



Nature-based Solutions Benefits and Trade-Offs

DEEP DIVE

NOTE: This document is an accompanying resource to the [Watershed Investment Program How-To Guide](#). Readers are strongly encouraged to review the guidance in its entirety before delving into any accompanying subject-matter “Deep Dives,” including this document.



One of the key advantages of nature-based solutions (NbS) over gray solutions is their potential to deliver on multiple benefits. NbS are usually initiated and/or designed to serve one or more primary driving challenges that stakeholders, project developers or funders are most interested in. The additional benefits that the intervention may deliver on are often called co-benefits, since they are secondary to the primary benefits but may still be of value to those involved in the project or other potential supporters. This guide focuses on water security outcomes as the primary benefit(s) of NbS, but it is important to understand the full range of benefits that these water-focused NbS can deliver on.

Equally, if not more important is awareness of the trade-offs that should be taken into account when considering investment in specific NbS. Trade-offs are the negative aspects of a given intervention or suite of interventions, including detrimental impacts, the non-delivery of a benefit of interest or some other aspect of the solution set that is undesirable. Essentially a trade-off is what is you are willing to give up or accept with the implementation of a particular intervention or project.

Elements of NbS Benefits: Who, Where, and When

Based on the work of the [Benefit Accounting of Nature-based Solutions for Watershed project](#) (CEO Water Mandate, Pacific Institute, The Nature Conservancy, Danone and LimnoTech), benefits of NbS can be categorized into five themes: water quantity, water quality, carbon, biodiversity and socioeconomic (see Figure 1). There are also some types of cross-cutting benefits that extend across these categories and are fundamental to the environmental and socioeconomic health of the watershed. One example of this is soil health, which is important for carbon sequestration, water quantity and sustainable agricultural production, among other outcomes of interest.

An important aspect of benefit identification and accounting is understanding the **Who, Where** and **When** of benefit delivery from the NbS Investment Portfolio. Each of these aspects are described below.

Determining **who** receives the benefits, and who might be negatively impacted from NbS, is critical to the long-term success of an NbS program such as a Watershed Investment Program. Knowing who a portfolio of NbS might benefit can help with identifying program investors. It also helps avoid or mitigate negative impacts on different groups of stakeholders, including local communities and Indigenous Peoples. For example, protection of a forest may benefit a water utility company in a downstream city, whose water treatment costs are stabilized due to avoided increase in sediment loading. At the same time, protection may benefit local communities in terms of jobs and health and well-being benefits. Other benefits include avoided loss of carbon storage, which benefits the global community, and possible recreational opportunities that could benefit the local communities and visitors from near and far.

THEME	BENEFITS
Water quantity	<ul style="list-style-type: none"> Reduced/avoided surface runoff and associated erosion Improved/maintained surface water storage Increased/maintained groundwater recharge and storage Improved/maintained flow regime Improved/maintained flood protection and mitigation (inland and coastal)
Water quality	<ul style="list-style-type: none"> Improved/maintained surface water quality Improved/maintained groundwater quality
Carbon	<ul style="list-style-type: none"> Improved/maintained carbon sequestration Reduced carbon emissions
Biodiversity and environment	<ul style="list-style-type: none"> Improved/increased terrestrial habitat availability and quality (including soil health; see Box 4) Improved/maintained aquatic habitat availability and quality Improved/maintained terrestrial habitat connectivity Improved/maintained aquatic habitat connectivity Improved/maintained support for local pollinators Improved/maintained natural pest control Increased/maintained abundance and diversity of native plant species Increased/maintained abundance and diversity of native animal species
Socio-economics	<ul style="list-style-type: none"> Improved/maintained climate adaptation and mitigation Improved/maintained livelihood opportunities Improved/maintained human health Improved/maintained agriculture/agricultural output Expanded/maintained religious/spiritual settings Enhanced/maintained microclimate regulation Improved/maintained opportunities for education/scientific study Increased/maintained food security Improved/maintained recreation/tourism opportunities Increased/maintained property/land value

FIGURE 1. Types of NbS benefits (from CEO WM Guide)

The geographic scale, or the **where**, of benefit delivery is also an important factor in understanding the flow of benefits and what this means for program funding and stakeholder engagement. Some benefits are delivered at or very close to the implementation site(s), while others are experienced further downstream or even outside of the watershed, such as in the example provided above where the global community benefited from avoided loss of carbon storage. For many interventions there is a strong correlation between the scale of implementation and the ability to deliver benefits further downstream in the watershed. For example, riparian buffers along a small stream length may deliver water quality benefits immediately downstream of the intervention, but then might be offset by additional sources of diffuse pollution downstream. However, if riparian buffers were placed along a significant portion of a stream length then the likelihood of delivering water quality benefits to downstream water users is more likely. The geographic scale of impact also depends on the specific intervention type.

