The Mobile Ship Channel Project

An Environmental Impact Review by Mobile Baykeeper

Abstract

This paper summarizes Mobile Baykeeper's technical concerns regarding the deepening and widening of the Mobile Ship Channel and the 20-year operation and maintenance dredge management plan that the United States Army Corps of Engineers (USACE) Mobile District has implemented. The USACE concluded this project will have minimal-to-no negative impact on biological resources due to changes in oxygen, salinity, and sedimentation. This is a result of inadequate data and short-term model results which fail to accurately represent the spatial and temporal dynamics of a complex estuarine system. We are urging an end to in-bay disposal to prevent negative impacts to habitats and wildlife. We call for the implementation of protective measures, such as the beneficial use of sediment for shoreline restoration, marsh creation, and the installation of oxygen injection wells. These are not novel approaches, but successful methods implemented in other thriving ports. Additionally, the existing study the USACE relies on to conclude that there is no link between erosive ship wake and shoreline loss is insufficient. This should be revised with additional data collection and consideration of beneficial use applications for shoreline restoration, particularly in sensitive areas like the western shore. Finally, the USACE's argument that thin-layer placement is essential to maintaining bathymetric and habitat integrity in Mobile Bay is unfounded and should not obscure the negative effects that in-bay disposal has on an estuarine system. Mobile Baykeeper is seeking to collaborate with the USACE Mobile District to find solutions that help our community thrive, strengthen our economy, and ensure the long-term health of our bay. Critique and input are welcomed and encouraged by reviewers.

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Introduction

Mobile Baykeeper is a nonprofit community organization that exists to defend and revive the coastal waters of Alabama. Our organization is working towards a future where our oyster and submerged aquatic vegetative beds recover, where our communities are not fearful of consuming locally caught fish and recreating in our waterways, and where our communities take responsibility for these things. This document summarizes the negative impacts of current dredge disposal practices, along with additional concerns related to erosive ship wake energy and changes to water quality in Mobile Bay. Our organization is advocating on behalf of community concern and founded on scientific critique of these issues. Over 1,000 community members have sent over 5,000 letters to key federal officials through a Mobile Baykeeper action alert about the critical need to address these issues. We have also spoken or listened to over 200 attendees at public town hall meetings and their testimonies have validated the actions we are pursuing. Additionally, we have consulted with various experts who have expressed concern about the USACE claims that the project causes "minimal-to no harm" to biological resources and water quality.

Our requests to the USACE include:

- No in-bay disposal that is not beneficial use.
- Baykeeper's involvement and approval of future beneficial use projects.
- Formal study on other wave energy mitigation along the ship channel.
- In-channel dissolved oxygen system use like that deployed in the Savannah Harbor.
- Creation of a private cost-share program to convert waterfront property to living shoreline.
- Large-scale public waterfront property conversion project to living shoreline.

Background

In 2018, Mobile Baykeeper submitted one of several comment letters addressing the USACE Draft Supplemental Environmental Impact Statement to evaluate improvements to the Mobile Harbor Federal Navigation Channel. Our comments remain consistent since this submission and echo other commenters' concerns regarding salinity, oxygen, sedimentation, and impacts on biological resources. Specifically, key issues we highlighted in 2018 included: 1) the use of a one-year simulation for the hydrodynamic and water quality modeling study instead of a longer time period; 2) the lack of data representing bay-wide impacts of ship wake on shoreline erosion; 3) limited sampling and analysis on benthic organism impacts; and 4) requests to implement more mitigation techniques.

Our concerns were dismissed and repeated in submission of comments regarding the Mobile Harbor General Reevaluation Report, along with the Integrated Final Supplemental Environmental Impact Study in 2019. We stated that "the Corps fails to consider the impacts identified in the study as significant. There are several examples where negative impacts are described but are deemed negligible due to various reasons that are unsubstantiated. We firmly believe that simply adding up the number of impacts deemed "negligible" equates to a substantial number of impacts." These comments include scrutiny of: 1) conclusions of temporary and minor impacts from dredge placement operations; 2) minor impacts from turbidity and resuspension of sediment; 3) impacts to submerged aquatic vegetation (SAV) as a result of turbidity and siltation; 4) the short-sightedness of only using sea level rise (SLR) to determine future impacts; 5) the dismissal of continued shoreline erosion due to shoreline armoring; 6) no long-term spatial modeling of sediment resuspension and movement from dredge placement and resulting impacts on benthic habitats; 7) insufficiencies with oyster larval modeling and simulation of hypoxic conditions voiced by local scientists that was not taken into consideration; 8) no consideration of sediment resuspension from ship wake and subsequent impacts incurred by benthic species as a result; and 9) Environmental Protection Agency (EPA) comments regarding a need for sediment fate modeling, which the USACE determined to be unnecessary as they would be "following protocols".

The USACE hosted several Interagency Working Group (IWG) pre-project meetings which were designed to bring together representatives from federal and state agencies in addition to the Port Authority and the Mobile Bay National Estuary Program to discuss concerns regarding environmental impacts associated with the project. Experts in attendance of these meetings suggested and/or stated the following which were either not implemented or fully addressed in the final study (USACE 1):

Water Quality Impacts

- Modeling efforts [should] be conducted on a multiple-year level for water quality impacts under various hydrological conditions and that the wet or dry hydrologic scenarios should also meet the needs for conducting habitat impact assessments.
- Concerns with the simulation period were expressed by the EPA as to why [the USACE] are not using existing information to look at a 3-year simulation period. The Mobile District expressed that the project is on a strict schedule and budget and these restrictions prevent the study from conducting simulations beyond one year.
- Experts questioned if the Mobile District had confidence that the conditions represented in the 2010 simulation period adequately represent seasonal conditions.
- The Alabama Department of Environmental Management (ADEM) expressed concern about only using conditions from 2010, and questioned how valid interpretations of drought and wet years would be.
- The United States Fish and Wildlife Service (USFWS) raised a concern that the impacts of the project on top of SLR could cause a tipping point for biological resource response.
- The Alabama Department of Conservation and Natural Resources Marine Resources Division (MRD) expressed concerns regarding the presentation of the dissolved oxygen (DO) data coming out of the water quality model. The MRD has

data from 2015 and 2016 showing DO levels associated with existing oyster reefs at 5 sites in Mobile Bay. These data are not consistent with the DO outputs from the water quality model.

Shoreline Erosion

- The USFWS expressed concerns about possible erosion along the mid-bay shoreline and possible impacts to property owners and living shorelines due to increases in ship sizes.
- The National Marine Fisheries Service pointed out that a deeper channel in theory will also cause displacement of more water.

Sedimentation

- Concern regarding effects of benthic communities in open water placement areas such the relic oyster shell mining area.
- What are the limiting distances and other factors that would make a particular [beneficial use] option considered to be uneconomical?

Mobile Baykeeper has continued to reiterate similar concerns to those raised by the IWG over the past 6 years regarding the non-comprehensive environmental impacts estimated by the USACE regarding the Mobile Harbor Deepening and Widening project and the ensuing operation and maintenance dredging. This overview touches on issues we find most pressing today in pursuit of defending and reviving the coastal waters of Alabama and advocating for what we believe is both right and possible to accomplish in pursuing both economic prosperity for the state while not jeopardizing our environment.

Overview of Concerns

There are three main areas of concern that Mobile Baykeeper has presented to the USACE. These include impacts to biological resources from operation and maintenance dredge disposal and alterations to physical conditions within Mobile Bay, erosive wave energy deteriorating shorelines from commercial ship wake, and a lack of evidence to support claims that in-bay disposal is beneficial and necessary from an ecological standpoint.

All thin-layer placement (TLP) activities referenced herein are not designated as beneficial use by the USACE but are formally designated as Transitional Placement material. This material is "kept in the system but will naturally move through the system or be rehandled" (USACE 2). All TLP activities of concern are specifically in reference to the placement of an estimated >90 million cubic yards (~4.5 mcy/yr) of operation and maintenance material (that which must be excavated to maintain channel dimensions) adjacent to the shipping channel over a 20-year period (USACE 3) (Figure 1). Ongoing or completed beneficial use (BU) projects such as the Dauphin Island Causeway Restoration are not addressed here as the ecosystem benefits reaped from these projects do not compensate or address negative impacts to in situ conditions such as low oxygen, turbidity, and salinity encroachment at a bay-wide scale.

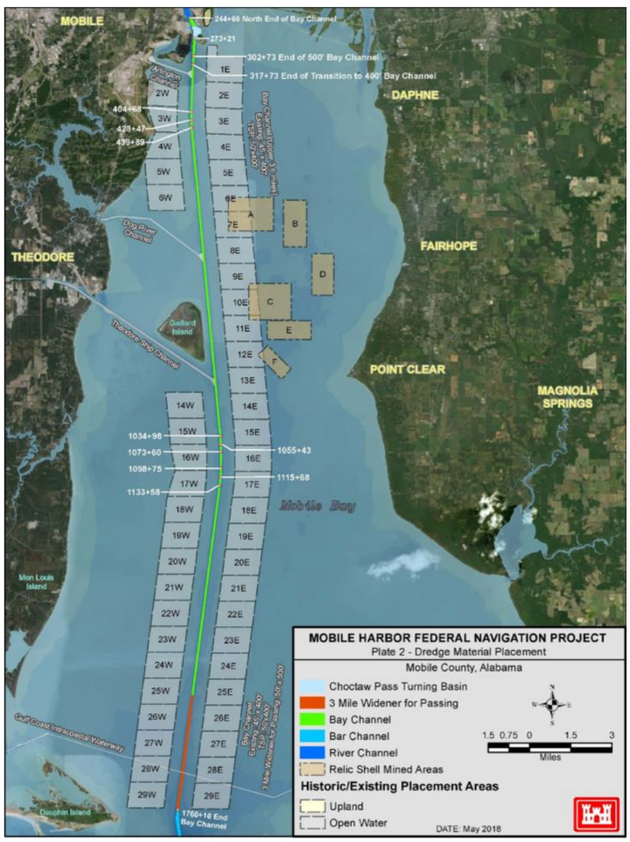

Figure 1) Thin-layer placement areas of interest (does not include polygons A-F) (USACE 3).

I. Biological Impacts

A. Burial and Recovery

The USACE states that burial and recovery impacts to benthic infauna will likely be minimal as the Mobile Bay system is already highly disturbed, a majority of benthic infauna taxon are opportunistic to stressor recovery, impacts are anticipated to be temporary, and that similar environments have seen quick recovery post disposal (USACE 1). While most studies concur that recovery can take place on the order of months to a year, these outcomes are highly contingent on conditions of existing benthic assemblages, the frequency of disturbance, and the longevity of disturbance (Wilber et al, 2007). These studies often focus on opportunistic taxon that can migrate vertically through the dredge material, with monospecific pioneer species abundance being a main metric for recovery. This vertical migration is not possible for all macrofauna and is dependent upon the depth of dredge spoil deposited on the native benthos. For example, TLP for Mobile Bay is described as exceeding no more than 12 inches (~30 cm) (USACE 5). According to Maurer et al (1987), invertebrate test taxon mortalities increased with exposure to depths of 32 cm, whereas some could not migrate successfully within even 1cm of additional material. Moreover, studies have demonstrated that < 1 mm of sediment deposition on oyster cultch is enough to significantly reduce spat settlement outcomes (Poirier et al, 2021).

