

COMMUNITY TREES

MAP SET:

BRIDGEWATER TOWNSHIP

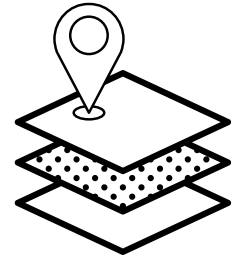
2022



A GUIDE TO THE MAP SET

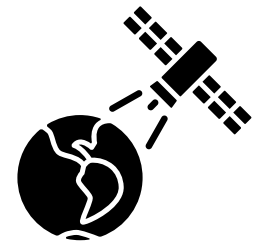
WHAT IS GIS?

GIS is the abbreviation for geographic information systems, computer software that allows the user to overlay multiple layers of information, such as streets, buildings, and vegetation, on the earth's surface. GIS can help to better understand the distribution of these elements and discover relationships and patterns.



TERMS

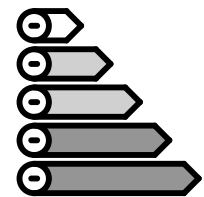
LiDAR is the abbreviation for light detection and ranging, a remote (i.e. satellites or planes) sensing technology that can calculate the height of an object, such as buildings or vegetation, on the earth's surface.



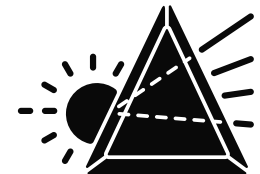
Aerial photographs and **satellite imagery** are both remotely sensed images distinguished by the altitude and characteristics of the sensors, namely cameras or electronic scanners. In general, data taken at low-altitude captures more detail, but covers a smaller area. Some sensors can capture energy from portions of the electromagnetic spectrum, such as infrared, that the human eye cannot see! These additional wavelengths, or bands, provide more data to help distinguish between features on the ground.



Image classification is the task of categorizing pixels based on their spectral characteristics in a raw image. **Supervised** classification means the analyst teaches the software to classify the pixels, while **unsupervised** means the classes are assigned based on the distribution of values. The final result might be a map of land cover classes (agriculture, urban, forest, etc.), impervious surfaces, or tree canopy cover.



NAIP is the abbreviation for USDA's National Agriculture Imagery Program which, every three years, collects four-band "leaf-on" data (i.e. during the growing season) at a 1-meter (about 3.2 feet) resolution. The four-bands are red, green, blue, and near infrared, which can help distinguish healthy and diseased vegetation.



TERMS CONTINUED

Land cover is the physical land type (forest, open water, wetlands, crops) and can be determined from remotely sensed images.

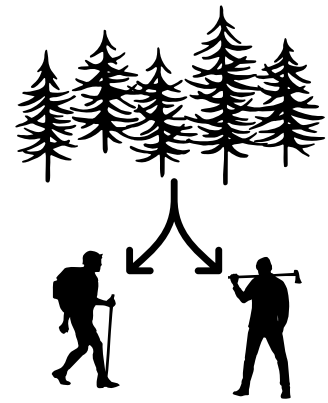
Land use is how people are using the land (recreation, industrial, residential, agriculture, commercial) and cannot necessarily be determined using satellite imagery or aerial photographs.

NLCD stands for National Land Cover Database, which provides nationwide United States data on land cover and land cover change at a 30m resolution. Since 2001, consistent methodologies and collection at 2-3 year intervals enables monitoring and trend assessments of land cover and associated changes over time. See the side bar for a brief overview of the land cover classes.

GRASS GIS, Geographic Resources Analysis Support System, is a free and open-source GIS software that began in 1982. It was developed as an international team effort that includes scientists and developers from various fields, including federal U.S. agencies, universities, and private companies. However, like most free software, it relies on users to develop new tools and applications and refine existing ones. **QGIS** is another example of a volunteer-driven, free and open-source GIS software that relies on users to improve and advance the product. **ArcGIS**, produced by Esri, is an example of a GIS software that is maintained and updated by a for-profit company. Selecting the appropriate GIS software might depend on the application, models to be integrated, and analyst/user comfort level,

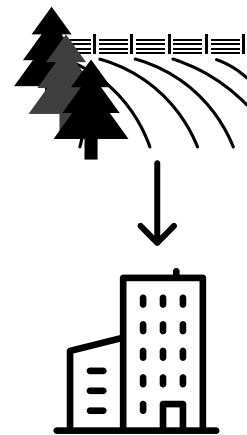
FUTURES, FUTure Urban-Regional Environment Simulation, is an open-source land change model developed by the Landscape Dynamics Group at NC State University to examine regional-scale impacts of urbanization on the environment.

It uses base data of land cover maps through time, as well as existing socio-economic, environmental (e.g. protected lands), or infrastructure (e.g. roads), and historical and projected population data to predict where future development is likely to occur.



11	Open Water
12	Perennial Ice/ Snow
21	Developed, Open Space
22	Developed, Low Intensity
23	Developed, Medium Intensity
24	Developed, High Intensity
31	Barren Land (Rock/Sand/Clay)
41	Deciduous Forest
42	Evergreen Forest
43	Mixed Forest
51	Dwarf Scrub*
52	Shrub/Scrub
71	Grassland/Herbaceous
72	Sedge/Herbaceous*
73	Lichens*
74	Moss*
81	Pasture/Hay
82	Cultivated Crops
90	Woody Wetlands
95	Emergent Herbaceous Wetlands

* Alaska only



TERMS CONTINUED

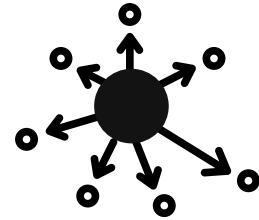
Stormwater runoff is snow melt or rainfall that, instead of soaking into the soil, flows over the ground and into stormdrains or waterbodies. Runoff doesn't receive any treatment, so anything it picks up (trash, chemicals, bacteria, sediment, etc.) can be flushed into our streams, rivers, and lakes and cause impairments for wildlife and human use. The large volume of runoff can also cause flooding, streambank erosion, and wash away habitat for wildlife.



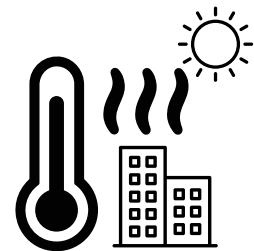
Impervious surfaces prohibit the infiltration of water and are generally man-made structures, such as roads, sidewalks, buildings, parking lots, etc. Higher percentages of impervious surfaces in an area correspond to lower infiltration rates (ability of water to absorb into the soil) and increases in stormwater runoff.



Habitat connectivity is concerned with wildlife's ability to migrate between suitable environments necessary for survival, reproduction, and life cycle. As landscapes are increasingly developed, habitats, such as forests, may be fragmented into smaller areas which may not be suitable for a particular species or may not provide all elements necessary for a creature's life cycle.



Urban heat islands (UHI) are metropolitan areas that are a lot warmer than neighboring rural areas due to a higher percentage of materials that absorb and trap heat from the sun, such as buildings and roadways. UHIs often have higher energy costs, air pollution levels, and heat-related illness and mortality. Trees and other vegetation help to counteract this effect by shading surfaces, deflecting radiation, and releasing moisture.



Census tracts are small, semi-permanent subdivisions of a county used in statistical analyses to determine trends in an area over time and managed by the US Census Bureau.



TERMS CONTINUED

Agroforestry is the intentional inclusion of trees and shrubs in crop and livestock farming systems for environmental, economic, and social benefits. Examples of agroforestry practices and some of its benefits include:

Alley cropping - Growing crops in alleys between regularly spaced rows of trees and shrubs intended to: diversify revenue streams, protect crops, and reduce soil erosion, nutrient leaching, and water runoff from fields.

