
PREPARING FOR DISASTER:

The National Estuary Program's Role in
Pre-Disaster Planning, Post-Disaster Recovery,
and Hazard Mitigation



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Disclaimer

The findings and recommendations reported in this white paper are made available for informational purposes only and do not represent the Environmental Protection Agency’s position on the topics covered.

Terms

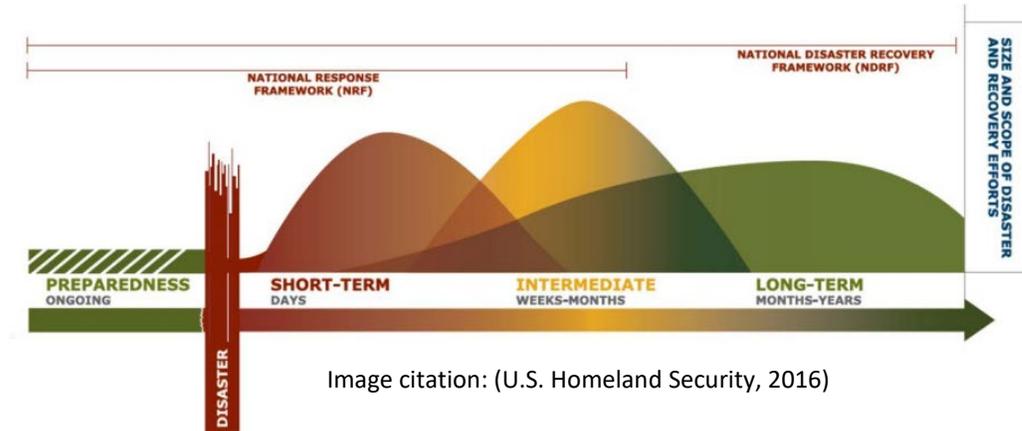
These terms are defined by the [National Disaster Recovery Framework \(2016\)](#):

Disaster Recovery: The capabilities necessary to assist communities affected by an incident to recover effectively.

Disaster Response: The capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.

Hazard Mitigation: The capabilities necessary to reduce loss of life and property by lessening the impact of disasters.

Resiliency: The ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies.



Acronyms

BBP	Barnegat Bay Partnership
BTNEP	Barataria Terrebonne National Estuary Program
BTEF	Barataria Terrebonne Estuary Foundation
CBBEP	Coastal Bend Bays and Estuaries Program
CCMP	Comprehensive Conservation Management Plan
CRS	Community Rating System
DWH Spill	Deepwater Horizon Oil Spill
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
HMP	Hazard Mitigation Plan
JFO	Joint Field Office
LHMP	Local Hazard Mitigation Plan
NEP	National Estuary Program
NDRF	National Disaster Recovery Framework
NRC	National Response Center
RSF	Recovery Support Function
SFEI	San Francisco Estuary Institute
SFEP	San Francisco Estuary Partnership

Executive Summary

Over half of the 28 National Estuary Programs' (NEP) study areas have been affected by a disaster or hazard event, including: hurricanes, floods, fires, nor'easters, and hazardous waste spills. Throughout this white paper, four case studies demonstrate that NEPs play an important role in pre-disaster planning, post disaster recovery, and hazard mitigation initiatives; acting primarily as capacity builders, communicators, conveners of partners and community members, and scientific experts.

The case studies also reveal several challenges and lessons learned the NEPs encountered during post-disaster recovery and hazard mitigation initiatives. Such challenges and lessons learned include: 1) the lack of thorough planning within the CCMP and engagement with state and regional Hazard Mitigation Officers; 2) the need to determine the appropriate role for the NEP during disaster recovery and/or hazard mitigation; 3) the difficulty with securing funding for hazard mitigation and post-disaster recovery projects; and, 4) the process of working with outdated policy to carry-out nature-based infrastructure for resiliency planning.

Considering the important role that NEPs play in disaster recovery and hazard mitigation, the challenges that these four case studies illustrate, and the likelihood that the frequency of hazard and disaster events will increase in the future (See Appendix 1), it is vital that NEPs not only continue to engage in this type of work, but also receive appropriate support from partners to enhance their effectiveness.

BARNEGAT BAY PARTNERSHIP – SUPERSTORM SANDY

- Acted as a conduit of information to the public and to partners
- Provided scientific expertise to decision-makers
- Operated as a community convener

Challenges & Lessons Learned

- Identifying thorough planning procedures
- Building an effective information-sharing role with the right decision makers
- Providing positive and informative messages

BARATARIA-TERREBONNE NATIONAL ESTUARY PROGRAM – DEEPWATER HORIZON OIL SPILL

- Provided non-biased media engagement
- Conducted public outreach and education
- Coordinated volunteer activities
- Provided scientific and technical expertise

Challenges & Lessons Learned

- Determining BTNEP's appropriate role as a scientific expert and educator during recovery activities
- Continuing to emphasize prevention and mitigation

COASTAL BEND BAYS & ESTUARIES PROGRAM – HURRICANE HARVEY

- Acted as a trusted scientific resource to decision-makers and the community
- Provided data and resources to contribute to the data pool on the impacts of Hurricane Harvey on natural resources

Challenges & Lessons Learned

- Accurately planning for monitoring and tracking post-disaster data
- Communicating effectively with local, state, and federal government partners

SAN FRANCISCO ESTUARY PARTNERSHIP – HAZARD MITIGATION AND RESILIENCY PLANNING

- Enabling innovative action through a well-informed CCMP
- Acting as a community conduit for resiliency work and highlighting the importance of regional approaches to hazard mitigation / resiliency planning

Challenges & Lessons Learned

- Innovative projects, outdated approval processes
- Working regionally while balancing local needs

Introduction

The 28 National Estuary Programs are situated in coastal communities across the United States and are often at the frontlines when a disaster or hazard event occurs (See Appendix 2). Before, during, and after disaster or hazard events, NEPs use their connections with community members and numerous partners to build local capacity for effective action. NEPs communicate credible, scientific information, lead outreach initiatives, support environmental assessment tasks, and conduct many other pre- and post-



disaster activities within their study areas and watershed. This white paper includes four case studies detailing the experiences and challenges that NEPs have with disaster recovery scenarios or hazard mitigation initiatives.

The first case study focuses on Barnegat Bay Partnership located along the central New Jersey coastline and the Partnership's experience with Superstorm Sandy in 2012. The second case study highlights Barataria-Terrebonne National Estuary Program, located in the southeast coast of Louisiana, and the Program's experience with the 2010 Deepwater Horizon Oil Spill. Next, the third case study is about Coastal Bend Bays and Estuaries Program, located in the southeast coast of Texas, and the Program's disaster recovery initiatives after 2017's Hurricane Harvey. Finally, the last case study features San Francisco Estuary Partnership and the Partnership's innovative action in the hazard mitigation and resiliency field.

These case studies are informed by interviews with NEP staff, publicly available information, material posted on the NEP websites, and various journal articles. The information collected in these case studies can be shared with other NEPs, coastal communities, and other relevant stakeholders in order to learn from and improve pre-disaster recovery planning, post-disaster recovery initiatives, and hazard mitigation planning.

A Case Study of Barnegat Bay Partnership:

Experiences and Lessons Learned from Superstorm Sandy

Introduction and Background

This case study explores Barnegat Bay Partnership's (referred to as "the BBP" or "the Partnership") experience with Superstorm Sandy, including pre-disaster recovery planning, BBP's role during recovery efforts, and lessons learned.

Hurricane Sandy made landfall in the U.S. on October 29, 2012 and was [one of the costliest tropical storms](#) in United States history, with damages totaling upwards of \$65 billion USD (NOAA Hurricane Research Division, 2017). This Category 1 hurricane had a pressure typical of a Category 3 storm and approached the East Coast during a spring high tide. Only days after the hurricane, the region was hit by a powerful nor'easter, causing further devastation to the area. With these factors combined, what came to be known as Superstorm Sandy [generated flooding and wind damage](#) in 24 states in the northeast and mid-Atlantic (FEMA, 2013). New Jersey was one of the most severely impacted, with more than [346,000 homes damaged](#) (Smith, 2013).

Located primarily in Ocean County, NJ, the Barnegat Bay Partnership is one of the Environmental Protection Agency's 28 [National Estuary Programs](#) and was profoundly affected by Superstorm Sandy (EPA, 2017). Communities like Bay Head, Seaside Heights, and many others in BBP's study area suffered substantial damages during the storm.

Barnegat Bay Partnership's Role in Pre-Disaster Recovery Planning

Prior to Sandy, the BBP was heavily engaged in discussions and research about the current and future effects of sea-level rise, increased flooding,

BBP Played a Vital Role During Superstorm Sandy Recovery

- Acted as a conduit of information to the public and to partners
- Provided scientific expertise to decision-makers
- Operated as a community convener

BBP Learned Valuable Lessons throughout this Experience

- Identifying thorough planning procedures
- Building an effective information-sharing role with the right decision makers
- Providing positive and informative messages

and stronger and more frequent tropical storms on their watershed and community. However, much of the community had been lulled into a sense of security. The last major hurricane to hit the region was [Hurricane Donna in 1960](#); the worst previous storm to hit the state was the Ash Wednesday [Nor'easter in 1962](#) (NOAA National Hurricane Center, n.d.; Rose, 2012). Because the population of the Jersey Shore then was less than 20% of what it is today, the possibility of a storm like Superstorm Sandy was unimaginable to many.

