URBAN STORMWATER WETLANDS

Research into Form & Function

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NEPF
ENVIRONMENTAL FLUID MECHANICS LAB

CAU

RESEARCH PROBLEM

How do we combine
hydraulic engineering and **landscape design**
to create new forms of constructed wetlands
that offer **urban functions** and **resiliency benefits** for cities?

DESIGN GUIDELINES

Case Study Cities

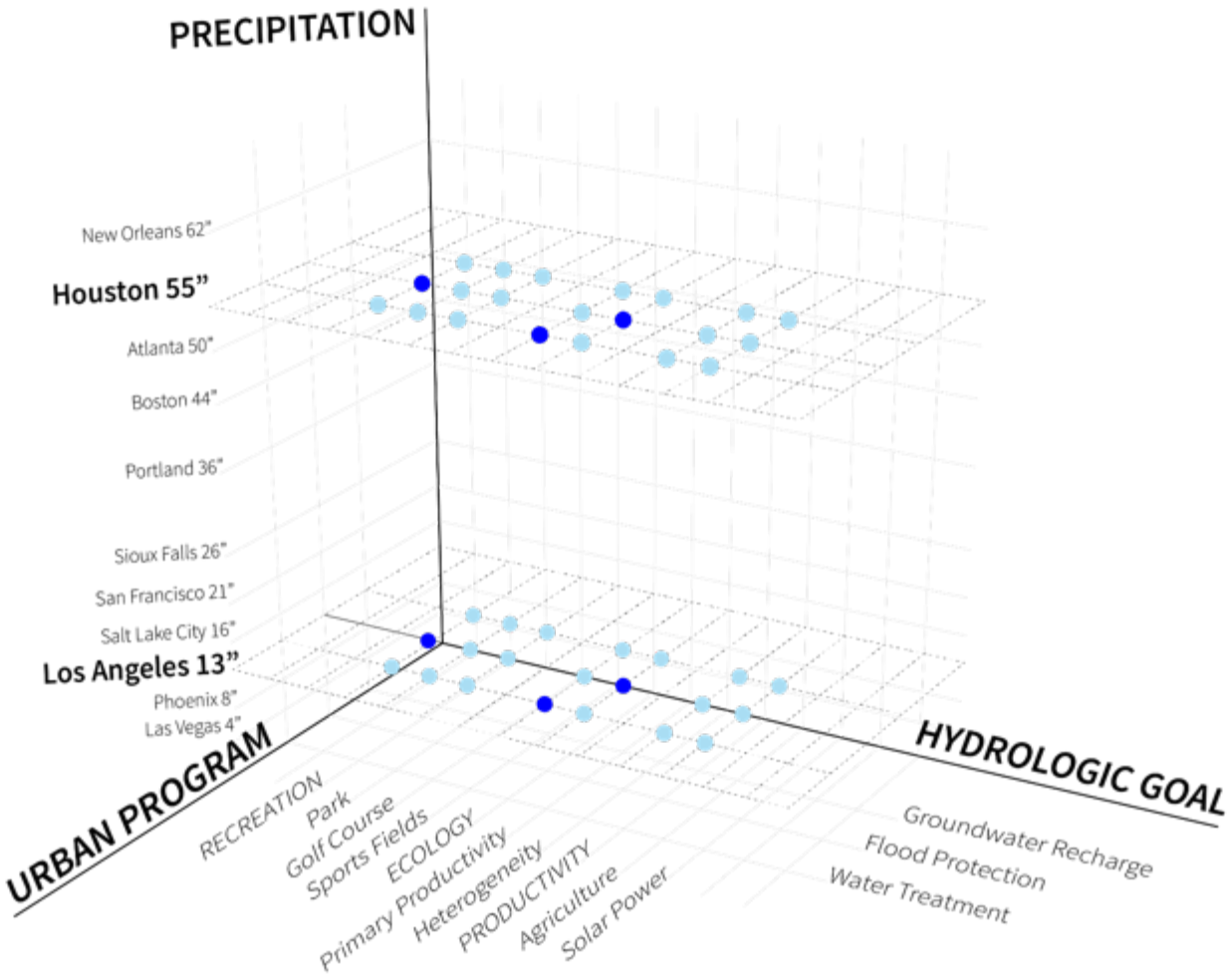
Los Angeles

- Hot + dry climate
- Severe water scarcity
- Flooding problems
- #5 fastest growing metro in 2013-2014
- 13 million people

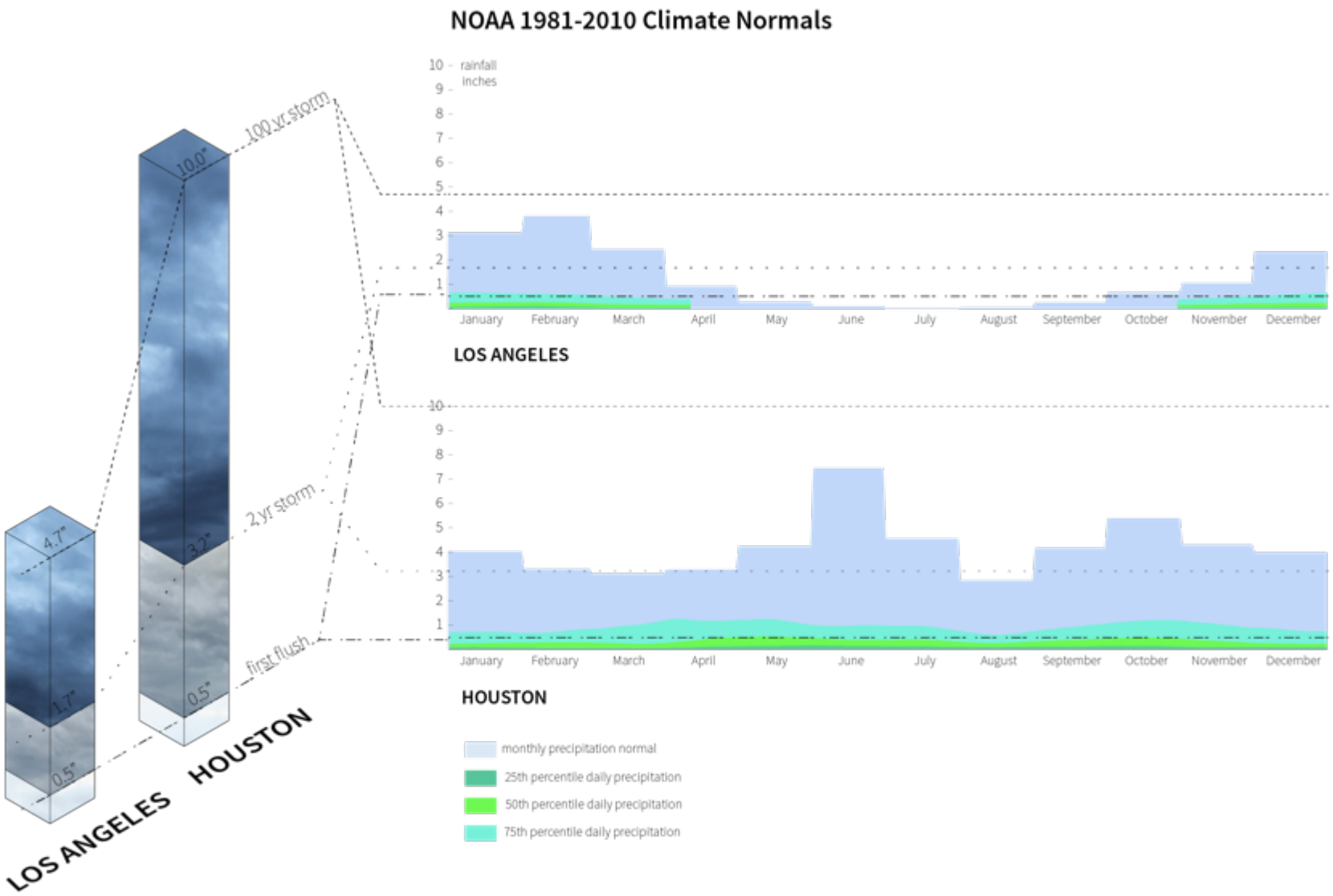
Houston

- Hot + wet climate
- Flat and low-lying
- 2016 wettest year in 60+ years, led to severe flooding
- #1 fastest growing metro in 2013-2014
- 6.5 million people

