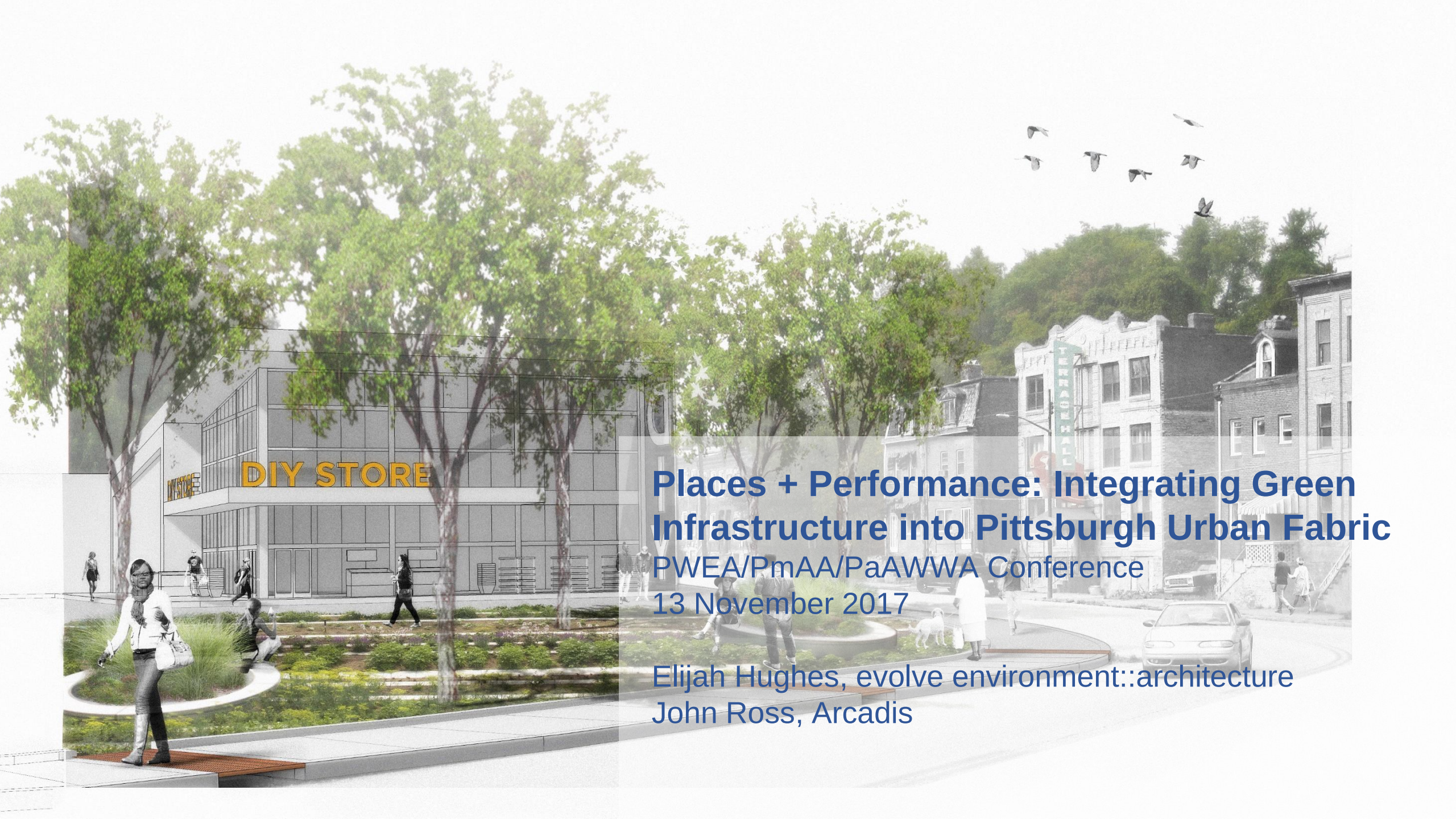


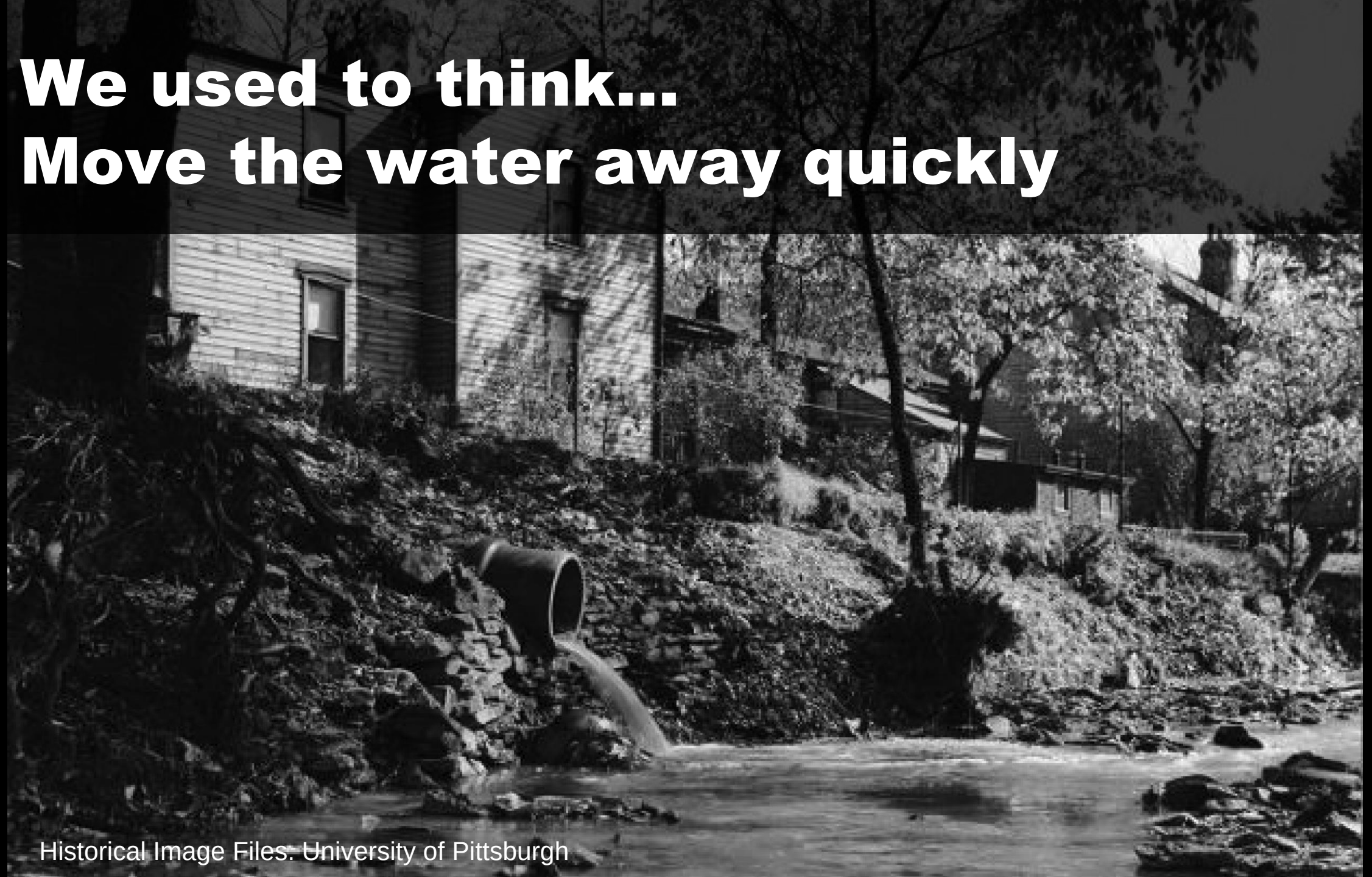
Places + Performance: Integrating Green Infrastructure into Pittsburgh Urban Fabric

PWEA/PmAA/PaAWWA Conference
13 November 2017

Elijah Hughes, evolve environment::architecture
John Ross, Arcadis

At the turn
of the 20th century,
Pittsburgh embarked
on its biggest
infrastructure
improvement campaign,
building sewers, water
lines, roads, power lines
that created the
city we know today.

We used to think…
Move the water away quickly



Historical Image Files: University of Pittsburgh

We solved our stormwater and waste issues with a single system.

Historical Image Files. University of Pittsburgh

The system functions differently in dry weather than when it rains.

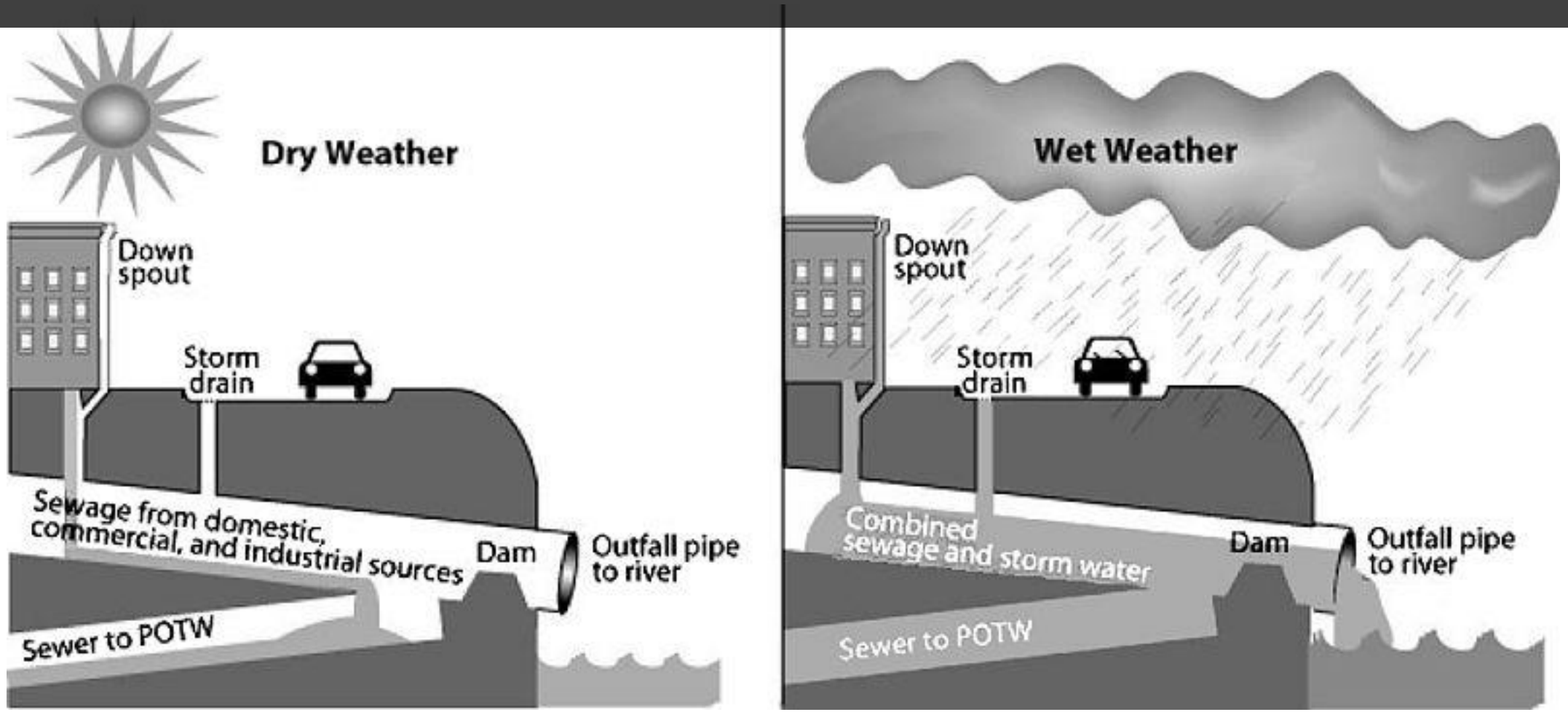


Image: US Environmental Protection Agency

The Clean Water Act requires us to address our overflows.

Image: 3 Rivers Wet Weather

We need to create next century green infrastructure.

The Green First Plan is the map to our future vision.

