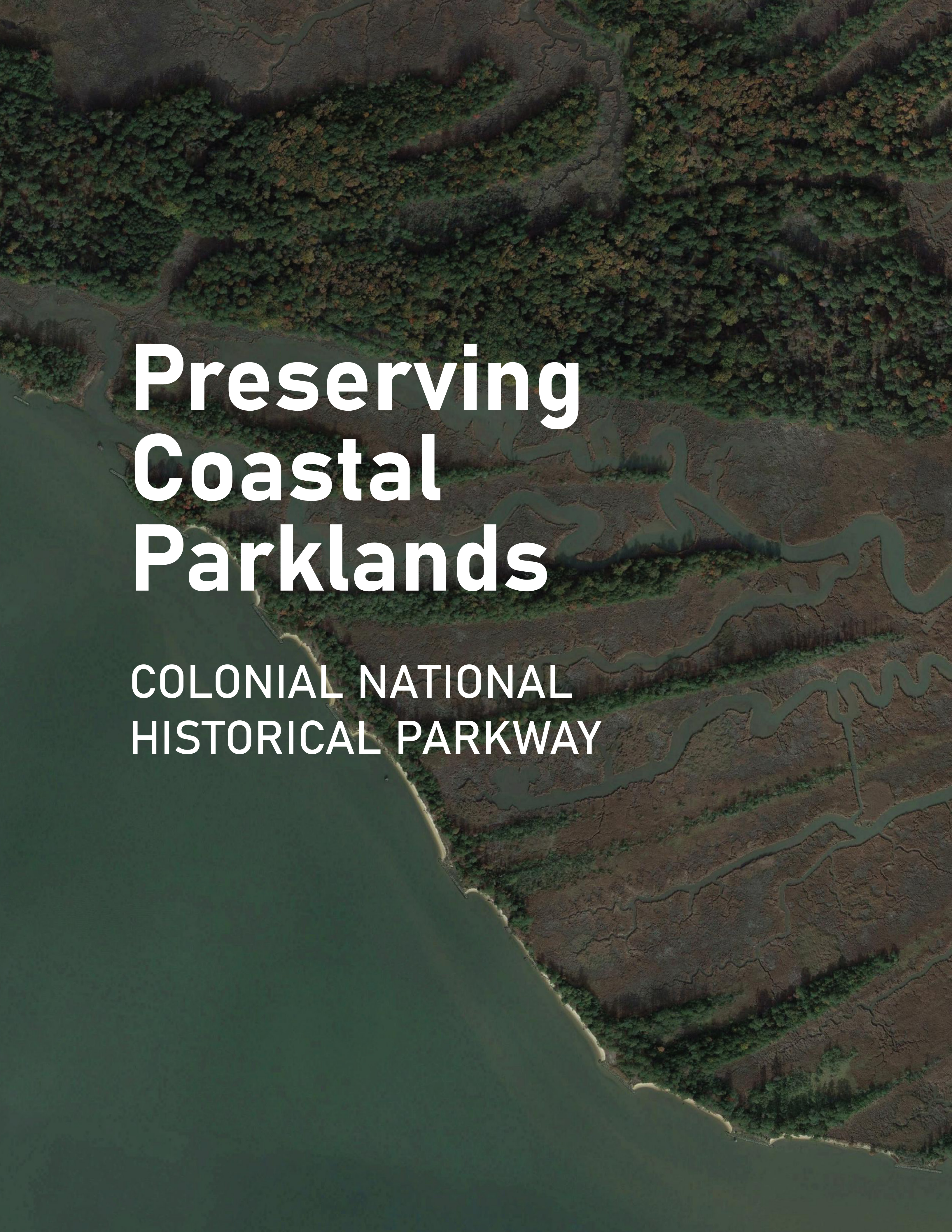

Preserving Coastal Parklands

COLONIAL NATIONAL HISTORICAL PARKWAY

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This report covers findings from the first year of the Preserving Coastal Parklands project, funded by a Cooperative Ecosystem Studies Units grant through the US Army Corps of Engineers Engineering With Nature program. This research was done in cooperation with Colonial National Historical Park.

The report was prepared by investigators at the University of Virginia, The Nature Conservancy, and the National Park Service.

Recommended citation: Davis, B., C. Johnson, J. Specht, I. Hametz, and M. Dawkins. 2023. Preserving Coastal Parklands, Vol. 1: Colonial National Historical Parkway. University of Virginia, Charlottesville, VA. 77 pp.

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Executive Summary

Coastal parklands are culturally significant landscapes where unique natural and historical forms and forces are affected directly by climate change. Natural and nature-based features (NNBF) work with natural forms and processes to produce desirable effects such as slowing erosion or protecting areas from storm surges. Because they work with the natural qualities of a landscape, the implementation of NNBF to combat the deleterious effects of sea level rise in coastal parklands is both imperative and distinctly complicated.

Colonial National Historic Park is particularly vulnerable to sea level rise and flooding associated with storms as climate changes. This research identifies key landscape qualities, processes, and characteristics that relate to climate adaptation objectives established by the park. The natural infrastructure concepts discussed here both support pressing management priorities and enable long-term ecological resilience and habitat transition. They also aim to offer stronger interpretive experiences to park visitors that better accommodate ongoing and future change. The hope is to demonstrate how working with the landscape to confront challenges of today connects us to the stories of original inhabitants, colonists, enslaved people, and their descendants who have lived, worked, and helped make this significant cultural landscape that is preserved for the enjoyment of future generations.

The research described in this document took place between February 2022 and January 2023, and was divided into four stages: site investigation led off-site by researchers and onsite by collaborators at Colonial National Historic Park, a design workshop to collaboratively discuss design opportunities, testing and development of natural infrastructure concepts framed in the workshop, and concept refinement. The multi-disciplinary team brings together landscape architectural and history expertise from the University of Virginia, social science and conservation expertise from The Nature Conservancy, and large-scale resilience and institutional coordination expertise from the National Park Service and EA Engineering, Science, and Technology Inc, PBC. Our approach leverages the tools of our team to investigate what is particular about this landscape, and how its specific qualities can play a role in generating more resilient and meaningful landscapes over time.

Executive Summary

This document describes the context of Colonial National Historical Park, introduces the research framework, outlines four NNBF concepts developed over the course of the study, and makes suggestions for future development and implementation. These concepts range in scope and scale to meet the challenges the park will face as climate changes, from local adaptive actions to large-scale multi-year partnerships. Our recommendation is to implement the Groins from "Tree Groins and Bars" as a pilot project, and to work to combine these with the beneficial use of sediment described in "The Shallows" in partnership with the USACE.

Concepts

Tree Groins and Bars

This concept integrates onshore and nearshore shoreline protection strategies. Tree groins and nearshore bars make use of local materials and local hydrological dynamics to frame a large, shallow region of relative calm to protect an exposed stretch of the Colonial Parkway that is facing accelerated erosion. The groins can be piloted by focusing on the ongoing tree removal operations in the park with little additional outside funds, and we expect the trees would have an accretionary effect on their own.

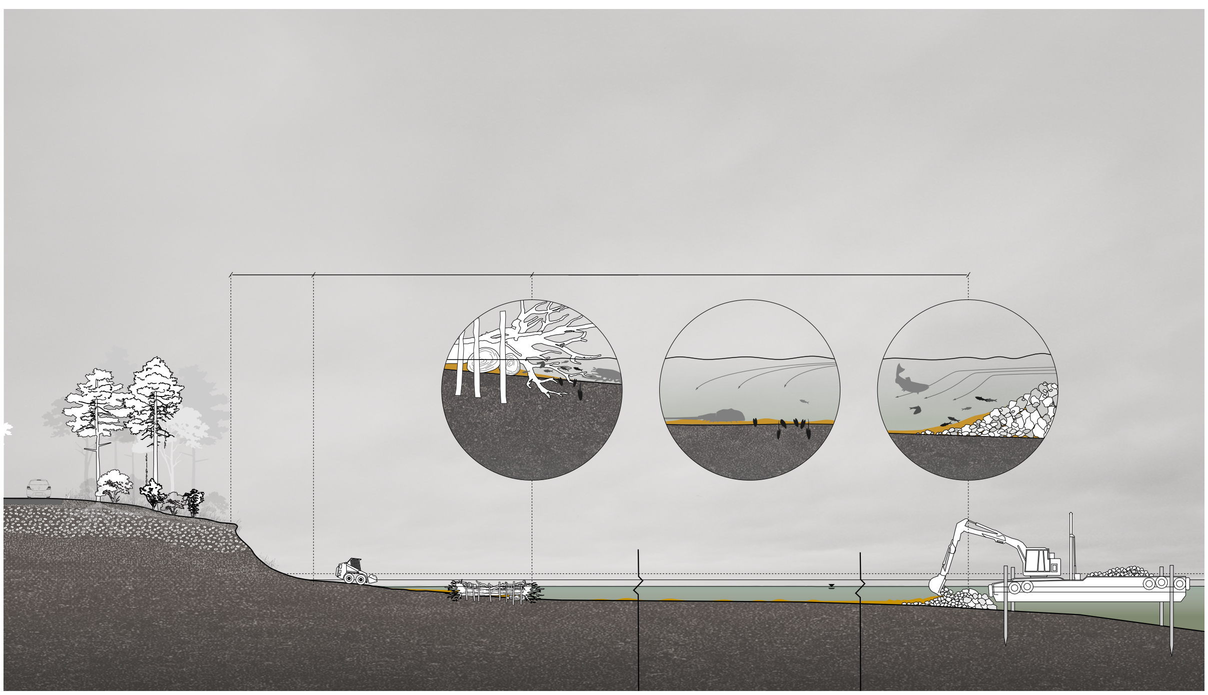

Figure 1. Tree Groins and Bars schematic section.

The Shallows

Making beneficial use of the large quantities of dredged sediment (approximately 200,000 cubic yards annually) pulled from the federal channel surrounding Jamestown Island has the potential to preserve historic processes and landscape features in the riparian and coastal zone. In our view, the beneficial use of large amounts of sediment is the primary means of adapting the park to sea level rise using NNBF. This proposal enables bluff protection, parkway preservation, wetland aggradation, and interpretation of the sediment placement processes that were fundamental to the creation of the Parkway. Partnering with USACE to place sediment dredged from the Goose Hill channel in key areas around Jamestown Island could dampen increasingly strong hydrological forces, support native ecological communities, and enhance visitor experience of this historical landscape. This approach would allow a practical interpretation of the technique for enabling river navigation that was fundamental to Jamestown and that has been ongoing in this location for 140 years.

Figure 2. Shallows sediment source, placement, and change over time.

The Breach

The introduction of a wide, shallow breach at the location of the existing parking lot, dividing the naturally-formed isthmus from the filled portion of the parkway, would restore the natural geomorphology and could enhance sediment exchange and promote marsh-building in College Creek. It would also enable opportunities for interpreting the ingenuity and labor that was required for the original construction of the Parkway and is critical to its future viability.

Figure 3. The Breach, aerial perspective rendering. Illustrates how proposal would facilitate exchange of water and sediment between James River and College Creek.

The Isthmus Flats

Sea level rise and increasing salinity will shape the future of Jamestown Island. By creating a new marsh platform on the original isthmus road bed that introduces visitors to the Island, this design seeks to harness these changing forces to commemorate and reinterpret some of the site's most defining features, such as the marshes, bald cypress trees, and coastal structures.

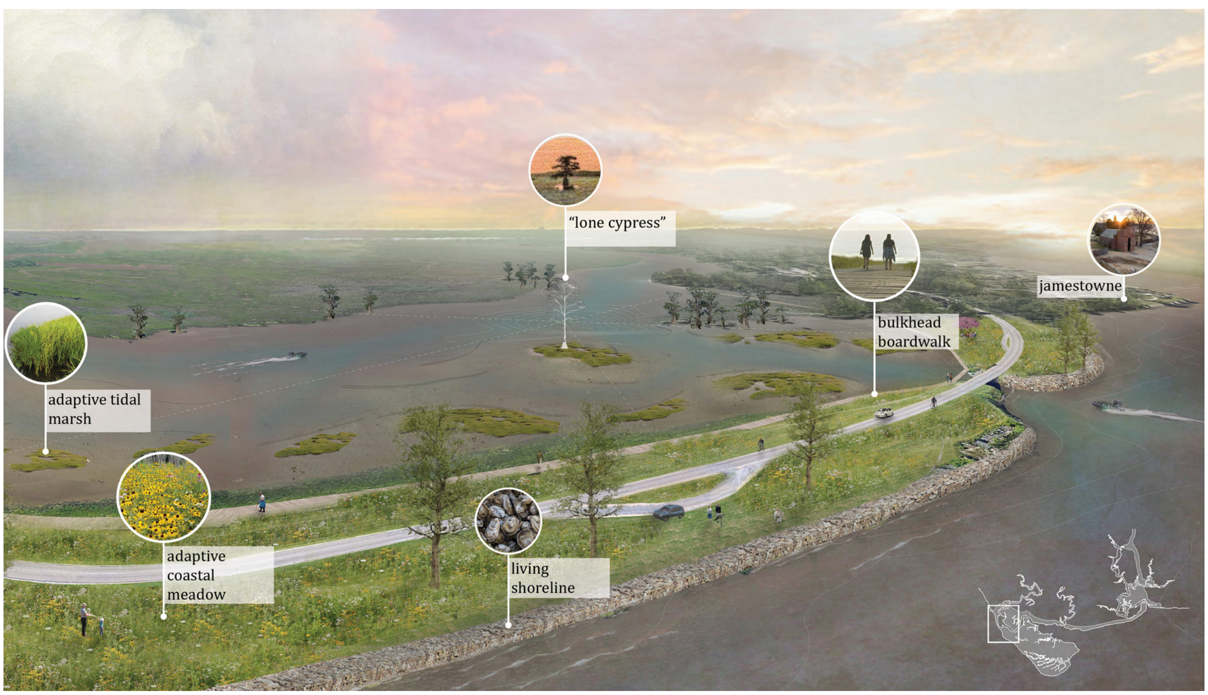

Figure 4. Isthmus Flats concept, aerial perspective.

Introduction

This report summarizes research, design, and development of natural and nature-based features (NNBF) for climate adaptation in Colonial National Historical Park. Colonial National Historical Park (COLO) includes several geographically distinct units - Jamestown, Williamsburg, and Yorktown - connected by a 23-mile scenic roadway, the Colonial Parkway, that together showcase the beginning and end of Colonial America. We are focusing on the Jamestown part of the park with this work. While the focus of COLO is its historical story, the entire park has a direct hydrological link to the Chesapeake Bay and is bounded by two of the Bay's largest tidal rivers. In addition to more than 30 miles of shoreline along the James and York Rivers, the park's natural resources include a variety of aquatic and terrestrial habitats, with associated wildlife and recreational value.

As a national historical park and cultural landscape, COLO is an inheritance; something meaningful and valuable received from the past and passed on to the future. Because of this, design and form matter. It is not enough to impose general solutions to erosion or flooding and leave the interpretation of this history and cultural values to a museum or visitor center exhibits. The landscape itself is the most powerful interpretive device in a national park, and maintaining its integrity is critical to the conservation of its cultural and natural resources. Any new form, whether restoring habitat, limiting erosion, or providing parking, must itself maintain the integrity of the cultural landscape. This approach is not new to our project, but is fundamental to the best traditions of the National Park Service, and it is in line with an NNBF approach that values and works with the natural processes particular to a place. In this context, design becomes an act of interpretation itself, not merely problem-solving enabling interpretation by other means.

The emphasis of park management at COLO is on exploring and explaining the history of the area. As such, the park is the steward for important historical and cultural resources, many of which are still buried underground. These resources are threatened by sea level rise through both inundation and saltwater intrusion into the coastal landscape that harbors them. The park's diverse coastal and terrestrial habitats are also threatened by sea level rise and increased storm surge impacts, with much of Jamestown Island projected to be underwater by 2050 and vulnerable areas of the Parkway threatened by erosion. Our team's work seeks to enhance cultural experience and protect fragile ecosystems while providing a management strategy for key locations in the park that keeps pace with changes wrought by rising sea level.

Following the presentation of proposed nature-based solutions both during an in-person meeting at the park and following a review of this report, the park considered the design concepts and chose the Tree Groins and Bars design concept to move forward for consideration. To best understand what factors drove the park's decision-making and whether the process of identifying these alternatives was useful, we met with the park to discuss the process, concepts, and lessons learned. This discussion is integrated into the Design Concepts section of the report.

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Framework

CULTURE, ECOLOGY, AND INFRASTRUCTURE

Jamestown Island lies fifteen miles from the Chesapeake Bay on the James River. It was the site of the first permanent English settlement in North America in 1607, and has a rich history of human habitation that extends from the last Ice Age through the 20th century. It is also home to diverse wetland and terrestrial ecosystems that provide habitat for a variety of plant and animal species, many of which are rare, threatened, and endangered. Jamestown Island is threatened by sea level rise through both inundation and saltwater intrusion, as well as increased storm surge impacts. These entangled issues – of history and culture, natural resources, and critical infrastructures at risk – informed our characterization of the site and subsequently our research approach to NNBF development.

Though changes threaten the park as it exists today, Jamestown Island is a historically dynamic place. Research into these dynamics, past and present, inform the designs proposed here. This research involved GIS work, site visits, archival research, and analysis of existing studies and practices, maintenance, and goals. As outlined in Colonial National Historical Park's Integrated Coastal Climate Change Vulnerability Assessment [1], the National Park Service has short-term goals to maintain access and protect historical artifacts and facilities at the park; and long-term goals to maintain cultural landscape features, to preserve habitat and increase ecological transition, and to make stronger interpretive connections to the challenges original inhabitants and colonists faced living on a marshy, tidal, flooding, and shifting coast.

Our framework bridges these goals by connecting shoreline maintenance practices and the experiences of park visitors, descendant communities, and tribes with histories, ecological communities, and geomorphological changes that shaped the ridges and shallows that have characterized this region for thousands of years. Understanding Jamestown with this specificity ties design to historical, hydrological, and ecological dynamics particular to each site of interest. The NNBF approaches described in this document can often work in conjunction with conventional approaches such as segmented breakwaters or coastline rip-rap and in some cases may supplant the need for these features, which are generally not in keeping with the character of the landscape and erode the integrity of the cultural and natural heritage of Colonial National Historical Park.

Culture

A History of the Edge

A deep history of relationships with the water's edge characterizes Jamestown Island. The island's dynamic shoreline has fostered a wide range of landscape interactions over time. Before the 17th century, this island was occasionally visited by the Powhatan, with archeological evidence at sites including Black's Point [2]. During this period, the shore of Jamestown Island was not settled permanently – it was visited seasonally for plant and animal resources [3]. Permanent settlement came with European colonization. Jamestown was selected strategically in 1607; the water was deep enough to anchor boats and the island didn't have permanent indigenous settlements [4]. This strategic choice resulted in a new cultural project– building consistent lives on inconsistent ground. This paradox developed into a complex relationship with the edge between water and land, as the dynamic shoreline and marshy island proved a challenge to inhabit.

Shifting Approaches

Human access to Jamestown Island has shifted over time. Evidence describes an island accessed by water, with a lively, inhabited edge in its early history [5]. Tidewater indigenous Americans had seasonal camps along the banks during warm months and in winter, with the waterway used for both food and transportation [6]. Later, the island's single point of land access, known as the Isthmus, was a key factor for early European settlement; affording inhabitants a defensive point which resulted in its use in major conflicts over time, including the Revolutionary War and Civil War. The Isthmus washed away in the late 18th century during a major storm event and ferries became the main mode of transportation to the island [7]. 19th century sources (including Figures 5 and 8) describe an island cleared for farming and a river used for recreation and fishing along a sandy shoreline level with the water. Before significant erosion occurred, Jamestown island was predominantly agricultural and its tourism was defined by boat access. The 1857 celebration of the 250th Anniversary of the founding of Jamestown saw thousands of people coming by boat to the island and camping there overnight (Figure 6).

During the Civil War, a road from the mainland was constructed: Mainland Bridge. In the 20th century, a push to connect Jamestown Island with Williamsburg and Yorktown resulted in Colonial Parkway, which reestablished past connections with the Island and James River's shore by constructing a new isthmus with dredged sediment near the location of the original road. Colonial Parkway was constructed between 1930 to 1958 according to aesthetic ideals of time. This necessitated sweeping curves and

Figure 5. Church Tower Ruin, 1805. Artist Unknown.

gentle slopes away from the road. It also made shoreline maintenance increasingly important and led to an ongoing practice of protecting this critical infrastructure and the resources it connected, both cultural and natural.

