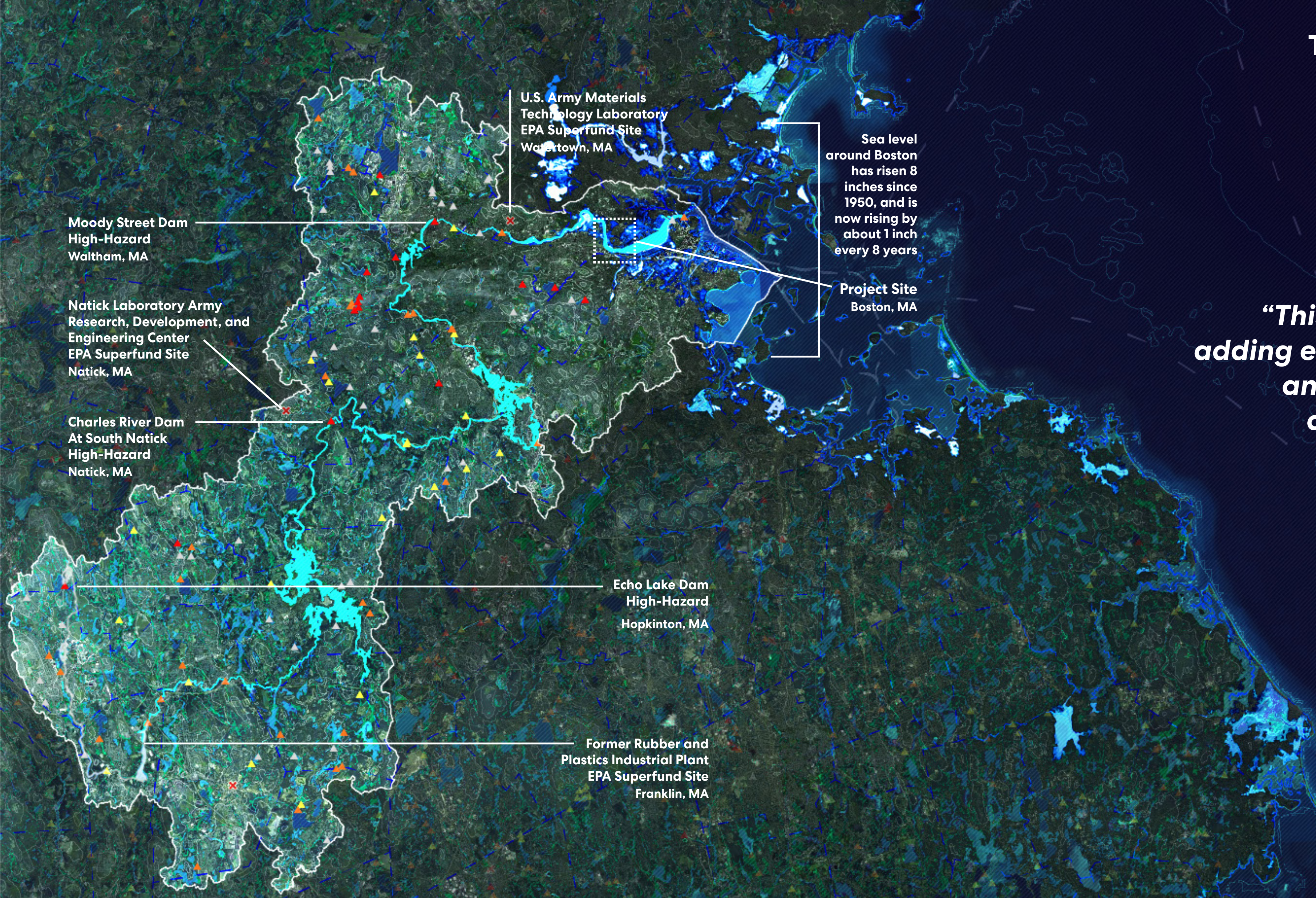


The Charles River: A Living Shoreline

The Charles is part of a vast hydrological network which is at risk of flooding & infrastructural decay. While the upper portion flows like a river, the lower basin between Boston and Cambridge acts more like a pond, leading to increased water temperatures, high concentrations of pollution, and eutrophic conditions.

“This work argues for the importance of adding ecological foundation for monitoring and restoration work that moves from a narrow focus on water quality to a broader focus on river health.”



Moody Street Dam
High-Hazard
Waltham, MA

Natick Laboratory Army
Research, Development, and
Engineering Center
EPA Superfund Site
Natick, MA

Charles River Dam
At South Natick
High-Hazard
Natick, MA

Echo Lake Dam
High-Hazard
Hopkinton, MA

Former Rubber and
Plastics Industrial Plant
EPA Superfund Site
Franklin, MA

U.S. Army Materials
Technology Laboratory
EPA Superfund Site
Waltham, MA

Sea level
around Boston
has risen 8
inches since
1950, and is
now rising by
about 1 inch
every 8 years

Project Site
Boston, MA

- Charles River**
- 80 miles long
 - Intersects 23 municipalities
 - Fed by 80 streams
- Charles River
Drainage Basin**
- Includes 33 lakes and ponds
 - Intersects 35 municipalities
 - Contains 3 EPA Superfund sites
 - Contains 46 Significant or High-Hazard dams

Legend

Projected Sea Level Rise

6'
5'
4'
3'
2'
1'
0'

Hydrology
Wetland
EPA Superfund Sites
Watershed Boundary

At-Risk Dams

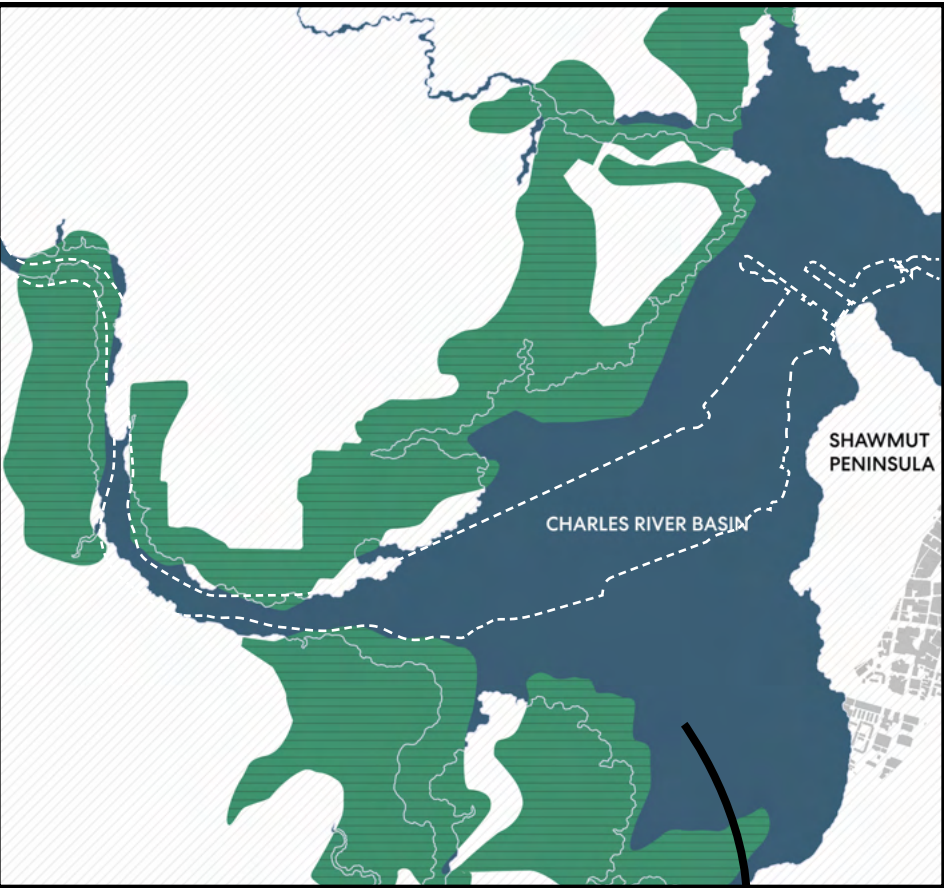
Low Hazard
Significant Hazard
High Hazard
N/A (Private)

