	79.7	-188.0	-37.4
	R-143T	966	212.8	47.0	-84.8	-39.6
	R-144	972	443.5	56.6	-26.8	-38.0
	R-145	989	357.7	76.2	9.7	-1.0
	R-146	982	455.7	33.6	20.4	-7.1
	R-147	984	361.8	66.7	34.1	4.5
	R-148	985	390.7	33.5	44.5	-11.7
	R-149	984	373.9	85.1	39.2	-5.1
	R-150	973	313.5	67.2	39.8	-29.9
	R-151	967	348.9	104.0	48.2	-10.1
South Control Area	R-152	979	303.5	66.1	51.4	-37.3
	R-153	977	336.1	126.7	75.2	15.3
	R-154	979	315.3	116.4	69.3	-17.0
	R-155	988	313.2	157.0	75.0	2.9
	T-156	952	326.1	113.0	99.9	-13.3
	T-157	976	335.6	130.7	94.7	-38.1

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach Weighted Average	R-80 to R-122	44,384	23.4	95.6	34.2	50.6
Porpoise Point Weighted Average	R-122A to R-122C	1,102	-	-49.6	40.5	-43.2
North Control Area Weighted Average	R-123 to R-136	13,734	-45.4	94.5	61.4	1.7
Project Area Weighted Average	R-137A to R-151	14,727	306.9	63.6	-15.5	-23.4
South Control Area Weighted Average	R-152 to T-157	5,850	321.6	118.4	77.5	-14.6

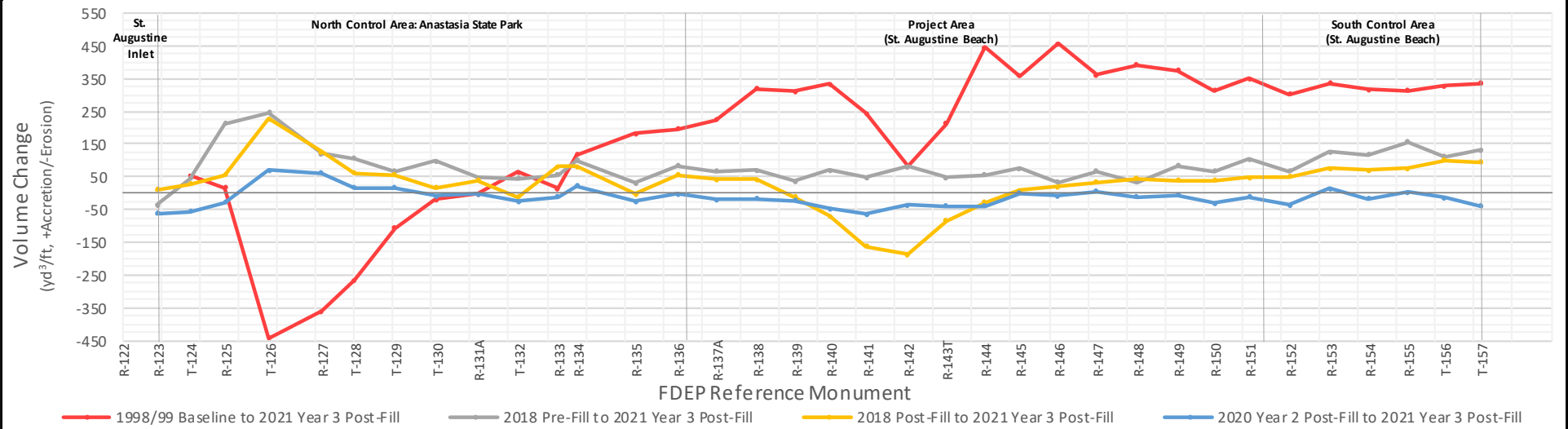
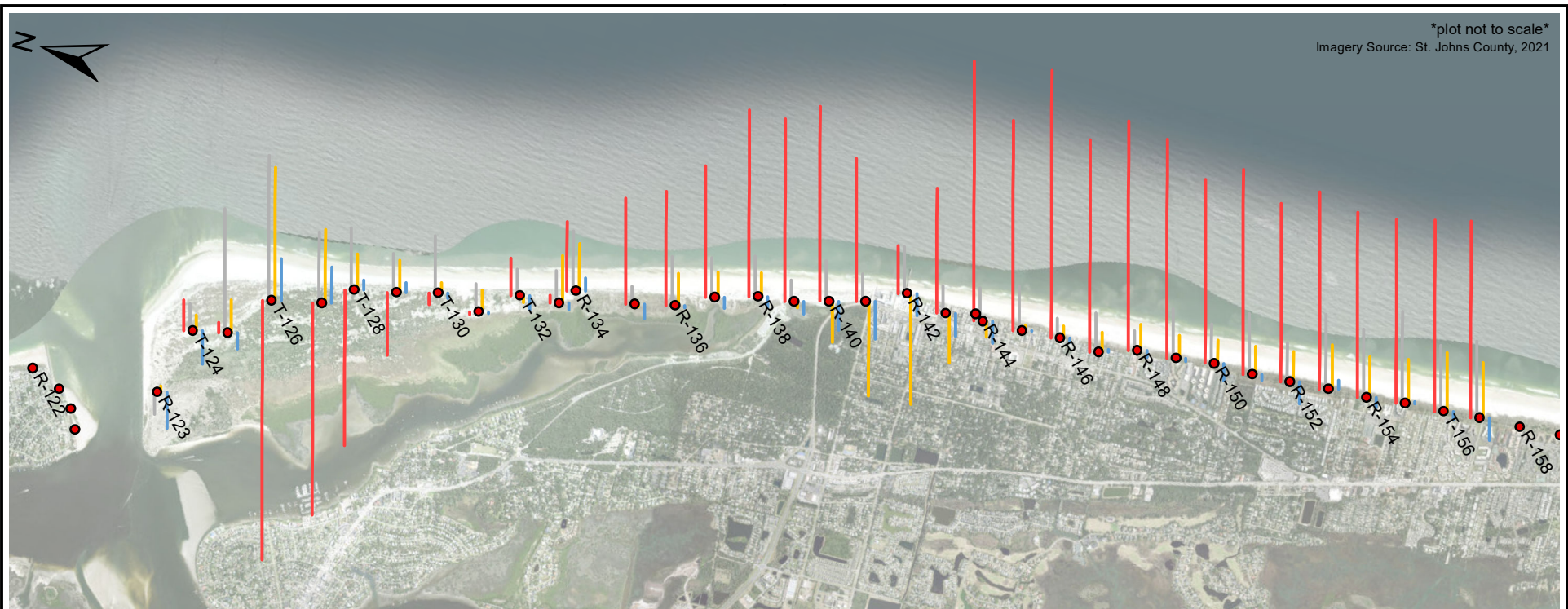


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JACKSONVILLE, FL 32256
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**FIGURE 3.11: TOTAL BEACH VOLUME CHANGES
NORTH OF ST. AUGUSTINE INLET
ST. JOHNS COUNTY SPP MONITORING
ST. JOHNS COUNTY, FL**



PROJECT	C2021-050
DRAWN BY	PL
SHEET	1 OF 1
DATE	JAN 2022



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**FIGURE 3.12: TOTAL BEACH VOLUME CHANGES
 SOUTH OF ST. AUGUSTINE INLET
 ST. JOHNS COUNTY SPP MONITORING
 ST. JOHNS COUNTY, FL**



PROJECT	C2021-050
DRAWN BY	PL
SHEET	1 OF 1
DATE	JAN 2022

Table 3.7 Summary of Volume Changes (cy/ft)

Area Details	Vertical Compartment	Weighted Average Volume Change (cy/ft)			
		1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach* (R-80 to R-122)	Dune to MHW	-5.6	14.0	5.7	6.5
	MHW to -20 ft-NAVD	23.4	49.2	35.2	36.0
	Below -20 ft-NAVD	5.7	32.3	-6.7	8.0
	Total	23.4	95.6	34.2	50.6
	Total Above -20 ft-NAVD	17.8	63.2	40.9	42.5
Porpoise Point (R-122A/B/C inside the inlet)	Dune to MHW	-	-32.9	-4.7	-3.0
	MHW to -20 ft-NAVD	-	-18.6	36.2	1.5
	Below -20 ft-NAVD	-	1.9	9.1	-41.7
	Total	-	-49.6	40.5	-43.2
	Total Above -20 ft-NAVD	-	51.5	-31.5	1.5
North Control Area/Anastasia State Park (R-123 to R-136)	Dune to MHW	28.8	38.1	20.9	6.0
	MHW to -20 ft-NAVD	-54.1	41.0	33.1	-0.1
	Below -20 ft-NAVD	-20.1	15.4	7.4	-4.3
	Total	-45.4	94.5	61.4	1.7
	Total Above -20 ft-NAVD	-25.3	79.1	54.0	5.9
Project Area/St. Augustine Beach (R-137A to R-151)	Dune to MHW	109.4	26.6	-7.6	-1.8
	MHW to -20 ft-NAVD	210.9	4.7	-26.8	-7.2
	Below -20 ft-NAVD	-13.4	32.3	18.9	-14.4
	Total	306.9	63.6	-15.5	-23.4
	Total Above -20 ft-NAVD	320.3	31.3	-34.4	-9.0
South Control Area/St. Augustine Beach (R-152 to T-157)	Dune to MHW	60.1	24.7	17.0	7.8
	MHW to -20 ft-NAVD	161.9	59.9	40.6	-2.0
	Below -20 ft-NAVD88	99.6	33.7	19.8	-20.4
	Total	321.6	118.4	77.5	-14.6
	Total Above -20 ft-NAVD	222.0	84.6	57.6	5.8
Total Volume Change South of the Inlet	Dune to MHW	69.3	30.8	7.8	2.9
	MHW to -20 ft-NAVD	98.0	28.3	8.2	-3.5
	Below -20 ft-NAVD	3.0	25.9	14.5	-11.4
	Total	170.3	85.0	30.5	-12.0
	Total Above -20 ft-NAVD	167.3	59.1	16.0	-0.6

*1998/99 baseline survey does not include R-80 through R-116

Table 3.8 Summary of Volume Changes (cy)

Area Details	Vertical Compartment	Volume Change (cy)			
		1998/99 Baseline – 2021 Year 3 (Sep '98/Apr '99– Sep '21)	2018 Pre-Fill –2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach* (R-80 to R-122)	Dune to MHW	-33,791	623,433	253,472	290,706
	MHW to -20 ft-NAVD	140,852	2,183,348	1,561,643	1,599,625
	Below -20 ft-NAVD	34,296	1,435,597	-299,035	355,592
	Total	141,357	4,242,377	1,516,079	2,245,923
	Total Above -20 ft-NAVD	107,061	2,806,780	1,815,114	1,890,331
Porpoise Point (R-122A/B/C inside the inlet)	Dune to MHW	-	-36,228	-5,231	-3,342
	MHW to -20 ft-NAVD	-	-20,535	39,898	1,657
	Below -20 ft-NAVD	-	2,122	10,018	-45,948
	Total	-	-54,642	44,685	-47,632
	Total Above -20 ft-NAVD	-	-56,764	34,667	-1,685
North Control Area/Anastasia State Park (R-123 to R-136)	Dune to MHW	395,434	522,802	287,502	82,748
	MHW to -20 ft-NAVD	-742,783	563,670	454,786	-1,400
	Below -20 ft-NAVD	-276,227	211,079	101,067	-58,441
	Total	-623,577	1,297,551	843,354	22,907
	Total Above -20 ft-NAVD	-347,349	1,086,472	742,287	81,348
Project Area/St. Augustine Beach (R-137A to R-151)	Dune to MHW	1,662,639	404,439	-115,815	-24,279
	MHW to -20 ft-NAVD	3,205,321	71,520	-407,172	-102,337
	Below -20 ft-NAVD	-203,682	491,324	287,765	-211,458
	Total	4,664,277	967,282	-235,222	-338,073
	Total Above -20 ft-NAVD	4,867,959	475,958	-522,987	-126,616
South Control Area/St. Augustine Beach (R-152 to T-157)	Dune to MHW	351,424	144,638	99,510	45,641
	MHW to -20 ft-NAVD	947,216	350,650	237,713	-11,697
	Below -20 ft-NAVD	582,659	197,384	115,959	-119,107
	Total	1,881,299	692,672	453,183	-85,163
	Total Above -20 ft-NAVD	1,298,640	495,288	337,224	33,943
Total Volume Change South of the Inlet	Dune to MHW	2,409,496	1,055,261	277,004	104,110
	MHW to -20 ft-NAVD	3,409,754	979,042	304,345	-115,434
	Below -20 ft-NAVD	102,749	881,583	496,219	-389,006
	Total	5,922,000	2,915,886	1,077,568	-400,329
	Total Above -20 ft-NAVD	5,819,250	2,034,302	581,350	-11,324

*1998/99 baseline survey does not include R-80 through R-116

3.4 Longshore Reconfiguration: Diffusion Analysis

For the last half-century, many authors have studied beach fill adjustment due to longshore sediment transport processes. With some assumptions, the procedure of the analysis proves relatively straightforward. On a scale of years to decades, one assumes the beach profile invariant. However, the beach fill disrupts the natural shape of the shoreline. Following the theory first outlined by Pelnard-Considere (1956), as cited in Dean (2002), a beach fill represents a perturbation or a planform anomaly to the local uninterrupted shoreline, which, over time, longshore sediment transport tends to smooth. The analysis assumes the principal mechanism for sediment transport is the longshore current due to obliquely breaking waves. Further, the analysis considers sediment transport proportional to the longshore component of the energy flux of the breaking wave (e.g., Inman and Bagnold, 1963). Further assumptions include: 1) spilling breakers, 2) small breaking angles, 3) a profile that translates landward or seaward without change of form, 4) longshore diffusivity remaining constant for all nourishment projects, and 5) all nourishment projects placed along the entire project domain (monuments R-137A to R-151).

A linearized approximation results in the following governing equation for planform evolution,

$$\frac{\partial y}{\partial t} = G \frac{\partial^2 y}{\partial x^2} \quad (\text{Equation 1})$$

where y is the cross-shore position of the shoreline at time t , and x is the alongshore distance. This equation (a form of the heat conduction equation) contains a number of possible analytical solutions; the boundary conditions (at the lateral ends) specify the particular solution. The longshore diffusivity parameter, G , governs the rate of evolution of the project. In this linearized treatment,

$$G = K \frac{H_0^{2.4} C_{G0}^{1.2} g^{0.4}}{8(s-1)(1-p)C_* k^{0.4}(h_*+B)} \left[\frac{\cos^{1.2}(\beta_0 - \alpha_*) \cos 2(\beta_0 - \alpha_*)}{\cos(\beta_0 - \alpha_*)} \right] \quad (\text{Equation 2})$$

where K is an empirical non-dimensional constant (0.77), H is the wave height, C_G is the wave group velocity, g is the acceleration due to gravity, s is the specific gravity of sand (2.65), p is the sediment porosity (0.35), C is the wave velocity, κ is the ratio of the breaking wave height to the breaking water depth (~ 0.78), h^* is the water depth of limiting sediment motion (depth of closure), B is the height of the berm above the water level, β is the shoreline azimuth, and α is the direction of the waves. The subscripts 0 and * denote conditions in deep water and at the depth of limiting motion. The longshore diffusivity parameter, G , relative to the project area is roughly $0.14 \text{ ft}^2/\text{sec}$ (Dean, 1990).

Given an initial shoreline similar to a rectangular planform, one may describe the evolution of the shoreline as follows,

$$y(x, t) = \frac{Y}{2} \left\{ \text{erf} \left[\frac{L}{4\sqrt{Gt}} \left(\frac{2x}{L} + 1 \right) \right] - \text{erf} \left[\frac{L}{4\sqrt{Gt}} \left(\frac{2x}{L} - 1 \right) \right] \right\} \quad (\text{Equation 3})$$

where Y is the initial width of the planform anomaly (beach fill), L is the project length, t is time, and erf is the error function (defined in Equation 4).

$$\text{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-u^2} dz \quad \text{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-u^2} dz \quad (\text{Equation 4})$$

The $L/\sqrt{Gt}$ term governs the shoreline evolution rate. The fraction of the placed sand remaining within the project area at time t is expressed in Equation 5.

$$M(t) = \frac{1}{Y_L} \int_{-L/2}^{L/2} y(x,t) dx = \frac{2\sqrt{Gt}}{L\sqrt{\pi}} \left(e^{-(Y/2)^2} - 1 \right) + \operatorname{erf} \left(\frac{L}{2\sqrt{Gt}} \right) \quad (\text{Equation 5})$$

The fraction of sand remaining in the placement location proves an effective indicator of the long-term fill performance. This analysis considered the entire volume of sand placed during initial construction and the subsequent nourishment projects. However, the additional effects of the long-term background transport rate at the project site should be taken into consideration. The background transport rate, in conjunction with the longshore diffusivity rate, provides a predicted percentage of sand remaining in the nourishment domain over time. A calibrated and verified GENESIS (Generalized Model for Simulating Shoreline Change; Hanson and Kraus, 1989) model specified an average background transport rate of 10.9 cy/ft/yr (or 154,170 cy/yr) in the project area (USACE, 1998).

The longshore diffusivity parameter (G) serves as a calibration parameter to fit the predicted sand transport volume to the volumes calculated from periodic profile surveys. For the calculated volumes from the periodic surveys, Taylor Engineering applied the following assumptions:

1. The beach fill volume immediately before the 2002 restoration project is zero.
2. All information in the analysis considered the mid-date (mid-point between the start and end of construction or survey durations) as the representative time (i.e., the 2018 nourishment construction date of April 2018 represents the January–July 2018 construction period).

A previous calibration exercise (Taylor Engineering, 2006) indicates the optimal longshore diffusivity agrees with the value (0.14 ft²/sec) proposed by Dean. Figure 3.13 shows predicted and calculated nourishment volumes remaining in the project area from 2002 through September 2021. The predicted volume remaining line begins in 2002 with the entire original fill volume (4.2 mcy) and diminishes after each nourishment project at a rate determined by the equations described above. The vertical lines indicate the 2005, 2012, and 2018 projects. The magnitude of each line is obtained by adding the placement volumes (2.8 mcy for 2005, 2.1 mcy for 2012, and 0.75 mcy for 2018) to the pre-fill volumes (calculated from the monitoring surveys).

The diffusion analysis equations assume a rectangular beach fill footprint. Although the St. Johns County SPP is non-rectangular, the diffusion equations agree with the calculated monitoring volumes within the first two years following the original restoration project. Following the 2004 hurricanes, the calculated volumes diverge below the predicted values, likely a result of the significant storm-induced erosion. Contrarily, the relatively mild sea conditions and natural post-storm recovery processes between the 2005 and 2012 nourishments coincide with a calculated volume surplus compared to the predicted values and hence, better than expected project performance. In February 2012, the project area contained nearly 636,900 cy more sand than predicted.

Immediately after the 2012 nourishment, Hurricane Sandy and several nor'easter storms affected the project area. Similar to the trend following the 2004 hurricanes, the calculated volume in December 2012 was less than the predicted volume (-306,600 cy). Throughout the 2012 project lifespan, the project performance fluctuated. After Hurricane Sandy, the project lost volume generally at or less than the predicted rates but never recovered the initial erosion volume. However, the project incurred large volume losses during the 2016 and 2017 hurricane seasons, which included hurricanes Matthew and Irma as well as numerous severe nor'easters. The storm-induced erosion likely caused the 1,157,800 cy difference between the predicted and actual volume as of December 2017.

The 2018 pre- to post-fill surveys indicates the project area gained 392,000 cy more sand than the 2018 project placed, likely a result of post-storm natural recovery. Of note, due to the large volume losses from August 2015 to December 2017, the beginning of the predicted performance curve in Figure 3.13 lies below the curve for the 2012 project. During the first year following construction of the 2018 project, the project lost much more sand than predicted (-760,000 cy calculated vs -106,000 cy predicted) due to severe erosion below MHW (particularly below -20 ft-NAVD). As of August 2019, with the initial volume excess partially offsetting the recent erosion, the remaining project volume was about 189,000 cy less than predicted. The project gained large amounts of sand below -20 ft-NAVD contour in the second year following construction, offsetting the calculated volume from the predicted by nearly 860,000 cy. If only the volume above the -20 ft-NAVD contour is analyzed for the dispersion analysis between 2019 and 2020, there would only be a difference of 36,000 cy between the calculated and predicted volumes. As of September 2021, the calculated volume exceeds the predicted volume by roughly 600,000 cy. Minimal losses occurred above MHW and moderate losses occurred below MHW. This erosion brings the calculated volume down closer to the predicted performance curve, slightly offsetting the large gains experienced during the previous year but still remaining well above the predicted performance curve.

Of note, the project length for the predicted performance calculations is based on the authorized R-137A to R-151 project area (i.e., 2.8 miles). The analysis does not adjust the project length based on the constructed length of individual projects, such as the shorter 1.5-mile long 2012 project and 0.75-mile long 2018 project. A shorter project will disperse fill faster than a longer project; however, much of the initially dispersed fill from the 2012 and 2018 projects remains within and benefits the authorized 2.8-mile long project area. Similarly, the calculated volume remaining is based on volume changes within the 2.8-mile long project area rather than the shorter individual project areas. This approach evaluates the performance of the project area as a whole rather than individual project lengths, which may have been limited by funding or dredge volume restrictions rather than beach fill needs. If the project area were limited to the 2012 or 2018 placement areas, the project would not appear to perform as well due to the placement area experiencing significant erosion; the erosion is counterbalanced by the accretion to the north and south of the placement area and within the analyzed project area.

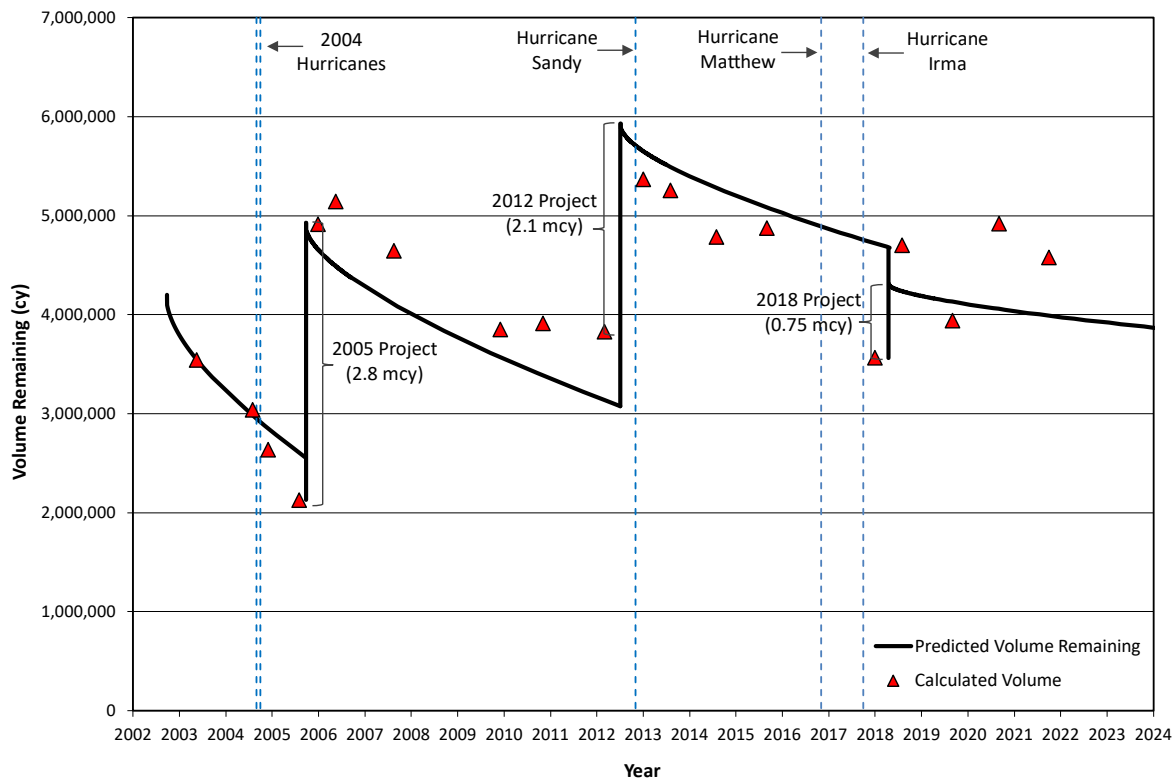


Figure 3.13 Predicted and Calculated Volume Remaining Over Time

3.5 Berm Position and Associated Project Performance

The authorized project design template includes a 60 ft wide berm with a crest elevation of +9.0 ft-NAVD, a foreshore slope at 1V:20H (1 ft vertical to 20 ft horizontal) to MLW, followed by a 1V:30H (1 ft vertical to 30 ft horizontal) slope tying into the existing elevations (Figure 3.14). The 60 ft design berm width measures seaward from the erosion control line (ECL). The authorized construction template includes variable-width advance fill with a crest elevation of +9.0 ft-NAVD and a 1V:20H foreshore slope to the existing elevations.

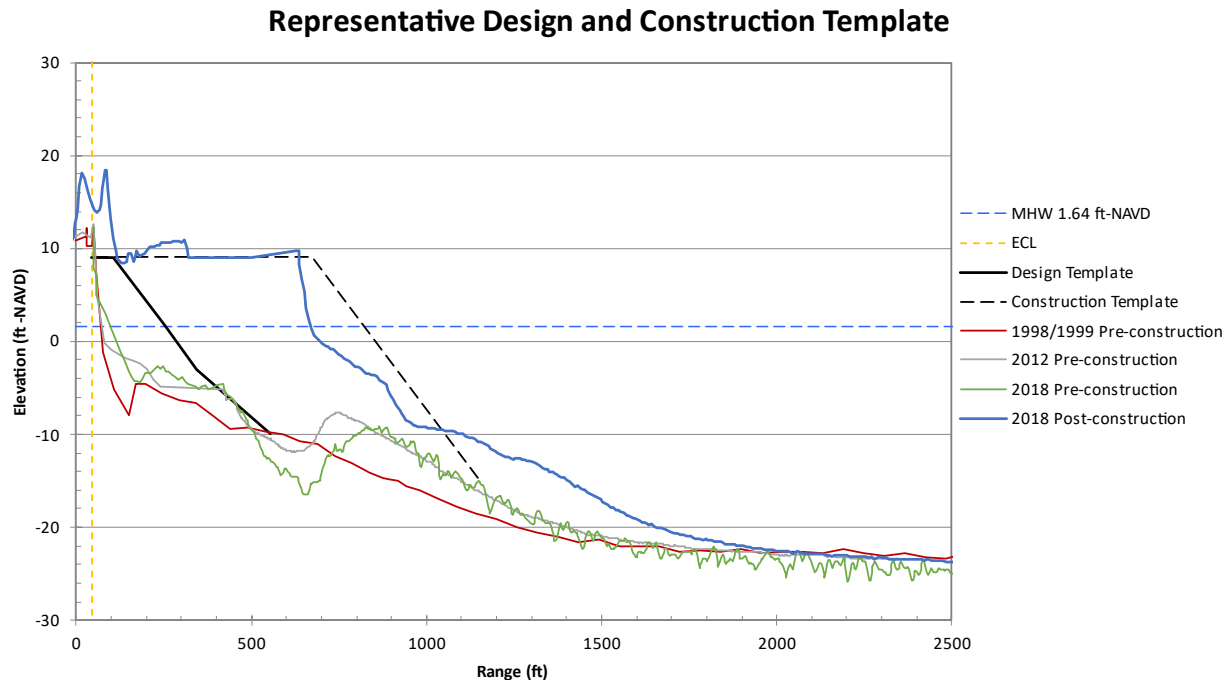


Figure 3.14 Representative Design and Construction Templates

As the authorized design berm width is fundamental to the project’s storm protection benefits, analysis of the remaining berm width indicates project performance. Table 3.9 shows the project performance based on the +6 ft-NAVD contour position (measured with respect to the FDEP monument location) before and after the 2018 nourishment, in 2020, and in 2021. Notably, this analysis did not use the +9 ft-NAVD authorized berm elevation, as some profiles had a wide berm that peaked just shy of this elevation. Additionally, due to lack of fill placement at the south end of the project area in 2012 and 2018, the existing berm, though wide, does not reach the authorized elevation. Therefore, this analysis selected an elevation of +6 ft-NAVD to avoid skewed results from such discrepancies. The +6 ft-NAVD contour generally lies within an area of the profile with a similar slope as the design profile and provides a reasonable representation of the existing berm width relative to the design template.

Prior to the 2018 project, existing conditions breached the +6 ft-NAVD contour (the “berm”) of the design template at R-142 to R-143 and R-150 to R-151; overall, the berm remained 38.7 ft seaward of the design template on average throughout the project area (R-137 to R-151). Laurent and Trudnak (2019) reported the effects of the 2018 project, indicating the 2018 project advanced the berm 252.1 ft on average relative to pre-fill conditions within the 2018 placement area (R-140 to R-144), while the remainder of the project area experienced minimal change. Immediately after construction of the 2018 project, the berm was located 154.0 ft seaward of the design template on average within the project area.

As of August 2019, one year after construction, the berm remained 140.9 ft seaward of the design template on average throughout the project area. Two years following construction, the shoreline breached the design template at R-142, R-150, and R-151; however, on average, the project area remained 133.7 ft seaward of the design template. Analysis of the year three post-construction survey indicates the berm shifted an average of -19.7 ft landward in the project area over the past year. The berm breached the design berm at R-142, R-150, and R-151; the berm position lies within 40 ft of the design

berm position at R-141 and R-143T. On average, the berm lies 114.1 ft seaward of the design berm throughout the full project area and 40.2 ft seaward of the design berm in the 2018 placement area.

Table 3.9 Berm Position Summary

FDEP Reference Monument	6 ft- NAVD Design Berm Position (ft)	Distance from Design Berm Position (ft, + seaward/- landward)					Berm Position Change (ft)			
		1999 Baseline	2018 Pre-Fill	2018 Post-Fill	2020 Year 2	2021 Year 3	1999 baseline – 2021 Year 3	2018 Pre-Fill – 2021 Year 3	2018 Post-Fill –2021 Year 3	2020 Year 2 – 2021 Year 3
R-137A	305.0	-257.8	8.5	126.3	165.7	151.6	409.4	143.1	25.3	-14.1
R-138	210.4	-210.4	118.6	125.6	221.2	212.1	422.4	93.5	86.4	-9.1
R-139	289.5	-226.7	106.5	385.7	254.2	218.3	445.0	111.8	-167.4	-35.9
R-140	302.8	-253.5	32.2	368.3	207.8	131.8	385.3	99.6	-236.5	-76.0
R-141	318.6	-250.7	8.7	328.2	128.3	16.3	267.1	7.7	-311.8	-112.0
R-142	186.8	-128.2	-130.1	195.7	-76.8	-132.3	-4.1	-2.2	-328.0	-55.5
R-143T	396.8	-133.4	-52.2	175.5	76.7	37.8	171.2	90.0	-137.7	-38.9
R-144	311.0	-129.9	44.7	200.7	189.1	164.1	294.0	119.4	-36.6	-25.0
R-145	323.3	-135.6	119.6	111.9	214.3	231.1	366.7	111.5	119.2	16.9
R-146	285.2	-181.5	168.2	158.7	230.1	244.7	426.2	76.5	86.0	14.6
R-147	501.4	-212.0	126.3	106.6	173.1	225.3	437.3	99.0	118.8	52.2
R-148	279.6	-236.8	59.8	70.4	170.0	189.4	426.2	129.6	119.0	19.4
R-149	318.0	-235.1	35.5	63.6	133.0	55.4	290.5	19.8	-8.2	-77.7
R-150	300.8	-261.2	-25.6	-33.7	-38.8	-16.5	244.6	9.0	17.2	22.3
R-151	384.9	-239.4	-33.3	-50.3	-28.9	-7.3	232.1	26.1	43.0	21.7
Weighted Average		-205.9	38.7	154.0	133.7	114.1	320.0	75.4	-39.9	-19.7

4.0 EBB SHOAL BATHYMETRIC ANALYSIS

This chapter documents observed changes to the St. Augustine Inlet ebb shoal complex through analysis of the following bathymetric surveys: 2018 pre-dredge, 2018 post-dredge, 2020 year 2, and 2021 year 3 conditions. As previously mentioned, the 2018 project dredged the eastern end of the navigation channel (within the ebb shoal region) in addition to the south end of the permitted borrow area in the southern lobe of the ebb shoal; the project did not dredge any part of the shoals or navigation channel by Porpoise Point. The St. Johns County CSR project for Vilano Beach utilized shoals in the inlet interior as borrow areas for its nourishment in 2021. Figure 4.1 shows the borrow area and survey boundaries. Due to weather restrictions, the 2020 inlet survey occurred between July and October 2020 and acts as a pre-dredge survey for the CSR project. Additionally, the 2021 year three inlet survey occurred between March and May 2021 and acts as a post-dredge survey for the CSR project; this survey is noted as the 2021 interim survey in the 2020 monitoring report (Laurent, Craig, and Lamb). In addition to meeting the requirements of the joint coastal permit for the SPP project, the comparison of the 2020 year two survey and the 2021 year three survey depicts the changes to the inlet as a result of the CSR project and updates information regarding the inlet's sand resources.

Taylor Engineering applied digital terrain modeling techniques to the survey data to create three-dimensional representations. Figure 4.2 to Figure 4.5 present the 2018 pre-dredge, 2018 post-dredge, 2020 year two, and 2021 year three bathymetric surfaces. Figure 4.6 presents the 2018 pre-dredge to 2021 year three bathymetric changes, Figure 4.7 presents the 2018 post-dredge to 2021 year three changes, and Figure 4.8 presents the 2020 year two to 2021 year three changes. Figure 4.9 depicts the sediment thickness above the authorized dredge depths and Figure 4.10 shows the elevation changes along cross-sectional transects through the ebb shoal borrow area as depicted in Figure 4.1. Table 4.1 presents the volume changes, as depicted in Figure 4.6 to Figure 4.8, rounded to the nearest hundred cubic yards.

Table 4.1 Inlet and Borrow Area Volume Changes

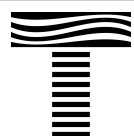
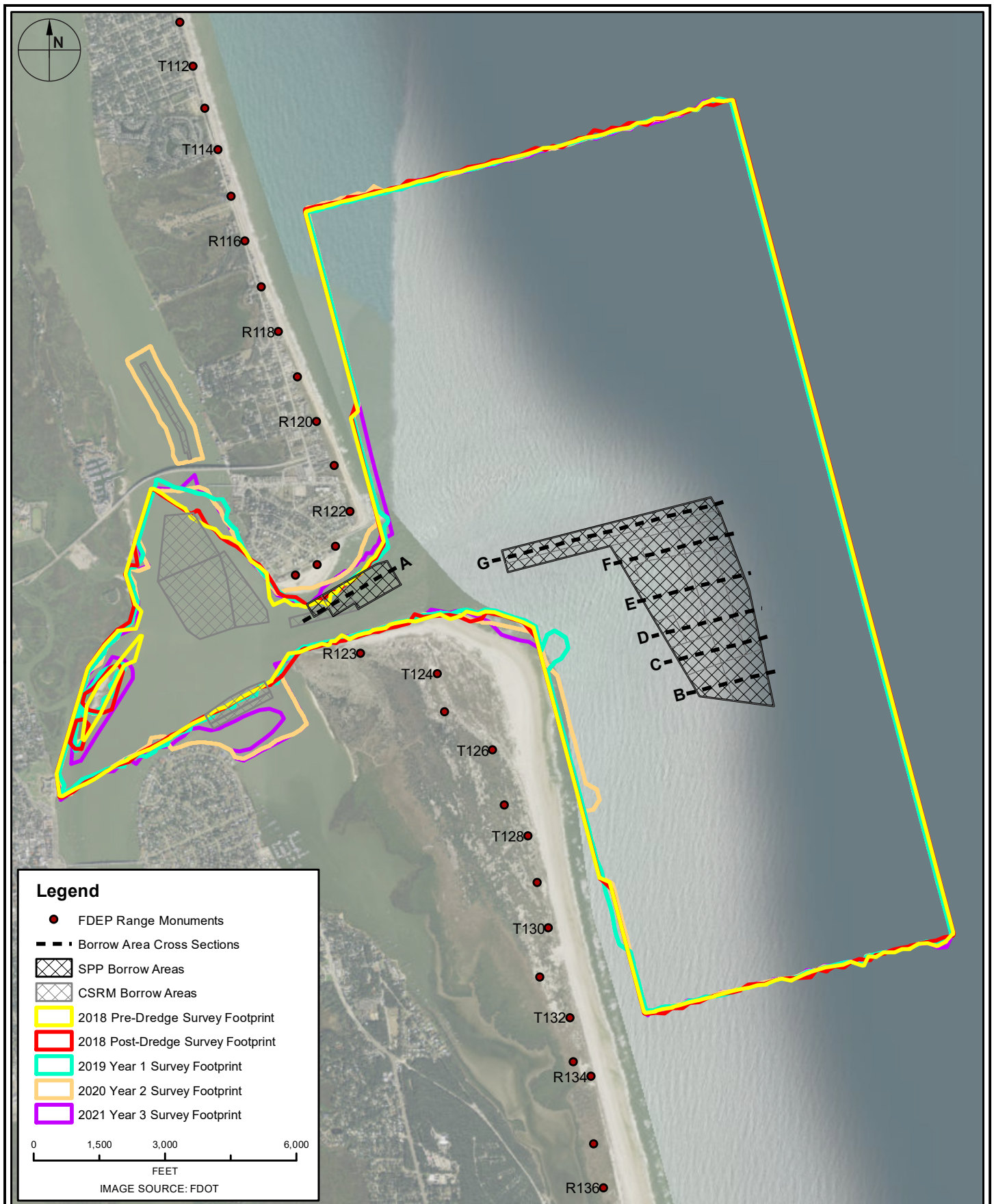
Comparison		Volume Change (cy)		
		Full Survey Extent	Ebb Shoal Borrow Area	Porpoise Point Borrow Area
2018 pre-dredge – 2021 year three	Cut	-4,754,400	-813,500	-52,000
	Fill	4,425,600	907,200	41,900
	Net	-328,800	93,700	-10,100
2018 post-dredge – 2021 year three	Cut	-4,562,400	-381,200	-46,900
	Fill	3,908,200	1,134,700	92,600
	Net	-654,200	753,500	45,700
2020 year two – 2021 year three	Cut	-3,667,500	-183,700	-80,700
	Fill	1,847,900	401,600	54,500
	Net	-1,819,700	217,900	-26,200

Comparing the 2021 year three survey to the October 2017 (i.e., 2018 pre-dredge) survey indicates the ebb shoal borrow area increased in volume by 93,700 cy; a decrease in volume totaling -813,500 cy

occurred primarily in the navigation channel and the south end of the borrow area (i.e., the areas dredged in 2018), whereas accretion of 907,200 cy occurred primarily in the central portion of the borrow area. The entire survey area decreased in volume by -328,800 cy. Throughout the entirety of the survey area, the most severe losses occurred within the 2021 CSRM borrow area and within the navigation channel at the north of the ebb shoal borrow area where the 2018 project dredged (Figure 4.6). The most significant accretion occurred along the crest of the northern lobe of the ebb shoal and within the central section of ebb shoal. Other areas where significant accretion occurred include within the inlet, at the north and south of the inlet throat, and in the nearshore at R-125.

Three years following construction (i.e., the 2018 post-dredge – 2021 year three comparison), the 2018 borrow area gained 753,500 cy of material. This volume includes -381,200 cy of volume loss, which occurred primarily along a strip immediately south of and parallel to the navigation channel. 1,134,700 cy of accretion occurred in the central region of the borrow area and in the navigation channel; infilling is evident in areas that the 2018 project dredged (Figure 4.7). Accretion trends continued at the inlet throat and north of the ebb shoal. Erosion is evident along the western edge of Porpoise Point and across the inlet flood shoal where it was dredged for the CSRM project.

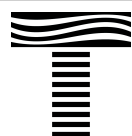
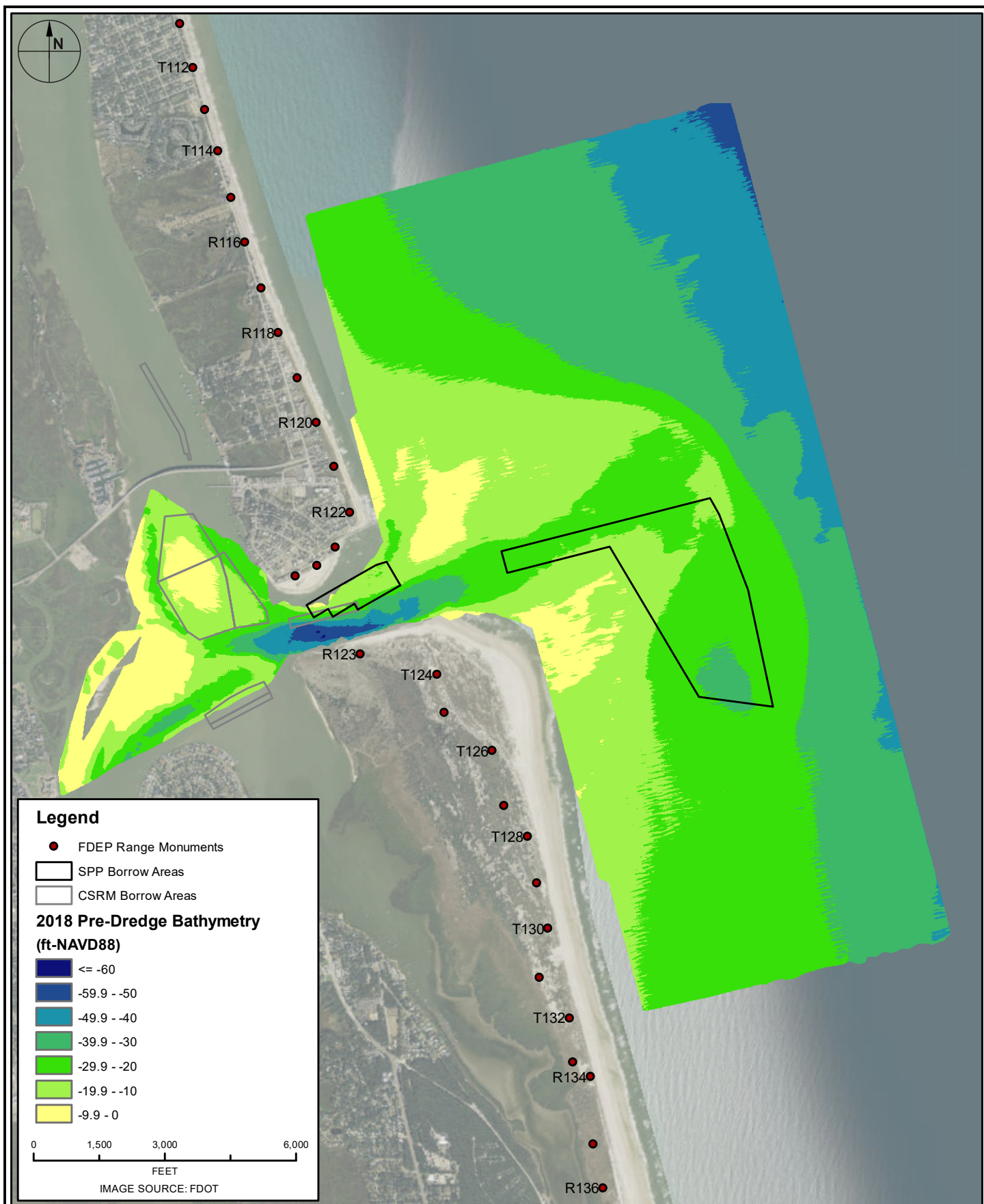
Over the past year (2020 year two – 2021 year three), the ebb shoal borrow area gained 217,900 cy of sediment. The accretion occurred in the navigation channel and central region of the ebb shoal. In total, the survey domain lost -1,819,700 cy (the net of -3,667,500 cy of sediment loss and 1,847,900 cy of accretion). Volume loss primarily occurred in the 2021 CSRM borrow areas—the flood shoal and Davis shoal. In addition, although the CSRM borrow area located in the inlet throat was not dredged, it still experienced significant erosion in the past year. Apart from areas dredged as part of the CSRM project, generally areas of significant erosion and accretion occurred close to each other, indicating localized redistribution of material. Figure 4.9 depicts the available sediment above the authorized dredge limits which totals to less than 0.15 million cy within the Porpoise Point Borrow Area, 0.7 million cy in the inlet entrance channel, and 3.0 million cy in the southern lobe of the ebb shoal. Notably, available volumes are limited by the St. Augustine Inlet Management Implementation Plan which limits the project volume to 179,000 cy/yr times the number of years between nourishment events.



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**FIGURE 4.1 ST. JOHNS COUNTY SPP
BORROW AREA AND SURVEY BOUNDARIES
ST. JOHNS COUNTY, FLORIDA**

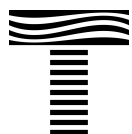
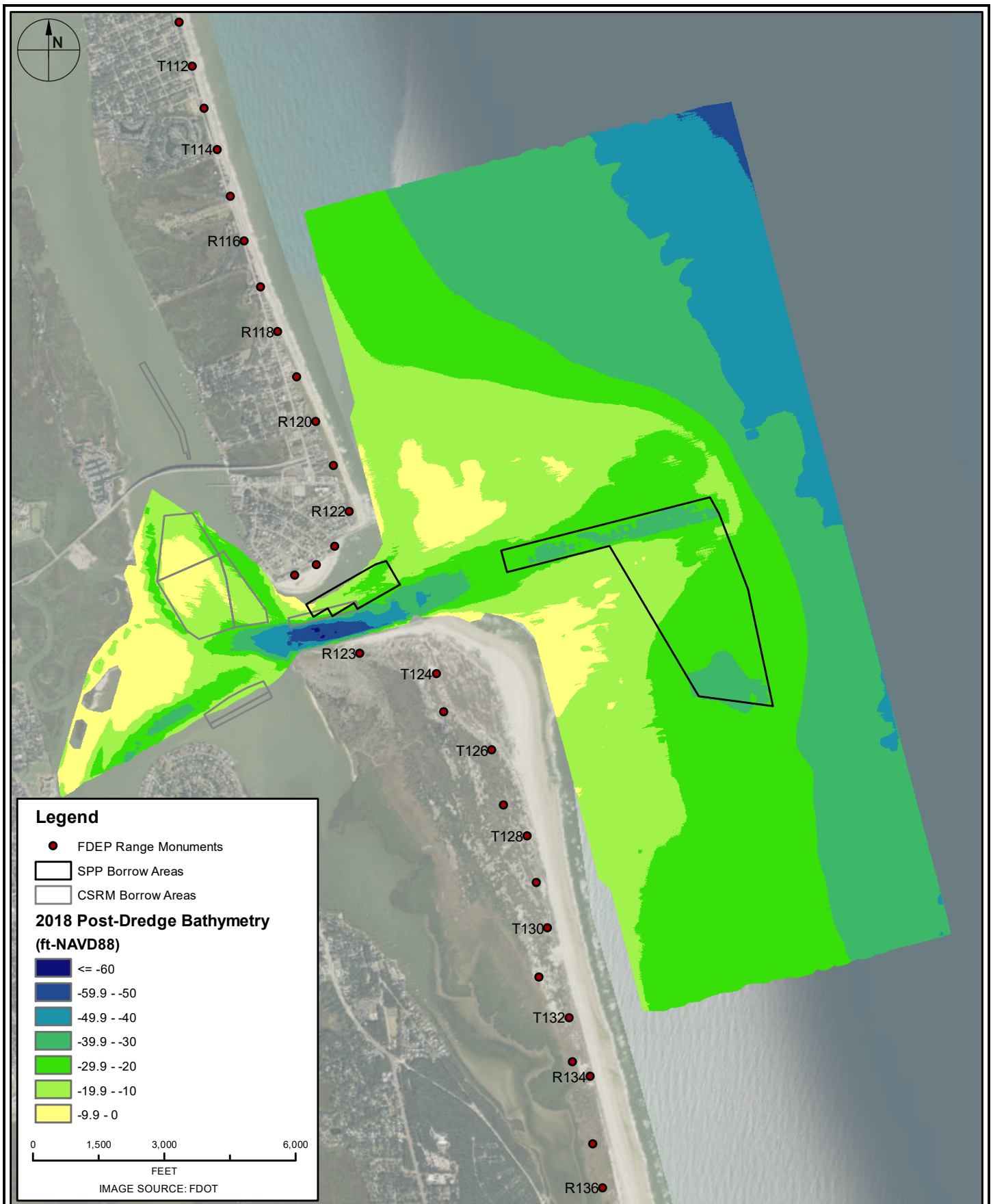
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**FIGURE 4.2 ST JOHNS COUNTY SPP
2018 PRE-DREDGE CONDITIONS
ST JOHNS COUNTY, FLORIDA**

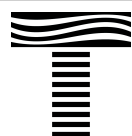
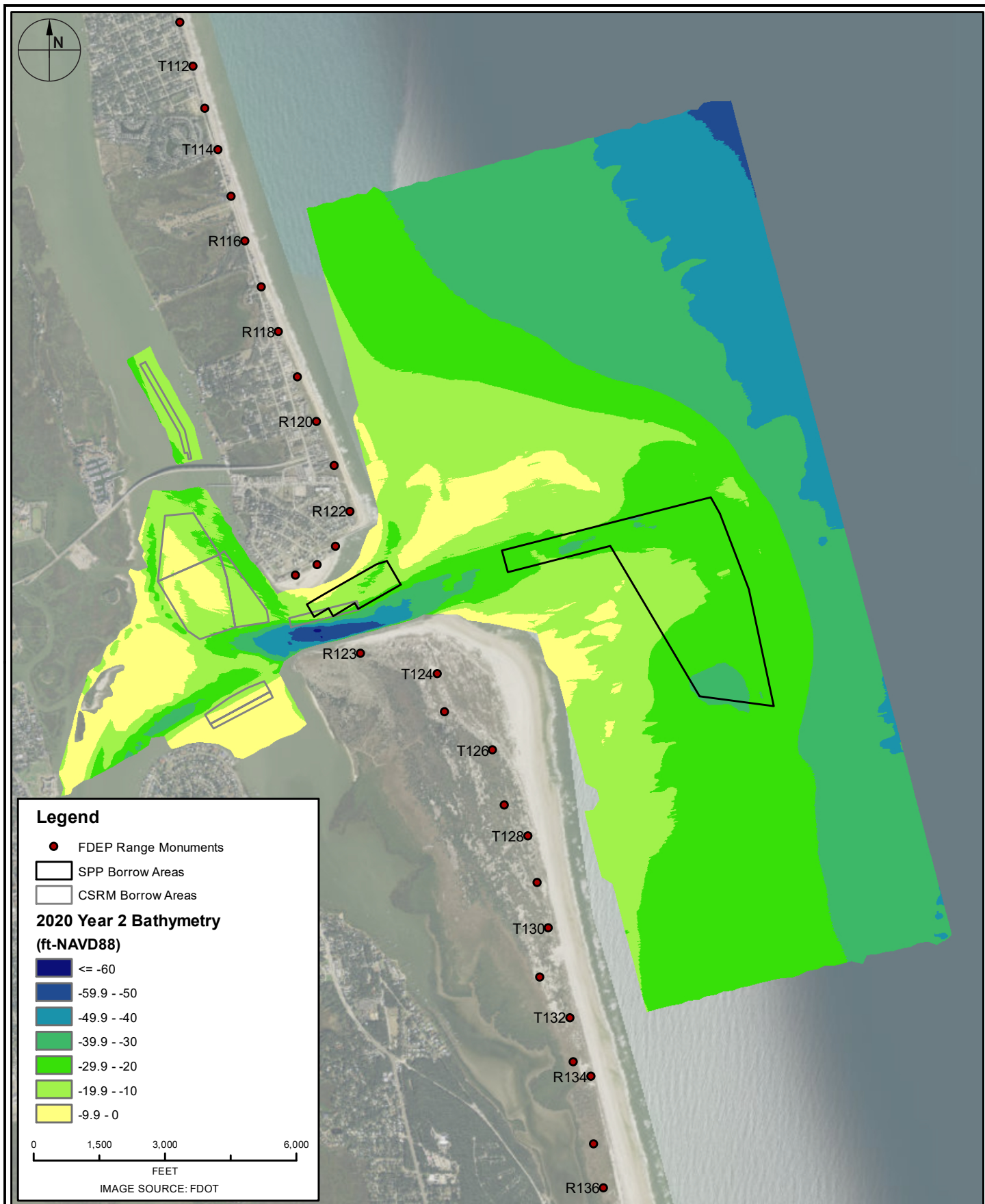
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**FIGURE 4.3 ST JOHNS COUNTY SPP
2018 POST-DREDGE CONDITIONS
ST JOHNS COUNTY, FLORIDA**

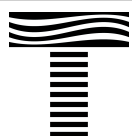
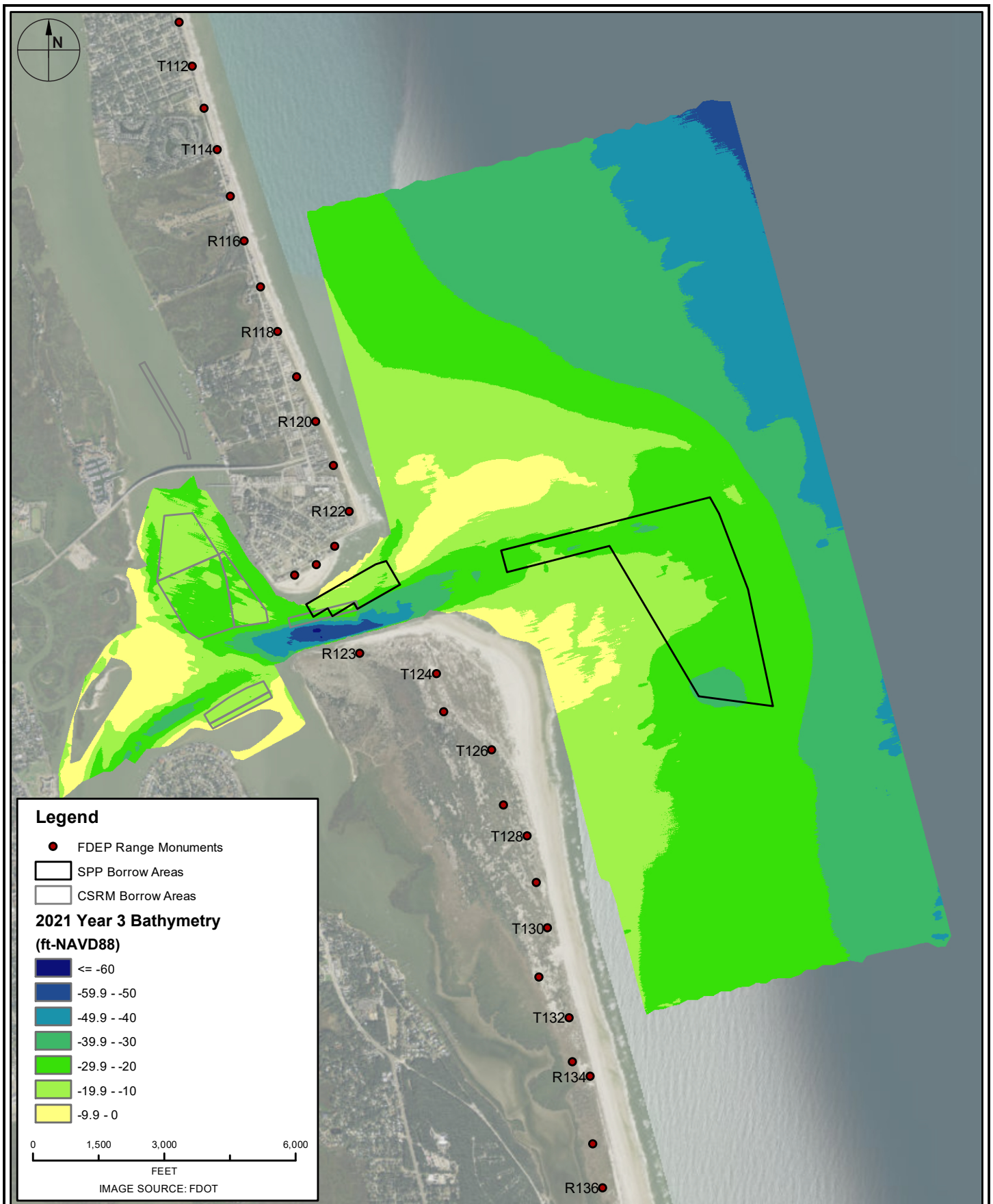
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**FIGURE 4.4 ST JOHNS COUNTY SPP
2020 YEAR 2 CONDITIONS
ST JOHNS COUNTY, FLORIDA**

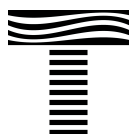
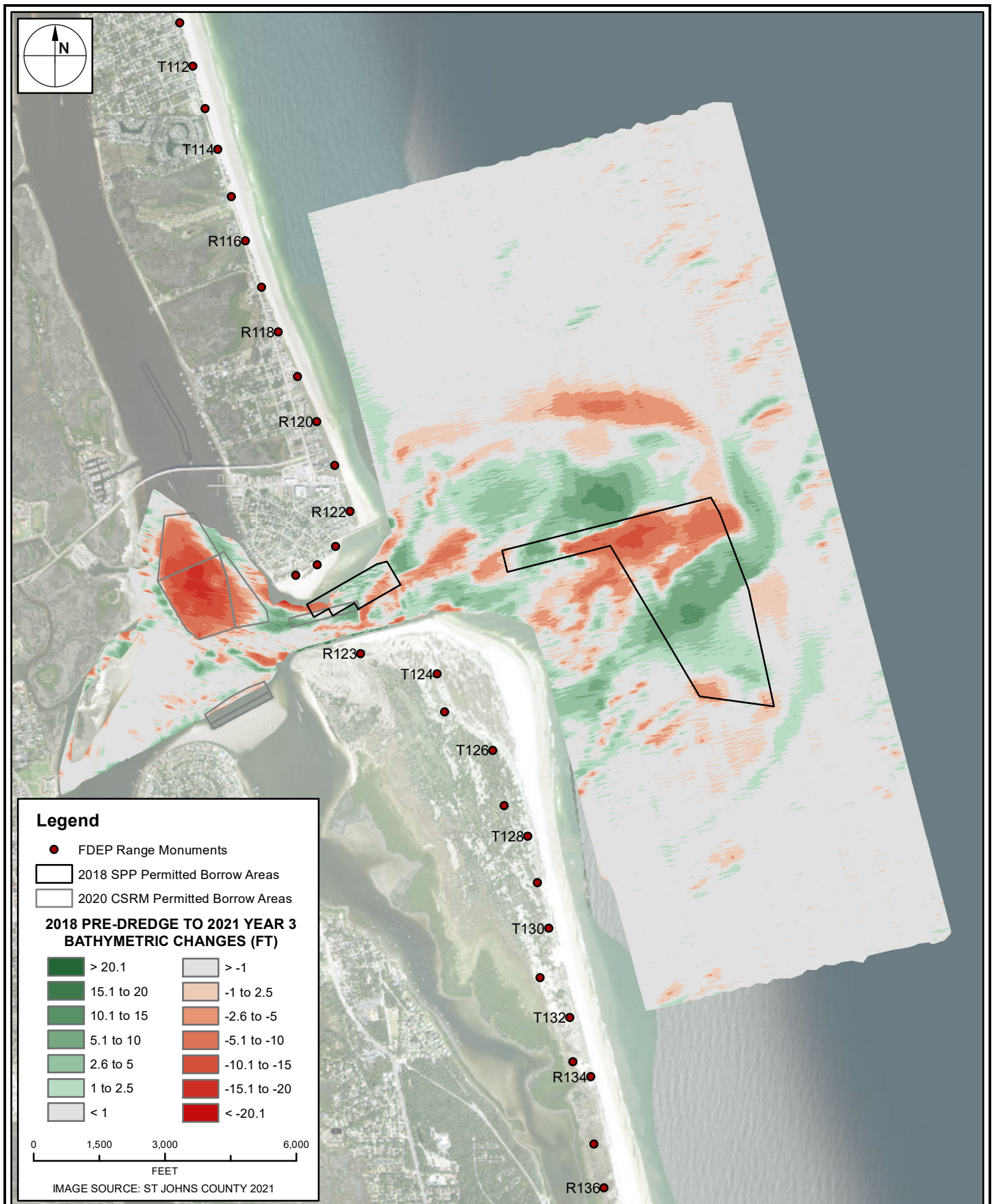
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**FIGURE 4.5 ST JOHNS COUNTY SPP
2021 YEAR 3 CONDITIONS
ST JOHNS COUNTY, FLORIDA**

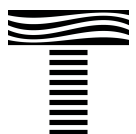
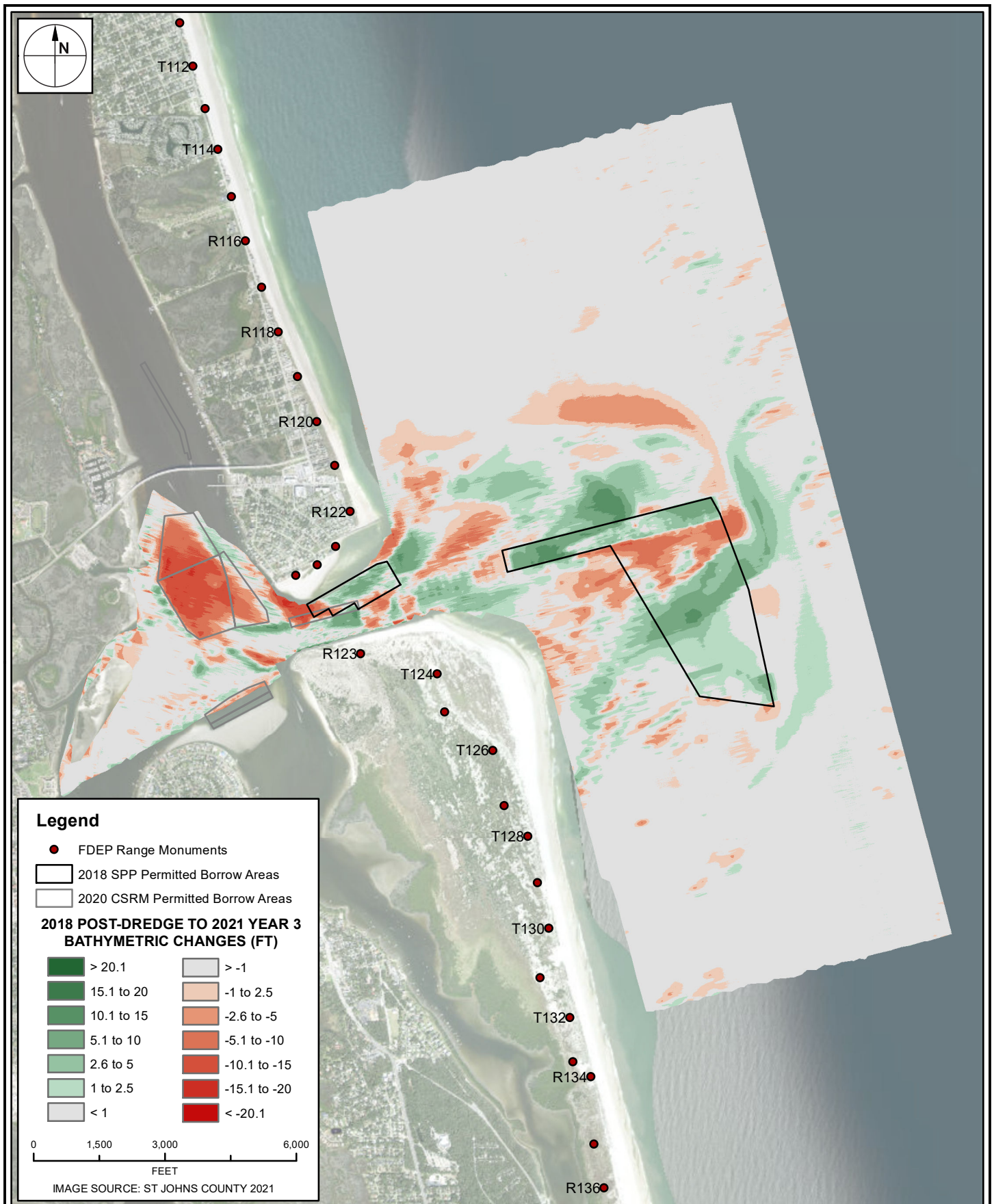
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**FIGURE 4.6 ST JOHNS COUNTY SPP
2018 PRE-DREDGE TO 2021 YEAR 3
BATHYMETRIC CHANGES
ST JOHNS COUNTY, FLORIDA**

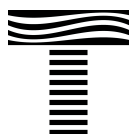
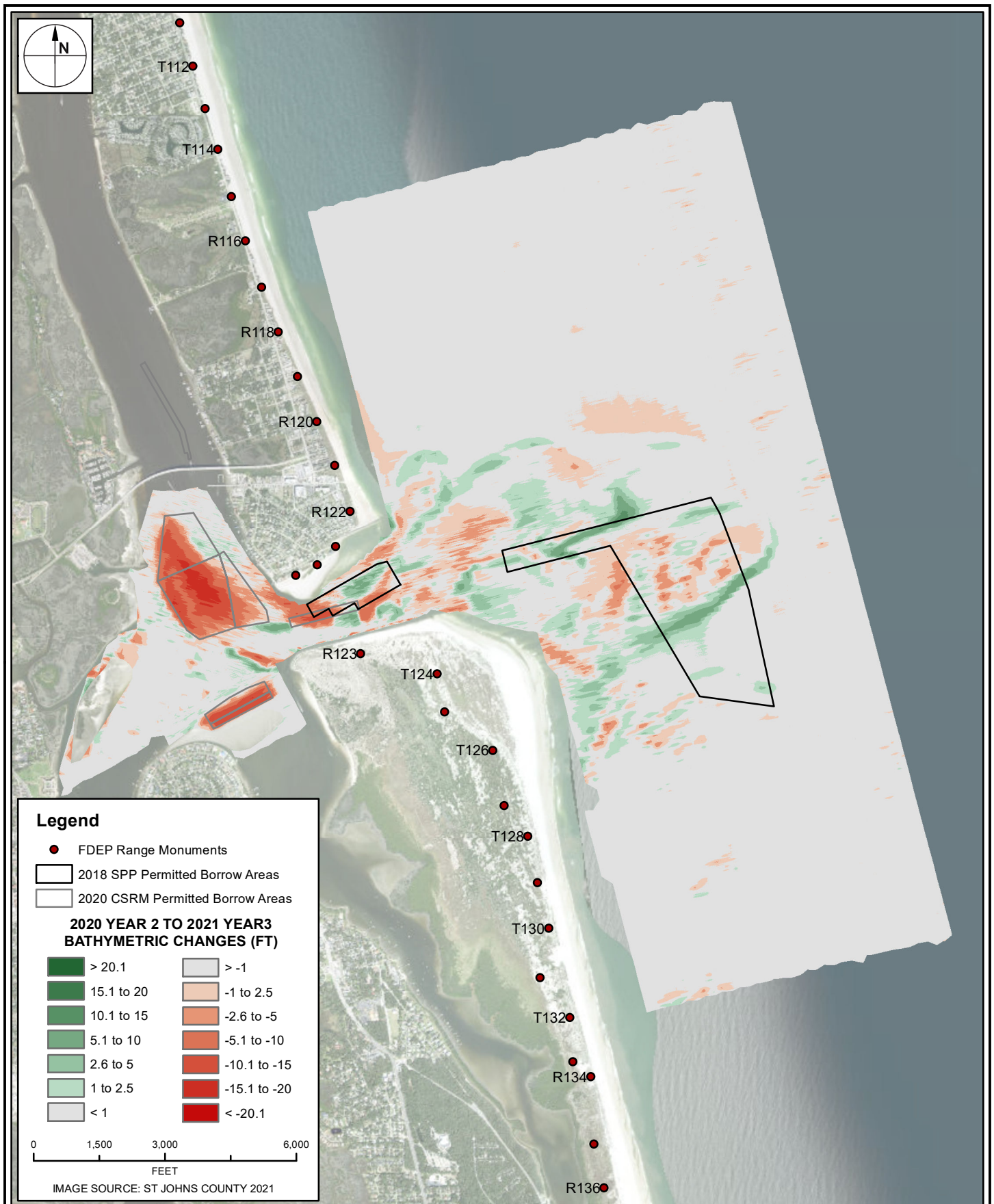
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**FIGURE 4.7 ST JOHNS COUNTY SPP
2018 POST-DREDGE TO 2021 YEAR 3
BATHYMETRIC CHANGES
ST JOHNS COUNTY, FLORIDA**

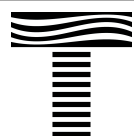
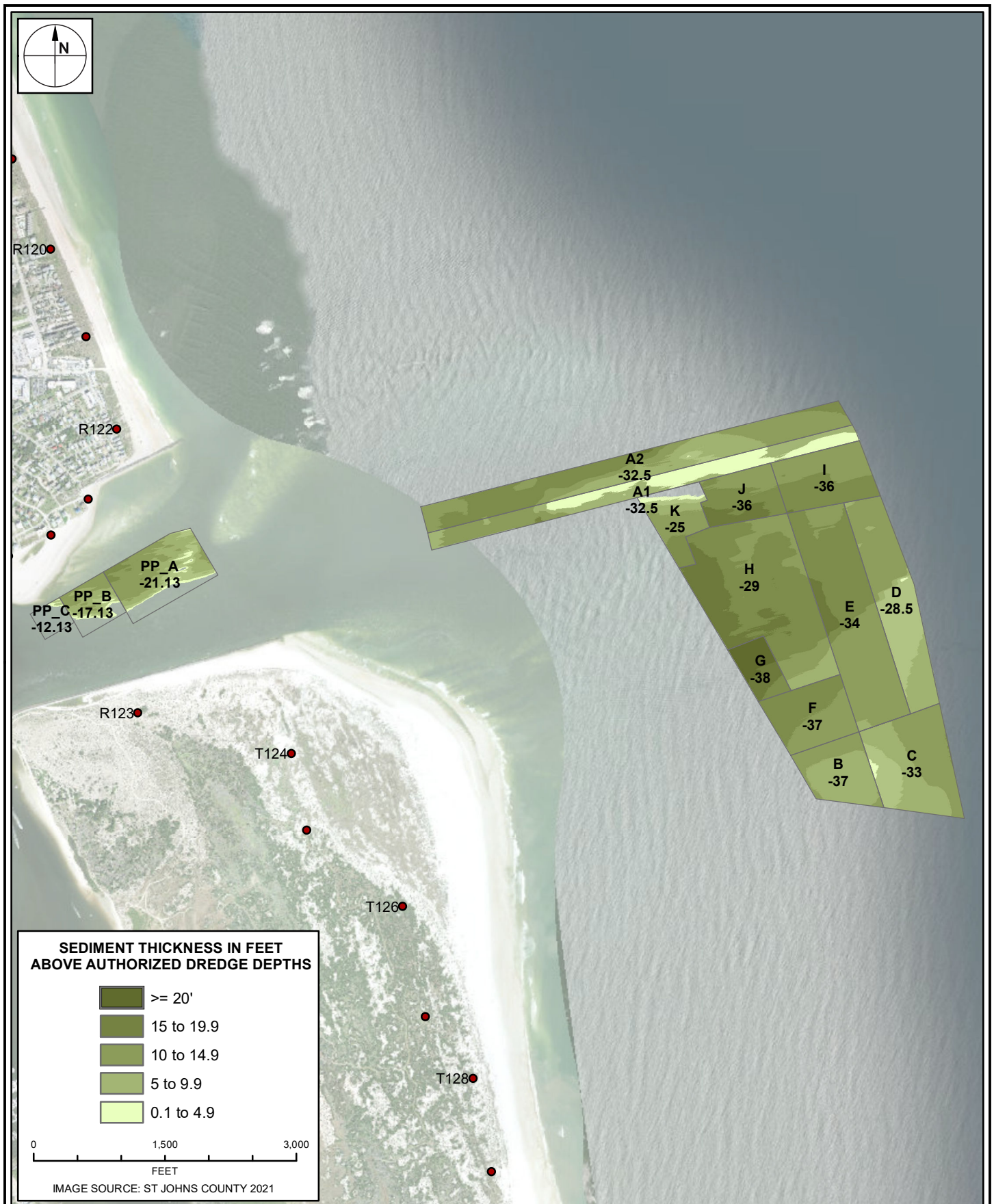
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**FIGURE 4.8 ST JOHNS COUNTY SPP
2020 YEAR 2 TO 2021 YEAR 3
BATHYMETRIC CHANGES
ST JOHNS COUNTY, FLORIDA**

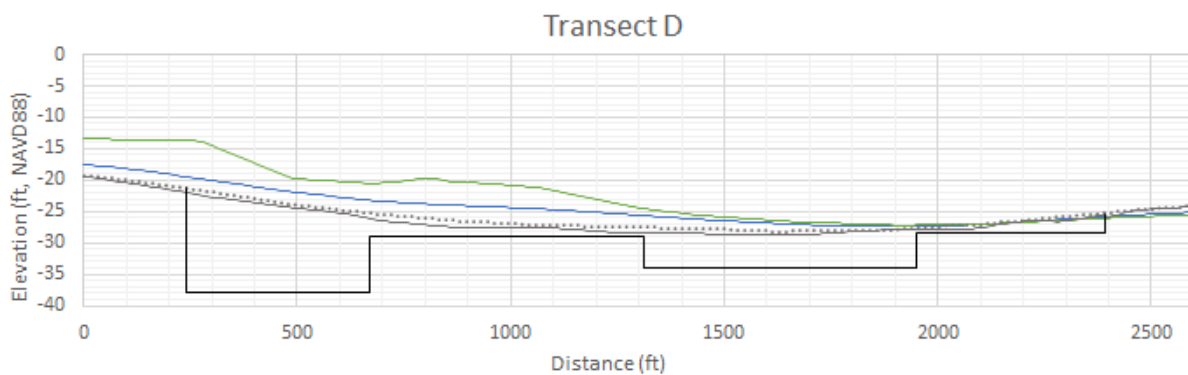
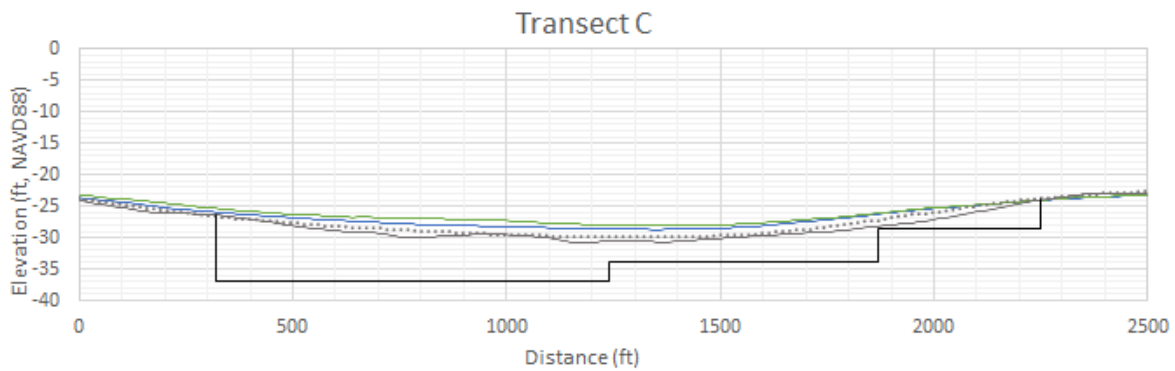
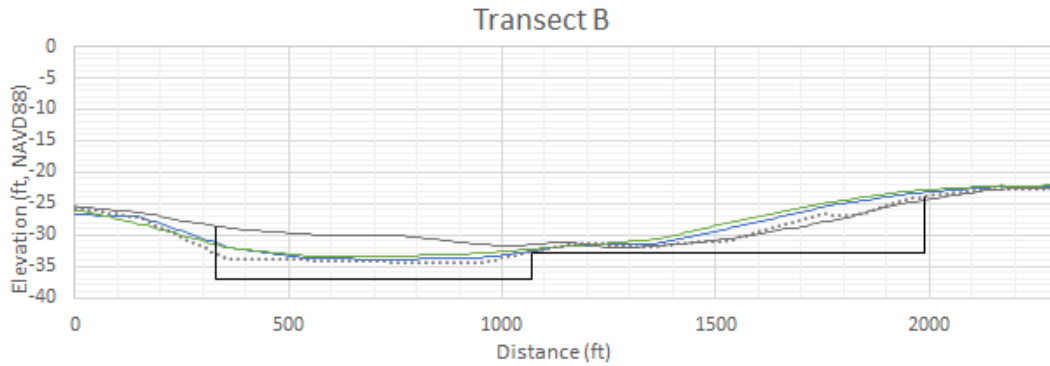
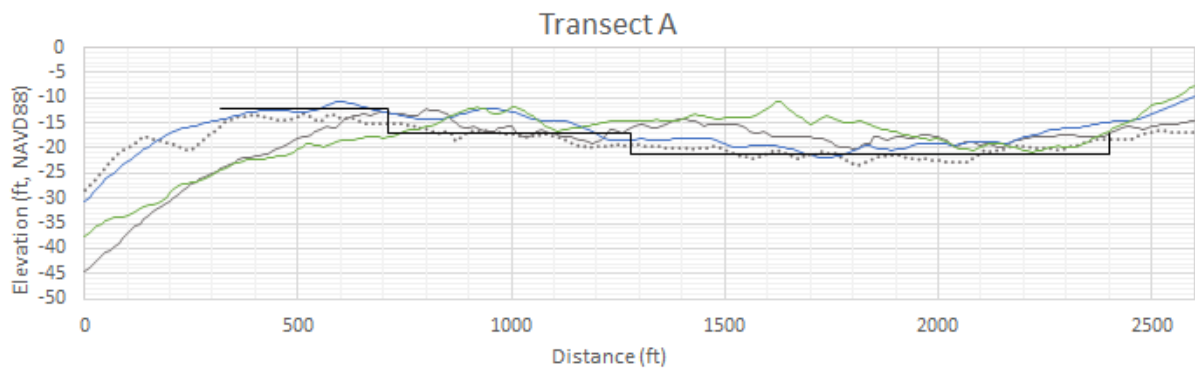
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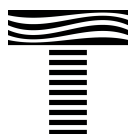
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**FIGURE 4.9 ST JOHNS COUNTY SPP
 BORROW AREA SEDIMENT THICKNESS
 ABOVE AUTHORIZED DREDGE DEPTHS
 ST JOHNS COUNTY, FLORIDA**

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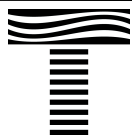
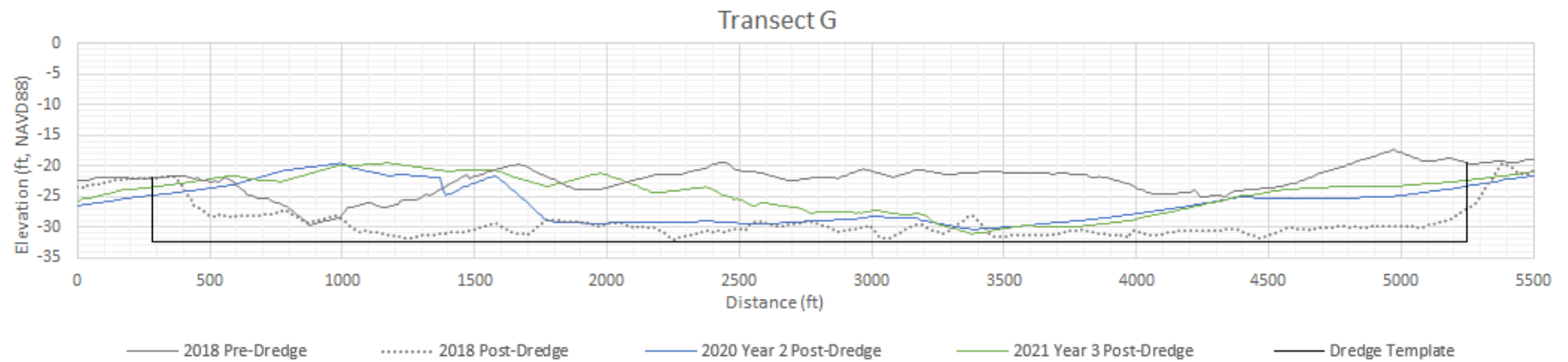
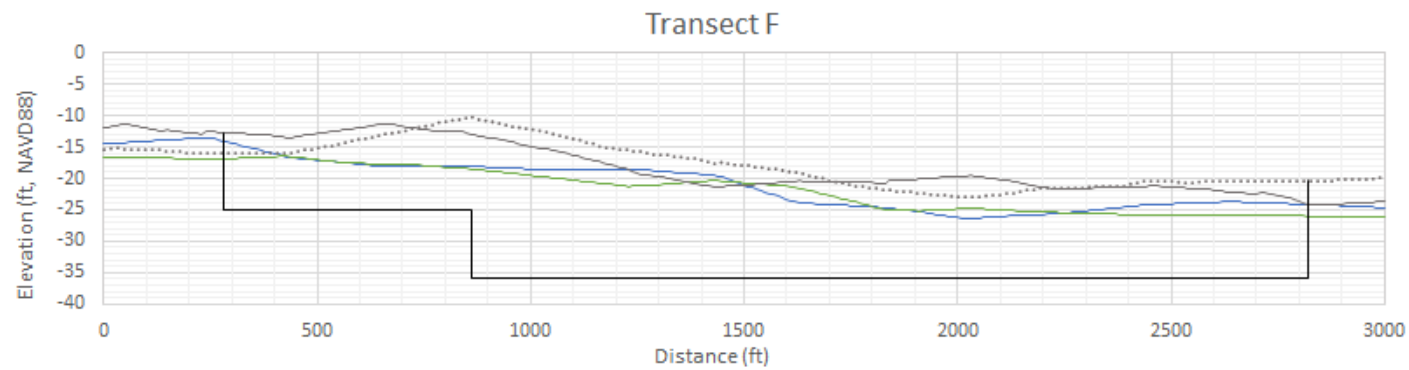
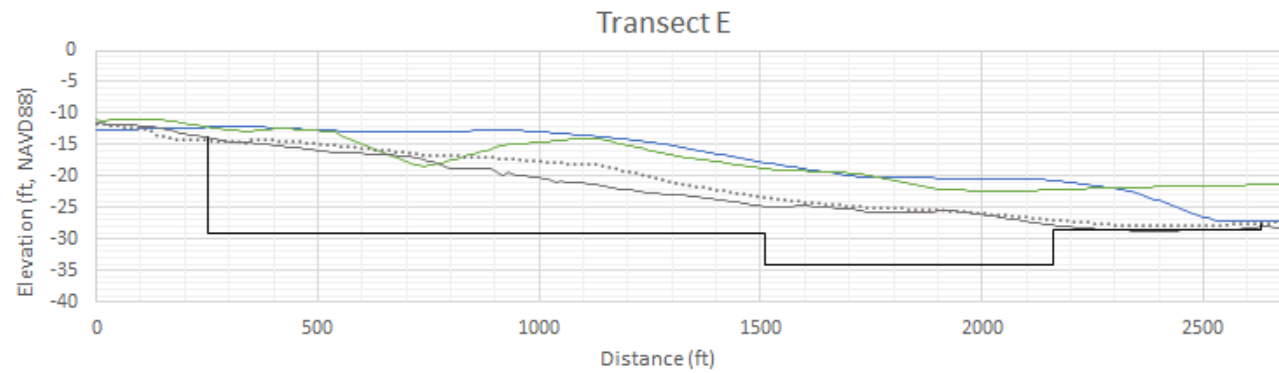
—— 2018 Pre-Dredge
..... 2018 Post-Dredge
—— 2020 Year 2 Post-Dredge
—— 2021 Year 3 Post-Dredge
—— Dredge Template



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**FIGURE 4.10 ST. JOHNS COUNTY
 SPP BORROW AREA TRANSECTS
 ST. JOHNS COUNTY, FLORIDA**

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FIGURE 4.10 ST. JOHNS COUNTY SPP
 BORROW AREA CROSS SECTIONS
 ST. JOHNS COUNTY, FLORIDA

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5.0 CONCLUSIONS

5.1 Summary

This report satisfies the year three post-construction monitoring requirements for the 2018 nourishment of the St. Johns County SPP as required by FDEP Permit Number 0295429-002-JC. For beach monitoring, the shoreline and beach volume analyses compare the 1998/99 baseline (i.e., pre-construction survey of the 2002 restoration project), 2018-pre-fill, 2018 post-fill, and 2020 year two conditions to the 2021 year three conditions. The 1998/99 baseline to 2021 year three comparison demonstrates the cumulative effect of the 2002, 2005, 2012, and 2018 nourishment projects. The 2018 pre-fill to 2021 year three comparison shows the effect of the 2018 project approximately three years after construction. The 2018 post-fill to 2021 year three comparison details the evolution of the 2018 project since construction. Finally the changes over the past year are illustrated in the 2020 year two to 2021 year three comparison. The longshore diffusion and berm width analyses also document project performance. For borrow area monitoring, comparisons of the 2018 pre-dredge, 2018 post-dredge, and 2020 year two conditions to the 2021 year three conditions reveal changes within the St. Augustine Inlet channel and ebb shoal complex.

5.1.1 Control Areas

Overall, the north control area gained 1.7 cy/ft on average (22,907 cy total) over the past year. The central portion of the control area showed moderate accretion which transitioned to mostly mild to moderate erosion to the north and south. Above MHW the control area gained 6.0 cy/ft on average (82,748 cy total) while the area between MHW and -20 ft-NAVD had a minimal loss of -0.1 cy/ft on average (-1,400 cy total). The measured erosion increased with proximity to the inlet, which is a historically dynamic area. The most erosion occurred below -20 ft-NAVD (averaging -4.3 cy/ft or -58,441 cy total). Consistent with the minor gain in volume in the north control area, the MHW contour shifted seaward an average of 5.4 ft. The shoreline fluctuated between advance and retreat throughout the north control area, with the most significant changes near the inlet.

In the past year the south control area experienced moderate losses, with accretion occurring only at R-153 and R-155. The area averaged -14.6 cy/ft of erosion on average, or -85,163 cy total. The most significant losses occurred below the -20 ft-NAVD contour (averaging -20.4 cy/ft, -119,107 cy), while minor losses occurred between MHW and -20 ft-NAVD (averaging -2.0 cy/ft, -11,697 cy), and moderate accretion occurred above MHW (averaging 7.8 cy/ft, 45,641 cy). Since 1998/99, the north control area lost -623,577 cy (-45.4 cy/ft), primarily due to subaqueous erosion at R-126, R-127, and R-128; meanwhile, the south control area gained 1,881,299 cy (321.6 cy/ft) from net southerly dispersion of fill and experienced gains at all monuments for all the analyzed vertical compartments. The MHW position change from the baseline condition decreases with movement away from the project area indicating the dispersion of fill from the project area and into both the north and south control areas. In the past year, significant seaward movement occurred at R-133 and R-134, otherwise MHW shoreline positions remained relatively stable, fluctuating between minor shoreline advance and retreat.

5.1.2 North of St. Augustine Inlet

Overall, mild to moderate accretion occurred north of the inlet over the past year with the CSRM project controlling the monitoring area's averages and accretion trends. The largest volume gains occurred between MHW and -20 ft-NAVD averaging 36.0 cy/ft (1,559,625 cy); this increase in nearshore volume is

observed outside of the CSRM footprint and might indicate the positive effects of fill dispersion paired with a calm period allowing for beach recovery. Moderate accretion occurred above MHW and below -20 ft-NAVD averaging 6.5 cy/ft (290,706 cy) and 8.0 cy/ft (355,952 cy), respectively. Monuments to the north of the CSRM project experienced mild accretion rates and to the south experienced variable erosion and accretion. In the past year, the northernmost section of Vilano Beach experienced mild shoreline retreat until about R-90, where the trend transitioned to shoreline advance.

Initial construction of the federal Vilano Beach Coastal Storm Risk Management Project occurred in 2020. In addition to this project, a one-time nourishment of the beach directly north of this project in South Ponte Vedra Beach is set to occur in the next year. Due to these nourishment events, Taylor Engineering suggests that this section of beach is either monitored independently or monitored as one large, combined report in the future. We recommend further discussions with FDEP and USACE to choose the best strategy for monitoring these overlapping areas. If all three projects are collecting and analyzing data, unique perceptions of what is occurring along this section of beach could occur due to differing interpretations of data.

5.1.1 Project Area

During the third year following construction of the 2018 project, the project area (R-137 to R-151) MHW shoreline receded an average of -12.6 ft, with moderate recession occurring within the 2018 placement area (R-140 to R-144) and mild recession and accretion to the north and south. The project area still lies an average of 48.1 ft seaward of the pre-project MHW location despite breaching the pre-fill shoreline position at R-140 and R-141. The berm moved landward -352.3 ft on average (Section 3.5). Similar to the MHW shoreline position, the analysis of the year three post-construction survey indicates the berm shifted an average of -19.7 ft landward in the project area over the past year. The berm breached the design berm at R-142, R-150, and R-151 and is nearing the design berm position at R-141 and R-143T. On average, the berm lies 114.1 ft seaward of the design berm throughout the full project area and 40.2 ft seaward of the design berm in the 2018 placement area.

Beach volume analyses indicate the project area experienced moderate erosion three years following construction. As expected, erosion was the largest within the 2018 placement area and decreases with movement away from the project area— a pattern indicative of fill dispersion. Overall, the project area (R-137 to R-151) lost -23.4 cy/ft on average (-338,073 cy total), with mild erosion occurring above and below MHW (-9.0 cy/ft and -14.4 cy/ft, respectively). Relative to pre-construction conditions, the project area gained 118.4 cy/ft on average (967,282 cy total), with accretion occurring at all profiles. The beach profiles (Appendix B) indicate the growth of a nearshore bar around the -10 ft-NAVD contour from the inlet south to approximately R-143; this growth of the nearshore bar is likely due to a period of relatively low storm activity occurring since 2018 and allowing for calm conditions and beach recovery.

5.1.2 Porpoise Point

Net erosion occurred at Porpoise Point over the past year averaging -43.2 cy/ft or -47,632 cy in total. This contrasts with the monitoring data from the previous year, which indicated accretion across all comparison periods in 2020 (Laurent, Craig, and Lamb, 2021). In general, the most eastern portion of the point (R-122A) experienced moderate accretion, while the central (R-122B) and western (R-122C) portions of the point experienced moderate to significant erosion. Majority of volume loss occurred below -20 ft-NAVD, where the channel bank shifted north to a similar position as the 2018 pre-fill condition—this accounted for -41.7 cy/ft of erosion on average. Significant changes above MHW occurred at R-122B

where the shoreline retreated and much of the berm became intertidal, lying between the MHW and MLW contours. These changes are reflected in the bathymetric analysis which also indicates significant changes within the inlet throat.

5.2 Recommendations

Taylor Engineering recommends that St. Johns County continue collecting and analyzing annual beach profile and borrow area bathymetry data in compliance with FDEP Permit Number 0295429-002-JC. Pre-construction, post-construction, and annual beach profiles provide crucial data for regional long-term monitoring and project planning. Following this year's report, physical monitoring is on a bi-annual schedule until the next nourishment event. Examination of the 2021 survey data indicates that as of September 2021, R-142, R-150, and R-151 breached the USACE approved design template and R-141 and R-143 are close to breaching the template. As of September 2021, an estimated 2.0 million cy is needed to fill the 2005/2012 construction template and approximately 1.7 million cy to fill the 2018 construction template. Notably, these volumes are indicative of beach conditions prior to erosive nor'easters that effected the County in the Fall of 2021. Areas of Porpoise Point receded significantly over the past year and we suggest the County continue to monitor the Point. Thus, future monitoring efforts should pay close attention to these erosional areas to track any beach recovery or additional erosion.

Overall the following conclusions are pulled from this year's physical monitoring analysis: continued dispersion of fill is observed from the placement area, throughout the project area, and into the control areas; significant erosion at the center of the 2018 placement area continues; the effects of the CSRSM fill placement are evident within the Vilano Beach monitoring area; and a period of less extreme storm events allowed for beach recovery throughout the monitoring area following numerous years of significant storm events (Hurricane's Matthew and Irma in 2016 and 2017).

Taylor Engineering recommends the County seek permission to remove the monitoring area north of the inlet as it is included in studies for the nourishment activity in South Ponte Vedra and Vilano Beaches. Critically, the monitoring of the St. Augustine Inlet complex should continue paying close attention to the effects that the SPP and CSRSM projects have on each other, the inlet, and surrounding shorelines. We recommend a regional monitoring effort that discusses the monitoring of the South Ponte Vedra Dune Restoration Project, the CSRSM Project, and the SPP to provide one holistic perspective of all three projects, St. Augustine Inlet, and the beaches to its north and south. At the very least, we recommend combining the physical monitoring of the South Ponte Vedra Beach Dune Project with the CSRSM Project due to overlapping beach monitoring areas. Discussions between the County, FDEP, and Taylor Engineering should continue to discuss all options for monitoring the St. Johns County Beaches north and south of St. Augustine Inlet.

