U.S. EPA Resilient Design & Planning Tools & Project Examples

U.S. Army Corps of Engineers
Engineering with Nature (EWN®) Landscape Architecture
Lunch & Learn Webinar
6/16/2020

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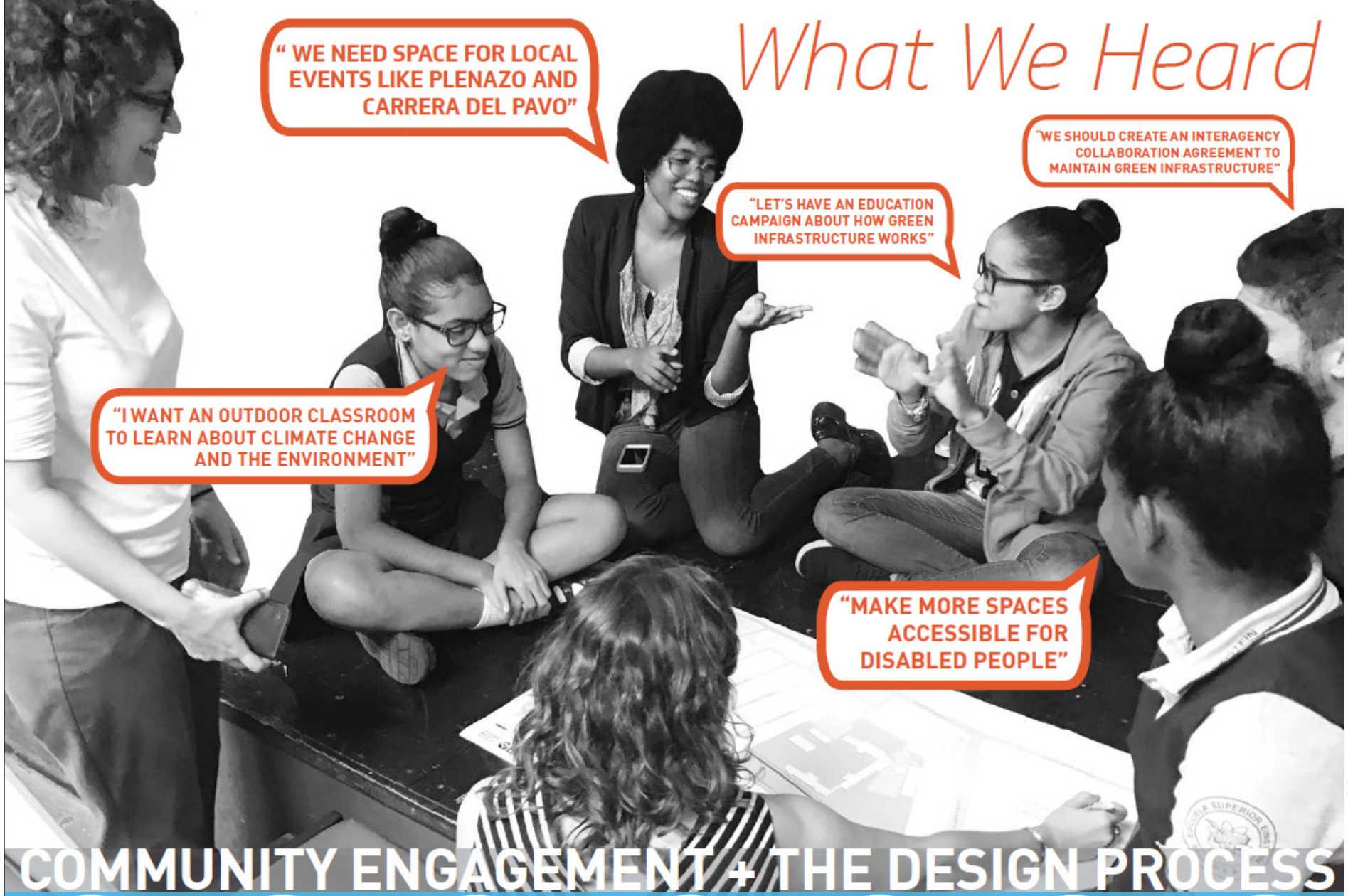
How Engineering with Nature (EWN®) Landscape Architecture (LA) Has Been Done at EPA

- Green infrastructure (GI) integrated with complete streets
  - Integrative hazard mitigation planning incorporating GI design practices

- Viewing public open spaces as multi-functional landscapes
- Facilitating community-based design charrettes in partnership with EPA regional offices and community partners
- Using LA concept designs to develop near term strategies to assist community partners with implementing proposed projects
  - Identifying implementation and maintenance partners and funding

What We Heard



COMMUNITY ENGAGEMENT + THE DESIGN PROCESS

What Tools Have Been Used at EPA Related to EWN® – LA Design & Research?

- Greening America's Communities
- Smart Growth Implementation Assistance
- Integrative Hazard Mitigation Planning Assistance
- Resilient Design Assistance Pilots
- Recovery and Resilience Partnership: Mexico Beach, FL
- Regional Resilient Planning Toolkit

Design Typologies Typically Developed for Communities

- Scale of projects:
  - Neighborhood
  - Multiple city blocks
  - Urban main street corridors
  - Small drainage area
- Number of concept designs per project: 2 – 6
- Common Design Typologies:
  - Public open spaces: parks, recreational areas, plazas
  - Streetscapes: complete & green streets, street right-away areas
- Designs that may be replicable or adapted to other parts of a community or to communities with similar interests/circumstances

Benefits Typically Addressed With EPA Projects/Tools

- Stormwater and flood management
- Air quality protection
- Urban heat island mitigation
- Economic and community revitalization
  - Assisting disadvantaged communities (environmental justice)
  - Enhancing community sense of place with public open spaces
- Improved pedestrian access and safety
- Enhancing transit and pedestrian transportation infrastructure options

Typical Make Up LA Design Teams

- Nationally renowned LA firms with specialized experience in design, planning, and implementation of:
  - GI
  - Green and complete streets
  - Community-based design & public engagement
  - Transit oriented development
- Usually a team of 2 – 4 designers
  - May include environmental/civil engineer

Example Design Projects

- Design for Resilience in Brattleboro's Lower Whetstone Brook Corridor: Brattleboro, VT (2017): resilient design for redevelopment and recreational opportunities to address flooding for various neighborhood areas
- Smart Growth Implementation Assistance: Caño Martín Peña, San Juan, PR (2018): Water plaza design approach for addressing urban flooding in an environmental justice community
- Recovery and Resilience Partnership: Mexico Beach Stormwater Management and Greenspace Project. Mexico Beach, FL (2019): GI design assistance (stormwater and open space) applied as part of recovery effort for Hurricane Michael
- Huntington, WV (2019): pilot of resilient design assistance approach for flood management and community redevelopment; building off of earlier integrative hazard mitigation planning
- Seaford, DE (2019): similar to Huntington, WV, but a coastal community

Brattleboro, VT

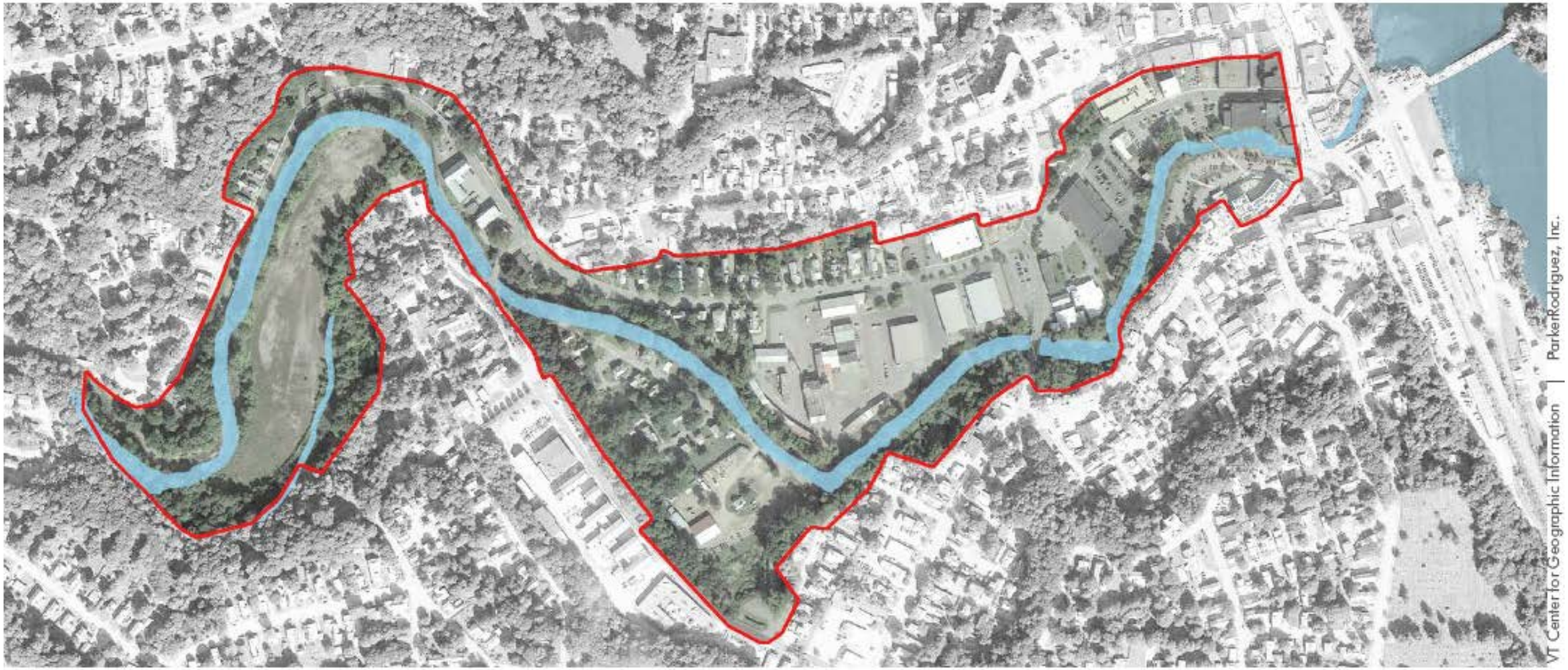


FIGURE 1. Overall site aerial

Brattleboro, VT

PLAN

The Whetstone Brook is largely channelized in the urban zone, its boundary defined either by tall retaining walls, actual building foundations or stone rip rap embankments. In addition, the cross section of the brook gets narrower as it approaches Main Street. This portion of the brook constricts flow and changes fluvial dynamics during heavy rain due to these characteristics. Buildings and paved parking areas occupy the majority of the brook's edges, but strategic softening and widening of the edges can help to buffer velocity and volume of storm events and provide recreational opportunities accessible from adjacent neighborhoods and public spaces.