Project Site

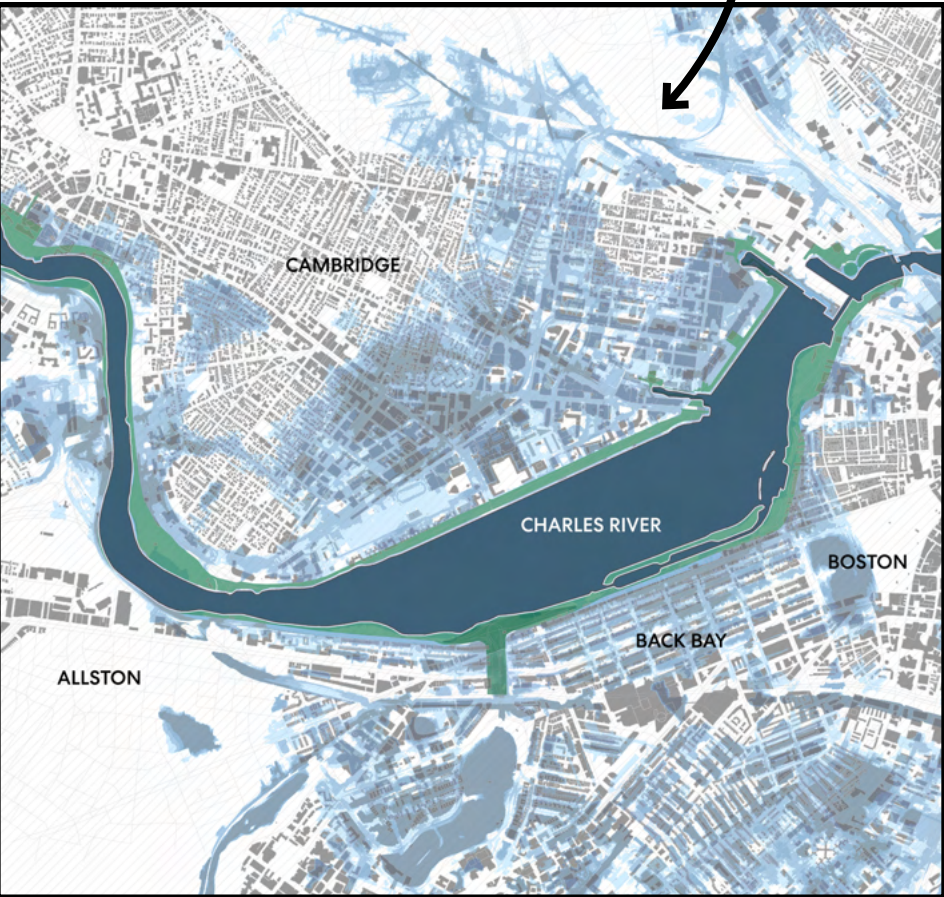
0 1.5 3 6 miles

Rediscovering a lost landscape

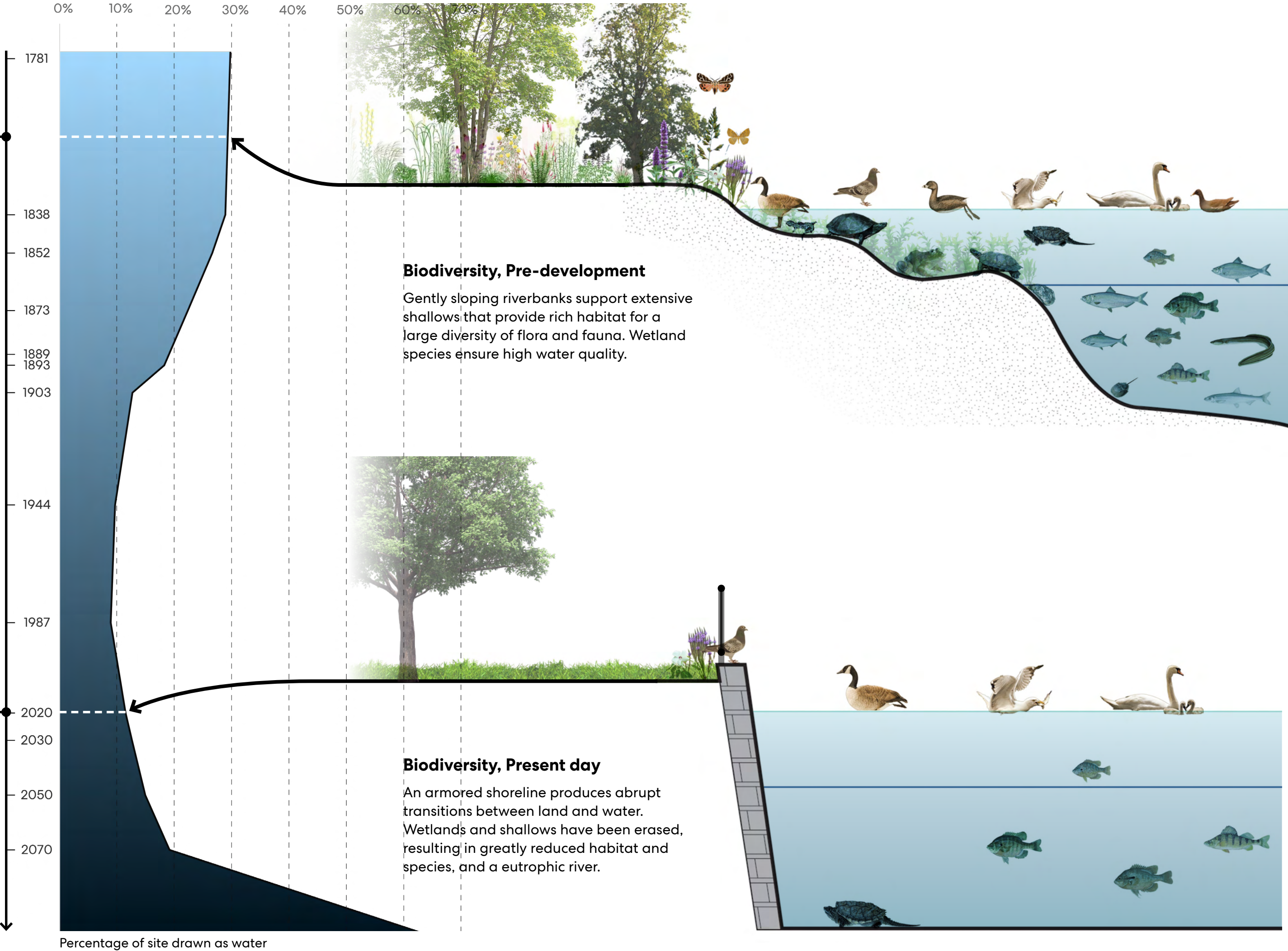
The Charles has a long history of geoengineering and infill. Sea level rise projections demonstrate water will likely return to those filled areas.



Pre-development (1770's)



Urbanization (Present) and Imminent sea level rise projections



Flora + Birds

Reptiles

Aquatic Animals

Flora + Birds

Reptiles

Aquatic Animals

The largely developed edge conditions of the present-day Charles are not conducive to biodiversity, and water quality is generally poor. It is critical to understand these conditions to evaluate their capacity to combat the effects of climate change.

In 2020,

259
species of plants

173
species of animals

are **Endangered,**

Threatened, or of Special Concern under the Massachusetts Endangered Species Act.

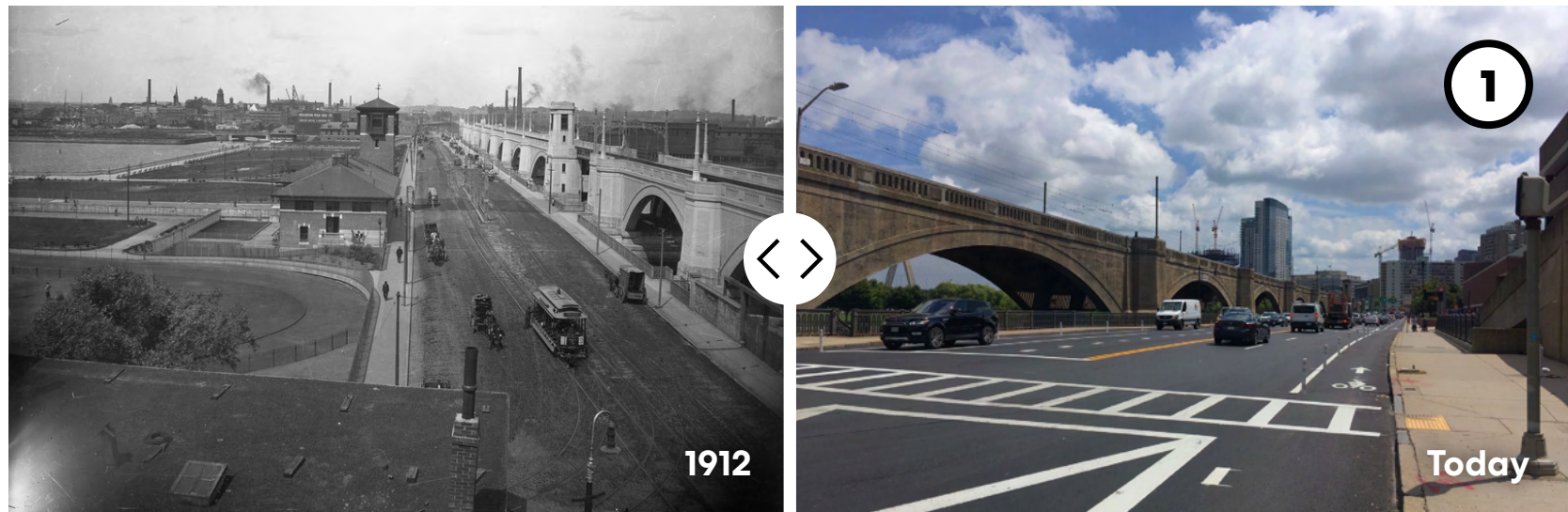
Confronting a century of car culture



Much of the historic public open space of the Charles River Esplanade has been lost or become inaccessible due to the proliferation of vehicular infrastructure, walling the river off from the adjacent communities.

Two representative sites were strategically chosen as case studies to test interventions designed to reverse past mistakes and expand ecological habitat.

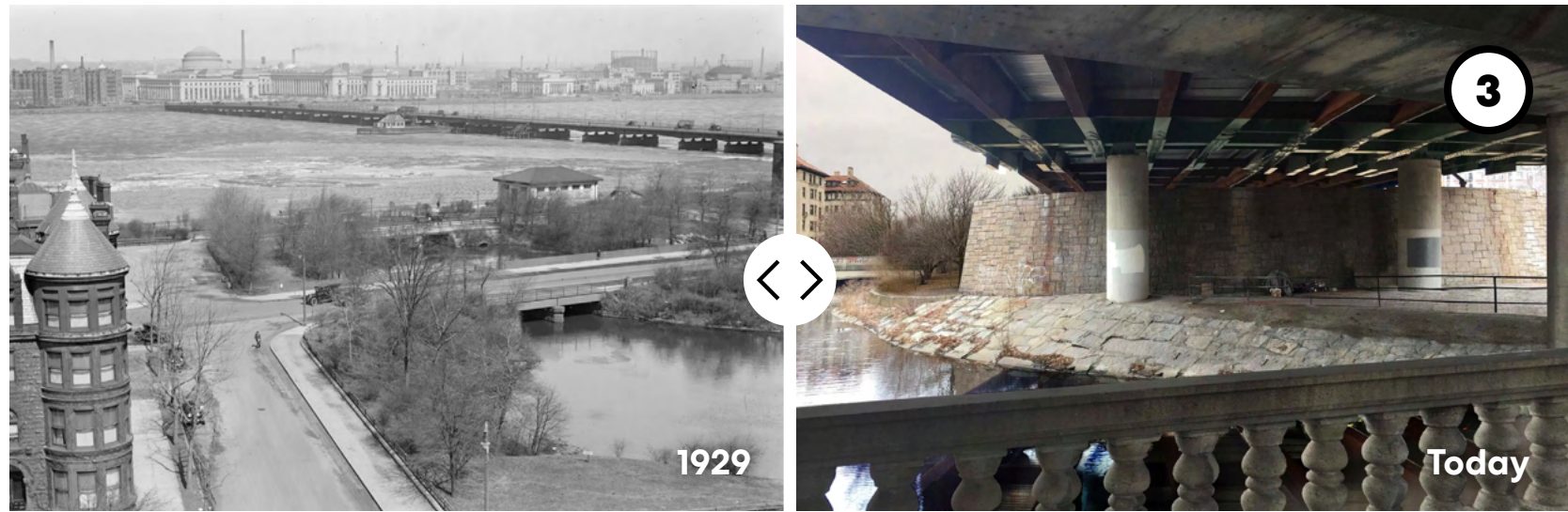
Charles River Dam



Charles River Esplanade



Charlesgate



Designing an actively inclusive process

The engagement framework inspires a clear and focused framework that breaks down silos and foregrounds complex, interdependent issues needing resolution. Elevating the interconnectedness of mobility, environmental, and social systems helped unite a diverse community around a shared vision and goals.

PURPOSE

Restoring the aquatic health of the Charles River by employing natural systems to replace aging gray infrastructure. An expanded performative landscape of reconstituted wetland habitat reestablishes the historic estuary ecosystem of the river basin and strives to mitigate the anticipated impacts of climate change on adjacent neighborhoods.

PLACE

Knit the marginalized neighborhoods that were disconnected from the riverfront by the Massachusetts Turnpike back into this signature open space network through improved accessibility, greater connectivity between existing mobility networks, and an expanded Esplanade.

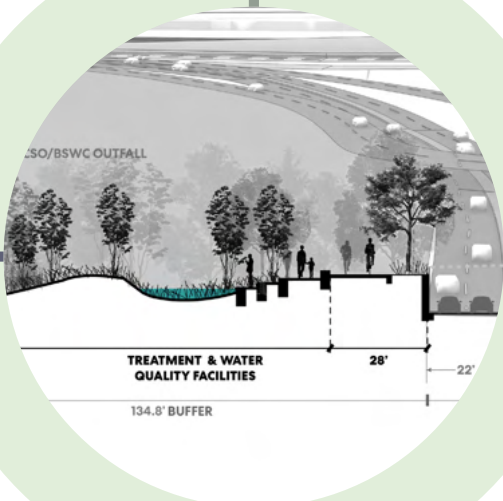
PERSPECTIVE

Build consensus and unity among the myriad stakeholders - community groups, activists, municipalities, and government agencies - around a shared vision of an enhanced and reinvigorated waterfront that centers the river and parkland.

