



The Town of Kiawah Island

Comprehensive Marsh Management Plan



February 2023

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Acknowledgements

This document synthesizes input and work by several dedicated people and organizations who guided its development: the Town of Kiawah Island Town Council, Planning Commission, and staff; residents who attended meetings and hosted site tours; and the consultant team of Biohabitats and Elko Coastal Consulting. This plan also builds upon previous efforts by the Kiawah Island Community Association and the Kiawah Conservancy. We also thank all participants in the August workshop for ending their time and perspectives.

Introduction

Although the health of the salt marsh in Kiawah has been considered in several recent assessment and planning processes, this is the first document to focus solely on the marsh and bring together various tools for its management. In April 2022, the Town of Kiawah (TOKI) Planning Department launched this Comprehensive Marsh Management Plan (CMMP) as an effort to consolidate existing marsh-related needs and recommendations across the Kiawah entities to guide future marsh management on the island.

This planning effort was not conceived as a new undertaking to collect or analyze data. Instead, it is a work of synthesis: bringing together management perspectives and tools based in science, community, policy, and restoration as they have been suggested in previous studies and plans for Kiawah, and pertinent models from comparable island and marsh-front

communities. Accordingly, this document summarizes key messages and highest priority recommendations but does not repeat the full details of the technical rationale for each strategy. Instead, it refers out to previous planning efforts or Appendices as appropriate.

This document recommends collaboration among entities, clearly delegating responsibilities, refining regulations, and guided education efforts to manage Kiawah's marshes as a community. A few actions can be implemented quickly; however, most will require more than one organization or sector and require refinement in a collaborative forum.

The CMMP is envisioned to be a living document that should be revisited once every five years to assess the effectiveness of implemented recommendations, and adapt as needed for improved management.



Marsh Management Goals

A FRAMEWORK FOR MARSH PROTECTION



MONITOR: Detect changes in wetland vegetation species composition and structure within the salt marsh over time



PROTECT: Prevent or correct trajectories leading to impairments to the marsh by adopting marsh management regulation



ENGAGE: Educate the public, property owners, and decision-makers about undesirable marsh changes



RESTORE: Manage vulnerable areas and mitigate against future issues and undesirable changes

Resilience *n.* The capacity of a system or community to recover from unexpected impacts.



Creating this Plan

The CMMP process was launched in April 2022 with a kick-off meeting of town staff, key stakeholders, and the consultant team to establish a collective understanding of habitat characteristics, recreational & homeowner access needs, town infrastructure & development plans, and impending impacts from sea-level rise. The team then toured the marshfront to speak to property owners and staff about concerns.

The consultants then reviewed previous work, undertook some original spatial analysis, and launched a series of 13 interviews or small group meetings with experts. The wider community was informed of the CMMP process, educated about marsh management challenges, consulted with during public meetings, and involved through surveys, direct interviews, and interactive online input opportunities, which included a survey and an interactive map where participants could label and identify areas of concern. During the summer of 2022, several engagement activities took place including the release of a project website, a town podcast, and an

online StoryMap. Community engagement culminated in a planning charette and community open house.

Community members, outside experts, and Kiawah staff and officials joined the consultant team on Thursday, July 21, for a planning workshop and community drop-in event that harnessed the talents and energies of many experts and stakeholders. Based on concepts introduced by the consultant team, which were informed by the prior input, participants refined the preliminary marsh management plan actions, recommendations, and educational strategies to directly inform the CMMP. The community drop-in event directly followed the charette during the afternoon, and allowed for the public to explore and provide feedback on preliminary marsh management concepts.

Project Website

<http://elkocoastal.com/kiawah-cmmp>



Connected by Water: Salt Marsh in the Low Country

The gradual shorelines of the lowcountry give rise to its long tides and broad swaths of salt marsh, the inundated coastal wetlands that rise along our protected shores. Dominated by smooth cordgrass (*Sporobolus alterniflorus*), these marshes today comprise over 4,500 acres on Kiawah Island. Their distribution, however, is not fixed; instead it is as dynamic as the shoreline itself. This is in part because marshes are the interface between land and sea, influenced by each. It is useful to understand the salt marsh through three lenses, each of which presents its own set of management opportunities.

CONNECTED TO THE SEA

Salt marshes are one of the most productive ecosystems in the world. They provide essential food, refuge, and nursery habitats for more than 75% of fisheries species, including shrimp, blue crabs and many finfish. Just as fish that use the marsh as nursery travel out to the open water, so the ocean's status affects our marshes. Sea level rise and storm surge are existential threats to marsh along a fixed, hardened shoreline where upslope migration is impossible.

AN EVER-CHANGING BOUNDARY

The edge of a salt marsh is its most prominent features to many. Tidal creeks meander, with deposits of silt and material on the insides of curves where water moves slowly, and marsh erosion on the outer edge of curves. Salt marshes provide important protection for shorelines from erosion by buffering wave action and trapping sediments.

SHARED WATERSHEDS

Finally, we also consider Kiawah's marsh as a recipient of water that flows from the uplands - not only on the island, but on the adjoining mainland. Salt marshes reduce flooding by slowing and absorbing rainwater and protect water quality by filtering runoff and metabolizing excess nutrients (NOAA-NOS, 2017). The watershed affecting the marsh crosses multiple jurisdictions, and land-use, water quality, and zoning ordinances from each of them affect the long term prospects of the salt marsh that rings the island.

"Spring in the Lowcountry sounds like a flock of Bobolinks slinging their discordant songs around the tidal marsh"

-J. Drew Lanham

Planning & Management Context

The primary goal of this planning effort is to bring together the multiple threads of marsh-related work that are underway or planned. Several recent or concurrent planning efforts have goals and strategies related to the marsh.

KIAWAH CONSERVANCY MARSH VULNERABILITY STUDY & NATURE-BASED ALTERNATIVES (IN PRESS)

Beginning in January 2020, KICA, College of Charleston and the Lowcountry Hazards Center started the Marsh Vulnerability Project to map historic change in marsh vegetation, highlight current geologic features, and catalogue human infrastructure. The vulnerability project is one of a series of Marsh and Groundwater studies, which provide a complete picture of the water below and around the island. Together these efforts will provide our island with a comprehensive understanding of Kiawah's coastal environment, how it changes over time, and what actions island leaders should take to preserve their special island community.

FLOOD MITIGATION AND SEA LEVEL RISE ADAPTATION (2018)

In the spring of 2017, the Town of Kiawah Island's Environmental Committee formed a subcommittee to proactively identify steps the community could take to address increased flooding frequency and adapt to future water level changes. One important finding for marshes is that the challenge facing our marshes is probably not from wave induced erosion, but rather from insufficient accreting sediment for vertical growth or from barriers

preventing inland migration. Thus, construction of new living shorelines may provide benefits only in limited locations along Kiawah. In other places, marsh will be unable to fill in behind them because of limited sediment.

2019 COMPREHENSIVE PLAN AMENDMENTS

The 2019 Amendments put forth an ambitious set of natural resource goals, including: "Formalize a marsh management plan that explores various methods of protection for the Island's marsh and manages the interface between highlands and critical area that is vital to a healthy salt marsh."

KIAWAH ISLAND COMMUNITY ASSOCIATION RESILIENCE PLAN

KICA and other island entities are collaborating to prepare for the long-term impacts of climate change, including the increased frequency of storms and rising sea levels. In 2020 KICA established the Adaptive Management Plan Task force, with the endorsement of the town, to seek member input in the initial development of a plan that will allow Kiawah to adapt with changing environmental conditions. This plan will utilize critical data collected from the Town of Kiawah Island's new tide gauge at the Kiawah River Bridge. The gauge records water levels that will be analyzed to understand any changes over time.

Management Concerns: Climate Change and Sea Level Rise

SEA LEVEL RISE

All future management of Kiawah’s marshes must be understood in light of climate change. Even if greenhouse gas emissions were eliminated today, continued warming and sea level rise would occur due to the current accumulation of emissions.

The sea level around Charleston rose by 11 inches from 1950 to 2016 (Figure 1), about 1 inch every 2 years within the last ten year period analyzed (2006-2016). Figure 2 shows the range of SLR possible given the effort to decarbonize the global economy, with low/intermediate/high projections for 2100 at 1.2 ft/3.5 ft/8 ft, respectively. Climate change is also changing rainfall patterns to favor more intense storm events, with more precipitation coming quickly, and an increased frequency and intensity of hurricanes.

