Cities, Water, and Green-Gray Resiliency Planning

Examples of Urban Waterway Restoration and Redevelopment in North America

Simposio de Cuencas Hidrográficas de PR 2022

March 10, 2022

LimnoTech

Water Environment | Scientists Engineers

Overview

Introduction

Green to Gray Approaches

Designing from risk to opportunity

Project Examples

Toronto, ON: The Lower Don Lands

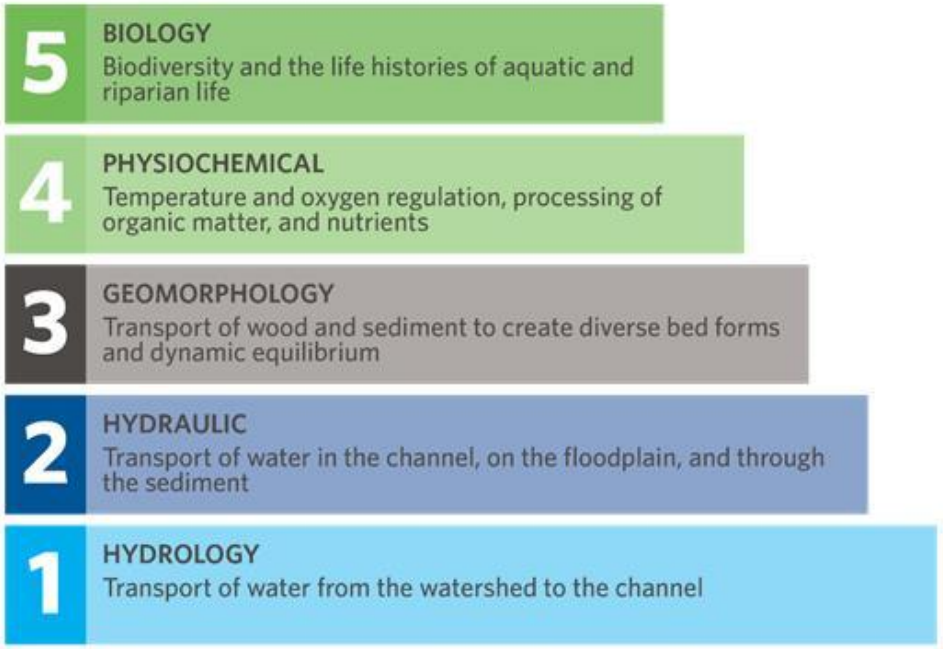
Austin, TX: Waller Creek

Dallas, TX: Trinity River

Site design and Green-gray Integration

Engineering with Nature

1. **Getting from risks to opportunities**
2. **Understanding the site context**
   - Scale: watershed to river to coastline
   - The stack of natural functions
   - Communities
3. **Actioning**
   - Identifying projects and involving people
   - Getting to construction



Waterfront / waterway restoration projects underway

- The Lower Don Lands in Toronto (2008-present)
- The Tulsa Gathering Place (2011-2017)
- Austin Waller Creek (2012-present)
- Dallas Trinity River (2015-present)
- Jefferson National Expansion Memorial (2010-2015)
- Houston Buffalo Bayou (2017)
- Detroit Riverfront: Ralph C Wilson Jr Centennial Park (2018 -present)
- Buffalo Waterfront: Ralph C Wilson Jr Centennial Park (2019 - present)

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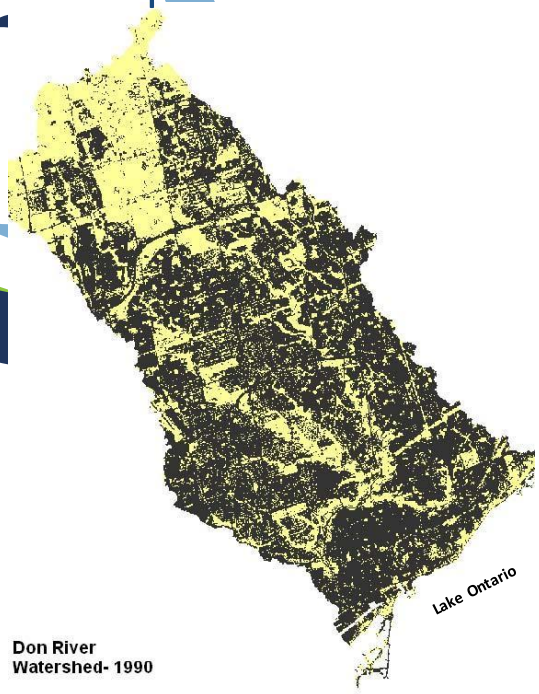
Toronto Lower Don Lands

The Toronto Lower Don Lands project combined:

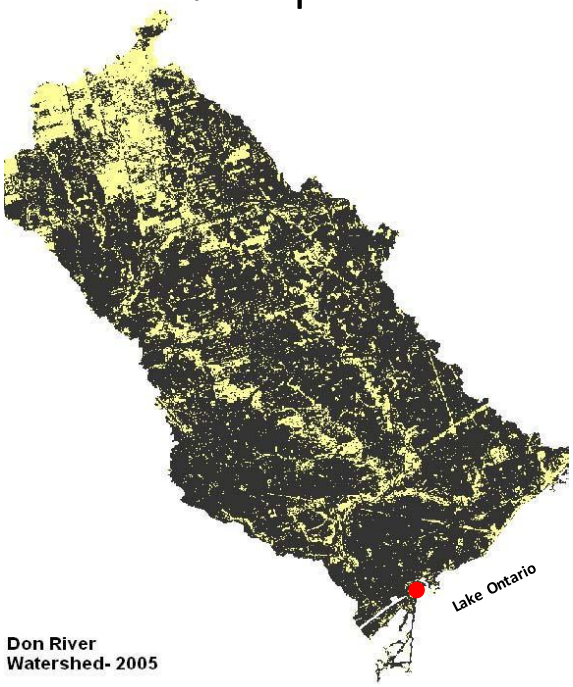
- Design of a new mouth for the Don River,
- Design of engineered control structures,
- Detailed hydraulic and hydrodynamic flood modeling,
- Ecological design of riverine wetlands and resiliency margins
- Permitting, and
- Urban design/ landscape architecture for a new district of the City of Toronto.

