



CANTEEN CREEK - CAHOKIA CREEK WATERSHED PLAN

**A GUIDE TO PROTECTING AND
RESTORING WATERSHED HEALTH**

DRAFT
DECEMBER 2018

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Canteen-Cahokia Creek Watershed Plan

A Guide to Protecting and Restoring Watershed Health

September 2018

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EXECUTIVE SUMMARY

Introduction

Stormwater management for Madison County is guided by the policy framework established in the Madison County Stormwater Management Plan, a county-wide document that seeks to address the effects of urbanization on stormwater drainage. The plan sets broad policy for Madison County as a whole, and sets policy and provides specific recommendations for each watershed's unique circumstances through individual watershed plans.

In 2013, Madison County and HeartLands Conservancy began to develop the first large-scale watershed plan in the county, for the upper Silver Creek watershed. This plan was completed in 2016 and is pending adoption by the county.

In 2015, the county began to move ahead with watershed plans for two additional adjacent watersheds: the Indian Creek-Cahokia Creek watershed and the Canteen Creek-Cahokia Creek watershed. By working on the two watersheds simultaneously, the planning team could gather input on both watersheds at once from communities straddling the watershed boundary.

This watershed plan offers guidance for managing watershed resources on public property, as well as providing a platform to encourage other watershed stakeholders (landowners, residents, businesses, developers, public agencies, and non-profits) to participate. The plan is not regulatory, meaning it does not become law. The intent is to encourage voluntary improvements to water quality and stormwater management in the watershed, for agricultural, urban, and natural areas and waters.

Executive Summary Contents

Introduction

Goals, Objectives, & Targets

Issues

Critical Areas

Management Measures Action Plan

Information & Education Plan

Implementation

Measuring Success

Canteen-Cahokia Creek Watershed

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Figure 1. Watershed Location

The Canteen-Cahokia Creek Watershed

The Canteen-Cahokia Creek watershed is located approximately 12 miles northeast of downtown St. Louis, Missouri. The majority of the watershed lies within Madison County, Illinois, but another 24% lies within St. Clair County. The watershed's 262 miles of streams drain roughly 57,000 acres of land.

The Canteen-Cahokia Creek watershed project area contains numerous subwatersheds, called HUC12s and HUC14s. "HUC" stands for Hydrologic Unit Code, a number that identifies the general location and size of the watershed. Many of the issues identified in the watershed are assessed at these subwatershed levels.

The watershed is home to 64,000 residents. Agricultural land makes up 29% of the watershed, with most of that land in row crop farming. Ten municipalities, nine townships, and two counties are located within the watershed.



Figure 2. Location of Canteen-Cahokia Creek watershed in the State of Illinois.

Goals, Objectives, and Targets

The plan promotes a functioning, healthy watershed and guides the development, enhancement, and implementation of actions to achieve these goals:

GOALS
GOAL 1: Reduce Flooding/Mitigate Flood Damage
GOAL 2: Improve Surface Water Quality
GOAL 3: Promote Environmentally Sensitive Development
GOAL 4: Support Healthy Habitat
GOAL 5: Develop Organizational Frameworks
GOAL 6: Conduct Education and Outreach

Objectives were developed to specify progress towards these goals. Targets in this plan were set at levels that can feasibly be reached by the implementation of a suite of Best Management Practices (BMPs), or Management Measures, over time. The targets include a 25% reduction in phosphorus loading and a 15% reduction in nitrogen loading by 2030 (based on Illinois Nutrient Loss Reduction Strategy), and a 20% reduction in sediment loading (based on estimated impacts of proposed BMPs) by 2030.

Key Watershed Issues

Analysis of the existing and predicted future conditions in the watershed (Appendix A: Watershed Resource Inventory) included collecting data from several government data sources, delineating HUC14 watershed boundaries, using the U.S. Environmental Protection Agency (USEPA) Spreadsheet Tool for Estimating Pollutant Loads (STEPL), conducting an aerial assessment of stream and riparian conditions, field checks, and stakeholder engagement. From this research, the following issues were identified:

Flooding issues

- **Prevalent flooding, within and outside floodplains:** All municipalities in the watershed have experienced flooding. Respondents to the Flood Survey reported 697 flood events per year outside the 100-year floodplain, while only about 30 were within floodplains. (Note: these are the floodplains currently “in effect,” identified in the 1970s to 1980s Federal Emergency Management Agency (FEMA) maps.)
- **Undersized stormwater infrastructure:** In many areas, stormwater infrastructure (e.g., culverts, ditches) is undersized for the amount of water it has to handle, leading to flooding.
- **High water table/groundwater:** When the soil is already saturated, stormwater cannot infiltrate and runs off on the surface.
- **Large areas of impervious cover:** New development and the creation of large areas of impervious surfaces have dramatically changed stormwater drainage in some areas, leading to flooding.
- **Backup issues when the river is high:** If the canals in St. Clair County or the Cahokia Canal at Hartford do not drain to the Mississippi River, the inland waterways back up, causing flooding.
- **Logjams and beavers:** Beavers and logjams contribute to localized flooding issues.
- **Channelization:** When streams are straightened (channelized), such as in Collinsville Township, water moves through them much more quickly and can exacerbate downstream flooding.
- **Sediment deposition:** Dredging of lakes and detention basins is needed to maintain water storage capacity. Dredging can be very expensive.
- **Levee breach:** Levee breaches can lead to flooding in the area behind the levee.

Water quality issues

- **Drinking water source protection:** Communities such as Edwardsville and Maryville, and many individuals in the unincorporated county, use well water as their water supply. Contamination of these water sources is a life safety issue and can be costly to remediate.
- **Soil erosion:** Soil erosion contributes large amounts of sediments to streams and waterways.
 - **From streambanks, stream channels, and lake shorelines:** Many residents in the watershed have had yards collapse into a stream because of bank and channel erosion. Logjams can exacerbate the problem, causing scouring and bank collapse.
 - **From farmland:** Valuable topsoil often erodes from the land when the soil is exposed.
 - **From construction sites:** Improperly stored earth at construction sites is highly prone to erosion.
- **Sediment:** Sediment is highly prevalent in streams and runoff throughout the watershed. When soil erodes from the landscape, it ends up as sediment and silt in streams. The soil carries other pollutants such as phosphorus, iron, and manganese with it. When sediment is deposited in streams and detention basins, it forces the water upwards, which can lead to flooding. **Total Suspended Solids (TSS)** and **bottom deposits** are two of the pollutants identified in Canteen

Creek and Schoenberger Creek North (also known as Harding Ditch), respectively on the 2018 Illinois EPA (IEPA) 303(d) List.

- **Pollutants in streams:**
 - **Phosphorus:** Phosphorus is carried into waterways along with soil particles. It often comes from agricultural fertilizer or lawn fertilizer. It can lead to harmful algae blooms. Phosphorus is one of the pollutants identified in Cahokia Creek (Cahokia Canal) on the 2018 IEPA 303(d) List.
 - **Manganese and iron:** Iron is one of the pollutants identified in Cahokia Creek (Cahokia Canal) on the 2018 IEPA 303(d) List. Manganese has also been identified in high levels in Collinsville water. These elements are found in naturally high levels in soil in the area. Both can be toxic to aquatic plants and animals.
 - **Barium:** Barium is one of the pollutants identified in Canteen Creek on the 2018 IEPA 303(d) List. The source of this pollutant is not known (possibly industrial or mining activity). Barium can be toxic to aquatic life and to human life if the level of exposure is too high.
 - **Chloride:** Application and storage of road salt is a concern where water with high concentrations of chloride flows into groundwater or streams. Chlorides increase treatment costs for water supplies and are harmful to aquatic life in waterways.
 - **Mercury:** High mercury levels have been found in fish in Dunlap Lake by Southern Illinois University Edwardsville (SIUE) researchers. Residents have been advised to only catch and release fish, not eat them.
 - **Chloride:** Application and storage of road salt is a concern where water with high concentrations of chloride flows into groundwater or streams. Chlorides increase treatment costs for water supplies and are harmful to aquatic life in waterways.
- **Low Dissolved Oxygen:** Low levels of dissolved oxygen in water cannot support aquatic life. Low dissolved oxygen levels are often a result of algae growth that uses up oxygen in the water, which is caused by high levels of nutrients such as nitrogen and phosphorus. Low DO is listed as an impairment to Cahokia Creek (Cahokia Canal) and Schoenberger Creek North (Harding Ditch) on the 2018 IEPA 303(d) List.
- **Sewage contamination from private systems:** Poor maintenance of private sewage systems can lead to raw human waste in waterways.
- **Combined sewers:** Hartford has sewer pipes that carry both stormwater and sanitary waste (combined sewers). When large volumes of stormwater enter the system, overflows can carry untreated waste out onto the land and into streams.
- **Infiltration into/out of ageing pipes:** Some pipes in Edwardsville and Maryville are over 100 years old. Sewage can leak out of sewer pipes, and groundwater leak into water supply pipes.
- **Livestock waste management:** Improperly treated livestock waste can also reach waterways.
- **Litter and dumping:** Littering and unlawful dumping are widespread, particularly at streams.
- **Algae blooms and fish die-outs:** These are common in lakes and streams, resulting from an excess of fertilizer.
- **Point source discharges:** A single source of pollution that is discharged into waterways, such as pollution from a sewage treatment plant.
- **Leachate from landfills:** Liquid that has passed through a landfill and extracted dissolved and suspended matter from it, known as leachate, can pollute waterways.
- **Contact through boating, swimming, fishing:** People use the lakes in the watershed for recreation, often coming into direct contact with the water and becoming exposed to pollutants in it.

Land cover and development issues

- **Poorly planned development.** Many older developments in the watersheds did not include adequate drainage infrastructure, which has exacerbated water quality and flooding issues. New development often increases the speed of stormwater runoff and does not provide for long-term maintenance of drainage infrastructure, even if it meets local building and stormwater requirements.
- **Mining legacy:** East of Collinsville, mining activities have left behind mine tailings and issues with subsidence that may affect drainage and water quality. Development must be sensitive to this.

Habitat issues

- **Poor riparian condition:** The area either side of a stream is known as the riparian area. This area is considered to be in poor condition when there is not enough vegetation to support the streambanks and provide shade to the stream. These conditions are also important for wildlife, particularly neotropical migratory songbirds that use the Mississippi River flyway.
- **Fish die-outs:** Algae blooms can remove so much oxygen from water that fish suffocate. Maryville has seen at least one such event.
- **Invasive species present:** Invasive species crowd out native species such as plants that protect streambanks from erosion.
- **Unprotected habitat for endangered species:** Where their native habitat is not preserved, threatened and endangered species such as the chorus frog cannot be expected to thrive over the long term.

Organizational needs/issues

- **Lack of levee maintenance:** Some levees in the watershed are reportedly not being adequately maintained (Burdick Creek and Canteen Creek). Levee districts have struggled to find funding to maintain the levees that they are responsible for.
- **Lack of detention basin maintenance:** Detention basins are often not being maintained/dredged to maintain their sediment storage and water storage capacities.
- **Lack of code enforcement:** In some cases, municipal stormwater, development, subdivision, and floodplain codes are not being fully enforced.
- **Lack of funding:** Funding from government entities and other groups is often needed to maintain and expand stormwater infrastructure and improve water quality.
- **Need for strong partnerships:** A network of partner organizations/groups is needed to make large strides towards addressing flooding and other issues in the watersheds.

Information and outreach issues

- **Need for communication and collaboration:** Communication about funding and technical resources is sometimes lacking between potential partners; this information could help bring awareness, technical resources, and funding to address issues.
- **Need for outreach to key stakeholders:** A large group of landowners and other key stakeholders working together is needed to make progress towards addressing flooding and other issues.

Critical Areas

“Critical Areas” were identified at locations in the watershed where existing or potential future causes and sources of pollutants or existing functions are significantly worse than other areas of the watershed, OR there is significant potential for the area to make progress towards one or more of the plan’s goals. The Critical Areas were identified using survey and stakeholder information, aerial and field assessments, and U.S. Department of Agriculture (USDA) modeling.

The following Critical Areas were identified:

1. Critical Stream Reaches: Highly or moderately degraded stream reaches with high channelization (11.60 miles)
2. Critical Logjam Areas: Stream reaches with high susceptibility to logjams (15.02 miles)
3. Critical Riparian Areas: Highly degraded riparian areas (15.64 miles)
4. Critical Wetland Areas: Areas suitable for wetland restoration (256 acres)

Implementation

The “Action Plan” is designed to provide partners with recommended actions, known as Management Measures, which address the plan’s goals, objectives, and targets.

Recommended Management Measures

Programmatic Measures, including general remedial, preventive, and policy watershed-wide measures, and **Site-Specific Measures**, on-the-ground practices that can be implemented to improve surface and groundwater quality and flooding, are recommended. Management Measures identified for Critical Areas are prioritized for short-term implementation (e.g., wetland restoration projects in Critical Wetlands Areas). All recommendations in the plan are for guidance only and are not required by any federal, state, or local agency.

Together, these practices can make changes in the watershed that will meet and exceed the Impairment Reduction Targets. Significant participation from local landowners, farmers, residents, municipalities, and developers will be needed to achieve these targets.

Programmatic Measures

Protection and management of natural areas

- Conservation Development design, which protects natural features like streams, steep slopes, and forest in new development (especially subdivisions).
- Open space and natural area protection from the design stage through to the stage where the landowner owns the property.
- Green infrastructure incentives, which promote the protection of forest, wetlands, and other green infrastructure.
- Long-term management and maintenance of natural areas, through management agreements with responsible entities.
- Monitoring of water quality, flow, and stream health to help measure progress.

Restoration of natural areas

- In-lieu fee ecological mitigation, a type of program that funds the restoration of ecologically sensitive wetlands and streams to mitigate for the losses of those features to new development.
- Native landscaping, which encourages the use of native plants on public and private property.
- Stream Cleanup Team, which removes litter and debris from streams and waterbodies.

Wastewater management

- Sewage Treatment Plant upgrades, which reduce the pollutant loading in wastewater discharge from wastewater facilities.
- Private sewage monitoring, a proactive program that samples private sewage systems to check for water quality problems and to encourage regular maintenance.

Natural resource policy

- Flood Damage Prevention Ordinance, which limits inappropriate development in floodplains, adopted by counties and municipalities.
- Riparian Buffer Ordinance, which limits development in riparian areas (areas adjacent to streams and waterbodies), encouraging forest and grassland that helps to filter and slow down runoff.
- Watershed plan integrated into community policies and programs.

Funding

- Federal and state programs such as the Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Incentives Program (EQIP) are available to landowners in the watershed to finance practices that prevent soil erosion, among other benefits.
- Financial support for stormwater infrastructure, such as a Stormwater Utility, that is dedicated to upgrades and maintenance of detention basins, ditches, and other conveyance structures.

Site-Specific Measures

Agricultural

- Animal waste treatment systems, which provide proper treatment and use of waste (primarily manure) from livestock operations.
- Bioreactors, also known as denitrifying bioreactors, which are ditches filled with woodchips that remove nitrogen from water leaving tile-drained fields.
- Comprehensive Nutrient Management Plans (CNMPs), which are farm-specific plans to eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland, reducing water pollution and increasing soil health.
- Conservation tillage (reduced tillage/no-till), which leads to a reduction in soil erosion and the transport of associated nutrients, such as phosphorus, to the waterways.
- Contour buffer strips, which are narrow strips of perennial vegetation that slow surface runoff and trap sediment, significantly reducing sheet and rill erosion and removing pollutants from runoff.
- Cover crops, which prevent erosion, improve soil health, break pest cycles, and suppress weeds.
- Grassed waterways, which are vegetated channels designed to slow surface water to reduce soil erosion and flooding.
- Nutrient Management Plans (NMPs), which are farm-specific plans for determining nutrient needs for crops and obtaining the maximum return from fertilizers.
- Ponds, which store stormwater, settle out sediments, and allow nutrient uptake by aquatic organisms.
- Riparian buffers, which are vegetated zones immediately adjacent to streams that protect the stream channel.
- Terraces, which consist of ridges and channels constructed across the slope of a field, reducing soil erosion and surface runoff on sloping fields.
- Water and Sediment Control Basins (WASCOBs), which are small earthen ridge-and-channel structures or embankments built across a small watercourse in a field. They hold runoff, reducing the amount of sediment and sediment-borne phosphorus leaving the field and preventing the formation of gullies.
- Wetlands, which function as one of the most effective pollution removal practices.

Forest

- Forest stand improvement, which manages forest species composition (including removal of invasive species), can increase infiltration, reduce erosion, and provide long-term wildlife habitat.

Urban areas

- Bioswales, also known as vegetated swales, which increase infiltration and delay stormwater surges during heavy rainfall.
- Detention basins (new and retrofitted), which store flows during and incrementally release the stored water.
- Pervious pavement, which allows infiltration of stormwater into a below-ground storage area through holes.
- Rain gardens, which temporarily store and infiltrate rain water, significantly slowing the flow of water, improving water quality, and providing wildlife food and habitat.
- Rainwater collection and reuse, using rain barrels or cisterns.
- Single property flood reduction strategies, which differ from property to property, based on the sources of flooding and appropriate flood reduction strategies.
- Stormwater system maintenance and expansion, which is crucial for the efficient conveyance of stormwater.
- Tree planting (e.g., street trees), to decrease and filter stormwater, reduce air temperatures, provide pleasing aesthetics.
- Urban filter strips, which remove sediment and pollutants and enhance infiltration of surface water runoff.

Streams and lakes

- Logjam removal, which removes debris from the stream channel, reducing scouring in the stream channel and the risk of floods overtopping the channel.
- Shoreline stabilization, which reduces bank erosion along lake shores.
- Streambank and channel stabilization and restoration, which includes stabilization and grade control structures, and re-meandering. These reduce erosion and, in some cases, provide flood storage.

Measuring Success

Water quality monitoring may be conducted, as funding allows, on a three to five year cycle through the year 2030. This may be done by the by the National Great Rivers Research and Education Center (NGRREC). A set of Progress Report Cards is included in Appendix H, which includes milestones for short-term (one to 10 years; 2018 to 2028), medium-term (10 to 20 years; 2028 to 2038), and long-term (20+ years; 2038+) timeframes. The report card can be used to identify and track plan implementation and effectiveness. Checking in at appropriate milestones helps watershed partners make corrections and ensure that progress is being made towards achieving the plan's goals.

Information and Education Plan

Public outreach and educational activities are vital for supporting a healthier watershed. The Information and Education component of this plan supports the cumulative actions of partners, stakeholders, and the public across the watershed to accomplish its goals and objectives.

Recommended information and outreach activities include:

- Municipal outreach;
- Watershed plan outreach;
- An Agricultural BMP Workshop;
- An Urban BMP workshop;
- A BMP Tour;
- A public events booth;
- Field days;
- Educational signs;
- School projects; and
- Watershed protection awareness.

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SECTION 1: INTRODUCTION

Simply stated, a “watershed” is the area of land that drains into a common waterbody, such as a creek or river. It can be thought of as a large bathtub: when a drop of water hits anywhere in the tub, it eventually finds its way to the drain (the lowest point). The rim of the bathtub is like the watershed boundary—any drop falling outside it will not reach the drain. On land, a watershed boundary is determined by topography, and it includes surface water bodies (e.g., streams, rivers, lakes, reservoirs, and wetlands), groundwater (e.g., aquifers and groundwater basins), and the surrounding landscape.

