Squeezed between rising seas and landward development, many of New Hampshire’s tidal wetlands, including salt marshes, are in danger of disappearing. Deciding how to protect them requires the ability to conduct “apples to apples” comparisons of marshes across the coastal landscape. The New Hampshire Salt Marsh Plan was designed to meet that need, and this user guide can help you put the Plan to work for the state’s marshes. You can use the Plan, along with your community’s values and priorities, to protect, restore, or study salt marshes.

The Plan includes an online geospatial planning tool that ranks a marsh’s resilience according to its condition, vulnerability to sea level rise, and potential for adaptation, which generates specific management recommendations. These rankings can help identify which sites are most vulnerable or adaptable to rising seas—critical information for investments in efforts to conserve or restore these precious resources.
CONTENTS

3 About the Plan
4 A Snapshot of New Hampshire Salt Marsh Resilience
7 Creating the Plan
9 Putting the Plan to Work
19 Looking Ahead

Suggested citation
The New Hampshire Salt Marsh Plan is not intended to fit neatly in a binder or sit on a shelf. It is an integrated set of products and tools to support policy making, restoration, and conservation of New Hampshire’s salt marshes. The Plan is comprehensive in its geographic scope, the breadth of partners who created it, and the ways you can apply it or combine it with other analyses.

The Plan originates from a geospatial analysis that is comparable across wetland sites. The data driving its underpinning analyses range from the local and site specific (e.g., ditches or tidal restrictions) to the widely available (e.g., land use data for impervious surfaces). The Plan uses 19 metrics to rank a wetland’s current condition, vulnerability to sea level rise, and adaptation potential. These rankings allow you to categorize wetlands and generate specific recommendations for their management.

You can use the Plan to compare the resilience of salt marshes, locate those for which a particular management tool may be most effective, and assess the potential return on investment of different strategies. Combined with local knowledge and other data, the Plan is a powerful tool to guide future decisions affecting the state’s marshes.

Why we created the Plan

Along New Hampshire’s 326-mile tidal shoreline, tidal wetlands, and their constituent habitat salt marshes, are a precious resource. They buffer against storm surge, reduce erosion, fortify upland property, improve water quality, create habitat for fish and wildlife, provide recreation opportunities, and support local economies. Unfortunately, as the rate of local sea level rise accelerates, marshes that can’t keep pace will be lost. Those that can migrate to higher ground may be blocked by steep slopes, development, or infrastructure that alters the flow of water and sediment they need to survive.

In the context of changing sea levels and precipitation patterns, understanding a marsh’s ability to sustain itself relative to the larger landscape can help us preserve it and the benefits it provides. Yet, we often lack the information about marsh resilience we need to decide how best to apply finite resources for conservation and restoration. Communities, planners, and conservation organizations can spend hundreds of thousands of dollars on projects without a systematic way of comparing marshes to support their decisions. This plan can help.

The team

An extensive network of partners collaborated to create, test, and refine this Plan. They included a wide range of academic, municipal, agency, and non-profit experts and New Hampshire citizens (See page 19). The New Hampshire Department of Fish and Game and the Great Bay National Estuarine Research Reserve led the Plan’s development, with support from the New Hampshire Coastal Program and the National Oceanic and Atmospheric Administration’s Office for Coastal Management.
Information about salt marsh resilience can help us invest strategically in actions to restore and protect marshes that are likely to persist and provide benefits over time. The *New Hampshire Salt Marsh Plan* highlights which marshes are likely to adapt to sea level rise, and how that relates to models of where marshes are likely to migrate in the future.

The team used the Plan’s framework to calculate an overall resilience score for each of the state’s salt marshes (see Figure 1 and 2). The most resilient sites are in the Hampton Seabrook Estuary, along the Atlantic Coast, and on the Squamscott River in Great Bay. These wetlands are fairly large with a greater percentage of high marsh, indicating good condition. They also have relatively large adjacent spaces into which marshes could expand as seas rise, indicating high potential for adaptation. Some of the least resilient are the narrow fringing marshes along Great Bay and the Cocheco River. Dominated by a single low marsh grass, these wetlands have more bare patches and little space to migrate. The Plan allows you to zoom and pan an area of interest, compare marshes, and see the extent of their projected migration space (shown in purple in Figure 1). Ensuring that the migration space around a resilient marsh remains undeveloped can help these marshes expand inland as seas rise.