The USACE asserts that "benthic macrofauna in Mobile Bay are dominated by polychaetes and macrofaunal abundances are relatively low in this area compared to other Gulf of Mexico (GOM) estuaries" (USACE 6). Polychaetes are noted as an opportunistic taxon capable of rapid recovery after disturbance (Thompson Engineering, 2024). However, a study by Wilber et al. (2019) contradicts this conclusion, showing that Mobile Bay has moderate-to-high benthic macrofauna abundance and diversity compared to other northern GOM areas, particularly regarding potential prey assemblages for Gulf sturgeon (Figure 2). Therefore, the degree to which polychaetes are holistically representative of benthic assemblage recovery for Mobile Bay is questionable when other more sensitive individuals are present that may be less opportunistic in nature.

Table 2
Mean density (per m^2) of potential prey families in the EMAP data set that contributed at least 5% to dissimilarities (SIMPER) between neighboring regions. Shading is used to illustrate where sites with similar potential prey assemblages were grouped into regions. Sites are abbreviated as PO – Pontchartrain, CH - Chandeleur Sound, LB – Lake Borgne, MS – Mississippi Sound, MB - Mobile Bay, PA – Panhandle, PB – Pensacola Bay, CB – Choctawhatchee Bay, SA – St. Andrews Bay, APAL – Apalachicola Bay, AB - Apalachee Bay, W. Co. FL – West Coast of Florida.

Taxon	Family	PO	CH	LB	MS	MB	PA	PB	CB	SA	APAL	AB	WFL
Oligochaete	Tubificidae	139	10	18	5	58	11	8	11	10	19	203	121
Polychaete	Pilargidae	14	118	169	82	65	12	61	25	17	29	3	2
	Ampharetidae	239	20	136	10	48	5	67	0	2	0	24	33
	Chaetopteridae	0	0	0	0	0	0	0	0	108	2	0	0
Amphipoda	Ampeliscidae	0	184	0	14	2	7	8	0	108	72	786	467
	Haustoriidae	0	80	1	45	0	110	36	0	277	0	41	23
Bivalve	Mytilidae	1	40	2	4	0	0	1	0	2	7	429	3
	Mactridae	414	182	351	22	27	21	2	0	0	49	2	1
	Tellinidae	1	86	129	11	3	13	8	3	87	51	69	27
Gastropoda	Hydrobiidae	690	1	127	0	1	0	0	0	0	0	0	0
	Cochliopidae	339	46	223	0	9	0	2	0	0	0	4	1
Nemertean	Nemertea	11	378	46	144	50	26	40	0	79	61	133	57

Figure 2) Table extracted from Wilber et al (2019) comparing Mobile Bay (MB) mean density of Gulf sturgeon prey to other study sites across the northern GOM. Mobile Bay has representation for 5-out-of-6 taxon and 9-out-of-12 families of macrofauna types. 6 of these 12 study sites are critically protected habitat for Gulf sturgeon.

According to the USACE, "benthic organisms that occur in the bay bottom sediments may be destroyed or severely impacted by the physical placement of sediment. However, it is believed that affected areas are small in relation to surrounding areas and would rapidly recover within 12-18 months back to pre-project conditions" (USACE 4). Addressing disposal area as small compared to surrounding areas is an improper means to assess the magnitude of impact on the area receiving TLP. Literature assessing spatial influence on recovery times for benthic organisms indicates that the size of the impacted area itself determines recovery time, not its size compared to adjacent areas. For example, a study done by Guerra Garcia et al (2003) shows that recovery in "smaller areas" (1,000 m^2) took ~7 months whereas recovery took years for impacted areas on the scale of 100,000 m^2. According to the 2012-2022 USACE Mobile District DA Usage Map, the average area of active dredge disposal in designated parts of the bay is 236,457 m^2 (Bullock, 2024). Furthermore, >21,000 acres of in-bay disposal cells will be used over the next 20 years on a rotational basis for disposal (USACE 3).

Experts on benthic recovery post dredge disposal do acknowledge that there is no consensus on what metrics constitute "recovery" (Wilber et al, 2007). In the case of TLP for this project, annual placement of up to 4.5 mcy of material over the course of 20 years creates a recovery scenario less extensively documented in literature, as most dated studies look at recovery time periods on the order of months, up to a year of one-instance post placement. The assumption that Mobile Bay would recover similarly to systems in Texas, the Mississippi Sound, and Gulfport, Mississippi because of its bathymetry and tidal dynamics does not fully address the compounding impacts from this recurrent activity, nor does it determine outcomes associated with changes in both physical and biological conditions resultant from disposal (USACE 1, Baux et al, 2020). Less attention has been given to sampled sites subjected to repetitive disposal dumping and the long-term effects of pulse recovery, or outcomes related to functionality changes for ecosystem services resulting in community shifts. This can lead to trophic level energy transference issues and secondary impacts on fisheries (Bolam et al, 2016). In fact, a 1992 Mobile Bay USACE study on benthic impact of dredge disposal states that at the time, it was impossible to determine secondary fishery impacts from these disturbances (Clarke et al, 1992). However, more modern studies have been able to model negative primary and secondary productivity impacts as a result of dredge activities (Kjelland et al, 2015).

B. Dissolved Oxygen and Stratification

The USACE utilized a CEQUAL-ICM Water Quality Hydrologic model (USACE water quality model) with data from 2010 to run for the period of one year to determine impacts on water quality resulting from changing dimensions of the ship channel with a SLR scenario compared to a no project outcome. Changes to salinity and oxygen were deemed to be the most important factors to assess biological resource outcomes via the IWG (USACE 1). According to the USACE, the time of year under which oxygen conditions would likely be most deleterious would be during warmer months. DO model results between the months of June – September showed average conditions no lower than 6.7 mg/L; therefore, it was inferred that there will be no negative outcomes for biological resources as this is well above the hypoxic, or low oxygen threshold of 2 mg/L (USACE 4). This assumption is applied to benthic organisms including macroinvertebrates, oysters, SAV, and fish. However, observed data used to validate the model does show that DO would frequently be close to the 2 mg/L hypoxia threshold, but because this was not reflected in the daily average model output, this was not considered to be reflective of consistent conditions (USACE 4, Figure 3). Low DO conditions are tightly coupled to hydrologic conditions in the bay which can be exacerbated by climate change factors and anthropogenic impacts. Mobile Baykeeper has several critiques regarding the accuracy of the model, particularly regarding the decision not to include a warming water scenario and inadequate validation of stratification in the model.

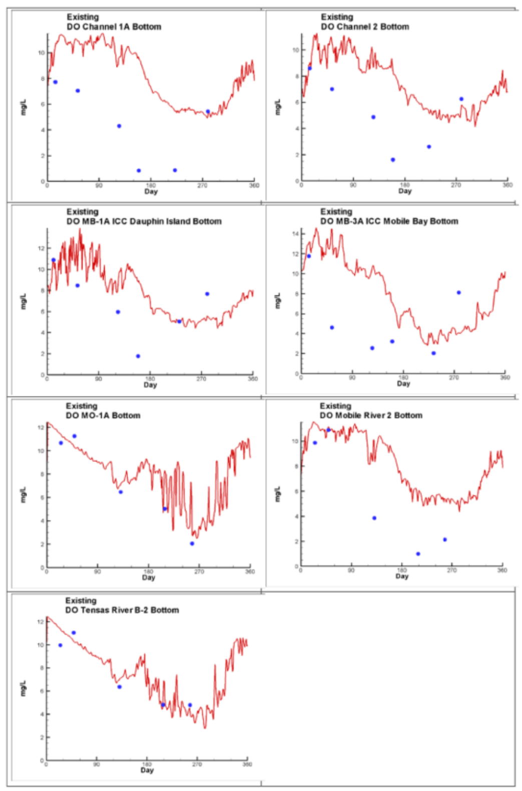

Figure 77. Comparison of Simulated and Measured Bottom DO values

Figure 3) Simulated daily average DO levels (red) versus measured DO levels (blue) from the Three Dimensional Hydrodynamic, Water Quality, and Sediment Transport Modeling of Mobile Bay report (USACE 7).

Given the shallow bathymetry of Mobile Bay, our system is more susceptible to experiencing hypoxic conditions, as is evidenced by the historic occurrence of jubilees

(May,1973). Additionally, climate change pressure should be of universal concern for experts assessing estuaries like Mobile Bay, as “nearly 94% of oxygen depleted regions are expected to experience a 2 degree C° temperature increase by the end of the century” (Coogan et al 2021). This projected trend is of importance when considering the impact of altering large-scale bay processes (i.e. ship channel modifications and TLP) as “increased temperature, changes in oxygen saturation and biological temperature dependent decay will continue to drive down dissolved oxygen concentration” (Coogan et al 2021). Despite this, and suggestions from the IWG to extend the length of time that the model was run, the USACE water quality model only used data from 2010 with no increasing water temperature scenario and it was concluded that DO outcomes would not be deleterious. Hypoxia has been widely documented in Mobile Bay (Figure 4) and has recently trended towards a higher frequency of hypoxic conditions. For example, data derived from the Alabama Real-Time Coastal Observing System (ARCOS) show that a majority of DO levels in May and October 2023 at Meaher State Park are negatively skewed towards hypoxic levels (Figure 5). Furthermore, when comparing instances of increased water temperature readings to decreased DO readings for the same station, during months signified as being more susceptible to hypoxic conditions by the USACE (June-September), there were several instances of hypoxia just last year (Figure 6). These ARCOS examples are only representative of one area and time, and therefore are not meant to exemplify bay-wide conditions. These instances are provided to demonstrate that the USACE, which is required to estimate impacts at a large-scale, were not able to accurately reflect DO conditions in concert with warming waters.

