Urban Tree Canopy Assessment Summary Report for Culver, IN

Urban Green Infrastructure Resilience Cohort

December 2025

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Acknowledgments

This project was made possible through grant funding awarded to Indiana University by the U.S. Department of Agriculture's National Institute of Food and Agriculture and the U.S. Forest Service (USFS) Urban and Community Forestry Program as part of the Inflation Reduction Act Grant Program, which supports local investment in the future of U.S. forests and aims to help disadvantaged communities in Indiana enhance their resilience to climate change through the expansion of urban tree canopies. The initiative was driven by the vision of Indiana University's Environmental Resilience Institute (ERI) to strengthen the management of public trees and enhance Indiana's urban forests as living infrastructure. A collaborative team—including research educators, student fellows, local government staff and stakeholders, urban forestry consultants, and GIS specialists—came together to collect and analyze baseline data and develop tools for climate mitigation, adaptation, and long-term canopy resilience. This partnership reflects a shared commitment to advancing sustainable ecosystem services and preparing Indiana communities for the challenges of a changing climate.

The ERI recognizes the following Urban Green Infrastructure Cohort partners.

Local Governments:	*Climate Fellow:*	*Urban Forestry Consultants and GIS Specialists*
Town of Culver	Emerson Wells	Davey Resource Group

Executive Summary

The value of having trees and green spaces in communities has shifted, and urban tree canopy is an essential part of a city or town's infrastructure. Trees offer more than 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 directly influences the 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 accessible to local governments and community stakeholders, improving planning and management capabilities. 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 leaf-on tree conditions, into different land cover classifications for four Indiana communities. ERI also paired each of the four communities with a McKinney Climate Fellow from their McKinney Climate Fellows program, a workforce development initiative focused on climate, sustainability, and community resilience. The Town of Culver, one of the local governments selected for this year's cohort, completed the consultant-fellow-government partnership. This collaboration 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 municipal boundary of the Town of Culver spans approximately 1.15 square miles (736 acres; see Table 1). As of 2025, the community's existing tree canopy covers 27% of land area. Analysis shows an attainable tree canopy of 56%, which includes the additional 28% of plantable area. 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. Existing and Possible Tree Canopy Land Cover in Culver, Indiana

Local Government	Total Acres	Tree Canopy Acres	Preferred Plantable Acres
Town of Culver	736	201	209
Percent of Total	**100%**	**27%**	**28%**

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Assignment

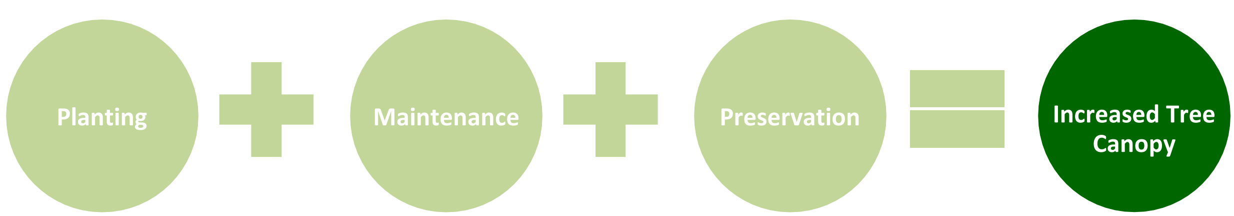
The assignment by ERI was to translate digital imagery showing detailed leaf-on conditions into different land cover classifications represented as individual geographic information system (GIS) layers. DRG created five land cover GIS layers for the Town of Culver, Indiana. Land cover classifications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

The existing, possible, and preferred tree canopy of Culver 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, the local government, 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.

Percentage of tree canopy for Culver was calculated and summarized by geographic unit. Climate fellows met with the local government representatives to identify and select geographic units; then, local government provided DRG with necessary GIS boundaries for these selected units. The analyzed geographic units for Culver included public vs private property, zoning, and subdivisions. Selected geographic units 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 includes 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.



Summary of the Town of Culver Existing Tree Governance

Public Tree Governance

Public trees in Culver are governed by multiple entities. The Town Manager oversees much of the day-to-day operations of Culver and works with a variety of city employees, including the Town Clerk's office and the Parks office. Culver has a Tree Commission that meets with some regularity and assists in making tree-related decisions for the city. It was the Tree Commission that funded Culver's participation in the 2025 UGI Cohort.

Culver Community Schools will be receiving a large amount of the planned trees for Culver, and as such will be a partner in determining where trees could be planted, and which species are preferred. The Superintendent has met with the Tree Commission to plan and confirm tree sites.

Additionally, the Lake Maxinkuckee Environmental Fund is a local nonprofit working to maintain the health of Culver's Lake area. As tree planting can help in pollutant filtering from soil and air, this group is also a stakeholder in Culver's urban forestry efforts.

Culver is in the planning stages of increasing focus on urban forest management. Over the summer, the Tree Commission, along with the Town Manager and the UGI Cohort Fellow, spent time discussing an update to the town's Tree Ordinance and applying to return as Tree City USA. Additionally, town leadership is pursuing the idea of having an arborist work for the city as part of the team managing public trees in Culver.

Land Cover Assessment

Culver's current land cover was identified and assessed using the 2024 National Agricultural Imagery Program (NAIP) leaf-on, multispectral imagery—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 Culver.

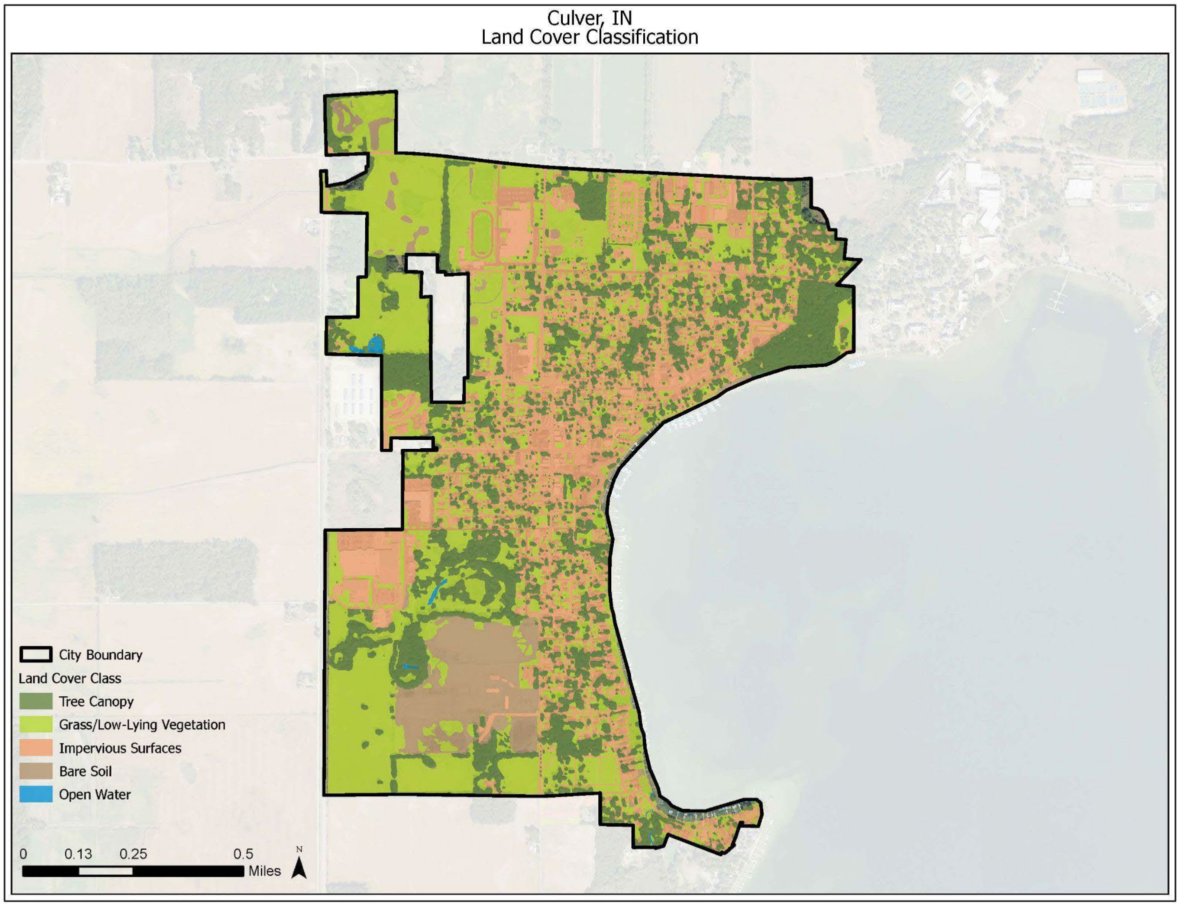


Figure 1. Town of Culver land cover classification and distribution.

Table 2 and Figure 2 present the land cover results within Culver's municipal boundary. The study area covers 736 acres or approximately 1.15 square miles. Tree canopy cover is 27%, with a total of 201 acres of existing tree canopy. Pervious surfaces and bare soils cover 43% of total land area, and impervious surface and open water make up the remaining 29%.