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Appendix A

FDEP Reference Monument Locations and Orientations

Table A.1 FDEP Reference Monument Locations and Orientation

Area Description	FDEP Monument	Northing ¹ (ft)	Easting ¹ (ft)	Azimuth ² (°N)	Elevation (ft-NAVD)
Vilano Beach (North of St. Augustine Inlet)	R-80	2071589.43	553221.69	75	13.2
	R-81	2070504.14	553451.43	75	15.7
	R-82	2069511.51	553687.17	75	12.1
	R-83	2068459.47	553869.00	75	16.8
	R-84	2067396.82	554120.03	75	14.6
	R-85	2066379.28	554356.02	75	15.6
	R-86	2065377.36	554556.60	75	17.3
	R-87	2064355.48	554819.38	75	18.9
	R-88	2063334.80	555042.04	75	17.8
	R-89	2062398.22	555233.72	75	17.0
	R-90	2061397.66	555472.63	75	15.5
	R-91	2060368.98	555664.56	75	18.2
	R-92	2059333.59	555876.17	75	14.0
	R-93	2058361.01	556112.12	75	13.5
	R-94	2057355.72	556301.45	75	21.8
	R-95	2056383.43	556495.90	75	19.1
	R-96	2055374.38	556760.02	75	15.2
	R-97	2054378.39	557002.40	75	23.5
	R-98	2053382.52	557200.08	75	24.7
	R-99	2052355.00	557425.03	75	23.6
	R-100	2051340.16	557661.96	75	17.6
	R-101	2050324.66	557879.74	75	18.3
	R-102	2049348.97	558103.42	75	24.5
	R-103	2048381.47	558321.91	75	18.1
	T-104	2047420.02	558557.68	75	21.4
	R-105	2046454.35	558792.65	75	15.3
	R-106	2045513.26	559073.67	75	22.4
	R-107	2044435.73	559357.88	75	24.7
	R-108	2043408.20	559630.27	75	16.7
	R-109	2042423.61	559870.56	75	21.9
	T-110	2041337.66	560153.48	75	25.8
	R-111	2040320.32	560466.29	75	26.5
	T-112	2039325.32	560768.11	75	24.4
	R-113	2038355.17	561043.54	75	20.3
	T-114	2037423.69	561335.16	75	20.0
	R-115	2036348.78	561648.28	75	13.7
	R-116	2035333.23	561962.61	75	11.8
	R-117	2034275.87	562336.86	75	12.8
	R-118	2033255.76	562719.89	75	15.6
	R-119	2032233.21	563155.84	75	12.3
	R-120	2031206.45	563598.70	75	10.8

Area Description	FDEP Monument	Northing ¹ (ft)	Easting ¹ (ft)	Azimuth ² (°N)	Elevation (ft-NAVD)
	R-121	2030203.64	564004.20	75	15.7
	R-122	2029152.76	564352.72	75	6.9
Porpoise Point (Inside Inlet)	R-122A	2028353.18	564027.90	155	9.5
	R-122B	2027938.21	563605.44	155	5.7
	R-122C	2027699.52	563116.29	155	7.3
North Control Area (Anastasia State Park)	R-123 ³	2025910.03	564595.34	75	9.3
	T-124	2025445.27	566349.61	75	17.3
	R-125	2024572.17	566521.02	75	11.2
	T-126	2023701.14	567618.67	75	6.9
	R-127	2022440.60	567880.30	75	5.1
	T-128	2021737.46	568420.86	75	15.4
	T-129	2020672.22	568634.55	75	14.4
	T-130	2019635.87	568894.43	75	11.3
	R-131A	2018510.58	568697.39	75	7.7
	T-132	2017594.10	569375.67	75	10.4
	R-133	2016587.52	569449.82	75	4.8
	R-134	2016245.15	569858.77	75	15.7
	R-135	2014709.78	569926.01	75	3.4
	R-136	2013703.17	570154.23	75	3.3
Project Area (St. Augustine Beach)	R-137A	2012784.88	570623.68	75	6.3
	R-138	2011713.58	570920.45	75	6.9
	R-139	2010792.36	571042.06	75	5.9
	R-140	2009936.50	571280.80	75	4.8
	R-141	2009033.46	571515.13	75	7.5
	R-142	2008050.00	571987.59	75	10.9
	R-143T	2006967.50	571758.65	75	8.1
	R-143	2006234.22	571942.97	75	8.6
	R-144	2006002.22	571810.73	75	10.0
	R-145	2004974.90	571833.50	75	9.1
	R-146	2003979.99	571909.69	75	11.4
	R-147	2002934.98	571810.82	75	11.0
	R-148	2001996.63	572107.69	75	8.2
	R-149	2000990.32	572163.42	75	11.1
	R-150	2000010.09	572297.74	75	10.8
	R-151	1999005.19	572276.20	75	8.0
South Control Area	R-152	1998020.29	572344.51	75	9.6
	R-153	1997017.89	572421.62	75	8.0
	R-154	1996029.08	572459.64	75	8.7
	R-155	1995031.45	572571.16	75	10.4
	T-156	1994028.53	572628.97	75	9.0
	T-157	1993096.49	572704.97	75	12.6

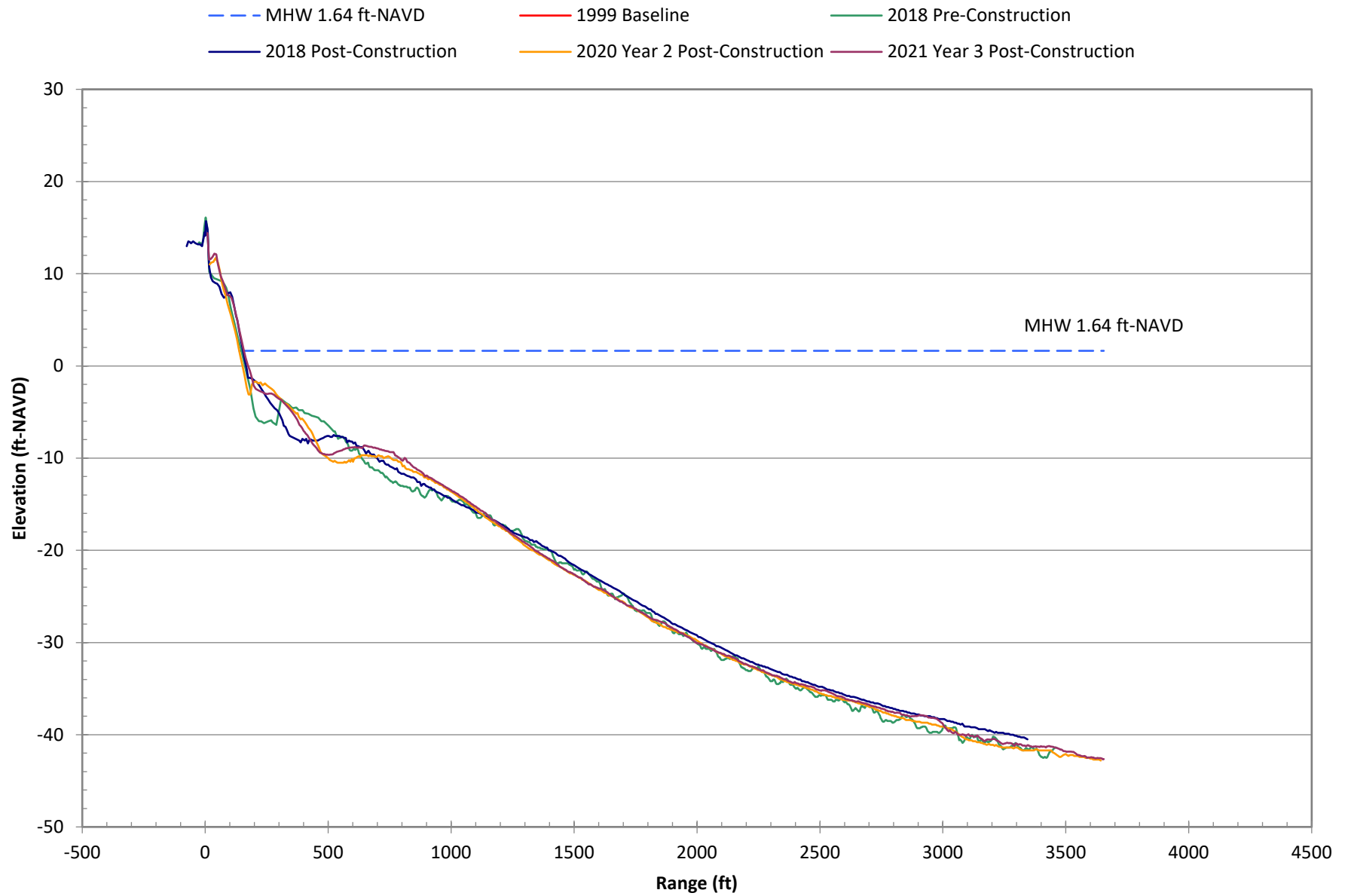
¹Florida State Plane East (0901), NAD 83 US Feet

²Degrees clockwise from north

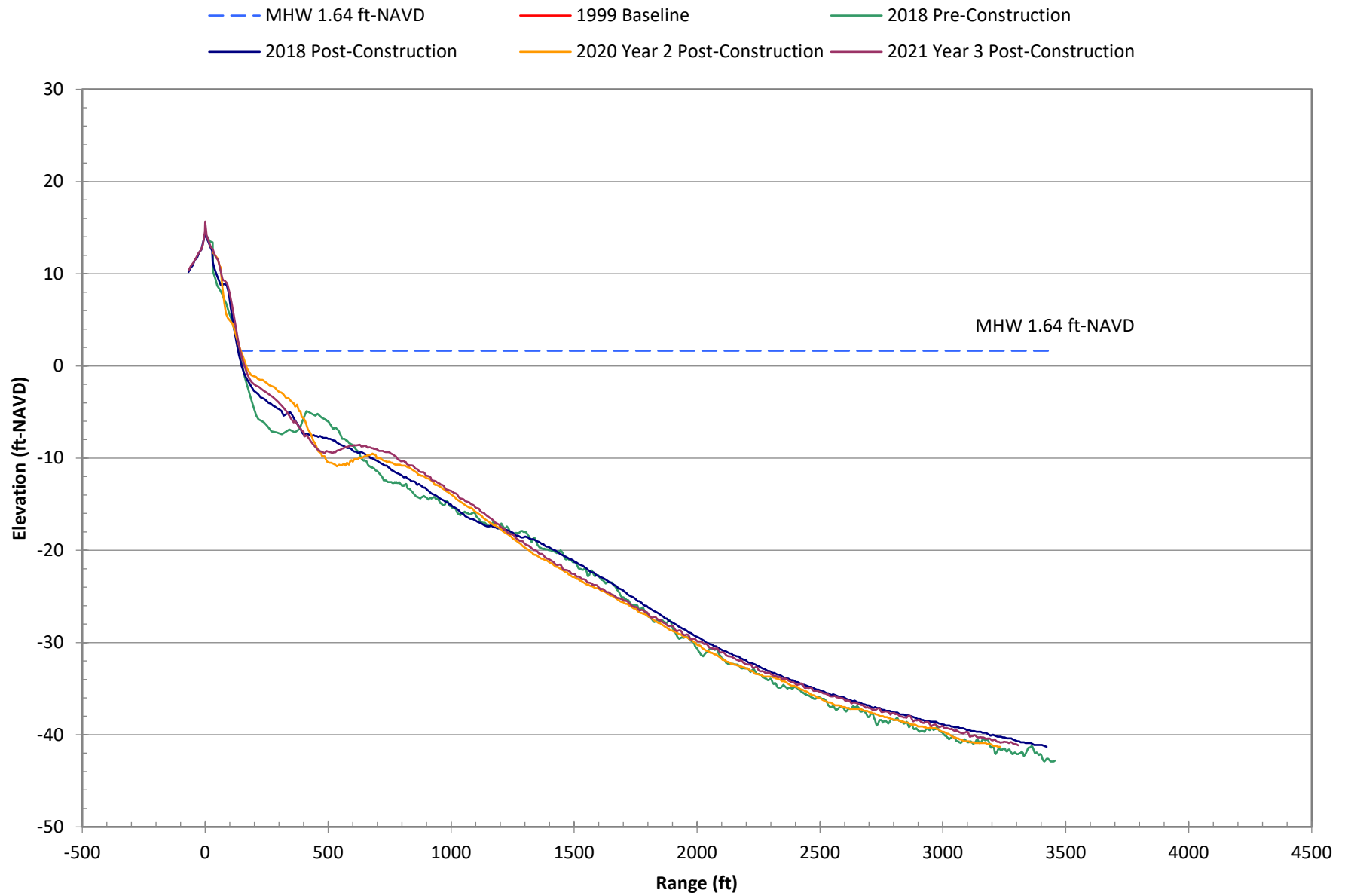
³R-123 surveyed with a 45° azimuth prior to 2007

Appendix B
Beach Profile Plots

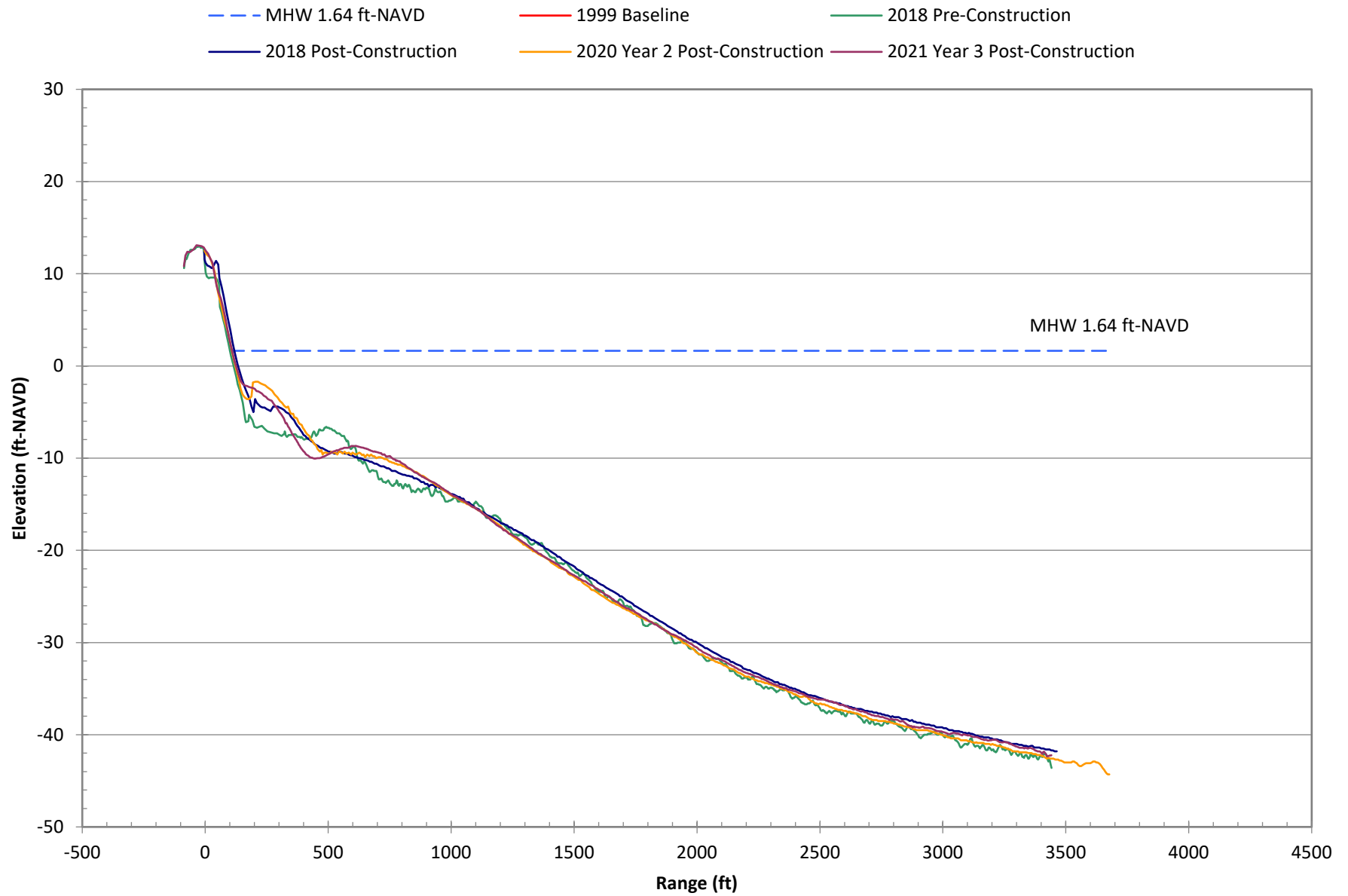
Survey Data at R-80 for Selected Years



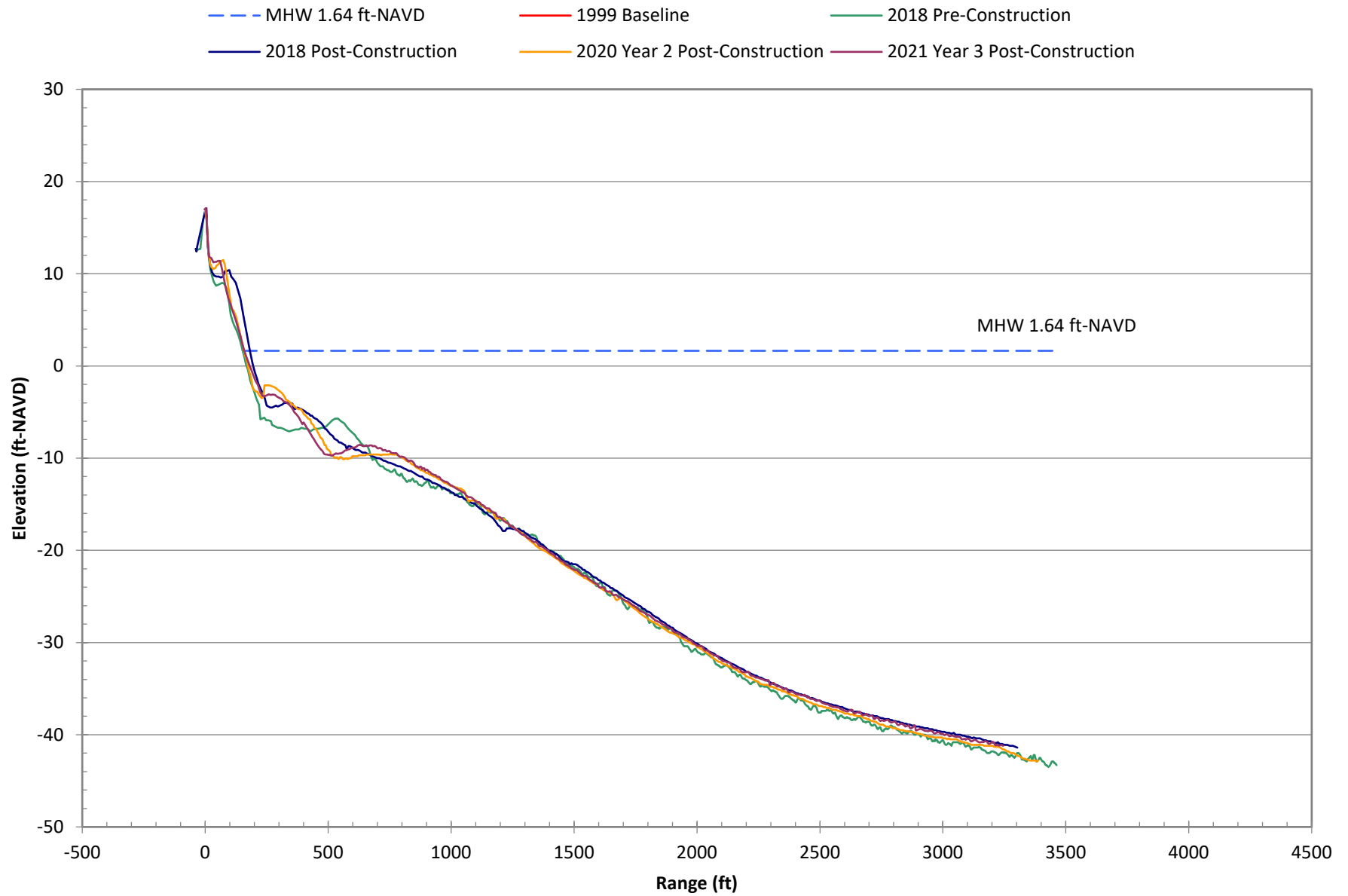
Survey Data at R-81 for Selected Years



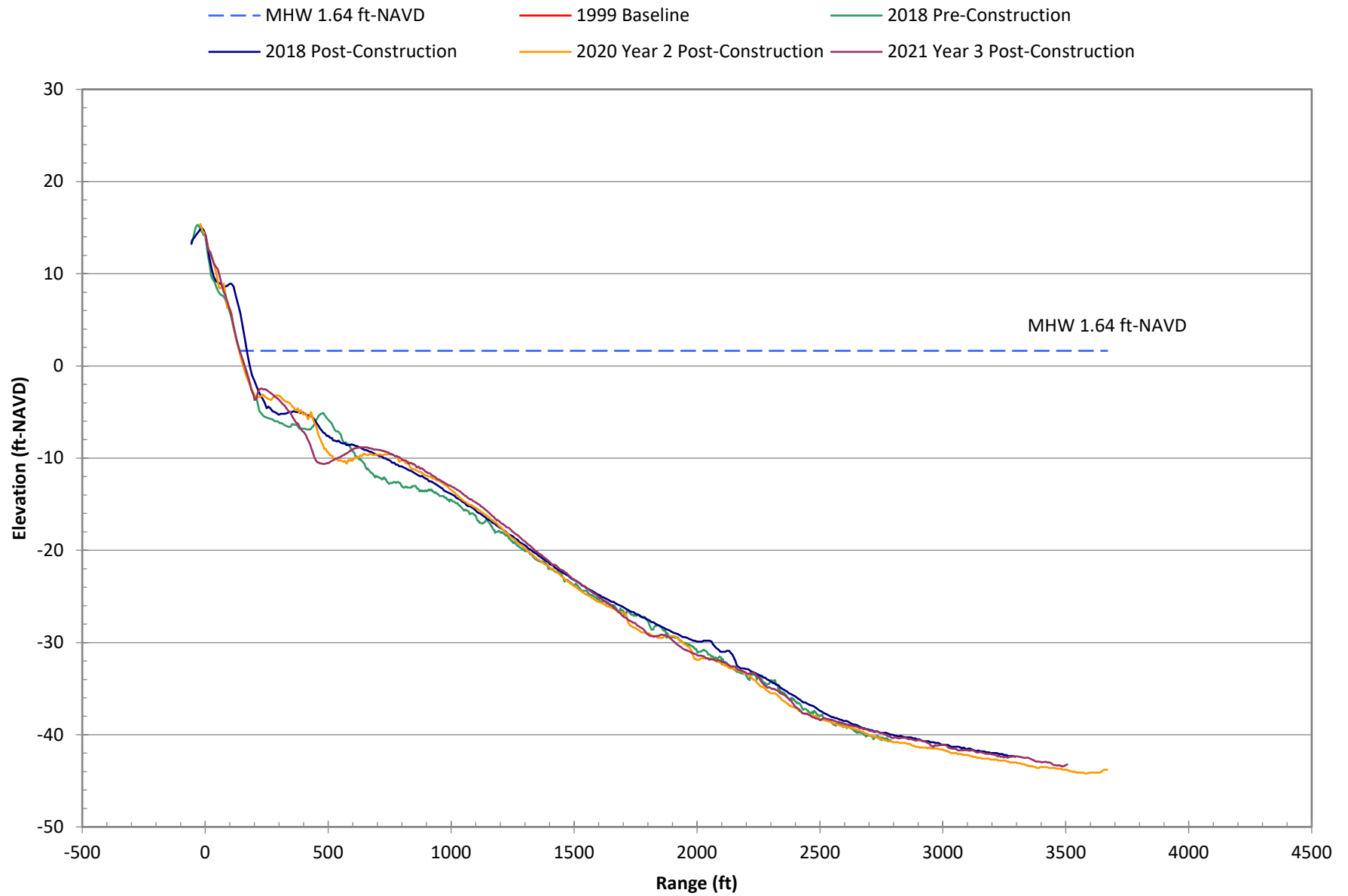
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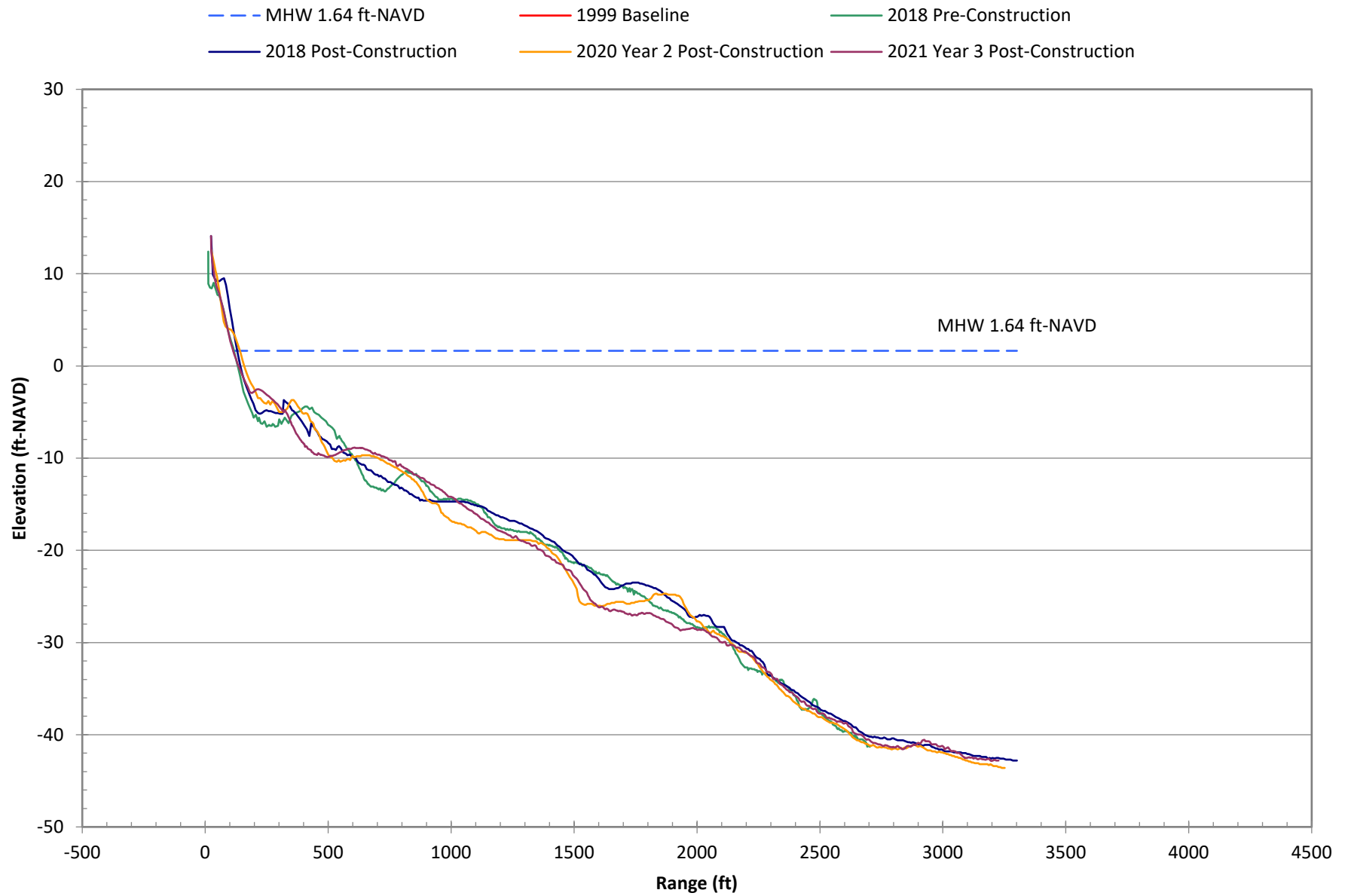
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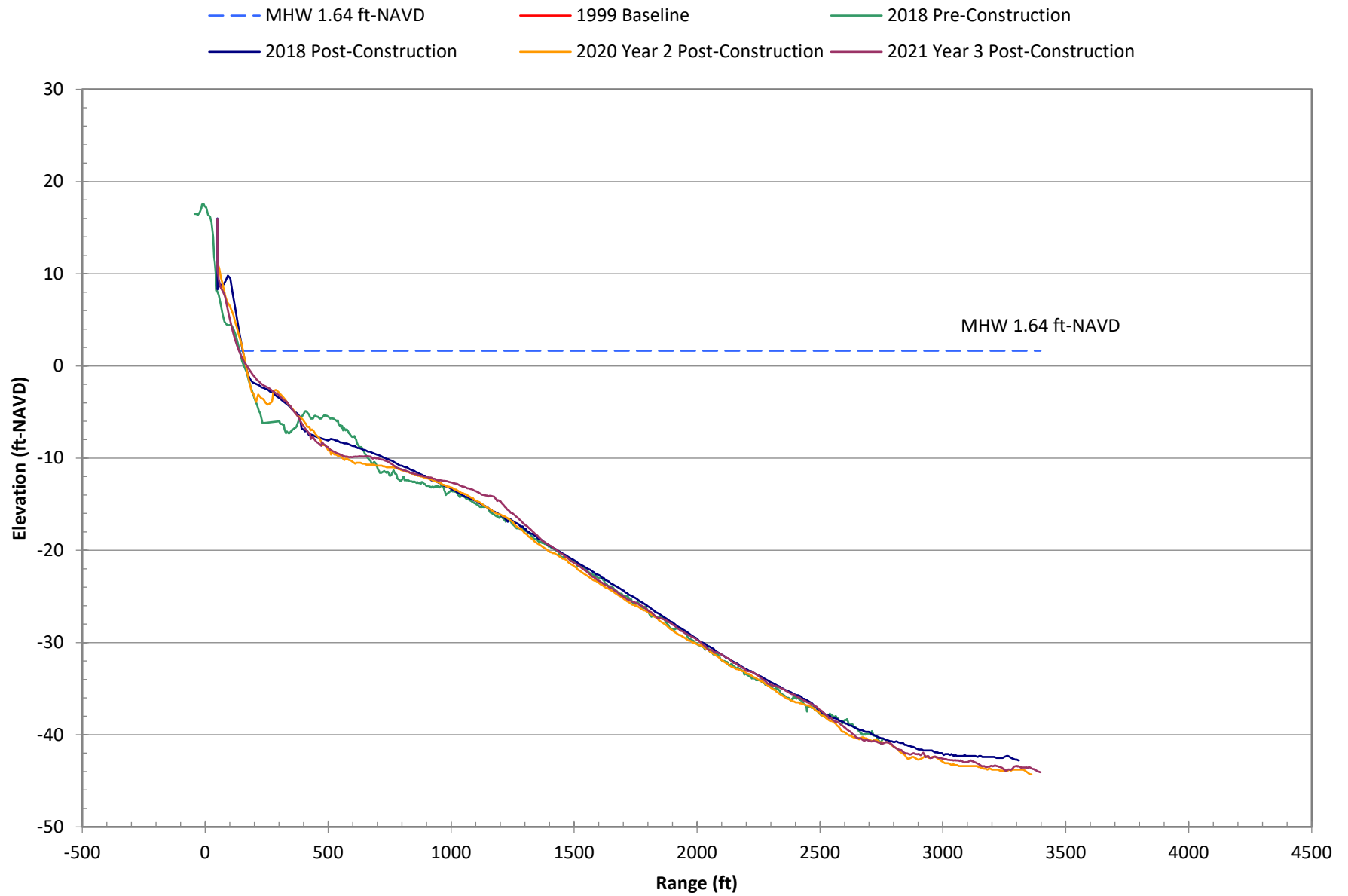
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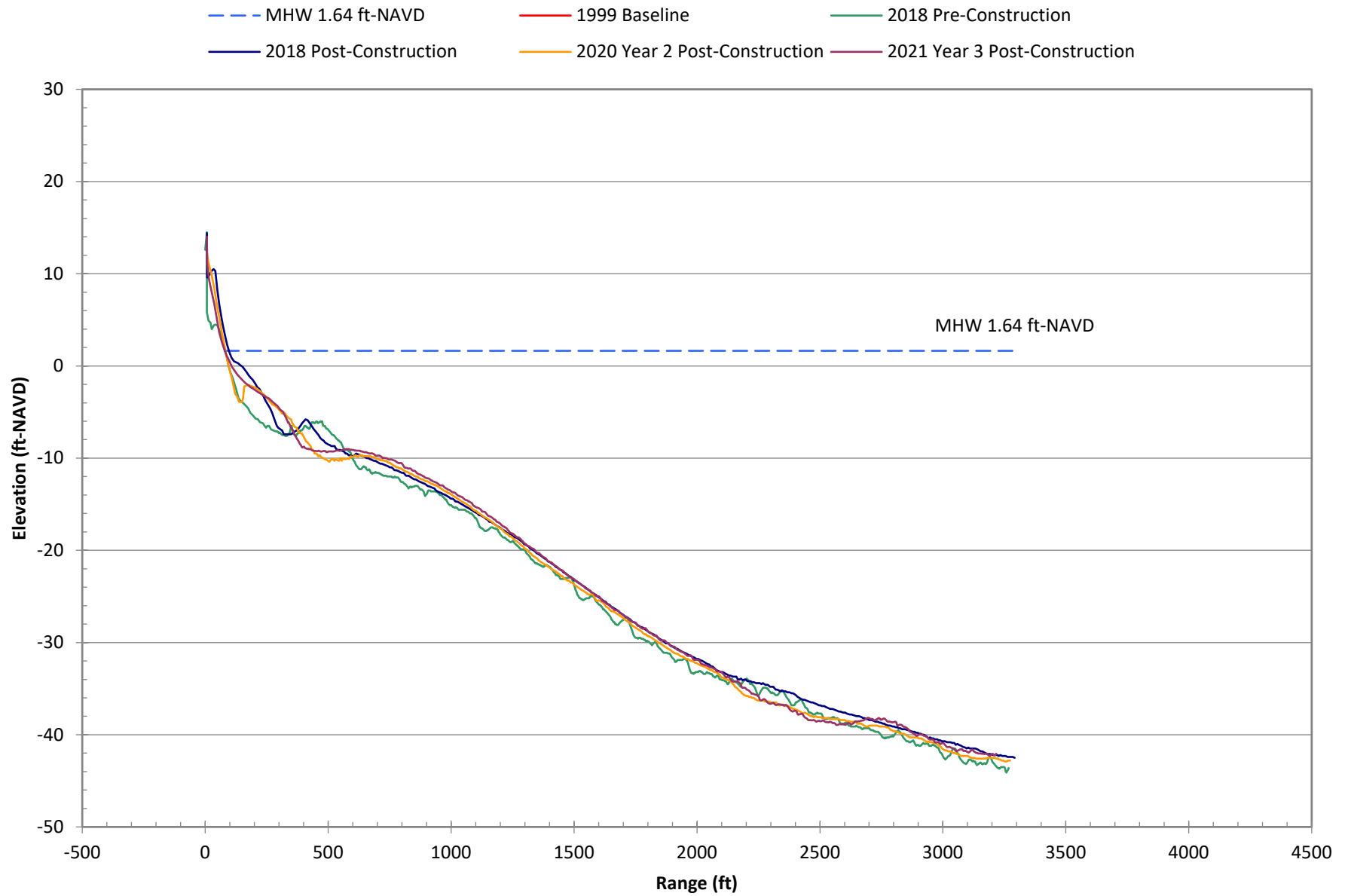
Survey Data at R-85 for Selected Years



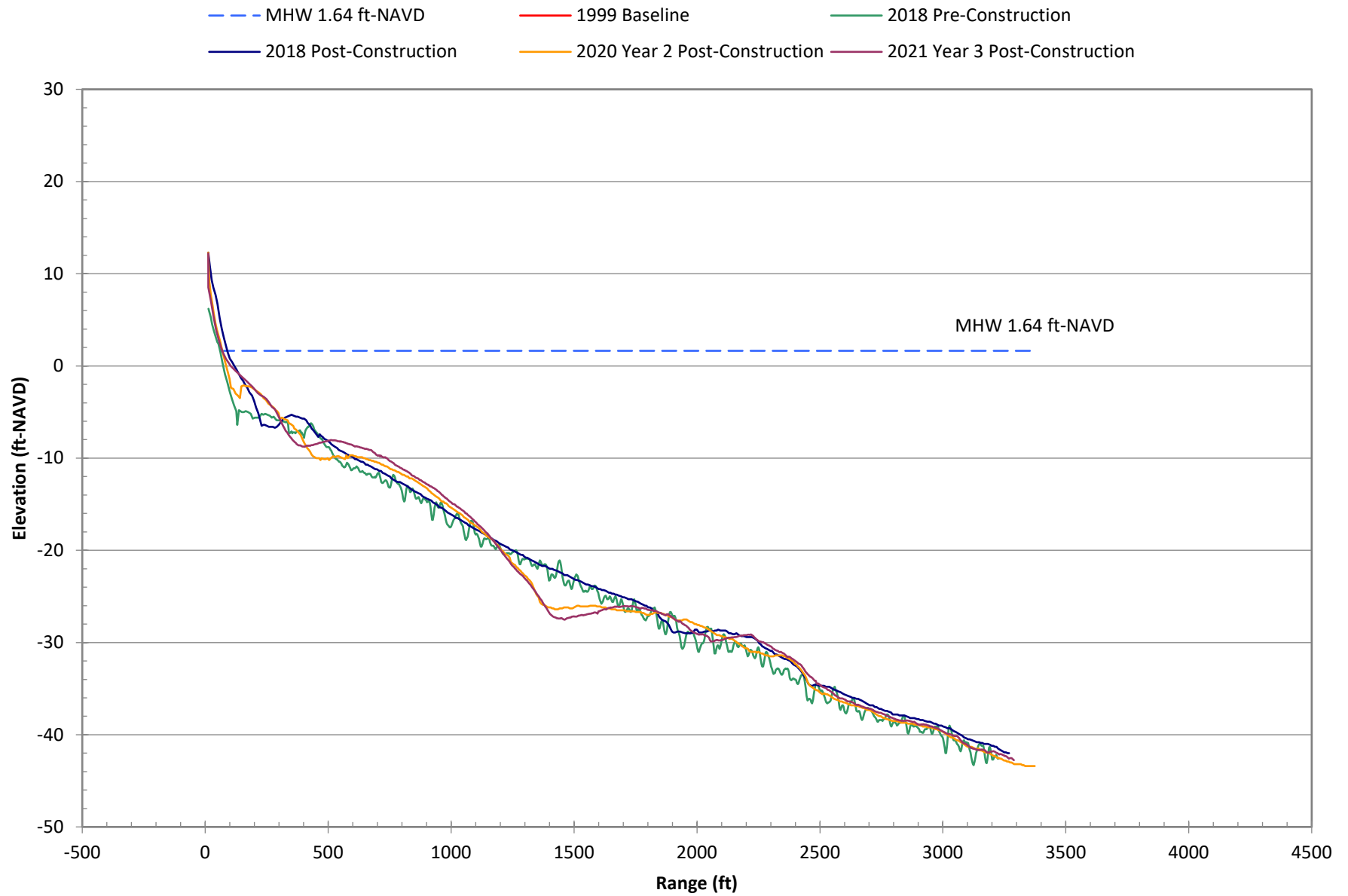
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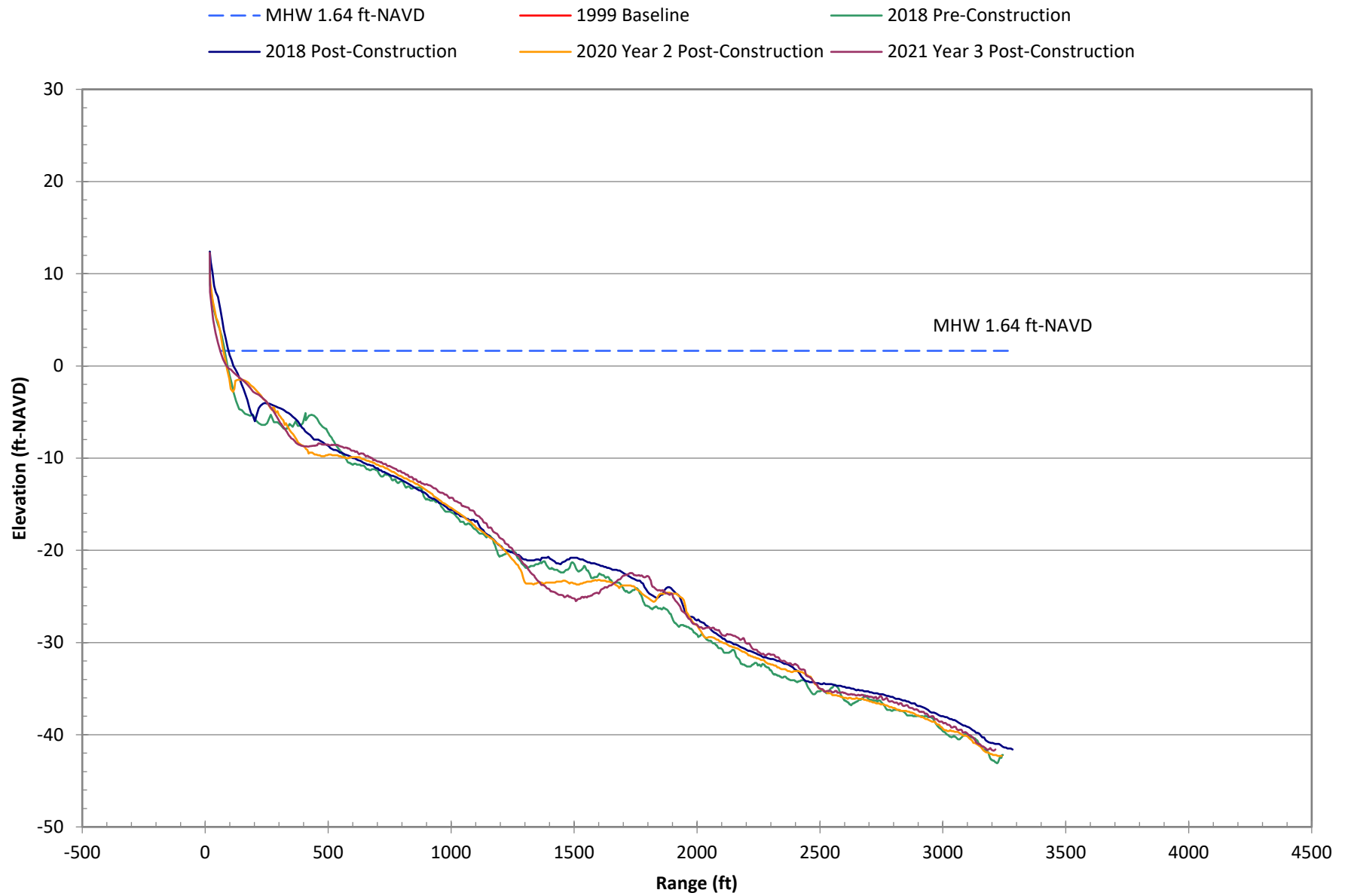
Survey Data at R-87 for Selected Years



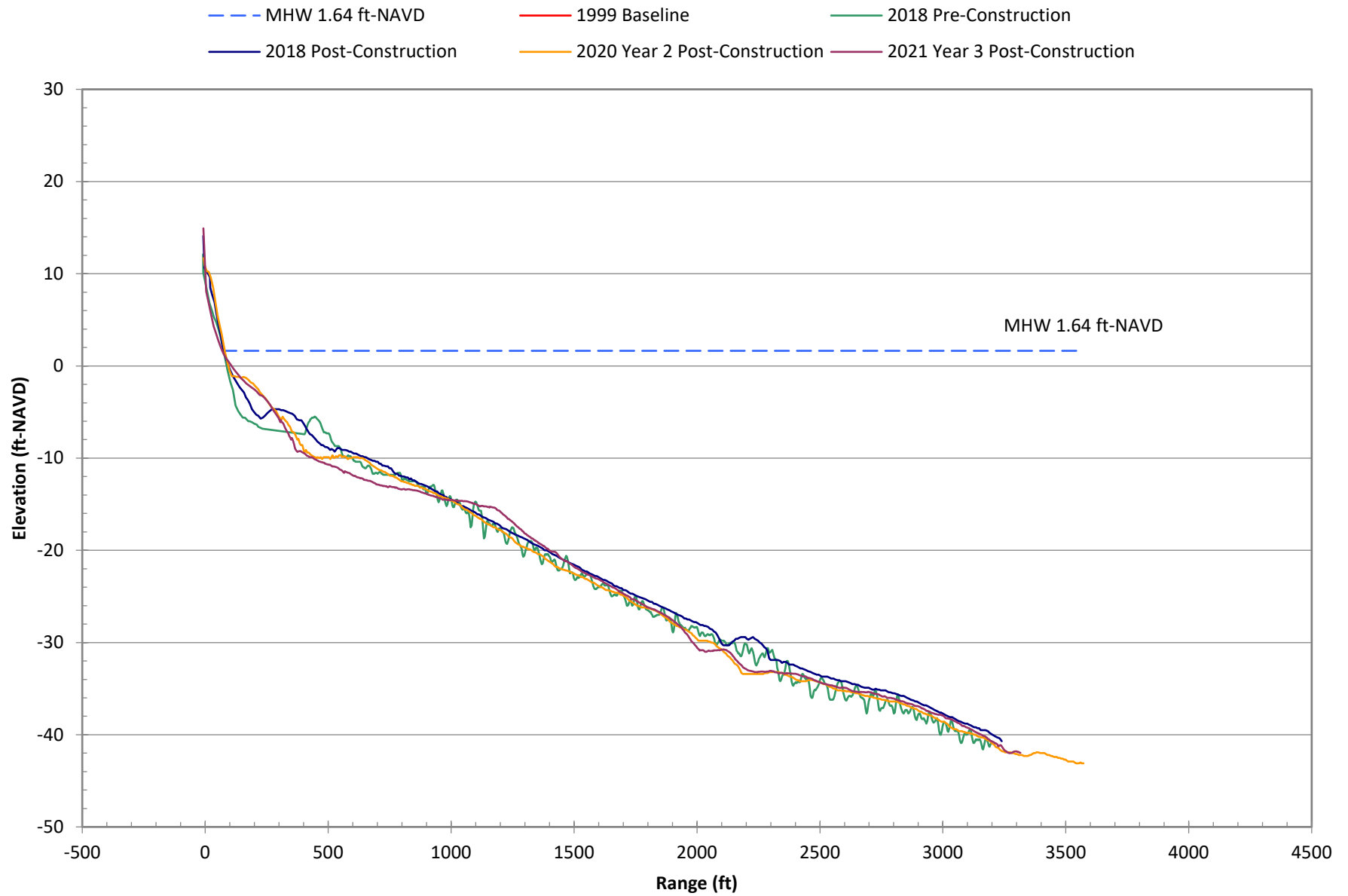
Survey Data at R-88 for Selected Years



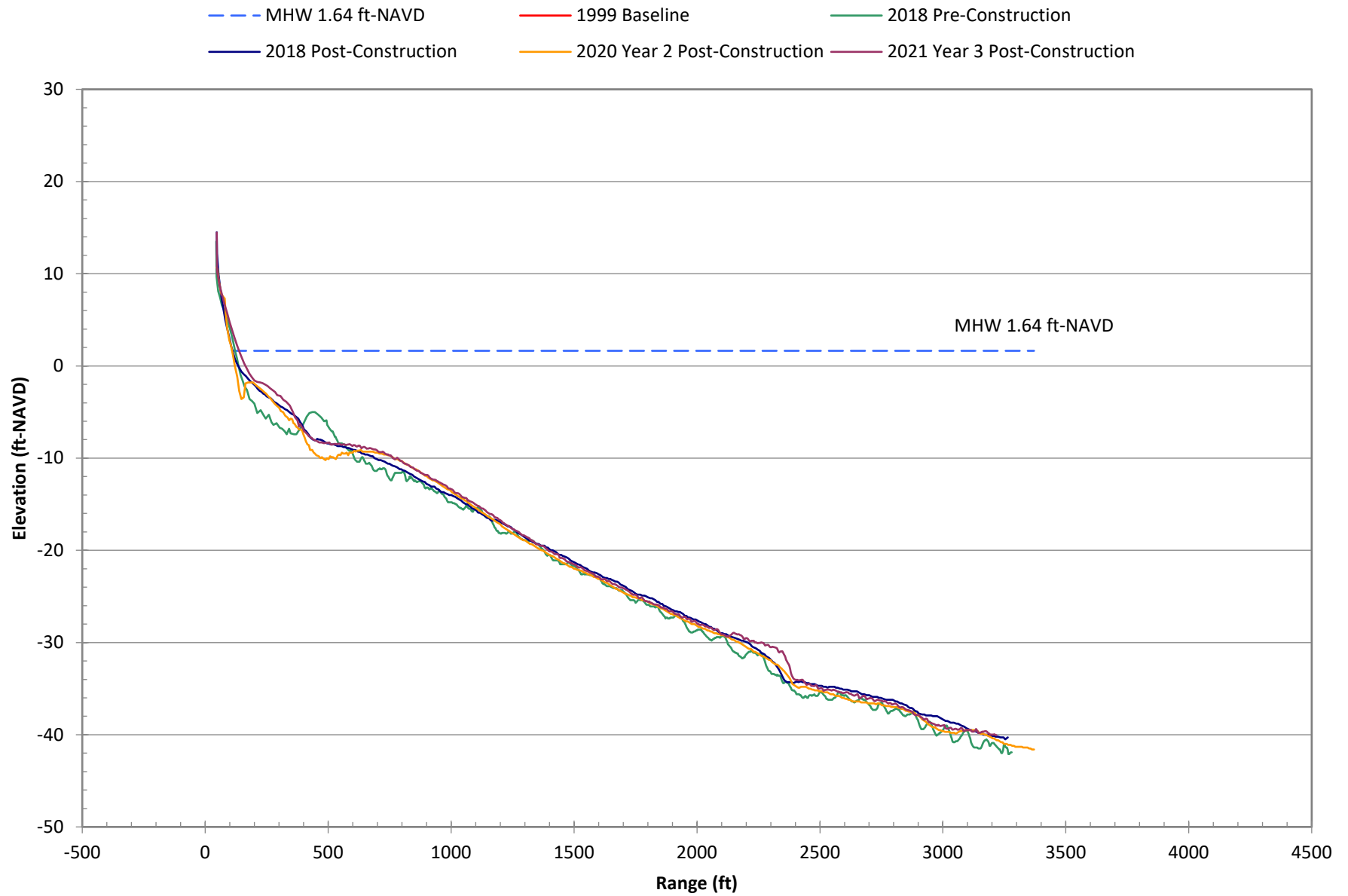
Survey Data at R-89 for Selected Years



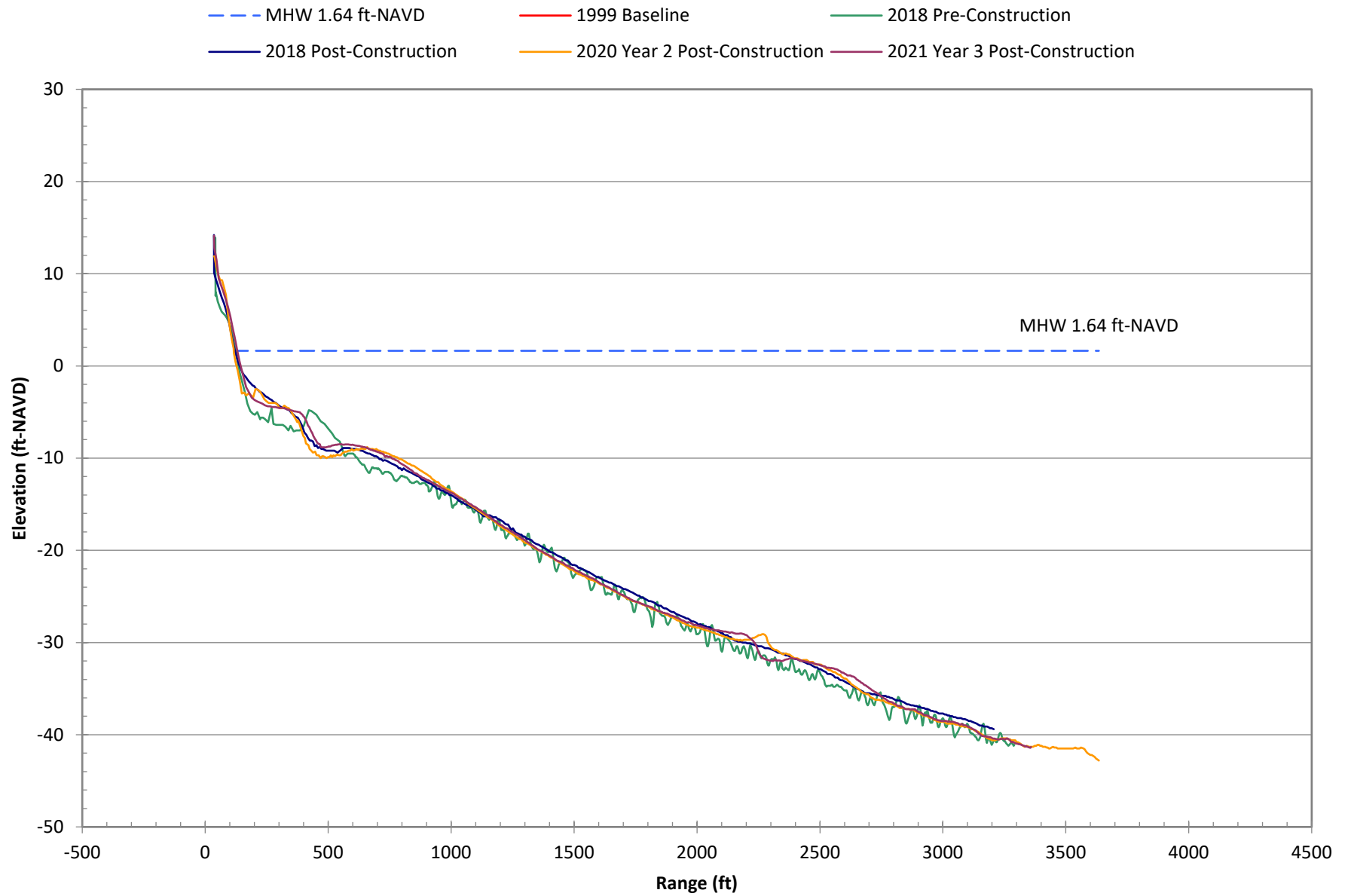
Survey Data at R-90 for Selected Years



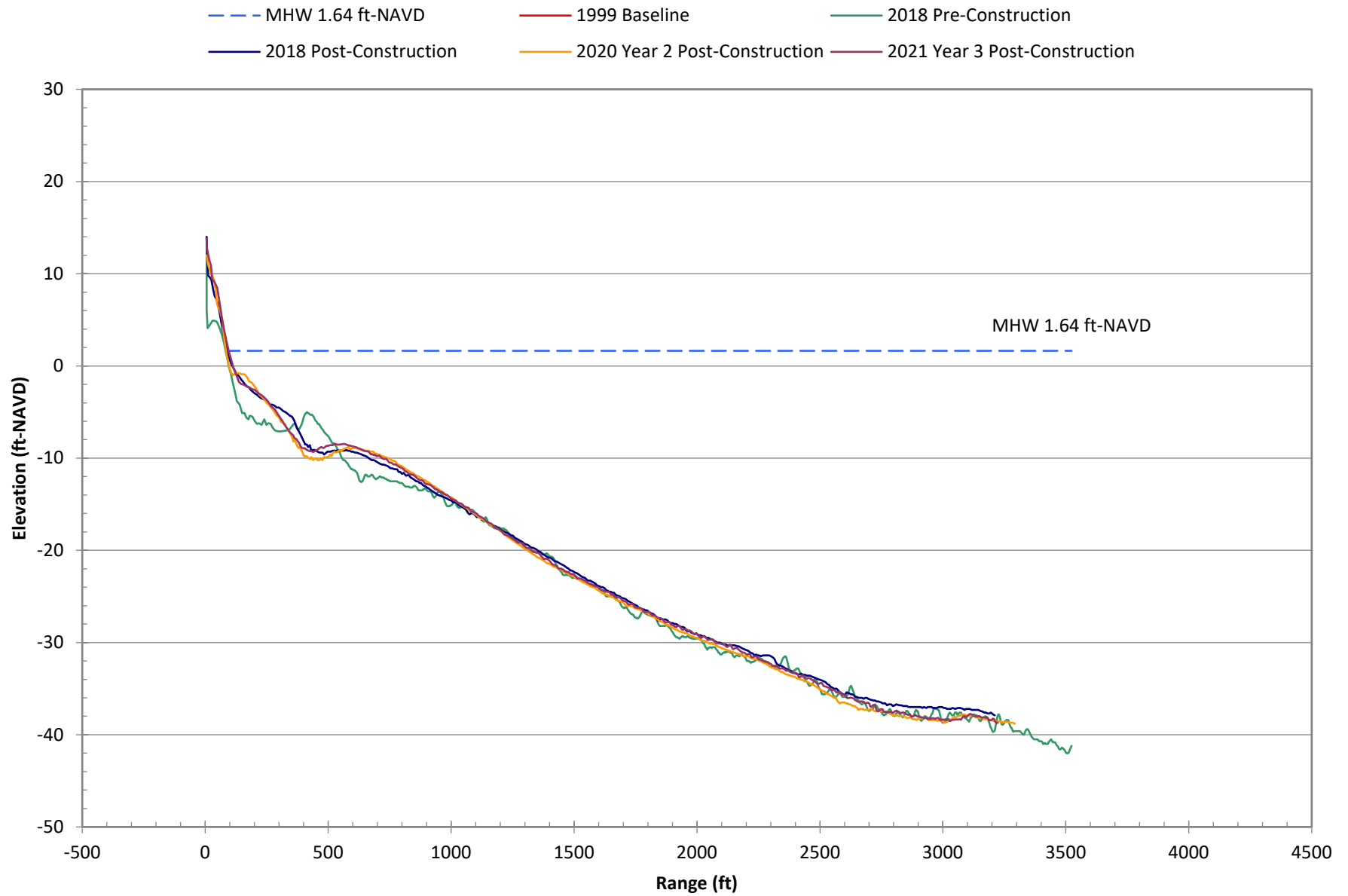
Survey Data at R-91 for Selected Years



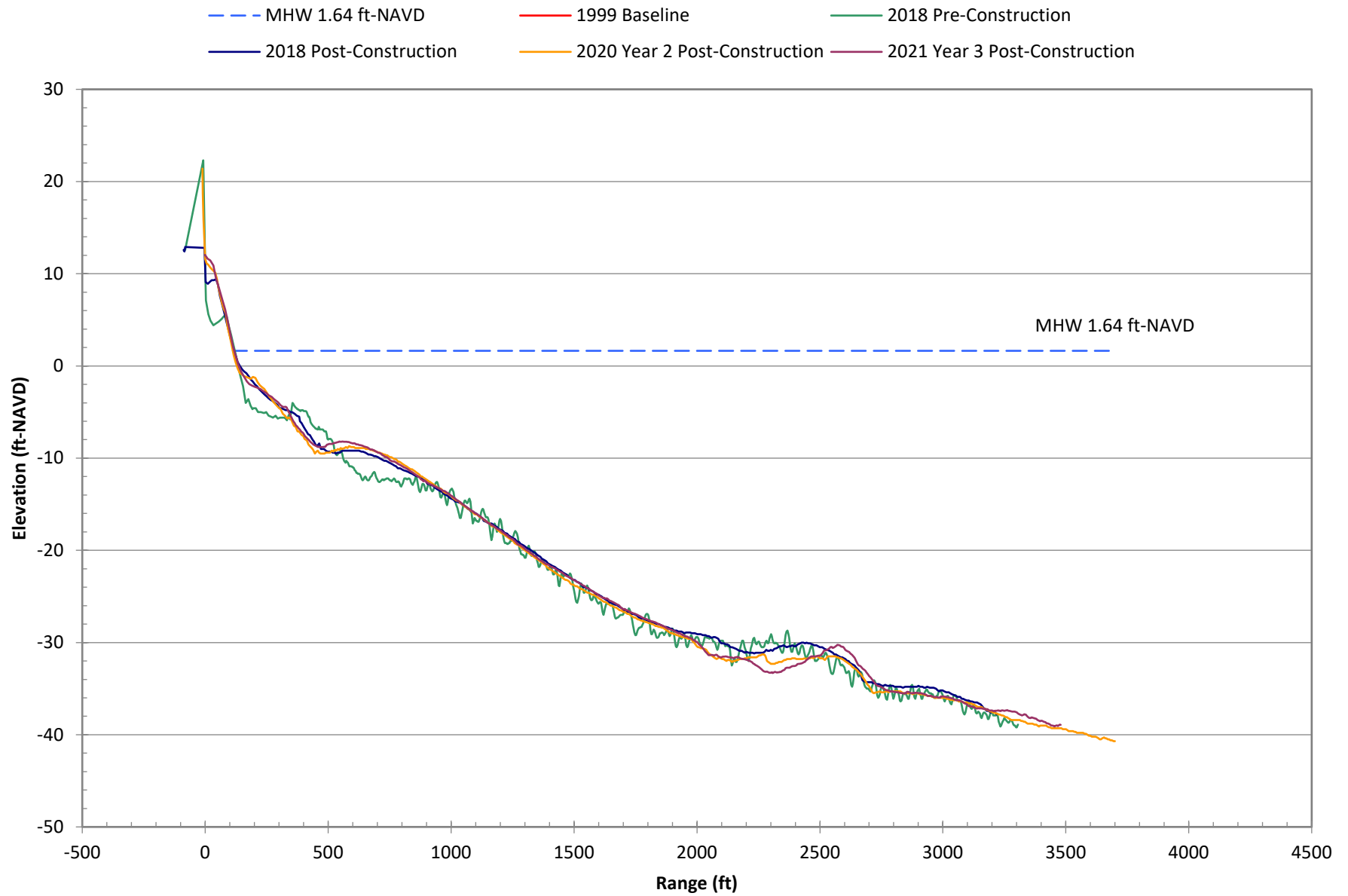
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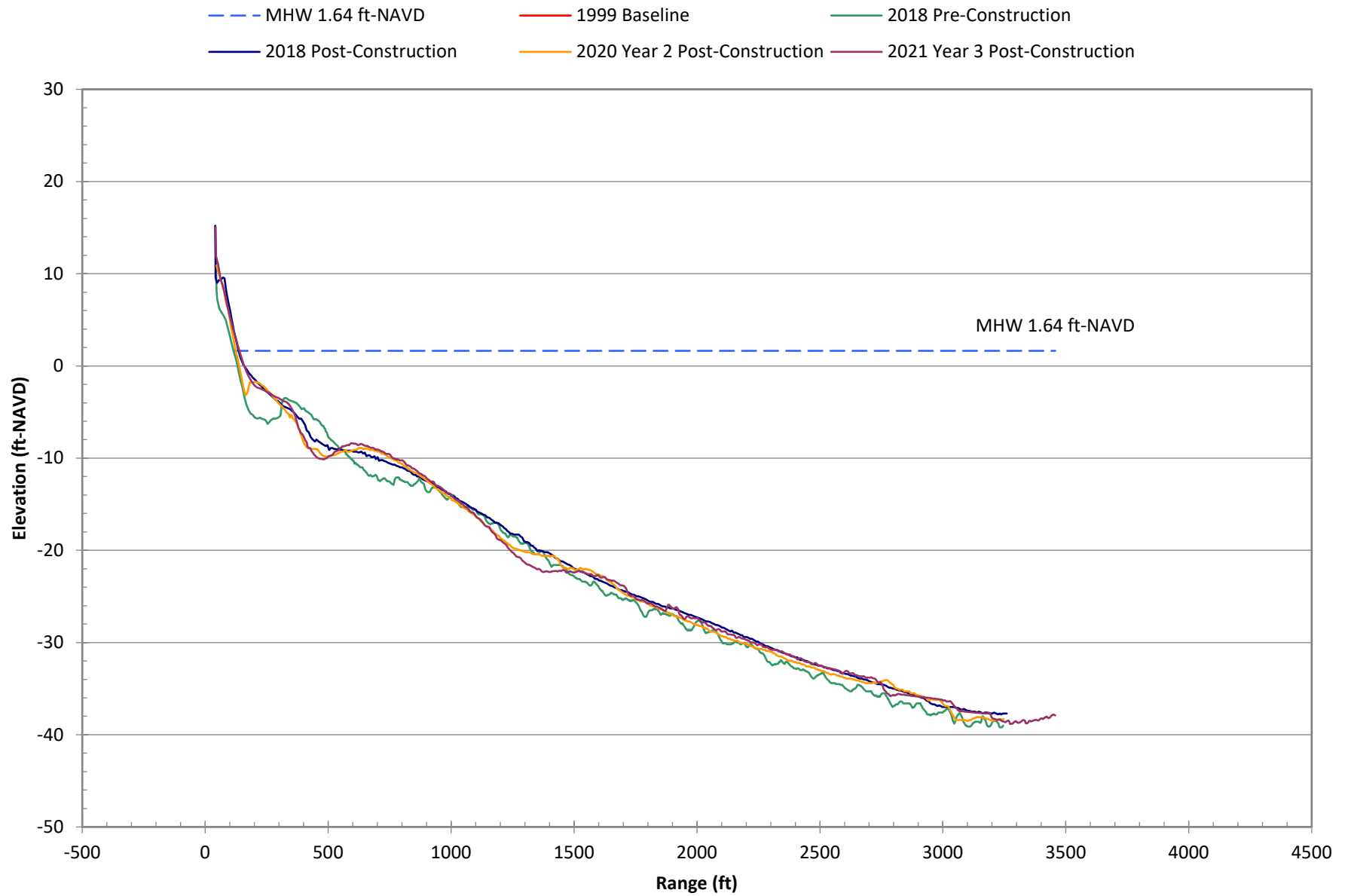
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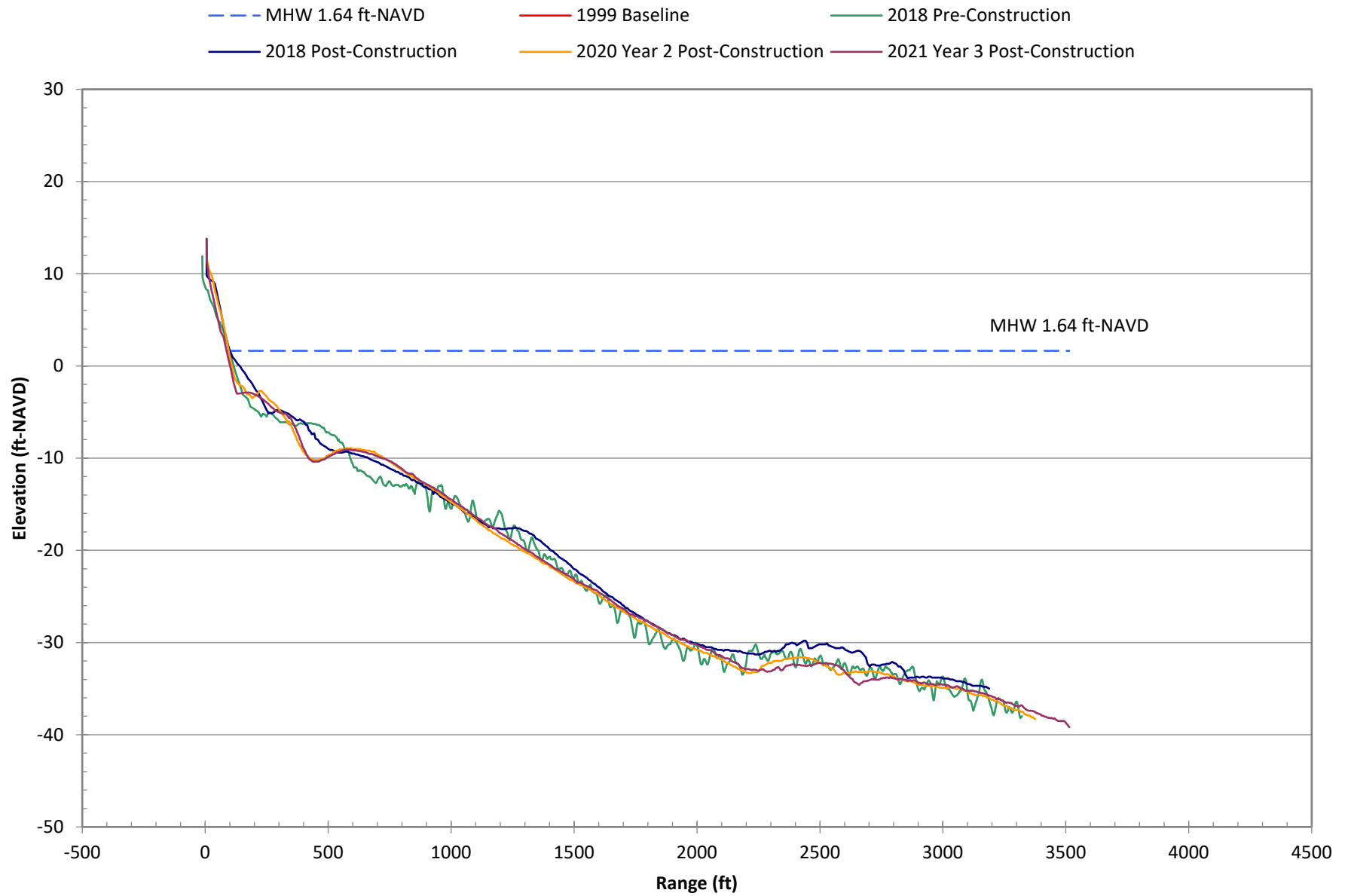
Survey Data at R-94 for Selected Years



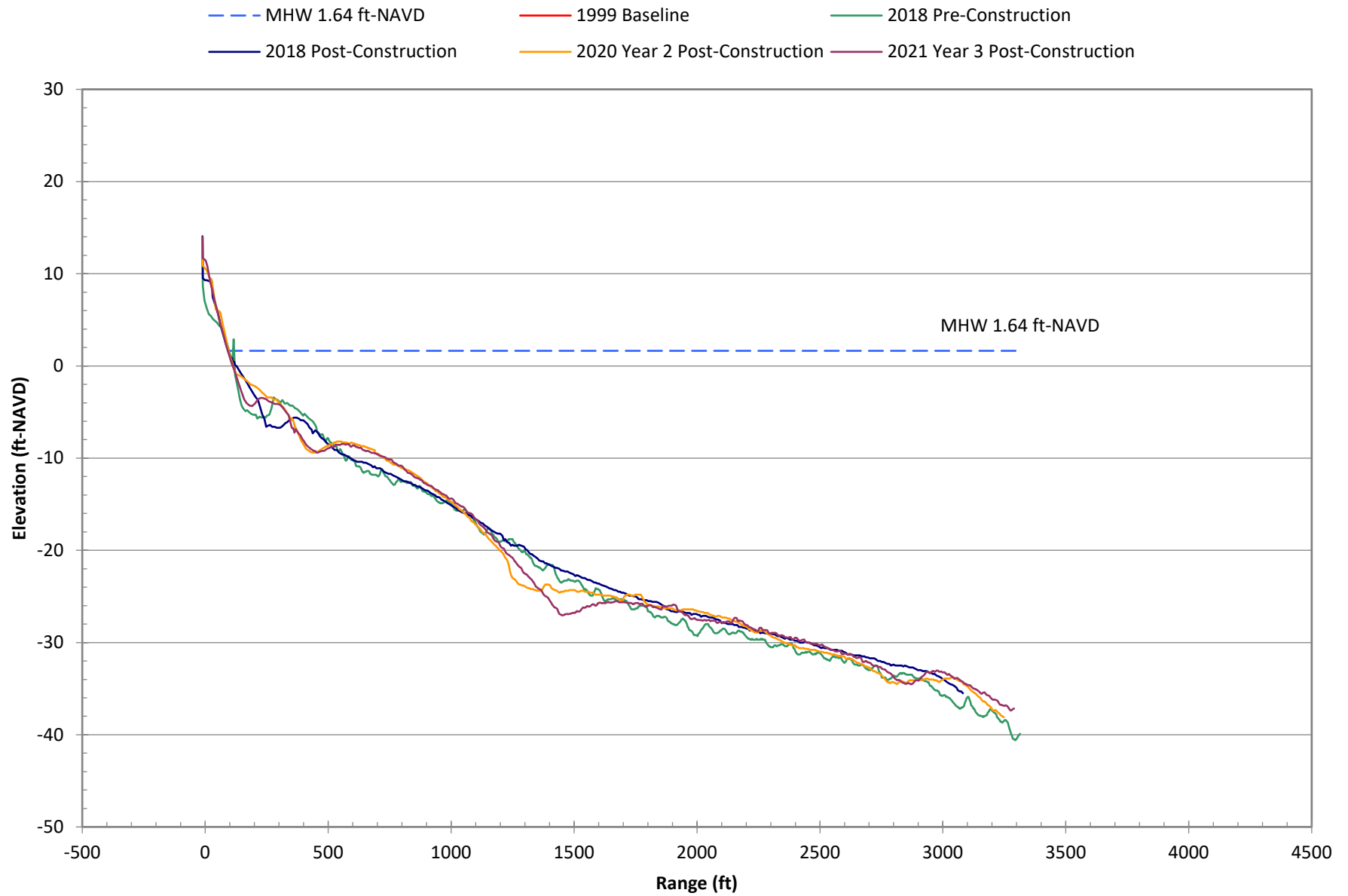
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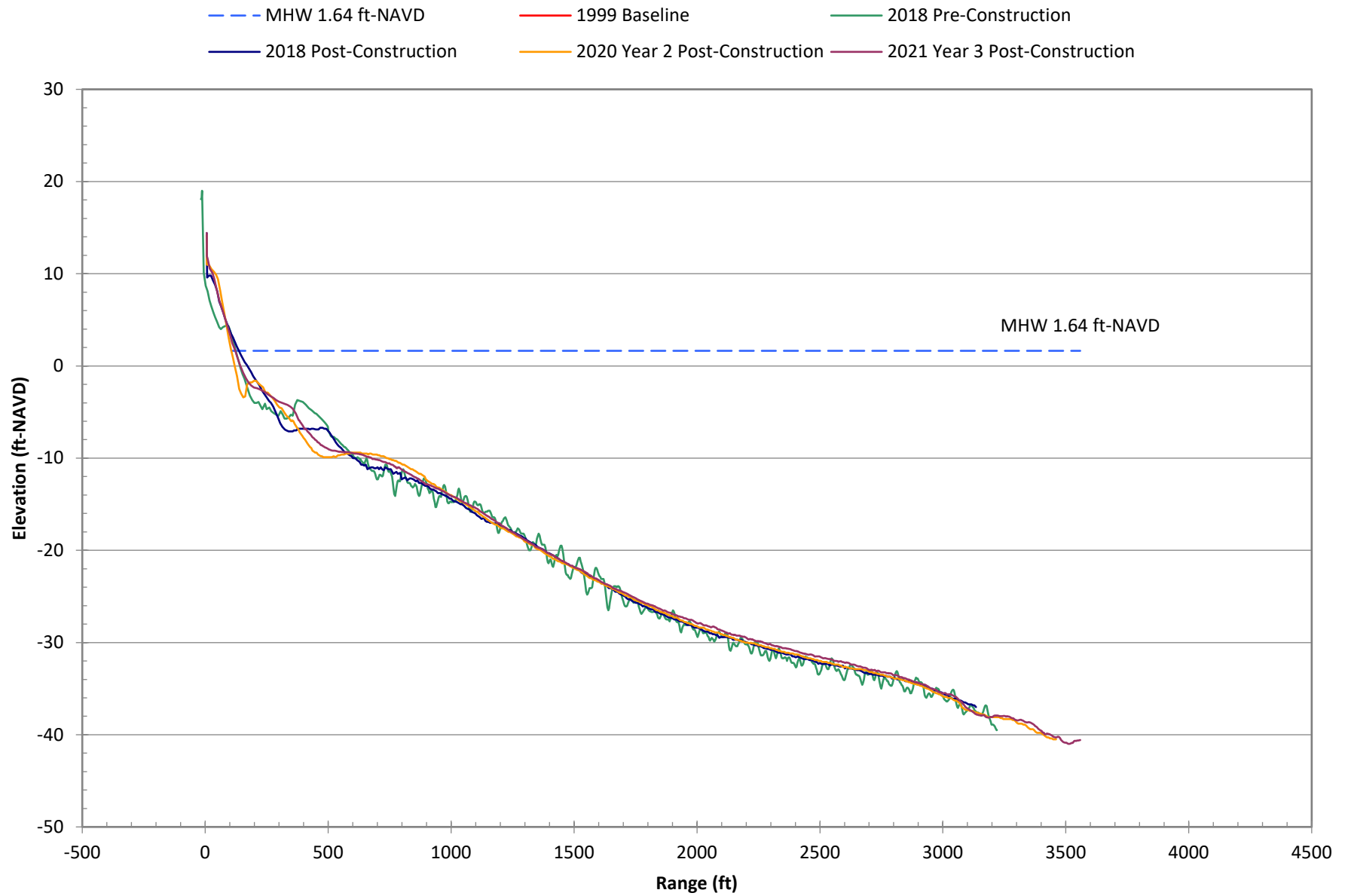
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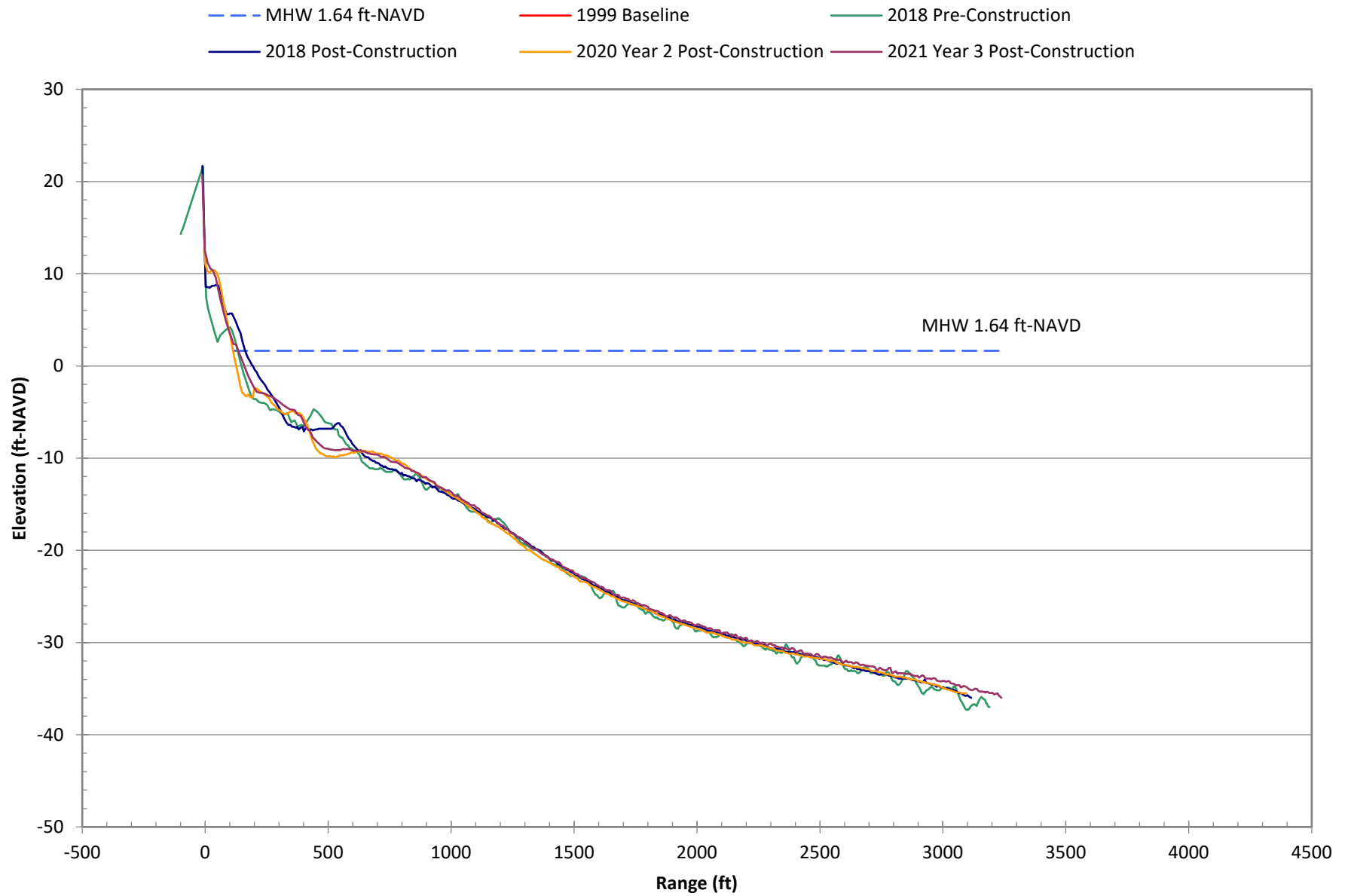
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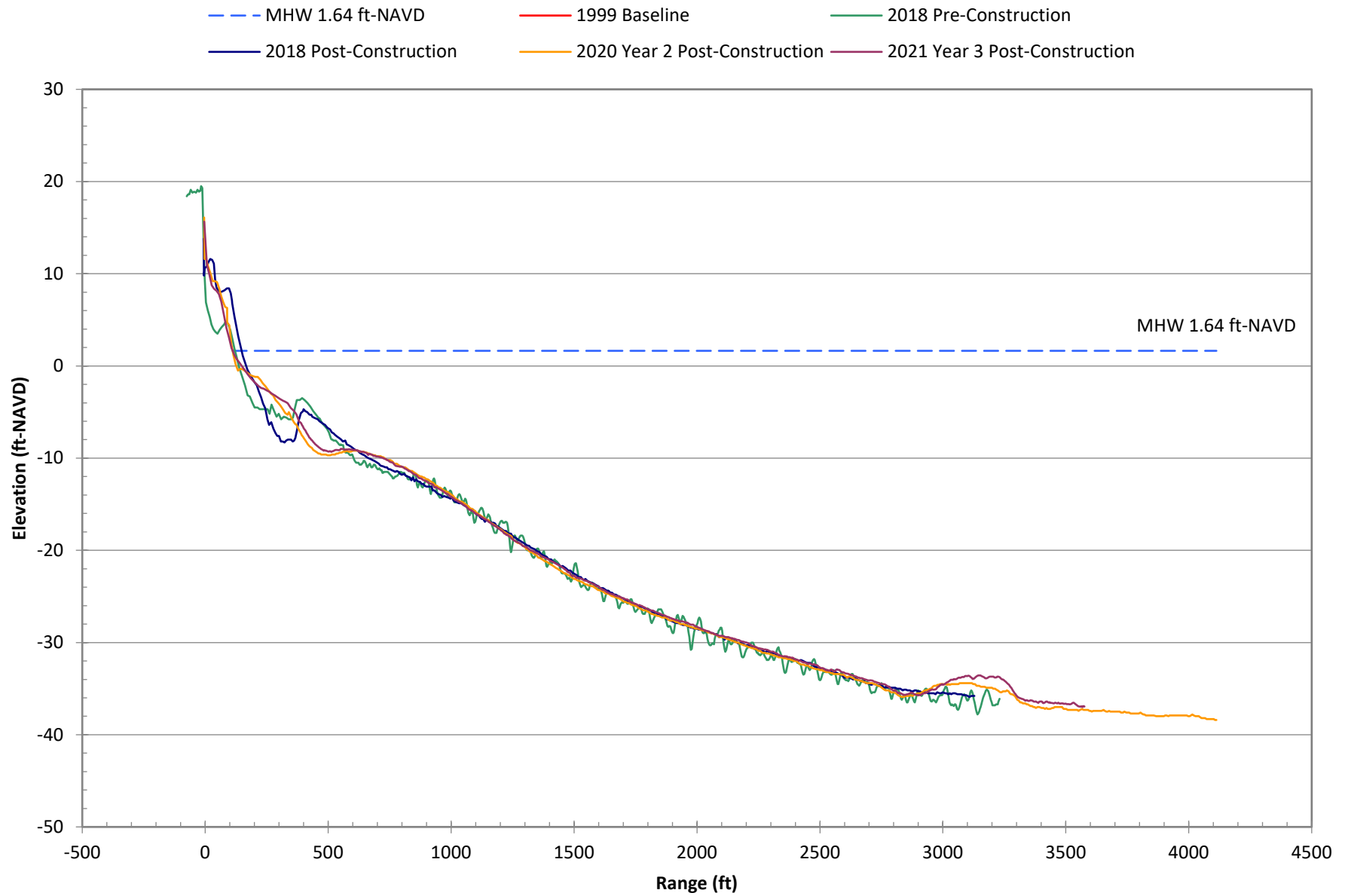
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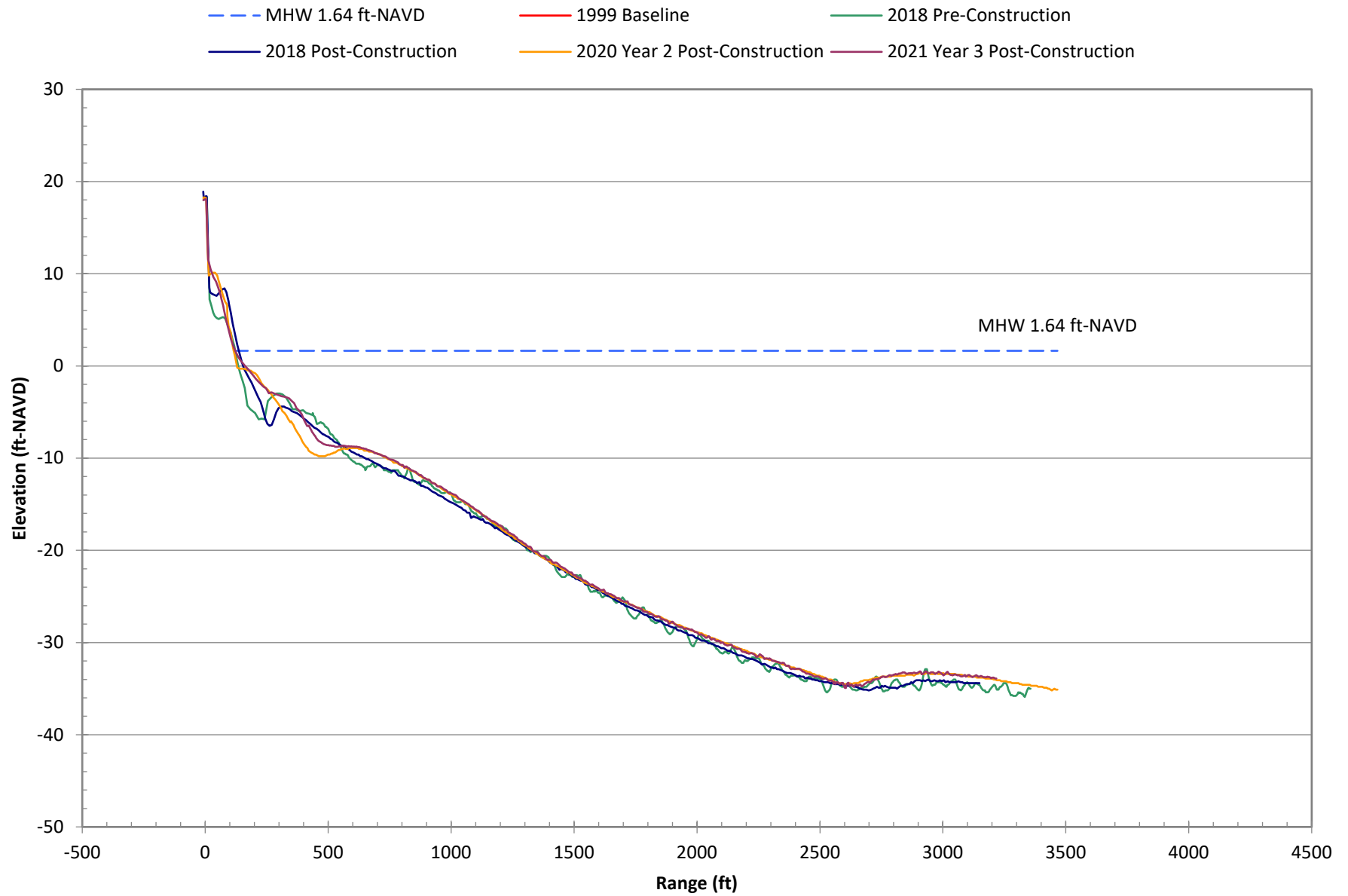
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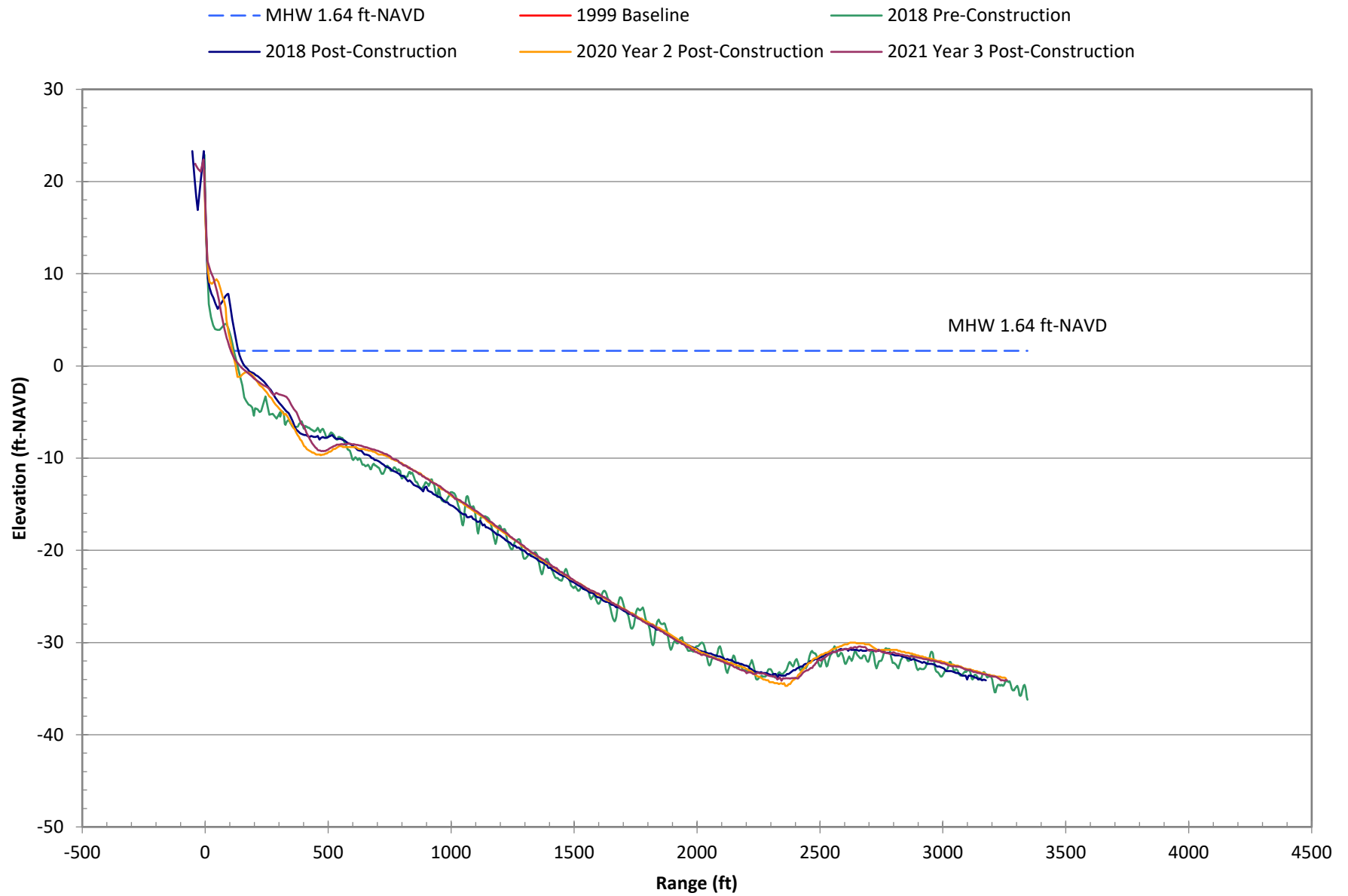
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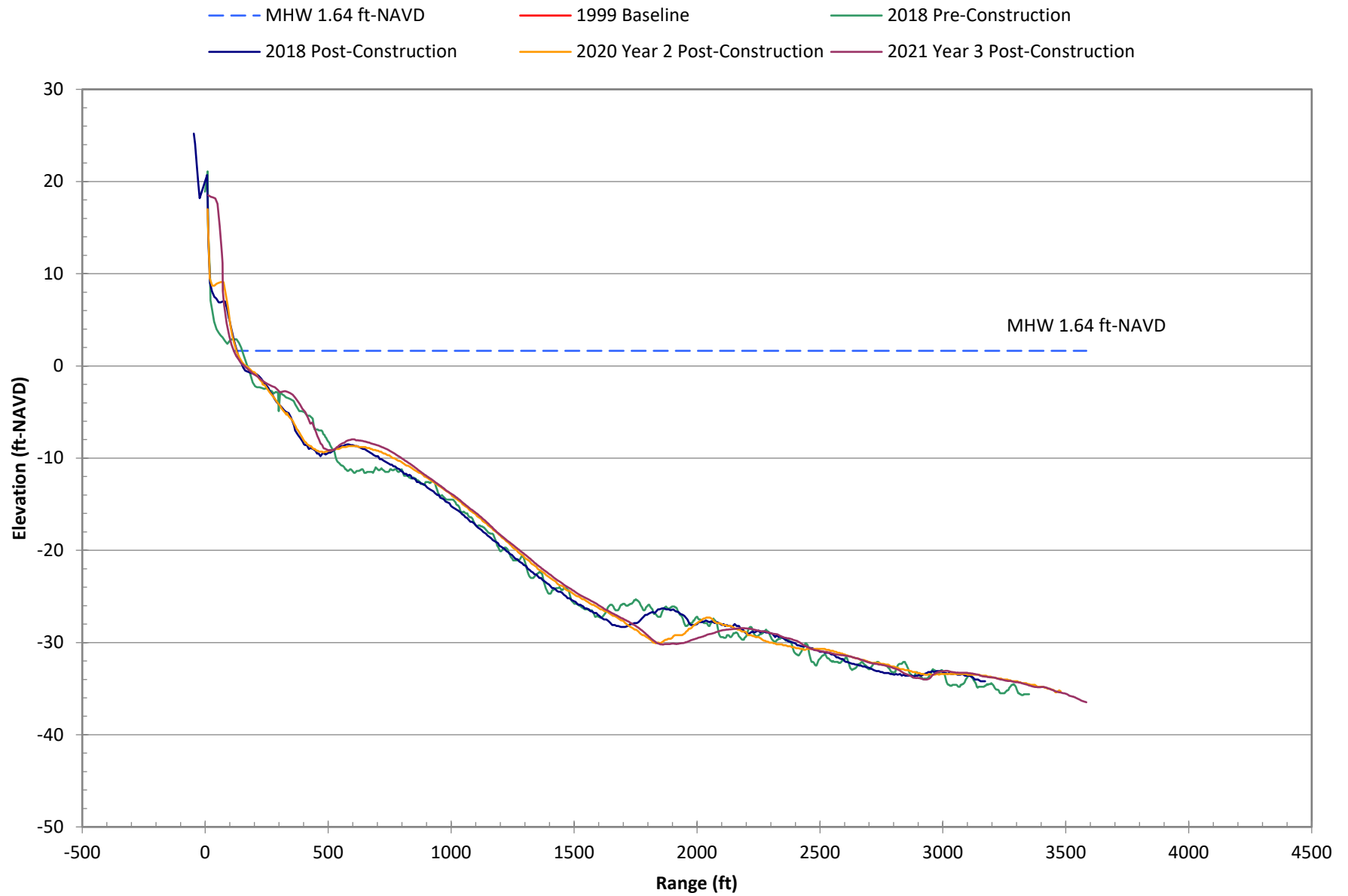
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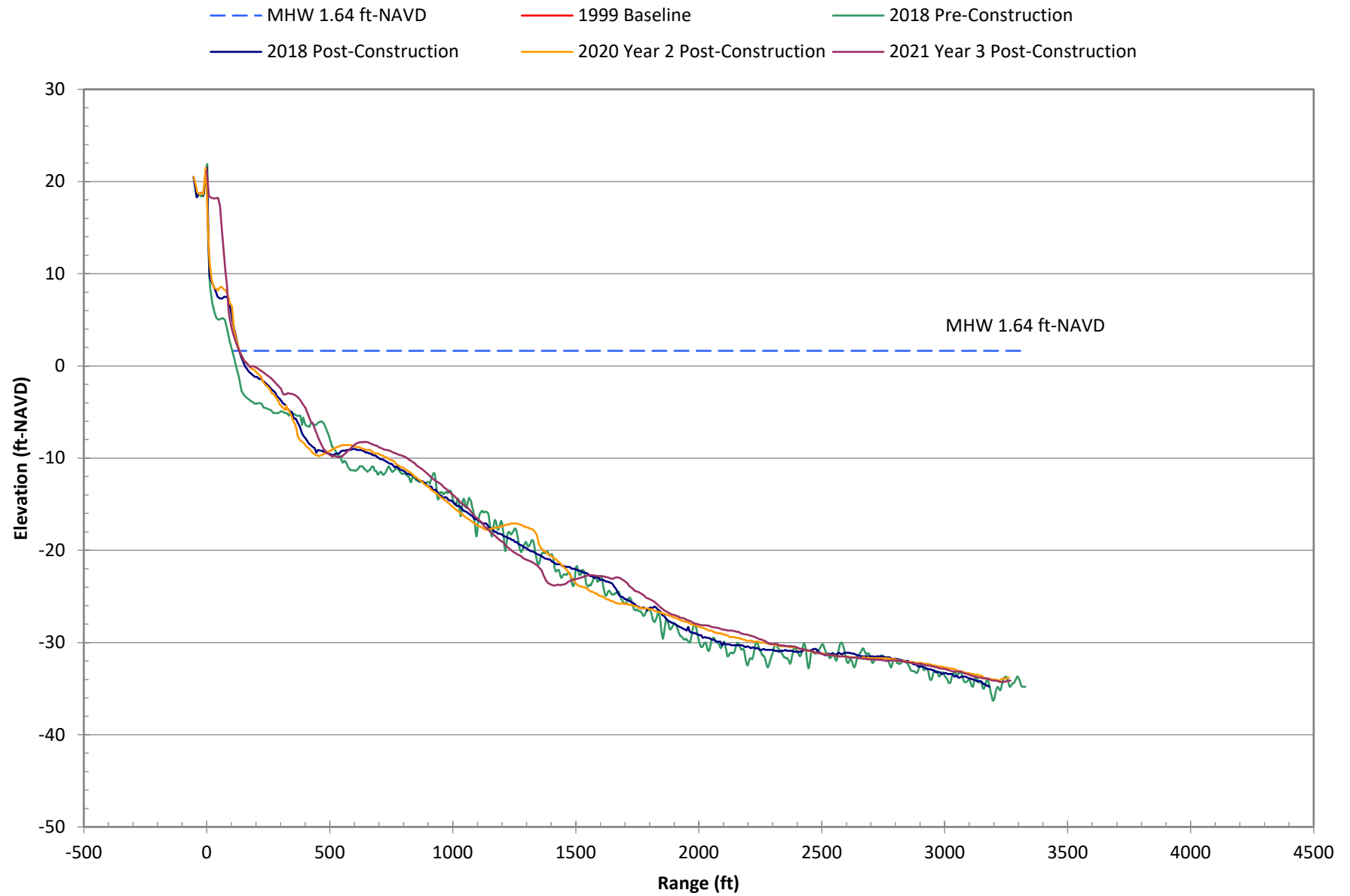
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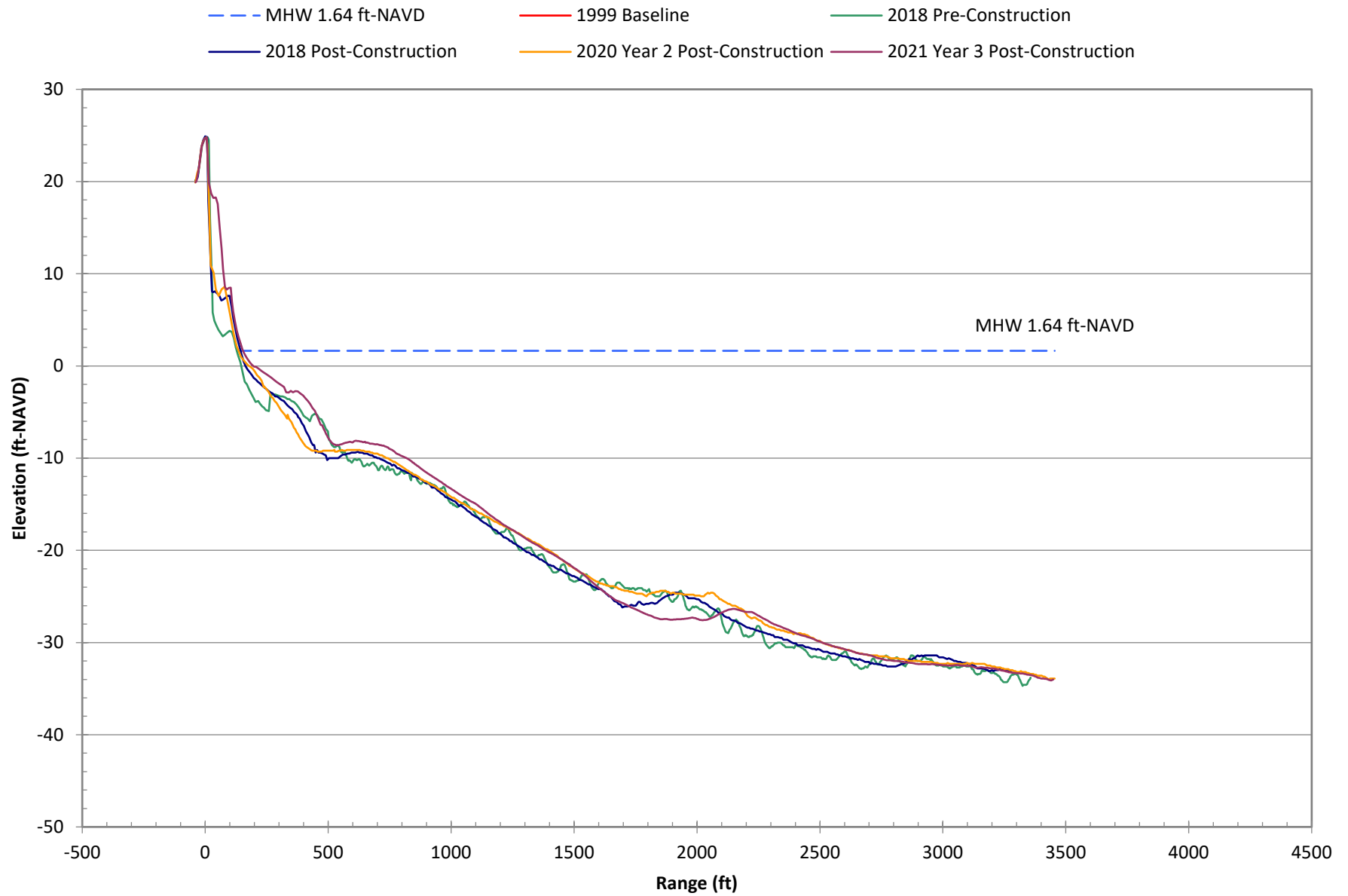
Survey Data at R-103 for Selected Years



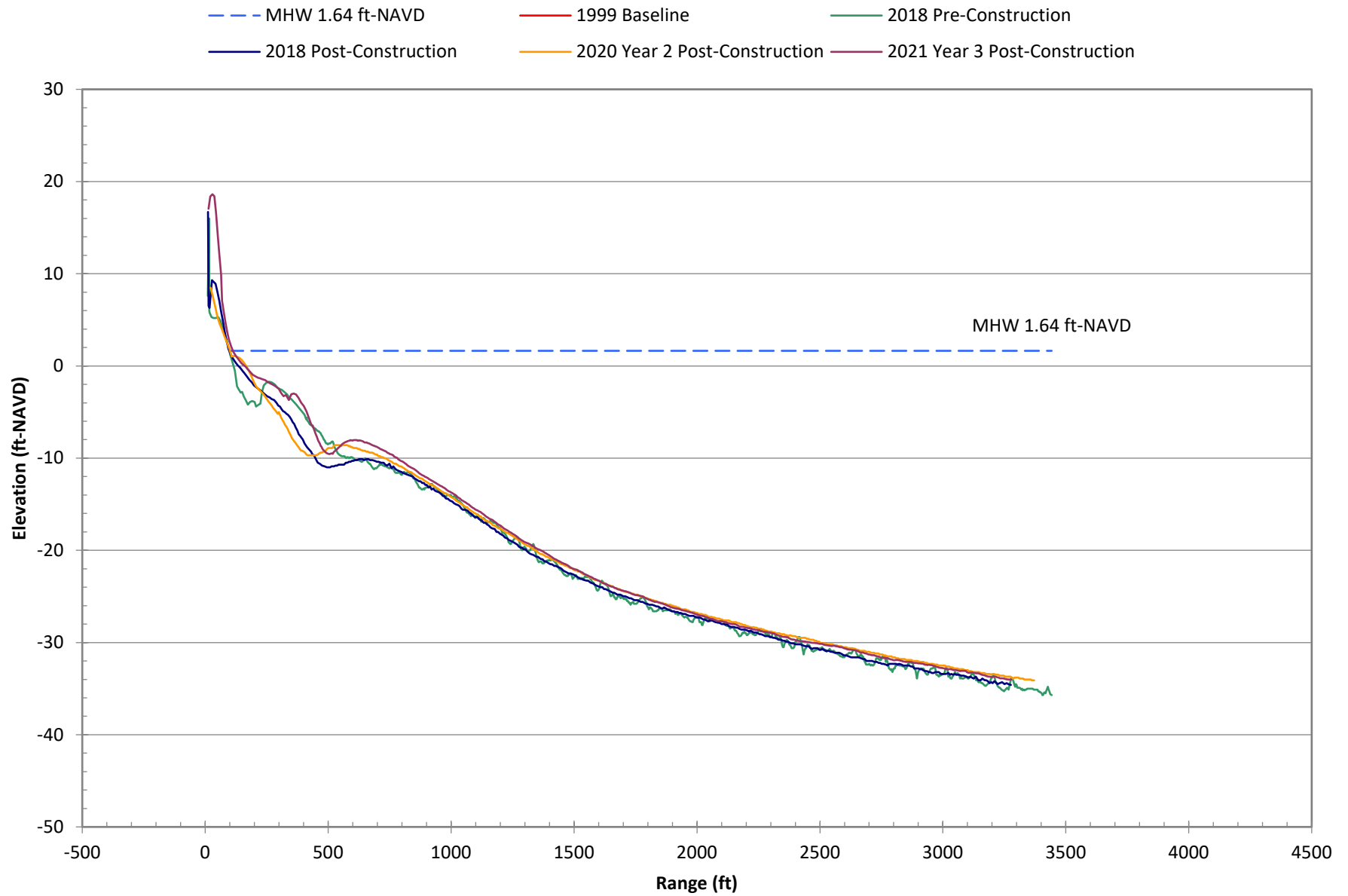
Survey Data at T-104 for Selected Years



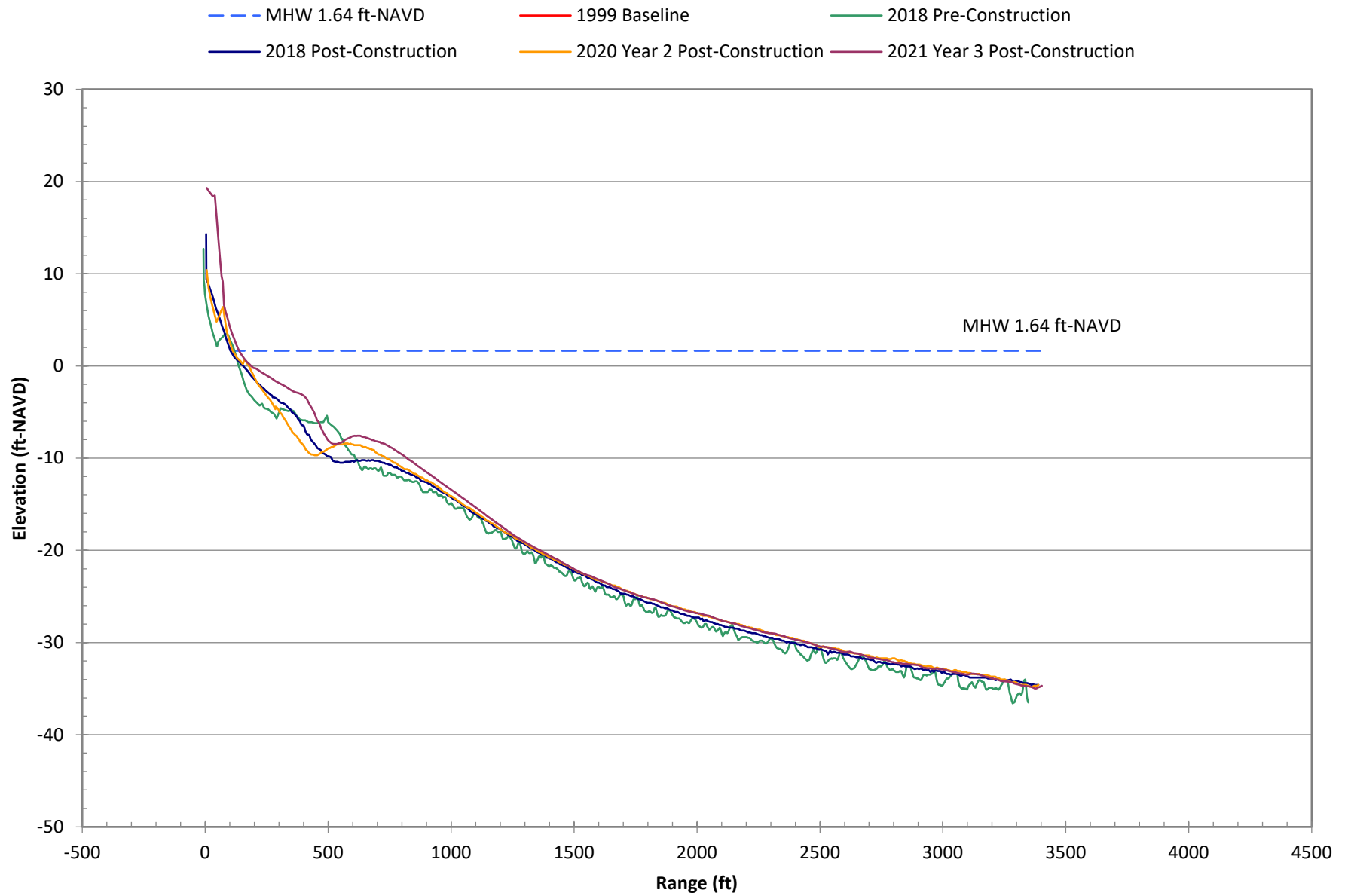
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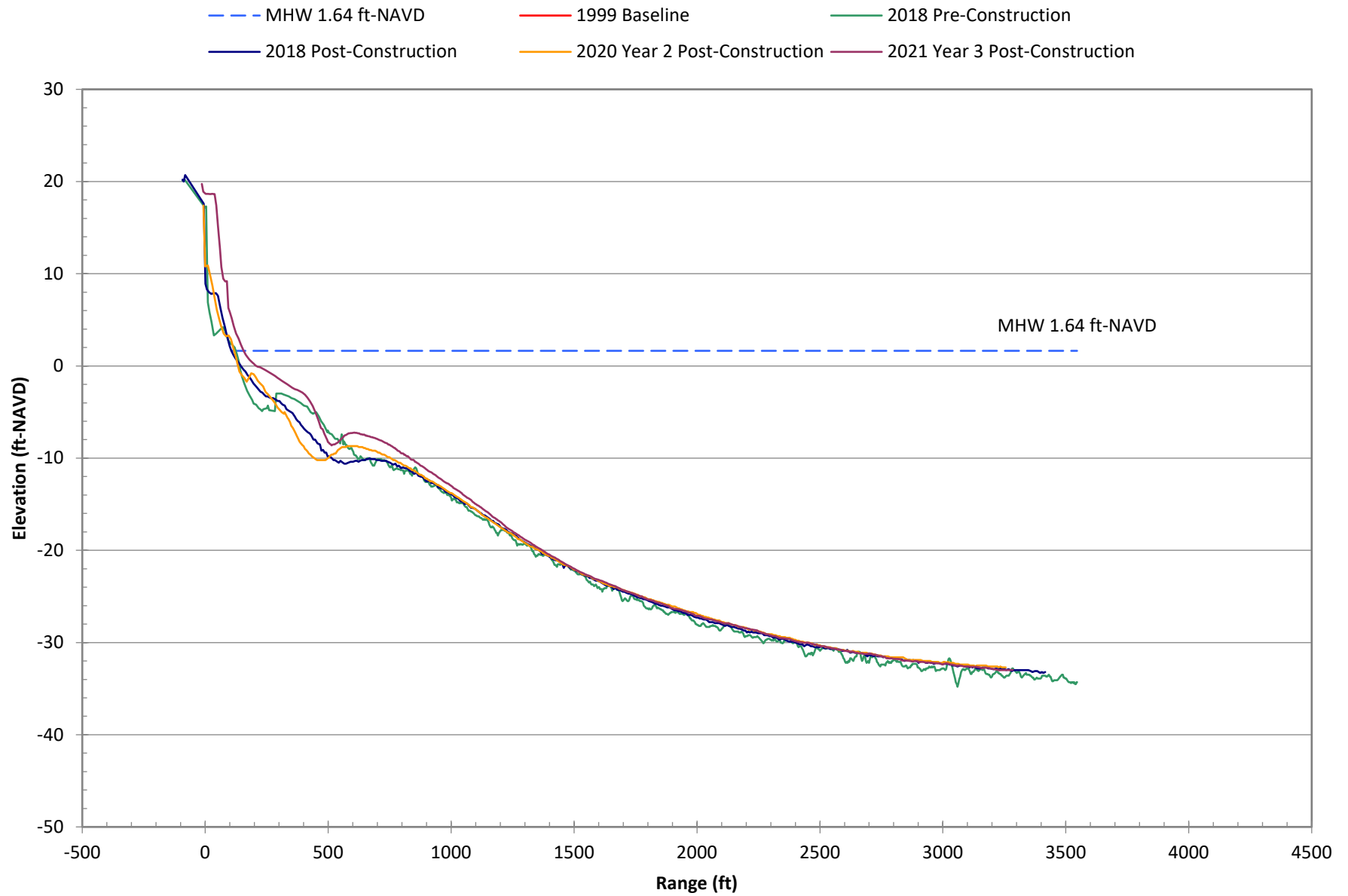
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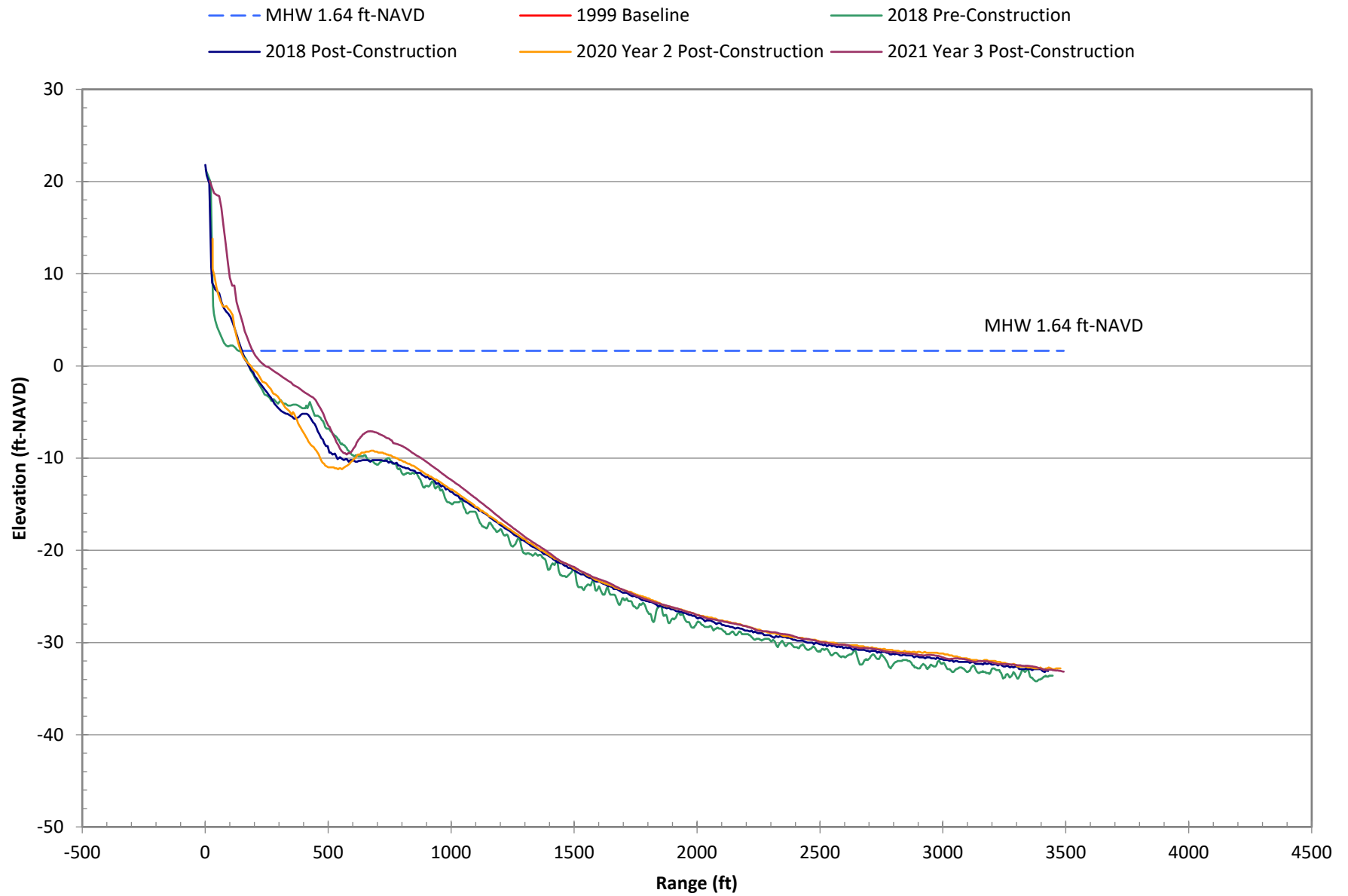
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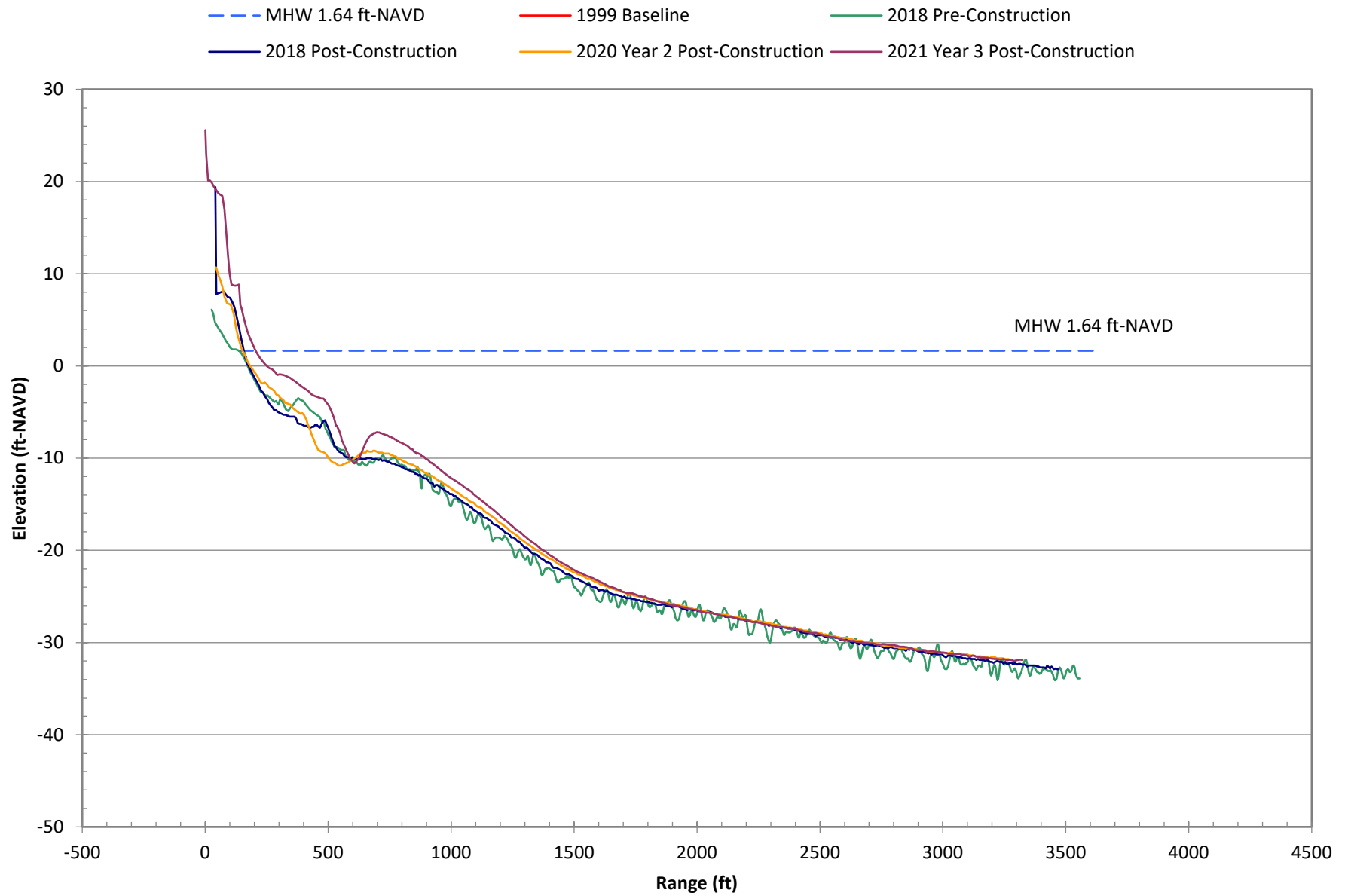
Survey Data at R-108 for Selected Years



