A New Spatial Model for Prioritizing Green Infrastructure Investment in Southeast Michigan

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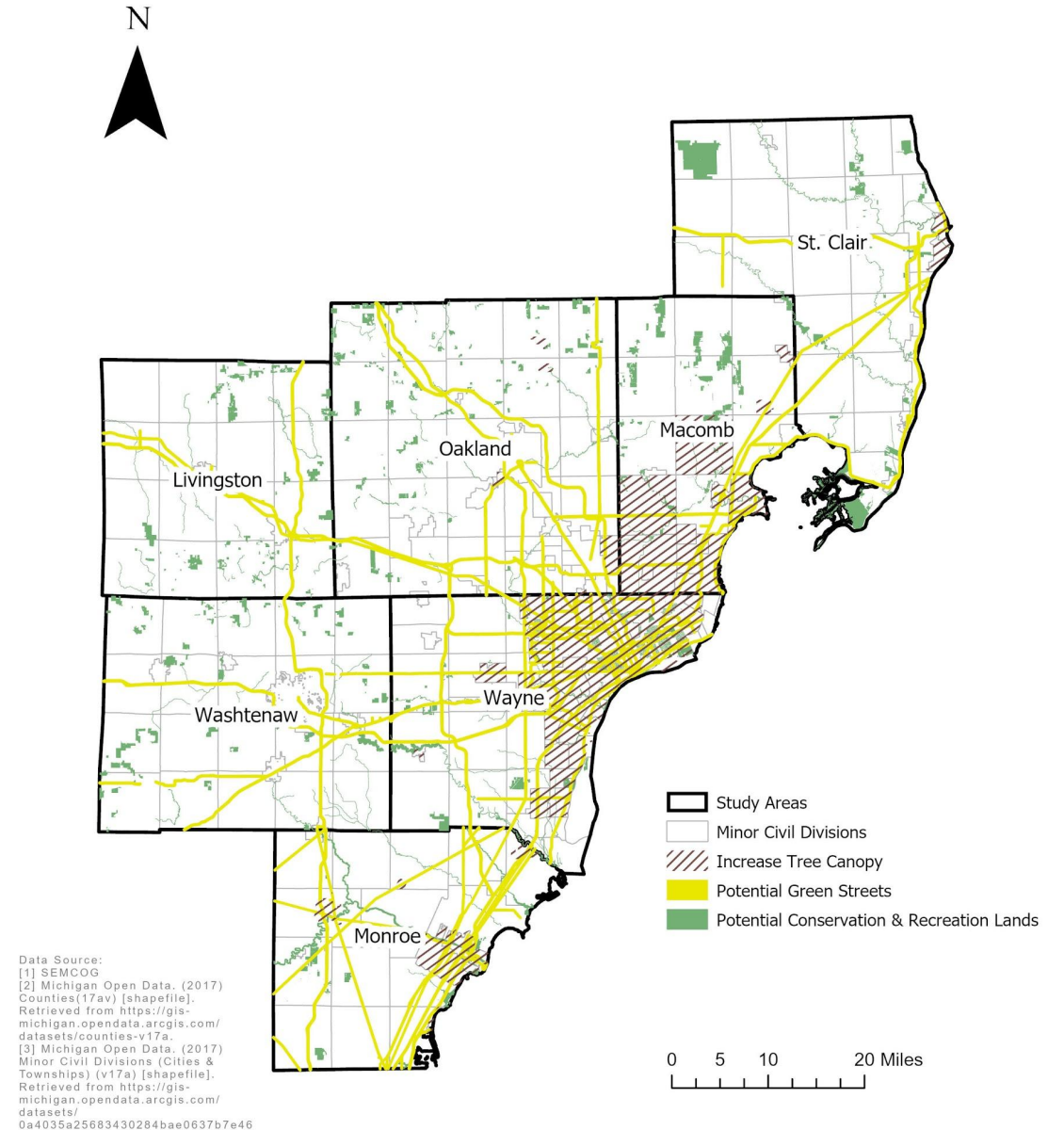UNIVERSITY OF MICHIGAN

GLISA
A NOAA RISA TEAM

Multi-criteria Analysis Case Studies

1. Southeast Michigan (Regional)
2. Detroit Reforestation Initiative Case
3. Washtenaw County Case

Case Study: Southeast Michigan (Regional)

