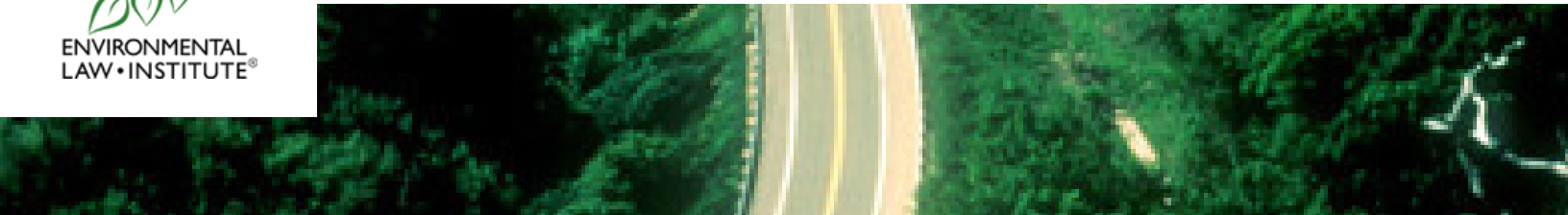
Embedding Natural Resource Expertise in Hazard Mitigation Planning

Opportunities for Integration in the Mississippi River Basin

Environmental Law Institute

Jan. 2024



The Environmental Law Institute (ELI) makes law work for people, places, and the planet. Since 1969, ELI has played a pivotal role in shaping the fields of environmental law, policy, and management, domestically and abroad. Today, in our sixth decade, we are an internationally recognized, nonpartisan research and education center working to strengthen environmental protection by improving law and governance worldwide.

ELI staff contributing to this paper include Research Associate Jesse Ferraioli, Senior Science and Policy Analyst Rebecca Kihslinger, Senior Attorney Amy Reed, Staff Attorney Cecilia Diedrich, Public Interest Environmental Law Fellow Zoe Vogel, and Research Associate Isabella Blanco. The authors would like to thank our partners and colleagues who have provided invaluable ideas for and input into this paper. We also want to acknowledge the contributions of our former ELI colleagues, whose work we have used and built on here. Funding for research and drafting was provided by the Walton Family Foundation.

Cover photo by unknown author, entitled “Great River Road - The Magnificent Mississippi River and Towering Forested Bluffs” (cropped from original). *See* https://nara.getarchive.net/media/great-river-road-the-magnificent-mississippi-river-and-towering-forested-bluffs-aef9f6

Contents

1. Introduction

The Mississippi River Basin ("Basin") is the fourth-largest watershed in the world.[1] The Mississippi River itself is the largest in terms of discharge, and the Basin includes the largest continuous system of wetlands in North America.[2] The people who live throughout the Basin have experienced numerous major floods, historically and in recent years.[3] Due to factors including local and regional land use and water management practices and the growing intensity and frequency of rainfall due to climate change, flooding is becoming an even greater risk in the watershed. According to the World Resources Institute, by 2080, the annual at-risk GDP of the Basin is projected to reach $11.7 billion and the annual at-risk population is projected to reach 15 million people.[4] Investment in flood mitigation is imperative to prevent these losses from being realized.

Flood protection in the Basin is primarily achieved through a system of levees.[5] They are the backbone of flood protection along the Mississippi River, with the main levee system stretching 3,500 miles.[6] Over time, many of these levees have been enlarged following failures during flood events.[7] While levees protect local neighboring lands from floods, they can increase the speed of a river's flow, resulting in worsened flooding along other stretches of the river– and requiring municipalities downstream to construct levees of their own. In fact, riverine flood risk in the lower Mississippi River has increased by 20% over the past 500 years, and about 75% of that risk is attributable to river engineering.[8] As climate change intensifies flooding, these levees are constructed higher, and flood risk

---

[1] *Mississippi River Facts*, NAT'L PARK SERV., https://www.nps.gov/miss/riverfacts.htm (last visited December 29, 2023).
[2] *Mississippi River Basin*, WATER ENCYCLOPEDIA, http://www.waterencyclopedia.com/Mi-Oc/Mississippi-River-Basin.html (last visited Jan. 2, 2024).
[3] *See, e.g.*, Tamsen Reed et al., *Adapting to Climate Change in the Upper Mississippi River Basin: Exploring Stakeholder Perspectives on River System Management and Flood Risk Reduction*, ENV'T HEALTH INSIGHTS 14:1-10, Dec. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7780184/pdf/10.1177_1178630220984153.pdf.
[4] Maggie Gonzalez & Samantha Kuzma, *Nature-Based Flood Mitigation Can Help Mississippi River Farmers*, WORLD RES. INST. (July 6, 2020), https://www.wri.org/insights/nature-based-flood-mitigation-can-help-mississippi-river-farmers.
[5] *Id.*
[6] *Levee Systems*, U.S. ARMY CORPS OF ENG'RS, https://www.mvd.usace.army.mil/About/Mississippi-River-Commission-MRC/Mississippi-River-Tributaries-Project-MR-T/Levee-Systems/ (last visited Jan. 2, 2024).
[7] Nicholas Pinter, *The Problem with Levees*, SCIENTIFIC AMERICAN (Aug. 1, 2019), https://blogs.scientificamerican.com/observations/the-problem-with-levees/.
[8] Samuel E. Munoz et al., *Climatic Control of Mississippi River Flood Hazard Amplified by River Engineering*, 556 NATURE 95 (2018), https://web.whoi.edu/coastal-group/wp-content/uploads/sites/38/2020/12/Munoz-2018-Climatic-control-of-Mississippi-River-flood-hazard-amplified-by-river-engineering.pdf.

downstream continues to worsen. Levees are also expensive to repair, and after a major flood event, not all the breached levees can be repaired.[9]

Levees not only raise the risk of downstream flooding but also create a deceptive sense of security, encouraging agricultural activities and development in flood-prone regions along the river. This has resulted in the loss of about 90% of the Upper Mississippi River's native floodplain wetlands over the years.[10] These critical floodplain areas historically acted as storage containers for water--when the river flooded, these wetland areas would absorb the excess water. To reduce future losses, new types of hazard mitigation measures are necessary. Nature-based flood protection measures can restore and bolster an ecosystem's natural capacities for absorbing the impacts of floods.

Nature-based solutions (NBS) have been increasingly used for flood risk mitigation in the context of climate changes and urbanization[11] and have proven effective in reducing peak flow, runoff, food volume, inundation area, and hazard level.[12] As a 2022 White House Report to the National Climate Task Force describes, nonstructural solutions like elevating homes will reduce flood risks to individual structures, while integrating nature-based solutions that restore or protect nearby wetlands and floodplains will reduce the flood risk of many nearby assets at once.[13] For example, a single acre of wetlands can hold up to 330,000 gallons of water (about two-thirds the volume of an Olympic-size swimming pool), which could protect 13 nearby homes from thigh-high flooding.[14]

In recent years, the Federal Emergency Management Agency (FEMA) has begun prioritizing nature-based solutions (NBS) as alternatives or additions to traditional grey infrastructure measures for flood risk reduction. FEMA has identified NBS for reducing the risk of natural hazards and disasters in resources for planners and communities. State, local, and Tribal

---

[9] Tammy Webber & Josh Funk, *Flooded Farmers Face Growing Dilemma in Warming World*, FOX25 (Dec. 15, 2019), https://okcfox.com/news/local/flooded-farmers-face-growing-dilemma-in-warming-world-12-15-2019.

[10] *Id.*; Maggie Gonzalez & Samantha Kuzma, *Nature-Based Flood Mitigation Can Help Mississippi River Farmers*, WORLD RES. INST. (July 6, 2020), https://www.wri.org/insights/nature-based-flood-mitigation-can-help-mississippi-river-farmers.

[11] *See* Tim D. Fletcher et al., *SUDS, LID, BMPs, WSUD and More – The Evolution and Application of Terminology Surrounding Urban Drainage*, 12(7) URB. WATER J. 525 (2015), https://www.tandfonline.com/doi/epdf/10.1080/1573062X.2014.916314?needAccess=true *and* A. Fiori & E. Volpi, *On the Effectiveness of LID Infrastructures for the Attenuation of Urban Flooding at the Catchment Scale*, WATER RES. RSCH., May 2020, https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020WR027121.

[12] *See* Sandra Costa et al., *Effectiveness of Nature-Based Solutions on Pluvial Flood Hazard Mitigation: The Case Study of the City of Eindhoven (The Netherlands)*, RESOURCES, March 2021.

[13] WHITE HOUSE COUNCIL ON ENV'T QUALITY ET AL., OPPORTUNITIES TO ACCELERATE NATURE-BASED SOLUTIONS: A ROADMAP FOR CLIMATE PROGRESS, THRIVING NATURE, EQUITY, AND PROSPERITY 20 (2022).

[14] C. ASKEW-MERWIN, NATURAL INFRASTRUCTURE'S ROLE IN MITIGATING FLOODING ALONG THE MISSISSIPPI RIVER 9 (Northeast-Midwest Institute 2020), https://www.nemw.org/wp-content/uploads/2020/03/Natural-Infrastructures-Role-Mitigating-Flooding.pdf.

FEMA-approved hazard mitigation plans are beginning to incorporate natural systems protection and nature-based solutions as goals and/or explicit hazard reduction strategies in a wide range of ways. Most, but not all, state hazard mitigation plans include goals/objectives that are related to the impacts of natural hazards on the environment or use nature-based strategies to address the state's risk. Some state and local plans have gone further, identifying a number of nature-based actions in their mitigation strategies. Knowing whether and how these strategies are implemented in practice--and their effectiveness at mitigating risk--could encourage more communities to adopt nature-based solutions.

Natural resource agencies, NGOs, and community-based organizations have demonstrated the adaptive and resilient capacity of floodplain ecosystems and the effectiveness of nature-based hazard mitigation measures.[15] Involving these key players in hazard mitigation planning and the project implementation process can help hazard mitigation entities fill information gaps and aid in the identification and prioritization of viable nature-based mitigation actions to address identified risks.

One way that natural resource experts can help integrate NBS into the hazard planning process is by leveraging existing GIS-based wetland assessment and prioritization tools. The Environmental Law Institute has identified several tools developed by state agencies and conservation organizations across the country to identify priorities for restoration and conservation, which can be leveraged during hazard mitigation planning (Box 1).[16] These tools are helpful in determining the location of strategically valuable aquatic resources and prioritizing investments in their restoration and protection.

Box 1: ELI Hazard Mitigation Workshop Fall 2023

ELI hosted a workshop in October 2023 that provided an opportunity for wetland agencies and hazard mitigation planners to discuss opportunities for using wetland and floodplain restoration and protection prioritization tools and methodologies in the hazard mitigation planning process, as well as to discuss partnership-building among wetland and natural resource agencies and organizations, hazard mitigation planners, and project developers. This workshop was attended by state and local hazard mitigation planners; FEMA staff; representatives from the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers; state and Tribal wetlands programs; and participants from NGOs, boundary organizations, and community-based organizations.

[15] *Annotated Bibliography*, compiled for this report on file with the Environmental Law Institute.
[16] *See* ERIC SWEENEY ET AL., A HANDBOOK FOR PRIORITIZING WETLAND AND STREAM RESTORATION AND PROTECTION USING LANDSCAPE ANALYSIS TOOLS (Env't L. Inst. 2013), https://www.eli.org/sites/default/files/eli-pubs/d23_09.pdf *and* JAMES MCELFISH ET AL., DEVELOPING WETLAND RESTORATION PRIORITIES FOR CLIMATE RISK REDUCTION AND RESILIENCE IN THE MARCO REGION (Env't L. Inst. 2016), https://www.eli.org/sites/default/files/files-pdf/Targeting-Conservation-and-Restoration-in-the-MARCO-Region-Final-Report-December-2016.Cover_.pdf.

Purpose of Report

The purpose of this report is to identify opportunities for scaling up the use of natural and nature-based infrastructure projects as hazard mitigation strategies through the formation of better partnerships that build the capacity of decision-makers to effectively address flood hazard risks. While many of these opportunities and lessons will apply in communities across the U.S., this report is focused geographically on the Mississippi River Basin, where the ongoing and increasing flood risks challenging the current infrastructure highlight a growing need to find adaptive solutions—and present an important opportunity to leverage and advance nature-based hazard mitigation efforts.

Section 1 of this report describes recent developments at FEMA that encourage the integration of nature-based solutions into hazard mitigation planning and grant programs and discusses some of the common challenges to advancing nature-based projects within the FEMA framework. Section 2 moves into strategies for scaling up nature-based projects in the Mississippi River Basin, focusing on opportunities for building partnerships among natural resource experts and hazard mitigation planners. This section also discusses opportunities for using prioritization and restoration tools developed by natural resource experts in other contexts in the hazard mitigation planning process. Finally, Section 3 of this report describes the importance of building capacity among hazard mitigation planners and local decision-makers to encourage the use of nature-based solutions, both generally and by communities in the Mississippi River Basin region.

1.1 What Are Nature-based Solutions?

While terminology and definitions vary, in the hazard mitigation context FEMA defines nature-based solutions (referred to interchangeably as "NBS" here) to mean "sustainable planning, design, environmental management and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience."[17]

For purposes of this report, nature-based solutions are an umbrella term encompassing similar terms such as green infrastructure, natural and nature-based features, natural climate solutions, and natural infrastructure.[18]

FEMA further categorizes NBS based on measures' *scale* and *location*:

- Watershed or landscape scale: Interconnected systems of natural areas and open space. These are large-scale practices that require long-term planning and coordination.

[17] *Nature-Based* Solutions, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/emergency-managers/risk-management/climate-resilience/nature-based-solutions (last visited Jan. 18, 2024).
[18] OFF. OF MGMT. & BUDGET, EXEC. OFF. OF THE PRESIDENT, M-24-03, ADVANCING CLIMATE RESILIENCE THROUGH CLIMATE-SMART INFRASTRUCTURE INVESTMENTS AND IMPLEMENTATION GUIDANCE FOR THE DISASTER RESILIENCY PLANNING ACT 3 (2023).

- Neighborhood or site scale: Distributed stormwater management practices that manage rainwater where it falls. These practices can often be built into a site, corridor, or neighborhood without requiring additional space. (FEMA, for example, considers green infrastructure as a subcategory of NBS because the projects are smaller in scale.[19])
- Coastal areas: Nature-based solutions that stabilize the shoreline, reducing erosion and buffering the coast from storm impacts. While many watershed and neighborhood-scale solutions work in coastal areas, these systems are designed to support coastal resilience.[20]

NBS can also include updating existing laws and policies, such as local zoning and building codes.

Multiple Benefits of Nature-Based Solutions

Among other things, NBS can help combat climate change, reduce flood risk, improve water quality, protect coastal property, restore and protect wetlands, stabilize shorelines, reduce urban heat, and add recreational space (see Box 2).[21] In FEMA's NBS guide for local communities, *Building Community Resilience with Nature-Based Solutions*, nature-based solutions are described as being most effective where they are part of local, regional, and state planning efforts around the following:

- Hazard mitigation and risk reduction;
- Climate resilience;
- Watershed management;
- Source water protection; and
- Land use and economic development plans. [22]

[19] FED. EMERGENCY MGMT. AGENCY, FEMA ECONOMIC BENEFIT VALUES FOR GREEN INFRASTRUCTURE 4 (2022).
[20] FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: A GUIDE FOR LOCAL COMMUNITIES 5 (2021).
[21] *Nature-Based Solutions*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/emergency-managers/risk-management/climate-resilience/nature-based-solutions (last visited Jan. 18, 2024).

Box 2: Nature-Based Hazard Mitigation Actions[22]

There are a wide variety nature-based hazard mitigation strategies, from land conservation and restoration to green infrastructure to land use policy. These projects can address a range of hazards while also providing other environmental and community benefits.

Types of projects include:

• Land conservation – Identifying and protecting land for hazard mitigation and ecosystem benefits.

• Wetland, floodplain, and habitat restoration – Restoring functions and habitat areas that have been lost or degraded for hazard mitigation benefits.

• Green infrastructure – Land conservation and storm water management projects (e.g., bioswales, rain gardens, green roofs) that provide flood and drought mitigation benefits.

• Land use projects – Land use policy and regulatory actions such as zoning, greenways, and growth management in high hazard areas.

• Dune restoration, living shorelines, and coastal wetland restoration – Coastal protection and restoration projects that provide protection from flooding and storm surge.

Nature-based projects can provide mitigation benefits for a variety of hazards, including:

- Riverine flooding
- Urban flooding
- Coastal flooding and storm surge
- Drought
- Wildfire

Unlike gray infrastructure projects, nature-based projects often provide additional co-benefits, including:

- Habitat protection
- Wildlife protection
- Other ecosystem services (e.g., improved water quality)
- Increased property values for neighboring properties
- Green jobs
- Recreation space for the surrounding community
- Public health benefits
- Carbon sequestration

[22] FED. EMERGENCY MGMT. AGENCY, MITIGATION IDEAS: A RESOURCE FOR REDUCING RISK TO NATURAL HAZARDS (2013); FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: A GUIDE FOR LOCAL COMMUNITIES (2021).

Nature-based solutions offer multiple environmental co-benefits, including improved water quality; this occurs where NBS help provide filtration of pollutants from stormwater runoff and reduce the volume of polluted water entering rivers, lakes, and coastal areas.[23] In older cities with combined sewer systems, NBS can help minimize untreated sewage in community waterways by lowering the risk of combined sewer overflows during heavy rainfall.[24] Additionally, these measures can contribute to cleaner water supplies by safeguarding the land around drinking water reservoirs, preventing polluted runoff. Nature-based solutions such as trees and parks aid in absorbing and filtering air pollutants, leading to improved air quality and healthier wildlife habitats by preserving open spaces and enhancing aquatic and wildlife environments.[25]

Environmental co-benefits also offer many additional co-benefits to the physical and mental health of people. For example, by adding trees and vegetation to mitigate the "urban heat island effect," there is a reduced risk of heat-related illnesses.[26] Improving air and water quality reduces exposure to harmful pollutants.[27] NBS that preserve and expand open space also provide more areas of recreation, which can contribute to improved mental and physical well-being.[28]

While the environmental and social co-benefits present a compelling case for adopting nature-based solutions, these solutions can also offer communities potential cost savings. This is because NBS avoid certain infrastructure needs, reduce post-disaster rebuilding costs, and mitigate climate change impacts.[29]

While not always the case, nature-based approaches can often be more cost-effective than traditional gray infrastructure.[30] One notable area of savings is in avoiding flood losses. A 2015 EPA study suggested potential nationwide savings in the hundreds of millions of dollars through the integration of nature-based solutions in new developments.[31] Additionally, NBS prove cost-effective in stormwater management for new developments, especially in older cities with combined sewer systems.[32] A specific example from New York City showcases the cost advantages of nature-based solutions in reducing combined sewer overflows.[33] The nature-based alternative is estimated to cost around $1.5 billion, significantly less than the $3.9 billion required for the traditional gray infrastructure

[23] *Id.* at 11.
[24] *Id.*
[25] *Id.*
[26] *Id.* at 12.
[27] *Id.*
[28] *Id.*
[29] *Id.* at 13.
[30] *Id.*
[31] *Id.*
[32] *Id.*
[33] *Id.*

option.[34] Moreover, nature-based solutions contribute to reduced drinking water treatment costs by implementing cost-effective watershed-scale conservation practices.[35]

1.1.1 Adoption of Nature-Based Solutions in the Mississippi River Basin

In recent years, there has been a growing integration of nonstructural approaches to hazard mitigation in the Mississippi River region.[36] In Davenport, Iowa, for example, the county has created a riverfront parkland and marsh, rather than a permanent floodwall, to perform natural flood control.[37] Further downstream, Arnold, Missouri also has a floodable riverfront park, which it is expanding through buyouts that will also help protect its downstream neighbor, Kimmswick.[38] At the southern end of the Basin, the Nature Conservancy purchased over 5,000 acres of the Atchafalaya Basin to decrease the height of the canal levies and cut notches in the banks to allow floodwaters to flow through wetlands.[39] These communities' approaches encourage the use of wetlands as natural resilience against flood hazards and can help demonstrate the effectiveness of NBS to other communities in the region.

1.1.2 Integrating NBS into Hazard Mitigation Plans

Overview of Hazard Mitigation Planning. Hazard mitigation is defined as "any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards."[40] It is an attempt to act preemptively to avoid or mitigate damages from natural disasters, thus breaking the cycle of disaster damage, reconstruction, and repeated damage from the next disaster. As established in the Disaster Mitigation Act of 2000,[41] hazard mitigation plans (HMPs) identify potential risks that a state, Tribal, or local community faces from hazards; assess the capabilities of the government entity to address the risks; and develop goals and actions to reduce risk from the hazards across the plan area.[42] Hazard mitigation plans are developed by a range of entities, often involving committees that include members from federal, state, and local agencies, but plan development

---

[34] *Id.*
[35] *Id.*
[36] Qizhong Guo, *Strategies for a Resilient, Sustainable, and Equitable Mississippi River Basin*, 2(3) RIVER 336 (2023).
[37] Willy Blackmore, *A Better Way to Decrease Disastrous Flooding on the Mississippi River*, AUDUBON (Fall 2019), https://www.audubon.org/magazine/fall-2019/a-better-way-decrease-disastrous-flooding.
[38] *Id.*
[39] *Natural Solutions for a Natural Problem*, THE NATURE CONSERVANCY (June 16, 2020), https://www.nature.org/en-us/about-us/where-we-work/priority-landscapes/mississippi-river-basin/mississippi-river-flood-solutions/.
[40] 44 C.F.R. § 201.2 (2000).
[41] Pub. L. No. 106-390, 114 Stat. 1552 (2000) (amending the Robert T. Stafford Disaster and Emergency Assistance Act).
[42] 44 C.F.R. pt. 201.

generally is led by a state or local emergency management agency (or a consultant hired by such an agency).

