

# Strategies for Operationalizing Nature-Based Solutions in the Private Sector

**The Nature Conservancy Business Council**  
Natural Infrastructure Working Group

# Strategies for Operationalizing Nature-Based Solutions in the Private Sector

## About The Nature Conservancy's Business Council

TNC's Business Council is an invitation-only, collaborative platform for leading global companies to recognize value, gain expertise, and share experiences in corporate practices that will help create a world where people and nature thrive.

Nature-based solutions (NBS) have the potential to address pressing engineering needs while restoring natural landscapes. NBS – sometimes called natural infrastructure and green infrastructure – incorporate the natural environment that mimic or work in concert with natural processes to provide clean water, clean air, flood, fire and drought risk reduction, and other benefits. Unlike many forms of grey infrastructure, NBS also offer an array of economic, social, and environmental co-benefits. While there are several studies showing the application of these solutions in the public sector, there are far fewer studies highlighting how companies can operationalize and scale NBS. Building off the research of the World Business Council for Sustainable Development and other publications, this white paper shares knowledge from leading companies on opportunities, drivers, and strategies for scaling NBS. This shared knowledge was aggregated from interviews done with the eight member companies of The Nature Conservancy's Business Council between March and May 2018. The white paper ends by providing recommendations for how other companies can use these lessons to operationalize NBS within their own operations.

---

## CONTRIBUTING AUTHORS

Jeff Conti, Yale University

Nathan Cummins, The Nature Conservancy

Brad Gentry, Yale University

Lowell George, The Nature Conservancy

Abby Martin, Yale University

Jen Molnar, The Nature Conservancy

Martha Rogers, The Nature Conservancy

Jim South, The Nature Conservancy

Lauren Stoneburner, Yale University.

---

## CONTRIBUTORS

Tamara Barker, United Parcel Service

Lori Blair, The Boeing Company

Gabriela Burian, Bayer AG

Nathan Craig, Duke Energy Corporation

Paul Costa, The Boeing Company

Michael Donahue, AECOM

Dava Kaitala, The BNSF Railway Company

Gabe Lewis, Chevron Corporation

John Lovenburg, The BNSF Railway Company

Jon Philipsborn, AECOM

Tommy Polzin, The Dow Chemical Company

Steve Shestak, The Boeing Company

Kathryn Spitznagle, Caterpillar Inc.

Mark Weick, The Dow Chemical Company

# Contents

Introduction ..... 1

What are Nature-Based Solutions?..... 3

Primary and Secondary Drivers of  
Nature-Based Solutions ..... 8

Strategies for Operationalizing  
Nature-Based Solutions ..... 14

Internal Roadmap for Operationalizing  
Nature-Based Solutions ..... 17

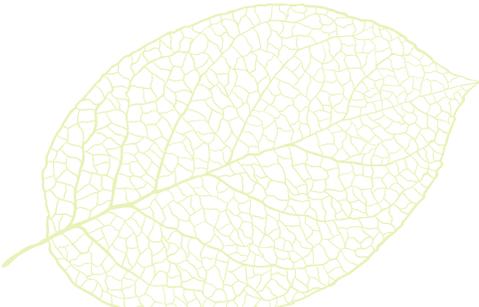
Conclusion and Next Steps ..... 20

Appendix A: Additional Resources ..... 21

Appendix B: Interview Process ..... 23

Appendix C: Questionnaire ..... 24

Appendix D: Key Questions to Consider Along  
Roadmap to Operationalizing Nature-Based Solutions ..... 26



# Introduction

Over the past several years, the public sector, environmental non-profits (including the World Business Council for Sustainable Development and The Nature Conservancy), businesses, and academic institutions have worked to advance the public and private sectors' capacity to incorporate nature-based solutions (NBS), particularly natural infrastructure and green infrastructure, into business operations. Collectively, they have published high-level strategic assessments of business drivers, cost benefits, available resources, as well as context-specific case studies (see Appendix A).

These efforts are important and complement the large body of work that has focused on evaluating the effectiveness of NBS in the public sector. For example, public coastal wetlands prevented more than \$625 million in property damages during Hurricane Sandy and reduced property damages throughout the Northeastern United States by 10 percent, on average.<sup>1</sup> More broadly, NBS, such as wetland and oyster reef restoration, could prevent up to \$50 billion in damages to assets along the Gulf Coast and have an average benefit-to-cost ratio of 3.5:1.<sup>2</sup> These examples highlight the potentially high cost effectiveness of NBS to the public sector and provide a glimpse into the potentially large benefits of private-led projects

The preceding body of literature on private-sector NBS initiatives, however, has shown that gathering information on specific policies, incentive programs, and technical methods and considerations can be challenging. This difficulty is, in part, because private-sector solutions are typically tailored to the business, location, and context of the project. Several NBS project selection tools have been released to aid in this process, but they are no replacement for localized knowledge and the broad integration of NBS into business processes.<sup>3</sup>

Despite the recent improvements in identifying and advancing the business drivers for NBS in the private sector, the topic needs further analysis and development to promote widespread corporate adoption. To date, there have been limited discussions around effective strategies for integrating NBS into business operations to achieve scale. This white paper seeks to address this gap by reviewing what drives private sector interest in NBS; how project managers integrate NBS into a company's decision-making processes; and what strategies have been employed to fully operationalize NBS within a company.

---

## Natural Infrastructure Initiative

In 2015, Caterpillar Inc. convened The Restoring Natural Infrastructure Summit which brought together more than 150 attendees representing companies, non-governmental organizations, policy makers, equipment dealers, and customers to discuss the challenges and opportunities to address the world's natural infrastructure issues. After the summit, Caterpillar Inc. formed the Natural Infrastructure Initiative, a coalition of parties interested in driving the changes necessary to develop and restore natural infrastructure. The coalition includes representatives from AECOM, Brown & Root, Caterpillar Inc., Dawson & Associates, Duck's Unlimited, Great Lakes Dredge & Dock, The Nature Conservancy and the University of Georgia. To date, the initiative has focused on increasing the awareness of and investment in natural infrastructure.

- 
- 1 Siddharth Narayan, Michael W. Beck, Paul Wilson, et al., "The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA," *Scientific Reports*, 2017 (7: 9643).
  - 2 Reguero, Michael W. Beck, David N. Bresch, Juliano Calil, and Imen Meliane, "Comparing the Cost-Effectiveness of Nature-Based and Coastal Adaptation: A Case Study from the Gulf Coast of the United States," *Plos One*, April 11, 2018.
  - 3 Two examples of project selection tools developed are the Natural Capital Coalition's Protocol Toolkit and the Ecosystem Services Identification & Inventory Tool. See Natural Capital Coalition. "The Natural Capital Protocol Toolkit," available at <https://naturalcapitalcoalition.org/protocol/protocol-toolkit/>; and Ecosystem Services Identification & Inventory (ESI) Tool. "About ESI," available at <http://www.esiitool.com/about/>.

In doing research for this white paper, we relied on both external sources and interviews with individuals across eight different companies, including sustainability leaders and environmental engineering experts. In total, we interviewed 18 individuals. All interviews occurred between March and May 2018. Appendix B lists all individuals interviewed, and Appendix C contains the questionnaire used for each interview.

Through these interviews and other reviews of the literature, this white paper presents a roadmap for operationalizing NBS within a company. Within this roadmap, we present strategies that can be implemented to move towards operationalization. Before presenting the framework, we review the standard definition of NBS, green infrastructure, and natural infrastructure. We then present a series of examples of NBS that have been implemented across the contributing companies. Throughout the white paper, we have also included case studies from the member companies that relate to specific projects or initiatives adopted within the company. Overall, the interviews revealed that companies are motivated to adopt NBS because of its ability to solve multiple business challenges simultaneously, but that fully operationalizing NBS will require long-term collaboration with both non-profits and policy makers.