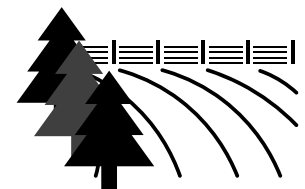
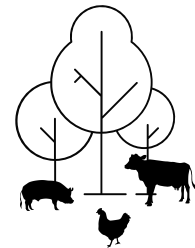
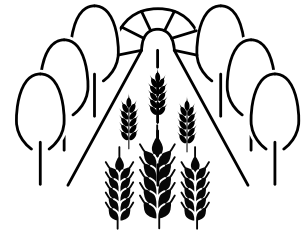
Riparian buffers - Strips of permanent vegetation alongside a stream, wetland or lake planted or retained to protect crops by buffering floods, produce income in marginal farmland prone to flooding, diversify income, provide wildlife habitat and corridors, stabilize soils, and filter nutrients, pesticides, and sediment from farm runoff.

Silvopasture - Managing a wooded pasture through rotational grazing to support livestock and fodder trees or timber stand production to diversify income, improve livestock health, provide shade and wind protection, and support wildlife habitat.

Windbreaks - Strips of trees or shrubs strategically planted to protect crops, reduce soil loss, diversify income, provide wildlife corridors, and block views and odors. Also called shelterbelts, hedgerows, or living snow fences.

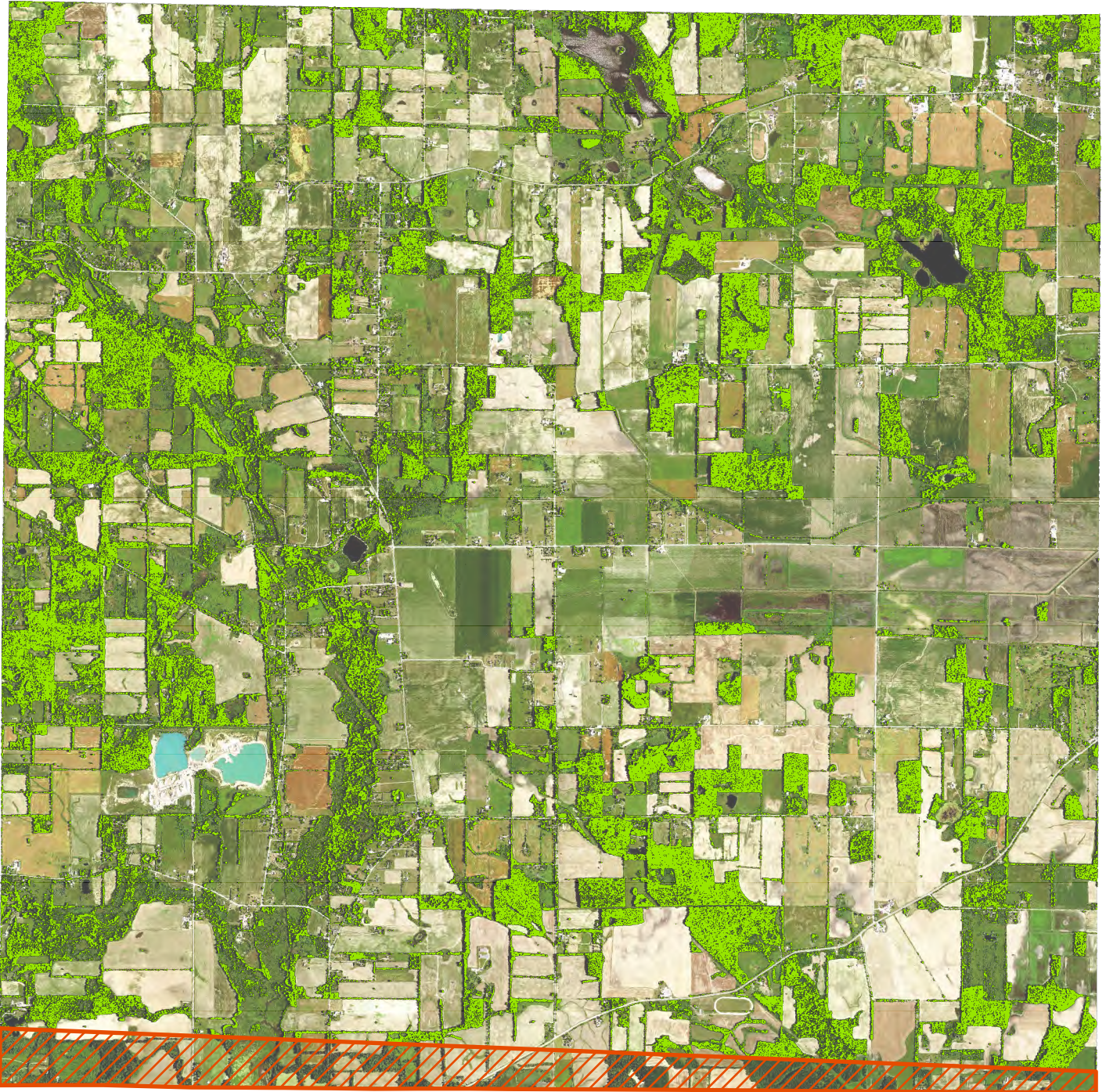
Watershed is all the land area that captures rainfall and snowmelt or other water runoff, like irrigation, and funnels it to a particular waterbody, such as a creek or river and eventually to an outflow point, such as a bay or ocean.

Headwaters are the start of the channel system and therefore close to a main source of water, such as a mountain stream or a groundwater aquifer seep. Downstream network health starts with nutrients, sediment, temperature, organic matter, and habitat quality in the headwaters.





Tree Canopy

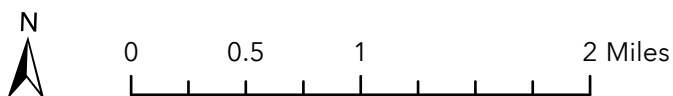
Bridgewater Township



This map depicts tree canopy, the leafy cover provided by branches, and illustrates density and distribution across the township. Tree location influences the many social, economic, and environmental benefits they provide. Tree canopy was identified using 2020 aerial photography and 2017 LiDAR data, which determines the height of ground features. Areas where LiDAR data was unavailable (red cross hatch) were excluded from calculations.

-  Tree Canopy
-  Data unavailable

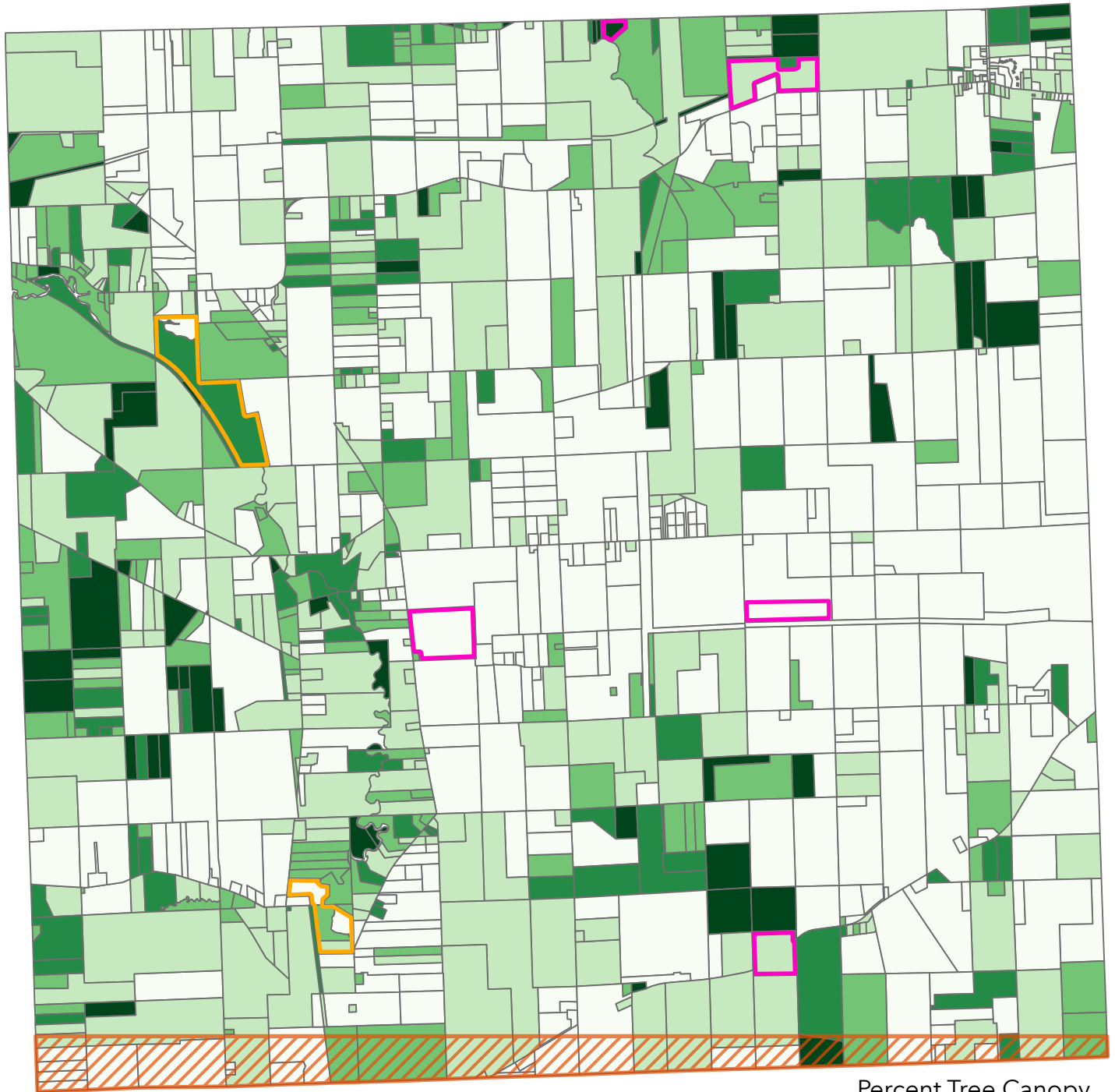
Percent of Township Covered by Tree Canopy: 25% (5891 acres)