Once a hazard mitigation plan has been completed, it must be formally adopted by the state, local jurisdiction, or Tribal government and be approved by FEMA. The plan then must be implemented, consistently reviewed and updated, and submitted for reapproval every five years.[43] FEMA requires an approved HMP for a jurisdiction (state, local, or Tribal government) to be eligible for the various federal hazard mitigation grant programs administered by the agency. A list of FEMA grant programs that require applicants to have a hazard mitigation plan can be found on the FEMA website (available here).

State, local, and Tribal HMPs must meet certain requirements to ensure the plan effectively addresses and reduces the impact of natural hazards.[44] The plan must outline the detailed planning process for its development, including the participants and agencies contributing to its formulation. The plan must also include a risk assessment that provides a factual foundation for mitigation activities, including identification of the type and location of natural hazards, analysis of the vulnerability of people and property given the identified risks, and estimates of potential losses to structures.

The "mitigation strategy" section of a state's HMP serves as the blueprint for how a jurisdiction will mitigate identified risks: it defines state goals, evaluates pre- and post-disaster hazard management policies, and identifies and prioritizes cost-effective and technically feasible "mitigation actions." Mitigation actions identified in state hazard mitigation plans must be linked directly to the state's risks, capabilities, and objectives. They should also be linked to local plans, where specific local actions and projects are identified. For state plans, the Coordination of Local Mitigation Planning section focuses on supporting local plans, their review processes, and criteria for prioritizing communities.

The mitigation strategy also includes an analysis of state capabilities to mitigate hazards (e.g., state programs) and funding opportunities. The state capability assessment should not only address the ways the state's existing capabilities can aid the mitigation effort but also areas where the state needs to strengthen its capabilities. The capabilities section is an "evaluation based on existing capabilities that demonstrates the state's commitment to mitigation, identifies a wide range of resources that go beyond FEMA to implement mitigation activities, and reveals areas to target improvements."[45]

With respect to process, an identified plan maintenance process ensures ongoing monitoring, evaluation, and updating; a formal "plan adoption process" precedes

---

[43] 44 C.F.R. § 201.3; *Mitigation Planning and Grants*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/requirements (last visited Dec. 18, 2023).

[44] *See* 44 C.F.R. §§ 201.4, 201.6, 201.7 (outlining the requirements for state, local, and Tribal mitigation plans).

[45] FED. EMERGENCY MGMT. AGENCY, FP 302-094-2, STATE MITIGATION PLANNING POLICY GUIDE 24 (2022).

submission for approval. The plan also must include assurances of compliance with federal statutes and regulations.[46]

Recently, planners have also been required to consider climate change and the probabilities of future hazard events in all FEMA-approved hazard mitigation plans.[47] This involves considering potential changes in conditions, such as how long-term shifts in weather patterns and climate might influence the identified hazards affecting the state.[48]

More information on minimum HMP requirements is found in Box 3.

[46] 44 C.F.R. § 201.4.

[47] FED. EMERGENCY MGMT. AGENCY, FEMA RESOURCES FOR CLIMATE RESILIENCE (2021).

[48] *Id.* at 12.

Box 3: Summary of State Hazard Mitigation Plan Requirements[49]

States must have FEMA-approved Standard Mitigation Plans that comply with certain requirements to be considered eligible for non-emergency Stafford Act assistance and FEMA mitigation grants. These plans must be developed through a **planning process** that coordinates with other state and federal agencies, interested groups, and other ongoing state planning and mitigation efforts. The planning process must also include processes for reviewing and updating the plan every five years.

Beyond this, plans must include the following elements:

- A description of the planning process.
- A **Risk Assessment**, providing the factual basis for proposed activities, that characterizes and analyzes natural hazards and risks throughout the state, enabling comparison of potential losses and determining priorities for mitigation, including overviews of:
    - Type and location of natural hazards, including previous occurrences and future probabilities, and maps as needed;
    - State vulnerability to relevant hazards, based on local risk assessments;
    - Losses to vulnerable structures, including estimations of dollar losses to state-owned and operated facilities.
- A **Mitigation Strategy** for reducing losses from hazards identified in the risk assessment, including a discussion of:
    - State goals to guide activity selection;
    - State capabilities to mitigate hazards, including state and local policies and funding capacities;
    - Identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation activities and description of linkages to overall strategy and local plans;
    - Sources of funding to implement activities;
    - FEMA-approved mitigation plan that provides for reduction of flood losses to structures for which NFIP coverage is available.
- A section discussing **Coordination of Local Mitigation Planning**, including:
    - State processes to support local plans;
    - State process to coordinate, review, and link local plans to state plan;
    - Process of prioritizing community and local jurisdictions for support.
- A **Plan Maintenance Process** including:
    - Monitoring and evaluation for updates;
    - Monitoring implementation of mitigation measures;
    - Review of progress towards mitigation goals.
- A **Plan Adoption Process**.
- **Assurances** of compliance with relevant State and Federal statutes and regulations of that period.

[49] 44 C.F.R. § 201.4. States may also develop Enhanced State Plans, which makes them eligible to receive additional HGMP funds, based on 20% of the total estimated Stafford Act assistance. 44 C.F.R. § 201.5. Requirements for local and Tribal plans are similar. 44 C.F.R. §§ 201.6, 201.7.

Incorporating NBS in Mitigation Plans

In technical assistance resources released over the last few years, FEMA has placed some emphasis on integrating nature-based solutions in plans and programs. In 2021, FEMA released a guide "to help communities identify and engage the staff and resources that can be used to implement nature-based solutions to build resilience to natural hazards, which may be exacerbated by climate change."[50] This guide defines nature-based solutions; provides economic justification for NBS; describes environmental and social co-benefits; describes the integration of NBS in planning, policymaking, and implementation; and identifies potential funding opportunities.[51]

For hazard mitigation planning, the guide recommends engaging a steering committee in both annual reviews and the five-year plan update process, assessing the community's most pressing hazards, and updating HMPs by integrating nature-based solutions into the long-term goals and specific mitigation actions.[52]

Building on the 2021 guide, FEMA released a second report in 2023 that details five strategies that can help NBS projects meet risk reduction, climate resilience, and other community goals.[53] The strategies are:

1. Building Strong Partnerships

   NBS projects work best when different partners and organizations rally around common goals. Communities will benefit most by establishing partnerships early and fostering them through the life of a project.

2. Engaging the Whole Community

   Community engagement is key to carrying out NBS projects that work for the Whole Community. Community and project leaders will see better results by reaching out to all community members early and often.

3. Matching Project Size with Desired Goals and Benefits

   The range of NBS and hybrid solutions provides many options to reduce risk. The size and reach of an NBS project, or group

[50] FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: A GUIDE FOR LOCAL COMMUNITIES (2021) (Leveraging Nature-Based Solutions in an Era of Climate Change).
[51] *See id.*
[52] *Id.* at 15.
[53] FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: STRATEGIES FOR SUCCESS (2023).

of projects, should match the level of benefits a community wants.

4. Maximizing Benefits

   NBS offer many different benefits to communities. By making small additions to project designs or combining multiple solutions, communities can get more for their investment.

5. Designing for the Future

   This means planning for a combination of changes in climate, population patterns and community development. Doing so helps communities implement solutions that can adapt to changing risks and reduce impacts of future events.[54]

Incorporation of NBS in Existing State and Tribal HMPs. ELI recently reviewed 52 state and Tribal hazard mitigation plans to better understand to what extent they are incorporating nature-based solutions—e.g., conservation and restoration of wetlands and floodplains, use of green infrastructure—particularly looking for references to NBS among the plan goals and explicit hazard reduction strategies. We found that 38 out of 50 state plans included goals and objectives relevant to natural systems protection.[55] Forty-one of the 52 state and Tribal plans that we reviewed included nature-based actions. We identified 189 NBS actions over the reviewed plans.

While our review identified a number of nature-based mitigation actions, we found there are still many opportunities to improve. Most existing state and Tribal plans lack a comprehensive analysis of the risk to natural resources from natural hazards and the subsequent effect on vulnerability; the identification of well thought out and specific nature-based hazard mitigation actions; development of meaningful prioritization criteria; and/or implementation and monitoring details for nature-based strategies. Most of the nature-based mitigation activities included in state and Tribal plans are general, nonspecific activity types (e.g., "use green mitigation techniques including bioswales, rain gardens, and permeable pavers," or "protect and restore natural floodplain functions").

In the report describing the survey results, ELI makes several recommendations for improving the integration of nature-based goals into state hazard mitigation plans moving forward. ELI recommends that states identify and include natural resources protection and restoration experts as key members of the planning team, invest in monitoring and assessment of nature-based mitigation projects to help planners communicate the value of such projects to the public, and include a more comprehensive evaluation of the value of

---

[54] *Id.* at 4.

[55] REBECCA KIHSLINGER ET AL., NATURE-BASED MITIGATION GOALS AND ACTIONS IN STATE AND TRIBAL HAZARD MITIGATION PLANS (Env't L. Inst. 2021), https://www.eli.org/sites/default/files/eli-pubs/nature-based-mitigation-goals-and-actions-final.pdf.

natural systems in the assessment of risk and vulnerability, such as evaluating the risk to natural systems and how the loss of natural habitats contributes to increased risk from hazards in the risk and vulnerability assessment. Finally, the authors recommend conducting a review of legal barriers to integrating nature-based strategies into hazard mitigation planning.

1.2 FEMA Developments on Nature-Based Solutions

FEMA's emphasis on nature-based solutions is apparent in the agency's recent updates to hazard mitigation planning guidance and other key policy areas (e.g., the Benefit-Cost Analysis Toolkit and the Hazard Mitigation Assistance grant programs) that influence which projects are funded with federal hazard mitigation money.[56] In this section, we discuss how updates to the BCA—including adding new landcover types and ecosystem service values—better enable applicants to quantify the benefits of their green infrastructure projects. We go on to describe recent updates to the agency's hazard mitigation grant programs, include the introduction of a more nuanced scoring system in 2023 that categorizes NBS projects into two tiers, assigning more points to "watershed or landscape-scale" initiatives.

1.2.1 Benefit-Cost Analysis (BCA) Toolkit Updates

To apply for FEMA hazard mitigation grants, applicants must perform an analysis of cost-effectiveness by comparing the net present value of future risk reduction benefits to costs in a process called the Benefit-Cost Analysis (BCA). The BCA results in a Benefit-Cost Ratio (BCR), which should be 1.0 or greater for a project to be considered "cost-effective."

Historically, NBS have been difficult to quantify in the BCA, with applicants and observers citing the following reasons:

- Many local communities do not have capacity to conduct modeling and analysis necessary to conduct a BCA for NBS.[57]
- The BCA is unable to account for all of the externalities *avoided* by choosing a nature-based solution over grey infrastructure.

---

[56] Another example of FEMA's commitment to supporting nature-based solutions is the agency's recent updates to the management requirements to require consideration of nature-based solutions as alternatives for all projects that have the potential to affect floodplains or wetlands. FACT SHEET: Biden-Harris Administration Announces Roadmap for Nature-Based Solutions to Fight Climate Change, Strengthen Communities, and Support Local Economies. *FACT SHEET: Biden-Harris Administration Announces Roadmap for Nature-Based Solutions to Fight Climate Change, Strengthen Communities, and Support Local Economies*, THE WHITE HOUSE, https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/08/fact-sheet-biden-%e2%81%a0harris-administration-announces-roadmap-for-nature-based-solutions-to-fight-climate-change-strengthen-communities-and-support-local-economies/ (last visited Jan. 31, 2024).

[57] Participant contribution to "Wetlands and Hazard Mitigation: Opportunities for Integration" workshop held by the Environmental Law Institute (Oct. 31 & Nov. 1, 2023).

- The framework is not inherently tailored for watershed decision-making and encourages projects with more narrowly defined goals.[58]
- Present hazard risk reduction is prioritized over future risk reduction.[59]
- There is a lack of data on $/acre/year values for hazard mitigation benefits for each existing land cover type.[60]
- Few pre-calculated benefits for NBS in the BCA toolkit and lack of flexibility for incorporating ecosystem service values in BCA.[61]
- Lack of technical guidance to help applicants complete the BCA.[62]

BCA Updates to Facilitate Incorporation of NBS. To address some of the challenges noted above, FEMA has updated its *Benefit-Cost Analysis (BCA) Toolkit*[64] to encourage greater uptake of NBS.

In 2013, FEMA issued its first ecosystem services policies to incorporate pre-calculated values for ecosystem services into the BCA analysis for riparian and green open space land cover categories.[65] These ecosystem service values capture and account for the broader "area of benefit" associated with each project and provide generalized value estimates that could be representative of ecosystems throughout the United States.[66] They are calculated as

Box 4: Benefit-Cost Analysis Key Definitions[63]

- Ecosystem Service: The direct or indirect contributions that ecosystems make to the environment and human populations.
- Land Cover Category/Type: The post-mitigation land type. Examples include forest, urban green open space, rural green open space, riparian, etc.
- Ecosystem Service Values/Benefits: Calculated as dollars per acre per year ($/acre/year) values according to land cover category/type.

[58] Participant contribution to "Wetlands and Hazard Mitigation: Opportunities for Integration" workshop held by the Environmental Law Institute (Oct. 31 & Nov. 1, 2023).
[59] THE NATURE CONSERVANCY & EARTH ECONOMICS, STRESS TESTING THE BCA TOOLKIT WITH NATURE-BASED SOLUTIONS: OBSERVATIONS AND RECOMMENDATIONS FOR THE FEDERAL EMERGENCY MANAGEMENT AGENCY (2021).
[60] Participant contribution to "Wetlands and Hazard Mitigation: Opportunities for Integration" workshop held by the Environmental Law Institute (Oct. 31 & Nov. 1, 2023).
[61] THE NATURE CONSERVANCY & EARTH ECONOMICS, STRESS TESTING THE BCA TOOLKIT WITH NATURE-BASED SOLUTIONS: OBSERVATIONS AND RECOMMENDATIONS FOR THE FEDERAL EMERGENCY MANAGEMENT AGENCY (2021).
[62] *Id.*
[63] *C.1. Key Elements of the Benefit-Cost Ratio*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/guide/part-5/c/1 (last visited Dec. 12, 2023).
[64] *See generally Benefit-Cost Analysis*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/tools/benefit-cost-analysis (last visited Jan. 22, 2024) (providing the BCA Toolkit).
[65] FED. EMERGENCY MGMT. AGENCY, FP-108-024-01, CONSIDERATION OF ENVIRONMENTAL BENEFITS IN THE EVALUATION OF ACQUISITION PROJECTS UNDER THE HAZARD MITIGATION ASSISTANCE (HMA) PROGRAMS (2013).
[66] FED. EMERGENCY MGMT. AGENCY, FEMA ECONOMIC BENEFIT VALUES FOR GREEN INFRASTRUCTURE 17 (2022).

dollars per acre per year ($/acre/year) values according to land cover type. The use of ecosystem services values makes it easier to account for the ecosystem benefits provided by NBS in the BCA.[67]

A 2016 update expanded the ecosystem services policy, introducing ecosystem service values for new land cover categories—including wetlands, forest, and marine and estuary. The update also adds new eligible mitigation activities (i.e., activities FEMA will fund), including floodplain and stream restoration, green infrastructure, post-wildfire mitigation, and aquifer storage and recovery.[68]

FEMA again updated the BCA in June 2020 to remove the requirement that projects must achieve a threshold benefit-cost ratio of 0.75 or above using traditional risk reduction benefits before applicants could include ecosystem service values in a final BCA.[69] This change was intended to ease technical and monetary burdens on applicants and make FEMA hazard mitigation funding programs more accessible to nature-based projects.[70] This seminal update acknowledges the importance of the natural environment in community resilience and allows nature-based hazard mitigation projects to be considered cost-effective based on their ecosystem service values alone.[71]

In June 2022, FEMA again updated the BCA policy to include new land cover types (including coral reefs, shellfish reefs, and beaches and dunes) and modify existing land cover categories, e.g., breaking the wetlands category down into inland wetlands and coastal wetlands and narrowing the broad green open space category into urban green open space and rural green open space.[72] This update also added 22 new individual ecosystem service values across all land cover types and increased several of the landcovers' dollar per acre values.

Further updates in July 2022 related to green infrastructure. The updates added four ecosystem service value categories for green infrastructure, including bioretention, permeable pavements, green roofs, and urban trees, as well as nine economic benefits, including avoided carbon emissions, energy cost savings, carbon sequestration, reduced

---

[67] THE NATURE CONSERVANCY & EARTH ECONOMICS, STRESS TESTING THE BCA TOOLKIT WITH NATURE-BASED SOLUTIONS: OBSERVATIONS AND RECOMMENDATIONS FOR THE FEDERAL EMERGENCY MANAGEMENT AGENCY (2021), https://www.scienceforconservation.org/assets/downloads/TNC-EE_BCA_Report_NBS_Aug2021.pdf.

[68] FED. EMERGENCY MGMT. AGENCY, FEMA ECONOMIC BENEFIT VALUES FOR GREEN INFRASTRUCTURE 2 (2022).

[69] FED. EMERGENCY MGMT. AGENCY, FP-108-024-02, ECOSYSTEM SERVICE BENEFITS IN BENEFIT-COST ANALYSIS FOR FEMA'S MITIGATION PROGRAMS POLICY (2020) (recognizing that the natural environment is an important component of a community's resilience strategy and removing the 0.75 benefit-cost ratio requirement).

[70] FED. EMERGENCY MGMT. AGENCY, FEMA ECOSYSTEM SERVICE VALUE UPDATES 3 (2022).

[71] *Id.*

[72] *Id.* at 12-13.

drought risk, wildlife habitat, reduced heat risk, property value improvement, air pollutant removal, and stormwater capture and quality.[73]

1.2.2 Incorporation of NBS in FEMA Grant Programs

In addition to other sources of public and private funding, FEMA's Hazard Mitigation Assistance (HMA) programs present a potential funding opportunity to pay for the restoration and protection of critical natural infrastructure while improving outcomes and reducing costs of future disasters.[74] The programs include the longstanding Flood Mitigation Assistance (FMA) Program and Hazard Mitigation Grants Program, as well as the recently established Building Resilient Infrastructure and Communities (BRIC) Program (2019) and the Safeguarding Tomorrow Revolving Loan Fund Program (2021).[75]

Table 1: Overview of FEMA Hazard Mitigation Assistance Programs

	Description	**Eligible Projects**
The Building Resilient Infrastructure and Communities (BRIC) Program	Helps states, local communities, Tribes, and territories undertake hazard mitigation projects to reduce future disasters and natural hazards. Initiated in 2020, the program provides resources for capacity building – including set-asides for states and Tribes – and proactive mitigation projects. In 2023, a total of $1 billion was available under BRIC's various funding streams. BRIC's 2023 program priorities include incentivizing projects that mitigate risk to public infrastructure and disadvantaged communities, address climate change and enhance climate resilience, incorporate adoption and enforcement of the latest published edition of building codes, and incorporate nature-based solutions. The 2023 program also includes special considerations for newly designated Community Disaster Resilience Zones.[76]	FEMA will fund the following activities: evaluation, adoption, and or implementation of codes that reduce risk, enhancement of existing, adopted codes to incorporate more current requirements or higher standards, and development of professional workforce capabilities related to building codes through technical assistance and training.

[73] FED. EMERGENCY MGMT. AGENCY, FEMA ECONOMIC BENEFIT VALUES FOR GREEN INFRASTRUCTURE 9-11 (2022).

[74] Other potential sources of funding include NOAA's Community-Based Restoration Program, the National Coastal Resilience Fund, FEMA's Public Assistance program, HUD's Community Development Block Grant Program, and EPA's Section 319 Nonpoint Source Management Program. FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: A GUIDE FOR LOCAL COMMUNITIES 25-27 (2021) (describing nature-based projects that qualify for each federal funding option).

[75] *Hazard Mitigation Assistance Grants*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation (last visited Dec. 18, 2023).

[76] *See Summary of FEMA Hazard Mitigation Assistance (HMA) Programs*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/fact-sheet/summary-fema-hazard-mitigation-assistance-hma-programs (last visited Jan. 22, 2024).