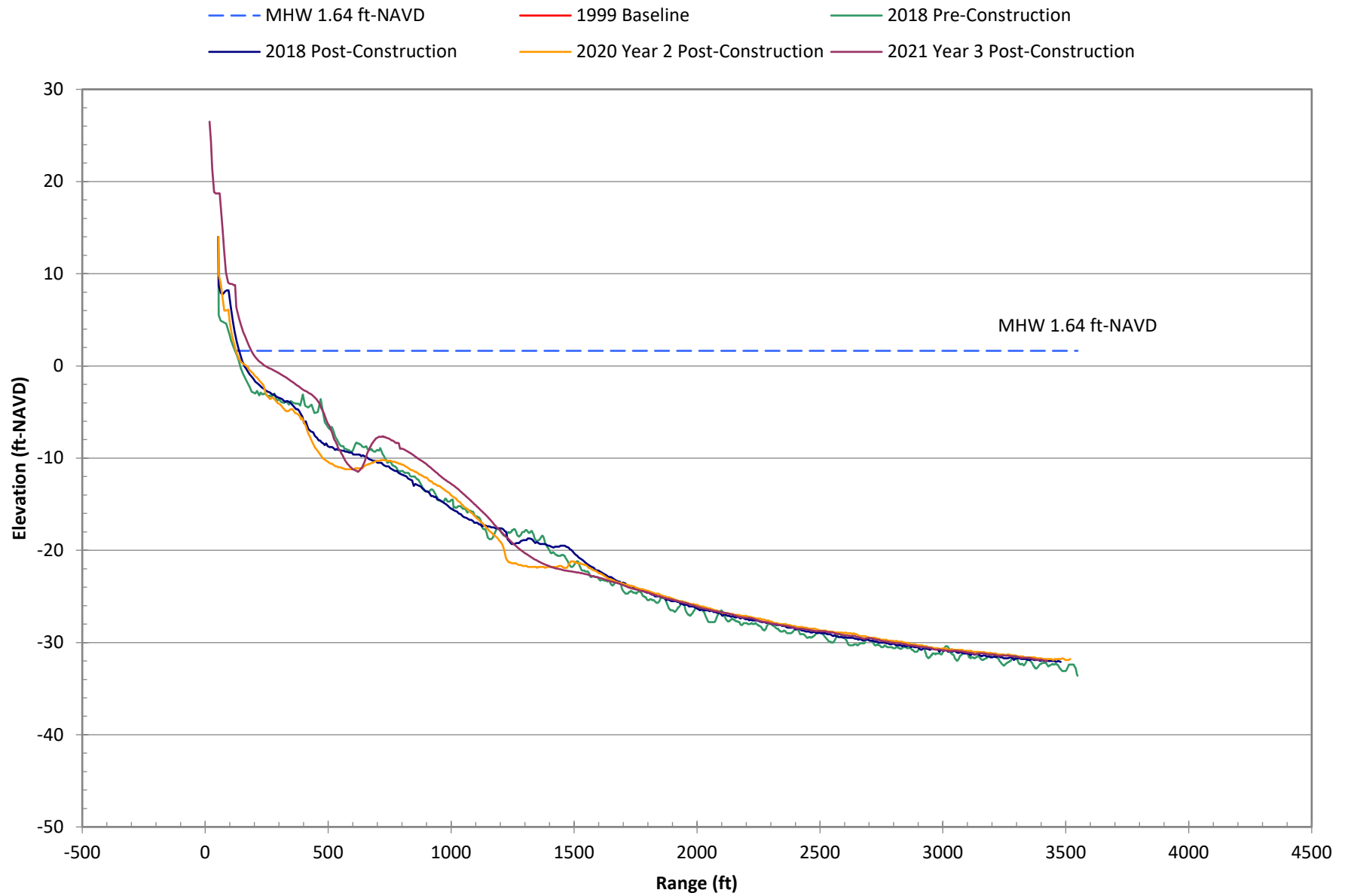
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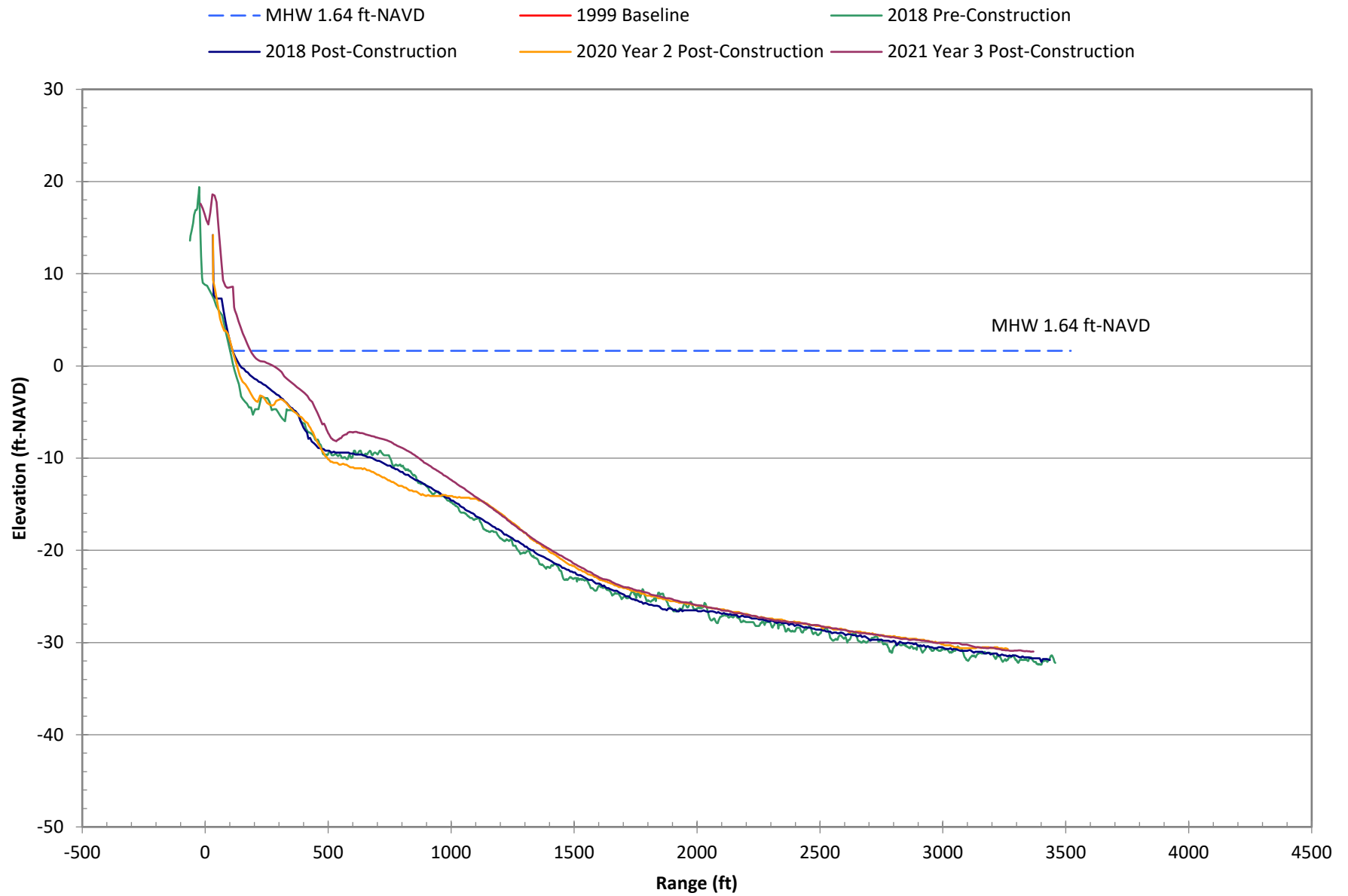
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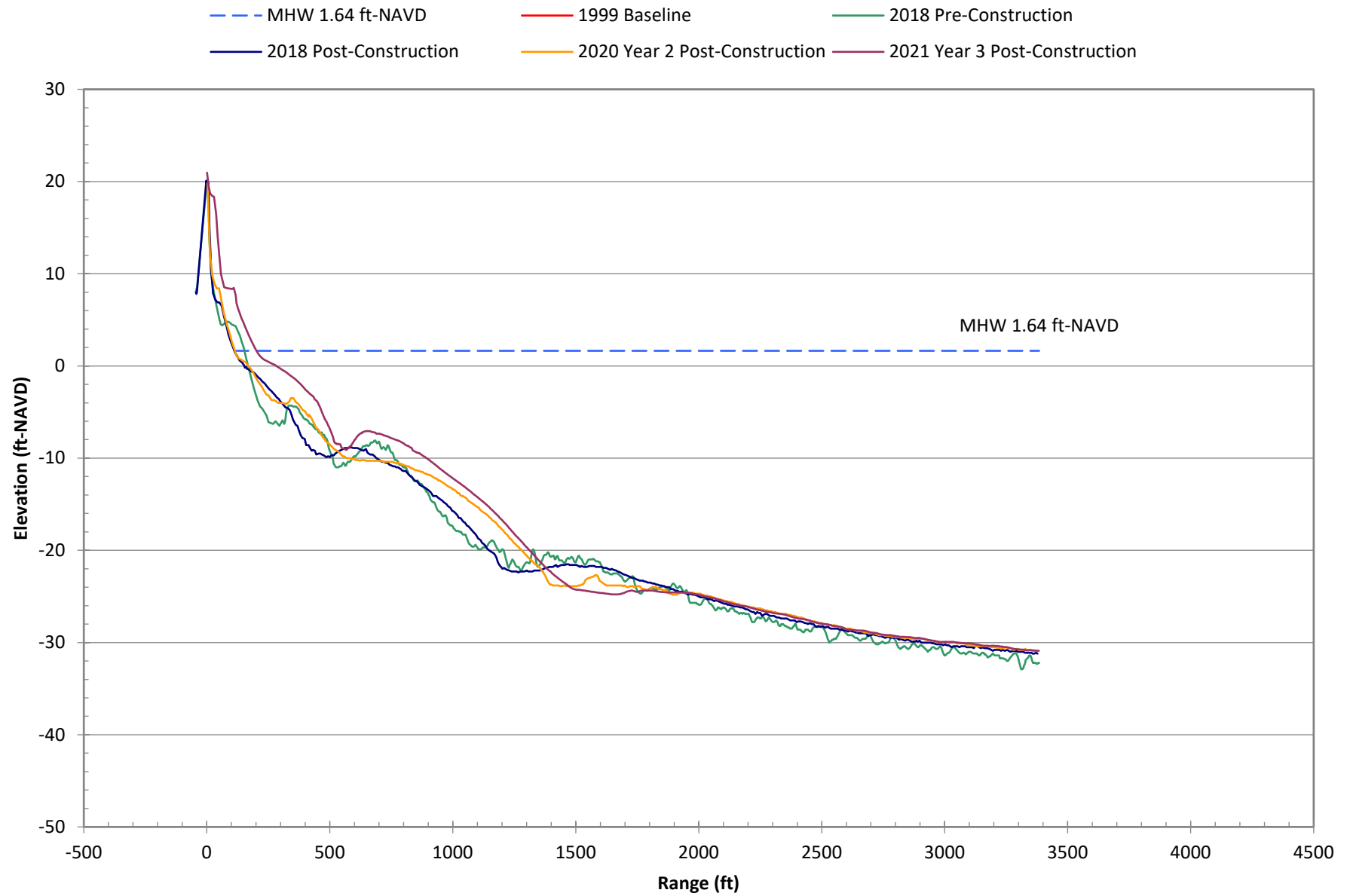
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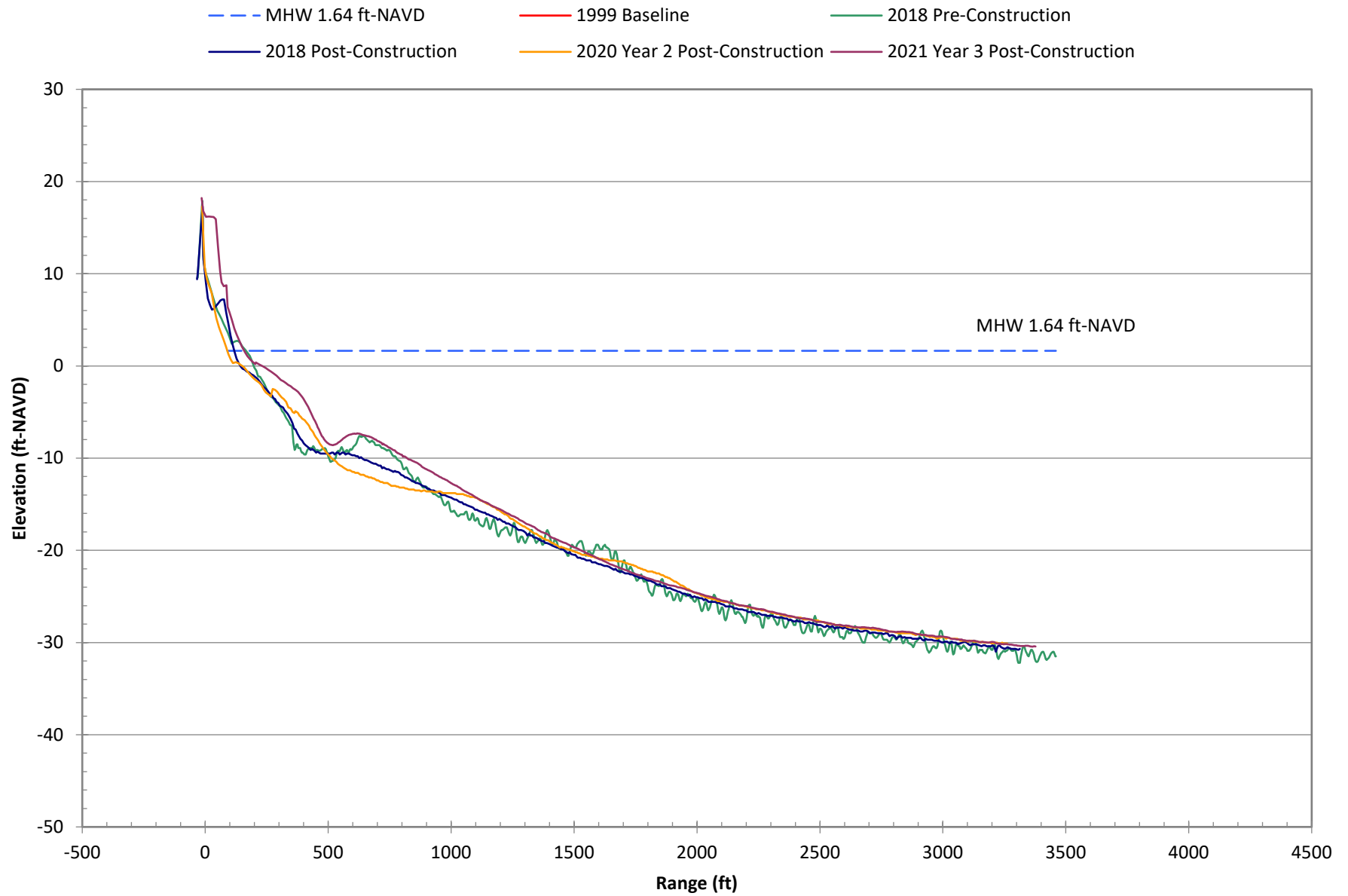
Survey Data at R-112 for Selected Years



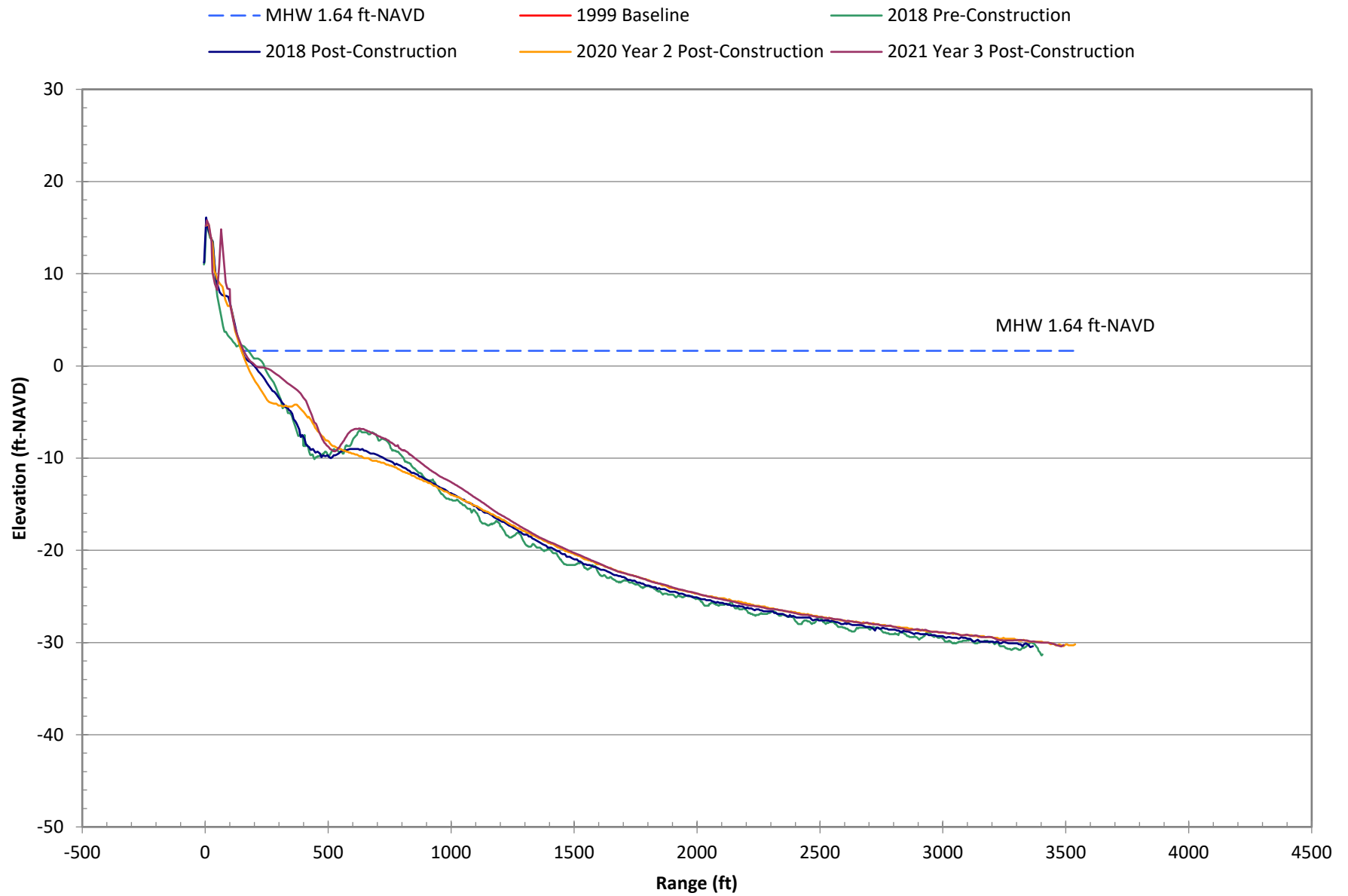
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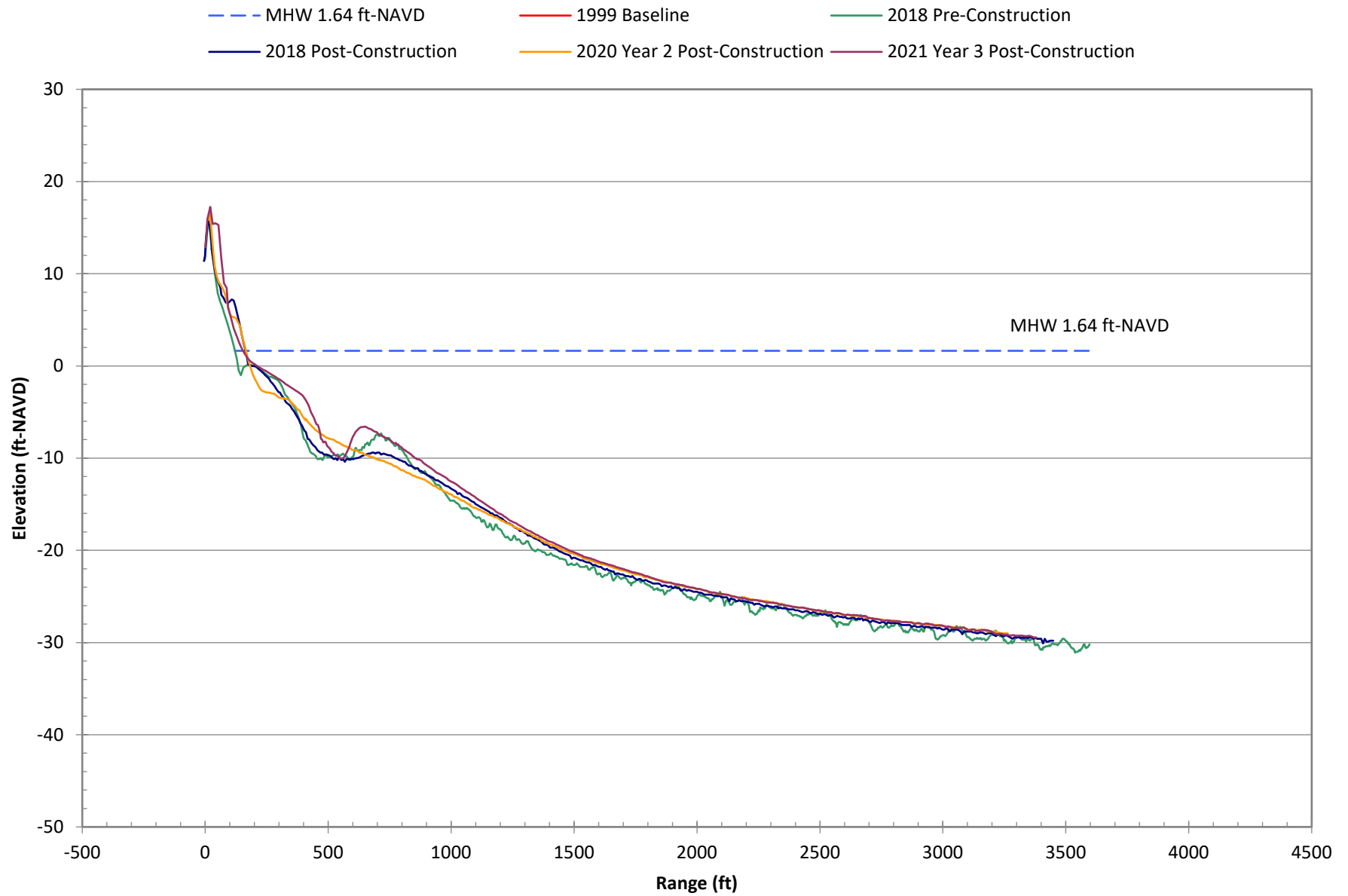
Survey Data at R-114 for Selected Years



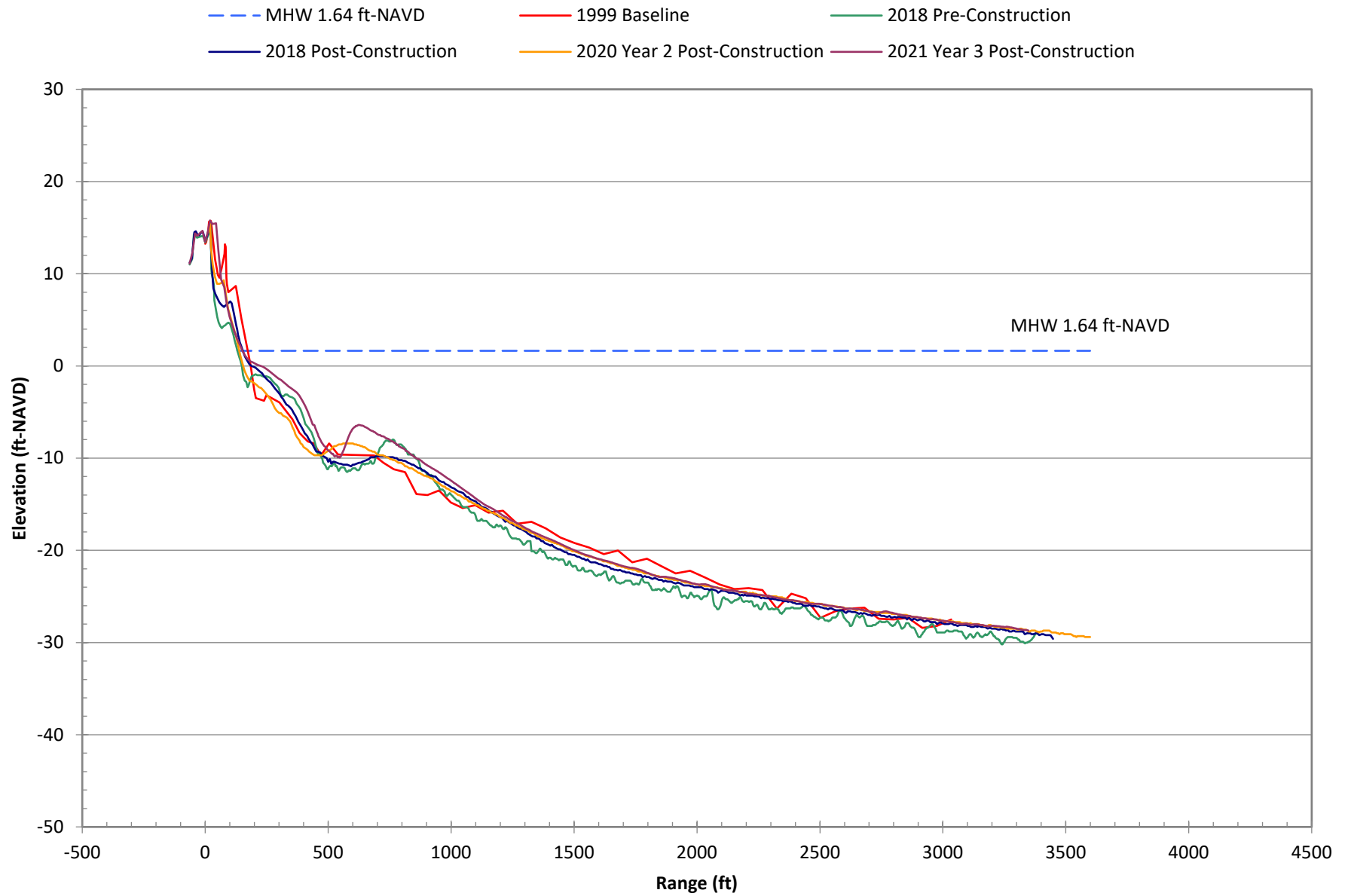
Survey Data at R-115 for Selected Years



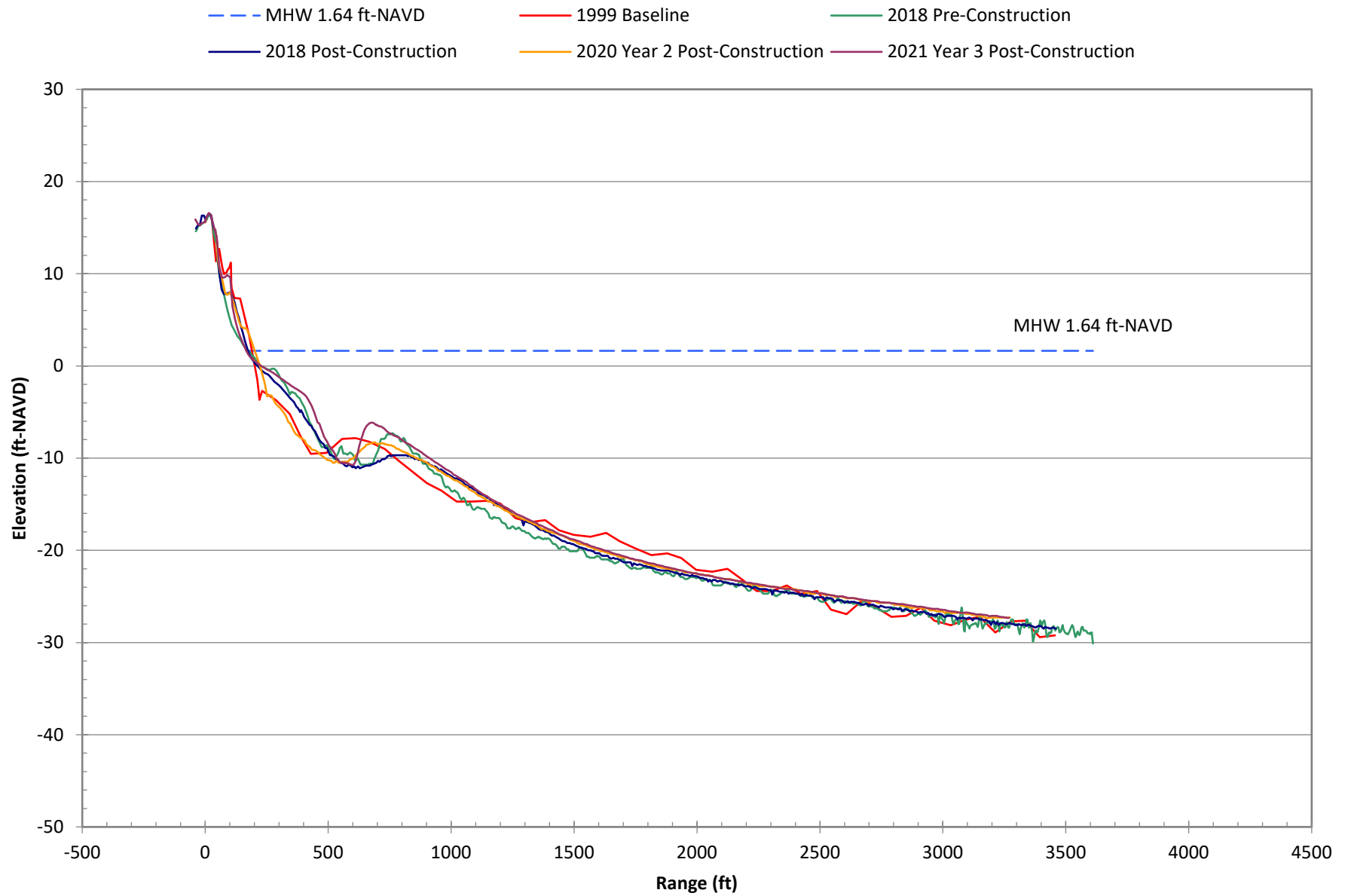
Survey Data at R-116 for Selected Years



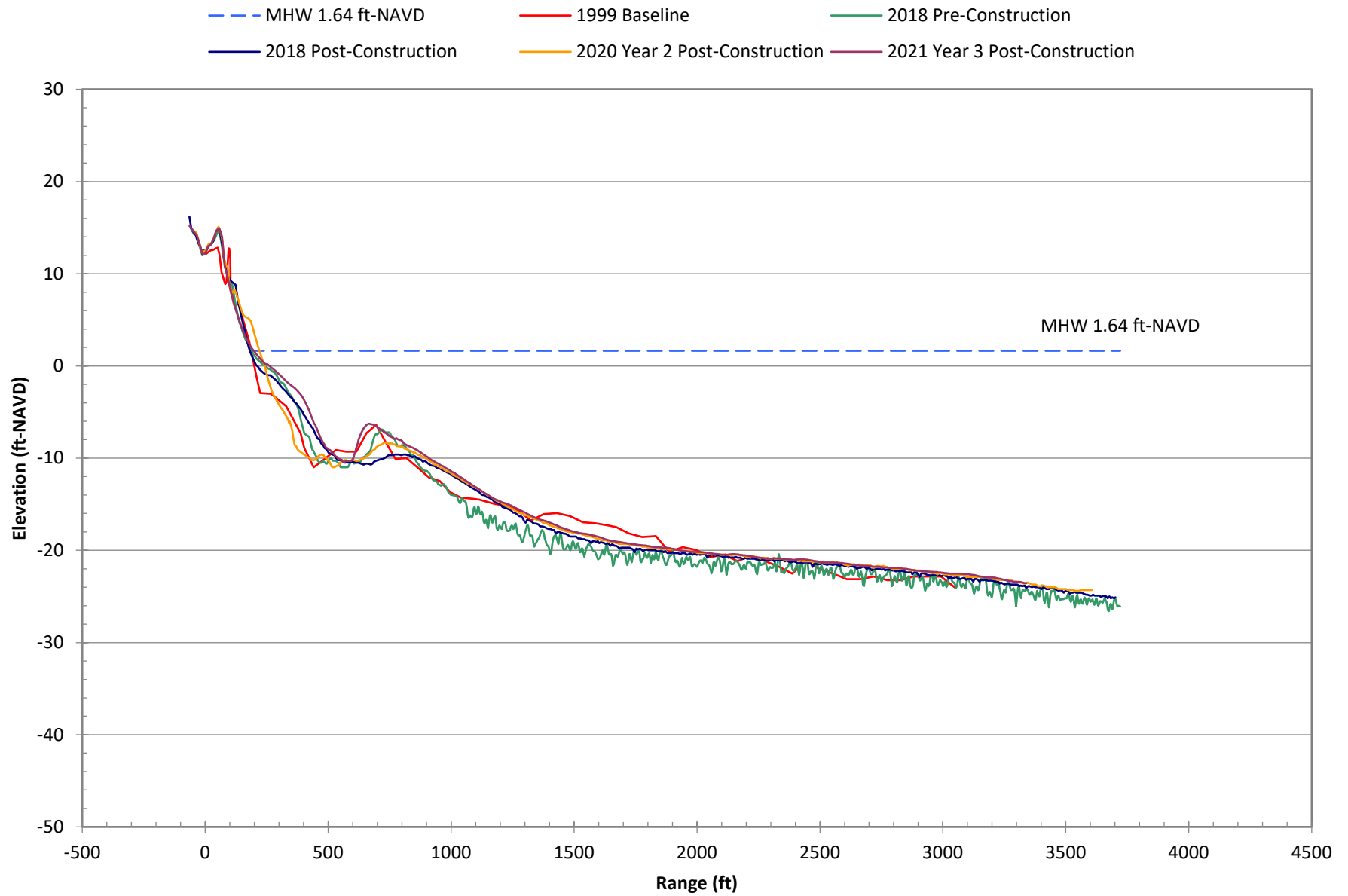
Survey Data at R-117 for Selected Years



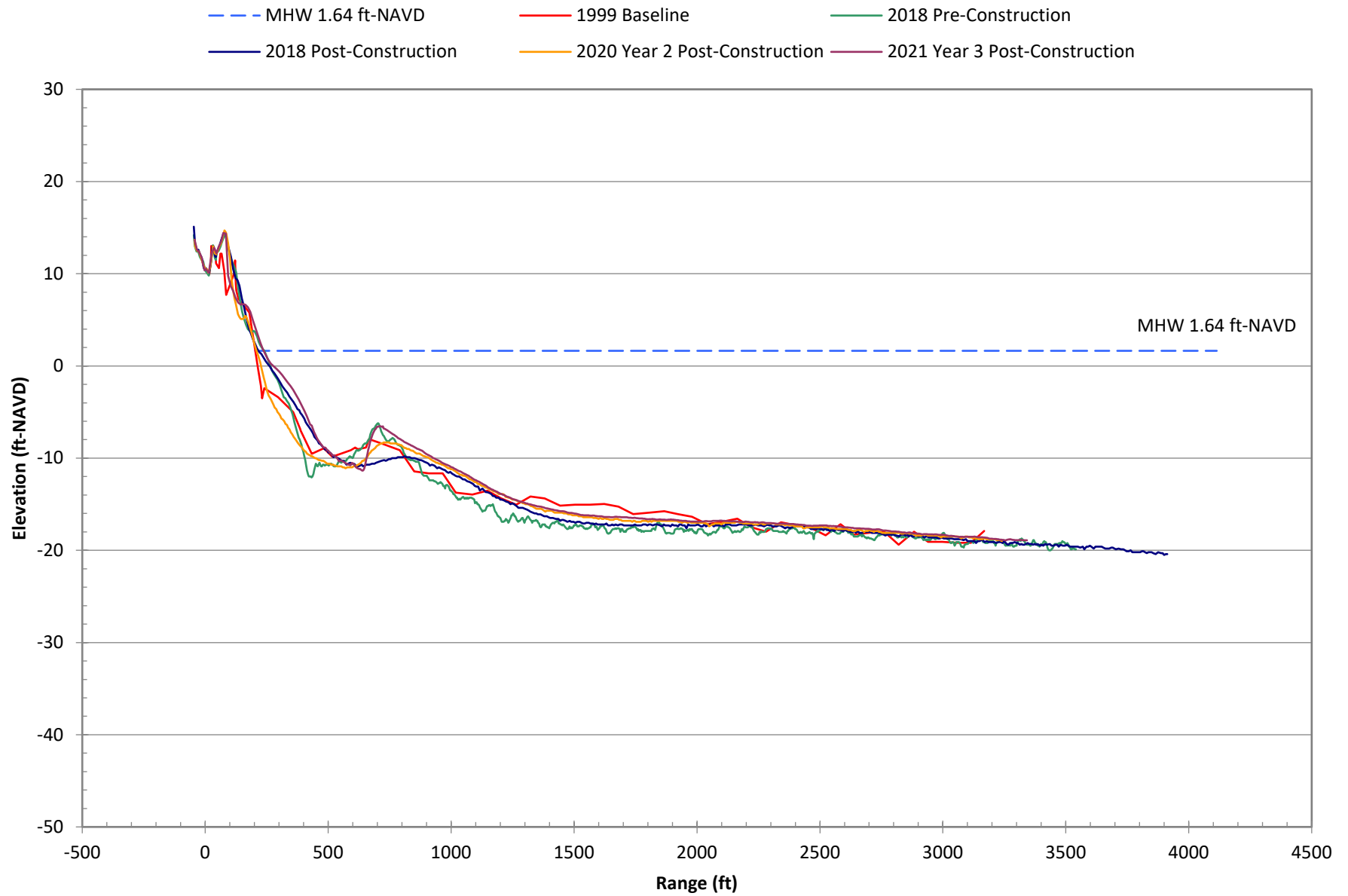
Survey Data at R-118 for Selected Years



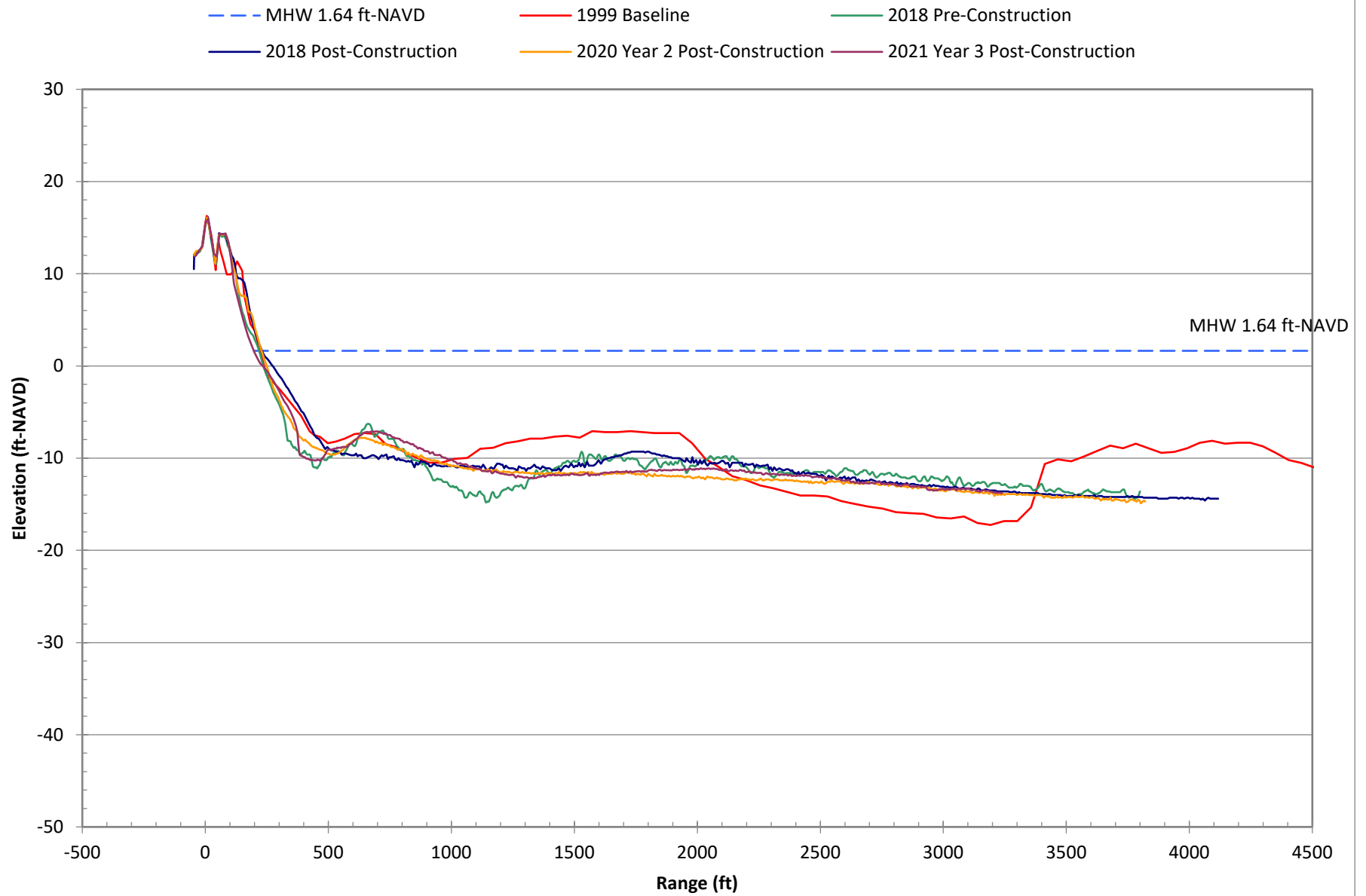
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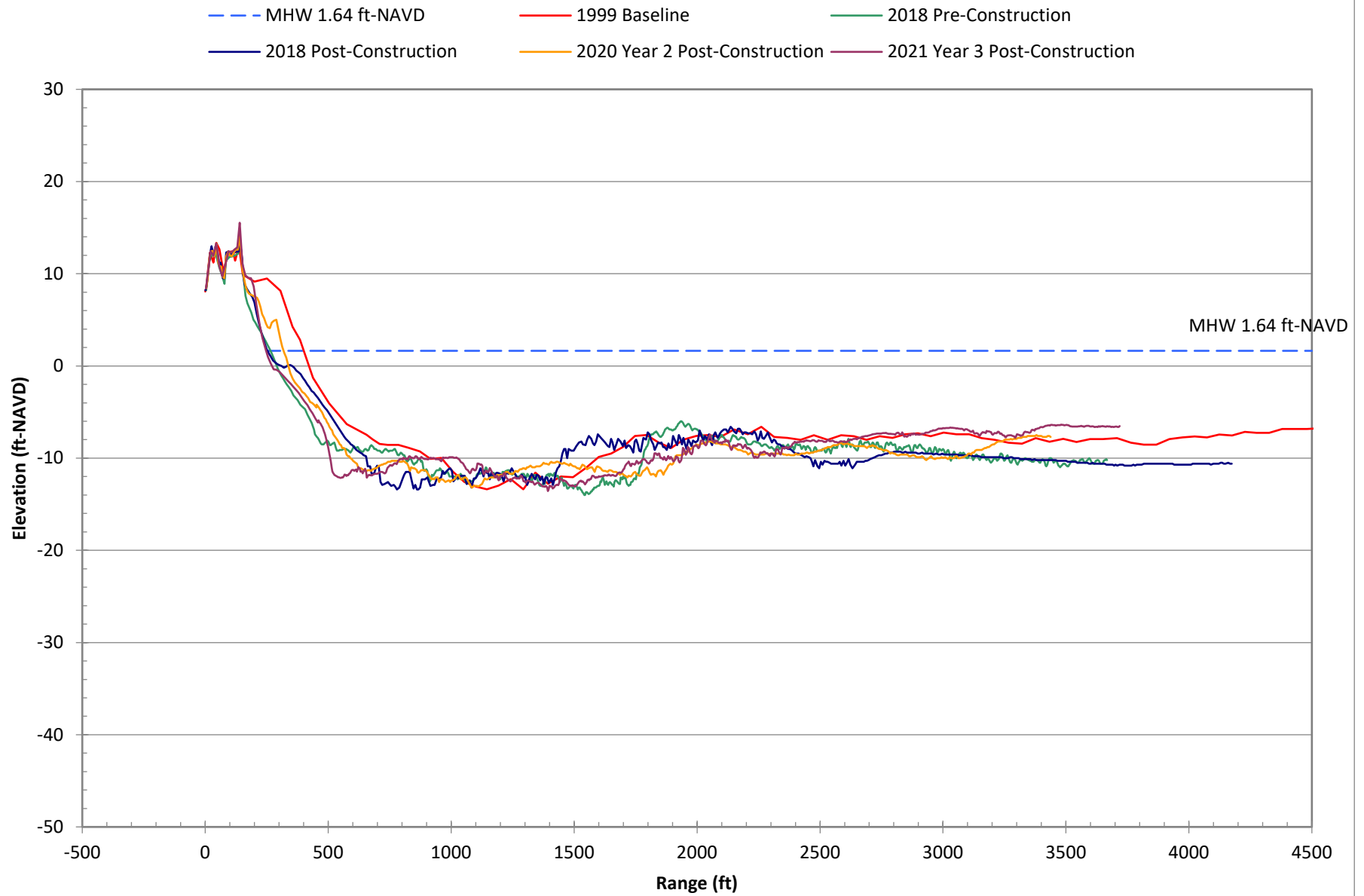
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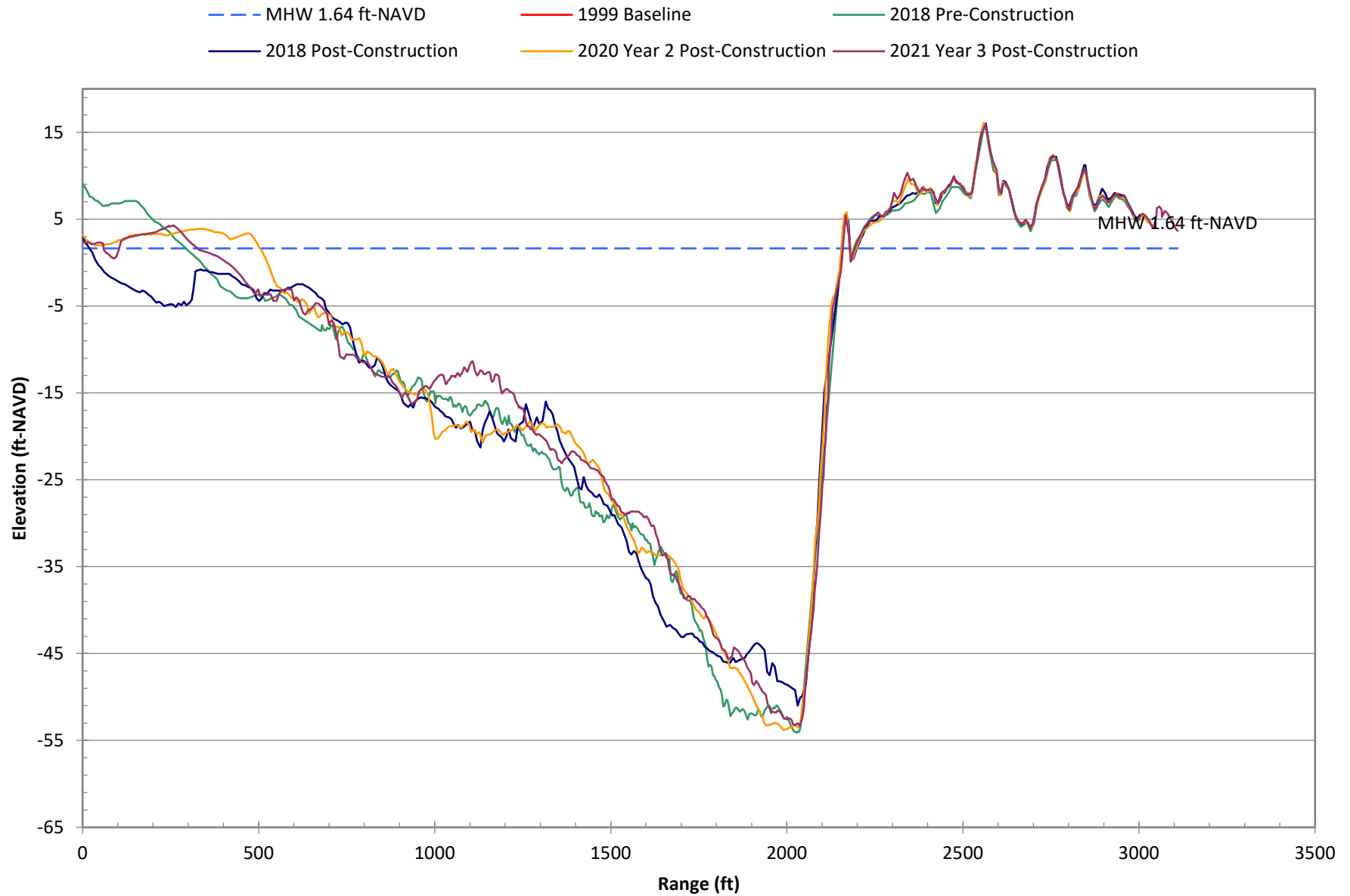
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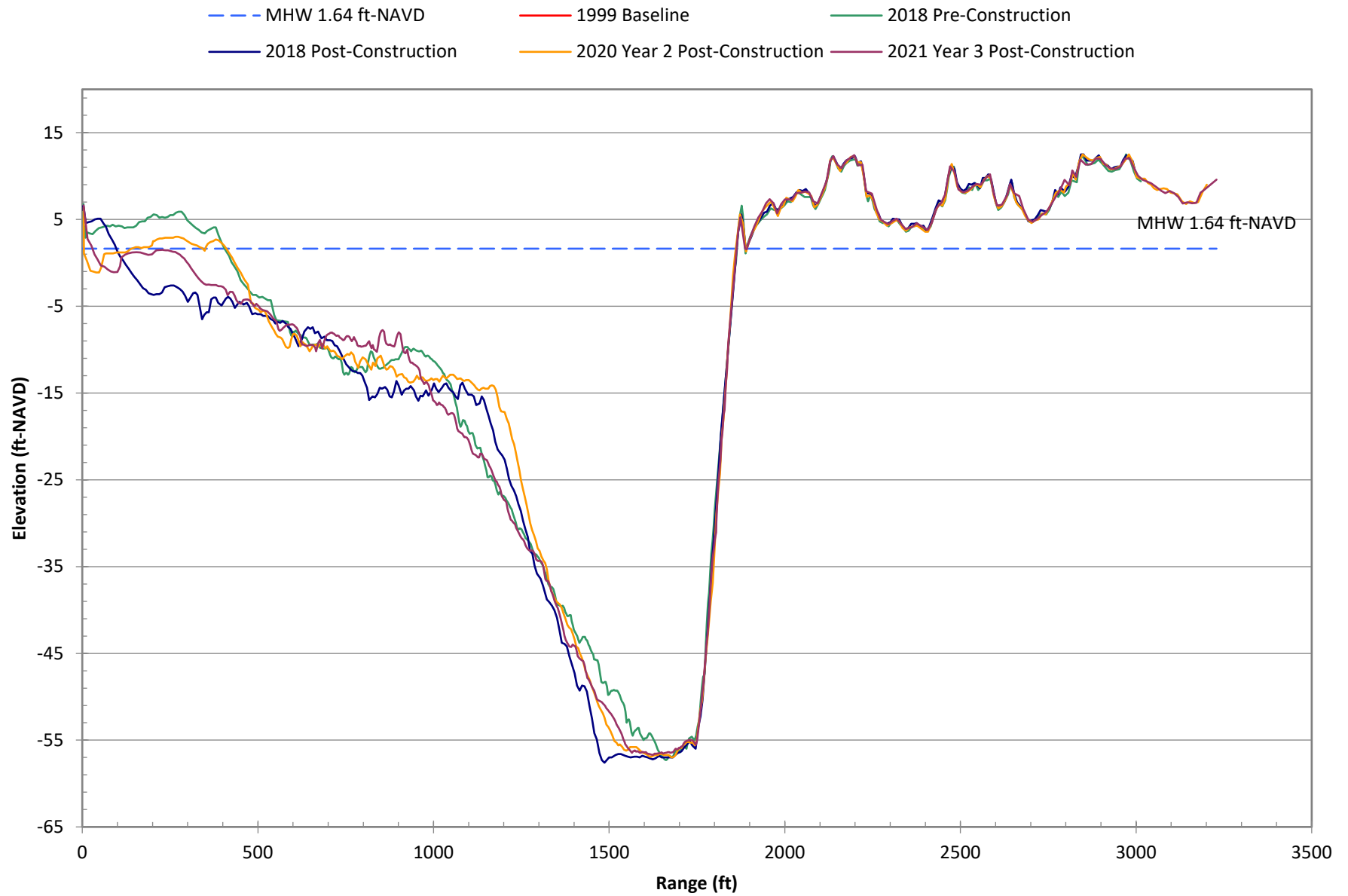
Survey Data at R-122 for Selected Years



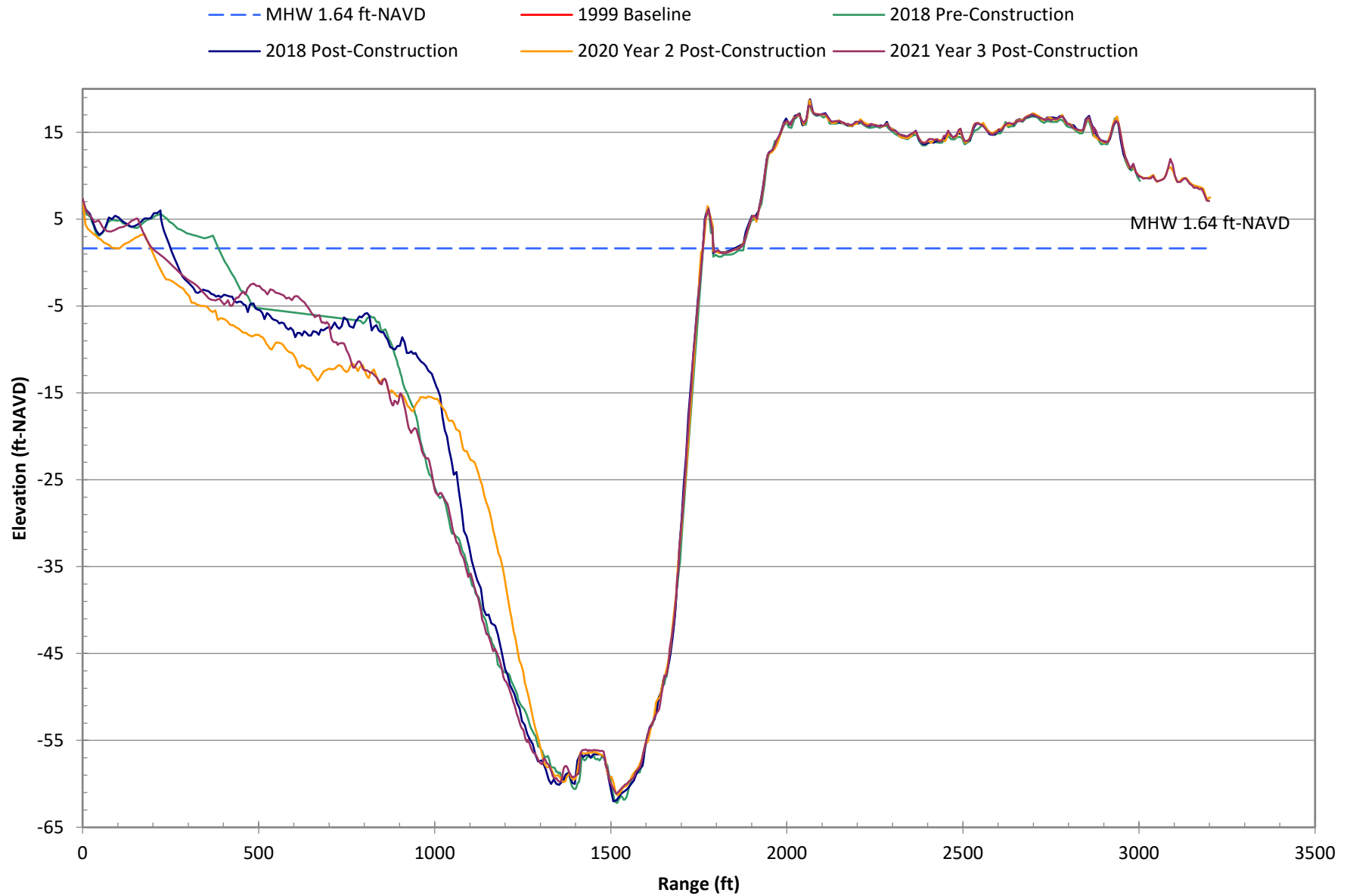
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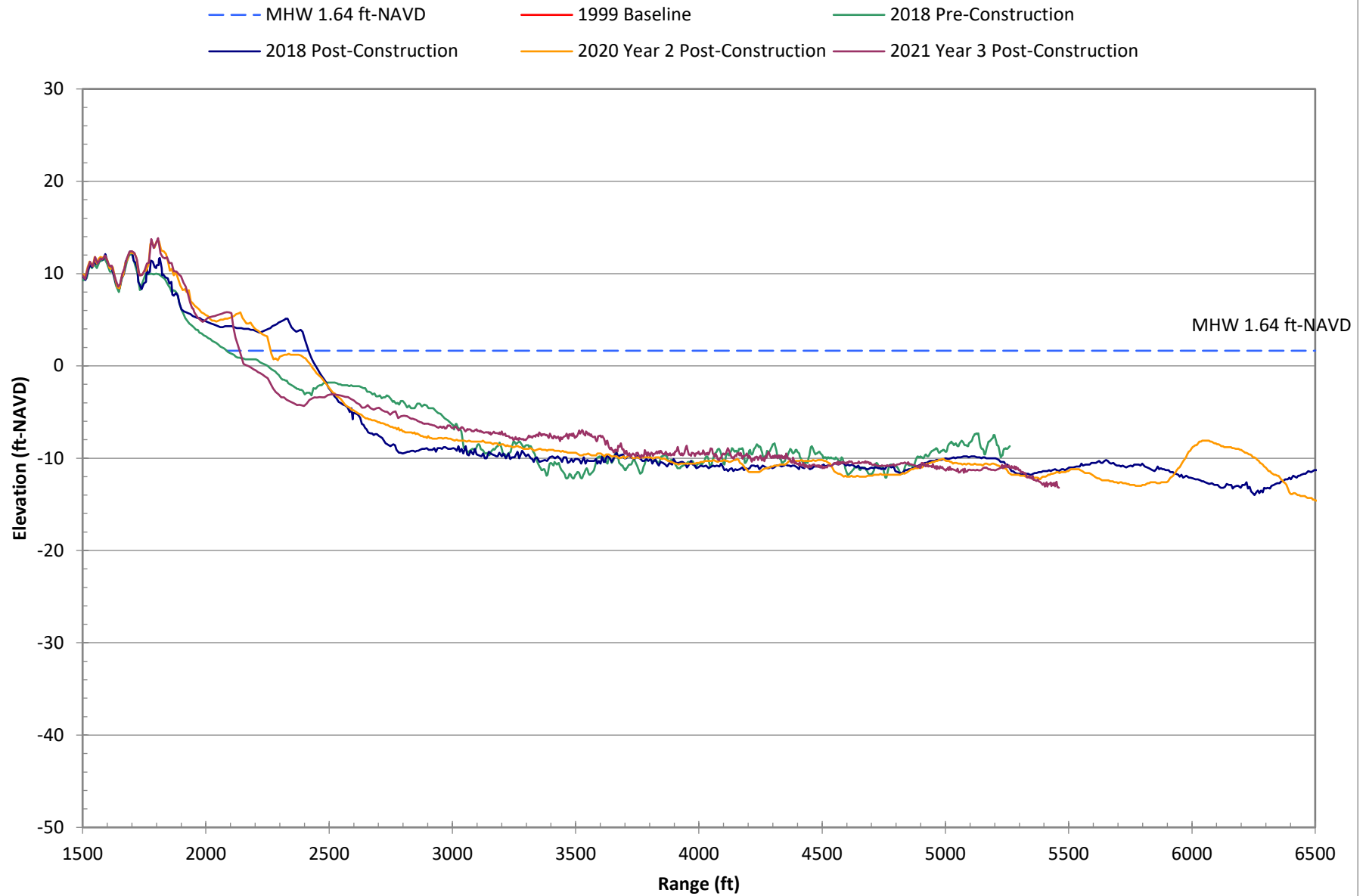
Survey Data at R-122B for Selected Years



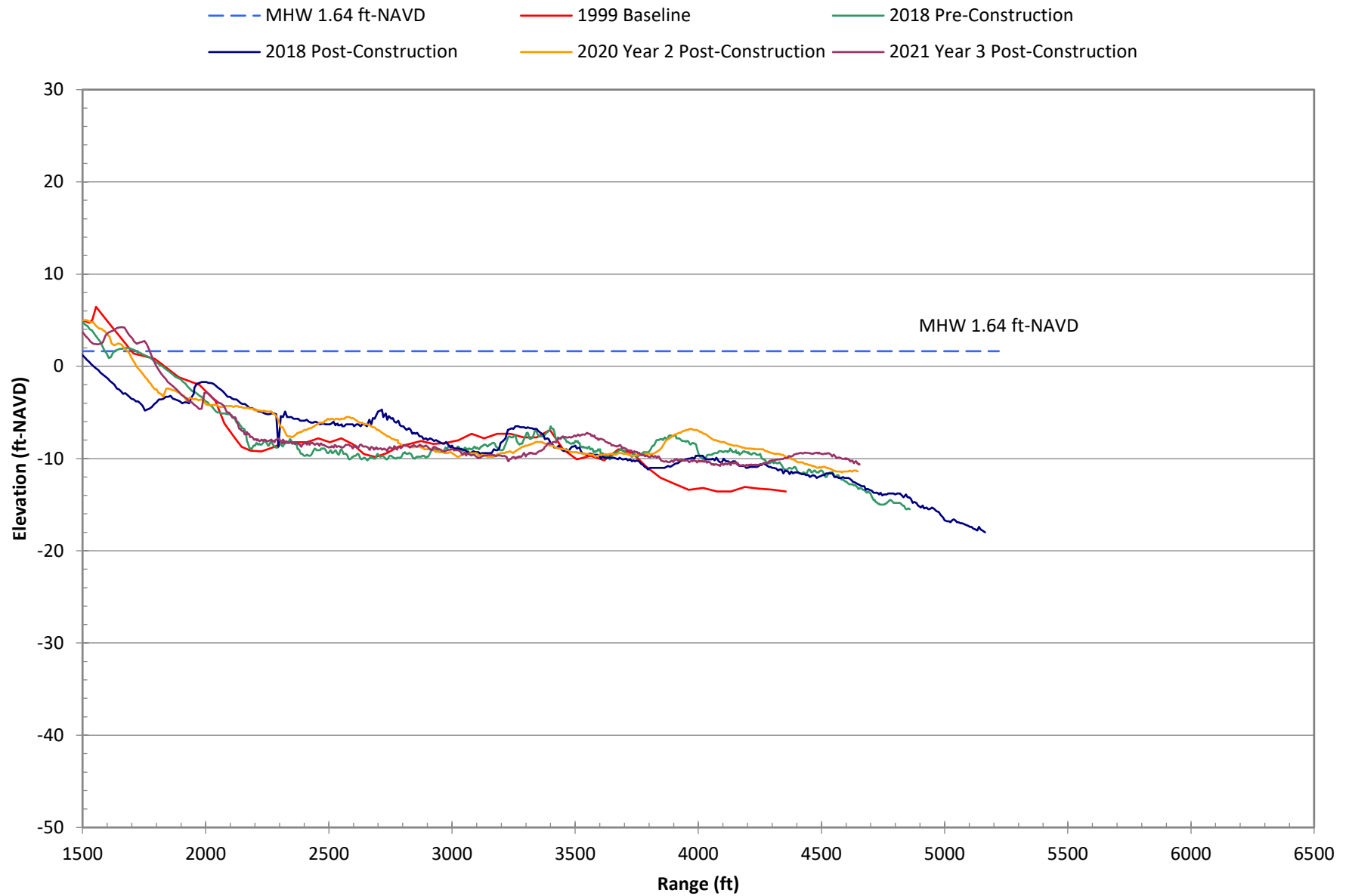
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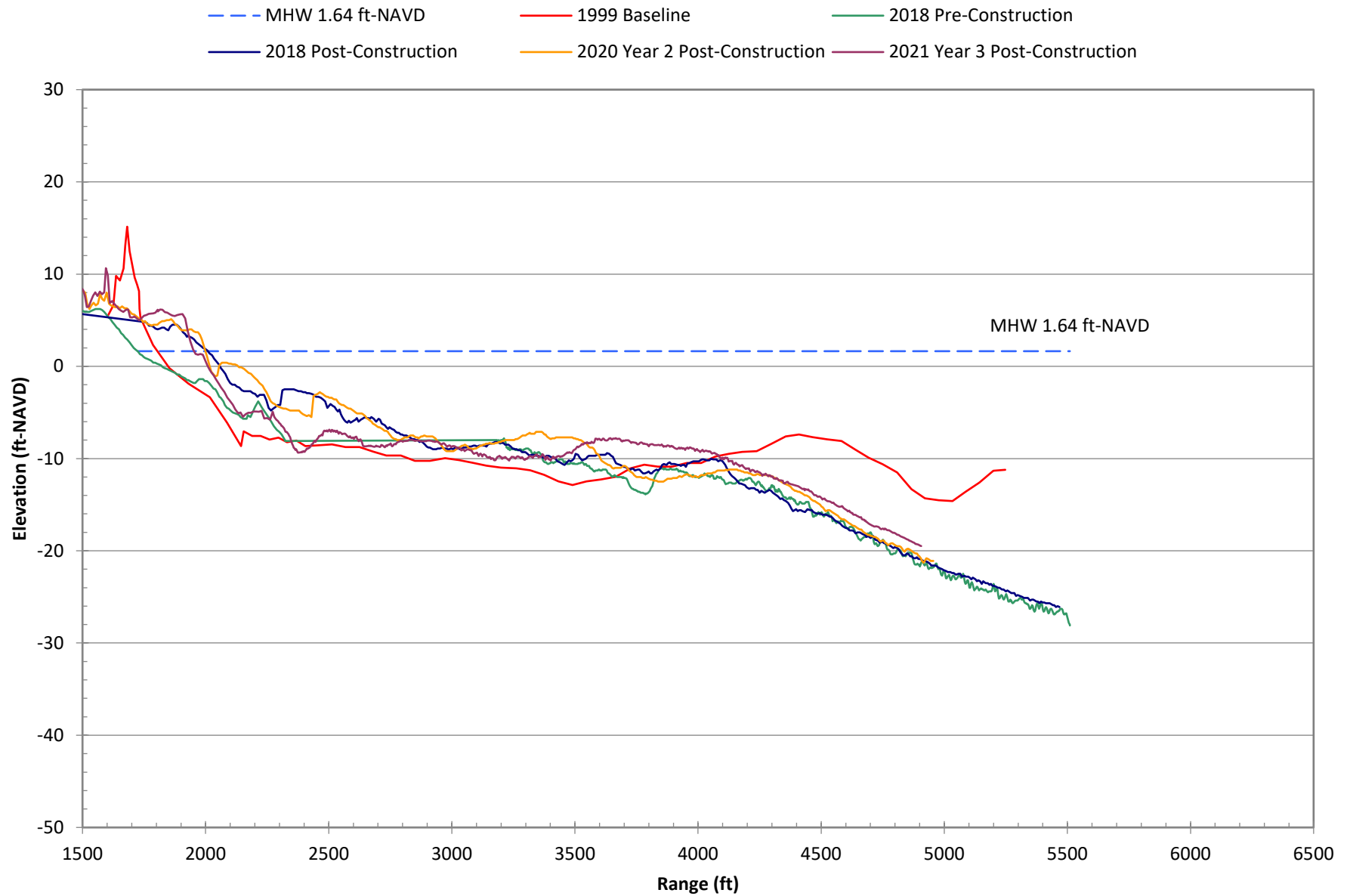
Survey Data at R-123 for Selected Years



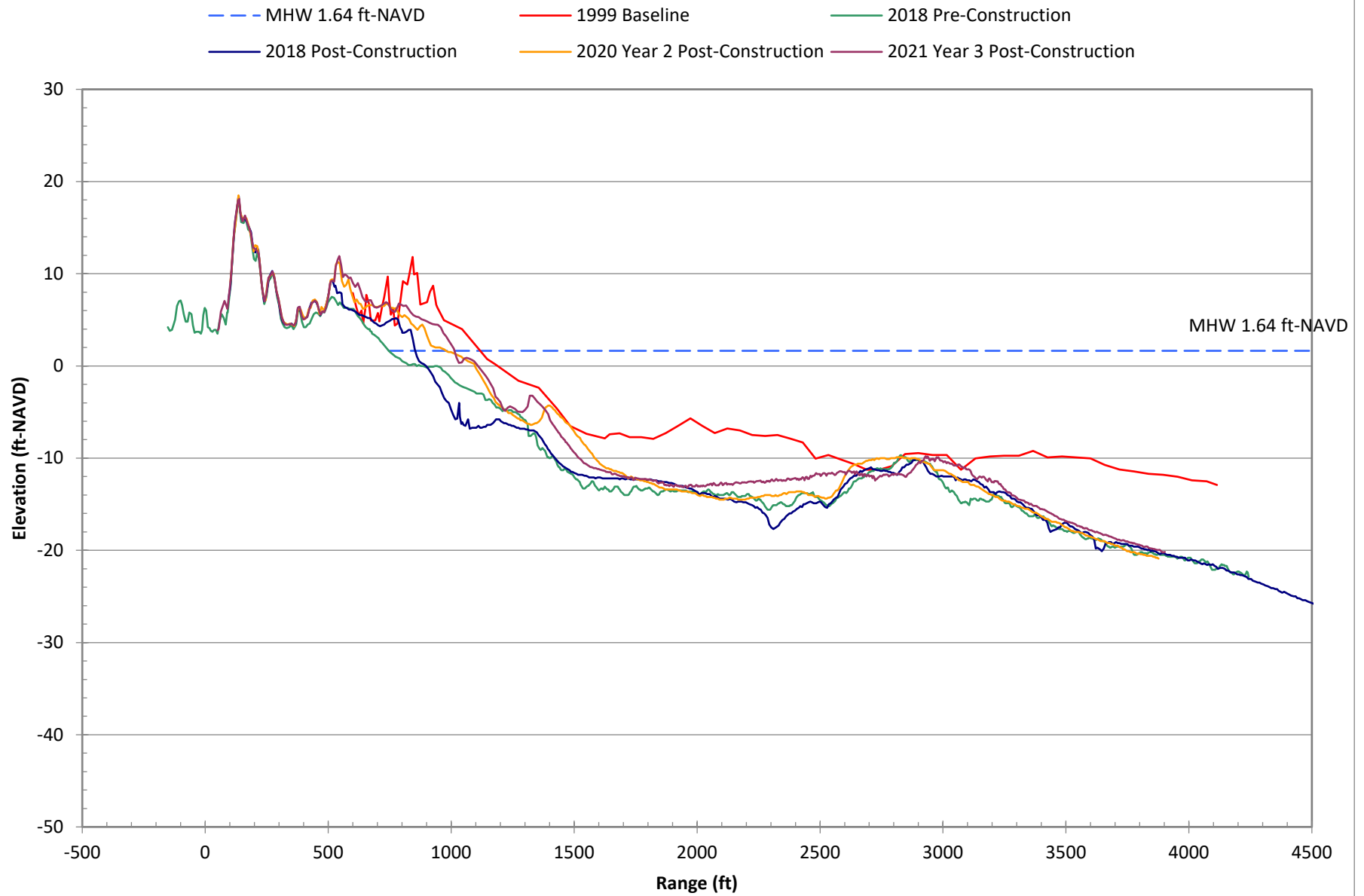
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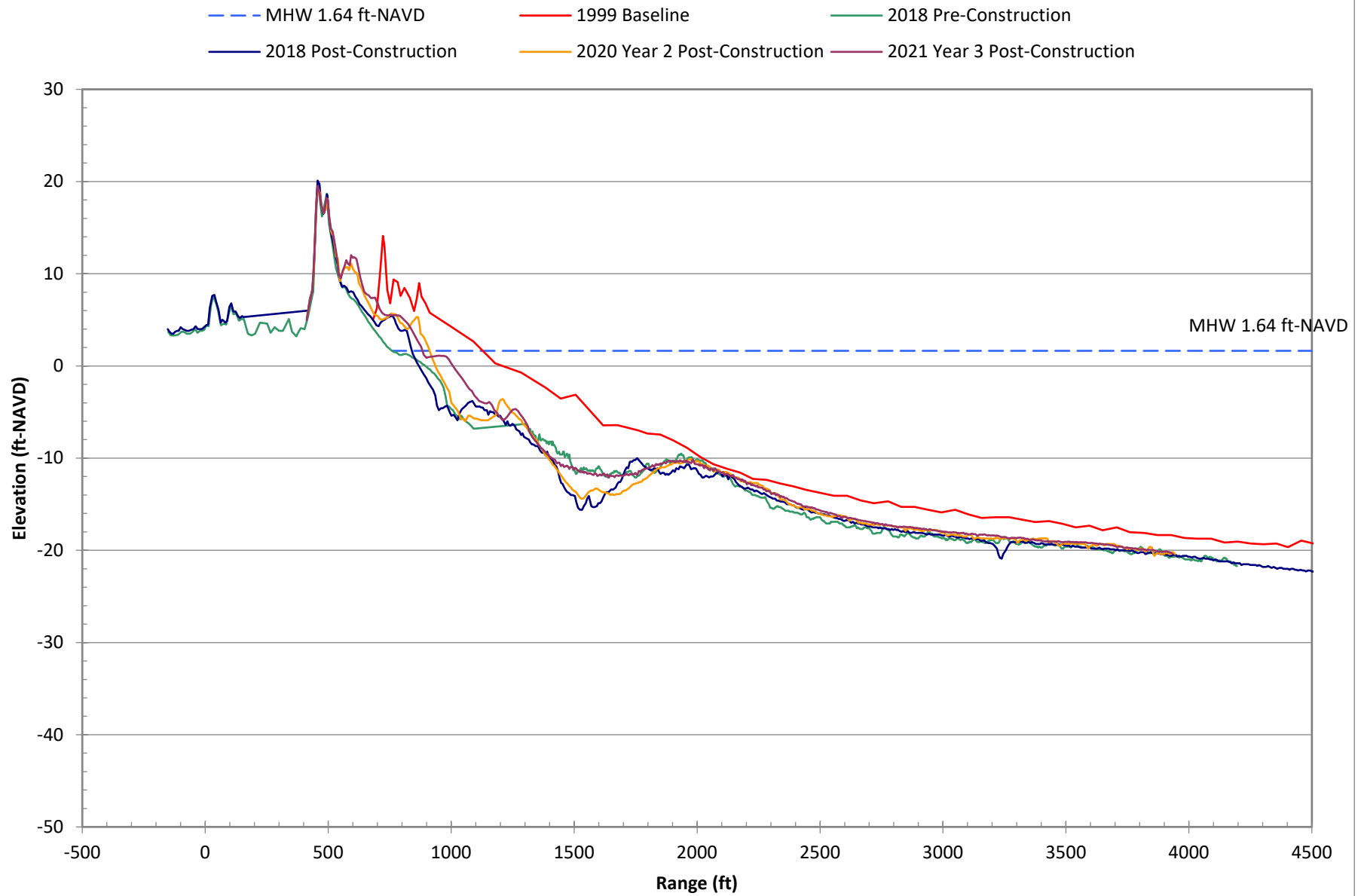
Survey Data at R-125 for Selected Years



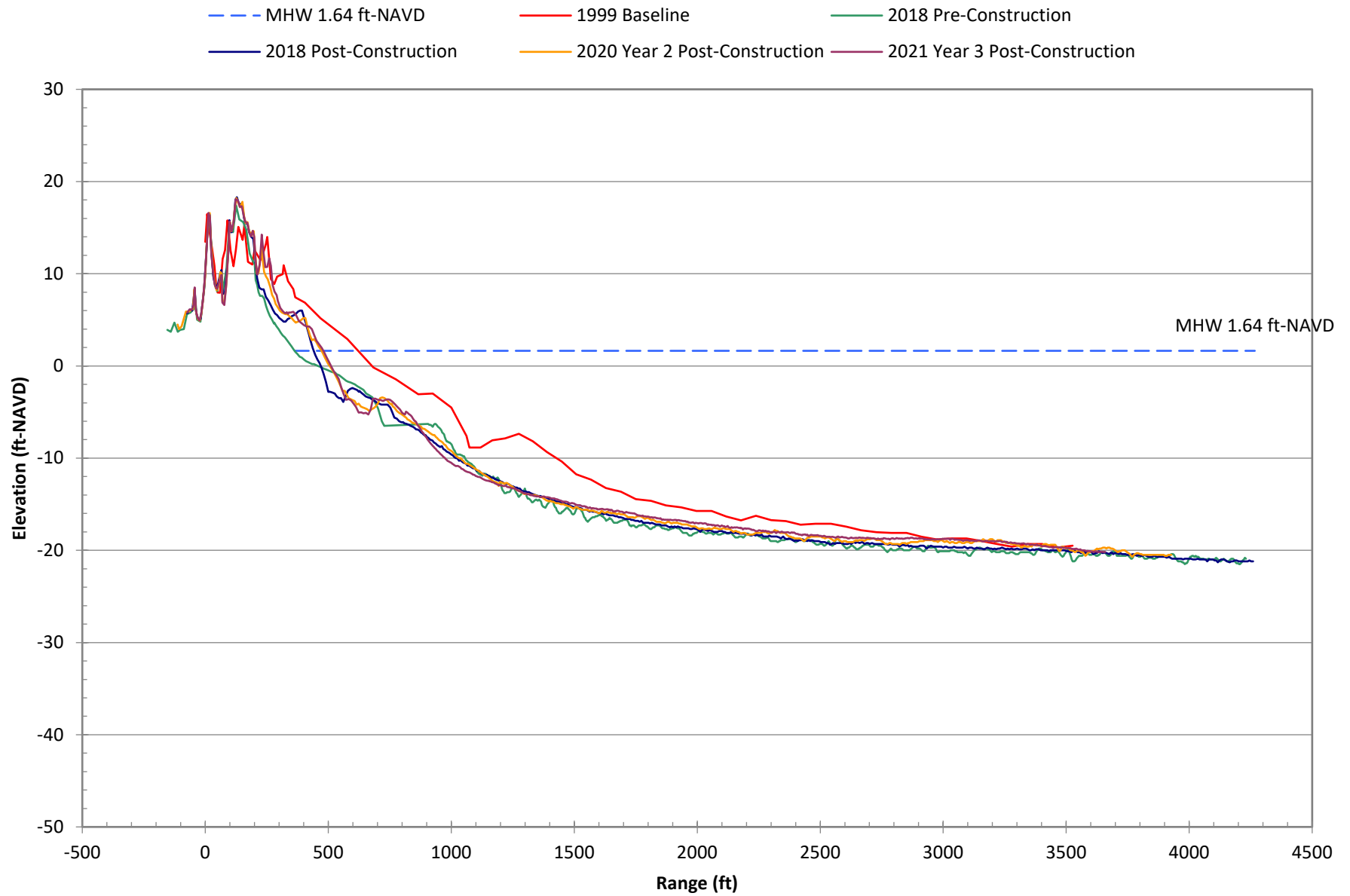
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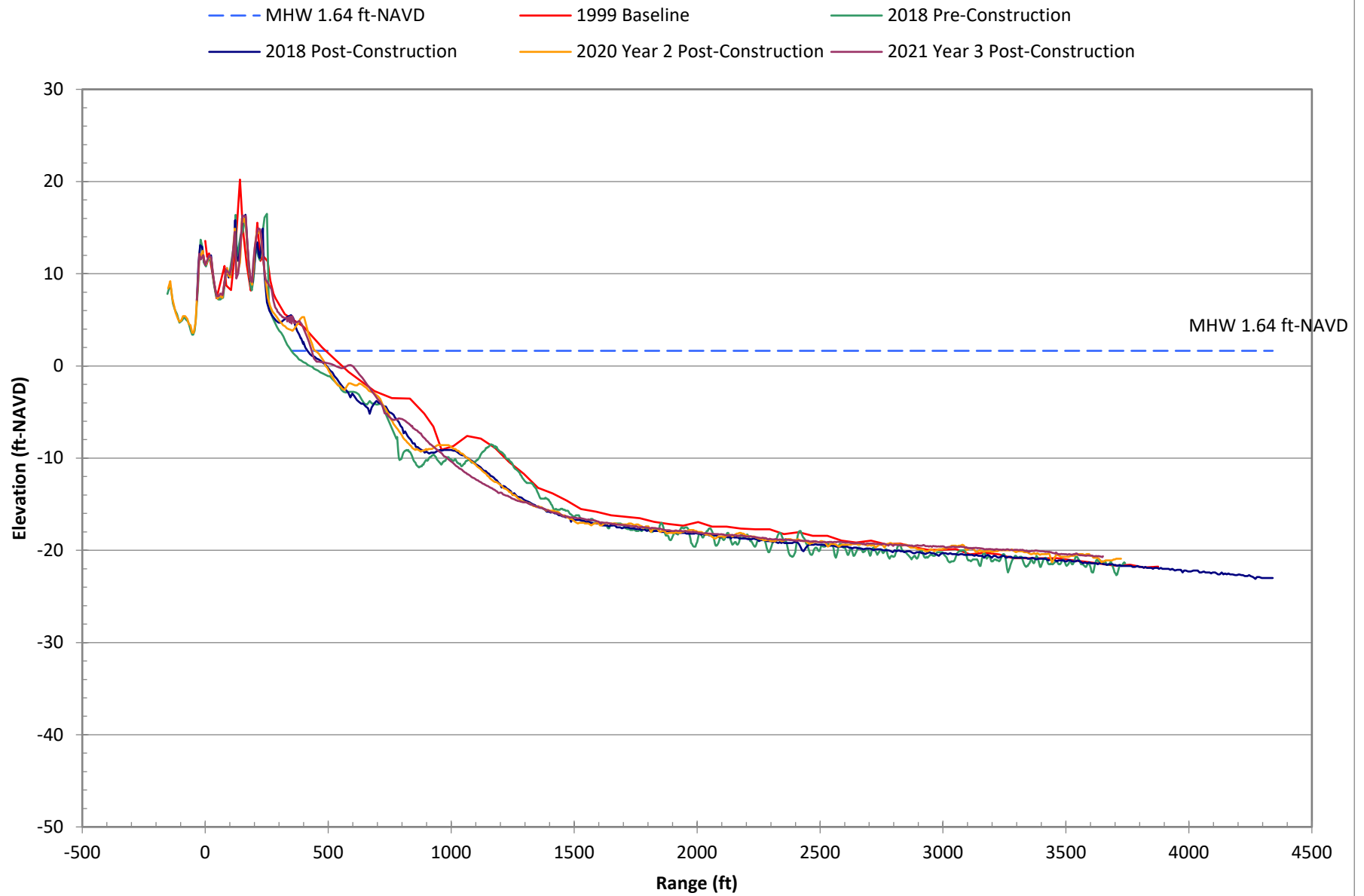
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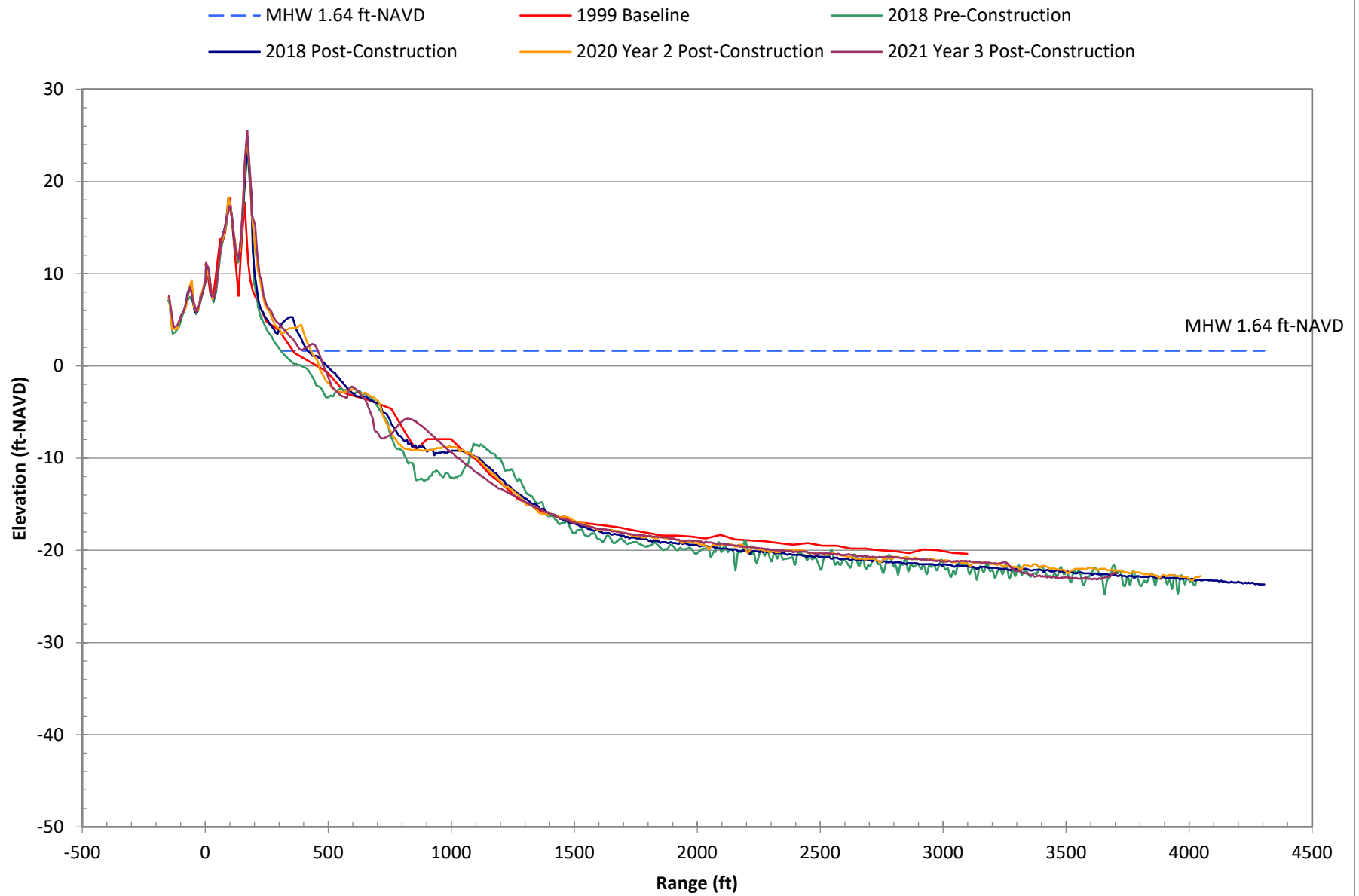
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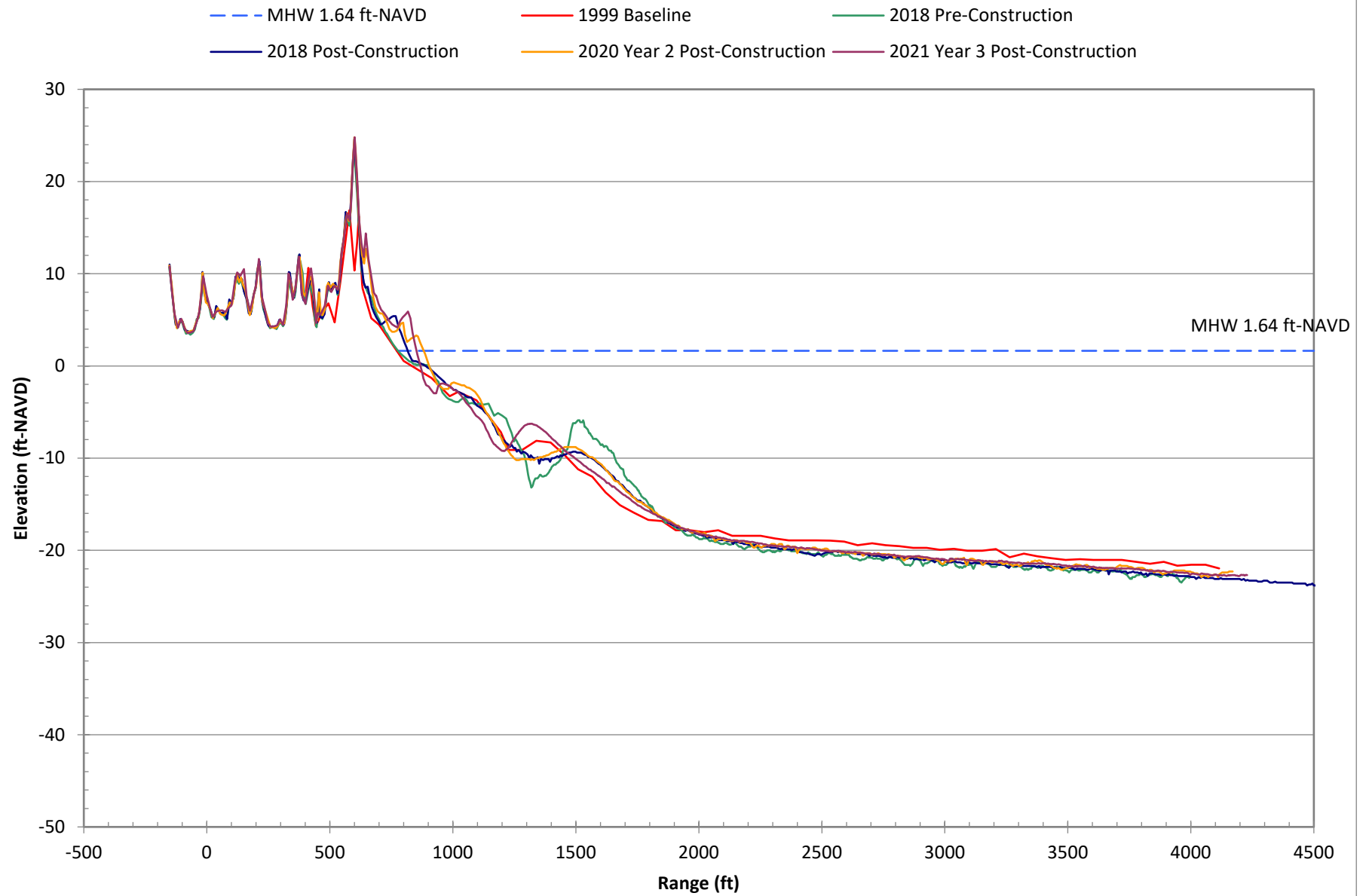
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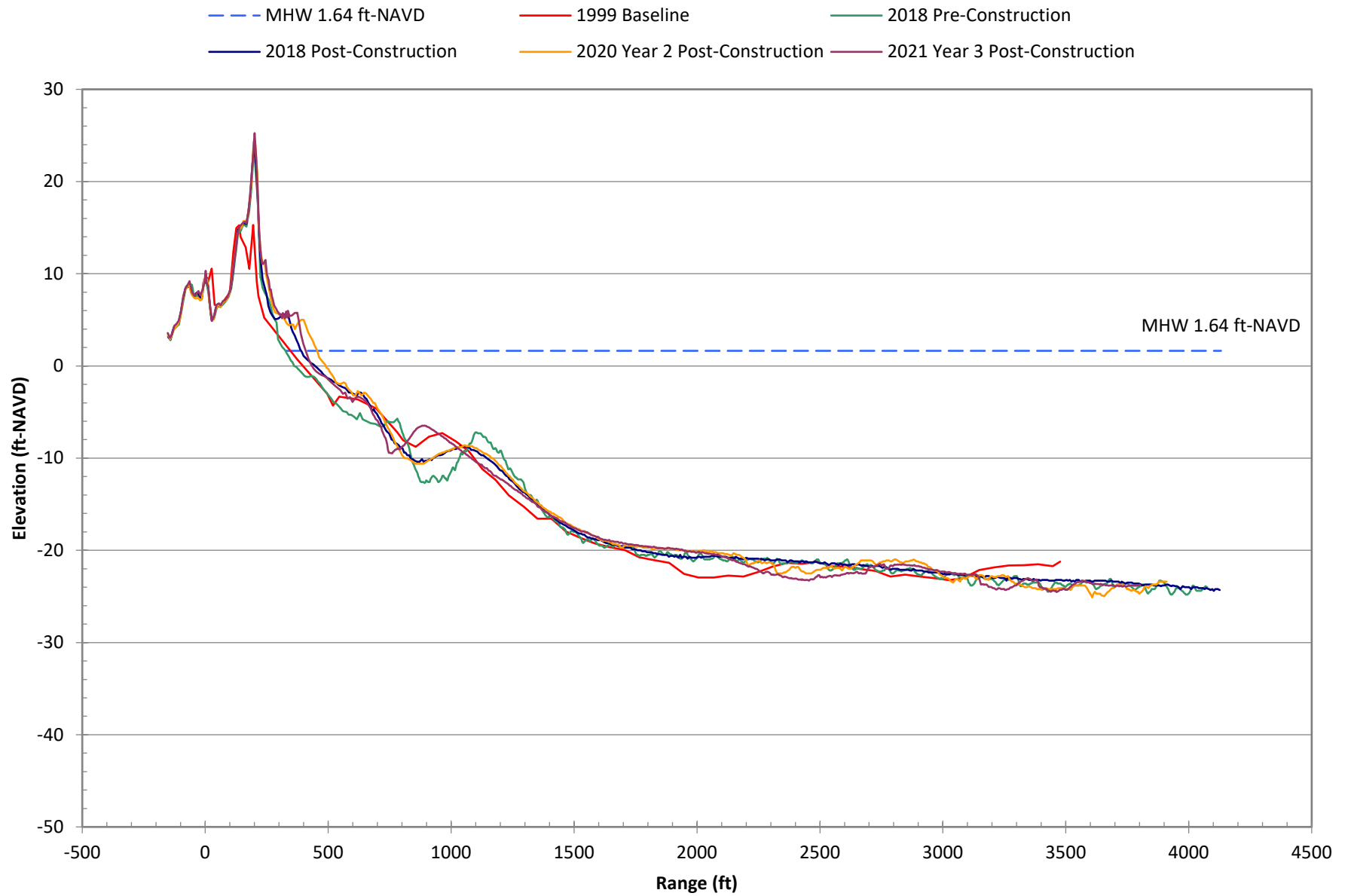
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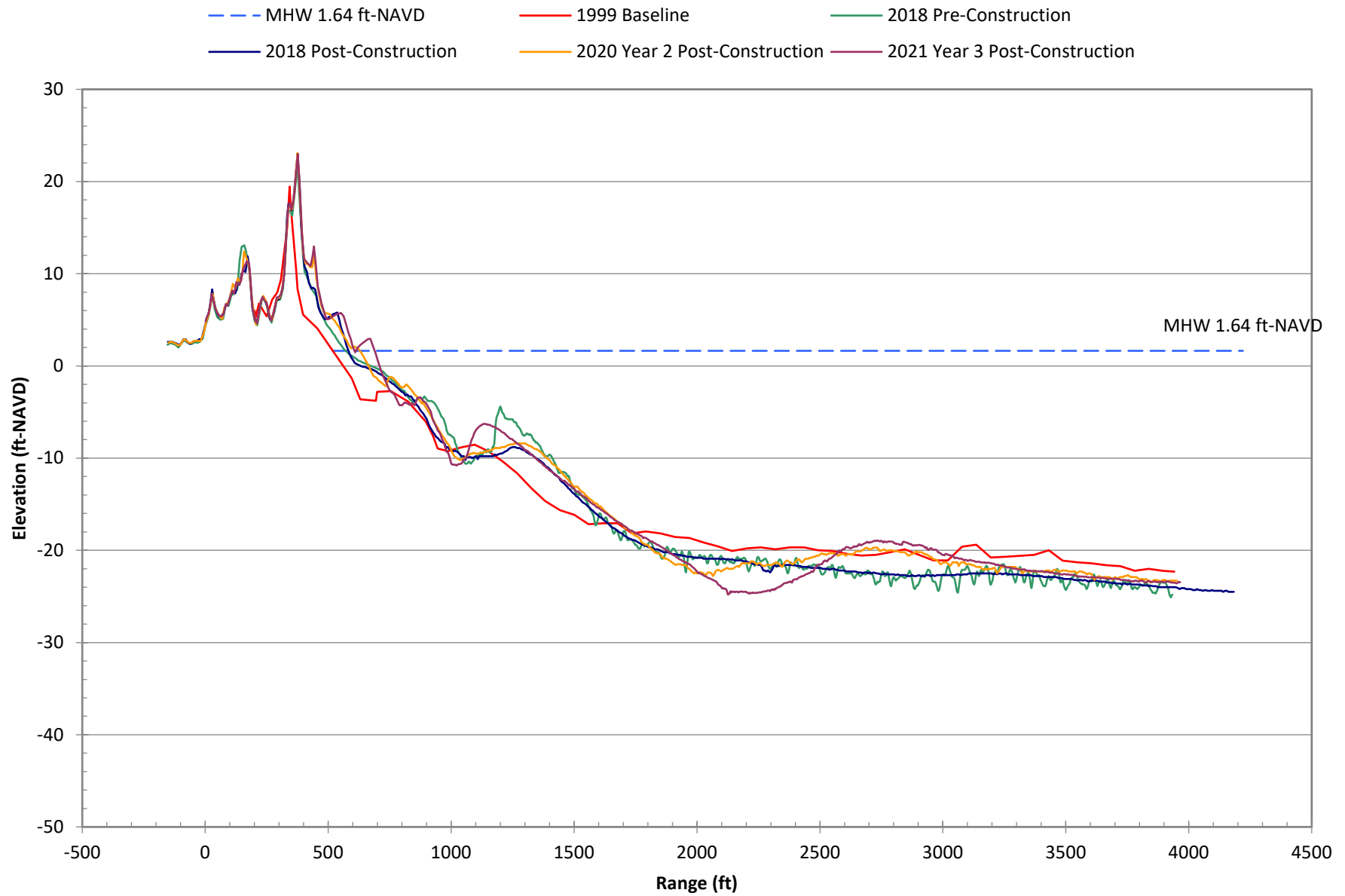
Survey Data at R-131A for Selected Years