Data Sources: NAIP (2020); Washtenaw County GIS Program -
Bridgewater Boundary and LiDAR (2017)
Datum/Projection: NAD83 Michigan State Plane (South)
Layout by: Lyndsay Zemanek, March 15, 2022

Tree Canopy - All Parcels

Bridgewater Township

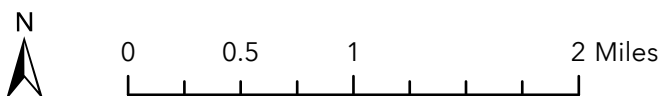


This map categorizes parcels by percent tree canopy cover. Tree canopy was determined using an unsupervised clustering algorithm applied to 2020 NAIP Aerial Imagery in combination with 2017 LiDAR data and then aggregated by land parcel. Note: Tree canopy percentages on the southern edge are skewed due to lack of canopy data.

Percent Tree Canopy

- 0 - 20%
- 20.1 - 40%
- 40.1 - 60%
- 60.1 - 80%
- > 80%
- Canopy Data Unavailable
- Recreation Lands
- Conservation Lands

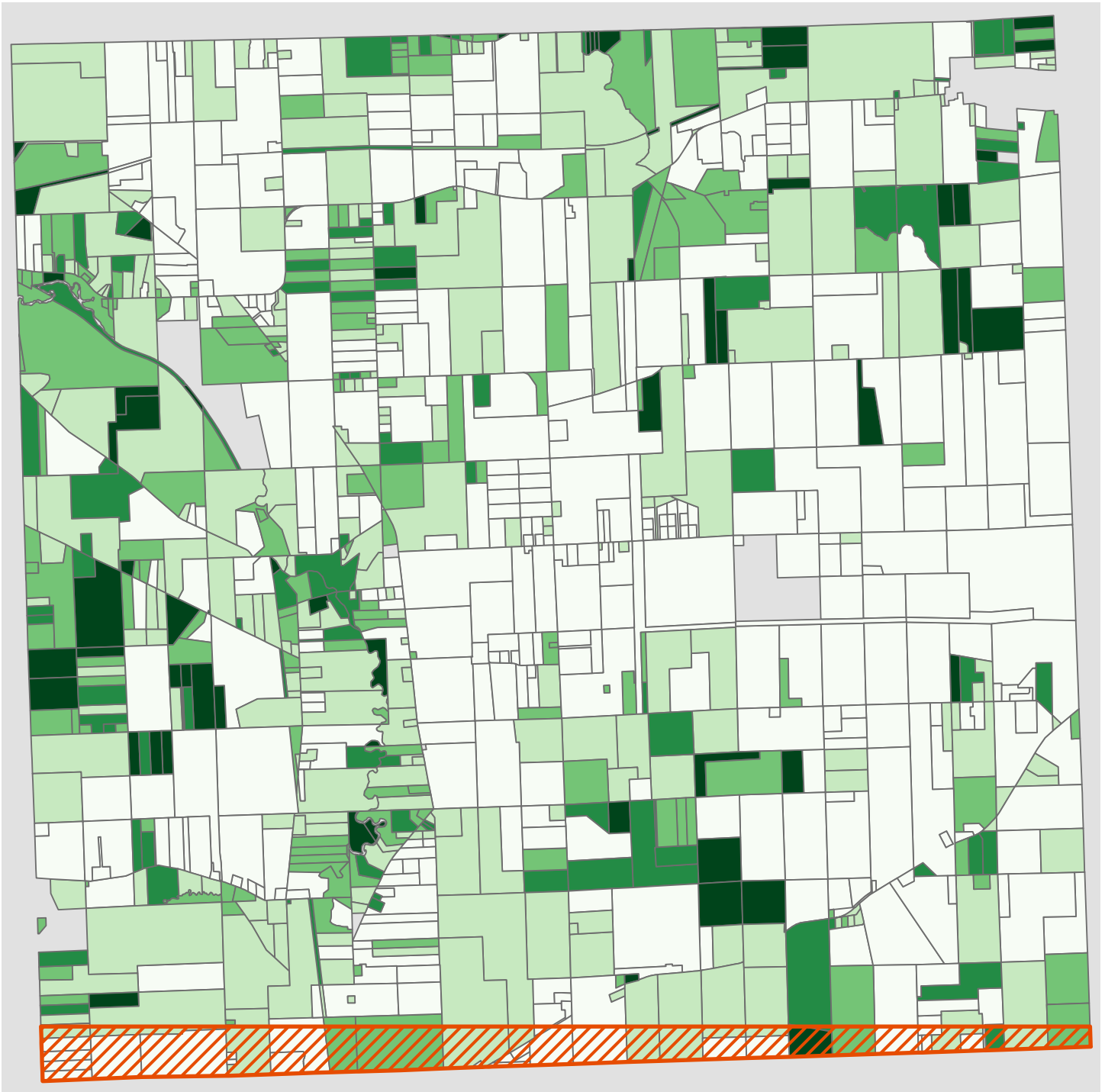
Mean tree canopy in all parcels: 30%



Data Sources: NAIP 2020; Washtenaw County GIS Program - LiDAR, Parcels, Conservation/Recreation Lands
Datum/Projection: NAD 1983 State Plane Michigan South
Analysis/Cartography: Lyndsay Zemanek, May 10 2022

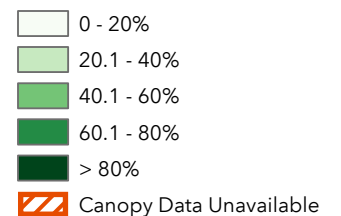
Tree Canopy - Agricultural Parcels

Bridgewater Township



This map categorizes parcels zoned Agriculture by percent tree canopy cover. Tree canopy was determined using an unsupervised clustering algorithm applied to 2020 NAIP Aerial Imagery in combination with 2017 LiDAR data and then aggregated by land parcel. Note: Tree canopy percentages on the southern edge are skewed due to lack of canopy data.

