US Army Corps
of Engineers ®
Wilmington District

General Re-evaluation Report and Environmental
Surf City, Onslow and Pender Counties, North Carolina
Coastal Storm Risk Management Project

Appendix D: Adaptation Strategy

Final

February 2025

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1.0 Introduction

The Wilmington District, U.S. Army Corps of Engineers (USACE) has prepared an adaptation plan to manage the future impacts of sea-level change (SLC) for the Recommended Plan at Surf City. The following presents updated information on existing and future conditions for sea-level change within the project, and recommendations to address the issue.

2.0 Background

The Authorized Project template presented in the 2010 integrated feasibility and environmental impact statement for the Surf City/North Topsail Beach (SCNTB) Coastal Storm Risk Management (CSMR) project was designed to be at an elevation of 6-feet NAVD88, with a dune elevation of 14-feet NAVD88 and a dune crest width of 25-feet (**Figure 1**).

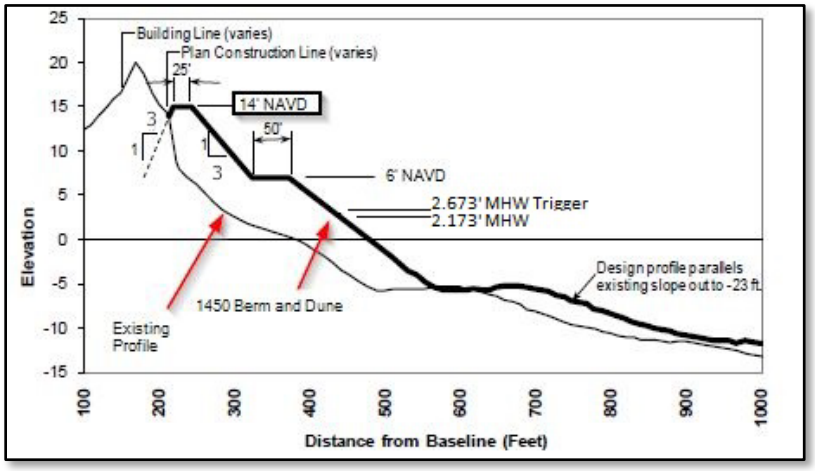
The Authorized Plan and the certified cost estimate included a +/-6- inch tolerance (raise) on the profile berm elevation in its analysis. Adaptation actions for the Recommended Plan were constrained due to the limited scope for this study which included no updated ot new modeling of different profile scenarios (see **Appendix M**).

Sensitivity to sea-level change for the Authorized Plan was calculated using National Research Council (NRC) curves 1 and 3 and evaluated over the 50-year economic benefits planning horizon. Conclusions reached during this analysis included:

The historical rate of relative sea-level change for this project was found to be .008 ft/year as observed between 1953 and 1993.

- The low assumption curve represented by NRC curve 1 indicated that over the 50 life of the project an increase in water level of 0.8 ft would be observed (0.016 feet/year).
- The high assumption, NRC curve 3, calculated an overall water level increase of 2.2 ft over the life of the project (0.044 ft/yrs.).

Figure 1. Authorized Project Template.



3.0 Sea-level change analyses and adaption scope

The base year for this analysis is 2024, which corresponds to the end of construction and the first year that the project will accrue economic benefits. The project scope allows for an adjustment of the top of berm profile 0.5 +/-feet within the 50-year period of performance: 2024 thru 2073.

3.1 Relative sea-level change analyses

The historical SLC trends and future RSLC projection rates for the project were re-evaluated using guidance in Engineer Pamphlet EP 1100-2-1 “Procedures to Evaluate Sea-level Change: Impacts, Responses and Adaptation” (30Jun2019) and Engineer Regulation (ER) 1100-2-8162 (Dec 2013).

The SeaLevel Tracker tool, https://climate.sec.usace.army.mil/slr_app/, provides an estimate of observed sea-level trends and projected RSLC curves. The future RSLC projections are presented as “Low”, “Intermediate”, and “High” SLC scenarios based on global and local change effects. The historic MSL is represented as either 19-year or 5-year midpoint moving averages. Guidance in using the Sea-Level Tracker and technical background is provided in the “Sea-Level Tracker User Guide”, Version 1.0, December 2018.

Table 1 summarizes the results of this analysis. The base year is shown (i.e., 2024) with a 100-year RSLC evaluation window. All estimates are presented in feet, MSL.

