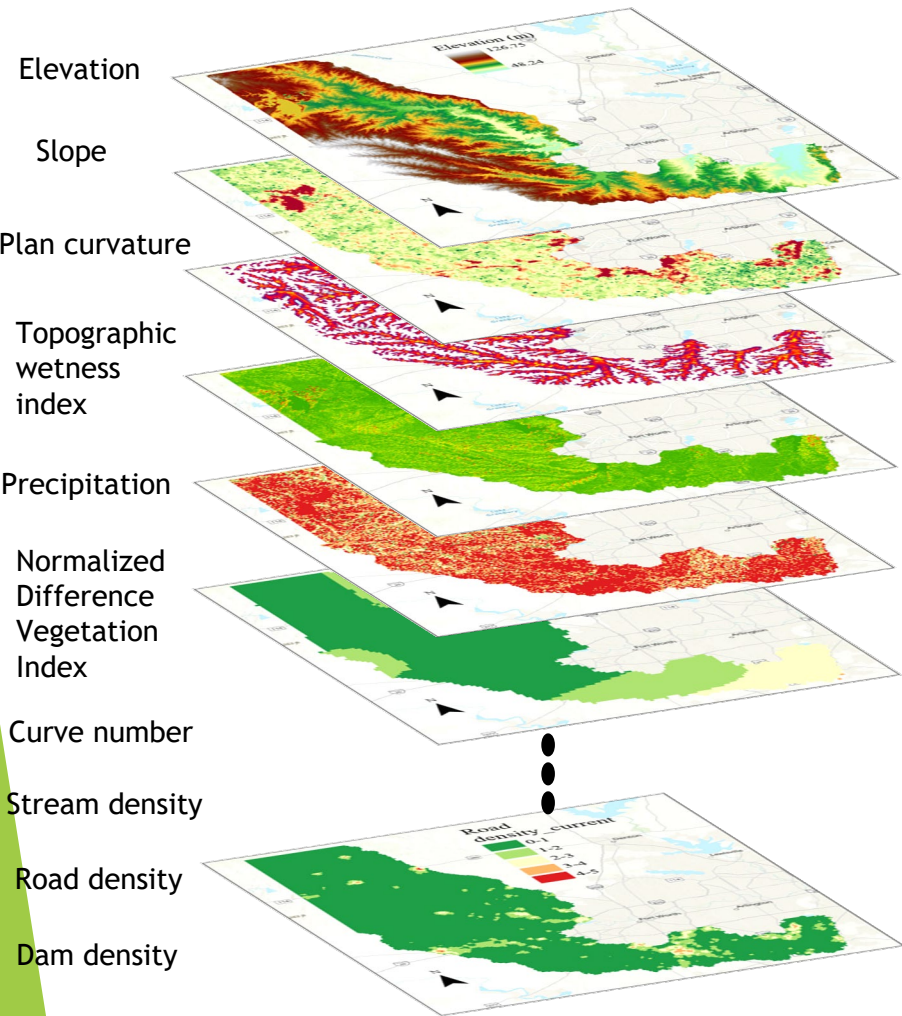




# Environmental Planning and Economic Considerations

# Flood Prioritization: GIS Stacking Model

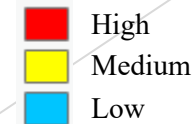
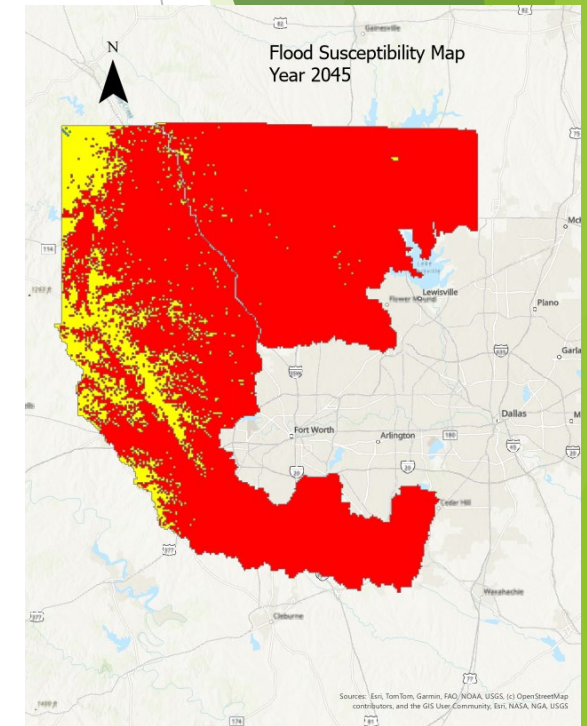
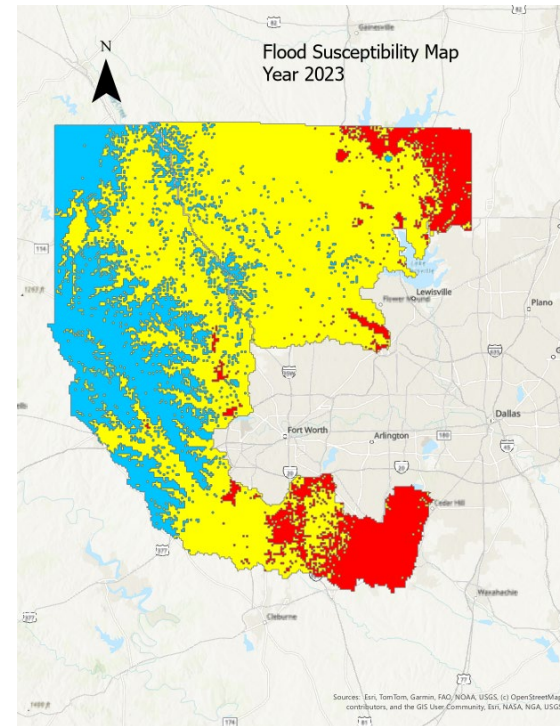
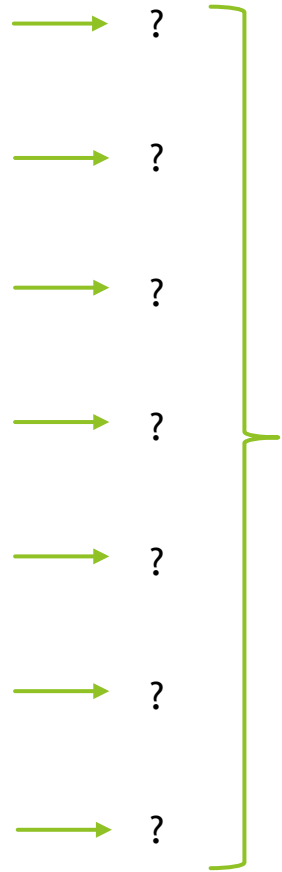
## I. Stormwater management in a large-scale: flood susceptibility mapping