The Canteen-Cahokia Creek watershed is an area in southwestern Illinois that drains to the Mississippi River (Figure 1). Rain falling on the watershed collects phosphorus and sediment on its way downhill to Cahokia Creek (Cahokia Canal). Excessively high concentrations of these and other pollutants in Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch) earned these creeks a place on the 2018 IEPA 303(d) list of impaired waters for several successive years. Flooding is also a problem throughout the watershed, both where creeks rise up out of their banks and in urban areas (i.e., “flash flooding”).

In 2012, Madison County began work on a county-wide Stormwater Management Plan to manage stormwater runoff. The plan is founded in four principles:

1. Acknowledging that multiple communities are connected by waterways and the actions of one jurisdiction will impact upstream and downstream jurisdictions. Stormwater management efforts should focus on a watershed-scale perspective.
2. Recognizing that a systems approach is needed in managing stormwater.
3. Recognizing that existing streams, creeks, bodies of water, and wetlands are infrastructure that needs to be protected and maintained.
4. Recognizing that future growth and a high quality of life are dependent on managing the effects of stormwater.

Based on these principles, the county will incorporate watershed-level stormwater management plans for all of the major watersheds in the county. The Upper Silver Creek Watershed-Based Plan was completed in 2016. This plan and the Indian Creek-Cahokia Creek Watershed Plan are on the same schedule. The American Bottom Watershed Plan, for that portion of the Judy’s Branch-American Bottom watershed that is in Madison County, is scheduled to be completed by 2020.

A watershed plan is a strategy for managing watershed resources on public property, as well as providing a platform to encourage other watershed stakeholders (e.g., land owners, residents, businesses, developers, and non-profits) to participate. The plan is not regulatory, meaning it does not become law. The intent is to encourage voluntary improvements to stormwater management and water quality in the watershed.

Canteen-Cahokia Creek Watershed

Table 1. Jurisdictions in the Canteen-Cahokia Creek watershed.

Jurisdiction	Area within watershed (acres)
County (inclusive of municipalities)	57,277
St. Clair	13,752
Madison	43,525
Municipalities	28,146
Caseyville	3,528
Collinsville	8,489
Edwardsville	3,755
Fairview Heights	2,494
Glen Carbon	4,491
Hartford	51
Maryville	3,032
Pontoon Beach	2,018
South Roxana	288
Troy	588
Unincorporated Areas	29,131
St. Clair County	22,620
Madison County	6,511
Township	57,279
Canteen (St. Clair County)	2,836
Caseyville (St. Clair County)	10,998
Chouteau	4,244
Collinsville	22,795
Edwardsville	11,214
Jarvis	2,992
Nameoki	2,147
O'Fallon	50
Pin Oak	3

The Canteen-Cahokia Creek watershed is located approximately 12 miles northeast of downtown St. Louis, Missouri. The watershed's 262 miles of streams drain roughly 57,000 acres of land. The watershed contains numerous subwatersheds, called HUC12s and HUC14s. "HUC" stands for Hydrologic Unit Code, a number that identifies the general location and size of the watershed. Many of the issues identified in the watershed are assessed at these subwatershed levels.

Cahokia Creek (Cahokia Canal) and Canteen Creek are the major streams delivering water from the watershed to the American Bottom and then to the Mississippi River. Smaller tributaries in the watershed include Judy's Branch, Burdick Branch, Schoolhouse Branch, and Little Canteen Creek.

The watershed is home to approximately 64,000 people. Urban land makes up 44% of land cover, and agricultural land makes up another 29%, with most of that land in row crop farming. All or portions of 10 municipalities, nine townships, and two counties are located within the watershed (Table 1 and Figure 3).

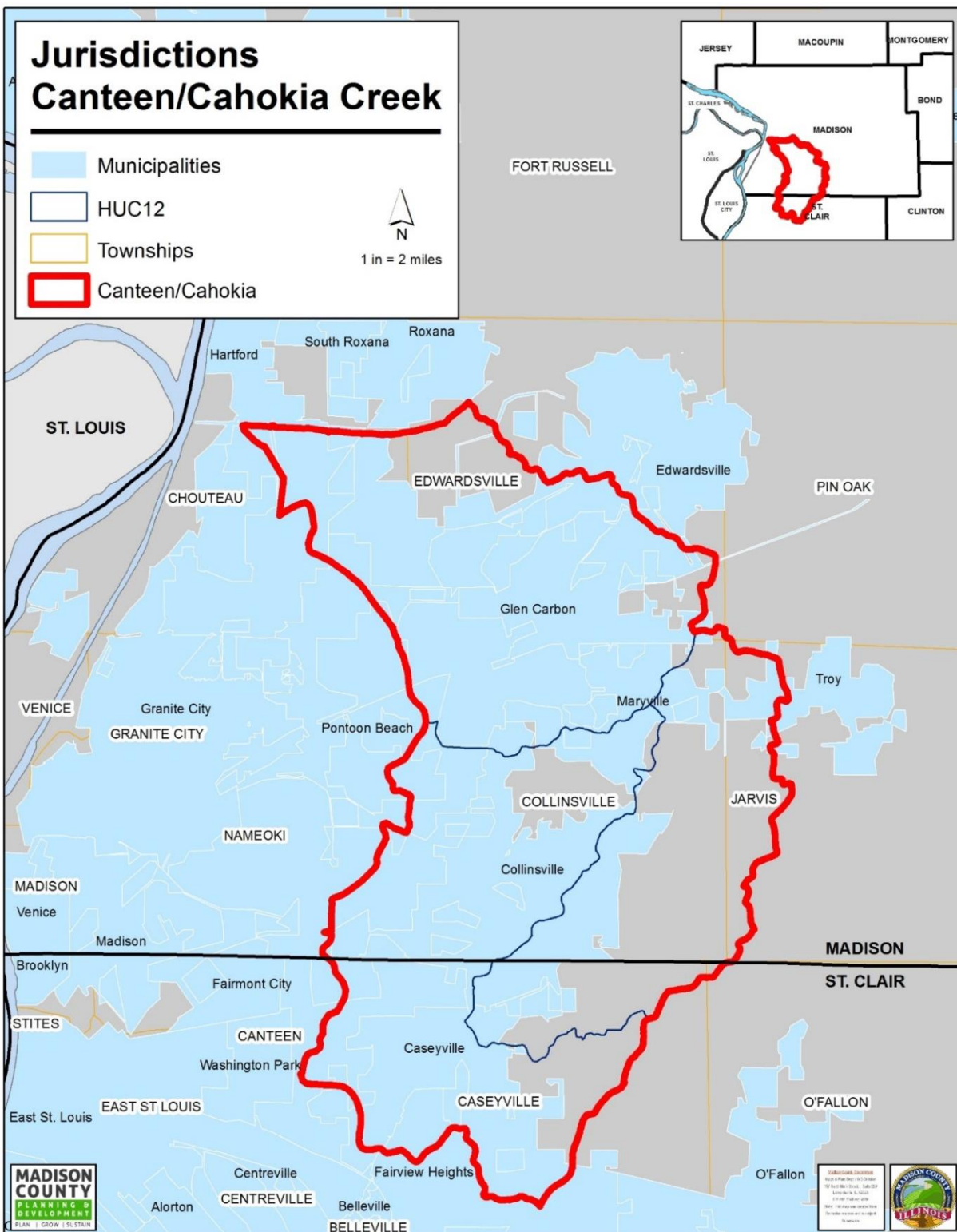


Figure 3. The Canteen-Cahokia Creek watershed, containing three HUC12 subwatersheds and all or portions of 10 municipalities.

Purpose

The purpose of the Canteen-Cahokia Creek Watershed Plan is to promote a healthy, functioning watershed that sensitively balances farming, development, and natural ecosystems, including restoring surface water quality to Cahokia Creek (Cahokia canal) and its tributaries and managing stormwater in floodplains and communities. The plan should enhance, manage, and protect the watershed's human, natural, and socio-economic resources by identifying strategies and resources that promote the health and safety of human inhabitants, improve surface and groundwater quality, prevent flood damage, protect wildlife, and increase environmental education.

Madison County Stormwater Plan

The Madison County Stormwater Plan is the overall framework for stormwater management in the county which guides regulations, identifies flood and water quality problems, establishes BMPs, and prioritizes projects. The Canteen-Cahokia Creek watershed is one of 10 watersheds for which a watershed plan will be developed as part of the Stormwater Plan. Direction and approval for the Stormwater Plan comes from the Madison County Stormwater Commission, whose members include County Board members and municipal representatives.

The Madison County Stormwater Plan also references stormwater runoff which is transported through Municipal Separate Storm Sewer Systems (MS4s). Madison County acts as the Coordinator for the MS4 Co-Permittee Group which consists of 26 communities (including the county itself). The group works together to help the individual communities and townships meet the six minimum control measures of their ILR40 permits.

The minimum requirements are: 1) public education and outreach, 2) public participation/involvement, 3) illicit discharge detection and elimination, 4) construction site runoff control, 5) post-construction runoff control, and 6) pollution prevention/good housekeeping. Madison County's MS4 activities in 2014 included technical training, outreach at public events, and hazardous waste collection.

Authority

The State of Illinois Counties Code (55 ILCS 5/) gives counties the authority to adopt and enforce floodplain regulations that apply to all buildings, structures, construction, excavation, and fill in the floodplain. The Counties Code also allows "management and mitigation of the effects of urbanization on stormwater drainage" in Madison County, St. Clair County, and seven other counties (55/ILCS 5/5-1062.2).

(55/ILCS 5/5-1062.2) Stormwater management. ... The purpose of this Section shall be achieved by:

- (1) Consolidating the existing stormwater management framework into a united, countywide structure.*
- (2) Setting minimum standards for floodplain and stormwater management.*
- (3) Preparing a countywide plan for the management of natural and man-made drainageways. The countywide plan may incorporate watershed plans.*

The Section also allows the establishment of a stormwater management planning committee, whose principal duties "shall be to develop a stormwater management plan for presentation to and approval by the county board, and to direct the plan's implementation and revision." The Madison County Stormwater Commission fulfills this role. The stormwater plan it creates must be reviewed by the Illinois Department of Resources Office of Water Resources (IDNR-OWR), and can include elements such as

rules for floodplain and stormwater management, fees or taxes from new development, and incentives for using green infrastructure and other approved drainage structures. Illinois municipalities also have the authority to adopt stormwater plans (65 ILCS/ Art 11 prec Div 110 – Flood Control and Drainage).

Methodology

Madison County and HeartLands Conservancy developed a watershed planning approach based on guidance from the Stormwater Master Plan, the county Stormwater Commission, IEPA's Nonpoint Source Program, and the USEPA's nine elements of watershed planning. The planning process included the following components:

1. Watershed area data collection and analysis
2. Delineation of subwatersheds
3. Technical Committee and Advisory Groups
4. Stakeholder engagement
5. Key issue identification and goal setting
6. Critical Areas identification
7. Management Measure and target development
8. Implementation plan
9. Stormwater Commission and County Board review
10. Integration into the county-wide Stormwater Master Plan

Watershed Data Collection and Analysis

A Watershed Resource Inventory (Appendix A) was developed by the U.S. Army Corps of Engineers (USACE), which reviews the existing conditions within the watershed. The inventory documents existing conditions in Cahokia Creek (Cahokia Canal) and its tributaries including channelization, erosion, riparian area condition, soil types, demographics, land use/land cover, and climate. Existing pollutant loads of nitrogen, phosphorus, and sediment are estimated from existing land uses using the STEPL from the USEPA. See planning inputs (right) for a list of data collected or generated for the Watershed Resources Inventory.

Aerial assessment of stream and riparian conditions

Little information existed about the condition of the streams in the watershed. To gather information about the stream reaches, geo-referenced video footage was taken by USACE on low-level helicopter flights over the larger streams in the watershed. Staff viewed the videotapes to assess three parameters for each stream: streambank erosion, degree of channelization, and condition of the riparian area.

Detention basin survey

USACE looked at aerial photographs of the watershed, along with U.S. Geological Survey (USGS) topographic maps, an elevation dataset, and the National Hydrography Dataset, to identify detention and retention basins in both Cahokia Creek watersheds. A point was created for each basin located in or very close to a group of five or more buildings, to avoid classifying natural ponds as detention basins. Fifty-eight detention or retention basins were identified in the watershed. Site visits were made to 13 of the 107 accessible basins identified, in order to determine their condition.

Delineation of subwatersheds

The watershed contains three subwatersheds, or hydrologic units (HUCs), called HUC12s. To provide more detailed analysis and recommendations for the watershed, the HUC12s were further divided into 10 even smaller HUC14 subwatersheds. USACE used USGS methodology for defining watersheds in the Watershed Boundary Dataset (WBD), a component of the National Hydrography Dataset (NHD). Throughout this plan, the term “subwatershed” refers to the HUC14 subwatershed level.

Planning inputs

The following types or sources of data were used to shape the Plan:

Watershed Resources Inventory

Watershed boundaries (incl. HUC14s)
Streams and waterbodies
Direction of flow
Topography
Climate (incl. temperature and precipitation)
Geology
Aquifers
Wells
Hydric and hydrologic soils
Erodible soils
Water table
Jurisdictional roles (federal, state, and local)
Demographics
Land use/land cover
Ecological significance
Fish and wildlife populations
Transportation infrastructure
Cultural/historic resources
Impervious cover
Streambank & streambed erosion
Channelization
Logjams
Detention and retention basins
Floodplains
Infrastructure in floodplains
National Flood Insurance Program (NFIP) communities
IEPA 303(d) impaired waters
Other water quality data
Spreadsheet for Estimating Pollutant Loads (STEPL) analysis

Watershed Plan

Agricultural Conservation Planning Framework (ACPF) GIS tools
Best Management Practice (BMP) pollutant reduction efficiencies

Stakeholder engagement

Advisory Group
Open House Events
Stakeholder meetings
Flood Survey
Landowner/Farmer Survey

Technical Committee

A Technical Committee consisting of experts in stormwater management, water quality, stream and soil health, conservation, and urban planning guided data collection and analysis. The committee was represented by Madison County Planning and Development, Heartlands Conservancy, USACE, Madison County Emergency Management Agency, Madison County Highway Department, and Madison County Soil and Water Conservation District. The Technical Committee provided input to USACE on the Watershed Resources Inventory (Appendix A) and provided technical guidance on recommendations and subsequent drafts of the plan. Specifically, the committee reviewed the methodology of data collection, draft nutrient reduction targets and other targets, Flood Survey results, Best Management Practices (BMPs), and milestones for plan implementation.



Stakeholder Engagement

Early on and throughout the planning process, the planning team engaged more than 600 individuals from more than 70 entities. Interviews were conducted with stakeholders including townships, municipalities, the Madison County Farm Bureau, and County Board members. Small group meetings allowed attendees to provide locations of floods and other issues on large paper maps, and give detailed input on stormwater issues in the watershed. Five Open House events were also used to gather input and get feedback from the general public. Presentations at regularly scheduled meetings of organizations such as the Edwardsville Rotary and the East-West Gateway Council of Government's Water Resources Committee allowed the project planning team to reach larger groups efficiently.

Municipalities were asked about their drinking water source(s), wastewater treatment system(s), and flooding, as well as issues such as erosion, siltation, and water quality issues. Other stakeholders were asked about these issues in their jurisdiction or on their property. A table summarizing the input from municipalities can be found in Appendix A (Watershed Resource Inventory). Stakeholder input was particularly helpful in shaping the Critical Area locations and the Information and Outreach section of the plan, which identifies outreach gaps and opportunities with specific events and groups. Some of the

issues identified during outreach include recurrent flooding, high levels of sediment, phosphorus, and nitrogen, and inadequate communication/coordination among potential watershed partners.

Flood Survey

As another component of stakeholder outreach, the Madison County Community Flood Survey for the Canteen-Cahokia Creek watershed was sent to 2,400 randomly selected addresses in the watershed—as well as posted online—following the initial stakeholder meetings. More than 450 responses were received. The results revealed trends in flooding locations, frequency, and impacts (Appendix B). The survey found that 11% of respondents experienced flooding in the last decade, and those respondents experience an average of 1.3 floods per year.

Key Issue Identification and Goal Setting

Using the results of the stakeholder outreach process, the project team and technical committee identified the key issues—such as erosion and flash flooding—in the watershed. As the key issues evolved, common themes emerged and the project team was able to develop overarching goals and objectives for the watershed.

Critical Areas Identification

In addition to identification of key issues, the project team used information gathered from municipalities, townships, the county, individual property owners, and a variety of technical and spatial data resources and modeling to determine the locations of Critical Areas in the watershed. A “Critical Area” is a location in the watershed where existing or potential future causes and sources of pollutants are significantly worse than other areas, or there is significant potential to make progress towards watershed plan goals.

Management Measures and Targets

Based on the Watershed Resource Inventory and input from stakeholders and the public, management measures and targets were identified. Management Measures include potential Best Management Practices (BMPs) for prevention, remediation, restoration, and maintenance to achieve water quality, natural resources, and flood control objectives. For each BMP, the plan identifies pollutant load reduction and other benefits, approximate costs, and a schedule for implementation. Sources of financial and technical support are also identified, and measures of success and milestones are established to monitor the ongoing progress of the plan.

Spreadsheet Tool for Estimating Pollutant Loads (STEPL)

USACE used the STEPL, which uses land cover, precipitation, and elevation data to estimate nitrogen, phosphorus, and sediment runoff from specific drainage areas. The tool created estimates for current land use conditions and future land cover scenarios incorporating Management Measures. The Technical Committee used these numbers to set targets for pollutant load reduction in the watershed.

Agricultural Conservation Planning Framework (ACPF)

Heartlands Conservancy used the Agricultural Conservation Planning Framework (ACPF), a set of Geographic Information System (GIS) tools developed by the USDA to identify locations where certain BMPs (e.g., terraces, grassed waterways) would be well-suited. The ACPF uses topographic data (LiDAR) to create maps of drainage pathways across agricultural land. These drainage pathways are used alongside land cover, rainfall, and soils data to create useable maps within the watershed. Heartlands Conservancy worked closely with USDA to use the ACPF tools to get the most accurate and useful results for this watershed.

Implementation Plan

For each Management Measure, an implementation schedule was developed. Partners in the watershed plan can monitor progress and effectiveness using progress report cards (Appendix H).

Water quality monitoring

Water quality monitoring data was collected for the watershed (from ISGS, IEPA, and other sources), and a monitoring plan was created for the coming years (Appendix F).

Stormwater Commission and County Board Review

Drafts of the plan will be reviewed by the Madison County Stormwater Commission. The Stormwater Commission will make a recommendation to the County Board on whether to adopt the plan as a part of the county-wide Stormwater Management Plan.

Integration into Madison County Stormwater Management Plan

Upon adoption by the County Board, the watershed plan will become a part of the county-wide Stormwater Management Plan.

SECTION 2: GOALS, OBJECTIVES, AND TARGETS

Goals and Objectives

A set of long-term goals and objectives were developed to address the challenges and issues associated with maintaining a healthy, functioning watershed (Table 2). These goals address the issues identified in the Watershed Resources Inventory, Community Flood Survey, and input from residents, land owners, businesses, and government officials. Each goal and objective aligns with a challenge/issue to be addressed, a set of recommended Best Management Practices (BMPs), organizations implementing those BMPs, specific and general projects using those BMPs, and ranking of the priority of the recommended BMPs.

Table 2. Goals and objectives of the Watershed Plan.