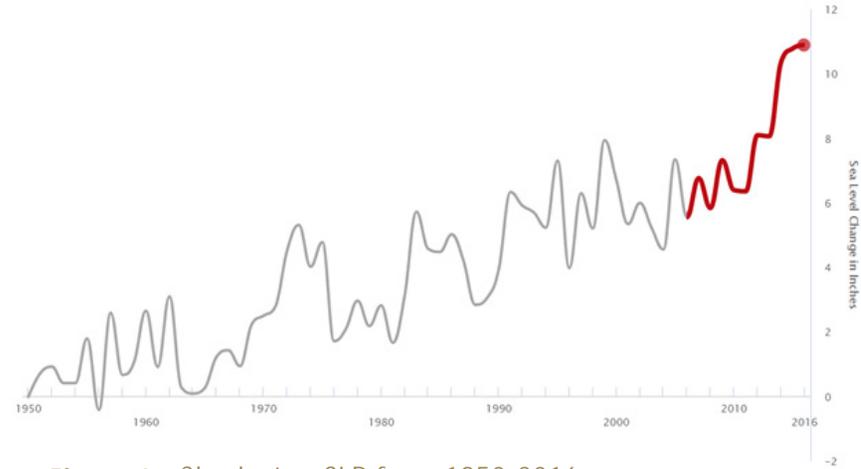


Figure 1 - Charleston SLR from 1950-2016

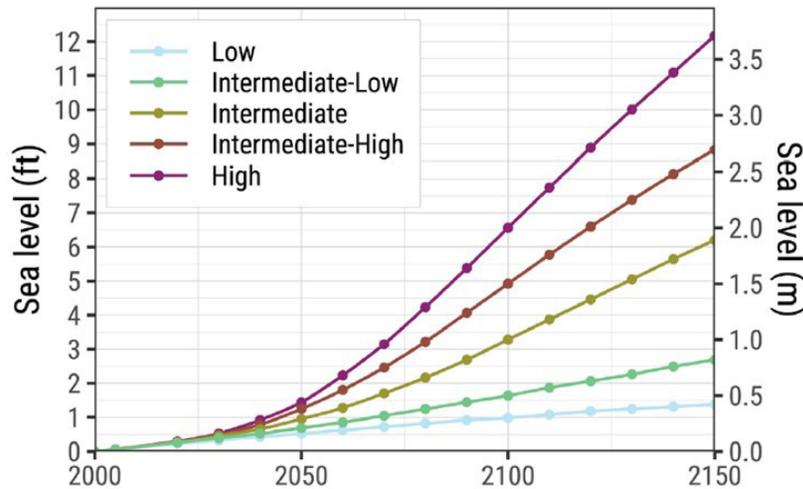


Figure 2 - Projected Charleston SLR from 2000-2150

Scenario	Year		
	2050	2100	2150
Low	0.5	1.0	1.4
Intermediate-Low	0.7	1.6	2.7
Intermediate	1.0	3.3	6.2
Intermediate-High	1.2	4.9	8.8
High	1.4	6.6	12.2

Units in feet relative to year 2000

Management Concerns: Public Input

Several high-profile concerns provided impetus for this planning effort, such as hotspots of shoreline erosion that are threatening infrastructure and the observed conversion of high marsh to open mud flats. For the purposes of this plan, we focused on two ways of understanding management concerns and threats to the salt marsh. The first was to seek community input on concerns and locations of management issues. The second was to synthesize the stressors that undermine ecological function from a data-driven perspective, whether or not they draw public attention, with analysis from primary literature, previous planning documents, and expert interviews.

Two years ago, the Kiawah Adaptive Management Committee conducted a survey, and 36% of the 1,643 respondents described themselves as “extremely concerned” about the salt marsh. Fifty-three respondents to the current CMMP community survey prioritized bank erosion and associated

property loss as their top concern, followed closely by the continued ability of the marsh to sustain fisheries, wildlife, and a diverse salt marsh ecosystem.

A formal threats analysis, with causal factors identified in chains is beyond the scope of this document, and some of the concerns overlap or exacerbate each other. They also vary by ultimate cause; some result from global trends beyond the control of local managers, and others are closely related to local land use decisions. In both cases, the management recommendations in this plan were selected and refined as direct responses to concerns expressed.

BANK EROSION

Tidal creeks and the marshes around them are dynamic systems that move continually, depositing material (accreting) on the insides of curves, and eroding banks on the outside. Though there are some areas where water management and stormwater appears to be contributing to erosion, most of the hotspots of erosion and conflict in Kiawah are exactly where a geomorphologist would expect them to be, on the outside of tidal creek meanders. This is good news for the present, indicating that the changing climate is not yet causing widespread erosion. However, it is a source of pain and expense to homeowners, and sea level rise will start to make the problem more widespread, so the “Restore” section of this document offers recommendations for bank stabilization.

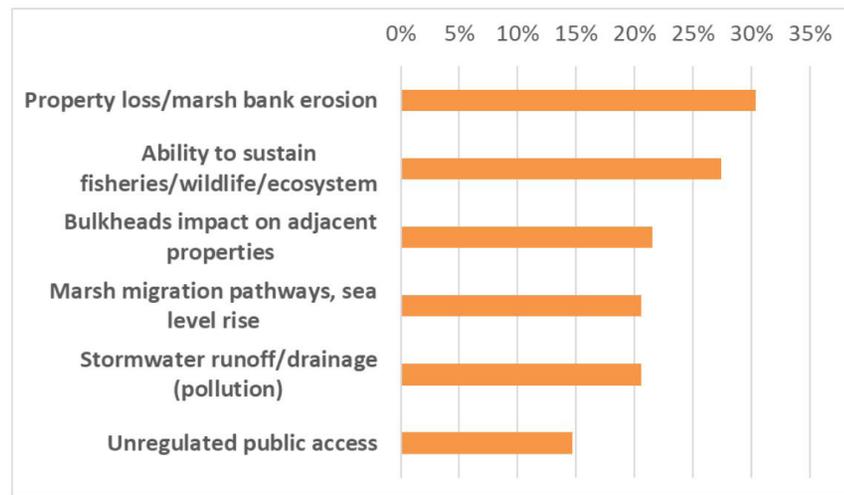


Figure 3 - Prioritized marsh management concerns (n = 53).

Additional Management Concerns

TRADITIONAL BULKHEADS

Armoring structures such as bulkheads have traditionally been used for erosion control. Bulkheads are effective at “holding the line” along an eroding shoreline, often to the detriment of surrounding areas. However, bulkheads are not necessarily the best solution for flood management or for a green approach to marsh preservation. Because hard walls cannot absorb or dissipate wave energy, that energy rebounds and causes local turbulence. This can often kill vegetation, convert marsh to mud flats, or scour and deepen the nearshore. Neighbors who do not have bulkheads are particularly concerned about these issues, because their own erosion problems often become worse if bulkheads are constructed nearby.

HABITAT QUALITY

Habitat quality depends on many factors, the most important of which for Kiawah are water quality and vegetation, understood as the plant community composition, distribution, and vigor.

Water Quality

Marshes can be sensitive to the quantity and temperature of fresh water entering them, so runoff from streets and developed areas can compromise the marsh, though the nutrient loading of fertilizers is of less concern than it is in the uplands, since it is diluted by tidal fluctuations. Water management recommendations can preserve the current vigor of the marsh.

Vegetation

In many ways, the vigor of marsh vegetation is an emergent property that responds to the freshwater balance, inundation, and erosion. The unvegetated to vegetated ratio (UVVR) is an early sign that marsh vegetation is drowning and converting to mudflats or open water. Where there is space to do so, the marsh might also migrate upland. Over time, as the existing marshes become submerged and higher elevation land begins to be more frequently saturated from the tidal cycle, wetland vegetation will migrate to their more preferred saturation tolerance.

UNREGULATED PUBLIC ACCESS

Recreational users can trample vegetation, which results in local erosion that can become more severe during storm events.

Identified Areas of Concern



PUBLIC INPUT

Residents of Kiawah and other concerned stakeholders identified points of management concern in the marsh through an interactive online mapping

tool and during the workshop. The management recommendations in this plan were selected and refined as direct responses to concerns expressed.

