CHAPTER 8

THE NATURE-BASED EXCHANGE

Workshop Products and Resources

The Nature Conservancy · SURCULUS · School of Architecture Resilient Urban Design · Biohabitats Southeast Atlantic Bioregion · Robinson Design Engineers

Summary & Key Takeaways from Workshops 1-7

- **In the world of nature-based solutions, there are two key players: nature and people.** Nature is resilient; nature was here before us and will be here after us. Our best shot for long-term prosperity is to work with – rather than against – nature in ways that are mutually beneficial.
- **People are key to making nature-based solutions successful.** From education, outreach, and engagement with stakeholders and communities to communication, coordination, and partnerships with experts and practitioners, nature-based solutions will not become an expected practice without the involvement of people from all backgrounds, experiences, and stages of life.
- **Relationships matter.** Our relationship with nature and with other people requires trust, patience, and a willingness to listen to the stories of the past and present to inform our future.
- On the surface, **nature-based solutions** are designed to support the resilience of a particular site, yet if we dive deeper, we can see that projects designed with the community and in support of community needs **can also contribute to the resilience of the people in that community.**
- **Nature-based solutions cannot be viewed merely through an environmental lens**. Culture and economics must also align for these solutions to be accepted, demanded, and implemented on a large-scale. While society and funding continue to present some barriers, change is happening as acceptance for these projects grows.
- For nature-based solutions to thrive, **we must break from tradition and change our perspective** on how we think, plan, fund, and design these projects. We must get creative, put nature at the base of all our decisions, and start focusing on the ways that nature can be the solution to, as opposed to the cause of, our problems.

- **Plans should be in-sync with the design process** by supporting new and creative methods, materials, and monitoring needs. Plans should create expectations that nature-based solutions are among the suite of options considered.
- **Designing nature-based solutions requires addressing risks, adjusting for uncertainties, and planning for the project's full life cycle.** Designers must be flexible and adaptable throughout the design and construction process as changes arise.
- **Designers must consider and value all aspects of nature** – including natural processes, past and present landscape conditions, flora, and fauna – in each design. For nature-based solutions to reach their maximum potential, nature must be respected and understood on small and large scales.
- **Communication and messaging on nature-based solutions should be constructed with the audience in mind.** Understanding your audience is key to connecting them to nature-based solutions in a way that is personal, relatable, and long-term.
- **Change is happening**; nature-based solutions are becoming more accepted and expected thanks to changes in education, design practices, plans, and effective outreach. But we are not done yet; **there is still more work to do.**
- The challenges facing nature-based solutions continue to be widespread. **But every project, conversation, and partnership get us closer to knocking down the physical, mental, political, and relational barriers that stand in our way.**
- To change actions and attitudes, **we must first change the way we think.** We must think about nature; we must be proactive for equity and justice; we must be conscientious of societal needs and economic limitations; we must consider long-term perspectives and holistic viewpoints; and we must be aware that what is best for us personally may not be what is best for the community or environment, forcing us to set aside ourselves for the bigger picture. Once we have changed the way we think, we can change our behavior and then we can educate others on the importance of doing the same.

Pathway to Natural and Nature-Based Solutions

The journey to a completed natural or nature-based project (NNBS; also known as a green infrastructure project) follows the same path used for traditional, grey infrastructure. However, there are some minor differences within each step of the pathway, most notably an added education component for green projects. This pathway identifies the similarities and differences between green (NNBS) and grey projects.

1 IDENTIFY ISSUES & OPPORTUNITIES

Consider who you can educate about NNBS during this step...
For example, the **project team, client** and/or **owner**.

Green & Grey

- ☐ Identify a site or project
- ☐ Identify issues and/or opportunities at the site
- ☐ Work closely with client and/or owner

2 RESEARCH & FEASIBILITY

Consider educating the **project team, funders** and **community members** about NNBS during this step.

Green

- ☐ Research past and present site conditions, natural cycles and systems, and local plant and animal species
- ☐ Gather community knowledge on the site's use, value, and impact
- ☐ Incorporate risk into models

Grey

- ☐ Research existing conditions
- ☐ Use standard models

3 DESIGN PROCESS

? *Permit not required? Go to to step 5!*

Green

- ☐ Follow design standards
- ☐ Refer to Best Practices
- ☐ Create initial design
- ☐ Consider different itterations to maximize benefits

Grey

- ☐ Follow design standards
- ☐ Refer to Technical Manuals
- ☐ Create initial design

4 PERMITTING PROCESS

Green

Note that this may take longer

Grey

Note that this may take less time

- ☐ If the project requires this step, work with permitting agencies to finalize design during either process

! Consider educating the **permitting agencies,** and **decision makers** about NNBS during this step.

Educate the **construction team (including laborers and subcontracters)** and **community members.**

Green

$-$$

Typically **lower** in cost

Grey

$$-$$$

Typically **higher** in cost

☐ Build project, address problems and constraints as they arise during either process

5 *TIME FOR CONSTRUCTION!*

6 *COMPLETED PROJECT*

Green

Increase in ecological, social, and economic benefits!

☐ Celebrate the project's completion!

Grey

One or **few** benefits to client/owner

Educate the **inspectors, managers, influencers** and **thev public** about the completed project and the incorporated

7 MONITORING AND MAINTENANCE

Green

- ☐ Conduct maintenance (typically low cost $)
- ☐ Conduct monitoring (typically low cost $)

Grey

- ☐ Conduct maintenance (potentially high cost $$-$$$)

Educate the **maintenance crew, monitoring crew, interest groups** about best practices on NNBS projects.

CASE STUDY SCENARIO // CROWFIELDS CONDOMINIUMS

Asheville, North Carolina

Issue identified: Creek bisected by a bridge culvert has severe undermining concerns and will need repair and/or replacement.

Opportunity identified: During the repair phase, with grading work unavoidable, an opportunity was identified to install a bioretention feature to alleviate sediment going straight into the creek, filter runoff from the road and incorporate native plants.

Photo provided by Robinson Design Engineers.

1 STEP ONE
Identify Issues and Opportunities

The process of identifying issues and opportunities related to environmental concerns involves a thorough assessment of various factors. **Factors to consider include flooding, habitat and diversity loss, water quality, and heat-related problems**. Alternatively, opportunities may emerge, like land restoration or new development initiatives. When a group decides to address a specific issue or seize an opportunity, they must navigate a complex web of decision-makers. This typically includes private or public owners who possess decision-making authority. Additionally, it involves the community, which must establish a connection with these decision-makers, as well as third parties like research groups or non-profits who play a role in facilitating these connections.

Securing funding for the proposed project is a critical step in the process. Groups must weigh the options of public versus private funding sources, taking into account the urgency of the problem they are addressing. Ideally, the funding should encompass various phases, such as design, community engagement, engineering, permitting, construction, maintenance, and long-term monitoring.