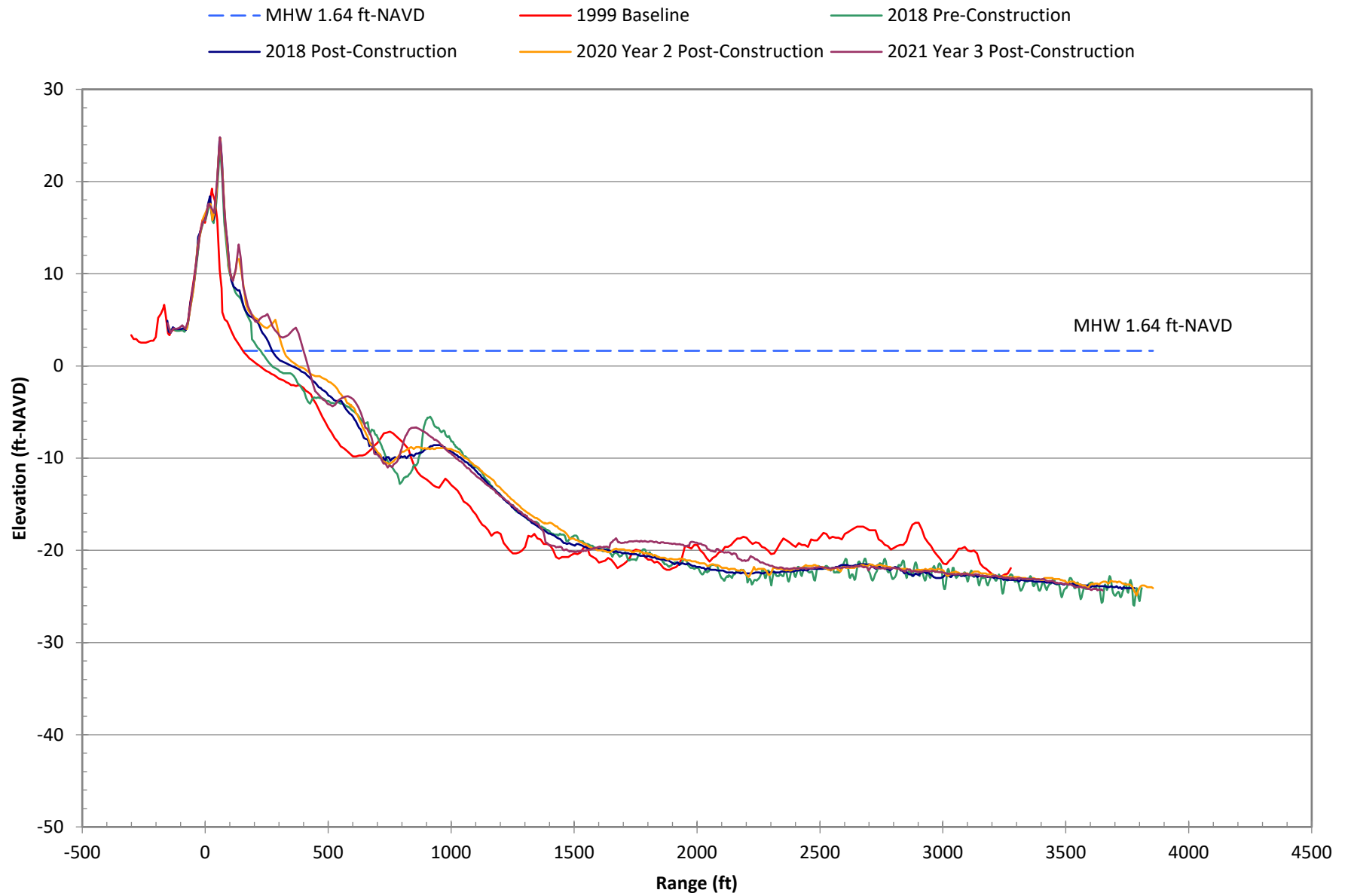
Survey Data at T-132 for Selected Years



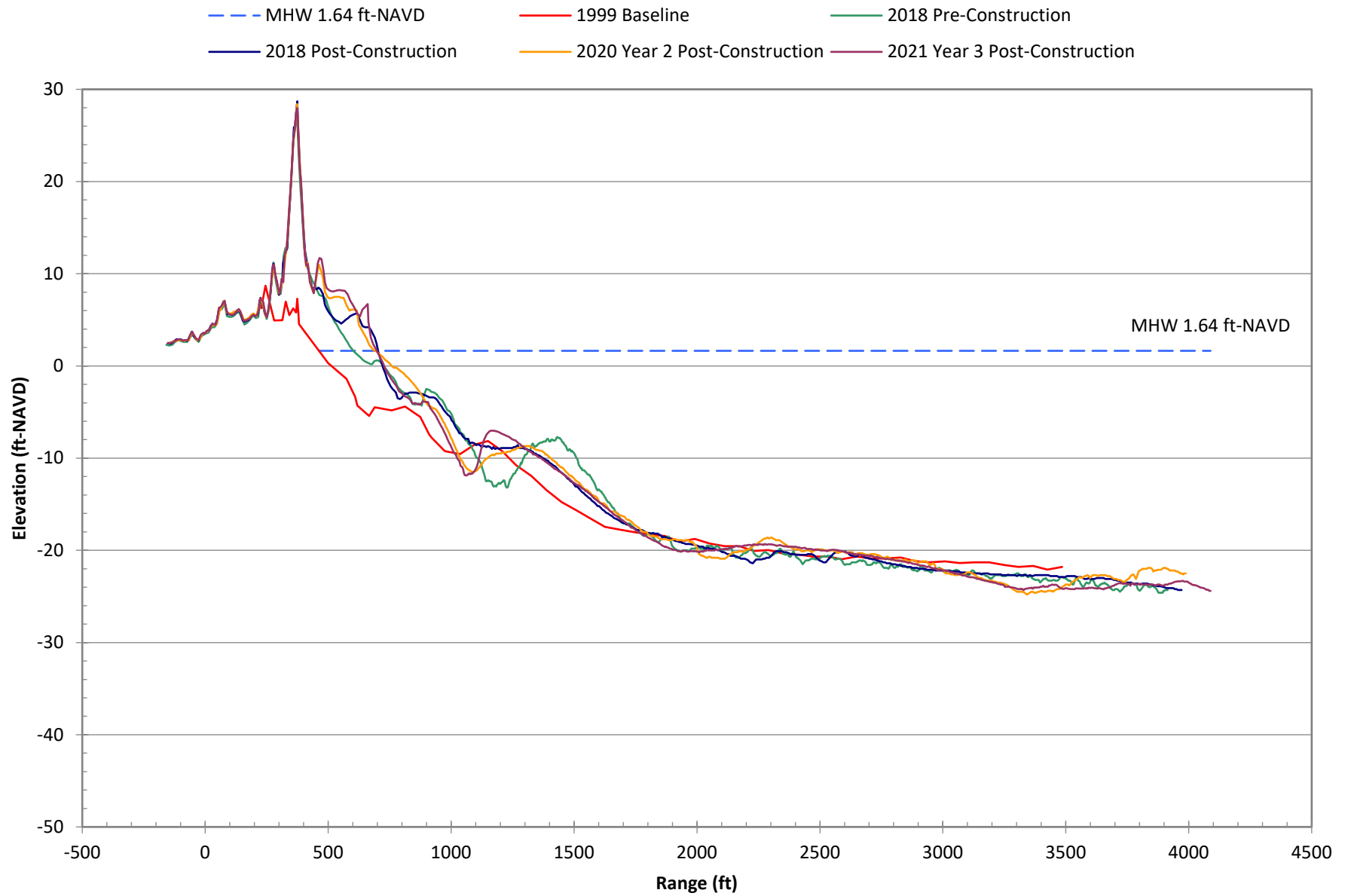
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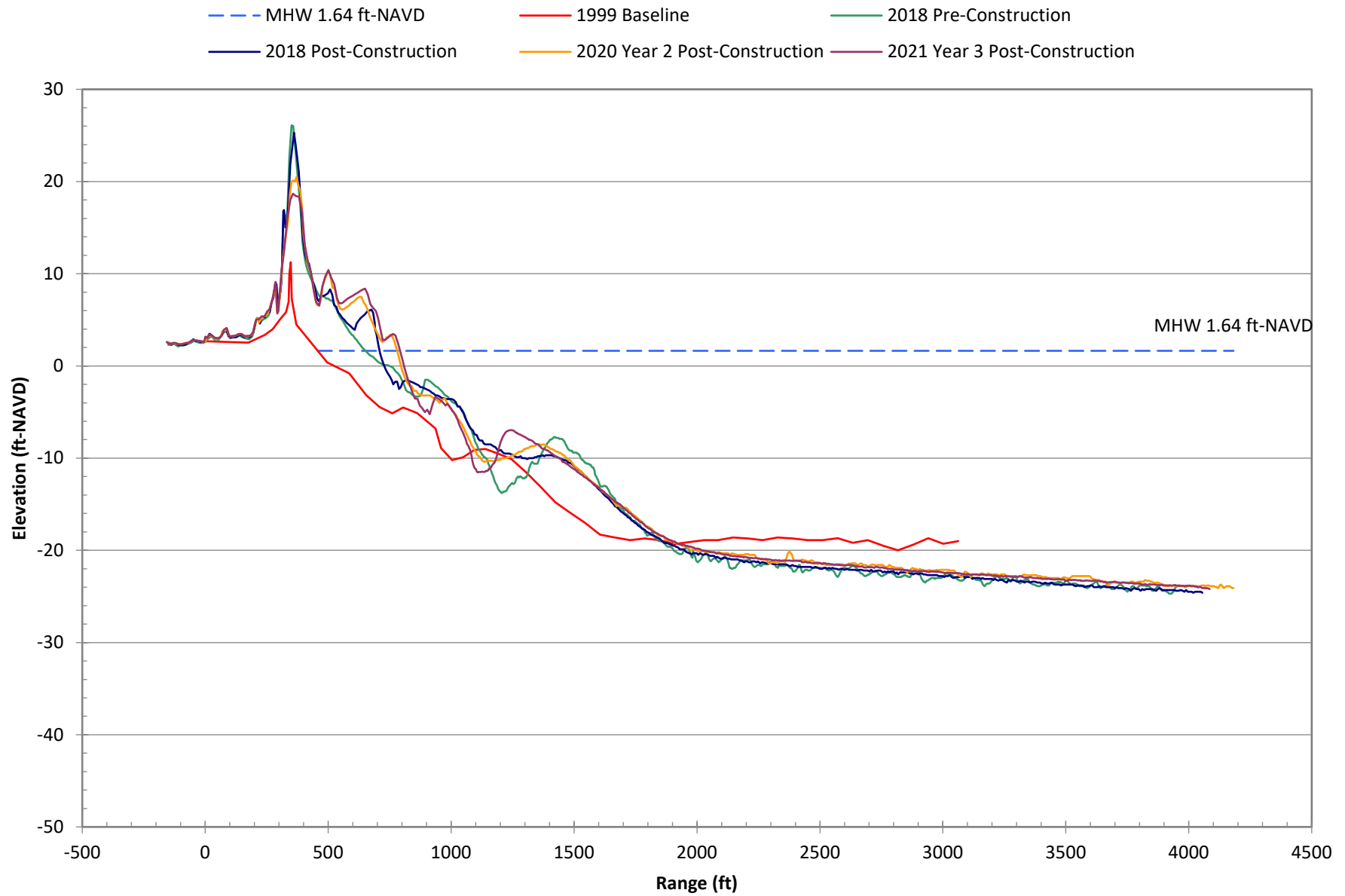
Survey Data at R-134 for Selected Years



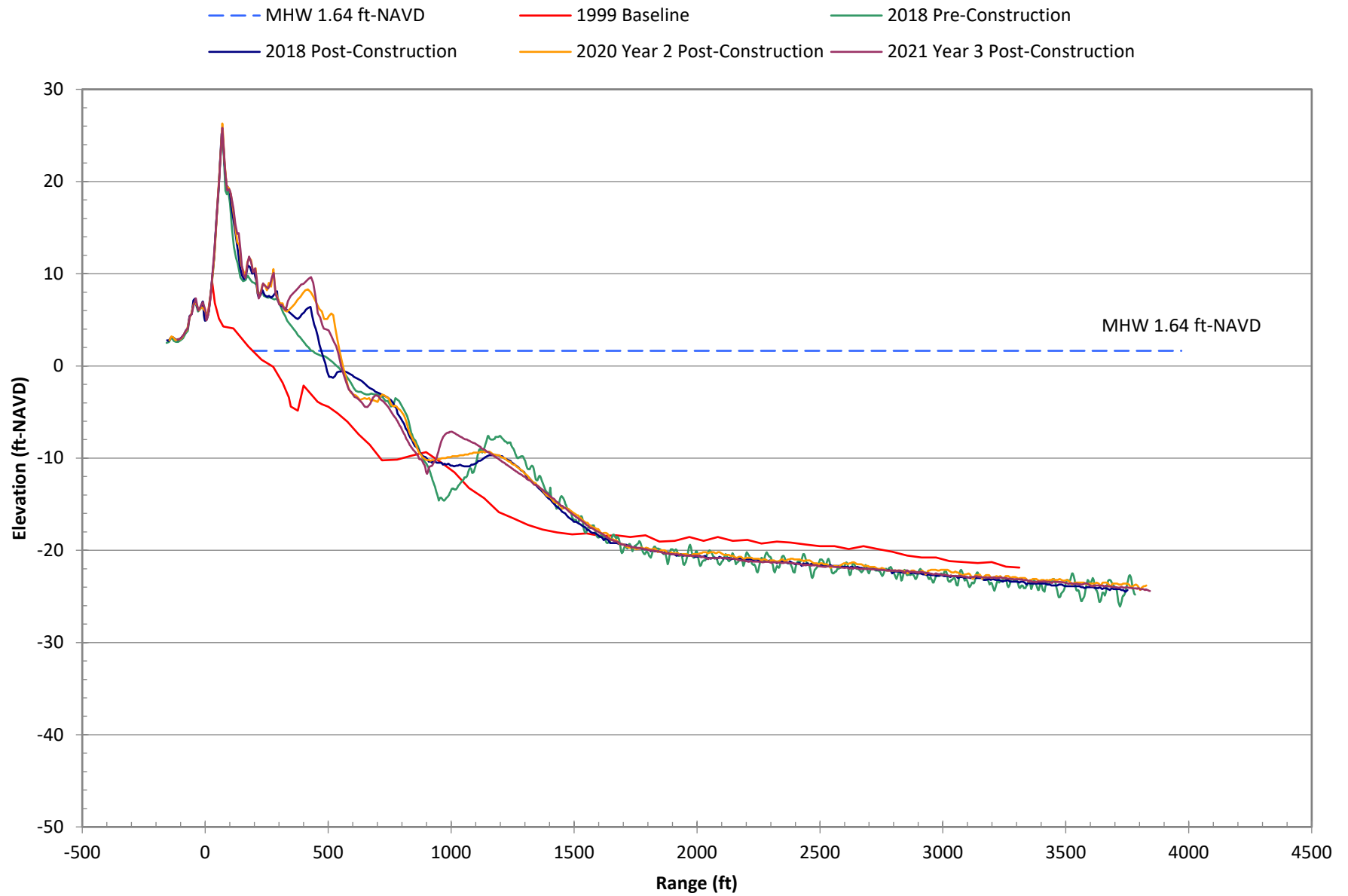
Survey Data at R-135 for Selected Years



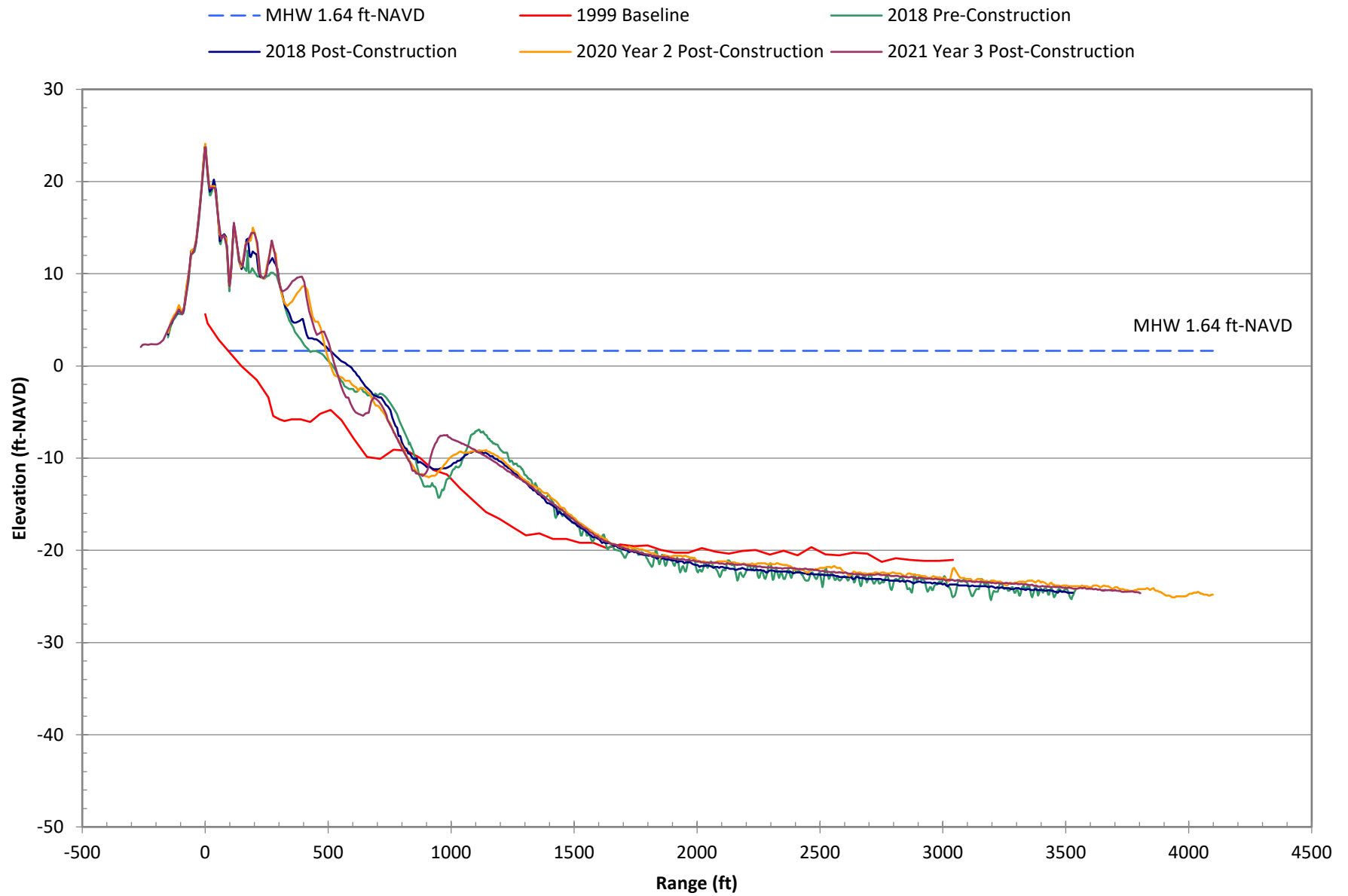
Survey Data at R-136 for Selected Years



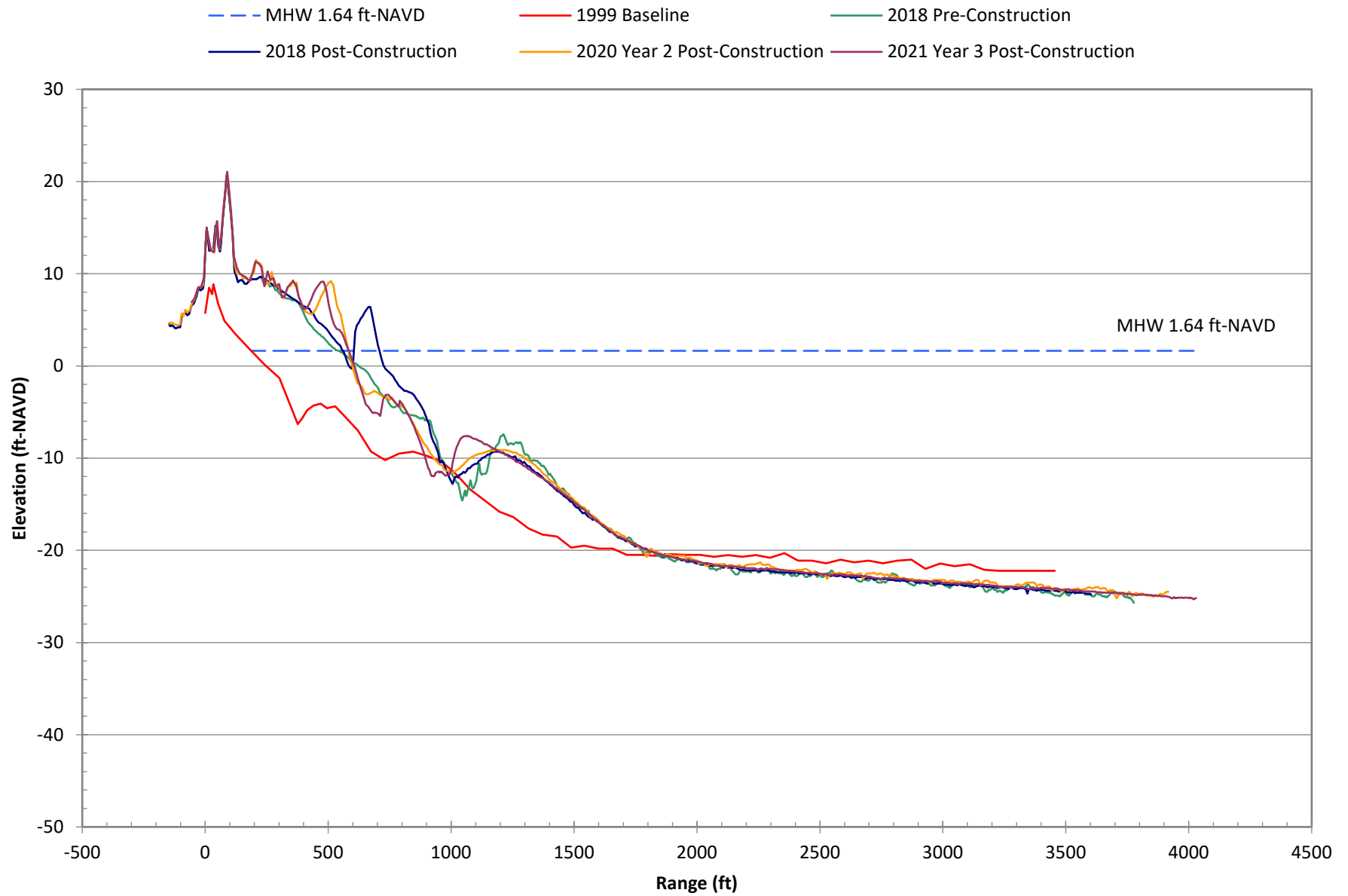
Survey Data at R-137A for Selected Years



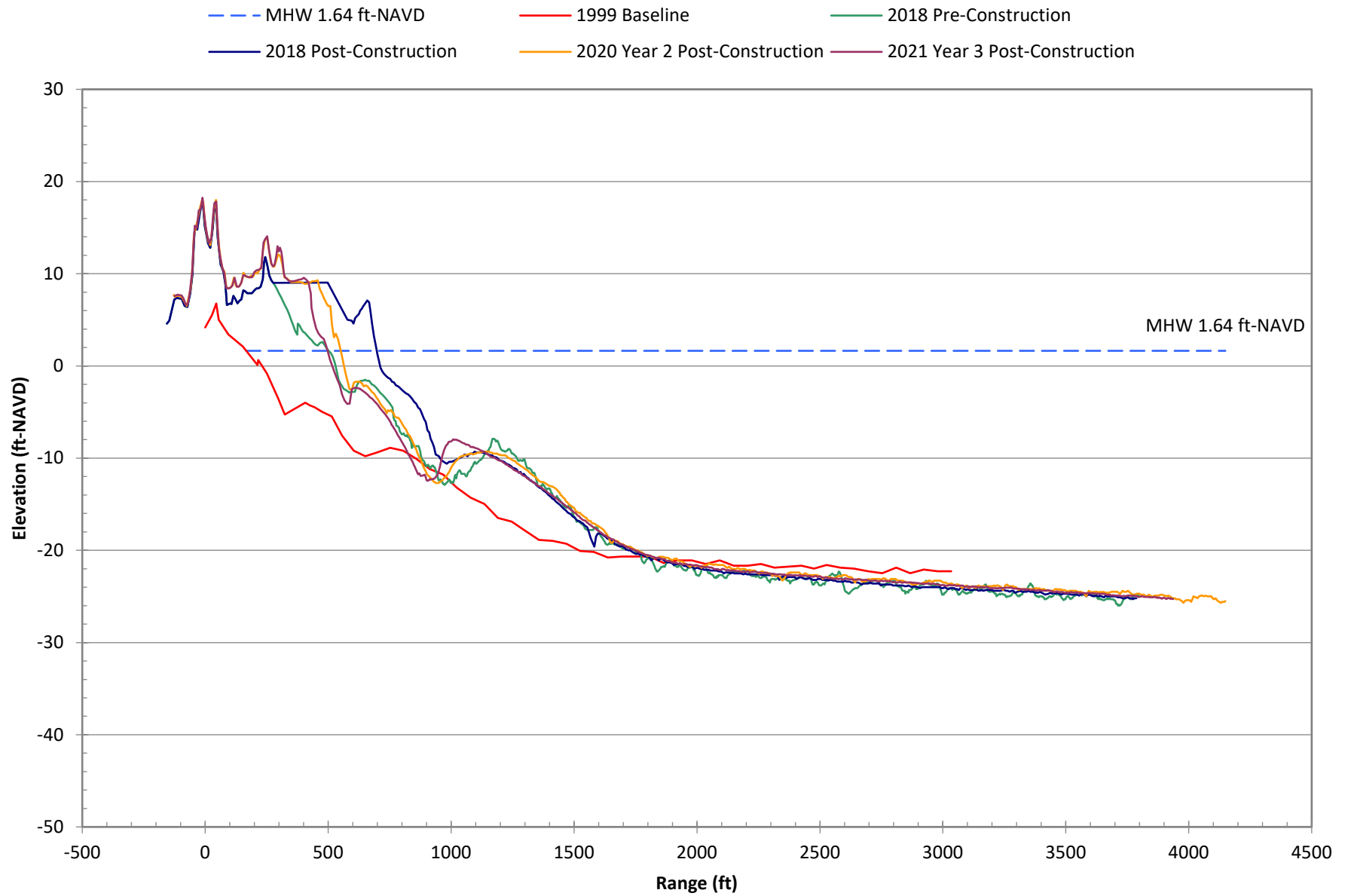
Survey Data at R-138 for Selected Years



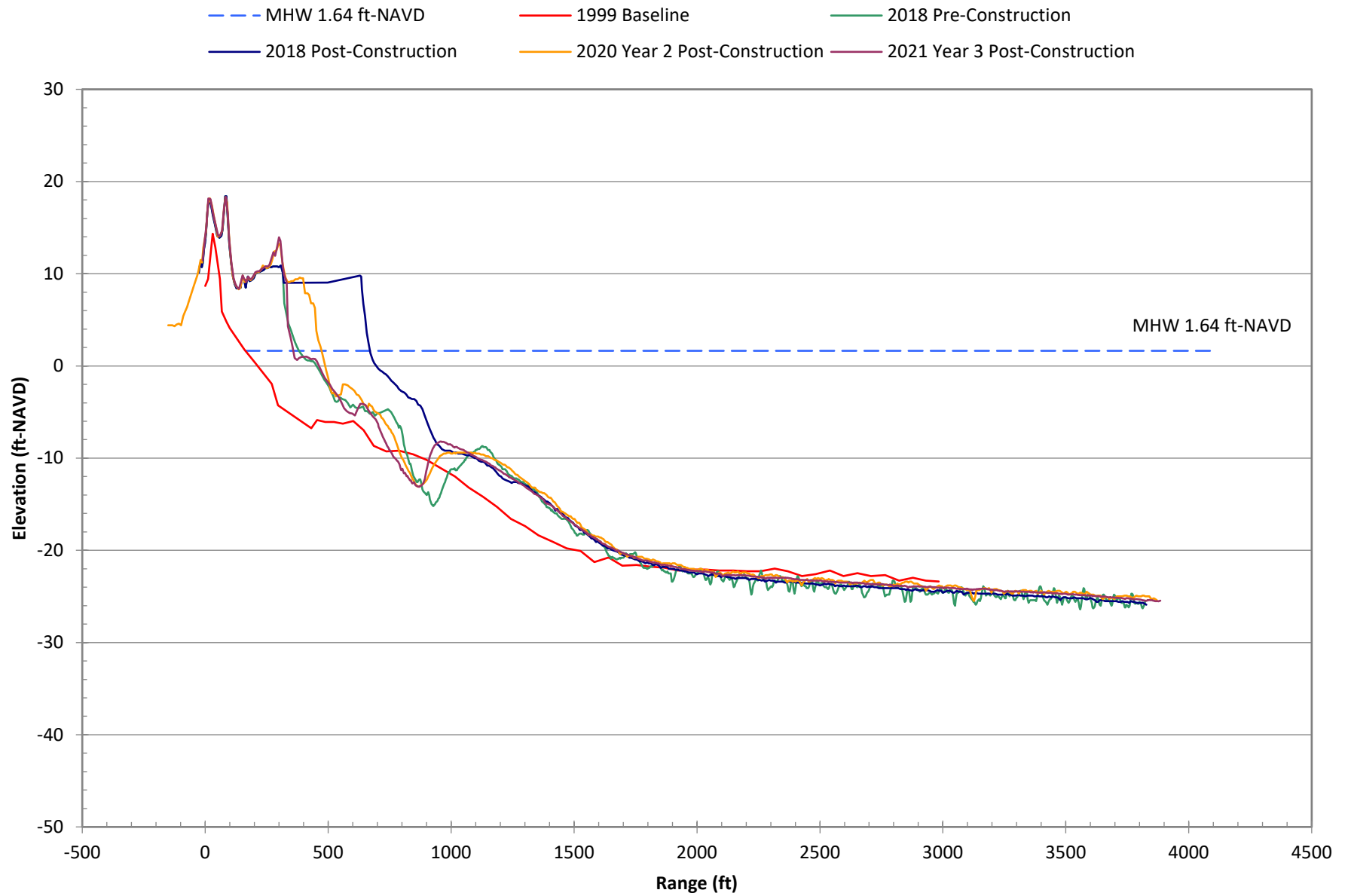
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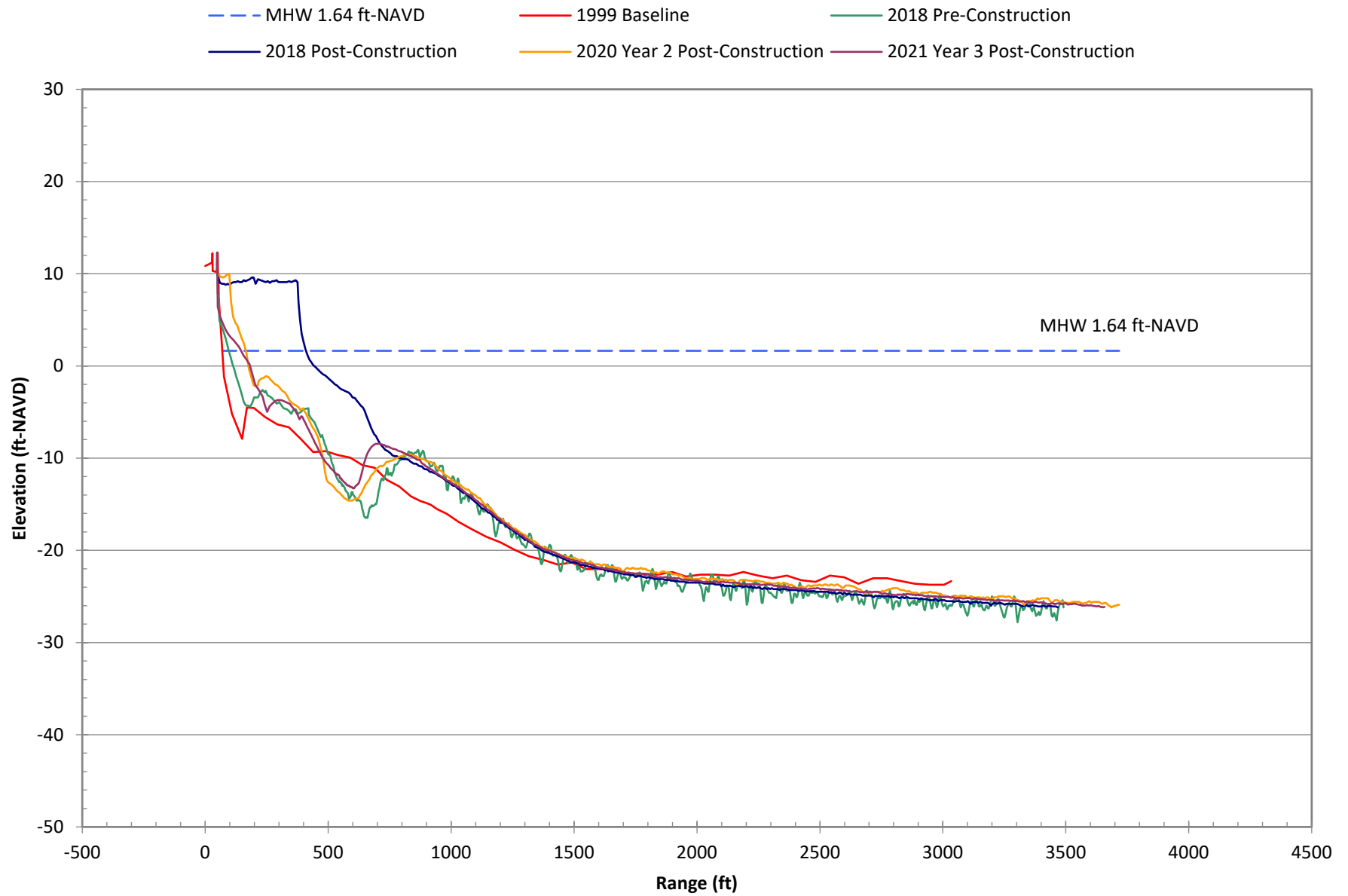
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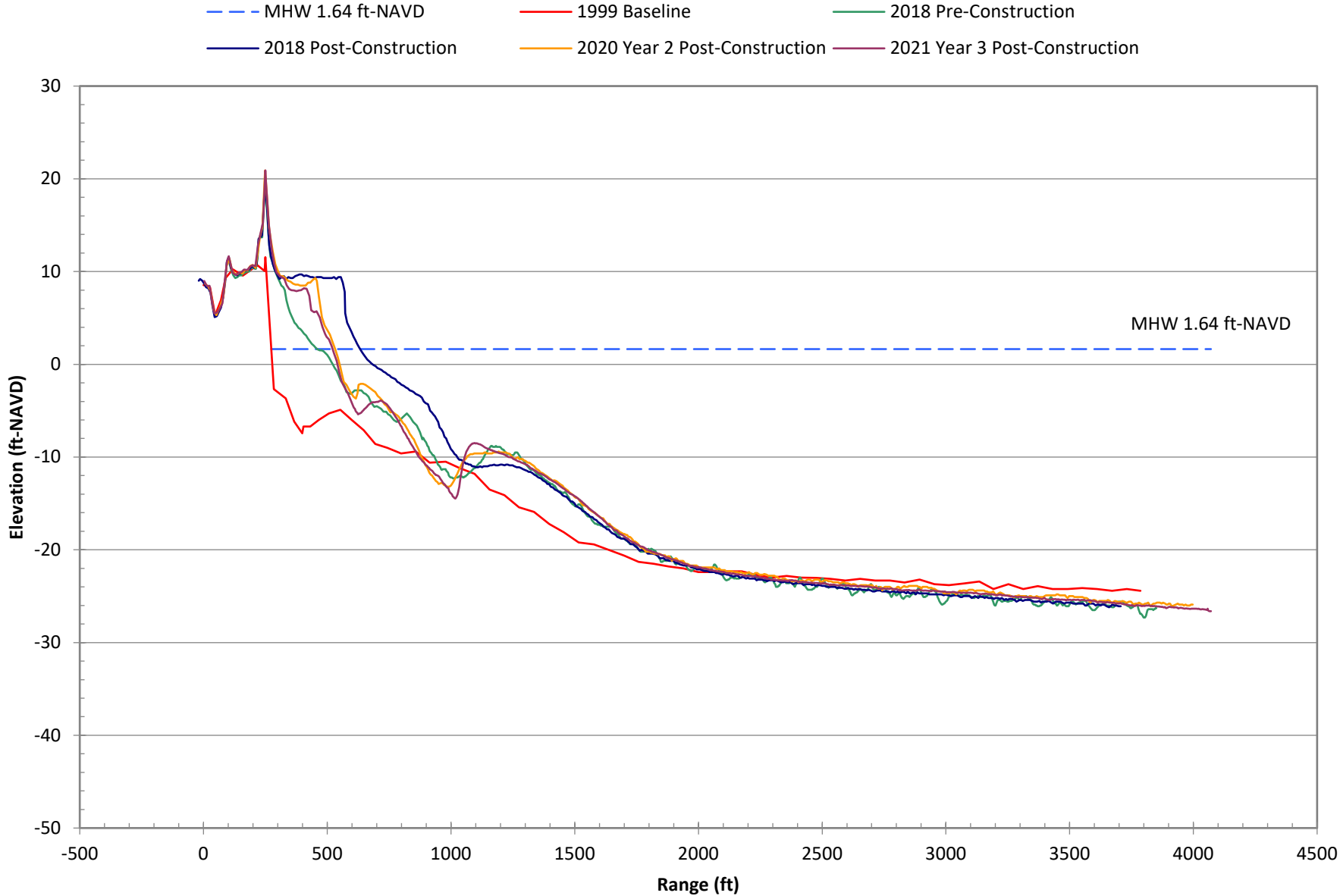
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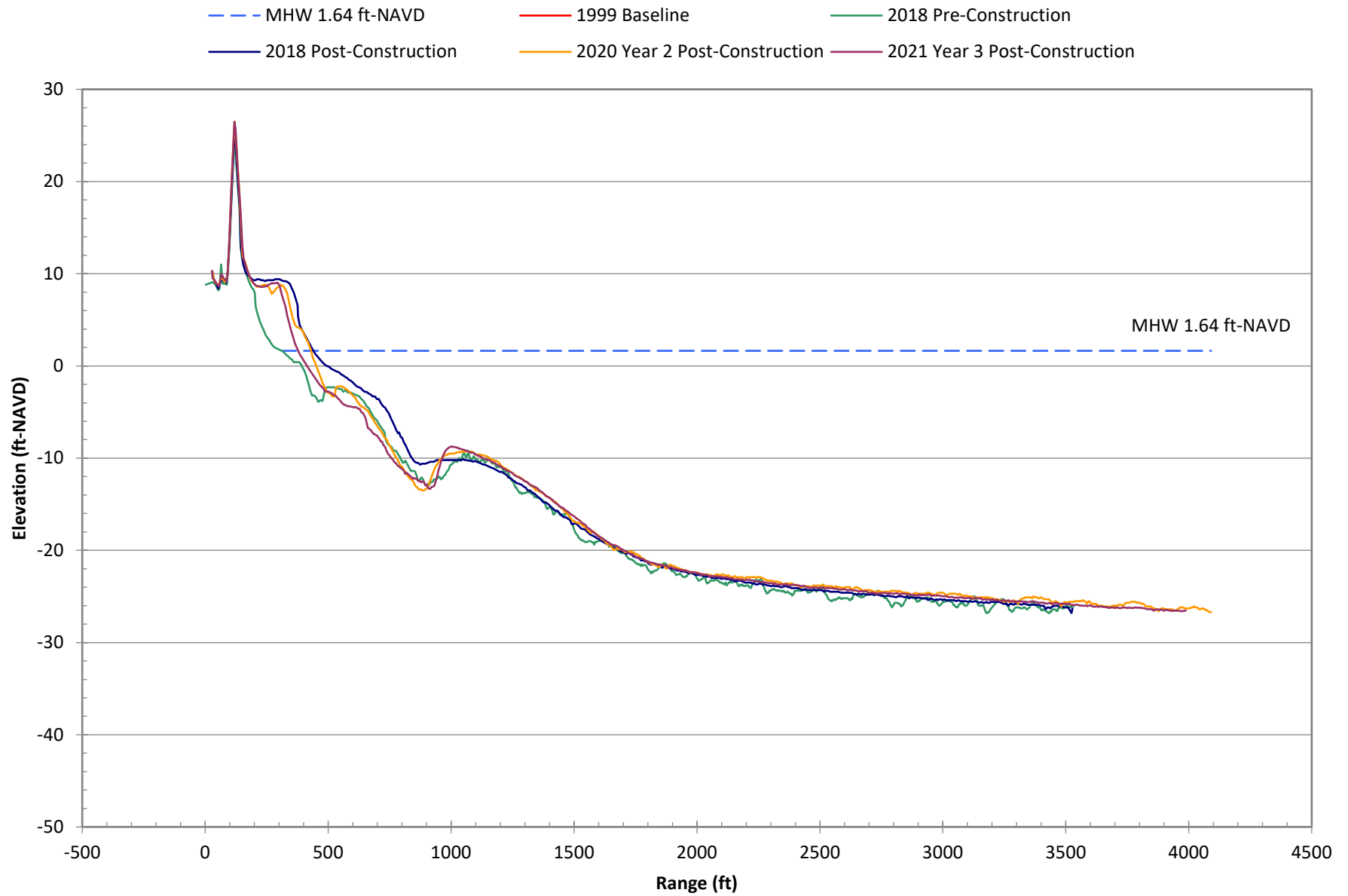
Survey Data at R-142 for Selected Years



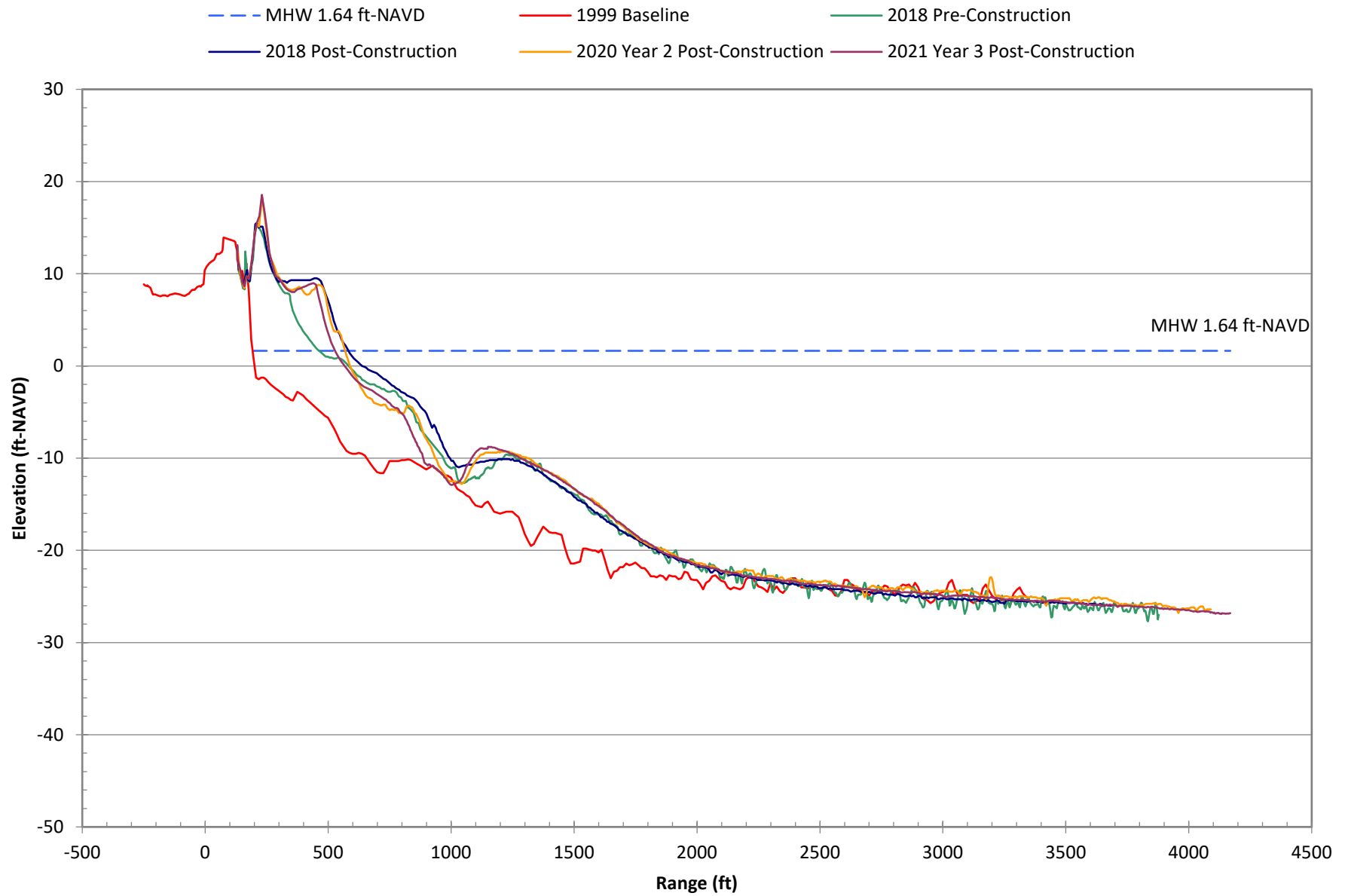
Survey Data at R-143T for Selected Years