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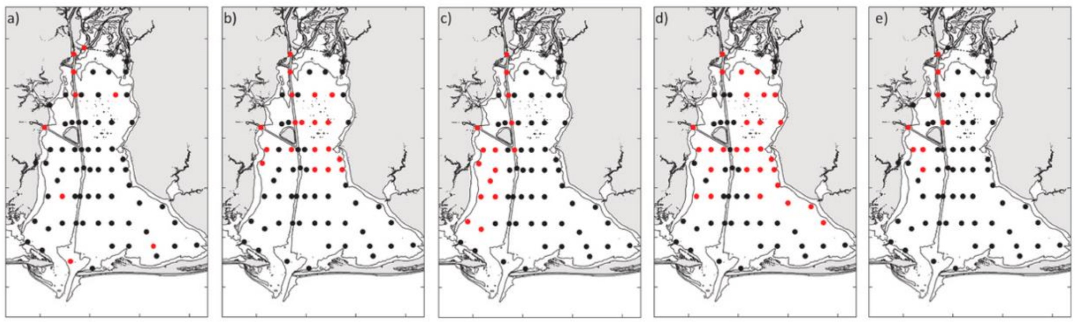


Fig. 2. Bay wide CTD surveys conducted on (a) July 25–26, (b) August 1, (c) August 7, (d) August 16, and (e) August 29–30, 2019, showing the minimum DO concentration from the CTD cast with DO ≤ 2 mg l^{-1} (red dots), and DO > 2 mg l^{-1} (black dots). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Figure 4) Water column profile data displayed in panels between July and August in 2019 with red dots displaying hypoxic conditions. Of the 65 stations sampled in this study, 63% were hypoxic during one survey period (Coogan et al, 2019).

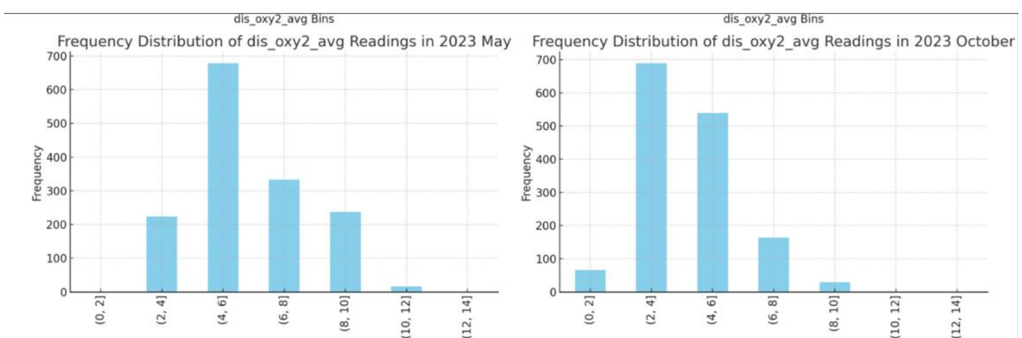


Figure 5) ARCOS average DO levels from the Meaher State Park station for May and October 2023 organized into DO level bins by frequency. This location and these months were selected to demonstrate hypoxia trends as the USACE performed benthic sampling surveys to determine macrofauna assemblage composition and sensitivity to water quality changes in October 2016 and May 2017 in the upper portion of Mobile Bay close to this station (USACE 4). Data extracted by Mobile Baykeeper in July 2024 and displayed using Python.

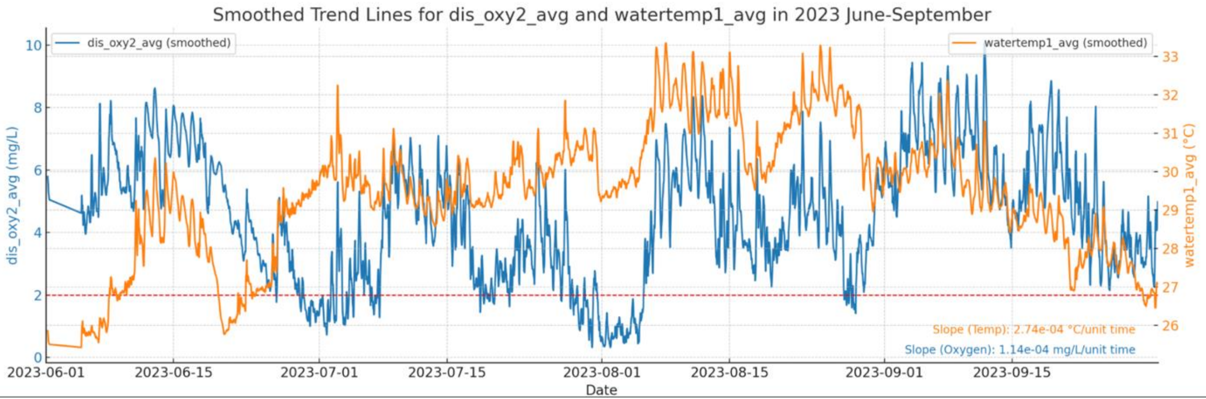


Figure 6) Average DO (blue) and water temperature (orange) levels with respective axes recorded at the Meaher State Park ARCOS station for June – September 2023. The horizontal dashed red line represents the threshold for hypoxic conditions (2 mg/L). Data extracted by Mobile Baykeeper in July 2024 and displayed using Python.

According to the USACE Engineer Research and Development Center modeling report, during periods of higher river inflow, the water column was generally completely mixed and low DO was primarily observed during low flow times of the year (USACE 7). The report details how the USACE water quality model was improved to include benthic fluxes from nutrients and other considerations to account for low bottom DO specifically in relation to data acquired from Tensaw-Delta stations, but there is little representation in the bay outside of the channel itself for model validation and no further explanation as to whether mixing or stratification was further considered in these areas (USACE 7). In fact, 2011 cast data from the University of South Alabama along the ship channel are the only points used to validate model simulations of stratification in the bay, despite literature suggesting that stratification is the dominant driver for oxygen regimes in the portion of the bay in which a majority of TLP disposal sites are located (Dzwonkowski et al, 2011, Coogan et al, 2021). Stratification is important to realistically represent to estimate negative impacts, as it can be exacerbated by a deeper channel which can influence salinity intrusion and impact DO levels.

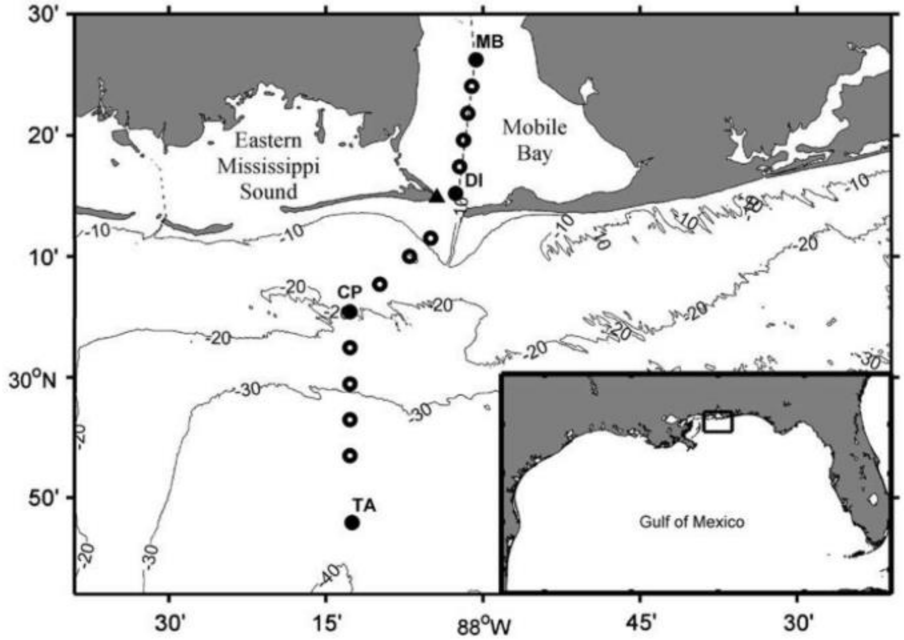


Figure 7) CTD cast data used to validate stratification in the USACE water quality model. These cast stations align the ship channel. No other observed data points to validate stratification were used in more shallow portions of the bay subject to hypoxic conditions (Dzwonkowski et al, 2011).

Sediment resuspension from dredging maintenance activities can also impact DO levels due to resuspension of nutrients and organic matter and the subsequent increase in biological oxygen demand in the water column (Spieckermann et al, 2022). The CEQUAL-ICM Water Quality Model does offer features to quantify changes in abiotic and biotic conditions that can result from sediment resuspension, such as eutrophication. For example, a general feature the model offers is the inclusion of sediment-water oxygen and nutrient fluxes which may be computed in a predictive sub-model or specified with observed sediment-oxygen demand rates (USACE 7). However, sediment was not included as an active variable in the model to simulate subsequent changes to DO, nutrients, and oxygen demand from TLP resuspension (USACE 7, Figure 8).

Table 3. Water Quality Model State Variables

Temperature	Salinity
Fixed Solids	Cyanobacteria
Diatoms	Other Phytoplankton
Zooplankton 1	Zooplankton 2
Labile Dissolved Organic Carbon (DOC)	Refractory Dissolved Organic Carbon
Labile Particulate Organic Carbon	Refractory Particulate Organic Carbon
Ammonium (NH4)	Nitrate + Nitrite Nitrogen (NO3)
Urea	Labile Dissolved Organic Nitrogen (DON)
Refractory Dissolved Organic Nitrogen	Labile Particulate Organic Nitrogen
Refractory Particulate Organic Nitrogen	Total Phosphate (TP)
Labile Dissolved Organic Phosphorus (DOP)	Refractory Dissolved Organic Phosphorus (DOP)
Refractory Particulate Organic Phosphorus	Labile Particulate Organic Phosphorus
Particulate Inorganic Phosphorus	Chemical Oxygen Demand (COD)
Dissolved Oxygen (DO)	Particulate Biogenic Silica
Dissolved Silica	Internal Phosphorus Group 1
Internal Phosphorus Group 2	Internal Phosphorus Group 3
Clay	Silt
Sand	Organic Sediments

Figure 8) This table shows variables that are optional to include in the USACE water quality model with those highlighted in green to be the selected active variables. Clay, silt, sand, and organic sediments were not included as active variables and therefore could not be varied in concentration to simulate resuspension and estimate respective outcomes on DO levels (USACE 7).

Rather than incorporating sediment into the model to determine biogeochemical fluxes that may occur with changes in temperature, salinity, labile dissolved or particulate nutrients or carbon, or phytoplankton presence at different times of the year, a constant sediment oxygen demand (SOD) value (1.0 g/m^2) was set for inshore waters (USACE 7). SOD is influenced by fluctuations in water temperature, water flow and other variables and is suggested to be calculated as a result of these factors changing in mechanistic models, rather than used as a fixed constant in empirical models because it is not reflective of conditions at a broad scale (Beirise, 2016). A 2022 study of Mobile Bay incorporated a variable sediment oxygen demand into their model which changes with vertical and horizontal eddy diffusion and water depth which was incorporated into a vertical dissolved oxygen variance equation (Liu et al, 2022). In fact, this paper demonstrated wind-driven hypoxia events in 2019 in which the SOD was critical to modeling these processes as primary production and SOD produced top-to-bottom differences in oxygen profiles within one period (Liu et al, 2022).

