WORKSHOP 1 PROCEEDINGS // MAY 18TH, 2022

THE NATURE-BASED EXCHANGE

Introduction to Natural & Nature-based Solutions

The Nature Conservancy · SURCULUS · School of ARCHITECTURE Resilient Urban Design · Biohabitats SOUTHEAST ATLANTIC BIOREGION · Robinson Design Engineers

Acknowledgments

Planning Team: This workshop series would not have been possible without the time, effort, and expertise of the planning team. Their countless hours of work led to the formation of a robust workshop series that Increased knowledge, spurred discussion, and produced tangible outcomes for South Carolina.

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Contributors: The successful execution of each workshop was due to our amazing contributors, including our speakers, panelists, and facilitators as well as those who worked behind the scenes to help us with planning and logistics, funding, and agenda-shaping.

Clemson Design Center
Host venue

Surculus
The Nature Conservancy
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Robinson Design Engineers
Nature-Based Exchange compendium

Amy Nguyen
Nature-Based Exchange compendium design

Workshop Series Timeline

There is often a gap between conceptualizing ideas for natural and nature-based solutions (NNBS) and developing practical and solution-oriented plans using them. To close this gap, The Nature Conservancy, Clemson's Resilient Urban Design Program, and the City of Charleston conducted a series of practical and outcome-based workshops that will bring together a variety of local partners to discuss and develop NNBS. The goal was to synthesize existing knowledge and information on NNBS, align it with opportunities and barriers within the state of South Carolina, and create practical and equitable steps for implementation.

There are a total of seven workshops in the series. The first workshop serves as a springboard for the rest of the series, offering an introduction to NNBS and gathering input from participants. The information gathered during this workshop will inform the focal topics for the remaining workshops.

Workshops 2 through 7 focused on one specific topic each to ensure a targeted conversation with produced outcomes.

WORKSHOP 1
Introduction to Natural and Nature-based Solutions
May 18th, 2022

WORKSHOP 2
Common Messaging on Natural and Nature-based Solutions
July 27th, 2022

WORKSHOP 3
Planning for Natural and Nature-based Solutions
September 14th, 2022

WORKSHOP 4
Funding Natural and Nature-Based Solution
November 16th, 2022

WORKSHOP 5
Equity in Natural and Nature-Based Solutions
January 18th, 2023

WORKSHOP 6 & 7
Design Standards for Natural and Nature-Based Solutions, Part 1 & 2
March 22nd, 2023
May 17th, 2023

Workshop 1: Introduction to Natural and Nature-based Solutions

Nature-based solutions incorporate both the natural environment and engineered systems that mimic or work in concert with natural systems to provide flood, fire, and drought risk reduction, as well as cleaner water and air.

Natural and nature-based solutions (NNBS) are a method to enhance ecosystem resilience in both natural and human-dominated systems. While these solutions are often considered for coastal problems such as sea level rise and flooding, riverine and urban systems can also benefit from this design. When implemented correctly, NNBS can provide habitat protection, prevent wildlife loss, create greener cities, and combat issues such as extreme weather, food production, and water resource management. These solutions act to protect, sustainably manage, and restore ecosystems to promote biodiversity and human well-being.

By working with existing natural systems and human-made infrastructure, NNBS can produce long-term social, economic, and environmental benefits.

MORNING SESSION
(9:30 am - 12:00 pm)

- Welcome and Introduction
- Presentation #1
  Nature Has Solutions - Why Science Matters by Joshua Robinson, MS, PE, Robinson Design Engineers
- Presentation #2
  Using Nature to its Full Advantage by Keith Bowers, FASLA, PLA, PWS, Biohabitats
- Panel Discussion

AFTERNOON SESSION
(1:30 - 4:00 pm)

- Featured Speaker
  The Intersection of Nature & Culture in the Gullah Geechee Cultural Heritage Corridor by Dionne Hoskins-Brown, PhD, NOAA
- Breakout Activities
- Performance, Cost, & Maintenance of NNBS Discussion
- Future Working Session Topic Selection and Discussion

Speaker Bio

Joshua Robinson, MS, PE

Joshua Robinson is a licensed professional engineer with 18 years of experience in analyses, planning, design, and implementation of natural resources and living infrastructure engineering projects across the Southeast. **Joshua founded Robinson Design Engineers (RDE) in 2008 in an effort to provide ecologically-based engineering analyses and design for low impact development projects, and to integrate ecosystem restoration into urban and rural communities.**

Joshua also serves as adjunct faculty at the College of Charleston's Environmental Geosciences Department, where he teaches on watershed hydrology and advises graduate students on research projects involving tidal hydrology, rainfall hydrology, water quality, and ecosystem restoration. Joshua was recently an instructor in NOAA's "Nature-Based Infrastructure for Coastal Hazards" training workshop, and Clemson's Coastal Low Impact Development (LID) workshop series.

