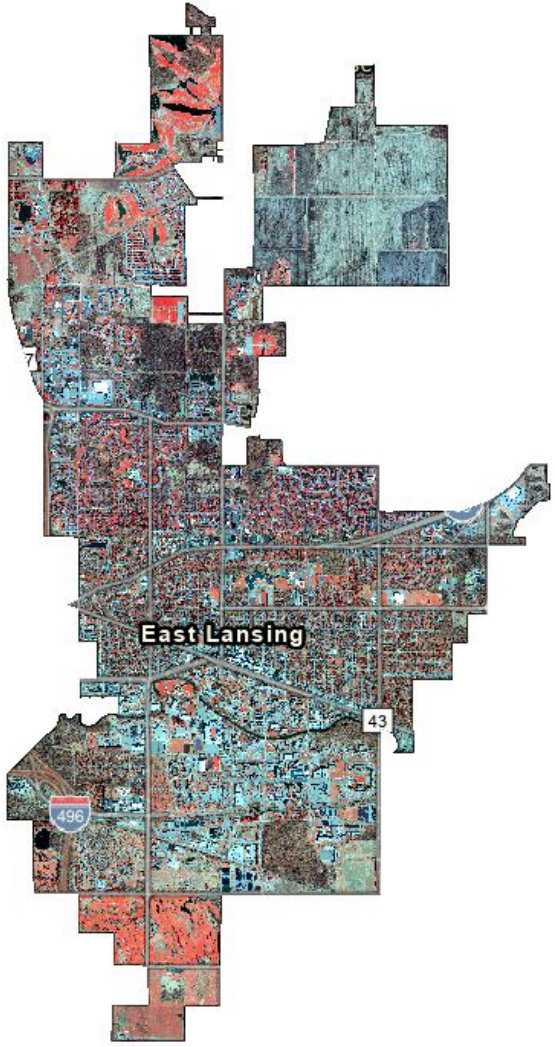
Supporting Storm Water Management Initiative for Community Resilience

Pradip Shrestha
Catalyst Leadership Circle Fellow
University of Michigan

July 28, 2022

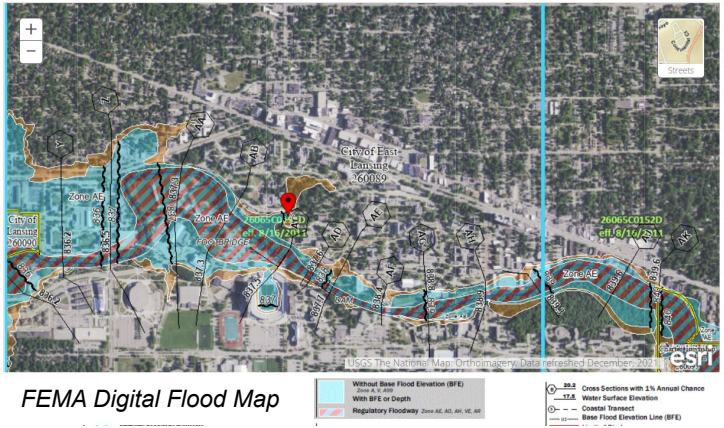


MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

Urban flooding is expected to be more pronounced due to climate change and land use (urban) developments