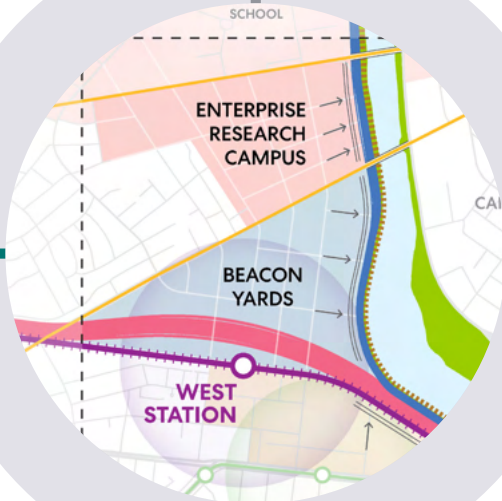
SOCIAL Engagement and Understanding



ENVIRONMENTAL Mapping and Analysis

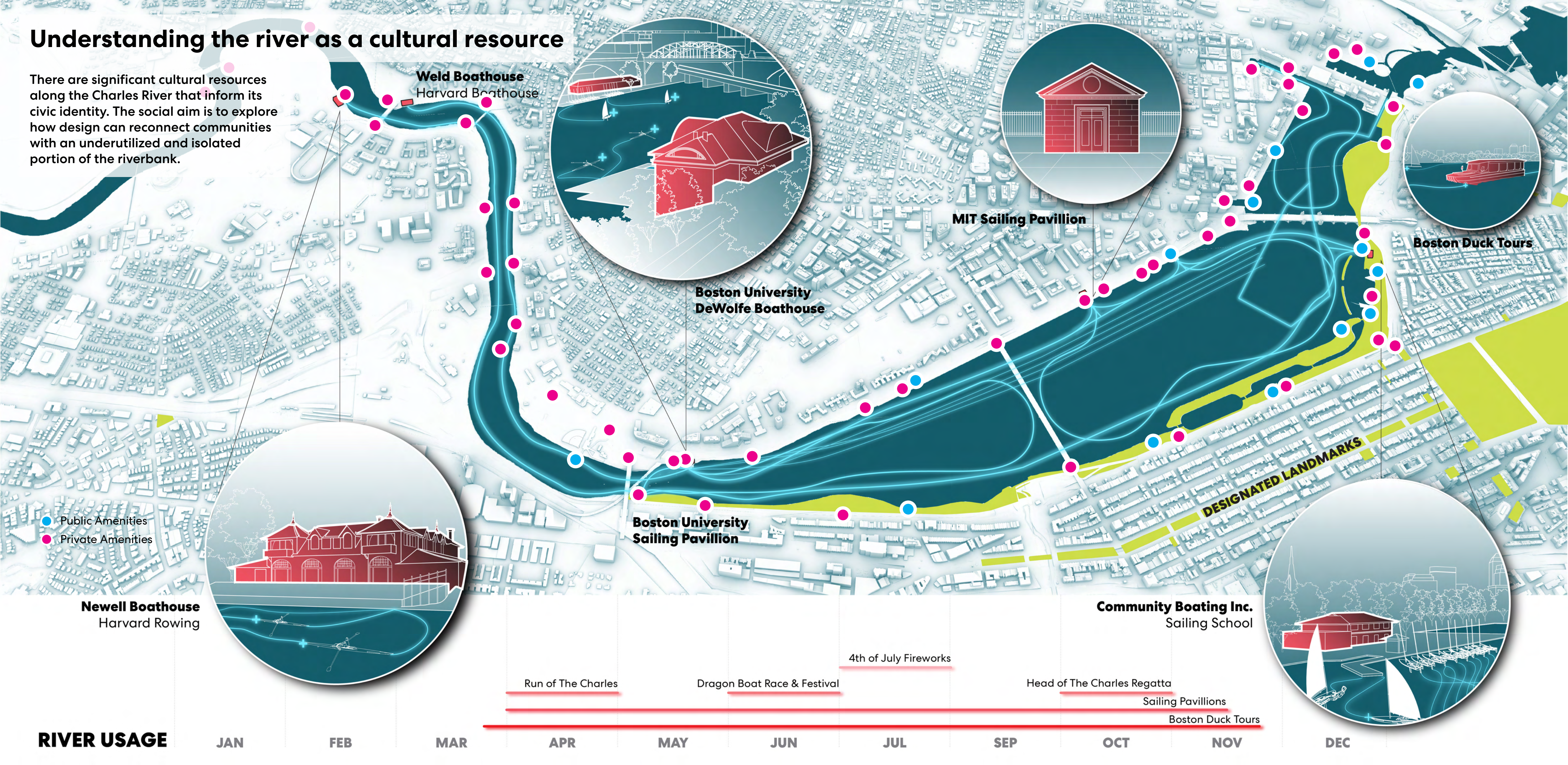


ECONOMIC Research and Planning

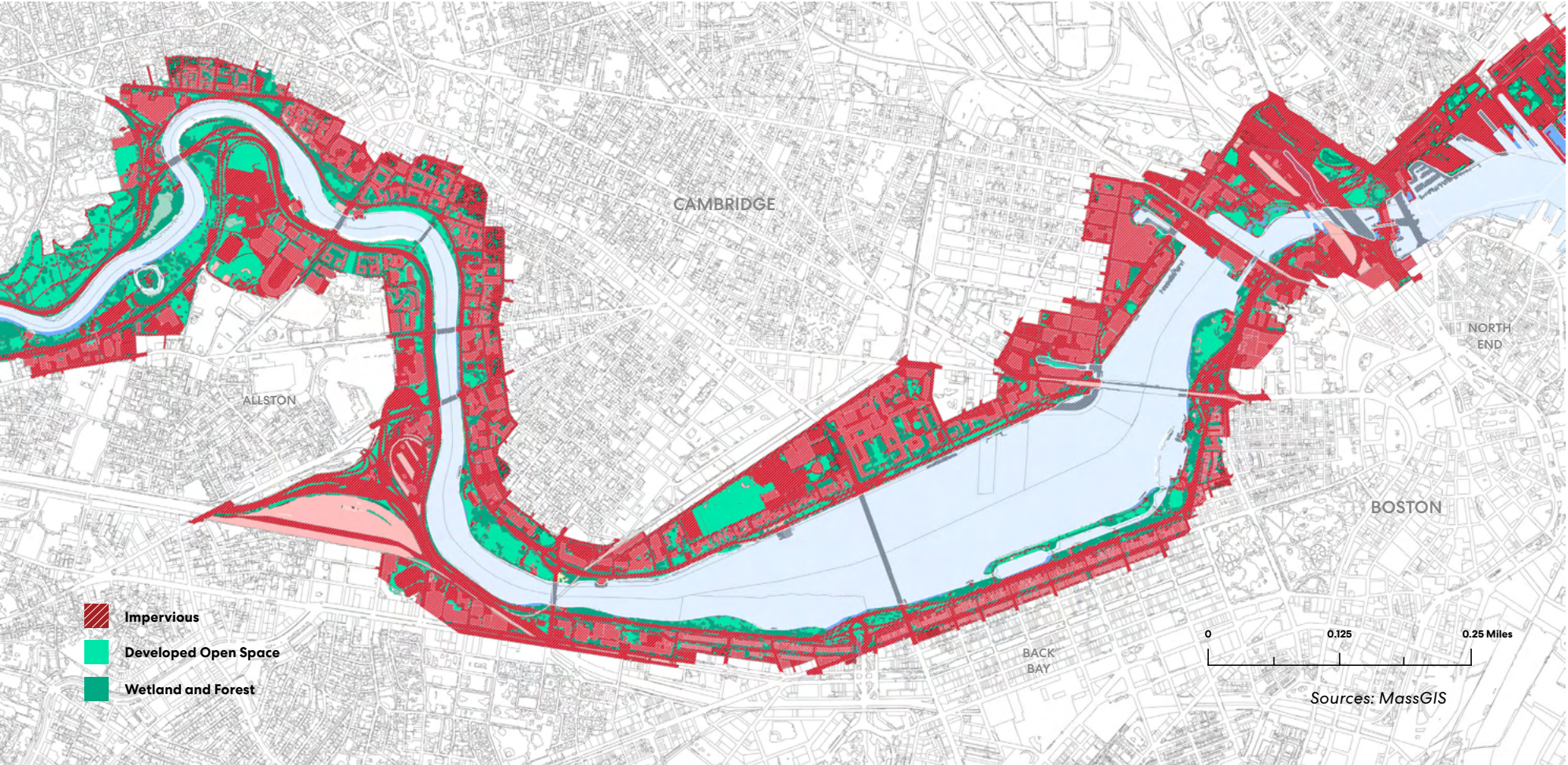


Understanding the river as a cultural resource

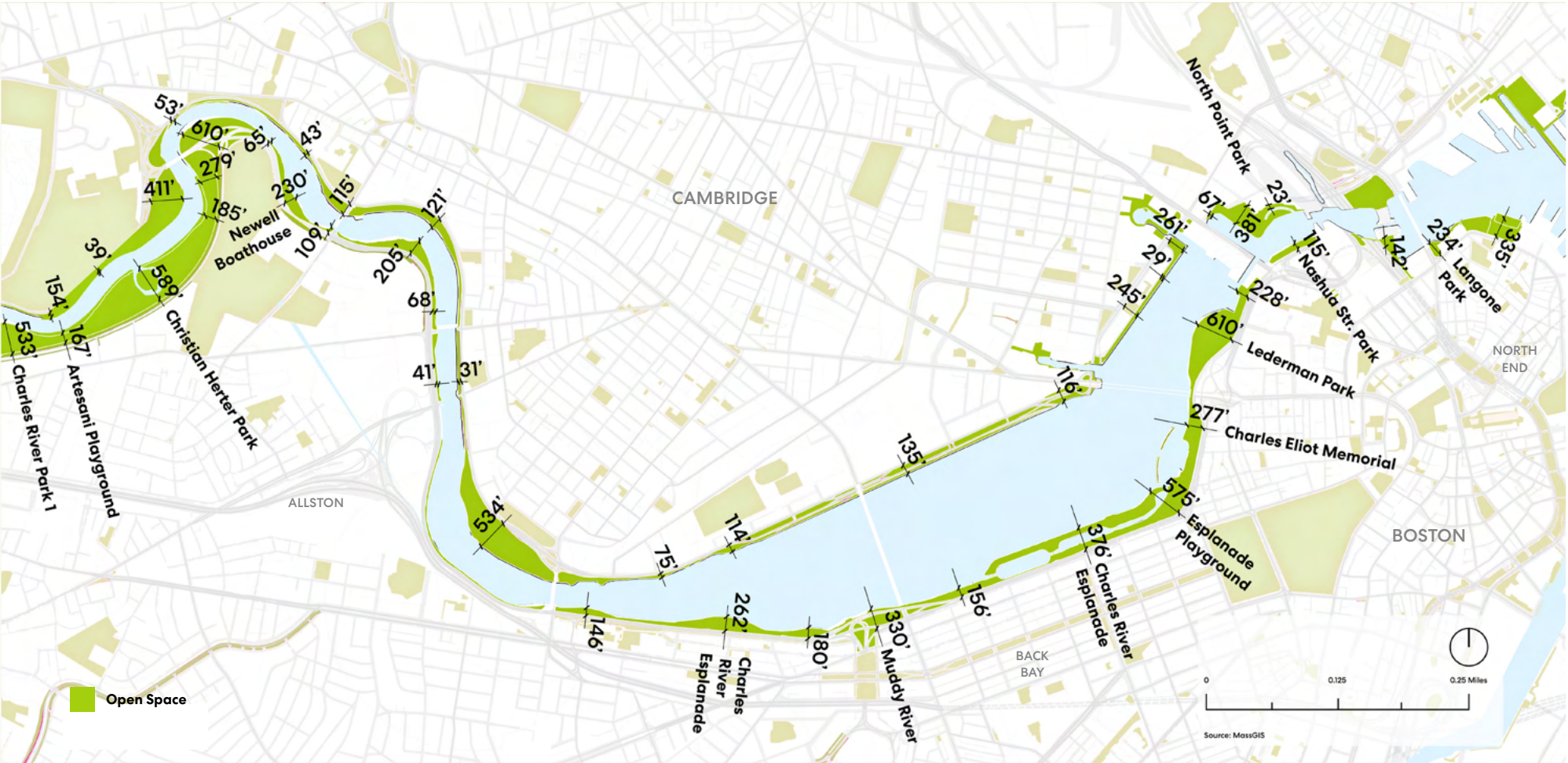
There are significant cultural resources along the Charles River that inform its civic identity. The social aim is to explore how design can reconnect communities with an underutilized and isolated portion of the riverbank.