- **Green Infrastructure Vision for Southeast Michigan** (*SEMCOG, 2014*)
  - **Increase Urban Tree Canopy**: communities with less than 20% tree canopy are highlighted as a priority for increasing tree canopy;
  - **Potential Green Streets**: this illustrates major roads that could either increase tree canopy or implement constructed green infrastructure (e.g., bioswales, rain gardens);
  - **Potential Conservation and Recreation**: this highlights GI that could be added to the public green infrastructure network.
- Our Project:
  - **Problem**: There is broad support for investing in green infrastructure in the region, but existing plans do not provide spatially detailed prioritization that incorporates their many different economic and social benefits.
  - **Approach**: Conduct a regional multi-criteria analysis combining multiple layers illustrating different benefits. Our focus is on forms of green infrastructure with trees.

N

St. Clair

Macomb

Oakland

Livingston

Wayne

Washtenaw

Monroe

Study Areas
Minor Civil Divisions
Increase Tree Canopy
Potential Green Streets
Potential Conservation & Recreation Lands

Data Source:
[1] SEMCOG
[2] Michigan Open Data. (2017) Counties(17av) [shapefile]. Retrieved from https://gis-michigan.opendata.arcgis.com/datasets/counties-v17a.
[3] Michigan Open Data. (2017) Minor Civil Divisions (Cities & Townships) (v17a) [shapefile]. Retrieved from https://gis-michigan.opendata.arcgis.com/datasets/0a4035a25683430284bae0637b7e46

0   5   10   20 Miles

Case Study: Southeast Michigan(Regional)