The purpose of the City-Wide Assessment is to create a “Green First” approach to regulatory compliance that:

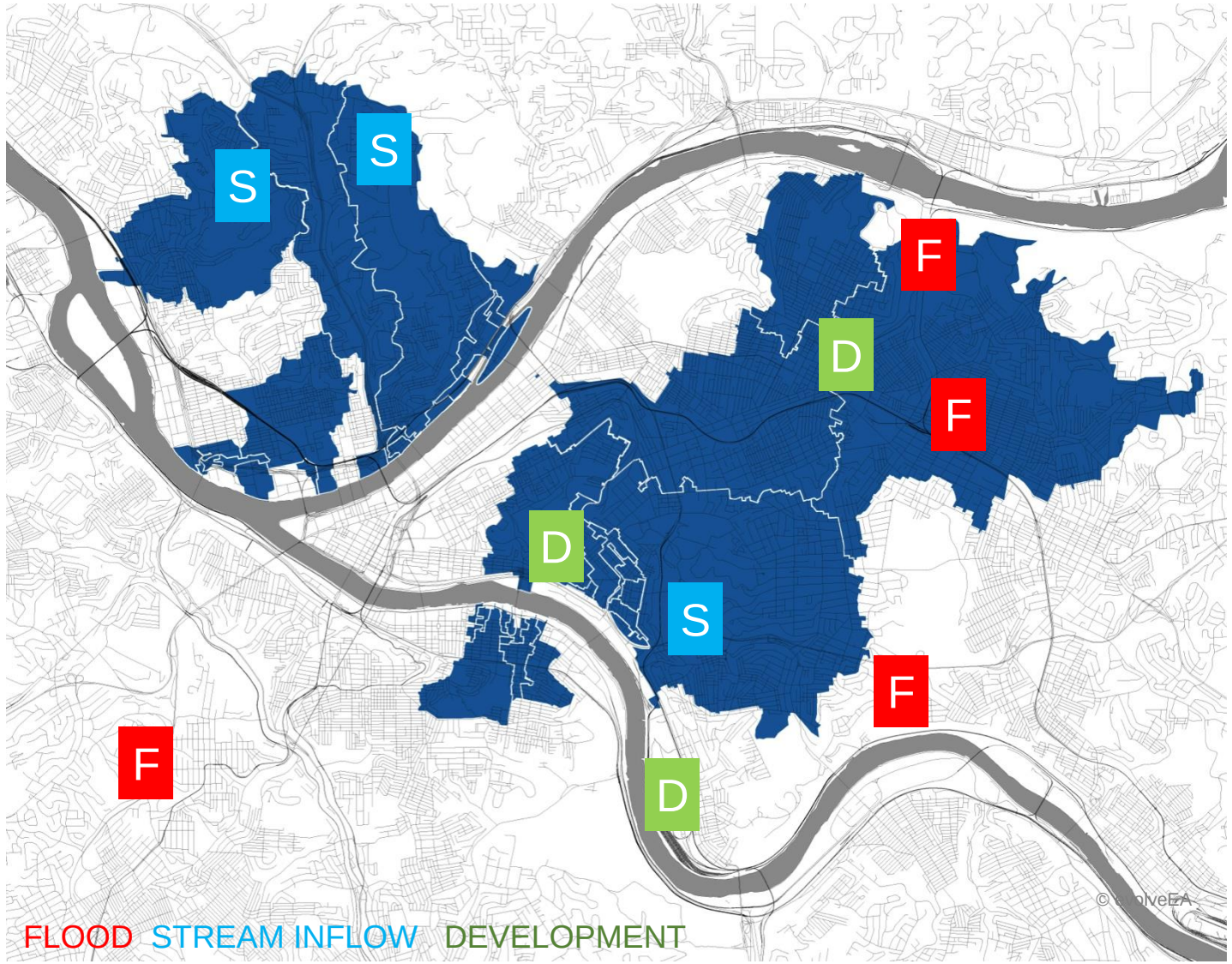
PEOPLE increases resiliency and minimizes hazards
PLANET improves our rainwater system functioning
PLACE enhances urban environments
PERFORMANCE stimulates economic growth

The Green First Plan is ENGINEERED

We need to keep rainwater out of the system. We can be most effective by focusing efforts on the sheds that contribute the most to the system.

We identified the top 30 sheds and overlaid other criteria:

RISK	LOWER RISK
OPPORTUNITY	EASY TO IMPLEMENT
DEVELOPMENT	HIGH ACTIVITY
SYNERGIES	MULTIPLE BENEFITS



The Green First Plan is ENGINEERED

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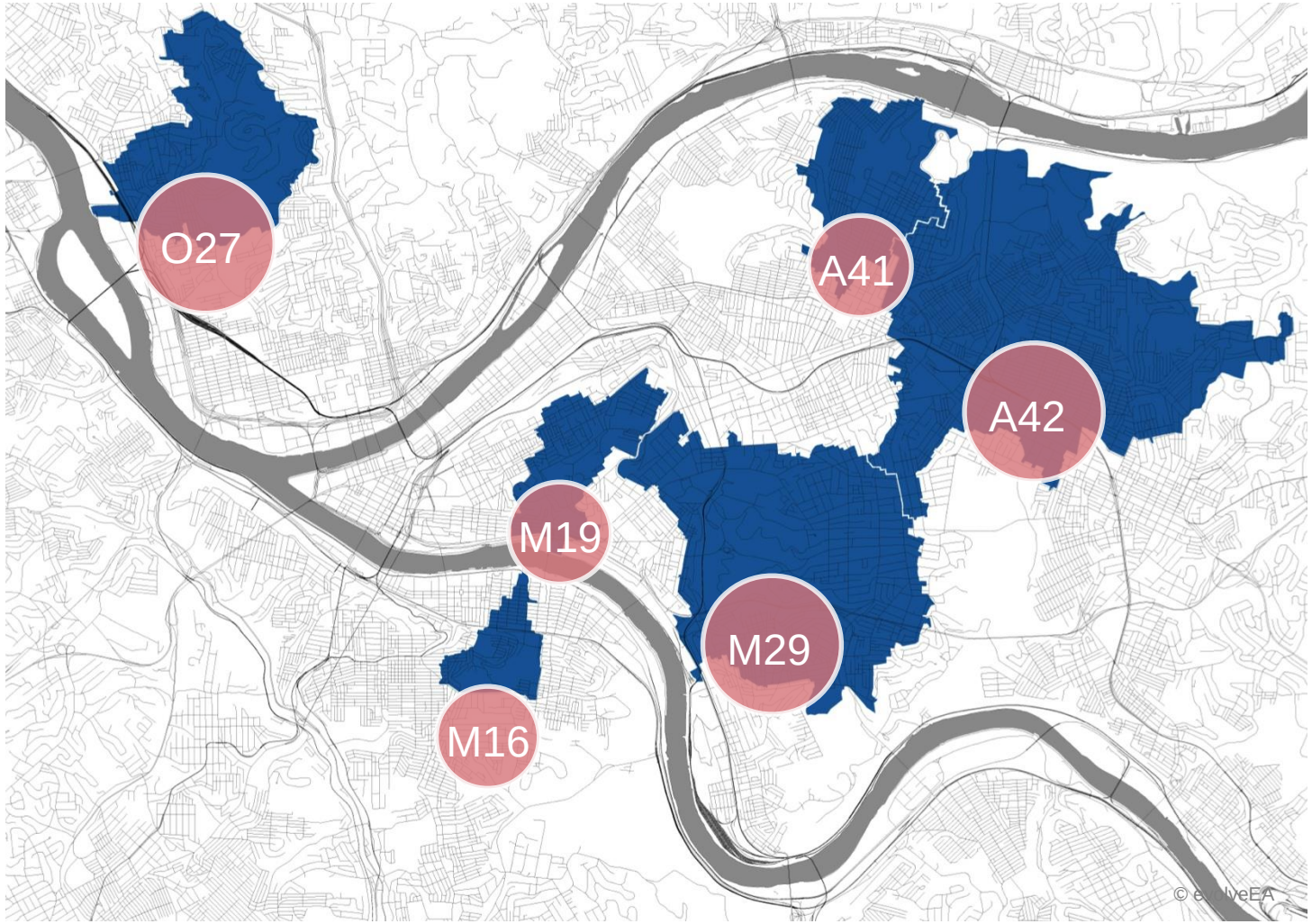
DEVELOPMENT	HIGH ACTIVITY
SYNERGIES	MULTIPLE BENEFITS

and chose 6 priority sheds



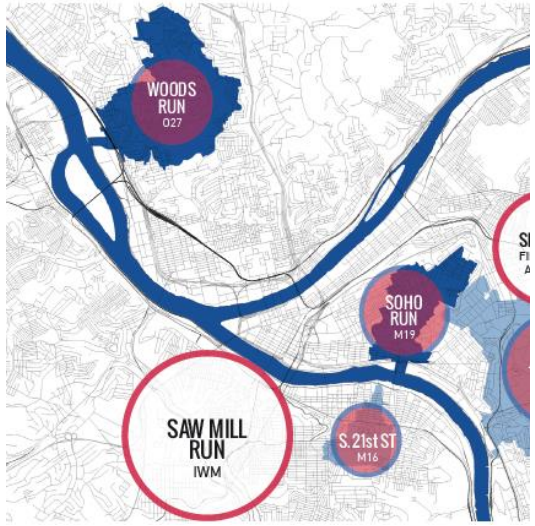
We are using a methodology that can be used across the city and the region.

© evolveEA

The Green First Plan

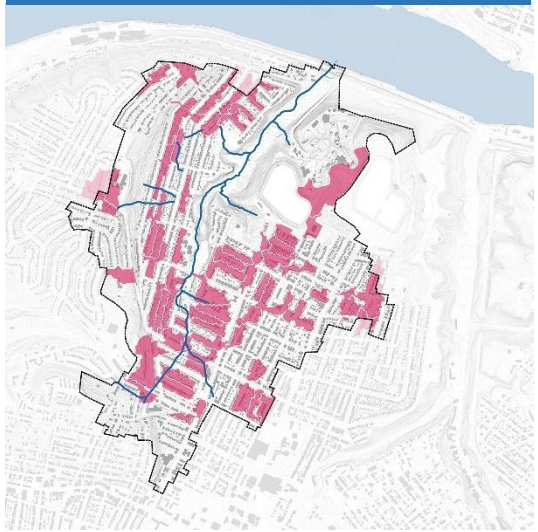
WORKS AT DIFFERENT SCALES.

At the **CITY-WIDE SCALE** we are



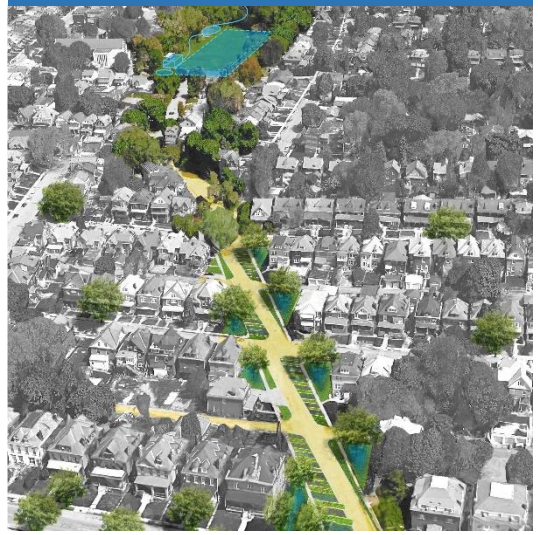
CREATING A CITY WIDE MODEL, POLICY, AND FUNDING STRATEGY

At the **SEWERSHED SCALE** we are



DEVELOPING COMMUNITY INFORMED SEWERSHED MASTERPLANS

At the **PROJECT SCALE** we are



IMPLEMENTING PRIORITY PROJECTS & CONNECTED NETWORKS

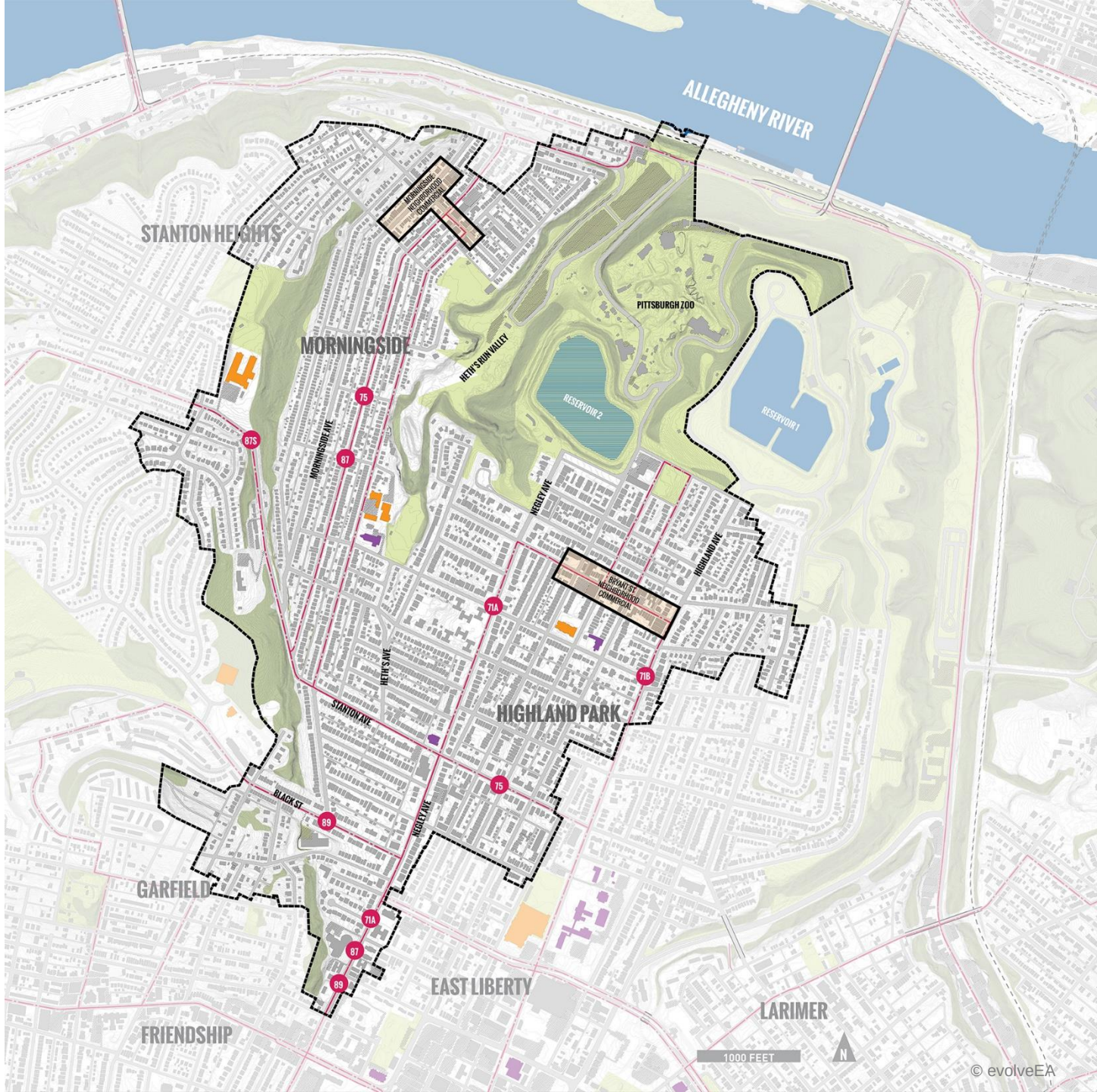
Water has always determined the identity of our neighborhoods.