FIGURE 22. Proposed plan enlargement

EXISTING ELEMENTS

- A Brattleboro Co-op
- B New England Youth Theater
- P Municipal Transportation Center

PROPOSED ELEMENTS

1. Preston Park
2. Extended Whetstone Pathway
3. Future pedestrian bridge
4. Terraced outdoor seating
5. NEYT outdoor amphitheater

Brattleboro, VT

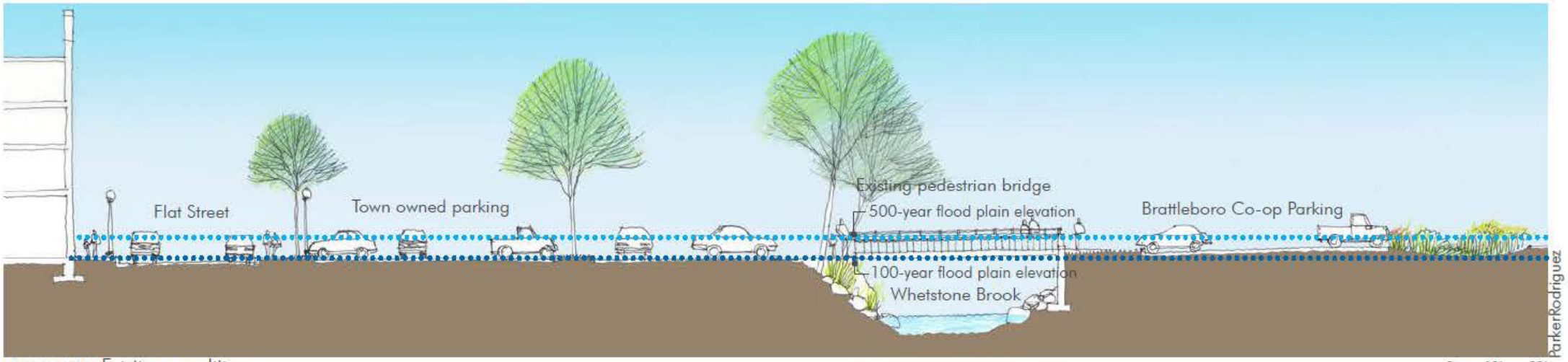


FIGURE 23. Existing conditions

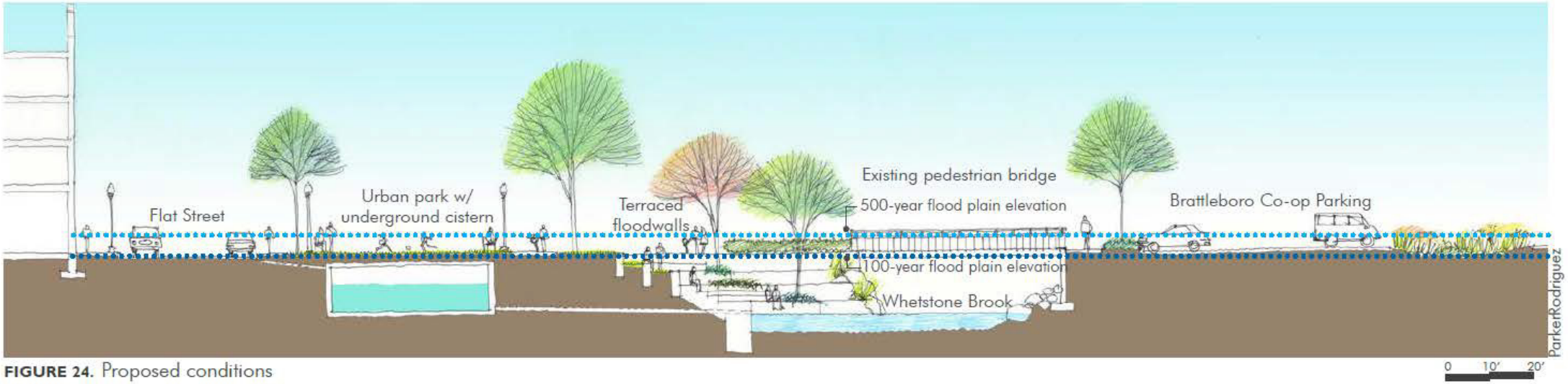


FIGURE 24. Proposed conditions

Brattleboro, VT