- **Partner**: the Southeast Michigan Cou[...]
  Governments (SEMCOG)
- **Study Area**:
  - 7 Counties
  - Population: 4.7 million (*2010 Ce[...]*
  - Area: 4,598 sq. miles
- **Goal**: conduct more specific analysis [...]
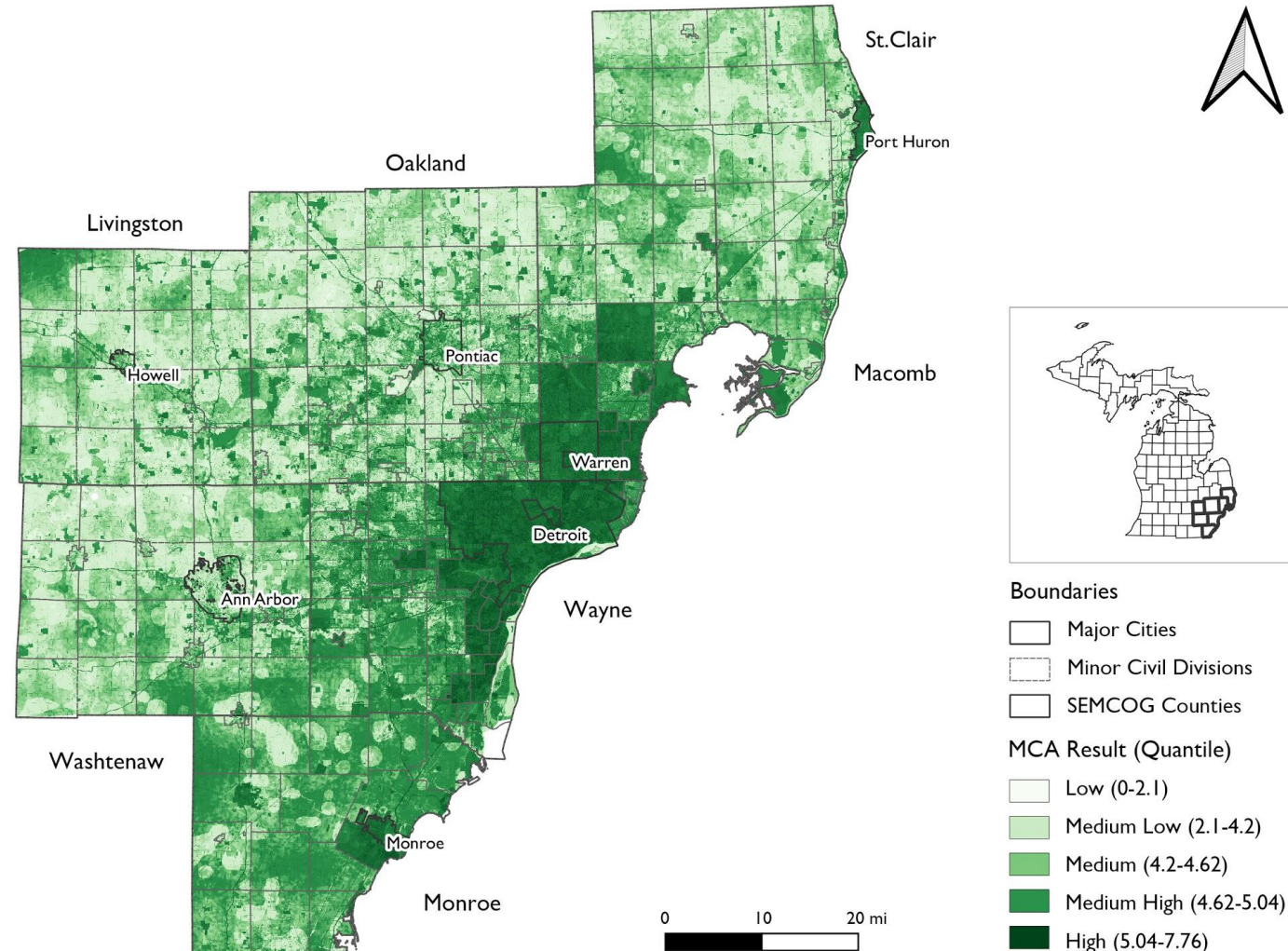 prioritize where to plant more trees [...]
  each SEMCOG GI Vision category
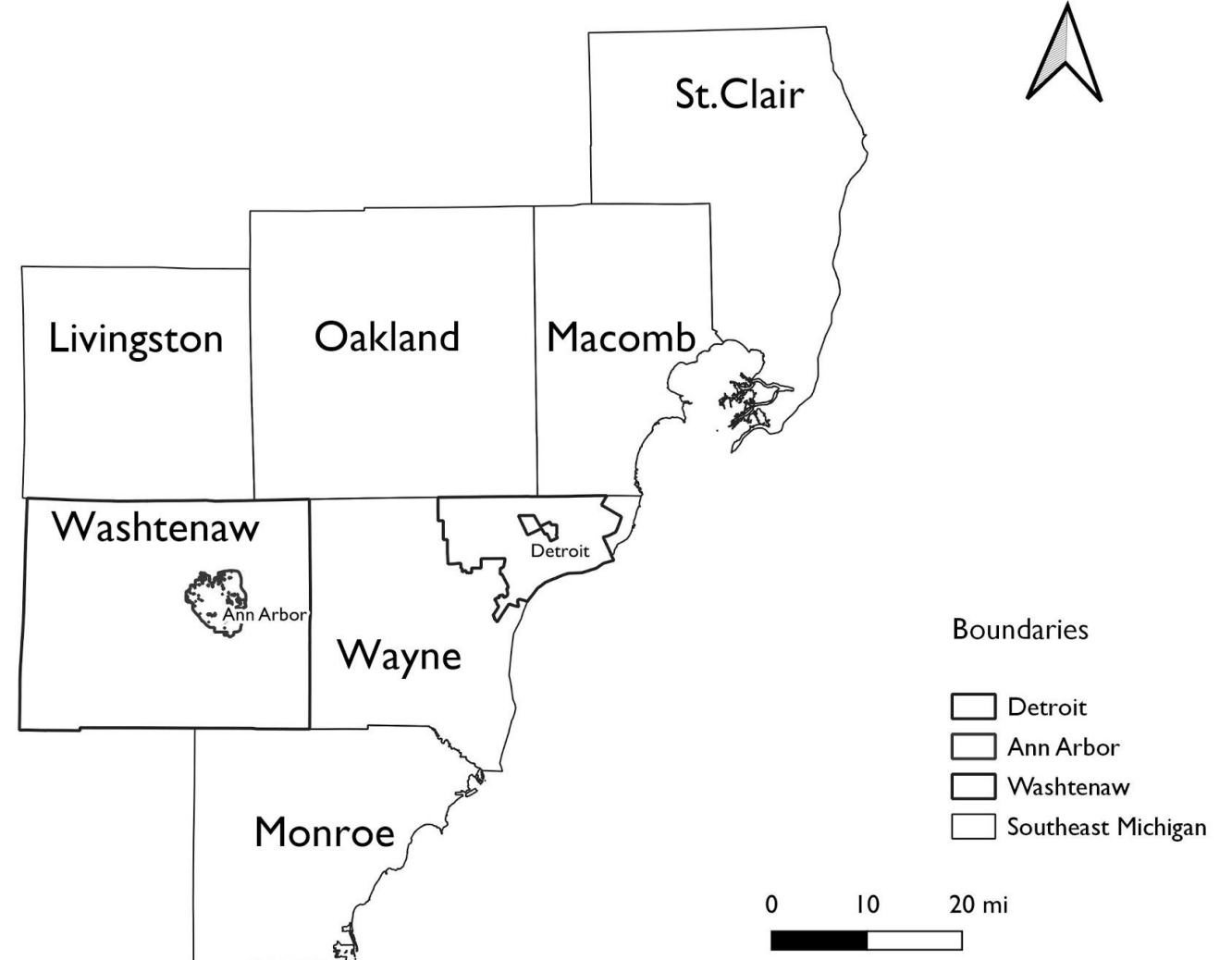
Case Study: Southeast Michigan(Regional)