Don River Watershed: Changing Land Use with Time

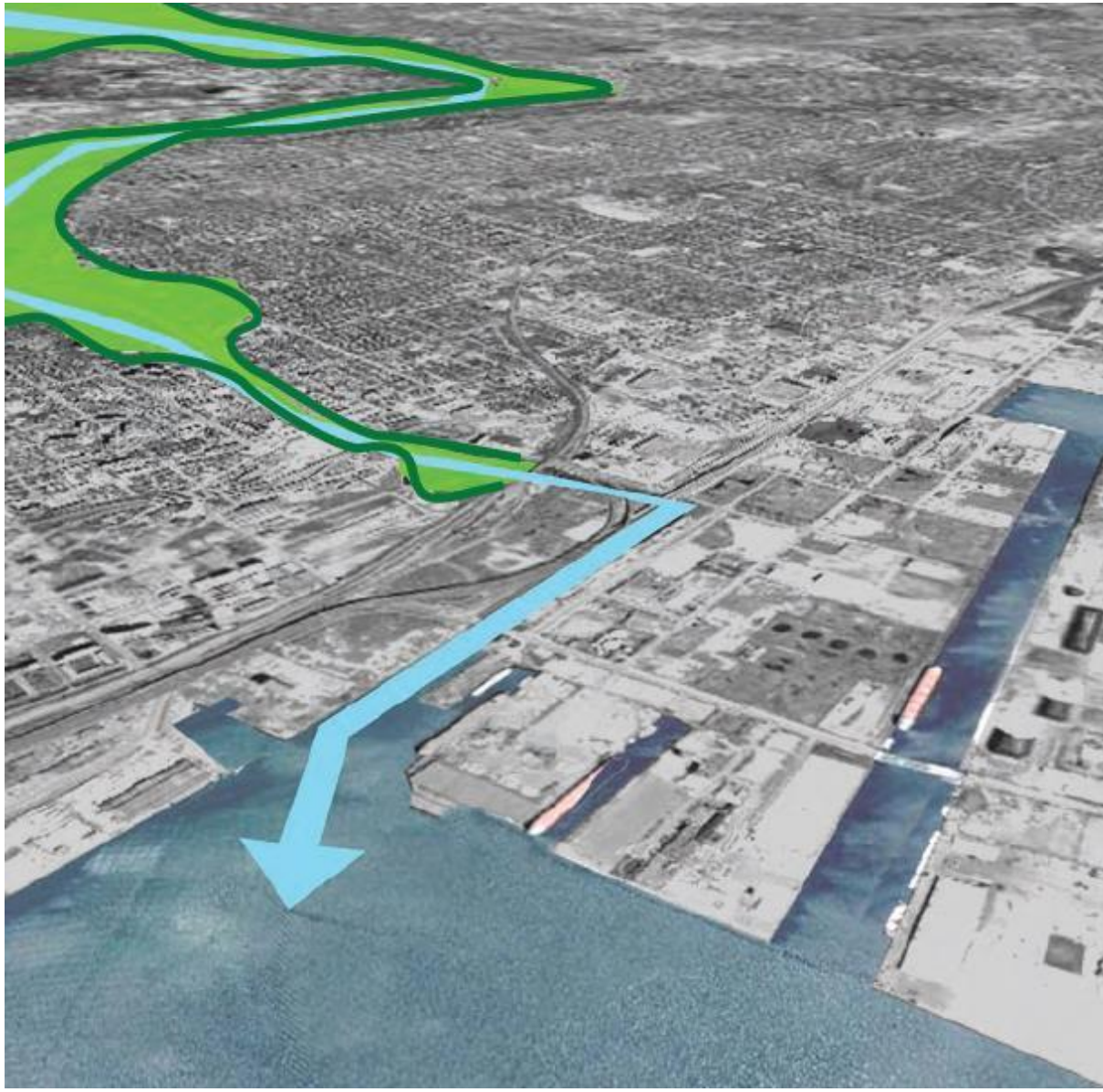
1990 – 70% Impervious

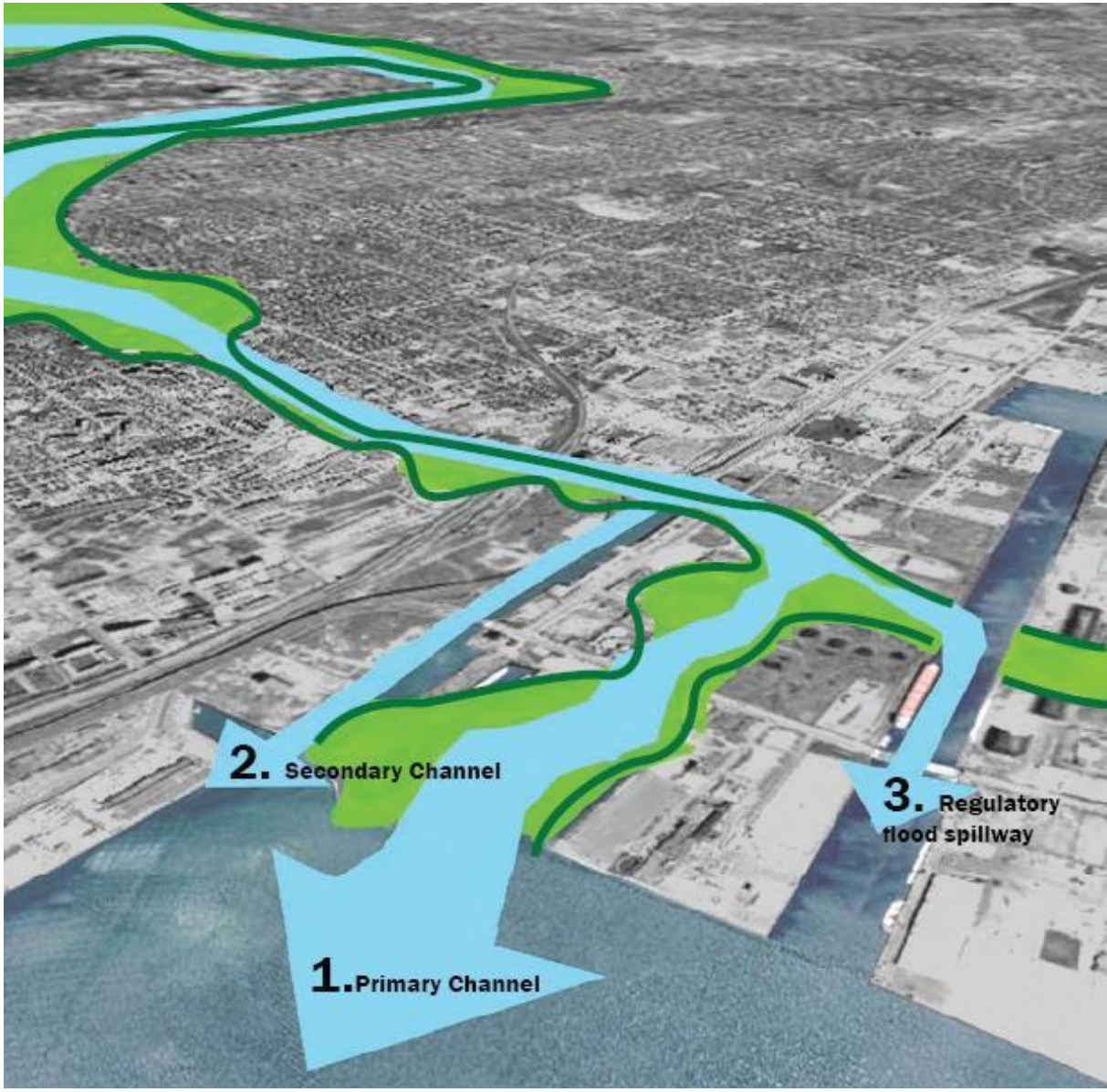


2005 – 84% Impervious

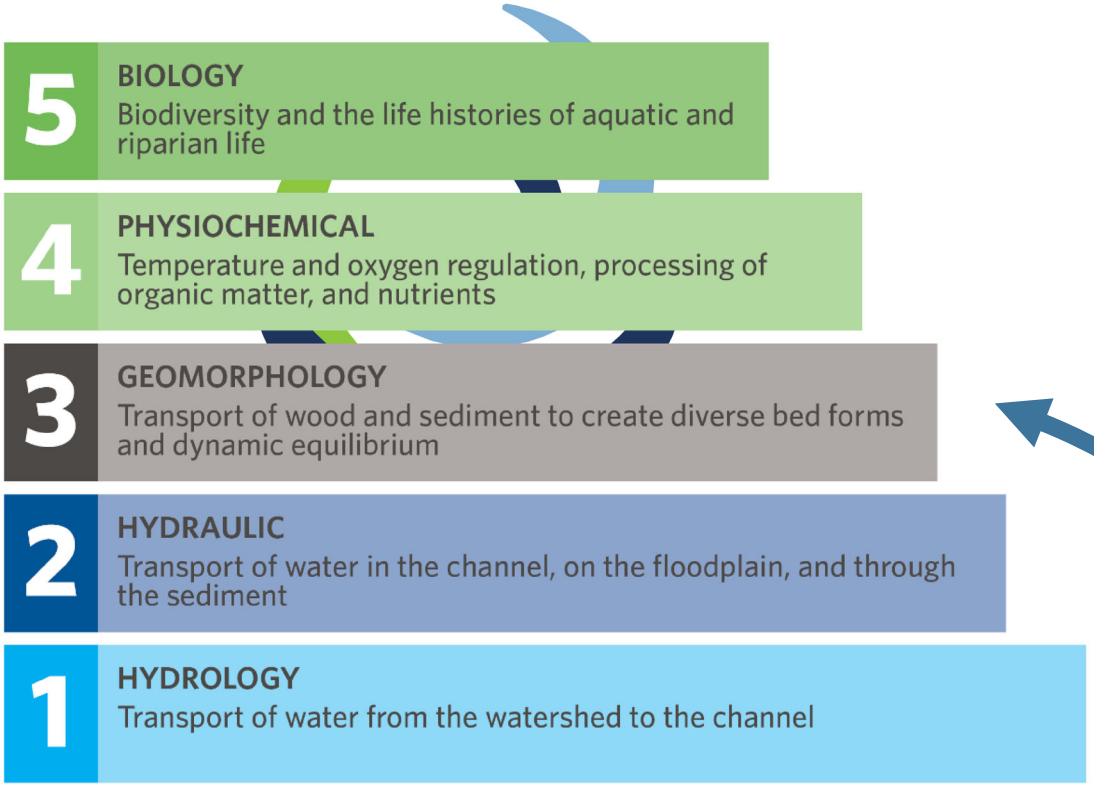


From Amirsalari, 2007, Masters Thesis University of Waterloo, Dept. of Geography

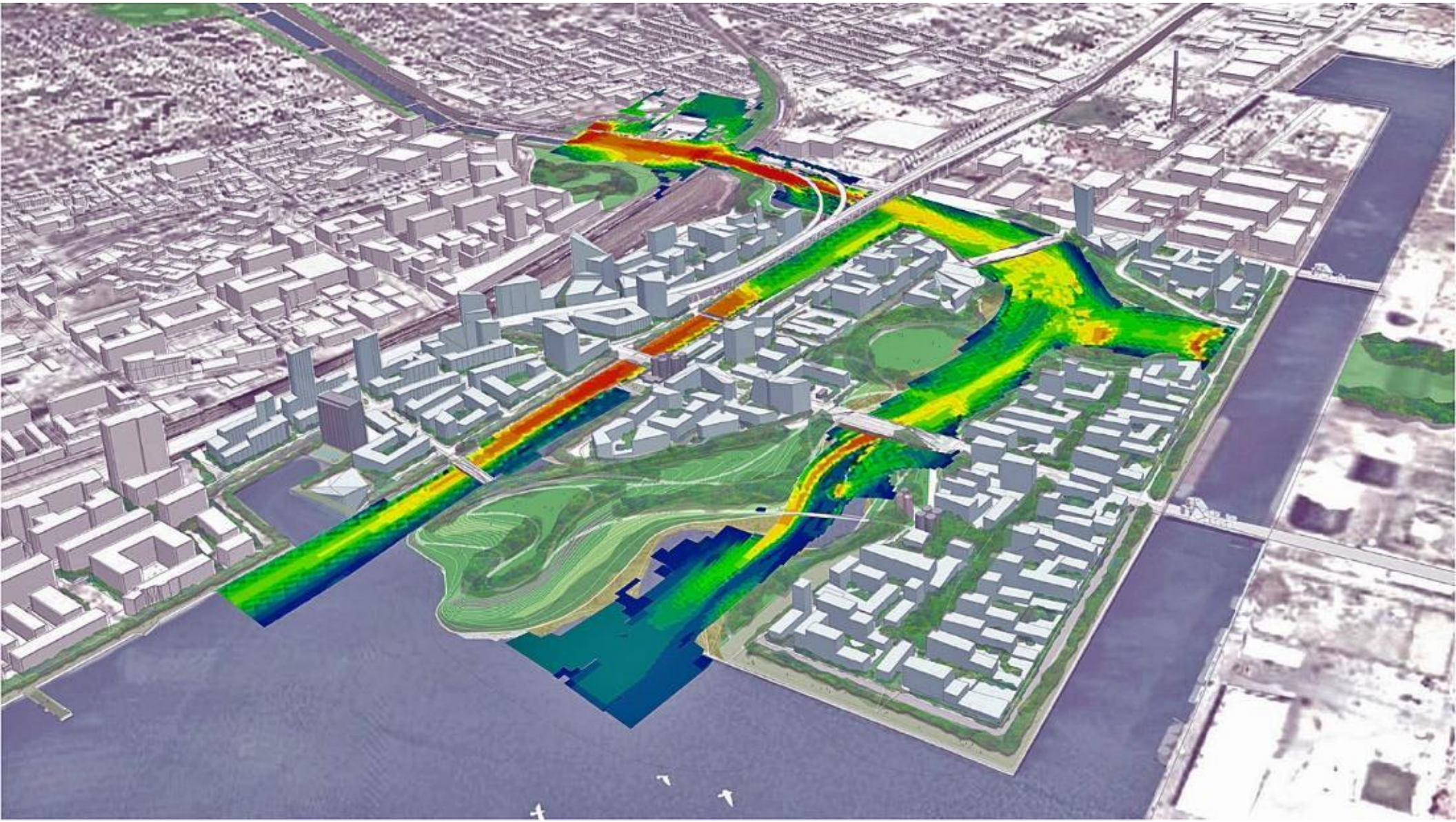


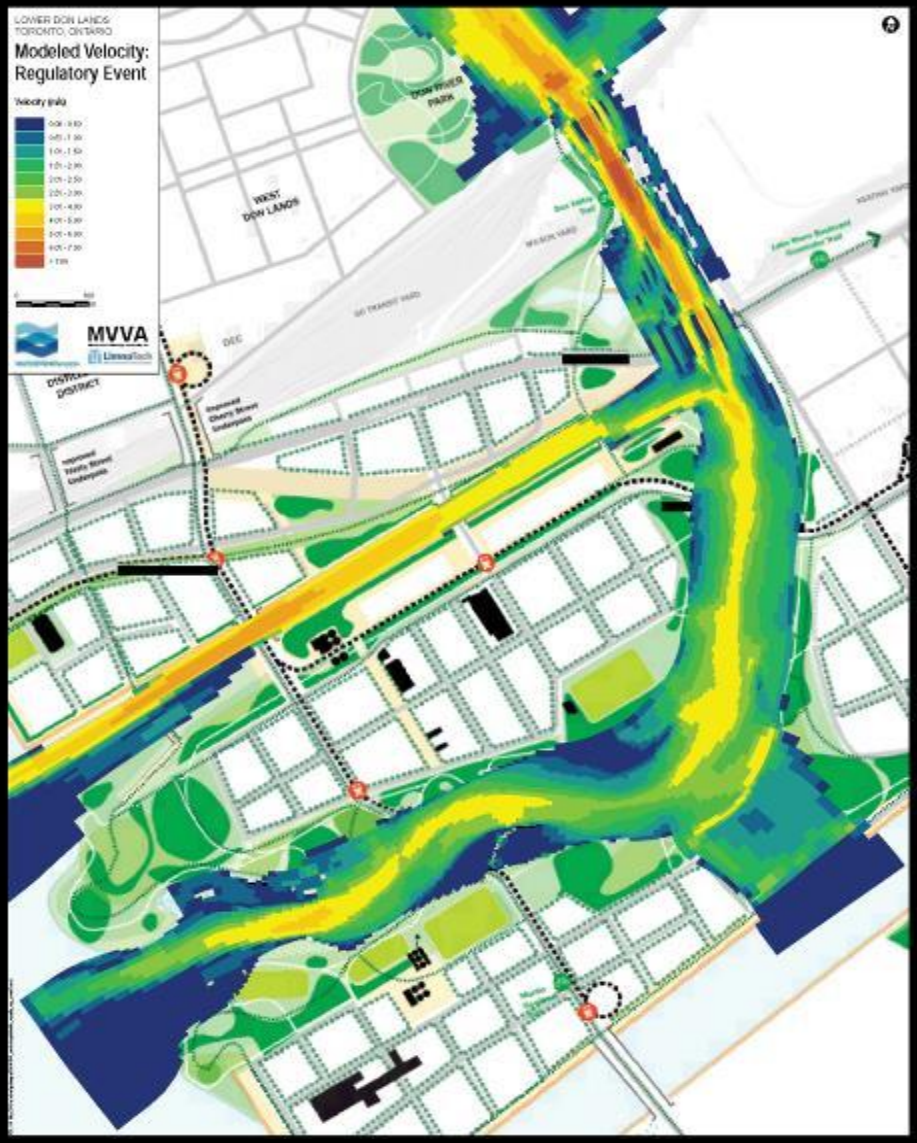

2. Secondary Channel
3. Regulatory flood spillway
1. Primary Channel

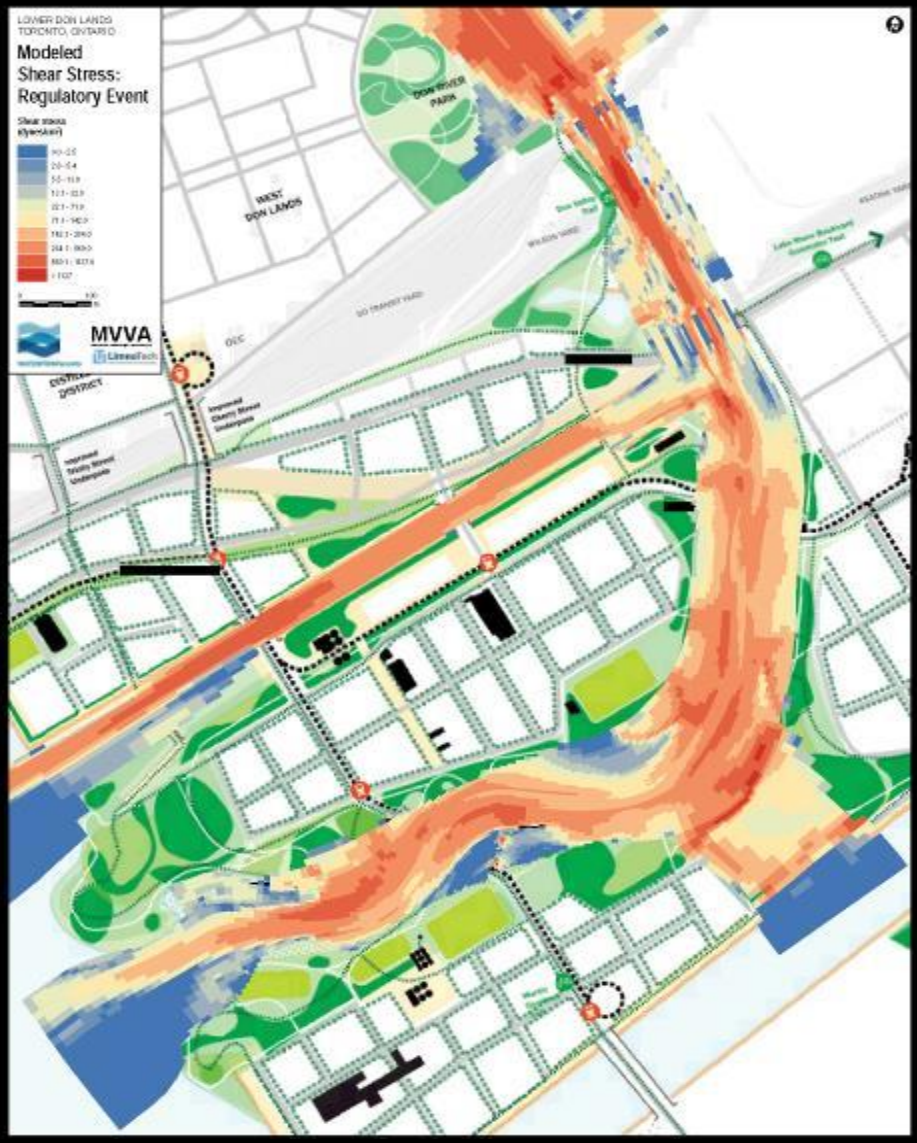
Effects of Modified Hydrology



Urbanized hydrology requires a step adaptation in geomorphology that manages the hydraulics of flooding




LOWER DON LANDS