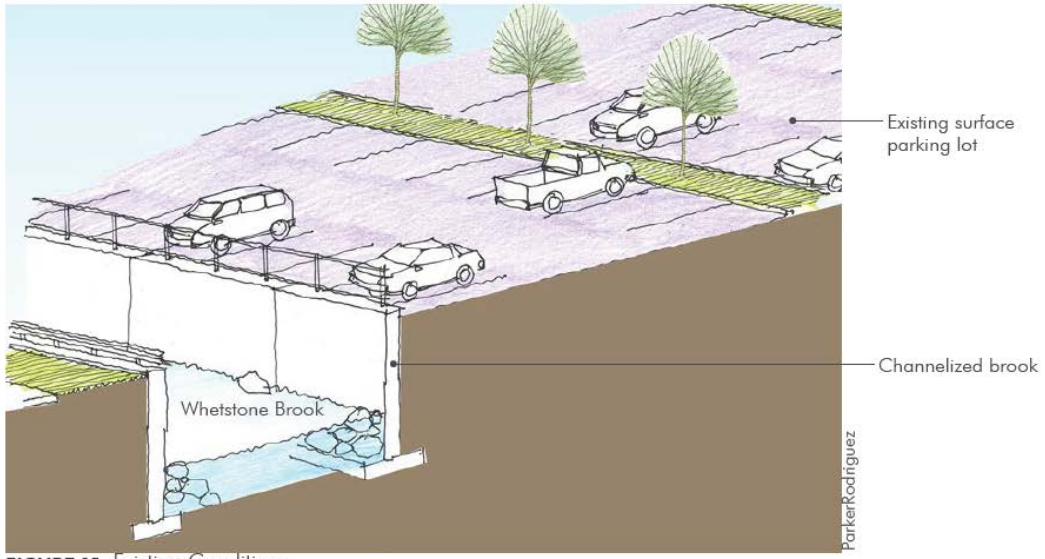


FIGURE 25. Existing Conditions

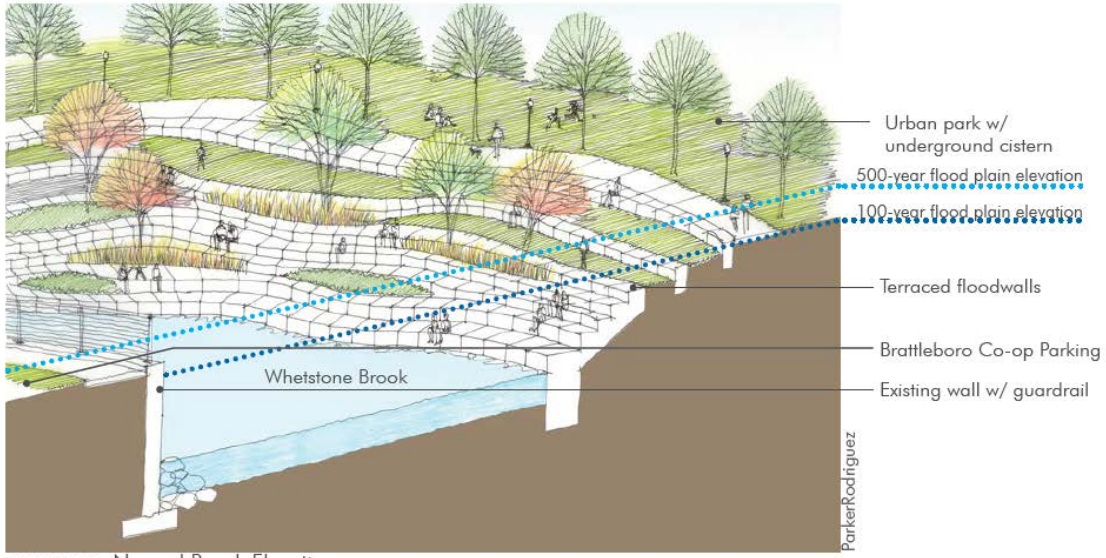


FIGURE 26. Normal Brook Elevation

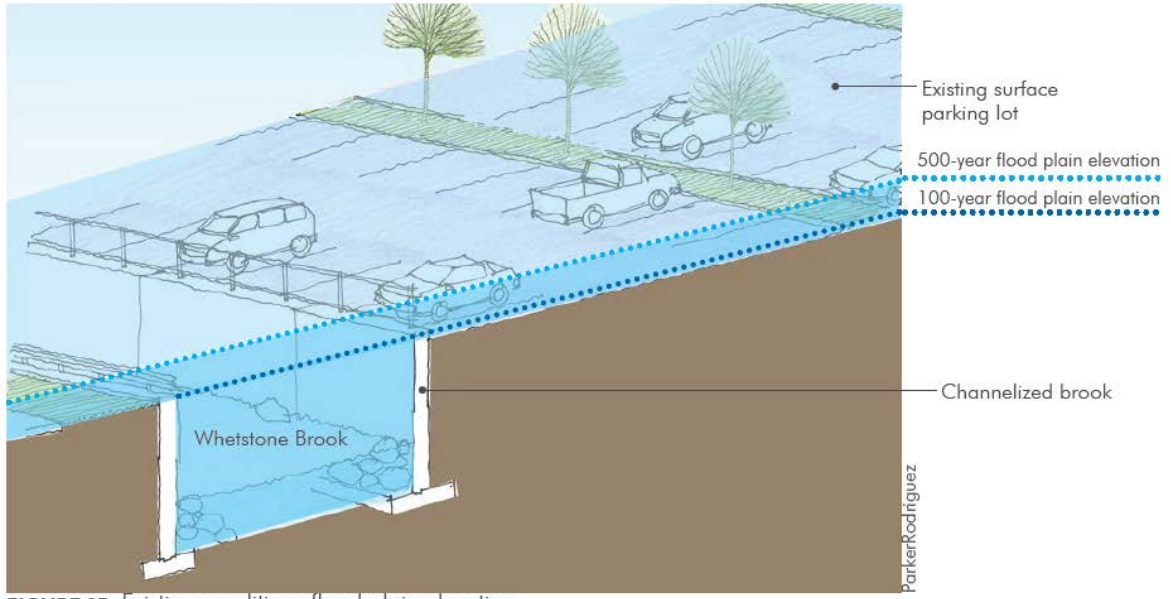


FIGURE 27. Existing conditions flood plain elevation

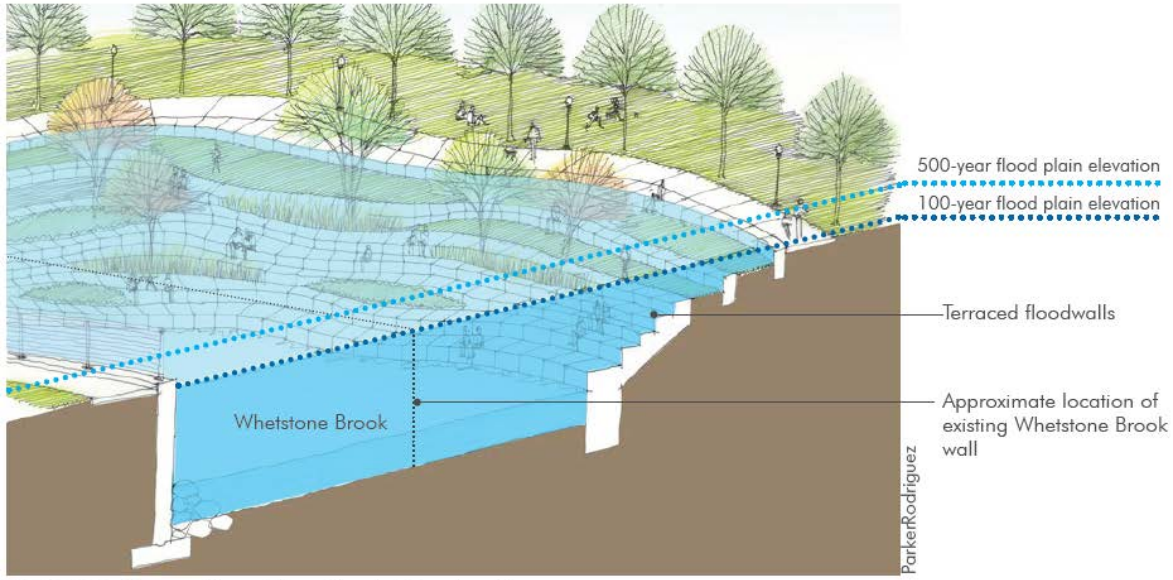


FIGURE 28. Proposed conditions flood plain elevation

Caño Martín Peña, San Juan, PR

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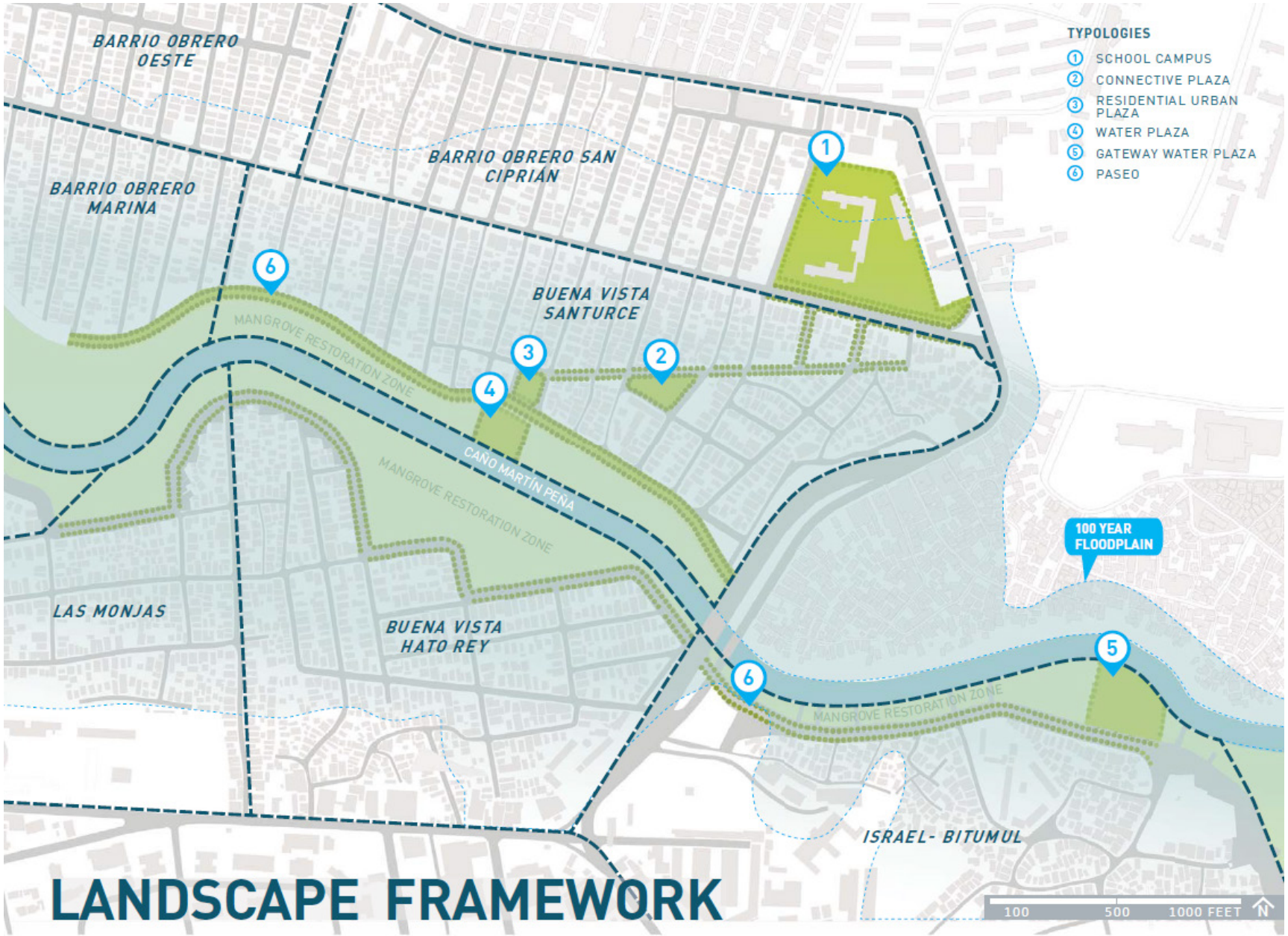
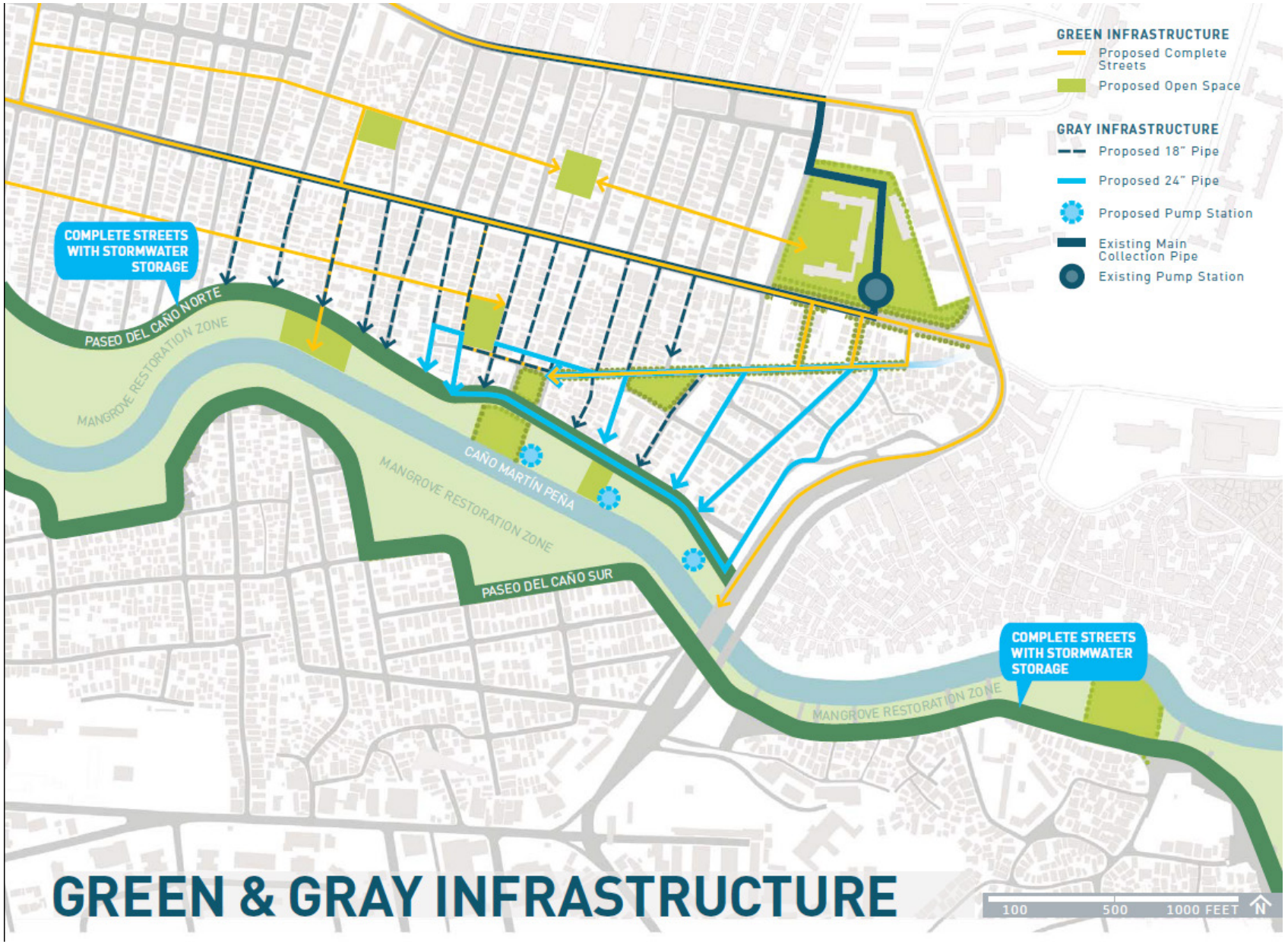