Table 1. Wilmington, North Carolina (Station #8658120) Relative Sea-Level Change.

Project		USACE			NOAA			
Year	Year	Low	Int	High	Low	Int-Low	Int-High	High
Epoch	1992	-0.162	-0.162	-0.162	-0.162	-0.162	-0.162	-0.162
Original Authorization	2014	-0.008	0.036	0.178	-0.008	0.036	0.135	0.249
Start	2024	0.062	0.155	0.451	0.062	0.155	0.362	0.6
	2034	0.132	0.291	0.799	0.132	0.291	0.646	1.052
	2044	0.201	0.446	1.22	0.201	0.446	0.987	1.608
	2054	0.271	0.618	1.716	0.271	0.618	1.385	2.265
	2064	0.341	0.808	2.286	0.341	0.808	1.84	3.025
End	2074	0.411	1.015	2.929	0.411	1.015	2.352	3.888
	2084	0.481	1.24	3.648	0.481	1.24	2.922	4.853
	2094	0.551	1.484	4.44	0.551	1.484	3.548	5.919
	2104	0.621	1.744	5.306	0.621	1.744	4.232	7.089
	2114	0.691	2.023	6.246	0.691	2.023	4.973	8.36
	2124	0.761	2.32	7.261	0.761	2.32	5.771	9.735
2014 to 2024 Increase=		0.07	0.12	0.27	0.07	0.12	0.23	0.35
50 Year Increase=		0.35	0.86	2.48	0.35	0.86	1.99	3.29
100 Year Increase=		0.70	2.17	6.81	0.70	2.17	5.41	9.14

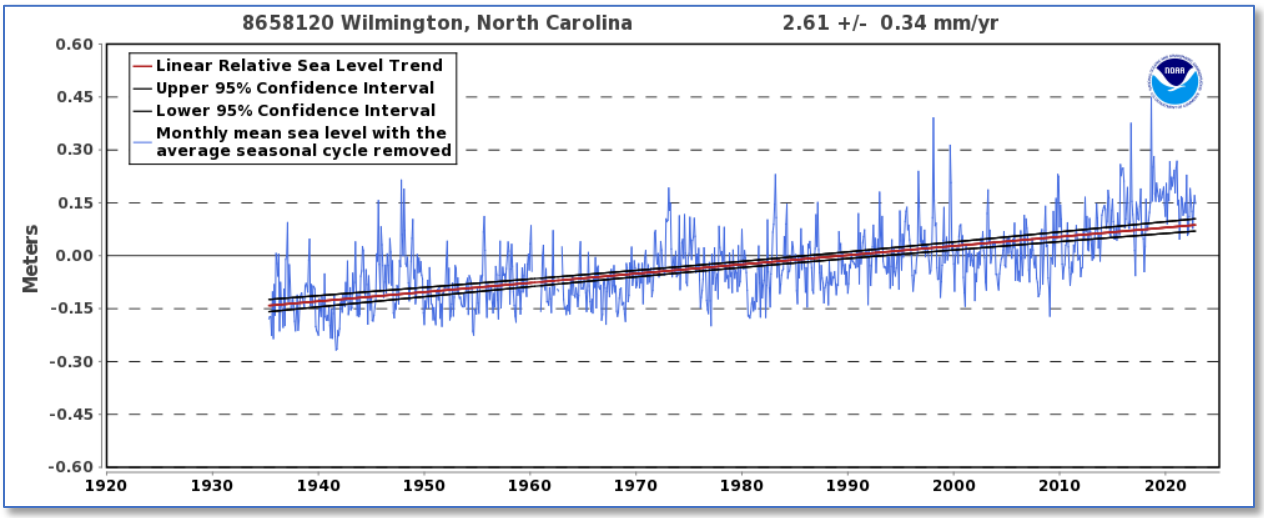
The updated RSLC projections informed the future risk associated with expected SLC. Trends provided by the Sea-Level Tracker, since the original 2010 estimates, indicate that RSLC at the project has decreased in acceleration. However, changes in these trends would trigger the recommendations presented in this plan sooner than predicted.

3.2 Historical sea-level change rate trend analyses

Historical sea-level trends were also re-evaluated for the project. For consistency with the Authorized Plan this analysis was based on the NOAA tide gauge located in Wilmington, North Carolina (Station #8658120), within the Cape Fear River and project area. The gage is compliant and active with a historic record ranging from 1935 to present.