The USACE responded to our initial critique that their water quality model was not representative of realistic oxygen levels by citing a Willmott Index Agreement score of 0.7 (USACE 8). Additional metrics which would have helped to determine if the model could be fit better such as the mean absolute error, root mean square error, or r-squared value were not provided. This score indicates that the model may be oversimplified and that additional predictors may need to be implemented to seek better fit. Additionally, the USACE states that the model has a positive oxygen bias of 1.96 mg/L, which may be coming from oversimplification of modeling DO which can be complex and have a non-linear relationship with other factors such as temperature and salinity (USACE 8). All of these examples are reasons that Mobile Baykeeper believes DO was inaccurately represented in the model. As a result, conclusions about potential harm to biological resources from changes in DO due to channelization or sedimentation fail to reflect actual conditions in the bay.

Mobile Baykeeper has requested that the USACE Mobile District consider implementing an oxygen injection system (or other validated technique) to mitigate conditions which are conducive to hypoxia events. As one of the environmental mitigation projects for the Savannah Harbor Expansion Project, two oxygen injection plants were constructed by the USACE on the Savannah River to offset anticipated decreases in DO due to navigation channel deepening (USACE 10). In 2012, the Expansion Project Final Environmental Impact Statement and General Re-evaluation Report specified the requirement to operate the injection system from June 15th through September 30th, during the warmest months of the year when DO concentrations in the river are generally at their lowest (USACE 10). To determine system efficiency and effectiveness, the Savannah USACE district created a series of Success Criteria instead of using a target DO concentration, as estuarine river systems tend to be vertically, spatially, and temporally, dynamic (USACE 10). The Savannah USACE district demonstrated through Lines of

Evidence that all Success Metrics were not only achieved, but also exceeded for many measures attributed to oxygen saturation, retention, water column diffusion, and spatial impact (USACE 10, Figure 9). The Port of Savannah spent approximately half of their project budget on environmental and historic preservation mitigation alone, a project that carried a total cost of $973M compared to $365M for the Port of Mobile deepening and widening project (Carse et al, 2020).

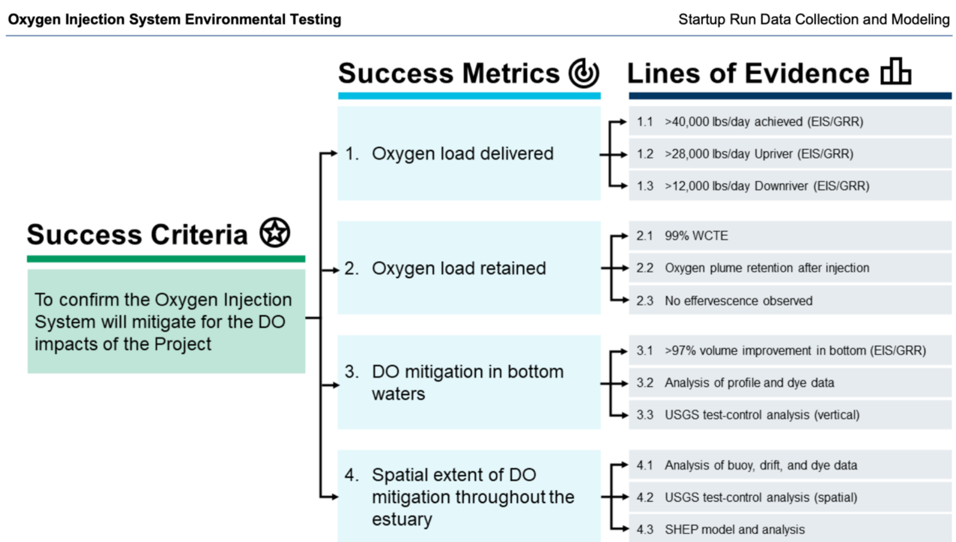


Figure 4-2 Lines of Evidence Approach Summary

Figure 9) Success Criteria and Metrics and Lines of Evidence created by the USACE Savannah District to test the oxygen injection system's ability to deliver and retain oxygen, mitigate low bottom DO, and cover the boundaries of the impacted project area. During the trial run study, 1) oxygen loading rates were exceeded 2) 99% of injected oxygen into the system was retained for extended periods of time 3) field tests demonstrated dispersion, vertical diffusion, and bottom versus surface DO control which was reflected in 98% of model cells and 4) critically deepened designated zones experienced DO mitigation relief (USACE 10).

C. Salinity

The USACE water quality model salinity results are only projected over 1 year with SLR scenarios and are therefore not comprehensive of long-term outcomes on estuarine and riverine processes in the future (USACE 7). The USACE model output indicates that salinity would, at most, increase 1-3 ppt from deepening and widening and the USACE concluded that this change would not negatively impact benthic organisms or other biological resources (USACE 7). Salinity is a driver for ecotones, or the distribution and occurrence of flora and fauna throughout a study area, but viewing the impact that salinity has on organisms within a vacuum is not ecologically sound. The compounding stress of alterations in salinity, water temperature, oxygen, and sediment placement over the course of 20 years was not analyzed but would provide a better estimate of how these parameters influence biological response in concert. Moreover, interest in the degree to which the channel transfers saline water spatially is currently being studied by local researchers (Sreeshylam et al, 2023). Gradual or seasonally exacerbated salinity encroachment has significant acute and chronic effects on the diverse habitats that estuarine systems support, especially since salinity is a primary driver for stratification and hypoxia (Livingston, 1996). For example, Mobile-Tensaw Delta canopy tree stress tied to increasing salinity can have cascading effects for the resiliency of a sensitive ecosystem (Balder et al, 2024). In the Savannah Harbor Project, a freshwater rerouting plan was used to mitigate salinity stress to 740 acres of wetlands (USACE 15). Coastal squeeze on viable oyster habitat resulting from salinity encroachment and other factors in North Carolina further highlights the complexity of how physical drivers should be compared with other factors to understand in situ response (Tice-Lewis et al, 2022). We believe it is important to consider long-term impacts by using historic changes in salinity to project outcomes with increasing temperatures. There is also a great opportunity to engineer controls for salinity encroachment. In Louisiana, the Coastal Protection and Restoration Authority worked to address salinity encroachment from the Lake Charles Harbor and Terminal District channel impacting the Chenier Plain within the Calcasieu-Sabine Basin. Among several considered techniques, dredge material was used to build berms to control salinity levels in sensitive areas which share waterway connectivity (3BL Media, 2017 & Reckdahl, 2017).

D. Impacts to Submerged Aquatic Vegetation and Oysters

According to the Operational Sediment Budget by Byrnes et al (2013), Mobile Bay has received over 481 million cubic yds of new work or maintenance dredge material between 1854 - 2010. SAV extent in Mobile Bay has concurrently declined with 53% less SAV existing on average since the mid-1900s because of anthropogenic activities (SAV Survey Literature, Estes et al, 2015). Additionally, oyster populations have declined by ~90% since the 1950s according to commercial landings data (NOAA Fisheries, 2023). The Alabama Department of Conservation and Natural Resources specifically attributes the direct and indirect degradation of oyster habitat in Mobile Bay to channel dredging and dredge material placement activities among other anthropogenetic factors (ADCNR, 2021).

The USACE concludes in the Final Environmental Impact Statement that benthic habitat impacts are negligible because there is no SAV or oyster beds within the direct vicinity of TLP areas, that changes to salinity and oxygen are not deleterious, and that an increase in turbidity levels from sediment resuspension would be temporary (USACE 4). However, the repetitive placement of up to 4.5 mcy of dredge material across 21,560 acres of in-bay disposal sites over the course of 20 years has great potential to bury benthic habitats and degrade water clarity. Mobile Baykeeper is working towards a future where our SAV and oyster beds resiliently recover, which includes the 1,395 acres of historic SAV beds along the western shore where future dredge placement can preclude any potential for long-term recovery if TLP activities move forward (Figure 10). Our ability to make better choices by finding alternative solutions to manage maintenance dredge material is not a novel concept and is integral to recovering our benthic habitats. For example, the USACE Jacksonville District changed in-bay disposal operations in partnership with the Tampa Bay Estuary Program (TBEP) and other environmental stakeholders to address SAV loss. Since the 1980s, no in-bay disposal outside of BU has been placed into Tampa Bay due to its direct negative impacts on seagrass and secondary fisheries that depend on this benthic habitat resource (Estevez, 1989). According to the TBEP, a 43% decline in historic seagrass coverage was directly related to dredging operations for the port and in-bay dredge disposal (Greening et al, 2014, Sampson 2021). The TBEP was able to embark on a long-term dredge disposal plan with their USACE district which, combined with other coordinated efforts, allowed them to achieve a recovery of seagrass in Tampa Bay to historic 1950s levels by the mid-2010s (Greening et al, 2014).

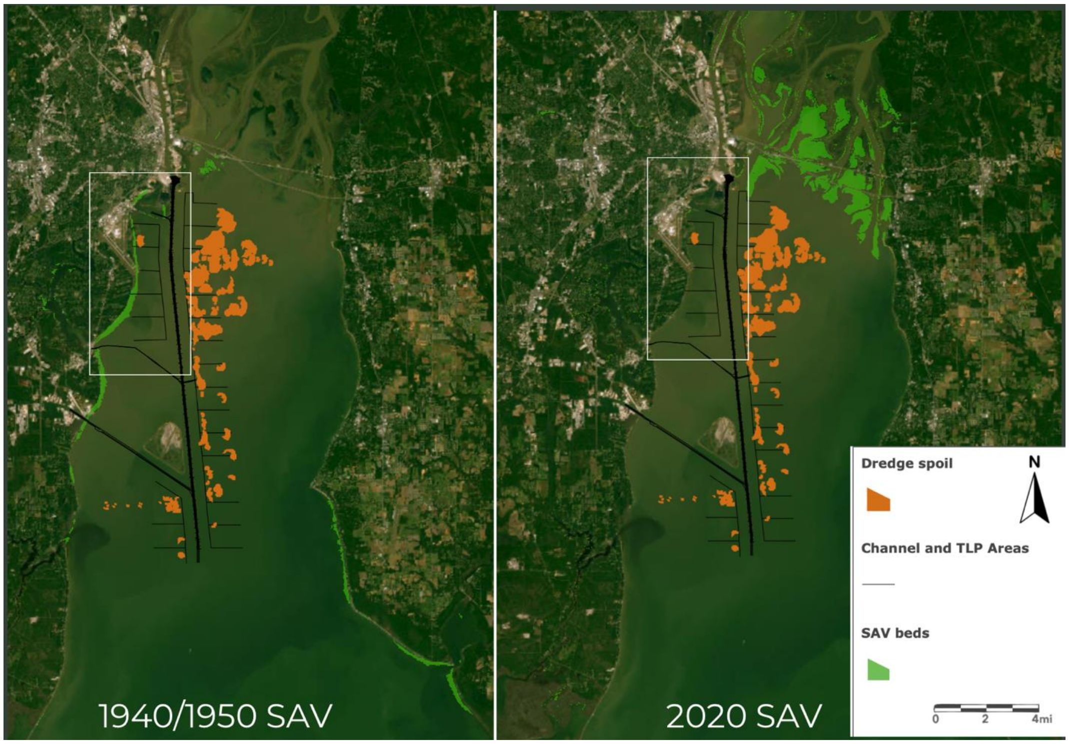


Figure 10) 1940s/1950s versus 2020 SAV bed map with dredge placement area overlay. The boxed area shows the difference in acreage along the western shore where future TLP areas are allotted. Shapefiles acquired from USACE and Thompson Engineering.