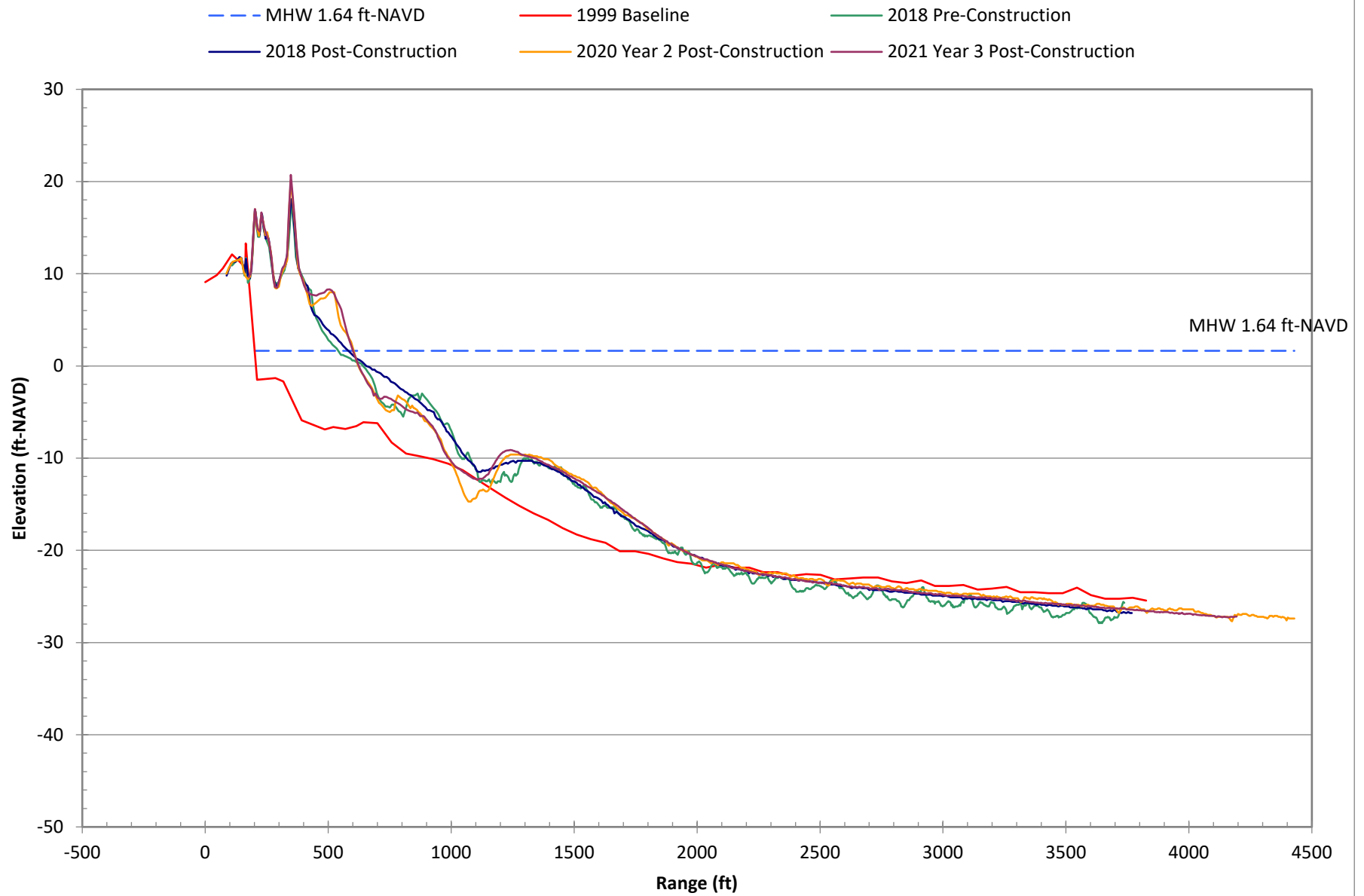
Survey Data at R-143 for Selected Years



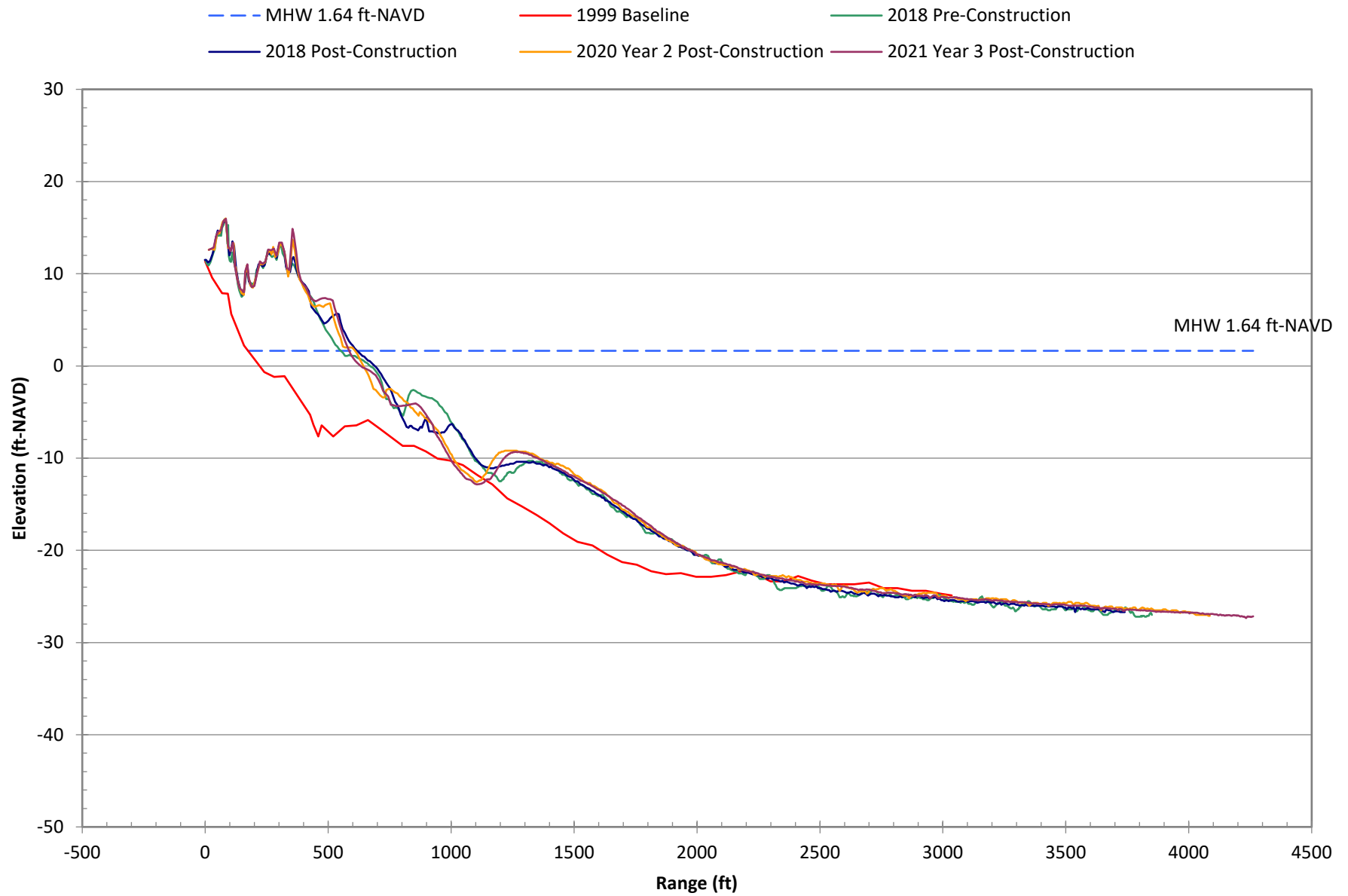
Survey Data at R-144 for Selected Years



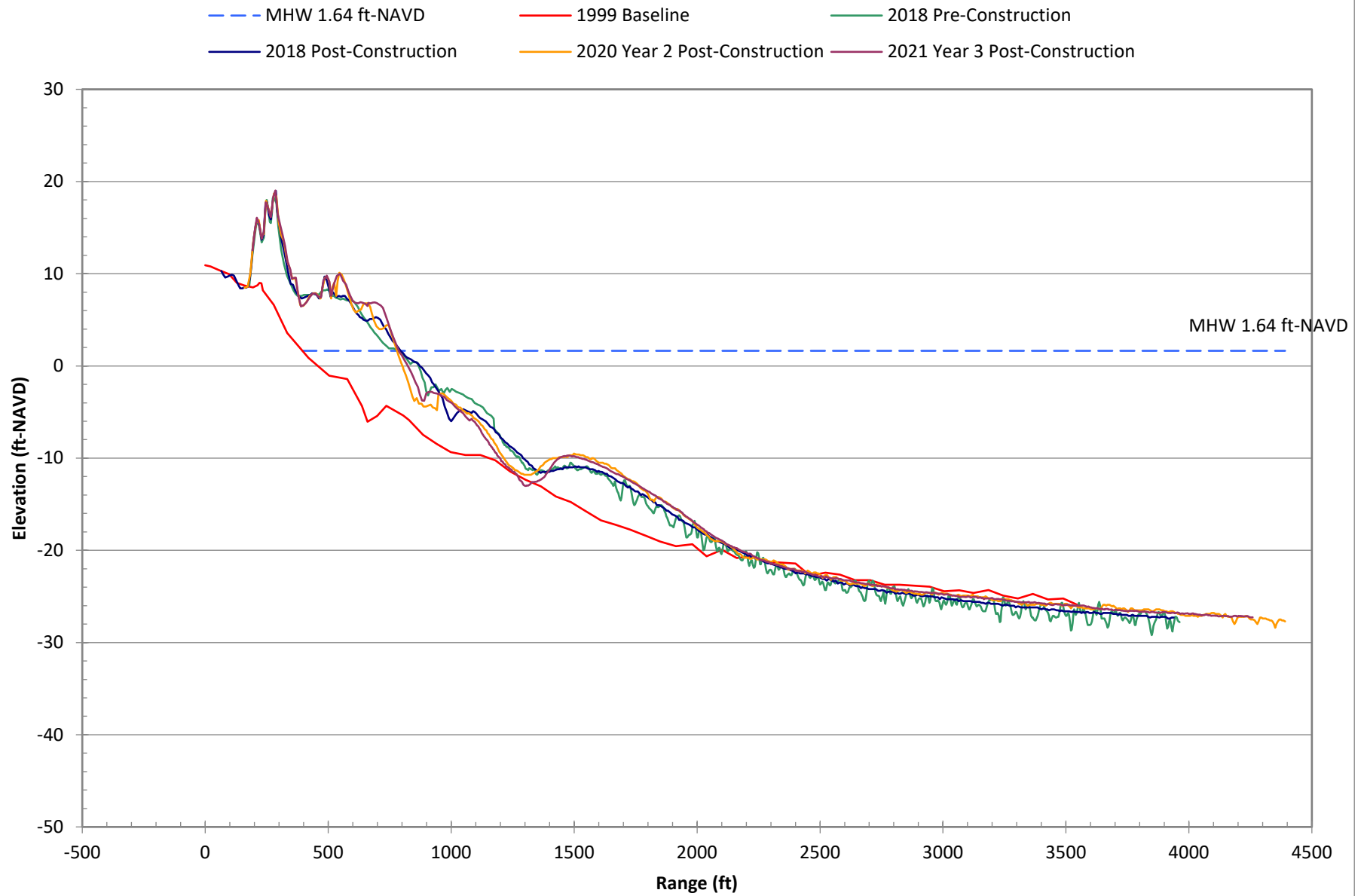
Survey Data at R-145 for Selected Years



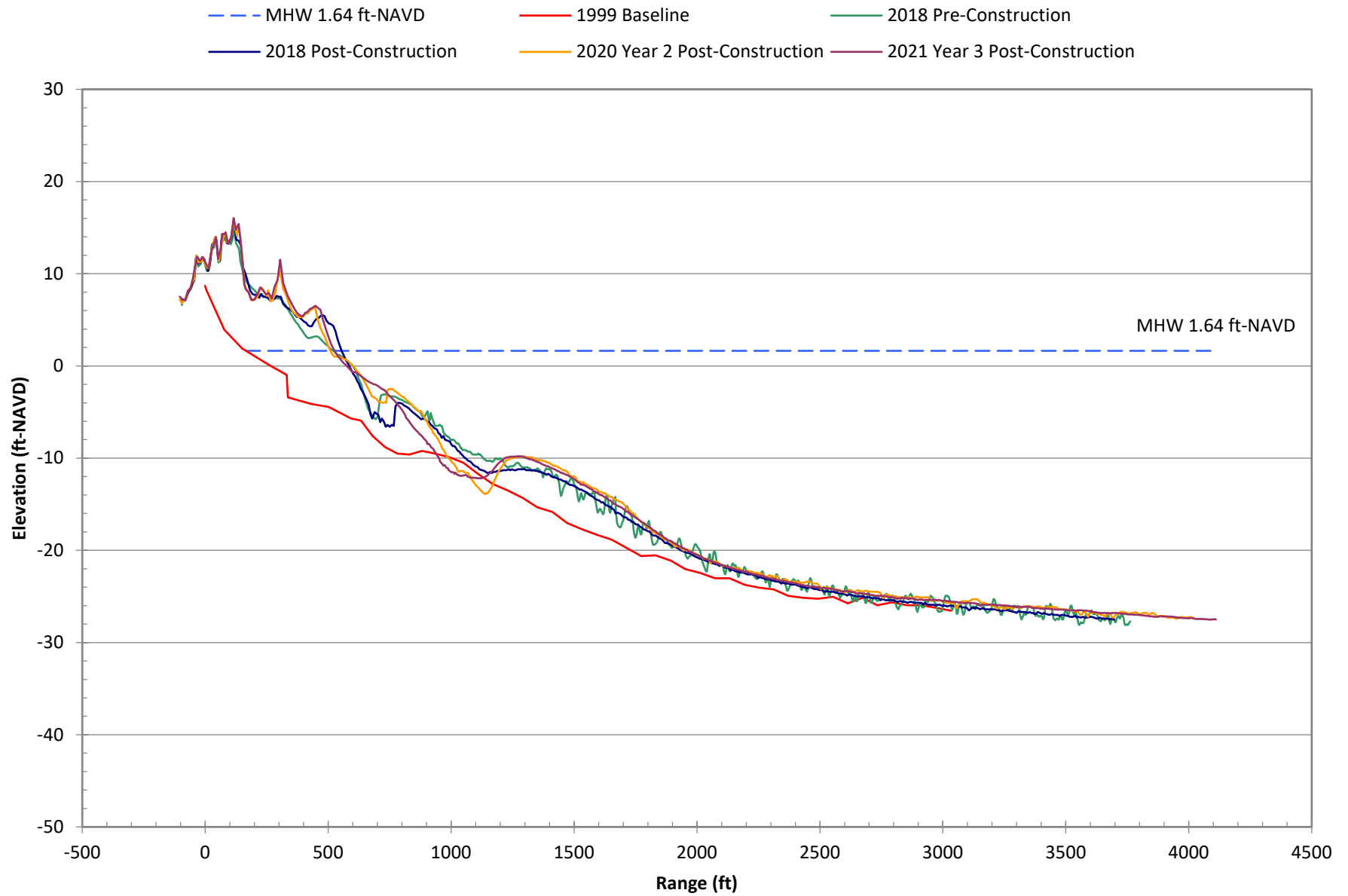
Survey Data at R-146 for Selected Years



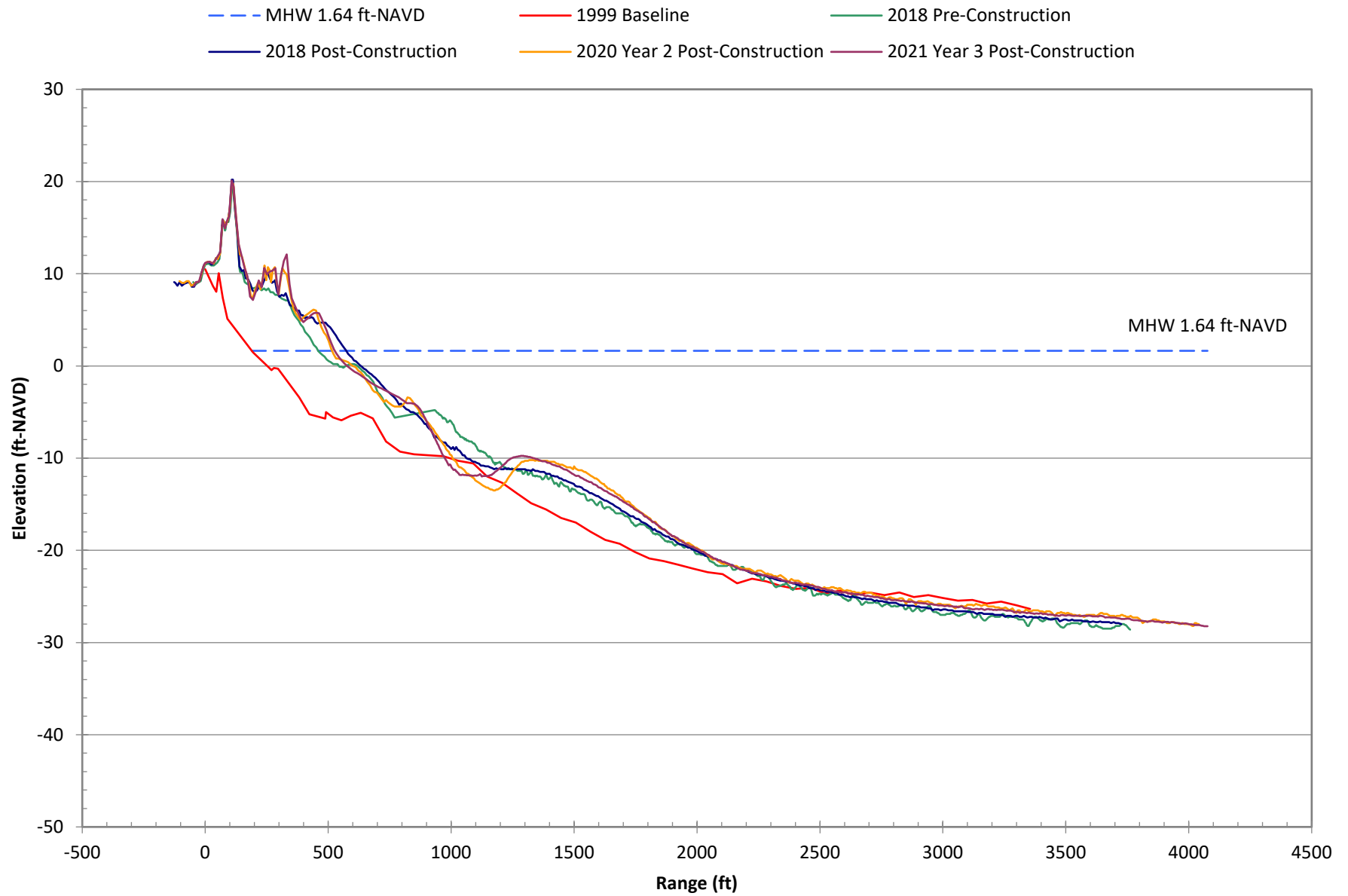
Survey Data at R-147 for Selected Years



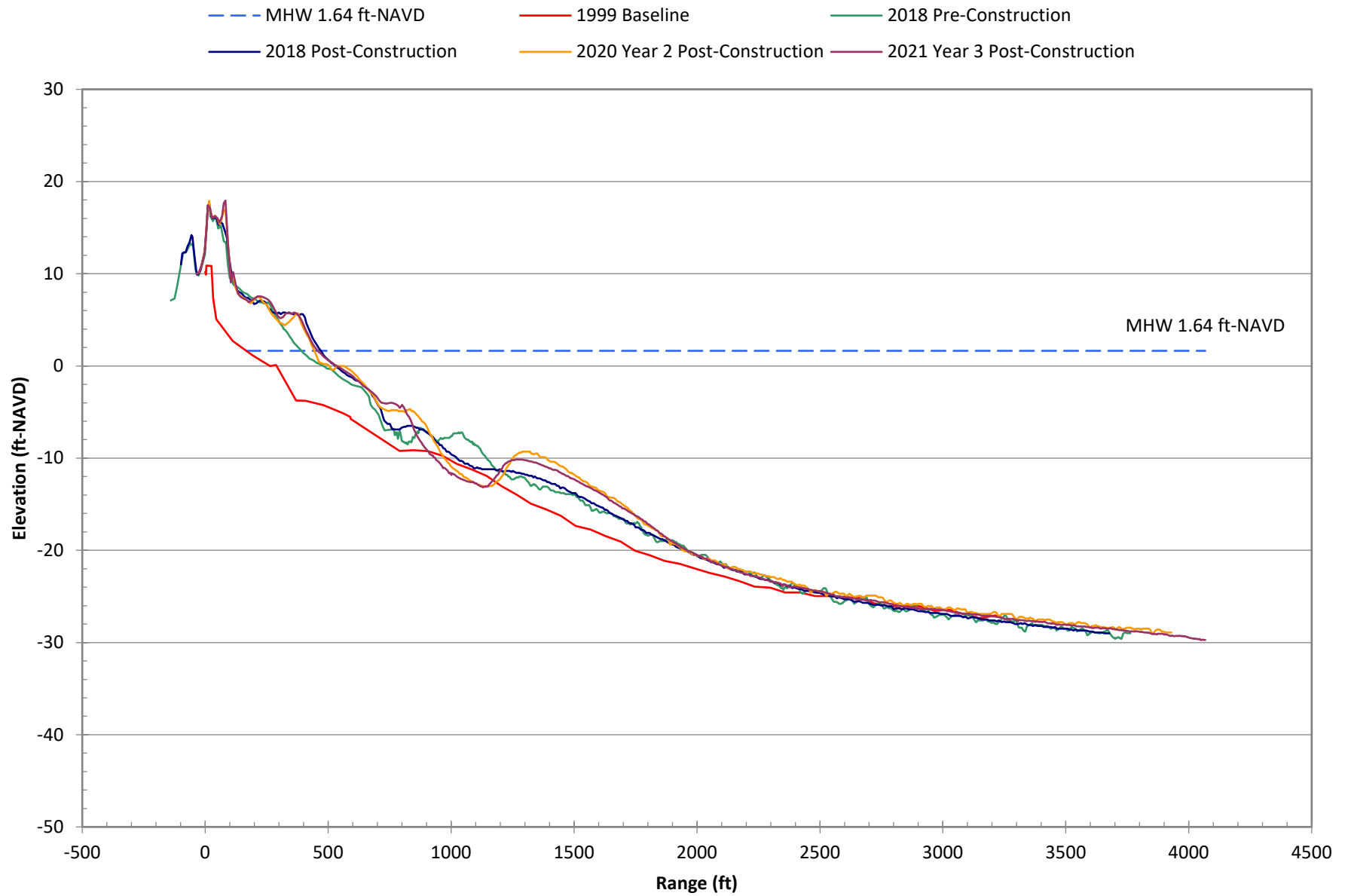
Survey Data at R-148 for Selected Years



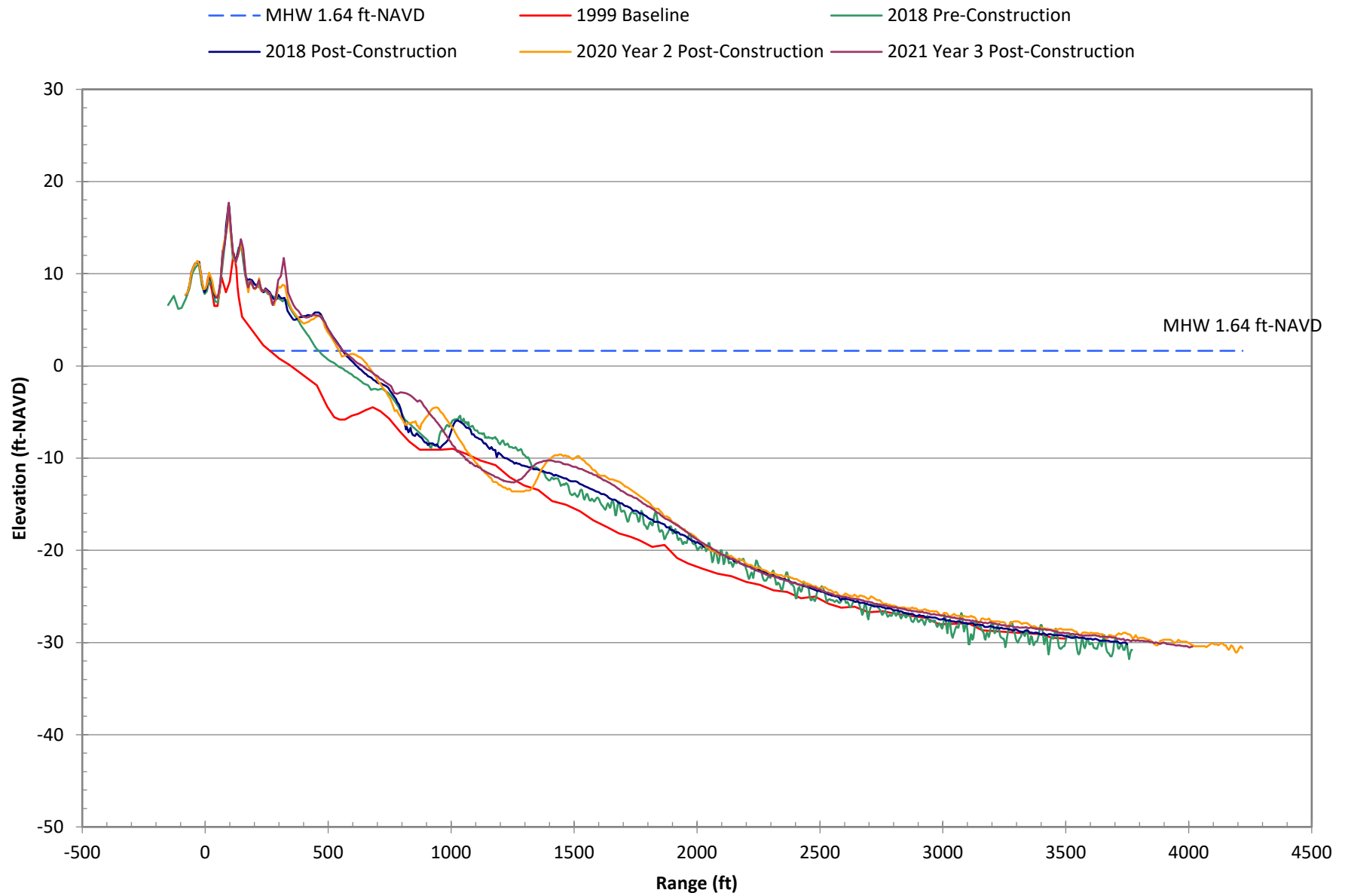
Survey Data at R-149 for Selected Years



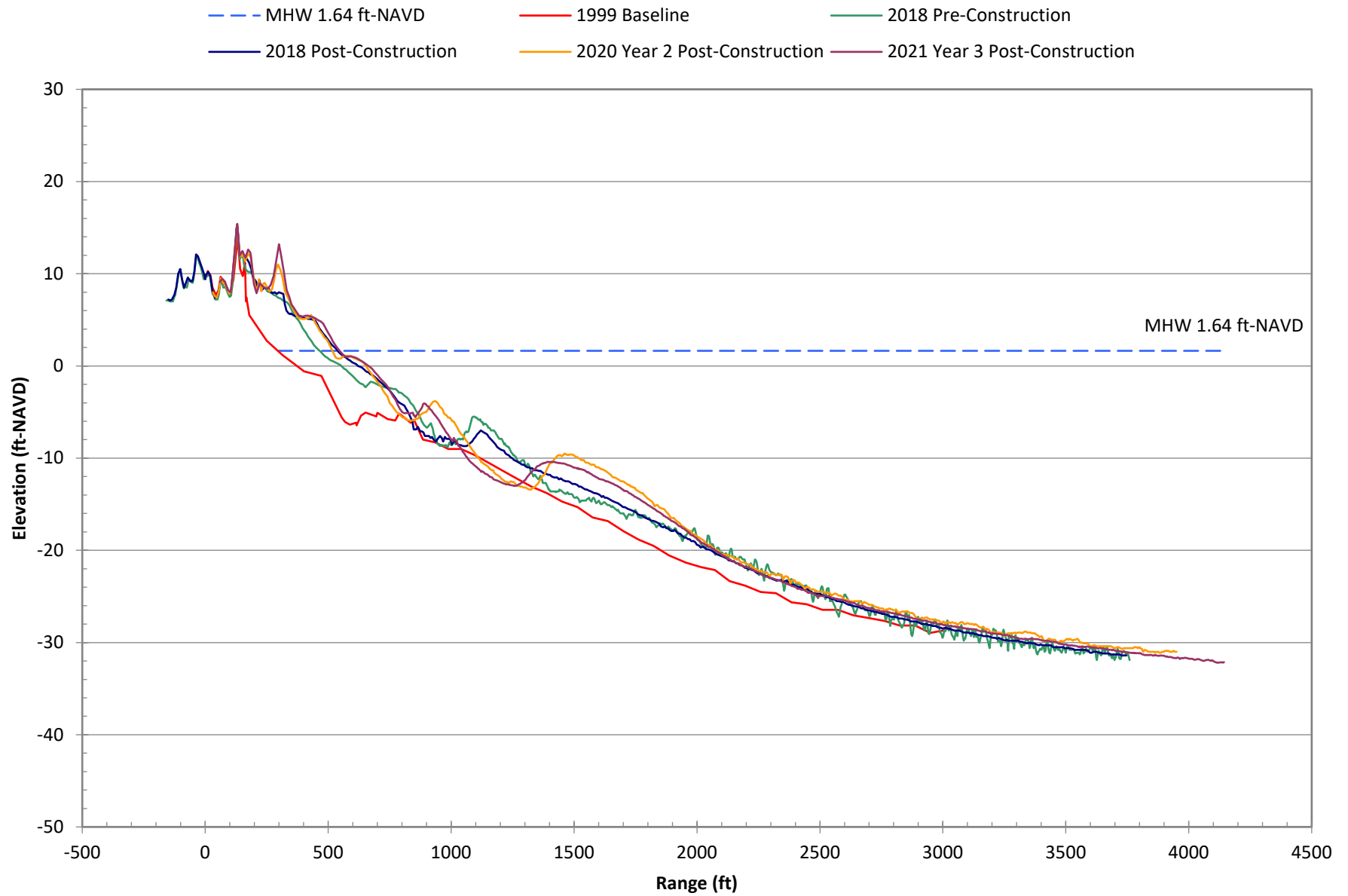
Survey Data at R-150 for Selected Years



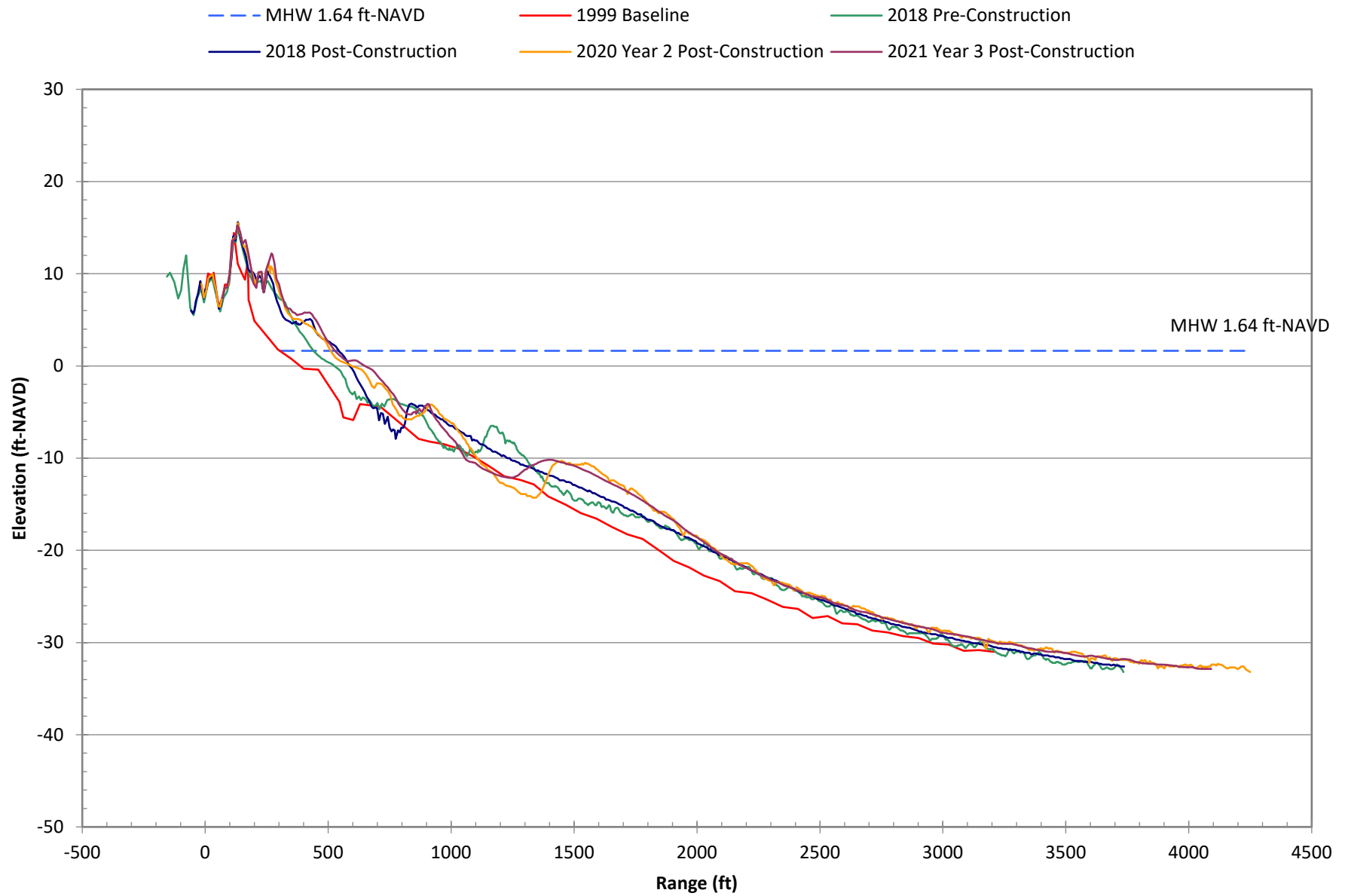
Survey Data at R-151 for Selected Years



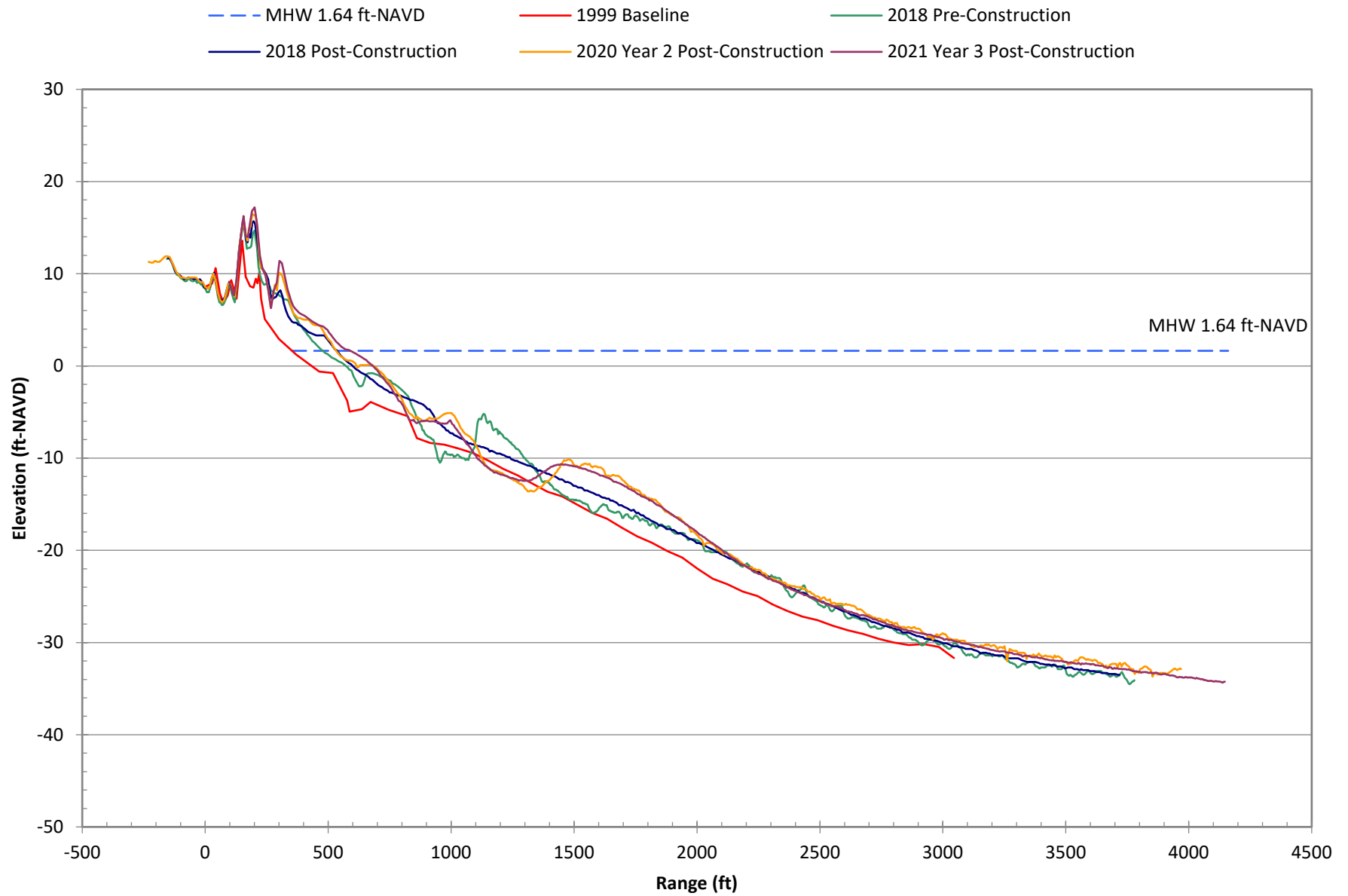
Survey Data at R-152 for Selected Years



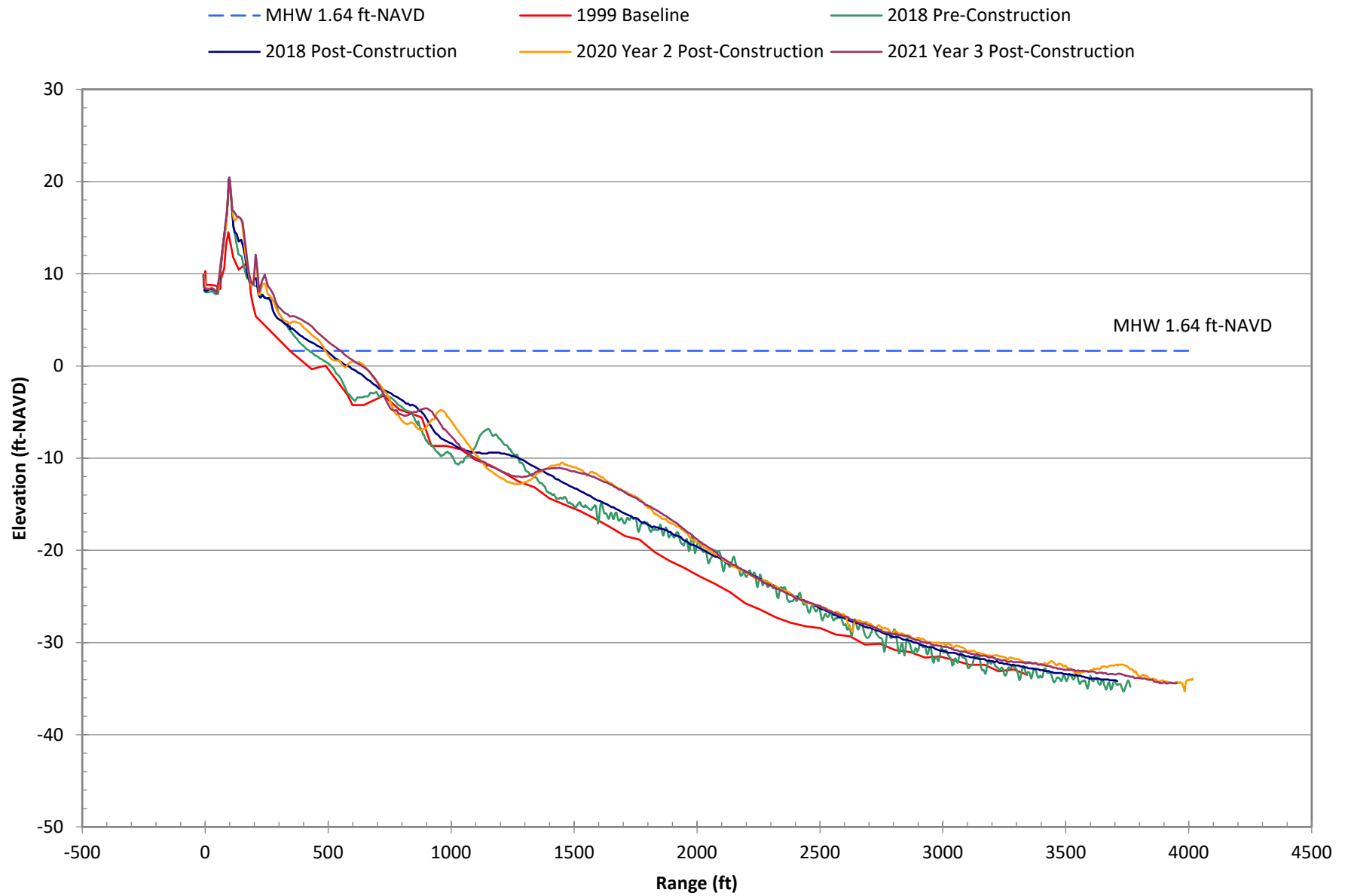
Survey Data at R-153 for Selected Years



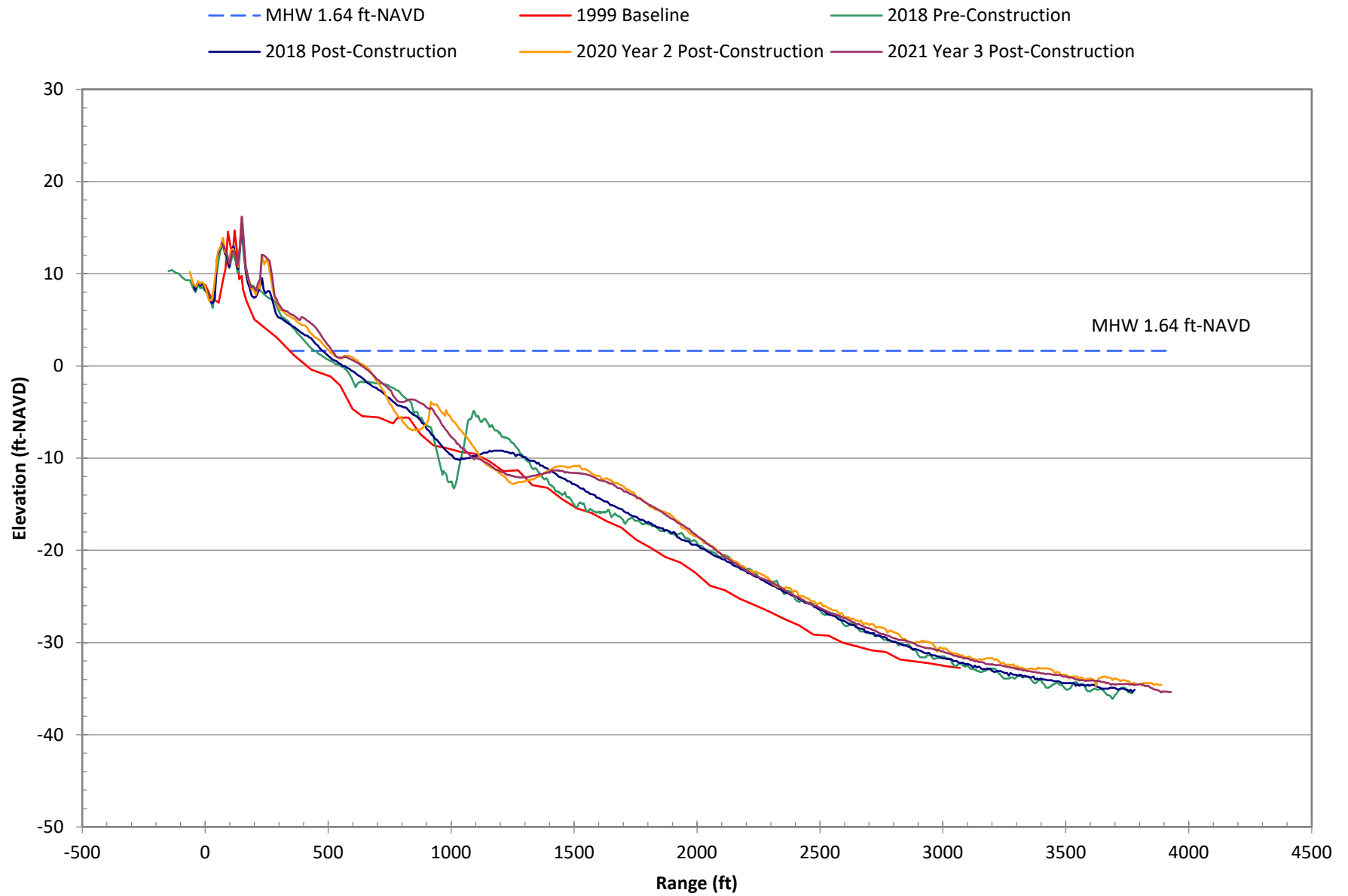
Survey Data at R-154 for Selected Years



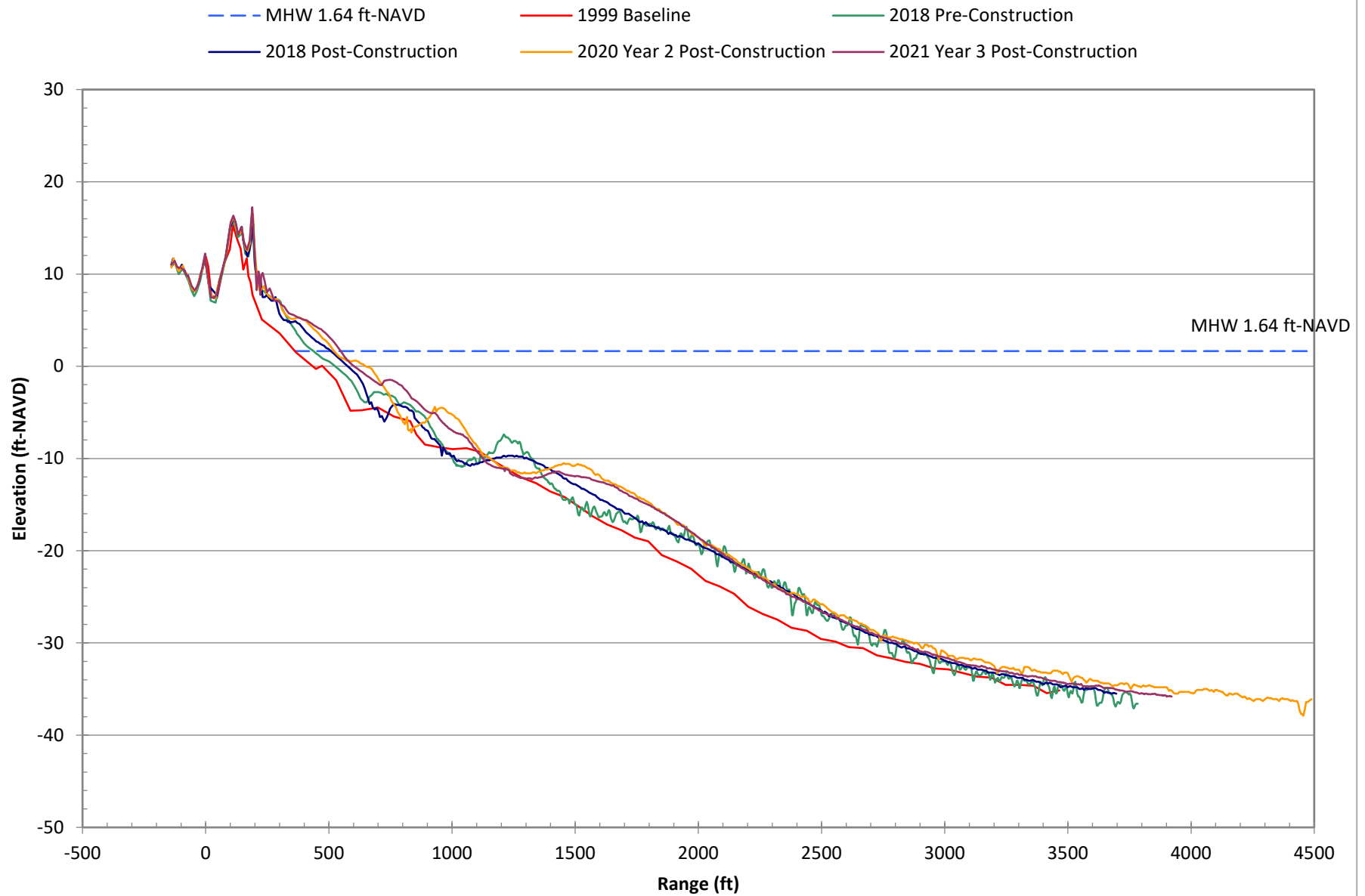
Survey Data at R-155 for Selected Years



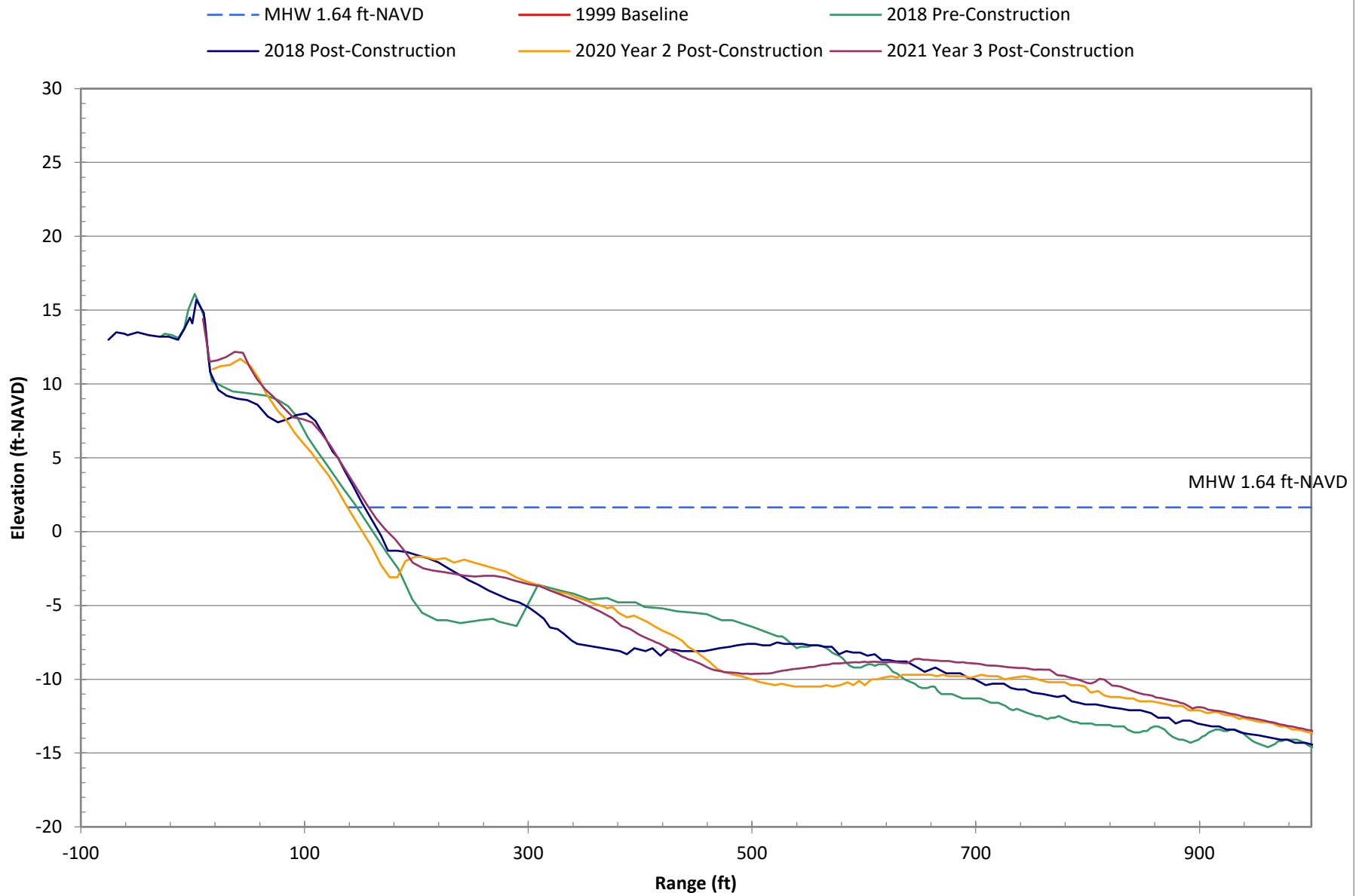
Survey Data at T-156 for Selected Years



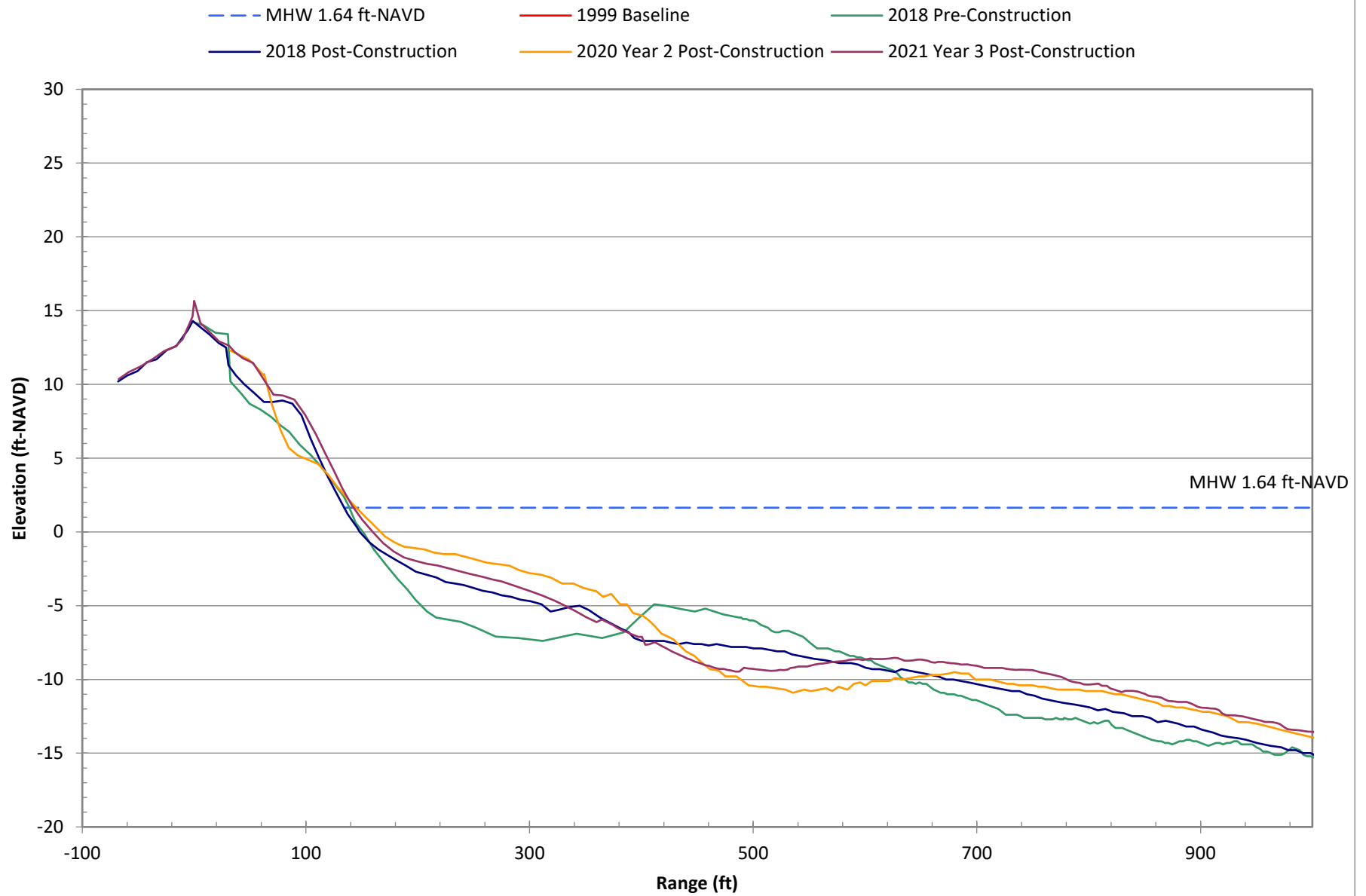
Survey Data at T-157 for Selected Years



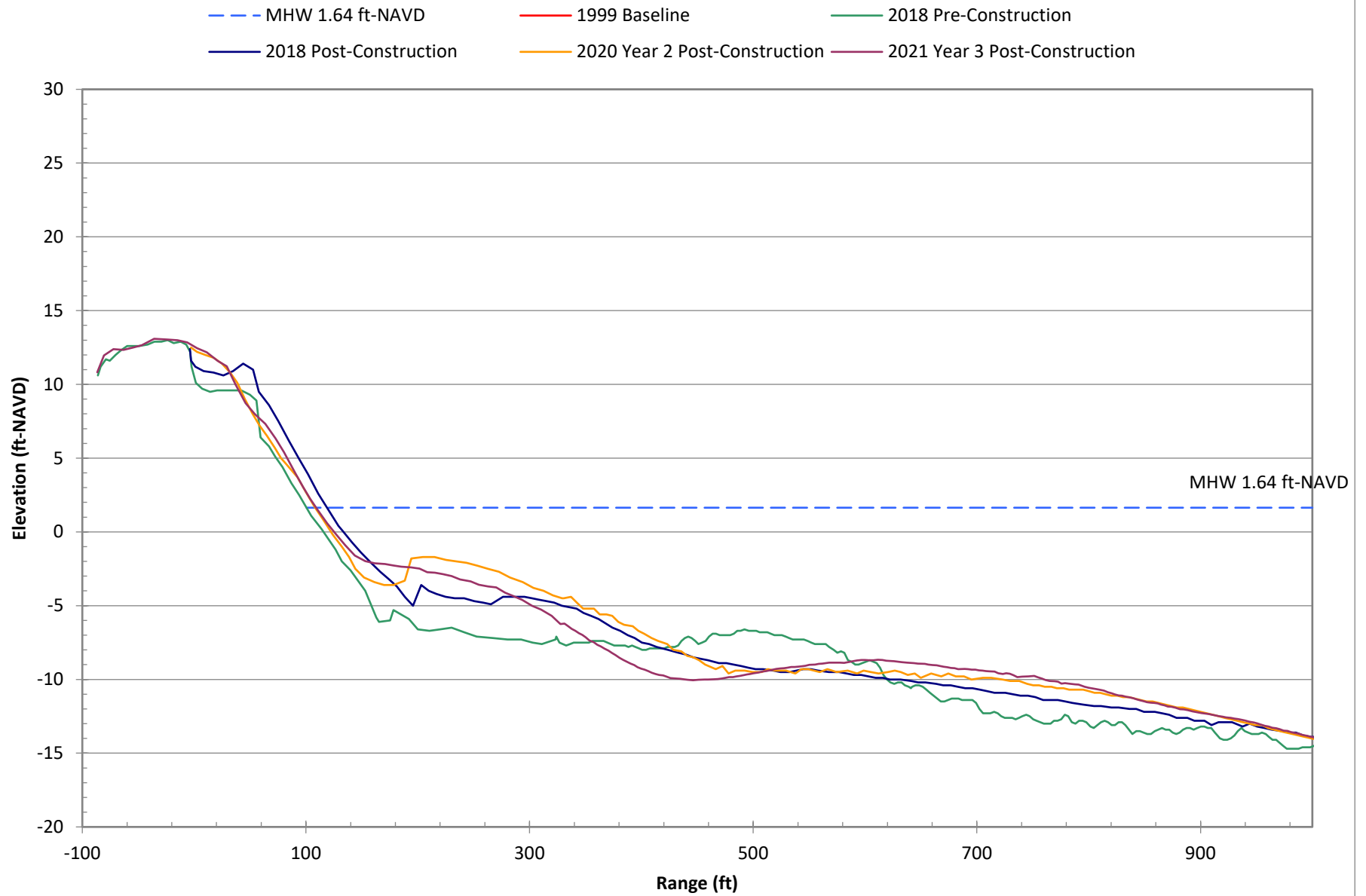
Survey Data at R-80 for Selected Years



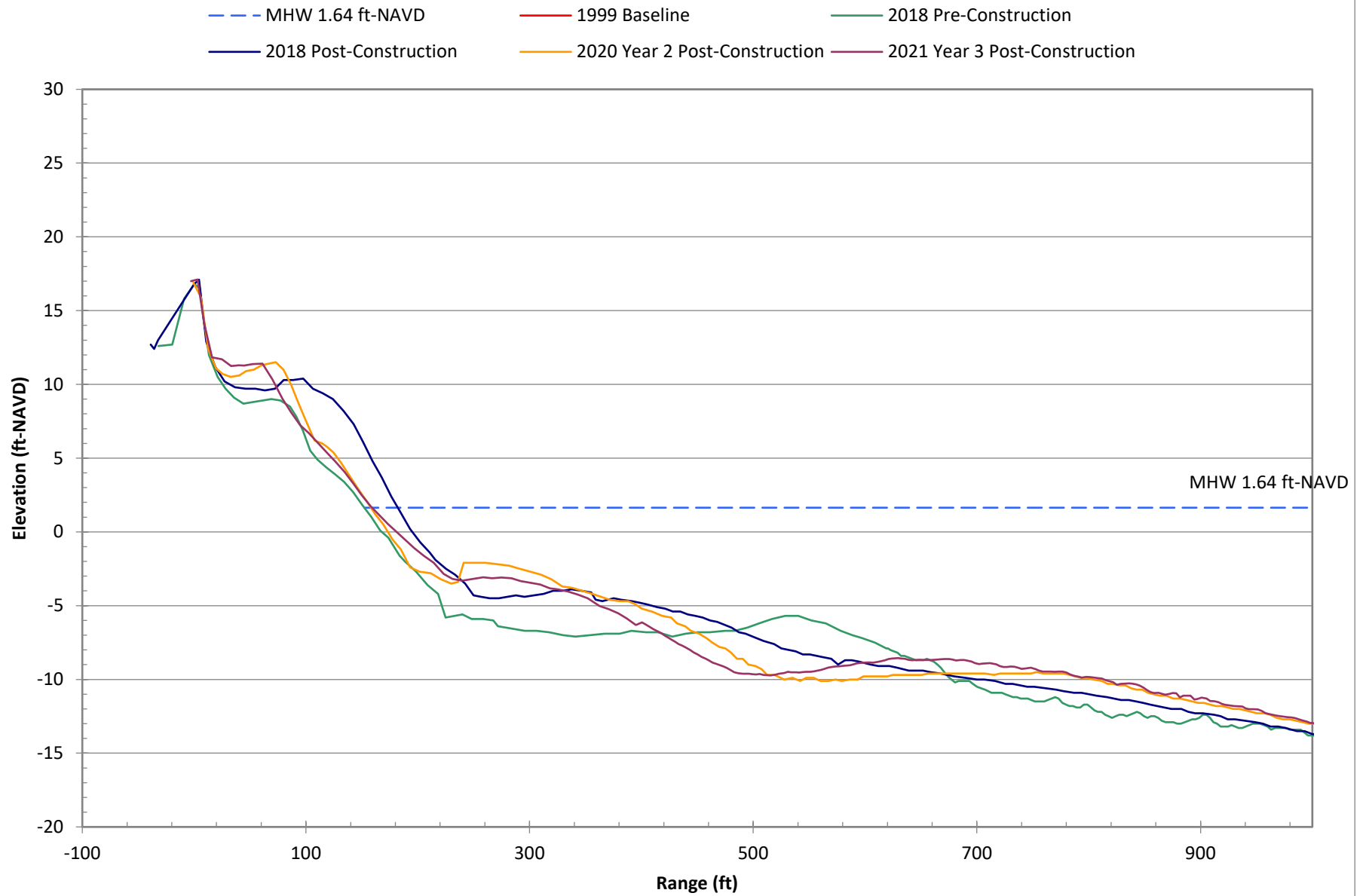
Survey Data at R-81 for Selected Years



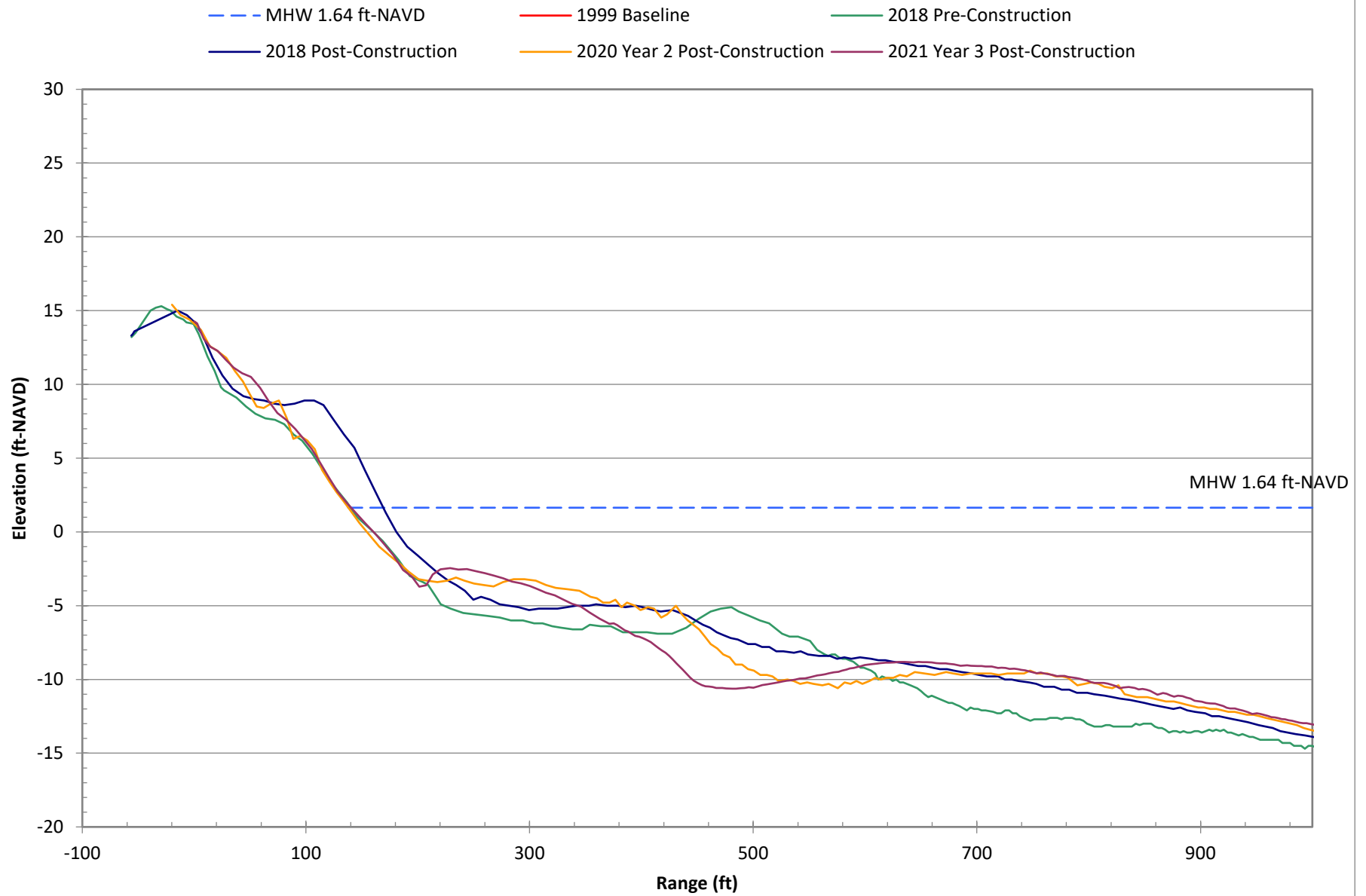
Survey Data at R-82 for Selected Years



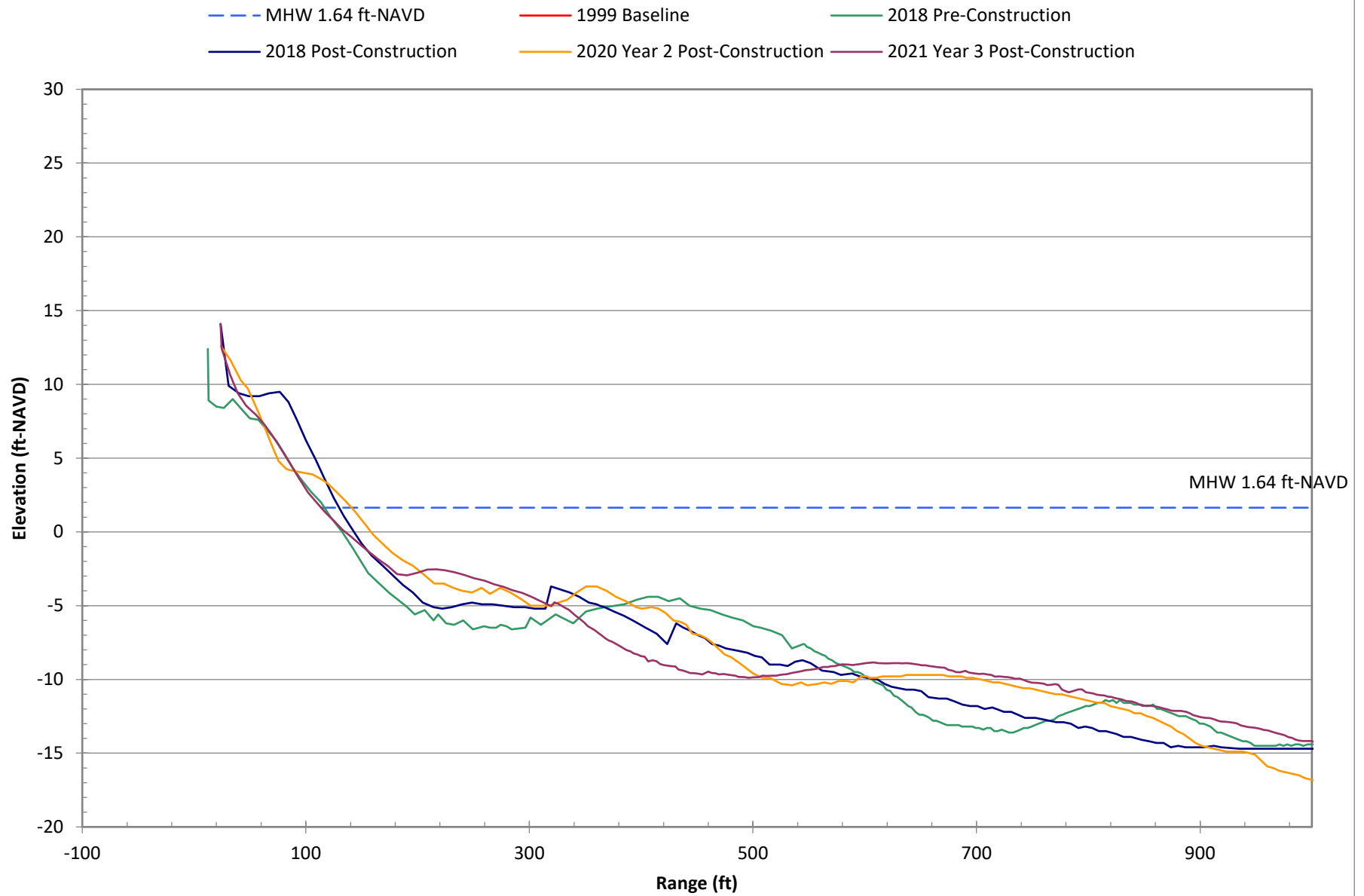
Survey Data at R-83 for Selected Years



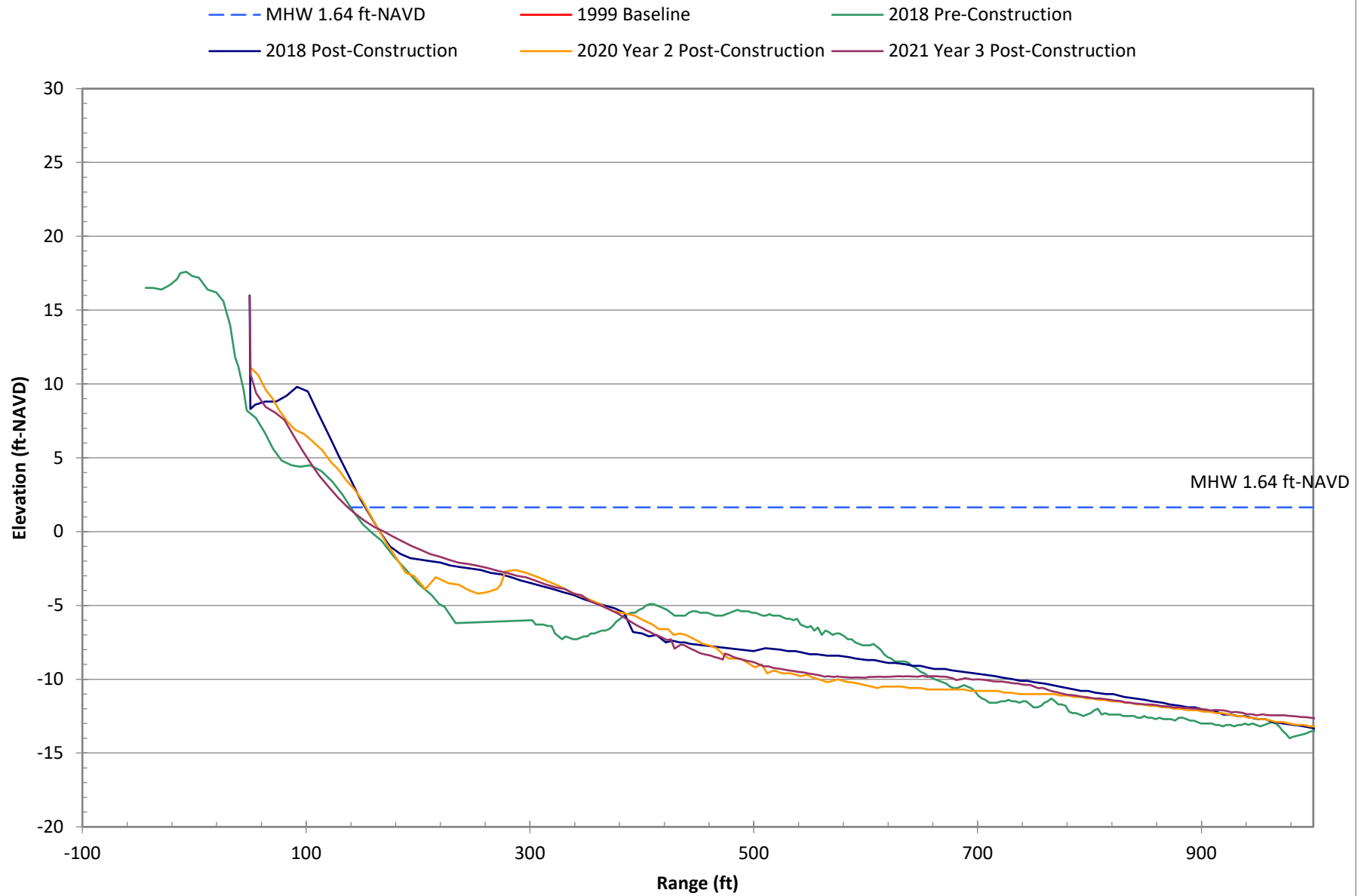
Survey Data at R-84 for Selected Years



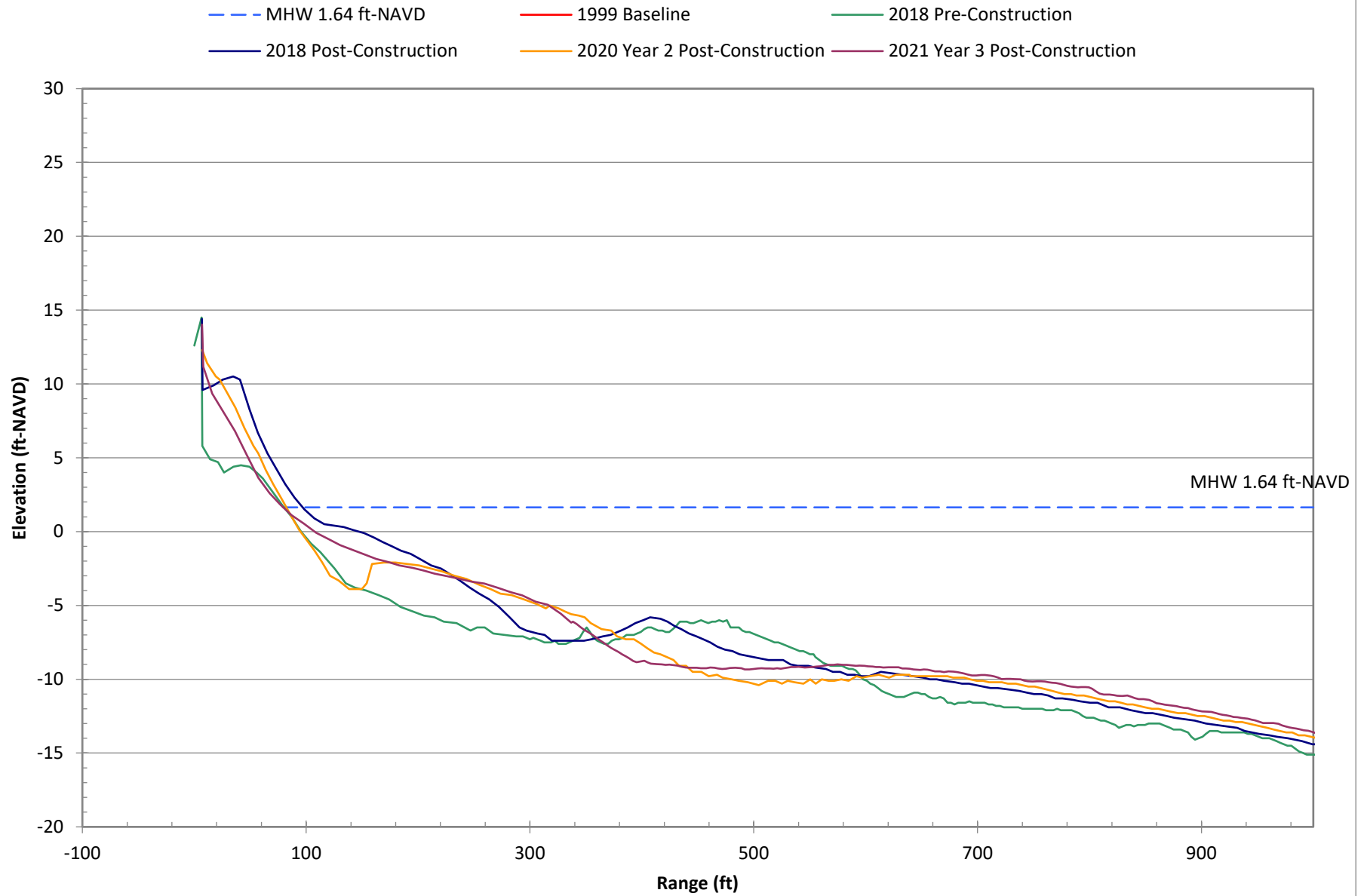
Survey Data at R-85 for Selected Years



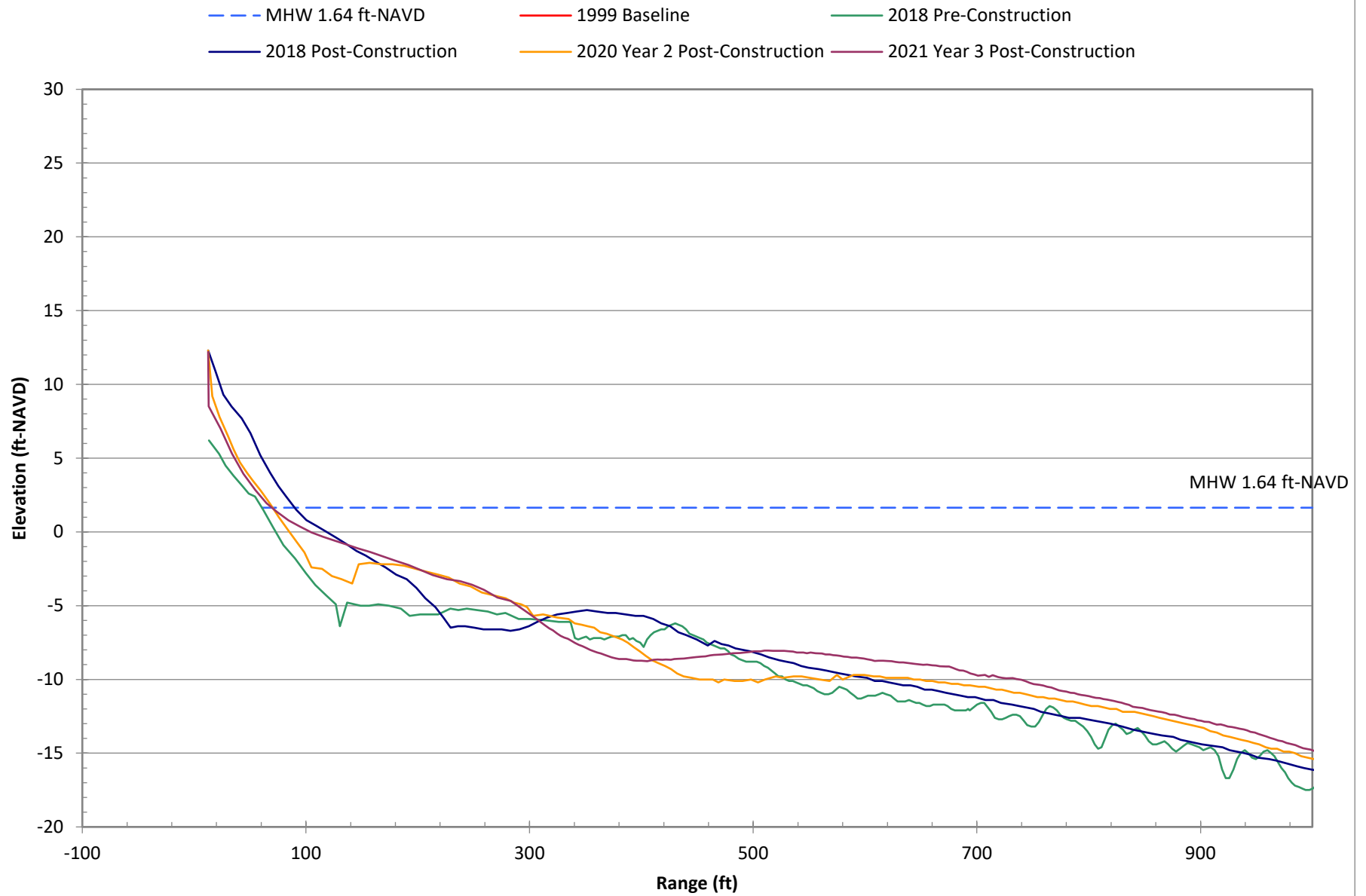
Survey Data at R-86 for Selected Years



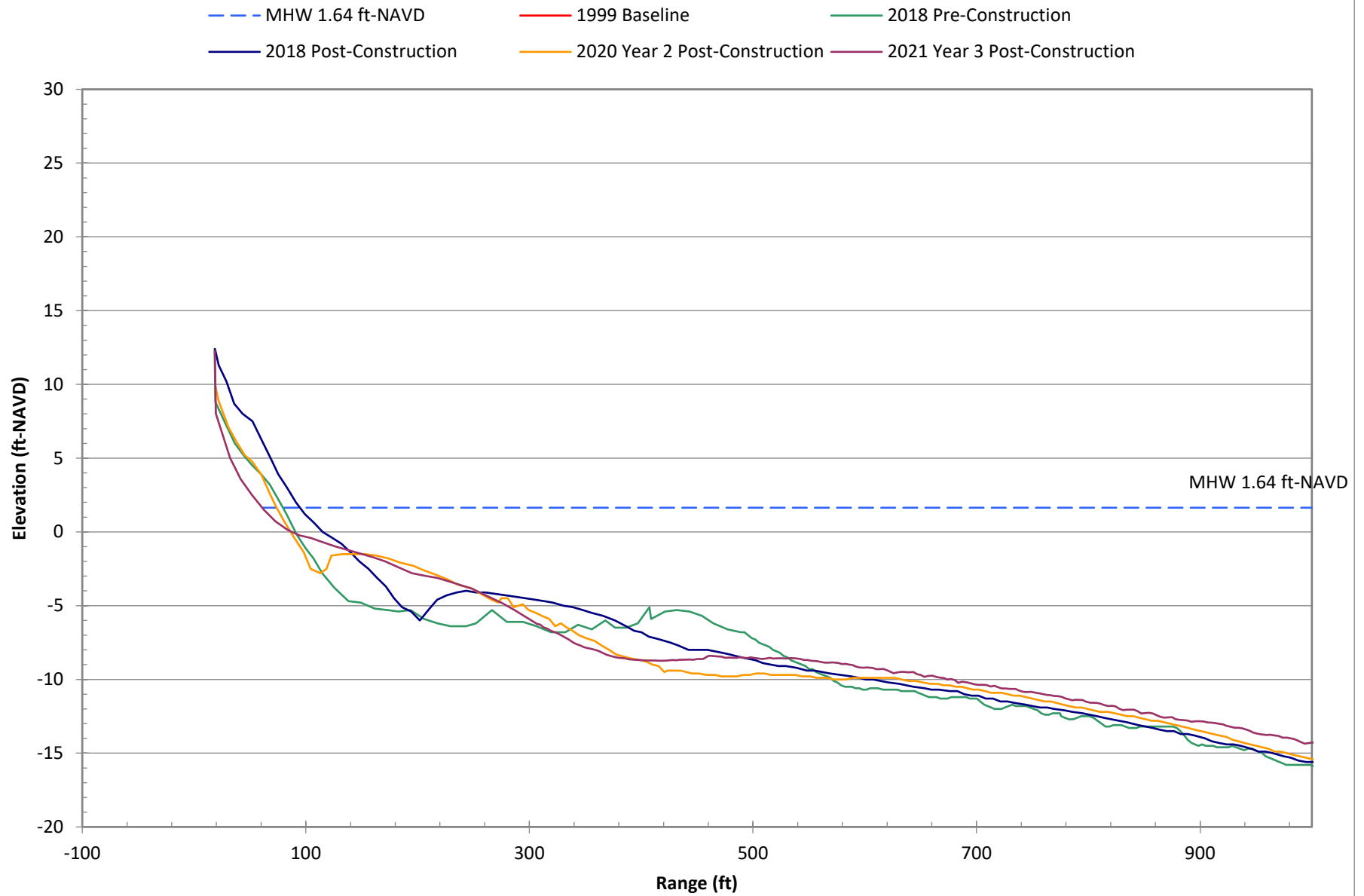
Survey Data at R-87 for Selected Years



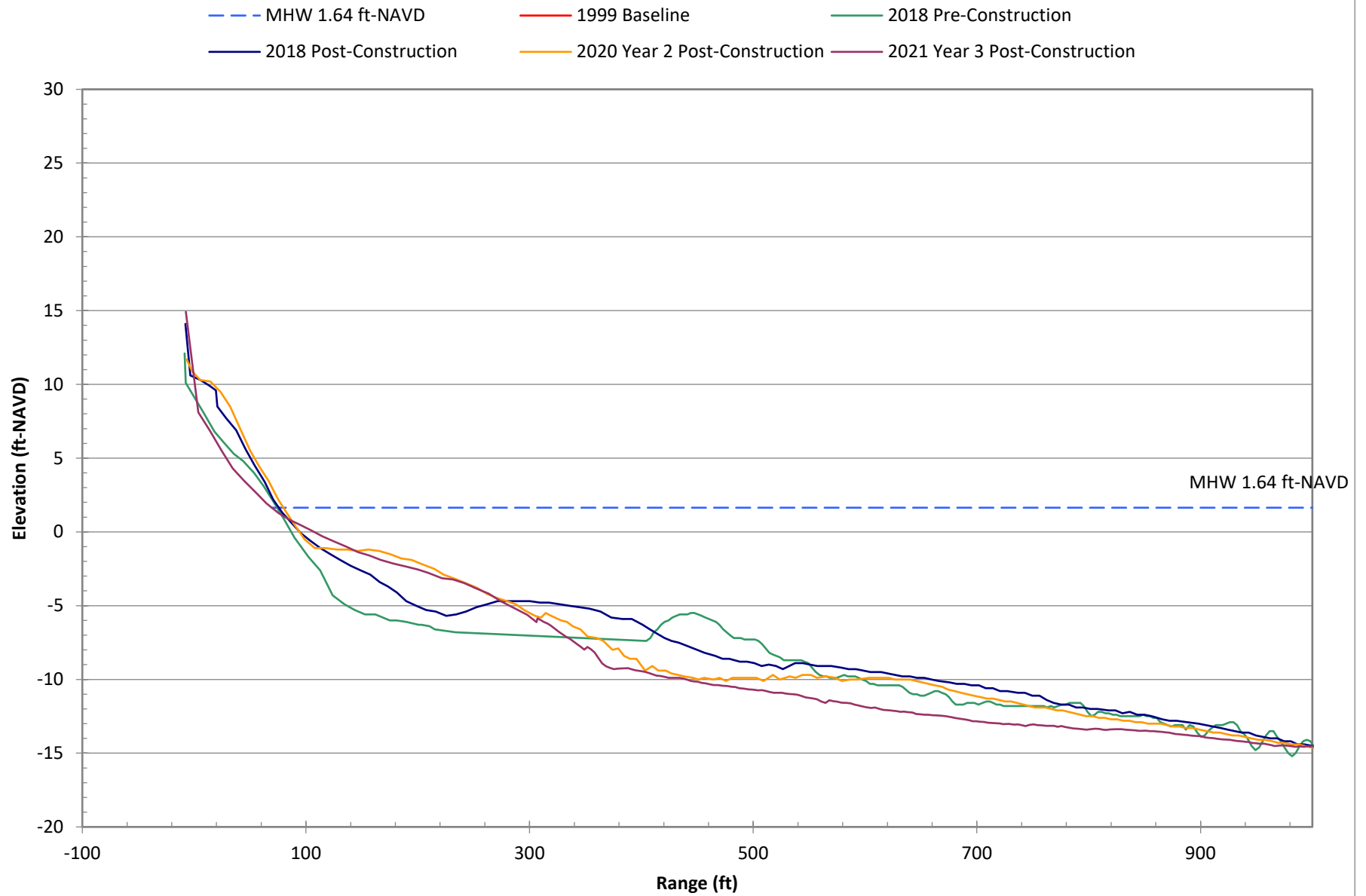
Survey Data at R-88 for Selected Years



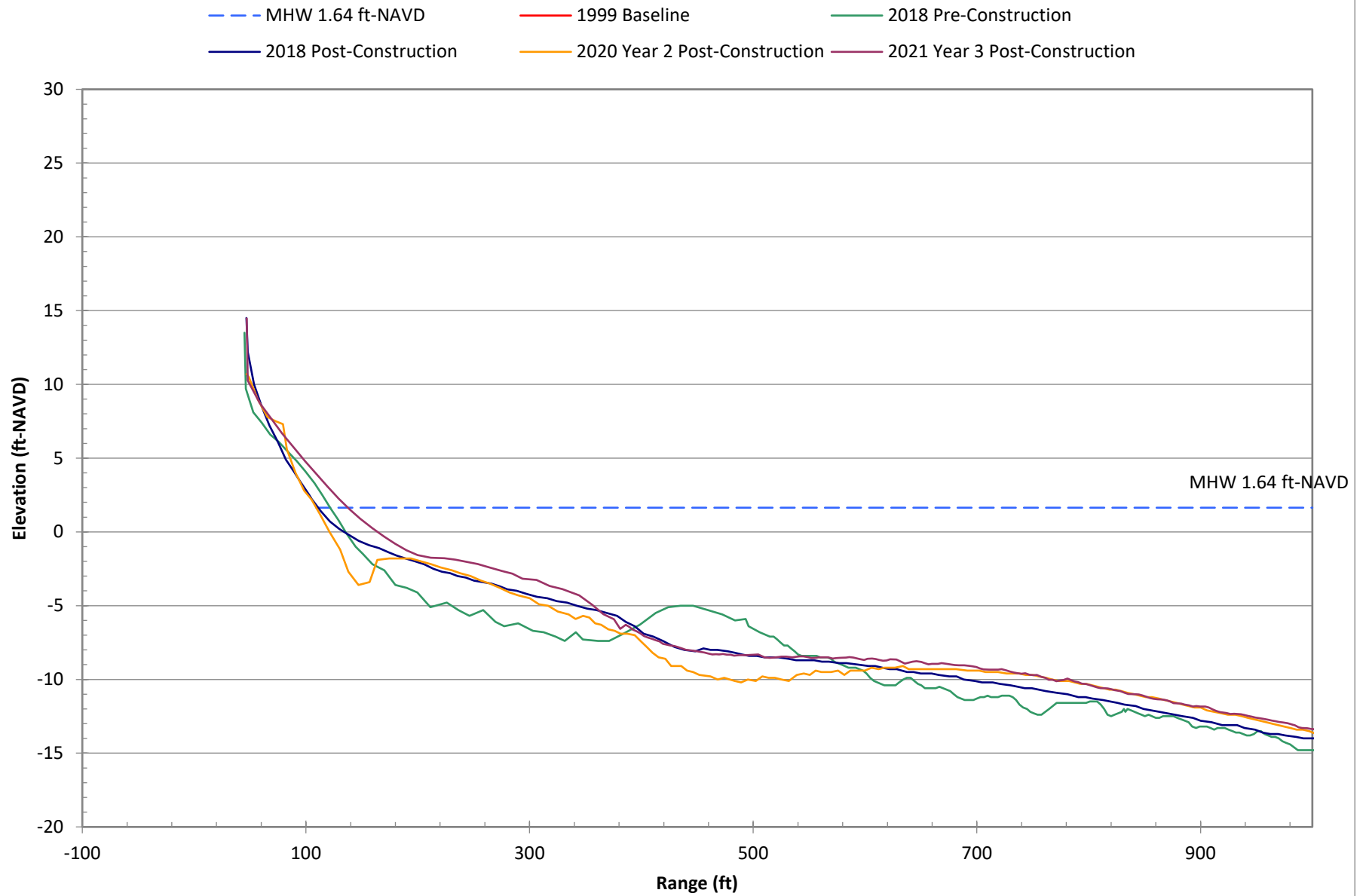
Survey Data at R-89 for Selected Years



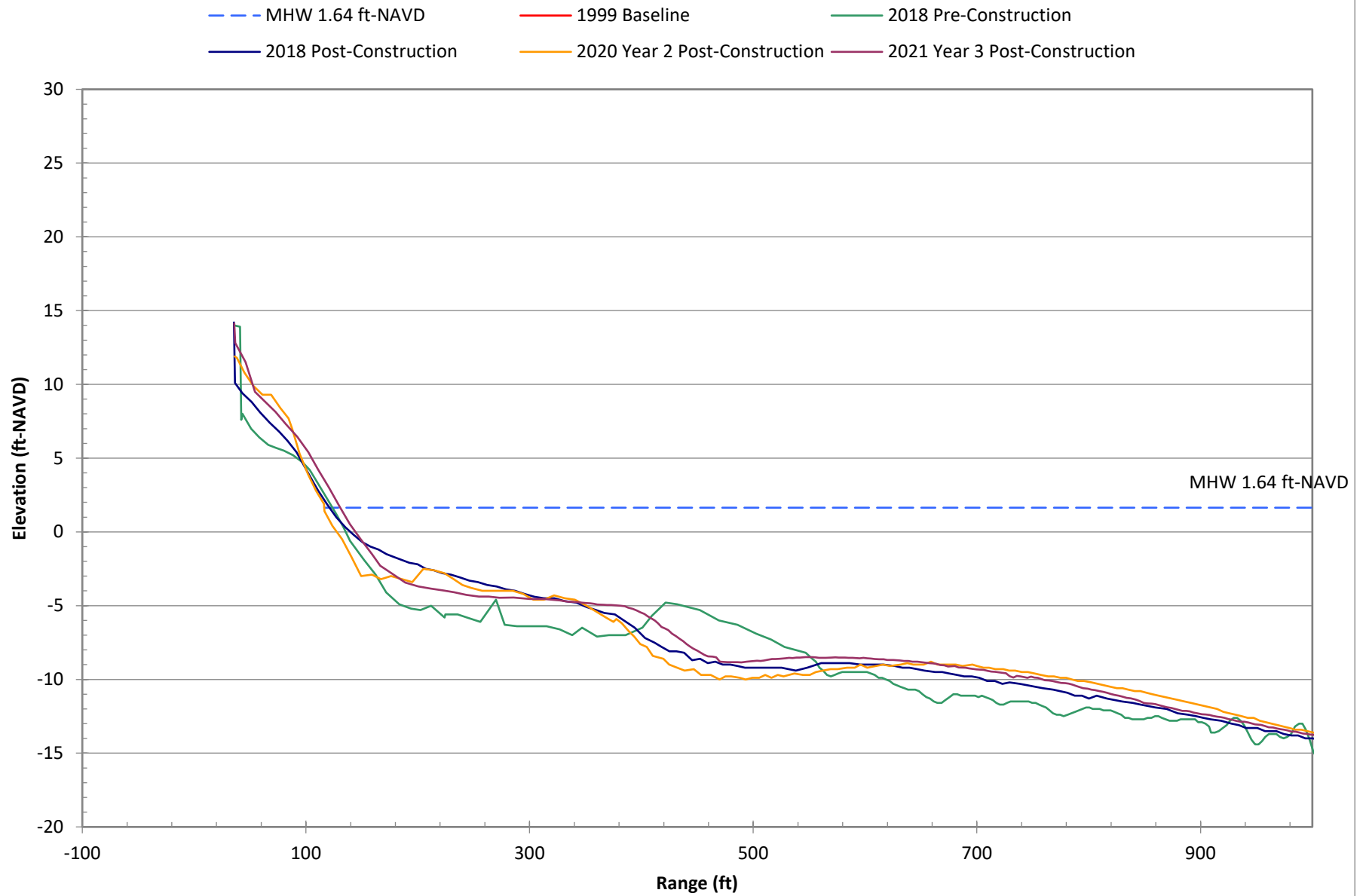
Survey Data at R-90 for Selected Years



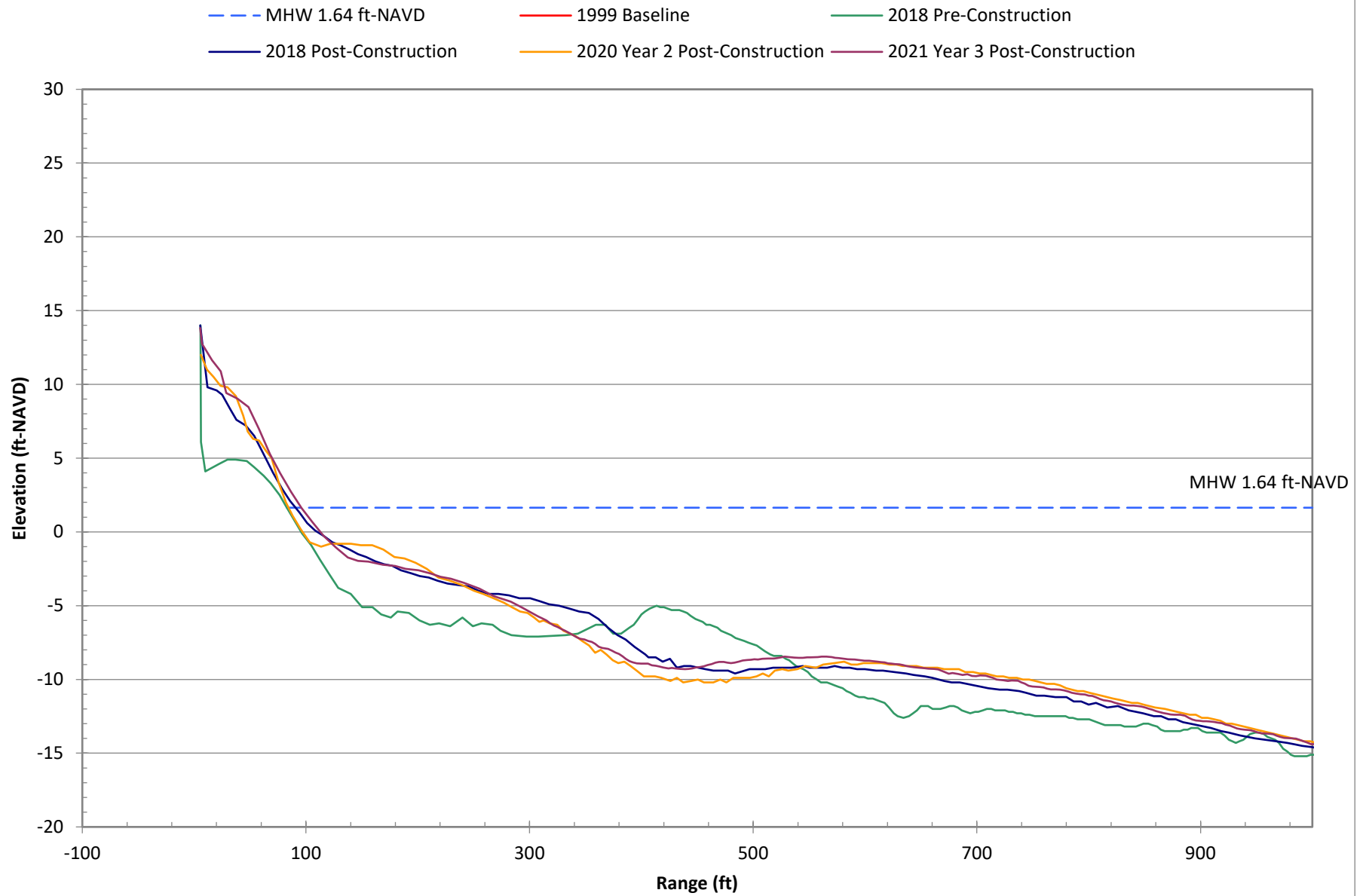
Survey Data at R-91 for Selected Years



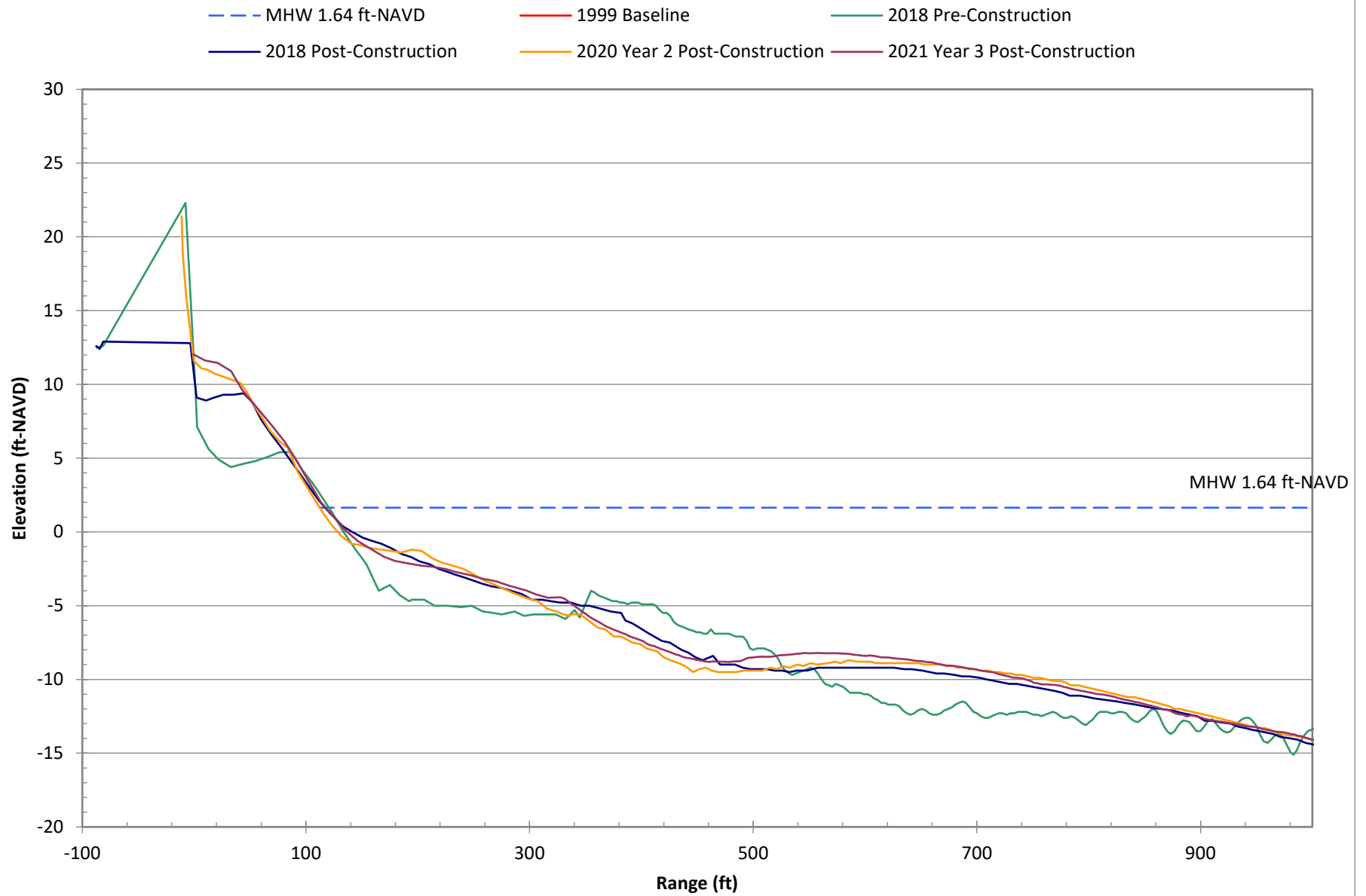
Survey Data at R-92 for Selected Years



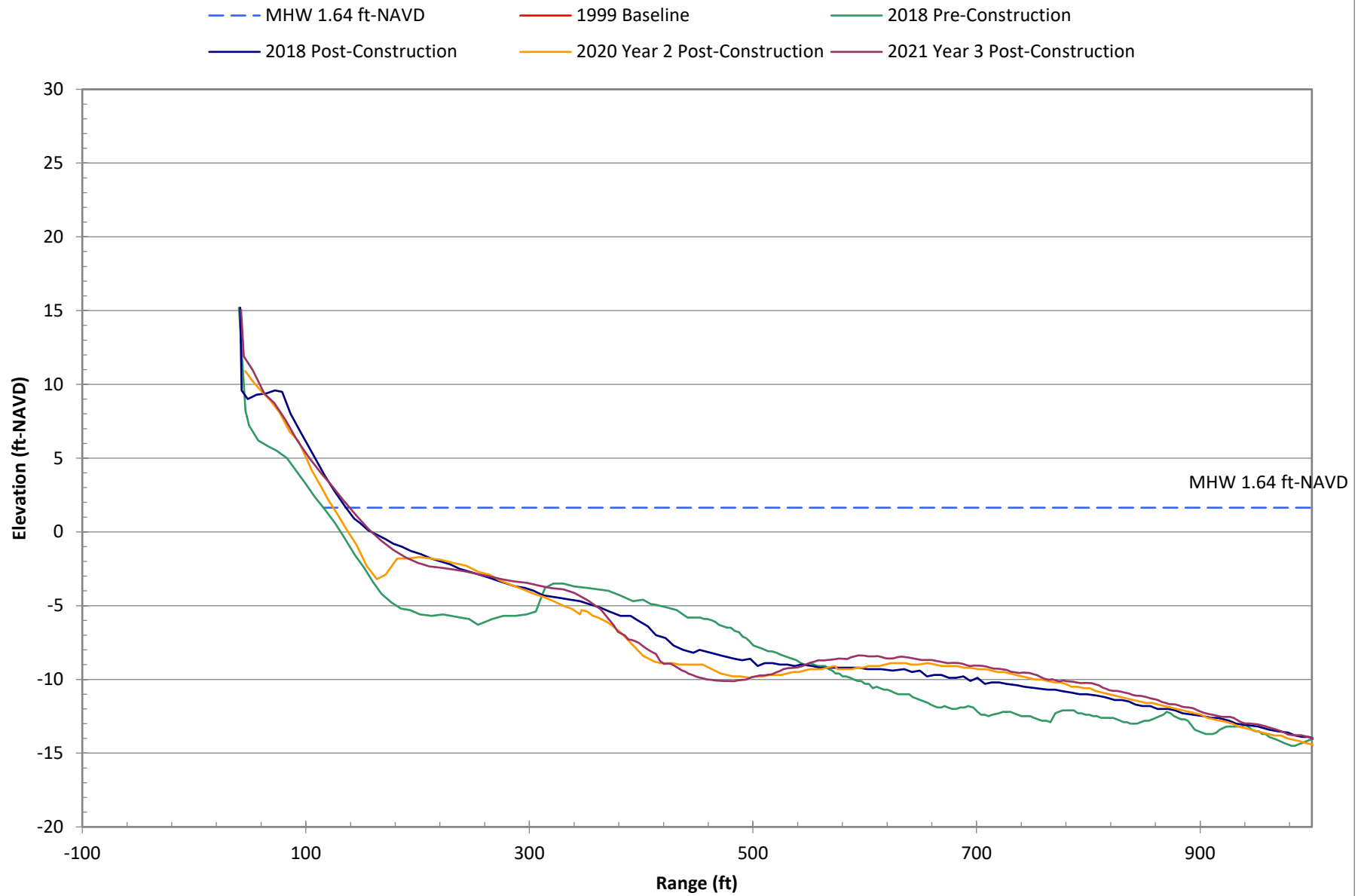
Survey Data at R-93 for Selected Years



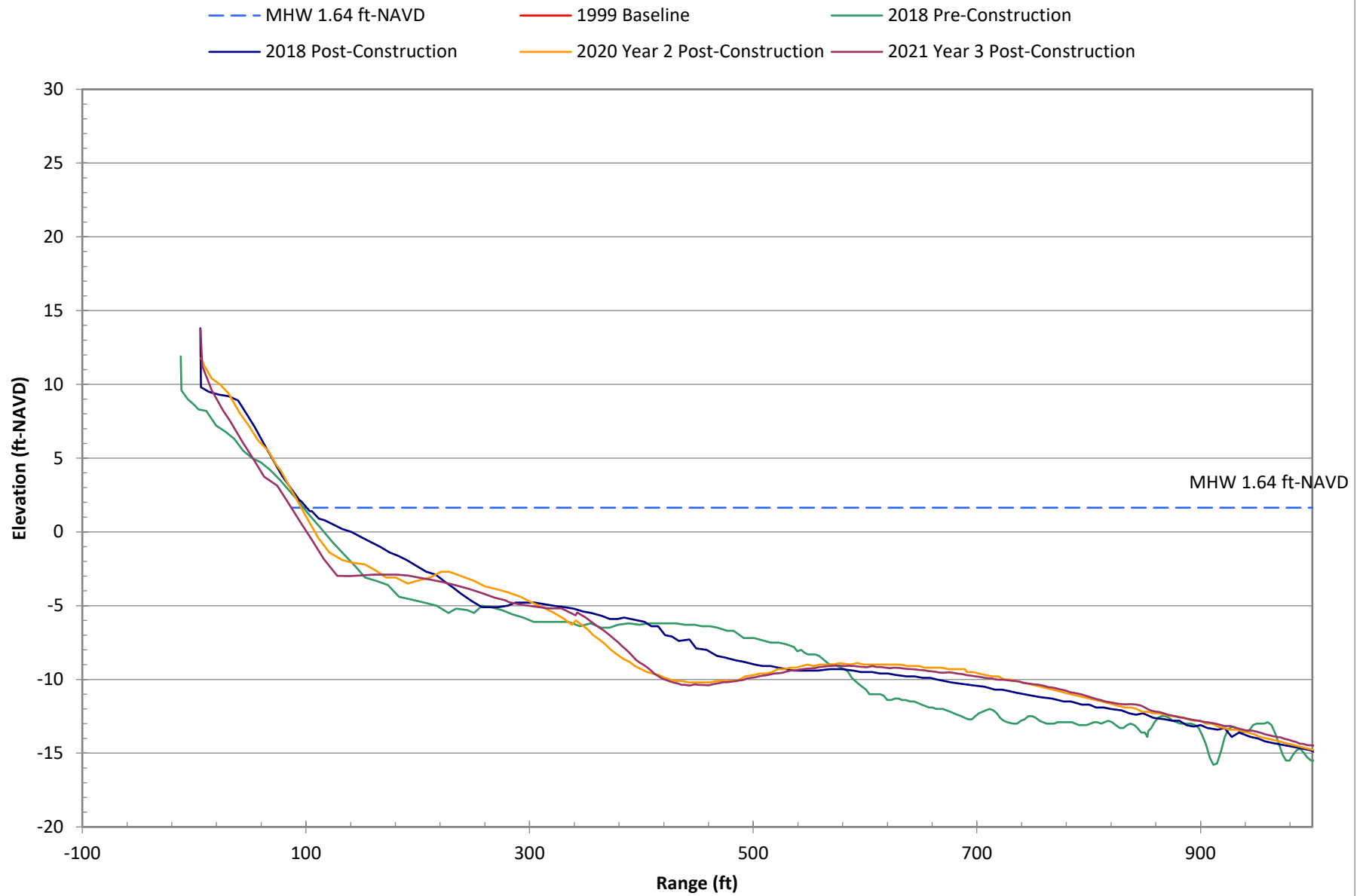
Survey Data at R-94 for Selected Years



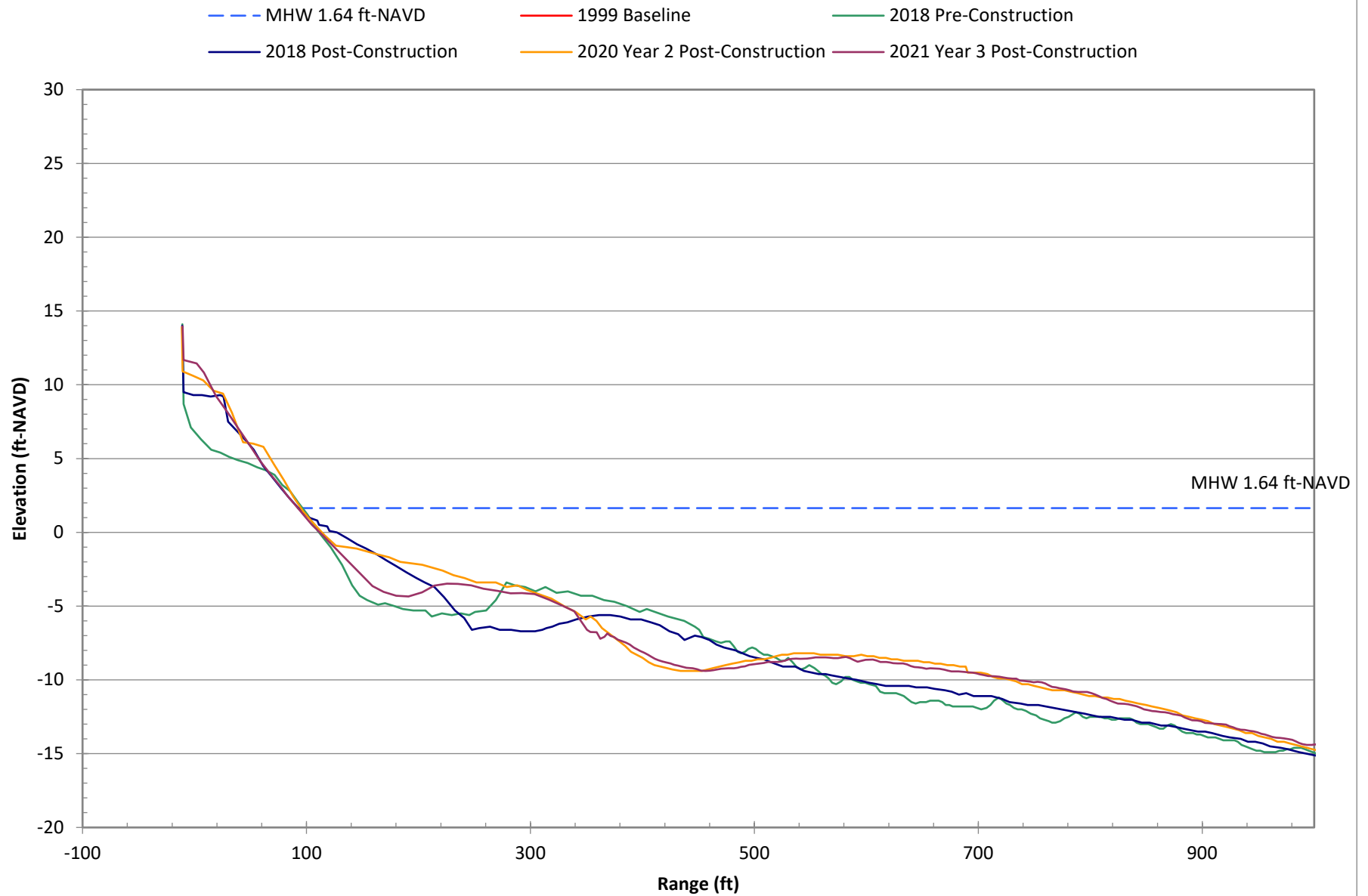
Survey Data at R-95 for Selected Years



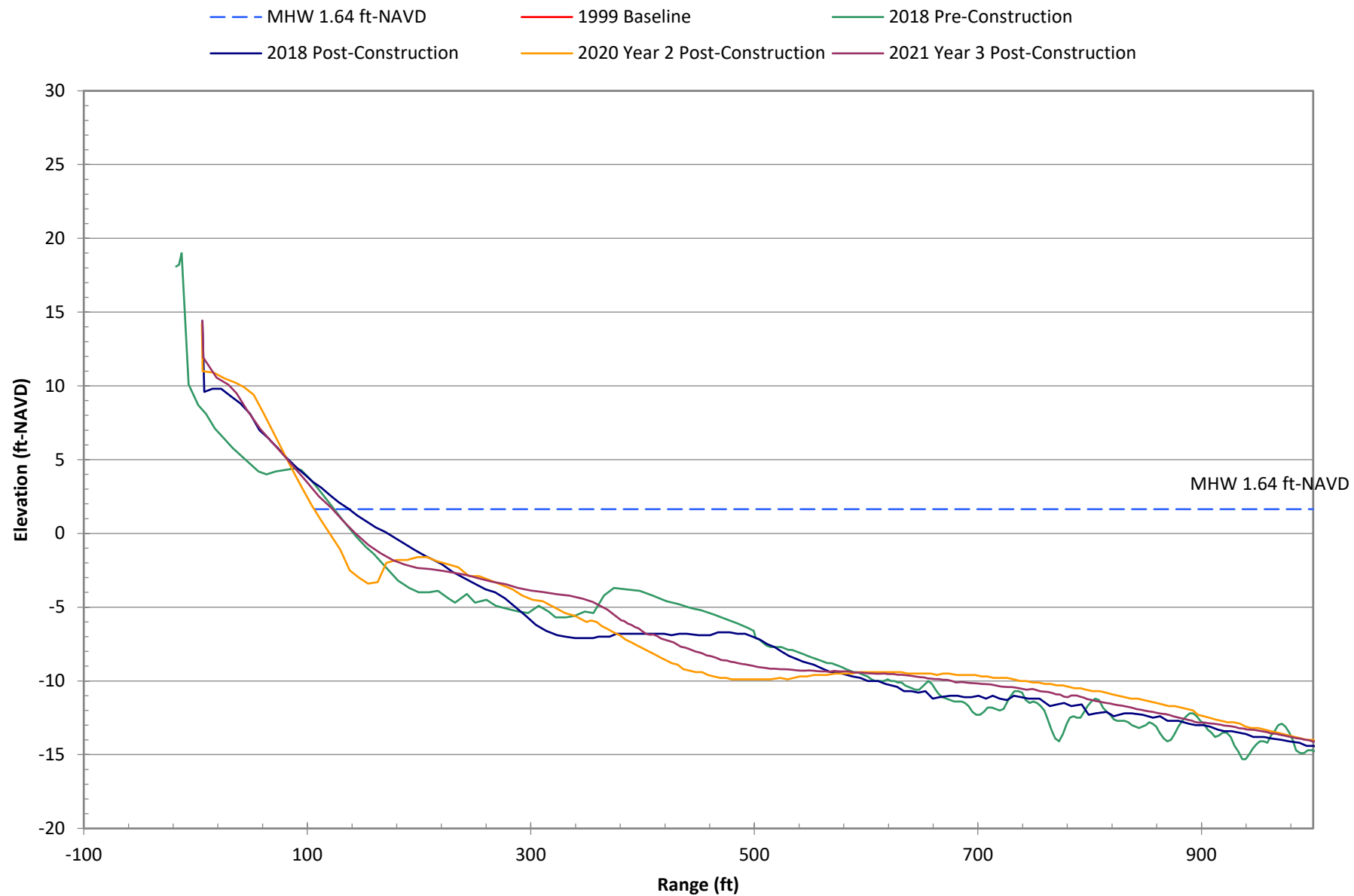
Survey Data at R-96 for Selected Years



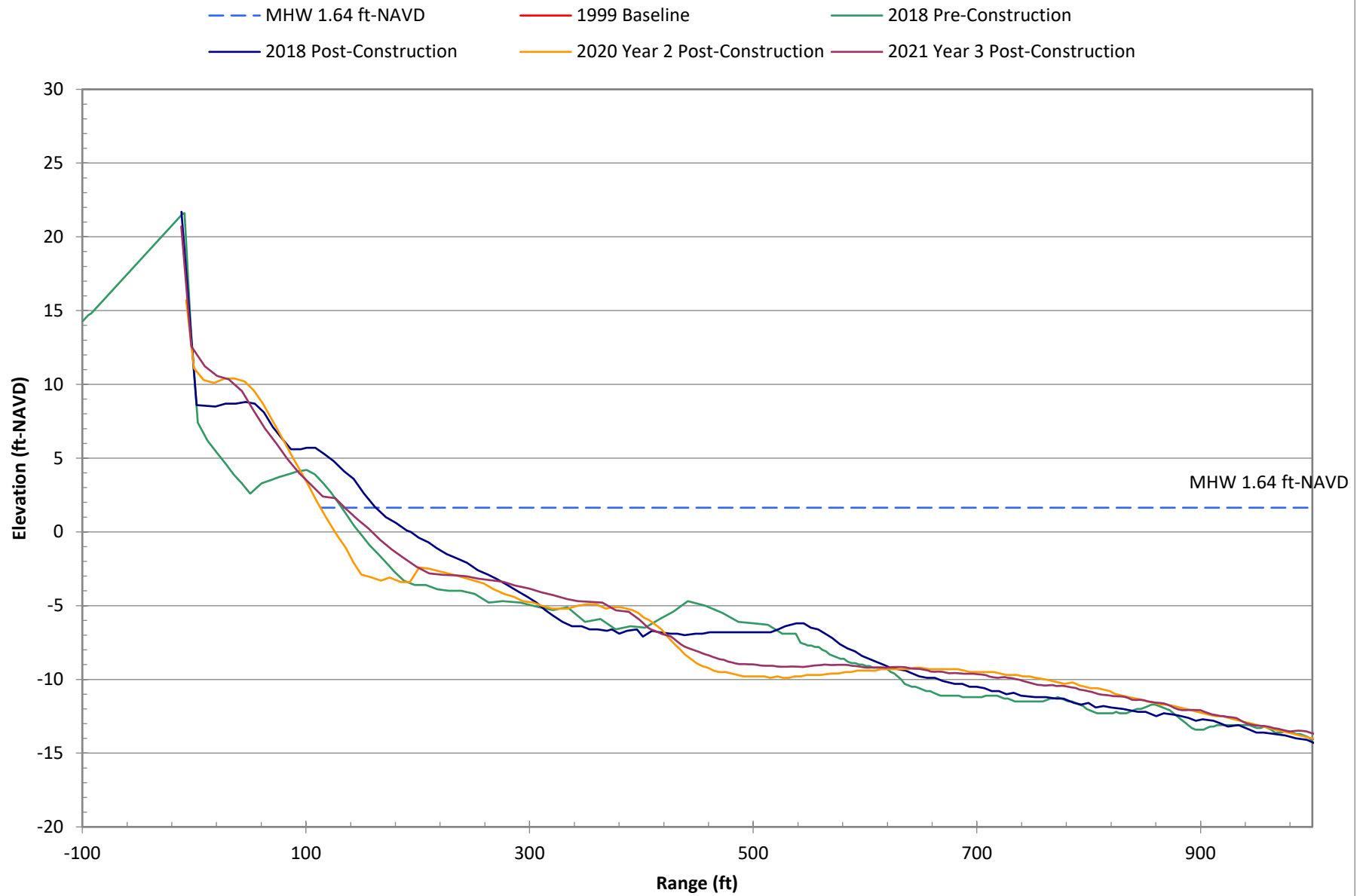
Survey Data at R-97 for Selected Years



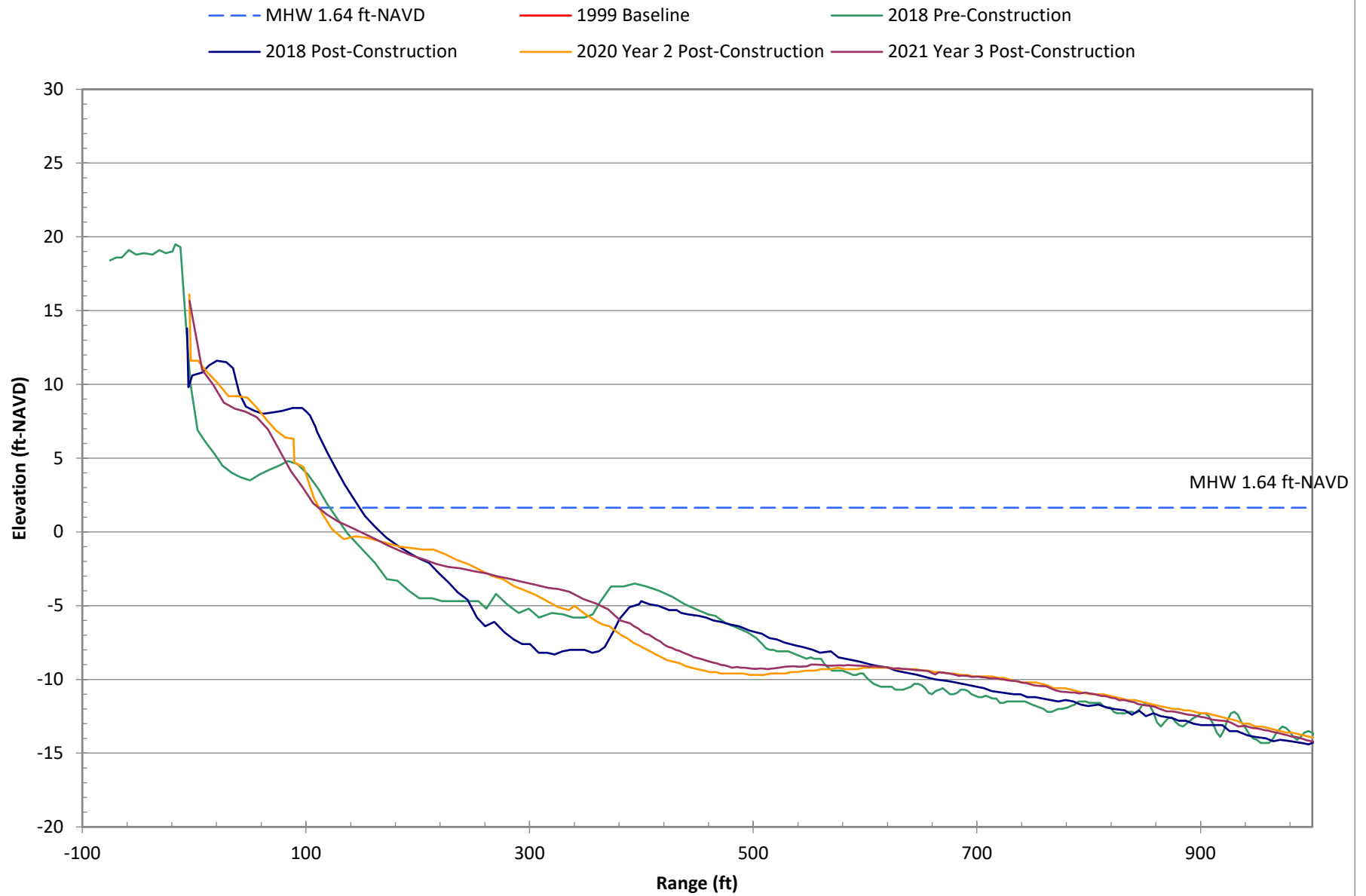
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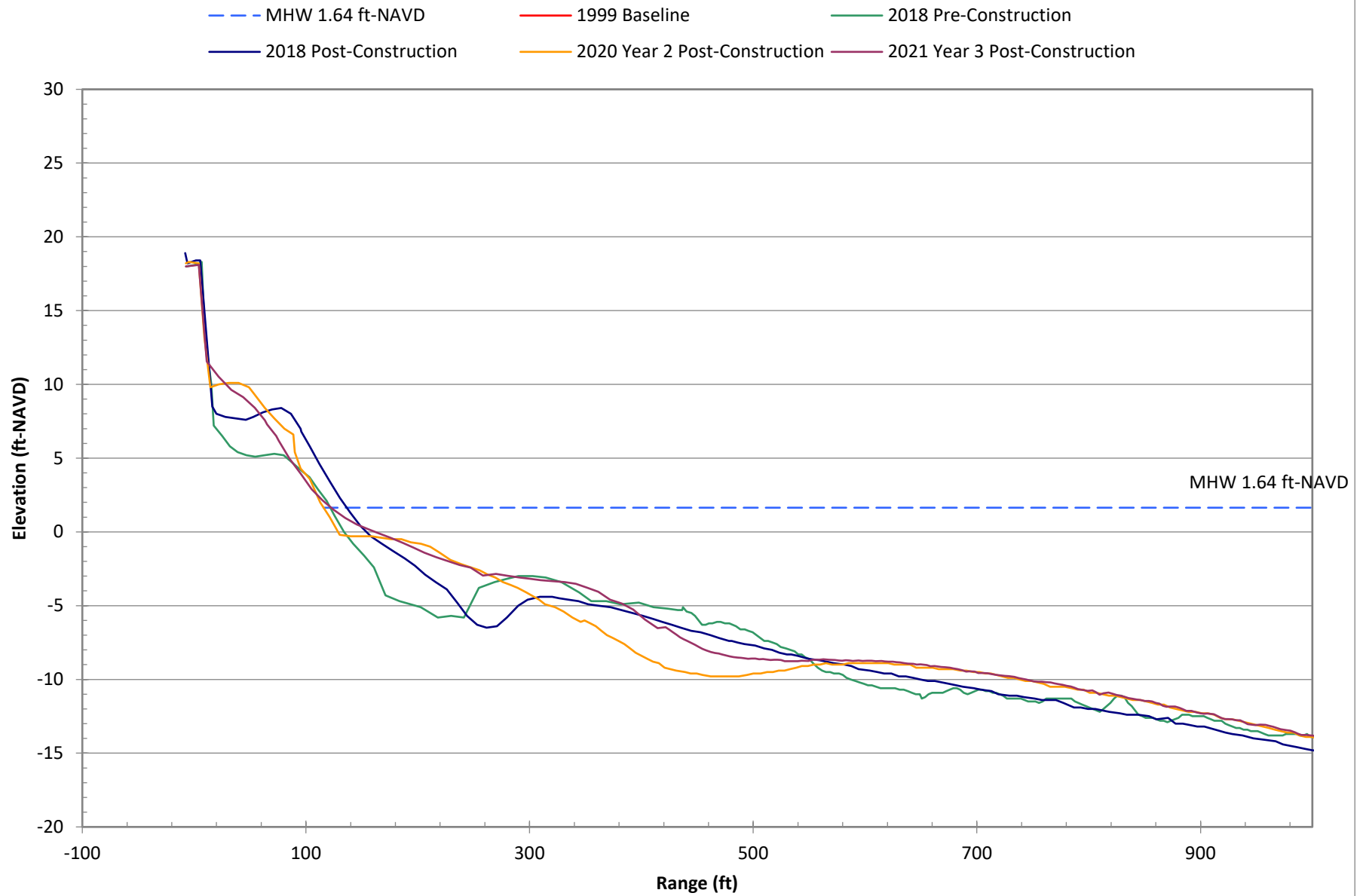
Survey Data at R-99 for Selected Years