Goals	Objectives
Reduce Flooding/Mitigate Flood Damage	<ul style="list-style-type: none"> • Increase stormwater captured, stored, and infiltrated. • Limit development in the 100-year floodplain. • Institute development standards that minimize impervious surfaces. • Preserve the natural flow of streams and slow peak stream flow. • Promote ongoing maintenance of stormwater storage and conveyance infrastructure. • Provide information about flood damage prevention and insurance. • Provide information about development in high water table areas.
Improve Surface Water Quality	<ul style="list-style-type: none"> • Ensure clean drinking water sources through groundwater protection where applicable. • Decrease pollutant loading to Cahokia Creek (Cahokia Canal) and its tributaries, and remove Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch) from the IEPA 303(d) List. • Reduce phosphorus by 25% by 2030. • Reduce sediment by 20% by 2030. • Reduce nitrogen by 15% by 2030. • Maintain DO levels above standard minimums. • Reduce manganese concentrations in Canteen Creek to 1,000 µg/L. • Create a private sewage assessment/maintenance strategy. • Monitor water quality and identify trends. • Increase awareness of consequences of littering/illegal dumping.
Promote Environmentally Sensitive Development	<ul style="list-style-type: none"> • Conserve sensitive lands. • Increase the acreage of forest, native grassland, and wetlands. • Use wetland mitigation banking or in-lieu fee programs. • Implement low-impact development strategies. • Work with municipalities to amend policies and regulations to include conservation, native landscaping, stormwater management, and low-impact design, and to improve enforcement of existing codes.
Support Healthy Habitat	<ul style="list-style-type: none"> • Promote healthy ecosystems within streams and riparian areas. • Monitor fish and aquatic macroinvertebrate communities. • Identify and protect key natural features and wildlife corridors. • Prioritize “green” stormwater management approaches. • Create an invasive species removal strategy.
Develop Organizational Frameworks	<ul style="list-style-type: none"> • Activate a network of partners to implement the plan. • Leverage funding from a variety of sources to implement the plan.
Conduct Education and Outreach	<ul style="list-style-type: none"> • Identify opportunities to assist stakeholders with watershed management. • Connect watershed stakeholders to decision-makers and experts. • Offer opportunities for public education and participation in watershed matters • Develop public recognition programs focused on the watershed plan’s goals.

GOAL 1: REDUCE FLOODING AND MITIGATE FLOOD DAMAGE

Manage and mitigate floods to improve water quality, reduce property damage and health risk, and reduce infrastructure maintenance costs.

Within the watershed, there is a need for further outreach and dissemination of resources about flood damage prevention and flood insurance; a decrease in impervious surface area; preservation and slowing of natural stream flow; an increase in flood storage and infiltration features such as detention basins, wetlands, and no-till agriculture; and changes in policy to discourage development in flood-prone areas.

Flood Management Objectives:

- 1.1 Increase the amount of stormwater captured, stored, and infiltrated in the watershed, particularly upstream of areas with periodic or regular property damage caused by flooding.*
- 1.2 Limit development in the FEMA identified 100-year floodplain.*
- 1.3 Ensure all existing levees are safe, and plan for maintenance and/or removal to minimize risk of flood damage.*
- 1.4 Institute development standards that seek to minimize the amount of impervious surfaces in new development and redevelopment projects.*
- 1.5 Preserve the natural flow regime of streams in the watershed, and identify opportunities to slow peak stream flow and recharge groundwater where increases in flood height are acceptable.*
- 1.6 Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure (e.g., detention basins and ponds) to maximize storage capacity.*
- 1.7 Provide information and outreach about flood damage prevention and flood insurance.*
- 1.8 Provide information about development in high water table areas.*

GOAL 2: IMPROVE SURFACE WATER QUALITY

This plan aims to improve surface water quality in the watershed, so that the streams can be safely used by residents, and to remove Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch) from the IEPA 303(d) list of impaired waters.

Three creeks have been listed on the 2018 IEPA 303(d) list of impaired waters for several successive years. The causes of impairment for these creeks include phosphorus, Total Suspended Solids (TSS), manganese, barium, Dissolved Oxygen, fecal bacteria, alteration in stream-side or littoral vegetative covers, changes in stream depth and velocity patterns, loss of instream cover, ammonia, turbidity, bottom deposits, aquatic algae, sludge, and odor.

For this plan, numerical reductions for impairments in the watershed are based on observed conditions and monitoring data, as well as Illinois water quality standards. The Watershed Impairment Reduction Targets table on page 35 (Table 3) provides details on the sources of these reduction targets.

Water Quality Objectives:

- 2.1 *Decrease overall pollutant loading to Cahokia Creek and its tributaries, and remove Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch) from the Illinois EPA 303(d) list of impaired waters.*
- 2.2 *Protect drinking water sources from pollutants that threaten human health or increase treatment costs.*
- 2.3 *Achieve a 25% reduction in phosphorus from the watershed by 2030. (i.e., a 25% reduction in the annual total phosphorus load by 2030, based on the Illinois Nutrient Loss Reduction Strategy.)*
- 2.4 *Achieve a 20% reduction in sediment from the watershed by 2030. (i.e., a 15% reduction in the annual sediment load by 2030, based on estimates from a suite of BMPs that also address the needed phosphorus reduction.)*
- 2.5 *Achieve a 15% reduction in nitrogen from the watershed by 2030. (i.e., a 15% reduction in the annual total nitrogen load by 2030, based on the Illinois Nutrient Loss Reduction Strategy.)*
- 2.6 *Maintain Dissolved Oxygen (DO) levels above standard minimums. (i.e., consistently maintain levels higher than the minimum concentrations set in Illinois standards (35 Ill. Adm. Code 302, set by the Illinois Pollution Control Board in 2011). These standards are different for March to July and August to February.)*
- 2.7 *Reduce manganese concentrations in Canteen Creek to 1,000 µg/L, per the Cahokia Canal Watershed TMDL Report.*
- 2.8 *Create a strategy to improve the assessment and maintenance of private sewage systems (i.e., septic tanks) for correct functioning.*
- 2.9 *Monitor the watershed's water quality to identify trends and evaluate the success of watershed management activities.*
- 2.9 *Create a strategy to increase understanding and awareness of the consequences of littering and illegal dumping.*

GOAL 3: PROMOTE ENVIRONMENTALLY SENSITIVE DEVELOPMENT PRACTICES

Promote development practices that protect environmentally sensitive lands (e.g., steep slopes, wetlands, and forests), conserve soil, limit new impervious surfaces, and increase the use of native vegetation.

Development Objectives:

- 3.1 Conserve sensitive lands by taking them out of crop production and/or protecting them from development. These lands include cropland that frequently floods, steep slopes, and forested lands adjacent to waterways (riparian areas).*
- 3.2 Increase the acreage of forest, native grassland, and wetland in the watershed while reducing the acreage of impervious surface area and turf grass. Reconnect forest tracts for habitat connectivity.*
- 3.3 Use wetland mitigation banking or in-lieu fee programs to offset the environmental impacts of new development.*
- 3.4 Implement low-impact development (LID) strategies so that important watershed processes and water resource functional values are protected. Development should allow high infiltration, use minimal impervious surface area, protect trees and native vegetation, and have adequate stormwater and sediment detention.*
- 3.5 Work with municipalities to amend their comprehensive plans, zoning ordinances, and subdivision regulations to include conservation, native landscaping, stormwater management, and low-impact development standards, and to enforce existing codes.*

GOAL 4: SUPPORT HEALTHY FISH AND WILDLIFE HABITAT

Improve and protect habitat in streams and water bodies to promote biodiversity.

Habitat Objectives:

- 4.1 Promote healthy ecosystems within streams and riparian areas to provide habitat for a wide variety of native fish, invertebrate, plant, and animal species.*
- 4.2 Monitor fish and aquatic macroinvertebrate communities alongside water quality data to assess suitability of habitat.*
- 4.3 Identify and protect key natural features and corridors for wildlife, including wetlands, forest, and grassland, to prevent the loss or degradation of fish and wildlife habitat.*
- 4.4 Prioritize “green” stormwater management approaches that use native vegetation to naturally filter pollutants over conventional structural approaches, such as riprap and piped conveyance.*
- 4.5 Create a strategy to remove invasive species within the watershed, and educate landowners about invasive species and how to safely remove them.*

GOAL 5: DEVELOP ORGANIZATIONAL FRAMEWORKS TO IMPLEMENT WATERSHED GOALS

Facilitate partnerships with stakeholders and leverage resources to implement the watershed plan.

Organizational Framework Objectives:

- 5.1 *Activate a network of partners dedicated to implementing the watershed plan and other water quality and stormwater management issues throughout the county.*
- 5.2 *Leverage funding from a variety of sources to implement the watershed plan.*

GOAL 6: CONDUCT EDUCATION AND OUTREACH

Promote public awareness, understanding, and stewardship of the watershed and the watershed plan.

Education and Outreach Objectives:

- 6.1 *Identify opportunities to assist municipalities, counties, state and federal agencies, and other stakeholders with watershed management and conservation efforts.*
- 6.2 *Connect watershed residents, farmers, and business owners to decision-makers and experts with knowledge about water quality, flooding issues, and solutions.*
- 6.3 *Offer effective opportunities for public education, training, and participation in watershed matters, including information-based resources and demonstration projects.*
- 6.4 *Develop public recognition programs focused on the watershed plan's goals.*

Watershed Impairment Reduction Targets

Establishing “Impairment Reduction Targets” is an important part of the watershed planning process. It enables calculations to be made about how implementation of a suite of Management Measures can be expected to reduce watershed impairments over time. The Implementation Reduction Targets for this watershed plan are based on the Illinois Nutrient Loss Reduction Strategy, published by IEPA in 2015. The strategy describes a comprehensive suite of BMPs for reducing nutrient loads from wastewater treatment plants and urban and agricultural runoff. Its targets are a 25% reduction in phosphorus and a 15% reduction in nitrogen by 2025, with an eventual target of 45% reduction for both nutrients. This watershed plan adds a target of a 20% reduction of sediment (Table 3).

Additional watershed-wide impairment reduction targets were established for dissolved oxygen, flood damage, habitat degradation, wetlands, surface water infiltration, and private sewage. A target for manganese in Canteen Creek identified in the Total Maximum Daily Load (TMDL) for the larger Cahokia Creek (Cahokia Canal) watershed is also included.

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Table 3. Watershed-wide impairment reduction targets, their basis, and reductions from Critical Areas and other areas recommended.

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Areas and other areas
Water Quality/Aquatic Life: Phosphorus	57,110 lbs/year of phosphorus loading, based on STEPL model	25% or 14,278 lbs/year reduction in phosphorus loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy	1,686 lbs/year reduction from Critical Stream Reaches and other poor condition stream reaches 517 lbs/year reduction from Critical Riparian Areas and other riparian areas 194 lbs/year reduction from Critical Wetland Areas 11,701 lbs/year reduction from other agricultural areas 267 lbs/year reduction from urban and forested areas
TOTAL			14,119 lbs/year or 26% total phosphorus reduction
Water Quality/Aquatic Life: Sediment	17,522 tons/year of sediment loading, based on STEPL model	20% or 3,504 tons/year reduction in sediment loading by 2050, based on estimated impacts of proposed BMPs.	429 tons/year reduction from Critical Stream Reaches and other poor condition stream reaches 150 tons/year reduction from Critical Riparian Areas and other riparian areas 81 tons/year reduction from Critical Wetland Areas 2,492 tons/year reduction from other agricultural areas 94 tons/year reduction from urban and forested areas
TOTAL			3,432 tons/year or 20% total sediment reduction
Water Quality/Aquatic Life: Nitrogen	288,422 lbs/year of nitrogen loading, based on STEPL model	15% or 43,263 lbs/year reduction in nitrogen loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy	7,458 lbs/year reduction from Critical Stream Reaches and other poor condition stream reaches 2,019 lbs/year reduction from Critical Riparian Areas and other riparian areas 390 lbs/year reduction from Critical Wetland Areas 33,247 lbs/year reduction from other agricultural areas 40,516 lbs/year reduction from urban and forested areas 1,339 lbs/year reduction from urban and forested areas
TOTAL			52,631 lbs/year or 18% total nitrogen reduction
Water Quality/Aquatic Life: Dissolved Oxygen	Cahokia Creek (Cahokia Canal) and Schoenberger Creek North (Harding Ditch) impaired for dissolved oxygen in 2018 and previous years	No samples lower than the minimum concentration in streams: <u>March – July:</u> 5.0 mg/L at any time, 6.0 mg/L daily mean averaged over 7 days <u>August – February:</u> 3.5 mg/L at any time, 4.0 mg/L daily mean averaged over 7 days, 5.5 mg/L daily mean averaged over 30 days Based on 35 Ill. Adm. Code 302 (Illinois Pollution Control Board (IPCB), 2011). No samples lower than the TMDL standards of 5.0 mg/L instantaneous minimum or 6.0 mg/L minimum during at least 16 hours of any 24-hour period (from Cahokia Canal Watershed TMDL).	93,878 feet streambank and channel stabilization and restoration, including riffle pools and other structures that increase re-aeration 140 acres of poor condition riparian areas ecologically restored, including 100% Critical Riparian Areas

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Table 3, continued.

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Reduction from Critical Areas and other areas
Water Quality/Aquatic Life: Manganese in Canteen Creek	423 µg/L average observed value on impaired segment of Canteen Creek, from 2009 Cahokia Canal Watershed TMDL Report	No samples higher than the general use water quality standard of 1,000 µg/L (from Cahokia Canal Watershed TMDL).	Soil erosion control practices also reducing manganese: 4 acres contour buffer strips 8,024 acres cover crops 81 acres grassed waterways 8,024 acres reduced tillage (conservation tillage/no-till) 20,000 feet terraces 1 acre Water and Sediment Control Basins
Flood Damage: Flooding inside and outside floodplain	11% of Flood Survey respondents experienced flooding in the last 10 years. 27% of these reported monetary loss of >\$5,000 over that time due to flooding.	100 acres dry detention basins installed 50 acres wet detention basins installed Retrofits & maintenance of existing detention basins	100 acres dry detention basins installed 50 acres wet detention basins installed Retrofits & maintenance on all 58 identified existing detention basins Single property flood reduction strategies
Habitat Degradation: Invasive/non-native plant species in riparian areas; hydrologic changes due to loss of wetlands; logjams	The riparian areas along 39% of streams assessed (15.1 miles) are in poor condition. Of this, 82,579 ft are Critical Riparian Areas. 15.02 miles Critical Logjam Areas noted.	100% Critical Riparian Areas restored Majority of riparian areas in poor condition restored 100% Critical Logjam Areas assessed, ~100 ft logjams removed	140 feet of poor condition riparian areas ecologically restored, including 100% Critical Riparian Areas 100% Critical Logjam Areas assessed
Wetland Loss: Flood storage and filtration functions	Thousands of acres of wetlands lost since pre-settlement; loss of ecosystem functions	100% Critical Wetlands Areas restored	256 acres (100%) Critical Wetlands Areas restored
Reduced infiltration to groundwater	Current mean 31.3% impervious cover; 2.8% annual increase in impervious cover (2006-2011); current 10,432 acres developed open space (2011 NLCD) or 5,888 acres open space (EWG).	Preservation of open space and infiltration measures used in new and redevelopment Increase in rain gardens Increase in pervious surfaces in new and redevelopment	Preservation of open space and infiltration measures in all new and redevelopment, e.g., designed for Conservation Development and green infrastructure 100,000 sq. ft of rain gardens installed 100 rain barrels/cisterns installed
Fecal Coliform: Private sewage	Over 2,000 private sewage systems estimated in watershed. Estimated 10% private sewage failure rate nationwide.	Samples of fecal coliform from streams and waterbodies meet the Illinois standard of a geometric mean of 200 cfu/100 ml in a minimum of 5 samples taken over ≤30 days; based on 35 Ill. Adm. Code 302 (IPCB, 2011). Proactive inspection programs for private sewage, not just complaint-based	Reduction in in-stream measured fecal coliform in streams Proactive county/municipal inspection programs for private sewage, beyond complaint-based assessment Reductions following maintenance and replacement as a result of private sewage inspections

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Table 4. Causes and sources of watershed impairments and the associated goals that address them.

IEPA or other impairment	Cause of impairment	Known or potential source of impairment	Goals
Structural Flood Damage	Encroachment in 100-year floodplain (known impairment)	Channelized streams; Agricultural drain tiles; Wetland & riparian buffer loss; Logjams and other obstructions in streams; Existing and future urban impervious surfaces;	1, 3, 5
Structural Flood Damage	Urban flooding / flash flooding (known impairment)	Existing and future urban impervious surfaces; Inadequate stormwater infrastructure (e.g. too few detention basins); Poor stormwater infrastructure design & function; Lack of funding for stormwater infrastructure; Agricultural drain tiles; Traditional development design	1, 5
Water Quality - Aquatic Life	Nutrients: Phosphorus (known impairment) and Nitrogen (potential impairment)	Streambank & channel erosion; Agricultural row crop runoff; Failing private sewage systems; Wastewater treatment plants; Lawn fertilizer; Level of landowner education; Livestock operations (manure)	2
Water Quality - Aquatic Life	Sediment: Total Suspended Solids / Turbidity (known impairment)	Streambank & channel erosion; Agricultural row crop runoff; Construction sites; Livestock operations (manure)	2
Water Quality - Aquatic Life	Low dissolved oxygen (known impairment)	Heated stormwater runoff from urban areas; Lack of natural riffles in streams (incl. channelized streams)	2
Water Quality - Aquatic Life	Manganese (known impairment)*	Naturally high manganese levels in soil and rocks; Atmospheric deposition from industry (e.g. primarily coal-fired power plants); Discharges from industrial operations;	2
Habitat Degradation	Invasive/non-native plant species & degradation in riparian and other natural areas (known impairment)	Existing and introduced invasive species populations; Logjams, trash/debris, and other obstructions in streams; Level of public education	3, 4, 6
Habitat Degradation	Loss and fragmentation of open space/wetlands/natural habitat (known impairment)	Inadequate protection policy; Lack of land acquisition funds; Traditional development design; Streambank, channel, and riparian area modification; Lack of restoration and maintenance funds; Wetland & riparian buffer loss	3, 4, 5

SECTION 3: ISSUES AND CRITICAL AREAS

Key Issues Identified

The following issues were identified in the watershed planning process. Issues are organized by the primary goal to which they relate, such as flooding. For some issues, Critical Areas where the issue is most prevalent or impactful were identified (see p.49).

Flooding

Issue: Prevalent Flooding, within and outside floodplains. Flooding is highly prevalent in the watershed, both inside and outside of floodplains, and in rural and urban areas. Urban flooding was probably the most important to the municipalities interviewed; all of them had experienced at least some flooding in developed areas. Open House attendees and Flood Survey respondents reported flooding on their properties and on the roads around them. The Madison County Community Flood Survey, administered in 2015, revealed significant and widespread flooding problems affecting residents and property owners in the watershed (Appendix B). Frequent flooding damaged homes and businesses, causing health and safety impacts, as well as monetary loss. See Table 4 for causes and sources associated with flooding.

FEMA has identified approximately 19% of the watershed as 100-year floodplain. This area is largely in the bottomland area west of the bluffs, and also along the Canteen Creek corridor. Eight communities in the watershed are enrolled in the National Flood Insurance Program. A 2010 Oates Associates report for Madison County found 16 road overtopping locations in the watershed based on Flood Insurance Rate Maps (FIRMs), many at creek crossings (Appendix A).

Some areas of flatter, higher ground in the watershed that are not in the floodplain have still been flooded by flash floods/urban flooding from time to time. This flooding is a result of increased impervious surfaces (i.e., developed areas), changes in local hydrology (e.g., ditches installed or filled in), and severe storm events with heavy rainfall. Ninety-six percent of the flooding reported in the Madison County Community Flood Survey did not occur in floodplains (Appendix B). Lack of stormwater infrastructure, inadequate infrastructure (e.g., undersized culverts), aging infrastructure, and inadequate maintenance of infrastructure all contribute to the issue of flooding outside of floodplains.