DESIGN SCENARIOS



RAINFALL SCENARIOS



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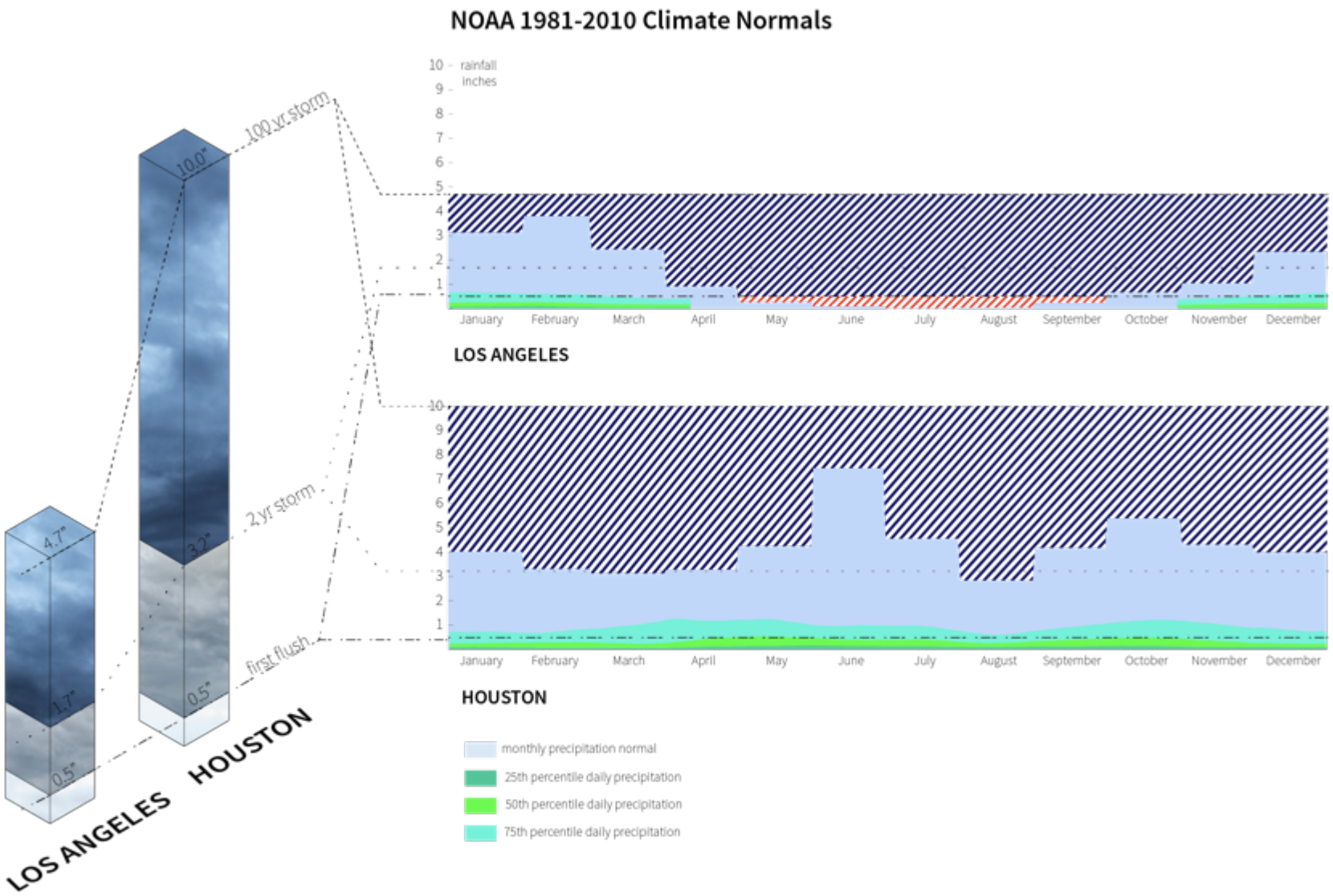
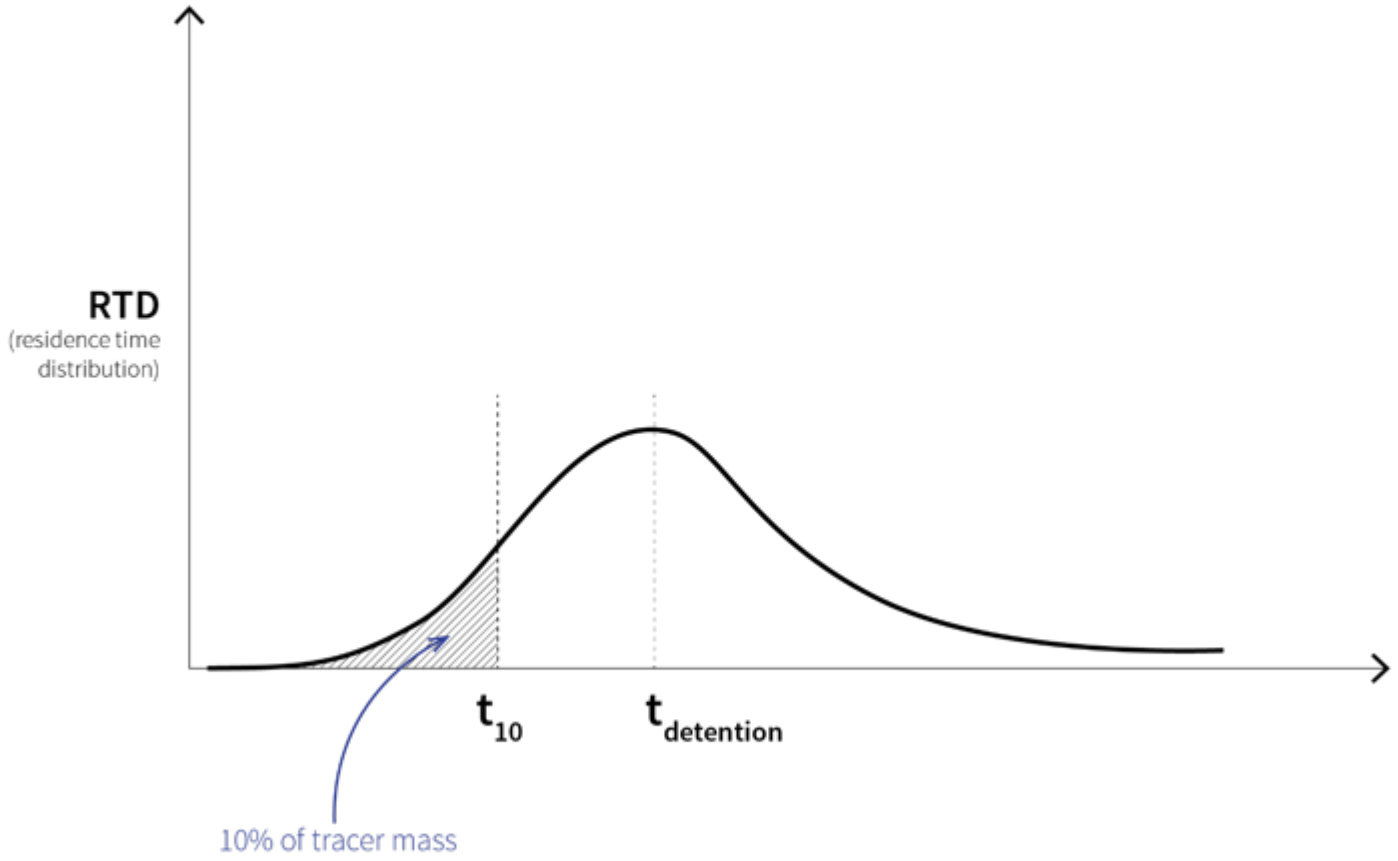
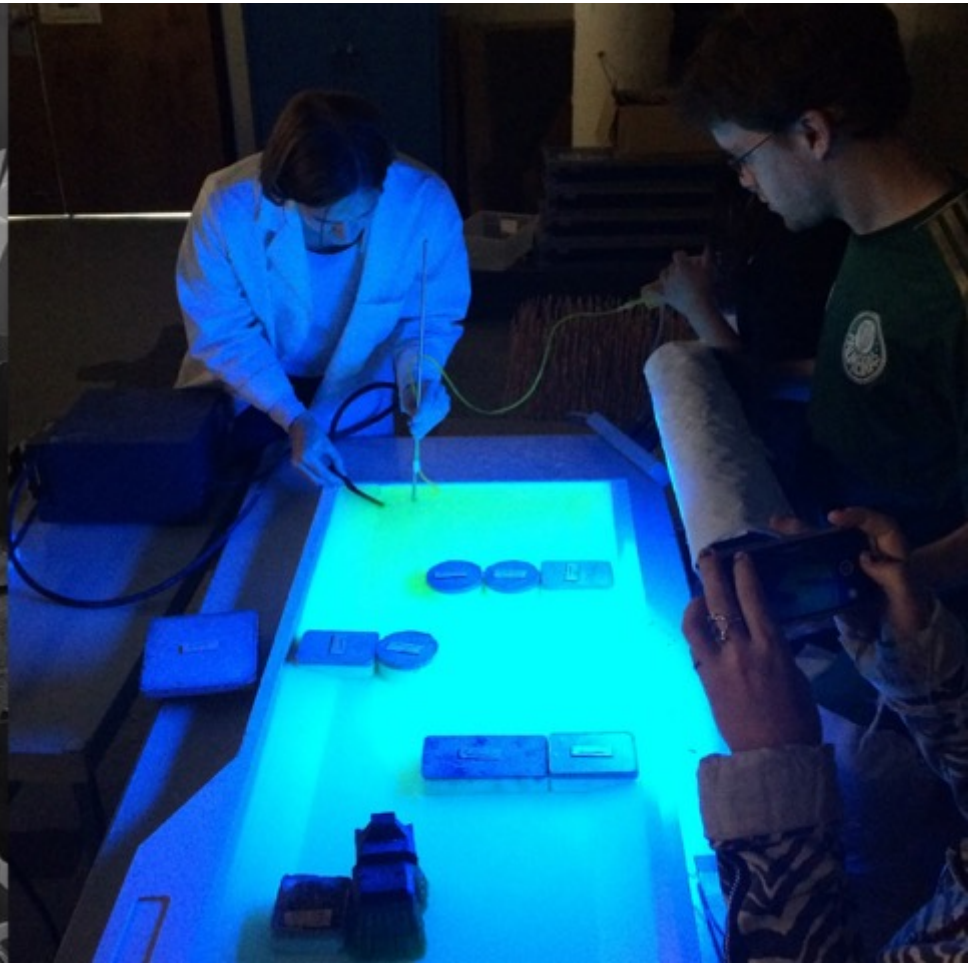