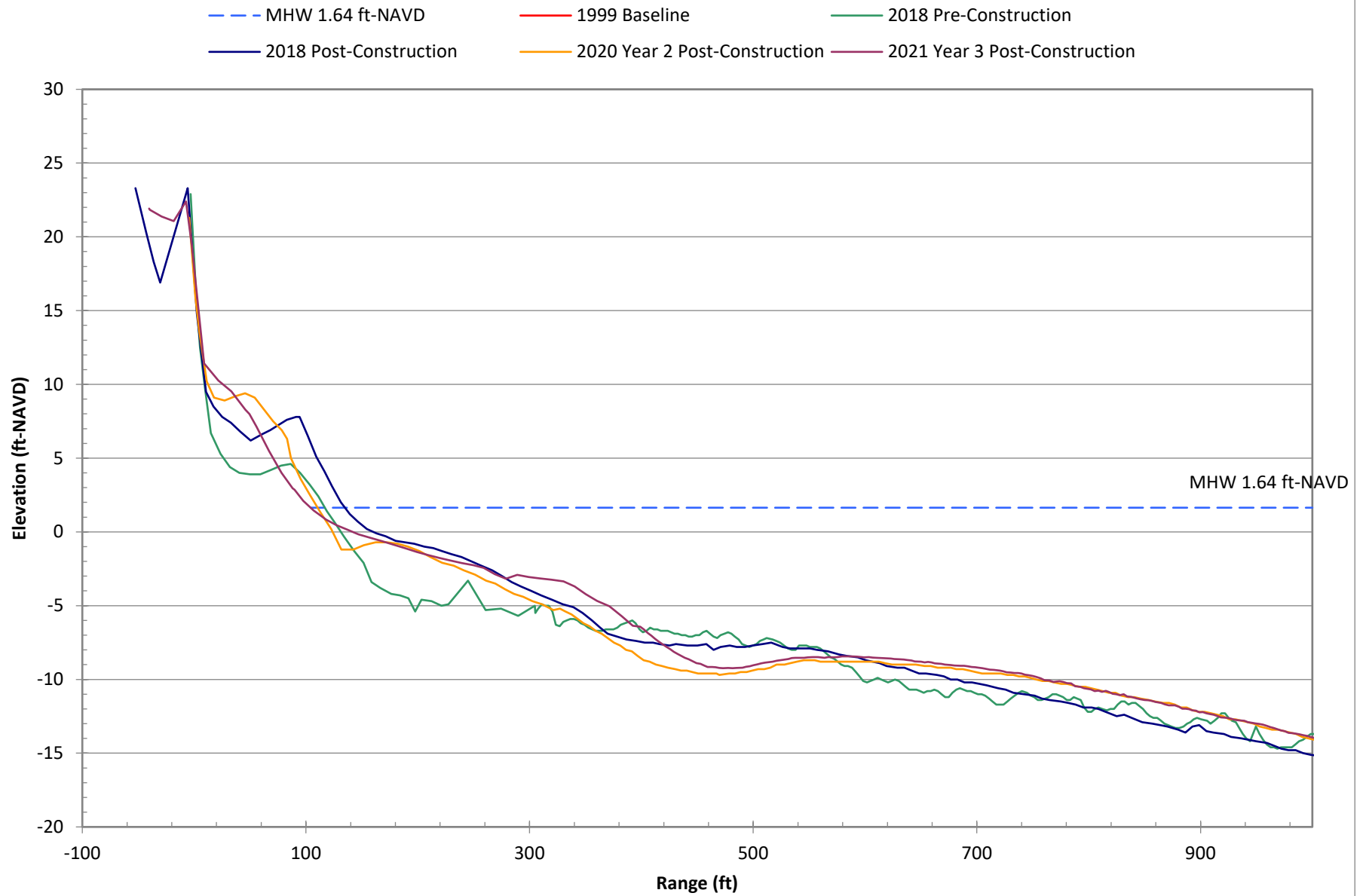
Survey Data at R-100 for Selected Years



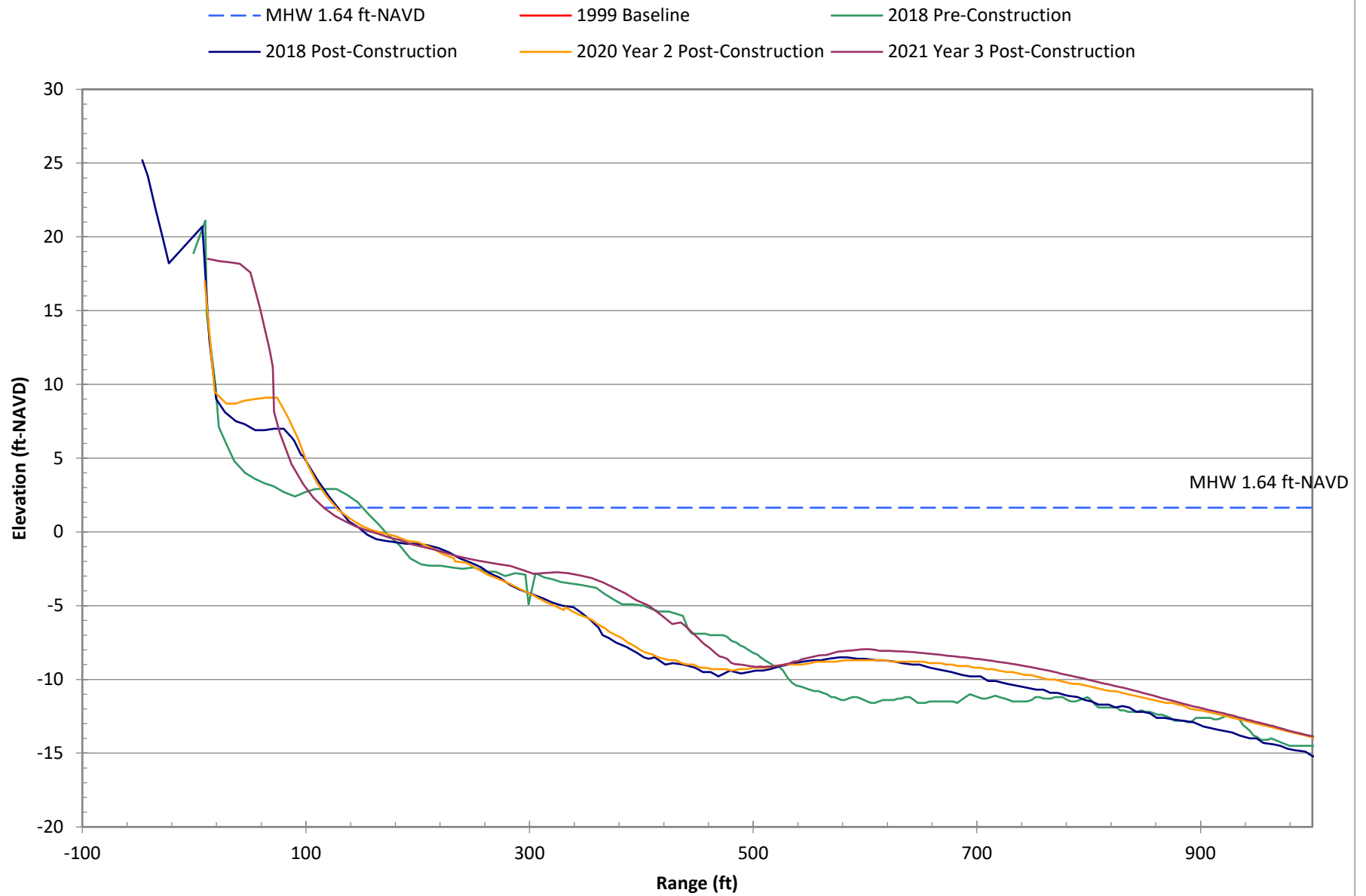
Survey Data at R-101 for Selected Years



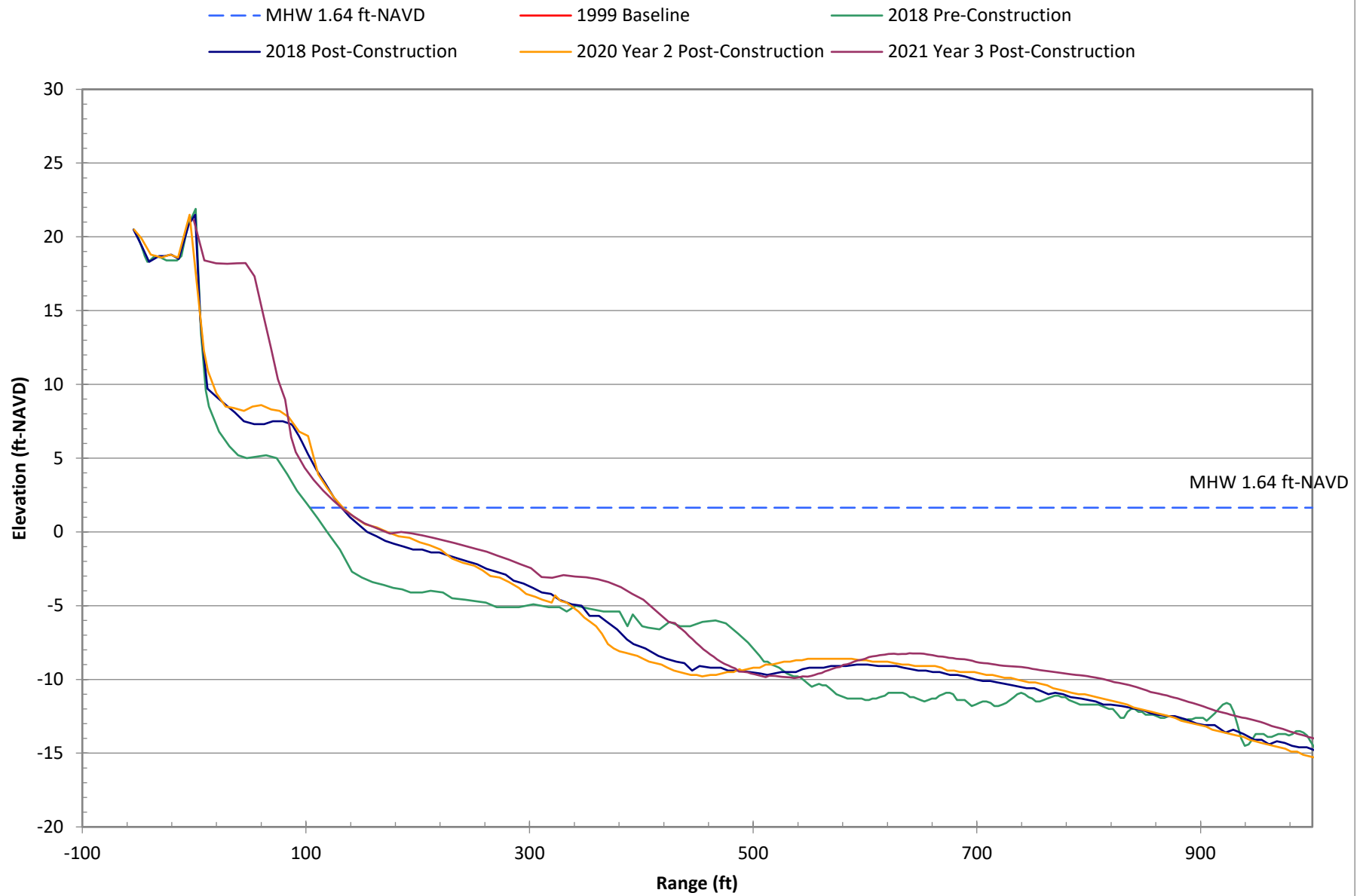
Survey Data at R-102 for Selected Years



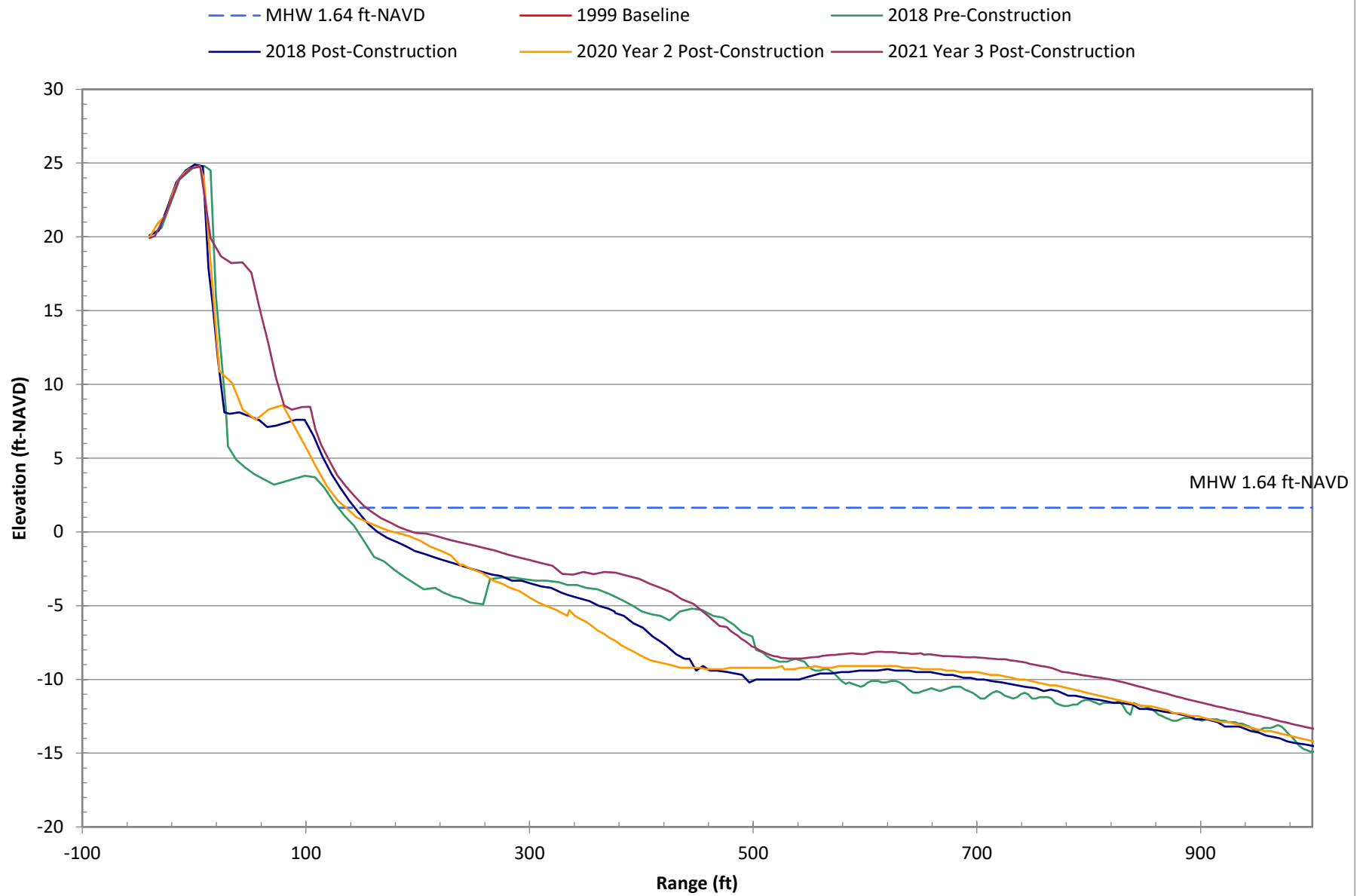
Survey Data at R-103 for Selected Years



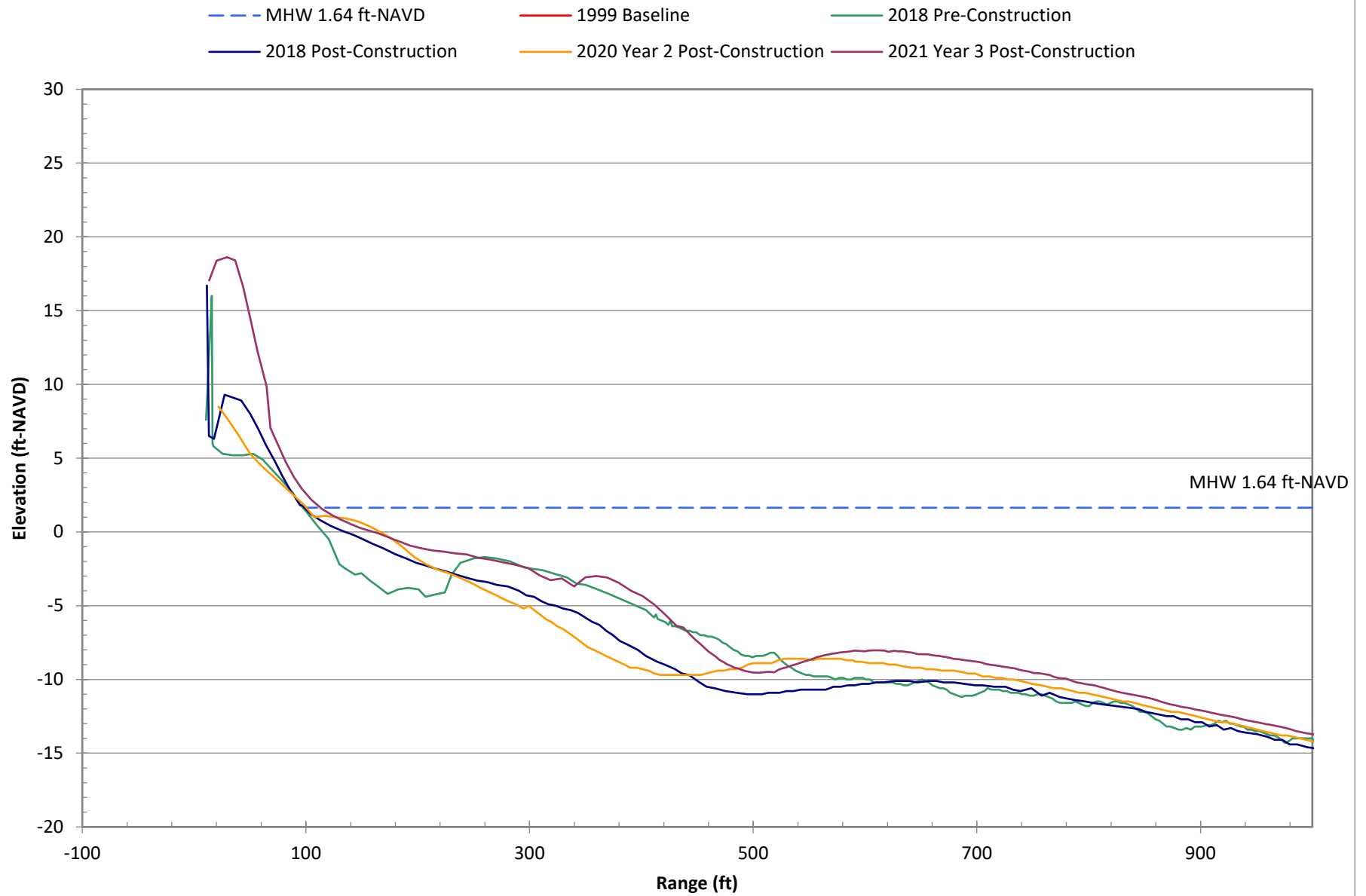
Survey Data at T-104 for Selected Years



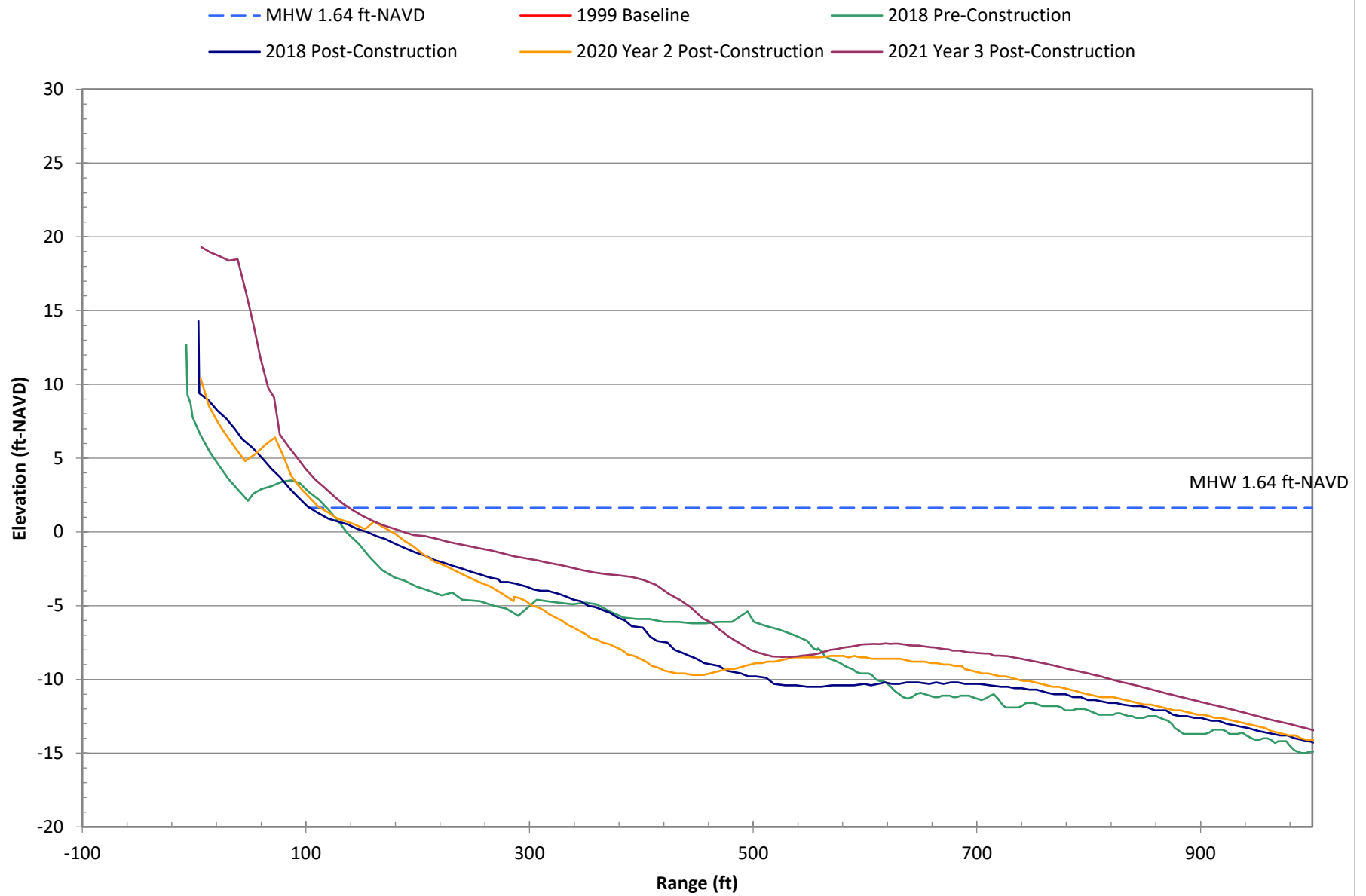
Survey Data at R-105 for Selected Years



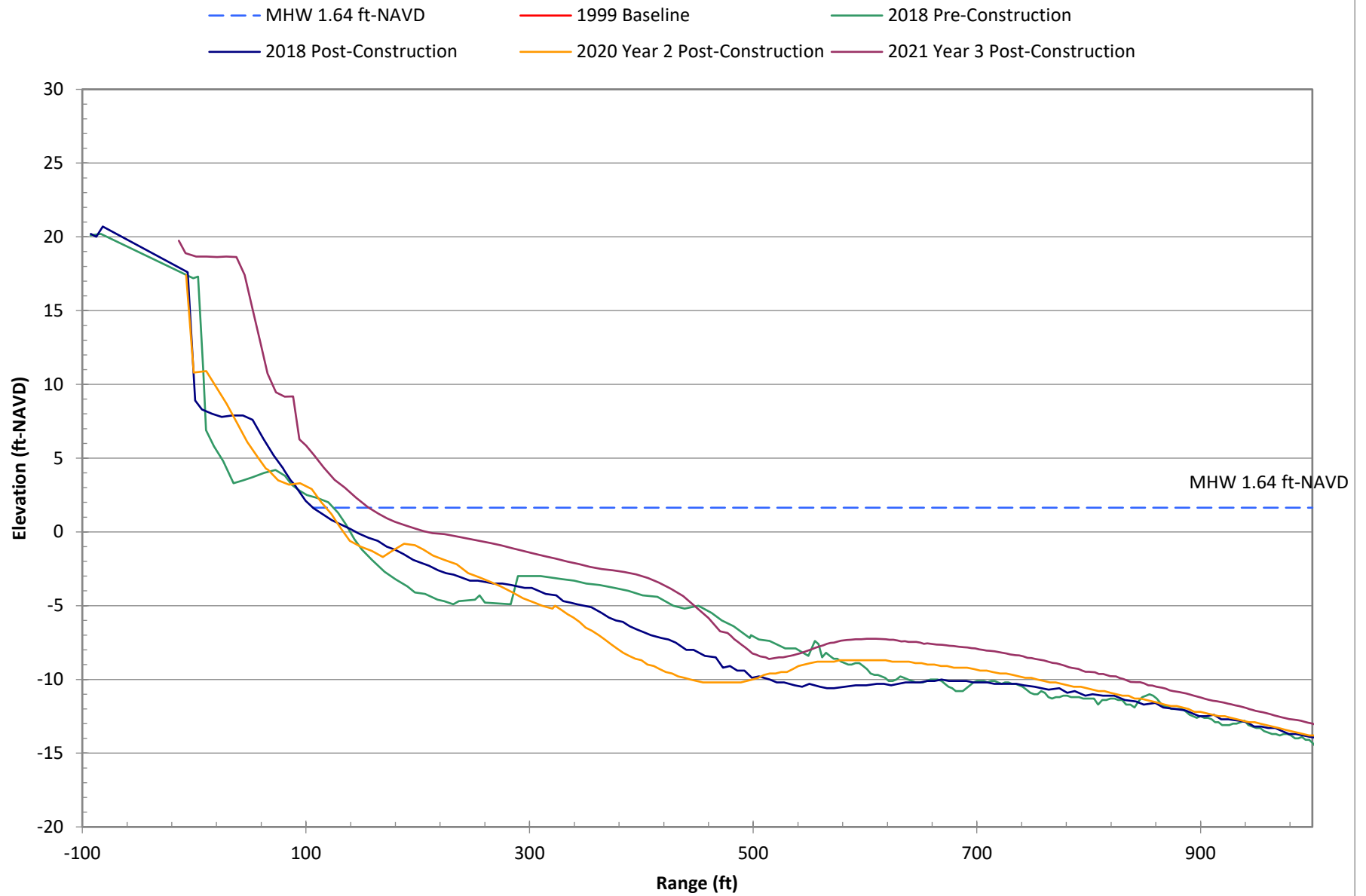
Survey Data at R-106 for Selected Years



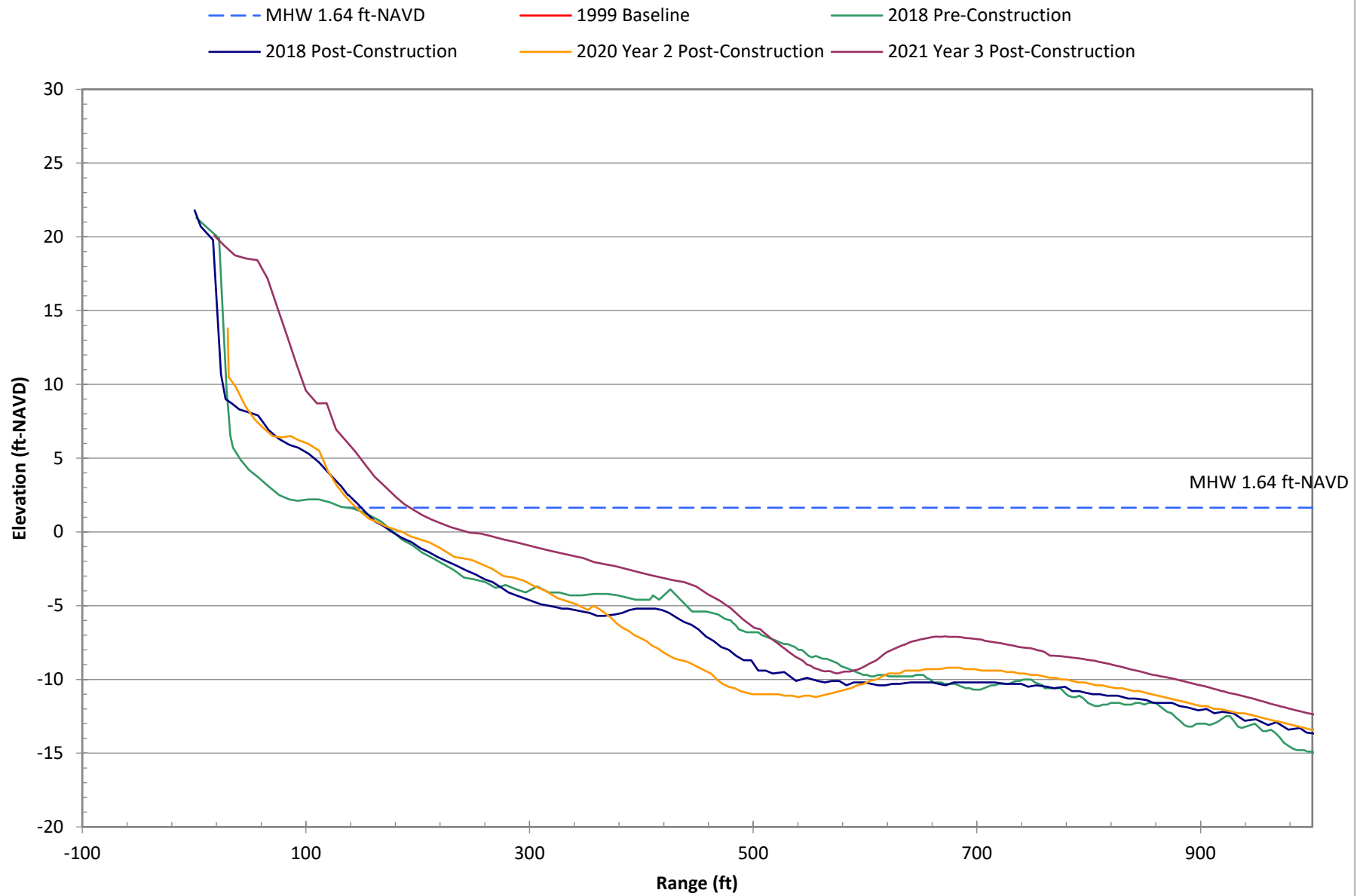
Survey Data at R-107 for Selected Years



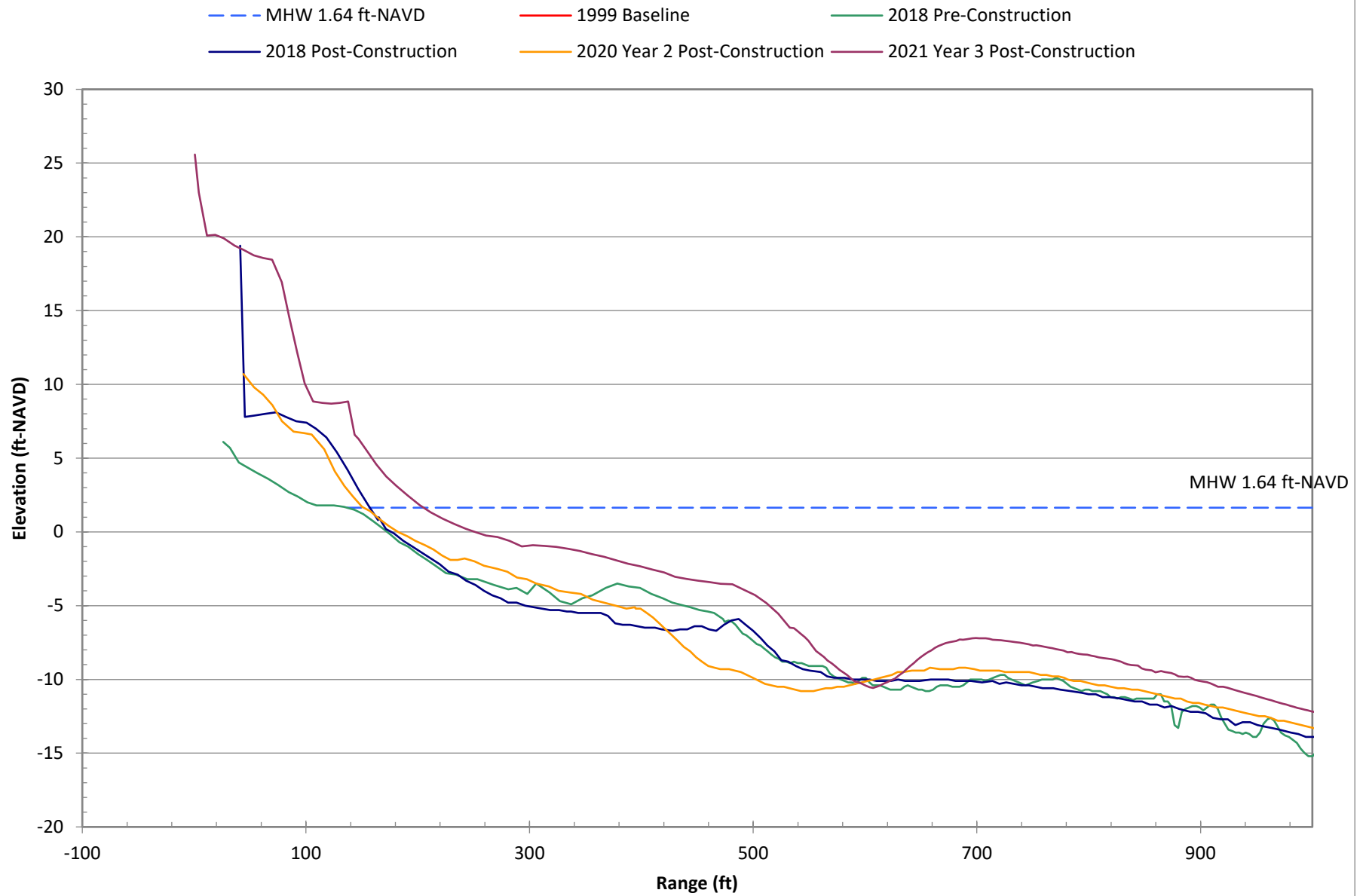
Survey Data at R-108 for Selected Years



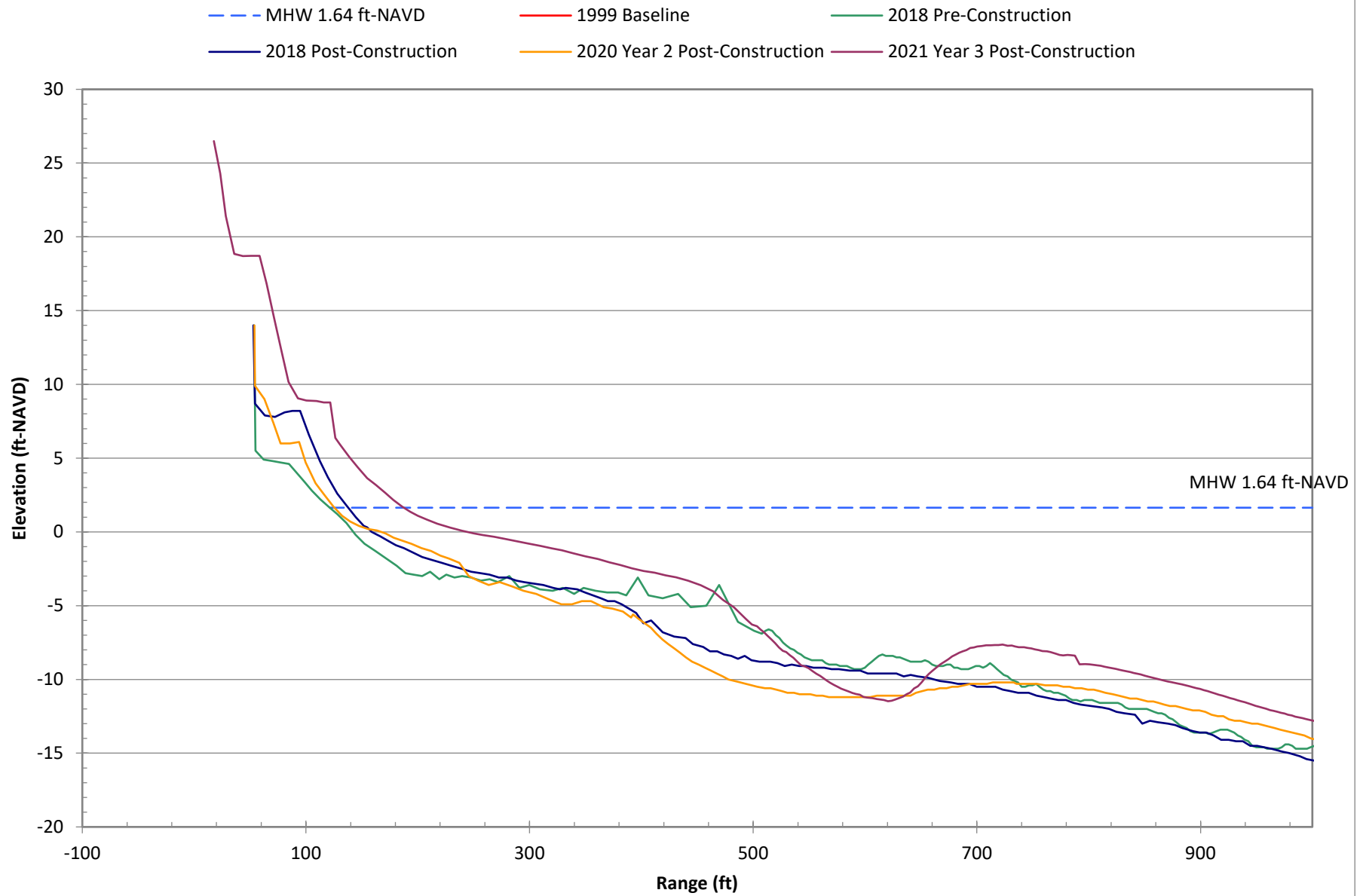
Survey Data at R-109 for Selected Years



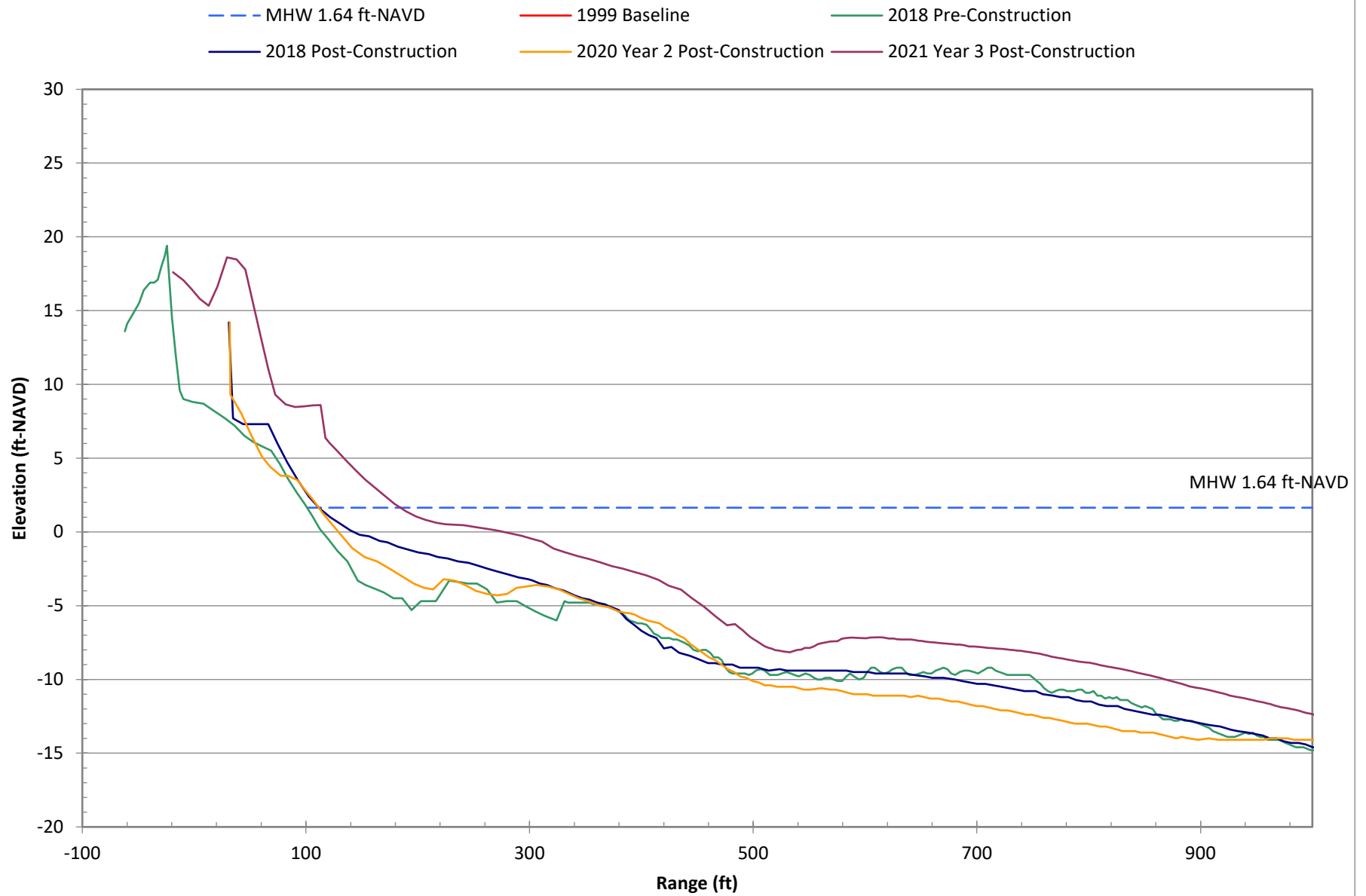
Survey Data at T-110 for Selected Years



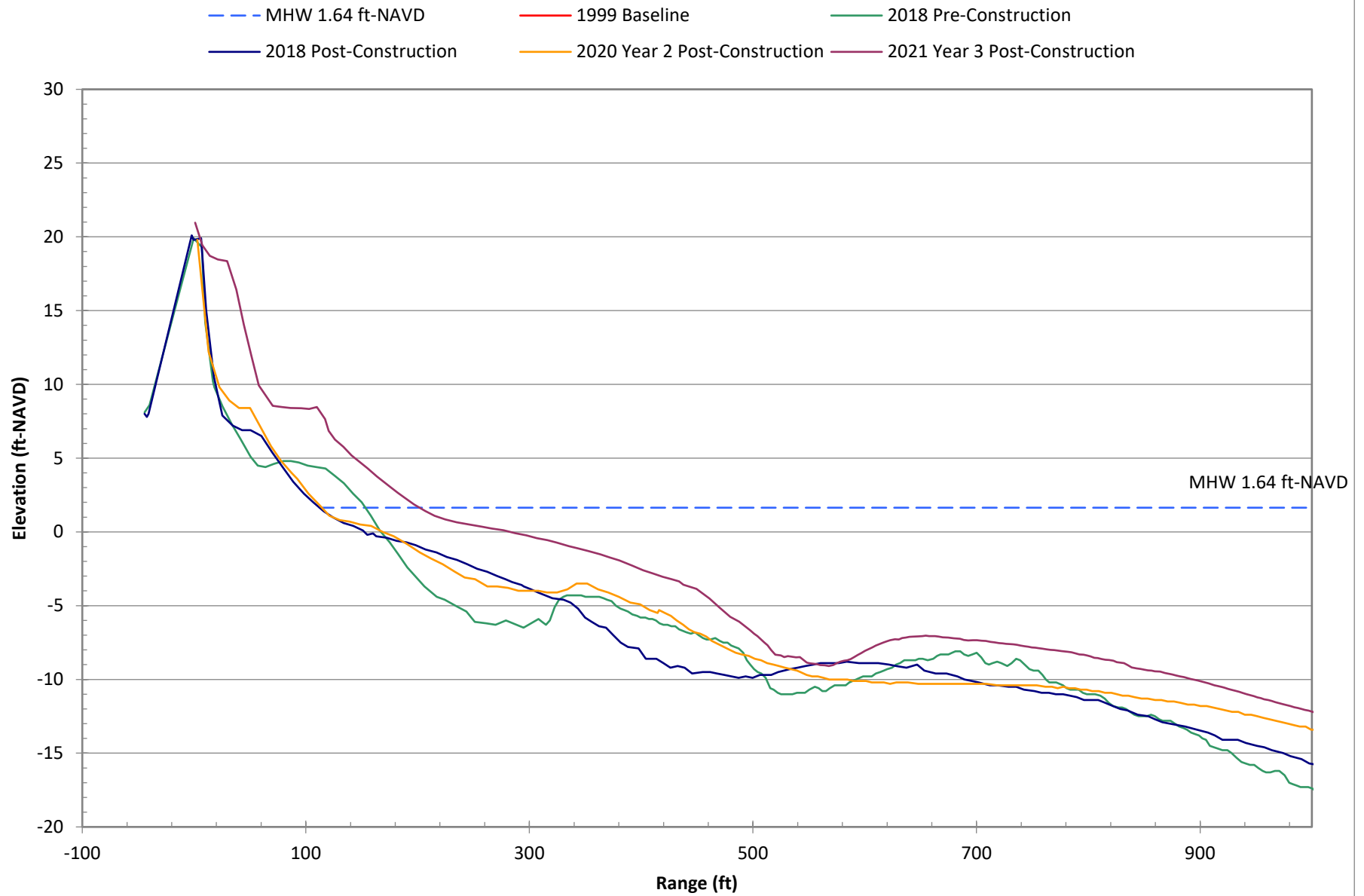
Survey Data at R-111 for Selected Years



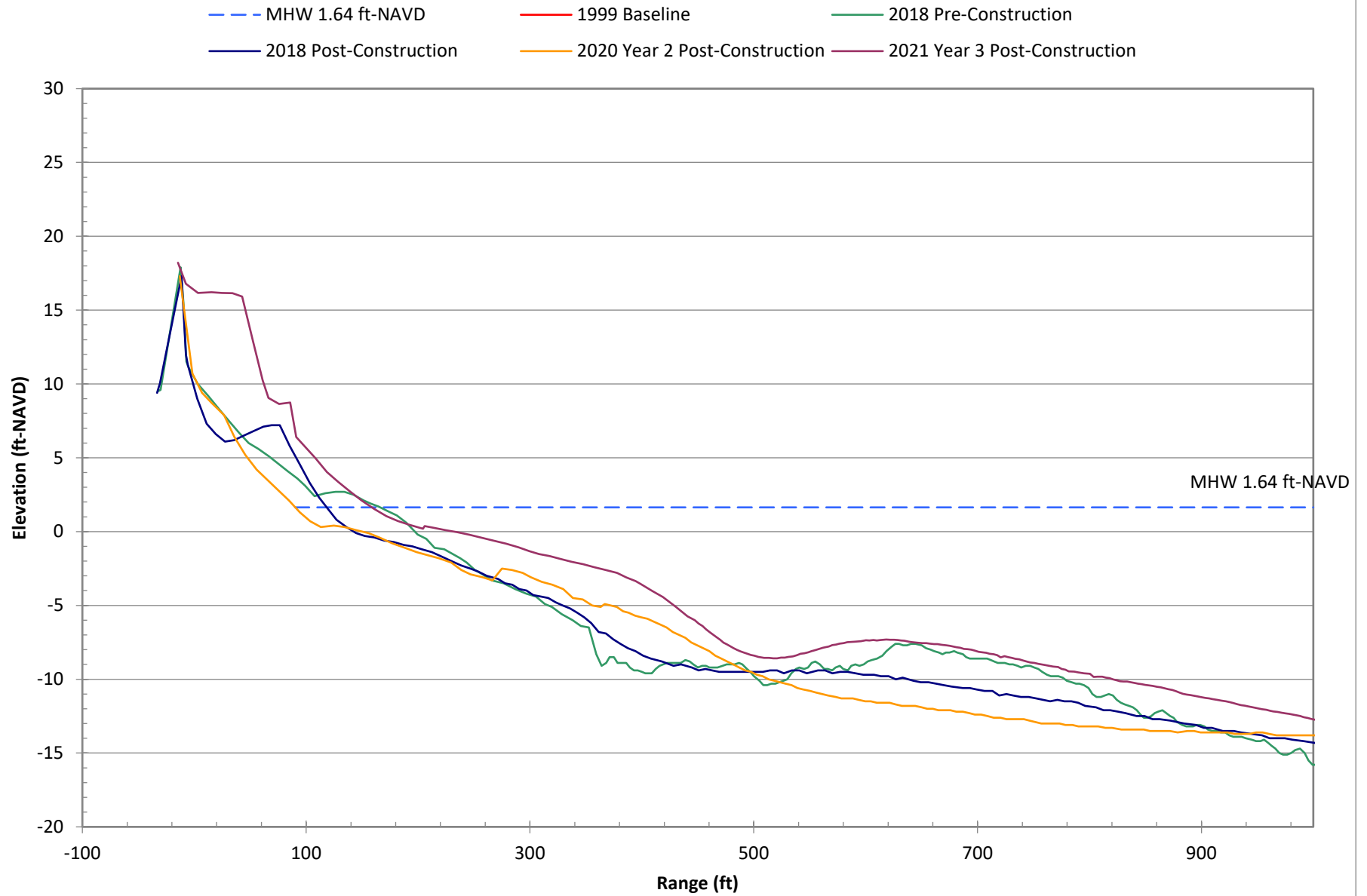
Survey Data at R-112 for Selected Years



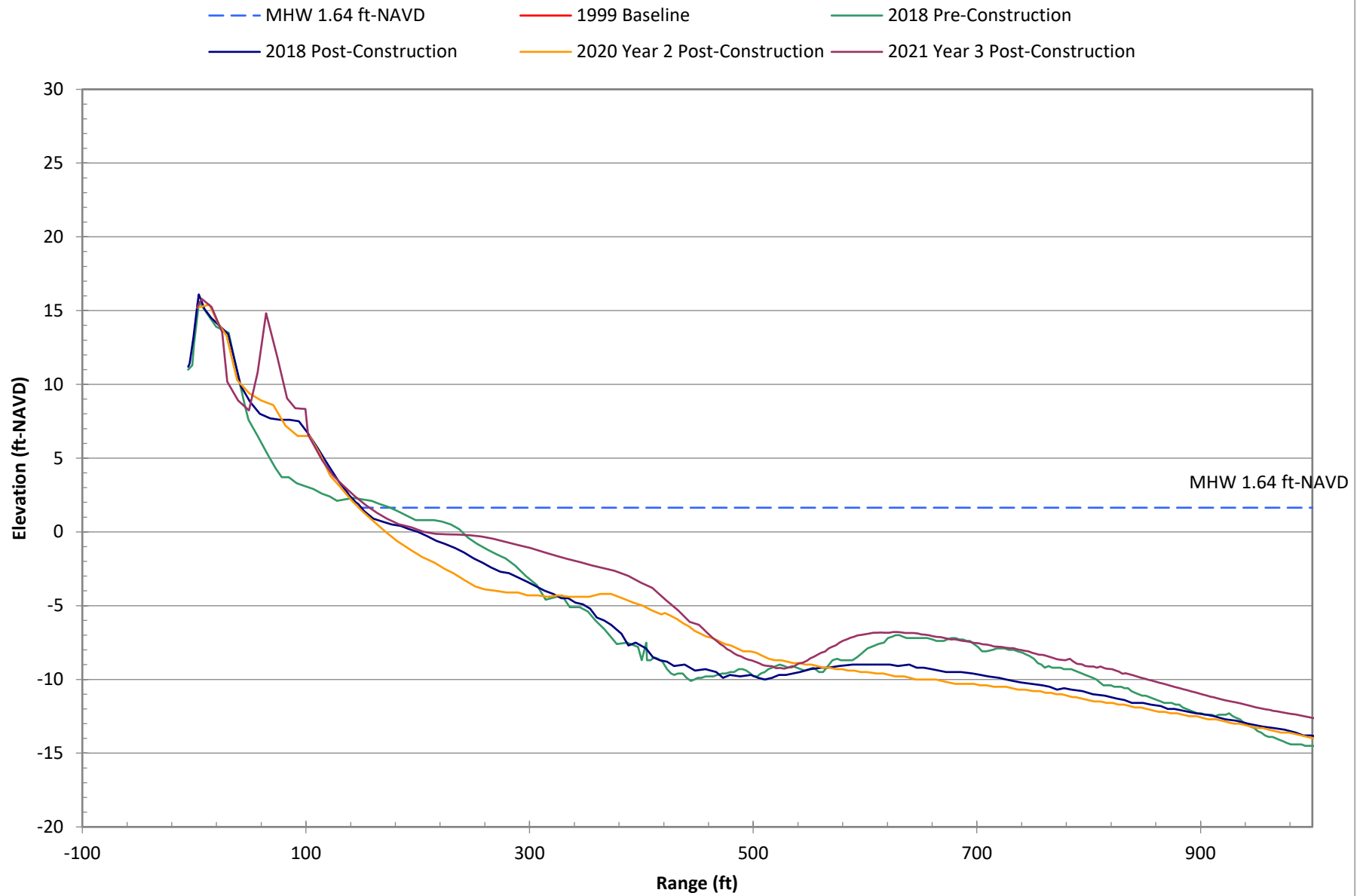
Survey Data at R-113 for Selected Years



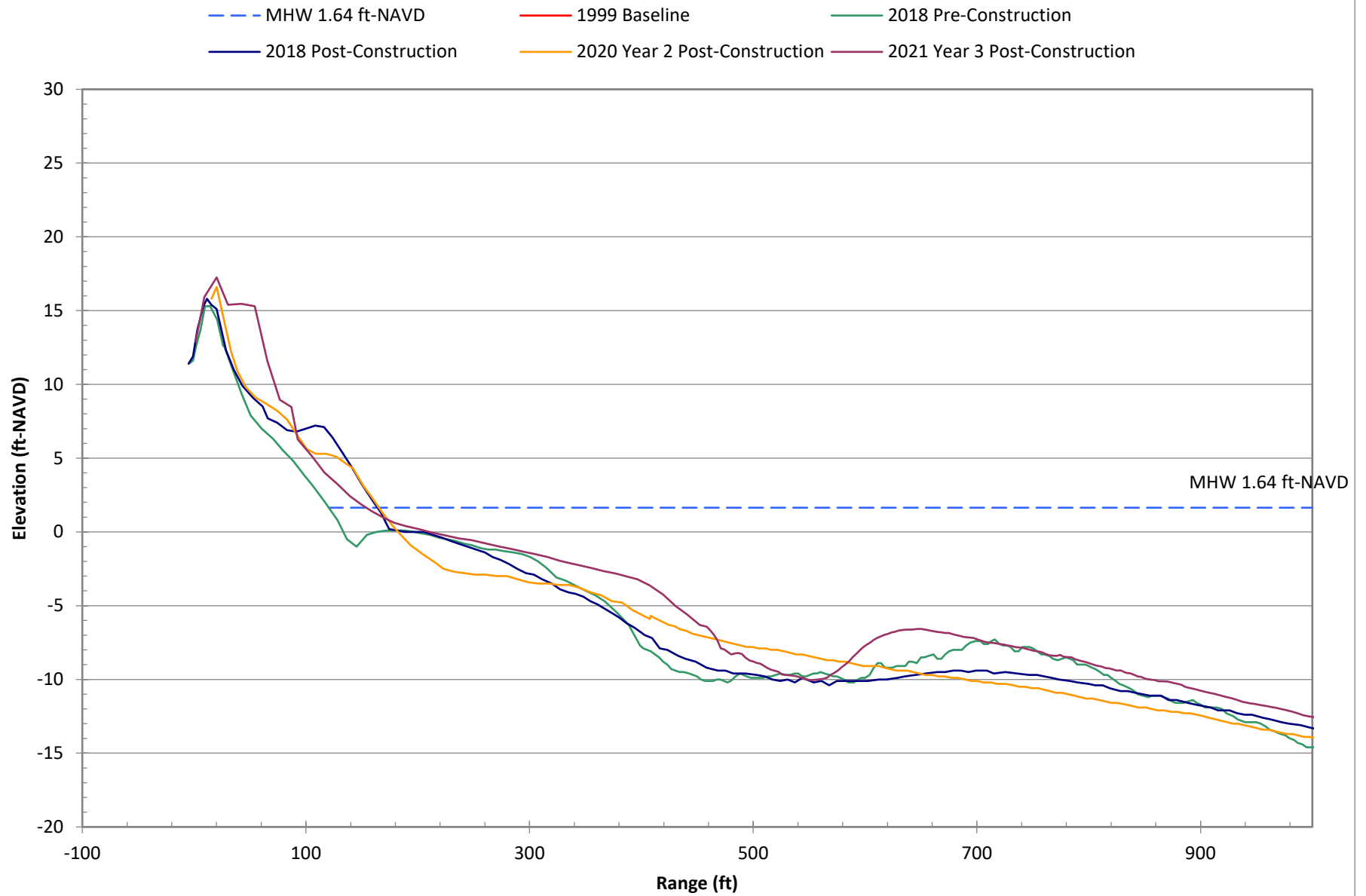
Survey Data at R-114 for Selected Years



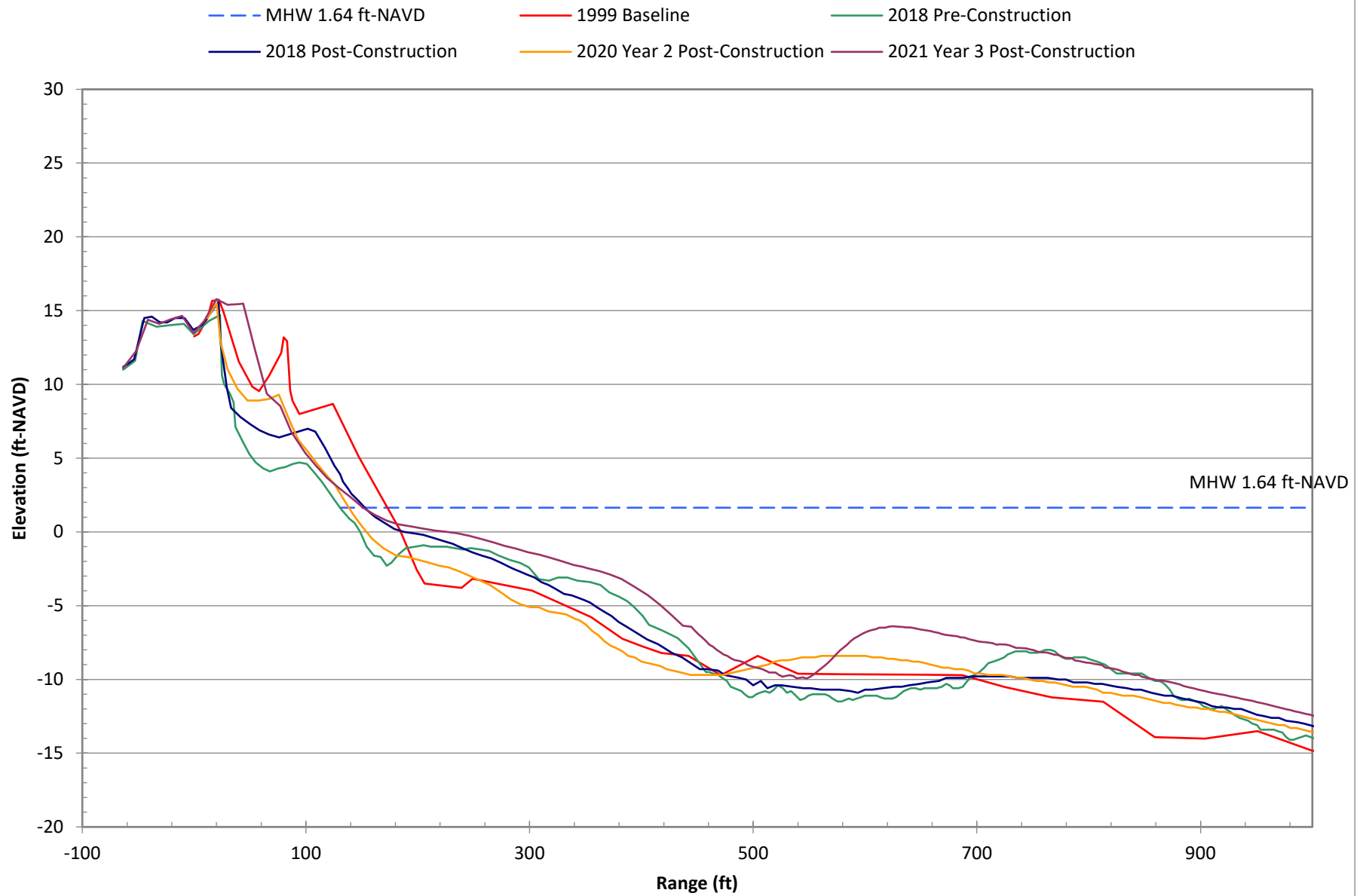
Survey Data at R-115 for Selected Years



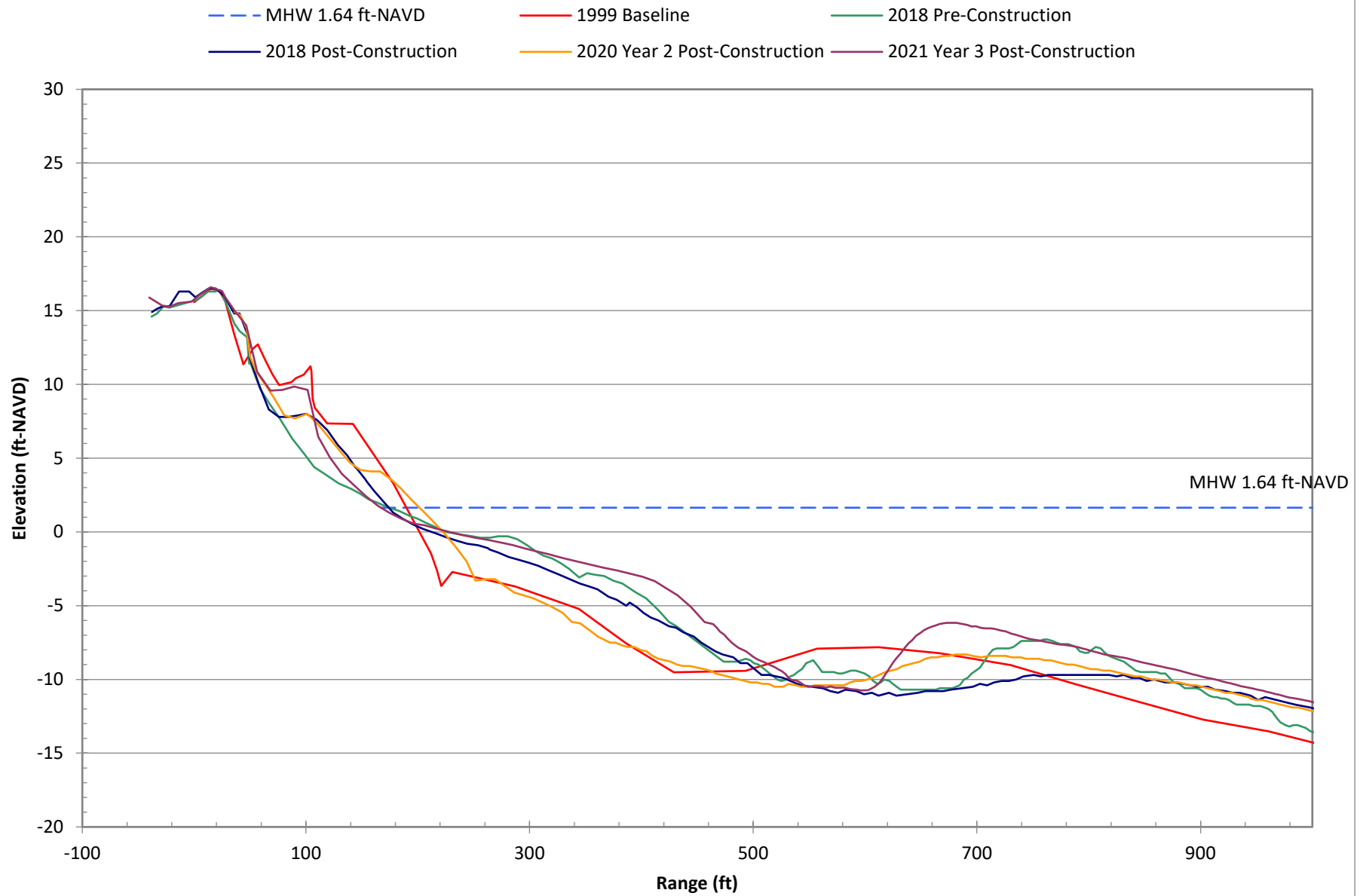
Survey Data at R-116 for Selected Years



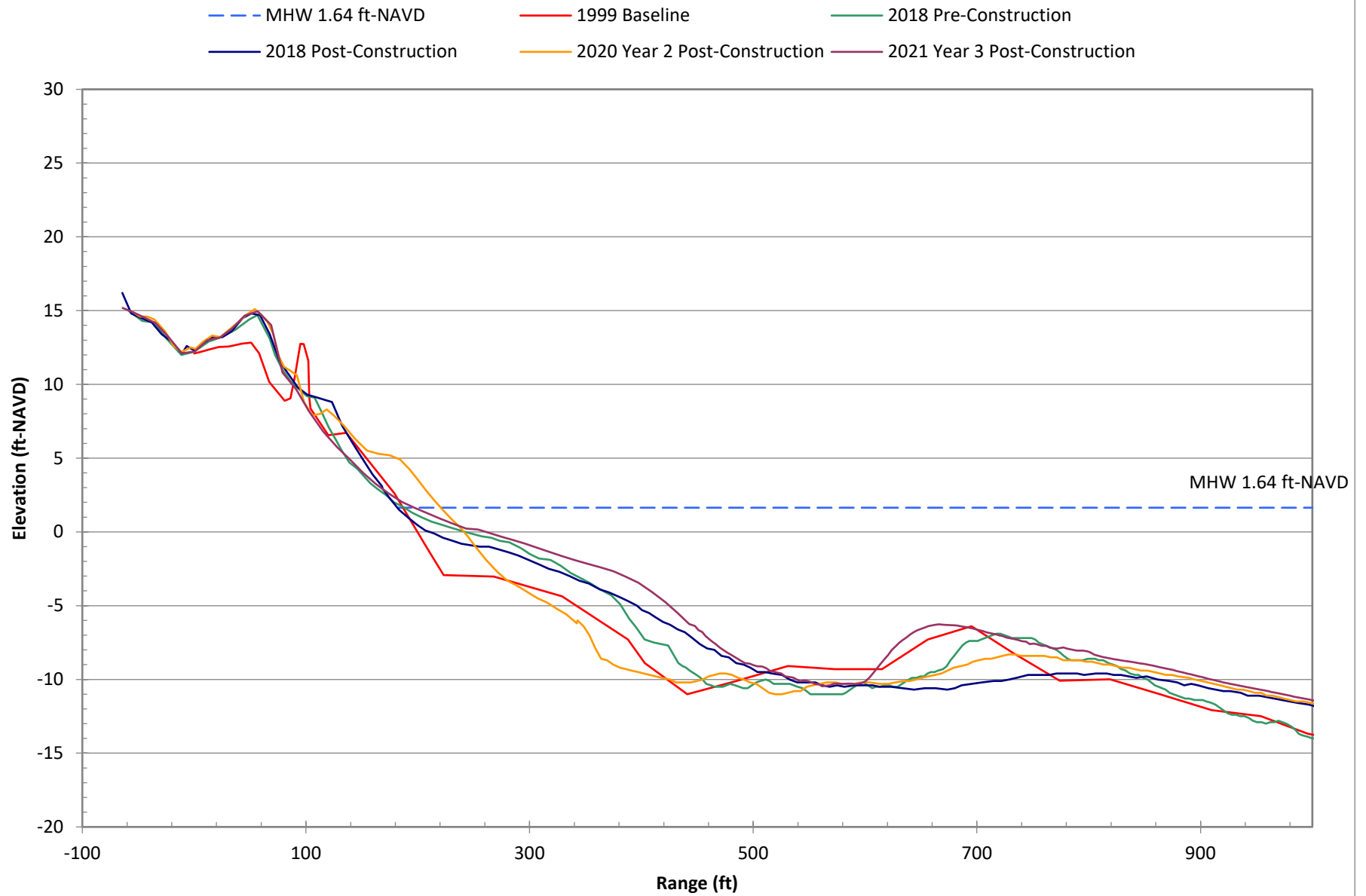
Survey Data at R-117 for Selected Years



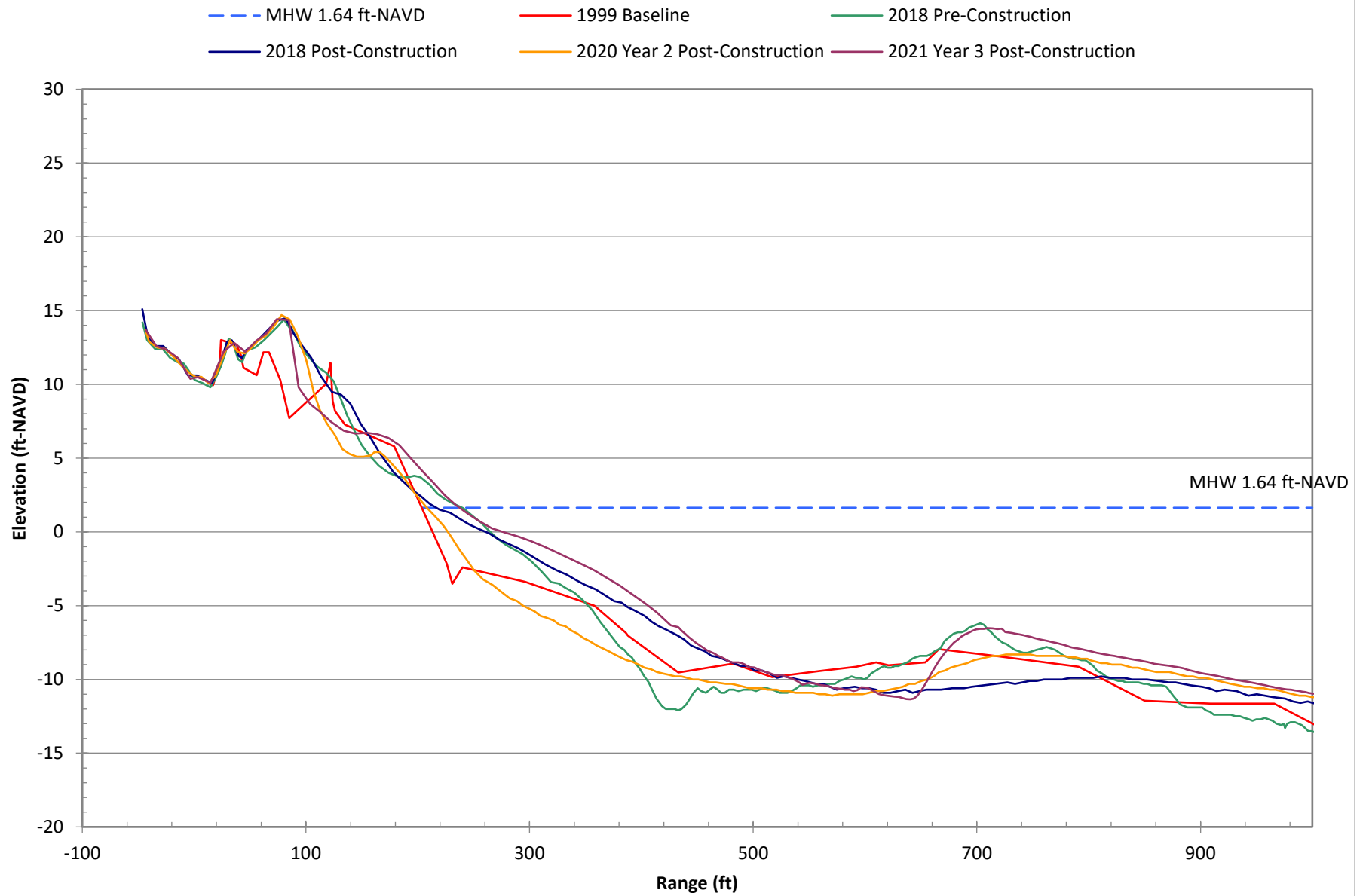
Survey Data at R-118 for Selected Years



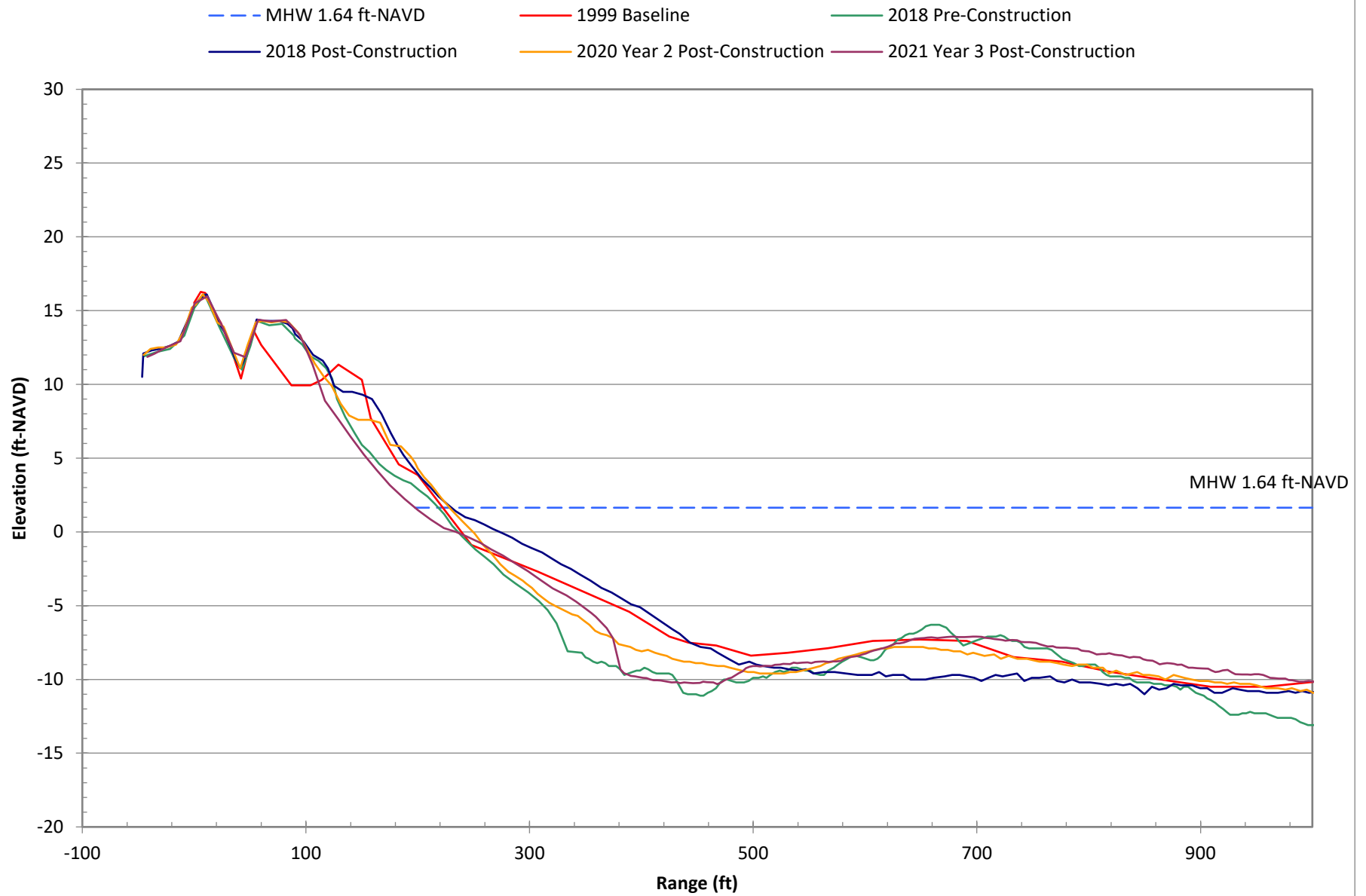
Survey Data at R-119 for Selected Years



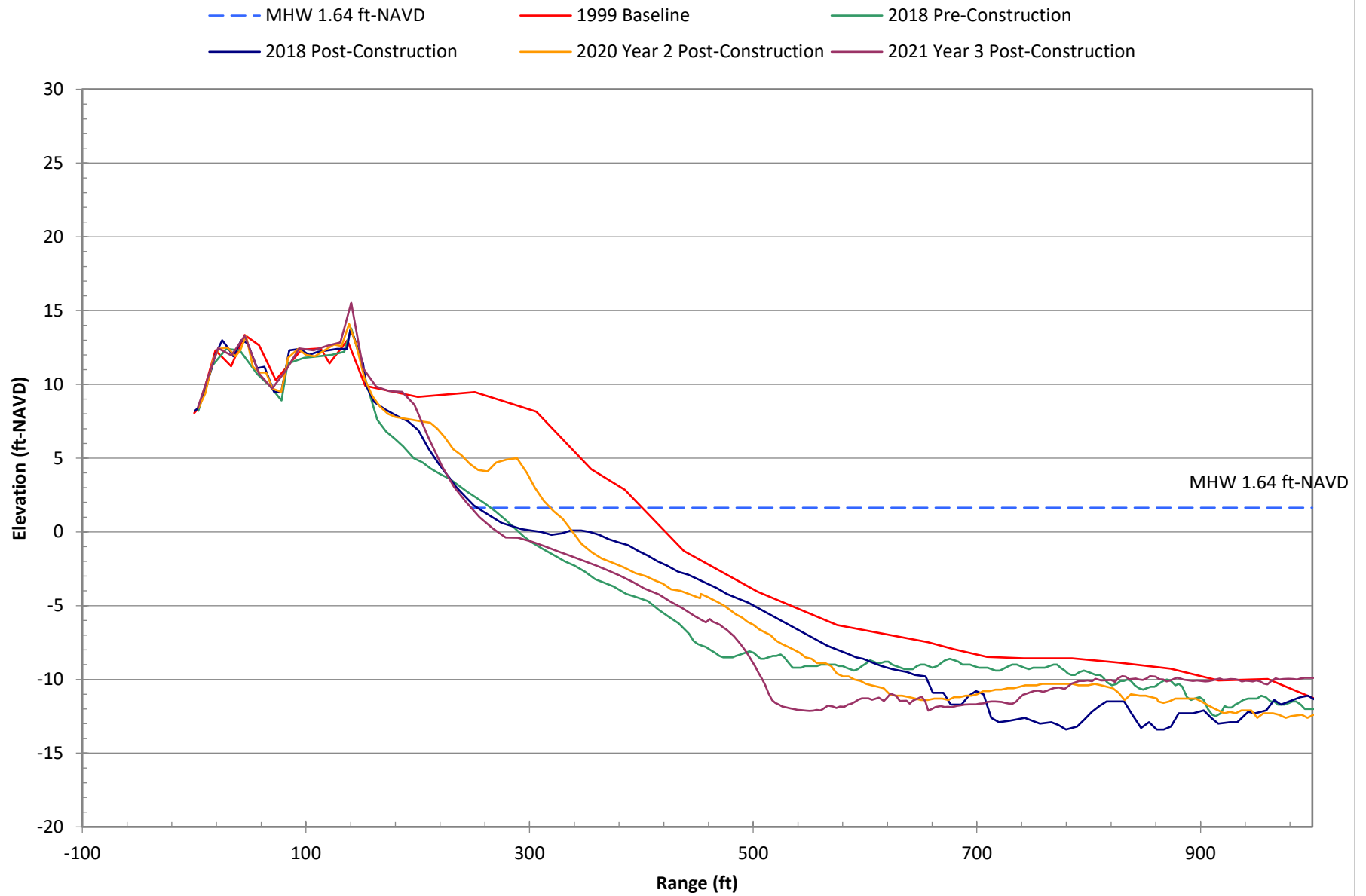
Survey Data at R-120 for Selected Years



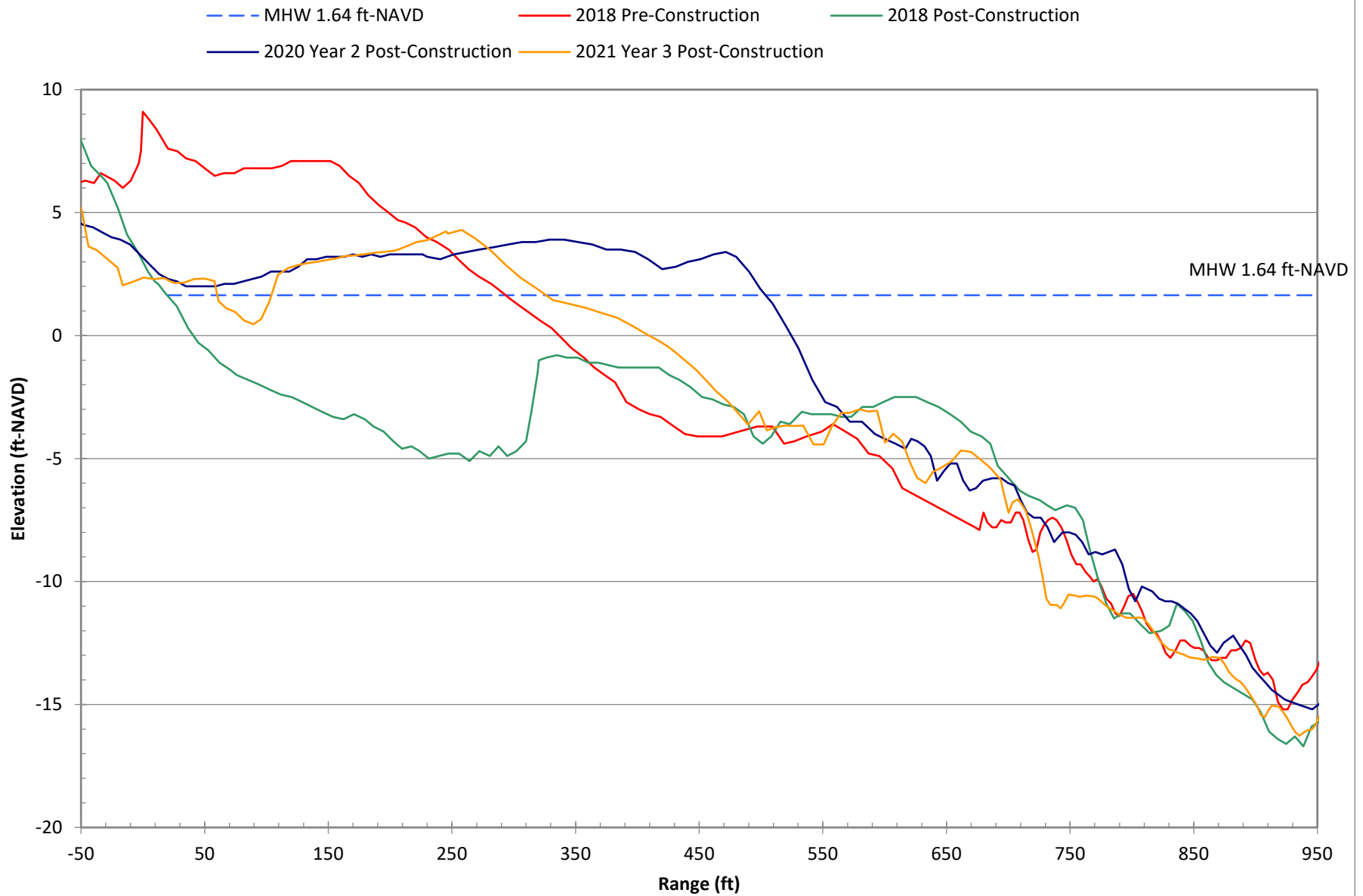
Survey Data at R-121 for Selected Years



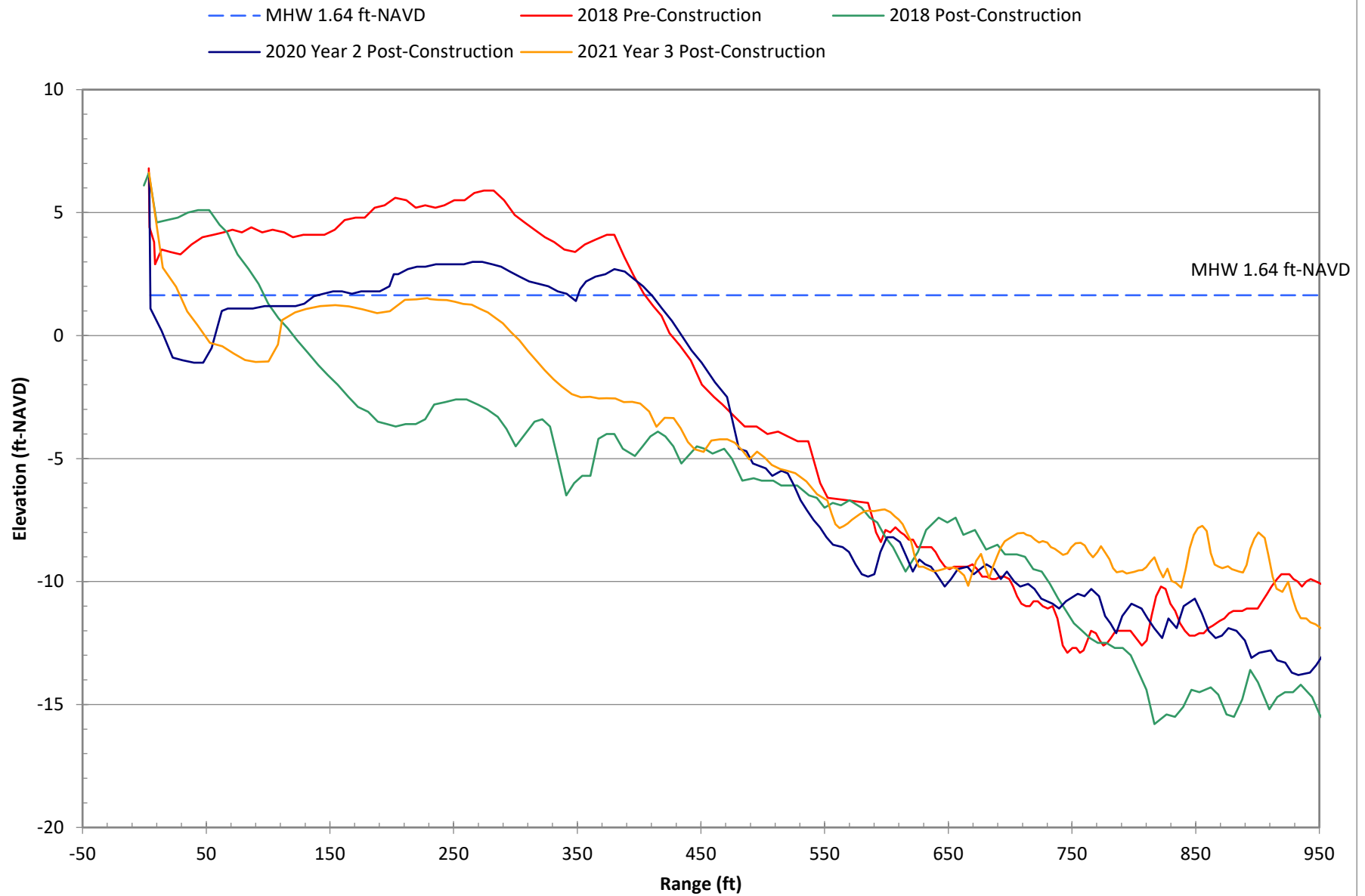
Survey Data at R-122 for Selected Years



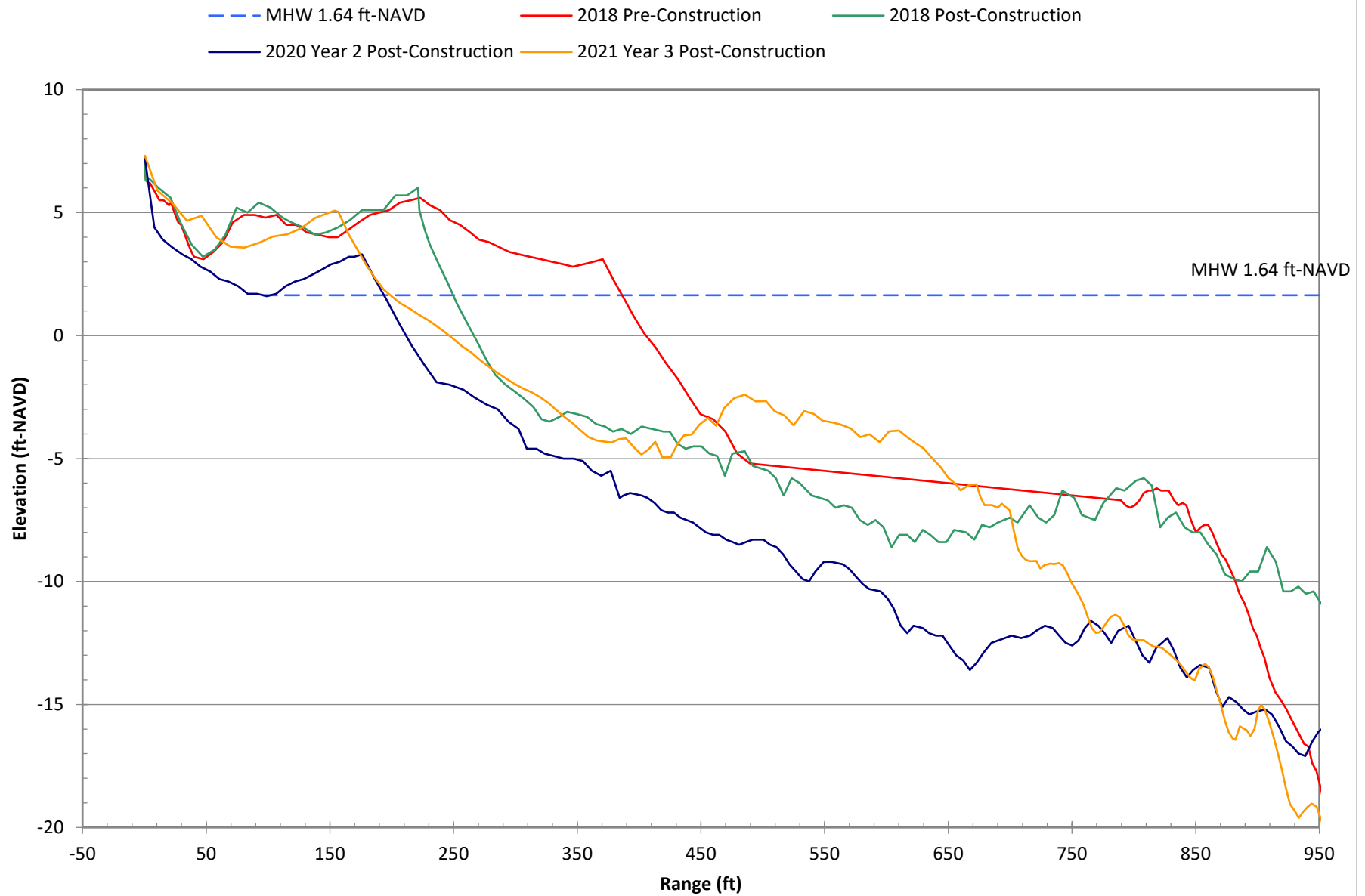
Survey Data at R-122A for Selected Years



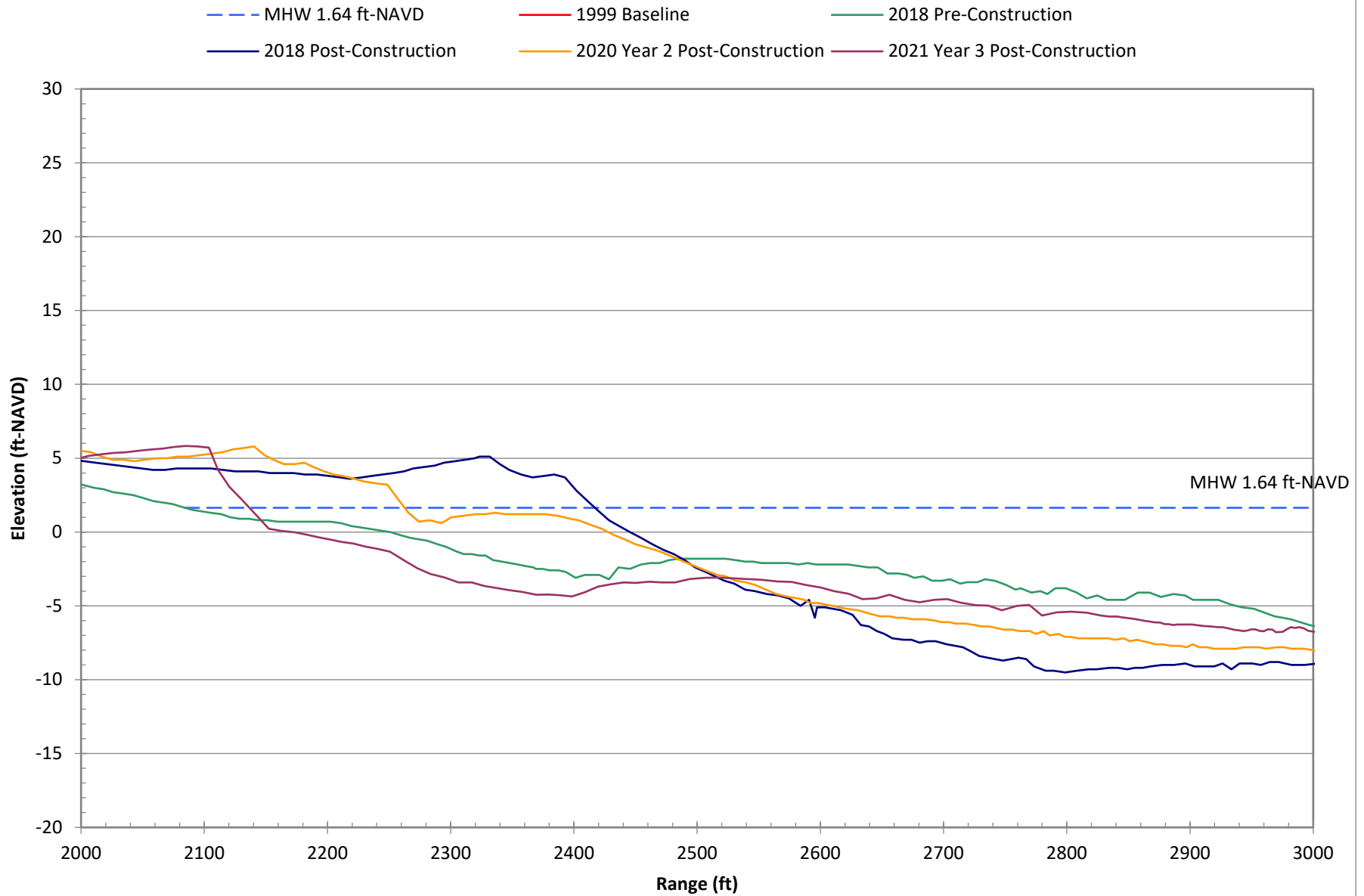
Survey Data at R-122B for Selected Years



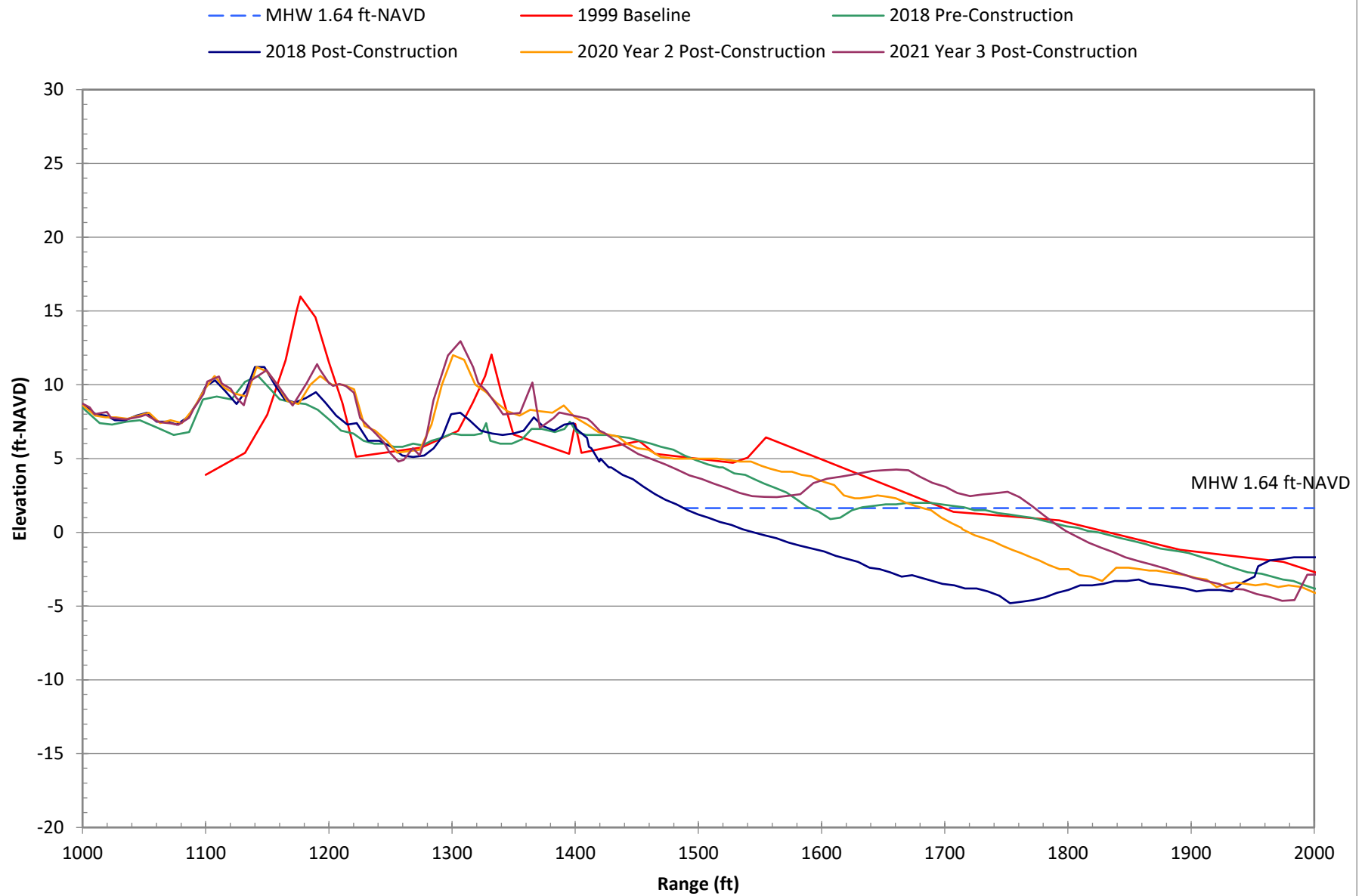
Survey Data at R-122C for Selected Years



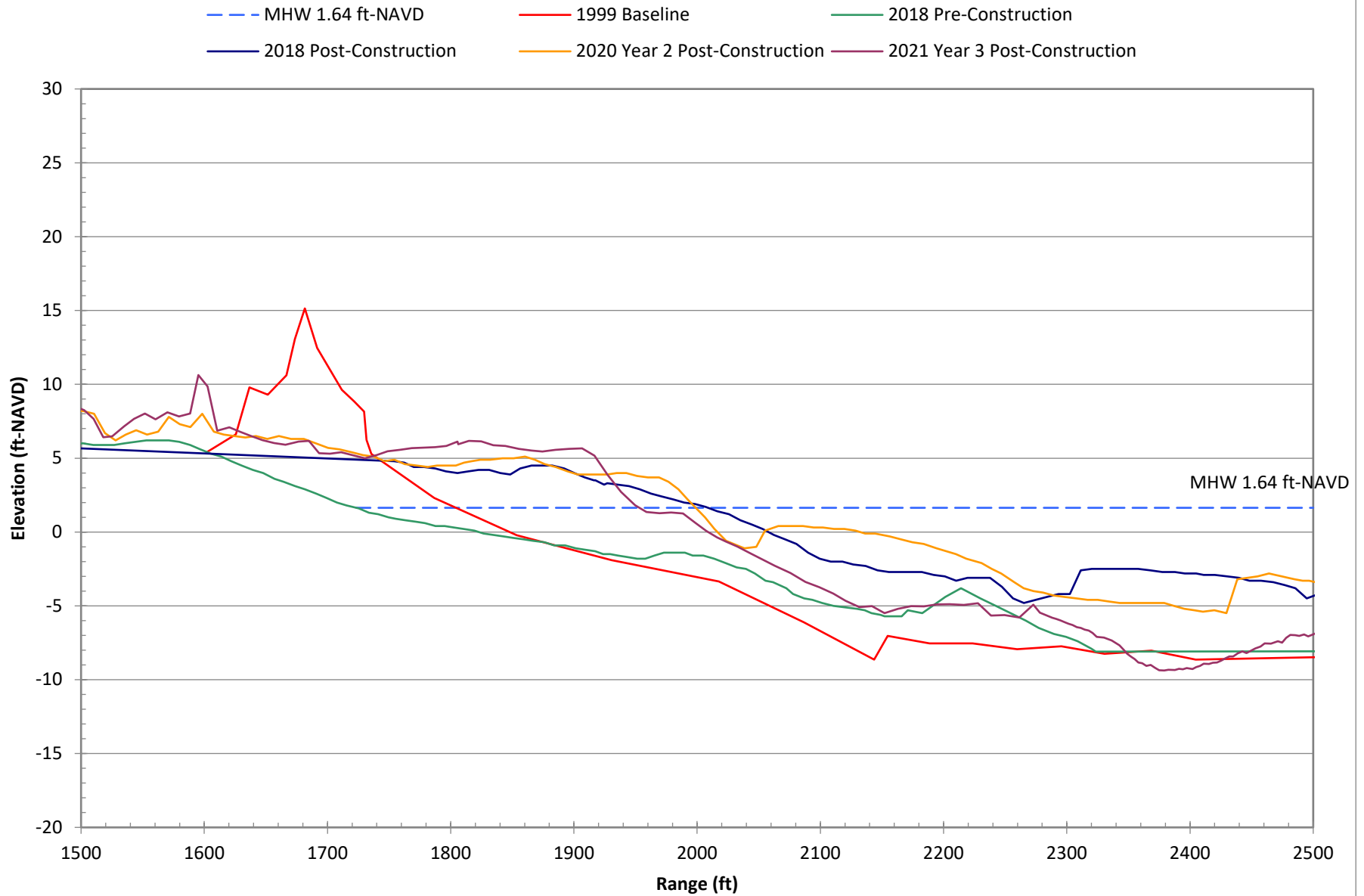
Survey Data at R-123 for Selected Years



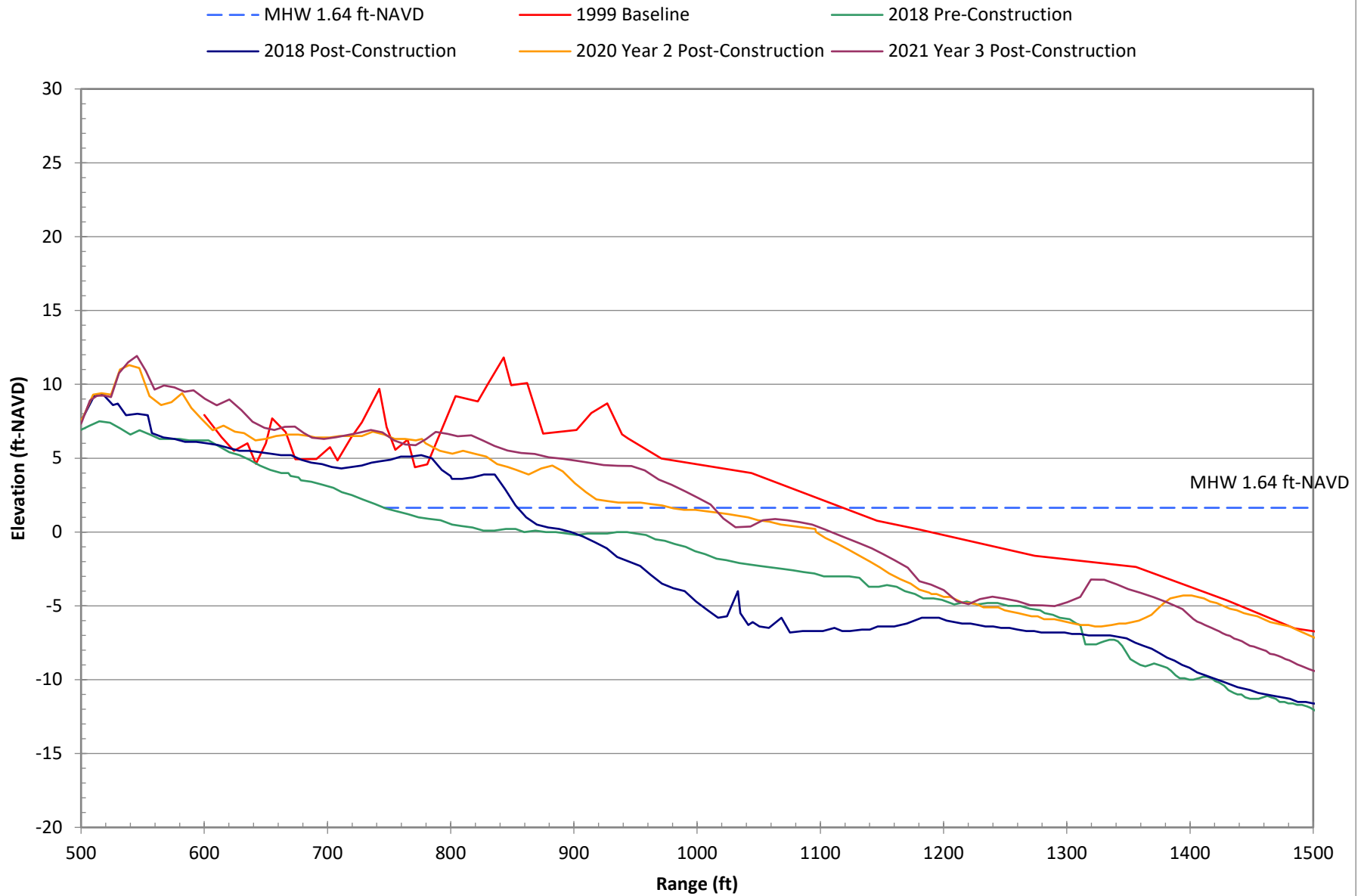
Survey Data at T-124 for Selected Years



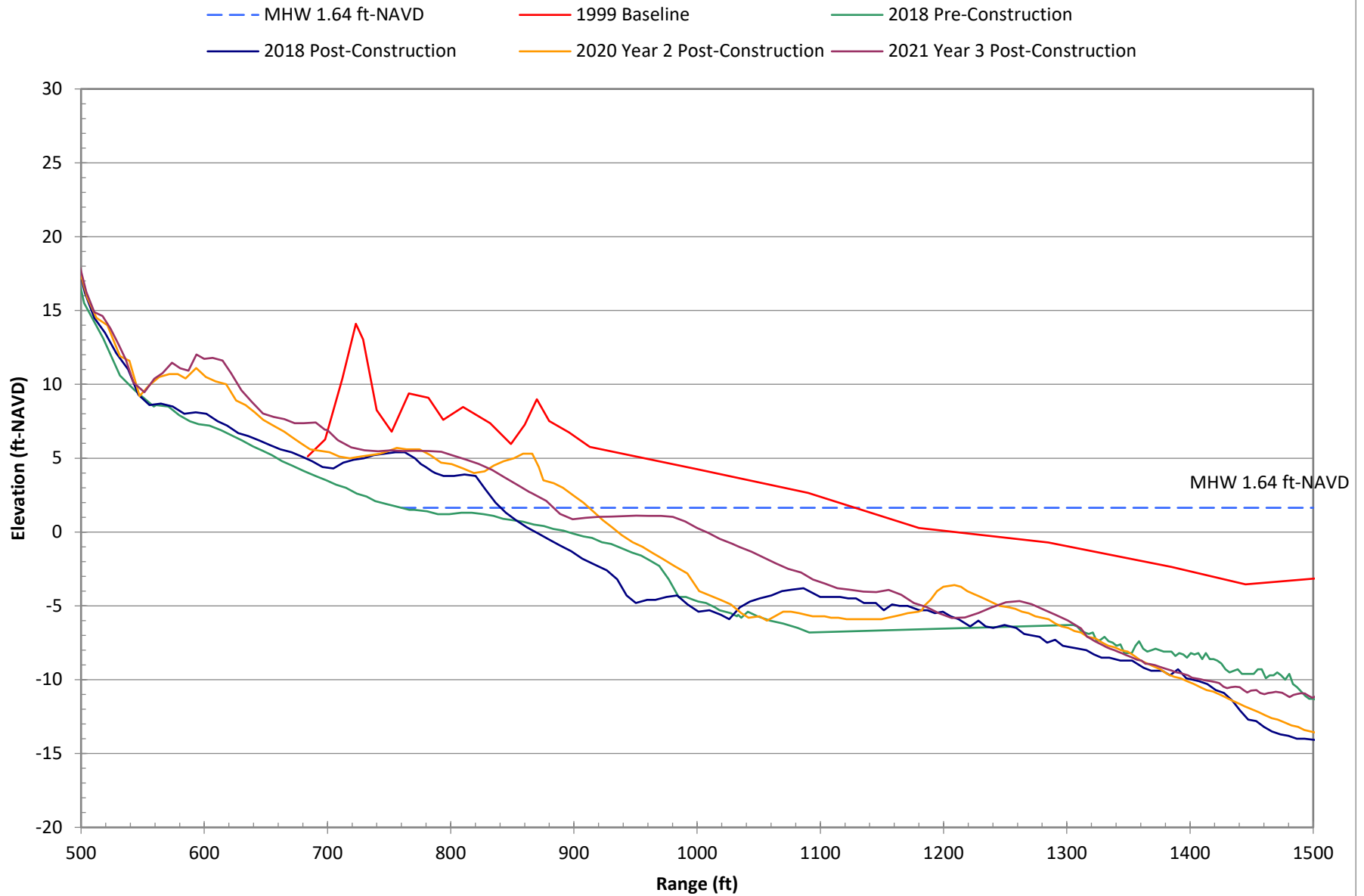
Survey Data at R-125 for Selected Years



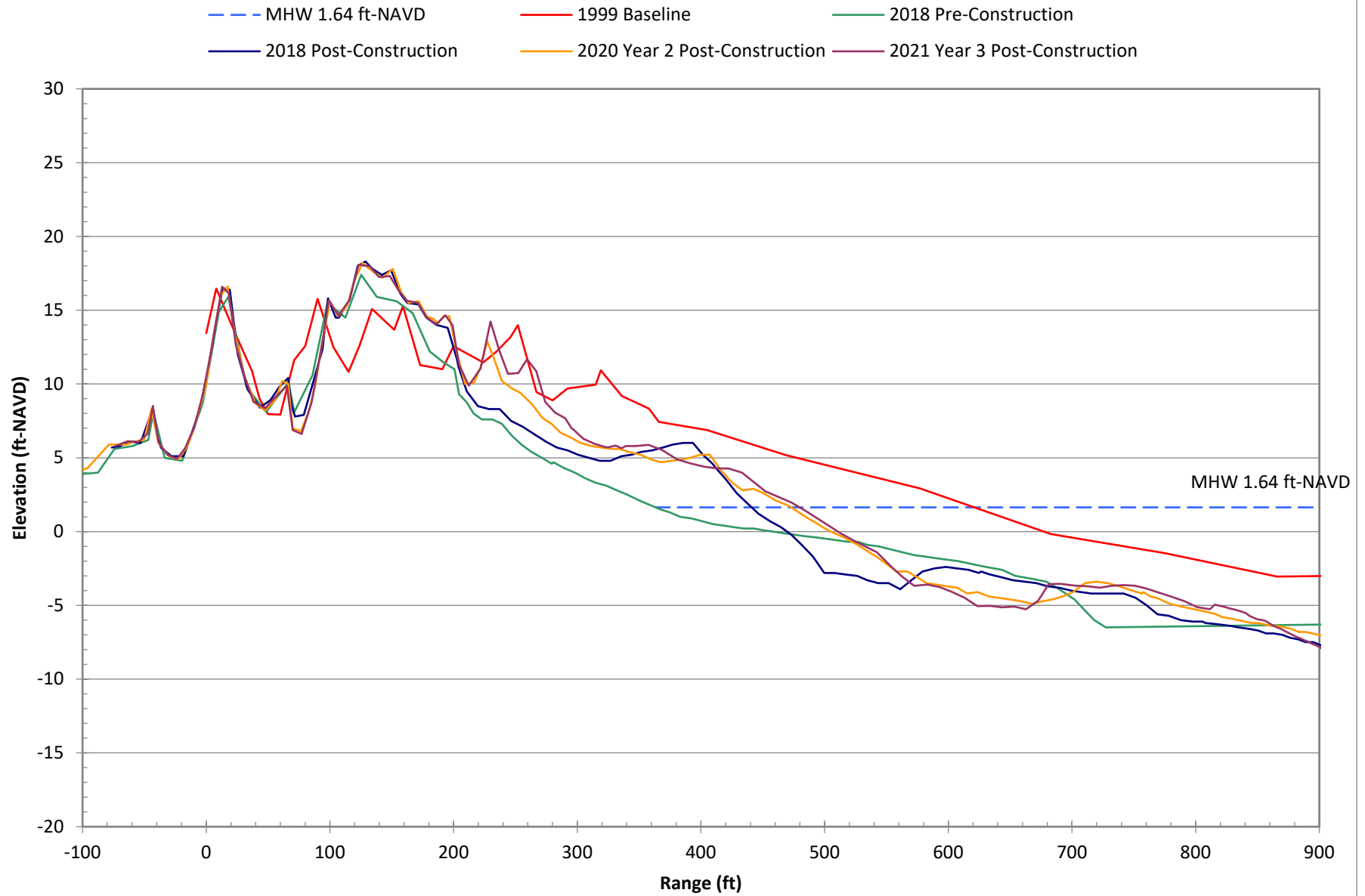
Survey Data at T-126 for Selected Years



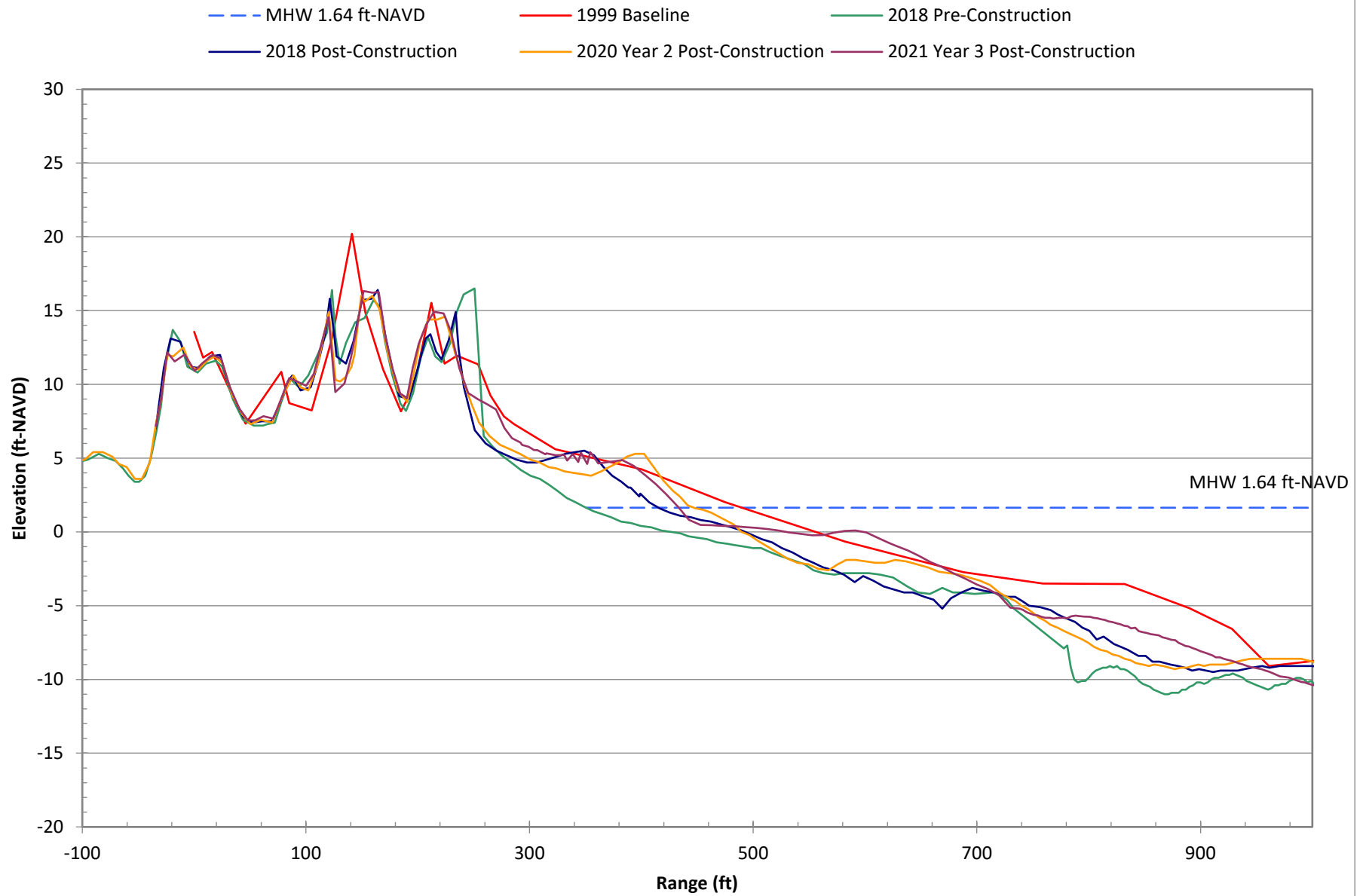
Survey Data at R-127 for Selected Years



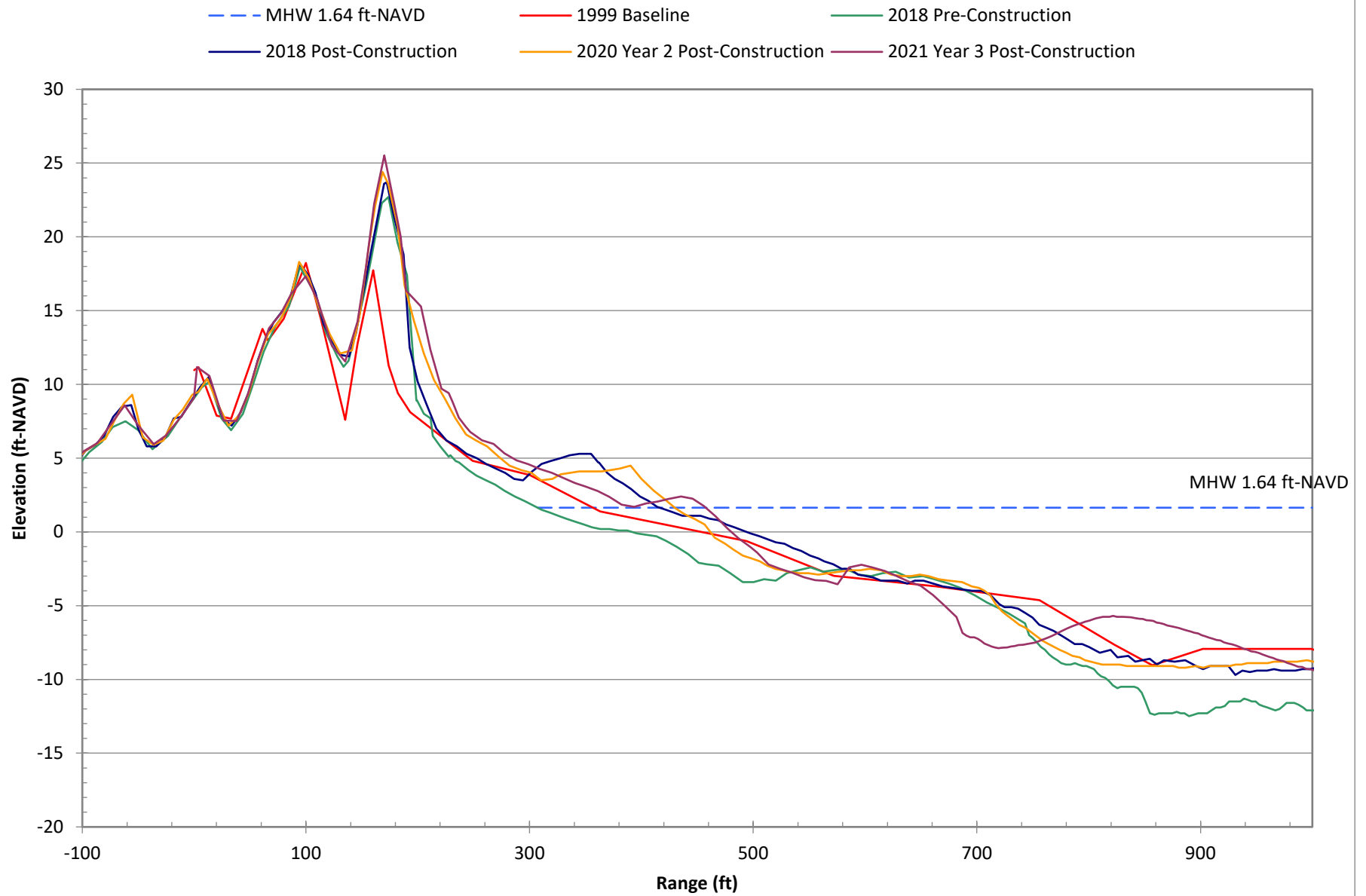
Survey Data at T-128 for Selected Years



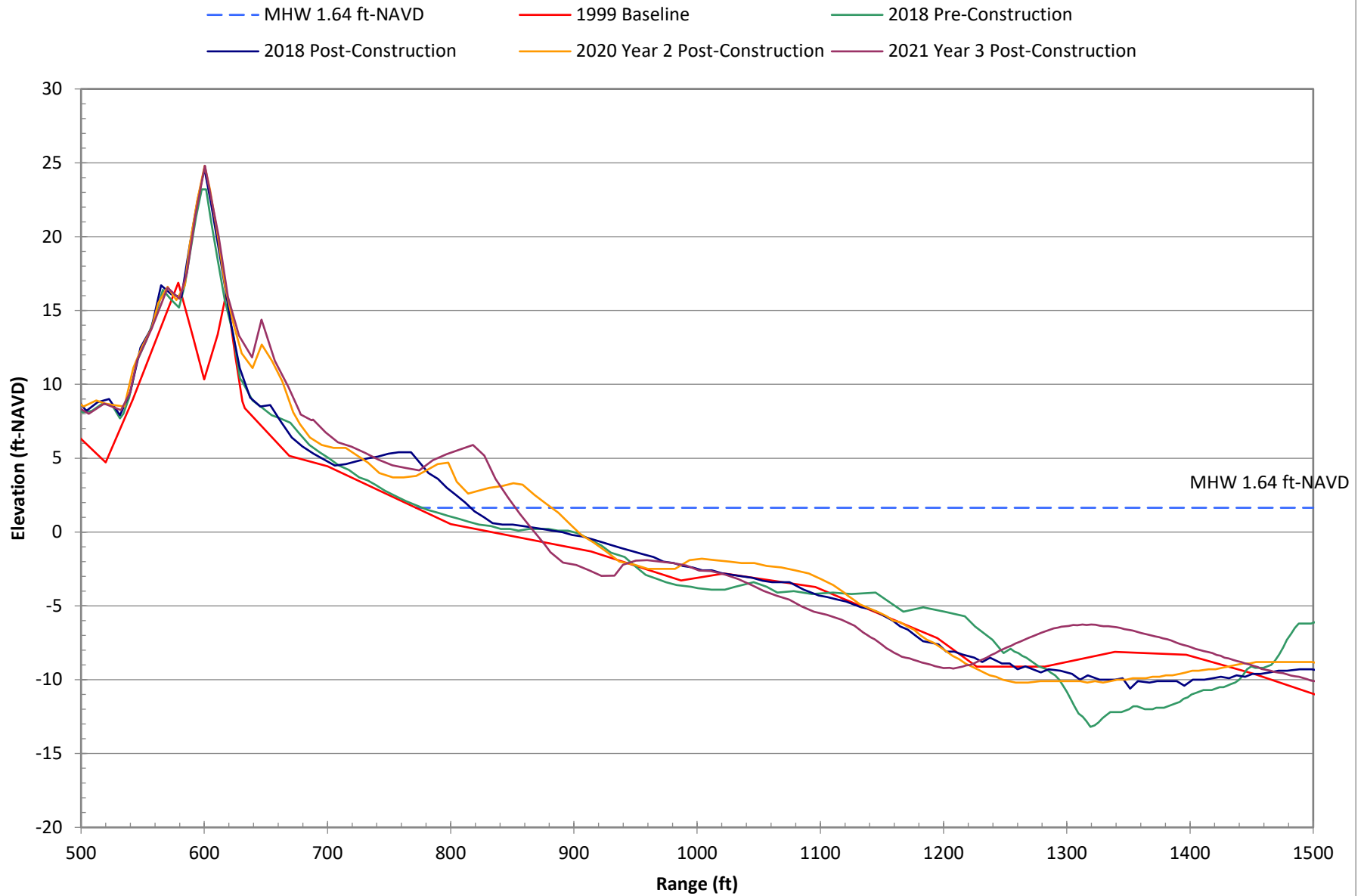
Survey Data at T-129 for Selected Years



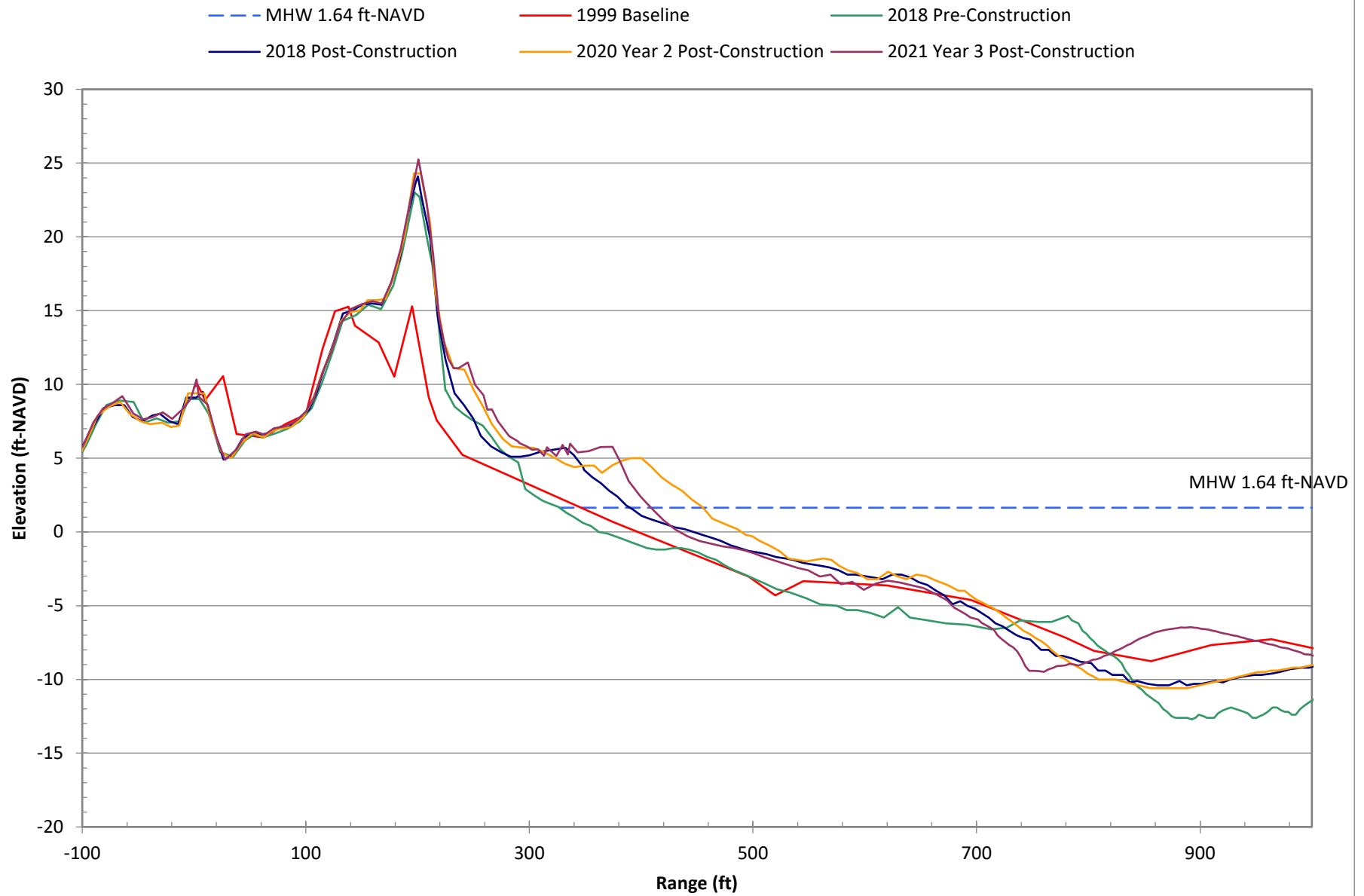
Survey Data at T-130 for Selected Years



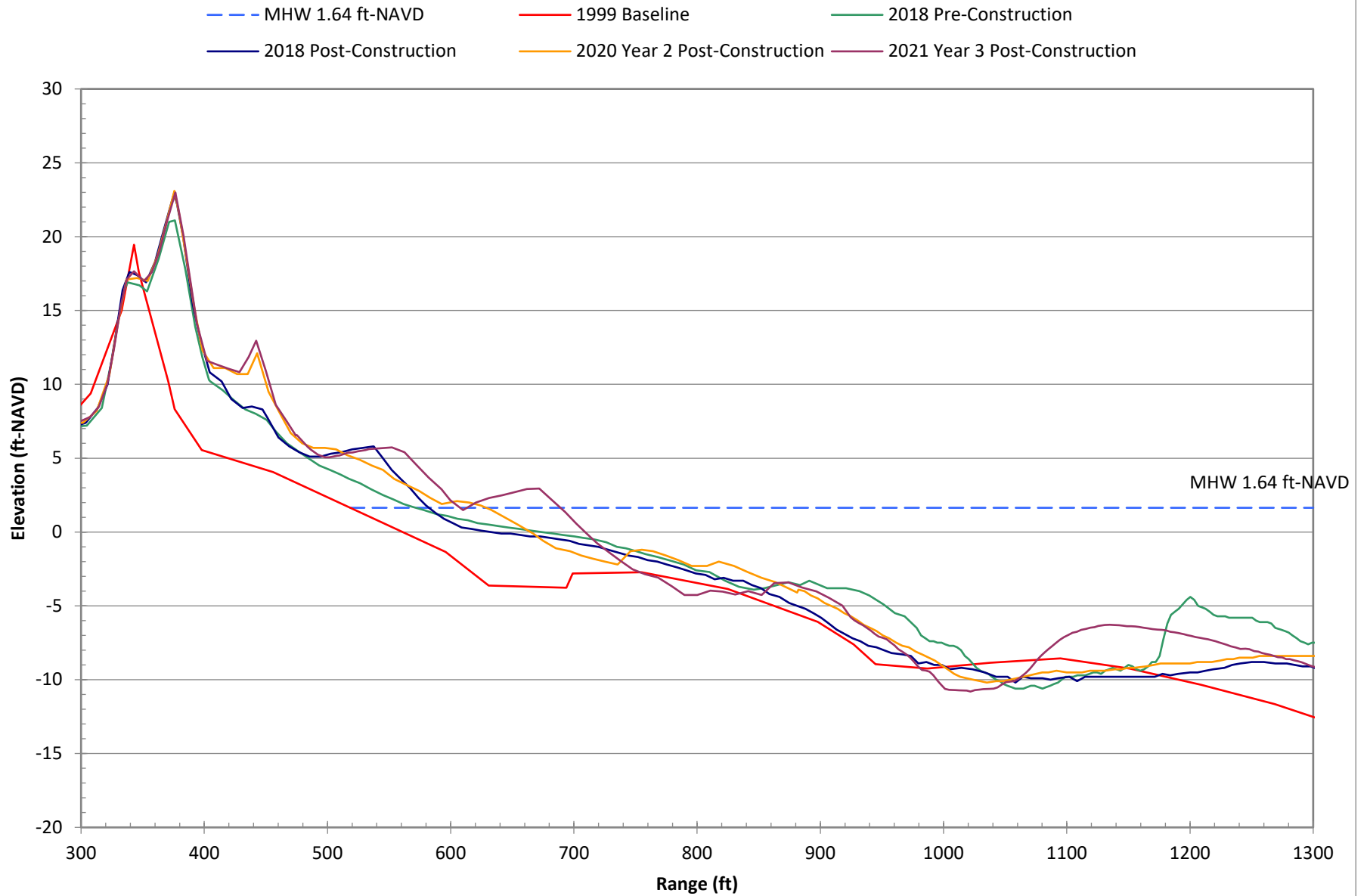
Survey Data at R-131A for Selected Years