---

*Public coastal wetlands prevented more than \$625 million in property damages during Hurricane Sandy and reduced property damages throughout the Northeastern United States by 10 percent, on average.*



©Vojtech Herout

# What are Nature-Based Solutions?

There are many similar yet distinct terms for NBS, including green infrastructure and natural infrastructure. Unfortunately, there is no universal definition for any of these terms and, in many instances, they are used interchangeably, which may add to confusion. Below, we define the three terms that are most relevant to this white paper.<sup>4</sup>

**Nature-based solutions (NBS)** is the broadest term referring to project solutions that are motivated and supported by nature and that may also offer environmental, economic, and social benefits, while increasing resiliency. NBS include both green and natural infrastructure, but may also include other non-infrastructure solutions, such as ecosystem-based management (e.g., forest carbon projects and conservation)<sup>5</sup>

**Green infrastructure** generally refers to projects designed and built in urban areas. Typically, urban areas are more degraded and, as such, green infrastructure projects require a more engineered solution, such as a bioswale, permeable pavement, or a green roof.<sup>6</sup>

**Natural infrastructure** generally refers to projects that incorporate existing or restored natural landscapes, such as floodplains, wetlands, and forests. Typically, natural infrastructure projects involve a strategically managed landscape, such as a forest or wetland, to provide a set of desired benefits, such as carbon sequestration, flood control, or water filtration.<sup>7</sup>

In this report, for ease of exposition, we use the term “nature-based solutions,” or NBS, to refer to both natural and green infrastructure projects. We recognize that NBS encompasses a much broader set of strategies, many of which are not addressed explicitly in this white paper.

In recent years, NBS projects have been adopted by companies in increasingly large numbers. Companies are utilizing NBS to solve a wide array of operations and maintenance challenges. Below, we discuss the range of NBS that were highlighted in our company interviews, broken out by the challenges that they address.

---

4 For an explanation of how the use of these terms have differed in the academic, public, and private sectors see: José Maria Cardoso da Silva and Emily Wheeler, “Ecosystems as Infrastructure,” *Perspectives in Ecology and Conservation*, 2017 (15): pp. 32-25.

5 “Nature-Based Solutions,” International Union for Conservation of Nature, available at <https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions>.

6 “Natural & Green Infrastructure,” Association of State Wetland Managers, available at <https://www.aswm.org/wetland-science/wetlands-and-climate-change/natural-green-infrastructure>.

7 Suzanne Ozment, Kara DiFrancesco, and Todd Gartner, “Natural Infrastructure in the Nexus,” Nexus Dialogue Synthesis Paper, 2015, available at [http://www.iwa-network.org/wp-content/uploads/2016/06/Natural-Infrastructure-in-the-Nexus\\_Final-Dialogue-Synthesis-Paper-2015.pdf](http://www.iwa-network.org/wp-content/uploads/2016/06/Natural-Infrastructure-in-the-Nexus_Final-Dialogue-Synthesis-Paper-2015.pdf).



© The Nature Conservancy | Constructed Wetland

## Water Treatment

**Constructed Wetlands:** Constructed wetlands are a natural method of filtering water. The vegetation in wetlands traps suspended solids as water flows through the system while plants and microorganisms take up other pollutants in the water. For example, a constructed wetland can convert organic nitrogen from fertilizer into usable inorganic forms. Constructed wetlands are often cheaper to build and require lower operations and maintenance expenses than a wastewater treatment plant, but do require more physical space than a wastewater treatment plant. Constructed wetlands are one of the most popular forms of NBS – the U.S. Environmental Protection Agency estimates that there are more than 1,000 operating constructed wetlands in the U.S. and more than 5,000 in Europe.<sup>8</sup>

**Treatment Channels:** Rocks can be strategically placed within naturally occurring streams to treat industrial water. For example, limestone is an alkaline agent that can be used to neutralize strong acids. Lining a channel with limestone will naturally balance acidic waters without requiring a chemical treatment system. As the stream's water becomes neutralized, the habitat can be restored through, in part, substrate selection and geochemistry. As the habitat is restored, fish and other wildlife will be able to take up habitat in it. Streams can also be built to meander to provide additional time for water treatment and infiltration.

---

8 U.S. Environmental Protection Agency, "Constructed Treatment Wetlands," August 2004, available at <https://nepis.epa.gov/Exe/ZyPDF.cgi/30005UPS.PDF?Dockkey=30005UPS.PDF>.



© Kevin Arnold

## Reducing Stormwater Runoff

**Bioswales:** Bioswales are shallow ditches that are designed to manage stormwater runoff from nearby impervious surfaces, such as roads and parking lots. For example, the construction of naturally vegetated filter strips in parking lots can protect nearby water bodies by mitigating the effects of nonpoint source pollutants such as floatables, nutrients, pesticides, sediments, and suspended solids, as well as slowing and reducing the amount of runoff. Portland, Oregon, installed one of the first large-scale bioswales (2,330 lineal feet) in 1996 in the Willamette River Park to capture and reduce pollutant runoff into the Willamette River.

**Bioretention Ponds:** Bioretention ponds, like bioswales, are designed to treat stormwater runoff, typically from nearby large impervious surfaces. The area surrounding the pond uses strategically placed soils and plants to remove water pollutants. Stormwater is then stored in the ponding area for a few days where it will infiltrate the ground or evapotranspire. The remaining water is slowly released into a nearby water body. Bioretention ponds were first developed in the early 1990s by the Prince George's County, Maryland, Department of Environmental Resources.<sup>9</sup>

**Rain Gardens:** Rain gardens operate similarly to bioswales and bioretention ponds, but are often smaller and simpler. They consist of a depressed area that is filled with grasses and other perennial plants that collect, slow, and filter rainwater.



© Karine Aigner

**Green Roofs:** Green roofs refer to traditional roofs that have been overlaid with a waterproof membrane, soil, and plants. Green roofs impact stormwater runoff via two mechanisms: (i) the plants on the roof absorb stormwater directly, reducing the amount of water that makes it into the sewer system; and (ii) the plants on the roof slow the rate at which stormwater flows into the sewer system. Additionally, green roofs can provide business benefit by reducing ambient air temperatures and by reducing building energy requirements. They also create habitat for birds and insects. Green roofs were first introduced as a modern concept in the 1950s and 1960s but, more recently, the green roof business has been growing 10% to 15% annually in the United States.<sup>10</sup>

9 U.S. Environmental Protection Agency, "Stormwater Technology Fact Sheet: Bioretention," September 1999, available at <https://nacto.org/wp-content/uploads/2012/06/US-EPA-1999.pdf>.

10 Hilary Brueck, "Raising the Green Roof: Why More Big-City Businesses are Putting Plants Up Top," *Forbes*, May 31, 2017, available at <https://www.forbes.com/sites/hilarybrueck/2017/05/31/raising-the-green-roof-why-more-big-city-businesses-are-putting-plants-up-top/#56ddd15353fb>; and U.S. General Services Administration, "The Benefits and Challenges of Green Roofs on Public and Commercial Buildings," May 2011, available at [https://www.gsa.gov/cdnstatic/The\\_Benefits\\_and\\_Challenges\\_of\\_Green\\_Roofs\\_on\\_Public\\_and\\_Commercial\\_Buildings.pdf](https://www.gsa.gov/cdnstatic/The_Benefits_and_Challenges_of_Green_Roofs_on_Public_and_Commercial_Buildings.pdf).



© Carlton Ward Jr.