Overlay geospatial analysis

weight

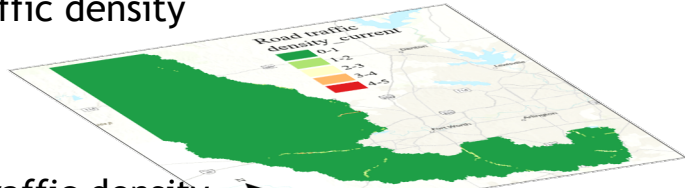
AHP (Analytic Hierarchy Process) method



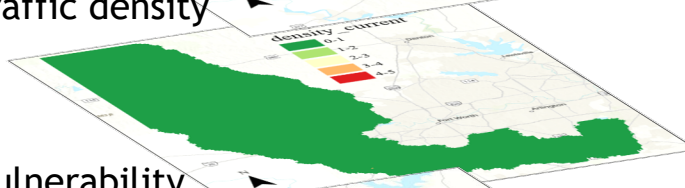
# GIS Stacking Model

## II. Stormwater management in a large-scale: flood vulnerability mapping, flood control prioritization mapping

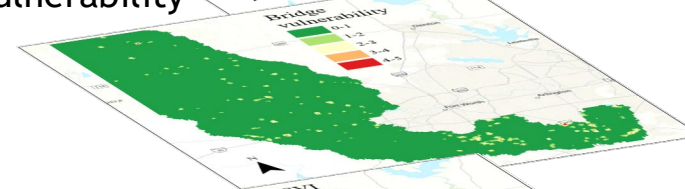
Road traffic density



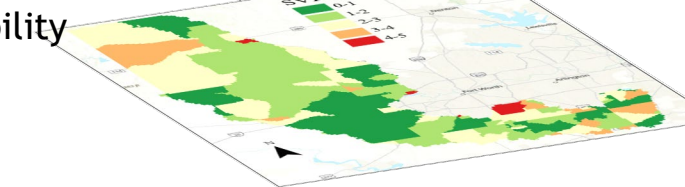
Bridge traffic density



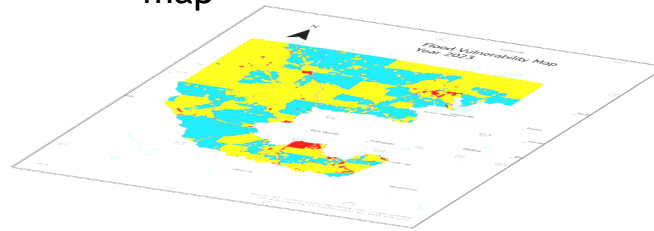
Bridge vulnerability



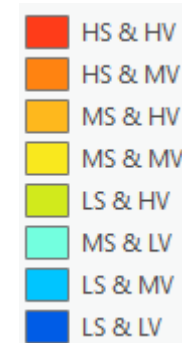
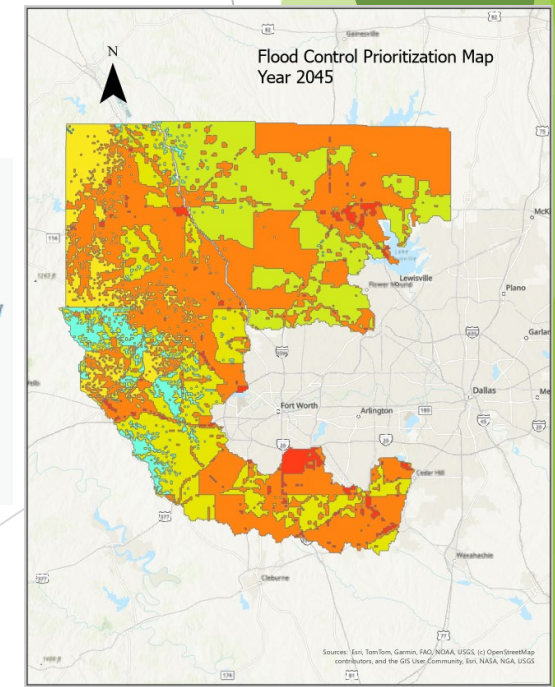
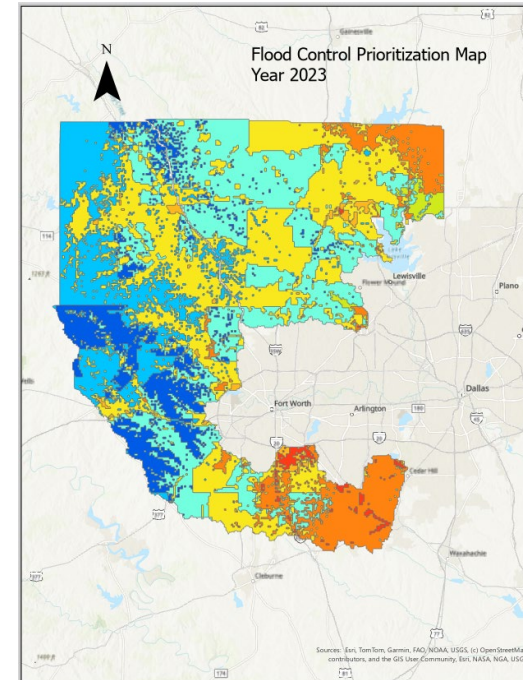
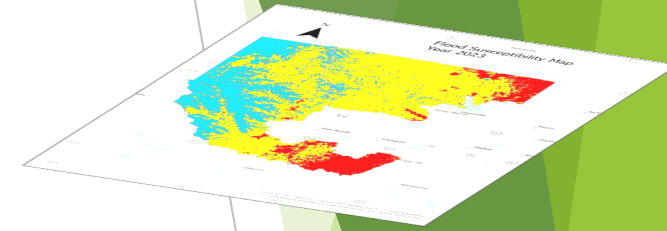
Social vulnerability index