Just as critical to understand are the temporal aspects of NbS benefits, or **when** NbS benefits will be delivered or experienced. The trajectory of benefit timing varies widely depending on NbS type and local context. The [NbS Factsheets Deep Dive](#) details illustrative graphs for delivery of water security outcomes for each NbS intervention type, including how quickly benefits are expected to be delivered. For example, forest protection starts providing benefits immediately, while forest restoration takes several years to reach full potential benefits, with differences in timing of delivery of recreation, water security, carbon and biodiversity benefits. Timing of benefit delivery can sometimes create a challenge in securing funding for NbS programs, with some types of investors looking for more immediate benefits. The strength of NbS, however, is that often benefit delivery is maintained for a much longer time period, in many cases indefinitely, which is in contrast to many gray infrastructure solutions whose benefits can degrade over time.

Examples of Trade-offs

For any project planning or design process, it is critical to consider the trade-offs that come with selection of a particular intervention or set of solutions. Balancing the needs and values of different stakeholders is not easy, but it's important to be transparent about the positives and negatives, or benefits and trade-offs, for all options. Some examples of possible trade-offs from specific NbS include:

- Increase in vegetative cover, such as from reforestation, can reduce annual water availability due to an increase in evapotranspiration from the additional vegetation.
- Protecting or restoring natural land cover does not allow that land to be used for productive uses which could result in increased incomes for specific stakeholders, such as row crop agriculture, or for development.
- Restoration of formally inhabited lands requires residents to move elsewhere, which could have a variety of negative impacts on individuals and families. For example, floodplain reconnection may require homes that have been built behind levees to be removed and their inhabitants to relocate. Demand for land to conduct large-scale implementation of certain NbS categories is a material issue, especially for marginalized communities, and therefore integrating equity considerations and Free Prior Informed Consent into stakeholder consultation processes is essential to ensure sustainable WIP execution.

In some cases it might be possible to mitigate against possible trade-offs. One way to do this through the specific design or implementation approach of an NbS. For example, rules for a protected forest may still allow local community members to hunt and gather food, avoiding negative impacts on traditional food sources. Another way to mitigate for a potential trade-off is to compensate a stakeholder group for lost benefits, or to provide other benefits that are equal or better than the lost benefits. For example, fencing of a streambank to promote riparian vegetative growth may result in loss of access to water for ranging cattle, but the project could provide funding for an alternative water supply for the cattle.

Identifying and Accounting for Benefits and Trade-offs

A number of initiatives and organizations have explored the identification, accounting and quantification of benefits and trade-offs from NbS. The depth of information needed for decision making varies between projects and points in the project process. In some cases it is sufficient to simply identify benefits and trade-offs, while in other cases there needs to be an accounting of these positive and negative outcomes during the project design and /or after project implementation as part of the monitoring program. For other projects or decision-making steps a full quantification of the financial value of some or all of the benefits and trade-offs are required, particularly for making the business case for investors in NbS programs.

The CEO Water Mandate's [Benefit Accounting project](#) provides clear guidance on the difference between identification, accounting and quantification of NbS benefits in their guide (Figure 2 below).