## Erosion Control

**Best Land Management Practices:** Farmers and other large-scale land users can implement various forms of NBS as best management practices to reduce fertilizer and insecticide runoff and erosion. For example, buffer strips of native vegetation around fields can reduce nutrient-rich runoff from reaching nearby waterways. And, fields with steep slopes or lands that are highly susceptible to erosion can benefit from areas of native plantings. The U.S. Department of Agriculture includes many of these practices in their recommendations.<sup>11</sup>

**Green-Grey Hybrids:** In hybrid approaches, NBS is combined with grey infrastructure to maximize the benefits of both approaches. Hybrid infrastructure has been studied extensively in the context of coastal resilience where, for example, sea walls may be combined with oyster reefs to protect against erosion and flooding.<sup>12</sup>



© BNSF | Xeriscaping at BNSF Railway HQ Campus

## Reduced Irrigation and Maintenance Needs

**Strategic Planting:** Strategic planting includes both native landscapes and xeriscaping. Native landscaping refers to the planting of a landscape with plants and grasses that are native to the region. Xeriscaping began as a movement around conserving water in gardens in the western United States. Today, it refers to landscapes that are designed to require less irrigation. Xeriscaping focuses on selecting plants for water conservation, which may or may not be native plants.<sup>13</sup> Both landscaping tactics are important sources of habitat for birds and insects and are more resistant to disease and drought. Strategic planting can provide business value by reducing maintenance costs, often through reduced irrigation needs and pesticide application, and less-frequent mowing. Less mowing can also result in reduction of fossil fuels consumed and fewer emissions.

- 
- 11 A.N. Sharpley, T. Daniel, G. Gibson et al., "Best Management Practices for Minimize Agricultural Phosphorus Impacts on Water Quality," U.S. Department of Agriculture, July 2006, available at <https://www.ars.usda.gov/ARSUserFiles/oc/np/BestMgmtPractices/Best%20Management%20Practices.pdf>.
- 12 Ariana E. Sutton-Grier, Kateryna Wowk, and Holly Bamford, "Future of Our Coasts: The Potential for Natural and Hybrid Infrastructure to Enhance the Resilience of Our Coast Communities, Economies, and Ecosystems," *Environmental Science & Policy*, 2015 (vol. 51): 137-148.
- 13 Becca Rodomsky-Bish, "The Seven Principles of Xeriscape," Cornell Lab of Ornithology, October 20, 2015, available at <http://content.yardmap.org/learn/the-seven-principles-of-xeriscape/>.



© Chevron | Richmond Water Enhancement Wetland

## Reuse of Decommissioned Sites

**Wetland Restoration:** In the U.S., large areas of unused land can be restored, enhanced, or preserved as wetlands. These wetlands provide important habitats for plants and animals, including migratory birds. In many instances, these wetlands can be sold as compensatory mitigation credits under the Clean Water Act. Mitigation banks serve as compensation for unavoidable impacts caused by infrastructure or other projects. As of 2013, there were more than 1,800 established wetland mitigation banks in the United States.<sup>14</sup>

**Bioengineering Inland Waters:** Bioengineering, or the use of natural systems or processes in engineering, can be used to enhance large-scale landscapes such as those remaining after a site is decommissioned. For example, as large treatment systems are decommissioned, wetland vegetation, pollinator habitat, and habitat enhancement for bat and avian species can be used as natural solutions to not only enhance the old industrial landscape, but also to further remediate the site, control nonpoint source pollution, and provide an educational area for the local community. Another example is the use of walls of willow trees that capture sediment upstream and prevent it from dirtying downstream rivers.<sup>15</sup>

## Chevron Corporation's Restoration of Decommissioned Sites

The Chevron Corporation's Richmond Water Enhancement Experimental Wetland is situated on 90 acres of former effluent treatment ponds and serves as an attractive resting spot for migratory waterfowl, full of deep channels and dense areas of reeds and duck mounds. During the spring and fall, more than 100 species of birds seek refuge in the marsh. Chevron also completed the Wildcat Creek Marsh Restoration Project on more than 250 acres of natural wetlands northeast of a refinery. Over the years, sediments had been deposited that cut off tidal access to these wetlands. Restoration included forming slough channels to the saltwater marsh. The tides flow through these wetlands and into two restored ponds. The wetlands now provide critical habitat for two endangered species – the Salt Harvest Mouse and the California Clapper Rail.

14 U.S. EPA, "Mitigation Banking Factsheet," available at <https://www.epa.gov/cwa-404/mitigation-banking-factsheet>.

15 Sara Mynott, "Bioengineering Could be the Answer to Dirt-Free Dams," Energy, Resources, and the Environment, EU General Assembly, April 11, 2013, available at <https://blogs.egu.eu/geolog/2013/04/11/bioengineering-could-be-the-answer-to-dirt-free-dams/>.



© Aliaksei | New York City Manhattan Central Park



© BNSF

# Primary and Secondary Drivers of Nature-Based Solutions

Companies adopt NBS for a variety of reasons. NBS frequently result in outsized and longstanding benefits due to their ability to address multiple business challenges at once.<sup>16</sup> For this reason, NBS are often dubbed “win-win” solutions, providing cost-effective business solutions and ecosystem value.

We interviewed eight companies for whom seven specific drivers were primary or secondary reasons for motivating internal adoption of NBS.<sup>17</sup> Figure 1 (page 9) summarizes which drivers were most frequently listed as primary concerns and Figure 2 (page 11) summarizes which drivers were most frequently listed as secondary. A full summary of each driver is provided below.

In terms of primary NBS drivers, lower project costs (financial savings) and managing regulatory requirements and risk were the most frequently cited. While not listed as a top primary driver, achieving sustainability goals was most frequently cited as a secondary driver for NBS. These results show that companies are motivated to adopt NBS because of their ability to directly influence the bottom line and achieve regulatory compliance while helping them accomplish long-term sustainability goals.

---

## The BNSF Railway Company Erosion and Bank Stabilization

BNSF increasingly uses a hybrid green-grey infrastructure approach to deal with erosion around its railroad bridge piers. Rather than a conventional method called armoring that cements stones in place within waterways, BNSF uses large stones and leaves gaps that can fill naturally with silt and aquatic vegetation. These gaps allow small fish and other aquatic species to hide to avoid predators. This technique often outperforms conventional approaches on both financial and physical metrics and is preferred by permitting agencies. Maintenance for the stone-vegetation combination is comparable to, or less expensive than, maintenance required for the conventional cemented riprap. Similarly, steep hillsides in right-of-ways are prone to erosion. Where it makes sense, BNSF is increasingly replacing its conventional hardening the slope with concrete with a green-grey mix, interspersing rocks with native plantings. BNSF found that conventional flat concrete panels could sometimes lead to erosion under the panel or in adjacent areas but mixing in vegetation slows water flows and can better stabilize the banks.

---

16 C.S. Holling, “Resilience and Stability of Ecological Systems,” *Annual Review of Ecology and Systematics*, 1973 (vol. 4): pp. 1-23.

17 For the purposes of reporting results, we have combined responses from short-term financial savings and long-term financial savings into one category, “lowering project costs,” and from managing risk and managing regulatory requirements into one category, “managing regulatory requirements & risk.” See Appendix C for a list of all ten drivers discussed in the interviews.

Figure 1

**Primary Business Drivers for Adopting Nature-Based Solutions**

Number of positive company responses if a driver was a primary concern



**Primary Drivers**

**Lowering Project Costs**

NBS can provide both short- and long-term financial savings for a company. Almost every company cites lower capital expenditures and greater savings in operations and maintenance (O&M) as a major driver of NBS. NBS often require less labor, machinery, and material inputs to create, maintain, and operate than grey infrastructure projects.