Table 2. Land Cover in Culver, Indiana

Local Government	Total Acres	Tree Canopy Acres	Impervious Acres	Pervious Acres	Bare Soil Acres	Water Acres
Town of Culver	736	201	216	263	54	2
Percent of Total	100%	27%	29%	36%	7%	< 1 %

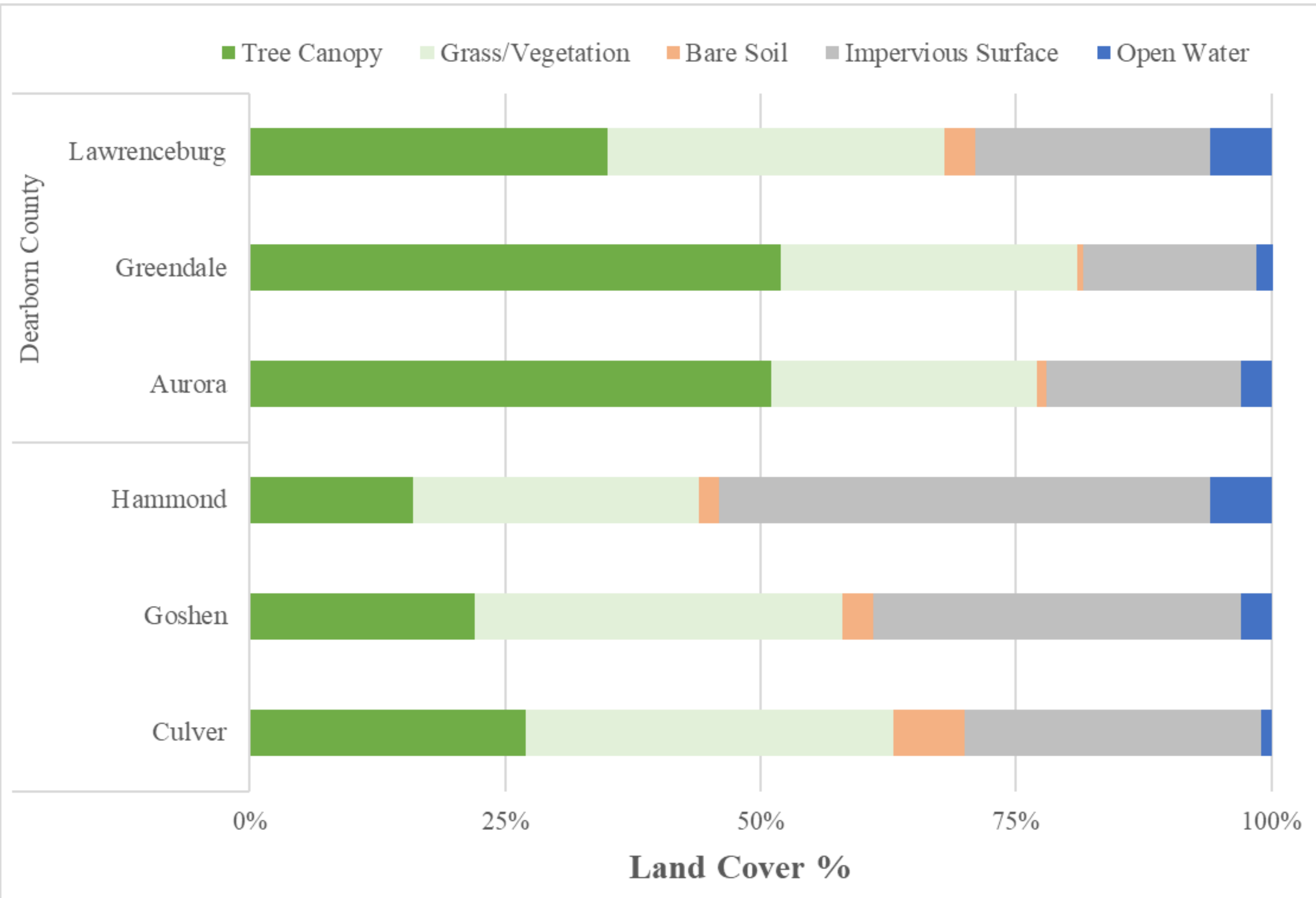


Figure 2. Land cover classification variances for the municipalities participating in the 2025 Urban Green Infrastructure Resilience Cohort.

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 area. 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 within Culver's municipal boundary. There are 317 acres of grass/vegetation (pervious) land and bare soil, which represents the possible tree canopy area. When considering only the practical or preferred plantable area within this, however, the acreage available to future tree canopy is 209 acres (28%). The sum of existing tree canopy and preferred plantable area presents a maximum of approximately 56% tree cover.

Table 3. Tree Canopy Cover and Planting Potential in Culver, Indiana

Local Government	Total Acres	Tree Canopy Acres	Possible Tree Canopy Acres	Preferred Plantable Acres	Maximum Tree Canopy Acres
Town of Culver	736	201	317	209	410
Percent of Total	100%	27%	43%	28%	56%

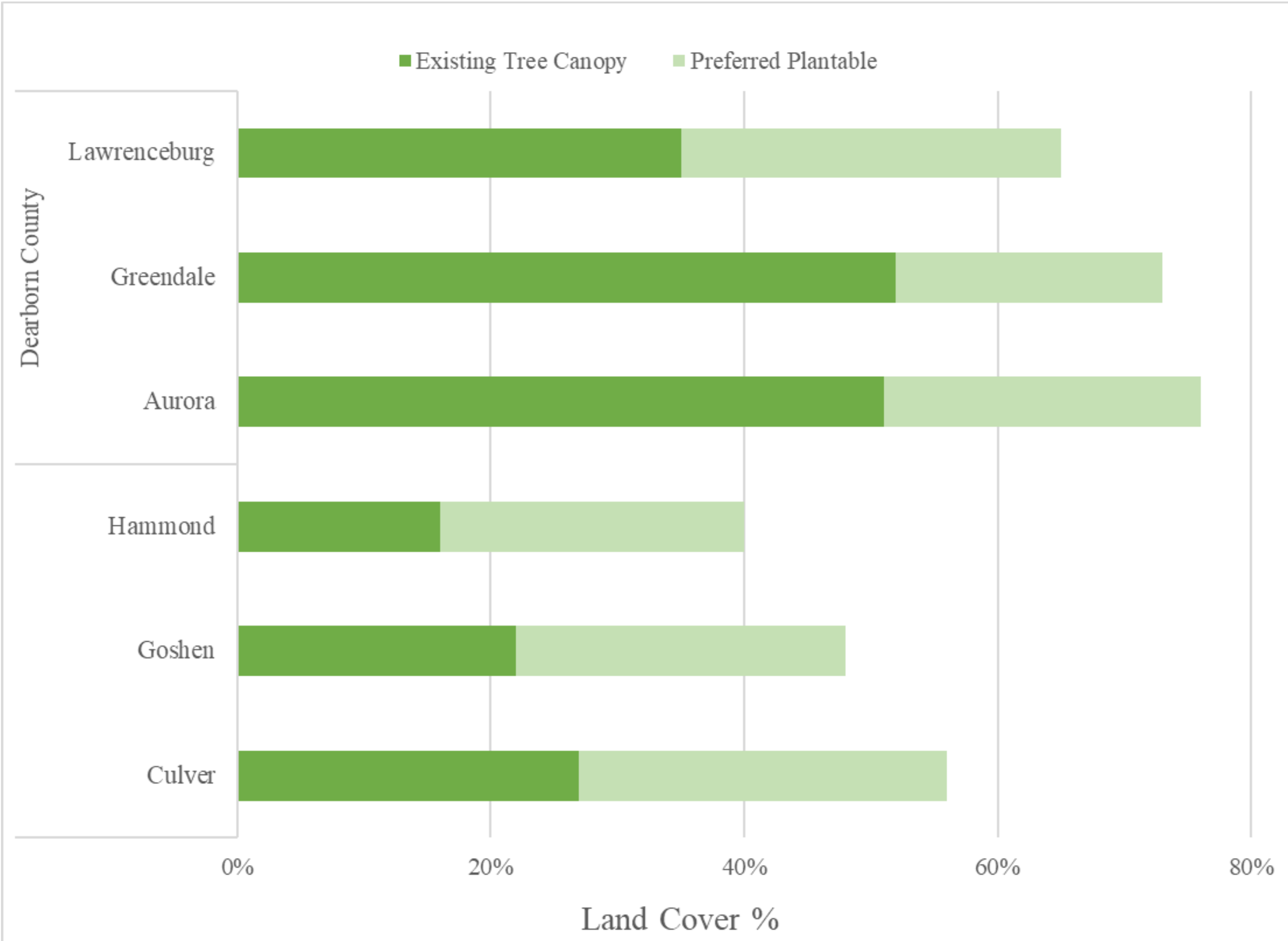


Figure 3. Percentage of existing tree canopy cover, preferred plantable area, and maximum tree cover for each municipality participating in the 2025 Urban Green Infrastructure Resilience Cohort.

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 the 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 209 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 5% and 9%, respectively, totaling an estimated 740 plantable locations. Figure 4 presents an account of the number of plantable locations by priority within the study area. Figure 5 illustrates the resulting prioritized plantable areas within Culver, Indiana.