Subsiding Quarters apartment, September 2021



FEMA Digital Flood Map

9% of the city is in the floodplain, includes 1,200 homes & above 200 businesses

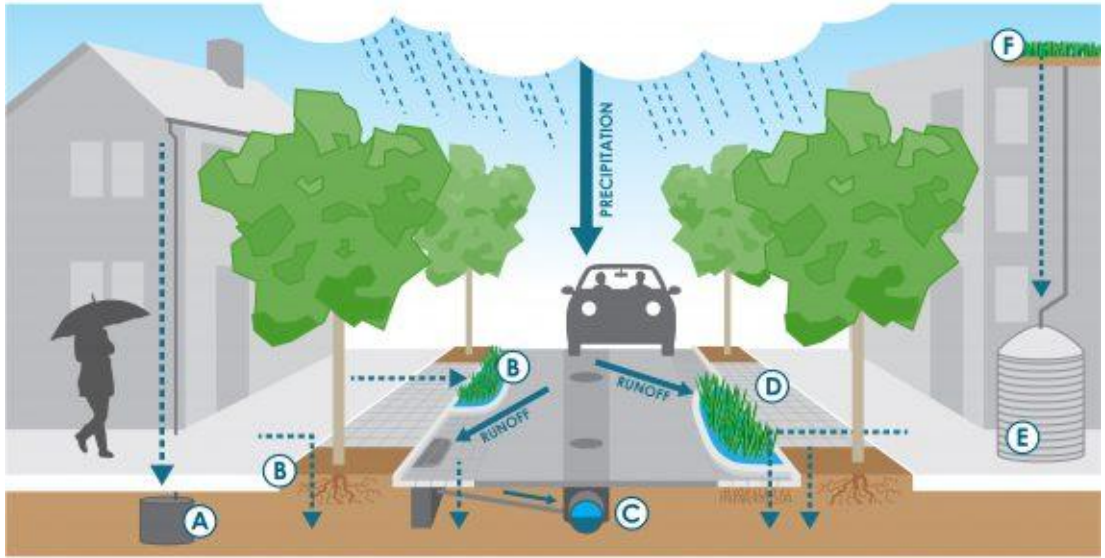
3 in 4 people in the floodplain have no-flood insurance

CITY OF EAST LANSING, MICHIGAN

EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

East Lansing aims to address the urban flooding via development of green infrastructures to reduce runoff volume entering the City's stormwater system



A: Dry Well B: Stormwater Planter C: Storm Drain D: Permeable Paving E: Rainwater Harvesting Cistern F: Green Roof

Benefits

Hydrology restored

Runoff managed at the source

Multi-functional landscapes-aesthetics

Ecosystem services

Scalable

CITY OF EAST LANSING, MICHIGAN

EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

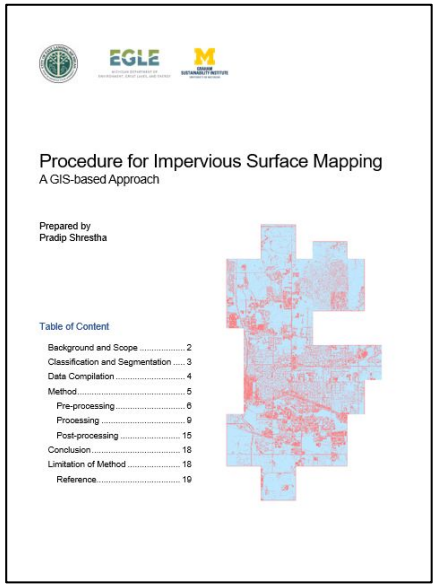
What will be achieved?

Goal

Inform and support citywide planning efforts, leveraging state of art technology for stormwater and resiliency planning

Deliverables

1. Generate an urban impervious dataset that displays citywide impervious area at the parcel level
2. Document the workflow as a procedural manual



Method

Data Compilation

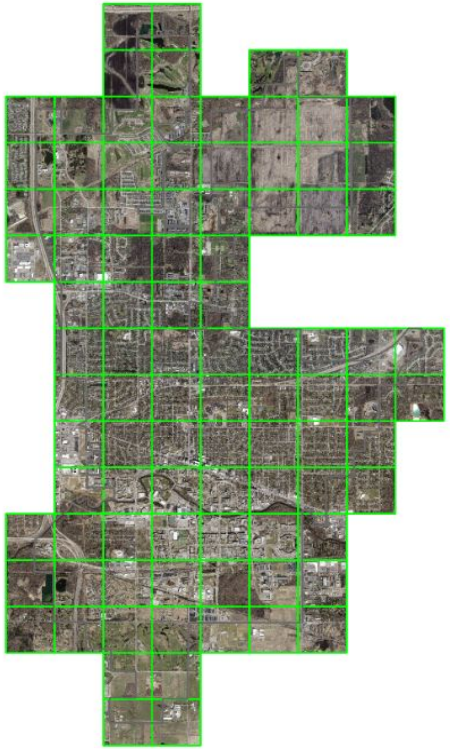
- 2020 3-inch multispectral image (4 bands)
- Ancillary datasets (city boundary and parcel layer)

Approaches

Manual: Prior knowledge of the area, timely

Digitization: Although accurate, labor intensive, costly

Automation: Machine learning (ML) image classification



EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

Steps for impervious layer development

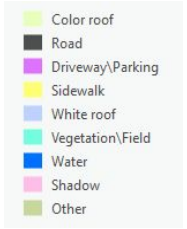
Mean shift segmenter

Input (Mosaic raster)