Certain NBS may also provide direct, upfront financial savings due to lower installment costs, such as constructed wetlands in lieu of wastewater treatment plants. Other NBS may require more upfront costs but, over time, will provide financial savings due to their reduced O&M expenses. For example, a xeriscape landscape may be more expensive to install than turf, but will be cheaper over the long term because it requires less water than turf and does not require mowing.<sup>18</sup>

18 World Business Council for Sustainable Development, "The Business Case for Natural Infrastructure," December 2015, available at [https://www.naturalinfrastructureforbusiness.org/wp-content/uploads/2016/02/WBCSD\\_BusinessCase\\_jan2016.pdf](https://www.naturalinfrastructureforbusiness.org/wp-content/uploads/2016/02/WBCSD_BusinessCase_jan2016.pdf).

## Managing Regulatory Requirements and Risk

After lowering project costs, the companies cite managing regulatory requirements and risk as the second ranked primary driver of NBS adoption. Regulations can drive adoption of NBS on various company landholdings, such as active sites, contaminated sites, and habitat sites, given their risk is properly mitigated.

For active operations, key regulations range from federal statutes, like Clean Water Act requirements, to local regulations, like municipal stormwater fees. Active operations sites can use NBS to speed up the permitting process, which can save a company time and money. But, NBS, like any new infrastructure project, must comply with all federal, state, and local regulations.

For sites with existing or newly-created habitat, companies should proactively plan for compliance with federal statutes like the Endangered Species Act. With proper planning, companies can mitigate their risk and create successful environmental outcomes through NBS investments in habitat.

The geographic location of the site can also affect the amount of regulatory risk related to the site. For example, establishment, maintenance, and sustainability of NBS is more challenging in areas with shorter growing seasons and harsher weather conditions (e.g., the high latitude plains of the U.S. and Canada). These challenges present increased regulatory risk to achieving regulatory milestones for NBS projects.

Contaminated sites are regulated through various state and federal EPA regulations. On the federal side, one of the main regulatory drivers comes through The Comprehensive Environmental Response, Compensation, and Liability Act, commonly referred to as CERCLA, which grants the Federal Government the authority to recover damages from the release of hazardous substances into the environment that results in degradation or harm to the natural environment.<sup>19</sup> For properties that require restoration or remediation, NBS can help to facilitate the agreed-upon outcomes.

However, while regulatory requirements can be key drivers to NBS adoption on various types of company landholdings, in some cases regulations can provide implementation deadlines that can hamper the adoption of NBS. It is important for flexibility in monitoring and compliance to ensure the benefits of NBS can be appropriately realized while abiding with the regulations' outcomes.<sup>20</sup> Nevertheless, NBS can serve as a venue for engaging local policymakers on the benefits of NBS and for facilitating a more pragmatic regulatory framework.

---

## The Boeing Company Using Green Infrastructure for Regulatory Engagement

The Boeing Company uses green stormwater infrastructure for connecting and collaborating with the surrounding community. The Boeing Company complements its green stormwater infrastructure projects with environmental education components for policy makers and the general public, including factory, facility, and site tours. These public outreach initiatives are instrumental for improving the regulatory outlook around nature-based solutions. The Boeing Company's work in this area has been most recently recognized in late 2018 by the Wildlife Habitat Council as a recipient of four awards for work at three sites pertaining to habitat restoration and preservation. These habitats also play a vital role in NBS for compliance and outreach activities. In addition, The Boeing Company uses NBS to inform career opportunities with populations in industrial or urban areas, enabling a more diverse and localized workforce including STEM-related tours to high school and colleges student on how NBS systems play a role in business operations.

---

19 The damaged natural resource must be controlled by the U.S. Government, including fish, wildlife, air, water, and drinking water, and must be restored to its baseline condition, including compensation for any lost use that occurred during the damaged period.

20 An example of this can be seen in the policy flexibility necessary in monitoring and compliance for cities to invest in NBS in addition to or in replacement of grey infrastructure for stormwater management.

Figure 2

### Secondary Business Drivers for Adopting Nature-Based Solutions

Number of positive company responses if a driver was a secondary concern



## Secondary Drivers

### Achieving Sustainability Goals

Achieving sustainability goals was the most-cited secondary driver for NBS, which exemplifies the multi-benefit argument in favor of NBS investments. Over the last several years, more companies have published sustainability goals and/or released sustainability reports than ever before. In 2011, slightly less than 20% of S&P 500 companies reported on sustainability; by 2017 the share had increased to 85%.<sup>21</sup> The implementation of NBS within standard decision-making practices helps signal a company's commitment to environmental practices and can contribute to enterprise-level financial goals.

21 Governance & Accountability Institute, Inc., "Flash Report, 85% of the S&P 500 Companies Published Corporate Sustainability Reports in 2017," March 20, 2018, accessed July 26, 2018, available at <https://www.businesswire.com/news/home/20180320006125/en/FLASH-REPORT-85-SP-500-Index%C2%AE-Companies>.

## Increasing Marketing/Branding

Often, NBS provide a concrete way for a company to demonstrate its commitment to sustainability and the environment. The ability for companies to successfully market project results that demonstrate these priorities and commitments to consumers is becoming increasingly important. A 2017 survey of more than 20,000 consumers commissioned by Unilever showed that more than one-in-five consumers would intentionally choose brands that made their sustainability credentials more transparent.<sup>22</sup>

## Enhancing Company Culture

NBS, as a tactic for achieving sustainability goals, offer companies a tangible way to demonstrate to their employees that they care about the environment. For example, installing a bioswale outside of an office building can allow a company to achieve public recognition through a certification program like the Wildlife Habitat Certification. These certificates can help market the company's environmental culture to prospective employees, especially millennials. Strategies like these will become increasingly important as millennials make up a larger share of the workforce. The Brookings Institution estimates that millennials will make up three-quarters of the workforce by 2025.<sup>23</sup> And, in a separate study done by Fidelity Investments, millennials reported that they would be willing to take, on average, a \$7,600 reduction in pay for an improved work life, including purposeful work and company culture.<sup>24</sup>

## Engaging Community Stakeholders

The many ancillary benefits of NBS make it an ideal instrument for facilitating engagement with community stakeholders, such as residents, customers, and local regulators. Where site safety allows, NBS can even provide the opportunity to make a company's land available to the community, further connecting private entities and the greater public.

---

## Bayer AG Customer Engagement

Bayer AG offers programmatic funding and technical assistance to provide NBS to its clients. The company sees uptake of NBS as a key way to help lower the company's scope three emissions – an accounting of all indirect emissions occurring in the value chain of a company. To accomplish this, the team works with farmers on best management practices that incorporate NBS and strives to reduce deforestation. In providing capacity for farmers to adopt best management practices, NBS also creates stronger ties with agricultural communities, generates repeat business, and improves its public image. Working with farmer groups, climate market specialists and others, Bayer AG is building a carbon accounting framework for the agriculture sector that will account for the greenhouse gas emission reductions resulting from the adoption of climate-smart ag practices. This framework will allow for supply chains to promote Climate Smart Architecture and may someday lead to the ability for growers to capture the value of increasing the sustainability of their operations.

22 Unilever, "Report Shows a Third of Consumers Prefer Sustainable Brands," press release, May 1, 2017, available at: <https://www.unilever.com/news/Press-releases/2017/report-shows-a-third-of-consumers-prefer-sustainable-brands.html>.

23 Fred Dews, "Brookings Data Now: 75 Percent of 2025 Workforce Will Be Millennials," The Brookings Institution, July 17, 2014, available at <https://www.brookings.edu/blog/brookings-now/2014/07/17/brookings-data-now-75-percent-of-2025-workforce-will-be-millennials/>.

24 Fidelity Investments, "Better Quality of Work Life is Worth \$7,600 Pay Cut for Millennials," press release, April 7, 2016, available at <https://www.businesswire.com/news/home/20160407005736/en/Quality-Work-Life-Worth-7600-Pay-Cut>.