Objectives addressing this issue:

- ◆ Increase stormwater captured, stored, and infiltrated.
- ◆ Institute development standards that minimize impervious surfaces.



Issue: Undersized stormwater infrastructure: In many areas, stormwater infrastructure (e.g., culverts, ditches) is undersized for the amount of water it has to handle, leading to flooding. There are also water quality implications. In 2016, IEPA listed urban runoff/storm sewers as a source of impairment of water quality in Cahokia Creek (Cahokia Canal), Canteen Creek, Schoenberger Creek North (Harding Ditch). Also in 2016, IEPA listed highway/road/bridge runoff as a source of impairment of water quality in Schoenberger Creek North (Harding Ditch). When water carries pollutants, debris, and sediment into storm drains and ditches, there is no filtration before the runoff reaches streams and lakes.

Objectives addressing this issue:

- ◆ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure.

Issue: High water table/groundwater: The water table is less than 50 cm deep in 48% of the soils covering the watershed, particularly in the bottomland west of the bluffs. Rainfall leads to saturation of soils with a high water table more quickly. When the soil is already saturated, stormwater cannot infiltrate and runs off on the surface, contributing to flooding.

Objectives addressing this issue:

- ◆ Increase the amount of stormwater captured, stored, and infiltrated in the watershed
- ◆ Provide information about development in high water table areas.

Issue: Large areas of impervious cover: New development and the creation of large areas of impervious surfaces has dramatically changed stormwater drainage in some areas, leading to flooding. The mean imperviousness in the watershed is 31.3% as of 2011, and is set to increase as more development is added to the watershed. Developed land is predicted to increase 219% under a long-term future build-out scenario (see Appendix A). Unless steps are taken to install green infrastructure that allows for infiltration, this development will add large areas of impervious cover and exacerbate flash flooding.

Objectives addressing this issue:

- ◆ Institute development standards that seek to minimize the amount of impervious surfaces in new development and redevelopment projects.

Issue: Backup issues when the river is high: When the Mississippi River is high, the gates at the levee close and the river rises on its side of the levee. Cahokia Canal drains more slowly to the Mississippi River when this happens, or not at all, causing the inland waterways to back up. Pumps along the levees can only work so hard to move water from behind the levee to the Mississippi River. During the December 2015/January 2016 heavy rain, the water moving towards the river had nowhere to go and caused water to back up far inland of the river.

Objectives addressing this issue:

- ◆ Increase the amount of stormwater captured, stored, and infiltrated in the watershed.

Issue: Logjams and beavers: Beavers and logjams contribute to localized flooding issues that can be significant in size. Along streams, a beaver-caused logjam can cause the stream to rise above its banks and flood adjacent lands. Some of these logjams are beneficial to areas downstream, as they slow the peak stream flow and can reduce flooding downstream. In other cases, the flooding and streambank scouring caused by the logjam do more harm than good.

Objectives addressing this issue:

- ◆ Preserve the natural flow regime of streams in the watershed, and identify opportunities to slow peak stream flow
- ◆ Limit development in the FEMA identified 100-year floodplain

Issue: Channelization: When streams are straightened (channelized), such as in Collinsville Township, water moves through them much more quickly and can cause flooding downstream by reaching the next choke point in large volumes. In 2016, IEPA listed channelization as a source of impairment of water quality in Canteen Creek and Schoenberger Creek North (Harding Ditch).

Objectives addressing this issue:

- ◆ Preserve the natural flow regime of streams in the watershed.

Issue: Sediment deposition: Dredging in Dunlap Lake and Holiday Lake, as well as in countless detention basins, is needed to maintain water storage capacity. Detention basins are often not dredged as often as is necessary to maintain their sediment storage and water storage capacities. This can happen when ownership or maintenance requirements associated with a detention basin are unclear, or simply because dredging can be very expensive.

Objectives addressing this issue:

- ◆ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure (e.g., detention basins and ponds) to maximize storage capacity
- ◆ Reduce sediment by 20% by 2030.

Issue: Levee breach: A small levee in St. Clair County had a 50 to 75 foot breach in 1995, leading to flooding behind it. The levee had no evidence of deterioration beforehand. Flood Insurance Rate Maps (FIRM) show the area behind the levee (e.g., Keller Blvd) as being in the AE zone, which means the area is at an elevation that would be flooded by a 100-year flooding event (a flood with a one percent probability of occurring in any given year). There are no plans to accredit the levee. The 1995 water line can be seen on properties on Forest Lane. There are seven miles of non-federal levees in the watershed, mostly along Little Canteen Creek and a small segment along Canteen Creek, which do not have the same level of oversight as those maintained by the U.S. Army Corps of Engineers. Local drainage districts and levee districts often struggle for funding, and are limited in the maintenance activities they can perform.

Objectives addressing this issue:

- ◆ Ensure all existing levees are safe, and plan for maintenance and/or removal to minimize risk of flood damage.

Surface water quality

Table 4 lists the known water quality impairments in the watershed and their associated causes and sources. The following issues do not refer to point sources of pollution from the six facilities in the watershed that hold a NPDES permit for discharging wastewater into the watershed.

Issue: Drinking water source protection: Communities such as Edwardsville, Maryville, Collinsville, and Caseyville, and many individuals in the unincorporated county, use well water as their water supply. Contamination of these water sources is a life safety issue and can be costly to remediate.

Objectives addressing this issue:

- ◆ Decrease pollutant loading to Cahokia Creek (Cahokia Canal) and its tributaries.
- ◆ Protect drinking water sources from pollutants that threaten human health or increase treatment costs.
- ◆ Monitor water quality and identify trends.

Several municipalities in the watershed (Glen Carbon, Fairview Heights, Pontoon Beach) purchase surface water for use. Surface water originating in the Mississippi River is often purchased from suppliers such as the Bond-Madison Water Company (which buys water from Illinois American Water).

Issue: Soil erosion: Soil erosion contributes large amounts of sediment to streams and waterways. Soil that erodes from industrial areas can carry contaminants into streams. In 2016, IEPA listed contaminated sediment as a source of impairment of water quality in Schoenberger Creek North (Harding Ditch). Soil can also erode on farmland when it is exposed to the erosive action of the wind and precipitation. It can also come from streambanks, stream channels, and lake shorelines. Construction sites can also contribute significantly to soil erosion when erosion control practices are not properly planned or followed. In 2016, IEPA listed site clearance as a source of impairment of water quality in Canteen Creek.

Objectives addressing this issue:

- ◆ Reduce sediment by 20% by 2030.

Because 29% of the watershed is agricultural (and most is row crops), farming practices factor significantly in the amount of soil reaching the waterways. An estimated 36% of sediment in the watershed comes from cropland (see Appendix A, p.252). In 2016, IEPA listed crop production as a source of impairment of water quality in Cahokia Creek (Cahokia Canal) and Canteen Creek, and agriculture as a source of impairment for Cahokia Creek (Cahokia Canal). In Madison County, 75% of corn and 37% of soybeans are produced using conventional tillage practices, which contribute to high soil erosion. Conservation tillage (i.e., reduced tillage) and no-till practices contribute significantly less sediment and nutrients. Only 1% of corn and 7% of soybeans in Madison County are in no-till crop production.

In addition to soil erosion from farmland, streambank and channel erosion contributes much of the sediment loading in the watershed. Streambank erosion has a very high sediment delivery rate (100%) to the stream. None of the streams assessed in the watershed had "high" streambank erosion, but 40% of the streams assessed had "moderate" streambank erosion (including Critical Stream Reaches, which had moderate streambank erosion and high channelization – see p.49). Forty percent of streams



Severe streambank erosion on Silver Creek near Troy, spring 2014.
Photo:HeartLands Conservancy.

assessed had moderate streambank erosion. Streambanks contribute an estimated 43% of sediment in the watershed to streams (see Appendix A, p.252). Stream erosion is especially problematic in areas that are becoming increasingly urbanized, due to the increased volume of water reaching streams in “flashy” surface flow during storm events. In 2018, IEPA listed streambank modifications/destabilization (“changes in stream depth and velocity patterns”) as a source of impairment of water quality in all three 303(d) listed streams in the watershed.

Streambank erosion is exacerbated by logjams, which are woody vegetation and/or other debris that obstructs a stream channel and backs up stream water. Over 15 miles of Critical Logjam Areas (identified at locations of concentrated logjams) were identified in the watershed (see p.49). Logjams can be both a cause and a result of streambank erosion. They can alter flow, which directs water outwards to the streambanks and increases scouring and bank erosion. Logjams result from streambank erosion when a stream is incising or meandering excessively, causing large woody vegetation on the banks to be undercut and fall into the stream. Several stakeholders identified beavers as a cause of logjams along creeks in the watershed.

Issue: Sediment

Sediment deposition is the result of soil erosion. Sediment is highly prevalent in streams and runoff throughout the watershed. When soil erodes from the landscape, it ends up as sediment and silt in streams. The soil carries other pollutants such as phosphorus, iron, and manganese with it. When sediment is deposited in streams and detention basins it forces the water upwards, which can lead to flooding. **Sedimentation/siltation** and **TSS** are two of the pollutants identified in Cahokia Creek (Cahokia Canal) on the 2018 IEPA 303(d) List.

Objectives addressing this issue:

- ◆ Reduce sediment by 20% by 2030.

Issue: Pollutants

Pollutants in lakes and streams come from a variety of sources and impact human health and activity in many ways. Boating, swimming, and fishing bring people into direct contact with the water, and floodwaters bring all the contaminants they contain up onto the land. Listed here are several pollutants found in streams and waterbodies in the watershed.

Objectives addressing this issue:

- ◆ Decrease overall pollutant loading to Cahokia Creek and its tributaries.

Phosphorus is carried into waterways along with soil particles. It often comes from agricultural fertilizer or lawn fertilizer. An estimated 46% of phosphorus in the watershed comes from cropland, with another 41% from urban areas (see Appendix A, p.252). Phosphorus can lead to harmful algae blooms. It is one of the pollutants identified in Cahokia Creek (Cahokia Canal) and Schoenberger Creek North (Harding Ditch) on the 2018 IEPA 303(d) List. Fertilizers and erosion on crop land contribute to significant nutrient loading (phosphorus and nitrogen). This issue is detailed in the 2015 Illinois Nutrient Loss Reduction Strategy.

Manganese and iron are also carried with soil. Iron is one of the pollutants identified in Cahokia Creek (Cahokia Canal) on the 2018 IEPA 303(d) List. Manganese has also been identified in high levels in Collinsville water. These elements are found in naturally high levels in soil in the area. Both can be toxic to aquatic plants and animals.

Iron may also be present in high concentrations in Canteen Creek. There is an area in the creek where the water color changes from clear to orange. Tests by the City of Collinsville show that

the pH is neutral (i.e., the water is not acidic). The discoloration is likely mining-related—there is a slag pile nearby with an adjacent ditch that is completely orange-colored. The slag piles in the area have mostly been capped, but there may be a gap, and/or the mining waste may have mixed with soil that enters the creek when streambanks collapse, which has also been seen in this area.

Barium: Barium is one of the pollutants identified in Canteen Creek on the 2018 IEPA 303(d) List. The source of this pollutant is not known (possibly industrial or mining activity). Barium can be toxic to aquatic life and to human life if the level of exposure is too high. The barium impairment may be related to the noticeable area in Canteen Creek where the water color is orange. Testing undertaken by the City of Collinsville showed that the pH is fairly neutral (i.e., it is not acidic). The color change is likely mining related—there is an orange-colored slag pile nearby.

Chloride: Application and storage of road salt is a concern where water with high concentrations of chloride flows into groundwater or streams. Chlorides increase treatment costs for water supplies and are harmful to aquatic life in waterways.

Issue: Low Dissolved Oxygen (DO)

Low levels of DO in water cannot support aquatic life. Low DO levels are often a result of algae growth that uses up oxygen in the water, which is caused by high levels of nutrients such as nitrogen and phosphorus. Cahokia Creek (Cahokia Canal) and Schoenberger Creek North (Harding Ditch) have had a 303(d) List impairment for DO for several years, including 2018.

Objectives addressing this issue:

- ◆ Maintain DO levels above standard minimums.
- ◆ Monitor water quality and identify trends.

Issue: Sewage contamination from private systems

Poor maintenance of private sewage systems can lead to raw human waste in waterways. The watershed has over approximately 2,000 private sewage systems (i.e., septic systems). USEPA uses a figure from the U.S. Census Bureau that at least 10% of septic systems nationwide have stopped working, while local government officials estimate that the failure rate in this watershed is actually much higher (up to 90% in older developments). Several municipalities and Open House attendees reported occurrences of and bad odors from failing systems. A private manifold collection system in Collinsville that covers several homes has severe problems leading to bad odors, and is currently being assessed (see Specific Project Location #5).

Objectives addressing this issue:

- ◆ Create a private sewage assessment strategy.

Issue: Combined sewers

When large volumes of stormwater enter the system, overflows can carry untreated waste out onto the land and into streams. In 2016, IEPA listed combined sewer overflows and sanitary sewer overflows as a source of impairment of water quality in Schoenberger Creek North (Harding Ditch). Ammonia, a decomposition product from urea and protein, is one of the impairments to Schoenberger Creek North (Harding Ditch) on the 2018 IEPA 303(d) List. The ammonia impairment in Schoenberger Creek North (Harding Ditch) may be linked to combined sewers, because it is found in domestic wastewater. However, it is also found in some fertilizers, is a byproduct of certain industrial processes, and is contributed to by aquatic life and fish in streams.

Objectives addressing this issue:

- ◆ Decrease overall pollutant loading to Cahokia Creek and its tributaries, and remove Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch) from the Illinois EPA 303(d) list of impaired waters.

Issue: Infiltration into/out of ageing pipes

All of the municipalities in the watershed have some separate storm and sanitary sewer systems. However, several municipalities report that aging infrastructure (some pipes are over 100 years old in Edwardsville and Maryville) has led to instances of infiltration of stormwater into the sanitary system, resulting in sewer backups, de facto combined sewers, and occurrences of combined sewer overflows (CSOs). This situation results in property damage, raw sewage draining into surface water, and increased costs of cleanup and sewage treatment for municipalities.

Objectives addressing this issue:

- ◆ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure (e.g., detention basins and ponds) to maximize storage capacity
- ◆ Monitor water quality and identify trends.

Issue: Livestock waste management

Waste from livestock on farms and in animal feeding operations (AFOs) can contribute nutrients and bacteria including fecal coliform to surface water if it is not properly stored and treated. There are a few livestock operations in the eastern parts of the watershed.

Objectives addressing this issue:

- ◆ Monitor water quality and identify trends.

Issue: Litter and dumping

Trash and debris is an issue throughout the watershed, but particularly in places where roads cross creeks and their tributaries. People throwing trash out of car windows or dumping unwanted or hazardous materials leads to debris deposits that are eyesores, harm to fish and wildlife, and obstructions in the creek. Illegal dumping of large objects into or next to creeks is also an issue, particularly in wooded, secluded areas. St. Clair County is continually fighting dumping, particularly at a wetland. Open House attendees mentioned litter, trash, and debris on their property or on the creeks and streams they drive past.

Objectives addressing this issue:

- ◆ Decrease pollutant loading to Cahokia Creek and its tributaries.
- ◆ Increase awareness of consequences of littering/illegal dumping.

Issue: Algae blooms and fish die-outs

Algae blooms are caused by excess nutrients (e.g., phosphorus and nitrogen) running off into lakes, ponds, detention basins, and other areas of still, shallow water. The nutrients often come from excess application of fertilizers to farmland and lawns, as well as nutrients carried in eroded soil particles. A neighborhood lake in the City of Collinsville contains a great deal of sediment and has had issues with algae blooms. Related to algal blooms, fish die-outs can occur when nutrient levels are high. A retention basin in a Maryville neighborhood also experiences fish die-outs following algae growth in the spring (see Specific Project Location #3).

Objectives addressing this issue:

- ◆ Reduce phosphorus by 25% by 2030.
- ◆ Reduce nitrogen by 15% by 2030.

Issue: Point source discharges

In 2018, IEPA listed municipal point source discharges as a potential source of impairment of water quality in Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch). None of the six facilities with National Pollutant Discharge Elimination System (NPDES) permits in the watershed exceeded their pollutant limits in 2017 (based on available data through the Discharge Monitoring Report (DMR) online database).

Objectives addressing this issue:

- ◆ Decrease overall pollutant loading to Cahokia Creek and its tributaries.
- ◆ Reduce phosphorus by 25% by 2030.
- ◆ Reduce sediment by 20% by 2030.

Issue: Leachate from landfills

In 2018, IEPA listed landfills as a source of impairment of water quality in Schoenberger Creek North (Harding Ditch). Landfills can create nonpoint source pollution when leachate (i.e., liquid that passes through a landfill and contains dissolved, suspended or microbial contaminants from the waste) and/or runoff from landfills makes its way into the waterways. There are 26 landfills in the Canteen-Cahokia Creek watershed, according to the data layer hosted by the Illinois Resource Management Mapping Service (2018). Six of these are in the subwatershed that drains to Little Canteen Creek, that drains to Schoenberger Creek North (Harding Ditch), where the Illinois EPA 303(d) listed impairment was identified.

Objectives addressing this issue:

- ◆ Decrease overall pollutant loading to Cahokia Creek and its tributaries.
- ◆ Monitor water quality and identify trends.

Land Cover and Development

Issue: Poorly Planned Development. Flooding and water quality issues are exacerbated by new development that does not include well-designed drainage and green infrastructure. The watershed includes several examples of such poorly planned development, where floods, siltation, streambank erosion, and sewer backups have plagued the structures, roadways, and adjacent property. Current development policy among most watershed communities does not actively promote green infrastructure as a way to manage stormwater and allow infiltration.

Objectives addressing this issue:

- ◆ Conserve sensitive lands.
- ◆ Implement low-impact development strategies.
- ◆ Increase the acreage of forest, native grassland, and wetlands.
- ◆ Use wetland mitigation banking or in-lieu fee programs.

Development in the Metro East is occurring at a rapid pace. Madison and St. Clair counties combined lose 0.33 acre of agricultural land to development every minute, according to the USDA's National Agricultural Statistics Service (NASS) for 2007 to 2012. The population in the watershed is also projected to increase over the next few decades. New development will likely occur within and around municipalities and in unincorporated areas in the watershed, consuming as much as 40,000 acres of farmland and 7,000 acres of forest/grassland. New impervious surfaces will compound the problems of flooding, lack of infiltration, and poor water quality. Without changes in policy, local flash flooding will pose significant risks to both new and existing development. Furthermore, maintenance agreements are not always put in place for new development to ensure stormwater features continue to function. (See the issue, "Need for Updated Operations.") Municipalities in the watershed need stronger policies to maintain stormwater infrastructure, protect steep slopes, and preserve native vegetation as development occurs.

Issue: Mining legacy

East of Collinsville, mining activities have left behind mine tailings and issues with subsidence that may affect drainage and water quality (such as mercury). Development must be sensitive to this. Mining activity occurred throughout a large area on the eastern side of the watershed up until the 1950's. In some areas, "gob piles" of pyrite, a byproduct of coal extraction, was left behind. It has since been remediated in at least one area where subdivisions were planned and built. Unfortunately, mining waste at other locations may be polluting streams. At a stream flowing by the old landfill in the City of Collinsville, the soil and water are orange in color - a sign that

Objectives addressing this issue:

- ◆ Decrease pollutant loading to Cahokia Creek and its tributaries.
- ◆ Increase the acreage of forest, native grassland, and wetlands.

mine waste or landfill leachate is reaching the stream. Often, the best and cheapest use of such polluted lands and soils is forest or prairie.