TORONTO, ONTARIO
Modeled Velocity:
Regulatory Event
Velocity (m/s)
MVVA
DOWNTOWN
DISTRICT
DON RIVER
PARK
WEST
DON LANDS
GO TRANSIT YARD
Lake Shore Boulevard
Underpass Trail
Improved
Cherry Street
Underpass
Improved
Trinity Street
Underpass


LOWER DON LANDS
TORONTO, ONTARIO
Modeled
Shear Stress:
Regulatory Event
Shear stress
(dynes/cm²)
MVVA
DOWNTOWN
DISTRICT
DON RIVER
PARK
WEST
DON LANDS
GO TRANSIT YARD
Lake Shore Boulevard
Underpass Trail
Improved
Cherry Street
Underpass
Improved
Trinity Street
Underpass


Michael Van Valkenburgh Associates 2012

Austin Waller Creek

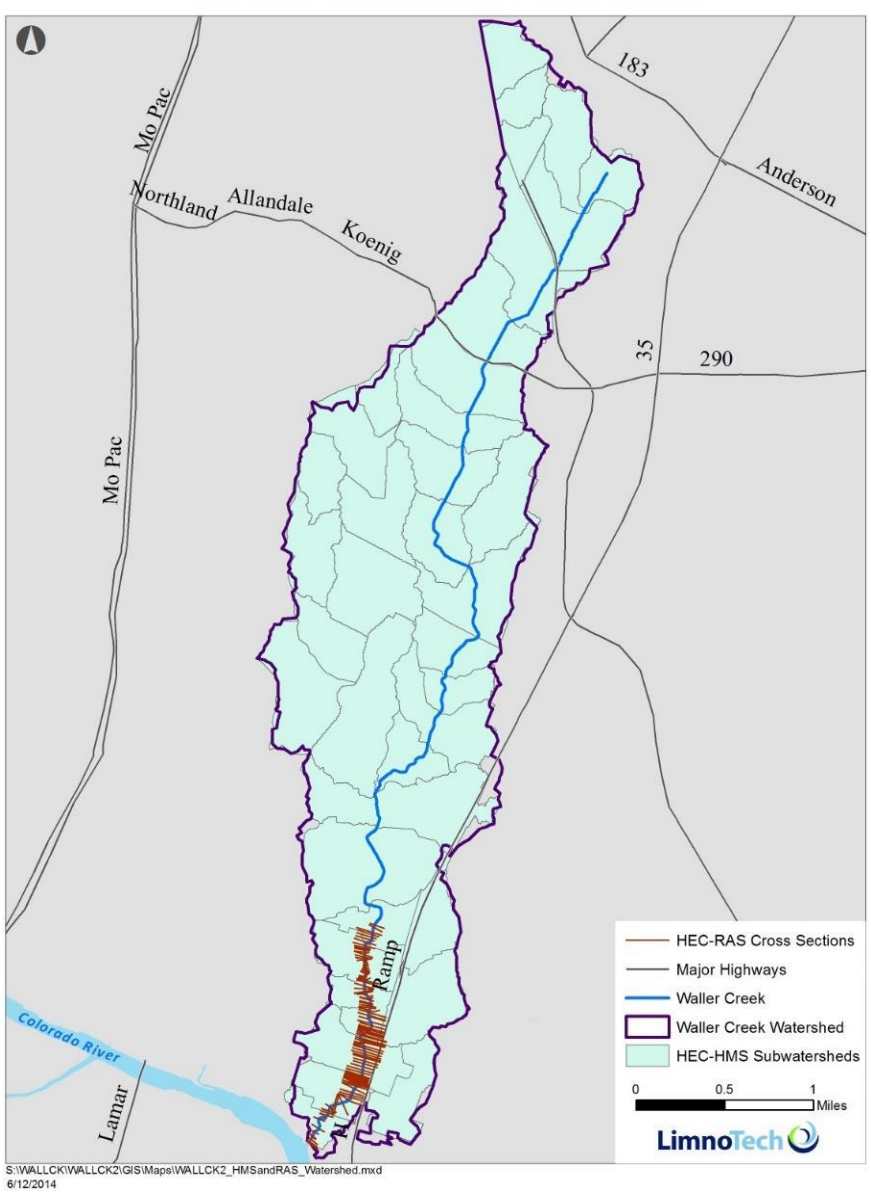
The Waller Creek project is underway and combines:

- Hydrologic and hydraulic modeling
- Channel geomorphic evaluation and channel design for modified hydrology
- Stormwater outfall modification and improvement
- Ecological design for radically altered hydrology

Waller Creek Watershed

Heavily urbanized watershed

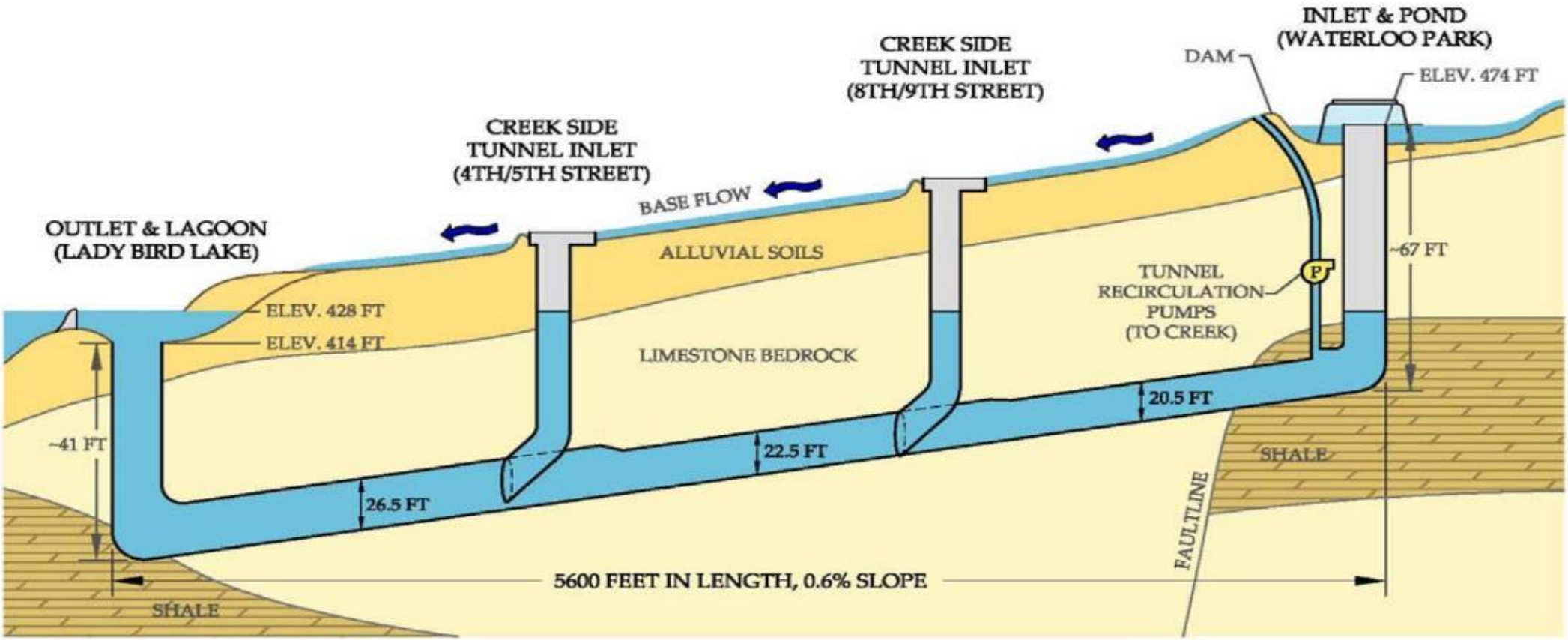
Extreme flooding and erosion in the lower reaches



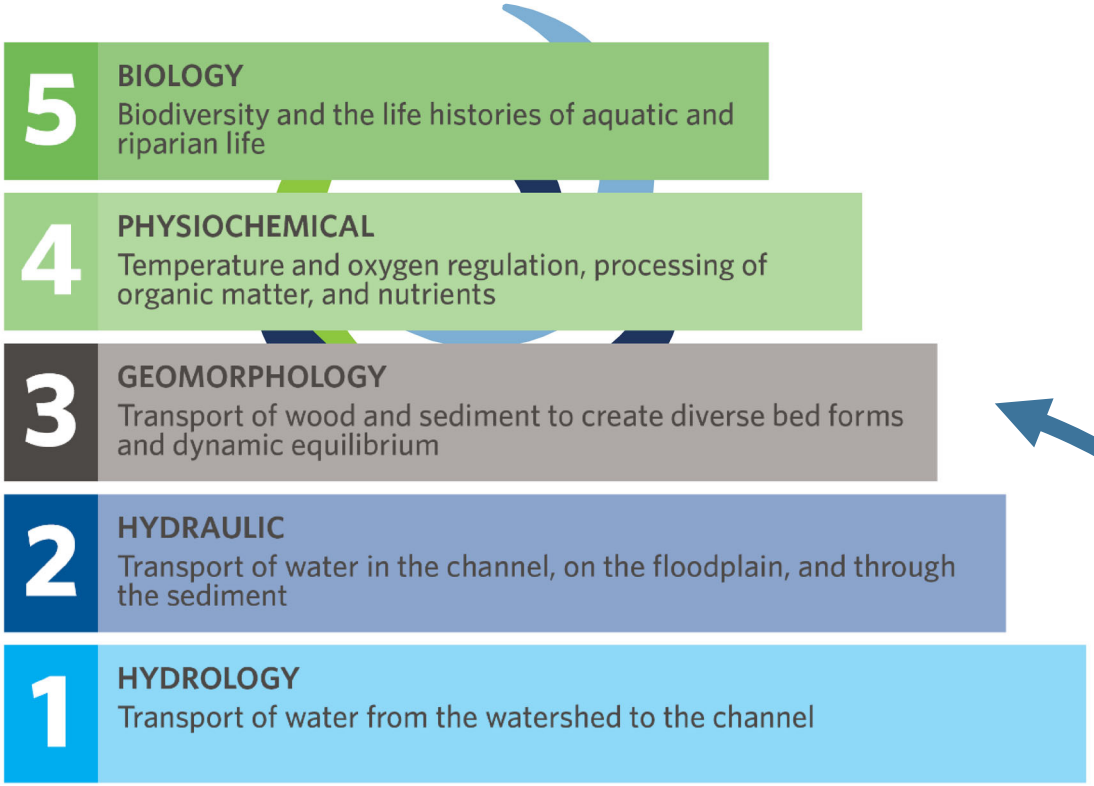



Austin, TX - Waller Creek

Michael Van Valkenburgh Associates 2012

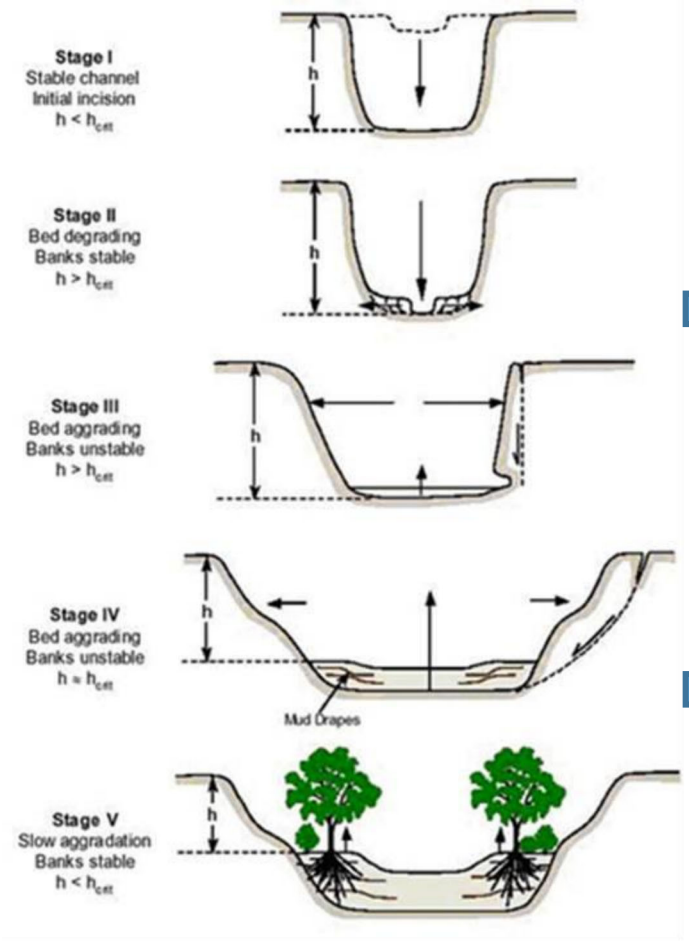

INLET & POND
(WATERLOO PARK)
DAM
ELEV. 474 FT
CREEK SIDE
TUNNEL INLET
(8TH/9TH STREET)
CREEK SIDE
TUNNEL INLET
(4TH/5TH STREET)
BASE FLOW
OUTLET & LAGOON
(LADY BIRD LAKE)
ALLUVIAL SOILS
~67 FT
TUNNEL
RECIRCULATION
PUMPS
(TO CREEK)
P
ELEV. 428 FT
ELEV. 414 FT
LIMESTONE BEDROCK
20.5 FT
~41 FT
22.5 FT
SHALE
26.5 FT
FAULTLINE
5600 FEET IN LENGTH, 0.6% SLOPE
SHALE