## Mitigating Natural Disaster Risk

Reducing the damage, or risk of damage, that natural disasters can cause is important to companies that face flooding, landslides, fires, and extreme heat events. For this reason, several of the companies interviewed see natural disaster risk mitigation as an important driver for NBS implementation. In March 2018, Chevron Corporation issued its second report describing the company's approach to managing and planning for climate change. The nearly 50-page report dedicates an entire section to risk management and physical risk which includes potential risk from climate change.<sup>25</sup> In the public sector, the federal government invested more than four billion dollars in dune construction along Mid-Atlantic beaches following Hurricane Sandy.<sup>26</sup>

## Promoting Employee Well-being

NBS can bring employees closer to nature. For example, a native plant garden can include a walking path for employees to enjoy during their lunch breaks, or a constructed wetland can create scenic views outside of an employee's office. Research shows that as little as 15 minutes outside in nature can reduce stress levels<sup>27</sup> and that views of nature can increase worker satisfaction.<sup>28</sup> Companies with highly effective workplace health and productivity initiatives generally experience reductions in per-employee health-care costs and fewer days lost due to illness.<sup>29</sup>

---

25 Chevron Corporation, "Chevron Issues Second Climate Report for Investors," press release, March 1, 2018, available at <https://www.chevron.com/stories/chevron-issues-second-climate-report-for-investors>.

26 U.S. Army Corps of Engineers North Atlantic Division, "Hurricane Sandy Coastal Management: Facts and Figures," October 2013, available at <https://www.usace.army.mil/Portals/2/docs/Emergency%20Ops/Hurricane%20Sandy/Sandy%20Facts%20Brochure%20October%202013.pdf>.

27 Liisa Tyrväinen, Ann Ojala, Kalevi Korpela et. al., "The Influence of Urban Green Environments on Stress Relief Measures: A Field Experiment," *Journal of Environmental Psychology*, 2014 (vol. 38): 1-9.

28 Lene Lottrup, Ulrika K. Stigsdotter, Henrik Meilby, and Anne Grete Claudi, "The Workplace Window View: A Determinant of Office Workers' Work Ability and Job Satisfaction," *Landscape Research*, 2015 (vol. 40, no. 1): 57-75.

29 Keith Caver, Thomas O. Davenport, and Steven Nyce, "Capturing the Value of Health and Productivity Programs," *People & Strategy*, Winter 2015 (vol. 38, no. 1): 30-35.



©Jen Molnar | A Dow Plant and nearby wetland in Texas.

# Strategies for Operationalizing Nature-Based Solutions

The drivers of NBS reviewed in the previous section provide insights into common strategies for operationalizing NBS adoption internally. These strategies, explained in more detail below, focus on external partnerships, company culture, company policies, company leadership, and company structure. The strategies are especially helpful to understanding and overcoming potential barriers to NBS.

Common barriers mentioned during the interviews include: decentralized business operations, internal resistance to change, lack of in-house expertise to handle site-specific issues with NBS deployment, regulatory risk, company brand concerns, lack of internal resources dedicated to these technologies, and perceived uncertainty in terms of costs and performance of NBS.

The strategies highlighted in the company interviews help address multiple barriers. For example, setting a company-wide goal for NBS can help enable the leadership and culture change necessary to reduce the perceived uncertainty of cost and performance outcomes of NBS. Other strategies are more targeted. For example, external partnerships or advocacy around beneficial public policy can provide a company the specific expertise necessary for scaling NBS adoption within a certain framework, but such partnerships will not change the internal perceptions of uncertain project outcomes or costs. This section provides a framework to guide companies in identifying strategies to operationalize NBS.

## External Partnerships

NBS are site-specific and require detailed understanding of the natural systems in the area to work effectively. Often, such knowledge is difficult for a company to maintain internally. Companies can solve this problem through developing external partnerships to provide expertise, share best practices, and streamline project design and implementation. External partnerships can also increase the transparency and impact of the work by providing third-party verification and amplifying the story within their networks. Further, external partnerships can be a forum for learning and leadership when it comes to advocating for public policy incentives for NBS.

## Company Culture

Several companies point to a company culture that supports environmental solutions as being critical for the success of NBS adoption. Tactics for developing such a culture include organizing like-minded individuals into resource groups where they can share knowledge and experiences and proactively educate company stakeholders through storytelling. While top-level leadership buy-in on NBS can also help develop such a culture, it is important to engage employees across all levels of the organization. If there is not engagement at all levels, then adoption of NBS can lead to issues with company branding, lack of employee understanding or engagement, and/or missed opportunities.

## Company Policies

Many company policies can help employees select and site NBS and demonstrate its performance benefits and financial savings. For example, building NBS into standard design templates helps ensure they are considered during the feasibility studies of project alternatives. Another opportunity lies in increasing the payback period for projects to more accurately capture lifetime project costs. This can reduce perceived uncertainty around performance and financial costs, as companies may be initially unsure of how to prove the return on investment. Finally, companies who develop NBS projects that complement grey infrastructure can move from an “either” to a “both” approach, making NBS a more desirable option.

---

## Duke Energy Corporation Company Culture

Duke Energy Corporation has developed, through top-down and bottom-up engagement, a culture that emphasizes environmental considerations. Company leadership has empowered project managers to make decisions based on environmental sensitivity and lifetime project impacts, not just upfront costs. In turn, department leadership has made the case for NBS across the company. As a company organized primarily around assets, Duke Energy Corporation representatives identified trust and mutual understanding as key components for creating company-wide environmental awareness. While consideration of NBS in the decision-making processes is not a formal system, Duke Energy Corporation’s environmental health and safety policy emphasizes protecting and responsibly managing natural resources as essential to a cleaner environment, the quality of life in the communities Duke Energy Corporation serves, and Duke Energy Corporation’s long-term business success.

## Company Leadership

Sustainability leadership within an enterprise can take many forms. Operationalizing NBS requires leadership from across the company to provide the necessary set of NBS opportunities and guidance for implementing NBS. For example, board or C-suite leadership can help facilitate the creation of strong, enterprise-level sustainability goals that are well-resourced. Individual employees may also provide leadership through their participation in employee resource groups or through their use of decision-support tools. Finally, government relations teams can demonstrate leadership within their company and within their industry by advocating for NBS with key regulatory agencies.

## Company Structure

Companies with decision structures that encourage ongoing dialog between departments often find it easier to deploy NBS. For example, when property managers involve the legal and finance departments early in the project planning process, it helps all stakeholders to better understand characteristics of the proposed NBS, including its benefits, costs, and risks in relation to the business-as-usual alternative. A dialog between these different groups early in the process can lead to a more-defined set of outcomes and metrics to track throughout the project's life. Companies can use decision-support tools to empower project decision makers, such as site managers, to better utilize NBS alternatives. Decision-support tools can provide a structured framework for assessing economic, environmental and social benefits for all stakeholders.



©Boeing | Restoration in the Washington Duwamish waterway

# Internal Roadmap for Operationalizing Nature-Based Solutions

The aim of operationalizing NBS is to embed NBS throughout a company's operations and rhythms. Once NBS is successfully operationalized, NBS will be better considered, promoted, and implemented across all departments, geographies, and employee levels. Fully operationalizing NBS takes time, however, and is best achieved through the sustained successful incorporation of short-term goals. In addition, operationalizing NBS requires early buy-in from many departments across the company. Different departments may be more critical at different times, but all departments should be integrated into the decision-making and implementation process as early as possible.