**A SNAPSHOT OF NEW HAMPSHIRE SALT MARSH RESILIENCE**

Figure 1. Overall marsh resilience scores for tidal wetlands across the New Hampshire Coastal Zone.
Figure 2. The marsh in Stratham (above) has high resilience because it has a large and intact high marsh plain, minimal signs of invasives or ditching, and a relatively natural buffer area. The Durham marsh (below) is less resilient due to its relative lack of habitat diversity, its erosion and fragmentation, and its low-lying location.
A marsh’s overall resilience score is based on its current condition (CC), vulnerability to sea level rise (VL), and adaptation potential (AP). Knowing a wetland’s score can inform its management (Figure 3, Table 1). For example, if you are interested in restoration, these scores allow you to identify marshes with a single issue to address (e.g., to facilitate migration) and could benefit from strategic intervention. Others (e.g., those for which a two-stage restoration is necessary) may require more expensive, invasive management action.

Table 1. Total area, number of marsh units, and average resilience score for marshes that fall into each management category.

<table>
<thead>
<tr>
<th>Management category</th>
<th>Elements of resilience</th>
<th>Number of marsh units</th>
<th>Total marsh area (acres)</th>
<th>Average resilience score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation priority</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>43</td>
</tr>
<tr>
<td>Improve condition</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>34</td>
</tr>
<tr>
<td>Reduce vulnerability</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>29</td>
</tr>
<tr>
<td>Facilitate migration</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>17</td>
</tr>
<tr>
<td>Two-stage restoration necessary</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>23</td>
</tr>
<tr>
<td>Limit investment</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>6</td>
</tr>
<tr>
<td>Statewide Totals</td>
<td></td>
<td></td>
<td></td>
<td>224</td>
</tr>
</tbody>
</table>
The New Hampshire's Salt Marsh Plan is based on a national analysis that ranked salt marsh resilience to sea level rise across broad landscapes with similar land use, land cover, and hydrology characteristics. That analysis defined “resilience” as an integrative measure of a marsh’s capacity to persist in place, or migrate to another location, as rates of sea level rise accelerate. It combined 13 GIS-based metrics of current marsh conditions, vulnerability to sea level rise, and adaptation potential to rank marsh units from the least to the most resilient.

Using high-resolution land cover data from NOAA’s Coastal Change Analysis Program (C-CAP), we mirrored the national analysis to create GIS layers for New Hampshire’s tidal wetlands. Then we downscaled the national study’s core metrics to use local data sets where available and added new and locally relevant metrics, such as the presence of invasive species, berms, and ditches. We also translated the rankings into specific management recommendations for each salt marsh and created a platform for conducting ongoing technical assistance to use the science.

Defining marsh units

The first step in the Plan’s development was to establish a spatial unit of analysis. We created 224 marsh units by delineating “similar” areas of marsh based on the nearest neighbor clustering of NOAA’s high resolution tidal wetland habitat data. The initial systematic analysis produced over 900 marsh units; the technical advisory team reviewed these to create units that are locally relevant and of a suitable size for project planning. From that foundation, we analyzed the current conditions, vulnerability to sea level rise and adaptation potential of individual marsh units—the scale at which land managers make decisions. We then used the scores to categorize the marsh units and identify the most relevant management options for each category. Finally, we designed a field assessment protocol that allows users to consider aspects of a site that are too small to detect with GIS or are non-spatial in nature, such as public access or importance as a cultural resource.

Three elements of marsh resilience

- **Current marsh conditions**
  A marsh that is in good condition has a healthy and diverse plant community with minimal signs of human impact within or surrounding the marsh.

- **Vulnerability to sea level rise**
  A marsh that has low vulnerability to sea level rise sits higher within the tidal prism and has soils that are less susceptible to erosion and degradation as seas rise.

- **Adaptation potential**
  A marsh with high adaptation potential will remain physically connected to other marshes and has space to migrate inland as seas rise.

