

Reflections

on planning, designing,
implementing, and
maintaining N&NBD

Tinkering

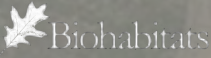


Sandy River Engineered Log Jam for Juvenal Salmonid Fish Habitat





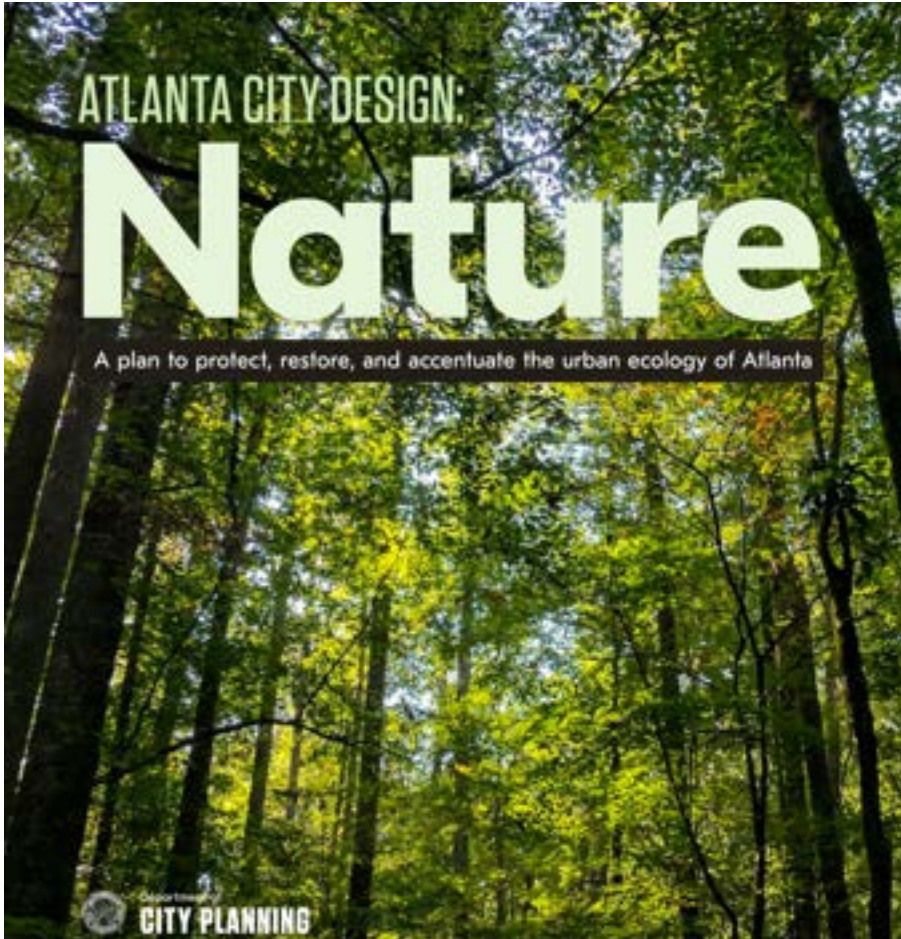
Kenilworth Aquatic Gardens National Park Freshwater Tidal Wetlands Restoration






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Per NOAA tide gauge data, Charleston has experienced **1.07 FT of sea level rise** in the past 100 years.

...almost 1/2 the total amount of sea level rise in the last 100 years has been in the last 20 years... That means the rate of sea level rise is increasing faster now than in the past.

Are We in the Midst Of a Sixth Mass Extinction?

A Tally of Life Under Threat

The International Union for Conservation of Nature has evaluated 82,200 species, shown here, for their ability to survive.

Each symbol represents 100 species assessed:

THREATENED

NOT THREATENED



Stark Indicators Of Extinction Risks

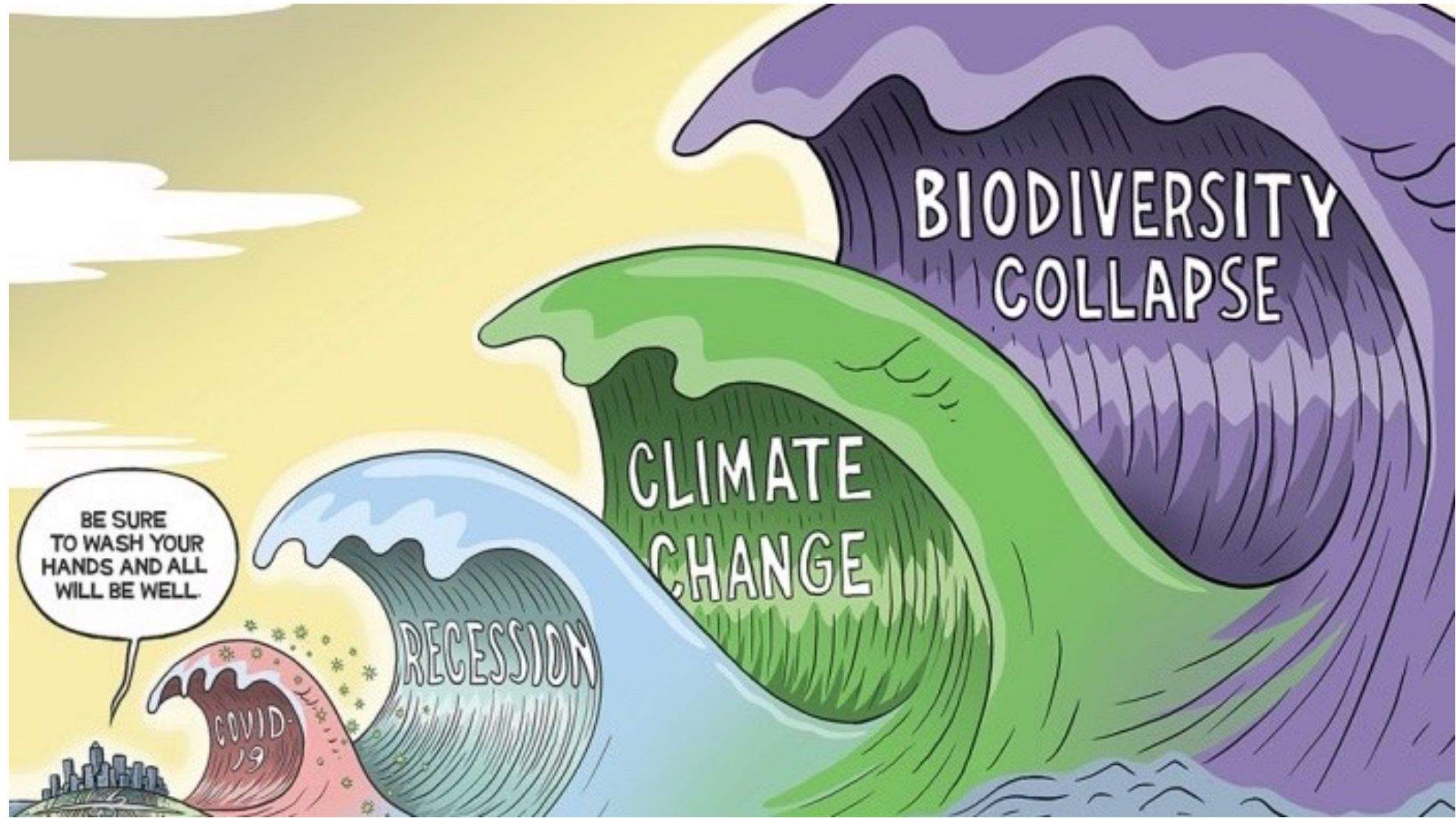
Most known species of birds, mammals and amphibians have been evaluated; the percentage of each group that is threatened is considered a reasonable estimate.



