GREATER LAFAYETTE CLIMATE ACTION PLAN

January 2023

ACKNOWLEDGMENTS

LAND ACKNOWLEDGMENT

At its simplest, a land acknowledgment is recognition that our community is living on land that was stolen from indigenous people. Greater Lafayette resides on land that was stolen from Bodwéwadmi (Potawatomi), Kiikaapoi (Kickapoo), Peoria, Kaskaskia, and Myaamia (Miami) Nations. These tribes are the land's past, present, and future caretakers.

Whether a person intends to or not, everyone is a steward of the land where they live and work. The way that people lived in our community in the past impacts how we live and travel in it today. The decisions that we (individuals, businesses, and local governments) make today will impact how the next generation lives in and travels through our community. Taking action on climate change requires that we acknowledge the decisions and actions of those that came before us, and make changes in how we live today in hopes that it creates a better world for future generations. Acknowledging and respecting indigenous people that have resided on and stewarded this land for thousands of years is a vital part of this process.

LEADERS IN THE GREATER LAFAYETTE CLIMATE ACTION PLAN

This Climate Action Plan was truly a community-wide effort. The Mayors of Lafayette and West Lafayette and County Commissioners received regular updates on the progress of the plan and provided input. This effort was spearheaded by the joint leadership committee, which was comprised of government employees, a West Lafayette Go Greener Commissioner, and contractors from Greeley and Hansen. Several interns and fellows from both Purdue and Indiana University helped in our technical studies. A diverse advisory committee made up of community members and content specialists provided input and expertise. Local and regional stakeholders attended input sessions to give feedback and advise on all the areas covered in this plan.

LOCAL ELECTED LEADERS

- Mayor John Dennis, City of West Lafayette
- Mayor Tony Roswarski, City of Lafayette
- Tippecanoe County Commissioners
  - Tracy Brown
  - David Byers
  - Tom Murtaugh

JOINT LEADERSHIP COMMITTEE

- Michael J Burnett Thompson, Tippecanoe County Government
- Maithilee Das Lappin, Greeley and Hansen
- Margy Deverall, City of Lafayette
- David Henderson, City of West Lafayette
- Amy Krzton-Presson, formerly Tippecanoe County Government
- Dr. Lindsey Payne, Purdue University and West Lafayette Go Greener Commission

COMMUNICATION COMMITTEE

- David Hunke, City of Lafayette
- Amy Krzton-Presson, formerly Tippecanoe County Government
- Patty Payne, City of Lafayette
- Jenifer Van Schuyver, City of West Lafayette

EXTERNAL AGENCIES, PARTNERS, AND CONTRIBUTORS

- Environmental Resilience Institute (ERI), Indiana University
- Madison Hodges, Intern for West Lafayette, formerly Purdue University
- Collin Huffines, Intern for Lafayette, formerly Indiana University
- ICLEI, Local Governments for Sustainability
- John Lenti, formerly Greeley and Hansen
- Nick Polak, ERI Climate Fellow, Indiana University
- Soar Strategies
- Spanish translation provided by Mónica Casanova, Diana Hernandez, and Eloquence Language Services
- Matthew Vining, Intern for Tippecanoe County, formerly Purdue University

ADVISORY COMMITTEE

- Office of Ron Alting, Indiana State Senate
- Amanda Balser, Tippecanoe County Department of Public Health
- Sadie B. Harper-Scott, National Association for the Advancement of Colored People (NAACP)
- Paul Moses, Greater Lafayette Commerce
- Loring (Larry) Nies, Purdue Civil and Ecological and Environmental Engineering
- Mike Parks, Tippecanoe County Government Department of Transportation
- Anabel Prokopy, West Lafayette Climate Strike, former West Lafayette High School student
- Dan Rhodes, Duke Energy
- Shannon Stanis, NICHES Land Trust
- Wes Tillett, Lafayette Urban Ministry (LUM)
- Melissa Widhalm, formerly with the Purdue Climate Change Research Center

COMMUNITY STAKEHOLDERS AND FOCUS AREA EXPERTS CONSULTED

- Energy
  - Center for Energy Education
  - Duke Energy
  - Huston Electric, Solar Division
  - Purdue Climate Change Research Center
  - Purdue School of Civil Engineering
  - Solarize Indiana
  - Tipmont REMC

- Waste, Recycling, and Composting
  - Circular Indiana
  - Dirt Wain
  - Earth Mama Compost
  - Irving Materials, Inc.
  - Lafayette Renew
  - Milestone Contractors
  - Purdue Office of Sustainability
  - Purdue School of Agricultural and Biological Engineering
  - West Lafayette Water Resource Recovery Facility
  - Oscar Winski

- Agriculture and Forestry
  - Conservation Cropping Systems Initiative
  - Purdue Forestry and Natural Resources
  - Tippecanoe Area Plan Commission
  - Tippecanoe County Parks Department
  - Tippecanoe Soil and Water Conservation District
  - Tree Lafayette
  - Urban Soil Health
  - Wabash River Enhancement Corporation
  - West Lafayette Parks Department

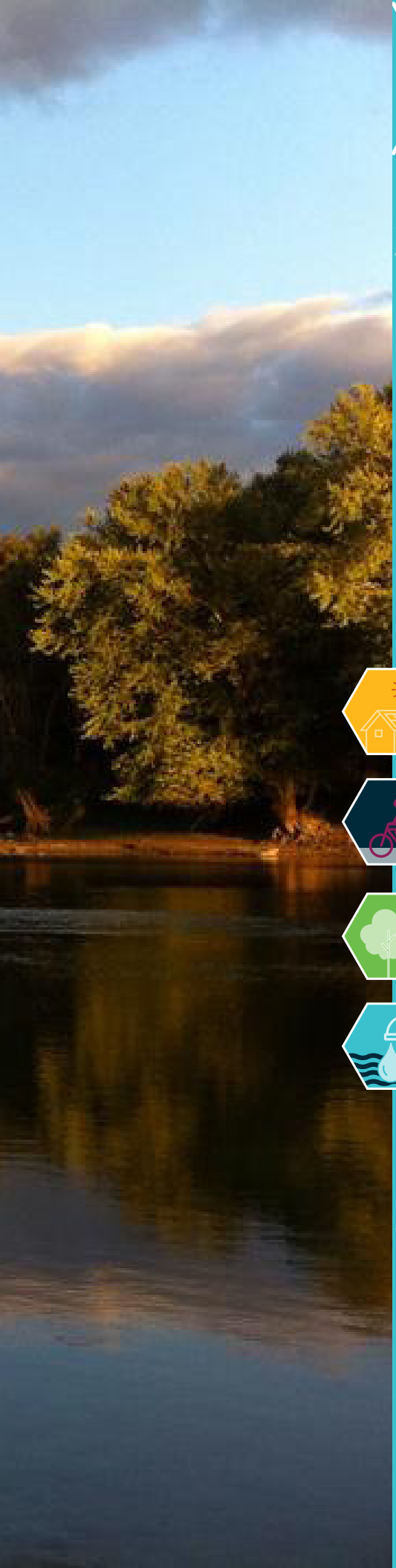
- Transportation
  - Amtrak
  - Bird Scooter
  - CityBus
  - City of Lafayette Engineering Department
  - Tippecanoe Area Plan Commission
  - Tippecanoe Highway Department
  - Wabash River Enhancement Corporation

- Manufacturing
  - Arconic
  - Caterpillar
  - Cook Biotech
  - Evonik
  - General Electric
  - Henry Poor Lumber Company
  - Saab
  - Subaru of Indiana Automotive
  - Tate and Lyle
  - Wabash National

- Community, Health and Safety
  - Bauer Family Resources
  - Centier Bank
  - Community Foundation
  - First Merchants Bank
  - 1st Source Bank
  - Franciscan Health
  - Greater Lafayette Commerce
  - Henriott Group
  - HomesteadCS
  - Kirby Risk
  - Lafayette Fire Department
  - Lafayette Theater
  - Lafayette Urban Ministry
  - Long Center for the Performing Arts
  - MatchBOX Coworking Studio
  - Mental Health America
  - Meridian Health
  - Old National Bank
  - Purdue Extension
  - Reed & Company
  - Tippecanoe Arts Federation
  - Tippecanoe County Health Department
  - Valley Oaks Health
  - West Lafayette Fire Department
  - West Lafayette Police

GRAPHIC CREDIT

- Icons from the nounproject.com
- Jill Sommerfeld, Greeley and Hansen



CONTENTS

A WORD FROM OUR ELECTED OFFICIALS

We live in a world that is being threatened by those of us who inhabit it. Mankind has made so many advances in our short time on this planet that we seem to have forgotten the fact that our planet is a living, growing thing that needs care and respect.

It is with that understanding that I enthusiastically accept and embrace the Greater Lafayette Climate Action Plan. It's time we all do!

- John R. Dennis, Mayor of West Lafayette

Climate change is and will continue to impact weather patterns and quality of life in our region. Energy independence and being prepared for extreme weather will save money and strengthen our community. Together, we can work for a stronger future for Tippecanoe County.

- Tracy Brown, Tippecanoe County Commissioner

Around the world, climate change is affecting lives and ecosystems. Events linked to climate-related risks, both large and small, are on the rise. Greater Lafayette is responding to build resilience through community-based adaptations by reducing the greenhouse gases that are at the origin of the problem. Together we can make an impact!

- Tony Roswarski, Mayor of Lafayette

GREATER LAFAYETTE CLIMATE ACTION PLAN INITIATIVE PROCLAMATION
JUNE 5, 2021

WHEREAS, climate change endangers our health by affecting our food and water sources, the air we breathe, the weather we experience, and our interactions with the built and natural environments; and

WHEREAS, every American is vulnerable to the impacts associated with climate change, some populations are disproportionately vulnerable, including those with low income, some communities of color, immigrant groups (including those with limited English proficiency), Indigenous peoples, children and pregnant women, older adults, vulnerable occupational groups, persons with disabilities, and persons with preexisting or chronic medical conditions; and

WHEREAS, by making choices that reduce greenhouse gas pollution, and preparing for the changes expected in the future, we can reduce risks from climate change; and

WHEREAS, the benefits from addressing climate change include improved quality of life for residents, new development opportunities, better management of our region's resources, preservation of vital ecosystems, economic resilience, and improved health outcomes; and

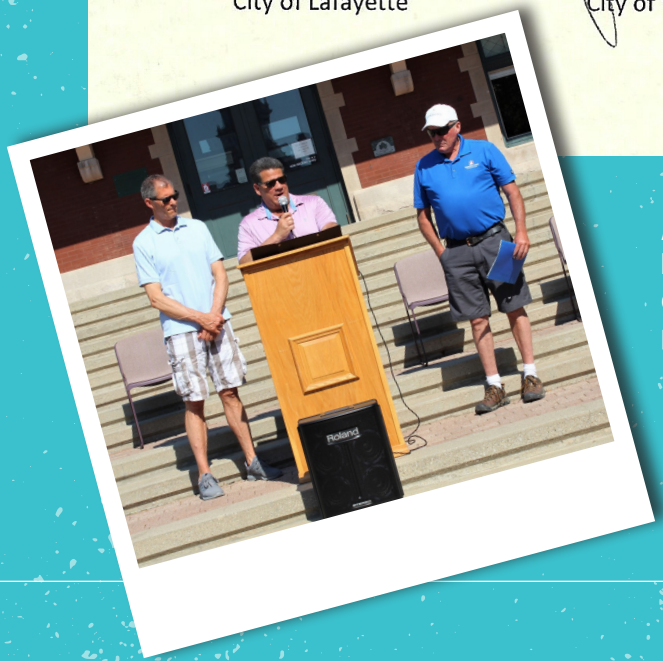
WHEREAS, in 1972 the United Nations General Assembly designated June 5th as World Environment Day and urged governments to undertake on this day activities that preserve and enhance the environment;

NOW THEREFORE, I, **Tony Roswarski, Mayor of the City of Lafayette**, **John Dennis, Mayor of the City of West Lafayette**, and **David Byers, Tippecanoe County Commissioner**, do hereby proclaim on World Environment Day, that the Cities of Lafayette, West Lafayette, and Tippecanoe County are joining forces in a historic, cooperative **Climate Action Plan Initiative**. By proactively addressing climate change through mitigation and adaptation initiatives, these three agencies commit to collectively lead economic, social, and environmental improvements throughout the Greater Lafayette region.

Tony Roswarski, Mayor
City of Lafayette

John Dennis, Mayor
City of West Lafayette

David Byers, Commissioner
Tippecanoe County



A Greater Lafayette Climate Action Plan kick-off event was held on World Environment Day (Saturday, June 5, 2021) during which leaders from each community formally signed a proclamation launching this initiative.

EXECUTIVE SUMMARY

Artwork by Cameron Moberg

A ROADMAP FOR AN EQUITABLE QUALITY OF LIFE

Greater Lafayette's economy, community health, quality of life, and environment are threatened by the effects of climate change. This climate action plan will help prepare for the future and build a stronger, more resilient community. It is a roadmap that will guide our government, businesses, and residents in reducing greenhouse gas emission and preparing for extreme weather events.

PLANNING PROCESS

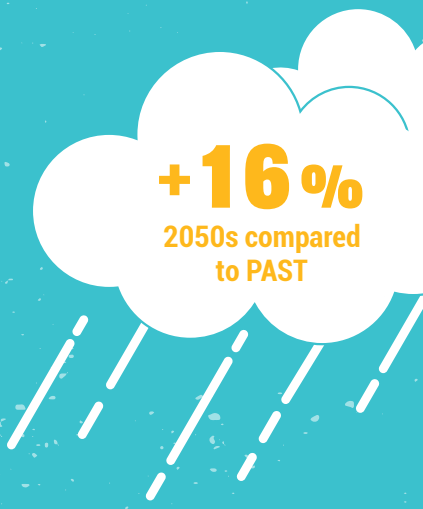
1. Conduct Greenhouse Gas Inventory
2. Technical Studies
3. Engage the Community
4. Forecast Future Scenarios & Set Goals
5. Create the Plan
6. Implement & Assess the Plan

How will Climate Change Impact Tippecanoe County in the next 25 years?

Average Hottest Day of the Year Will Increase

2050s
105°F

1970 - 2000s
95°F



Projected Change in SPRING rainfall

Source: Indiana Climate Change Impacts Assessment

SETTING A GOAL

To keep climate change impacts at a minimum, Greater Lafayette's goal is to reduce it's green house gas emissions by

58% BY 2030

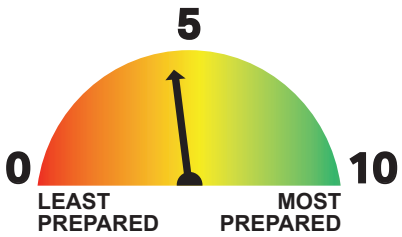
Efforts must be made in government operations, private industry, and households to meet this goal. This plan should be revisited and reassessed over time to track our progress and adjust our strategies.

Several technical studies were conducted to inform decision making and determine the best course of action.

HOW PREPARED ARE WE FOR EXTREME WEATHER?

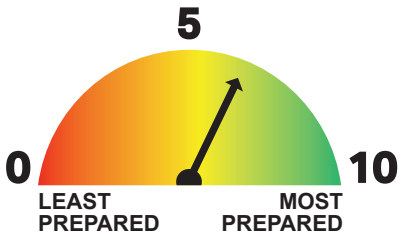
Results from the Hoosier Resilience Index

Extreme Heat



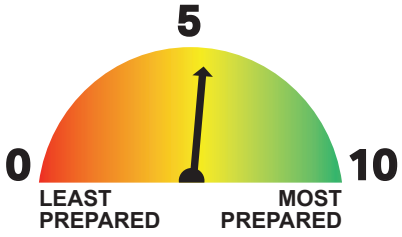
Readiness Score = 4.63

Extreme Precipitation



Readiness Score = 5.89

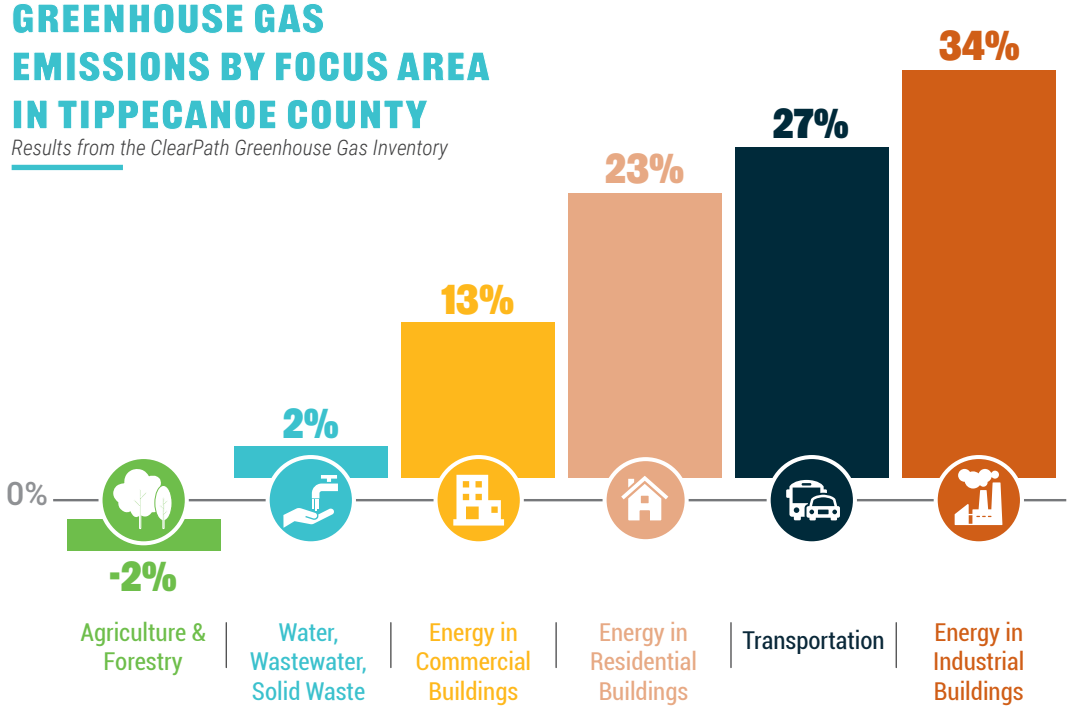
Floodplain Management



Readiness Score = 5.49

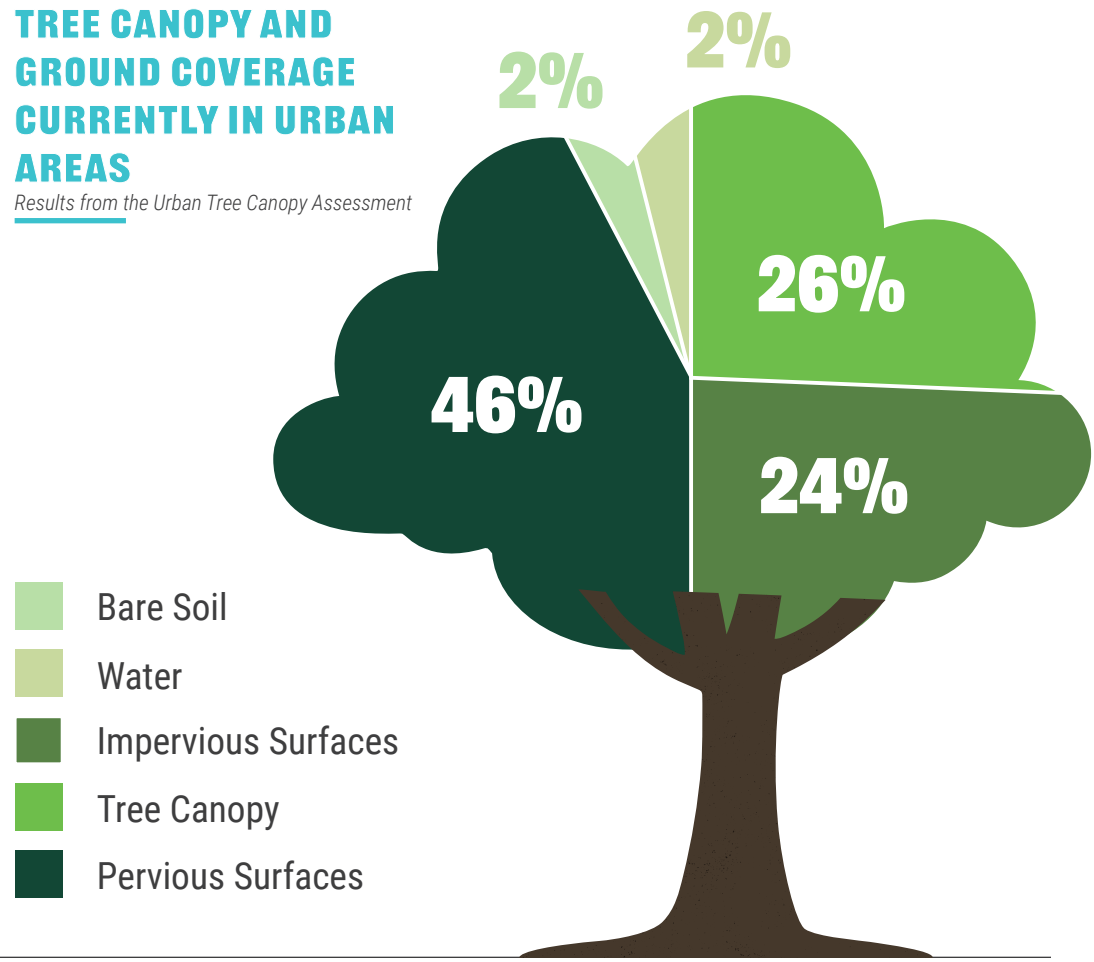
GREENHOUSE GAS EMISSIONS BY FOCUS AREA IN TIPPECANOE COUNTY

Results from the ClearPath Greenhouse Gas Inventory



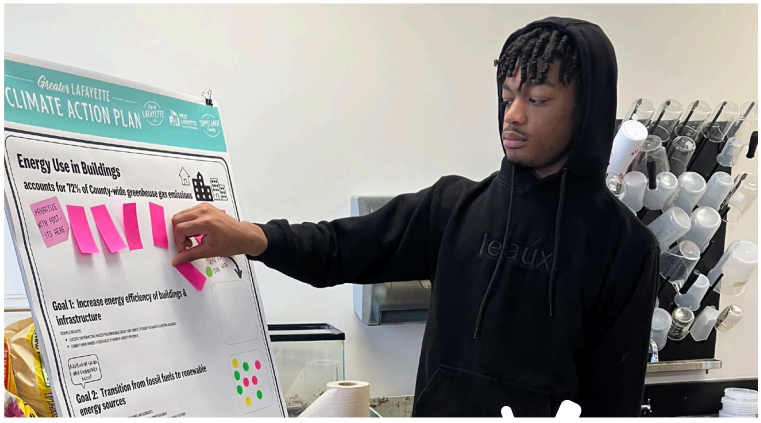
TREE CANOPY AND GROUND COVERAGE CURRENTLY IN URBAN AREAS

Results from the Urban Tree Canopy Assessment



A COMMUNITY-FOCUSED PLAN

In addition to technical studies, we conducted multiple public surveys, hosted six public input meetings, convened an advisory committee, and consulted a variety of stakeholders, community leaders, and experts. Our technical studies identified the most effective reduction strategies, and integrating community voices helped prioritize these strategies.



TOP RESPONSES FROM OUR FIRST COMMUNITY SURVEY:

Biggest Concerns About Climate Change

- Increase in Extreme Weather Events
- Air Quality Impacts
- Availability of Clean Drinking Water
- Risks to Vulnerable Populations

FOCUS AREAS AND GOALS

	1 FOCUS AREA: ENERGY USE IN THE BUILT ENVIRONMENT	2 FOCUS AREA: TRANSPORTATION	3 FOCUS AREA: AGRICULTURE AND FORESTRY	4 FOCUS AREA: WATER, WASTEWATER, & SOLID WASTE
GOAL 1	Increase Energy Efficiency of Buildings and Infrastructure	Reduce Vehicle Miles Traveled	Support a Climate-ready Farming Community	Enhance Recycling, Waste Reduction, and Composting !
GOAL 2	Begin Transition From Fossil Fuels to Renewable Sources !	Incentivize Zero and Low Carbon Fuel Transit (and Equipment) !	Enhance, Protect, and Improve Access to Our Natural Resources !	Protect the Quality of Our Water
GOAL 3	Foster Innovation	Reduce Heat-island Impacts and Stormwater Run-off Associated With Transportation Infrastructure		Harvest Wastewater Energy and By-products
GOAL 4	Increase Social Resilience			

PRIORITY

During public input, **Focus Area 1** was identified as the public's highest priority, with an emphasis on **Goal 2**. Additional goals the public identified as a priority within each focus area are identified with an ! symbol.

INTRODUCTION

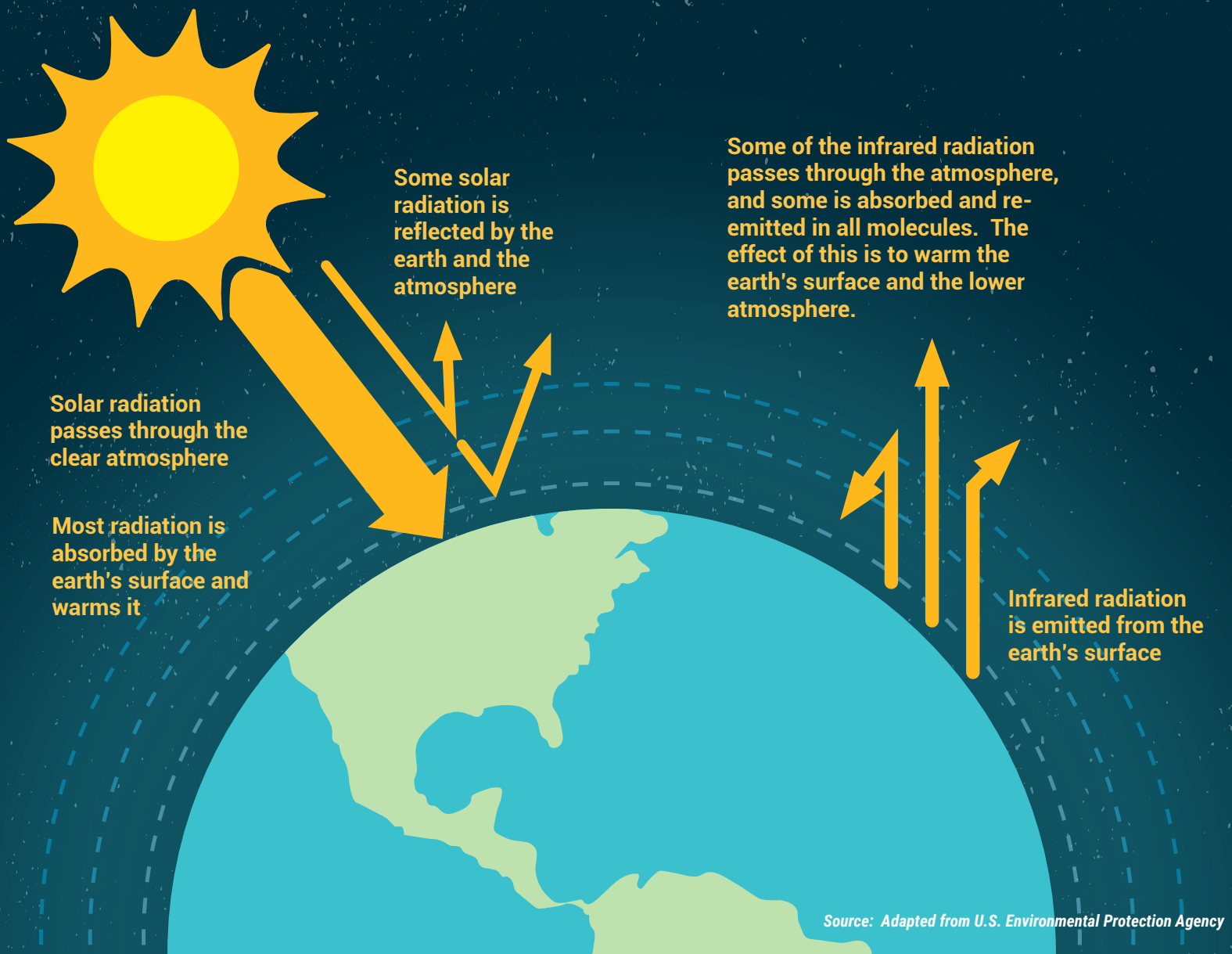
THE ESSENTIALS OF CLIMATE CHANGE

Climate change is the greatest environmental challenge of the 21st century. The use of carbon-producing energy sources, e.g., natural gas, coal-fired power, petroleum, ethanol, etc., increases the amount of greenhouse gases in Earth's atmosphere, which causes our global climate to change dramatically. This poses a serious threat not just to the environment, but also to our economies and our health. Scientists predict that with the current trends in fossil fuel use, Americans may see more severe and frequent heat waves, droughts, precipitation events, floods, and wildfires in the future. At the same time, addressing climate change also presents an opportunity to create a healthier, safer, and more equitable world. This requires action at all levels, and local governments have a unique role to play in building low-carbon communities.

GREENHOUSE GAS
(noun)

Any of various gaseous compounds (such as carbon dioxide or methane) that absorb infrared radiation, trap heat in the atmosphere, and contribute to the greenhouse effect.

THE GREENHOUSE GAS EFFECT



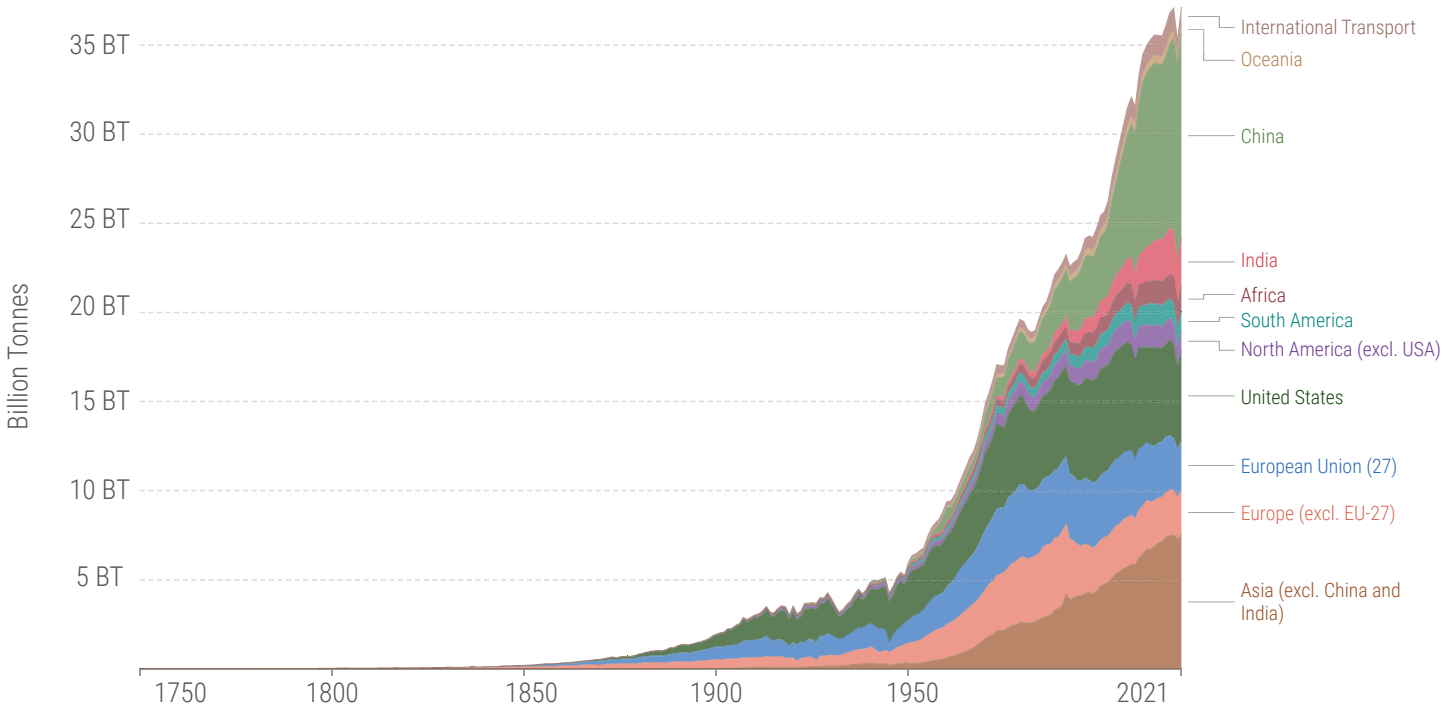
Source: Adapted from U.S. Environmental Protection Agency

GLOBAL CARBON EMISSIONS FROM FOSSIL FUELS (1900-2014)

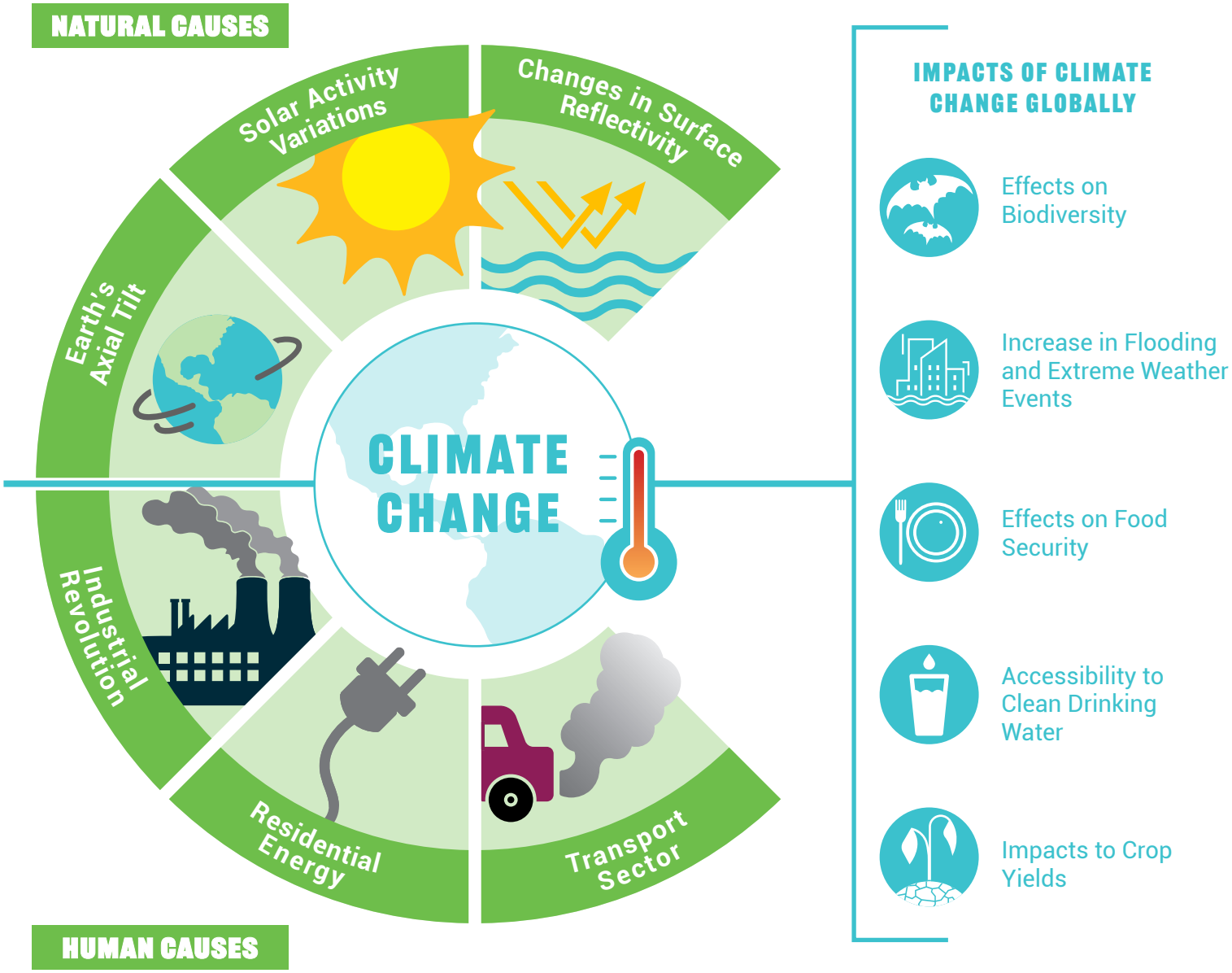
ANNUAL CO_2 EMISSIONS BY WORLD REGION

Our World in Data

This measures fossil fuel and industry emissions. Land use change is not included.



Source: Our World in Data based on the Global Carbon Project (2022)



Source: www.cas-press.com/article_138801

In 2015, 196 nations adopted the Paris Climate Accord, an international treaty on addressing climate change. Its goal is to limit the global temperature increase due to climate change to below 3.6 degrees Fahrenheit (2 degrees Celsius).

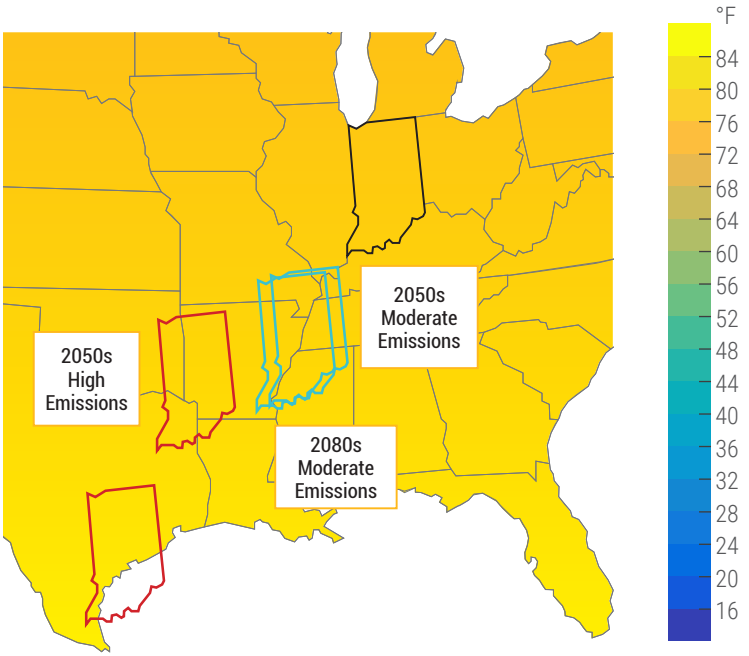
The Paris Climate Accord creates a framework for supporting, monitoring, and reporting countries' individual and collective climate goals to reduce greenhouse gas emissions. In order to be successful, this effort must come from every level of government, private corporations, and individuals. No one group or entity can do it all.

To complement this global pledge, local action is needed to reduce Greater Lafayette's contribution to climate change and adapt to its current and future impacts.

This Climate Action Plan takes advantage of policies and commitments that our local government is uniquely positioned to implement – actions that can reduce energy use and waste, create local jobs, improve air quality, preserve our local landscape and history, and reduce risk to people and property, ultimately benefiting Greater Lafayette for years to come.

CLIMATE CHANGE IN OUR COMMUNITY

The climate in Greater Lafayette will change in the coming years due to climate change. We can reduce the impacts of climate change by taking action. Like other communities in Indiana, we are experiencing hotter summers and heavier rain events in the spring, and these effects will become more extreme over time. In 2018, Purdue University's Climate Change Research Center published the "Indiana's Past & Future Climate: A Report from the Indiana Climate Change Impacts Assessment (IN CCIA)" which predicts the effects of climate change on Hoosiers. By 2050, the climate in Tippecanoe County will resemble the summer heat and rainfall of Arkansas, and eventually southern Texas by 2080, if no action is taken.



Source: ag.purdue.edu/indianaclimate/indiana-climate-report

Hotter summers, wetter springs, drier falls, and warmer winters will have a variety of impacts on the quality of life for residents of Greater Lafayette. This will make spending time outdoors in the summer uncomfortable for many residents, and increase heat-related risk for other residents. Those that work outdoors, do not have home air conditioning, or that have heart-related health conditions will struggle the most with hotter summers. Increased spring rainfall and flooding will add additional stress to roads and buildings near waterways. Farmers' abilities to prepare fields and plant crops will be impacted, threatening their incomes. Children in kindergarten today will experience these effects throughout their lifetime.

PREDICTED IMPACTS TO OUR COMMUNITY

NUMBER OF >95°F DAYS PER YEAR

2 1970 - 2000s

37 2050s

AVERAGE HOTTEST DAY OF THE YEAR

95°F 1970 - 2000s

105°F 2050s

AVERAGE COLDEST DAY OF THE YEAR

-13°F 1970 - 2000s

-3°F 2050s

PROJECTED CHANGE IN SPRING RAINFALL

+16%

2050s compared to PAST (1970 - 2000s)

CLIMATE ACTION PLANNING

Climate Action Planning is a way to address current climate change-related issues and prepare for future challenges. The sooner action is taken, the more effective the plan will be and the less costly impacts will be to communities. There are two common strategies to addressing climate change concerns: adaptation and mitigation. In order to be as effective as possible, our plan utilizes both strategies to maximize readiness for climate change. Additional co-benefits can emerge from mitigation strategies that provide benefits beyond climate change and help our community create a cleaner, safer, healthier future for Greater Lafayette.

ADAPTATION

(noun)

Preparing for climate change impacts already happening or soon-to-come.

Adaptation strategies focus on reducing the risk from the harmful effects of climate change and creating communities ready to tackle even the toughest of climate concerns. Examples include: emergency preparedness for floods and tornadoes, cooling centers for community members with no air conditioning to cool off on high heat days, or better access to affordable, healthy nutritious food for those with low-income.

MITIGATION

(noun)

Reducing the future effects of climate change by reducing greenhouse gas emissions.

Mitigation strategies focus on reducing greenhouse gas emissions and addressing them at the source to lessen the effects of climate change in the future, and make future adaptation efforts easier and cheaper. Examples include: improving building energy efficiency, creating on-site renewable energy generation, and increasing electric vehicle usage.

Climate Action Plans are designed to be a roadmap and guide for community decision-making as they reduce greenhouse gas emissions and adapt to climate change impacts. These plans include a variety of technical studies, such as greenhouse gas inventories, vulnerability assessment, forecasting and goal setting, as well as multiple opportunities for community engagement. After the plan is implemented, it is continually assessed to track progress and goals are adjusted to adapt to changing communities needs.

PLANNING PROCESS

Photo by Trevor Mahlmann


Imagination Station

GREATER LAFAYETTE CLIMATE ACTION PLAN

MISSION STATEMENT

To build a resilient Greater Lafayette by designing policies and implementing initiatives to reduce greenhouse gas emissions and protect equitable quality of life for current and future generations.

OUR PROCESS

The Cities of Lafayette, West Lafayette, and Tippecanoe County are addressing climate change through both mitigation and adaptation initiatives. Each entity is committed to leading economic, social, and environmental improvements both within government operations and throughout the community. Climate change does not stop at the banks of the Wabash, and climate action must take place at all levels – governmental to individual.

Several studies were conducted during the formation of this Climate Action Plan as baseline information is needed to decide the best course of action and to make informed decisions. These studies include an inventory of our community's greenhouse gas emissions, identifying vulnerable populations in our community, assessing how prepared we are for the effects of climate change, and taking an inventory of the tree canopy in our urbanized areas. All of the studies were conducted for each community: Lafayette, West Lafayette, and Tippecanoe County so the results could be utilized for unique actions in each unique community. However, the results summarized in this plan are the County-wide results, as they incorporate all three jurisdictions. The results of these studies are summarized below.

TECHNICAL STUDIES

Greenhouse Gas Inventory

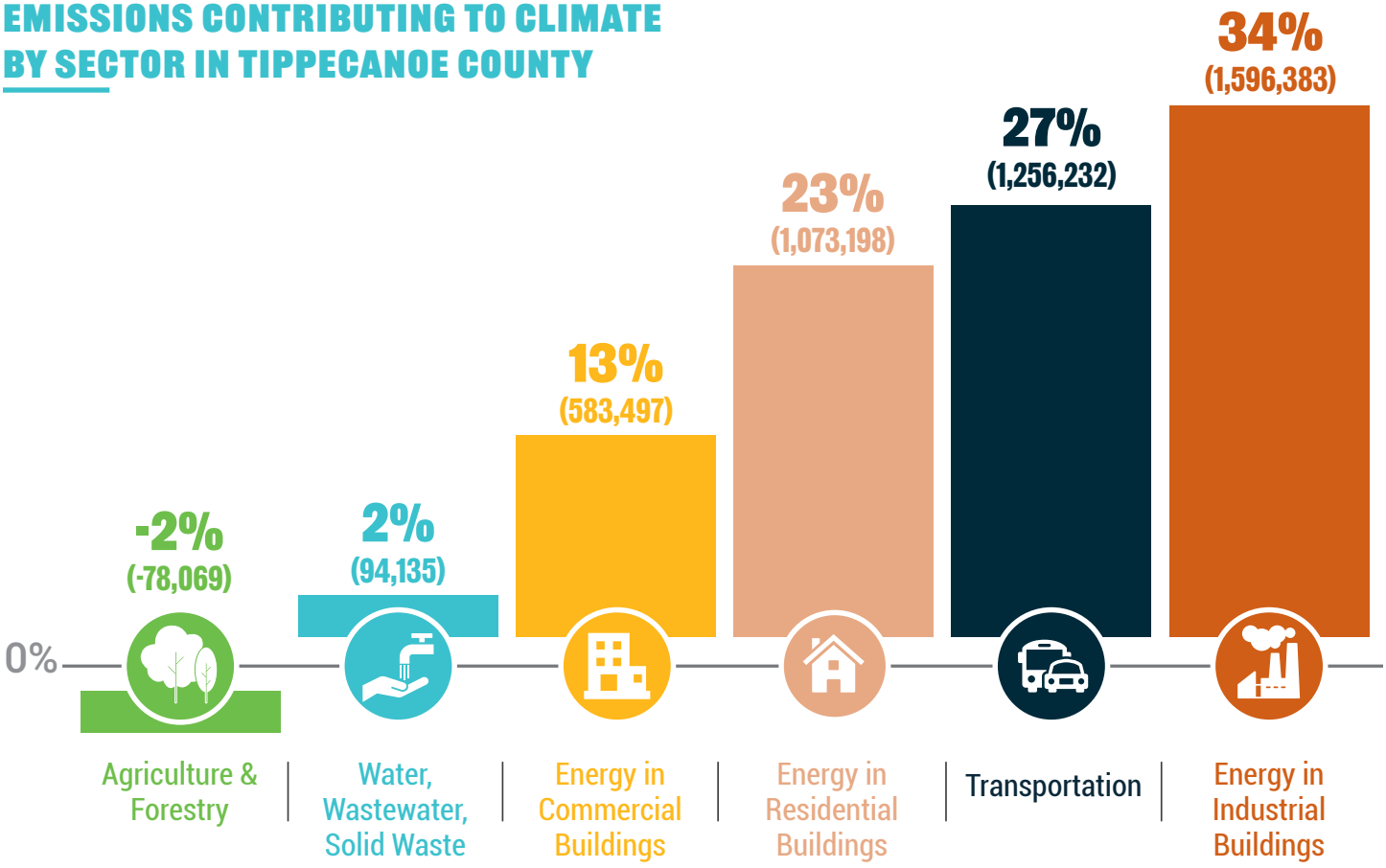
In 2021, supported by the international nonprofit ICLEI, who works with local governments in sustainability planning efforts, Lafayette, West Lafayette, and Tippecanoe County compiled greenhouse gas emissions from the year 2017. Using ICLEI USA's ClearPath tool, each entity calculated greenhouse gas emissions and identified ways to reduce emissions. As Tippecanoe County's greenhouse gas inventory encompasses Lafayette and West Lafayette's emissions, it ultimately provides a comprehensive view of all emissions from Greater Lafayette. The Tippecanoe County 2017 inventory serves as the baseline year from which to measure progress over time as the plan is implemented. The greenhouse gas inventory results can be seen in Appendix B. From this greenhouse gas inventory, ICLEI calculated our "science-based target" and provided us with measurable goals as we work towards a cleaner future.

SCIENCE-BASED TARGET

(noun)

Climate goals in line with the latest climate science. They represent your community's fair share of the ambition necessary to meet the Paris Agreement commitment to keep warming below 1.5°C.

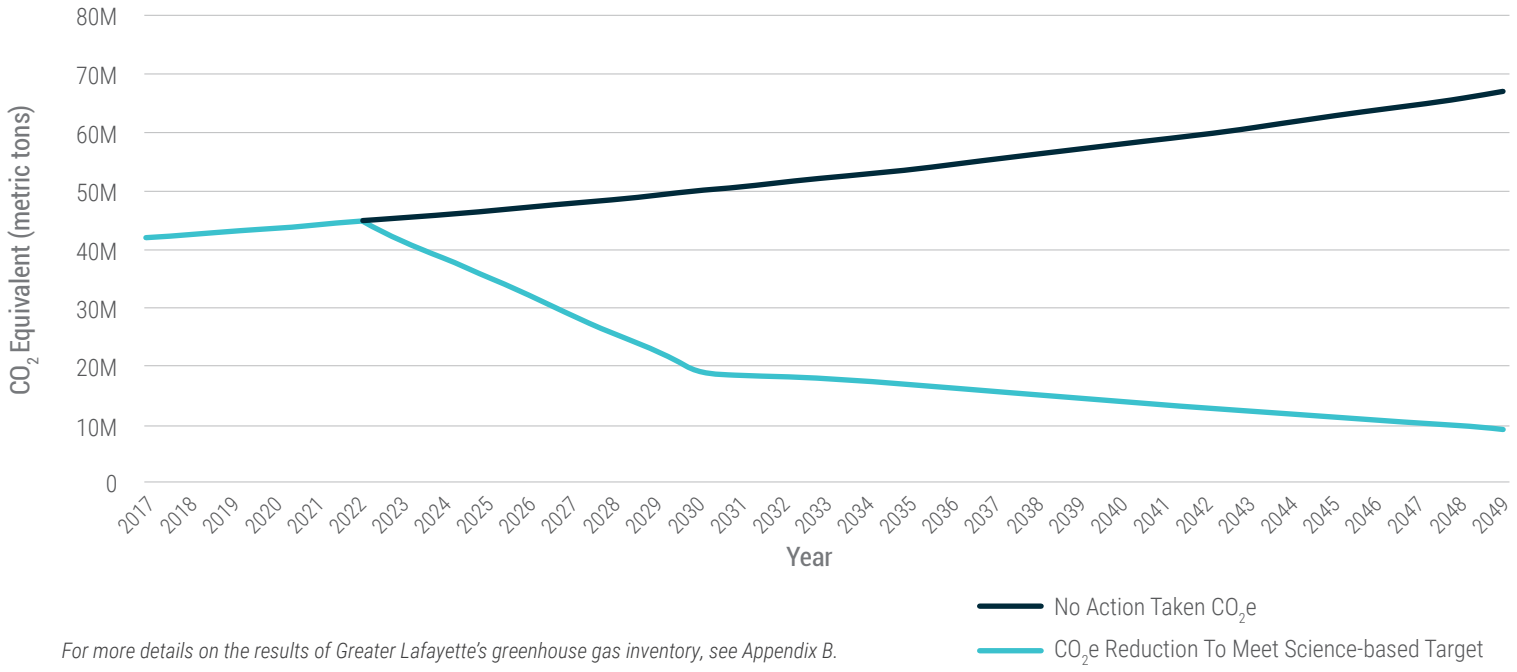
EMISSIONS CONTRIBUTING TO CLIMATE BY SECTOR IN TIPPECANOE COUNTY



58% BY 2030

Greater Lafayette's science-based target is a 58% reduction in community wide greenhouse gas emissions by 2030.

NO ACTION TAKEN VS. SCIENCE-BASED TARGETS



For more details on the results of Greater Lafayette's greenhouse gas inventory, see Appendix B.

HIGH IMPACT STRATEGIES

that will help Greater Lafayette reach its science-based target:

- ☑ **Low-income Household Weatherization Programs**
- ☑ **Photovoltaic Solar at Industry, Commercial, and Residential Buildings**
- ☑ **Education and Incentives for Heat Pumps and Geothermal**
- ☑ **Education and Promotion of Electric Vehicles**
- ☑ **Increasing Public Transit Coverage**
- ☑ **Residential Energy Education**
- ☑ **Increasing Electric Vehicle Charging Infrastructure**

Equity and Vulnerability

While we will all be impacted by hot summers and heavy rains in the spring, some people are more vulnerable and will be impacted more severely than others. Community members with health conditions, outdoor jobs, housing or food vulnerabilities, or language barriers will experience the effects of climate change more severely and have more trouble accessing appropriate support resources.

WHO WILL BE IMPACTED?

All of us will be impacted, but some more than others

CLIMATE EFFECTS

Air Pollution

Extreme Heat

Increased Food Prices

Drought

Flooding & Water Contamination

HEALTH THREATS

Asthma & Allergies

Heat-related Illness

Drowning & Injuries

Pest-borne Diseases

Malnutrition

POPULATIONS & THEIR VULNERABILITIES

Children
Developing Organs & Spend More time outdoors

People of Color
Structural Racism & Health Disparities

Immigrants
Language Barriers & Physically Intensive Jobs

Elderly
Low Immunity, Pre-existing Conditions & Limited Mobility

Low Income
Less Resources, Less Means to Evacuate & Inadequate Infrastructure

In our planning process we were mindful of these vulnerable, high-risk populations, and paid special consideration in developing our goals and strategies such that our Climate Action Plan does not continue to disadvantage people already facing challenges. Actions in the plan specifically target areas with high Social Vulnerability and seek to reduce the impacts of climate change on our most vulnerable members of our community. Throughout implementation of this plan, the CDC Social Vulnerability Index should be consulted to identify neighborhoods of high vulnerability to target for outreach and programs that will benefit those populations. The tree canopy assessment (described in detail in the technical studies) also took minority populations and median income into account.

SOCIAL VULNERABILITY

(noun)

Susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood.

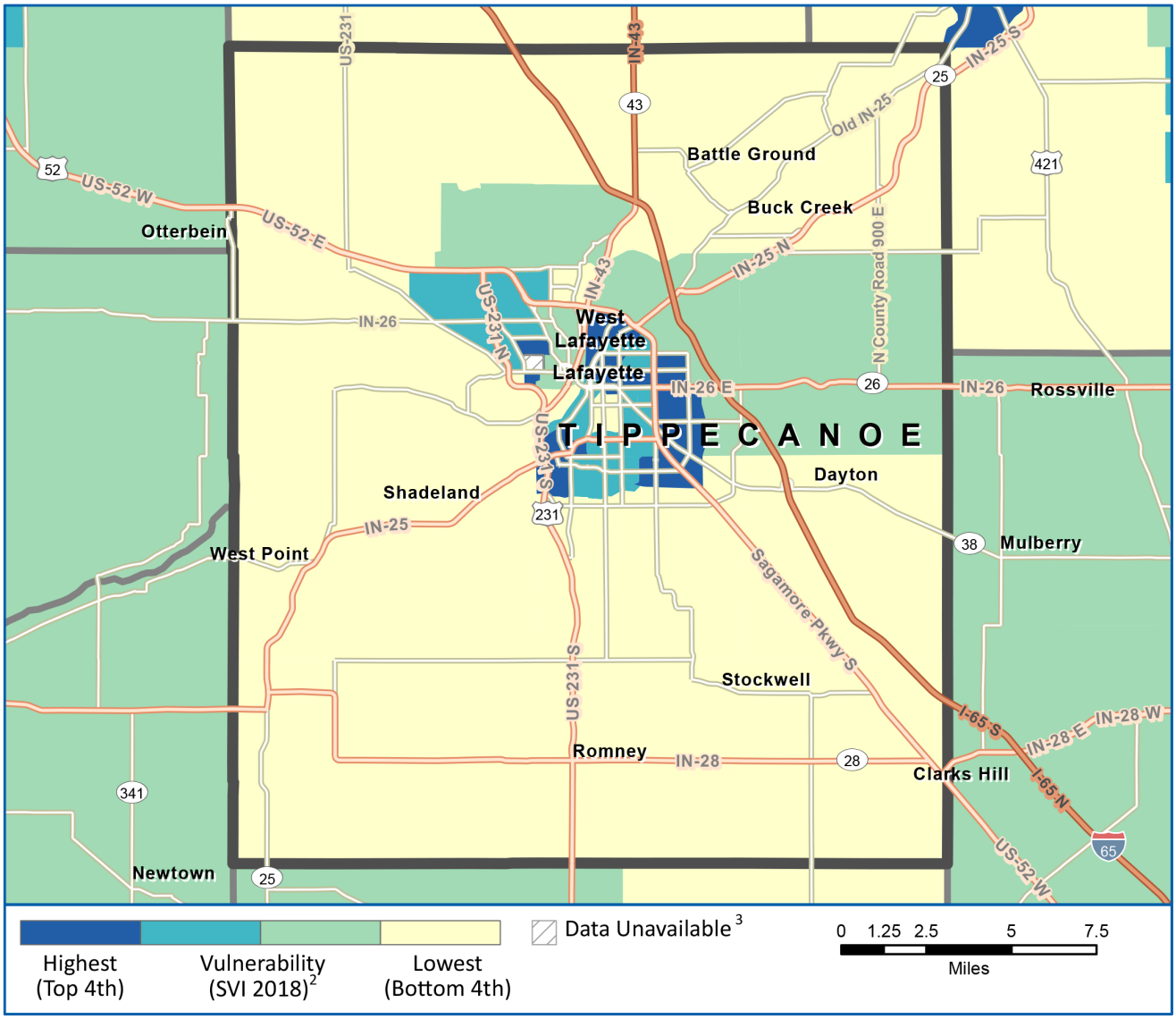
CDC Social Vulnerability Index 2018

Tippecanoe County, Indiana

PART 1

SVI SOCIAL VULNERABILITY INDEX

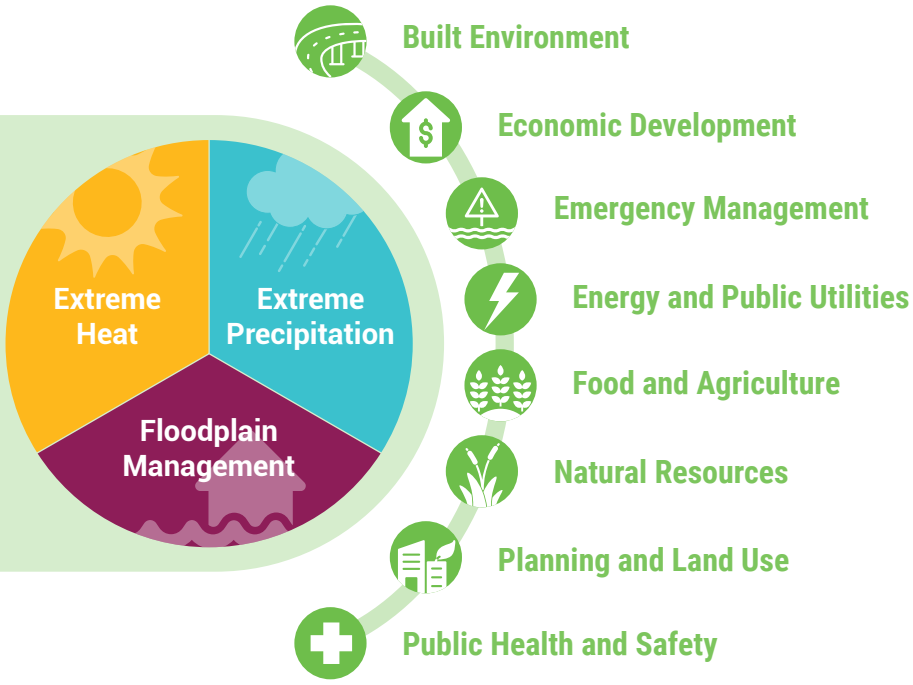
Overall Social Vulnerability[1]



Hoosier Resilience Index Assessment

In collaboration with Indiana University's Environmental Resilience Institute, we completed the Hoosier Resilience Index (HRI) Readiness Assessment to evaluate the preparedness of Tippecanoe County to withstand the impact of various climate risks. This assessment compared Tippecanoe County's preparedness for these effects with other Indiana counties.

The HRI allows local governments to rank their "readiness" across eight focus areas and three climate-related topics.



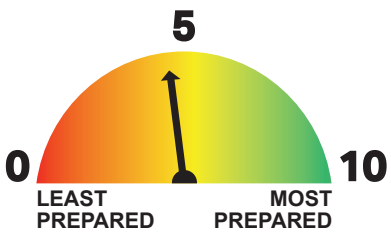
The results provided us with information to select our reduction strategies and prepare our residents, local government, and infrastructure for climate change impacts. While the HRI Assessment indicates Tippecanoe County is generally above average for climate change impact readiness, there is room to improve.

This Climate Action Plan lays the foundation for the implementation of strategies to further prepare Tippecanoe County, and as a result Greater Lafayette, to be a more resilient community.

HOW PREPARED ARE WE FOR EXTREME WEATHER?

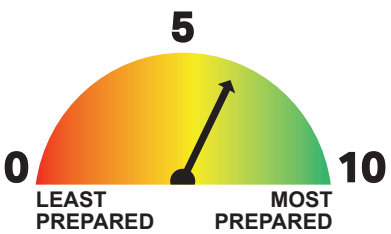
Results from the Hoosier Resilience Index

Extreme Heat



Readiness Score = 4.63

Extreme Precipitation



Readiness Score = 5.89

Floodplain Management

Readiness Score = 5.49

The full results of our Hoosier Resilience Index can be viewed in Appendix D.

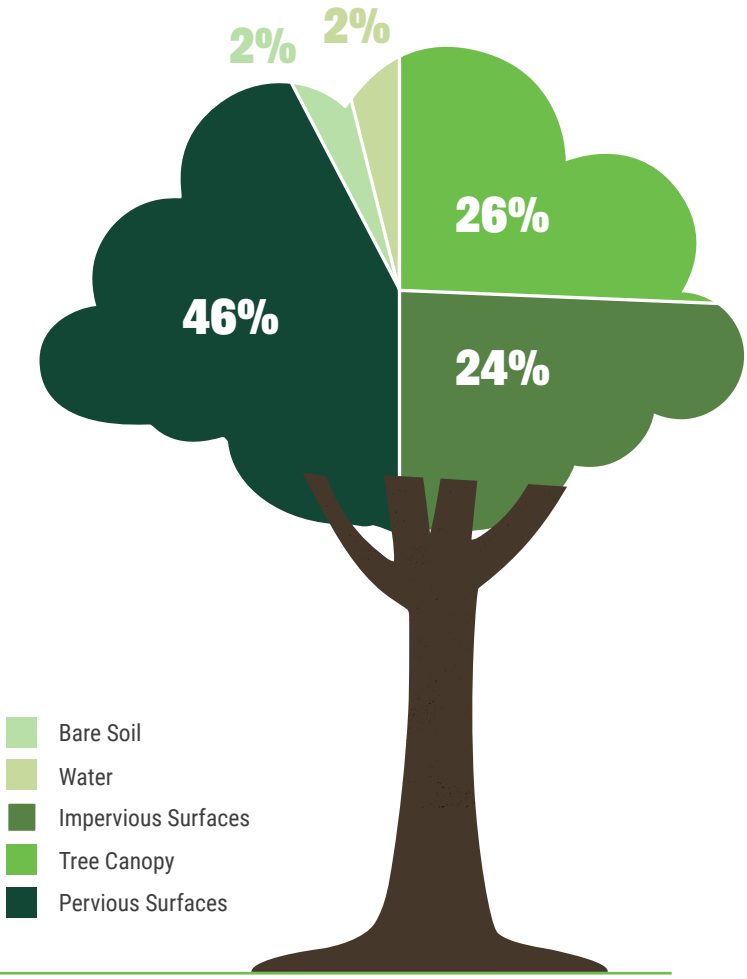
Tree Canopy Assessment

The urban tree canopy is an essential part of a city's infrastructure contributing to an increased quality of life in Indiana communities. Unlike other components of community infrastructure, trees, with proper care and protection, will continue to increase in value with each passing year. Trees, not only, provide aesthetics and shade, but numerous quantifiable environmental benefits, including stormwater management, watershed protection, water quality improvements, temperature moderation and cooling, reduction of air pollutants, and energy conservation. Ultimately, the amount of urban tree canopy determines the amount of economic, environmental, and social benefit a community receives.

Greater Lafayette took part in IU's Environmental Resilience Institute's Urban Green Infrastructure Resilience Cohort utilizing the services of Davey Resource Group to assess the existing tree canopy and identify opportunities to increase the canopy with future plantings. To study where trees will make the most community impact, a prioritized planting area was developed based upon the following factors: existing tree canopy percentage, proximity to hardscape, urban heat island index, floodplain proximity, soil permeability, soil erosion, slope, population density, minority population, and median household income. This tree canopy report will be utilized by both Cities, as well as non-profits such as Tree Lafayette and West Lafayette Tree Friends as we implement the Climate Action Plan. Additionally, the report will be used to explore a tree ordinance to guide future development outside of Lafayette and West Lafayette city limits. The full Tree Canopy Report can be found in Appendix C.

TREE CANOPY AND GROUND COVERAGE CURRENTLY IN URBAN AREAS

Results from the Urban Tree Canopy Assessment



COMMUNITY INPUT IN THE PLANNING PROCESS

Our Climate Action Planning process involved community members, stakeholders, and expert input throughout the entire process. We informed the community through newsletters, a public website, presentations, and news releases. Public input was sought at open, public meetings, interactive displays at community festivals, and online surveys. Diverse groups were engaged through public input meetings with local high school classrooms and a community group of senior citizens, attending the local Latino Fest with interactive posters, and providing newsletters and surveys in both English and Spanish. A website was created to make the newsletter and public surveys available, and this website was advertised in all local public libraries in both English and Spanish. Surveys were also made available at the County Health Department's COVID testing and vaccine clinic. The first community survey had over 600 responses in both English and Spanish.

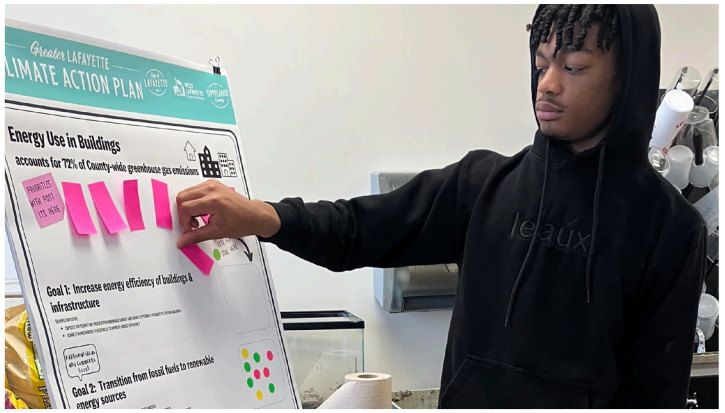
2

Surveys

5

Public Input Meetings

SUMMARY OF ENGAGEMENT: Throughout the planning process, Greater Lafayette utilized a comprehensive approach to engage stakeholders.