1

Train

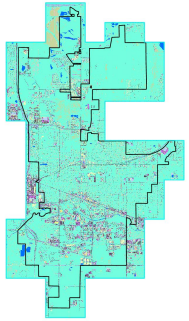
3



Test/Classify

4

Classifier (ML)
Random forest

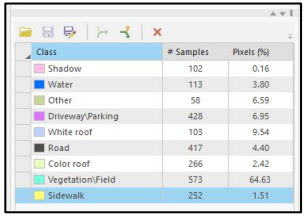


5

Accuracy assessment

Parcel impervious

Generate & Inspect



Class	# Samples	Pixels (%)
Shadow	102	0.16
Water	113	3.80
Other	58	6.59
Driveway\Parking	428	6.95
White roof	103	9.54
Road	417	4.40
Color roof	266	2.42
Vegetation\Field	573	64.63
Sidewalk	252	1.51

Train samples

2

EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

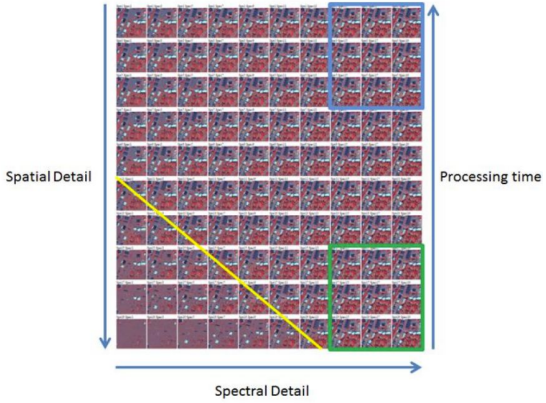
GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

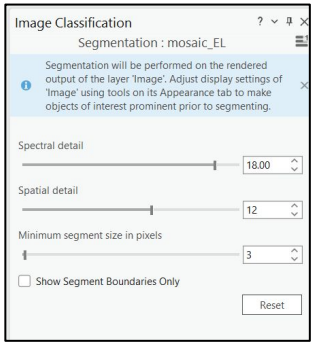
Classification and segmentation considerations

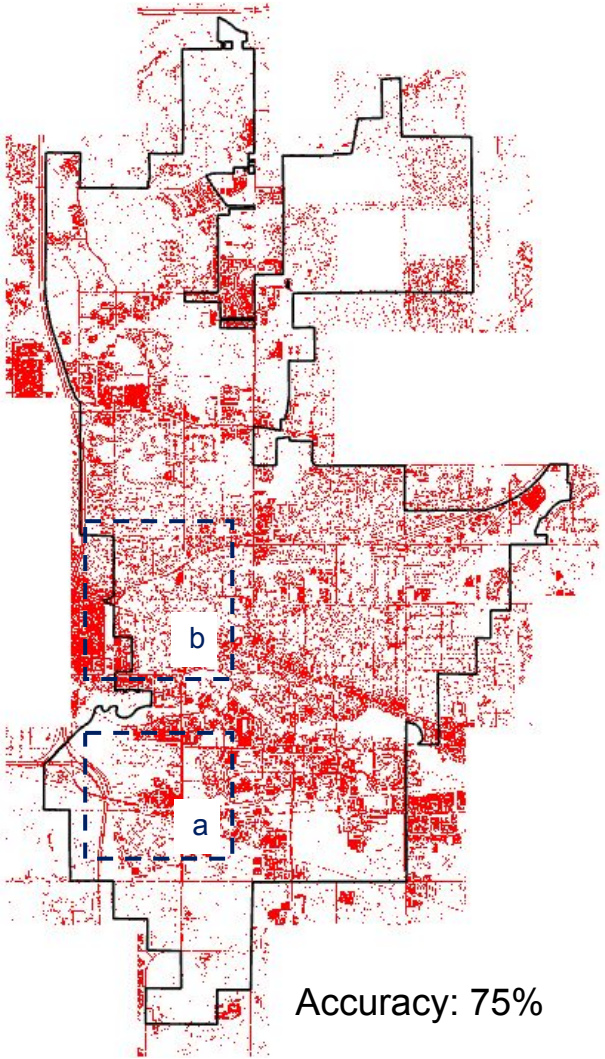
Processing time is related to amount of detail, less details takes longer (more smoothing)

