

# **ADVANCING COASTAL RESILIENCE: AN INSTITUTIONAL ANALYSIS OF LIVING SHORELINES IN NEW HAMPSHIRE**

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## TABLE OF CONTENTS

ACKNOWLEDGMENTS .....	ii
LIST OF FIGURES .....	v
LIST OF TABLES .....	vi
LIST OF ACRONYMS .....	vii
ABSTRACT .....	ix

### CHAPTER 1: INTRODUCTION

1.1 Significance .....	1
1.2 How Resilience Theory Affected Coastal Management Paradigms .....	4
1.2.1 Engineering Resilience & the Conventional Paradigm of Coastal Management .....	4
1.2.2 Ecological Resilience & Adaptive Management .....	5
1.2.3 Evolutionary Resilience & Social-Ecological Systems .....	7
1.3 Research Design & Methodology .....	11
1.3.1 Research Question .....	11
1.3.2 Research Design .....	11
1.3.2.1 Institutional Analysis and Development Framework .....	12
1.3.2.2 Social-Ecological System Resilience Framework .....	15
1.3.3 Interview Methods .....	16
1.3.4 Focus Group Methods .....	17
1.3.4.1 Wagon Hill Farm .....	18
1.3.4.2 Cutts Cove .....	19
1.3.5 Data Analysis Methods .....	20
1.3.6 Review of General Barriers & Opportunities .....	21
1.4 Thesis Outline .....	23

### CHAPTER 2: LIVING SHORELINE POLICY IN NEW HAMPSHIRE

2.1 Introduction .....	25
2.2 Who Are the Actors & What Are Their Positions? .....	25
2.3 What Rules Do Actors Follow to Make Decisions? .....	28
2.4 What Are the Patterns of Interaction Between Actors? .....	38
2.5 Analysis .....	42
2.5.1 Actors .....	43
2.5.2 Rules .....	45
2.5.3 Patterns of Interaction .....	54
2.6 Discussion .....	59

### CHAPTER 3: WAGON HILL FARM, NH

3.1 Site Description & Background .....	61
3.2 Who Are the Actors & What Are Their Positions? .....	65
3.3 What Rules Do Actors Follow to Make Decisions? .....	68
3.4 What Are the Patterns of Interaction Between Actors? .....	69
3.4.1 Funding .....	71
3.4.2 Data Collection .....	72
3.4.3 Permitting & Regulatory Requirements .....	73

3.4.4 Outreach & Public Engagement .....	75
3.5 Data & Analysis .....	76
3.5.1 Technical & Physical .....	78
3.5.2 Financial & Resource .....	80
3.5.3 Legal & Regulatory .....	84
3.5.4 Community & Planning .....	86
3.6 Discussion .....	89
CHAPTER 4: CUTTS COVE, NH	
4.1 Site Description & Background .....	92
4.1.1 Sarah Mildred Long Bridge Project .....	94
4.1.2 Market Street Gateway Park .....	94
4.2 Who Are the Actors & What Are Their Positions? .....	95
4.3 What Rules Do Actors Follow to Make Decisions? .....	97
4.4 What Are the Patterns of Interaction Between Actors? .....	97
4.4.1 Funding .....	98
4.4.2 Data Collection .....	101
4.4.3 Permitting & Regulatory Requirements .....	101
4.4.4 Outreach & Public Engagement .....	102
4.5 Data & Analysis .....	102
4.5.1 Technical & Physical .....	104
4.5.2 Financial & Resource .....	106
4.5.3 Legal & Regulatory .....	109
4.5.4 Community & Planning .....	111
4.6 Discussion .....	113
CHAPTER 5: ANALYSIS AND RECOMMENDATIONS	
5.1 Comprehensive Analysis .....	116
5.2 Resilience Analysis .....	119
5.3 Recommendations .....	125
APPENDICES	
A – IRB Approval .....	130
B – IRB Renewal .....	131
C – Interview Protocol .....	132
D – Wagon Hill Farm Focus Group 1 Agenda .....	134
E – Wagon Hill Farm Focus Group 2 Agenda .....	135
F – Cutts Cove Focus Group Agenda .....	136
G – Cutts Cove Qualtrics Survey .....	137
H – General Barriers & Opportunities Matrix .....	138
REFERENCES .....	140

## LIST OF FIGURES

Figure 1.1: Adaptive management cycle, as seen in Nyberg (1999)

Figure 1.2: A conceptual framework for the interconnection of an SES, adapted from Folke (2006)

Figure 1.3: The internal structure of the action situation, as seen in Ostrom (2011)

Figure 1.4: Positions of 30 interview participants

Figure 1.5: Positions of 19 focus group participants

Figure 2.1: Actors commonly involved in a living shoreline permitting process, classified by their role and organizational scale or jurisdiction

Figure 2.2: Permitting requirements of a living shoreline in NH and the actors that receive them

Figure 2.3: Permitting process of a living shoreline in NH

Figure 2.4: Identified policy barriers and opportunities to suitable living shoreline implementation

Figure 3.1: Site of the planned living shoreline at Wagon Hill Farm, Durham

Figure 3.2: Map of Wagon Hill Farm; Source: Ibis Wildlife Consulting

Figure 3.3: Actors included on the Wagon Hill Farm Living Shoreline Workgroup, classified by their role and organizational scale or jurisdiction

Figure 3.4: Overhead view of the planned Wagon Hill Farm living shoreline site and reference marsh with the historic shoreline from 1992 outlined in pink

Figure 3.5: The Wagon Hill Farm process map with steps identified as barriers (red) and opportunities (blue) by focus group participants

Figure 4.1: Site of the living shoreline in Cutts Cove, Portsmouth

Figure 4.2: The USS Albacore is moved through Cutts Cove. Source: <http://www.ussalbacore.org>

Figure 4.3: Rip-rap along the southern shoreline in Cutts Cove

Figure 4.4: Conceptual design of the riverfront park, as seen in RSG & Richardson & Associates (2013)

Figure 4.5: Actors included on the Cutts Cove living shoreline project team, classified by their role and organizational scale or jurisdiction

Figure 4.6: The Cutts Cove process map with steps identified as barriers (red) and opportunities (blue) by focus group participants

## LIST OF TABLES

Table 1.1: Variables of the IAD Action Situation

Table 1.2: Factors of an SES and their effect on resilience

Table 1.3: Wagon Hill Farm focus group participants

Table 1.4: Cutts Cove focus group participants

Table 1.5: Inter-coder Reliability and Agreement

Table 1.6: Barriers and opportunities to the broad implementation of living shorelines as identified in the literature, and organized by categories adapted from Clean Water America Alliance (2011)

Table 2.1: Policy barriers and opportunities of a living shoreline implementation process as identified by interview participants, and organized by categories adapted from Clean Water America Alliance (2011)

Table 3.1: Participants of the first Wagon Hill Farm living shoreline meeting

Table 3.2: Wagon Hill Farm Living Shoreline Workgroup participants as of January 2017

Table 3.3: Participants of the first Wagon Hill Farm focus group

Table 3.4: Process map of the Wagon Hill Farm living shoreline project as described by focus group participants

Table 3.5: Participants of the second Wagon Hill Farm focus group

Table 3.6: Barriers and opportunities of the Wagon Hill Farm living shoreline implementation process as identified by focus group members, and organized by categories adapted from Clean Water America Alliance (2011)

Table 4.1: Cutts Cove living shoreline project team as of February 2017

Table 4.2: Cutts Cove focus group participants

Table 4.3: Process map of the Cutts Cove living shoreline project as described by focus group participants

Table 4.4: Barriers and opportunities of the Cutts Cove living shoreline implementation process as identified by focus group members, and organized by categories adapted from Clean Water America Alliance (2011)

Table 5.1a: Comparison of barriers and opportunities identified from the literature and the NH case study

Table 5.1b: Comparison of barriers and opportunities identified from the literature and the NH case study

Table 5.2a: NH Barriers and opportunities that correspond to SES low resilience factors

Table 5.2b: NH Barriers and opportunities that correspond to SES high resilience factors

## LIST OF ACRONYMS

AM: Adaptive Management

ARM: Aquatic Resource Mitigation

CAW: New Hampshire Coastal Adaptation Workgroup

CIP: Capital Improvement Program

Corps: U.S. Army Corps of Engineers

CRS: Community Rating System

CWA: Clean Water Act

DHR: New Hampshire Division of Historic Resources

DPW: Department of Public Works

EPA: U.S. Environmental Protection Agency

FHWA: Federal Highway Administration

FWS: U.S. Fish & Wildlife Service

GBNERR: Great Bay National Estuarine Research Reserve

GDP: Gross Domestic Product

GP: General Permit

IAD: Institutional Analysis and Development

IP: Individual Permit

NH CRHC: New Hampshire Coastal Risk and Hazards Commission

NH: New Hampshire

NHB: New Hampshire Natural Heritage Bureau

NHCP: New Hampshire Coastal Program

NHDES: New Hampshire Department of Environmental Services

NHDOT: New Hampshire Department of Transportation

NHPA: National Historic Preservation Act of 1966

NMFS: NOAA National Marine Fisheries Service

NWP: Nationwide Permit

PCN: Pre-Construction Notification

PGP: Programmatic General Permit

PREP: Piscataqua Region Estuaries Partnership

R&C: Review & Compliance

RPR: Request for Project Review

SELT: Southeast Land Trust

SES: Social-Ecological System

SHPO: State Historic Preservation Office

SLR: Sea-Level Rise

SRP: Seacoast Reliability Project

SRPC: Strafford Regional Planning Commission

SV: Self-Verification

TNC: The Nature Conservancy

UNH: University of New Hampshire

USDOT: U.S. Department of Transportation



## ABSTRACT

Flooding, costal erosion, and storm surge pose immediate and increasing risks to our nation's coasts. In response, both federal and state environmental and natural resource agencies are calling for strategies to promote coastal resilience, such as living shorelines. Living shorelines are shoreline stabilization and restoration techniques that aim to reduce damage from erosion and storms and promote ecosystem functions. Despite policies promoting living shorelines, there are significant challenges to implementing living shorelines in the state of New Hampshire. In order to foster the implementation of living shoreline projects, New Hampshire's Department of Environmental Services Coastal Program and New England coastal state partners are collaborating in a regional research project, *High Resolution Coastal Inundation Modeling and Advancement of Green Infrastructure and Living Shoreline Approaches in the Northeast*, funded through a NOAA Regional Coastal Resilience Grant. Using statewide stakeholder interviews, case-specific focus groups, and document analysis, this research contributes to the larger, regional effort by analyzing the institutional barriers and opportunities to implementing living shorelines in New Hampshire.

Institutional barriers in New Hampshire include the lack of an actor responsible for shoreline management planning, and wetlands rules that classify dual purpose projects into single purpose categories and encourage in-kind replacement of failing grey infrastructure. Institutional opportunities include a wetlands permitting system that creates norms for practice, and opportunities for pre-application and ongoing project meetings with regulators and other stakeholders. This research then applies the lens of social-ecological resilience theory to develop recommendations about which barriers and opportunities should be priorities for institutional change to promote coastal resilience in New Hampshire.

## **Chapter 1: Introduction**

### **1.1 Significance**

Coastal communities around the nation face immediate and increasing risk due to the cumulative effects of climate change and sea-level rise (SLR). In some areas, the occurrence of flooding has increased by as much as 925% since 1960 (NOAA, 2014), and the costs of damage from and adaptation to storm surge and SLR are estimated to be upwards of \$990 billion through 2100 (Neumann et al., 2015). These trends and projections encompass a significant social and economic threat to coastal counties, which represent less than 10% of the total land area of the contiguous United States, yet are home to nearly 40% of the U.S. population, have a population density four times the national average, and generate 45% of the country's Gross Domestic Product (GDP) (NOAA, 2013b). In the Northeast region alone, coastal counties account for 66% of the population and 71% of the GDP of those states (National Ocean Economics Program, 2015; NOAA, 2013a). In response to these changing conditions and growing hazards, both federal and state environmental and natural resource agencies are calling for the prioritization of approaches that foster coastal resilience, such as living shorelines (e.g. (NH CRHC, 2016; NHDES, 2015a; President's Task Force, 2014)).

Living shorelines are shoreline stabilization and restoration techniques that aim to reduce damage from erosion and storms and promote ecosystem functions. Also referred to as green or soft shorelines, natural and nature-based features, or natural or hybrid infrastructure, living shorelines incorporate native vegetation and other natural elements, either alone or in combination with harder, stabilizing structures, and maintain the continuity of the natural land-water interface (NOAA, 2015; RAE, 2015; SAGE, 2015). Living shorelines have been shown to reduce wave energy, trap sediments, decrease erosion, and provide the services of a functioning

ecosystem, while enhancing coastal resilience (NOAA, 2015; SAGE, 2015). Living shorelines are recognized as providing benefits, including stabilizing shorelines and protecting nearby communities from coastal hazards. For example, research by Gedan et al. (2011) found living shorelines significantly attenuate wind, wave, and storm surge energy, reducing property damage and human death. Similarly, Arkema et al. (2013) modeled SLR scenarios to quantify risk along the nation's shoreline and determined living shorelines significantly protect the country's most vulnerable populations from coastal hazards.

New Hampshire's (NH) policies clearly identify living shorelines as a priority shoreline management approach. Beginning with the 2014 NH Shoreline Management Conference, the NH Coastal Program (NHCP), the Great Bay National Estuarine Research Reserve (GBNERR), the NH Coastal Adaptation Workgroup (CAW), and other partner organizations have engaged in collaborative discussions about strategies to promote coastal resilience. The *2016 Coastal Zone Management Act Section 309 Assessment* identified the following goal for the NHCP's five-year strategy update:

Develop and provide guidance for shoreline protection strategies that consider climate change impacts and protect ecosystem services, including natural flood protection and habitat, and identify potential demonstration sites for living or soft shorelines. (NHDES, 2015, p. 75)

In 2013 the NH legislature established the NH Coastal Risk and Hazards Commission (NH CRHC) to, "recommend legislation, rules, and other actions to prepare for projected sea level rise and other coastal and coastal watershed hazards such as storms, increased river flooding, and storm water runoff, and the risks such hazards pose to municipalities and state assets in New Hampshire" (Senate Bill 163, 2013). One of the Commission's recommendations for reducing the vulnerability of natural resources is to "[e]ncourage state agencies and municipalities to consider ecosystem services provided by natural resources in land use planning, master plans,

and asset decisions” by “explor[ing] options to minimize shoreline hardening and promot[ing] natural or hybrid shoreline protection strategies” (NH CRHC, 2016, p. 62). Since 2013, NH towns are authorized to include in their master plans management provisions to respond to projected coastal risks due to increased frequency of storm surge, flooding, and inundation (Senate Bill 164, 2013). Some NH towns, including Rye, Seabrook, and Dover, have or are in the process of including climate change considerations to their master plans. For example, the Town of Seabrook’s Master Plan Chapter 9 addresses Coastal Hazards and Adaptation and includes the recommendation to identify eroding and unstable shorelines and prioritize areas for nature-based approaches (Town of Seabrook, 2016).

Despite clear state-wide policy priorities promoting living shorelines, there are barriers to implementing living shorelines in NH and elsewhere. In order to better understand state-specific institutional challenges to and opportunities for fostering implementation of living shoreline projects, NHCP and partners in other New England coastal states are collaborating in a regional research project, *High Resolution Coastal Inundation Modeling and Advancement of Green Infrastructure and Living Shoreline Approaches in the Northeast*, funded through a NOAA Regional Coastal Resilience Grant. The following research is part of this larger, regional effort.

The subsequent sections of this chapter will: first, describe the relevance of resilience theory for coastal management; second, explain our research design, including our research objectives, analytic framework, data collection methods, and data analysis; and, finally, review the literature on general barriers and opportunities to the broad development and utilization of living shorelines.

## **1.2 How Resilience Theory Influences Coastal Management**

The concept of resilience has long been used to describe the ability to bounce back from shock or disturbance. In many ways, our understanding of disturbance and resilience has shaped how many fields have tried to manage for unpredictable events throughout the years (Davoudi, 2012). However, since the middle of the twentieth century, the theory of what resilience is and how it relates to disturbance has been changing, and, with it, our perceptions of how best to manage dynamic systems that regularly experience the effects of stressors. This section will describe that change and how it has affected our approach to coastal management.

### ***1.2.1 Engineering Resilience & the Conventional Paradigm of Coastal Management***

Prior to a major shift in the perspective of resilience in the 1960s and 1970s, the dominant perception of the environment was one of predictable stability. It was widely believed an ecological system inhabited a single, stable state, which it constantly attempted to maintain. Free from the altering effects of external stressors, it was thought the system would continually self-organize back to an expected equilibrium (Berkes, Colding, & Folke, 2003; Davoudi, 2012; Folke, 2006). The concept of resilience as the measure of how fast a system can consistently and predictably return to its single equilibrium is known as engineering resilience (Davoudi, 2012; Folke, 2006; Lloyd, Peel, & Duck, 2013), and methods of promoting this type of resilience centered on the removal of stressors on and disturbance to the system.

Based on the steady-state views and assumptions of engineering resilience, management of resource systems has predominantly sought to remove stress and mitigate change in order to preserve an environment in equilibrium (Folke, 2006), with contemporary institutions developing with the goal of reducing disturbance and uncertainty in natural systems. Institutions, as defined

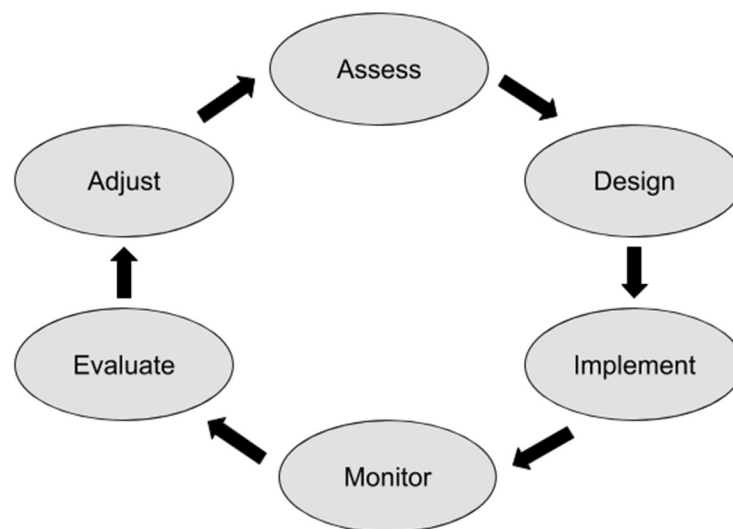
by North (1990), are humanly-devised constraints that shape and establish a stable structure to human interaction. Stability was pursued through top-down resource management and policies, which invested in the simplification and strict control of ecosystem processes (Folke, Olsson, Norberg, & Hahn, 2005; Holling & Meffe, 1996).

The philosophy of predictable stability, from the perspective of engineering resilience, extended to the realm of coastal management and protection, where, over the last few decades, the traditional approach to protecting shorelines has been to “harden” them with seawalls and bulkheads (O’Donnell, 2017; Spalding, Ruffo, et al., 2014; Stancheva et al., 2011). This implementation of “grey infrastructure” sought to maintain a static coastline by separating it from the water, which was seen as an uncertain force of change, and defending it from stressors, such as storm surges and waves (Bilkovic, Mitchell, La Peyre, & Toft, 2017; O’Donnell, 2017). Likewise, institutions of coastal management turned to forms of command-and-control approaches and policies, both regulating and normalizing the use of grey, engineered infrastructure, promoting the effort to reduce disturbance (Holling & Meffe, 1996; Lloyd et al., 2013; SAGE, 2015). Coastal hardening is used as an effort to control coastal dynamics by shielding shorelines and coastal properties from wave energy and predictable environmental conditions. To date, hardening shorelines remains the common solution to coastal protection (Stancheva et al., 2011) and the approach developers are familiar implementing and regulators are familiar permitting (O’Connell, 2010; Sutton-Grier, Wowk, & Bamford, 2015).

### ***1.2.2 Ecological Resilience & Adaptive Management***

Spearheaded by the work of ecologist C.S. Holling in the 1960s and 1970s, the ecological resilience perspective brought about a new way of viewing natural systems. Rather than seeing

the environment as a system to be managed with the goal of maintaining a single equilibrium, the concept of ecological resilience introduced the idea the natural system could exist within multiple possible stable states, and defined resilience as the capability of a system to persist in its current state (Davoudi, 2012; Folke, 2006; Lloyd et al., 2013). This shift in management objectives from managing for a single, predictable equilibrium to managing for multiple, unpredictable equilibria, demanded a new management approach that incorporated system feedback. The process of ecosystem-based adaptive management (AM) was designed to deal with the complexities inherent in natural systems, as well as uncertainty about natural resource management outcomes (Holling, 1978). Adapted and refined (Fig. 1.1), AM is a process for managing complex ecological resource systems, a systematic method of experimenting and learning through implementation and evaluation (Nyberg, 1999; Pratt Miles, 2013). Moreover, AM allows for an iterative progression of solutions for managing natural resources as the system responds to feedback from prior management actions (Berkes et al., 2003).



**Figure 1.1: Adaptive management cycle, as seen in Nyberg (1999)**

It is important to note that, despite a shift in perception from viewing coastal management as an effort to maintain a single state to an effort to maintain a preferred state within multiple possible states, the premise of both the engineering and ecological perspectives of resilience is a belief in stable system equilibria (Davoudi, 2012), which can be successfully maintained through the removal of disturbance. Stress and disturbance on, what can be viewed as a subjectively desirable state, is seen as being external to the system, and able to be separated. Under this premise, the resulting focus of relevant institutions on coastal management is to isolate the land from the water via coastal armoring to mitigate undesirable stress on the terrestrial system. Paradoxically, recent evidence shows how this controlling approach to coastal management actually reduces the adaptive capacity and, ultimately, the resilience of a coastal system (e.g. (Kittinger & Ayers, 2010)).

### ***1.2.3 Evolutionary Resilience & Social-Ecological Systems***

Building on complex systems theory and adaptive management, which emphasize feedback controls, social-ecological systems (SES) theory strives to integrate links between social systems, including human action, institutions, and the use of resources and ecological systems (Fig. 1.2) (Berkes et al., 2003; Berkes & Folke, 1998; Lloyd et al., 2013). According to SES theory, high variability through disturbance and unpredictability is an important driver of learning and adaptation. Additionally, unlike with the engineering and ecological resilience perspectives, disturbance is an inherent and internal element in a resilient system, which should be factored into management rather than separated from it (Berkes et al., 2003; Folke, 2006). As defined in Berkes et al. (2003), resilience is (1) the amount of change a system can experience, while still retaining its same state, functions, and structure; (2) the capability of a system to self-



organize; and (3) the ability to increase the capacity for learning and adaptation. Davoudi (2012) defines this perception of resilience as “evolutionary resilience,” in which a system must learn to adapt and transform in response to inherent stressors. Characterized as a system of ecological and biophysical processes affecting and affected by anthropogenic forces and social institutions, the coastal zone is an example of a linked SES (Kittinger & Ayers, 2010; Lloyd et al., 2013).

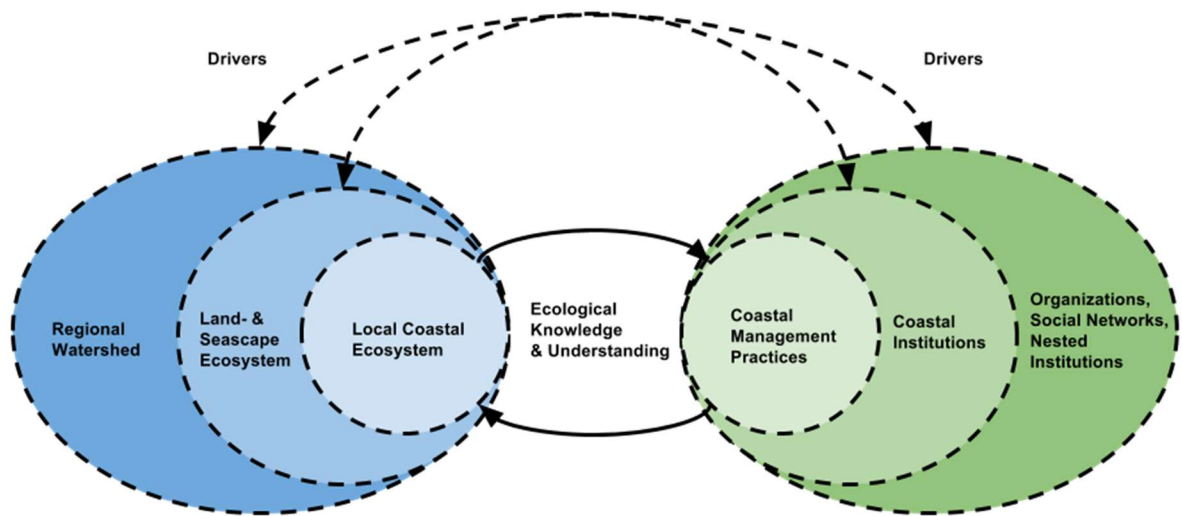


Figure 1.2: A conceptual framework for the interconnection of an SES, adapted from Folke (2006)

Using SES theory, natural resource systems are viewed as complex, unpredictable, and intimately linked with the institutions that manage them. As a result, successful and sustainable management requires a new focus on the factors that affect the overall resilience and adaptability of these systems. Based on the literature, we identify six key SES factors:

***Diversity:*** Representing the variety of elements within systems – both ecological and social – diversity affects the capacity of systems to persist in the face of change (Berkes et al., 2003). Elements can range from approaches to ecological niches to organisms to stakeholders, where a lower diversity offers a more uniform or restricted set of options in each case and a

higher diversity offers a greater amount or more specific options. Higher diversity of elements within a system provides more alternative ways to reorganize and maintain function when the system is faced with disturbance or change, thereby increasing its resilience (Folke, 2006; Folke et al., 2005; Low, Ostrom, Simon, & Wilson, 2003).

**Redundancy:** Redundancy represents the overlap of functional roles that are shared between individual elements within the system. This overlap can occur between roles of actors or organizations within an institution, as well as between roles of organisms in the environment (Folke et al., 2005). Similar to diversity, redundancy enhances the adaptive capacity of a system in the face of disturbance, as a disturbance that affects one element will not necessarily affect that element's role in the system, allowing for a greater chance of self-organization within the system (Folke, 2006; Folke et al., 2005; Low et al., 2003).

**Flexibility:** This represents the ability or willingness of a structure, organization, institution, or ecosystem to deal with, respond to, and shape change, while providing similar functions and remaining in a similar, favorable state (Berkes et al., 2003; Folke, 2006; Folke et al., 2005). The less flexible, and more rigid, an element is, the less likely that self-organization will occur in the face of disturbance or change, reducing system resilience.

**Integration:** Representing the amount of inclusion and association among elements within a system, integration can be observed through a collaborative, multi-stakeholder or public process, as well as through the incorporation of diverse roles or elements in a natural or social system. However, integration also refers to the generation and use of multiple types of information and knowledge systems, including experiential, experimental or local knowledge, as well as how that knowledge is incorporated into institutions (Berkes et al.,

2003; Lloyd et al., 2013). This integration of knowledge is critical for adaptive management and for building social-ecological resilience (Berkes et al., 2003).

***Acceptance of change and uncertainty:*** This factor represents the anticipation of variability, disturbance, and unpredictable events and conditions inherent in complex SESs. Change in a system can be due to dynamic interactions of system elements and feedbacks. Lower acceptance of change and uncertainty through the promotion of policies or approaches that look to lock a system in a static state will end up producing lower system resilience or more severe disturbance. Additionally, a lack of this kind of acceptance can lead to the development of more reactive than proactive measures and policies (Berkes et al., 2003; Lloyd et al., 2013).

***Scale:*** Scale represents the spatial, temporal, or organizational context or scope through which an aspect is being perceived. Both complex systems and institutions are often hierarchical, containing nested subsystems, where the scale and of the analysis or management of such systems must be considered in order to be effective. Likewise, system-wide, cross-scale dynamics, both spatial and temporal, must be acknowledged in order to recognize and successfully manage system feedback (Berkes et al., 2003; Folke, 2007).

As detailed above, SES theory introduced a new perspective on resilience and interconnection between social and ecological systems, which brought about a shift in the factors viewed as important for promoting sustainable resource management. Effective management promotes the integration between dynamic ecological and social systems, where the feedback from one directly affects the other, and accepts the role of disturbance as a necessary driver of adaptability and learning. While engineering and ecological resilience approaches are still prevalent in coastal management, as demonstrated by the increasing level of coastal armoring

(Gittman et al., 2015; Stancheva et al., 2011), the evolutionary approach is influencing policy and the perception of coastal managers. Factors contributing to adoption of the evolutionary approach include emerging evidence of the detrimental effects of grey coastal infrastructure and subsequent loss of system resilience (e.g. (Arkema et al., 2013; Gittman, Scyphers, Smith, Neylan, & Grabowski, 2016; SAGE, 2015; Stancheva et al., 2011)), the reported benefits of natural coastal infrastructure, such as living shorelines, and flexible governance (e.g. (Folke et al., 2005; Spalding, McIvor, et al., 2014; Spalding, Ruffo, et al., 2014)). This research focuses on understanding how institutions of coastal management are currently constructed in NH and how they affect the implementation of living shorelines.

### **1.3 Research Design & Methodology**

#### ***1.3.1 Research Questions***

1. How do coastal management institutions inhibit or facilitate the implementation of living shorelines in NH?
2. How do opportunities and barriers to the implementation of living shorelines in NH correspond to SES factors identified in the literature as promoting and limiting resilience?

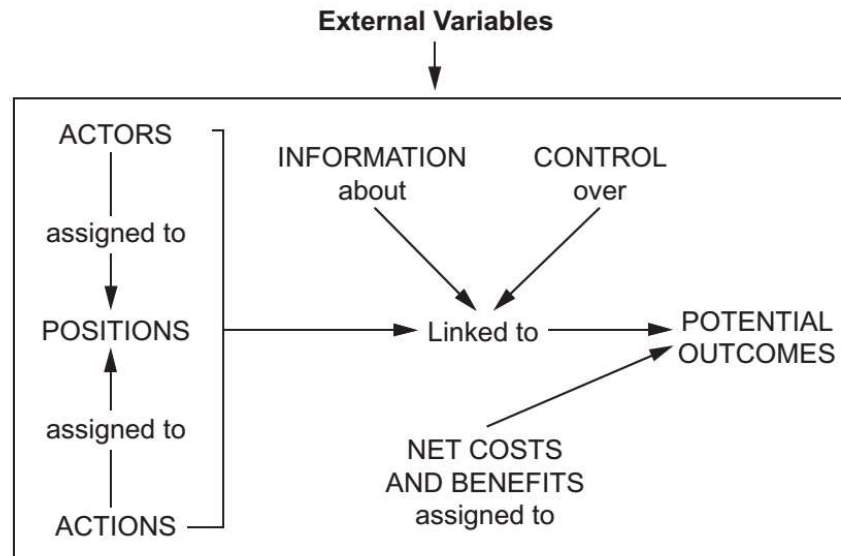
#### ***1.3.2 Research Design***

This research project is an in-depth case study of living shoreline implementation in NH, with two specific living shoreline projects serving as subcases. A case study is an appropriate design for the comprehensive, qualitative analysis of contemporary conditions and events, where those conditions cannot be manipulated (Yin, 2009). The state level case study analyzes the broader NH institutional environment for implementing living shorelines, while two subcases

provide specific implementation examples. We used a mixed-methods approach to gather qualitative data, which included document review, semi-structured stakeholder interviews and focus groups with living shoreline project teams. We analyzed the data using the Institutional Analysis and Development (IAD) framework to identify institutional opportunities and barriers (Research Question 1) and the SES Resilience Framework to determine how those identified institutional characteristics corresponded to factors of SES resilience (Research Question 2).