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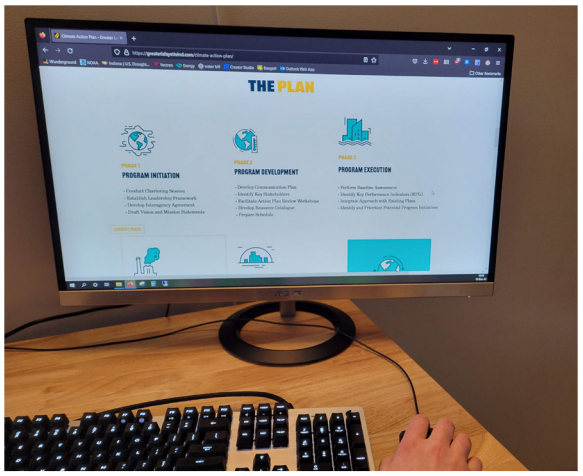
Advisory Committee Meetings

3

Information Presentations



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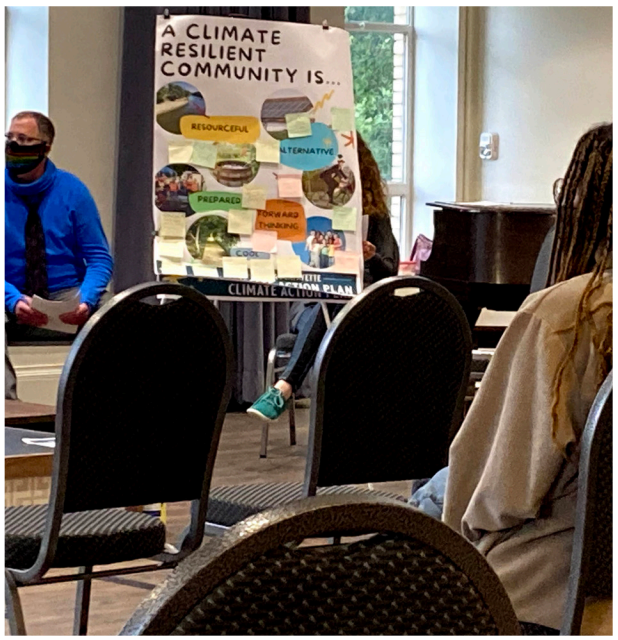
City and County Council Meetings

Interactive Posters at

2

Community Events



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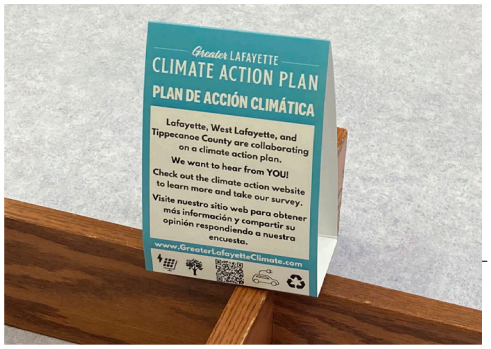
Focus Group Meetings



COMMUNITY SURVEY #1 RESPONSES

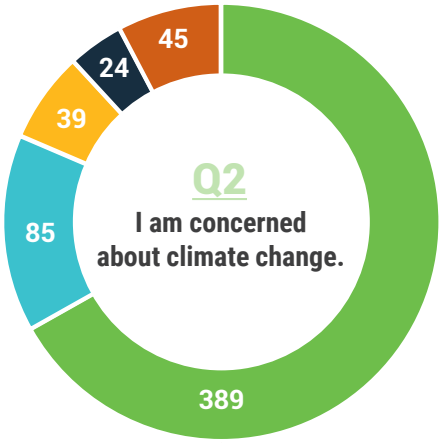
Survey responses were used to identify community concerns, prioritize goals, and aid the local government in developing initiatives to reduce greenhouse gas emissions and prepare for climate change.

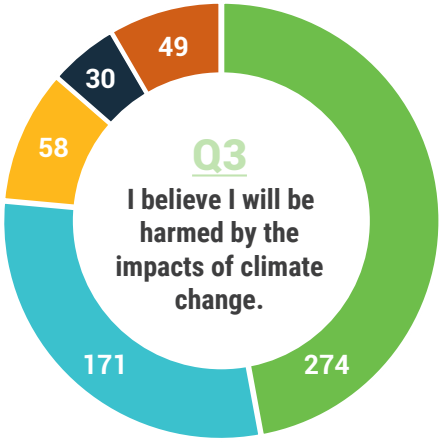
TOP RESPONSES FROM OUR FIRST COMMUNITY SURVEY:

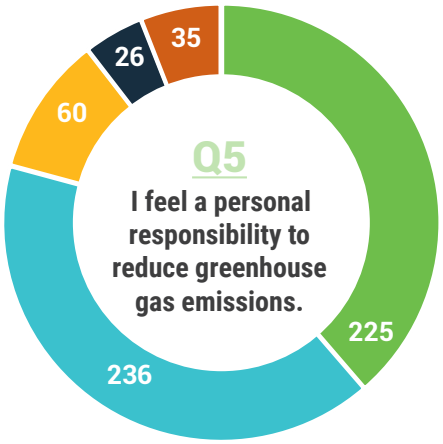
Biggest Concerns About Climate Change

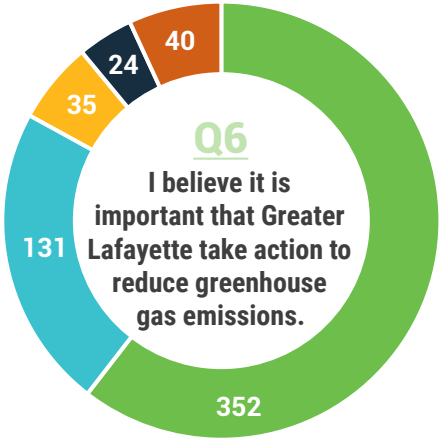
- Increase in Extreme Weather Events
- Air Quality Impacts
- Availability of Clean Drinking Water
- Risks to Vulnerable Populations

How much do you agree with the following statement?









Public input was sought at the beginning of the process to gauge concerns regarding climate change, and towards the end of the process to identify public priorities in climate action.

The public identified a priority goal within each focus area

THINGS TO CELEBRATE

There are many efforts already happening in Greater Lafayette that are reducing our community's greenhouse gas emissions, and better preparing us for climate change impacts. Before this plan was even formed, many community members, organizations, and local businesses were doing their part to improve our community.

Agriculture/Forestry

- ☑ GrowLocal Lafayette - nourishes communities through local gardens
- ☑ Niches Land Trust - protecting and improving existing natural areas
- ☑ WREC and Soil and Water - support conservation farming practices
- ☑ Tree Lafayette - planted 250 trees in Lafayette in 2022 alone

Energy Use in Built Environment

- ☑ Solar arrays installed by the City of Lafayette in 2022 will result in a reduction of over 400 metric tons of carbon dioxide a year.
- ☑ City of Lafayette - converting street lights to high efficiency LEDs
- ☑ LUM and Hoosier Interfaith Power and Light - working with churches to improve energy efficiency and increase stewardship

Transportation

- ☑ Wabash River Enhancement Corporation - working to increase multi-use trails throughout the Wabash River corridor
- ☑ Kirby Risk and Wabash National employees enjoy free transportation to and from work, thanks to an employer-paid partnership with CityBus.
- ☑ Bicycle-friendly businesses - Brokerage Brewing, Purdue Federal Credit Union, Westminster Village

Water, Waste Water, and Solid Waste

- ☑ West Lafayette Water Resource Recovery Facility - residents can drop off food waste that is used in anaerobic digesters and processed to generate electricity for the facility.
- ☑ Tippecanoe Solid Waste District has recycled over 141,000 lbs of electronics in 2022 alone
- ☑ Wabash River Enhancement Corporation has funded projects that keep almost 20,000,000 lbs of sediment pollution out of streams and rivers in 2022 alone.

BRINGING IT ALL TOGETHER - GOALS & STRATEGIES

Photo by Trevor Mahlmann

4 FOCUS AREAS

The 2017 greenhouse gas inventory divided Tippecanoe County's emissions across eight categories. Ultimately, our reduction strategies combined some of these categories and are divided into four areas.

FOCUS AREA: ENERGY USE IN THE BUILT ENVIRONMENT

FOCUS AREA: TRANSPORTATION

FOCUS AREA: AGRICULTURE AND FORESTRY

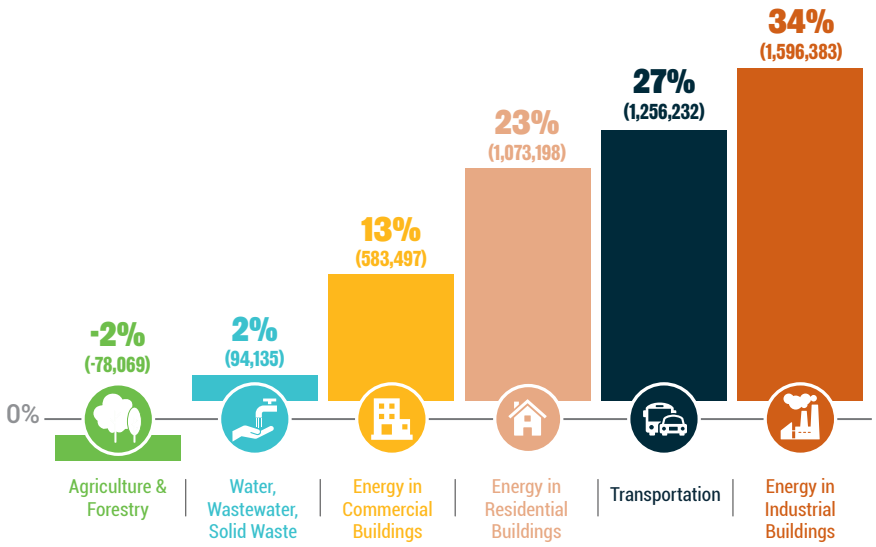
FOCUS AREA: WATER, WASTEWATER, & SOLID WASTE

Initiatives in each area are designed to create the foundation necessary to achieve climate resiliency and reduce greenhouse gas emissions. These initiatives will equip Greater Lafayette with the educational, procedural, and developmental resources imperative to improving overall resiliency and quality of life for all. While implementing actions for each focus area is critical to achieving the goals laid out in the Climate Action Plan, some areas have higher emissions than others. Subsequently, this plan prioritizes focus areas "Built Environment" and "Transportation" as they are the two highest emitting areas according to the 2017 greenhouse gas inventory.

2030
REDUCE
CO_2e emissions by
58%

2050
REDUCE
CO_2e emissions by
80%

EMISSIONS CONTRIBUTING TO CLIMATE BY SECTOR IN TIPPECANOE COUNTY



USING THIS PLAN

Previous sections of this plan explained climate change, climate action, and impacts to our community. The following sections are a guide and framework for taking action. This framework is divided into four areas, each area having a set of broad goals, and each goal having specific actions that can be taken to achieve those goals. The focus area action tables summarize the cost to implement, potential co-benefits and implementation timeline associated with each of the actions in the plan.

GOALS

During public input, participants were asked to prioritize goals within each focus area. This allows those working on implementation to focus their limited resources on goals and initiatives that the public prioritizes and that will have the biggest impact. These goals are marked as "Public Priority Goal!" Throughout public input, we heard repeatedly that the government should be setting an example to reduce greenhouse gas emissions in government operations. To address this, initiatives focused on reducing the greenhouse gases produced by local government operations are grouped and labeled.

ACTIONS

Each goal will be followed by actions that will help meet the goal and will be labeled like this example:

EBE1-A
Energy in the Built Environment Goal 1-Action A

COST TO IMPLEMENT

The estimated cost of implementing each action has been characterized based on a relative scale as follows:

$ = LOW COST
Government departments can implement the activity within existing budgets.

$$ = MEDIUM COST
Activity may require reassessing budgets, support from community partners, or outside sponsorships.

$$$ = HIGH COST
Activity will likely require grant funding or corporate sponsorship, will need to plan budget well in advance.

CO-BENEFITS

Many of the strategies in this plan have benefits outside of their main objectives, and these are called co-benefits. Co-benefits can strengthen vulnerable populations, give businesses and individuals insulation from rising fuel prices, improve air quality, and protect our natural resources.

CO-BENEFITS
(noun)
Benefits above and beyond mitigating climate change.

Types of Co-benefits

- ✔ Supports Local Economy
- ✔ Produces Local Energy
- ✔ Improves Air Quality
- ✔ Creates Jobs and/or Develops Workforce
- ✔ Improves Local Resilience
- ✔ Improves Public Health
- ✔ Cost Savings Accrued
- ✔ Supports Biodiversity Preservation
- ✔ Benefits the Most Vulnerable
- ✔ Scalable or Transferable To Other Communities

IMPLEMENTATION TIMELINE

In the following focus area sections, the time-frame of actions to be completed is identified as Short-term, Mid-term and Long-term as follows:

Short-term **Mid-term** **Long-term**

FOCUS AREA:

1 ENERGY USE IN THE BUILT ENVIRONMENT (EBE)

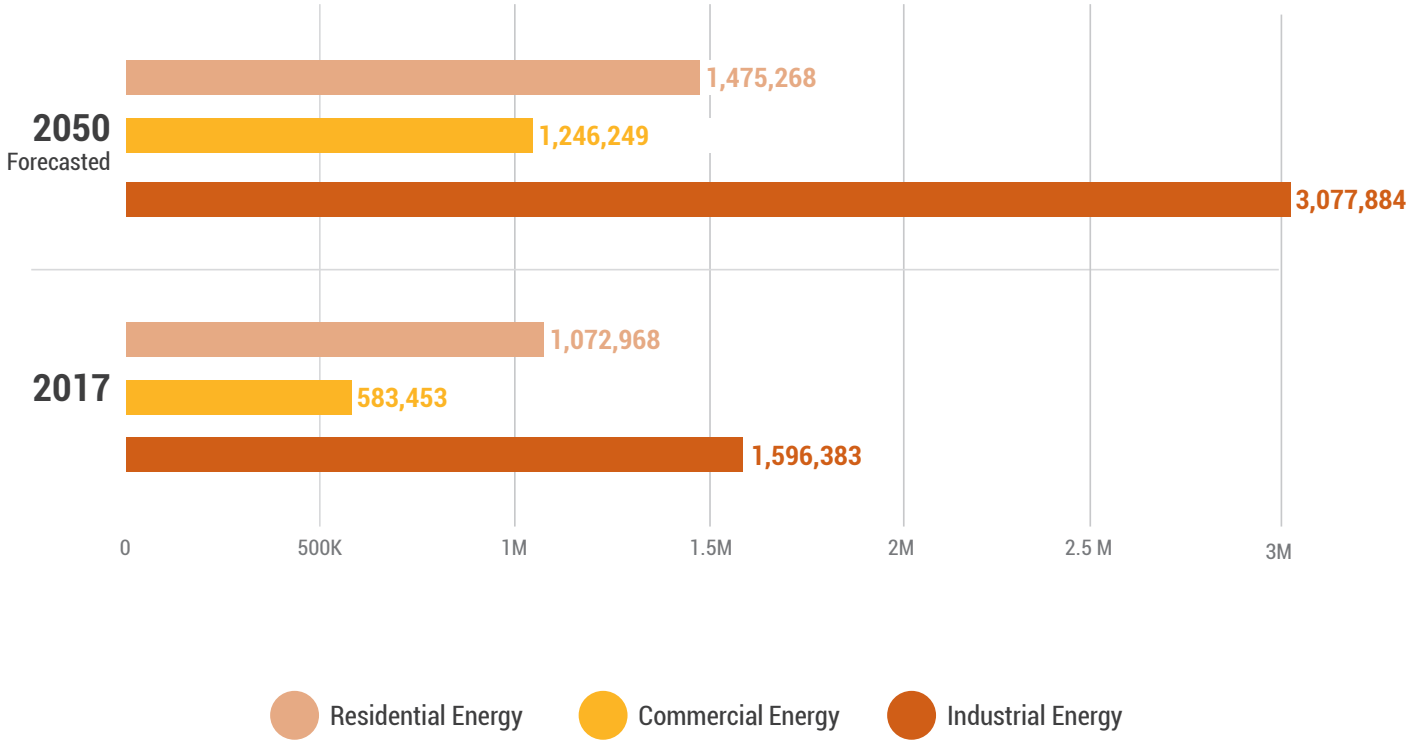
FOCUS AREA 1: ENERGY USE IN THE BUILT ENVIRONMENT

OVERVIEW/BACKGROUND

The built environment refers to the homes where we live, the places we work, and the buildings needed to support our daily lives. For Greater Lafayette, the energy used to heat, light, cool, and power these buildings is responsible for a majority of our greenhouse gas emissions, and can be divided into three categories: residential energy use, commercial energy use, and industrial energy use. Public input also identified this area as a priority, and analysis from ClearPath suggested that actions taken in this area can have the highest impact on reducing our community's greenhouse gas emissions.

It is important to note that Duke Energy supplies a majority of the residents in Tippecanoe County with electricity. As a result, the success of our transition from fossil fuels to renewable sources, is largely dependent upon Duke Energy fulfilling their Climate Goals. In short, Duke Energy has set goals to reach a 50% reduction of their 2005 greenhouse gas emissions by 2030, and net-zero by 2050. Greater Lafayette will be working with Duke Energy to assist and support, in its best capacity, this transition of fuel sources. More information about Duke Energy's commitment to Sustainability, Climate Actions, and Environmental actions can be found on their website.

Greenhouse Gas Emissions Forecasted to 2050 If No Action is Taken



For more details on the results of Greater Lafayette's greenhouse gas emissions source data inventory, see Appendix B.

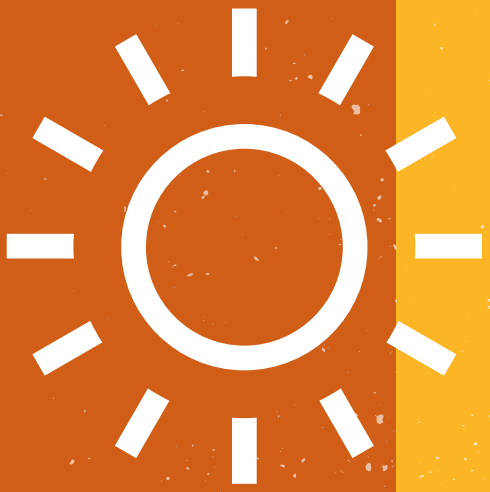
OUR PLAN GOING TOWARDS 2030

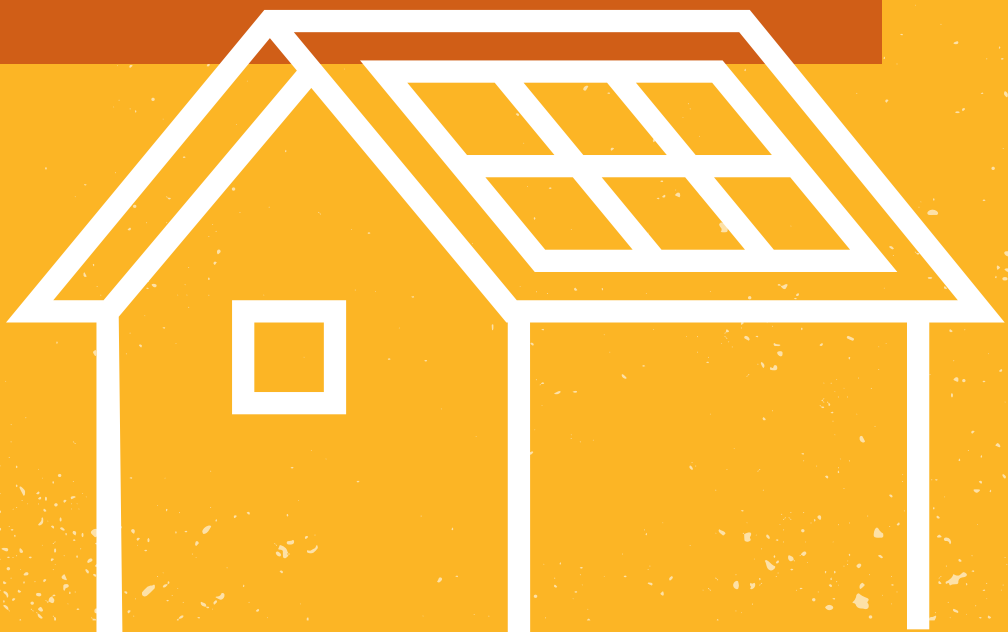
EBE GOAL 1
Increase Energy Efficiency of Buildings and Infrastructure

EBE GOAL 2
Begin Transition From Fossil Fuels to Renewable Sources

EBE GOAL 3
Foster Innovation

EBE GOAL 4
Increase Social Resilience





FOCUS AREA 1: ENERGY USE IN THE BUILT ENVIRONMENT

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
GOAL 1: Increase Energy Efficiency of Buildings and Infrastructure				
EBE 1-A	Gov. operations: Develop a plan for evaluating and increasing energy efficiency in government buildings.	$	✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
EBE 1-B	Hold public education and outreach campaign on energy consumption and building efficiency.	$	✔ Improves Local Resilience ✔ Cost Savings Accrued	
EBE 1-C	Create an expedited permitting review process for projects improving energy efficiency of buildings.	$	✔ Cost Savings Accrued	
EBE 1-D	Explore transparent benchmarking program for large buildings.	$$	✔ Cost Savings Accrued	
EBE 1-E	Identify funding for improving energy efficiency in low income or multi-family homes. Provide education on these programs.	$	✔ Improves Local Resilience ✔ Benefits the Most Vulnerable	
GOAL 2: Begin Transition from Fossil Fuels to Renewable Sources - **Public Priority Goal**				
EBE 2-A	Gov. operations: Create Renewable Energy Master Plan for Government Operations.	$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
EBE 2-B	Incentivize renewable energy use for homes and businesses – award and recognition.	$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	

FOCUS AREA 1: ENERGY USE IN THE BUILT ENVIRONMENT

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
EBE 2-C	Explore ordinances requiring new developments to meet sustainability standards or include sustainable features such as being solar-ready.	$$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
EBE 2-D	Create community solar cohort and/or buy-in program for neighborhoods.	$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
EBE 2-E	Host solar informational seminars for residents and businesses.	$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
EBE 2-F	Develop incentives for adoption of solar, electrified appliances, and net-zero buildings.	$$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
EBE 2-G	Host booths with solar-ready home information at home/remodel showcase events.	$	✔ Produces Local Energy ✔ Improves Local Resilience	
EBE 2-H	Explore District Heating Opportunities.	$	✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
EBE 2-I	Achieve Solsmart rating by specific target date	$$$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Scalable or Transferable to Other Communities	
EBE 2-J	Acquire funding to implement solar for public schools.	$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
EBE 2-K	Identify areas that cannot be developed to install community solar fields (e.g. brownfields).	$	✔ Supports Local Economy ✔ Produces Local Energy ✔ Creates Jobs and/or Develops Workforce ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	●–○–○→
EBE 2-L	Advocate for stronger state policy regarding renewable energy.	$	✔ Produces Local Energy ✔ Improves Local Resilience	●–○–○→
EBE 2-M	Explore and utilize community renewable energy programs.	$	✔ Supports Local Economy ✔ Produces Local Energy ✔ Creates Jobs and/or Develops Workforce ✔ Improves Local Resilience ✔ Scalable or Transferable to Other Communities	●–●–○→
EBE 2-N	Establish / Revise solar ordinance	$	✔ Produces Local Energy ✔ Improves Local Resilience	●–●–○→
GOAL 3: Foster Innovation				
EBE 3-A	Advance newly formed “Industrial Roundtable”, include discussions on climate risks and how they will impact business/industry.	$	✔ Supports Local Economy ✔ Improves Local Resilience ✔ Cost Savings Accrued	●–○–○→
EBE 3-B	Provide workshops to industry, business, and residents on going solar and the electrification process.	$	✔ Supports Local Economy ✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued	●–○–○→
EBE 3-C	Develop an incentive and recognition program for converting buildings to electric and/or net zero.	$$	✔ Supports Local Economy ✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	●–●–●→

FOCUS AREA 1: ENERGY USE IN THE BUILT ENVIRONMENT

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
GOAL 4: Increase Social Resilience				
EBE 4-A	Create a network of resiliency hubs to support vulnerable community members during extreme weather events.	$$$	✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable ✔ Scalable or Transferable to Other Communities	
EBE 4-B	Develop a green jobs program to train minorities for employment in the renewable energy field.	$$	✔ Supports Local Economy ✔ Creates Jobs and/or Develops Workforce ✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable ✔ Scalable or Transferable to Other Communities	

PARTNERS IN PLANNING:

- Center for Energy Education
- Duke Energy
- Greater Lafayette Career Academy
- Greater Lafayette Commerce
- Hoosier Interfaith Power and Light
- Ivy Tech
- NAACP
- Solar United Neighbors
- Tippecanoe Area Plan Commission

2

FOCUS AREA:
TRANSPORTATION (T)

FOCUS AREA 2: TRANSPORTATION

OVERVIEW/BACKGROUND

Greenhouse emissions from the transportation area come from the fossil fuels burned to move people and materials from one location to another, e.g., greenhouse gas emissions from cars, trucks, trains, boats, and planes. In order to reduce emissions in this area, it is important to focus on reducing our dependence on fossil fuel-burning vehicles in our daily lives while also encouraging low and no carbon alternate forms of transportation.

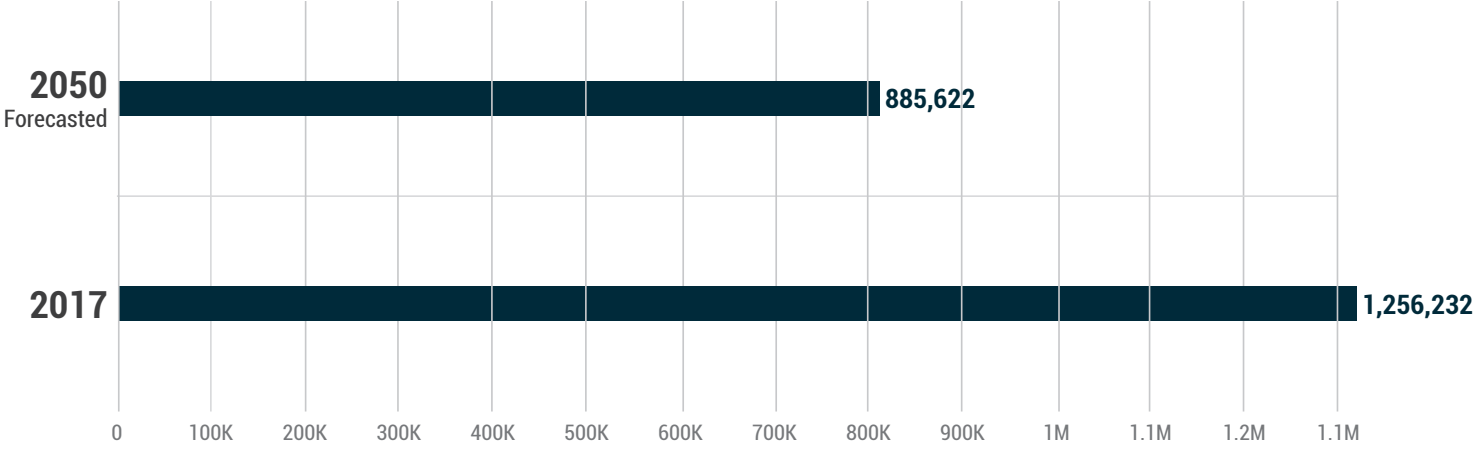
The presence of I-65 in Tippecanoe County makes interstate travel by vehicle convenient, but increases greenhouse gas emissions from vehicles traveling through our county. Local governments have little to no impact on the vehicles traveling through our county, but we can make alternative modes of local travel more accessible and local electric vehicle adoption easier.

Transportation infrastructure, such as roads and parking lots, can increase the urban heat island effect which will disproportionately impact low-income neighborhoods with higher amounts of paved surfaces. This is especially detrimental to those that use public transit or walk to work. Community-wide planning can have huge impacts on the types of transportation available, the walkability of our communities, and the negative impacts of high heat days and ozone days.

OZONE DAYS

(noun)

Ozone at ground level is a harmful air pollutant, because of its effects on people and the environment, and it is the main ingredient in "smog." Ozone days are designated by meteorologists based on weather conditions and air pollution.



For more details on the results of Greater Lafayette's greenhouse gas emissions source data inventory, see Appendix B.

OUR PLAN GOING TOWARDS 2030

T GOAL 1
Reduce Vehicle Miles Traveled.

T GOAL 2
Incentivize Zero and Low Carbon Fuel Transit and Equipment

T GOAL 3
Reduce Heat-island Impacts and Stormwater Run-off Associated with the Infrastructure Required to Support the Transportation Area

FOCUS AREA 2: TRANSPORTATION

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
GOAL 1: Reduce Vehicle Miles Traveled				
T1-A	Gov. operations: Encourage alternate transportation in government operations (e.g. insurance discounts, shower facilities, free bus passes, carpooling networks).	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health	●–●–○→
T1-B	Implement Transportation Demand Management Program	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Scalable or Transferable to Other Communities	●–●–○→
T1-C	Update transportation plans to include greenhouse gas goals, improve bike/ped infrastructure management.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable	●–●–●→
T1-D	Advertise and expand rideshare & bus options to connect residential areas to industrial/high employment areas.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Benefits the Most Vulnerable	●–●–○→
T1-E	Invest in trail projects/implement existing plans for bike infrastructure and complete streets.	$$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable	●–●–●→
T1-F	Collaborate with businesses to promote employer sponsored bus passes, bike/walk to work programs, and increased accessibility to safe bike storage. Identify low-cost incentives such as bonus days off.	$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable	●–○–○→
T1-G	Develop a plan for dense communities – Transit Oriented Development	$$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Supports Biodiversity Preservation ✔ Benefits the Most Vulnerable	●–●–●→

FOCUS AREA 2: TRANSPORTATION

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
T1-H	Develop an educational campaign on safe bike laws, bike maintenance, and safe bike routes.	$	✔ Improves Public Health	
T1-I	Explore park-and-ride locations in rural areas.	$$	✔ Improves Air Quality ✔ Improves Local Resilience	
T1-J	Increase implementation of roundabouts.	$$$	✔ Improves Air Quality ✔ Improves Public Health	
T1-K	Encourage walking to school, safe routes to school program.	$	✔ Improves Air Quality ✔ Improves Public Health ✔ Cost Savings Accrued ✔ Benefits the Most Vulnerable	
GOAL 2: Incentivize Zero and Low Carbon Fuel Transit and Equipment - **Public Priority Goal**				
T2-A	Gov. operations: Conduct a study and develop a plan to convert government and public fleet vehicles to EV, & lawn maintenance equipment to electric.	$$$	✔ Improves Air Quality ✔ Cost Savings Accrued	
T2-B	Develop education programs to support EV adoption.	$	✔ Supports Local Economy ✔ Improves Air Quality	
T2-C	Incentivize EV charging stations for existing industrial, commercial, and residential buildings.	$$	✔ Supports Local Economy ✔ Improves Air Quality	
T2-D	Encourage and/or incentivize the conversion of gas-powered lawn equipment to electric power for the public.	$	✔ Improves Air Quality ✔ Cost Savings Accrued	
T2-E	Install EV charging stations in public parks and multi-family housing.	$$$	✔ Benefits the Most Vulnerable ✔ Supports Local Economy ✔ Improves Air Quality ✔ Improves Local Resilience	
T2-F	Explore ordinances on EV charging infrastructure for new commercial, industrial, and multi-family housing development.	$	✔ Supports Local Economy ✔ Improves Air Quality ✔ Improves Local Resilience ✔ Benefits the Most Vulnerable	

FOCUS AREA 2: TRANSPORTATION

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
T2-G	Work with local school and education programs to train auto mechanics on EV.	$$	✔ Supports Local Economy ✔ Create Jobs and/or Develops Workforce ✔ Improves Local Resilience ✔ Benefits the Most Vulnerable	
GOAL 3: Reduce Heat-island Impacts, Stormwater Run-off, and Ozone Impacts Associated with Transportation				
T3-A	Explore and adopt the use of urban cooling surfaces and strategies in new and existing paved surfaces.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable	
T3-B	Identify low or no-cost transportation for movement between resilience hubs and residential areas.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable	
T3-C	Convert underutilized or unused paved surfaces to green space.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Supports Biodiversity Preservation	
T3-D	Use road salt alternatives during winter road maintenance to reduce run off.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Supports Biodiversity Preservation	
T3-E	Provide education on ozone days and ozone prevention.	$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Benefits the Most Vulnerable	

PARTNERS IN PLANNING:

- » CityBus
- » Greater Lafayette Commerce
- » Tippecanoe Area Plan Commission
- » Tippecanoe County Health Department

3

FOCUS AREA:
AGRICULTURE AND FORESTRY (AF)

FOCUS AREA 3: AGRICULTURE AND FORESTRY

OVERVIEW/BACKGROUND

The Agriculture and Forestry (AF) focus area is unique. While agricultural activities contribute to greenhouse gas emissions (example: methane from livestock), the forests in Greater Lafayette act as a **carbon sink**, and absorb greenhouse gasses. This offers an opportunity to offset our community's greenhouse gas emissions by protecting existing forests and planting new trees in urbanized areas, and is one of the most effective and cheapest ways to combat climate change. Habitat restoration and new tree plantings are important, but mature trees and prairies provide a large carbon sink that is already active, less costly, and requires much less planning.

By focusing on opportunities to promote urban forestry, coordinating with our rural partners on smart farming approaches, and encouraging equitable access to green space, Greater Lafayette will reduce negative environmental impacts and increase local quality of life. More access to green spaces and a dense urban tree canopy improves public health and increases outdoor recreation opportunities, making the community more attractive to businesses and individuals.

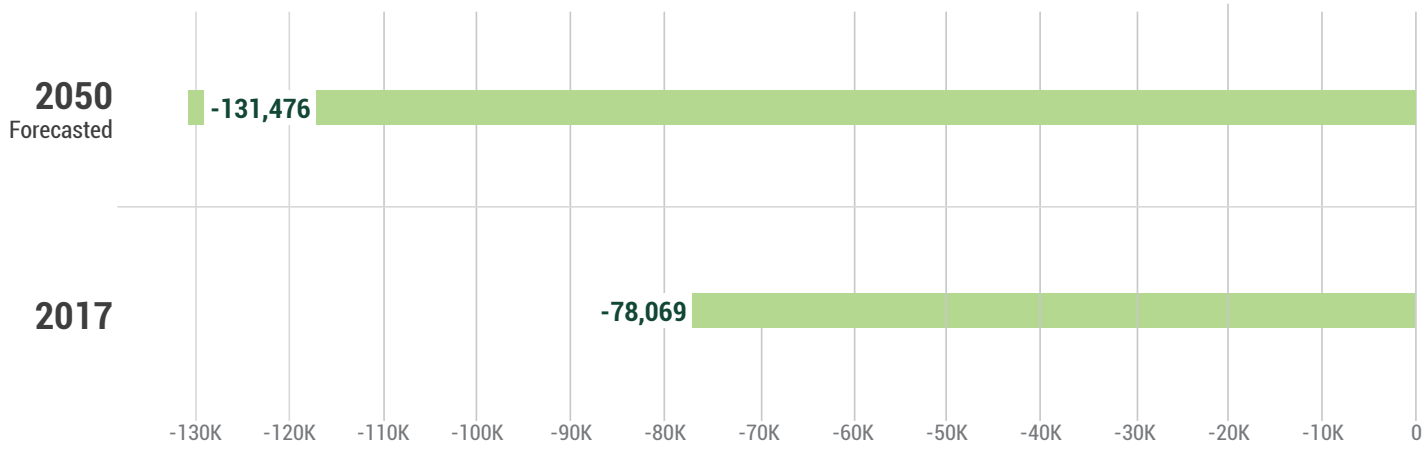
In addition, this focus area provides a great opportunity for supporting water quality in addition to forestry. Long term stormwater management and heat island reduction goals are more achievable by increasing the area of permeable surfaces and planting more urban trees.

CARBON SINK

(noun)

A carbon sink is anything that absorbs more carbon from the atmosphere than it releases. Many plants, algae, and microbes are carbon sinks.

Greenhouse Gas Emissions Forecasted to 2050
If No Action is Taken



For more details on the results of Greater Lafayette's greenhouse gas emissions source data inventory, see Appendix B.

OUR PLAN GOING TOWARDS 2030

AF GOAL 1

Support a Climate-ready Farming Community

AF GOAL 2

Enhance, Protect, and Improve Access to Our Natural Resources

FOCUS AREA 3: AGRICULTURE AND FORESTRY

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
GOAL 1: Support a climate-ready farming community				
AF 1-A	Support local groups working to increase best management practices (cover crops, filter strips, and grassed waterways).	$	✔ Supports Local Economy ✔ Improves Local Resilience ✔ Supports Biodiversity Preservation ✔ Scalable or Transferable to Other Communities	●–○–○→
AF 1-B	Work with agricultural extension, NRCS, and Soil and Water to share information about climate impacts to agriculture.	$	✔ Supports Local Economy ✔ Improves Local Resilience ✔ Supports Biodiversity Preservation ✔ Scalable or Transferable to Other Communities	●–○–○→
AF 1-C	Conduct a study to see if additional farmers markets are needed and desired in neighborhoods further from the town center.	$	✔ Supports Local Economy ✔ Create Jobs and/or Develops Workforce ✔ Improves Local Resilience ✔ Improves Public Health ✔ Support Biodiversity Preservation ✔ Benefits the Most Vulnerable	●–○–○→
AF 1-D	Provide information/workshop on agri-solar to local farmers.	$	✔ Supports Local Economy ✔ Produce Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued	●–○–○→
GOAL 2: Enhance, Protect, and Improve Access to Our Natural Resources - **Public Priority Goal**				
AF 2-A	Gov. operations: Increase use of native plants in all government landscaping projects.	$	✔ Improves Local Resilience ✔ Improves Public Health ✔ Supports Biodiversity Preservation	●–○–○→
AF 2-B	Gov. operations: create a plan to eliminate the invasive plants on public property and replace them with native plants.	$	✔ Cost Savings Accrued ✔ Improves Local Resilience ✔ Supports Biodiversity Preservation	●–●–○→

FOCUS AREA 3: AGRICULTURE AND FORESTRY

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
AF 2-C	Gov. operations: Increase support for local parks departments and partner with local organizations to acquire and protect existing high quality forested areas.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Cost Savings Accrued ✔ Supports Biodiversity Preservation ✔ Benefits the Most Vulnerable	●–●–○→
AF 2-D	Use the tree canopy assessment to identify areas of unused lawns - such as in parks and businesses - that could be used to increase our urban canopy.	$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Supports Biodiversity Preservation ✔ Benefits the Most Vulnerable	●–●–○→
AF 2-E	Develop a community initiative to map invasive plants and provide incentives for eliminating the use of invasive species	$$	✔ Cost Savings Accrued ✔ Supports Biodiversity Preservation	●–●–○→
AF 2-F	Identify areas in Greater Lafayette that are underserved by parks and open spaces and develop a plan to improve access in these areas.	$$	✔ Improves Public Health ✔ Improves Local Resilience ✔ Supports Biodiversity Preservation ✔ Benefits the Most Vulnerable	●–●–○→
AF 2-G	Identify additional areas for reforestation in urban and rural areas.	$$	✔ Improves Air Quality ✔ Improves Local Resilience ✔ Improves Public Health ✔ Supports Biodiversity Preservation	●–●–○→

PARTNERS IN PLANNING:

- NICHES Land Trust
- Tippecanoe Area Plan Commission
- Tippecanoe Parks Department
- Tippecanoe Soil and Water Conservation District
- Tree Lafayette
- Wabash River Enhancement Corporation
- West Lafayette Tree Friends

4

FOCUS AREA:

WATER, WASTEWATER, AND SOLID WASTE

FOCUS AREA 4: WATER, WASTEWATER, AND SOLID WASTE

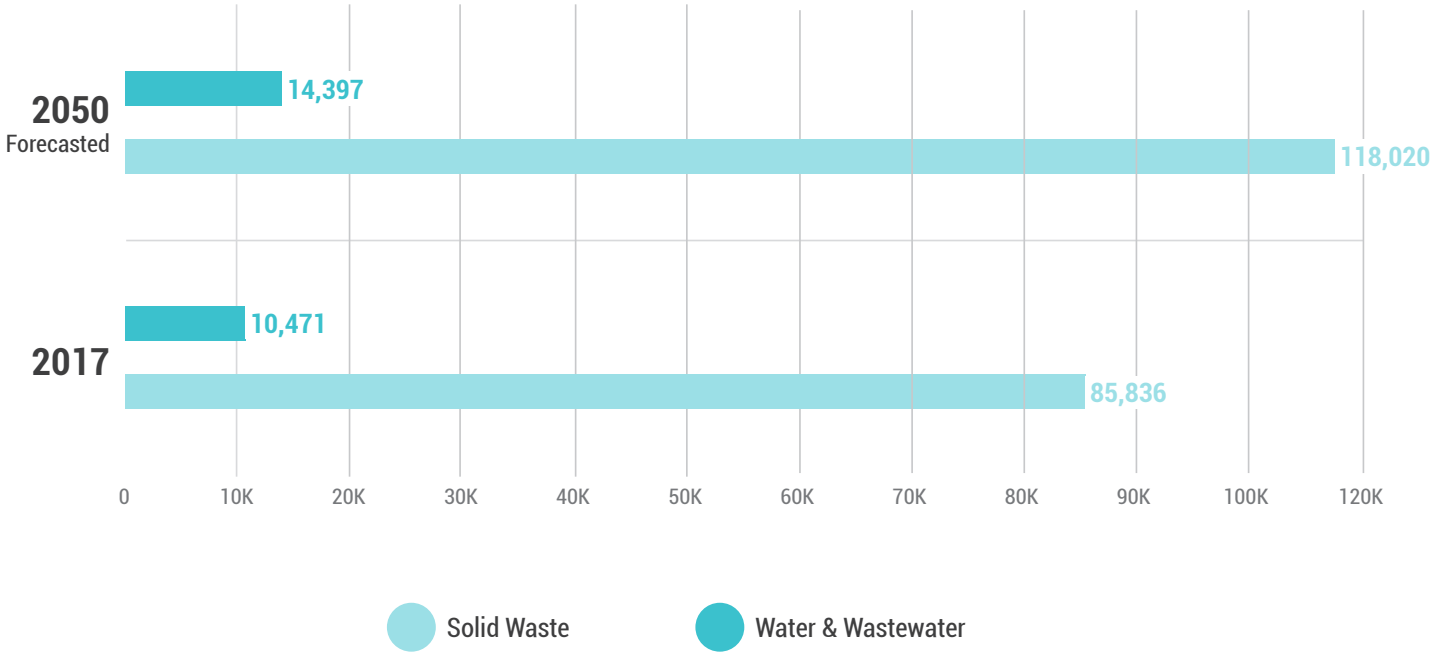
OVERVIEW/BACKGROUND

Wastewater and solid waste represent enormous opportunities to re-imagine resources that were typically considered useless. Wastewater and solid waste can be leveraged to reduce our community's greenhouse gas emissions while reducing and reusing to save costs in other areas. Best solid waste management practices reduce the materials that end up in landfill, or worse, in natural habitats. Recycling reduces emissions by avoiding the energy required to convert raw materials into new products. Wastewater can also be used for energy generation, heat recovery, and agriculture production. Compared to the Energy Use in the Built Environment or Transportation areas, this area has a relatively small greenhouse gas footprint. While financial resources should not be heavily dedicated to this area, this area does provide some opportunities to get creative with our household and industrial waste, and identify cost-savings through reuse.

SOLID WASTE
(noun)

Any material that is disposed of, discarded, or recycled.

Greenhouse Gas Emissions Forecasted to 2050 If No Action is Taken



For more details on the results of Greater Lafayette's greenhouse gas emissions source data inventory, see Appendix B.

OUR PLAN GOING TOWARDS 2030

AF GOAL 1

Enhance Recycling, Waste Reduction, and Composting

AF GOAL 2

Protect the Quality of Our Water

AF GOAL 3

Harvest Wastewater Energy and By-products

FOCUS AREA 4: WATER, WASTEWATER, AND SOLID WASTE

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
GOAL 1: Enhance Recycling, Waste Reduction, and Composting - **Public Priority Goal**				
WWSW 1-A	Gov. operations: Conduct waste stream audit for government operations.	$	✔ Cost Savings Accrued	
WWSW 1-B	Create recognition program for increased recycling within the business community.	$	✔ Cost Savings Accrued ✔ Scalable or Transferable to Other Communities	
WWSW 1-C	Provide e-waste education with-in the business community.	$	✔ Supports Local Economy	
WWSW 1-D	Explore composting opportunities within business and residential communities.	$	✔ Cost Savings Accrued	
WWSW 1-E	Discourage single-use plastics through education.	$	✔ Improves Public Health ✔ Supports Biodiversity Preservation	
WWSW 1-F	Develop food waste reduction and composting campaign.	$	✔ Cost Savings Accrued	
GOAL 2: Protect the Quality of Our Water				
WWSW 2-A	Conduct a study of the status of the Teays Aquifer and the rate of water consumption.	$ $	✔ Improves Local Resilience	
WWSW 2-B	Create a flooding risk manage-ment program.	$	✔ Improves Local Resilience	
WWSW 2-C	Implement the regional water-shed management plan for the Region of the Great Bend of the Wabash River.		✔ Improves Local Resilience ✔ Improves Public Health	

FOCUS AREA 4: WATER, WASTEWATER, AND SOLID WASTE

	Actions	Cost to Implement	Co-Benefits	Implementation Timeline
GOAL 3: Harvest Wastewater Energy and By-products				
WWSW 3-A	Gov. Operations: Incorporate increased greywater use and water reuse.	$$$	✔ Cost Savings Accrued	
WWSW 3-B	Develop wastewater energy master plan.	$	✔ Produces Local Energy ✔ Improves Local Resilience ✔ Cost Savings Accrued	
WWSW 3-C	Explore heat recovery from wastewater.	$	✔ Improves Local Resilience ✔ Cost Savings Accrued	
WWSW 3-D	Increase public awareness on greywater reuse systems.	$	✔ Improves Local Resilience ✔ Cost Savings Accrued	

PARTNERS IN PLANNING:

- Circular Indiana
- Lafayette Renew
- Food Finders, Lafayette Urban Ministry, Food Pantries
- Oscar Winski
- Tippecanoe Area Plan Commission
- Tippecanoe Recycling and Solid Waste District
- Wabash River Enhancement Corporation
- West Lafayette Water Resource Recovery

MOVING FORWARD

SUCCESSFUL IMPLEMENTATION

Successful implementation of this plan requires immediate action. Staffing support from each local government entity, identifying funding for implementation, and establishing a framework for community involvement are critical to the success of this Climate Action Plan.

As time goes on and initiatives are implemented, the greenhouse gas inventory will need to be revisited periodically to track our progress. Updating the greenhouse gas inventory every three years and updating the entire Climate Action Plan after 2030 will allow government employees to monitor our community's progress and adjust initiatives as needed.

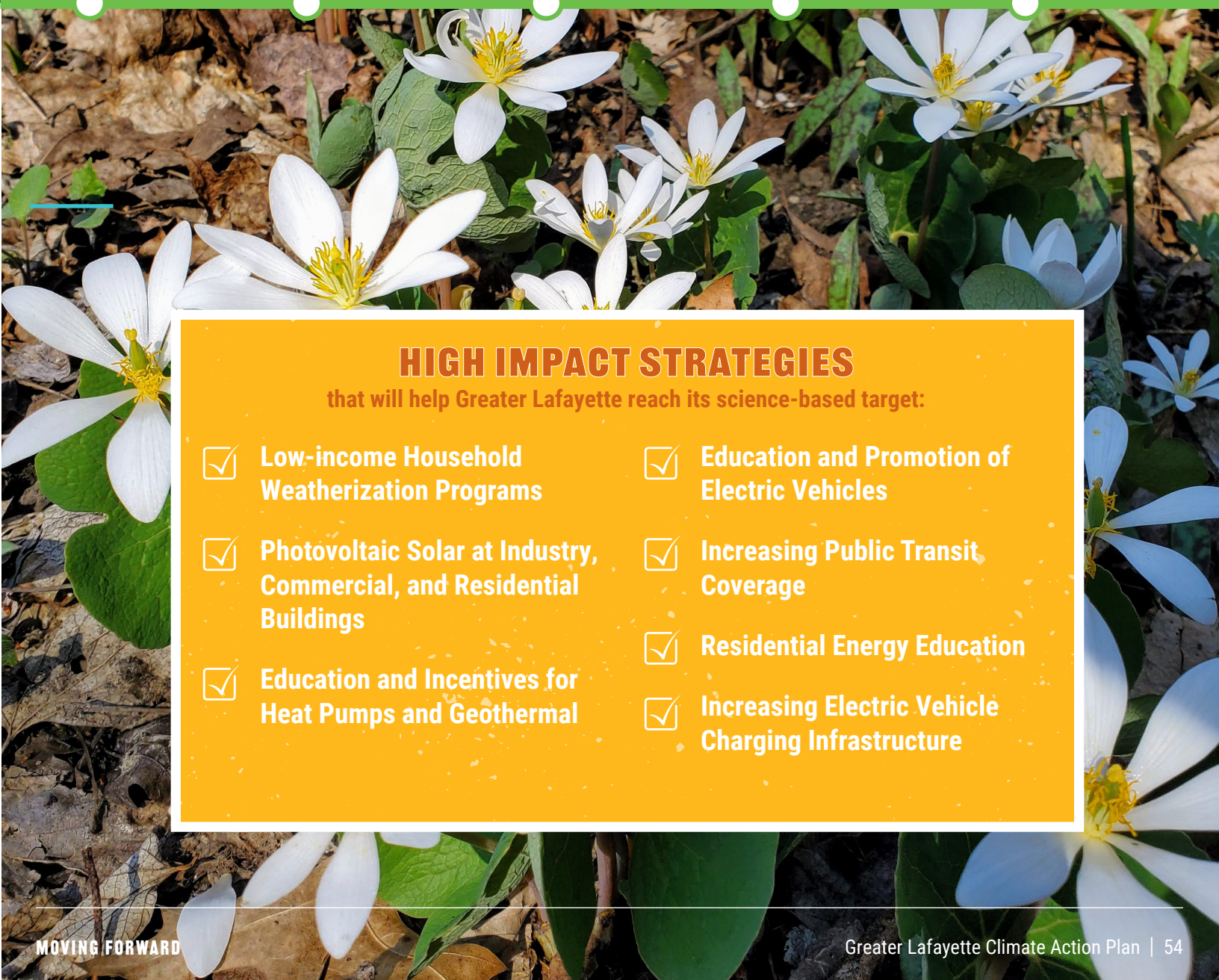
2022
Climate Action Plan Approved

2023
Greenhouse Gas Inventory Updated for year 2020

2025
Greenhouse Gas Inventory Updated for year 2023

2028
Greenhouse Gas Inventory Updated for year 2026

2031
Climate Action Plan Update



HIGH IMPACT STRATEGIES

that will help Greater Lafayette reach its science-based target:

- ☑ **Low-income Household Weatherization Programs**
- ☑ **Photovoltaic Solar at Industry, Commercial, and Residential Buildings**
- ☑ **Education and Incentives for Heat Pumps and Geothermal**
- ☑ **Education and Promotion of Electric Vehicles**
- ☑ **Increasing Public Transit Coverage**
- ☑ **Residential Energy Education**
- ☑ **Increasing Electric Vehicle Charging Infrastructure**

FUNDING THIS PLAN

Providing dedicated staff members to implement this plan, and pursuing projects to reduce emissions with government operations will require financial support from the local government entities. Many of these projects will save tax dollars in the long run, and are an investment in the future for our community. Investment in solar panels will insulate government operations from rising energy prices. Investment in energy efficient building upgrades will lower the energy use and the cost of these buildings. Investing in natural resources such as tree plantings and stormwater infrastructure will reduce stress on our waste water treatment plants and reduce flooding along the Wabash River.

Many of the community-wide programs outlined in this action plan can be funded through state, local, and federal grants and programs. There are many federal grant programs to support reducing energy use in buildings and the transition to renewable resources.

- The Inflation Reduction Act, passed in 2022, is a source of rebates and programs aimed at tackling climate change.
- Duke Energy and other energy providers also provide incentives and programs to increase energy efficiency in buildings.
- ICLEI provides both information resources and support for pursuing these financial resources, such as the The Energy Efficiency and Conservation Block Grant Program. These and other avenues should be explored to support our community in reducing greenhouse gas emissions caused by powering our buildings.
- Community Development Block Grants are available to support rural communities in improving public facilities, stormwater improvements, and wastewater/drinking water improvements.
- The Bloomberg Initiative for Cycling Infrastructure is a grant program to fund ambitious cycling infrastructure projects and connect cities.
- The Bipartisan Infrastructure Law established the Strengthening Mobility and Revolutionizing Transportation (SMART) grant program to fund projects focused on improving transportation efficiency and safety.

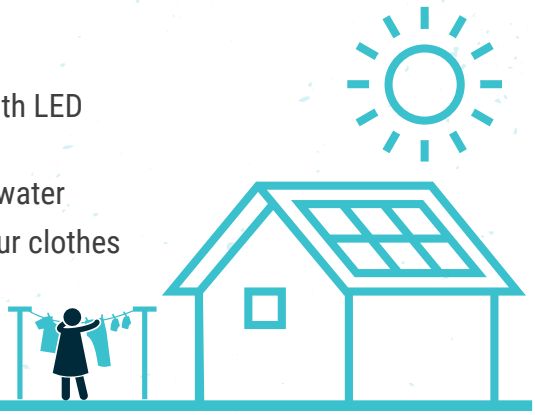
WHAT YOU CAN DO TO WORK TOWARDS CLIMATE CHANGE SOLUTIONS

Mitigating and preparing for climate change will take action at every level. Individual actions, while seemingly small, have a ripple effect and can collectively make a big impact. Here are some actions that individuals can do at home or at work to do your part.

To see how some of these actions can impact your daily life, our society, and overall greenhouse gas emissions in our region, refer to Appendix G.

ENERGY AND BUILT ENVIRONMENT

- ☑ Get an energy audit and improve the insulation in your home
- ☑ Convert gas powered appliances to electrical
- ☑ Install solar arrays to power your home
- ☑ Replace your light bulbs with LED energy efficient bulbs
- ☑ Wash your clothes in cold water
- ☑ Use a clothesline to dry your clothes
- ☑ Keep thermostat 1 degree cooler in the winter



TRANSPORATION

- ☑ Use public transit
- ☑ Walk or bike when possible for errands or commuting to work
- ☑ Carpool
- ☑ Consider a hybrid or EV for your next vehicle

AGRICULTURE AND FORESTRY

- ☑ Reduce your food waste
- ☑ Try substituting meat with more sustainable alternatives such as tofu, beans, nuts or plant-based meat
- ☑ Shop at your farmer's market to support local economy
- ☑ Use native plants in your landscaping

- ☑ Plant trees on your property
- ☑ Support organizations that are protecting local natural resources
- ☑ Reduce pollution caused by mowing by converting your un-used turf to native plantings and mow in the evening
- ☑ Replace your gas powered lawn tools with electric battery powered tools

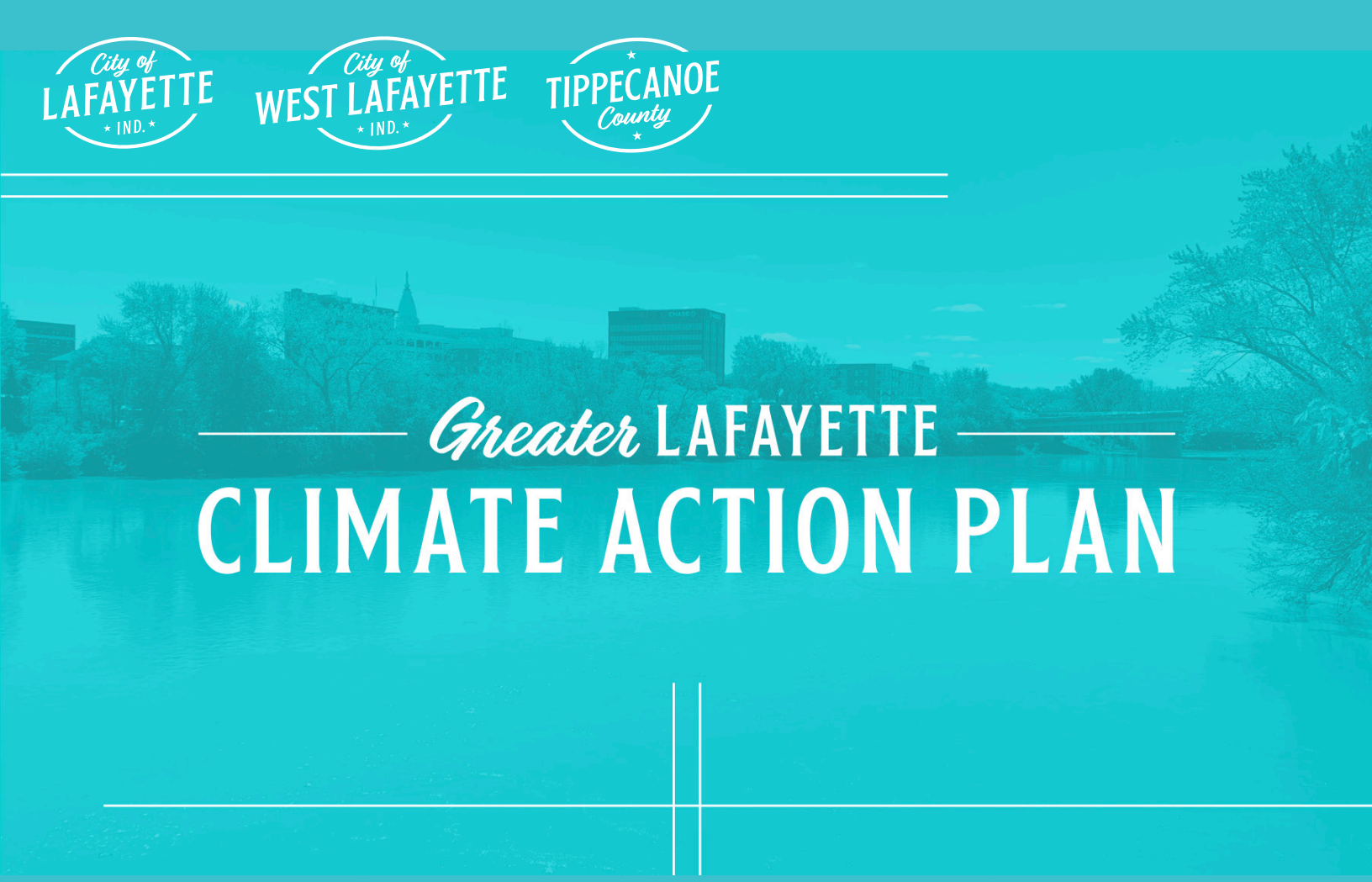
WATER, WASTEWATER AND SOLID WASTE

- ☑ Reduce your food waste
- ☑ Utilize the West Lafayette food waste drop off for the food waste you do create
- ☑ Buy less things to reduce your carbon footprint
- ☑ Opt for items wrapped in less packaging at the store

City of LAFAYETTE IND.

City of WEST LAFAYETTE IND.

TIPPECANOE County



Greater LAFAYETTE
CLIMATE ACTION PLAN

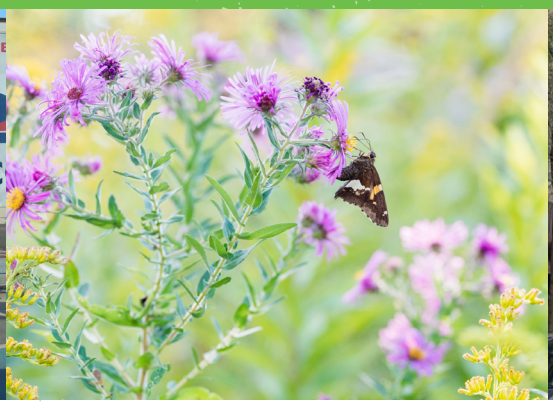
Check out the Greater Lafayette Climate Action Plan website to learn more.