Key Indicators: UVVR & Shoreline Change

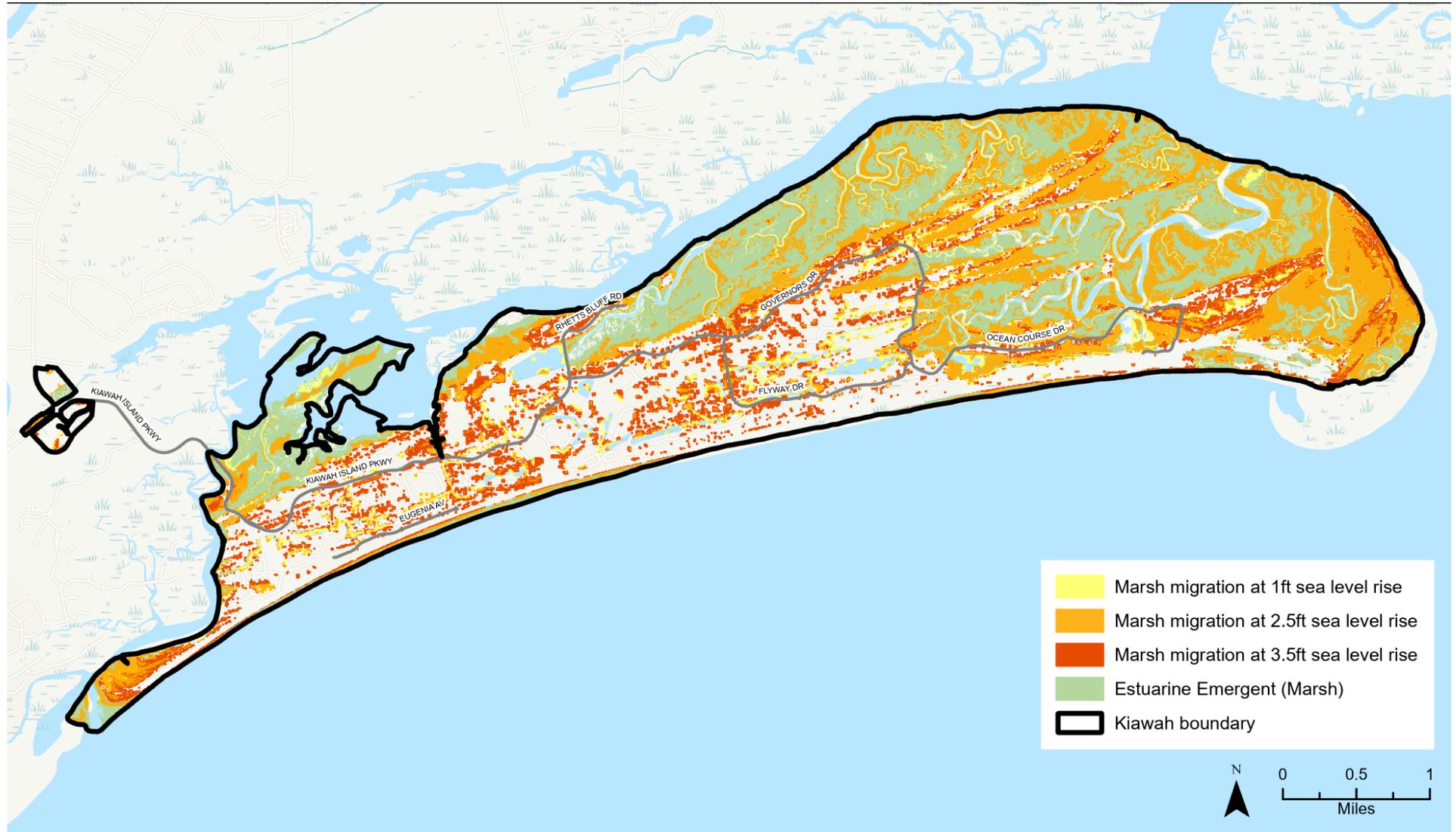


UVVR & SHORELINE EROSION

This figure shows two important indicators that are recommended elements of the monitoring plan, the unvegetated to vegetated ratio (UVVR), and current patterns of erosion and accretion. UVVR can be informative about the current

trajectory of a marsh. A stable tidal marsh, with intact marsh plains and little deterioration tends to a UVVR of about 0.1. Higher values indicate degradation, usually a result of open water conversion. The other dataset on this figure shows eroding areas in red and newly formed land in yellow.

Status of the Marsh: Sea Level Rise



MARSH MIGRATION

This map shows the predicted future distribution of marsh. If the current salt marsh is unconstrained by development and able to migrate, the plants will move upslope to areas that are currently dry uplands as sea levels rise. The

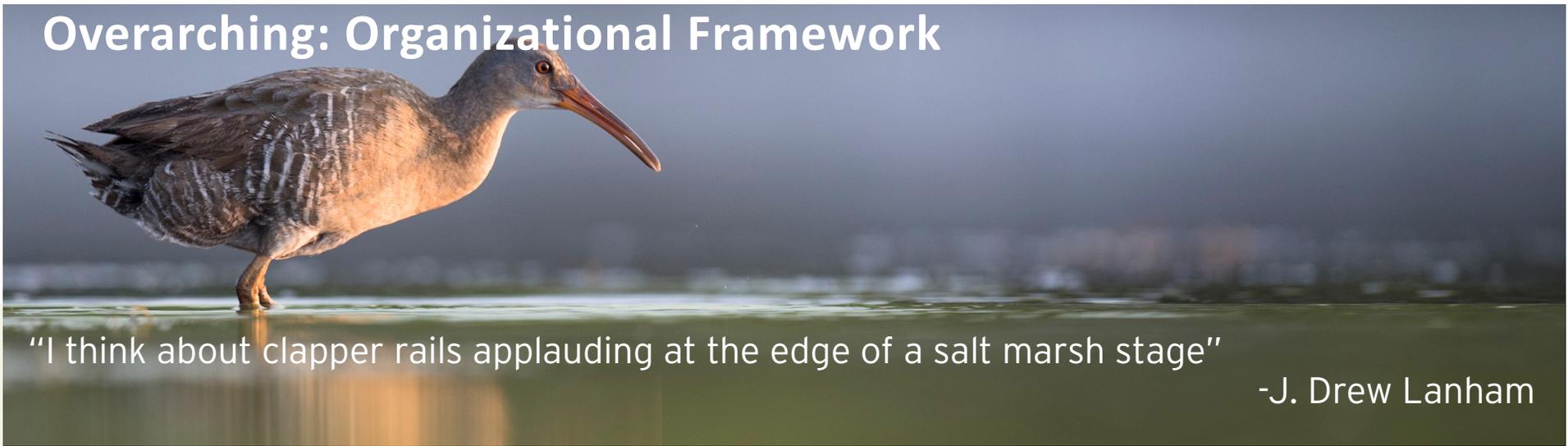
orange indicates the future expanse of salt marsh under 2.5 feet of sea level rise. Tidal marshes are highly dynamic communities and have the capacity to adapt to SLR, by the accretion of sediments through tidal exchange. Water level is an indicator and recommended element of the monitoring plan.

Recommendations

The remainder of this document is about solutions: how to track the trajectory of the marsh; how to regulate the structures that control it; how to engage people in responsible stewardship; and how to restore systems and functions where they are broken. These include both synchronous and iterative activities that are interdependent.

Kiawah Island has a unique multi-entity governance, comprised of several independent organizations that support the community. Comprehensive protection and implementation of these recommendations will require better coordination and streamlining of the many entities that currently touch the marsh (see facing page).

Overarching: Organizational Framework

A photograph of a clapper rail standing in a salt marsh at dusk. The bird is in profile, facing right, with its long, straight bill pointing forward. The background is a soft, blurred landscape of water and marshland under a twilight sky. The bird's feathers are a mix of brown and grey, with some white streaking on its wings.

“I think about clapper rails applauding at the edge of a salt marsh stage”

-J. Drew Lanham

Overarching: Organizational Framework

MARSH OF Ks

Town of Kiawah Island

Incorporated in 1988, the Town is the municipal government of the Island.

- building permits
- code enforcement
- planning & zoning services
- promoting tourism
- beach management & protection
- wildlife management & protection
- community outreach



KICA

(Kiawah Island Community Association)

Incorporated in 1976, KICA is a non-profit corporation formed to maintain common facilities and serve as a vehicle for the administration and enforcement of covenants and restrictions.

- owns, maintains + improves common properties
- member education & outreach
- long-term planning
- landscaping of common properties
- maintains roads behind main gate



Kiawah Island Golf Resort

Kiawah Island Golf Resort is a world-class hotel and resort. The Resort caters to the guests that visit the Island.

- Night Heron Park & Kamp Kiawah (wildlife education/nature tours)
- Mingo Point (oyster roast and kayak launch), boat excursions and fishing charters
- Manages the five golf courses.



Kiawah Conservancy

The Kiawah Conservancy is a chartered non-profit, section 501(c)(3), grassroots organization. The Conservancy provides the vision, leadership, and resources necessary to preserve and enhance Kiawah Island's unique balance of nature and development.

- preservation and stewardship of critical wildlife habitats
- programs to encourage and assist landowners in the protection of the unique natural environment of Kiawah.
- an accredited member of the Land Trust Alliance
- education



Kiawah Partners

Since 1988, Kiawah Partners (KP) has been the master planner and community developer committed to using an environmentally sensitive Master Plan as a compass, preserving and protecting the natural beauty of the Island's 10,000 acres.

- residential community design, master planning
- development agreements and entitlements
- real estate brokerage operations
- private club design, construction, management
- architectural controls



Kiawah Island Architectural Review Board

The goal of the ARB is to help property owners harmonize the built world of architecture within its natural setting. Using a determined set of standards and guidelines for community areas and residences in accordance with the comprehensive Master Plan, the Board enforces standards applicable to all construction and landscaping.



Kiawah Island Real Estate

Kiawah Island Club

Overarching Recommendation: Organizational Framework

Kiawah Island Inter-Entity Executive Committee (KIIEEC)

In the past, umbrella topics that touch several of Kiawah entities' missions have been addressed through formation of cross-entity task forces. This approach recognizes that the entities have the expertise and networks to develop solutions that will serve all stakeholders. For effective marsh management, it is necessary to determine and coordinate marsh management and education responsibilities of each entity. Many of the following recommendations cannot be implemented by the Town alone. They will require the support of most, if not, all Kiawah entities. Therefore, an overarching recommendation is a framework for organizational collaboration between entities (e.g., Kiawah Island Inter-Entity Executive Committee (KIIEEC)). The KIIEEC should receive and share information about each implementation action undertaken.

KIIEEC should include each of the actors in the Marsh of Ks in roles of responsibility that agree with their purview. Additional members could include others in advisory roles: peer communities, funding agencies, consultants, contractors, SCOR, SC Sea Grant, SC DHEC or other state agencies, NOAA, FEMA and other federal actors, and Clemson Extension and educational or academic partners.