(Above) Stream restoration project at Givens Estate a 200- acre retirement community in Asheville, North Carolina.

(Above) Constructed wetland project at a neighborhood in James Island, South Carolina.

(Above) Daylighting and stream restoration of Smith Branch in Columbia, South Carolina. Of the nearly 3,000 linear feet of stream located at the park, 2,000 had been piped underground since the 1950's. RDE's stream daylighting design restored the stream to the open air and revitalized the floodplain, now a key attraction of the public park.

WORKSHOP 1 PROCEEDINGS // INTRODUCTION

Nature Has Solutions: Why Science Matters

As the farmer-poet Wendell Berry once wrote, "**We cannot know what we are doing until we know what nature would be doing if we were doing nothing**." This philosophy guides the work of Robinson Design Engineers (RDE) and inspires them to emulate and catalyze the natural processes of self-renewing ecosystems. They are practitioners of nature-based solutions to flooding, erosion and sedimentation, stormwater management, and aquatic ecosystem impairment. Whether they are rehabilitating an urban creek, naturalizing a stormwater pond, stabilizing a riverbank, designing a green roof, enhancing the hydrology of a wetland system, or expanding a floodplain, their projects seek to:

1. **Reclaim as much natural function as possible**, and
2. **Enhance the system's capacity for self-renewal**.

These two goals require careful study of the natural context of the project area—particularly its geologic history, landscape process domain, and main biological actors and interactions. In the case of a living shoreline, for example, they restore the salt marsh edge by catalyzing and accelerating the natural healing process: strategically placed oyster shell reduces wave energy, induces sediment deposition, and allows marsh grasses and shellfish to reclaim their habitat and stabilize the marsh sediments. Without these simple interventions, the natural process would unfold in a similar manner but over a much longer time.

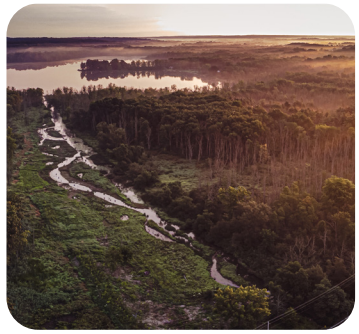
Where human systems have drastically altered the natural landscape processes, whether through damming or dredging rivers, filling saltmarsh with trash, extirpating keystone species, or massive land clearing, we must first recognize that "restoration" of nature is not fully possible in our lifetime. However, modern tools such as computer-based modeling of natural phenomena, remote sensing and data collection, and community-based monitoring, offer us new opportunities to study our natural systems and learn from them. This knowledge can help us restore functions that have been lost, while also guiding us to design new forms that benefit our human communities, such as urban riverscapes, natural breakwaters, and green stormwater infrastructure. Considering the many challenges we face, nature-based solutions are the best way to reconcile our communities to the natural world and build self-renewing systems of resilience.

Speaker Bio

Keith Bowers, FASLA, PLA, PWS

As the founder and president of Biohabitats, Keith Bowers leads a multidisciplinary mission driven organization focused on conservation planning, ecological restoration, and regenerative design.

Keith has applied his expertise to more than 1,000 projects throughout North America. Keith's work spans the scales from site-specific nature-based design projects that conserve biodiversity, mitigate climate change, and address environmental injustices, to regional landscape level projects that conserve habitat, sequester carbon and restore ecosystem processes. Keith served on the IUCN Commission on Ecosystem Management and currently serves on the board for the University of Pennsylvania's Ian L. McHarg Center for Urbanism and Ecology. Keith also served on the boards of the Society for Ecological Restoration and the Wildlands Network.



(Above) Beaver Creek Restoration – Restoring meander bends, reestablishing oxbows, and reconnecting Beaver Creek to an active floodplain in Northeast Ohio.

(Above) Anacostia Wetland Restoration – Planting freshwater tidal wetland plants along the shoreline of the Anacostia River in Washington D.C., to enhance aquatic habitat and improve water quality.