We need to embed green infrastructure in our communities.

A41 HETH'S RUN

SHED CAPTURE ANALYSIS

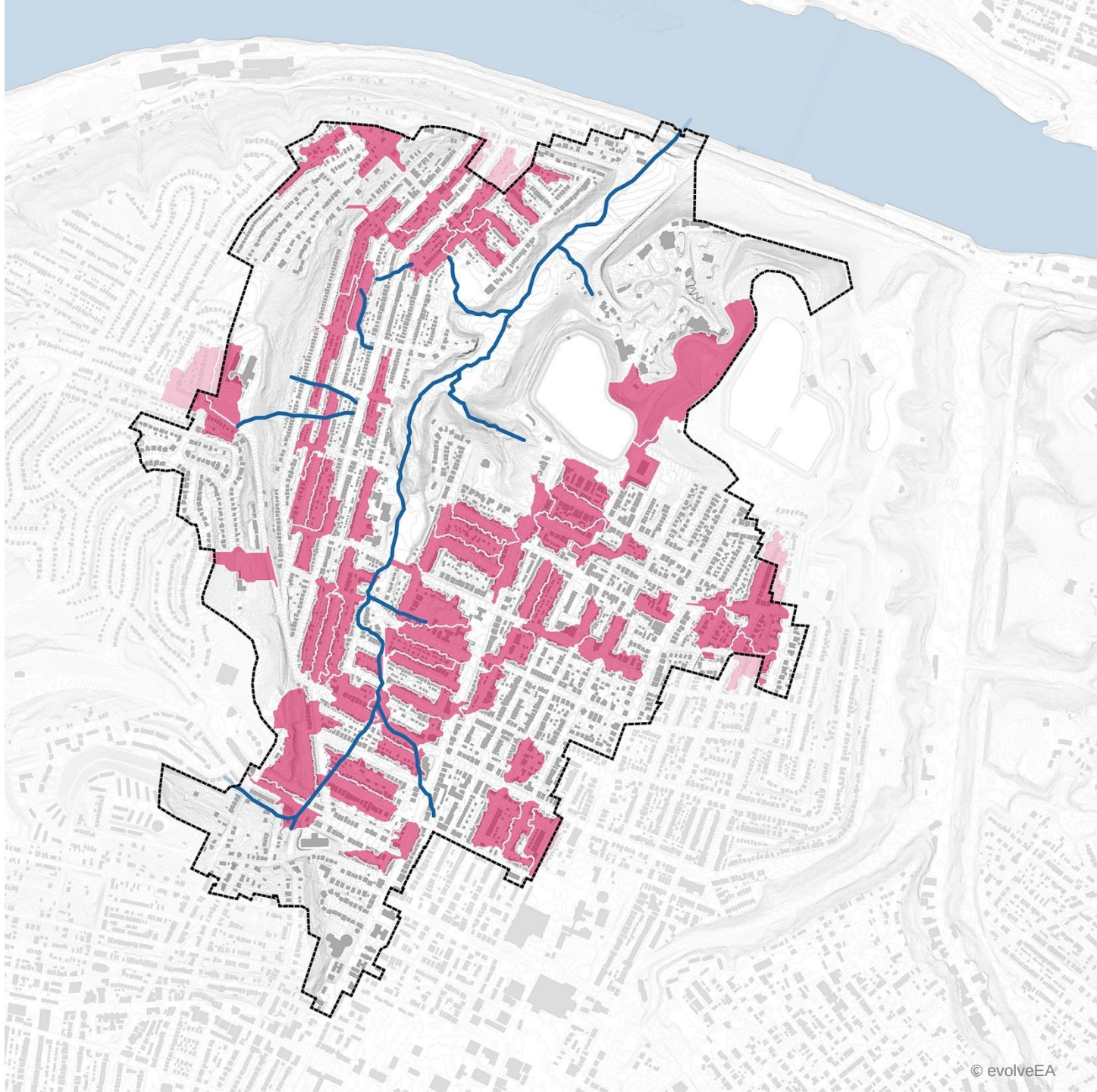
We investigated development patterns for each shed.



A41 HETH'S RUN

SHED CAPTURE ANALYSIS

High capture areas were identified.



Historic Streams and Target Areas

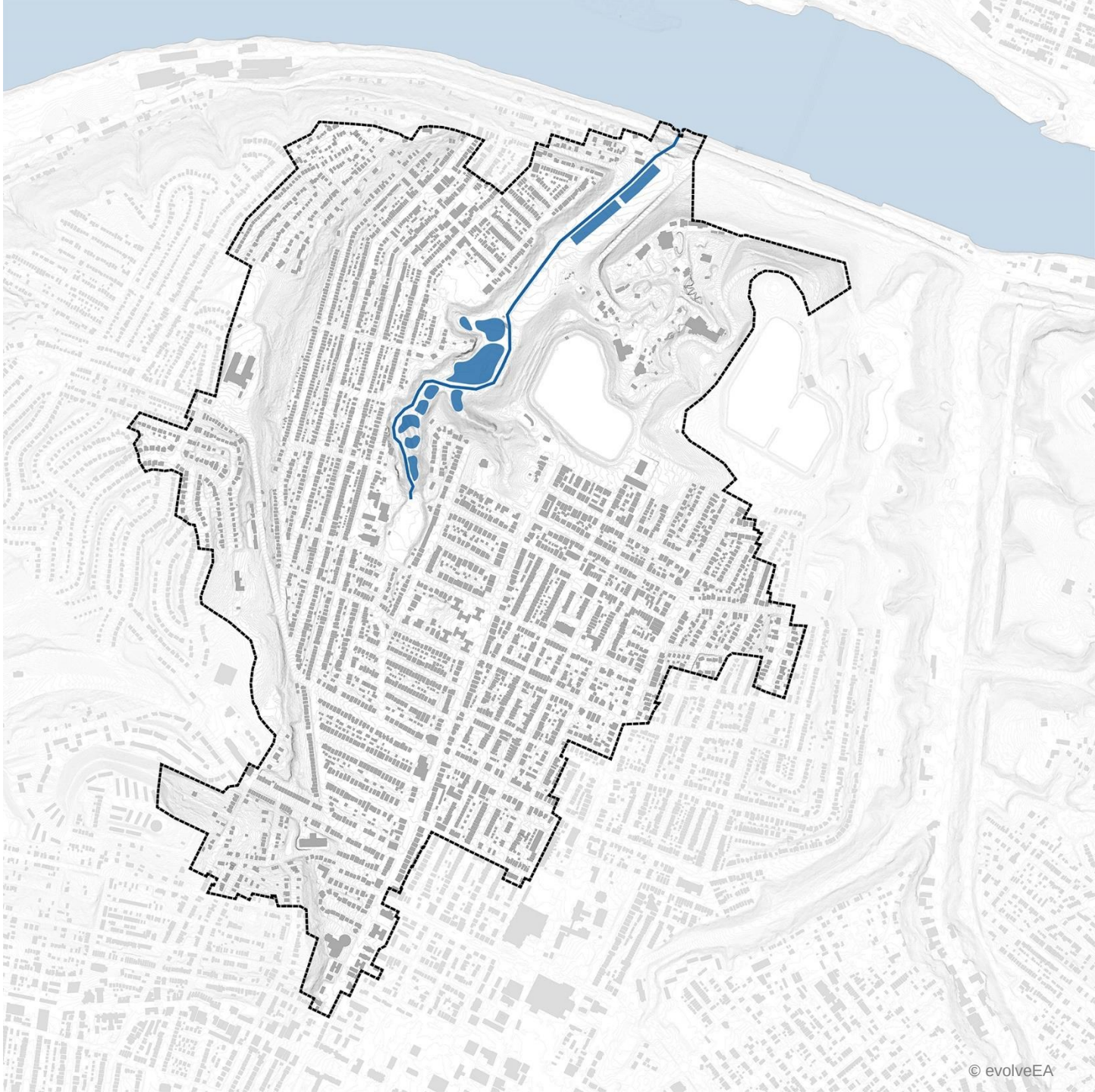
A41 HETH'S RUN

SHED CAPTURE ANALYSIS

High capture areas were identified.

Most sheds share a similar kit of parts:

STORAGE



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A41 HETH'S RUN

SHED CAPTURE ANALYSIS

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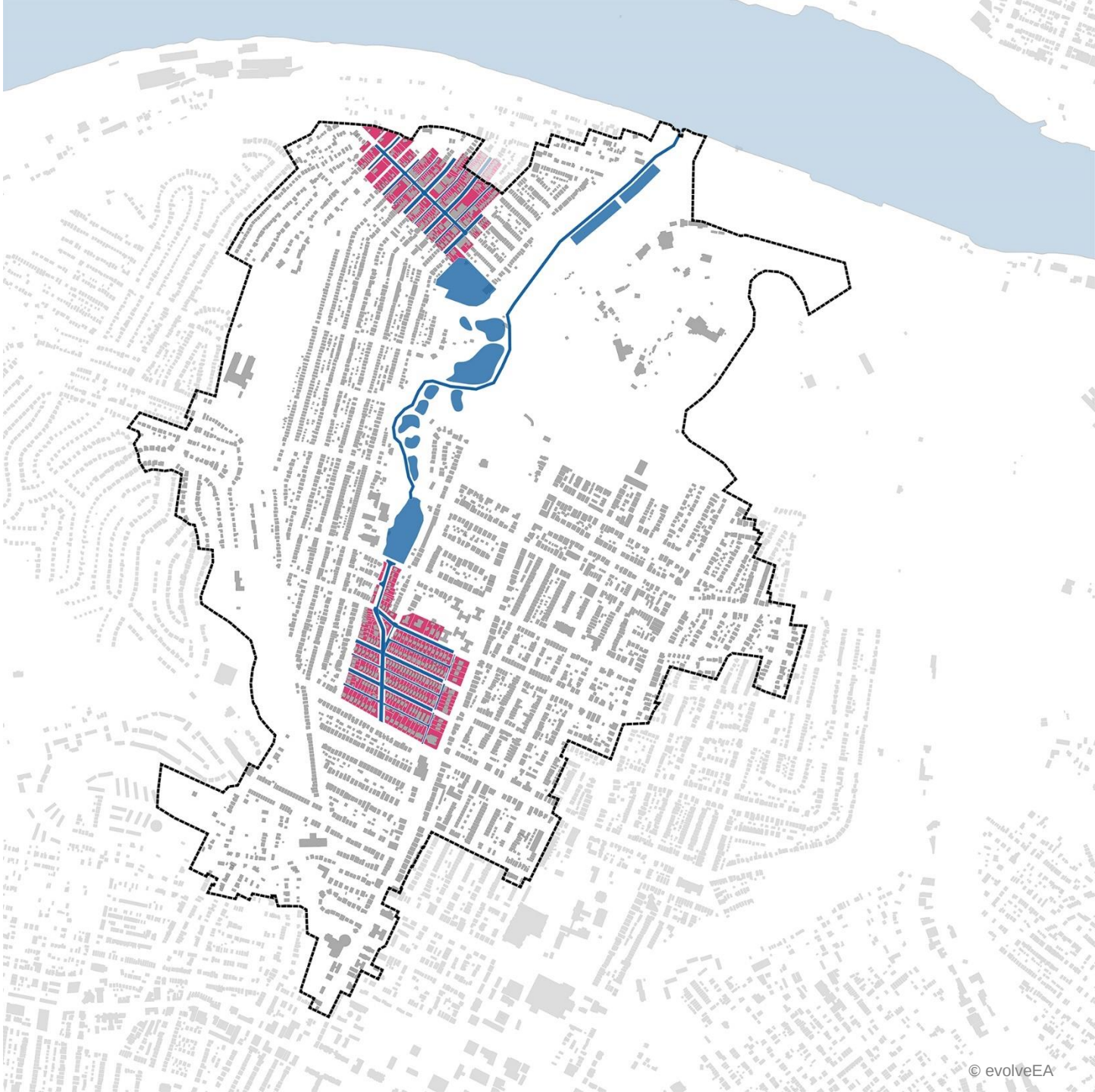
Most sheds share a similar kit of parts:

STORAGE

CONVEY



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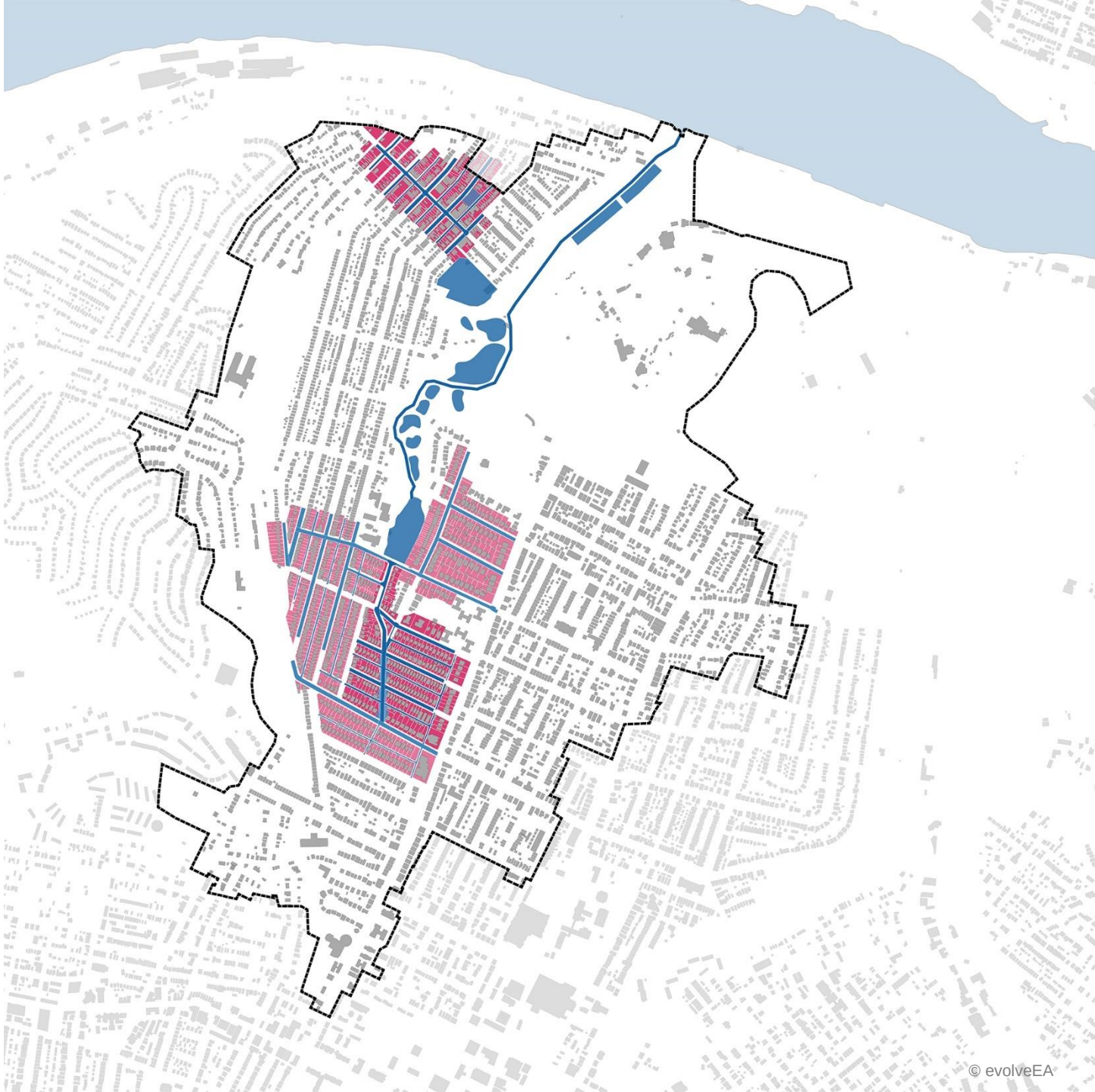
A41 HETH'S RUN

SHED CAPTURE ANALYSIS

High capture areas were identified.

Most sheds share a similar kit of parts:

- STORAGE
- CONVEY
- CAPTURE



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A41 HETH'S RUN

SHED CAPTURE ANALYSIS

High capture areas were identified.

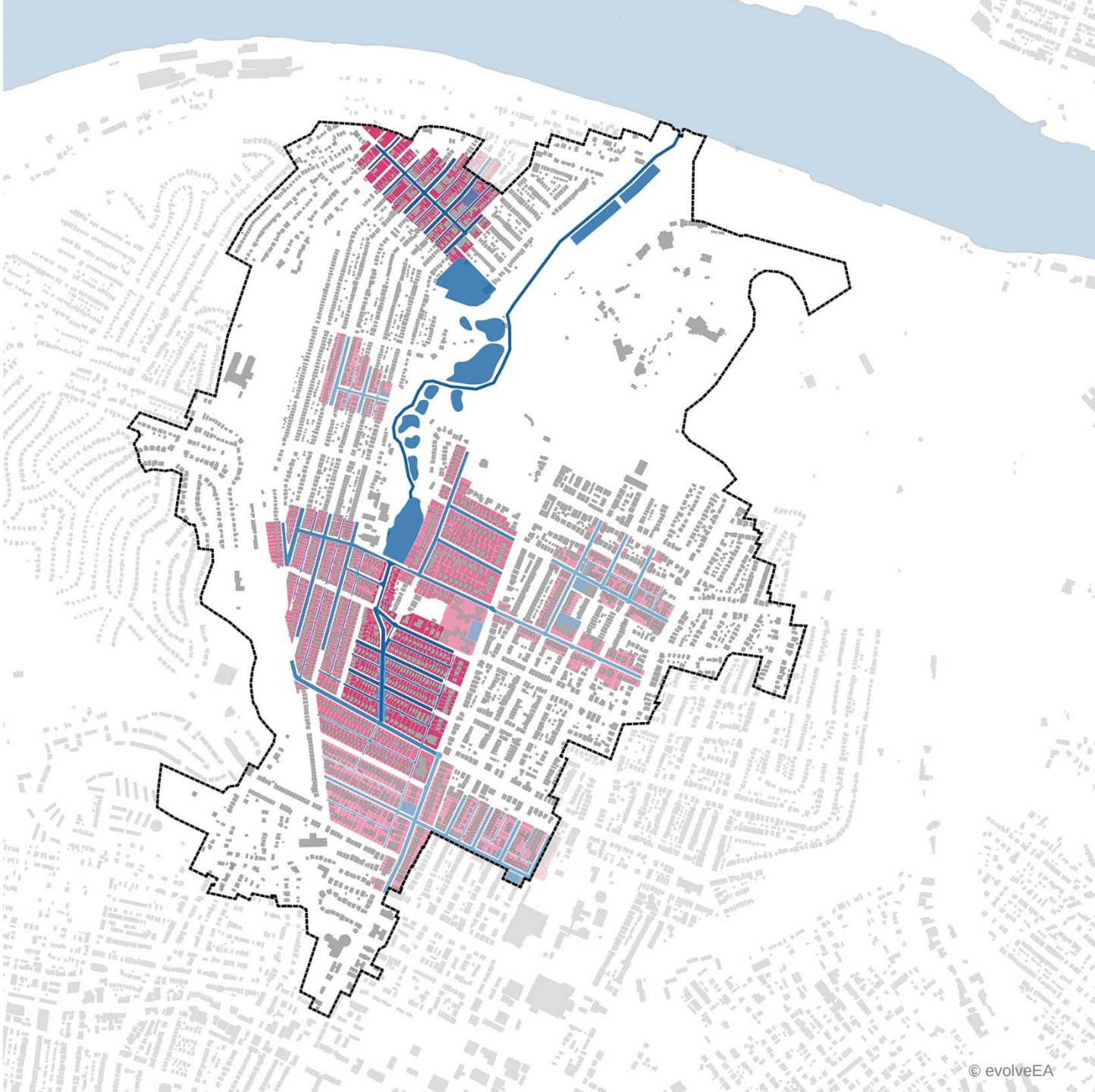
Most sheds share a similar kit of parts:

STORAGE

CONVEY

CAPTURE

working as a system.



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A41 HETH'S RUN

SHED CAPTURE ANALYSIS

High capture areas were identified.

Most sheds share a similar kit of parts:

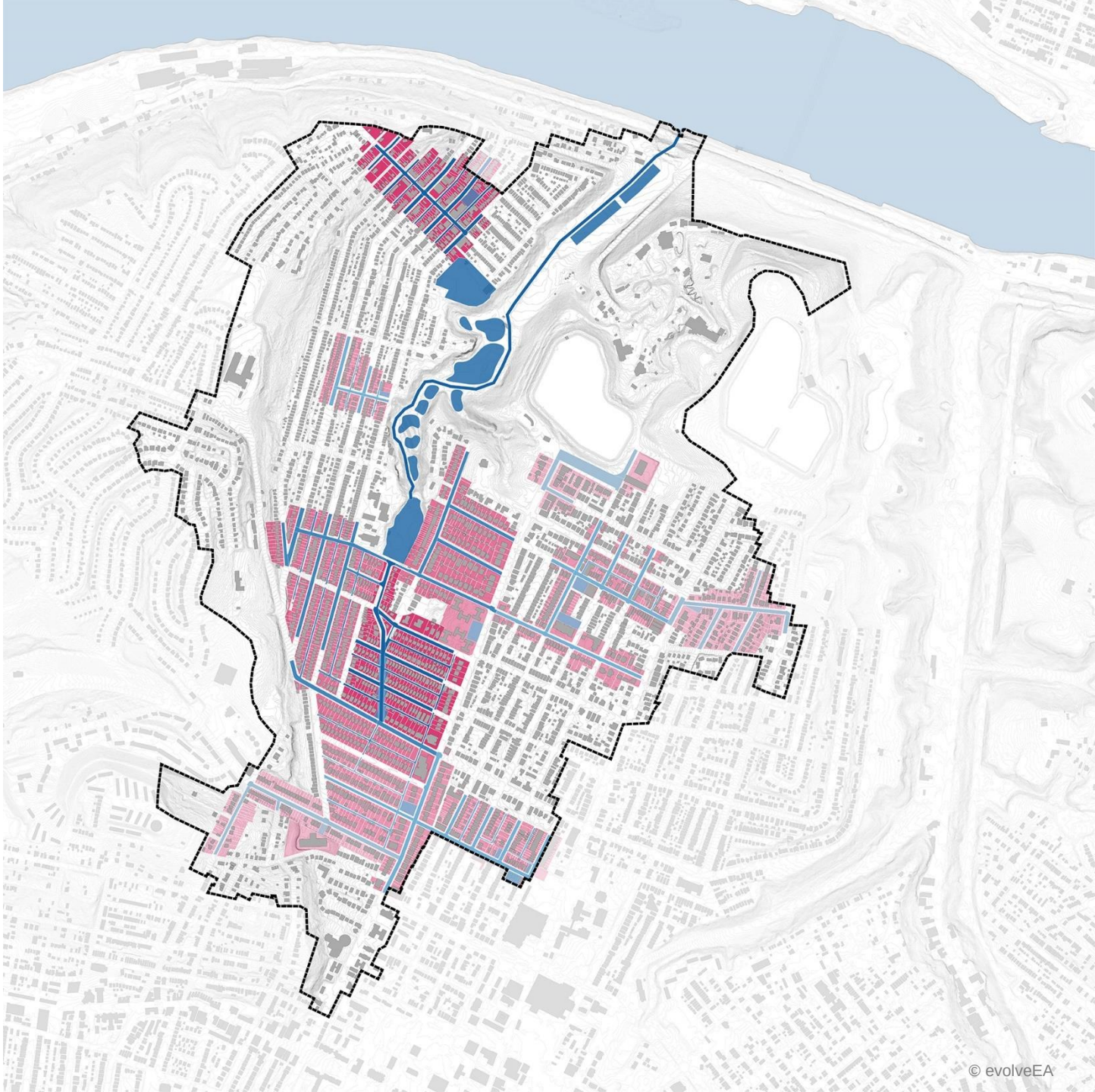
STORAGE

CONVEY

CAPTURE

working as a system.

These solutions can provide economic opportunity, increase safety and lower risk, and can dramatically improve the places in our communities.