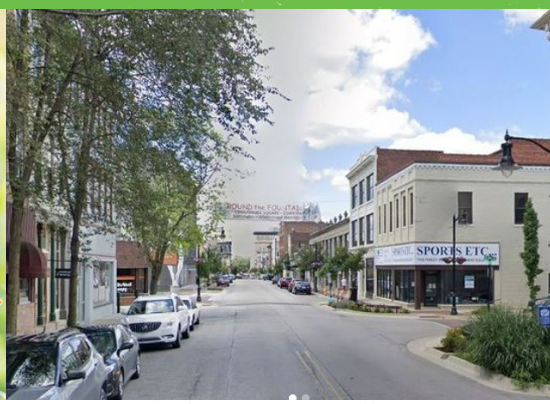
www.GreaterLafayetteClimate.com

APPENDICES


Rolling
Salad Garden
¡No me tires! Soy un cultivo de cobertura.
Los cultivos de cobertura en este jardín están trabajando para mejorar la salud del suelo. Al plantar un cultivo de cobertura después de la temporada de hortalizas, mantenemos el suelo cubierto evitando la erosión, combatiendo las malezas, aflojando la parte superior del suelo, entre otros beneficios.
Principios de la salud del suelo
1.Minimizar la perturbación
Perturbar el suelo lo menos posible
2.Maximice la cobertura del suelo
Mantenga el suelo cubierto
3.Maximizar la biodiversidad
Uso de la rotación de cultivos y cultivos de cobertura
4.Proporcionar raíces vivas continuas
Mantenga plantas creciendo durante todo el año
Cultivo de avena
Los beneficios de este cultivo son crecimiento rápido, supresión de malezas y su relación positiva con los hongos micorrícicos en el suelo.
Escanea con la cámara fotográfica de su teléfono móvil.
URBAN SOIL HEALTH
USDA
www.urbansoilhealth.org
YAKIMA

APPENDIX A: RESOURCES





DUKE ENERGY

Neighborhood Energy Saver Program - Information about free walkthrough energy assessments designed to help lower electric bills

Lower My Bill Toolkit - A landing for the links to the sources Duke provides on methods to lower bills

» Toolkit includes:
  - Smart Saver
  - Shop the Online Savings Store
  - Find Discounts at Local Retail Stores (there is potential for partnering with local businesses here)
  - Seasonal Tips Spring & Summer
  - EnergyWise Home
  - Home Energy Report
  - Home Energy House Call
  - Other billing assistance and energy usage understanding education

Smart $aver - Home improvement opportunities (rebate opportunity in parenthesis):

» HVAC Installations ($300)
  - HVAC Information
» Heat pump water heater installations ($350)
  - Heat Pump Water Heater Information
» Insulation & Sealing - Attic ($250)
  - Insulation & Sealing (Attic and Ductwork) Information
» Seal Ductwork ($100)
  - Insulation & Sealing (Attic and Ductwork) Information
» Pool Pump ($300)
  - Pool Pump Information
» Link for finding a Smart Saver Contractor

ENERGY STAR INFORMATION

» Energy Star Federal Tax Credits & Other Incentives for Energy Efficiency

INDIANA STATE GOVERNMENT

» Indiana Office of Energy Development

INDIANA CLIMATE CHANGE IMPACTS ASSESSMENT

» Indiana's Past & Future Climate: A report from the Indiana Climate Change Impacts Assessment
» Indiana Climate Change Impacts Assessment

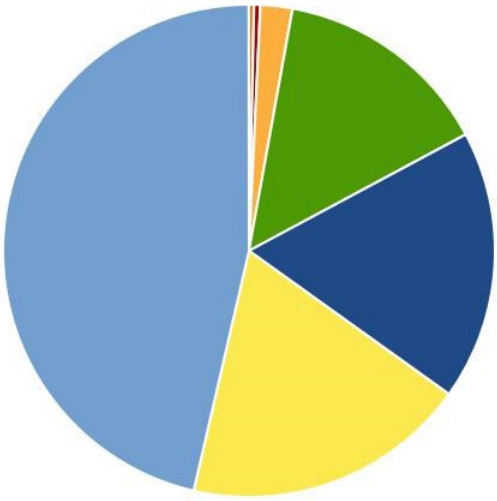
ELECTRIC SCHOOL BUS INITIATIVE

APPENDIX B: GREENHOUSE GAS INVENTORIES

Greenhouse Gas Inventory for

City of Lafayette 2017

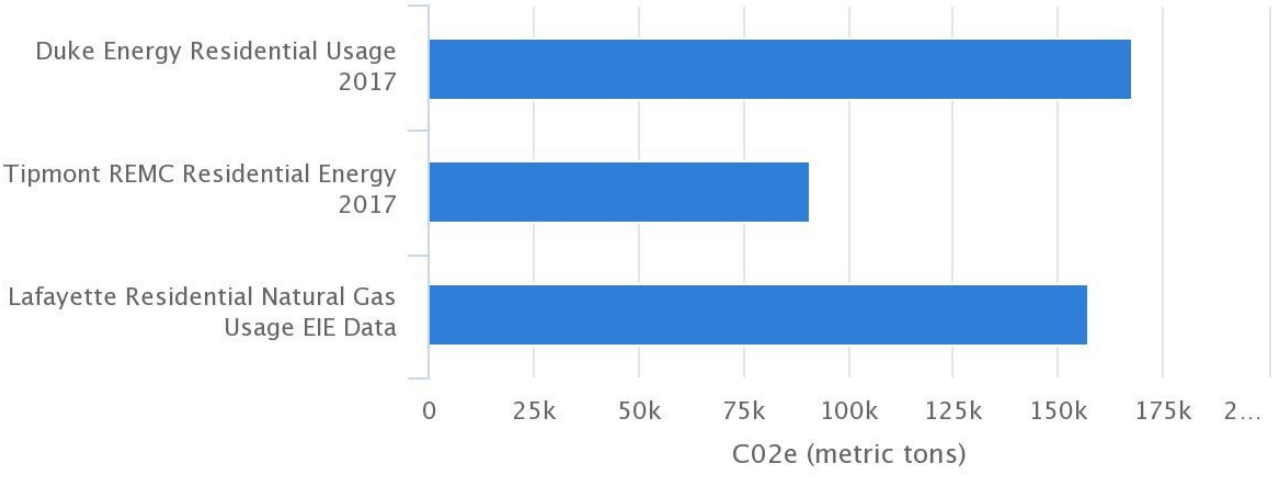
CO2e By Category



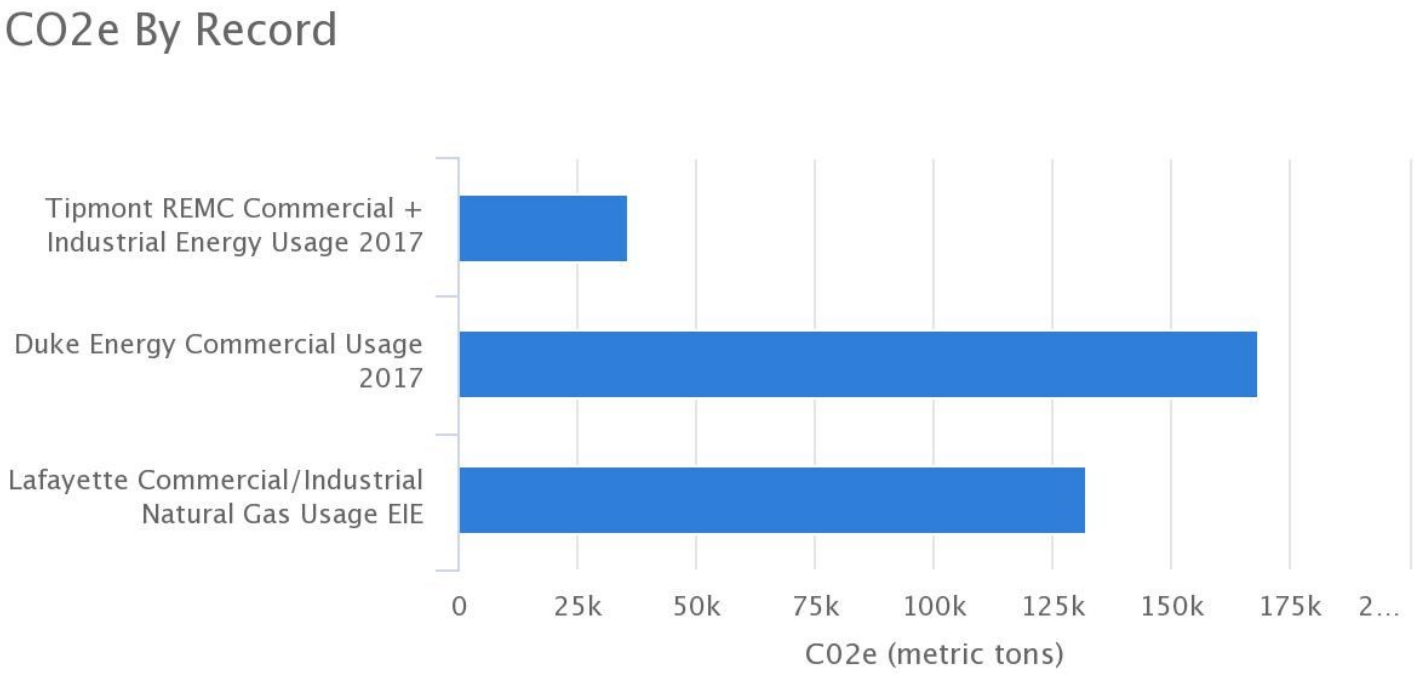
Water & Wastewater
Process & Fugitive Emissions
Solid Waste
Commercial Energy
Residential Energy
Transportation & Mobile Sources
Industrial Energy

Residential Energy

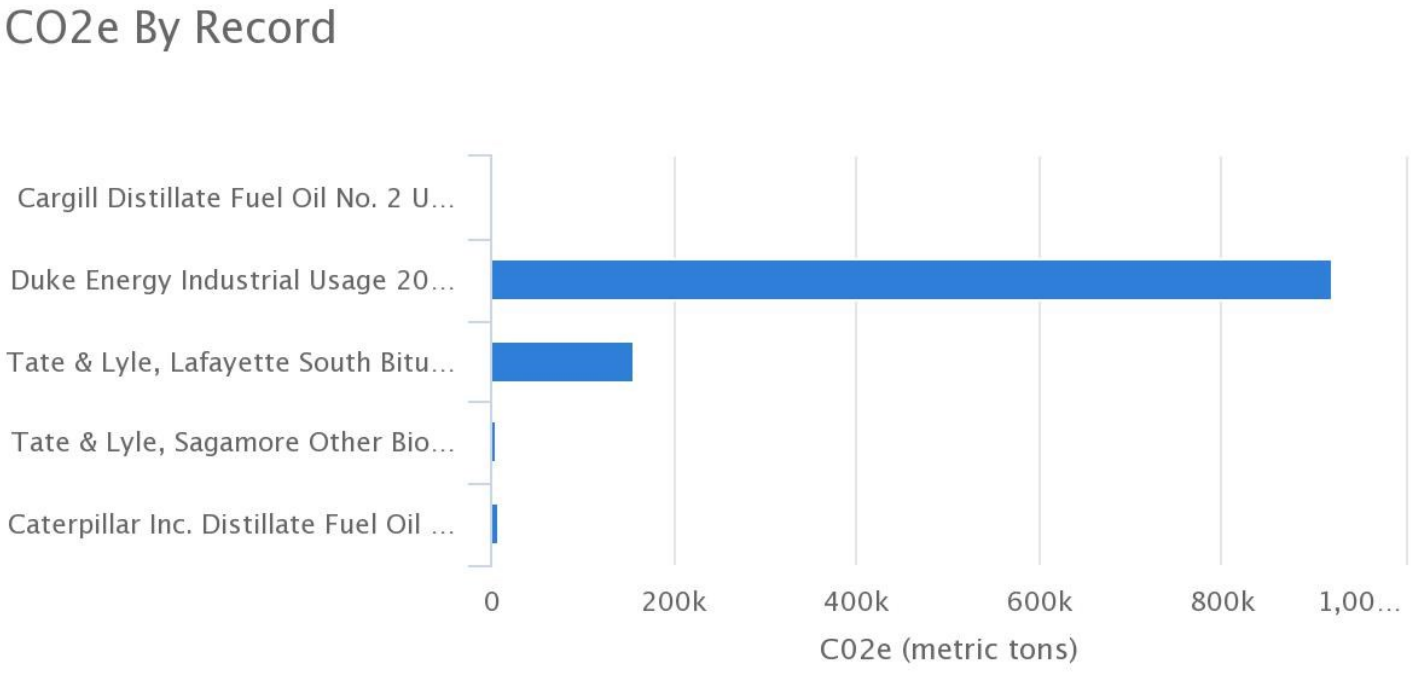
CO2e By Record



Commercial Energy

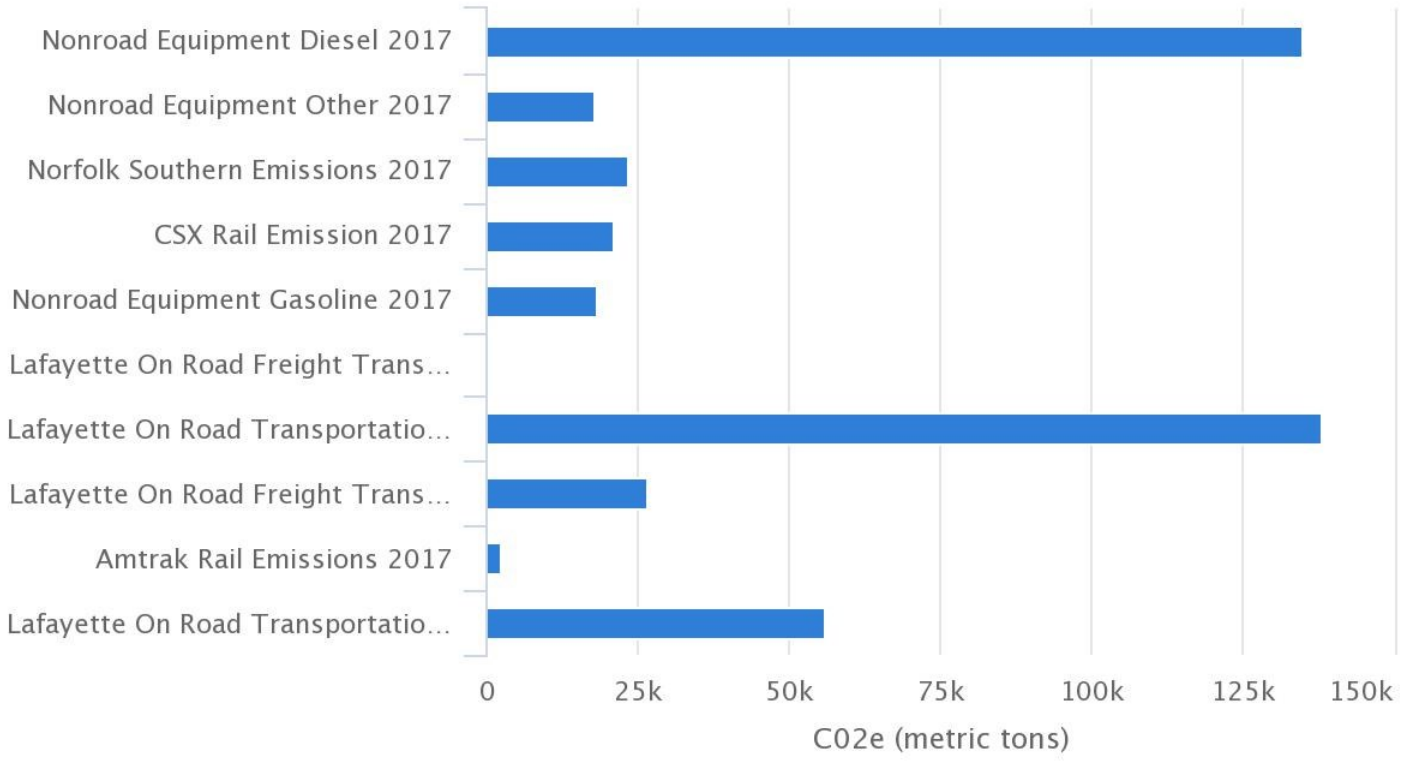


Industrial Energy



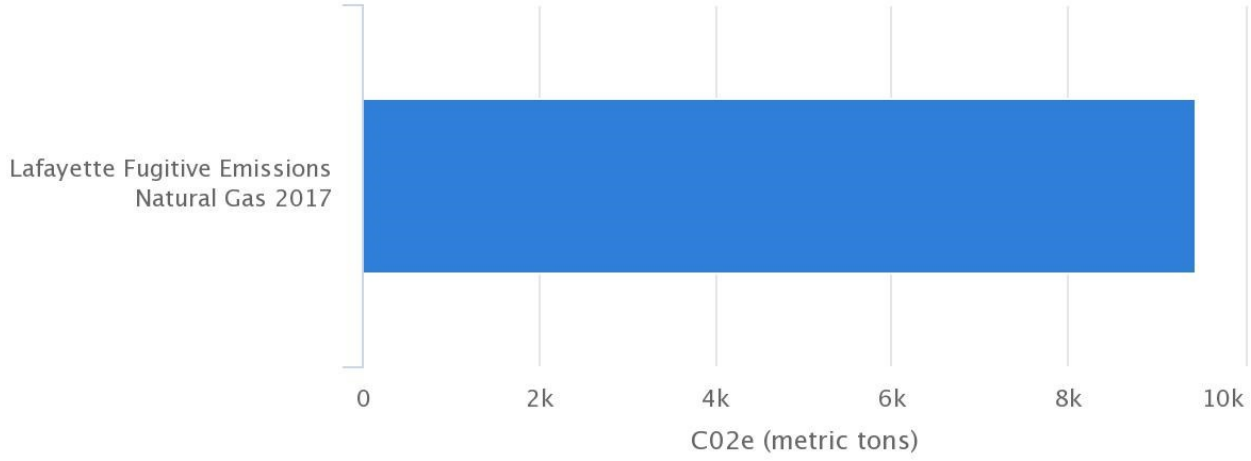
Transportation

CO2e By Record



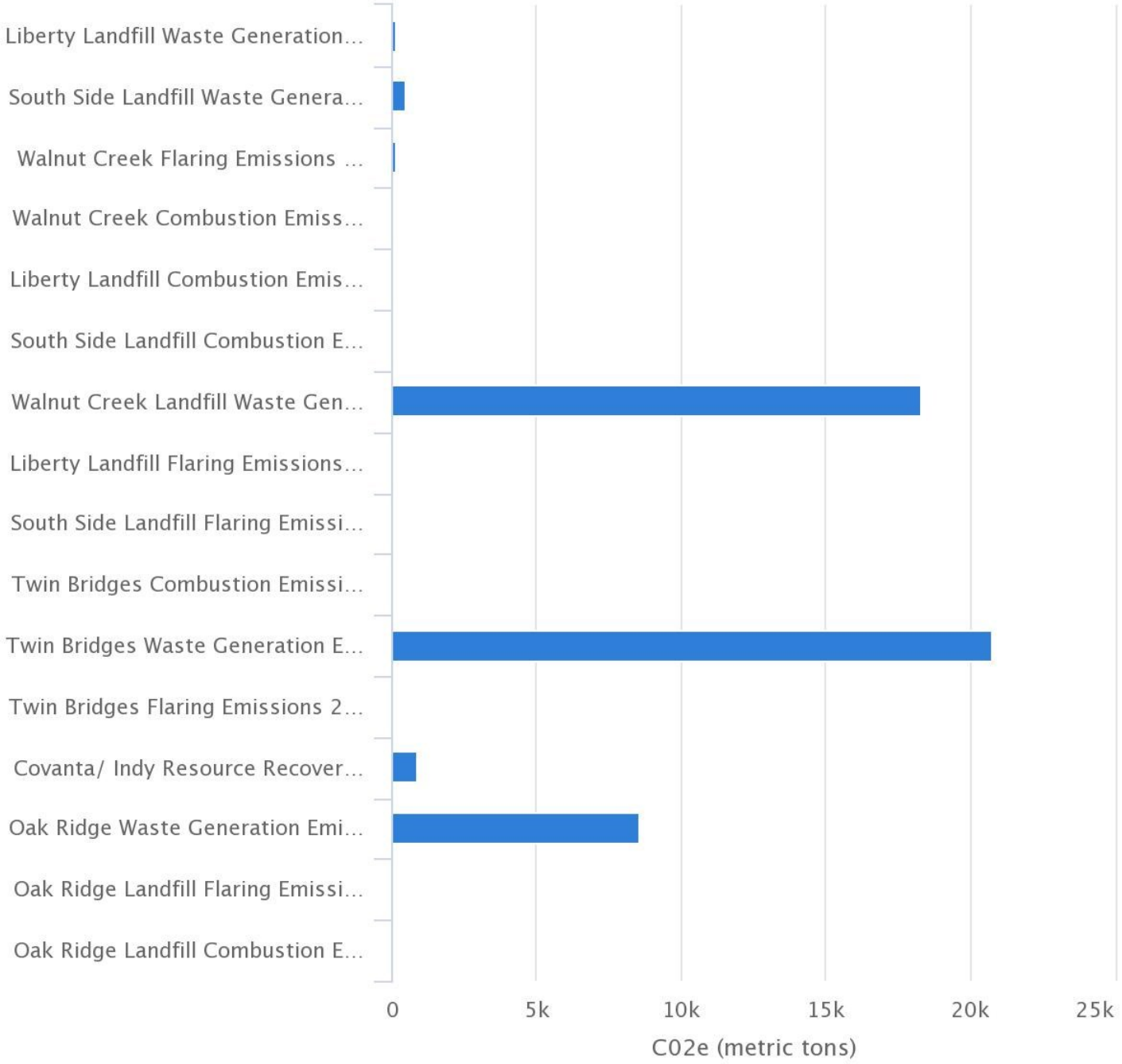
Process and Fugitive Emissions

CO2e By Record

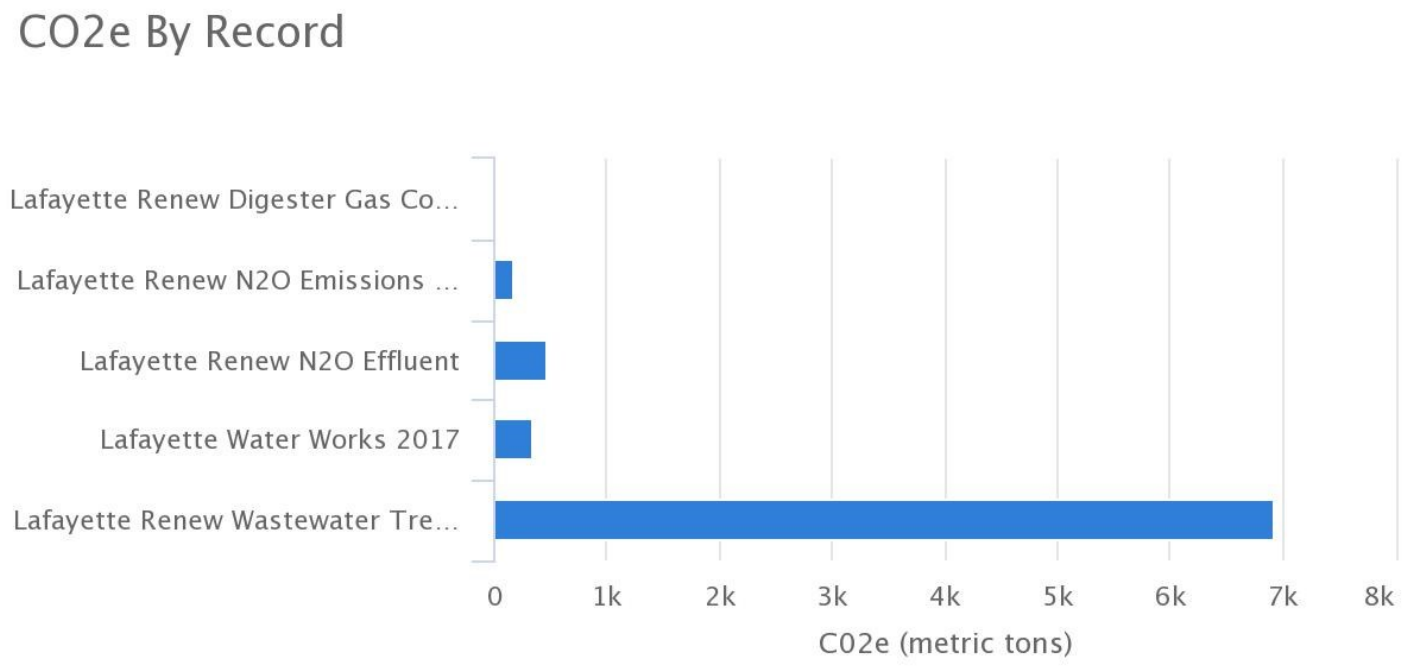


Solid Waste

CO2e By Record



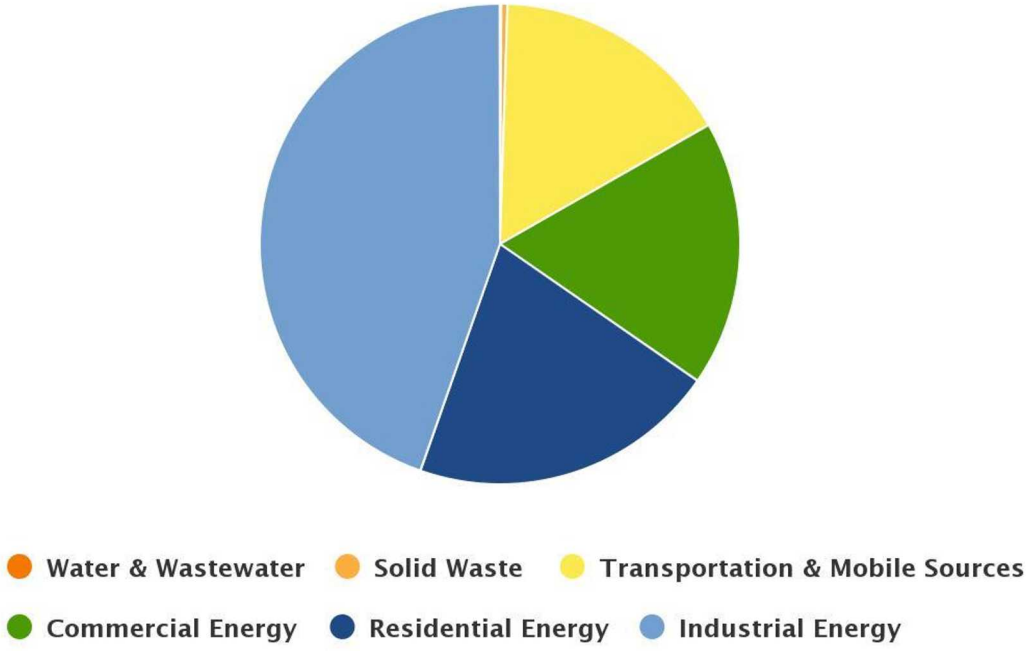
Water, Waste Water, and Solid Waste



Greenhouse Gas Inventory for West Lafayette 2017

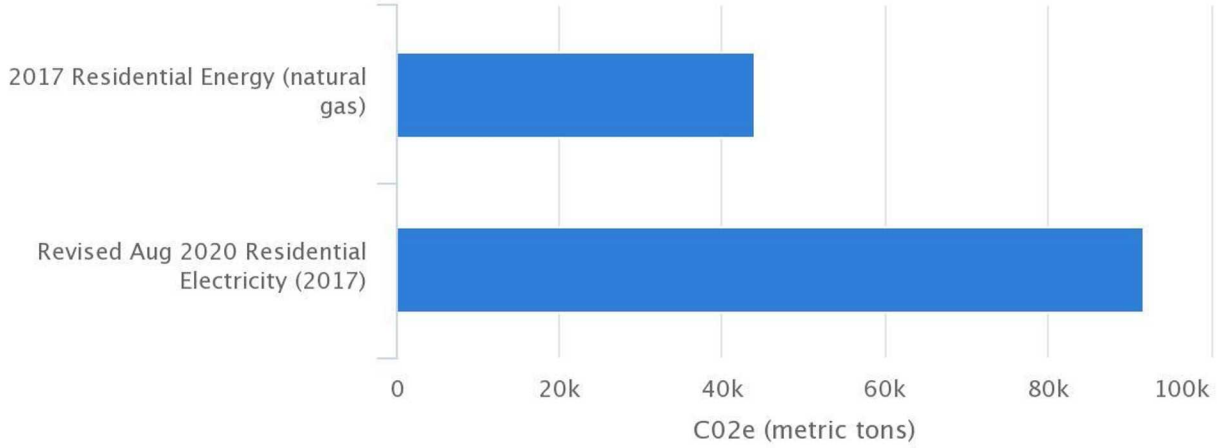
CO2e By Category

All Sectors

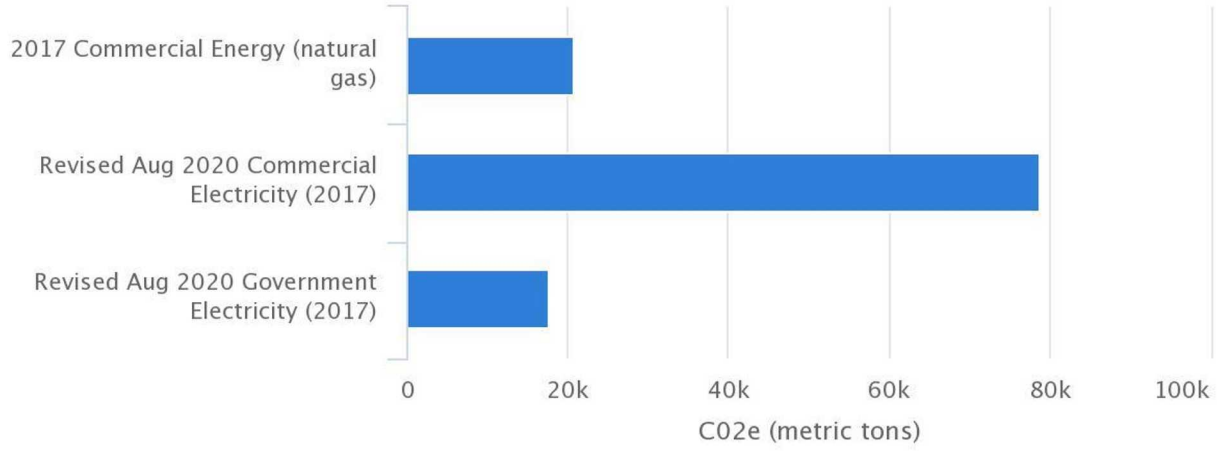


CO2e By Record

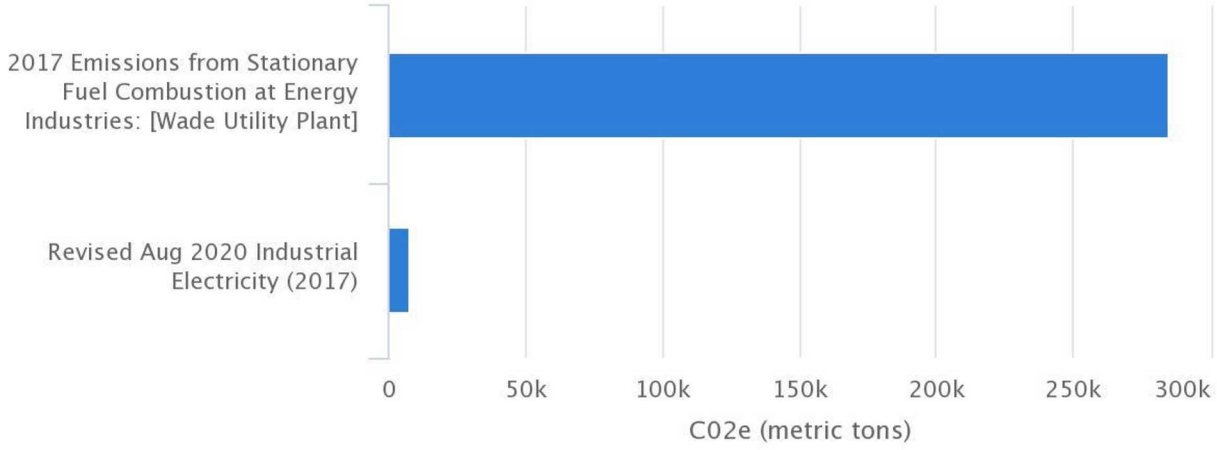
Residential Energy



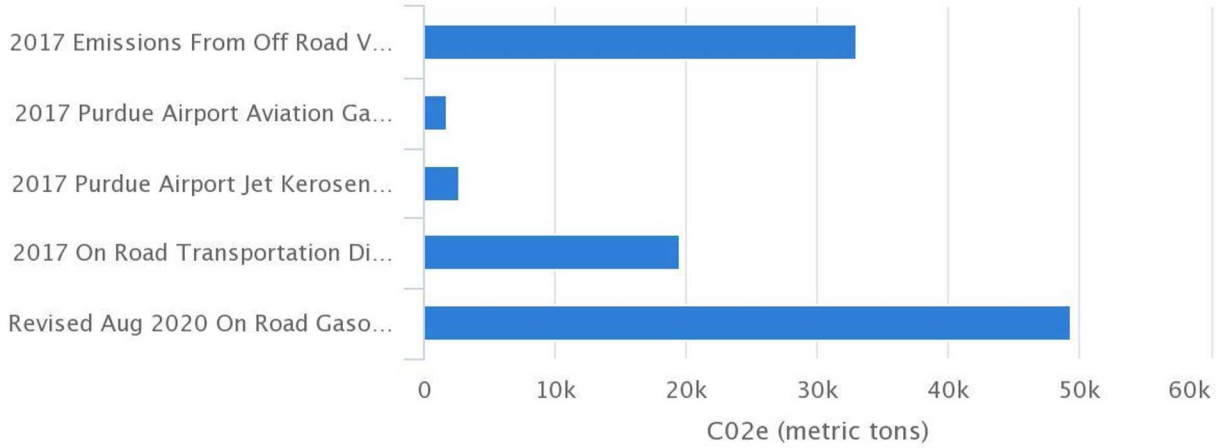
CO2e By Record
Commercial Energy



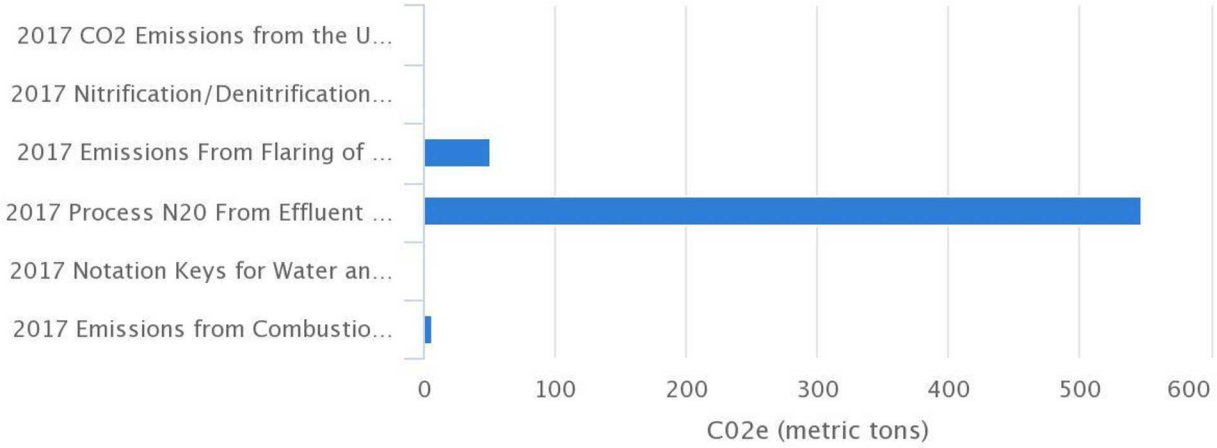
CO2e By Record
Industrial Energy



CO2e By Record
Transportation

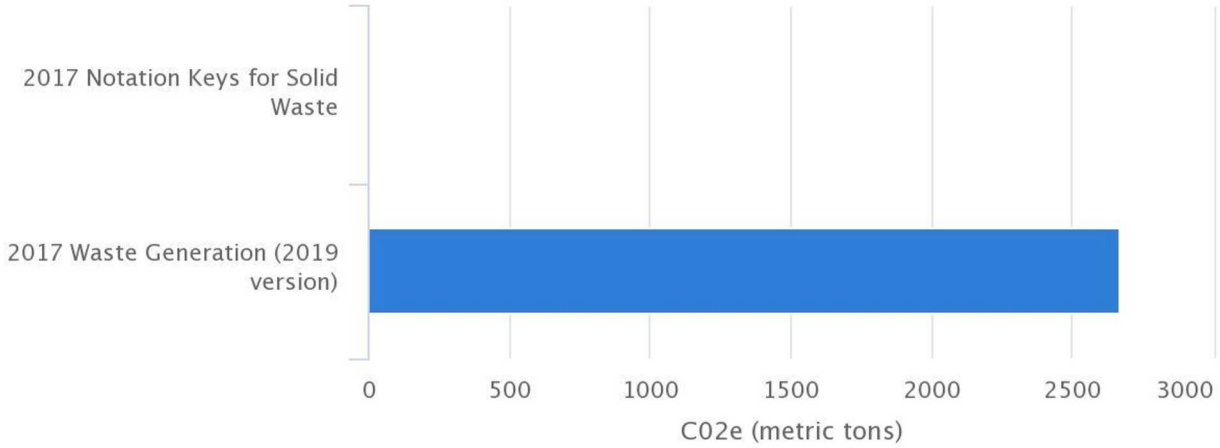


CO2e By Record
Water and Waste Water



CO2e By Record

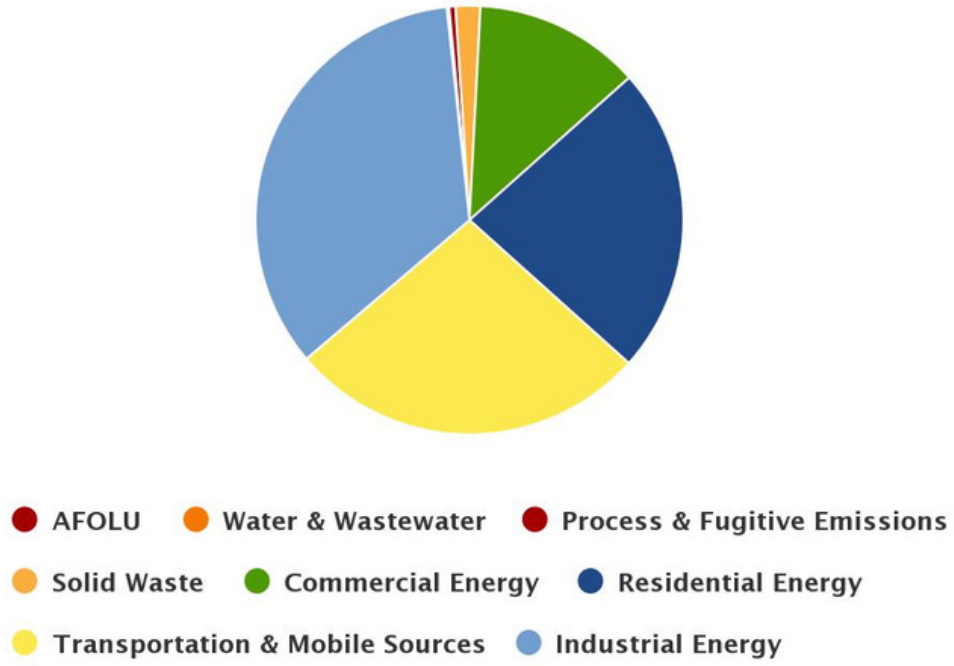
Solid Waste



Greenhouse Gas Inventory for Tippecanoe County 2017

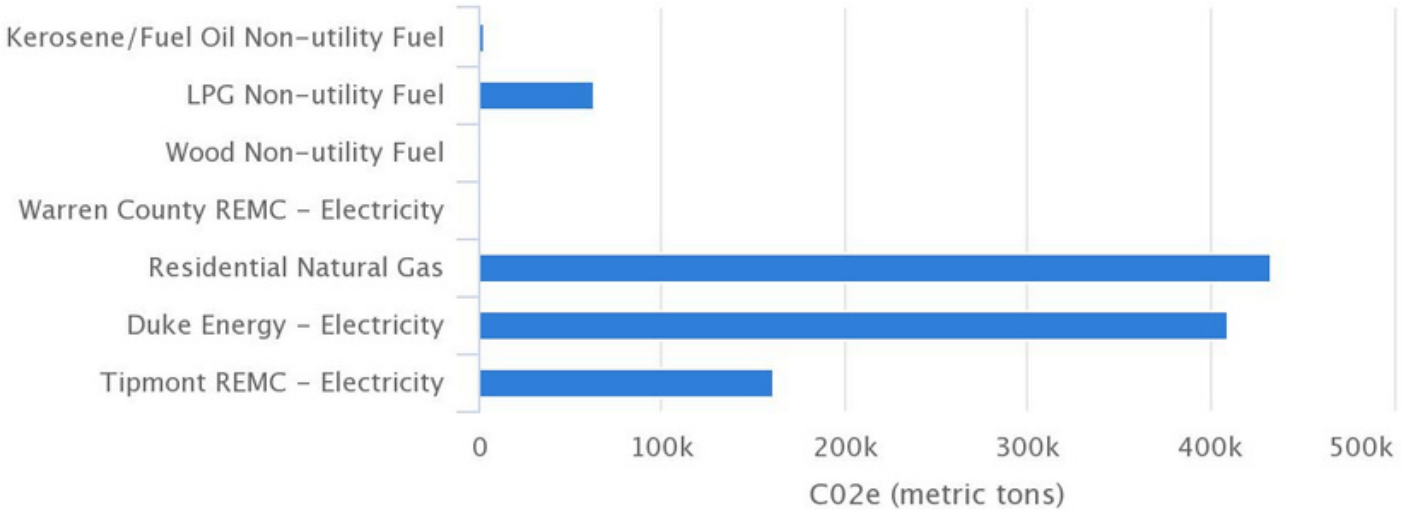
All Sectors

CO2e By Category



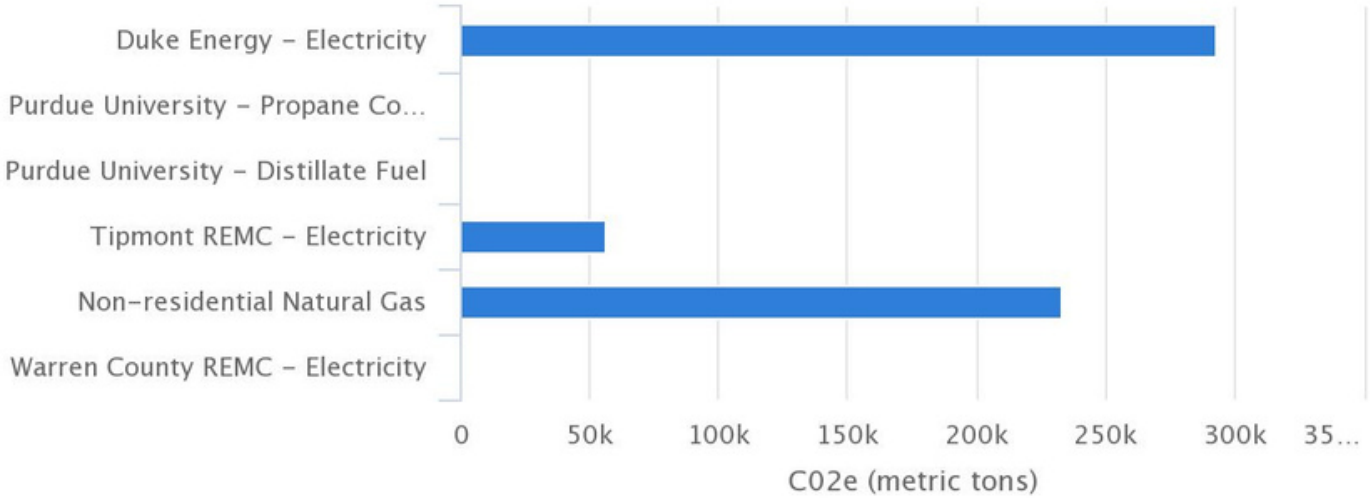
Residential Energy

CO2e By Record



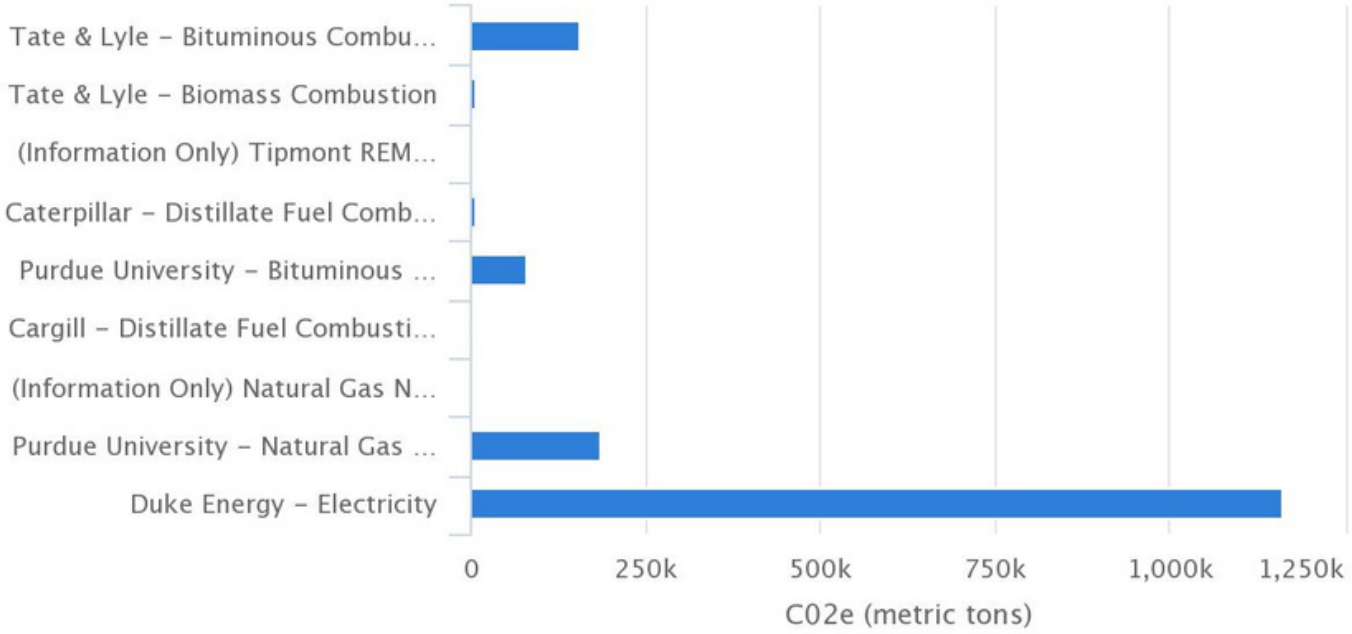
Commercial Energy

CO2e By Record



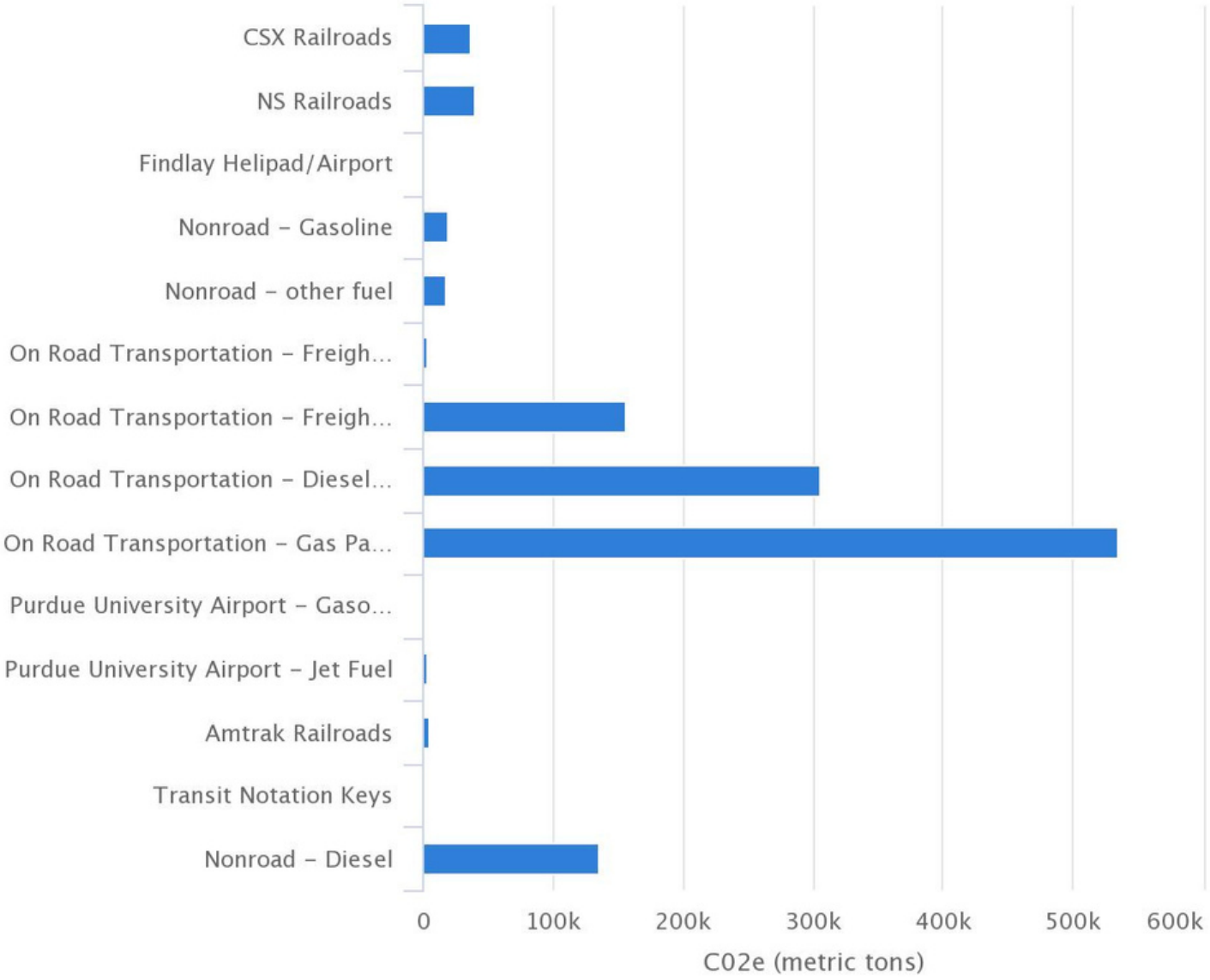
Industrial Energy

CO2e By Record



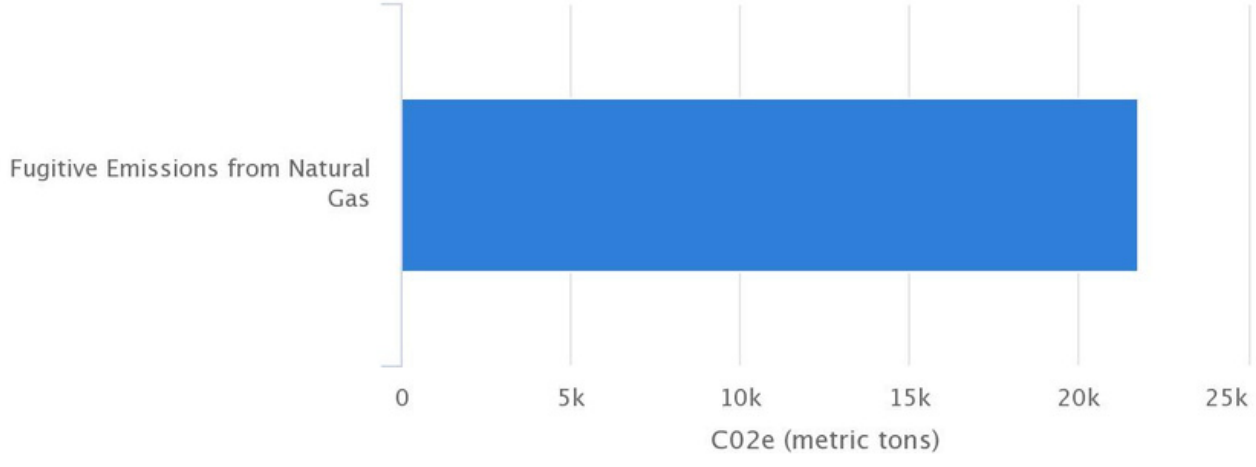
Transportation

CO2e By Record



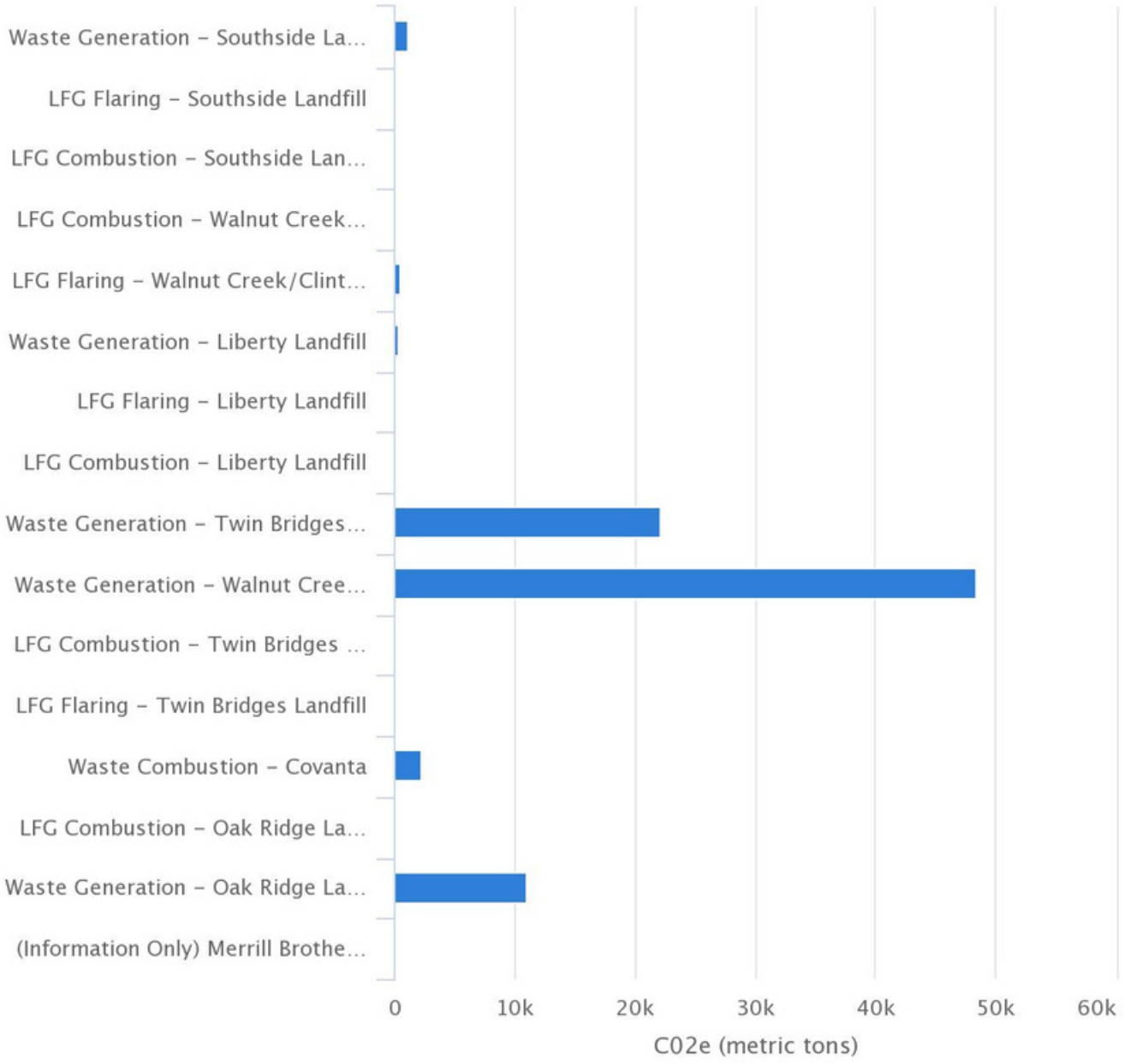
Process and Fugitive Emissions

CO2e By Record



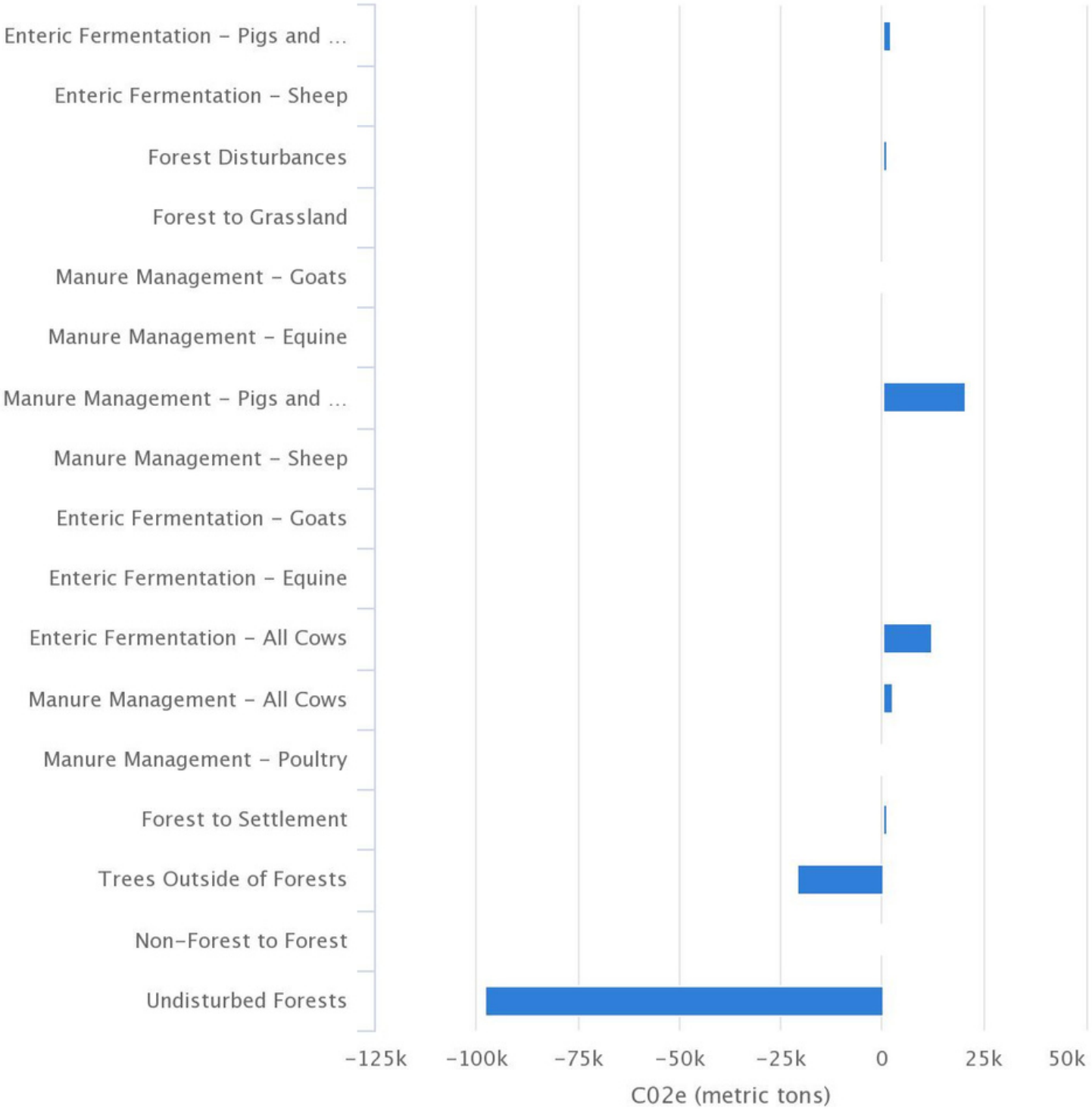
Solid Waste

CO2e By Record

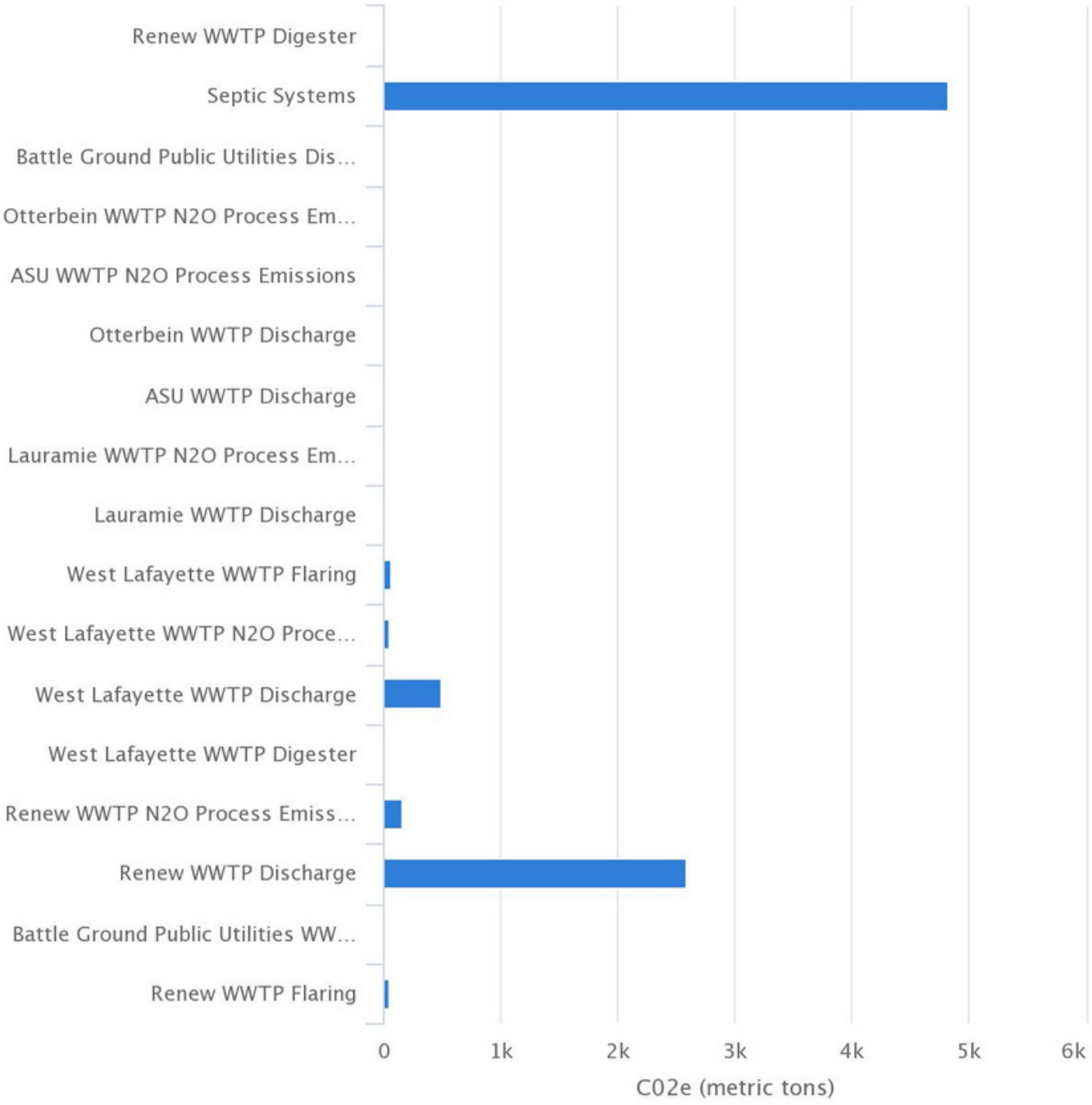


Agriculture, Forestry, and other Land Use (AFOLU)

CO2e By Record



Water and Waste Water
CO2e By Record



Local Government	Lafayette, IN2017

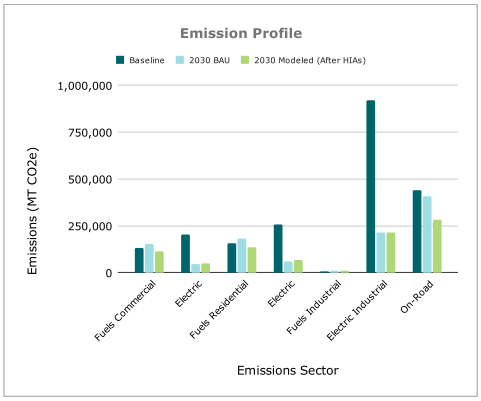
High Impact Action Analysis Summary Report: Lafayette, IN 2017

SBTs and Emissions Goals	Baseline Year	2030 Per Capita	2030 Absolute	Baseline Scope 1 & 2 (MT CO2e)	2030 Scope 1 & 2 (MT CO2e)
	2017	63.4%	57.5%	2,297,068	976,978

Growth Rates	Commercial	Residential	Industrial	On-Road Transportation	Grid Decarbonization
	Population Growth	Population Growth	Population Growth	Population Growth	CES
	16.13%	16.13%	16.13%	16.13%	-80.00%

Abbreviation Key	
SBT	Science-Based Target
HIA	High Impact Actions
VMT	Vehicle Miles Traveled
EV	Electric Vehicles
SF	Square Feet (ft^2)
EB	Existing Buildings

	Baseline & Forecasted Emissions			Modeled Emissions (After HIAs)	
	Baseline Emissions (MT CO2e)	% of total (Adjusted)	2030 Forecasted Emissions (MT CO2e)	2030 Modeled Emissions (MT CO2e)	Percent Change
Fuels Commercial	132,044	6%	153,337	114,878	-25.1%
Electric Commercial	204,138	9%	47,411	48,132	1.5%
Fuels Residential	157,309	7%	182,676	136,859	-25.1%
Electric Residential	258,796	**11%**	60,106	68,109	13.3%
Fuels Industrial	7,828	0%	9,090	9,090	0.0%
Electric Industrial	920,131	**39%**	213,701	213,701	0.0%
On-Road Transportation	439,164	**19%**	407,216	284,033	-30.3%
Sum of Primary Sectors	2,119,410	90%	1,073,537	874,803	-18.5%
Inventory Total	**2,346,719**	-	-	-	-



HIA Overview				
Type	Name	Net Reduction (MT CO2e)	Description	Explanation/Source
Grid Decarbonization	CES	**1,284,871**	Clean Energy Standard: 80% Reduction in carbon intensity (kg CO2/MWH) by 2030.	General Clean Energy Standard Goal Reduction from grid decarbonization occurs within the 2030 forecast, before other High-Impact Actions are modeled.
High Level VMT Reduction	Aggressive (10% VMT Reduction)	**40,722**	10% Reduction in total VMT	Generic aggressive baseline
On-Road Electric Vehicles Adoption	Moderate (4.5% Annual Growth)	**69,145**	22.5% of VMT is EV by 2030. This action influences an increase in Residential & Commericial buildings electricty emissions.	Middleground of BAU and aggressive approaches, https://evadoption.com/ev-sales/ev-sales-forecasts/
Commercial Building Efficiency	IECC 2018	**4,394**	All new buildings including 1% of existing Sq FT (renovations and turnover) will meet IECC 2018 (36.95% reduction in building EUI)	https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28125.pdf https://www.eia.gov/consumption/commercial/data/2012/c&e/pdf/e2.pdf
Residential Building Efficiency	IECC 2018	**5,570**	All new buildings including 1% of existing Sq FT (renovations and turnover) will meet IECC 2018 (36.95% reduction in building EUI)	https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28125.pdf https://www.eia.gov/consumption/commercial/data/2012/c&e/pdf/e2.pdf
Commercial Building Electrification	New Buildings, All Electric	**36,006**	All new buildings & 1% Existing Sq FT per year are electrified. This action influences an increase in Commericial buildings electricty emissions.	Based on % of building stock experiencing major retrofit or replacement each year. https://www.schroders.com/en/sysglobalassets/digital/real-estate-de/publications/2.-pages-from-property-chronicle-q6_online-2.pdf
Residential Building Electrification	New Buildings, All Electric	**42,896**	All new buildings & 1% Existing Sq FT per year are electrified. This action influences an increase in Residential buildings electricty emissions.	Based on % of building stock experiencing major retrofit or replacement each year. https://www.schroders.com/en/sysglobalassets/digital/real-estate-de/publications/2.-pages-from-property-chronicle-q6_online-2.pdf

2030 Outlook				
	2030 Absolute SBT	57.5%	2030 Per Capita SBT	63.4%
	Reduction Achieved (Abosolute)	58.7%	Reduction Achieved (Per Capita)	64.5%
	Percent To Go (Absolute)	-1.26%	Percent To Go (Per Capita)	-1.08%

Notice:

The HIA summary is a high-level analysis that represents an example pathway to achieving your Science Based Targets (based on your 2017 baseline year). This analysis uses national data and assumptions to form our preset scenarios. In short, the HIA summary should be used as an illustrative high-level, general pathway to support decision-making but should not be used as the sole influence on decision-making directly. However, the analysis remains as a demonstration of the need for swift and ambitious action.

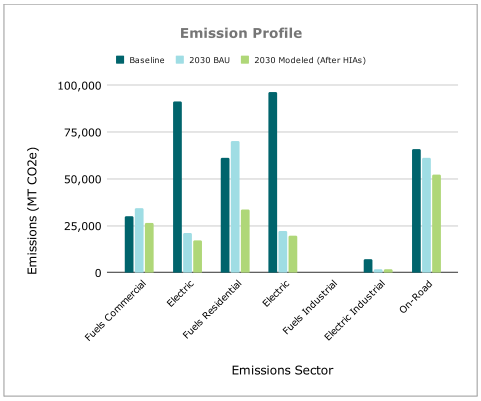
High Impact Action Analysis Summary Report: West Lafayette, IN 2018

SBTs and Emissions Goals	Baseline Year	2030 Per Capita	2030 Absolute	Baseline Scope 1 & 2 (MT CO2e)	2030 Scope 1 & 2 (MT CO2e)
	2018	63.3%	57.8%	671,963	283,338

Growth Rates	Commercial	Residential	Industrial	On-Road Transportation	Grid Decarbonization
	Population Growth	Population Growth	Population Growth	Population Growth	CES
	14.80%	14.80%	14.80%	14.80%	-80.00%

Abbreviation Key	
SBT	Science-Based Target
HIA	High Impact Actions
VMT	Vehicle Miles Traveled
EV	Electric Vehicles
SF	Square Feet (ft^2)
EB	Existing Buildings

	Baseline & Forecasted Emissions			Modeled Emissions (After HIAs)	
	Baseline Emissions (MT CO2e)	% of total (Adjusted)	2030 Forecasted Emissions (MT CO2e)	2030 Modeled Emissions (MT CO2e)	Percent Change
Fuels Commercial	29,884	8%	34,306	26,298	-23.3%
Electric Commercial	91,429	**23%**	20,992	17,169	-18.2%
Fuels Residential	61,270	**16%**	70,336	33,574	-52.3%
Electric Residential	96,473	**25%**	22,150	19,797	-10.6%
Fuels Industrial		0%	0	0	0.0%
Electric Industrial	7,298	2%	1,676	1,676	0.0%
On-Road Transportation	65,804	**17%**	61,328	52,129	-15.0%
Sum of Primary Sectors	352,158	90%	210,787	150,642	-28.5%
Inventory Total	**674,836**	-	-	-	-



HIA Overview				
Type	Name	Net Reduction (MT CO2e)	Description	Explanation/Source
Grid Decarbonization	CES	**179,268**	Clean Energy Standard: 80% Reduction in carbon intensity (kg CO2/MWH) by 2030.	General Clean Energy Standard Goal Reduction from grid decarbonization occurs within the 2030 forecast, before other High-Impact Actions are modeled.
High Level VMT Reduction	BAU (0% VMT Reduction)	**0**	0% Reduction in total VMT	Generic BAU baseline
On-Road Electric Vehicles Adoption	US-BAU (3% Annual Growth)	**8,263**	15% of VMT is EV by 2030. This action influences an increase in Residential & Commericial buildings electiricty emissions.	https://evadoption.com/ev-sales/ev-sales-forecasts/
Commercial Building Efficiency	IECC New + 5% Existing	**4,330**	All new buildings and 1% of existing Sq FT (renovations and turnover) will meet IECC 2018 (36.95% reduction in building EUI) & 5% Existing Sq FT (renovations and turnover) EUI is reduced by 20%.	https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28125.pdf https://www.eia.gov/consumption/commercial/data/2012/c&e/pdf/e2.pdf
Residential Building Efficiency	IECC New + 5% Existing	**4,569**	All new buildings and 1% of existing Sq FT (renovations and turnover) will meet IECC 2018 (36.95% reduction in building EUI) & 5% Existing Sq FT (renovations and turnover) EUI is reduced by 20%.	https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28125.pdf https://www.eia.gov/consumption/commercial/data/2012/c&e/pdf/e2.pdf
Commercial Building Electrification	New Buildings, All Electric	**7,689**	All new buildings & 1% Existing Sq FT per year are electrified. This action influences an increase in Commericial buildings electiricty emissions.	Based on % of building stock experiencing major retrofit or replacement each year. https://www.schroders.com/en/sysglobalassets/digital/real-estate-de/publications/2.-pages-from-property-chronicle-q6_online-2.pdf
Residential Building Electrification	5% EB Electrified	**35,295**	5% of existing SF per year is electrified. This action influences an increase in Residential buildings electiricty emissions.	Because heating systems are replaced at a minimum of 10 years, this scenario represents half replacement with all electric heating systems. https://www.energystar.gov/campaign/heating_cooling/replace

2030 Outlook				
	2030 Absolute SBT	57.8%	2030 Per Capita SBT	63.3%
	Reduction Achieved (Abosolute)	57.2%	Reduction Achieved (Per Capita)	62.7%
	Percent To Go (Absolute)	0.61%	Percent To Go (Per Capita)	0.53%

Notice:

The HIA summary is a high-level analysis that represents an example pathway to achieving your Science Based Targets (based on your 2018 baseline year). This analysis uses national data and assumptions to form our preset scenarios. In short, the HIA summary should be used as an illustrative high-level, general pathway to support decision-making but should not be used as the sole influence on decision-making directly. However, the analysis remains as a demonstration of the need for swift and ambitious action.