Nevertheless, the BBP staff continued educating the community about the watershed and participated as local scientific experts in relevant conversations. Starting in July 2012, a BBP staffer was invited to be part of the planning team for the development of [Multi-Jurisdictional All-Hazard Mitigation Plan for Ocean County, New Jersey](#). This FEMA-approved plan identifies hazards through a vulnerability analysis and develops a mitigation plan to save lives, reduce property damage, and increase

community resiliency during destructive events. This document also qualifies the county for pre-disaster and post-disaster grant funding (Ocean County, NJ, 2014). As an active stakeholder in Ocean County, the BBP helped ensure that future climate risk language was highlighted throughout the document. While the planning process began several months before Sandy, much of the document was written post-Sandy and was published in 2014.

Barnegat Bay Partnership's Role in Disaster Response and Recovery

Superstorm Sandy Response

Within the first days to weeks after a destructive event, [disaster response efforts](#) prioritize saving lives, protecting property and the environment, and meeting basic human needs (U.S. Homeland Security, 2016). Because most disaster response activities require training beforehand and/or are addressed by other local, state, and federal agencies, the BBP did not have a large role in such activities. However, one of BBP's staff was previously trained and contributed significant time with the Hazardous Materials Mitigation Response Team. Although only one staff member was trained to assist with immediate response activities, the staff member's in-depth knowledge about the watershed and natural resources from a scientific standpoint was a significant asset to the response-related activities. While having this type of training is not a requirement for the National Estuary Program, the Barnegat Bay Partnership found that familiarity with these types of response activities was helpful from an awareness standpoint.

Superstorm Sandy Recovery

In comparison with disaster response activities, [disaster recovery efforts](#) are long-term and aim to provide stabilization and rehabilitation to different aspects of the impacted areas, including: economic viability, human health and wellbeing,



Post Superstorm Sandy damage and cleanup. *Photos by Army National Guard Sgt. 1st Class Jim Greenhill (top); Barnegat Bay Partnership / Martha Maxwell-Doyle (middle and bottom).*

infrastructure, and natural and cultural resources (U.S. Homeland Security, 2016). As a partnership invested in restoring, protecting, and enhancing the natural resources of the Barnegat Bay ecosystem, the BBP had and continues to have a direct and vital role in disaster recovery activities post-Sandy.

Communicating with Partners and the Public

With guidance from NEP colleagues in Florida with hurricane recovery experience, the BBP adopted the role to serve as a conduit for sharing information with community members and partners.

With strong ties to the communities within the its study area, the BBP prioritized updating community members and key partners through several activities. The BBP updated its easily-accessible webpage that listed contact information for food banks, aid centers, and other emergency services. Additionally, an email list was developed to update subscribers on FEMA-related activities and other relevant recovery information. These activities were simple ways to keep locals informed if they looked to the BBP's website for information. In subsequent months after the hurricane, the BBP periodically developed newsletter articles on recovery activities and positive stories to keep the community engaged. These important tasks ensured that concerned citizens received reliable information from a non-biased source.

In addition to providing online materials, another significant component of the BBP's communication strategy was staying up-to-date with its partners about progress on recovery activities. The BBP enabled regular contact with FEMA's Joint Field Office (JFO), a [multiagency group set up by Homeland Security after a destructive event](#) that establishes response and recovery priorities (U.S. Homeland Security, 2006). Given the extent of property damage affecting residential homes and businesses, the primary focus of recovery efforts was to get back to "some kind of normal." At first it was challenging for the BBP and its partners to call attention to unmet recovery needs for natural resources, specifically within the study area. However, the BBP staff leveraged their positions as trusted scientific resources, developed connections to individuals within the JFO, and invited them to BBP [management committee meetings](#) (Barnegat Bay Partnership, 2018). By engaging with staff in the

JFO, the BBP remained up-to-date on FEMA recovery activities and continually provided well-informed input. As an additional action, the BBP requested that a member of the JFO arranged weekly updates by phone. These calls were open for all of the BBP's partners to listen in and participate, which was a critical strategy for the BBP to inform invested groups about on-going recovery work and ensured that efforts were not duplicated during this particularly hectic time.

Providing Scientific Expertise

The BBP provided evidence-based information and data throughout post-storm recovery with a specialized lens on the region's watershed and natural resources.

After Superstorm Sandy occurred, FEMA required the county to develop a recovery plan to qualify for various federal assistance. Since the Ocean County Planning Department is one of the BBP's 30 partners, the Partnership's staff contributed to [Ocean County's Recovery Plan](#) post-Sandy (Ocean County, NJ, 2015). As scientific experts and educators of the local watershed, the BBP is identified as a key stakeholder and as a technical expert in the plan. In addition to the BBP's contributions to the recovery plan, the program offered its scientific expertise for multiple post-hurricane studies, reports, and online tools, including a [beach and dune performance assessment](#), a [community resiliency planning tool](#), the [U.S. Army Corps of Engineers study on resilient adaptation](#), and more (The Richard Stockton College of New Jersey, 2012; New Jersey Resilient Coastal Communities Initiative, 2018; U.S. Army Corps of Engineers North Atlantic Division, 2014).

Post-disaster monitoring is a crucial component to determine the extent of environmental damage. While the BBP did not have a post-disaster monitoring plan in place after Superstorm Sandy, the program quickly recognized the need for a dynamic way to improve data-collection tactics. With this in mind, the BBP developed an annual

citizen science event, first launched in 2015, called “[Paddle for the Edge](#)” (Barnegat Bay Partnership, 2018). This data collection event engages volunteers with access to canoes, kayaks, or paddleboards to record basic information about the shoreline. This activity was created to improve the shoreline characterization throughout the estuary and to connect citizens to their watershed. With the collected data, the volunteers contribute to a growing database that provides an overview of the ever-changing shoreline. With this program in place, the BBP will be ready to monitor the changes to the shoreline after storm events in the future.

Organizing Recovery Initiatives

The BBP operated as a community organizer for events associated with recovery efforts and promoted education about extreme weather events like Superstorm Sandy.

After the storm, the BBP functioned as a clearinghouse for hundreds of individuals interested in post-disaster volunteer work. The BBP directed these concerned citizens to various organizations to support recovery efforts. In addition to directing volunteers, the BBP dedicated their time and resources to bring the community together to examine ways to mitigate the effects of extreme weather events, sea level rise, and other climate risks. The BBP, at the invitation of the Toms River mayor, [partnered with the Institute on Science for Global Policy](#) and other groups to jumpstart local conversations about the personal, economic, and community-wide significance of diverse climate and storm issues (The Institute on Science for Global Policy, 2015).

Following the storm, the BBP worked with [EPA's Climate Ready Estuaries Program](#), the NOAA-funded [Jacques Cousteau National Estuarine Research Reserve, New Jersey Sea Grant Consortium](#), NJDEP Coastal Management Program, [Rutgers University Bloustein School of Planning and Public Policy](#), and [Sustainable New Jersey](#) to develop the [Getting to Resilience website](#). This self-assessment

tool helps communities reduce their vulnerability and increase their preparedness by linking planning, mitigation, and adaptation. Using this assessment tool, communities can find out how their preparedness can be worth valuable points and save money through FEMA's [Community Rating System](#) and Sustainable Jersey (New Jersey Resilient Coastal Communities Initiative, 2018).

Much later after the Superstorm Sandy, the [BBP developed the Jersey-Friendly Yards](#) website with funding from NJDEP to teach homeowners and community members about how smart landscaping can prevent the negative effects of stormwater runoff, nutrient accumulation, and pet waste on the watershed (Rethink the Lawn and Reduce Your Environmental Impact, 2018). The [BBP sponsored community events](#) including “Experience Jersey-Friendly Yards” and “Greening Your Landscape While Protecting the Watershed” to educate participants about using green infrastructure techniques, like rain barrels and rain gardens, to improve water quality (Barnegat Bay Partnership, 2018).

It is important to note that these types of tools are incorporated into the local Hazard Mitigation Plan as well as receive [Community Rating System \(CRS\) flood mitigation credits](#). The BBP plans to continue these types of community engagement events and tool development to promote positive protection of the watershed and community resilience.

Lessons Learned

In many ways, Superstorm Sandy was a wake-up call for the BBP and New Jersey shoreline communities alike. While six years have passed since Superstorm Sandy, a number of communities within the BBP study area are still recovering. For some communities it may be 10 years before recovery efforts are close to completion. The valuable lessons learned from Superstorm Sandy will continue to inform the BBP's future decision-making.