- **Region-Wide Green Infrastructure Priority Map**

   6 MCA Factors:
   - Stormwater Management
   - Social Vulnerability
   - Access to Green Space
   - Urban Heat Island
   - Air Quality
   - Habitat Connectivity

Boundaries

- Major Cities
- Minor Civil Divisions
- SEMCOG Counties

MCA Result (Quantile)

- Low (0-2.1)
- Medium Low (2.1-4.2)
- Medium (4.2-4.62)
- Medium High (4.62-5.04)
- High (5.04-7.76)

Case Study: Detroit Reforestation Initiative

- **Partner**: Detroit Reforestation Initiative (DRI)
- **Study Area**: Detroit
  - Population:674,841 *(2019 Census)*
  - Area:142.9 sq. miles
- **Goal**: Align DRI's tree planting strategy with the MCA analysis to identify future tree prioritization, including info for how many trees should be planted in the proposed area and what's the cost;

Case Study: Detroit Reforestation Initiative

PLANTING STRATEGY		KEY GOALS	IDEAL SITE CRITERIA
NEIGHBORHOOD TREE CANOPY		LOW CANOPY NEIGHBORHOODS, CITY PLANNING LOCATIONS, HIGH POPULATION DENSITY, VULNERABLE POPULATIONS	LOW TREE CANOPY, HIGH POPULATION DENSITY, VULNERABLE POPULATIONS, PROXIMITY TO PARKS AND OR SCHOOLS
VEGETATIVE BUFFERS		RESIDENTIAL OR SCHOOL PROXIMITY TO HEAVY TRAFFIC CORRIDORS, VULNERABLE POPULATIONS	LOW TREE CANOPY, MEDIUM TO HIGH POPULATION DENSITY, VULNERABLE POPULATIONS, PROXIMITY TO SCHOOLS, PROXIMITY TO HIGH TRAFFIC VOLUME, HIGH ASTHMA RATES
LAND-BASED VENTURES		CONTIGUOUS VACANT LOTS WITH LOWER HOUSING STOCK, PROXIMITY TO SCHOOLS OR TRAINING CENTERS, ZONING	LOW TO MEDIUM POPULATION DENSITY, BUNDLES OF VACANT LANDS > 0.5 ACRES, PROXIMITY TO EXISTING LAND-BASED VENTURES, PARCELS ZONED BY RIGHT, NON-CONTAMINATED SITES
PARKS & GREENWAYS		PROXIMITY TO OR IN PARKS AND GREENWAYS WITH LOW TREE CANOPY COVER, CITY PLANNING LOCATIONS	LOW TREE CANOPY, IN OR NEAR A PARK, MEDIUM TO HIGH POPULATION DENSITY, VULNERABLE POPULATION, PROXIMITY TO HIGH TRAFFIC VOLUME
COMMERCIAL CORRIDOR PLANTINGS		TARGETTED COMMERCIAL, CULTURAL, OR ROADWAY IMPROVEMENT LOCATIONS, "HEAT ISLAND" SITES	LOW TREE CANOPY, HIGH POPULATION DENSITY, VULNERABLE POPULATIONS, COMMERCIAL THOROUGHFARE, HEAT ISLAND LOCATIONS, TRAFFIC CALMING LOCATIONS
LOW POPULATION AREAS		LOW FUTURE DEVELOPMENT POTENTIAL AREAS, PROXIMITY TO AREAS OF CONCERN, FLOOD AREAS, PROXIMITY TO OUTDOOR RECREATION AREAS	LOW TREE CANOPY, LOW POPULATION DENSITY, VULNERABLE POPULATIONS, HEAT ISLAND LOCATIONS