KIIEEC should coordinate marsh management decisions for consistency in education/messaging and determining pathways forward for monitoring and adaptive management. Each entity should formally join the KIIEEC through a resolution or similar action to formalize the committee. Members should commit to incorporating the appropriate steps in marsh management into their own governance and documents as well as seek opportunities to weave these recommendations into their internal plans. As a body, KIIEEC should consider each of this plan's recommendations and develop implementation plans by 2024.

The governance structure of KIIEEC needs to be formalized by the entities themselves. Although the group should engage in open conversation to express concerns, build agreement, and get buy-in, it needs a clear statement of a decision-making protocol that does not rely solely on consensus.



Recommendation I: Monitor

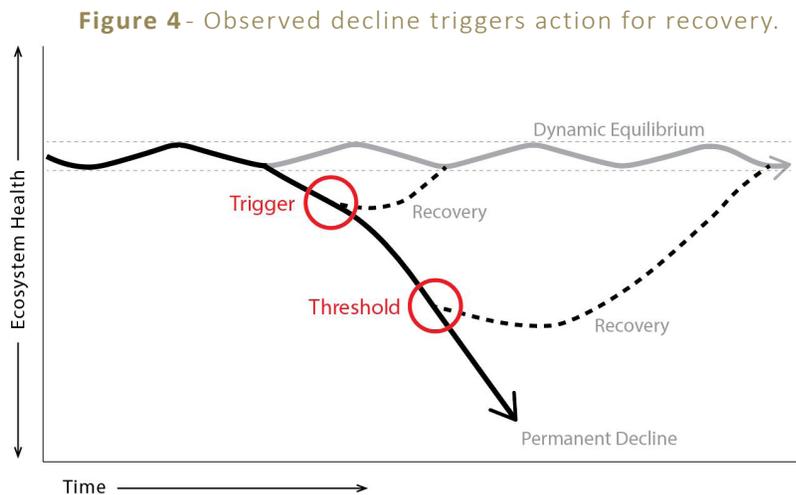
Marshes degrade in ways that may not be readily visible, so understanding the current status and likely trajectory of Kiawah’s marsh requires documenting the key indicators of its health. Although a complete monitoring protocol with procedures, timelines, locations and responsible parties is beyond the scope of a Marsh Management Plan, creating and implementing such a monitoring effort is necessary to advance the science-based management recommendations to maintain the important benefits of Kiawah’s marsh. Such monitoring is also requisite for the process of adaptive management, in which management strategies and techniques are altered in light of data collection that records the success and opportunities for improvement for any management actions that are taken.

The recommended monitoring framework for Kiawah’s marshes is based on the common vocabulary and approach developed by the Kiawah Island Flood Mitigation and Sea Level Rise Subcommittee. It tracks the state of the art in ecosystem management based on thresholds.

Ecologists have long recognized that disrupted ecosystems do not respond to stress in a steady, predictable way. Instead, the interwoven systems of soils, water, plants, invertebrates and animals can reach sudden turning points and crash unexpectedly. Such “thresholds” are the point at which small changes can cause rapid degradation and shift the system to a different state (Figure 4).

Recent years have seen concerted efforts to identify indicators that a system is on a path towards such thresholds and allow managers to intervene in a timely way. KICA, in collaboration with experts and under the leadership of Lucas Hernandez, developed preliminary trigger indicators for Kiawah’s marshes, including values for UVVR and changes in location and composition of vegetation. If appropriate actions are taken at these trigger points, the severe consequences of reaching marsh health thresholds can be avoided.

Figure 5- Adaptive management is a cyclical process.





MONITORING FRAMEWORK

More than one current management document for Kiawah lays out elements of a marsh monitoring framework, including the 2019 Comprehensive Plan Amendments and the findings of a task force assembled by the Kiawah Conservancy to consider marshes. A comprehensive monitoring program should include both field-based and remote data collection.

The environmental committee of the Town Wildlife Department planned to undertake aerial orthography of the island every three years to monitor changes in the salt marsh (NR element 2.c). The Kiawah Conservancy recommends establishing long-term field sites for marsh vegetation monitoring quadrats from open water to highlands to record visual evidence if communities of high marsh *Borrchia frutescens* and *Spartina patens* become sparse and slowly transition to communities of *Sporobolus alterniflorus* and *Salicornia spp.* Monitoring in these quadrats and at additional locations could also include invertebrate abundance and density, water quality, oyster reef abundance and survival, land cover, and recreational fisheries. Unpublished outcomes of the KICA Adaptive Management Plan also informed this recommendation.

PARTNERS

TOKI, as the lead actor in marsh monitoring, should partner with the Conservancy to implement a regular, comparable monitoring protocol and partner with KICA to assist with the human resilience elements. Additionally, ARB should assist with an inventory of marshfront structures, including shoreline protection devices.

IMPLEMENTATION

Establish a five-year monitoring program to quantify the duration and frequency of marsh health thresholds and identify Trigger Points to alert the island if it is approaching a threshold. Response Plans for thresholds should be developed before the triggers are reached. Recommendations of this plan should be implemented in advance to preserve marsh health and reduce risk of hitting the triggers. Monitoring should include both educational citizen science, and internal technical mapping, elements. Based on the state of the science at the time of report publication, the following triggers are recommended. Prior to each five-year update, a panel of marsh science experts should convene to adaptively modify the triggers based on state-of-the-art knowledge.

Trigger: Unvegetated-vegetated ratio (UVVR) greater than 0.05.

Threshold: Decreased productivity/community distribution

Trigger: 5 feet of critical line movement into upland/marshfront (1 ft/yr).

Threshold: Erosion of private property/infrastructure

Trigger: 30% increase in tidal flood days (water levels at Kiawah River Bridge and Ocean Park tide gauges > 7.0 ft MHHW).

Threshold: Increased tidal flood days

Response plans are suggested in the following sections (e.g., Protect: Shoreline stabilization options to address marshfront erosion.)



II: Protect

A consistent management approach to Kiawah’s marsh will depend on a regulatory framework that governs the actions that organizations or individuals are allowed to take in the marsh. SC DHEC will be engaged

in this effort because they have jurisdiction from the critical line to open water (figure 8). This section describes six policy or regulatory actions to protect Kiawah’s marsh.

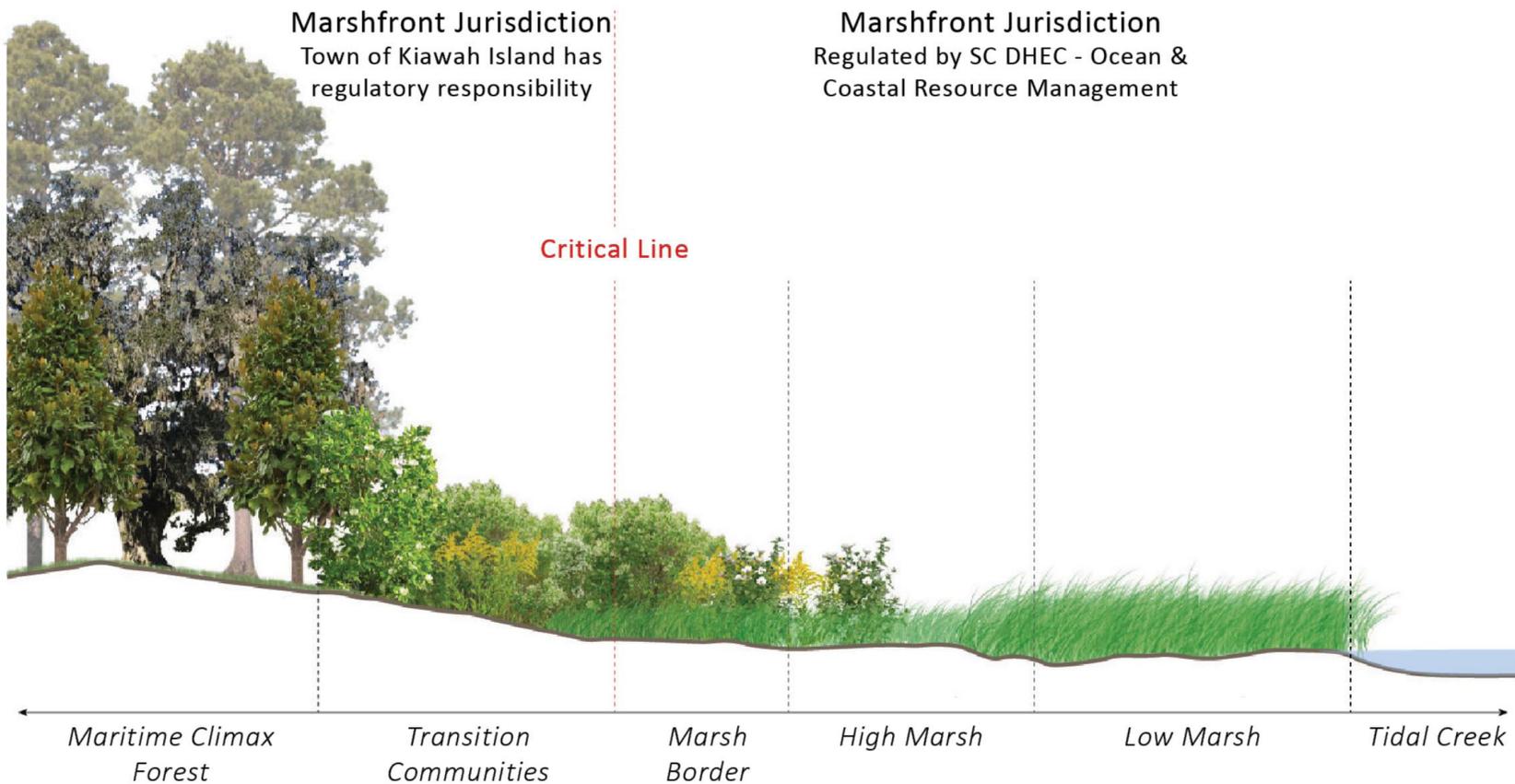


Figure 8- The “Critical Line” is a biophysical jurisdictional feature that will shift with the edge of the marsh as it migrates due to sea level rise



CODE

Recommendation: Consolidate Town Code’s existing marsh-related elements.