Lesson #1: Planning, planning, planning!

The BBP learned that it is critical to thoroughly consider and document its roles in pre-disaster recovery planning and hazard mitigation, and to identify planning processes regarding both the region's natural resources and communities.

When Superstorm Sandy hit, the BBP did not have post-disaster monitoring procedures, hazard mitigation language embedded into their Comprehensive Conservation Management Plan (CCMP), or a plan for post-disaster communication. Even though the BBP is very well connected to its local county, without these planning procedures in place, the BBP did not have much leverage for involvement in a number of recovery activities. Instead, the Partnership had to devote resources to foster new connections with the hurricane recovery decision-makers at the state and federal level. As a result, the BBP was not fully prepared to react to the quick response times and turnaround needed after a disaster event. These circumstances became evident as the region and funding entities prioritized rebuilding damaged infrastructure before the summer vacation months and "shovel-ready" project proposals. Unfortunately, the BBP did not have the experience to anticipate this reality. Although the program submitted several project proposals with partners focused on resiliency and restoring natural resources, some proposals were rejected for being too expensive or not immediately executable. Thus, the BBP was overlooked for several watershed recovery projects (e.g., shoreline or wetland restoration) and community infrastructure (e.g., water supplies, stormwater [flood] management). Several proposals included use of common monitoring and assessment metrics to guide future decision-making on certain types of projects for which little information was available in New Jersey (e.g., thin-layer deposition, hybrid shorelines). It became clear to the BBP that rebuilding with resiliency was less of a priority than building back rapidly. Without pre-disaster planning and ready-to-go projects, the BBP

did not have the opportunity to help change these outcomes.

As the BBP revises its original 2002 CCMP, the Partnership is including emerging climate threats, like sea level rise and storm severity, and [integrating results from a broad, risk-based vulnerability assessment](#) (EPA, 2016). By emphasizing these topics in its revised CCMP, the BBP is positioning itself for improved planning for post-disaster recovery initiatives and for funding opportunities related to hazard mitigation and pre-disaster recovery planning. The CCMP will be incorporated by reference into the LHMP to ensure their projects are eligible for FEMA hazard mitigation grants. Additionally, the BBP has identified post-disaster monitoring locations so that in the future, the Partnership can act quickly after a disaster event to assess the watershed. However, a post disaster monitoring plan is still needed.

Lesson #2: It's all about information-sharing

The BBP learned that its role as a nimble communicator is crucial during disaster recovery to both its partners and the public

Superstorm Sandy was the most extreme weather event the BBP has experienced since the program's creation in 1995. As such, the Partnership had to determine its niche during hurricane recovery along with the numerous other organizations and agencies involved in these efforts. The BBP is recognized for supporting decision-making on the best available science and communicating credible, scientific information to its partners and the public; thus, the role of communicator became the Partnership's main responsibility during recovery activities. However, this role did not come without challenges. The dynamic and fast-paced nature of response and recovery efforts hindered communication channels with the BBP, since disaster recovery officials were simply unaware of BBP's expertise with the local watershed. Furthermore, FEMA officials within the Joint Field

Office rotated every 2 to 3 weeks, which created another obstacle for consistent communication with the BBP.

To address these challenges, the BBP has prioritized building and maintaining communication networks with disaster recovery officials. By improving channels of communication with local, state, and federal emergency management offices and State Silver Jacket Teams, and through recognition in local and state hazard mitigation plans, the program is better prepared to fulfill its role as an effective communicator to the public and its partners.

Lesson #3: The need for positive and well-informed messages with the public and partners

The BBP learned that positive and consistent messages are most effective during disaster recovery to foster important conversations about community and natural resource resiliency.

Long before Superstorm Sandy, the BBP established itself as a local scientific source and educator regarding environmental issues within the community. Superstorm Sandy gave community members a far-too-personal understanding of the impact of extreme weather intensified by climate change. As community awareness has increased about these climate change, the BBP continues to host meaningful conversations about how communities and future generations can plan for change and thrive. Post-Sandy, the BBP also recognized the newly energized public and experienced new audiences gaining interest in the Barnegat Bay watershed, including local businesses. The BBP leveraged this new-found interest to bring new stakeholders to the table and incorporate them into future climate adaptation efforts.

An important component of this work is highlighting opportunities for change and success stories to keep people engaged. After a disaster event, accusatory and negative messages can be commonplace, but remain ineffective. The BBP staff

discovered that people within the study area responded well to positive messages and success stories. Throughout the region's recovery process, the BBP has dedicated its resources to create educational messages that both teach and inspire.

The BBP continues to craft messages that highlight success stories to better prepare the community and partners against future extreme weather events. The Partnership also aims to provide messages about other types of disaster events like fires and flooding.

Discussion

The Barnegat Bay Partnership played a significant role during recovery efforts post-Superstorm Sandy. The BBP functioned as a community convener, an educator, and a communicator to not only the general public, but also to the Partnership's 30+ partners and other recovery officials. As local experts of the watershed and the region's natural resources, the BBP was able and continues to provide objective scientific information during the often-chaotic process of disaster recovery.

Throughout the recovery process, the BBP learned important lessons, including the utility of pre-disaster recovery planning, the need for credible science-based information to support decision making, the power of positive communications, and the importance of defining and carrying out a unique role that builds on its recognized strengths as a National Estuary Program. [Current predictions](#) show that frequency and intensity of storms is likely to worsen in the New Jersey area, supporting the need for better planning for flooding, drought, and fire events (U.S. EPA, 2016). Going forward, the BBP is working to improve its disaster preparedness by embedding its CCMP with findings from its vulnerability assessment and improving communication networks with disaster officials. However, there is still a need for a post-disaster monitoring plan.

A Case Study of Barataria- Terrebonne National Estuary Program:

Experiences and Lessons Learned from the Deepwater Horizon Oil Spill

Introduction and Background

Barataria-Terrebonne National Estuary Program (referred to as “BTNEP” or “the Program”), located in southeast Louisiana, was one of several National Estuary Programs that [played a crucial role](#) in disaster recovery activities after the Deepwater Horizon Oil Spill (Greening, et al., 2017). This case study explores BTNEP’s experience with the spill including pre-disaster recovery planning, BTNEP’s role during recovery efforts, and major lessons learned.

On April 20, 2010, the oil-drilling rig *Deepwater Horizon*, located in the Macondo Prospect in the Gulf of Mexico, exploded. [The explosion](#) resulted in 11 deaths, 17 injuries, and one of the [worst environmental disasters](#) in United States’ history (U.S. EPA, 2015; Bray, 2018). Over an 87-day period, nearly 134 million gallons of oil flowed into the Gulf of Mexico until the leak was capped on July 15, 2010.

Over 1,100 miles of coastline, 1,200 miles of deep ocean floor, and 68,000 square miles of surface water were polluted by the oil. [The spilled oil contaminated](#) the coasts of 5 states including Texas, Louisiana, Mississippi, Alabama, and Florida, severely disrupting their economies and their ecosystems (NRDC, 2015). It is estimated that the overall loss of impacted fisheries could be \$8.7 billion by 2020 and in Louisiana alone, leisure visitor spending dropped by [\\$422 million from 2010 to 2013](#) (Oceana, 2015). Deep-sea corals, biologically diverse habitats, and wildlife suffered dramatic die-offs. Close to one million seabirds, five-thousand marine mammals, and one-thousand sea turtles

BTNEP Played a Vital Role During DWH Spill Recovery

- Providing non-biased media engagement
- Conducting public outreach and education
- Coordinating volunteer activities
- Providing technical expertise

BTNEP Learned Valuable Lessons Throughout Recovery Efforts

- Determining BTNEP’s appropriate role during recovery activities
- Emphasizing prevention and mitigation

were impacted. As a result, a [\\$USD 20.8 billion settlement](#) was approved against the owners and operators of the oil rig (NOAA, 2017).

Pre-Disaster Planning

From 1991 to 2015, about [19 thousand oil release reports](#) were made by the National Response Center (NRC) within BTNEP’s estuary boundary (Barataria-Terrebonne National Estuary Program, 2018). Given the frequency of oil spills and BTNEP’s dedication to protect and preserve the estuary, the Program ensured that oil-spill prevention and planning documents were in place early on. Oil spill prevention was embedded into the Program’s Comprehensive Conservation Management Plan (CCMP) in 1996. As the CCMP was updated through the years, oil spill prevention and early detection action plans have also been continually implemented.

BTNEP promotes meaningful engagement with important partners on oil spill prevention and early

detection. Members of BTNEP's [Management Conference](#), including the Louisiana Oil Spill Coordinators Office and the Louisiana Independent Oil and Gas Association, participate in decision-making activities as well as the development and implementation of the CCMP (Barataria-Terrebonne National Estuary Program, 2018). The diverse set of stakeholders within the Management Conference convenes quarterly to represent the community's collective voice on watershed issues. In addition to the program's inclusive Management Conference, BTNEP has produced materials on oil spill prevention, including an [Oil Spill Prevention Calendar](#) which was sent to oil industries and partners annually in 2005, 2007, and 2010 (Barataria-Terrebonne National Estuary Program, 2010). The calendar focuses on mitigation and details different oil spill prevention techniques for more common types of spills. Additionally, [BTNEP's Spill Prevention Guide](#) highlights the need to invest in preventative measures or be prepared to pay for the consequences later (Barataria-Terrebonne National Estuary Program, 2011).