Table 4. Results of Prioritized Plantable Area Analysis

	Very High Acres	High Acres	Moderate Acres	Low Acres	Very Low Acres	Total Acres
Town of Culver	11	19	26	38	115	209
Percent of Total	5%	9%	12%	18%	55%	100%

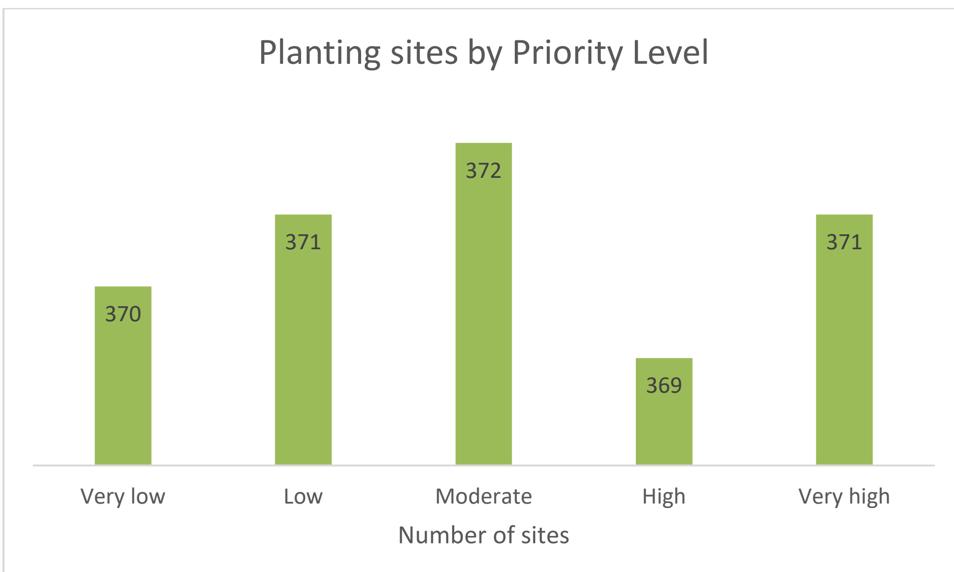


Figure 4. Count of locations of prioritized plantable areas

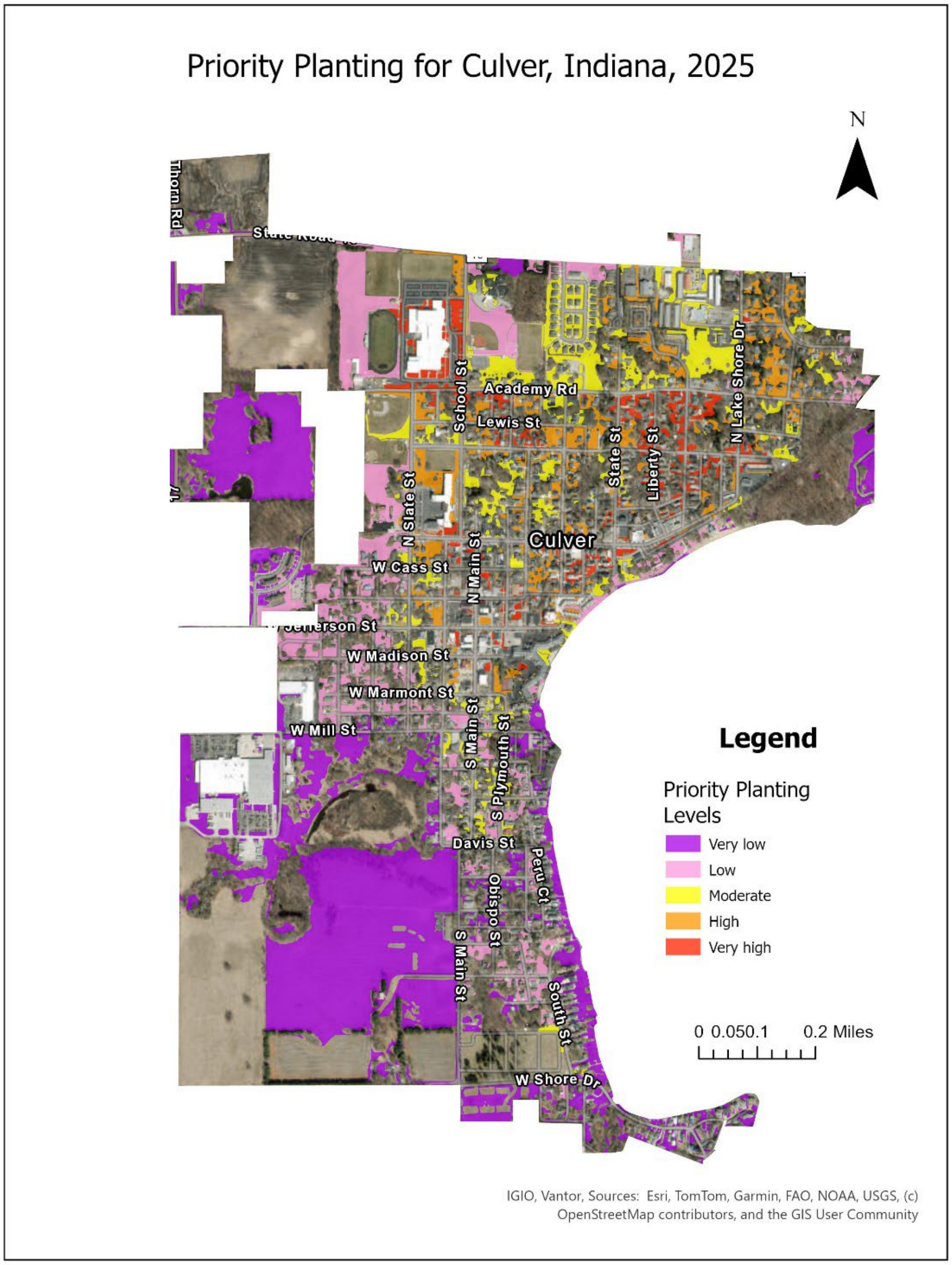


Figure 5 Prioritized plantable areas within Culver, Indiana

Geographic UTC Analysis

For developing planting strategies and working with community stakeholders, DRG mapped tree canopy cover by geographies that were chosen by the Town of Culver. Appendix C contains a list of selected geographic units. This report summarizes the UTC assessment by public versus private, zoning, and subdivision land use.

Tree planting strategies are necessary to meet tree canopy goals. Typically, after conducting 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 supports 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 lowest existing tree canopy and/or the largest preferred plantable area.

Tree Canopy on Private Versus Public Land

Figure 6 shows private and public land within the Town of Culver's municipal boundaries. There are 168 acres of public land and 568 acres of private land. Table 5 shows the existing tree canopy on public lands at 20% and tree canopy on private lands at 29%. Where canopy exists most in a community is where there is more potential for creating tree preservation policy.

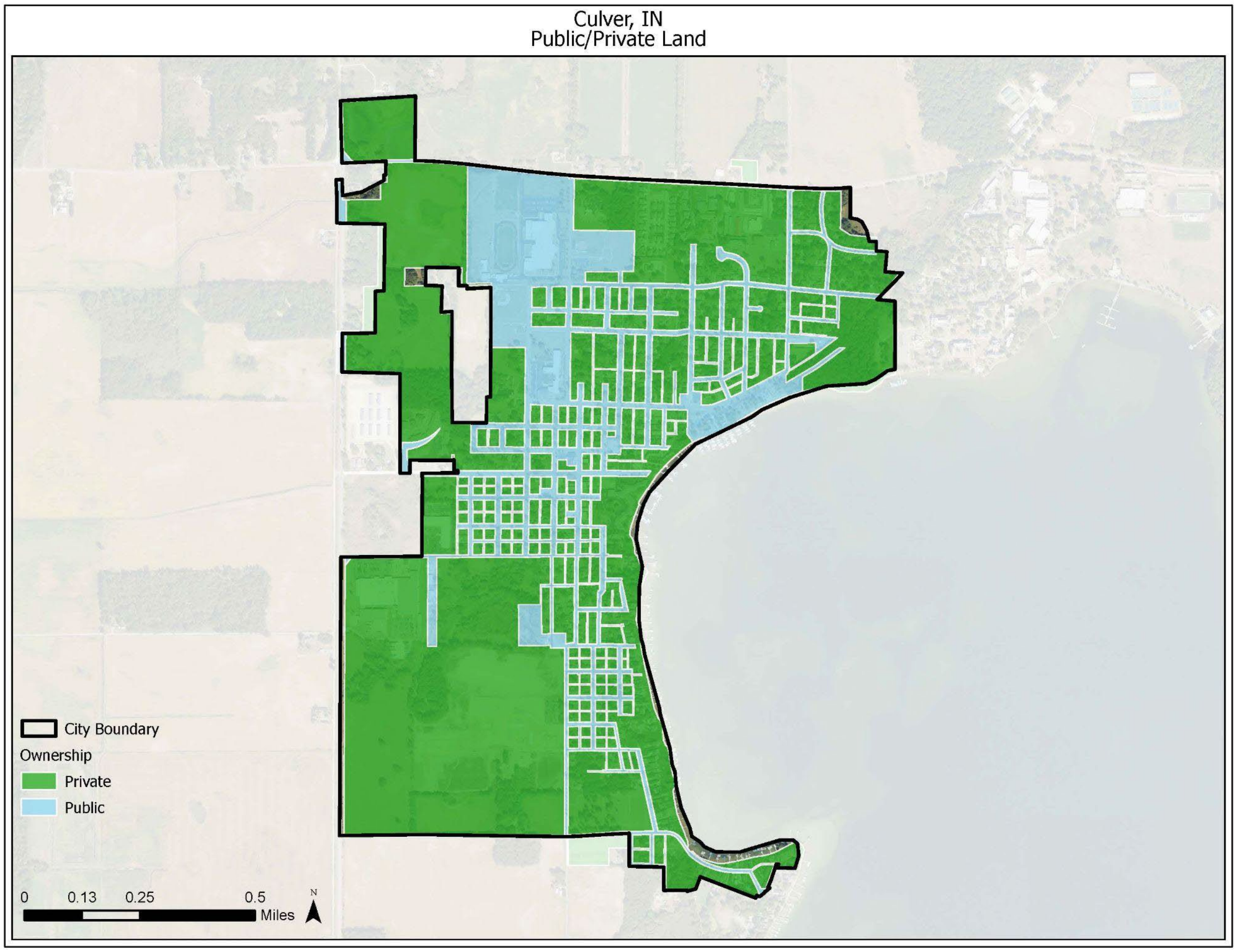


Figure 6. Town of Culver privately owned land (blue) and publicly owned land (green).