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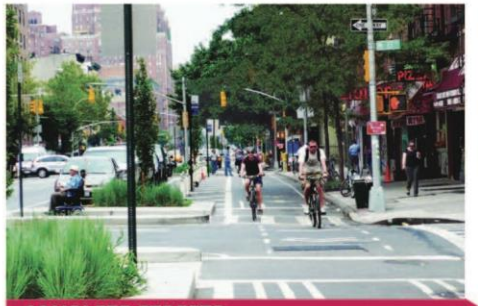
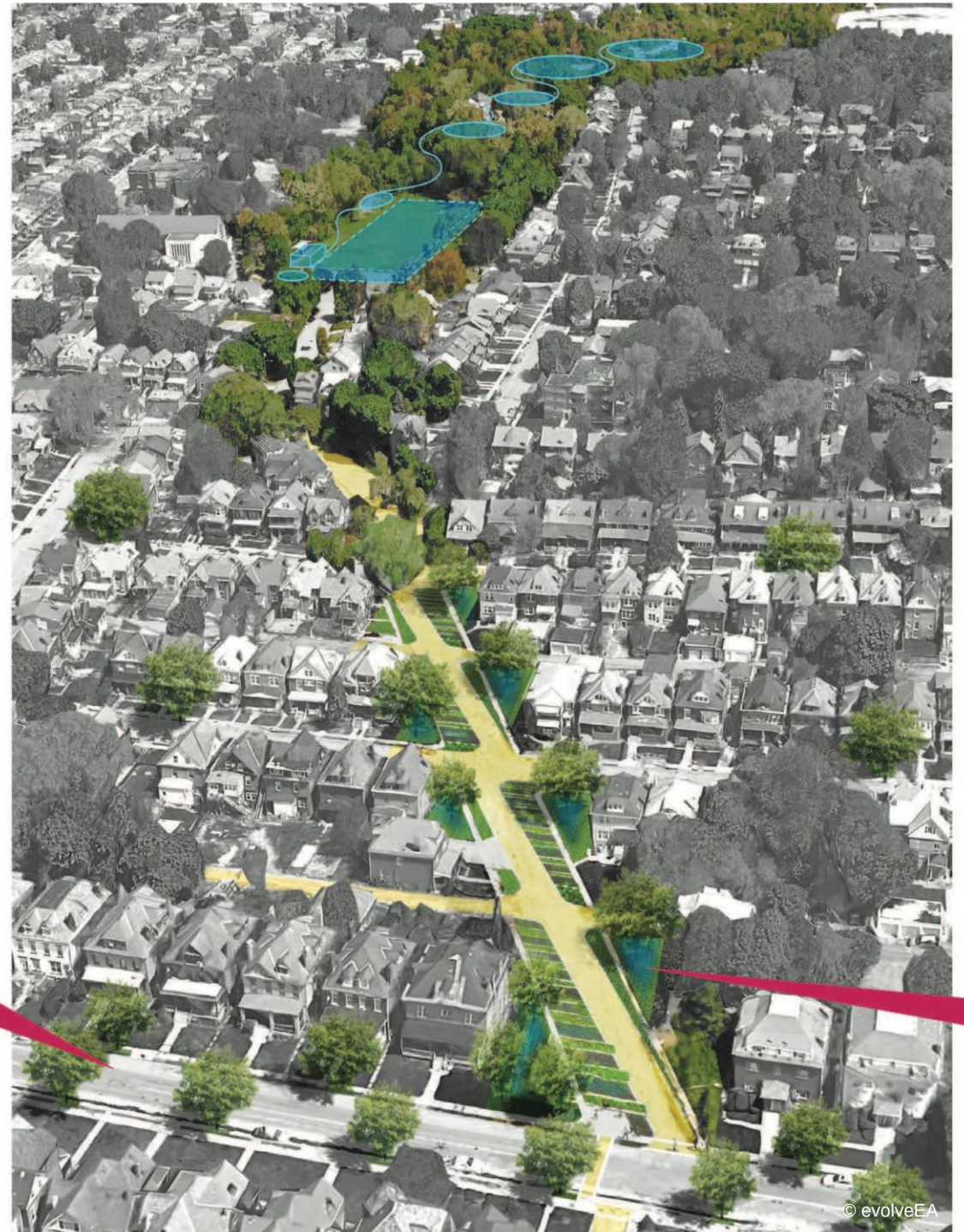
This yields a series of **STRATEGIES.**

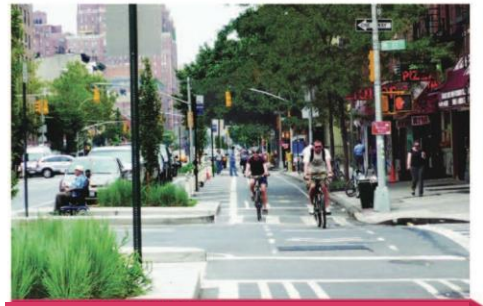
They align with larger city initiatives.



COMPLETE STREETS

© evolveEA



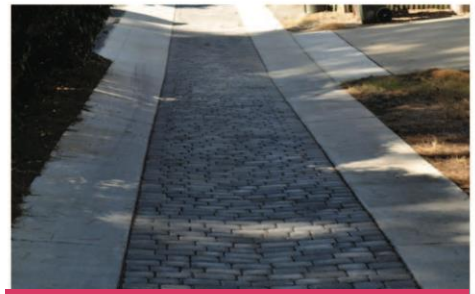


COMPLETE STREETS

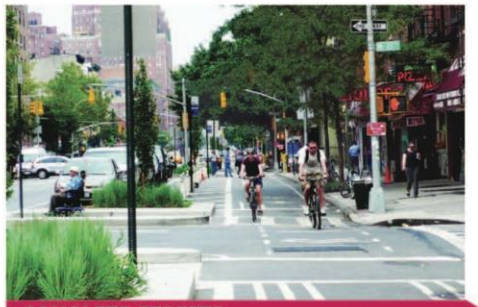
They can offer economic opportunity.

BIOSWALES

They can be part of ongoing maintenance.



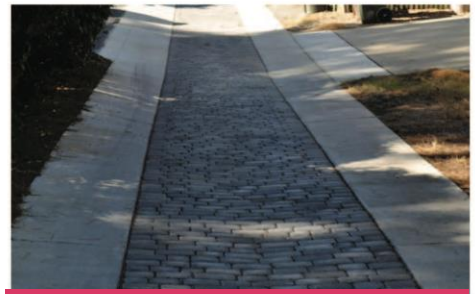
GREEN ALLEYS



COMPLETE STREETS

BIOSWALES

They require interagency cooperation.



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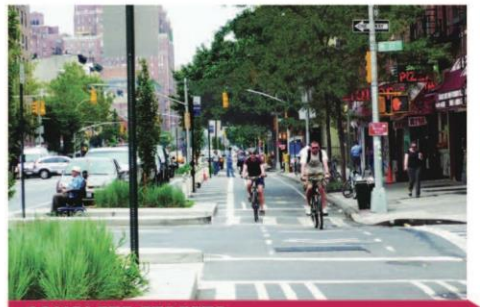
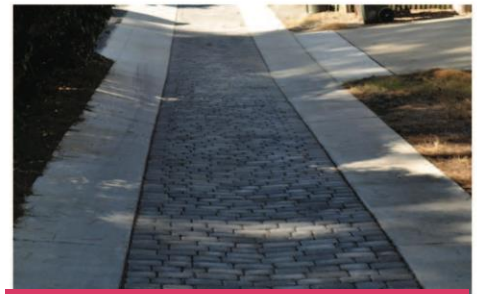


COMPLETE STREETS

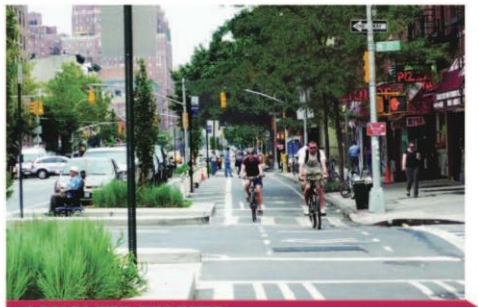
IMPROVED STREETS

BIOSWALES

SUBSURFACE STORAGE



GREEN ALLEYS



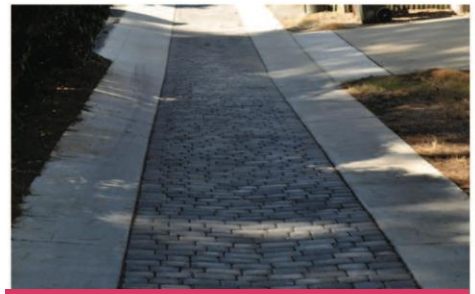
COMPLETE STREETS

They create memorable civic spaces.

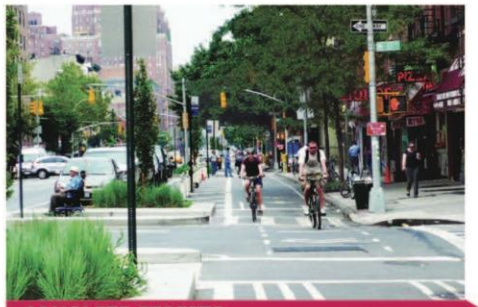
IMPROVED STREETS

BIOSWALES

SUBSURFACE STORAGE



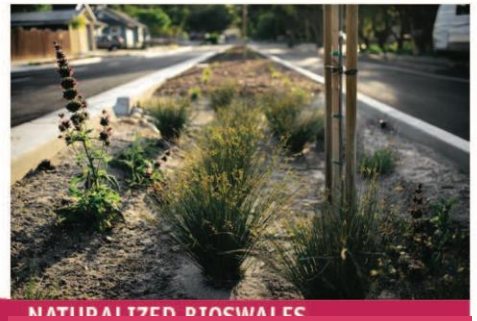
GREEN ALLEYS



COMPLETE STREETS

CONSTRUCTED WETLAND

IMPROVED STREETS



BIOSWALES

Created with public private partnerships.

How do urban design and stormwater management work together?