It is important to note, however, that these types of activities and materials addressed the "typical oil spill." The extent and severity of the Deepwater Horizon Oil Spill (DWH Spill) was beyond anything BTNEP – along with industry, regulators, and responders – had ever dealt with before. In comparison to other oil spill events, the environmental and economic impacts of the DWH Spill are still very much felt today.

Barataria-Terrebonne National Estuary Program's Role in Recovery

[Disaster recovery efforts](#) are long-term and aim to provide stabilization and to rehabilitate many different aspects of the impacted areas, including: economic viability, human health and well-being, infrastructure, and natural and cultural resources (U.S. Homeland Security, 2016). As a program invested in preserving, protecting, and restoring the natural resources of the Barataria-Terrebonne



Deepwater Horizon oil spill. Photos from top by BTNEP; US Coast Guard; BTNEP.

National Estuary, BTNEP had a direct role in disaster recovery activities post-oil spill.

Communication and Media Relations

One of the most important roles that BTNEP adopted immediately after the spill was as a reliable source of accurate information for media outlets.

Given the size of the oil spill event and the response to it, media outlets heavily covered the story and sometimes provided misleading or false

information. Adding to the confusion, federal and state responders with a scientific understanding of the situation were often unable to directly engage with the media as they were occupied with containing the spill and related recovery activities. As a trusted source and communicator, BTNEP had the ability to share factual, non-biased information with the media almost daily to counteract misinformation.

The director of BTNEP at the time participated in numerous interviews and gave presentations to local, national, and international reporters. [Presentations included](#): explanations of the Oil Pollution Act and the process of spill response; the composition of oil and its influence on natural resources; the differences between technological and natural disasters; an explanation of dispersants, their impacts, and when they can and cannot be used; and information about how coastal landscapes are both important naturally and economically (Greening, et al., 2017). In addition, BTNEP staff brought reporters to accessible, affected areas on boats and trucks to give them a closer look of the impacts. This hands-on engagement piqued the interest of many corporate partners, resulting in guided tours with the BTNEP director and several oil company representatives to the damaged areas as “lessons learned” opportunities.

Conducting Public Outreach and Education

Throughout the recovery process, BTNEP created informative materials and actively engaged with the community to educate individuals about oil spills and the recovery process.

To continue to dispel misinformation about the oil spill, BTNEP produced and distributed a series of factsheets that provided easy-to-understand information to address frequently asked questions. These fact sheets, titled [Oil Spill Cleanup in a Marsh Environment](#), [Chemical Dispersants](#), and [Using Booms in Response to Oil Spills](#) are posted on a [Deepwater Horizon Oil Spill Resources page](#) on the BTNEP website (Barataria-Terrebonne National

Estuary Program, 2010). The program's website also hosted links to additional, relevant resources and contact information.

After the spill, many schoolchildren were frightened by the news and how their families' health and finances would be affected by the oil spill. To quell these concerns, BTNEP's Education Coordinator volunteered to visit schools to provide accurate and age-appropriate information about the impacts of the oil spill. With presentation slides, hands-on learning activities, and exploratory scenarios, the students were both engaged and comforted by the educational information. During these presentations, the Education Coordinator also shared the turtle rehabilitation program with the students, which was very popular and taught the students about different wildlife recovery initiatives.

Coordinating Volunteer Activities

As a valued stakeholder within the community, BTNEP served as a volunteer coordinator for locals who wanted to help protect the region's natural resources.

Following the spill, volunteer interest was very high. BTNEP served as a major volunteer coordinator to point interested parties in the right direction. Given the fact that cleanup activities require specialized training to handle hazardous chemicals, many individuals could not participate directly in such cleanup activities. BTNEP encouraged these concerned citizens to donate much needed materials instead – such as paper towels, cameras, gloves, rope, and soap – to assist with recovery efforts. As BTNEP received large quantities of these donated items, staff coordinated deliveries to assist other agencies and organizations in severely affected areas, like Grand Isle, that were not set up to receive such donations.

Providing Technical Expertise

As scientific specialists of the local watershed, BTNEP staff and program initiatives provided much needed technical expertise during recovery efforts to inform good decision-making.

Both before and after the oil spill, BTNEP prioritized hiring and maintaining highly skilled staff in a variety of areas, allowing the Program's staff to be effective leaders during recovery processes. By having specialized roles in areas like education, watershed science, wildlife, and media communications, the Program efficiently executed recovery activities such as engagement with news outlets, education outreach with local schools, and contribution to the oiled sea turtle rehab operation with Audubon Nature Institute. Additionally, due to previous professional involvement in oil spill management, the BTNEP director at the time served as an important scientific resource to spill response officials. This specialized knowledge allowed the BTNEP director to provide critical guidance on the best methods to remove oil from wetlands for optimum recovery.

In addition to the Program's staff resources, BTNEP contributed important data and resources to characterize the extent of damage on local habitats. Since 2005, BTNEP has continually conducted bird monitoring surveys, as [the area is home to more than 400 species of birds](#) (Barataria-Terrebonne National Estuary Program, n.d.). After the spill, this data proved to be extremely useful for post-spill monitoring surveys of oiled birds and tracking affected populations. To assist the parishes to track the damages to their local communities, BTNEP purchased and used eight GPS cameras to photograph and obtain GPS coordinates and dates to track the spread of oil from the spill.

Funding Opportunities

Despite not receiving any funding from FEMA, the Coast Guard, or the DWH Spill settlement, BTNEP utilized its network of partnerships to support some of the recovery activities.

After a disaster event, funding opportunities for various recovery efforts become available, although sometimes difficult to track down. Even though BTNEP did not receive disaster relief funding from FEMA, Coast Guard, or funding from the settlement, BTNEP utilized alternative opportunities to help support their recovery activities after the spill. Founded in 1995, [Barataria-Terrebonne Estuary Foundation](#) (BTEF) is a non-profit created to support BTNEP's mission (Barataria-Terrebonne Estuary Foundation, n.d.). After the oil spill, concerned individuals from around the country donated to the foundation to support the program's recovery initiatives. In addition, a local bank organized a fundraiser for BTEF, providing further financial support. International, national, and local companies also donated to advance restoration activities.

In a show of solidarity and support, Delaware Center for the Inland Bays, one of the 28 National Estuary Programs, planned a [charity concert on the beach](#) for BTNEP, which was a huge success (Delaware coastal businesses rally for Gulf aid, 2010). Hundreds of people attended the event and donated, contributing approximately \$60,000 to the Gulf recovery efforts. Despite these additional funding opportunities, most of the financial support was derived through the National Estuary Program's base funding to BTNEP, provided by EPA.

Lessons Learned

Given the massive impact of the spill, the numerous spill responders entering the region, and the widespread media coverage, this type of disaster scenario was different than anything BTNEP had ever experienced before. It has been eight years since the Deepwater Horizon Oil Spill occurred, and the damages [still linger](#) today (U.S. National Ocean Service, 2017). Despite BTNEP's in-depth engagement and planning prior to the DWH Spill the Program faced a number of challenges throughout the recovery process. These challenges presented BTNEP with a variety of learning opportunities that continually inform the Program's current and future decision-making.

Lesson #1: Determining BTNEP's Role throughout Disaster Recovery Initiatives

BTNEP learned the importance of identifying the program's role as a non-biased educator, scientific expert, and community facilitator throughout recovery initiatives.

After a disaster event such as the DWH Spill response is fast-moving and dozens of outside entities – federal, state, private, and NGOs – are incorporated into the recovery process. During recovery efforts, BTNEP pinpointed the program's most effective role during recovery activities. With BTNEP's previous experience in oil spill recovery and community engagement combined with the program's detailed knowledge about the watershed, BTNEP was uniquely set up to support a variety of post-disaster recovery activities as a community educator, scientific expert, and facilitator. By fulfilling these specific roles throughout oil spill recovery, BTNEP contributed significantly to the recovery efforts within the region. Additionally, by following state [Hazard Mitigation Plans](#), the program ensured that they were taking appropriate steps, along with the spill recovery officials, to address and fulfill the needs of the community and natural resources (State of Louisiana, 2014). BTNEP plans to maintain and

improve engagement with local and state partners to update and refine action plans specifically related to oil spills in planning documents such as the CCMP.

Lesson #2: Emphasizing Oil Spill Prevention vs. Reaction

BTNEP learned to renew the program's emphasis on preventative rather than reactive measures to mitigate negative impacts from oil spills and other disaster events.

