

# WHAT ARE NATURE-BASED SOLUTIONS?

This guide defines nature-based solutions as sustainable planning, design, environmental management, and engineering practices that weave natural features or processes into the built environment to build more resilient communities. While this guide uses the term nature-based solutions, other organizations use related terms, such as green infrastructure, natural infrastructure, or Engineering with Nature®, a program of the U.S. Army Corps of Engineers. As a best practice, use the term that best resonates with your target audience.

## Green Infrastructure and Low Impact Development

Some organizations use the term green infrastructure to capture the value and functions of natural lands. For example, the [Conservation Fund](#) defines green infrastructure as “a strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem value and functions and provides associated benefits to human populations.”

Other organizations use the term green infrastructure for nature-based solutions to urban stormwater pollution. These organizations emphasize solutions that protect water quality and aquatic habitat. The other outcomes, such as mitigating natural hazards, are seen as co-benefits. Low impact development is another term that is often used to describe nature-based solutions for urban stormwater. In the field of stormwater management, “green infrastructure” and “low impact development” are sometimes used interchangeably.

## Natural Infrastructure

The term “natural infrastructure” is often used to describe natural or naturalized landscapes that are actively managed to provide multiple benefits to communities. The [International Institute for Sustainable Development](#), a think tank, notes that active management is what sets natural infrastructure apart from nature. For example, a managed wetland is a type of natural infrastructure. Manipulating water levels and cleaning out plant growth can enhance a managed wetland’s water quality, habitat, and flood storage benefits.

## Engineering with Nature

Organizations that design and operate water infrastructure projects may also refer to Engineering with Nature®, a term that comes from the [U.S. Army Corps of Engineers’ \(USACE\) Engineering with Nature Initiative](#). This term refers to water resources projects that use collaborative approaches to project design and operation to create multi-functional infrastructure. Engineering with Nature® can result in projects that deliver a broader range of economic, ecosystem services, and social benefits.

## Bioengineering

Bioengineering is a term that is used to describe projects that mimic natural processes in order to reduce hazards. An example of bioengineering would be using a combination of natural and manmade materials to stabilize a slope, giving vegetation a chance to become established to reduce future erosion.

## Tying It All Together

The common thread among these terms is that nature-based solutions provide more value than single-purpose gray infrastructure. Gray infrastructure refers to public works structures that are engineered to provide a specific level of service under specific scenarios. In the context of drinking water and wastewater, gray infrastructure includes water and wastewater treatment plants, pipes, catch basins, and stormwater basins. In the context of coastal communities, gray infrastructure

includes sea walls, groins, and breakwaters. While gray infrastructure provides only the service for which it was designed, nature-based solutions yield additional community and ecosystem services benefits.

Ecosystem services is a term used to describe all of the benefits that we get from the environment — everything from air, food, and water to the enjoyment of nature and natural resources.

## CATEGORIES OF NATURE-BASED SOLUTIONS

This guide categorizes nature-based solutions practices based on scale and location:

- **WATERSHED OR LANDSCAPE SCALE:** Interconnected systems of natural areas and open space. These are large-scale practices that require long-term planning and coordination.
- **NEIGHBORHOOD OR SITE SCALE:** Distributed stormwater management practices that manage rainwater where it falls. These practices can often be built into a site, corridor, or neighborhood without requiring additional space.
- **COASTAL AREAS:** Nature-based solutions that stabilize the shoreline, reducing erosion and buffering the coast from storm impacts. While many watershed and neighborhood-scale solutions work in coastal areas, these systems are designed to support coastal resilience.

The illustrations on the following pages are examples of nature-based solutions and do not cover all options.



Rain Garden — City Hall in Bay Village, OH

# WATERSHED SCALE

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## LAND CONSERVATION

Land conservation is one way of preserving interconnected systems of open space that sustain healthy communities.

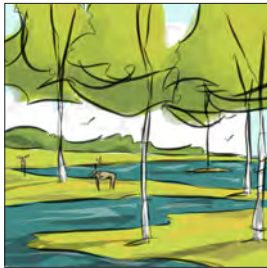
Land conservation projects begin by prioritizing areas of land for acquisition. Land or conservation easements can be bought or acquired through donation.



## GREENWAYS

Greenways are corridors of protected open space managed for both conservation and recreation.