LOW-FLOW AND FLOODPLAINS

COMPARATIVE METRICS





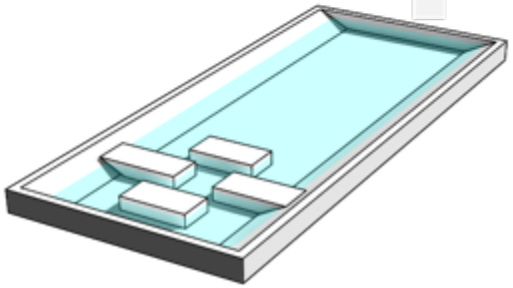
PERFORMANCE METRICS

Theta 10

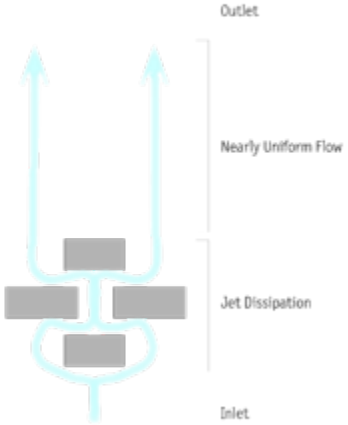
$$\Theta 10 = T_{10}/T_n$$

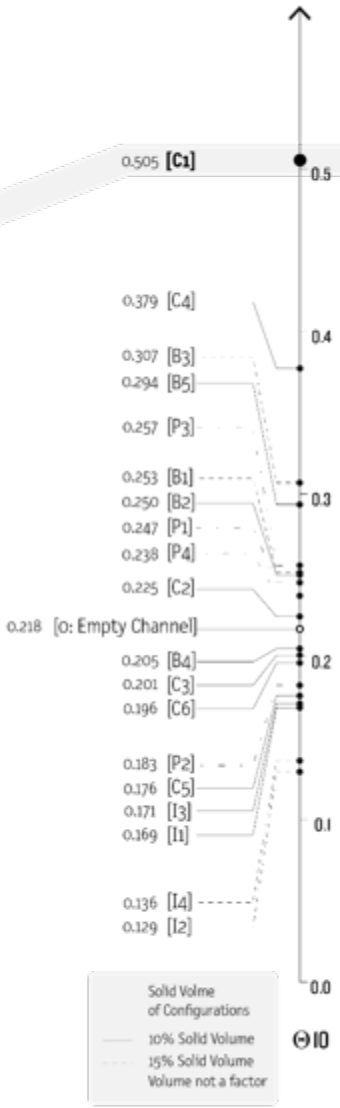
Nominal Residence Time

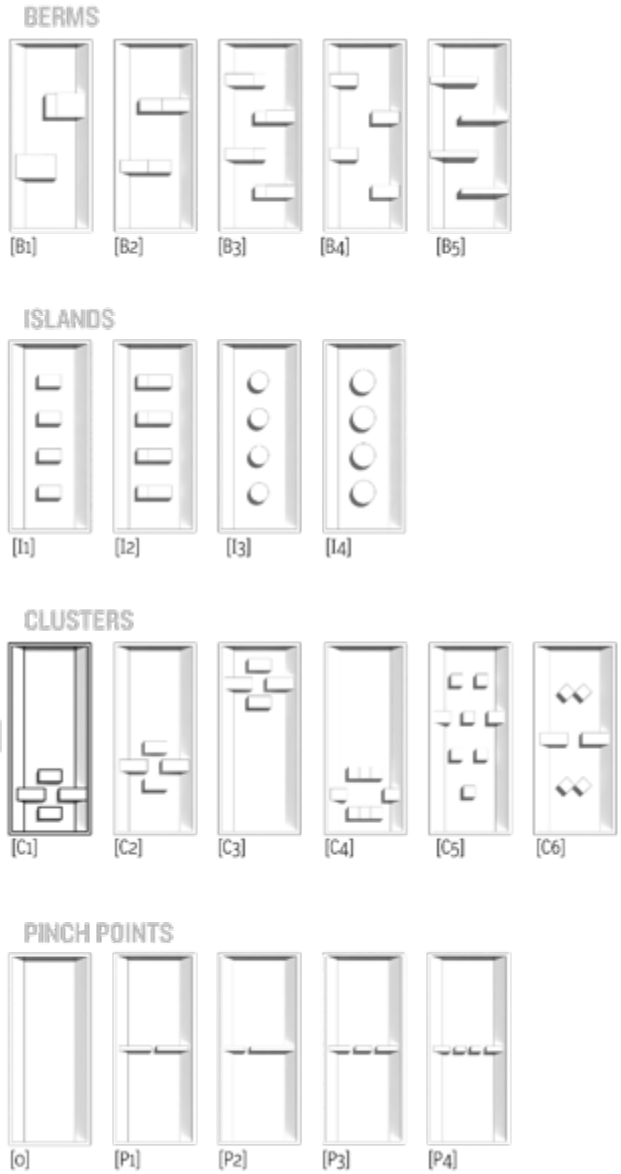
$$T_n = V/Q$$

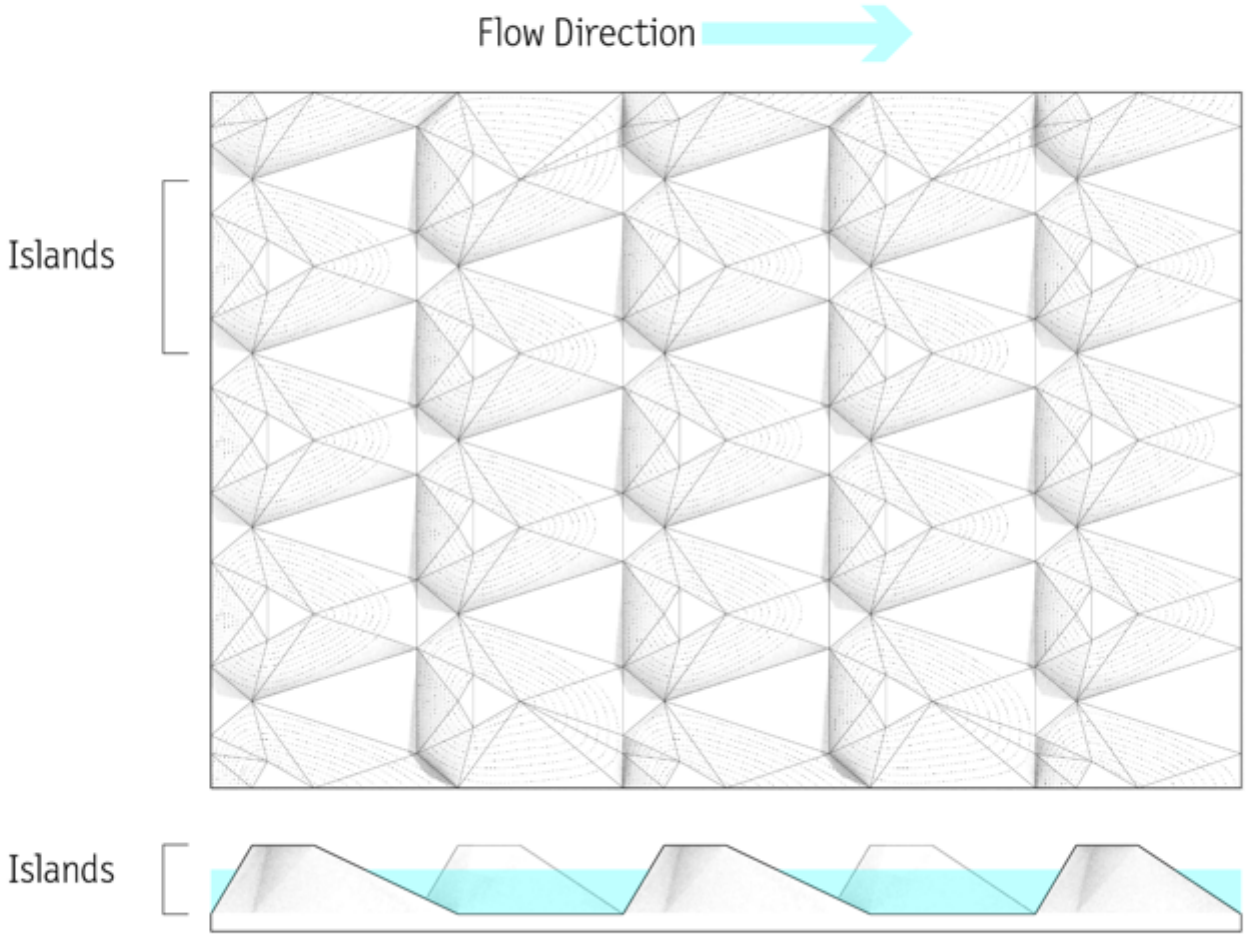


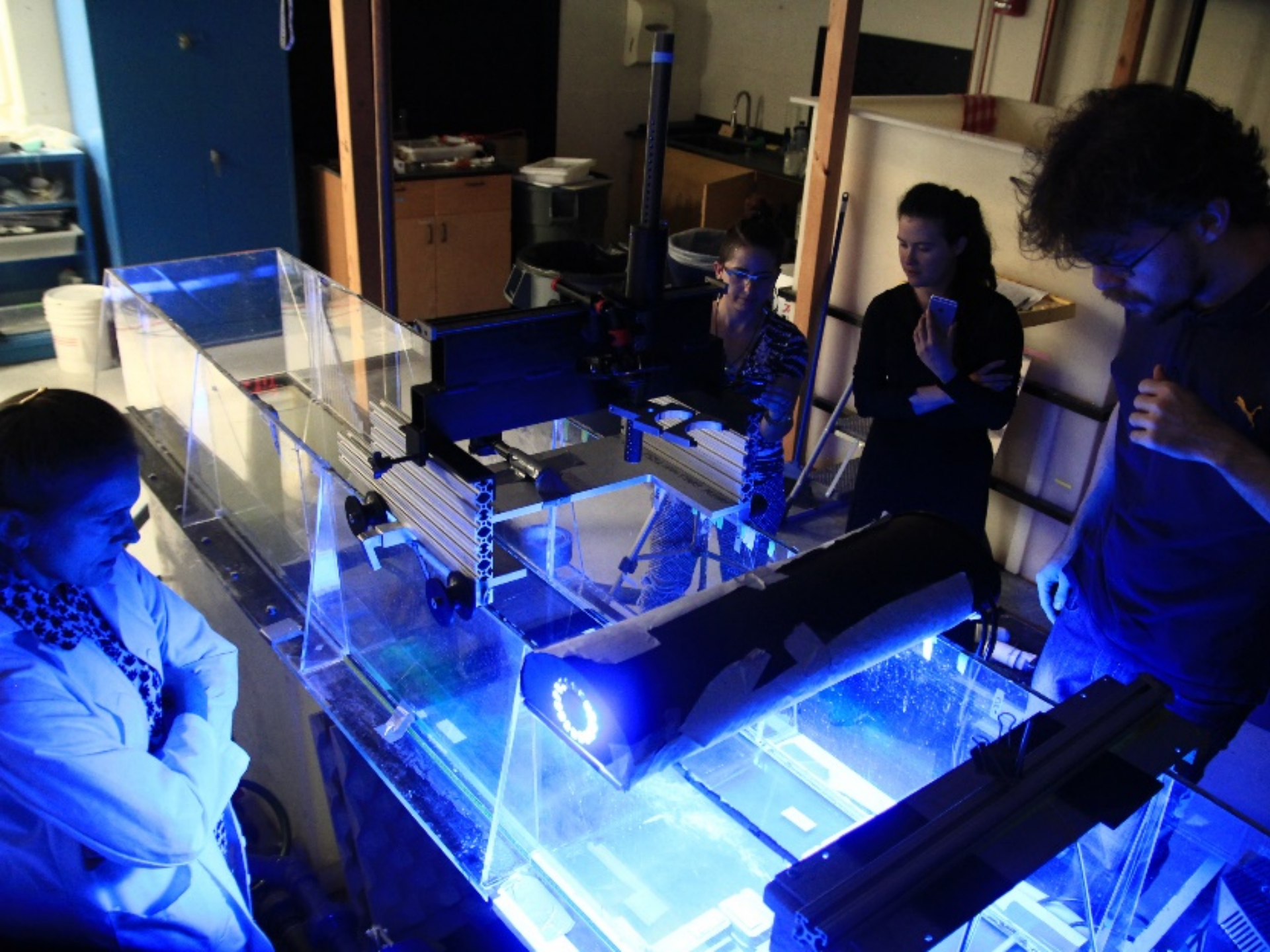
Best performing scenario:
[C1] Island Cluster at Inlet