If communities were to plant all preferred plantable area, tree canopy area could increase to 40% on public land and 60% on private land. The Town of Culver has the most potential for change within private land, which contains 176 acres of preferred plantable land area.

Table 5. Urban Tree Canopy by Landowner Type (Private vs. Public).

Local Government	Land Ownership	Total Acres	Tree Canopy		Preferred Plantable		Max Tree Canopy	
			Acres	Percent	Acres	Percent	Acres	Percent
Town of Culver	Public	168	34	20%	34	20%	68	40%
	Private	568	167	29%	176	31%	343	60%

Tree Canopy by Zoning

Table 6 shows existing tree canopy and preferred plantable area by zoning type within the Town of Culver. Culver has the most acreage of existing tree canopy within Residential zones (184 acres), while the Municipal Park zones has the highest percentage of land covered by tree canopy (37%). Both Industrial and Business/Commercial zones have the same canopy coverage, at 13%.

Residential land also contains the most potential to add new tree canopy. If 188 acres of preferred plantable area within residential zoning were to be planted, tree canopy on residential land would increase to 61%, and overall tree canopy in the town would grow to 53%.

Table 6. Tree Canopy by Zone Type

Zoning*	Acres	Tree Canopy		Preferred Plantable		Max Tree Canopy	
		Acres	Percent	Acres	Percent	Acres	Percent
Residential	613	184	30%	188	31%	372	61%
Industrial	72	9	13%	9	13%	18	25%
Business/Commercial	44	6	13%	10	23%	16	37%
Municipal Park	7	3	37%	2	23%	5	60%

*The *Agricultural zone is excluded from this table because it comprised only 0.03 acres, with a Max Tree Canopy of the same extent.*

Tree Canopy by Subdivision

Table 7 shows existing and preferred plantable tree canopy across Culver's subdivisions. Existing tree canopy within these subdivisions totals 83 acres, which represents more than two-fifths of Culver's entire urban forest. If all preferred plantable area was planted within these subdivisions, canopy cover could increase to 67%.

Table 7. Tree Canopy Cover by Subdivision

Town of Culver Subdivisions	Total Acres	Tree Canopy Acres	Preferred Plantable Acres	Maximum Tree Canopy Acres
All Subdivisions	290	83	111	194
Percent of Total	100%	29%	38%	67%

Figure 7 shows the distribution of existing tree canopy cover across 73 of Culver's 84 subdivisions. Subdivisions with 0.25 acres or less were excluded from the analysis to reduce skew from extremely small land units. The majority of subdivisions (57) have less than 40% canopy cover, with the highest concentration (18) in the 20-30% range. In contrast, only 16 subdivisions exceed 40% canopy cover, indicating that dense tree cover within subdivisions is concentrated in just a few areas. Uneven distributions suggest some subdivisions may be experiencing fewer environmental, societal, and health benefits associated with canopy cover.

While a 40% canopy cover benchmark has historically been used as a general goal for urban tree canopy, using it here provides a comparative reference to illustrate areas with relatively higher or lower canopy cover. However, today's approach recognizes that opportunities to create canopy vary greatly within each community. A more nuanced, site-specific strategy—tailored to the characteristics, constraints, and opportunities of each subdivision—can better guide planting priorities and ensure resources are directed where they will have the greatest long-term impact.

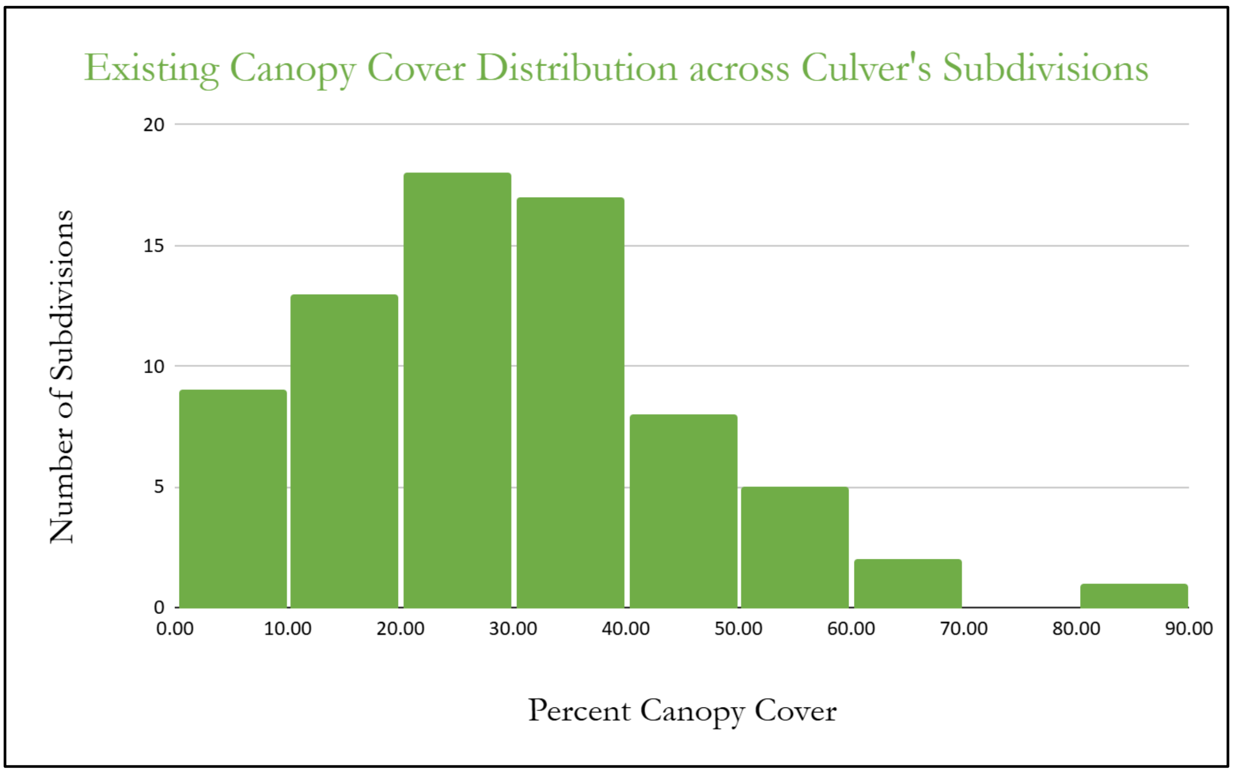


Figure 7. Canopy cover distribution across Culver's subdivisions.

Town of Culver Prioritized Planting Areas- 2025 UGI Cohort

The following sections describe the work done by the 2025 UGI Cohort. This Inflation Reduction Act (IRA)-funded project was a collaboration between multiple partners, including the city of Goshen, Indiana University's Environmental Resilience Institute (ERI), Davey Resource Group (DRG), and our Community Engagement Specialist, Alison Zajdel.

Project Background

Culver was among four Indiana communities (Culver, Dearborn County, Goshen, and Hammond) selected by the ERI for the 2025 UGI Cohort. Each community was paired with a McKinney Climate Fellow, who applied GIS-based analysis to the landcover data provided by DRG. Priority Planting Areas were first found for the entire city. Because the project supports work done in disadvantaged communities (DACs) as defined by the Climate and Economic Justice Screening Tool (CEJST), Fellows then clipped the Priority Planting Areas to the DAC census tracts. The resulting data allowed for Fellows, with their city supervisors, to select sites for up to 100 trees to be planted in areas where they are most needed. The following sections contain the maps generated by this work.

Priority Planting Analysis

The maps below show the Priority Planting Analysis for the entire community of Culver, along with those for two biophysical components that contribute to the data included in the analysis: variations in urban heat island effect, and vulnerability from flooding. Also included is a map showing the planting priority for sociodemographic vulnerability. Methods used to create these maps can be found in Appendix B.