(Above) Fernhill Treatment Wetlands – Conversion of former sewage lagoons to native wetlands, creating an ecological bridge between wastewater treatment and the watershed, where water is cleansed, cooled and naturalized before its return to the Tualatin River in Forest Grove, OR.

WORKSHOP 1 PROCEEDINGS // PANEL DISCUSSION

Using Nature to its Full Advantage

Biohabitats has been designing, constructing and managing natural and nature-based projects since 1985. Being one of the early pioneers in the practice of ecological restoration and conservation planning, Biohabitats has seen the names describing this work evolve over time. While much of their early work was informed by the natural sciences and the fields of engineering and landscape architecture, there was little precedent for how to effectively apply ecologically based design to the landscape. In hindsight, one could say that they were '**tinkering**' with ways to repair ecological systems. Over time however, as their experience grew and as they learned more about the changing world around them, their work took on a whole new level of complexity and urgency.

Today's natural and nature-based work is driven largely by concerns over the looming collapse of biodiversity, climate change, and environmental justice. However, we cannot view nature simply in terms of the problems facing it, but also as a source of the many benefits and services it provides for life on this planet. As nature-based work continues, it would benefit us (and nature) to remember three key ideas:

1. **Nature is place-based**, **meaning it cannot be franchised to different locations**. Each site is uniquely unique. Pulling in local ecological knowledge and community support for site-specific projects is vital.

2. **Nature is alive**. We are dealing with living beings, living systems on a living planet, all in a dynamic balance. As life continues to evolve, so does our thinking and design.

3. **Nature is about reciprocity (a riot of reciprocity)**. When working with nature, we are influencing a suite of complex interrelationships and processes, nested systems, flows and cycles, all of which we may not yet fully realize or understand. Without a thoughtful understanding of nature – the physical elements, the relationships between and among species, and the processes that stitch life together – nature-based solutions will fail. If our tinkering is to evolve into positive, long-term impacts, we must continue to evolve, embracing all aspects of nature.

Panel Discussion

Panelists

Liz Fly, PhD, Director of Resilience & Ocean Conservation, TNC

Regina Ciphrah, PhD, Owner, Verbalizing Visions

Todd Martin, PLA, SITES AP, City of Columbia Parks & Recreation

Erin Stevens, RLA, LEED AP, President, Surculus

Brandan Scully, PE, PhD, US Army Corps of Engineers

Discussion moderated by Keith Bowers, Biohabitats.

In your experience, what have been specific barriers to implementing natural or nature-based solutions?

TODD MARTIN: Perception is a big one in the community. Most of the community is thriving and begging for this type of infrastructure, but there is a small segment of the community that doesn't really see the value; they see it as a danger, especially with water, wildlife, that type of situation. So, there's that component and then I say maintenance. Making sure that you understand the maintenance that you're getting into and that you're comfortable with maintaining these kinds of structures. **You also need to have the budget to maintain these types of structures** and the willingness to provide education because they're completely different than what we're used to maintaining.

ERIN STEVENS: I think that perception is an interesting concept because I think a lot of people in theory love the idea of nature but then once we start to implement it, we realize that the flowers and the butterflies are lovely but that also means snakes and mosquitoes and alligators. We must embrace that nature is dirty and messy and it can be inconvenient. We must also recognize that while these solutions and designs and ideas do have an immense benefit, there is a side to it that's not what we're used to. **We need to embrace the dirty side of nature as well**.

LIZ FLY: After a disaster, people immediately want to fix the problem and go back to how it was. They go back to the traditional gray infrastructure because they know it and know it works. Their minds do not go to the slower evolution of a natural solution that will renew over time and become better and stronger and stronger. That's a really important concept here to think about. **We need to build in pre-disaster so that we're ready for post disaster**.

BRANDAN SCULLY: I'll take it back to tinkering. **With a lot of these nature-based solutions there's not a set way to do it**. So, when we talk about agencies like the Corps or any state DOT, they want to have a way to do it - a recognized technological approach - and if the answer is we're going to tinker and it might not work, taxpayers don't love to hear that. You want to be assured that your solution's going to work.

REGINA CIPHRAH: I think the barrier that we have is the business of how we do school. What we measure of student learning and growth is valued in test scores and not necessarily in the skill sets and ingenuity that they're exposed to when they come out and learn about projects like the Boyd Living Shoreline. **How they engage in that and the work that they do, that really is learning; it's just not how we measure it**. And then it's the business of how we fund things like that. The schools don't have a lot of the resources that they may need to blur the walls of what the classroom looks like and provide the opportunities for educators to enact these types of projects with students and their families.