Locating the Parkway along the coast is symbolic, as it recalled the nation's reinvigorated fascination with its origins along the edge and the importance of coastal landscapes. The Isthmus and College Creek overlooks are two examples of grand viewsheds along Colonial Parkway, where the James River and Back Bay are on full display.

Marking Change: The Lone Cypress

Beginning in the early 19th century, accounts mention an old cypress tree located along the shoreline that was drawn further and further into James River as time passed. It was thought that this tree once stood on dry land and marked the site of the original fort, and its position became a part of the local lore of a changing shore. The lone cypress shaped people's understanding of the island and what had happened there, underlining the cultural relationship with shore dynamics and land loss.

In 1854, Robert Sully explains that "there is, some distance from the beach, a Cypress Tree, under water [sic] to its lower branches– In the recollection of the living, Carriages, once, drove around this tree–It is now at least 60 yards from the beach" [8]. The tree was about 250 years old when it fell into the water in 1993. Multiple sources, including National Park Service reports, describe the Lone Cypress and use it as a key reference for the receding shoreline. In 1957, about a century after Sully's account, Hatch states that "the Old Cypress, standing several hundred feet from the shore above the landing site… is visible evidence of the erosion that has taken at least 25 acres of the western part of the townsite" [9].

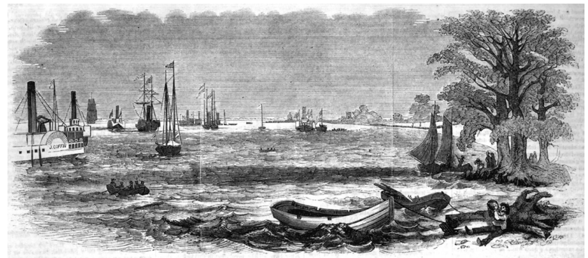


Figure 6. The Fleet, published in Harpers Bazaar, 1857.

Figure 7. Postcard of the Lone Cypress Tree (The Association for the Preservation of Virginia Antiquities).

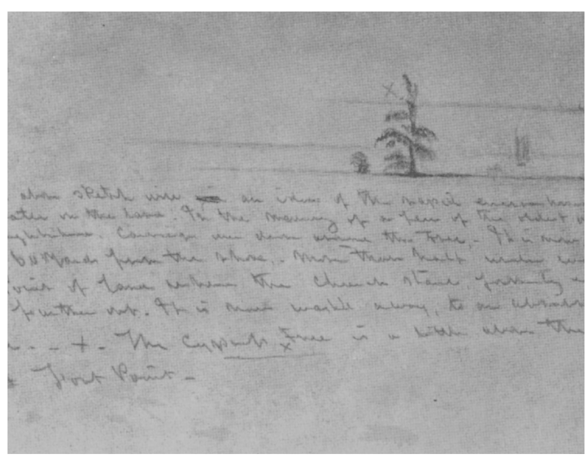


Figure 8. Robert Sully sketch, Lone Cypress Tree. (1942)

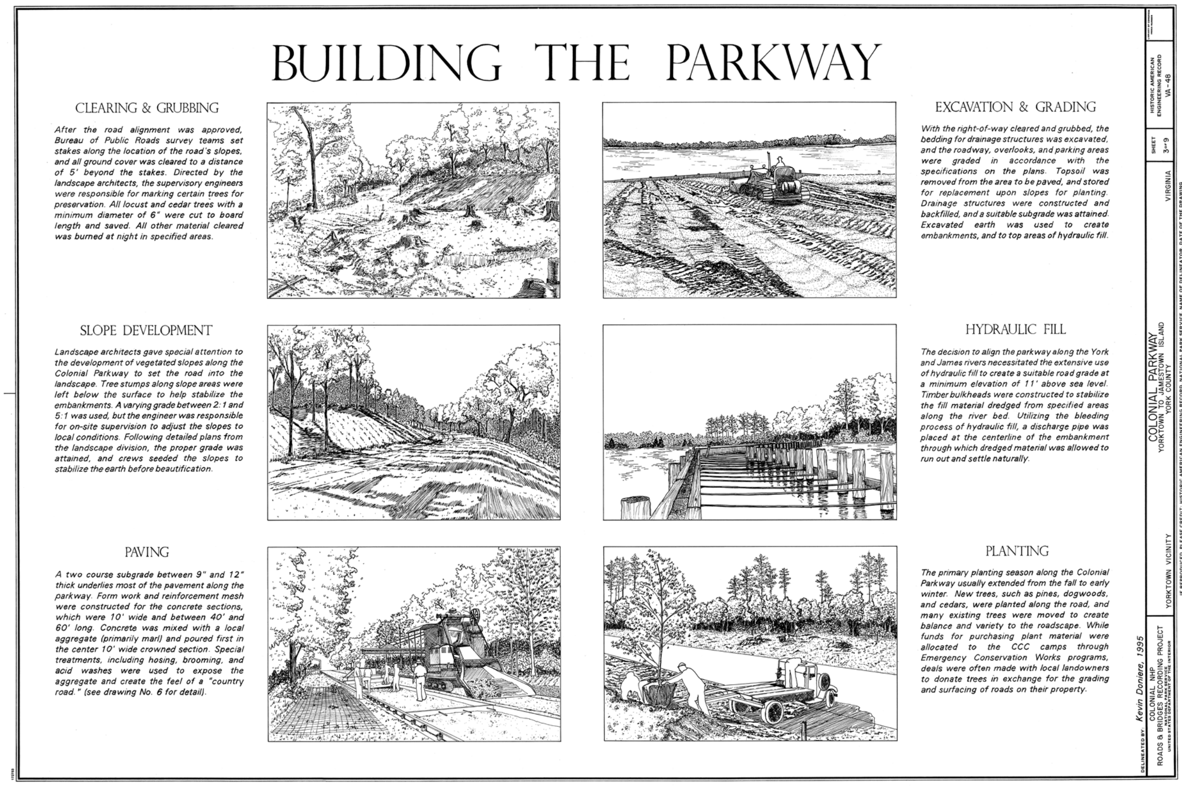


Figure 9. “Building the Parkway” from Historic American Engineering Record (HAER), 1995 Colonial NHP Roads and Bridges Recording Project.

Figure 10. Construction of the Parkway (1933)

Figure 11. Parkway grading before concrete was poured, near College Creek. (1940s)

Ecology

Climate Change and Sea Level Rise

Colonial National Historical Park is within several meters of sea level and is tidally influenced. Therefore, park lands, as well as cultural and natural resources, are particularly vulnerable to changes in relative sea level and flooding associated with storms. The threat to COLO and its resources is primarily from the combined effects of tides, storm surges, and sea-level rise. According to Monahan and Fisichelli [10], climate change will probably affect all aspects of the park's natural and cultural resource management.

Between 1950 and 2003, the mean sea level trend at the Gloucester Point gauge was an increase of 0.15 in/year, more than twice the 20th century global average of 0.07 in/year, probably due to local subsidence [11]. Flooding during storm events such as nor'easters and hurricanes is likely to increase in severity and frequency as climate continues to change, with projected storm intensity and rainfall rate increases. Sea level rise and storm surge vulnerability at COLO will have impacts including: loss of land and critical habitat, increased erosion and accretion due to storm surge, rising groundwater tables and possible saltwater intrusion, and loss of freshwater marsh ecosystems [12].

The James River has long fetches on both the eastern and western ends of the island. In 2003, storm surges associated with Hurricane Isabel damaged shoreline stabilization structures, eroded beaches, washed away several archeological sites along the Parkway and on Jamestown Island. The storm also severely damaged the Jamestown visitor center (damaging or destroying artifacts there) and several tour road bridges. In addition to flooding, storms concentrate erosive waves on the park's shoreline [13].

Plant Communities

Ecological resources across the island include diverse wetland and forested-upland ecosystems that provide habitat for a variety of plant and animal species, many of which are rare, threatened, and endangered. Wetland ecosystems consist of extensive tidal, freshwater-to-mesohaline marshes and forested swamps that cover about two-thirds of the island. Marshes typically are fresh in the upper reaches of most drainages but transition to oligohaline and mesohaline in the lower reaches. NPS and NOAA marsh migrations predictions show a dramatic transition in the coming decades in which most freshwater and oligohaline marshes will become brackish and unconsolidated shoreline [14], creating implications for visitor experience, local ecology, and Parkway viewsheds.

Monitoring in 2013 revealed the presence of "66 species of marsh birds, including

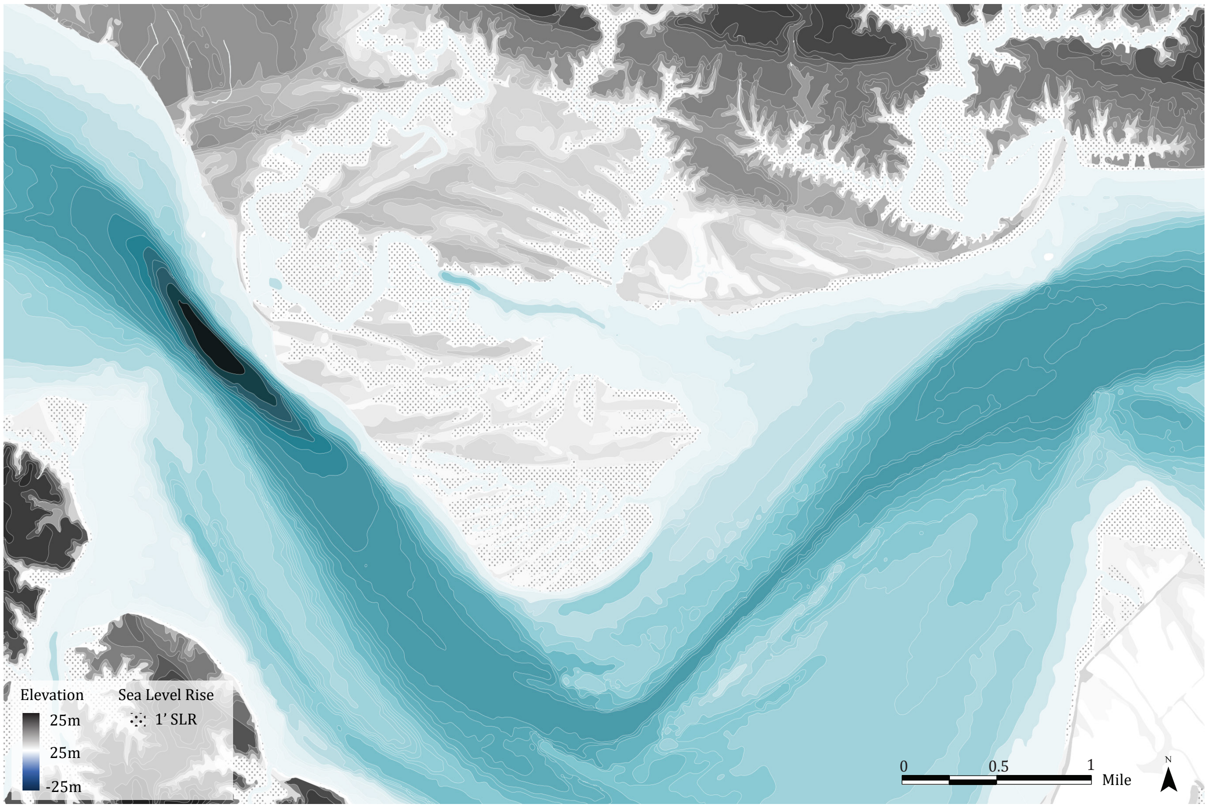


Figure 12. Sea level rise data: VIMS 2020 projection for Norfolk, VA (Sewells Point, VA - Station ID: 8638610)

rails and bitterns that are obligates of the tidal marsh and sensitive to changes within their breeding and foraging habitat; such habitat changes could occur due to relative sea-level rise" [15].

Pine and mixed-hardwood forests cover adjacent upland ridges that are bordered by the marshes. As sea level rises and groundwater increases in salinity, these forests will begin to wither and be colonized by salt-water tolerant marsh species, like Phragmites. The composition of the existing marshes has started to change as the water becomes more saline. The globally "imperiled" and state-wise "critically imperiled" Tidal Bald Cypress swamp exists in a transition zone between open tidal water and tidal marsh at Swanns Point and Jamestown Island [16]. This area amounts to less than an acre of the 10,000+ acres of the park, and this area will continue to shrink as sea level rises.

1.2 Framework | Ecology

Notable Plant Communities (NPS designations)

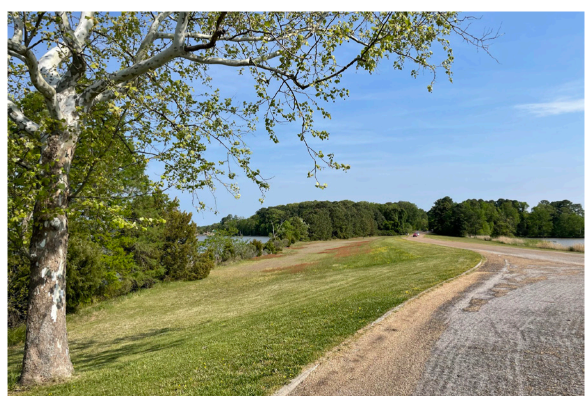
Oligohaline Marsh

Coastal Plain Loblolly Pine - Oak Forest

Freshwater Marsh

Tidal Bald Cypress Forest

Beaches



Cultural Meadow

Figure 13. Ecological data: 2008. Geospatial data for the Vegetation Mapping Inventory Project of Colonial National Historical Park

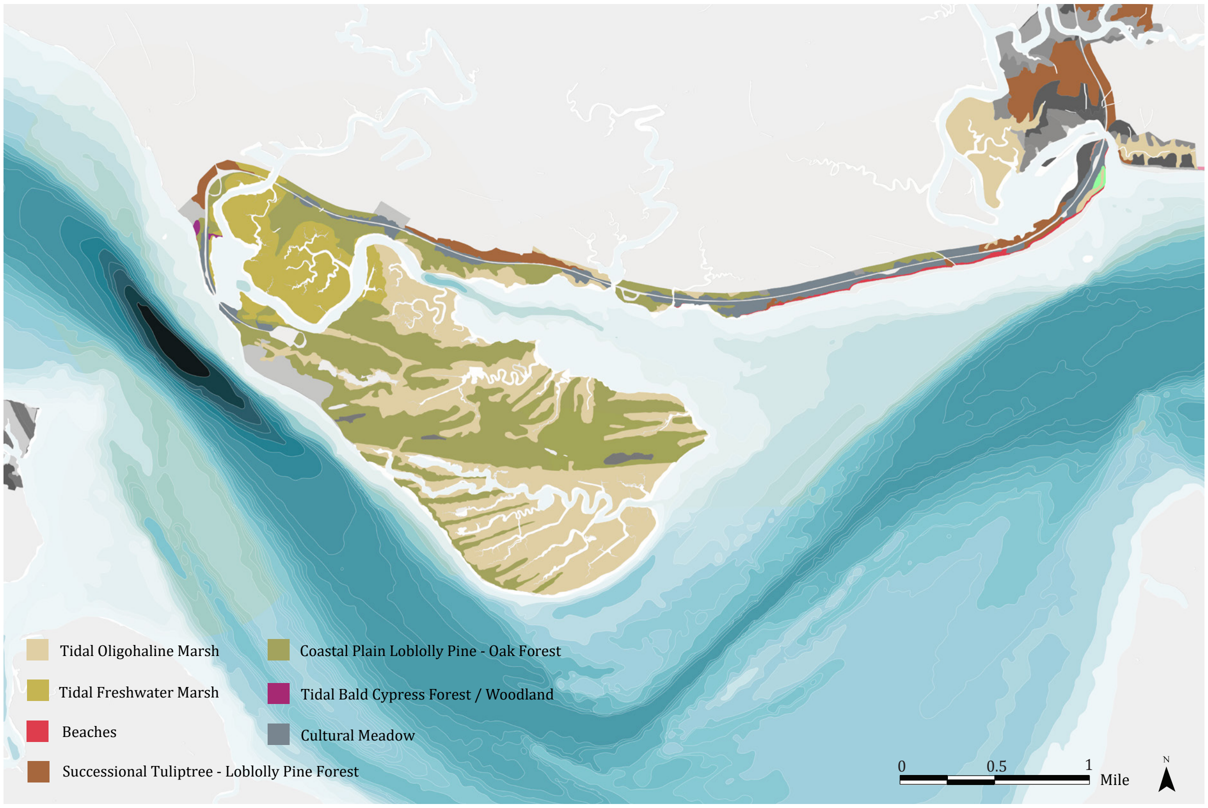


Figure 14. Ecological data: 2008. Geospatial data for the Vegetation Mapping Inventory Project of Colonial National Historical Park

Infrastructure

Shoreline Structures

When European settlers arrived at Jamestown Island in 1607, the shoreline was more than 400 ft to the west of its 2001 position. Since 1607, Jamestown Island has been extensively eroded on almost all sides, except along Back River, by storm-generated high tides and strong waves and currents. Between 1894 and 1901, a seawall was constructed along the western edge of Jamestown Island to curb erosion; this structure is still functioning and is now considered historic. In response to its changing environment, the National Park Service has continued the tradition of managing the relationship between Jamestown Island and the water, from mosquito ditching to shoreline hardening.

As of 2013, 28% of Jamestown Island's shoreline is armored through an array of 55 structures including breakwaters, bulkheads, piers, revetments, seawalls and marsh sills [17]. Because much of the historical significance and cultural resources in Colonial National Historical Park are associated with and located along the shoreline, erosion is a critical concern. Historic rates of shoreline change vary with location and amount of anthropogenic interference (i.e., shoreline nourishment and/or installation of shoreline protection structures). Between 1937 and 2009 the shoreline change rate (negative values for overall shoreline loss) in the Jamestown unit ranged from -1.2 to 7.0 m/year, with an overall average rate of 0.1 m/year [18].

Figure 15. Recorded shoreline change + infill at the isthmus, 1937-2020 (Sources: Milligan Plate 13)

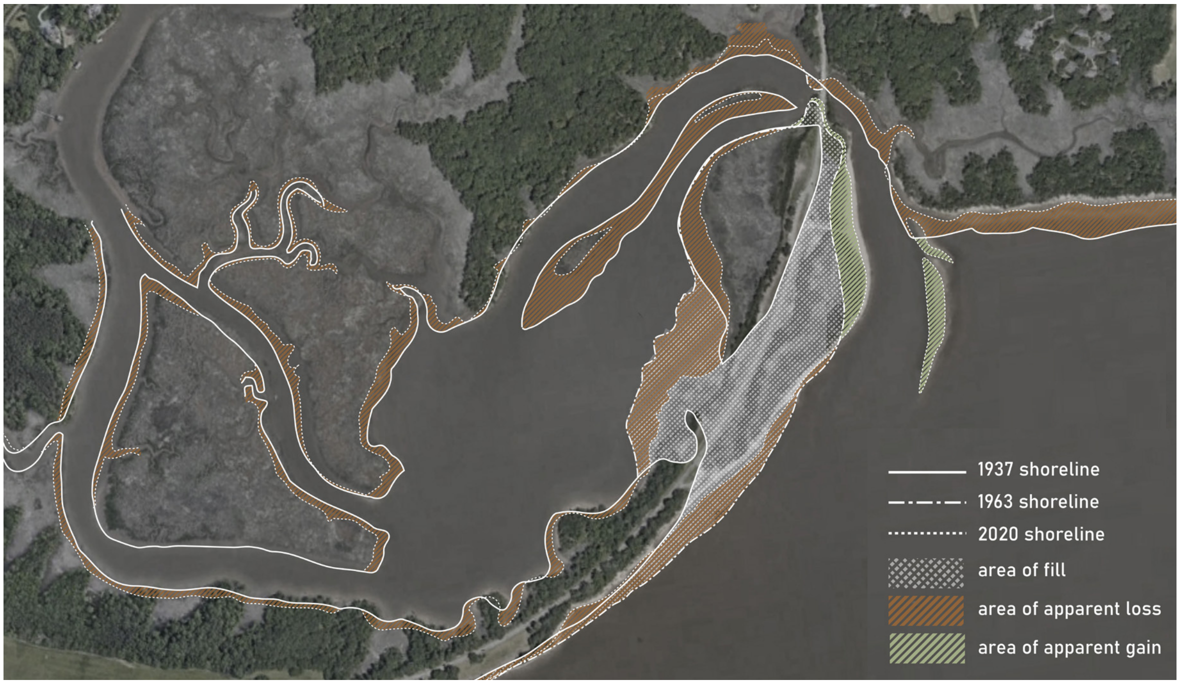


Figure 16. Recorded shoreline change + infill at College Creek, 1937-2020 (Sources: Milligan Plate 15)

Colonial Parkway

Colonial Parkway is a 23-mile historic roadway that guides visitors between the main sites of Colonial National Historical Park: Jamestown, Williamsburg, and Yorktown. Part of a larger American parkway movement, initial designs were directed by NPS engineer Oliver G. Taylor and NPS landscape architect Charles E. Peterson, who envisioned a road to "provide continuity to the visitor experience of motoring through nearly 400 years of American colonial history" [19]. Utilizing parkway design techniques inspired by the Bronx River Parkway and Mount Vernon Memorial Highway, the road offers sweeping viewsheds of the York and James Rivers; large curves; a diversity of natural and cultural landscapes, and a respite from modern intrusions and commercial development. For these reasons and many more, Colonial Parkway is "one of the best remaining examples of the American parkway movement" [20]. It is also critical infrastructure for Colonial National Historical Park as it is the primary access route for visitors. Much of the parkway is threatened in the Jamestown region, especially on the shoreline and particularly around areas of historic fill.