The importance of emphasizing preventative actions was heavily reiterated to BTNEP throughout the DWH Spill recovery process. The Deepwater Horizon Oil Spill was a man-made disaster that caused catastrophic environmental and economic damages to affected regions. Toxins, like oil and chemical spills, remain one of BTNEP's priority concerns, since more and larger spills occur in this program's study area than in any other area in the United States (Barataria-Terrebonne National Estuary Program, 2011). Since these oil and chemical spills are man-made, they are entirely preventable. Throughout recovery efforts, BTNEP and its acting Management Conference members served as educators to school groups and to several private oil and gas companies interested in reducing oil and chemical spill risk. This interest demonstrated by both community members and private companies not only verified to BTNEP the importance of preventative measures as the number one way to reduce negative environmental impacts, but also indicated the community's willingness to learn how to improve.

With this renewed interest, BTNEP continues to educate local community members and corporate partners about preventative actions to ensure that they are well-suited to protect the surrounding communities and natural resources.

Discussion

Throughout the Deepwater Horizon Oil Spill recovery process, BTNEP fulfilled a crucial role as a non-biased educator and community organizer. BTNEP's unique position as source of watershed experts, volunteer coordinators, and educators allowed the program to be nimble with activities such as media, community, and private sector engagement. Additionally, because of the program's

dedicated work within the study area, BTNEP provided important data, such as bird survey data and GPS data, to assist with wildlife and habitat rehabilitation after the spill. The lessons learned from these recovery efforts will assist BTNEP going forward with their future decision-making related to hazard mitigation and pre-disaster planning. Overall, this program's strong foundation proved to be an invaluable resource throughout the Deepwater Horizon Oil Spill recovery initiatives.



Deepwater Horizon oil spill impacts. *Photo by BTNEP.*

A Case Study of Coastal Bend Bays and Estuaries Program:

Experiences and Lessons Learned from Hurricane Harvey

Introduction and Background

This case study explores Coastal Bend Bays and Estuaries Program's role in Hurricane Harvey pre-disaster preparedness activities, post-disaster recovery initiatives, and lessons learned from these experiences.

[Coastal Bend Bays and Estuaries Program](#) (referred to as CBBEP or "the Program") is one of 28 National Estuary Programs and is located along the south-central Texas coastline (Coastal Bend Bays and Estuaries Program, 2018). With a [515-square mile study area](#), CBBEP protects and restores bays, estuaries, and bayous in the Copano, Aransas, Corpus Christi, Nueces, Baffin, and upper Laguna Madre systems. The Program joined the National Estuary Program in 1994 and CBBEP's first Comprehensive Conservation Management Plan was approved in 1999 (Coastal Bend Bays and Estuaries Program, 2018).

[Hurricane Harvey made landfall](#) with maximum sustained winds of 130mph in south-central Texas on August 25th, 2017 as a Category 4 hurricane (National Weather Service, 2017). In the following days, [Hurricane Harvey stalled](#) in southern Texas and [produced catastrophic rainfall](#) and flooding throughout the impacted areas (The Weather Channel, 2017; National Weather Service, 2017). Southeast Texas and southwest Louisiana received [40-60 inches of rainfall](#) – 27 trillion gallons of rain – over a 6-day period (National Hurricane Center, 2017). In some areas, storm surge levels surpassed 12 feet above ground level (National Weather Service, 2017). [Over 300,000 structures](#) in the affected region were [flooded](#), some as a result of rainfall and others from storm surge (CBS News, 2017). Adjusted for inflation, [Hurricane Harvey is](#)

CBBEP Played a Vital Role During Hurricane Harvey Recovery

- Acting as a trusted scientific resource
- Providing data and resources about the impacts of Hurricane Harvey on important natural resources

CBBEP Learned Valuable Lessons throughout this Experience

- Monitoring and tracking post-disaster data
- Communicating effectively with local, state and federal government partners

[the second costliest tropical cyclone on record](#) after 2005's Hurricane Katrina, with a total of \$125 billion USD in damages (National Hurricane Center, 2017). Coastal Bend Bays and Estuaries Program was severely affected by Hurricane Harvey and played an important role in pre-disaster and post-disaster activities.

CBBEP's Role in Pre-Disaster Planning

Before Hurricane Harvey, CBBEP was involved in several pre-disaster planning initiatives that aim to increase the Program's preparedness for current and future changes in sea-level, weather patterns, geology, hydromorphology, and other potential hazards. The Program continues to be involved in these types of activities.

Using the CCMP to Guide Action

A large part of this preparedness is reflected in the Program's [newly updated CCMP](#) – the 2nd draft currently available online for public review (Coastal Bend Bays and Estuaries Program, 2018). In particular, Chapter 14 "Coastal Resilience", of the plan is entirely focused on the impacts of changing climatic and environmental conditions and the

important role CBBEP must play in [“effective avoidance, mitigation, minimization and adaptation strategies”](#) (Coastal Bend Bays and Estuaries Program, 2018).” This section of the CCMP is heavily influenced by the vulnerability assessment conducted in 2016 in partnership with The Nature Conservancy. Through this assessment, the Program is well-informed about the likely impacts on the study area’s coastal habitats and wildlife most susceptible to storm surge and flooding from future storms, due to sea level rise, erosion, subsidence, and other processes. The vulnerability assessment also produced five recommended actions that are used to develop the Program’s Coastal Resilience Action Plan. Actions within this plan include: facilitating studies to better understand the wide range of effects of climate change; assisting development and implementation of adaptive management plans to conserve and protect coastal resources; and, developing formal and informal education materials that are locally relevant to share with local communities. Furthermore, CBBEP will share the results of the adaptive management plans to counties and city leadership for their use in planning. The Coastal Resilience Action Plan and accompanying goals is an important step to set CBBEP up for successful implementation of important climate adaptation tasks, like promoting hazard mitigation and pre-disaster planning.

Utilizing Partnerships to Encourage Effective Planning

The Program’s 2016 vulnerability assessment and other studies on sea-level rise and advanced storms are shared with local government officials to assist with planning, establishing CBBEP as a center of excellence on the study area’s natural resources. Additionally, the Program engages with more than 32 government, corporate, and non-profit partners to involve them in outreach about climate risks and preparedness.

CBBEP is also named in the Texas Coastal Bend Council of Governments’ [Coastal Bend Hazard Mitigation Action Plan](#), which identifies the program



Damage caused by Hurricane Harvey. *Photos by Owen Fitzsimmons.*

as a partnering agency to carry out specific hazard mitigation action items (Coastal Bend Mitigation Action Plan, 2012).

CBBEP’s Role during Post-Disaster Recovery

Rockport, Texas is within the CBBEP study area and was the site of Hurricane Harvey’s landfall with 130mph winds and 20 inches of rain. Nearby, [Port Aransas was devastated by the storm](#), with Aransas County (population: 23,000) suffering [more destroyed single-family homes than Harris County](#) (population: 4.5 million) (South Texas Economic Development Center, 2018; McGraw, 2018). Despite these damages and the extreme flooding that resulted from the storm, CBBEP staff self-described the study area’s impacts as “fairly modest” in comparison to other affected areas. CBBEP was fortunate to not have any major lasting

water quality problems, but certain regions in the Program's study area, like the rookery islands, suffered severe damages.

For the first six months after the hurricane, most activities were immediate disaster response-focused— such as cleaning the streets of downed power lines, garbage, and debris— and carried out by local government entities. State and local partners are very experienced with hurricane response and recovery, so their plans were prepared and well-executed. As response activities slowly transitioned into longer-term recovery activities, CBBEP played a crucial role in providing both scientific expertise and resources to decision-makers and local partners.

Offering Partners Scientific Information and Receiving Support in Return

CBBEP played and continues to play an important role as scientific experts on coastal habitats and wildlife, providing crucial resources and data to decision-makers and local partners throughout the Hurricane Harvey recovery process.

One of the first actions that CBBEP took after Hurricane Harvey hit the region was to get out on the ground— once it was safe to do so— and take photographs of the hurricane's impacts on the study area's habitat. This action, while simple, was extremely important for CBBEP, as these photos were some of the first to be released of the hurricane's impacts on the region's natural resources. As such, the Program was not only able to immediately begin conducting assessments of the natural resources of the bay, but also got noticed by a local outdoor journalist. This journalist [wrote a story about the environmental impacts of the storm](#) (Sikes, 2017). Readers responded quickly by seeking CBBEP out to donate to the Program to assist with recovery activities. CBBEP responded to this by providing a website to accept donations from concerned citizens. CBBEP also worked with private foundations and corporations that provided funding for immediate and long-term restoration efforts.