Flood vulnerability map



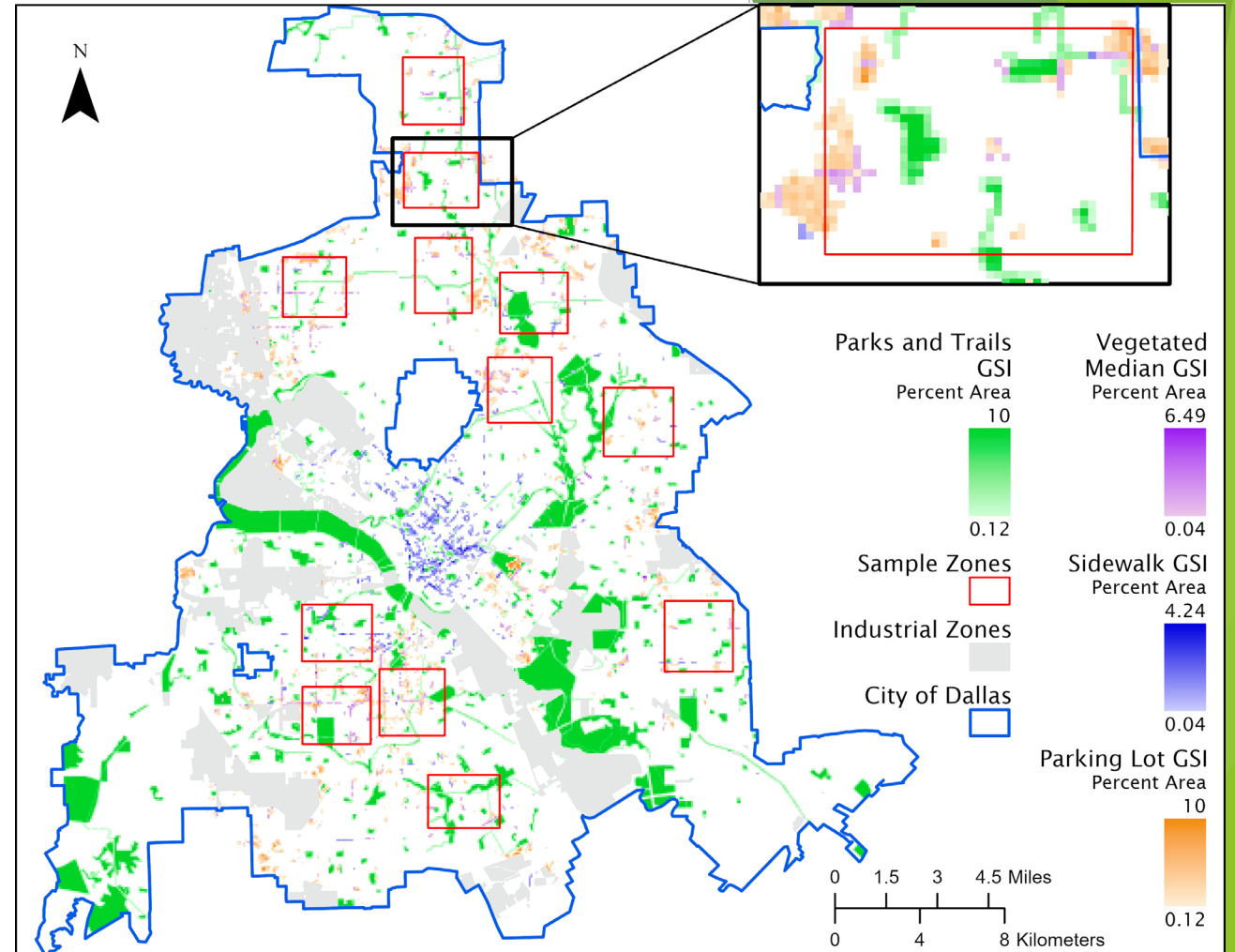
Flood susceptibility map



- Identify some areas with both high flood potential and low resilience, pilot area candidate
- Help with efficient resources allocation
- Effective for large-scale area

## Predicting GSI Candidate Locations by Percent Imperviousness

- 4 Bioretention GSI Locations:
  - 35% of Non-Residential Sidewalks  $\geq$  8ft wide
  - 10% of Parking Lots
  - 10% of Parks and Trails
  - 35% of Vegetated Road Medians
- Random Forest Regression Models
  - Predict percent cover of 4 candidate locations using 2020 Percent Impervious area
  - Modeled from the City of Dallas data
  - Randomly selected subset where GSI candidate could exist
  - Isolated to 12 sample zones not in industrial zones and suburban style developed areas
  - 80% Training 20% Testing