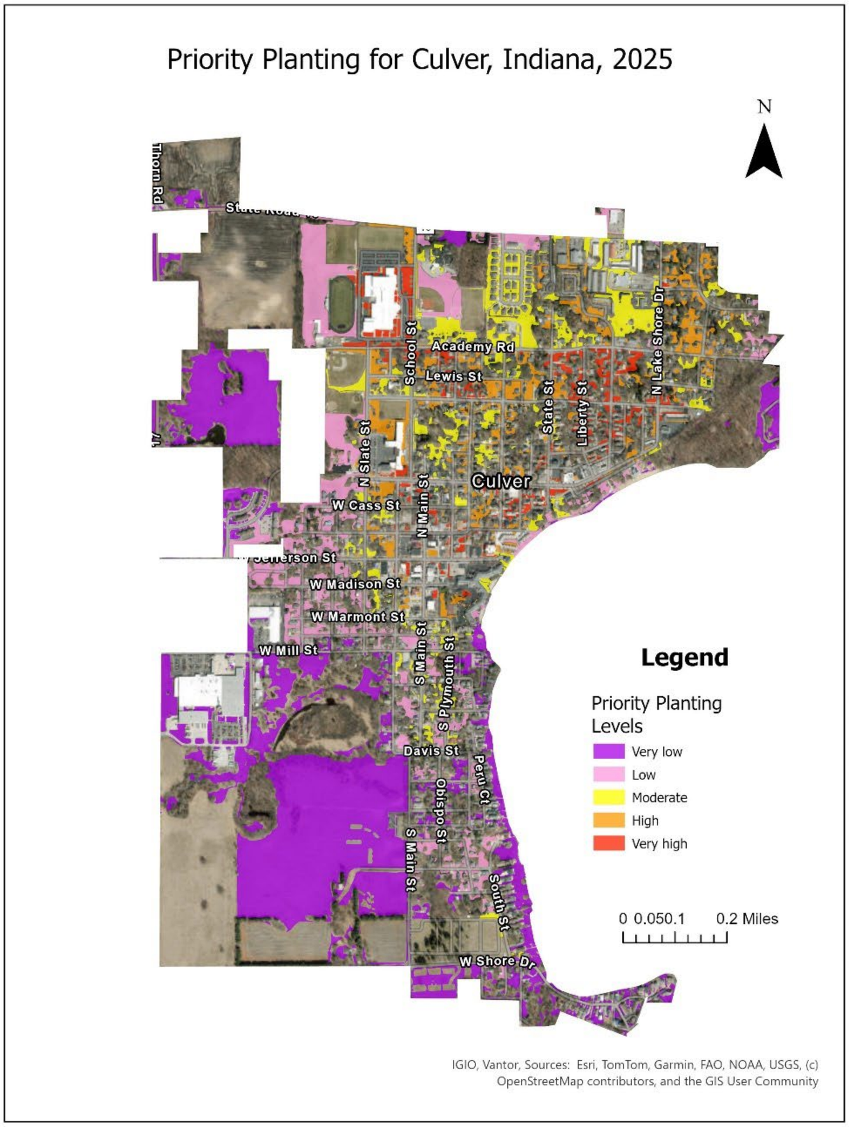


Figure 8. Priority planting areas in Culver

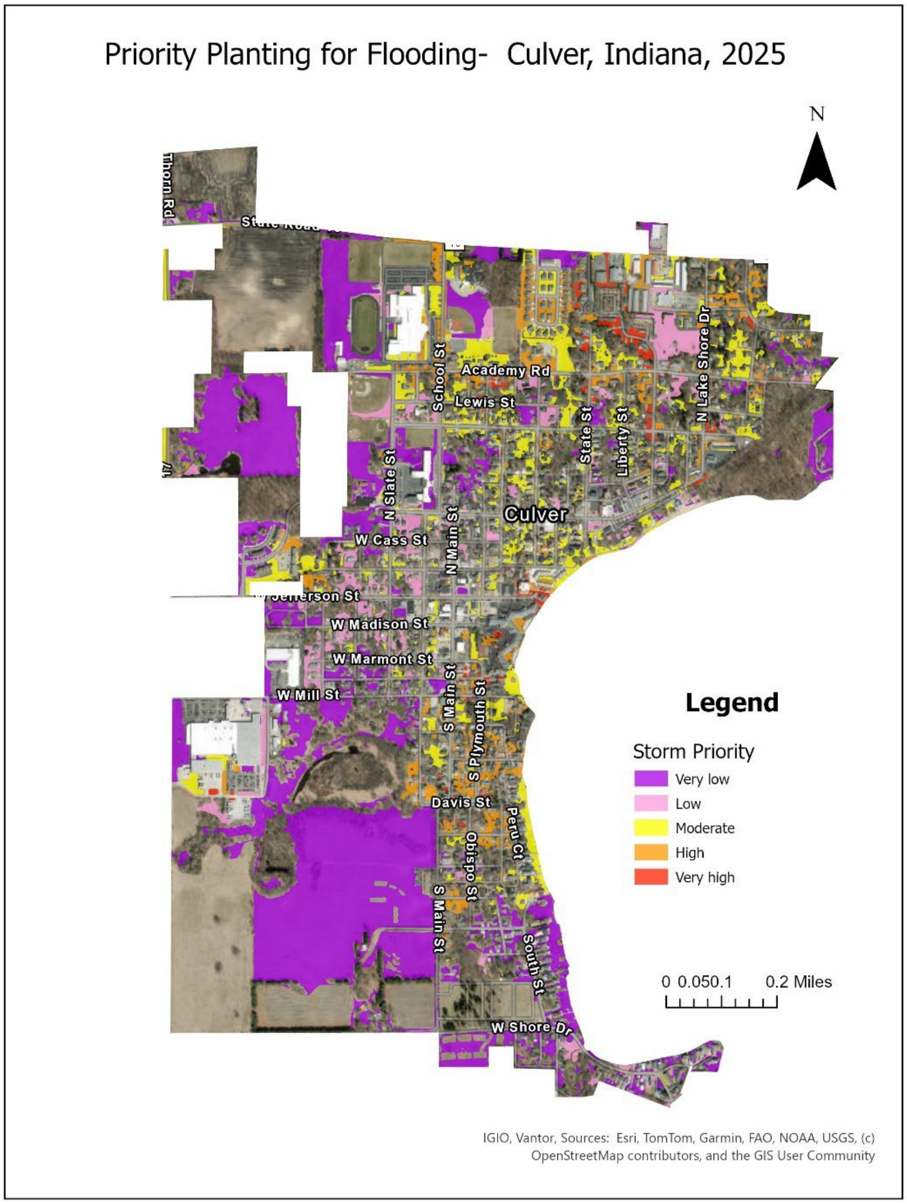


Figure 9. Prioritized planting areas for flooding resilience in Culver

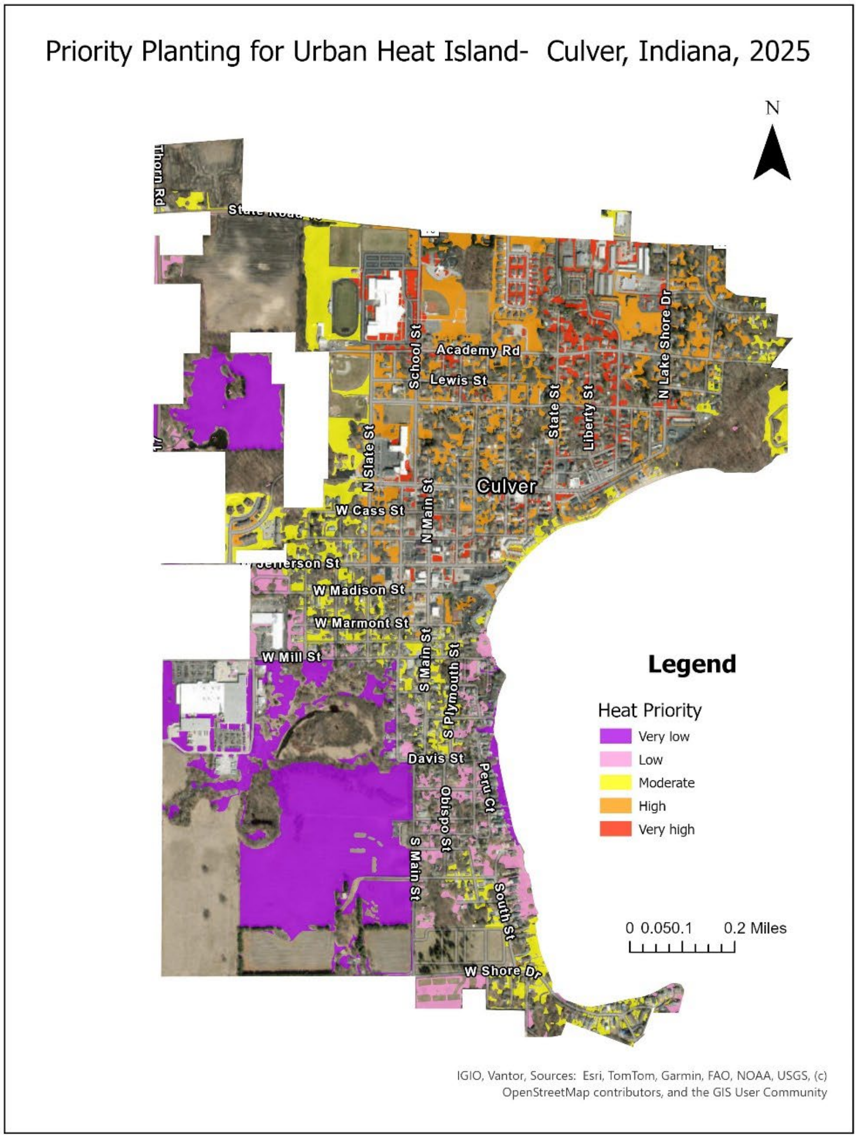


Figure 10. Prioritized planting areas for urban heat island resilience in Culver

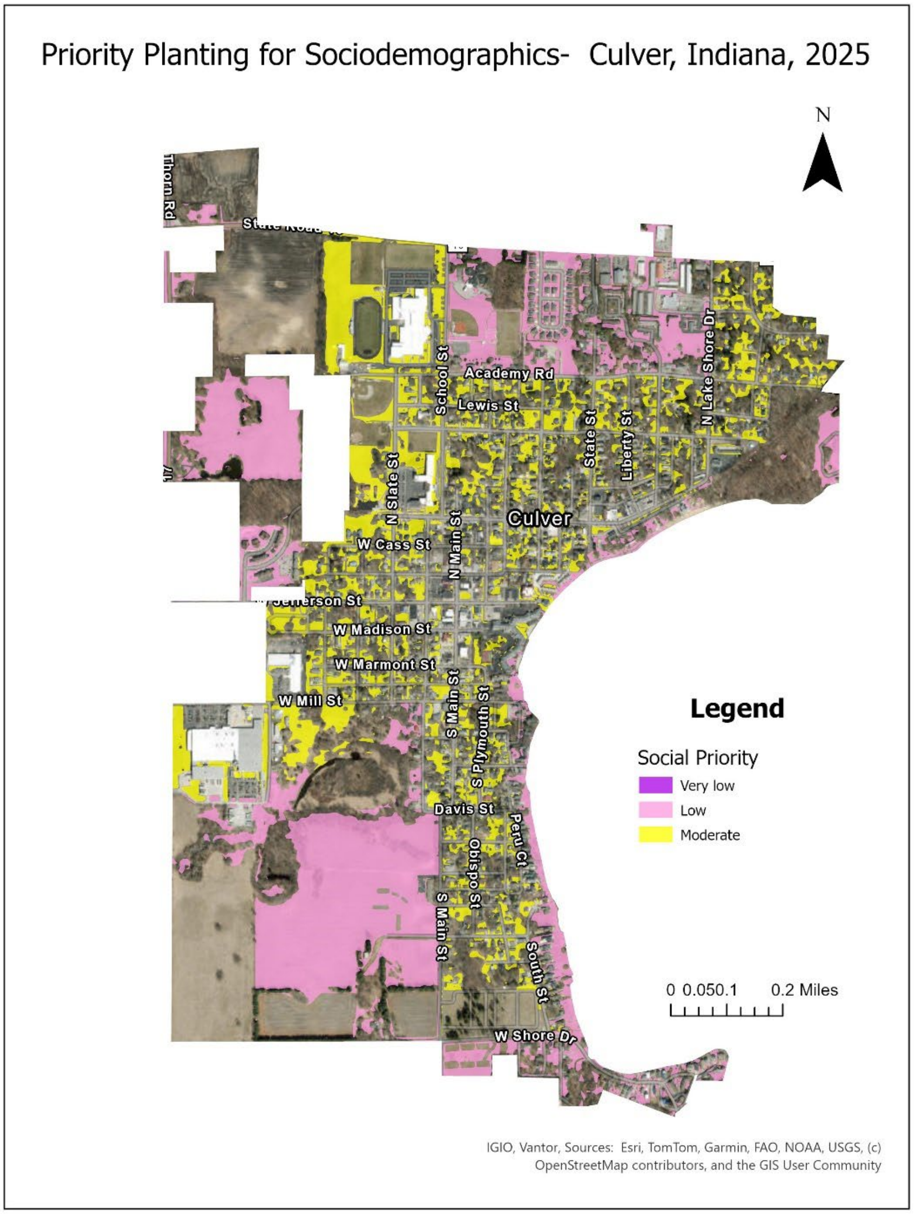


Figure 11. Prioritized planting areas for sociodemographic resilience

Planting sites for Spring 2026 plantings

The map below shows the sites proposed, along with backup sites, for the 100 trees to be planted in April 2026. The sites were selected based on data from the Priority Planting Analysis as well as through community engagement done throughout the summer and fall of 2025. The Culver Tree Commission were essential in determining the best locations for the trees to be planted.

Proposed tree planting sites in Culver, 2025

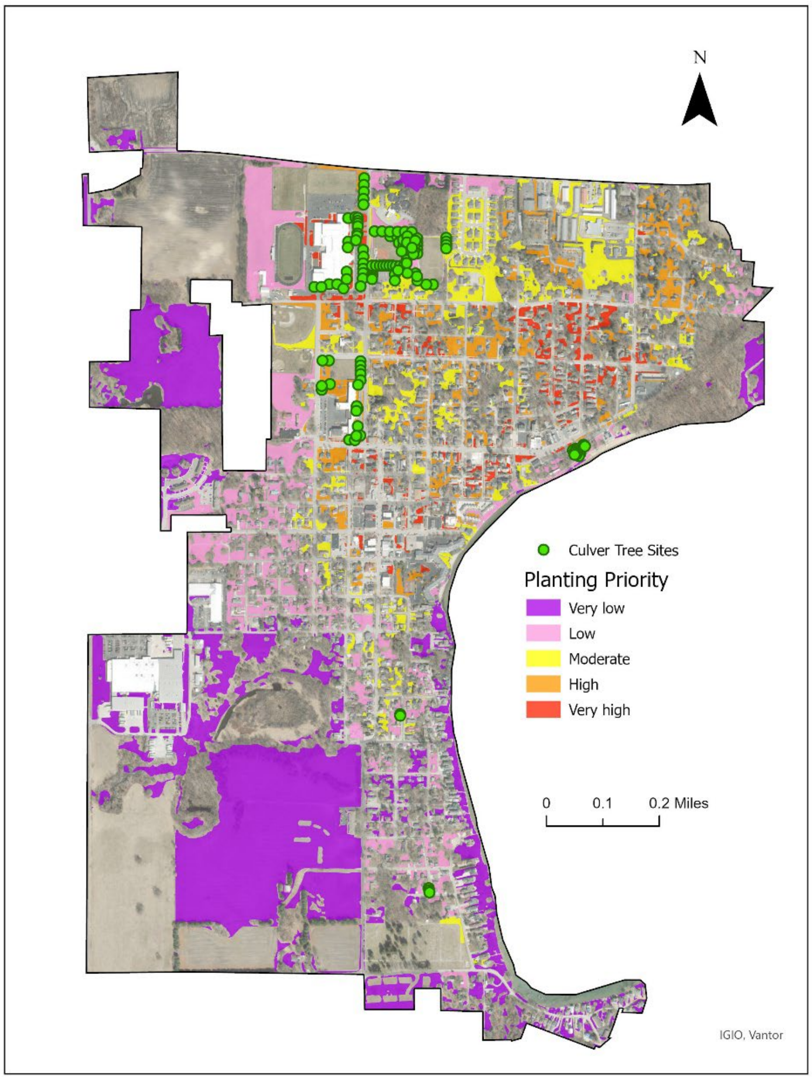


Figure 12. Proposed tree sites for 2026 Culver tree planting

April 2026 Tree Planting

Planting of the 100 trees is scheduled for April 2026. All are to be planted in sites chosen with community members, and all will be within higher priority planting areas in the DAC tracts in Culver. All trees will be cared for over the next three years (2026, 2027, 2028) by Davey Resource Group or a local contractor in collaboration with Davey Resource Group. Trees will be watered as needed during the summer months, inspected for condition and health, and will receive a pruning during the summer of 2028.

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 government study for the Town of Culver has an existing tree canopy cover of 27% with an attainable tree canopy of 56%. The preferred plantable area is equivalent to 209 acres. Plantable areas designated as Very High and High priority in the 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 Tools, a free software suite from the U.S. Forest Service and partners. This bolsters support of trees and an understanding of the importance for tree planting, maintenance, and preservation. Today, Indiana local governments and their partners need to make initiatives to help promote and sustain the urban tree canopy for the community and future generations to come

Tree Establishment and Maintenance

Aftercare

Trees are essential in local communities, making tree care a wise investment for tree owners. Healthy trees increase property values, provide for wildlife, beautify surroundings, clean and lessen stormwater runoff, purify air, and save energy by providing shade in summer and protection in winter. Regular maintenance of new and established trees ensures trees remain healthy and structurally sound.

New Tree Maintenance

Irrigation - Trees require consistent, thorough watering for at least three years post-planting.