Justification: Currently, there are several different locations for marsh-related regulation, including Sec. 12-76 Waterfront development standards; Sec. 12-104 Accessory uses, buildings/structures; and Sec. 12-127 Compatibility buffering standards. Users must cross reference to identify pertinent regulation.

Implementation: Existing regulations and carefully drafted future ordinances adopted by the town should populate this section. This will help make the code easier to navigate when searching for ordinances that relate to marsh management.

The ultimate destination of stormwater on Kiawah Island is the marsh. KICA is the entity responsible for the island’s stormwater drainage system. In the spring of 2020, members approved a special assessment to fund six infrastructure improvement projects that represent a foundational step in Kiawah’s water management planning. The infrastructure improvements are expected to be complete by the end of 2022.

PERMIT

Recommendation: Streamline natural solutions permitting at local, state, federal levels to maintain balance between development and a healthy marsh.

Justification: Recent progress in the permitting of living shoreline by DHEC OCRM and work by the Living Shorelines Working Group has made standard design options for living shorelines far easier to permit than they were even three years ago. Nevertheless, the regulatory structures can still be difficult to navigate for individual landowners and their engineering consultants.

At the local level, few options exist for private property solutions particularly along areas that are not subject to tidally induced erosion (i.e., do not qualify for an OCRM critical permit). Options are needed that meet owners’ flood mitigation needs while preserving marsh function.

Implementation: KIEEC creates a work group of engineers, contractors, staff, and other stakeholders to develop appropriate, constructible, and aesthetic green flood control and marshfront shoreline management options. TOKI pilots innovative design and leads permitting for local solutions, opening a pathway for neighboring landowners.

Partnerships: KIEEC, ARB



STORMWATER MANAGEMENT

Recommendation: Strictly limit impermeable surfaces, formalize stormwater BMPs for private properties.

Justification: Current stormwater regulations simply direct designers to convey water to the critical line or other outfall point, without consideration of its potential effects on the marsh. Low Impact Development (LID) is an integrated, comprehensive approach to land development or redevelopment that works with nature to manage stormwater as close to its source as possible. LID practices can protect local water quality and reduce urban flooding through best practices in stormwater management. Widespread implementation will also reduce pollution of the marsh by filtering and nutrient retention.

The Conservancy's green infrastructure practices and standards from the LID manual for coastal South Carolina (Ellis et al 2014) include implementing practices at the site scale to reduce runoff volumes, modifying practices to prevent bypass during intense storm events, periodically revisiting design storms and mapped flood plains, using adaptable plants in place of native species, and using stormwater as a water source for irrigation.

Implementation: TOKI and ARB develop complementary regulations for private properties. KIIEEC works with KICA to implement to the extent possible in public works. KIIEEC draws from the Conservancy's Green Infrastructure and Low Impact Development Practices manual.

Partnerships: ARB, Conservancy, KICA, KIIEEC

BULKHEADS + MARSHFRONT BERMS

Recommendation: Regulate bulkheads and other flood/erosion control structures upland of critical line.

Justification: Article 17 TOKI's municipal code allows TOKI to review bank retention designs and submit comments and recommendations, but provides little authority to guide decision-making.

Implementation: Codify ARB standards with a Town ordinance requiring that bulkheads beyond the critical line may only be constructed with prior-OCRM approval, must be constructed flush with adjacent grade/elevation, and any disturbed land must be backfilled and planted with appropriate vegetation. All erosion control or flood mitigation construction regardless of location relative to the critical line requires a Town permit with proof of location and a depiction of the certified critical line. Bulkheads on high ground are not recommended; rather, options for shoreline restoration (like terracing) are included in Section X.

Partnerships: ARB, KIIEEC

Ordinance precedence (City of Folly Beach § 151.23) regulates berms, bulkheads, riprap, seawalls, revetments and retaining walls (See Appendix X). No portion shall be placed beyond the critical line without approval of OCRM. All structures placed wholly or partly within the setback from the critical line must be maintained in an intact usable condition or removal may be sought at the owners expense. New or substantially improved methods cannot be combined in a manner that would compound flooding, significantly impair drainage, or cause adjacent shoreline impacts.



Setbacks/Buffers

Controlling stormwater with vegetative buffers is one of the most effective ways to protect salt marsh habitat (see Appendix 6.2).

According to Morganello and Rose (2013), vegetative buffers provide the following benefits:

- 1. Reduce pollution in stormwater runoff,*
- 2. Reduce shoreline erosion and property damage caused by flooding,*
- 3. Provide increased privacy to the homeowner while still maintaining a view corridor,*
- 4. Serve as wildlife habitat, and*
- 5. Save the homeowner money, especially when native plant species are dominant, as little to no water, fertilizers or pesticides are needed to maintain this area of the yard.*

There are many types of vegetative buffers depending on the intent, location, and desired appearance and function. For example, the level of manicuring by property owners determines the differences between

undisturbed, natural, and landscaped buffers. Natural buffers involve the removal of invasive species and planting of native vegetation.

Other South Carolina communities with residential critical line buffers or setbacks include but are not limited to Beaufort County (50' buffer), Charleston County (35' setback + minimum 15' buffer that prohibits lawns and impermeable surfaces), James Island (35' setback + 15' buffer), City of Charleston (35' setback), and the Town of Mount Pleasant (35' setback + 25' buffer). A detailed listing of other S.C. local governments' marshfront regulations on bulkheads, setbacks, and buffers has been provided to TOKI staff.

Note that the ARB regulates within their purview of aesthetics. TOKI needs to adopt ordinances to complement this with marsh preservation in mind. This applies specifically to setbacks and bulkheads.



SETBACKS

Recommendation: Standardize and codify ARB’s marsh setback rule and codify the buffer requirement. For new development, the marsh setback is recommended to be 30 feet from the property line or the OCRM critical line, using whichever is most restrictive.

Justification: Early real estate transactions, which included smaller lots with no marsh “ownership,” were conveyed marshward to a set property line. More recent transactions, with larger lots that include marsh, have been conveyed out to MHW. To standardize regulations, the setback should be measured from the property line or the OCRM critical line, using whichever is most restrictive.

Implementation: This recommendation is consistent with the ARB’s Designing with Nature Guidelines and with TOKI Ordinance 2013-1, which added Article 12, Section 12A-216(G.), Reductions to OCRM Critical Line Setbacks. At least the first 10 feet (closest to marsh) is established as a natural buffer, to be maintained only with native vegetation. Appendix 6.2 provides educational materials about the types of native vegetation that are recommended, as well as best management practices. Property owners can also learn more about creating healthy, watershed-friendly landscapes through the Carolina Yards program (<https://www.clemson.edu/extension/carolinayards/>)

The new ordinance exempts existing structures, which can be renovated at the previous setback. If existing structures are closer than 30 feet from marsh, they are exempted but redevelopment may not encroach any closer to the property line or the OCRM critical line, using whichever is most restrictive: (i.e., reoccupy existing footprint, no additional encroachment toward marsh). If 10 feet exists between critical line, a native buffer should be enforced. Within the setback, pervious surfaces are prohibited (to reduce the disturbance of the area) as well as impervious surfaces. The only construction allowed in the setback are boardwalks, fences, piers, and flood/erosion control structures as defined by previous recommendation.

- Partnerships: ARB, KIIEEC





III: Engage

Engagement is the means by which residents and decision-makers become informed, active, and strategic stewards of Kiawah's salt marsh. This section outlines recommended content, audience and techniques for education about the salt marsh.

Engagement is also a key step in increasing regulation and oversight of marsh resources. As a partner activity for the other goals, at first engagement should focus solely on education and marsh literacy, and evolve into a more concerted effort to achieve marsh management outcomes. Early efforts should utilize town and other entities' (particularly KICA and the Conservancy) websites as well as social media. The education campaign for Kiawah bobcats could serve as a useful model.

What is Marsh Literacy?