Percent Tree Canopy



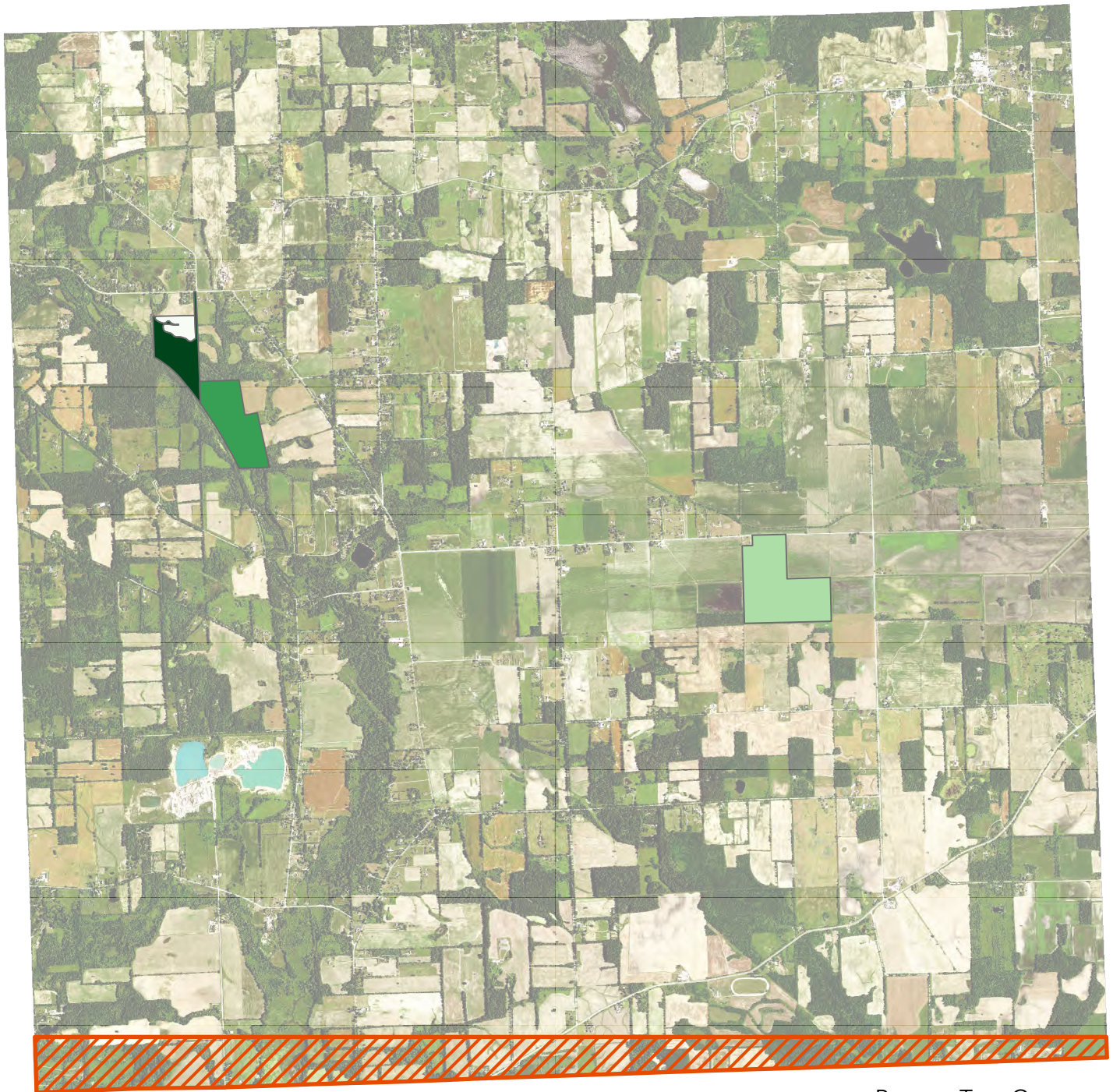
Mean tree canopy in Agricultural Parcels: 39%



Data Sources: NAIP 2020; Washtenaw County GIS Program - LiDAR, Parcels; Bridgewater Township - Zoning
Datum/Projection: NAD 1983 State Plane Michigan South
Analysis/Cartography: Lyndsay Zemanek, May 10 2022

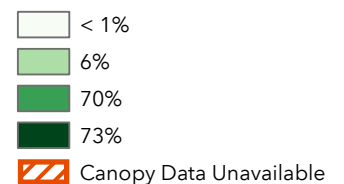
Tree Canopy Conservation Preservation Parcels

Bridgewater Township



This map categorizes parcels zoned Conservation Preservation by percent tree canopy cover. Tree canopy was determined using an unsupervised clustering algorithm applied to 2020 NAIP Aerial Imagery in combination with 2017 LiDAR data and then aggregated by land parcel. Note: Tree canopy percentages on the southern edge are skewed due to lack of canopy data.

Percent Tree Canopy



Mean tree canopy in Conservation Preservation Parcels: 37%

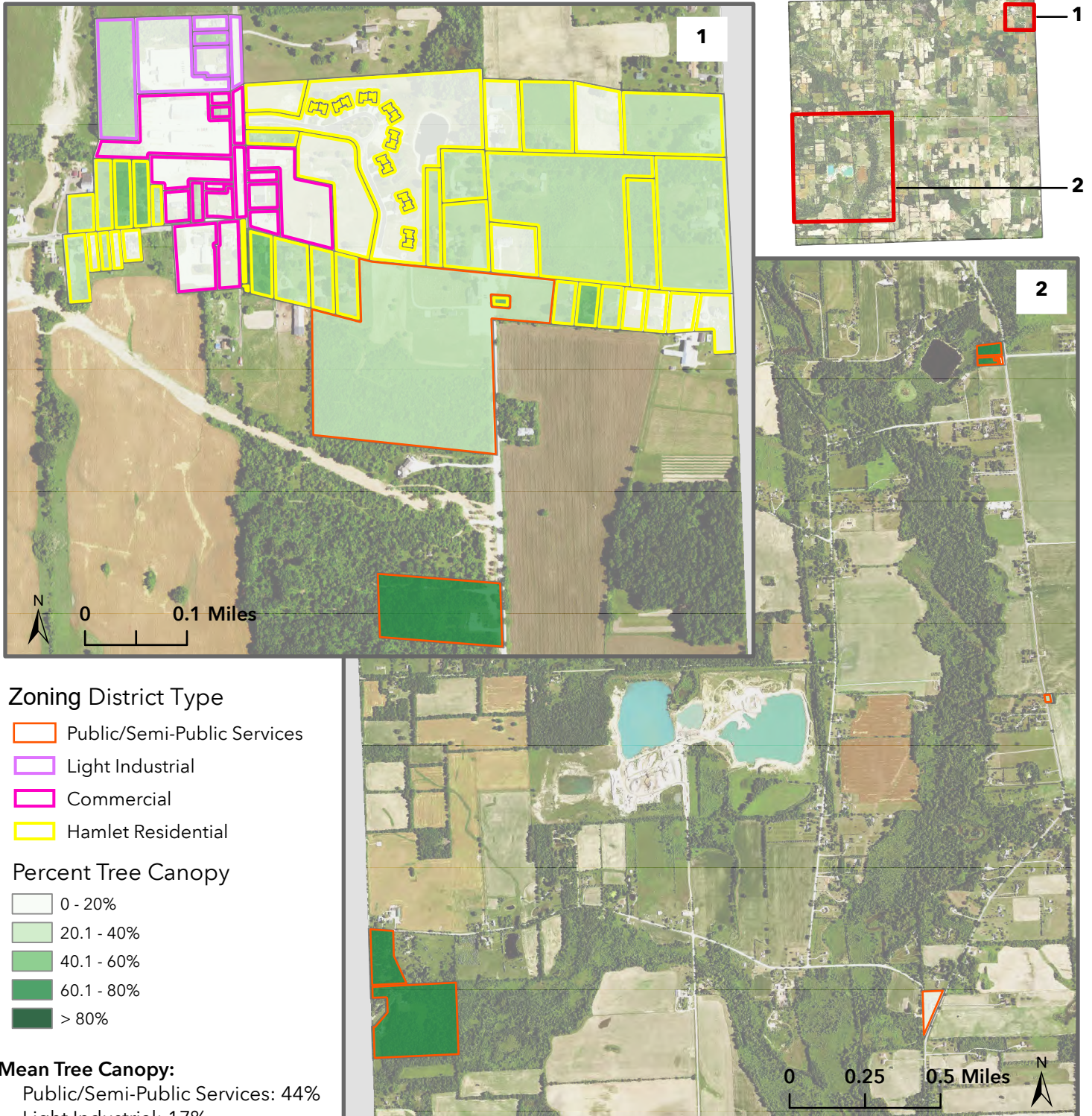


Data Sources: NAIP 2020; Washtenaw County GIS Program - LiDAR, Parcels; Bridgewater Township - Zoning
Datum/Projection: NAD 1983 State Plane Michigan South
Analysis/Cartography: Lyndsay Zemanek, May 10 2022