How do we embed diversity, equity, and inclusion (DEI) into the projects that we're working on?

REGINA CIPHRAH: I think often a lot of projects come in to extract data from the community without really seeding information or really valuing what's there. We often have an idea of what science looks like and who does science and what methods are valued. **Yet, communities who have been here for generations can tell you stories about what they have been observing and solutions that they have that never get brought to the table**. Solutions are usually brought to them with the expectancy that they will buy into the idea rather than asking, "What is it that you know? What is it you're doing? And how can we work together to solve this problem?'

> "Community engagement is not a nine-to-five job. How do we show up in ways and spaces where community members are to get the people that we want to speak to? We must meet them where they are."
>
> - Regina Ciphrah, Verbalizing Visions

TODD MARTIN: Trying to get a good cross-section with the entire community is really difficult. Community meetings alone just aren't enough. **It's not a one size fits all approach. Every community is going to be different.**

BRANDAN SCULLY: **You have to break out of this mindset that we're going to do this during business hours.**

ERIN STEVENS: There is an obligation to provide more equitable access to these things especially in an urban context where people might not have the access to drive to the mountains for the weekend. How do we bring these natural elements to the city so that there's more equitable access to the very clear and quantifiable benefits of exposure to natural elements in our everyday life?

KEITH BOWERS: We need to find ways to think about communities and the value communities and people bring versus the value of real estate.

WORKSHOP 1 PROCEEDINGS // PANEL DISCUSSION

Based on your experience, what is needed for NNBS to be successful?

LIZ FLY: Funding and maintenance.

REGINA CIPHRAH: The maintenance is probably the daunting factor in the conversation. **Engaging youth in this work and indoctrinating them with the idea that this is part of being a community member and living in this space.**

TODD MARTIN: **Private project incentives are huge.** In Columbia, they have a utility fee you pay monthly, and it's based off your impervious area. **In the public sector, I think funding is huge. Also, community buy-in and education.** When you do these types of projects, go for it to a certain degree and provide the educational signage. Maybe do some things that are a little more jarring, that makes you stop and say, "Why did they engineer a beaver dam in the middle of a park?"

ERIN STEVENS: We should be making sure the regulations are going to support this type of thinking down to the smaller, less glamorous projects. The only way this will be successful and reap the benefits that it can offer is being able to implement it at all scales and all types of projects. **We should figure out how to adjust our regulations to be more adaptable to embrace the living system as a solution as opposed to being the strict checklist of the gray infrastructure that we're accustomed to designing**.

BRANDAN SCULLY: Natural solutions tend to be a lot cheaper in some instances than traditional hard engineering because you're not doing as much. We must understand that it's a trade-off: you can spend a lot of money now and then have to take care of your asset as it degrades over time, or you can spend less money now and have it improve its benefit over time. I don't think a lot of information about that is readily available. **It's not just the capital cost that you need to look at, but the total cost of ownership**. And on the other side of that, I don't think there's a lot of literature about that.

KEITH BOWERS: **Life supports life.** If we're sacrificing a tree because we're supporting something else, then we're sacrificing life. And the more we can bring life back into our urban areas, back into our neighborhoods, our communities, or to the infrastructure that we're building, that's going to perpetuate and support more life. Natural and nature-based solutions **provide stacked benefits**. So, you may be solving for one benefit, say storm surge protection, but if you're using natural and nature-based solutions more than likely you're also getting benefits from a biodiversity standpoint, from a carbon sequestration standpoint, from a water filtration and water quality enhancement standpoint. **You're providing all these stacked benefits and yet in your cost-benefit analysis we very rarely, if at all, account for all those externalities**.

What are some of the obstacles and challenges you've had with maintenance as well as things you've tried that have been successful?

> "You can spend a lot of money now and then have to take care of your asset as it degrades over time, or you can spend less money now and have it improve its benefit over time"
> - Brandon Scully, PE, PhD

LIZ FLY: I think training and education is huge in that. **Training and education for parks department and local government staff to go out and do the maintenance.**

TODD MARTIN: Education is very important and not just for civil, landscape architects, and the people managing and overseeing this, but for the actual people in the field that's doing the work. Providing an incentive for them because they don't make a lot of money doing this and we ask a lot of them. We should pay them more to do this kind of work; they need to have a desire to do this kind of work as well.