Note: DRI's current priority planting strategies, which are carried out in isolation

- **UM-DRI Suitability Criteria**
  - **Air Quality**
    - Estimated PM2.5
    - Estimated Ground-level Ozone
    - Traffic Volume
  - **Social Equity**
    - Low Tree Canopy
    - Heat Vulnerability Index
    - Heat Island Locations
    - Distance to Parks
  - Stormwater Management
    - Runoff from Land use
  - **Public Health**
    - Asthma Rate

Case Study: Detroit Reforestation Initiative

- **Two new factors:**
  - **Traffic Volume**
    - Indicator: Average Annual Daily Traffic (*Michigan Department of Transportation, 2019*)
    - Method: Kernel Density with a 400-meter buffer
  - **Asthma Rate**
    - Indicator: Current Asthma Prevalence Among Adults Aged ≥18 years (%) (*Behavioral Risk Factor Surveillance System, 2020*)

Note: *Haven't yet combined MCA factors to generate the MCA score*
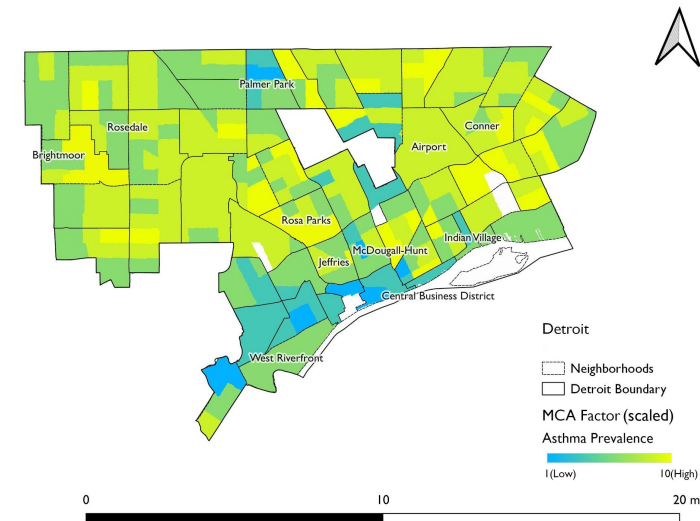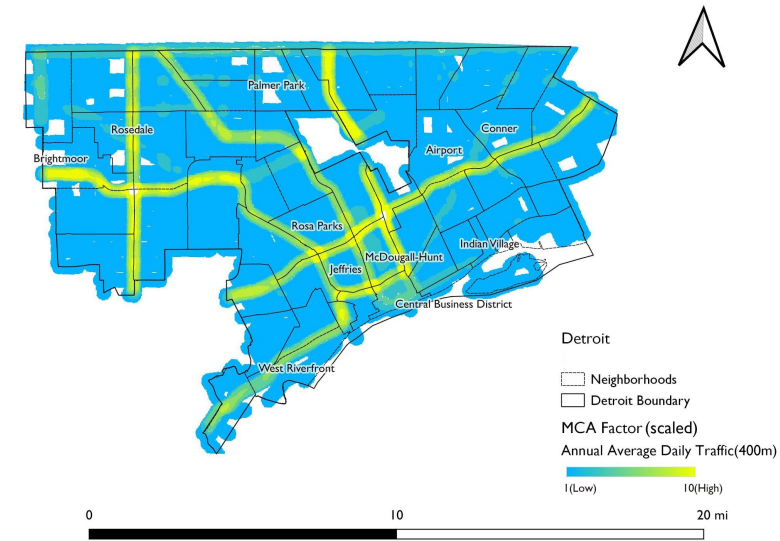
Case Study: Washtenaw County Case