Identifying management options

When overall resilience is broken down into the elements of current conditions, vulnerability to sea level rise, and adaptation potential, different combinations of marsh conditions emerge, each with its own set of management options. The team generated eight categories of marshes and developed a management rationale or goal for each. Through meetings and workshops with land protection, restoration, and state and municipal policy experts, we identified specific management actions that could increase marsh resilience. With the input of the technical advisory team, we determined which management actions would be likely to succeed in each marsh category.
Metrics derived from local data
With input from the technical advisory team, we identified local data sets and metrics for each element of resilience. (See Table 2.) We worked together to combine these metrics into a model, generate a score for each element, and calculate an overall resilience score for each marsh unit.

Table 2. Metrics used to calculate each marsh unit’s resilience. Access a full explanation of each metric in the Plan’s Data Notes.

**CURRENT CONDITION**

- **Marsh area / edge length** (core/edge): a larger marsh with less edge means less exposure and higher resilience.
- **Unvegetated / vegetated area** (UVVR): fewer unvegetated areas indicate higher resilience.
- **Percent impervious cover** within the 150 meter buffer of each marsh unit: less impervious cover indicates less potential for runoff and higher resilience.
- **Percent natural cover** within the 150 meter buffer of each marsh unit: a more naturally vegetated buffer indicates higher resilience.
- **Percent agricultural cover** within 150 meter buffer of each marsh unit: less agriculture in the buffer indicates lower potential for runoff and higher resilience.
- **Number of rare plants and animals** within the marsh unit: more rare species correspond with higher resilience.
- **Estimated nitrogen loading** to the marsh (kg/yr): less nitrogen inputs increases resilience.
- **Linear feet of ditching** per marsh unit area (ditch density): fewer man-made ditches indicate higher resilience.
- **Percentage of the marsh with Phragmites**: less of this invasive indicates higher resilience.
- **Habitat diversity** (based on Shannon diversity index): a diversity of habitat types indicates higher resilience.
- **Proportion of migration spaces with berms**: fewer man made berms along the marsh boundary indicate higher resilience.

**VULNERABILITY TO SEA LEVEL RISE**

- **Erodibility of soils** within each marsh unit: less susceptibility to erosion indicates higher resilience.
- **Mean tidal range** for each marsh unit: a larger tidal range corresponds with higher resilience.
- **Percentage of marsh below Mean Higher High Water** (MHHW): less area below MHHW indicates higher resilience.
- **Percentage of marsh below Mean Tide Level**: less area below Mean Tide Level indicates higher resilience.

**ADAPTATION POTENTIAL**

- **Percent of marsh shoreline that is hardened**: less armoring along the shoreline indicates higher resilience.
- **Amount of migration space** with 1.5 meters of sea level rise: a marsh with more low lying buffer areas into which it can migrate as seas rise will have higher resilience.
- **Connectedness of marsh units**: as a marshs’ shapes changes with sea level rise, those units that stay more physically connected to other marshes have higher resilience.
- **Sinuosity of shoreline**: an intricate shoreline with lots of inlets and variable physical characteristics provides diverse habitat options and distributes flooding in a way that increases resilience.
PUTTING THE PLAN TO WORK

You can use the New Hampshire Salt Marsh Resilience Plan to support a range of efforts to manage and protect New Hampshire's tidal wetlands. This section outlines each of the Plan’s core products, how you can use them, and case studies for their application.
PUTTING THE PLAN TO WORK

New Hampshire Salt Marsh Viewer

The New Hampshire Salt Marsh Plan—its resilience scores, underlying metrics, and summary products—are available through an interactive map viewer with a number of useful features.

- **Interactive map:** This displays resilience scores and allows users to zoom and pan to find wetlands of interest.
- **Marsh attributes:** From the map, you can click on a marsh to get more details about that site, including the metrics used to calculate resilience score, which can guide marsh management.
- **Summary findings:** Within the viewer, you can find summary results for individual towns and the state and find the most and least resilient marshes within an area of interest.
- **Background:** You can also find links to related reports and background information, including the marsh management options table, the technical user guide, marsh profiles, and other specific tools for assessing and enhancing marsh resilience.

Using the Viewer

Resource managers and scientists can use the Viewer to identify suitable locations for field testing of restoration or adaptation techniques. For example, a researcher interested in testing a new technique for restoring agricultural ditches can use the Viewer to locate marshes with low current condition scores, and from among these, identify sites with a high density of ditches. The Viewer also can help locate sites that represent a diversity of conditions or that have other characteristics that facilitate research, such as proximity to a road.