Caño Martín Peña, San Juan, PR



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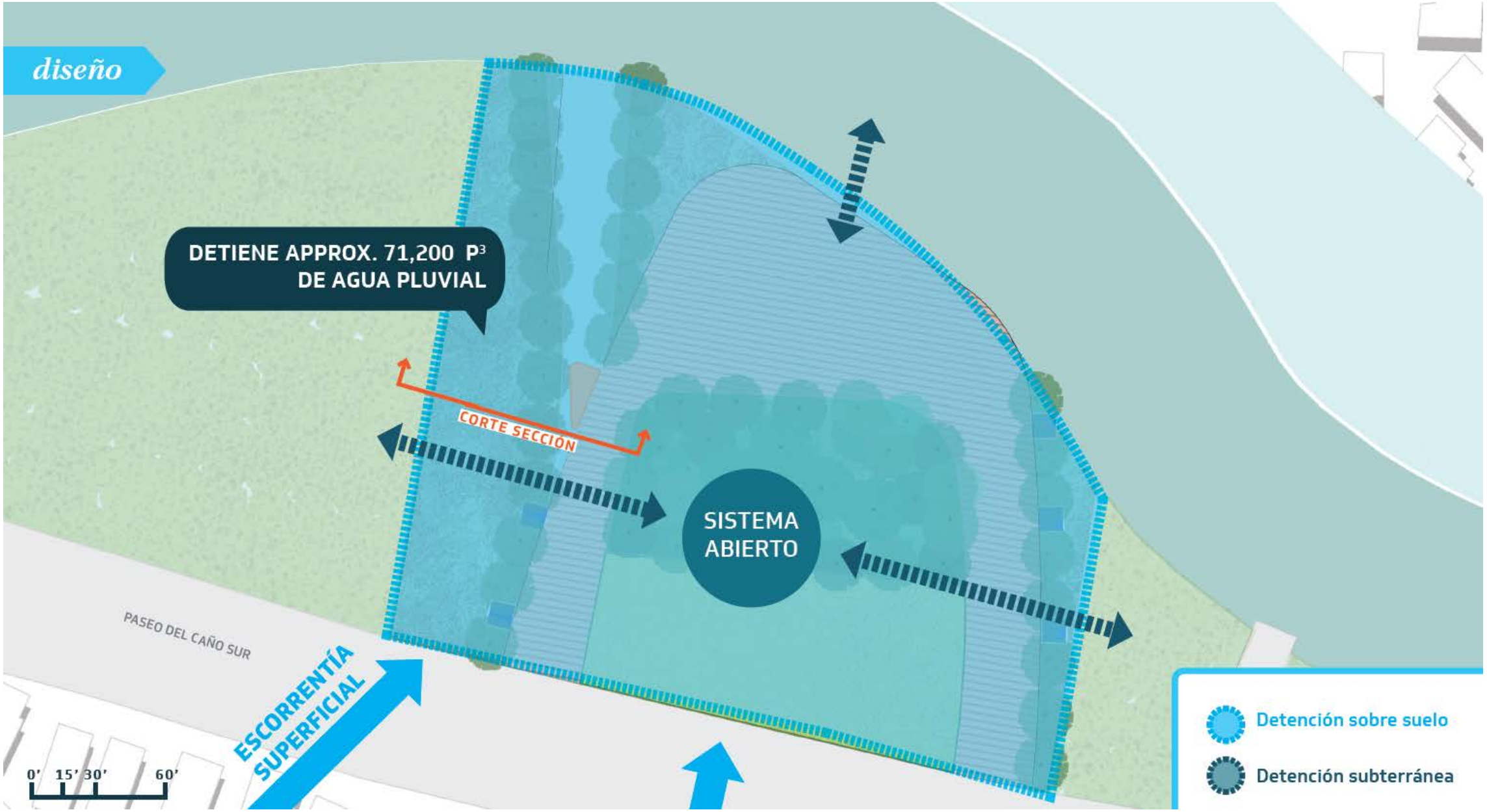