Effects of Modified Hydrology

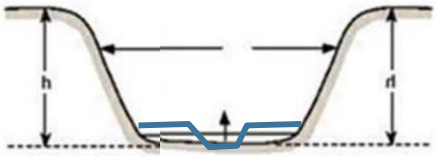


Radically altered hydrology requires a step adaptation in geomorphology

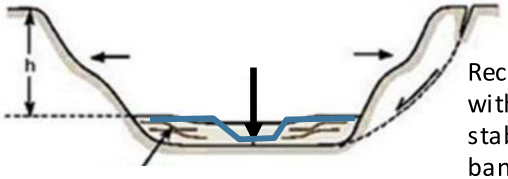
Adapted Channel Evolution



Tunnel construction -> hydrologic shift

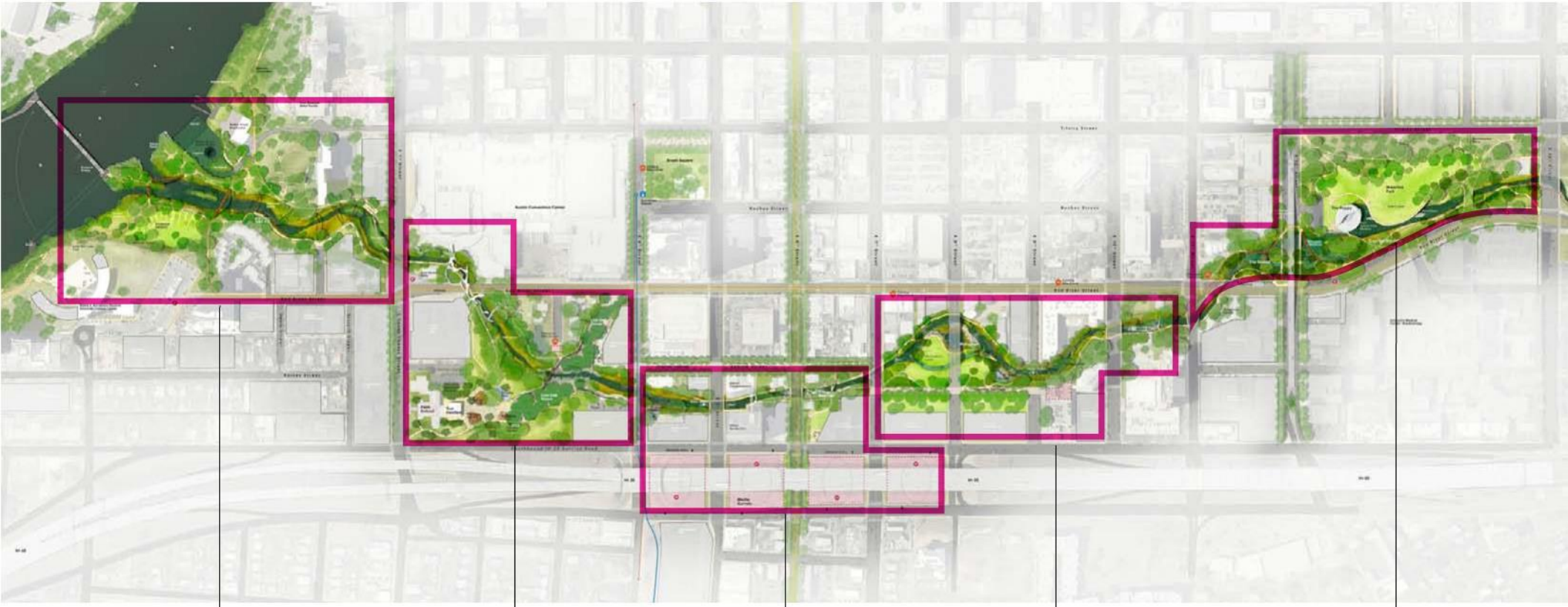


Reconfigured channel with stabilized/sloughed banks, bed modified for low flow range



Reconfigured channel with stabilized/sloughed banks, aggradation stops /reverses, bed adapts to low flow range


8TH ST BR
EXISTING GRADE
(SEVERE EROSION)
STABILIZED SLOPE
(PROPOSED)
CONSTRUCTED
SLUMP BLOCK
100 YR WSE
2 YR WSE
HYDROSCEEDED
SLOPE
LIMESTONE BLOCK
SEATING AT TOE OF SLOPE
SOIL LIFTS W/
BRUSH LAYERING
AND HYDROSEEDING
RECONSTRUCTED
BASEFLOW CHANNEL
COIR LOG
AT TOE
FLOODPLAIN
WETLAND BENCH