Figure 3 (page 19) provides high-level guidance on actionable steps to integrate NBS into a business's operations, which we dub an internal roadmap for operationalizing NBS. In Appendix D, we provide guiding questions to consider during each part of the journey. In the discussion below, we also highlight the most critical departments that should be engaged at each step. This internal roadmap was created through collective discussions with the Business Council members and does not represent any one company's experience.

The first step to operationalizing NBS is for a company to **identify a set of opportunities** within the company where NBS can be immediately implemented. The primary goal of this step is for the company to identify early champions and begin to develop an evidence base, focused around a few sites, as to where NBS can provide operational value. Key departments to engage during this step are engineering, sustainability, facility managers and operations managers. The sustainability department can provide information on NBS and the facility and operations managers will have access to capital projects that are already approved for funding.

In the second step, the company should **engage key stakeholders** around the design and coordination of the opportunities identified in step one. These stakeholders need to be engaged early in the decision-making process to ensure that NBS can be effectively incorporated into the identified opportunity. Important departments for this engagement are government relations, environmental health and safety, and sustainability. These departments, for example, can help avoid potential regulatory pitfalls and ensure that the NBS opportunity has the necessary coordination and support.

The third step involves **implementing one, or a set, of pilot NBS projects across the company**. This set of pilot projects will consist of the opportunities identified in step one and, ideally, they will highlight the unique approach of NBS and its ability to contribute to the company's bottom line. The primary goal of this step is to develop a strong set of localized evidence that NBS are efficient and cost-effective engineering solutions for the company.

In addition, through implementing an NBS on company property, the company will begin to expand the network of NBS advocates within the organization. Key departments to engage with during this step include project managers, who will help coordinate the implementation of the project, and finance, who can help track the cost-effectiveness of the project.

In the fourth step, cost and performance information from the pilot projects will be aggregated together to **develop a business case** for operationalizing NBS across the company. Arguments in favor of NBS may be strengthened if they are made in relation to the costs and performance of the business-as-usual grey alternative. Key stakeholders to engage during this stage include operations, who can provide feedback on the implementation and maintenance of the pilot, engineers, who can provide information on the performance of the NBS in relation to the business-as-usual alternative, and finance, who can calculate project savings figures.

The aggregated information should include a description of the relevant NBS identified, a breakdown of the business benefits realized from the pilot projects, and a list of any unintended benefits (or costs) realized from the pilot projects' implementation. Aggregated information can be complemented with case studies that cite successes of the early pilot projects and external resources, such as other case studies or scientific research. The case studies should include a description of the NBS used, an explanation of the engineering problem addressed by the NBS, and an outline of the key drivers of the business benefits (e.g., cost savings, regulatory compliance). Finally, external evidence should be incorporated to advocate for the effectiveness of other NBS or for the applicability of NBS to other engineering problems and/or geographies within the organization. The primary goal of this step is to develop an effective communications strategy for upper management that reduces the level of perceived uncertainty or risk associated with NBS.

---

## The Dow Chemical Company's Water Treatment via Limestone Channels

Dow project engineers were tasked with developing an innovative solution for treating low pH-level surface water that was contaminated with mine materials, such as zinc and manganese. The project managers developed a natural treatment process that successfully improved the water quality before it entered a downstream creek. The treatment process relied on a limestone-lined channel, followed by a small habitat wetland, that raised the pH level and created an environment where manganese-utilizing bacteria could grow and sequester/remove zinc. The channel was constructed to facilitate colonization of native wetland plants that will further ensure the longevity of treatment in the channel. The channel created habitat for fish and insects, and avoided a mechanical treatment system that would involve power and solids management by not having to install a water treatment plant.

In the final step, **NBS is operationalized throughout the company**. Ultimately, this step involves embedding NBS into all relevant business decisions and adopting a business decision-making process that considers the full suite of benefits of NBS, which typically have more ancillary benefits than business-as-usual grey alternatives. Operationalizing NBS takes time. Unlike the four preceding steps, this step may take years for a company to complete or may be a part of a decade-long company journey. Companies can create waves of success around operationalizing NBS by creating both short- and long-term goals that highlight more frequent achievements. It's important to recognize that fully operationalizing NBS may be beyond the scope of the company as it may require regulatory changes and/or scientific advances that will need to be made by external partners. Companies should focus on driving change within the areas where they can make tangible progress. Key stakeholders to engage with in this process include communications, who can convey a company's success internally and externally, and external partners, who can collaborate with the company to overcome broader barriers to NBS adoption.

**Figure 3** **Estimated Timeline for NBS Operationalization.**  
Recommended steps and timeframes for operationalizing NBS within a company.



# Conclusion and Next Steps

The learnings and strategies presented here are not perfect – there is no one-size-fits-all solution to be found for operationalizing NBS. The road to operationalizing NBS is long, but the tactics and strategies identified above can accelerate the process. Our interviews with member companies highlighted the importance of engaging a range of company departments early in the process and the importance of identifying quick-win projects to serve as initial pilots.

There is a strong need for more qualitative and quantitative case studies demonstrating the business case for NBS. As more companies share results and demonstrate return on investment through NBS, there will be greater motivation to adopt these practices throughout the private sector. This sharing could take many forms, including distributing case studies of how NBS can help accomplish enterprise-level company goals beyond environmental sustainability goal performance.

Lastly, the importance of policy cannot be overstated. Policy can either facilitate or inhibit the adoption of NBS. Key regulations discussed in this paper, like the Clean Water Act, provide an important role in pushing the adoption of NBS across industries. However, there can be regulatory barriers as well – for example, regulation that is too narrow in scope or too direct in guidance creates perceived uncertainty around NBS and makes these strategies less desirable or impossible options for regulatory compliance. There need to be more constructive dialogues between public, private, and non-governmental actors on these regulatory issues to ensure the greatest opportunity for scaling NBS.

This white paper has put together a framework to allow companies to operationalize NBS. Nevertheless, there is more work needed to understand these issues. Future research and work on this topic should encourage additional collaborations among private, public, and non-governmental organizations interested in scaling NBS to further understand the policy and financial components involved in company decision making regarding NBS projects. To sustain NBS over the long term, a commitment to NBS will need to be made not just within companies, but also across public and non-governmental organizations and, more importantly, promoted through broad collaborations.

---

## The BNSF Railway Company Permitting Decision Tool for NBS Operationalization

Construction permitting staff at BNSF realized that NBS could help solve a challenge with staff education and visibility around environmental permitting requirements. In many cases, projects that incorporated NBS required fewer or less arduous environmental permits, saving the company money and time: permit applications had shorter timelines, and often had less arduous mitigation requirements and environmental constraints. At the outset of project design, managers could run through a series of questions about their sites and the tool would provide a list of permits to research, plus one-page overviews of the regulation and its requirements. Seeing a list of permits required motivated managers to launch conversations with the environmental staff about opportunities to reduce the number or timeline of permits, which allowed environmental staff to offer NBS options early in the project design phase, reducing ecosystem impacts and lowering permitting costs. The tool was developed entirely in-house, so costs were minimal and have been easily recouped by time gained in the design and permitting process.

# Additional Resources

The Environmental Protection Agency maintains one of the most thorough databases of natural infrastructure technology, case studies, and financing vehicles. Useful resources include an [overview of natural infrastructure technology](#), list of [funding opportunities](#), and examples of [cost-benefit analyses](#), including interactive calculators.

A team of researchers from The Nature Conservancy, the University of California, Santa Cruz, and ETH Zurich developed an interactive open-source software on [Coastal Resilience](#) that shows the cost-effectiveness of various adaptation solutions in the Gulf Coast. The software was based, in part, on Swiss Re's natural catastrophe model that assesses flood risks and adaptation solutions. Specifically, the research team applied the Economics of Climate Adaptation, which Swiss Re developed in collaboration with partners, to assess the drivers of coastal risk and to evaluate the cost-effectiveness of different adaptation options, including grey options (such as levees and home elevation) and NBS (such as wetland and reef restoration).