Consideration of sediment resuspension and turbidity as a result of in-bay disposal were not explicitly mentioned as being modeled or considered for SAV impacts in terms of light extinction thresholds for SAV over the course of 20 years due to in-bay placement nor was the radius of area by which this resuspended material could move and impact nearby SAV communities modeled (USACE 6). Similarly, an oyster larval tracking model was utilized to determine whether dimension alterations would influence oyster larvae flushing from the system and impact settlement outcomes, but sedimentation was not included as a model parameter despite being significantly tied to spat settlement and filtration efficiency outcomes let alone burial of substrate (Figure 11, USACE 6, Poirier et al 2021). The USACE Particle Tracking Model used to determine outcomes for oyster larvae can be used to determine outcomes on benthic habitat as a result of sediment particulate moving in relation to dredging activities (Figure 12, USACE 9).

Table 5.1. Overview of oyster model components including: input variables and environmental parameters

PARAMETER	VALUE (Status/Unit of measure)
Spatial scale	42,868 cells
Adaptive time step	Seconds (s)
Length of simulation	April through September
Initial oyster larvae	5400 particles
Depth (# of layers)	Averaged to 3 layers
Low Dissolved Oxygen (DO) threshold	2.4 mg/l
High Dissolved Oxygen (DO) threshold	N/A
Low Salinity threshold	6 ppt
High Salinity threshold	37 ppt
DO mortality threshold duration	10,000 s to live outside threshold
Salinity mortality threshold duration	10,000 s to live outside threshold
Temperature mortality threshold duration	10,000 s to live outside threshold

Figure 11) Table of oyster larvae model parameters used to determine mortality outcomes for oyster populations as a result of channel dimension changes via flushing or inability to settle on substrate (USACE 6).

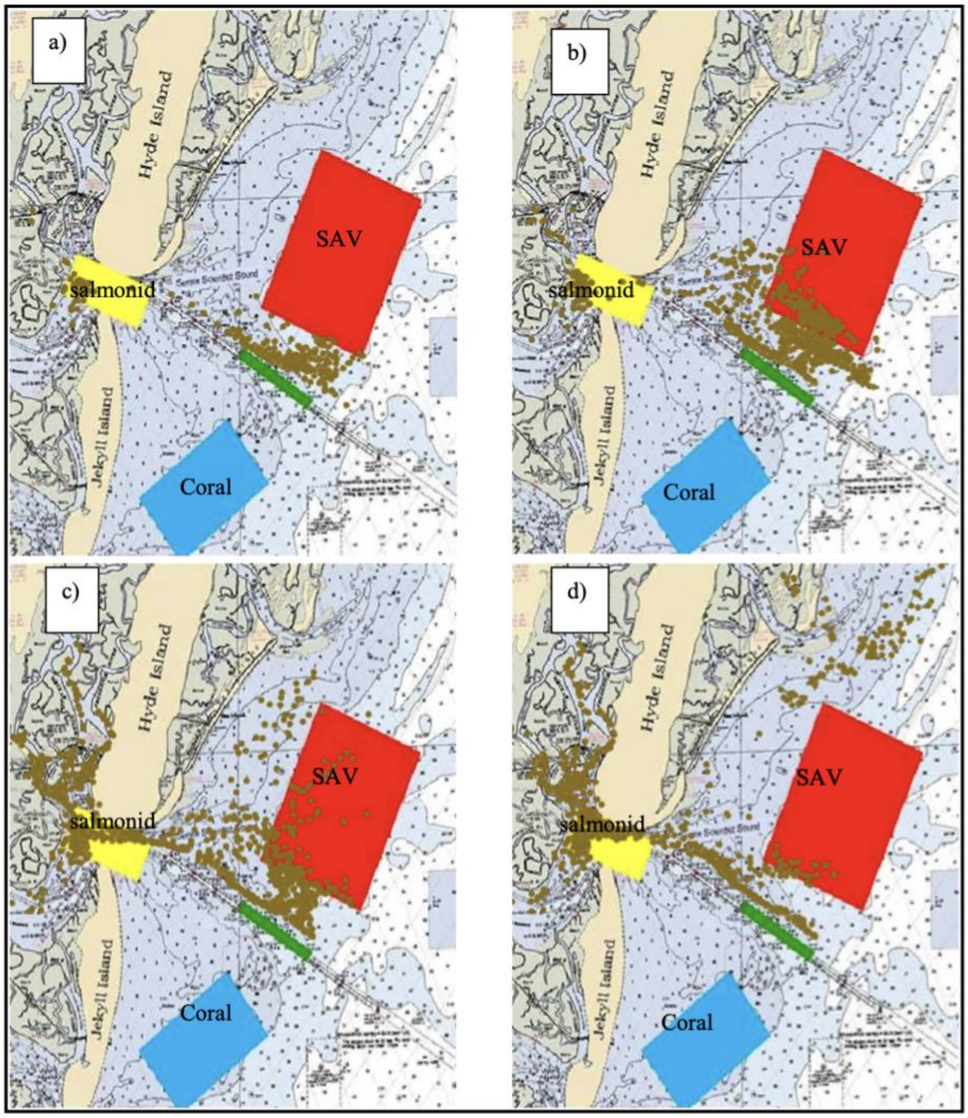


Figure 2-53. Particle Positions Shown for the First, Second, Third, and Seventh Days after Dredging Begins Using a Hopper Dredge with no Overflow

Figure 12) Example of a USACE Particle Tracking Model which simulates the dispersion, fate, and accumulation of particulate within a period resultant from dredging activities (USACE 9).

E. Biological Impacts Conclusion

In summary, the USACE assessment of abiotic conditions and their direct or indirect effects on biological resources does not adequately reflect real-world conditions or account for the full range of stressors related to the deepening, widening, and maintenance of the Mobile Bay ship channel. The USACE water quality model and oyster larval model do not validate real-world conditions and were too narrowly designed to accurately predict negative biological outcomes from stratification and sedimentation. Specifically, there is a lack of long-term model projections considering future stressors such as increasing temperatures and frequent hypoxic event occurrence. Additionally, sediment-oxygen flux impacts from resuspension on SAV, oysters, and benthic organisms were not measured.

II. Ship Wake Erosion

The IWG identified commercial wake-based shoreline erosion to be a topic of concern which resulted in the USACE developing a Vessel-Generated Wave Energy (VGWE) Model to assess impacts (USACE 1). Five wave energy sensors were deployed to collect data for 62 days, but the only sensor east of the channel was removed from final analysis, thus leaving no eastern shore representation of ship wake impacts and minimal representation along the western shoreline in the northern portion of the bay (USACE 7, Figure 13). Upon further peer review, the USACE deployed five more sensors in the southern portion of the bay for 45 days to address external concerns that the current spatial array is likely not reflective of the entire bay (USACE 7). Ultimately, all of this data validated the VGWE Model which was used to assess changes in vessel-generated wave energy for with-and-without project forecasting in 2025 and 2035 (USACE 7). The USACE concluded that there would be no difference in vessel wave energy, despite the model having low precision outcomes and underestimating wave energy (USACE 7) which we believe is likely a result of lacking spatial data to further improve the model.

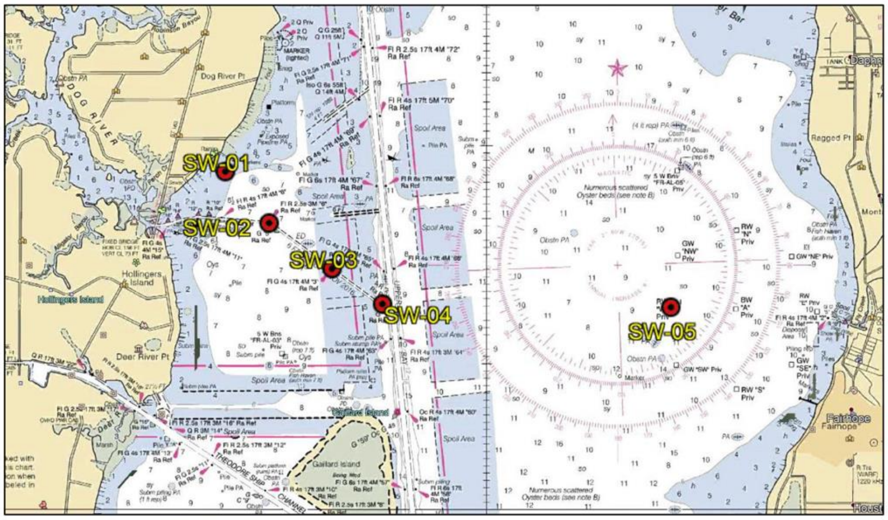


Figure 6: Map of Station Locations

Figure 13) Pressure sensors deployed to measure continuous wavelet transformation from ship wake disturbance. Sensor SW-05 was removed from analysis as the USACE did not recommend using the captured dataset due to weakness and inability to isolate from background disturbance (USACE 7).

The USACE also performed a Cumulative Impact Assessment to determine if there is a historic relationship between shoreline erosion and vessel activity to determine if correlation of these variables would sustain into the future with channel modifications potentially increasing ship traffic (USACE 7). Seven shoreline sites were initially selected to signify trends in shoreline change over time, but only three were used in analysis for meeting USACE criteria of having ten points of shoreline data available between 1840 and 2011(USACE 7, Figure 14).

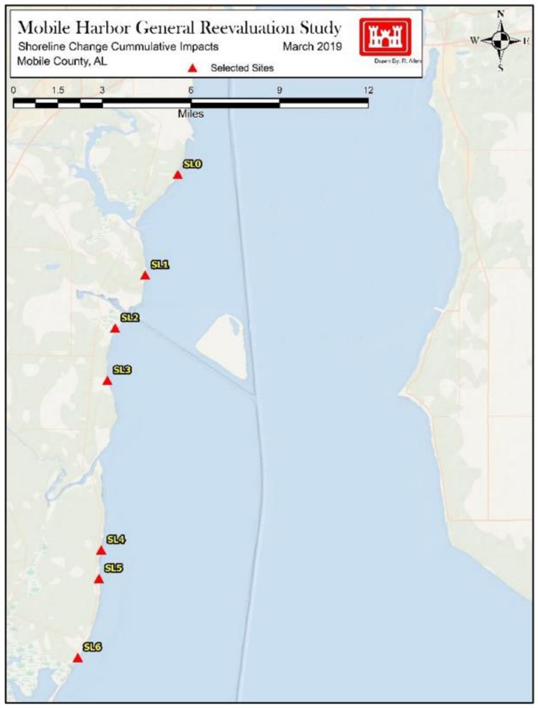


Figure 39: Selected sites used to evaluate shoreline change.