To ensure the success of the project, it is essential to hire professionals with expertise in design and engineering, **preferably those with knowledge of and experience in natural resource enhancement or ecological design**. These experts will play a crucial role in guiding the project towards its environmental and community-oriented goals.

POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE

Does my site feel unproductive in terms of biodiversity?

Do I feel comfortable with having areas that can be managed and areas that can be left “wild”?

Will I contact nearby property owners to see if they are willing to participate in the overall watershed-based planning?

CASE STUDY SCENARIO // ANGEL OAK PRESERVE

Angel Oak Park, Johns Island, South Carolina

Research conducted: Research was conducted to get a better understanding of the Angel Oak's size and health as well as the surrounding area. Archaeologists found evidence that revealed the past locations of cabins of enslaved people, a plantation house, and an oak alleé. This knowledge led the designers to include opportunities along the boardwalks for historical interpretation.

Feasibility analysis: To ensure project feasibility, research results are used to inform all design decisions. Designers also consider the needs of the Angel Oak and the other surrounding plants, such as the space their roots require to grow and flourish without interruption.

Photo provided by the Lowcountry Land Trust.

2 *STEP TWO*
Research and Feasibility

Conducting research and determining design feasibility are critical to produce a successful nature-based project that offers long-term social and ecological benefits. Research is needed to fully understand the context of the issue or opportunity; only once understood can the best solution for the site be determined.

Ecological data on past and present site conditions is vital. Research should encompass **natural cycles** (including water, nutrient, energy, and climate) as well as **physical landscape features** (such as water, elevation, light, wind, and human impact), **plant composition and placement**, and **soils**. **Fauna** should also be considered (including habitat and food web needs) in present and future contexts.

The affected community should be engaged during the research phase to identify issues and potential solutions and offer valuable knowledge on the site's use, value, and impact. Early and often engagement with community members will not only provide valuable information but it can also lead to increased community buy-in.

Risk and adaptive management should be considered to ensure project feasibility. Incorporating risk models and future models can address, and hopefully reduce, risk.

POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE

Has the site been thoroughly researched?

Do I understand the issues and opportunities present at the site through an ecologic, social, and economic lens?

Has the affected community been involved in the research-gathering phase?

Does the risk of implementing a project outweigh the risk of leaving the site as-is?

CASE STUDY SCENARIO // ANDREWS RAIN GARDENS

Andrews, South Carolina

Design Process: In the spring of 2022, The Nature Conservancy and Clemson Extension installed two small rain gardens in the Town of Andrews. After the two sites were chosen, the design team calculated the ideal size and placement of the gardens based on runoff patterns and other factors. Both gardens followed a standard bean-shape design with a rock outfall, although one garden was connected to a cistern to slowly receive additional water. The selection and placement of plants were dependent on the amount of water and sunlight at each location in the garden, requiring a detailed understanding of the site and the flow of water within the garden. Native plants were chosen for their ecosystem benefits.

Photo provided by Tanya Ackerman; photo of Andrews Library Rain Garden.

3 *STEP THREE*
Design Process

The design phase incorporates all the data collected during the research and feasibility phase. If nature-based solutions have not been part of the conversation, this is the time for them to be introduced. The design team should use existing design standards and technical guidance, when available. When designing nature-based elements, designers should **incorporate best practices** when design standards do not exist.

The design should fully address the issue or opportunity present at the site and should be designed in a way that meets community needs and desires, when possible. Designers should present a suite of solutions to the client that **fit within budget, are appropriate for site conditions, are culturally sensitive, and fit within the regulatory framework**. Ideally some, if not all, of the proposed solutions will be natural or nature-based with the ultimate goal being that the client chooses a green design over a grey one.

POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE

Were feasible, appropriate nature-based solutions offered to the client?

Was the client educated on the benefits of a nature-based approach and the value added over a traditional grey design?

Did I ask anyone in the community if this design would be accepted and maintained?

CASE STUDY SCENARIO // BARBERRY WOODS

Johns Island, South Carolina

Permitting process: The Barberry Woods project was driven by repetitive flooding that impeded egress from this residential neighborhood from hours to days depending on storm severity. The project incorporated ecological enhancements and bio-engineering designs, including new wetlands for flood storage, stream stabilization, enhanced floodplain storage, and improved overall infiltration through bio-infiltration practices, to alleviate flooding in the community. Permitting efforts include an Individual Permit with the USACE, Erosion and Sediment Control and Coastal Zone Consistency (CZC) permitting with SC DEHC, Site Plan Permitting with Charleston County and the City of Charleston and a FEMA No-Rise submittal. Checklists devised by permitting agencies do not always account for nature-based solutions, making the permitting process tricky and sometimes illogical (like paying a wetland mitigation fee to help wetlands). Working through this process can require time and coordination.

Photo provided by WK Dickson.

4 STEP FOUR
Permitting Process

Just like in traditional infrastructure, permitting is often an iterative process with design as the design team make changes requested by the permitting agencies. It is during the permitting phase that the design transitions from the initial design to the final design (which will be used for construction). To make permitting easier, it's important to **engage regulatory agencies early and often** in the design process to address questions and concerns and ensure regulatory requirements are met.

General permits often provide for faster review and approval. Unfortunately for South Carolina, **many nature-based projects do not currently fall under general permits**. As a result, the permitting process for a nature-based solution can be longer and more cumbersome for the design team than a traditional grey design. Allowing ample time in the project timeline to receive permits can avoid frustration and keep the project on track.

POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE

Am I familiar with the permitting process for the nature-based solution being proposed?

Is a pre-application meeting an option prior to permit submittal? If so, have I taken the opportunity to meet with the permitting agency to discuss project specifics?

Am I prepared to be flexible with the design depending on the response from the permitting agency?

CASE STUDY SCENARIO // CRAB BANK RESTORATION

Off the coast of Mount Pleasant, South Carolina

Construction process: In 2017 Crab Bank, a bird sanctuary, significantly eroded, and the Conservation League, SCDNR, conservation partners, and Coastal Expeditions came up with a solution to rebuild the bank with sand dredged during the Charleston Harbor's deepening project. Funding was initially a barrier with an estimation that was more than the actual cost, but because the Norfolk Southern Dredging Company had the necessary equipment already in the area, the cost was cut from the initial $4 million to $377,000. The US Army Corps of Engineers covered 65%, leaving $132,000 for the community to raise which they did successfully.

Photo provided by Adam Boozer.

5 *STEP FIVE*
Time for Construction!