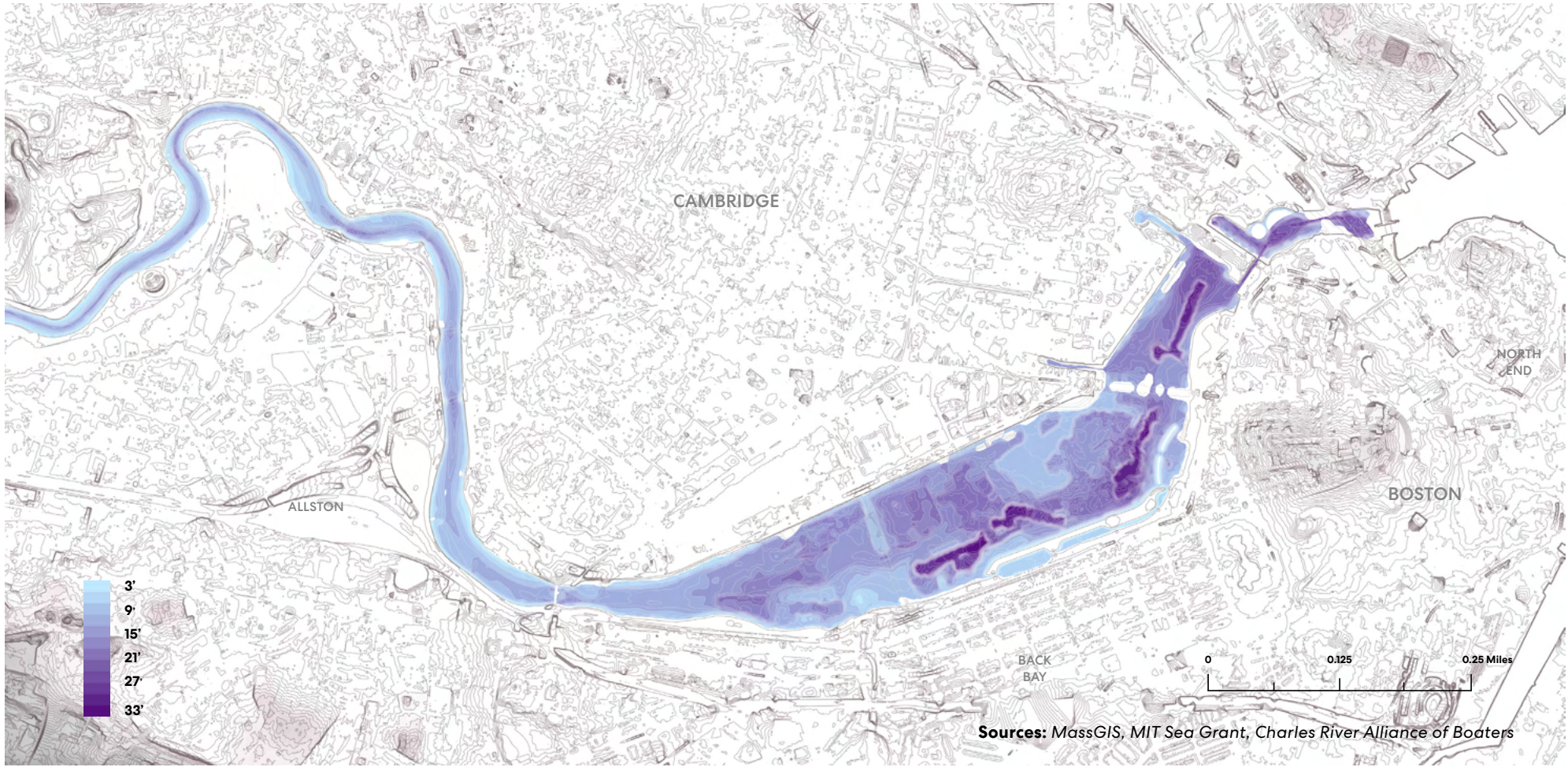
Quantifying the magnitude of the challenge



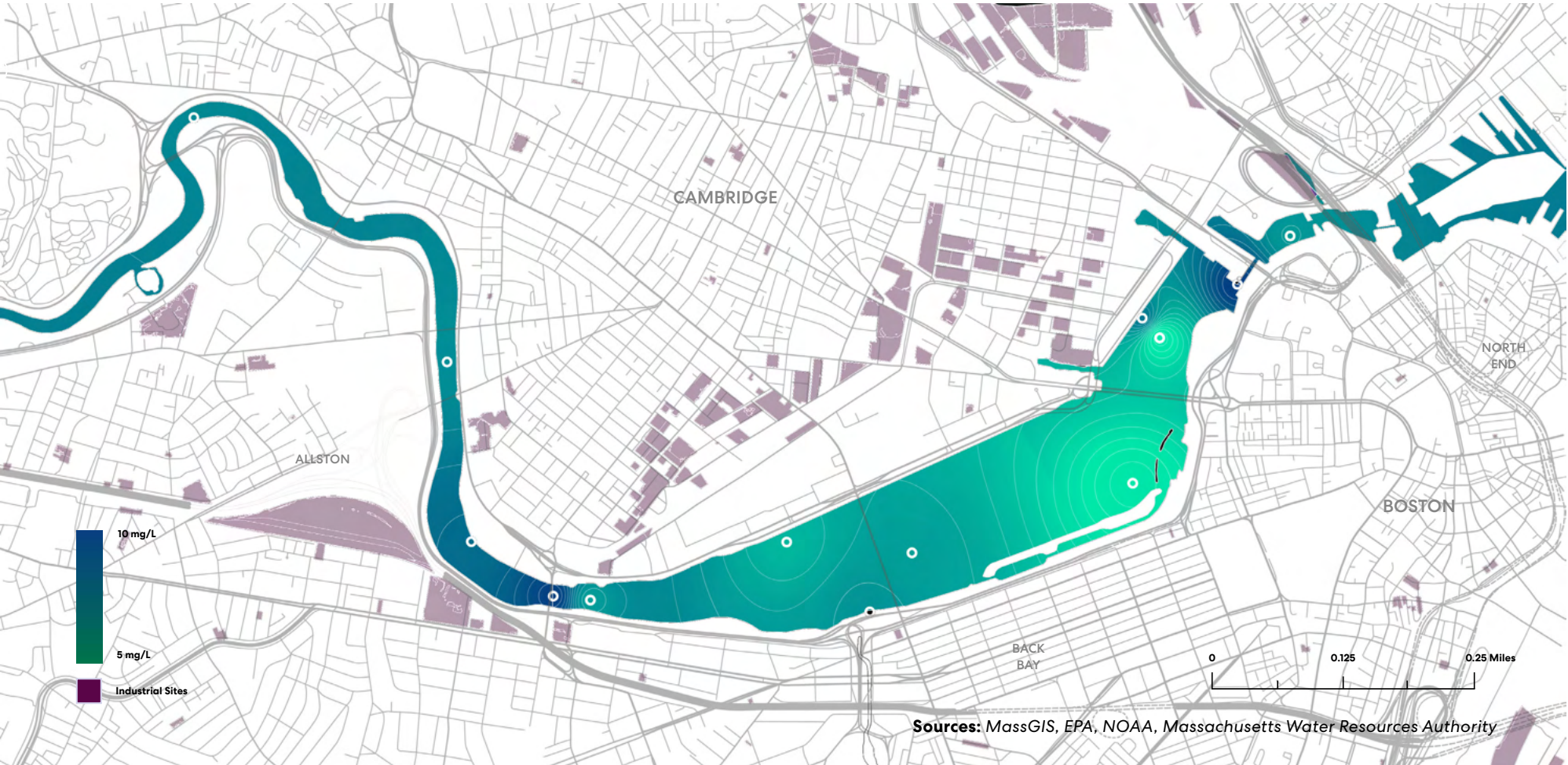
Impervious Surfaces dominate the riverbanks, exacerbating stormwater runoff



Riverbank Widths vary greatly, producing inequitable access to open spaces



Bathymetry drives the flow rate of the river, which decreases as the basin widens



Pollution (Dissolved Oxygen) reaches its highest concentration ahead of the dam

Challenges



Invasive Species



Pollution

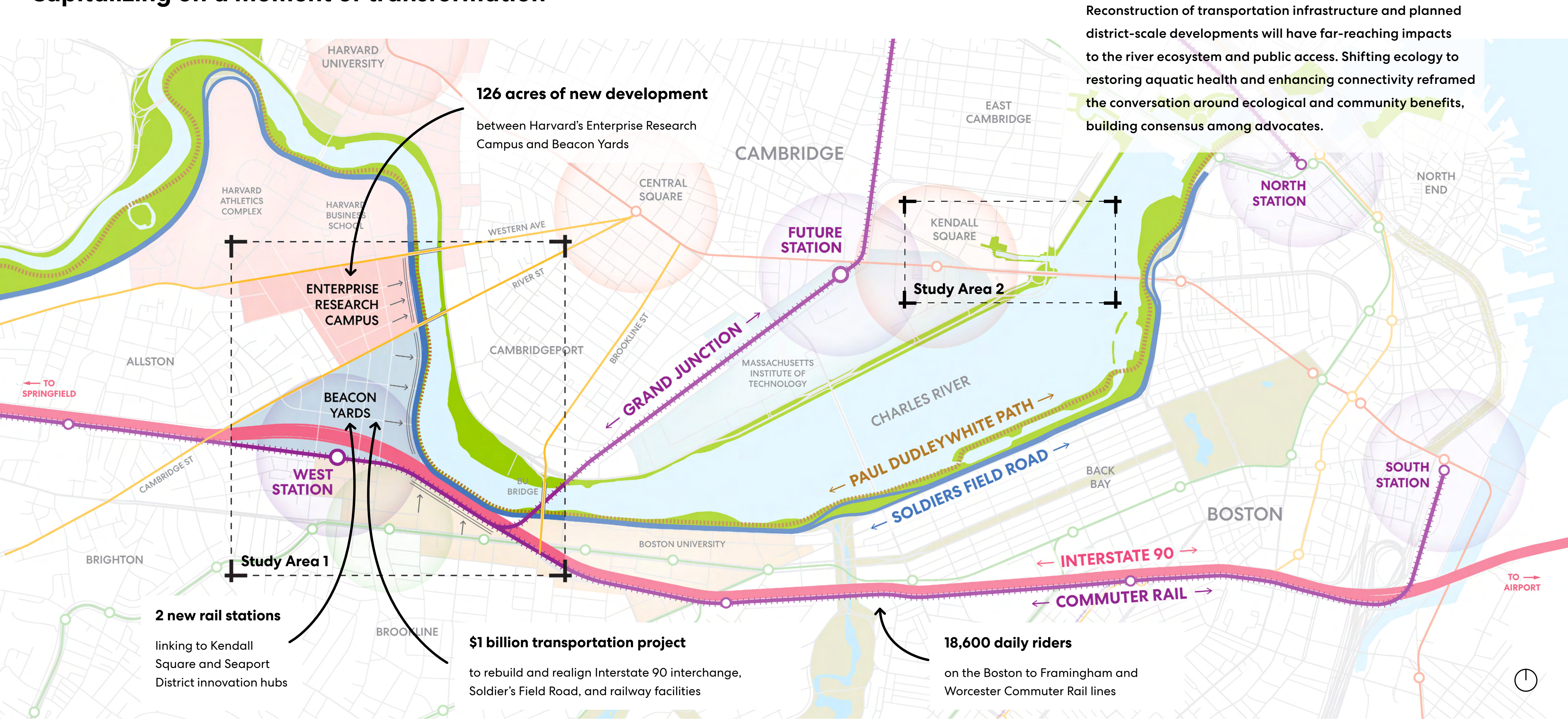


Combined Sewer Overflows



Destabilized Riverbanks

Capitalizing on a moment of transformation



Reconstruction of transportation infrastructure and planned district-scale developments will have far-reaching impacts to the river ecosystem and public access. Shifting ecology to restoring aquatic health and enhancing connectivity reframed the conversation around ecological and community benefits, building consensus among advocates.