Figure 14) Shoreline study sites used to extract historic aerial imagery and NOAA shoreline data to quantify loss or gain of shoreline extent between 1840 and 2011. No eastern shore study sites were included in this study. SL1, SL3, and SL6 were selected for further analysis (USACE 7).

Average linear regression rate of shoreline change at each site from 1917/1918 and 2010/2011 were contrasted with vessel calls to port from 1956 to 2017 (USACE 7). The USACE found that there was a direct relationship between an increase in vessel calls and increases in erosion across the three study sites which disassociated in the late 1990s (USACE 7, Figure 15). To further determine whether this visual correlation was not coincidental, the USACE investigated historical shoreline extent and other factors for each of the sites. Ultimately, only one site, SL1, was used for further analysis to determine if ship wake activity coming from the Mobile Bay ship channel has caused historic shoreline loss and is susceptible to causing further loss into the future. The USACE concluded that because this relationship devolved past the 1990s, and because a majority of bayfront shoreline has been armored in some capacity since 1997, it is unlikely that this trend would resurge in the future (USACE 7, Figure 16). Given that these conclusions were drawn from data at a single site and did not account for the potential of shoreline armoring to worsen erosion (Gittman et al., 2015), Mobile Baykeeper asserts that the findings are not fully reliable and that the study should be improved. We also recommend partnering with local stakeholders, resource managers, and restoration engineers to repurpose dredge material for BU in both private and public cost-share living shoreline restoration projects.

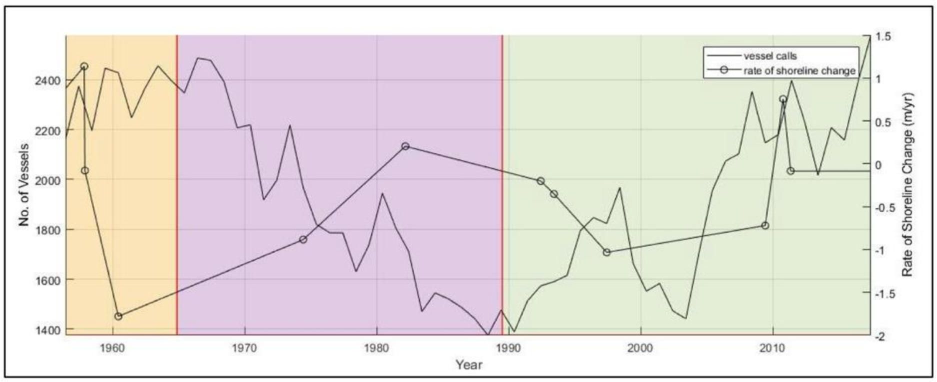


Figure 48: Plot of vessel count for Mobile Harbor between 1956 and 2017 of all vessels having a draft greater than 19 feet compared to combined average shoreline change rates for sites SL1, SL3, and SL6. Channel dimension changes are identified using the plot background.

Figure 15) Vessel calls to port contrasted with average rate of shoreline change for SL1, SL3, and SL6. An inverse relationship between negative shoreline extent and vessel calls is visually apparent until the late 1990s to early 2000s (USACE 7).

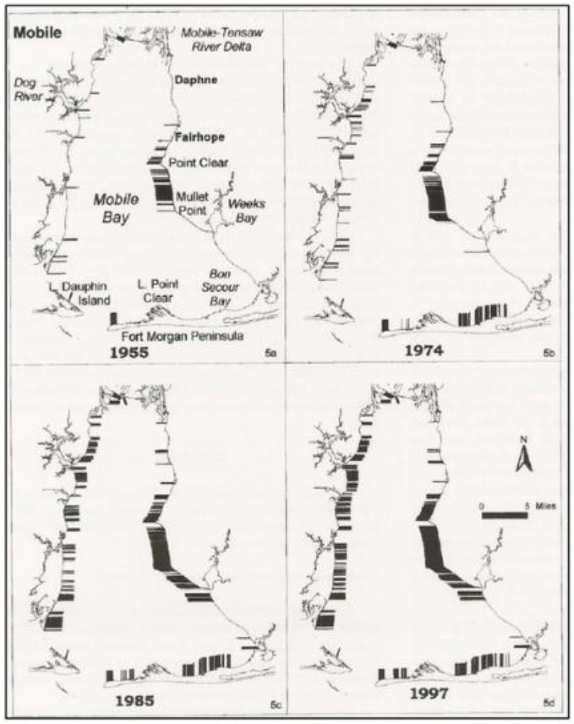


Figure 44: Spatial and Temporal Distribution of shoreline armoring between 1955 and 1997 extracted from Douglass and Pickel (1999).

Figure 16) The USACE referenced this Byrnes et al (2013) study figure showing shoreline armoring density around Mobile Bay. The bottom right-hand panel is used to substantiate the claim that the relationship between port calls and shoreline erosion devolved due to a majority of shoreline being hardened. This is also used to support the assumption moving forward into the future, and under a deepening and widening scenario, that it would be unlikely for this trend to continue.

III. Sedimentation and Starvation Arguments

A. Inadequacies of Modeling

A 2015 USACE study looked at sediment deposition and erosion while modeling impacts of TLP for certain in-bay disposal sites. The study used 2012 dredge data from a 4–5-month period (Feb 2010 - June 2010) and two Hurricane scenarios (Gustav 2008 and Ida 2009) (USACE 7). The USACE found +/- 9 cm of sediment would deposit or erode for one model year (2010). No quantification of how this erosion would contribute to suspended sediment concentrations (SSC) in Mobile Bay was provided on an annual basis or as a compounding factor over time.

According to a high-resolution sediment dynamic study performed in Mobile Bay in 2008 and 2009, background seasonal SSC ranged from 0.015 - 0.07 g/L (Ha et al, 2012). The USACE does not provide specific grid cell dimensions for the GSMB Multi-Block Hydrodynamic Model used to measure sediment dynamics as the +/- 9 cm rate is representative of sediment movement within each grid cell (USACE 7). However, if we calculate the area that annual TLP (4.5 mcy) covers at the maximum height of 30 cm, calculate what proportion of this area erodes annually (+/- 9 cm), convert this area to mass and divide this value by the bay's volume with annual flushing residence time (34 days), then we can roughly estimate the SSC contribution of TLP annually (Figure 17).

Annual TLP Area Calculation

$$4.5 \text{ M cy} \times \frac{0.7645 \text{ m}^3}{1 \text{ cy}} = \frac{3.44 \text{ M m}^3}{0.3 \text{ m}} = 11.4675 \text{ M m}^2$$

Annual Area Eroded

$$11.4675 \text{ M m}^2 \times 0.09 \text{ m} = 1.0321 \text{ M m}^3$$

Erosion Mass Calculation

$$1.0321 \text{ M m}^3 \times \frac{1{,}220 \text{ kg}}{\text{m}^3} = 1.259 \text{ B kg} \times \frac{1{,}000 \text{ g}}{1 \text{ kg}} = 1.259 \text{ T g}$$

1,220 kg/m^3 (1.22 g/cm^3) = wet bulk sediment density average from variable core depths derived from Table 2 of Marot, M. E., & Smith, C. G. (2012). Radioisotopic data of sediment collected in Mobile and Bon Secour Bays, Alabama(No. 2012-1172). US Geological Survey.

Annual Bay Volume Calculation with Residence Time

$$413 \text{ sq miles} \times \frac{2{,}589{,}988.11 \text{ m}^2}{1 \text{ sq mile}} = 1.069 \times 10^9 \text{ m}^2 \times 3 \text{ m} = 3.21 \times 10^9 \text{ m}^3$$

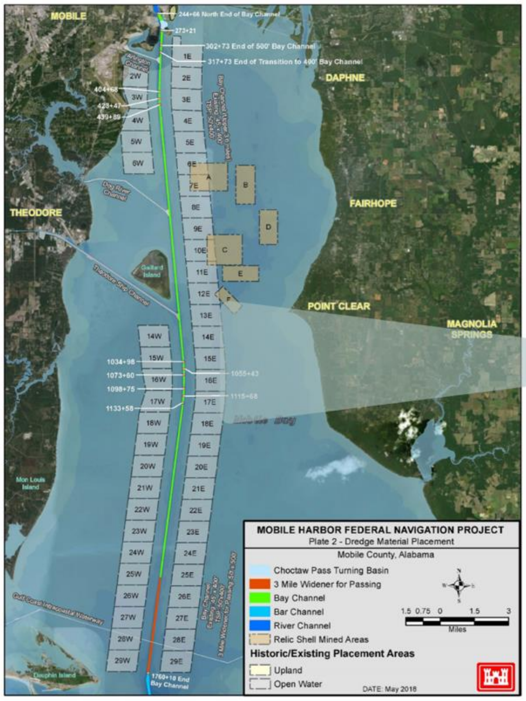
$$3.21 \times 10^9 \text{ m}^3 \times \frac{1{,}000 \text{ L}}{\text{m}^3} = 3.21 \times 10^{12} \text{ L} \times \frac{365 \text{ days}}{34 \text{ days}} = 3.4475 \times 10^{13} \text{ L}$$

Annual TLP Suspended Sediment Calculation

$$\frac{1.259 \times 10^{12} \text{ g}}{3.4475 \times 10^{13} \text{ L}} = 0.0365 \text{ g/L}$$

Figure 17) Rudimentary suspended sediment concentration calculation for annual TLP volume placed into the bay using the maximum height of TLP (.30 m) (USACE 11), the USACE erosion rate of 9 cm (.09 m/yr), an average wet bulk density value for Mobile Bay sediment (1,200 kg/m^3) (Marot et al, 2012), an average bay depth of 3 meters, and a bay-wide volume with a residency time of 34 days (Coogan et al 2021).

The USACE sediment model did not estimate the degree to which sediment resuspension would occur because of TLP, nor the length of time, but was used to narratively describe that impacts would be minimal due to the +/- 9 cm rate of deposition (USACE 7). Additionally, the model did not quantify the dispersion and fate of this material, but instead cited that annually 35% of this material falls back into the channel to be dredged again, and the remaining 65% of material is widely dispersed by natural waves, winds, and currents (Byrnes et al, 2013). According to our final calculation in Figure 17, the annual SSC contribution of TLP to Mobile Bay is ~ 0.0365 g/L. Compared to the seasonal low- and high-end SSC values for Mobile Bay from Ha et al (2012) (0.015 - 0.07 g/L) this input would make Mobile Bay's SSC 1.5 to 3.5 times greater than it was prior to TLP being continued again in 2012 (USACE 12). However, because TLP is ongoing, and the bay will annually receive 4.5 mcy of dredge material, it is also important to consider the erosion rate (+/- 9 cm/yr) from a compounding perspective. The USACE manages TLP placement on a rotational basis of 4-6 years to allow recovery of benthos where TLP was already placed (USACE 11). Under the assumptions that 1) the USACE does not exceed 30 cm in TLP height 2) the placed material can erode up to 9 cm every year 3) the USACE will place more material in the same area after 4-6 years have passed 4) and 100% of the dredge material moves from the initial placement area to enter the channel or become widely dispersed, then the SSC resultant from TLP activities is compounding each year (Figure 18). According to Figure 18, SSC from TLP activities alone would be 5x greater in 5 years, and 3.6 - 13 x greater than seasonal background levels from Ha et al (2012). These equations and conceptual diagrams are meant to provide a simple suggestion for being able to measure the change in turbidity from these activities on both a short-term and long-term basis in the absence of this information being provided by the USACE. It is important to fully quantify the degree to which turbidity will increase because of TLP to truly determine whether impacts are minimal or significantly different.