#### ***1.3.2.1 Institutional Analysis and Development Framework***

Commonly employed to evaluate institutions of natural resource and common-pool resource management, Ostrom's IAD framework is well-suited for the analysis of coastal management. Within the IAD framework, an "action situation" is identified as an analytic conceptual unit that can be used to explain patterns of behavior and decision-making within an institution (Ostrom, 2007, 2011; Ostrom, Cox, & Schlager, 2014). For example, the process for permitting a living shoreline project is an action situation. The structure of the action situation is described using a cluster of variables that include 1) the set of actors, 2) the positions to be filled by participants, 3) the set of allowable actions and their linkages to outcomes, 4) potential outcomes that are linked to actions, 5) the level of control each participant has over choice, 6) the information available to the actors, and 7) the costs and benefits assigned to actions and outcomes (Fig. 1.3). Based on the literature, we defined these seven IAD variables and how they apply to coastal management (Table 1.1).



**Figure 1.3: The internal structure of the action situation, as seen in Ostrom (2011)**

The IAD framework is widely used by researchers but is also known for a lack of guidance on how to define and apply its variables (Schlager & Cox, 2018). For this research we, therefore, used the list of seven variables to define three questions for analysis:

1. Who are the actors involved in implementing living shorelines and what are their positions? This question addresses the “set of actors”, “positions”, and “level of control over choice and decision” variables.
2. What rules do actors follow in order to make decisions? This question addresses the “set of allowable actions” and “potential outcomes”. “Information available” and “costs and benefits of actions and outcomes” are also addressed to the extent rules govern what information and costs and benefits can be considered in decisions.
3. What are the patterns of interaction between actors? This question focuses analysis on elements of several IAD variables related to decision-making practices, such as “set of allowable actions” and “level of control over choice and decisions”.

**Table 1.1: Variables of the IAD Action Situation**

<b>Variable</b>	<b>Definition</b>
<b>Set of Actors</b>	The number of and specific individuals or organizations acting upon and within the SES. The participants of this study are those acting upon coastal management projects and decisions in coastal NH.
<b>Positions</b>	The roles of the actors within the action situation. This includes both an individual's position within an organization, as well as the individual and organization's role within the greater SES. In the case of coastal management, these roles can include decision-makers, project planners, regulators and permittees, project developers, etc.
<b>Set of Allowable Actions</b>	Methods, technologies, and behaviors that are acceptable and can be used based on rules, restrictions, and positions within the institution. Within the SES of coastal management, this can include examples such as permissible projects or activities along a coastline, or authorized responsibilities in a position. Actions that do not fall into this category would be identified as disallowed actions within the same institution.
<b>Potential Outcomes</b>	The possible results that actors' decisions and actions have upon the system, and the region, events and elements that are affected by those decisions and actions.
<b>Level of Control over Choice and Decision</b>	Authority or capacity of actors to act by their own volition without the conference and/or approval of others. Examples of this variable could be observed through an organization having a strictly advisory role and not being able to implement projects directly, or with a project that first requires permitting approval.
<b>Information Available</b>	The quantity, quality and type of information that actors within the SES have about the system that they are acting upon, about how their actions and the actions of others affect the system, and about the costs and benefits of those actions and outcomes. This information can come from different sources such as local knowledge and experience, experimentation or observations from within the system, and external sources.
<b>Costs and Benefits of Actions and Outcomes</b>	The costs and benefits of various actions and their associated outcomes can be economic, social, and/or environmental. For example, a method of coastal protection may initially cost less money to implement than another method (economic cost), and the perceived protection may cause the land behind it to become a popular gathering place (social benefit), but the structure itself may harm nearby coastal habitat (environmental cost). There may be differing costs and benefits among interrelated actors and groups, as well.

Allowable actions and control over decisions are determined by the rules that actors must follow, while those rules along with the information available to actors and the costs and benefits of potential outcomes help to shape the patterns of interaction between actors in the action situation. Grouping variables in this way can assist in isolating perceived opportunities or barriers in a process and help to better focus recommendations for positive change.

#### ***1.3.2.2 Social-Ecological System Resilience Framework***

Using the six factors identified from the literature that affect the resilience of SESs (see Section 1.2.2), we designed the following framework (Table 1.2) to organize data in relation to system resilience. System characteristics, such as identified barriers or opportunities to living shoreline implementation, are classified as to which factor(s) they correspond with through use of the definitions in Section 1.2.2. They are then organized as to how, according to the literature, they promote either a relatively low or high level of resilience in a system.

This framework will be used to answer our second research question, and exhibit whether characteristics that promote higher system resilience also correspond with opportunities to living shoreline implementation, and characteristics that promote lower system resilience also correspond with barriers to living shoreline implementation.



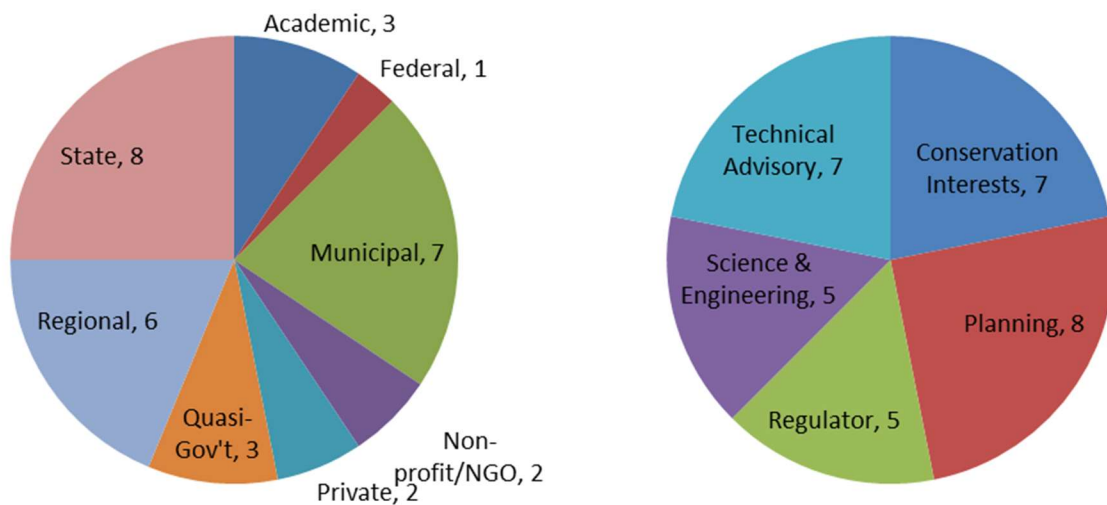
**Table 1.2: Factors of an SES and their effect on resilience**

SES Factors	Low Resilience	High Resilience
<b>Diversity</b>	<ul style="list-style-type: none"> <li>• Uniform/consistent approaches</li> <li>• Little ecological variety in species/functional groups/habitats</li> <li>• Restricted set of stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>• Site-specific/tailored approaches</li> <li>• Large ecological variety in species/functional groups/habitats</li> <li>• Diverse set of stakeholders</li> </ul>
<b>Redundancy</b>	<ul style="list-style-type: none"> <li>• Unique functionality among system elements, actors, and roles</li> </ul>	<ul style="list-style-type: none"> <li>• Functional overlap among system elements, actors, and roles</li> </ul>
<b>Flexibility</b>	<ul style="list-style-type: none"> <li>• Command-and-control regulations and policies</li> <li>• Strict or rigid structure and organization</li> <li>• Suppression of disturbance or change</li> </ul>	<ul style="list-style-type: none"> <li>• Structure that includes social or regulatory mechanisms that allow for learning and ways to respond to and shape change</li> <li>• Utilization of an AM approach</li> </ul>
<b>Integration</b>	<ul style="list-style-type: none"> <li>• Little stakeholder or public participation, interaction, or collaboration</li> <li>• Siloed information gathering</li> <li>• Little cross-discipline knowledge or interaction</li> </ul>	<ul style="list-style-type: none"> <li>• Broad stakeholder and public participation, interaction, and collaboration</li> <li>• Generation and use of multi-discipline qualitative, quantitative, and local knowledge</li> </ul>
<b>Acceptance of Change and Uncertainty</b>	<ul style="list-style-type: none"> <li>• Reactive</li> <li>• Assumes predictable and linear system interactions</li> <li>• Little response to system feedbacks</li> </ul>	<ul style="list-style-type: none"> <li>• Proactive</li> <li>• Anticipates and responds to unpredictable and dynamic system interactions and feedbacks</li> </ul>
<b>Scale</b>	<ul style="list-style-type: none"> <li>• Centralized governance</li> <li>• Narrow temporal or spatial perspectives</li> </ul>	<ul style="list-style-type: none"> <li>• Multi-level or poly-centric governance</li> <li>• Long-term and system-wide perspectives</li> </ul>

### ***1.3.3 Interview Method***

Semi-structured interviews were conducted with 30 individual stakeholders from July 2016 to September 2017. Participants were selected through both a purposive expert sampling method and a snowball sampling method to represent a range of professionals that could be directly involved in living shoreline projects in NH (Figure 1.4). The interview protocol asked participants to speak about their perspectives on living shoreline use and implementation, including perceived benefits, barriers, and possible solutions to barriers (Appendix C).

Researchers with interviewing experience provided input into the design of the interview protocol, which was tested and slightly revised based on feedback from two interviewees. The test interviews were included in the data set due to the quality of the data and due to time constraints. Interviews lasted from 45-90 minutes and were conducted in person and on the phone, and were audio recorded. Written notes were also taken.

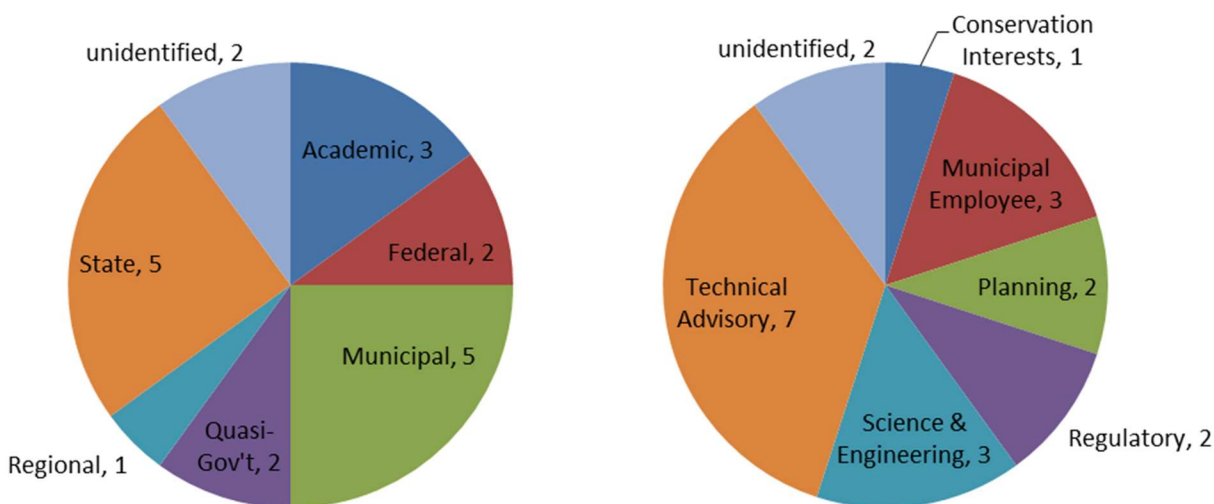


**Figure 1.4: Positions of 30 interview participants.** As two participants each held two positions, the above charts show the combined total of 32 positions.

### 1.3.4 Focus Group Methods

Three focus groups were held between February 2 and March 21, 2017 for the two living shoreline project subcases. Two focus groups were held for the project team implementing a living shoreline at Wagon Hill Farm in Durham, NH and one focus group was held for the project team implementing a living shoreline at Cutts Cove in Portsmouth, NH. All project team members were invited to participate in the focus groups. Out of the 31 project members across the two subcases, 19 participated. Their positions are displayed in Figure 1.5. Focus group participants were asked to describe the process of project implementation, then identify and discuss opportunities, barriers, and potential solutions to barriers. Focus group process agendas

were reviewed during their design by individuals with prior focus group experience and amended based on feedback (Appendix D-F). Focus groups were audio recorded to ensure accuracy and written notes were taken.



**Figure 1.5: Positions of 19 focus group participants. As one participant held two positions, the above charts show the combined total of 20 positions.**

#### ***1.3.4.1 Wagon Hill Farm***

The first Wagon Hill Farm focus group was held on February 2, 2017 with 11 of the 19 project members invited (Table 1.3). Participants described the steps of the project's implementation process, which were captured roughly chronologically on banner paper. These data were later thematically and chronologically organized to create a process map of the project's implementation.

The second focus group was held on February 7, 2017 with nine project members, including one new participant who did not attend the first focus group. On supplied worksheets, participants listed up to three barriers and up to three opportunities they perceived in the implementation process. They then placed sticker dots, which were color-coded for barriers and opportunities, on the steps of the process map they associated with the barrier or opportunity.

Participants then engaged in a facilitated conversation of process steps that received the most dots and discussed potential solutions to identified barriers.

Both focus groups lasted for 60 minutes and took place during regular project team meetings held at the Durham Town Hall.

**Table 1.3: Wagon Hill Farm focus group participants**

<sup>1</sup>: Attended first focus group only; <sup>2</sup>: Attended second focus group only

<b>Name</b>	<b>Title</b>	<b>Organization</b>
Tom Ballestero	Associate Professor	University of New Hampshire
Melinda Bubier	ARM Fund Program Restoration Specialist	NHDES Wetland Mitigation Program
David Burdick	Associate Professor	University of New Hampshire
Rachel Gasowski <sup>1</sup>	Parks & Recreation Director	Town of Durham
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Kevin Lucey	Restoration Coordinator	NH Coastal Program
Mike Lynch	Public Works Director	Town of Durham
Gregg Moore	Associate Professor	University of New Hampshire
Kyle Pimental	Principal Regional Planner	Strafford Regional Planning Commission
Lori Sommer <sup>1</sup>	Mitigation Coordinator	NHDES Wetland Mitigation Program
Todd Selig <sup>2</sup>	Town Administrator	Town of Durham
<i>anonymous<sup>1</sup></i>	<i>unidentified</i>	<i>unidentified</i>

#### ***1.3.4.2 Cutts Cove***

The Cutts Cove focus group was held on March 21, 2017 with 13 of the 23 project members invited (Table 1.4). Time constraints restricted the research to a single focus group. Therefore, an online Qualtrics survey was used to gather preliminary data to create a draft process map in advance (Appendix G). The survey was distributed to all 23 invited participants. Six participants completed the survey and one corresponded directly by email to explain their role and responsibility with the project. The survey responses were thematically and chronologically organized to create a preliminary process map of project implementation. Participants at the focus group reviewed and amended the process map. The focus group then

followed the same process used in the second Wagon Hill Farm focus group, with participants identifying barriers and opportunities, individually associating these with specific process steps, discussing process steps with the most barriers and opportunities identified by all, and brainstorming potential solutions to barriers.

The focus group lasted for 80 minutes and took place during a regular project team meeting held at the NH Department of Environmental Services (NHDES) Portsmouth Office.

**Table 1.4: Cutts Cove focus group participants**

<b>Name</b>	<b>Title</b>	<b>Organization</b>
Peter Britz	Environmental Planner	City of Portsmouth
Melinda Bubier	ARM Fund Program Restoration Specialist	NHDES Wetland Mitigation Program
David Burdick	Associate Professor	University of New Hampshire
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Mike Johnson	Marine Habitat Resource Specialist	NOAA National Marine Fisheries Service
Ruth Ladd	Policy and Technical Support Branch Chief	US Army Corps of Engineers
Steve Miller	Conservation Commission Chair	City of Portsmouth
David Price	East Region Inspector	NHDES Wetlands Bureau
Lori Sommer	Mitigation Coordinator	NHDES Wetland Mitigation Program
Christos Tsiamis	Community Engagement Specialist	Great Bay National Estuarine Research Reserve
<i>anonymous</i>	<i>unidentified</i>	<i>unidentified</i>
<i>anonymous</i>	<i>unidentified</i>	<i>unidentified</i>
<i>anonymous</i>	<i>unidentified</i>	<i>unidentified</i>

### ***1.3.5 Data Analysis Methods***

A codebook was developed with preset codes based on the variables of the IAD framework (Table 1.1) and SES resilience factors (Table 1.2) identified in the literature, as well as codes based on emergent themes from the data. The codebook was developed and tested with two other researchers to determine inter-coder reliability and agreement (Table 1.5). Inter-coder reliability was tested twice with each researcher separately and once with both researchers together. Additionally, the reliability of the first coding was calculated after the enactment of expanded unitization of codes, increasing reliability by as much as 24%, and demonstrating the

issues of unitization seen in Campbell et al. (2013). Subsequent testing, after reconciliation of disagreement and codebook revisions, produced inter-coder reliability of 45.7% to 50.2% for primary and secondary codes, and 48.8% to 52.9% for primary codes alone, with inter-coder agreement of 92% to 94%. According to Campbell et al. (2013), this was an exceptional level of inter-coder agreement and an acceptable level of reliability for this exploratory research.

**Table 1.5: Inter-coder Reliability and Agreement**

	Researcher 1			Researcher 2			Researcher 1 & 2	
	Reliability		Agreement	Reliability		Agreement	Reliability	
	All Codes	Primary Codes		All Codes	Primary Codes		All Codes	Primary Codes
<b>First Coding</b>	40.6%	45.1%	94.5%	35.2%	35.2%	94.3%	31.2%	34.4%
<b>Expanded Unitization</b>	42.9%	47.4%		59.3%	59.3%			
<b>Second Coding</b>	50.2%	52.9%	94.0%	45.7%	48.8%	92.0%		

Interviews were transcribed. Interview data were coded and analyzed following the approaches described in Campbell et al. (2013) and Ritchie & Spencer (1994), through the use of NVivo qualitative coding software. Using the described frameworks in Section 1.3.2 Research Design, interview data were analyzed for themes of how current institutional elements affected the conditions that contribute to the successful management of SESs for resilience.

### ***1.3.6 Review of General Barriers & Opportunities***

While the goal of this research is to identify barriers and opportunities to living shoreline implementation specific to NH, several studies and reports, such as those from Clean Water America Alliance (2011), the Engineer Research and Development Center (ERDC) (2015), Restore America's Estuaries (RAE) (2015), Systems Approach to Geomorphic Engineering (SAGE) (2015) and Sutton-Grier et al. (2015), have identified general barriers and opportunities to their broad implementation as a coastal management technique. Using an adaptation of the

categorical organization presented by Clean Water America Alliance (2011), we classified these general barriers and opportunities from the literature under one of the following four themes (Appendix H):

***Technical/Physical:*** Characteristics having to do with aspects such as the technical design and standards, required environmental conditions, provided benefits, or physical attributes of living shoreline projects.

***Financial/Resource:*** Characteristics having to do with the financial or resource costs and benefits of living shorelines, including time, capacity, and funding sources.

***Legal/Regulatory:*** Characteristics having to do with the rules, regulations, and policies surrounding living shoreline implementation, as well as characteristics of those positions that apply and enforce them.

***Community/Planning:*** Characteristics having to do with the social aspects of living shorelines, including community planning, public perceptions and communication, and municipal decision-making.

We use the framework adapted from Clean Water America Alliance (2011) because, not only can it effectively encompass all the identified system characteristics under one of the four categories, but we believe this organization will prove to be useful for practitioners focusing on finding solutions for specific barriers in specific sectors.

To reduce duplication across references, we identified discrete barriers and opportunities and compiled them on Table 1.6, to create a comprehensive overview of the system characteristics in the literature. This analysis shows that general technical and physical barriers to living shoreline implementation center around a lack of information and knowledge of design, performance, and feedbacks, while opportunities include benefits of hybrid approaches, as well

as knowledge gaps that will be filled with demonstration projects. Financial and resource barriers include the lack of funding, a lengthy timescale required for establishing and testing approaches, and financial risk and uncertainty, while benefits suggest the creation of new incentives and funding sources, and the generation and use of knowledge in financial decision-making. Legal and regulatory barriers focus on a challenging and inhibitive permitting process, and on current policies that promote the status quo of traditional grey infrastructure. Similar to financial opportunities, regulatory opportunities focus on the creation and sharing of knowledge to better guide decision-making. Lastly, community and planning barriers are primarily identified as a lack of communication and coordination among stakeholders, as opportunities focused on creating partnerships and knowledge. Overall, the sources identified many more barriers, as compared to opportunities, to living shoreline implementation, which may reflect the focus of many reports on identifying barriers.

Data from Table 1.6 will be compared against barriers and opportunities specific to NH cases as part of a comprehensive analysis in Chapter 5.

## **1.4 Thesis Outline**

The following chapters are organized as follows: Chapter 2 describes living shoreline policy in NH, analyzing perceived barriers and opportunities. Chapter 3 and Chapter 4 analyze the Wagon Hill Farm and Cutts Cove living shoreline project implementation processes respectively. Chapter 5 provides a comprehensive analysis and discussion, analysis of barriers and opportunities compared to SES resilience, recommendations, and concluding thoughts.



**Table 1.6: Barriers and opportunities to the broad implementation of living shorelines as identified in the literature, and organized by categories adapted from Clean Water America Alliance (2011). 1 – (ERDC, 2015); 2 – (Gedan et al., 2011); 3 – (Clean Water America Alliance, 2011); 4 – (RAE, 2015); 5 – (SAGE, 2015); 6 – (Sutton-Grier et al., 2015)**

	<b>Barriers</b>	<b>Opportunities</b>
<b>Technical/ Physical</b>	<ul style="list-style-type: none"> <li>• Lack of design standards and best practices<sup>3,6</sup></li> <li>• Techniques have variable levels of performance or success<sup>5,6</sup></li> <li>• Not practical in all situations due to landscape restrictions or environmental conditions<sup>1,5,6</sup></li> <li>• Hybrid systems can still have some negative ecological impacts<sup>6</sup></li> <li>• Regulators and developers are still learning how to design projects<sup>5</sup></li> <li>• Lack of technical knowledge or experience<sup>3</sup></li> <li>• Lack of data and understanding of the provided benefits and co-benefits<sup>1,2,3</sup></li> <li>• Difficulty quantifying and communicating the benefits and co-benefits<sup>1</sup></li> <li>• Uncertainty in risk due to lack of technical knowledge or experience<sup>5</sup></li> <li>• Uncertainty regarding the performance, timing, and scale needed to provide a certain amount of coastal protection<sup>1,6</sup></li> <li>• Uncertainty regarding the effects of climate change and SLR on performance<sup>1</sup></li> <li>• Uncertainty in feedbacks in the overall sediment system, and resulting effects and consequences<sup>5</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Hybrid approaches can be used in areas where there is limited space<sup>6</sup></li> <li>• Hybrid approach can aid coastal habitat restoration by temporarily reducing disturbance and protecting natural infrastructure in its more vulnerable early stages<sup>6</sup></li> <li>• Innovation in hybrid designs where natural and built infrastructure are combined to capitalize on the strengths of both while aiming to minimize the weaknesses of each<sup>2,6</sup></li> <li>• Demonstration projects and case studies provide opportunities for experimentation, allowing stakeholders to learn the best practices and uses, and to resolve some of the uncertainties<sup>1</sup></li> <li>• Development of risk and resilience performance metrics to consider processes and outputs across a range of scales, including at the scale of the overall system<sup>1</sup></li> </ul>
<b>Financial/ Resource</b>	<ul style="list-style-type: none"> <li>• Lack of funding for implementation<sup>3</sup></li> <li>• Difficulty synchronizing funding sources, budgets, &amp; schedules<sup>1</sup></li> <li>• Public funds often require permit compliance and cost-sharing<sup>1,5</sup></li> <li>• Lack of funding for adaptive management<sup>1</sup></li> <li>• Lack of data and understanding of the economic costs and benefits<sup>1,3,6</sup></li> <li>• Too much financial risk, without enough incentives<sup>3</sup></li> <li>• Uncertainty regarding the lifecycle costs needed to operate and maintain<sup>1</sup></li> <li>• Time required to develop and test new living shoreline techniques<sup>5</sup></li> <li>• Time required for the natural systems to provide the necessary level of coastal protection<sup>6</sup></li> <li>• Uncertainty of the lifecycle costs needed to implement, operate, &amp; maintain<sup>1,3</sup></li> <li>• Site-specific decision-making overlooks system-wide benefits to other constituencies, and imposes costs on the property owner<sup>4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Leverage partnerships and funding to promote and incentivize the use of living shorelines in support of community resilience<sup>1</sup></li> <li>• Offer incentives through programs such as FEMA's CRS and NOAA's CELCP, or through Corps cost sharing ratio<sup>1</sup></li> <li>• Generation of a compilation of information on the ecosystem goods and services and quantify their value<sup>1</sup></li> <li>• Development of a consistent set of metrics to effectively monetize ecosystem goods and services and incorporate consideration of them into project cost-benefit analyses<sup>1</sup></li> </ul>
<b>Legal/ Regulatory</b>	<ul style="list-style-type: none"> <li>• Projects require decisions made by both Federal and State regulatory agencies<sup>1</sup></li> <li>• Rules and regulations at all levels can be conflicting, restrictive, or lacking<sup>3</sup></li> <li>• Living shoreline use is heavily influenced by regulatory decisions<sup>1</sup></li> <li>• Existing regulatory process is based on traditional hardening techniques, and these methods are often easier to permit<sup>4,5,6</sup></li> <li>• Permitting processes can be lengthy and challenging<sup>5</sup></li> <li>• The federal regulatory regime has perpetuated the status quo bias in favor of hardening shorelines<sup>4</sup></li> <li>• Construction schedule restrictions can restrict or preclude living shoreline implementation<sup>1</sup></li> <li>• Both NEPA and Municipal policies can inhibit the application of adaptive management<sup>1</sup></li> <li>• Lack of policies that support efficient coordination and decision making for living shoreline projects<sup>1</sup></li> <li>• Existing regulatory schemes fail to adequately consider system-wide impacts or benefits of coastal management decisions<sup>4</sup></li> <li>• Projects are permitted on a case-by-case basis precluding the development of comprehensive programmatic, regional, landscape, or system-focused projects<sup>1</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Development of policies to achieve robust coordination and data sharing among resource and planning agencies<sup>1</sup></li> <li>• Development of guidance documents and criteria that facilitate science-based decision-making for regulatory agencies<sup>1</sup></li> </ul>
<b>Community/ Planning</b>	<ul style="list-style-type: none"> <li>• Lack of system-wide planning tools necessary for the proper evaluation of individual coastal management decisions<sup>1,4</sup></li> <li>• Lack of coordination among stakeholders to determine where living shorelines could best be used to reduce risk throughout an entire region<sup>1,3</sup></li> <li>• Limited expertise in the coastal planning and development community on when and where living shorelines are appropriate<sup>6</sup></li> <li>• Lack of common definitions for living shorelines<sup>1</sup></li> <li>• Lack of coordination among the emergency response, recovery, and mitigation communities preventing the encouragement of more resilient solutions following a disaster<sup>1</sup></li> <li>• Lack of communication and cooperation at Federal, State, and local levels of government<sup>1,3</sup></li> <li>• Lack of outreach to private interests, coastal decision-makers, and property owners, about the shortcomings of traditional hardening techniques and the benefits of living shorelines<sup>1,3,4</sup></li> <li>• Lack of effective risk communication methods and visualization tools to communicate data and information to stakeholders<sup>1</sup></li> <li>• Land-use planning and zoning policies often discourage or limit living shoreline use<sup>1</sup></li> <li>• Potential property rights constraints or issues<sup>3,5</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Creation and utilization of public/private partnerships to decrease redundancies, link opportunities, and serve as a catalyst for comprehensive living shoreline implementation<sup>1</sup></li> <li>• Development of a guidebook with information on living shorelines that could be implemented during the recovery process following a disaster<sup>1</sup></li> <li>• Incorporation of living shorelines into existing decision support and communication tools<sup>1</sup></li> <li>• Hybrid approaches can provide a greater level of confidence than natural approaches alone<sup>6</sup></li> </ul>

## **Chapter 2: Living Shoreline Policy in New Hampshire**

### **2.1 Introduction**

This chapter will describe the policies that surround living shoreline implementation in NH, primarily focusing on living shoreline projects that are both public and restoration-based. The following sections will delve into the actors that could be involved in an implementation, the regulatory elements required to permit a project, and their interconnection in the permitting process. Finally, interview data are used to identify and support opportunities and barriers within NH's institution of living shoreline permitting and implementation.