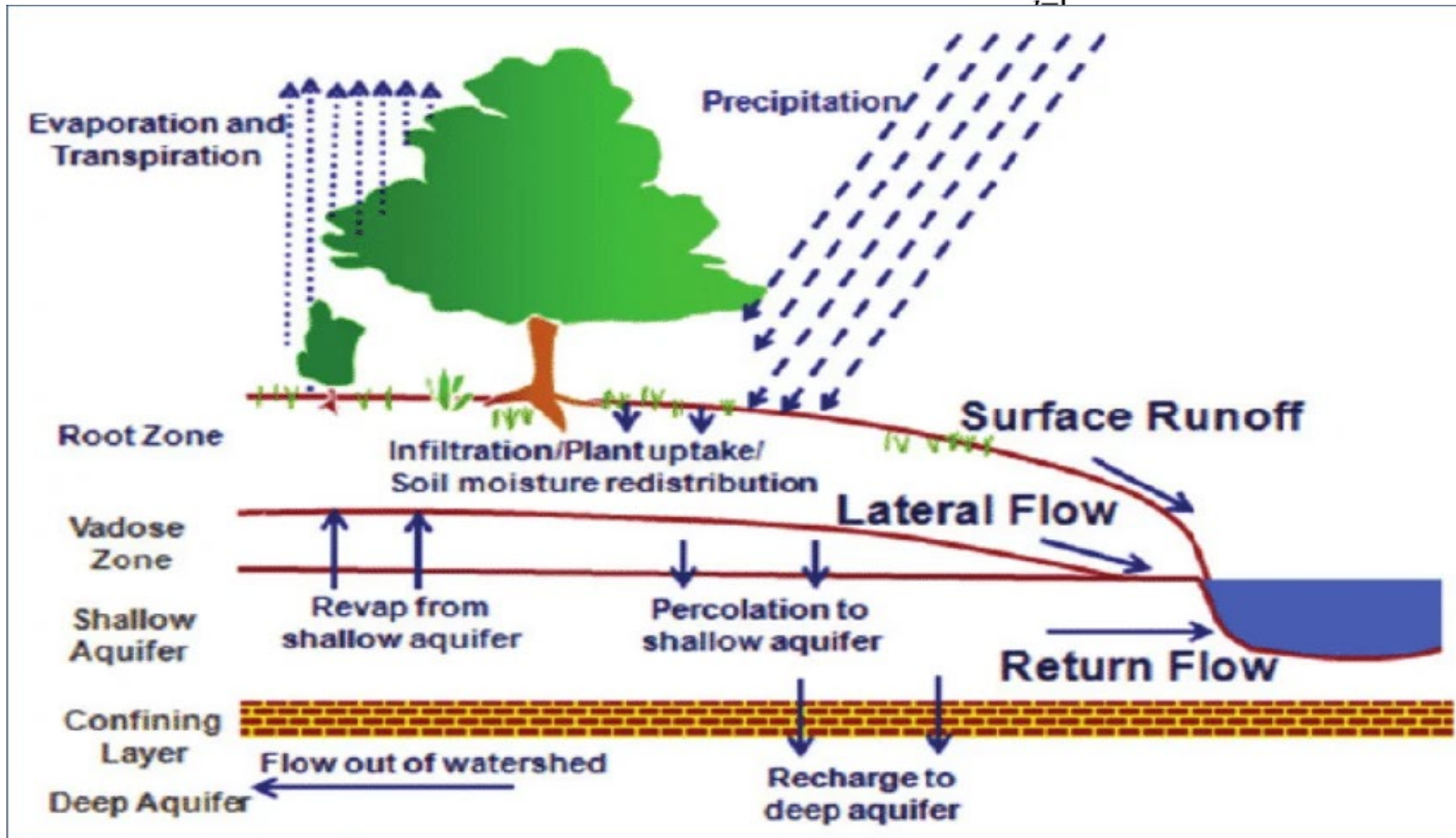


DESCRIPTIVE STATISTIC	SIDEWALKS	PARKING LOTS	PARKS AND TRAILS	VEGETATED MEDIANS
TRAIN MAE	0.33	0.93	1.27	0.37
TRAIN R2	0.43	0.47	0.76	0.40
TEST MAE	0.35	1.24	1.80	0.57
TEST R2	-0.20	0.09	0.50	-0.07
OOB MAE	0.43	1.04	2.13	0.62
OOB R2	0.07	0.09	0.34	-0.12

Heidari, Bardia, Victoria Prideaux, Katherine Jack, and Fouad H. Jaber. 2023. "A Planning Framework to Mitigate Localized Urban Stormwater Inlet Flooding Using Distributed Green Stormwater Infrastructure at an Urban Scale: Case Study of Dallas, Texas." *Journal of Hydrology* 621 (June): 129538. <https://doi.org/10.1016/j.jhydrol.2023.129538>.  
 Jack, Kathy, Fouad Jaber, Bardia Heidari, and Victoria Prideaux. 2022. *Green Stormwater Infrastructure for Urban Flood Resilience: Opportunity Analysis for Dallas, Texas*. Dallas, TX. <https://www.nature.org/content/dam/tnc/nature/en/documents/GSIanalysisREVFINAL.pdf?vu=dallasgsi>.

# SWAT Modeling

$$SW_t = SW_o + \sum_{i=1}^n (R_{day} - Q_{surf} - E_a - W_{seep} - Q_{gw})$$



# SWAT - GSI module

Edit LID Parameters: Subbasin 1

URBNAME  
UCOM  
URHD  
URLD

Green Roof | Rain Garden | Cistern | Porous Pavement

RG_ONOFF	RG_IMO	RG_IYR	RG_FAREA	RG_SOLOP
1	1	1900	1	1
RG_ETCOEF	RG_FC	RG_WP	RG_KSAT	RG_POR
0.3	0.3	0.15	500	0.4
RG_HYDEFF	RG_SOLDPT	RG_DIMOP	RG_SAREA	0
0.1	0.01	0	0.01	
RG_STH	RG_SDIA	RG_BDIA	RG_STS	RG_ORIFICE
1.81	1	1	0.5	1
RG_OHEIGHT	RG_ODIA			
0.51	0.4			