In addition to the photos, CBBEP had several on-going monitoring, multi-year efforts of the [seagrass beds](#) as well as the [coastal rookery islands](#) (popular nesting islands for various species of birds), prior to the hurricane (Palmer, 2017; Coastal Bend Bays and Estuaries Program, 2017). As a post-disaster monitoring action, the program conducted follow-up analyses on these programs to assess Hurricane Harvey's impacts on these crucial habitats. The greatest impact was on the rookery islands— vegetation had been fully removed, educational signage had been knocked over and destroyed, and some islands were completely swept away by the force of the waves. Due to these impacts, approximately 10 years of restoration activities and management progress were reversed. As a post-disaster recovery activity, CBBEP put together an impact survey about these devastated natural resources and shared it with state and federal partners. These partners were able to seek immediate funding to start the restoration process, which was and continues to be a very [successful endeavor](#) (Tunnell, 2018). Throughout these recovery initiatives, CBBEP worked closely with Texas Parks & Wildlife Dept., Texas Commission on Environmental Quality, and the Texas General Land Office.

CBBEP's Lessons Learned

CBBEP faced several challenges throughout recovery activities and as the region continues to recover from Hurricane Harvey's drastic impacts. From these challenges, CBBEP has learned important lessons that will continue to inform the Program well into the future.

It has been approximately one year since Hurricane Harvey made landfall on U.S. soil. Communities are still very much engaged with the long-term recovery process post-hurricane. As a Program invested in the community and the local coastal environments, CBBEP is continually learning from Hurricane Harvey and from the recovery activities the Program has been engaged in.

Lesson #1: The Importance of Monitoring and Tracking

CBBEP learned the importance of conducting assessments of the study area as soon as possible post-disaster. However, questions about the frequency of on-going monitoring remain.

Due to the Program's fundraising successes from photographing the destruction of the study area's natural resources, the benefits of quickly and accurately tracking and sharing the impacts on the environment after a disaster event were clearly demonstrated to CBBEP. However, during these monitoring and tracking efforts, CBBEP staff noted the importance, and the Program's lack of, of consistent and recent data and maps to compare post-disaster monitoring and tracking data to. While the Program realizes that mapping all existing habitats annually may not be necessary, comparing post-disaster data to 10-year-old maps does not accurately portray the effects of a disaster event as destructive as Hurricane Harvey.

To address this challenge, CBBEP is strategizing to find a balance between establishing routine tracking and monitoring efforts and the frequency of these tasks. In the coming years, it is likely that the Program will have a greater understanding about implementing such a balance.

Lesson #2: The Challenge and Importance of Communicating with Local, State, and Federal Partners

Since natural resource recovery is a relatively low priority during disaster recovery, CBBEP learned the best way to ensure that its needs are properly communicated through the most effective channels.

CBBEP encountered several communication challenges throughout the recovery process. While state government partners were well-prepared to act after Hurricane Harvey, local government entities were not as well-versed in this type of disaster response and recovery scenario. Coupled with the fact that repairing and recovering natural

resources is relatively low on the disaster recovery priorities list, CBBEP had to learn the most effective way to communicate with these decision-makers and to highlight the importance of protecting and restoring the important natural resources in the Program's study area.

To address this communication challenge, CBBEP learned that the Program's positive impacts during recovery efforts and identified recovery needs must be documented and, more importantly, shared with FEMA through local government partners to secure crucial FEMA funding for recovery projects. Communicating these impacts and needs with local government groups is essential for CBBEP to ensure that both the Program itself and local government entities do not miss opportunities to receive and implement funding for recovery activities.

Discussion

Disaster recovery activities post-Hurricane Harvey will continue for years to come. Coastal Bend Bays and Estuaries Program played an important role as scientific experts and stewards of the study area's natural resources and learned several lessons about the challenges of disaster recovery along the way. The Program provided crucial tracking and monitoring data about important resources like seagrass and the rookery islands, vital habitats for wildlife and nesting sites for a variety of migratory and local birds. CBBEP highlighted the importance of these resources and tracked the impacts of Hurricane Harvey on these areas and continues to do this important work.

Throughout these initiatives, CBBEP faced challenges regarding monitoring and communicating with disaster recovery decision-makers. However, these challenges have turned into lessons learned and the Program is working to use these experiences to continue to be an important voice and steward of the natural resources of the area.

A Case Study of San Francisco Estuary Partnership:

Experiences and Lessons Learned from Hazard Mitigation and Resiliency Initiatives

Introduction and Background

This case study explores [San Francisco Estuary Partnership's](#) (referred to as SFEP or "the Partnership") role in implementing nature-based resiliency and hazard mitigation initiatives and the lessons learned from implementing these activities.

SFEP, one of 28 National Estuary Programs, was established by the State of California and the U.S. Environmental Protection Agency in 1988 when the San Francisco Bay and Sacramento and San Joaquin River Delta (referred to as the San Francisco Bay-Delta Estuary) was identified as an estuary of national significance.

The [San Francisco Bay-Delta Estuary](#) is one of the largest in North America, encompassing almost 60,000 square miles and close to 40 percent of the state of California (San Francisco Estuary Partnership, 2016). The program's study area includes nine counties, 101 cities, and millions of people. The waters and wetlands within the study area provide vital habitat to a wide variety of plants and animals. Additionally, much of the fresh water from the program's study area is diverted to supply population and agricultural centers in California.

The San Francisco Bay-Delta Estuary is [vulnerable](#) to various climate-related challenges, including: changes in precipitation and weather patterns, increasing water temperature, sea-level rise, changes in water availability, and changes in sedimentation and erosion patterns (U.S. EPA, 2012). Given these threats to the estuary, SFEP has responded by prioritizing nature-based resiliency initiatives and hazard mitigation activities to

SFEP Highlights Importance of Regional Approach to Hazard Mitigation and Resiliency Planning

- Enabling innovative action through a well-informed CCMP
- Acting as a community conduit for resiliency work

SFEP Learned Valuable Lessons from Resiliency Work

- Innovative projects, outdated approval processes
- Working regionally while balancing local needs

improve the estuary and support the region's climate preparedness.

SFEP's Role in Hazard Mitigation and Resiliency Planning

SFEP plays a dynamic role to support resiliency and hazard mitigation planning within the region. Housed within a region with a long-standing emphasis on climate-related issues, SFEP's locally-driven priorities have accentuated climate adaptation actions from early on. Continuing this commitment to support climate adaptation, SFEP's updated 2016 CCMP, called the [Estuary Blueprint](#), demonstrates the Partnership's current and future role in innovative climate adaptation projects that are geared towards long-term resiliency and hazard mitigation (San Francisco Estuary Partnership, 2016). Through these projects, SFEP supports regional resiliency by acting as a community convener of experts in the field, as well as providing resources and support to smaller organizations.

Enabling Innovative Action through a Well-Informed CCMP

With a well-informed CCMP, SFEP is equipped to address and assist hazard mitigation and climate adaptation initiatives within the region, enhancing the long-term preparedness of the communities and natural resources in the study area.

Integrating Resilience throughout the CCMP to Demonstrate a Multi-Benefit Approach

By naming “Resilience” as one of four key goals and integrating this goal throughout the 32 actions detailed in the 2016 Estuary Blueprint, SFEP develops and tracks its role in resiliency work to better serve the surrounding communities and habitats.

While resiliency and climate adaptation are highlighted in 15 of the 32 actions, four actions (Action 14 through Action 17) specifically address hazard mitigation initiatives, recovery planning, climate adaptation projects, and resiliency projects.

Throughout these four actions, SFEP emphasizes the importance of nature-based infrastructure, natural resource protection, and [multi-benefit climate adaptation projects](#) in order to promote initiatives that not only increase the region's resilience to current and future hazards, but also provide positive environmental and economic benefits (San Francisco Estuary Partnership). One example of a multi-benefit climate adaptation project is SFEP's collaboration on a [horizontal levee project](#) in the Oro Loma and Castro Valley Sanitary Districts (Oro Loma and Castro Valley Sanitary Districts to Test Experimental Levee, 2015). This innovative project not only creates abundant wildlife habitat, but it also slows storm surges, buffers rising sea levels, and removes nutrients that jeopardize water quality—qualities that benefit the surrounding communities' health and well-being. By having this type of language embedded into the CCMP, SFEP is able to commit resources to these

multi-benefit hazard mitigation and resiliency projects.

CCMP Actions Informed by Influential Partnerships and Relevant Documents

SFEP's active commitment in the CCMP to engage with decision-makers at the regional and federal level improves the Partnership's position as a key provider of technical support and resources to protect the study area's habitat and surrounding communities.

In addition to resilience goals interspersed among SFEP's CCMP's actions, the Partnership's actions are responsive to recommendations found in informative climate-related documents including, [Baylands and Climate Change: What We Can Do](#) and [Safeguarding California: Reducing Climate Risk](#) (San Francisco Estuary Institute, 2015; Natural Resources Agency, 2014). Furthermore, the 2016 Estuary Blueprint actions refer to important pre-disaster recovery planning resources, such as the National Disaster Recovery Framework (NDRF) and the creation of state and local hazard mitigation plans. SFEP has built up key relationships with some agencies active in resiliency planning through strategic investments and leveraging assistance in priority areas. SFEP's CCMP actions are well-informed by these partnerships within the disaster preparedness and recovery arenas. SFEP works with regional partners, including Association of Bay Area Governments (ABAG) and the San Francisco Bay Conservation and Development Commission (BCDC) to integrate FEMA's Recovery Support Function (RSF) core recovery capability for natural and cultural resources into local and regional resilience plans, hazard mitigation plans, and climate adaptation plans. SFEP also contributes to planning and guidance efforts such as [Adapting to Rising Tides](#) and the Delta Stewardship Council's [Delta Levee Investment strategy](#) (San Francisco Bay Conservation and Development Commission, 2018; Delta Stewardship Council, n.d.).