126 acres of new development

between Harvard's Enterprise Research Campus and Beacon Yards

2 new rail stations

linking to Kendall Square and Seaport District innovation hubs

\$1 billion transportation project

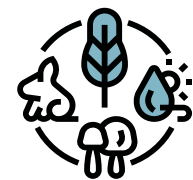
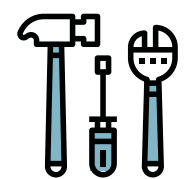
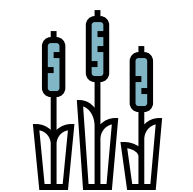
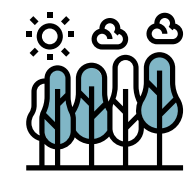
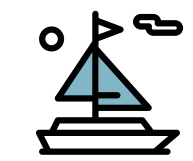
to rebuild and realign Interstate 90 interchange, Soldier's Field Road, and railway facilities

18,600 daily riders

on the Boston to Framingham and Worcester Commuter Rail lines

Study Area 1 - “The Throat”

The confluence of Interstate 90, Soldiers Field Road, and a rail corridor immediately adjacent to the river (aka The Throat) has long severed communities from the Charles. A river-first approach built broad consensus for an all-at-grade solution that was adopted as the preferred solution by the state.



01 — Themes

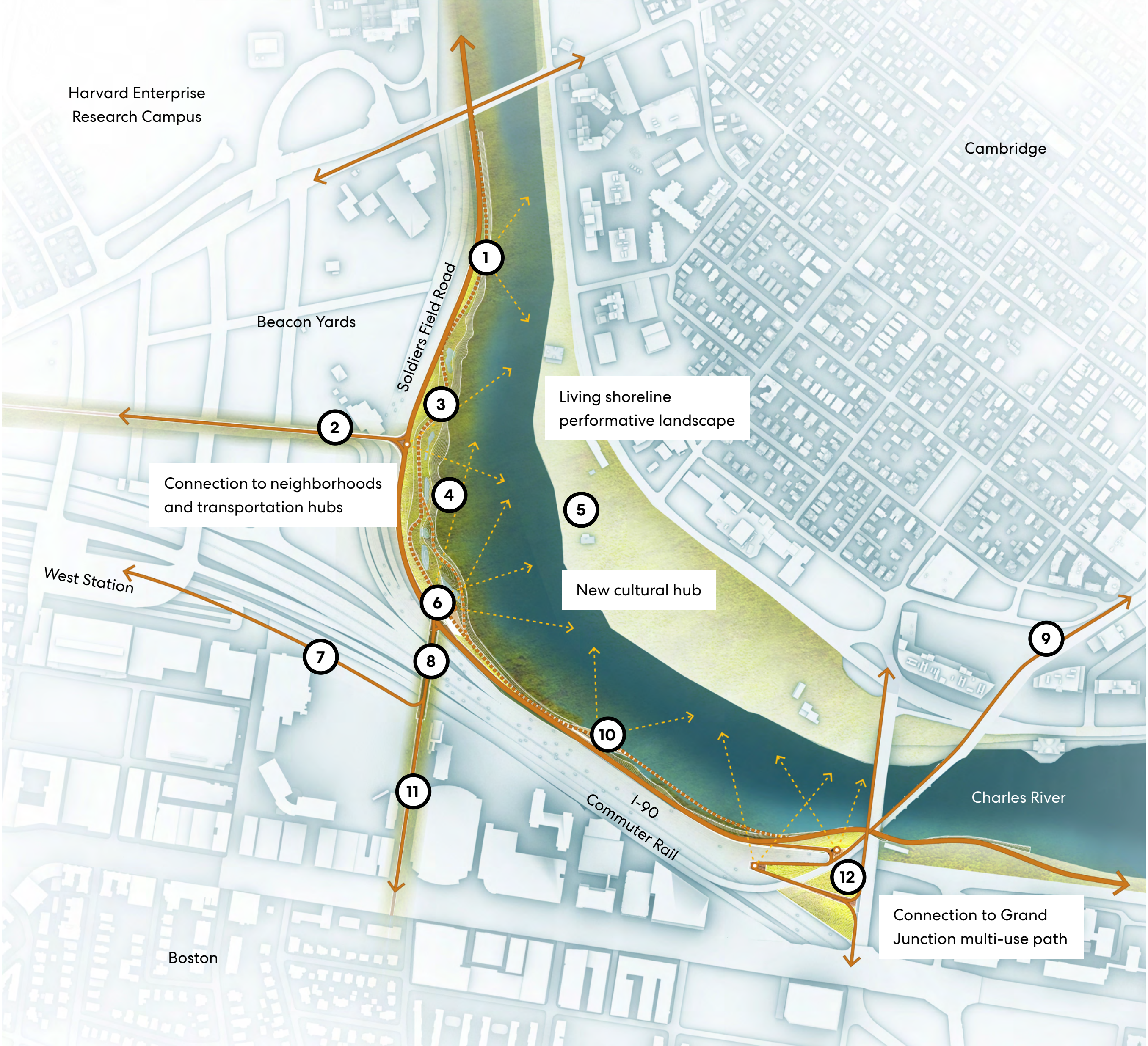
- **Celebrate** the rich history and culture of the Charles River
- **Bio-diverse** ecological shoreline that stabilizes the edge condition
- **Resilient** infrastructure systems that benefit generations to come
- **Social equity** and equal access and a sense of ownership for all

02 — Principles

- Propose a series of landscape systems that **mitigate the impacts of pollution** discharge and improve environmental conditions.
- Address the impacts of climate change to **create a resilient riverfront**.
- Re-imagine the river's edge as a **natural living shoreline** of rich and diverse ecosystems.
- Introduce robust circulation systems & open spaces **connecting surrounding communities to riverfront**.

03 — Strategies

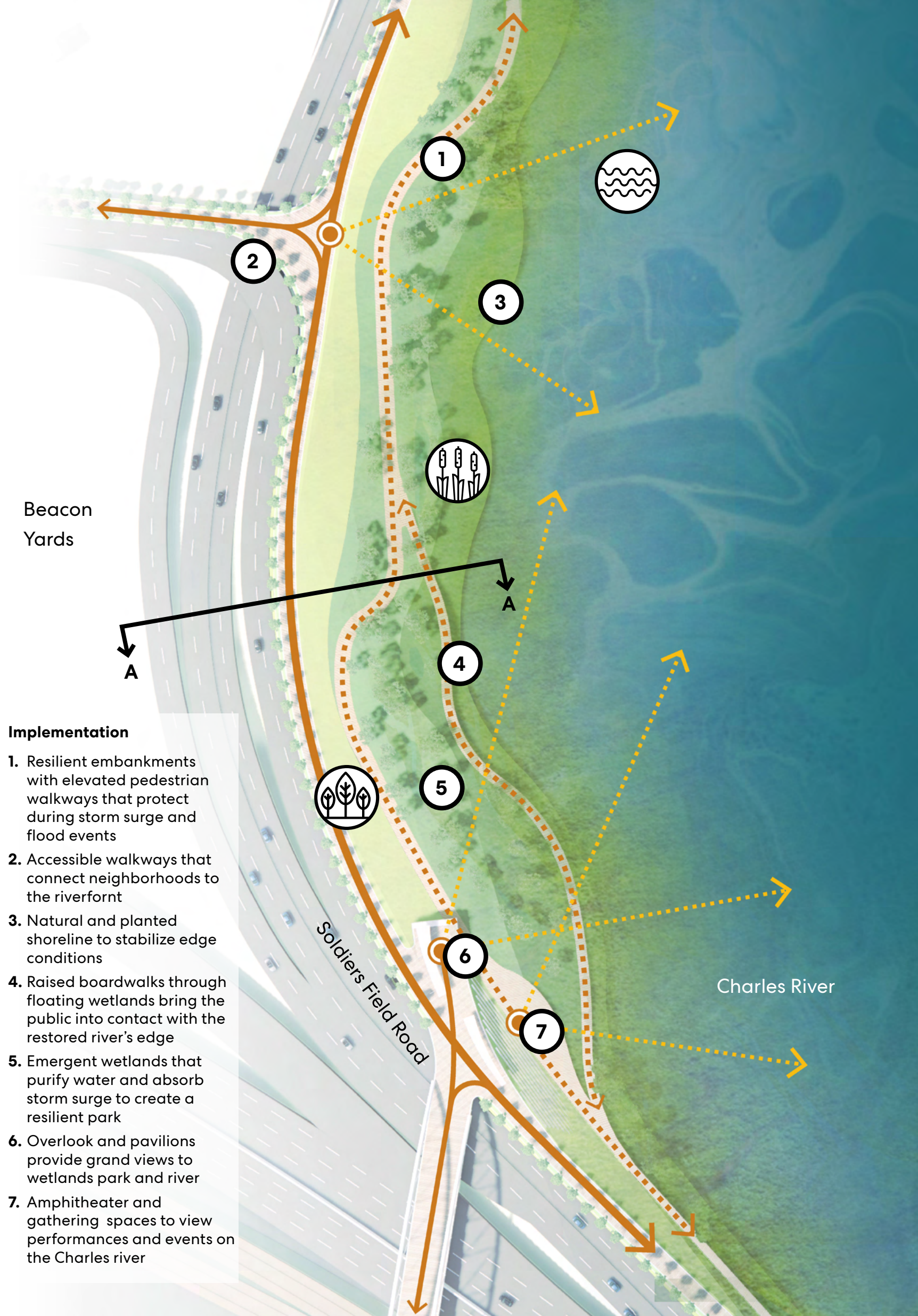
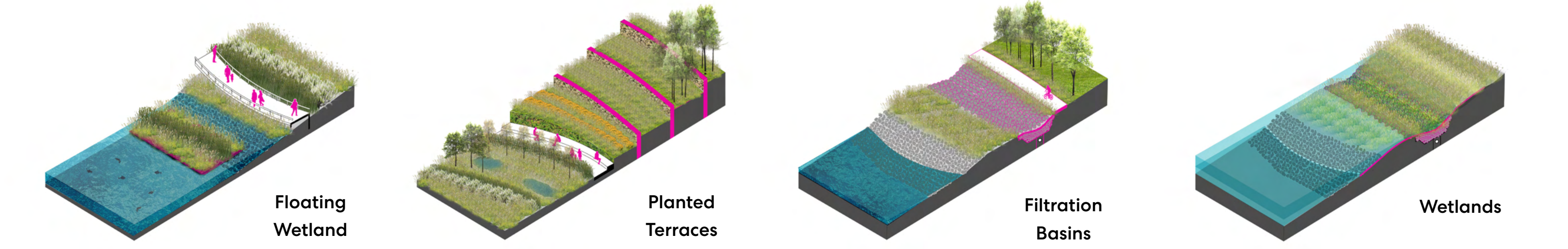
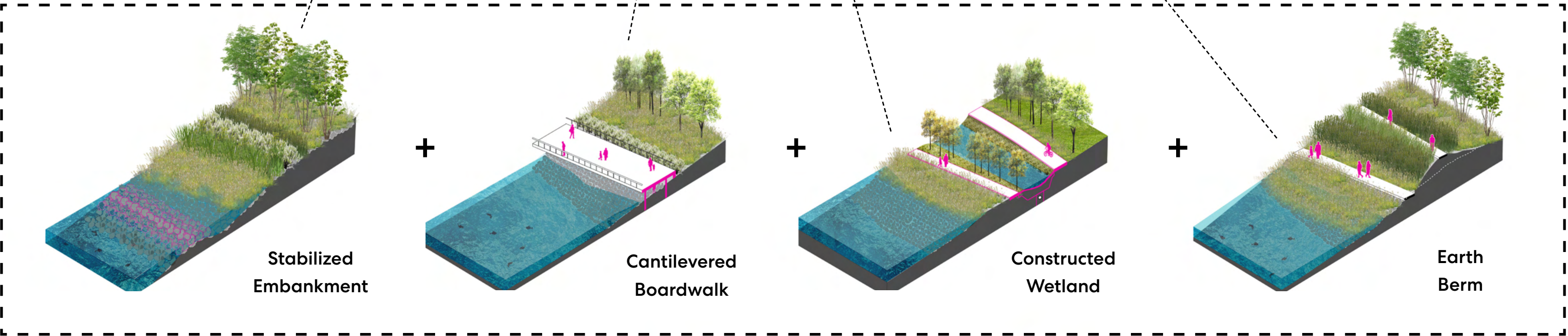
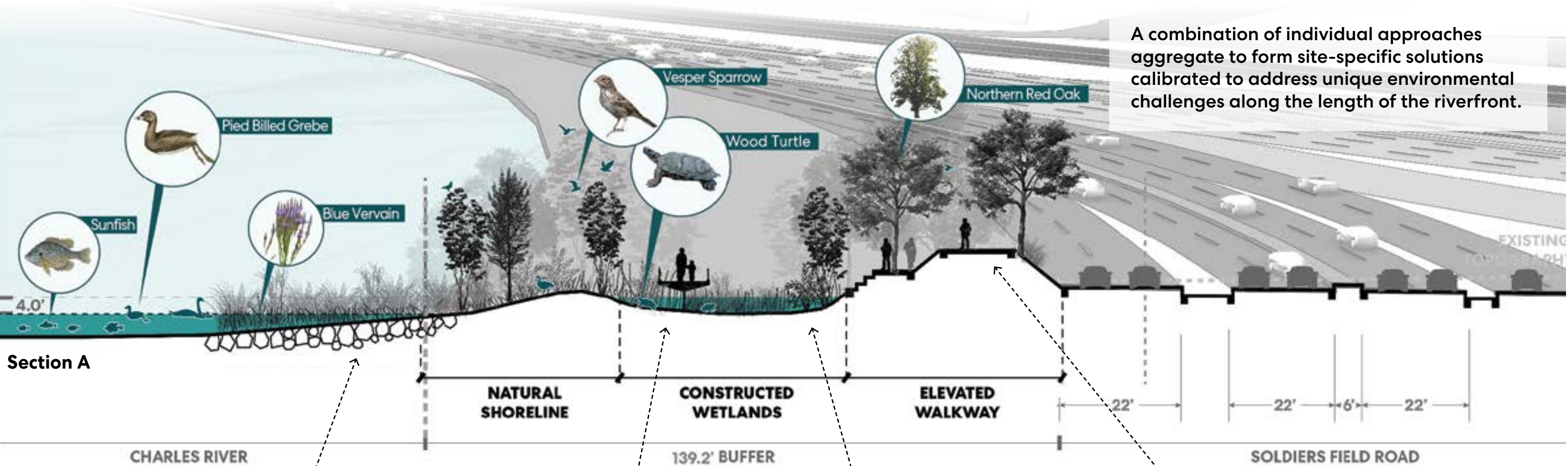
- Create a **toolkit of landscape strategies** that respond to the varying conditions along the river's edge.
- Draw upon knowledge gained from precedent examples and **best management practices**.
- Weave individual solutions into comprehensive framework plan that **restores the river's ecology**.