Greenways often follow rivers or other natural features. They link habitats and provide networks of open space for people to explore and enjoy.



## WETLAND RESTORATION AND PROTECTION

Restoring and protecting wetlands can improve water quality and reduce flooding. Healthy wetlands filter, absorb, and slow runoff.

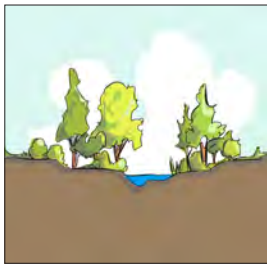
Wetlands also sustain healthy ecosystems by recharging groundwater and providing habitat for fish and wildlife.



## STORMWATER PARKS

Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding.

By storing and treating floodwaters, stormwater parks can reduce flooding elsewhere and improve water quality.



## FLOODPLAIN RESTORATION

Undisturbed floodplains help keep waterways healthy by storing floodwaters, reducing erosion, filtering water pollution, and providing habitat.

Floodplain restoration rebuilds some of these natural functions by reconnecting the floodplain to its waterway.

# NEIGHBORHOOD OR SITE SCALE



## RAIN GARDENS

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets.

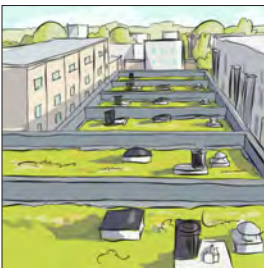
Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.



## VEGETATED SWALES

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope.

Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality.



## GREEN ROOFS

A green roof is fitted with a planting medium and vegetation. A green roof reduces runoff by soaking up rainfall. It can also reduce energy costs for cooling the building.

Extensive green roofs, which have deeper soil, are more common on commercial buildings. Intensive green roofs, which have shallower soil, are more common on residential buildings.



## RAINWATER HARVESTING

Rainwater harvesting systems collect and store rainfall for later use. They slow runoff and can reduce the demand for potable water.

Rainwater systems include rain barrels that store tens of gallons and rainwater cisterns that store hundreds or thousands of gallons.



## PERMEABLE PAVEMENT

Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers.

Permeable pavements are most commonly used for parking lots and roadway shoulders.



## TREE CANOPY

Tree canopy can reduce stormwater runoff by catching rainfall on branches and leaves and increasing evapotranspiration. By keeping neighborhoods cooler in the summer, tree canopy can also reduce the “urban heat island effect.”

Because of trees’ many benefits, many cities have set urban tree canopy goals.



## TREE TRENCHES

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater.

Tree trenches can be added to streets and parking lots with limited space to manage stormwater.



## GREEN STREETS

Green streets use a suite of green infrastructure practices to manage stormwater runoff and improve water quality.

Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

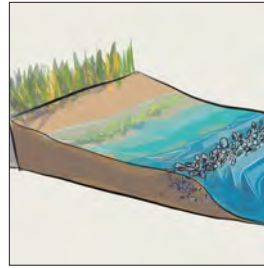
# COASTAL AREAS



## COASTAL WETLANDS

Coastal wetlands are found along ocean, estuary, or freshwater coastlines.

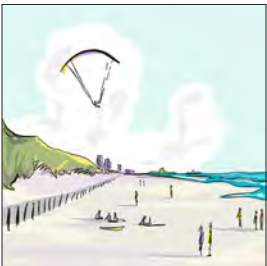
They are often referred to as “sponges” because of their ability to absorb wave energy during storms or normal tide cycles.



## OYSTER REEFS

Oysters are often referred to as “ecosystem engineers” because of their tendency to attach to hard surfaces and create large reefs made of thousands of individuals.

In addition to offering shelter and food to coastal species, oyster reefs buffer coasts from waves and filter surrounding waters.



## DUNES

Dunes are coastal features made of blown sand. Healthy dunes often have dune grasses or other vegetation to keep their shape.

Dunes can serve as a barrier between the water’s edge and inland areas, buffering waves as a first line of defense.



## WATERFRONT PARKS

Waterfront parks in coastal areas can be intentionally designed to flood during extreme events, reducing flooding elsewhere.

Waterfront parks can also absorb the impact from tidal or storm flooding and improve water quality.



## LIVING SHORELINES

Living shorelines stabilize a shore by combining living components, such as plants, with structural elements, such as rock or sand.

Living shorelines can slow waves, reduce erosion, and protect coastal property.