The construction of a nature-based solution is like any project in that it alters the existing site to some degree and requires a skilled labor force with appropriate tools to build. **Ideally the construction company (including its laborers and subcontractors) has some knowledge of nature-based solutions, or, even better, is an expert in nature-based solutions**. While an uninformed crew can be educated and still yield a successful project, prior knowledge of nature-based solutions may reduce error, miscommunication, and timeline delays. Substitutions, especially for plants, is one area where the knowledge of nature-based solutions (or lack thereof) is apparent. Unknowingly, uninformed crews may substitute a non-native plant for a native one, which can reduce ecosystem services and benefits and, in some instances, can cause harm to native fauna or alter natural cycles.

Additional factors to consider during construction include time of year, plant availability and supply chain, length of construction, and community outreach. To maintain the integrity of the design, the designer/engineer will stay involved throughout the entire construction process. Their involvement is crucial to address any problems or constraints that may arise. It is imperative that the design team remains flexible and adaptable, especially when implementing new techniques and materials.

POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE

Does the construction company (and any subcontractors and laborers) have knowledge of nature-based solutions? If not, how should I approach educating them to ensure all aspects of the design are executed as specified?

Are the plants specified in the design available and easily accessible?

How often is the designer/engineer checking in on the construction?

CASE STUDY SCENARIO // PORT ROYAL SOUND LIVING SHORELINE

Port Royal Sound, South Carolina

Project benefits: The Port Royal Sound Living Shoreline was completed in April 2016 using funding from the SC Sea Grant Consortium and the Lowcountry Institute. Led by SCDNR, the project was constructed with the help of local student volunteers. Built as part of a pilot study to test living shoreline materials, the design used manufactured wire reefs to help stabilize the shoreline and provide essential habitat to finfish and invertebrates. Thanks to pilot projects like this one which provided SCDHEC with valuable data, new living shoreline regulations were passed in 2021 that aim to make it easier for property owners to permit and build similar projects.

Photo credited to SC Department of Natural Resources.

6 STEP SIX Completed Project

Whether construction took a few hours or many months, the completion of a nature-based project is one to celebrate. Unlike traditional infrastructure which may only provide benefits and value to the property owner, complete **nature-based projects can offer a suite of benefits to the entire community and surrounding ecosystem.** Benefits of nature-based solutions can include, but are not limited to:

- Climate mitigation (reduced greenhouse gas emissions and enhanced carbon storage)
- Reduction of major climate risks, such as:
  - Coastal floods and shoreline erosion
  - Inland floods
  - Stormwater and sewer overflow
  - Extreme heat
  - Wildfire
  - Drought
- Job opportunities
- Improved water and air quality
- Fish, timber, and other natural products
- Recreational opportunities and access
- More resilient infrastructure
- Improved physical and mental health
- Cultural benefits
- Wildlife and biodiversity support
- Community development and economic revitalization

POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE

Did the construction of the project match the design specifications?

Is there educational signage at the site to inform visitors?

Who could benefit from the lessons learned during this project?

Benefits list taken from: White House Council on Environmental Quality, White House Office of Science and Technology Policy, White House Domestic Climate Policy Office, 2022. Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity. Report to the National Climate Task Force. Washington, D.C

CASE STUDY SCENARIO // HORRY COUNTY RECYCLING CENTER BIORETENTION

Loris, South Carolina

Maintenance process: Upkeep such as weeding, raking, and mowing occur monthly while mulching occurs annually. Additional care, including replanting or cleaning, happen as needed. Cleaning could include removing trash, clearing out underdrains, or cleaning out sediment accumulation.

Monitoring process: The garden is inspected quarterly (every 3 months). The monitors look for signs of erosion, dead plants, and any ponding occurring for more than 3 days.

Photo provided by Horry County Stormwater Management & Clemson Carolina Clear.

7 *STEP SEVEN*
Maintenance and Monitoring

Maintenance is a standard expectation for any project, green or grey. Ensuring that the project has a maintenance plan, budget, and responsible party will keep the site properly functioning for many years. With nature-based solutions, **maintenance is typically minimal and inexpensive** since the project relies on nature to heal itself. The type of maintenance needed will vary based on the type of project, but could include replacing or caring for plants, adding mulch or ground cover, altering sediment placement, and removing trash or debris.

Unlike traditional infrastructure, it is beneficial for a nature-based solution to also **have a long-term monitoring plan, budget, and responsible party.** The purpose of monitoring the project is to track changes (such as plant growth, species abundance, etc.) over time and verify the project is functioning properly and continuing to meet project goals. Monitoring can be very project- and site-specific but generally involves taking measurements, recording data and observations, and taking photographs. Regular site visits as well as observations after major weather events (such as hurricanes) help track progress and catch any problems that may arise.

POSSIBLE QUESTIONS TO ASK YOURSELF DURING THIS PHASE

Was money budgeted for long-term monitoring and maintenance?

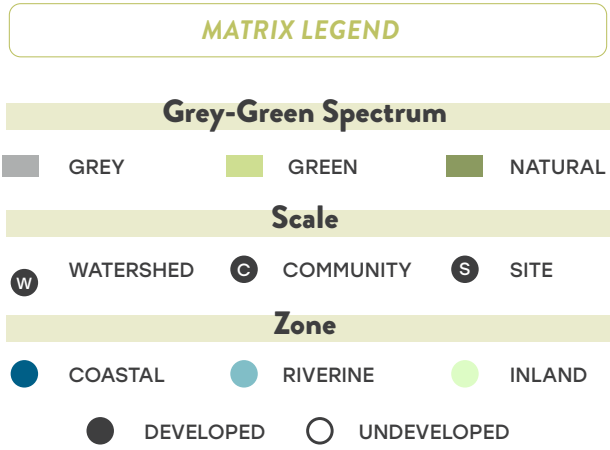
Is the project being monitored and maintained at regular frequency?

Are the monitoring and maintenance crews' experts on nature-based solutions? If not, what can I teach them to ensure long-term project success?

About the Matrix

Natural and nature-based solutions have the potential to address a suite of issues across the entire state of South Carolina. Intentionally bringing nature back into our undeveloped lands, our cities and towns, and even our own backyards will lavish our state with a host of ecologic, economic, and social benefits. While designs can be site-specific, not every natural and nature-based solution is appropriate for every issue and location.

As outlined in Steps 1 and 2 of the NNBS Pathways Tool, it is imperative that project goals are identified, and the project site fully researched, before a design is created. This means understanding the size (or scale) of the project, its location in the landscape, and whether it is on developed or undeveloped land, in addition to the conditions indicated in Steps 1 and 2 of the Pathways Tool. To aid the design process, this matrix identifies 36 natural and nature-based solutions that can be used in South Carolina, organized by type. While this is not meant to be a comprehensive list, it connects the selected methods with issues, scale, and zone to guide designers and stakeholders to a method suitable for the project's location and goals.