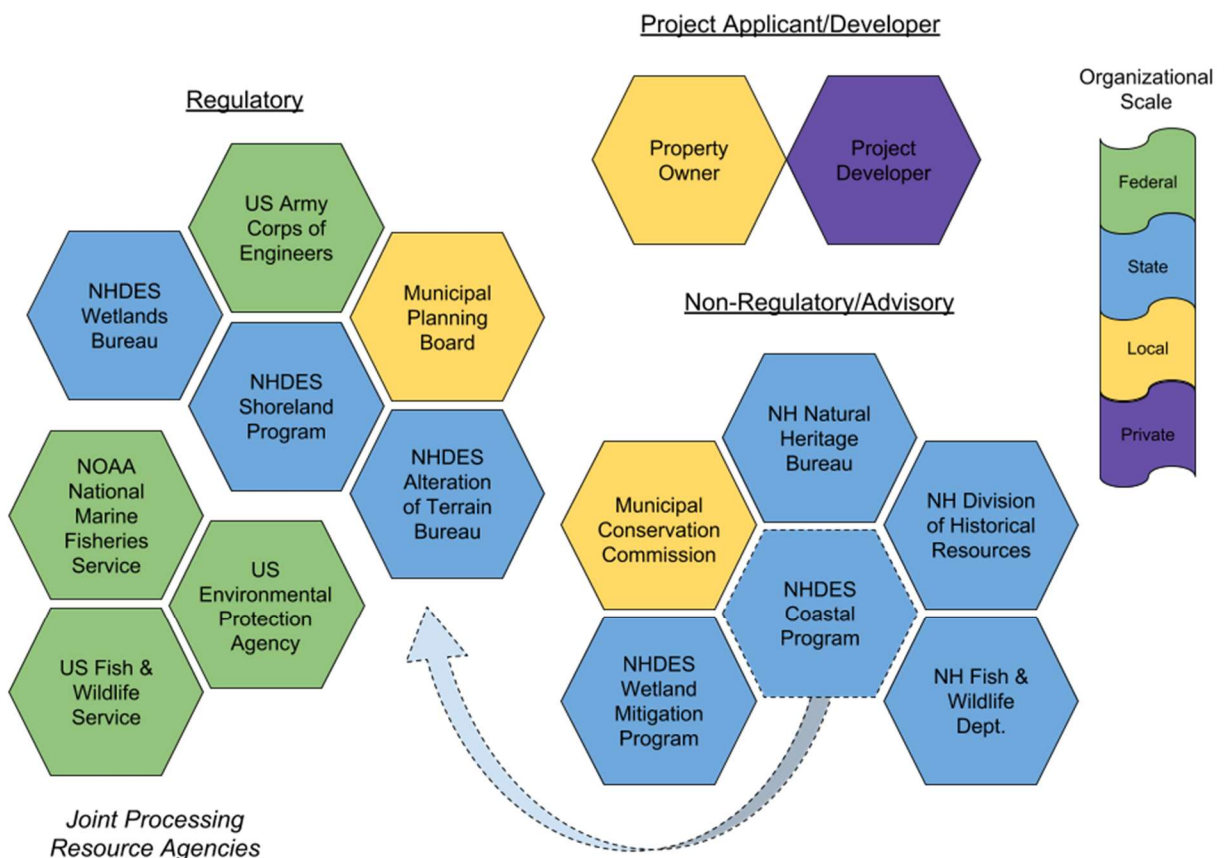
### **2.2 Who Are the Actors & What Are Their Positions?**

While, in many cases, the precise number and positions of actors participating in a living shoreline implementation will be project-specific, there are a number of organizations that will often be either required or highly advantageous to include in the process. Often, the core actors of a living shoreline project will mirror those of a development project in a wetland. Figure 2.1 shows a representation of actors that would be commonly involved in a living shoreline project in NH, classified by their role and organizational scale or jurisdiction.

#### ***Regulatory Actors***

Three regulatory entities, one each at the federal, state, and local level, share responsibility for reviewing and permitting applications for activities with wetland impacts: U.S. Army Corps of Engineers (Corps), the NHDES Wetlands Bureau, and the municipal Planning Board. Depending on the specifics of the project, other regulatory organizations may also be involved. For example, additional federal resource agencies, including the U.S. Environmental

Protection Agency (EPA), the NOAA National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (FWS), may also evaluate wetland permit applications during monthly, interagency Joint Processing Meetings hosted by the Corps (US Army Corps of Engineers, 2017). The NHDES Shoreland Program or NHDES Alteration of Terrain Bureau may be included if situational permitting is required due to the project's location or size. Lastly, while often acting as a non-regulatory agency when dealing with restoration projects, and displayed as such in Figure 2.1, NHCP could play a regulatory role if a proposed living shoreline project required Coastal Federal Consistency review. However, this permitting requirement would be very unlikely.



**Figure 2.1: Actors commonly involved in a living shoreline permitting process, classified by their role and organizational scale or jurisdiction**

### *Non-regulatory Actors*

Non-regulatory and advisory actors, those who are not directly involved in issuing permits, also fulfill critical roles in implementing living shorelines. The NH Natural Heritage Bureau (NHB) is a bureau of the NH Division of Forests and Lands that “finds, tracks, and facilitates protection of New Hampshire’s rare plants and exemplary natural communities” (NHDFL, n.d.). NHB maintains an inventory and database, which includes information about how rare the plant species is in New Hampshire and throughout its range, listing status under the NH Native Plant Protection Act of 1987 (NH RSA 217-A) and federal Endangered Species Act of 1973, and known sites where the species has occurred in the past and within the last 20 years. NHB is “a service to NH landowners and land managers” (NHDFL, n.d.), communicating directly with project applicants about species thought to be present in the area and assessing impacts projects could have on rare plants or natural communities. NHB also maintains information on rare wildlife, in cooperation with NH Fish & Game, which similarly assesses impacts projects could have on wildlife.

The NH Division of Historic Resources (DHR) acts as NH’s State Historic Preservation Office (SHPO) as part of , whose duties includes “preserving and protecting state-owned historical resources; issuing permits for archaeological projects on state lands or under state waters; and overseeing the treatment of unmarked human burials discovered during land-altering activities” (NHDHR, 2007; RSA 227-A). This agency is responsible for conducting Section 106 reviews for the National Historic Preservation Act of 1966 (NHPA) to confirm that publicly-assisted projects do no harm to the state’s historical or archaeological resources.

A community’s Conservation Commission is a volunteer municipal board charged with guiding the community’s long-term strategies for the protection and use of their significant

natural and watershed resources (RSA 36-A). Conservation Commissions have the authority to review all projects in their city or town wetlands that require a state wetland permit and submit comments and recommendations to the municipal Planning Board and NHDES Wetlands Bureau. Additionally, any project seeking expedited status on the NHDES wetlands permit must receive a signature from the Conservation Commission of the municipality, or it cannot qualify for expedited review.

Other non-regulatory actors who are likely to participate in the process include (1) state agencies, such as NHCP, (2) pseudo-governmental organizations, such as the Piscataqua Region Estuaries Partnership (PREP) and GBNERR, (3) regional organizations, such as the regional planning commissions and county conservation districts, and (4) non-profit organizations, such as The Nature Conservancy (TNC) and the Southeast Land Trust (SELT). Many of these organizations provide science-based resources, funding, outreach, or technical assistance to coastal municipalities and groups in NH. Additionally, these actors can often have unique roles in the implementation process. For instance, NHCP can influence the regulatory decisions through the wetland permitting process, regional planning commissions often assist communities and landowners with land-use planning, and non-profit organizations, such as TNC or SELT, may own the land on which the living shoreline is being implemented. Therefore, effective determination and inclusion of these non-regulatory actors can greatly affect the success of any project and should be carefully considered before and during project design and implementation.

### **2.3 What Rules Do Actors Follow to Make Decisions?**

When discussing rules that would affect a living shoreline project, the two most commonly cited regulations among interviewees were Fill & Dredge in Wetlands (RSA 482-A)

and Shoreland Water Quality Protection Act (RSA 483-B). The legal purposes for regulations RSA 482-A and 483-B, seen below in Box 2.1, center around the “protection and preservation” of the state’s submerged lands, wetlands, and adjacent woodland buffers from “despoliation and unregulated alteration,” as well as “uncoordinated, unplanned and piecemeal development.”

**Box 2.1 – The Purpose Statements from RSA 482-A & 483-B**

**482-A:1 Finding of Public Purpose.** – It is found to be for the public good and welfare of this state to protect and preserve its submerged lands under tidal and fresh waters and its wetlands, (both salt water and fresh-water), as herein defined, from despoliation and unregulated alteration, because such despoliation or unregulated alteration will adversely affect the value of such areas as sources of nutrients for finfish, crustacea, shellfish and wildlife of significant value, will damage or destroy habitats and reproduction areas for plants, fish and wildlife of importance, will eliminate, depreciate or obstruct the commerce, recreation and aesthetic enjoyment of the public, will be detrimental to adequate groundwater levels, will adversely affect stream channels and their ability to handle the runoff of waters, will disturb and reduce the natural ability of wetlands to absorb flood waters and silt, thus increasing general flood damage and the silting of open water channels, and will otherwise adversely affect the interests of the general public.

**483-B:1 Purpose.** – The general court finds that:

I. The shorelands of the state are among its most valuable and fragile natural resources and their protection is essential to maintain the integrity of public waters.

I-a. A natural woodland buffer, consisting of trees and other vegetation located in areas adjoining public waters, functions to intercept surface runoff, wastewater, subsurface flow, and deeper groundwater flows from upland sources and to remove or minimize the effects of nutrients, sediment, organic matter, pesticides, and other pollutants and to moderate the temperature of the near-shore waters.

I-b. Scientific evidence has confirmed that even small areas of impervious surface coverage can have deleterious impacts on water quality and the aesthetic beauty of our lakes and rivers if not properly contained or managed within each watershed. These impacts are known to reduce recreational opportunity, reduce property values, and pose human health risks.

II. The public waters of New Hampshire are valuable resources held in trust by the state. The state has an interest in protecting those waters and has the jurisdiction to control the use of the public waters and the adjacent shoreland for the greatest public benefit.

III. There is great concern throughout the state relating to the utilization, protection, restoration and preservation of shorelands because of their effect on state waters.

IV. Under current law the potential exists for uncoordinated, unplanned and piecemeal development along the state's shorelines, which could result in significant negative impacts on the public waters of New Hampshire.

These natural resources are identified as vital to “the public good and welfare of this state,” due to the ecological benefits they provide to coastal habitats and water quality, and the social

benefits such as flood protection, property value and “the commerce, recreation and aesthetic enjoyment of the public.” In most cases, interviewees identified similar purposes and goals for these regulations that focused on the protection of the wetlands and associated natural resources, either drawing from knowledge of the regulations themselves or from individual perception (e.g. LS02, 2016; LS03, 2016; LS04, 2016; LS06, 2016; LS08, 2016; LS18, 2016; LS27, 2017), demonstrating a shared understanding of the intended objectives of these regulations among stakeholders whom they would affect.

For the majority of cases, the rules that actors must follow when implementing a living shoreline project in NH will be the federal, state, and local regulations that influence and authorize development in a tidal wetland. Occasionally, specific actors may be bound by rules affecting what actions they can take, when, and where, but these are often on a case-by-case basis and are not covered in this section. The following subsections describe the regulatory components that would be required by an applicant to permit the implementation of a living shoreline project in the state.

### ***NHDES Wetlands Permit***

Pursuant to RSA 482-A, Fill and Dredge in Wetlands, and supported by the Wetlands Rules, Env-Wt, any person seeking to “excavate, remove, fill, dredge, or construct any structures in or on any bank, flat, marsh, or swamp in and adjacent to any waters of the state” (RSA 482-A:3) must first obtain an approved Wetlands Permit from the NHDES Wetlands Bureau before any work can be done. Along a tidal shoreline, the jurisdiction of this regulation applies from beyond the shore, including all submerged lands below the mean high tide, to adjacent areas 100 feet landward of the highest observable tide line. Therefore, a living shoreline project that

integrates elements such as coastal vegetation or an oyster reef, and requires consistent and temporary or constant inundation, must have such a permit filed.

As the primary tool of the state for regulating coastal and wetland projects, RSA 482-A requires conditions for a project are met based upon the project's classification – Minimum, Minor, or Major Impact – set forth in the Wetland Rules, Env-Wt 303. Project classification is determined by criteria including the size of impacts or disturbance, the proximity to a wetland, the type of wetland impacted, or specific types of projects or actions. A living shoreline project constructed on public land, overseen by a state agency, and classified as a restoration project, inherently designed to minimize environmental impacts and actively restore existing or historic habitat, would be classified as minimum impact project. However, should a living shoreline be developed on private land as an erosion control method, under the current rules, that project would more than likely be classified as major impact, and additional fees would be required with the application.

As part of the Wetland Rules, Env-Wt 404 sets tiered criteria for coastal stabilization projects, favoring the least intrusive method that is practically available. These methods are ordered as: 1) diversion of water, 2) vegetative stabilization, 3) rip-rap, and lastly, 4) walls, with increasing requirements for each tier of stabilization. Based upon these rules, the issuance of a Wetlands Permit should be taking this hierarchy of stabilization project types into account.

### ***NH General Permits***

Per Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899, the Corps is charged with the protection of water quality and navigability of the waters of the United States and is granted the regulatory authority over projects involving



activities such as the filling and dredging of materials or construction of structures within those waters or adjacent wetlands. Work in wetlands that is regulated under Section 404 of the CWA or Section 10 of the Rivers and Harbors Act, such as the construction of a living shoreline project, would require authorizing permits from the Corps before proceeding. However, in an effort to minimize duplication of work for both state and federal regulators, as well as applicants, and to expedite the permitting process for projects with minimal environmental impacts, the New England District of the Corps issued General Permits (GPs) for the state of NH that allow the NHDES Wetlands Permit to authorize specific activities and sizes of projects in lieu of permits from the Corps.

These GPs greatly enhances the discretion of the NHDES Wetlands Bureau for permitting projects, allowing Minimum Impact projects, also referred to as Self-Verification (SV) projects within the GPs, to proceed immediately after receiving DES authorization, unless notified by the Corps. Minor and Major Impact projects, referred to as Pre-Construction Notification (PCN) Required projects within the GPs, are authorized to proceed with written notification from the Corps within 30 days after DES authorization, and often do not need further permitting. The Corps will review applications for Minor and Major Impact projects monthly at interagency Joint Processing Meetings.

State GPs are effectual for five years from their issuance from the Corps, with the current NH GPs being adopted in August 2017. Prior to this adoption, the state had been issued a Programmatic General Permit (PGP) that functioned in much the same way as the current GPs, but was more resource-specific, focusing more on the resource where the project was being implemented rather than the category of the project itself (LS27, personal communication, October 16, 2017).

Before this prior PGP expired, the Corps and NHDES discussed changes to the language that would take affect with the new GPs. While the issuance of new state GPs offers a convenient window of opportunity to make changes to the permit, modifications to the GPs can be made if requested by NHDES. According to agents in NHDES, language from the Corps' recently released Nationwide Permit (NWP) 54 was considered during the drafting phase of the current NH GPs (LS27, 2017). NWP 54 specifically includes text authorizing the construction and maintenance of living shoreline projects for erosion control. Similarly, the 2017 NH GPs authorize the use of living shorelines under General Permit 9: Shoreline and Bank Stabilization Projects, and includes the following definition:

A term used to describe a combination of mostly naturally derived materials including plants, shell and rock or manufactured rock-like surfaces that are used along a shoreline exhibiting erosion to dissipate wave energy and to collect naturally deposited sediment. (US Army Corps of Engineers, 2017)

However, while a living shoreline project classified as a bank stabilization project in tidal waters would be considered a PCN Required project under GP 9, a living shoreline classified as a salt marsh restoration project would often be considered an SV project under GP 10: Aquatic Habitat Restoration, Establishment & Enhancement Activities. This, again, incentivizes a restoration classification.

If it is determined that the size or impact of a project does not fall within the criteria of the GPs, then an applicant must file an application for an IP with the Corps. A public notice is issued with the receipt of an IP application, which allows the public up to 30 days to comment on the project, and additional time for the applicant to respond to comments received. Additionally, a project requiring an IP would need a federal consistency certification from NHCP per Section 307 of the Coastal Zone Management Act, making them a regulatory actor in the process.

Requiring an IP can greatly increase the time necessary for the permitting and development of a project, but IPs are rarely needed in the cases of public restoration projects, and therefore, have not been included in following permitting process diagrams. It is possible, however, that a large, privately-owned living shoreline incorporating a hybrid design of a significant amount of hardening could require such permitting.

### ***NH Natural Heritage Bureau Review***

Before submitting the application for a Wetlands Permit, all projects must first initiate an NHB Review of the area where the project is to take place using an online NHB DataCheck Tool (NHB, 2005). The DataCheck Tool checks the NHB Database for records of rare species or natural communities in the vicinity of the proposed work and issues a report on the findings. If no records are found, an applicant will receive an official letter stating such that will be included in the Wetlands Permit. If there is a detection of a record, NHB agents – for plants or natural communities – or NH Fish & Game agents – for wildlife – will assess potential impacts caused by the project and send the resulting report to the applicant to be included in the Wetlands Permit.

As a completed report is required with the application for a Wetlands Permit, the NHB Review should be initiated well in advance, once a project site is identified, to allow time for any needed assessment should a rare species or natural community be detected.

### ***NH Division of Historical Resources Request for Project Review***

Required for any project with Federal involvement, a Request for Project Review (RPR)

must be submitted to the SHPO at the NH DHR. The RPR is the initial step in the Review & Compliance (R&C) process of the DHR, and of the Section 106 review of the NHPA, which requires federal agencies to consider the impacts of projects they carry out, authorize, or fund on historical or archeological resources. The DHR reviews these publicly-assisted projects to identify significant historic properties, and how adverse effects to them can be avoided or minimized. After receiving the response from the DHR, the lead federal agency is then responsible for coordinating Section 106 compliance if historical resources are identified in the vicinity of the project.

### ***Municipal Wetland Ordinances/Permits***

As with all wetland projects, a living shoreline implementation must comply with the specific, and often more stringent, zoning ordinances of the municipality in which it is being constructed. Common ordinances that would affect a living shoreline project include wetland buffers or setbacks, wetland protection districts, and conservation districts. Projects taking place within protected areas or within wetland buffer zones often require a variance or Conditional Use Permit granted from the local Planning Board. In some cases, towns (e.g. Hampton) will have their own wetlands permits that an applicant must complete and file with the Planning Board or Conservation Commission of the town, along with the completed DES Wetlands Permit application. In the case of a local wetlands permit or Conditional Use Permit, it must be authorized along with any state permits before the project may proceed.

In addition to receiving local permits to comply with municipal zoning ordinances, the DES Wetlands Permit requires that the application is reviewed by the town Conservation Commission and signed if it has no objection to the proposed work. If an application is not

signed by the Conservation Commission, it cannot apply for an expedited review from DES. The local Conservation Commission may also submit comments to NHDES and the local Planning Board regarding the permitting of the project. Additional copies of the DES Wetlands Permit application must be produced for and signed by the Town Clerk, who will distribute them to the Conservation Commission, the Planning Board, and the local governing body.

### ***NHDES Shoreland Impact Permit***

Pursuant to RSA 483-B, Shoreland Water Quality Protection Act, and supported by the Shoreland Protection Rules, Env-Wq 1400, the majority of construction, excavation, or filling within the protected shoreland of a waterbody first requires an authorized Shoreland Impact Permit from the NHDES Shoreland Program. For tidal waters, the protected shoreland is considered “all land located within 250 feet of the reference line of public waters” (RSA 483-B:4, XV) Therefore, a living shoreline design that included alterations to the shoreline between the highest observable tide line and 250 feet landward, such as a gradient changes to an upland slope, will require a NHDES Shoreland Impact Permit before proceeding.

### ***Alteration of Terrain Permit***

An Alteration of Terrain Permit, from the NHDES Alteration of Terrain Bureau, would possibly be required for larger living shoreline projects if certain conditions of earthmoving are necessary in its construction, such as the disturbance of 50,000 square feet of contiguous terrain, if any portion of that falls within protected shoreland. This permit is in place to protect surface and groundwater by ensuring that appropriate soil erosion and stormwater runoff control methods are in place during construction.

### ***Aquatic Resource Mitigation Funding***

Like its permitting, funding the construction of a living shoreline project is highly contextual, with money potentially coming from a range of sources such as private contributors, public funds, or grants. However, if classified as a restoration project, a living shoreline becomes eligible to be funded through projects that require submittal of compensatory wetland mitigation.

In accordance with Env-Wt 800, activities in the state that permanently impact wetlands may be required to mitigate those impacts through the funding of projects aimed at the creation, preservation, or restoration of similar wetlands that offer similar functions. A project applicant must first consider permittee-responsible mitigation, directly funding an on-site or local mitigation opportunity within the municipality in which the project is proposed. However, if no appropriate local projects are available for funding, an applicant may make an in-lieu mitigation payment into the Aquatic Resource Mitigation (ARM) Fund.

Managed by NHDES Wetland Mitigation Program, the ARM Fund is a financial account that uses pooled moneys from in-lieu mitigation payments to fund appropriate restoration, creation, or preservation projects within the same watershed as the corresponding activities that require mitigation. To receive funding, mitigation projects must go through a competitive application process, and are awarded grants based on the similarity of the wetland type and functions originally lost. Therefore, a living shoreline project that is, for example, functionally classified as a salt marsh restoration may either receive permittee-responsible mitigation funding directly from a project that is permanently impacting local salt marsh or apply for and receive ARM grants looking to mitigate for salt marsh impacts within the watershed.

A restoration project that is being used as compensatory mitigation, through permittee-responsible restoration or use of ARM funding, requires the applicant to provide five years of

condition monitoring of the site to ensure the restoration was successful, along with annual reporting back to the NHDES Wetland Mitigation Program (Env-Wt 803.04). This is unlike a traditional wetland project that would not require any kind of formal monitoring after implementation, and only needs to be developed to the specifications of the design plans permitted by the NHDES Wetlands Bureau.

## **2.4 What Are the Patterns of Interaction Between Actors?**

When implementing a living shoreline in NH, much of the interaction among actors occurs through the permitting process. As the design of a living shoreline will include aspects that are either below the mean high tide line of state waters or along the adjacent shoreline, there are specific regulatory components that will be required, per the previous section, to permit a project: 1) the NHDES Wetlands Permit, 2) Appendix B – Corps Secondary Impacts Checklist from the NH GPs, 3) the NHB Review, and 4) the Section 106 RPR. A project developer must also comply with any municipal wetlands ordinances and apply for any applicable municipal wetlands permits. Lastly, there are permits required in specific situations depending on the scope and design of the project: 5) the NHDES Shoreland Impact Permit and 6) the NHDES Alteration of Terrain Permit. Figure 2.2, below, illustrates a simplification of these necessary permitting elements with their associated agencies or organizations.

The full process of permitting a living shoreline (Fig. 2.3) starts with an initial phase of data collection, in which a project developer will identify the project need and gather the maps and imagery displaying the area and resources that will be impacted. After project designs are drafted, an applicant will present the plans with the Conservation Commission of the municipality. Although not required, a pre-application meeting with NHDES Wetlands Bureau to discuss the project is also highly recommended. These meetings provide a formal line of

communication between a project applicant and the organizations that will be reviewing the application, allowing the project to be discussed and potential design alterations be proposed. Additionally, if there is a federal component to the project, such as the use of federal funding or anticipated Section 106 Project Review, federal resource agencies are contacted, and a Lead Federal Agency is selected for the project – often either NOAA or the Corps. A project applicant must notify abutters to the property on which the project is taking place, and initiate an NHB Review, as that report will be included in the Wetlands Permit Application.



**Figure 2.2: Permitting requirements of a living shoreline in NH and the actors that receive them**

The applicant will submit an RPR to NH DHR, who will review the project to determine whether further information or review is needed, an archaeological survey is warranted, or the project is unlikely to impact historical resources and is free to proceed. Depending on the



physical location and size of the project, the application for a Shoreland Impact Permit or an Alteration of Terrain Permit would be required as well.

With an NHB Report acquired, and the RPR and any required Shoreland Impact Permit or Alteration of Terrain Permit Applications started, an applicant would then complete the Wetlands Permit Application, including the Corps' Appendix B, and submit it to the municipality for signatures from the Conservation Commission and Town or City Clerk. After being signed, the application would then be provided to the NHDES Wetlands Bureau for final decision. Depending on the impact level assigned to the project, the Corps may become involved in the decision whether to grant a permit, as might the federal resource agencies via the Corps' Joint Processing Meeting. More information or alterations may be required from the applicant, or a project could be permitted to proceed.

With multiple agencies reviewing the project at different times before work can be started, the process of permitting a wetlands project will take many months, with an exact timeframe dependent on the project's complexity or agencies' need for more information or alterations. Keeping agencies well-informed of the project and process can help to mitigate some of this needed time and is why early pre-application meetings are encouraged.

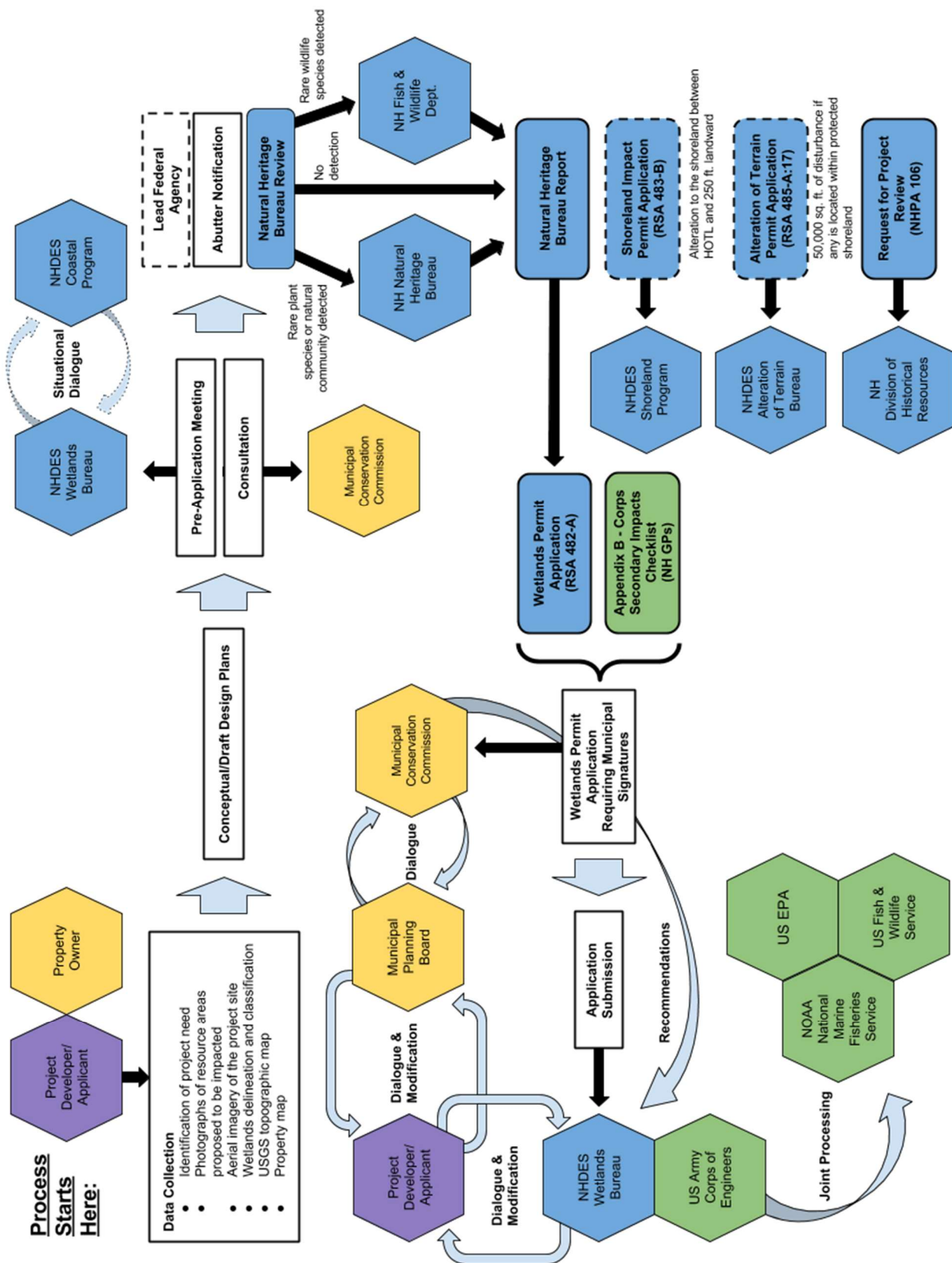


Figure 2.3: Permitting process of a living shoreline in NH

## 2.5 Analysis

In order to analyze barriers and opportunities within NH's institutional environment for living shoreline implementation, we identified themes within the categories of actors, rules, and patterns of interaction from among data gathered from stakeholder interviews. These themes were then classified by the categories adapted from Clean Water America Alliance (2011) as seen in Table 2.1. These themes are then used to support broader barriers and opportunities to living shoreline implementation throughout this section.

**Table 2.1: Policy barriers and opportunities of a living shoreline implementation process as identified by interview participants, and organized by categories adapted from Clean Water America Alliance (2011)**

	Barriers	Opportunities
<b>Technical/ Physical</b>		<ul style="list-style-type: none"> <li>• Ecological co-benefits promoted by living shorelines are consistent with the intent of state coastal regulations on development</li> <li>• Perceived overlap of functions and initiatives between living shorelines and stormwater management</li> <li>• Living shorelines help minimize cumulative impacts of development</li> </ul>
<b>Financial/ Resource</b>	<ul style="list-style-type: none"> <li>• ARM funding must go to projects with the same functions as those lost</li> <li>• Lack of resources for state agencies to monitor, evaluate, and enforce permitted projects</li> <li>• Difficulty synchronizing funding sources, budgets, &amp; schedules</li> </ul>	<ul style="list-style-type: none"> <li>• Recognition of long-term perspective for evaluating pilot projects</li> <li>• Wetland regulations could be used to incentivize the use of living shorelines</li> <li>• Programs such as CRS could be used to financially incentivize the use of living shorelines</li> </ul>
<b>Legal/ Regulatory</b>	<ul style="list-style-type: none"> <li>• The wetlands permitting process is burdensome and challenging</li> <li>• Challenge to apply and enforce wetland regulations consistently</li> <li>• Wetland regulations perceived to be inconsistently or subjectively enforced in the past</li> <li>• Conservation Commissions do not have the opportunity to comment on Shoreland Impact Permit applications</li> <li>• Regulations perceived as not differentiating between development and restoration</li> <li>• Regulators perceived as misunderstanding the objectives of living shoreline projects</li> <li>• Rules do not effectively distinguish or promote beneficial actions in wetlands</li> <li>• Regulatory aversion to wetland alteration and habitat conversion</li> <li>• Federal permitting is dependent on project size, regardless of type</li> <li>• State regulations facilitate in-kind replacement of failing structures</li> <li>• No monitoring or evaluation requirements for traditional infrastructure projects</li> <li>• Regulator position designed as more reactive</li> <li>• Regulators perceive that applicants view them in an adversarial role</li> <li>• Federal regulators comfortable permitting hard infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• NH GPs can be updated as necessary</li> <li>• Monitoring and evaluation required for restoration projects</li> <li>• Separate GPs for different activities in wetlands</li> <li>• Local, State, and Federal regulations with overlapping jurisdiction protecting wetlands</li> <li>• State wetland rules are being rewritten</li> <li>• New Wetland Rules may have regulations requiring engineering to dynamic systems</li> <li>• State wetland regulations are perceived as setting the norm for development in wetlands</li> <li>• Corps' Nationwide Permit 54 specifically defines and permits living shorelines</li> <li>• Regulators are willing to engage with applicants</li> <li>• Project developers guide applicants through the permitting process</li> <li>• State wetland rules include 3-tiered criteria for shoreline stabilization</li> </ul>
<b>Community/ Planning</b>	<ul style="list-style-type: none"> <li>• Municipal regulations are not consistent across towns</li> <li>• Town-level regulation does not allow for effective system-wide management</li> <li>• Minimal public involvement in the decision making of coastal projects</li> <li>• Some municipalities rarely update their ordinances</li> <li>• Many municipalities rarely implement proactive zoning ordinances</li> <li>• Stricter local regulations may not be appropriately recognized at the state level</li> <li>• As long as infrastructure is performing, it often will not be proactively altered</li> <li>• Municipal regulations do not require living shorelines as a technique</li> <li>• Developers prefer shorter decision-making and turnaround timescales</li> <li>• No actor has responsibility for proactive shoreline planning</li> <li>• Project developers do not promote living shorelines</li> </ul>	<ul style="list-style-type: none"> <li>• Aesthetic benefits promoted by living shorelines are consistent with the intent of state coastal regulations on development</li> <li>• Municipal officials and planners predominantly recognize aesthetic benefits of living shorelines and their importance to communities</li> <li>• State goal of a long-term, comprehensive shoreline management plan</li> <li>• Opportunities exist to include public participation in coastal management</li> <li>• Variances &amp; Conditional Use permits allow for exception in local regulations</li> <li>• Some municipalities are implementing proactive wetland ordinances</li> <li>• Some municipalities are using scientific data to support proactive ordinances</li> <li>• Some municipalities changing ordinances to be flexible for resilient approaches</li> <li>• Public participation included when rewriting the state Wetland Rules</li> <li>• Use of multi-discipline, stakeholder knowledge included when rewriting the state Wetland Rules</li> </ul>

### **2.5.1 Actors**

Much of the stakeholder interview data describing actors focused on federal and state regulators, with a large portion of that coming from the regulators themselves as they described how they viewed their own role. Additionally, stakeholders described how they perceived project developers and professional engineering firms.