Site Plan

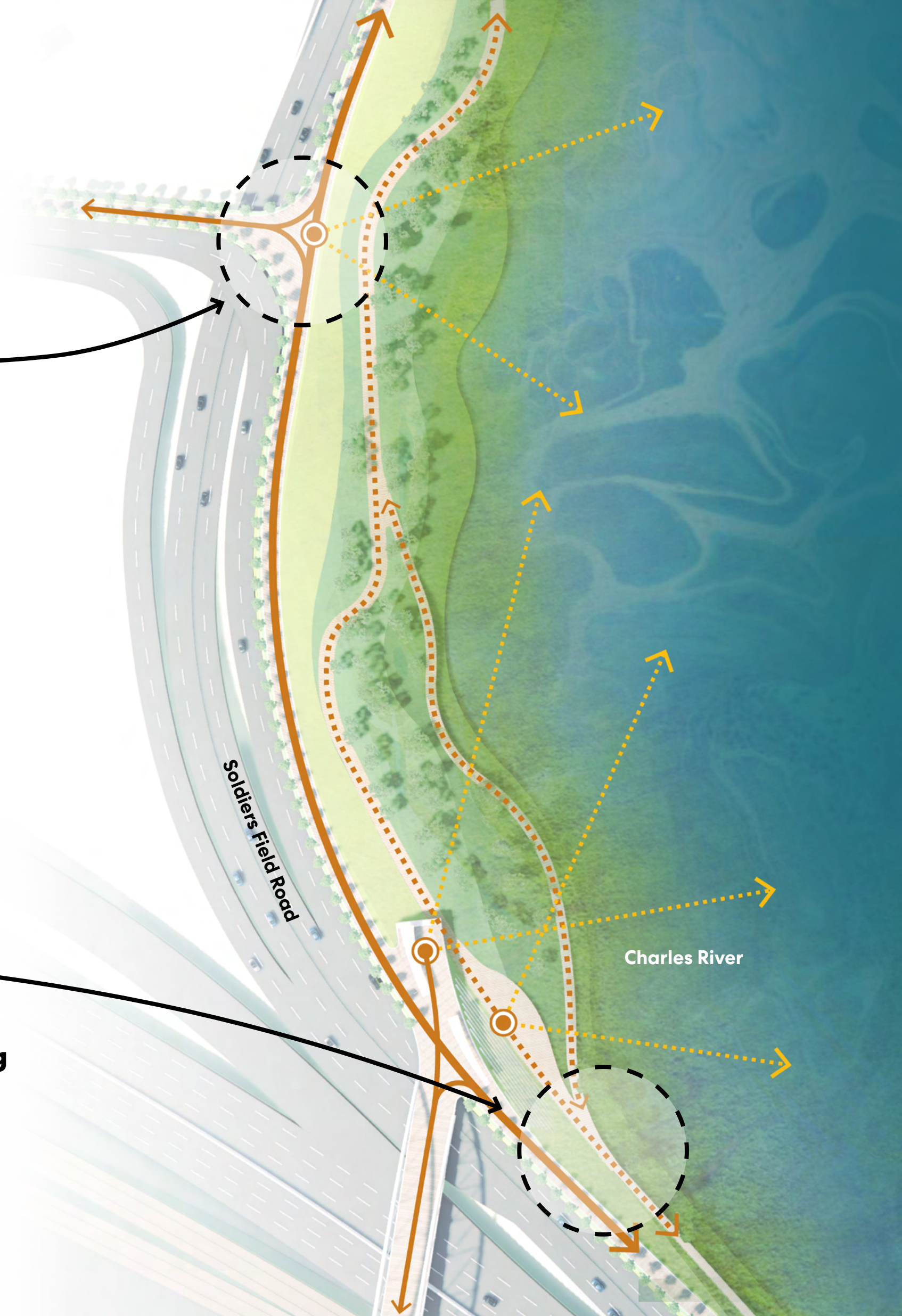
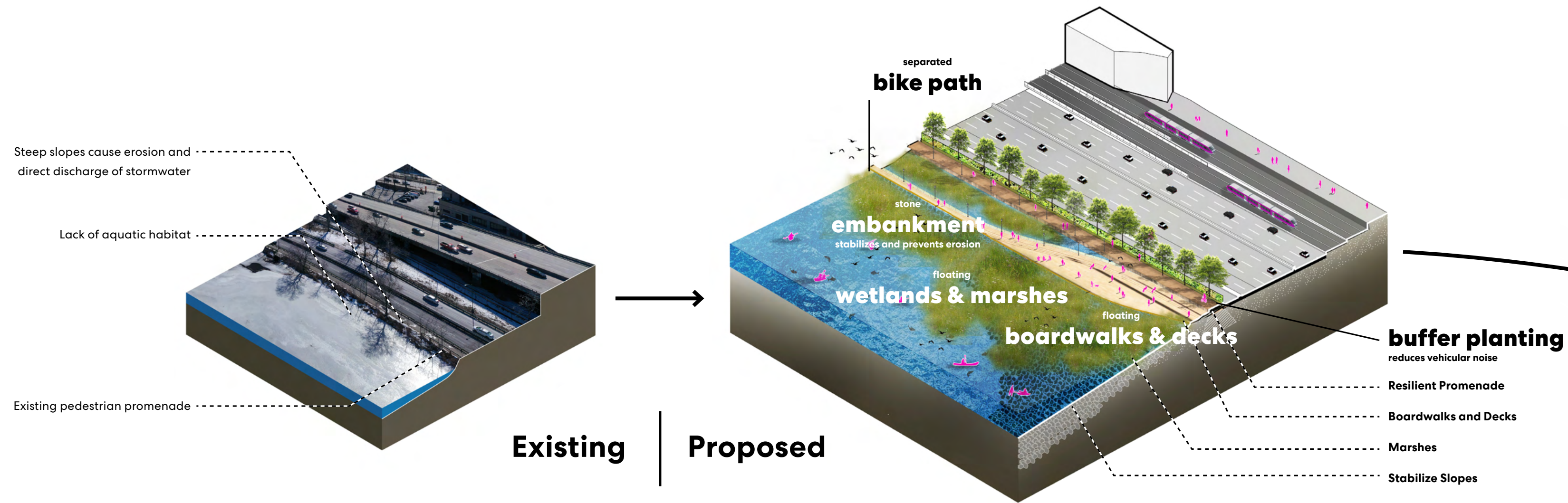
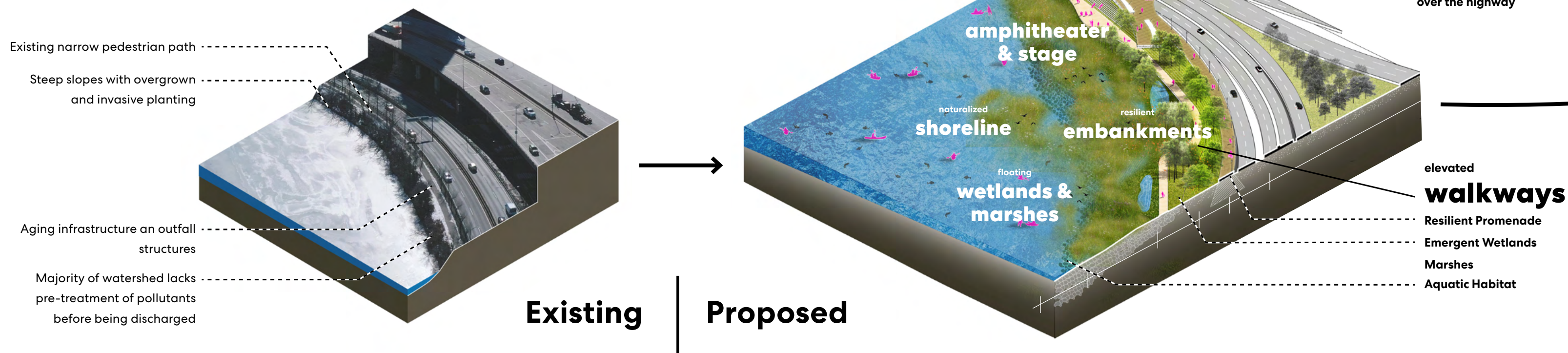
1. Floating wetlands and habitat shelves introduce habitat to spatially constrained segments of the waterfront
2. Connection to Beacon Yards Greenway and Allston neighborhood
3. Bermed landscape visually and acoustically shields parkland from adjacent transportation infrastructure
4. Living shoreline performative landscape
5. Existing Magazine Beach Park
6. Riverfront amphitheater and overlook plaza
7. Connection to new West Station
8. Civic-scale pedestrian bridge spanning transportation infrastructure celebrates access to riverfront
9. Connection to Grand Junction multi-use path
10. Boardwalk allows public access to restored riparian ecosystem
11. Connection to Boston University and Commonwealth Avenue
12. Overlook and gateway plaza create connections across roadways linking urban fabric to riverfront

Assembling a toolkit of strategies



Crafting a hollistic vision of the future

The interwoven goals are implemented with strategic tools, that focus on the ecological shoreline restoration, enhance bio-diversity, and resilient embankments. The comprehensive toolkits provide flexible design solutions to the riverfront's divers and complex edge conditions.