Matrix Definitions

Watershed Scale
Address problems spanning a large geographic area, such as across multiple towns or a large city. Most projects at this scale strive to build interconnected systems of natural areas and open space, requiring long-term planning and coordination.

Community Scale
Address problems that span across multiple properties. Projects at this scale require some planning and coordination among property owners but are less space-intensive than watershed scale projects.

Site Scale
Address small-scale, local problems on property that belongs to a single owner. These are projects that a homeowner could do in their own yard, such as managing rainwater where it falls or stabilizing the shoreline in front of their property.

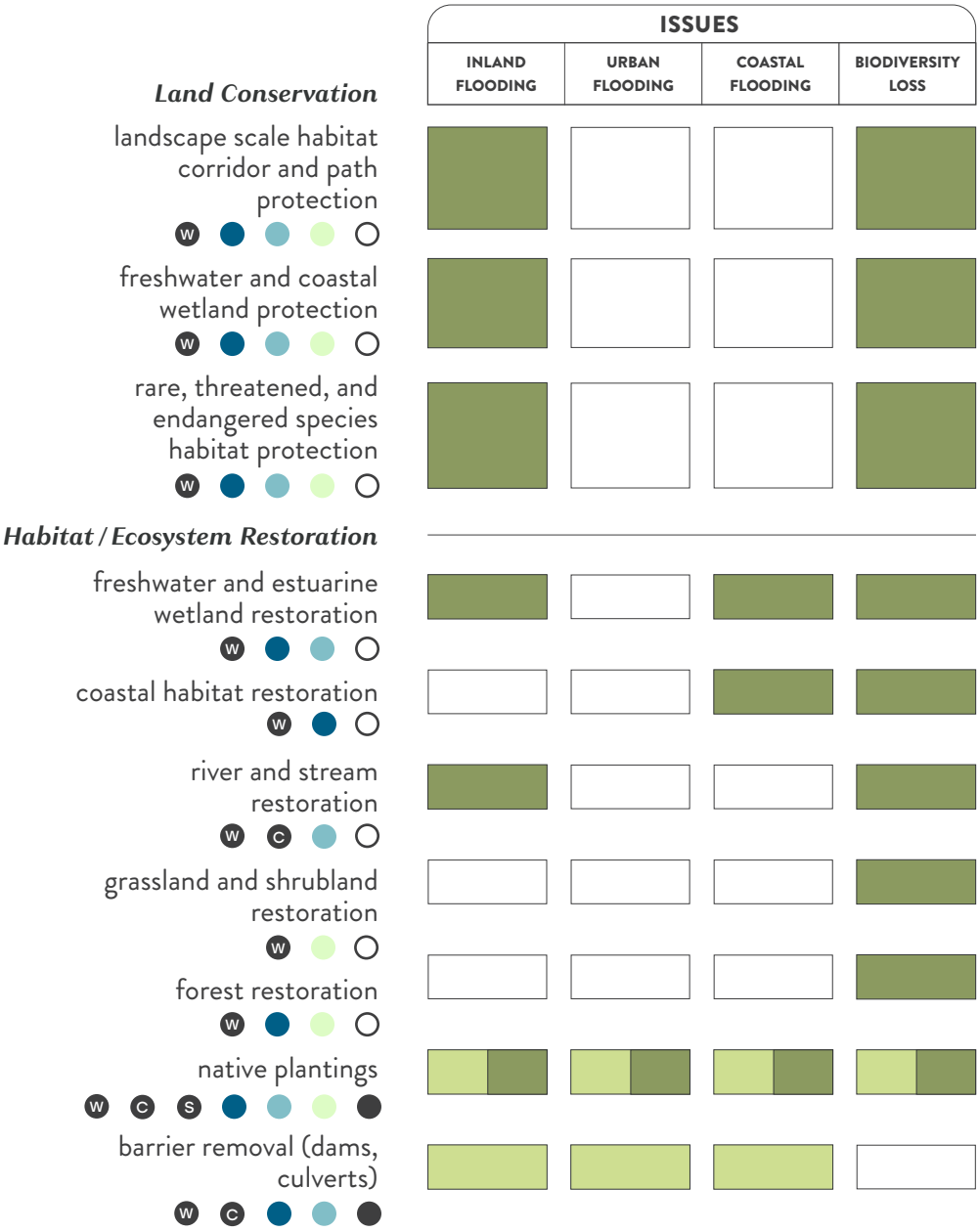
Coastal Zone
Stabilize the shoreline, reduce erosion, and buffer the coast from storm impacts.

Riverine Zone
Create and restore the hydrological flow in rivers, streams, and associated habitat.

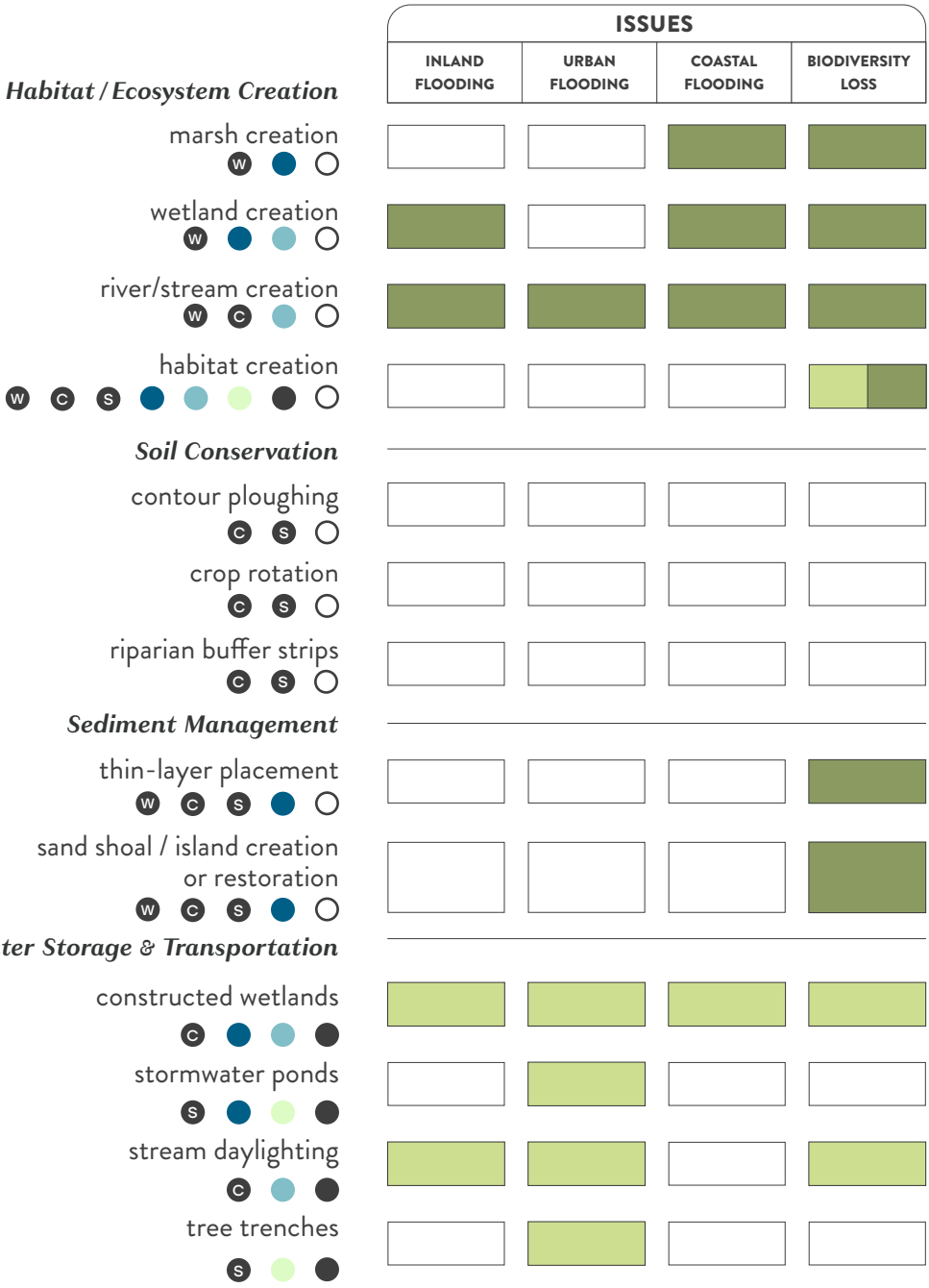
Inland Zone
Adaptable to all landscapes.