Edit Values  
Cancel Edits  
Save Edits  
Exit

Extend Parameter Edits

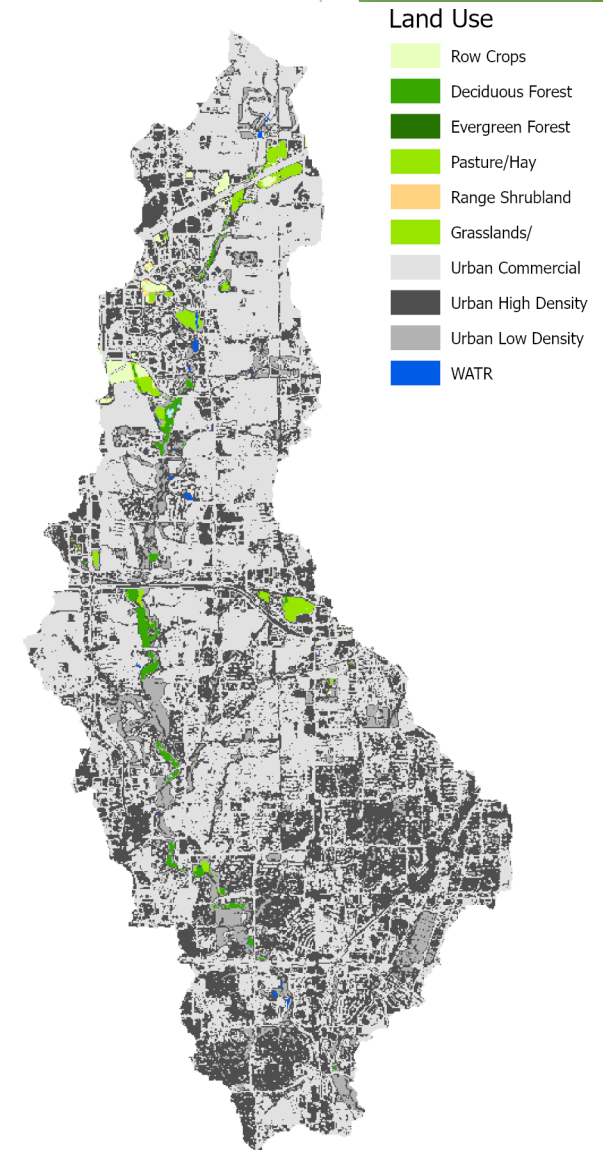
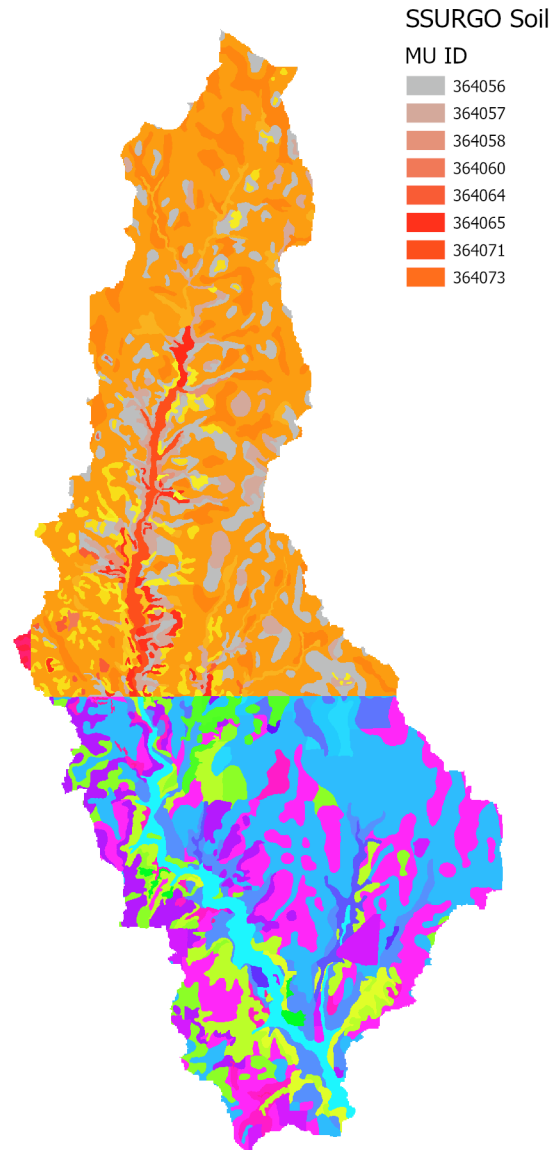