Tree Canopy Business and Residential Districts

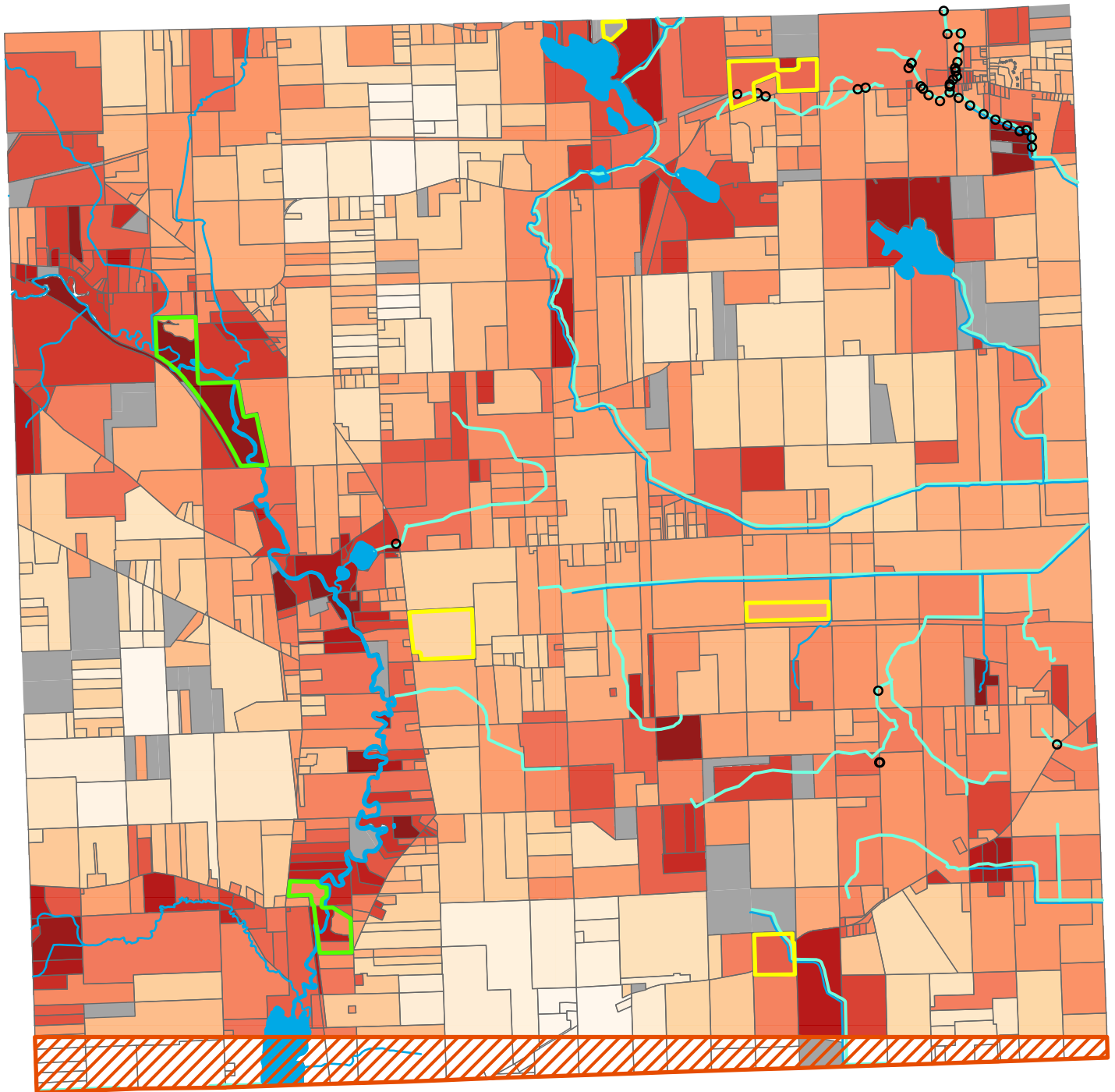
Bridgewater Township

This map categorizes parcels zoned Business or Residential by percent tree canopy cover. A parcel zoned as Public/Semi-Public Services, Light Industrial, or Commercial are considered Business Districts. Tree canopy was determined using an unsupervised clustering algorithm applied to 2020 NAIP Aerial Imagery in combination with 2017 LiDAR data and then aggregated by land parcel.



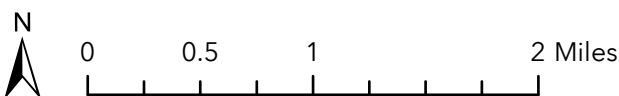
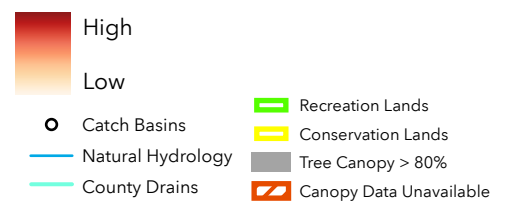
Planting Priority - Ecological Scenario

Bridgewater Township



This map depicts tree planting priority in a scenario focused on ecological variables. Priority rankings for each parcel are determined from two considerations:
1) potential for rain and irrigation runoff to impact water quality and
2) connectivity of surrounding woodlands. Parcels with more than 80% tree canopy cover have been excluded.