Fill

Sediment dredged from the James River was used as fill for the four Colonial Parkway bridges along the James River. "Approximately 1,700,000 cubic yards of earth went into the fill along the marshes and creeks… Grading and drainage contracts … accounted for the removal of half a million cubic yards in addition" [21]. These areas of fill are important not only as massive earth-moving projects, but as anthropogenic features with meaningful impacts on landscape evolution. Because they are artificial, rather than shaped by local geology and hydrological forces, they are particularly vulnerable to erosion. Their sensitivity makes them a key contemporary example of the longer history of dynamism and struggle for permanence on the island

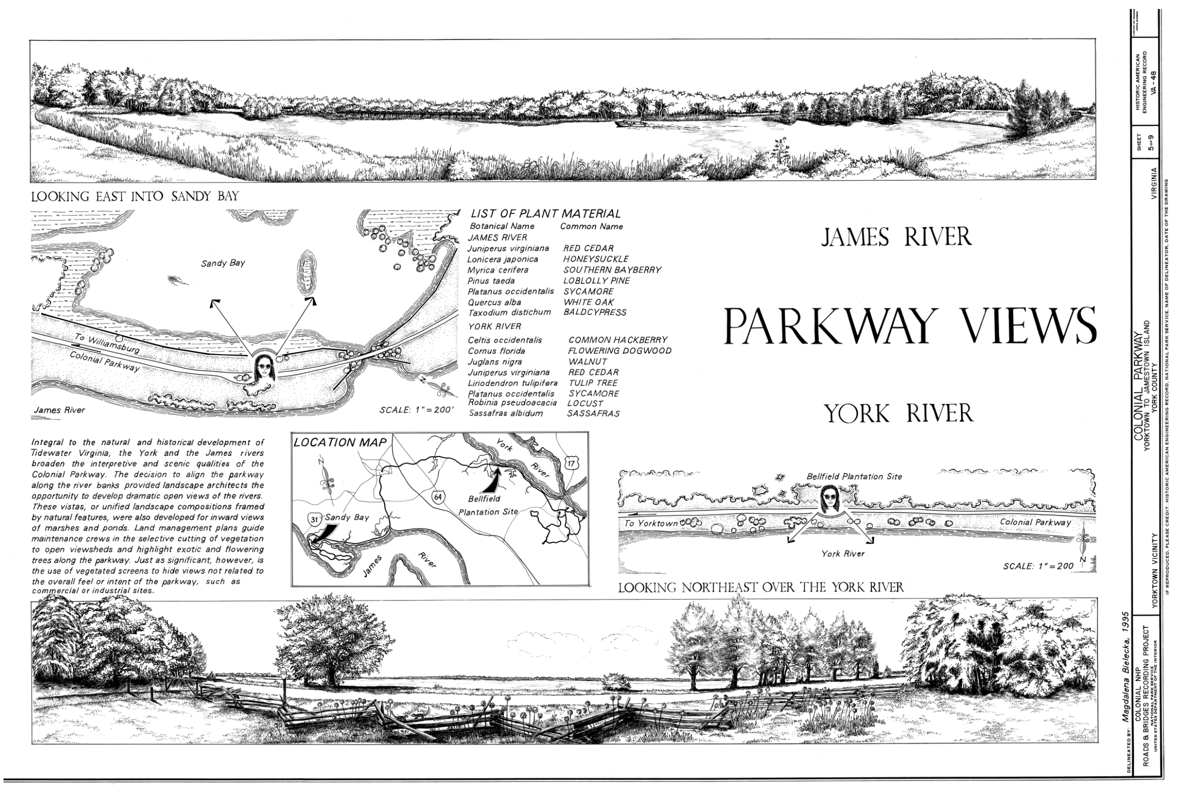


Figure 17. "Parkway Views", from HAER, 1995 Colonial NHP Roads and Bridges Recording Project

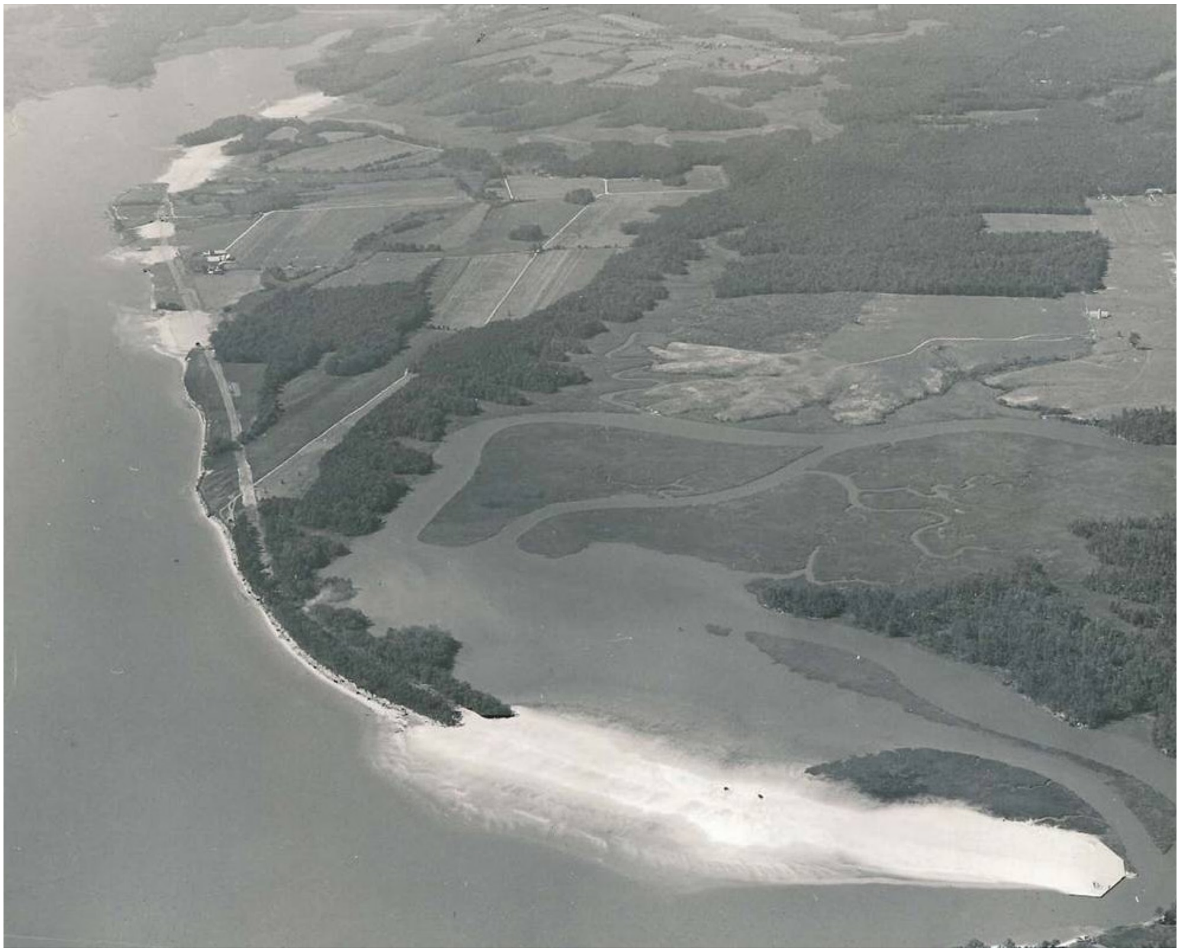


Figure 18. Aerial view of parkway infill project along College Creek (Source: NPS)

Design Concepts

FOUR CONCEPTS FOR JAMESTOWN ISLAND

Analysis of each site's unique dynamics and iterative testing of design concepts led to the development of four proposals that are generative, rather than simply protective; they build on the cultural and natural resources of the park as climate changes. As illustrated in Figure 19, these concepts range in scale and scope. Our recommendation is to implement the Tree Groins from "Tree Groins and Bars" as a pilot project, and to work to combine these with the beneficial use of sediment described in "The Shallows" in partnership with the USACE.

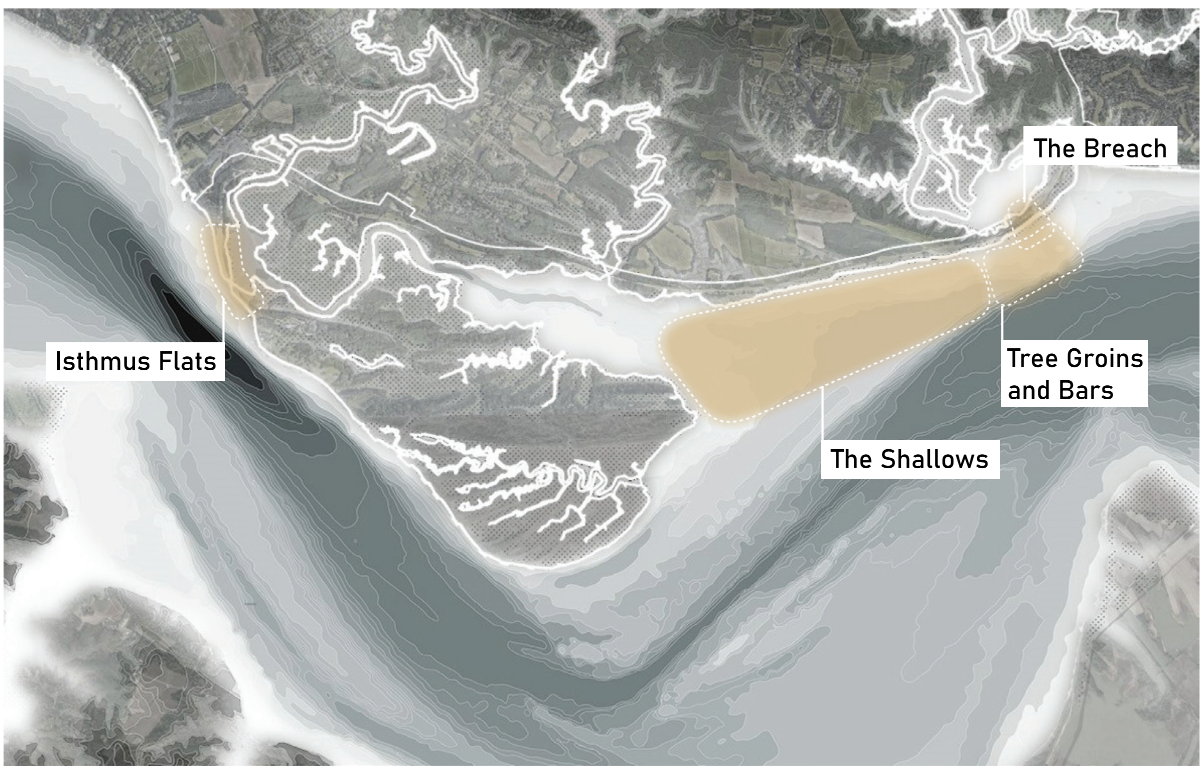


Figure 19. Key map of design concepts

Park natural and cultural resources staff were involved in the site visit and throughout the process of developing the NNBF designs. The park staff reviewed the report and then sent it to the superintendent for review and to select a design concept. The park took the following considerations into account as part of their decision-making process:

Design Timelines

The park was interested most in projects that could be accomplished in a shorter timeframe with relatively little effort given the time sensitivity of the coastal resilience issues at the park.

Protection of Cultural Resources

The immediate protection of cultural resources and the parkway were critical drivers of the park's decision-making. The park prioritized designs that would address the protection of these resources.

Relationship to Existing Plans and Efforts

The park considered how these design concepts would fit in with the existing James River Shoreline Plan, and how they addressed sea-level rise (SLR), erosion, and stormwater runoff. The park also reviewed the interactions of these projects with the ongoing Virginia Institute of Marine Science (VIMS) Shoreline Review and potential ways to overlap the project with data collection associated with work being done by VIMS.

Monitoring and Maintenance

The park was concerned about the cost and effort of ongoing monitoring and maintenance of all the proposed design concepts.

2.1 Tree Groins and Bars

This concept integrates onshore and nearshore shoreline protection strategies. Tree groins and nearshore bars make use of local materials and local hydrological dynamics to frame a large, shallow region of relative calm to protect an exposed stretch of the Colonial Parkway that is facing accelerated erosion. The groins can be piloted by focusing on the ongoing tree removal operations in the park with little additional outside funds, and we expect the trees would have an accretionary effect on their own.

2.1 Tree Groins and Bars

Background

The stretch of the Parkway along College Creek is severely threatened by shoreline erosion. Our analysis correlates this phenomenon with (1) the portion of the parkway constructed primarily on infill, (2) significant N-S fetch, and (3) sediment starvation in the nearshore zone. The goals of this proposal are to:

- Dissipate wave energy headed towards the zone of more severe erosion, especially from larger storms
- Increase deposition and shoreline replenishment
- Enhance visual interest and nearshore habitat value along this popular portion of the parkway

Figure 20. Bluff erosion and fallen trees west of College Creek

Our analysis shows that the morphology of the existing natural bluff is partially the reason that this parkway is in this location. The road clearly traces the bluff as it arcs along the James River, providing a high point along the drive and dramatic views across the river. Our archival research discovered historic woodcuts as well as early photographs of the bluffs in the area depicting them as dramatic, dynamic features. That is, they changed slowly, through toe erosion and mass wasting that exposed the stratigraphy of the bluff. These events would lead to trees falling into the nearshore where they would stay for a while, creating ecological diversity and offering bluff toe protection by acting as groins that slow sediment.

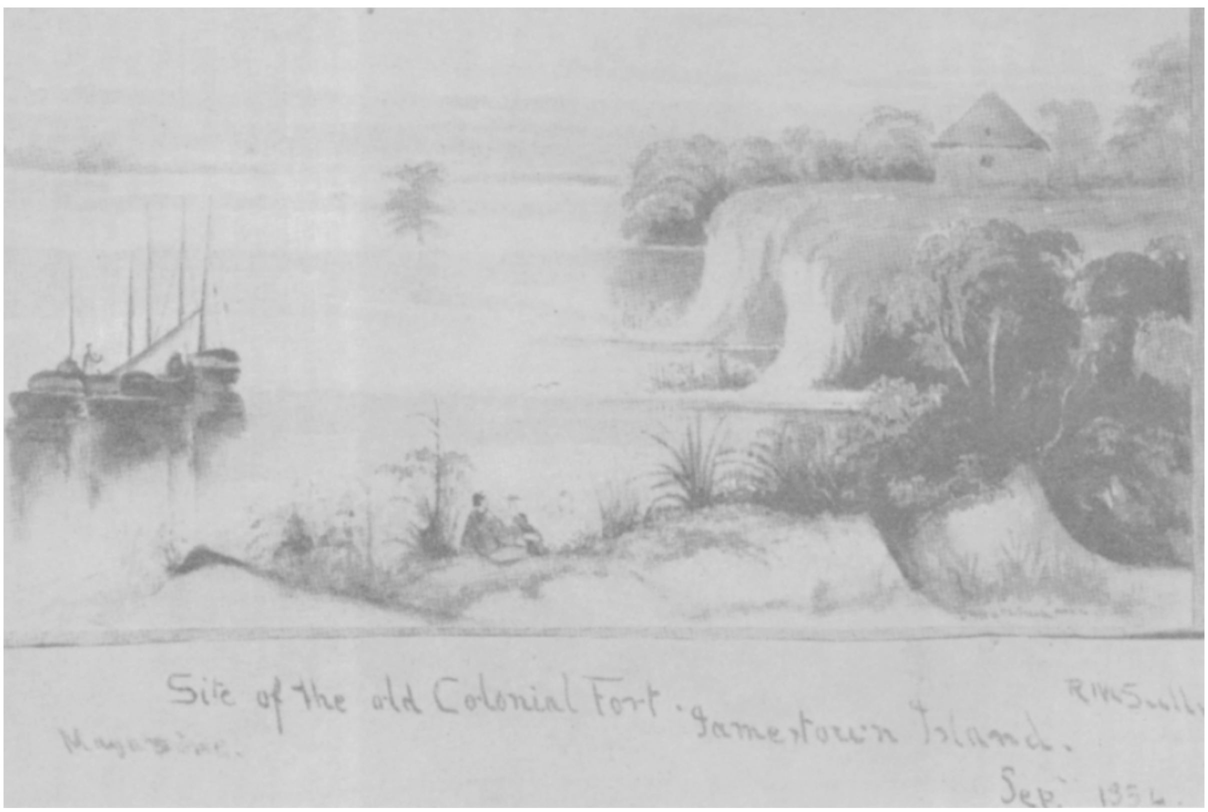


Figure 21. Sullivan sketch of Jamestown Island bluffs, Sept 1856

2.1 Tree Groins and Bars

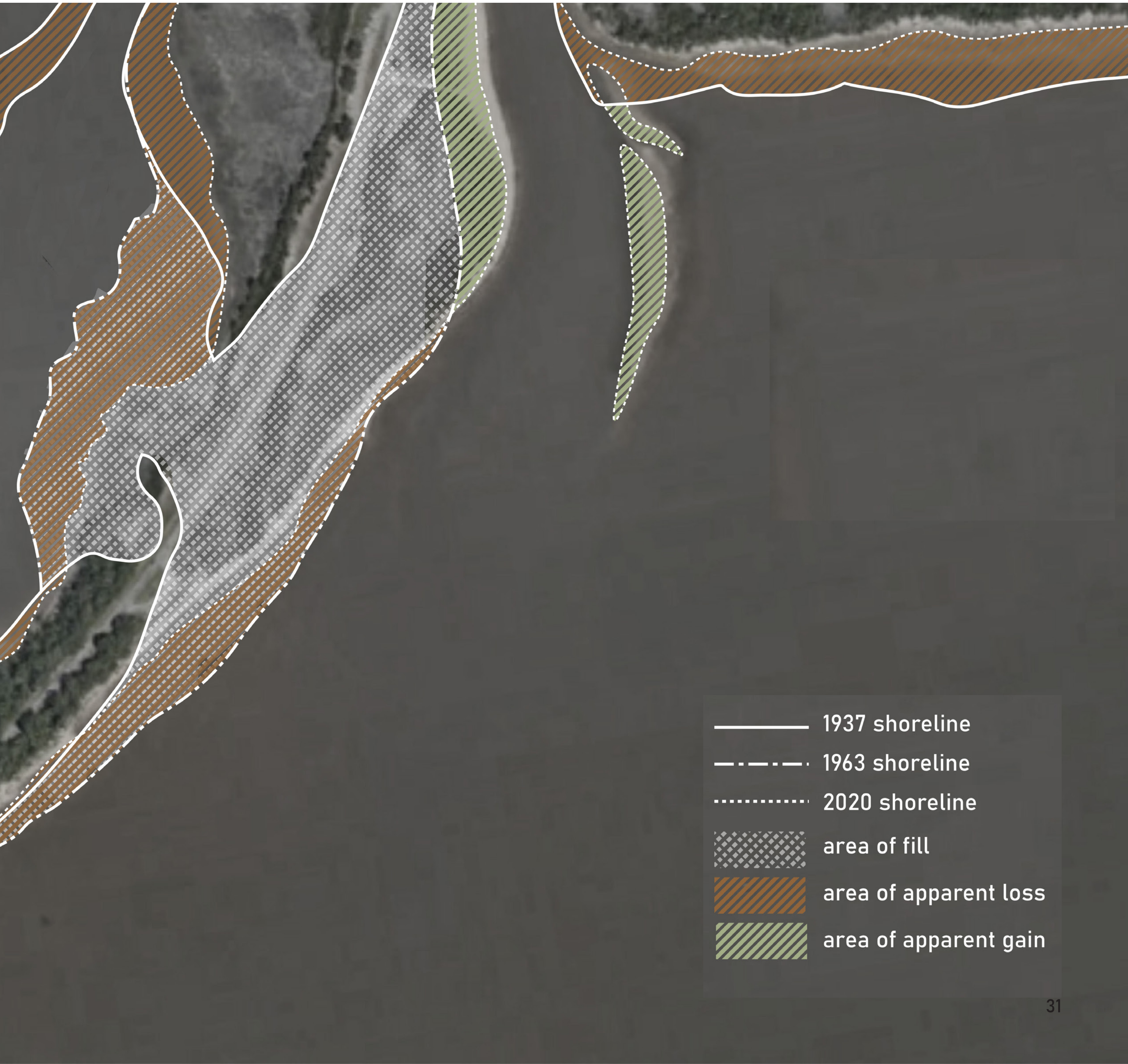
For centuries, access to this periodic drama has been an attraction in the area and ensured a supply of sediment in the nearshore zone.