Federal Status

Tracked Species
250
in the selected county





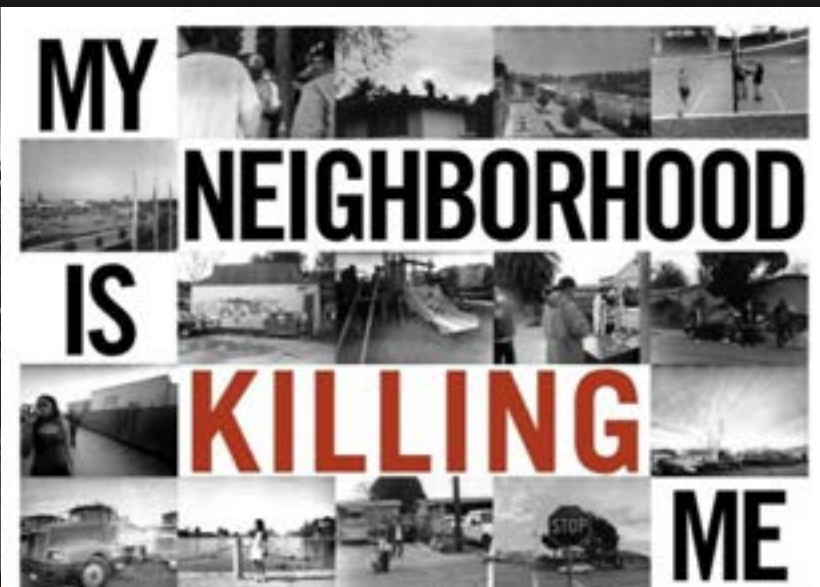
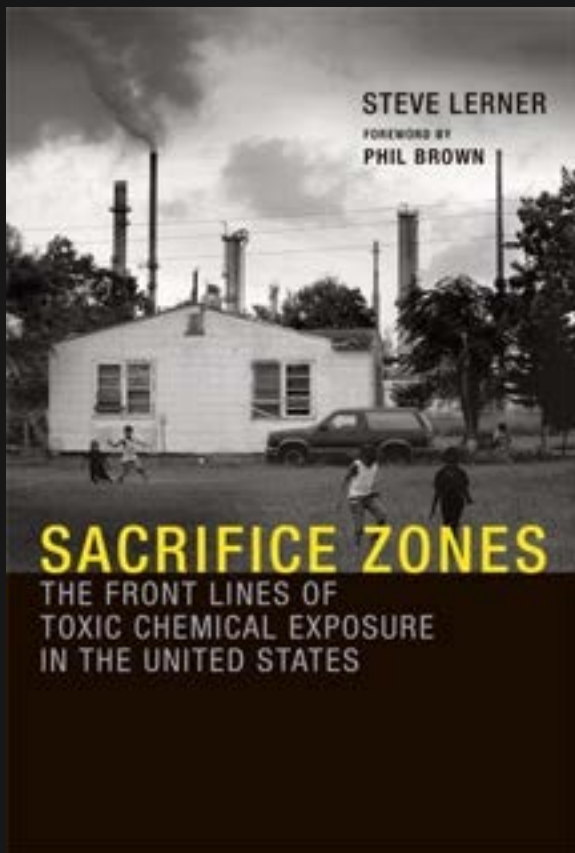
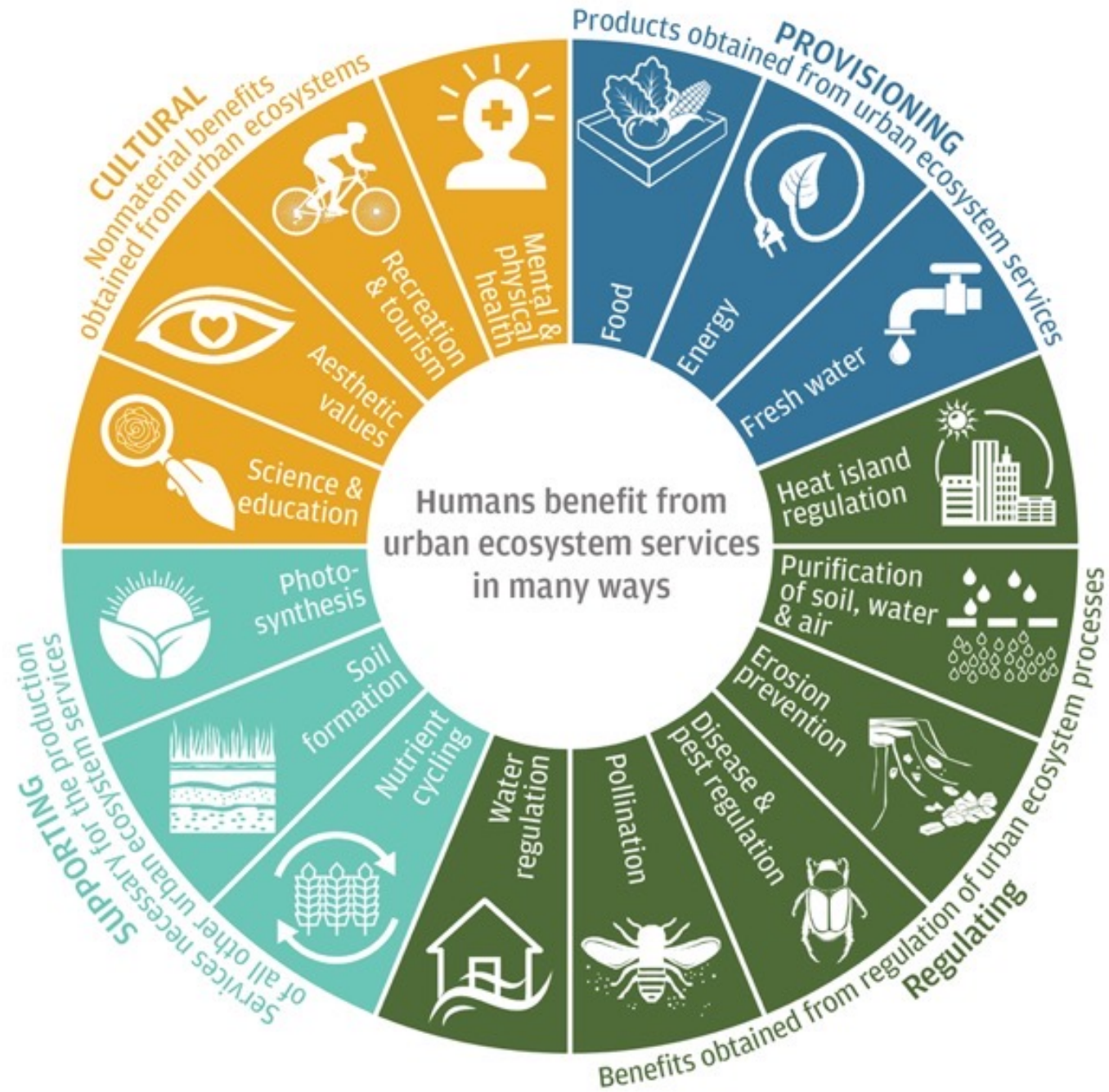