11.46 M m^2.	2025	2026	2027	2028	2029
13E	30 cm	21 cm	12 cm	3 cm	30 cm
	0.0365 g/L	0.0365 g/L	0.0365 g/L	0.0365 g/L	0.0365 g/L
14E		30 cm	21 cm	12 cm	3 cm
		0.0365 g/L	0.0365 g/L	0.0365 g/L	0.0365 g/L
15E			30 cm	21 cm	12 cm
			0.0365 g/L	0.0365 g/L	0.0365 g/L
16E				30 cm	21 cm
				0.0365 g/L	0.0365 g/L
17E					30 cm
					0.0365 g/L
Total Annual SSC (g/L)	0.0365	0.073	0.110	0.146	0.183

Figure 18) Conceptual diagram demonstrating the compounding increase on average SSC in Mobile Bay from annual placement of TLP. Cells 13E – 17E are selected to provide an example of an area that would receive 4.5 mcy of dredge material over time. For this example, we assume that the total area of each TLP cell is equal to the total surface area required (11.46 million m^2) to support 4.5 mcy of material placed at 30 cm in height. Each year, the height of TLP decreases in each cell from the initial placement year by ~ 9 cm to be widely dispersed in the bay or to enter the channel again. The erosion contributions from each cell compound over time, with total SSC values (g/L) presented at the bottom of the table.

B. Bathymetric Impacts

The USACE has stated that TLP is a sustainable means of managing operation and maintenance dredge material and an ecologically sound approach (USACE 11). One of the arguments for advocation of TLP is that it is important to maintain bay floor elevations so that over time the bay will not get deeper (NBC 15, 2024). The USACE cites the Byrnes et al (2013) Operational Sediment Budget frequently to substantiate why TLP is a suitable approach. According to this study, net bay deposition (2.076 mcy/yr) has been consistent for almost 100 years (1917/1918 - 1984 and 2011) and comparable to the second largest contribution of sediment to Mobile Bay coming from the Tensaw Delta system (2.841 mcy/yr) (Figure 19). The contribution of in-bay dredge disposal is labeled as Rm in Figure 19 (4.460 mcy/yr) and is almost twice as much volume input compared to the Delta which unlike TLP, deposits into marshes and tidal creeks via natural processes.

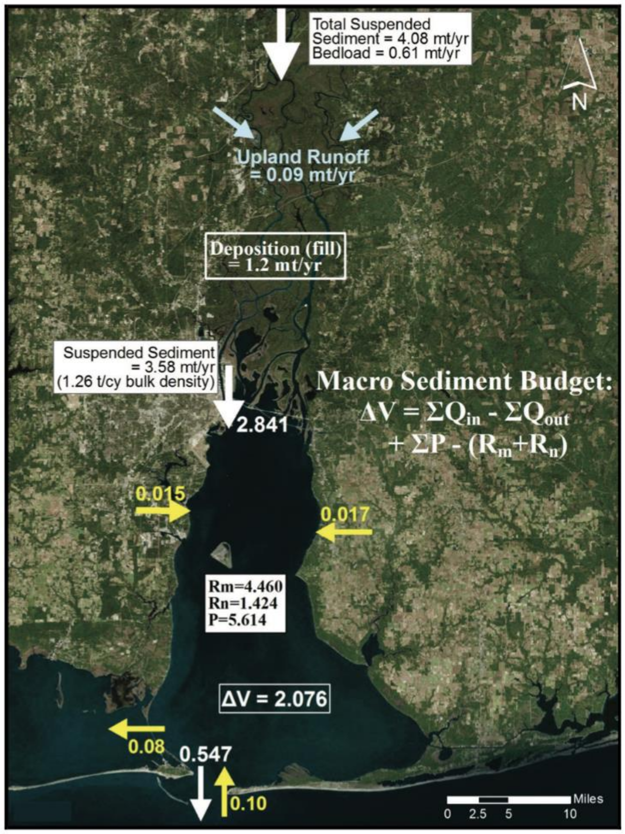


Figure 4. Macro-scale sediment budget for Mobile Bay, 1917–1918 to 1984–2011. Arrows show the direction of sediment movement throughout the bay, and numbers reflect the magnitude of net sediment transport in millions of cubic yards per year.

Figure 19) Operational sediment budget from Byrnes et al (2013). ΔV represents the net bay infilling rate.

Additionally, this Operational Sediment Budget states that "deltaic sedimentation at the head of Mobile Bay is consistent for all periods, as is net bay infilling. Channel dredging and placement are very noticeable, but the magnitude of in-bay deposition has decreased with the advent of offshore disposal in the 1980s" (Byrnes et al, 2013). The need for this additional in-bay deposition from a bathymetric perspective is questionable. For example, Figure 20 compares bay elevation changes from 1917/1918 to 1984/1987 on the left and 1917/1918 to 2004/2011 on the right. The change in elevation has either been positive, or exhibiting no change, for a majority of the bay (blue/green or no color) except for a few areas that are red or yellow (deeper areas). Given the bay has historically been infilling at a regular rate, not experiencing significant negative changes in elevation across a majority of the bay, and that an overwhelming majority of sediment supply comes from the Delta, it is not clearly demonstrated that TLP is sustaining bay elevations. In fact, Byrnes et al (2013) states that in order "to quantify the natural infilling rate of the Bay, survey data were evaluated to determine average seafloor depths for each survey period. Bay-bottom areas influenced by channel dredging and placement were excluded from the analysis". In addition, the USACE Regional Sediment Management Plan states that TLP does not significantly change bathymetric relief (USACE 12). Therefore, the necessity of sustaining depth using TLP has not been adequately quantified or verified.

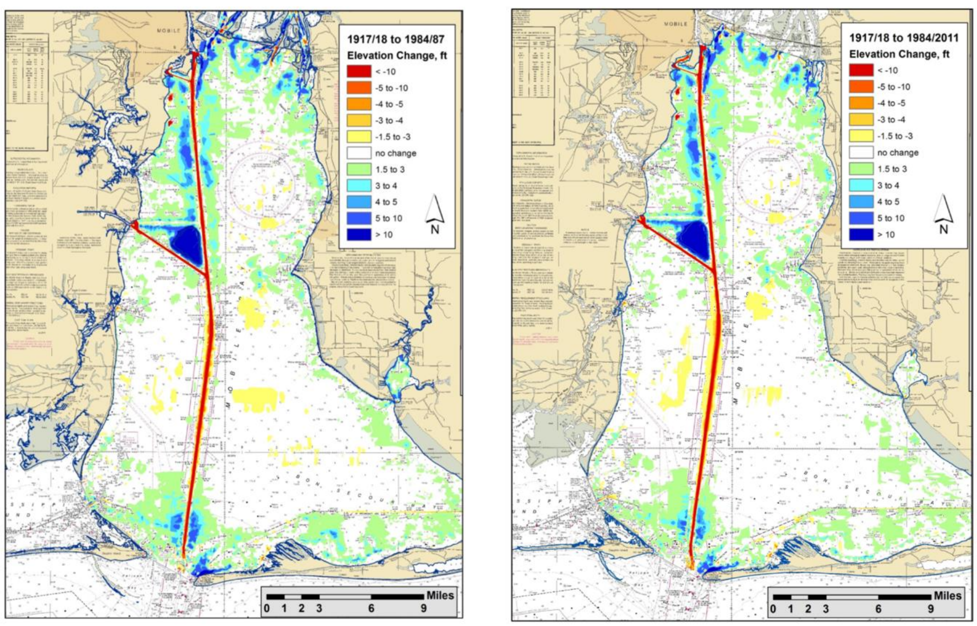


Figure 38. Bathymetric change between 1917/18and 1984/87 for Mobile Bay. Hot colors represent erosion (yellow to red and cool colors represent deposition (green to blue).

Figure 39. Bathymetric change between 1917/18 and 2004/11 for Mobile Bay. Hot colors represent erosion (yellow to red and cool colors represent deposition (green to blue).

Figure 20) Changes in bay-floor elevations from 1917/1918 to 1984/1987 (left) and 1917/1918 to 2004/2011 (right). Legend color scale shows warmer areas have exhibited negative change and cooler areas have exhibited positive change in elevation.

C. Sediment Dynamics

Another critique related to claims of beneficial outcomes associated with TLP is that this practice mitigates sediment starvation which otherwise results in habitat and shoreline loss (USACE 12). This is only substantiated through reference to findings from the Byrnes et al (2013) study as the fate of TLP accreting into sediment starved areas was not performed using the sediment model (USACE 7). Upon reviewing the Operational Sediment Budget study, the example provided here is specifically for the northwestern portion of the bay which is highlighted as a major example for why sediment should remain in the system (USACE 12) (Figure 21). Byrnes et al (2013) mentions that between 1918 and 1934, the portion of the western shore extending from Dog River to the Theodore Industrial Canal experienced, on average, 6.6 ft/yr shoreline loss, likely because of channel development and hurricanes. Between 1934 and 1957, accretion occurred along this stretch at an average rate of 9.7 ft/yr. This accretion was not from TLP, but instead resulted from direct dredge disposal placement by the USACE connecting the Mobile Channel to the Hollingers Island Channel (Byrnes et al, 2013). After placement was complete, the shoreline continued to erode between 1957 and 1982 with a net loss of 1.8 ft/yr. Between 1982-2010, the shoreline eroded at a rate of 2.9 ft/yr and most of the marsh areas created from dredge disposal between 1934 and 1957 eroded away (Byrnes et al, 2013).

Figure 17. Shoreline change segments for Mobile Bay.

Figure 21) Shoreline segments assessed for historical trends in Byrnes et al (2013). Example cited in this overview is "Dog River to Theodore Ship Channel" on the northwestern portion of Mobile Bay.