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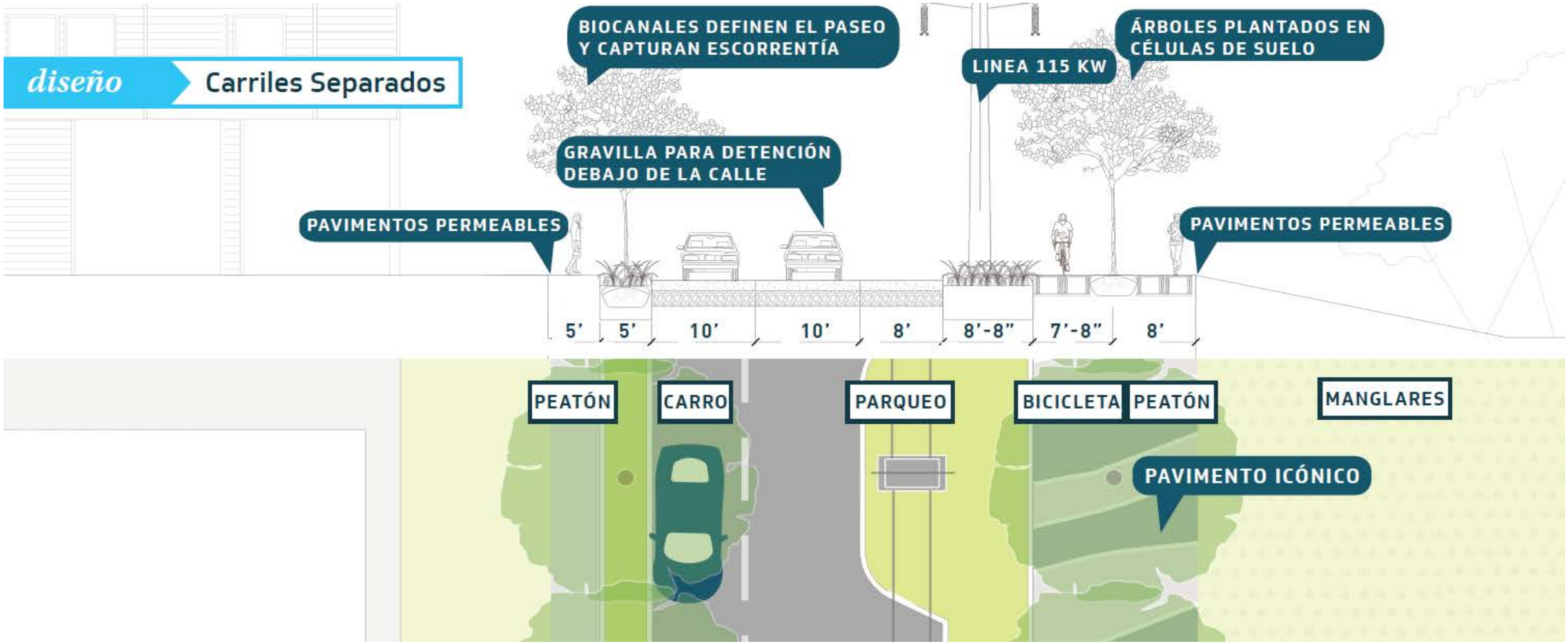
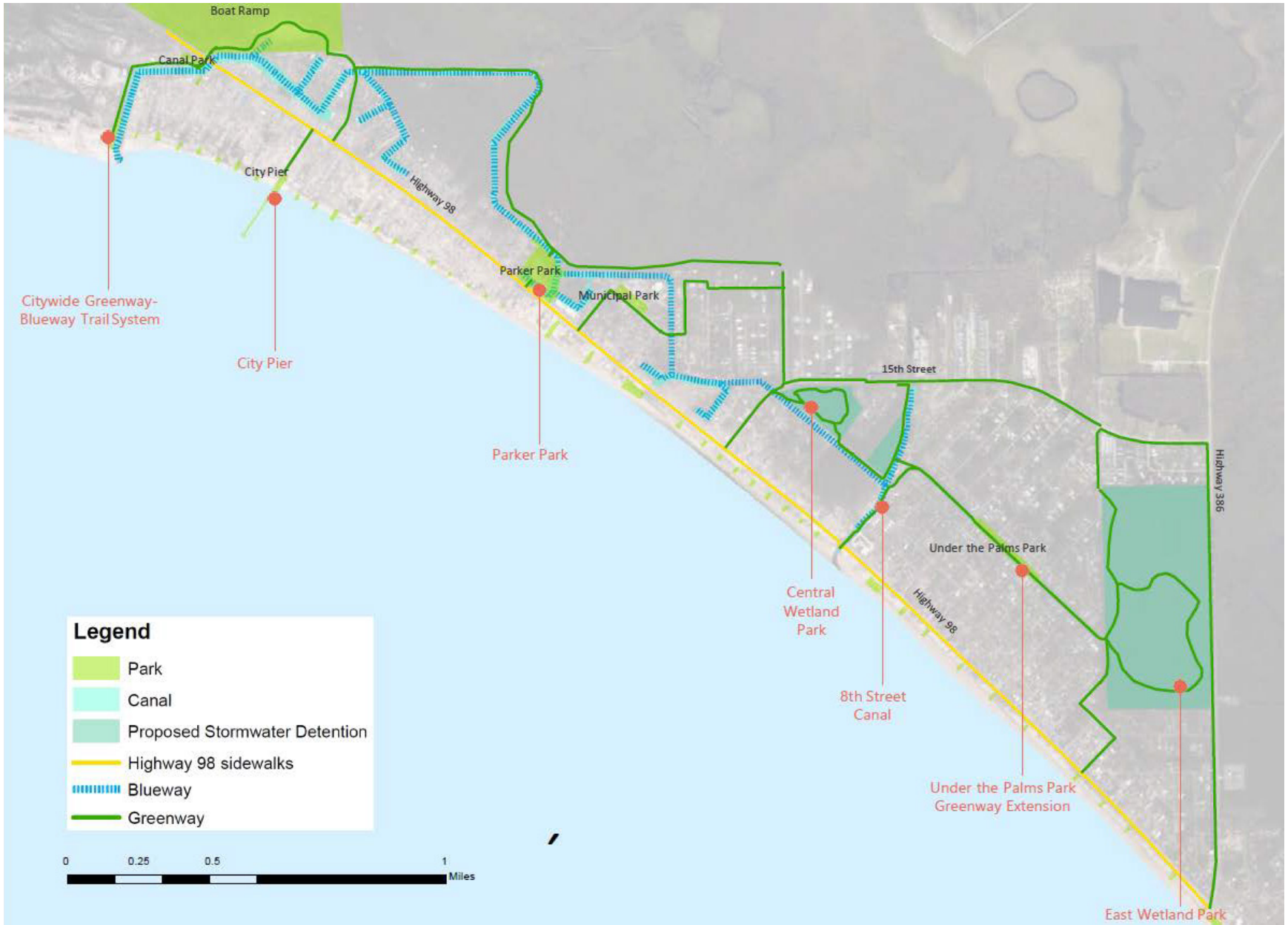


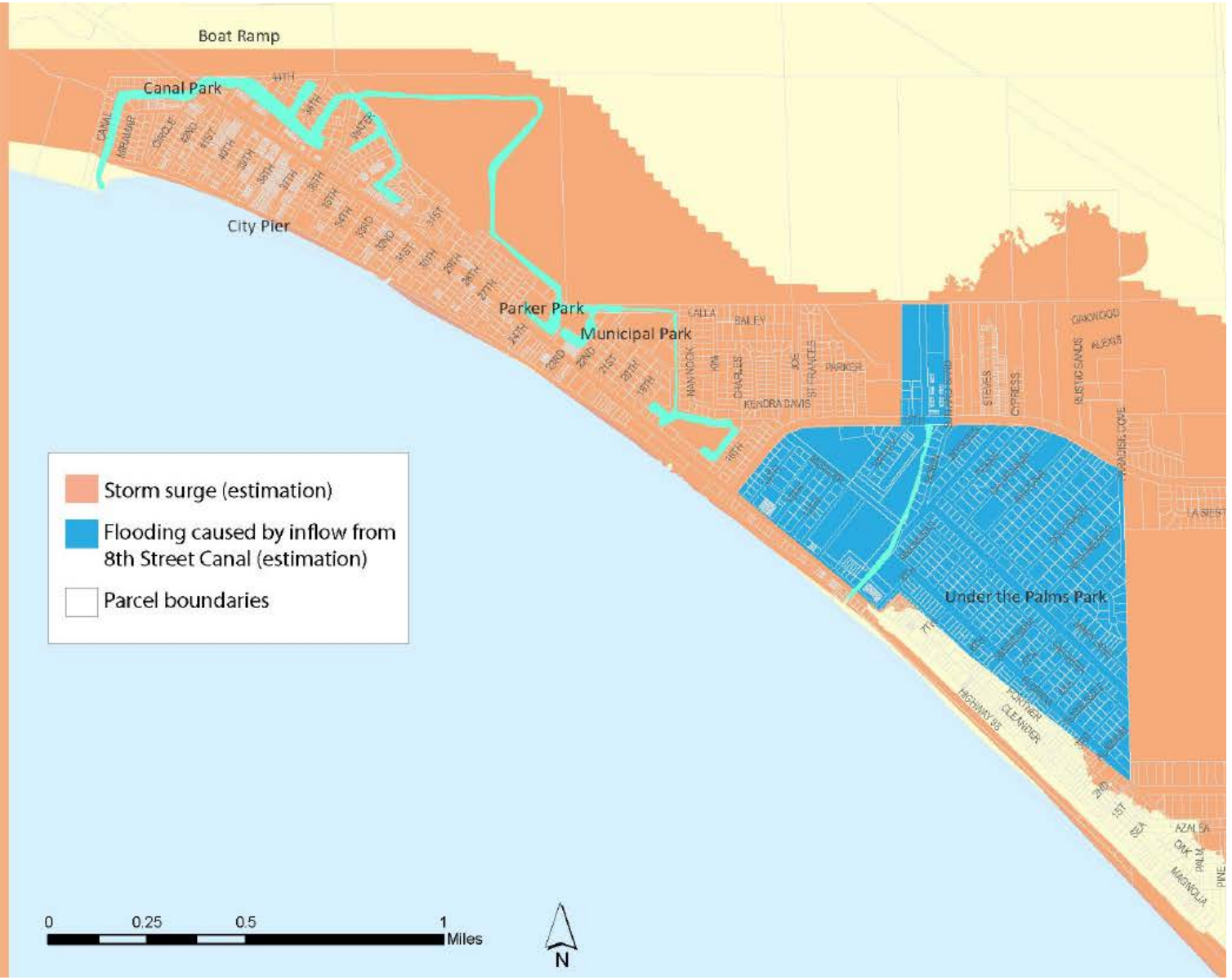
Caño Martín Peña, San Juan, PR

Mexico Beach, FL



Mexico Beach, FL

The 8th Street Canal allows water to backflow into the city during storms. The storm surge during Hurricane Michael entered 8th Street Canal and flooded inland neighborhoods, causing extensive damage.