ERIN STEVENS: **It's important to keep the people who either designed or thought of these systems engaged throughout construction and monitoring** because they understand the intention of the design and what plants should be there and what shouldn't. To make sure these are successful you have to have that vision carried out past construction and also through maintenance. You must also monitor the systems for an extended period of time to be sure they are functioning as they are intending so that we can design them better in the future.

REGINA CIPHRAH: This is about the generations to come and what they're going to inherit and so we've got to do that youth engagement piece – we've got to engage their families. **We've got to engage people in understanding that this is more important than your algebra one score.** If you don't get the why of these types of projects then we're totally missing the mark and perpetuating this thing - perpetuating that gray area - and not really be part of the solution. **There is so much you can learn by doing and by having the environment as the text.**

KEITH BOWERS: The 'living' part of that living infrastructure gets value engineered and compromised and that's the last thing that should be compromised on many of these projects. There's hardly any funding appropriated for maintenance and a lot of this living infrastructure takes at least three years, sometimes five to ten years, to really come in. In three years, you pretty well know the trajectory you're on and whether you're going to be successful or not, and you can make course corrections if you need to. But if you do anything less than three years then that project could be compromised in the future. **Embedding all those discussions and those ways of incorporating management and maintenance into your design from the very beginning helps.** If you wait to have those discussions when you're in the final construction documents then it's too late.

Speaker Bio

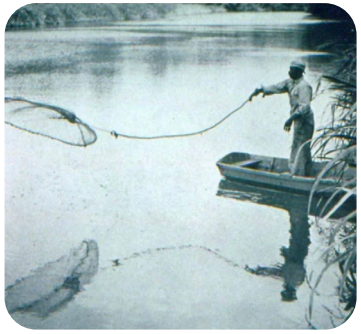
Dionne Hoskins-Brown, PhD

Dionne Hoskins-Brown is a NOAA Research Fisheries Biologist on loan from the National Marine Fisheries Service to Savannah State University. **Her long-term research on fish habitat and passion for African-American history on the coast led her to document the stories of Gullah Geechee fishing families in Georgia.**

For her work as an educator, she was selected as a recipient of the Emmeline Moore Prize, an honor bestowed by the American Fisheries Society for distinguished efforts to increase diversity in fisheries. Hoskins-Brown also serves as the Chairperson of the Gullah Geechee Cultural Heritage Corridor, a National Heritage Area. Hoskins-Brown received a Bachelors of Science in Marine Biology from Savannah State University and a Ph.D. from the University of South Carolina.

(Above) Ecological knowledges dates pre-emancipation and particularly to rice cultivation. Slaves planted rice by hand in the fields, which were irrigated using tidal flow from the Black River.

(Photo credit to Dr. Hoskins-Brown's presentation)

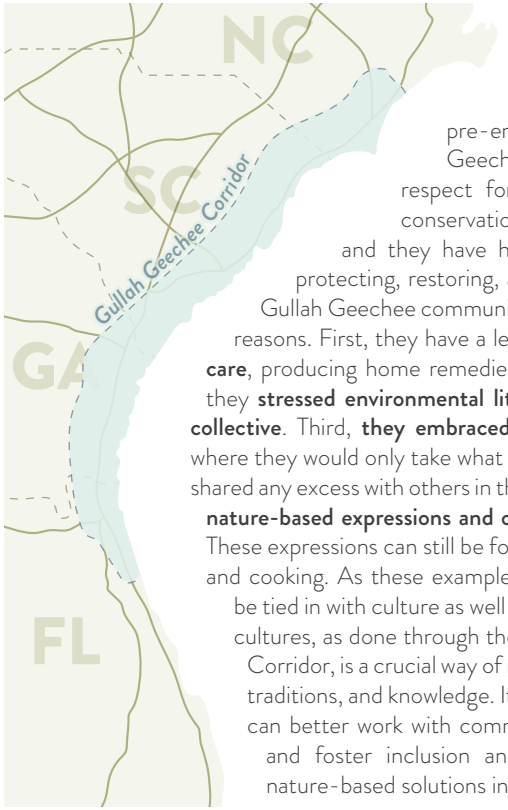


(Above) Fishing has been and continues to be an important aspect of Gullah culture, not only as a means to make a living and feed the family, but also as a community touchstone. Many times family reunions, fundraisers, and community celebrations are pot luck fish fries or oyster roasts.