Although this segment of shoreline was eroding consecutively during the period of gulf disposal, this net loss was much lower than the period that sediment was kept in the bay either through means of side-casting, direct shoreline disposal, or other means (Byrnes et al, 2013) (Figure 22). Most importantly, it should be noted that the USACE has stated that "shoreline recession and habitat loss could not be directly correlated to the removal of sediment from Mobile Bay" (USACE 12). This brings into question what factors were causing these erosion rates. The USACE fails to acknowledge in citing the Operational Sediment Budget the mention of dredging activities and dredge spoil management which were hypothesized to have connections to these trends. For example, between 1919 and 2014, dredge spoils were placed south of Arlington Pier (just north of the highlighted shoreline segment example) and perpendicular to the coast "effectively blocking alongshore sediment transport from the Mobile River" that would otherwise accrete along the western shore (Byrnes et al, 2013) (Figure 23). Ultimately, the proposition that TLP is needed to make good out of the historical damages incurred by the USACE which have exacerbated shoreline erosion is disjointed, especially when there has been no evidence to suggest that TLP material migrates to areas that are most impacted by ongoing pressures such as commercial ship wake.

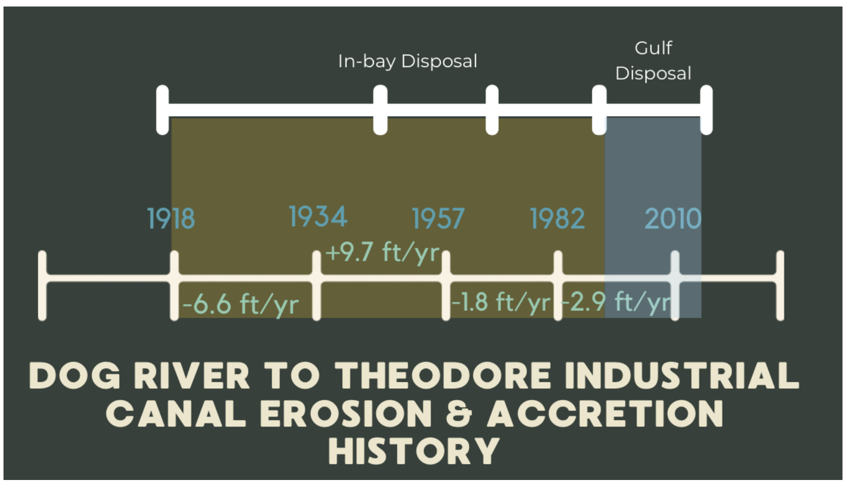


Figure 22) According to the Operational Sediment Budget study, after 1916, the Chief of Engineers recommended that dredge material be placed no less than 1,500 ft from the sides of the channel and by 1953 this distance increased to 2,000 ft for future operations up until the Water Resources and Development Act of 1986 called for disposed in the gulf (Byrnes et al, 2013). This Figure summarizes shoreline trends for the stretch of shoreline from Dog River to the Industrial Canal.

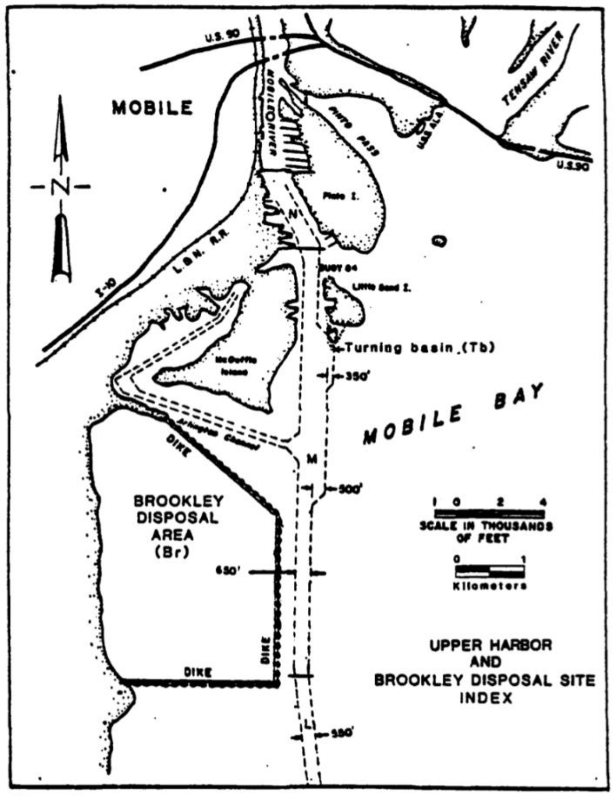


Figure 8.

Figure 23) Brookley Disposal Area hypothesized to have impacted the natural sedimentation pathway for accretion along the western shore between 1919 – 2014 (Byrnes et al, 2013, Mistovich et al, 1982).

D. Inter-port Dredge Management Comparison

This overview highlights other ports that do not use in-bay disposal methods, but instead haul material offshore, use upland containment dikes, or allocate towards BU (Table 1) (Figure 24). Mobile Baykeeper does not advocate for containment dike creation or upland fill that directly destroys existing marsh or wetlands. We believe there are ways to allocate dredge disposal towards BU, or hauling to areas like the existing Sand Island BU Area or Ocean Dredged Material disposal site. For example, Maryland has made in-bay dredge disposal unlawful (except for BU) and only two open-water placement sites remain for the area (MD. Environment Code § 5-1102 (2023)). Only the state of Virginia uses this area, and the VA Marine Resources Commission is working with their USACE district to find alternative management options for the most southern open water area as it supports blue crab overwintering grounds (Maryland Port Administration, 2023). Additionally, the New Orleans USACE District has the largest channel Operations and Maintenance program in the nation and dredges an average of 77 million cubic yards of material annually which accounts for a third of sediment dredged in the entire nation (USACE 14). According to USACE, this district leads in BU alternative application. Between 1976 and 2019, dredge material has been put to BU in creation of over 74,000 acres of habitat (USACE 14). These comparisons are meant to demonstrate that maintenance of successful ports can uphold environmentally sound principles without compromising profits.

Port	Channel Dimension (ft)	Channel Length (miles)	Annual Dredge Maintenance Volume (mcy)	Operation & Maintenance Dredge Management	Economic Importance
Mobile	50 x 500	29	4.5	In-bay disposal	1. $98B statewide 2. > 350,000 jobs
Savannah	42 x 500	21	7.8	Upland containment dikes	1. Largest container handler along South Atlantic coast 2. 4th in nation for import and export for container cargo
Chesapeake	50 x 700	150 (includes Patapsco River and Baltimore Harbor)	4.7	>1.5 mcy every 4 years into VA in-bay disposal site, BU, & Ocean disposal	1. $80B in freight in 2023 2. > 150,000 direct and indirect jobs in 2023
New Orleans	variable	variable	77	BU & Ocean disposal	2020 revenue of >$90M from cargo, rail, industrial, real estate, and cruise industries

Table 1) Port statistics and dredge management activity comparisons. The following resources are cited for each port: 1) Mobile (Cason, 2024) 2) Savannah (USACE 13) 3) Chesapeake (Maryland Port Administration n.d. & 2023), (Maryland State Archives), and (Mahoney, 2024) and 4) New Orleans (USACE 14) and (Terrell et al, 2023).

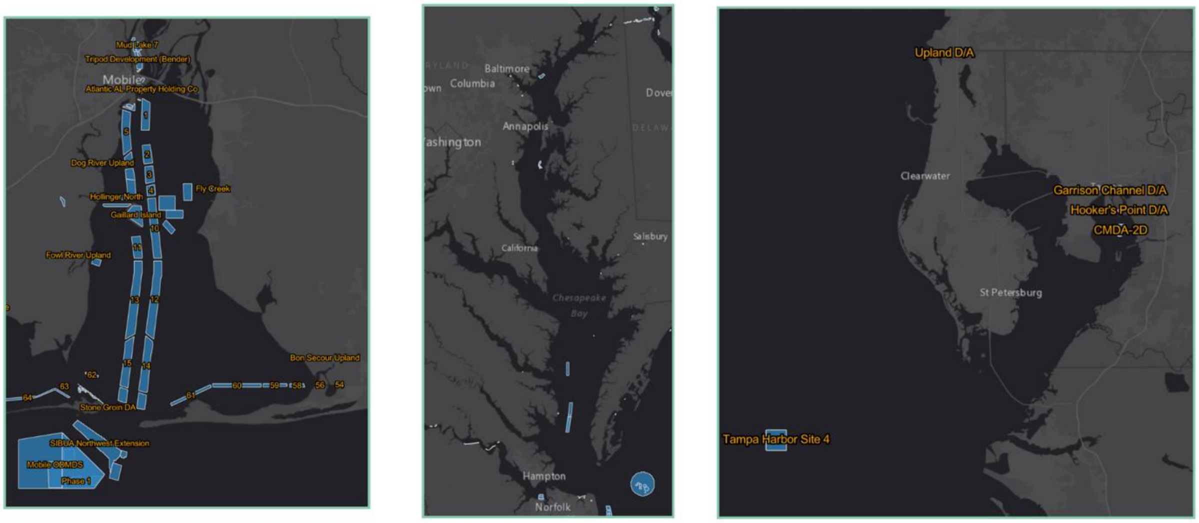


Figure 24) Blue areas show dredge placement in Mobile Bay, Chesapeake Bay, and Tampa Bay from left to right. Chesapeake Bay has very few in-bay disposal sites that are not BU because the state of Maryland has banned this practice. Tampa Bay disposes of dredge material offshore, in containment dikes, or through BU application. Screen shots taken from the U.S. Army Corps of Engineers Geospatial Active Placement Areas ArcGIS mapping tool (published in March 2017 and last updated on September 17, 2024).

In summary of this section on sedimentation and starvation arguments, there is no evidence to support that in-bay disposal is critical to sustain bay elevations or to re-nourish shoreline and habitats. We believe that the best use of dredge material to support vanishing habitat is direct BU application. Other comparable and successful ports are not resorting to in-bay disposal methods, and we believe Mobile Bay should not be treated as an anomaly in being at the “forefront of implementing TLP as an innovative and sustainable method for managing dredged material” (Ganic, 2024).

Conclusion

Mobile Baykeeper is seeking to collaborate with the USACE Mobile District to protect the health of our bay while also promoting economic prosperity for the state, as we believe it is both possible and critical that we maintain and support both. Ultimately, the decision to move forward with current plans, despite the lack of information to support that TLP is not harmful and theoretically beneficial, is incredibly unpragmatic in light of the multitude of resources documenting negative outcomes incurred for water quality, tidal, and subtidal habitats from in-bay disposal activities and the subsequent regulatory changes being made to address them (In-bay Disposal Alternatives and Limitation Literature). Our organization wants to bring a variety of stakeholders and resource managers to the table to find more strategic solutions to managing this material, such as maximizing use of dredged material through beneficial use projects and disposing of the remaining material offshore. Additionally, we are advocating for creative mitigative solutions to be utilized in combatting salinity intrusion, hypoxia conditions, and erosive ship wake energy through implementation of berms or sills, oxygen wells, and more comprehensive studies on erosion trends and vessel activity.

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