Analysis

This has created a paradox, where bluff erosion is critical to landscape integrity and function of the landscape, but maintaining the bluff is important to preserve the parkway. Traditional shoreline protection strategies

(breakwater or riprap revetment) are not desirable in this location because they fundamentally alter the nature of the bluff-riparian landscape. In addition to being undesirable, conventional protection measures may be difficult to implement here due to two issues of access: 1) through conversations with NPS staff we understand there is a desire to avoid heavy construction equipment on the Parkway, and 2) the extremely wide, shallow condition of the nearshore

Figure 22. Overlay of shoreline change and infill along Parkway at College Creek, 1937-2020



prevents easy access by barge.

This proposal was sited along a zone of severe erosion. Wave modeling (Figures 23 and 24) supports onsite observation, and underlines the particular vulnerability of this stretch of the parkway. Implementing a new NNBF practice consisting of shoreline bluff groins and offshore subtidal rock sills could both address issues of vulnerability, access, and constructability and create more diverse habitat conditions along this portion of the shoreline while maintaining the dramatic character of the bluff landscape and interpreting the natural process of mass-wasting and tree-fall for future generations.

This Tree Groins and Bars concept draws inspiration from nearby shoreline morphologies. Looking just downstream at the mouth of College Creek, we see the paired nature of the sub-tidal sandbar/spit and a wooded nearshore sill/beach. There are two lines of defense between wave action and the parkway: one which dissipates wave action offshore,

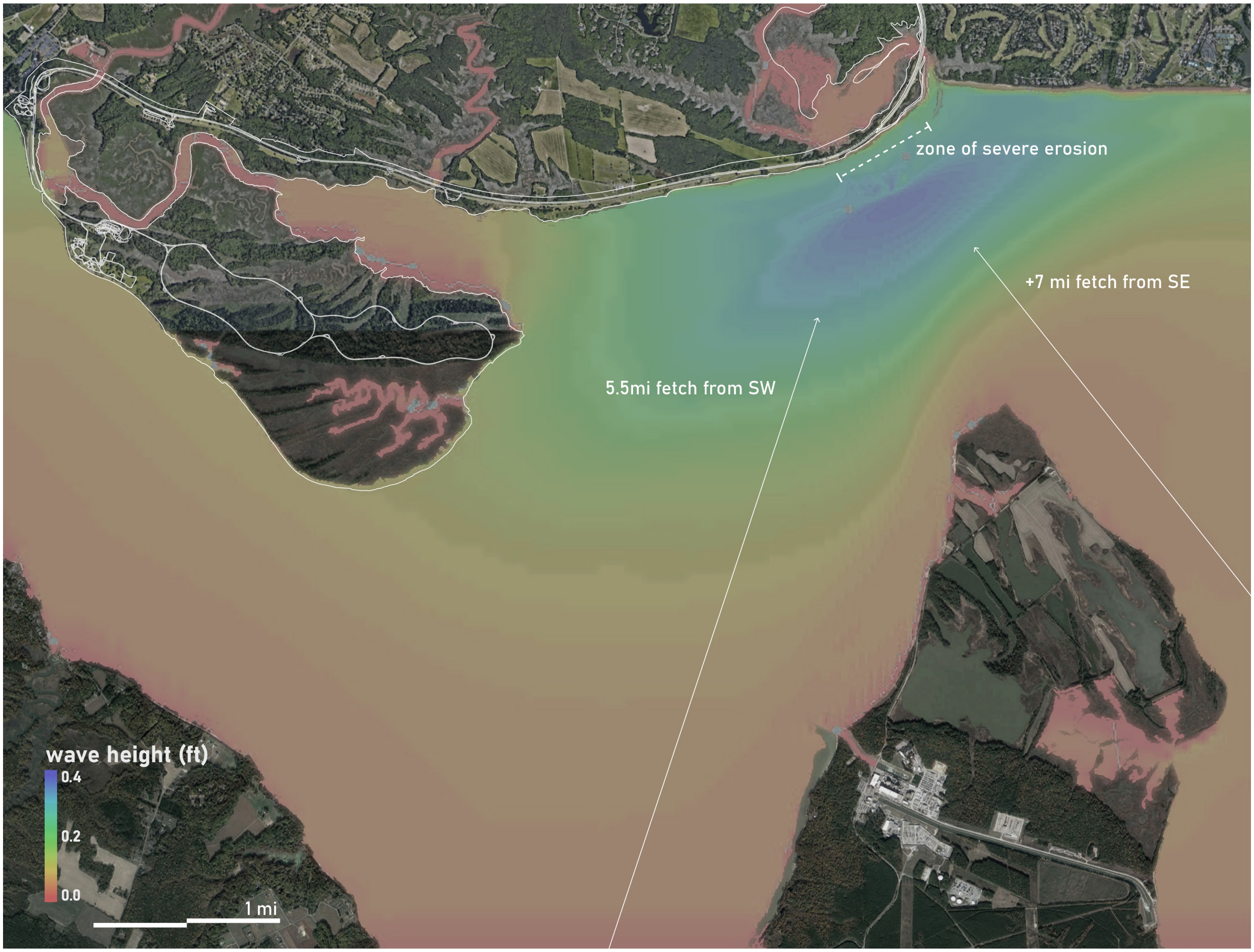


Figure 23. CMS Wave model results illustrating zone of high wave action along Parkway

and another which accumulates and holds sediment. These features may contribute to the fact that this portion of the parkway doesn't suffer from the same erosion issues seen upstream and has actually accumulated shoreline since the parkway's construction (Figure 24).

Design

The interventions proposed create three major nearshore zones: (1) submerged bars near the edge of the channel, (2) low-energy "flats", and (3) beach groin structures. Tree Groins and Bars demonstrates an approach that would slow bluff erosion considerably while maintaining nearshore processes along the toe and interpreting the historic processes of mass-wasting and tree-fall. In this concept, trees culled from parkland for public safety and viewshed purposes would be brought to the bluff and installed using light equipment in the configuration depicted in Figures X and Y. These groins would function to slow longshore sediment transport. This effect is observable now in the area on the trees

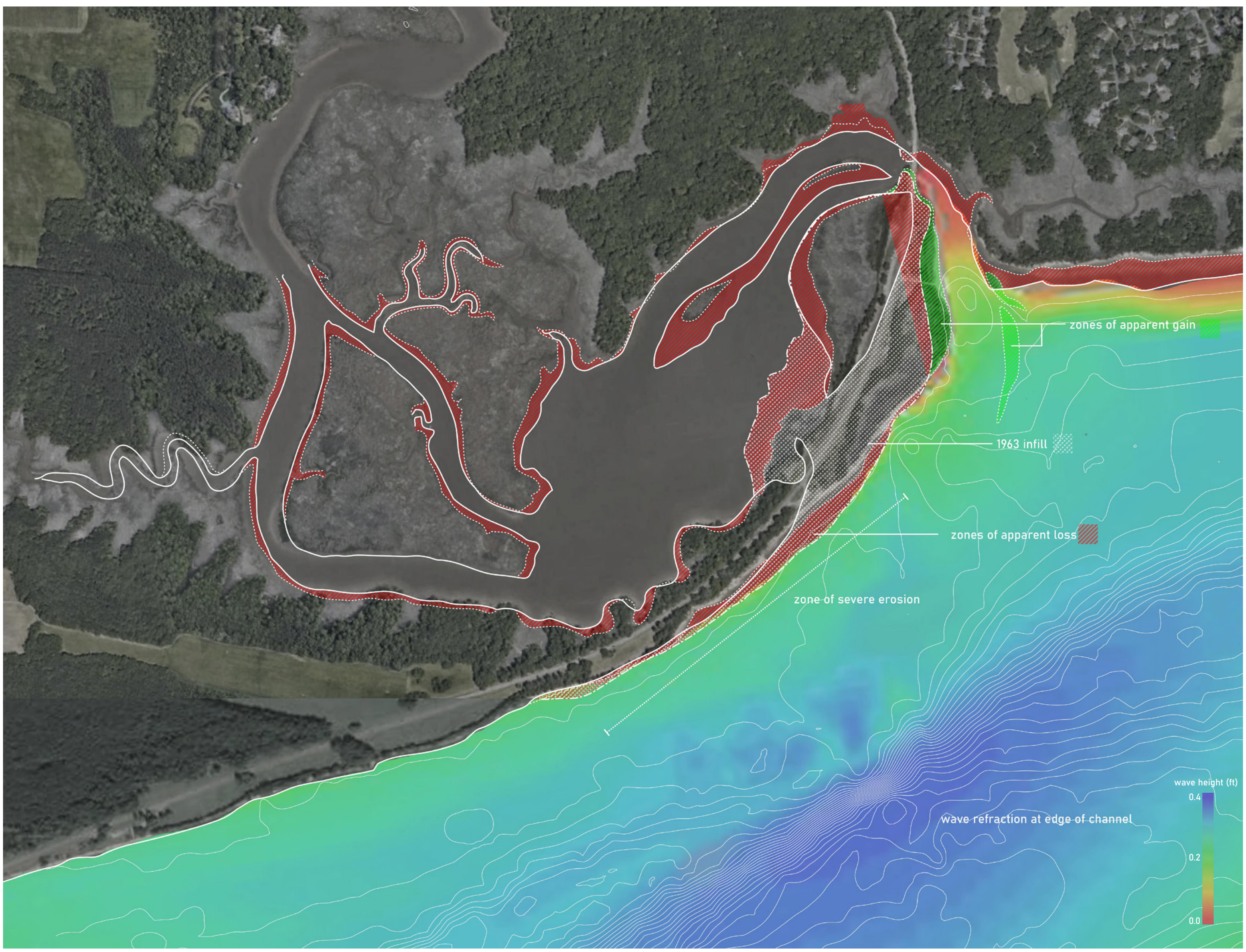


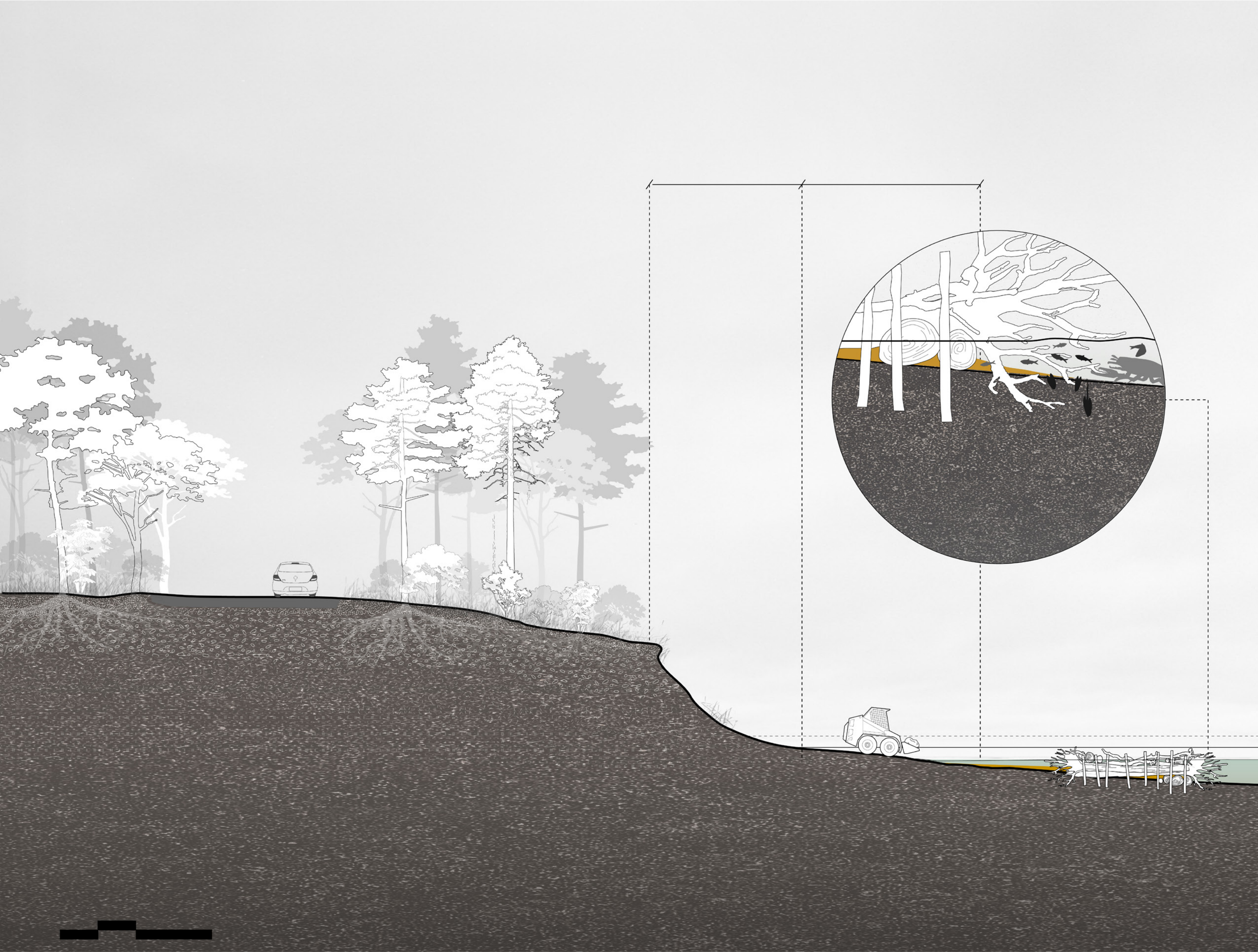
Figure 24. Plan illustrating waveheights, shoreline change, bathymetry, and zone of severe erosion along Parkway.

2.1 Tree Groins and Bars

that have fallen into the water from the bluff. By slowing the sediment transport, the beach in front of the bluff would grow considerably, creating protection for the foot of the bluff. Groins and bars are fairly conventional, and would work well in concert with bluff stabilization for larger storms by means of a revegetated structural toe.

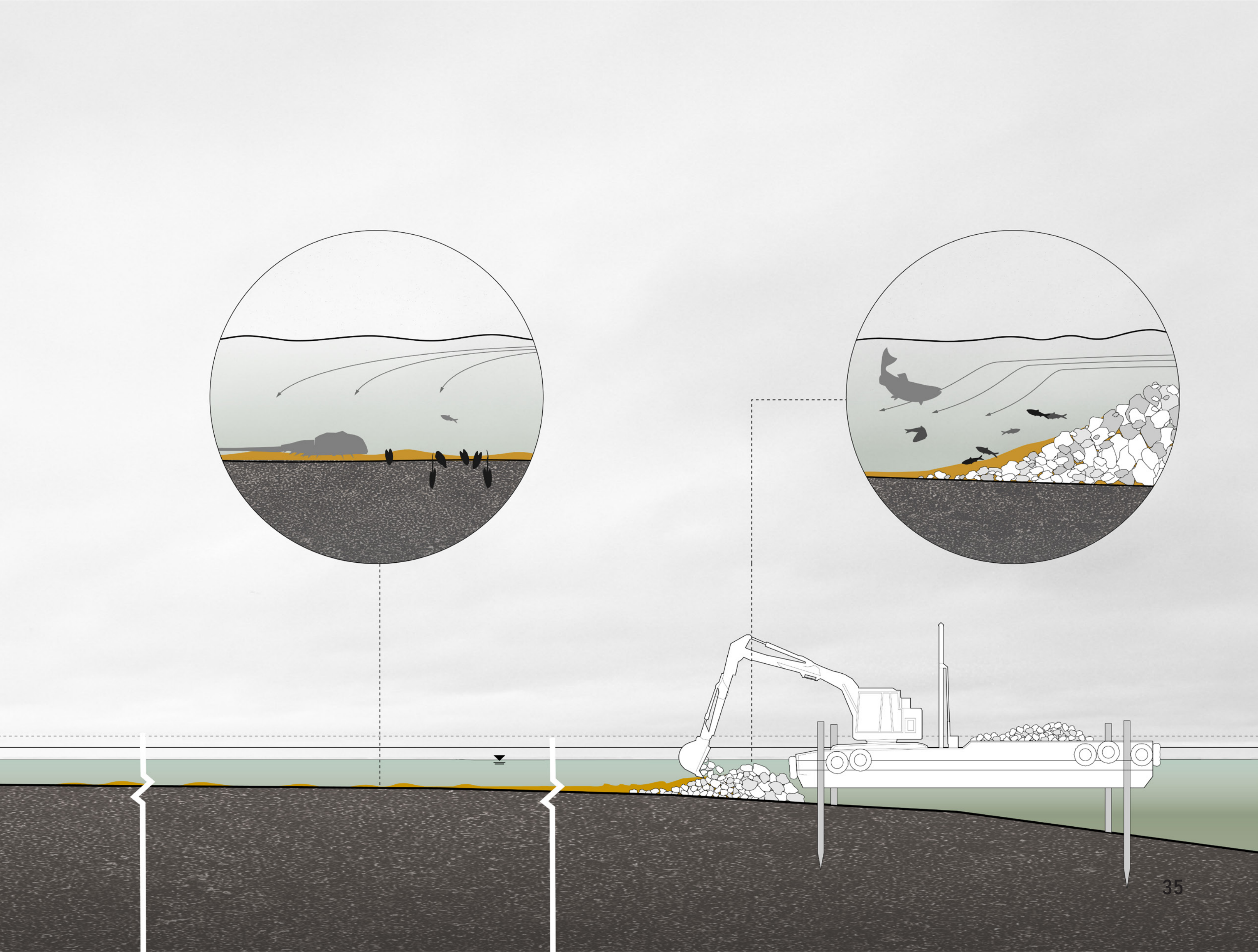
The offshore bars would be placed at the edge of the shallow zone. We anticipate that the construction could happen in approximately 4-5’ of water, given the necessary draft of barge equipment needed to create rubble bars. These bars would act similarly to breakwaters, lowering energy behind and raising the bed elevation over time by accreting sediment. This sediment would act as a low-energy “flat” that would serve to dissipate wave height through friction over a long horizontal surface, providing protection for the foot of the bluff while allowing nearshore processes that are critical to the habitat and experience of

Figure 25. Tree Groins and Bars concept section



the landscape to remain intact.

It is important to note that while the Tree Groins and Bars concept is conceived together, we believe some beneficial effects could be achieved through the tree groins alone. Instead of the bars, this practice could be paired with beneficial use of dredged sediment (discussed in more depth in the following section on The Shallows) to similar effect. Our initial analysis, including basic computational wave modeling, suggested that while the offshore bars would have some effect, it is not possible to construct them near enough to the bluff to maximize protection. The majority of the bluff protection comes from the shallower bathymetry behind the bars and the wider beach produced by the toes themselves. When combined with the cost considerations, potential navigational issues, and constructability issues raised by our study of the bars, our recommendation is to implement the Tree Groins as a pilot project, and to work to



2.1 Tree Groins and Bars

combine these with the beneficial use of sediment described in The Shallows.