Just as we expect citizens to have a basic understanding of the functioning and structure of government, and its most important safeguards, we want a community that understands basic information about Kiawah's marsh. This includes what it is (it's not a swamp! It doesn't have alligators!) and how we understand its health and trajectory through the key thresholds as described in Monitor. It also means understanding the effects of management actions, such as hardened shorelines or unfiltered stormwater runoff. The Kiawah Conservancy's catalog of shoreline management practices and Clemson's stormwater guides summarize much of this information and are great resources to share.

CITIZEN SCIENCE

Recommendation: Develop citizen science program for marsh conditions.

In conjunction with the monitoring plan, create an interactive "Show us your marsh!" form that is submitted to TOKI with photos and a description of the marsh indicator observed. As used in regional sea level and king tide trackers, a time stamp can link weather conditions, tide stage, etc.

Justification: Encouraging engagement with the marsh and documenting use can move people into the ladder of engagement (figure X).



Figure 9 - Ladder of Engagement



OUTREACH

Recommendation: Hire local organization to undertake a concerted outreach campaign, based on materials from the Conservancy and this CMMP process.

Justification: Background information and understanding is needed to explain why new policies/ordinances are being considered and their role in marsh management.

Implementation: Marsh education materials should be included in regular events, for example, they could feature in a quarterly series at council meetings and/or Our World presentations. In a less formal setting, options could include an annual marsh management month and/or periodic happy hour updates. Work with the Resort to develop public education materials, co-host events (e.g., marsh sweep), and hold staff (e.g., boat captains) education sessions.

Explain the rationale behind the CMMP recommendations and new regulations.

Partnerships: In this case, partners are both educators and educatees (the ones being educated) and include KICA; Conservancy; ARB, Resort; Realtors (convey pertinent information to new buyers); Rental management companies and property owners of STRs; BZA; Other Partners.



IV: Restore

RESTORATION OVERVIEW

In addition to monitoring, regulation, and education, active and restorative management of the marsh is a key component of a comprehensive approach. From the marsh's point of view, the best option for marsh management is often conservation of the land through acquisition, so the first recommendations focus on financing and acquisition for conservation. The next section summarizes some of the approaches that have been used on Kiawah and others that might be considered in the long term. It draws heavily on the Conservancy's work on nature-based solutions marsh management, adding a few restoration and management techniques that could be considered depending on site conditions. Where property owners are concerned about erosion and loss, active management can stabilize the shoreline with methods that vary widely in their impacts to the habitat value and long term resilience of the marsh. Finally, this section closes with recommendations for pilot marsh restoration and shoreline stabilization efforts.



FUND

Recommendation: Annually monitor and update funding opportunities for marsh restoration.

Funding may come from a variety of sources as opportunities arise, including:

- The National Oceanic and Atmospheric Administration (NOAA) which regularly funds projects that increase coastal resilience to the effects of sea level rise;
- The National Fish and Wildlife Foundation (NFWF) which has ongoing programs to fund approaches to habitat preservation and restoration;
- And the recently formed South Carolina Office of Resilience (SCOR) which sometimes offers to provide the matching funds needed to secure external funding.
- Special consideration should be given to the formation of a TOKI Marsh Mitigation Fund, drawing on new sources of funding emerging from regulations and policy as laid out in this plan. A marsh mitigation fund could be an ongoing source of match funding when required by federal, state, or private grant entities.

ACQUIRE

Recommendation: Acquire additional parcels of marsh and marshfront property.

Justification: As an accredited land trust and qualified conservation organization, the Conservancy serves as the lead actor to protect marsh and marshfront lands.

Implementation: Support ongoing land acquisition and conservation easement efforts of the Conservancy. Consider upstream land acquisition in the watershed outside of municipal boundaries. Preserve lots in undeveloped areas or low-density developments.

Partnerships: Conservancy



RESTORATION TECHNIQUES

Recommended restoration methods include

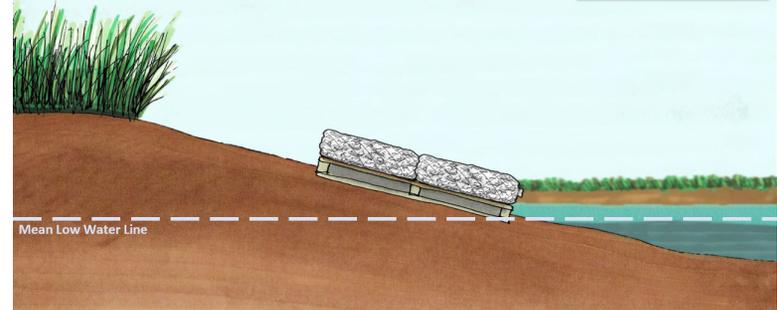
- the development of living shorelines, particularly along edges of the marsh facing tidal creeks as opposed to open ocean,
- the stabilization of eroding banks by use of structural elements such as envirolok,
- revegetation with native marsh plants,
- construction of oyster reefs to provide habitat but also attenuate storm surge, and
- the use of stormwater BMPs to slow and filter runoff from impervious surfaces to curb flooding and decrease in water quality.

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Informed by monitoring and supported by policy and regulations recommended in this plan, restoration activities can help to mitigate the impacts of existing and future development and the pressures of sea level rise on Kiawah's marshes. By investing attention and resources into the restoration of marsh functionality, a healthy trajectory can be achieved. Management strategies to enhance tidal marsh persistence include restoration of riverine sediment supply, thin-layer sediment placement, drainage enhancement, shoreline protection, and invasive species management (Day et al 2007, Blum and Roberts 2009, Wigand et al 2017, Thorne et al 2018).

Nature-Based Shoreline Stabilization:

Oyster Shell Bags

Oyster recruitment

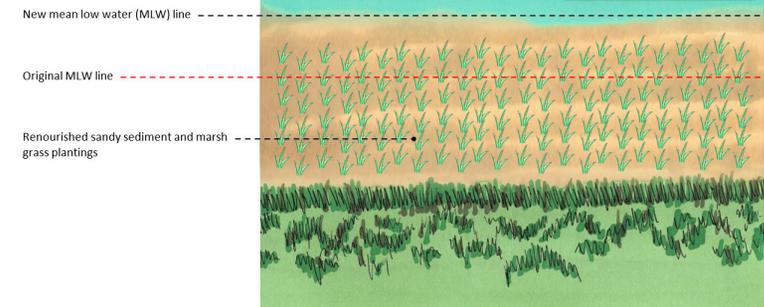


Concerns Addressed:
Bulkheads impact on marsh and adjacent shorelines
Property loss
Reduction of marsh benefit as nursery ground for marine life

Nature-Based Shoreline Stabilization:

Plantings

Vegetation with renourishment



Concerns Addressed:
Bulkheads impact on marsh and adjacent shorelines
Property loss
Reduction of marsh benefit as nursery ground for marine life

Kiawah Conservancy has developed a collaborative report on nature-based solutions, such as marsh restoration, oyster reef restoration, permeable surfaces, and rain gardens, to help reinforce and augment natural infrastructure. The document provides a suite of previously vetted nature-based solutions for Kiawah Island following engagement with key organizational stakeholders.



RESTORATION TECHNIQUES: LIVING SHORELINES

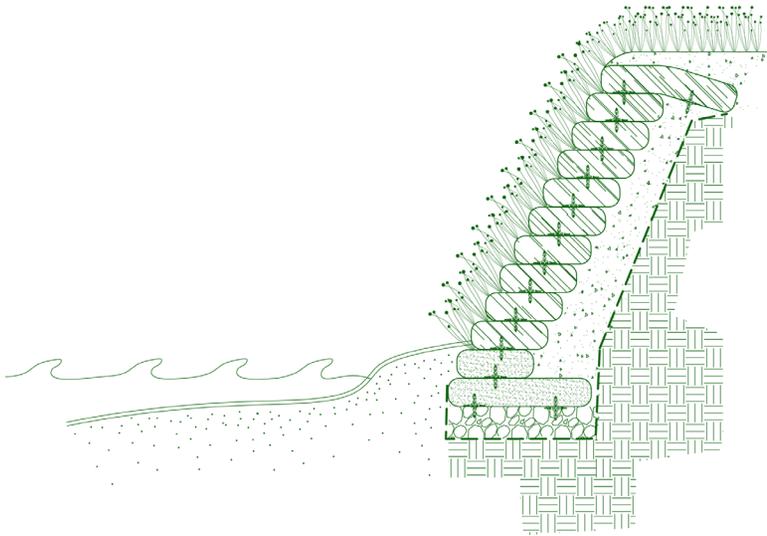


Living shorelines are a method of shoreline stabilization using plants and natural materials to reduce erosion and slow the wave energy associated with storms. Rather than creating a barrier between the shore and water, as with conventional bulkheads and seawalls, a living shoreline allows for a natural transition. The shoreline can thus provide erosion protection while still performing valuable ecosystem services and maintaining aesthetic character that makes Kiawah unique and desirable place to live and visit.



RESTORATION TECHNIQUES: ENVIROLOK

Envirolok is a geobag system designed to stabilize shorelines. Because it doesn't have an offshore wavebreak component, it cannot diffuse wave energy, but it is designed to recruit vegetation that will continue to stabilize shorelines over time. It is effective with sufficient sunlight.