Train samples and land use class – higher the better result

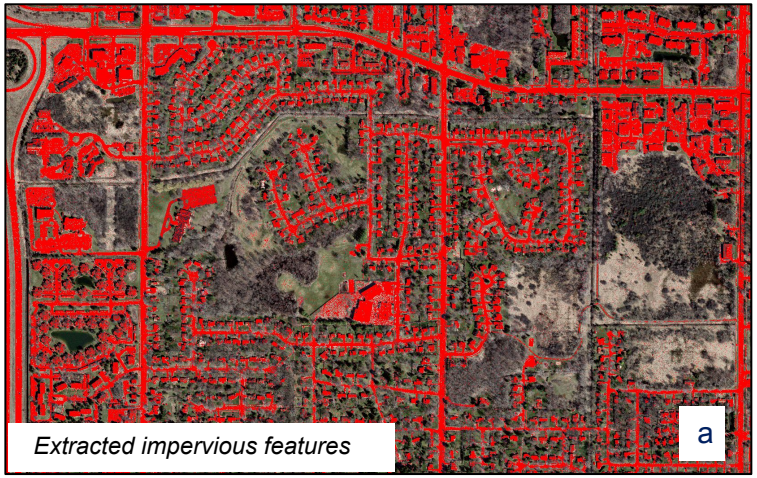
Processing environment – GPU requirements

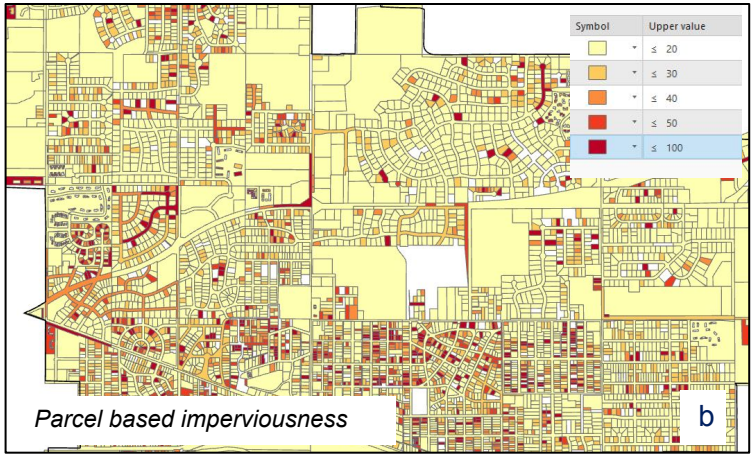






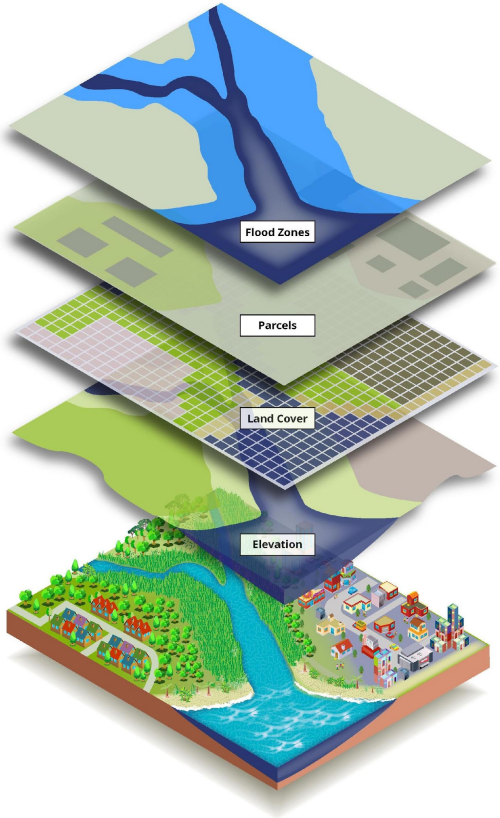
Accuracy: 75%





EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

Application for GI planning



NOAA GI Mapping Guide

Study the magnitude, rate and extent of urban sprawl (urban landscape)

Consistent & precise measurement to assess storm water utility fees

Developing storm water remediation plans

CITY OF EAST LANSING, MICHIGAN

EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

Acknowledgements

Project team: Don, Cliff and Shannon

Fellows

Graham's CLC Fellowship and Sarah

Thank You