The regulatory constraints for the Tree Groins include a Standard Joint Permit Application (JPA) from USACE-Norfolk, a JPA Chesapeake Bay Preservation Act Wetlands Permit (James City County Wetlands Board), and Section 404 Clean Water Act (VDEQ). The Tree Groin concept could likely be covered for NEPA compliance with a categorical exclusion. This concept is anticipated to entail minimal cost and moderate complexity.

Figure 26. Concept aerial render of toes and bars construction along Parkway

Feedback

After reviewing the team's proposed design concepts, the park chose this concept for further consideration. The groins and bars project seemed to be easily implementable in a short time period and would provide protection to the parkway. The park is also interested in doing the groins and bars components separately and is curious about how successful the tree groins would be if the sill is not constructed.

2.1 Tree Groins and Bars

Figure 27. Concept illustration for timber toe construction

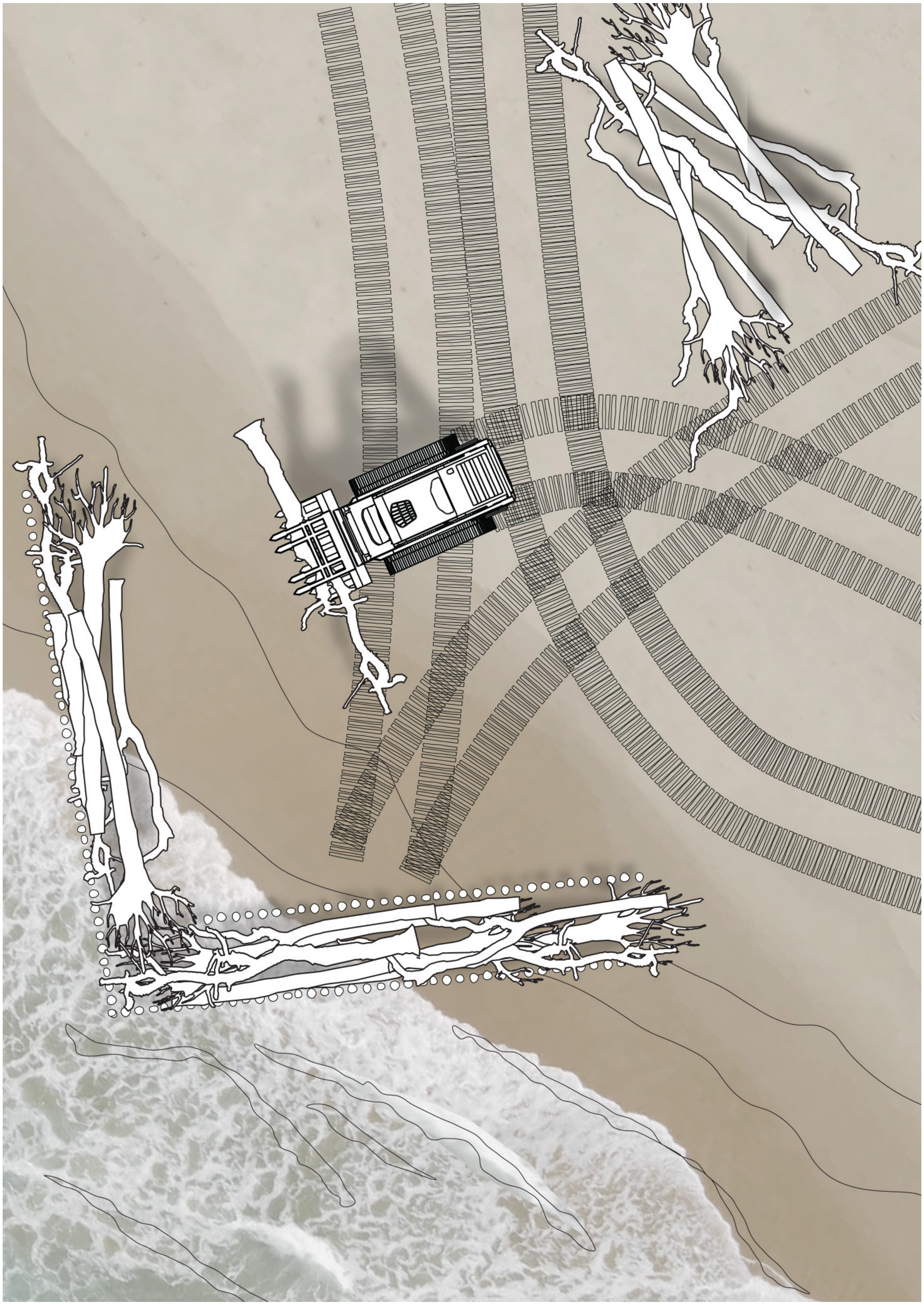
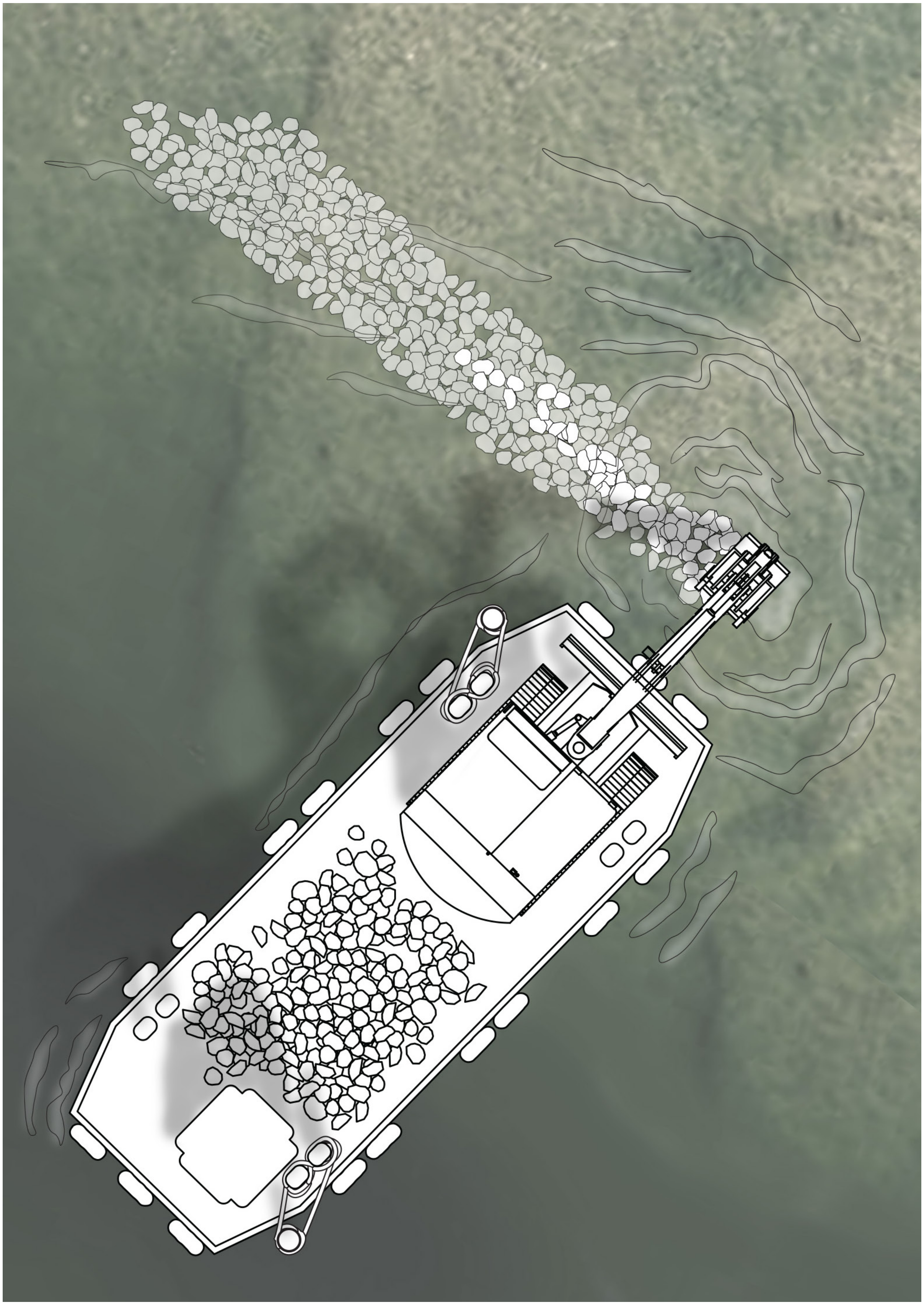


Figure 28. Concept illustration for nearshore bar construction

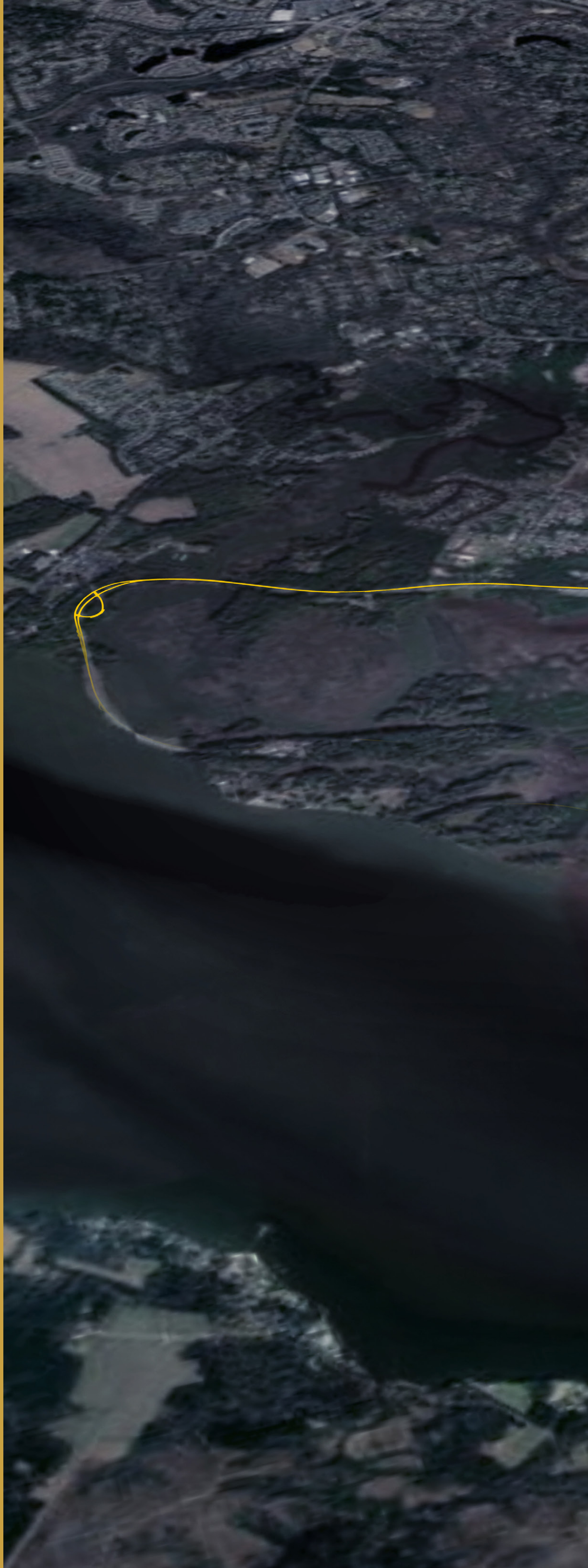


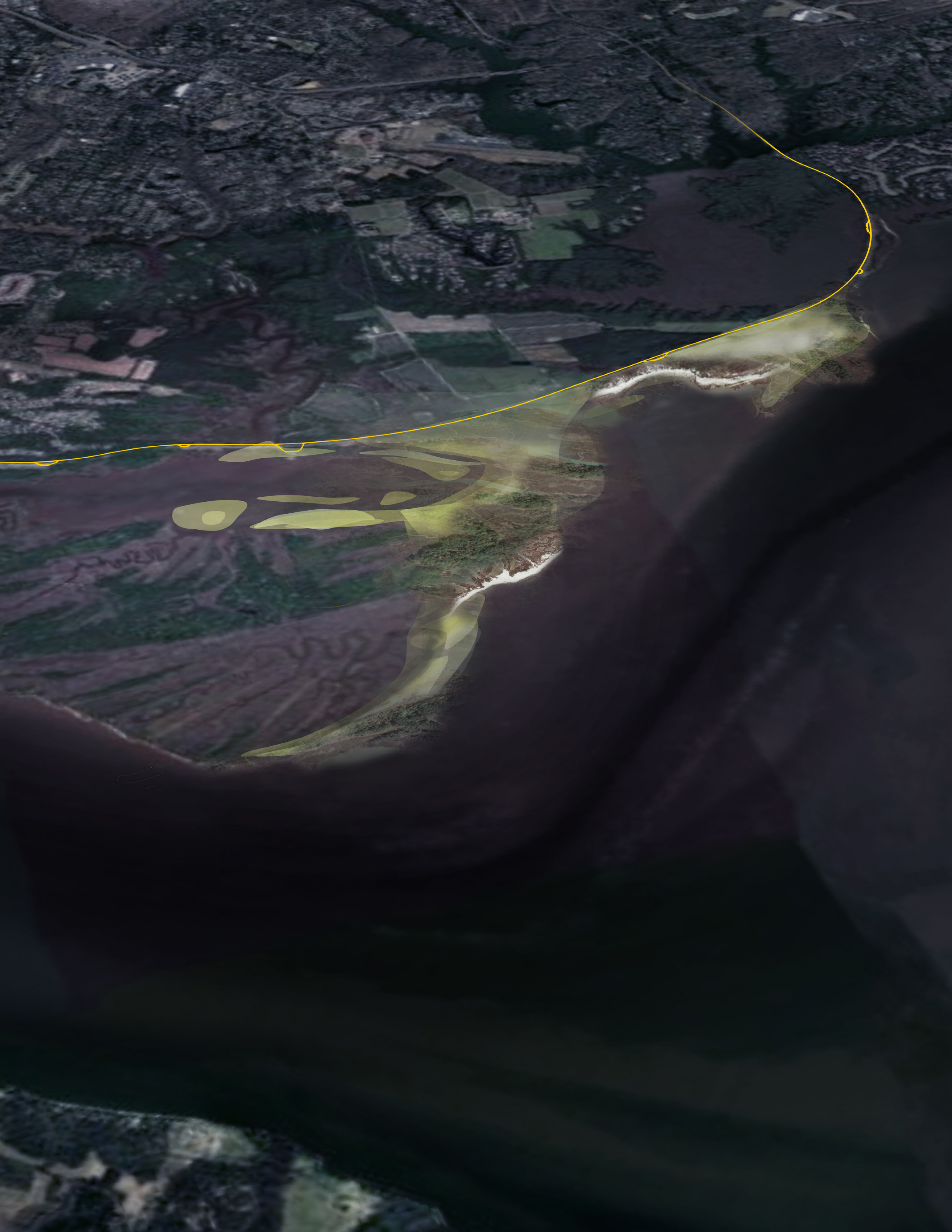
2.1 Tree Groins and Bars

Figure 29. Concept aerial render of Parkway character and visitor interaction along toes and bars

2.2 The Shallows

Making beneficial use of the large quantities of dredged sediment – approximately 200,000 cubic yards (cy) annually – pulled from the federal channel surrounding Jamestown Island has the potential to preserve historic processes and landscape features in the riparian and coastal zone. In our view, the beneficial use of large amounts of sediment is the primary means of adapting the park to sea level rise using NNBF. This proposal enables bluff protection, parkway preservation, wetland aggradation, and interpretation of the sediment placement processes that were fundamental to the creation of the Parkway. Partnering with USACE to place sediment dredged from the Goose Hill channel in key areas around Jamestown Island could dampen increasingly strong hydrological forces, support native ecological communities, and enhance visitor experience of this historical landscape. This approach would allow a practical interpretation of the technique for enabling river navigation that was fundamental to Jamestown and that has been ongoing in this location for 140 years.





2.2 The Shallows

Background

This proposal addresses large-scale sediment supply, marsh evolution on Jamestown Island, and bluff protection to help preserve the Parkway and minimize risks to critical infrastructure. A partnership with the US Army Corps of Engineers to adaptively manage the sediment surrounding Jamestown Island could enable the park to grow and change alongside higher relative sea levels, increased storm surges, and larger flood events anticipated with future climate change in a manner that is consistent with the sedimentary nature of the island and larger landscape.

While not an active part of the experience of Jamestown now, navigation was a foundational element for the colonial history of the island and placement of dredged sediment was critical to the construction of the Parkway. Waterborne transit has been fundamental to the settlements in this area dating back long before European colonization, when members of the Powhatan confederacy would trade and travel along the rivers and smaller creeks between major settlements and hunting camps like those on Jamestown Island. Though not a part of the colonial history, the cultural practice of dredging has been ongoing in this landscape since 1854 [22] and has been federally mandated since the 1884 passage of the Rivers and Harbors Appropriations Act.

Dredging is an extension of the historical, maritime character of the settlements here, and is the greatest source of ongoing federal investment in the landscape. Considering the practice in concert

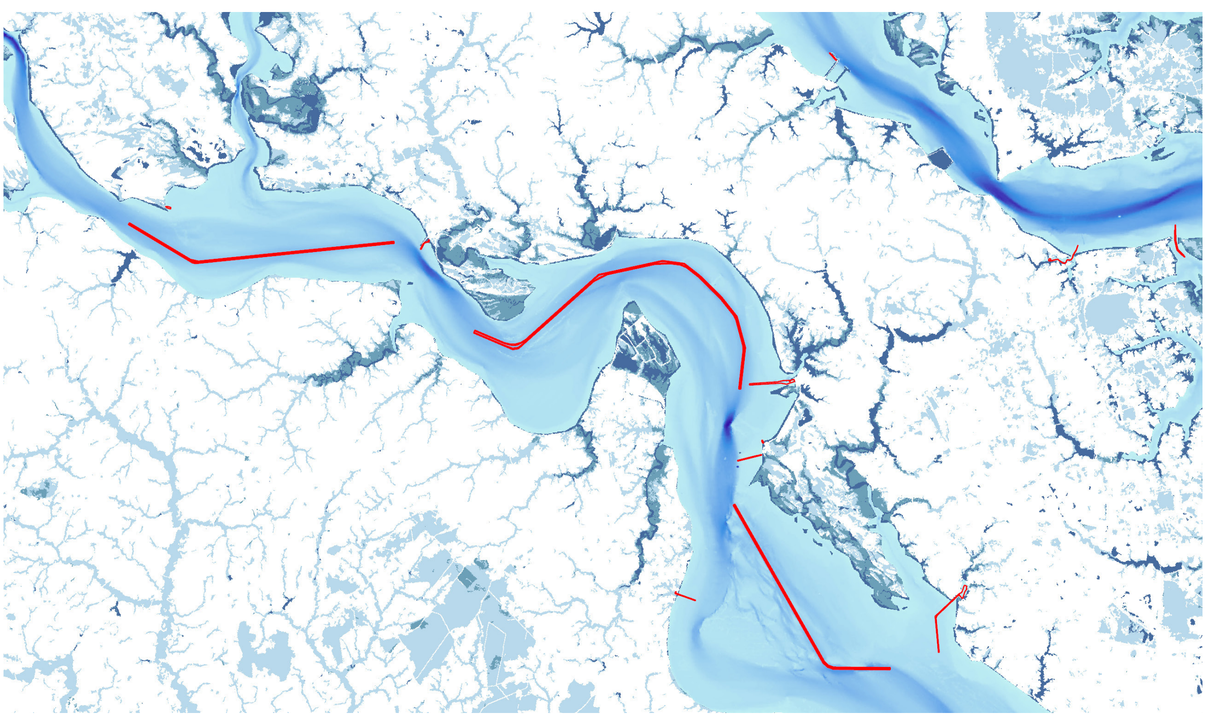


Figure 30. Channels maintained by the US Army Corps in red.

Figure 31. Dredging occuring just offshore of Jamestown Island.

with recreational and ecological goals is critically important as sea level rises in the area. Two actively dredged channels are directly adjacent to Jamestown Island: Dancing Point-Swann Point (DP-SP) Channel, and Goose Hill Channel. Dredging for these channels occurs as close as 1000 to 2000 ft from the park boundary. Maintenance reports for both DP-SP and Goose Hill Channels in 2017 describe the removal of 290,000 cy between Jan and Feb 2017, and removal of 800,000 cy from July to December 2017 [23]. The volumes removed from this region are very high relative to the whole of James River due to the mixing dynamics between fresh and salt water.