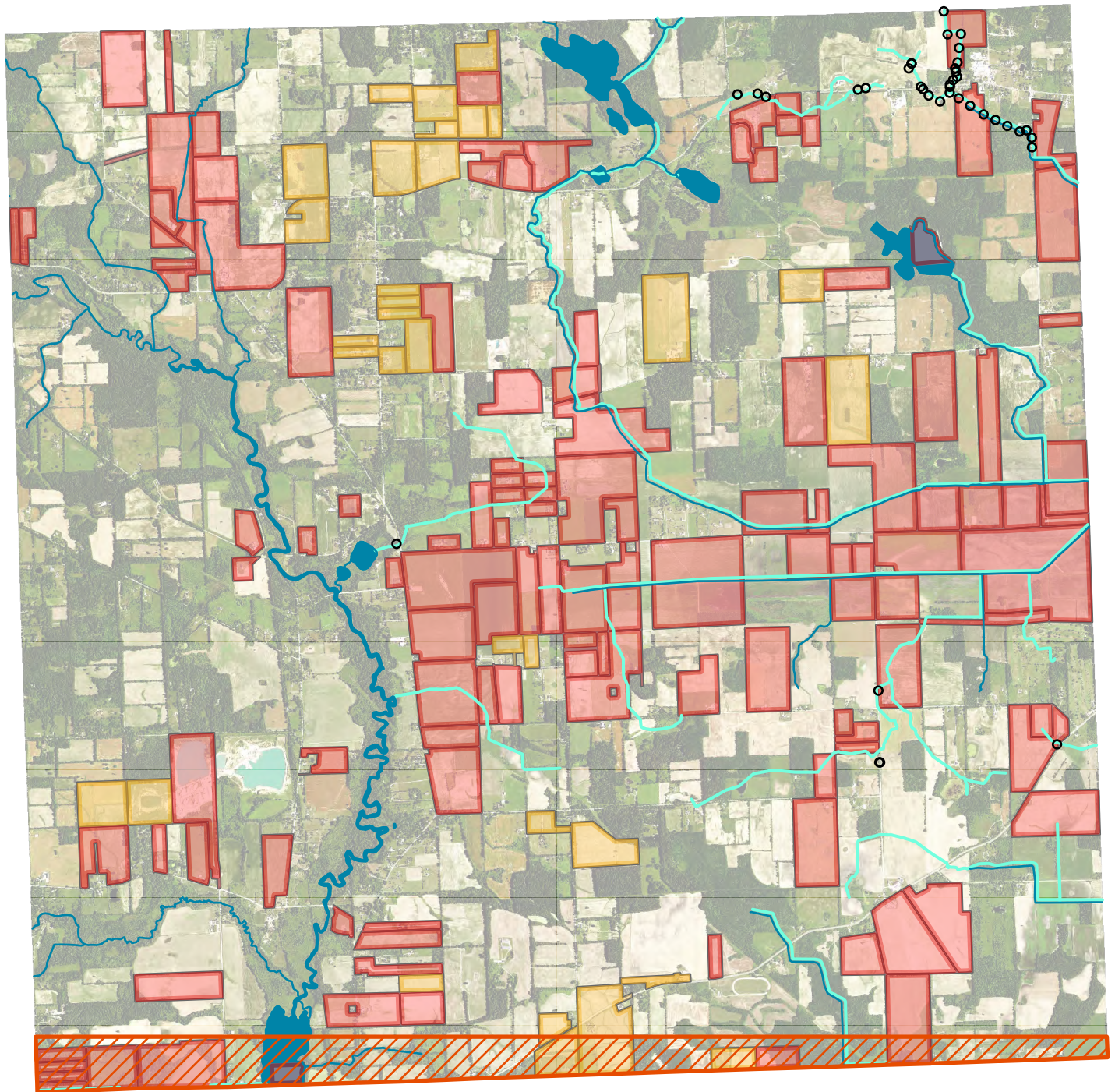
Tree Planting Priority



Data Sources: NAIP (2020) | Washtenaw County GIS Program - LIDAR, Parcels, Recreation and Conservation Lands | Washtenaw County Water Resources Commissioner's Office - County Drains, Catch Basins | Michigan Open GIS - Hydrography
Datum/Projection: NAD 1983 State Plane Michigan South
Analysis/Cartography: Lyndsay Zemanek, May 18 2022

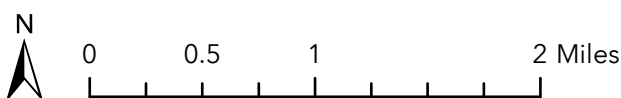
Priority Planting - Agroforestry Scenario (2)

Bridgewater Township



This map depicts two-tiers of parcels where agroforestry practices (the intentional mixing of trees with crops or livestock) on agricultural parcels larger than 10 acres with less than 10% tree canopy may improve water quality. **High priority** parcels are within a quarter mile of natural hydrology, county drains, or catch basins. **Moderate priority** parcels are further than a quarter mile from natural hydrology, county drains, or catch basins.

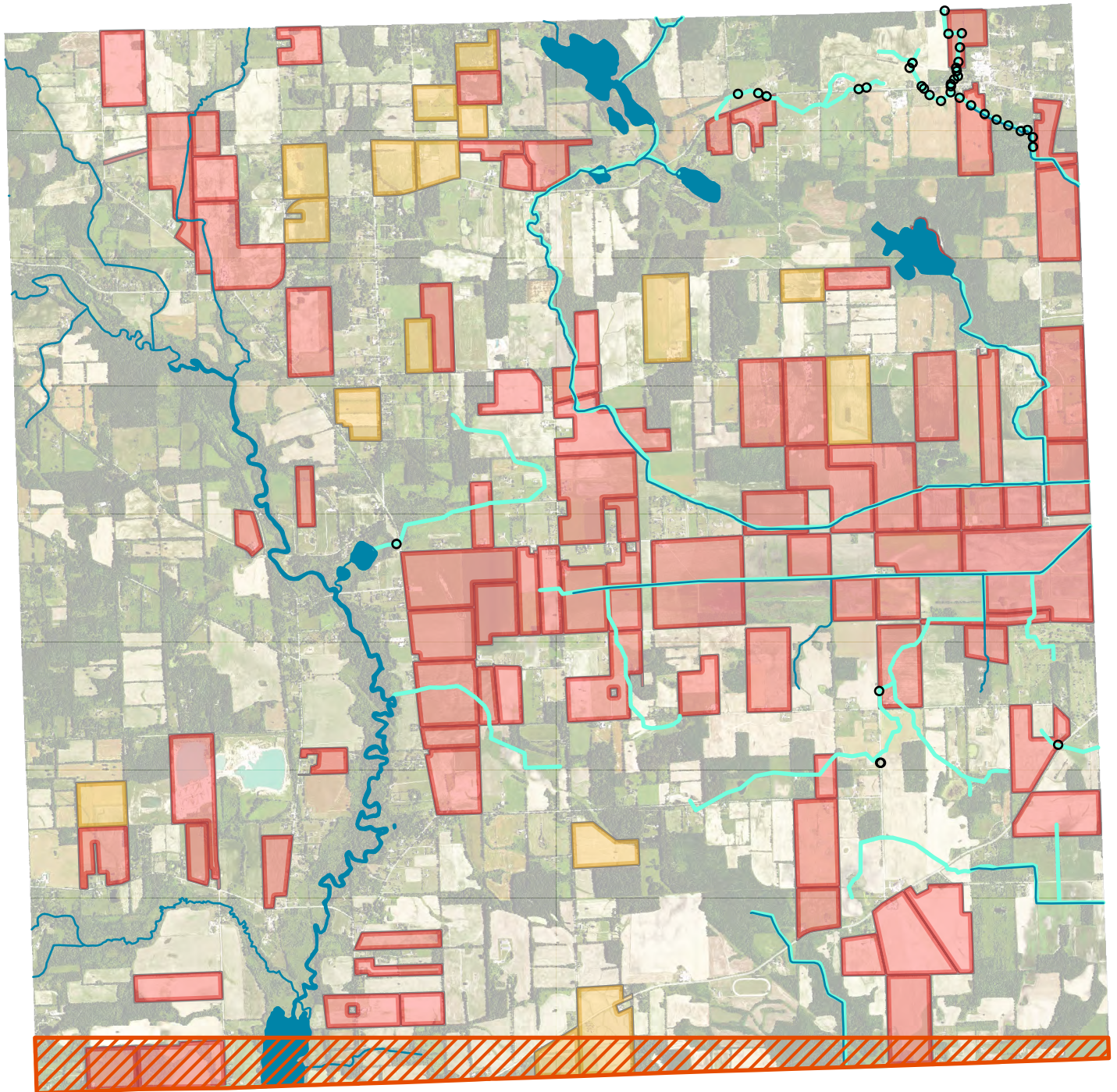
	Tier 1 - High Priority
	Tier 2 - Moderate Priority
	Catch Basins
	County Drains
	Natural Hydrology
	Canopy Data Unavailable



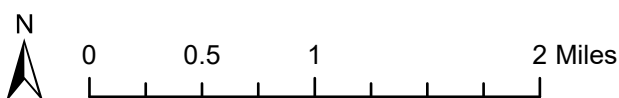
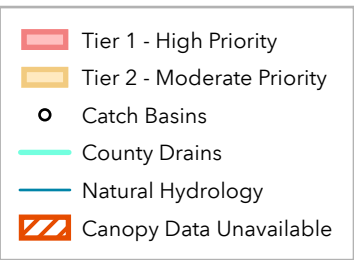
Data Sources: Washtenaw County GIS Program - Parcels; LiDAR | Washtenaw County Water Resources Commissioner's Office - Catch Basins and Drains | Bridgewater Township - Zoning | State of Michigan Open GIS - Hydrography
Datum/Projection: NAD 1983 State Plane Michigan South
Analysis/Cartography: Lyndsay Zemanek | May 31 2022