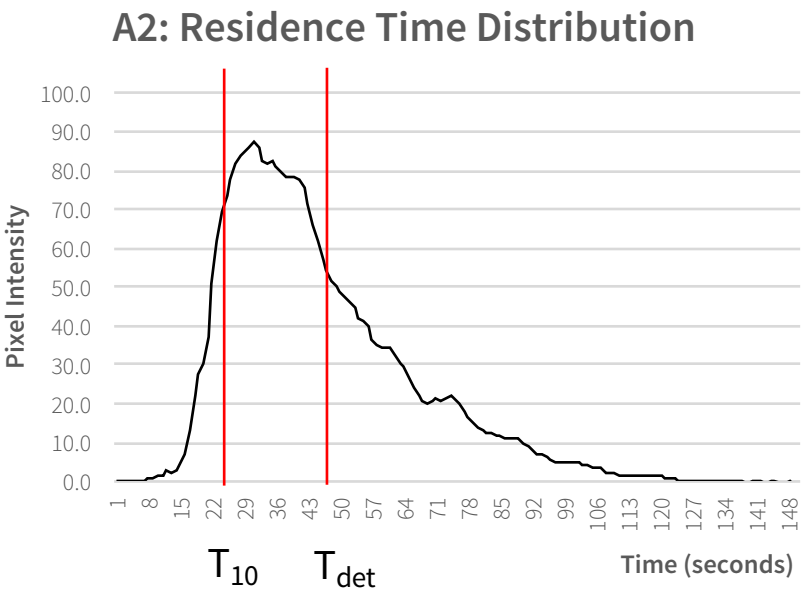


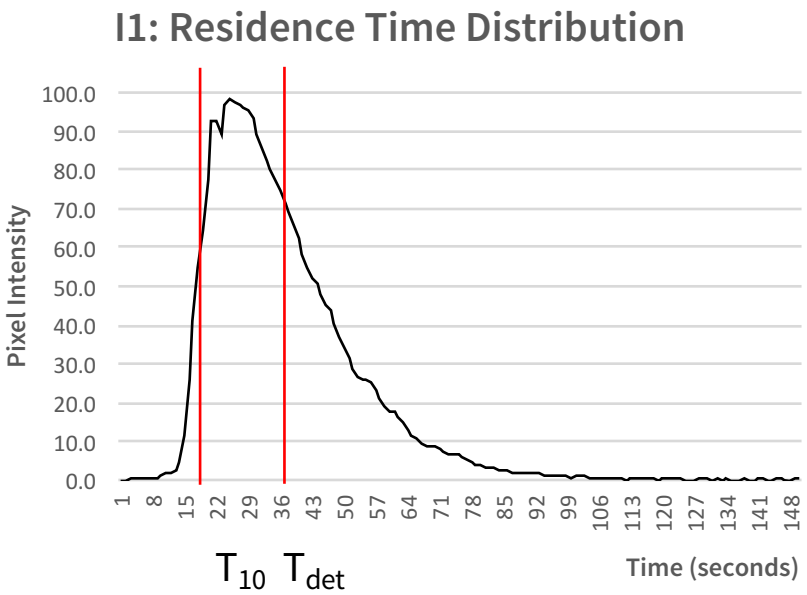


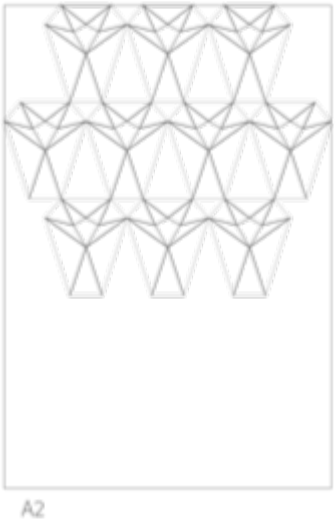

Flow Direction
Islands
Islands



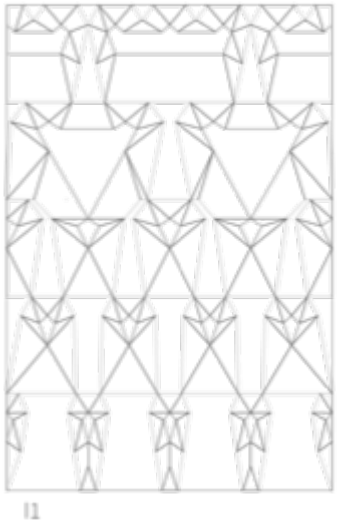
PRELIMINARY DATA





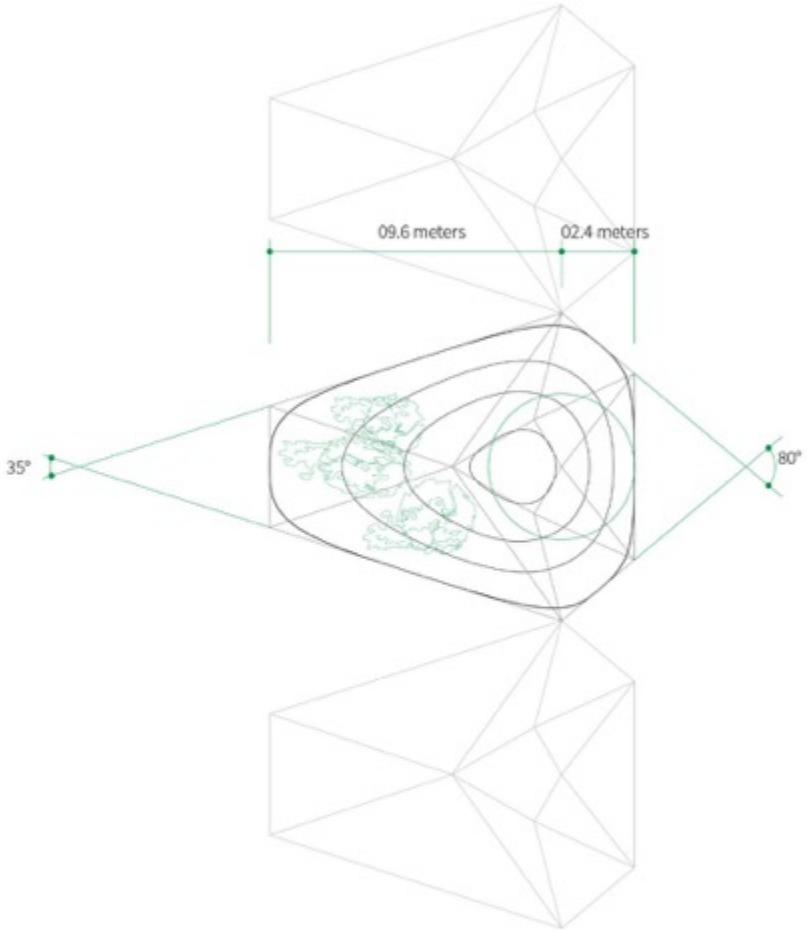


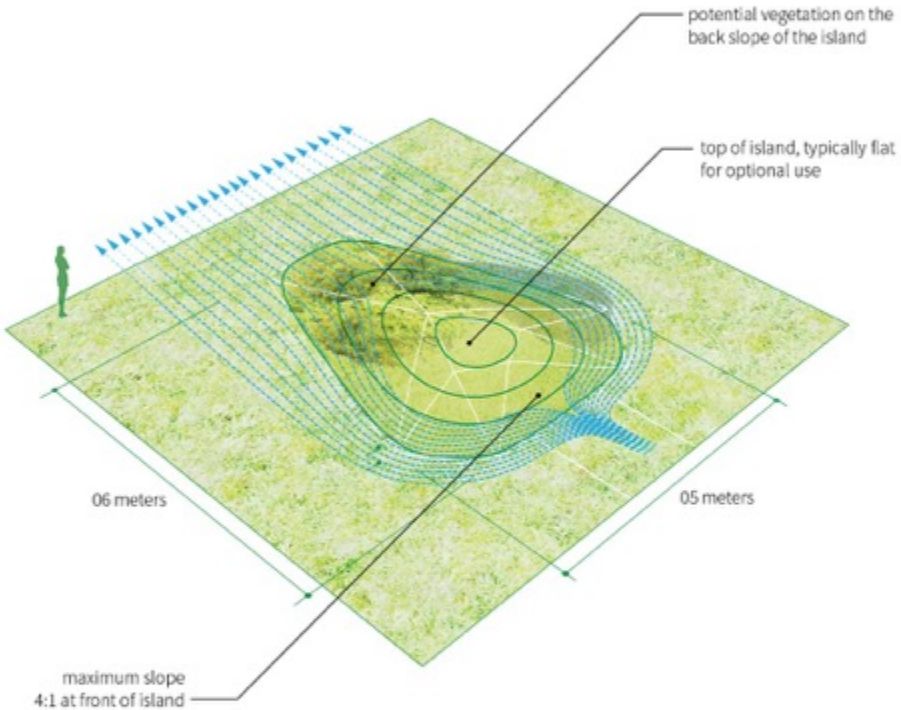
T_{10}= 24 sec
T_{det}= 46 sec
Theta10= 0.53