Land managers working in New Hampshire Fish and Game are using the Viewer to review permit applications to confirm a proposed location for a restoration or research project is appropriate. They might, for example, feel more comfortable approving a pilot project for a risky experimental technique in a marsh that is in poor condition and has low overall resilience. Or, the agency might want to confirm that a large-scale investment in restoration is directed at wetlands that have high adaptation potential and are likely to persist as the climate changes.

Figure 5. Online interface for the New Hampshire Salt Marsh Viewer.
PUTTING THE PLAN TO WORK

Marsh Management Options Table

Using drawings of different marshes, Table 4 (next page) illustrates how to interpret a marsh’s unique combination of resilience scores and identify actions to help sustain it. The Table also explains the reasoning behind specific management notes provided for individual wetlands in the Viewer and Marsh Profiles.

You can use the Marsh Management Options Table as a high-level framework for identifying strategies based on a site’s physical setting and ecology. Before determining a course of action, it is critical to do a field assessment of the marsh of interest and consider local factors that influence its management, such as community priorities for the area.

Using the Table

You can use this Table in two ways. First, if you are interested in a specific marsh, you can review its resilience scores and then consult the Table to select appropriate management actions. Alternatively, you may be interested in a specific management technique, such as facilitated migration or ditch remediation. You also can use the Table to find the combination of resilience scores for which that technique is likely to be effective and then use the Viewer to find marshes that meet that criteria.

One strategy for sustaining a marsh is to protect adjacent land so that it can expand inland as seas rise. However, permanently conserving natural buffer areas can be expensive, so it is strategic to invest in marshes that are more likely to adapt and persist over time.

<table>
<thead>
<tr>
<th>Management category</th>
<th>Elements of resilience</th>
<th>Conservation score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CC VL AP</td>
<td></td>
</tr>
<tr>
<td>Conservation priority</td>
<td>High Low High</td>
<td>5</td>
</tr>
<tr>
<td>Improve condition</td>
<td>Low Low High</td>
<td>3</td>
</tr>
<tr>
<td>Reduce vulnerability</td>
<td>High High High</td>
<td>3</td>
</tr>
<tr>
<td>Facilitate migration</td>
<td>High Low Low</td>
<td>1</td>
</tr>
<tr>
<td>Two stage restoration necessary</td>
<td>High High Low</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Low Low Low</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Low High High</td>
<td>1</td>
</tr>
<tr>
<td>Limit investment</td>
<td>Low High Low</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3. Resilience of marsh units explored by the Seabrook Hampton Estuary Alliance.

For example, the Seabrook Hampton Estuary Alliance wanted to support their efforts to protect natural areas around the Estuary using a data driven and easy to explain process. They used the Table and resilience scores to prioritize parcels for conservation in and around marshes with high or moderate resilience (Figure 6 and Table 3). These would be most likely to persist, migrate inland, continue to support fish and wildlife, and provide the biggest return on investment. With a shorter list of priority parcels, the Alliance has been able to help towns approach landowners and seek funding for land conservation.
Management Options to Maximize Marsh Resilience

Table 4 (below) summarizes management options based on a marsh’s Current condition (CC), Vulnerability to relative sea level rise (VL), and Adaptation potential (AP). Options are considered from an ecological, rather than socioeconomic, perspective. Green text indicates a positive condition, red reflects a negative one. Marshes that required two-stage restoration have two resilience categories that are impaired so are likely to need more costly solutions.