Transport of dredged material can be a major cost item in determining the economic feasibility of a project. Relatedly, a supply of sediment is critical to landscapes like those around Jamestown Island. The close proximity of this large volume of dredged sediment presents an exceptional opportunity for Beneficial Use of Dredge (BUD) to protect critical infrastructure, enhance habitat, and ensure the preservation and conservation mission of the National Park Service at Colonial National Historical Park. Combined with the January 2023 USACE policy to beneficially use 70% of the nation's federally dredged sediment

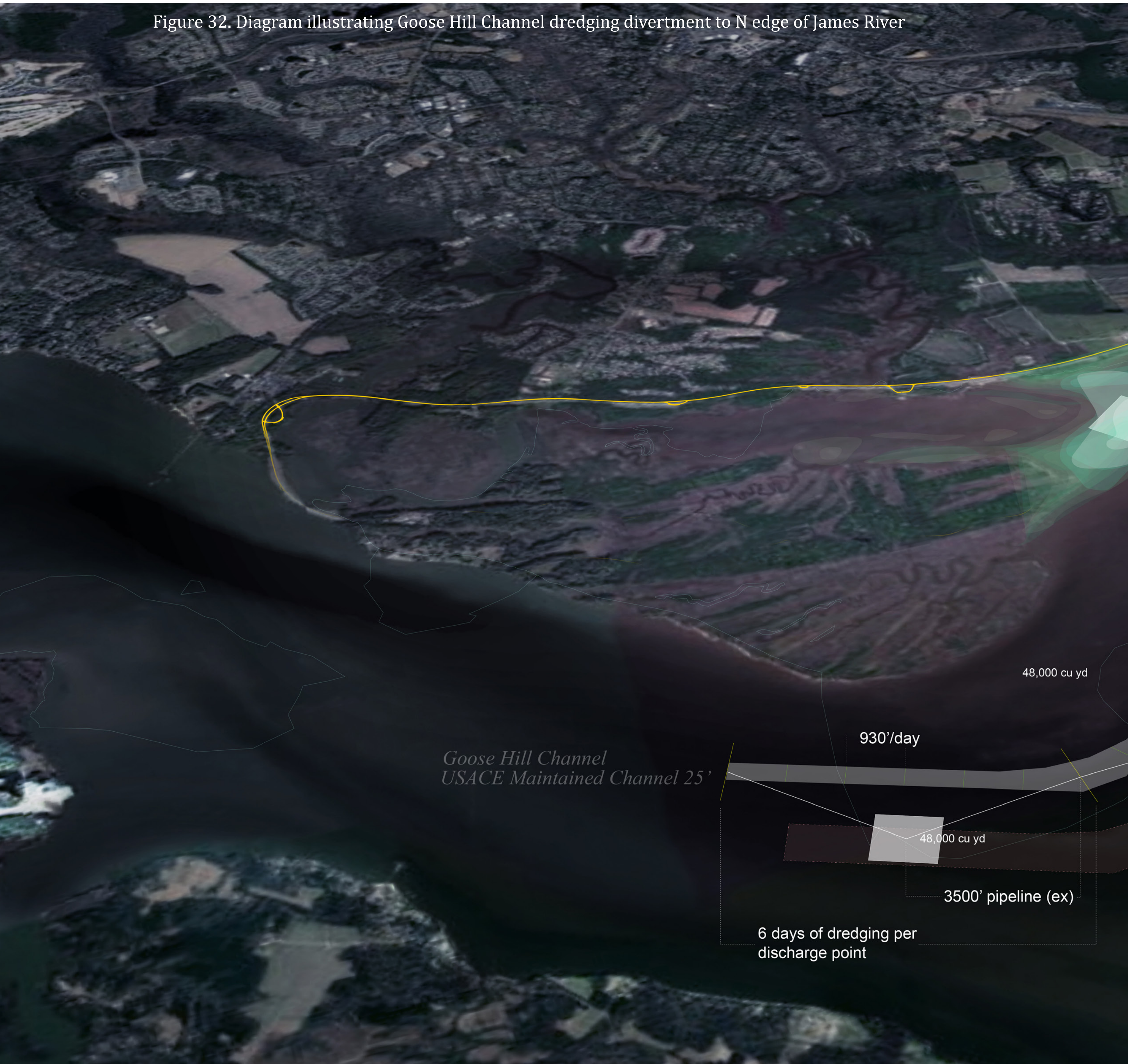
2.2 The Shallows

by 2030 [24], this concept should be of particular interest for the US Army Corps of Engineers Norfolk District, and should be prioritized.

Analysis

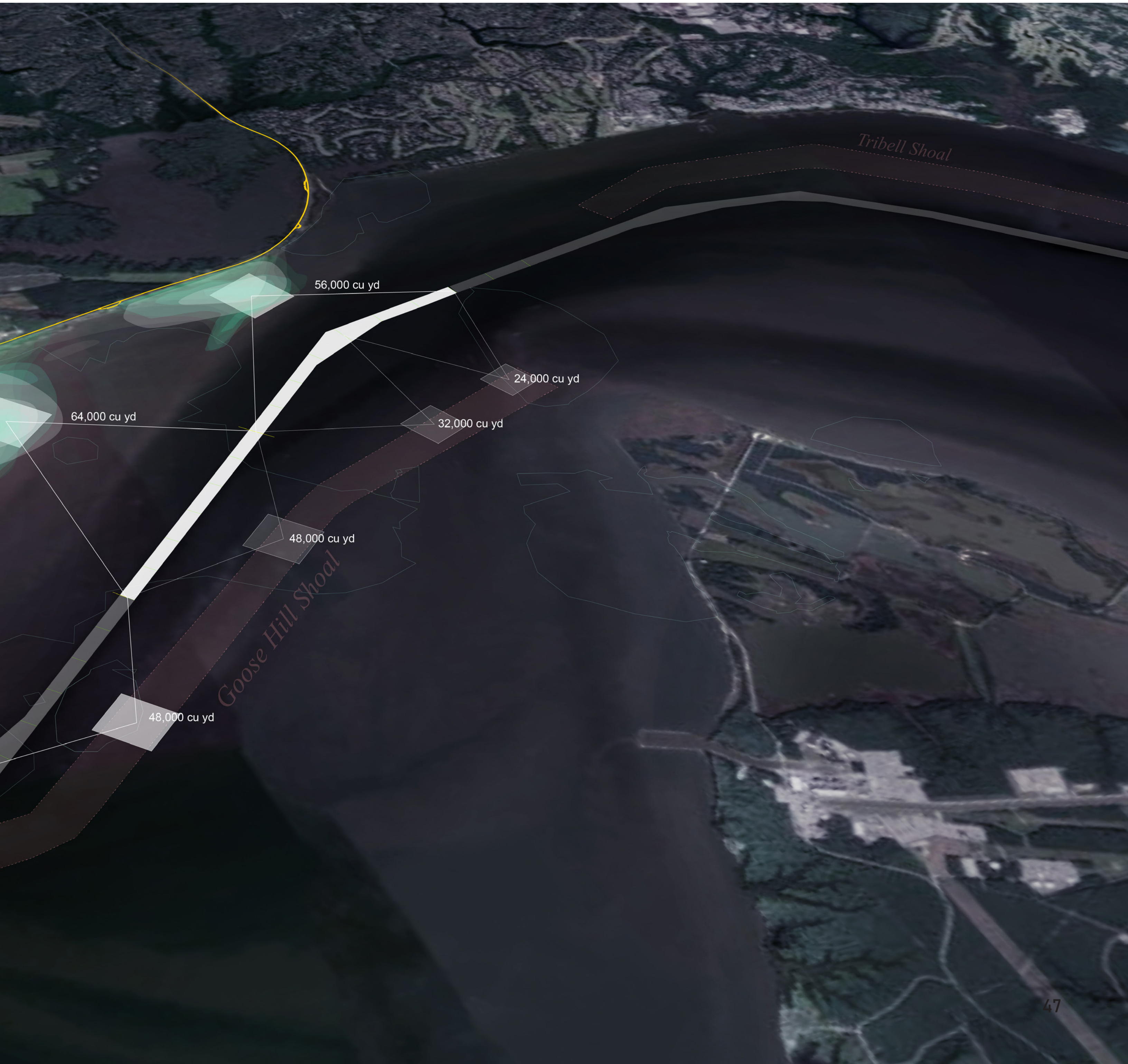
Though dredge sediment is currently placed south of the navigation channel, on a shoal across the river from Jamestown Island (see Figure below), it was historically placed on both the south side of the channel and the north side, near the park. By reviewing historical navigation charts, we were able to determine that this practice of placing sediment on the north side of the channel likely ceased

Figure 32. Diagram illustrating Goose Hill Channel dredging divertment to N edge of James River



in the early 1970s. A 1975 Army Corps Engineer Research and Development Center (ERDC) report [25] details this historical practice and studies the potential for placing material on the north side again in order to minimize channel infill. They concluded that:

"Shifting the downstream 9000 feet of the existing Goose Hill shoal reach disposal area from the south side to the north side of the channel would probably be beneficial. Material dumped in the revised location would either remain in the relocated disposal area or be dispersed into non-maintained areas and not return to the channel."



2.2 The Shallows

That is, ERDC recommended resumption of placement on the north side on the basis of a large-scale physical hydraulic model with the aim of "determining if the disposal areas are performing satisfactorily in terms of retaining dredged material placed therein" [27].

This recommendation was made without consideration of the potential benefits of the sediment, which was the focus of our study. We found that sediment placed on the north side of the river in strategic locations would provide nearshore protection and sediment supply to help tidal marshes keep up with sea level rise. These areas, which were simply "non-maintained areas" according to the priorities of the 1975 study, are the critical zones under threat from sea level rise within the larger Colonial National Historical Park landscape.

Placing dredge material along the north side of the channel as shown in The Shallows would have a two-fold aim: 1) to create a shallower nearshore environment along the Parkway, and 2) to enable tidal wetlands in the area to keep up with sea level rise through aggradation. The US Coast and Geodetic Survey Map from 1882 provides a snapshot of the bathymetric

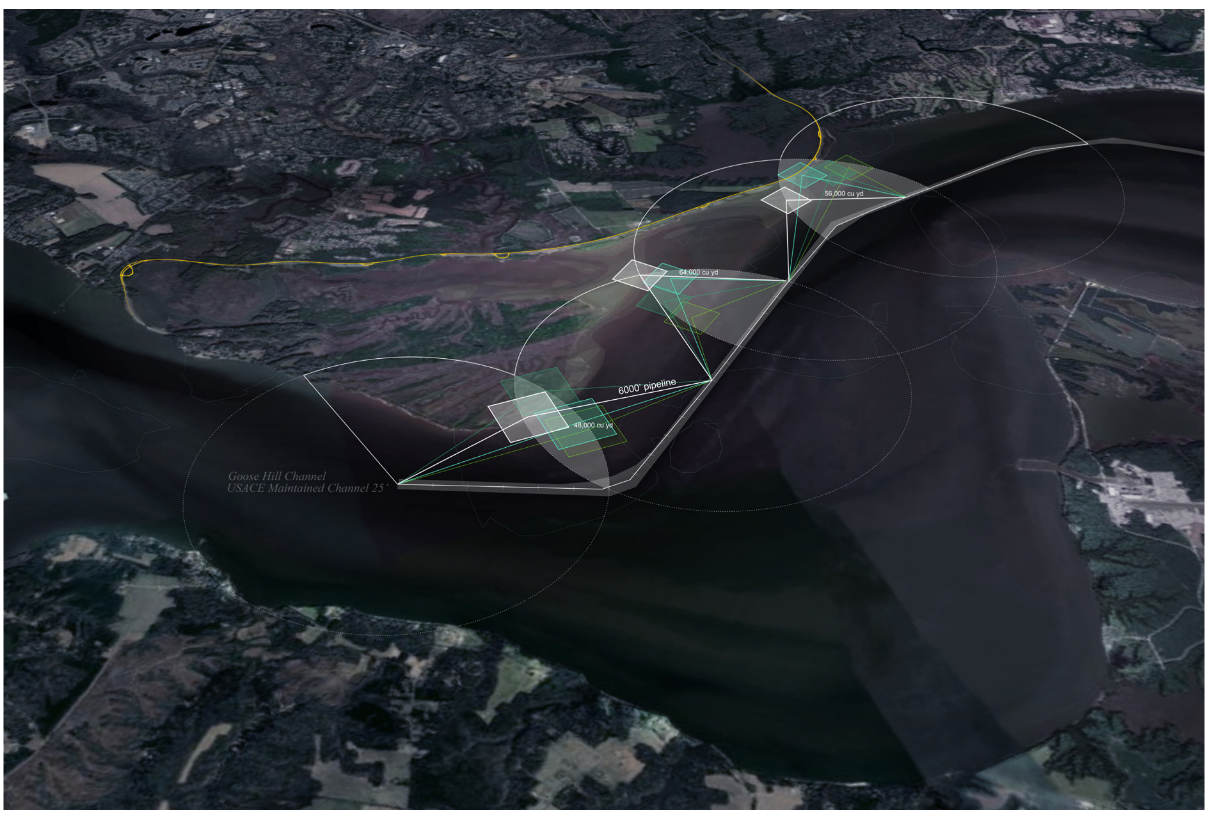


Figure 33. Adaptive management of dredge placement as sediment distributes over time

conditions in the area near the parkway just as dredging was commencing. Depths of 1-3 feet are indicative of the condition at this time. A NOAA navigational chart from 1972 gives depths of 1-2 feet consistently in the area. However, between 1972 and 2022 the depths in this area have grown, commonly in the range of 2-5’ deep.
This loss of elevation is enabling larger waves driven from the south to attack the bluff along the Parkway. In addition, the tidal marshes of College Creek and Back River are struggling to maintain enough sediment supply to keep up with water level elevations.

The Shallows concept demonstrates that beneficial use of the significant amounts of sediment from Goose Hill channel would address both of these issues, and would likely not add to the cost of ongoing dredging. The Shallows concept would also help to meet the USACE priority of 70% beneficial use of dredge material, and would not increase the sediment load in the channel according to the USACE’s own study. The Shallows concept would achieve all of these goals without major new expenditure or the need for artificial structures or a capital project, while maintaining the feel and function and character of the historic landscape even

Figure 34. Marsh aggradation and infrastructural protection

as sea level rises. It is the type of win-win-win situation that is rare when confronted with complex challenges, and should be determinedly pursued.

The hurdles to implementation for The Shallows concept exist with regard to jurisdictional boundaries between federal lands and state waters, and interagency collaboration between the USACE and NPS, and state partners. However, the landscape processes and values of conservation, preservation, and infrastructure risk reduction cross these boundaries, more so as the water level rises and land erodes. Now more than ever it is critical to surpass these traditional hurdles. The USACE Engineering with Nature Program could serve as a go-between for the NPS and USACE, as they are establishing a track record of facilitating the necessary coordination.

Design

In this concept, the aim is to both construct a shallower nearshore zone along the Parkway and to encourage tidal wetlands to aggrade through beneficial use of dredged material. Two strategic placement locations are chosen for the downstream 9000 feet of the Goose Hill channel. These locations were chosen by working with the contract parameters for the dredging contracts, a working knowledge of the hydraulics in the area, and the location of the vulnerable areas along the Parkway and the critical wetlands areas of Back River.

As sediment is dredged, an estimated 60,000-70,000 cy of sediment would be placed near the mouth of Back River, while another 40,000-50,000 cy of sediment would be placed in the nearshore zone near the eroding bluff. From these locations, sediment placed in subtle cone shapes through hydraulic pumping would slowly move with currents and waves into the desired locations. The sides of the cone would be sloped 1-3% in a natural angle of repose, and the sediment would rise to the low tide level, creating a temporary tidal flat. A similar concept was piloted and successfully implemented by USACE at Horseshoe Bend in the Atchafalaya River, and could work here [28]. In that case, dredged sediment was placed upstream of an eroding island and was allowed to accumulate along the island through currents, rather than being placed there directly at greater expense. Formally, the project at COLO would also have similarities with the Sears Point tidal flat restoration project in the San Francisco Bay [29]. In that case subtle mounds were created that eroded with tidal currents and raised the bed elevation for the whole area. The subtle cones created through placing dredged sediment at COLO similarly would erode and deform over a larger area, raising the bed elevation of the nearshore next to the Parkway and the wetlands on Jamestown Island.

A monitoring plan to track the material could be implemented over the course of the year, with the information directly feeding into an adaptive management practice. What is learned about the movement of the sediment (its speed, its direction, its effects on shoreline and wetland bathymetry) would influence the placement the next year. This sort of adaptive management approach is similar to current dredging practices where a pre-construction survey occurs, except in this case post-construction surveying would occur as well. Over time, this practice would be diminished, as patterns emerge and can be relied upon, with cheaper shoreline and wetland surveys replacing the need for bathymetric survey.

The Shallows concept emphasizes the ongoing practices and natural processes of the landscape– in this case dredging for navigation, and waves and currents– in order to create shallow horizontal beds of aggraded sediment near the shoreline. This horizontal approach creates ideal conditions over a larger area over time, minimizes new capital inputs, allows for adaptive management year by year, and does not disturb the existing ecological and cultural resources, including views, that are so critical to the park. A drive along the Parkway that features rock revetments and rock nearshore breakwaters is completely out of character and totally different from a drive along the broad shallows of Goose Hill Shoal as one approaches Jamestown Island.

This approach is generally more resilient, enabling smaller interventions where they are needed, such as the Toes concept described above, or other, more conventional methods. Importantly, this concept can self-repair and build up over time, thereby enabling the shoreline and wetlands to persist longer as waters rise.

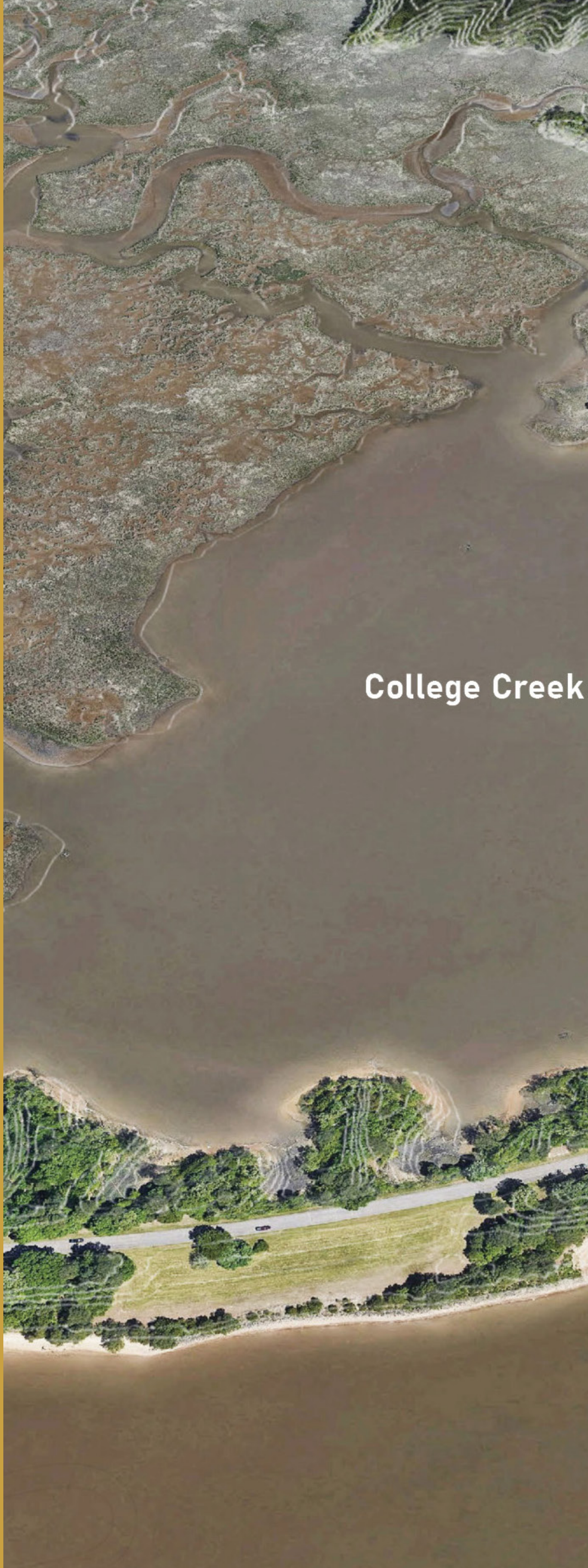
The regulatory constraints for this proposal include a JPA from USACE-Norfolk, a JPA Chesapeake Bay Preservation Act Wetlands Permit (James City County Wetlands Board), Section 404 Clean Water Act (VDEQ), and a JPA for subaqueous and tidal wetlands permits. The concept is also likely to require a NEPA EA or EIS. This concept is anticipated to entail moderate cost and high complexity.