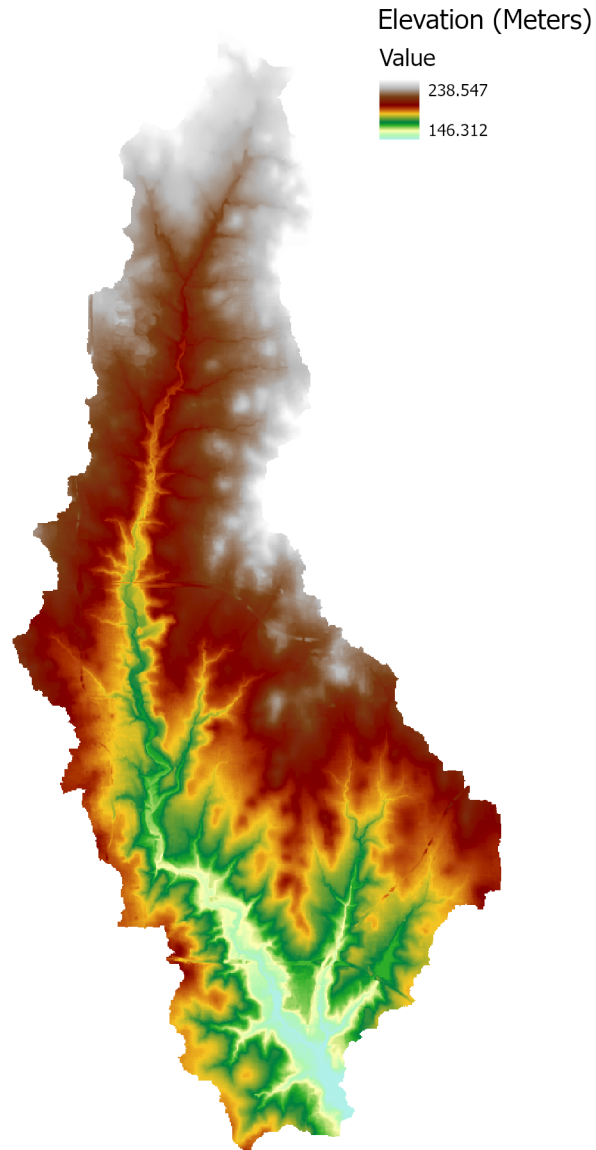
- Extend ALL LID Parameters
- Extend Edits to Current Subbasin
- Extend Edits to All Subbasins
- Extend Edits to Selected Subbasins