- Any newly planted trees that don't experience the equivalent of 1 inch of rainfall a week should be placed on a watering schedule.
- Know the soil texture at the planting location to understand its water-holding capacity.
- Establish a soil moisture monitoring protocol to ensure adequate water levels throughout the year.
    - The watering season for most trees mimics the growing season, approximately May 1 through October 31.
    - Deciduous trees need no supplemental water when leaves are not on trees, approximately November 1 through April 30.
    - Conifers and broadleaf evergreens should receive supplemental water

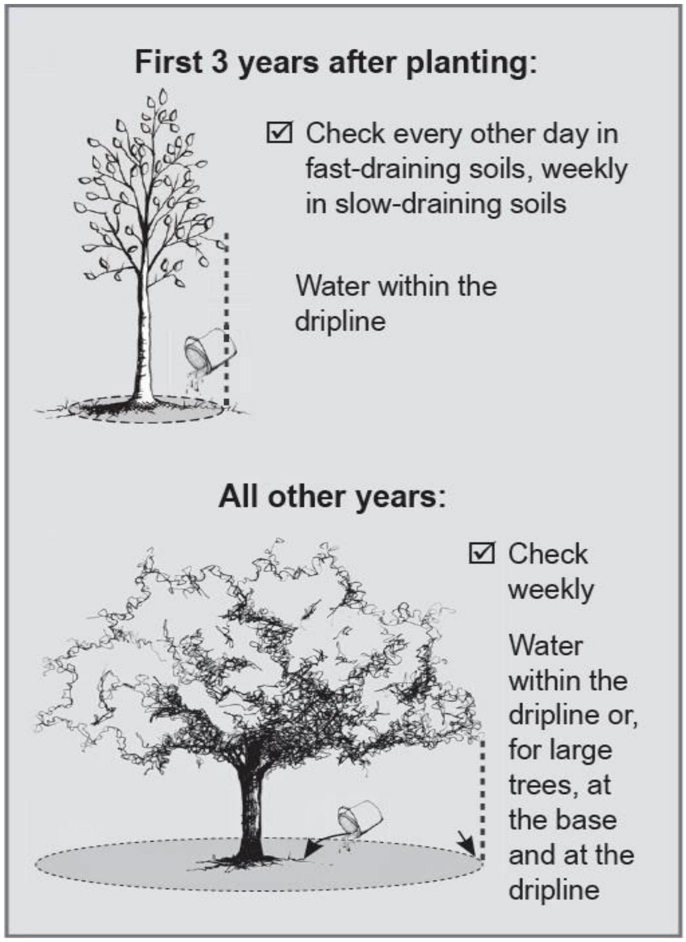
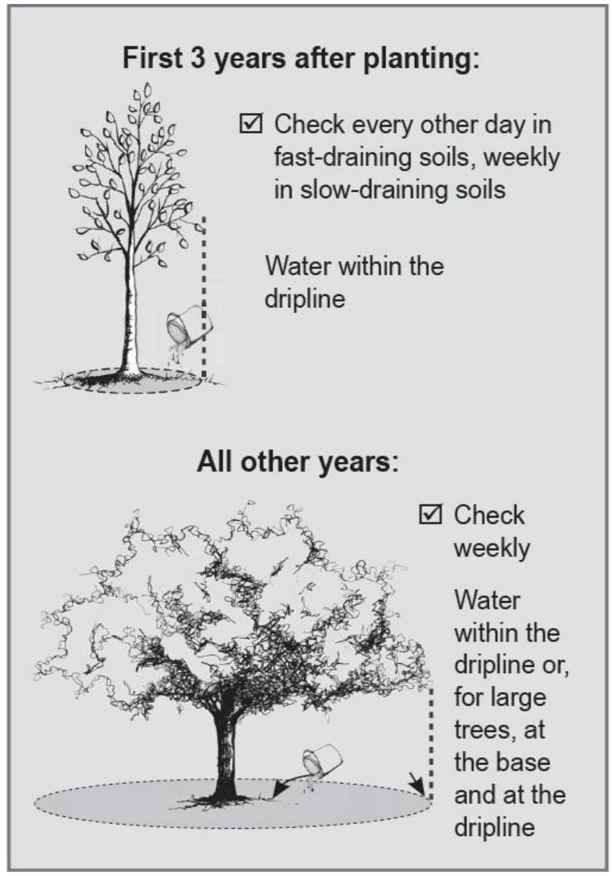


Figure 1: First 3 years after planting: If the soil is dry, provide about 1-1/2 gallons of water per diameter inch of the trunk. Source: US Forest Service



throughout the fall and winter, approximately November 1 through April 30.

- Newly planted trees should receive a minimum of 1 inch of water per inch of caliper per week (Figure 1).
  - To offset the lack of water provided by rain or the water table at the site, newly planted trees should receive a minimum of 5 gallons of water per caliper inch at each watering.
  - Several methods of irrigation can effectively water trees in natural areas, including hand-watering, irrigation bags, soaker hoses, or bucket drip irrigation.
  - Tall-sided irrigation bags should be used only when trees are a minimum of 1.5 inches in caliper trees with branching starting above 3 feet.

<u>Planting Circle Maintenance</u>: Reduced environmental stresses, such as temperature extremes or weed competition, positively impact tree health.

- Keep the initial planting circle clear of vegetation and other debris by removing it by hand or cutting it with a string trimmer, careful not to strike the tree trunk.
- If mulch maintenance is attainable or desired, use natural wood chips or shredded bark, needles, or leaves free of any extraneous material such as soil, stones, and debris.

- Replenish mulch as needed to maintain a 2 to 3-inch deep layer around the tree, leaving 3 inches around the trunk clear from mulch. Do not use weed killer near small or thin-barked trees.

Figure 2: *To prevent long-term damage associated with trunk wounding, install protection around the trunk*

Tree Protection

- Rabbits and deer may browse on trees shorter than 3 feet tall.
  - Make a 4-inch wide and 32-inch tall wire cage to place around the tree (Figure 2).
  - Secure the cage to the ground with a stake.
  - Plastic tree guards are also effective.
- Voles, mice, and rabbits may damage stem cambium using wood to trim teeth.
  - Apply a repellent following labeled directions.
- Deer may damage stem cambium using the stem as an antler rub and beavers may damage stem cambium using wood to trim teeth or cut for use in dams.
  - Install loose-fitting 48-inch tall and minimum 4-inch diameter tree guards, made of wire or plastic mesh, around the tree trunk.
- All wildlife tree protection should be monitored seasonally and adjusted or removed as needed.
- Stakes installed at the tree's planting are typically removed after 1 year or one full growing season when they are capable of supporting themselves.

Tree Health

- The majority of all pruning should happen during leaf-off conditions and by a licensed arborist in accordance with ANSI A300 *Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance*.
- Large-growing trees should be pruned to maintain a central leader to 20 feet.
- Lateral branching should be retained to deter deer from using the stem as an antler rub.
- After the first growing season, trees may be pruned to remove any dead, diseased,

damaged, or dying branches (Figure 3).

- After the third growing season, branches may be removed that are clustered together or are crossing.
- Tools used to prune shall be sharp and cleaned thoroughly with alcohol, hydrogen peroxide, or chlorine bleach before pruning.
- Treatment of cuts with wound dressing or paints should not be used.

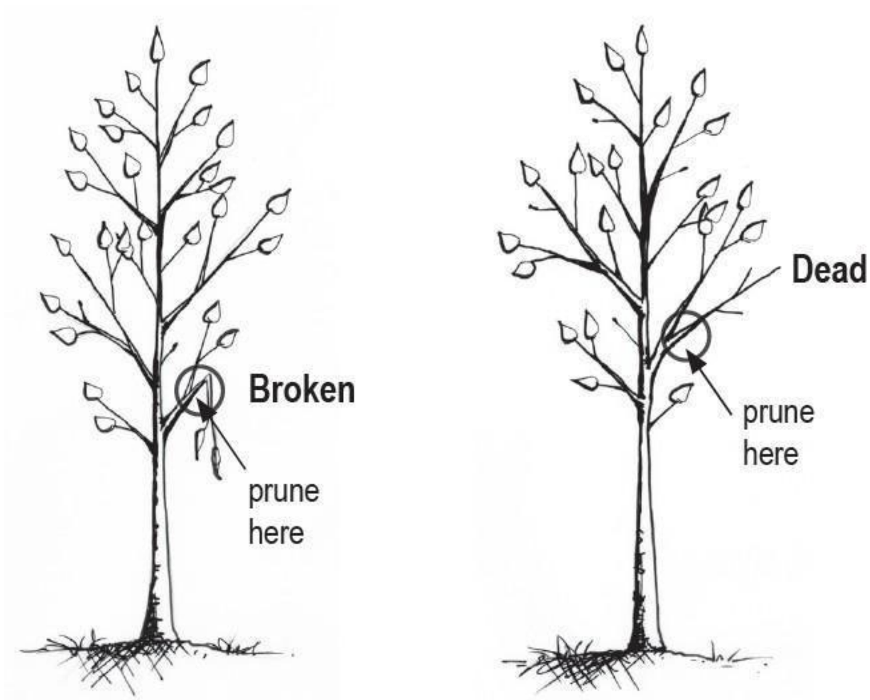


Figure 3: *Prune only branches that are broken or dead. You may also remove competing leaders if present. Most trees should have one central leader. If there are two or more leaders, choose which one you want to remain and remove the other(s). Source: US Forest Service Tree Owner's Manual. www.treeownersmanual.info.*

Established Tree Maintenance

Monitor Tree Health: When conducting routine checks of trees in an orchard, it's essential to diligently observe for any signs of distress or irregularities such as:

- *Visible Signs of Decay or Damage*: Look for areas of decay, cracks, splits, or wounds on the trunk, branches, or bark. These can indicate underlying issues such as fungal infections, pest infestations, or structural weaknesses.
- *Unusual Growth Patterns*: Keep an eye out for abnormal growth patterns such as excessive leaning, sudden changes in canopy density, or the presence of epicormic shoots (new growth from dormant buds on branches or trunks). These can signal stress or underlying health issues.
- *Presence of Pests or Pathogens*: Inspect for signs of pest infestations such as insect activity, chew marks, or the presence of larvae. Additionally, check for symptoms of diseases such as unusual lesions, discoloration, or wilting foliage.
- *Root Zone Issues*: Examine the area around the base of the tree for signs of root damage, soil compaction, or root girdling (roots circling the trunk). These issues can affect the tree's stability and nutrient uptake (Figure 4).
- *Abnormal Leaf Characteristics*: Look for abnormalities in leaf size, shape, color, or texture. This can include premature leaf drop, yellowing or browning of leaves, or unusual spotting or discoloration.
- *Structural Integrity*: Assess the overall structure of the tree, including the integrity of major branches

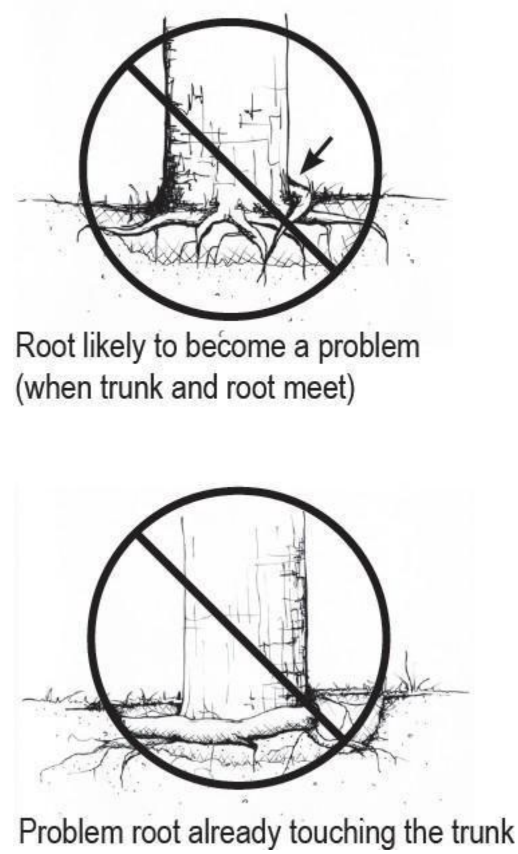


Figure 4: *Roots that encircle the trunk will likely cause health or safety problems later. Make sure that soil or mulch is never piled against the root collar. Source: US Forest Service Tree Owner's Manual. www.treeownersmanual.info.*

and the main trunk. Pay attention to any signs of weakness, such as cracks or splits, that could indicate a risk of failure.

If any abnormalities are detected during the inspection, it's important to document them thoroughly and monitor them closely over time. Additionally, it's advisable to report these findings to a local tree care professional or certified arborist for further evaluation and advice on appropriate treatment options. Depending on the specific issues identified, treatment options may include pruning, pest or disease management, soil amendments, or other corrective measures aimed at preserving the health and safety of the tree.

Potential tree stewards for future tree care

Culver's Tree Commission has historically stewarded the bulk of the city's public trees, watering during the growing season, installing deer guards, and maintaining mulch. As the city continues to add more trees, it is beneficial to consider other groups within the community that could assist with the management of tree care.

One idea under discussion is the stewardship of the trees planted on the public school grounds. There is potential for the students at the schools to participate in a volunteer, educational effort to help maintain these trees. The students could, along with a supervising school faculty member, could learn basic tree care skills, and then work as a group to water and mulch the trees during the growing season. If a Youth Tree Tenders program could be established, the responsibilities and capabilities of the students could be increased, allowing them to take leadership roles in maintaining the trees on their school grounds.

Upcoming projects and grants

Additional trees are planned to be planted in Culver soon after the April 2026 planting. At least a portion of these will be planted in the Right-of Way areas in the downtown area. The town is also working to get a well installed in Cavalier Park, which will help greatly with watering once the trees are no longer in the stewardship plan covered by the grant. According to conversations with ERI staff, the city of Culver is interested in contracting with an arborist to help care for the town's public trees. All of these activities should be of great benefit to the growth and management of Culver's urban forest. Because of the care and commitment of Culver's leadership, and the town's Tree Commission, the community urban forest should continue to grow and provide valuable ecosystem services for years 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

Methodology and Accuracy Assessment

Davey Resource Group Canopy Height Modeling and Classification Methodology

Davey Resource Group utilized 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.

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 Deep Learning Artificial Intelligence tools that 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.

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 NAIP imagery. 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. 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.

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

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 NAIP 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 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 NAIP 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 NAIP 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	138	2	5	0	0	145	95.17%	4.83%
	Impervious	0	121	1	0	0	122	99.18%	0.82%
	Grass/Vegetation	5	4	190	2	0	201	94.53%	5.47%
	Bare Soils	0	0	0	31	0	31	100.00%	0.00%
	Water	0	0	0	0	1	1	100.00%	0.00%
	Column Total	143	127	196	33	1	500		
	User's Accuracy	96.50%	95.28%	96.94%	93.94%	100.00%		Overall Accuracy	96.20%
	Errors of Commission	3.50%	4.72%	3.06%	6.06%	0.00%		Kappa Coefficent	0.9452

4. 1. 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 ((138+121+190+31+1)/500 = 96.20%).

   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 [138/143 = 96.50%]).

Producer's Accuracy – Probability of a reference pixel being correctly classified (correct land cover classifications divided by the row total [138/145 = 95.17%]).

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 3.50% 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 4.83% of all canopy classified is actually 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	Hectares	Percentage	Lower Bound	Upper Bound
Tree Canopy	200.8	27.3%	25.6%	28.9%
Impervious Surfaces	216.0	29.4%	27.7%	31.0%
Grass & Low-Lying Vegetation	263.4	35.8%	34.0%	37.6%
Bare Soils	54.1	7.4%	6.4%	8.3%
Open Water	1.6	0.2%	0.0%	0.4%
Total	735.9	100.00%		

Statistical Metrics Summary

Overall Accuracy =	96.20%
Kappa Coefficient =	0.9452
Allocation Disagreement =	2%
Quantity Disagreement =	1%

Accuracy Assessment

Class	User's Accuracy	Lower Bound	Upper Bound	Producer's Accuracy	Lower Bound	Upper Bound
Tree Canopy	96.5%	95.0%	98.0%	95.2%	93.4%	97.0%
Impervious Surfaces	95.3%	93.4%	97.2%	99.2%	98.4%	100.0%
Grass & Low-Lying Vegetation	96.9%	95.7%	98.2%	94.5%	92.9%	96.1%
Bare Soils	93.9%	89.8%	98.1%	100.0%	100.0%	100.0%
Open Water	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix B

Prioritized Plantable Area Methodology -

The analysis for prioritized plantable areas begins with the landcover analysis data provided by Davey Resource Group. From there, GIS layers are built using this data, along with publicly accessible data sources, to determine where ecosystem services provided by trees (flood resilience, urban heat island cooling, and sociodemographic equity) are most needed. The process used to determine priority planting areas was developed by the US Forest Service and is used by Davey Resource Group in their analyses. For the 2025 UGI Cohort, McKinney Climate Fellows completed this analysis with support from Davey Resource Group and ERI staff. Additional details on this process can be provided upon request.

Six data layers comprise the flooding vulnerability priority analysis: K-factor (soil erodibility), hydrologic soil groups (water infiltration rates), slope, floodplain proximity [all sourced from USDA data], distance to tree canopy, and distance to impervious surfaces [both sourced from landcover analysis data]. The data from each of these layers is combined into a single weighted raster with the following relative weights:

DATA LAYER	WEIGHT
K-factor	.15
Hydrologic soil groups	.15
Slope	.1
Floodplain proximity	.2
Distance to tree canopy (inverse)	.1
Distance to impervious surfaces	.3
TOTAL COMBINED	1.0

The urban heat island layer data is sourced from US Geological Survey satellite imagery. Summer surface temperature data from one hot day each in 2024 and 2025 were derived from this data and then averaged, for a single reading of surface temperature across the study area.

The sociodemographic priority areas were determined from three variables- race (percent nonwhite), income, and population density. All data was sourced from Simply Analytics. These factors were combined into a single layer, with all being weighted the same.

The analysis produced four maps- 1) Priority Planting for Flood Resilience, 2) Priority Planting for Urban Heat Island Resilience, 3) Priority Planting for Sociodemographic Resilience, and, finally, 4) an overall composite map of Priority Planting Areas for Culver.

Appendix C

Summary of Assessed Local Government and Analyzed Geography Metrics

Geographic Unit	City of Culver	City of Goshen	City of Hammond	Cities of Aurora, Greendale, Lawrenceburg
Census Block Groups	X	X	X	X
Census Tracts			X	X
Parcels	X	X	X	X
Subdivisions	X	X		X
Public vs Private	X	X	X	X
Rights-of-Way	X			X
Zoning	X	X	X	
Parks	X	X		X
Council Districts			X	X
Neighborhoods		X		
Voter Districts				
Wards				
Flood Hazard	X	X		
Landuse		X		X
Watersheds	X	X		
Ownership	X	X	X	X