Local Government	Tippecanoe County, IN2017

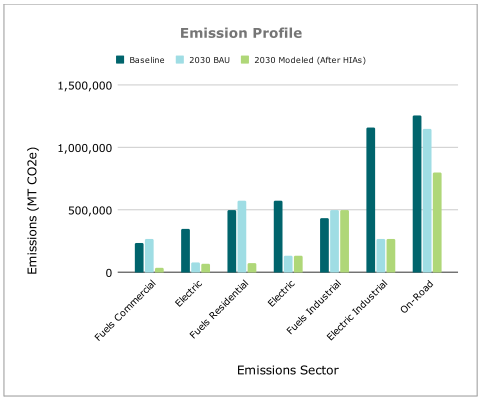
High Impact Action Analysis Summary Report: Tippecanoe County, IN 2017

SBTs and Emissions Goals	Baseline Year	2030 Per Capita	2030 Absolute	Baseline Scope 1 & 2 (MT CO2e)	2030 Scope 1 & 2 (MT CO2e)
	2017	63.4%	57.9%	4,462,966	1,878,690

Growth Rates	Commercial	Residential	Industrial	On-Road Transportation	Grid Decarbonization
	Population Growth	Population Growth	Population Growth	Population Growth	CES
	14.93%	14.93%	14.93%	14.93%	-80.00%

Abbreviation Key	
SBT	Science-Based Target
HIA	High Impact Actions
VMT	Vehicle Miles Traveled
EV	Electric Vehicles
SF	Square Feet (ft^2)
EB	Existing Buildings

	Baseline & Forecasted Emissions			Modeled Emissions (After HIAs)	
	Baseline Emissions (MT CO2e)	% of total (Adjusted)	2030 Forecasted Emissions (MT CO2e)	2030 Modeled Emissions (MT CO2e)	Percent Change
Fuels Commercial	233,299	5%	268,131	34,832	-87.0%
Electric Commercial	350,154	8%	80,486	69,403	-13.8%
Fuels Residential	500,872	**11%**	575,652	74,780	-87.0%
Electric Residential	572,096	**13%**	131,502	132,776	1.0%
Fuels Industrial	434,789	10%	499,703	499,703	0.0%
Electric Industrial	1,161,595	**26%**	267,004	267,004	0.0%
On-Road Transportation	1,256,234	**28%**	1,149,831	802,007	-30.3%
Sum of Primary Sectors	4,509,039	99%	2,972,309	1,880,505	-36.7%
Inventory Total	**4,549,025**	-	-	-	-



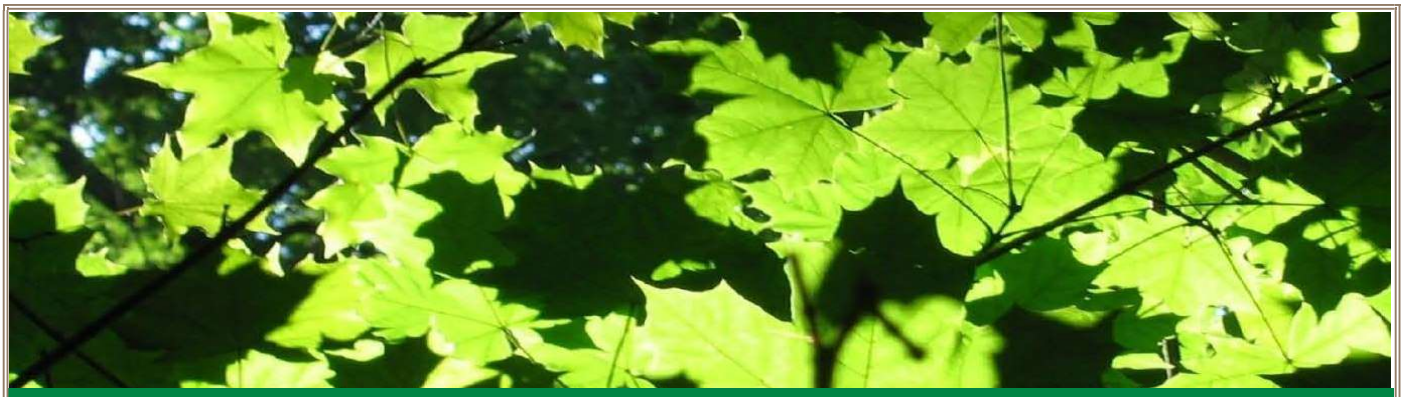
HIA Overview				
Type	Name	Net Reduction (MT CO2e)	Description	Explanation/Source
Grid Decarbonization	CES	**1,915,970**	Clean Energy Standard: 80% Reduction in carbon intensity (kg CO2/MWH) by 2030.	General Clean Energy Standard Goal Reduction from grid decarbonization occurs within the 2030 forecast, before other High-Impact Actions are modeled.
High Level VMT Reduction	Aggressive (10% VMT Reduction)	**114,983**	10% Reduction in total VMT	Generic aggressive baseline
On-Road Electric Vehicles Adoption	Moderate (4.5% Annual Growth)	**204,177**	22.5% of VMT is EV by 2030. This action influences an increase in Residential & Commericial buildings electricty emissions.	Middleground of BAU and aggressive approaches, https://evadoption.com/ev-sales/ev-sales-forecasts/
Commercial Building Efficiency	IECC New + 10% Existing	**28,154**	All new buildings and 1% of existing Sq FT (renovations and turnover) will meet IECC 2018 (36.95% reduction in building EUI) & 10% Existing Sq FT (renovations and turnover) EUI is reduced by 20%.	https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28125.pdf https://www.eia.gov/consumption/commercial/data/2012/c&e/pdf/e2.pdf
Residential Building Efficiency	IECC New + 10% Existing	**45,999**	All new buildings and 1% of existing Sq FT (renovations and turnover) will meet IECC 2018 (36.95% reduction in building EUI) & 10% Existing Sq FT (renovations and turnover) EUI is reduced by 20%.	https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28125.pdf https://www.eia.gov/consumption/commercial/data/2012/c&e/pdf/e2.pdf
Commercial Building Electrification	10% EB Electrified	**221,961**	10% of existing SF per year is electrified. This action influences an increase in Commericial buildings electricty emissions.	Because heating systems are replaced at a minimum of 10 years, this scenario represents an all electric replacement of heating systems. https://www.energystar.gov/campaign/heating_cooling/replace
Residential Building Electrification	10% EB Electrified	**476,530**	10% of existing SF per year is electrified. This action influences an increase in Residential buildings electricty emissions.	Because heating systems are replaced at a minimum of 10 years, this scenario represents an all electric replacement of heating systems. https://www.energystar.gov/campaign/heating_cooling/replace

2030 Outlook				
	2030 Absolute SBT	57.9%	2030 Per Capita SBT	63.4%
	Reduction Achieved (Abosolute)	58.3%	Reduction Achieved (Per Capita)	63.7%
	Percent To Go (Absolute)	-0.39%	Percent To Go (Per Capita)	-0.34%

Notice:

The HIA summary is a high-level analysis that represents an example pathway to achieving your Science Based Targets (based on your 2017 baseline year). This analysis uses national data and assumptions to form our preset scenarios. In short, the HIA summary should be used as an illustrative high-level, general pathway to support decision-making but should not be used as the sole influence on decision-making directly. However, the analysis remains as a demonstration of the need for swift and ambitious action.

APPENDIX C: TREE CANOPY ASSESSMENTS/ PLANTING PLANS



Urban Tree Canopy Assessment Summary Report

Urban Green Infrastructure Resilience Cohort

September 2022

Prepared for:
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Indiana University
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Prepared by:
Davey Resource Group, Inc.
295 S. Water Street, Suite 300
Kent, Ohio 44240
800-828-8312

DAVEY® Resource Group

Acknowledgments

A fundamental inspiration for this project was the vision of Indiana University's Environmental Resilience Institute (ERI) to promote and preserve Indiana's urban forest and improve the management of public trees by addressing climate change and sustainable ecosystem services. The collaborative project team of research educators, student fellows, local government staff and stakeholders, urban forestry consultants, and GIS specialists through baseline data analysis established mitigation and adaptation tools for future tree planting projects and canopy continuity and resiliency focused initiatives. Indiana University is thankful for the grant funding it received from the Indiana Department of Natural Resources, Division of Forestry, Community and Urban Forestry program (IDNR CUF) in cooperation with the U.S. Forest Service (USFS) through its Urban and Community Forestry (U&CF) Grant Program. The IDNR CUF grant program is designed to encourage communities to create and support long-term and sustained urban and community forestry programs throughout Indiana.

The ERI recognizes the following Urban Green Infrastructure Cohort partners.

Local Governments:
- City of Fishers
- City of Fort Wayne
- City of Huntington
- City of Lafayette
- City of Terre Haute
- City of West Lafayette
- Tippecanoe County
- Town of Merrillville
- Town of Zionsville

Climate Fellows:
- Joey Mendolia
- Ava Hartman
- Andrew Russell
- Grace Olsen
- Matthias Benko
- Rae Handy
- Jonathan Thomas

Urban Forestry Consultant and GIS Specialist:
- Davey Resource Group, Inc.

Executive Summary

Urban tree canopy is an essential part of a city or town's infrastructure. Trees provide more than the traditional values of aesthetics and shade. They provide numerous quantifiable environmental benefits, including stormwater management, watershed protection, water quality improvements, temperature moderation and cooling, reduction of air pollutants, and energy conservation. The amount of urban tree canopy determines the amount of economic, environmental, and social benefit a community receives. Trees contribute greatly to the quality of life in Indiana communities, and—unlike the other components of community infrastructure—tree populations, with proper care and protection, will continue to increase in value with each passing year.

Over the last 20 years, there have been great advances in quantifying the urban forest. Geographic information system (GIS) has become more available to local governments and community stakeholders to assist with planning and management, and the value of trees and green spaces in communities has shifted. The results of urban tree canopy assessments are especially valuable for reasonable, rational, and defensible planning of tree planting and canopy preservation projects.

For the Urban Green Infrastructure (UGI) Resilience Cohort, Indiana University's Environmental Resilience Institute (ERI) contracted Davey Resource Group, Inc. "DRG" to translate digital imagery showing detailed leaf-on conditions into different land cover classifications for nine Indiana communities. In addition to consultant and climate fellow participation, local government cohort participation included the City of Fishers, City of Fort Wayne, City of Huntington, Town of Merrillville, City of Terre Haute, Town of Zionsville, and joint participation from City of Lafayette, City of West Lafayette, and Tippecanoe County. This consultant-fellow-government cohort partnership has provided a resource for community planning and tools that illustrate current baseline land cover percentages, including an improved understanding of tree canopy and preferred plantable area.

The project area includes the municipal boundaries of all patriating cities and towns and the unincorporated urbanized area of Greater Lafayette. This project area is approximately 383 square miles or 245,003 acres (Table 1). Cumulatively, the cohort's 2021 existing tree canopy is at 24% cover. The analysis projects an attainable tree canopy of 49%; this is the sum of the existing tree canopy and plantable area (26%). Reaching the maximum tree canopy will be a challenge; however, preserving existing tree canopy, establishing realistic canopy goals, and harnessing the maximum amount of ecosystem benefits by planting, maintaining, and caring for trees (particularly large-growing trees) when appropriate are prudent and responsible endeavors.

Table 1. Summary of Existing and Possible Tree Cover for the Urban Green Infrastructure Resilience Cohort Urban Tree Canopy Assessment Project Partnership

Local Government	Total Acres	Tree Canopy Acres	Preferred Plantable Acres
City of Fishers	24,450	5,234	8,206
City of Fort Wayne	71,040	16,934	21,192
City of Huntington	6,043	1,497	2,108
City of Lafayette	18,832	3,284	5,406
City of Terre Haute	22,360	5,744	6,148
City of West Lafayette	8,859	1,901	2,545
Tippecanoe County	29,028	9,642	7,319
Town of Merrillville	21,299	4,661	6,456
Town of Zionsville	43,092	9,370	3,116
Total	245,003	58,267	62,495
Percent of Total	100%	24%	26%

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Assignment

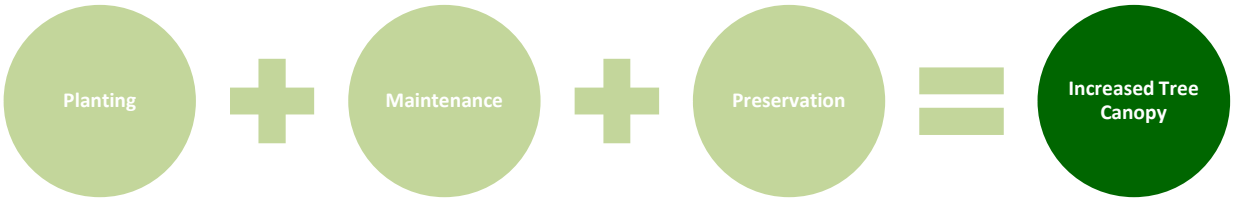
The assignment by ERI was to translate digital imagery showing detailed leaf-on conditions into different land cover classifications represented as individual geographic information system (GIS) layers. DRG created five land cover GIS layers for each of the nine local governments. Land cover classifications were tree canopy (trees/forest/shrub); grass/low-lying vegetation (grass/meadow); impervious surfaces; bare soil; and open water. Appendix A contains the land cover classification assessment methodology.

For each local government, the existing, possible, and preferred tree canopy was analyzed, and preferred plantable area was prioritized. Possible tree canopy is the amount of land that is theoretically available for the establishment of tree canopy. This includes all pervious and bare soil surfaces. Preferred plantable area was determined by DRG, local governments, and climate fellows identifying reasonable "real world" areas to plant trees. These areas are pervious surfaces likely within rights-of-way (ROW) of highways and streets; private property parcels of residential, commercial, or industrial uses; and parks or other vacant lands. Appendix B contains the prioritized plantable area assessment methodology.

Percentages of tree canopy for each local government were calculated and summarized by geographic unit. Climate fellows met with local government representatives to identify and select geographic units; then, each local government provided DRG with necessary GIS boundaries for these selected units. Commonly analyzed geographic units included census block groups and tracts, public vs private property, and zoning. Selected geographic units for each local government are shown in Appendix C.

Accompanying this *Urban Tree Canopy Assessment Summary Report*, DRG delivered the assessment and analysis results as GIS data files, metadata, Excel™ spreadsheets containing land cover metrics and geographic unit analyses, and a slide show results summary.

Growing tree canopy must consist of a mix of tree maintenance activities. Tree planting is part of the equation, but also is existing tree routine maintenance and tree preservation related to development impacts. Having a tree canopy assessment is one of the first tools necessary to grow, maintain, and protect tree canopy for the enjoyment by future generations efficiently and effectively.



Land Cover Assessment

Each local government's current land cover was identified and assessed using the 2021 Nearmap high resolution aerial imagery as a primary resource and the 2020 National Agricultural Imagery Program (NAIP) leaf-on, multispectral imagery as a secondary resource—see Appendix A for methods. Classified land cover data includes pervious, impervious, bare soils, open water, and tree canopy. Figure 1 illustrates the resulting distribution of land cover for the municipal boundary of the City of Fishers, Indiana. All nine local government land distribution illustrations can be found in Appendix D. Eight of the nine governments used their municipal boundary as their study area. Tippecanoe County used their unincorporated urbanized area as their study area.

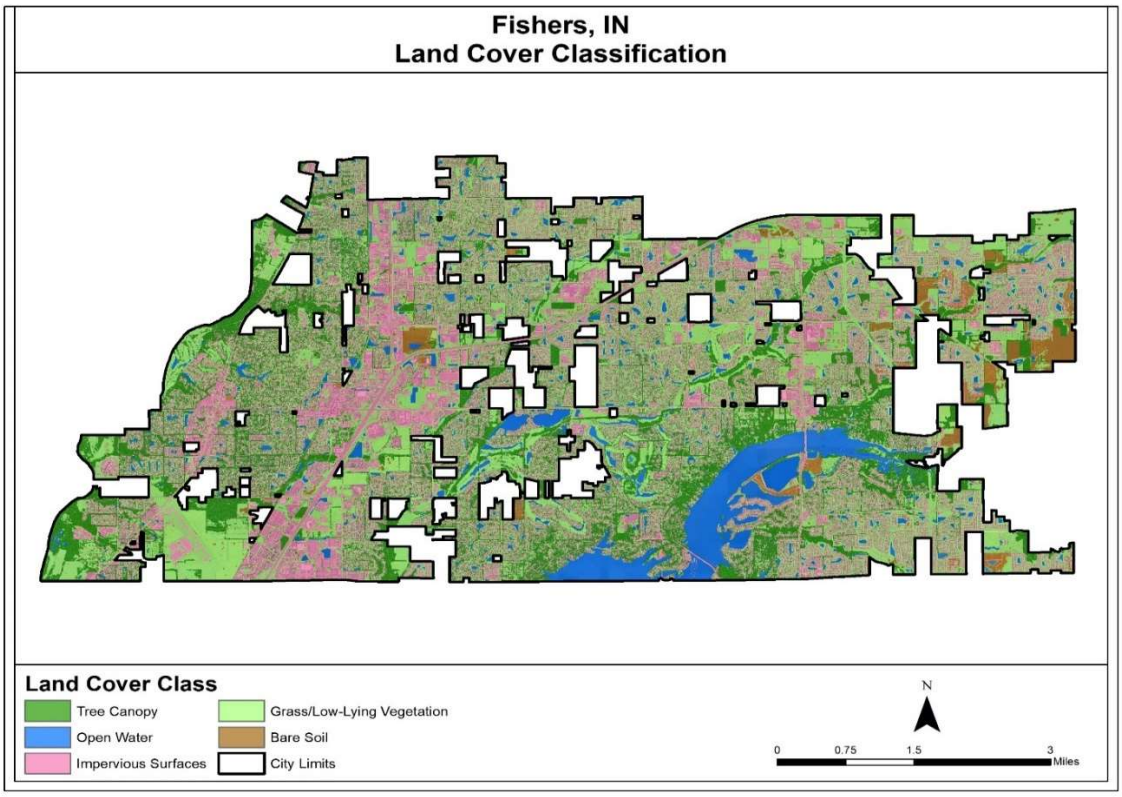


Figure 1. City of Fishers land cover assessment results (2021).

Table 2 and Figure 2 present the land cover results for each local government's municipal or unincorporated urbanized area boundaries. The study area covers 245,003 acres or 383 square miles. The average tree canopy cover among nine local governments is 24%, with a total of 58,267 acres of existing tree canopy. The City of Fort Wayne, City of Huntington, City of Terre Haute, and Tippecanoe County are all at or above the average. Pervious surfaces and bare soils cover 50% of total land area, and impervious and open water make up the remaining 26%. Tippecanoe County and the Towns of Merrillville and Zionsville have more than the average distribution of pervious and bare soil, and they have more tree canopy than impervious surfaces; in contrast, the other local governments have less tree canopy than impervious surfaces.

Table 2. Results of Land Cover Classification Analysis by Local Government (2021)

Local Government	Total Acres	Tree Canopy Acres	Impervious Acres	Pervious Acres	Bare Soil Acres	Water Acres
City of Fishers	24,450	5,234	7,166	9,602	649	1,798
City of Fort Wayne	71,040	16,934	23,996	25,197	3,137	1,775
City of Huntington	6,043	1,497	1,677	2,332	449	87
City of Lafayette	18,832	3,284	7,457	7,605	297	189
City of Terre Haute	22,360	5,744	5,959	8,704	1,589	364
City of West Lafayette	8,859	1,901	2,402	4,116	240	201
Tippecanoe County	29,028	9,642	3,856	14,293	638	599
Town of Merrillville	21,299	4,661	3,642	11,799	801	396
Town of Zionsville	43,092	9,370	3,671	15,719	13,777	555
Total	245,003	58,267	59,826	99,367	21,578	5,964
Percent of Total	100%	24%	24%	41%	9%	2%

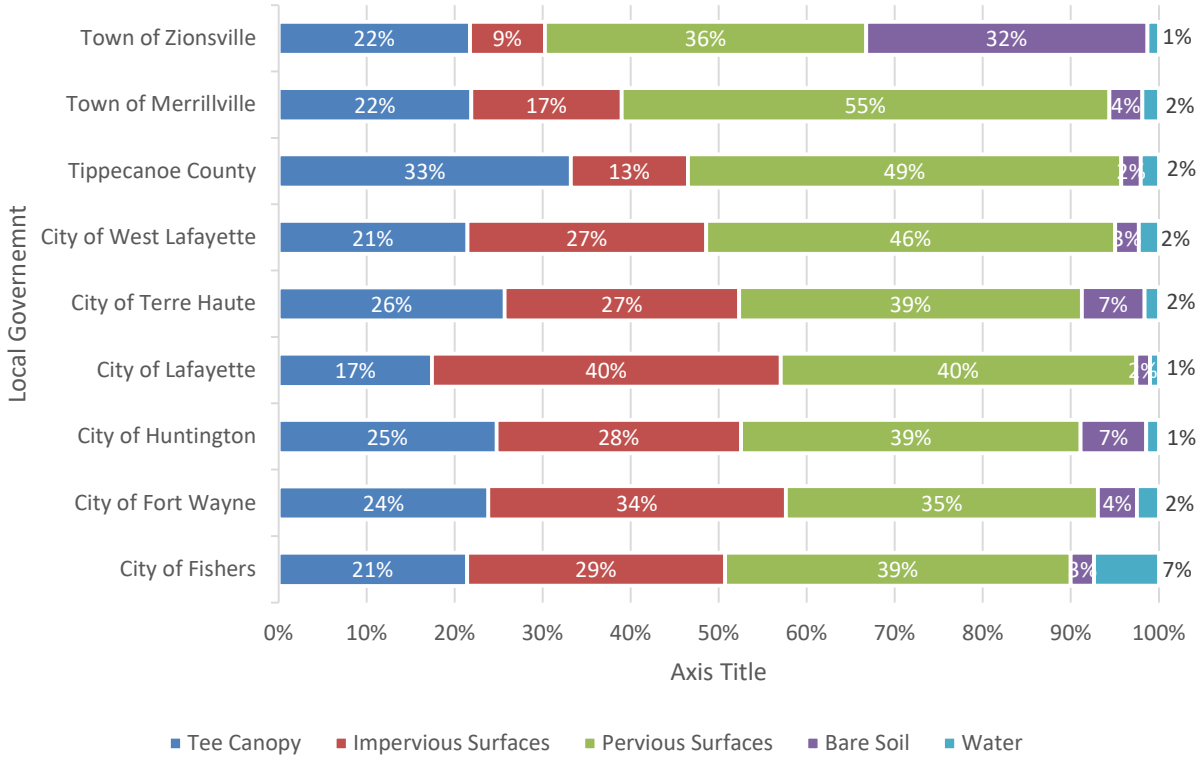


Figure 2. Percentages of land cover by local government (2021).

Urban Tree Canopy Analysis

Land cover data were further analyzed to better understand the potential for urban tree canopy (UTC) within the local government study areas. Theoretically, all pervious surfaces and bare soils previously reported in the land cover analysis could be planted with trees for future tree canopy—collectively, these represent possible UTC. However, the planting of all land use areas is understandably not practical for implementing actual planting projects, nor is it realistic for urban forest planning and management. In this analysis, possible UTC is refined to provide consideration for land use. Land use generally excluded agricultural land, cemeteries, golf courses, utility rights-of-way, recreational fields, etc. The resulting area is called preferred plantable. The preferred plantable area is based on a "real world" approach to the identification of reasonable areas to plant trees.

Table 3 and Figure 3 present the UTC analysis results for each local government municipal or unincorporated urbanized area boundaries. The average possible UTC among all nine local governments is 49%, with a total 120,945 acres. Considering only the practical or preferred plantable areas, the acreage available to future tree canopy drops to 63,384 and 26% average. The sum of existing tree canopy and preferred plantable presents a max UTC of approximately 50% among all nine local governments. The median max UTC is 53%. Governments with max UTC potential above par the City of Huntington at 60%, Tippecanoe County at 58%, and the City of Fishers and City of Fort Wayne both at 55%.

Table 3. Results of Urban Tree Canopy Analysis by Local Government (2021)

Local Government	Total Acres	Tree Canopy Acres	Possible UTC Acres	Preferred Plantable	Maximum UTC	Maximum UTC Percent of Total Acres
City of Fishers	24,450	5,234	10,251	8,206	13,441	55%
City of Fort Wayne	71,040	16,934	28,334	21,192	39,015	55%
City of Huntington	6,043	1,497	2,781	2,108	3,605	60%
City of Lafayette	18,832	3,284	7,902	5,406	8,690	46%
City of Terre Haute	22,360	5,744	10,293	6,148	11,892	53%
City of West Lafayette	8,859	1,901	4,356	2,545	4,446	50%
Tippecanoe County	29,028	9,642	14,931	7,319	16,961	58%
Town of Merrillville	21,299	4,661	12,601	6,456	11,116	52%
Town of Zionsville	43,092	9,370	29,496	3,116	12,486	29%
Total	245,003	58,267	120,945	62,495	121,651	-
Percent of Total	**100%**	**24%**	**49%**	**26%**	**50%**	**-**

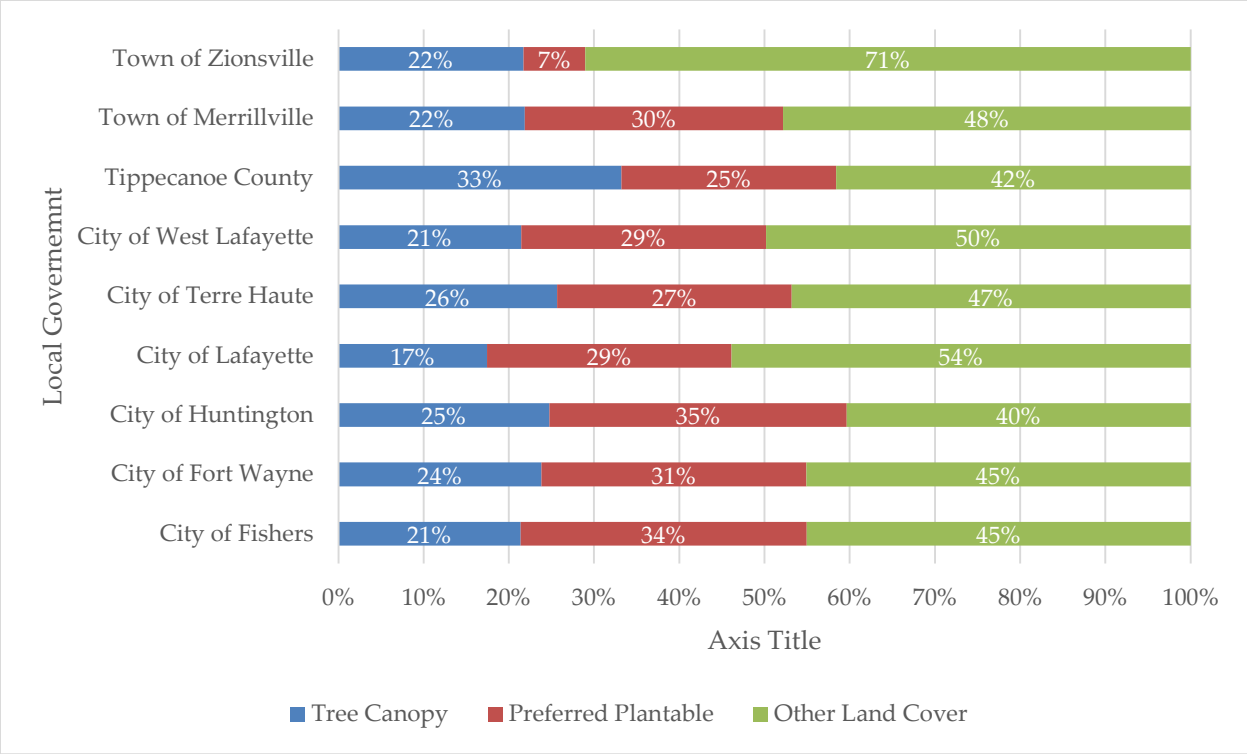


Figure 3. Percentages of urban tree canopy by local government (2021).

Prioritized Plantable Area

Planting urban trees improves community health by reducing the risks of urban heat island effect and degradation from rain and flood events as well as increases urban forest connectivity and human well-being. To study where trees will make the most community impact, the climate fellows, with DRG's guidance and local government input, categorized the preferred planting areas by creating a prioritized planting area analysis. Several community factors were selected, weighted, indexed by grid, and averaged within polygons across each local government study area to prioritize planting areas; see Appendix B for methods. Typical factors include existing tree canopy percent, proximity to hardscape, urban heat island index, floodplain proximity, soil permeability, soil erosion factor (K-factor), slope, population density, minority population, and median household income. Analysis results concluded with preferred planting polygons/areas assigned 1 of 5 classifications between very low to very high.

The plantable area analysis found 62,491 acres of land with the potential for new tree canopy categorized as Very High, High, Moderate, Low, and Very Low for the purpose of returned community benefit; see Table 4. Very High and High plantable areas average 7% and 11%, respectively, totaling an estimated 206,638 plantable locations. Figure 4 presents an account of the number of plantable locations by priority within all local governments study areas, and Figure 5 illustrates the resulting prioritized plantable areas for the municipal boundary of the City of Fishers, Indiana. All nine local government prioritized plantable areas illustrations can be found in Appendix E.

Table 4. Results of Prioritized Plantable Area Analysis by Local Government (2022).

	Very High Acres	High Acres	Moderate Acres	Low Acres	Very Low Acres	Total Acres
City of Fishers	502	1,495	1,822	1,440	2,942	8,200
City of Fort Wayne	1,653	2,032	3,380	5,280	8,847	21,192
City of Huntington	277	284	650	469	428	2,108
City of Lafayette (Stormwater)	231	389	615	1,089	3,082	5,406
City of Terre Haute	335	385	582	886	3,960	6,148
City of West Lafayette (Stormwater)	116	161	329	316	1,623	2,545
Tippecanoe County (Stormwater)	367	898	1,447	1,887	2,722	7,321
Town of Merrillville	531	955	2,519	1,873	579	6,456
Town of Zionsville	75	113	198	358	2,371	3,114
Total	4,086	6,712	11,542	13,597	26,554	62,491
Percent of Total	7%	11%	18%	22%	42%	100%

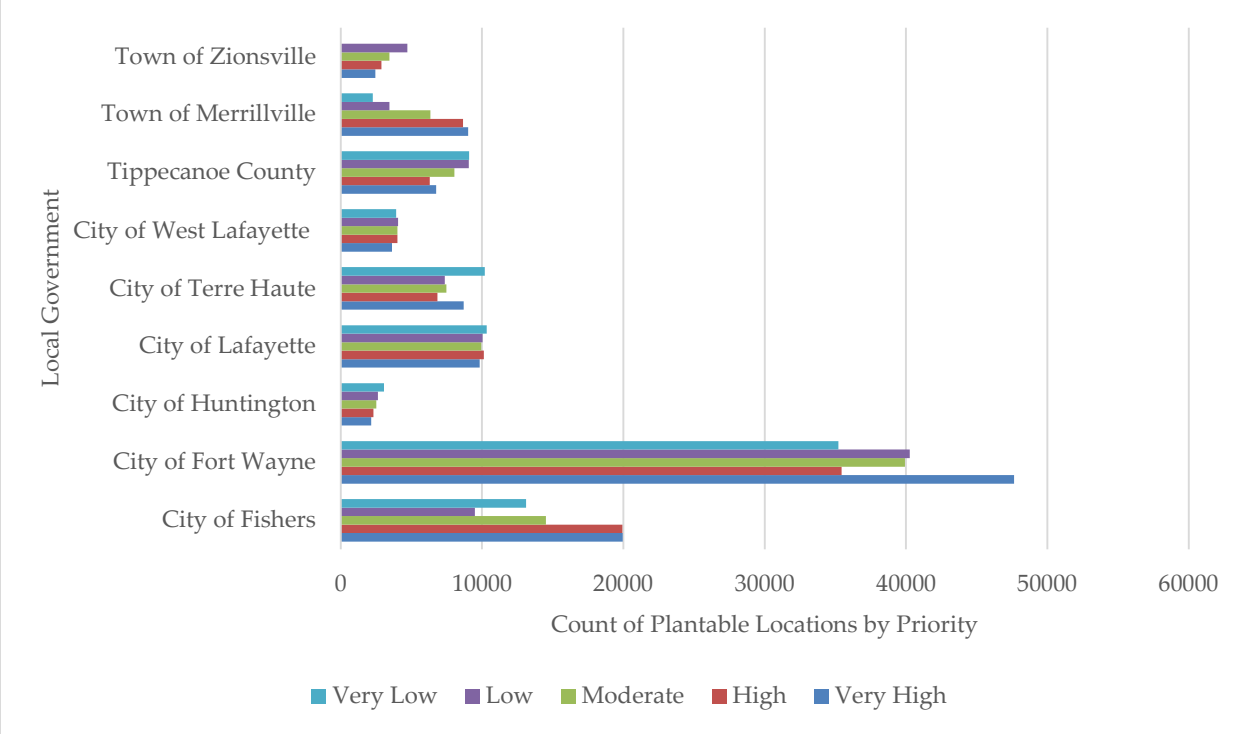


Figure 4. Count of locations of prioritized plantable areas by local government (2022).

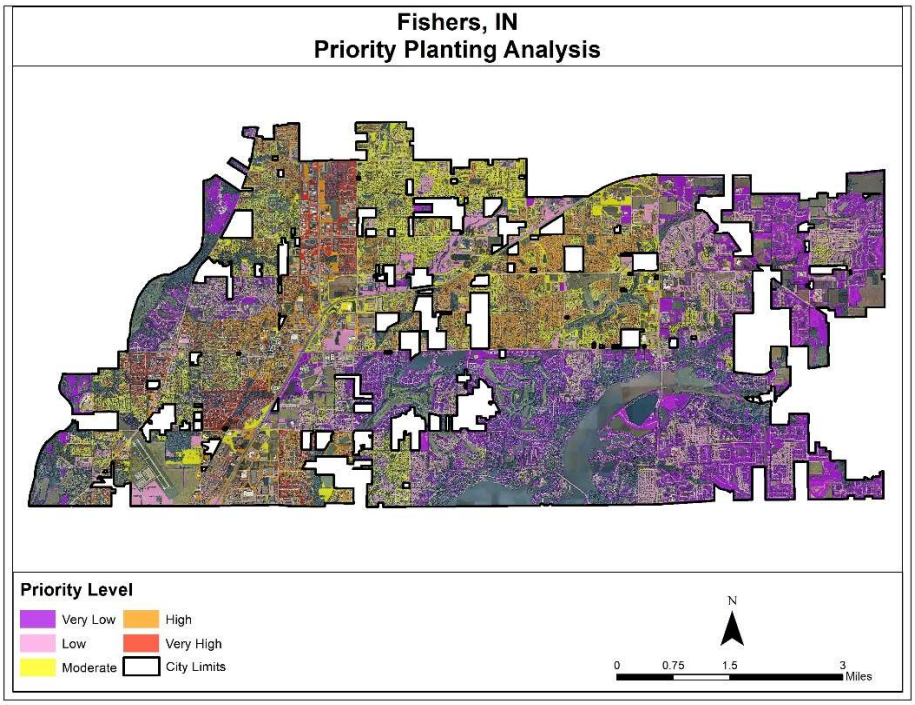


Figure 5. Prioritized plantable areas within Fishers, Indiana (2022).

Geographic UTC Analysis

For developing planting strategies and working with community stakeholders, DRG calculated and made spatially explicit the UTC data by multiple geographic units specific to each local government. Appendix C contains a list of selected geographic units for each local government. This report summarizes the UTC assessment by public versus private and zoning land usage because these were commonly calculated among local governments.

Tree planting strategies are necessary to meet tree canopy goals. Typically, after having conducted a land cover and UTC assessment, tree canopy goal setting is the next step. There will be difficult-to-meet strategies and easy-to-meet strategies. This summary will focus on two easy-to-meet strategies: (1) Tree preservation policy development within geographic areas that have the most existing tree canopy, and (2) tree planting within geographic areas that have the largest preferred plantable area.

Private Versus Public UTC Analysis

Among eight of nine local governments, 11% of the study area's tree canopy is on public land and 89% of the study area's tree canopy is on private land. (The public vs private land analysis was not conducted in the City of Fort Wayne's study.)

Table 5 shows existing tree canopy among public lands ranged from 15% (City of Fishers) to 27% (City of Terre Haute), and tree canopy among private lands ranged from 17% (City of Lafayette) to 35% (Tippecanoe County). Where canopy exists most in a community is where there is more potential for creating tree preservation policy. The City of Lafayette, City of Terre Haute, and City of West Lafayette have most tree canopy within public lands. City of Fishers, City of Huntington, Tippecanoe County, and Town of Merrillville have most tree

canopy within private lands. The Town of Zionsville has an even spread of tree canopy between public and private lands.

Where canopy does not exist in a community is where there is the most potential for creating new tree canopy and tree planting projects. Theoretically, if each community were to plant all preferred plantable area, there would be a percent change in tree canopy. Table 5 also shows an approximation of percent change. The City of Fishers, City of Huntington, Tippecanoe County, Town of Merrillville, and Town of Zionsville have the most potential for change within public lands. City of Lafayette, City of Terre Haute, and City of West Lafayette have most tree canopy within private lands.

Table 5. Results of UTC Analysis for Geographic Unity Private Lands versus Public Lands by Local Governments (2021). Yellow shading indicates areas recommended for tree preservation policy (high existing tree canopy) or tree planting (high preferred plantable area relative to existing tree canopy).

Local Government	Geographic Unit	Acres	Tree Canopy		Preferred Plantable		Max Tree Canopy	
			Acres	Percent	Acres	Percent	Acres	Percent
City of Fishers	Public	4,207	634	15%	1,106	26%	1,740	41%
	Private	20,240	4,600	23%	7,100	35%	11,700	58%
City of Fort Wayne*	Citywide	71,040	16,934	24%	22,080	31%	39,015	55%
City of Huntington	Public	1,071	176	16%	352	33%	528	49%
	Private	4,972	1,321	27%	1,756	35%	3,077	62%
City of Lafayette	Public	3,132	619	20%	729	23%	1,348	43%
	Private	15,577	2,653	17%	4,630	30%	7,283	47%
City of Terre Haute	Public	4,363	1,173	27%	1,004	23%	2,177	50%
	Private	17,997	4,570	25%	5,144	29%	9,714	54%
City of West Lafayette	Public	1,118	289	26%	205	18%	494	44%
	Private	7,725	1,610	21%	2,334	30%	3,944	51%
Tippecanoe County	Public	3,128	677	22%	750	24%	1,427	46%
	Private	25,901	8,965	35%	6,569	25%	15,534	60%
Town of Merrillville	Public	1,915	337	18%	592	31%	929	48%
	Private	19,384	4,323	22%	5,864	30%	10,188	53%
Town of Zionsville	Public	2,085	458	22%	378	18%	836	40%
	Private	41,006	8,912	22%	2,738	7%	11,650	28%

*The City of Fort Wayne did not geographically analyze private vs public lands.

Zoning Land Use UTC Analysis

Among seven of nine local governments, 66% of the study area's tree canopy is residential land use, 25% of the study area's tree canopy is vacant/special land use, and 9% is commercial/industrial/institutional land use. The zoning land use analysis was not conducted

for the City of Lafayette or City of West Lafayette. DRG consolidated land use types for simplicity of reporting.

Table 6 shows tree canopy cover within residential land uses ranged from 26% (Town of Merrillville) to 36% (City of Terre Haute), ranged from 10% (City of Fort Wayne) to 39% (Tippecanoe County) within vacant/special land uses, and ranged from 10% (Tippecanoe County) to 19% (City of Terre Haute) within commercial/industrial/institutional land uses. Where canopy exists most in a community is where there is more potential for creating tree preservation policy. The City of Fishers, City of Fort Wayne, City of Terre Haute, Town of Merrillville, and Town of Zionsville have most tree canopy within residential land use. The City of Huntington and Tippecanoe County have most tree canopy within vacant/special land use. Among the local governments, tree canopy cover is typically lowest within commercial/ industrial/institutional land uses.

Where canopy does not exist in a community is where there is the most potential for creating new tree canopy and tree planting projects. Theoretically, if each community were to plant all preferred plantable area, there would be a percent change in tree canopy. Table 6 also shows an approximation of percent change. Potential for change occurs most often within commercial/industrial/institutional land uses throughout all local governments.

Table 6. Results of UTC Analysis for Geographic Unit Zoning Land Use by Local Governments (2021). Yellow shading indicates areas recommended for tree preservation policy (high existing tree canopy) or tree planting (high preferred plantable area relative to existing tree canopy).

Local Government	Geographic Unit	Acres	Tree Canopy		Preferred Plantable		Max Tree Canopy	
			Acres	Percent	Acres	Percent	Acres	Percent
City of Fishers	Residential Districts	8,058	2,655	33%	2,978	37%	5,633	70%
	Commercial/Industrial/Institutional	1,132	158	14%	326	29%	484	43%
	Vacant/Special Districts	11,815	2,102	18%	4,034	34%	6,135	52%
City of Fort Wayne*	Residential Districts	51,297	14,553	28%	16,989	33%	31,542	61%
	Commercial/Industrial/Institutional	18,702	2,273	12%	4,885	26%	7,158	38%
	Vacant/Special Districts	1,032	107	10%	203	20%	311	30%
City of Huntington	Residential Districts	2,875	920	32%	1,146	40%	2,066	72%
	Commercial/Industrial/Institutional	1,699	246	14%	518	31%	764	45%
	Vacant/Special Districts	451	163	36%	133	29%	296	66%
City of Lafayette	Citywide	18,832	3,284	17%	5,406	29%	8,690	46%
City of Terre Haute	Residential Districts	8,378	3,013	36%	2,725	33%	5,739	68%
	Commercial/Industrial/Institutional	5,734	1,070	19%	1,739	30%	2,809	49%
	Vacant/Special Districts	5,044	931	18%	946	19%	1,877	37%
City of West Lafayette	Citywide	8,859	1,901	21%	2,545	29%	4,446	50%

Table 6 (continued)

Local Government	Geographic Unit	Acres	Tree Canopy		Preferred Plantable		Max Tree Canopy	
			Acres	Percent	Acres	Percent	Acres	Percent
Tippecanoe County	Residential Districts	12,953	4,150	32%	3,900	30%	8,050	62%
	Commercial/Industrial/Institutional	2,893	293	10%	742	26%	1,035	36%
	Vacant/Special Districts	13,186	5,199	39%	2,676	20%	7,876	60%
Town of Merrillville	Residential Districts	10,434	2,762	26%	3,324	32%	6,086	58%
	Commercial/Industrial/Institutional	4,724	575	12%	1,390	29%	1,964	42%
	Vacant/Special Districts	4,543	1,088	24%	1,268	28%	2,356	52%
Town of Zionsville	Residential Districts	17,804	6,035	34%	347	2%	6,383	36%
	Commercial/Industrial/Institutional	1,468	188	13%	1,192	81%	1,380	94%
	Vacant/Special Districts	23,446	3,103	13%	1,508	6%	4,611	20%

*The City of Lafayette and West Lafayette did not geographically analyze zoning land use.

Discussion

The management of trees in an urban forest can be challenging. Local governments have to balance the recommendations of tree experts, the needs of residents, the pressures of local economics and politics, the concerns for public safety and liability, the physical aspects of trees, the forces of nature and severe weather, and the desires for all of these issues to be resolved. Local governments must carefully consider each specific issue and balance these pressures with a knowledgeable understanding of their current UTC. If balance is achieved, beauty will flourish, and the health of community trees and residents will sustain.

The national trend is urban forests are losing invaluable tree canopy. The UGI Cohort local government study area has an existing tree canopy cover of 24% with an attainable tree canopy 46%. The preferred plantable area is equivalent to 62,495 acres. Plantable areas designated as Very High and High priority in each local government's prioritized planting plan should be planted first.

If not planted or preserved, trees will be lost due to development, natural mortality, insects and diseases, and climate change. Reaching projected tree canopy potentials will require the UGI local governments to preserve all existing tree canopy while expanding the urban forest in designated preferred plantable areas. Further analyzing, establishing, planning, and setting out to achieve a tree canopy goal from a public and private perspective is the only way local governments will slow the loss of trees and tree canopy. If local governments want to sustain tree canopy, setting goals will help organize tree planting programs and direct tree preservation. Establishing realistic and achievable tree canopy goals will help capitalize on the economic, environmental, and social benefits trees provide to the community.

Many communities have set tree canopy goals, standards, or policies. Each UGI Cohort local government should consider setting a tree canopy goal that is attainable in a set period. The

goal should be communitywide, and objectives can be more specific like public vs private lands or zoning land use based. To ensure goals are obtainable, utilize the results of the UTC assessment and the provided GIS tools to develop annual tree planting projects and tree preservation tactics. Increase public outreach efforts about the urban forest and the benefits it provides to the community using i-Tree Canopy and Hydro. This bolsters support of trees and an understanding of the importance for tree planting, maintenance, and preservation. Today, Indiana local governments and city partners need to make initiatives to help promote and sustain the urban tree canopy for the community and future generations to come.

Glossary

bare soil land cover: The land cover areas mapped as bare soil typically include vacant lots, construction areas, and baseball fields.

canopy: Branches and foliage which make up a tree's crown.

canopy cover: As seen from above, it is the area of land surface that is covered by tree canopy.

geographic information systems (GIS): A technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates.

impervious land cover: The area that does not allow rainfall to infiltrate the soil and typically includes buildings, parking lots, and roads.

i-Tree Canopy: The i-Tree Canopy tool allows users to easily photo-interpret Google aerial images of their area to produce statistical estimates of tree and other cover types along with calculations of the uncertainty of their estimates. A simple, quick, and inexpensive means for cities and forest managers to accurately estimate their tree and other cover types.

i-Tree Hydro: The i-tree Hydro tool is a desktop application that stimulates the effects of changes in urban tree cover and impervious surfaces on the hydrological cycle, including hourly stream flows, and water quality.

land cover: Physical features on the earth mapped from satellite or aerial imagery such as bare soils, canopy, impervious, pervious, or water.

open water land cover: The land cover areas mapped as water typically include lakes, oceans, rivers, and streams.

pervious land cover: The vegetative area that allows rainfall to infiltrate the soil and typically includes parks, golf courses, and residential areas.

possible UTC: The amount of land that is theoretically available for the establishment of tree canopy within the city boundary. This includes all pervious and bare soil surfaces.

preferred plantable area: The amount of land that is realistically available for the establishment of tree canopy within the city boundary. This includes all pervious and bare soil surfaces with specified land uses.

right-of-way (ROW): A strip of land generally owned by a public entity over which facilities, such as highways, railroads, or power lines, are built.

tree: A tree is defined as a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

tree benefit: An economic, environmental, or social improvement that benefited the community and resulted mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

urban forest: All of the trees within a municipality or a community. This can include the trees along streets or rights-of-way, parks and greenspaces, and forests.

urban tree canopy assessment (UTC): A study performed of land cover classes to gain an understanding of the tree canopy cover, particularly as it relates to the amount of tree canopy that currently exists and the amount of tree canopy that could exist. Typically performed using aerial photographs, GIS data, or LIDAR.

Appendix A
Land Cover Classification Methodology and Accuracy Assessment

Davey Resource Group "DRG" Canopy Height Modeling and Classification Methodology

DRG utilized raster-based height modeling from LiDAR data in combination with an object-based image analysis (OBIA) semi-automated feature extraction method to process and analyze current high-resolution aerial imagery to identify tree canopy cover and land cover classifications. The use of imagery analysis is cost-effective and provides a highly accurate approach to assessing your community's existing tree canopy cover. This supports responsible tree management, facilitates community forestry goal-setting, and improves urban resource planning for healthier and more sustainable urban environments.

Tree canopy was extracted from 2018 United States Geological Survey (USGS) 3DEP LiDAR data in ArcGIS®. A digital surface model (DSM) was created by interpolating the maximum values of the first returns of each laser pulse across a 3-foot grid surface (raster). A speckled output was created because some pulses can entirely or partially pass-through tree canopy before detecting a return, so maximum focal statistics in a 3 by 3 rectangular grid window were applied to the DSM to create a smooth surface.

Another raster representing the elevations of solid surfaces which LiDAR does not penetrate - usually ground and buildings, but occasionally dense evergreens as well, was created by interpolating the minimum values of the last returns (which are also the first return in instances of single return). Mean focal statistics in a 3 by 3 cell window were applied to this raster. The last return raster was subtracted from the first return raster, creating a canopy height model (CHM) – a representation of the heights of objects with complex return structures above the ground. In addition to trees, this includes built structures such as power lines, poles, transmission towers, gantries, etc. The edges of buildings also appeared in the CHM as a result of different cell assignment and focal statistic types applied to the first and last return rasters. The heights of dense evergreens were underestimated due to the inability of LiDAR to penetrate to the ground for a proper base for height.

A constant raster of CHM cells with a height greater than 15 feet was created as a representation of tree canopy. Holes less than 500 square feet were filled to eliminate dubious small gaps while preserving discernable canopy gaps. This raster was then shrunk by 2 cells and expanded back by 2 cells. This process eliminated narrow or small features such as building edges, power lines, and poles.

Advanced image analysis methods were used to classify, or separate, the remaining land cover layers from the overall imagery. The semi-automated extraction process was completed using Feature Analyst, an extension of ArcGIS®. Feature Analyst uses an object-oriented approach to cluster together objects with similar spectral (i.e., color) and spatial/contextual (e.g., texture, size, shape, pattern, and spatial association) characteristics. The land cover results of the extraction process was post-processed and clipped to each project boundary

prior to the manual editing process in order to create smaller, manageable, and more efficient file sizes. Secondary source data, high-resolution aerial imagery provided by each UTC city, and custom ArcGIS® tools were used to aid in the final manual editing, quality checking, and quality assurance processes (QA/QC). The manual QA/QC process was implemented to identify, define, and correct any misclassifications or omission errors in the final land cover layer.

A normalized digital elevation model (nDSM) was created by subtracting a DEM interpolated from ground-classified returns instead of last returns from the DSM. This surface provides more accurate tree canopy heights and includes the full heights of buildings as well. The nDSM was masked to the finalized tree canopy to provide a CHM capable of summarizing tree heights.

Classification Workflow

1) Prepare imagery for feature extract
2) ion (resampling, rectification, etc.), if needed.
3) Gather training set data for all desired land cover classes (impervious, bare soil). Water samples are not always needed since hydrologic data are available for most areas.
4) Extract canopy from LiDAR. Fill small holes and shrink and expand to remove building edges and power lines.
5) Edit and finalize canopy layer at 1:2,000 scale. A point file is created to digitize-in small individual trees that will be missed during the extraction. These points are buffered to represent the tree canopy. This process is done to speed up editing time and improve accuracy by including smaller individual trees.
6) Extract remaining land cover classes.
7) Edit the impervious layer to reflect actual impervious features, such as roads, buildings, parking lots, etc. to update features.
8) Using canopy and actual impervious surfaces as a mask; input the bare soils training data and extract them from the imagery. Quickly edit the layer to remove or add any features. Davey Resource Group tries to delete dry vegetation areas that are associated with lawns, grass/meadows, and agricultural fields.
9) Assemble any hydrological datasets, if provided. Add or remove any water features to create the hydrology class. Perform a feature extraction if no water feature datasets exist.
10) Use geoprocessing tools to clean, repair, and clip all edited land cover layers to remove any self-intersections or topology errors that sometimes occur during editing.

Land Cover Classification Code Values

Land Cover Classification	Code Value
Tree Canopy	1
Impervious	2
Pervious (Grass/Vegetation)	3
Bare Soil	4
Open Water	5

11) Input canopy, impervious, bare soil, and hydrology layers into DRG's Five-Class Land Cover Model to complete the classification. This model generates the pervious (grass/low-lying vegetation) class by taking all other areas not previously classified and combining them.
12) Thoroughly inspect final land cover dataset for any classification errors and correct as needed.
13) Perform accuracy assessment. Repeat Step 11, if needed.

Automated Feature Extraction Files

The automated feature extraction (AFE) files allow other users to run the extraction process by replicating the methodology. Since Feature Analyst does not contain all geoprocessing operations that DRG utilizes, the AFE only accounts for part of the extraction process. Using Feature Analyst, DRG created the training set data, ran the extraction, and then smoothed the features to alleviate the blocky appearance. To complete the actual extraction process, DRG uses additional geoprocessing tools within ArcGIS®. From the AFE file results, the following steps are taken to prepare the extracted data for manual editing.

1) DRG fills all holes in the canopy that are less than 30 square meters. This eliminates small gaps that were created during the extraction process while still allowing for natural canopy gaps.
2) DRG deletes all features that are less than 9 square meters for canopy (50 square meters for impervious surfaces). This process reduces the amount of small features that could result in incorrect classifications and also helps computer performance.
3) The Repair Geometry, Dissolve, and Multipart to Singlepart (in that order) geoprocessing tools are run to complete the extraction process.
4) The Multipart to Singlepart shapefile is given to GIS personnel for manual editing to add, remove, or reshape features.

Accuracy Assessment Protocol

Determining the accuracy of spatial data is of high importance to DRG and our clients. To achieve to best possible result, DRG manually edits and conducts thorough QA/QC checks on all urban tree canopy and land cover layers. A QA/QC process will be completed using ArcGIS® to identify, clean, and correct any temporal discrepancies in LiDAR-derived tree canopy, misclassification or topology errors in the final land cover dataset. The initial land cover layer extractions will be edited at a 1:2,000 quality control scale in the urban areas and at a 1:2,500 scale for rural areas utilizing the most current high-resolution aerial imagery to aid in the quality control process.

To test for accuracy, random plot locations are generated throughout the city area of interest and verified to ensure that the data meet the client standards. Each point will be compared with the most current Nearmap high-resolution imagery (reference image) to determine the accuracy of the final land cover layer. Points will be classified as either correct or incorrect and recorded in a classification matrix. Accuracy will be assessed using four metrics: overall accuracy, kappa, quantity disagreement, and allocation disagreement. These metrics are calculated using a custom Excel® spreadsheet.

Land Cover Accuracy

The following describes DRG's accuracy assessment techniques and outlines procedural steps used to conduct the assessment.

1. *Random Point Generation*—Using ArcGIS, 1,000 random assessment points are generated.
2. *Point Determination*—Each point is carefully assessed by the GIS analyst for likeness with the aerial photography. To record findings, two new fields, CODE and TRUTH, are added to the accuracy assessment point shapefile. CODE is a numeric value (1–5) assigned to each land cover class and TRUTH is the actual land cover class as identified according to the reference image. If CODE and TRUTH are the same, then the point is counted as a correct classification. Likewise, if the CODE and TRUTH are not the same, then the point is classified as incorrect. In most cases, distinguishing if a point is correct or incorrect is straightforward. Points will rarely be misclassified by an egregious classification or editing error. Often incorrect points occur where one feature stops and the other begins.
3. *Classification Matrix*—During the accuracy assessment, if a point is considered incorrect, it is given the correct classification in the TRUTH column. Points are first assessed on the Nearmap imagery for their correctness using a "blind" assessment—meaning that the analyst does not know the actual classification (the GIS analyst is strictly going off the Nearmap imagery to determine cover class). After all random points are assessed and recorded, a classification (or confusion) matrix is created. The classification matrix for this project is presented in the table below. The table allows for assessment of user's/producer's accuracy, overall accuracy, omission/commission errors, kappa statistics, allocation/quantity disagreement, and confidence intervals.

Reference Data	Classes	Tree Canopy	Impervious Surfaces	Grass & Low-Lying Vegetation	Bare Soils	Open Water	Row Total	Producer's Accuracy	Errors of Omission
	Tree Canopy	220	1	11	0	0	232	94.83%	5.17%
	Impervious	3	236	15	0	0	254	92.91%	7.09%
	Grass/Vegetation	7	9	443	2	1	462	95.89%	4.11%
	Bare Soils	0	2	6	20	0	28	71.43%	28.57%
	Water	0	0	1	0	23	24	95.83%	4.17%
	Column Total	230	248	476	22	24	1000		
	User's Accuracy	95.65%	95.16%	93.07%	90.91%	95.83%		Overall Accuracy	94.20%
	Errors of Commission	4.35%	4.84%	6.93%	9.09%	4.17%		Kappa Coefficient	0.9125

4. Following are descriptions of each statistic as well as the results from some of the accuracy assessment tests.

   Overall Accuracy – Percentage of correctly classified pixels; for example, the sum of the diagonals divided by the total points ((220+236+443+20+23)/1,000 = 94.20%).

   User's Accuracy – Probability that a pixel classified on the map actually represents that category on the ground (correct land cover classifications divided by the column total [220/230 = 95.65%]).

   Producer's Accuracy – Probability of a reference pixel being correctly classified (correct land cover classifications divided by the row total [220/232 = 94.83%]).

   Kappa Coefficient – A statistical metric used to assess the accuracy of classification data. It has been generally accepted as a better determinant of accuracy partly because it accounts for random chance agreement. A value of 0.80 or greater is regarded as "very good" agreement between the land cover classification and reference image.

   Errors of Commission – A pixel reports the presence of a feature (such as trees) that, in reality, is absent (no trees are actually present). This is termed as a false positive. In the matrix below, we can determine that 4.35% of the area classified as canopy is most likely not canopy.

   Errors of Omission – A pixel reports the absence of a feature (such as trees) when, in reality, they are actually there. In the matrix below, we can conclude that 5.17% of all canopy is classified as another land cover class.

Allocation Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less-than-optimal match in the spatial allocation (or position) of the classes.

Quantity Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than perfect match in the proportions (or area) of the classes.

Confidence Intervals – A confidence interval is a type of interval estimate of a population parameter and is used to indicate the reliability of an estimate. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter based on the observed probability of successes and failures. Since all assessments have innate error, defining a lower and upper bound estimate is essential.

Confidence Intervals

Class	Acreage	Percentage	Lower Bound	Upper Bound
Tree Canopy	1,900.9	21.5%	21.0%	21.9%
Impervious Surfaces	2,401.6	27.1%	26.6%	27.6%
Grass & Low-Lying Vegetation	4,116.0	46.5%	45.9%	47.0%
Bare Soils	240.5	2.7%	2.5%	2.9%
Open Water	200.5	2.3%	2.1%	2.4%
Total	8,859.5	100.00%		

Statistical Metrics Summary	
Overall Accuracy =	94.20%
Kappa Coefficient =	0.9125
Allocation Disagreement =	4%
Quantity Disagreement =	1%

Accuracy Assessment

Class	User's Accuracy	Lower Bound	Upper Bound	Producer's Accuracy	Lower Bound	Upper Bound
Tree Canopy	95.7%	94.3%	97.0%	94.8%	93.4%	96.3%
Impervious Surfaces	95.2%	93.8%	96.5%	92.9%	91.3%	94.5%
Grass & Low-Lying Vegetation	93.1%	91.9%	94.2%	95.9%	95.0%	96.8%
Bare Soils	90.9%	84.8%	97.0%	71.4%	62.9%	80.0%
Open Water	95.8%	91.8%	99.9%	95.8%	91.8%	99.9%

Appendix B
Prioritized Plantable Area Methodology

Planting Location Polygons

The planting location polygons were created for each local government by taking all grass/open space and bare ground areas and combining them into one dataset. Non-feasible planting areas such as agricultural fields, recreational fields, major utility corridors, airports, etc. were removed from consideration. This layer was reviewed and approved by a climate fellow and local government before the analysis proceeded. The remaining planting space was consolidated into a single feature and then exploded back out to multipart features creating separate, distinct polygons for each location.

How Polygons Were Prioritized

With assistance from climate fellows, DRG assessed several environmental and demographic factors to identify and prioritize planting potential. The tables below present the features listed for each community. Each local government customized their lists and prioritized by—rated ranking with summation of 1.00—the factors (tables below). Each factor was then assessed using data from various sources and analyzed using separate grid maps. Values between zero and four—with zero having the lowest priority–were assigned to each grid assessed. The grids were overlain, and the values were averaged to determine the priority levels at an area on the map. The averages were binned into five (5) classes with the higher numbers indicating higher priority for planting. These classes ranged from Very Low to Very High.