Mexico Beach, FL

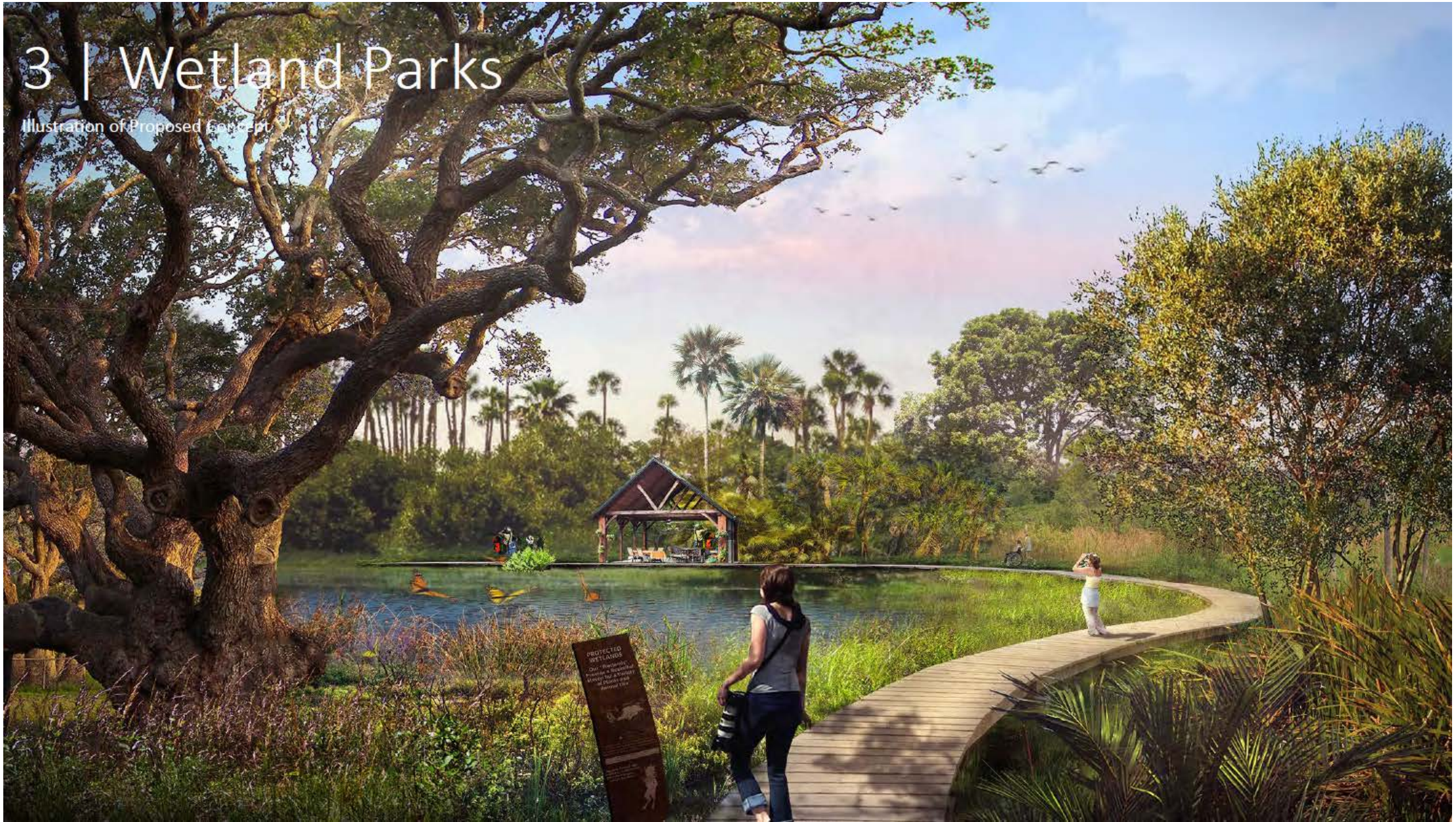
3 | Wetland Parks

Diagram of Proposed Design Concept

Vacant wetland properties located along the stormwater network can be enhanced to hold excess stormwater during rain events.

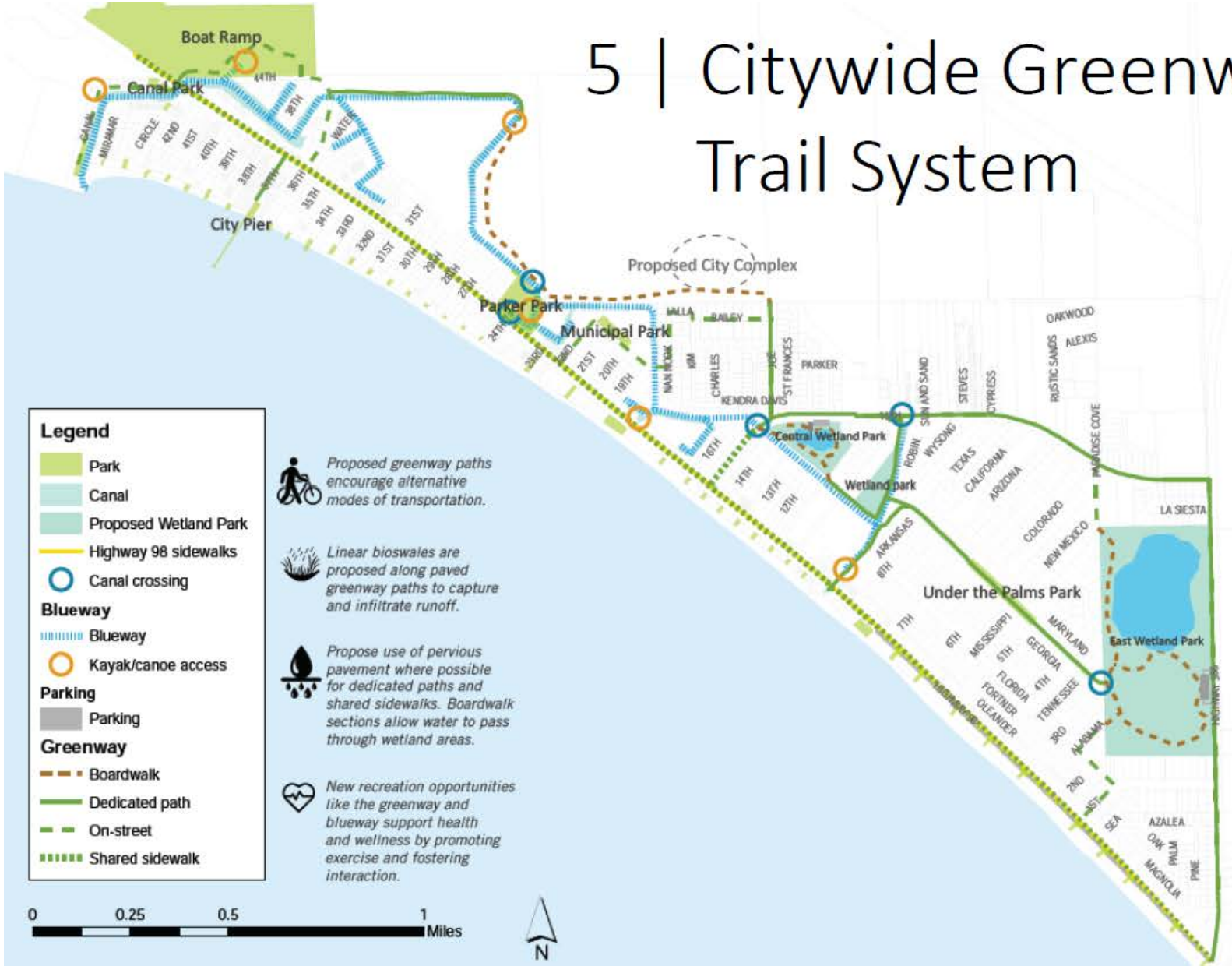
The wetlands also provide recreation opportunities for wildlife watching, walking or biking along street edges and boardwalk paths.

Mexico Beach, FL



Mexico Beach, FL

5 | Citywide Greenway-Blueway Trail System




Boardwalk.


Dedicated path.


On-street path.


Shared sidewalk.


Blueway.

Huntington, WV

APPENDIX A – CONCEPT DESIGN PLAN FOR 15TH ST. WEST THROUGH 13TH ST. WEST

MADISON AVENUE GREEN STREET CONCEPT: ADVANCED DESIGN

OPPORTUNITIES

- **A** Combat flooding at the intersection of Madison Avenue and 14th Street W by repairing the cracked pavement and adding best management practices (BMPs) adjacent to the problem area.
- **B** Provide a highly visible stamped intersection at Madison Avenue and 15th Street W to enhance the rails-with-trails experience for walkers, joggers, and cyclists.
- **C** Reduce urban heat island effect by providing shade trees, native plantings, and pavement removal when possible.
- **D** Improve pedestrian experience along Madison Avenue by incorporating entrance/gateway signage, improved crosswalks, and traffic-calming measures.
- **E** Provide a designated bicycle lane where space is available.
- **F** Add sharrow markings where space isn't available for a designated bicycle lane.
- **G** Utilize permeable pavement in highly-visible sidewalks, parking spaces, and parking lots.

CHALLENGES

- **A** There is a lack of capacity for routine maintenance, repair, and replacement of aging infrastructure.
- **B** High amount of impervious surfaces create localized flooding issues.
- **C** Truck traffic and industrial activities create high sediment accumulation on the streets.
- **D** Fast vehicular speed and lack of crosswalks create an unsafe pedestrian experience.

GENERAL RECOMMENDATIONS

1. Retrofit existing planting strips (between the sidewalk and the roadway) into stormwater best management practices (BMPs).
2. Clean out, repair, and/or replace all aging infrastructure.
3. Repurpose existing vacant lots into community amenities.