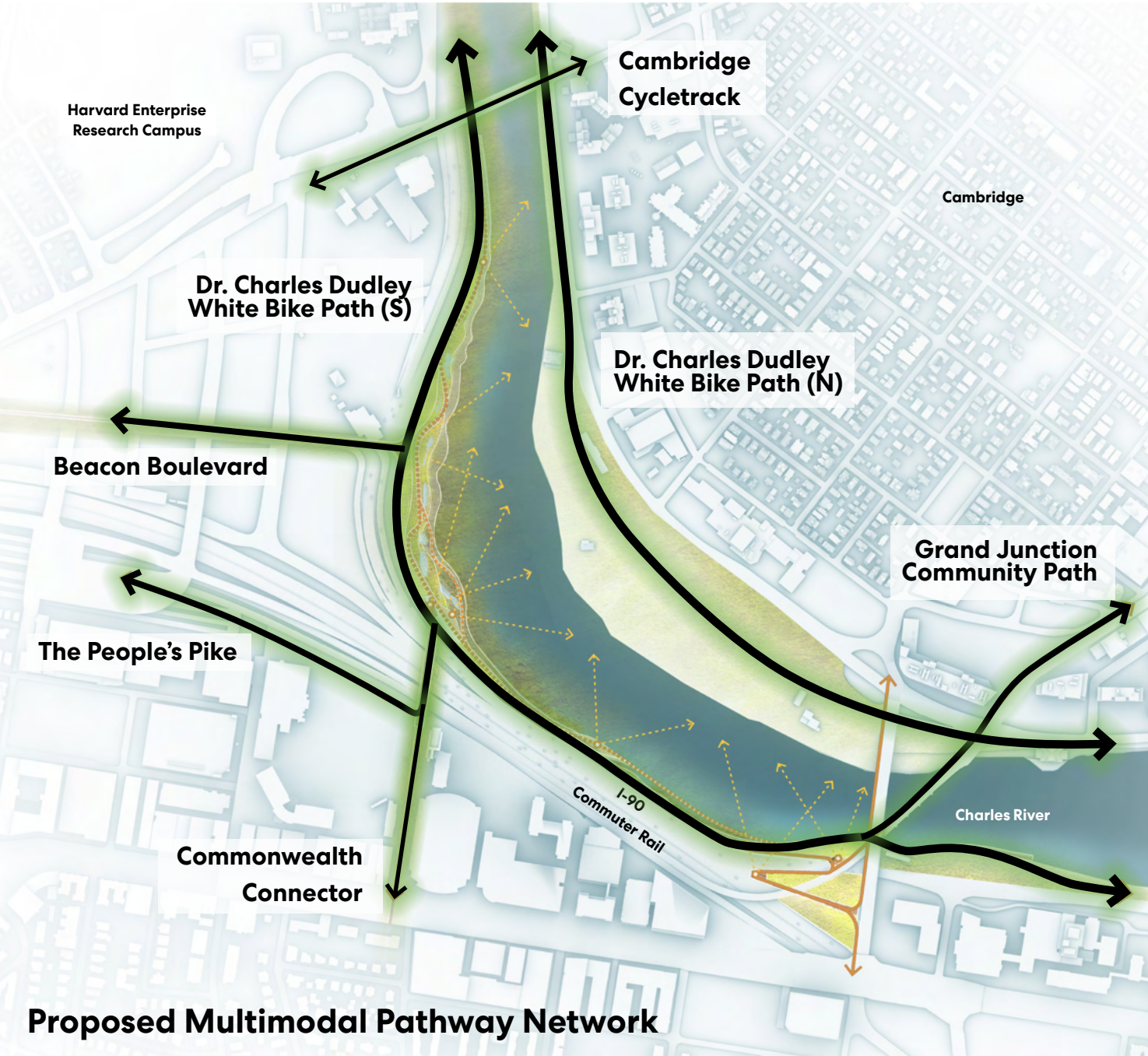


Fostering comprehensive connectivity



Present Accessibility Challenges

Regional infrastructure corridors weave along and across the Charles river, severing adjacent communities from public open spaces and waterfront of the Esplanade.



A Robust, Expansive Multimodal Network

Narrow shared pedestrian walkways adjacent to roadways are replaced with robust multi modal mobility systems that have adequate buffer from the vehicular traffic. They allow pedestrian to engage with the river elevating the overall experience.

CLEAN AIR
Trees absorb and reduce air borne pollutants

ARTWORK
Murals give the local artists & the community space for expression

HABITAT
Native plantings create a habitat corridor for local flora and fauna

COMMUNITY
Have access to a public green corridor and a barrier to the train lines

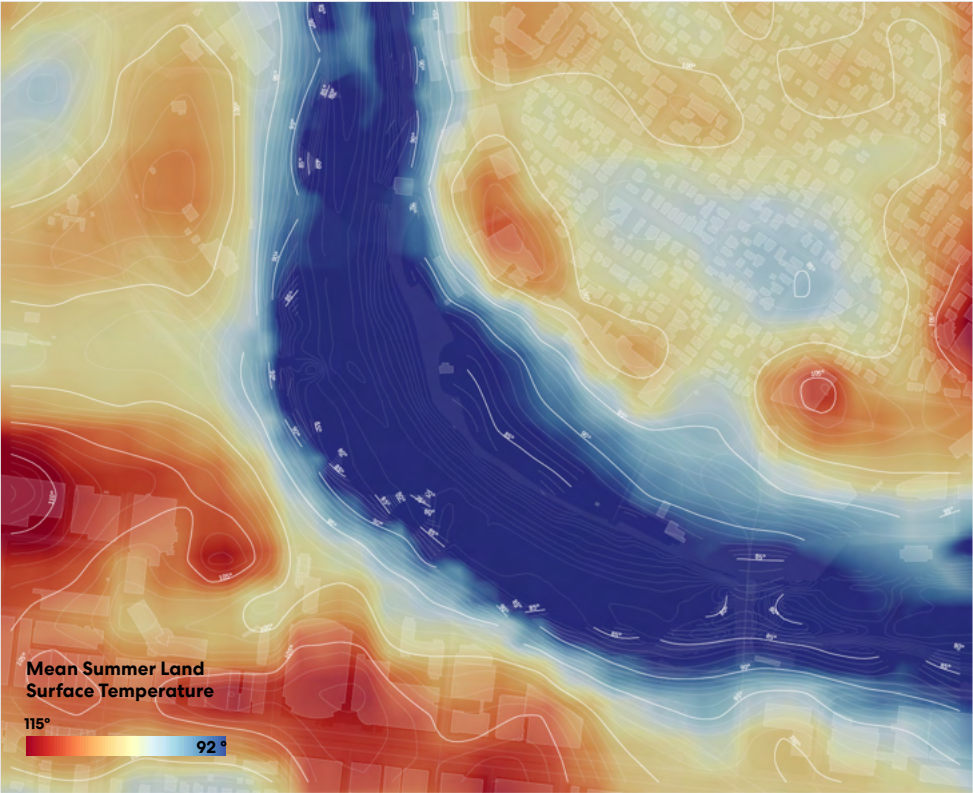
BIKE PATH
A dedicated bike lane offers a low emission and safe transit route for commuters and leisure riders

WATER MANAGEMENT
Planted medians absorb runoff and filter pollutants.

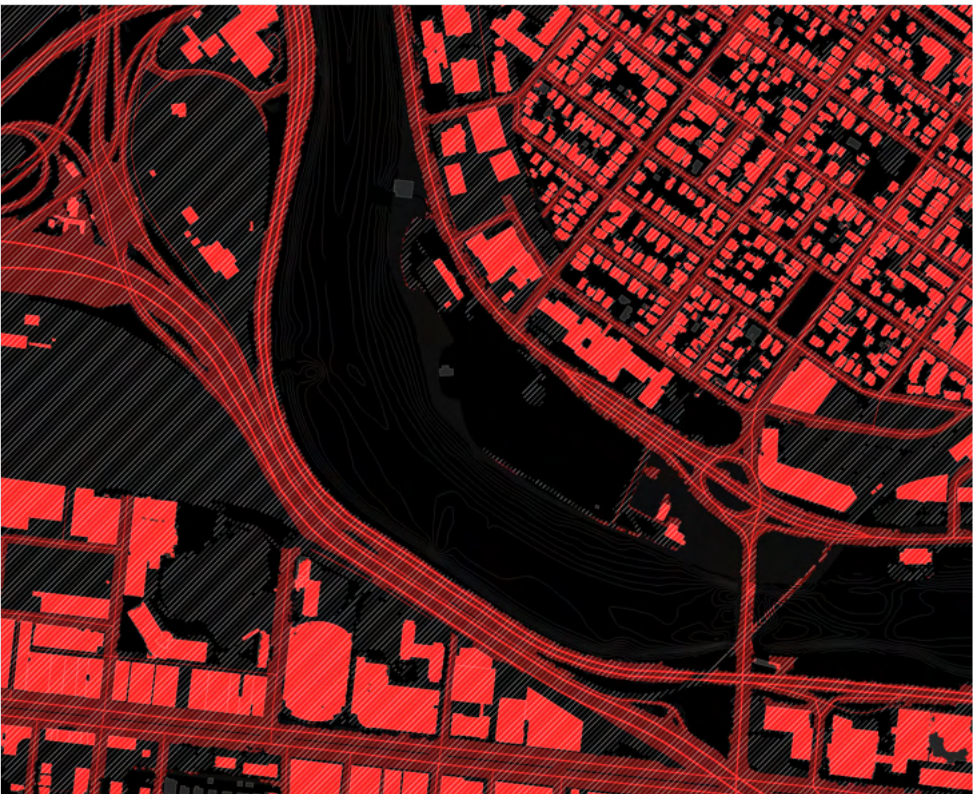
WALKWAY
An accessible and lit pedestrian walkway provides an inclusive promenade for all

Centering social & ecological resiliency

Large expanses of impervious pavements and densely built urban fabric exacerbate the impacts of extreme heat and stress the river edge's ecology. These limit the opportunities to mitigate storm surge and sea level rise.



Impervious surfaces drive higher land surface temperatures, adversely impacting human comfort and stressing the adjacent riparian ecology.



Extensive impervious surfaces adjacent to the Charles River prevent natural filtration, resulting in higher pollutant levels and reduced water quality.