Factor Priority Ranking Variables for the City of Fishers, Indiana

Dataset	Source	Weight
Proximity to Hardscape	Urban Tree Canopy Assessment	0.10
Proximity to Canopy	Urban Tree Canopy Assessment	0.15
Floodplain Proximity	National Hydrologic Dataset	0.15
Soil Permeability	Natural Resource Conservation Service	0.05
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.05
Slope	National Elevation Dataset	0.05
Heat Islands	Urban Tree Canopy Assessment	0.15
Population Density	U.S. Census Bureau	0.10
Minority Population	U.S. Census Bureau	0.10
Median Household Income	U.S. Census Bureau	0.10

Factor Priority Ranking Variables for the City of Fort Wayne, Indiana

Dataset	Source	Weight
Proximity to Hardscape	Urban Tree Canopy Assessment	0.12
Proximity to Canopy	Urban Tree Canopy Assessment	0.05
Floodplain Proximity	National Hydrologic Dataset	0.10
Soil Permeability	Natural Resource Conservation Service	0.05
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.05
Slope	National Elevation Dataset	0.10
Heat Islands	Urban Tree Canopy Assessment	0.15
Population Density	U.S. Census Bureau	0.10
Minority Population	U.S. Census Bureau	0.10
Median Household Income	U.S. Census Bureau	0.10
Health Effects	Simply Analytics	0.08

Factor Priority Ranking Variables for the City of Huntington, Indiana

Dataset	Source	Weight
Proximity to Hardscape	Urban Tree Canopy Assessment	0.20
Proximity to Canopy	Urban Tree Canopy Assessment	0.05
Floodplain Proximity	National Hydrologic Dataset	0.10
Soil Permeability	Natural Resource Conservation Service	0.05
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.05
Slope	National Elevation Dataset	0.10
Heat Islands	Urban Tree Canopy Assessment	0.15
Population Density	U.S. Census Bureau	0.1
Minority Population	U.S. Census Bureau	0.1
Median Household Income	U.S. Census Bureau	0.1

Factor Priority Ranking Variables for the City of Lafayette, Indiana

Dataset	Source	Weight
Urban Heat Island Index	Urban Tree Canopy Assessment	0.20
Proximity to Canopy	Urban Tree Canopy Assessment	0.20
Soil Permeability	National Hydrologic Dataset	0.20
Air Quality	i-Tree Canopy	0.20
Population Density	U.S. Census Bureau	0.10
Income	U.S. Census Bureau	0.05
Asthma Prevalence	CDC 500 Cities Study	0.05

Factor Priority Ranking Variables for the Town of Merrillville, Indiana

Dataset	Source	Weight
Proximity to Hardscape	Urban Tree Canopy Assessment	0.20
Proximity to Canopy	Urban Tree Canopy Assessment	0.05
Floodplain Proximity	National Hydrologic Dataset	0.10
Soil Permeability	Natural Resource Conservation Service	0.05
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.05
Slope	National Elevation Dataset	0.10
Heat Islands	Urban Tree Canopy Assessment	0.15
Population Density	U.S. Census Bureau	0.10
Minority Population	U.S. Census Bureau	0.10
Median Household Income	U.S. Census Bureau	0.10

Factor Priority Ranking Variables for the City of Terre Haute, Indiana

Dataset	Source	Weight
Proximity to Hardscape	Urban Tree Canopy Assessment	0.20
Proximity to Canopy	Urban Tree Canopy Assessment	0.05
Floodplain Proximity	National Hydrologic Dataset	0.10
Soil Permeability	Natural Resource Conservation Service	0.10
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.05
Slope	National Elevation Dataset	0.05
Heat Islands	Urban Tree Canopy Assessment	0.15
Population Density	U.S. Census Bureau	0.10
Minority Population	U.S. Census Bureau	0.10
Median Household Income	U.S. Census Bureau	0.10

Factor Priority Ranking Variables for Tippecanoe County, Indiana

Dataset	Source	Weight
Urban Heat Island Index	Urban Tree Canopy Assessment	0.30
Proximity to Canopy	Urban Tree Canopy Assessment	0.20
Soil Permeability	National Hydrologic Dataset	0.20
Population Density	U.S. Census Bureau	0.15
Income	U.S. Census Bureau	0.15

Factor Priority Ranking Variables for the City of West Lafayette, Indiana

Dataset	Source	Weight
Proximity to Hardscape	Urban Tree Canopy Assessment	0.20
Proximity to Canopy	Urban Tree Canopy Assessment	0.05
Floodplain Proximity	National Hydrologic Dataset	0.05
Soil Permeability	Natural Resource Conservation Service	0.10
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.05
Slope	National Elevation Dataset	0.05
Heat Islands	Urban Tree Canopy Assessment	0.15
Population Density	U.S. Census Bureau	0.10
Minority Population	U.S. Census Bureau	0.10
Median Household Income	U.S. Census Bureau	0.15

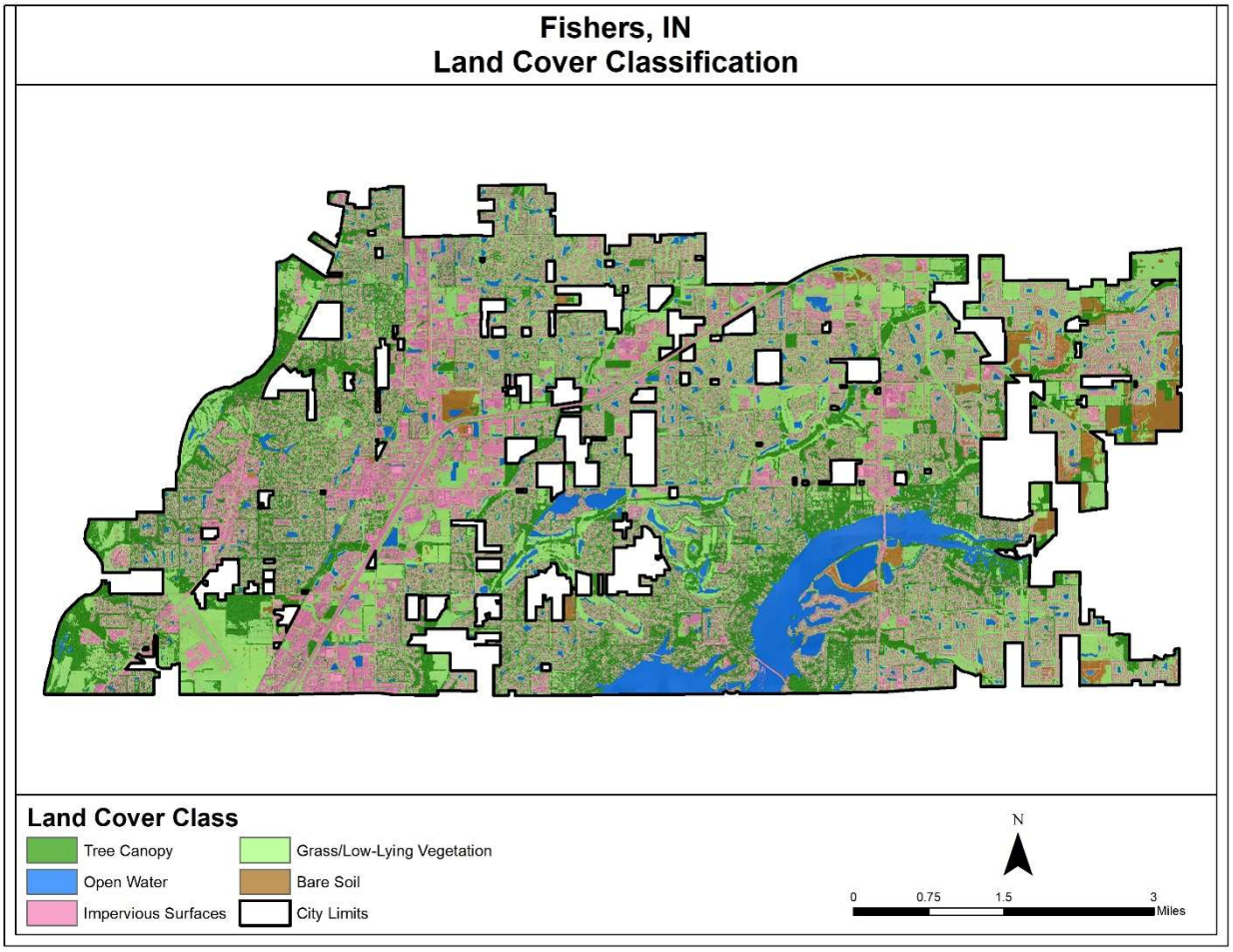
Factor Priority Ranking Variables for the Town of Zionsville, Indiana

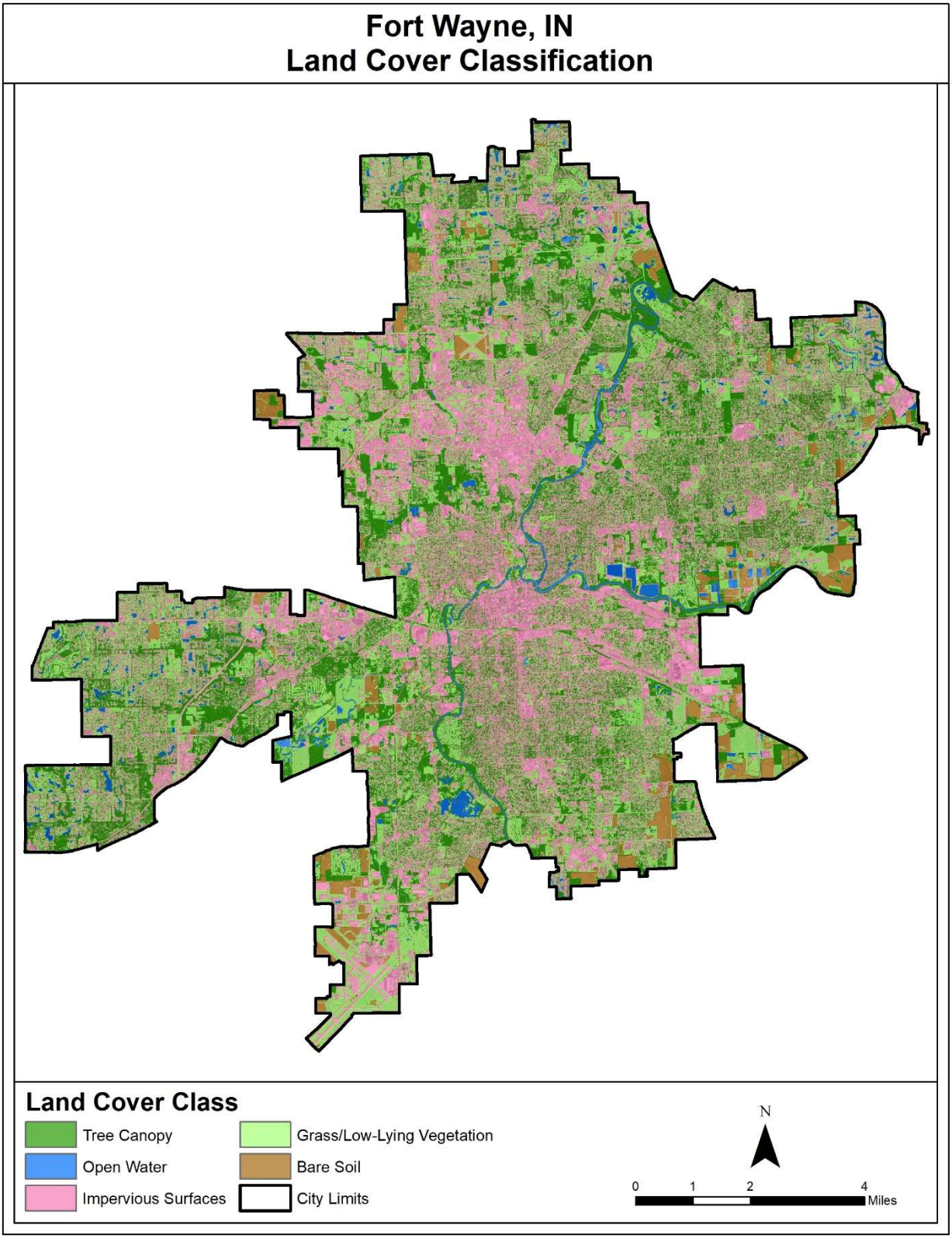
Dataset	Source	Weight
Proximity to Hardscape	Urban Tree Canopy Assessment	0.20
Proximity to Canopy	Urban Tree Canopy Assessment	0.05
Floodplain Proximity	National Hydrologic Dataset	0.10
Soil Permeability	Natural Resource Conservation Service	0.05
Soil Erosion (K-factor)	Natural Resource Conservation Service	0.05
Slope	National Elevation Dataset	0.10
Heat Islands	Urban Tree Canopy Assessment	0.15
Population Density	U.S. Census Bureau	0.05
Minority Population	U.S. Census Bureau	0.125
Median Household Income	U.S. Census Bureau	0.125

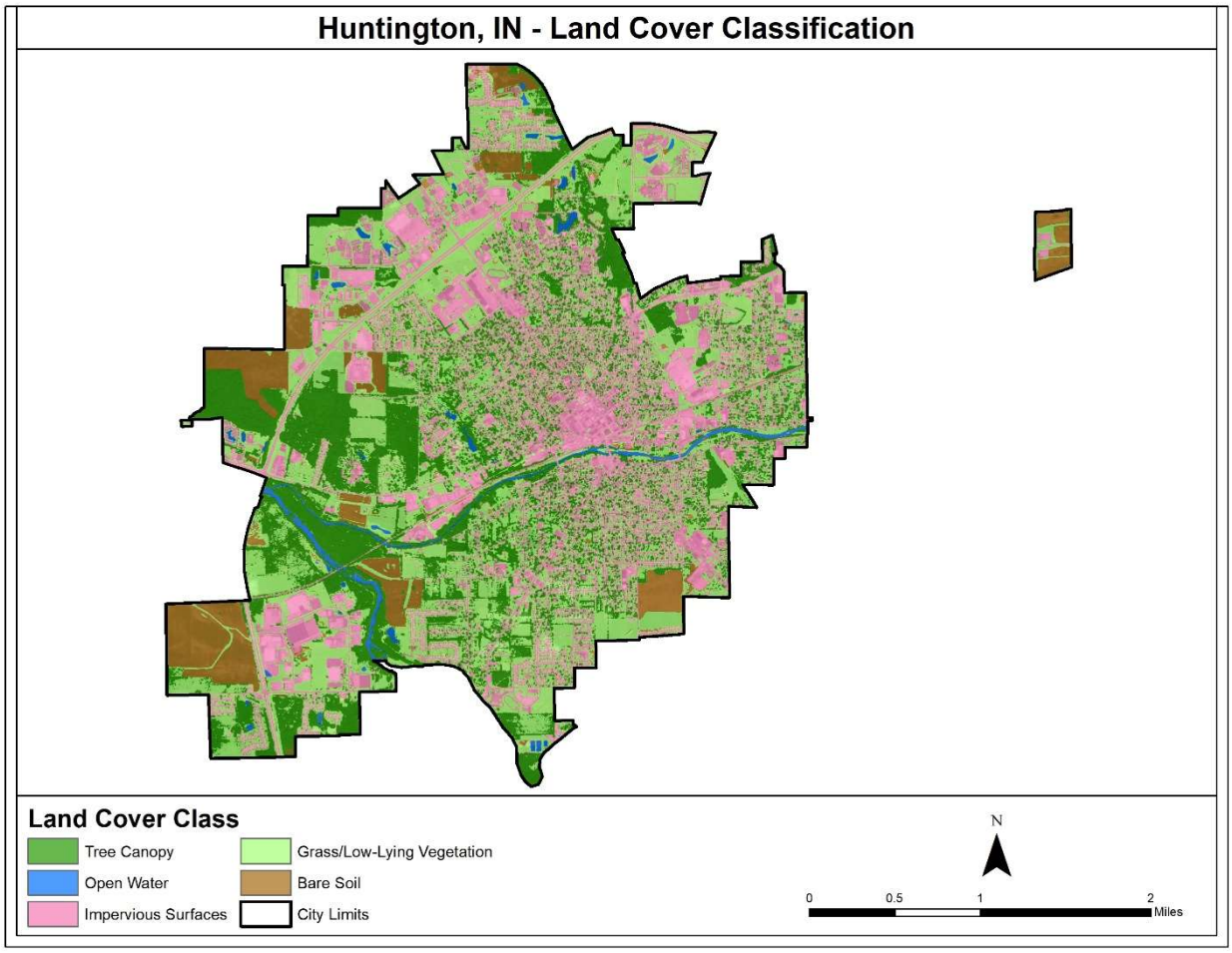
Appendix C
Summary of Assessed Local Government and Analyzed Geography Metrics

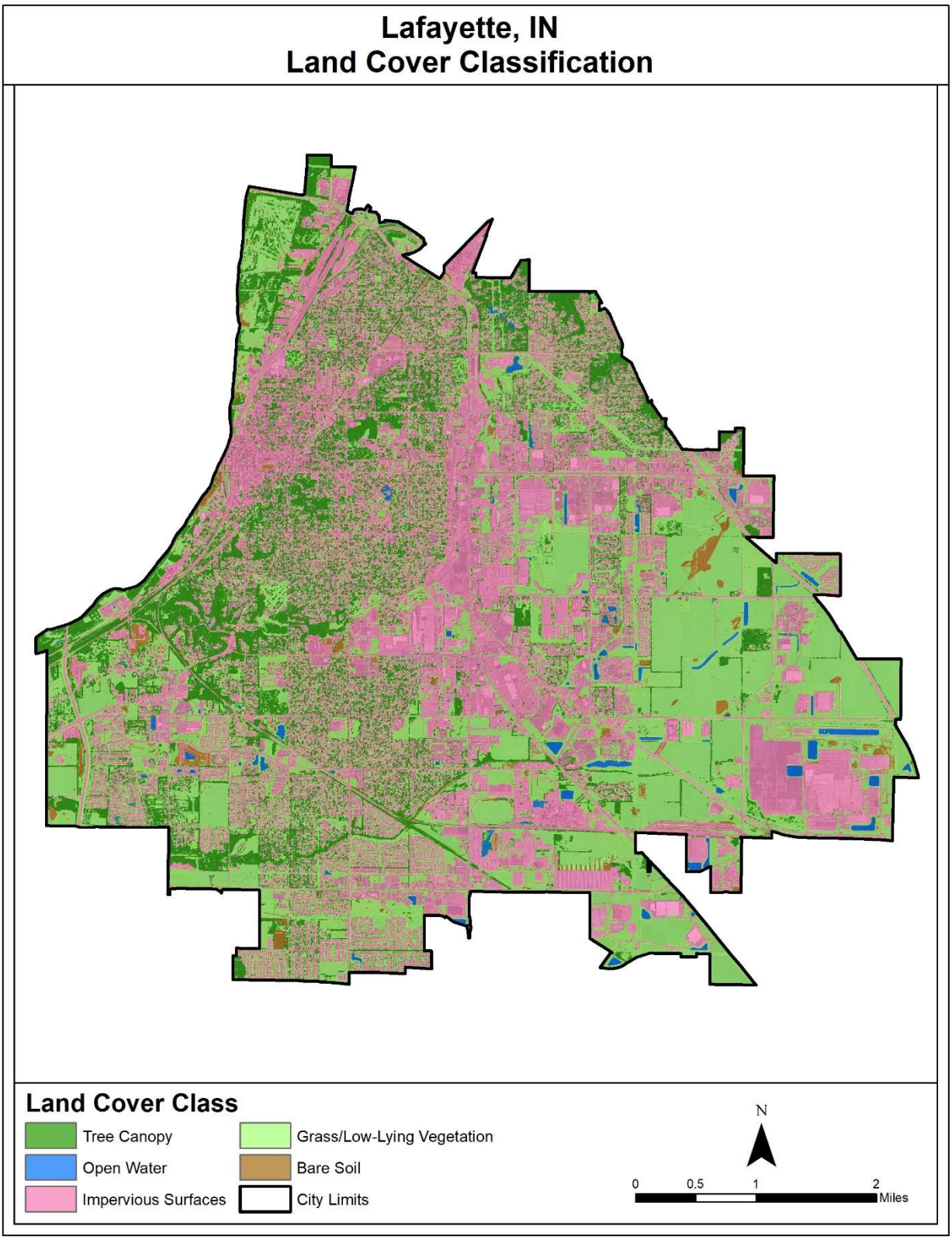
Geographic Unit	Local Government								
	City of Fishers	City of Fort Wayne	City of Huntington	City of Lafayette	City of Terre Haute	City of West Lafayette	Tippecanoe County	Town of Merrillville	Town of Zionsville
Census Block Groups	X	X	X	X	X	X	X	X	X
Census Tracts	X	X	X	X	X	X	X	X	X
Parcels	X	X	X	X	X	X	X	X	X
Subdivisions	X	X	X				X	X	
Public vs Private	X		X	X	X	X	X	X	X
Rights-of-Way	X		X						
Zoning	X	X	X		X		X	X	X
Zoning Consolidated			X		X		X		X
Parks		X			X				X
Council Districts				X	X	X			X
Neighborhoods				X		X			
Zoning Districts			X						
Voter Districts			X						
Precincts								X	
Wards								X	
Mowing Areas									X
Urban vs Rural									X
Annexations						X			
Towns							X		
Managed Lands							X		
County Council Districts							X		
Pruning Area		X							
Flood Hazard Areas		X							

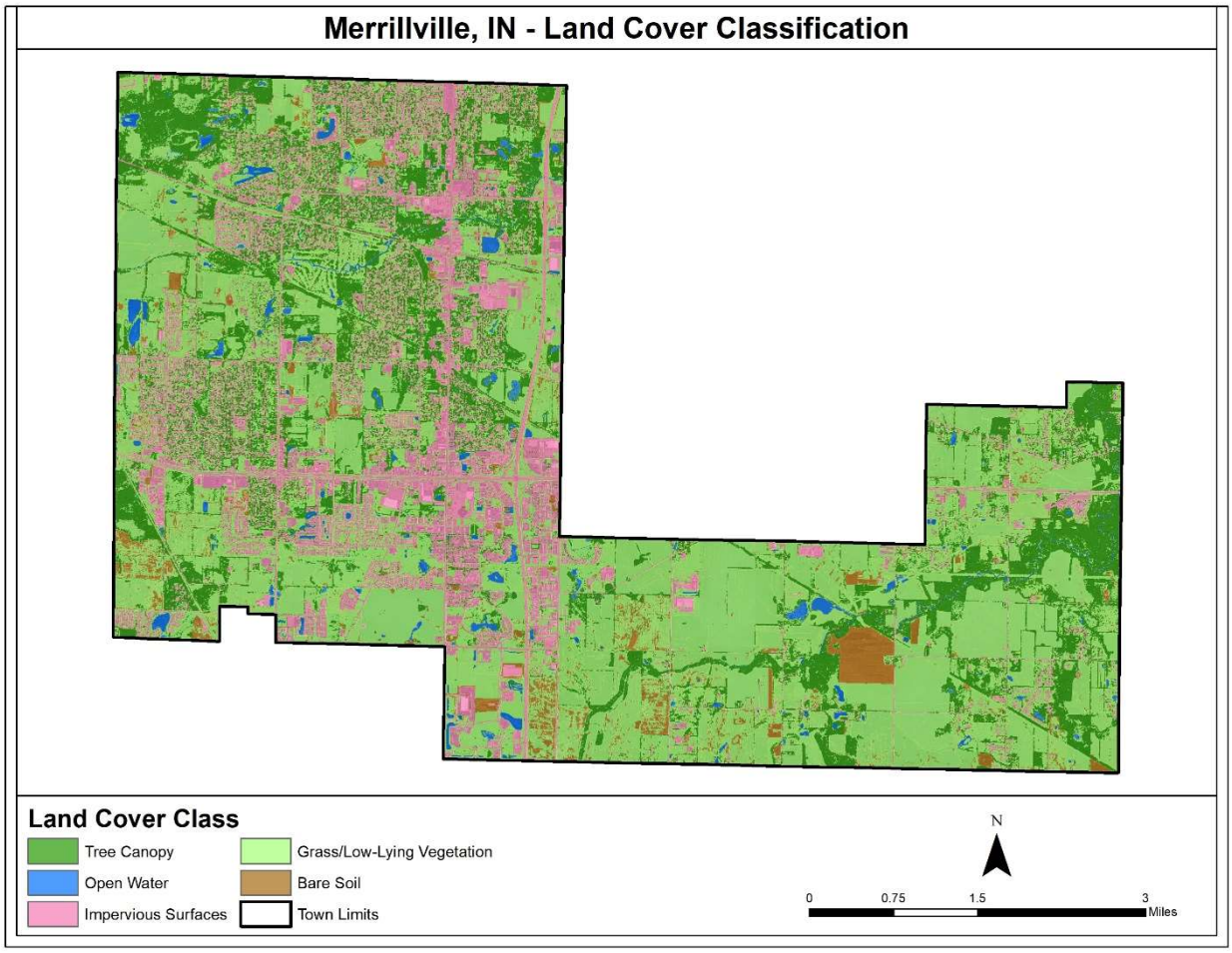
Appendix D
Local Government Land Cover Distribution Illustrations

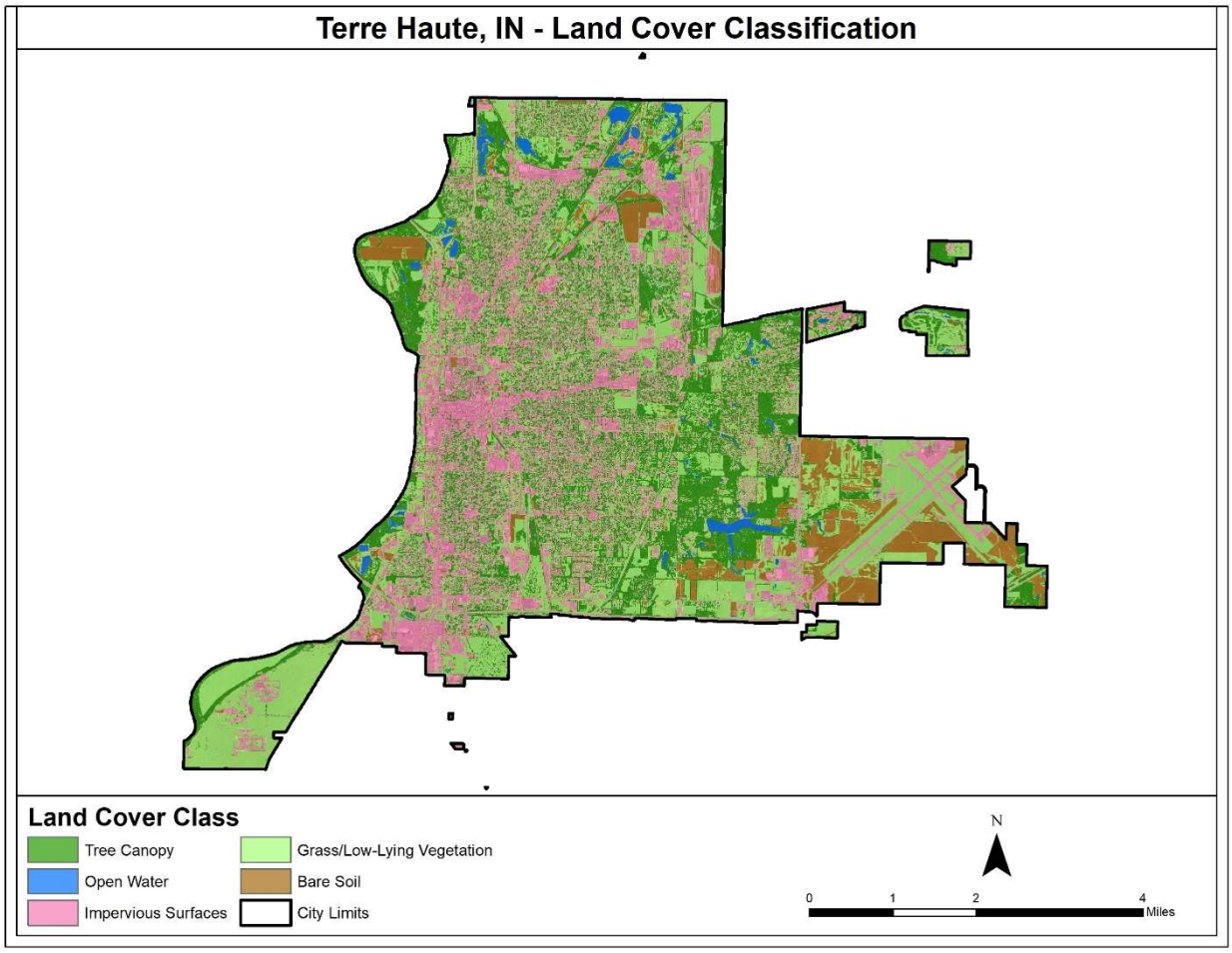


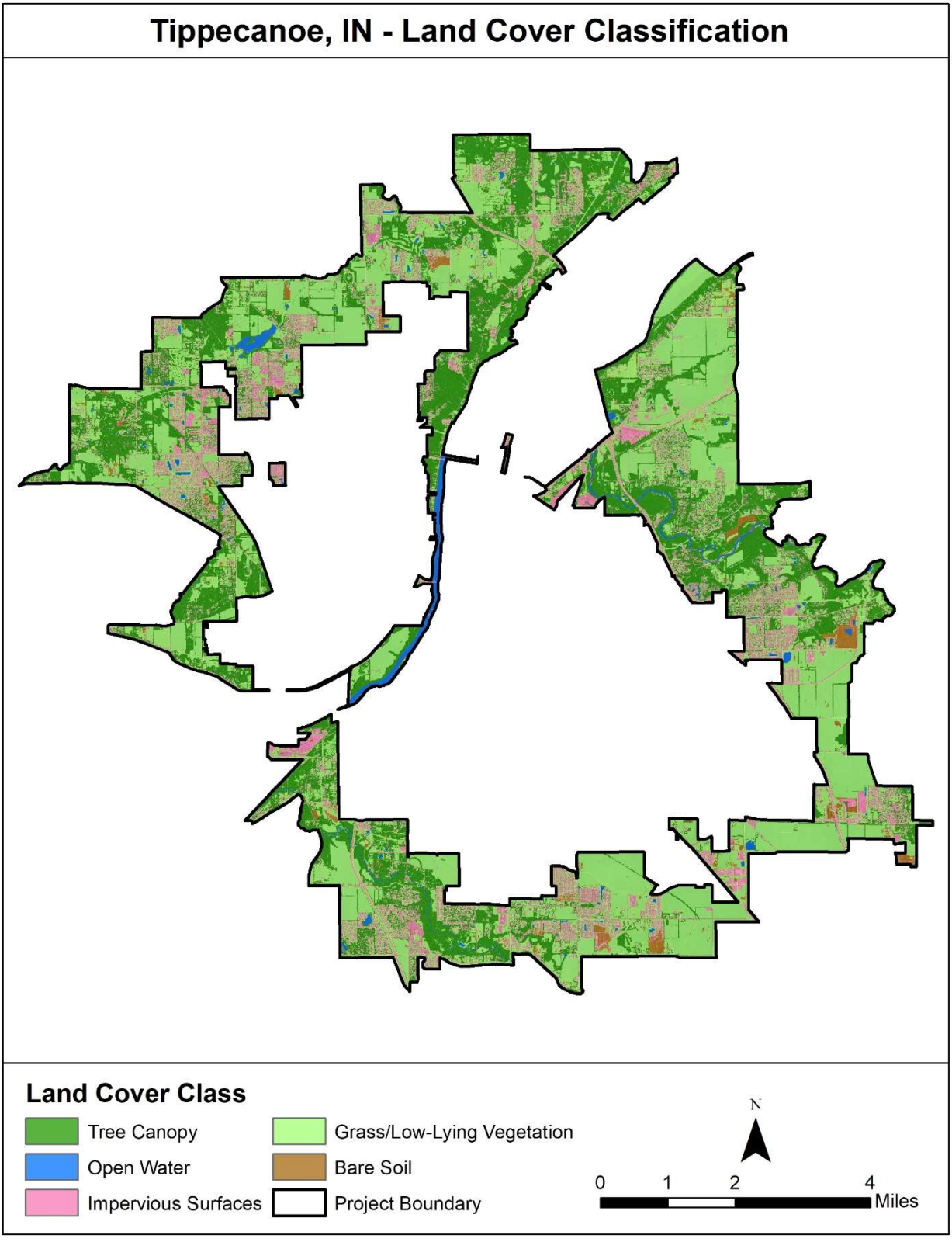

Fort Wayne, IN
Land Cover Classification
Land Cover Class
Tree Canopy
Grass/Low-Lying Vegetation
Open Water
Bare Soil
Impervious Surfaces
City Limits
N
0
1
2
4
Miles

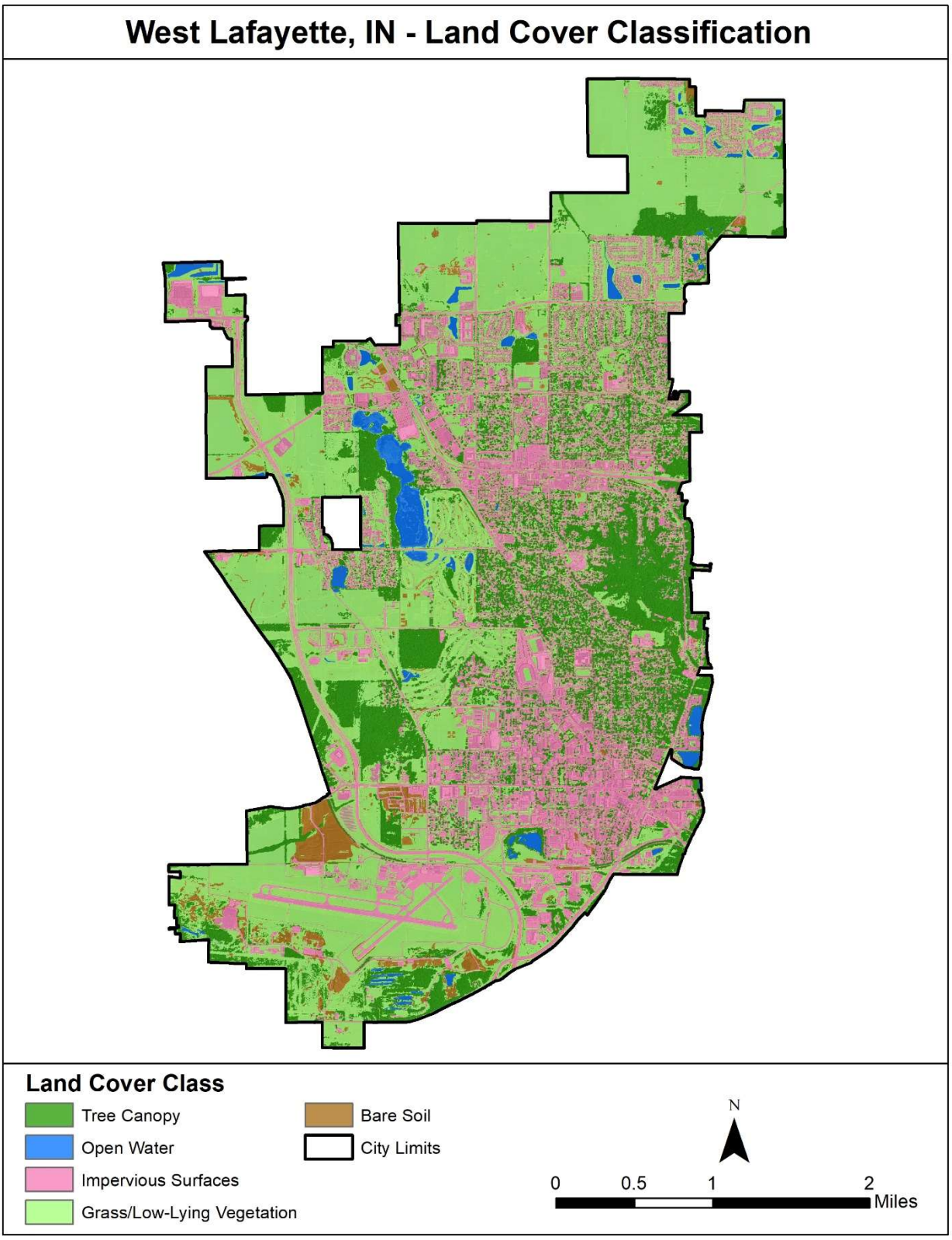

Huntington, IN - Land Cover Classification
Land Cover Class
Tree Canopy
Open Water
Impervious Surfaces
Grass/Low-Lying Vegetation
Bare Soil
City Limits
N
0
0.5
1
2
Miles

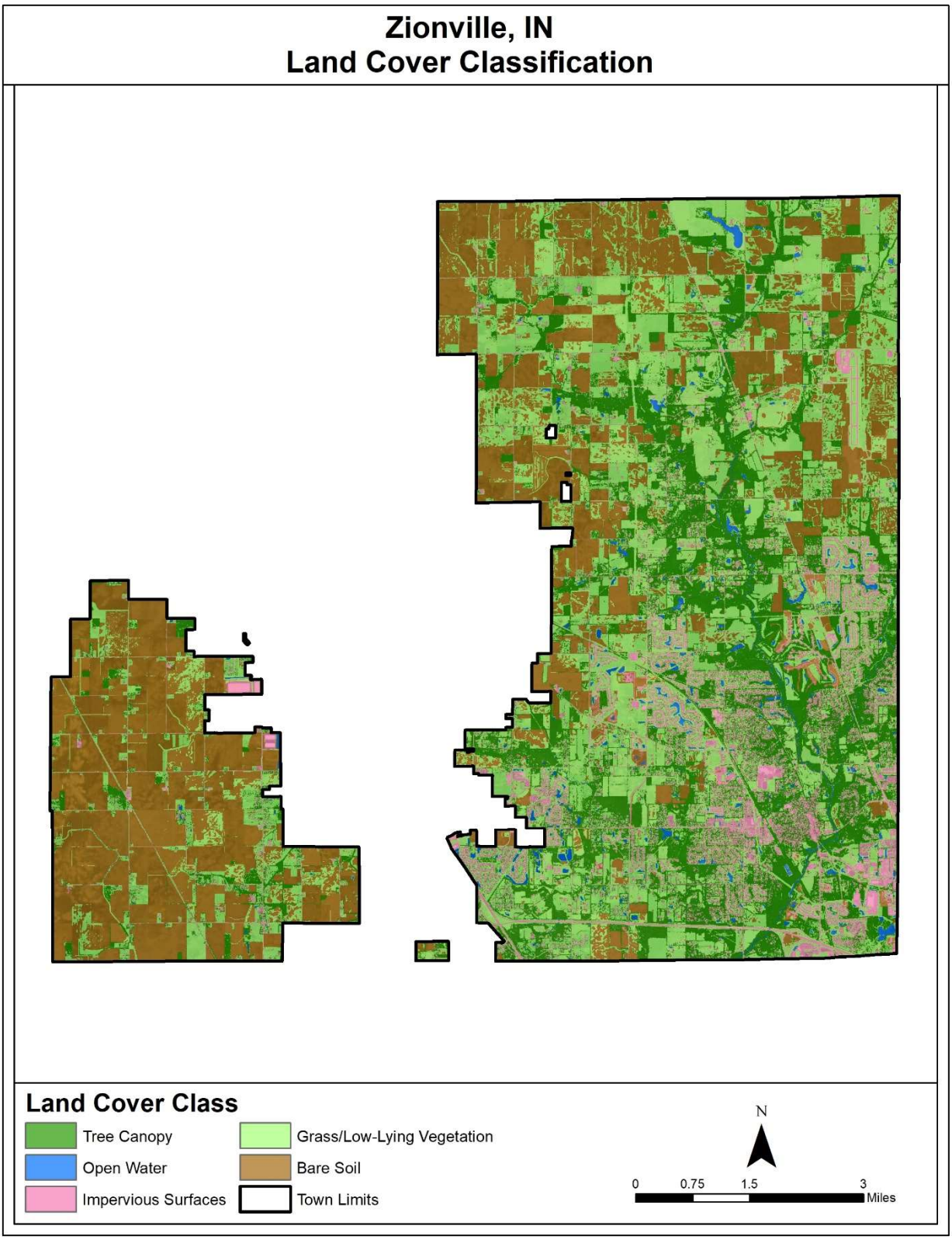

Lafayette, IN
Land Cover Classification
Land Cover Class
Tree Canopy
Grass/Low-Lying Vegetation
Open Water
Bare Soil
Impervious Surfaces
City Limits
N
0
0.5
1
2
Miles


Merrillville, IN - Land Cover Classification
Land Cover Class
Tree Canopy
Open Water
Impervious Surfaces
Grass/Low-Lying Vegetation
Bare Soil
Town Limits
N
0
0.75
1.5
3
Miles

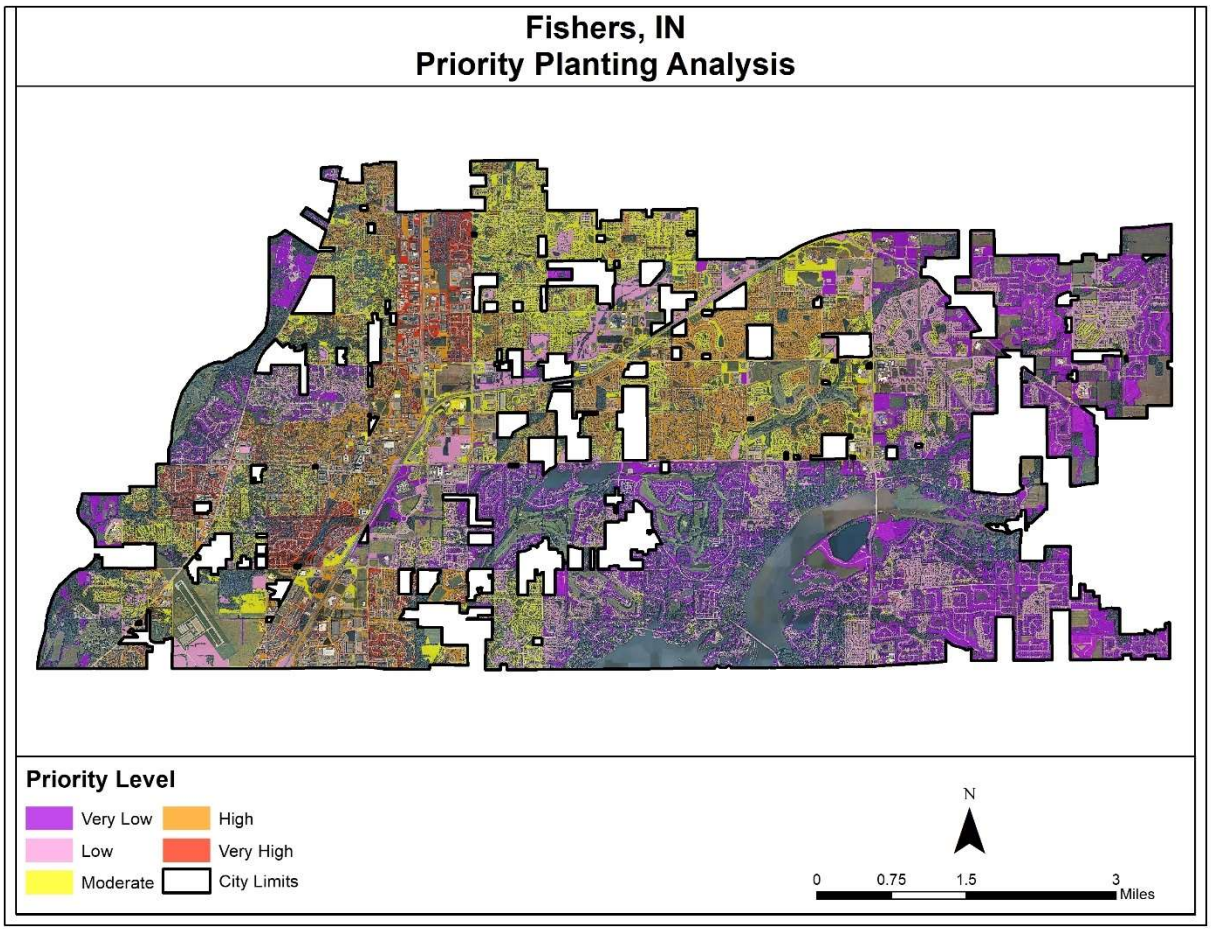

Terre Haute, IN - Land Cover Classification
Land Cover Class
Tree Canopy
Open Water
Impervious Surfaces
Grass/Low-Lying Vegetation
Bare Soil
City Limits
N
0
1
2
4
Miles


Tippecanoe, IN - Land Cover Classification
Land Cover Class
Tree Canopy
Open Water
Impervious Surfaces
Grass/Low-Lying Vegetation
Bare Soil
Project Boundary
N
0
1
2
4
Miles


West Lafayette, IN - Land Cover Classification
Land Cover Class
Tree Canopy
Open Water
Impervious Surfaces
Grass/Low-Lying Vegetation
Bare Soil
City Limits
N
0
0.5
1
2
Miles

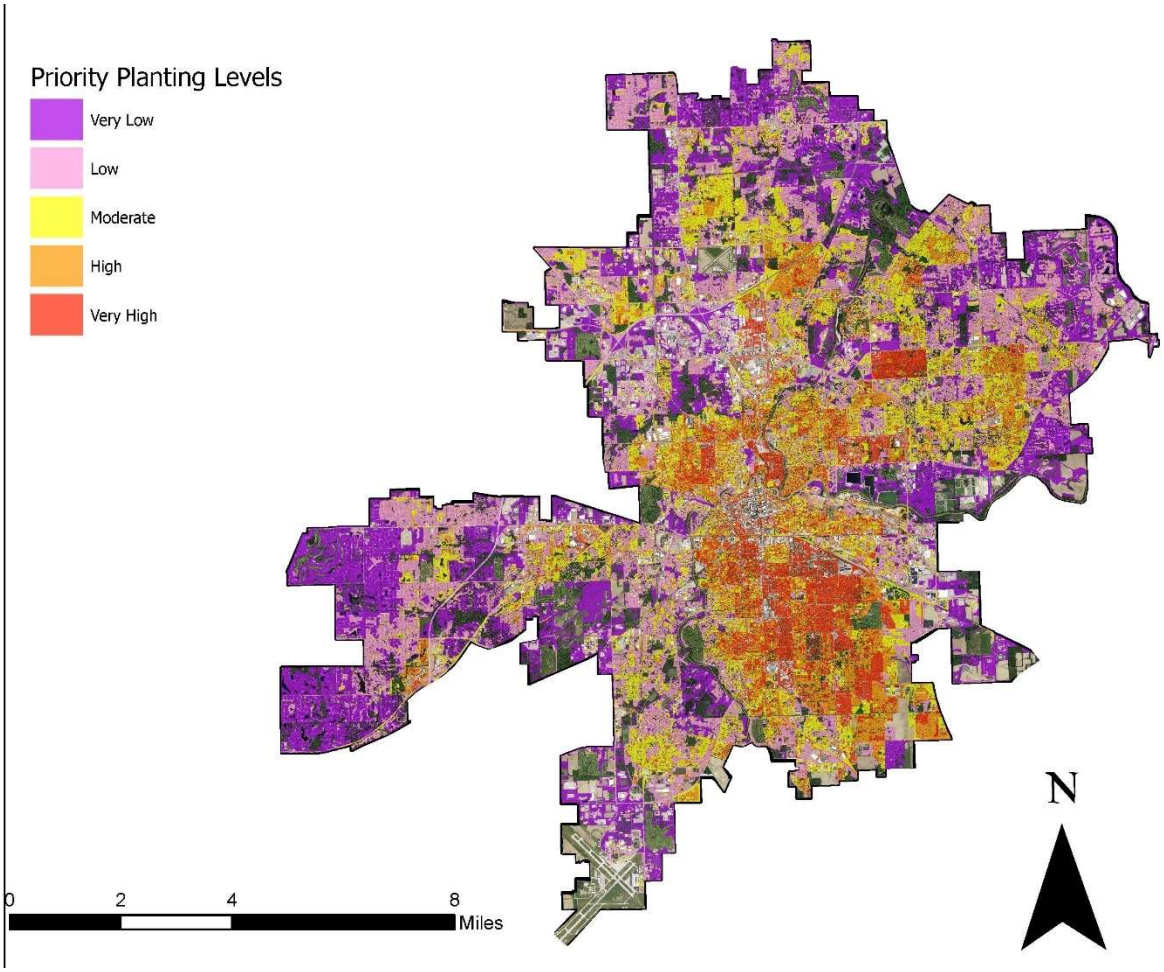

Zionville, IN
Land Cover Classification
Land Cover Class
Tree Canopy
Grass/Low-Lying Vegetation
Open Water
Bare Soil
Impervious Surfaces
Town Limits
N
0
0.75
1.5
3
Miles

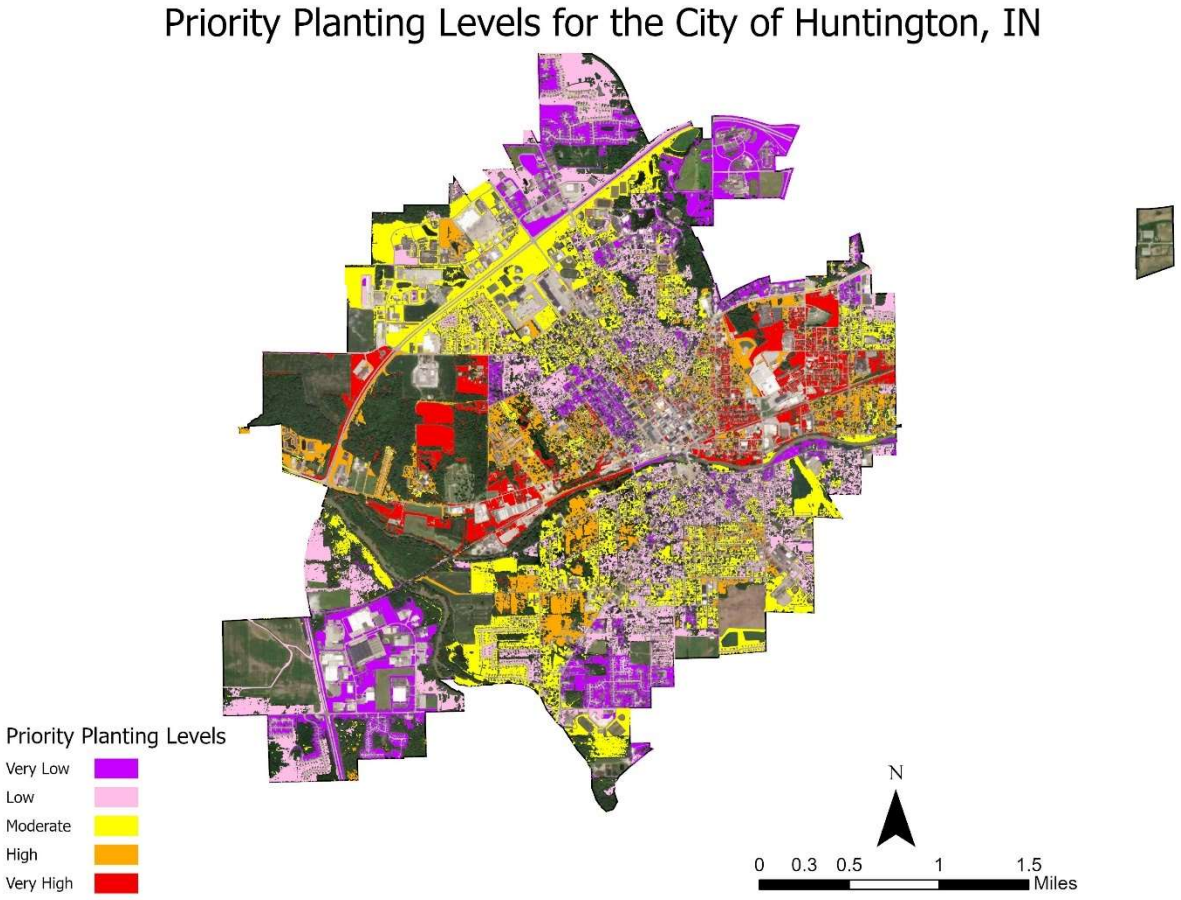
Appendix E
Local Government Prioritized Plantable Area Illustrations



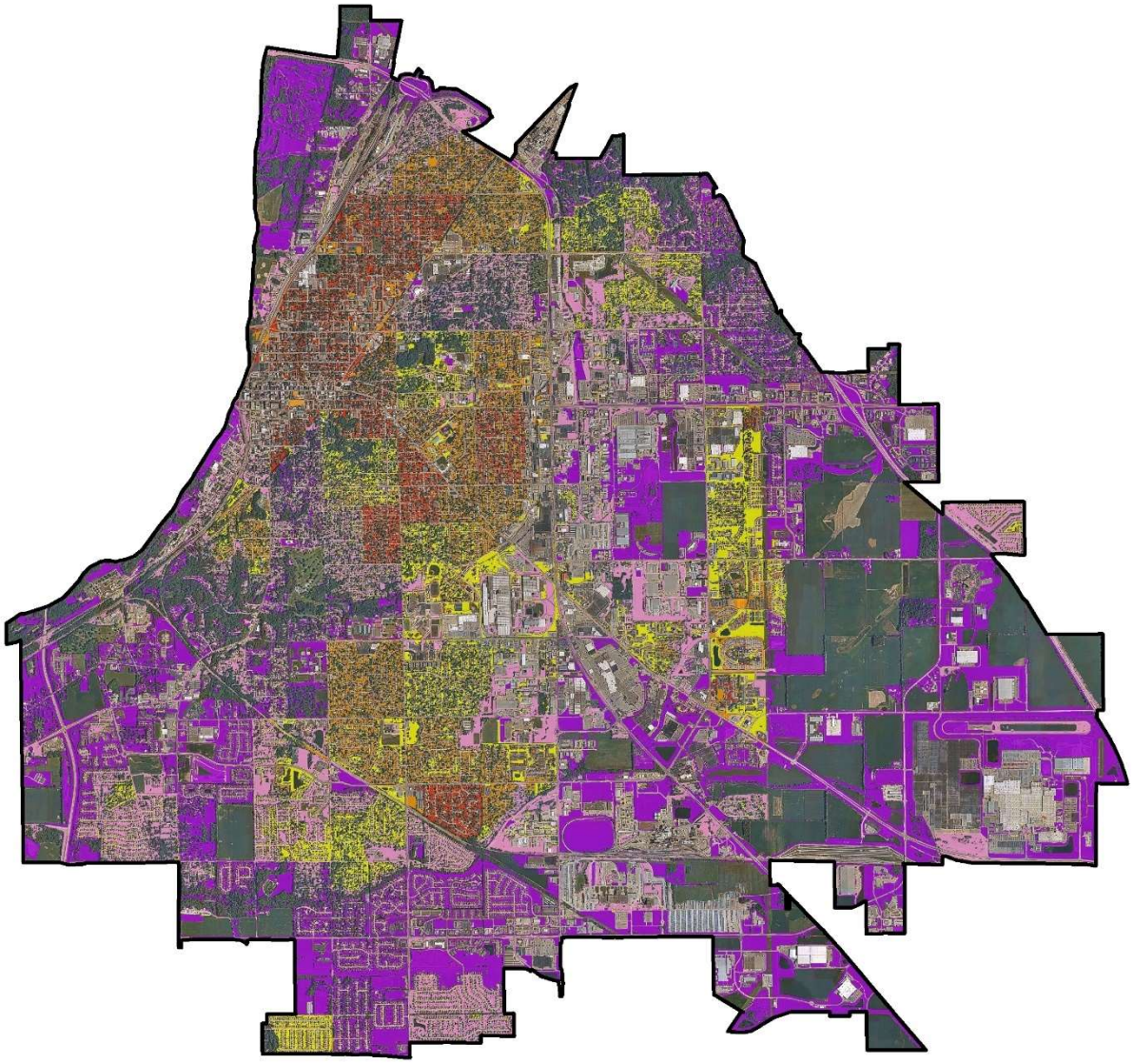
City of Fort Wayne, IN

Prioritized Plantable Area




Priority Planting Levels for the City of Huntington, IN
Priority Planting Levels
Very Low
Low
Moderate
High
Very High
N
0 0.3 0.5 1 1.5
Miles

Lafayette, IN - Priority Planting Analysis

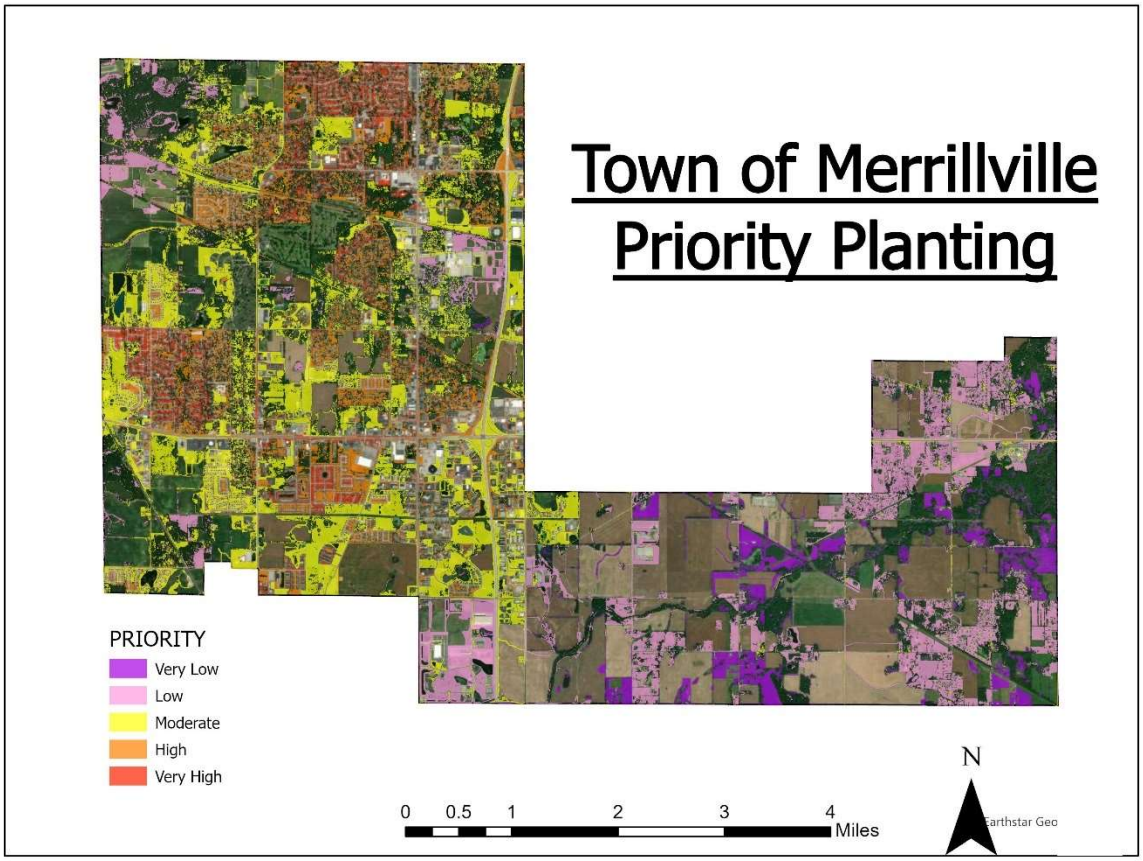


Priority Level

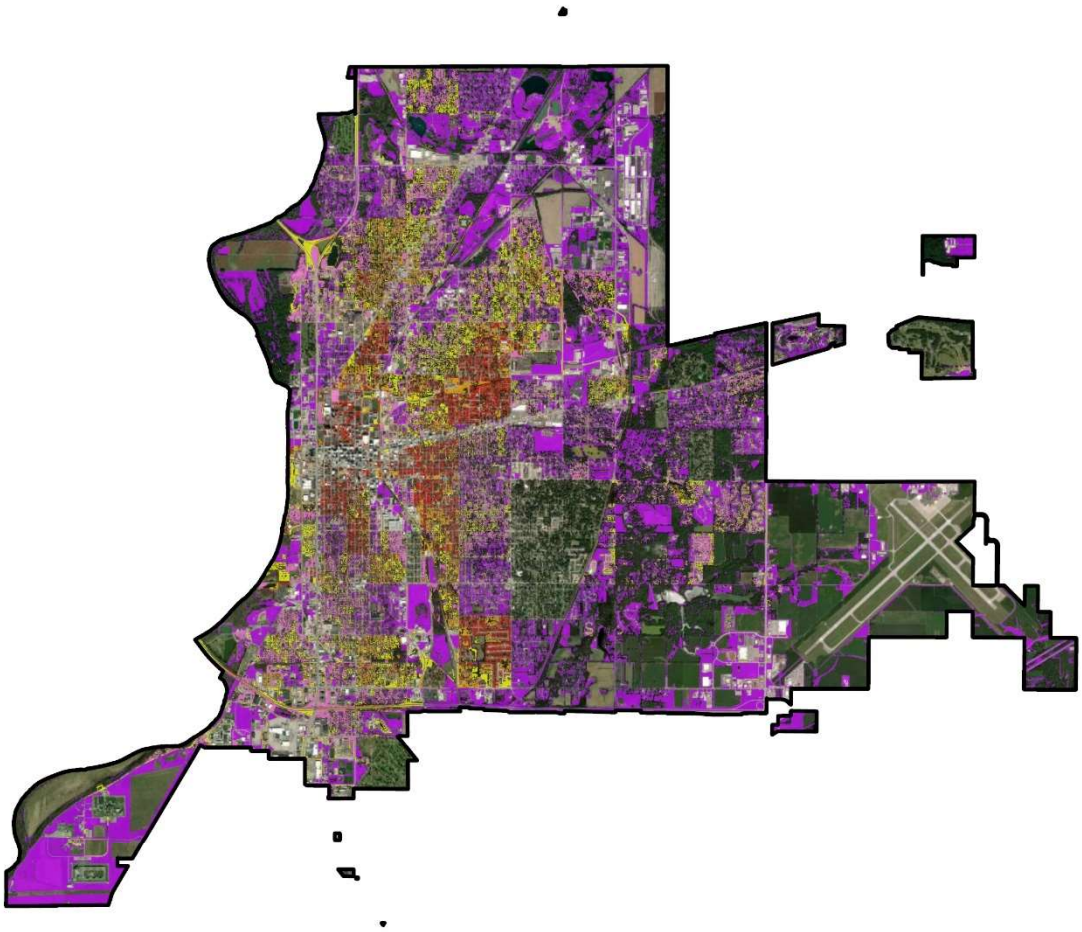
- Very Low
- Low
- Moderate
- High
- Very High
- City Limits

N

0 0.5 1 2 Miles


Town of Merrillville
Priority Planting
PRIORITY
Very Low
Low
Moderate
High
Very High
0 0.5 1 2 3 4
Miles
N
Earthstar Geo

Terre Haute Priority Planting Map



Earthstar

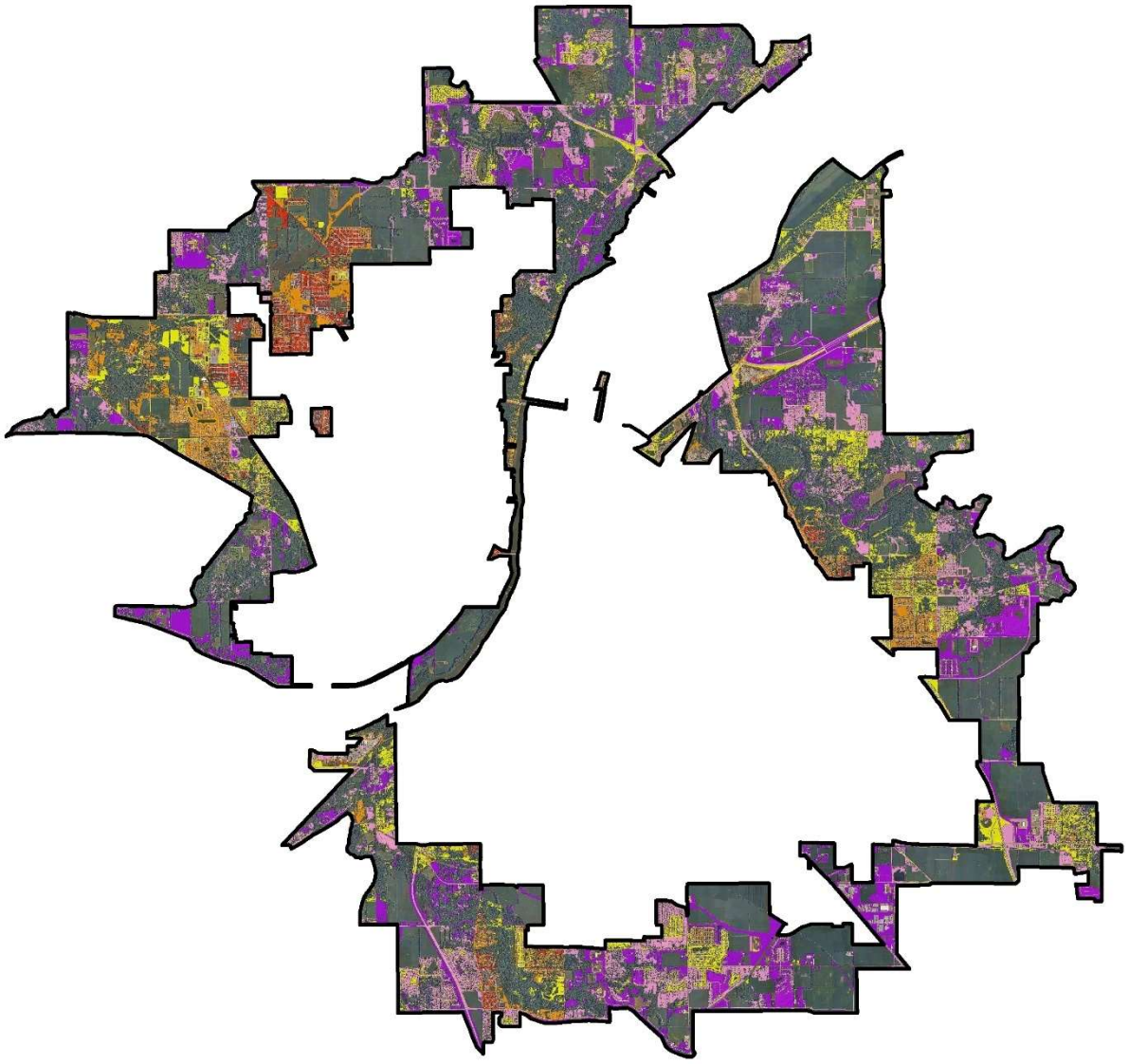
Priority Planting Levels

- Very Low
- Low
- Moderate
- High
- Very High

N

0 0.5 1 2 3 4 Miles

Tippecanoe, IN - Priority Planting Analysis

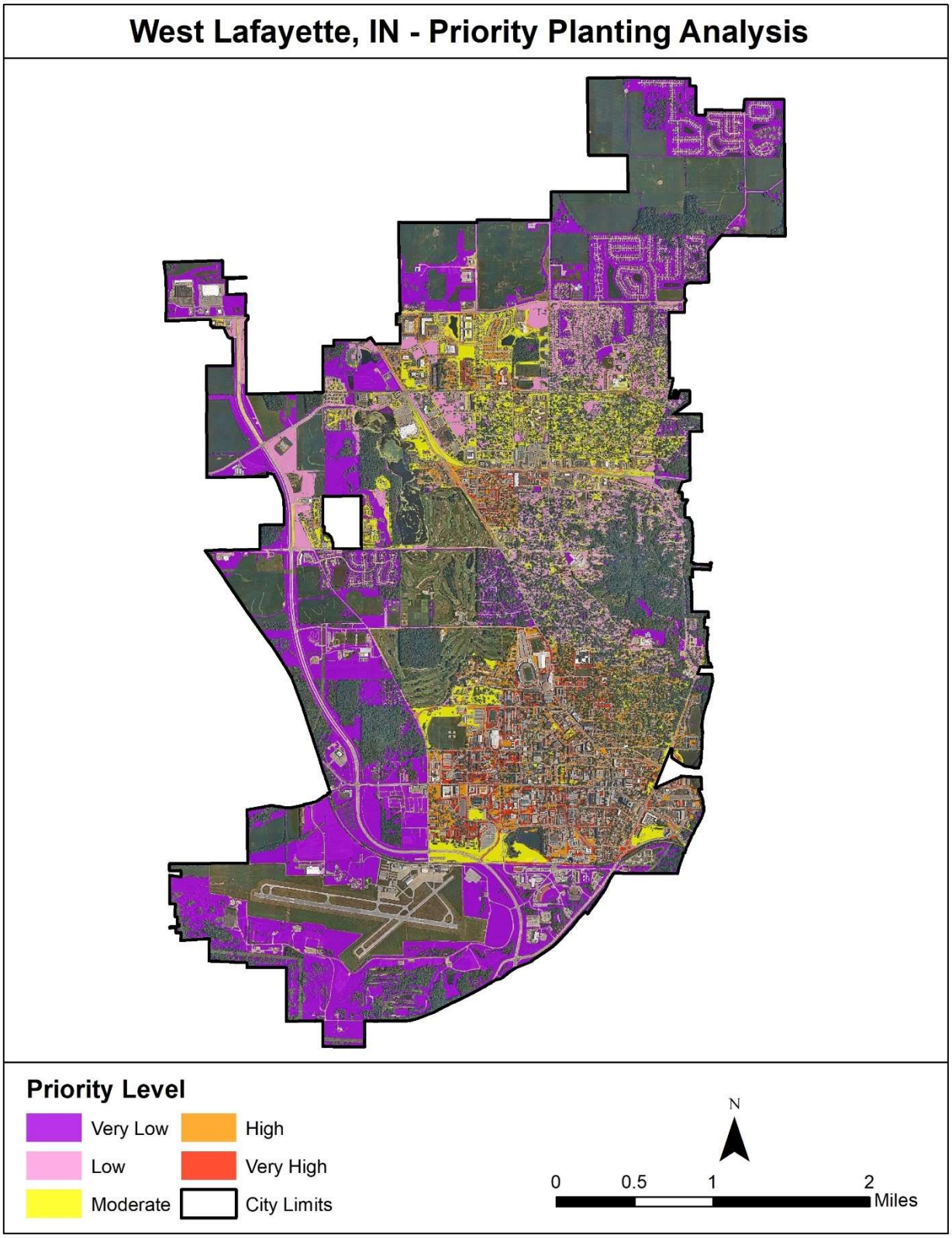


Priority Level

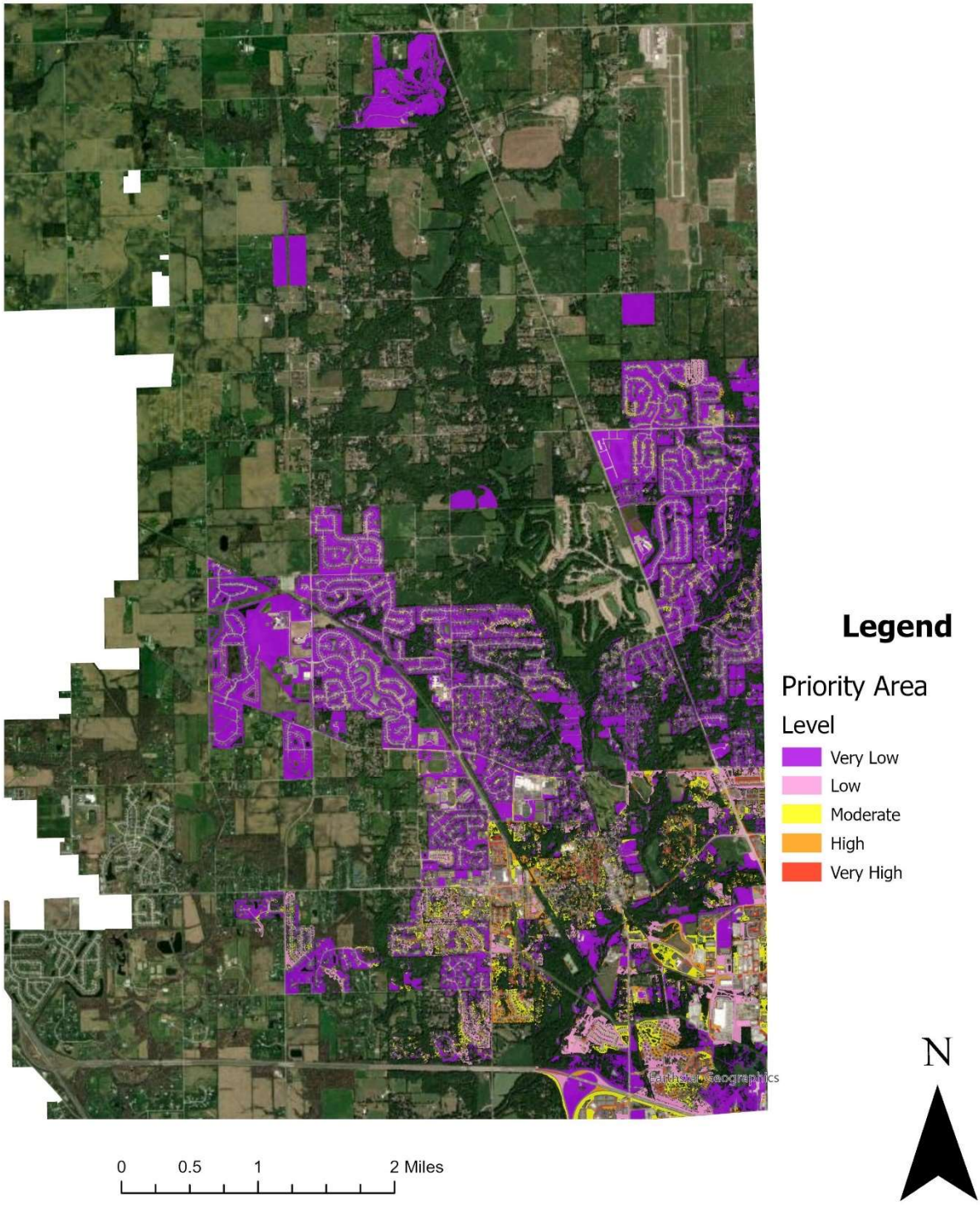
- Very Low
- Low
- Moderate
- High
- Very High
- Project Boundary

N

0 1 2 4 Miles


West Lafayette, IN - Priority Planting Analysis
Priority Level
Very Low
Low
Moderate
High
Very High
City Limits
N
0
0.5
1
2
Miles

Zionsville, IN Priority Planting Areas



2022 Tree Planting Plan - Lafayette, Indiana

Created by Joey Mendolia

Indiana University Environmental Resilience Institute McKinney Climate Fellow – Lafayette Department of Public Works and Engineering

j.f.mendolia@gmail.com

Introduction

During Summer 2022, The City of Lafayette partnered with Indiana University's Environmental Resilience Institute (ERI) to create an equity focused tree planting plan that serves to mitigate climate change impacts such as stormwater runoff and extreme urban heat. An ERI McKinney Climate Fellow worked with the Lafayette Department of Public Works and Engineering to conduct stakeholder engagement, spatial analysis, and grant research to create the tree planting plan. In previous years, this partnership between ERI and Lafayette yielded a greenhouse gas (EHG) emissions inventory.

Findings from the community-wide greenhouse gas inventory will be used to help residents and local officials understand Greater Lafayette's current emissions profile and to help employees from both Cities and the County create their joint climate action plan to reduce emissions, increase energy efficiency, and improve air quality.[1] A tree planting plan is a fundamental first step for Hoosier cities, towns and counties committed to combating the climatic changes communities in Indiana are already experiencing. Some notable trends include heavier rainfalls in spring and winter, more river and flash flood events and more freeze-thaw events, creating issues in transportation infrastructure.[2]

Analysis performed this summer will aid Lafayette, and Tippecanoe County in preparing the Greater Lafayette Climate Action Plan (CAP) that tackles some of the communities' biggest hurdles in climate mitigation. The tree planting plan itself will support the CAP vision statement: A climate-resilient community, a reduced carbon footprint, and an equitable quality of life for all within Greater Lafayette.

Key Concepts (Intergovernmental Panel on Climate Change (IPCC))[3]

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.
Climate Change: Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.
Ecosystem Services: Ecological processes or functions having monetary or non-monetary value to individuals or society at large. These are frequently classified as (1) supporting services such as productivity or biodiversity maintenance, (2) provisioning services such as food or fiber, (3) regulating services such as climate regulation or carbon sequestration, and (4) cultural services such as tourism or spiritual and aesthetic appreciation.

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[1] https://greaterlafayetteind.com/climate-action-plan/
[2] https://ag.purdue.edu/indianaclimate/indiana-climate-report/
[3] https://www.ipcc.ch/sr15/chapter/glossary/

Environmental Equity: Equity is the principle of fairness in burden sharing and is a basis for understanding how the impacts and responses to climate change, including costs and benefits, are distributed in and by society in more or less equal ways. It is often aligned with ideas of equality, fairness and justice and applied with respect to equity in the responsibility for, and distribution of, climate impacts and policies across society, generations, and gender, and in the sense of who participates and controls the processes of decision-making.
Greenhouse Gas (GHG): Greenhouse gasses are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself and by clouds. This property causes the greenhouse effect. Water vapor (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4) and ozone (O3) are the primary GHGs in the Earth's atmosphere. Moreover, there are a number of entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Beside CO2, N2O and CH4, the Kyoto Protocol deals with the GHGs sulfur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). See also Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O) and Ozone (O3).
Green Infrastructure: The interconnected set of natural and constructed ecological systems, green spaces and other landscape features. It includes planted and indigenous trees, wetlands, parks, green open spaces and original grassland and woodlands, as well as possible building and street-level design interventions that incorporate vegetation. Green infrastructure provides services and functions in the same way as conventional infrastructure.
Resilience: The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation.
Sustainability: A dynamic process that guarantees the persistence of natural and human systems in an equitable manner.