Feedback

The dredging project was of interest to the park, but park staff felt it would require too much time and coordination to implement. The park also had questions about contaminants in the James River and if this design concept would be feasible. The park noted that they were surprised that we did not propose thin-layer placement (TLP) of sediment on wetlands in the low marsh. The team explained that the shallows concept was intended to provide a similar outcome to TLP by letting the tides and currents move material into the low marsh.

2.3 The Breach

The introduction of a wide, shallow breach at the location of the existing parking lot, dividing the naturally-formed isthmus from the filled portion of the parkway, would restore the natural geomorphology and could enhance sediment exchange and promote marsh-building in College Creek. It would also enable opportunities for interpreting the ingenuity and labor that was required for the original construction of the Parkway and is critical to its future viability.




existing channel
increase sediment exchange, promote marsh building
the breach
reduced erosion along bluff

2.3 The Breach

Background

The portion of the parkway adjacent to College Creek was constructed circa 1957, using 1.7 million cy of dredged sediment to connect an existing shoal at the mouth of the creek to the mainland. This effectively narrowed the outlet of College Creek to a single channel between the concrete footings of a bridge. Huge volumes of sand were hydraulically pumped onto the shoal, coincident with the College Creek parking lot down to the creek mouth, to form the roadbed of the parkway as an extension of the adjacent bluff.

While enabling the sinuous and broad curves of the Parkway that visitors experience, confining the mouth of College Creek has had two negative effects over the last sixty years: a lack of sediment in College Creek, and strong currents at the mouth. Lack of sediment into College Creek may limit the ability of marshes to aggradate in response to SLR, while the strong outflow from below the bridge may be limiting replenishment of the beaches

Figure 35. College Creek mouth

along the James side of the parkway. Most troublingly, the narrowed outlet has also created a dangerously strong current at the mouth of the creek. The outlet is a popular spot for fishing and bathing. It has also been the site of multiple fatalities.

Other areas along the parkway were treated similarly on the James River side, with creek mouths being controlled by bridge openings and hydraulically placed sediment being used to build up the roadbed. These are the areas experiencing the greatest amount of erosion today.

Reimagining the stretches of parkway as the dynamic shoals they once were, while still allowing vehicle access, would preserve the historic qualities and user experience of the parkway while conserving the original landscape character. A precedent for this exists in the stretch of parkway across Powhatan Creek.

Analysis

Before 1957 at least two inlets, separated by a large island-and-shoal complex, formed the mouth of College Creek. In aerial photographs from 1937 and 1953

Figure 36. Eroding beach at existing parking area

2.3 The Breach

an opening that is approximately two times the bridge span can be seen at today's bridge location. A second, wider opening is evident at the location of today's parking area near the start of the historic bluff. These combined openings would have meant that the currents between James River and College Creek would have significantly less velocity and may have led to a slightly larger tidal prism.

The wetlands complex of College Creek is now likely sediment-poor because of the small size and non-agricultural nature of most of its watershed. Its wetlands are

Figure 37. Existing conditions of breach site

largely reliant on tidal inputs, with high tides bringing silts and clays that help them build up over time. The watershed is small (about 12 square miles) and the sediment-shed (the area of the watershed not behind dams) is a little over one-third of that (about 5 square miles). The tidal range in College Creek may have been reduced by constraining the opening, resulting in a smaller tidal prism and a reduction in sediment over time.

A 2010 study by the Shoreline Studies Program at VIMS demonstrates that since the completion of the parkway in 1957 [30], the wetlands of College Creek and

2.3 The Breach

the hydraulically-filled area have been subjected to moderate erosion and these effects seem to be increasing significantly. Erosion rates at the parking area now imperil the parking area and will eventually threaten the parkway itself.

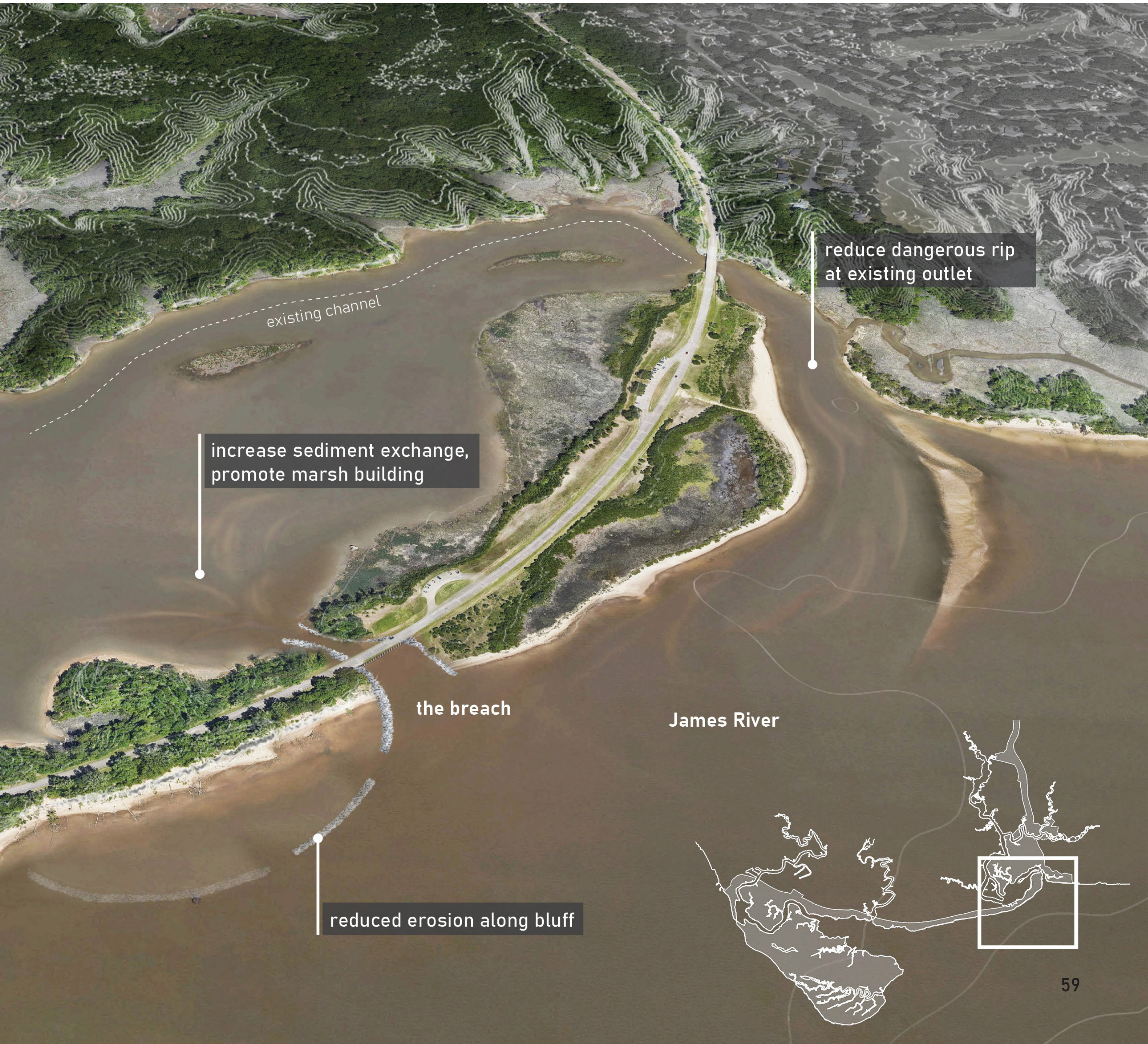
Our analysis of Parkway documents found that the original design life of the project was fifty years, and it is now sixty-six years old. The need to redesign the parkway to maintain its integrity as sea level rises is acknowledged, in addition to the need for safety features. The design of a nature-based feature, The Breach, can resolve many of these issues for the

Figure 38. Breach concept illustration

future. While necessitating significant expenditure, it would represent an investment in public safety, ecological conservation of the wetlands complex of College Creek, and in protecting the cultural resource that is the Colonial National Parkway.

Design

The introduction of a wide, shallow breach at the location of the existing parking lot (where erosion is evidently most severe) would roughly divide the naturally-formed isthmus from the in-filled portion of the parkway and achieve

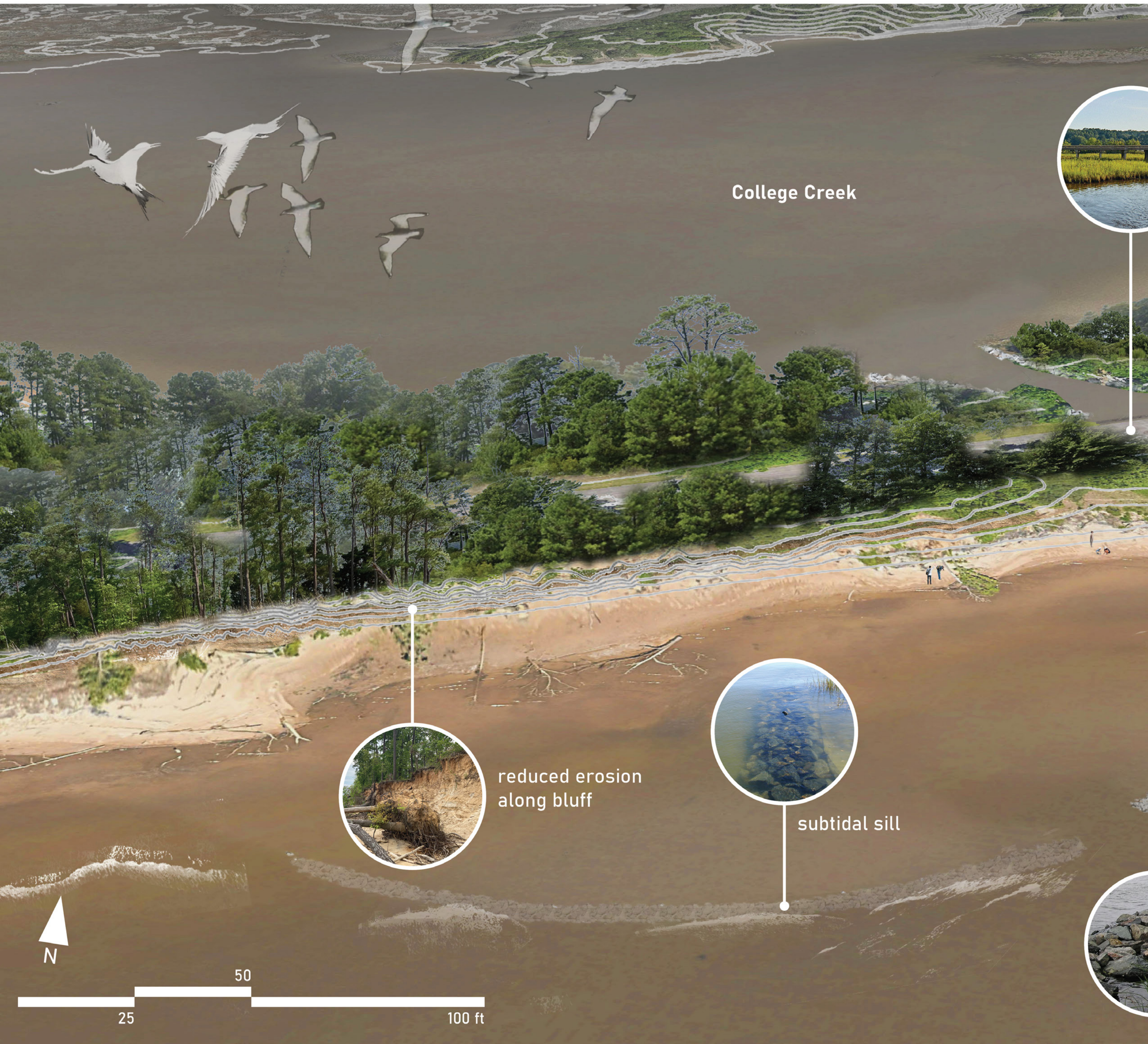


2.3 The Breach

three related, important objectives. This breach could enhance sediment exchange to the benefit of both marshes and the adjacent shoreline, while also reducing the tidal current under the existing bridge, and potentially lessening wave attack on the vulnerable bluff to the east.

In contrast to the narrow, concrete-walled channel constructed in 1957, the character of this breach is intended to mirror the character of the parkway across Powhatan Creek, crossing a wide, shallow tidal channel and providing views towards both the marshes of College Creek and the James River. At the mouth

Figure 39. Aerial rendering of breach concept



of the breach, a series of submerged rocks sills could lower wave action and enhance deposition along the most rapidly-eroding portion of the isthmus, mirroring the effect of the sandbars and existing marsh sills just south of the College Creek outlet.

The parking area would be moved to the College Creek side of the parkway (see Figure below). Finally, the infrastructure improvements associated with the new bridge could be extended into the nearshore to create shore stabilization structures. Any remaking of the parkway would necessitate mobilization of large equipment and machinery that could

2.3 The Breach

be utilized for nearshore structures in a special case.

There are important questions around this concept that remain unresolved. Wave and hydrodynamic modeling of this concept would need to be developed. VIMS has looked at this area but only modeled a very narrow additional opening. A variety of options that better take advantage of the natural geomorphology and the historical landscape conditions (the bluff, the shallow nearshore, the historic opening in the vicinity of the parking) should be studied to ensure the viability and resilience of the parkway and enable the marshes of College Creek to aggrade with sea level rise.

The regulatory constraints for this concept include a JPA from USACE-Norfolk, a JPA Chesapeake Bay Preservation Act Wetlands Permit (James City County Wetlands Board), Section 404 Clean Water Act (VDEQ), and a JPA for subaqueous and tidal wetlands permits.

The concept is likely to require a NEPA EA or EIS. Construction would also likely result in high costs and traffic impacts given significant change to the roadway. A rough estimate for the timeline is 5-10 years. This concept is anticipated to entail high cost and very high complexity.

Feedback

The breach project was of interest due to the erosion at the parking pullout, however, the park had reservations based on previous modeling in this area. Results suggested that a breach will not meaningfully increase sediment to upstream wetlands, nor will it reduce flooding. This project also required a higher engineering effort. The National Park Service also must allow natural processes to occur and felt that this concept was inconsistent with this mandate.

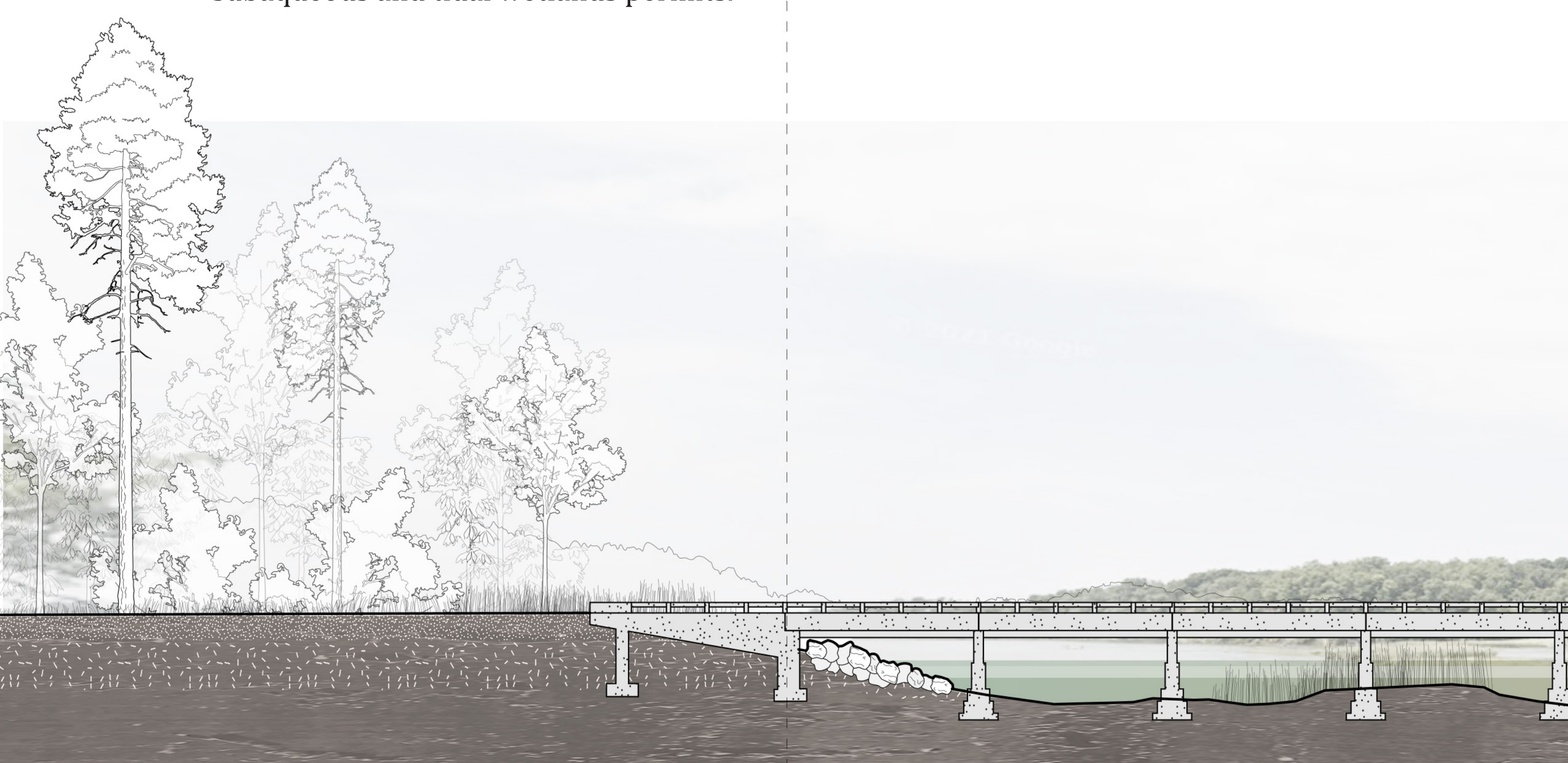
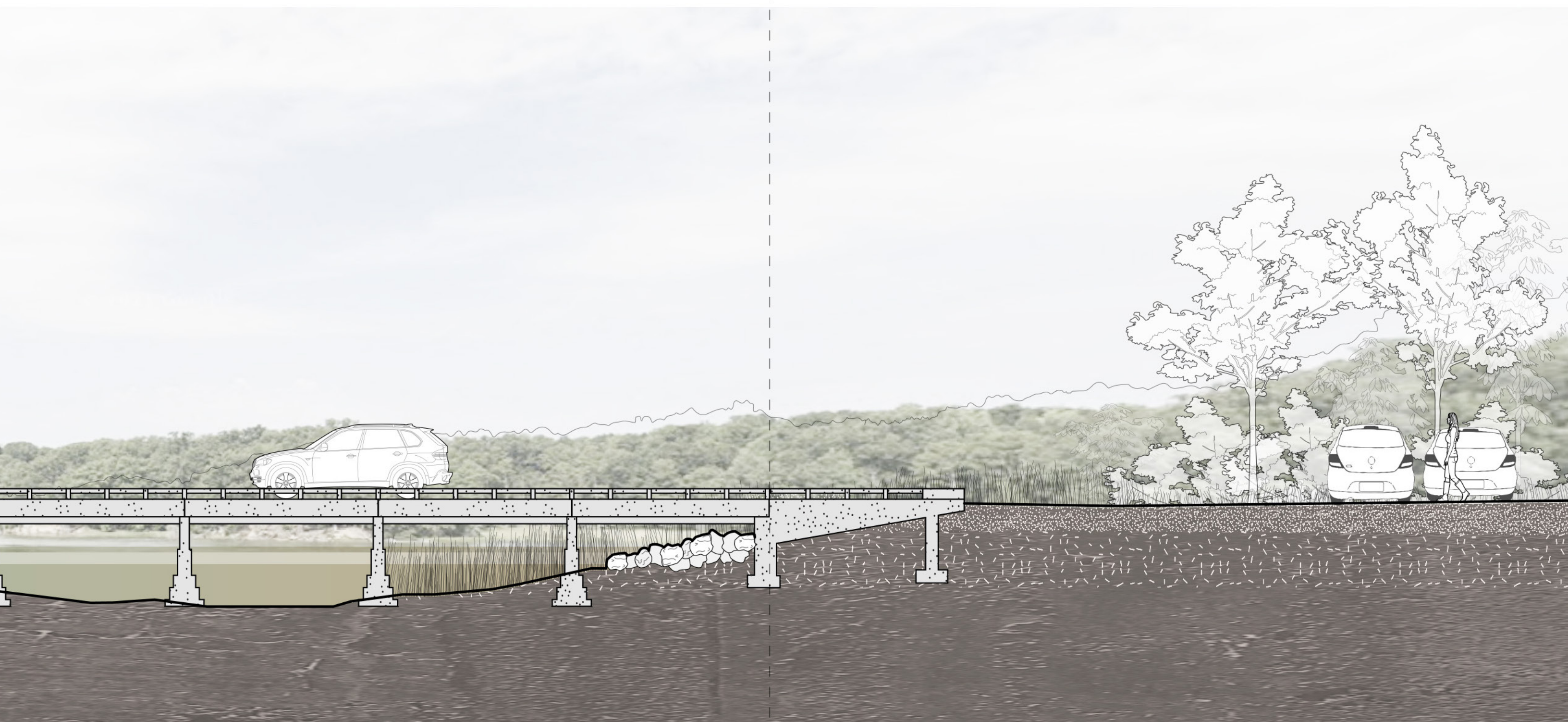


Figure 40. Section of breach concept



2.4 Isthmus Flats

Sea level rise and increasing salinity will shape the future of Jamestown Island. By creating a new marsh platform on the original isthmus roadbed, this design seeks to harness these forces to commemorate and reinterpret some of the site's most defining features, such as the marshes, bald cypress trees, and coastal structures.