Image Source: Sojourners Magazine



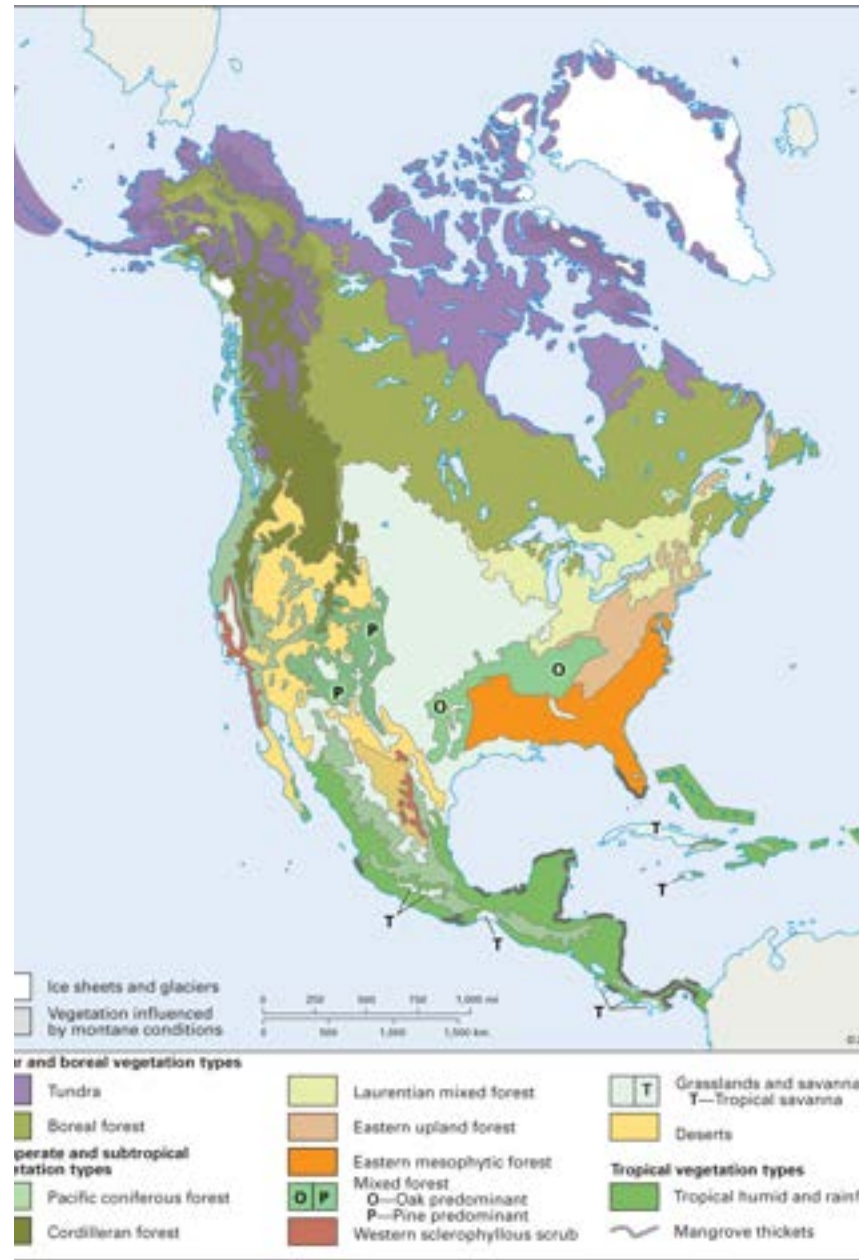
Place-based

Floodplain Reconnection and Stormwater Management, Anne Arundel County, MD





ILLUSTRATION BY LUISA RIVERA/YALE E360





Redhorse Bend Nature Preserve Restoration, , Freemont, OH



Flooding in North Charleston, South Carolina, in the aftermath of Hurricane Joaquin in 2015

Ryan Johnson/Flickr



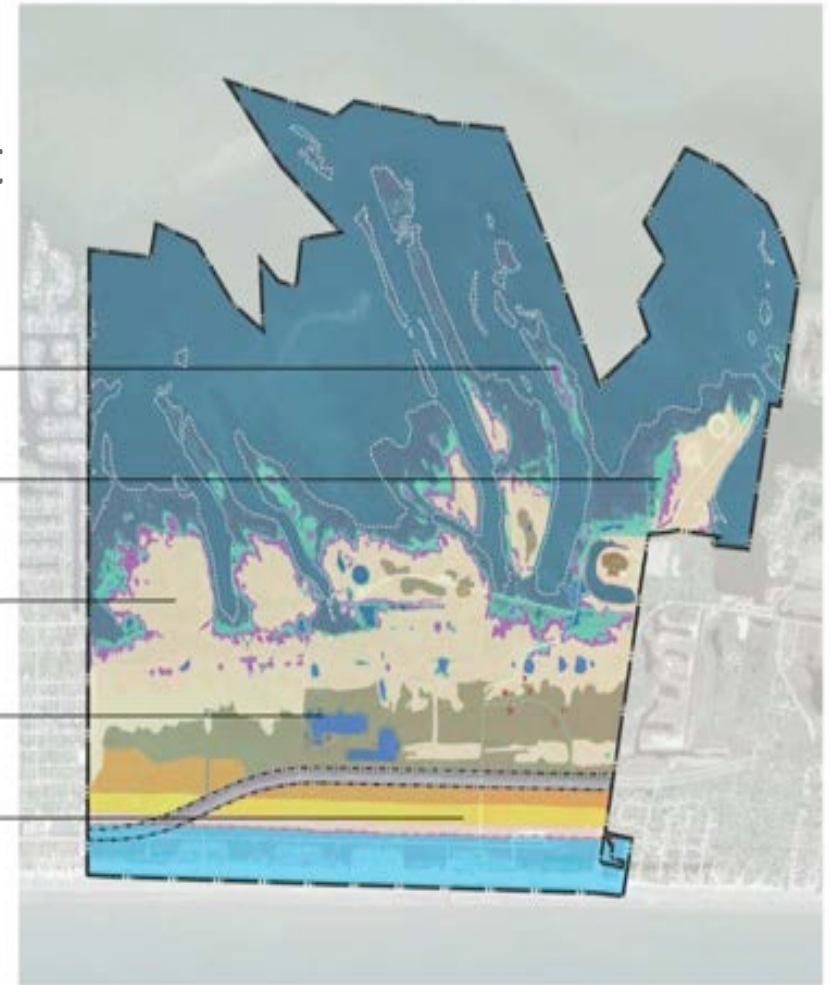
Wildfire plume over Santa Fe, New Mexico 2022