<table>
<thead>
<tr>
<th>Elements of Marsh Resilience</th>
<th>Interpretation of this Management Category</th>
<th>Management Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong> Low <strong>High</strong></td>
<td>A marsh in good condition that will migrate inland naturally over the long-term.</td>
<td><strong>Prioritize conservation:</strong> Allow marsh to self maintain. Fee or conservation easement purchase of marsh or migration space. Managed relocation of structures in marsh or migration space.</td>
</tr>
<tr>
<td><strong>Low</strong> Low <strong>High</strong></td>
<td>A marsh in poor condition that is not currently vulnerable to sea level rise and has potential to migrate inland naturally.</td>
<td><strong>Improve condition:</strong> Prioritize established restoration techniques. Decrease current stressors to marsh e.g., <em>Phragmites</em> or invasive crab control. Mitigate water quality issues in surrounding watershed, e.g., reduce fertilizer application in residential and agricultural areas.</td>
</tr>
<tr>
<td><strong>High</strong> <strong>High</strong> <strong>High</strong></td>
<td>A marsh in good condition that will adapt if it can out-pace current vulnerability to sea level rise.</td>
<td><strong>Reduce vulnerability:</strong> Increase sediment supply to current marsh footprint though strategies like thin layer sediment placement and removal of barriers to hydrologic flow within the marsh.</td>
</tr>
<tr>
<td><strong>High</strong> Low <strong>Low</strong></td>
<td>A marsh in good condition that cannot maintain its current footprint long-term without active management.</td>
<td><strong>Facilitate migration:</strong> Enhance marsh adaptation potential. Remove infrastructure or topographical barriers to inland migration. Protect marsh’s current footprint.</td>
</tr>
<tr>
<td><strong>High</strong> <strong>High</strong> <strong>Low</strong></td>
<td>A marsh in good condition but also vulnerable to sea level rise and cannot maintain current footprint without active management.</td>
<td><strong>Two-stage restoration necessary:</strong> Implement thin layer sediment placement, but only if barriers to inland migration are removed first. Two marsh resilience categories are deficit likely making projects more costly.</td>
</tr>
<tr>
<td><strong>Low</strong> Low <strong>Low</strong></td>
<td>A marsh in poor condition not currently vulnerable to sea level rise, but cannot maintain current footprint without intervention.</td>
<td><strong>Two-stage restoration necessary:</strong> Apply proven restoration techniques within current marsh footprint, e.g., invasive species management, but only if removal of barriers to migration are planned. Two marsh resilience categories are deficit likely making projects more costly.</td>
</tr>
<tr>
<td><strong>Low</strong> <strong>High</strong> <strong>High</strong></td>
<td>A marsh in poor condition that has potential to migrate inland naturally, if it can out-pace sea level rise.</td>
<td><strong>Two-stage restoration necessary:</strong> Apply proven restoration techniques within current marsh footprint that ideally also increase sediment supply to marsh, e.g. ditch remediation, tidal crossing restoration.</td>
</tr>
<tr>
<td><strong>Low</strong> <strong>High</strong> <strong>Low</strong></td>
<td>A marsh in poor condition marsh that will not persist in the future.</td>
<td><strong>Limit investment:</strong> Marsh will likely disappear so test innovative science, abandon marsh or implement highly engineered solution: Limit investment in land protection or restoration activities as effectiveness will be relatively short-term.</td>
</tr>
</tbody>
</table>

This table summarizes management options based on a marsh’s Current condition (CC), Vulnerability to relative sea level rise (VL), and Adaptation potential (AP). Options are considered from an ecological, rather than socioeconomic, perspective. Green text indicates a positive condition, red reflects a negative one. Marshes that required two-stage restoration have two resilience categories that are impaired so are likely to need more costly solutions.
PUTTING THE PLAN TO WORK

Marsh Profiles

Within the New Hampshire Salt Marsh Plan’s data viewer, you can select a site and review its Marsh Profile—a succinct summary of its resilience and the data used to calculate the scores. In some cases, the Profile includes notes on actions that could help sustain the marsh based on its resilience scores and underlying characteristics. You can download a Marsh Profile to send it via email, discuss it at a meeting, or include it as part of a grant or permit application.

How to use the Salt Marsh Profiles

These Profiles can help municipalities, land managers and residents protect individual marshes in many ways. Land use boards have found it helpful to review a relevant Profile when considering an application for a development project that would impact a tidal wetland or its buffer area. For example, development adjacent to a healthy, resilient marsh could be particularly damaging if not sited and designed carefully. Or, one can combine the Viewer and a Profile to determine if a proposed development falls within an area likely to transition to salt marsh as seas rise, making structures built in that area more likely to experience tidal flooding in the future. You also can use the Profiles to justify a land use decision and rally support for a marsh.

Land managers can use the Profiles to identify specific restoration and adaptation strategies that maximize marsh resilience. For example, marshes with low current conditions could be restored through hydrological improvements, ditch remediation, or invasive species removal. Alternatively, a marsh with high vulnerability to sea level rise and high adaptation potential could be treated with experimental techniques such as thin layer placement of sediment, which raises the level of the marsh surface.