- **Partner**: Washtenaw County Parks and Recreation Commission (WCPARC)
- **Study Area**:
  - Washtenaw County
    - Population: 344,791 (*2010 Census*)
    - Area: 722 sq. miles
- **Natural Areas Preservation Program** (NAPP)
  - Purchases Lands with special ecological, recreational, and educational benefits to ensure their preservation and promote public uses and participation.
- **Goal**: integrate MCA analysis for reviewing lands nominated by landowners and deciding future forestation prioritization

a. Case Study Area: Washtenaw County
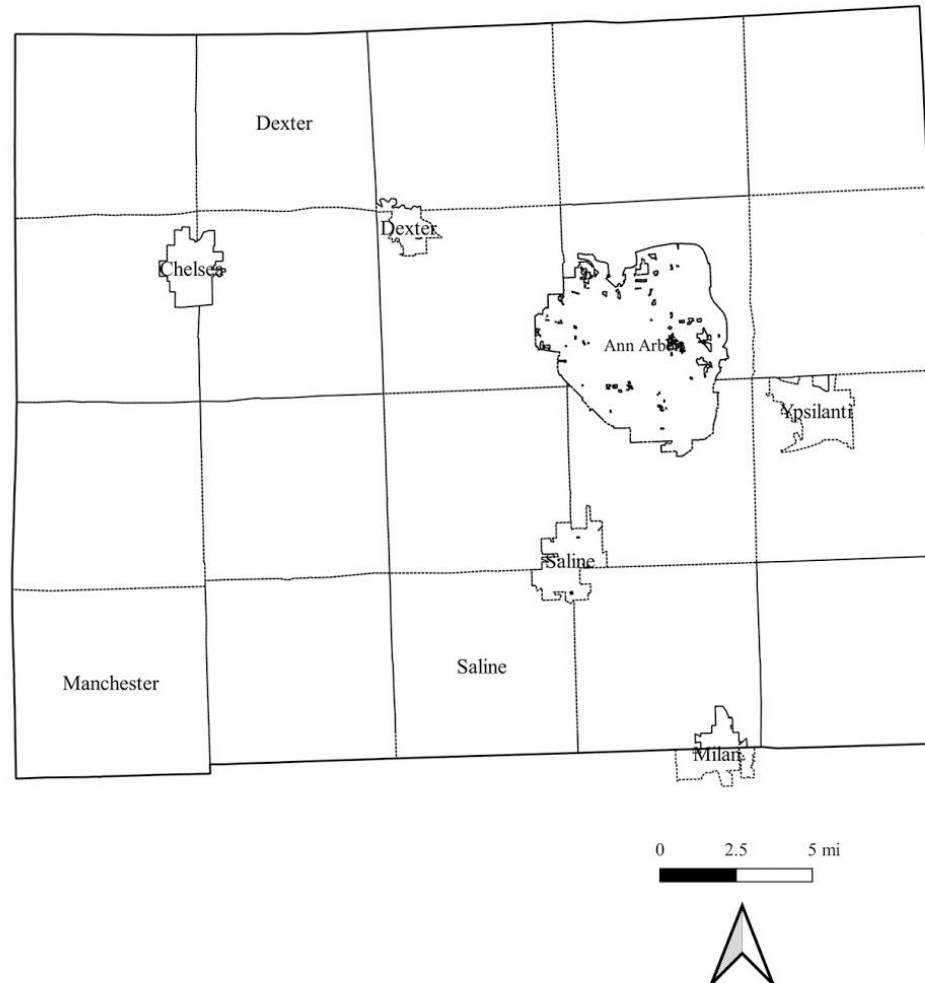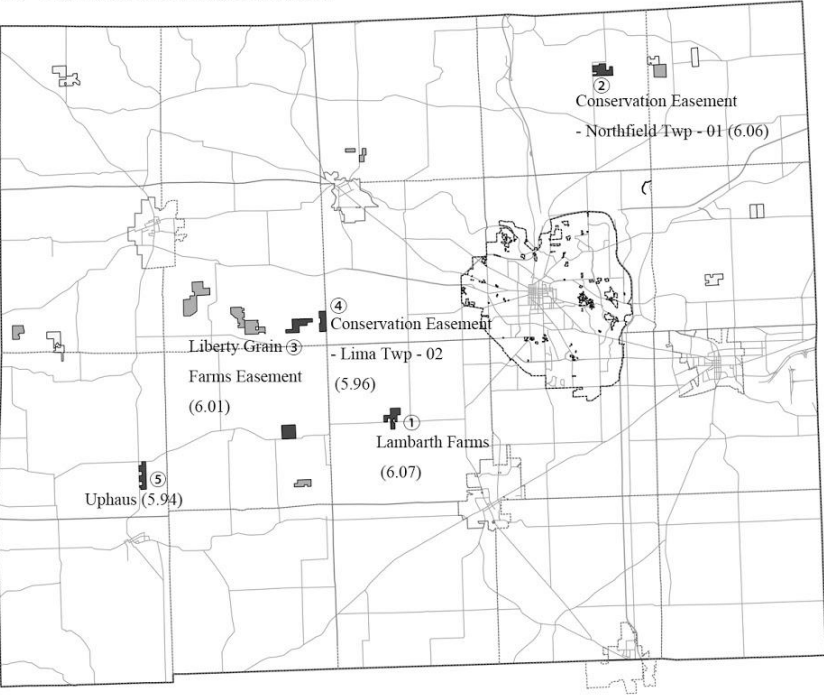
Case Study: Washtenaw County Case