INSPIRATION


REPURPOSED COMMERCIAL UNIT


FARMERS' MARKET IN PARKING LOT


BUS PASSENGER WAITING AREA

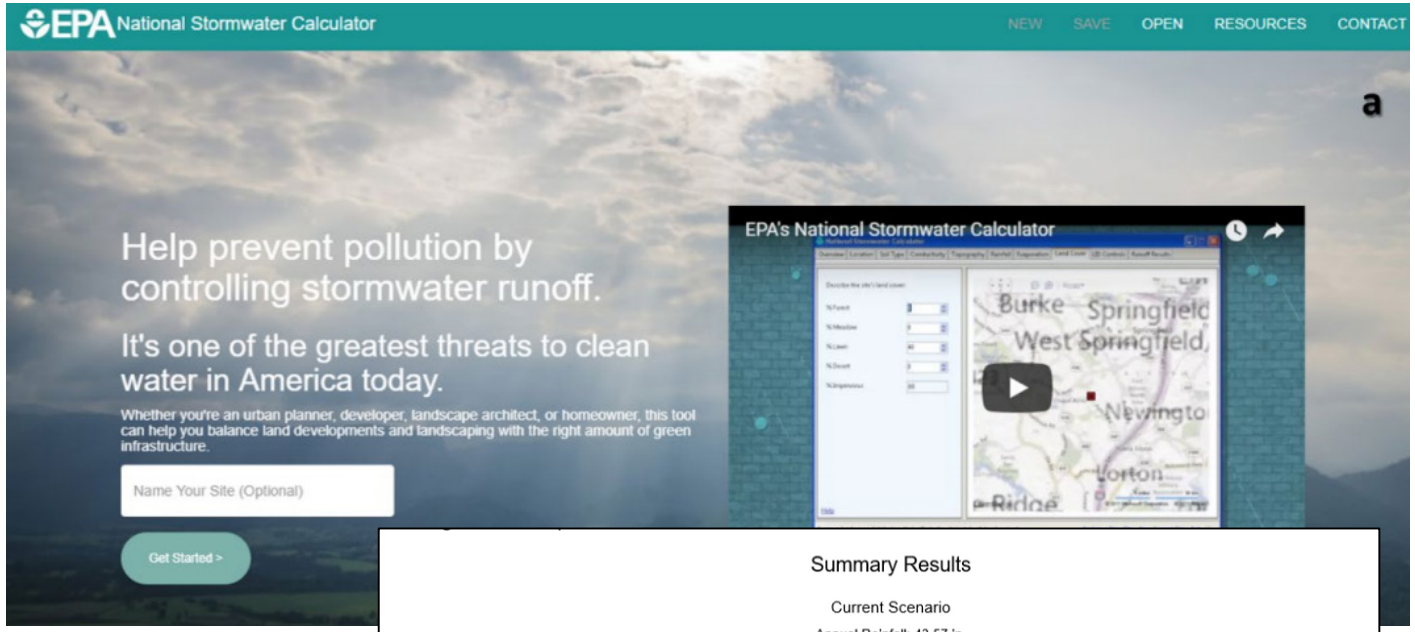

GATEWAY SIGNAGE

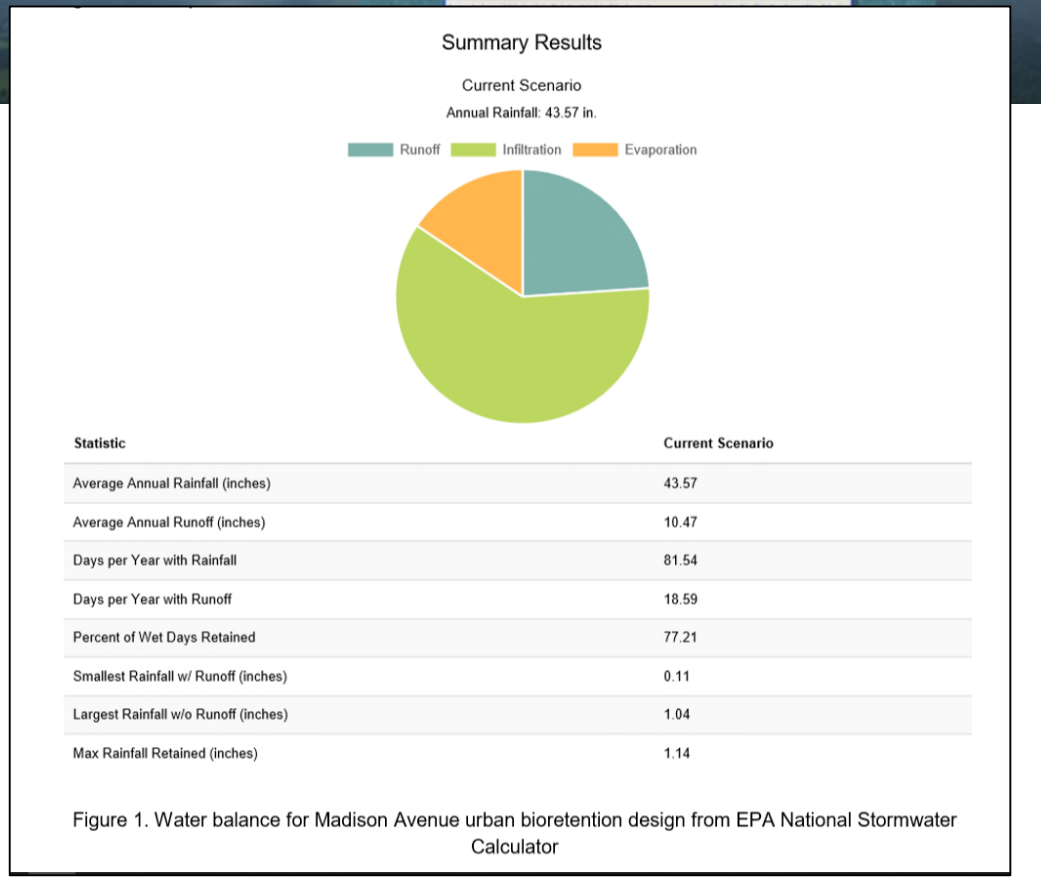

POCKET PARK


POCKET PARK EVENT SPACE

Huntington, WV

- Feasibility Design Plans (10 - 20% Design):
  - Use of U.S. EPA National Stormwater Calculator
  - Estimated stormwater runoff reductions from proposed green infrastructure designs
  - Planning level capital/construction and maintenance costs





Summary Results

Current Scenario

Annual Rainfall: 43.57 in.

Runoff Infiltration Evaporation

Statistic	Current Scenario
Average Annual Rainfall (inches)	43.57
Average Annual Runoff (inches)	10.47
Days per Year with Rainfall	81.54
Days per Year with Runoff	18.59
Percent of Wet Days Retained	77.21
Smallest Rainfall w/ Runoff (inches)	0.11
Largest Rainfall w/o Runoff (inches)	1.04
Max Rainfall Retained (inches)	1.14

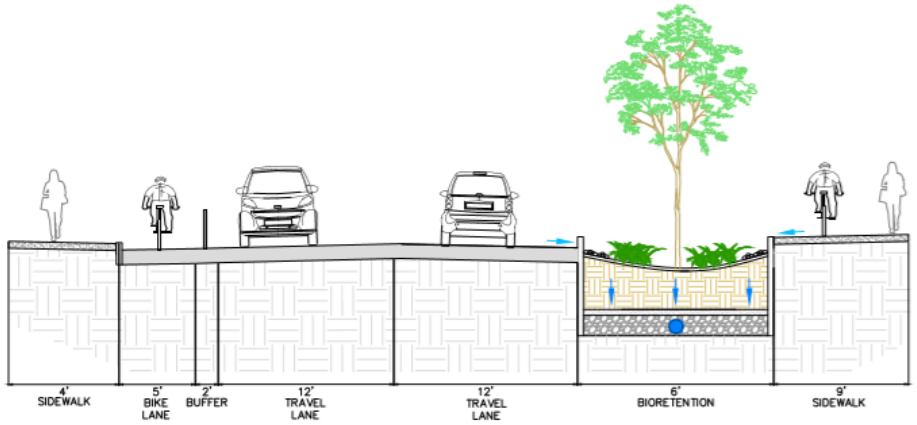
Figure 1. Water balance for Madison Avenue urban bioretention design from EPA National Stormwater Calculator

EPA National Stormwater Calculator: https://www.epa.gov/water-research/national-stormwater-calculator

Huntington, WV

Feasibility Design (10 – 20%)

SECTION A-A'
(NOT TO SCALE)



SECTION B-B'
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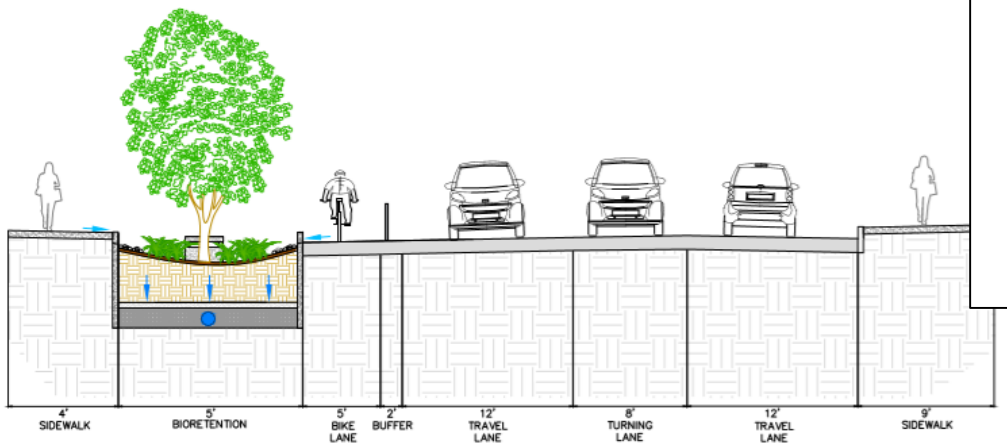


NOT FOR CONSTRUCTION

TETRA TECH

Madison Avenue
Green Street Feasibility Design

C-04

Table 1. Bioretention features feasibility design specifications

Bioretention Feature	Surface Area (ft^2)	Treatment Volume (ft^3)
Urban Bioretention Features (14 individual features) Feasibility Design	2,484	4,802
Minimum Required Sum	***2,322***	***4,490***

Table 2 Summary of EPA National Stormwater Calculator generated costs

Concept Design	Capital Cost	
	Low	High
Madison Avenue	$42,477	$58,753

Seaford, DE

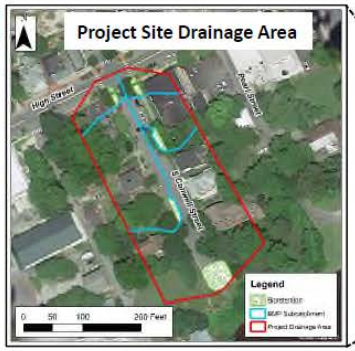
CITY OF SEAFORD, SUSSEX COUNTY, DELAWARE
GREEN INFRASTRUCTURE CONCEPTUAL PLAN
SITE: SOUTH CONWELL STREET

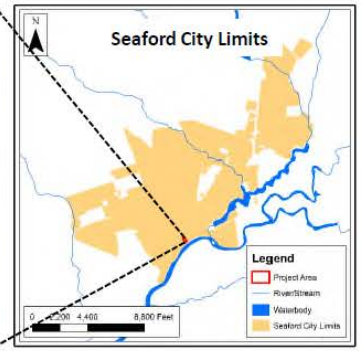
Site Location			
Date of Field Visit	7/24/2019	Latitude	38° 38' 22.1424" N
Field Visit Personnel	J. Smith	Longitude	-75° 36' 46.2744" W
Major Watershed	Nanticoke River	Landowner	City of Seaford
Street Address	South Conwell Street between High St to Nanticoke River		

Existing Site Description: The proposed project site includes the South Conwell Street roadway corridor between High Street and Nanticoke River. Conwell Street is a 2-lane largely residential roadway that dead ends near the river. The existing road is approximately 30 feet wide with discontinuous sidewalks. Conwell Street was selected by the community as a location for a green infrastructure beautification and destination location project. Potential improvements include traffic-calming and bioretention bump-outs, a large end-of-street bioretention cell with walkway and viewing platform, adding a bicycle rack, improving existing sidewalk connectivity, and leaving room for vehicles to turn-around.