By exploring the metrics used to calculate a marsh’s resilience, one can further refine a restoration plan. For example, when considering thin layer placement, you could look at the metric “percentage of the marsh below mean higher high water (MHHW).” A marsh that is almost all below MHHW might need feet of additional sediment to keep up with sea level rise and be too costly to consider, while a site that is mostly above MHHW may be more feasible to restore. You can access a customized summary of a marsh and its management options by contacting the Great Bay National Estuarine Research Reserve, www.greatbay.org.

Figure 7. Marsh Profile for Sagamore Creek.
PUTTING THE PLAN TO WORK

GIS Data Layers and Notes

The Plan’s GIS Data Layers and Notes provide detailed explanations of the datasets and methods used to calculate the marsh resilience scores. The Data Notes explain how individual datasets, such as ditch density or marsh edge sinuosity, were calculated and weighted in the analysis of each of the resilience scores. The scores, as well as some of the spatial metrics used to calculate them, are available through New Hampshire’s geospatial data repository, GRANIT. These GIS layers can be downloaded and used in customized analyses. See Data Notes for the NH Salt Marsh Plan

Using the GIS Data Layers and Notes

Experienced users can download and use the GIS results for their own analyses or create custom products and evolve them over time. For example, The Nature Conservancy used the resilience scores, along with a suite of other metrics, to identify regionally important conservation opportunities for the 2021 New Hampshire Coastal Watershed Conservation Plan. They identified salt marshes with a high resilience score, along with any undeveloped buffer areas, as “resilient marsh areas” that should be prioritized when identifying conservation focus areas. In many cases, these resilient marshes provide other services—such as preserving wildlife or storing flood waters—elevating their importance in conservation planning.

This example illustrates how the resilience metrics are shaping marsh conservation priorities in New Hampshire. Land trusts, conservation organizations, and municipalities now use the 2021 New Hampshire Coastal Watershed Conservation Plan to help focus and align land protection efforts in the region. To learn more about this application of the Plan, see www.connect-protect.org.

Figure 8. Data from the NH Salt Marsh Plan helped identify priority areas for conservation. See: www.connect-protect.org.
PUTTING THE PLAN TO WORK

Site Level Planning Tools

Through the New Hampshire Salt Marsh Viewer, restoration practitioners and natural resource managers can access other tools to help them further explore the conditions and needs of a particular marsh. On the Background tab in the Viewer, there are links to the following tools.

- **Field assessment check-list**: this provides a set of criteria that should be considered and measured to supplement information provided by the New Hampshire Salt Marsh Viewer.
- **Land use policy guide**: This builds on the Marsh Management Options Table and provides further guidance on policies that are most important to consider in different situations.
- **Restoration planning guide**: This complementary guide also builds on the Marsh Management Options Table and provides further guidance on specific restoration techniques and adaptation practices that are most suitable depending on the attributes of a marsh.

**Using the Site Level Planning Tools**

Land stewardship specialists at Great Bay National Estuarine Research Reserve use the Site Level Planning Tools to conduct field assessments and select appropriate management actions. For example, they found one Great Bay marsh to be in good current condition with low vulnerability to sea level rise, but also low adaptation potential. Biologists looked carefully at the spatial metrics of the site through the Viewer and then used the checklist to guide a field assessment. They found the gently sloping topography could enable the marsh to migrate inland, but barriers exist that may slow or impede this transition.

One of the Tools—the Restoration Planning Guide—provided specific recommendations for management actions based on the site’s resilience scores and other metrics. The field visit indicated that land between the wetland and upland may need to be re-graded to facilitate the movement of marsh plants inland, illustrating how the Plan can help identify places where migration barriers could be softened or removed with minimal impact on infrastructure.

**Figure 9. Site level planning tools can be accessed through the background tab of the Viewer.**
As part of Plan development, all of New Hampshire’s tidal wetlands were organized into discrete, cohesive marsh units. Each has somewhat unique characteristics with logical boundaries; such as a road, creek or a habitat transition; and a consistent number and name that has been reviewed by the management community. (These methods are explained in detail in the Plan’s Data notes, at www.greatbay.org/salt-marsh-plan.) The current size of the marsh units (25 acres, on average) is suitable for regional planning, however the project team will be working to divide them into smaller units to better facilitate parcel level decisions in the future.