#### **Barriers:**

##### ***No actor has responsibility for comprehensive shoreline management planning***

Implementing living shoreline projects and, more broadly, managing New Hampshire's coastal shoreline requires collaboration from federal, state, and municipal representatives and other stakeholders. The purpose section of the Shoreland Water Quality Protection Act cites the "potential...for uncoordinated, unplanned and piecemeal development along the state's shorelines, which could result in significant negative impacts on the public waters of New Hampshire" (RSA 483-B:1) However, no actor is responsible for proactively identifying potentially suitable sites for living shorelines, planning for their implementation, and coordinating project success. For example, the state and federal regulatory role is limited to responding to proposed activities with potential wetland impacts, and does not include proactively promoting solutions (LS09, 2016; LS29, 2017; LS30, 2017). Without a responsible actor or group of actors, living shoreline implementation is uncoordinated, unplanned, and piecemeal.

##### ***Project developers do not promote living shorelines to clients***

A number of interviewees, including municipal officials, state and federal officials, and

engineers, said project developers in NH do not promote living shorelines to their clients for coastal projects because they lack design guidance, comfort with the technology, and data about costs (LS01, 2016; LS02, 2016; LS23, 2016).

### Opportunities:

#### ***Regulators are willing to engage with applicants***

Many federal and state regulators said they would like to interact more with the public. According to these interviews, the public's perception of government environmental agency staff as "no" people limits interaction. These regulators said they are, in fact, eager to share their experiences and want applicants to consider them a resource before and during the permitting process (LS09, 2016; LS18, 2016; LS29, 2017). Only two interviewees called attention to the regulators willingness to meet and provide useful feedback about projects. According to a project applicant, "I'll say this, that working in the state of New Hampshire with DES, they really come to the table" (LS10, 2016). Similarly, a municipal representative mentioned their appreciation of the work by NHDES Wetlands Bureau staff, especially given their limited resources (LS01, 2016).

#### ***Project developers guide applicants through the permitting process***

Several stakeholders, including a municipal representative, an engineering company, and a project applicant, identified professional project developers, including engineering and consulting firms, as knowledgeable about how to navigate the living shoreline permitting process. Interviewees pointed out that developers advance projects for a living, know the different agencies and reviewers, and have the capacity and administrative support to streamline

the process. Developers, therefore, often serve as a guide to applicants through the permitting process (LS01, personal communication, February 2, 2018; LS10, 2016; LS22, 2016).

### **2.5.2 Rules**

#### **Barriers:**

***Classifying dual purpose living shoreline projects into single purpose project classification causes uncertainty for regulators about how to consider project benefits and negative impacts***

Federal and state rules regulating wetlands require living shoreline projects to be classified as either (1) bank and shoreline stabilization or (2) restoration and enhancement activities, when they are in fact dual purpose activities that do not fit neatly into either category. When classified as bank and shoreline stabilization projects, living shoreline projects present regulators with an unfamiliar permitting situation. According to one state agency representative speaking about the NH General Permit from the Corps:

I think permitting could very well be a hindrance.... They don't speak directly to [living shorelines] in the Bank & Shoreline Stabilization section of the General Permit, but there is sort of some quasi-language that speaks to what ultimately will be probably interpreted as sort of a living shoreline type of project.... There will likely be some regulatory issues... because regulatory folks... probably won't know how to treat these things. (LS27, 2017)

A couple of state agency representatives noted that the novelty and complexity of living shoreline projects present challenges for regulators, who strive to apply and enforce wetland regulations consistently across shoreline protection projects (LS29, 2017; LS30, 2017).

As a state agency representative explained, living shoreline projects are “lump[ed]...into general development in the seacoast ” (LS18, 2016). As a result, one project developer noted that regulators do not “distinguish between restoration versus development” (LS13, 2016). Living shorelines have benefits for both shoreline stabilization and ecosystem function, but stabilization

projects are not typically evaluated for their benefits to habitat or other ecosystem functions.

Classifying a living shoreline project as stabilization makes it hard for regulators to consider the project's full range of benefits.

However, when classified as a restoration activity, living shoreline projects also pose challenges for regulators. Regulators may be uncomfortable with the project's hard, engineered components and the negative impacts on wetland habitat during project installation. As one project developer commented,

Basically, there has to be a new regulatory and enforcement structure built around the distinction between development versus restoration. And... to make an omelet, you're going to have to break eggs. To do restoration, you're going to have to have equipment and excavation or dredging in the coastal zone, which [policy makers] have always been trying to prevent for decades. (LS13, 2016)

As another project developer explained:

There's still a little bit of naivety... in the regulatory community about what [living shoreline projects] are.... I think sometimes [regulators] tend to think they are traditional wetland – coastal wetland – mitigation projects, and they treat them that way. They're really shoreline protection measures, if it's a classic living shoreline, and as such, we should be able to allow for the use of hybrid designs that allow for hardening – that may have engineering elements in them that go beyond just living components, natural components...

The biggest [challenge] is, as a new mitigation technique that's being employed in New England, regulators tend to fit it in the box of mitigations – a type of mitigation that they're used to. So... they're resistant to hybrid designs, and they want to treat it like a mitigation site that you build, you protect it for its ecological resources, and you don't worry that the fact that it actually has a second – has a different purpose. To some regulators, I've tried to explain this. This is similar to stormwater management. A lot of stormwater management can be done where you create a vegetated detention basin, and it may have great ecological function most of the time, but its primary purpose is stormwater management. (LS22, 2016)

These project developers raise two important issues. First, living shoreline projects may contain hard, engineered components whose installation requires construction in the coastal zone, causing potential negative habitat impacts on wetlands, none of which are typically associated

with restoration projects, and therefore raise permitting questions for regulators. Second, restoration projects are not typically evaluated for their erosion control benefits. Classifying a living shoreline project as restoration, again, makes it hard for regulators to consider the project's full range of benefits. As the second project developer elaborated:

Some of the regulations limit our ability to utilize areas of habitat to augment living shoreline designs, because it's considered an impact and not a benefit to the environment. So they treat it like they would any other impact. So there's a permanent loss of resource as opposed to the fact that you're actually modifying the resource to allow a larger – to the benefit of creating more resource. And there's not an easy [regulatory] pathway... to allow that to occur. (LS22, 2016)

Interviews with both engineers and scientists called attention to what they perceive as this exclusive focus in the wetland regulations on the negative impacts of a living shoreline project on resources and a lack of consideration of the project's greater benefits to coastal habitats. In an interview a regulator shared a related experience, in which an applicant became upset when they were asked to mitigate the negative impacts of a proposed project, which they expected would provide greater net benefits to ecosystem function, but which received no consideration of its expected benefits (LS09, 2016). Specifically, RSA 482-A aims to protect wetlands from “despoliation and unregulated alteration, because such despoliation or unregulated alteration *will* adversely affect the value of such areas...” (emphasis added). Designed to prevent harmful alteration in wetlands, the rules do not provide a mechanism for assessing whether a project can be expected to lead to greater benefits to the coastal system and habitats that the rules are intended to protect.

Similarly, regulators at the *Coastal Nature-Based Infrastructure: Practices and Regulatory Issues* workshop hosted by the Northeast Regional Ocean Council in May 2017, identified habitat conversion as a regulatory barrier to implementing living shorelines. A state agency representative recounted hearing federal regulators struggling with the same dilemma:



Just from what I've heard from personnel locally, NOAA National Marine Fisheries Service, they have a whole permitting section. And I've heard their permittees be concerned about, [for example,] trading this mud flat for a fringing marsh. "What about the resources in the mud flat? Should those be mitigated for? Is that going to be a loss of eel grass or shellfish habitat...?" So I think that those federal permitting agencies are still trying to wrap their head around these tradeoffs. (LS11, 2016)

Project permittees are not clear about how to evaluate living shoreline-as-restoration projects with some negative resource impacts, but which, if successful, will provide greater overall benefits to coastal resources.

In summary, classifying living shoreline projects as restoration and enhancement projects presents regulators with an unfamiliar situation: how to consider hard, engineered components, negative habitat impacts associated with construction, and habitat conversion, none of which are typical of restoration projects. And, classifying living shoreline projects as bank and shoreline stabilization projects presents regulators with a different unfamiliar situation: how to account for the project's benefits to coastal resiliency, which is not typical of stabilization projects. Rules forcing dual purpose living shoreline projects to be classified as either (1) bank and shoreline stabilization or (2) restoration and enhancement activities, therefore, make it hard for regulators to consider tradeoffs between the full range of benefits and costs of living shorelines projects.

***Easy in-kind replacement discourages the replacement of inadequate or failing grey infrastructure with living shorelines***

Several interviewees observed that it is easier and cheaper to keep failing hard infrastructure in place or replace it with the same "in-kind" design, as compared to replacing it with a living shoreline (LS03, 2016; LS13, 2016; LS29, 2017; LS30, 2017). A broad range of stakeholders identified as a project benefit the ability of living shorelines to become self-sustainable, in contrast to grey infrastructure, which has no ability to mend itself or adapt to

changing conditions without additional human intervention (LS03, 2016; LS04, 2016; LS06, 2016; LS10, 2016; LS28, 2017; LS29, 2017; LS30, 2017). Nevertheless, even grey infrastructure projects that are inadequate given current environmental conditions, are expected to continually fail, and are ecologically detrimental are easier to keep or replace in-kind (LS13, 2016; LS25, 2016). Without requirements to monitor and evaluate grey infrastructure projects (LS18, 2016; LS21, 2016), grey infrastructure is rarely proactively fixed even if it is slowly and visibly failing. Once it fails catastrophically, grey infrastructure is often replaced in-kind (LS13, 2016).

### ***Town-level shoreline regulations vary across municipalities***

As one stakeholder who works with municipalities explained, it is often extremely difficult to get proactive, environmental ordinances passed in communities (LS23, 2016). As a state agency representative explained:

Yeah, it's messy. I mean, there definitely is a lack of consistency [across municipal regulations].... The nature of New Hampshire is that the communities... are grounded in their own identities, and as a result, the system is set up to regulate based on their own preferences and their own priorities. (LS04, 2016)

Some municipalities are reluctant to issue regulations requiring or promoting specific techniques for coastal protection or management, such as living shorelines, in the first place (LS14, 2016; LS19, 2016; LS20, 2016; LS21, 2016). The exchange below illustrates some of the dilemmas municipal official face:

[LS21D]: But if you're thinking do we have anything in our regulations that requires a certain type of approach for flood protection versus another type of approach, I don't think we do.

[LS20D]: No, nothing like that.

[LS19D]: We've... toyed around with the idea of – should we have design standards for seawalls? Is that really a path we want to go down? And we typically shake our heads and say “no,” because what if the science were to change.

[LS21D]: Well, we don't have the expertise for that. And then if somebody builds a seawall to our design standards, and it fails –

[LS19D]: Fails, and we'll be liable.

[LS21D]: They'll be suing us.

The above conversation with municipal officials demonstrates how both a lack of technical capacity to implement effective municipal regulations and concerns about liability are barriers for some municipalities to implement town-level regulations for shoreline protection.

In contrast, towns can have town-level wetland regulations that are more protective than state regulations, but one planner raised their concern that, when issuing permits, state permitters do not appropriately consider town-level wetland regulations (LS03, 2016). Municipalities may, therefore, feel disempowered to exceed the state's requirements for permitting living shorelines. In other cases, communities with town-level wetland regulations have not updated their ordinances in decades (LS24, 2016).

According to a planner, the resulting "patchwork" of municipal regulations, in which adjacent towns have different standards that affect the same ecosystem, poses problems for comprehensive and coordinated coastal management (LS03, 2016). For example, one state agency representative expressed concern that different municipal standards and priorities could lead to piecemeal living shoreline implementation in which neighboring grey infrastructure could negatively impact living shoreline success (LS18, 2016).

#### Opportunities:

#### ***Benefits promoted by living shorelines are consistent with the intent of state coastal regulations on coastal development***

Many stakeholders identified ecological benefits of living shorelines that correlate closely with the values state coastal regulations seek to protect (see Box 2.1), including the protection of

coastal habitats and infrastructure and ecological co-benefits. According to two project applicants:

Well, again habitat value [of a living shoreline] is associated with trying to maintain the ecosystem, while at the same time arresting erosion issues or issues that are negatively affecting infrastructure. So the habitat value could be anything for aquatic species, or land borne species, which are taking advantage of or using that environment, whether it's for looking for food or part of its own lifecycle, or just places to rest, or do whatever they do during their lifecycle. So, they're either rearing and growing, or their procreating. And depending on the lifecycle, you would like to preserve as much of the habitat as you can, because, obviously, as the more and more habitat shrinks, then the species are stressed and all other conservation efforts that are targeting those species are not going to be very successful if the habitat doesn't exist for them. (LS13, 2016)

[A living shoreline is] a biologically-based system, so you're creating habitat at the same time you're providing shoreline protection. And the other advantage is that you are structurally attenuating wave energy, as opposed to putting in a hard point like seawall, where the seawall has to be so robust to absorb all the energy immediately, hopefully not reflect it to some vulnerable location, and withstand the highest level storms. The seawall does tend to provide some minimal habitat, I suppose, because the hard surface can make [habitat] – barnacles or something else encrusting on the surface, but it's pretty minimal as to what it provides for habitat value. Whereas, if you have the linear [and] horizontal space, you can create a multi-tiered living shoreline with multiple elements of subsurface, surface, and above-surface living elements. It creates a whole linear ecosystem along the shoreline, which provides huge biological benefits. (LS22, 2016)

As these two stakeholders described, living shorelines act as a method of coastal protection, while concurrently creating and enhancing “habitats and reproduction areas for plants, fish and wildlife of importance” (RSA 482-A), as is sought after in the state wetland regulations. Additionally, a state agency representative credited living shorelines with helping to minimize the cumulative impacts of development (LS02, 2016).

### ***Planners and municipal officials appreciate the aesthetic benefits of living shorelines***

In addition to often citing the ecological benefits described above, planners and municipal officials commonly discussed the potential for living shorelines to provide social benefits, which are highly valued by both municipalities and state wetland regulations. 10 of the 12 interviewees

who are municipal officials and/or planners (out of the total of 30 interviewees), discussed either the importance of aesthetics or the aesthetic benefits of living shorelines. For example:

Aesthetics is another [benefit of a living shoreline]. If you're viewing the shoreline from either across the river or across from a boat, I think it's a much nicer view.... It would be aesthetically more pleasing [than hardening], give a nicer view [for] the people across the river. They'd probably rather look at some green than a whole bunch of rocks and things like that. (LS14, 2016)

According to another interviewee, "...visual impact is of utmost importance to most of the towns in coastal NH" (LS15, 2016). A planner expanded on the importance of aesthetics:

[Residents] pride themselves on the look and feel of the community. They view that very highly. It's a very high value to them. And so... if it were a situation of "well, if we did it the old way, it would be, maybe, a wall or something, some hard infrastructure." I could see a situation where if it were something like that, that would perhaps not be really in keeping with the look and feel that the town likes to see. That if there were an alternative that would blend more with the landscape, and would keep the town's character more what it is, as opposed to more of a built up environment, I could see them responding positively to that. (LS17, 2016)

Only two of the 18 interviewees who are not municipal officials or planners (one of whom works closely with communities) spoke to aesthetics. According to these data, municipal officials and planners explicitly mention the value of aesthetic benefits of living shorelines more than other stakeholders.

### ***New wetland regulations are expected to establish new norms for shoreline protection***

During interviews, a broad range of stakeholders commented on the ongoing rewrite of New Hampshire's wetland rules and their expectations for the new rules to establish new norms for shoreline protection. For example, as one municipal planner stated:

I think, ultimately, it will depend on whether the state and federal regulations start requiring living shorelines. Certainly if the rules are written such that they have to take into account that technique of protecting shoreline – if that becomes the norm, if you will

– the designers [and] engineers will have to take that into account as they’re designing these projects right from the start.... (LS14, 2016)

Regulators also perceive that state wetland rules effectively establish expectations to which the public responds (LS29, 2017; LS30, 2017). Therefore, the wetland rule revisions that are currently underway present an opportunity to create new norms for shoreline protection that foster the implementation of living shorelines.

The current NH wetland rules include a basic, three-tier hierarchy to shoreline stabilization approaches, favoring vegetative stabilization over grey infrastructure (Env-Wt 404). According to one planner:

I think [developers] find that it’s easier to go through the permitting process if they’ve implemented and incorporated some [green] techniques in their design, versus proposing a grey or a hardened shoreline, and have the regulators say “I don’t think this meets the letter of the law. We’d like you to go back to the drawing board and propose something different... (LS14, 2016)

Nevertheless, stakeholders, such as those at the regional level in planning and conservation, identified a need for new wetland rules that do more to promote living shorelines and better protect NH’s natural resources (LS03, 2016; LS24, 2016).

Many interviewees expect the new rules will emphasize dynamic environmental factors, prioritize living shorelines, and require applicants to prove soft approaches do not work before allowing shoreline hardening (LS02, 2016; LS03, 2016; LS04, 2016; LS05, 2016; LS06, 2016; LS07, 2016; LS18, 2016; LS29, 2017; LS30, 2017). At the same time, as one stakeholder who works in conservation interests pointed out, it is difficult to implement regulations that inhibit shoreline hardening (a stick approach), as municipalities don’t like being told what to do and, in the “live free or die” state, “[it] is really hard to [tell communities] ‘you must’” (LS24, 2016).

The following exchange illustrates municipal officials’ consideration of whether new regulations

should use a stick or incentive (i.e. “carrot”) approach, which rewards implementation of living shorelines:

[LS19]: I feel that those changes would almost have to come through some regulations. Unless people are forced to do something, they might not be –

[LS21]: Or some kind of an incentive.

[LS19]: Yeah.

[LS21]: I don’t know that it necessarily has to be regulation, but I think you’re basically right. I don’t think it’s going to happen by itself, so there has to be either regulation that pushes people in that direction, or a tax abatement, or some other kind of incentive that would push people in that direction. Another carrot.

[LS20]: Incentive-based regulation. (LS19, 2016; LS20, 2016; LS21, 2016).

Many interviewees indicated their interest in new incentives fostering living shorelines, while also decreasing the need for greater capacity in enforcement. For example, one state agency representative said it should be easier to permit living, as compared to grey, shoreline projects:

I think there is... a general interest... within the Coastal Program and... DES – to the extent that we can and the extent that we should – [in] trying to incentivize [living shorelines]. And we could incentivize them by making thresholds lower for these types of things. We could incentive them by making the permit process more expedited for living shoreline projects, and that may happen at some point. (LS27, 2017)

### **2.5.3 Patterns of Interaction**

#### **Barriers:**

#### ***Living shoreline projects can be harder to permit, as compared to grey infrastructure projects***

Lack of familiarity with living shoreline projects and lack of data for implementation can lengthen the permitting process for living shorelines, creating an additional barrier. For example, one municipal official noted that permitting living shoreline projects can be even harder than permitting grey infrastructure projects because the regulators are less familiar with living

shoreline projects (LS01, 2016). This lack of familiarity poses a barrier on top of the existing wetland permitting process, which several municipal actors, project applicants, and actors who provide technical assistance to communities already find complex, convoluted, long, burdensome, and challenging (LS01, 2016; LS07, 2016; LS08, 2016; LS10, 2016; LS22, 2016). For example, one project applicant recalled their permitting experience and the various stakeholders with whom they interacted:

Wetlands Bureau, Natural Heritage Bureau, Division of Historic Resource, U.S. Fish and Wildlife Service... I think I'm missing something, but you get the idea. And [the permitting process] was challenging.... I work with all these people, and I have contacts at all these agencies, and it was still, start to finish, to get all the permits in place, probably a six-month process.... [T]he process isn't that clear. It's convoluted and challenging and there's tons of permits. (LS07, 2016)

Similarly, a municipal official said:

I think rip-rap is just what people know and do when it's what [is] in the regulatory framework. I think that needs to be looked at, so that it's not harder to do living than it is hardened shorelines... We need people that are willing to go through the process and say, "This is just absolutely ludicrous. It took me 60 hours to acquire the data to fill out the permit." And that's [what] we hear all the time from the normal regulatory process: it's too burdensome, it's too hard.... (LS01, 2016)

As identified above by both the applicant and municipal official, and pointed out by a regulator, the length of time to permit a project is an important constraint for project developers.

Developers have short time-frames for projects and are unlikely to consider projects that require more than a few months of pre-implementation data collection and evaluation (LS09, 2016).

Therefore, lengthening the project timeline can make living shorelines a less attractive shoreline protection solution, as compared to hardening.

### ***Synchronizing funding sources, budgets, and schedules***



As mentioned in Section 2.3, a living shoreline project in NH that is classified as restoration can qualify for ARM funding. However, according to Env-Wt 805.01(a) of the Wetland Rules, compensatory mitigation projects must match the type and function of the wetlands lost, limiting the projects that can apply for mitigation funds (Env-Wt). Therefore, this can create situations where restoration projects and mitigation funds are not available at the same time. NHDES suggests municipalities have restoration projects ready in case a development requires mitigation. However, even when communities try to do so, capacity limits their ability to maintain a priority list of projects and synchronizing the timing of projects with funding remains difficult (LS19, 2016; LS20, 2016; LS28, 2017). Communities are left with either unfunded projects during windows of development or money left over that they cannot use.

### ***Public outreach, education, & engagement necessary***

Interviewees across multiple stakeholder groups identified opportunities for the public to become involved in shoreline protection decisions, such as through public hearings on individual projects as authorized by RSA 91-A, Access to Governmental Records and Meetings, which are posted and open for public comment and feedback (LS03, 2016; LS05, 2016; LS06, 2016; LS07, 2016; LS14, 2016; LS15, 2016). In one case, a planner perceived public participation for a coastal project to be quite significant and extensive:

The public's been involved quite a bit. There's a committee that was established to oversee the [project]... and so those committee members are all members of the public.... They have numerous public meetings at all times. All their meetings are open to the public, and they actually put out a newsletter that people can sign up for to automatically receive an email on things that are going on. [There is] quite a bit of information on [the municipality's] website about the... project. And the newspaper reporters do a pretty good job of covering those meetings, and anything big that happens ends up in the paper.... [T]he committee's had dozens of public meetings, and there's been turn over on the

committee, so anyone that really wants to get involved has a pretty good chance of either having their voice heard or certainly finding out about what's going on with the [project]. (LS14, 2016)

In addition to public feedback on specific coastal projects, participants identified multiple outreach initiatives to involve the public and provide information on topics of coastal management (LS01, 2016; LS03, 2016; LS05, 2016; LS06, 2016; LS07, 2016; LS19, 2016; LS24, 2016; LS26, 2016), and state agents noted the public is involved in the process of rewriting NH's Wetland Rules and GP's, as there are public meetings and comment periods, with stakeholders from multiple disciplines offering feedback, which are taken into consideration and implemented as appropriate (LS18, 2016; LS27, 2017).

However, despite the existence of opportunities for public participation, many interviewees identified an overall lack of public engagement in shoreline protection decisions (LS01, 2016; LS03, 2016; LS06, 2016; LS07, 2016; LS08, 2016; LS25, 2016). As one scientist assessed:

I don't think the public is aware of the problems and the issues and the opportunities. So the public's not really doing anything right now. The public is... just out of it. I mean, we hope that they're going to be part of the discussion, but right now, I don't see the public as really being part of the discussion. (LS08, 2016)

Should the public participate in a public hearing, it is unclear how their input will be used in decision-making. As a stakeholder who works for a technical advisory organization stated:

[I]t's up to these... local people really paying attention, and taking the time out of their busy lives to, first of all, read up about [a project], do their homework, have [something] quasi-intelligent to say about it, maybe, and then go to the public hearing, which is in the evening, and speak up. And so, again, the beauty is there's the opportunity for public participation. But how often is that actually acted upon? And how often does that make any difference in the evaluation of and then the formulation of a final plan? (LS07, 2016)

Several stakeholders viewed the public's lack of knowledge, information, and confidence in living shoreline and soft shoreline management approaches as a barrier to living shoreline

implementation (LS02, 2016; LS03, 2016; LS11, 2016; LS24, 2016; LS25, 2016). And perceiving minimal public engagement in the process, stakeholders often suggested additional outreach to try to reduce the number of private property owners who were individually turning to grey infrastructure to stabilize their shorelines, increasing the amount of armored coastline at the community level.

### Opportunities:

#### ***Regulators encourage pre-application meetings early in the project***

Regulators said they encourage pre-application meetings, during which they meet with applicants while projects are still being designed (LS09, 2016; LS18, 2016; LS29, 2017). Meeting early allows participants to identify and discuss project challenges and options before too many resources are invested into a specific project design.

#### ***Project meetings make the wetlands permitting process more efficient***

Regulators encourage face-to-face project meetings to bring together the many advisory and regulatory actors who have a role in permitting a living shoreline with applicants. For example, one project applicant said:

You can get all those parties in one room on a big project, and get feedback, so that you're not... solving it in one office, and then going to the next office and the two don't know what's [been done]... So I've been extremely pleased with New Hampshire's ability to bring all the players together into a forum, so that it can be much more efficient. (LS10, 2016)

Bringing together all stakeholders facilitates communication, simplifies the logistics for applicants of coordinating input, and reduces the length of the permitting process. In addition, such meetings bring together in one place the diverse expertise needed for project success.

According to one regulator, in project meetings “we can tailor expertise... to project needs” (LS29, 2017). Face-to-face meetings allow actors with relevant expertise to discuss project options together and provide input to applicants to increase the likelihood of project success.

## **2.6 Discussion**

Throughout the interview data, there are multiple examples of stakeholders identifying benefits of living shorelines that closely coincide with the objectives of state-level wetland regulations in NH. Such benefits include the conservation of fish and wildlife habitat, the improvement of water quality, the management of storm and flood waters, and the preservation of recreational and aesthetic enjoyment for the public. One might, therefore, assume it would be easier to implement living shorelines as a coastal management approach than an approach, such as coastal armoring, which may not promote these same policy objectives. However, the current regulatory regime for coastal management in NH not only fails to adequately weigh a project’s positive benefits against negative impacts, but also facilitates the repair and in-kind replacement of inadequate or failing grey, coastal infrastructure. Coupled with the difficulty of effectively classifying living shorelines utilizing hybrid designs as either a restoration project or a bank stabilization project, the permitting process for living shorelines is perceived to be overly complex and arduous. Additionally, without the experience and confidence in living shoreline approaches, project developers, who would normally be guiding applicants through a difficult permitting process, are not promoting these techniques to coastal landowners.

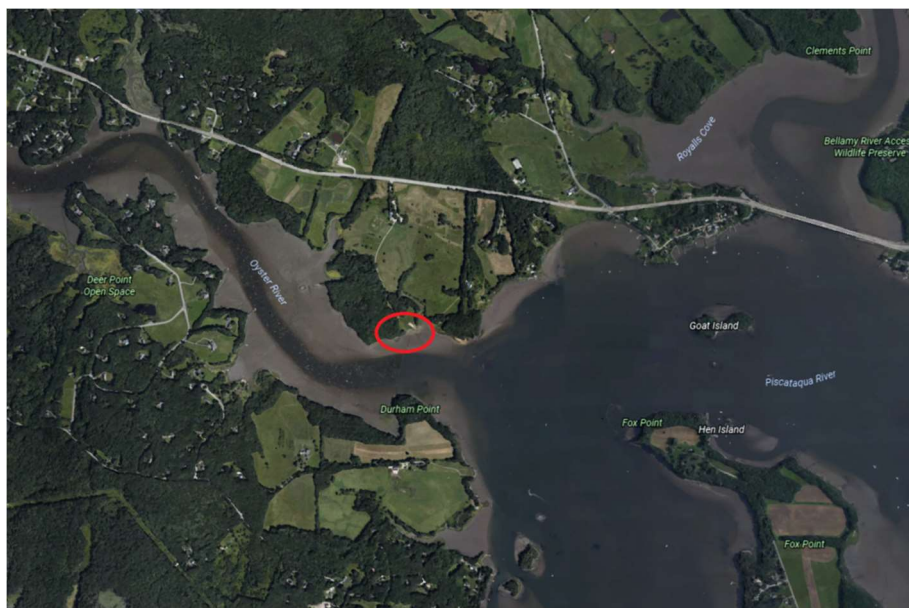
Nonetheless, evidence of both methods to overcome these barriers and opportunities to facilitate future living shoreline development is already apparent in the data. Regulators are promoting a collaborative approach with applicants and are encouraging them to engage during

pre-application meetings early in the permitting process. Project teams are using a diverse set of actors to effectively navigate the permitting process and are developing living shoreline projects that can be utilized as demonstration sites to advance local knowledge. And changes in the new NH GPs and future NH Wetlands Rules suggest a shift to be more accommodating for greener coastal management. While NH institutions for coastal management are familiar with permitting and implementing traditional grey infrastructure, there are changes that are occurring to allow for softer, greener techniques to be more easily established on the state's coastline.

## Chapter 3: Wagon Hill Farm, NH

### **3.1 Site Description & Background:**

Purchased by the town of Durham, NH for \$3.1 million in 1989, Wagon Hill Farm is a 139-acre property located along Route 4, east of the downtown (Fig. 3.1 & 3.2). Along with having a number of historic structures on-site, Wagon Hill Farm hosts a significant amount of recreational outdoor activities and community events, as well as environmental research and conservation opportunities. Since purchasing the property 28 years ago, the town of Durham and its Department of Public Works (DPW) have been aware of severe erosion occurring along the site's 6800-foot, southern shoreline, where the mouth of the Oyster River empties into Little Bay. In many areas along this shoreline, the fringing salt marsh has receded, and the subsequent erosion has forced the town, multiple times, to move existing structures, such as fences, away from the water. Solutions to this erosion issue have been discussed and reported on over the years, but little had been done until the start of the Wagon Hill Farm living shoreline project in 2016.