The Flood Mitigation Assistance (FMA) Program	Provides funding to eliminate flood risks to buildings insured by the National Flood Insurance Program. This program funds both planning and projects.[77]	FEMA will fund the following activities and projects: capability and capacity building activities, mitigation plans, technical assistance by states to communities, project scoping, localized flood risk reduction projects, individual flood mitigation projects, management costs, partnership development to conduct eligible mitigation activities, enhancing floodplain management, severe repetitive loss strategy development.
The Hazard Mitigation Grant Program	Provides financial assistance to state, local, Tribal, and territorial governments to implement mitigation measures that go beyond the restoration of damaged infrastructure. These measures can include the construction of protective infrastructure, development of hazard-resistant building codes, community education programs, and other proactive strategies to reduce the vulnerability of communities to disasters. The HMGP funds voluntary actions that protect either private or public property.[78]	Eligible activities include the following: planning and enforcement (developing hazard mitigation plans, acquisition of hazard prone homes and businesses, post-disaster code enforcement), flood protection (protecting homes and business with permanent barriers, elevating structures above known flood levels, reconstructing a damaged dwelling, drainage improvement projects), retrofitting, and construction of safe rooms.

[77] *See Flood Mitigation Assistance Grant Program*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/flood-mitigation-assistance (last visited Jan. 22, 2024).
[78] *See Hazard Mitigation Grant Program (HMGP)*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/hazard-mitigation (last visited Jan. 22, 2024).

The Safeguarding Tomorrow Revolving Loan Fund	Provides capitalization grants to states, eligible federally recognized Tribes, and territories to establish revolving loan funds that provide hazard mitigation assistance for local governments to reduce risks from natural hazards and disasters.[79]	FEMA will provide capitalization grants for entities to establish funds for mitigation projects that increase resilience and mitigation impacts of drought, extreme heat, severe storms, wildfires, floods and earthquakes.

Funding NBS with HMA Grants. HMA grants focus on reducing environmental hazards through mitigation projects and have increasingly prioritized nature-based projects or projects with nature-based features. In 2015, FEMA announced the eligibility of a suite of new activities for mitigation funding under the HMA program, including floodplain and stream restoration. FEMA emphasizes that "these solutions encompass sustainable environmental management practices designed to restore, mimic, or enhance natural systems and processes, contributing to the mitigation of natural hazards while fostering economic, environmental, and social resilience."[80]

Despite their eligibility, relatively few NBS projects have been funded through FEMA hazard mitigation grant programs to date. However, FEMA, NGOs, and other stakeholders have begun to catalog case studies in hopes that more grant applicants will learn about and embrace NBS.[81] For example, in the 2021 Mitigation Action Portfolio, FEMA described 65 projects, organized by primary hazard, that had received mitigation funding;[82] 15 of these were nature-based solutions, and the majority of nature-based solutions addressed inland and coastal flooding.[83] There are also case studies included in FEMA's 2023 R*eport on Building Community Resilience with Nature-Based Solutions*. One case study highlighted in

[79] *See Safeguarding Tomorrow Revolving Loan Fund*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/storm-rlf (last visited Jan. 22, 2024).
[80] *When You Apply: Things to Know and Do When Applying for Hazard Mitigation Grant Program Funds*,
FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/hazard-mitigation/when-you-apply (last visited Dec. 18, 2023).
[81] *See* FED. EMERGENCY MGMT. AGENCY, HAZARD MITIGATION ASSISTANCE: MITIGATION ACTION PORTFOLIO (2020); FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: A GUIDE FOR LOCAL COMMUNITIES (2021). For two examples of reports that have catalogued case studies (including some funded by FEMA), *see* ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING (Nat'l Wildlife Fed. 2022); THE NATURE CONSERVANCY, PROMOTING NATURE-BASED HAZARD MITIGATION THROUGH FEMA MITIGATION GRANTS 40 (2021), https://www.nature.org/content/dam/tnc/nature/en/documents/Promoting-Nature-Based-Hazard-Mitigation-Through-FEMA-Mitigation-Grants-05-10-2021-LR.pdf.
[82] FED. EMERGENCY MGMT. AGENCY, HAZARD MITIGATION ASSISTANCE: MITIGATION ACTION PORTFOLIO (2020)
[83] *Id.* at 3.

the report is Kansas City, Missouri's Smart Sewer program, which uses small-scale solutions (e.g., rain gardens, green roofs, pervious pavers) along with larger projects (e.g., bioswales, permeable pavement, infiltration trenches, prairies, detention wetlands) to help the city meet its stormwater management goals while also working toward net zero emissions by 2040.[84]

FEMA has established a database of BRIC projects to promote transparency and stories of success. One example of a funded project comes from Canton, Mississippi. The community applied for funding for the MLK South Flood Mitigation Project, aiming to enhance flood resilience by upgrading drainage systems, improving detention/retention ponds, and expanding riverbank buffers in flood-prone areas. The project aims to reduce the impact of flooding, with a focus on implementing nature-based solutions and addressing specific issues identified in active National Flood Insurance Program policies and previous loss claims.[85]

Updates to the Project Selection Process. Recent changes to the BRIC and FMA application scoring systems may result in additional funded NBS projects.

For the first two BRIC cycles after the program was established, FEMA employed a uniform scoring system for nature-based projects, allotting a fixed 10 points regardless of the size or significance of the nature-based components. This approach made it challenging to differentiate between projects with substantial nature-based elements and those without.[86] The 2023 Notice of Funding Opportunity (NOFO) for the BRIC Program introduced a more nuanced scoring system, categorizing NBS projects into two tiers.[87] The first tier assigns fewer points to "neighborhood or site-scale" nature-based endeavors, while the second tier awards more points to "watershed or landscape-scale" initiatives, particularly those supporting coastal resilience. The top tier now allocates 15 points (out of a total of 100 points) for technical evaluations, a higher percentage of the total points available than in previous iterations.[88]

The 2023 NOFO for the FMA Program has also made updates for NBS solutions. The scoring criteria have been amended since 2021, when consideration for climate change *or* incorporation of nature-based solutions was allotted 200 points; now, the categories have

---

[84] FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: A GUIDE FOR LOCAL COMMUNITIES 25 (2021).
[85] *Mississippi: City of Canton Martin Luther King Stormwater Improvement Project*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/case-study/mississippi-city-canton-martin-luther-king-stormwater-improvement-project (last visited Dec. 18, 2023).
[86] *See* Anna Weber, *Building Resilience, BRIC by BRIC: BRIC's Fourth Year*, NAT. RES. DEF. COUNCIL (Dec. 18, 2023), https://www.nrdc.org/bio/anna-weber/building-resilience-bric-bric-brics-fourth-year ("we recommend that FEMA provide more detail on the nature-based components of each project, so that the public can better understand which projects include such elements and what proportion of the overall project cost will support nature-based solutions").
[87] *Id.*
[88] *Id.*

been separated, and incorporation of nature-based solutions is allotted 100 points (no partial points are assigned to the category).[89] Furthermore, in the 2023 NOFO, FEMA specifically recognized "that many effective resilience solutions, such as nature-based solutions, yield critical benefits that are not monetizable."[90] Therefore, "these key performance indicators are not determinative of whether an application to the FMA grant program is selected for funding."[91] It is also not clear the evaluation criteria that are used when determining whether or not a project is awarded the 100 NBS points (i.e., are points awarded to projects that only include ancillary NBS components). These changes may lead to additional funded NBS projects. Future changes, such as establishing a dedicated set-aside within the funding pool exclusively for nature-based projects,[92] may continue to be necessary.

1.2.3 Challenges to Obtaining FEMA Funding for Nature-Based Solutions

Successfully obtaining FEMA funding for nature-based projects still proves to be a hurdle, for many reasons that include but are not limited to: applicants lack capacity to identify, develop, and administer mitigation projects; the BCA often requires extensive analysis and modeling for NBS; and the funding mechanism is structured to favor traditional approaches.

Lack of Capacity. A 2021 GAO report cited lack of technical capacity and the complexity of the grant application processes as significant challenges for hazard mitigation grant program applicants.[93] In fact, the various challenges associated with the grant application process were cited as a reason that 35% of the funds that FEMA has allocated under the Hazard Mitigation Assistance program from 1989 through early 2018 have gone unspent.[94]

Furthermore, communities, especially small and historically marginalized communities, lack the capacity to identify, apply for, administer, implement, and manage NBS-centered projects. Communities that are already stretched thin lack the incentive to undertake costly and time-consuming grant applications, especially when implementing a nature-based project entails coordinating with multiple agencies and may involve expensive

---

[89] FED. EMERGENCY MGMT. AGENCY, THE DEPARTMENT OF HOMELAND SECURITY (DHS) NOTICE OF FUNDING OPPORTUNITY (NOFO) FISCAL YEAR 2021 FLOOD MITIGATION ASSISTANCE 29 (2021); FED. EMERGENCY MGMT. AGENCY, THE DEPARTMENT OF HOMELAND SECURITY (DHS) NOTICE OF FUNDING OPPORTUNITY (NOFO) FISCAL YEAR 2022 FLOOD MITIGATION ASSISTANCE 33 (2022); FED. EMERGENCY MGMT. AGENCY, THE DEPARTMENT OF HOMELAND SECURITY (DHS) NOTICE OF FUNDING OPPORTUNITY (NOFO) FISCAL YEAR 2023 FLOOD MITIGATION ASSISTANCE 44 (2023).

[90] FED. EMERGENCY MGMT. AGENCY, THE DEPARTMENT OF HOMELAND SECURITY (DHS) NOTICE OF FUNDING OPPORTUNITY (NOFO) FISCAL YEAR 2023 FLOOD MITIGATION ASSISTANCE 9 (2023).

[91] *Id.*

[92] Anna Weber, *Building Resilience, BRIC by BRIC: BRIC's Fourth Year*, NAT. RES. DEF. COUNCIL (Dec. 18, 2023), https://www.nrdc.org/bio/anna-weber/building-resilience-bric-bric-brics-fourth-year

[93] U.S. GOV'T ACCOUNTABILITY OFF., GAO-21-140, DISASTER RESILIENCE: FEMA SHOULD TAKE ADDITIONAL STEPS TO STREAMLINE HAZARD MITIGATION GRANTS AND ASSESS PROGRAM EFFECTS (2021).

[94] Thomas Frank, *States Shun Billion in Federal Aid as Climate Costs Soar*, CLIMATEWIRE (Feb. 26, 2021), https://www.eenews.net/climatewire/stories/1063726077/search?keyword=hazard+mitigation.

modeling and planning/siting that differs from current infrastructure solutions in a municipality. While there are some provisions specifically designed to increase accessibility for small and impoverished communities, there are a very limited number of communities who can actually benefit. For example, under the FEMA BRIC program, small and impoverished communities are eligible to receive a non-federal cost share reduction to 10% non-federal, 90% federal.[95] However, the definition of "small impoverished community" is very limited, notably excluding larger impoverished communities and Tribes, who are often evaluated as one Tribal population, rather than individual towns or subsets.[96]

Benefit-Cost Analysis. A 2022 White House report on opportunities to accelerate nature-based solutions underscores the importance of conducting unbiased cost-benefit analyses, emphasizing the need for analyses that carefully establish baselines, set timelines to account for potential lags in benefit or cost accrual, and, wherever feasible, quantify the monetary value of the benefits associated with nature-based solutions.[97] As described above, FEMA has made a number of recent changes to the BCA in order to make it easier to quantify NBS. However, many applicants lack the capacity to undertake the extensive and expensive analysis and modeling necessary to conduct the BCA for many NBS projects. Stakeholders describe a lack of data[98] and a need for pre-calculated values for ecosystem services, like flood and fire mitigation, as challenges.

For example, the Nature Conservancy has suggested that developing $/acre/year values for hazard mitigation benefits of existing land cover types, such as for the storm buffering value of wetlands, should be included in the FEMA BCA toolkit.[99] A 2021 GAO report also recommended the development of more pre-calculated benefits to simplify the mitigation grant application process for local communities while ensuring that investments are cost-effective.[100]

---

[95] 42 U.S.C. § 5133(a).

[96] BRITTANY PARKER & JESSIE RITTER, BUILDING RESILIENCE THROUGH NATURAL INFRASTRUCTURE: BARRIERS AND OPPORTUNITIES WITHIN FEMA HAZARD MITIGATION AND HUD COMMUNITY DEVELOPMENT BLOCK GRANT PROGRAMS 42 (Nat'l Wildlife Fed. 2021); *see also* Thomas Frank, *FEMA Climate Grants Pose Challenge for Poor Communities*, CLIMATEWIRE (June 1, 2021), https://www.eenews.net/articles/fema-climate-grants-pose-challenge-for-poor-communities.

[97] WHITE HOUSE COUNCIL ON ENV'T QUALITY ET AL., OPPORTUNITIES TO ACCELERATE NATURE-BASED SOLUTIONS: A ROADMAP FOR CLIMATE PROGRESS, THRIVING NATURE, EQUITY, AND PROSPERITY 21 (2022).

[98] Thomas H. Douthat et al., *Stakeholder Perceptions About Incorporating Externalities and Vulnerability into Benefit-Cost Analysis Tools for Watershed Flood Risk Mitigation*, SUSTAINABILITY, May 2023.

[99] THE NATURE CONSERVANCY & EARTH ECONOMICS, STRESS TESTING THE BCA TOOLKIT WITH NATURE-BASED SOLUTIONS: OBSERVATIONS AND RECOMMENDATIONS FOR THE FEDERAL EMERGENCY MANAGEMENT AGENCY 6 (2021).

[100] U.S. GOV'T ACCOUNTABILITY OFF., GAO-21-140, DISASTER RESILIENCE: FEMA SHOULD TAKE ADDITIONAL STEPS TO STREAMLINE HAZARD MITIGATION GRANTS AND ASSESS PROGRAM EFFECTS 37 (2021).

Another challenge arises from the differences in evaluating NBS versus traditional grey infrastructure projects. While nature-based projects typically emphasize long-term environmental benefits and resilience to change and hazards, traditional grey infrastructure projects are perceived to have more immediate effects and are more easily quantified.[101] This issue is enhanced by the dynamic nature of NBS, as nature-based projects tend to grow and adapt over time.[102] While FEMA now encourages greater consideration of how a project will influence future hazard risk (i.e., through piloting a lower discount rate that assigns greater value to future benefits), more guidance is needed on how future conditions can be quantified and incorporated into BCA.[103]

Finally, the BCA framework is not inherently geared toward watershed level decision-making and instead encourages projects with more narrowly defined goals. This kind of site-scale, project-by-project analysis can fail to capture the broader watershed dynamics and externalities, such as the consequences of moving water downstream faster in a different area to reduce risk in the target area (where the quicker flows may increase potential for flooding downstream).[104] Thus, the BCA cannot adequately account for the externalities avoided by choosing NBS over grey infrastructure.

Watershed-Based Planning and the Issue of Scale. Watersheds are the scale at which the major hydrological, chemical, and biological processes that determine the functions and services NBS can provide occur. Understanding and taking into account geographic context, hydrology, and other watershed processes is necessary to achieve the desired ecological objectives of an ecosystem restoration project. Upstream land uses, for example, can heavily influence a downstream jurisdiction's flood risks and the ability of a restoration project to mitigate those risks.

Planning for NBS at the watershed scale can identify mitigation needs within the watershed and general areas for project siting (individual project development will rely on more fine-grained and site-specific details) that will most effectively address those mitigation needs. However, most hazard mitigation projects are planned at the jurisdictional level (e.g., city, town, or county). This mismatch in scale has the potential to lead to projects that do not

---

[101] Hilde Eggermont et al., *Nature-Based Solutions: New Influence for Environmental Management and Research in Europe*, 24(4) GAIA – ECOLOGICAL PERSPECTIVES FOR SCI. AND SOC'Y 243 (2015).
[102] ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING (Nat'l Wildlife Fed. 2022).
[103] *Fiscal Year 2022 Notices of Funding Opportunities for Hazard Mitigation Assistance Grants*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/notice-funding-opportunities/fy2022-nofo (last visited Jan. 19, 2024); THE NATURE CONSERVANCY & EARTH ECONOMICS, STRESS TESTING THE BCA TOOLKIT WITH NATURE-BASED SOLUTIONS: OBSERVATIONS AND RECOMMENDATIONS FOR THE FEDERAL EMERGENCY MANAGEMENT AGENCY 7 (2021),
[104] Thomas H. Douthat et al., *Stakeholder Perceptions About Incorporating Externalities and Vulnerability into Benefit-Cost Analysis Tools for Watershed Flood Risk Mitigation*, SUSTAINABILITY, May 2023.

adequately address flood risk and may lead to a lack of trust in the ability of NBS to provide results.

Depending on the community's particular needs and opportunities, site-scale (e.g., rain gardens, green roofs, tree canopy) or watershed-scale (e.g., land conservation, greenways, wetland restoration, floodplain restoration) NBS may be most appropriate. Nature-based solutions can provide larger-scale benefits where planned and applied at a watershed scale, but this also requires more partners, planning, and capacity; on the other hand, site-scale projects can provide important mitigation benefits for individual properties or neighborhoods, and they may help provide important evidence of the effectiveness of NBS.

A "watershed approach" is a conceptual framework for agencies responsible for wetlands protection, pollution, and management control to look for opportunities to leverage limited resources to meet common protection, mitigation, and restoration goals of a watershed while enhancing the resiliency and adaptive capacity of the landscape.[105] There are five fundamental components of a watershed approach:

- Focusing on the watershed,
- Engaging and educating stakeholders and affected communities,
- Identifying partners and building trust among them,
- Basing processes and decisions in strong science and data, and
- Tracking, reporting, and learning from results.[106]

Tailoring this to hazard mitigation, a watershed approach might be used to identify and characterize the natural functions of the watershed and analyze how the benefits (or potential benefits) of such functions might aid in mitigating hazard risk.

Several state wetlands/natural resource agencies in the Mississippi River Basin employ a watershed approach to state resource management to improve water quality and reduce

---

[105] U.S. ENV'T PROT. AGENCY, OFFICE OF WATER, EPA 840-S-96-001, WATERSHED APPROACH FRAMEWORK 6-8 (1996); IOWA WATERSHED APPROACH INFORMATION SYSTEM, https://iwa.iowawis.org/about.php (last visited Dec. 21, 2023). The Army Corps, who has used a watershed approach in siting compensatory mitigation sites, a watershed approach "facilitates the proper framing of a problem by evaluating it on a system level to identify root cause(s) and it's interconnectedness to problem symptoms" and "enables the design of solutions that considers the benefits of water resources for a wide range of stakeholders within and around the watershed." PRINCIPLES AND REQUIREMENTS FOR FEDERAL INVESTMENTS IN WATER RESOURCES, U.S. ARMY CORPS OF ENG'RS 5 (2013). Interagency Guidelines provide that information appropriate for such an analysis includes but is not limited to trends in aquatic habitat loss, cumulative impacts of past activities, projected water utilization trends, needs of sensitive species and resources, special conditions, and chronic environmental problems. FINAL INTERAGENCY GUIDELINES, U.S. ARMY CORPS OF ENG'RS 15 (2014).

[106] GAYLE KILLAM, PROTECTION AND RESTORATION BY WATERSHED – A COMPILATION: MISSISSIPPI RIVER CORRIDOR FOCUS (Env't L. Inst. 2023).

flood risk, including in Tennessee,[107] Iowa,[108] and Louisiana.[109] The benefits of using a watershed approach in hazard mitigation planning include incorporating environmental externalities into the planning process, addressing a wider reach of stakeholders, and potentially lowering the cost of mitigation via the integration of NBS.

Improving Coordination. Making decisions at a watershed scale can also help improve coordination among state and federal agencies and other interested stakeholders, helping to improve efficiency by prioritizing actions that leverage efforts across a range of programs. Even when mitigation projects utilize federal funding, mitigation projects in the United States are mostly designed and executed at the local level or under state programs that coordinate local efforts.[110] Integrated planning at the regional watershed scale is infrequent, while hazard mitigation is primarily driven by local governments or state programs, lacking coordination across neighboring jurisdictions.[111] In the Mississippi River Basin, for example, local management of upstream levees can *increase* risk for downstream stakeholders, highlighting the need for a regional collaboration around flood risk management.[112] To address these issues, there's a growing call for a shift to collaborative,

---

[107] *Watershed Management Approach*, TENN. DEP'T OF ENV'T & CONSERVATION, https://www.tn.gov/environment/program-areas/wr-water-resources/watershed-stewardship/watershed-management-approach.html (last visited Dec. 27, 2023). The Tennessee Watershed Management Approach is a watershed approach to water quality protection and restoration. It works to synchronize public involvement, identify challenges, plan, monitor, assess, and permit activities by watershed.

[108] IOWA WATERSHED APPROACH INFORMATION SYSTEM, https://iwa.iowawis.org/about.php (last visited Dec. 21, 2023). The Iowa Watershed Approach, which is funded by an award under HUD's National Disaster Resilience Competition, serves to reduce floods and improve water quality.

[109] LOUISIANA WATERSHED INITIATIVE, https://watershed.la.gov:443/ (Dec. 27, 2023). The Louisiana Watershed Initiative coordinates funding, data, and resources among five state agencies to reduce flood risk through a watershed-based approach.

[110] Thomas H. Douthat et al., *Stakeholder Perceptions About Incorporating Externalities and Vulnerability into Benefit-Cost Analysis Tools for Watershed Flood Risk Mitigation*, SUSTAINABILITY, May 2023; ENV'T L. INST. & THE NATURE CONSERVANCY, WATERSHED APPROACH HANDBOOK: IMPROVING OUTCOMES AND INCREASING BENEFITS ASSOCIATED WITH WETLAND AND STREAM RESTORATION AND PROTECTION PROJECTS (2014), https://www.eli.org/sites/default/files/eli-pubs/watershed-approach-handbook-improving-outcomes-and-increasing-benefits-associated-wetland-and-stream_0.pdf.