Using Marsh Units
Multiple agencies are using the marsh units to organize monitoring and tracking of marshes over time. The New Hampshire Coastal Program is using the marsh units to plan an expanded monitoring program so they visit a range of tidal wetlands across the region each year. In addition, they use the marsh unit naming system to organize several types of data, (e.g., permits, restoration projects, and monitoring) to enable them to easily cross-reference information. For example, you can combine field data and the marsh resilience scores in an analysis to evaluate restoration projects and determine why certain techniques worked better in one location than another.
Technical Assistance

Staff from the Great Bay National Estuarine Research Reserve are available to provide technical assistance to municipalities, restoration practitioners and others interested in using the New Hampshire Salt Marsh Plan for land use, conservation, restoration, or research planning. Technical assistance can include conversations to discuss the data and the implications or the development of a customized map or analysis to support planning. These maps can help you communicate an important threat or opportunity related to the marshes you care about. Or, we can help scientists design monitoring and research projects that advance our understanding of how quickly we are seeing changes to our marshes and why.

Accessing Technical Assistance

The Great Bay Reserve team customizes maps and develops narrative explanations that communities can use to support a municipal Master Plan or a Natural Resource Inventory. A summary of the resilience scores for all the marshes in a municipality can guide discussions and planning for land conservation, open space plans, and targeted restoration to address vulnerabilities.

For example, the Town of New Castle requested assistance during their Master Plan update process. The Reserve provided custom maps to help identify high quality marshes for continued protection and areas where marshes are likely to expand with sea level rise and would therefore benefit from an expanded buffer to protect the marsh and the surrounding community.

Municipalities and others interested in technical assistance should contact the Great Bay Reserve.

Figure 11. A map of marsh resilience, prepared for New Castle’s master plan.
LOOKING AHEAD

The New Hampshire Salt Marsh Plan is a starting point. It is a way to think collectively about how to sustain and restore salt marshes holistically and spark conversations about how to take strategic action. However, after exploring the maps, the analyses, the Marsh Profiles, and the management options you need to get dirty. You need to get in the field, take measurements, talk to landowners, and think hard about the social impacts of any interventions and potential confounding impacts to adjacent natural systems.

The Great Bay National Estuarine Research Reserve plans to use the Plan’s tools and products in ways that advance our own science, monitoring, and stewardship activities in partnership with our colleagues at the New Hampshire Coastal Program. Over time, we will add to the data and update the GIS viewer when needed. As we all move forward, please know that we are a resource for anyone in New Hampshire who wants to work alongside us to maintain our marshes.

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LEARN MORE

• Explore the results, access the viewer and download related products from: www.greatbay.org/salt-marsh-plan

• Download the data from GRANIT

• Learn more about a national scale analysis of marsh resilience.

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The New Hampshire Salt Marsh Plan Team

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Brianna Fischella, Coastal Research Specialist, Great Bay NERR  
Kirsten Howard, Coastal Resiliency Specialist, New Hampshire Coastal Program  
David Justice, GIS Analyst, University of New Hampshire  
Julie LaBranche, Senior Planner, Rockingham County Planning Commission  
Fay Rubin, NH GRANIT Project Director, University of New Hampshire

**TECHNICAL ADVISORY TEAM**

Peter Britz, Director of Planning and Sustainability, City of Portsmouth  
Matt Craig, Habitat Program Manager, Casco Bay Estuary Partnership  
Alyson Eberhardt, Extension Specialist, University of New Hampshire  
Joanne Glode, Southern NH Stewardship Ecologist, The Nature Conservancy, NH Chapter  
Duane Hyde, Land Conservation Director, Southeast Land Trust of New Hampshire  
Trevor Mattera, Habitat Program Manager, Piscataqua Region Estuaries Partnership  
Slade Moore, Habitat Restoration Coordinator, Maine Coastal Program  
Nancy Pau, Wildlife Biologist, United States Fish and Wildlife Service  
Kristen Puryear, Ecologist, Maine Natural Areas Program  
Brooke Smart, Resource Conservationist, USDA Natural Resource Conservation Service  
Michael Routhier, Information Manager, Earth Systems Research Center, University of New Hampshire  
Suzanne Schull, GIS Specialist, Padilla Bay National Estuarine Research Reserve  
Rob Vincent, Research Coordinator, MIT Sea Grant College Program