The Lattice
New Connectivity

The Grove
Shaded Respite

The Narrows
Intensified Urbanity

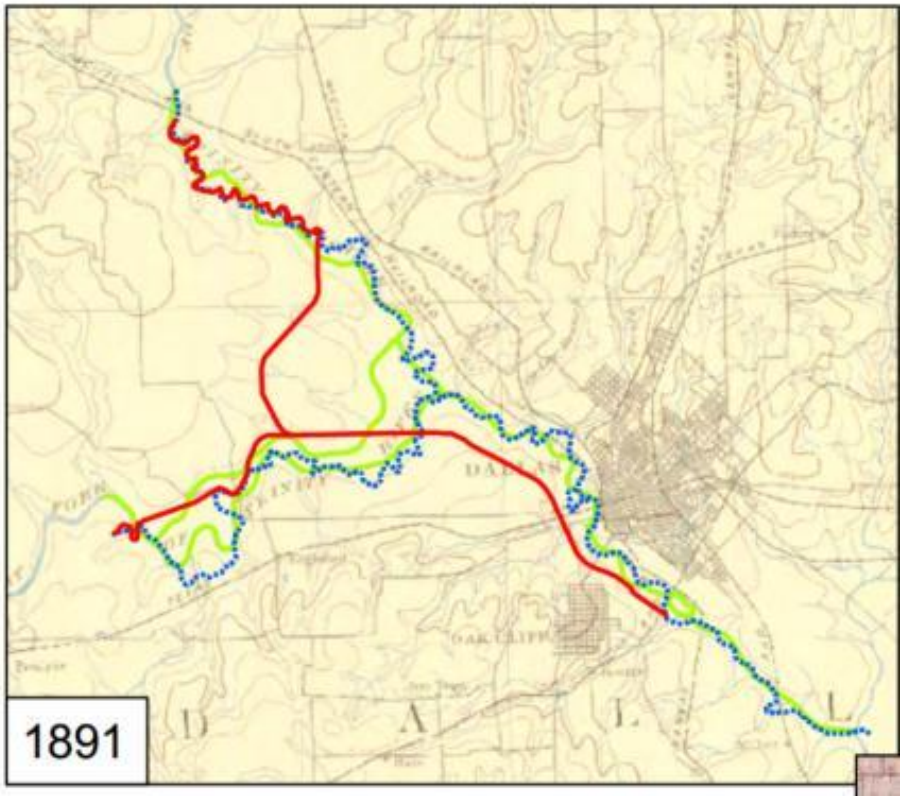
The Refuge
Immersive Experience

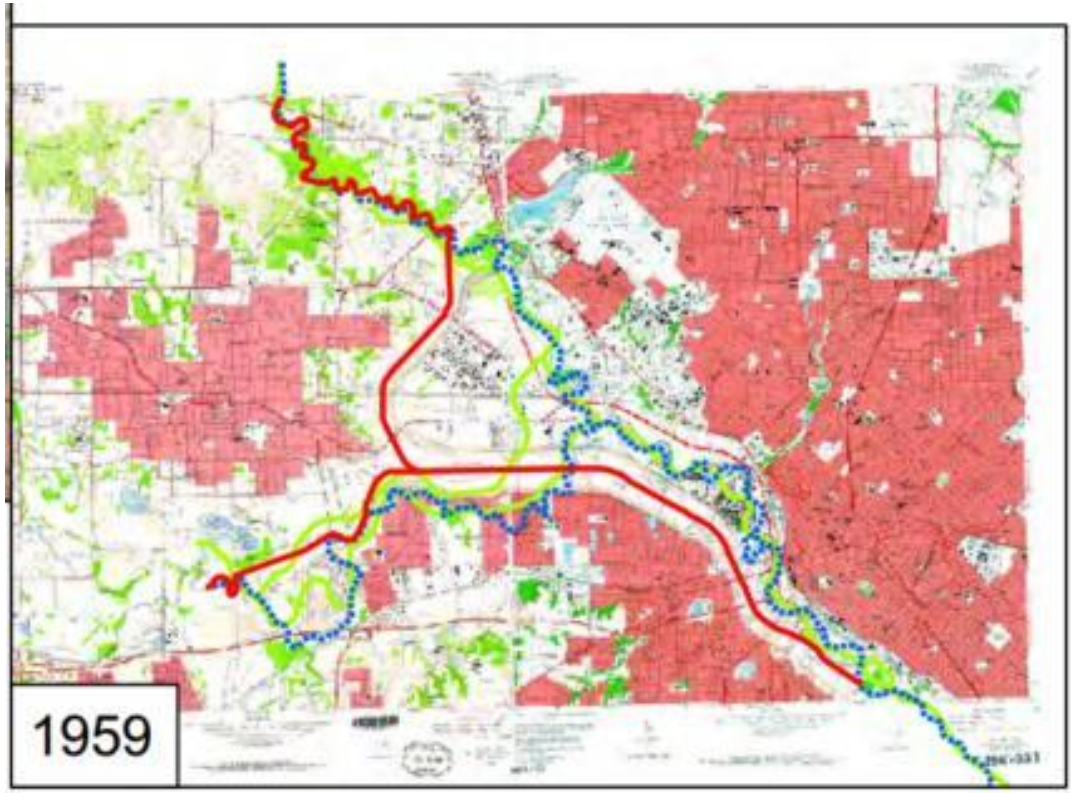
The Confluence
Vibrant Gathering Spaces

Dallas, TX Trinity River

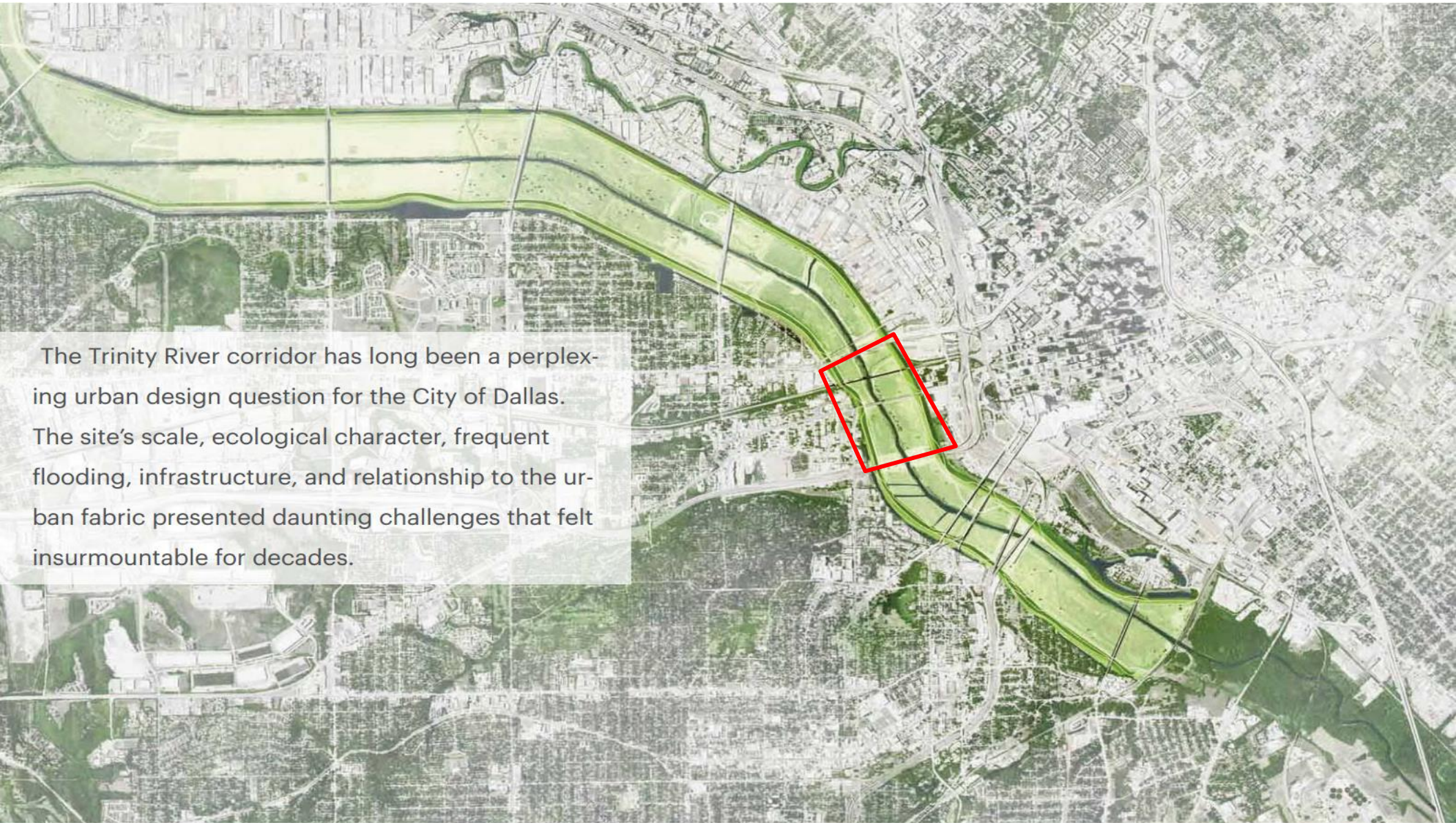
- Flood management
- Sediment management
- Corps permitting and levee management
- River Channel modification / stream geomorphology
- Ecological design of wetlands and river edge margins, grasslands
- Park and trail planning

Changes in historic channel configuration

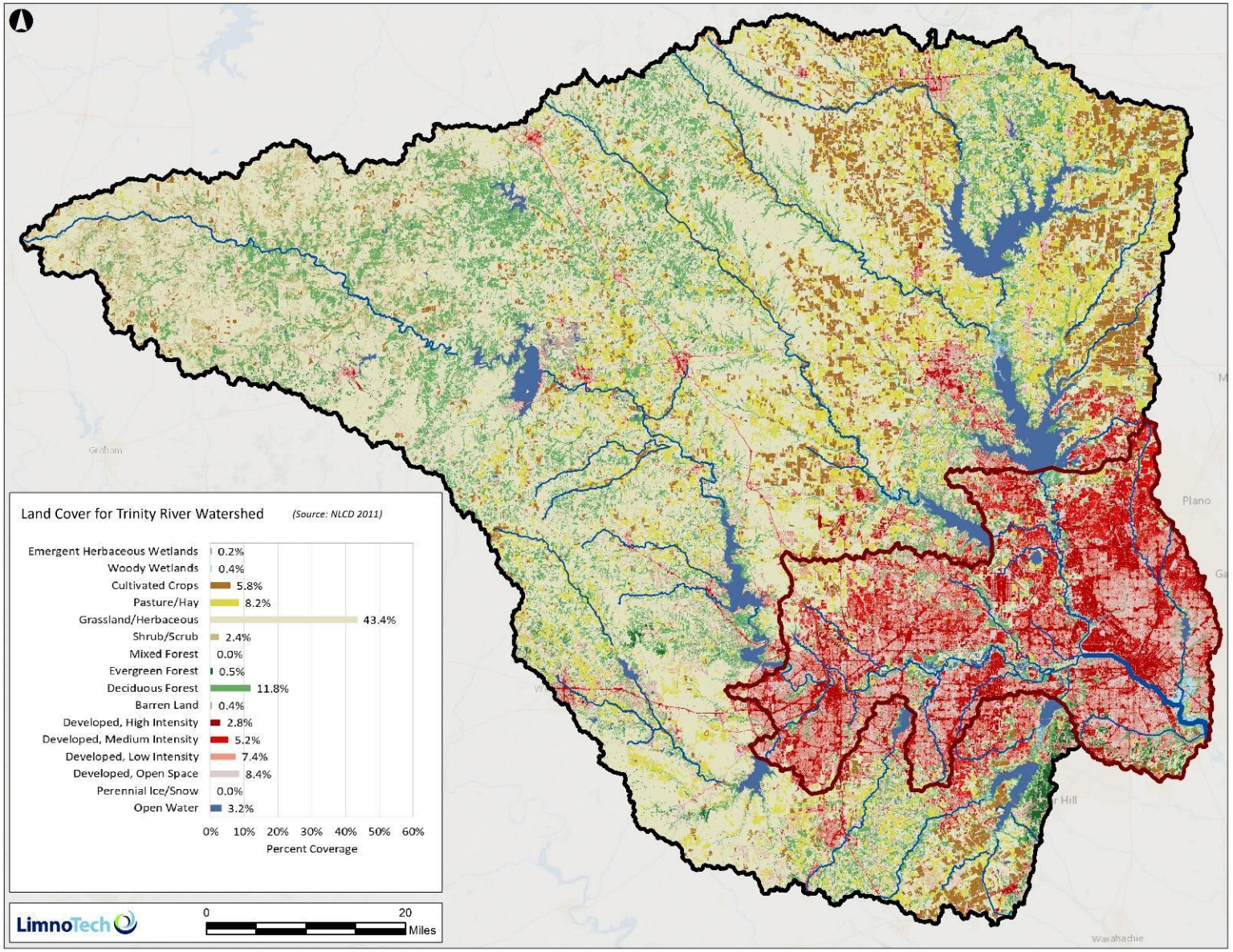




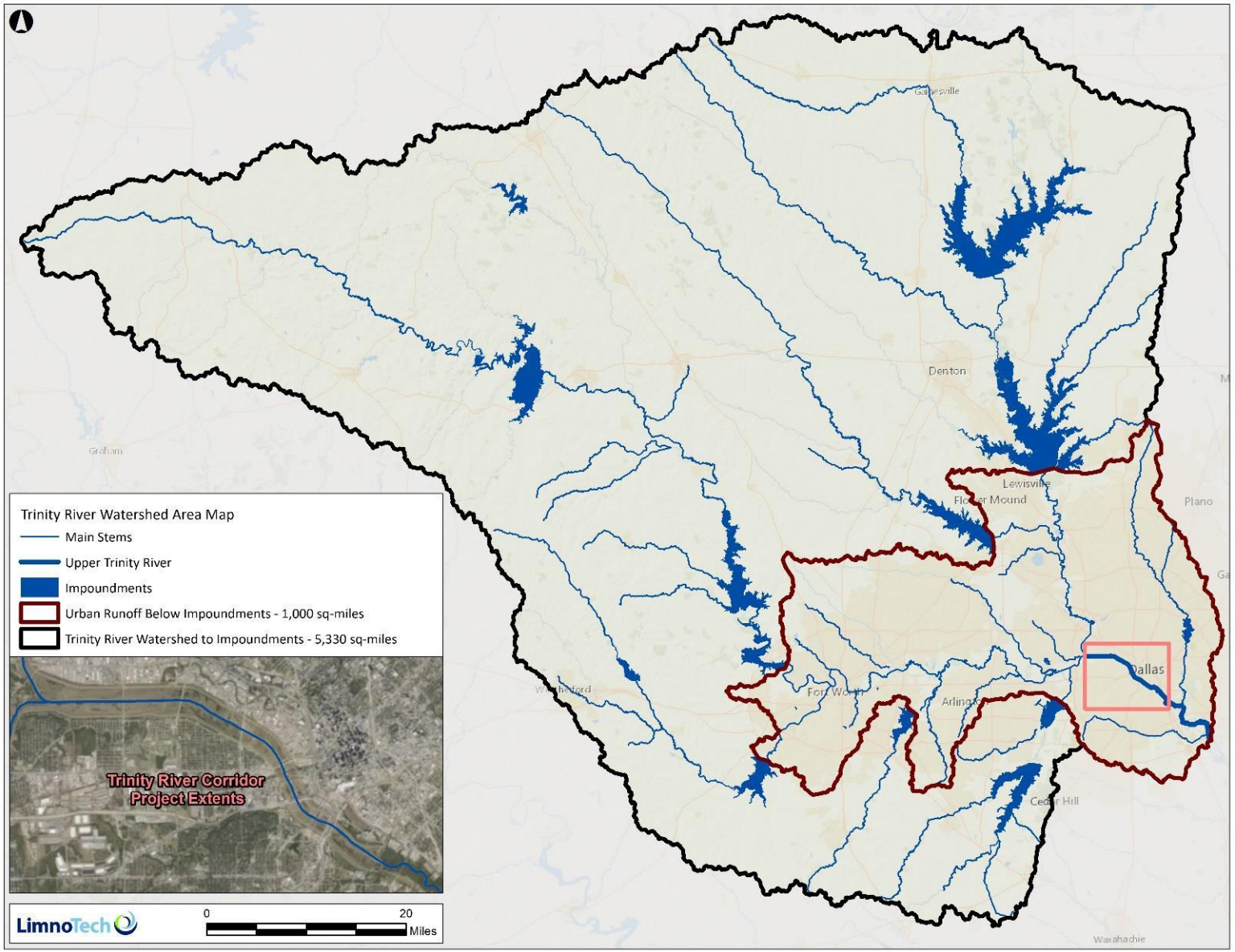
CH2M HILL, 2009. Fluvial Geomorphic Assessment and Basis of Design for River Realignment.



The Trinity River corridor has long been a perplexing urban design question for the City of Dallas. The site's scale, ecological character, frequent flooding, infrastructure, and relationship to the urban fabric presented daunting challenges that felt insurmountable for decades.