Developed
Land that has been built on or heavily altered for human use. May have houses, roads, utilities, and other infrastructure that makes it ready for human habitation or other uses.

Undeveloped
Land that has not been built on or heavily altered for human use. Lacks buildings, infrastructure, and utilities and is considered vacant or uninhabited by humans. This land could be left in its natural state, used for agricultural purposes, or used for grazing.


ISSUES
INLAND FLOODING
URBAN FLOODING
COASTAL FLOODING
BIODIVERSITY LOSS
Land Conservation
landscape scale habitat corridor and path protection
freshwater and coastal wetland protection
rare, threatened, and endangered species habitat protection
Habitat / Ecosystem Restoration
freshwater and estuarine wetland restoration
coastal habitat restoration
river and stream restoration
grassland and shrubland restoration
forest restoration
native plantings
barrier removal (dams, culverts)


ISSUES
SEDIMENT & SOIL LOSS
SHORELINE EROSION
WATER QUALITY IMPAIRMENTS
DROUGHT
WILDFIRE
AIR POLLUTION
URBAN HEAT


ISSUES
INLAND FLOODING
URBAN FLOODING
COASTAL FLOODING
BIODIVERSITY LOSS
Habitat / Ecosystem Creation
marsh creation
wetland creation
river/stream creation
habitat creation
Soil Conservation
contour ploughing
crop rotation
riparian buffer strips
Sediment Management
thin-layer placement
sand shoal / island creation or restoration
Water Storage & Transportation
constructed wetlands
stormwater ponds
stream daylighting
tree trenches


ISSUES
SEDIMENT & SOIL LOSS
SHORELINE EROSION
WATER QUALITY IMPAIRMENTS
DROUGHT
WILDFIRE
AIR POLLUTION
URBAN HEAT


ISSUES
INLAND FLOODING
URBAN FLOODING
COASTAL FLOODING
BIODIVERSITY LOSS
Water Filtration
bioretention ponds
bioswales
rain gardens
permeable pavement
Green Space Creation
parks
greenways
urban gardens
stormwater parks
waterfront parks
Built Environment Enhancement
green roofs
green facades
Shoreline Stabilization
living shorelines
revegetation

ISSUES						
SEDIMENT & SOIL LOSS	SHORELINE EROSION	WATER QUALITY IMPAIRMENTS	DROUGHT	WILDFIRE	AIR POLLUTION	URBAN HEAT

Policy Recommendations for Natural & Nature-Based Solutions

Although the first year of the Nature-Based Exchange did not devote an entire workshop to policy considerations for natural and nature-based solutions (NNBS), the topic came up repeatedly in each of the workshops. There are many groups actively interested in this topic and will be something the Nature-Based Exchange explores more deeply in subsequent years. The following are general considerations and recommendations discussed during Year 1 as well as several examples and resources from other states. This list is not exhaustive but meant to show a few examples. Additionally, the resources below have a heavy emphasis on flooding and stormwater; there is future opportunity to explore further policy recommendations for NNBS that provide benefits for other issues.

General Considerations

- Promoting NNBS requires policy and practices that affect both how we build and where we build. Community planning and regulations can direct development to areas that are less vulnerable to hazards, while site design practices and construction can be required to reduce those vulnerabilities.1
- Managing hazards and improving community resilience will require a variety of large and small policies and practices that occur at different scales and in different parts of the community.[1]
- Policies and practices will involve may different governmental departments and involve several different code sections. This will require comprehensive planning and coordination.[1]
- Increasing community resilience and effective NNBS is not easily done in an ad hoc or piecemeal manner. Instead, they should be incorporated into the most basic planning and decision-making activities of the community. [1]
- All policies and practices need to consider risk, adaptive management, and future conditions.

State Planning and Funding

South Carolina can incorporate NNBS approaches into resilience planning. The South Carolina Office of Resilience, established in September 2020, recently released the Statewide Risk Reduction and Resilience Plan[2]. This plan calls out NNBS in several recommendations, including establishing a resilience grant/loan program that would fund projects including NNBS, reviewing and removing barriers to permitting NNBS, and prioritize and fund land conservation that provides flood mitigation benefits.

Other states that have incorporated NNBS into resilience planning include[3]:

- Virginia (HB 516, 2022): Specified that the Virginia Coastal Resilience Master Plan must be updated at least every five years and must recognize the importance of protecting and enhancing natural infrastructure and nature-based approaches to flood mitigation when possible.
- California (AB 72, 2021): Required the Natural Resources Agency to explore and implement options to establish a more coordinated and efficient regulatory review and permitting process for coastal adaptation projects that use natural infrastructure.
- California (SB 170, 2021): Allocated funding to support regional climate adaptation planning and action plans. The bill specifies the plans shall use natural infrastructure to respond to climate vulnerabilities where feasible.
- Florida (SB 712, 2020): Required the Departments of Environmental Protection and Economic Opportunity, in cooperation with local governments in coastal areas, to develop a model stormwater management program that could be adopted by local governments. The program must contain ordinances that target nutrient reduction practices and use green infrastructure.