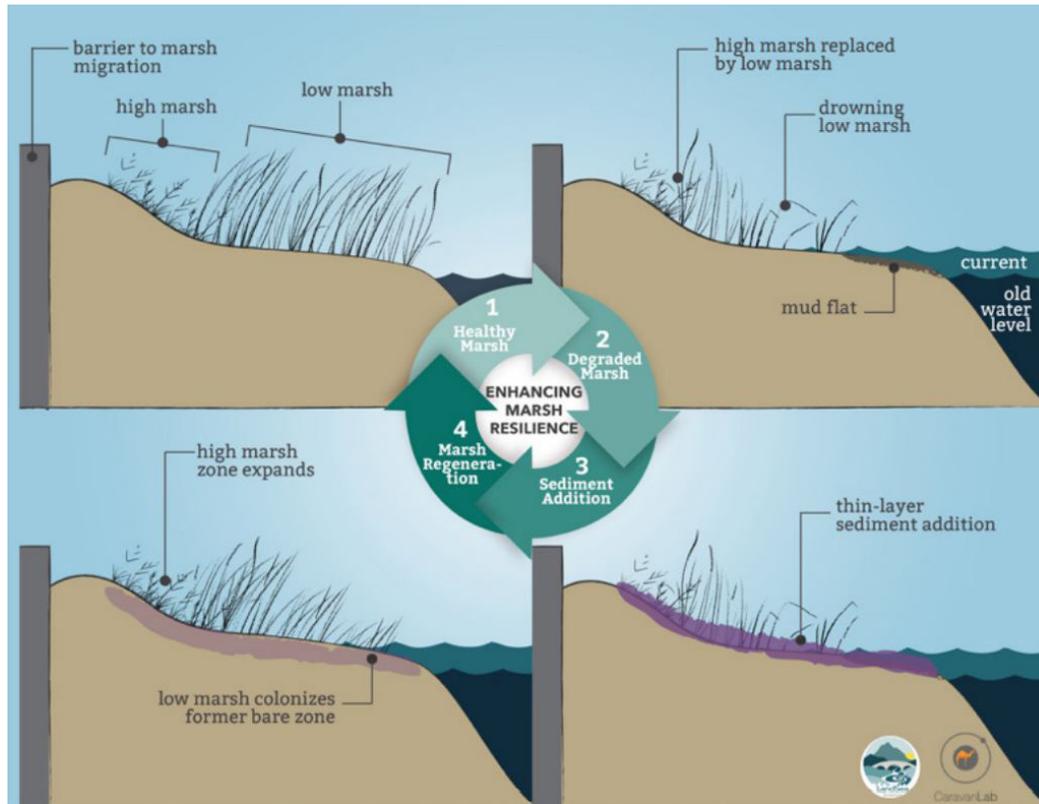


Credit: Envirolok





RESTORATION TECHNIQUES: THIN LAYER PLACEMENT



Credit: U.S. Army Corps of Engineers

Concerns Addressed

- Marsh health
- Reduction of marsh benefit as nursery ground for marine life
- Loss of protection offered by marsh

Credit: National Estuarine Research Reserve Association (NERRA)

Thin layer placement (TLP) of reused dredge material is a novel technique that is gaining favor for coastal restoration and resiliency applications in other regions.

TLP involves pumping wet dredge sediment from a floating vessel onto the targeted area over existing wetlands to evenly cover with a thin layer (6" or less). The depth of sediment is such that the covered vegetation can grow through and adapt to the new elevation over a couple of growing seasons.

Projects have been completed using this technique along the East Coast, but they rely on favorable views by permitting offices to be permissible. Precedent projects exist for the use of TLP for marsh resiliency along the east coast, but few are located in South Carolina. A 2-hectare TLP project within Jekyll Creek outside Savannah, Georgia was completed in 2019.



RESTORATION TECHNIQUES: PRESCRIBED BURNING

Marshes throughout the world have been managed through the strategic use of fire and burning practices for thousands of years. Large-scale prescribed burning has been used as an experimental method of marsh restoration in the US Gulf states with promising results that point to its use in the management of invasive species, addition of needed nutrients to marsh soils, and there are even some study results that indicate burning as a method for promoting accretion of organic and inorganic materials in marshes that could keep pace with sea level rise as predicted in some coastal areas.

Prescribed burning as a tool for ecological restoration on all types of land cover has been well documented and is strictly permitted, with protocol in place to minimize risk and ensure a successful burn. While public perception of the use of fire may require education to placate concerns, the results are likely to be worth the effort. Potential partners include The Nature Conservancy and the South Carolina Department of Natural Resources.

For more information, see *USGS Open-File Report 2012-1031 "Effects of Prescribed Burning on Marsh Elevation Change and the Risk of Wetland Loss"* U.S. Geological Survey, Reston, Virginia 2012



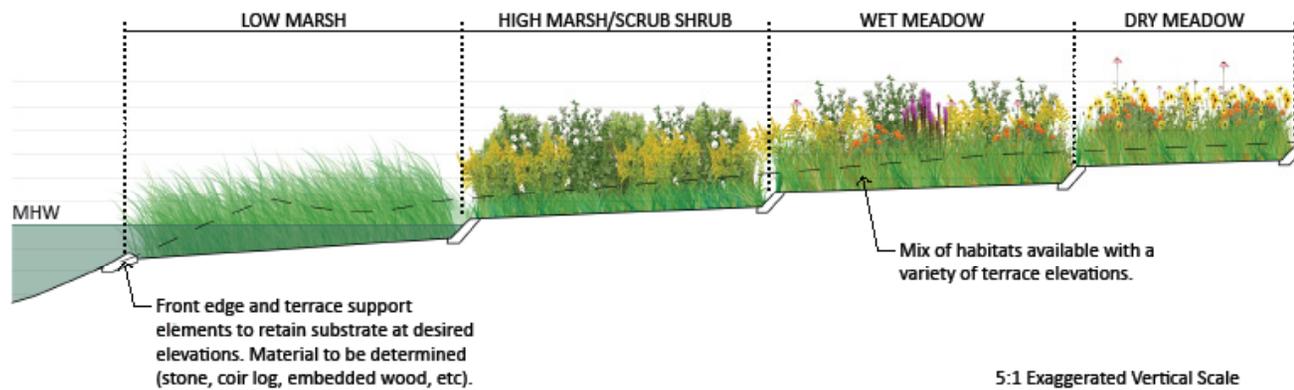
N.C. Forest Service crews monitor a marsh burn on Mar. 30, 2021.
Credit: Nicolas Xique



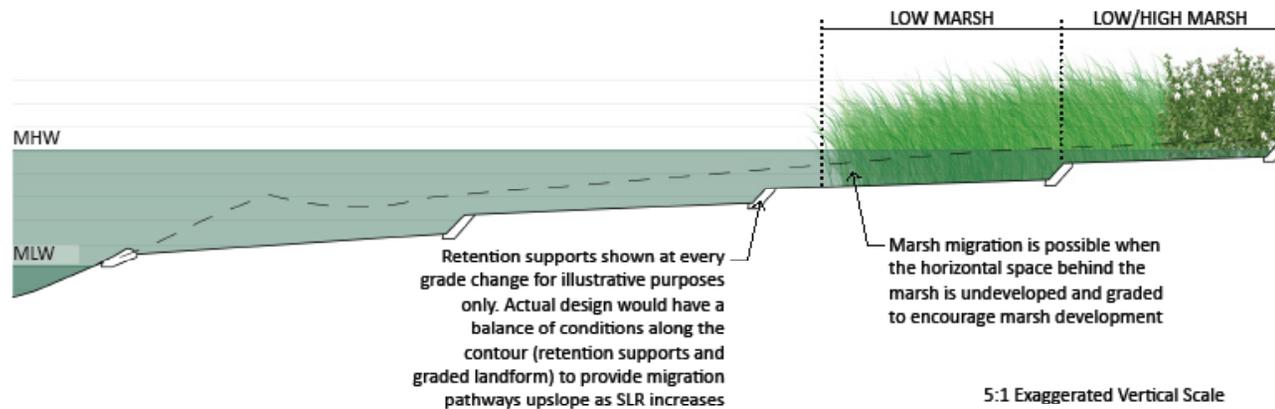
RESTORATION TECHNIQUES: RESILIENCY TERRACING

Where space permits, an option to counter loss of shoreline protection is terracing, which can allow for a limited amount of marsh migration

and vegetative & habitat diversity. **The diagrams below** show a barrier (retention feature) at every elevational change,



Proposed Resiliency Terrace Section (Current Water-level Scenario)