**Figure 3.1: Site of the planned living shoreline at Wagon Hill Farm, Durham**





Figure 3.2: Map of Wagon Hill Farm; Source: Ibis Wildlife Consulting

In 1990, not long after the purchase of the property, a Wagon Hill Farm Advisory Committee was formed to focus on the use and management of Wagon Hill Farm. Unfortunately, some key stakeholders were absent from the committee. For example, while the DPW was charged with maintaining the property, there were no members from the department included on the 36-member committee. Not being able to reach consensus among its members, and being viewed by some as ineffective, the committee disbanded a few years after its conception.

In 1995, at the request of the Durham Recreation Committee and the Strafford Regional Planning Commission (SRPC), the management consulting firm, the Cavendish Partnership, prepared a Master and Management Plan for Wagon Hill Farm – hereafter referred to as the “Cavendish Report.” The planning process of the Cavendish Report promoted extensive public participation and input, hosting three workshops for the community, as well as multiple, diverse lines of communication throughout the report’s development. The Cavendish Report identified that “creating a ‘balance’ between the natural, economic, political, and social environments in which constructive change can occur” (The Cavendish Partnership et al., 1995) would be a core challenge to the future management of Wagon Hill Farm, mirroring the goals of successful SES management.

Within the report, the Cavendish Partnership highlighted the deteriorating condition of the shoreline, citing the cause of the erosion as a result of “soil and ice and tidal forces and human intervention,” including “overuse by visitors” (The Cavendish Partnership et al., 1995). To address this issue, the report suggested the use of a soft, natural approach, hardening with rip-rap only where necessary.

This erosion, unchecked, has and will continue to result in degradation of the shoreline and salt marshes, negative impacts on wildlife, shell fish, and fish habitats. It is recommended that a shoreline stabilization program be implemented as soon as possible.



The measures taken should as minimally as possible [sic], emulating the natural conditions of the shoreline. (The Cavendish Partnership et al., 1995)

A rough process for the implementation of this kind of stabilization method was also included:

A softer form of shoreline stabilization would require the installation of vegetated fiber roll along the toe the slope backfilled with soil suitable for the salt marsh plantings. The system would include palette mats that are pre-vegetated to begin the initial revegetation of shoreline areas. This method is most desirable where the salt marsh has eroded and replacement is required to prevent further degradation of the salt marsh. (The Cavendish Partnership et al., 1995)

Through public input, the stabilization work was identified as a priority as part of the management at Wagon Hill Farm. While these specific recommendations were not immediately put into action, this proposed solution to the erosion problem was the first formal endorsement of the use of a living shoreline approach at Wagon Hill Farm, and the report set a foundation for future management plans for the property.

In order to help address the identified issue of foot traffic over the marsh to the water, Durham applied for and received a \$50,000 Coastal Zone Management grant in 2001, allowing the town to construct a public beach with water access and signage, as well as a split-rail fence along the remaining marsh. The town also contacted Dr. David Burdick, of the University of New Hampshire (UNH), the following year regarding the restoration of the salt marsh. However, while it was determined to be feasible, no project was initiated or went forward. In addition, to control a portion of the continuing erosion, approximately 20 feet of rip-rap was installed near the beach in 2006.

In 2009, the Durham Conservation Commission contracted Ellen Snyder, of Ibis Wildlife Consulting, to prepare a Stewardship Plan for Wagon Hill Farm to assess the resources of the property and make recommendations to guide their future management. The coastal erosion along the shoreline was again reported as a priority issue, with human activity again identified as

a primary contributing factor. Along with recommendations on improving the existing trail network and beach area to encourage their use and divert visitors off the marsh, the Stewardship Plan suggested the creation of off-shore oyster reefs, as well as a living shoreline:

A relatively new approach to protecting and restoring coastal shoreline is to create a “living shoreline.” In the past, hard structures, such as rip-rap and seawalls, have been used to prevent coastal erosion. Research has shown however, that these structures often increase erosion and limit the ability of the shoreline to carry out natural processes. The “living shoreline” technique uses more natural materials or a mix of soft and hard materials. This approach may be suitable for the shores along Wagon Hill Farm to prevent further erosion and begin to restore the salt marsh. (Snyder, 2009)

Additionally, the Stewardship Plan advised partnering with TNC, UNH, and NHCP for technical assistance and potential funding sources.

That same year, Ray Konisky of TNC and David Burdick proposed a joint project along the shoreline of Wagon Hill Farm that would combine a coastal salt marsh restoration with a constructed, offshore oyster reef to attenuate waves. However, the salt marsh restoration was abandoned after it was determined that an oyster reef would not provide sufficient wave protection due to its distance from the shore and elevational changes of the tides. The offshore oyster reef was still constructed.

Aside from moving the fence away from the shoreline, very little was done in terms of controlling the ever-progressing erosion, until the issue was brought back into focus at the end of 2014, with the first steps of what would become a Wagon Hill Farm Living Shoreline Workgroup.

### **3.2 Who Are the Actors & What Are Their Positions?**

In December 2014, as part of the NH Shoreline Management Conference, *The Hard and the Soft of Shoreline Management*, NHCP presented Wagon Hill Farm as a case study to

conference attendees in order to discuss hypothetical shoreline management solutions. A living shoreline was a proposed solution discussed and workshopped for the erosion issue at this site. Due to later news that Durham had allocated money in the 2016 Capital Improvement Program (CIP) specifically for erosion control at Wagon Hill Farm, NHCP approached Mike Lynch, Public Works Director of Durham, soon after this conference, to discuss the opportunity of a potential living shoreline implementation along the Wagon Hill Farm coastline. With the town interested in the idea, the first meeting of the Wagon Hill Farm living shoreline project took place in January 2016 at the Durham Town Hall, where the following group (Table 3.1) discussed the feasibility of the project, the potential causes of the erosion, and additional funding options.

**Table 3.1: Participants of the first Wagon Hill Farm living shoreline meeting**

<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Organization</i></b>
David Burdick	Associate Research Professor	University of New Hampshire
Wayne Burton	Town Councilor	Town of Durham
Rachel Gasowski	Parks & Recreation Director	Town of Durham
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Kevin Lucey	Restoration Coordinator	NH Coastal Program
Mike Lynch	Public Works Director	Town of Durham
Gregg Moore	Associate Research Professor	University of New Hampshire
Todd Selig	Town Administrator	Town of Durham

The first meeting was viewed as a success, due to the interest from those involved and the potential availability of additional funding. Soon after, a core workgroup was established, and NHCP institutionalized and facilitated regular project meetings at the Town Hall, often held monthly. At these meetings, the workgroup would discuss the project's current status, potential challenges, and next steps. Specific parties were invited to the established group, as it was determined that their inclusion would be beneficial. Such individuals included Dr. Tom Ballestero, a civil engineer and associate professor at UNH, David Price, East Region Inspector

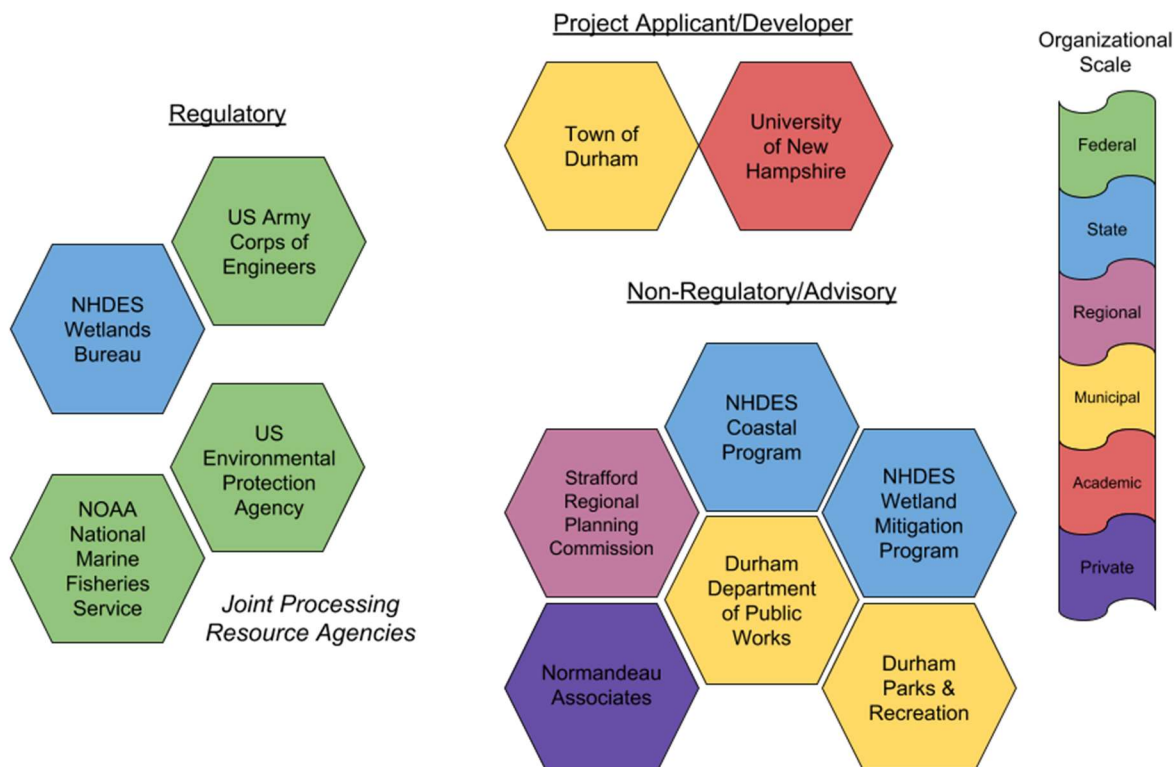
at NHDES Wetlands Bureau, and Lori Sommer, Mitigation Coordinator at NHDES Wetland Mitigation Program. NHDES agents recommended including regional contacts from federal agencies such as EPA, the Corps, and NMFS, so that they were aware of the project and available for input. Sarah Allen, a scientist working for the environmental consulting firm Normandeau Associates was included on the project as a representative of Eversource Energy, when it was determined the living shoreline project may be funded in part by wetland mitigation money coming the Eversource Seacoast Reliability Project (SRP). The following is the list of actors who were part of the Wagon Hill Farm Living Shoreline Workgroup as of January 2017, and who were invited to take part in the two focus groups held in February 2017 (Table 3.2).

**Table 3.2: Wagon Hill Farm Living Shoreline Workgroup participants as of January 2017**

<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Organization</i></b>
Sarah Allen	Principal Scientist	Normandeau Associates
Tom Ballestero	Associate Professor	University of New Hampshire
Melinda Bubier	ARM Fund Program Restoration Specialist	NHDES Wetland Mitigation Program
David Burdick	Associate Professor	University of New Hampshire
Liz Durfee	Regional Planner	Strafford Regional Planning Commission
Rachel Gasowski	Parks & Recreation Director	Town of Durham
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Gail Jablonksi	Business Manager	Town of Durham
Mike Johnson	Marine Habitat Resource Specialist	NOAA National Marine Fisheries Service
Dave Keddell	Regional Division Project Manager	US Army Corps of Engineers
Mark Kern	Environmental Scientist	US Environmental Protection Agency
Kevin Lucey	Restoration Coordinator	NH Coastal Program
Mike Lynch	Public Works Director	Town of Durham
Gregg Moore	Associate Professor	University of New Hampshire
Kyle Pimental	Principal Regional Planner	Strafford Regional Planning Commission
David Price	East Region Inspector	NHDES Wetlands Bureau
Todd Selig	Town Administrator	Town of Durham
Lori Sommer	Mitigation Coordinator	NH DES Wetland Mitigation Program
Dori Wiggin	East Region Supervisor	NH DES Wetlands Bureau

A conceptual visualization of the makeup of the workgroup (Fig. 3.3) shows a larger and more diverse collection of non-regulatory/advisory organizations than the more basic set from

the previous chapter. However, some of the state agencies responsible for specific permitting elements are noticeably missing, including NHB and DHR. While these agencies would be involved in the process moving forward, as the permits for the living shoreline would require elements from each, it was determined that their direct involvement on the workgroup was unnecessary at that time.



**Figure 3.3: Actors included on the Wagon Hill Farm Living Shoreline Workgroup, classified by their role and organizational scale or jurisdiction**

### **3.3 What Rules Do Actors Follow to Make Decisions?**

Members of the Wagon Hill Farm Living Shoreline Workgroup follow the federal, state, and local regulations in place for the development of a salt marsh restoration project in a tidal wetland, as described in Chapter 2. While the project is not expected to warrant Alteration of Terrain permitting, it will be subject to required permitting per RSA 482-A, Fill and Dredge in

Wetlands, and RSA 483-B, Shoreland Water Quality Protection Act, with all associated permitting elements.

### **3.4 What Are the Patterns of Interaction Between Actors?**

On February 2, 2017, a number of members of the Wagon Hill Farm Living Shoreline Workgroup (Table 3.3) gathered at the Durham Town Hall for a focus group designed to map the process of implementing the living shoreline project at Wagon Hill Farm. The finalized process map developed from the information gathered during the focus group can be seen on Table 3.4.

**Table 3.3: Participants of the first Wagon Hill Farm focus group**

<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Organization</i></b>
Tom Ballestero	Associate Professor	University of New Hampshire
Melinda Bubier	ARM Fund Program Restoration Specialist	NHDES Wetland Mitigation Program
David Burdick	Associate Professor	University of New Hampshire
Rachel Gasowski	Parks & Recreation Director	Town of Durham
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Kevin Lucey	Restoration Coordinator	NH Coastal Program
Mike Lynch	Public Works Director	Town of Durham
Gregg Moore	Associate Professor	University of New Hampshire
Kyle Pimental	Principal Regional Planner	Strafford Regional Planning Commission
Lori Sommer	Mitigation Coordinator	NHDES Wetland Mitigation Program
<i>unidentified</i>	<i>unidentified</i>	<i>unidentified</i>

While the long-term goal of the town is to manage the erosion along the entire southern shore of Wagon Hill Farm, the workgroup has split the work into three sites, with the living shoreline discussed in this chapter being developed at Site A, which starts at the public beach and ends approximately 300 feet to the west at a historic stone pier.

Table 3.4: Process map of the Wagon Hill Farm living shoreline project as described by focus group participants

	2014-2015	2016		2017	
<b>Identify Problem</b>	Durham master plan - need marsh restoration	WHFLS Work Group: 11 possible causes of erosion	Data Collection for Areas A, B, C		
<b>Propose Management Action</b>	NH Shoreline Conference: WHF example	NHCP & DPW discuss possible solutions	Discuss need for broad site management/control foot/dog traffic	Plan/design/engineer Area A pilot site & Competitive bid Areas B+C	Plan/design/engineer Areas B+C & Competitive bid Areas B+C
<b>Implement Management Action</b>	Fence moved 20ft			Implement Area A pilot Living Shoreline	Implement Area A pilot Living Shoreline
<b>Monitor Management Action</b>					5 year post implementation monitoring
<b>WHF Living Shoreline Work Group</b>		NHCP institutionalizes meetings - 10/yr	Meetings Scope work	Meetings	Meetings
<b>Permitting</b>		Decide who is lead federal agency: NOAA or USACE	No permits desirable for pre-implementation monitoring Durham limbs trees- no NEPA	Expedited general permit for temp. structure: NHB, Wetlands, Shoreland, Sec. 106	General permit for sites A, B, C & Sec. 106 New process - meet with feds & state regulators
<b>Public Engagement/Outreach</b>	Durham master plan meetings include WHF conservation, ag. rec. Trail mapping?	Durham Day	Society for Ecological Restoration field trip	Open town meetings	Durham Day Interactive bulletin board
<b>Explore Funding</b>		NHCP & DPW discuss funding opportunities	DES Wetlands & USACE connect Possibility to use Seacoast Reliability Project ARM funds for WHF	Durham applies for 2nd NHCP grant & receives funding award and approach Durham	
<b>Obtain Funding</b>			Durham approves 2016 budget with \$ for WHF LS project	Durham & NHCP 2nd grant on G+C agenda for approval	

### **3.4.1 Funding**

Funding of the project thus far came from many different sources, with each source having different prerequisites, allowed uses, and windows of availability. While the Town of Durham had allocated \$368,250 of appropriations and in-kind funds in the 2016 CIP to mitigate for the erosion, it was required that other grants and sources of funding were sought out.

The workgroup secured a \$20,000 NHCP Coastal Resilience Grant that included an equal \$20,000 match from the town, which could be put towards, what the workgroup identified as, Phase I of the project. This phase included actions such as pre-implementation monitoring and data collection, wetland delineation, alternative analyses, and pre-permitting meetings. A second NHCP Grant for \$28,332 was applied for, but still required Governor & Executive Council approval. This grant would cover the items of Phase II of the project, including further site characterization and monitoring, project planning and design, and permitting such as NHPA Section 106 and the NHB Report. Mitigation funds from the Eversource SRP were undetermined, but estimates put the available funds over \$200,000, which could potentially be used for Phase III, construction and implementation of a pilot project at Site A. There was also the possibility of additional ARM funds being used, but these funds would need to be applied for. In order to be eligible for ARM funds, the project would need to establish some scope with objectives; an advanced level of design and planning; a construction budget; completed pre-implementation monitoring; a commitment and plan for five years of post-implementation monitoring; and calculations of functions and values restored.



### **3.4.2 Data Collection**

The cause of the erosion along the coastline at Wagon Hill Farm was integral to the design of the living shoreline project that would be installed, and while there were reported claims of potential causes, there were no collected data to support one claim over another. Therefore, the UNH researchers on the project team set out to monitor the site and gather pre-implementation data in order to best determine the cause and extent of the erosion issue.

Through the use of over 80 erosion pins installed along the shoreline and historical aerial maps overlaid with current maps (Fig. 3.4), it was estimated that the rate of erosion at the site was approximately one foot per year over the last 20 years.



**Figure 3.4: Overhead view of the planned Wagon Hill Farm living shoreline site and reference marsh with the historic shoreline from 1992 outlined in pink**

Starting with 11 potential causes for the shoreline erosion and marsh recession, including boat wakes, human and animal traffic, insufficient light, and herbivory, the UNH researchers

tested and narrowed down the possible causes through methods of observation and instrumental measurements. Wildlife cameras were set up to capture foot traffic over the marsh and other visual cues, while instruments such as pressure transducers and light meters were set up to measure environmental conditions and changes. Additionally, the lower limbs of the trees adjacent to the marsh were taken down, with light levels measured both before and after. Through this data gathering, it was determined that forces such as boat wakes were less problematic, while shading from the trees along the bank, human and dog foot traffic, small waves and tidal forces, and upland stormwater runoff were determined to be a significant cause of the current situation.

Additionally, in order for a fringing salt marsh to sustain itself and build itself up as sea-level rises, it requires a reliable source of sediments that it can accrete. The final experimental assessment needed before the construction of the living shoreline on the site was to measure the available sediments in the system. To do this, the researchers planned to construct a temporary, 30-foot-long barrier made of wooden posts and coir logs in the inter-tidal zone, and test whether sediments accumulate behind it, replicating what they hoped to see with a marsh-and-sill living shoreline. The results from this data collection not only would guide the design of the living shoreline itself but direct the workgroup on priority issues when putting together a comprehensive land management plan for the site.

#### **3.4.3 Permitting & Regulatory Requirements**

There were many regulatory requirements the workgroup had to address in order to permit the living shoreline. One of the first was to determine which federal agency would be the Lead Federal Agency for the project. NHCP decided, between the Corps and NOAA, that the

Corps would take this role, providing leadership and assistance for requirements such as the DHR Section 106 review.

One area where additional regulatory action was avoided was in regard to the limbing of the trees along the shoreline. Had the work team used NHCP money to fund this work, it would have first required a NEPA review. The Town of Durham, having the resources through the DPW, did the limbing itself, thus circumventing the requirement of a NEPA review.

During a team meeting to discuss the permitting process, there was some initial confusion between stakeholders as to how the temporary, experimental structure would be permitted. State agents and UNH researchers had planned on permitting this structure separate from the final living shoreline structure. However, the federal regulator expected the temporary structure to come as part of the entire project's permit application. As the results of the experimental structure would help guide the final design of the living shoreline, the participants decided it was necessary that the permitting of this structure was separate from the rest of the project, as long as all components were properly permitted.

The experimental structure classified as a Minimum Impact Project and required the application of an Expedited NHDES Wetland Permit that included the NH PGP and NHB Review. In addition, due to the nature of the living shoreline being a publicly funded restoration project with state oversight, NHDES determined the project would also classify as a Minimum Impact Project that would require a Wetland Permits with the GP Appendix B and the NHB Report, as well as an RPR for Section 106.

#### **3.4.4 Outreach & Public Engagement**

Public engagement at Wagon Hill Farm became a priority in 2015 when SRPC was assisting Durham in updating their 2015 Master Plan. Within the Recreation Chapter of the Master Plan is a section devoted to Wagon Hill Farm and its long-term use. When SRPC brought their recommendations to the Planning Board at a public hearing, many residents attended to voice their opinions. Between the representatives from the different town boards and the participating public, there were three philosophies of thought for the desired future use of the property: conservation, agriculture, and recreation. While there was contention among the different groups, all three interests were eventually included in the Master Plan with the recommendation to continue collaboration towards an updated management plan. This focus on the future goals and management for the property provided the impetus for controlling the erosion along the southern shoreline.

The site of the future living shoreline got more public attention in September 2016 at Durham Day, an annual community celebration and barbeque held at Wagon Hill Farm. Equipped with an informational poster created by SPRC staff, *What Could a Living Shoreline at Wagon Hill Farm Look Like*, Mike Lynch, David Burdick, Kirsten Howard, and Trevor Mattera engaged interested residents with details of the issue along their coast and the solutions in the works.

Shortly after Durham Day, in October 2016, the Society of Ecological Restoration – New England held its two-day conference, *Ecological Restoration in a Changing Climate*. During the second day of the conference, David Burdick and Trevor Mattera hosted a field trip showcasing a number of salt marsh restoration sites in the area. Wagon Hill Farm was the last site visited, where we described the erosional issue taking place, and put the participants to work, designing

potential living shoreline approaches that could be implemented. Many of the plans that the field trip participants designed included elements that focused on including and educating the public. This included allowing visitors to view the living shoreline from a walkway or raised platform, as well as learn about its design and benefits from informational signage.

### **3.5 Data & Analysis:**

On February 7, 2017, the following members of the Wagon Hill Farm Living Shoreline Workgroup (Table 3.5) gathered at the Durham Town Hall for a second focus group to identify and discuss the barriers and opportunities that they had experienced or expected to encounter during the implementation process of this project. Participants identified a subset of barriers and opportunities on worksheets, and then marked those elements on the process map using colored dots, in order to guide the discussion. Process barriers and opportunities were later organized thematically for analysis (Table 3.6).

**Table 3.5: Participants of the second Wagon Hill Farm focus group**

<b><i>Name</i></b>	<b><i>Title</i></b>	<b><i>Organization</i></b>
Tom Ballestero	Associate Professor	University of New Hampshire
Melinda Bubier	ARM Fund Program Restoration Specialist	NHDES Wetland Mitigation Program
David Burdick	Associate Professor	University of New Hampshire
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Kevin Lucey	Restoration Coordinator	NH Coastal Program
Mike Lynch	Public Works Director	Town of Durham
Gregg Moore	Associate Professor	University of New Hampshire
Kyle Pimental	Principal Regional Planner	Strafford Regional Planning Commission
Todd Selig	Town Administrator	Town of Durham

**Table 3.6: Barriers and opportunities of the Wagon Hill Farm living shoreline implementation process as identified by focus group members, and organized by categories adapted from Clean Water America Alliance (2011)**

	<b>Barriers</b>	<b>Opportunities</b>
<b>Technical/ Physical</b>	<ul style="list-style-type: none"> <li>• No other local example to reference</li> <li>• Limited experience/design guidance in northern climates</li> <li>• Long term history of habitat change in [Oyster River]</li> <li>• Unsure how process has worked elsewhere</li> <li>• People's perception/understanding of the concept was not well developed – difficult to “see”</li> <li>• No established process (state &amp; Fed) (design, construction...)[1]</li> <li>• Design options are experimental to some extent, risky</li> <li>• Design of shoreline</li> <li>• Sediment budget in system (will learn)</li> </ul>	<ul style="list-style-type: none"> <li>• Spectrum of expertise</li> <li>• UNH's role – combined technical experience as well as the ability to convey the info to various groups. Also vested in the project from a research perspective.</li> <li>• UNH has the knowledge to scope the work</li> <li>• UNH Staff</li> <li>• Work w/ NHCP as participants</li> <li>• First Erosion Control LS in NH</li> <li>• Provides demonstration project to leverage future work</li> <li>• Data collection for this project and future use</li> <li>• Wagon Hill is “visible”</li> <li>• Access</li> </ul>
<b>Financial/ Resource</b>	<ul style="list-style-type: none"> <li>• Few sources of funding in NH that support innovative projects</li> <li>• Complex funding needs or limitations</li> <li>• Funding sources limited, complicated, political (Fed funding requirements)</li> <li>• Federal funding limits actions (slows process, prevents particular actions)</li> <li>• Funding/cost – project may be expensive to implement since it is “new”</li> <li>• Funding of data collection &amp; monitoring uncertain</li> <li>• Funding unclear</li> <li>• Uncertainty of funding sources</li> <li>• ARM mismatch</li> <li>• Synchronizing the timing funding opportunities</li> <li>• Significant time requirement for meetings</li> <li>• Monitoring post-construction into long term</li> <li>• Time &amp; funds allocated to understanding the problem</li> <li>• Time it takes searching for and applying funding sources</li> </ul>	<ul style="list-style-type: none"> <li>• Federal funding limits action (ensure that undertaking is prudent &amp; not detrimental)</li> <li>• Durham allocating money in the budget</li> <li>• Work w/ ARM as participants</li> <li>• Town's involvement, particularly the DPW. They have resources, ideas &amp; experience to implement the project</li> <li>• [UNH also has] the resources/knowledge to pursue the research, which an engineering firm would not</li> <li>• Tracking costs of project</li> <li>• UNH to collect data and monitor without certain funding</li> </ul>
<b>Legal/ Regulatory</b>	<ul style="list-style-type: none"> <li>• Permit hurdles for pilot or final</li> <li>• No established process (state &amp; Fed) (...permitting)[2]</li> <li>• Permit process</li> <li>• Permitting</li> <li>• Sec 106 His. Res. – No excavation</li> <li>• Regulatory objection to fill</li> <li>• Various constraints</li> <li>• Lack of communication or consensus among permitting agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Regulators engage in the process</li> <li>• NHDES</li> </ul>
<b>Community/ Planning</b>	<ul style="list-style-type: none"> <li>• Many players needed to attend mtg's &amp; discuss</li> <li>• Site control/management</li> <li>• Competing uses, needs, goals for site (maybe)</li> <li>• Absence of two of the three “user” groups</li> <li>• No agriculture or conservation</li> <li>• “Too many cooks in kitchen”</li> <li>• Unable to agree on anything</li> <li>• Multiple expectations of community property</li> <li>• Future options are limited by previous mgt decisions (ie beach)</li> <li>• Education/outreach necessary</li> <li>• Public engagement in Durham</li> <li>• Community support</li> <li>• WHF “visitor” habits</li> <li>• Lack of community input on future use of WHF</li> <li>• Existing and future public use</li> <li>• Perception of the public to avoid federal funding in case of hidden requirements or “strings attached”</li> <li>• Perception of mistrust from the public due to the receiving of Eversource funding, making the science “illegitimate”</li> <li>• Lack of an institutionalized “task force” for living shoreline projects</li> </ul>	<ul style="list-style-type: none"> <li>• Success seen as trifecta of engineering, ecological, &amp; social success</li> <li>• Interest from multiple agencies, parties, researches in making a pilot project happen &amp; figuring out causes first</li> <li>• Integrated plan to manage people &amp; use, restore habitat</li> <li>• Strafford Regional Planning</li> <li>• Recreation was represented [*marked as Barr]</li> <li>• Public outreach/education</li> <li>• Public engagement in Durham</li> <li>• Community knowledge of ecosystem and climate change characteristics</li> <li>• [Local Knowledge] provided context</li> <li>• Providing local knowledge was helpful in understanding history of site/property</li> <li>• Community support</li> <li>• Understood importance of property to town</li> <li>• “Caretaker” – could this person provide education/stewardship for entire property</li> <li>• Partnership between Durham &amp; UNH</li> <li>• Durham staff attitude, willingness to take action</li> <li>• Town Leadership</li> <li>• Selection of Durham is important (buy-in)</li> <li>• Some communities are leaders – some follow by example</li> <li>• Town embraces an adaptive management approach</li> </ul>

### **3.5.1 Technical & Physical**

#### **Barriers:**

##### ***Lack of design standards & technical guidance – specifically for northern climates***

Considered to be the first erosion-control living shoreline in NH, and with very few projects in New England from which to draw experience, many of the identified technical and physical barriers to implementing the living shoreline at Wagon Hill Farm centered around a lack of local references and guidance for the design. Additionally, group members perceived that there was no established process for the construction and monitoring of a living shoreline that they could easily reference. As described by one focus group participant, “we can plan and build something similar to what’s out there using a template of what we think is successful, but I think the guidance is limited.”

##### ***Lack of technical knowledge & experience***

Similarly, as this was a new technique to many, some participants cited group members’ inexperience with living shorelines overall as a barrier to the project. This included a lack of understanding of the living shoreline approach that was described as “hard to see” when presented with the concept for the project, as well as an uncertainty of how living shorelines were implemented elsewhere.

##### ***Risk due to uncertainty in design & performance***

There was a significant experimental factor to this project that the workgroup acknowledged. For instance, the living shoreline at Area A was designed in multiple sections, each using different materials. This had initially been done to demonstrate what distinct styles of

living shorelines could look like at the site. However, upon seeing this multi-sectioned construction, the town decided that it would be beneficial to build the project that way, allowing stakeholders to evaluate how each design functioned and performed. Members of the workgroup recognized the inherent risk in this sectional arrangement, which the town was willing to accept.

### ***Unknown sediment budgets & habitat changes in system due to feedback***

The uncertainty of how habitat and environmental conditions would change with the introduction of new system feedback was identified as a challenge by scientists on the focus group. Conditions that were mentioned included the sediment budget in the system and how that might change if, for example, dams in the watershed were removed.

### ***Opportunities:***

#### ***Creation of demonstration site to foster learning & experience for future projects***

Although being the first example of an erosion-control living shoreline in NH came with identified challenges, focus group participants also acknowledged the benefits of exhibiting this project as a demonstration site to leverage future work. This idea was supported due to the fact that the Wagon Hill Farm living shoreline is a “visible” site, with a large amount of the public visiting the nearby beach, lawn, and trails annually.