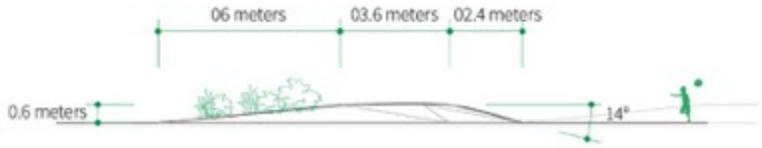


T_{10}= 20 sec
T_{det}= 37 sec
Theta10= 0.55

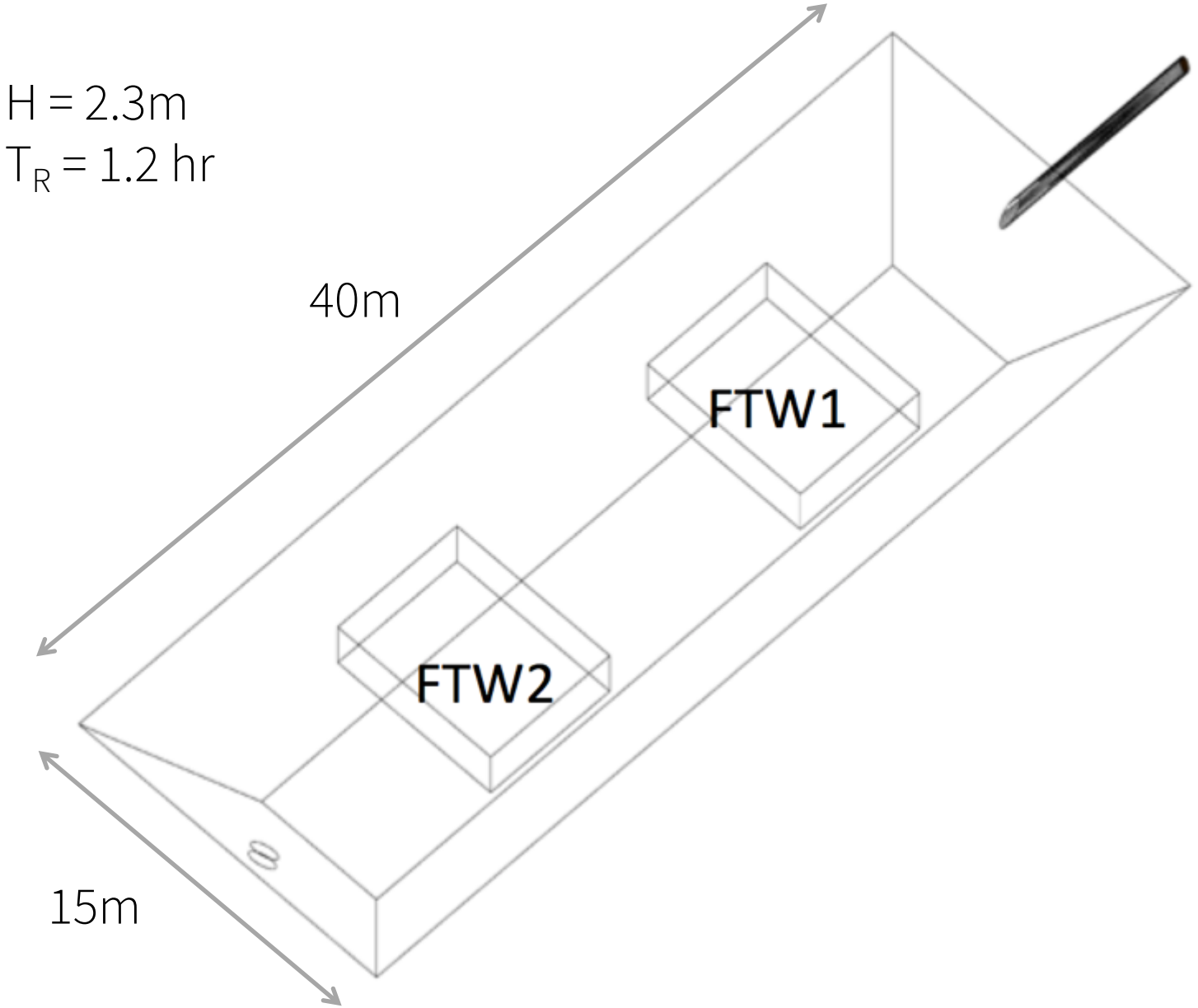
ISLAND SHAPE & WATER FLOW



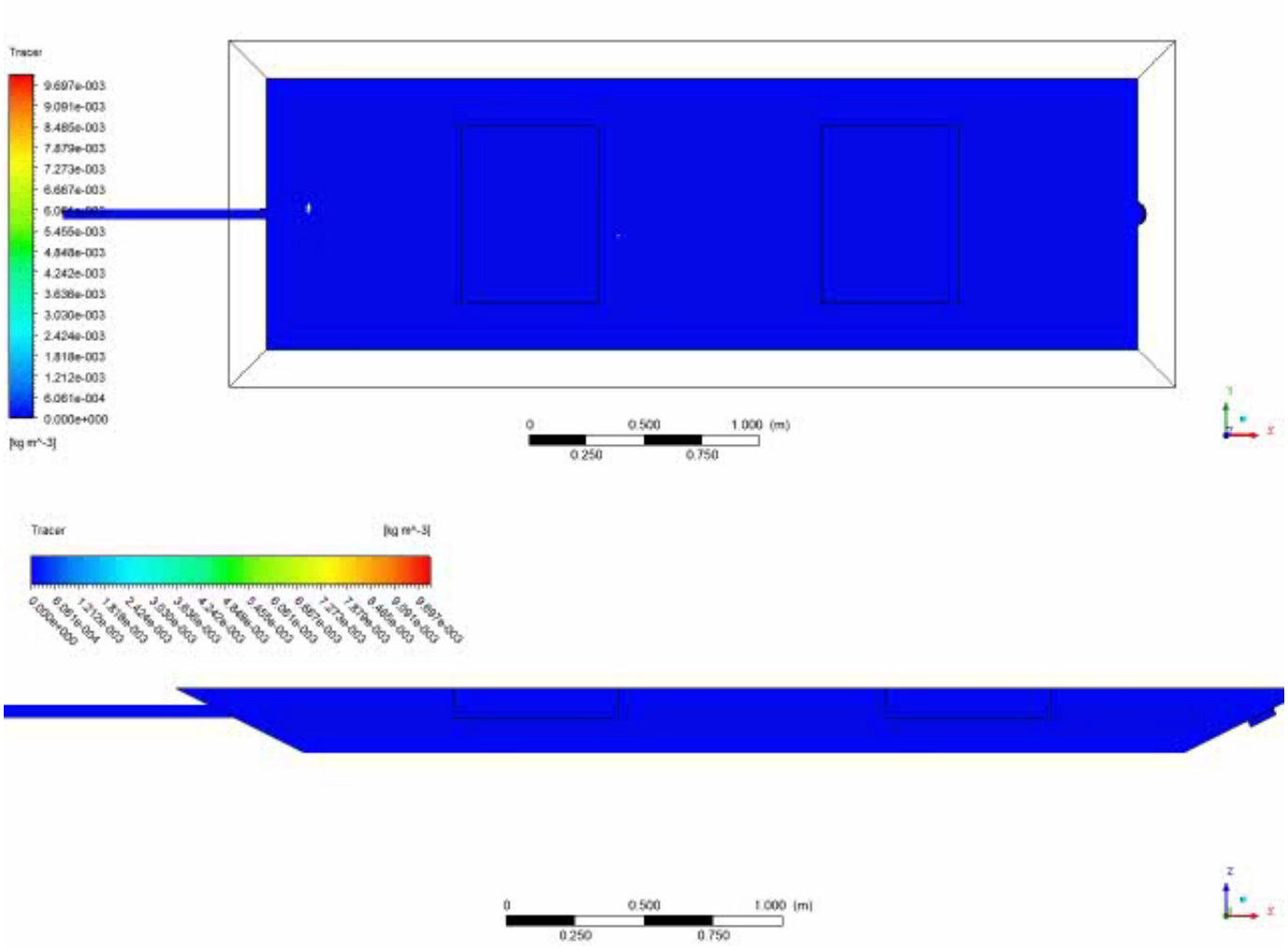




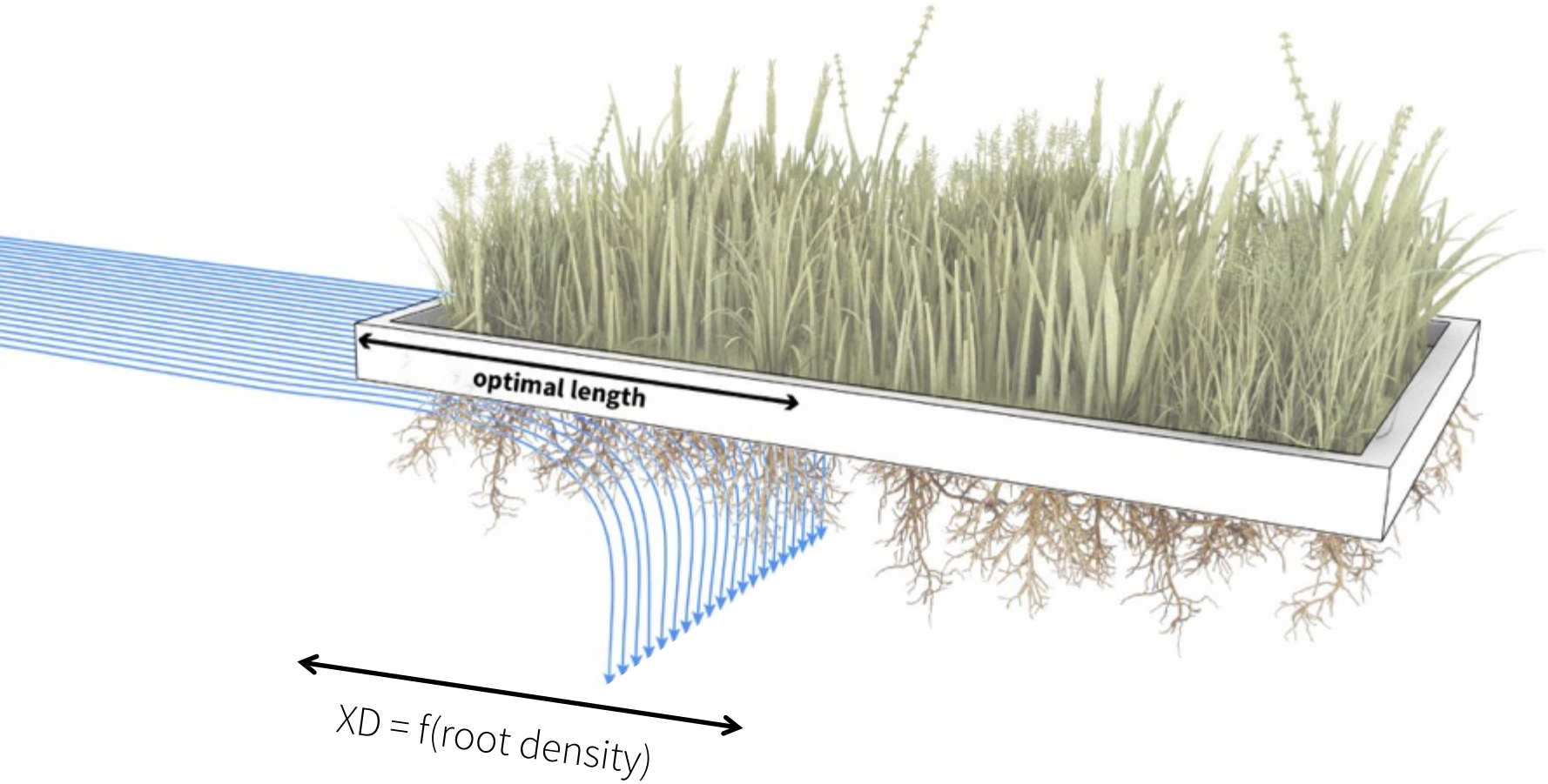
CFD modeling of Stormwater Pond with FTW based on pond described in Khan et al 2013



Scalar Transport Modeling
With First-Order Reaction in Root Zone
Me/Mo = 0.91



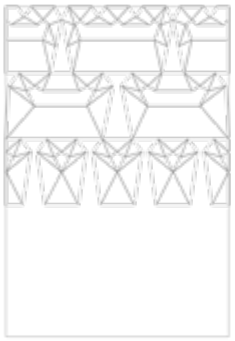
Importance of Leading Edge

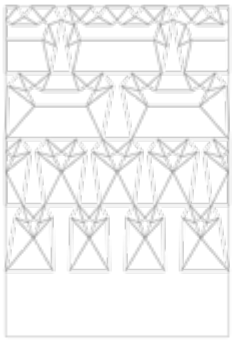


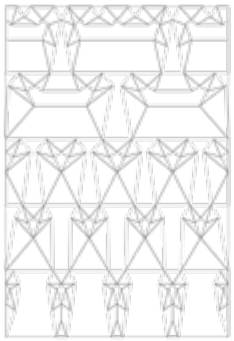
70% of treatment provided in first 1-m of FTW