Selected Subbasins

Subbasins

# SWAT Modeling Example

## - Highly urbanized area at Whiterock Creek



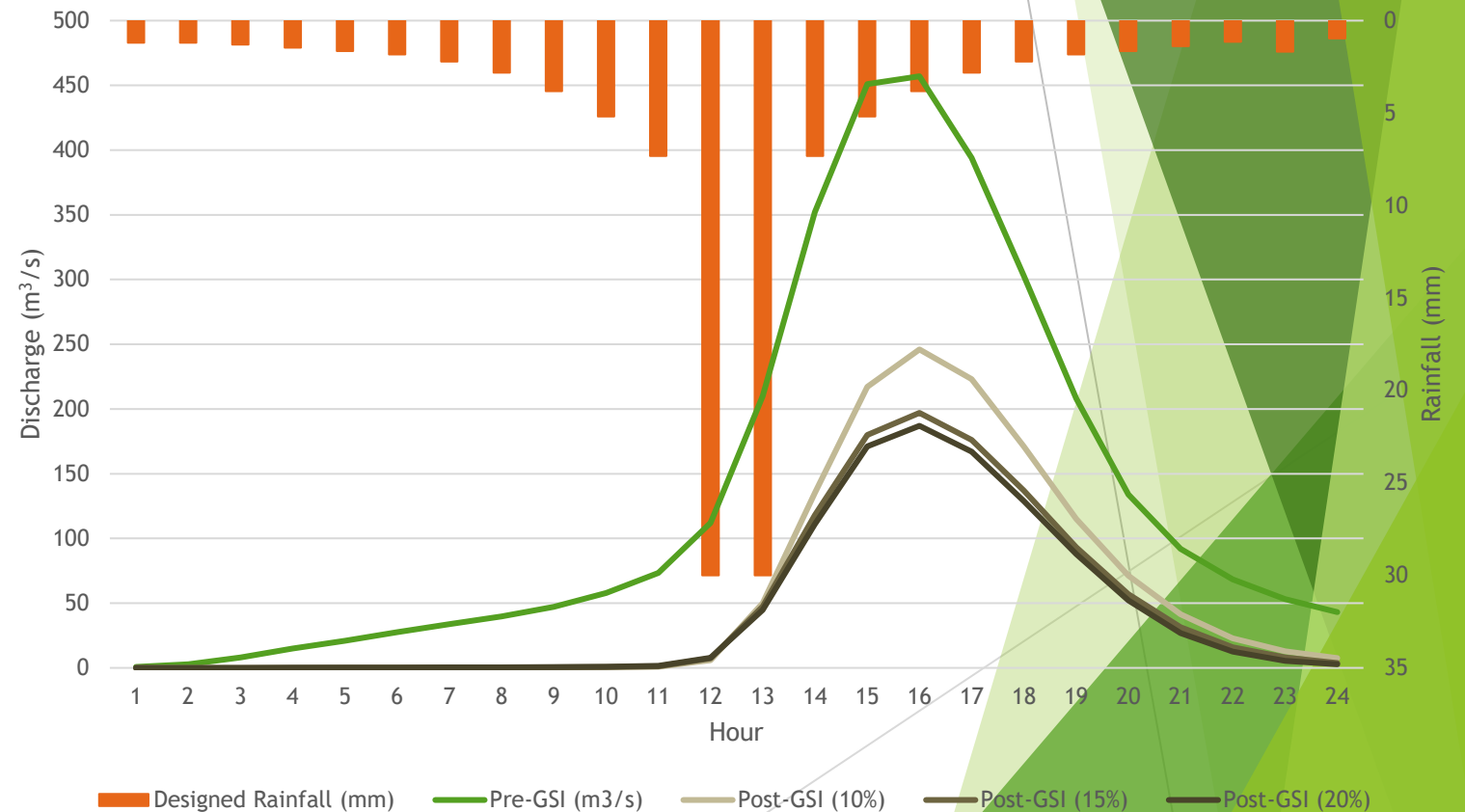
# SWAT Modeling Example

## - Highly urbanized area at Whiterock Creek

### Modeled GSI Parameters

0.1	Fraction of impervious areas draining water to the rain garden
0.3	Evapotranspiration coefficient
0.3	Field capacity of the amended soil (mm/mm)
0.15	Wilting point of the amended soil (mm/mm)
500	Saturated hydraulic conductivity of the amended soil layer (mm/hr)
0.4	Porosity of the amended soil layer (mm/mm)
0.1	Hydraulic efficiency factor (considering clogging up and anisotropy ratio) (0-1)
0.9	Depth of the amended soil (m)
0.1	Fractional area of the rain garden storage surface to the impervious area of an urban HRU (0-1)
0.45	Depth of the rain garden storage (m)
0.15	Height of the orifice from the bottom of the storage (m)
0.05	Diameter of the orifice pipe (m)