Drainage Area Characteristics		Proposed Characteristics*	
Drainage Area, acres	1.68	Proposed BMPs	Bioretention
Hydrologic Soil Group	A	Minimum Storage Volume, ft³	2,937
Total Impervious, %	52	Total Storage Volume, ft³	4,920
Design Storm Event, in	2.7	BMP Area, ft²	3,174

Proposed Green Infrastructure Description: Proposed BMPs include converting vegetated bump-outs at High Street to bioretention to address localized nuisance flooding, adding two additional bioretention bump-outs along Conwell Street, and adding a large bioretention cell at the end of Conwell Street in the existing roadway. Bioretention specifications include 9 inches ponding depth and 24 inches of media. These BMPs are designed to capture and treat runoff from Conwell Street while still allowing pedestrian, vehicle, and transit access.





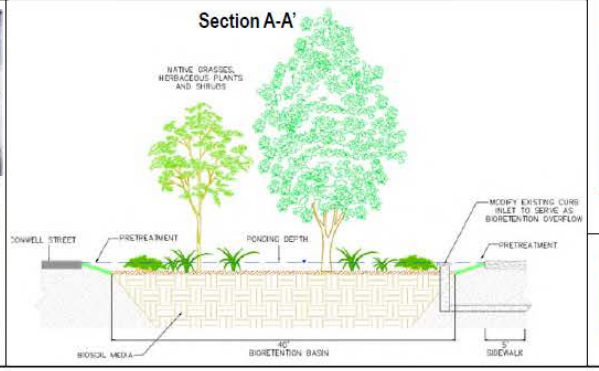
*Green Infrastructure characteristics are based on field observations and GIS data resources available at the time of conceptual design analysis. Note that final design characteristics will be dependent on a detailed site survey and could vary slightly from conceptual design characteristics.

Current Street View (Facing Southeast to Nanticoke River)

Current Street View (Facing Northwest to High Street)

Example Photo: Bioretention Bump-Out

Example Photo: Overlook Platform



Regional Resilience Toolkit

Regional Resilience Toolkit: 5 Steps to Build Large-Scale Resilience to Natural Disasters

From 2013 to 2018, the Federal Emergency Management Agency (FEMA) and U.S. Environmental Protection Agency (EPA) helped three California regions take large-scale action for disaster resilience. Based on these technical assistance projects, FEMA and EPA partnered with the Metropolitan Transportation Commission/Association of Bay Area Governments (MTC/ABAG) to create a toolkit that helps regions plan for disasters by working across multiple jurisdictions and with non-governmental partners.

The *Regional Resilience Toolkit* (PDF) (228 pp, 33 MB, About PDF) focuses on the regional scale because disasters happen at a regional scale, and a coordinated process across multiple jurisdictions can result in safer communities. The toolkit is set up to allow multiple jurisdictions and levels of government to work together for regional-scale actions. It is also designed for non-governmental partners and community groups to engage in a more inclusive and holistic process so that resilience actions are guided by core community values.

Multi-hazard resilience may address risks from wildfires, drought, hurricanes, extreme heat, flooding, earthquakes, landslides, sea level rise, winter storms, and more. This toolkit can help partners across a region address multiple hazards simultaneously within the context of federal, state, and local planning requirements and funding streams. Resilience can include actions that address both immediate, pressing needs as well as decisions that protect long-term investments.

Regional Resilience Toolkit

Building Blocks for Regional Resilience 2020

EPA's Office of Community Revitalization is using the *Regional Resilience Toolkit* through the Building Blocks Program in four projects to help multiple jurisdictions come together to identify shared natural disaster risks and a common action plan for the region. Through on-site workshops, EPA will support communities and their partners as they set resilience goals, prioritize assets to protect, and develop resilience strategies and funding plans. All four project areas contain federally designated Opportunity Zones and will address economic resilience as part of their planning process. The projects are:

Pilot projects:

- Land of Sky Regional Council, North Carolina
- Southern Minnesota
- Milwaukee Metropolitan Sewerage District, Wisconsin
- Portland Metropolitan Region, Oregon

https://www.epa.gov/smartgrowth/regional-resilience-toolkit

Similarities Between EWN® LA Design Research and EPA Design Assistance

- **Integrating ecosystem service/nature-based solutions into conventional engineering practices:**
  - Flood management, stormwater management, habitat enhancement, resilient infrastructure, etc.
  - Multi-functional landscape-based design solutions
- **Design workshop process utilized to develop place based concept designs that can be replicated with similar future projects**
  - Integrating existing planning, design, and engineering expertise with exceptional LA design teams
  - Sharing results with implementing partners (local, state, regional, and federal)

Potential Opportunities for Collaboration

Sharing best LA design solutions applicable to USACE district needs

Partnering on existing or future EWN® and/or EPA LA design projects

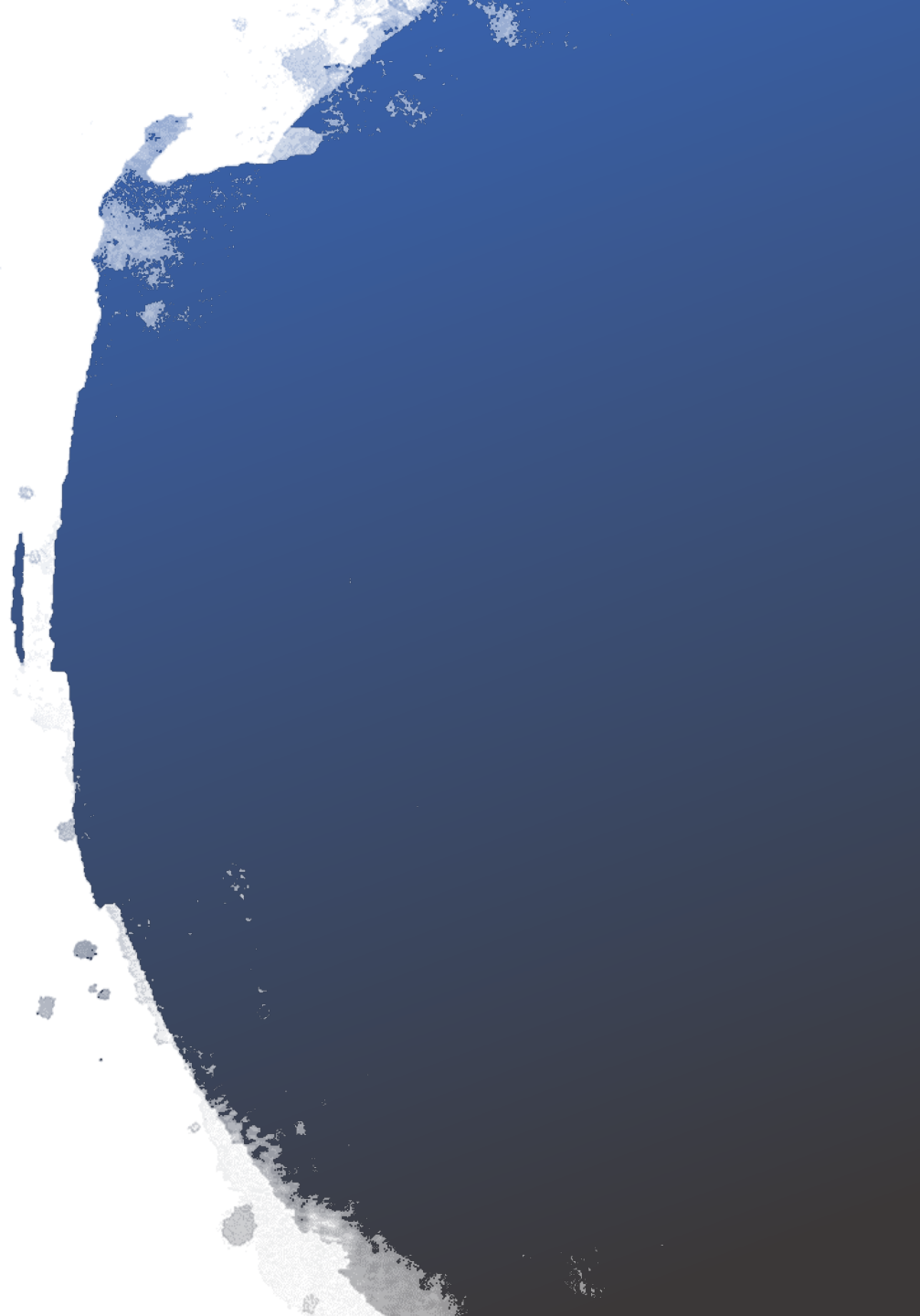
*Resilient design and planning: expanding types of applications

*Supporting implementation of LA designs

*Measuring effectiveness and performance of implemented designs

Collaborating on publishing and presenting results of LA design projects

Next Steps?



Thank You

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