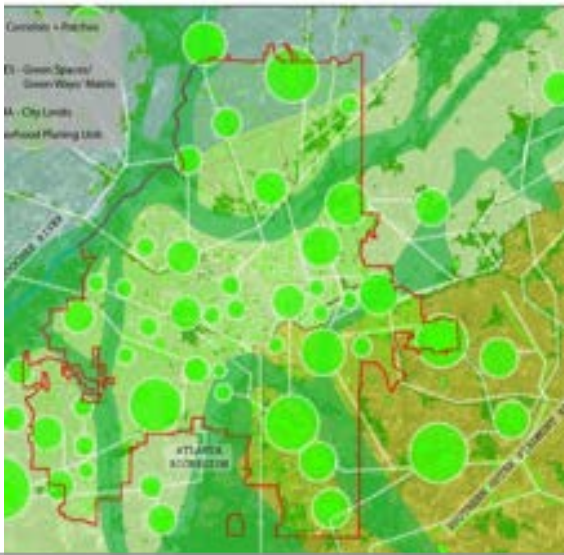
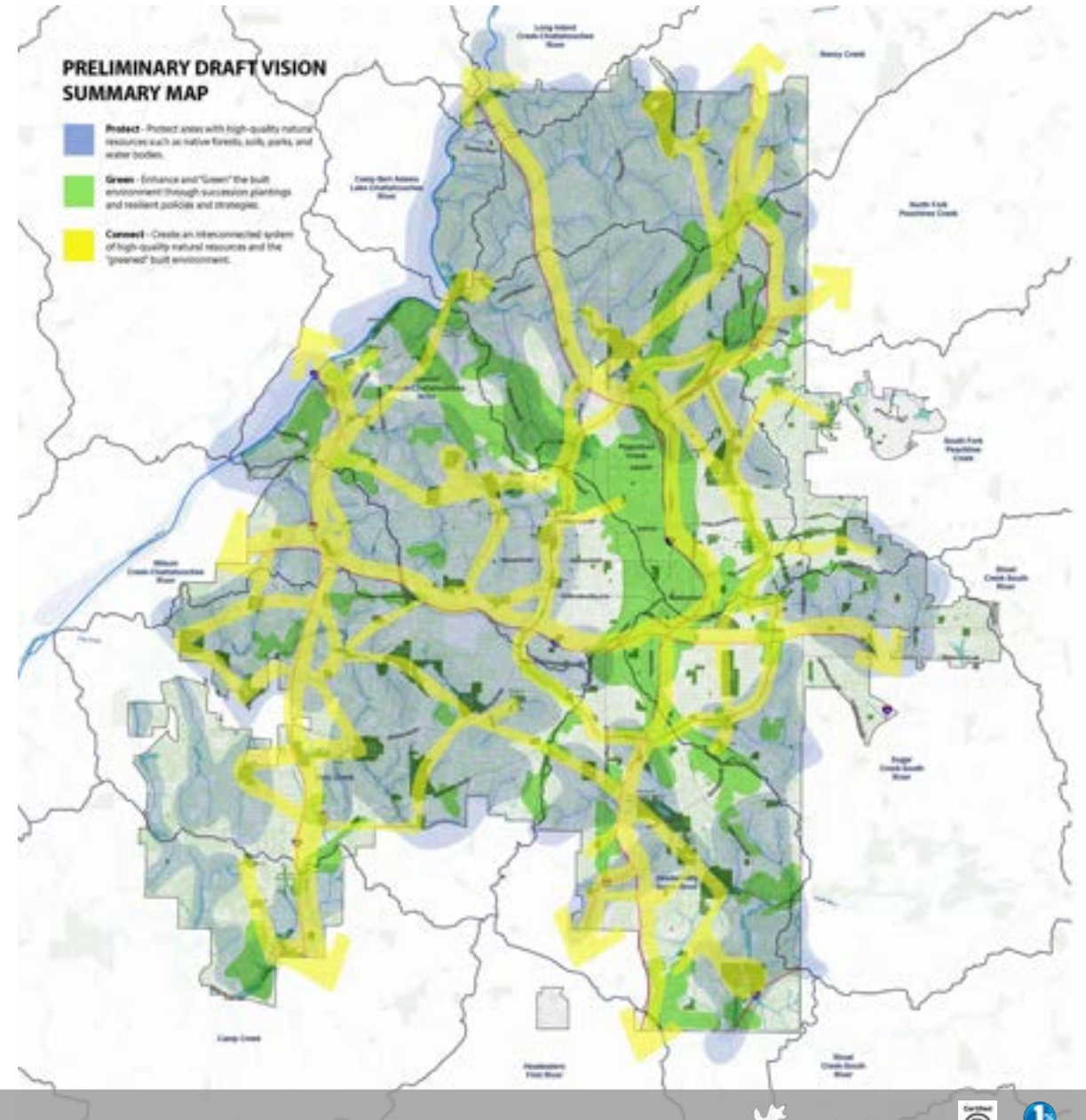
Erin English