By actively engaging in these planning processes, SFEP is positioned to be a provider of technical support and resources to potentially protect natural resources and communities in the case of a hazard event. Overall, These CCMP actions guide SFEP to address hazard mitigation and resiliency, better preparing the Partnership for current and potential hazard events such as floods, sea level rise, and the water quality impacts from fires.

SFEP Acting as a Community Conduit for Resiliency Work

As a partnership-oriented program, SFEP naturally brings groups together and provides vital resources to various stakeholders to tackle regional resiliency and hazard mitigation challenges.

SFEP acts as a convener to unite different organizations and entities and initiate necessary conversations or projects about resiliency, preparedness, and hazard mitigation. With many local organizations and stakeholders focused on different aspects of the same topic of resiliency and natural resource protection, it is beneficial for SFEP to actively engage with these partners. As a partnership and place-based program, SFEP naturally plays an important role in bringing people together, either as a project implementer or a project facilitator. In this way, the Partnership assists with administrative and financial capacity, as well as creating better regional communication between local, regional, and federal agencies, businesses, and other environmental organizations. With SFEP's 38+ partners, the Partnership brings together big cities and smaller towns with different organizations, often with a focus on environmental justice, who typically do not have the resources to initiate such projects.

As an example of the Partnership's convening power, SFEP is working with the San Francisco Estuary Institute (SFEI) and The Watershed Project on a community-driven project to create a [North Richmond Shoreline Vision](#) (McGlynn, 2018). The North Richmond area has a higher-than-average poverty rate and houses a disproportionate amount

of chemicals and toxins compared to other communities. Through a collaborative approach, SFEP, SFEI and The Watershed Approach engaged with local stakeholders through an inclusive polling process to determine local watershed priorities and what locals would like to see happen within the watershed. One major goal of the project was to determine how to marry environmental resource protection with addressing equity issues.

Through projects like the North Richmond Shoreline Vision initiative, SFEP engages with their local stakeholders and other groups to provide support, technical expertise, fiscal support, and communication support to further promote their resilience goals to protect the local communities and natural resources.

Lessons Learned

Throughout SFEP's innovative approaches to address current and potential hazards, the Partnership has faced substantial challenges. From these challenges, SFEP has learned valuable lessons that the Partnership working to utilize in its current and future planning process.

Lesson #1: Innovative Infrastructure, Outdated Processes

Permitting Difficulties

Nature-based infrastructure projects such as horizontal levees and other multi-benefit climate adaptation projects often face slow-downs due to outdated permitting processes.

With innovations such as horizontal levees and other types of natural resource infrastructure projects, SFEP and others have faced policy conflicts in the Bay area between agencies with permitting and approval processes, often slowing down the permitting process. One example of a policy conflict is the issue of bay fill. The creation of Habitat Transition Zones in projects like ecotones or horizontal levees requires the import of fill material. Various agencies in the Bay area have different minimum fill requirements to achieve project goals.

Additionally, some permitting agencies penalize the restoration community for fill as if they were grey infrastructure developers. While these considerations are technically equitable, restoration groups like SFEP have significantly different end goals for projects like a horizontal levee (e.g. creation of habitat and water quality improvement) than grey infrastructure developers (e.g. creation of an apartment building). This lack of consideration regarding the purpose of the bay fill causes significant amount of frustration and slowdowns throughout the permitting process. However, SFEP is working with local governments to work with lawmakers and partners to issue permits for these types of innovations. In Action 17 in the Estuary Blueprint, SFEP lays out an in-depth plan to address this permitting issue.

Investment Difficulties

Nature-based infrastructure projects are very new innovations and are considered to be experimental due to this newness. As such, government agency funders view these projects as an investment risk.

As a partnership that heavily relies on partner support and financial contributions, experimental projects such as horizontal levees are difficult to fund. Despite the multitude of benefits that a nature-based infrastructure project may provide, government agency funders are risk-averse and shy away from these types of initiatives. Furthermore, given these projects' experimental nature, it is a challenge to demonstrate to funders that an expensive long-term investment will, in fact, pay itself off or be useful to the environment and the surrounding communities. As a new arena for planners and investors alike, it will be years until concrete data is available to quantify the benefits of nature-based infrastructure projects.

Lesson #2: Working Regionally while Balancing Local Needs

Communities working in silos unintentionally exacerbate negative environmental impacts in other areas. SFEP is working towards implementing regional approaches to bring the necessary stakeholders together.

As is common among local governments, organizations, and stakeholder groups across the country, groups tend to work within their individual silos, rarely interacting or interacting on a limited level. However, environmental issues are not bound by jurisdictional boundaries— hazards like flooding and sea level rise affect large swathes of land regionally. As a partnership focused on bringing different groups together to protect and restore the San Francisco Bay-Delta Estuary, it can be challenging for SFEP to pull these siloed groups together to work regionally rather than locally. For example, as cities within the SFEP study area build infrastructure to protect their community members from sea level rise, having this infrastructure in one area is likely to exacerbate changes on nearby shorelines. For example, sea walls tend to increase erosion dramatically in the adjacent parcels of land by amplifying the force of the waves. These results demonstrate that sea walls are often counterproductive to the goal of protecting the land from rising sea levels. Therefore, continuing to conduct these types of isolated projects does more harm than good for the region.

To combat this problem, SFEP promotes regional partnerships to address complex environmental issues. Collaborating with SFEI, the Partnership is advocates for methods like the [Operational Landscape Units](#) concept, in which projects are mapped out as regional bubbles, and the watershed approach, in which projects are targeted based on watershed boundaries (San Francisco Estuary Institute, 2018). SFEP hopes to include the various stakeholders within a given region to bring important players together and invest in

sustainable, beneficial environmental initiatives that enhance the entire region's resilience.

Discussion

SFEP is a leader of hazard mitigation initiatives and resiliency activities within the NEP community, enabling effective engagement through action-oriented documents and communicating with a variety of stakeholders within the Partnership's study area. Additionally, thorough engagement in these types of activities lays the groundwork for participation in recovery activities in case of a hazard or disaster event.

However, hazard mitigation and resiliency planning activities bring challenges— such as finding financial support for experimental infrastructure projects, balancing the needs of the region with the needs of the locals, and navigating outdated permitting processes. Despite these challenges, the Partnership is working to continually address these roadblocks and will adapt as new challenges arise.



A SFEP project site. *Photo by SFEP.*

Conclusion

The 28 National Estuary Programs experience different strengths and challenges depending on the program's locally-driven priorities and planning documents, like the CCMP. However, the 28 NEPs are unified in that they all thrive on diverse partnerships, science, and the goal to protect and restore the natural resources within their study areas. These similarities between the NEPs create a strong foundation for the NEPs' involvement in complex issues such as pre-disaster planning activities, post-disaster recovery activities, and hazard mitigation initiatives.