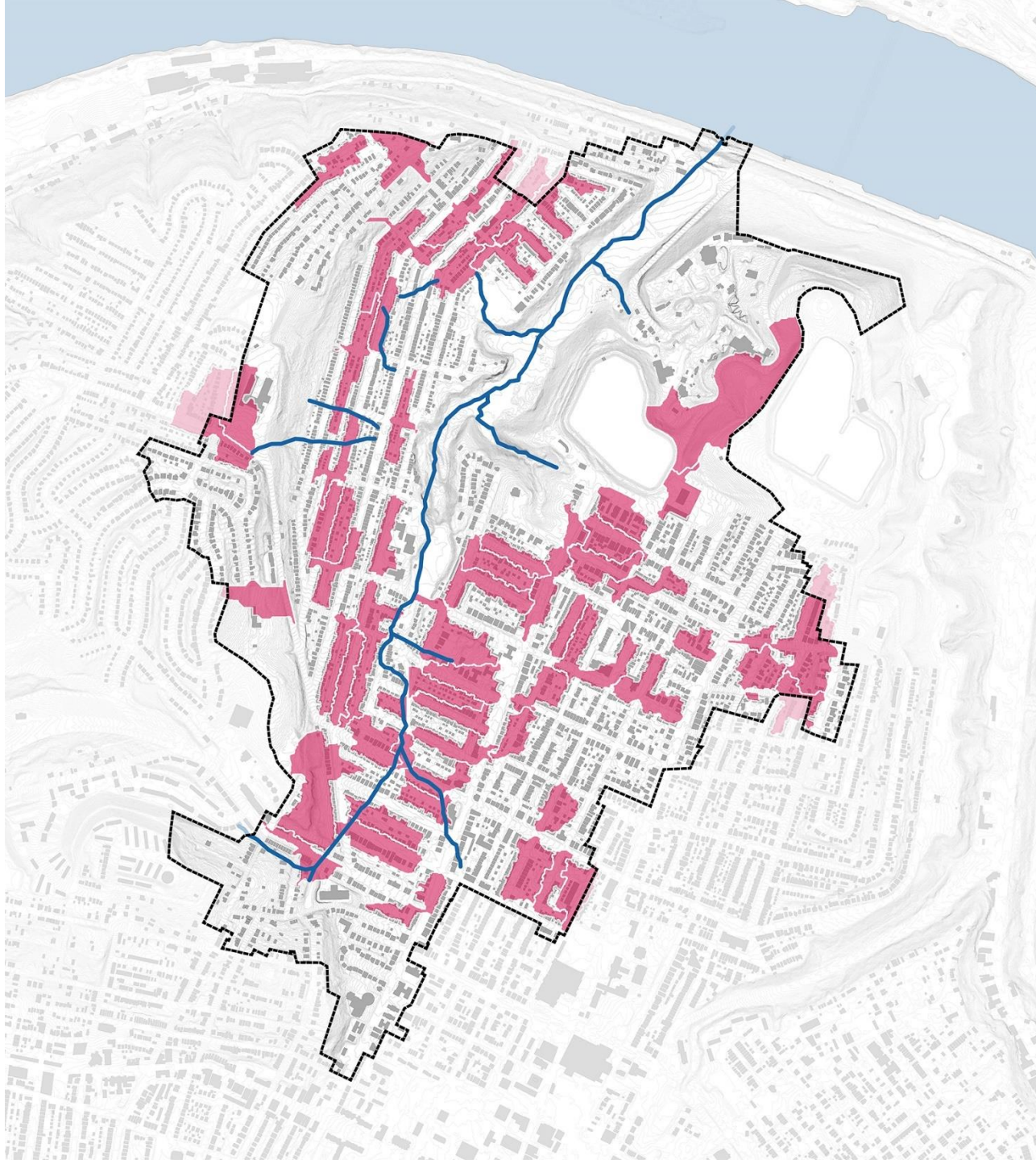
Network of GI Systems

Identify High Capture Areas

Identify Opportunities

Capture/Convey/Storage

Develop a Strategic System



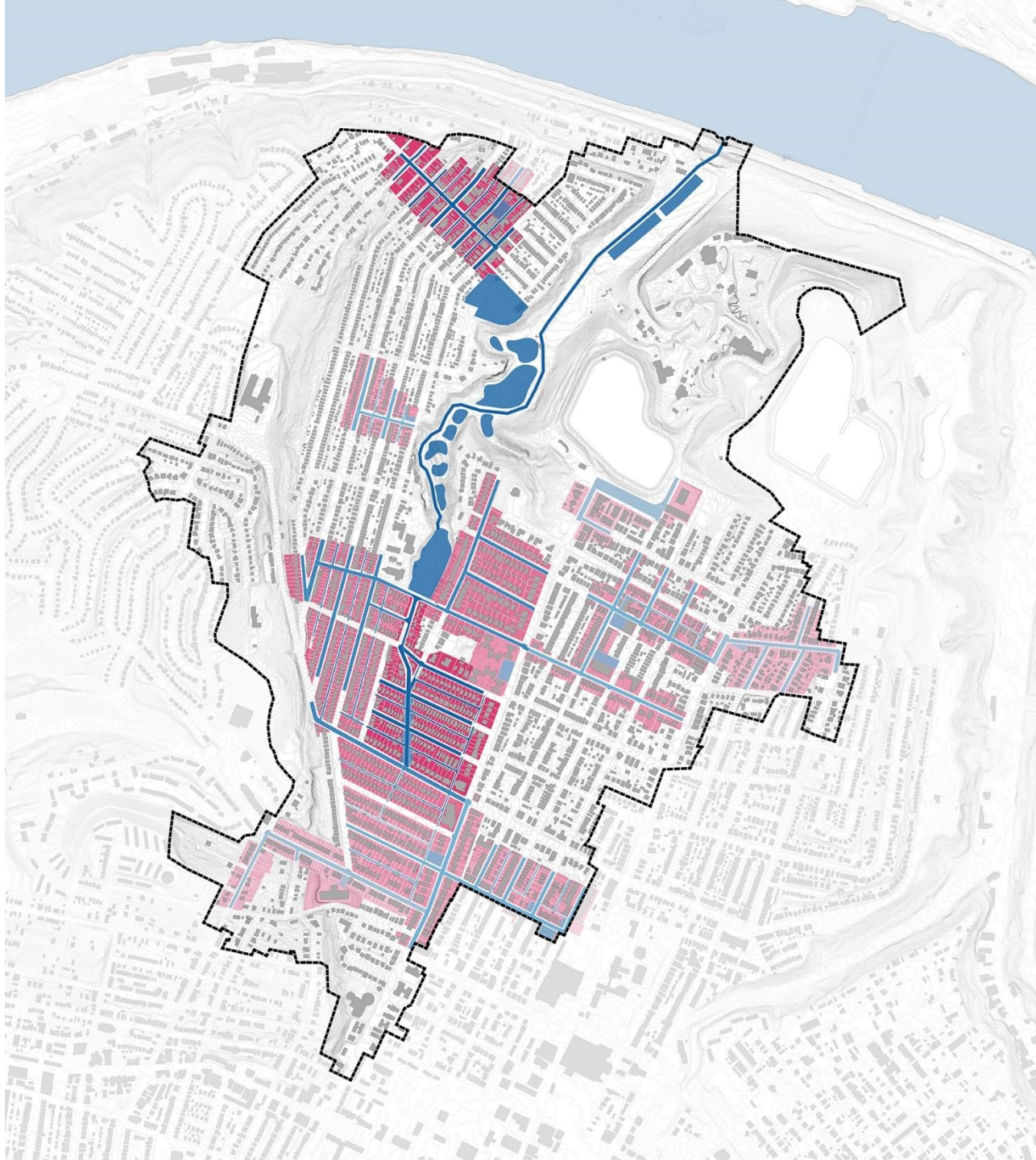
Network of GI Systems

Evaluate Opportunities

Economic/Ecological/Social Value
Needs of the Communities
Benefits to the Neighborhoods

Analyze GI Systems

Requirements/Constraints
Performance
Costs



Network of GI Systems

Analyze System

Requirements / Constraints

Performance

Costs

A 41 - All focus areas	A 41 - Controlled Area and Volume				A 41 - BMP Unit Cost Template	
GI Strategy	Tributary Impervious Area Detain and Slow Release [acres]	Tributary Impervious Area Detained and Daylighted [acres]	Total BMP Footprint [acres]	Total Runoff Storage Volume [MG]	Cost per Imp Acre Removed [$M]	Total cost estimate [$M]
"Green the Valley" Water Quality Detention			9.0			$ 8.09
Valley Detention Costs			9.0	2.9		$ 3.19
Valley Conveyance Costs						$ 4.90
"Stop and Drop" Detention		50.0	1.5	2.0	$ 0.10	$ 4.78
Heth's Playground		*42.3*	*0.9*	*1.7*	*$ 0.08*	*$ 3.30*
Mellon Terrace		*2.8*	*0.3*	*0.1*	*$ 0.26*	*$ 0.71*
Natoli Field		*3.4*	*0.1*	*0.1*	*$ 0.15*	*$ 0.51*
Vetter and Chislett		*1.5*	*0.1*	*0.1*	*$ 0.17*	*$ 0.25*
"Establish / Expand Network" GI Volume	32.4	44.5	6.8	3.1	$ 0.20	$ 15.39
Flow through Rain Garden	*14.8*		*0.8*	*0.6*	*$ 0.18*	*$ 2.60*
Road diet Swale		*9.6*	*0.6*	*0.4*	*$ 0.17*	*$ 1.59*
Stormwater Intersection Bumpout		*20.0*	*1.1*	*0.8*	*$ 0.25*	*$ 5.03*
Distributed Storage Tree Trench		*14.9*	*0.6*	*0.6*	*$ 0.16*	*$ 2.44*
Green Alley [add-on]	*17.7*		*3.7*	*0.7*	*$ 0.21*	*$ 3.74*
Conveyance						$ 8.69
Building Disconnect Cost						$ 4.75
Enhanced Curb & Gutter Conveyance Costs						$ 2.39
Pipe Network Conveyance Costs						$ 1.56
Total Controlled	32	94	17.3	5.2	$ 0.29	$ 37.0
Total Controlled - without Valley Development					$ 0.23	$ 28.9

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Network of GI Systems

Overview of GI System

LEGEND

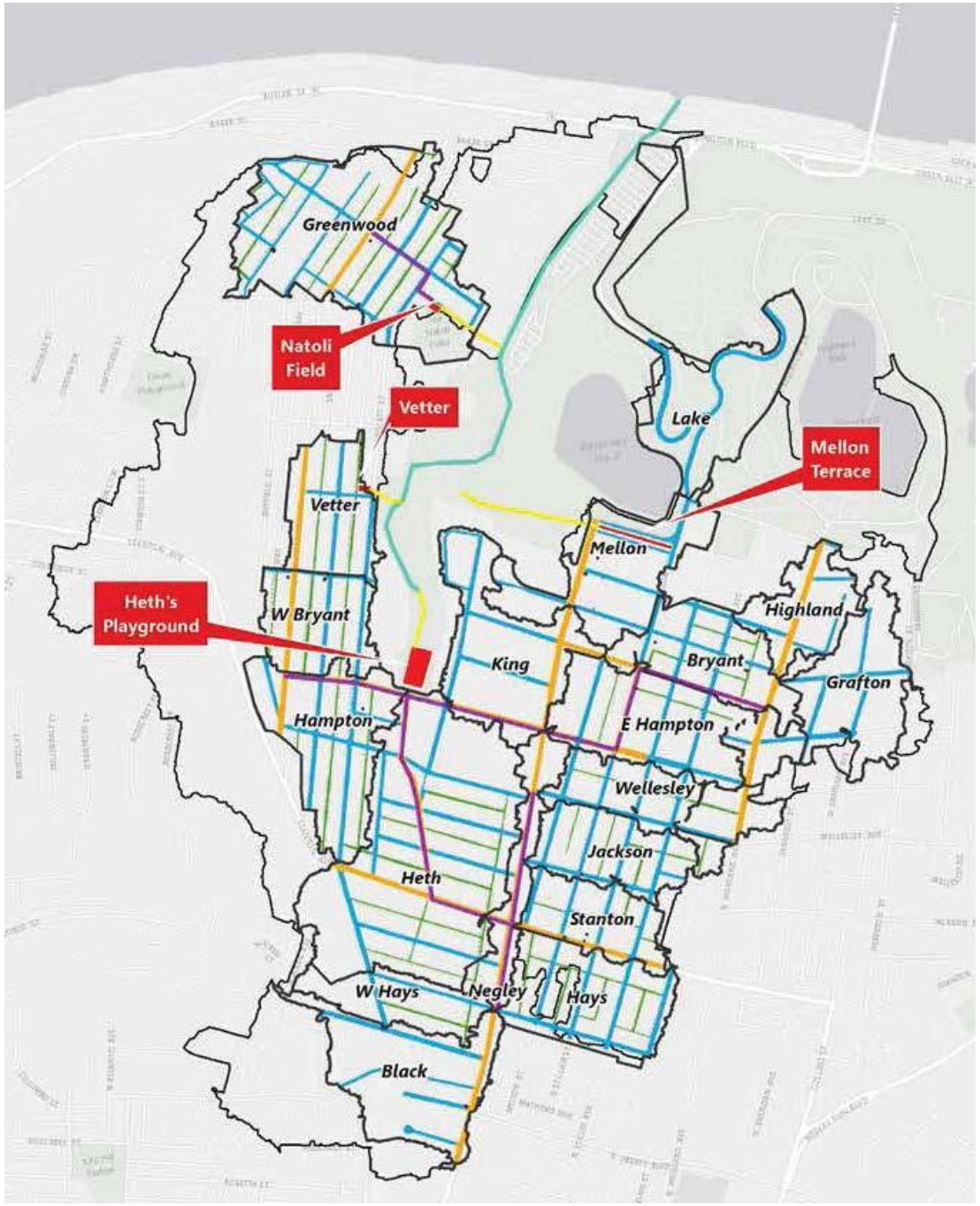
- Distributed Detention Sites

Stormwater Feature

- Complete Street
- Green Alley
- Improved Street

Conveyance

- Storm Sewer Conveyance
- Distributed Detention Conveyance
- Daylighted Conveyance



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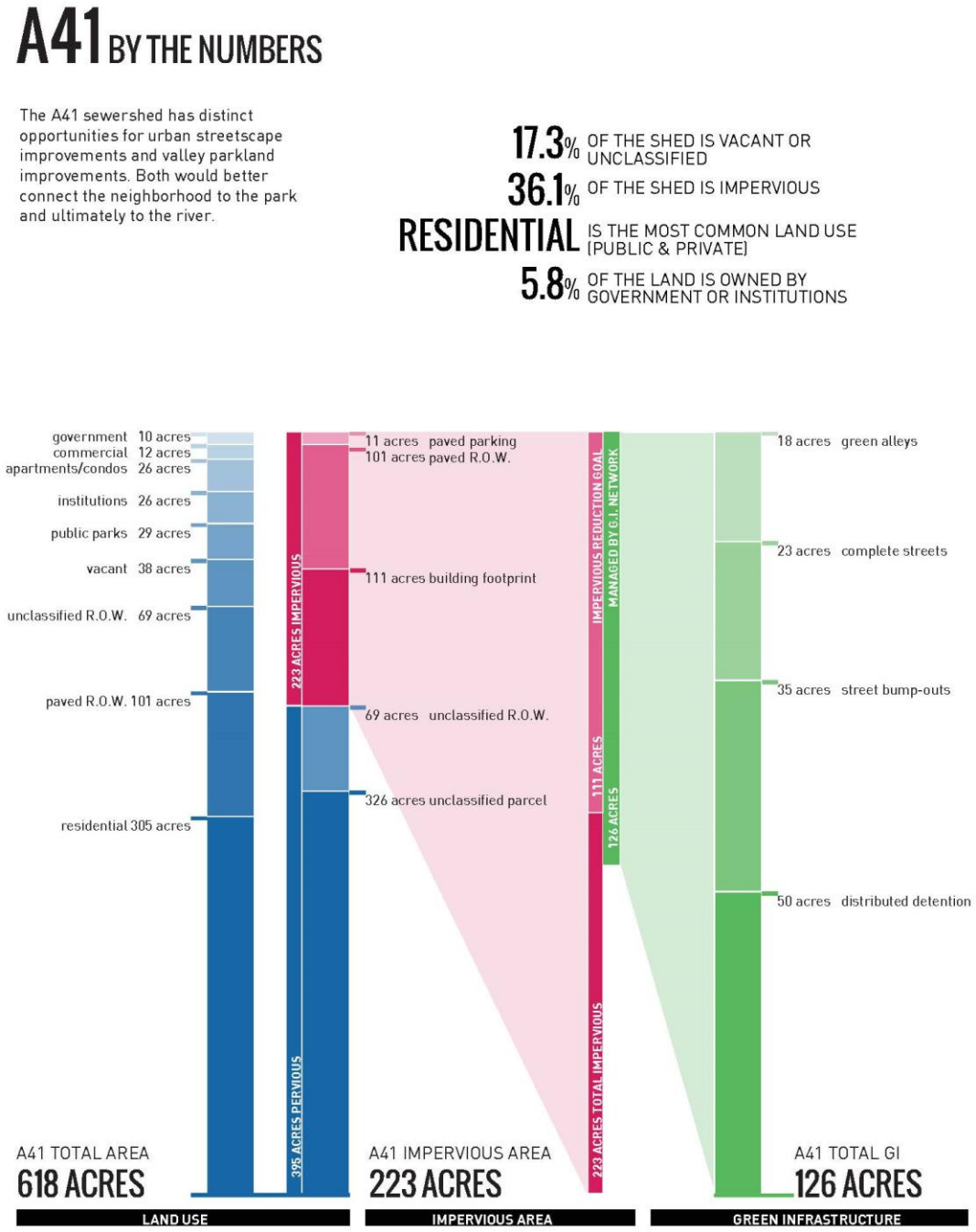
Network of GI Systems

“Watershed by the Numbers”

Impervious Area Managed by GI

Green Alleys	**18 AC**
Complete Streets	**23 AC**
Street Improvements	**35 AC**
Distributed Detention	**50 AC**
Total Impervious Managed	**126 AC**



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How does this look in a more complicated shed?

M19 Soho Run

NETWORK W/ TARGET AREAS

Stormwater modeling breaks down the larger sewershed into subsheds. These target areas provided by Hatch Mott Macdonald contribute the highest volume of water to the M19 sewershed. Removing 100% of the water from the pervious surfaces in these target sheds will prevent combined sewer overflows for rainfall events up to 1.5" over 24 hours.