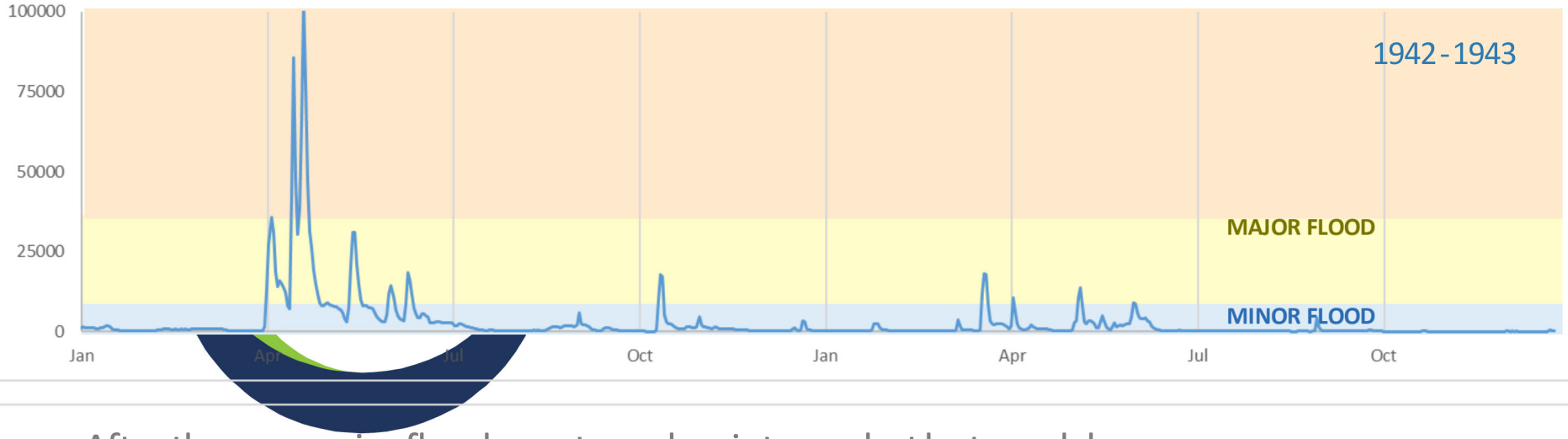


The watershed is split: grassland and forest upstream of the reservoirs, and urbanized downstream.

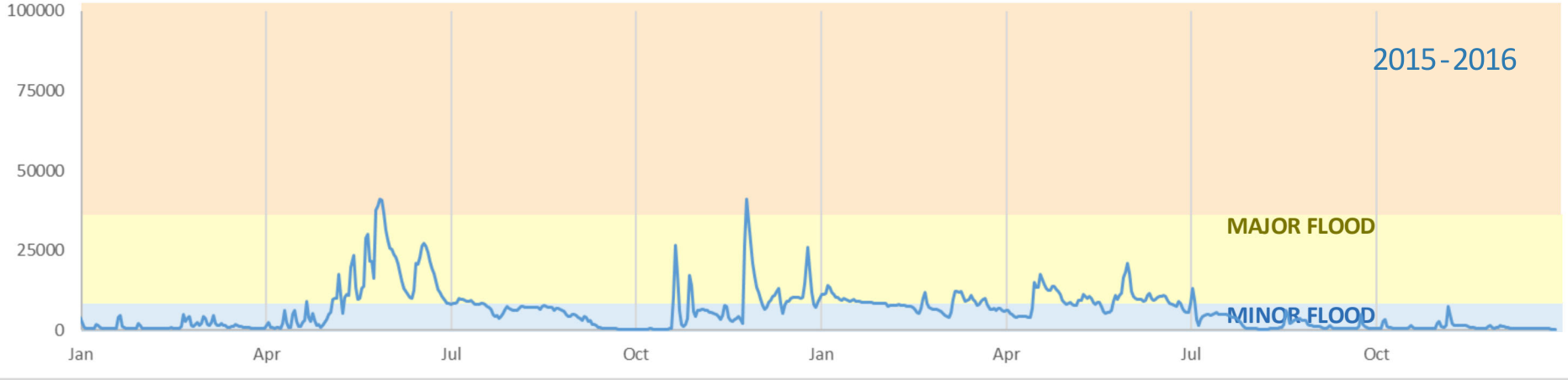


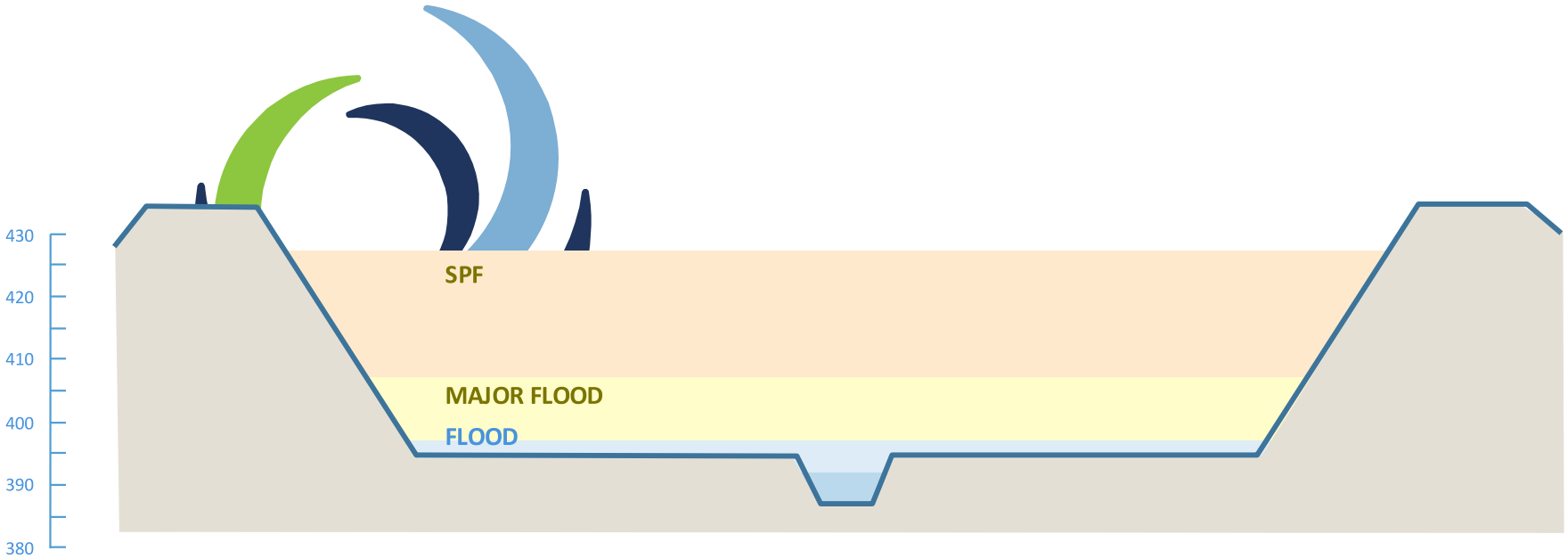
The watershed upstream of Dallas covers more than 6,000 square miles, with a network of dams and reservoirs.

Before the reservoirs: flood events are intense, but short in duration.



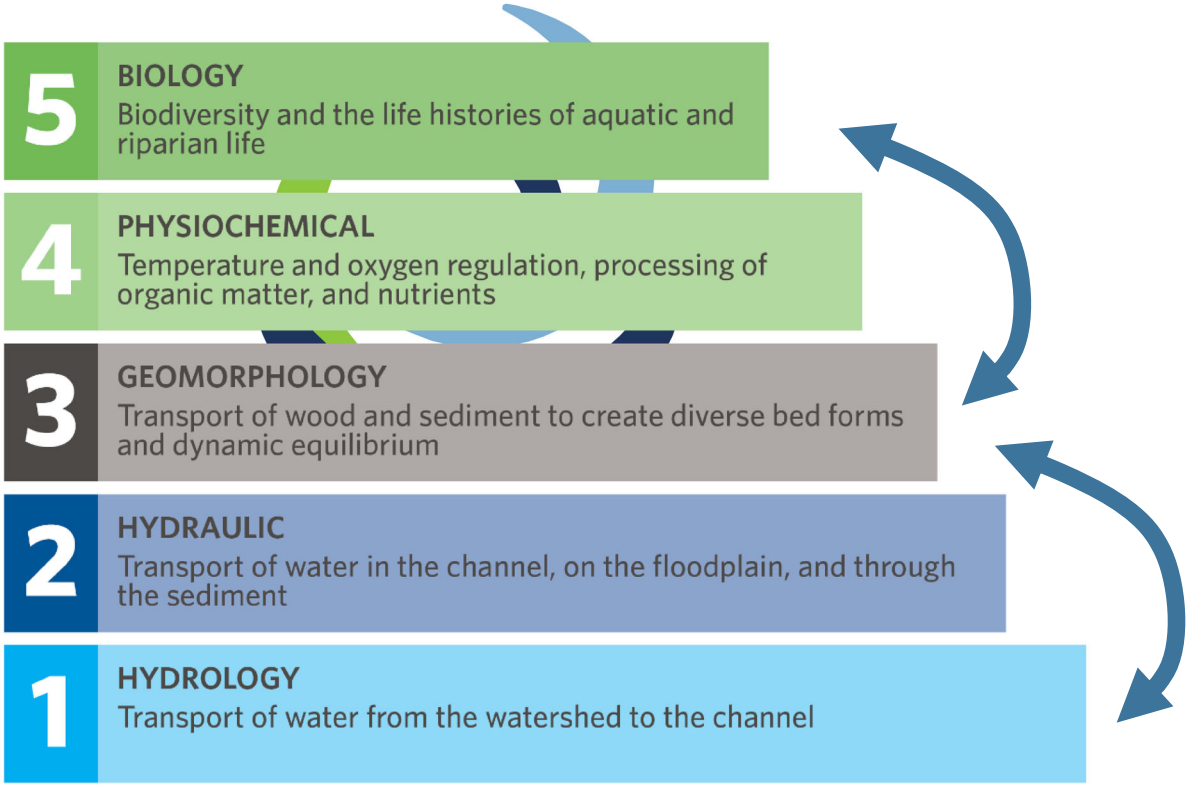
After the reservoirs: flood events are less intense, but last much longer.





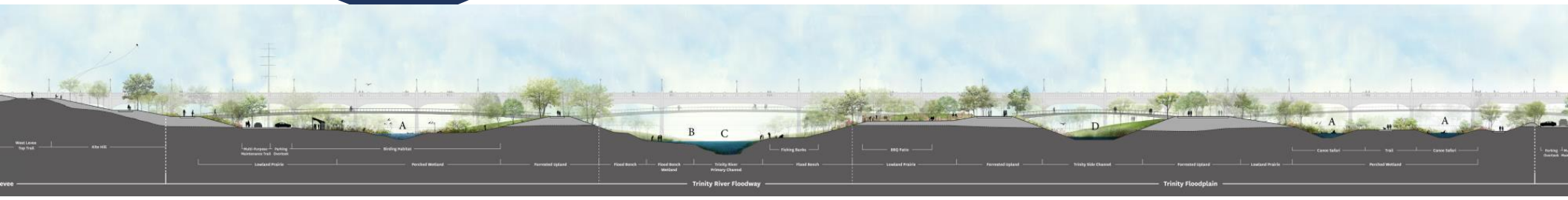
Because the floodway is maintained in a broad and flat condition, a minor flood and a major flood look the same.