Hydrograph Comparison: Pre- and Post-GSI Implementation

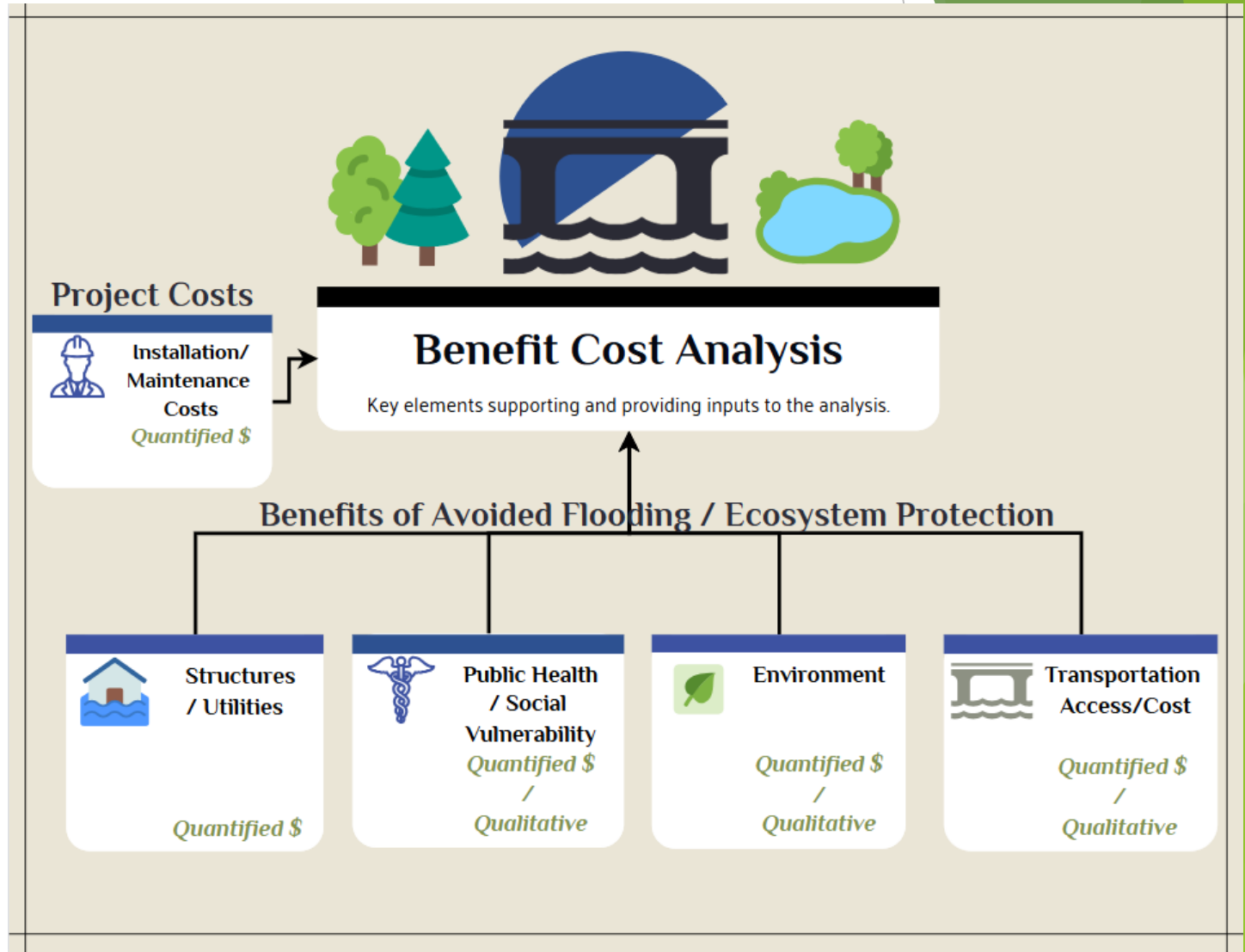


# Environmental & Economic Considerations

- **What is the cost of doing nothing in terms of increased flood damages?**
  - Economic analysis will estimate the flood-related costs to transportation, homes, and other structures of projected increased stormwater (without storage solutions) in two geographies:
    - TSI study area
    - Downstream areas
- **What regional stormwater solutions provide the biggest bang for the buck?**
  - Economic analysis will estimate the benefits of specific, regional alternatives to increase storage through regional detention of stormwater and compare benefits to costs.
- **What's the economic case for conserving greenspace and investing in green stormwater infrastructure?**
  - Economic analysis will provide information on the economic and environmental benefits of these local strategies.

# Cost Benefit of a Specific TSI Alternative

- Integrates information from:
  - Optimization model
  - Hydrology & Hydraulic modeling of flooding
  - Environmental analysis
  - Transportation analysis
  - Engineering cost estimates



# Contact

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