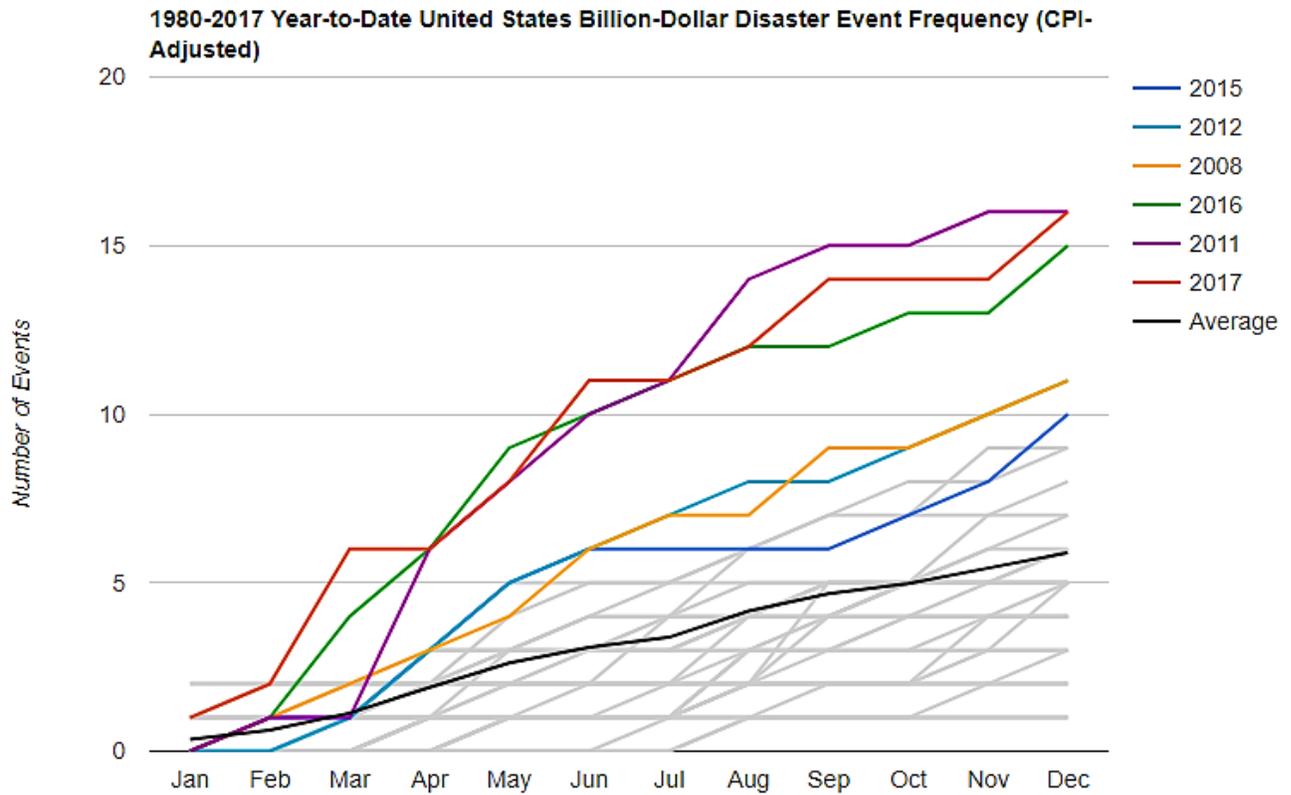
These four case studies on Barnegat Bay Partnership, Barataria-Terrebonne National Estuary Program, Coastal Bend Bays and Estuaries Program, and San Francisco Estuary Partnership illustrate the important role the NEPs may adopt to effectively address to pre-disaster planning, post-disaster recovery, and hazard mitigation initiatives. Over half of the 28 NEPs have come face-to-face with a disaster event, and these four case studies demonstrate that NEPs are crucial stakeholders during the various aspects of disaster planning, recovery, and hazard mitigation— acting as community conveners, non-biased communicators, scientific experts on natural resources, and educators. The NEPs are built on partnerships with many groups such as local / regional / state / federal government, the private sector, academic groups, and non-profits. This wide variety of partnerships allows the NEPs to be nimble in their actions, bringing together different stakeholders and providing resources and expertise when needed.

These case studies also demonstrate the difficulties and lessons learned that are often encountered during this type of work. While the NEPs are built on partnerships, effective communication with important decision-makers can be a significant challenge if appropriate planning has not taken prior to a disaster or hazard event. Without proper planning, the NEPs analyzed in this white paper frequently faced issues such as: communicating with decision-makers and disaster recovery personnel, securing funding for post-disaster or hazard mitigation projects, prioritizing activities like post-disaster monitoring, and determining the most appropriate role for the NEP's activities during disaster recovery or hazard mitigation. In addition, the case studies demonstrate the challenges with outdated permitting processes and working regionally while balancing local needs.

In consideration of these challenges, there are a number of steps NEPs may adopt to improve overall readiness and effectiveness. Additionally, it is vital for the partners of NEPs to provide support to the NEPs to enhance this important work in pre-disaster planning, disaster recovery, hazard mitigation, and overall resiliency. Working to update CCMPs to include initiatives regarding hazard mitigation, using the [National Disaster Recovery Framework](#) as a guide, is an important first step to ensure proper communication post-disaster event (U.S. Homeland Security, 2016). In addition, NEP engagement with local and [state partners](#) during current and future creation of [Multi-Jurisdictional All Hazard Mitigation Plans](#) will better-connect NEPs to funding opportunities for recovery and hazard mitigation projects (FEMA, 2018; FEMA, 2018). NEPs may also consider joining the [state-level Silver Jackets Team](#) to support local and state flood risk management efforts (Silver Jackets, n.d.). Furthermore, NEPs may be able to support local government partners in obtaining a higher rating in the [Community Rating System \(CRS\)](#) to improve flood risk management codes, including stormwater, watershed, and nature-based mitigation (Association of State Floodplain Managers, 2018). Solidifying these connections with will ensure that the NEP is properly prepared for a hazard event or disaster event. Given the power of the National Estuary Programs to support hazard mitigation, pre-disaster planning initiatives, and post-disaster recovery activities, equipping the NEPs with the proper tools and support will only bolster the country's overall resilience as the coasts are faced with future hazard and disaster events.

Appendices

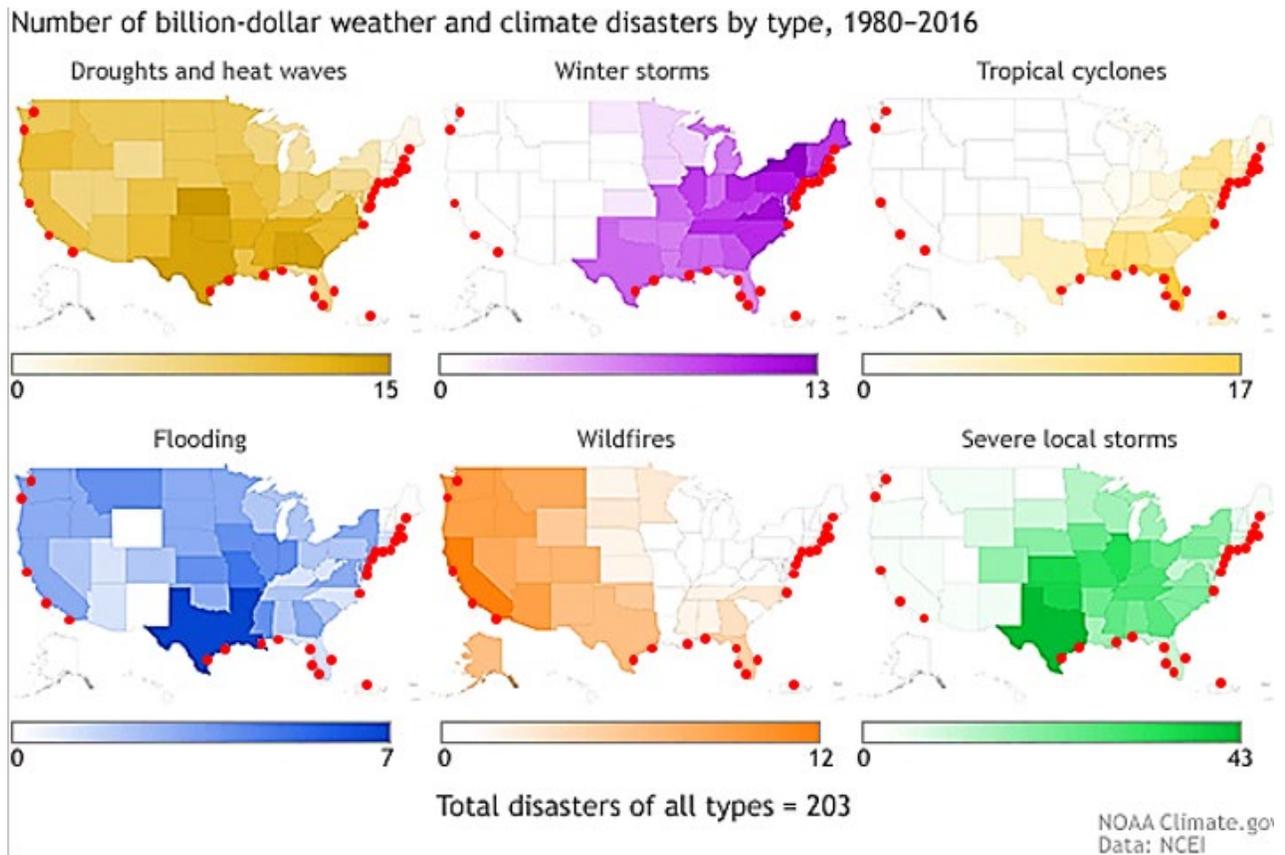
Appendix 1



Event statistics are added according to the date on which they ended.

“1980-2017 Year-to-Date United States Billion-Dollar Disaster Event Frequency (CPI-Adjusted).” *Billion-Dollar Weather and Climate Disasters: Overview*, NOAA National Centers for Environmental Information, 9 July 2018, www.ncdc.noaa.gov/billions/.

Appendix 2



Locations of the NEPs superimposed onto a map that shows frequency of billion-dollar weather and climate disasters by type in the U.S.

Smith, Adam B. "Number of Billion-Dollar Weather and Climate Disasters by Type, 1980–2016." *2016: A Historic Year for Billion-Dollar Weather and Climate Disasters in U.S.*, NOAA National Centers for Environmental Information, 9 Jan. 2017, www.climate.gov/news-features/blogs/beyond-data/2016-historic-year-billion-dollar-weather-and-climate-disasters-us.

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