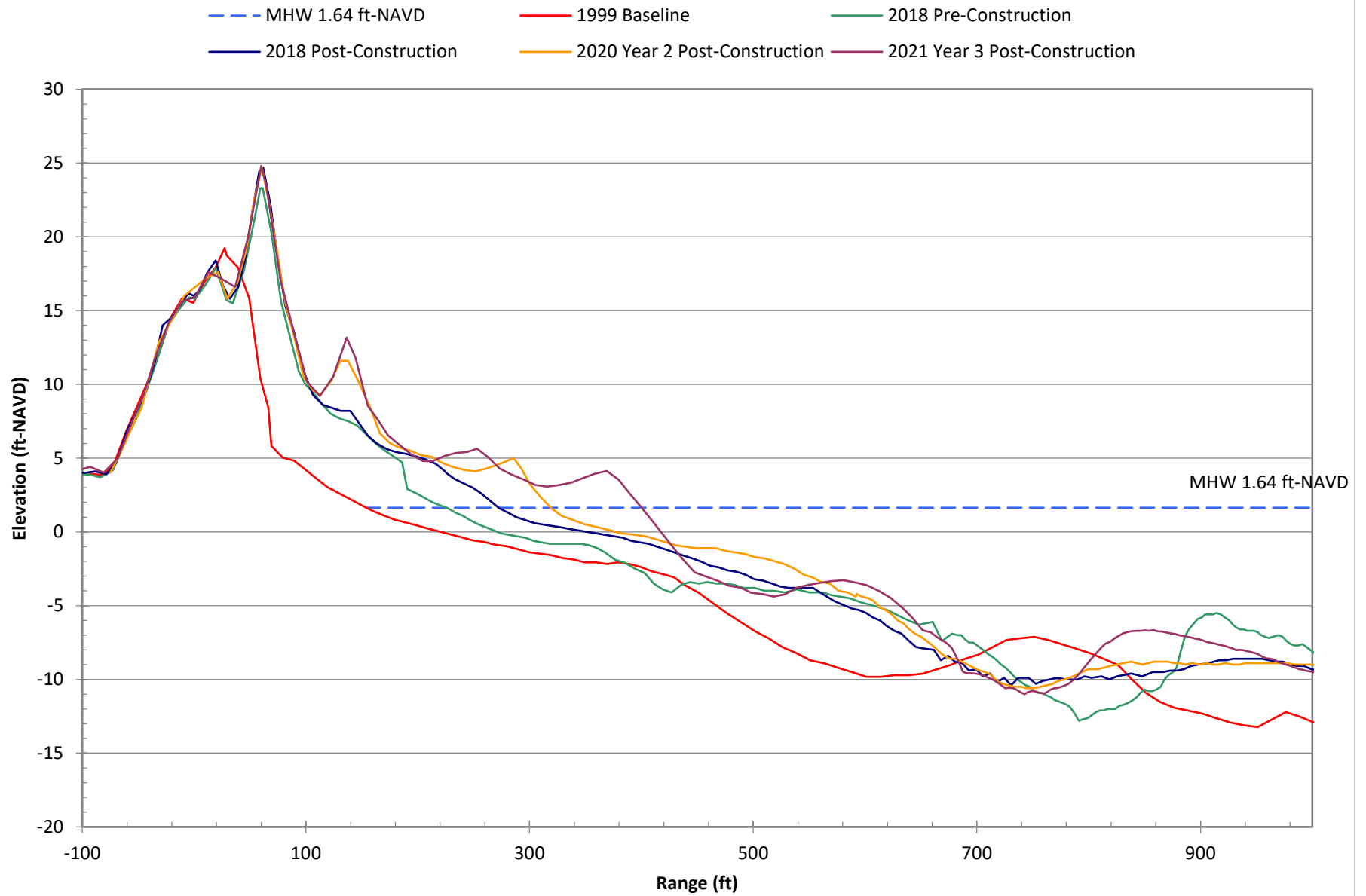
Survey Data at T-132 for Selected Years



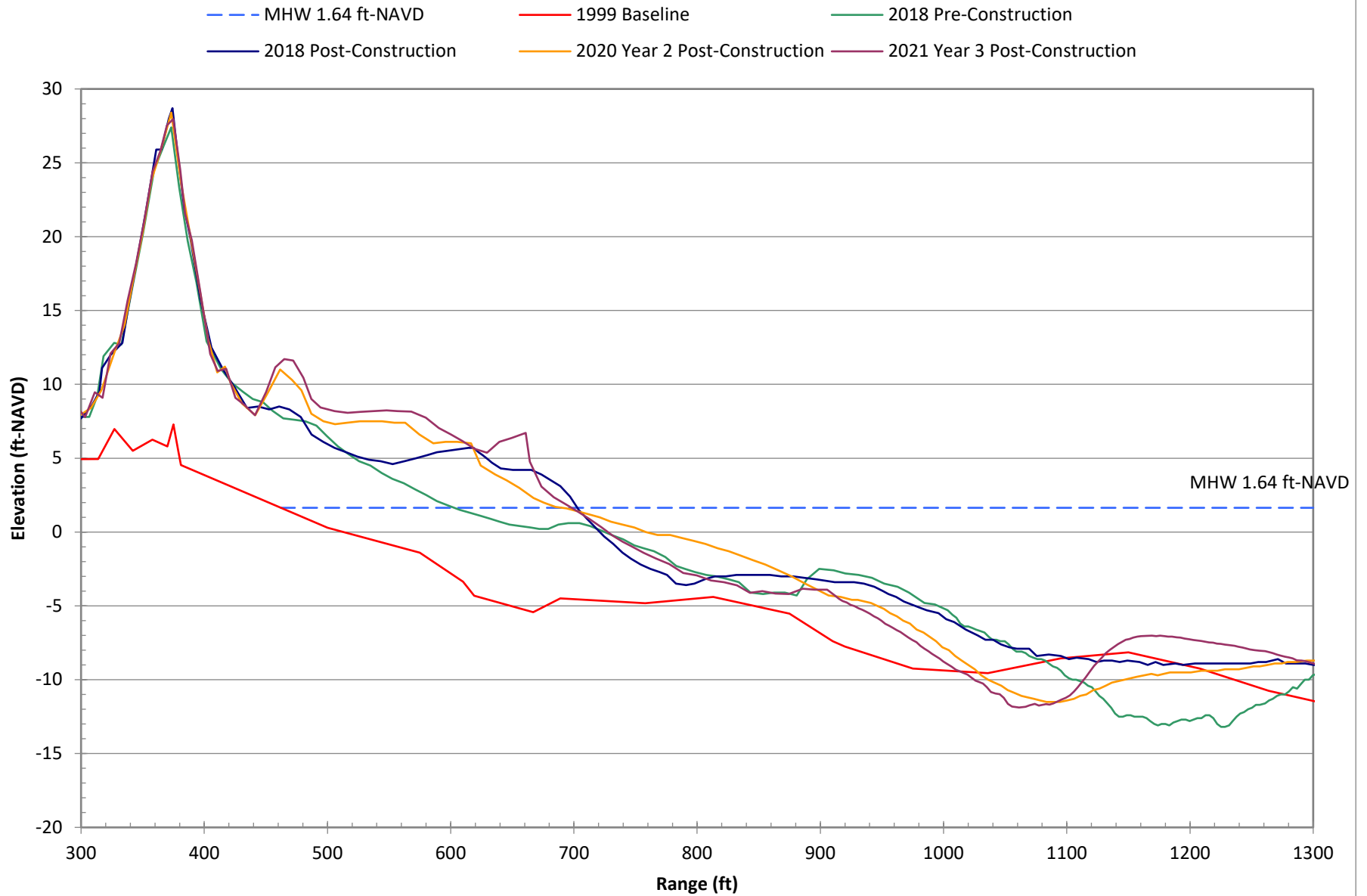
Survey Data at R-133 for Selected Years



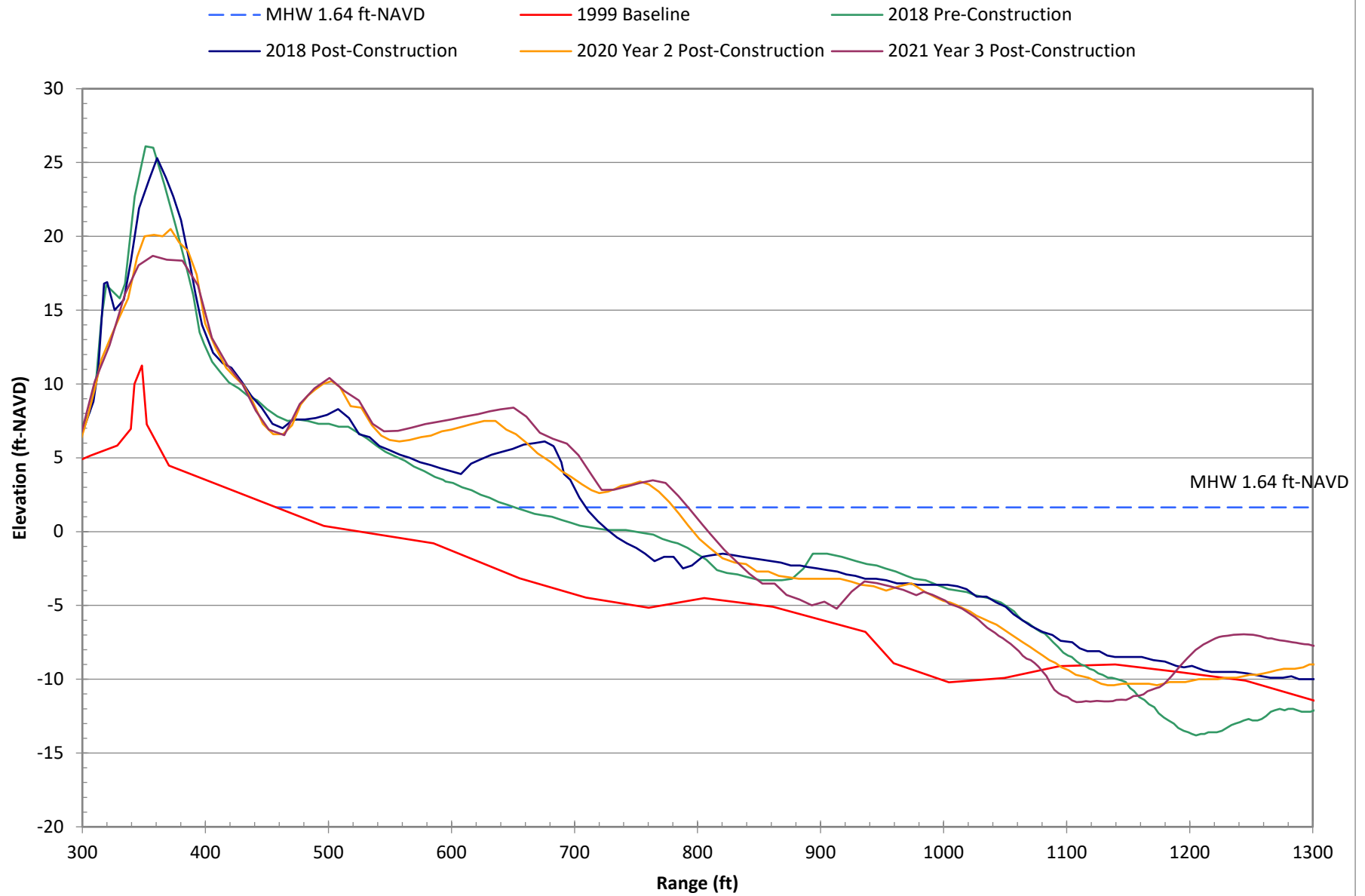
Survey Data at R-134 for Selected Years



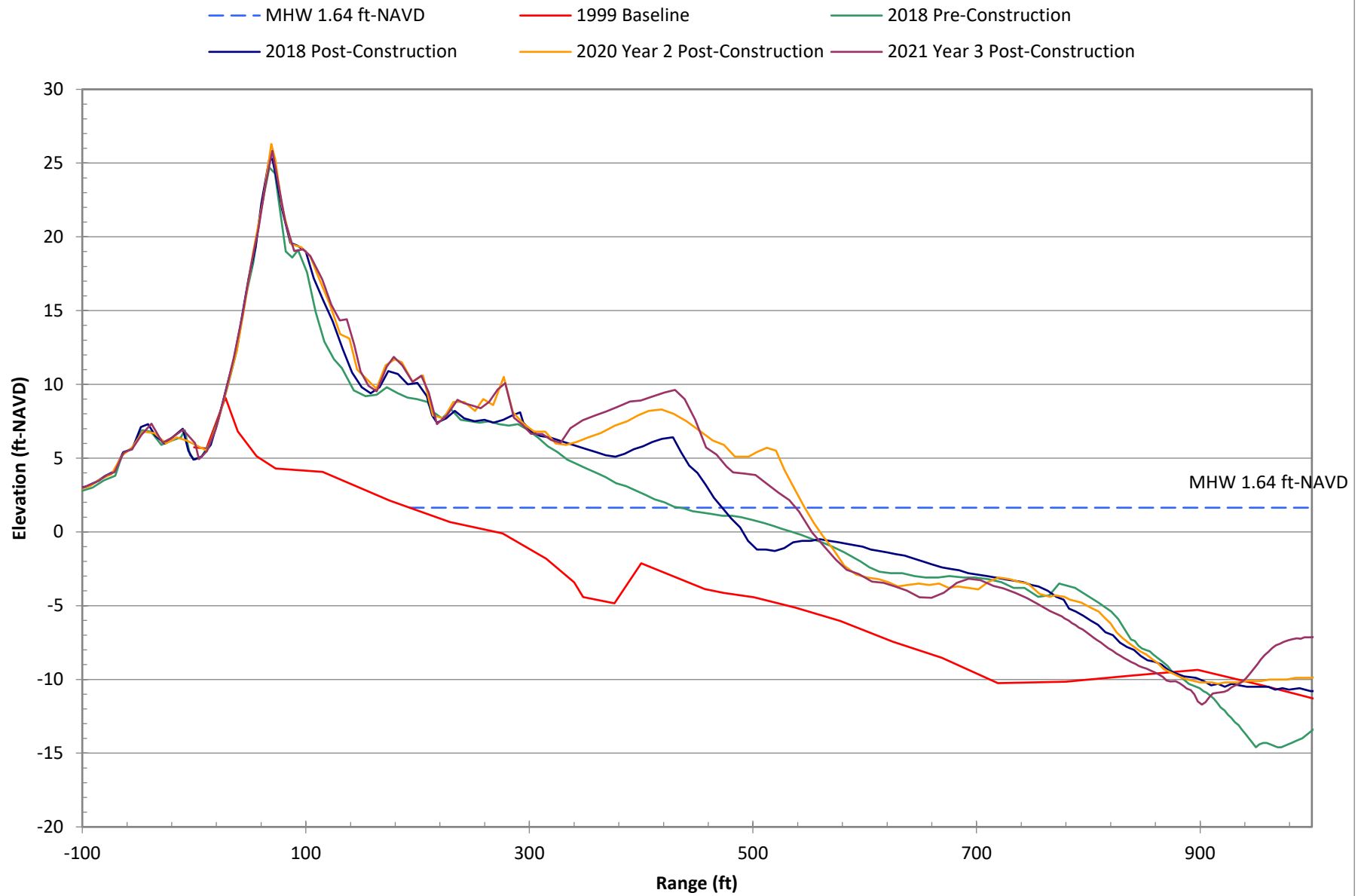
Survey Data at R-135 for Selected Years



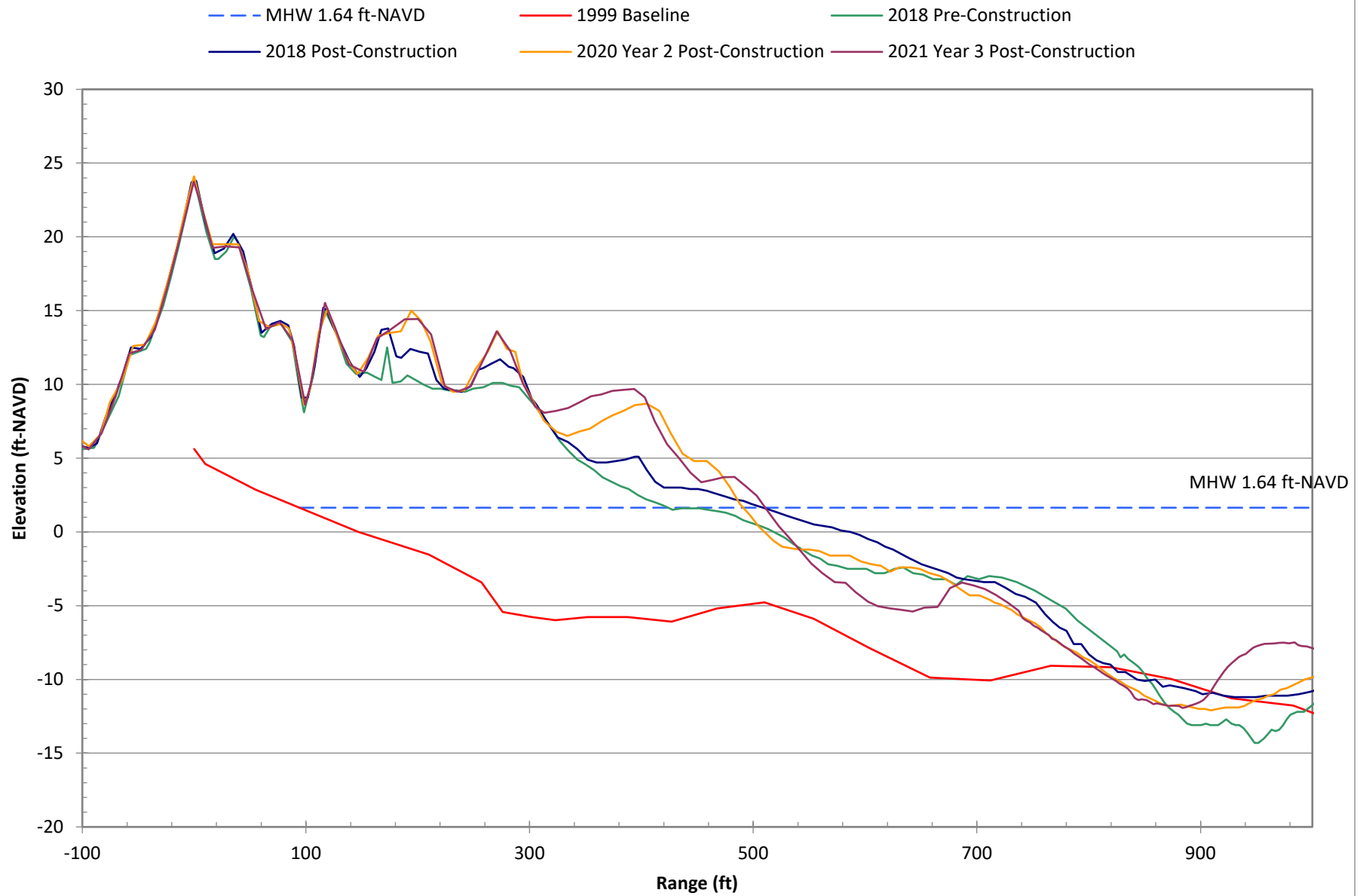
Survey Data at R-136 for Selected Years



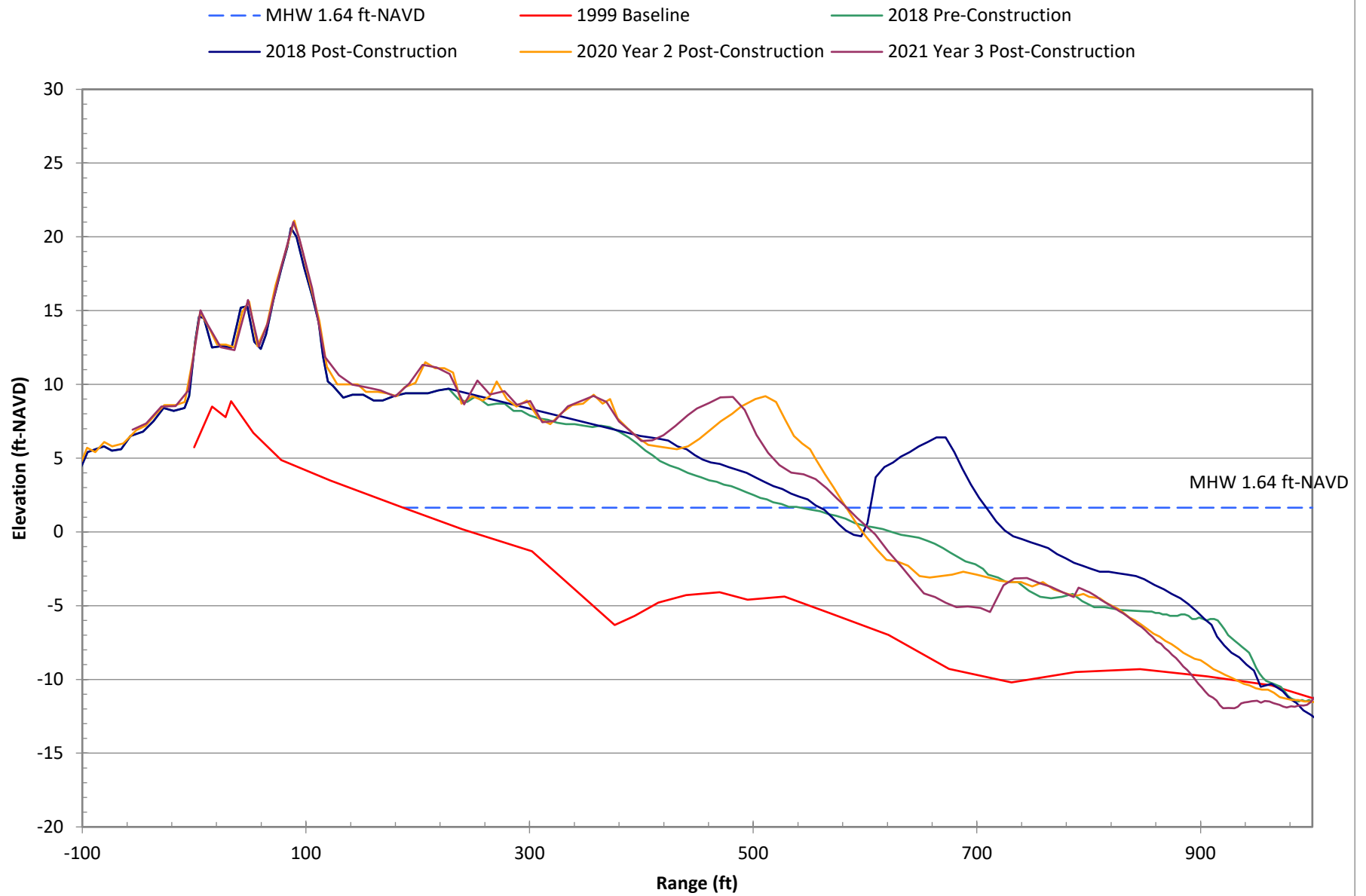
Survey Data at R-137A for Selected Years



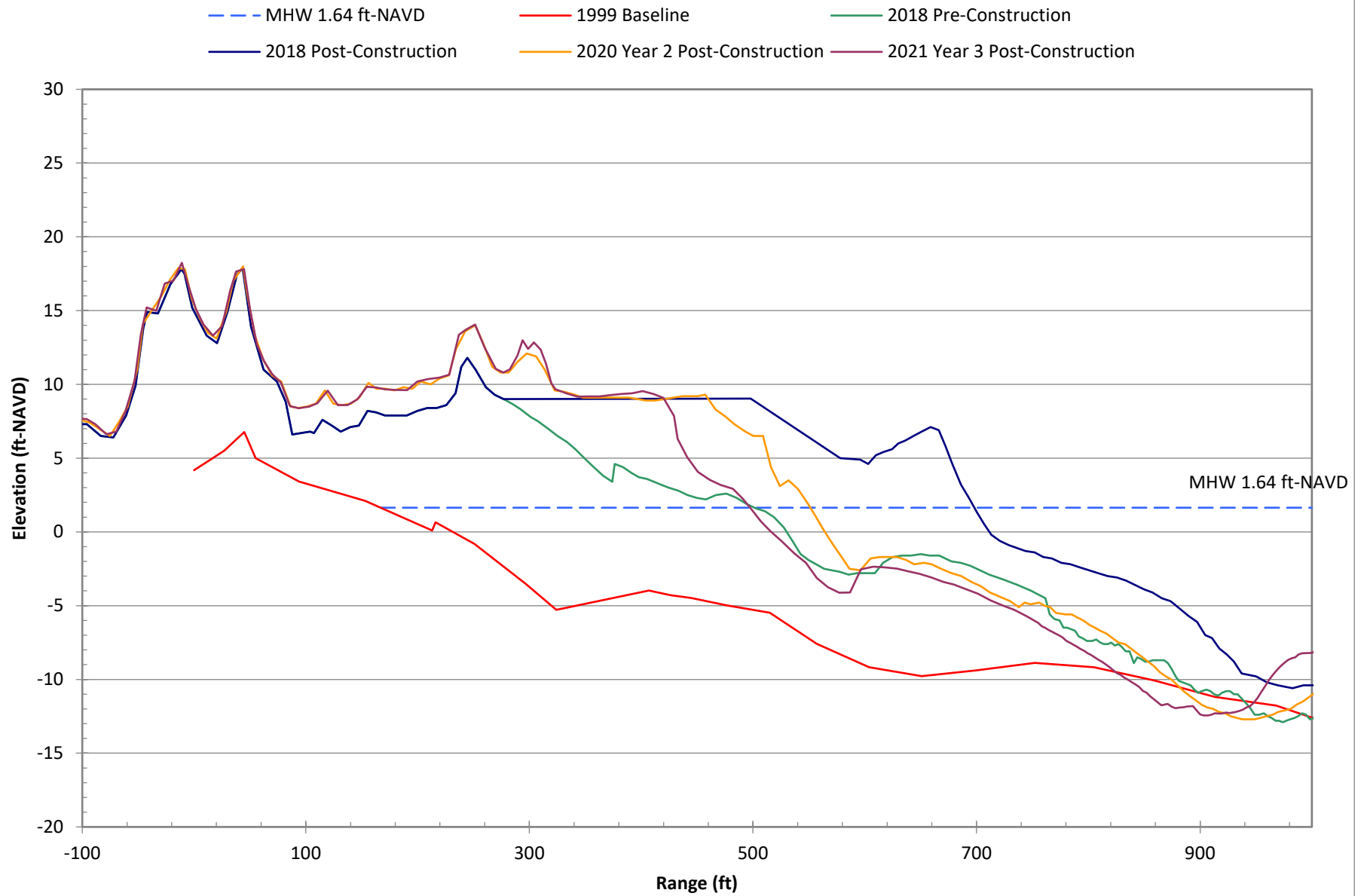
Survey Data at R-138 for Selected Years



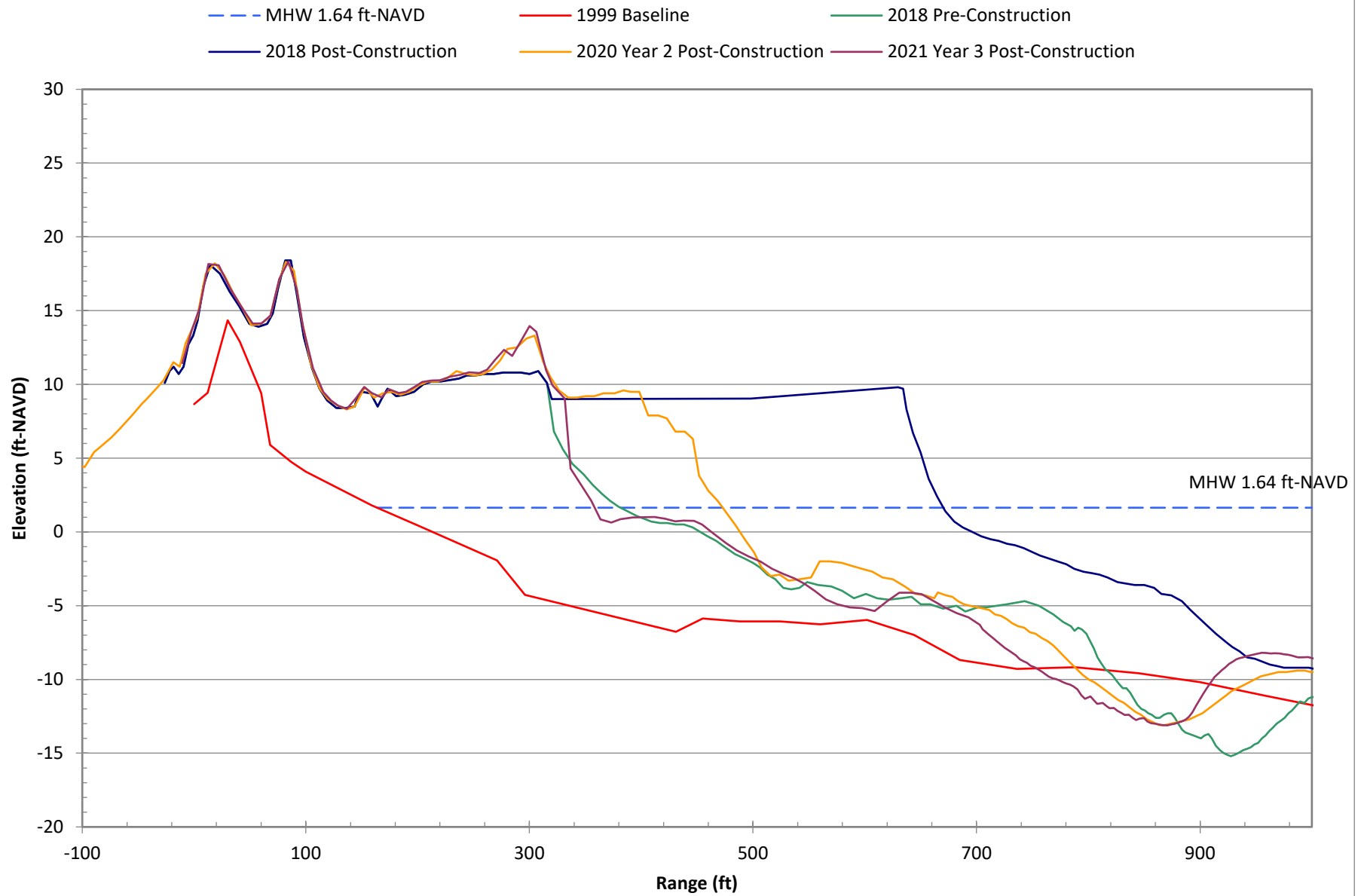
Survey Data at R-139 for Selected Years



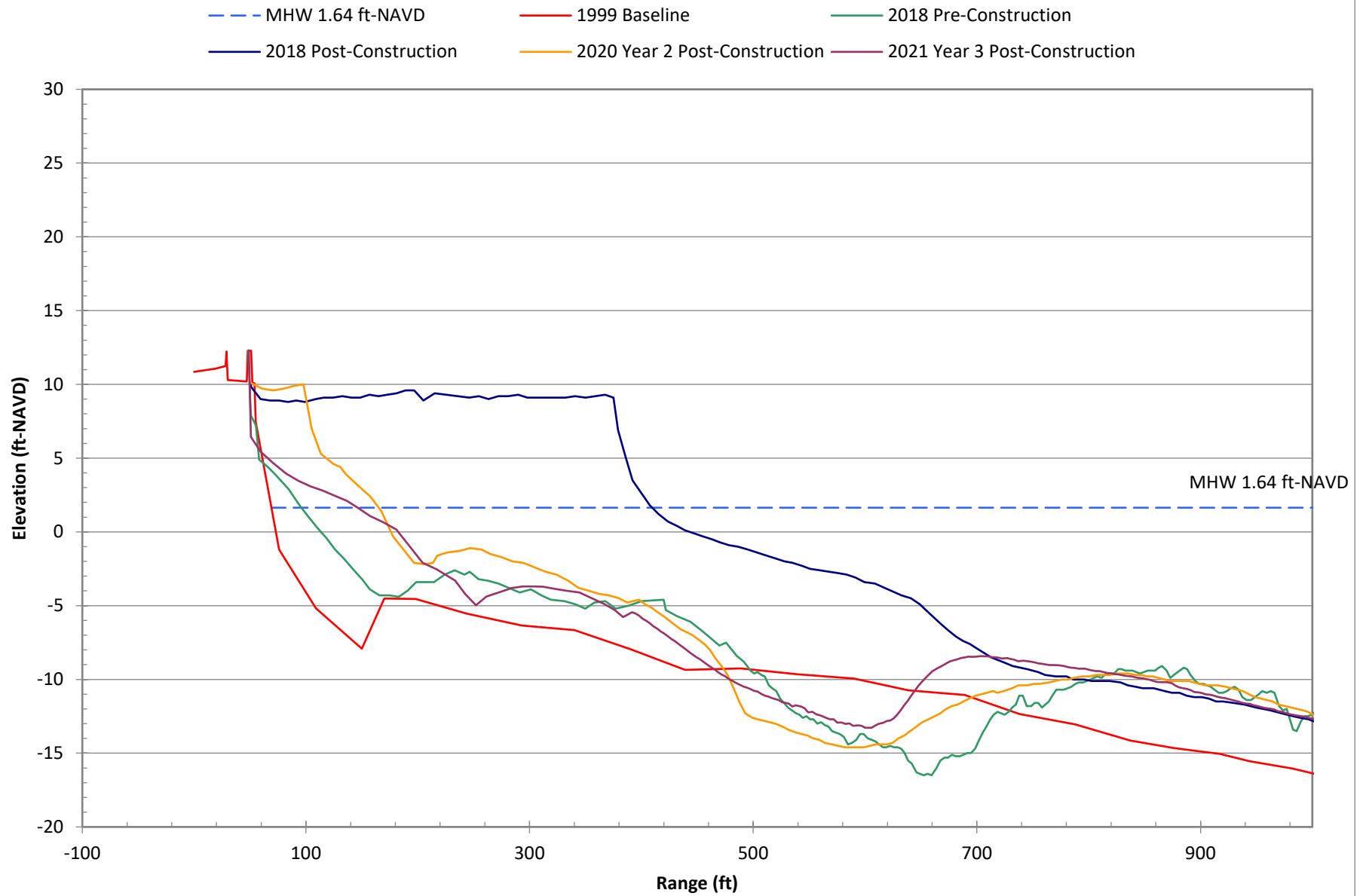
Survey Data at R-140 for Selected Years



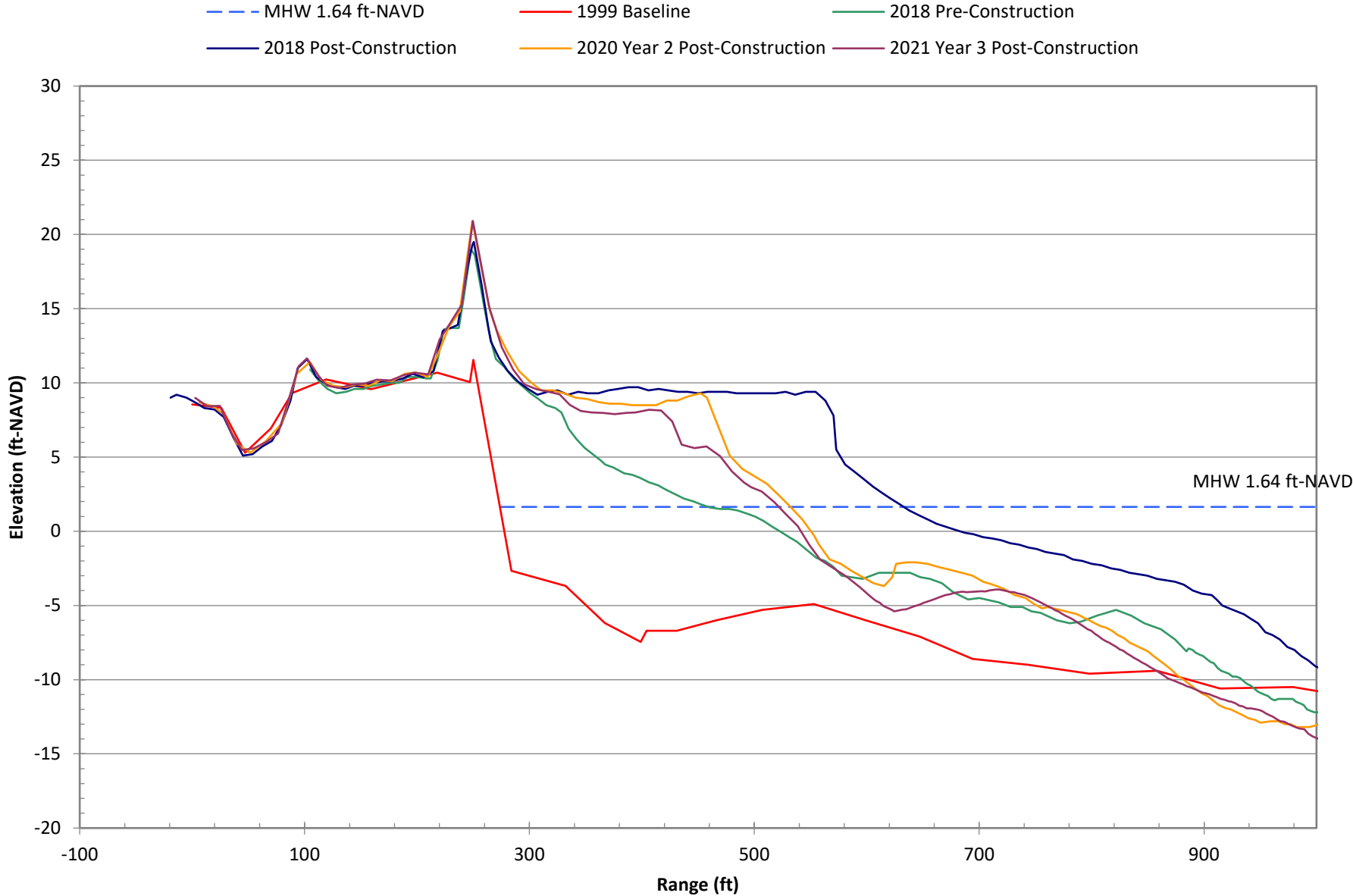
Survey Data at R-141 for Selected Years



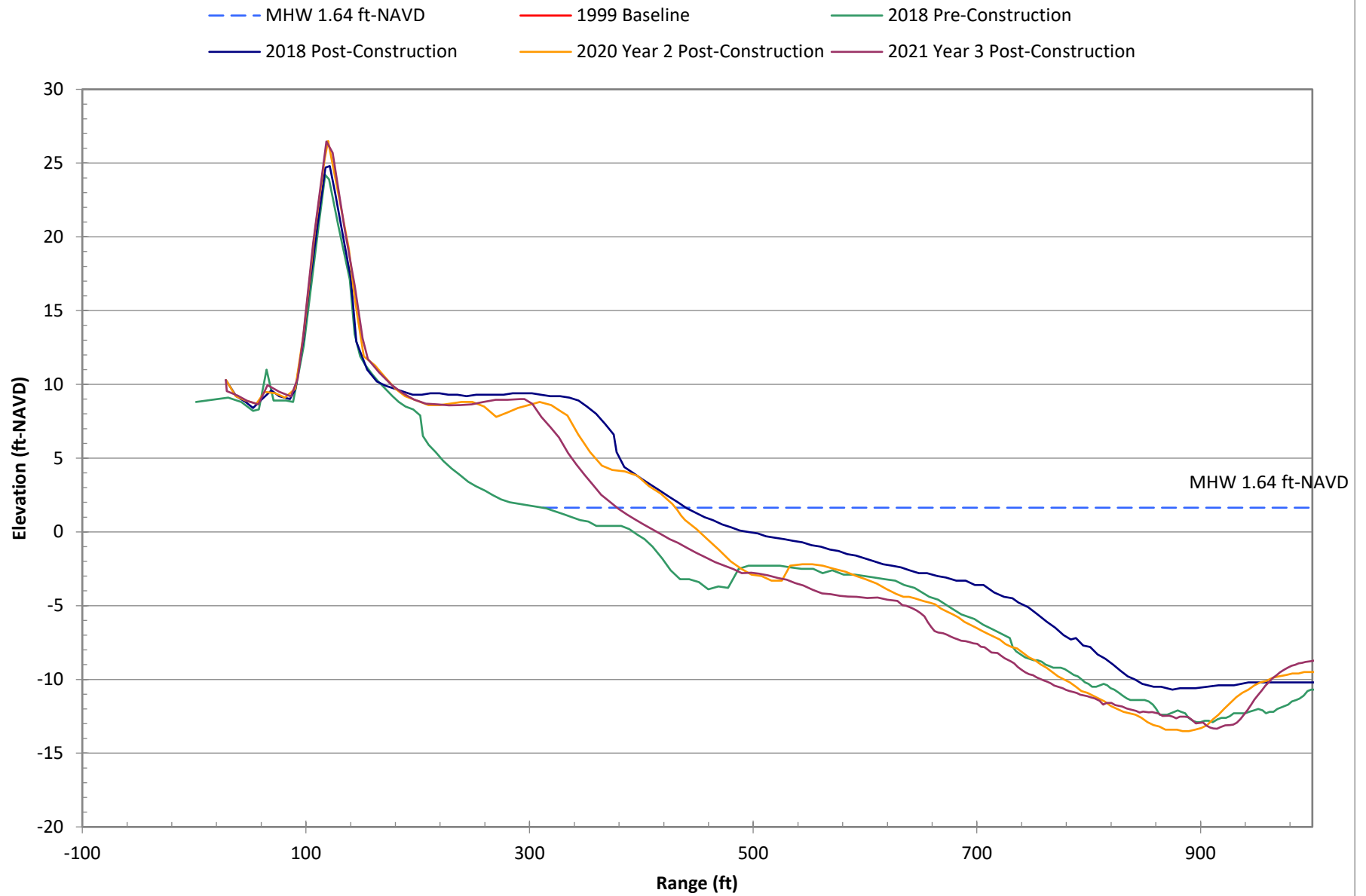
Survey Data at R-142 for Selected Years



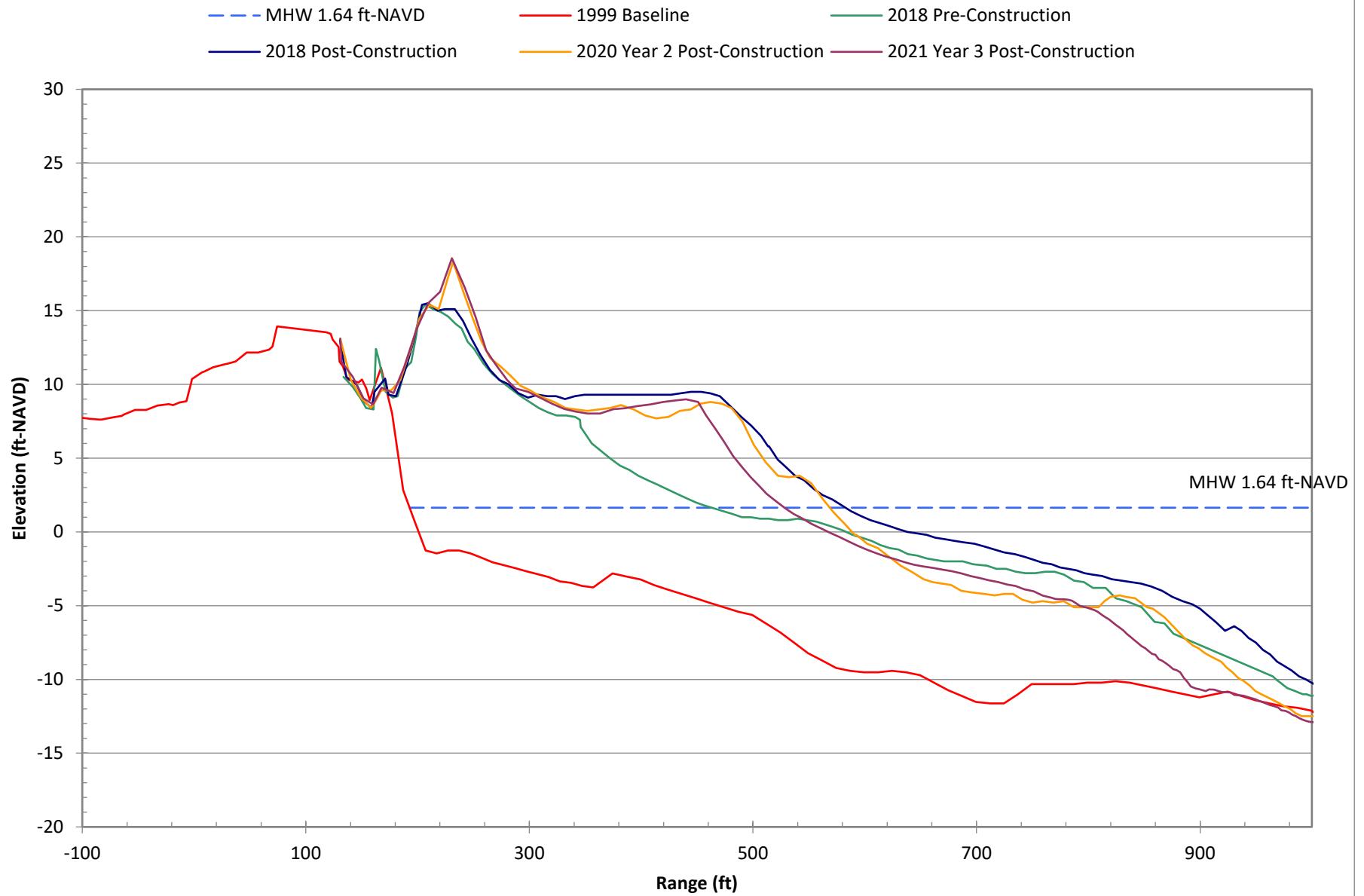
Survey Data at R-143T for Selected Years



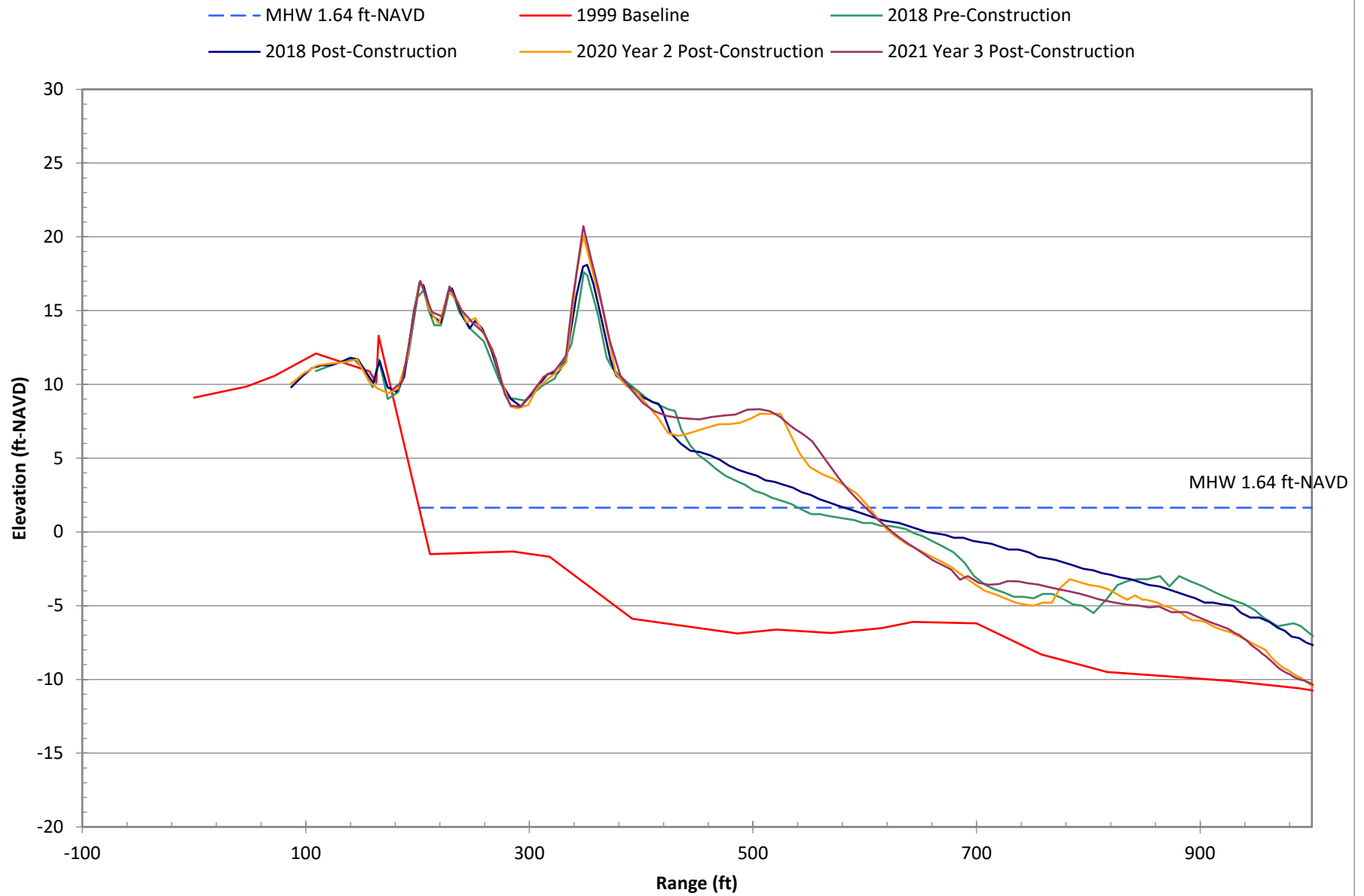
Survey Data at R-143 for Selected Years



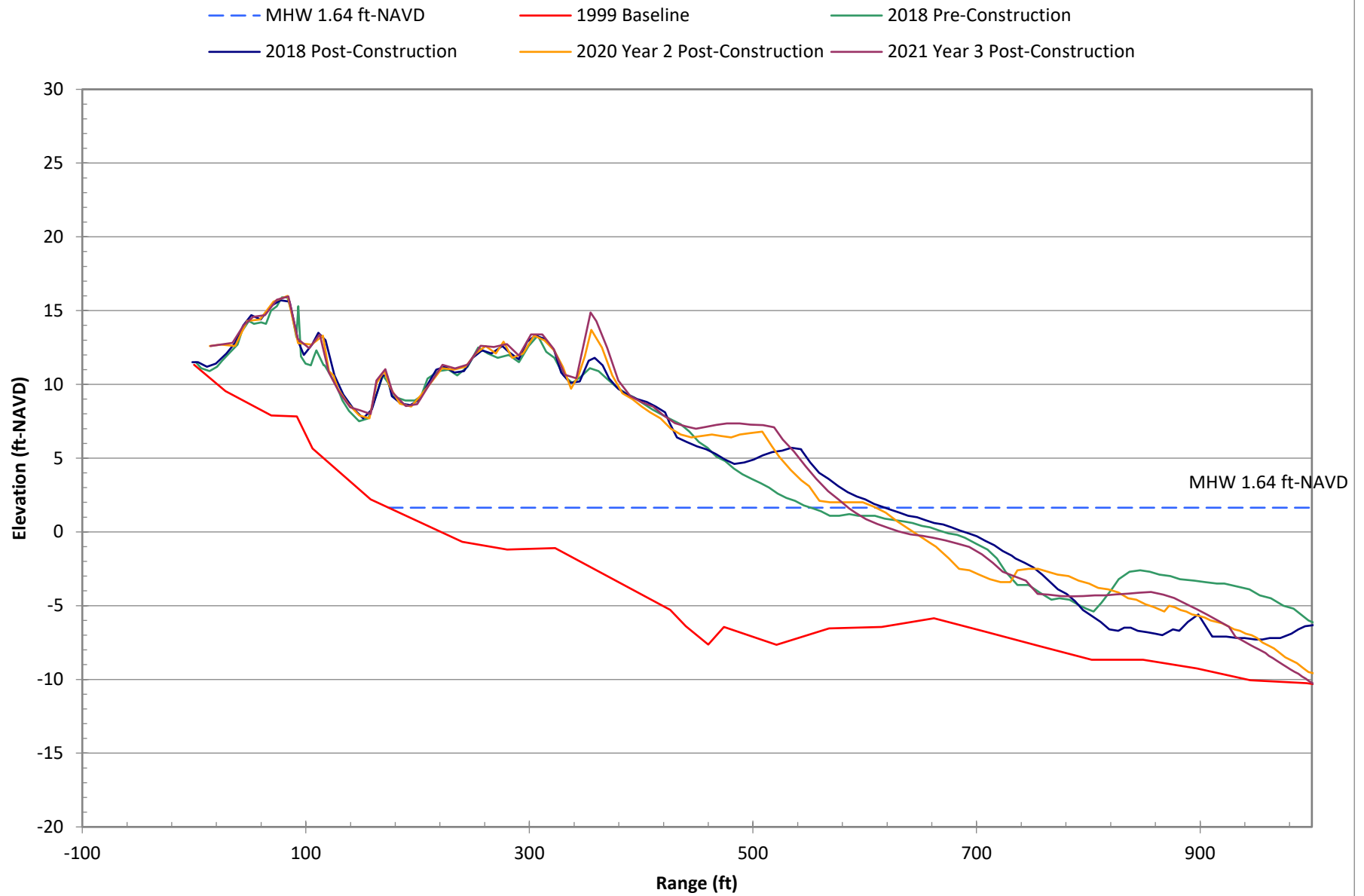
Survey Data at R-144 for Selected Years



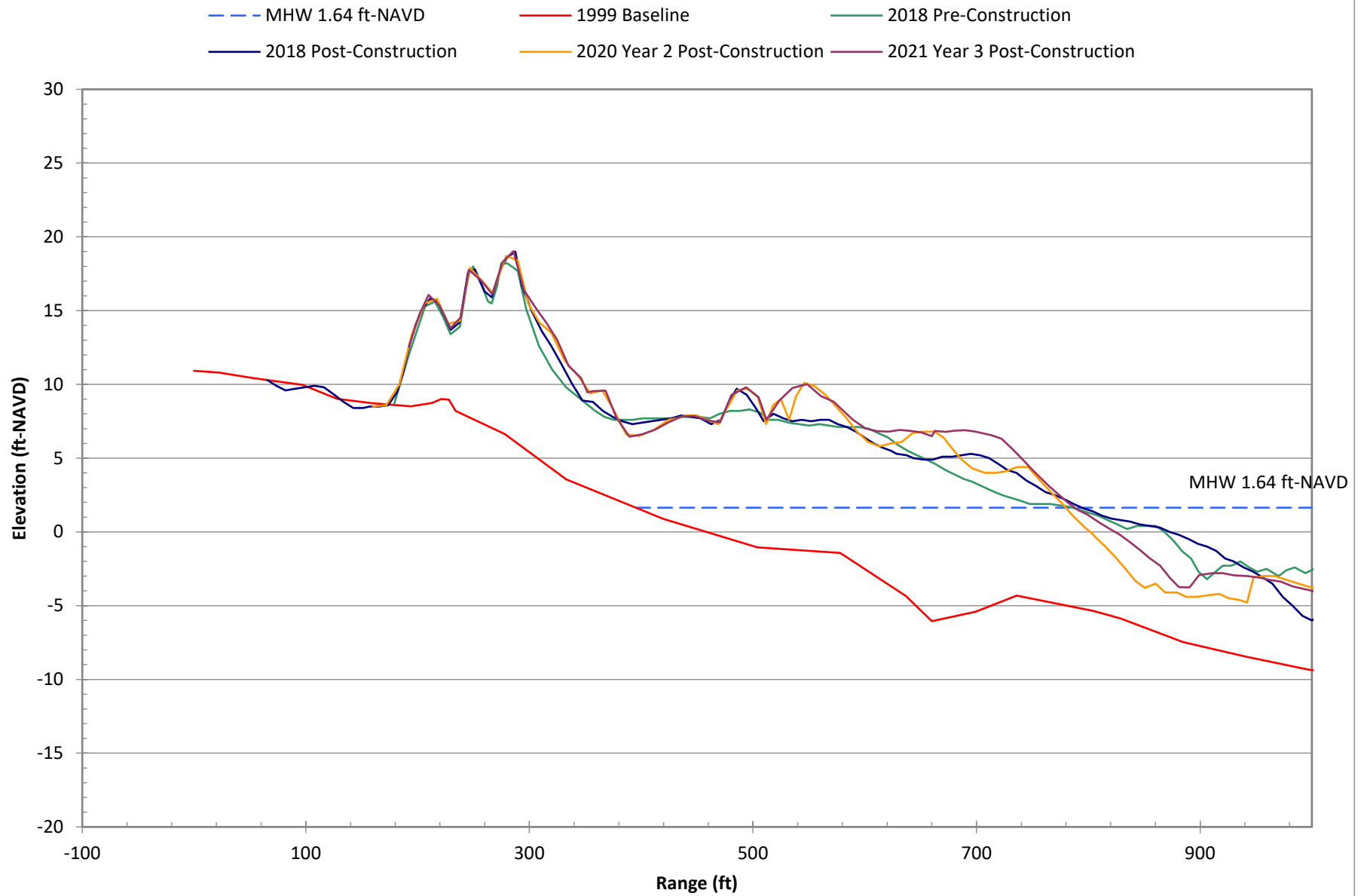
Survey Data at R-145 for Selected Years



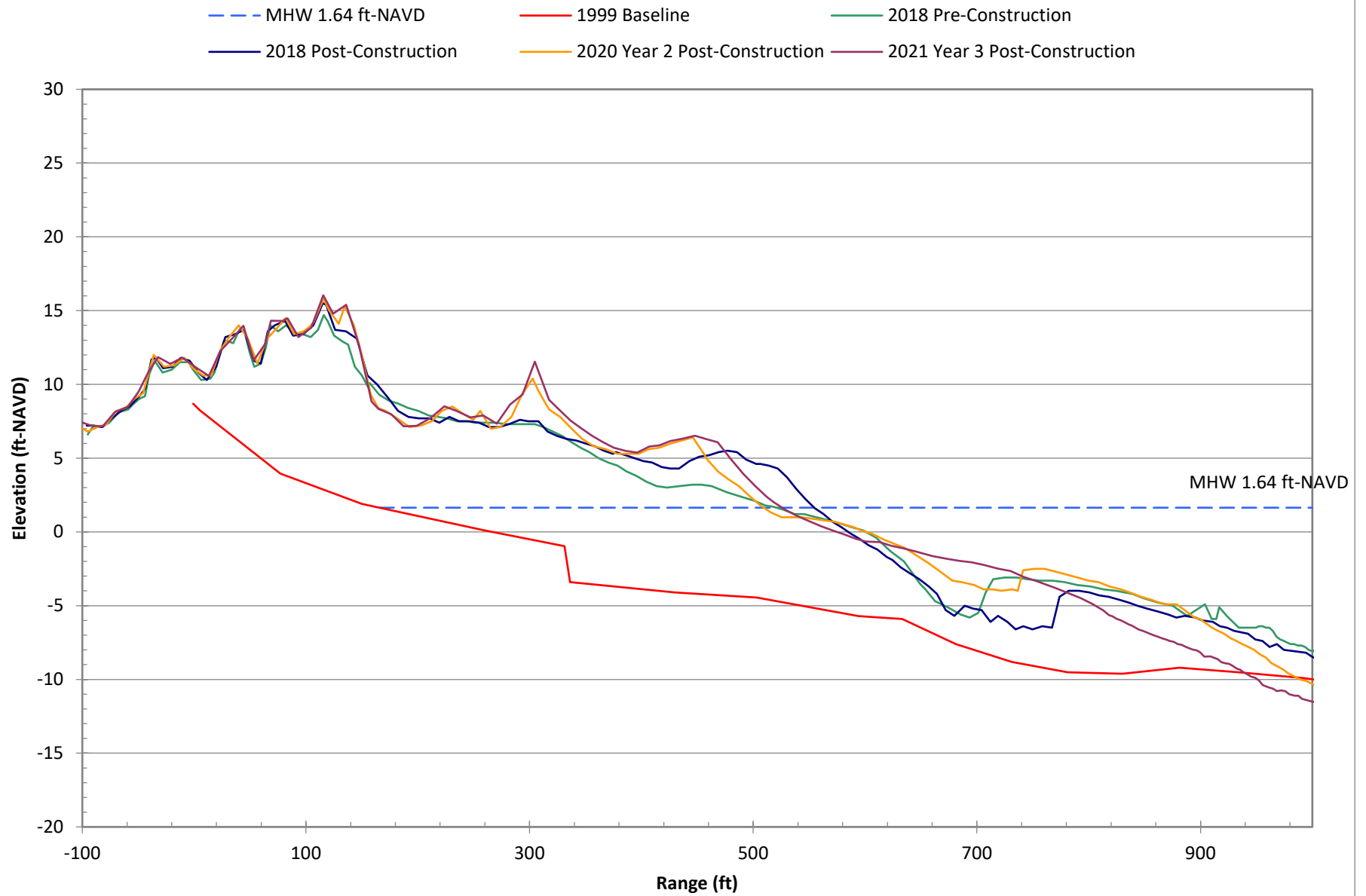
Survey Data at R-146 for Selected Years



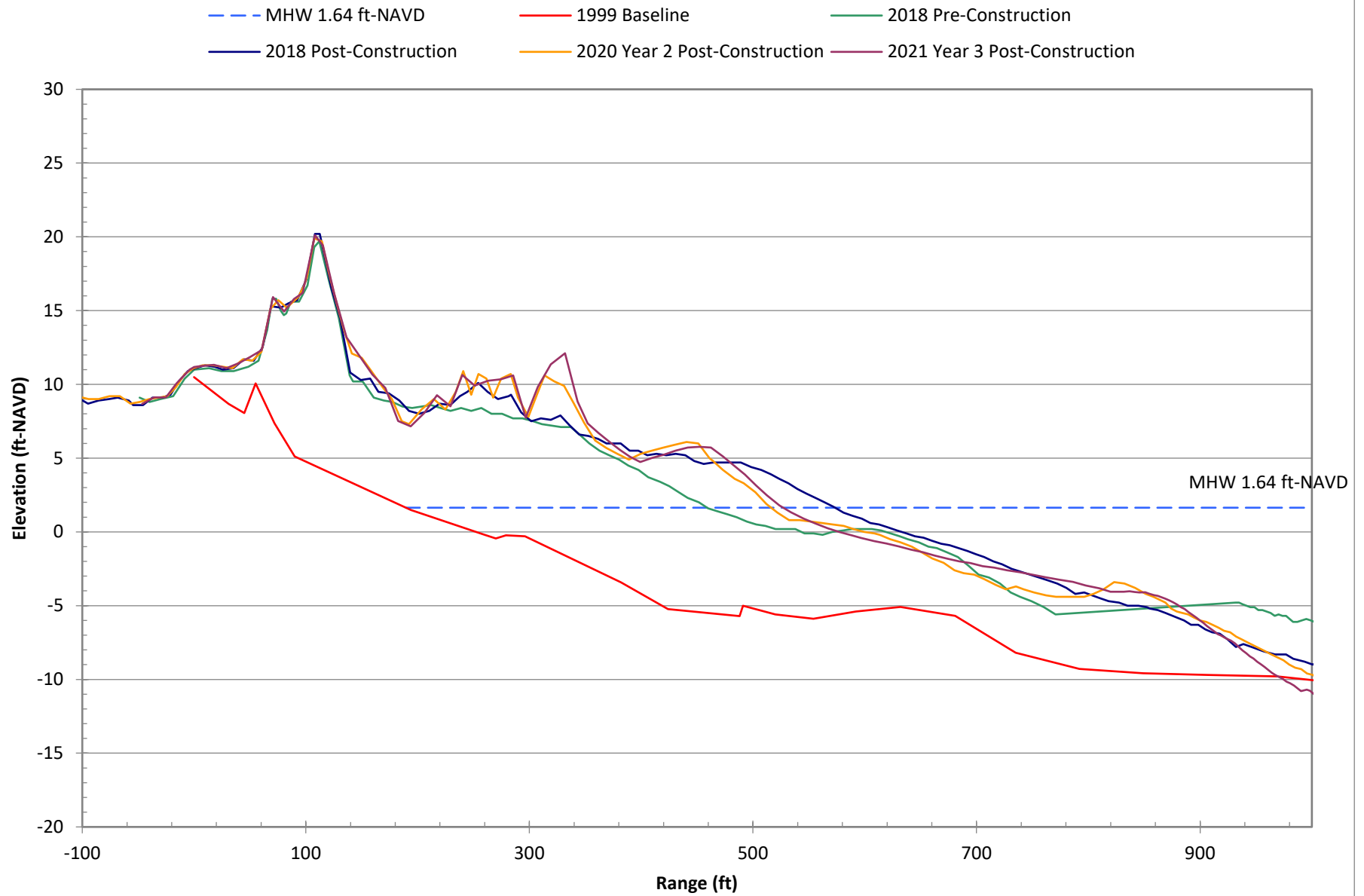
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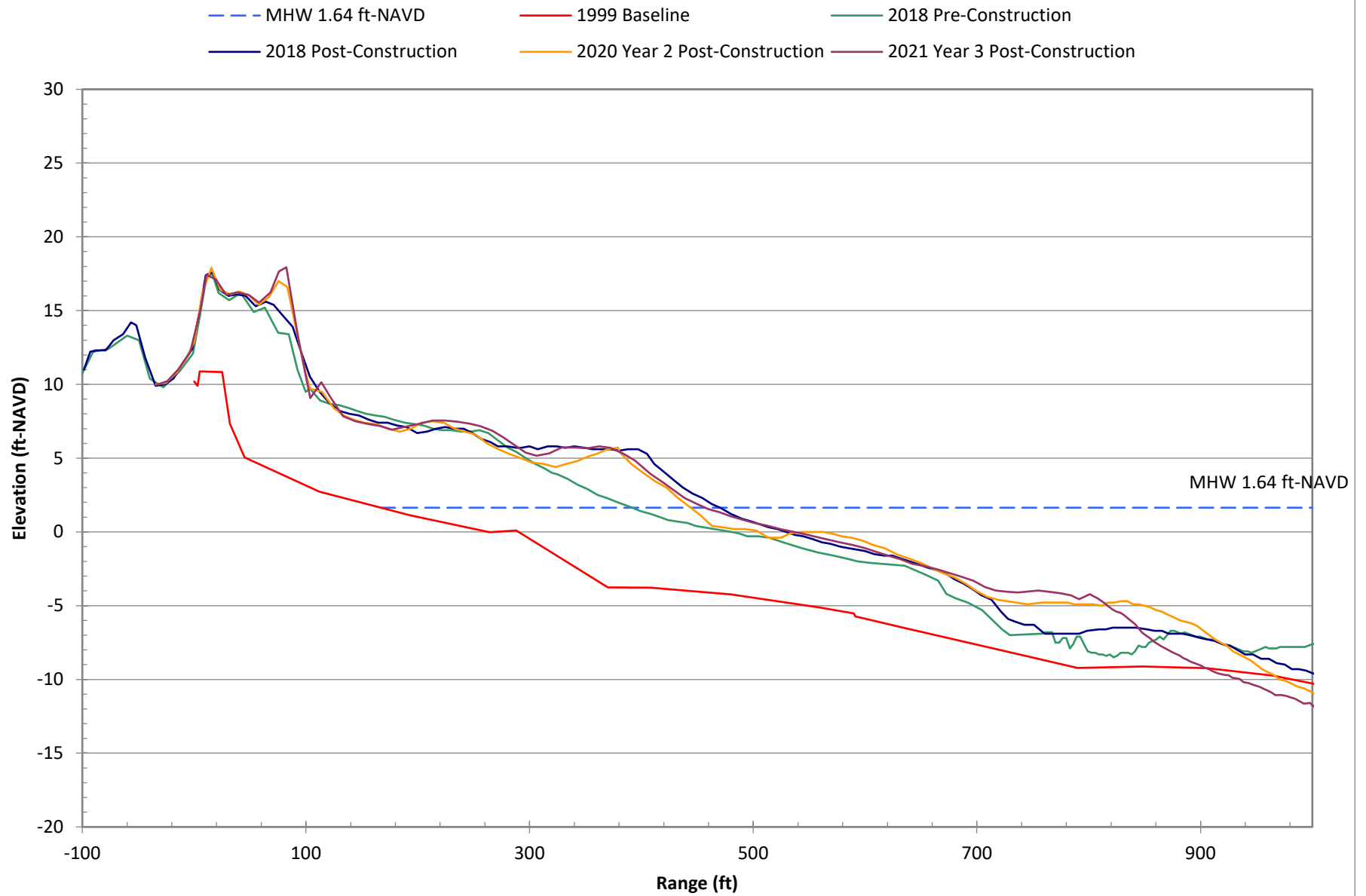
Survey Data at R-148 for Selected Years



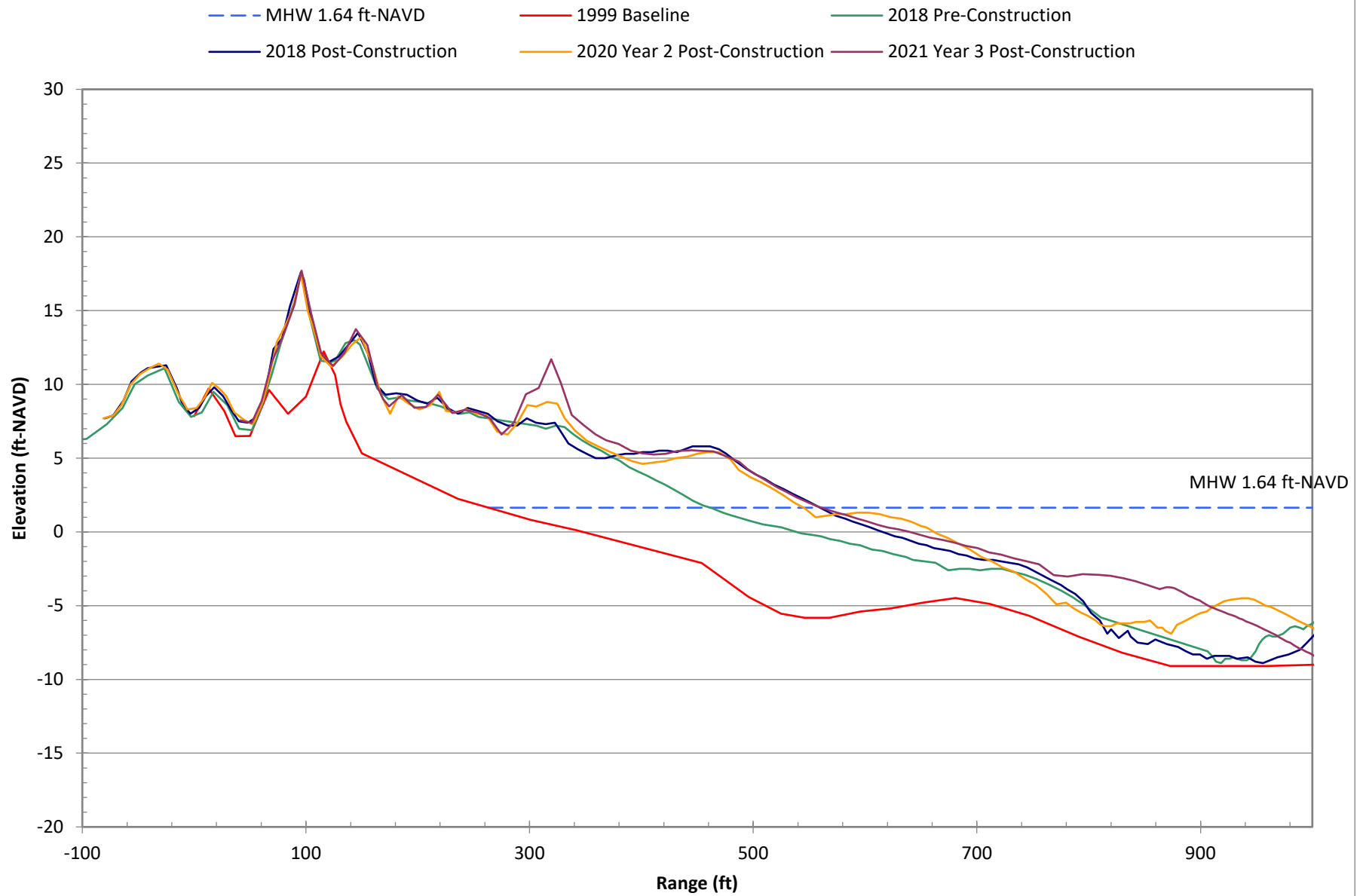
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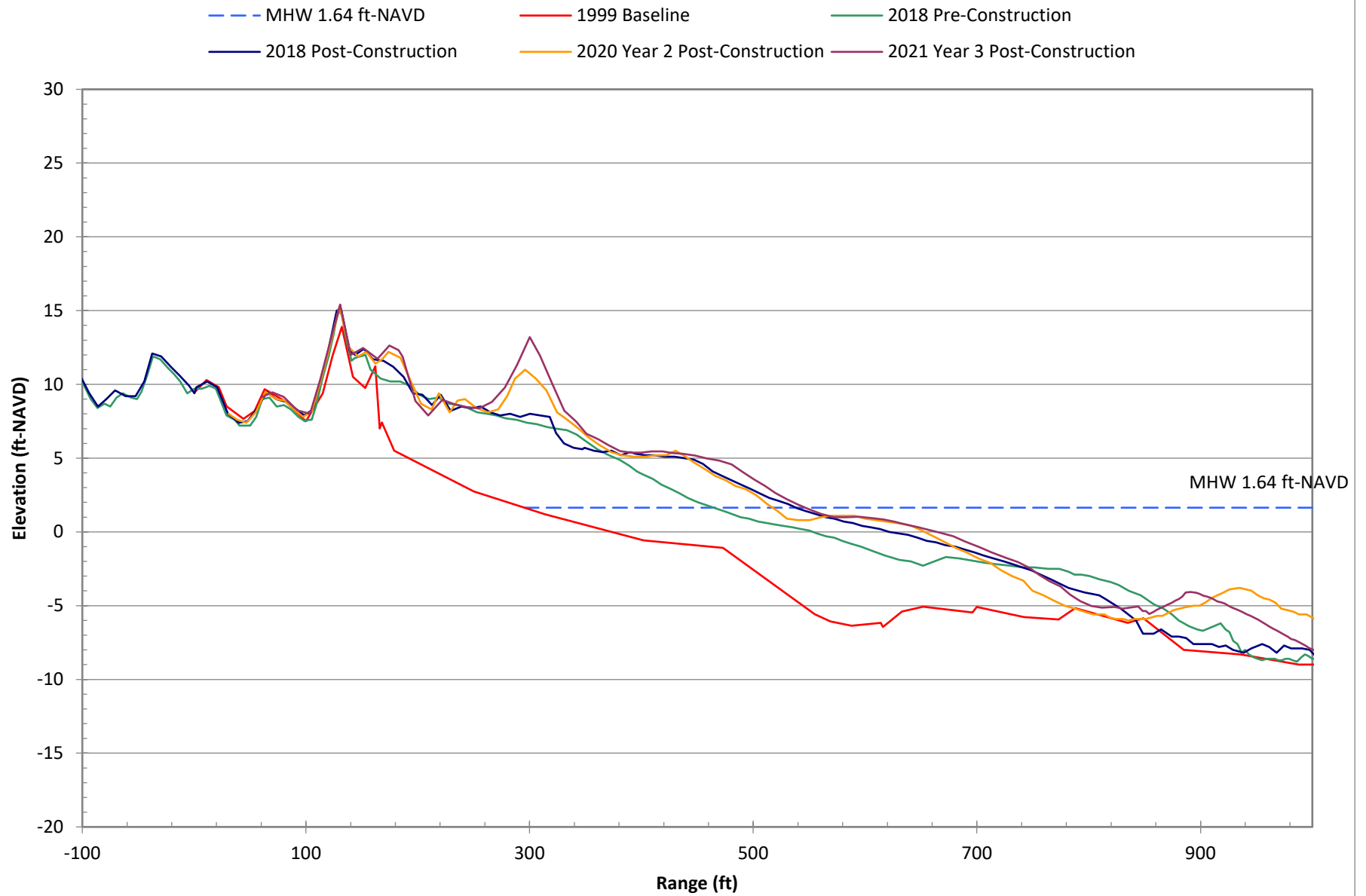
Survey Data at R-150 for Selected Years



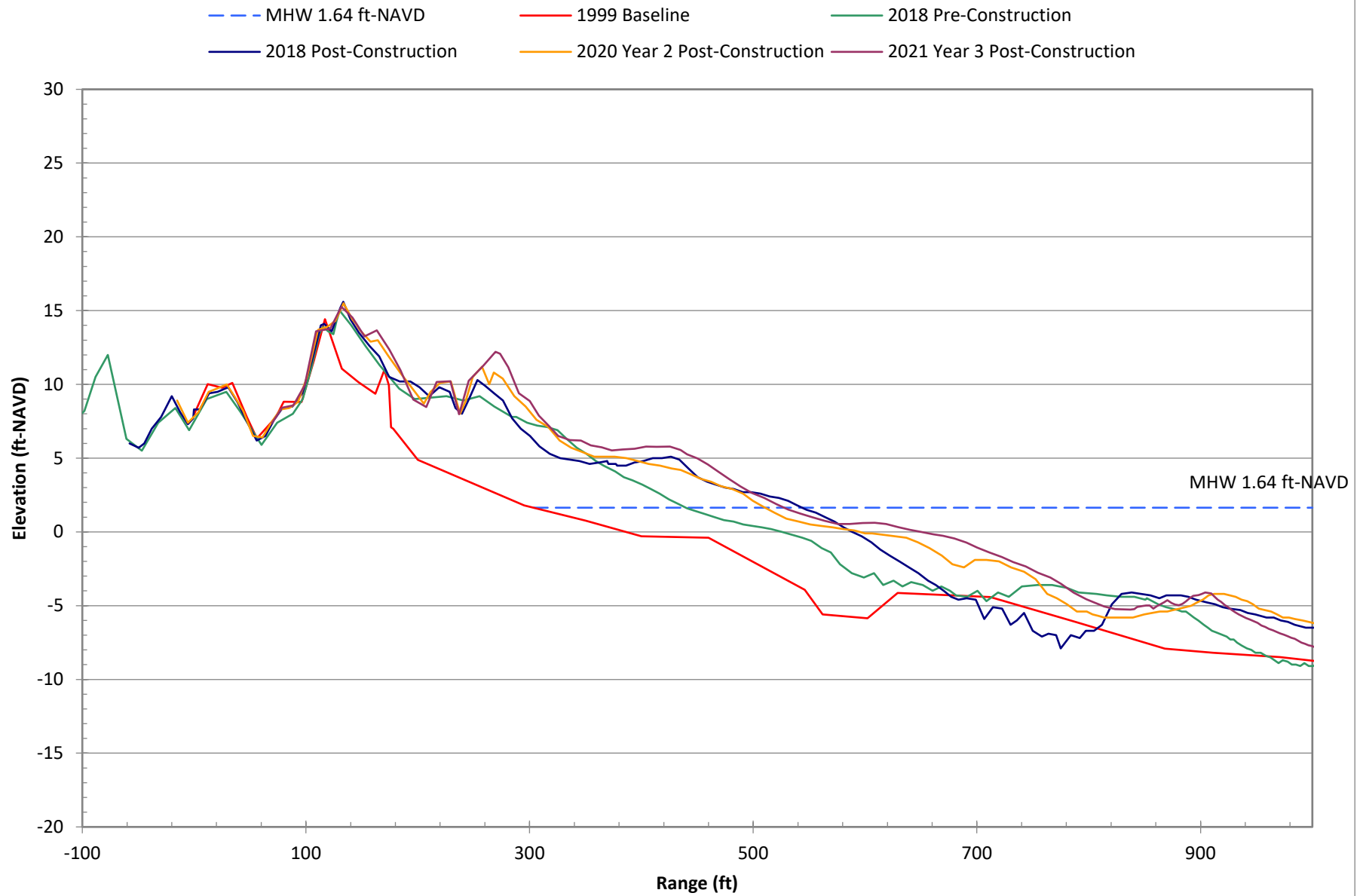
Survey Data at R-151 for Selected Years



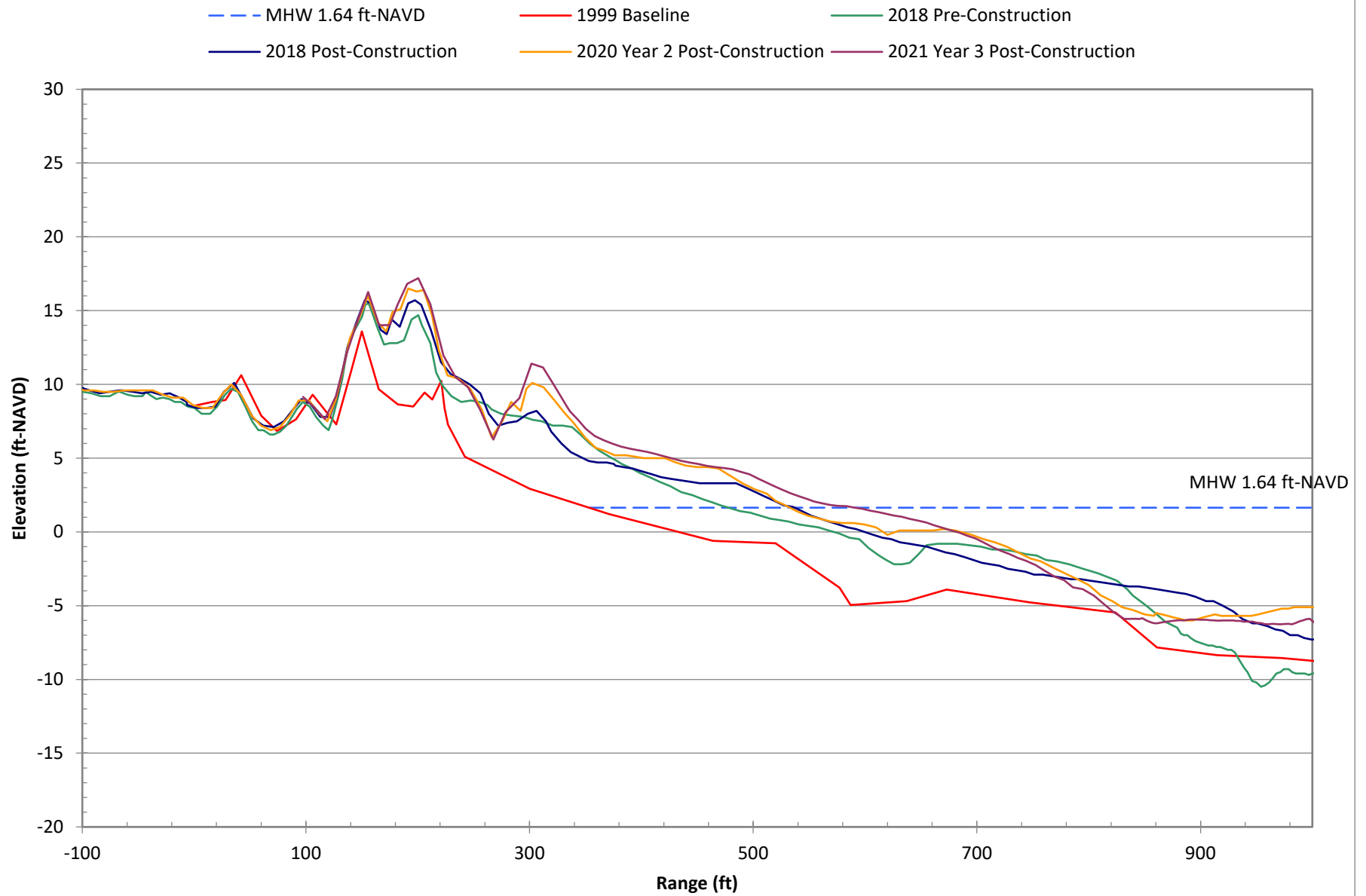
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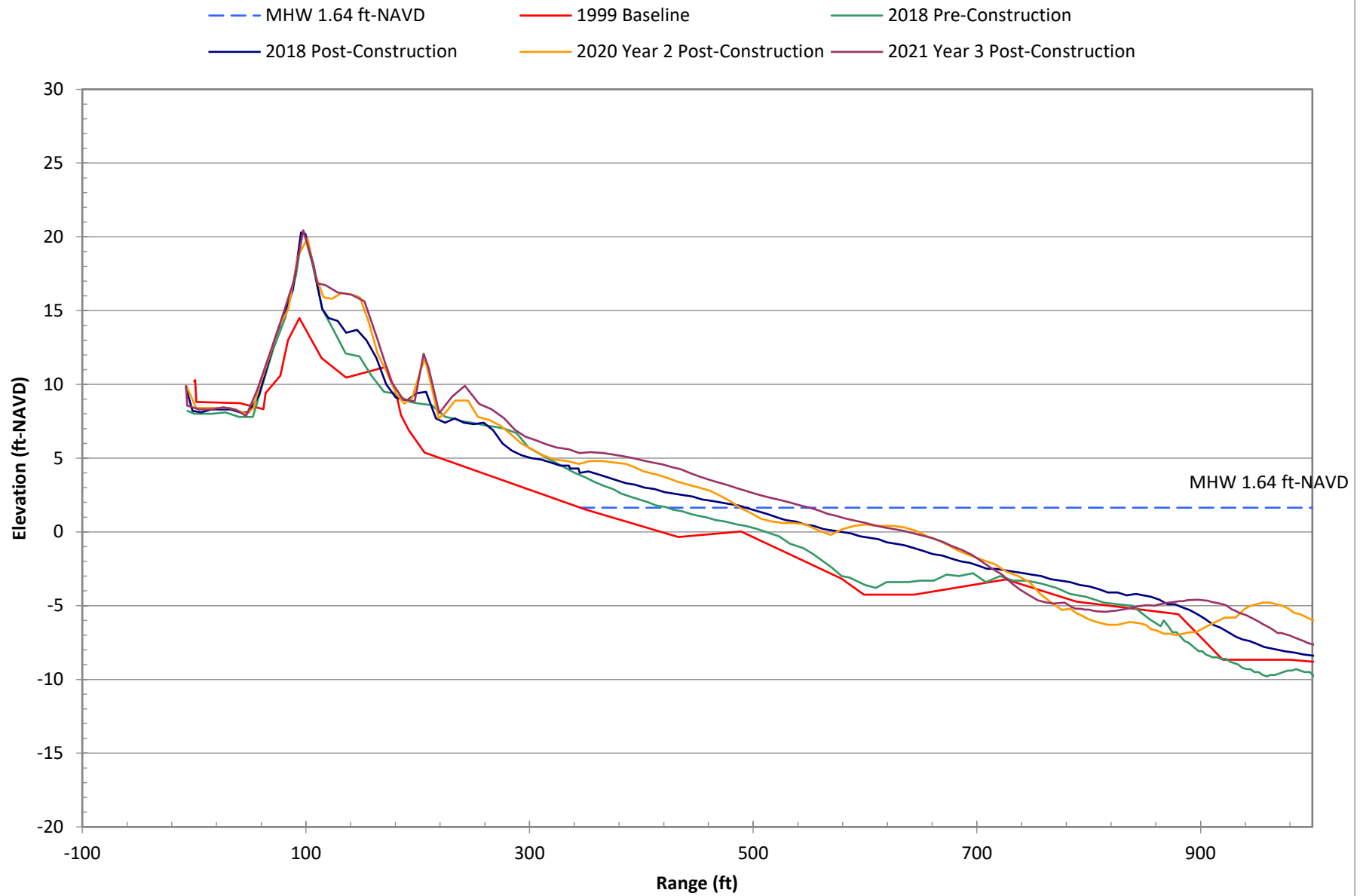
Survey Data at R-153 for Selected Years



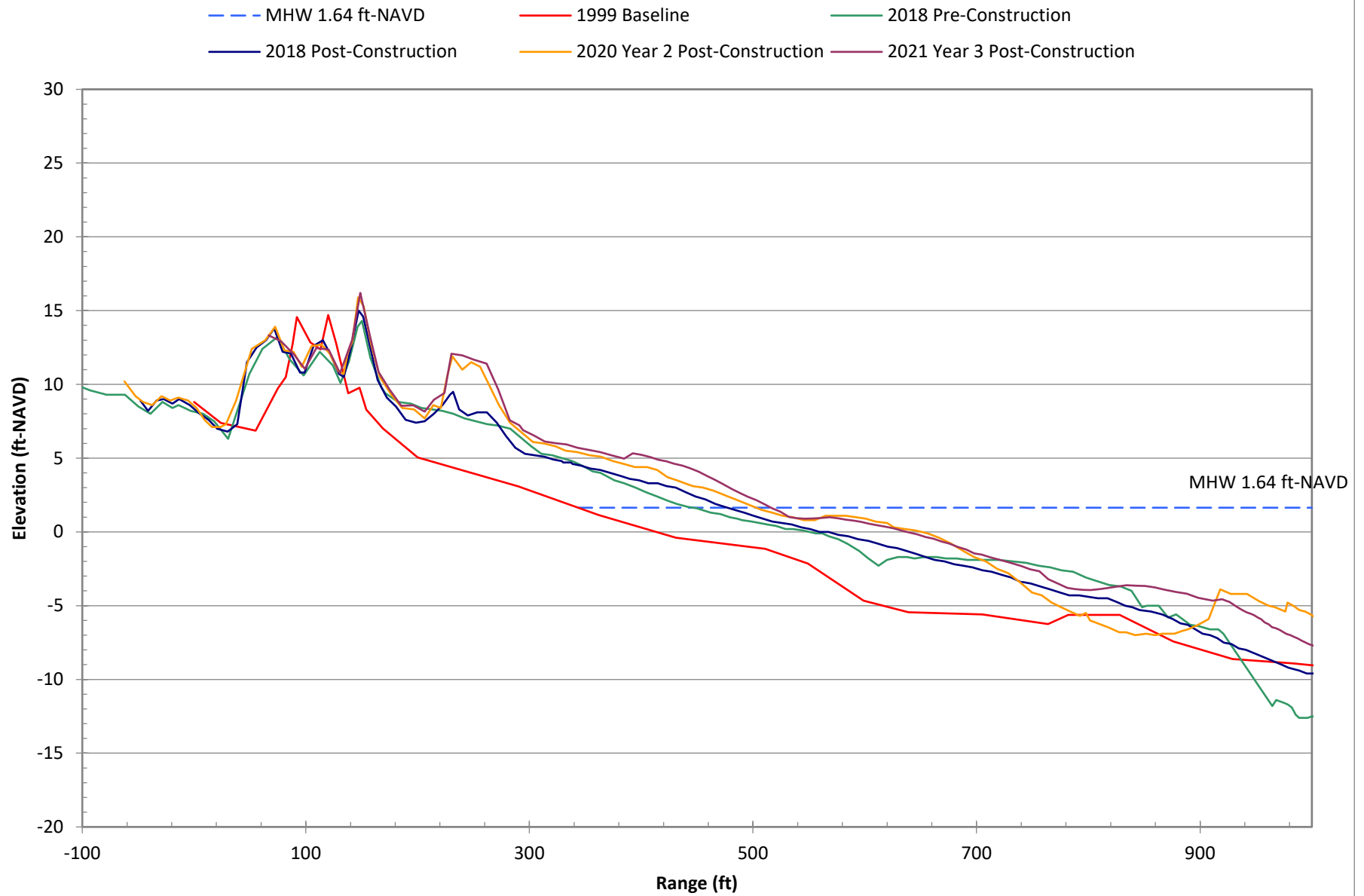
Survey Data at R-154 for Selected Years



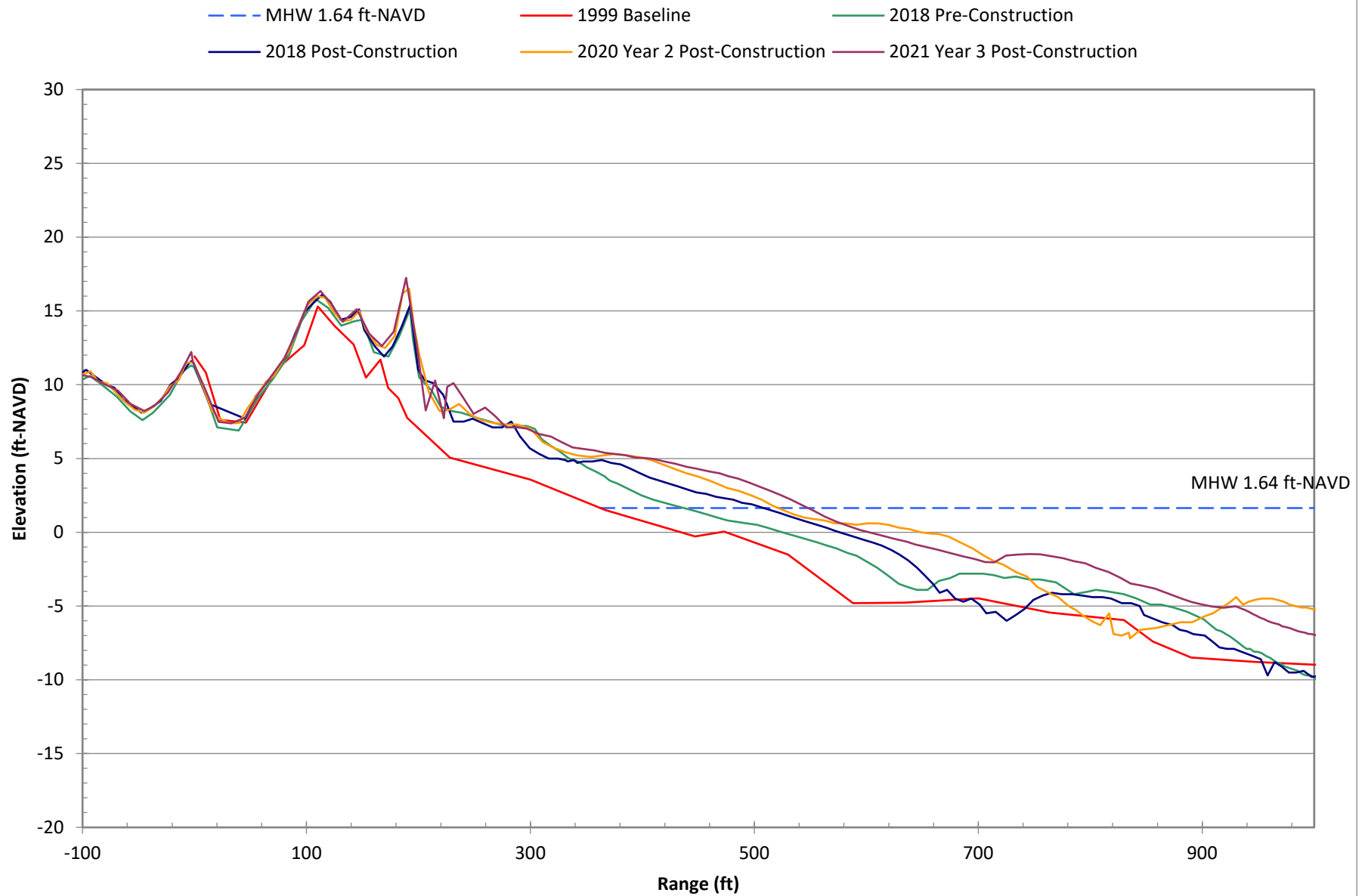
Survey Data at R-155 for Selected Years



Survey Data at T-156 for Selected Years

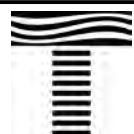


Survey Data at T-157 for Selected Years



Appendix C

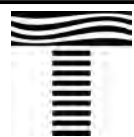
MHW Contours on 2021 Aerials



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MEAN HIGH WATER CONTOURS
ST JOHNS COUNTY SHORE PROTECTION PROJECT
ST. JOHNS COUNTY, FLORIDA

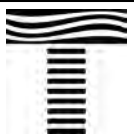
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MEAN HIGH WATER CONTOURS
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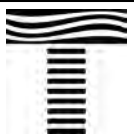
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MEAN HIGH WATER CONTOURS
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
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Legend

MHW Contour

- 1999 Baseline
- 2018 PreFill
- 2018 Post-Fill
- 2020 Year 2 Post-Fill
- 2021 Year 3 Post-Fill

FDEP Coastal Range Monument

0 250 500
FEET

IMAGE SOURCE: ST. JOHNS COUNTY, 2021



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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

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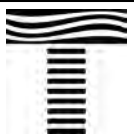
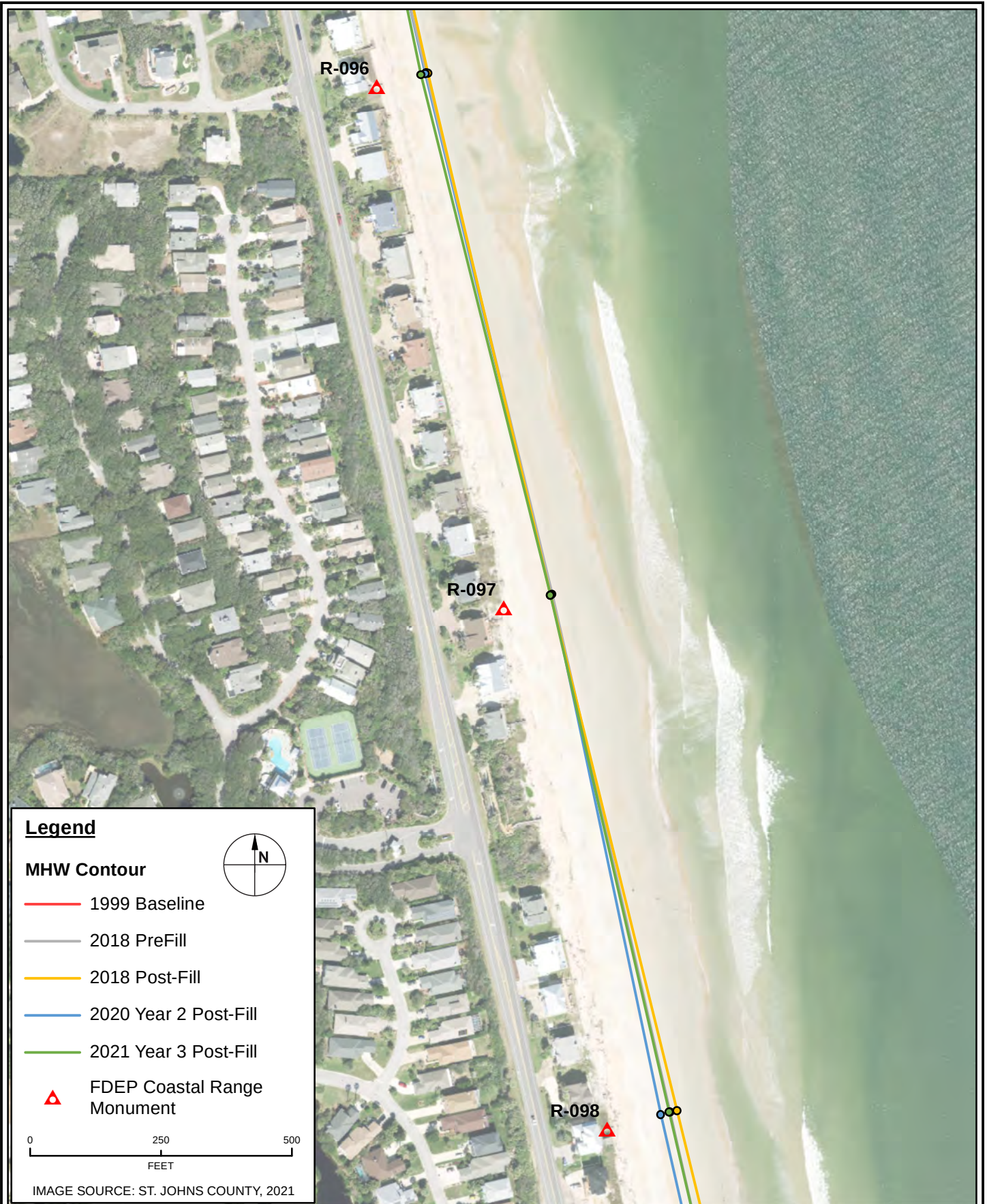


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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

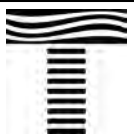
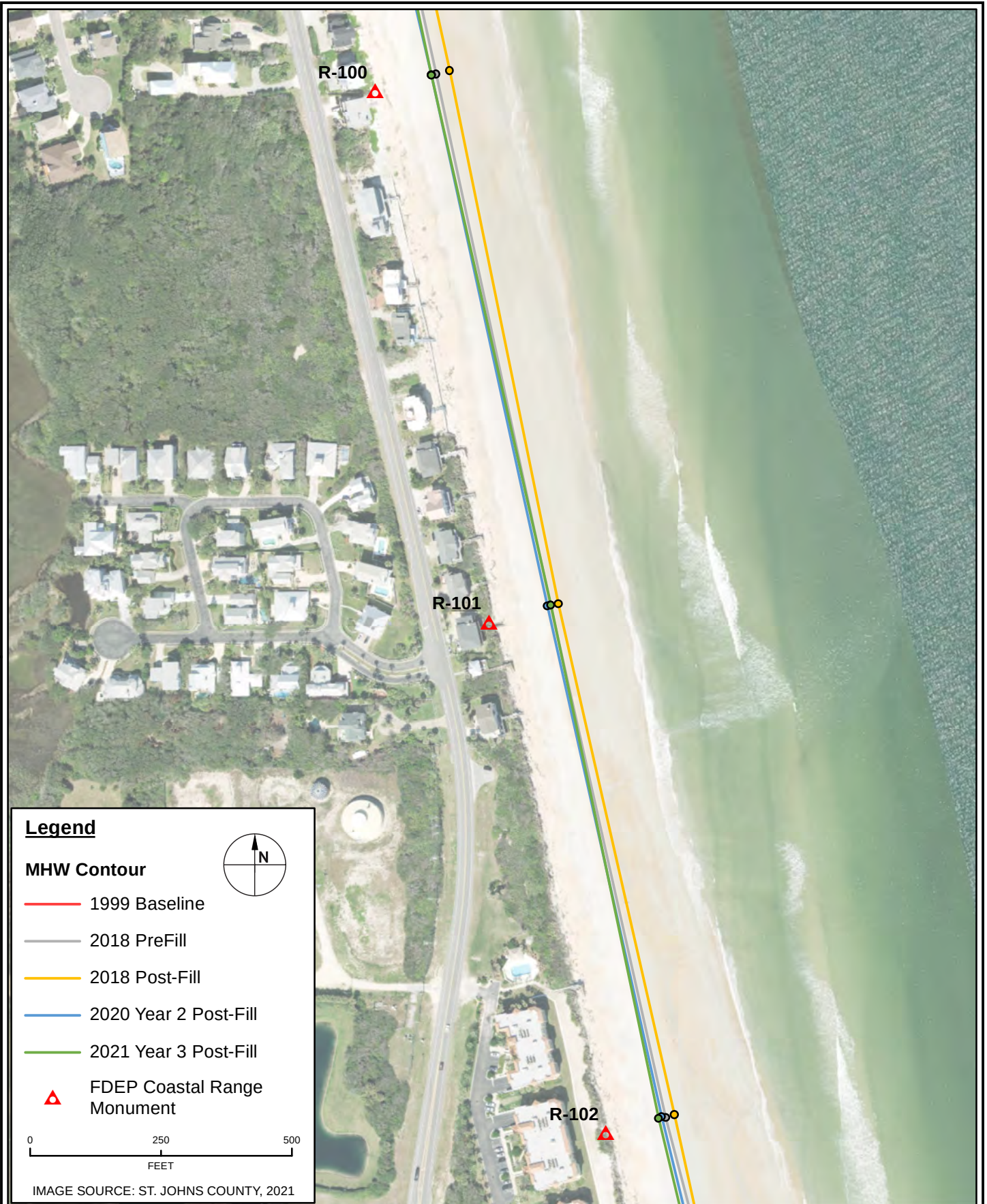
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
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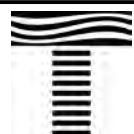
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MEAN HIGH WATER CONTOURS
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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