(Photo credit: https://www.hiltonheadisland.org/gullah/culture/)

The Intersection of Nature & Culture in the Gullah Geechee Cultural Heritage Corridor

The final presentation of the day was given by the featured speaker, Dr. Dionne Hoskins-Brown (of NOAA's National Marine Fisheries Service). Her presentation took a detailed look at the intersection of nature and culture within the Gullah Geechee Cultural Heritage Corridor.



Nature-based solutions are not new to the Lowcountry; rather, they have been present in Gullah Geechee culture since pre-emancipation days. The Gullah Geechee people have always held a deep respect for nature; they were stewards and conservationists before the terms existed and they have historically understood the value of protecting, restoring, and engaging with the environment. Gullah Geechee communities are nature-based for a variety of reasons. First, they have a legacy that **embraced nature for self-care**, producing home remedies using natural ingredients. Second, they **stressed environmental literacy in the home and among the collective**. Third, **they embraced a sustainable, green value system** where they would only take what they needed (or could preserve) and shared any excess with others in the community. Fourth, they relied on **nature-based expressions and occupations for economic resilience**. These expressions can still be found today in art, sweetgrass baskets, and cooking. As these examples show, nature-based solutions can be tied in with culture as well as ecology. Preserving nature-based cultures, as done through the Gullah Geechee Cultural Heritage Corridor, is a crucial way of maintaining nature-based ideologies, traditions, and knowledge. It is by building off this history that we can better work with communities, use existing infrastructure, and foster inclusion and innovation to produce dynamic nature-based solutions in the future.

Gullah Geechee communities are nature-based because...

Gullah Geechee communities embrace nature for self-care

Sassafras tree leaves
Sassafras albidum

Toothache Tree
Zanthoxylum clava-herculis

Woody Mullein
Verbascum thapsus L.

- ☐ Spirits of Ammonia for upset stomach
- ☐ Persimmon bark for diarrhea
- ☐ Fatback or Nightshade plant leaves to heal sores
- ☐ Turpentine, camphor, kerosene, and sugar to remedy a cold
- ☐ Woody Mullein poultriced to remove swelling
- ☐ Sassafras tea to treat measles
- ☐ Toothache Tree for mouth pain
- ☐ Blackberry root for diarrhea
- ☐ Moss tea for asthma

Have a sustainable, green, value system

- ☐ Take what you need but do not take anything else.
- ☐ Share goods with fellow community members.
- ☐ Practice sustainable fishing and farming practices (such as crop rotation and returning shells to oyster reefs).

The image on the left showcases a rice field at Mulberry Plantation near Moncks Corner in Berkeley County, SC. (Photo credit: Library of Congress)

WORKSHOP 1 PROCEEDINGS // FEATURED SPEAKER

Environmental literacy is a core value in the home and among the collective

- ☐ Ecological knowledge predates emancipation.
- ☐ Oral histories describe fishing and farming practices.
- ☐ Acted as stewards and conservationists out of a deep respect and understanding of nature.

(Photo credit: Penn Center Historical Timeline)

Nature-based expressions and occupations for economic resilience

- ☐ Food collection (harvesting crops, fishing, hunting) and cooking.
- ☐ Paintings e.g. artist and painter Jonathan Green
- ☐ Sweetgrass baskets made of *Spartina patens*
- ☐ Heritage tourism

Workshop Takeaways

The workshop accomplished two main goals: (1) to educate attendees on what natural and nature-based solutions (NNBS) are and how they are currently being implemented in South Carolina and (2) to solicit feedback that will aid in designing the remaining workshops. Ultimately, this workshop series aims to produce tangible products and outcomes that will increase the use of NNBS in the state.

Natural and Nature-based solutions:

1. Reclaim as much natural function as possible, and
2. Enhance the system's capacity for self-renewal.

How to Approach Making a Change:

There is power in perception. We must work together to change the perception around NNBS to one that not only accepts, but also encourages and expects, the use of NNBS.

- **Workshop 2**: Common Messaging | This workshop began to address this perception shift by devising some common messaging that practitioners can use when talking about NNBS. Using a standard message will reduce confusion and build support with the public.

Existing mindsets must be broken. We cannot keep fooling ourselves that as "experts" our way is the best way and that our work operates on a 9am – 5pm schedule. We must work with communities, listening to their needs and concerns, rather than simply talking at them.