"lone cypress"
living
shoreline

2.4 Isthmus Flats

Background

When English settlers first arrived in 1607, Jamestown was a peninsula connected to the mainland by a narrow isthmus. Having just one narrow entrance likely made Jamestown easier to defend, and settlers erected a guard house near the isthmus to monitor movement on and off the island. Local residents recognized that the stability of the isthmus was an issue by the early 1700s, as flooding made access unreliable and dangerous. Some petitioned the House of Burgesses for funds to stabilize the area in 1734-1735; however, their request was declined [31]. Sometime around 1780, the isthmus was finally breached in a storm and the James River began to flow into the Back River.

The current isthmus that connects Jamestown with the mainland via the Colonial Parkway was built in 1955-56. The project was made possible in large part due to Mission 66, which provided funds for National Park Service projects. Colonial National received $7.5 million to complete construction of the Parkway and for visitor centers at Jamestown and Yorktown [32]. As with many other locations along the Parkway on the James River, the isthmus was created from hydraulic fill dredged from the James River (possibly from Goose Hill Flats, which is along Jamestown Island's shoreline). The area is subject to high current velocities and wave attack, due to the long fetch to the west and being located on an outside bend of the river. The shoreline has been hardened by placing rip rap on the river side to minimize the effects of these forces. This

Figure 41.

Figure 42.

Figure 43.

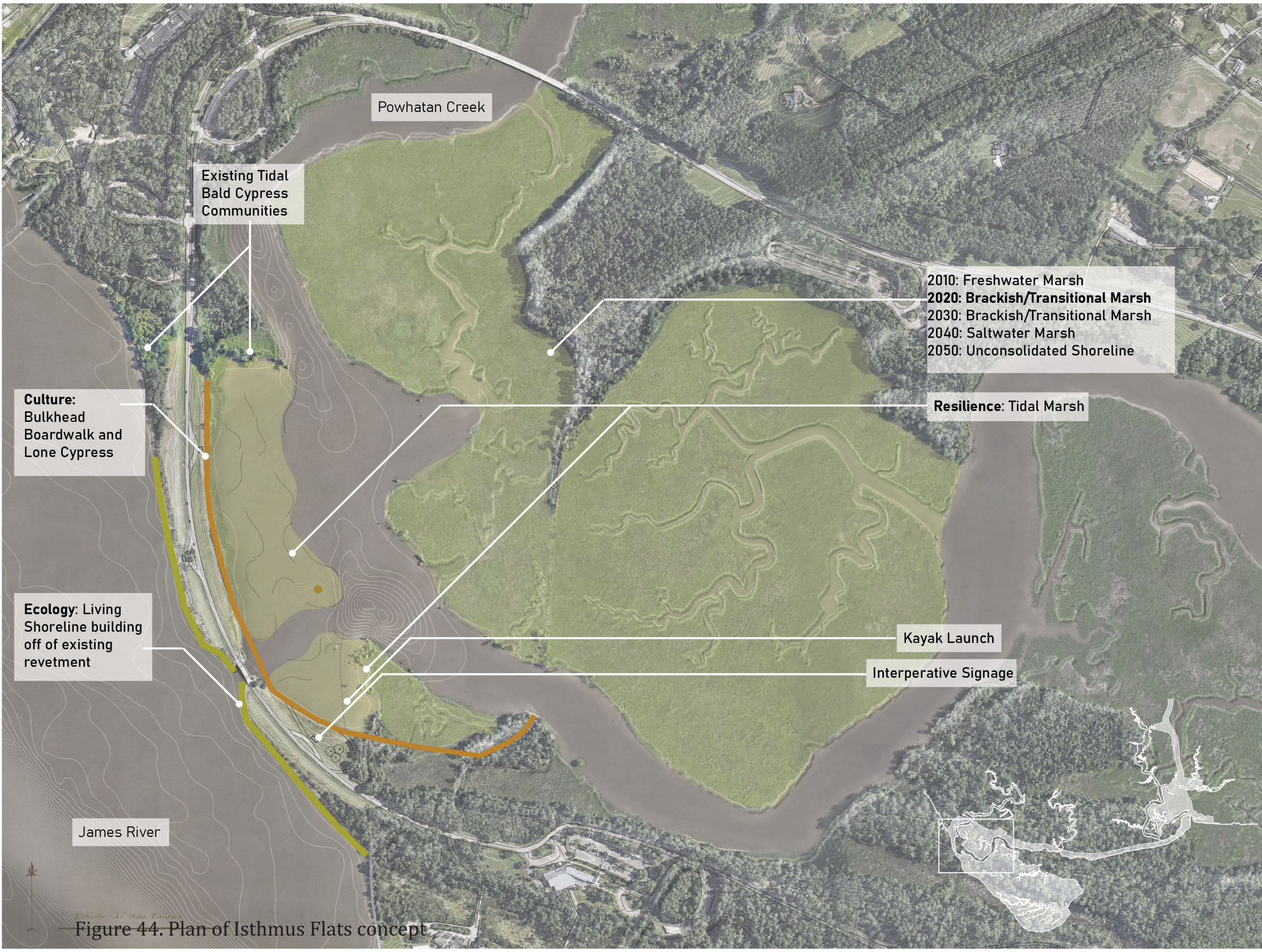


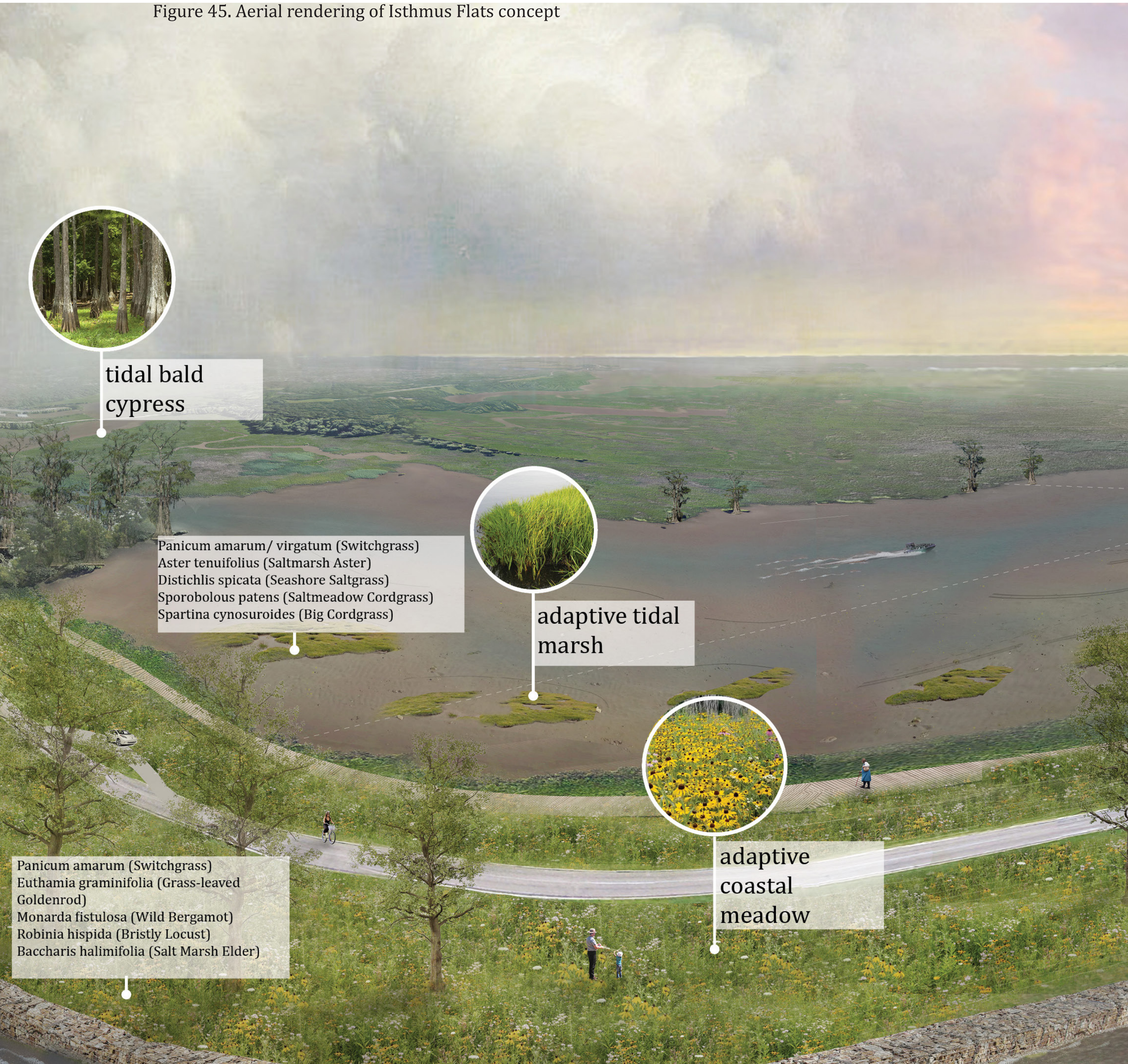
Figure 44. Plan of Isthmus Flats concept

2.4 Isthmus Flats

rip rap will have to be enlarged in the future to maintain the Isthmus.

The contemporary condition is a hybrid between two historical conditions. Powhatan Creek and Back River connect to the James River through an inlet in the isthmus, and a large tidal flat is sited on the creek side of the isthmus (Sandy Bay). The opening provides a control point in the local hydrological system. The tidal flat connects two remnants of the cypress forest that was endemic in this area to extensive freshwater wetlands dominated by emergent aquatic species located further inland. .

Figure 45. Aerial rendering of Isthmus Flats concept



Analysis

The James River side of the Isthmus is hardened and subject to significant waves and currents, both during storms and daily events. This will remain the case for the foreseeable future and therefore this is not recommended as a good candidate for NNBF. However, on the Back River/ Powhatan Creek side of the isthmus there is significant ecological complexity and cultural resources, as well as interpretive opportunities for park visitors as a main entry and a significant water view of the James River and the protected waters of the creek.

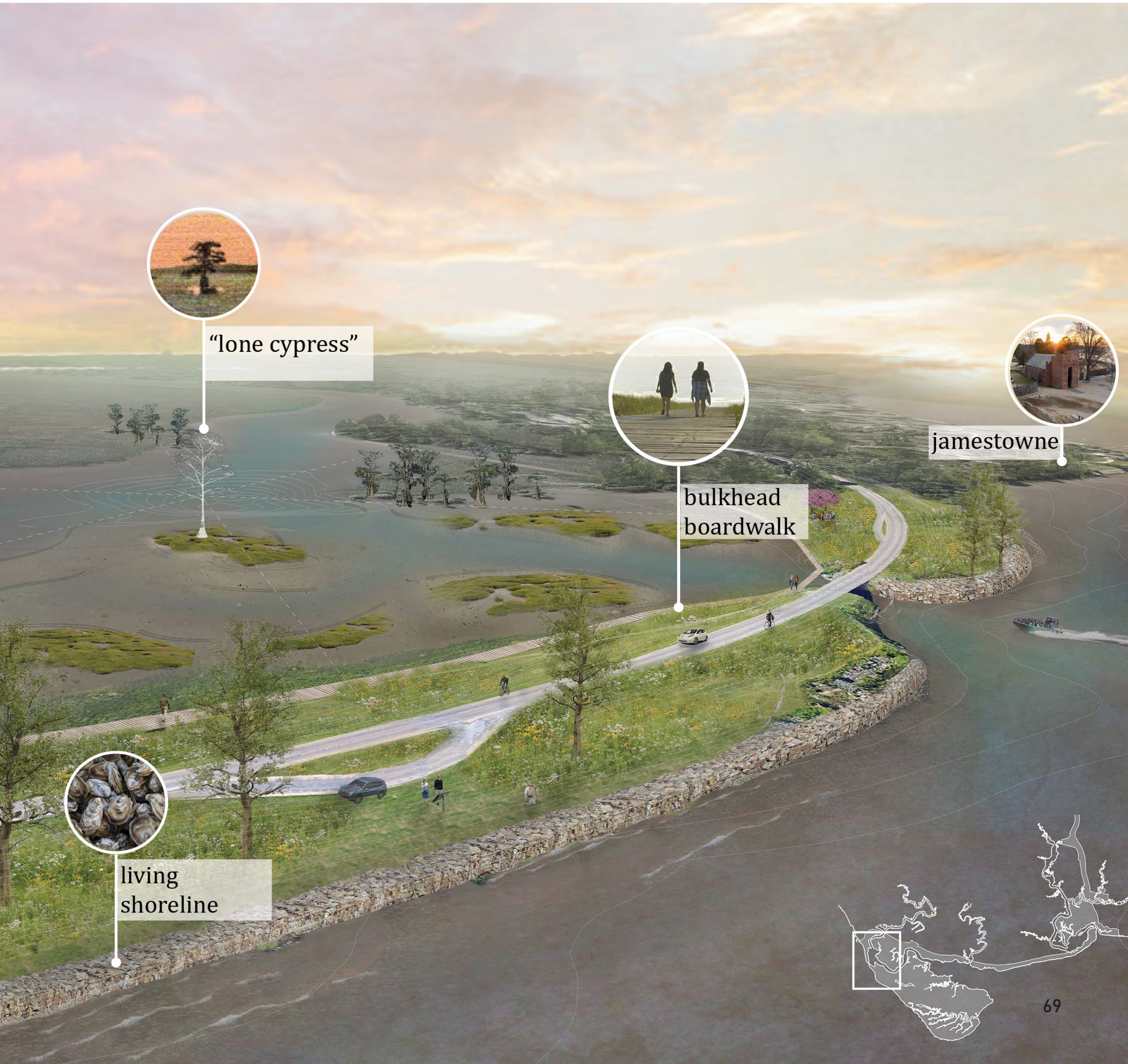


Figure 46. Section through Isthmus Flats


Bulkhead Boardwalk
Existing Bulkhead
Upper Limit Wetland: 2.895’
Sea Level Rise 2050: .92’
Mean High Water: .82’
Mean Low Water: -1.10’

2.4 Isthmus Flats

There are three natural resources which seem most at issue and which present opportunities to consider NNBF associated with the future of the park. The first is the oligohaline marshes of Back River. The second are the remnant bald cypress tidal forests that persist on the edges of the tidal flat. The third are the shoulders of the parkway, which are referred to as "cultural meadow" in NPS management documents. Currently these shoulders are mown grass separated from the tidal flat of Sandy Bay by an old wooden bulkhead, which, when compared with the beauty and richness that a meadow in this region might offer, offers a withered perspective on our culture to park visitors.

In addition to the parkway itself, two cultural resources are notable here, both of which are historic roads and relate to the old relationship of Jamestown Island to the region. In aerial imagery it is clear that an old roadbed exists to the east of the isthmus on the far side of the Back River. This high ground has changed the hydrology of the oligohaline wetlands in the area and created ground for tree growth in the marsh. It suggests an opportunity for circulation and interpretation of this history, if conceived of as a pathway connected to the parkway up by the James River Association offices, and terminating with an overlook on Back River (see Figure X).

The tidal flat where the bald cypress remnants are represents an even more significant cultural resource in this area. This is likely the location of the colonial-era Great Road, the first highway of the English colonies, and the presence of an old road bed and the original isthmus may explain the persistent tidal flat in this area. The significance and various forms this landscape has taken– from natural landform to path to road to tidal flat– traces a narrative arc that is significant for both the history and future of COLO.

Design

The Isthmus is currently the gateway to Jamestown Island. This concept demonstrates that an NNBF approach focused on the tidal flat of Sandy Bay offers the opportunity to bolster the marshes and cypress forests and interpret the site history in ways that enhance visitor experience. To achieve this, dredge sediment would be used to build up the tidal flat using thin layer placement, creating a mixture of tidal marsh and tidal flat that reads as more of a feature with a defined edge. The edges near the parkway would be built up to connect the marsh to the slopes of the road bed and enable future marsh migration. The slopes of the cultural meadow that are currently maintained as mown grass would instead become a gradient from tidal flat to low marsh to high marsh to woods. Finally, a boardwalk could be constructed along the line of the existing bulkhead along the isthmus to interpret that structure and bring visitors closer to the water.

These simple changes would take the form of a small-scale beneficial use sediment project, and could likely be achieved with interagency collaboration with the USACE. It would create conditions for the cypress forest and the tidal marsh to expand and potentially keep pace with sea level rise. This site holds the globally imperiled tidal bald cypress communities, a large tidal flat, expansive views of the Back and James Rivers on either side, and the sites of several historical photographs and drawings of the shoreline. The proposed concept uses natural features to reconstruct the story of the landscape and people and to set up new conditions for its evolution with rising salinity and water levels in the future. The image presented to visitors would be one of a landscape that maintains its richness and value while undergoing constant change, and it would set a stage for visitors to witness the next century of evolution and tradition at COLO.

Increasing the adaptive capacity of rare and threatened ecological communities is a priority to prevent their collapse. The target communities are the tidal bald cypress forests, oligohaline marshes, and what is referred to by the National Park Service as "cultural meadow," which lines the isthmus on either side of the parkway. By propagating more salt-tolerant bald cypress trees, this critically-imperiled community would have a stronger chance at surviving rising salinity and water levels, while paying tribute to the "lone cypress" witnessed by early settlers. Utilizing hay bales in the tidal flat would help to accrete sediment that would build marshland, giving it space and time to migrate. The mowing of the cultural meadow would be prevented so that the seed bank could regenerate, and parts could be replanted with heirloom seeds of plant varieties of importance to the indigenous and Black communities that have lived on that land. Finally, a trail and additional parking lot would allow for expanded visitor engagement with this historic site that is often passed over (Figure 46). Visitors could see the remnants of the 1950s infrastructure project, explore the mysterious bald cypress forest, and witness a marsh migrating, all within the context of an ever-changing historical park.

The regulatory constraints for this concept include a Standard Joint Permit Application (JPA) from USACE-Norfolk, a JPA Chesapeake Bay Preservation Act Wetlands Permit (James City County Wetlands Board), and Section 404 Clean Water Act (VDEQ). This concept is anticipated to entail moderate cost and high complexity.

Feedback

The park had limited input on the isthmus flats project but did not feel this project was the best fit for the needs of the park.

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