Background: UTCC Ecosystem Services, Climate Impacts & Equity

If you've ever walked down the sidewalk on a hot summer day, you've felt one of the ecosystem services provided by tree canopy. Heat reduction from shading, increasing air quality through carbon dioxide sequestering, absorbing stormwater flow, and establishing greenspace connectivity are all ways trees benefit a community. Neighborhoods with higher tree canopy typically have higher property values and increased rates of education. Additionally, mental health benefits associated with just the sight of greenery have been shown to increase with higher levels of tree canopy. Overall, trees help to provide a better functioning urban ecosystem and a healthier, more productive environment for humans.

Lafayette, Indiana is located in the northwest portion of the state between Chicago and Indianapolis. Mostly surrounded by agricultural lands, Lafayette is situated on the banks of the Wabash River, with West Lafayette (the home of Purdue University)

on the other side. Lafayette's current UTCC is nearly 17.5%, while impervious surfaces constitute almost 40% of the city, according to the most recent UTCC assessment by Davey Resource Group (DRG). While this region could be impacted by climate change in numerous ways, the potentially two most impactful changes are an increase in extreme heat events and an increase in extreme precipitation events.

According to a climate report developed by Purdue University, the number of extreme hot days has already increased in Indiana and is expected to continue to rise. Extreme heat threatened the health of many populations, but most specifically the elderly and those in low-income neighborhoods with lack of UTCC. Extreme heat also reduces crop yields, which is vital for Indiana's economy.[4]

Along with heat, annual precipitation has also increased in Indiana, with the majority of this rainfall occurring in heavy downpours leaving long periods of drought in between. UTCC and other green infrastructure like retention ponds and green roofs help to mitigate the flow of water during these extreme precipitation events. A community with higher levels of UTCC will be more capable of curbing the effects of soil erosion and extreme heat that can lead to the crippling of city infrastructure.[5] Establishing resilience to changing weather conditions will help ensure economic, social and environmental prosperity for Greater Lafayette.

Incorporating equity into a tree planting plan not only enhances the level of resilience or the community overall, but works to address traditionally ignored portions of the population that are typically lacking adequate UTCC. A plethora of studies conclude that urban green space distribution is correlated with socioeconomic status, such as education, income, occupation, and ethnicity/race. These studies find that neighborhoods with higher socioeconomic status generally have greater access to green space.[6] [7] [8] The absence of green space and recreational facilities in low-income neighborhoods is linked with lower physical activity and higher levels of obesity, both contributing to higher risks of mortality. [9] Simply put, exposure to nature in both the short and long term can have multiple positive health benefits. Lower-income communities are typically stripped of those benefits due to lack of UTCC. Increasing UTCC in

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[4] https://ag.purdue.edu/indianaclimate/indiana-climate-report/
[5] https://ag.purdue.edu/indianaclimate/urban-ecosystems-report/
[6] Gordon-Larsen, P., Nelson, M. C., Page, P., & Popkin, B. M. (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics*, *117*(2), 417-424.
[7] Jennings, V., & Johnson Gaither, C. (2015). Approaching environmental health disparities and green spaces: an ecosystem services perspective. *International journal of environmental research and public health*, *12*(2), 1952-1968.
[8] Jennings, V., Johnson Gaither, C., & Gragg, R. S. (2012). Promoting environmental justice through urban green space access: A synopsis. *Environmental Justice*, *5*(1), 1-7.
[9] Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *The lancet*, *372*(9650), 1655-1660.

lower-income communities not only provides these health benefits, but increases the resilience of the community as a whole.

Methodology

Goals & Deliverables

The goal of the 2022 McKinney Climate Fellowship (MCF) was to identify areas of Laffayette in most need of UTCC increase through GIS analysis and community engagement, and then to develop an equity focused tree planting plan for a specific location that may be extrapolated to the city as a whole. Grants were to be identified and recommendations for application drafted. Deliverables include the tree plan itself and the recommendations for grant applications, along with priority planting maps and an UTCC assessment by Davey Resource Group (DRG).

Key Partners & Roles

The 2022 McKinney Climate Fellow, Joey Mendolia, was responsible for conducting stakeholder engagement, refining the ‘No Planting-Sites’ map delivered by DRG, conducting GIS spatial analysis to determine priority planting areas, writing the tree planting plan, and identifying grants and formulating recommendations for application.

For the City of Lafayette Department of Engineering and Public Works, Urban Forester Tim Detzner worked with Mr. Mendolia on multiple aspects of the project. Mr. Detzner assisted with stakeholder identification and contact information. He provided information regarding previous plans and tree ordinances, and he relayed knowledge regarding tree species around Lafayette and information regarding planting in the Public Right of Way. Mr. Detzner connected Mr. Mendolia with employees at the Department of Parks and Recreation who helped further refine the ‘No Planting Sites’ map and helped supply additional background information.

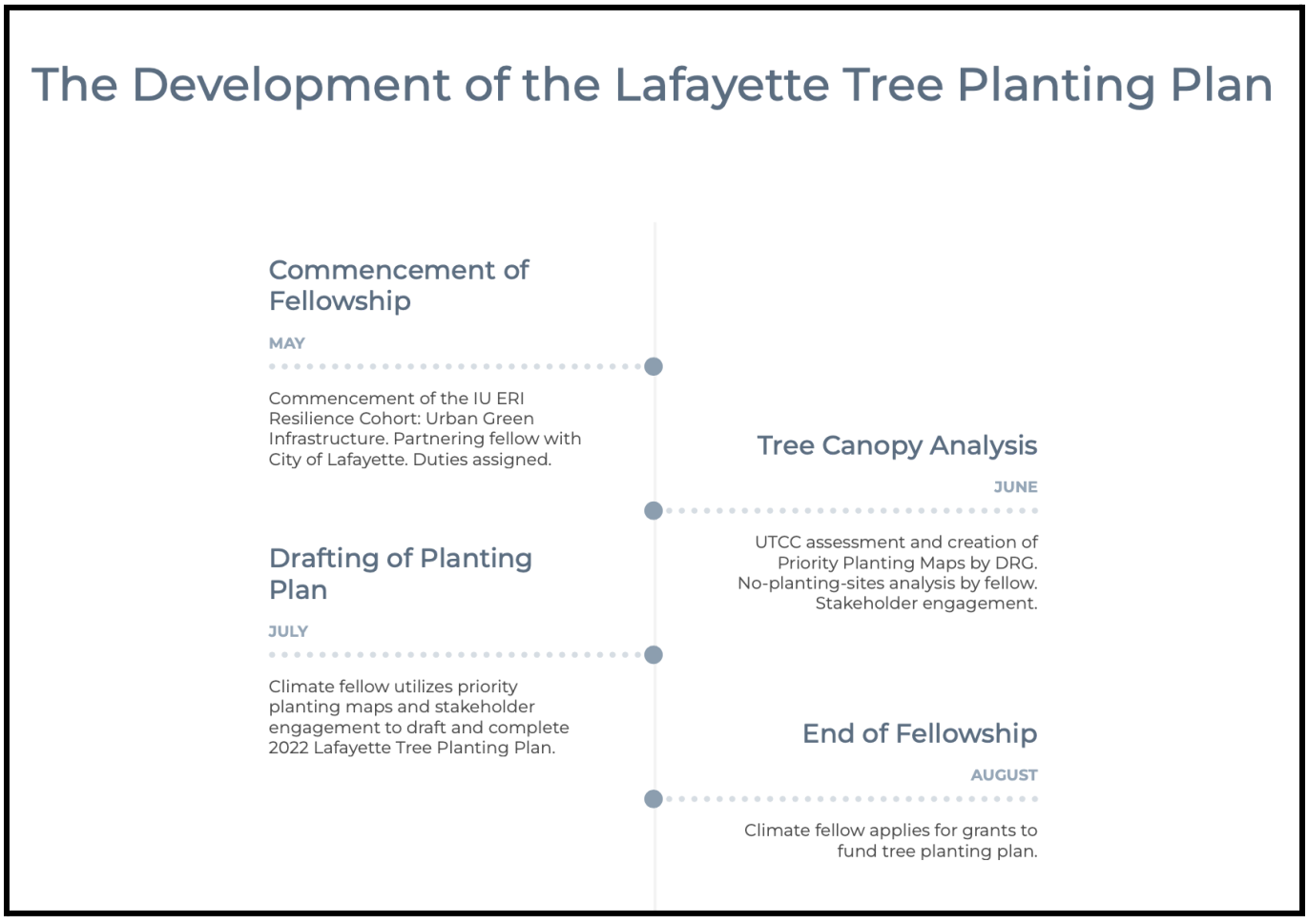
Tree Lafayette, the community’s most prominent tree planting non-profit organization, informed Mr. Mendolia of current tree planting operations and what they would like to see addressed in this tree planting plan. For the actual planting of trees, it is recommended that the City of Lafayette partner with Tree Lafayette both to coordinate volunteers and to help secure funding. In past years, Tree Lafayette has been vital to increasing UTCC throughout Lafayette.

Staff at the IU Environmental Resilience Institute, assisted in the creation of this tree plan by providing support through bi-weekly check-ins, providing resources and

GIS assistance, and coordinating weekly guest speakers whose advice helped in the creation of this plan.

DRG supplied data from their UTCC assessment, which involved LiDAR surveys of Lafayette. They offered GIS data analysis and support, and assisted with much of the data processing. Lastly, DRG will be compiling a final UTCC assessment for the entirety of Indiana using the tree planting plans from all 2022 McKinney Climate Fellows participating in the Urban Green Infrastructure Cohort.

Figure 1: Timeline of the development of the 2022 Lafayette Tree Planting Plan



The development process of the 2022 Lafayette Tree Planting Plan started with the partnering of Joey Mendolia, the 2022 McKinney Climate Fellow (MCF), with the City of Lafayette Department of Engineering and Public Works. Once this partnership was formed, Mr. Mendolia worked with Tim Detzner, the city's Urban Forester, to create a work plan and timeline.

Following, DRG disseminated data and maps displaying proposed 'No-Planting-Sites' in Lafayette. These maps came in the form of an ArcGIS Shapefile, and a GoogleEarth Shapefile. The MCF then analyzed the maps and marked locations that should either be added, removed or expanded. The MCF then sent these maps and marked locations to employees at the City of Lafayette Department of Parks and Recreation, along with stakeholder organizations around the community, such as Tree Lafayette. Once responses were received, Mr. Detzner reviewed the locations, then the MFC submitted the approved locations to DRG to update their 'No-Planting-Sites' map.

Utilizing online surveys and in-person meetings, the MCF then gathered information from stakeholders to identify variables the community would most like to see addressed in the tree planting plan. These responses centered around reduction of extreme heat, increasing air quality, equitable access to nature, and the establishment of tree canopy in low-income neighborhoods. Combined with socioeconomic and health variables, such as median household income and asthma rates, there were a total of seven variables. These variables were weighted to add up to 1 (Table 1). The MCF then relayed the weighting index to DRG, who then created the priority planting maps for Lafayette using ArcGIS software.

Once the maps were created, the MCF analyzed them to identify specific locations for tree planting. The MCF then worked with Mr. Detzner to ground-truth the locations and select appropriate tree species for planting. To do, so Mr. Detzner and the MCF walked the selected neighborhoods selecting Public Right of Way locations based on the size and amount of trees they could fit, and selecting species based on Indiana nativity and amount of nearby tree species.

To fund the 2022 Lafayette Tree Planting Plan, the climate fellow researched, identified, and selected grants for application. As the most applicable, the Indiana American Water Grant Program was selected for application in 2023. The climate fellow prepared grant materials so that Lafayette is ready to apply when the program reopens for application in 2023.

Priority Analysis/Public Outreach/Next Steps

Responses to survey questions (created using Google Forms) revealed priorities that community members would like to see addressed in the 2022 Lafayette Tree Planting Plan. These variables were then weighted according to the amount of stakeholder response and through internal discussion in the City of Lafayette Department of Public Works and Engineering (Table 1). DRG then utilized this priority weighting index to create the priority planting map for Lafayette.

This map, along with zoomed-in maps of specific high-priority areas of Lafayette, delineate which areas are most prone to negative impacts from climate change and which are the least. These areas could then benefit from the planting of trees, which would help to mitigate future weather conditions such as increased heat and increased flooding events. Overall, three major regions of Lafayette were identified as 'Very-High Priority', which will be discussed in more detail in the following pages.

Table 1: Priority Variables and Weighting

Variable	Data Origin	Weighting
Distance to Canopy (equitable distribution of canopy)	Urban Tree Canopy Assessment	0.2
Soil Permeability	National Resources Conservation Service	0.2
Air Quality	iTree Canopy	0.2
Urban Heat Island	Urban Tree Canopy Assessment	0.2
Population Density	U.S. Census Bureau	0.1
Income	U.S. Census Bureau	0.05
Health (Asthma rate)	CDC 500 Cities	0.05

The 'No Planting Sites' analysis was accomplished through visual investigation by the MCF and employees of the Lafayette Dept. of Parks and Rec. Using Google Earth, the fellow marked the locations of land that either needed to be included or removed from the site list, along with areas already included that needed to be expanded or shrunk. The MCF made a list of the choices and sent them to the Dept. of Parks and Rec. employees. These employees approved the list, along with Mr. Detzner in the Lafayette Public Works and Engineering Department. The fellow then sent the list to DRG, who updated their initial version to include the new sites in the priority planting map below.

Once DRG delivered the priority planting map to the MCF, he then utilized GIS to analyze high-priority neighborhoods in Lafayette. The fellow identified three high-priority areas in Lafayette and coordinated with Mr. Detzner regarding specific locations to plant in those areas. Once the locations were selected, the fellow and Mr. Detzner ground-truthed the sites and selected specific trees for each location. Tree selections

and locations were marked for future planting in Table 2. The main priority planting map, along with the more specific locations and explanations regarding each, are attached (Figures 2, 3, 4 & 5).

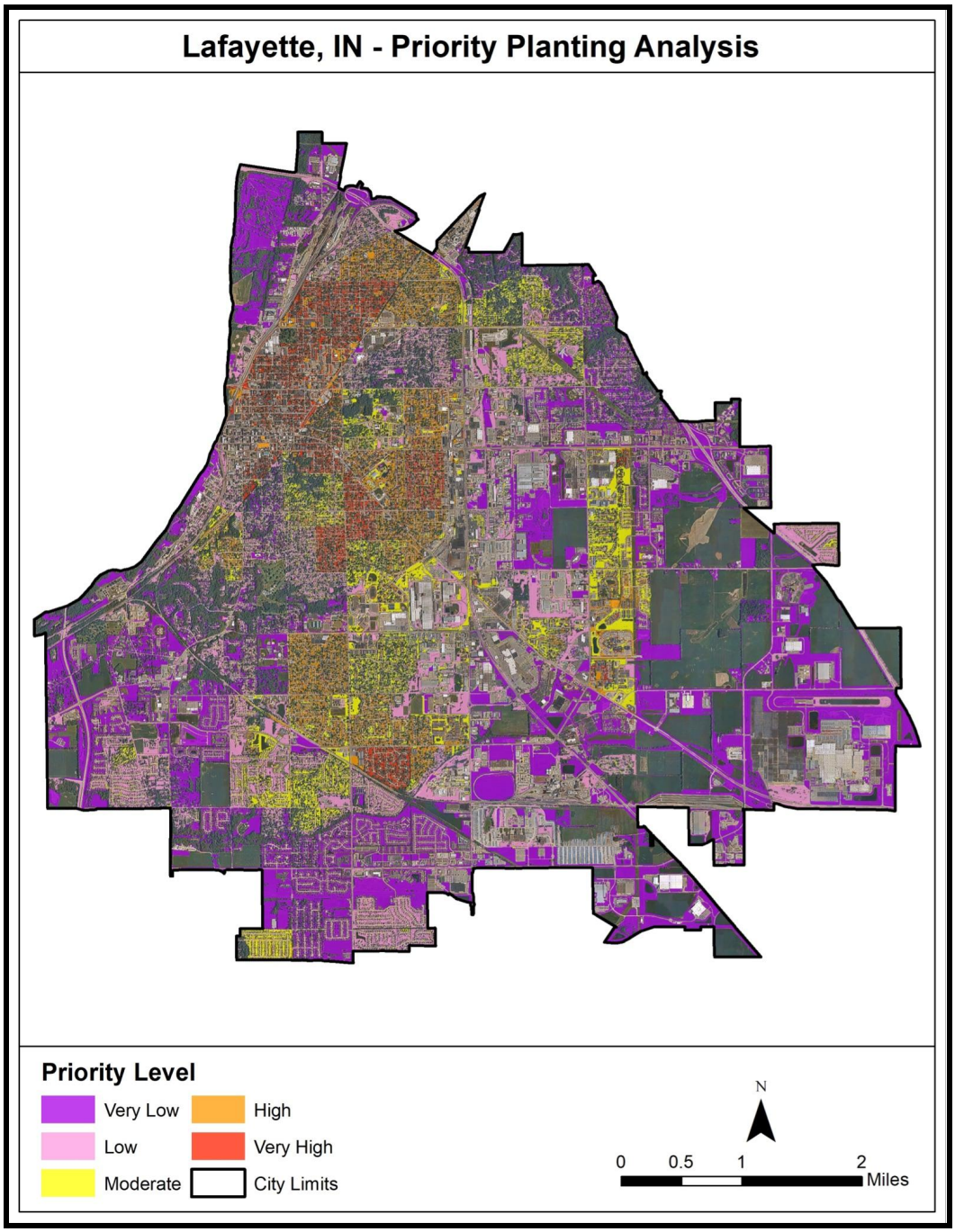


Figure 2: Priority Planting Map - Lafayette, Indiana

The main priority planting map of Lafayette displays areas ranking from very low to very high in terms of need for tree planting. This map utilizes the seven variables listed in Table 1. From a first glance, it is clear that central and northwest Lafayette are

the areas of highest priority, with a deeply red pocket in south Lafayette. Southwest, far south, and the general eastern portion of Lafayette are lower priority areas.

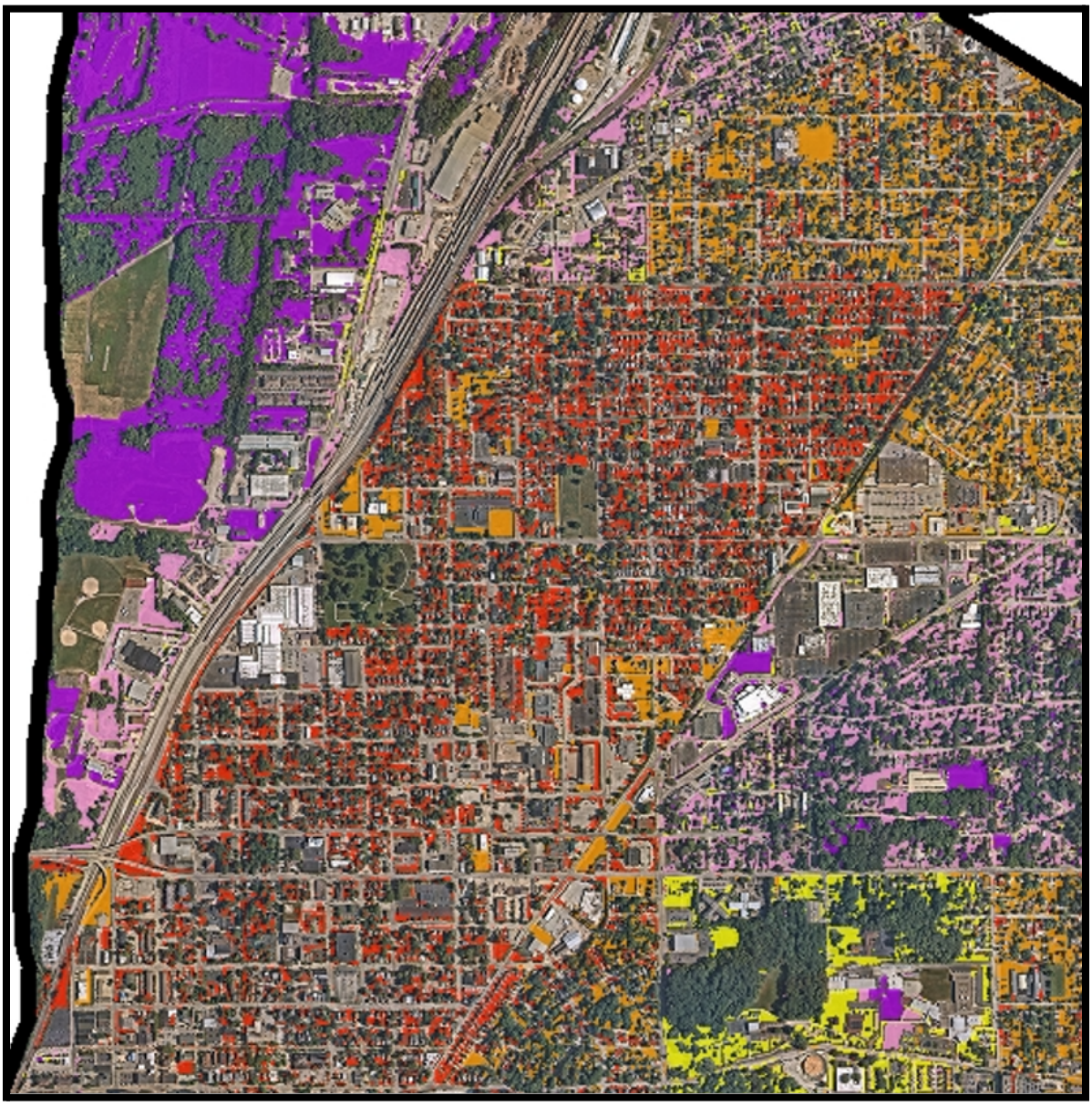


Figure 3: Northwest Lafayette Priority Planting Site (see legend in Figure 2)

The northwest neighborhoods of Lafayette primarily include Downtown, Centennial and Lincoln. While this area was identified as a priority area, recent tree planting efforts have been focused in these neighborhoods that may not have been evident on the newest satellite imagery. Future imagery may demonstrate a decreased level of tree planting need. Mr. Detzner has stated that tree planting will still occur in future years in this area of Lafayette.

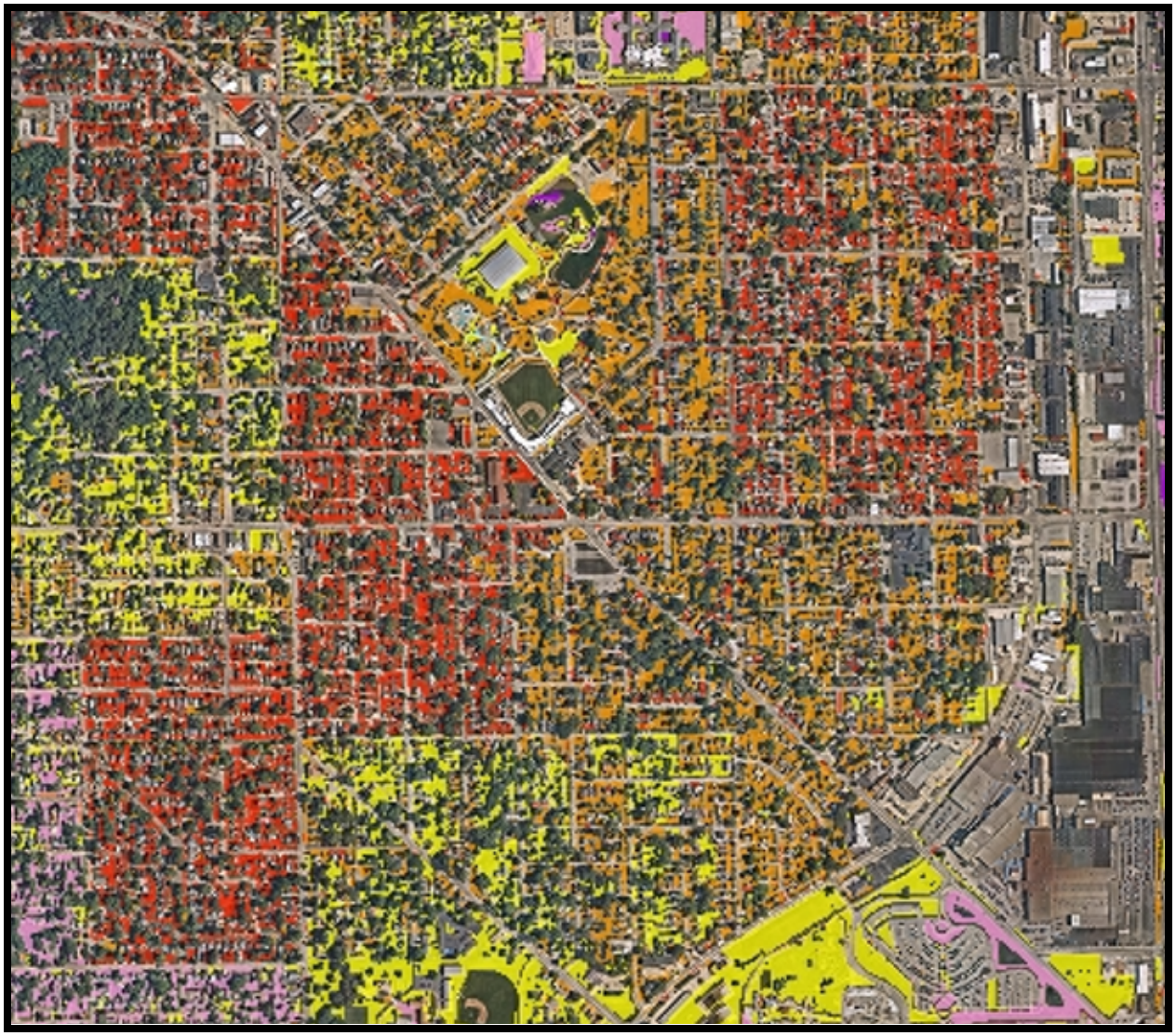


Figure 4: Central Lafayette Priority Planting Site (see legend in Figure 2)

Central Lafayette primarily consists of the following neighborhoods: Oakland Triangle, South Oakland, Central, Columbian Park, Wallace Triangle and Valley Center. Of these neighborhoods, Oakland triangle, which is situated in the upper left quadrant of the above image, along with the northern portion of South Oakdale and the southern portion of Central, display high-priority tree planting needs.

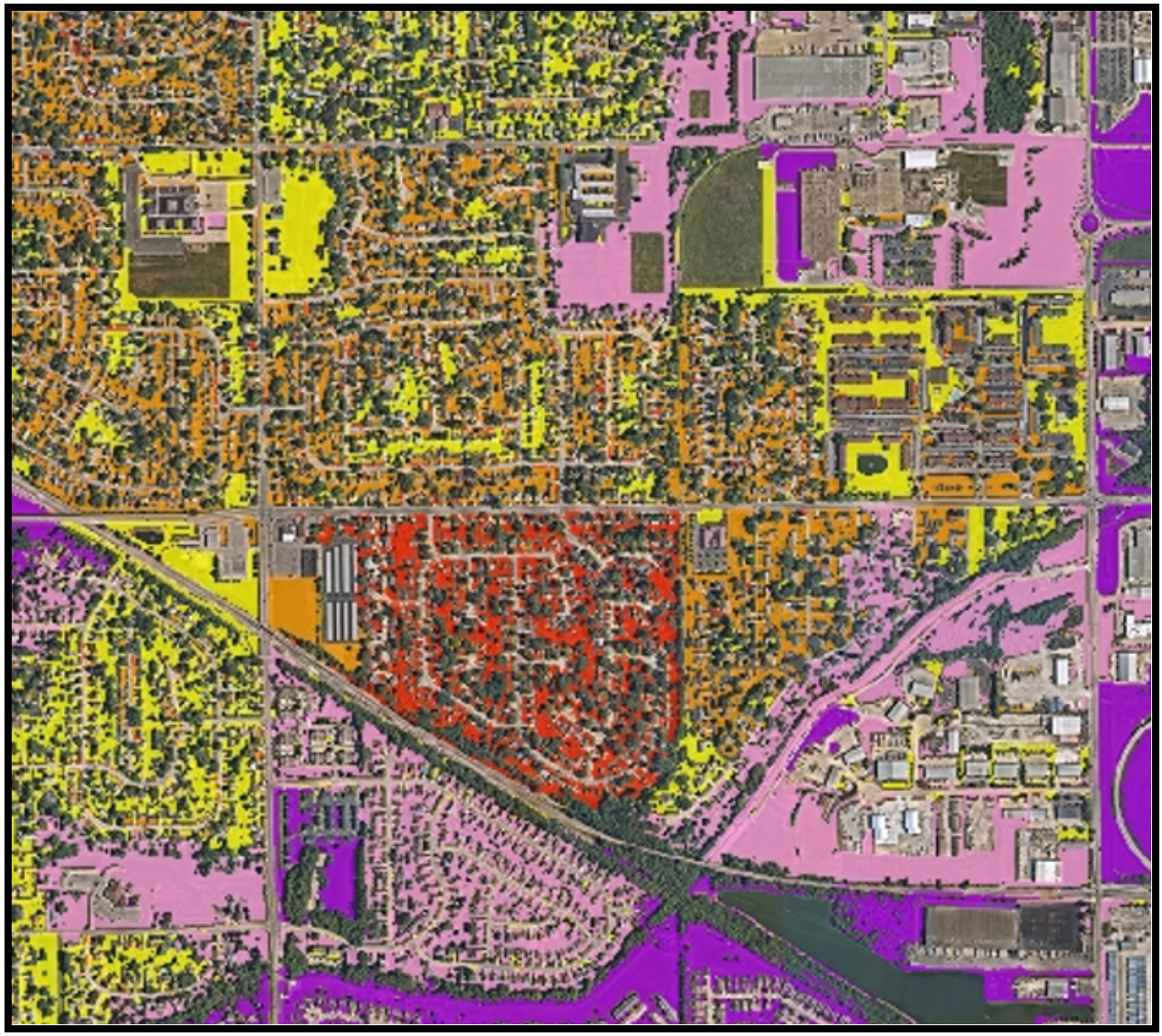


Figure 5: South Lafayette Priority Planting Site (see legend in Figure 2)

Brady Lane was the highest priority neighborhood in southern Lafayette. Upon on-the-ground inspection by Mr. Detzner, this location was selected to be the primary neighborhood of focus for the tree planting plan. Further details about the Brady Lane neighborhood and how tree planting will be implemented is on the following pages.

Site Selection - Brady Lane Neighborhood

Background

Brady Lane is a neighborhood in southern Lafayette. According to the UTCC assessment performed by DRG, Brady Lane contains 28% tree canopy, 39% impervious surfaces and 28% pervious surfaces. This location was chosen not only due

to its very-high level of priority, but also because of its high number of Public Right of Way spaces available, as identified by Mr. Detzner and the MCF. A map of the Brady Lane neighborhood is below (Figure 6). Specific tree planting locations throughout Brady Lane, along with the species selected for those locations, are noted below in Table 2.

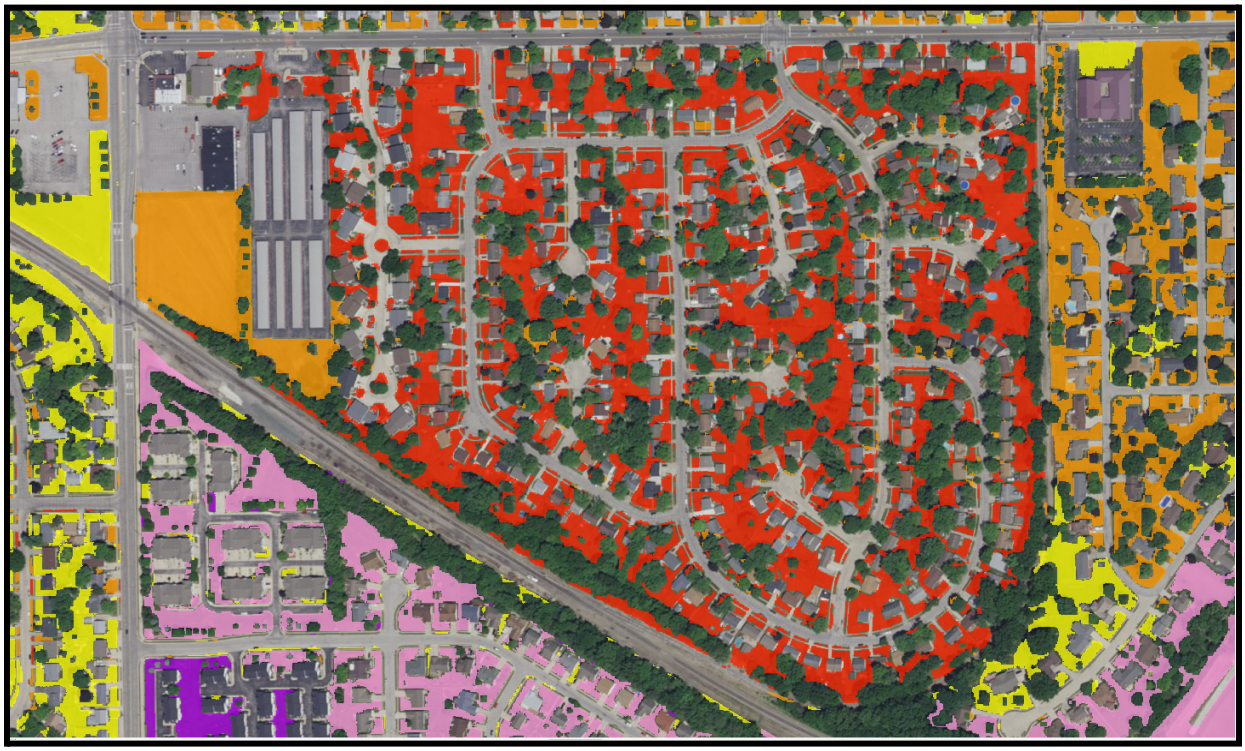


Figure 6: Brady Lane neighborhood priority planting locations (see legend in Figure 2)

Table 2: Tree Planting Locations & Species Selections

Location	# Trees	Species, Number & Address
Brady Lane	**2**	2017 - Fall Fiesta Sugar Maple (1) (facing Pipers Glen) 2101 - White Oak (1) (facing Pipers Glen)
Hanover Drive	**X**	**X**
Crown Lane	**8**	2008 - Slender Silhouette Sweetgum (2) 2008 - Magyar Ginkgo (2) (facing Pipers Glen) 3228 - Ivory Silk Lilac (2), 3283 - Yellowwood (2),
Pipers Glen Drive	**58**	3204 - Native Flame Hornbeam (2) 3208 - Native Flame Hornbeam (1) 3205 - White Oak (2) 3209 - Endowment Sugar Maple (2)

		3209 - Scarlet Oak (1) 3215 - Green Vase Zelkova (2) 3217 - Autumn Gold Ginkgo (2) 3221 - Green Vase Zelkova (1) 3225 - Ivory Silk Tree Lilac (2) 3229 - Frontier Elm (2) 3236 - Swamp White Oak (1) 3237 - Ivory Silk Tree Lilac (1) 3240 - Musashino Zelkova (1) 3302 - Frontier Elm (2) 3303 - Slender Silhouette Sweetgum (2) 3306 - Green Mtn. Sugar Maple (1) 3310 - Rotundiloba Sweetgum (2) 3311 - Native Flame Hornbeam (1) 3314 - Sweetgum (1) 3319 - Exclamation London Planetree (3) 3220 - Scarlet Oak (1), Musashino Zelkova (1) 3224 - Kentucky Coffeetree (1) 3326 - Native Flame Hornbeam (1) 3327 - Musashino Zelkova (2) 3228 - Kentucky Coffeetree (2) 3330 - Native Flame Hornbeam (1) 3334 - Native Flame Hornbeam (1) 3342 - Emerald City Tulip Poplar (1) 3346 - Emerald City Tulip Poplar (2) 3347 - Northern Pin Oak (1) 3354 - Ivory Silk Tree Lilac (1) 3358 - Autumn Gold Ginkgo (2) 3363 - Allee Elm (1) 3367 - Allee Elm (1) 3367 - Scarlet Oak (2) (facing Chaucer)
Heatherfield Drive	**18**	2101 - Princeton Sentry Ginkgo (2) 2105 - Scarlet Oak (1) 2105 - Green Mountain Sugar Maple (2) (facing Sean court) 2108 - Emerald City Tulip Poplar (1) 2202 - Emerald City Tulip Poplar (1) 2206 - Native Flame Hornbeam (1) 2207 - Magyar Ginkgo (1) 2222 - Princeton Sentry Ginkgo (2) 2300 - Ivory Silk Lilac (2) 2304 - Ivory Silk Lilac (1) 2308 - Kentucky Coffeetree (2) 2308 - Frontier Elm (2)
Sean Court	**4**	3213 - Yellowwood (1) 3221 - Musashino Zelkova (1) 3226 - Princeton Sentry Ginkgo (1) 3229 - Native Flame Hornbeam (1)

Pickwick Court	**3**	3318 - Yellowwood (1) 3322 - Yellowwood (1) 3347 - Yellowwood (1)
Chaucer Drive	**66**	3304 - Emerald City Tulip Poplar (1) 3308 - Emerald City Tulip Poplar (2) 3214 - White Oak (2) 3214 - Emerald City Tulip Poplar (1) 3214 - Exclamation London Planetree (2) (facing Heatherfield) 3215 - Scarlet Oak (1) 3218 - Kentucky Coffeetree (1) 3219 - Autumn Gold Ginkgo (1) 3226 - Yellowwood (1) 3230 - Allee Elm (1) 3231 - Exclamation London Planetree (1) 3234 - Northern Pin Oak (1) 3242 - Kentucky Coffeetree (1) 3246 - Yellowwood (1) 3250 - Princeton Elm (1) 3254 - Red Rage Black Gum (2) 3304 - Autumn Gold Ginkgo (1) 3313 - Exclamation London Planetree (1) 3317 - Exclamation London Planetree (1) 3321 - Silk Tree Lilac (2) 3324 - Emerald City Tulip Poplar (1) 3328 - Princeton Sentry Ginkgo (2) 3332 - Musashino Zelkova (1) 3340 - Rotundiloba Sweetgum (2) 3344 - Kentucky Coffeetree (1) 3348 - Yellowwood (1) 3349 - Rotundiloba Sweetgum (2) 3352 - Yellowwood (1) 3353 - Kentucky Coffeetree (2) 3353 - Northern Pin Oak (2) (facing Comanche) 3356 - Sugar Maple (1) 3360 - Green Vase Zelkova (2) 3364 - Northern Pin Oak (1) 3403 - White Oak (2) 3403 - Autumn Gold Ginkgo (2) (facing Comanche) 3410 - Musashino Zelkova (2) 3411 - Musashino Zelkova (1) 3414 - Frontier Elm (1) 3419 - Frontier Elm (2) 3422 - Ivory Silk Lilac (1) 3427 - Exclamation London Planetree (1) 3430 - Exclamation London Planetree (2) 3442 - Princeton Sentry Ginkgo (2) 3446 - Red Rage Black Gum (1) 3447 - Red Rage Black Gum (2)

		3454 - Native Flame Hornbeam (1) 3466 - Kentucky Coffeetree (1) 3467 - Kentucky Coffeetree (1)
Commanche Trail	**23**	3208 - Magyar Ginkgo (1) 3213 - Autumn Gold Ginkgo (2) 3213 - Native Flame Hornbeam (1) (facing Tara) 3220 - Slender Silhouette Sweetgum (1) 3232 - Emerald City Tulip Poplar (1) 3236 - Allee Elm (1) 3314 - Red Rage Black Gum (1) 3318 - Slender Silhouette Sweetgum (1) 3323 - Yellowwood (2) 3326 - Autumn Gold Ginkgo (1) 3330 - Native Flame Hornbeam (2) 3335 - Allee Elm (1) 3347 - Ivory Silk Lilac (2) 3353 - Frontier Elm (2), Red Rage Black Gum (1), Scarlet Oak (1) 3353 - Magyar Ginkgo (3) (facing Bariger)
Kingsmill Court	**7**	3211 - Swamp Whie Oak (1) 3212 - Swamp White Oak (1) 3216 - Musashino Zelkova (1) 3227 - Slender Silhouette Sweetgum(1) 3228 - Kentucky Coffeetree (1) 3231 - Ivory Silk Lilac (2)
Bamford Court	**3**	2304 - Kentucky Coffeetree (1) 2305 - Endowment Sugar Maple (1) 2309 - Endowment Sugar Maple (1)
Tara Court	**4**	2419 - Princeton Sentry Ginkgo (2) 2505 - Scarlet Oak (1) 2508 - Green Vase Zelkova (1)
Regent Court	**5**	2500 - Autumn Gold Ginkgo (1) 2501 - Ivory Silk Lilac (1) 2504 - Ivory Silk Lilac (1) 2505 - Exclamation London Planetree (1) 2516 - Exclamation London Planetree (1)
Bariger Court	**4**	2320 - Yellowwood (1) 2324 - Yellowwood (1) 2333 - Princeton Sentry Ginkgo (2)
Total # of Trees =	**205**	

Grant Selection

Given the high number of trees to be planted in the Brady Lane neighborhood, it is suggested that multiple grants be applied to over multiple years in order to fulfill this plan. To start, the MCF gathered materials to prepare for application to the Indiana American Water Environmental Grants Program. The grant has a maximum funding amount of $10,000. For 2022, the City of Richmond, Indiana was awarded a grant from this program for a native tree planting project with goals similar to this Lafayette tree planting plan.[10] Due to project similarities, it is expected that Lafayette would also achieve success in applying for the grant. In following years, more grants should be applied to, such as the Indiana Department of Natural Resources Community and Urban Forestry Grant Program (CUF).[11]

Recommendations & Next Steps (*Appendix III: Transition Document)

To be successful in not only implementation of this tree planting plan, but in the continued success and health of Lafayette's urban forest, certain biophysical and social requirements must be enacted. To start, the City of Lafayette must coordinate the general maintenance of the trees, including watering, mulching and pruning. In Indianapolis, for example, non-profit organization Keep Indianapolis Beautiful, Inc. waters trees they plant in the public-right-of-way for three years, in coordination with the city. They also prune the trees every three years. Following the three years, local community organizations are entrusted with tree maintenance.[12]

Additionally, it is of equal importance to fit this tree planting plan, as well as any other tree planting in Lafayette, into the Greater Lafayette Climate Action Plan that is currently in the Report Development process.[13] This step will ensure seamless coordination between acting organizations and stakeholders, while maximizing ecosystem services and capitalizing on resilience efforts. And lastly, it will be important to consider the following:

1. Trends – species diversity, size distribution, condition, primary maintenance needs.
2. 5- and 10-year strategies for maintenance schedules.
3. Annual, 5-year and 10-year budgets for maintenance activities.
4. Assessment of current personnel, equipment and capacities to meet management needs
5. Potential pest and disease management needs

[10] https://www.amwater.com/inaw/news-community/environmental-grant-program
[11] https://www.in.gov/dnr/forestry/programs/community-and-urban-forestry/grants/
[12] https://www.kibi.org/community-forestry
[13] https://greaterlafayetteind.com/climate-action-plan/

6. Relevant goals for forest cover (ensure current city goals are based on actual canopy maps and plantable open space)

By utilizing this tree plan and conforming to the Greater Lafayette Climate Action Plan, the City of Lafayette can better prepare itself for the questions of tomorrow and engineer a brighter, more equitable and resilient future for all Lafayette residents. Thank you for taking the time to read this 2022 Lafayette Tree Planting Plan.

Additional Resources

Environmental Resilience Institute: Tools & Resources - https://eri.iu.edu/tools-and-resources/index.html

City Parks Alliance - https://cityparksalliance.org

City4Forests Learning Guide - https://cities4forests.com/lg-urban-forests-for-healthier-cities/

Vibrant Cities Lab - https://www.vibrantcitieslab.com

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Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *The lancet*, *372*(9650), 1655-1660.

Appendices

Appendix I: Approved Trees in Lafayette

CITY OF LAFAYETTE

URBAN FORESTRY

TREE SPECIES RECOMMENDATION

This list is a guide of the most appropriate trees for planting in the public right of way (planting strip between the sidewalk and the street). The list should be used in conjunction with the amount of space—width of the right of way (ROW) available. While there is no perfect tree, there are appropriate tree choices for most situations. Each planting space should be evaluated and any limiting restriction factors such as soil quality, soil pH, drainage, sunlight exposure, utilities, rooting area (soil volume), and traffic lanes vs parked cars should be noted.

All of these species *should* do well in the urban environment of Lafayette but each tree has different tolerances. Small, columnar, and medium trees may be suitable for use in parking lot design. All tree selections must be approved by the City Forester and a permit must be obtained for planting trees in the public right of way.

Special note: Until further notice there is a moratorium on planting maples due to the threat of the Asian Longhorn Beetle arriving in Lafayette.

SMALL TREES **4' planting strips under power lines**	**Aerosol salt Tolerant**	**Soil salt Tolerant**	**Drought Tolerant**
Acer ginnala – Amur Maple	Moderate	Moderate	High
Acer grandidentatum – Rocky Mtn. Glow Maple	Moderate	Moderate	High
Acer tataricum – Tatarian Maple	Moderate	Moderate	High
Amelanchier spp. – Serviceberry (Single trunk)	Moderate	Moderate	Moderate
Crataegus crus-galli var. inermis – Thornless Hawthorn	Low	Poor	High
Crataegus phaenopyrum – Washington Hawthorn	Moderate	Moderate	High
Malus 'Adirondack' – Adirondack Crabapple	Moderate	Moderate	Moderate
Prunus sargentii 'JFS-KW58' - Pink Flair Cherry	Moderate	Moderate	High
Syringa pekinensis – Chinese Tree Lilac	High	Moderate	Moderate
Syringa reticulata – Japanese Tree Lilac	High	Moderate	High

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SMALL TREES—with BROAD SPREADING CROWNS **5' and greater planting strips under power lines**	**Aerosol salt Tolerant**	**Soil salt Tolerant**	**Drought Tolerant**
Acer griseum – Paperbark Maple	Moderate	Moderate	Moderate
Acer truncatum – Shangtung Maple	Moderate	Moderate	High
Amelanchier species – Serviceberry	Moderate	Moderate	Moderate
Carpinus caroliniana – American Hornbeam	None	Poor	Moderate
Cornus kousa – Kousa Dogwood	Moderate	Moderate	Moderate
Maackia amurensis – Amur Maackia	Moderate	Moderate	High
Malus 'Royal Raindrops' – Royal Raindrops Crabapple	Moderate	Moderate	Moderate
Ostrya virginiana – American Hophornbeam	Moderate	Moderate	Moderate
Prunus sargentii – Sargent's Cherry	Moderate	Moderate	High
Prunus x yedoensis – Yoshino Cherry	Low	Low	Moderate
Prunus x incamp – Okame Cherry	Moderate	Poor	Moderate
Styrax japonica	High	Moderate	High
Zelkova serrata 'Wireless'	Moderate	Unknown	High

COLUMNAR TREES **4' to 5' planting strips with *no power lines***	**Aerosol salt Tolerant**	**Soil salt Tolerant**	**Drought Tolerant**
Carpinus betulus - 'Frans Fontaine' Hornbeam	None	Moderate	Moderate
Carpinus caroliniana – 'Palisade' Hornbeam	None	Poor	Moderate
Celtis occidentalis – 'Prairie Sentinel' Hackberry	Moderate	Moderate	High
Gingko biloba - 'Princeton Sentry' Ginkgo	Moderate	Poor	High
Liquidambar styraciflua - 'Slender Silhouette' Sweetgum	Moderate	Moderate	Moderate
Prunus sargentii 'Columnaris' –Columnar Sargent Cherry	Moderate	Moderate	High
Prunus sargentii 'JFS-KW58' – Pink Flair Cherry	Moderate	Moderate	High
Quercus robur x bicolor 'Regal Prince' – Columnar English Oak	High	High	Moderate
Quercus robur 'Fastigiata' - Columnar English Oak	High	High	Moderate
Zelkova serrata 'Musashino' - Musashino Zelkova	Moderate	Unknown	Unknown

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MEDIUM TREES **5' wide planting strips with *no power lines***	**Aerosol salt Tolerant**	**Soil salt Tolerant**	**Drought Tolerant**
Acer campestre 'Queen Elizabeth' – Hedge Maple	Moderate	Moderate	Moderate
Acer miyabei 'Morton' - State Street Maple	Moderate	Moderate	Moderate
Betula nigra – River Birch (standard form)	Low	Moderate	Moderate
Koelreuteria paniculata - Golden Raintree	Moderate	Moderate	High
Nyssa sylvatica – Black Tupelo or Blackgum	Moderate	Moderate	High
Prunus virginiana – 'Canada Red Chokecherry'	Moderate	Moderate	Moderate
Robinia x ambigua 'Purple Robe'	High	High	Medium
Ulmus species – Elm hybrids (DED resistant) (Bosque, Frontier, Patriot, Accolade, etc.)	Moderate	Moderate	Moderate

LARGE TREES **6' and wider planting strips with *no power lines***	**Aerosol salt Tolerant**	**Soil salt Tolerant**	**Drought Tolerant**
Acer x freemannii – Freeman maple cultivars	Moderate	Moderate	Moderate
Acer saccharum – Sugar Maple	Low	Low	Moderate
Aesculus hippocastanum - Horse Chestnut	Moderate	Moderate	Moderate
Aesculus glabra - Ohio Buckeye	Low	Moderate	Moderate
Betula nigra – River Birch (clump form)	Low	Moderate	Moderate
Carya cordiformis – Bitternut Hickory	Moderate	Moderate	Moderate
Carya glabra – Pignut Hickory	Moderate	Moderate	High
Carya laciniosa – Shellbark Hickory	Moderate	Moderate	High
Carya ovata – Shagbark Hickory	Moderate	Moderate	High
Carya tomentosa – Mockernut Hickory	Moderate	Moderate	Moderate
Celtis occidentalis - Hackberry	Moderate	Moderate	High
Cladrastis kentukea - Yellowwood	Moderate	Moderate	Moderate
Corylus columa - Turkish Filbert	Low	Low	High
Gingko biloba – Gingko (*male only cultivars)*	Moderate	Moderate	High
Gymnocladus dioicus - Kentucky Coffeetree 'Espresso' (male only)	Moderate	Moderate	High
Liquidambar styraciflua 'Rotundiloba' (fruitless cultivar)	Moderate	Moderate	Moderate
Liquidambar styraciflua 'Hapdell' – Happidaze Sweetgum *(fruitless cultivar)*	Moderate	Moderate	Moderate
Liriodendron tulipifera - Tulip Poplar	Moderate	Moderate	Moderate
Quercus alba – White Oak	Moderate	Moderate	Moderate

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URBAN FORESTRY

LARGE TREES **6' and wider planting strips with *no power lines***	**Aerosol salt Tolerant**	**Soil salt Tolerant**	**Drought Tolerant**
Quercus bicolor – Swamp White Oak	Moderate	Moderate	Moderate
Quercus coccinea – Scarlet Oak	Moderate	Moderate	Moderate
Quercus ellipsoidalis – Northern Pin Oak	High	High	High
Quercus imbricaria – Shingle Oak	High	High	High
Quercus macrocarpa – Bur Oak	High	High	High
Quercus muehlenbergii – Chinkapin Oak	Moderate	Moderate	High
Quercus montana – Chestnut Oak	Moderate	Moderate	High
Quercus rubra – Red Oak	High	High	High
Quercus shumardii - Shumard Oak	Moderate	High	High
Platanus occidentalis - Sycamore	Moderate	Moderate	High
Platanus x acerifolia 'Morton Thornhill'– Exclamation London Planetree	Moderate	Moderate	High
Styphnolobium japonicum – Japanese Pagoda Tree	Moderate	Moderate	High
Tilia tomentosa – Silver Linden	Moderate	Moderate	Moderate
Ulmus species – Elms hybrids (DED resistant) (Princeton, Patriot, Morton Accolade, Allee, Prospector, etc.)	Moderate	Moderate	Moderate
Zelkova serrata 'Green Vase' or 'Village Green' – Japanese Zelkova	Moderate	Unknown	High

LANDSCAPE TREES

These trees make excellent park trees and are suitable for other large areas but are not suitable for the public right of way due to urban intolerance i.e. salt, pollution, size, habit, messy acorns or fruit, disease prone, etc.

Acer nigrum – Black Maple
Acer palmatum – Japanese Maple
Cercis canadensis – Redbud
Cornus florida – Flowering Dogwood
Fagus grandifolia – American Beech
Fagus sylvatica – European Beech
Magnolia 'Elizabeth' – Elizabeth Magnolia (with reservations. Can be difficult to establish.)
Magnolia virginiana – Sweetbay Magnolia (plant in protected area. Marginally hardy for Indiana)
Magnolia stellata – Star Magnolia
Oxydendrum arboreum – Sorrel tree or Sourwood
Parrotia persica - Persian Parrotia
Taxodium distichum – Bald Cypress

Appendix II: Prohibited/Undesirable Trees in Lafayette

Prohibited/Undesirable Trees for Right of Way and Parking Lots

Common Name	Scientific Name	Issues
Amur corktree	Phellodendron amurense	invasive seed, weak wood
Arborvitae	Thuja spp.	Visibility obstruction
White Birch	Betula papyrifera	Boring insects, sensitive to humidity
Boxelder	Acer negundo	invasive, poor habit/form
Buckthorn and Glossy Buckthorn	Rhamnus cathartica, Frangula alnus	invasive, weak wood
Northern Catalpa	Catalpa speciosa	messy fruit, weak wood
Choke Cherry	Prunus virginiana	epicormic growth (suckers) messy fruit, weak wood
Honeylocust	Gleditsia triacanthos	Multiple insect problems
Siberian elm	Ulmus pumila	disease problems, messy crown, weak wood
Slippery red elm	Ulmus rubra	disease problems
American Sweetgum	Liquidambar styraciflua	messy fruit - fruitless variety OK
Black Locust	Robinia pseudoacacia	visibility obstruction,
Norway Maple	Acer platanoides	invasive, shallow rooted
Red Maple	Acer rubrum	potential monoculture, soil ph sensitive
Silver Maple	Acer saccharinum	invasive, shallow rooted, weak wood
Mulberry	Morus alba	messy fruit, invasive
Russian Olive	Elaeagnus angustifolia	disease prone, invasive
Osage Orange	Maclura pomifera	large, messy fruit
Ornamental Pear	Pyrus spp.	weak wooded, invasive
Pin Oak	Quercus palustris	Soil ph sensitive
Persimmon	Diospyrus viginiana	invasive seed, weak wood
Tree of Heaven	Ailanthus altissima	Invasive, weak wood
Walnut	Juglans spp.	messy fruit, allelopathy
Willow	Salix spp.	weak wood, messy

Appendix III: Transition Document

Joey Mendolia – 2022 McKinney Climate Fellow, Resilience Cohort with the City of Lafayette Department of Public Works and Engineering from May 2022 - August 2022. Reporting supervisor – Tim Detzner, Urban Forester for the City of Lafayette.

The 2022 McKinney Climate Fellow, Joey Mendolia, was responsible for conducting stakeholder engagement, refining the 'No Planting-Sites' map delivered by DRG, conducting GIS spatial analysis to determine priority planting areas, writing the tree planting plan, and identifying grants and formulating recommendations for application. Stakeholders consulted included employees of the Lafayette Dept. of Parks and Rec., Lafayette Urban Forester Tim Detzner, and members of the non-profit organization Tree Lafayette. Mr. Detzner also recommended environmentally concerned members of the community to be included in a Google Forms survey. Mr. Mendolia utilized these individuals' responses in the creation of the weighted variables for the priority planting map. Locations deemed 'Very-High' by the priority planting analysis were then closely examined by Mr. Mendolia. Upon consultation with Mr. Detzner, the team selected the neighborhood of Brady Lane in southern Lafayette as their area of focus. Mr. Detzner and Mr. Mendolia walked the neighborhood and selected specific locations and tree species to be planted. This information was input into the tree planting plan for future use. Mr. Mendolia then filled out application material for the Indiana American Water Environmental Grant Program and finished his fellowship by writing this transition document.

Important Hyperlinked Data:

- No planting sites shapefile zip or geodatabase (ArcGIS layer)
- Priority planting sites shapefile zip of geodatabase (ArcGIS layer)
- Weighting scheme for priority planting sites (Excel) **(IN PLANTING PLAN)**
- Summary table for priority planting sites (Excel)
- Map documents
    - Map of priority planting sites (PDF/JPEG)

Documents detailing prioritization methodology:

- Priority planting set-up (updated from DRG's original instructions)
- Priority planting analysis (updated from DRG's original instructions)
- Classification & Accuracy Assessment (DRG)

Grant Writing

- Indiana American Water Environmental Grant application is in process. All information apart from the budget is complete. Budgetary information will be written by Tim Detzner. The 2022 period is closed. The application is being prepared for March 31, 2023.

Other Tasks

- City data to be shared with Hannah Gregory (hansgreg@iu.edu) for the Indiana Green CityMapper

Next Steps and Role Assignments

Project Component	Tasks and subtasks	Task Owner Name & Contact
Grant Writing	*Grant proposal development & submittal*	*City of Lafayette Grants Manager*
Tree Planting	*Coordination of volunteers, identification and allocation of resources*	*Tim Detzner, Urban Forester (tdetzner@lafayette.in.gov)*

General single points of contact (SPOCs)

SPOC Name, Designation & Contact	Organization	Note
Anagha Gore, Resilience Programs Coordinator, (anagore@iu.edu); Matt Flaherty, Resilience Implementation Manager (flahertm@iu.edu)	*Indiana University Environmental Resilience Institute*	*UGI Cohort program leads, can provide technical assistance & further guidance on data analysis, planting plan & other components, etc.*
Will Ayersman (william.ayersman@davey.com) Nick Antenucci (nicholas.antenucci@davey.com) Aren Flint (aren.flint@davey.com) Shelby Huth (shelby.huth@davey.com)	*Davey Resource Group*	*Davey Resource Group spatial analysis experts can help provide technical assistance and data analysis in regards to the priority planting map and other components.*
Tim Detzner, Urban Forester (tdetzner@lafayette.in.gov)	*City of Lafayette Dept. of Public Works & Engineering*	*Mr. Detzner has an extensive knowledge of native and non-native trees, proper tree planting and care methods, and tree canopy expansion efforts in Lafayette.*
info@treelafayette.org	*Tree Lafayette*	*Tree Lafayette is capable of coordinating volunteer efforts for tree planting and care, and is actively involved in the expansion of tree canopy in Lafayette.*

Appendix A
Methodology and Accuracy Assessment

Davey Resource Group Canopy Height Modeling and Classification Methodology

Davey Resource Group utilized raster-based height modeling from LiDAR data in combination with an object-based image analysis (OBIA) semi-automated feature extraction method to process and analyze current high-resolution aerial imagery to identify tree canopy cover and land cover classifications. The use of imagery analysis is cost-effective and provides a highly accurate approach to assessing your community's existing tree canopy coverage. This supports responsible tree management, facilitates community forestry goal-setting, and improves urban resource planning for healthier and more sustainable urban environments.

Tree canopy was extracted from 2018 United States Geological Survey (USGS) 3DEP LiDAR data in ArcGIS®. A digital surface model (DSM) was created by interpolating the maximum values of the first returns of each laser pulse across a 3-foot grid surface (raster). A speckled output was created because some pulses can entirely or partially pass-through tree canopy before detecting a return, so maximum focal statistics in a 3 by 3 rectangular grid window were applied to the DSM to create a smooth surface.

Another raster representing the elevations of solid surfaces which LiDAR does not penetrate - usually ground and buildings, but occasionally dense evergreens as well, was created by interpolating the minimum values of the last returns (which are also the first return in instances of single return). Mean focal statistics in a 3 by 3 cell window were applied to this raster. The last return raster was subtracted from the first return raster, creating a canopy height model (CHM) – a representation of the heights of objects with complex return structures above the ground. In addition to trees, this includes built structures such as power lines, poles, transmission towers, gantries, etc. The edges of buildings also appeared in the CHM as a result of different cell assignment and focal statistics types applied to the first and last return rasters. The heights of dense evergreens were underestimated due to the inability of LiDAR to penetrate to the ground for a proper base for height.

A constant raster of CHM cells with a height greater than 15 feet was created as a representation of tree canopy. Holes less than 500 square feet were filled to eliminate dubious small gaps while preserving discernable canopy gaps. This raster was then shrunk by 2 cells and expanded back by 2 cells. This process eliminated narrow or small features such as building edges, power lines, and poles.

Advanced image analysis methods were used to classify, or separate, the remaining land cover layers from the overall imagery. The semi-automated extraction process was completed using Feature Analyst, an extension of ArcGIS®. Feature Analyst uses an object-oriented approach to cluster together objects with similar spectral (i.e., color) and spatial/contextual (e.g., texture, size, shape, pattern, and spatial association) characteristics. The land cover results of the extraction process was post-processed and clipped to each project boundary prior to the manual editing process in order to create smaller, manageable, and more efficient file sizes. Secondary source data, high-resolution aerial imagery provided by each UTC city, and custom ArcGIS® tools were used to aid in the final manual editing, quality checking, and quality assurance processes (QA/QC). The manual QA/QC process was implemented to identify, define, and correct any misclassifications or omission errors in the final land cover layer.

A normalized digital elevation model (nDSM) was created by subtracting a DEM interpolated from ground-classified returns instead of last returns from the DSM. This surface provides more accurate tree canopy heights and includes the full heights of buildings as well. The nDSM was masked to the finalized tree canopy to provide a CHM capable of summarizing tree heights.

Classification Workflow

1) Prepare imagery for feature extraction (resampling, rectification, etc.), if needed.
2) Gather training set data for all desired land cover classes (impervious, bare soil). Water samples are not always needed since hydrologic data are available for most areas.
3) Extract canopy from LiDAR. Fill small holes and shrink and expand to remove building edges and power lines.
4) Edit and finalize canopy layer at 1:2000 scale. A point file is created to digitize-in small individual trees that will be missed during the extraction. These points are buffered to represent the tree canopy. This process is done to speed up editing time and improve accuracy by including smaller individual trees.
5) Extract remaining land cover classes.
6) Edit the impervious layer to reflect actual impervious features, such as roads, buildings, parking lots, etc. to update features.
7) Using canopy and actual impervious surfaces as a mask; input the bare soils training data and extract them from the imagery. Quickly edit the layer to remove or add any features. Davey Resource Group tries to delete dry vegetation areas that are associated with lawns, grass/meadows, and agricultural fields.
8) Assemble any hydrological datasets, if provided. Add or remove any water features to create the hydrology class. Perform a feature extraction if no water feature datasets exist.
9) Use geoprocessing tools to clean, repair, and clip all edited land cover layers to remove any self-intersections or topology errors that sometimes occur during editing.
10) Input canopy, impervious, bare soil, and hydrology layers into Davey Resource Group's Five-Class Land Cover Model to complete the classification. This model generates the pervious (grass/low-lying vegetation) class by taking all other areas not previously classified and combining them.
11) Thoroughly inspect final land cover dataset for any classification errors and correct as needed.
12) Perform accuracy assessment. Repeat Step 11, if needed.

Automated Feature Extraction Files

The automated feature extraction (AFE) files allow other users to run the extraction process by replicating the methodology. Since Feature Analyst does not contain all geoprocessing operations that Davey Resource Group utilizes, the AFE only accounts for part of the extraction process. Using Feature Analyst, Davey Resource Group created the training set data, ran the extraction, and then smoothed the features to alleviate the blocky appearance. To complete the actual extraction process, Davey Resource Group uses additional geoprocessing tools within ArcGIS®. From the AFE file results, the following steps are taken to prepare the extracted data for manual editing.

1) Davey Resource Group fills all holes in the canopy that are less than 30 square meters. This eliminates small gaps that were created during the extraction process while still allowing for natural canopy gaps.
2) Davey Resource Group deletes all features that are less than 9 square meters for canopy (50 square meters for impervious surfaces). This process reduces the amount of small features that could result in incorrect classifications and also helps computer performance.
3) The Repair Geometry, Dissolve, and Multipart to Singlepart (in that order) geoprocessing tools are run to complete the extraction process.
4) The Multipart to Singlepart shapefile is given to GIS personnel for manual editing to add, remove, or reshape features.

Accuracy Assessment Protocol

Determining the accuracy of spatial data is of high importance to Davey Resource Group and our clients. To achieve to best possible result, Davey Resource Group manually edits and conducts thorough QA/QC checks on all urban tree canopy and land cover layers. A QA/QC process will be completed using ArcGIS® to identify, clean, and correct any temporal discrepancies in LiDAR-derived tree canopy, misclassification or topology errors in the final land cover dataset. The initial land cover layer extractions will be edited at a 1:2000 quality control scale in the urban areas and at a 1:2500 scale for rural areas utilizing the most current high-resolution aerial imagery to aid in the quality control process.

To test for accuracy, random plot locations are generated throughout the city area of interest and verified to ensure that the data meet the client standards. Each point will be compared with the most current Nearmap high-resolution imagery (reference image) to determine the accuracy of the final land cover layer. Points will be classified as either correct or incorrect and recorded in a classification matrix. Accuracy will be assessed using four metrics: overall accuracy, kappa, quantity disagreement, and allocation disagreement. These metrics are calculated using a custom Excel® spreadsheet.

Table 1. Land Cover Classification Code Values

Land Cover Classification	Code Value
Tree Canopy	1
Impervious	2
Pervious (Grass/Vegetation)	3
Bare Soil	4
Open Water	5

Land Cover Accuracy

The following describes Davey Resource Group's accuracy assessment techniques and outlines procedural steps used to conduct the assessment.

1. *Random Point Generation*—Using ArcGIS, 1,000 random assessment points are generated.

2. *Point Determination*—Each point is carefully assessed by the GIS analyst for likeness with the aerial photography. To record findings, two new fields, CODE and TRUTH, are added to the accuracy assessment point shapefile. CODE is a numeric value (1–5) assigned to each land cover class (Table 1) and TRUTH is the actual land cover class as identified according to the reference image. If CODE and TRUTH are the same, then the point is counted as a correct classification. Likewise, if the CODE and TRUTH are not the same, then the point is classified as incorrect. In most cases,

distinguishing if a point is correct or incorrect is straightforward. Points will rarely be misclassified by an egregious classification or editing error. Often incorrect points occur where one feature stops and the other begins.

3. *Classification Matrix*—During the accuracy assessment, if a point is considered incorrect, it is given the correct classification in the TRUTH column. Points are first assessed on the Nearmap imagery for their correctness using a "blind" assessment—meaning that the analyst does not know the actual classification (the GIS analyst is strictly going off the Nearmap imagery to determine cover class). After all random points are assessed and recorded; a classification (or confusion) matrix is created. The classification matrix for this project is presented in Table 2. The table allows for assessment of user's/producer's accuracy, overall accuracy, omission/commission errors, kappa statistics, allocation/quantity disagreement, and confidence intervals (Figure 1 and Table 3).