"[Corporate Water Stewardship and the Case for Green Infrastructure](#)" focuses on green infrastructure solutions aimed at water stewardship, including wetland restoration and protection, natural floodplains, and riparian buffers. The report was produced by Conservation International and includes a list of green infrastructure solutions, the risks that each solution addresses, the benefits realized from each solution, and potential finance mechanisms for green infrastructure investments. In addition, the report ends with a suite of real-world examples of private companies investing in green infrastructure as a part of a water stewardship strategy.

"[Natural Infrastructure: Investing in Forested Landscape for Source Water Protection in the United States](#)" (focus on pages 17-30). This 2013 World Resources Institute report explores opportunities in land conservation to maintain cleaner, more reliable water supplies. Despite its water utility focus, it provides a transferable framework for making the business case for natural infrastructure, including an

accessible discussion of green vs. grey infrastructure optimization. Within the website hosting the report are tools relevant to companies interested in evaluating the potential for natural infrastructure projects. The inVEST tool is available as a preliminary resource for looking at economic tradeoffs between natural and grey infrastructure projects. Additionally, the Conservation Priority Index gives weighted criteria for how to prioritize watershed and land conservation on company properties.

"[A Financial and Environmental Analysis of Constructed Wetlands for Industrial Wastewater Treatment](#)" is an excellent example of in-depth quantitative analysis using both financial and materials/land-use considerations. It is a peer reviewed case study of the Dow facility in Seadrift, TX. While this is a specific example in a specific context, it provides a useful framework for cost-benefit analysis and an accounting of non-traditional considerations to make the case for natural infrastructure over traditional grey. The report estimated a net value savings of \$200 million in choosing green over grey infrastructure.

The World Business Council for Sustainable Development (WBCSD) has a [platform](#) featuring several highly relevant reports and tools. The platform contains a [Business Case](#) report and [Incentives](#) report that provide great high-level overviews on strategic natural infrastructure project development and implementation. This platform is overall an excellent synthesis introducing broad-view natural infrastructure concepts, business drivers, applications, benefits, case study-based technologies, and incentives and financing. Additional useful resources include a [NI decision tree](#), [Project Select Tool](#), and a [library of case studies](#).

The above mentioned WBCSD platform also contains two [modules](#) in PowerPoint form that come closest to accomplishing the goal of this white paper, especially the second subtitle, “Implementation and Action Planning.” It includes a tutorial on the Project Select Tool that can help make the financial case for a natural infrastructure project, a list of other useful decision-making tools, and a framework for developing a natural infrastructure action plan.

The [Ecosystem Services Identification & Inventory \(ESII\)](#) tool, developed jointly by TNC, Dow, and EcoMetrix Solutions Group, rapidly and cost-efficiently identifies and quantifies ecosystem services delivered across a landscape and produces results that can be integrated into a company’s engineering models. This tool was designed to help companies understand the value of nature on its sites and promote further protection and enhancement.

The [Natural Capital Protocol](#) is a framework designed to allow businesses to understand how resource use impacts natural capital stocks, and in turn how resource usage can affect long-term business operations. While not directly informing the natural infrastructure implementation process, the Protocol and [Natural Capital Protocol Toolkit](#) are useful framing devices that allow decision makers to assess and understand how their company impacts important and potentially regulated inputs, products, and waste materials. Used in concert with the Natural Capital Protocol, the Toolkit is an up-to-date database that compiles tools, methodologies, and approaches for businesses to assess and evaluate their natural capital. Together, they can help businesses paint a picture of the issues that natural infrastructure can help address.

The Boeing Company and the Wildlife Habitat Council (WHC) compiled a report, “[Transforming Remediation Sites in Conservation Assets: How Companies Leverage Business Needs for Positive Environmental Outcomes](#),” which outlines strategies to incorporate conservation into cleanup sites. The report features case studies that demonstrate how site remediation can improve public perception, reduce costs through biodiversity restoration, provide green spaces for education and recreation, incorporate event-based restoration methods on restricted sites, and align with community needs and goals. The report outlines five phases of the remediation process, and it recommends partnering with wildlife and conservation organizations, particularly for third-party certification such as WHC Conservation Certification.

[Creating Clean Water Cash Flows](#) details the costs and benefits from installing natural infrastructure for stormwater management on private properties in Philadelphia. The report discusses O&M obligations, potential financing mechanisms, and other key considerations for urban green stormwater infrastructure. A helpful cost comparison of tools is provided in the [abbreviated issue brief](#).

[21<sup>st</sup> Century Engagement: Investor strategies for incorporating ESG considerations into corporate interactions](#) is directed towards investors who want to advocate that the companies they invest in commit to stronger ESG (environmental, social, and governance) goals and actions.

A recent Federal Highway Administration study, “[Nature-Based Solutions for Coastal Highway Resilience](#),” provides an overview of natural infrastructure tools for large-scale coastal construction.

# Interview Process

Three Yale University graduate students and staff from The Nature Conservancy conducted interviews with eight member companies of the Natural Infrastructure Working Group within The Nature Conservancy's Business Council. The participating companies included: The Boeing Company, The BNSF Railway Company, Caterpillar Inc., Chevron Corporation, The Dow Chemical Company, Duke Energy Corporation, Bayer AG<sup>1</sup>, and United Parcel Service. All interviews were conducted in Spring 2018 from March through May. The interviews included conversations with sustainability leaders, environmental engineering experts, and Business Council liaisons. The table below identifies all individuals interviewed.

## Companies and Participating Individuals

COMPANY	NAME	TITLE
Bayer AG	Gabriela Burian	Strategic Advisor for Food & Agriculture in Americas
The Boeing Company	Steven Shestag	Director, Enterprise Remediation
BNSF	Dava Kaitala	General Director, Construction Permitting & Sustainability
BNSF	John Lovenburg	Vice President, Environmental
BNSF	Chad Prior	Director of Environmental Engineering & Operations
BNSF	David Smat	General Director of Environmental Engineering & Operations
Caterpillar Inc.	Kathryn Spitznagler	Director of Global Sustainability
Chevron Corporation	Gabe Lewis	Property Transfer & Beneficial Reuse Advisor, Chevron Environmental Management Company
Dow Chemical	France Guertin	Program Manager, Engineered Natural Technologies
Dow Chemical	Thomas Polzin	Program Manager for Ecosystem Services & Nature
Dow Chemical	Mike Uhl	Senior Environmental Manager
Duke Energy Corporation	Michael Abney	Senior Environmental Resource Manager
Duke Energy Corporation	Nathan Craig	Director, Federal Environmental Policy Analysis & Strategy
Duke Energy Corporation	Scott Fletcher	Natural Resources Manager
Duke Energy Corporation	Steve Jester	Vice President, Water Strategy, Hydro License, & Lake Service
Duke Energy Corporation	Eric Lattimer	Senior Environmental Specialist at the Crystal River Mariculture Center
Duke Energy Corporation	Derek Ware	Timber Manager
UPS	Michael Chavez	Project Manager, Corporate Plant Engineering & Construction Management Group

<sup>1</sup> Monsanto Company was acquired by Bayer AG AG in June 2018.

# Questionnaire

For this questionnaire, please consider natural infrastructure projects and initiatives as the following: Natural infrastructure incorporates both the natural environment and engineered systems that mimic natural processes or work in tandem with natural systems to provide flood, fire, and drought risk reduction, clean water, and clean air benefits. These natural systems can complement or replace “grey infrastructure,” the conventional systems of concrete pipes, water treatment plants, and other human-made infrastructure. Natural infrastructure is sometimes referred to as “green infrastructure,” though some practitioners use green infrastructure more broadly to describe rain gardens or energy efficient equipment.