Habitat

Issue: Poor Riparian Conditions. The area to either side of a stream is known as the riparian area. The forested riparian area along Cahokia Creek and other major creeks in non-urbanized areas provides habitat for neo-tropical migratory songbirds which fly through and/or nest there after migrating from Central and South America. The songbirds require dense forest interior conditions without holes or gaps, which encourage nest predators such as raccoons, opossums, skunks, and cowbirds. Vegetation, particularly forest, in the riparian area supports the streambanks and provides shade to the stream. Approximately 39% of the riparian area along streams is in “poor” ecological condition (Appendix A, Table A.46). IEPA listed loss of riparian habitat ("alteration in stream-side or littoral vegetative covers") as a source of impairment of water quality in all three 303(d) listed streams in the watershed in 2018. "Loss of instream cover" was also listed as an impairment for all of the 303(d) listed streams; instream cover, i.e. debris and vegetation, acts as habitat for aquatic organisms.

Objectives addressing this issue:

- ◆ Conserve sensitive lands.
- ◆ Work with municipalities to amend policies and regulations to include conservation, native landscaping, stormwater management, and low-impact design.
- ◆ Prioritize “green” stormwater management approaches.
- ◆ Identify and protect key natural features and wildlife corridors.

Issue: Fish die-outs

Algae blooms can remove so much oxygen from water that fish suffocate. Maryville has seen at least one such event. See "Algae blooms and fish die-outs", p.44.

Objectives addressing this issue:

- ◆ Reduce phosphorus by 25% by 2030.
- ◆ Reduce nitrogen by 15% by 2030.

Issue: Invasive Species

Invasive species, such as bush honeysuckle, tree-of-heaven, garlic mustard, and climbing euonymous (wintercreeper), are threats to many natural areas because they crowd out native trees and shrubs that protect streambanks from erosion. Invasives also crowd out food sources of animals and insects, further degrading the ecosystem. See Table 4 for causes and sources associated with habitat degradation.

Objectives addressing this issue:

- ◆ Create an invasive species removal strategy.
- ◆ Work with municipalities to amend policies and regulations to include conservation, native landscaping, stormwater management, and low-impact design.
- ◆ Increase the acreage of forest, native grassland, and wetlands.
- ◆ Monitor fish and aquatic macroinvertebrate communities.

Issue: Unprotected Habitat for Endangered Species

Federally endangered species such as the Indiana bat and leafy prairie clover may be present in the watershed. Where their native habitat is not preserved, threatened and endangered species such as the chorus frog cannot be expected to thrive over the long term. Removing invasive species and protecting native habitat around streams will provide locations for endangered species to thrive.

Objectives addressing this issue:

- ◆ Promote healthy ecosystems within streams and riparian areas.
- ◆ Conserve sensitive lands.
- ◆ Use wetland mitigation banking or in-lieu fee mitigation.
- ◆ Identify and protect key natural features and wildlife corridors.
- ◆ Monitor fish and aquatic macroinvertebrate communities.

Organizational needs/issues

Issue: Lack of levee maintenance

Some levees in the watershed are reportedly not being adequately maintained (e.g., Burdick Creek and Canteen Creek). Levee districts have struggled to find funding to maintain the levees that they are responsible for.

Objectives addressing this issue:

- ◆ Ensure all existing levees are safe, and plan for maintenance.
- ◆ Leverage funding from a variety of sources to implement the plan.

Issue: Lack of detention basin maintenance

Detention basins are often not being maintained/dredged to maintain their sediment storage and water storage capacities. This can happen when ownership or maintenance requirements associated with a detention basin are unclear, or simply because dredging can be very expensive. Older detention basins may no longer function properly and would benefit from adding extended detention outlet structures and vegetation, which would remove sediment and alter flow-through patterns.

Objectives addressing this issue:

- ◆ Promote ongoing improvement and maintenance of stormwater storage and conveyance infrastructure.
- ◆ Activate a network of partners dedicated to implementing the watershed plan.

Issue: Lack of code enforcement

In some cases, existing municipal stormwater, development, subdivision, and floodplain codes are not being fully enforced. Codes related to development in floodplains and sediment and erosion control during construction are particularly important when it comes to protecting water quality and preventing flood damage.

Objectives addressing this issue:

- ◆ Activate a network of partners dedicated to implementing the watershed plan.

Issue: Lack of funding

Funding from government entities and other groups is often needed to maintain and expand stormwater infrastructure and improve water quality. There are a variety of funding sources and programs available to implement goals and objectives of the watershed plan. Existing resources include IEPA Section 319, Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), foundation grants, and various other programs.

Objectives addressing this issue:

- ◆ Leverage funding from a variety of sources to implement the plan.
- ◆ Develop public recognition programs focused on the watershed plan's goals.

Issue: Need for strong partnerships

A network of partner organizations/groups is needed to make large strides towards addressing flooding and other issues in the watersheds. There are many potential partners in the region dedicated to different aspects of water quality and stormwater management, including federal agencies, state agencies, non-profits, land trusts, land owners, institutions, and local governments. To effectively implement the watershed plan and the county's stormwater program, a network of these partners should be established to help tackle certain issues and objectives.

Objectives addressing this issue:

- ◆ Formalize a network of partners to implement the plan.

Information and Outreach

Issue: Need for communication and collaboration

The public engagement process for the plan revealed a need for education on water quality and flooding for the general public. For example, the Flood Survey revealed a need for further education about flooding and flood insurance. In the Canteen-Cahokia watershed, 2.4% of Flood Survey respondents did not know that all or part of their property was in the floodplain. The majority of flooding reported in the survey (96%) was outside of FEMA-designated floodplains, and five percent of property owners had flood insurance policies on structures outside of the floodplain. Over half of respondents who experienced flooding did not report it to anyone. Given that 11% of respondents experienced flooding over the last 10 years, there is a clear mandate to further educate residents on flood damage prevention and mitigation. Communication about funding and technical resources is also sometimes lacking between potential partners; this information could help bring awareness, technical resources, and funding to address issues.

Objectives addressing this issue:

- ◆ Connect watershed stakeholders to decision-makers and experts.
- ◆ Offer opportunities for public education and participation in watershed matters.

Issue: Need for outreach to key stakeholders

Because a large proportion of the watershed is private property, and water-based recreation is uncommon, individual interactions with streams and waterbodies in the watershed are limited. Education and outreach efforts to engage landowners and other key stakeholders are needed to increase environmental awareness and achieve the goals of this plan. A single regulatory agency or group cannot be as effective as a combined effort with other groups all working towards the same goal. Many people will work hard to help make the watershed better if they understand what to do and how it will help.

Objectives addressing this issue:

- ◆ Develop public recognition programs focused on the watershed plan's goals.

Critical Areas

For this plan, a “Critical Area” is best described as a location in the watershed where existing or potential future causes and sources of pollutants or issues are significantly worse than other areas of the watershed, OR there is significant potential for the area to make progress towards one or more of the watershed plan goals. The following Critical Areas were identified:

1. Highly or moderately degraded stream reaches with high channelization (Critical Stream Reaches);
2. Stream reaches with high susceptibility to logjams (Critical Logjam Areas);
3. Highly degraded riparian areas (Critical Riparian Areas);
4. Areas of prevalent flooding (Critical Flooding Areas); and
5. Areas suitable for wetland restoration (Critical Wetland Areas).

The Management Measures recommended are focused on these Critical Areas, but are also recommended for application elsewhere in the watershed where conditions are suitable.

The location and extent of each Critical Area was informed by data collected in the Watershed Resource Inventory, including an aerial assessment of streambank condition, riparian area condition, and channelization. Information was also collected during stakeholder engagement. The Agricultural Conservation Planning Framework (ACPF), a GIS model developed by USDA, provided locations for Critical Areas on agricultural land. The following explains how the Critical Areas were delineated.

Critical Stream Reaches

Critical stream reaches exhibit highly eroded banks or stream beds, or degraded channel conditions, which are a major source of total suspended solids (sediment), phosphorus and nitrogen carried with it. **11.6 miles** of stream reaches have been identified as high priority “Critical Stream Reaches,” using aerial assessment and field verification data on streambank erosion, streambed erosion, and channelization. The critical reaches have high or moderate streambank erosion AND high channelization. Streambank stabilization and channel restoration BMPs, including bioengineering, will greatly reduce sediment and nutrients transported downstream, increase dissolved oxygen levels, and improve habitat.

Critical Logjam Areas

Critical areas for logjams were delineated from known locations of logjams identified in the aerial stream assessment for this Watershed Plan. The Critical Logjam Areas are stream reaches where a logjam is within 0.25 mile of at least one other logjam. These areas represent current or likely locations of logjams, but not where they would cause the greatest flood impacts or damage. **Fifteen miles** (15.02 miles) of streams have been identified as Critical Logjam Areas. Localized assessment is recommended for these reaches to determine whether logjam removal is appropriate and cost-effective at specific locations. The American Fisheries Society’s 1983 “Stream Obstruction Removal Guidelines” are a reliable source for determining what types of logjams should be removed.

Critical Riparian Areas

Critical riparian areas are areas adjacent to stream reaches that:

- 1) Have limited or no vegetated buffer beside the stream (i.e., “poor” riparian condition as determined by aerial assessment), and/or
- 2) Receive significant surface runoff and groundwater and have high ecological significance (i.e., riparian areas that are determined as “Critical Zones” by the ACPF modeling—see Appendix D).

Along the stream corridors, **82,579 feet (15.64 miles)** were identified as Critical Riparian Areas. Removal of invasive species and revegetation of these areas with appropriate native vegetation will increase surface water infiltration and reduce sediment and nutrient flows to the streams.

Critical Wetland Areas

Wetlands are highly effective at filtering pollutants from surface water, in addition to providing flood storage and wildlife habitat benefits. Critical wetland areas, which are highly suitable for restoration/construction of wetlands, were found as:

- 1) Areas on agricultural land that are highly suitable for nutrient removal wetlands and have high, very high, or critical runoff risk, as determined by the ACPF.

Because the ACPF tool is directed at agricultural land, the nutrient removal wetlands output by the model are all in agricultural fields. They tend to be large areas, ranging between 0.9 and 66 acres.

The Critical Wetland Areas identified can catch sediment which has eroded from agricultural land and stream channels close to the sources of such sediment. There are **256 acres** of Critical Wetland Areas in the watershed.

All of the Critical Areas identified in the watershed are shown in Figure 4. Pages 52 to 71 show the Critical Areas in more detail in each HUC14 subwatershed. Each individual type of Critical Area is shown in maps in Appendix D, with more information about the sources of data behind the selection of Critical Area locations.

A great deal of Cahokia Creek was identified as both a Critical Stream Reach and a Critical Riparian Area. Other areas in the watershed where Critical Areas overlapped included segments of Burdick Branch, Schoolhouse Branch, and Canteen Creek. In total, 42 miles of streams had two or more Critical Areas overlapping (16% of streams in the watershed).

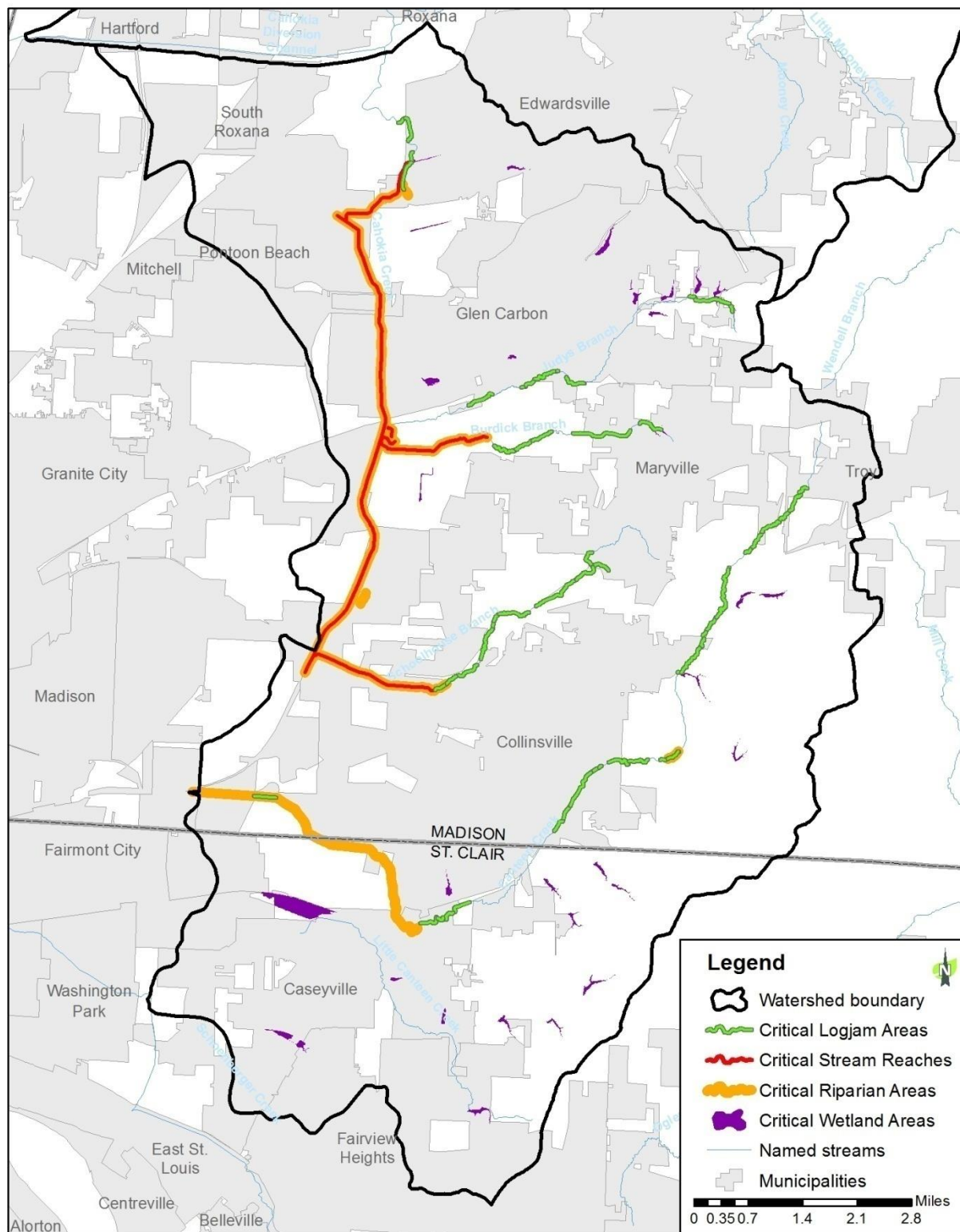


Figure 4. Critical Areas for logjams, riparian buffers, stream reaches, and wetlands. See Appendix D for maps of each individual Critical Area type.

HUC 071401030101: American Bottoms-Cahokia Creek (Edwardsville area)

This subwatershed drains South Roxana and portions of Edwardsville. I-255 bisects it from north to south, and Illinois State Route 111 runs through its western half. I-270 also runs along the subwatershed's southern boundary.

Area: 8,393 acres

Named streams: Cahokia Creek

Counties: Madison

Municipalities: Edwardsville, Hartford, Pontoon Beach, South Roxana

Townships: Chouteau, Edwardsville

Critical Logjam Areas: 5,233 feet (1 mile) of Critical Logjam Areas were identified in two segments along Cahokia Creek.

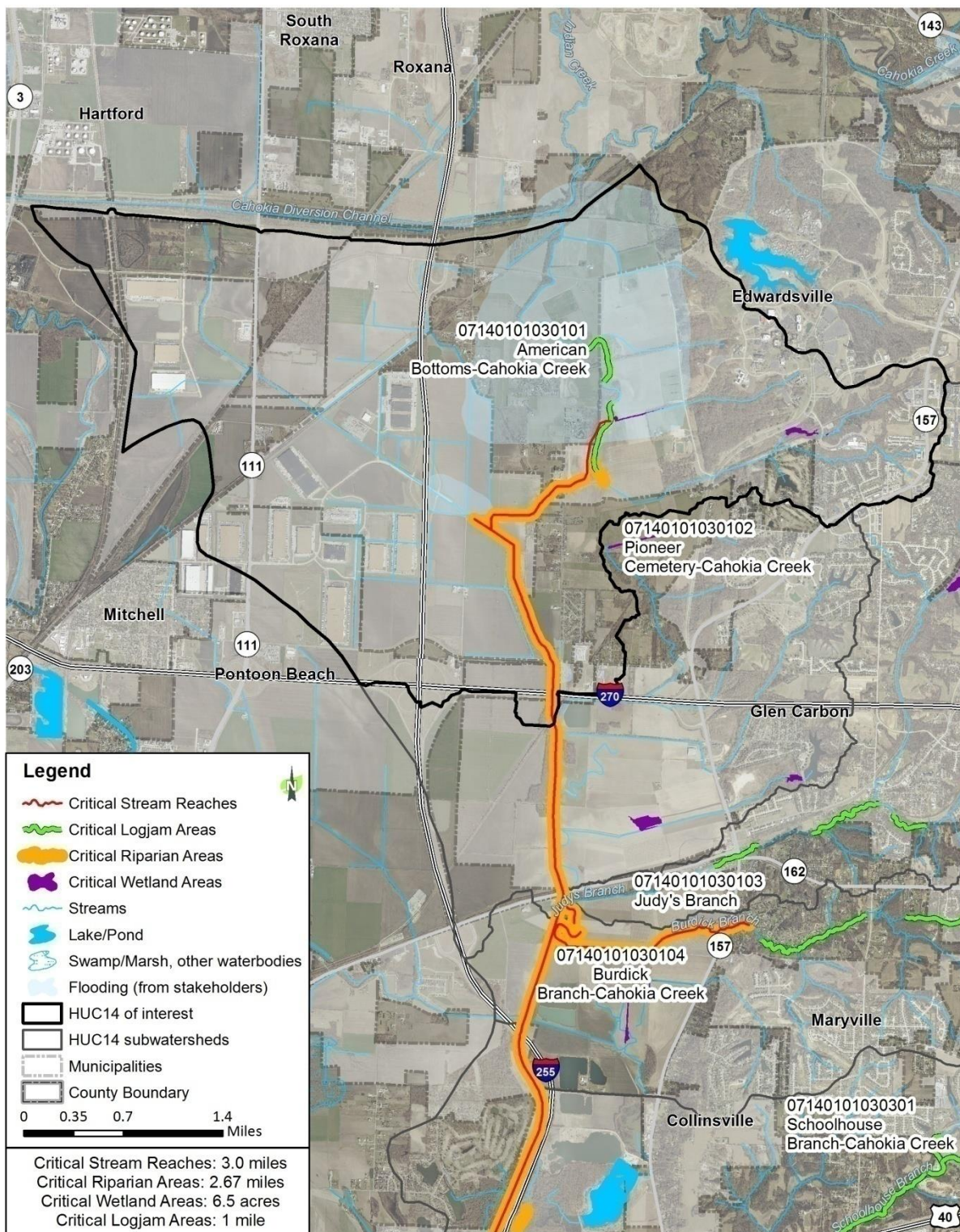
Critical Stream Reaches: 15,850 feet (3.0 miles) of Critical Stream Reaches were identified in one segment along Cahokia Creek.