Table 2. Classification Matrix

	Classes	Tree Canopy	Impervious Surfaces	Grass & Low-Lying Vegetation	Bare Soils	Open Water	Row Total	Producer's Accuracy	Errors of Omission
Reference Data	Tree Canopy	183	2	18	0	0	203	90.15%	9.85%
	Impervious	2	376	12	0	0	390	96.41%	3.59%
	Grass/Vegetation	2	14	349	1	0	366	95.36%	4.64%
	Bare Soils	2	3	3	20	0	28	71.43%	28.57%
	Water	0	0	0	0	13	13	100.00%	0.00%
	Column Total	189	395	382	21	13	1000		
	User's Accuracy	96.83%	95.19%	91.36%	95.24%	100.00%		Overall Accuracy	94.10%
	Errors of Commission	3.17%	4.81%	8.64%	4.76%	0.00%		Kappa Coefficent	0.9115

4. Following are descriptions of each statistic as well as the results from some of the accuracy assessment tests.

   Overall Accuracy – Percentage of correctly classified pixels; for example, the sum of the diagonals divided by the total points ((183+376+349+20+13)/1,000 = 94.10%).

   User's Accuracy – Probability that a pixel classified on the map actually represents that category on the ground (correct land cover classifications divided by the column total [183/189 = 96.83%]).

   Producer's Accuracy – Probability of a reference pixel being correctly classified (correct land cover classifications divided

by the row total [183/203 = 90.15%]).

Kappa Coefficient – A statistical metric used to assess the accuracy of classification data. It has been generally accepted as a better determinant of accuracy partly because it accounts for random chance agreement. A value of 0.80 or greater is regarded as "very good" agreement between the land cover classification and reference image.

Errors of Commission – A pixel reports the presence of a feature (such as trees) that, in reality, is absent (no trees are actually present). This is termed as a false positive. In the matrix below, we can determine that 3.17% of the area classified as canopy is most likely not canopy.

Errors of Omission – A pixel reports the absence of a feature (such as trees) when, in reality, they are actually there. In the matrix below, we can conclude that 9.85% of all canopy is classified as another land cover class.

Allocation Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than optimal match in the spatial allocation (or position) of the classes.

Quantity Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than perfect match in the proportions (or area) of the classes.

Confidence Intervals – A confidence interval is a type of interval estimate of a population parameter and is used to indicate the reliability of an estimate. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter based on the observed probability of successes and failures. Since all assessments have innate error, defining a lower and upper bound estimate is essential.

Confidence Intervals

Class	Acreage	Percentage	Lower Bound	Upper Bound
Tree Canopy	3,284.4	17.4%	17.2%	17.7%
Impervious Surfaces	7,457.0	39.6%	39.2%	40.0%
Grass & Low-Lying Vegetation	7,604.9	40.4%	40.0%	40.7%
Bare Soils	296.9	1.6%	1.5%	1.7%
Open Water	188.9	1.0%	0.9%	1.1%
Total	18,832.1	100.00%		

Statistical Metrics Summary	
Overall Accuracy =	94.10%
Kappa Coefficient =	0.9115
Allocation Disagreement =	4%
Quantity Disagreement =	2%

Accuracy Assessment

Class	User's Accuracy	Lower Bound	Upper Bound	Producer's Accuracy	Lower Bound	Upper Bound
Tree Canopy	96.8%	95.6%	98.1%	90.1%	88.1%	92.2%
Impervious Surfaces	95.2%	94.1%	96.3%	96.4%	95.5%	97.4%
Grass & Low-Lying Vegetation	91.4%	89.9%	92.8%	95.4%	94.3%	96.5%
Bare Soils	95.2%	90.6%	99.9%	71.4%	62.9%	80.0%
Open Water	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Prioritized Planting – Planting Location

The planting location polygons were created by taking all grass/open space and bare ground areas and combining them into one dataset. Non-feasible planting areas such as agricultural fields, recreational fields, major utility corridors, airports, etc. were removed from consideration. This layer was reviewed and approved by the City of Goshen before the analysis proceeded. The remaining planting space was consolidated into a single feature and, then, exploded back out to multipart features creating separate, distinct polygons for each location. Using zonal statistics, the priority grid raster was used to calculate an average value for each planting location polygon. The averages were binned into five (5) classes with the higher numbers indicating higher priority for planting. These classes ranged from Very Low to Very High.

How Sites Were Prioritized

To identify and prioritize planting potential, Davey Resource Group assessed a number of environmental and demographic features, including proximity to canopy, soil permeability, air quality, population density, income, asthma prevalence, and urban heat island index. Each factor was assessed using data from various sources and analyzed using separate grid maps. Values between zero and four (with zero having the lowest priority) were assigned to each grid assessed. The grids were overlain and the values were averaged to determine the priority levels at an area on the map. A priority ranging from Very Low to Very High was assigned to areas on the map based on the calculated average of all grid maps.
Once the process of identifying priority was completed, the development of planting strategies was the next task. All potential planting sites were not treated equal as some sites were considered to be more suitable than others. Through prioritization, sites were ranked based on a number of factors pertaining to storm water reduction and a relative urban heat island index. While available planting sites may ultimately be planted over the next several decades, the trees that are planted in the next several years, should be planned for areas in most need, and where they will provide the most benefits and return on investment.

Priority Ranking Variables

Dataset	Source	Weight
Urban Heat Island Index	Urban Tree Canopy Assessment	0.20
Proximity to Canopy	Urban Tree Canopy Assessment	0.20
Soil Permeability	National Hydrologic Dataset	0.20
Air Quality	iTree Canopy	0.20
Population Density	U.S. Census Bureau	0.10
Income	U.S. Census Bureau	0.05
Asthma Prevalence	CDC 500 Cities Study	0.05

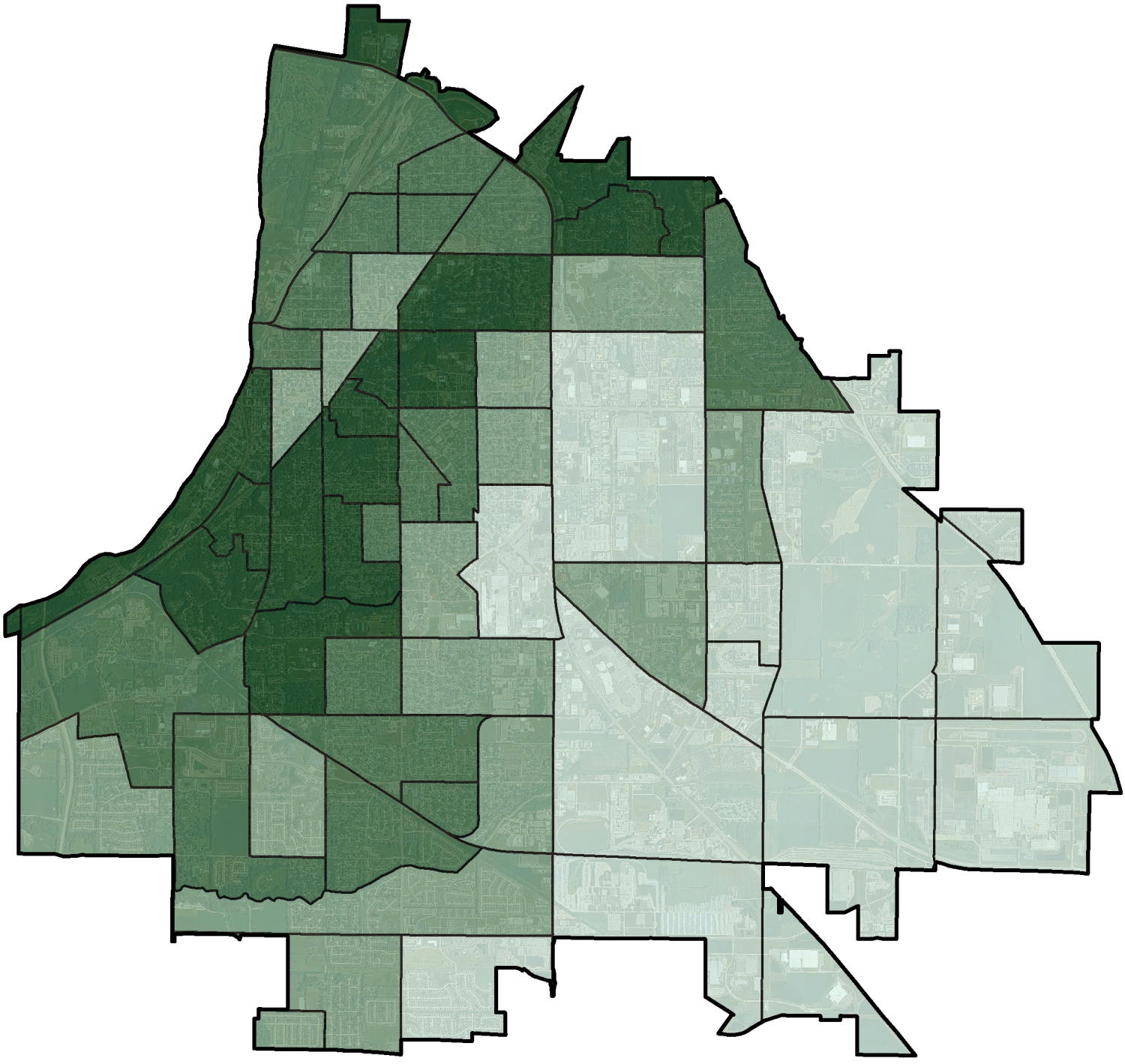
Land Cover Metrics														
NAME	ACRES	CANOPY ACRES	CANOPY PERCENT	IMPERVIOUS ACRES	IMPERVIOUS PERCENT	PERVIOUS ACRES	PERVIOUS PERCENT	BARE SOIL ACRES	BARE SOIL PERCENT	WATER ACRES	WATER PERCENT	PREFERRABLE ACRES	PREFERRABLE PERCENT	MAXIMUM UTC PERCENT
Tippecanoe	29,028.29	9,641.94	33.22%	3,856.22	13.28%	14,292.73	49.24%	638.2	2.20%	599.21	2.06%	7,318.75	25.21%	58.42%
West Lafayette	8,859.49	1,900.86	21.46%	2,401.59	27.11%	4,115.99	46.46%	240.5	2.71%	200.55	2.26%	2,544.67	28.72%	50.18%
Lafayette	18,832.09	3,284.42	17.44%	7,456.99	39.60%	7,604.86	40.38%	296.87	1.58%	188.95	1%	5,405.64	28.70%	46.14%

Land Cover Metrics on City of Lafayette-owned Public land, Tippecanoe County Public Land, private land														
OWNERSHIP	UNIQUE	ACRES	CANOPY ACRES	CANOPY PERCENT	IMPERVIOUS ACRES	IMPERVIOUS PERCENT	PERVIOUS ACRES	PERVIOUS PERCENT	BARE SOIL ACRES	BARE SOIL PERCENT	WATER ACRES	WATER PERCENT	PREFERRABLE ACRES	PREFERRABLE PERCENT	MAXIMUM UTC PERCENT
Public (County)	3	122.61	13.2	10.77	29.46	24.02	48.23	39.34	8.41	6.86	23.3	19.01	45.95	37.48	48.25
Private	1	15,577.50	2,652.59	17.03	5,746.12	36.89	6,766.95	43.44	260.22	1.67	151.61	0.97	4,630.48	29.73	46.75
Public	2	3,131.99	618.63	19.75	1,681.41	53.69	789.68	25.21	28.24	0.9	14.03	0.45	729.21	23.28	43.03

Land Cover Metrics on Tippecanoe County Public Land, City of West Lafayette-owned Public land, or private land														
OWNERSHIP	UNIQUE	ACRES	CANOPY ACRES	CANOPY PERCENT	IMPERVIOUS ACRES	IMPERVIOUS PERCENT	PERVIOUS ACRES	PERVIOUS PERCENT	BARE SOIL ACRES	BARE SOIL PERCENT	WATER ACRES	WATER PERCENT	PREFERRABLE ACRES	PREFERRABLE PERCENT	MAXIMUM UTC PERCENT
Public (County)	1	17.3	2.23	12.88	9.4	54.33	5.67	32.8	0	0	0	0	5.53	31.96	44.83
Public	2	1,117.51	288.93	25.85	531.8	47.59	222.74	19.93	10.86	0.97	63.18	5.65	205.13	18.35	44.21
Private	3	7,724.69	1,609.71	20.84	1,860.39	24.08	3,887.59	50.33	229.63	2.97	137.37	1.78	2,334.01	30.22	51.05

Land Cover Metrics on Tippecanoe Public land, Municipal-owned Public Land, Township Public Land, or private land														
OWNERSHIP	UNIQUE	ACRES	CANOPY ACRES	CANOPY PERCENT	IMPERVIOUS ACRES	IMPERVIOUS PERCENT	PERVIOUS ACRES	PERVIOUS PERCENT	BARE SOIL ACRES	BARE SOIL PERCENT	WATER ACRES	WATER PERCENT	PREFERRABLE ACRES	PREFERRABLE PERCENT	MAXIMUM UTC PERCENT
Public	1	2,903.36	627.18	21.6	1,200.66	41.35	777.72	26.79	55.02	1.89	242.77	8.36	686.04	23.63	45.23
Public (Municipal)	2	185.78	42.89	23.09	27.22	14.65	110.56	59.51	3.21	1.73	1.9	1.02	48.31	26.02	49.11
Public (Township)	3	38.61	7.11	18.42	11.5	29.8	18.18	47.09	1.81	4.7	0	0	15.58	40.33	58.75
Private	4	25,900.54	8,964.75	34.61	2,616.83	10.1	13,386.26	51.68	578.16	2.23	354.53	1.37	6568.82	25.36	59.97

Lafayette, IN
Canopy Percent by Block Group



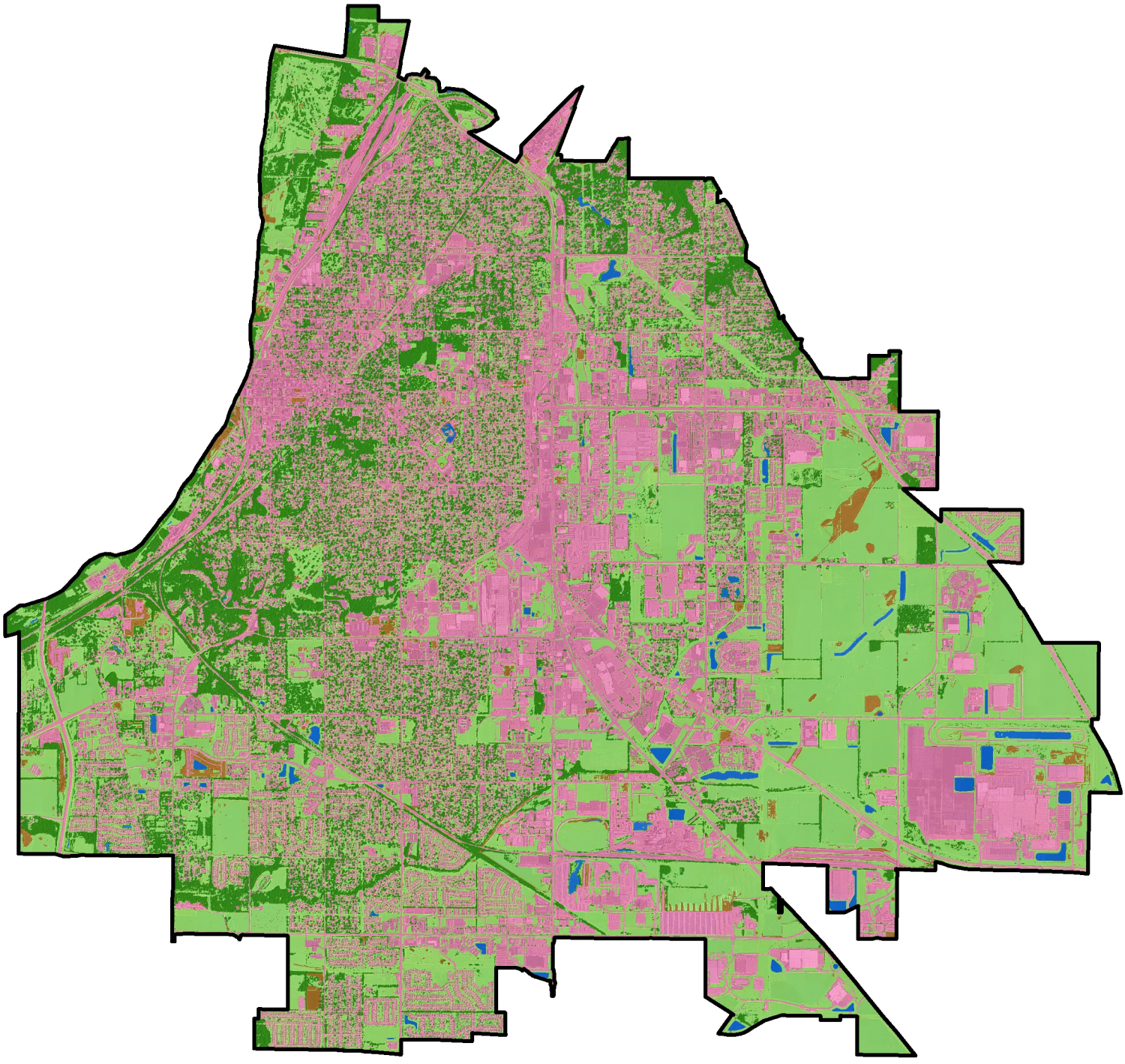
Canopy Percent

- Under 10%
- 10% - 20%
- 20% - 30%
- Over 30%
- City Limits

N

0 0.5 1 2 Miles

Lafayette, IN
Land Cover Classification



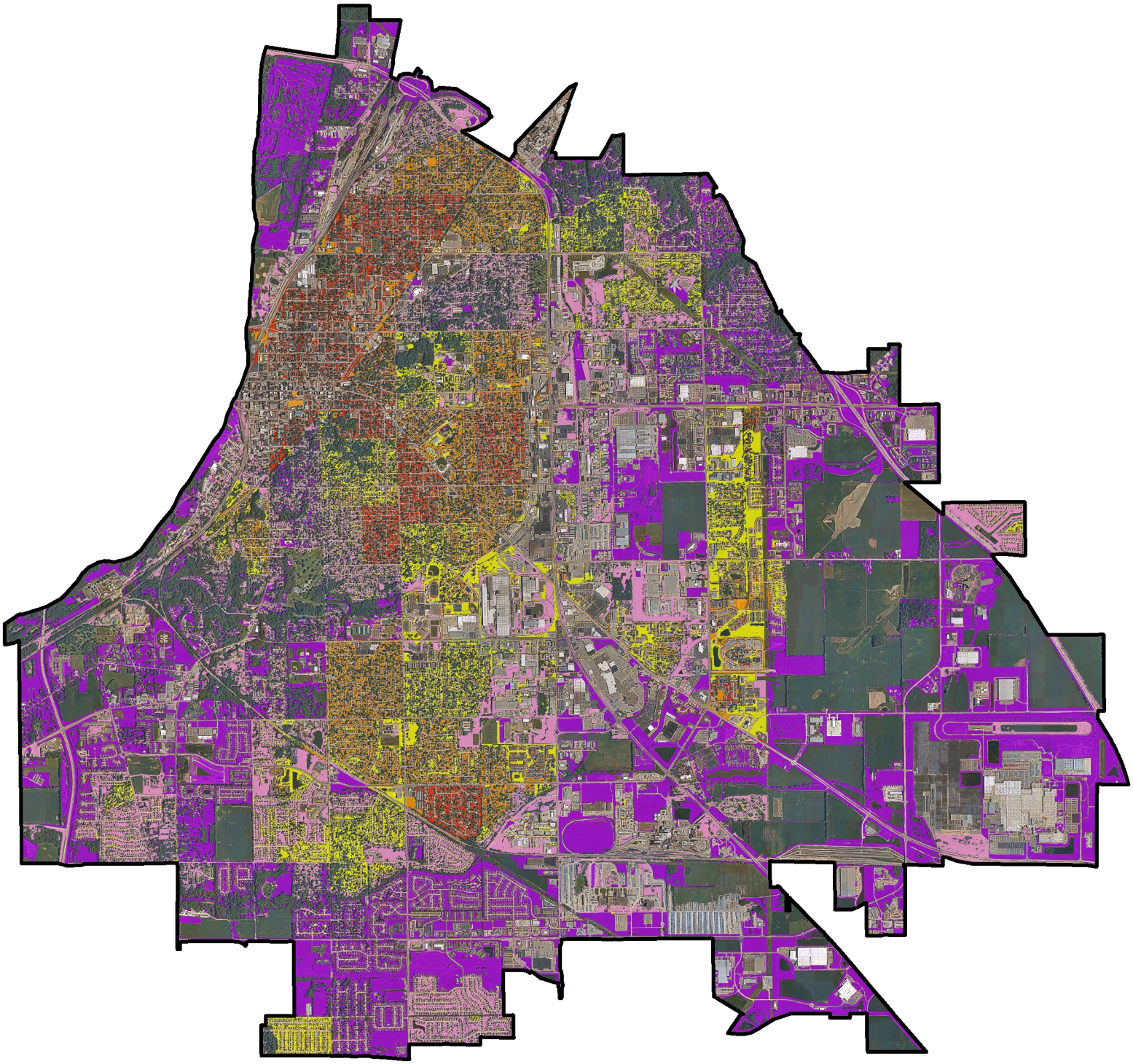
Land Cover Class

- Tree Canopy
- Grass/Low-Lying Vegetation
- Open Water
- Bare Soil
- Impervious Surfaces
- City Limits

N

0 0.5 1 2 Miles

Lafayette, IN - Priority Planting Analysis



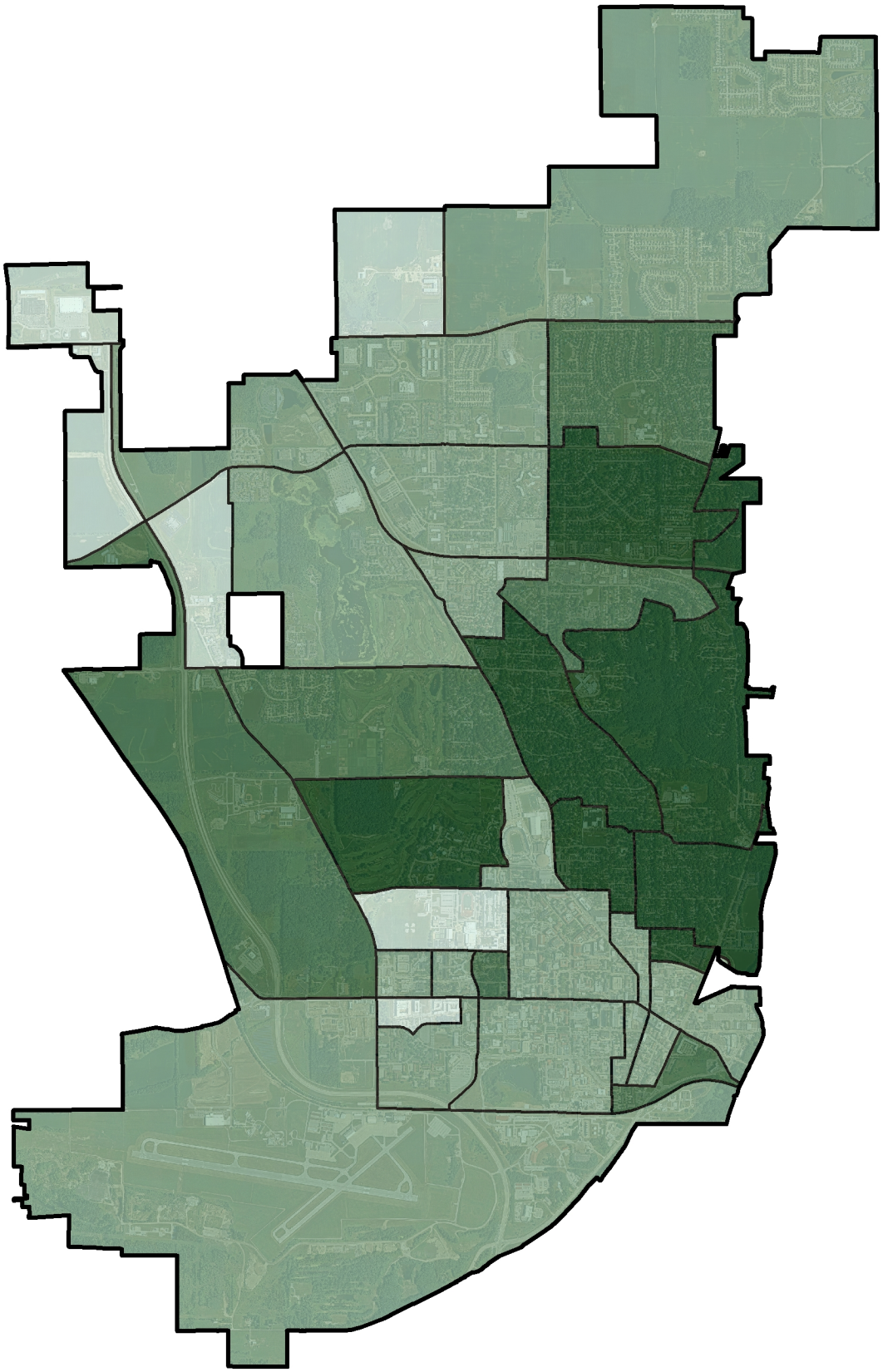
Priority Level

- Very Low
- Low
- Moderate
- High
- Very High
- City Limits

N

0 0.5 1 2 Miles

West Lafayette, IN - Canopy Percent by Block Group



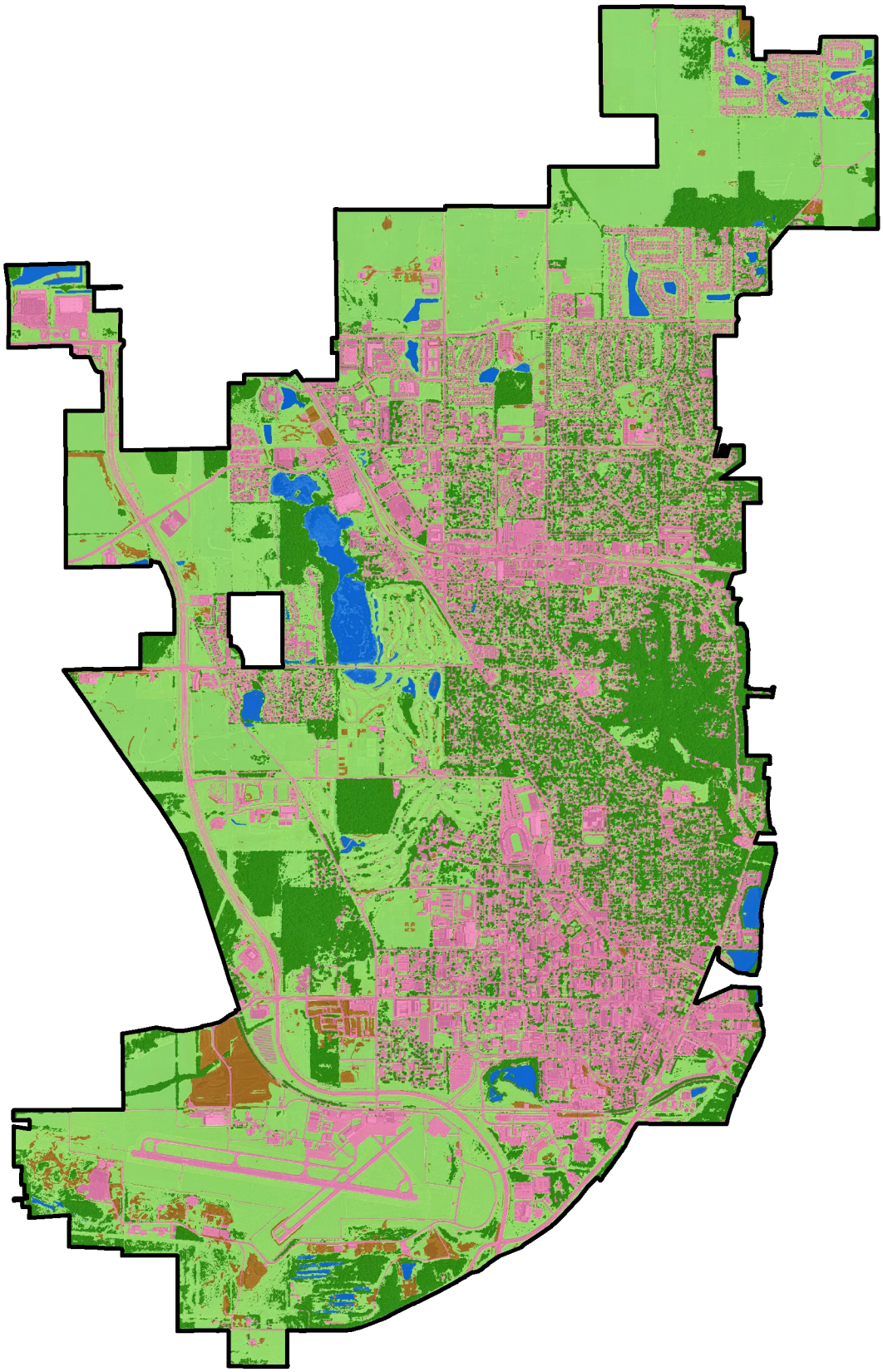
Canopy Percent

- Under 10%
- 10% - 20%
- 20% - 30%
- Over 30%
- City Limits

N

0 0.5 1 2 Miles

West Lafayette, IN - Land Cover Classification



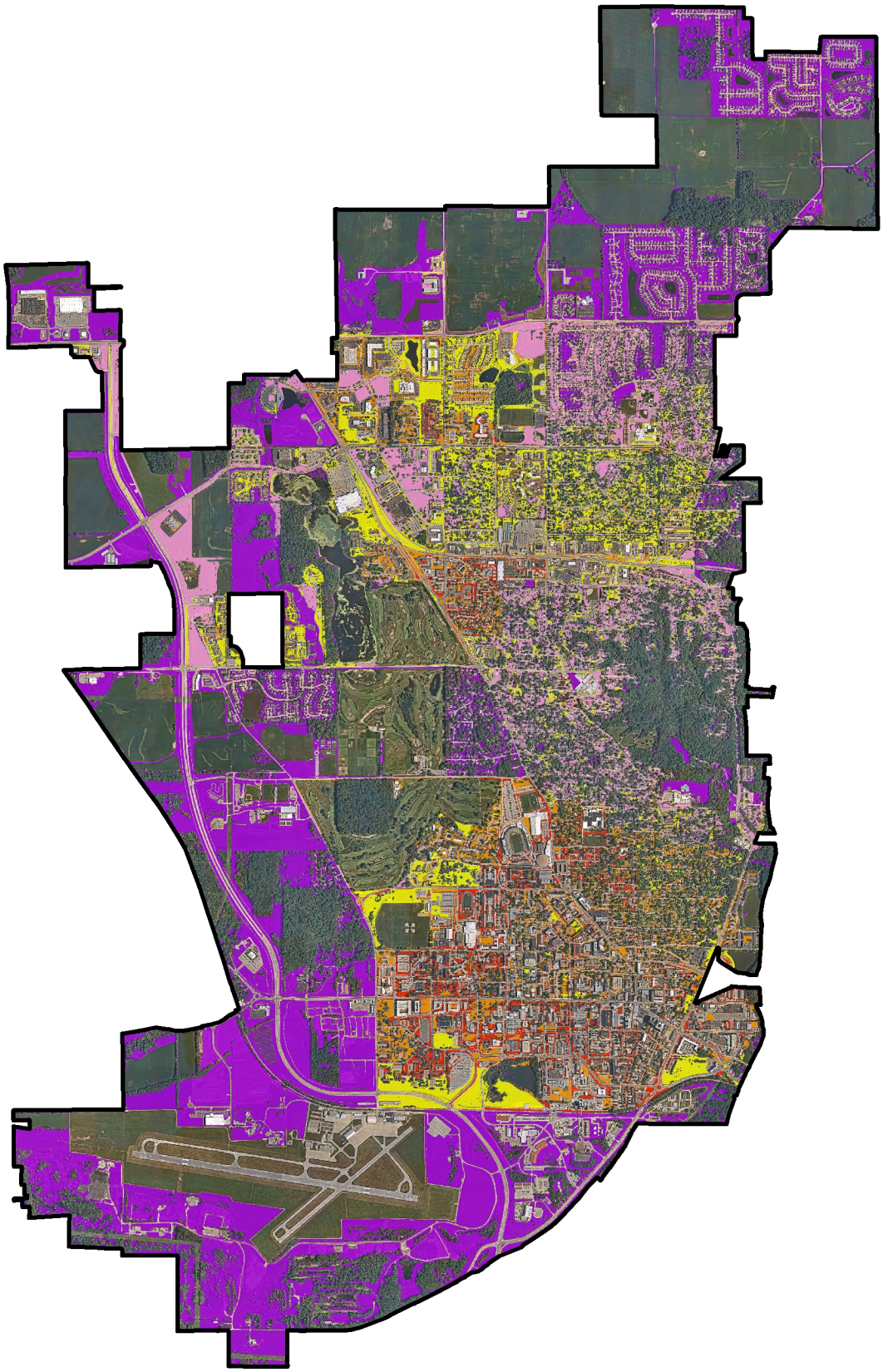
Land Cover Class

- Tree Canopy
- Open Water
- Impervious Surfaces
- Grass/Low-Lying Vegetation
- Bare Soil
- City Limits

N

0 0.5 1 2 Miles

West Lafayette, IN - Priority Planting Analysis



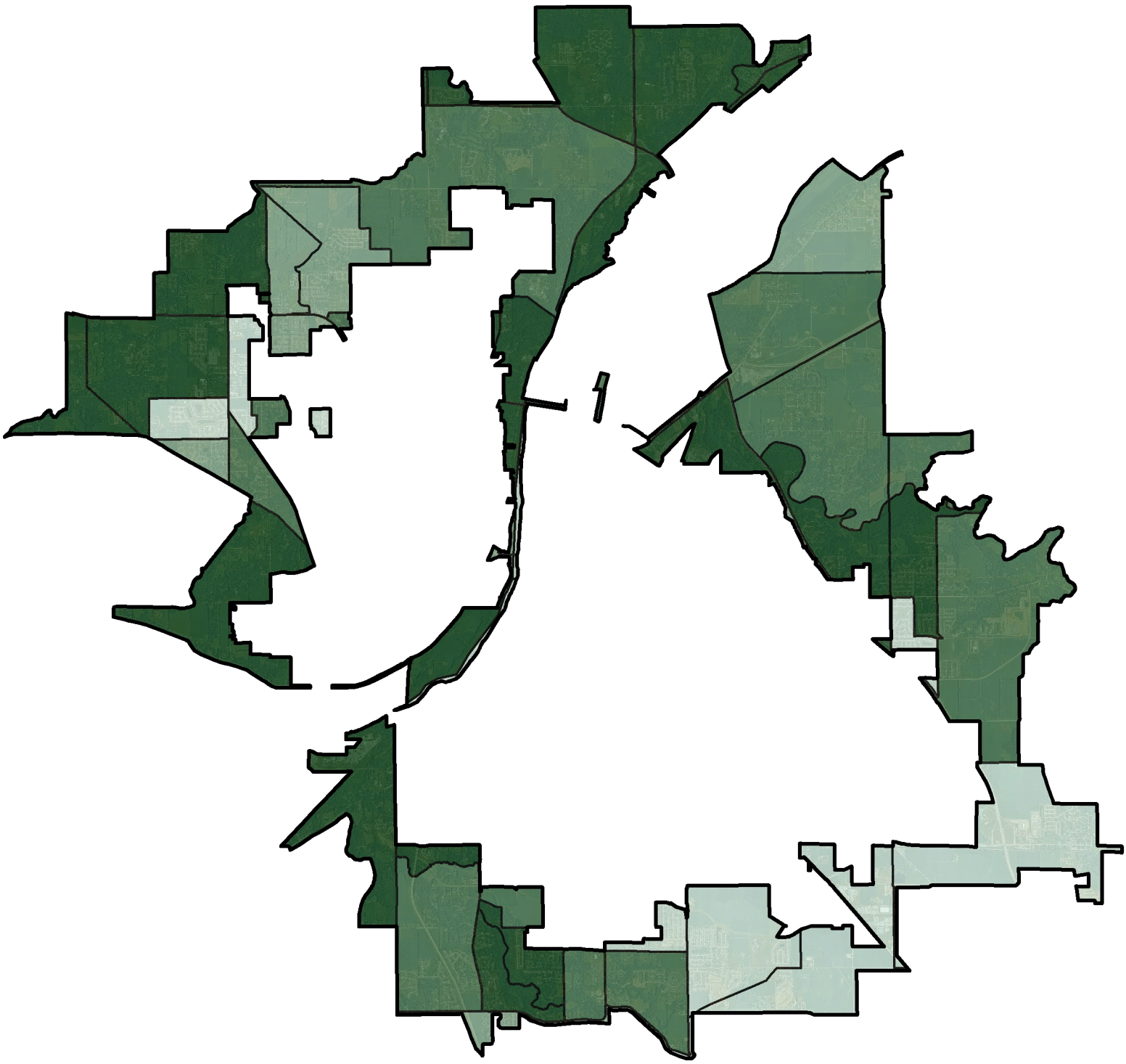
Priority Level

- Very Low
- Low
- Moderate
- High
- Very High
- City Limits

N

0 0.5 1 2 Miles

Tippecanoe, IN - Canopy Percent by Block Group



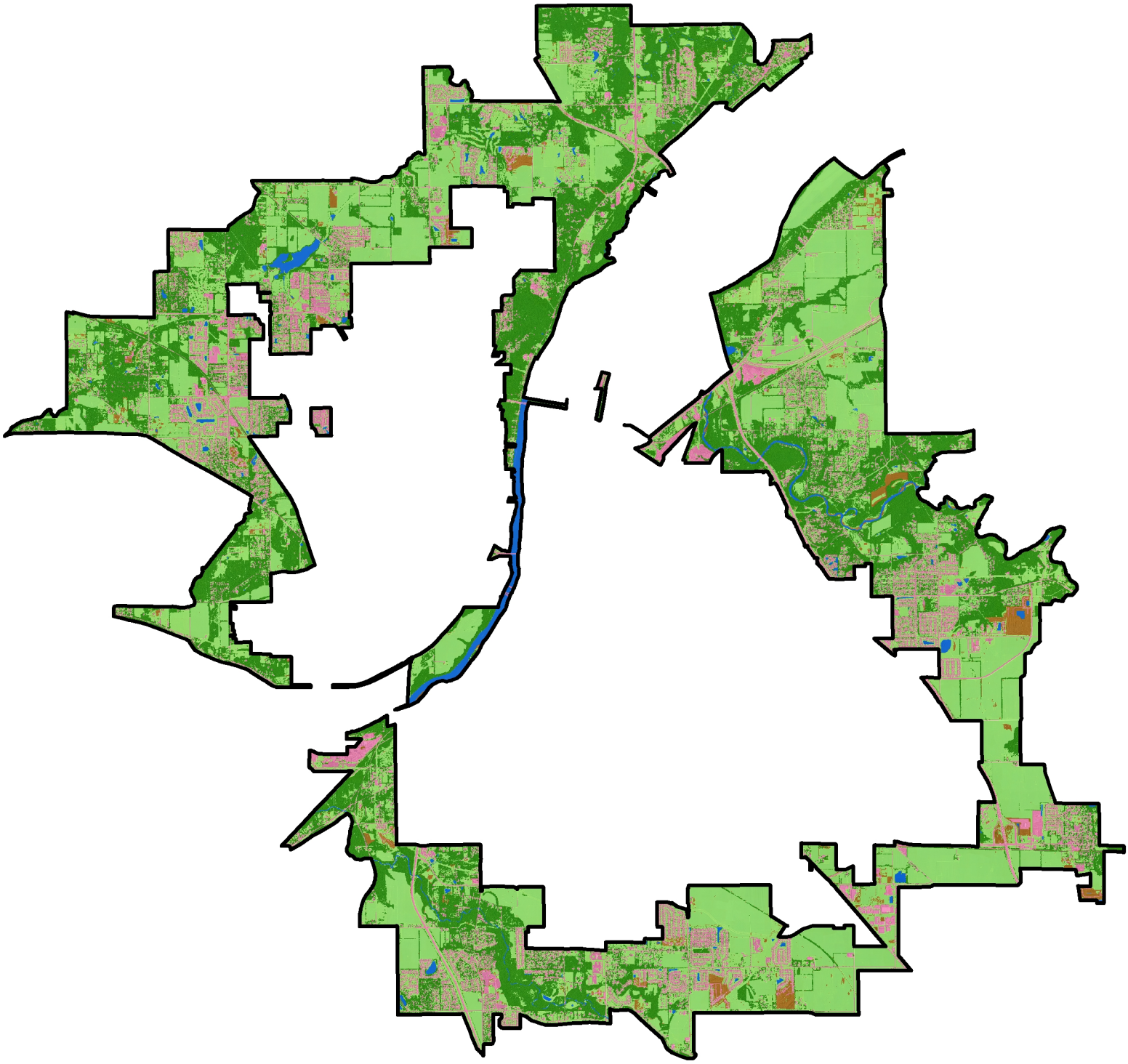
Canopy Percent

- Under 15%
- 15% - 25%
- 25% - 35%
- Over 35%
- Project Boundary

N

0 1 2 4 Miles

Tippecanoe, IN - Land Cover Classification



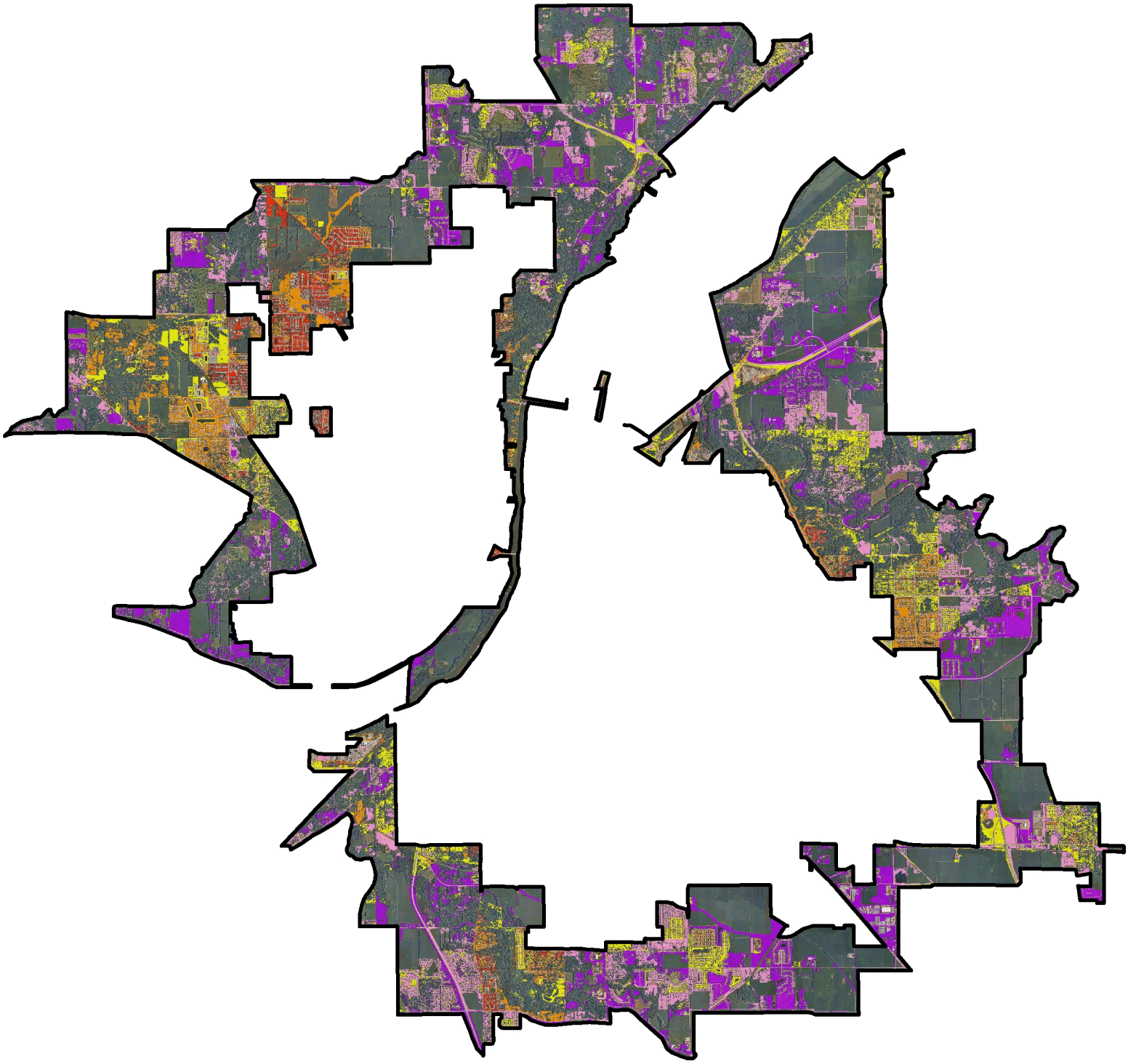
Land Cover Class

- Tree Canopy
- Grass/Low-Lying Vegetation
- Open Water
- Bare Soil
- Impervious Surfaces
- Project Boundary

N

0 1 2 4 Miles

Tippecanoe, IN - Priority Planting Analysis



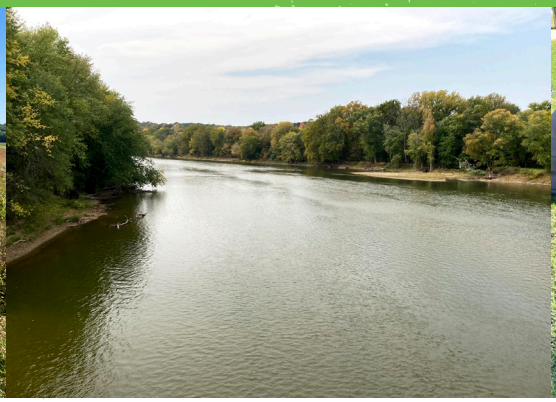
Priority Level

- Very Low
- Low
- Moderate
- High
- Very High
- Project Boundary

N

0 1 2 4 Miles

APPENDIX D: HOOSIER RESILIENCE INDEX



PREPARED FOR ENVIRONMENTAL CHANGE GRAND CHALLENGE INITIATIVE
ENVIRONMENTAL RESILIENCE INSTITUTE

Hoosier Resilience Index

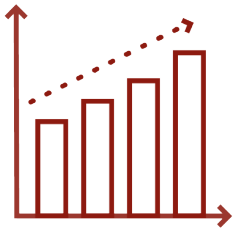
Understand your Community's Climate Risks

Use the map and charts at **hri.eri.iu.edu** to explore extreme heat, extreme precipitation, and floodplain land use data state-wide, county-by-county, and for your hometown.

The Index Provides:

Climate Projections

for each county and incorporated city and town in Indiana.



Readiness Assessment

to help local governments pinpoint the specific actions they could take to prepare.

Responding to climate change is expensive. Preparing is much less expensive.

Contact ERI

@Prepared4Change
833-ERI-ATIU (374-2848)

resindex@iu.edu
hri.eri.iu.edu

The Index will help local governments and residents understand:

How your community is vulnerable to climate change

Ways to reduce the impacts of climate change on underserved neighborhoods

How prepared your community is for these changes

The path to making your community more resilient

Climate Impacts | Hoosier Resilience Index

Lafayette, Indiana

	Current	2050s Projected
Average days per year above 90ºF	**20**	**58-70**
Average nights per year above 68ºF	**21**	**47-57**
Average events per decade at or above 2 inches of precipitation	**12**	**13-14**

Land area in Lafayette's floodplain	
Agricultural	**109 acres (9%)**
Developed	**981 acres (85%)**
Forest	**0 acres (0%)**
Wetland	**65 acres (6%)**
Total	**1,155 acres**

Precipitation events do not increase much. Why does it matter?

Although the number of extreme precipitation events is not projected to increase much, the amount of rainfall per storm is expected to increase, meaning that places near existing floodplains are more likely to flood. In addition, more precipitation is projected to occur in winter and spring, and less in the summer and fall.

What will more flooding mean for residents?

Areas close to existing floodplains, but not in them, will become more likely to flood as heavier rainfalls occur. Low-income households in these areas may have a harder time coping with the increased flood risk.

A floodplain is an area of low-lying ground near a body of water that is prone to flooding.

What will hotter days and nights mean for residents?

People who work outside in the summer are particularly at risk of being affected by high temperatures. In addition, emergency room visits increase when our bodies don't have a chance to cool down at night for several nights in a row.

People with weaker immune systems are more likely to experience heat-related illnesses, as are people in homes without air conditioning.

Want help identifying how you can make your community more prepared?
Visit **hri.eri.iu.edu** and click on "Readiness Assessment" to sign up for your hometown's tailored assessment, or email resindex@iu.edu.

Hoosier Resilience Index

Part of the Prepared for Environmental Change Grand Challenge

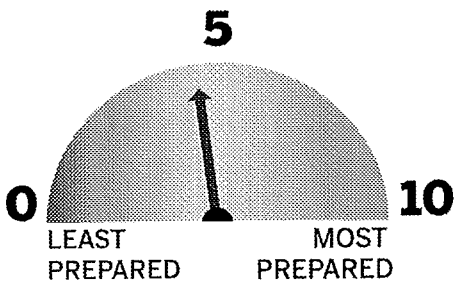
Readiness assessment

Community: West Lafayette

Congratulations on completing your Hoosier Resilience Index Readiness Assessment! The scores provided below reflect your community's readiness based on your responses to the questions in the Assessment. All scores are within a range of 1 to 10. A higher score indicates greater preparedness. Scores are not comparable between communities because each city, town, and county completes a unique set of questions in its Readiness Assessment.

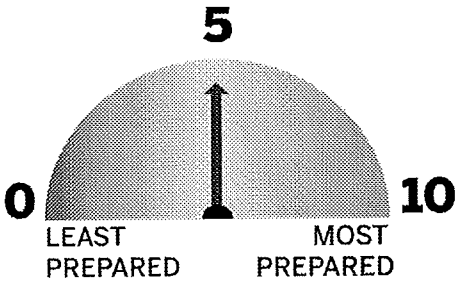
Based on the responses provided in the Hoosier Resilience Index Readiness Assessment, the Environmental Resilience Institute issues West Lafayette, on a scale of 1-10, the following scores:

Extreme Heat



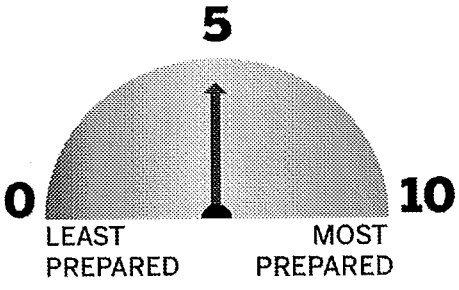
Readiness Score = 4.54

Extreme Precipitation



Readiness Score = 5.12

Floodplain Management



Readiness Score = 5.16

These scores are based on a self-assessment, and are only as useful as the accuracy of your responses. We encourage you to refer back to your responses to seek ways to improve your scores in the future. Your tailored Readiness Assessment link will not change.

Information submitted through the Readiness Assessment and the scores received by each community will not be displayed to the public. Refer to the User Manual <https://hri.eri.iu.edu/about/user-manual/completing-readiness-assessment.html/#data> for more information about the use of these data. Additionally, the information entered into your tailored Readiness Assessment will be saved until they are changed or cleared at your request. You may continue to use this tool and recalculate your score as you update existing services and implement new initiatives.

INDIANA UNIVERSITY
ENVIRONMENTAL RESILIENCE INSTITUTE

Next Steps for Climate Resilience in Tippecanoe County, IN

Prepared by the Environmental Resilience Institute using the results of Tippecanoe County's Hoosier Resilience Index Readiness Assessment
April 2022

In June 2021, Tippecanoe County completed the Hoosier Resilience Index Readiness Assessment to understand and evaluate its preparedness for the impacts of climate change. This report contains a review of the Assessment results, suggestions for prioritizing next steps, relevant funding opportunities, and case studies from Midwestern local governments.

Results

Figure 1. Hoosier Resilience Index Readiness Assessment Results, Tippecanoe County, IN, December 2021

The scores in Figure 1, ranging from 0 to 10, indicate how prepared Tippecanoe County is for the three primary risks from climate change in Indiana: an increasing number of extreme heat events, an increasing number of extreme precipitation events, and an increasing risk of flooding along rivers and streams. Street flooding, also known as surface or nuisance flooding, is also a major impact of climate change in Indiana. This impact is addressed within the extreme precipitation questions and score in the Assessment. Table 1 shows Tippecanoe County's scores in comparison to Hoosier governments that have also completed the Assessment.

Table 1. A Comparison of Tippecanoe County's Assessment Scores as of December 2021

Score Categories	**Tippecanoe County**	Average, All Indiana Communities, *n =17*
Extreme Heat	**4.63**	4.67
Extreme Precipitation	**5.89**	5.27

Floodplain Management	**5.49**	5.07

* Incorporated areas in Indiana designated as Cities

Results by Readiness Assessment Worksheet

The Readiness Assessment is divided into eight worksheets, each geared toward the focus area of a typical local government department. Table 2 shows how Tippecanoe County scored in each worksheet in all three risk categories. Actions undertaken in the built environment category indicate a high level of preparedness, especially for floodplain land use. Lower scores in energy and public utilities drive Tippecanoe County's overall scores lower. This chart can be used to identify departments that may need to make climate change preparedness a higher priority.

Table 2. Tippecanoe County's Assessment Scores by Worksheet, as of December 2021

	Extreme Heat Score	Extreme Precipitation Score	Floodplain Land Use Score
Built Environment	4.00	8.50	8.00
Economic Development	4.00	4.00	4.00
Emergency Management	5.00	5.80	5.80
Energy and Public Utilities	3.43	4.29	4.29
Food and Agriculture	5.67	6.67	6.67
Natural Resources	5.25	5.64	5.64
Planning and Land Use	4.44	4.75	4.40
Public Health and Safety	4.00	6.67	6.67
Overall	4.63	5.89	5.49

Results by Readiness Assessment Impact

The Assessment is also divided into twenty-two separate specific climate change impacts relevant in Indiana. Viewing the results in terms of preparedness for each impact can illuminate prioritization areas. Table 3 shows each score by impact.

Table 3. Tippecanoe County's Assessment Scores by Impact, December 2021

	Impacts*	Extreme Heat Score	Extreme Precipitation Score	Floodplain Land Use Score
Built Environment	1. Stress on transportation systems	4.00	5.00	6.00
	2. River and surface flooding in developed areas	N/A**	9.33	9.00
	3. Stormwater management infrastructure	N/A**	10.00	10.00
Economic Development	4. Local economy and low-income residents	4.00	4.00	4.00
Emergency Management	5. Communication systems	9.00	9.00	9.00
	6. Strain on government services	4.67	6.40	6.40
	7. Impacts on residents	2.67	2.67	2.67
Energy and Public Utilities	8. Power Supply Issues	4.50	4.50	4.50
	9. Drinking water	2.00	2.00	2.00
	10. Wastewater treatment	N/A**	8.00	8.00
Food and Agriculture	11. Food shortages	5.67	6.67	6.67
Natural Resources	12. Inland wetlands and waterways	9.00	8.50	8.50
	13. Threats to sensitive species in natural areas	4.50	4.50	4.50
	14. Rural and urban forests	3.00	3.33	3.33
Planning and Land Use	15. Floodplain inundations and surface flooding	10.00	10.00	6.50
	16. Warm temperatures in developed areas	2.67	3.00	3.00
	17. Habitat for sensitive species in developed areas	2.00	2.00	2.00
	18. Anticipated and unanticipated impacts	5.00	3.33	3.33
Public Health and Safety	19. Illnesses from outdoor air pollution	4.00	N/A**	N/A**
	20. Illnesses from indoor air pollution	6.00	6.00	6.00
	21. Heat related illnesses	2.67	N/A**	N/A**
	22. Illnesses from disease carrying vectors	7.00	7.00	7.00

* The impact text has been shorted for this table. For the full impact text, see Appendix A.

** N/A: The local government had no relevant questions or responses for the corresponding impact in the Assessment.

Progress

Below are the three impacts for which Tippecanoe County is most prepared, according to the answers you provided.

Impact 2: Increased likelihood of river and surface flooding in developed areas

- Tippecanoe County has compared 100-year and 500-year flood maps with a map of housing and business locations, and any houses or businesses in the floodplain have been adequately protected from anticipated flood levels. The local government has adopted a zoning ordinance that prevents new housing and business construction in the 100-year and 500-year floodplain.

- Tippecanoe County has compared topographic and watershed maps with a map of housing and business locations, and any housing or businesses at risk of surface flooding have been adequately protected from anticipated water impacts. The county has also adopted a zoning ordinance that prevents new housing and business construction in areas prone to surface flooding or has implemented an ordinance that requires on-site stormwater management.

- Tippecanoe County has adopted equitable post-flood repair policies and procedures, but does not have a plan to regularly update them or incorporate them into other planning efforts. The local government is researching methods to increase funding allocated for maintenance/repair.
    - Next Steps: Tippecanoe County can adopt equitable post-flood repair policies and procedures and incorporate them into other planning efforts. The policies and procedures should be updated regularly, and the county has increased funding allocated for maintenance/repair.

Impact 3: Increased likelihood of impacts on stormwater management infrastructure.

- Tippecanoe County understands how climate vulnerabilities will impact existing and planned green stormwater infrastructure across the community and is starting to plan protection and adaptation efforts. The county has completed a few retrofits so that green stormwater infrastructure is better able to handle heavier rain events. Tippecanoe County has adopted and is implementing a more intensive maintenance program, and, working across departments and with relevant community organizations, has launched one or more land use and/or water capture programs to divert rainwater from the storm system. Tippecanoe County is in the process of proposing ordinances or other policy options to require new developers to manage stormwater on-site and/or size green stormwater infrastructure to accommodate expected higher volumes of water.

- Tippecanoe County has completed enough gray stormwater system retrofits, has effectively integrated a more intensive maintenance program, and launched a sufficient number of programs that prevent rainwater from entering the gray infrastructure system, such that they are confident in the system's ability to handle heavier rain events. Tippecanoe County has adopted an ordinance or policy that requires new developers to combine green stormwater infrastructure installations with appropriately sized stormwater infrastructure to accommodate expected higher volumes of water.

- The Tippecanoe County has launched a program to increase the number of private green stormwater infrastructure or other low-impact development projects, has implemented an ordinance or other policy mechanism to increase their use, and can demonstrate through maps or other metrics the increased presence of these techniques. Additionally, the county is implementing strategies to reduce stormwater runoff from impervious surfaces across its jurisdiction, with a focus in the most vulnerable areas of the community. Strategies are being implemented in parking lots, alleys, parks, vacant lots, parkways, and grading near sidewalks for green stormwater infrastructure. The county is starting to prioritize managing stormwater on-site in all new construction.

- Tippecanoe County and stormwater influencers and decision-makers within its watershed have implemented joint solutions to deal with heavier rain events that often lead to surface flooding and/or river flooding. These communities and entities meet regularly to evaluate the results of the implemented solutions and tweak them as needed.

Impact 5: Increased stress on existing communication systems during extreme weather

- Tippecanoe County has adopted and is implementing a plan to improve its communications network. The plan includes short-term, medium-term, and long-term policies and procedures to accomplish its recovery needs in the event of a disaster. The plan includes methods of communication that will be able to reach residents, including diverse and vulnerable households, when traditional communication networks fail.
    - Next Steps: Tippecanoe County can fortify its communications network following an in-depth analysis of related strengths and weaknesses. The system should be routinely tested. Tippecanoe County can adopt post-event recovery policies and procedures to repair communications services. The policies and procedures should be updated regularly, and be appropriate for reaching diverse and vulnerable households, including residents for whom English is not their first language.

- Tippecanoe County has assessed its communications needs with respect to climate change, and has developed a complete list of local, state, and federal agency contacts that could be needed before, during, and after an extreme weather event. Tippecanoe County updates the list annually, at minimum.

Prioritizing Actions

Listed below are the actions for which Tippecanoe County scored the lowest when considering the financial and social burdens of climate change, and among the three primary risks from climate change in Indiana. These actions should be considered for prioritization without eliminating support for the projects already underway.

Social and Financial Burden

People of color, low-income populations, individuals with pre-existing conditions, and other vulnerable populations are hit first and hardest by the impacts of climate change. In addition, ERI understands that preparing for and responding to climate change is expensive. But a study released in 2018 by the National Institute of Building Sciences shows that **a dollar invested in hazard mitigation yields six dollars in benefits over time** [i]. Start planning today by integrating funding strategies into your local government's financial planning.

The following bullets demonstrate how Tippecanoe County can take steps now to prepare its communities for the social and economic burden of climate change – whether costs are borne by residents or the government. Consider these recommended actions, for which Tippecanoe County marked level 2 or lower:

- 4A: Evaluate how climate change impacts could affect the local economy - Businesses can anticipate increased costs from extreme weather event recovery, supply chain disruptions, insurance rates, and more. Conducting a climate change economic impact analysis can help a community understand how the changing climate will affect local economic activity.

- 4D: Establish a protocol for providing assistance to residents that may face financial strain caused by climate hazards - Vulnerable residents often do not have the resources necessary to respond to or recover from climate hazards. To prevent vulnerable residents from being disproportionately affected by climate hazards, local governments can dedicate thoughtful planning, funding, and assistance while recognizing that some populations will be especially vulnerable and understanding what their needs might be.

- 7C: Enhance community networks and connections for vulnerable communities - As the impacts of climate change worsen, individuals with special circumstances may face difficulties that make preparing for and responding to flooding, extreme heat, and other impacts more challenging. Language and cultural barriers, health issues, and strained incomes are only a few examples. To reach and protect all residents, local governments can make special accommodations through existing community networks.

- 8D: Establish a protocol for providing assistance to residents who may face financial strain caused by higher energy costs - As the number and severity of high heat events increases, low-income residents might not have access to air conditioning or be able to

afford to run it. To prevent vulnerable households from being disproportionately affected by the financial strain of energy bills, local governments can implement measures to reduce these impacts and consider the need for funding assistance.

- 11B: Develop a plan to address local and global food supply emergencies - Rising temperatures and extreme weather can affect the resilience of the food storage and distribution systems. Transit time, reliability, and efficiency can be negatively impacted by climate events as roadways and other infrastructure are damaged. Accordingly, communities should develop and maintain a plan to address local and global food supply emergencies and be well prepared to enact it.

- 11C: Increase local food purchasing - As climate change increasingly threatens farm viability and distribution networks, a more diverse and localized set of food resources (farms, processors, distributors) can protect communities against food insecurity. Local food procurement can support a robust local food system that is more resilient and less vulnerable to external shocks such as droughts, heat waves, and hurricanes.

- 18C: Integrate funding for readiness actions into financial planning - Preparing for the impacts of climate change is expensive but responding to events made worse by climate change will likely be pricier. As local governments take steps to avoid or lessen impacts when they hit, they need to consider how to pay for their resilience initiatives. Financing can draw from public and private sources, including state and federal grant funding, working through public-private partnerships, private foundations, and local taxes and fees, among other options.

Preparing for Extreme Heat

Given that **the number of high heat events in Tippecanoe County are expected to jump from the current number of 11 high heat days and nights to between 35 and 45 by the 2050s**[ii], consider these recommended actions, for which Tippecanoe County marked level 2 or lower:

- 1A: Prepare roadways and bridges for higher maximum temperatures and more freeze-thaw events - Designing roadways and bridges for higher maximum temperatures and more freeze-thaw events includes tactics such as using heat-tolerant street landscaping, ensuring asphalt/concrete mixtures and other construction materials are appropriate for anticipated flooding and temperatures changes (e.g., to reduce potholes), adopting and implementing increased standards for drainage capacity for new transportation infrastructure and major rehabilitation projects, and ensuring pavement grooving and sloping is appropriate for anticipated flooding, among other strategies.

- 6B: Identify and protect critical infrastructure from higher temperatures - Extreme heat can prevent electric plants from being able to cool down because source water will be too warm to cool the plant. If plants have to cut back on power generation, and power

demand increases, blackouts and brownouts can occur. Heat waves can also cause roadways and pavement to buckle, and other infrastructure failures.

- 6C: Involve critical facility and emergency infrastructure managers in climate change preparedness and management - Involving the on-site managers of critical facilities and community infrastructure can ensure that these individuals understand the increasing threats posted by climate change, and how to prepare and respond. Involving these individuals in preparedness planning and activities will also increase the communication connections that exist across the local emergency preparedness community.

- 7A: Educate residents about steps they can take to improve personal emergency preparedness - Even in small- and medium-sized disasters, employees may become overwhelmed quickly with response needs and service gaps can arise. In today's changing climate reality, as extreme events become more frequent and severe, local governments can benefit from taking steps in advance to increase individual household preparedness and engage members of the community as vital partners.

- 7B: Identify and prepare for hazardous conditions that could occur from higher temperatures and floods - Floods can come in contact with hazardous waste – such as sewage treatment plants, coal ash pits, livestock waste lagoons, superfund and brownfield sites, and more – and contaminate the area affected by flooding. Flood damage to infrastructure and transportation systems can also prevent aid from reaching the area. Extreme heat can prevent electric plants from being able to cool down because source water will be too warm to cool the plant. If plants have to cut back on power generation, and power demand increases, blackouts and brownouts can occur.

- 8A: Work internally and with the local utility to increase power supply preparedness - There are a number of initiatives that local governments with municipally owned utilities can implement to decrease the risk of power outages during and after storms. Even if a local government does not operate the community's power grid, local officials can run internal and community-wide programs to support energy efficiency, and they can meet with electricity and natural gas providers to express their interest and concern in decreasing power supply issues due to the threats of climate change.

- 9C: Improve efficiency of water use in local government operations - Improving the efficiency of water use can help cities, towns, and counties save money and conserve resources. Water treatment and operations use a large amount of electricity. By being more efficient with water use, Spencer will require less water treatment, which can reduce energy demand. Additionally, using water inefficiently will help prevent water shortages during droughts or periods of contamination during floods.

- 9D: Develop a drought protection and response plan - Diversifying water sources helps to reduce the risk that water supply will fall below water demand. Increasing available

storage is another strategy to protect water levels. Identifying an alternative water source is important for when all other options fail.

- 9E: Educate rural residents about the impacts of climate change on drinking water sources - Climate change can have a significant impact on the availability of safe drinking and non-potable water for rural residents. Pumps and treatment systems do not work during power outages, run dry during water shortages, and water sources can become bacteria-ridden in times of flood. Local governments, often through public health departments, can educate residents about threats that are likely to increase due to climate change, and about backup systems and other possible solutions.

- 11E: Support efforts to protect pollinators - Pollinator populations are already declining due to changing and decreasing habitats and increases in disease due to rising temperatures and longer growing seasons. Supporting a high diversity of pollinators is important for food production even when managed bees are present in high numbers. Local governments can help insect (e.g., bees, butterflies, moths, wasps) and vertebrate (e.g., hummingbirds, bats) pollinators on publicly owned and managed land by selecting pollinator-friendly plants in landscaping and green infrastructure installations, and through public education and planning policies and documents.

- 13A: Promote habitat restoration through native landscaping and conservation on public and private property - Sensitive species rely on native plants and specific habitats for survival. Human development has reduced native habitat availability, and what's left is particularly at risk due to climate change. Promoting and planting more native plants increases the likelihood of sensitive species' survival. Co-benefits of native landscaping and habitat restoration include increased flood storage, better water quality, and habitat for pollinators.

- 13C: Encourage continuous blocks of forests and avoid fragmentation - The presence of an extensive tree canopy is associated with measurable decreases in air temperature, compared to areas without dense tree cover. By encouraging continuous blocks of forests, avoiding fragmentation, and promoting native landscaping, sensitive species will be able to transverse areas and stay connected to productive habitats where they can survive and reproduce. These blocks also provide cooling benefits to surrounding areas.

- 13D: Identify and protect ecologically significant ("critical") areas such as nursery grounds, spawning grounds, and areas of high species diversity - As climate change continues, certain species will not be able to survive increasing average temperatures and other impacts. Areas high in biodiversity and healthy habitats suitable for species to reproduce may fall into decline.