South Carolina is committed to land conservation and resilience through a suite of public programs and investments and a long-running conservation ethic among private landowners statewide. With 3 million acres conserved to date, South Carolina Governor Henry McMaster has staked a bold goal of doubling that number by 2050. SC Conservation Bank, established in 2002, invests in voluntary protection of private and public lands through a competitive grant

process guided by statewide prioritization mapping that incorporates resilience values. Additionally, the SC Department of Natural Resources owns and manages state Wildlife Management Areas and Heritage Preserves contributing significantly to the state's network of conserved and resilient lands. The SC Office of Resilience is empowered to support not only buyouts of properties with repetitive flood loss, but also floodplain restoration projects, and to invest in resilient land acquisition projects. For Fiscal Year 2023 – 2024, the South Carolina General Assembly, with support from Governor Henry McMaster, allocated $32.5 Million to the SC Conservation Bank for conservation project awards and $20 Million for habitat protection and land conservation acquisition to SC Department of Natural Resources. Additionally, the budget includes $200 Million to SCOR, which Governor McMaster describes as "for the purpose of identifying and preserving culturally or environmentally significant properties in which public access is in jeopardy of being lost forever due to development, mismanagement, flooding, erosion, or from storm damage."

Other funding mechanisms states have put in place to support NNBS projects include[3]:

- Arizona (SB 1740, 2022): Created a water conservation grant program to fund projects aimed at improving water use efficiency and reliability, including green infrastructure projects.
- The District of Columbia (D.C. Law 22-155, 2018): Created the Green Finance Authority to increase private investment in clean water, stormwater management and green infrastructure projects.
- Florida (SB 976, 2021): Encouraged new approaches and financing mechanisms for the protection of the state's wildlife corridor, including public-private partnerships, payments for ecosystem services, and blended financing for resilience and green infrastructure.
- Louisiana (HB 2, 2022): Appropriated over $3 million to the Lower Ninth Ward Green Infrastructure Project.
- Maryland (HB 653, 2022): Specified that the maintenance and repair of source watersheds, including the installation and maintenance of green infrastructure that improves water quality, is eligible for the same forms of

financial assistance as other water collection and treatment infrastructure. The bill also defined green infrastructure as "a land-based natural area or natural feature, or a system or feature designed to protect, mimic or enhance a natural function, that: absorbs and filters pollutants; protects communities from flooding or storm surge; reduces erosion; or sequesters carbon."

- The New Jersey Department of Environmental Protection and the state Infrastructure Bank partnered to administer the New Jersey Water Bank, which provides low-cost financing for water projects, including green infrastructure. The Infrastructure Bank was established under the New Jersey Infrastructure Trust Act as an independent state financing authority.

Local Plans, Regulations, and Incentives

- Local regulations, which require compliance, and incentive programs, which are voluntary, both play a key role in the utilization (or lack thereof) of NNBS – through both how we build and where we build.
- Regulations include codes and ordinances. Below are useful resources including model ordinances and policy examples from several cities around the country.
- Zoning ordinances specify the type of land uses and intensity uses allow on any given parcel.[4] Creating denser development and open space preservation may often be the most efficient and best way to promote overall resilience to flood hazards.[1]
- Street standards or road design guidelines dictate the width of the road for expected traffic, turning radius, the distance to other road to connect to each other, and intersection design requirements. Often, curb and gutter are required with road design which makes roadside infiltration swales and practices unfeasible and encourages pipe and pond collection systems.[4]
- Parking requirement generally set the minimum, not maximum, number of parking spaces required for retail and office parking. Setting minimums leads to parking lots designed for peak demand periods, which can create acres of unused pavement during the rest of the year.[4]

- Minimum setback requirements can spread development out by leading to longer driveways and larger lots. Establishing maximum setback lines for both residential and retail development brings buildings closer to the street, reducing the impervious cover associated with long driveways, walkways, and parking lots.[4]
- Model Flood Resilient Development and Building Ordinance -- augments the provisions of existing floodplain management regulations to enhance specific elements of residential building design in flood-prone areas. Specifically, it requires that structures built in Coastal A Zones meet the construction standards of Coastal V Zones. It also expands the regulations that are applicable in the 1% annual chance floodplain to the 0.2% annual chance floodplain. Under this ordinance, new structures associated with critical facilities cannot be located in the 0.2% floodplain. All new development must be built to an elevation that is 2 feet above the 0.2% flood elevation, measured from the bottom of the lowest horizontal structural member. Finally, it requires that real estate agents inform prospective buyers of the documented flood risk of the property.[1]
- Model Enhanced Stormwater Resilience Ordinance -- focuses on two elements that are generally not addressed in stormwater management regulations. The ordinance limits the amount of impervious cover that can be used in new development, based on the zoning classification of the project. It also mandates that stormwater from rooftop runoff be directed through an infiltrative area or structure before it is discharged into a conveyance system or a surface water body. These regulations enhance existing regulations by reducing stormwater runoff, and thus reducing the likelihood of flooding caused by peak flows that overwhelm the downstream infrastructure.[1]
- Model Tidal Flooding Resilience Ordinance -- recognizes that the most at-risk coastal properties are those that are vulnerable to damage from regular tidal flooding events. Therefore, it creates a regulatory district called the Area of Coastal Tidal Vulnerability (ACTV) in which there are additional land-use regulations, oversight over infrastructure investments, and investments in land conservation. The boundary of the ACTV is meant to be "rolling" in that

it moves upland as sea levels rise. Thus, in every new decade, an additional area is added to the ACTV based on the anticipated rate of sea level rise.[1]

- Green Factor Policy in Fife, WA -- In order to receive a project permit, new developments, redevelopments and construction sites must have a landscaping plan that achieves the green factor. Plans meet the green factor by implementing green factor elements, each of which have a score. The total green factor score that must be met is calculated by dividing "the green area factor by the lot area". Each green factor element has a correlated multiplier, which is used to calculate the green factor. The green factor elements include green roofs.[5]
- Policy for Construction of Vegetated Roofs in Devens, MA -- When building a green roof, a member of the construction team must be a Green Roof Professional (GRP). The policy requires that the vegetation on the roof not be an invasive species, and that it must be native plants with seeds appropriate to Devens' USDA hardiness zone (5b). Green roofs shall have a minimum of 4 inches of growing media that cover 40% of the roof area, with at least 80% coverage within three years of the date they are planted.[5]
- Sustainable Development Policy in Chicago, IL-- The Sustainable Development Policy requires that development projects earn a number of points by implementing select sustainable strategies. It applies to new developments, TIF funded developments receiving over $1 million, or multi-family housing projects over 5 units that receive specific financial assistance. All new developments are required to reach 100 points. The two compliance pathways are earning points from the strategies menu without building certifications or earning points from a building certification and earning the reset of the points from the strategies menu. The menu includes strategies in the following categories: health, energy, stormwater, landscapes, green roofs, water, transportation, solid waste, work force and wildlife. The green roofs will earn a project 10 points if 50-100% of the building's net roof area is covered with vegetation, or 20 points if it covers 100% of the net roof area. The net roof area is the gross roof area with the exception of the area for mechanicals, maintenance pathways, window washing systems, swimming

pools and skylights. More than 5 million square feet of green roofs have been implemented in Chicago to date as a result of its policy initiatives in support of green roofs.[5]