Critical Riparian Areas: 14,119 feet (2.67 miles) of Critical Riparian Areas were identified along Cahokia Creek. One segment occurred in the same area as the Critical Stream Reach.

Critical Wetland Areas: 6.5 acres of Critical Wetland Areas were identified in two areas of the eastern portion of the subwatershed.

Flooding locations were **identified by stakeholders** in three areas, the largest of which was located around Cahokia Creek in the northern portion of the subwatershed east of I-255.

HUC 07140101030101: American Bottoms-Cahokia Creek



HUC 071401030102: Pioneer Cemetery-Cahokia Creek (Glen Carbon area)

This subwatershed drains the western portion of Glen Carbon. I-270 bisects it from west to east, and Illinois State Routes 157 and I-255 also run through it. The subwatershed's western half is primarily agricultural land, while its eastern portion contains some urban areas.

Area: 3,671 acres

Named streams: Cahokia Creek

Counties: Madison

Municipalities: Edwardsville, Glen Carbon, Pontoon Beach

Townships: Chouteau, Edwardsville

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

Critical Stream Reaches: 7,623 feet (1.44 miles) of Critical Stream Reaches were identified in one segment along Cahokia Creek. The entire main channel of Cahokia Creek in this subwatershed was determined to be a Critical Stream Reach.

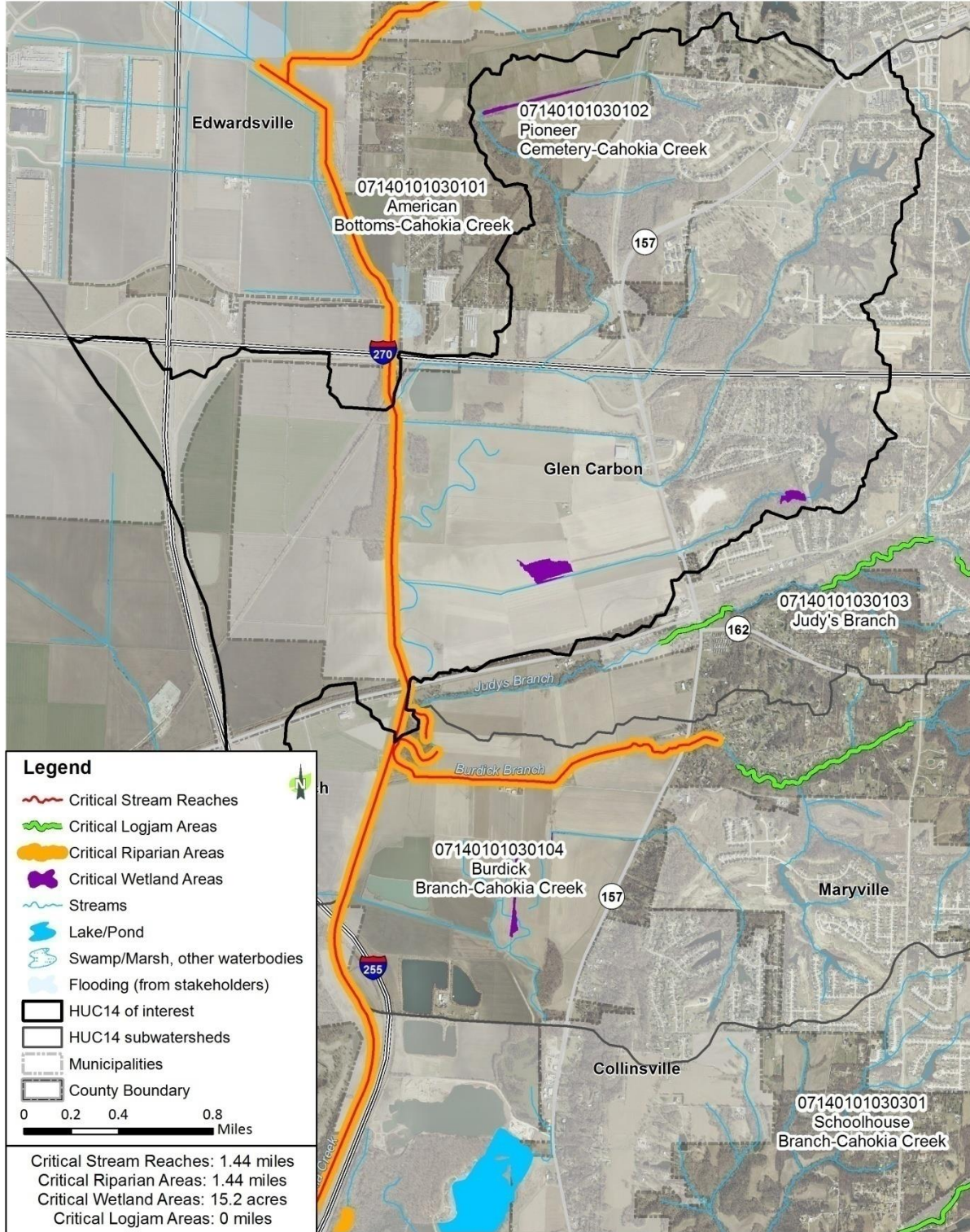
Critical Riparian Areas: 7,623 feet (1.44 miles) Critical Riparian Area were identified, the majority of which occurred along the Cahokia Creek (also a Critical Stream Reach).

Critical Wetland Areas: 15.2 acres of Critical Wetland Areas were identified in three agricultural areas in the subwatershed.

No **Flooding locations** were **identified by stakeholders** in this subwatershed.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030102: Pioneer Cemetery-Cahokia Creek



HUC 071401030103: Judy's Branch (Glen Carbon area)

This subwatershed drains the eastern portion of Glen Carbon and the southern portion of Edwardsville. I-270 and Illinois State Route 159 run through its center. Illinois State Routes 157 and 162 also cross the southern boundaries. This subwatershed is primarily made up of urban land.

Area: 5,706 acres

Named streams: Judy's Branch

Counties: Madison

Municipalities: Edwardsville, Glen Carbon, Maryville

Townships: Edwardsville

Critical Logjam Areas: 10,477 feet (2 miles) of Critical Logjam Areas were identified in four segments along Judy's Branch throughout the subwatershed.

Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

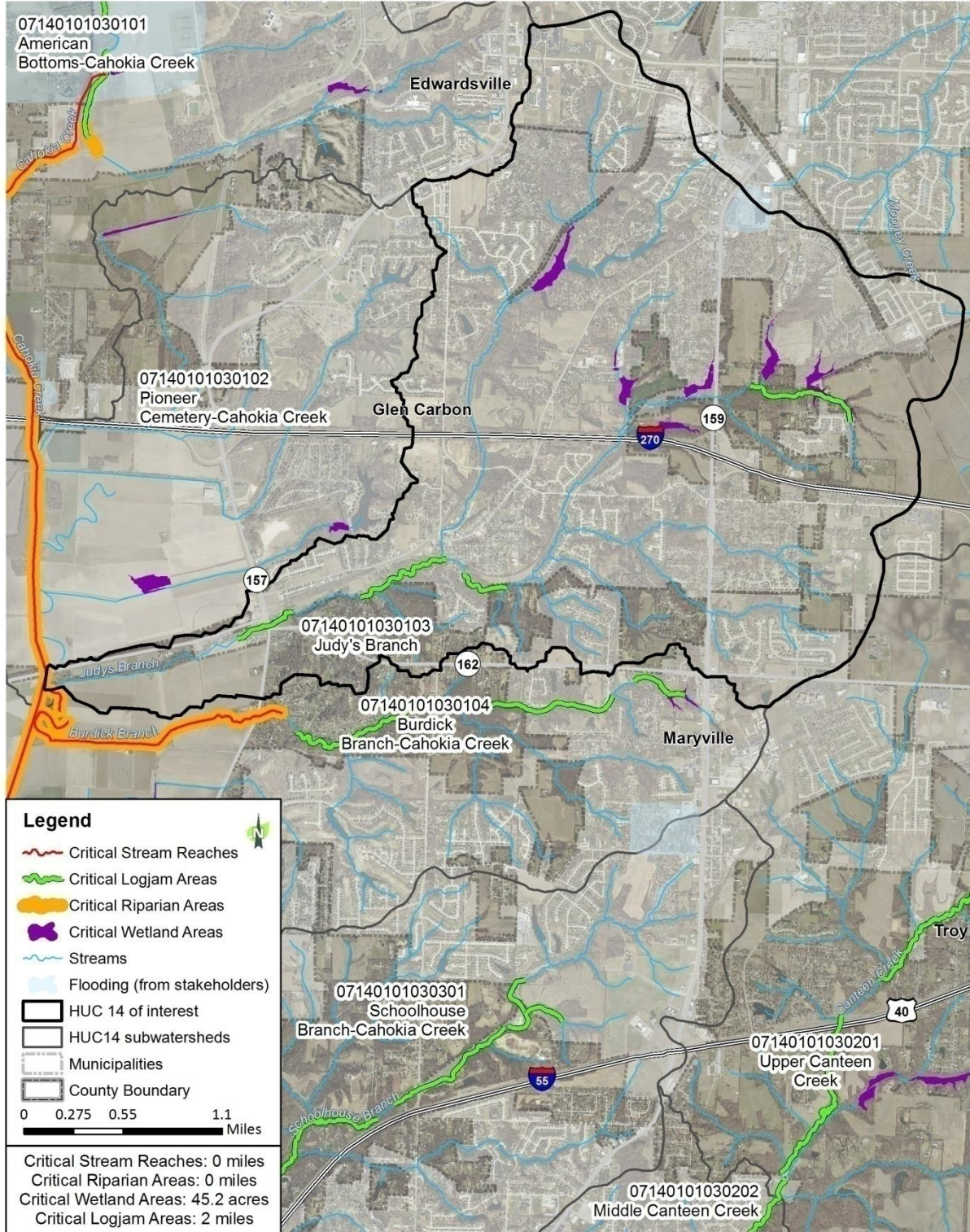
Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: 45.2 acres of Critical Wetland Areas were identified along Judy's Branch and its tributaries in the northern portion of the subwatershed.

Flooding locations were **identified by stakeholders** in one location to the east of Illinois State Route 159 near the subwatershed's northern boundary. This area is along and north of Cottonwood Road and primarily contains a parking lot and retail store.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030103: Judy's Branch



HUC 071401030104: Burdick Branch-Cahokia Creek (Maryville area)

This rectangular-shaped subwatershed lies just south of Illinois State Route 162. It drains the western side of Maryville and the northern portion of Collinsville. I-255 and Illinois State Routes 157, 159, and 162 run through it. This subwatershed is a mix of agricultural and urban areas.

Area: 3,376 acres

Named streams: Burdick Branch, Cahokia Creek

Counties: Madison

Municipalities: Collinsville, Maryville, Pontoon Beach

Townships: Collinsville

Critical Logjam Areas: 11,088 feet (2.1 miles) of Critical Logjam Areas were identified in three segments along Burdick Branch in the northern portion of the subwatershed.

Critical Stream Reaches: 13,868 feet (2.63 miles) of Critical Stream Reaches were identified in segments along Cahokia Creek and Burdick Branch.

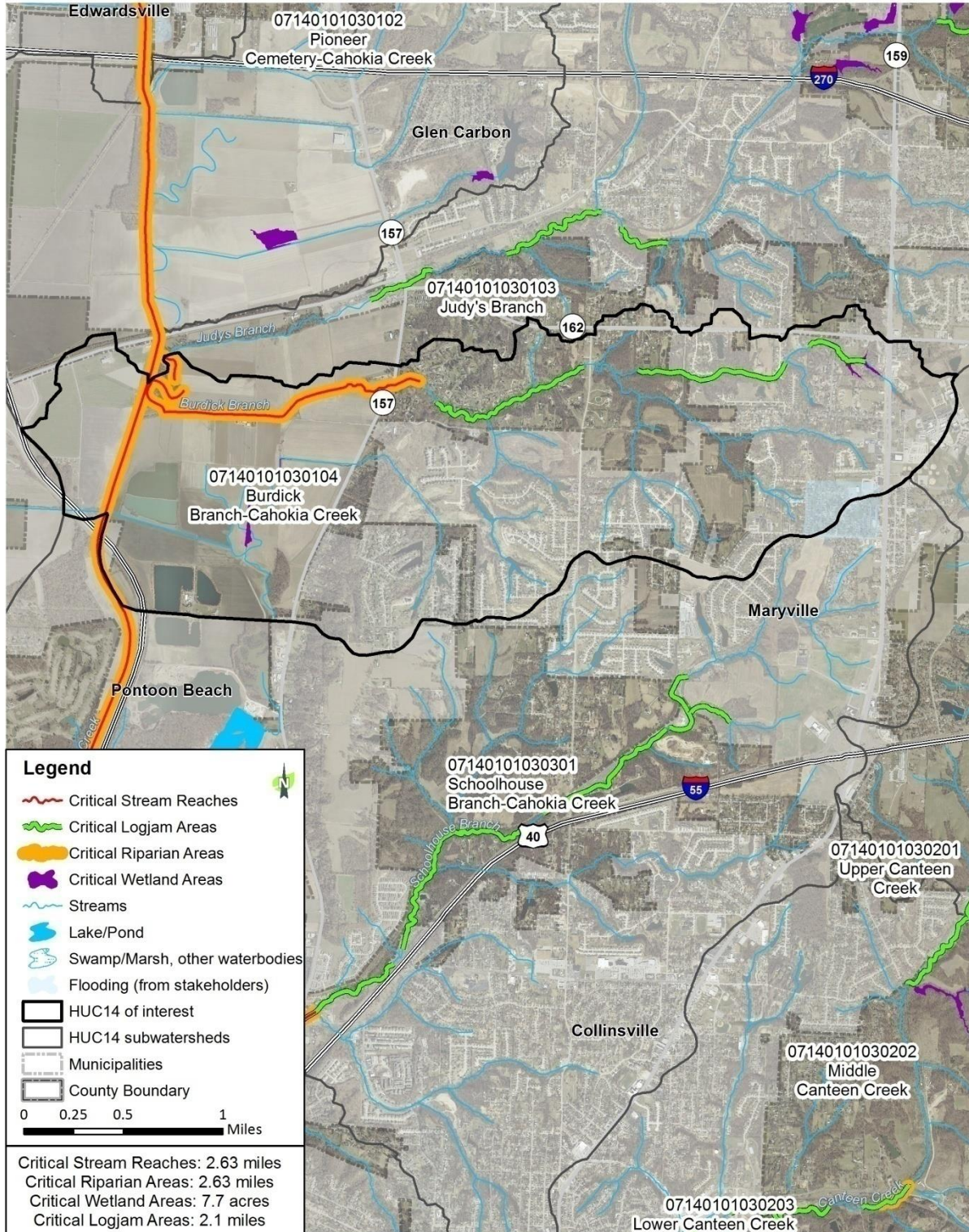
Critical Riparian Areas: 13,868 feet (2.63 miles) of Critical Riparian Areas were identified along Cahokia Creek and Burdick Branch. These areas are also considered Critical Stream Reaches.

Critical Wetland Areas: 7.7 acres of Critical Wetland Areas were identified in three segments throughout the subwatershed.

Flooding locations were **identified by stakeholders** in a residential area of Maryville, in the area around Williams and Drost roads.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030104: Burdick Branch-Cahokia Creek



HUC 071401030201: Upper Canteen Creek (Troy area)

This subwatershed drains the headwaters of Canteen Creek. It also drains the eastern portion of Maryville and western portion of Troy. I-70, I-55, Illinois State Routes 162, and U.S. Route 40 run through it. The northern portion of the subwatershed is a mix of urban and agricultural land, while the southern portion is primarily agricultural.

Area: 5,509 acres

Named streams: Canteen Creek

Counties: Madison

Municipalities: Collinsville, Maryville, Troy, Glen Carbon

Townships: Collinsville, Jarvis

Critical Logjam Areas: 14,498 feet (2.7 miles) of Critical Logjam Areas were identified in three segments along the main channel of Canteen Creek.

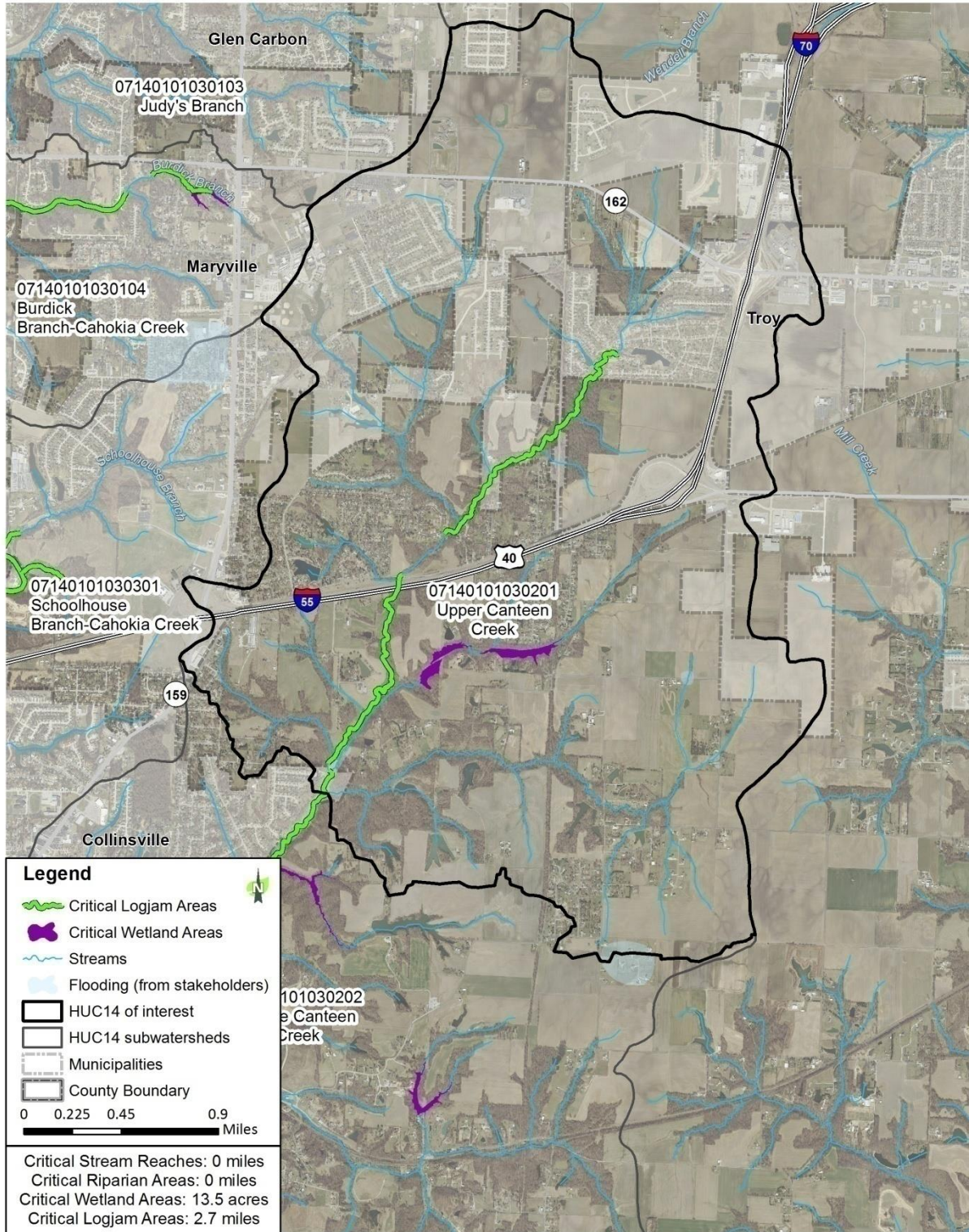
Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: 13.5 acres of Critical Wetland Areas were identified in three segments along a tributary of Canteen Creek in the south-central portion of the subwatershed.