Effects of Modified Hydrology



Urbanized and managed hydrology was historically combined with a simplified geomorphology.

Adding complexity of form creates a base for ecological diversity.

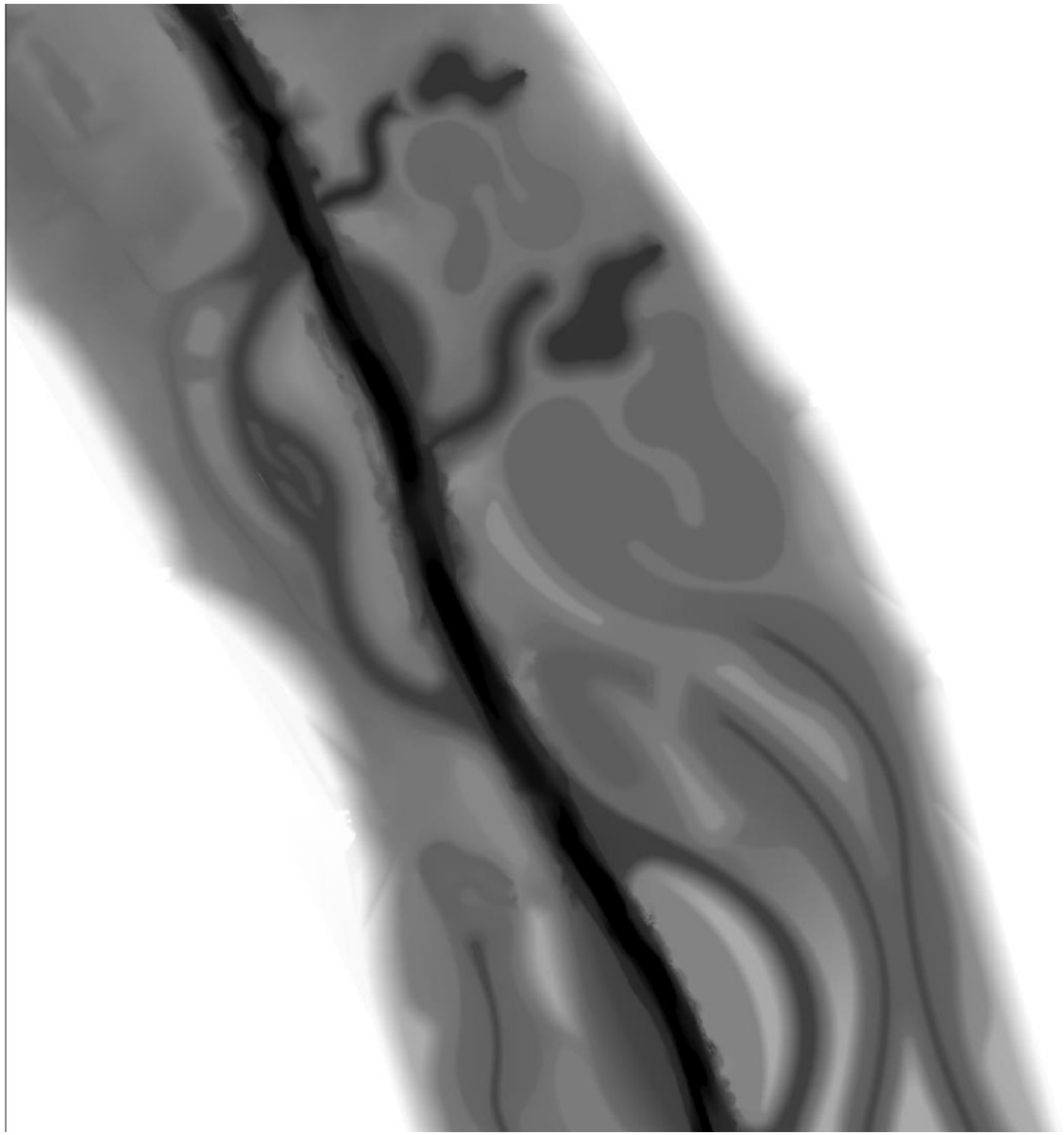


This diversity of form will also support greater ecological diversity and habitat, allowing a greater range of terrestrial and aquatic plant and fish species.

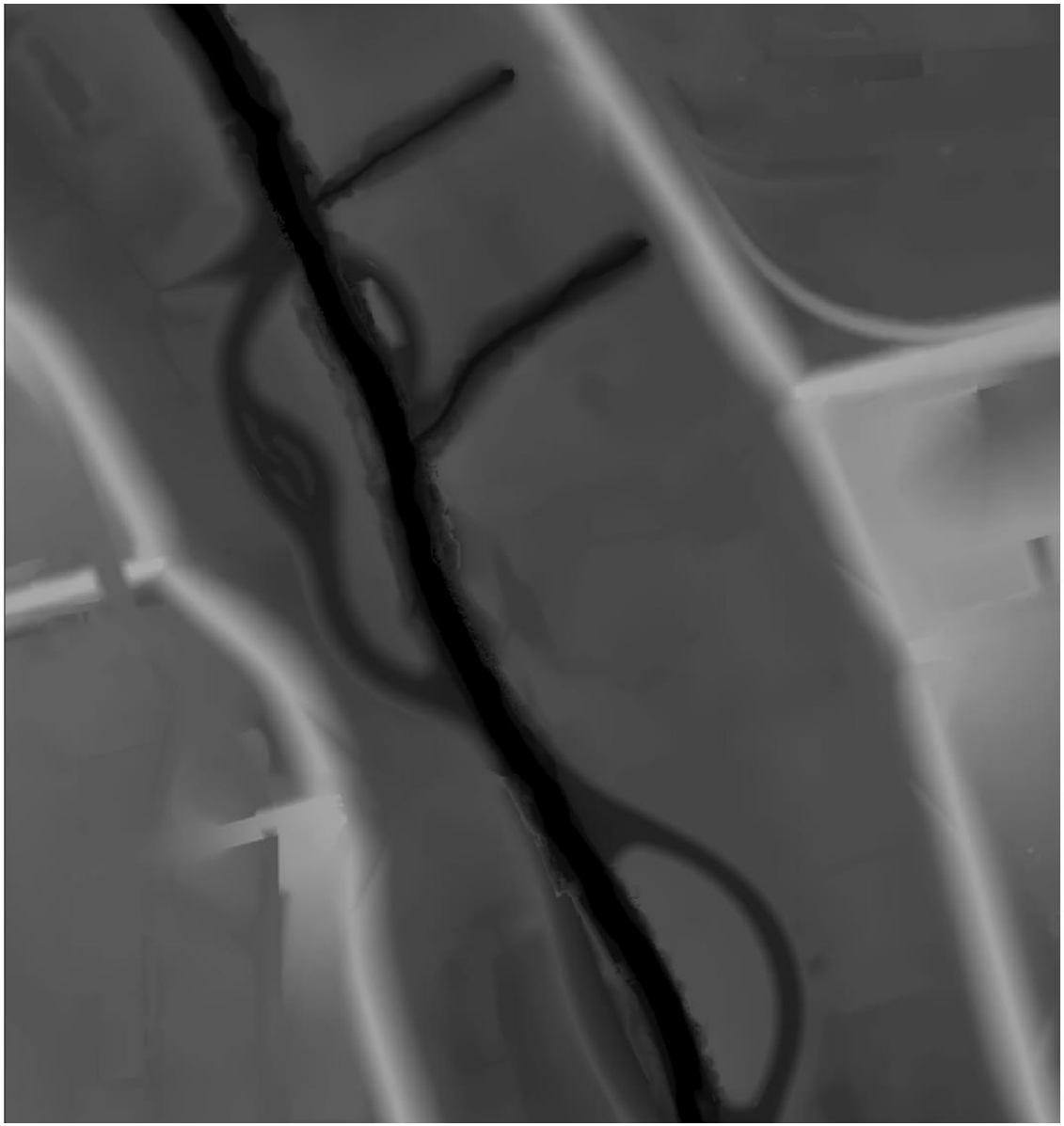

Union Pacific Railroad

09/04/18

09/18/18



10/12/18



11/02/18

11/12/18

11/13/18

11/28/18

01/08/19

02/07/19

A new program strategy elevates civic spaces to high points of the design, connecting directly to city infrastructure.

With the gateway parks acting as the primary formal spaces, the floodway becomes an accessible, wild landscape that tolerates inundation

Site design and Green-gray Integration

Engineering with Nature

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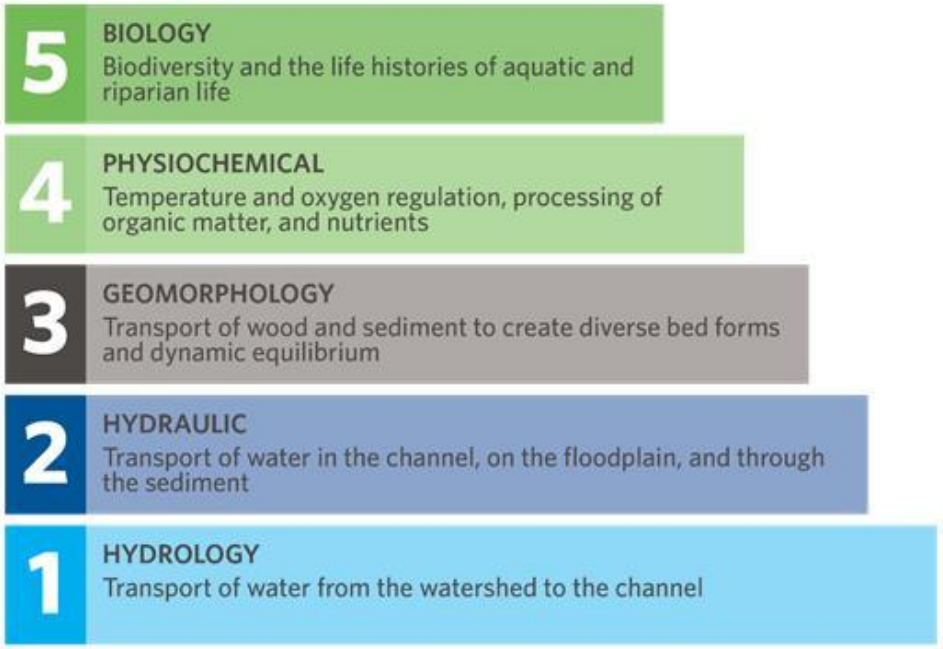

Ecological Restoration in an Urban Context: Functional Lift