An Accessible Riverfront for All

A new network of gradually sloping ADA accessible pathways provides opportunities to connect across these barriers via elevated pedestrian bridges. A series of overlooks and sloping lawns create spaces to gather, pause and appreciate views to the river.

boardwalks & wetlands

create a network of a connected riverfront

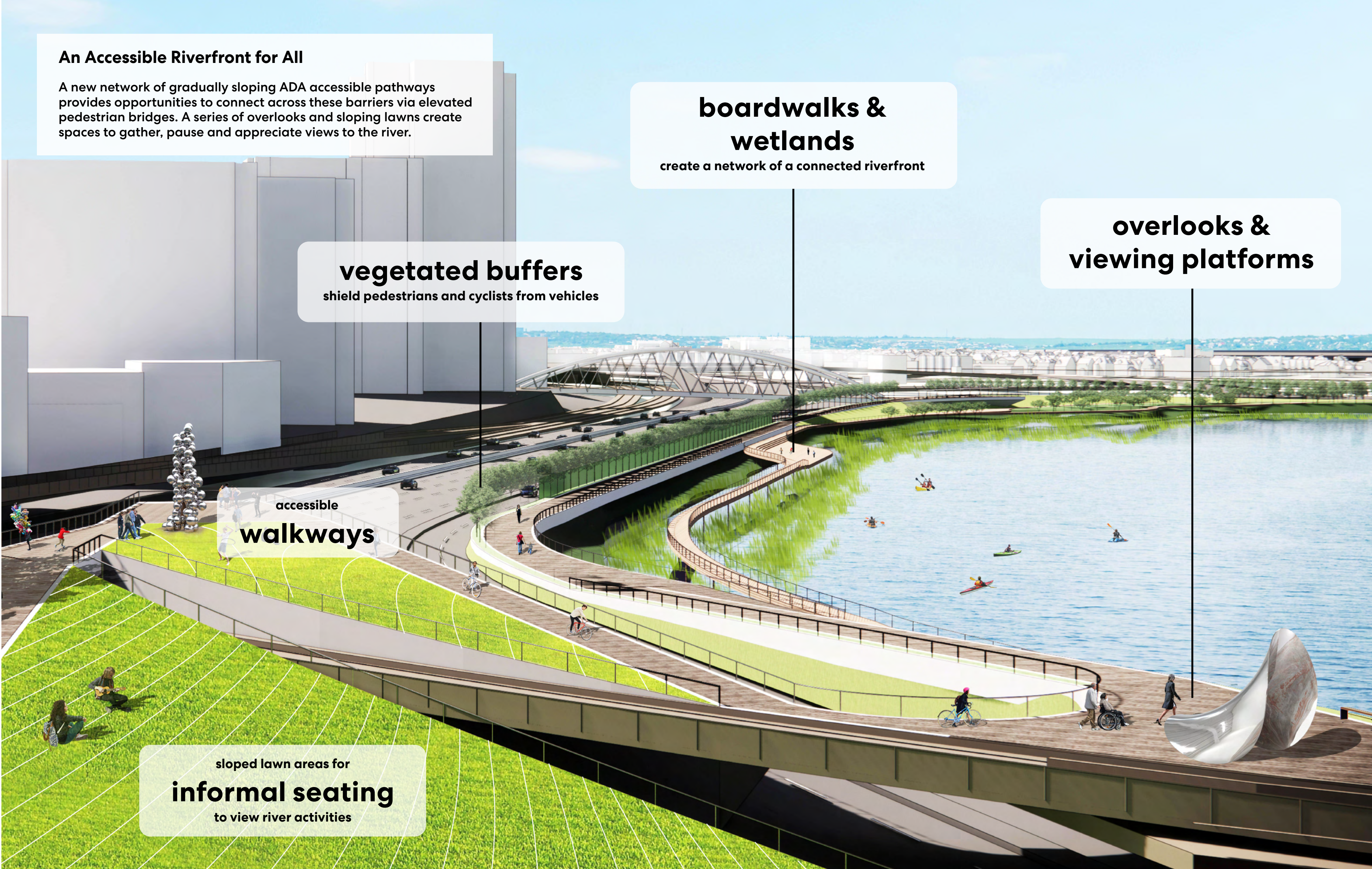
overlooks & viewing platforms

vegetated buffers

shield pedestrians and cyclists from vehicles

accessible walkways

sloped lawn areas for informal seating to view river activities



Gray to green: transforming infrastructure for the future

The extensive infrastructure along Charles River in poor condition, minimizing habitat, threatening aquatic health, and creating barriers to access. Employing naturalized, performative landscape strategies achieves the same objectives while enhancing riparian ecology, providing universal accessibility, and increasing resiliency.



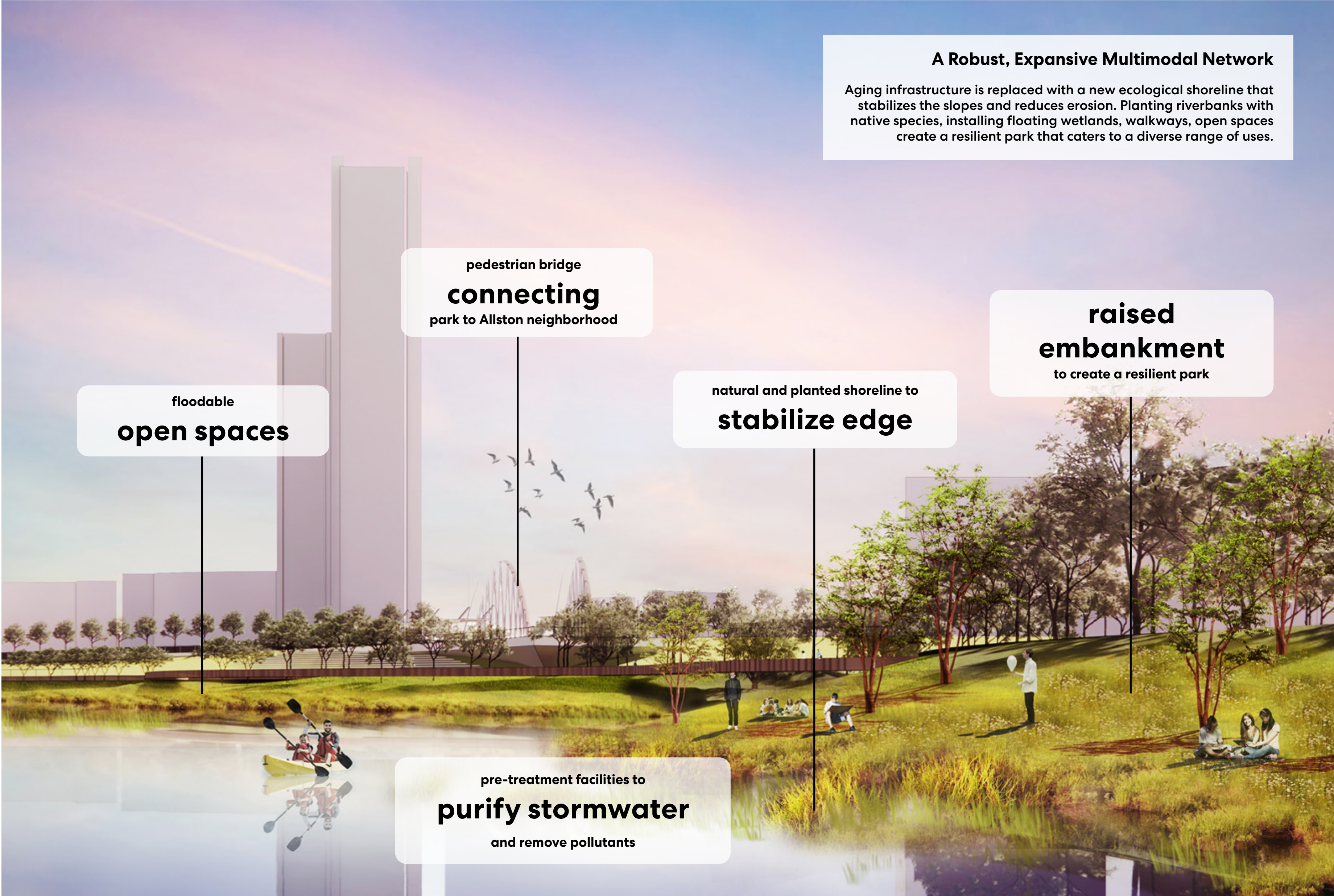
Armored Shoreline



Combined Sewer Outfalls



Highway Viaduct



A Robust, Expansive Multimodal Network

Aging infrastructure is replaced with a new ecological shoreline that stabilizes the slopes and reduces erosion. Planting riverbanks with native species, installing floating wetlands, walkways, open spaces create a resilient park that caters to a diverse range of uses.

pedestrian bridge
connecting
park to Allston neighborhood

raised embankment
to create a resilient park

floodable
open spaces

natural and planted shoreline to
stabilize edge

pre-treatment facilities to
purify stormwater
and remove pollutants

Testing assumptions with real-world interventions

Documenting localized ecological transformations:

Plant Selection

Plant selection was an important element of a successful installation, as choosing the correct species was vital in creating a habitable and resilient ecosystem

- Native wetland species
- Diversity of root and vegetation types
- Salt tolerance to succeed in brackish water
- Availability of mature wetland plugs
- Visual interest of species throughout the seasons



Blue Vervain
Plant Survival: Abundant; very successful



Swamp Milkweed
Plant Survival: Established



Swamp Rose
Plant Survival: Abundant; very successful



Seaside Goldenrod
Plant Survival: Established



Swamp Rose-Mallow
Plant Survival: Abundant; very successful



Blue Flag Iris
Plant Survival: Present but poorly established

Thriving Wetland Habitat

These interventions of wetland led to a lush, green wetland that hosted wildlife from ducks to monarch caterpillars.

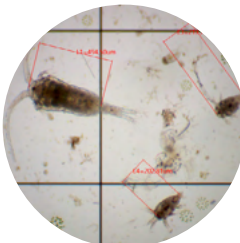
In addition to absorbing and removing phosphorus from the river, the project revealed changes in the local ecology that improve the overall ecological function and water quality.



Caterpillar



Goose Eggs



Insects



Canadian Goose

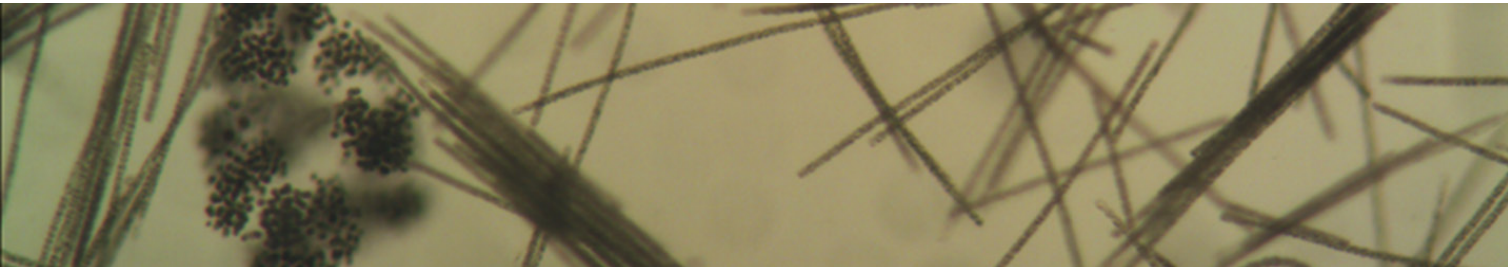


Great Blue Heron



Native Minnows

Thriving Micro-organisms



Microscope image of cyanobacteria examined by Max Rome



Regenerative Ecologies

An ecological shift is achieved by replacing sparse vegetation and invasive species with native flora that promotes bio-diversity. Green infrastructure such as wetlands, pre-treatment facilities, and bio-swales purify water and remove harmful pollutants, resulting in improved water quality.

create social and cultural
connections

foster an
urban ecosystem

eliminate direct discharge of
pollutants and improve
water quality

restore the
aquatic habitat

Study Area 2 - Broad Canal

Fostering Collaboration & Building Community Capacity



Greening the Broad Canal with floating wetland technology has the potential to be a flagship regional project. This installation will build upon the success of the pilot project to focus attention on issues of aquatic pollution and demonstrate the role that wetland habitat can play in achieving and supporting a healthy river.



Site Plan

1. A public, non-motorized boat dock provides public access to the watershed for surrounding communities.
2. Floating wetlands transform a hardened embankment into a lush habitat for wildlife.
3. A reserved channel at the center of the canal preserves access for watercraft and provides natural light to aquatic habitat.
4. A cantilevered boardwalk brings residents through the wetlands while addressing a critical gap in surrounding pedestrian networks.
5. Existing walkways are enhanced with civic stairways that allow the community to gather.
6. Connections to the pathways along the Charles River help to link open spaces severed by vehicular infrastructure.

Envisioning a resilient park for all

SOCIAL

Cultivate diverse open spaces and network of circulation systems that promote access and a sense of ownership to all.

ENVIRONMENTAL

Re-imagine the Charles River edge as a natural, living shoreline hosting rich and diverse native ecosystems that mitigate impacts of pollution.

ECONOMIC

Replace existing failing infrastructure with resilient and green infrastructure.

improved
water quality

6.6
acres of wetlands absorb water,
and filter nitrogen, heavy
metals, and phosphorous.

10
acres of parks
and wetlands

1,750
linear feet of new multi modal
promenades and boardwalks