Flooding locations were identified by stakeholders: one area in the northern portion of the subwatershed in Glen Carbon, and three areas in the southern portion.

HUC 07140101030201: Upper Canteen Creek



HUC 071401030202: Middle Canteen Creek (east of Collinsville)

This square-shaped subwatershed drains the eastern portion of Collinsville. It is made up of mostly agricultural and forested land. It primarily lies in Madison County; however, extends slightly in to St. Clair. Illinois State Route 159 runs through its western half.

Area: 5,064 acres

Named streams: Canteen Creek

Counties: Madison, St. Clair

Municipalities: Collinsville, Maryville

Townships: Collinsville, Jarvis

Critical Logjam Areas: 8,630 feet (1.6 miles) of Critical Logjam Areas were identified in four segments along the main channel of Canteen Creek.

Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

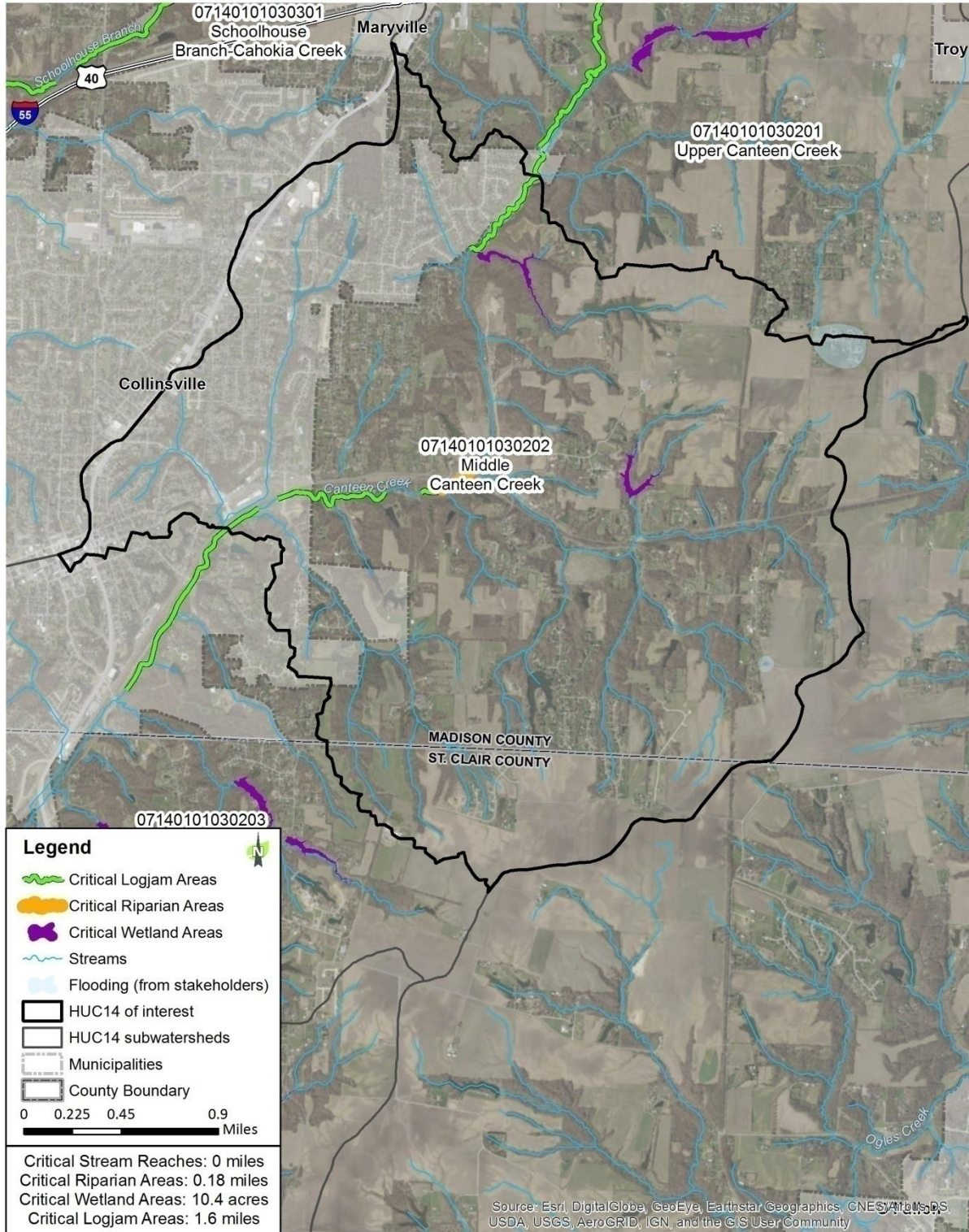
Critical Riparian Areas: 935 feet (0.18 mile) of Critical Riparian Areas were identified along Canteen Creek in the center of the subwatershed.

Critical Wetland Areas: 10.4 acres of Critical Wetland Areas were identified in two locations, both of which are forested areas along a tributary of Canteen Creek.

Flooding locations were **identified by stakeholders** in five locations throughout the watershed, one of which surrounds the area identified as a Critical Riparian Area.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030202: Middle Canteen Creek



HUC 071401030203: Lower Canteen Creek (Collinsville area)

This subwatershed lies in both Madison and St. Clair County, and drains the southeast side of Collinsville and the northeast side of Caseyville. Illinois State Route 159 bisects it from north to south. The western portion of the subwatershed is made up of primarily urban areas, while the west side is mainly agricultural and forested land.

Area: 3,961 acres

Named streams: Canteen Creek

Counties: Madison, St. Clair

Municipalities: Collinsville, Caseyville

Townships: Caseyville

Critical Logjam Areas: 9,876 feet (1.9 miles) of Critical Logjam Areas were identified in two segments along Canteen Creek: one in the northern portion and one in the southwestern portion of the subwatershed.

Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

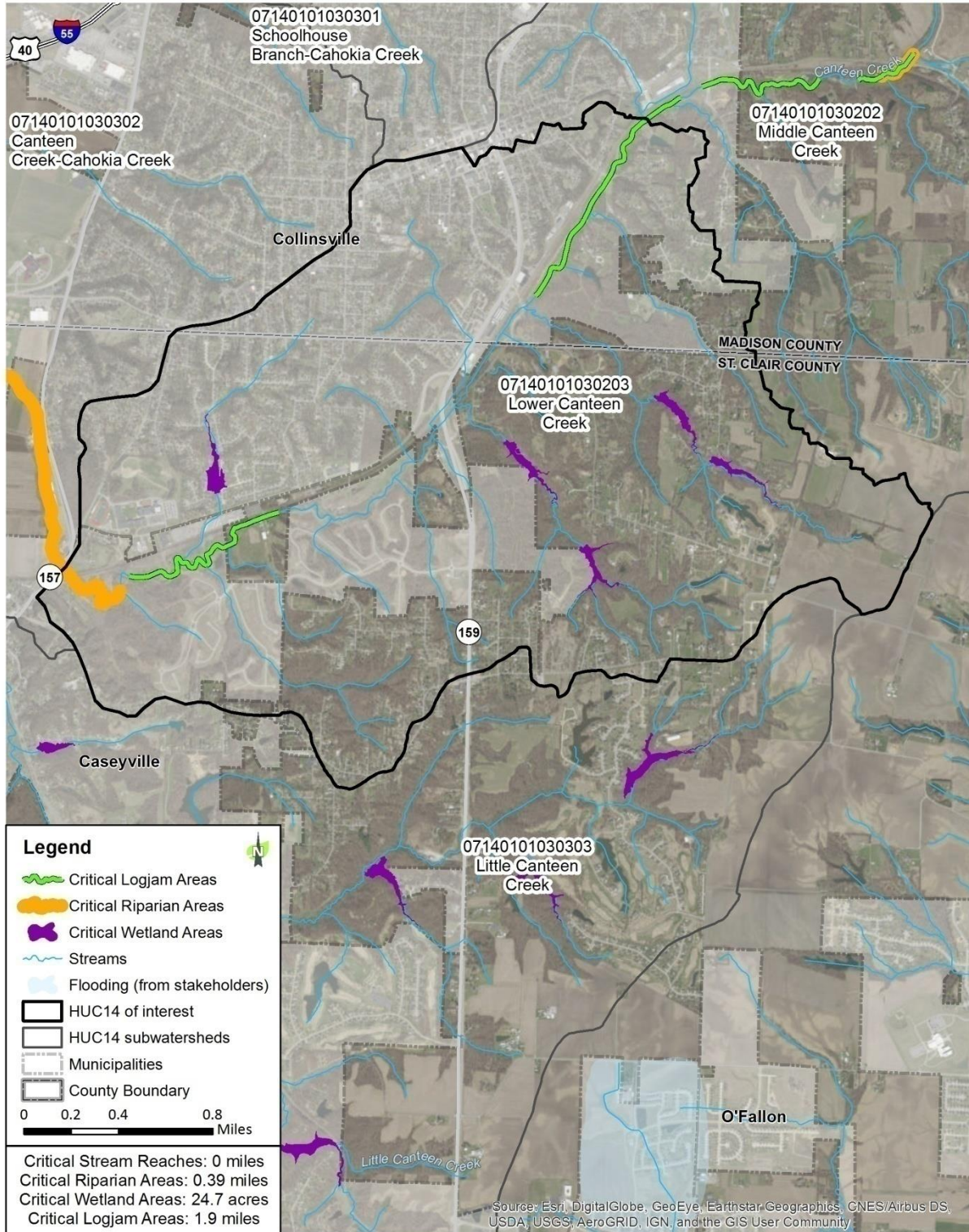
Critical Riparian Areas: 2,035 feet (0.39 mile) of Critical Riparian Areas were identified along Canteen Creek in the western portion of the subwatershed.

Critical Wetland Areas: 24.7 acres of Critical Wetland Areas were identified in five locations throughout the subwatershed, one of which is a residential area of Collinsville.

No **Flooding locations** were **identified by stakeholders** in this subwatershed.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030203: Lower Canteen Creek



HUC 071401030301: Schoolhouse Branch-Cahokia Creek (Collinsville area)

This triangular-shaped subwatershed drains the northern portion of Collinsville, the southwestern portion of Maryville, and eastern portions of Pontoon Beach. I-55, I-255, and Illinois State Routes 157 and 159 run through it. This subwatershed is a mix of urban and agricultural land.

Area: 7,157 acres

Named streams: Cahokia Creek, Schoolhouse Branch

Counties: Madison

Municipalities: Collinsville, Maryville, Pontoon Beach

Townships: Collinsville

Critical Logjam Areas: 17,928 feet (3.4 miles) of Critical Logjam Areas were identified along School House Branch.

Critical Stream Reaches: 23,820 feet (4.51 miles) of Critical Stream Reaches were identified in two segments in the western portion of the subwatershed; one along Cahokia Creek, and the other along Schoolhouse Branch.

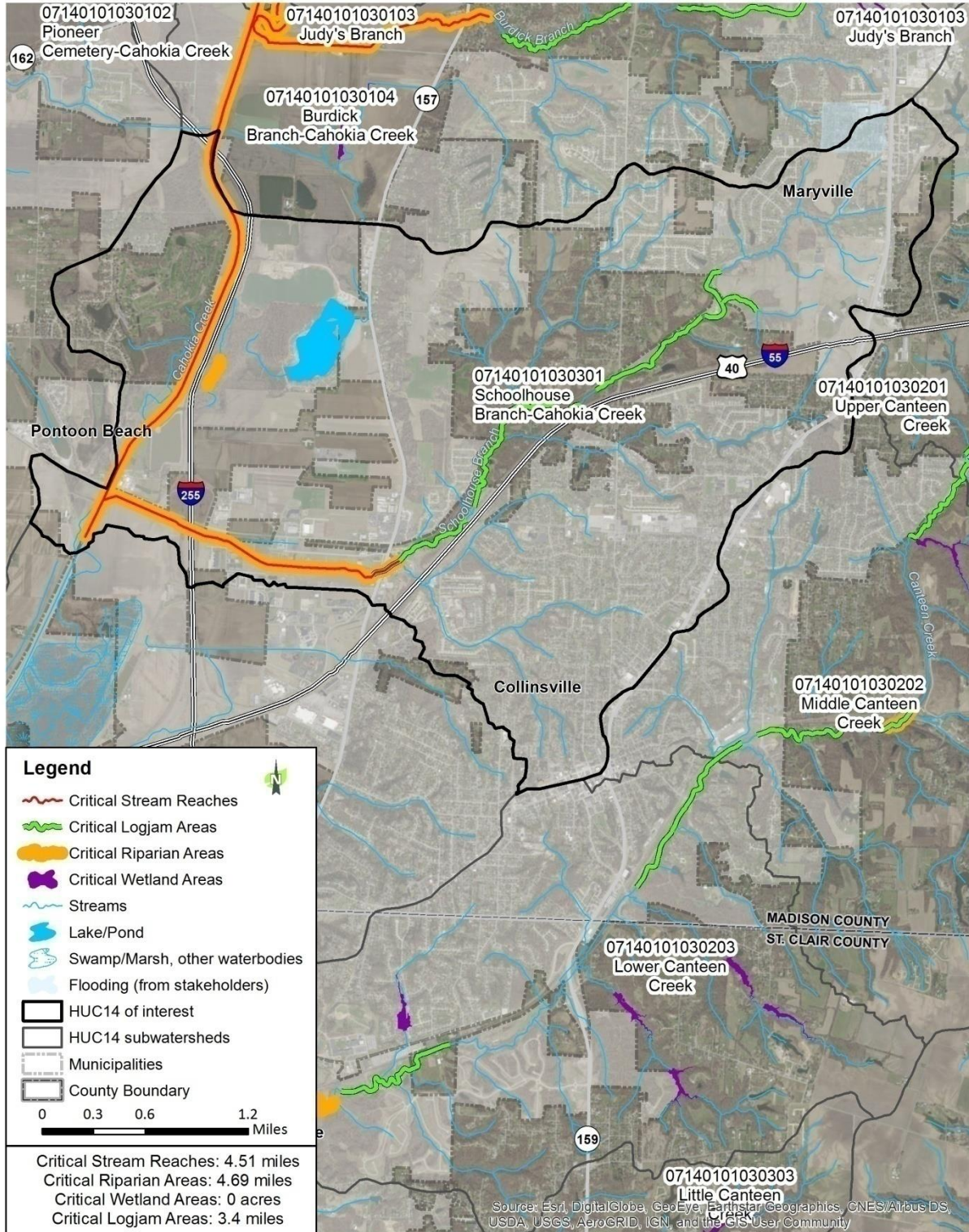
Critical Riparian Areas: 24,779 feet (4.69 miles) of Critical Riparian Areas were identified in the subwatershed. These areas are the same as those identified as Critical Stream Reaches.

Critical Wetland Areas: No Critical Wetland Areas were identified in the subwatershed.

Flooding locations were **identified by stakeholders** in three locations throughout the subwatershed; one in Pontoon Beach and the other two in Maryville.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030301: Schoolhouse Branch-Cahokia Creek



HUC 071401030302: Canteen Creek-Cahokia Creek (Collinsville area)

This round-shaped subwatershed lies at the Madison-St. Clair county line. I-55, I-255, and Illinois State Route 157 run through it. It drains the southwestern portion of Collinsville.

Area: 5,911 acres

Named streams: Canteen Creek

Counties: Madison, St. Clair

Municipalities: Caseyville, Collinsville, Fairmont City, Pontoon Beach

Townships: Canteen, Caseyville, Collinsville

Critical Logjam Areas: 1,509 feet (0.3 miles) of Critical Logjam Areas were identified along Canteen Creek in the western portion of the watershed.

Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

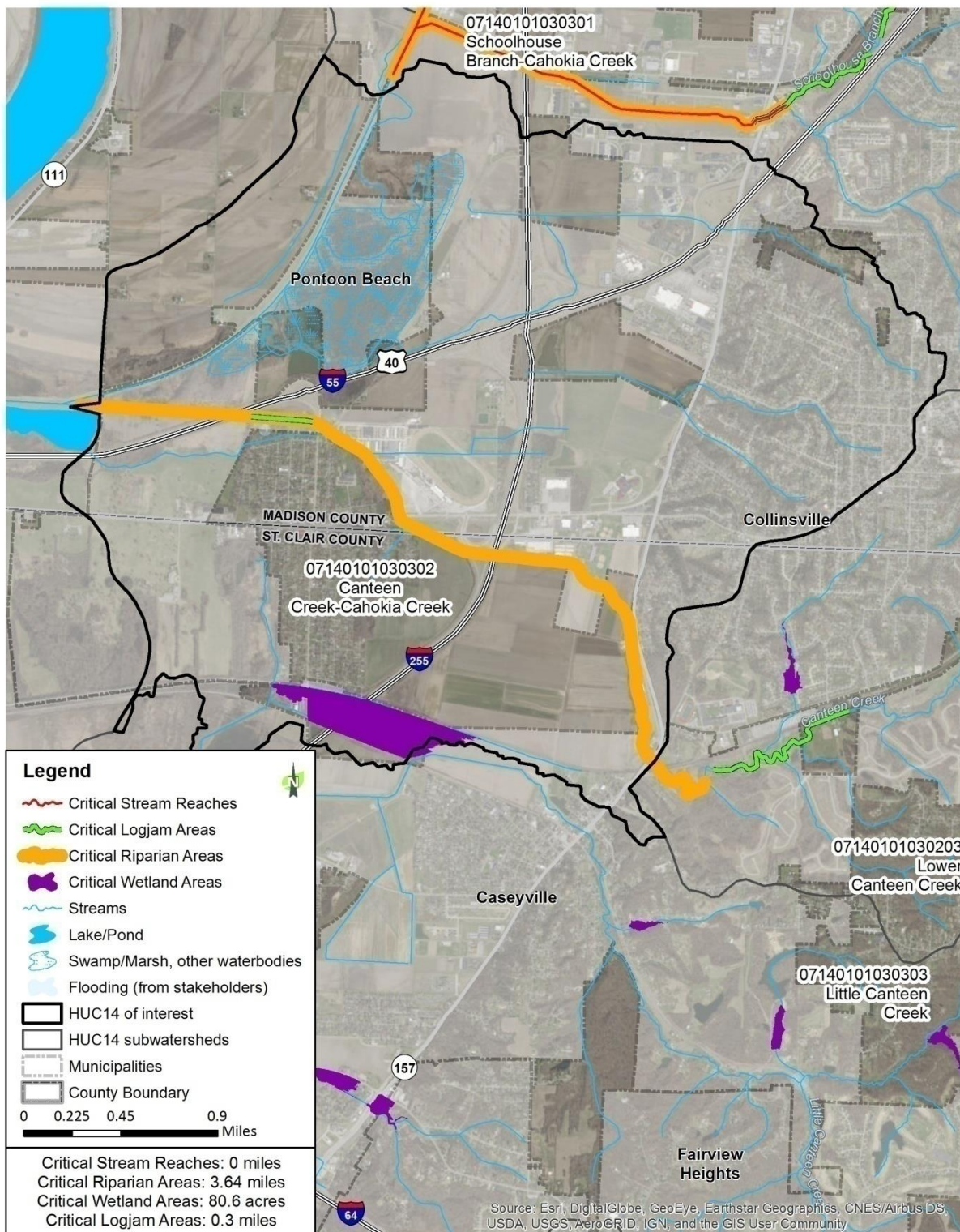
Critical Riparian Areas: 19,201 feet (3.64 miles) Critical Riparian Areas were identified in one segment along the main channel of Canteen Creek.