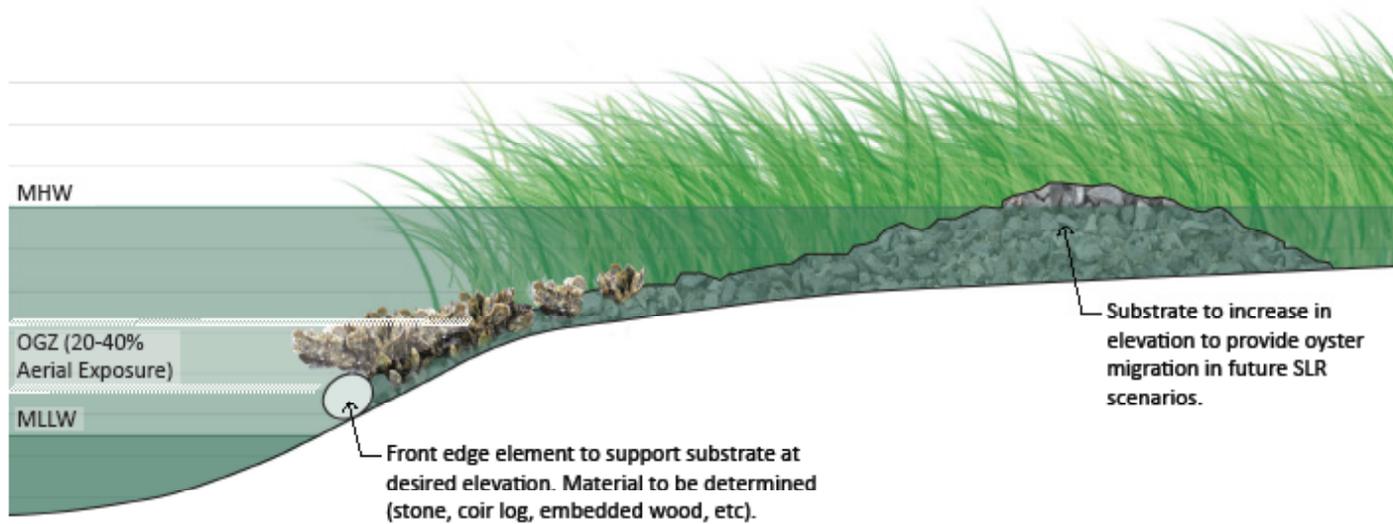
Proposed Resiliency Terrace Section (+3 SLR Water-level Scenario)



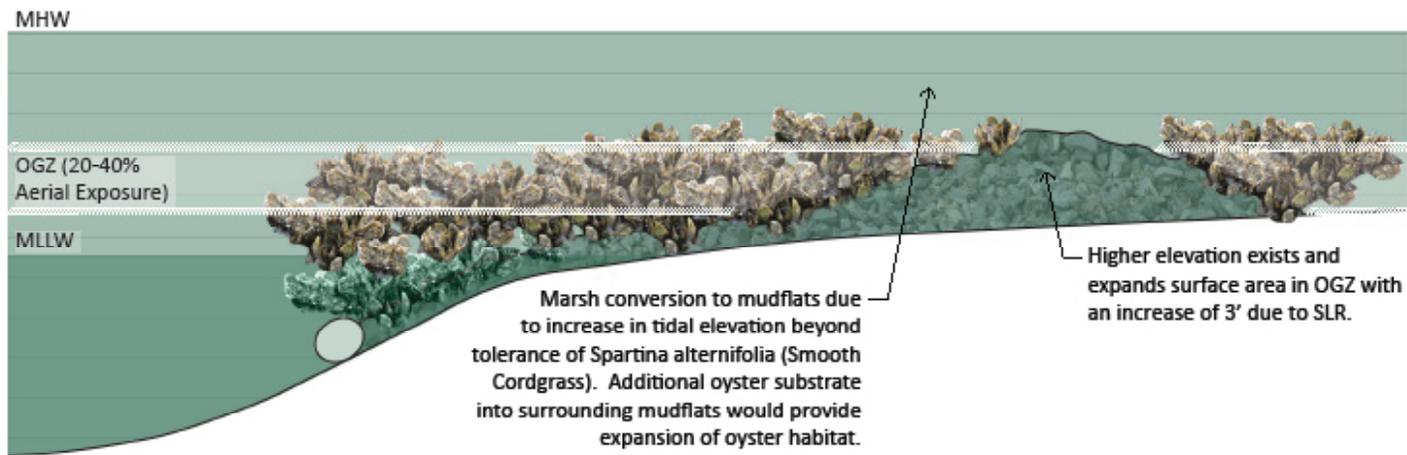
RESTORATION TECHNIQUES: OYSTER REESTABLISHMENT

Oysters exist only within the tidal zone, and are considered ecological engineers because their presence alters the surrounding environment to the benefit of many types of flora and fauna. They are filter feeders and benefit water quality by removing sediments, nutrients and contaminants from the water, in addition to plankton, which is their main food source. The subsequent water quality benefits and wave attenuation impacts from their reef formations provide favorable conditions for the growth of submerged aquatic vegetation (SAV).

Oysters are mobile as spat (baby oysters) but once they set onto a surface they become sedentary. Oyster shell, both living and non-living, provides the ideal condition for setting of spat and overtime can form a large community of oysters, referred to as oyster reefs. Oyster reefs are a complex matrix of shell and small unoccupied space (interstitial space) that provides habitat and refugia for a wide range of species, both juvenile and mature; SAV also provides similar habitat benefits and are supported by the presence of the oyster reef, as noted above.



Proposed Oyster Establishment Section (Current Water-level Scenario)



Proposed Oyster Establishment Section (+3 SLR Water-level Scenario)



Figure 10- Living Shoreline. Credit: Biohabitats, Inc.

RECOMMENDATION: PILOT

Recommendation: Prioritize voluntary, multi-property-scale, comprehensive demonstration/pilot living shoreline project (near-term)

Justification: Given the risks posed to private landowners on Kiawah by the various impacts of sea level rise, and the challenge of widespread adoption of solutions by owners, it makes sense to enroll properties in a pilot program to both test and demonstrate the value of a living shoreline project.

Implementation: Property owners may volunteer to participate in a living shoreline project that weaves together the constructed and natural systems of the marsh. Uniting adjacent properties under a single permitted structure would allow for greater impact and is essential to the success of the project. A public-facing restoration project, like this pilot living shoreline project on private property, has a potential impact through visibility and accessibility, as well as impact for habitat and marsh health.

Partnerships: TOKI, Conservancy, Resort, Developer, and private landowners



Above: A group of marsh-front property owners as pictured in this aerial photo of a residential area in Beaufort illustrates a similar condition to that found on Kiawah Island. While homeowners enjoy their privacy and individual ownership, the marsh itself is a feature that connects all adjacent properties,

both in its benefits and its growing challenges. This management plan recommends the coordination of a large-scale marsh restoration project that invites buy-in from multiple consecutive landowners in order to achieve a maximum effect.



RECOMMENDATION: RESTORE

Recommendation: Assess feasibility and conceptual design of a large-scale community-administered shoreline stabilization project (2-3 years)

Justification: Areas of Kiawah Island have been losing ground to erosion, which will only worsen with sea level rise. A large-scale public shoreline stabilization project with marsh elements could bolster the erosion-mitigating potential of the marsh.

Implementation: Beachwalker Park lost between 70 and 100 feet of land as a result of Hurricane Matthew in 2016, and continues to lose ground through tidal and flooding-related erosion along the Kiawah River. TOKI's emergency beach access road is compromised and may soon be impassible. This location is a public site with interest from multiple stakeholders with buy-in, will, and capacity to complete the restoration, who can offer access the site for restoration activities.

Partnerships: Charleston County Park and Recreation Commission, Developer



Figure 11 - Erosion along the Kiawah River near Beachwalker Park.
Credit: Biohabitats, Inc.



Left: The causeway entrance to Kiawah Island is experiencing significant degradation due to erosion caused by trampling. Over time, and coupled with SLR, the parkway infrastructure could be compromised by a sharp decline in marsh health, accelerating erosion. Management techniques could include the thoughtful design of public access (e.g. boardwalk or fenced path), paired with the use of previously detailed restoration techniques, such as revegetation and living shoreline.



Left: Mingo Point was identified as a hot spot of concern due to erosion occurring along the bank of the Kiawah River. While erosion on the outside bank of a stream is natural, in this location it could eventually undercut the road and parking infrastructure, as it has at Beachwalker Park. As seen on previous pages, there are a suite of management techniques that could be used here, including Envirolok and other nature-based bank stabilization designs.

Below: Beachwalker Park presents an extreme case of bank erosion and loss of marsh. Because the steepness of the bank and presence of parking lot limits the marsh from migrating eastward as the river naturally shifts, the marsh is disappearing in this location. Recommended treatment here includes removing part of the parking lot to re-grade the bank and use Envirolok and similar bank stabilization.



Next Steps

It is important to capitalize on the momentum and discussion from this planning process as soon as possible. As described above, creating a forum for discussion and agreement (KIIEEC) is an immediate need. Within that framework, the next steps should include rigorous focus on actionable

steps for marsh protection. The following recommendations have active partnerships or a foundation that raises them to the fore of immediate consideration.

FIRST IMPLEMENTATION PRIORITIES

The overarching recommendation of this plan is to create a forum for organizational collaboration among entities in the Kiawah Island Inter-Entity Executive Committee (KIIEEC).



MONITOR: Develop scope of work for Kiawah Conservancy's baseline monitoring efforts.



PROTECT: Consolidate and propose revisions to marsh-related elements of Town Code.



ENGAGE: Formalize KIIEEC and schedule outreach activities over the 18-month time horizon



RESTORE: Take action to manage marsh access and erosion near the causeway entrance (page 39).

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