2010 Habitat



Projected 2060 Habitat





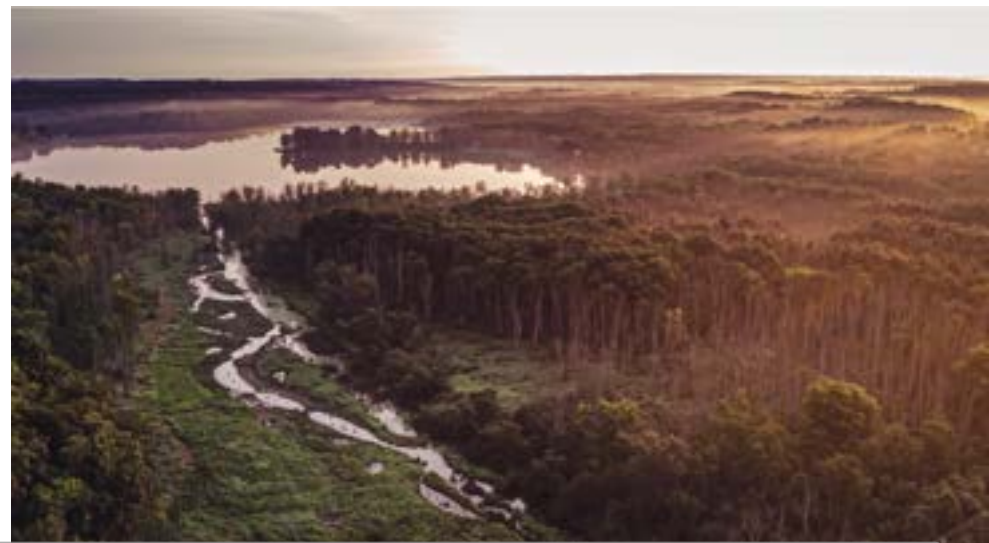
Photograph by Eric Champlin, atlantatrails.com



It's Alive!

Georgia Tech Biosystems Engineering Building Stormwater Capture, Treatment and Reuse, Atlanta, GA





Beaver Creek Floodplain Reconnection and Water Quality Enhancement, Munson Township, OH



Sandy River Engineered Log Jam for Juvenal Salmonid Fish Habitat

Carbon Storage in Earth's Ecosystems

Achieving net-zero by 2050 depends on the Earth's natural carbon sinks.

Forests play a critical role in regulating the global climate. They absorb carbon from the atmosphere and then store it, acting as natural carbon sinks.

Where is Carbon Stored?

There are various carbon pools in a forest ecosystem.

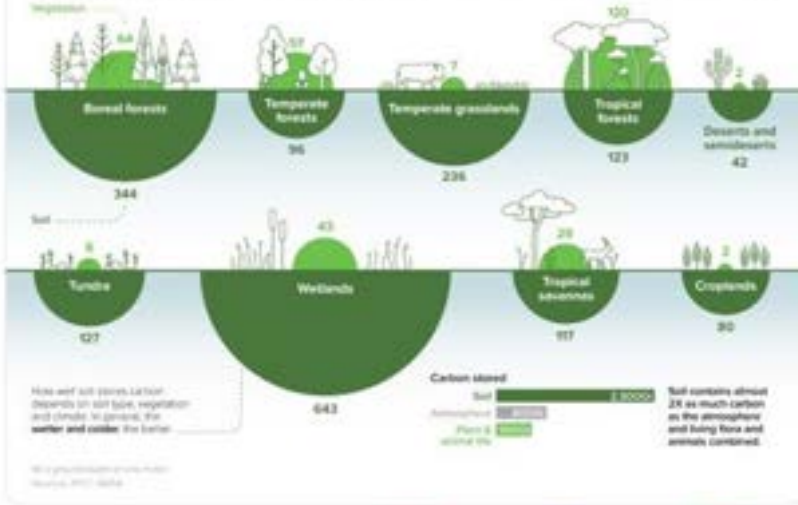


Carbon Storage

Tonnes of Carbon per Hectare*

The world's forests absorb around **15.6 gigatonnes** of CO₂ each year. That's around 34% the annual CO₂ emissions of the United States.

However, around **8.1 gigatonnes** of CO₂ leaks back into the atmosphere due to deforestation, fires and other disturbances.



Carbon Streaming is protecting the Earth's natural carbon sinks with carbon credit streams across the following REDD+ projects:



Rinco Rays
Borneo, Indonesia
150,000 hectares



Cerrado Biome
Brazil
100,000 hectares



MerVivo Blue Carbon
Baja California Sur, Mexico
20,000 hectares



Learn more at CARBONSTREAMING.COM

NEO: NETZ
DTCQB: QFSTF
FSE: M2Q

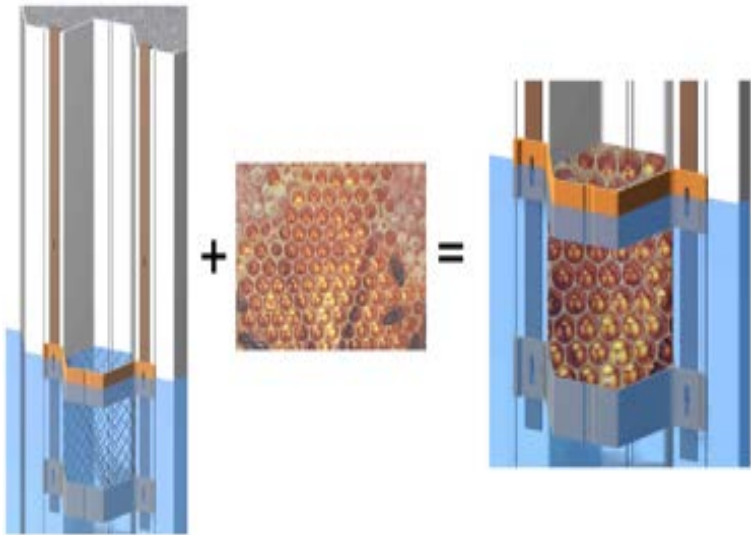


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Unity Park Large Wood Habitat Structures, Greenville, SC