Incentives can be an important local tool for encouraging NNBS. Examples include[4]:

- Stormwater fee discount or credit – NNBS practices result in a stormwater credit and/or for those municipalities where there is a stormwater fee, NNBS practices receive a discount from the fee.
- Development incentives – Municipalities can offer incentives such as reduced permit fees, expedited permit process, higher density development allowance, and/or exemptions from permitting requirements if NNBS practices are used.
- Rebates and installation financing – Municipalities can offer grants, matching funds, low-interest loans, tax credits, and/or reimbursement when NNBS practices are used.
- Awards and recognition programs – Municipalities can recognize the people and places where NNBS practices are implemented. Recognition examples include newspaper articles, website announcements, notes in utility bill mailings, and/or NNBS-design contests.
- Monetary incentives – Incentives for landowners can include the outright purchase of land for protection or tax reductions for lands placed in easements.

Transportation[6]

There are two Federal requirements that could, in part, be addressed through the consideration and planning of nature-based solutions for coastal roads and bridges. There also is the option to create a programmatic mitigation plan, which can incorporate nature-based solutions.

- Discuss potential environmental mitigation activities and locations. The 20-year metropolitan transportation plan (MTP) and long-range statewide transportation plan (LRSTP) must include: "[a] discussion of types of

potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the [MTP and LRSTP]. The discussion may focus on policies, programs, or strategies, rather than at the project level. The [State and metropolitan planning organization (MPO)] shall develop the discussion in consultation with applicable Federal, State, regional, local and Tribal land management, wildlife, and regulatory agencies." As you are considering environmental mitigation activities and locations during transportation planning, consider their resilience functions. Are there natural areas that make sense to restore or protect because they are providing a resilience value to a road in addition to providing critical habitat?

- Improve the resiliency of the transportation system to natural hazards. 23 CFR § 450.206(a) calls for State DOTs and MPOs to "carry out a continuous, cooperative, and comprehensive statewide planning process that provides for consideration and implementation of projects, strategies, and services that will … improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation." NNBS can serve as a first line of defense and improve the resilience of roads in the coastal environment. For example, if properly designed, investing in the preservation, enhancement, and/or construction of natural shorelines can enhance the resilience of transportation assets protected by that shoreline.
- Consider developing a programmatic mitigation plan. Transportation agencies may choose to develop a programmatic mitigation plan in consultation with partner agencies with jurisdiction and special expertise in the resource areas, as part of the statewide and metropolitan transportation planning process. Programmatic mitigation plans address the potential environmental impacts of future transportation projects on a regional scale. These collaborative plans allow transportation and resource agencies to eliminate redundant investments, share data, and identify potential mitigation sites more effectively. The creation of this regional plan should reduce the level of coordination required on individual projects and reduce uncertainty around the level of effort needed to address potential ecological impacts. Another

benefit of programmatic mitigation plans is that the plan recommendations will be given substantial weight during the environmental review and permitting process. Consider identifying opportunities for nature-based solutions in a programmatic mitigation plan, which could make it easier to apply them to individual projects and reduce the need for offsite mitigation.

Agriculture[7]

Policy makers can enable the implementation of nature-based approaches through a variety of means including by law and regulation, economic incentives, capacity building, and communications.

- Governments, international agencies, businesses, and NGOs should support capacity and resources in agricultural extension services to advance the implementation of NNBS in agriculture in an inclusive and equitable manner.
- Policy makers should realign existing public subsidies and support for agriculture and fisheries, which total over $700B/yr globally with only 15% supporting the provision of public goods through NNBS. Public investments should support agriculturalists to produce food in ways that support nature and mitigate climate change. For example, the Conservation Title in the Farm Bill can continue to increase funding for source water protection activities that enhance water quality.
- Policy makers can also use innovative new approaches to provide bridge or transition funding to agriculture. These tools include agricultural lending, impact investing, and corporate investment incentives to benefit farmers who adopt NNBS practices.
- New insurance tools that reduce the risk to farmers for adopting NNBS or transitioning crop types or practices can help accelerate a transition to NNBS.

Equity

Section authored by Jenny Brennan, Climate Analyst, Southern Environmental Law Center

As practitioners work to advance the use of nature-based solutions, it is imperative that projects are planned and sited to achieve equity. This can mean that all communities, regardless of wealth or resource levels, have access to nature-based options, and residents are able to help shape the planning and design process from the very beginning to make sure that a project suits the needs of their neighborhood.

Nature-based options can successfully mitigate climate impacts such as heat and flooding more effectively than grey solutions alone, are often less damaging for the local environment than grey solutions, and more cost-effective in the long run. Nature-based solutions often can mitigate multiple hazards at once, such as vegetated stormwater retention park that controls flooding while mitigating urban heat effects. It is therefore important that the benefits of these projects are justly distributed across communities to offset existing harms and disproportionate impacts. Due to historical patterns of racial and economic injustice, people of color and lower wealth households often face greater exposure to environmental harms.[8] Future increases in climate-driven flood risks, for example, are expected to disproportionately impact Black communities in the South.[9] Additionally, due largely to historic practices of redlining, neighborhoods of low wealth and more people of color tend to have fewer trees and green spaces to help mitigate heat, which puts these populations even more at risk to extreme heat health hazards.[10] If designed and planned appropriately, nature-based solutions can help communities mitigate these challenges.