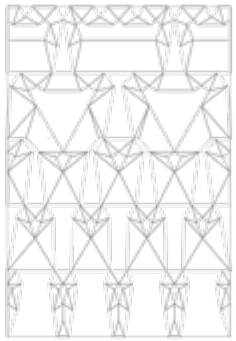
EXPERIMENT CONFIGURATIONS

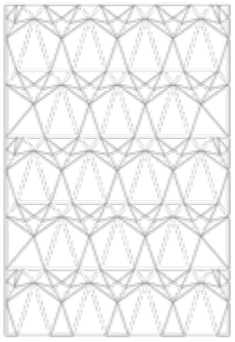
Topographies

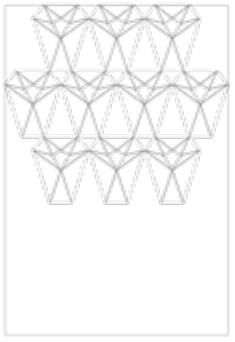


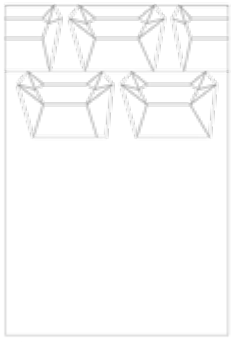


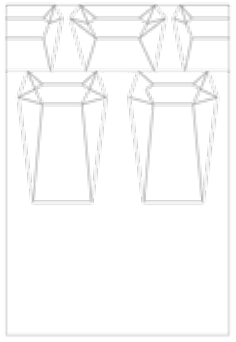


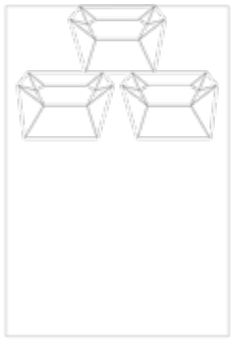


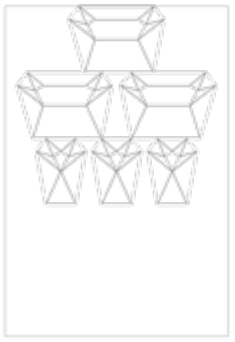


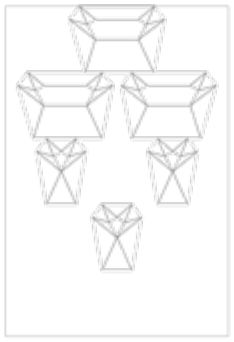


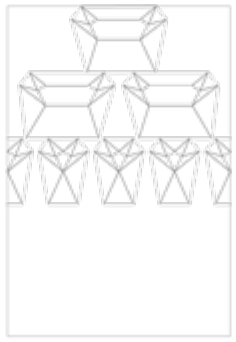




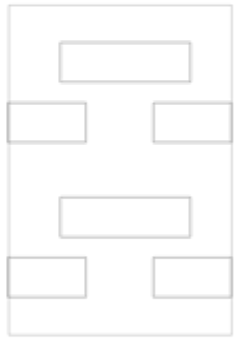