- **Three types of lands**
  - WCPARC conservation lands (N=21);
  - WCPARC preserved recreation lands (N=33);
  - Inactive nominated lands (N=107).
- **Customized Weighting system**
  - Stormwater Management:25
  - Urban Heat Island: 10
  - Social Vulnerability: 10
  - Habitat Connectivity: 25
  - Access to Green Space: 10
  - Air Quality: 20

	Conservation Land			Preserved Recreation Land			Inactive Nominations		
Rank	Name	Area (acre)	Overall MCA Score	Name	Area (acre)	Overall MCA Score	Name	Area (acre)	Overall MCA Score
1	Lambarth Farms	150.13	6.07	Dominican Meadows Preserve	81	5.94	Newman	27	6.53
2	Conservation Easement - Northfield Twp - 01	163.64	6.06	Northfield Woods Preserve	81	5.88	Morehouse1	40	6.48
3	Liberty Grain Farms Easement	166.84	6.01	Highland Preserve	50	5.83	Morehouse2	40	6.48
4	Conservation Easement - Lima Twp - 02	115	5.96	Scio Woods Preserve	91	5.78	DPG-Malick	66	6.38
5	Uphaus	137.66	5.94	Arbor Woods Preserve	22	5.78	Ponte	30.0300007	6.25

Stormwater Management + Land Connectivity explains 41.4% of the variance of MCA scores
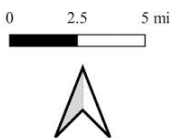
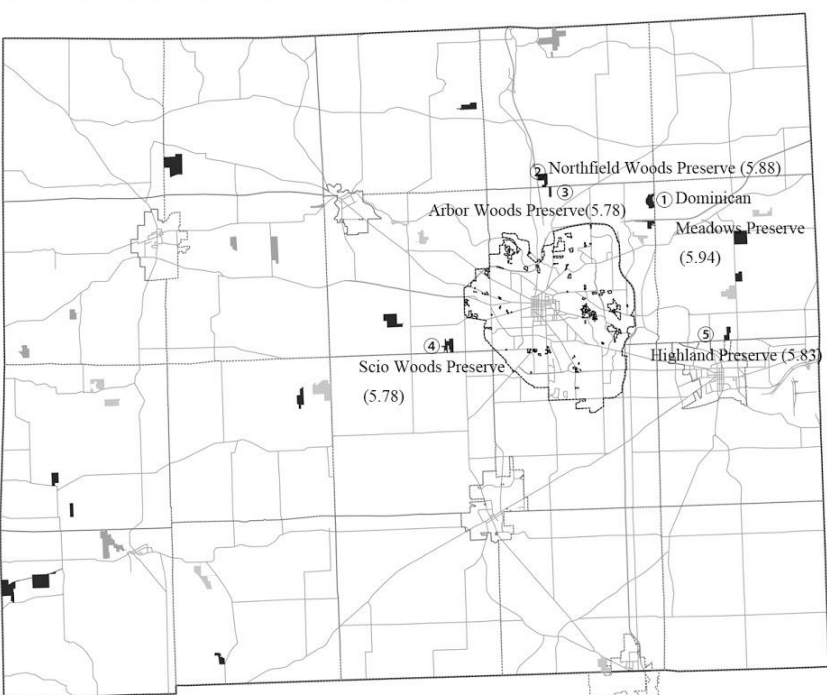# Case Study: Washtenaw County Case