#### ***Data collection to support current & future project design***

Seen as a significant, yet uncommon, opportunity for the project, the workgroup was allowed the time and resources to sufficiently assess the erosion issue and collect pre-implementation data before designing a solution. As described by Kirsten Howard:



I think it was a big commitment from Durham to say ‘Ok, we actually need to step back and figure out what’s going on here,’ when a lot of people... had opinions about what they thought the issue is. So I think that it’s to their credit to actually say ‘Ok, we’re willing to take maybe a year to really figure this out.’ Not everybody is inclined to do that.

It was widely agreed upon, among focus group participants, that the data collection was critical to the design of a successful, sustainable project, allowing for the project designers to determine the aspects that would be necessary to halt the erosion, and to facilitate future project development.

### ***Project meetings incorporate diverse expertise needed for project success***

Many focus group participants saw the benefit of their workgroup incorporating many different stakeholders with a range of knowledge and expertise. This included staff from UNH and NHCP for their technical knowledge and assistance to get the living shoreline designed and constructed. It was also seen to benefit the project that UNH had a vested interest from a research perspective.

### ***Site access***

Unlike some project sites, the Wagon Hill Farm site is easily accessible for both people and vehicles, and as it is publicly owned, it is open to site visits without needing landowner permission. Stakeholders identified this accessibility as a benefit to the implementation process.

## **3.5.2 Financial & Resource**

### **Barriers:**

### ***Uncertainty of funding sources***

Challenges regarding the funding of the project were discussed multiple times throughout the focus group. Of the nine people in attendance, five (56%) identified the general action of “Obtain Funding” as one of their three barriers. The actions of “Explore Funding” and “Obtain Funding,” with the specific, associated steps, accounted for eight of the possible 27 barrier dots (30%) in the exercise.

One of the prevalent themes of the challenge of funding was the uncertainty involved, both in obtaining it and knowing how much would be needed. As described by David Burdick:

I think it was the uncertainty in funding. Uncertainty always creates barriers. If you talk to anybody who’s doing anything, creating anything, there’s uncertainty. And so, one of the biggest uncertainties – we all know we want to do something good, but we don’t know if we can get it done, if we have the resources to get it done the way it should be done.

David Burdick specifically highlighted the challenge in the uncertainty of funding from the Eversource SRP mitigation later on in the discussion:

On the funding side, just tying it to the Eversource funding, we’re kind of going along, and we’re spending a lot of time... and we’re just sort of all hoping [to receive this funding].

### ***Significant costs of time & money***

Participants also identified the costs of the project as a barrier, both in terms of the financial costs of understanding the problem and implementing the living shoreline, and of the costs in time for meetings and pre-implementation monitoring. These costs led to even further uncertainty as to how much funding should be budgeted and sought after for different actions in the process. This barrier was closely related to the common technical barrier of limited experience in design.

### ***Lack of funding sources***

Limited funding sources, especially those that support innovative projects, was seen as a challenge, due to the presumed higher costs of a pioneering technology and a new and unfamiliar implementation process.

### ***Complexity & requirements of public & federal funding***

Focus group participants perceived that funding sources had a challenging number of requirements or limitations on where, when, and how they could be used. This included the requirement to match habitat and functions for ARM funds, as well as the prevention of particular actions when using Federal funds.

### ***Synchronizing funding sources, budgets, & schedules***

Another significant theme observed when discussing the barriers of funding was of the timing of funds, and specifically, the synchronizing of the windows of funding availability with the windows in which actions needed to be taken and those funds could be utilized. As described by Gregg Moore:

It's not like there's a rotating door, like "Hey, get your good idea all squared away. Just come on in, and press the button, and money comes out." We've had to have all these meetings, and all these things have to align, and then you go "Oh, shit...." So, the synchronizing, the timing of opportunities for match – for funding or match – they rarely align.

### ***Long-term funding for monitoring & adaptive management***

Lastly, looking to the future, the workgroup perceived that there would be a challenge procuring long-term funds to be used for required post-implementation monitoring and any potential alterations or maintenance for the living shoreline as those data are gathered.

### Opportunities:

#### ***Source of funding as impetus for project***

During the focus group, there were four opportunities identified regarding the funding of the project. The first was Durham allocating money in their budget to begin with. Without that financial support from the town, many in the group agreed that this project had little chance of being pursued.

#### ***Federal funding to incentivize implementation in support of resilience***

The second was the concept that the use of federal funds gave confidence that the undertaking was prudent. The combination of NHCP grants and ARM funding required that the project be a salt marsh restoration that supported coastal resilience.

#### ***Integration of stakeholders who can provide funding, resources, & flexibility***

The third funding opportunity was recognizing the different stakeholders that could bring capacity and resources to the table. Participants identified ARM Program representatives, Lori Sommer and Melinda Bubier from NHDES. Additionally, the town of Durham was recognized, and particularly the DPW for “hav[ing] the resources, ideas, and experience to implement the project.” Finally, UNH staff were acknowledged for having the resources to perform the research needed, as well as the flexibility to start collecting pre-implementation data before having all funds in-hand.

#### ***Tracking economic costs to use for & compare to future projects***

Lastly, as it was discussed by Melinda Bubier, the tracking of costs for this project would

be a great opportunity for others wanting to implement a living shoreline in the future:

I think it would be very unique and beneficial to future projects and other towns following [this] project if... we could funnel that information to this core group, so that you could lay out the costs – and the true costs.... What is the design cost, the construction cost? And part of that construction cost is really being honest about what the DPW puts into it.... Really tracking, so that when we move projects forward the next time, people aren't sticker-shocked – when you put it out to a consulting firm, or you put it out to bid – as to what that true cost really is.

It was agreed that tracking the costs of money and time of this project would then allow for future projects to become “compressed” and cheaper.

### **3.5.3 Legal & Regulatory**

#### **Barriers:**

##### ***The wetlands permitting process is burdensome & challenging***

Permitting of both the experimental structure and the final living shoreline design was a commonly identified barrier among focus group members, because of a lack of an established permitting process for a living shoreline. Participants felt that this was due to a project like this not having been permitted in NH.

It was also mentioned that in other areas of research there are established processes for research permits that do not currently exist for this kind of research in tidal wetlands. Therefore, the required permitting for data collection and, specifically, the 30-foot experimental structure, was significant, adding complexity to and slowing the implementation process of the project.

##### ***Lack of communication or consensus among permitting agencies***

The prior barrier was further compounded when there was confusion between state and federal regulators as to how the project was being permitted, and how the experimental structure

fit into that permitting process. Had there not been a need to permit the experimental structure or had there been a recognized research permit or process, researchers would have had the structure in place in the fall of 2016 with data available for the following year.

### ***Regulatory objections to fill***

Additionally, stakeholders identified that regulatory objections to excavation and fill within tidal wetlands made living shoreline permitting and implementation more difficult. Similarly, excavation in the shoreland would potentially require a costly archaeological investigation of the site due to Section 106 Review, discouraging the workgroup to grade inland.

### ***Opportunities:***

#### ***Regulators are willing to engage with applicants***

While the lack of an established permitting process and regulators' unfamiliarity with permitting a living shoreline were seen as barriers, the level of participation of those same regulators was seen as a benefit to the process, with many focus group participants citing the inclusion of the agents from NHDES Wetlands Bureau and the Corps as an opportunity. According to the state agents, this integration and the opportunity to visualize the technology was allowing them to overcome a "resistance" to these types of projects.

#### ***Support of project from regulatory agencies***

In addition to a willingness to participate as part of the workgroup, stakeholders perceived that the regulators and resource agencies involved had genuine interest in and support of the project, which was viewed as a great benefit to its implementation.

### **3.5.4 Community & Planning**

#### **Barriers:**

##### ***Many actors required to come together for the project***

Many focus group participants acknowledged the difficulty of coordinating and gathering so many stakeholders with busy schedules for formalized meetings.

##### ***Site control & management can be challenging with multiple expectations & competing uses for the site***

Many participants discussed barriers stemming from a difficulty in balancing the management of the property and its shoreline with what the public wanted or expected. There was an agreed upon perception that the public strongly valued the beach, access to the water, and a place for their dogs to have fun, thereby, potentially not aligning with the needs of the workgroup to prevent people and animals from traveling over the living shoreline and marsh.

This difference of values was acknowledged by Gregg Moore during the focus group:

What we perceive is useful or needed is not necessarily what [the public wants]. Folks who are tax payers think “This money shouldn’t be used for this. It should be...” – God knows what.

Aside from simply focusing on the living shoreline site, participants discussed the comprehensive management of the Wagon Hill Farm property, which was determined to be an important aspect of the sustainable management of the project. The contention that was encountered during the Master Plan update was seen as a potential source for barriers, especially if the process for determining the property management was missing crucial stakeholders, such as those representing the interests of agriculture and conservation.

### ***Public outreach, education, & engagement necessary***

Although identified by some of the participants as a barrier to the implementation process, there was a recognized need for education and outreach to help the public understand what this project was about and how their support factored into its success. This was due to the many identified challenges that the project faced that linked back to public behaviors and opinions, including Wagon Hill Farm visitors walking on the marsh, the perception that the public avoided federal funding in case of “strings attached” and hidden requirements, and public mistrust due to the perception that using Eversource funding made the science “illegitimate.” As focus group participants acknowledged that community support would be necessary for the success of the project, this kind of public outreach to break through these perceptions would be required.

### ***Opportunities:***

#### ***Collaboration from multiple stakeholders to look at project comprehensively & solve an issue***

Although there were perceived difficulties of organizing formalized meetings, many saw the benefit of having the number of diverse stakeholders present and involved in the process. For example, SRPC was identified for their help with the public engagement. Additionally, participants called out the partnership between Durham and UNH as a real driver of this project.

#### ***Integrated plan to manage people & use, while restoring habitat***

Dealing with the erosion issue with a comprehensive plan was viewed very positively by participants. It was recognized that simply installing the living shoreline alone would not get at the root cause of the problem and dealing with visitors’ behavior and site management was



equally important. To this end, it was also suggested that a “caretaker” position could be created to help aid in this comprehensive management plan.

Additionally, the success of the project was discussed in terms that mirrored the successful management of social-ecological systems. Gregg Moore identified the opportunity of having an integrated plan to both manage people and restore habitat, and discussed the ideas of both technical and social success:

I’m getting back to Tom’s point about success, right? So, whether there’s a viewing platform, from an ecological perspective makes no difference. But I do think that – especially with the way this is playing out with the players at this table – we need to talk about success at – I think we need to embrace success as engineering success, ecological success, and social success as the solution. We can’t pick and choose, in my view on that, because it is a public resource.

It was questioned by other participants whether this concept of requiring “a trifecta” to success was a barrier to the implementation of the project, but he quickly defended his opinion: “No, I think it’s an opportunity because then it stands up better with the three of those in place.” And others saw the potential for support of future projects due to this complete social-ecological success.

### ***Public outreach, education, & engagement for building & integrating local knowledge***

Although also identified as a challenge by many, public outreach, education, and the garnering of community support was seen an opportunity of promoting this project. Moreover, participants acknowledged the local knowledge that they gathered and could use in the process, including the understanding of the contextual history of the site and the importance of the property to the town.

### ***Durham leadership, attitude, & willingness to take action***

The leadership of Durham as a community and of their DPW on this project was also identified by multiple participants as an opportunity. There was a perception that the town had an attitude and willingness to take action that coupled with the resources and experience of the DPW to greatly benefit the project's implementation. This buy-in from Durham was deemed significant, as it created the opportunity of other communities following by example.

It was also identified that, while the town was very supportive of the project, it was also very transparent to the public, extensively communicating what was happening to town boards and residents alike, while balancing the amount of information provided, so as not to overwhelm their audience. Town officials on the workgroup agreed, stating that this level of transparency was typical for Durham, and facilitated the process for them, as there was less pushback on projects. It was perceived that not all communities had as transparent a process, but this was common for projects of all sizes in Durham.

Lastly, many of the technical opportunities discussed during the focus group stemmed from Durham's willingness to adopt and, according to Mike Lynch, "embrace" an adaptive management approach to this project, which in itself was seen as a significant opportunity.

### **3.6 Discussion:**

While there were a number of barriers in the process of implementing the living shoreline at Wagon Hill Farm, as identified by the Wagon Hill Farm Living Shoreline Workgroup, many of those were due to inexperience of those involved with the design, implementation, funding, and permitting of the first erosion control living shoreline in NH. However, just as frequent was the identification of this project being an opportunity for all those involved to learn, adjust,

streamline, and optimize their processes, so as to facilitate future living shoreline projects in the state.

Much of this project's capacity to serve as a learning opportunity can be attributed to Durham's embrace of a true adaptive management approach to its implementation. This began with the lengthy, yet critical, phase of assessing and understanding the issue through acquiring pre-implementation data at the site. This assessment is directly affecting the final project's design, implementation, and comprehensive management. Taking this experimental design a step further, the town is motivated to try a multi-staged living shoreline, with differently designed sections, in order to monitor and evaluate the efficacy of varying constructions. To allow for this, the town is consciously accepting a higher burden of uncertainty and risk in the project. However, seeing the value in the information that even a section's failure can provide, the town is taking a long-term view of this project and its influence on future living shoreline projects at Wagon Hill Farm and elsewhere in NH.

Another element that appears to be helping the workgroup overcome barriers, and advance the project's implementation, is utilizing the flexibility of the allowable actions of actors on the project team. For example, UNH researchers were flexible as to when they could go out to the site and install the equipment needed for pre-implementation data gathering, when waiting could have cost the project team valuable time and caused them to miss vital windows of opportunity. Similarly, the Durham DPW used town resources to get the trees along the shoreline limbed, absorbing the costs, with the added benefit of avoiding the need for a NEPA review and additional regulatory hurdles. Being able to recognize and effectively employ this inherent flexibility in the allowable actions of some positions is a strategy that the workgroup is utilizing to reduce costs and decrease barriers.

Lastly, as identified by the participants of the focus group, the high level of diversity and integration of positions and knowledge within the workgroup significantly benefits the process. Although this inclusion comes at a real economic cost, with participants needing to regularly find time to meet, the advantage of having the right stakeholders at the table to discuss and resolve issues or confusions as they come up keeps the process advancing and keeps all those involved on the same page. This inclusion also provides important stakeholders with direct exposure and experience that will help them overcome barriers stemming from unfamiliarity of projects of this type, facilitating future implementation processes.

There are certainly barriers within the Wagon Hill Farm living shoreline implementation process that will not be overcome simply through experience or integration alone and require more direct intervention. These include a regulatory environment that is averse to structures and fill, regardless of purpose, and funding sources that are variable and uncertain. However, within this institutional framework, the Wagon Hill Farm Living Shoreline Workgroup is advancing a project that could be used in the future as a model that could help to overcome such challenges.

## Chapter 4: Cutts Cove, NH

### 4.1 Site Description & Background:

Located in Portsmouth, NH, just east of Route I-95 and north of Market Street, Inner Cutts Cove is a small inlet where North Mill Pond meets the Piscataqua River (Fig. 4.1). The upland on the southern slope of the cove is owned by the city, and the fringe salt marsh on the southern bank has been degraded for decades. In 1985, the decommissioned submarine, the USS Albacore, was transported through Cutts Cove to its present place of residence, Albacore Park, south of Market Street (Fig. 4.2). After the Albacore's successful move, the bank was armored with stone rip-rap, and has remained that way until recently (Fig. 4.3), when the site was targeted for salt marsh restoration to mitigate for the nearby Sarah Mildred Long Bridge replacement project (Dinan, 2016).



Figure 4.1: Site of the living shoreline in Cutts Cove, Portsmouth



Figure 4.2: The USS Albacore is moved through Cutts Cove. Source: <http://www.ussalbacore.org>



Figure 4.3: Rip-rap along the southern shoreline in Cutts Cove

#### **4.1.1 Sarah Mildred Long Bridge Project**

A lift bridge that spans the Piscataqua River, and connects Portsmouth, NH with Kittery, Maine as part of the U.S. Route 1 Bypass, the 77-year-old Sarah Mildred Long Bridge was closed in August 2016, with a new, replacement bridge scheduled to be opened in September 2017 (WGME, 2016). The construction project, NH Department of Transportation (NHDOT) Project #15731, consisting of the erection of the new Sarah Mildred Long Bridge, the removal of the old Sarah Mildred Long Bridge, and the relocation of the railroad that travels across Cutts Cove, is estimated to impact a total of 101,230 square feet of wetlands and tidal buffer zone. In 2014, a Wetlands Permit was approved for the project, which included a one-time, in-lieu mitigation payment of \$351,895.87 to the NHDES ARM Fund (NHDES, 2014).

#### **4.1.2 Market Street Gateway Park**

Starting with a conceptual plan in 2008, the city of Portsmouth has been developing and implementing its Market Street Gateway Corridor Improvement Project: a series of significant streetscape and waterfront enhancements along Market Street, which includes the construction of the new Sarah Mildred Long Bridge. The objective of the project is to create a more memorable and inviting gateway into the city's historic downtown area (The Cecil Group, 2008). As part of the Market Street Gateway project, a riverfront park is planned for development on the parcel of filled land between Market Street and the southern bank of Cutts Cove (Fig. 4.4).

This riverfront park will take a presently uninviting tract of land and convert it into an attractive public greenspace, significantly increasing the visibility of the Cutts Cove shoreline and restoration site. However, the parcel, where the park will be built, serves as the point of access to the Cutts Cove salt marsh restoration site, thereby requiring timing and coordination



between projects. The riverfront park project was permitted by the NHDES Wetlands Bureau in 2015, and town officials estimate that construction will begin in 2018 (NHDES, 2015b).



Figure 4.4: Conceptual design of the riverfront park, as seen in RSG & Richardson & Associates (2013)

## **4.2 Who Are the Actors & What Are Their Positions?**

The project team of the Cutts Cove living shoreline (Table 4.1) closely resembles that of a traditional wetland restoration project for mitigation, including project engineers and developers from UNH, regulators from NHDES and the Corps, and city officials from Planning and the Conservation Commission. Additionally, the team includes representatives from federal resource agencies, as well as from NHDES Wetland Mitigation Program, NHDOT, and FHWA from where funding would be coming.



**Table 4.1: Cutts Cove living shoreline project team as of February 2017**

<b>Name</b>	<b>Title</b>	<b>Organization</b>
Joel Ballestero	Research Engineer	University of New Hampshire
Tom Ballestero	Associate Professor	University of New Hampshire
Peter Britz	Environmental Planner	City of Portsmouth
Melinda Bubier	ARM Fund Program Restoration Specialist	NHDES Wetland Mitigation Program
David Burdick	Associate Professor	University of New Hampshire
Nancy Carmer	Economic Development Program Manager	City of Portsmouth
Michael Hicks	Project Manager	US Army Corps of Engineers
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Gino Infascelli	Public Works Permitting Officer	NHDES Wetlands Bureau
Mike Johnson	Marine Habitat Resource Specialist	NOAA National Marine Fisheries Service
Dave Keddell	Regional Division Project Manager	US Army Corps of Engineers
Mark Kern	Environmental Scientist	US Environmental Protection Agency
Ruth Ladd	Policy and Technical Support Branch Chief	US Army Corps of Engineers
Robert Landry	Administrator	NHDOT Bureau of Bridge Design
Steve Miller	Conservation Commission Chair	City of Portsmouth
Gregg Moore	Associate Professor	University of New Hampshire
David Price	East Region Inspector	NHDES Wetlands Bureau
Mike Ruth	Ecologist	USDOT Federal Highway Administration
Fred Short	Research Professor	University of New Hampshire
Jamie Sikora	NH Division Environmental Program Manager	USDOT Federal Highway Administration
Lori Sommer	Mitigation Coordinator	NHDES Wetland Mitigation Program

A conceptual visualization of the makeup of the project team (Fig. 4.5) illustrates a structure with fewer non-regulatory/advisory organizations than Wagon Hill Farm from Chapter 3, but a similar showing of regulatory agencies. Like the visualization from Wagon Hill Farm, the actors shown below are those that are actively communicating and meeting as part of the project team. Organizations and agencies excluded from the visualization, such as NHB and DHR, do not signify an exclusion from the process as a whole, but simply a lack of representation on the formal project team at the time of this research.

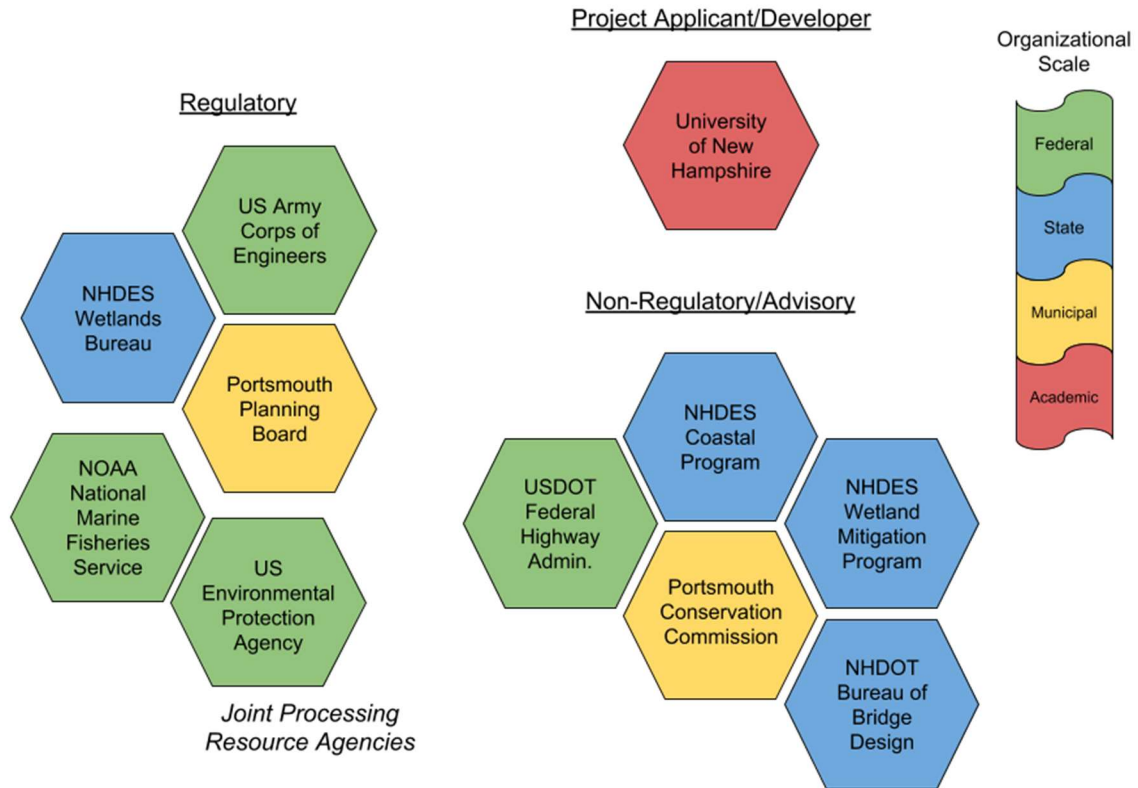


Figure 4.5: Actors included on the Cutts Cove living shoreline project team, classified by their role and organizational scale or jurisdiction

#### **4.3 What Rules Do Actors Follow to Make Decisions?**

The Cutts Cove living shoreline is a public salt marsh restoration mitigating for the wetland impacts caused by the Sarah Mildred Long Bridge. Therefore, the rules followed by involved actors match those described in Section 2.3. This includes rules concerning the appropriate disbursements of permittee-responsible and in-lieu payments, as required of NHDOT.

#### **4.4 What Are the Patterns of Interaction Between Actors?**

On March 21, 2017, a number of project team members of the Cutts Cove living shoreline (Table 4.2) gathered at the NHCP office at the Pease International Tradeport in Portsmouth for a project update meeting and focus group. The focus group was designed to map

**Table 4.2: Cutts Cove focus group participants**

<b>Name</b>	<b>Title</b>	<b>Organization</b>
Peter Britz	Environmental Planner	City of Portsmouth
Melinda Bubier	ARM Fund Program Restoration Specialist	NHDES Wetland Mitigation Program
David Burdick	Associate Professor	University of New Hampshire
Kirsten Howard	Coastal Resilience Specialist	NH Coastal Program
Mike Johnson	Marine Habitat Resource Specialist	NOAA National Marine Fisheries Service
Ruth Ladd	Policy and Technical Support Branch Chief	US Army Corps of Engineers
Steve Miller	Conservation Commission Chair	City of Portsmouth
David Price	East Region Inspector	NHDES Wetlands Bureau
Lori Sommer	Mitigation Coordinator	NHDES Wetland Mitigation Program
Christos Tsiamis	Community Engagement Specialist	Great Bay National Estuarine Research Reserve
<i>unidentified</i>	<i>unidentified</i>	<i>unidentified</i>
<i>unidentified</i>	<i>unidentified</i>	<i>unidentified</i>
<i>unidentified</i>	<i>unidentified</i>	<i>unidentified</i>

the process of the living shoreline project implementation at Cutts Cove, and to identify and discuss the opportunities and barriers they had experienced or expected to encounter during the process. Prior to convening, the entire project team was surveyed to gather information of the implementation process at Cutts Cove. This information was used to make a preliminary process map, which was reviewed and amended at the focus group. The finalized process map developed during the focus group can be seen on Table 4.3.

#### **4.4.1 Funding**

In 2013, before the NHDOT had settled on mitigating Sarah Mildred Long Bridge project impacts via an in-lieu fee to the ARM fund, they had approached researchers at UNH to see if a Permittee-Responsible Mitigation project could be created. Professors David Burdick, Gregg Moore, and Ray Grizzle developed a mitigation plan for Cutts Cove involving salt marsh restoration, in the form of a living shoreline; eel grass bed restoration; and mudflat enhancement.

Table 4.3: Process map of the Curtis Cove living shoreline project as described by focus group participants

	2013	2014	2015	2016	2017	Future
<b>Identify Problem</b>	NHDOT - SML Bridge impacts tidal wharf NOAA: Eel grass (NEPA)	Data collection: invertebrates & sediment samples	Data collection: Condition of marine bottom	Data collection: fish		
<b>Propose Management Action</b>	NHDOT engages UNH Team: Eel grass	UNH proposed to NHDOT: Eel grass & rock Mudflat dredge & LS	UNH proposal - limited Mudflat & 800 ft LS	UNH Team adds restoration engineer to develop construction UNH & DES meets to review design	Bid & select with contractor	Wharf replacement berth work
<b>Permitting</b>			UNH submits permit to wetlands for mudflats	UNH submits permit for 800ft LS to Wetlands UNH & DES meet and review permit - need additional information	Pre-construction review of conditions in permit	
<b>Explore Funding</b>	Considered for mitigation SML Bridge	Mitigation project too long NHDOT negotiates \$400k in-lieu ARM for Bridge (not wharf)	UNH proposed to DES for ARM Fund with DOT match: mudflat & 800ft LS	UNH Team, ARM Program staff, NHDOT discuss funding construction of 200ft LS & 3-5 yr monitoring (DOT match)	NHDES, NHDOT, UNH effort to fund 600ft LS: mitigation (NEPA?) - New process with Fed Highway - Eel grass can come back in	Funding
<b>Obtain Funding</b>			\$135k ARM Fund Grant approval: 200ft LS & 2/3 mudflat			
<b>LS Project Meeting</b>		NHDOT organizes 1st meeting		UNH Team organizes 2nd meeting	UNH Team organizes 3rd meeting	
<b>Public Engagement/Outreach</b>		NHDOT & UNH present project to Cons. Comm. - before Sept.	Discussions UH & City DPW about concept	Project presented to Portsmouth Cons Comm - for permit Need for collaboration park & LS project -	DPW & UNH - collaborate for access to site	
<b>Implement Management Action</b>		Need to collaborate with park				LS Construction - May Planting (summer/fall) with volunteers & schools
<b>Monitor Management Action</b>						5 year post implementation monitoring
<b>Park</b>						Roadway - permitted Park - 1-2 yrs out

This project was taken before the Portsmouth Conservation Commission in 2014, where it was determined that its timing would have to be coordinated with the construction of the already-designed riverfront park. However, with the mitigation project expected to take too long, NHDOT instead negotiated the \$351,895.87 in-lieu fee with NHDES, approved in Wetlands Permit 2014-01053, and the restoration project was taken off the table.

In 2015, UNH researchers applied for ARM funding for a proposed 800-foot living shoreline and mudflat enhancement project in the cove. This proposal was defended to a large group of federal and state agency staff on-site, and was later approved, albeit only partially funded. The UNH team was awarded \$134,736 of ARM funds, which would cover the costs of a 200-foot living shoreline project and approximately two thirds of the proposed mudflat enhancement. Additionally, NHDOT pledged an equal match of funds, to be used for earthwork and three to five years of monitoring.

In the spring of 2016, a restoration engineer joined the UNH team to help develop plans for the needed earthwork. Meanwhile, the UNH team continued meeting with NHDOT and NHDES ARM Program staff in order to secure the funding for the promised match. These discussions eventually led to a project group meeting in an effort to acquire funding for the full project as it was initially proposed, again including the lost 600 feet. NHDOT submitted the idea of advance mitigation, wherein the mitigation, for which NHDOT would be responsible for a future wharf replacement as part of the Sarah Mildred Long Bridge project, could be put towards this restoration project. This process, however, needed approval from the U.S. Department of Transportation (USDOT) – Federal Highway Administration (FHWA), who would be reimbursing NHDOT for the costs of the mitigation. This was the first time that project partners

could recall a collaboration of this kind between NHDOT and FHWA, and initially it seemed promising, as all parties involved supported the idea.

However, by the time of the project meeting and focus group, the plan had fallen through, with NHDOT and FHWA in disagreement. According to project members, FHWA claimed that another NEPA assessment was needed for the wharf replacement and was not willing to risk advanced funds before that took place. NHDOT stated that a NEPA assessment had taken place for the bridge project, including the wharf replacement, and therefore, was not needed again. However, NHDOT would not take the same risk by putting forth its own money for the advance mitigation. At that time, funding for the additional 600 feet of living shoreline had not been secured.

#### **4.4.2 Data Collection**

Data collection in Cutts Cove began back in 2014, with an ecological assessment that included soil sampling and preliminary marine bottom surveys, as well as an invertebrate survey. Physical and ecological data collection continued through 2015 and 2016 with further marine bottom surveys and fish surveys.

#### **4.4.3 Permitting & Regulatory Requirements**

Permitting of the Cutts Cove living shoreline project consisted of the Wetlands Permit (2016-01460) that was presented to the Portsmouth Conservation Commission and submitted to NHDES in May 2016. This permit application also included the NH PGP, NHB report, and DHR RPR. According to project members, there were multiple discussions during that year between the UNH team proposing the project and the NHDES staff permitting it, in order for the state

agents to gather additional information. However, due to the role of state oversight and the salt marsh restoration occurring at the site, the project was permitted as an expedited Minimum Impact Project in November 2016. Then, in March 2017, the UNH team, the contractor, and the NHDES regulator met for a pre-construction review of the conditions in the permit.