- **Workshop 4**: Equity | This workshop sought to address and improve issues of equity in NNBS by exploring where inequities lie and what solutions exist. Learning about historical and first-hand accounts of inequities can cause a mindset shift that leads us to listen and engage with communities in more equitable ways.

Everyone must get ready: firms in the industry, funders, decision-makers, community members, practitioners. For NNBS to expand and be successful, there must be buy-in from all stakeholders. This means communities must be educated on it and support it, funders must require it, firms must be willing and capable to do this work, and communities must be instilling in the next generation a desire to appreciate and maintain these systems.

- **Workshop 3**: Planning | This workshop explored ways that a community can get ready for NNBS through effective planning. Understanding what plans exist and what their purpose is can show where opportunities exist for NNBS, which can then be used by planners to enhance future plans.

- **Workshop 5**: Funding | This workshop examined how NNBS projects can be successfully funded, either through "external" funding sources or "internal" funding sources. Knowing what funding opportunities to pursue and how to complete grant applications can be the difference between implementing a NNBS project in a community or using traditional gray infrastructure.

- **Workshops 6 and 7**: Design Standards | These two workshops explored how NNBS can become more standard among the design community by discussing current practices, existing challenges, and future solutions. Providing resources and actionable steps to everyone in the design process – including those who design, install, and conduct monitoring and maintenance – can inspire the creation of future projects and enhance their success.

An Analysis of NNBS Performance, Cost, and Maintenance:

- Gray and green infrastructure have diverging performance curves: gray infrastructure gradually diminishes in value whereas green infrastructure increases in value as it grows.
- Green infrastructure can be cheaper than gray infrastructure, but the way the money is budgeted is different due to multi-year maintenance costs.
- Maintenance must be embedded in the design, budget, and execution of NNBS projects for optimal success.
- Decision makers at all levels of government want more data showing the long- and short-term success of NNBS projects so they can show stakeholders why they support these projects.
- As practitioners, we should be selling the benefits, not the features, of NNBS to the public.

Thank you to our attendees...

Thank you to everyone who attended the workshop. These individuals contributed their thoughts, energy, and enthusiasm to the exchange and are responsible for the ideas and content produced in this compendium.

Allison Acosta **City of Charleston Stormwater Department**

Tashya Allen **NOAA Office for Coastal Management**

Emily Bentley **S.C. Emergency Management Division**

Keith Bowers **Biohabitats, Inc.**

Marian Brailsford **Edisto Island Preservation Alliance**

Jared Bramblett **HDR Inc.**

Matt Brewster **Clemson Master of Resilient Urban Design Student**

Joy Brown **The Nature Conservancy**

Lee Bundrick **Kiawah Conservancy**

Alex Butler **S.C. Office of Resilience**

Josh Cato **Clemson Master of Resilient Urban Design Student**

Abraham Champagne **WSP**

Regina Ciphrah **Verbalizing Visions**

Nathan Dittman **DesignWorks**

Sherri Fields **National Audubon Society, S.C.**

Liz Fly **The Nature Conservancy**

Matt Gorstein **S.C. Sea Grant Consortium**

Winslow Hastie **Historic Charleston Foundation**

Rachel Hawes **Coastal Conservation League**

Kasey Henneman **Black & Veatch**

Dionne Hoskins-Brown **NOAA SEFSC**

Carol Jackson **Private Citizen Retired**

Kaylan Koszela **City of Charleston**

Abi Locatis Prochaska **S.C. DNR / ACE Basin NERR**

Susan Lyons **Charleston 3x3 Advisory Committee and Groundswell**

David Mackey **Clemson Master of Resilient Urban Design Student**

Todd Martin **City of Columbia, S.C.**

Sara McDonald **South Carolina Aquarium**

Katie McKain **City of Charleston**

Kim Morganello **Clemson University Extension / Clemson Resilient Urban Design**

Dale Morris **City of Charleston**

Amy Nguyen **Robinson Design Engineers**

Stephen O'Connell **Black & Veatch**

Fred Palm **Edisto Island Community Association**

Nicole Pehl **The Nature Conservancy**
Walter Reigner **Black & Veatch**

Joshua Robinson **Robinson Design Engineers**
Becky Ryon **Coastal Conservation League**

Caroline Schnell **City of Charleston**

Brandan Scully **Army Engineer Research & Development Center**

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