TWO SUBSHEDS

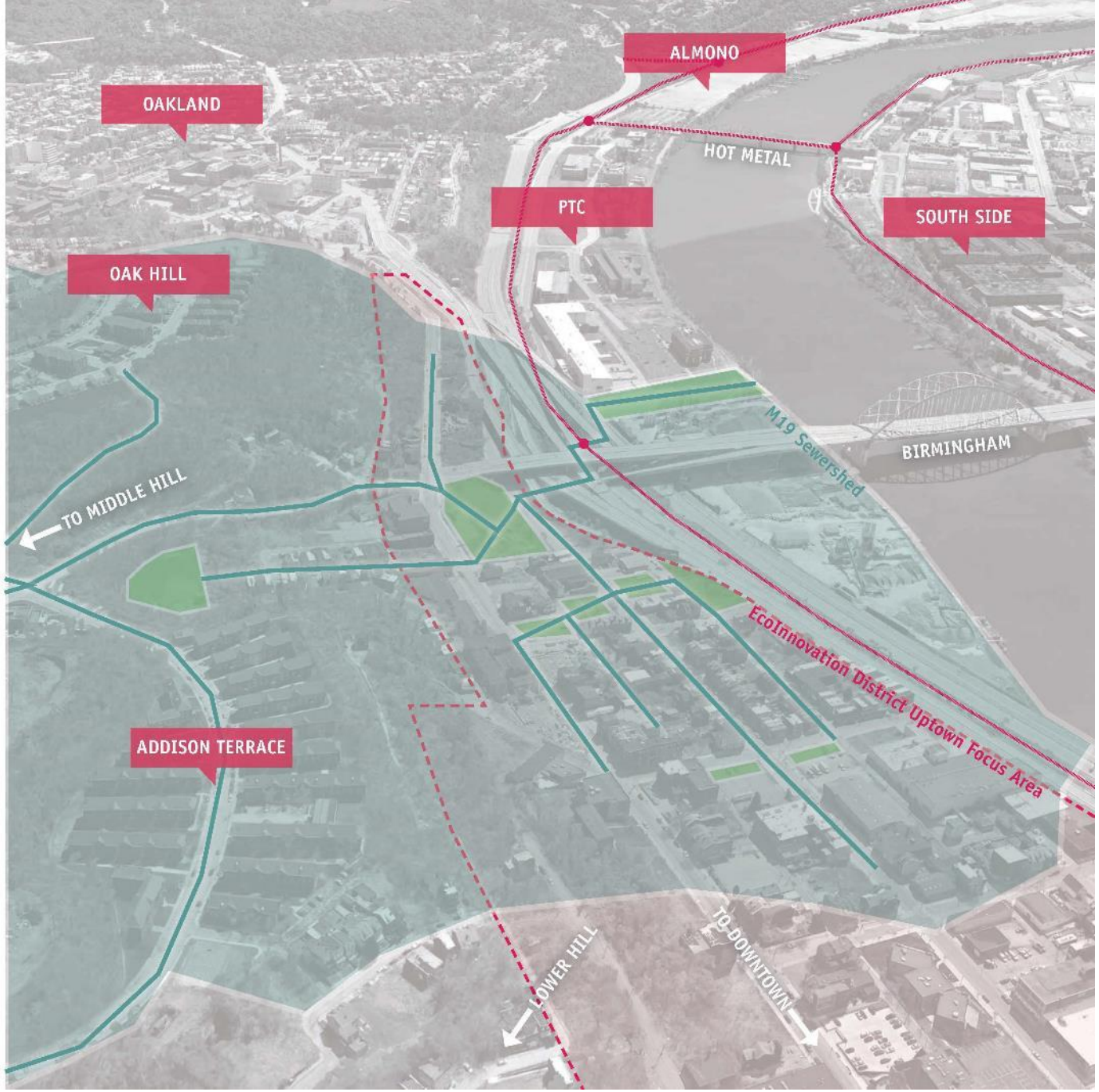
The hill leveling efforts that lead to the "Virtual Lake" functionally divided the Soho Run sewershed into two distinct subsheds: the Middle-Upper Hill District and Uptown.

Runoff Parcels
Detention Sites + Conveyance Network
Target Areas + Inlets

M19
SOHO RUN

PGH2O

UPTOWN URBAN CONTEXT



M19
SOHO RUN

PGH2O

OPPORTUNITIES IN UPTOWN

Bands of midblock greenspaces could provide tiered detention basins through Uptown while providing improved midblock connectivity. In addition to acting as a distributed detention network for stormwater, distributed parkland makes the neighborhood more walkable in support of higher density development in Uptown.

Green alleys could provide stormwater conveyance to the stormwater detention parks. In addition they serve as an offstreet route for cyclists and pedestrians.

Conversion of Brady Street to a stormwater conveyance park would allow stormwater to slowly make its way down to the Monogahela. The space under the nine bridges and on ramps carrying thirteen E-W lanes and six N-S lanes of traffic would be a dramatic public space providing access to the E-W Jail Trail Bikeway and would connect Uptown cyclists to the Pittsburgh Technology Center and Almono sites.

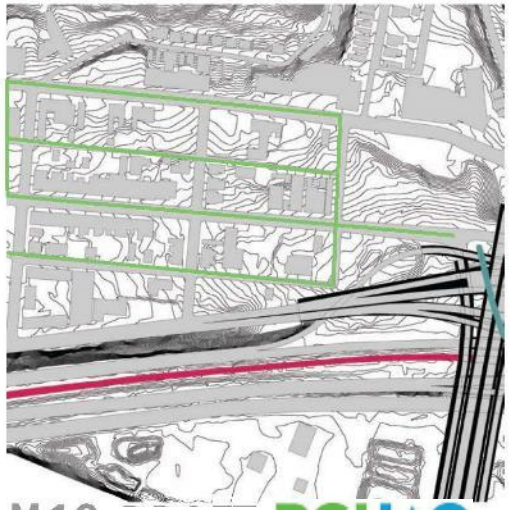
Detention Sites

Conveyance Network + Bike Routes

PGH2O

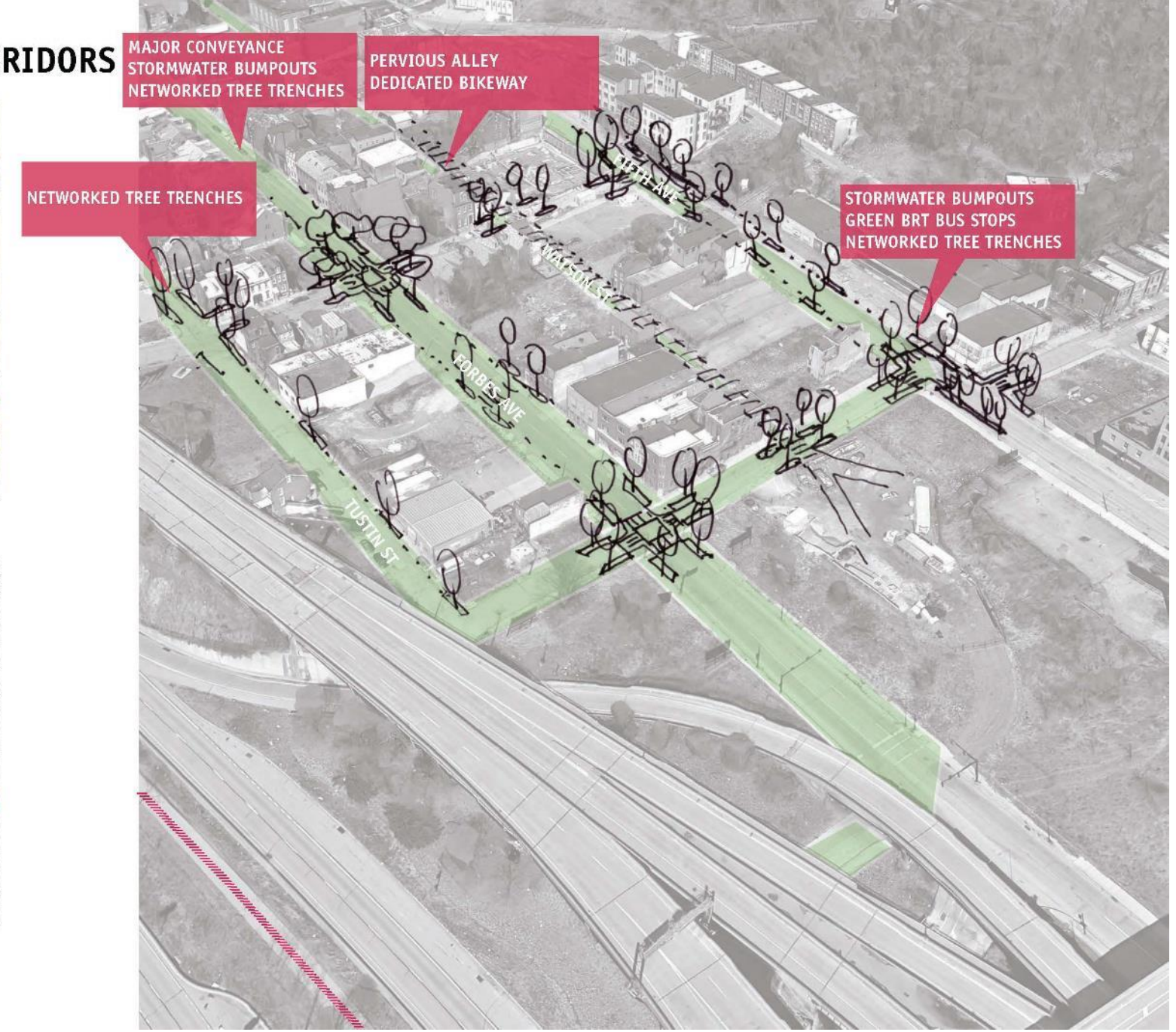
GREEN CONVEYANCE CORRIDORS

Street side rain garden in State College, PA
Source: Borough of State College

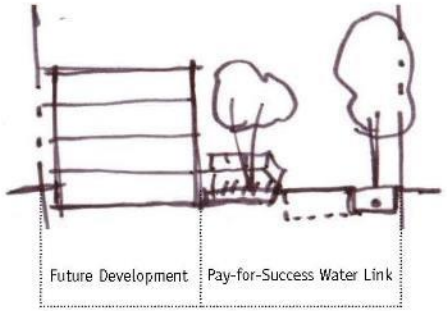


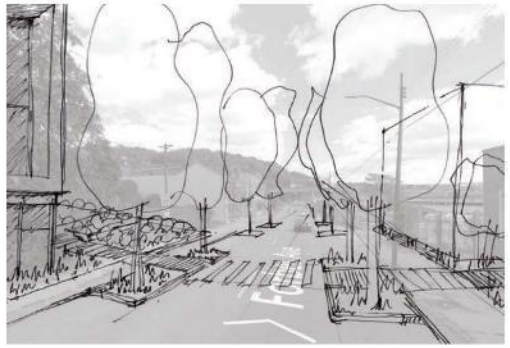
M19
SOHO RUN

PGH$_2$O

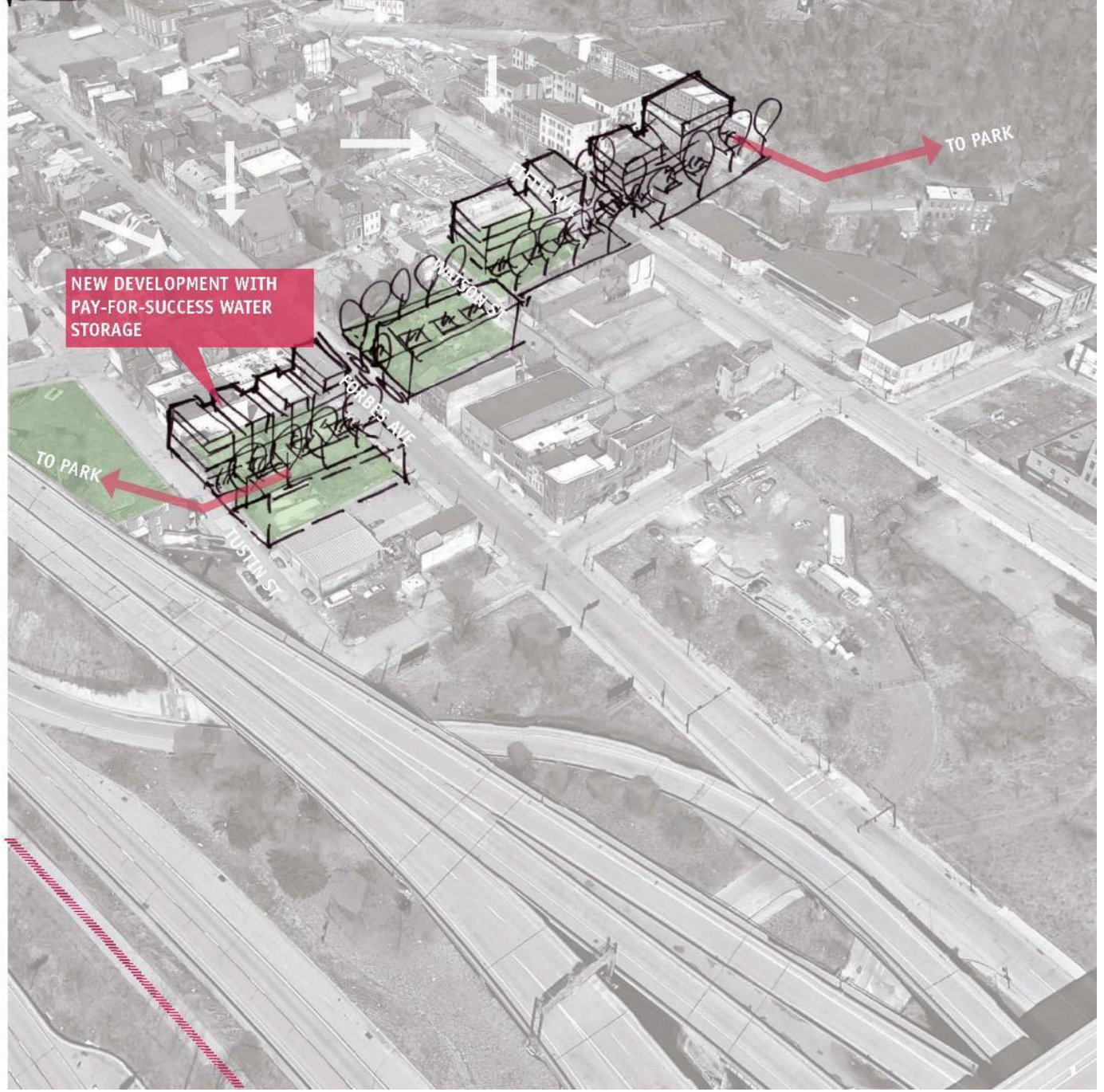


MID BLOCK WATER LINKS





Forbes Avenue Streetscape with networked conveyance and detention infrastructure.