Figure **2** presents the linear relative sea-level trend for this gauge. The regionally corrected rate of 0.00699 ft/yr was used as the rate of SLC (NOAA Technical Report NOS CO-OPS 065, 2013). Based on monthly mean sea-level data, the trend is estimated to be 2.61 mm/year (0.0085 ft/year) with a 95% confidence interval of +/- 0.34 mm/year (0.0011 feet/year). This is equivalent to an increase of 0.42 ft in sea-level for the 50-year period analysis of 2024 to 2073.

Figure 2. Relative Sea-Level Trend, NOAA Gage 8658120.



Regional sea-level trends for stations on the central east coast are shown in Figure **3**. Stations to the north and south of the project location show higher SLC trends. The results of this analyses indicate that the Wilmington gage rate of RSLC is relatively mild compared to other regional gages along the east coast.

Figure 3. Magnitude and confidence limits of trends for the southeast coast.

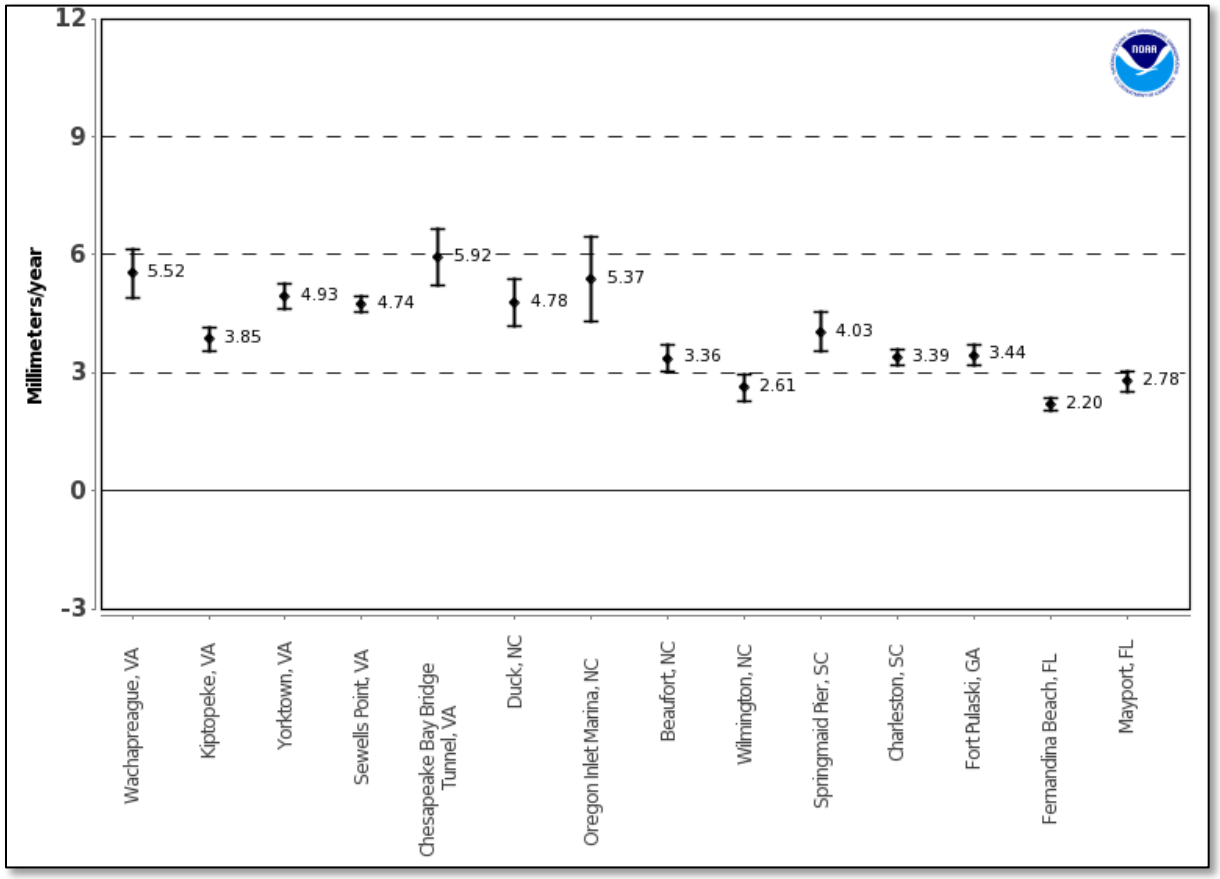


Figure 4 summarizes NOAA Gauge number 8658120's predicted SLC trends for years, 1992 to 2124. Trend lines represent SLC over the 19-Year (Metonic) epoch period and the 5-Year moving average. The light blue line represents the 5-year moving average and the heavy dark blue line represents the 19-year moving average. The 19-year average is useful in that this represents the moon's Metonic cycle and the tidal datum epoch. These estimates are referenced to the midpoint of the latest National Tidal Datum epoch, 1992.