- 14A: Measure, maintain, protect, and expand the jurisdiction's tree canopy - Climate change has already impacted the types of trees suitable for urban areas and rural

forests in Indiana, and will continue to affect the tree species that are able to survive in the region. Depending on the region, changes in temperatures and precipitation are expected to reduce habitat suitability for some species and increase habitat suitable for others.

- 16A: Pass a tree canopy ordinance – The presence of an extensive tree canopy is associated with measurable decreases in air temperature, compared to areas without dense tree cover.

- 16B: Designate vegetation protection areas – Adopt vegetation protection areas or zones to designate sections of land to be restored or kept for plants. The presence of plants is associated with measurable decreases in ambient air temperature.

- 16C: Promote energy efficiency and waste heat reduction – As buildings and vehicles operate, they release waste heat, which contributes to nearby temperatures.

- 17A: Integrate habitat protection strategies into zoning codes, comprehensive plans, and ordinances - As the climate changes, healthy habitats and natural areas with high biodiversity may fall into decline, causing species' numbers to decrease or even disappear. Local governments can use incentives, community planning documents, zoning codes, and other regulatory requirements to protect critical habitats.

- 18B: Conduct a greenhouse gas inventory and develop a plan to reduce emissions - As communities around the globe measure and monitor their emissions and implement strategies to achieve emissions reductions goals, the total amount of emissions contributing to global warming will decrease. The anticipated impacts of increased average annual temperatures, flooding, and extreme weather will still occur, but they will not be as bad as they could have been.

- 19A: Educate residents about the health impacts of poor air quality and provide an effective advance warning program for elevated pollution days - As temperatures continue to rise, Indiana will likely experience more days with unhealthy levels of air pollution. Educating residents about the health risks of poor air quality and having an effective air pollution warning system in place can reduce the adverse health impacts of air pollution.

- 19B: Develop and implement a plan for high air pollution days that calls for both public and private action – Given the connection between high temperatures and increased air pollution, it is important to advise residents of things they can do on high air pollution days to limit local emissions and to encourage residents to take action to protect their health and the health of the community. It is also important for local government to have policies in place to curtail their own high-emitting activities on "bad air" days.

- 19C: Develop local air pollution reduction programs – The best way to reduce the risk of illness from poor air quality is to prevent poor air quality in the first place. While much air pollution is regional, local sources of dust, soot, and smog-forming pollutants do contribute to local air quality, some quite significantly. Reducing those local emissions will improve local air quality.

- 21A: Educate about heat related illness and prevention - Communicating to the public can help people understand the risk factors and symptoms of heat-related illnesses to reduce their exposure and know how to act when a situation occurs.

- 21B: Conduct a heat vulnerability assessment and develop a heat management plan - A heat vulnerability assessment uses available data to quantify and map the heat risk throughout a community. A heat response plan includes strategies and procedures to respond to extreme health related emergencies.

- 21C: Implement programs or activities that reduce heat impacts in the built environment - Buildings, paved areas, and other impervious surfaces absorb heat from the sun and release it throughout the day and into the evening. This makes it difficult for residents to avoid the heat during extreme heat events and can even increase ambient air temperatures. Implementing green infrastructure projects and putting in place building codes requiring or incentivizing green and cool infrastructure can reduce ambient temperatures and provide access to cooler spaces, as well as improve quality of life generally.

Preparing for Extreme Precipitation

Given that **spring and winter precipitation is expected to increase between 13% and 20% across the state of Indiana, with more of this precipitation falling as rain[iii],** and that **42% of the amount of rain Indiana receives is already falling in heavier downpours**[iv], consider these recommended actions, for which Tippecanoe County marked level 2 or lower:

- 8C: Install back-up power options for critical facilities and systems - Most critical facilities and systems rely on energy to operate. During and after extreme weather, power grids are likely to fail, rendering critical infrastructure unusable.

- 14C: Identify and protect erosion-prone areas - As heavy precipitation events become more intense, erosion is becoming more common along rivers, lakes, and streams. Local governments can take erosion and stream and river migration into account when determining setback requirements.

Preparing for River Flooding

Given that **11,943 acres (35%) of Tippecanoe County's floodplain is developed[v]**, consider these recommended actions, for which Tippecanoe County marked level 2 or lower:

- 6F: Develop a debris management plan to direct post-flood response - Climate change will lead to more frequent and intense storms that may put communities and sites at risk that have not been previously impacted by flooding. More powerful storms may also generate large amounts of debris that will need to be appropriately managed.

- 14B: Measure, maintain, protect, and expand green spaces, and identify public land available for improved ecological management - Climate change has already impacted the types of trees suitable for urban areas and rural forests in Indiana, and will continue to affect the tree species that are able to survive in the region. Depending on the region, changes in temperatures and precipitation are expected to reduce habitat suitability for some species and increase habitat suitable for others.

- 15A: Complete the USEPA's Flood Resilience Checklist - The USEPA has developed the "Flood Resilience Checklist" to help local governments understand their preparedness for flood events. The checklist includes overall strategies to improve flood resilience as well as specific strategies to conserve land and discourage development in river corridors; to protect people, businesses, and facilities in vulnerable settlements; to direct development to safer areas; and to implement and coordinate stormwater management practices throughout the whole watershed.

- 15B: Participate in the National Flood Insurance Program Community Rating System - The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program offered by the Federal Emergency Management Agency (FEMA) that recognizes and encourages community floodplain management activities that exceed the minimum requirements.

Conclusion

This report includes many actions Tippecanoe County should consider when outlining strategies to prepare for climate change. While this list may seem overwhelming, taking action is vital. Delaying preparedness will make it harder and more expensive to recover from the impacts of climate change later on. See Appendix B for a list of funding opportunities and case studies demonstrating how your peers are adapting to climate change.

In addition to taking specific steps to increase your community's preparedness for climate change, consider tracking and reducing greenhouse gas emissions released by local government operations and across the jurisdiction. Through worldwide efforts to reduce these climate-change-causing emissions, everyone, in every country, will experience less intense climate change impacts.

As you continue down the path toward climate resilience, ensure that the most vulnerable residents in your community are protected and prepared. These individuals are often hit first and hardest.

Lastly, remember that you do not need to do this work all on your own. Everyone, including residents and businesses, has a role to play in addressing climate change. Contact the Environmental Resilience Institute for guidance on these efforts.

About the Environmental Resilience Institute

Indiana University's Environmental Resilience Institute brings together a broad, bipartisan coalition of government, business, nonprofit and community leaders to help Indiana better prepare for the challenges that environmental changes bring to our economy, health, and livelihood. In collaboration with partners across the state, the institute is working to deliver tailored and actionable solutions to Indiana communities.

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Appendix A – Readiness Assessment Impacts

Worksheet	Impact
Built Environment	Impact 1: Increased stress on roadways, bridges, and transportation systems
	Impact 2: Increased likelihood of river and surface flooding in developed areas
	Impact 3: Increased likelihood of impacts on stormwater management infrastructure
Economic Development	Impact 4: Increased likelihood of climate change impacting the local economy and low-income residents
Emergency Management	Impact 5: Increased stress on existing communication systems during extreme weather
	Impact 6: Increased strain on government services, critical facilities, resources, and emergency infrastructure
	Impact 7: Increased impacts on residents during and after flood and heat events
Energy and Public Utilities	Impact 8: Increased likelihood of power supply issues
	Impact 9: Increased likelihood of impacts on drinking water sources and distribution infrastructure
	Impact 10: Increased stress on wastewater treatment systems
Food and Agriculture	Impact 11: Increased likelihood of short-term and long-term food shortages of the local and global food supply
Natural Resources	Impact 12: Increased likelihood of impacts on the health and beneficial functionality of inland wetlands and waterways
	Impact 13: Threatened habitat, breeding, and survival of sensitive species
	Impact 14: Affected health and beneficial functionality of rural and urban forests, and other natural green spaces
Planning and Land Use	Impact 15: More frequent floodplain inundations and surface flooding
	Impact 16: Increased warm season temperatures in developed areas
	Impact 17: Threatened habitat for sensitive species
	Impact 18: Increased likelihood of anticipated and unanticipated impacts of climate change
Public Health and Safety	Impact 19: Increased likelihood of illnesses from increased outdoor air pollution
	Impact 20: Increased likelihood of illnesses from increased indoor air pollution
	Impact 21: Increased likelihood of heat related illnesses
	Impact 22: Increased likelihood of illnesses from disease carrying vectors (such as mosquitoes and ticks)

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Appendix B. Resources to Help You Get Started

The Hoosier Resilience Index Readiness Assessment is designed to be the beginning of a long-term process for building resilience in your community. Below are a funding and case study resources from the Environmental Resilience Institute Toolkit (ERIT) to help you continue down this path. Additional resources, including online trainings, tools, a list of adaptation strategies, and more is available at https://eri.iu.edu/erit/.

Funding Sources and Technical Assistance Resources

The chart below provides funding opportunities that may help Tippecanoe County start some of the actions listed under "Prioritizing Actions," above. More information about these opportunities, all with additional grant opportunities, is available at https://eri.iu.edu/erit/funding/index.html.

Preparedness Action Items	**Funding Opportunities**
Preparing for Social and Financial Burdens	
4A: Evaluate how climate change impacts could affect the local economy	Partners for Places – Partners for Places is a matching grant program for cities and counties that assist in projects for the environment, economy, and communities with a 1:1 match required.
4D: Establish a protocol for providing assistance to residents that may face finance strain caused by climate hazards	(None located to date)
7C: Enhance community networks and connections for vulnerable communities	(None located to date)
8D: Establish a protocol for providing assistance to residents who may face financial strain caused by higher energy costs	(None located to date)
11B: Develop a plan to address local and global food supply emergencies	Smart Growth Technical Assistance Programs -

	These programs offer technical assistance for expanding broadband, developing local food action plans, and more.
11C: Increase local food purchasing	Smart Growth Technical Assistance Programs - These programs offer technical assistance for expanding broadband, developing local food action plans, and more.
18C: Integrate funding for readiness actions into financial planning	Indiana Emergency Management Performance Grants (EMPG) - These grants are available to local, state, territorial, and tribal governments and can be used for preparation for all hazards. FEMA Hazard Mitigation Grant Program - Local and state governments, territories, and federally-recognized tribes can apply to this program to enact mitigation measures that reduce the risk of loss of life and property from future disasters. Building Resilient Infrastructure and Communities - This grant will support states, local communities, tribes, and territories as they undertake hazard mitigation projects to reduce the risks they face from disasters and natural hazards. FEMA Pre-Disaster Mitigation Grant Program - Local and state governments, territories, and federally-recognized tribes can apply to this program for planning and project grants that seek to reduce future losses before disaster strikes.
Preparing for Extreme Heat Events	
1A: Prepare roadways and bridges for higher maximum temperatures and more freeze-thaw events	Community Crossings Matching Grant - Provides funding to cities, towns, and counties across Indiana to make improvements to local roads and bridges. Eligible projects could include road resurfacing and preservation, bridge rehabilitation or replacement, and more.
6B: Identify and protect critical infrastructure from higher temperatures	Georgetown Climate Center Federal Funding Compendium for Urban Heat Adaptation -

	Although it was published in 2013, this resource aggregates and analyzes some current federal programs with potential to pay for state and local government adaptation to urban heat islands, including with infrastructure. FEMA Building Resilient Infrastructure and Communities (BRIC) - This grant supports states, local communities, tribes, and territories as they undertake hazard mitigation projects to reduce the risks they face from disasters and natural hazards.
6C: Involve critical facility and emergency infrastructure managers in climate change preparedness and management	(None located to date)
7A: Educate residents about steps they can take to improve personal emergency preparedness	Indiana Emergency Management Performance Grants (EMPG) - These grants are available to local, state, territorial, and tribal governments and can be used for preparation for all hazards.
7B: Identify and prepare for hazardous conditions that could occur from higher temperatures and floods	Hazardous Materials Emergency Preparedness (HMEP) Grant Program - HMEP grants are used to develop, improve, and implement emergency plans. Indiana Emergency Management Performance Grants (EMPG) - These grants are available to local, state, territorial, and tribal governments and can be used for preparation for all hazards. FEMA Pre-Disaster Mitigation Grant Program - Local and state governments, territories, and federally-recognized tribes can apply to this program for planning and project grants that seek to reduce future losses before disaster strikes.
8A: Work internally and with the local utility to increase power supply preparedness	DOE State Energy Program Competitive Financial Assistance Program - This program provides funding and technical assistance to states and territories to enhance energy security, advance state-led energy initiatives, and decrease energy waste.

9C: Improve efficiency of water use in local government operations	Creating Resilient Water Utilities - This resource provides water utility managers with tools, training and technical assistance needed to adapt to climate change. Water Infrastructure and Resiliency Finance Center - This USEPA resource provides financial expertise to communities that are financing drinking water, wastewater, and stormwater infrastructure.
9D: Develop a drought protection and response plan	WaterSMART Drought Response Program: Drought Contingency Planning Grants - This opportunity from the US Department of Interior is for states, tribes, irrigation districts, water districts, and other organizations to leverage their money and resources by cost-sharing drought contingency planning with Reclamation to build resilience to drought in advance of a crisis.
9E: Ensure back-up energy systems are in place for maintaining access to drinking water	(None located to date)
11E: Support efforts to protect pollinators	Funding Opportunities for Establishing Pollinator Habitat - A mixture of funding opportunities with some that are applicable to local governments and others that can passed along to private landowners.
13A: Promote habitat restoration through native landscaping and conservation on public and private property	USDA Agricultural Management Assistance Program - Technical and financial assistance is available to diversify operations and conservation practices including soil erosion control. USDA Conservation Innovation Grants - These grants are awarded to non-Federal governmental or non-governmental organizations, tribes, or individuals for the development and adoption of innovative approaches and technologies for conservation on agricultural lands. Natural Resources Conservation Service Technical Assistance -

	Assistance can help improve land management, water quality, habitat, recreational areas, agricultural operations, etc. and may be in the form of resource assessment, practice design, resource monitoring, or follow-up of installed practices.
13C: Encourage continuous blocks of forests and avoid fragmentation	National Fish Passage Program - This program provides funding to support improving fish passages by reconnecting fragmented habitat. National Park Service Land and Water Conservation Fund - This program provides matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities. DOT Transportation Alternatives Program - The Transportation Alternatives program provides funding to local and state governments to pursue environmental mitigation related to stormwater and habitat connectivity.
13D: Identify and protect ecologically significant ("critical") areas such as nursery grounds, spawning grounds, and areas of high species diversity	National Fish Passage Program - This program provides funding to support improving fish passages by reconnecting fragmented habitat. Model Forest Policy Program Implementation Assistance - This program is available to communities who have already assessed climate risks and identified resilience goals. MFPP assists communities with implementing adaptation goals. National Park Service Land and Water Conservation Fund - This program provides matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities. Lake and River Enhancement Program -

	This program helps protect and enhance aquatic habitat for fish and wildlife, and to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses. IDEM Clean Water Act Section 319(h) Grants - These grants are for projects that reduce documented non-point source water quality impairments. IDEM Clean Water Act Section 205(j) Grants - These grants are for water quality management planning to determine the nature, extent, and causes of point and non-point source pollution problems, as well as develop plans to resolve these problems. IDEM Pollution Prevention Grants - These grants are to encourage Indiana organizations to implement pollution prevention and source reduction projects and activities that will result in measurable environmental improvements. Great Lakes Restoration Initiative - This initiative is for nonpoint source projects in categories addressing agricultural nutrients and stormwater runoff.
14A: Measure, maintain, protect, and expand the jurisdiction's tree canopy	Model Forest Policy Program Implementation Assistance - This program is available to communities who have already assessed climate risks and identified resilience goals. MFPP assists communities with implementing adaptation goals. National Park Service Land and Water Conservation Fund - This program provides matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities. USDA Agricultural Management Assistance Program -

	This program is available to agricultural land (government parcels or not) and nonindustrial private forest land. Technical and financial assistance to construct or improve water management or irrigation structures, plant trees for windbreaks, or diversify their operation and conservation practices.
16A: Pass a tree canopy ordinance	Model Forest Policy Program Implementation Assistance - This program is available to communities who have already assessed climate risks and identified resilience goals. MFPP assists communities with implementing adaptation goals, including drafting and passing a tree ordinance. National Park Service Land and Water Conservation Fund - This program provides matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities. Georgetown Climate Center Federal Funding Compendium for Urban Heat Adaptation - Although it was published in 2013, this resource aggregates and analyzes some current federal programs with potential to pay for state and local government adaptation to urban heat islands.
16B: Designate vegetation protection areas	DOT Transportation Alternatives Program - The Transportation Alternatives program provides funding to local and state governments to pursue community improvements such as vegetation management. USDA Agricultural Management Assistance Program - This opportunity is appropriate after land has been designated for protection. This program is available to agricultural land (government parcels or not) and nonindustrial private forest land. Technical and financial assistance is provided to plant trees for windbreaks or diversify operation and conservation practices. Georgetown Climate Center Federal Funding Compendium for Urban Heat Adaptation -

	Although it was published in 2013, this resource aggregates and analyzes some current federal programs with potential to pay for state and local government adaptation to urban heat islands.
16C: Promote energy efficiency and waste heat reduction	DOE State Energy Program Competitive Financial Assistance Program - This program provides funding and technical assistance to states and territories to enhance energy security, advance state-led energy initiatives, and decrease energy waste. Georgetown Climate Center Federal Funding Compendium for Urban Heat Adaptation - Although it was published in 2013, this resource aggregates and analyzes some current federal programs with potential to pay for state and local government adaptation to urban heat islands.
17A: Integrate habitat protection strategies into zoning codes, comprehensive plans, and ordinances	National Fish Passage Program - This program provides funding to support improving fish passages by reconnecting fragmented habitat. Wildlife Conservation Society Climate Adaptation Fund - This program provides $50,000-250,000 awards to conservation nonprofits across the country to catalyze 1-2 year science-driven projects responding to the impacts of climate change on wildlife and people. National Park Service Land and Water Conservation Fund - This program provides matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities. Lake and River Enhancement Program - The Indiana Division of Fish and Wildlife's Lake and River Enhancement (LARE) Program is to protect and enhance aquatic habitat for fish and wildlife, and to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities.

	Natural Resources Conservation Service Technical Assistance - Assistance can help improve land management, water quality, habitat, recreational areas, agricultural operations, etc. and may be in the form of resource assessment, practice design, resource monitoring, or follow-up of installed practices.
18B: Conduct a greenhouse gas inventory and develop a plan to reduce emissions	(None located to date)
19A: Educate residents about the health impacts of poor air quality and provide an effective advance warning program for elevated pollution days	(None located to date)
19B: Develop and implement a plan for high air pollution days that calls for both public and private action	(None located to date)
19C: Develop local air pollution reduction programs	Indiana Volkswagen Environmental Mitigation Trust Program - This program provides grant opportunities for clean air projects that will significantly reduce diesel emissions across Indiana. DOT Congestion Mitigation and Air Quality Improvement (CMAQ) Program - The CMAQ program provides flexible funding to local and state governments for transportation projects and programs to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards (nonattainment areas) or maintenance areas.
21A: Educate about heat related illness and prevention	Georgetown Climate Center Federal Funding Compendium for Urban Heat Adaptation - Although it was published in 2013, this resource aggregates and analyzes some current federal programs with potential to pay for state and local government adaptation to urban heat islands.
21B: Conduct a heat vulnerability assessment and develop a heat management plan	Georgetown Climate Center Federal Funding Compendium for Urban Heat Adaptation -

	Although it was published in 2013, this resource aggregates and analyzes some current federal programs with potential to pay for state and local government adaptation to urban heat islands.
21C: Implement programs or activities that reduce heat impacts in the built environment	Georgetown Climate Center Federal Funding Compendium for Urban Heat Adaptation - Although it was published in 2013, this resource aggregates and analyzes some current federal programs with potential to pay for state and local government adaptation to urban heat islands. Model Forest Policy Program Implementation Assistance - This program is available to communities who have already assessed climate risks and identified resilience goals. MFPP assists communities with implementing adaptation goals. National Park Service Land and Water Conservation Fund - This program provides matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities.
Preparing for Extreme Precipitation Events	
8C: Install back-up power options for critical facilities and systems	DOE State Energy Program Competitive Financial Assistance Program - This program provides funding and technical assistance to states and territories to enhance energy security, advance state-led energy initiatives, and decrease energy waste.
14C: Identify and protect erosion	USDA Agricultural Management Assistance Program - Technical and financial assistance to construct or improve water management or irrigation structures, plant trees for windbreaks or, diversify their operation and conservation practices including soil erosion control, integrated pest management or transition to organic farming.
Preparing for River Flooding	

6F: Develop a debris management plan to direct post-flood response	FEMA Pre-Disaster Mitigation Grant Program - Local and state governments, territories, and federally-recognized tribes can apply to this program for planning and project grants that seek to reduce future losses before disaster strikes.
14B: Measure, maintain, protect, and expand green spaces, and identify public land available for improved ecological management	National Fish Passage Program - This program provides funding to support improving fish passages by reconnecting fragmented habitat. Wildlife Conservation Society Climate Adaptation Fund - This program provides $50,000-250,000 awards to conservation nonprofits across the country to catalyze 1-2 year science-driven projects responding to the impacts of climate change on wildlife and people. National Park Service Land and Water Conservation Fund - This program provides matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities. USDA Conservation Innovation Grants - These grants are awarded to non-Federal governmental or non-governmental organizations, tribes, or individuals for the development and adoption of innovative approaches and technologies for conservation on agricultural lands.
15A: Complete the USEPA's Flood Resilience Checklist	FEMA Flood Mitigation Assistance Grant Program - Local and state governments, territories, and federally-recognized tribes can apply to this program for projects and planning that reduces or eliminates long-term risk of flood damage to structure insured under the National Flood Insurance Program.
15B: Participate in the National Flood Insurance Program Community Rating System	FEMA Flood Mitigation Assistance Grant Program - Local and state governments, territories, and federally-recognized tribes can apply to this program for projects and planning that reduces or eliminates long-term risk of flood damage to structure insured under the National Flood Insurance Program.

Case Studies

The chart below provides case studies that demonstrate how other Midwestern local governments have completed these initiatives. A database of these and other case studies is available at https://eri.iu.edu/erit/case-studies/index.html.

Preparedness Action Items	Case Studies
Preparing for Social and Financial Burdens	
4A: Evaluate how climate change impacts could affect the local economy	(No case study yet. Please tell us if you know of an existing program we can cover)
4D: Establish a protocol for providing assistance to residents that may face finance strain caused by climate hazards	(No case study yet. Please tell us if you know of an existing program we can cover)
7C: Enhance community networks and connections for vulnerable communities	(No case study yet. Please tell us if you know of an existing program we can cover)
8D: Establish a protocol for providing assistance to residents who may face financial strain caused by higher energy costs	Cincinnati Energy Aggregation Program Reduces Utility Costs and Supports Renewable Energy
11B: Develop a plan to address local and global food supply emergencies	(No case study yet. Please tell us if you know of an existing program we can cover)
11C: Increase local food purchasing	Fredericktown, Missouri Prepares for Climate Change Drought Risk
18C: Integrate funding for readiness actions into financial planning	Grand Rapids, Michigan Includes Sustainability as a Core Part of its Strategic Plan
Preparing for Extreme Heat Events	
1A: Prepare roadways and bridges for higher maximum temperatures and more freeze-thaw events	(No case study yet. Please tell us if you know of an existing program we can cover)
6B: Identify and protect critical infrastructure from higher temperatures	(No case study yet. Please tell us if you know of an existing program we can cover)

6C: Involve critical facility and emergency infrastructure managers in climate change preparedness and management	Minnesota Assesses Climate Risk to Public Health
7A: Educate residents about steps they can take to improve personal emergency preparedness	(No case study yet. Please tell us if you know of an existing program we can cover)
7B: Identify and prepare for hazardous conditions that could occur from higher temperatures and floods	(No case study yet. Please tell us if you know of an existing program we can cover)
8A: Work internally and with the local utility to increase power supply preparedness	Vigo County, Indiana Improves Resilience to Energy Disruptions with Solar Power
9C: Improve efficiency of water use in local government operations	Fredericktown, Missouri Prepares for Climate Change Drought Risk
9D: Develop a drought protection and response plan	The City of Decatur, Illinois Implements Drought Mitigation Efforts to Protect Their Water Supply and Economy Fredericktown, Missouri Prepares for Climate Change Drought Risk
9E: Ensure back-up energy systems are in place for maintaining access to drinking water	Cincinnati, Ohio Amends Zoning Code to Support Urban Agriculture
11E: Support efforts to protect pollinators	Jennings County, Indiana Creates 600 New Pollinator Habitat Locations
13A: Promote habitat restoration through native landscaping and conservation on public and private property	Bloomington, Indiana Naturalizes Creek Bank to Manage Stormwater and Establish Native Plants Corydon, Indiana Removes Two Dams to Restore Ecosystem Health and Water Quality Gary, Indiana Installs Green Infrastructure to Revitalize Blighted Areas, Manage Stormwater

	The City of St. Louis Park, Minnesota Increases Green Infrastructure on Residential Properties
13C: Encourage continuous blocks of forests and avoid fragmentation	(No case study yet. Please tell us if you know of an existing program we can cover)
13D: Identify and protect ecologically significant ("critical") areas such as nursery grounds, spawning grounds, and areas of high species diversity	Lake County, Illinois Stormwater Commission Develops a Tool to Support Wetland Restoration Planning
14A: Measure, maintain, protect, and expand the jurisdiction's tree canopy	Gary, Indiana Installs Green Infrastructure to Revitalize Blighted Areas, Manage Stormwater Iowa City, Iowa Removes Vulnerable Wastewater Treatment Facility
16A: Pass a tree canopy ordinance	(No case study yet. Please tell us if you know of an existing program we can cover)
16B: Designate vegetation protection areas	Indianapolis, Indiana Converts Streetlamps to LED
16C: Promote energy efficiency and waste heat reduction	(No case study yet. Please tell us if you know of an existing program we can cover)
17A: Integrate habitat protection strategies into zoning codes, comprehensive plans, and ordinances	Cincinnati Inventories Greenhouse Gas Emissions to Help with Reduction Targets Fishers, Indiana measures Greenhouse Gas Emissions to Plan for Reduction Strategies
18B: Conduct a greenhouse gas inventory and develop a plan to reduce emissions	(No case study yet. Please tell us if you know of an existing program we can cover)

19A: Educate residents about the health impacts of poor air quality and provide an effective advance warning program for elevated pollution days	(No case study yet. Please tell us if you know of an existing program we can cover)
19B: Develop and implement a plan for high air pollution days that calls for both public and private action	Cincinnati Creates an Air Quality Advisory Action Plan for City Operations
19C: Develop local air pollution reduction programs	Cincinnati Creates an Air Quality Advisory Action Plan for City Operations School District in East Chicago, Indiana, Purchases Propane Buses to Address Local Public Health Concerns
21A: Educate about heat related illness and prevention	(No case study yet. Please tell us if you know of an existing program we can cover)
21B: Conduct a heat vulnerability assessment and develop a heat management plan	(No case study yet. Please tell us if you know of an existing program we can cover)
21C: Implement programs or activities that reduce heat impacts in the built environment	(No case study yet. Please tell us if you know of an existing program we can cover)
Preparing for Extreme Precipitation	
8C: Install back-up power options for critical facilities and systems	(No case study yet. Please tell us if you know of an existing program we can cover)
14C: Identify and protect erosion	Bloomington, Indiana Naturalizes Creek Bank to Manage Stormwater and Establish Native Plants Experts in Northwest Indiana Create an Adaptation Plan to Protect the Indiana Dunes
Preparing for River Flooding	

6F: Develop a debris management plan to direct post-flood response	Northeast Indiana Counties Collaborate to Develop Debris Management Plans
14B: Measure, maintain, protect, and expand green spaces, and identify public land available for improved ecological management	The City of St. Louis Park, Minnesota Increases Green Infrastructure on Residential Properties Two Midwestern Counties Adopt Incentive System to Reduce Runoff and Improve Flood Resilience in Agricultural Watersheds
15A: Complete the USEPA's Flood Resilience Checklist	(No case study yet. Please tell us if you know of an existing program we can cover)
15B: Participate in the National Flood Insurance Program Community Rating System	(No case study yet. Please tell us if you know of an existing program we can cover)

[i] Multihazard Mitigation Council (2018). Natural Hazard Mitigation Saves: 2018 Interim Report. Principal Investigator Porter, K.; co-Principal Investigators Scawthorn, C.; Huyck, C.; Investigators: Eguchi, R., Hu, Z.; Reeder, A; Schneider, P., Director, MMC. National Institute of Building Sciences, Washington, D.C. www.nibs.org.

[ii] Hoosier Resilience Index, "Climate Vulnerability: TEMPLATE, IN." Retrieved Jan 2, 2021, from https://hri.eri.iu.edu/climate-vulnerability/index.html?placeid=TEMPLATE#climateExpoHead.

[iii] Widhalm, M., Hamlet, A. Byun, K., Robeson, S., Baldwin, M., Staten, P., Chiu, C., Coleman, J., Hall, B., Hoogewind, K., Huber, M., Kieu, C., Yoo, J., Dukes, J.S. 2018. Indiana's Past & Future Climate: A Report from the Indiana Climate Change Impacts Assessment. Purdue Climate Change Research Center, Purdue University. West Lafayette, Indiana. https://bit.ly/2KDsaga.

[iv] Ibid.

[v] Hoosier Resilience Index, "Climate Vulnerability: TEMPLATE, IN." Retrieved Jan 2, 2021, from https://hri.eri.iu.edu/climate-vulnerability/index.html?placeid=TEMPLATE#climateExpoHead.

APPENDIX E: CDC VULNERABILITY ASSESSMENT

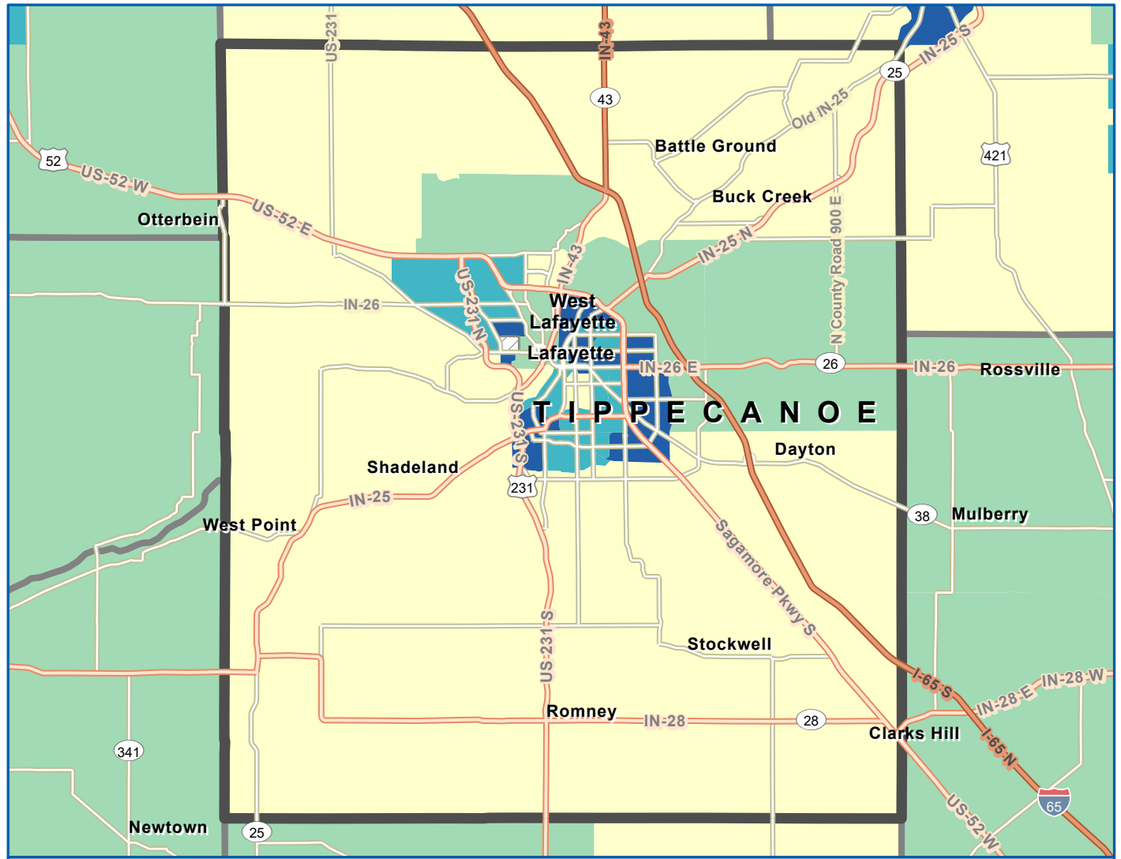


CDC Social Vulnerability Index 2018

Tippecanoe County, Indiana

PART 1

Overall Social Vulnerability[1]



Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Data Unavailable[3]

0 1.25 2.5 5 7.5
Miles

Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human-caused threats, such as toxic chemical spills. The **CDC Social Vulnerability Index (CDC SVI 2018)[4] County Map** depicts the social vulnerability of communities, at census tract level, within a specified county. CDC SVI 2018 groups **fifteen census-derived factors** into **four themes** that summarize the extent to which the area is socially vulnerable to disaster. The factors include economic data as well as data regarding education, family characteristics, housing, language ability, ethnicity, and vehicle access. Overall Social Vulnerability combines all the variables to provide a comprehensive assessment.

MAP PRODUCED 3/24/2020

GRASP

Agency for Toxic Substances and Disease Registry

Division of Toxicology and Human Health Sciences

ATSDR

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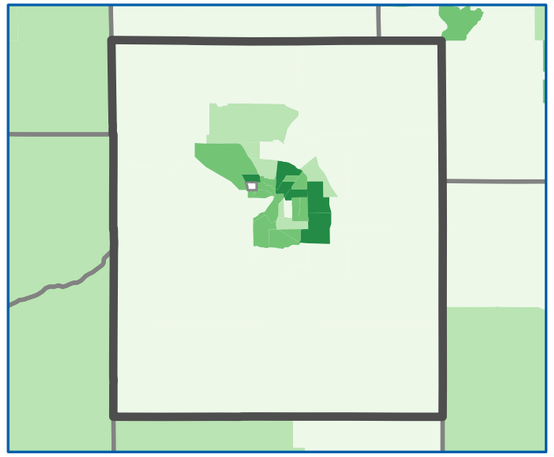
CDC SVI 2018 – TIPPECANOE COUNTY, INDIANA

PART 2

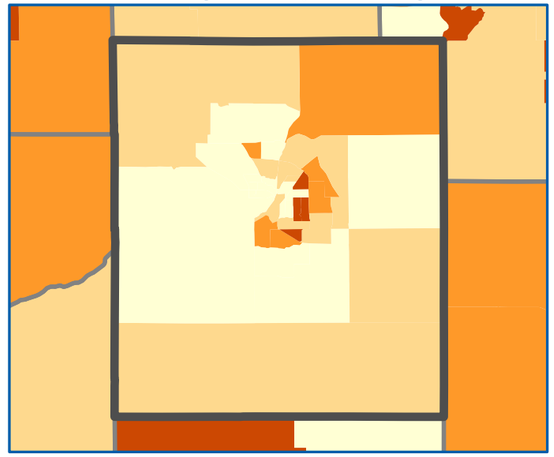
CDC SVI Themes

Socioeconomic Status[5]



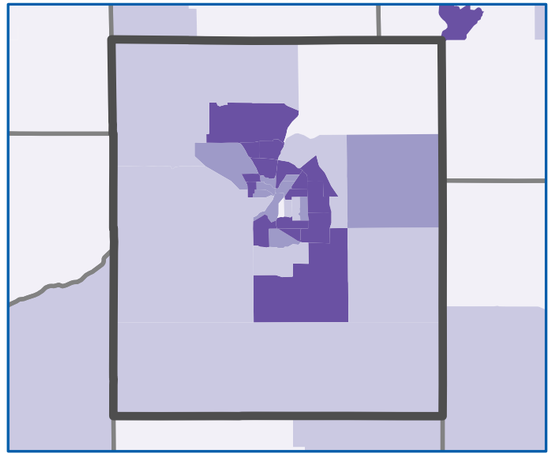
Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Household Composition/Disability[6]



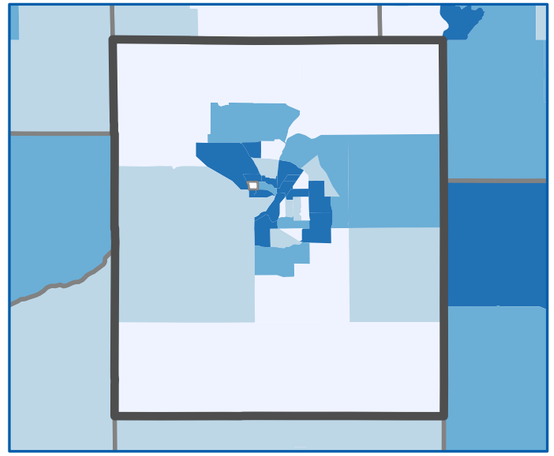
Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Race/Ethnicity/Language[7]



Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Housing Type/Transportation[8]



Highest (Top 4th) — Vulnerability (SVI 2018)[2] — Lowest (Bottom 4th)

Data Sources: [2]CDC/ATSDR/GRASP, U.S. Census Bureau, Esri® StreetMapTM Premium.

Notes: [1]Overall Social Vulnerability: All 15 variables. [3]Census tracts with 0 population. [4]The CDC SVI combines percentile rankings of US Census American Community Survey (ACS) 2014-2018 variables, for the state, at the census tract level. [5]Socioeconomic Status: Poverty, Unemployed, Per Capita Income, No High School Diploma. [6]Household Composition/Disability: Aged 65 and Over, Aged 17 and Younger, Single-parent Household, Aged 5 and over with a Disability. [7]Race/Ethnicity/Language: Minority, English Language Ability. [8]Housing Type/Transportation: Multi-unit, Mobile Homes, Crowding, No Vehicle, Group Quarters.

Projection: WGS 1984 UTM Zone 16N.

References: Flanagan, B.E., et al., A Social Vulnerability Index for Disaster Management. *Journal of Homeland Security and Emergency Management*, 2011. 8(1).

CDC SVI web page: http://svi.cdc.gov.

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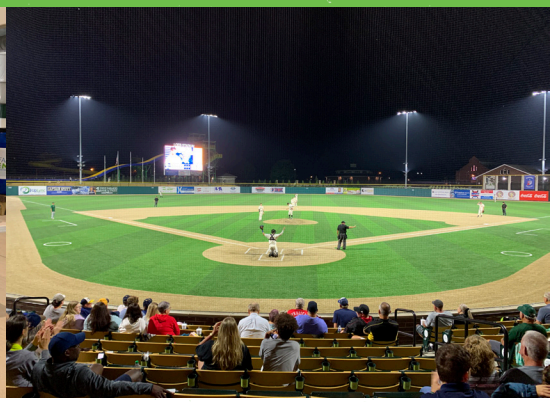
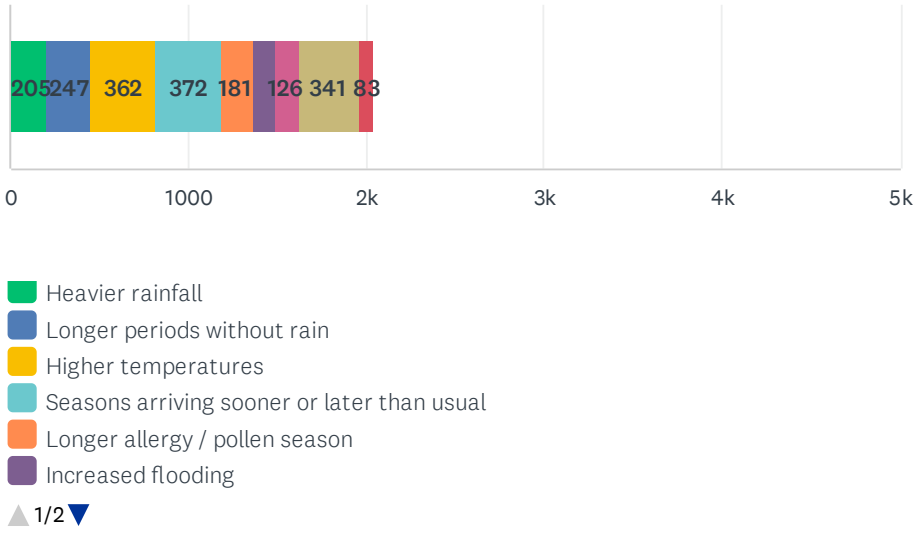
APPENDIX F: PUBLIC INPUT DOCUMENTS



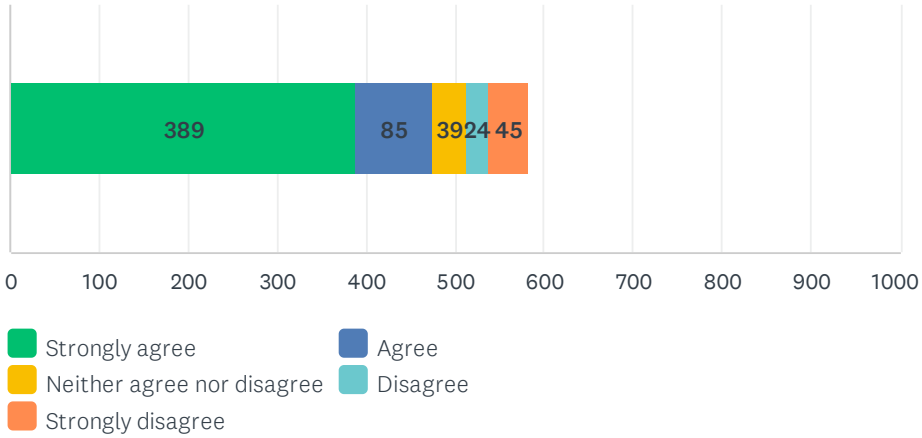
Q1 Have you noticed any of the following occurring more often in recent years? (Check all that apply)

Answered: 582 Skipped: 0



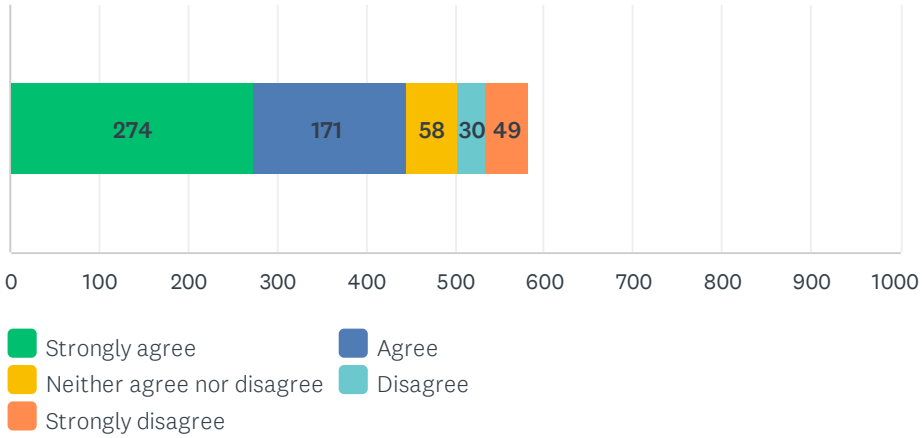
Q2 How much do you agree with the following statement? I am concerned about climate change.

Answered: 582 Skipped: 0



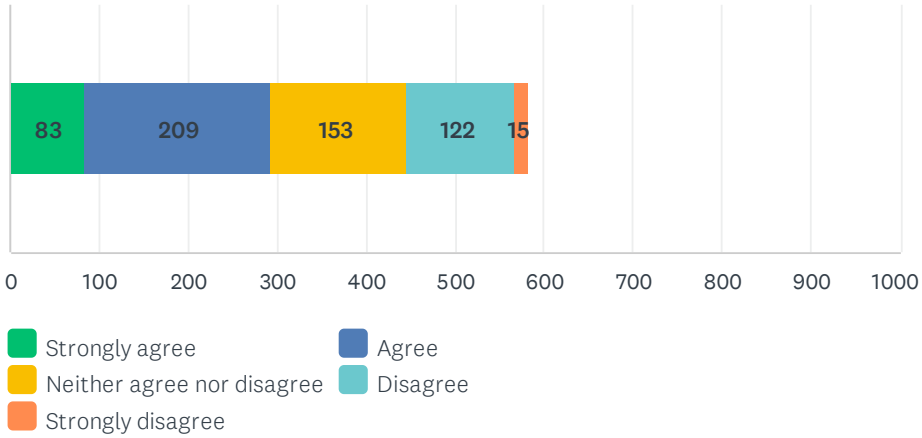
Q3 How much do you agree with the following statement? I believe I will be harmed by the impacts of climate change.

Answered: 582 Skipped: 0



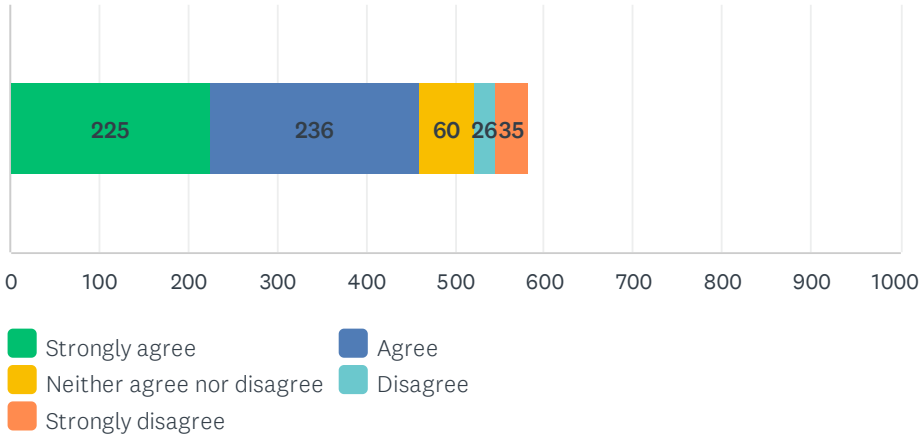
Q4 How much do you agree with the following statement? I am well informed on the impacts of climate change in Central Indiana.

Answered: 582 Skipped: 0



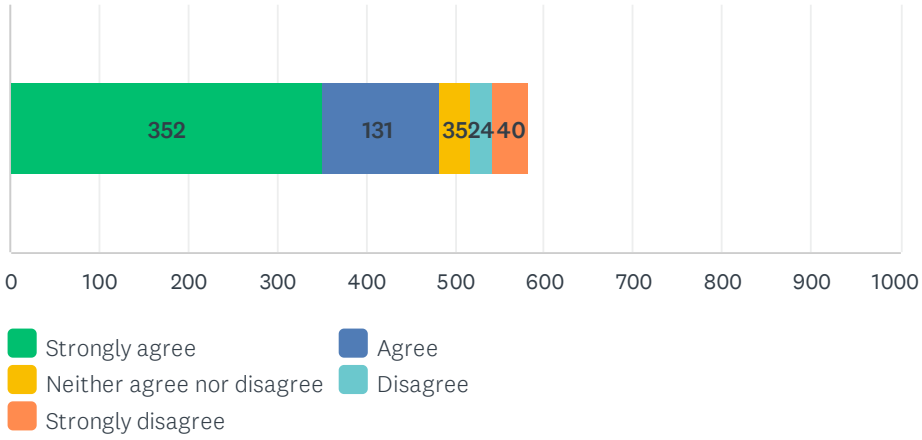
Q5 How much do you agree with the following statement? I feel a personal responsibility to reduce greenhouse gas emission.

Answered: 582 Skipped: 0



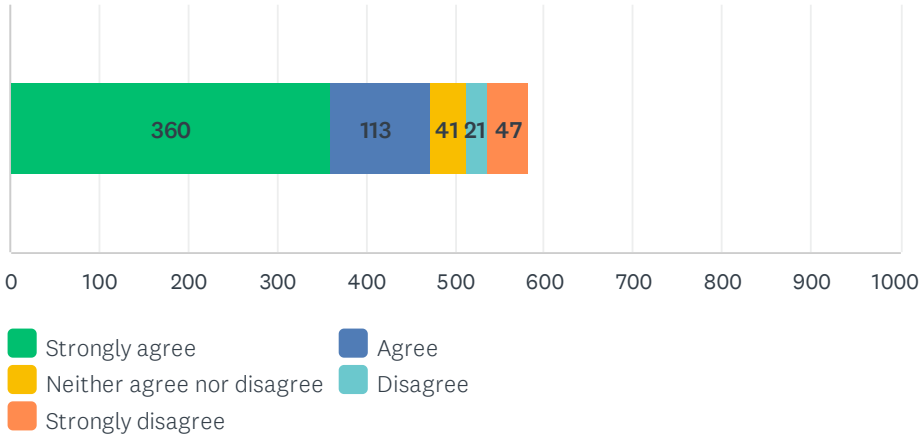
Q6 How much do you agree with the following statement? I believe it is important that Greater Lafayette take action to reduce greenhouse gas emissions.

Answered: 582 Skipped: 0



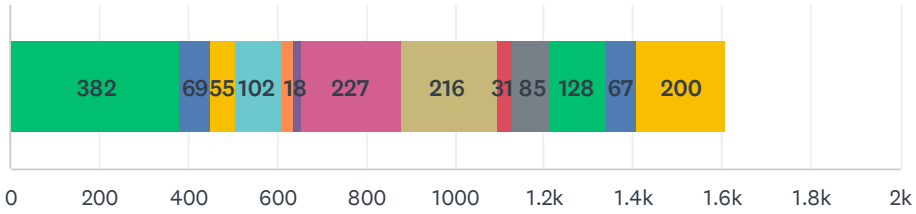
Q7 How much do you agree with the following statement? I believe it is important that Greater Lafayette take action to prepare for projected climate change.

Answered: 582 Skipped: 0



Q8 Of the following impacts of climate change, which are you most concerned about? (Select three)

Answered: 582 Skipped: 0

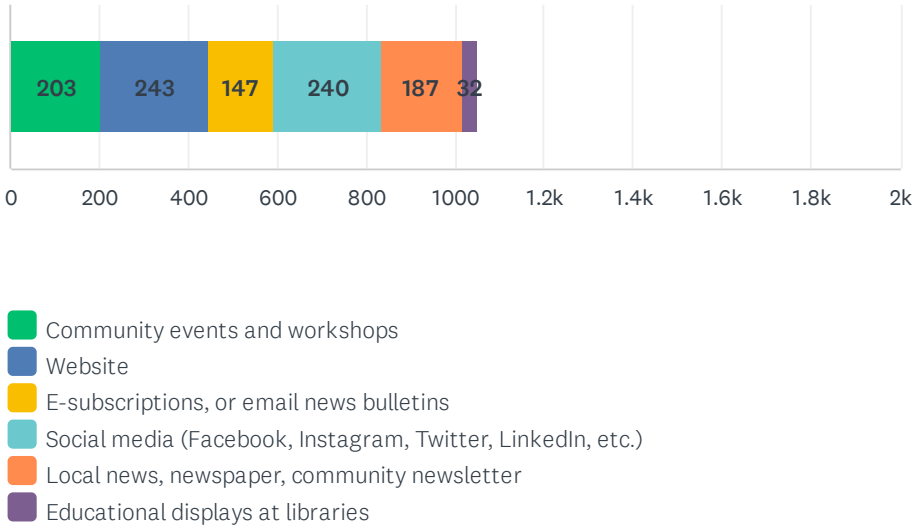


- Increase in extreme weather events (heat, cold, drought, flooding, tornadoes, etc.)
- More frequent power outages
- Increased demand for AC in the summer
- Costs associated with storm/disaster relief
- Decreased recreation due to decrease in water quality
- Decreased property value if located in a floodplain
- Air quality impacts
- Availability of clean drinking water
- Temperature-related illness

1/2

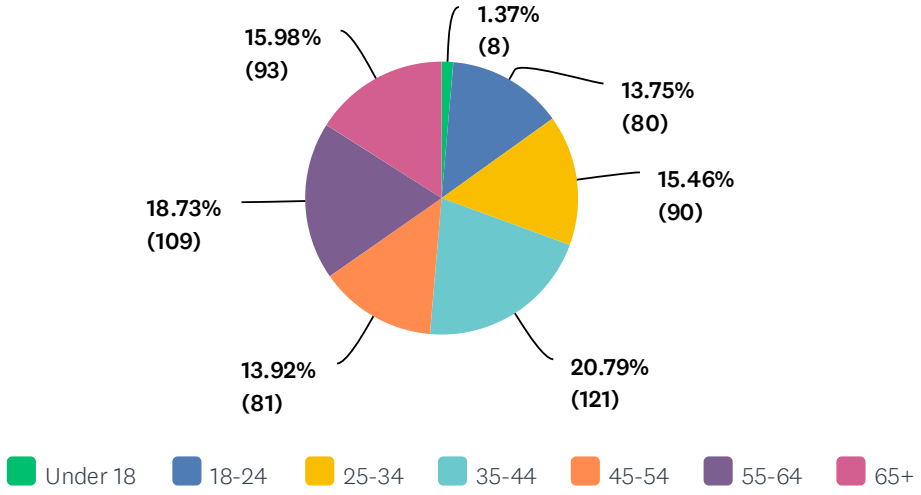
Q11 How would you want to learn more about the Greater Lafayette Climate Action Plan? Choose two.

Answered: 582 Skipped: 0



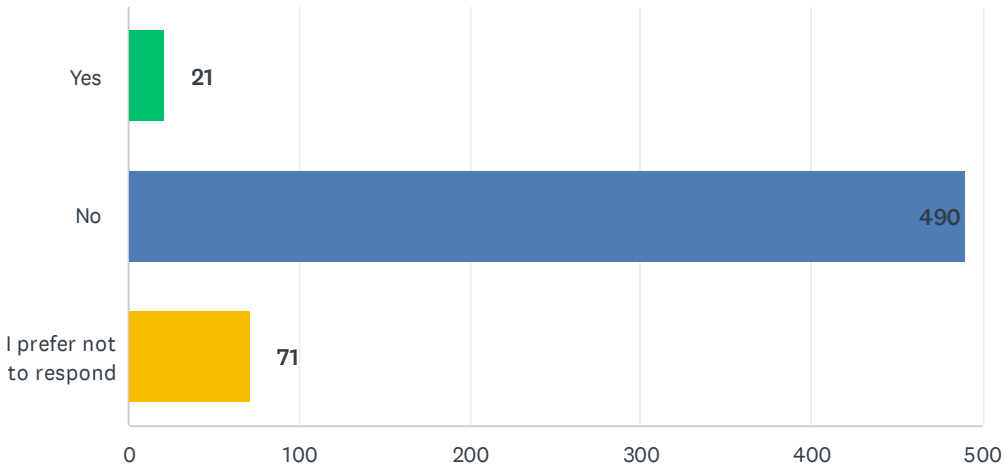
Q14 What age category describes you?

Answered: 582 Skipped: 0



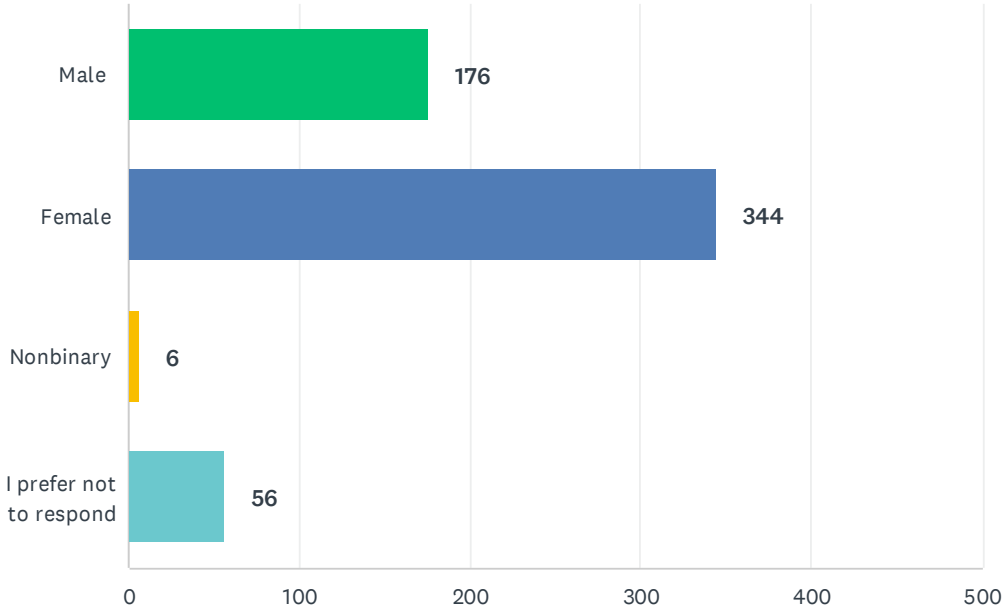
Q16 Do you identify as Hispanic or Latinx?

Answered: 582 Skipped: 0



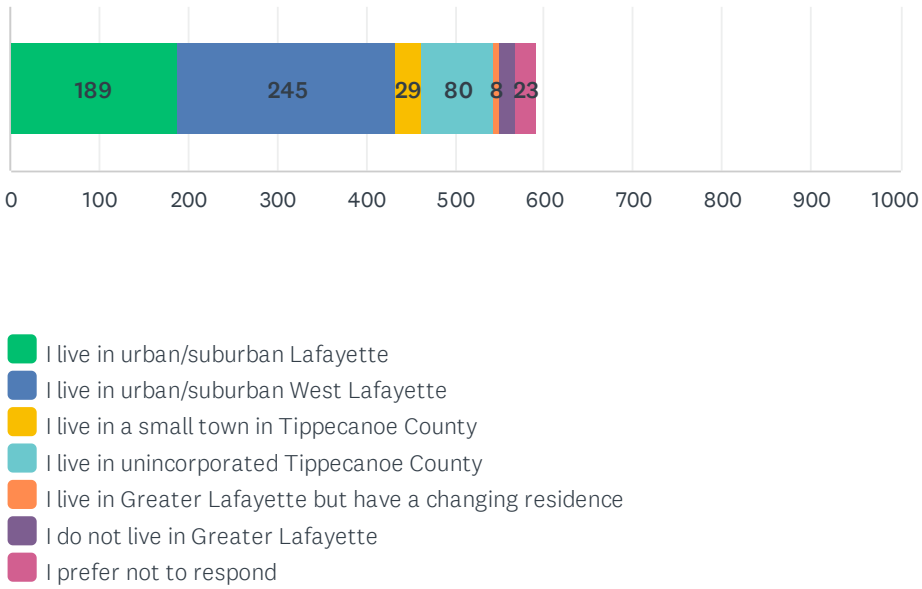
Q17 What is your gender?

Answered: 582 Skipped: 0



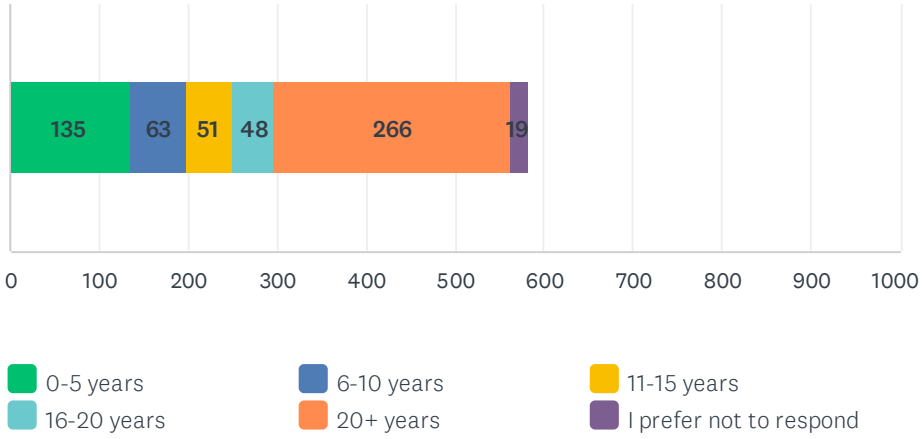
Q18 What is your affiliation with Greater Lafayette? (Select all that apply)

Answered: 582 Skipped: 0



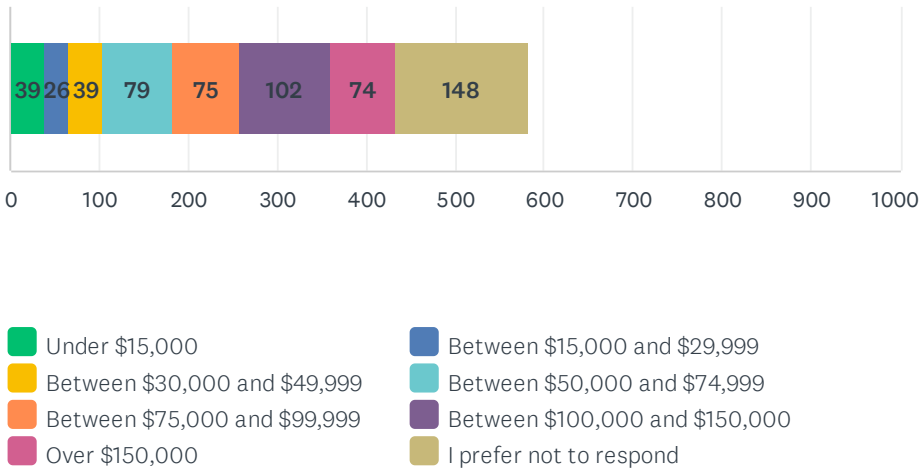
Q20 How long have you lived or worked in Greater Lafayette?

Answered: 582 Skipped: 0



Q21 What is your gross annual household income?

Answered: 582 Skipped: 0



APPENDIX G: CLIMATE CHANGE SOLUTIONS

CLIMATE ACTIONS:

How can we work towards climate change solutions as a community?

By starting a conversation with...

FRIENDS, FAMILY, COWORKERS, & NEIGHBORS

Average US Carbon Footprint

The average American has an average carbon footprint of:

20 metric tons CO_2/yr

(That's 5 times the average!)

Business as Usual Scenario

Lafayette would experience....

- ↑ Heat waves
- Worsened tornado season
- ↑ Flooding
- ↑ Polar vortex weather

...without any action.

CityBus System

Taking the bus for daily short trips can reduce carbon emissions by:

CityBus GREATER LAFAYETTE

328.5 kg/CO_2 per year per person

Other benefits to taking the bus:

- Less gas $$
- Reduces traffic
- No need to worry about parking
- Reduces car maintenance needs

Walking & Biking

Walking and biking is one of the healthiest ways to reduce carbon emissions!

Benefits to Walking & Biking:

- Improves cardiovascular health
- Saves on gas $$
- Improves mental health
- Near-net zero emissions

Reducing the Miles We Drive

The transportation sector accounts for:

14%

of global emissions.

Reducing Meat Consumption

Meat & dairy account for:

80%

of total food-related emissions

Reducing Food Waste

Food waste accounts for...

9.5-15%

of US households' greenhouse gas emissions.

TIP: Prioritize avoiding meat & dairy waste to further reduce emissions.

Substitutions

Concerned about getting enough protein without animals?

Try a new recipe with one of these protein sources!

Tofu | Beans | Nuts | Meat alternatives

TIP: Incorporating "Meatless Mondays" is a great way to try new things and reduce emissions!

Ways Greater Lafayette is Fighting Climate Change

Lobbying groups have been the most active in taking action on climate change in Lafayette.

Citizens' Climate Lobby

Actions fueled by activists & local organizations:
- Creation of the Greater Lafayette climate Action Plan
- Pledge from West Lafayette to fight climate change

Voting

Voting is the easiest way to make meaningful change in your community.

TIP: Register to vote a month before the election either on Indiana's election website, by mail, or in-person.

Reaching out to Legislators

Reaching out to tell your representatives why climate change is important to you makes a difference!

Reach out by:

Email | Mail | Phone

TIP: Research shows that more personal messages are taken more seriously.

Laundry

If 75% of America washed their clothes in cold water, that's equivalent to:

969,612 gasoline-powered cars off the road.

Hang drying your clothes could save you:

5.8% of your electricity bill

Heating & Cooling

Home heating systems represent:

42% of the average home electricity bill.

TIP: Cheap insulation like caulk & weatherstrips save 10% of your total energy costs. Also, programmable thermostats save an extra 10%!

Impacts of Changes in Your Home

If everyone in Lafayette did these 3 simple actions in their homes...

Washing clothes in cold water

Keeping the thermostat 1 degree colder in winter

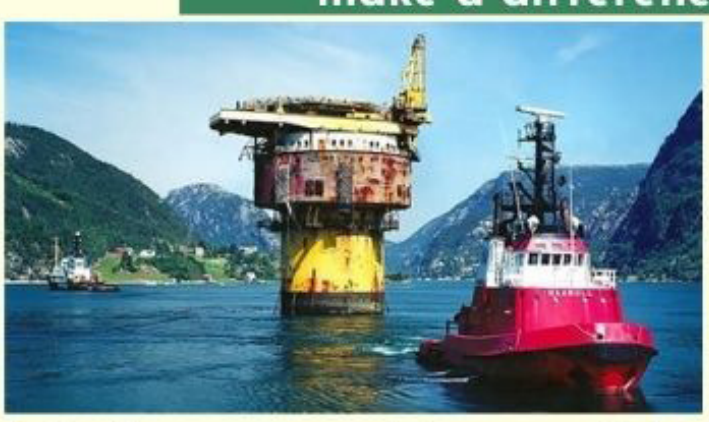
Switching 1 light bulb to an LED

...it would reduce carbon emissions by:

387.16 tons of CO_2

Impacts of Changes to Shopping Habits

Your decisions as a consumer make a difference!



In 1995, the Brent Spar Boycott dropped Shell's sales by:

50%

Action from consumer choices prevented Shell from dumping oil into the ocean.

Choosing to buy from environmentally ethical companies gives you the chance to make a positive impact on the planet!

Plastic Waste Reduction

Per year, the US plastic industry emits:

13,500,000 metric tons of CO_2

Green Businesses

Why support your local farmer's market?

LAFAYETTE FARMER'S MARKET SINCE 1839

- Supports local economy
- Freshest food
- Lowest carbon emissions due to transit

TIP: Look into other green businesses in Indiana working to combat climate change!

carbon neutral INDIANA

Whole Sun DESIGNS Homegrown Solar

APPENDIX H: ICON CREDITS

ICONS FROM THE NOUNPROJECT.COM

Thermometer icon by Fahmihorizon

CO_2 by Soremba

Thinking Process by Anna Sophie

Conversation by b farias

Target Arrow by Desainer Kanan

Wash hand by corpus delicti

Transportation by Icon Solutions

Factory by Zaenul yahya

House Solar panel by Laymik

Forest by Alina Oleynik

Megaphone by fauzan akbar

Sun by Alice Design

Factory Pollution by Gan Khoon Lay

Air Pollution by Soremba

Bats by RULI

Hunger by Nayeli Zimmermann

Drinking Water by LUTFI GANI AL ACHMAD

Drought by Laymik

Food price by Adrien Coquet

Flooding by Adrien Coquet

Respiratory Organ by ProSymbols

Drowning by Andrew Doane

Mosquito by Cristiano Zoucas

Children Playing Ball by Gan Khoon Lay

Family Migration by Gan Khoon Lay

Hunger by Alfonso Melolonta Urbán

High Temperature by Craig James Gordon

Elderly by Adrien Coquet

Money Decrease by Ayub Irawan

Pollution by DPIcons

Exhausted by Gan Khoon Lay

Bridge by Andrejs Kirma

Flooding by Adrien Coquet

Energy by Phạm Thanh Lộc

Agriculture by Cuputo

Reeds by MihiMihi

Increase by Vectorstall

Electric Car by Cuputo

Bus by Chanut is Industries

Cyclist by mikicon

Puzzle pieces by M.J. Moneymaker

Light Bulb by Botho Willer

Eco by Lnhi

Clothesline by Gan Khoon Lay