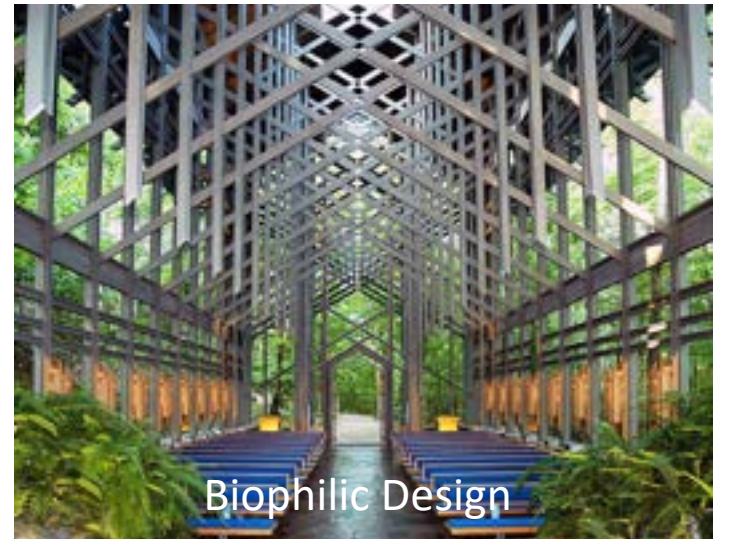




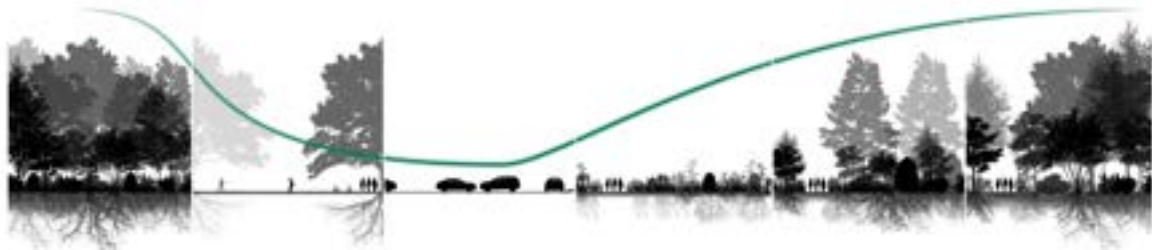
Biomimicry



Bioengineering



Biophilic Design



	REFERENCE	CONTRAST	ECOCOMMONS EXISTING SITE	PRIMARY	SECONDARY	MATURE
CARBON STORAGE - BIOMASS ONLY	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)
ECOLOGICAL VALUE	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)
WATER CAPACITY	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)	100,000 lbs (45,000 kg)

LIVING LABORATORY

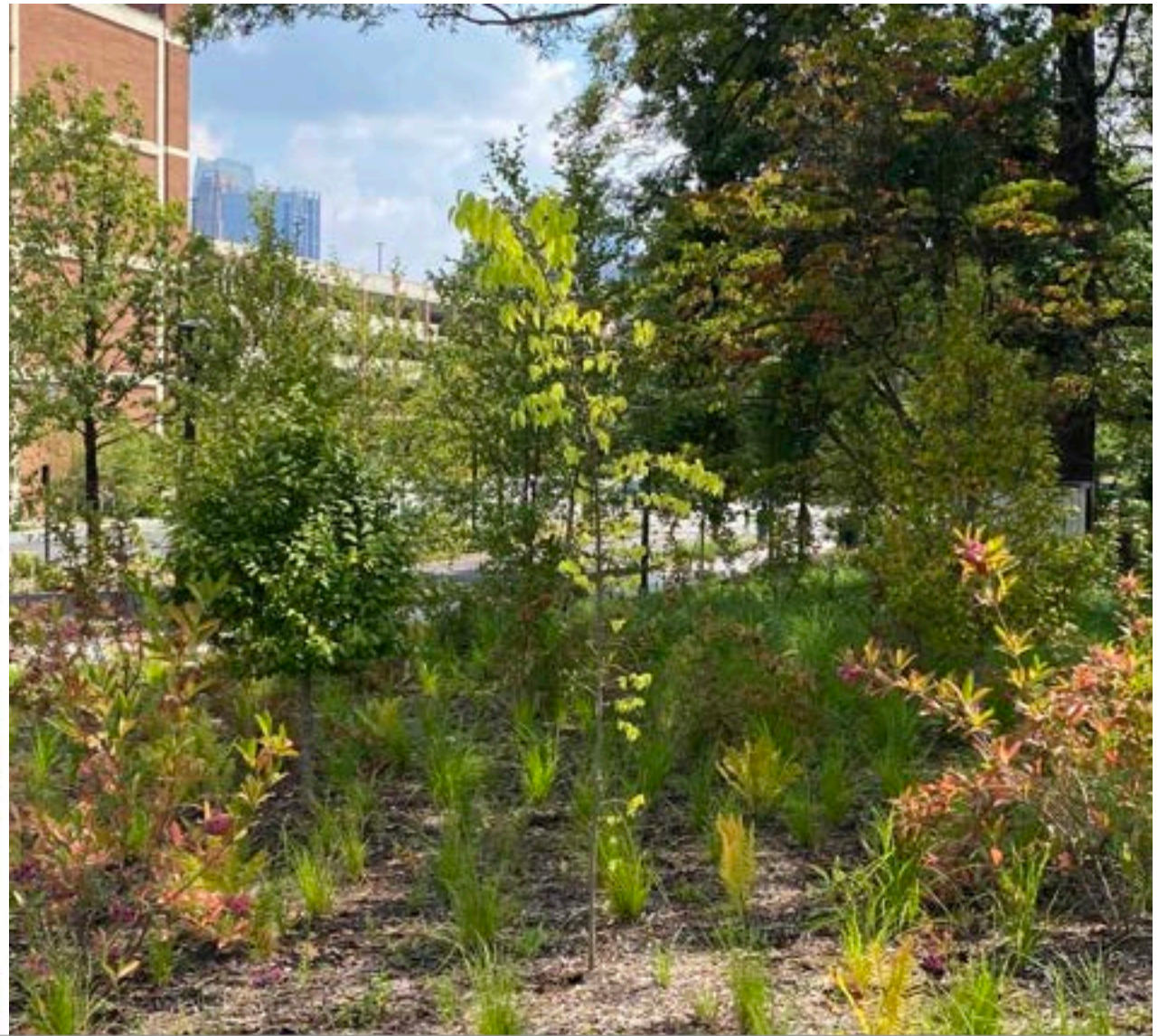
EcoCommons
LIVING BUILDING SECTOR

Monitoring

The EcoCommons aims to record on-site that original native plant and animal species have been lost and not be. The goal for the garden of the EcoCommons is to function as a high-performing learning and teaching landscape where ecological functions are being restored.

By restoring soil, water, and native plant communities, the EcoCommons aims to support greater biodiversity, absorb stormwater and sediment, capture air-polluting particles, and provide habitat, and a living laboratory for the students.

This ecosystem services have been restored, and a large of species, and various techniques are selected to enhance the collection. Based on these three categories: Climate Resilience & Water Use.



Georgia Tech EcoCommons Native Landscape and Stormwater Capture, Atlanta, GA



The first Birds & Brew brought community members together to celebrate new visitor amenities--including the picnic shelter, restroom and water garden--along with construction of the treatment wetlands.



Biodiversity

Slowed water behind beaver dams creates a rich ecotone, encouraging biodiversity through a dense food web and varied niches

Riot of Reciprocity

Wetlands

Beaver dams increase wetland edge, providing valuable wetland habitat

Soil

Beaver pond wetlands settle and build soil by slowing and trapping sediment and nutrients behind dams.