Priority Planting - Agroforestry Scenario (1)

Bridgewater Township

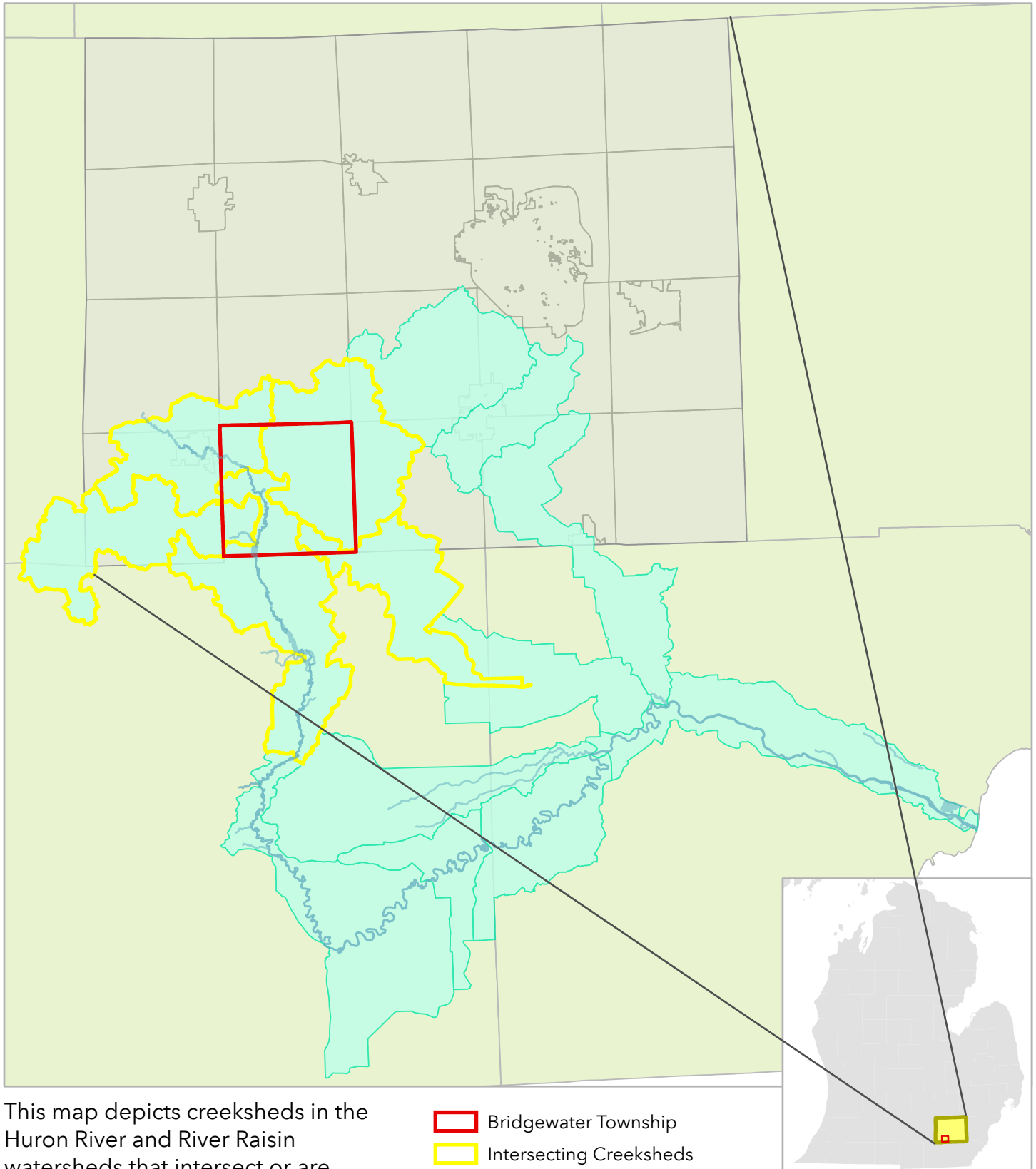


This map depicts two-tiers of parcels where agroforestry practices (the intentional mixing of trees with crops or livestock) on agricultural parcels larger than 20 acres with less than 10% tree canopy may improve water quality. **High priority** parcels are within a quarter mile of natural hydrology, county drains, or catch basins. **Moderate priority** parcels are further than a quarter mile from natural hydrology, county drains, or catch basins.







Data Sources: Washtenaw County GIS Program - Parcels; LiDAR | Washtenaw County Water Resources Commissioner's Office - Catch Basins and Drains | Bridgewater Township - Zoning | State of Michigan Open GIS - Hydrography
Datum/Projection: NAD 1983 State Plane Michigan South
Analysis/Cartography: Lyndsay Zemanek | May 31 2022

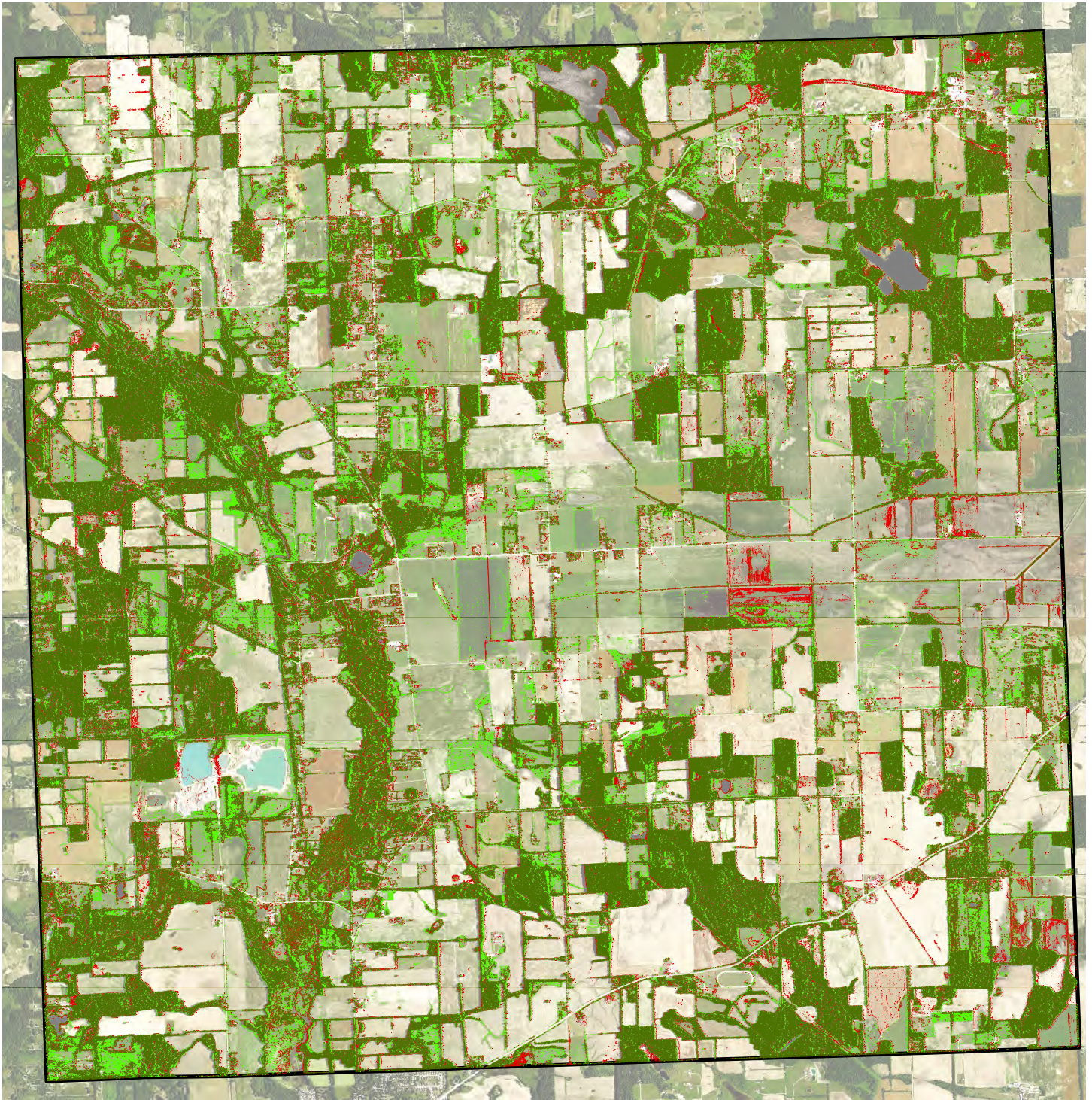
Watersheds of Bridgewater Township



This map depicts creeksheds in the Huron River and River Raisin watersheds that intersect or are downstream from Bridgewater Township.