There was no consensus among project members as to whether there was a Lead Federal Agency for the project, although, it was assumed by some to be FHWA.

#### **4.4.4 Outreach & Public Engagement**

Outreach for the project primarily consisted of discussions and collaboration between the UNH team and the City of Portsmouth's DPW, Conservation Commission, and Planning Board. Although the living shoreline and the riverfront park projects were planned for similar timetables, and many in the project group felt the work for the two projects could have been better synchronized, the park's designs had been permitted, and therefore, the city was reluctant to alter them. Nonetheless, coordination between these two projects is required, as access to the living shoreline site is through the parcel where the park will sit. This collaboration of timing is still ongoing.

Additional outreach is planned for the future construction of the living shoreline, when volunteers and school children will be invited to help plant vegetation.

#### **4.5 Data & Analysis:**

A subset of barriers and opportunities were identified by participants of the Cutts Cove focus group and marked on the process map using colored dots in order to guide the discussion. These process barriers and opportunities were later organized thematically for analysis (Table 4.4).

**Table 4.4: Barriers and opportunities of the Cutts Cove living shoreline implementation process as identified by focus group members, and organized by categories adapted from Clean Water America Alliance (2011)**

	<b>Barriers</b>	<b>Opportunities</b>
<b>Technical/ Physical</b>	<ul style="list-style-type: none"> <li>• Having to sequence the bridge project apart from the wharf replacement caused problems with the mitigation and getting the entire LS project completed</li> <li>• Construction limitations... working “in the dry” when water is low only; timing of day (no weekends), not before 8 or after 5; physical limits of practically sized machinery</li> <li>• Site constraints – limits for excavation, city proposed park, access, road, tidal changes, soft mud, Portsmouth allowable work hours/days</li> <li>• LS project is a compensatory mitigation project/requirements for SML bridge, which constrains what can be done – i.e. first responsibility for us is to ensure impacts are mitigated for</li> <li>• Early concept plans was hard to “see” the concept, esp. since LS so new</li> <li>• Not having the design plans earlier on caused some misunderstanding by members of ARM committee about benefits at this location</li> <li>• Decision to split project into two</li> <li>• Complex nature of mitigation</li> <li>• City park is a constraint for developing a resilient living shoreline (climate change &amp; marsh migration) marsh lifespan is constrained by limits of migration</li> </ul>	<ul style="list-style-type: none"> <li>• Developing some standard design plans for future LS opportunities will greatly facilitate future projects</li> <li>• Adds another method for restoration-type work, thus broadening the spectrum of available methods to mitigate impacts</li> <li>• Site characteristics – easy access, easy mobilization, easy stockpiling, constructability</li> <li>• Get professionals (engineer) on team early on in the process</li> <li>• Project team including engineers/designers has made the project more realistic</li> <li>• Lots of eyes on project, so many people/agencies who will get to see this type of work... will broaden exp. &amp; knowledge of important people/agencies to this type of work</li> <li>• Lots of room for growth and development of methods &amp; early start on an issue (erosion, habitat, WQ) that find solutions that work in the future</li> <li>• Holistic ecosystem – nature of original proposal</li> </ul>
<b>Financial/ Resource</b>	<ul style="list-style-type: none"> <li>• Lack of money</li> <li>• Process of approving funds from FWHA &amp; DOT is constraining constructing LS project</li> <li>• Coordination of funding. Because there are different sources available at different times, it is not accessible when it is needed</li> <li>• Funding... obviously. Timing of funding. Bureaucracy of funding</li> <li>• Conflicts between FHWA/DOT and other agencies in advance mitigation. All thought of except FHWA which said DOT must front the \$\$ and get paid back later</li> <li>• Combining ARM funds with Permittee Responsible Mitigation (PRM) scheduling can be difficult</li> <li>• Funding issues</li> <li>• Costs... this stuff is expensive to build/do/permit, Esp when compared to “visible” projects (roads, bridges, parks, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Funding – real impetus to move project forward</li> <li>• Funding of ARM fund is accomplished from funds from compensatory mitigation – funds may have been difficult to find otherwise</li> <li>• Use of ARM funds – a source of funding which came originally from a project right at the mitigation site</li> <li>• ARM potential future \$ - match from DOT</li> <li>• ARM funds</li> <li>• Use of UNH resources – physically close; great expertise &amp; passion for LS concept</li> </ul>
<b>Legal/ Regulatory</b>	<ul style="list-style-type: none"> <li>• Permitting – always a slow, thorough process. Not necessarily consistent. At times lack of clarity</li> <li>• Expiration of existing permits</li> <li>• Design plans for permitting</li> <li>• Communication among permitting agencies/agency – DOT/FHWA misunderstanding</li> <li>• All the components of the permitting seem very difficult to tease out into what is/are the consensus</li> <li>• Permitting questions with DES approving as minimum and Corps unclear if a major</li> </ul>	<ul style="list-style-type: none"> <li>• All resource agencies at the table and agreement on project value. This created a lot of support for the project and allowed for easier permitting process</li> <li>• Support from regulatory agencies &amp; community – without such support, successful projects are almost impossible</li> <li>• Interest in project from agencies</li> <li>• Bring project in during a pre-app with all state &amp; agency partners</li> <li>• Have more flexibility with permitting, meaning if the permit is based on a habitat that will never survive the location again – how/why would you base a permit on that? – base it instead on an improvement to habitat from what is there now</li> </ul>
<b>Community/ Planning</b>	<ul style="list-style-type: none"> <li>• A lot of agencies &amp; participants involved... trying to get all parties on same page, in same room, prioritize, etc... just a lot of eyes (might change in future)</li> <li>• So many partners; Misunderstanding of LS project</li> <li>• It is hard to understand who is driving this bus – multiple headers &amp; I am not clear on roles – Require a PI or lead</li> <li>• Coordination between LS project and City park plans – timing, esp. but also conflict with desire to create more gentle slope</li> <li>• Missed coordination w/ City – would have been good to have LS part of city plan</li> <li>• Timing w/ City park; needs space for project &amp; city park plans</li> <li>• Timing issues w/o city &amp; park; lack of marsh migration area</li> <li>• City park is a constraint for developing a resilient living shoreline (climate change &amp; marsh migration) marsh lifespan is constrained by limits of migration</li> <li>• The need and time commitment of public engagement</li> </ul>	<ul style="list-style-type: none"> <li>• Right partners at table for a variety of issues</li> <li>• Willingness of a large group of people/agencies to work together to find solution</li> <li>• Working more collaboratively on front end with DOT to look at project comprehensively</li> <li>• City has been supportive, despite the LS not being their project</li> <li>• UNH team creation</li> <li>• Public education at park</li> </ul>



#### **4.5.1 Technical & Physical**

##### **Barriers:**

##### ***Misunderstandings or miscommunication of project design & benefits***

The lack of a standard design concept and the unfamiliarity of both state and federal agents with living shoreline designs and benefits were seen as barriers that then affected the project's permitting and funding going forward. As recalled by a regulator when first reviewing the initial application:

Well, I remember the couple meetings with Rich Roach, and everybody's kind of going around – didn't really know enough about the project, hadn't really been pulled together... we just don't really know enough yet, and yet we have to issue – this permit has to go out.

Lori Sommer, of NHDES, also discussed sharing this misunderstanding of the design and benefits of the project:

I recall that [misunderstanding] was reflective of the ARM Fund Committee's first look at this concept when it came in, because I don't think they had much experience with these types of projects. Living shoreline work has been a recent kind of habitat restoration effort, so I think we're all learning. And when this first type of project was in front of the ARM Committee that isn't [very] familiar...with that kind of concept, I think there was hesitation in fully investing in it.

Had the design been further developed at the time, Lori believed there would have been a good chance of it being awarded full ARM funding.

##### ***Complex nature & constraining requirements of compensatory mitigation project***

It was noted that, unlike the Wagon Hill Project, which was a municipal project to halt erosion, the Cutts Cove living shoreline was specifically a compensatory mitigation project for the Sarah Mildred Long Bridge. Therefore, there were physical requirements in the type of

habitat and ecosystem functions that had to be replaced, technically constraining the project's design.

### ***Construction limitations & site constraints***

Specific site and construction limitations, such as the city only allowing work done between 8:00 am and 5:00 pm only on weekdays, the physical limits of practically-sized machinery, and the requirement of working “in the dry” when the tides were not high enough to flood over the project site were all noted as challenges for the project team. This window of timing for construction had to then overlap with a series of lower high tides, making the scheduling of work very stringent.

### ***Opportunities:***

#### ***Creation of demonstration site to foster learning & experience for future projects***

Much like the Wagon Hill Farm Living Shoreline Workgroup, the project team for Cutts Cove saw this project as a large opportunity to serve as a demonstration site, supporting similar projects in the future. As it was identified by one participant, this project “adds another method for restoration-type work, thus broadening the spectrum of available methods to mitigate impacts.” It was also recognized that this project would expand the experience of this type of technology with the involved agencies, provide data on the benefits of this technique in regard to benefiting habitat and water quality, and help develop standard designs for future living shorelines in the state.

### ***Project meetings incorporate diverse expertise needed for project success***

While there was a recognized misunderstanding of the project design early in the process, participants agreed that this barrier was overcome in 2016 when a UNH restoration engineer joined the team and applied their expertise to the design the project. Adding this technical capacity to the team was viewed as a significant opportunity, selected more than any other step on the process map, and the designs that were produced “made the project more realistic” for many of the state and federal agents involved. It was suggested that future projects include this engineering expertise early in the process.

It was also identified that this diverse stakeholder integration allowed for a number of people and agencies that are important to this process to be able to observe this type of work and broaden their experience and knowledge of living shoreline approaches.

### ***Site access***

Although the specific limitations to the site were well recognized by the project team, many also acknowledged the easy physical access to the project site, as well as the available space to stockpile materials and equipment and construct the living shoreline, as welcome opportunities.

### **4.5.2 Financial & Resource**

Aspects of funding were commonly perceived as challenges, with 12 of the 22 identified barriers on the process map (55%) falling under the categories of Exploring or Obtaining Funding. However, the funding on the table was also what got this project to become a reality.

### Barriers:

#### ***Significant costs of time & money***

It was quickly identified that it was simply expensive to design, permit, and build this type of project. This also included the required time that project team members needed to put into meeting and discussing the project.

#### ***Synchronizing funding sources, budgets, & schedules***

The timing and coordination of funding and funding sources was identified as a challenge multiple times and discussed extensively among the focus group participants. As expressed by one group member:

I think, veiled in this, which is very common for many restoration projects, you have many sources of funding that sunset at different times. And, just like in this project, it's not on the table at one time, and it makes it very challenging, and that's why it's... a barrier.

Similarly speaking to the difficulty of coordinating various funding sources, a federal regulator noted: "Combining ARM Fund with Permittee-Responsible Mitigation (PRM) – scheduling can be difficult."

#### ***Complexity & requirements of public & federal funding***

The unexpected disagreement between NHDOT and FHWA over the issuance of advance mitigation money was also brought up frequently as a hindrance to the living shoreline implementation. After the previous project meeting, many in the group had anticipated this money to be available for the missing 600 feet of the project. Therefore, the "bombshell" of FHWA saying "DOT must front the money and get paid back later" – as described by a federal regulator – was seen by many as "constraining construction" and, thus, a barrier to the process.

### ***Lack of funding sources***

As it was still uncertain whether there would be funding for the remaining 600 feet of the originally proposed project, a lack of current and future funding was a common topic among discussed challenges. Additionally, while ARM Program staff encouraged communities to have their “shovel-ready list” of projects, municipal officials revealed that, even for a city such as Portsmouth, there may be a need for additional resources dedicated to that effort:

We talked about it, but we haven’t been good about having that on-the-shelf project [list]. We know it’s advantageous to have it, and we want it, but... it’s hard to add a work task when you have other priorities. It’s hard to get those things you really want to do. We need three [more environmental planners].

### ***Opportunities:***

#### ***Source of funding as impetus for project***

While there were not a large number of diverse funding opportunities mentioned, the availability of ARM funds for this project was identified multiple times and focus group participants brainstormed possible ways of using the ARM program to further facilitate living shoreline implementation. A challenge of ARM funding, which was discussed, was the lack of ready project designs when direct mitigation or ARM money became available. However, Melinda Bubier brought up an idea that consisted of focusing funds, such as those from NHCP, specifically for designing projects so that plans were prepared when funds for those projects were offered:

I think it does get back to what you were saying, tying to the funding. When I mentioned the park, and couldn’t [the living shoreline] be part of the land planning... Maybe fit [that] into Kirsten’s program a little better, where that’s what the Coastal funds are for, for planning. So, if people are planning for these types of projects, include that in their city plan. Maybe if the city had included that in their park plan, whenever they developed it, and then the opportunity arose for the DOT mitigation, it would have been further along. I mean, they put together design plans for a park that’s not being constructed for two years. How neat would it be for them to plan for a living shoreline project that is

sitting on their shelf, when mitigation dollars become available, that that's available for them to do? Why is that different than a park, ultimately? I mean, they paid for that design.

This concept could then address the lack of resources that communities may have in trying to have predesigned projects.

### ***Integration of stakeholders who can provide funding, resources, & flexibility***

The availability of UNH as a valuable source of resources was identified as an opportunity to the Cutts Cove project, as it had been for the Wagon Hill Project.

### **4.5.3 Legal & Regulatory**

#### **Barriers:**

#### ***The wetlands permitting process is burdensome & challenging***

It was acknowledged that the permitting process was generally slow and arduous. Yet there were not many specific barriers discussed in terms of the permitting of the Cutts Cove project. As described by one of the participants, the actors involved in the process were slowly becoming accustomed to it:

The other [piece] is the permitting. And a lot of these are novel projects, and I think it seems like, slowly, we're getting all the permitting [figured out]. Everybody knows who everybody is. Everybody knows what's being expected, who's going to be federal lead, etc. That seems pretty straight forward.

Therefore, it seemed as though experience with the process was helping to overcome this barrier.

#### ***Lack of communication or consensus among permitting agencies***

Nonetheless, a theme related to regulatory barriers did emerge from the discussion of permitting: a perceived lack of communication between permitting agencies. One example that

was cited was the situation of NHDES approving the project as Minimum Impact and the Corps questioning whether it should be Major Impact. Another was the misunderstanding between NHDOT and FHWA on whether another NEPA review was required. These examples of miscommunication caused confusion that ultimately complicated the process.

### *Opportunities:*

#### ***Regulators are willing to engage with applicants***

A number of the focus group participants identified the regulatory agencies' presence at the table as an opportunity, making the permitting process easier and project success more likely. It was suggested to bring these agents into the project early during a pre-application meeting.

#### ***Support of project from regulatory agencies***

Similarly, stakeholders perceived genuine interest and support from regulatory agencies, which was viewed as a significant opportunity to the process. Regulators' agreement of the project's value was seen as a great benefit to this project and future work.

#### ***Create flexible permitting that adequately considers impacts & benefits***

As a way to promote projects that benefited coastal habitat, one participant suggested that permitting be more flexible to better consider benefits and impacts, especially of those dealing with habitat conversion. As it was put at the focus group, "if the permit is based on a habitat that will never survive [in that] location again, why would you base a permit on that? Base it, instead, on an improvement to habitat [that] is there now."

#### **4.5.4 Community & Planning**

##### **Barriers:**

##### ***Lack of coordination with city regarding site planning***

One recurring theme among the barriers concerning community and planning was the riverfront park. There were several references to its adverse effect on site access and long-term project success due to it being designed and scheduled separately from the living shoreline. Multiple participants, including Kirsten Howard, from NHCP, noted the lack of marsh migration area, which was an element many had hoped to see included:

The whole city issue is, in my mind, [missed] potential for collaboration on the project. Even in the construction, if they could have better coordinated the marsh migration area in particular. That was a novel idea that, at least, [NHCP was] interested in. But the timing just didn't really work, and the priorities weren't aligned.

This lack of an integrated migration area for the salt marsh was seen as an issue due to projected sea-level rise, and how that will affect the marsh in the near future.

##### ***Many actors required to come together for the project***

Having such a large project group with so many people involved was seen as a barrier, as it required getting a large number of parties in the same room and on the same page.

##### ***Lack of facilitator to coordinate project stakeholders and process***

In addition, meetings were not facilitated. According to Steve Miller, this made it difficult to determine who was leading the project. He introduced the concept of having a “bus driver” for the implementation process. Other participants added to this concept, suggesting the project facilitator’s role could keep a timeline of upcoming items, and generally spearhead the process. It was mentioned that this actor would “need that understanding of the permitting



process, the funding, the local coordination. They [would] need a pretty broad understanding of all the aspects.” It was proposed that this could be a role for NHCP.

### ***Public outreach, education, & engagement necessary***

As it was for Wagon Hill Farm, public engagement was discussed at the Cutts Cove focus group. And while it seen as necessary, it was also identified as a barrier for the amount of time and effort it required. As described by one focus group participant:

That last piece is always that whole public engagement. And my own personal experience is, if you don’t beat the bushes and get input from any person possible, ultimately, they’re going to make your life miserable. So, you can’t have enough public presentations... and it’s just time consuming.

### ***Opportunities:***

#### ***Collaboration from multiple stakeholders to look at project comprehensively & solve an issue***

While difficult to gather and coordinate a large group of project members, having “the right partners at the table” was seen as an opportunity for sharing knowledge and experience among stakeholders, and for having the right actors who could aid with “a variety of issues.” One participant also identified this project spurring the creation of a “UNH team” that could work on living shoreline projects.

#### ***Public outreach, education, & engagement for building & integrating local knowledge***

Through signage, volunteer involvement, and a visible location relative to the new park, there were many prospects of engaging with the public that the project team identified. As mentioned, this education of and support from the community was seen as vital to this project and future work.

### ***Integrated plan to manage people & use, while restoring habitat***

Some participants saw this project as an opportunity to work collaboratively with NHDOT, looking at a project comprehensively from the front end. This also included the integration of the outreach material and potential public education program.

### ***Portsmouth support of the project***

Lastly, while the living shoreline was not necessarily Portsmouth's project, many stakeholders recognized how supportive the city had been of its implementation.

## **4.6 Discussion:**

Unlike the project at Wagon Hill Farm, the primary purpose of the living shoreline at Cutts Cove is one of mitigation, and not to solve an existing erosional issue. This is an important distinction to make, as it greatly determines the objectives of the project, potentially affecting project bounds and defining opportunities and barriers.

As an example, funding was identified as one of the most significant barriers to the implementation process of Cutts Cove, with the uncertainty of sources causing the project to often become reduced or stalled. This barrier could be expected from a mitigation project, which is inherently bound by the amount of mitigation required and funds allocated. This is unlike a living shoreline at Wagon Hill Farm, where an actor is paying for a solution to an issue, and there should be less risk of funding becoming unavailable while the issue remains.

Conversely, as a salt marsh restoration project, the construction and monitoring of the living shoreline is eligible for complete funding as a wetlands mitigation project. Therefore, it

comes as no surprise that the ARM Fund is rightfully viewed, by project members, as a readily available resource and an opportunity. Although, as mentioned by participants of the focus group, project designs must be advanced enough to prove practicality and compete for funding. Having an engineer or designer early in the process is identified as a great advantage. And, while communities may not initially possess the needed resources to prepare these “shovel-ready” plans on their own, this becomes an area where a number of advisory organizations can become involved, helping to identify project sites, secure design funding, offer informational resources, and provide design guidance. Being proactive about having restoration plans prepared makes a community significantly more competitive for available ARM Funds, which could potentially decrease the uncertainty of funding when trying to acquire money from multiple sources.

An additional benefit of a public living shoreline project, with oversight from the state and the purpose of restoration, is that permitting can be quicker and cheaper, due to it being permitted as an expedited Minimum Impact project. This classification reduces the application fees, as well as the review and time needed for authorization. The reduced permitting time is greatly beneficial to a project that must be constructed during very specific and tight timing windows. The Cutts Cove project team additionally capitalized on this opportunity through the inclusion of involved stakeholders, and specifically, regulators, early in the project. While state agents recognized their inexperience with this type of project as a barrier, this inclusion was identified as an opportunity to grow their knowledge and comfort working with and permitting these techniques.

Similar to Wagon Hill Farm, it was identified that the inclusion of a wide array of diverse stakeholders facilitates the process by having access to the knowledge and expertise of those actors during the implementation and keeping those involved on the same page as the project

progresses. However, it was wisely mentioned during this focus group that this kind of collaborative effort greatly benefits from a “bus driver” to help steer the process and keep the project on task. Again, an advisory organization that has solid, general knowledge of all the elements of the process may best fit this role. With this position filled, the inclusion of multiple stakeholders early and throughout the process can greatly reduce or mitigate barriers, such as the uncoordinated timing and management of projects, or the communication between agencies, and increase the chance of a successful implementation.

## **Chapter 5: Analysis and Recommendations**

### **5.1 Comprehensive Analysis**

This research aims to both identify coastal management institutions that inhibit or facilitate living shoreline implementation and compare these to the living shoreline and SES literature. We therefore combined all barriers and opportunities identified through the NH state-level analysis and the Wagon Hill Farm and Cutts Cove subcases and compared these to the barriers and opportunities in the literature. We categorized all barriers and opportunities following the same format used in Table 1.6, based on the four categories used in Clean Water America Alliance (2011): technical/physical; financial/resource; legal/regulatory; and community/planning. This format is useful because, although this analysis is focused on institutional barriers, many other barriers and opportunities were identified in the course of this research. The Clean Water Alliance (2011) categories helped us represent these non-institutional barriers and opportunities, while focusing on those most relevant to the institutional analysis. Tables 5.1a and 5.1b (below), bring together the data from the literature, the state-level analysis, and the Wagon Hill Farm and Cutts Cove subcases. The barriers and opportunities categorized as “technical/physical” or “financial/resource” are shown in Table 5.1a, and those categorized as “legal/regulatory” or “community/planning” are shown in Table 5.2a. The upper section of each table (in orange) represents the barriers and opportunities that were identified in the literature, but not in our NH data. The middle section of each table (in blue) represents the barriers and opportunities that were identified in the literature and in our NH data. The lower section of each table (in green) represents the barriers and opportunities that were in our NH data, but not in the literature. Footnotes provide information about the specific data sources.

**Table 5.1a: Comparison of barriers and opportunities identified from the literature and the NH case study.**  
**Data source:** <sup>1</sup> Literature, <sup>2</sup> NH Statewide research, <sup>3</sup> NH Wagon Hill Farm subcase, <sup>4</sup> NH Cutts Cove subcase

	<u>Technical/Physical</u>	<u>Financial/Resource</u>
	<b>LITERATURE ONLY</b>	
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Techniques have variable levels of performance or success</li> <li>• Not practical in all situations due to landscape restrictions or environmental conditions</li> <li>• Hybrid systems can still have some negative ecological impacts</li> <li>• Lack of data &amp; understanding of the provided benefits &amp; co-benefits</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of data &amp; understanding of the economic costs &amp; benefits</li> <li>• Too much financial risk, without enough incentives</li> <li>• Site-specific decision-making overlooks system-wide benefits to other constituencies, &amp; imposes costs on the property owner</li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Hybrid approaches can be used in areas with limited space</li> <li>• Hybrid approach can aid coastal habitat restoration</li> <li>• Hybrid designs can capitalize on the strengths of natural &amp; built infrastructure while aiming to minimize the weaknesses of each</li> <li>• Development of risk &amp; resilience performance metrics to consider processes &amp; outputs across a range of scales</li> </ul>	<ul style="list-style-type: none"> <li>• Generation of a compilation of information on the ecosystem goods &amp; services, &amp; quantify their value</li> <li>• Development of a consistent set of metrics to effectively monetize ecosystem goods &amp; services, &amp; incorporate consideration of them into project cost-benefit analyses</li> </ul>
	<b>LITERATURE &amp; NEW HAMPSHIRE</b>	
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Lack of design standards &amp; technical guidance<sup>1,3</sup></li> <li>• Lack of technical knowledge &amp; experience<sup>1,3</sup></li> <li>• Unknown sediment budgets &amp; habitat changes in system due to feedback<sup>1,3</sup></li> <li>• Risk due to uncertainty in design &amp; performance<sup>1,3</sup></li> <li>• Misunderstandings or miscommunication of project design &amp; benefits<sup>1,4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Lack of funding sources<sup>1,3,4</sup></li> <li>• Synchronizing funding sources, budgets, &amp; schedules<sup>1,2,3,4</sup></li> <li>• Long-term funding for monitoring &amp; adaptive management<sup>1,3</sup></li> <li>• Complexity &amp; requirements of public &amp; federal funding<sup>1,3,4</sup></li> <li>• Significant costs of time &amp; money<sup>1,3,4</sup></li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Creation of demonstration sites to foster learning &amp; experience for future projects<sup>1,3,4</sup></li> </ul>	
	<b>NEW HAMPSHIRE ONLY</b>	
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Project developers do not promote living shorelines to clients<sup>2</sup></li> <li>• Complex nature &amp; constraining requirements of compensatory mitigation project<sup>4</sup></li> <li>• Construction limitations &amp; site constraints<sup>4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Uncertainty of funding sources<sup>3</sup></li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Benefits promoted by living shorelines are consistent with the intent of state coastal regulations on coastal development<sup>2</sup></li> <li>• Data collection to support current &amp; future project design<sup>3</sup></li> <li>• Project meetings incorporate diverse expertise needed for project success<sup>3,4</sup></li> <li>• Site access<sup>3,4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Integration of stakeholders who can provide funding, resources, &amp; flexibility<sup>3,4</sup></li> <li>• Tracking economic costs to use for &amp; compare to future projects<sup>3</sup></li> <li>• Source of funding as impetus for project<sup>3,4</sup></li> <li>• Federal funding to incentivize implementation in support of resilience<sup>3</sup></li> </ul>

**Table 5.1b: Comparison of barriers and opportunities identified from the literature and the NH case study;**  
**Data source:** <sup>1</sup> Literature, <sup>2</sup> NH Statewide research, <sup>3</sup> NH Wagon Hill Farm subcase, <sup>4</sup> NH Cutts Cove subcase

	Legal/Regulatory	Community/Planning
	<b>LITERATURE ONLY</b>	
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Projects require decisions made by both Federal &amp; State regulatory agencies</li> <li>• Rules &amp; regulations at all levels can be conflicting, restrictive, or lacking</li> <li>• Living shoreline use is heavily influenced by regulatory decisions</li> <li>• Existing regulatory schemes fail to adequately consider system-wide impacts or benefits of coastal management decisions</li> <li>• The federal regulatory regime has perpetuated the status quo bias in favor of hardening shorelines</li> <li>• Construction schedule restrictions can restrict or preclude living shoreline implementation</li> <li>• Both NEPA &amp; Municipal policies can inhibit the application of adaptive management</li> <li>• Lack of policies that support efficient coordination &amp; decision making for living shoreline projects</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of system-wide planning tools necessary for the proper evaluation of individual coastal management decisions</li> <li>• Lack of coordination among stakeholder to determine where living shorelines could best be used</li> <li>• Limited expertise in the coastal planning &amp; development community on when &amp; where living shorelines are appropriate</li> <li>• Lack of coordination among the emergency response, recovery, &amp; mitigation communities preventing the encouragement of more resilient solutions following a disaster</li> <li>• Lack of effective risk communication methods &amp; visualization tools to communicate data &amp; information to stakeholders</li> <li>• Land-use planning &amp; zoning policies often do not encourage, &amp; in some cases, limit, living shoreline use</li> <li>• Potential property rights constraints or issues</li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Development of policies to achieve robust coordination &amp; data sharing among resource &amp; planning agencies</li> <li>• Development of guidance documents &amp; criteria that facilitate science-based decision-making for regulatory agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Development of a guidebook with information on living shorelines that could be implemented during the recovery process following a disaster</li> <li>• Incorporation of living shorelines into existing decision support &amp; communication tools</li> <li>• Hybrid approaches can provide a greater level of confidence than natural approaches alone</li> </ul>
	<b>LITERATURE &amp; NEW HAMPSHIRE</b>	
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• The wetlands permitting process is burdensome and challenging<sup>1,2,3,4</sup></li> <li>• Living shoreline projects can be harder to permit, as compared to grey infrastructure<sup>1,2</sup></li> <li>• Lack of communication or consensus among permitting agencies<sup>1,3,4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Public outreach, education, &amp; engagement necessary<sup>1,2,3,4</sup></li> </ul>
<b>Opportunities</b>		<ul style="list-style-type: none"> <li>• Collaboration from multiple stakeholders to look at project comprehensively &amp; solve an issue<sup>1,3,4</sup></li> </ul>
	<b>NEW HAMPSHIRE ONLY</b>	
<b>Barriers</b>	<ul style="list-style-type: none"> <li>• Town-level shoreline regulation vary across municipalities<sup>2</sup></li> <li>• Easy in-kind replacement discourages the replacement of inadequate or failing grey infrastructure with living shorelines<sup>2</sup></li> <li>• Classifying dual purpose living shoreline projects into single purpose project classification causes uncertainty for regulators about how to consider project benefits and negative impacts<sup>2</sup></li> <li>• Regulatory objections to fill<sup>3</sup></li> </ul>	<ul style="list-style-type: none"> <li>• No actor has responsibility for comprehensive shoreline management planning<sup>2</sup></li> <li>• Many actors required to come together for the project<sup>3,4</sup></li> <li>• Site control &amp; management can be challenging with multiple expectations &amp; competing uses for the site<sup>3</sup></li> <li>• Lack of process for stakeholder coordination<sup>4</sup></li> <li>• Lack of coordination with city regarding site planning<sup>4</sup></li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>• Regulators are willing to engage with applicants<sup>2,3,4</sup></li> <li>• Project developers guide applicants through the permitting process<sup>2</sup></li> <li>• New wetland regulations are expected to establish new norms for shoreline protection<sup>2</sup></li> <li>• Regulators encourage pre-application meetings early in the project<sup>2</sup></li> <li>• Project meetings make the wetlands permitting process more efficient<sup>2</sup></li> <li>• Support of project from regulatory agencies<sup>3,4</sup></li> <li>• Create flexible permitting that adequately considers impacts &amp; benefits<sup>4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Integrated plan to manage people &amp; use, while restoring habitat<sup>3,4</sup></li> <li>• Public outreach, education, &amp; engagement for building &amp; integrating local knowledge<sup>3,4</sup></li> <li>• Municipal leadership, attitude, &amp; willingness to take action<sup>3</sup></li> <li>• Municipal support of the project<sup>4</sup></li> </ul>

Within the literature, many of the opportunities for living shoreline implementation focus on either the benefits to using hybrid approaches or the development of metrics or guidance documentation to promote their use. These opportunities were not identified by New Hampshire

stakeholders, who, instead, often focused on the inclusion and support of a diverse set of actors, or the incentive of available funding.