## Initial Questions on Natural Infrastructure Objectives, Past Experience, and Barriers

1. From the definition above, for what purpose(s) does your company utilize natural infrastructure projects?
2. Including pilot programs and mixed green-grey projects, what natural infrastructure has been installed at the company’s facilities, or what is planned to be installed? Please specify project type/strategy, size, purpose, and cost if available.
3. Please rank in order of importance all relevant drivers listed below for exploring and/or investing in natural infrastructure projects. Do not rank drivers not considered and please provide additional drivers that are missing from this list. For the top three drivers mentioned above, please list for each the specific intended outcomes of the project (e.g., carbon offsets for meeting sustainability goals).

<b>Natural Infrastructure Project Drivers</b>	<b>Ranking of Importance</b> 1 = Most Important; 9 = Least Important	<b>Intended Project Outcome</b>
Meeting Sustainability Goals		
Managing Regulatory Requirements (e.g., stormwater)		
Marketing Opportunities		
Promoting Employee Well-being (e.g., safety, retention)		
Enhancing Company Culture		
Promoting Community		
Engagement (e.g., recreational access)		
Managing Natural Disaster Risk (e.g., resiliency, flood control)		
Managing Risk		
Achieving Short-Term Financial Savings		
Achieving Long-Term Financial Savings		
Other (Please Specify)		

4. What were some of the anticipated (or unanticipated) co-benefits from the natural infrastructure projects?
5. What departments (facilities, operations, engineering) have you engaged with in making the case for natural infrastructure projects? Of these, which department(s) have been the most supportive? Which department(s) have been the least supportive? For the least supportive, what arguments did you use to gain their buy-in?
6. Are existing natural infrastructure projects generally viewed as successful within the company? Why? If no, why not?
7. What internal barriers exist to more widespread adoption of natural infrastructure across your organization?
8. Who within the company has championed natural infrastructure projects? Why?
9. What other individuals in your organization can speak to the implementation and financial decision-making processes related to natural infrastructure projects?

### Follow-up Questions on Project Financials, Performance & Decision-Processes

1. Please describe your company's decision-making structure and processes as it relates to natural infrastructure projects? If these differ significantly from the processes for other capital projects, please note how and why.
2. What budget(s) fund natural infrastructure projects? (e.g., operations, sustainability, site maintenance, etc.).
3. What financial analyses did your company undertake to evaluate and advocate for natural infrastructure projects that have been implemented? Please include as much detailed information as possible on assessed lifespan of projects, costs and benefits included, and where the most significant cost-savings for natural infrastructure were found (e.g., operations and maintenance, upfront capital costs, additional revenue streams).
4. How have natural infrastructure projects performed over time, both economically and functionally? What performance data or metrics do you collect to make this assessment, including tracked Operations and Maintenance costs? Are these performance data or metrics treated differently than grey infrastructure projects?
5. Are there any additional performance data or metrics that you do not currently collect but, in an ideal world, would be interested in tracking?
6. If you have installed a series of related natural infrastructure projects, how has design or implementation changed in subsequent iterations?

# Key Questions to Consider Along the Roadmap to Operationalizing Nature-Based Solutions

## Step 1: Identify Opportunities

Key Question	Relevant Department(s)
What benefits of NBS are well-established and connected to the operations of my company?	Sustainability
What regulatory framework must my company comply with? Can any regulatory requirements be addressed through NBS?	Government Relations
What are the most immediate planning and engineering needs at my site or within the organization that could be addressed using NBS?	Engineers; Facility Managers; Operations
What ancillary benefits (or costs) could be realized in the implementation of the NBS that would not be realized with a grey infrastructure alternative?	Government Relations; Sustainability
What lessons learned or business benefits from within the company, or from other companies, could be used as a benchmark for future projects?	Government Relations
What NBS are already being applied within my company?	Sustainability

## Step 2: Engage Key Stakeholders

Key Question	Relevant Department(s)
What project proposals already have capital secured for the project implementation?	Finance; Operations
Is there space for engagement with regulators, other companies, or non-profits?	Government Relations; Sustainability
Which project proposals or project managers can have the project design adjusted to incorporate NBS?	Operations
What local conditions need to be considered for successful project implementation (e.g., native plants, climate, topography)?	Engineers; Facility Managers; Maintenance; Operations
What adjustments will need to be made to the annual operations and maintenance for the NBS (e.g., limited mowing, controlled burns)?	Maintenance; Operations
What regulatory requirements and/or deadlines is the company under that could impact the timing or design of the NBS?	Environmental Health and Safety; Government Relations
What are the projected upfront capital costs and long-term operations and maintenance costs of the proposed NBS and how do they compare to the business-as-usual grey alternative?	Finance

### Step 3: Design & Implement Pilot NBS Projects

Key Question	Relevant Department(s)
Which project proposals or project managers can have the project design adjusted to incorporate NBS?	Operations
What local conditions need to be considered for successful project implementation (e.g., native plants, climate, topography)?	Engineers; Facility Managers; Maintenance; Operations
What adjustments will need to be made to the annual operations and maintenance for the NBS (e.g., limited mowing, controlled burns)?	Maintenance; Operations
What regulatory requirements and/or deadlines is the company under that could impact the timing or design of the NBS?	Environmental Health and Safety; Government Relations
What are the projected upfront capital costs and long-term operations and maintenance costs of the proposed NBS and how do they compare to the business-as-usual grey alternative?	Finance

### Step 4: Aggregate Information & Develop Business Case for Scale

Key Question	Relevant Department(s)
What unexpected benefits (or costs) were realized in the implementation of the NBS that would not have been realized with a grey infrastructure alternative?	Engineers; Facility Managers; Finance
What were the unexpected learnings from the pilot project implementation (e.g., staff resources involved, required additional outside services/expertise)?	Engineers, Facility Managers; Maintenance; Operations
How does the long-term actual performance of the implemented pilot NBS compare to expected performance?	Engineers; Finance
What is a vision for how a scaled NBS approach at your company would look like?	Executive Leadership; Sustainability

### Step 5: Operationalize NBS

Key Question	Relevant Department(s)
What are the primary NBS that the company should focus on going forward?	Engineers; Environmental Health and Safety; Sustainability
Where within the company are there the same or similar engineering needs as the ones addressed by the pilot projects?	Communications; Sustainability
How can the company better advocate for these solutions internally and with regulators, other businesses, and non-profits?	Communications; Marketing
What changes need to be made to standard decision-making processes (e.g., financial considerations, operations policy)?	Finance; Operations; Sustainability
What are the primary areas of uncertainty or risk in relation to NBS implementation?	Engineers; Government Relations; Security; Sustainability
Are there specific scientific advances that can be made to address the identified uncertainties or risks?	Sustainability
How do you create a culture that sustains NBS implementation with the company, including performance metrics, company alignment around the vision, complementary sourcing and procurement, and communications?	Communications; Executive Leadership; Marketing; Sustainability



The Nature Conservancy's Business Council is an invitation-only, collaborative platform for leading global companies to recognize value, gain expertise, and share experiences in corporate practices that will help create a world where people and nature thrive.

Companies and organizations that contributed to this white paper: AECOM, Bayer AG, The BNSF Railway Company, The Boeing Company, Caterpillar Inc., Chevron Corporation, The Dow Chemical Company, Duke Energy Corporation, Yale University, & United Parcel Service

For more information, please contact Nathan Cummins, [ncummins@tnc.org](mailto:ncummins@tnc.org),  
and Martha Rogers, [mrogers@tnc.org](mailto:mrogers@tnc.org).

Learn more at [Nature.org/BusinessCouncil](https://www.nature.org/BusinessCouncil)