[111] Thomas H. Douthat et al., *Stakeholder Perceptions About Incorporating Externalities and Vulnerability into Benefit-Cost Analysis Tools for Watershed Flood Risk Mitigation*, SUSTAINABILITY, May 2023.

[112] Tamsen Reed, Lisa Reyes Mason & Christine C. Ekenga, *Adapting to Climate Change in the Upper Mississippi River Basin: Exploring Stakeholder Perspectives on River System Management and Flood Risk Reduction*, ENV'T HEALTH INSIGHTS, Jan.-Dec. 2020, https://journals.sagepub.com/doi/epub/10.1177/1178630220984153.

watershed-scale management and planning in hazard mitigation to address both upstream and downstream consequences of mitigation and adaptation measures.[113]

Watershed-Scale Planning and Environmental Justice. Planning solely by jurisdiction may also overlook climate inequities and historical marginalization extending beyond jurisdictional boundaries. Historically, FEMA hazard mitigation practices tended to focus on protecting structures rather than prioritizing social vulnerability, which can lead to equity concerns in mitigation.[114] More recently, FEMA has made a number of changes to incorporate consideration of social vulnerability, including enhancing the public participation process for local mitigation planning and requiring an analysis of benefits to underserved and socially vulnerable populations.[115] However, protection of buildings, structures, and infrastructure must still be the mitigation strategy priority.[116]

Given that historic marginalization often occurs along natural features, such as in flood prone areas, thinking and planning at the watershed level can allow for greater consideration of equity in the planning process. An example from Norfolk, Virginia illustrates disproportionate and recurrent tidal and precipitation flooding in two predominantly African American neighborhoods situated in different jurisdictions.[117] Due to these inequities, mitigation strategies were planned at the watershed scale (the Ohio Creek Watershed) rather than by jurisdiction. In the Mississippi River Basin, the location of low-income communities and communities of color are often linked to topography. A National Wildlife Federation story map describes how lower-income communities of color "invariably occupy the lowest-lying most flood-prone parts of towns and cities" throughout the Basin.[118] The Mississippi River Delta, located at the southern end of the Basin, is one of the most impoverished areas in the U.S.[119] A story map shows the negative impacts of levees and upstream flood mitigation infrastructure on downstream areas in the Basin, where there is the strongest overlap between historic marginalization and flood risk in the delta.[120]

---

[113] Thomas H. Douthat et al., *Stakeholder Perceptions About Incorporating Externalities and Vulnerability into Benefit-Cost Analysis Tools for Watershed Flood Risk Mitigation*, SUSTAINABILITY, May 2023.
[114] *Id.* at 2.
[115] FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON 11 (2022), https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-policy-comparison.pdf.
[116] *Id.*
[117] CITY OF NORFOLK, DEP'T OF PUB. WORKS, OHIO CREEK WATERSHED MASTER PLAN (2012), https://www.norfolk.gov/DocumentCenter/View/79660/2012-8-10_Ohio_Creek_Watershed_Master_Plan.
[118] NAT'L WILDLIFE FED., DRAFT MISSISSIPPI RIVER WHITE PAPER 14 (2021), https://www.dropbox.com/s/ehrlb1ex0zqhq30/Mississippi%20River%20White%20Paper_3_11_2021.pdf?dl=0
[119] *Id.*
[120] *Id.*

Watershed-scale planning is essential to prioritize social vulnerability and to ensure that planning addresses the distributional consequences of flood hazard exposure and mitigation decisions.[121] NBS can play a crucial role in mitigating the hazards and risks resulting from historical inequalities in settlement patterns, land use, and property ownership.[122]

Other Challenges. One of the challenges facing NBS projects is that all funded mitigation activities, including nature-based projects, must be performed in accordance with priorities set out in the relevant state, Tribal, or local hazard mitigation plan(s). Although many plans are beginning to incorporate NBS (see Section 1.1.2), there is still a lot of opportunity to encourage planners and decision-makers that NBS are feasible, effective alternatives to traditional approaches.

In many cases, local officials still do not perceive NBS to have the same level of risk reduction certainty as traditional grey infrastructure solutions. This is a challenge noted by FEMA staff during a workshop convened by ELI in November 2023, as well as by various reports describing public perception of NBS. Such reports cite a belief that NBS displace rather than reduce risk,[123] greater trust in alternative grey measures,[124] and a perceived lack of evidence in the risk reduction of NBS.[125]

This knowledge gap may be explained by the relative newness of the incorporation of NBS into FEMA funding structures.[126] FEMA policies generally favor grey infrastructure, in some cases disincentivizing rural non-structural projects such as buyouts (which require the

---

[121] Thomas H. Douthat et al., *Stakeholder Perceptions About Incorporating Externalities and Vulnerability into Benefit-Cost Analysis Tools for Watershed Flood Risk Mitigation*, SUSTAINABILITY, May 2023.
[122] ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING 23 (Nat'l Wildlife Fed. 2022).
[123] Mae A. Davenport et al., *Building Local Community Commitment to Wetlands Restoration: A Case Study of the Cache River Wetlands in Southern Illinois, USA*, 45 ENV'T MGMT. 711 (2010).
[124] Rung-Jiun Chou, *Achieving Successful River Restoration in Dense Urban Areas: Lessons from Taiwan*, SUSTAINABILITY, Nov. 2016; ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING 91 (Nat'l Wildlife Fed. 2022) (discussing breaking path dependency).
[125] Luciana S. Esteves & Karen Thomas, *Managed Realignment in Practice in the UK: Results from Two Independent Surveys*, 70(10070) J. Coastal Rsch. 407 (2014); ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING 90 (Nat'l Wildlife Fed. 2022).
[126] This knowledge gap is particularly relevant when local municipalities are sub-applicants for BRIC grants. Under the BRIC program, the state emergency management agency is the primary applicant, and may have to prioritize between local projects. Without state familiarity with NBS, communities may be under-prioritized when submitting nature-based proposals. BRITTANY PARKER & JESSIE RITTER, BUILDING RESILIENCE THROUGH NATURAL INFRASTRUCTURE: BARRIERS AND OPPORTUNITIES WITHIN FEMA HAZARD MITIGATION AND HUD COMMUNITY DEVELOPMENT BLOCK GRANT PROGRAMS 31 (Nat'l Wildlife Fed. 2021).

entire agricultural property to be purchased, rather than just the damaged section).[127] Additionally, FEMA's national flood insurance policies incentivize local levee improvements, but this exacerbates issues for downstream communities (by increasing flow pressure) and hinders the implementation of NBS as alternatives to levees.[128]

2. Scaling Up Natural Infrastructure in the Mississippi River Basin and Beyond

There is an opportunity to expand the use of natural infrastructure within the basin, with numerous agencies and organizations dedicated to the conservation and restoration of wetlands. The challenge is how to best leverage this expertise systematically and cohesively. In this section, we discuss the opportunities for scaling up natural infrastructure as hazard mitigation solutions in the Mississippi River Basin and beyond. We focus on the importance of coordination with natural resource agencies in the hazard mitigation planning and project development process and describe opportunities for engagement of natural resource experts in the planning process and how prioritization, assessment, and restoration tools developed by natural resource agencies can be useful during the FEMA mitigation planning and evaluation process.

2.1 Building Partnerships with Natural Resource Experts in the FEMA Planning Process

Collaborations between local governments and private sector natural resource experts—including NGOs, nonprofits, and academic institutions—and wetlands agencies, are critical for the effective planning, execution, and upkeep of nature-based solutions. Such experts can help fill information gaps, raise community awareness of the natural barriers that existing ecosystems provide against hazards, and aid in identifying and prioritizing viable nature-based mitigation actions.

This section discusses opportunities during the FEMA hazard mitigation planning process to build partnerships with natural resource experts. We focus on four key parts of mitigation plan development: documenting the planning process; conducting the risk assessment; developing the mitigation strategy; and creating a process for plan maintenance (see Figure 1 for FEMA's description of the stages of hazard mitigation plan development).

---

[127] Tamsen Reed, Lisa Reyes Mason & Christine C. Ekenga, *Adapting to Climate Change in the Upper Mississippi River Basin: Exploring Stakeholder Perspectives on River System Management and Flood Risk Reduction*, ENV'T HEALTH INSIGHTS, Jan.-Dec. 2020, https://journals.sagepub.com/doi/epub/10.1177/1178630220984153.
[128] *Id.*

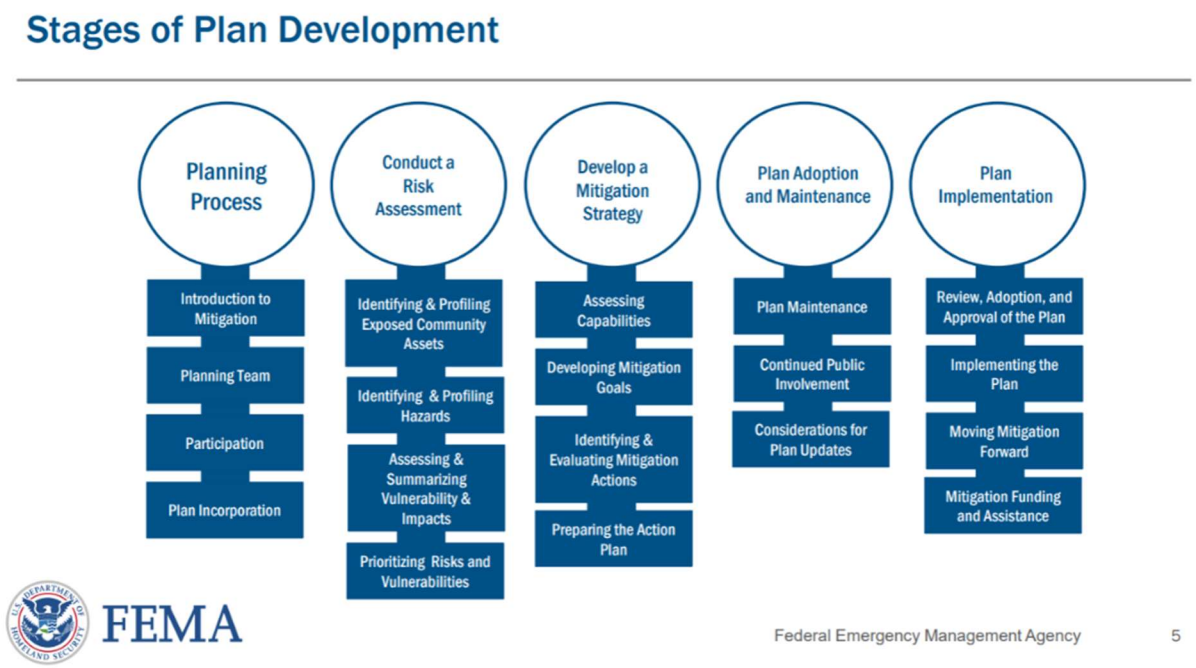


Figure 1. Source: FEMA Mitigation Planning Program Training Materials (n.d.)

Planning Process

FEMA Requirements. FEMA emphasizes a collaborative approach to hazard mitigation planning that engages various stakeholders to ensure comprehensive and effective hazard mitigation strategies. The planning process provides an opportunity for input from a diverse range of entities, including state, local, and Tribal agencies, educational institutions such as colleges and universities, private entities including nonprofit organizations, and quasi-governmental authorities like port authorities or utility districts performing critical functions.[129] As FEMA notes,

> [n]o single agency can be solely responsible for mitigation across all sectors. Collaboration among stakeholders with the authority, interest and expertise to implement mitigation measures that increase social and economic resilience, and resilience from natural hazard events, enables the state to leverage resources and mitigation investments to reduce risk. As part of this process, it is important that states actively engage the expertise of stakeholders and representatives from underserved communities and those working with these communities toward more equitable mitigation strategies.[130]

[129] 44 C.F.R. pt. 201; FED. EMERGENCY MGMT. AGENCY, FP 302-094-2, STATE MITIGATION PLANNING POLICY GUIDE 18, 97 (2022); FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON 3 (2022).

[130] FED. EMERGENCY MGMT. AGENCY, FP 302-094-2, STATE MITIGATION PLANNING POLICY GUIDE 43 (2022).

Moreover, recent updates in FEMA requirements underscore the importance of stakeholder engagement, defining participation criteria and emphasizing the inclusion of underserved communities.[131] The hazard mitigation plan is expected to document how public feedback is incorporated throughout the planning process, reflecting a commitment to transparency and community involvement.[132] Incorporation of public feedback can be achieved through holding public meetings and including community organizations on the planning community. Some communities have produced social vulnerability maps to target outreach and mitigation efforts.[133] However, these stakeholder engagement opportunities can become "box-checking" exercises if they do not reach the right community leaders, or if events are hosted and have minimal turnout. Hazard mitigation planners should consult with community leaders to determine *who* should be involved and *where* community engagement should take place to ensure that input is received and incorporated.

Involving Natural Resource Experts. It is crucial to fully integrate nature and natural infrastructure solutions and priorities throughout the community-based hazard mitigation planning process in order for NBS to be meaningfully considered as mitigation strategies.[134] This involves proactively engaging individuals with expertise in ecological sciences, urban planning, and natural resource management, as well as conservation organizations and agencies dedicated to fish, wildlife, and parks from the beginning of the planning process.[135]

Natural resource experts can bridge information gaps, help identify viable solutions, and make informed implementation decisions for siting NBS. For example, most state wetland agencies monitor wetland habitats and may conduct biological and functional wetlands assessments to track ecosystem health or identify watershed planning and conservation priorities.[136] In this context, natural resource experts can contribute knowledge of other existing plans as well as resources and tools (such as those described in Section 2.2) of which hazard planners may not have been aware.

The current FEMA framework does not assign a central or specific role to natural resource experts. However, there are opportunities to incorporate experts into the planning process, providing valuable assistance in developing a plan's mitigation strategy and

---

[131] *Id.* at 42-44; FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON 3 (2022).
[132] 44 C.F.R. pt. 201; FED. EMERGENCY MGMT. AGENCY, FP 302-094-2, STATE MITIGATION PLANNING POLICY GUIDE (2022); FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON (2022).
[133] Fiona Osborn & Rebecca L. Kihslinger, *Incorporating Environmental Justice Into Hazard Mitigation Plans* (Oct. 4, 2021), https://www.eli.org/vibrant-environment-blog/incorporating-environmental-justice-hazard-mitigation-plans.
[134] ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING 8 (Nat'l Wildlife Fed. 2022).
[135] *Id.* at 13.
[136] *Wetlands Monitoring and Assessment*, ENV'T PROT. AGENCY, https://www.epa.gov/wetlands/wetlands-monitoring-and-assessment (last visited Jan. 19, 2024).

integrating external natural resource initiatives.[137] Some states, e.g. Massachusetts, have a standing interagency committee that meets at least once a year to discuss internal policies, identify funding sources for mitigation projects, and act as "subject matter experts" for ongoing hazard mitigation projects.[138] In Massachusetts, this committee involves several natural resource experts, including representatives from the Department of Conservation and Recreation, the Department of Environmental Protection, and private organizations like the Weston Observatory at Boston College.[139] Fixed structures like this committee allow for formal integration of natural resource expertise into the hazard planning process and for oversight of ongoing hazard mitigation projects "from initiation to close-out."[140]

Engaging natural resource experts in the planning process may not be immediately possible for local hazard mitigation planners, especially in smaller localities with limited capacity. In these instances, it may first be necessary to invest in building the capacity of the natural resources program. For example, in the City of Snoqualmie, Washington, funding for the city's Forestry Department greatly increased once the value of the natural capital was communicated, allowing the department to grow from one full-time employee to four employees to implement natural infrastructure projects.[141] This example demonstrates the importance of involving natural resource experts early, as planning for NBS may require strengthening capacity in departments different from those associated with traditional grey infrastructure projects.

There should also be meaningful opportunities for other stakeholders to communicate their priorities, with an emphasis on the most vulnerable populations. Local community leaders, neighborhood groups, and indigenous communities contribute local and traditional ecological knowledge that should help inform the hazard [142] For example, in Orleans Parish, Louisiana, community-based organizations like Housing NOLA and Greenlight New Orleans participated in working group meetings during a hazard mitigation process, speaking for the unique needs of their communities and offering insight into how

---

[137] Fed. Emergency Mgmt. Agency, FP 302-094-2, State Mitigation Planning Policy Guide 42-44 (2022).

[138] *Massachusetts State Hazard Mitigation Interagency Committee*, STATE HAZARD MITIGATION TEAM, https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.mass.gov%2Fdoc%2Fshmic-responsibilities%2Fdownload&wdOrigin=BROWSELINK (last visited Jan. 31, 2024).

[139] *Id.*

[140] *Id.*

[141] ZACHARY CHRISTIN ET AL., NATURAL INFRASTRUCTURE ASSESSMENT: CITY OF SNOQUALMIE (2020), https://static1.squarespace.com/static/58a9a82db3db2bfa5def5c9c/t/5f022b0ae84f7d7af213e1d2/1593977635444/Snoqualmie_Natural_Infrastructure_Assessment_1_compressed.pdf; Lance Davisson, The Keystone Concept & Zachary Christin, Equilibrium Economics, contribution to "Wetlands and Hazard Mitigation: Opportunities for Integration" workshop held by the Environmental Law Institute (Oct. 31 & Nov. 1, 2023).

[142] ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING 13 (Nat'l Wildlife Fed. 2022).

mitigation planning can be leveraged.[143] Engaging these stakeholders can help the HMP consider all relevant goals, prioritize social vulnerability, and determine where nature-based approaches can be adopted to address common goals.

Risk Assessment

FEMA Requirements. The risk assessment phase of HMP development involves the identification and description of all natural hazards affecting the planning area, specifying the location and affected areas for each identified hazard, including historical information about past occurrences that covers the range of observed intensities and a quantification of the probability of future events that incorporates the impacts of changing conditions, including climate change.[144] The risk assessment also involves an analysis of losses to vulnerable structures and estimations of dollar losses to state (or locally, for the local hazard mitigation plan) owned and operated facilities. This vulnerability assessment should summarize the impacts each hazard may have on current and future assets, encompassing people, structures, systems, and natural, historic, and cultural resources, along with community-valued activities, while also describing the associated risks that render them susceptible to damage.

Hazard mitigation plans generally include a section for each hazard the state has identified for analysis. The analysis serves as the factual basis for the activities that are then included in the hazard mitigation strategy.[145] A thorough assessment of how natural hazards impact the environment and/or how loss of natural infrastructure can increase/influence risk can help planners to better understand the habitats and natural areas that are at risk—and the services that might be lost—if these areas are affected. This assessment can also identify the location or types of natural infrastructure projects that may help the state to address their risk.

It is important to remember that dynamic natural habitats rely on natural processes—including sea level rise and episodic storm events—to help them function and persist into the future. However, when development or other activities prevent habitats from migrating inland with sea level rise or otherwise disrupt the natural processes that make them function, then natural hazards can become a problem for nature. Natural systems need to be able to respond to rising sea level and episodic storms to remain viable in the face of

---

[143] Fiona Osborn & Rebecca L. Kihslinger, *Incorporating Environmental Justice into Hazard Mitigation Plans* (Oct. 4, 2021), https://www.eli.org/vibrant-environment-blog/incorporating-environmental-justice-hazard-mitigation-plans.

[144] 44 C.F.R. pt. 201; FED. EMERGENCY MGMT. AGENCY, FP 302-094-2, STATE MITIGATION PLANNING POLICY GUIDE (2022); FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON (2022). Note: this is separate from the hazard vulnerability assessment. A risk assessment provides information about what hazards are likely to occur, whereas a vulnerability assessment includes how often, extent, and severity of the hazard. *See Overview of Risk and Hazard Vulnerability Assessments*, FED. EMERGENCY MGMT. AGENCY, https://emilms.fema.gov/is_0559/groups/17.html (last visited Jan. 19, 2024).

[145] 44 C.F.R. § 201.4 (Standard State Mitigation Plans).

ongoing climate change. Risk assessments need to take into account this dynamism and the ability of natural systems to respond or adapt to changing conditions.

Involving Natural Resource Experts. Natural resource experts can help identify how the loss of critical ecosystems (e.g., coastal wetlands) can make populations more vulnerable to natural hazards (e.g., flooding, sea level rise).[146] Natural resource experts help communities identify the full range of natural assets, explore interactions between natural processes and hazards, pinpoint the local and climate drivers that may exacerbate the risk of such hazards, and determine geographic and temporal scales.[147]

In ELI's 2021 survey, we reviewed the risk assessment sections of 50 state HMPs to determine how they address risk to natural environments/ecosystems and how the loss of these habitats contributes to increased risk from hazards.[148] Many states (14) have no consistent discussion of natural systems or the environment in the risk assessment or vulnerability analysis.[149] Thirty-five states have some consistent discussion of the impacts to natural resources.[150] In many of the plans, however, the discussion is limited to a summary table for each hazard that generally includes a very brief discussion of impacts of the hazard to the environment among a list of other components (e.g., health and safety of the public and responders; continuity of operations; property, facilities, and infrastructure; economic condition; and public confidence in the jurisdiction's governance).