Technical and financial barriers that appeared solely in the literature often had to do with either uncertainty and a lack of available data or the disadvantages of using a site-specific approach, while regulatory barriers focused on restrictive policies that promote the status quo of grey infrastructure, and the community & planning barriers mainly covered inadequate coordination and communication among stakeholders. However, barriers unique to New Hampshire showed no overarching patterns, with diverse barriers across all categories.

Characteristics that were shared across NH and the literature included a lack of experience and technical guidance with these approaches, creating misunderstanding, uncertainty, and risk; a lack of funding sources for these expensive projects coupled with the difficulty of synchronizing funding sources that do become available; a regulatory regime that does not appropriately weigh the benefits of a living shoreline versus the impacts, thereby creating challenging permitting process; the difficulty of engaging and educating the public; and the lack of a coordinated effort of stakeholders to identify suitable sites and actively promote and implement living shoreline approaches.

## **5.2 Resilience Analysis**

A second objective of this research is to analyze whether the barriers to implementing living shorelines in NH (identified from practice), generally correspond to SES low resilience factors from the literature, and whether the opportunities to implementing living shorelines in NH (identified from practice), generally correspond to SES high resilience factors from the



literature. We therefore organized the NH barriers and opportunities to implementing living shorelines according to the SES resilience factors described in the literature. These factors were described earlier in Section 1.2.2. and summarized in Table 1.2. In Table 5.2a and Table 5.2b (below) NH living shoreline implementation barriers are highlighted in red and NH living shoreline implementation opportunities are highlighted in green.

As the SES literature notoriously underdefines how to operationalize SES variables for analysis, the researchers relied on their best judgment to categorize the NH barriers and opportunities according to the SES framework factors. For instance, the NH barrier “Lack of coordination with city regarding site planning” corresponds to the SES low resilience characteristic identified in the literature “Little stakeholder or public participation, interaction, or collaboration.” In some cases, a barriers or opportunity may be associated with more than one SES resilience factor. For example, the NH barrier “Town-level shoreline regulations vary across municipalities,” identified from stakeholder interviews, is an example of SES high resilience characteristic “Site-specific/tailored approaches,” and SES high resilience characteristic “Multi-level or poly-centric governance.”

Table, 5.2a categorizes NH barriers and opportunities to living shoreline implementation that correspond to SES low resilience factors. We categorized only one opportunity, in comparison to 27 barriers, among the SES low resilience factors. Table 5.2b categorizes NH barriers and opportunities to living shoreline implementation that correspond to SES high resilience factors. We categorized 22 opportunities, in comparison to only seven barriers, among the SES high resilience factors. In general, most opportunities correspond to SES high resilience factors and most barriers correspond to SES low resilience factors. These findings suggest that,

in general, the NH living shoreline stakeholders who contributed to this research value the factors identified in the literature as promoting resilience.

Interestingly, eight of the 57 barriers and opportunities do not correspond to the SES factors we expected they would. For example, stakeholders perceive the new state wetland regulations as an opportunity to establish new norms and promote living shorelines. But, achieving this outcome through the state scale is also associated with factors lowering system resilience, centralized governance. The fact that the NH stakeholders' who participated in this research nevertheless consider the new state regulations an opportunity, could suggest they consider other values, such as consistent norms and living shorelines themselves, to be more important, in comparison to resiliency. In another example, varying town-level regulations were often cited as a barrier to consistent wetland regulations and comprehensive, system-wide coastal management. This barrier corresponds to factors promoting SES resilience, including multi-level or polycentric governance (scale) and site-specific/tailored approaches (diversity). Again, the fact that the NH stakeholders' who participated in this research nevertheless consider the town-level regulations a barriers, could suggest they consider other values, such as consistency and a comprehensive approach, over resiliency. The lack of correspondence between these eight barriers and opportunities and the expected SES resilience factors, suggests that in, at least some cases, the NH living shoreline stakeholders' who contributed to this research value other priorities over system resilience. For the relevant eight opportunities and barriers, the lack of correspondence also suggests careful consideration should be given before acting to promote the one opportunity or overcome the seven barriers. For example, bringing together a large group of stakeholders to work on a project was perceived as a barrier, but also as an opportunity as it facilitated communication and made efforts more effective. Similarly, public outreach and

education, while acknowledged as difficult and perceived to be a barrier, was credited with actually having a positive influence on the long-term success of a project. In both of these cases, stakeholders saw the associated difficulty as barriers to implementing living shorelines, but also acknowledged their value to resilience. Therefore, to promote resilience, practitioners should work to address the associated difficulties, for example by engaging a project facilitator, rather than removing outreach and education or avoiding projects involving many stakeholders.

In summary, the findings suggest comparing barriers and opportunities to SES resilience factors identified in the literature has practical value. Practitioners could prioritize promoting the opportunities identified for living shoreline implementation that correspond to high SES resilience and overcoming barriers that correspond to low SES resilience. Addressing system characteristics that would simultaneously promote both living shoreline implementation and system resilience capitalizes on the effort to make change and maximizes the benefits. In contrast, in the cases where opportunities and barriers do not correspond to the SES high and low resilience factors, respectively, practitioners should carefully consider both stakeholders' values and the impacts on system resilience.

**Table 5.2a: NH Barriers and opportunities that correspond to SES low resilience factors**

SES Factors	Low Resilience
<b>Diversity</b>	<ul style="list-style-type: none"> <li>• No actor has responsibility for comprehensive shoreline management planning</li> <li>• Lack of funding sources</li> </ul>
<b>Redundancy</b>	<ul style="list-style-type: none"> <li>• Lack of funding sources</li> <li>• Uncertainty of funding sources</li> <li>• Project developers do not promote living shorelines to clients</li> </ul>
<b>Flexibility</b>	<ul style="list-style-type: none"> <li>• Classifying dual purpose living shoreline projects into single purpose project classification causes uncertainty for regulators about how to consider project benefits and negative impacts</li> <li>• Easy in-kind replacement discourages the replacement of inadequate or failing grey infrastructure with living shorelines</li> <li>• The wetlands permitting process is burdensome &amp; challenging</li> <li>• Complex nature and constraining requirements of compensatory mitigation project</li> <li>• Complexity &amp; requirements of public &amp; federal funding</li> <li>• Synchronizing funding sources, budgets, &amp; schedules</li> <li>• Construction limitations and site constraints</li> <li>• Significant costs of time &amp; money</li> </ul>
<b>Integration</b>	<ul style="list-style-type: none"> <li>• Lack of design standards &amp; technical guidance</li> <li>• Lack of technical knowledge &amp; experience</li> <li>• Lack of communication or consensus among permitting agencies</li> <li>• Misunderstandings or miscommunication of project design &amp; benefits</li> <li>• Lack of coordination with city regarding site planning</li> <li>• Lack of process for stakeholder coordination</li> </ul>
<b>Acceptance of Change and Uncertainty</b>	<ul style="list-style-type: none"> <li>• Project developers do not promote living shorelines to clients</li> <li>• Classifying dual purpose living shoreline projects into single purpose project classification causes uncertainty for regulators about how to consider project benefits and negative impacts</li> <li>• Risk due to uncertainty in design &amp; performance</li> <li>• Uncertainty of funding sources</li> <li>• Easy in-kind replacement discourages the replacement of inadequate or failing grey infrastructure with living shorelines</li> <li>• Regulatory objections to fill</li> </ul>
<b>Scale</b>	<ul style="list-style-type: none"> <li>• No actor has responsibility for comprehensive shoreline management planning</li> <li>• Unknown sediment budgets &amp; habitat changes in system due to feedback</li> <li>• New wetland regulations are expected to establish new norms for shoreline protection</li> </ul>

**Table 5.2b: NH Barriers and opportunities that correspond to SES high resilience factors**

SES Factors	High Resilience
<b>Diversity</b>	<ul style="list-style-type: none"> <li>• Town-level shoreline regulations vary across municipalities</li> <li>• Site control &amp; management can be challenging with multiple expectations &amp; competing uses for the site</li> <li>• Project meetings incorporate diverse expertise needed for project success</li> </ul>
<b>Redundancy</b>	<ul style="list-style-type: none"> <li>• Project developers guide applicants through the permitting process</li> <li>• Benefits promoted by living shorelines are consistent with the intent of state coastal regulations on coastal development</li> </ul>
<b>Flexibility</b>	<ul style="list-style-type: none"> <li>• Site access</li> <li>• Integration of stakeholders who can provide funding, resources, &amp; flexibility</li> <li>• Create flexible permitting that adequately considers impacts and benefits</li> </ul>
<b>Integration</b>	<ul style="list-style-type: none"> <li>• Public outreach, education, and engagement necessary</li> <li>• Many actors required to come together for the project</li> <li>• Regulators are willing to engage with applicants</li> <li>• Project developers guide applicants through the permitting process</li> <li>• Project meetings make the wetlands permitting process more efficient</li> <li>• Creation of demonstration sites to foster learning &amp; experience for future projects</li> <li>• Data collection to support current &amp; future project design</li> <li>• Integration of stakeholders who can provide funding, resources, &amp; flexibility</li> <li>• Project meetings incorporate diverse expertise needed for project success</li> <li>• Public outreach, education, &amp; engagement for building &amp; integrating local knowledge</li> <li>• Collaboration from multiple stakeholders to look at project comprehensively &amp; solve an issue</li> <li>• Regulators encourage pre-application meetings early in the project</li> </ul>
<b>Acceptance of Change and Uncertainty</b>	<ul style="list-style-type: none"> <li>• Unknown sediment budgets &amp; habitat changes in system due to feedback</li> <li>• Regulators encourage pre-application meetings early in the project</li> <li>• Project meetings make the wetlands permitting process more efficient</li> <li>• Federal funding to incentivize implementation in support of resilience</li> </ul>
<b>Scale</b>	<ul style="list-style-type: none"> <li>• Long-term funding for monitoring &amp; adaptive management</li> <li>• Town-level shoreline regulations vary across municipalities</li> <li>• Integrated plan to manage people &amp; use, while restoring habitat</li> <li>• Create flexible permitting that adequately considers impacts and benefits</li> <li>• Collaboration from multiple stakeholders to look at project comprehensively &amp; solve an issue</li> </ul>

### **5.3 Recommendations for facilitating the implementation of living shorelines in NH**

Based on our findings, we recommend NH pursue the following three opportunities to promote pre-project planning for living shorelines and three opportunities to promote successful project implementation. The six opportunities are discussed in more detail below.

Pre-project phase opportunities:

- Designate an actor to coordinate comprehensive shoreline management planning
- Strengthen and make more visible recommendations for pre-application meetings
- Amend state wetlands rules

Project phase opportunities:

- Use a facilitator to coordinate inclusive project workgroups with diverse participation
- Make clear how public knowledge and input will be used in living shoreline decisions
- Diversify funding sources

#### **Pre-project phase**

- **Designate an actor to coordinate comprehensive shoreline management planning**

Without a designated actor to coordinate shoreline management, living shoreline implementation is uncoordinated, unplanned, and piecemeal, which is contrary to the intent of existing NH regulation. Currently, the availability of public funding and resources encourages interested municipalities to “pioneer” public living shoreline projects. A state-level designated actor could provide technical assistance to these pioneering municipalities interested in living shorelines, including:

- (1) proactively identifying sites suitable for living shorelines based on physical, technical and social factors, including community values and aesthetic preferences;
- (2) encouraging interested municipalities to develop an “on-the shelf” project list of suitable sites and including these in municipal plans; and
- (3) coordinating proactive partial project designs for suitable sites with interested municipalities in preparation for future funding opportunities.

Engaging this designated actor could be included in changes to the wetlands rules as a criterion for expedited permitting, providing an incentive for municipalities or developers to engage the actor.

- **Strengthen and make more visible recommendations for pre-application meetings**

State regulators are eager to share their experiences and knowledge with potential project applicants. Involving regulators early in the process can also greatly reduce permitting barriers as regulators can study proposed designs and provide feedback before applicants invest significant resources in project design and planning. Although pre-application meetings are already encouraged, this recommendation could be made more obvious and more strongly, for example by mentioning this in outreach efforts to interested municipalities, project developers, and engineers.

- **Amend state wetlands rules**

Many stakeholders are aware of NH’s ongoing process to revise its wetlands rules and hope the rules will facilitate living shoreline implementation. Three specific recommendations for the rule revisions are:

- (1) Provide for an expedited wetlands permitting process or exemption for temporary, experimental structures intended for pre-project data collection;
- (2) Restrict the ease of in-kind replacement of inadequate or failing coastal grey infrastructure;

Project applicants perceive current regulations as making it easier and cheaper to replace grey shoreline infrastructure in need of repair or replacement with more of the same, instead of promoting the transition to a living shoreline. One planner suggested regulations restrict the replacement of hardened structures as they need augmentation or fail, unless an analysis demonstrates that a living shoreline is not a feasible replacement (LS03, 2016). Changing the regulations are likely to create new norms where hardened shoreline structures will be phased out and replaced with living shorelines wherever possible, in order to take advantage of the inherent self-sustaining ability of living shorelines.

- and (3) Reconsider single purpose project classification for living shorelines.

Rules that categorize living shorelines as either bank and shoreline stabilization projects or restoration and enhancement projects do not fully capture the dual purpose of living shorelines, and make it hard for regulators to consider tradeoffs between the full range of benefits and costs of living shoreline projects. Regulators can find it difficult to distinguish between projects that provide restoration and resiliency benefits and development projects that don't. Similarly, regulators may be uncomfortable with restoration projects that include hardening, fill, and habitat conversion, even if the final result is greater ecosystem benefits. Alternatives to the single project classification system could include a designated living shoreline classification or a classification for multi-purpose projects.



## **Project phase**

- **Use a facilitator to coordinate inclusive project workgroups with diverse participation**

Until the process for designing, permitting, and implementing living shorelines is more established in NH, diverse stakeholders should be engaged in facilitated workgroups to problem solve for successful project planning and implementation. For example, including engineers on the project team can help overcome technical challenges during the project design phase and is beneficial when presenting the proposed project to municipal, state, and federal officials.

Engaging municipal staff can facilitate integrated site management. Because limited funding and technical capacity restrict the ability of interested municipalities to implement living shorelines, engaging non-regulatory actors and organizations can provide the technical expertise needed for project designs, process management, and funding applications, such as ARM funding or federally-funded resilience grants.

A facilitator is critical to help a large group of diverse stakeholders build consensus around a project. For example, a facilitator can help prevent misunderstanding and miscommunication, prepare agendas, circulate meeting summaries, and coordinate actions between meetings to make in-person meetings efficient, provide project updates, coordinate funding sources, budgets, and schedules, navigate complex permitting and funding processes, facilitate communication between permitting agencies, and assist with coordinating with municipalities on site planning considerations.

- **Make clear how public knowledge and input will be used in living shoreline decisions**

The creation of local knowledge and experience using living shoreline technology, not only among the teams of stakeholders directly working on the projects, but also among coastal landowners and communities who could potentially make use of these approaches, is crucial to building local support and demand for living shoreline projects. Although opportunities exist for public participation in living shoreline decisions, actual public participation in coastal management decision-making is low and it often unclear how input will be used in decisions. In particular, local knowledge and input should be sought and included in integrated planning for site control and management of the area (land and water) around the living shoreline. Outreach and education are also critical for encouraging living shoreline implementation on private land.

### **(3) Diversify funding sources**

New sources of funding for implementing living shorelines are needed. Many stakeholders consider the uncertainty and complexity of existing funding options for living shorelines a barrier. For example, mitigation funding is not necessarily a good fit for innovative living shoreline projects, which include a risk of failure. Funding for longer-term maintenance and adaptive management are uncertain. Possibilities include designating ARM funding for longer-term maintenance and adaptive management, innovative financing techniques, such as green bonds or green banks, and financial incentives provided by the Community Rating System (CRS). CRS is a program that “recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards” (FEMA, 2018) by significantly reducing flood insurance premium rates for residents. According to several stakeholders and Macwhorter & Zaratzian (2016), CRS could incentivize living shoreline implementation, making it an attractive option for communities (LS19, 2016; LS20, 2016; LS25, 2016).

## Appendix A: IRB Approval

### University of New Hampshire

Research Integrity Services, Service Building  
51 College Road, Durham, NH 03824-3585  
Fax: 603-862-3564

05-Apr-2016

Mattera, Trevor  
NREN, G04 James Hall  
Durham, NH 03824

**IRB #:** 6438

**Study:** Advancing Coastal Resilience: An Institutional Analysis of Living Shorelines in New Hampshire

**Approval Date:** 05-Apr-2016

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved the protocol for your study as Expedited as described in Title 45, Code of Federal Regulations (CFR), Part 46, Subsection 110.

**Approval is granted to conduct your study as described in your protocol for one year from the approval date above.** At the end of the approval period, you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, *Responsibilities of Directors of Research Studies Involving Human Subjects*. This document is available at <http://unh.edu/research/irb-application-resources>. Please read this document carefully before commencing your work involving human subjects.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or [Julie.simpson@unh.edu](mailto:Julie.simpson@unh.edu). Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,



Julie F. Simpson  
Director

cc: File  
Ashcraft, Catherine

## Appendix B: IRB Renewal

### University of New Hampshire

Research Integrity Services, Service Building  
51 College Road, Durham, NH 03824-3585  
Fax: 603-862-3564

09-Mar-2017

Mattera, Trevor  
NREN, G04 James Hall  
Durham, NH 03824

**IRB #:** 6438

**Study:** Advancing Coastal Resilience: An Institutional Analysis of Living Shorelines in New Hampshire

**Review Level:** Expedited

**Approval Expiration Date:** 05-Apr-2018

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your request for time extension for this study. Approval for this study expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects. If your study is still active, you may apply for extension of IRB approval through this office.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, *Responsibilities of Directors of Research Studies Involving Human Subjects*. This document is available at <http://unh.edu/research/irb-application-resources> or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or [Julie.simpson@unh.edu](mailto:Julie.simpson@unh.edu). Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,



Julie F. Simpson  
Director

cc: File  
Ashcraft, Catherine

## Appendix C: Interview Protocol

\*\*\* Consent form. Audio taping. \*\*\*

**Introduction – “Speaking with... time, date.”**

**Project Description.**

1. Can you describe your *professional background/role (on this board)*, and how it relates to using living shorelines or other erosion control methods as part of coastal management?
  - a. How did you get into this role?
  - b. Can you talk about any specific projects or experiences dealing with coastal protection, conservation, or erosion control?
2. What does a living shoreline mean to you? How would you define one?
  - a. What do you think are the advantages of using a living shoreline? What are the disadvantages?
  - b. Do you think the advantages and disadvantages you’ve mentioned are taken into account when making coastal management decisions? Can you elaborate on how/why?
  - c. How would you characterize the state of living shoreline-related activities in NH?
  - d. (*Community Officials:* Are there any sites in your town that are highly vulnerable to coastal erosion?
    - i. Can you envision the town implementing a living shoreline at this site? Why or why not?
    - ii. Does the town own (other) properties or infrastructure on which you could foresee implementing a living shoreline? Where? Why do you think this is a good potential site?)
3. When a method of coastal protection or stabilization is required, what methods (do you think) are considered?
  - a. What factors (do you think) are considered when making this decision?
  - b. (*Community Officials:* What are required in your regulations concerning coastal protection?
    - i. What protective methods do you currently have in place?)
  - c. From your perspective, how does the process for making this decision generally play out?
  - d. How is the public involved in this process?

4. Can you speak about how coastal stabilization projects are evaluated or monitored before or after their implementation?
  - a. What is monitored and what data are gathered?
  - b. Are data compared to objectives and goals set for the project? How so/Why not?
  - c. Can you give any examples of a project or experience where things did not go to plan, and something unexpected had to be dealt with?
    - i. How was the situation dealt with?
  - d. \*\* Repeat these if hard infrastructure is not brought up. \*\*
5. How do you think scientific information is used when promoting, planning, or implementing coastal management approaches?
  - a. (*Regulators*: How do you use scientific information when developing coastal and wetland regulations?)
  - b. What types of science and information is used? (e.g. climate/ecosystem/engineering)
6. (4) What are the regulations that affect shoreline stabilization projects in NH?
  - a. From your perspective, what are the goals and objectives of these regulations?
  - b. How are these goals and objectives evaluated for effectiveness?
  - c. How successful do you think these regulations have been at achieving these objectives?
7. In your line of work, what challenges or difficulties do you (imagine you would) experience when trying to (*promote/implement/design*) living shorelines in NH?
  - a. Can you envision changes that would address these challenges (magic wand)?
  - b. What would be needed for these solutions to overcome these barriers?
  - c. How likely do you think these changes are?
    - i. What do you think is preventing them?
8. Are there any other related questions or topics you think would be important to discuss?
9. Are there any individuals you think I should interview for this study?
  - a. (*RPC*: Who are the key people in communities that I should connect with?)

**Thank you.**

## **Appendix D: Wagon Hill Farm Focus Group 1 Agenda – 2/2 10-12**

1 hour allotted for focus group @ 11

### **Format**

10am-11am: Monitoring Check-in & Design Input (Dave Burdick & Tom Ballestero)

### **Objectives**

- Check in on monitoring and design progress
- Provide input on preliminary design options

10am Welcome and Introductions

10:15am Summary of monitoring progress and presentation of preliminary design options

10:30am Input on design options; Determine adjustments for Tuesday, February 7 follow up meeting; 10am-12pm

11am-12pm: Focus Group (Cat Ashcraft and Trevor Mattera)

### **Objectives**

- Learn about development of Wagon Hill Farm Erosion Control Project process
- Map project process

11am Focus group research project overview

11:10am Discussion of project development up to present

11:40 Discussion of project development from present to completion

11:55 Next steps: second focus group meeting follow up Tuesday, February 7;  
10am-12pm

## **Appendix E: Wagon Hill Farm Focus Group 2 Agenda – 2/7 10-12**

1 hour allotted for focus group

### **10am-11am: Focus Group (Cat Ashcraft and Trevor Mattera)**

#### **Objectives**

- **Map project process**
- **Identify opportunities and barriers**

10am	Welcome back; Introductions; Focus group research project refresher
10:05am	Discussion of project development from present to completion
10:25am	Discussion of project opportunities and barriers
10:55am	Next steps

### **11am-12pm: Round 2 of design input (Dave Burdick & Tom Ballestero)**

#### **Objectives**

- **Revisit design options with input provided**
- **Identify site management next steps**

11am	Review design options
11:10am	Discuss options, identify any outstanding issues
11:40am	Update on SRPC work to summarize site management recommendations; discuss town stakeholder engagement needs; identify next steps
12pm	Adjourn



## **Appendix F: Cutts Cove Focus Group Agenda – 3/21 2-4pm**

80 min allotted for focus group @ 2:35

### **Objectives**

- Finalize map of project process
- Use map of project process to identify opportunities and barriers
- Characterize participants' experiences with project
- Brainstorm potential changes to address barriers or take better advantage of opportunities

### **Format**

Introduction to Meeting and Introductions by stakeholders (10 min)

Request for permissions to use perspectives shared at meeting (5 Min)

Update on Project to date and next steps (20 min)

Facilitated Focus Group:

Mapping the Process of the Project (30 min)

Identification and Discussion of participants' experiences (i.e. process challenges and opportunities); suggestions for improving the process (50 min)

Wrap-up and Thank you

## **Appendix G: Cutts Cove Qualtrics Survey**

1. Please briefly describe how and why this project got started, who was involved, and the rough date when the project began.
2. What were the steps that followed to move the project forward? Where you can, please include a brief explanation of how and why each step happened, who was involved, and roughly when this occurred. Please include as many steps up to the present.
3. When did you become involved in the project and why did you become involved at this point in the process?
4. We're interested in identifying the steps in the permitting process. If you haven't already included this information in your responses, please briefly describe what have been the steps in obtaining the permit(s) for this project. Who has been part of this process and approximately when did the permitting steps take place?
5. We'd also like to know about the steps in obtaining the funding for this project. If you haven't already included this information in your responses, please briefly describe these steps, who has been involved, and roughly when they took place.
6. What do you expect will be the next steps in moving the project forward from now through implementation and project completion? Please include as many steps as you can.

## Appendix H: General Barriers & Opportunities Matrix

Theme//Source	ERC C (2015) - 1	Gedan, et al. (2011) - 2	Clean Water America Alliance (2011) - 3	RAE (2015) - 4	SAGE (2015) - 5	Sutton-Grier (2015) - 6
<b>Technical/ Physical</b>	Uncertainties regarding the performance, timing, and scale of NNBF needed to provide flood risk reduction and decrease storm damages	[Living shorelines] will likely generate synergistic ecological benefits, but to date no experiments have specifically tested for the singular and interactive effect of this combined approach	Lack of understanding and knowledge of what green infrastructure is and the benefits it provides		Regulators and project sponsors alike are learning how to design living shorelines projects	Need to develop best practices and designs for natural and hybrid systems
	Uncertainties regarding the effects threats including sea level rise and climate change have on the performance of NNBF		Deficiency of data demonstrating benefits & performance		In urban environments, there is limited land, a variety of upland uses, and high velocity waters	Likely requires a substantial amount of space, which may not be possible
	The kinds and the extent of the ecosystem goods and services provided by different NNBF are generally poorly understood		Insufficient technical knowledge and experience		Uncertainty in risk because of lack of experience of techniques	Little data on how well hybrid systems perform, or how to estimate the coastal protection provided
	Clear and concise language about the benefits of NNBF is needed to be able to compare these features to the more traditional structural methods		Lack of design standards, best management practices, and implementation of green infrastructure		The overall sediment system needs to be taken into account to protect neighboring properties from experiencing stranded down drift shorelines or other consequences	Provides variable levels of coastal protection (non-linearity of the provisioning of coastal protection benefits) depending on the ecosystem, geography and also on the type and severity of storm
	It is difficult to describe and properly quantify the secondary and tertiary benefits of NNBF				Not all techniques have the same level of performance	Hybrid systems can still have some negative impacts on species diversity, and do not provide all the benefits of a natural system
	Construction schedule restrictions related to environmental concerns (e.g., dredging windows) remain an ongoing concern and may restrict or preclude the implementation of NNBF solutions				Not all techniques have the same level of success monitoring. Less practiced techniques may require more monitoring	
	NNBF are not practical in all instances					
<b>Financial/ Resource</b>	All USACE flood and coastal storm damage reduction projects require a cost-sharing partner, but aligning budgets and schedules for cost-sharing partnerships is an ongoing challenge		Not enough data about upfront and ongoing maintenance costs and economic benefits	Many of the greatest values of living shorelines both to the owner and to the other constituencies utilizing or affected by the estuary are overlooked by site-specific decision-making without considering system-wide benefits	Public funds are often tied to government permit compliance	Few data on the cost to benefit ratio for projects
	A greater understanding of the costs and benefits of NNBF is needed, particularly, in terms of how these features can increase the resilience of a community, ecosystem, or local economy		Perceived high cost over short and long term	Site-specific decision-making without consideration of system-wide values imposes the cost on the shoreline owner rather than spreading it across all of the constituencies benefited by a living shoreline installation	It takes time to develop and test new shoreline protection methods	It can take a long time for the natural systems to provide the necessary level of coastal protection
	Uncertainties regarding the lifecycle costs needed to operate and maintain NNBF		Lack of funding at all levels coupled with poor coordination or integration of programs and funds			
	Obtaining funding for adaptive management is an ongoing challenge for Federal agencies		Too much risk – not enough incentives			

Theme //Source	ERDC (2015) - 1	Gedan, et al. (2011) - 2	Clean Water America Alliance (2011) - 3	RAE (2015) - 4	SAGE (2015) - 5	Sutton-Grier (2015) - 6
Legal/ Regulatory	NEPA frequently poses a challenge to implementing timely adaptive strategies		Local rules can be lacking, conflicting, or restrictive	Hardened shoreline methods are often easy to permit	Permitting processes can be lengthy and challenging	Permitting can be more difficult process than for built projects
	In municipalities, existing policies hamper the application of adaptive management as municipalities may be paralyzed for reporting results that are below expectations		State water and land-use policies and property rights can be complicating factors	Except where states have responded to excessive hardening by advocating changes in permitting systems, the federal regulatory regime has perpetuated the status quo bias in favor of hardening shorelines	The existing regulatory process is centered on traditional "gray" or "hard" techniques	
	Land-use planning and zoning policies often do not encourage, and in some cases, limit, the use of NNBF		Federal rules can be conflicting, overly-prescriptive, without needed flexibility, or silent in key aspects	The existing regulatory schemes fail to adequately consider the system-wide impacts and benefits of shoreline management decisions, perpetuating a bias in favor of hardening	There may be land ownership constraints	
	The use of NNBF is heavily influenced by regulatory decisions; most projects that incorporate NNBF into project plans require decisions made by a variety of Federal and State regulatory agencies					
	There is a need for policies that support efficient coordination and decision making for NNBF projects that could impact wetlands, TES species, or essential fish habitat					
	Communication needs to be improved at multiple levels including among and within Federal, State, and local levels of government					
	Local agency planning often occurs without coordination with State and Federal regulatory agencies					
	Projects are often authorized and regulated on a case-by-case basis that precludes the development of comprehensive programmatic, regional, landscape, or system-focused projects					
	There is a need for improved risk communication methods and visualization tools to better communicate data and information to stakeholders and the public		Insufficient and inaccessible information about green infrastructure and its benefits for political leaders, administrators, agency staff, developers, builders, landscapers, and others, including the public	Watersfront property owners continue to use hardened shoreline protections because they are familiar with those methods	Lack of public awareness of performance and benefits of living shorelines	Limited expertise in the coastal planning and development community on which approaches to use where and when
	Outreach and communication should also target private interests and homeowners who determine the type of project to implement on their land		Community and institutional values that under-appreciate green infrastructure aesthetics and characteristics	Watersfront property owners lack information about both the shortcomings of hardened shoreline methods and the relative advantages of living shorelines		
Community/ Planning	There is a need for better communication and information sharing on NNBF		Lack of inter-agency and community cooperation	The various constituencies benefited in different ways by living shorelines do not recognize their common interest and hence have not combined into an effective advocacy force		
	NNBF remain a nebulous concept for many, including decision makers and others with the responsibility to implement coastal projects		Lack of codes and ordinances that facilitate the design and implementation of green infrastructure	The negative cumulative effects of hardening are underestimated by site-specific decision-making without considering system-wide impacts		
	Improved coordination among government agencies, academia, NGO, and others is needed to determine where NNBF could best be used to reduce risk throughout an entire region		Lack of acceptance of green infrastructure	System-wide planning tools are necessary for the proper evaluation of individual shoreline management decisions		
	Common definitions for NNBF would enable interested parties to communicate more effectively about these features					
	A gap in coordination among the emergency response, recovery, and mitigation communities is currently present that could be addressed to encourage the implementation of more resilient solutions following a disaster					

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