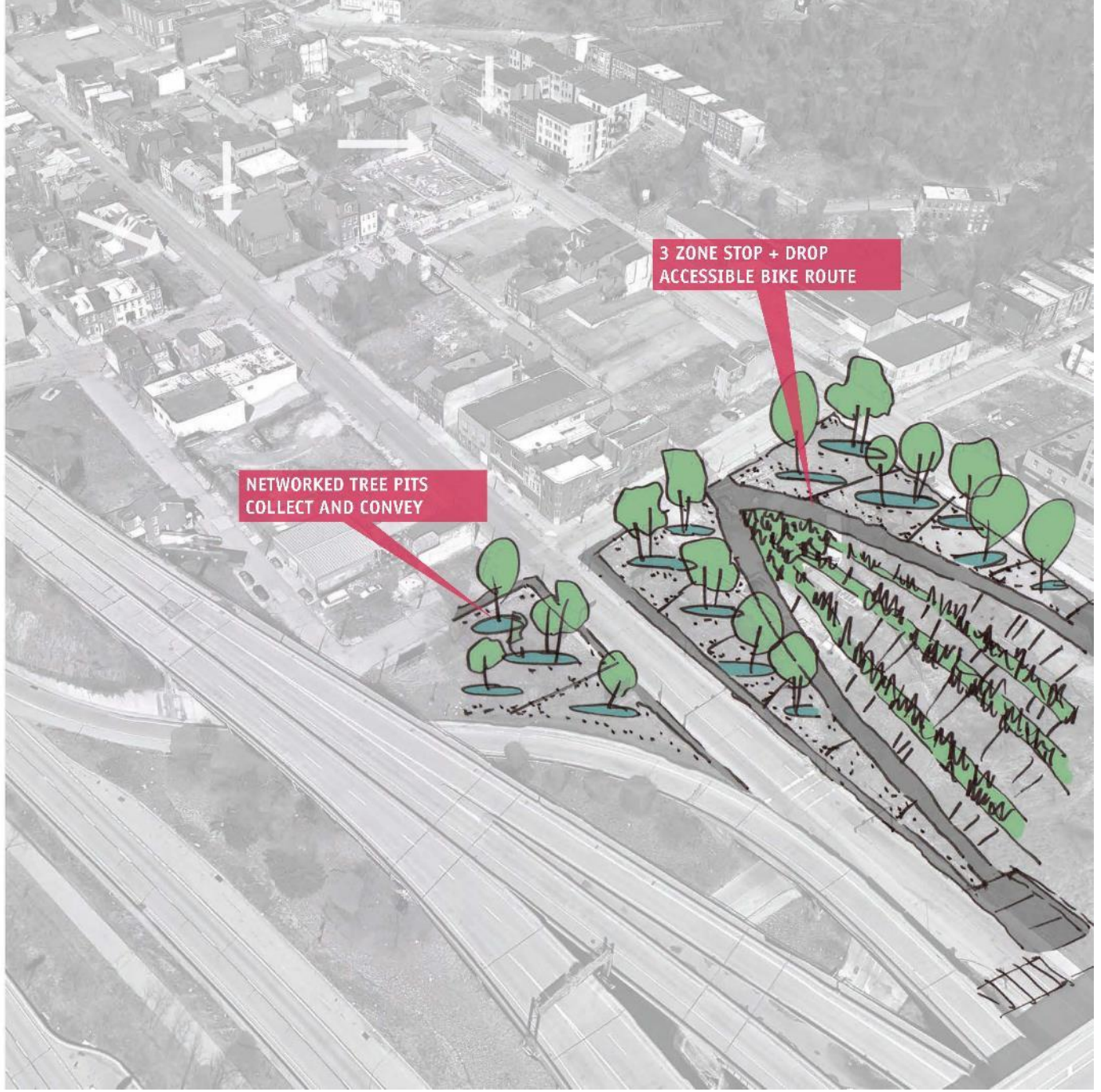
M19
SOHO RUN

PGH2O

UPTOWN PORTAL PARK

M19
SOHO RUN

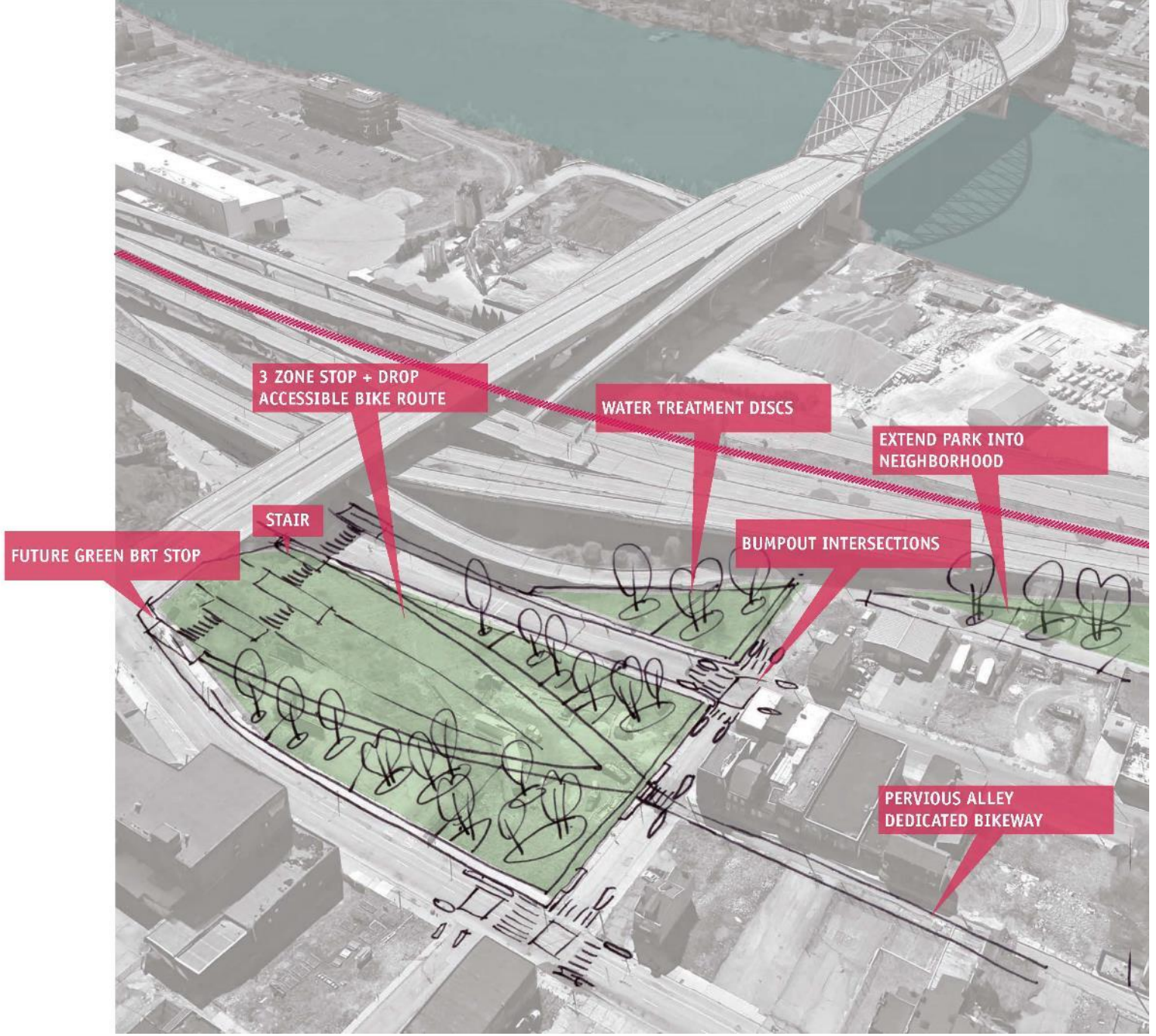
PGH$_2$O



UPTOWN PORTAL PARK

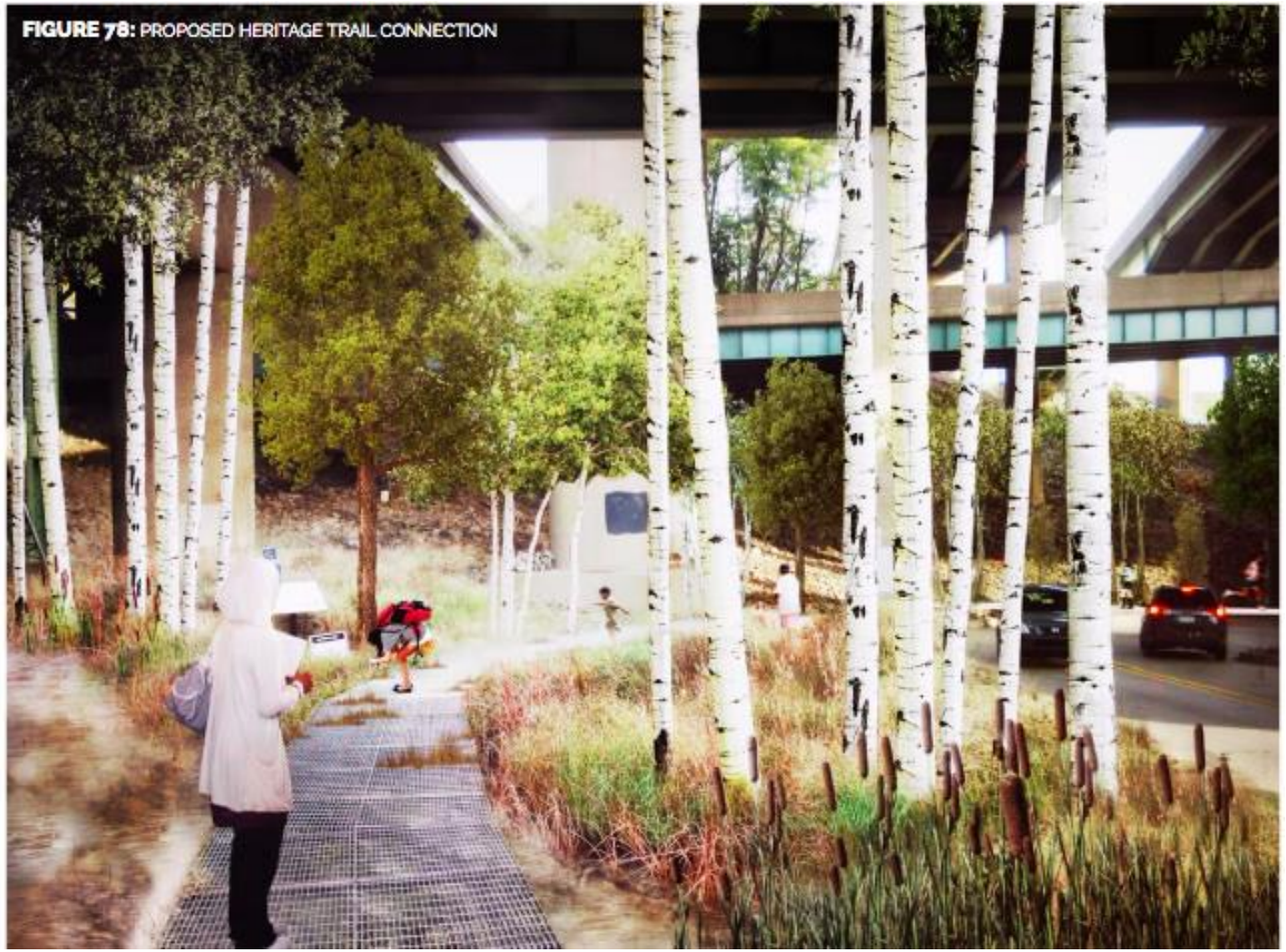
Seattle Olympic Sculpture Park
Source: deasy/penner & partners

M19
SOHO RUN



How do we integrate it into other planning processes?

M19 Soho Run



INTEGRATED INTO PLANNING

EcoInnovation District

INTEGRATED INTO PLANNING

Centre Avenue Plan

The Green First Plan
IN ACTION