A few states do go into more depth. California, for instance, has an entire section on the natural environment under the section on state assets at risk.[151] This includes a short section on ecosystems at risk. There is also a more in-depth assessment of effects on the natural environment in the profile on wildfire. In the New Jersey plan, there is a section on environmental impacts in most hazard profiles (e.g., the profiles on coastal erosion, dam and levee failure, drought, earthquake, hurricane and coastal storm, etc.).[152] The individual sections go into some detail about impacts; the drought profile has more information on impacts to the environment, including habitats. The Hawai'i plan includes an exposure

---

[146] ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING 8 (Nat'l Wildlife Fed. 2022).

[147] *Id.* at 20; Justin Bousquin & Kristen Hychka, *A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands – A Benefit Indicators Approach*, FRONTIERS IN ENV'T SCI., May 2019.

[148] REBECCA KIHSLINGER, AVI LI & HEATHER LUEDKE, NATURE-BASED MITIGATION GOALS AND ACTIONS IN STATE AND TRIBAL HAZARD MITIGATION PLANS (Env't L. Inst. 2021), https://www.eli.org/sites/default/files/eli-pubs/nature-based-mitigation-goals-and-actions-final.pdf.

[149] *Id.* at 41.

[150] *Id.*

[151] CAL. GOVERNOR'S OFFICE OF EMERGENCY SERVICES, 2018 CALIFORNIA STATE HAZARD MITIGATION PLAN (2018), https://www.caloes.ca.gov/HazardMitigationSite/Documents/002-2018%20SHMP_FINAL_ENTIRE%20PLAN.pdf.

[152] NEW JERSEY OFFICE OF EMERGENCY MGMT., 2019 NEW JERSEY STATE HAZARD MITIGATION PLAN (2019), http://ready.nj.gov/mitigation/2019-mitigation-plan.shtml.

analysis (in the hazard profiles on climate change and sea level rise, chronic coastal flood, dam failure, earthquake, event-based flood, hurricane, landslide and rockfall, tsunami, volcanic hazards, and wildfire) or qualitative analysis (in the hazard profiles on drought, hazardous materials, health risks, and high wind storms) for environmental resources in each hazard protocol.[153] In Massachusetts, the state plan uses "Natural Resources and Environment" as one of the sectors assessed for each hazard in the risk assessment.[154] Each hazard profile has a table that discusses each sector assessed, including natural resources and the environment; each profile also has a more in-depth discussion of impacts to natural resources and the environment (though some hazards have more discussion than others).

In addition to providing information on current risks, natural resource experts can identify the adaptive capacity of ecological systems—a critical factor in anticipating future events and hazards, especially in the context of climate change. While various models and indexes exist to inform planning,[155] external factors that impact adaptive capacity such as habitat connectivity and diversity require area-based expertise that natural resource experts can provide. Many state wetlands agencies have wetland monitoring and assessment programs, and their expertise can provide valuable data that can aid in identifying ecological systems' adaptive capacities and informing resilient strategies for the planning area.[156]

Mitigation Strategy

FEMA Requirements. The mitigation strategy portion of the HMP requires planners to explore existing institutional capabilities and identify strategies that can address the risks and vulnerabilities identified in the plan.[157] FEMA requires the plan to detail the capabilities of existing authorities, policies, programs, funding, and resources that can support the mitigation strategy—and the jurisdiction's ability to expand and enhance these capabilities. Opportunities for implementation through these capabilities (i.e., the policies, authorities,

---

[153] HAWAI'I EMERGENCY MGMT. AGENCY, STATE OF HAWAI'I 2018 HAZARD MITIGATION PLAN (2018), https://dod.hawaii.gov/hiema/files/2018/11/State-of-Hawaii-2018-Mitigation-Plan.pdf.

[154] MASSACHUSETTS EMERGENCY MGMT. AGENCY, MASSACHUSETTS STATE HAZARD MITIGATION AND CLIMATE ADAPTATION PLAN (2018), https://www.mass.gov/files/documents/2018/10/26/SHMCAPSeptember2018-Full-Plan-web.pdf.

[155] Examples include the Habitat Climate Change Vulnerability Index. *See Climate Change Vulnerability Index for Ecosystems and Habitats*, NATURESERVE, https://www.natureserve.org/products/climate-change-vulnerability-index-ecosystems-and-habitats (last visited Jan. 19, 2024).

[156] Examples of wetland assessment methods include Wisconsin's Wetlands and Watersheds Explorer Tool. *Wisconsin's Waters, Wetlands and Watersheds*, FRESHWATER NETWORK, https://maps.freshwaternetwork.org/wisconsin/ (last visited Jan. 19, 2024).

[157] 44 C.F.R. pt. 201; FED. EMERGENCY MGMT. AGENCY, FP 302-094-2, STATE MITIGATION PLANNING POLICY GUIDE (2022); FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON (2022).

and funding in place for the plan), particularly in the context of the National Flood Insurance Program (NFIP), must also be discussed.

Goals for reducing and avoiding long-term vulnerabilities to identified hazards are central to the mitigation strategy. The plan must describe how existing or future capabilities will support these goals. At the state level, an evaluation of laws, regulations, policies, and programs related to hazard mitigation, considering their impact on resilience to future events, including climate change effects, is required.

The mitigation strategy section must also include "an identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy."[158] Actions identified in the hazard mitigation plans must be linked directly to the state's risks, capabilities, and objectives.[159] For state plans, mitigation actions must also be linked to local plans, where specific local actions and projects are identified. The plan must describe criteria for prioritizing action implementation, define a timeframe, provide potential funding sources, make it clear how benefits are maximized relative to associated costs, and ensure environmental soundness and technical feasibility.

In ELI's 2021 review of 50 state hazard mitigation plans, we documented 177 nature-based actions in the plans, which they distilled into a range of strategies related to land conservation, restoration, green infrastructure, land use, and funding/programmatic efforts, policy and law, technical and informational, education and awareness, agency coordination, and partnership efforts.[160]

Involving Natural Resource Experts. Involving technical experts in the planning and implementation process can help fill information gaps, aiding in identifying and prioritizing viable nature-based mitigation actions. Hazard mitigation planners often do not have the experience with the analyses/studies necessary to assess natural infrastructure actions. Resource experts can be involved in identifying and prioritizing projects, including in siting and design. Moreover, experts from state agencies and/or regional NGOs can provide insight into watershed-scale priorities and help determine whether a given project will be

[158] 44 C.F.R. § 201.4 (Standard State Mitigation Plans). FEMA has characterized suggested mitigation actions into four types: (1) Local Planning and Regulations, (2) Structure and Infrastructure Projects, (3) Natural Systems Protection, and (4) Education and Awareness Programs. FED. EMERGENCY MGMT. AGENCY, MITIGATION IDEAS: A RESOURCE FOR REDUCING RISK TO NATURAL HAZARDS (2013).
[159] FED. EMERGENCY MGMT. AGENCY, MITIGATION IDEAS: A RESOURCE FOR REDUCING RISK TO NATURAL HAZARDS (2013).
[160] REBECCA KIHSLINGER ET AL., NATURE-BASED MITIGATION GOALS AND ACTIONS IN STATE AND TRIBAL HAZARD MITIGATION PLANS 5 (Env't L. Inst. 2021).

effective at a local scale in the context of the broader watershed (or whether the mitigation efforts needed to be effective would be at a larger scale).

While FEMA focuses on options providing the highest degree of risk reduction, natural resource experts can help identify and develop projects that provide these benefits while also providing other co-benefits such as improved air and water quality, preserved open spaces, lowered risk of combined sewer overflows and flooding, and positive impact to physical and mental health.[161] For example, the natural deposition of sediments from upstream or upland sources can enable marshes in deltas and estuaries to rebuild after storms and adapt to rising sea levels, making them more resilient against future flood risk.[162]

Figure 2: Number of Mitigation Actions by Category

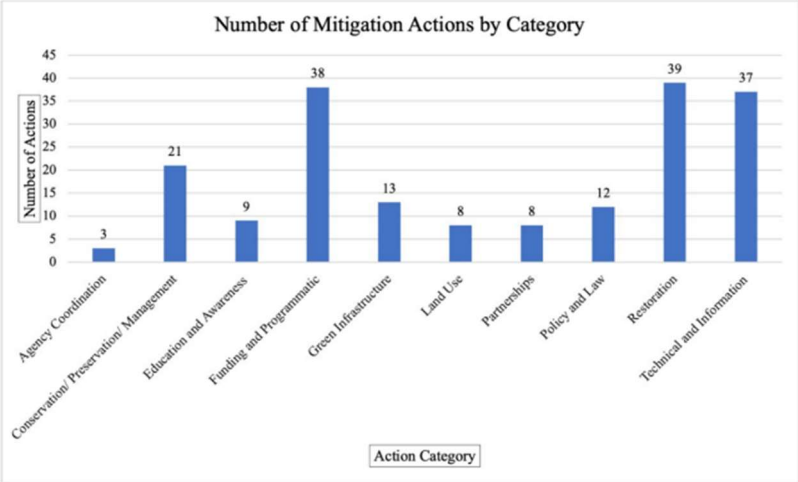


Figure 2. Source: REBECCA KIHSLINGER ET AL., NATURE-BASED MITIGATION GOALS AND ACTIONS IN STATE AND TRIBAL HAZARD MITIGATION PLANS 26 (Env't L. Inst. 2021).

Natural resource agencies, conservation groups, and watershed planners can also be instrumental in identifying other relevant plans that could be incorporated or that have identified specific projects that could provide hazard mitigation benefits. This coordination is important because it helps ensure a comprehensive mitigation strategy that not only addresses immediate risk reduction needs but also considers the long-term sustainability and ecological health of the affected areas. For instance, the New York Department of Environmental Conservation's Open Space Conservation Plan details evaluation and selection criteria that are used to determine spending priorities for the state's open space program.[163] This is an example of a local plan that includes conservation and restoration

[161] FED. EMERGENCY MGMT. AGENCY, BUILDING COMMUNITY RESILIENCE WITH NATURE-BASED SOLUTIONS: A GUIDE FOR LOCAL COMMUNITIES 11-13 (2021).
[162] ARSUM PATHAK ET AL., INCORPORATING NATURE-BASED SOLUTIONS INTO COMMUNITY CLIMATE ADAPTATION PLANNING 15 (Nat'l Wildlife Fed. 2022).
[163] *Id.* at 41.

goals, which can be leveraged by hazard mitigation planners when developing nature-based actions to include in the hazard mitigation plan.[164] These policies and plans can be informative for the development of nature-based actions that could be integrated into the hazard mitigation plan. They also bolster capacity for nature-based solutions because the nature-based project can build on/leverage an existing program.

As described above, the mitigation strategy section of the hazard mitigation plan must also include an analysis of capabilities to mitigate hazards and funding opportunities for hazard mitigation activities. This section can provide a way to catalog resources and existing capacity and an important opportunity to look for and find existing programs and resources that may have previously been unknown to hazard planners.

Plan Maintenance: Monitoring, Evaluation, and Updating

FEMA Requirements. In the final stage of the hazard mitigation planning process, FEMA requires a detailed description of the monitoring, evaluation, and updating methods required to ensure the ongoing effectiveness and relevance of the mitigation strategy.[165] As the plan is implemented, maintenance entails ensuring that stakeholders have the knowledge needed to perform tasks identified in the plan and are prepared to coordinate with others involved in implementing the plan.[166]

Monitoring is integral to tracking the plan's implementation over time, both before and after the execution of specific mitigation strategies to identify changes in hazard-prone areas and assess how these changes have impacted the vulnerability of assets. Ongoing monitoring and evaluation are important for plan updates (for state, local, and Tribal hazard mitigation plans) and for siting new projects.

Involving Natural Resource Experts. An often underappreciated (and underfunded) component of any natural infrastructure project is long-term maintenance and management. In fact, there are not yet any universally accepted and standardized approaches to monitoring the efficacy of nature-based solutions.[167] Monitoring, however, helps make the case for natural infrastructure projects: if the data suggests that they perform well in reducing risk and providing co-benefits, then there is a strong argument for implementing similar projects.

Given the uncertainties still remaining around use of NBS, there is a heightened emphasis on monitoring, evaluating, and subsequently updating existing projects and plans,

---

[164] *Id.*

[165] 44 C.F.R. pt. 201; FED. EMERGENCY MGMT. AGENCY, FP 302-094-2, STATE MITIGATION PLANNING POLICY GUIDE (2022); FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON (2022).

[166] *Lesson 5: Plan Implementation and Maintenance*, FED. EMERGENCY MGMT. AGENCY, https://emilms.fema.gov/is_0235c/groups/129.html (last visited Jan. 19, 2024).

[167] Prashant Kumar et al., *An Overview of Monitoring Methods for Assessing the Performance of Nature-Based Solutions Against Natural Hazards*, EARTH-SCIENCE REVIEWS, June 2021.

particularly compared to traditional grey infrastructure. Evaluation may also involve identifying knowledge gaps regarding the effectiveness of NBS in certain scenarios. Thorough monitoring and evaluation efforts contribute to a deeper understanding of the drivers and constraints of NBS implementation in specific areas, addressing gaps in knowledge regarding long-term versus immediate post-implementation effectiveness. This can contribute to a robust knowledge base offering evidence for the efficacy of NBS and presenting a persuasive case for wider adoption of NBS by others. Natural resource partners may provide necessary expertise or willingness to take-on these efforts, or at the very least, aid in identifying the cost of this component in the mitigation plan.

While they have not been universally accepted, NBS-specific indicators have been developed to measure the success of nature-based projects.[168] In one study that placed greater emphasis on the environmental co-benefits, the indicators included integrated environmental performance, health and well-being, transferability and monitoring, and citizen's involvement.[169] Another project focused on social co-benefits, using a social monitoring framework to quantify the project's impact on relationships with nature and well-being, psychosocial issues, and perceptions of safety and security.[170] The former project mostly utilized remote-sensing data, whereas the latter required a local monitoring team. These examples highlight the need for continuity in natural resource expertise, and the potential need for expanding capacity for monitoring nature-based solutions.

Natural resource partners can provide monitoring assistance, particularly for social and environmental co-benefits. Existing ground-based monitoring and assessment methodologies and remote-sensing tools provide useful opportunities to evaluate NBS.[171] Many state agencies have robust monitoring and assessment programs, and the U.S. EPA

---

[168] Nadja Kabisch et al., *Nature-Based Solutions to Climate Change Mitigation and Adaptation in Urban Areas: Perspectives on Indicators, Knowledge Gaps, Barriers, and Opportunities for Action*, ECOLOGY & SOC'Y, June 2016, at 3.

[169] *Id.* Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. While they are proposed by the authors in a climate change adaptation and mitigation context, they could also be used to evaluate how NBS differs from traditional grey infrastructure projects.

[170] Israa H. Mahmoud et al., *Setting the Social Monitoring Framework for Nature-Based Solutions Impact: Methodological Approach and Pre-Greening Measurements in the Case Study from CLEVER Cities Milan*, SUSTAINABILITY, Aug. 2021.

[171] Prashant Kumar et al., *An Overview of Monitoring Methods for Assessing the Performance of Nature-Based Solutions Against Natural Hazards*, EARTH-SCIENCE REVIEWS, June 2021. The U.S. EPA has established 3 levels of wetland monitoring: a landscape assessment, a rapid assessment, and an intensive site assessment. Landscape assessments rely on information typically gathered through remote sensing and stored as GIS data, a rapid assessment occurs at the regional scale of a watershed and uses various methods, and an intensive site assessment uses multi-metric indices such as the hydrogeomorphic approach or biological assessments to describe how well a wetland is functioning. The latter two levels require much greater capacity and research intensity than the former.

supports several of these efforts through regional monitoring and assessment groups in the Mid-Atlantic and Pacific Southwest. Both workgroups are comprised of state environmental agencies, university research centers, and NGOs. The SF Estuary Wetlands Regional Monitoring Program is another example of a ground-based monitoring and assessment group built on partnerships between NGOs, the U.S. EPA, NOAA Fisheries, the California Department of Fish and Wildlife, and others.[172]

2.2 Use of Natural Resource Prioritization Tools in the FEMA Planning Process

2.2.1 Why Use These Prioritization Tools?

Involving technical experts in the hazard mitigation planning and project implementation processes can be crucial for filing information gaps, helping to identify risks more fully, and aiding in the identification and prioritization of viable nature-based mitigation actions to address those risks. State wetland and natural resource agencies are a natural partner in this effort and have developed ways to assess and prioritize ecosystems.

Developed primarily for identifying and prioritizing wetland and stream protection and restoration projects, various natural resource tools and methodologies have been created by state and federal agencies (such as wetlands and natural resource agencies), nonprofits, and NGOs. These assessment tools identify high-priority areas for conservation and restoration by employing certain criteria, such as wildlife habitat, open space and recreation, water quality improvement, erosion control, and coastal conservation.[173] Although generally created to identify conservation opportunities in contexts other than hazard mitigation (e.g., water quality, compensatory mitigation, etc.), these tools can be used by practitioners and planners in a hazard mitigation context.

Several tools have been developed using GIS data to consider how various criteria overlap with wetlands and watersheds to allow planners to prioritize sites for restoration, conservation, and management on different scales. Each tool functions differently: some tools perform analysis to prioritize areas for conservation or restoration, while others provide outputs that serve as a basis for more analysis. Some tools have been developed for county-level use (e.g., the Lake County Wetland Restoration and Preservation Plan[174]) while

---

[172] *Collaborative Science for Healthy Wetlands*, SF ESTUARY WETLANDS REGIONAL MONITORING PROGRAM, https://www.wrmp.org/about/staff-and-leadership/ (last visited Jan. 31, 2024).

[173] JAMES MCELFISH ET AL., DEVELOPING WETLAND RESTORATION PRIORITIES FOR CLIMATE RISK REDUCTION AND RESILIENCE IN THE MARCO REGION (Env't L. Inst. 2016), https://www.eli.org/sites/default/files/files-pdf/Targeting-Conservation-and-Restoration-in-the-MARCO-Region-Final-Report-December-2016.Cover_.pdf.

[174] *Wetland Restoration & Preservation Plan (WRAPP) for Lake County, Illinois*, STORMWATER MGMT. COMM., https://www.lakecountyil.gov/2531/Wetland-Restoration-Preservation-Plan (last visited Jan. 31, 2024).

other tools have been developed for nationwide use (e.g, EPA's Recovery Potential Screening Tool[175] and the Rapid Benefits Indicator[176]).[177]

Insights gleaned from interviews with tool developers reveal a significant gap in their effectiveness in reaching the intended end-users (which, in some cases, are hazard planners). Thus, a generally untapped opportunity to reach these end users is to integrate these tools in the hazard planning process where they can help planners identify stakeholders and inform the risk assessment, vulnerability assessment, and mitigation strategy.

The Environmental Law Institute has identified a variety of restoration and prioritization tools across the country.[178] The table below shows a cross-section of these tools in the Mississippi River Basin. The following section will describe the capabilities of these tools and where each tool can be useful in the mitigation planning process.

[175] *Recovery Potential Screening Indicators: Social Indicators*, ENV'T PROT. AGENCY, https://www.epa.gov/rps/social-indicators#socio (last visited Jan. 19, 2024).
[176] *Rapid Benefits Indicators (RBI) Approach*, ENV'T PROT. AGENCY, https://www.epa.gov/water-research/rapid-benefit-indicators-rbi-approach (last visited Jan. 31, 2024).
[177] The scope of the tool is important for the scale of planning it can best support. Watershed and state level tools may be able to identify general areas for project siting while being unable to model more fine-grained and site-specific details. To be effective at the site scale, tools require data with high resolution, aggregated to a scale suitable for distinguishing variations within the designated management area. *See* Justin Bousquin & Kristen Hychka, *A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands – A Benefit Indicators Approach*, FRONTIERS IN ENV'T SCI., May 2019. Although this section will focus on the characteristics of each tool that could be integrated into the FEMA planning process rather than on the technical feasibility of each tool, it is still important to note that scale is an important feature of each tool.
[178] *Annotated Bibliography*, compiled for this report on file with the Environmental Law Institute.

2.2.2 Examples of Tools in the Mississippi River Basin (from county-level to national scale)

Tool	Developer	Region	Purpose
Lake County Wetland Restoration and Preservation Plan	Lake County Stormwater Management Commission (SMC), Lake County, Illinois	Lake County, Illinois	To identify and assess functional significance of existing and potentially restorable wetlands in Lake County, Illinois, to guide planning decisions and help with prioritization of wetland restoration and preservation efforts based on specific "wetland functions."
Wetlands by Design: A Watershed Approach	Wisconsin Department of Natural Resources, The Nature Conservancy in Wisconsin, and Conservation Strategies Group	Wisconsin	To provide prioritized choices for where to invest in both voluntary and regulatory wetland and watershed conservation.
Iowa Watershed Approach Information System (IWAIS)	Iowa Watershed Approach Homeland Security and Emergency Management (HSEMD), U.S. Army Corps of Engineers Rock Island District, and other Iowa Silver Jackets partners	Iowa	To identify areas that have the greatest Potential Of using a Watershed Approach to Reduce Flooding (POWAR F).
The Floodplain Prioritization Tool	The Nature Conservancy	Mississippi River Basin	To help federal, state, and local governments, county planners, land trusts, businesses, and citizens optimize their investments in floodplain restoration or conservation.