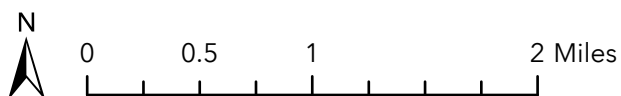
-  Bridgewater Township
-  Intersecting Creeksheds
-  Downstream Creeksheds
-  River Raisin and Tributaries





This map depicts tree canopy change between 2010 and 2020. Note that some areas of tree canopy change can be attributed to classification errors due to differences between each year's imagery like camera or sun angle, rather than actual canopy loss or gain. Tree canopy is also likely overestimated for both years due to inclusion of woody shrubs.

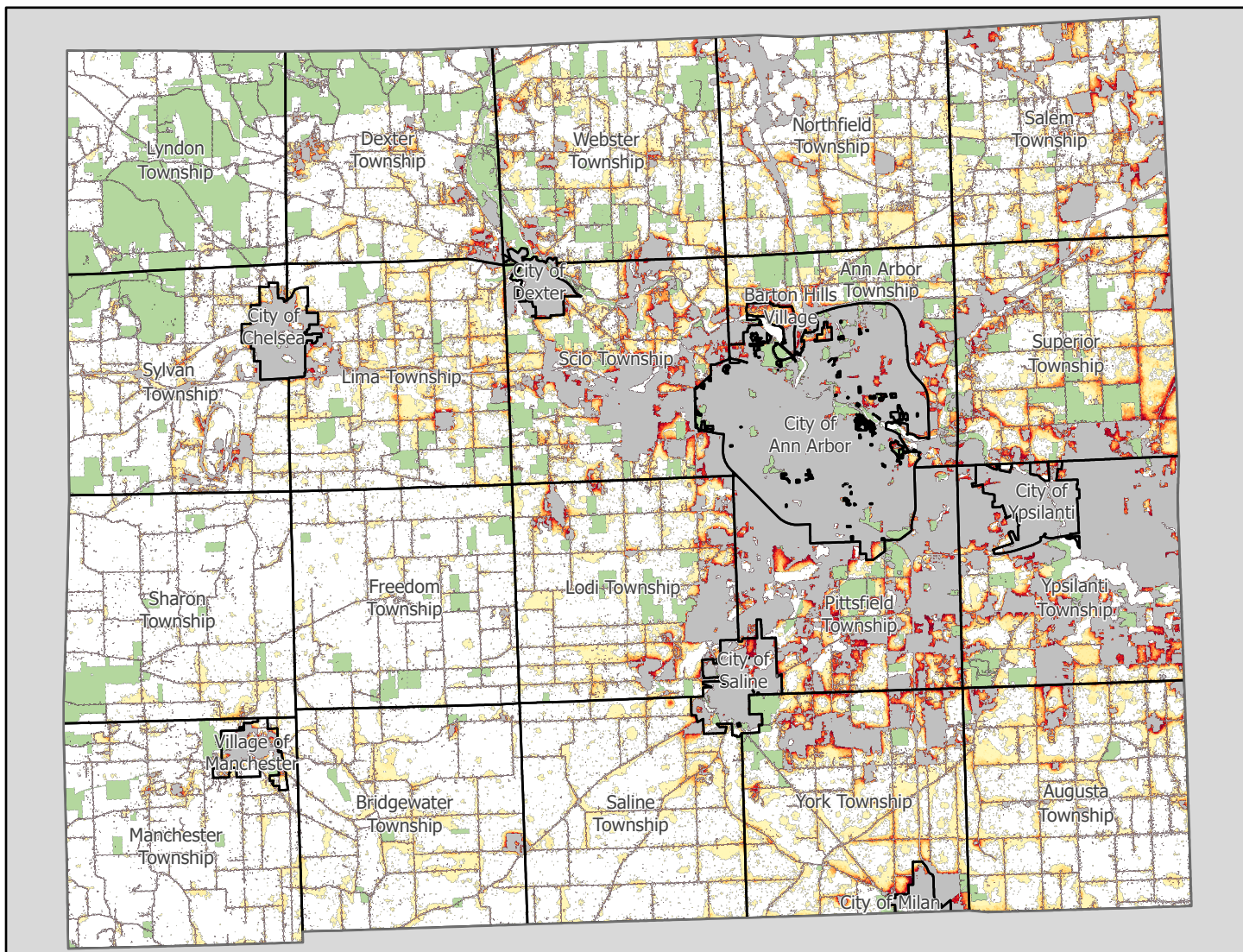
-  No Change
-  Canopy Loss
-  Canopy Gain



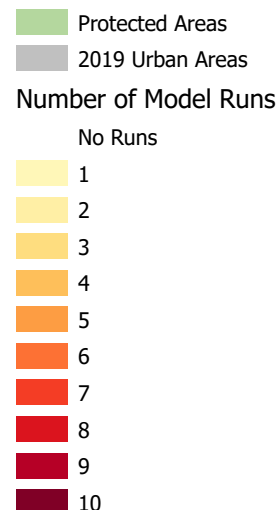
Data Sources: NAIP (2020, 2010); Washtenaw County GIS Program - Township boundary
Datum/Projection: NAD83 Michigan State Plane (South)
Analysis/Cartography: Lyndsay Zemanek, June 10 2022

FUTURES Urban Projections for 2045

Washtenaw County

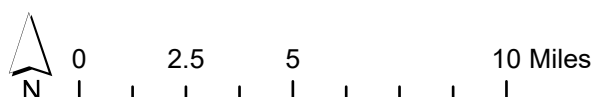


This map shows the potential growth of urban development in Washtenaw County by 2045. The projections were created in GRASS GIS using the FUTURES model, which takes into account factors such as relationships between population growth and past development, road density, distance to water, distance to highway interchanges, canopy cover, and proximity to existing development. NLCD classes 21-24 were considered urban. Due to randomness in the model, ten runs were executed in which the darkness of a pixel increases with the number of runs predicting it will be developed. The table below shows the predicted mean (and standard deviation) loss in acres for each landcover type. Forest includes deciduous, evergreen, and mixed forest. Agriculture includes pasture and crops.



Land Cover	Barren	Forest total	Scrub/shrub	Grassland	Ag total
Mean (acres)	94.78	6422.29	78.35	207.15	16059.25
SD(acres)	24.8	225.67	10.54	15.36	206.01

Data sources: NLCD (2019 urbanization), Washtenaw County Open Data (township borders, protected areas), SEMCOG (population projections)
Datum/Projection: NAD83 Albers Conical Equal Area
Layout: Thomas Estabrook, 5/17/2022



ACKNOWLEDGEMENT OF CONTRIBUTIONS

THANK YOU...

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Michigan Department of Natural Resources' Urban and Community Forestry Program

Data and Project Support

Washtenaw County GIS Program
Washtenaw County Water Resources Commissioner's Office
Ann Arbor Area Transit Authority
Carlisle Wortman
Huron River Watershed Council

Pilot Municipalities

Bridgewater Township | Sharon Township | City of Ypsilanti | Ypsilanti Township

Project Team

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Thomas Estabrook, UM Student Contractor - GIS Analyst
Lyndsay Zemanek, UM Student Contractor - GIS Analyst