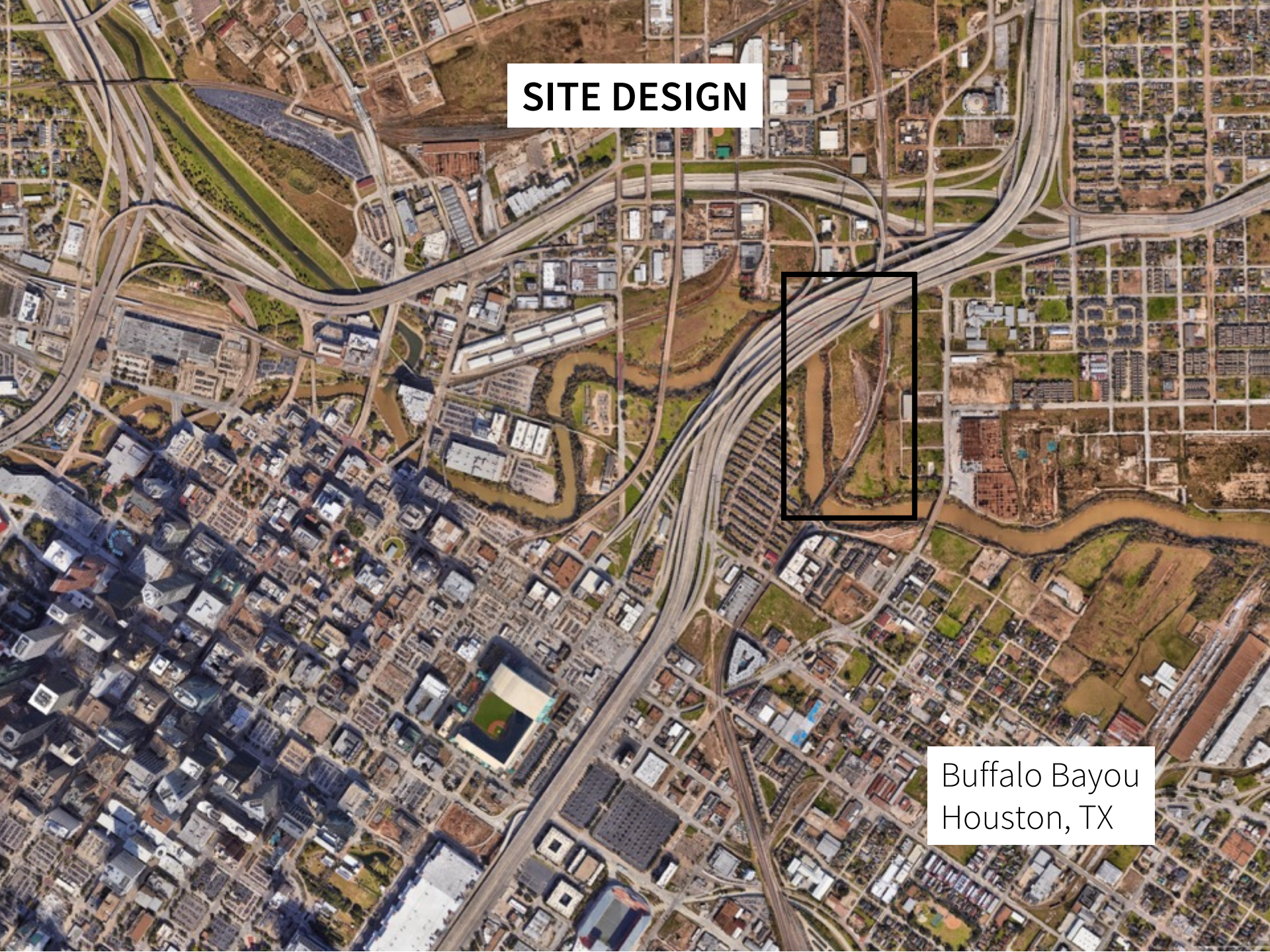




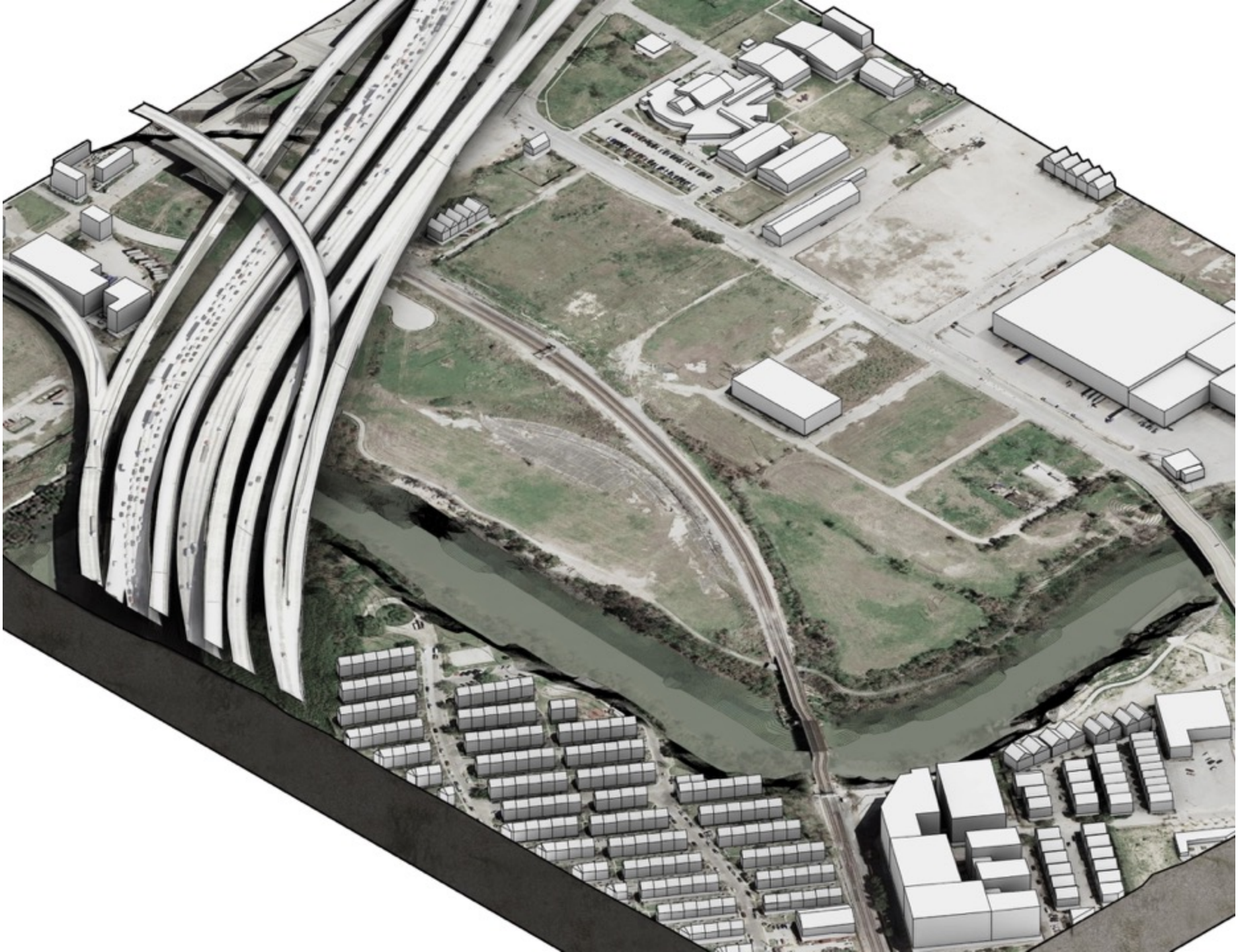
FTW

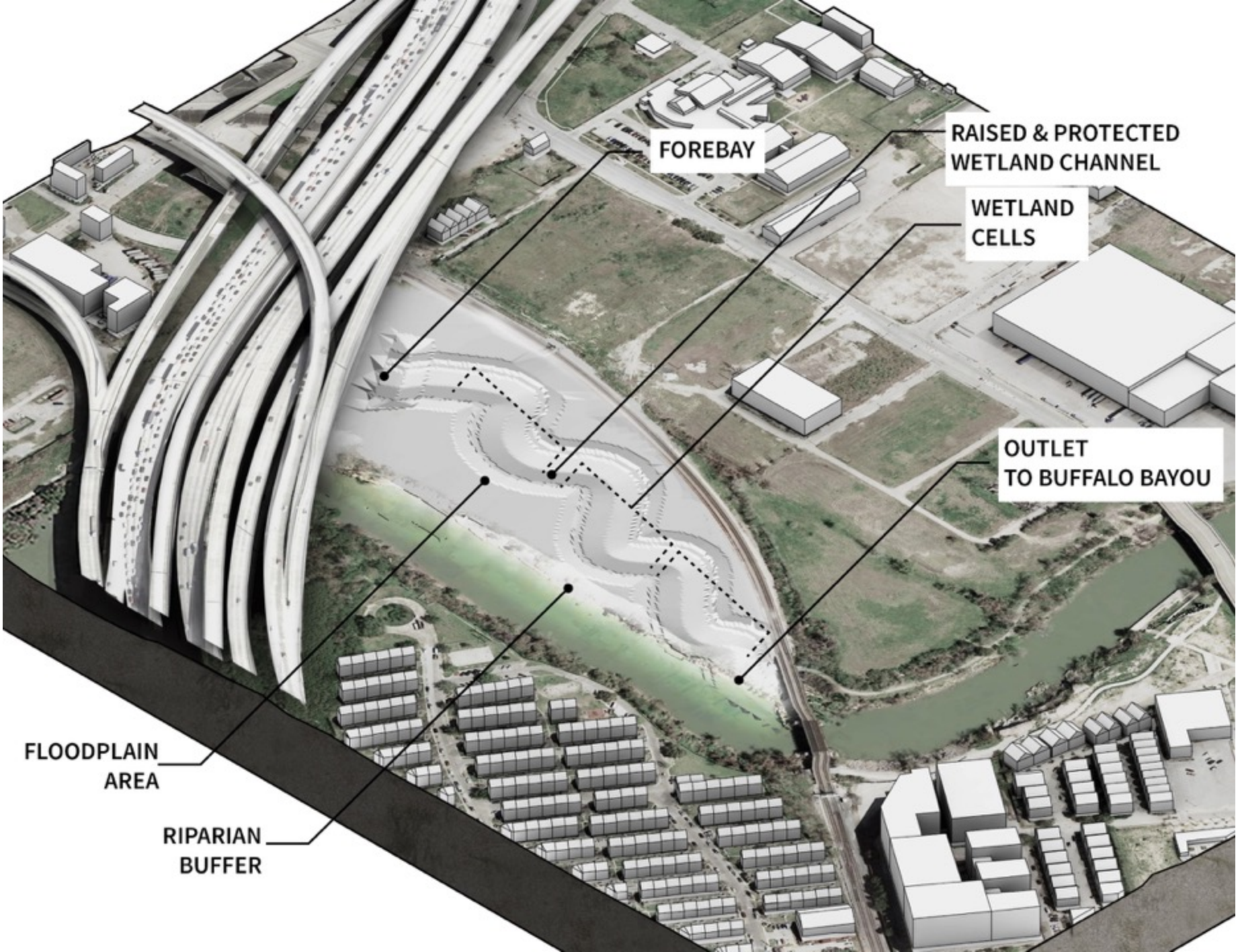


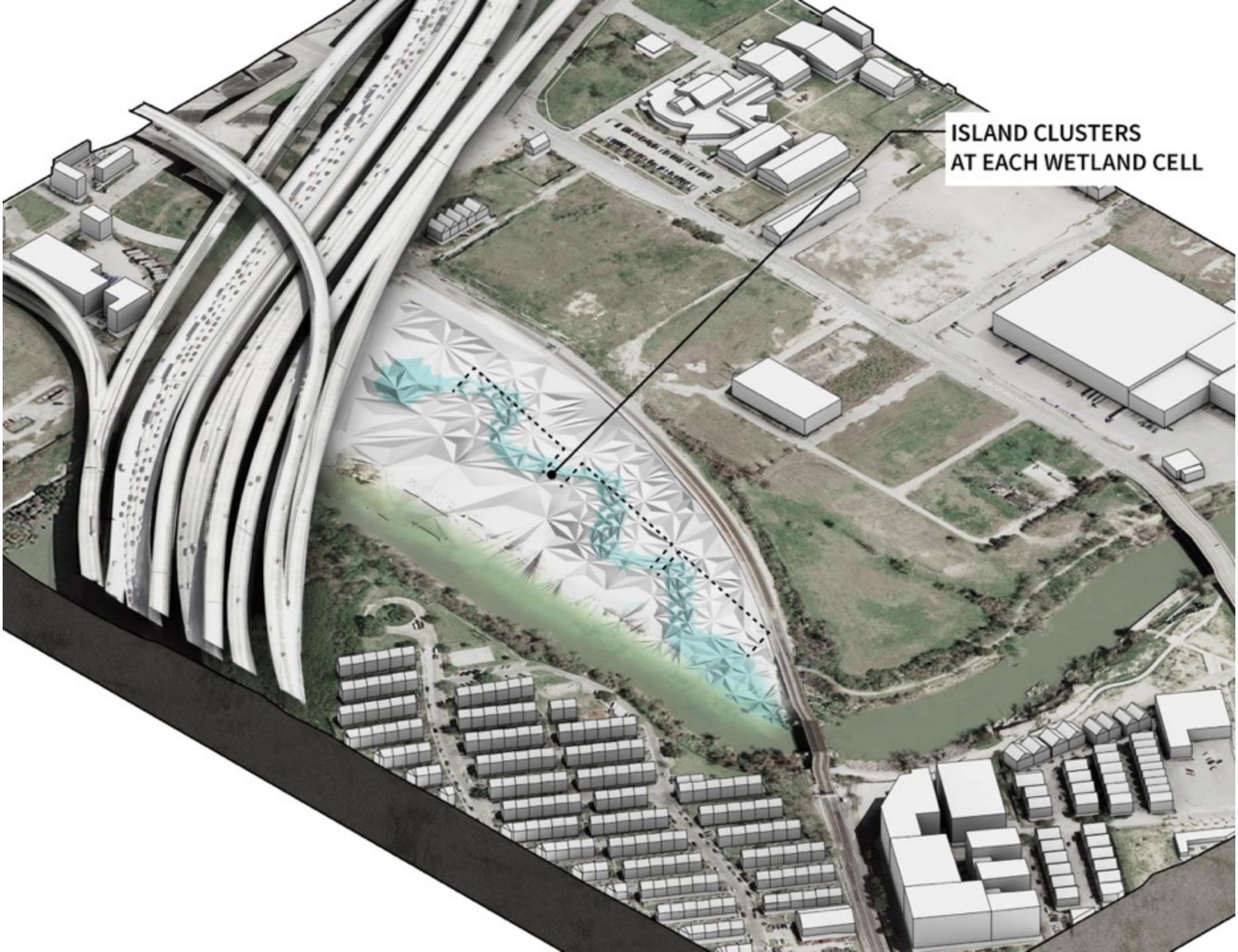
SITE DESIGN



Buffalo Bayou
Houston, TX




FOREBAY
RAISED & PROTECTED
WETLAND CHANNEL
WETLAND
CELLS
OUTLET
TO BUFFALO BAYOU
FLOODPLAIN
AREA
RIPARIAN
BUFFER


ISLAND CLUSTERS
AT EACH WETLAND CELL

WORK IN PROGRESS

Design Guidelines:
Summer 2017

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