EPA Recovery Potential Screening Methodology and Tool	EPA Office of Water	Nationwide	To identify differences among 12-digit Hydrologic Unit subwatersheds (HUC12s) that may influence their relative likelihood to be successfully restored, protected, or managed in other ways.
Geospatial Assessment of Flood Vulnerability Reduction (Rapid Benefits Indicator)	Justin Bousquin (Gulf Ecology Division, National Health and Environmental Effects Laboratory, U.S. Environmental Protection Agency) and Kristen Hychka (University of Maryland Center for Environmental Science)	Nationwide	To develop a nationally consistent dataset and demonstrate how this dataset can be used at different scales (regional or local) to rapidly assess flood reduction benefits.

2.2.3 Embedding Tools in the FEMA Planning Process

Planning Process: Ensuring Meaningful Participation

Identifying and meaningfully engaging stakeholders is an important part of the FEMA planning process. Mitigation planners often struggle to attract community groups and the public to attend meetings or participate in the process. Although not a primary purpose of prioritization tools, several of these methodologies incorporate social indices that can be used to help target outreach to vulnerable groups and specific communities. For example, the EPA Recovery Potential Screening Tool offers the option of comparing the restoration potential of watersheds by social indicator (examples of indicators include "watershed collaboration rating," "count of active watershed groups," "population," "average per capita income in watershed," and "aggregated socio-economic index in watershed").[179] The tool allows local watershed planners to quantify the local organizational engagement (that is, "the number of groups active in water quality restoration and protection in the watershed, or the magnitude of activity of such groups") based on metrics such as count of active watershed groups, the level of collaboration among stakeholder organizations in the

[179] *Overview: Selecting and Using Recovery Potential Indicators*, ENV'T PROT. AGENCY, https://www.epa.gov/rps/overview-selecting-and-using-recovery-potential-indicators (last visited Jan. 19, 2024); *Recovery Potential Screening Indicators: Social Indicators*, ENV'T PROT. AGENCY, https://www.epa.gov/rps/social-indicators#socio (last visited Jan. 19, 2024).

watershed based on a watershed collaboration rating, government agency involvement in restoration and protection projects, participation in land conservation programs, large watershed management potential, university proximity, decision-maker support, percent of protected land, and applicable regulation, among others.[180]

While these organizations and groups may provide insight into vulnerable populations whose voices should be included in the planning process, tools that incorporate a Social Vulnerability Index can further identify areas that should be prioritized, allow for targeted outreach to community leaders in these areas prioritized for mitigation planning, and provide information on the vulnerability of individual jurisdictions that can then be described in the risk assessment. Importantly, these tools should only provide a starting point for ground-truthing the data with on-the-ground assessments.

Risk Assessment: Identifying Risks and Vulnerabilities

As described above, the risk assessment examines the hazards faced by jurisdictions and the vulnerability assessment then determines likelihood, areal extent, and the impact on the community.[181]

Landscape prioritization tools can help to identify ecosystems at risk and the benefits that may be lost when these ecosystems are impacted. For example, the Bear River Watershed Wetland Conservation and Prioritization Tool prioritizes wetlands that are "riparian wetlands adjacent to perennial streams in impaired catchments," and specifically where these wetlands overlap with critical habitat for federally threatened, endangered, and Utah-sensitive species.[182] Another example is the Recovery Potential Screening (RPS) Tool, created by the Office of Water at the U.S. EPA for nationwide use, which allows users to screen by a set of ecological and social stressors. For example, a planning team may decide to screen by "% Wetlands" and "Soil Resilience" to determine where social vulnerability overlaps with ecosystems at risk.[183]

Some landscape prioritization tools frame prioritization directly in terms of the risk that will result from a failure to restore or conserve the natural functions of an ecosystem. One example is the South Platte Natural Capital Assessment. This assessment determined the top potential hazards for the South Platte region of Colorado and then demonstrated the

---

[180] *Id.*

[181] *See Overview of Risk and Hazard Vulnerability Assessments*, FED. EMERGENCY MGMT. AGENCY, https://emilms.fema.gov/is_0559/groups/17.html (last visited Jan. 19, 2024).

[182] RHYAN SEMPLER & DIANE MENUZ, PRIORITIZING WETLANDS FOR CONSERVATION IN THE UPPER BEAR RIVER WATERSHED 6 (2016) https://ugspub.nr.utah.gov/publications/non_lib_pubs/contract_deliverables/WCD-11.pdf.

[183] *Overview: Selecting and Using Recovery Potential Indicators*, ENV'T PROT. AGENCY, https://www.epa.gov/rps/overview-selecting-and-using-recovery-potential-indicators (last visited Jan. 19, 2024); *Recovery Potential Screening Indicators: Social Indicators*, ENV'T PROT. AGENCY, https://www.epa.gov/rps/social-indicators#socio (last visited Jan. 19, 2024).

possibility of loss or harm from the natural hazard by combining the probability of the hazard occurring with the potential impacts if the hazard did occur.[184]

FEMA's BCA considers the risk reduction benefits provided by a project. This entails considering the value of assets being protected by the mitigation project. In the FEMA BCA context, benefits to people are proxied by avoided human injury/loss of life, avoided displacement costs, avoided emergency management costs, and social benefits including avoided mental stress/anxiety and lost productivity.[185] For example, if the hazard was flooding, the number of individuals downstream presently vulnerable to flooding reflects how much of the population will benefit.[186] EPA's Rapid Benefits Indicator is one example of a tool that can consider how many people benefit from and by how much people would benefit from site restoration that reduced flood reduction.[187]

Several existing tools also describe where and how natural hazards intersect with social vulnerability and provide an initial screening for the most at-risk assets. Vulnerability screening indices can allow planners to identify where the highest level of risk intersects with the most vulnerable populations to prioritize certain mitigation actions in hazard planning.[188] For hazard mitigation plans, these tools can provide evidence for the scale and location of potential sites for NBS and also aid in profiling vulnerabilities in the risk assessment.[189] In particular, for updates to state, local, and Tribal hazard mitigation plans, the tools can show where vulnerable populations may have shifted or expanded since the last update.

Some, like The Iowa Watershed Approach Information System,[190] the Floodplain Prioritization Tool, and the Rapid Benefits Indicator, integrate the Social Vulnerability Index in their analyses. The Social Vulnerability Index (SoVI) uses census demographic

---

[184] *South Platte Natural Capital Project*, ENV'T PROT. AGENCY, https://www.epa.gov/urbanwaterspartners/south-platte-natural-capital-project (last visited Jan. 19, 2024).
[185] *C.1. Key Elements of the Benefit-Cost Ratio*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/guide/part-5/c/1 (last visited Dec. 12, 2023).
[186] Justin Bousquin & Kristen Hychka, *A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands – A Benefit Indicators Approach*, FRONTIERS IN ENV'T SCI., May 2019.
[187] *Id.* (providing examples).
[188] *Id.*
[189] FED. EMERGENCY MGMT. AGENCY, STATE MITIGATION PLANNING KEY TOPICS BULLETIN: MITIGATION STRATEGY (2022), https://www.fema.gov/sites/default/files/documents/fema_state-mitigation-planning-key-topics-bulletin-mitigation-strategy_2022.pdf.
[190] The Iowa Watershed Approach Information System (IWAIS) is an interactive data visualization platform designed to support and inform decisions related to strategic best management practice (BMP) implementation and the development of community flood resilience. IWAIS is specifically designed for the watersheds and communities participating in the Iowa Watershed Approach project funded by the U.S. Department of Housing and Urban Development. This platform helps the IWA achieve its goals focused on reducing flood risk, improving water quality, increasing flood resilience, and engaging stakeholders through outreach and education. IOWA WATERSHED APPROACH INFORMATION SYSTEM, https://iwa.iowawis.org/about.php (last visited Dec. 21, 2023).

data, often available at the census tract level, to characterize socio-economically vulnerable populations to environmental hazards using thirty-nine socioeconomic variables.[191] The index visually highlights geographic variations in social vulnerability, identifying areas with uneven capacity for preparedness and response. SoVI maps are available for all target watersheds as a useful tool to identify areas with high levels of social vulnerability, particularly at the intersections of flood risk.[192] This tool equates high SoVI with lower resilience to inform the prioritization of mitigation actions.[193] The Floodplain Prioritization Tool includes SoVI along with other indicators of present and potential vulnerability.[194] The tool includes layers for current population exposure to flood risks and projections for future population exposure to flood risks in 2050, as well as a layer on the potential flood damage to structures in each scenario.[195] The future layers could help fulfill FEMA's stipulation for assessing the future impact of hazards on assets. The Rapid Benefits Indicator, like the Iowa Watershed Approach, uses SoVI to identify assets that are most socio-economically vulnerable to flood risk and may require more assistance to build resilience because they have fewer resources to recover from flooding and other natural hazards.[196]

The Rapid-Benefits Indicator also uses another screening tool -- the Climate Resilience Screening Index (CRSI) -- to initially screen for vulnerable populations. The CRSI examines climate resilience at the county level and is scalable both upward and downward.[197] The index represents both the vulnerability of the entity to multiple climate events and the potential recoverability of these entities from climate events.[198] The Rapid-Benefits Indicator uses both SoVI and CRSI because CRSI includes domains more focused on how populations interact with the built environment (with indicators like infrastructure,

---

[191] *Social Vulnerability Index for the United States – 2010-14 and 2019 Indexes*, UNIV. S. CAROLINA COLLEGE OF ARTS AND SCIENCES, https://www.sc.edu/study/colleges_schools/artsandsciences/centers_and_institutes/hvri/data_and_resources/sovi/index.php (last visited Dec. 20, 2023); Susan L. Cutter & Christina Finch, *Temporal and Spatial Changes in Social Vulnerability to Natural Hazards*, 105(7) PROCEEDINGS OF THE NAT'L ACAD. OF SCIS. 2301 (2008); Justin Bousquin & Kristen Hychka, *A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands – A Benefit Indicators Approach*, FRONTIERS IN ENV'T SCI., May 2019.

[192] IOWA WATERSHED APPROACH INFORMATION SYSTEM, https://iwa.iowawis.org/about.php (last visited Dec. 21, 2023).

[193] *Id.*

[194] *Floodplain Prioritization Tool*, FRESHWATER NETWORK, https://freshwaternetwork.org/innovative-tools/floodplain-prioritization-tool/ (last visited Dec. 21, 2023).

[195] *Id.*

[196] Justin Bousquin & Kristen Hychka, *A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands – A Benefit Indicators Approach*, FRONTIERS IN ENV'T SCI., May 2019.

[197] ENV'T PROT. AGENCY, EPA600/R-17/238, DEVELOPMENT OF A CLIMATE RESILIENCE SCREENING INDEX (CRSI): AN ASSESSMENT OF RESILIENCE TO ACUTE METEOROLOGICAL EVENTS AND SELECTED NATURAL HAZARDS (2017).

[198] *Id.*

community preparedness, extent of ecosystem types, exposure, and loss) whereas SoVI is focused solely on demographic indicators and incorporates many more than CRSI.[199]

Mitigation Strategy: Coordination and Capacity

The capabilities section of the mitigation strategy is a real opportunity for states to identify the kind of natural resource programs and capacity that could be tapped to aid in the identification and implementation of nature-based projects. Equally important is the identification of possible funding sources for these projects. In addition to existing natural resource plans and funding programs, this section could include a review of available natural resource prioritization tools that could inform the analysis of risk and the identification of mitigation projects. Including these tools in the hazard mitigation plan could give their use more credibility among local decision-makers, and as part of the core planning team, natural resource experts can also help to ensure local governments have the capacity necessary to use them for assessing risks and identifying projects.

In the FEMA planning process, the capabilities section requires local, state, and Tribal planners to list the capacities that will allow for the implementation of the described plan or project. However, when planning for nature-based projects, a community's *need* for NBS and its *capacity* for implementing these projects do not always overlap geographically, and it is important to ensure that there is sufficient capacity at the local level for actually implementing and maintaining the NBS (*see more on local capacity building for natural infrastructure planning in Section* 3). Some existing tools may be able to provide useful information about where capacity building is needed. The Recovery Potential Screening Tool, for example, includes social context indicators such as government agency involvement, university proximity, and watershed management potential that are all important factors to consider in developing a mitigation strategy.[200] This can provide a baseline understanding the capacity of an area and can identify any gaps upfront that can be filled by building partnerships.

Siting Projects and Identifying Specific Mitigation Actions

For most tools, the primary benefit of their use in the hazard mitigation context is the identification and prioritization of potential areas in the watershed where conservation or restoration of wetlands or streams would provide mitigation benefits. Although most of the current tools do not identify specific project sites or projects, their results can support the development of actions that can address future flood risk and that can be included in the mitigation strategy section of the hazard mitigation plan.

---

[199] *Id.*; *Social Vulnerability Index for the United States – 2010-14 and 2019 Indexes*, UNIV. S. CAROLINA COLLEGE OF ARTS AND SCIENCES, https://www.sc.edu/study/colleges_schools/artsandsciences/centers_and_institutes/hvri/data_and_resources/sovi/index.php (last visited Dec. 20, 2023).

[200] *Recovery Potential Screening Indicators: Social Indicators*, ENV'T PROT. AGENCY, https://www.epa.gov/rps/social-indicators#socio (last visited Jan. 19, 2024).

The Nature Conservancy describes how large flood hazard mitigation projects may require complex modeling to quantify risk reduction. While initial project concepts can leverage data made available through FEMA, USACE, or other federal datasets, engineers are recommended for models being developed for FMA or HMPGP.[201] Depending on the scale of the study, larger watersheds or regional analyses for these models can cost between $100,000 and $300,0000. It is important to have a full picture of a watershed to recognize where a NBS project will be best sited, even if this means in a different jurisdiction upstream. Thus, natural resource prioritization tools that integrate existing wetland assessment and monitoring data in a way that prioritizes sites for planning could lower the cost of analysis needed to site and plan a nature-based project.

Furthermore, having a "broad picture" scope of why a project is best suited in a particular location can be useful for hazard mitigation planning. In Kentucky, the U.S. Army Corps of Engineers used NCLS Land Cover, LiDAR images, wetland inventory, and other available GIS datasets to create a tool to identify areas where green infrastructure and open space implementation could be used.[202] The tool is intended to inform updates to the State Hazard Mitigation Plan by providing a broad picture scope for green infrastructure planning without requiring new analyses every few years.[203]

One example of a tool that identifies prioritized areas is Wetlands by Design, developed by The Nature Conservancy. The tool identifies former (potentially restorable) wetlands in Wisconsin that have the potential to provide vital services, such as flood reduction and public safety. This approach not only considers the areal extent of lost/destroyed wetlands but also evaluates associated ecosystem services, including flood abatement and water quality protection. The tool includes watershed-scale assessments for flood abatement, fish and aquatic habitat, sediment reduction, nutrient transformation, and surface water supply and considers factors such as the opportunity for service provision, effectiveness, and significance to neighboring communities. For instance, a site surrounded by steep slopes has the opportunity for flood abatement, and if situated above flood-prone areas, it can provide significant flood reduction benefits to downstream communities.[204] This approach allows county planners to identify optimal locations for protecting and restoring wetlands that can aid in water storage and flood control in areas prone to damaging floods.[205] The Floodplain Prioritization Tool, created by the Nature Conservancy for use in the Mississippi River Basin, also identifies areas for optimizing investment in floodplain

---

[201] THE NATURE CONSERVANCY, PROMOTING NATURE-BASED HAZARD MITIGATION THROUGH FEMA MITIGATION GRANTS 40 (2021), https://www.nature.org/content/dam/tnc/nature/en/documents/Promoting-Nature-Based-Hazard-Mitigation-Through-FEMA-Mitigation-Grants-05-10-2021-LR.pdf.
[202] U.S. ARMY CORPS OF ENG'RS, KENTUCKY GREEN INFRASTRUCTURE & OPEN SPACE ANALYSIS FACT SHEET (2021), https://www.lrl.usace.army.mil/Portals/64/docs/Projects/FactSheets/KY_Green.pdf.
[203] *Id.*
[204] WIS. DEP'T OF NAT. RES. & THE NATURE CONSERVANCY, WETLANDS BY DESIGN: A WATERSHED APPROACH FOR WISCONSIN 8 (2017), https://freshwaternetwork.org/projects/wetlands-by-design/.
[205] *Id.* at 27.

restoration and conservation and can do so on a regional scale.[206] The Rapid-Benefits Indicator tool, created by EPA for nationwide use, also identifies areas where there is an overlap between flood-prone population and wetland restoration potential on a national scale.

The Recovery Potential Screening (RPS) Tool has been used in several statewide watershed assessments for priority setting in the Mississippi River Basin, including in North Dakota, Kansas, Louisiana, Tennessee, and Kentucky.[207] One version of the RPS tool is the Watershed Index Online (WSIO) Tool, which has been adapted from the RPS tool code and allows users anywhere in the U.S. to define an interstate project area and compare watersheds in rank-ordered tables, graphs, and maps. While WSIO has not been utilized for a watershed analysis of the Mississippi Basin, it has been used on multi-state and national scales.[208]

The FEMA planning process requires a description of how the mitigation project will result in risk reduction as well as how benefits are maximized relative to associated costs. The Iowa Watershed Approach Information System uses annualized expected flood loss estimates for cities to illustrate how much or how likely watershed approach practices upstream could reduce future flood losses in those cities.[209] The Iowa Watershed Approach Information System also describes how the flood reduction benefits of using nature-based or watershed approach solutions would be maximized at each potential site.[210] The "POWAR F" ratio is used to identify areas with the greatest potential to reduce downstream flood losses.[211] This tool calculates a ratio that describes money lost from potential flooding divided by the upstream watershed area. The area upstream is determined using another tool, EPA's WATERS Geoviewer (where a user can click on a certain point and find the area upstream).[212] The smaller the watershed above a flood impact area, the fewer watershed approach practices are needed to realize a reduction in flood levels. The greater the estimated dollar damage at the flood impact area, the more opportunity there is for

---

[206] *Floodplain Prioritization Tool*, FRESHWATER NETWORK, https://freshwaternetwork.org/innovative-tools/floodplain-prioritization-tool/ (last visited Dec. 21, 2023).
[207] *RPS Training and User Support*, ENV'T PROT. AGENCY, https://www.epa.gov/rps/rps-training-and-user-support (last visited Jan. 19, 2024).
[208] *See* Peter C. Van Metre et al., *Prioritizing River Basins for Intensive Monitoring and Assessment by the U.S. Geological Survey*, ENV'T MONITORING AND ASSESSMENT, June 2020 (providing an example).
[209] IOWA WATERSHED APPROACH INFORMATION SYSTEM, https://iwa.iowawis.org/about.php (last visited Dec. 21, 2023).
[210] *Id.*
[211] POWAR-F is an acronym for "Potential Of using a Watershed Approach to Reduce Floods" and is a ratio equal to "$ loss from potential flooding/Watershed Area (acres)." *See Iowa Watershed Approach*, IOWA HOMELAND SECURITY & EMERGENCY MGMT., https://homelandsecurity.iowa.gov/iowa-watershed-approach/ (last visited Jan. 30, 2024).
[212] *WATERS GeoViewer Description*, ENV'T PROT. AGENCY, https://www.epa.gov/waterdata/waters-geoviewer (last visited Jan. 19, 2024).

reducing potential dollar losses from building loss, content loss, and inventory loss.[213] Areas with the highest ratio identify areas where watershed approach practices (i.e., nature-based solutions) upstream would reduce future flood losses in the project area.

For nature-based solutions, the ratio of benefits to risk reduction and potential benefits to ecosystems are often undervalued by hazard mitigation planners.[214] Landscape prioritization tools can aid in better capturing these benefits and including them in the FEMA mitigation planning process. The Rapid-Benefits Indicator is a beneficiary-centric, non-monetary way to capture benefits to people from wetland restoration or protection efforts. The tool quantifies the number of people downstream who are currently exposed to flooding and may experience flood reduction benefits after site restoration to indicate how many people benefit.[215] The tool also looks at service scarcity to determine by how much people benefit from a potentially restored site: where there are fewer substitute sources of flood reduction services, the value of flood reduction services is greater.[216]

Looking to previous examples of successful nature-based mitigation projects or strategies is also important for planning, given that nature-based solutions are used less frequently than grey infrastructure in a hazard planning context. The Iowa Watershed Approach also includes best management practice mapping.[217] The mapping gathers baseline information on existing BMPs in watersheds and across Iowa to establish baseline conditions and assist with planning and implementation efforts. While the risk reduction of NBS is highly situational, there are also databases of projects that have incorporated NBS such as NOAA's Green Infrastructure Effectiveness Database and FEMA's Innovative Drought and Flood Mitigation Projects. These can provide examples for determining the best mitigation action.

As noted previously, most of the tools we describe here primarily identify areas for NBS, but do not identify site-specific projects. Once specific sites are identified, they will still need development and engineering (which requires capacity-building). Therefore, tools need to be used in combination with engineers and natural resource experts, reinforcing the need to include those experts early in the planning process.