Figure 4. Wilmington gage 8658120 - USACE Sea-Level Change Predictions, 1992 to 2124.

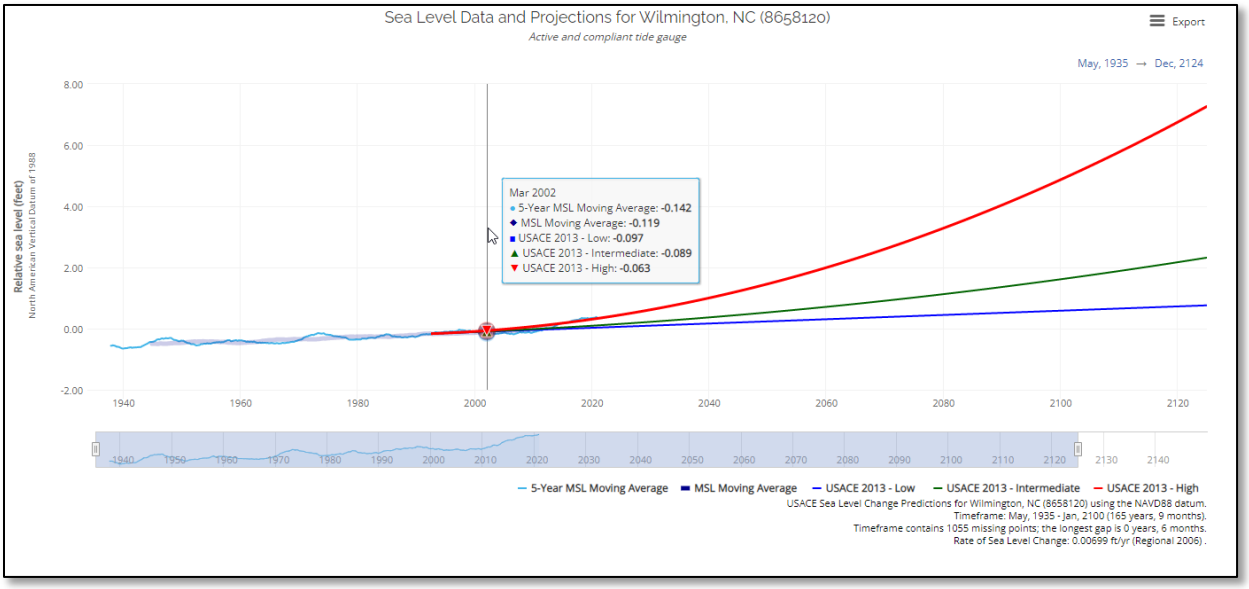
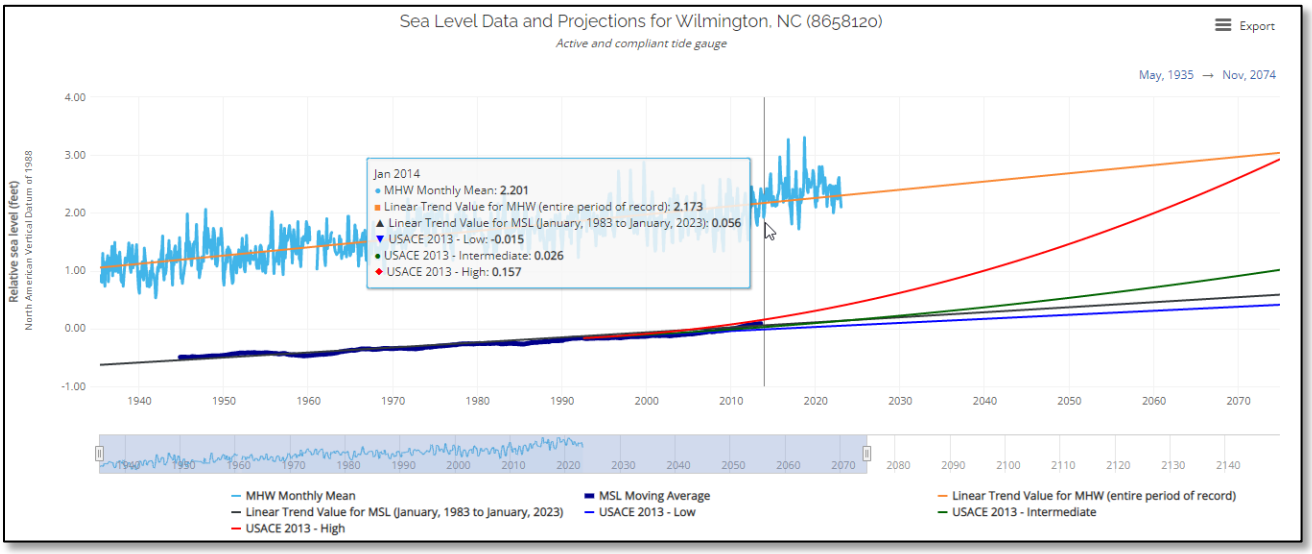