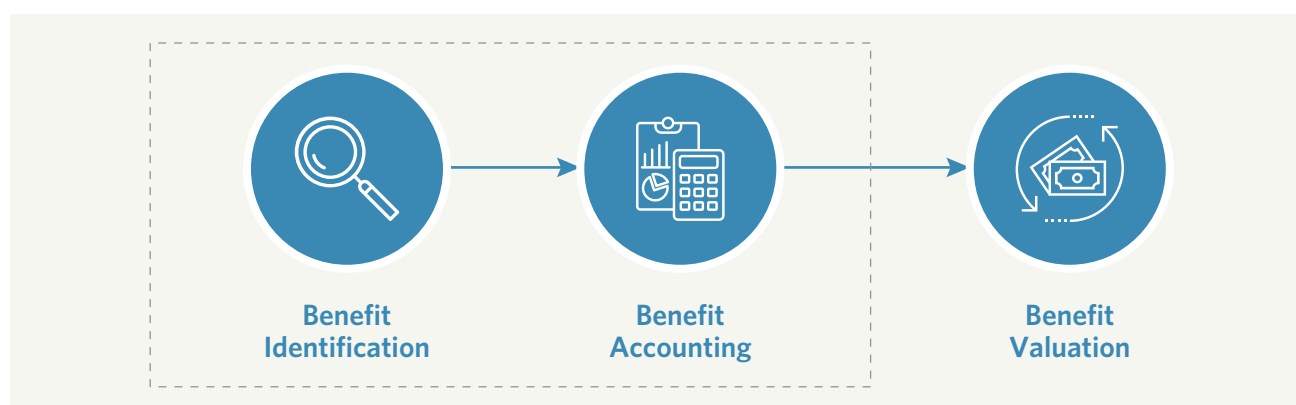


FIGURE 2.

Benefit Identification

Identification of NbS benefits and trade-offs can occur at any point during a project process, including pre-feasibility, feasibility, design or project tracking. The earlier benefits or trade-offs are identified, however, the greater the chance of: 1) maximizing benefits and minimizing trade-offs in project design, and 2) identifying relevant stakeholders who could become project supporters or project detractors, depending on the related project benefits or trade-offs.

It can be helpful to start with a broad list of potential benefits and trade-offs, but then narrow that list based on relevant factors, such as:

- Greatest interest to key stakeholders
- Closest link to possible project interventions
- Potential for biggest impact or risk
- Ability to quantify the benefit (in financial terms or otherwise)

The [Benefit Explorer Tool](#) offers an easy way for a user to identify possible benefits of interventions, but ideally this tool should be paired with stakeholder engagement and local expert opinion to account for local biophysical and socioeconomic context. The tool also does not consider trade-offs, which should be identified alongside the potential project benefits.

Benefit Accounting

For a number of NbS benefits and trade-offs it may be possible, and desirable, to estimate or track them in quantitative terms. This information can help with practical decision making between portfolios of NbS, and can build credibility and tangibility for the delivery of benefits under an NbS program. Some benefits and trade-offs are easier to account for than others, but it's likely that all can be quantified using one or more metrics.

The [Benefit Accounting for Nature-based solutions for Watersheds Guide](#) provides a sample of common accounting methodologies for a number of co-benefits of NbS for water security. This list is not exhaustive, however, and particular metrics and accounting approaches should be selected for a specific project or program based on stakeholder input, data availability and previously accepted methodologies.

Benefit Valuation

An estimate of the financial value of an NbS benefit, or financial impact of a trade-off, may be critical to building the business case for investment or weighing the pros and cons of a solution set. Particularly when comparing NbS to gray solutions, or considering an integrated portfolio, knowing the financial costs and benefits of each package of solutions is necessary for decision making or for making the case to investors. For example, if NbS benefits or trade-offs are to be considered in a Return on Investment calculation for a portfolio of interventions, it is necessary to calculate the financial value of these outcomes (please see the [Economic and Financial Analysis Deep](#) for additional details).

The field of NbS valuation is growing, but has strong foundations in ecosystem service valuation and other natural resource economic approaches. The best way to calculate values for NbS benefits varies across benefits and local contexts, but common methodologies include: empirical benefit functions (which estimate how benefits impact the 'bottom line' from increased revenues, avoided costs, or reduced risk), alternative costs (which compares alternative investment options for achieving the same delivery benefit), and willingness to pay (which relies on surveys and other tools to understand what the population is willing to pay for the service). As practical related examples, carbon sequestration could be valued using global carbon market values, or improvements in water quality could be valued using avoided costs for additional water treatment chemicals. Some ongoing efforts to support NbS benefit valuation through clarifying approaches or providing user-friendly tools include those by the [Natural Capital Protocol](#) (standard approach), [Ecometrics](#) (tool) and [Denskstatt](#) (white paper on NbS benefit accounting for Coca-Cola).