Hydrology

Wetlands formed by beavers act as sponges to absorb water during storms and release it in dry times to prevent flooding, reduce erosion, and feed groundwater





BIOLOGY STUDY POND

STORMWATER

WASTEWATER



Wastewater System

Biohabitats



Sidwell Friends School Natural Wastewater Treatment & Greywater Reuse, Washington, D.C.



Sidwell Friends School Natural Wastewater Treatment & Greywater Reuse, Washington, D.C.





ouR-HOME

Resilient by Design North Richmond Nature Based Design, North Richmond,
CA Image - Mithune



Repurposing Infrastructure

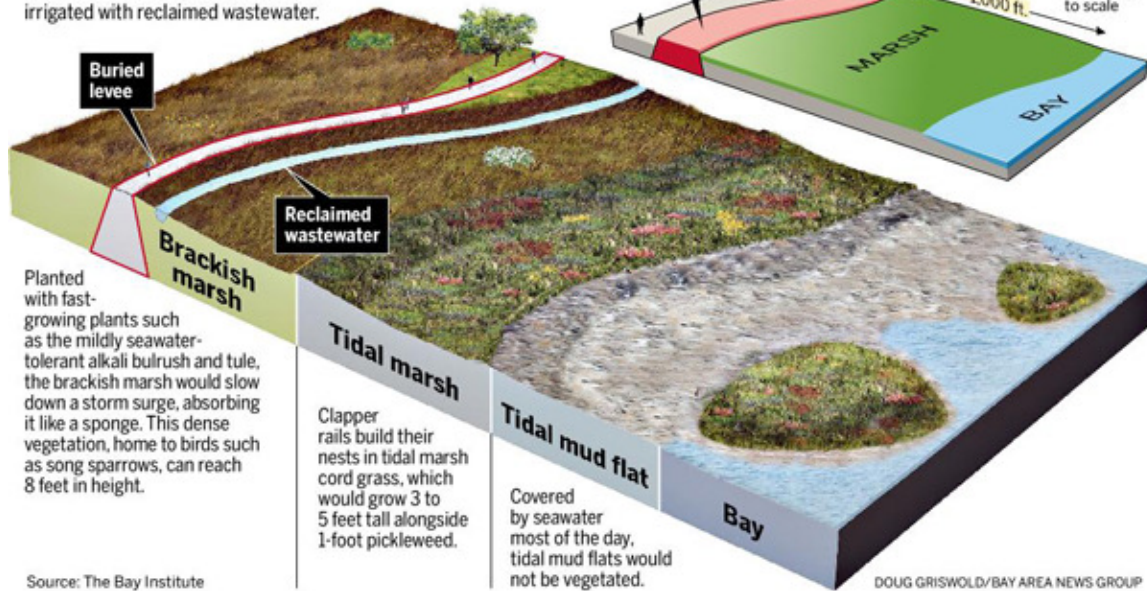
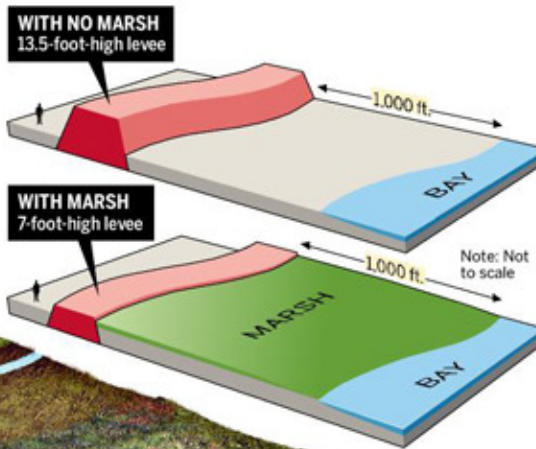
enhancing the ecotone

A new kind of levee

The Bay Institute, an environmental group, has proposed a number of "horizontal levees" for San Francisco Bay that blend a traditional earthen levee with restored tidal marshes. The marshes would be built up with sediment from local flood control channels. Marsh vegetation would be irrigated with reclaimed wastewater.

Marshes as barriers

Tidal marshes can slow down storm surges, meaning levees fronted by marshes can be built half as tall, and at half the cost, as traditional levees made of earth and clay.



Source: The Bay Institute

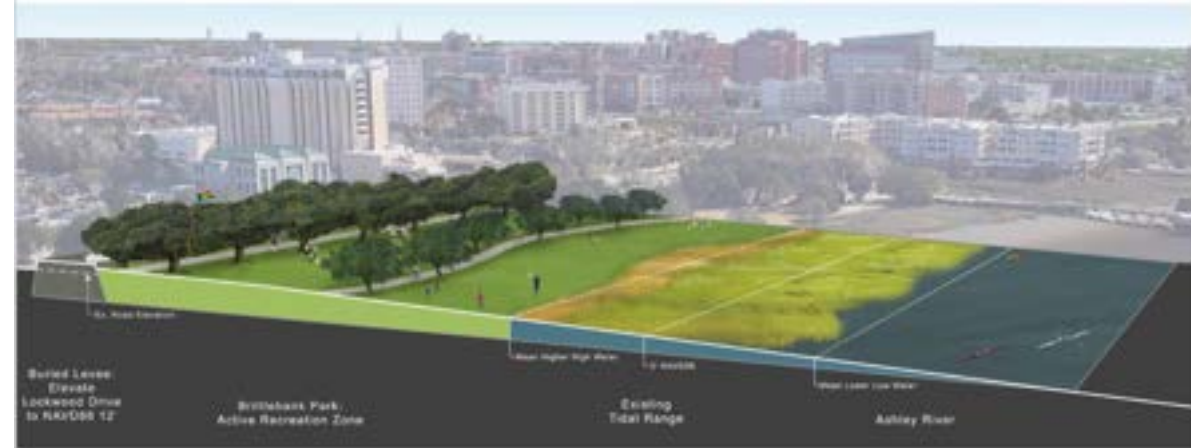


Illustration: DesignWorks



Floodplain reconnection and natural flood attenuation, Washington, DC



MARITIME FOREST

As vltium quite aurd quodit enveaquam, ut iur
 come nonnequifur collagat dromenem quator ut
 outperibus post, qui dlo dione sam, ut ut et collie
 optat comu quibus, expiquat pta andi pe ligit
 quaque autonum dloquam exereuo bea lome aut
 offi calectio ut aut re num exere apperatus mtra
 temoiti rem ante que paratit doloqans

VALLEY WETLAND

As vltium quite aurd quodit enveaquam, ut iur
 come nonnequifur collagat dromenem quator ut
 outperibus post, qui dlo dione sam, ut ut et collie
 comu quibus, expiquat pta andi pe ligit
 quaque autonum dloquam exereuo bea lome aut
 offi calectio ut aut re num exere apperatus mtra
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SHRUBLAND

The southerlyland adds strength to the dunes, acting
 as a spine or backbone. Shrub species may include
 bearberry, false beach heather, beach plum, weed,
 bayberry, and beach plum. Other species may include
 cacti, such as prickly pear cactus, and grasses like beach
 grass and little bluestem.