Monitoring, Evaluation, and Updating

Plan maintenance closes the loop in the FEMA hazard mitigation planning process and involves the process for monitoring, evaluating, and updating the plan. For NBS, monitoring and evaluation is critical to both 1) showcase the legitimacy of such projects in reducing risk and creating environmental, social, and economic co-benefits and 2) to inform new

---

[213] *Iowa Watershed Approach*, IOWA HOMELAND SECURITY & EMERGENCY MGMT., https://homelandsecurity.iowa.gov/iowa-watershed-approach/ (last visited Jan. 30, 2024).
[214] Justin Bousquin & Kristen Hychka, *A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands – A Benefit Indicators Approach*, FRONTIERS IN ENV'T SCI., May 2019.
[215] *Id.*
[216] *Id.*
[217] IOWA WATERSHED APPROACH INFORMATION SYSTEM, https://iwa.iowawis.org/about.php (last visited Dec. 21, 2023).

mitigation planning. Demonstrating the risk reduction and other benefits that NBS can provide provides evidence for other communities to implement these kinds of projects.

Many of the landscape prioritization and restoration tools are best integrated at earlier stages of the planning process (e.g., in risk assessment and project identification). However, natural resource agencies and organizations have developed other methodologies that can be useful for monitoring NBS. For example, EPA has developed various monitoring and assessment methodologies for a watershed approach that could be applied to the monitoring of nature-based projects.

2.3 Takeaways from ELI's 2023 Workshop on Opportunities for Integrating Natural Resource Expertise into the Hazard Mitigation Planning Process

The Environmental Law Institute recently facilitated a workshop that convened experts and professionals from natural resource agencies, FEMA, state and local emergency management agencies, and NGOs to discuss how to integrate existing landscape prioritization tools and methodologies created by natural resource professionals into the FEMA hazard mitigation planning process. The goal was to help state and Tribal wetlands programs increase their access to opportunities for restoration and protection by building priorities into state and local hazard mitigation plans.

One central focus of the discussion was to better understand how landscape prioritization tools can be integrated into hazard mitigation planning and project development at various scales (e.g., the watershed scale and the project or site scale). As discussed above, this issue of scale presents a challenge when identifying and designing nature-based solutions as the watershed is often the most appropriate scale for planning but project development requires an understanding of site-specific details. The workshop also included discussions on building capacity at the local government and how to scale up the formation of partnerships among wetland and hazard mitigation agencies and organizations.

This section describes some of the takeaways from the workshop. We detail the challenges and priority action items identified for using landscape prioritization tools in the hazard mitigation planning process at the site-specific and watershed scale to scale up NBS use.

2.3.1 Site-Scale Challenges

Participants discussed several site-scale challenges, ranging from funding and data limitations to lexicon-differences between hazard planners and natural resource experts.

Funding limitations

- Benefit-Cost Analysis (BCA)/Benefit-Cost Ratio (BCR)

As described above, calculating the BCA remains a challenge for scaling up the use of NBS. Many workshop participants suggested that natural resource prioritization tools could be modified to include criteria and outputs that could be useful in the BCA. Examples of BCA

criteria include the initial project costs, number of maintenance years and annual maintenance costs, total mitigation project cost, damages ($) before mitigation, and expected damages ($) after mitigation.[218]

- Other funding sources

While FEMA's HMA grants can be one potential funding opportunity for the restoration and protection of critical natural infrastructure, there are also other public and private sources of funding. However, each funding source will have limitations. For example, one participant noted that EPA Wetland Programs fund broad watershed assessments, but not as many site-specific projects.

Table 2: Examples of Other Federal Funding Opportunities	
Agency	Grant Programs
Housing and Urban Development (HUD)	Community Development Block Grant (CDBG) Program[219]
Housing and Urban Development (HUD)	Indian Community Development Block Grant (ICDBG) Program[220]
Housing and Urban Development (HUD)	Community Development Block Grant Disaster Recovery and Mitigation Program[221]
Environmental Protection Agency (EPA)	Healthy Watersheds Consortium Grants (HWCG)[222]
Department of Agriculture (USDA)	Natural Resources Conservation Service's Emergency Watershed Protection (EMP) Program[223]

[218] *CDBG-MIT Webinar Series*, HUD EXCHANGE, https://www.hudexchange.info/trainings/cdbg-mit-webinars/ (last visited Jan. 22, 2024).
[219] *Community Development Block Grant*, HUD EXCHANGE, https://www.hudexchange.info/programs/cdbg/ (last visited Jan. 30, 2024).
[220] *Indian Community Development Block Grant Program*, HUD EXCHANGE, https://www.hud.gov/program_offices/public_indian_housing/ih/grants/icdbg (last visited Jan. 30, 2024).
[221] *Community Development Blok Grant Disaster Recovery Grant Funds*, HUD EXCHANGE, https://www.hud.gov/program_offices/comm_planning/cdbg-dr (last visited Jan. 30, 2024).
[222] *Healthy Watersheds Consortium Grants (HWCG)*, ENV'T PROT. AGENCY, https://www.epa.gov/hwp/healthy-watersheds-consortium-grants-hwcg (last visited Jan. 30, 2024).
[223] *Emergency Watershed Protection*, NAT'L RES. CONSERVATION SERV., https://www.nrcs.usda.gov/programs-initiatives/ewp-emergency-watershed-protection (last visited Jan. 30, 2024).

Department of Agriculture (USDA)	Natural Resource Conservation Service's Conservation Stewardship Program (CSP)[224]
Department of Agriculture (USDA)	Natural Resource Conservation Service's Regional Conservation Partnership Program (RCPP)[225]

Language barriers

FEMA, EPA, natural resource experts, and communities may use different definitions of flooding and floodplain as well as different standards for defining flood risk. For example, FEMA defines floodplain as "any land area susceptible to being inundated by floodwaters from any source"[226] and maps flood zones based on areas that have a 1% annual chance of flooding.[227] This is notably different than the EPA definition(s) of floodplain, which are more tied to hydrology: "the land adjacent to the baseflow channel residing below bankfull elevation"[228] and "the term 'floodplain' shall mean the lowland and relatively flat areas adjoining inland and coastal waters."[229]

Design goals may also differ among natural resource and emergency management agencies – with hazard mitigation agencies designing sites to move water quickly away while natural resource agencies may design sites to hold water.

Data limitations at the site level

- Limited site-level modeling potential from watershed-level prioritization tools

Watershed-level prioritization tools can identify general areas for project siting but may not be able to model more fine-grained and site-specific details. Large-scale prioritization tools often draw from national data sets like the National Wetlands Inventory (NWI)[230] and

[224] *Conservation Stewardship Program*, NAT'L RES. CONSERVATION SERV., https://www.nrcs.usda.gov/programs-initiatives/csp-conservation-stewardship-program (last visited Jan. 30, 2024).
[225] *Regional Conservation Partnership Program*, NAT'L RES. CONSERVATION SERV., https://www.nrcs.usda.gov/programs-initiatives/rcpp-regional-conservation-partnership-program (last visited Jan. 30, 2024).
[226] *Glossary*, FED. EMERGENCY MGMT. AGENCY & NAT'L FLOOD INS. PROGRAM, https://www.floodsmart.gov/definitions#F (last visited Jan. 19, 2024).
[227] *Flood Maps*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/flood-maps (last visited Jan. 23, 2024).
[228] *Watershed Academy Web: Stream Corridor Structure*, ENV'T PROT. AGENCY, https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=637 (last visited Jan. 19, 2024).
[229] Exec. Order No. 11,988, 42 Fed. Reg. 26951 (May 24, 1977) (Floodplain Management).
[230] *National Wetlands Inventory*, U.S. FISH AND WILDLIFE AGENCY, https://www.fws.gov/program/national-wetlands-inventory (last visited Jan. 31, 2024)

are most commonly designed to function at a larger grain.[231] To be effective at the site scale, tools require data with high resolution, aggregated to a scale suitable for distinguishing variations within the designated management area.[232]

- Lack of riparian corridor data that shows areas of *past* wetlands, particularly in the Western U.S.

Multiple participants agreed that a significant data limitation is that many projects aimed at *restoration* are using tools that identify areas of existing wetlands or riparian areas. To identify opportunities for restoration, tools need to include areas that are not currently riparian but *used* to be. Given that many datasets only show *current* wetlands, it is difficult to get the full picture for restoration potential without considering previous flow patterns and how riparian corridors have shifted. One notable exception to this is Wisconsin's Wetlands by Design: A Watershed Approach, which has a layer for potentially restorable wetlands.[233]

Limitations to use of natural resource prioritization tools in the planning process

As discussed above, prioritization tools can aid in some elements of conducting a risk assessment and developing a mitigation strategy. Following FEMA's stages of plan development, a project plan needs expertise for assessing and summarizing vulnerability and helping to determine critical stakeholders, assessing a community's capabilities, developing mitigation goals, and evaluating potential mitigation actions that line up with a community's capabilities. While prioritization tools can provide a useful starting point for such an analysis, these next steps require additional capacity.

Furthermore, FEMA grant staff need to know how to use these tools to 1) make sense of the data in applications *and trust it*, and 2) be able to recommend it as a resource for those using FEMA BRIC Direct Technical Assistance, FEMA BRIC project scoping, Hazard Mitigation Grant Program (HMGP) Project Assistance, etc.

Embedding NBS before engineers are contracted

One potential challenge discussed was the fact that NBS projects need to be identified or embedded in a site-level project *before* the engineers begin to work out a plan to avoid planners defaulting to brick-and-mortar strategies. From a municipal planning perspective, using a tool to identify the best place for an ecosystem service project to be located can

---

[231] Participant from a State Water Quality Division, contribution to "Wetlands and Hazard Mitigation: Opportunities for Integration" workshop held by the Environmental Law Institute (Oct. 31 & Nov. 1, 2023); *National Wetlands Inventory*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/program/national-wetlands-inventory (last visited Jan. 30, 2024).

[232] Justin Bousquin & Kristen Hychka, *A Geospatial Assessment of Flood Vulnerability Reduction by Freshwater Wetlands – A Benefit Indicators Approach*, FRONTIERS IN ENV'T SCI., May 2019.

[233] WIS. DEP'T OF NAT. RES. & THE NATURE CONSERVANCY, WETLANDS BY DESIGN: A WATERSHED APPROACH FOR WISCONSIN 8 (2017), https://freshwaternetwork.org/projects/wetlands-by-design/.

help planners to visualize how projects that center restoration can aid in risk reduction. Once priority areas are identified (based on potential to provide ecosystem services or other criteria identified in prioritization tools), then the next step can be co-layering other benefits and bringing in engineers.

FEMA funding favors grey infrastructure solutions

One FEMA participant noted that favoring the use of restoration and NBS requires a very mindful and innovative planning process. However, planning grants are not generally large enough to hire a plan developer to lead a planning effort that meaningfully integrates natural infrastructure. Additionally, the FEMA funding structure was designed for the built environment and public safety—not explicitly wetlands restoration. Thus, ecosystem services, in this traditional structure, are seen as only ancillary benefits.

2.3.2 Site-Scale "Action Item" Priorities

Workshop participants identified various action items that could be implemented to scale up site-scale nature-based projects.

Prioritizing siting and planning for nature-based projects based on impact and avoiding co-benefit "box-ticking"

There are multiple approaches to integrating nature-based projects into a mitigation strategy. One approach involves incorporating natural infrastructure elements into grey infrastructure projects, while another involves initiating a comprehensive nature-based project from the start. Although both methods are valid, the first may be the only feasible option in certain situations. However, it is crucial to emphasize that NBS should not be treated merely as a checkbox in funding applications.

A State Hazard Mitigation Officer proposed a policy to create a funding mechanism for Green Infrastructure projects. The policy would involve creating a restoration market, where planned grey infrastructure projects that will disrupt the environment can offset their impacts by restoring wetlands or floodplains on properties that have been previously acquired through buyouts by FEMA and the state. By siting restoration projects on properties where they could contribute most efficiently and functionally to the identified goals of a given jurisdiction, the NBS may be more effective and cost-effective for that community than co-locating nature-based benefits on a planned grey infrastructure site. This policy envisions a cradle-to-grave approach for the land that has been acquired through a FEMA buyout: when an infrastructure project is planned, offset funding goes into the restoration of the buyout properties to create a cost-effective, impactful, and sustainable natural infrastructure strategy.

Facilitating "sister cities" initiatives with upstream and downstream cities

One participant recommended that more cities could develop partnerships along shared natural resources to facilitate coordinated, effective adoption of natural infrastructure. For example, Montgomery County and Prince George's County in Maryland have collaborated

to manage the Anacostia Watershed. Since 2006, the Anacostia Watershed Restoration Partnership has facilitated many nature-based projects along the Anacostia River focused on stream restoration, trash reduction, impervious surface treatment, wetland restoration, and reduction of suspended sediments under the leadership of a steering committee with representation from the U.S. Army Corps of Engineers and state and county environmental professionals from Montgomery County, Prince George's County, and the District of Columbia.[234] The steering committee and the U.S. Army Corps of Engineers partners help to coordinate and prioritize goals for this watershed-scale project that involves multiple cities.

Another large-scale example of river-based collaboration is the Mississippi River Cities and Towns Initiative's Disaster Resilience and Adaptation Program.[235] The program engaged with FEMA to create a multi-state Pre-Disaster Mitigation Grant (PDM) option, which MCRTI funds at a rate of $100 million or greater annually. The program also worked with ten states in the Mississippi River corridor to complete a multi-state disaster vulnerability assessment that can be aggregated at the corridor level and builds the mitigation and response capabilities of the states in the Basin.

Opportunities for tools to help local jurisdictions compile data for BCA

For NBS to be centered in a project, rather than just ancillary, multiple FEMA employees noted that their risk reduction capabilities must be quantified. This is not a function of most landscape prioritization tools. While many agreed that *more* tools are not necessarily the solution to integrating NBS into the hazard mitigation planning process, this may be one area where there is a gap between an existing tool's outputs and their applicability to hazard mitigation funding attainment.

Addressing the information gap between people who create the tools and its intended users

Several participants emphasized the importance of developing prioritization and restoration tools with ongoing input from the intended end-users. When a tool is expected to have diverse end-users, participants stressed the need for tool creators to anticipate and identify specific phases in the planning process when each end-user could utilize the tool.

According to a state emergency management officer, while they are not opposed to using natural resource prioritization tools and see their potential benefits, integrating a new tool into their existing structured work streams would require additional effort. Therefore, tool

---

[234] *Anacostia Watershed Restoration*, U.S. ARMY CORPS OF ENG'RS, https://www.nab.usace.army.mil/Missions/Environmental/Anacostia-Watershed-Restoration/ (last visited Jan. 19, 2024); *Restoration Progress Dashboard*, ANACOSTIA PARTNERSHIP, https://www.anacostia.net/dashboard2020.html#goal5 (last visited Jan. 30, 2024).

[235] MISSISSIPPI RIVER CITIES & TOWNS INITIATIVE, DISASTER RESILIENCE AND ADAPTATION PROGRAM, https://static1.squarespace.com/static/5845a70859cc6819f2dfdb9e/t/5a1da14f085229dccc1f57c6/1511891306301/Disaster+Resilience+Prog+1-pager%5B2567%5D.pdf (last visited Jan. 19, 2024).

creators should design tools with a clear understanding of where and how they can seamlessly integrate into the planning process. The same officer also highlighted that a single training session might not be sufficient to persuade their office to adopt a new tool, emphasizing the importance of multiple exposures to encourage its use.

2.3.3 Watershed-Scale Challenges

Participants discussed several watershed-scale challenges ranging from the challenge of scale and the power dynamics between local governments and regional planning structures.

The challenge of scale

Workshop participants described how hazard mitigation planning is most often done by state and local officials at the jurisdictional scale rather than on the watershed scale. This "mismatch" of scales can present multiple challenges, including 1) the best mitigation strategies for the watershed may be sited upstream of the jurisdiction in question, 2) upstream conditions may limit the effectiveness of downstream NBS, and 3) planning by jurisdiction may overlook climate inequities and the historical marginalization of communities that extend beyond jurisdictional boundaries but align with a natural feature (one participant provided the example in Norfolk, Virginia, where two predominantly African American neighborhoods, in different jurisdictions, experience disproportionate and recurrent tidal and precipitation flooding).[236]

To create multi-jurisdictional scale plans that follow watershed boundaries, participants suggested "coordinating-up" with a watershed agency or regional planning authority. On the suggestion that this role could also be played by an NGO, one participant noted that local governments often avoid working with watershed NGOs because they are regarded as "focused on advocacy" and "unconcerned with the locals and their needs." While this shouldn't discourage the role of third parties, it is an important dynamic to understand.

Reluctance of towns/counties to give up authority

One participant noted that planning on the watershed scale is important, but that designating regional planning commissions or deferring to state watershed agencies to coordinate a plan could be unsuccessful due to the reluctance of individual counties and towns to give up authority over setting their own hazard planning priorities. Another participant agreed that planning on the watershed scale, if done without sufficient local input, can supersede local authority and lead to resistance.

[236] CITY OF NORFOLK, DEP'T OF PUB. WORKS, OHIO CREEK WATERSHED MASTER PLAN (2012), https://www.norfolk.gov/DocumentCenter/View/79660/2012-8-10_Ohio_Creek_Watershed_Master_Plan.

2.3.4 Watershed-Scale "Action Item" Priorities

Workshop participants identified several action items for implementing nature-based mitigation projects on a watershed scale.

Planning by watershed

Participants emphasized the significance of clearly defining the target watershed for planning NBS and incorporating community input into this delineation. One participant pointed out that, in the context of watershed-scale projects, there is a tendency to rely on jurisdictional boundaries. However, the participant suggested that an alternative ecosystem-based measure (i.e., a watershed approach), or a combination thereof, might prove to be more effective.

Opportunities for funding watershed scale planning

As discussed above, the watershed is the most appropriate scale for understanding the risk reduction benefits of NBS, and it is important for funding sources to consider how to invest in planning and project development at that scale. Although funding is often designated at the state or local level rather than by watershed, there are several basin-specific programs for funding watershed scale planning. Examples include the Chesapeake Bay Program's Small Watershed Grants,[237] the National Fish and Wildlife Foundation's Five Star and Urban Waters Restoration Grant Program,[238]and the National Estuary Program's Watersheds Grant Program.[239] Participants agreed that applying more funding to watershed scale planning could be beneficial.

Participants also agreed that more funding is needed to build capacity for regional scale authorities to engage in watershed scale hazard mitigation planning. Several participants suggested that regional planning commissions may be able to help with crafting a plan, others noted it is difficult for them to apply for the planning grant. Therefore, state-level resource agencies may be a good place to coordinate. For example, Vermont helps apply for planning grants and then provides sub-awards to local jurisdictions for mitigation plans.

Another example was offered from Virginia, where the Department of Housing and Urban Development coordinated the Ohio Creek Watershed Project to increase floodplain resilience.[240] The Ohio Creek Watershed Project in Norfolk, Virginia involved planning a mix

---

[237] *Small Watershed Grants Programming*, CHESAPEAKE BAY PROGRAM, https://www.chesapeakebay.net/what/grants/small-watershed-grants (last visited Jan. 30, 2024).
[238] *Five Star and Urban Waters Restoration Grant Program*, NFWF, https://www.nfwf.org/programs/five-star-and-urban-waters-restoration-grant-program (last visited Jan. 30, 2024).
[239] *National Estuary Program Watersheds Grant Program*, RESTORE AMERICA'S ESTUARIES, https://estuaries.org/nep-watersheds-grant (last visited Jan. 30, 2024).
[240] *Ohio Creek Watershed Project*, CITY OF NORFOLK, https://www.norfolk.gov/3867/Ohio-Creek-Watershed-Project (last visited Jan. 30, 2024).

of green and grey infrastructure solutions to improve flooding and public access to waterways.[241] Plans included retrofitting streets with green infrastructure, implementing rain gardens and retention ponds, and building a tide gate structure to restore the ecological function of the eroded wetlands.[242] While this example does not involve coordination on the scale of a watershed like the Mississippi River, it illustrates how planning based on watershed can entail *a mindset shift*: in this scenario, jurisdictional boundaries do roughly align with the watershed, however, the solutions implemented are focused on the watershed because this is the scale of planning.

3. Building Community Capacity in the Region for Nature-Based Projects

Lack of capacity continues to be a major barrier to the identification and implementation of nature-based mitigation projects, particularly on the local scale. Local capacity is needed to apply for funding, to figure out what nature-based projects are feasible at that scale, and to implement, administer, monitor, and assess the projects. Hazard planners often do not have the necessary analytical experience to site, determine, and monitor natural infrastructure projects. A recent GAO report cited lack of technical capacity and complexity of the grant application processes as significant challenges for hazard mitigation grant program applicants.[243] In fact, the challenges associated with the hazard mitigation grant application process was cited as a reason that states have not spent 35% of the funds that FEMA has allocated under the Hazard Mitigation Assistance program from 1989 through early 2018.[244] Expanding the hazard mitigation planning and project development process from being driven by a single state or local emergency management agency to being based in partnerships will help to scale up the use of NBS.[245] For capacity-strained local communities, these partnerships are crucial.