b. Conservation Lands

Conservation Easement - Northfield Twp - 01 (6.06)

② Conservation Easement - Lima Twp - 02 (5.96)

④ Conservation Easement

Liberty Grain ③
Farms Easement (6.01)

① Lambarth Farms (6.07)

⑤ Uphaus (5.94)

Multi-criteria Analysis Result
Inactive Nominations
- 4.75-5.42 (Low)
- 4.75-5.89 (Medium)
- 5.89-6.07 (High)

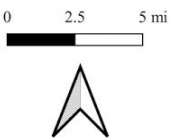Boundaries
- Ann Arbor
- Minor Civil Divisions
- Washtenaw
- Road Centerlines

0 2.5 5 mi

c. Preserved Recreation Lands

② Northfield Woods Preserve (5.88)
③ Arbor Woods Preserve (5.78)
① Dominican Meadows Preserve (5.94)

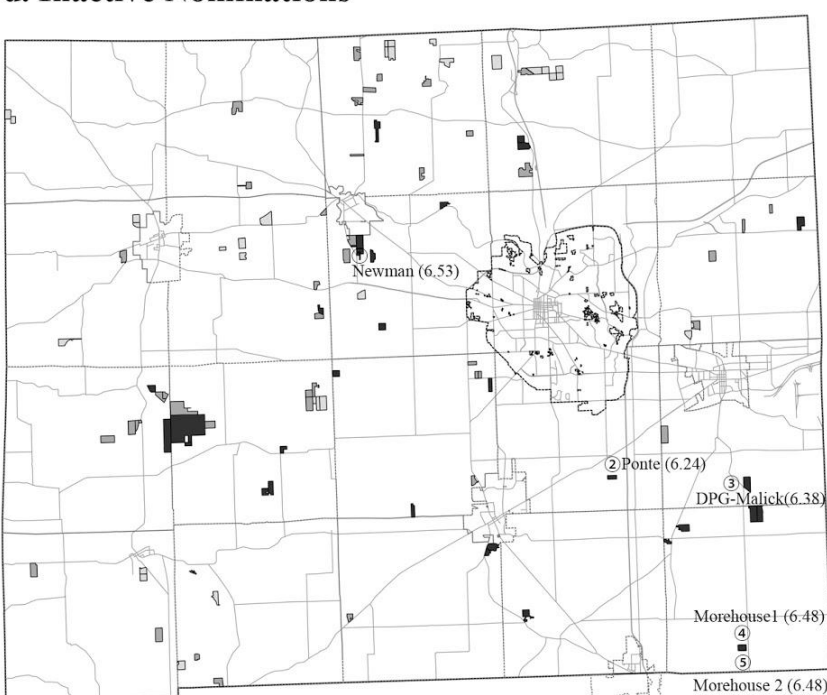④ Scio Woods Preserve (5.78)

⑤ Highland Preserve (5.83)

Multi-criteria Analysis Result
Inactive Nominations
- 3.77-4.49 (Low)
- 4.49-5.22 (Medium)
- 5.22-5.94 (High)

Boundaries
- Ann Arbor
- Minor Civil Divisions
- Washtenaw
- Road Centerlines

0 2.5 5 mi

d. Inactive Nominations

Newman (6.53)

② Ponte (6.24)
DPG-Malick (6.38)

Morehouse1 (6.48)
④
⑤
Morehouse 2 (6.48)

Multi-criteria Analysis Result
Inactive Nominations
- 4.39 - 5.11 (Low)
- 5.11 - 5.82 (Medium)
- 5.82 - 6.53 (High)

Boundaries
- Ann Arbor
- Minor Civil Divisions
- Washtenaw
- Road Centerlines

0 2.5 5 mi