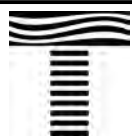
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MEAN HIGH WATER CONTOURS
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
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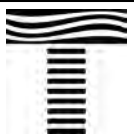
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

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Legend

MHW Contour

- 1999 Baseline
- 2018 PreFill
- 2018 Post-Fill
- 2020 Year 2 Post-Fill
- 2021 Year 3 Post-Fill

FDEP Coastal Range Monument

0 250 500
FEET

IMAGE SOURCE: ST. JOHNS COUNTY, 2021



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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

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Legend

MHW Contour

- 1999 Baseline
- 2018 PreFill
- 2018 Post-Fill
- 2020 Year 2 Post-Fill
- 2021 Year 3 Post-Fill

FDEP Coastal Range Monument

0 250 500
FEET

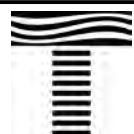
IMAGE SOURCE: ST. JOHNS COUNTY, 2021



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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

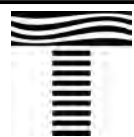
PROJECT	C2021-050
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

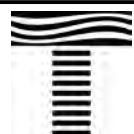
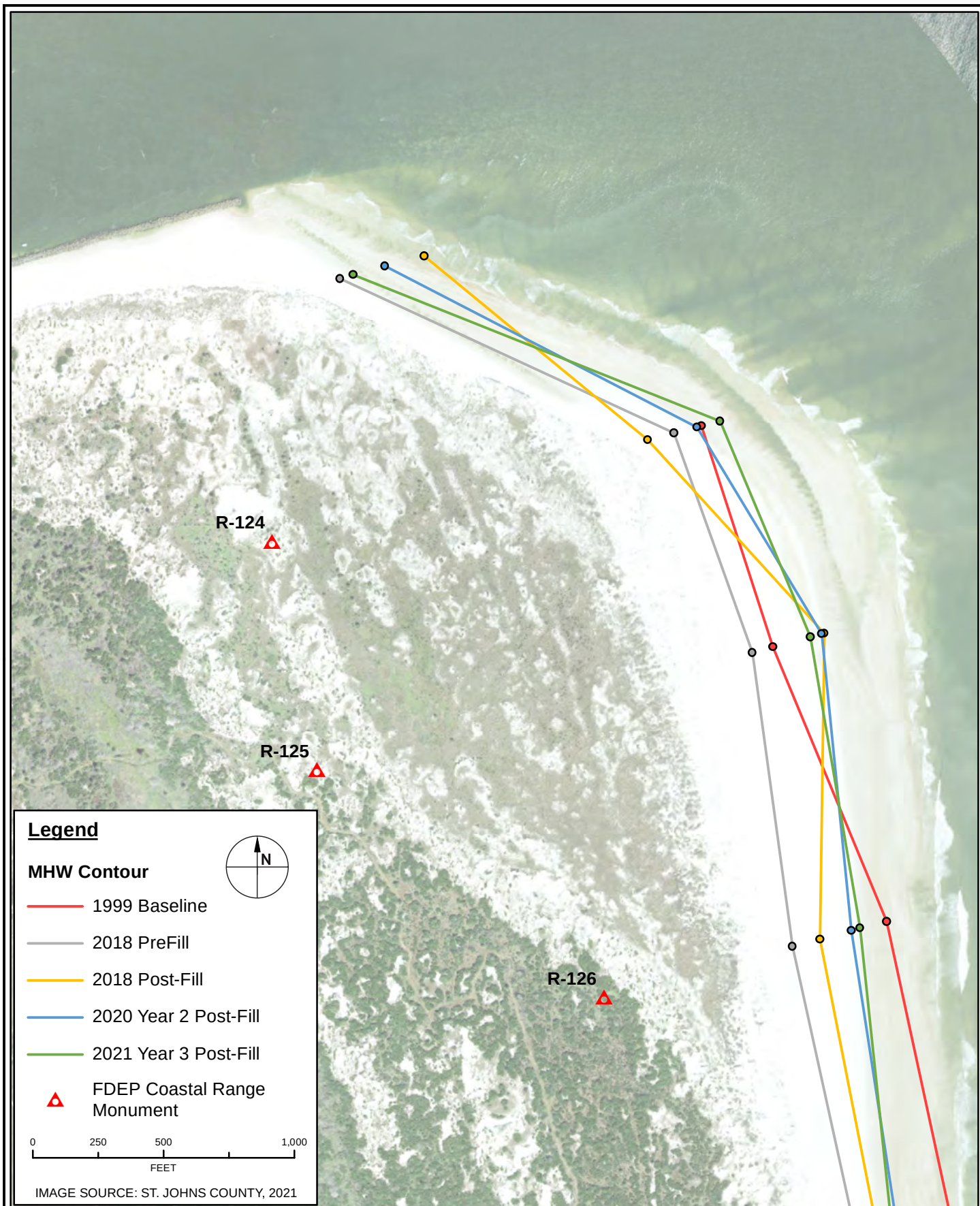
PROJECT	C2021-050
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

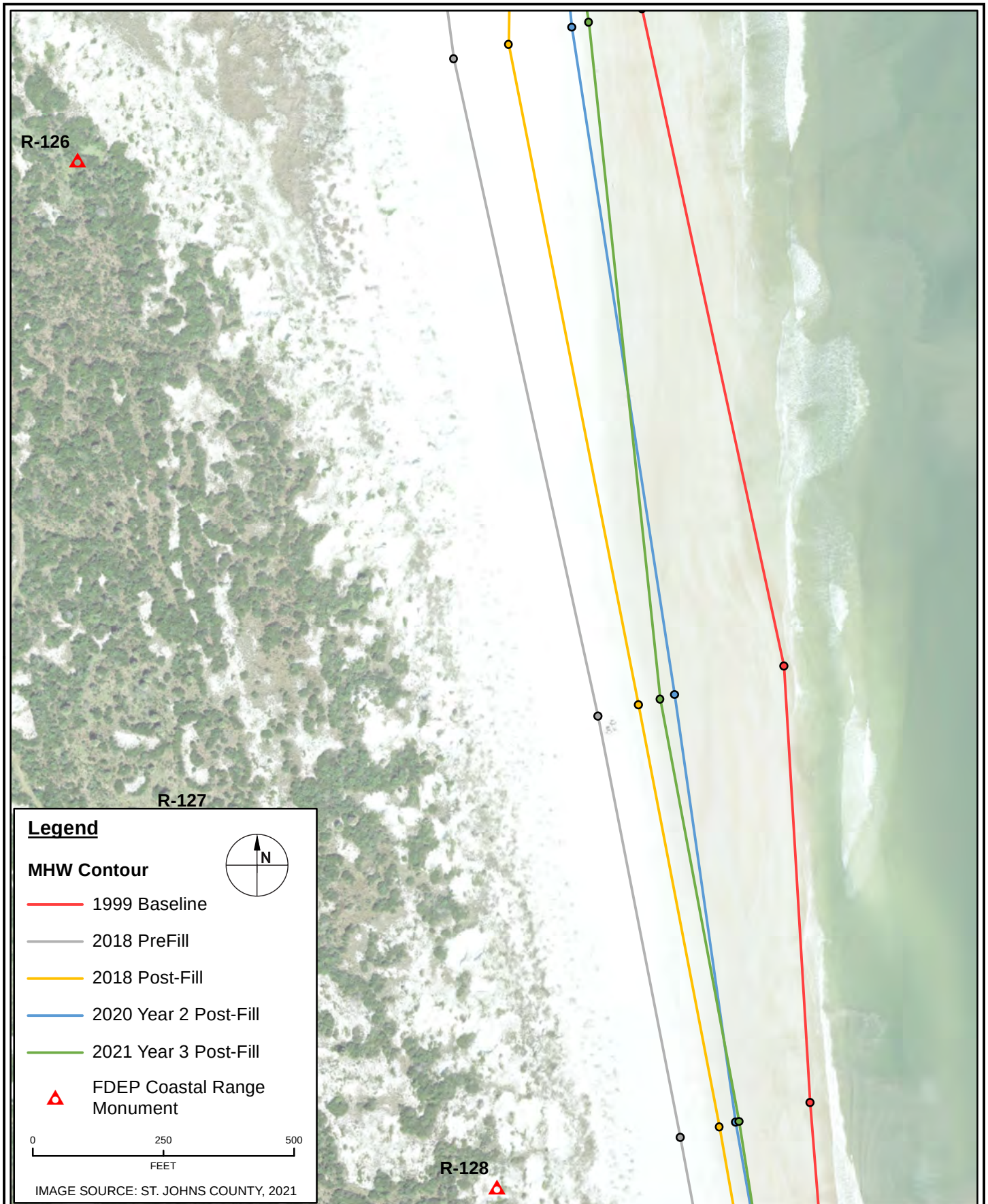
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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
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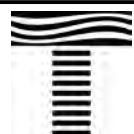
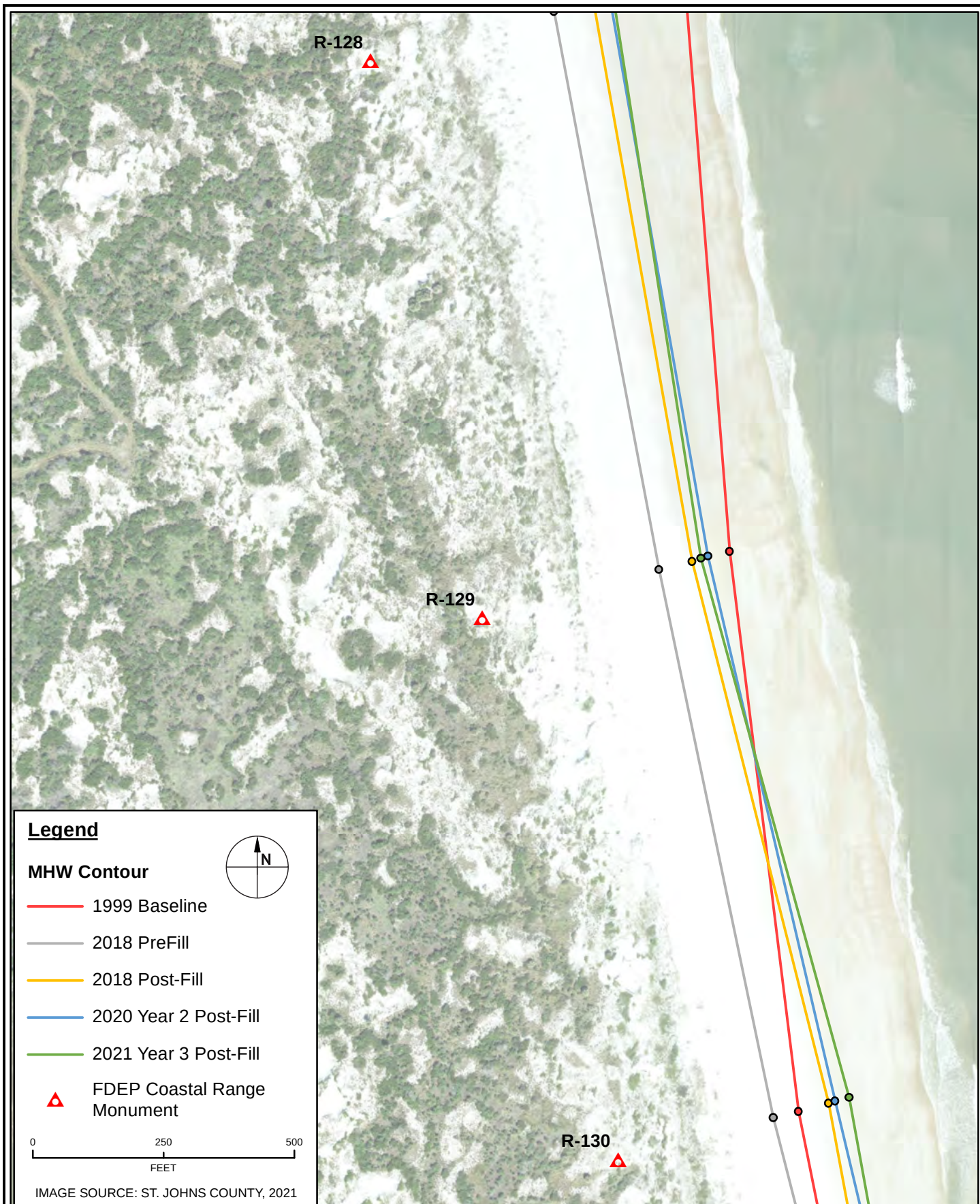
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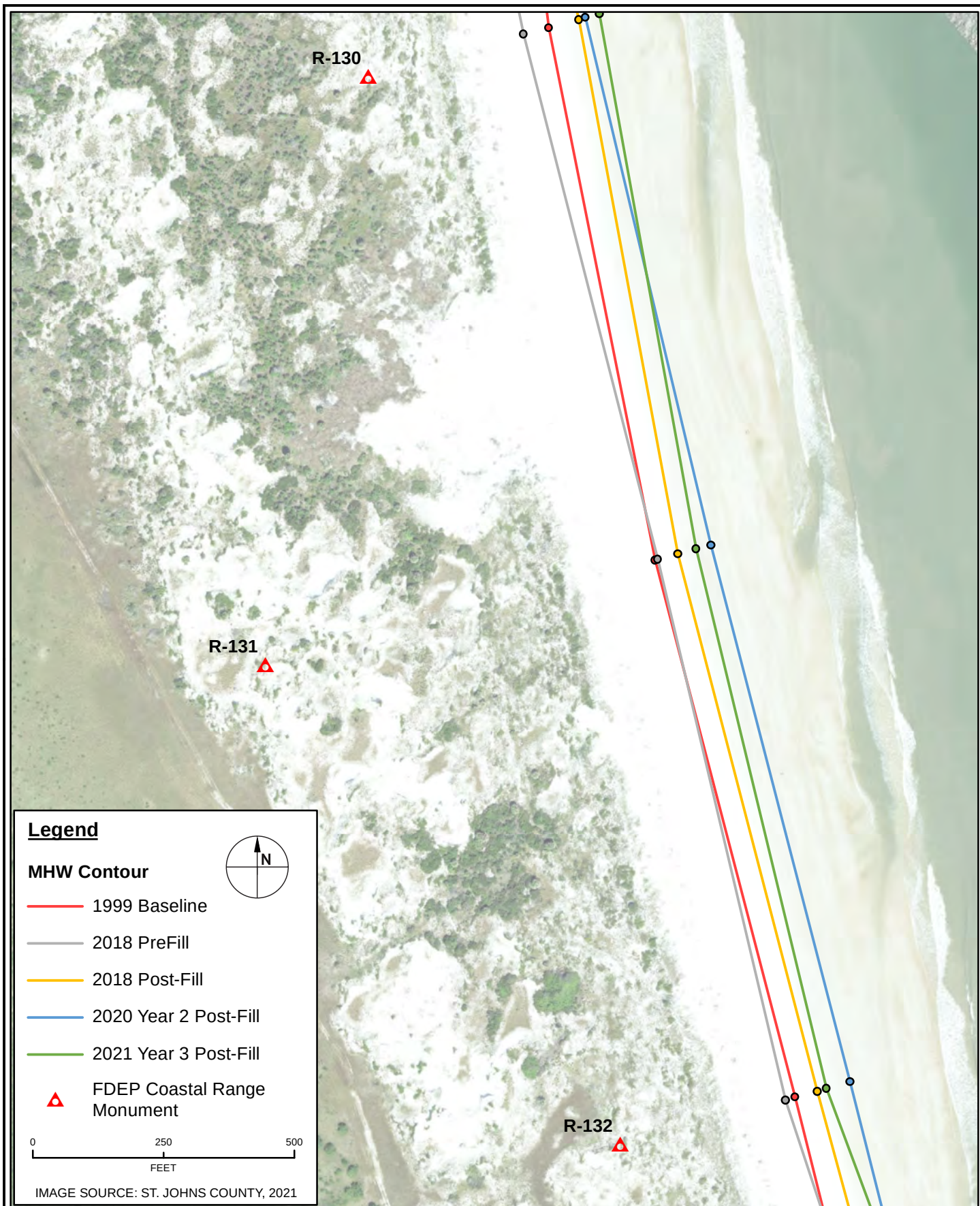
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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

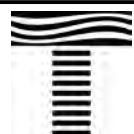
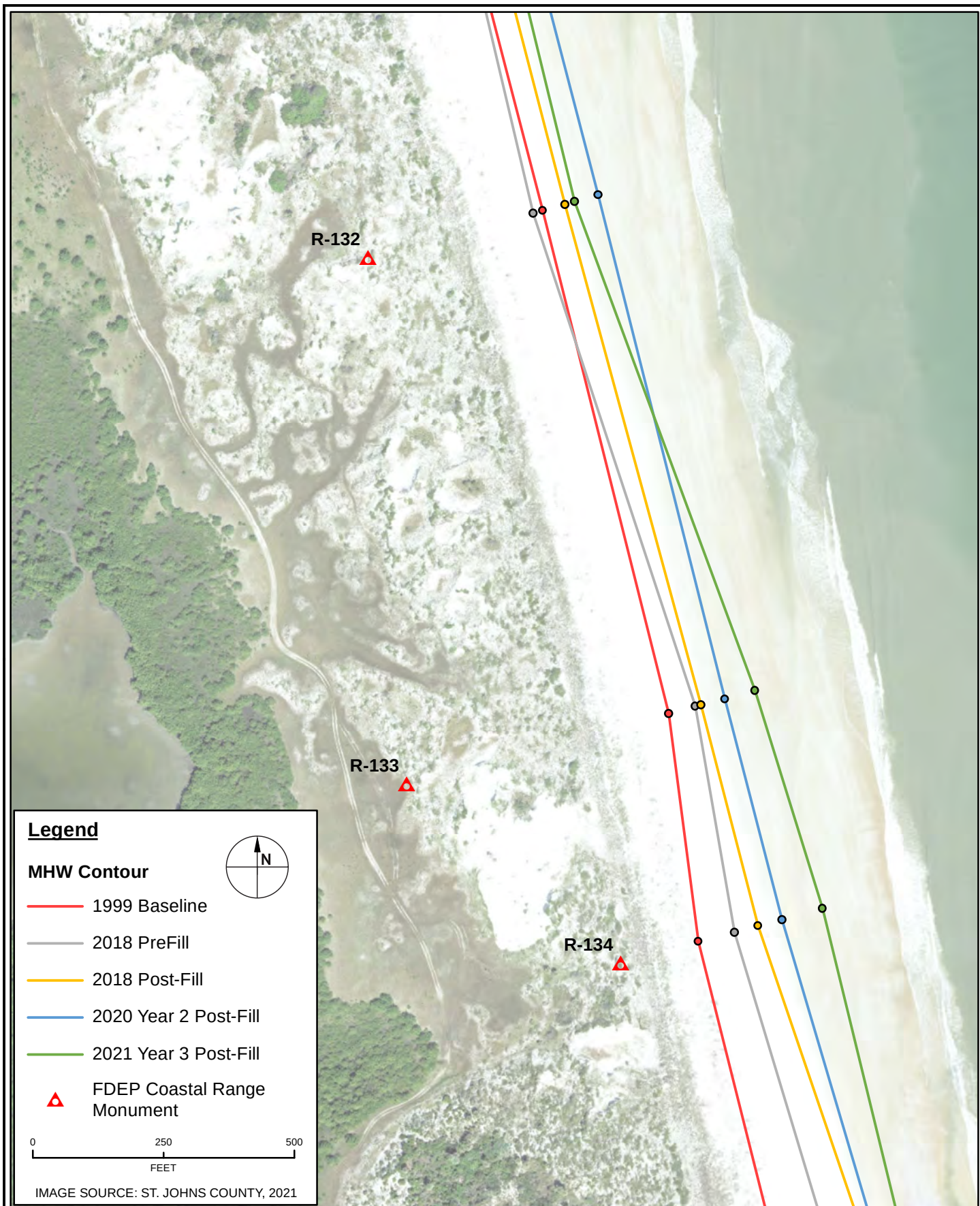
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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

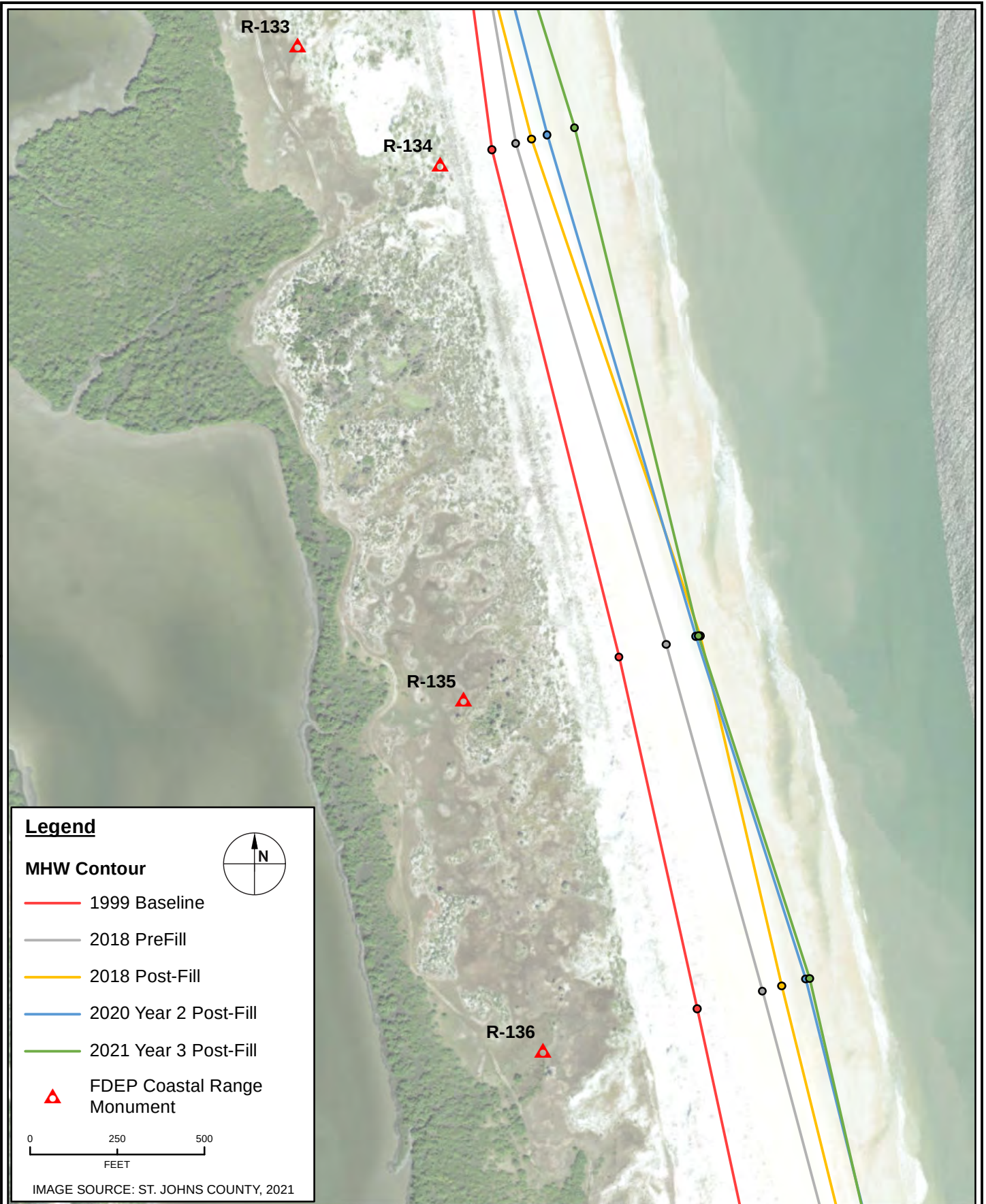
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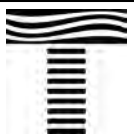
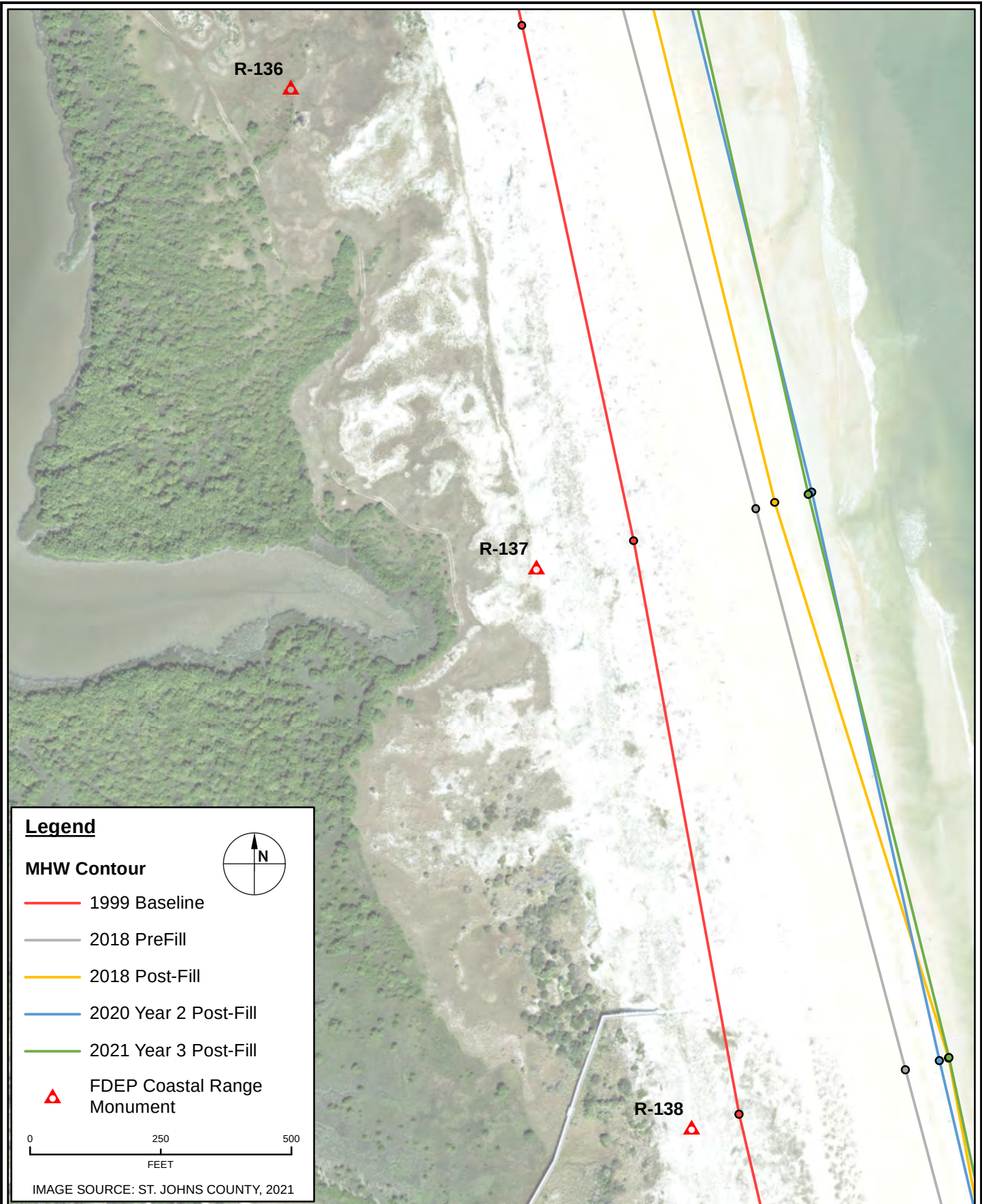
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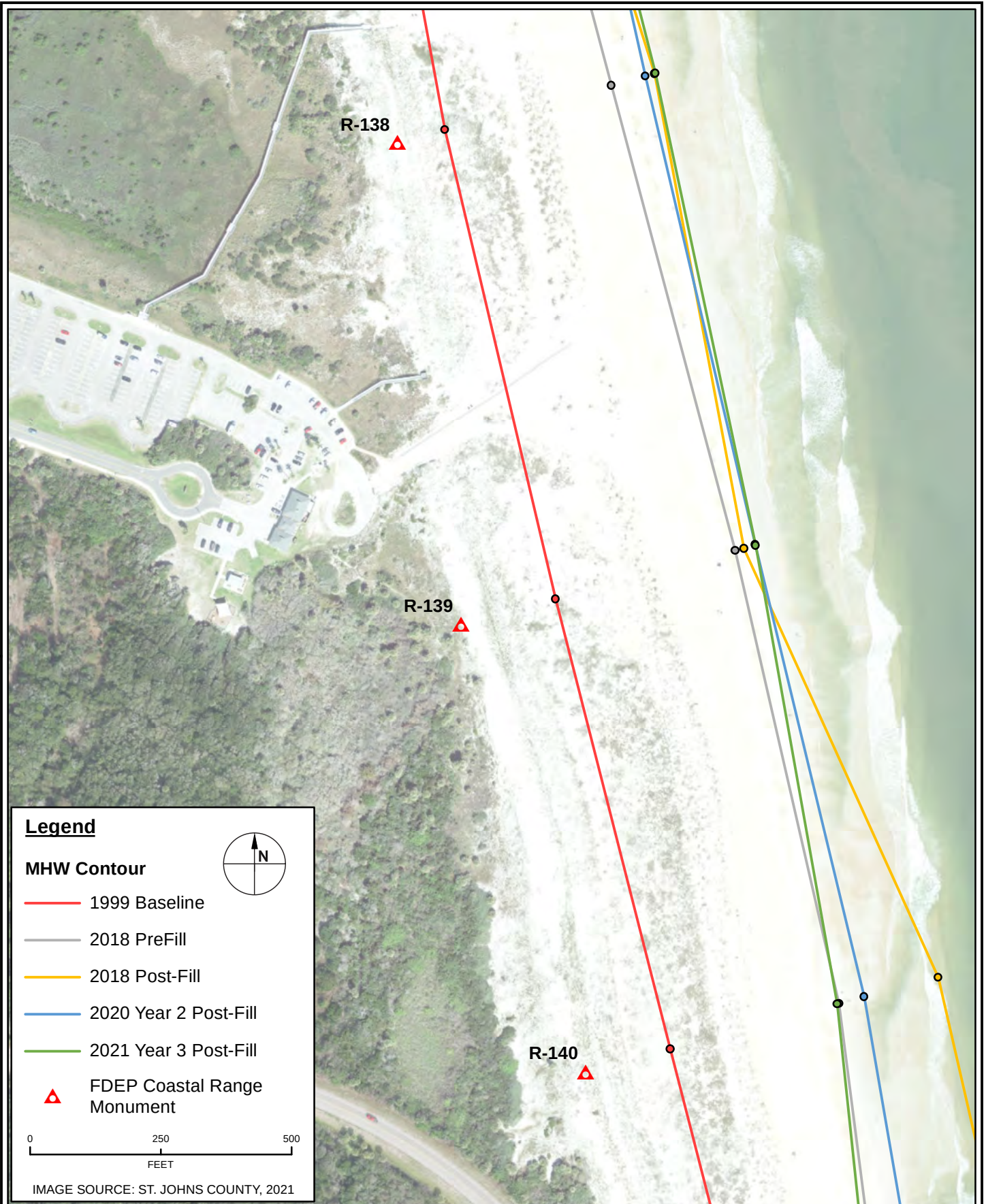
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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

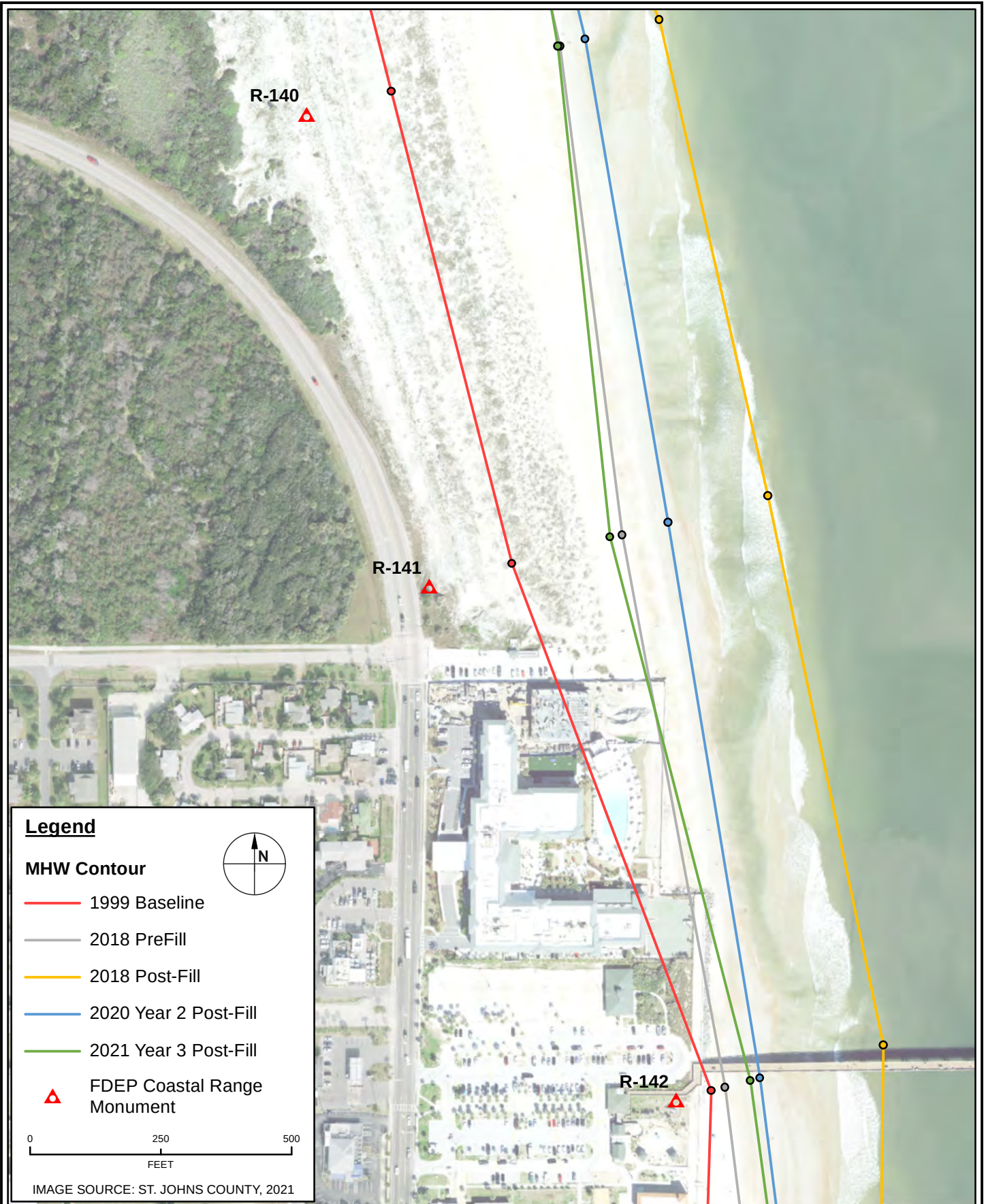
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Legend

MHW Contour

- 1999 Baseline
- 2018 PreFill
- 2018 Post-Fill
- 2020 Year 2 Post-Fill
- 2021 Year 3 Post-Fill

▲ FDEP Coastal Range Monument



0 250 500
FEET

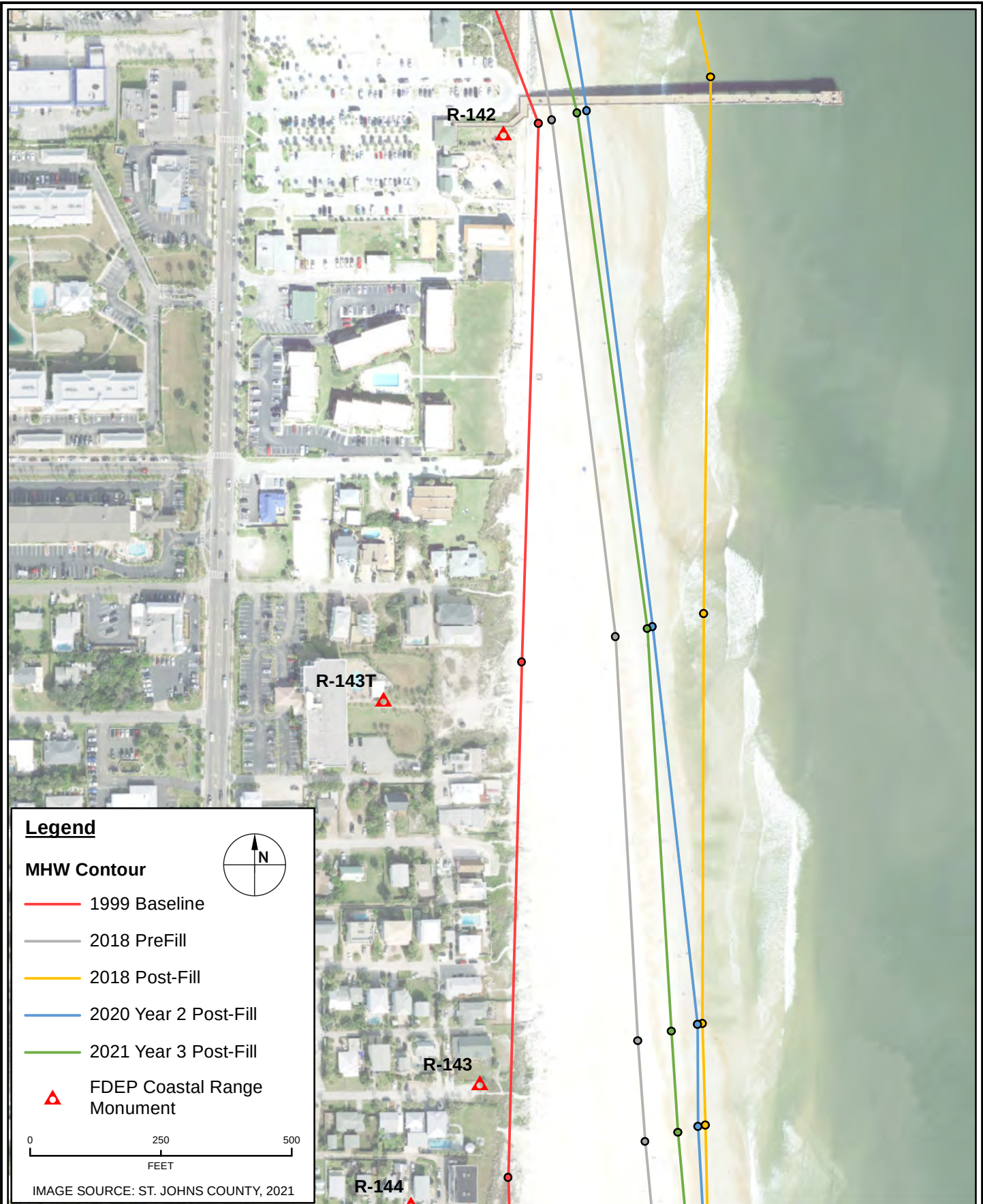
IMAGE SOURCE: ST. JOHNS COUNTY, 2021



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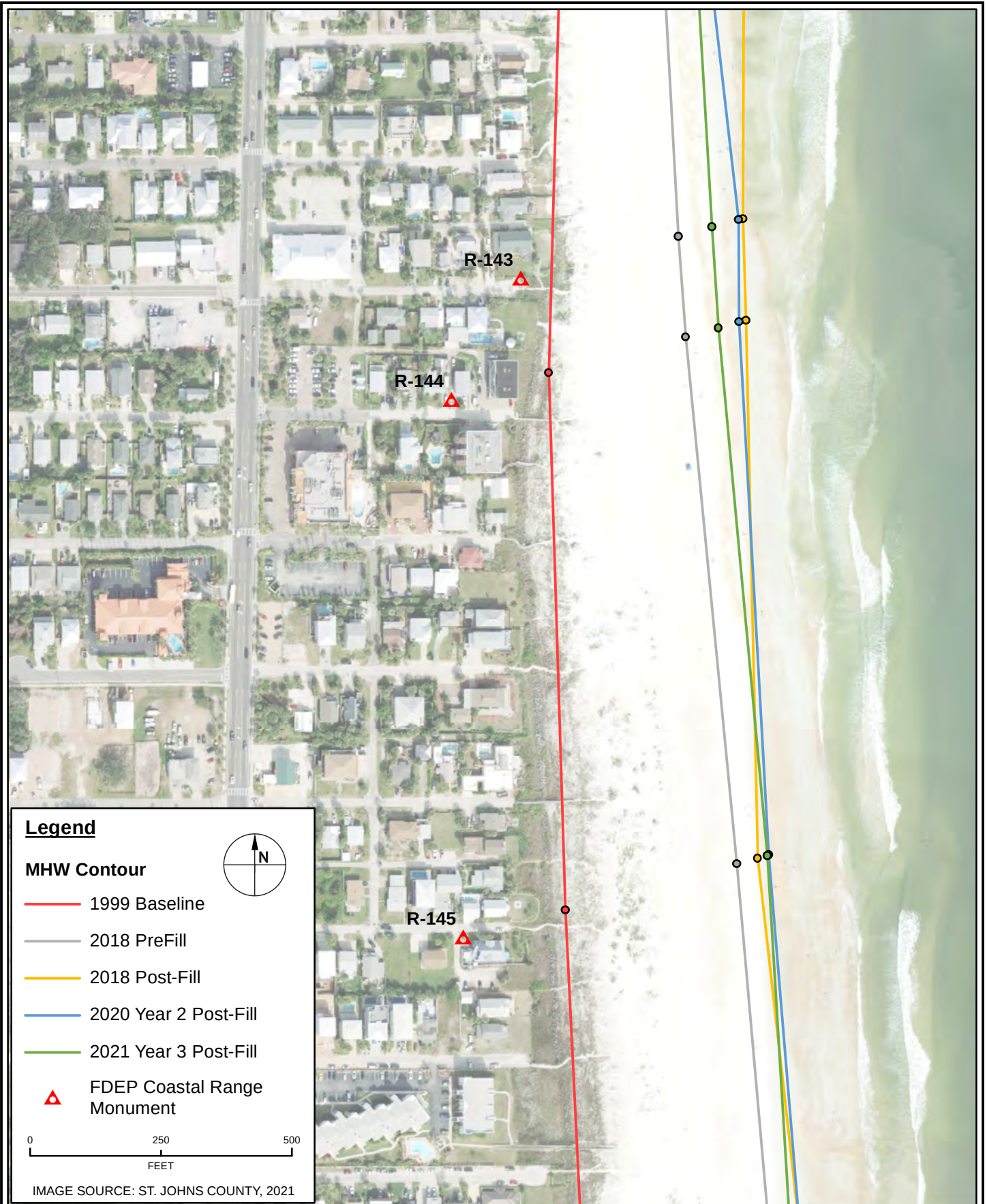
PROJECT	C2021-050
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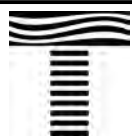
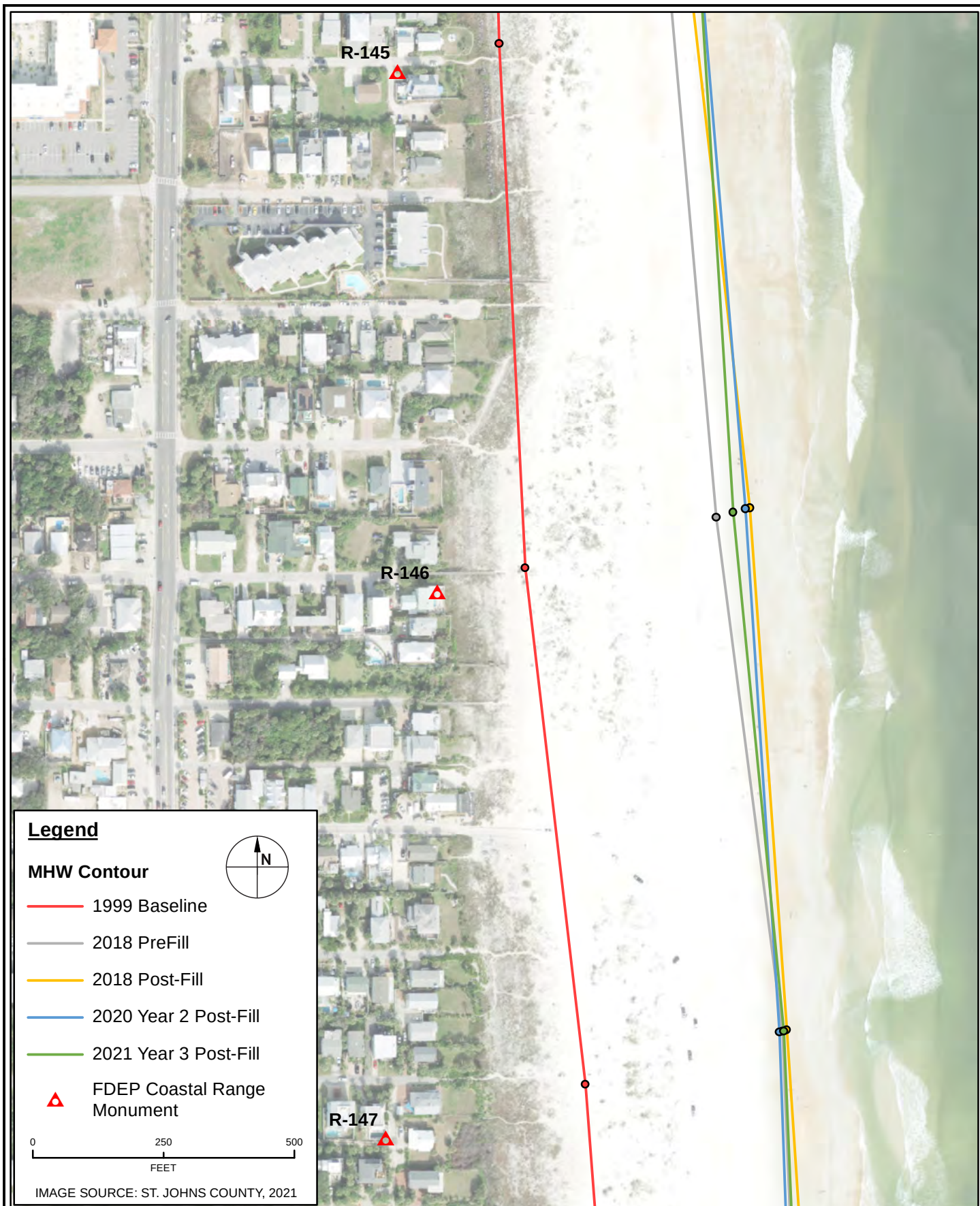
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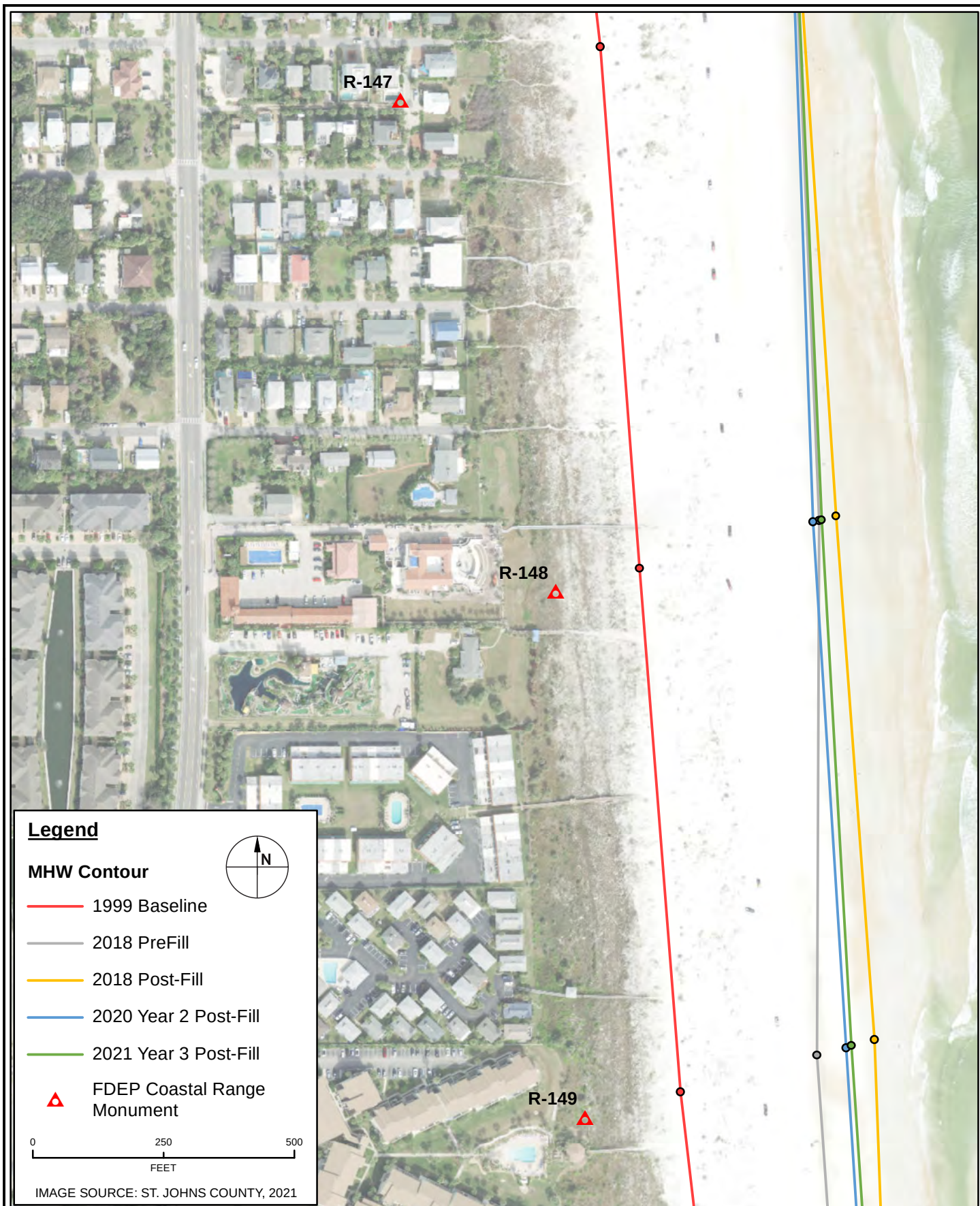
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 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

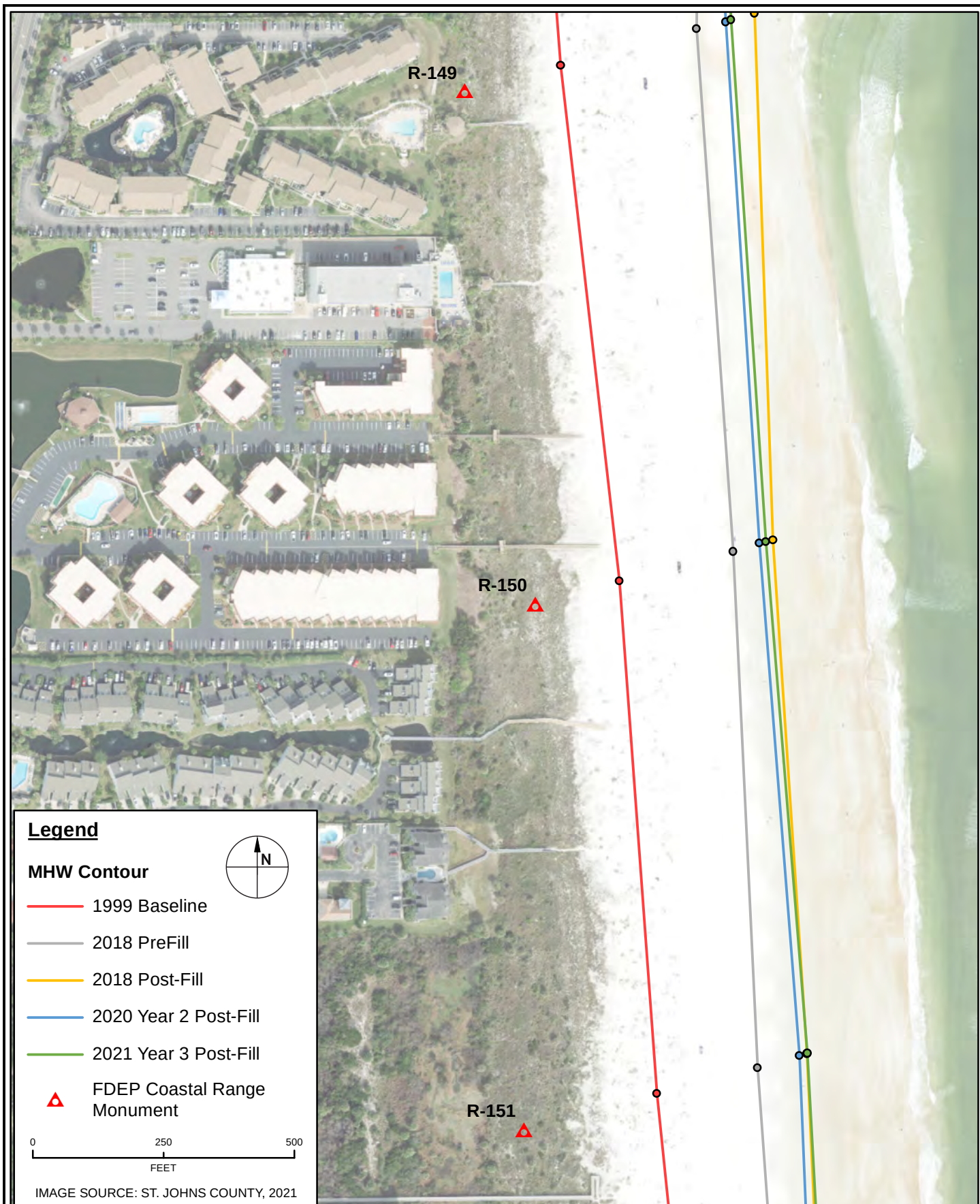
PROJECT	C2021-050
DRAWN BY	PL
SHEET	34 OF 39
DATE	JAN 2022



TAYLOR ENGINEERING INC.
10199 SOUTHSIDE BOULEVARD
SUITE 310
JACKSONVILLE, FL 32256
CERTIFICATE OF AUTHORIZATION # 4815

MEAN HIGH WATER CONTOURS
ST JOHNS COUNTY SHORE PROTECTION PROJECT
ST. JOHNS COUNTY, FLORIDA

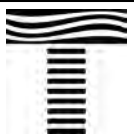
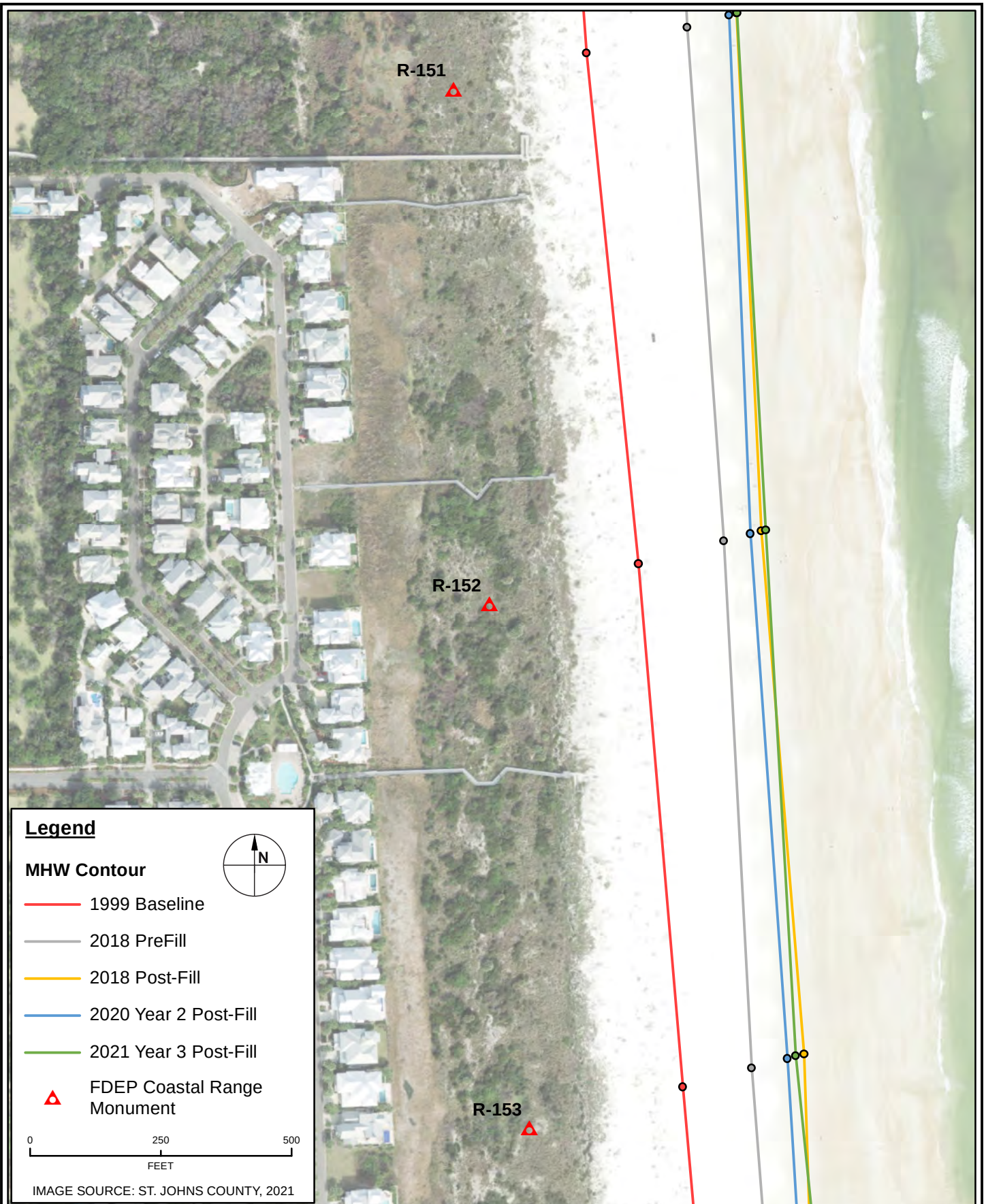
PROJECT	C2021-050
DRAWN BY	PL
SHEET	35 OF 39
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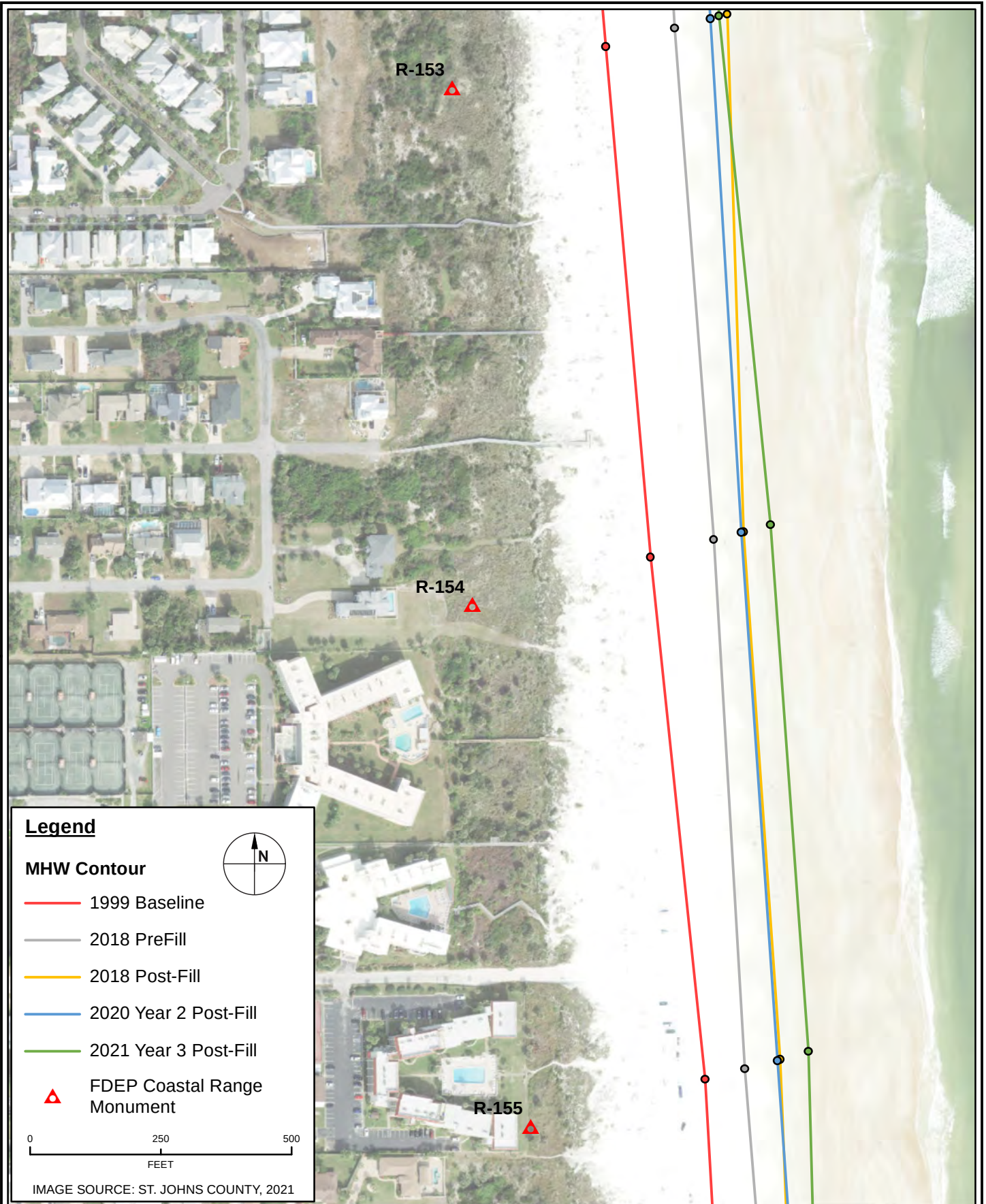
PROJECT	C2021-050
DRAWN BY	PL
SHEET	36 OF 39
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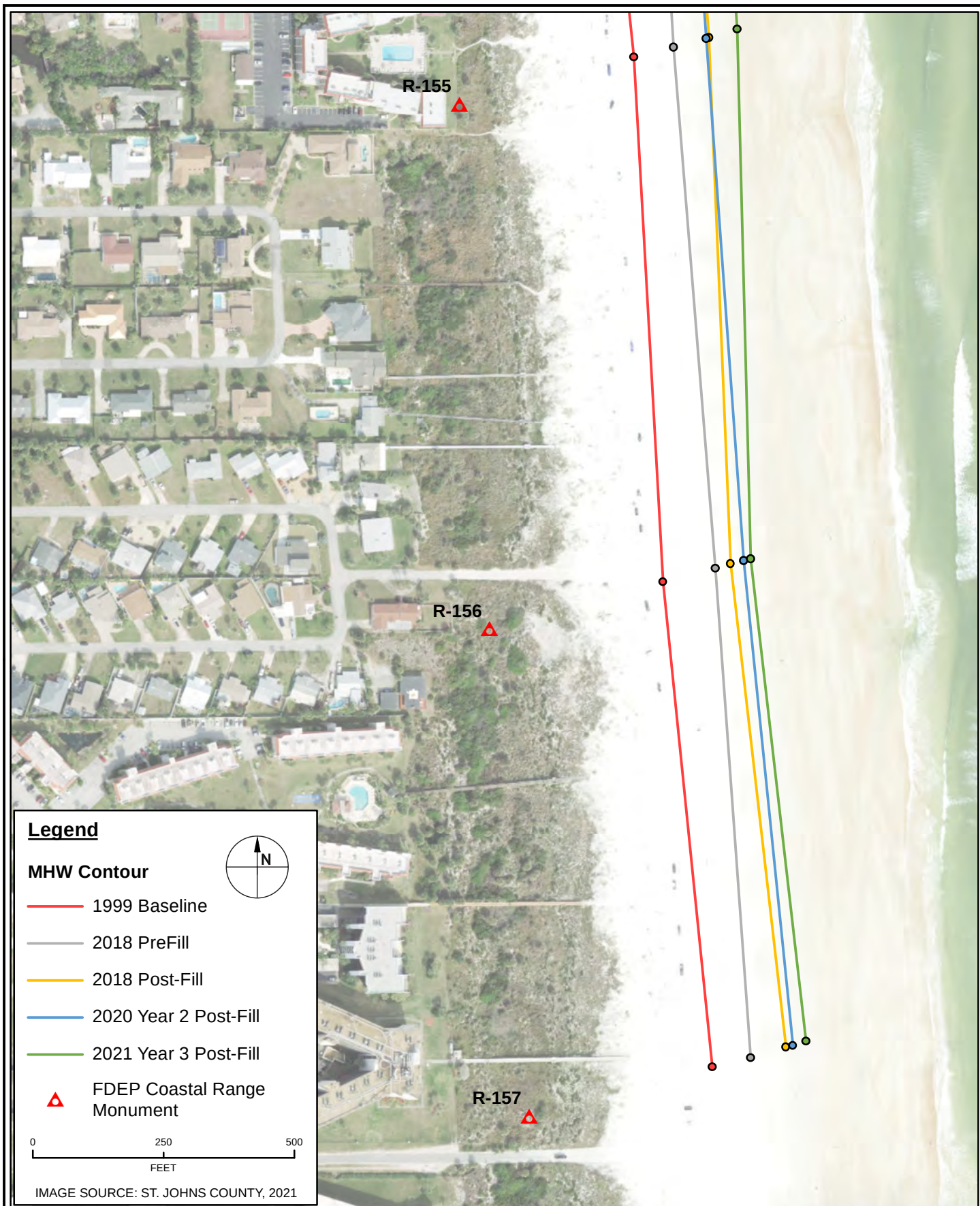
PROJECT	C2021-050
DRAWN BY	PL
SHEET	37 OF 39
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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

PROJECT	C2021-050
DRAWN BY	PL
SHEET	38 OF 39
DATE	JAN 2022



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MEAN HIGH WATER CONTOURS
 ST JOHNS COUNTY SHORE PROTECTION PROJECT
 ST. JOHNS COUNTY, FLORIDA

PROJECT	C2021-050
DRAWN BY	PL
SHEET	39 OF 39
DATE	JAN 2022

Appendix D

2021 Year Three Post-Construction Photographs



Figure D.1: St Johns County R-83 looking North (07/23/21)



Figure D.2: St Johns County R-83 looking East (07/23/21)



Figure D.3: St Johns County R-83 looking South (07/23/21)



Figure D.4: St Johns County R-83 looking West (07/23/21)



Figure D.5: St Johns County R-95 looking North (07/23/21)



Figure D.6: St Johns County R-95 looking East (07/23/21)



Figure D.7: St Johns County R-95 looking South (07/23/21)



Figure D.8: St Johns County R-95 looking West (07/23/21)



Figure D.9: St Johns County R-101 looking North (07/23/21)



Figure D.10: St Johns County R-101 looking East (07/23/21)



Figure D.11: St Johns County R-101 looking South (07/23/21)



Figure D.12: St Johns County R-101 looking West (07/23/21)



Figure D.13: St Johns County R-109 looking North (07/23/21)



Figure D.14: St Johns County R-109 looking East (07/23/21)



Figure D.15: St Johns County R-109 looking South (07/23/21)



Figure D.16: St Johns County R-109 looking West (07/23/21)



Figure D.17: St Johns County R-113 looking North (07/23/21)



Figure D.18: St Johns County R-113 looking East (07/23/21)



Figure D.19: St Johns County R-113 looking South (07/23/21)



Figure D.20: St Johns County R-113 looking West (07/23/21)



Figure D.21: St Johns County R-119 looking North (07/23/21)



Figure D.22: St Johns County R-119 looking East (07/23/21)



Figure D.23: St Johns County R-119 looking South (07/23/21)



Figure D.24: St Johns County R-119 looking West (07/23/21)



Figure D.25: St Johns County R-122 looking North (07/23/21)



Figure D.26: St Johns County R-122 looking East (07/23/21)



Figure D.27: St Johns County R-122 looking South (07/23/21)



Figure D.28: St Johns County R-122 looking West (07/23/21)



Figure D.29: St Johns County R-139 looking North (07/23/21)



Figure D.30: St Johns County R-139 looking East (07/23/21)



Figure D.31: St Johns County R-139 looking South (07/23/21)



Figure D.32: St Johns County R-139 looking West (07/23/21)



Figure D.33: St Johns County R-141 looking North (07/23/21)



Figure D.34: St Johns County R-141 looking East (07/23/21)



Figure D.35: St Johns County R-141 looking South (07/23/21)



Figure D.36: St Johns County R-141 looking West (07/23/21)



Figure D.37: St Johns County R-142 looking North (07/23/21)



Figure D.38: St Johns County R-142 looking East (07/23/21)



Figure D.39: St Johns County R-142 looking South (07/23/21)



Figure D.40: St Johns County R-142 looking West (07/23/21)



Figure D.41: St Johns County R-143 looking East (07/23/21)



Figure D.42: St Johns County R-143 looking South (07/23/21)



Figure D.43: St Johns County R-143 looking West (07/23/21)



Figure D.44: St Johns County R-143 looking North (07/23/21)



Figure D.45: St Johns County R-144 looking West (07/23/21)



Figure D.46: St Johns County R-144 looking North (07/23/21)



Figure D.47: St Johns County R-144 looking East (07/23/21)



Figure D.48: St Johns County R-144 looking South (07/23/21)



Figure D.49: St Johns County R-145 looking West (07/23/21)



Figure D.50: St Johns County R-145 looking North (07/23/21)



Figure D.51: St Johns County R-145 looking East (07/23/21)



Figure D.52: St Johns County R-145 looking South (07/23/21)



Figure D.53: St Johns County R-146 looking North (07/23/21)



Figure D.54: St Johns County R-146 looking East (07/23/21)



Figure D.55: St Johns County R-146 looking South (07/23/21)



Figure D.56: St Johns County R-146 looking West (07/23/21)



Figure D.57: St Johns County R-152 looking West (07/23/21)



Figure D.58: St Johns County R-152 looking North (07/23/21)



Figure D.59: St Johns County R-152 looking East (07/23/21)



Figure D.60: St Johns County R-152 looking South (07/23/21)



Figure D.61: St Johns County R-155 looking East (07/23/21)



Figure D.62: St Johns County R-155 looking South (07/23/21)



Figure D.63: St Johns County R-155 looking West (07/23/21)



Figure D.64: St Johns County R-155 looking North (07/23/21)

Appendix E

Beach Volume Changes

Table E.1 Dune to MHW Volume Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066.3	-	6.0	5.1	5.4
	R-81	1,063.8	-	7.5	5.0	4.8
	R-82	1,041.5	-	4.9	-3.5	0.8
	R-83	1,077.3	-	6.2	-8.8	-1.3
	R-84	1,067.7	-	4.8	-7.7	1.0
	R-85	1,031.8	-	1.4	-7.7	-2.6
	R-86	1,037.4	-	3.5	-8.0	-4.5
	R-87	1,049.3	-	4.9	-6.7	-3.7
	R-88	998.9	-	2.4	-7.2	-1.2
	R-89	991.3	-	-3.4	-9.6	-3.5
	R-90	1,035.8	-	-1.4	-5.6	-7.3
	R-91	1,049.1	-	3.0	3.3	2.7
	R-92	1,027.7	-	6.0	4.6	1.5
	R-93	1,010.3	-	12.1	3.6	2.4
	R-94	1,004.8	-	13.1	4.3	1.7
	R-95	1,016.3	-	8.6	-0.2	1.7
	R-96	1,033.9	-	1.2	-4.2	-4.5
	R-97	1,018.9	-	7.5	1.8	-0.8
	R-98	1,031.9	-	8.3	0.3	-0.8
	R-99	1,046.2	-	12.9	-3.4	-0.6
	R-100	1,039.4	-	11.0	-11.6	-2.7
	R-101	1,018.8	-	6.5	-3.4	-2.1
	R-102	995.7	-	7.1	-1.8	-3.2
	R-103	990.4	-	26.0	16.9	13.1
	T-104	991.6	-	32.1	21.4	19.4
	R-105	987.7	-	30.3	20.3	20.0
	R-106	1,048.1	-	22.3	17.7	18.0
	R-107	1,088.7	-	33.8	27.1	26.3
	R-108	1,038.1	-	38.2	34.2	33.6
	R-109	1,067.7	-	46.1	35.5	30.9
	T-110	1,092.9	-	52.5	27.4	27.9
	R-111	1,051.4	-	25.4	17.1	20.6
	R-112	1,023.8	-	43.1	25.5	27.4
	R-113	991.8	-	29.8	32.2	30.1
	R-114	1,047.3	-	26.7	27.0	32.1
	R-115	1,090.8	-	12.9	4.0	4.2
	R-116	1,090.3	-	16.7	5.1	5.1
	R-117	1,101.3	-9.0	17.4	7.7	6.4

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-118	1,092.5	-8.4	8.0	0.0	-2.4
	R-119	1,103.5	1.7	0.6	-3.2	-8.4
	R-120	1,090.0	6.8	0.0	-0.9	4.6
	R-121	1,089.4	-4.8	-2.9	-11.8	-9.4
	R-122	552.6	-33.9	8.7	3.7	-5.9
Porpoise Point	R-122A	279.1	-	-35.5	4.3	-12.6
	R-122B	551.2	-	-39.4	-7.4	-5.4
	R-122C	272.1	-	-17.0	-8.6	11.6
North Control Area	R-123	451.5	-	59.2	1.8	-11.3
	T-124	895.3	10.1	39.5	36.8	2.0
	R-125	1,006.6	7.9	75.6	50.8	8.5
	T-126	1,205.4	-21.9	71.9	44.0	16.5
	R-127	1,052.2	-47.9	41.0	22.7	3.7
	T-128	951.7	-25.2	35.6	12.7	5.6
	T-129	1,076.3	-6.1	13.0	7.7	4.6
	T-130	1,052.1	30.9	26.9	7.9	0.9
	R-131A	1,048.4	44.8	30.8	18.5	7.1
	T-132	1,026.1	38.0	24.4	12.0	1.5
	R-133	714.0	45.5	19.7	12.1	5.7
	R-134	968.5	63.0	30.3	19.4	8.2
	R-135	1,265.9	113.1	36.8	17.6	10.8
	R-136	1,019.9	128.0	30.8	15.3	7.6
Project Area	R-137A	1,043.8	142.3	46.2	26.0	1.2
	R-138	1,016.5	166.5	40.5	23.0	3.1
	R-139	921.1	146.8	32.2	11.5	-1.6
	R-140	910.7	137.3	46.4	-23.0	-14.3
	R-141	1,002.6	100.8	6.1	-81.3	-28.2
	R-142	1,029.3	3.6	2.7	-86.8	-14.5
	R-143T	966.1	65.9	27.3	-36.6	-9.0
	R-143	472.9	-	35.1	-12.3	-6.4
	R-144	972.0	98.8	33.2	-10.4	-6.7
	R-145	989.5	128.1	27.0	21.7	5.8
	R-146	982.3	148.7	20.8	9.0	7.5
	R-147	983.5	139.5	25.3	15.9	8.0
	R-148	984.8	121.5	22.9	7.5	7.2
	R-149	984.0	120.0	27.1	6.3	3.5
	R-150	973.3	93.3	17.4	1.2	5.6
	R-151	967.1	84.3	21.6	5.7	7.5
	R-152	978.6	70.8	24.9	13.3	8.0
	R-153	976.6	65.6	23.4	13.7	8.3

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
South Control Area	R-154	978.7	64.9	24.7	18.0	7.4
	R-155	988.1	56.6	29.1	22.8	10.1
	T-156	951.8	52.8	23.4	20.5	6.5
	T-157	976.1	49.6	22.7	13.8	6.4

Table E.2 MHW to -5 ft NAVD88 Volume Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066.3	-	9.8	3.8	0.9
	R-81	1,063.8	-	11.4	5.5	-8.6
	R-82	1,041.5	-	12.4	4.0	-3.1
	R-83	1,077.3	-	10.8	-0.1	-1.6
	R-84	1,067.7	-	7.7	1.2	0.2
	R-85	1,031.8	-	9.6	5.4	-3.1
	R-86	1,037.4	-	14.0	2.0	5.5
	R-87	1,049.3	-	14.0	-3.4	4.8
	R-88	998.9	-	20.0	4.4	5.8
	R-89	991.3	-	13.0	1.8	0.8
	R-90	1,035.8	-	16.3	8.9	-0.5
	R-91	1,049.1	-	18.3	8.7	12.7
	R-92	1,027.7	-	6.9	-4.7	0.5
	R-93	1,010.3	-	14.3	-0.2	-0.5
	R-94	1,004.8	-	11.3	-0.2	0.1
	R-95	1,016.3	-	15.0	0.3	4.8
	R-96	1,033.9	-	2.2	-7.7	-4.0
	R-97	1,018.9	-	3.6	-1.9	-7.9
	R-98	1,031.9	-	6.9	-0.7	5.3
	R-99	1,046.2	-	8.1	-5.3	9.2
	R-100	1,039.4	-	10.8	5.1	1.4
	R-101	1,018.8	-	14.4	11.4	5.1
	R-102	995.7	-	18.1	-0.2	6.5
	R-103	990.4	-	3.9	7.6	7.3
	T-104	991.6	-	30.1	10.8	10.5
	R-105	987.7	-	23.4	16.2	17.2
	R-106	1,048.1	-	15.1	14.6	13.6
	R-107	1,088.7	-	30.4	18.6	20.3
	R-108	1,038.1	-	28.7	26.0	26.4
	R-109	1,067.7	-	25.7	28.8	24.4
	T-110	1,092.9	-	31.3	35.9	28.0
	R-111	1,051.4	-	30.8	28.1	30.3
	R-112	1,023.8	-	46.7	27.7	37.9
	R-113	991.8	-	40.2	32.4	31.7
	R-114	1,047.3	-	17.9	23.0	22.2
	R-115	1,090.8	-	10.5	15.7	21.9
	R-116	1,090.3	-	10.9	10.9	15.8
	R-117	1,101.3	21.0	13.0	11.7	24.0

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-118	1,092.5	20.9	2.8	9.5	17.6
	R-119	1,103.5	21.6	6.6	10.0	15.2
	R-120	1,090.0	19.0	7.8	6.0	20.1
	R-121	1,089.4	-2.5	3.0	-9.9	0.6
	R-122	552.6	-29.3	1.7	-13.5	-10.2
Porpoise Point	R-122A	279.1	-	16.2	53.4	-21.8
	R-122B	551.2	-	-34.2	31.0	-27.5
	R-122C	272.1	-	-22.3	6.5	22.5
North Control Area	R-123	451.5	-	-36.3	-43.7	-39.6
	T-124	895.3	-10.2	-4.1	36.3	11.0
	R-125	1,006.6	29.7	25.1	-36.3	-40.3
	T-126	1,205.4	-32.4	36.9	54.6	6.1
	R-127	1,052.2	-71.9	29.7	33.9	19.2
	T-128	951.7	-58.1	0.6	4.9	0.5
	T-129	1,076.3	-10.8	21.5	15.6	7.8
	T-130	1,052.1	0.4	12.2	-5.7	-1.2
	R-131A	1,048.4	0.5	-1.0	-6.5	-12.7
	T-132	1,026.1	10.4	19.6	-3.2	-10.8
	R-133	714.0	27.6	-2.0	4.8	-0.9
	R-134	968.5	34.9	22.1	8.1	-2.3
	R-135	1,265.9	51.5	-2.3	-3.3	-11.1
	R-136	1,019.9	59.7	0.1	0.8	-2.6
Project Area	R-137A	1,043.8	66.8	-3.5	-5.0	-3.7
	R-138	1,016.5	88.7	-9.2	-19.1	-7.2
	R-139	921.1	83.9	-8.5	-33.7	-3.8
	R-140	910.7	75.6	-10.2	-48.3	-12.1
	R-141	1,002.6	60.2	-0.1	-66.5	-12.4
	R-142	1,029.3	32.8	12.8	-74.4	-9.5
	R-143T	966.1	68.7	-0.9	-49.3	-9.2
	R-143	472.9	-	0.5	-29.0	-10.3
	R-144	972.0	87.5	-7.8	-24.2	0.8
	R-145	989.5	97.9	-4.6	-18.3	0.6
	R-146	982.3	97.9	-8.1	-4.9	-0.5
	R-147	983.5	82.9	-14.6	-7.4	7.5
	R-148	984.8	83.3	3.8	10.3	-1.6
	R-149	984.0	89.2	9.0	-4.3	3.9
	R-150	973.3	72.4	14.1	4.3	3.5
	R-151	967.1	78.5	22.8	10.4	8.4
	R-152	978.6	64.6	10.5	3.6	4.8
	R-153	976.6	56.1	27.1	18.1	7.8

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
South Control Area	R-154	978.7	51.3	7.5	5.5	2.0
	R-155	988.1	34.9	22.4	1.4	2.7
	T-156	951.8	53.0	11.8	15.1	6.8
	T-157	976.1	51.8	25.6	23.8	7.7

Table E.3 -5 ft NAVD88 to -10 ft NAVD88 Volume Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066.3	-	-9.1	2.3	5.4
	R-81	1,063.8	-	-3.0	-1.2	5.5
	R-82	1,041.5	-	-0.6	-4.1	-6.5
	R-83	1,077.3	-	-4.7	-8.5	1.3
	R-84	1,067.7	-	-9.2	-16.6	-6.7
	R-85	1,031.8	-	-15.0	-8.9	-8.8
	R-86	1,037.4	-	-15.6	-8.9	-0.8
	R-87	1,049.3	-	-3.0	-3.5	2.8
	R-88	998.9	-	4.8	-1.1	9.7
	R-89	991.3	-	-7.8	-6.8	6.2
	R-90	1,035.8	-	-10.8	-20.1	-4.6
	R-91	1,049.1	-	3.1	3.8	13.2
	R-92	1,027.7	-	6.0	8.5	11.2
	R-93	1,010.3	-	-1.3	-0.5	6.4
	R-94	1,004.8	-	0.4	3.9	6.5
	R-95	1,016.3	-	-6.3	-2.2	3.4
	R-96	1,033.9	-	-12.9	-9.6	0.4
	R-97	1,018.9	-	-6.3	2.2	-2.3
	R-98	1,031.9	-	-11.9	0.5	7.5
	R-99	1,046.2	-	-9.8	-6.7	3.3
	R-100	1,039.4	-	-9.5	-2.6	5.9
	R-101	1,018.8	-	-1.7	2.1	13.9
	R-102	995.7	-	1.9	1.0	10.1
	R-103	990.4	-	10.8	18.9	15.9
	T-104	991.6	-	6.6	14.1	14.1
	R-105	987.7	-	13.0	25.3	27.2
	R-106	1,048.1	-	8.8	25.1	22.1
	R-107	1,088.7	-	12.5	30.1	29.1
	R-108	1,038.1	-	13.7	32.3	34.3
	R-109	1,067.7	-	17.9	30.0	36.8
	T-110	1,092.9	-	24.2	30.1	34.1
	R-111	1,051.4	-	3.9	20.4	28.7
	R-112	1,023.8	-	33.4	34.6	35.6
	R-113	991.8	-	29.5	40.0	30.4
	R-114	1,047.3	-	26.8	33.2	25.6
	R-115	1,090.8	-	20.8	32.2	20.9
	R-116	1,090.3	-	21.2	29.5	16.5
	R-117	1,101.3	30.8	22.6	32.5	29.9

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-118	1,092.5	24.9	15.9	28.1	32.0
	R-119	1,103.5	23.6	20.8	24.6	34.5
	R-120	1,090.0	15.5	17.9	20.0	26.9
	R-121	1,089.4	-85.2	11.9	7.5	7.8
	R-122	552.6	-52.4	69.6	65.0	54.9
Porpoise Point	R-122A	279.1	-	4.1	-6.5	-4.0
	R-122B	551.2	-	7.0	7.4	14.3
	R-122C	272.1	-	-16.5	-2.4	45.3
North Control Area	R-123	451.5	-	8.8	104.4	50.5
	T-124	895.3	-3.9	-3.1	-72.3	-70.9
	R-125	1,006.6	51.0	18.4	-24.7	-50.9
	T-126	1,205.4	-110.2	21.1	32.6	-7.1
	R-127	1,052.2	-88.3	8.0	7.7	4.0
	T-128	951.7	-51.0	-3.8	1.1	-4.6
	T-129	1,076.3	-26.8	14.4	4.2	5.2
	T-130	1,052.1	-4.9	15.2	5.7	8.3
	R-131A	1,048.4	4.7	-11.4	11.1	10.2
	T-132	1,026.1	-5.4	5.0	11.6	9.5
	R-133	714.0	21.2	-10.4	19.3	9.6
	R-134	968.5	30.6	-2.8	14.2	9.4
	R-135	1,265.9	17.2	-8.1	-7.2	6.0
	R-136	1,019.9	33.3	0.8	2.2	6.1
Project Area	R-137A	1,043.8	47.7	-1.0	10.7	6.6
	R-138	1,016.5	47.4	-7.9	6.3	7.5
	R-139	921.1	53.4	-7.6	-1.3	4.9
	R-140	910.7	45.2	-2.0	-17.0	-1.8
	R-141	1,002.6	25.9	-9.5	-33.4	-3.2
	R-142	1,029.3	21.1	-1.8	-42.9	2.4
	R-143T	966.1	38.8	-7.2	-23.3	-0.3
	R-143	472.9	-	-2.6	-13.4	-4.1
	R-144	972.0	61.4	-5.1	-13.1	-7.1
	R-145	989.5	54.5	-8.9	-8.1	0.9
	R-146	982.3	50.2	-14.7	-2.8	-2.9
	R-147	983.5	42.5	-13.0	-10.9	-4.6
	R-148	984.8	32.9	-20.1	-11.4	-10.5
	R-149	984.0	39.1	-20.2	-2.8	-2.0
	R-150	973.3	28.1	-7.7	-1.6	-11.5
	R-151	967.1	27.9	-15.0	-0.5	-4.0
	R-152	978.6	20.4	-14.5	-1.2	-8.3
	R-153	976.6	19.8	-7.6	-7.9	-6.7

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
South Control Area	R-154	978.7	17.4	-1.9	-6.2	-7.8
	R-155	988.1	11.5	5.1	1.8	-1.1
	T-156	951.8	21.3	-10.8	9.8	-2.7
	T-157	976.1	23.5	8.0	21.3	-1.6

Table E.4 -10 ft NAVD88 to -20 ft NAVD88 Volume Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066.3	-	25.3	12.2	7.2
	R-81	1,063.8	-	31.3	21.0	11.4
	R-82	1,041.5	-	17.2	1.9	1.5
	R-83	1,077.3	-	18.0	13.5	2.6
	R-84	1,067.7	-	41.9	14.4	9.2
	R-85	1,031.8	-	9.3	5.7	25.8
	R-86	1,037.4	-	27.3	11.7	20.2
	R-87	1,049.3	-	36.4	15.1	10.9
	R-88	998.9	-	39.4	23.7	10.0
	R-89	991.3	-	30.9	22.1	17.2
	R-90	1,035.8	-	-2.7	-14.2	-1.5
	R-91	1,049.1	-	26.6	12.8	6.6
	R-92	1,027.7	-	18.0	1.9	-2.2
	R-93	1,010.3	-	23.0	5.1	-0.5
	R-94	1,004.8	-	21.5	1.8	-0.7
	R-95	1,016.3	-	13.2	-8.0	2.6
	R-96	1,033.9	-	13.4	-2.8	5.4
	R-97	1,018.9	-	18.6	10.5	4.5
	R-98	1,031.9	-	8.6	11.2	-2.2
	R-99	1,046.2	-	12.8	9.7	4.9
	R-100	1,039.4	-	6.6	5.4	-2.9
	R-101	1,018.8	-	14.3	19.6	2.3
	R-102	995.7	-	16.7	23.5	1.4
	R-103	990.4	-	29.3	23.6	3.6
	T-104	991.6	-	10.5	9.5	0.5
	R-105	987.7	-	29.0	27.7	12.8
	R-106	1,048.1	-	19.2	25.1	9.8
	R-107	1,088.7	-	37.3	20.5	13.0
	R-108	1,038.1	-	25.0	19.1	14.9
	R-109	1,067.7	-	39.9	24.6	20.6
	T-110	1,092.9	-	43.8	33.1	20.6
	R-111	1,051.4	-	17.7	27.0	26.8
	R-112	1,023.8	-	48.4	44.0	42.4
	R-113	991.8	-	71.2	61.3	24.0
	R-114	1,047.3	-	44.1	40.6	45.8
	R-115	1,090.8	-	32.5	23.6	23.8
	R-116	1,090.3	-	36.2	16.6	26.5
	R-117	1,101.3	22.6	40.8	17.5	16.6

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep ‘98/ Apr ‘99–Sep ‘21)	2018 Pre-Fill – 2021 Year 3 (Dec ‘17– Sep ‘21)	2018 Post-Fill – 2021 Year 3 (Jul ‘18– Sep ‘21)	2020 Year 2 – 2021 Year 3 (Aug ‘20– Sep ‘21)
	R-118	1,092.5	13.6	38.6	13.8	8.9
	R-119	1,103.5	-0.8	68.5	21.1	7.9
	R-120	1,090.0	12.4	105.6	48.6	17.3
	R-121	1,089.4	41.2	-23.8	-46.3	23.0
	R-122	552.6	-18.8	10.5	1.3	-3.1
Porpoise Point	R-122A	279.1	-	29.5	43.7	43.9
	R-122B	551.2	-	-5.3	11.2	-24.0
	R-122C	272.1	-	-21.9	-51.0	-4.8
North Control Area	R-123	451.5	-	-69.3	-52.3	-60.8
	T-124	895.3	56.6	13.3	26.2	1.2
	R-125	1,006.6	-70.8	90.4	64.2	55.1
	T-126	1,205.4	-277.8	115.7	95.0	53.2
	R-127	1,052.2	-152.5	40.9	59.5	33.8
	T-128	951.7	-130.6	67.4	41.9	15.2
	T-129	1,076.3	-76.3	-10.9	9.2	-3.7
	T-130	1,052.1	-28.9	18.0	0.4	-5.4
	R-131A	1,048.4	-9.5	-1.9	-5.1	-8.6
	T-132	1,026.1	20.6	10.5	0.1	-6.9
	R-133	714.0	31.7	14.8	18.8	4.3
	R-134	968.5	39.5	5.7	4.9	-8.4
	R-135	1,265.9	29.6	-4.9	-2.9	-12.4
	R-136	1,019.9	30.0	10.6	1.8	-4.6
Project Area	R-137A	1,043.8	43.9	11.4	6.0	-4.9
	R-138	1,016.5	89.7	9.2	3.1	-3.3
	R-139	921.1	111.9	2.8	3.0	-7.4
	R-140	910.7	108.8	2.5	-1.3	-8.8
	R-141	1,002.6	71.2	11.9	-7.5	-11.3
	R-142	1,029.3	62.7	23.3	-7.7	8.8
	R-143T	966.1	81.6	3.5	3.7	-4.6
	R-143	472.9	-	16.4	2.1	0.5
	R-144	972.0	150.9	12.7	5.8	-1.3
	R-145	989.5	126.1	18.3	5.7	9.6
	R-146	982.3	131.5	6.8	1.0	-5.4
	R-147	983.5	116.0	20.5	9.2	-7.0
	R-148	984.8	100.4	5.8	12.9	-1.5
	R-149	984.0	112.5	27.5	18.2	1.6
	R-150	973.3	91.1	23.2	18.9	-8.3
	R-151	967.1	95.8	30.3	16.7	-1.3
	R-152	978.6	87.5	31.0	19.0	-14.9
	R-153	976.6	100.6	42.9	28.5	10.4

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
South Control Area	R-154	978.7	93.2	51.3	32.1	1.4
	R-155	988.1	96.5	54.7	30.7	4.6
	T-156	951.8	86.3	52.5	25.2	-2.2
	T-157	976.1	81.8	43.6	23.7	-14.9

Table E.5 -20 ft NAVD88 to Profile Extent Volume Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066.3	-	17.6	-47.7	19.5
	R-81	1,063.8	-	24.3	-36.3	33.5
	R-82	1,041.5	-	33.7	-33.8	27.0
	R-83	1,077.3	-	37.1	-15.8	23.8
	R-84	1,067.7	-	-3.4	-37.4	30.6
	R-85	1,031.8	-	-37.2	-75.1	-7.0
	R-86	1,037.4	-	2.6	-30.1	24.9
	R-87	1,049.3	-	37.4	-30.2	24.3
	R-88	998.9	-	-3.5	-66.3	7.7
	R-89	991.3	-	38.1	-51.0	26.4
	R-90	1,035.8	-	10.1	-60.9	23.0
	R-91	1,049.1	-	58.3	-5.5	30.5
	R-92	1,027.7	-	41.8	-18.2	6.2
	R-93	1,010.3	-	13.7	-29.9	21.9
	R-94	1,004.8	-	5.5	-36.8	17.7
	R-95	1,016.3	-	58.9	-16.1	9.3
	R-96	1,033.9	-	-3.4	-77.3	7.6
	R-97	1,018.9	-	28.8	-57.2	2.5
	R-98	1,031.9	-	42.6	23.3	23.3
	R-99	1,046.2	-	40.9	21.1	28.0
	R-100	1,039.4	-	45.2	12.8	29.8
	R-101	1,018.8	-	45.8	37.0	-0.3
	R-102	995.7	-	13.1	2.6	-8.7
	R-103	990.4	-	3.7	-2.1	-0.6
	T-104	991.6	-	46.0	18.5	10.7
	R-105	987.7	-	18.8	8.6	-46.1
	R-106	1,048.1	-	42.4	38.5	-9.8
	R-107	1,088.7	-	77.0	23.8	-3.8
	R-108	1,038.1	-	38.7	8.3	-4.6
	R-109	1,067.7	-	81.1	20.5	-4.4
	T-110	1,092.9	-	54.7	21.5	-0.2
	R-111	1,051.4	-	23.1	-9.5	-8.2
	R-112	1,023.8	-	63.9	46.1	4.7
	R-113	991.8	-	19.4	-4.1	-4.6
	R-114	1,047.3	-	43.7	29.7	-4.7
	R-115	1,090.8	-	53.1	30.2	-1.2
	R-116	1,090.3	-	54.0	26.6	2.0
	R-117	1,101.3	-12.7	91.3	24.2	1.2

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-118	1,092.5	13.4	43.2	30.4	5.1
	R-119	1,103.5	30.4	60.5	16.3	2.5
	R-120	1,090.0	0.0	0.0	0.0	0.0
	R-121	1,089.4	0.0	0.0	0.0	0.0
	R-122	552.6	0.0	0.0	0.0	0.0
Porpoise Point	R-122A	279.1	-	73.7	42.6	16.2
	R-122B	551.2	-	-31.5	13.1	-34.0
	R-122C	272.1	-	-4.1	-33.4	-116.6
North Control Area	R-123	451.5	-	0.0	0.0	0.0
	T-124	895.3	0.0	0.0	0.0	0.0
	R-125	1,006.6	0.0	2.8	1.9	0.5
	T-126	1,205.4	-0.1	1.6	0.4	2.1
	R-127	1,052.2	-0.4	1.7	2.2	0.7
	T-128	951.7	0.0	6.1	0.7	0.3
	T-129	1,076.3	12.9	28.7	18.2	3.2
	T-130	1,052.1	-17.0	25.8	9.6	-10.8
	R-131A	1,048.4	-44.7	31.8	19.7	1.8
	T-132	1,026.1	-0.1	-14.4	-31.7	-17.6
	R-133	714.0	-112.8	33.2	26.1	-30.3
	R-134	968.5	-49.7	46.7	34.6	15.8
	R-135	1,265.9	-30.6	8.7	-8.3	-17.6
	R-136	1,019.9	-56.2	41.3	35.6	-9.6
Project Area	R-137A	1,043.8	-76.5	14.4	5.0	-18.1
	R-138	1,016.5	-73.9	37.2	27.7	-17.6
	R-139	921.1	-84.9	18.1	9.9	-13.3
	R-140	910.7	-34.7	32.6	20.1	-11.7
	R-141	1,002.6	-14.8	39.1	27.6	-8.7
	R-142	1,029.3	-38.4	42.7	23.7	-24.6
	R-143T	966.1	-42.3	24.3	20.8	-16.6
	R-143	472.9	-	38.5	18.1	-16.6
	R-144	972.0	44.9	23.6	15.2	-23.7
	R-145	989.5	-48.9	44.3	8.7	-18.0
	R-146	982.3	27.5	28.8	18.1	-5.8
	R-147	983.5	-19.2	48.6	27.3	0.6
	R-148	984.8	52.5	21.0	25.2	-5.3
	R-149	984.0	13.1	41.7	21.8	-12.1
	R-150	973.3	28.6	20.2	17.0	-19.2
	R-151	967.1	62.4	44.3	15.9	-20.7
	R-152	978.6	60.1	14.1	16.7	-26.9
	R-153	976.6	93.9	40.9	22.9	-4.6

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
South Control Area	R-154	978.7	88.6	34.8	19.9	-19.9
	R-155	988.1	113.7	45.8	18.3	-13.4
	T-156	951.8	112.6	36.0	29.4	-21.8
	T-157	976.1	128.9	30.8	12.1	-35.7

Table E.6 Total Volume Changes

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
Vilano Beach	R-80	1,066.3	-	49.6	-24.3	38.5
	R-81	1,063.8	-	71.6	-6.0	46.6
	R-82	1,041.5	-	67.7	-35.4	19.8
	R-83	1,077.3	-	67.4	-19.8	24.8
	R-84	1,067.7	-	41.7	-46.0	34.3
	R-85	1,031.8	-	-31.9	-80.6	4.3
	R-86	1,037.4	-	31.8	-33.4	45.2
	R-87	1,049.3	-	89.8	-28.7	39.1
	R-88	998.9	-	63.1	-46.5	31.9
	R-89	991.3	-	70.8	-43.4	47.2
	R-90	1,035.8	-	11.6	-91.9	9.0
	R-91	1,049.1	-	109.3	23.0	65.8
	R-92	1,027.7	-	78.7	-7.8	17.3
	R-93	1,010.3	-	61.7	-21.9	29.7
	R-94	1,004.8	-	51.8	-26.9	25.4
	R-95	1,016.3	-	89.4	-26.2	21.7
	R-96	1,033.9	-	0.6	-101.6	4.9
	R-97	1,018.9	-	52.3	-44.5	-4.0
	R-98	1,031.9	-	54.4	34.5	33.2
	R-99	1,046.2	-	64.9	15.5	44.7
	R-100	1,039.4	-	64.2	9.2	31.5
	R-101	1,018.8	-	79.3	66.7	18.9
	R-102	995.7	-	56.9	25.0	6.1
	R-103	990.4	-	73.8	65.0	39.3
	T-104	991.6	-	125.4	74.2	55.2
	R-105	987.7	-	114.4	98.1	31.1
	R-106	1,048.1	-	107.9	121.0	53.7
	R-107	1,088.7	-	191.1	120.2	84.9
	R-108	1,038.1	-	144.4	120.0	104.7
	R-109	1,067.7	-	210.7	139.3	108.4
	T-110	1,092.9	-	206.6	148.0	110.3
	R-111	1,051.4	-	100.9	83.1	98.2
	R-112	1,023.8	-	235.4	177.8	148.1
	R-113	991.8	-	190.1	161.8	111.7
	R-114	1,047.3	-	159.2	153.5	120.9
	R-115	1,090.8	-	129.8	105.7	69.6
	R-116	1,090.3	-	139.1	88.7	65.8
	R-117	1,101.3	52.7	185.0	93.6	78.1

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
	R-118	1,092.5	64.4	108.5	81.8	61.1
	R-119	1,103.5	76.5	156.9	68.8	51.7
	R-120	1,090.0	53.7	131.3	73.7	68.8
	R-121	1,089.4	-51.2	-11.8	-60.5	22.0
	R-122	552.6	-134.5	90.5	56.4	35.7
Porpoise Point	R-122A	279.1	-	88.0	137.4	21.6
	R-122B	551.2	-	-103.4	55.3	-76.6
	R-122C	272.1	-	-81.7	-88.8	-42.0
North Control Area	R-123	451.5	-	-37.6	10.2	-61.3
	T-124	895.3	52.6	45.6	27.0	-56.8
	R-125	1,006.6	17.8	212.3	55.9	-27.1
	T-126	1,205.4	-442.3	247.3	226.5	70.9
	R-127	1,052.2	-360.9	121.3	126.1	61.4
	T-128	951.7	-264.9	105.9	61.4	17.0
	T-129	1,076.3	-107.2	66.8	54.9	17.1
	T-130	1,052.1	-19.5	98.0	17.9	-8.2
	R-131A	1,048.4	-4.2	48.3	37.7	-2.1
	T-132	1,026.1	63.5	45.0	-11.1	-24.2
	R-133	714.0	13.2	55.3	81.0	-11.6
	R-134	968.5	118.3	102.0	81.3	22.7
	R-135	1,265.9	180.7	30.1	-4.1	-24.3
	R-136	1,019.9	194.8	83.5	55.6	-3.1
Project Area	R-137A	1,043.8	224.1	67.6	42.8	-18.9
	R-138	1,016.5	318.5	69.9	40.9	-17.6
	R-139	921.1	311.0	37.1	-10.6	-21.2
	R-140	910.7	332.3	69.3	-69.6	-48.8
	R-141	1,002.6	243.3	47.5	-161.0	-63.7
	R-142	1,029.3	81.9	79.7	-188.0	-37.4
	R-143T	966.1	212.8	47.0	-84.8	-39.6
	R-143	472.9	-	88.0	-34.4	-36.8
	R-144	972.0	443.5	56.6	-26.8	-38.0
	R-145	989.5	357.7	76.2	9.7	-1.0
	R-146	982.3	455.7	33.6	20.4	-7.1
	R-147	983.5	361.8	66.7	34.1	4.5
	R-148	984.8	390.7	33.5	44.5	-11.7
	R-149	984.0	373.9	85.1	39.2	-5.1
	R-150	973.3	313.5	67.2	39.8	-29.9
	R-151	967.1	348.9	104.0	48.2	-10.1
	R-152	978.6	303.5	66.1	51.4	-37.3
	R-153	976.6	336.1	126.7	75.2	15.3

Area Details	FDEP Reference Monument	Controlling Distance (ft)	Volume Change (cy/ft)			
			1998/99 Baseline –2021 Year 3 (Sep '98/ Apr '99–Sep '21)	2018 Pre-Fill – 2021 Year 3 (Dec '17– Sep '21)	2018 Post-Fill – 2021 Year 3 (Jul '18– Sep '21)	2020 Year 2 – 2021 Year 3 (Aug '20– Sep '21)
South Control Area	R-154	978.7	315.3	116.4	69.3	-17.0
	R-155	988.1	313.2	157.0	75.0	2.9
	T-156	951.8	326.1	113.0	99.9	-13.3
	T-157	976.1	335.6	130.7	94.7	-38.1