PUBLIC PARKS

FRED integrates a distinctive dune landscape with
 opportunities for development and recreation. In
 addition to controlled access to the central preserve and
 beach, public open spaces are distributed throughout
 the site in the valleys, on the decks and park that weave
 between buildings, and adjacent to neighboring
 communities. In addition to providing amenities such as
 shade, urban identity, and ornamental value, these
 parks are designed to integrate with the native dune
 ecology through the use of native and adapted
 vegetation.

DUNE GRASSES

Perennial grasses, followed by mosses and lichens, are
 typically the first plants to colonize dunes, able to
 tolerate salt spray, little to no fresh water, unstable
 substrates, occasional inundation during storms, low
 nutrient levels, and abrasion by wind and water. The
 roots of these grasses hold the sand and dune formation
 in place, acting as a resilient barrier to storm surge and
 flooding, providing significant habitat, and serving as a
 reservoir of sand when beaches erode. Beach grass
 combined with periodic sand burial creates a mound, the
 "tail" of a dune. Sea over-wash floods the dune grass
 periodically and can deposit as well as stain the sand,
 on any given day throughout the year. As the loosed
 grass lifts the back from sea setting they decay, adding
 organic material to the dune structure. The dune is not
 made of pure sand but decaying grass matter combined
 with sand. Buried grass adds body, weight, and moisture
 to the dune, as well as important fungi and essential
 bacteria that the beach grass thrives on. Decayed
 matter to sand ratio is essential for a strong dune.
 Important dune grass species include American
 beachgrass, Bayshore smooth cordgrass, tufted
 saltmeadow cordgrass, and Atlantic coastal
 panicgrass.

BEACH

The beach is a dynamic habitat zone, an interface
 between terrestrial and marine habitats, as well as the
 site of heavy recreational use. Sparsely vegetated
 dunes are interspersed with sand, shell, and pebble
 areas. Landforms have been built up over the past
 several thousand years by sand from the sea floor and
 by sand transported westward along the Long Island
 Shoreface by wave-generated longshore currents. Sand
 and silt/colloid areas of beach are important nesting
 areas for the State-listed endangered least tern and
 Federally listed threatened piping plover and
 sanderling. The Beach Armadillo is a Federally
 endangered plant that once ranged from Massachusetts
 to South Carolina. This low spreading, annual beach
 plant colonizes seaward habitats between the high tide
 line and the toe of the primary dune. It has been
 extirpated from two thirds of its historic range and is now
 found only in North Carolina, South Carolina, New York
 and New Jersey. It is found in sparsely vegetated areas
 and is easily outcompeted by perennial dune plants
 within dune areas.

OCEAN

The site is subject to semi-diurnal tides, with waves from
 the south and southeast, and large fetch. Sea level rise
 over next 50 years is projected at a minimum 0.5 feet
 (NOAA), requiring a flexible and adaptable ecological
 framework. Shallow nearshore waters are used as
 feeding areas. Important occasional species include
 Atlantic mackerel, black sea bass, winter flounder,
 summer flounder, and scup. Principal species using the
 area include leasting, northern puffer, black sea bass,
 striped bass, weakfish, flounder, and horseshoe crab.
 During the summer and early fall months, the Pileated
 woodpecker, endangered Kirtley's nighthawk, veery,
 and green sea turtles occur in New York coastal waters
 (NYSF, 1993) but do not nest in this area. Marine
 organisms, such as marine worms, insects,
 crustaceans, and mollusks, are an important component
 of diet for plovers and terns.

CONNECTIONS
 TO JAMAICA BAY

DEVELOPMENT
 IN THE DUNES



SECONDARY DUNES

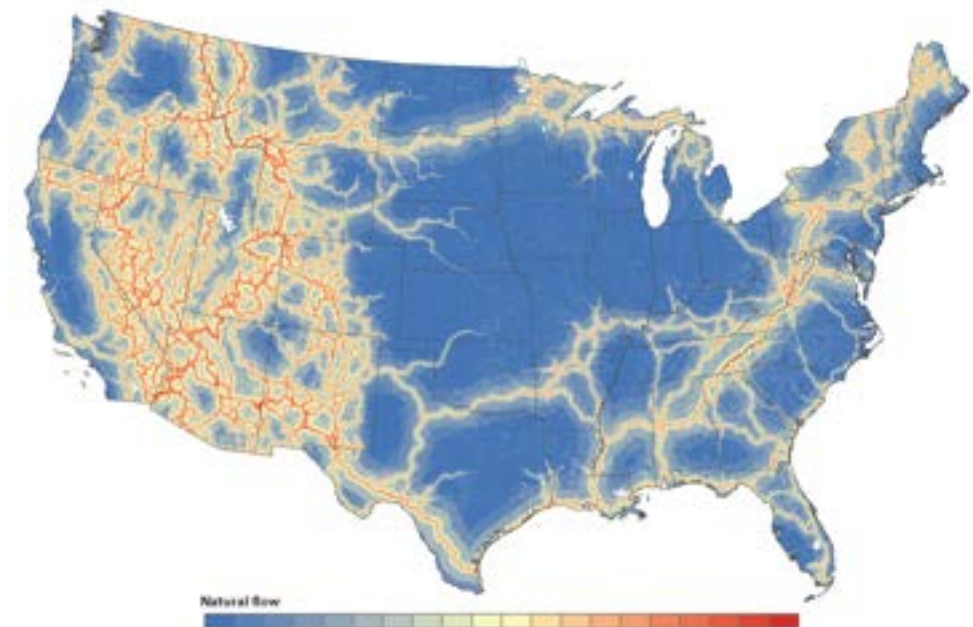
PRIMARY DUNE

BEACH

THE EASTERN WILDWAY



THE EASTERN WILDWAY is a vision for wildlife habitat connectivity in the eastern U.S./Canada. Comprised of six ecoregions, the Eastern Wildway provides a framework within which local, state, federal and private land managers can collaborate to connect and restore habitat to ensure the survival of native species and the health of local communities.



Final Reflections



Strand feeding bottlenose dolphins (*Tursiops truncatus truncatus*)

Photo courtesy of Ellen Jones © Passingbyphoto.com

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Using Nature to its Full Advantage

Dr. Brandan Scully, USACE

Todd Martin, City of Columbia

Dr. Liz Fly, TNC

Erin Stevens, Surculus

Dr. Regina Ciphrah, Verbalizing Visions, LLC

Francis Marion Forest; hooded pitcher plant (*Sarracenia minor*)