Figure 5 below contains similar information as the previous figure with the addition of the mean high water trend line, shown in orange. The red line in **Figure 5** is the High SLC prediction, the green is the Intermediate and the blue is the Low-rate prediction. The rates of observed sea-level change can fluctuate over time, but generally the 19-year moving average is increasing to a rate between the High and Intermediate rates. The 5-year moving average significantly increased after 2013 and trends above the High rate. Thus, at the current rate of SLC increase, the authorized tolerance in the project elevations could be exceeded in approximately 25 to 30 years following initial construction of the project.

Figure 5. Mean High Water Linear Trend.



3.3 Results

From the Wilmington, North Carolina (Station #8658120) Relative Sea Level Change, the low, intermediate, and high projected (relative) sea-level increases are projected to be +0.35, +0.86, and +2.48' by 2074. Both the intermediate and high sea-level change rates exceed the rate in the 2010 report for Authorized Plan. If realized, SLC will have an impact on renourishment volumes required and potentially impact the frequency of nourishments.

The project design berm height is 6' NAVD88 and is based on the original estimate historical rate of SLC of 0.008 ft/year. At the current rate of SLC increase, the volume to maintain the authorized berm height plus 0.5-foot tolerance, could be impacted in approximately 25 to 30 years following initial construction of the project in 2024.

4.0 Recommendations

The new SLC analyses determined that the critical SLC trigger for adaption should be the RSLC high projection.

Monitoring of the mean high-water elevation can be accomplished by the Wilmington District through use of the USACE Sea-Level Tracker tool. It is recommended that the linear trend of mean high water be reviewed annually to determine when the 0.5' increase is likely to occur. The linear trend value calculated in January 2014 (date of most recent SLC analysis) was 2.173' (Figure 4). Annual review of the linear trend value at the Wilmington gauge would reveal when sea-levels have increased at a rate that exceeds the tolerances included in the authorized project. If the linear trend indicates that the mean high-water elevation has exceeded 2.673' then consideration should be given to re-evaluation of the project to ensure the project is continuing to function as intended in the original authorization (see **Figure 1**).

In addition to monitoring the mean high-water elevation, the project should closely monitor renourishment volumes and nourishment frequency. Higher water elevations will create increased erosion rates along the project which will be ultimately reflected in the nourishment requirements. This should be monitored vs the total authorized costs to ensure the project can be maintained over the full 50-year period of Federal participation and to alert the USACE of a need to address any funding constraints related to the total authorized project cost limits.

The project tolerance of 0.5' is relatively small, however, the results of the sensitivity analysis were that both project costs and project damages were sensitive to SLC increases. The previous analysis indicated that the value of damages prevented increased at a much greater rate than the costs associated with maintaining the project during these same rates. For the curve 1 (Low) sensitivity, damages prevented was approximately 12 times the increases project costs. For curve 3 (High), damages prevented were approximately 10 times greater than associated project cost increases.

Because this project is post-authorization and does not have the budget under the normal renourishment cycle to incorporate more than 0.5' additional berm height; the District should consider appropriate steps in programming and planning to verify the long-term viability of the selected design.