FEMA recognized the lack of capacity for hazard mitigation planning in local communities and launched the Building Resilient Infrastructure and Community (BRIC) Direct Technical Assistance (DTA) initiative in 2020. Since 2020, BRIC DTA has provided capacity-building support for 74 cities, towns, parishes, boroughs, counties, federally recognized Tribes, and

---

[241] *Id.*
[242] CITY OF NORFOLK, DEP'T OF PUB. WORKS, OHIO CREEK WATERSHED MASTER PLAN (2012), https://www.norfolk.gov/DocumentCenter/View/79660/2012-8-10_Ohio_Creek_Watershed_Master_Plan.
[243] U.S. GOV'T ACCOUNTABILITY OFF., GAO-21-140, DISASTER RESILIENCE: FEMA SHOULD TAKE ADDITIONAL STEPS TO STREAMLINE HAZARD MITIGATION GRANTS AND ASSESS PROGRAM EFFECTS 37 (2021).
[244] Thomas Frank, *States Shun Billion in Federal Aid as Climate Costs Soar*, CLIMATEWIRE (Feb. 26, 2021), https://www.eenews.net/climatewire/stories/1063726077/search?keyword=hazard+mitigation.
[245] Laurie Pearce, *Disaster Management and Community Planning, and Public Participation: How to Achieve Sustainable Hazard Mitigation*, 28 NAT. HAZARDS 211 (2003).

territories in updating or developing a Hazard Mitigation plan (see Table 3 for a list of Mississippi River Basin communities that have received BRIC DTA support).[246]

Table 3: Mississippi River Basin Community Recipients of BRIC DTA Support		
Community	**DTA Request**	**Identified Challenges** **indicates nature-based or natural infrastructure priorities identified in the challenges.**
City of Birmingham, Alabama	The city requested help with grants management assistance and project scoping activities to support the city's drainage systems resiliency improvement projects.	• Mitigation project planning • Grants management
City of Cherokee, Iowa	The city requested help to implement nature-based solutions and develop a local mitigation partnership network.	• Mitigation project implementation (NBS) • Developing local mitigation partnership network
City of Riverton, Iowa	The city requested help to conceptualize projects to mitigate frequent flooding across a main route into Riverton used by general traffic and emergency services.	• Mitigation project planning
City of Thomasville, Georgia	The city and FEMA are working on the community's capacity to run benefit cost analysis, prioritizing mitigation projects, and developing Best Management Practices for planning for future growth and protection of community lifelines.	• Benefit-Cost Analysis • Mitigation project prioritization • Developing BMPs
Crawford County, Arkansas	The county requested help to assist with identifying sustainable, cost effective, nature-based solutions to protect against future flooding, as well as match the identified mitigation solution with appropriate funding mechanisms.	• Identifying nature-based solutions • Identifying funding mechanisms for mitigation solutions
Iowa Tribe of Kansas and Nebraska	The Tribe and FEMA are working to conceptualize a microgrid projects that would create a Tribal Utility Authority, decrease the Tribe's environmental impact, and increase their energy resilience.	• Project planning
Keweenaw Bay Indian Community, Michigan	The community is requesting help and assistance with developing an improved risk assessment and green infrastructure design criteria that meet multiple goals for hazard mitigation, cultural preservation, and protection of critical infrastructure and ecosystems.	• Developing risk assessment • Developing green infrastructure design criteria for hazard mitigation projects
Red Lake Nation, Minnesota	The nation is requesting help with grants management training to develop projects	• Grants management

[246] *BRIC Direct Technical Assistance*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/direct-technical-assistance (last visited Nov. 16, 2023).

	needed after the town of Red Lake was hit by two EF1 tornados in 2021.	
Robertson County, Kentucky	The county is susceptible to landslides and is requesting help to assist with conducting project scoping activities to address these challenges.	• Mitigation project planning
St. John the Baptist Parish, Louisiana	The parish is requesting help and assistance with project prioritization to address the significant flood risk the parish faces, both now and for the future.	• Mitigation project prioritization
Village of Depue, Illinois	The village and FEMA are working to address the mitigation concerns for the local wastewater treatment facility and identify solutions for relocating a flood tunnel.	• Mitigation project planning

Source: *BRIC Direct Technical Assistance Communities*, Fed. Emergency Mgmt. Agency, https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/direct-technical-assistance/communities (last visited Jan. 30, 2024).

The DTA requests provide insight into what communities need to successfully implement mitigation projects generally, and the opportunity for external experts to suggest nature-based projects to fulfill these hazard mitigation needs. We looked at the communities that received DTA assistance in the Mississippi River Basin to assess the challenges identified and to what extent these communities are seeking assistance related to NGS. Of the 11 communities in the Mississippi River Basin that received assistance, 8 requested direct-technical assistance with prioritizing, planning, and implementing mitigation projects: 4 requested assistance with identifying and prioritizing mitigation projects, 4 requested assistance with mitigation planning, and 1 requested assistance with mitigation project implementation. Other requests included assistance with identifying and managing funding mechanisms, completing the Benefit-Cost Analysis, developing local partnerships, and developing a risk assessment. Only three communities that received DTA in this region requested assistance specifically relating to the nature-based projects. Long-term monitoring and assessment, a crucial aspect of the planning process, is only addressed in a single DTA request for assistance establishing a local mitigation partnership network in Cherokee, Iowa. Long-term monitoring of nature-based projects requires established bodies devoted to assessing existing mitigation solutions and collaborating with neighboring jurisdictions to modify and plan for new mitigation projects.

In the long term, implementing nature-based mitigation projects may ultimately reduce strain on local capacity by requiring less upkeep and being cheaper to maintain.[247] However, it is necessary to build capacity for identifying, prioritizing, siting, and implementing nature-based projects in the FEMA planning and project development process. The remainder of this section will describe capacity-building recommendations that go beyond FEMA Direct-Technical Assistance.

[247] *Natural Infrastructure*, OFFICE FOR COASTAL MGMT., https://coast.noaa.gov/states/fast-facts/natural-infrastructure.html (last visited Jan. 30, 2024).

3.1 Utilizing Regional Capacity to Bolster Local Capacity for FEMA Mitigation Planning in the Mississippi River Basin

This section discusses ways that existing regional-scale organizations that are already performing wetlands assessments and setting priorities for the watershed could provide capacity for state and local hazard mitigation planning. By determining where wetlands restoration goals overlap with hazard mitigation planning opportunities, these organizations could inform the implementation of local hazard mitigation planning and bolster local capacity.

3.1.1 Regional Prioritization for Local Implementation

In a basin like the Mississippi River Basin, where the predominance of levees upstream can significantly affect the flood risk downstream, the most efficient flood risk mitigation projects should be coordinated through a basin-wide planning effort. As we have discussed, this kind of watershed scale coordination is important for large basins—but it is also important for smaller watersheds. Local community involvement in the planning, design, and maintenance of nature-based projects is critical to ensure that NBS equitably address the needs of local communities while addressing watershed-scale mitigation priorities.

3.1.2 Pinpointing Hubs of Potential Capacity for Regional Hazard Mitigation Prioritization and Planning

There are regional entities (such as watershed organizations, regional planning commissions, state agencies, and statewide conservation organizations) that focus on creating region-wide priorities for conservation in and beyond the Mississippi Basin. EPA, for example, supports several regional monitoring and assessment efforts, including working groups in the Mid-Atlantic and Pacific Southwest region. These working groups focus on the ecological health and function of the wetlands in these regions and build the capacity of states to assess the integrity of wetlands and develop long-term implementation plans to achieve restoration priorities determined by the assessments.[248] One example of a project undertaken by a regional group is reforestation of cleared land from Cairo, Illinois to the Port of Baton Rouge to expand habitats, reduce flooding, and lesson the amount of nutrients entering the river.[249]

The plans and resources developed by these working groups could help inform how nature-based mitigation strategies could both improve the functioning of wetlands while also

---

[248] *Mid-Atlantic Wetland Monitoring and Assessment*, ENV'T PROT. AGENCY, https://www.epa.gov/wetlands/mid-atlantic-wetland-monitoring-and-assessment (last visited Jan. 31, 2024); For an example, *see Monitoring & Assessment Strategy*, VIRGINIA DEP'T OF ENV'T QUALITY, https://www.deq.virginia.gov/our-programs/water/wetlands-streams/monitoring-assessment-strategy (last visited Jan. 19, 2024).

[249] Lower Mississippi River Batture Reforestation, LOWER MISSISSIPPI RIVER CONSERVATION COMMITTEE, https://www.lmrcc.org/our-work/projects/lower-mississippi-river-batture-reforestation/ (last visited Jan. 30, 2024).

reducing hazard risk. These regional working groups may be able to help ensure planned NBS are effective by coordinating with upstream and downstream users across jurisdictional and state boundaries.

In the Mississippi River Basin, the Upper Mississippi River Conservation Committee (UMRCC) and the Lower Mississippi River Conservation Committee (LMRCC) may provide regional frameworks for building capacity at the local level for scaling up NBS. Both committees have undertaken assessment efforts, including studies on habitat connectivity and water quality, and share a focus on long-term conservation planning and habitat restoration.[250] The board memberships of these committees show they are composed of representatives from each state's natural resource agencies and involve the EPA, United States Geological Survey, and Department of Agriculture as federal partners (with the addition of USFWS and USACE as federal partners for the LMRCC). However, these committees do not list any emergency management agency representatives or reference FEMA among the other federal partnerships.

The UMRCC has sub-committees on vegetation and invasive carp, as well as five technical committees.[251] This kind of regional expertise could help local planners determine where conservation and hazard mitigation goals overlap in each basin and communicate the benefits of the ecosystem services of the resources. Engaging hazard mitigation planners and emergency management professionals in the UMRCC may also help bridge the gap between natural resource and hazard mitigation professionals. This could also provide an opportunity for a federal partnership with FEMA.

Another regional group in the Basin that provides capacity is the Mississippi River Cities and Towns Initiative (MRCTI). MRCTI is a mayor-led, mayor-comprised association of local governments formed to address priorities in clean water, sustainable economies, disaster resilience and adaptation, international food and water security, and river culture and heritage. The MRCTI is conducting research on nature-based solutions to flooding in the region and could inform local mitigation plans with a suite of preferred nature-based projects based on various criteria. The association has an "Infrastructure Facility" group which provides capacity in the form of expertise and financial resources to members applying for Jobs Act funding. Assistance with resilience, FEMA, and mitigation strategy are all listed as competencies currently available through the Facility.[252]

---

[250] *See* LOWER MISSISSIPPI RIVER CONSERVATION COMMITTEE, https://www.lmrcc.org/about-us/what-we-do/ (last visited Jan. 19, 2024) *and* UPPER MISSISSIPPI RIVER CONSERVATION COMMITTEE, https://umrcc.org/ (last visited Jan. 19, 2024).

[251] UPPER MISSISSIPPI RIVER CONSERVATION COMMITTEE, https://umrcc.org/ (last visited Jan. 19, 2024).

[252] MISSISSIPPI RIVER CITIES & TOWNS INITIATIVE, INFRASTRUCTURE FACILITY, https://static1.squarespace.com/static/5845a70859cc6819f2dfdb9e/t/637e90b7098cb316c0dccb12/1669238970610/Capitol+Mtg+2022+Infra+Facility.pdf (last visited Jan. 19, 2024).

3.1.3 Leveraging Regional Capacity Building at the Local Scale

By embedding a focus on hazard mitigation and determining where conservation and mitigation goals overlap, regional entities might feasibly create regional planning priorities and project guidance that could then inform state and local hazard mitigation planning. The plans developed by regional entities could be listed in the capabilities assessment section of the hazard mitigation plan.[253] For example, in California, the Western Governors Association—a regional entity composed of Western state agencies—created a 10-year strategic plan to reduce wildfire hazard through restoring fire-adapted ecosystems.[254] This strategic plan is listed as a capability to mitigate risk. The outputs from this type of regional planning commission could conceivably bolster local capacity in the same way.

3.2 Other Recommendations for Building Capacity at the Local Scale

In addition to the support and assistance that regional entities may be able to provide local governments, there are other opportunities to build capacity at the local level to help local planners scale up the use of NBS.

3.2.1. Educating Local Governments to Encourage Buy-in for NBS

In order to scale up the use of NBS, it is necessary to have buy-in from local governments. Many local officials are more inclined to pursue traditional grey infrastructure risk reduction methods that are already familiar to them and may have already been employed in the community. Local officials may need more information on the benefits of NBS, including examples from other communities of similar size. This entails 1) educating local officials on *why* nature-based mitigation projects are effective risk reduction measures, and 2) describing how existing (or potentially restorable) natural assets can provide risk reduction for a community.

Education on why and how NBS should be implemented is needed in all decision-making spaces, from elected officials to the emergency management office to the planning division. One possible opportunity is for natural resource experts to partner with emergency managers on presentations that take place at large gatherings of local governments, where local officials and/or the public will be present. At the national level, this could be National League of Cities conferences and the U.S. Conference of Mayors, or other similar events. At

[253] FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING HANDBOOK 205 (2023), https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-handbook_052023.pdf.
[254] CAL. GOVERNOR'S OFFICE OF EMERGENCY SERVICES, CALIFORNIA STATE HAZARD MITIGATION PLAN 46-47 (2023), https://www.caloes.ca.gov/wp-content/uploads/Hazard-Mitigation/Documents/2023-California-SHMP_Volume-1_11.10.2023.pdf.

the state level, this could be Leagues of Cities and Towns State conferences, among others.[255]

For this education to be relevant and adoptable by capacity-strained communities, it must also be individualized. There is a continuing need to develop a more solid evidence base on the multiple benefits and cost-effectiveness of NBS to gain widespread support among both the public and decision-makers.[256] However, multiple participants in the recent ELI workshop noted that lengthy reports with examples of best practices will not be read by local governments, and that local government employees do not have the time or resources to be proactive unless they are brought something of value that would allow for easier implementation. Therefore, one idea is to develop concise, one-page case studies that exemplify potential NBS tailored based on size, capacity, and natural assets. If an external group can identify exactly how a community could implement NBS that were shown to be successful in another community of comparable size, capacity, and natural assets, then the probability of implementation would be greater. These one-page studies could be coupled with a brief analysis quantifying a county's natural infrastructure to make the case that such infrastructure is *critical infrastructure*.

This education must happen on a regular basis to ensure continuity in the understanding of NBS and willingness to adopt them. For example, mayoral turnover can make it difficult to establish consistent engagement and interest seeking opportunities to maintain partnerships among natural resource agencies and emergency managers and pursing NBS in the community. Therefore, a coordinated effort from a regional group could provide consistent justification for nature-based mitigation solutions, and having a regional plan that guides local planning would provide another layer of security for ensuring that momentum is not lost.

3.2.2 Identifying a Community's Natural Assets

Identifying the adaptation and resilience benefits that a community's natural assets already (or could potentially) provide can encourage greater local interest in pursuing NBS and may identify opportunities for funding the protection and restoration of such resources. Greater funding can also mean expanded local capacity for the planning and implementation of nature-based mitigation projects. In the City of Snoqualmie, Washington, funding greatly increased once the value of the natural capital was communicated to the city by an external consulting group. With more funding, the Forestry Department hired more people, expanding the city's local capacity for the implementation and maintenance of natural

[255] Examples include the Montana League of Cities and Towns (https://mtleague.org/conference/), Florida League of Cities (https://www.flcities.com/), and New Jersey State League of Municipalities (https://www.njlm.org/).

[256] NATURE-BASED SOLUTIONS TO CLIMATE CHANGE ADAPTATION IN URBAN AREAS: LINKAGES BETWEEN SCIENCE, POLICY AND PRACTICE 275-289 (Nadja Kabisch et al. eds. 2017) (Ch. 16: Partnerships for Nature-Based Solutions in Urban Areas – Showcasing Successful Examples).

infrastructure projects.[257] Furthermore, a community may be a more willing participant in a regional plan if the value of their natural assets is communicated.[258]

3.2.3 Capitalizing on Bridging Organizations

Nonprofits, academic institutions, community-based organizations, and so-called boundary organizations can identify opportunities for nature-based hazard mitigation projects in local jurisdictions that fit the objectives of the regional planning entities, encourage local buy-in, and ensure meaningful stakeholder participation. Boundary organizations are institutions, organizations, or partnerships, that bridge scientific and political groups in the coordination of efforts on and management of environmental issues.[259] An example of a boundary organization is Wetlands Watch in Norfolk, Virginia, which collaborates with local governments and academic institutions to identify needs related to floodplain management and sea-level rise adaptation.[260] They create adaptation guides and provide essential training to address these community needs, enabling the design of projects and the securing of necessary funding. Such "boundary organizations" play a pivotal role in connecting various stakeholders and facilitating the exchange of knowledge and resources.

One idea generated at the recent ELI workshop is the creation of a loose partnership of experts with the following expertise: 1) capacity to identify potential communities, provide education on green infrastructure, quantify their natural assets to encourage buy-in, and provide suitable options for NBS, 2) knowledge of the funding opportunities available to local communities, 3) knowledge of potential tools that can be helpful with siting a project and quantifying NBS, and 4) capacity to aid in funding applications and help with capacity-building on the local level to ensure a project's success. This "roving band of experts" would function similarly to a boundary organization.

Community-based organizations and academics can also ensure that consultation with stakeholders goes beyond "box-checking." While new FEMA guidelines require more stakeholder participation, this requirement can be met if opportunities for engagement are

[257] Lance Davisson, The Keystone Concept & Zachary Christin, Equilibrium Economics, contribution to "Wetlands and Hazard Mitigation: Opportunities for Integration" workshop held by the Environmental Law Institute (Oct. 31 & Nov. 1, 2023).
[258] This was a sentiment echoed by a local emergency management department at the "Wetlands and Hazard Mitigation: Opportunities for Integration" workshop held by the Environmental Law Institute (Oct. 31 & Nov. 1, 2023).
[259] DENIS BOISSIN, BOUNDARY ORGANIZATIONS: AN EFFICIENT STRUCTURE FOR MANAGING KNOWLEDGE IN DECISION-MAKING UNDER UNCERTAINTY (2009).
[260] WETLANDS WATCH, https://wetlandswatch.org (last visited Jan. 8, 2024).

created, even if no stakeholders engage.[261] In hazard mitigation and adaptation planning, there has to be a shift from planning *for*, to planning *with* communities.[262]

3.2.4 Advisory Committees

A final recommendation for building local capacity is to form advisory committees structured around natural hazards or environmental justice to allow for data sharing, stakeholder input, and ideation that can be integrated in hazard mitigation plan updates. Forming regional advisory committees based around a goal of reducing a specific hazard can allow for synergizing various local plans to address natural hazards more effectively. Long-term committees, such as the conservation committee in Portola Valley, California for example, effectively integrate landowners' feedback when determining strategies to cope with persistent landslide hazards. Forming advisory committees to center the needs of marginalized communities in planning can also ensure that these priorities are met when mitigation plans come up for review. In King County, Washington, the Hazard Mitigation Steering Committee dedicated two meetings to facilitating environmental justice structured discussions around environmental inequities and how hazard mitigation strategies may address these inequities in the development of the King County Regional Hazard Mitigation Plan.[263]

Short-term committees established during mitigation plan updates can also be effective in reaching vulnerable communities without placing a burden on them for continued involvement. In Harris County, Texas, the Houston NAACP was involved in the planning process, and in Orleans Parish, Louisiana community-based organizations such as Housing NOLA and Greenlight played active roles in the updating of local mitigation plans.[264]

---

[261] *See* FED. EMERGENCY MGMT. AGENCY, LOCAL MITIGATION PLANNING GUIDE SIDE-BY-SIDE COMPARISON 11 (2022) (for the new requirements). Workshop participants from a state hazard mitigation agency described how they have struggled with stakeholder engagement but still met the FEMA stakeholder guidelines in their most recent plan update.

[262] Laurie Pearce, *Disaster Management and Community Planning, and Public Participation: How to Achieve Sustainable Hazard Mitigation*, 28 NAT. HAZARDS 211 (2003).

[263] KING COUNTY EMERGENCY MGMT., KING COUNTY REGIONAL HAZARD MITIGATION PLAN: 2020-2025 (2020), https://kingcounty.gov/en/legacy/depts/emergency-management/emergency-management-professionals/-/media/depts/emergency-management/documents/plans/hazard-mitigation/KCRHMP_Final; Fiona Osborn & Rebecca L. Kihslinger, *Incorporating Environmental Justice into Hazard Mitigation Plans* (Oct. 4, 2021), https://www.eli.org/vibrant-environment-blog/incorporating-environmental-justice-hazard-mitigation-plans.

[264] Fiona Osborn & Rebecca L. Kihslinger, *Incorporating Environmental Justice Into Hazard Mitigation Plans* (Oct. 4, 2021), https://www.eli.org/vibrant-environment-blog/incorporating-environmental-justice-hazard-mitigation-plans.

4. Conclusion

Increased emphasis has been placed on non-structural and nature-based hazard mitigation solutions, including the restoration and protection of wetlands and floodplains, as cost-effective alternatives for flood hazard mitigation that also help achieve conservation goals like maintaining biodiversity. FEMA's recent updates to hazard mitigation planning guidance and grant criteria encourage the integration of nature-based solutions, but many challenges remain. Involving natural resource experts in the hazard mitigation planning and project implementation process can be crucial for filing information gaps, helping to more fully identify risks, and aiding in the identification and prioritization of viable nature-based mitigation actions to address those risks. Building partnerships is key to ensuring that communities have the capacity to integrate NBS in hazard mitigation plans and apply for, administer, implement, and monitor nature-based projects. One emerging opportunity is to leverage the significant investment that has been made by state agencies and conservation organizations across the country in developing wetland monitoring and assessment tools that prioritize wetlands and aquatic resources for conservation and restoration.