It is also critical that the potential impacts of poorly sited nature-based projects are acknowledged and avoided.[11] Nature-based solutions could contribute to displacement or gentrification in a neighborhood if care is not taken to avoid such impacts[12] If a project is planned or designed without adequate community engagement that centers the actual needs of a given community, rather than the perceived needs, the project will be unsuccessful. It is critical that neighborhoods affected by a project have key seats at the table and in leading a nature-based project.[13]

When implementing nature-based solutions, equity must be a central consideration in order to prevent worsening injustices or contributing to displacement. The following are good practices for incorporating equity into nature-based project implementation:

- **Community-centered, place-based, community-led** efforts are necessary and will be most successful.
- **Nature-based solutions must be accessible to all communities**, not just wealthier communities with the resources to hire consultants. It will take the entire workforce of nature-based practitioners to fill these gaps.
- **Nature-based options should maintain community cohesion by avoiding direct and indirect displacement**[14] Some green construction has resulted in gentrification that has pushed low-income residents out of their homes. It is crucial to consider measures to keep communities whole. For example, heirs' property owners may not be willing to convert their land to a traditional conservation easement, but there are other options to maintain land ownership while installing a nature-based solution to protect that community from climate hazards.
- **Elevate local and Indigenous Knowledge in project design and planning**.[15] Communities know their land the best and have lived experiences that can guide the placement and design of a nature-based project. Additionally, many nature-based solutions are built around methods from longstanding Indigenous Knowledge, and some local tribes may wish to have a hand in the implementation of these solutions. Practitioners should center native and local knowledge sources in planning processes.

Footnotes:

[1] Recommendations adapted from Enhancing Coastal Resilience with Green Infrastructure by Georgia Department of Natural Resources and UGA's Carl Vinson Institute of Government, published September 2020. https://coastalgadnr.org/ResiliencewithGreenInfrastructure

[2] South Carolina Strategic Statewide Resilience and Risk Reduction Plan, published June 2023. https://scor.sc.gov/resilience

[3] Information taken from State Policy Options for Green Infrastructure by the National Conference of State Legislatures, published December 2022. https://www.ncsl.org/environment-and-natural-resources/state-policy-options-for-green-infrastructure

[4] Information taken from Low Impact Development in Coastal South Carolina: A Planning and Design Guide by Ellis et al, ACE Basin and North Inlet-Winyah Bay National Estuarine Research Reserves, published 2014. https://northinlet.sc.edu/lid/

[5] Information taken from Green Roof and Wall Policy in North America: Regulations, Incentives, and Approaches by Hayden et al, Green Roofs for Healthy Cities, published 2023. https://greenroofs.org/policy-resources

[6] Information taken from Nature-Based Solutions for Coastal Highway Resilience: An Implementation Guide, by Webb et al, US Department of Transportation Federal Highway Administration, published August 2019. https://www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/implementation_guide/

[7] Information taken from Nature-based solutions in agriculture: The case and pathway for adoption by Iseman and Miralles-Wilhelm, FAO and The Nature Conservancy, published February 2021. https://www.fao.org/3/cb3141en/CB3141EN.pdf

[8] Chester Hartman & Gregory D. Squires (eds.), THERE IS NO SUCH THING AS A NATURAL DISASTER: RACE, CLASS AND HURRICANE KATRINA (2006). See also, e.g., Zack Colman & Daniel Cusick, 2 Hurricanes Lay Bare the Vulnerability of America's Poor, SCI. AM. (Oct. 1, 2018), https://www.scientificamerican.com/article/2-hurricanes-lay-bare-the-vulnerability-of-americas-poor/

[9] Wing, O.E.J., Lehman, W., Bates, P.D. et al. Inequitable patterns of US flood risk in the Anthropocene. Nat. Clim. Chang. 12, 156–162 (2022). https://doi.org/10.1038/s41558-021-01265-6

[10] Jeremy Hoffman, "The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas," Climate (2020), https://doi.org/10.3390/cli8010012; see also Jeremy S. Hoffman, "Throwing Shade," accessed July 18, 2023, http://jeremyscotthoffman.com/throwing-shade.

[11] Isabelle Anguelovski & Esteve Corbera. Integrating justice into Nature-Based Solutions to avoid nature-enabled dispossession (2022), Ambio, https://link.springer.com/article/10.1007/s13280-022-01771-7

[12] Alessandro Rigolon & Jon Christensen. Greening without Gentrification: Learning from Parks-Related Anti-Displacement Strategies Nationwide (2000), UCLA Institute of the Environment and Sustainability. https://www.ioes.ucla.edu/project/prads/

[13] Ebba Brink et al., Cascades of green: A review of ecosystem-based adaptation in urban areas (2016), Global Environmental Change, https://www.sciencedirect.com/science/article/abs/pii/S0959378015300674?via%3Dihub; Johanna Nalau et al., Ecosystem-based Adaptation: A review of constraints (2018), Environmental Science & Policy, https://www.sciencedirect.com/science/article/abs/pii/S1462901117310353?via%3Dihub

[14] Anguelovski, I., Corbera, E. Integrating justice in Nature-Based Solutions to avoid nature-enabled dispossession. Ambio 52, 45–53 (2023). https://doi.org/10.1007/s13280-022-01771-7

[15] Vogel B, Yumagulova L, McBean G, Charles Norris KA. Indigenous-Led Nature-Based Solutions for the Climate Crisis: Insights from Canada. Sustainability. 2022; 14(11):6725. https://doi.org/10.3390/su14116725

Looking Forward

The first year of the Nature-Based Exchange focused on bimonthly workshops that covered a range of topics identified by workshop participants. These seven workshops brought practitioners together to learn about natural and nature-based solutions, discuss problems and opportunities, brainstorm solutions, and network with individuals across state, industry, and sector lines. The success of the Exchange to date speaks to the timeliness of the workshop series and the significant need for the continuation of this type of regional scale coordination, engagement, planning and capacity building around nature-based solutions for resilience.

The next phase of the Nature-Based Exchange **is a transition from discussion to action**. The workshop series identified a shared vision and key needs to advance nature-based solutions in practical and equitable ways. Upcoming work will focus on needs advancement by providing resources and education where it will have the greatest immediate impact.

One of the biggest needs identified through the workshop series is **providing in-depth trainings** and **continuing education programs** to develop workforce capacity around nature-based solutions: from project development and design to regulatory authority to construction and maintenance.

In addition, the Exchange will **support the next generation of professionals** through graduate school fellowships and internships to enhance young professionals' experience and knowledge of nature-based solutions while also advancing resilience work in the state.

Along with workforce capacity, the workshop series identified the importance of the co-creation of nature-based project design and implementation with industry experts and community experts. To address this need, the Exchange will work towards **a series of design charettes** throughout our state, with deep and intentional community engagement and inclusion to design (and hopefully later fund and build) nature-based projects within their community.

Both the Common Messaging and Equity workshops identified the **need for more education around and familiarity of "nature-based solutions"**, which has become somewhat of a buzzword. To address this need, the Exchange is **hosting a podcast**, **Conversations with Nature**, to dive into this topic in an approachable and accessible way.

This is only a snapshot of what the Nature-Based Exchange hopes to accomplish in upcoming years. The Planning Team is so thankful to all who have participated to date. Working together, continuing conversations, and readily taking actionable steps will advance natural and nature-based solutions in South Carolina – and a key component is **YOU**.

Scan to visit our website and learn more about the Nature-Based Exchange.