Critical Wetland Areas: 80.6 acres of Critical Wetland Areas were identified in one large area of agricultural land near I-255 and the southern border of the subwatershed.

Flooding locations were **identified by stakeholders** in a small residential area near Canteen Creek and I-255 in Collinsville.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030302: Canteen Creek-Cahokia Creek



HUC 071401030303: Little Canteen Creek (Caseyville area)

This subwatershed lies at the southern end of the watershed and drains Caseyville and northern Fairview Heights. I-64, I-255, and Illinois State Route 159 run through it. The subwatershed is a mix of urban, agricultural, and forested land.

Area: 8,536 acres

Named streams: Little Canteen Creek, Schoenberger Creek

Counties: St. Clair

Municipalities: Caseyville, Fairmont City, Fairview Heights

Townships: Caseyville

Critical Logjam Areas: No Critical Logjam Areas were identified in this subwatershed.

Critical Stream Reaches: No Critical Stream Reaches were identified in this subwatershed.

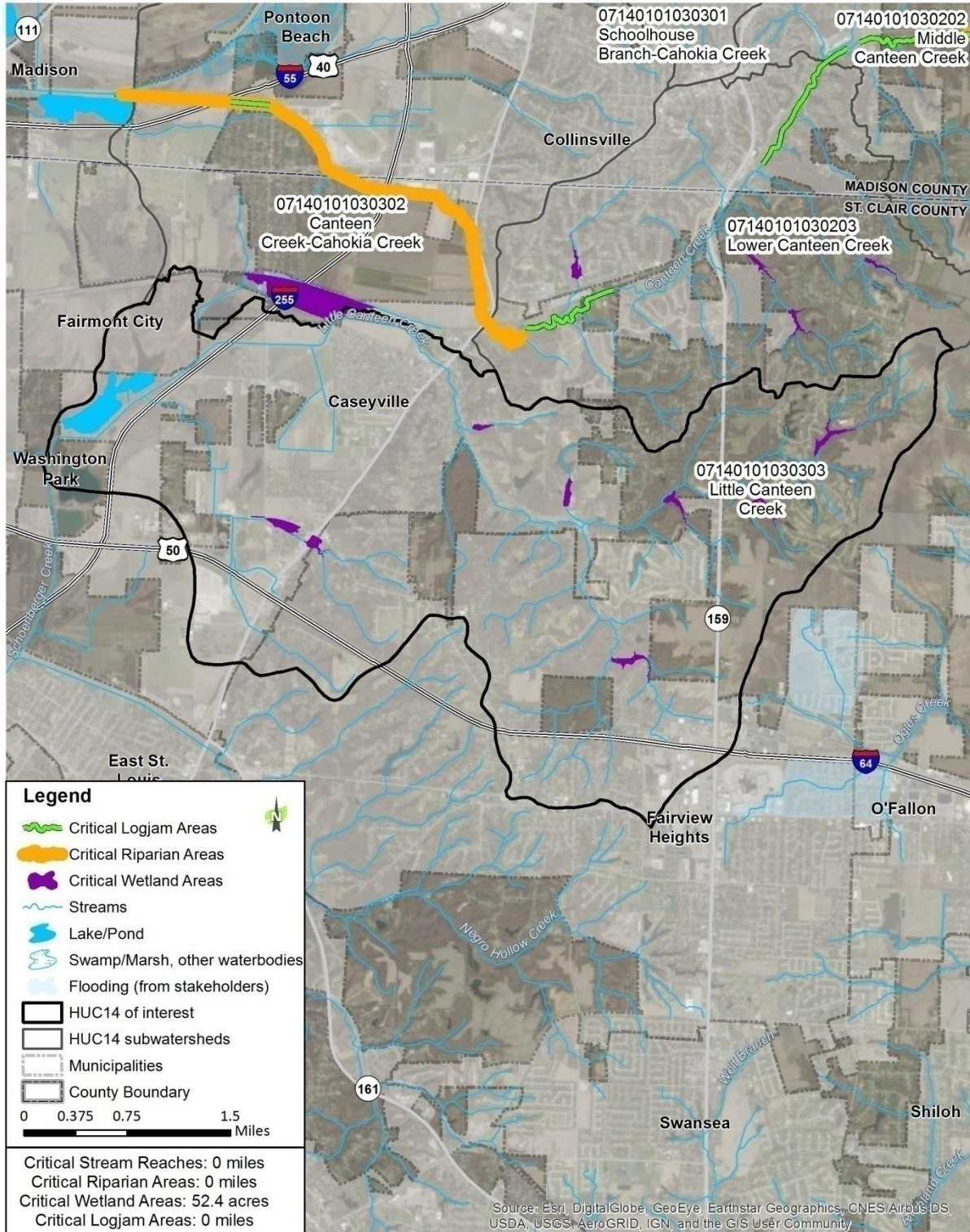
Critical Riparian Areas: No Critical Riparian Areas were identified in this subwatershed.

Critical Wetland Areas: 52.4 acres of Critical Wetland Areas were identified in eight locations throughout the subwatershed.

Flooding locations were **identified by stakeholders** in one location along the Little Canteen Creek in Caseyville.

Canteen-Cahokia Creek Watershed Plan

HUC 07140101030303: Little Canteen Creek



SECTION 4: OVERVIEW OF MANAGEMENT MEASURES

The term "Management Measures" or "Best Management Practices" generally describes acceptable practices that could be put into place to protect water quality and control stormwater. BMPs are typically designed to reduce stormwater volume, peak flows, and/or nonpoint source pollution.

Two types of Management Measures are recommended to address the goals of this plan:

- **Programmatic Measures:** general remedial, preventive, and policy watershed-wide Management Measures that can be applied by various stakeholders.
- **Site-Specific Measures:** locations where specific Management Measures can be implemented to improve surface and groundwater quality, green infrastructure, and flooding.

Programmatic Measures include policy changes, environmental monitoring, design processes, and other measures that can be applied by various partner and stakeholder organizations across the watershed. Information and education measures can be considered programmatic measures, and these are outlined separately in the Information and Education Plan section (Section 6).

Site-Specific Measures, which are often structural, can be implemented on the ground to improve surface and groundwater quality, green infrastructure, and flooding. The Site-Specific Management Measures are divided into four categories: **agricultural, urban, forest, and streams and lakes.**

This section provides an overview of many Management Measures that are recommended within the watershed.

Programmatic Management Measures

Conservation Development

Conservation Development, also known as Cluster Design or Open Space Design, is a set of tools for designing development in a way that protects open space, aquatic habitat, and other natural resources. Conservation Development subdivisions are characterized by compact, clustered lots surrounding a common open space, which often includes a waterway, waterbody, or detention area. This facilitates development density needs while preserving the most valuable natural features and ecological functions of a site.

Primary goal addressed: 3. Promote Environmentally Sensitive Development

Open space designs have many benefits in comparison to conventional subdivisions: they can reduce impervious cover, stormwater pollutants, construction costs, grading, and the loss of natural areas. Despite these benefits, many communities' zoning ordinances do not permit Conservation Development designs because of code requirements for minimum lot sizes, setbacks, frontage distances, and more. These ordinances should be amended to allow for the implementation of Conservation Development design. Ordinance effectiveness and implementation should be periodically reviewed.

Developers should be encouraged to set up management procedures that protect sensitive natural areas/open space. Natural areas and systems can be donated to a public agency or conservation organization for long-term management to ensure that they have regular maintenance over time and remain aesthetically pleasing and functional spaces. Alternatively, Homeowners Associations (HOAs) can

explicitly take on the management of the natural areas, writing rules about maintenance and fees into their bylaws.

As the area's population grows, the demand for recreational space also increases. Recreational features, such as multi-use trails, can be implemented alongside new or existing management measures to improve quality of life and provide educational opportunities for watershed residents. For example, hiking or biking trails can be established along levees, or portions of natural areas can be designated for picnicking or wildlife appreciation. Potential recreational opportunities should be explored when implementing the watershed plan BMPs.

Federal and state programs

Federal and state agricultural easement and working lands programs such as CRP, CSP, EQIP, and the Agricultural Conservation Easement Program (ACEP) are designed to reimburse farmers and landowners for implementing practices that protect soil and water health.

Primary goal addressed: 2. Improve Surface Water Quality

Financial support for stormwater infrastructure

Maintenance of wastewater treatment systems imposes costs on communities that are usually recaptured through municipal property taxes and/or sewer fees. Stormwater infrastructure, however, does not often have such dedicated funding. Permitted municipal separate storm sewer systems (MS4s) are required to meet minimum control measures, but there are needs and issues beyond these measures, such as flood mitigation, that do not have dedicated funding. Green infrastructure is also not often funded through typical stormwater programs.

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage

Several policy approaches can assign dedicated funding for stormwater infrastructure that prevents flooding and allows infiltration. As outlined in the 2015 Urban Flooding Awareness Act Report prepared by IDNR, USEPA recommendations for financing stormwater management include:

- Stormwater utility (or service fees),
- Property taxes/general funds,
- Sales tax,
- Special assessment districts,
- System development charges,
- Municipal bonds and state grants, and
- Low-interest loans.

These funding options are explored in more detail in Appendix C.

Flood Damage Prevention Ordinance

All counties and most communities in the watershed are members of the National Flood Insurance Program (NFIP), and as such, have a Floodplain Ordinance in effect. These ordinances require specific development standards for structures and activities in the 100-year floodplain (as designated by FEMA). Due to increasing flood risk and flood insurance rates from climatic changes and inadequate policies, strengthening these ordinances would help protect individuals and communities from flood loss and damage. One way of strengthening floodplain ordinances to reduce flood risk is to use text from the State of Illinois's Model Floodplain Ordinance, or the model ordinance published by the Association of

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage

State Floodplain Managers (ASFPM). In a 2014 report, HeartLands Conservancy reviewed flood prevention BMPs and recommended that Madison County adopt an updated, stand-alone Flood Damage Prevention Ordinance. Subsequently, HeartLands Conservancy created a draft ordinance based on state and regional best practices. The practices recommended include more stringent standards for development in floodplains so that flood damage becomes less likely and less severe. Ordinance effectiveness and implementation should be periodically reviewed.

Green infrastructure incentives

Green infrastructure can be defined as our region's natural resources, including open space, woodlands, wetlands, gardens, trees, and agricultural land. It can also be defined as the nodes and corridors of vegetation over the region, or the site-scale structures and landscaping that recreate natural processes (e.g., rainscaping). Green infrastructure results in a higher diversity of plants and animals, removal of nonpoint source pollution, infiltration of stormwater, and healthier ecosystems. Communities can offer incentives for developers that design for or implement green infrastructure, including flexible implementation of regulations, fee waivers, tax abatement, and streamlining the development review process. These incentives can be granted on a case-by-case basis.

Primary goal addressed: 3. Promote Environmentally Sensitive Development

Primary goal addressed: 2. Improve Surface Water Quality

In-lieu fee ecological mitigation

In-lieu fee mitigation is an opportunity to assist developers in meeting their mitigation needs while directing mitigation to high quality sites in the watershed. Under an in-lieu fee program, a developer can pay a fee in lieu of having to restore or protect wetlands on the development site, or to mitigate losses of those sites by protecting or restoring wetlands off-site. The fee goes to a third-party organization which can direct the funds to high quality ecological sites for which restoration efforts will have the most environmental impact.

Long-term management of natural areas

Developers should be encouraged to protect sensitive natural areas/open space and create naturalized stormwater management systems (including green infrastructure). These practices are key components of Conservation Development design. Developers should be encouraged to donate natural areas and systems to a public agency or conservation organization for long-term management. This ensures that the natural areas have regular maintenance over time and remain aesthetically pleasing and functional spaces. Alternatively, HOAs can explicitly take on the management of the natural areas, writing rules about maintenance and fees into their bylaws.

Primary goal addressed: 5. Develop Organizational Frameworks

Monitoring

Monitoring of water quality, flow, and stream health in the watershed will provide data that can be used to support future resource management decisions and assess the effectiveness of Management Measures that are implemented. NGRREC, a partner on this plan, is well-situated to conduct this monitoring.

Primary goal addressed: 2. Improve Surface Water Quality

Continuous monitoring at USGS gage 05588720 located on Judy's Branch in Glen Carbon will provide a broad assessment of the effect of land management practices in the watershed on surface water quality throughout the year. It will also allow trends to be identified by comparing new monitoring data to

historical water quality data collected by USGS and the Illinois Water Sciences Center (IWSC) from this location.

In addition to continuous monitoring at the USGS gauge, secondary monitoring stations will be added upstream from the USGS gauge in order to identify the relative contributions of HUC14 subwatersheds to overall water quality in the larger watershed. Sampling locations will be identified near the outflow of each subwatershed, and samples will be collected quarterly to determine seasonal variations in water quality. Additional sampling will be done during major storm events. See Appendix F for more detail on the recommended monitoring components. See Section 7 (Implementation) for the monitoring timeline.

The following parameters will be monitored:

- Flow
- Sediment (TSS)
- Total Phosphorus
- Total Nitrogen
- Non-Purgeable Organic Carbon (NPOC)
- Soluble reactive phosphate (SRP)
- Nitrite+nitrate-nitrogen ($\text{NO}_2+\text{NO}_3\text{-N}$)
- Ammonium-nitrogen ($\text{NH}_4\text{-N}$)

Native landscaping

The use of native plants in landscaping on public and private property should be encouraged as a way to enhance stormwater management structures, slow down surface runoff, extend green infrastructure networks, and support wildlife. For example, the Rock Hill Trails subdivision, east of Wood River in unincorporated Madison County, displays several species of native plants in landscaping put in place through an IEPA 319 grant. Changes to weed control ordinances (or other ordinances that specify plant species to be used in landscaping) may be needed to allow appropriate growth of native plants. Ordinance effectiveness and implementation should be periodically reviewed. Likewise, the removal of invasive species is important in promoting biodiversity.

Primary goal addressed: 4. Support Healthy Habitat

Open space and natural area protection

Several actions can be taken to encourage the protection of natural areas and open space in new development. These include establishing a dedicated source of funding for open space acquisition and management, creating agriculture zoning districts with very large minimum lot sizes, adopting an open space and parks plan, and implementing regulations to protect steep slopes, wetlands, and other sensitive natural areas. Comprehensive plans should be regularly updated to help protect valuable natural areas and open space from development and guide new development in ways that minimize negative water quality and flooding impacts.

Primary goal addressed: 3. Promote Environmentally Sensitive Development



Open space and natural area protection / land conservation. Photo: USEPA.

Private sewage monitoring

Private sewage inspections are required by Madison County during real estate transactions and are performed following complaints; however, the inspections can occur many years apart for a single

Primary goal addressed: 2. Improve Surface Water Quality

property. More regular inspections (e.g., every three to five years) should be considered by watershed jurisdictions. An intensive inspection of private septic systems in areas with recurring problems should also be considered. Data on private sewage violations and water quality parameter exceedances should be collected and mapped. Connections to public sewer systems should be encouraged in new development. Counties and municipalities can create a Special Service Area (SSA) to fund improvements to localized private sewage problems.

Riparian Buffer Ordinance

A riparian buffer is an undisturbed naturally vegetated strip of land adjacent to a body of water. Among their many benefits, riparian buffers improve water quality, reduce erosion, store floodwater, and provide habitat for wildlife. In this region, oak-hickory forest or prairie grassland are appropriate vegetation types. A riparian buffer ordinance protects a riparian area of a certain width from new development and other disturbances, and promotes revegetation/reforestation.

Primary goal addressed: 3. Promote Environmentally Sensitive Development

Sewage Treatment Plant upgrades

Upgrades to wastewater treatment plants in the watershed should be installed to meet permit requirements, and to protect these critical facilities from flooding. Other improvements may include incorporating nutrient removal technologies. USEPA's draft "Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants" document, published in August 2015, is a good source of information about optimizing nutrient removal in different types of treatment systems. As a further measure, a Nutrient Credit Trading system can be set up. In this system, municipalities can create agreements a land conservation organization and IEPA to provide payments on a conservation easement that reduces nutrient discharge from agricultural land in order to offset a Sewage Treatment Plant's discharge.

Primary goal addressed: 2. Improve Surface Water Quality

Stream Cleanup Team

A Stream Cleanup Team with funding and resources dedicated to stream cleanup in the watershed would help to improve water quality, reduce flood risk (by removing litter and debris), and monitor stream health. Many Madison County residents were vocal in their support of the grant-funded Stream Cleanup Team that operated in 2008 to 2009. The program could be expanded from its previous scope to include an education component, roles for volunteers, and a stream inventory. The team could inform local sheriffs' departments about sites with the most litter/debris so that they can more effectively enforce laws on littering and dumping. In previous years (2013 to 2016), Streambank Cleanup and Lakeshore Enhancement (SCALE) grants from USEPA were made available to support cleanup efforts under Section 319 of the Clean Water Act. The funds were paid to groups that "have already established a recurring streambank or lakeshore cleanup," and used for dumpster rental, landfill fees, and safety attire. Local recipients such as Alton Marketplace/Main Street and the Village of Swansea received \$500 (or more if more participants were involved). This program may be funded again in future.

Primary goal addressed: 4. Support Healthy Habitat

Watershed plan supported and integrated into community plans

Watershed partners, including communities, should adopt or support the watershed plan and incorporate its goals and recommended actions into their policies (such as ordinances and comprehensive plans).

Primary goal addressed: 5. Develop Organizational Frameworks

Site-Specific Management Measures

The following BMPs are recommended for agricultural, forest, and urban areas, and streams and lakes. See Appendix E for more detailed descriptions of these BMPs, including the amount, cost, and pollutant load reduction.

Agricultural Measures

Animal waste storage/treatment system

Livestock produce waste, primarily manure, which needs to be well-managed to maintain water quality. Proper treatment and use of animal waste can be determined in a Comprehensive Nutrient Management Plan (CNMP) that helps farmers to integrate waste management into overall farm operations (see below). A waste storage and treatment system may be recommended for individual farms.

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: 75% sediment, 70% P, 65% N
Cost: \$260,000/waste storage structure

Bioreactors (denitrifying)

Bioreactors, also known as denitrifying bioreactors, are ditches filled with wood chips that contain denitrifying bacteria. The bioreactor is placed at the outlet of a tile drainage system, and the bacteria remove nitrogen from water leaving the system. Research has shown an estimated bioreactor lifespan of 15 to 20 years, after which the woodchips would be replaced if treatment was to be continued.

Primary goal addressed: 2. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 0% sediment, 0% P, 40% N
Cost: \$158/acre drained

Comprehensive Nutrient Management Plans (CNMPs)

A CNMP is a strategy for farmers to integrate livestock waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff (e.g., manure injection). When these structures and strategies are in place, manure is a useful asset to cropland that provides benefits to soil health.

Primary goal addressed: 2. Improve Surface Water Quality
Cost: \$55/acre planned for

Conservation tillage (reduced tillage/no-till)

Reducing the extent of tillage is known as conservation tillage; when no tillage is used, it is called no-till. Reducing tillage leads to a reduction in soil erosion and the transport of associated nutrients, such as phosphorus, to the waterways. No-till allows natural soil structure to develop, which results in increased infiltration of rain water, reduced surface runoff, and reduced overtopping of roads adjacent to farm fields.

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: 59% sediment, 52% P, 20% N
Cost: \$59/acre

Contour buffer strips

Contour buffer strips are strips of perennial vegetation that alternate with wider cultivated strips down a slope; the crop rows are farmed along the contour. The narrow strips of perennial vegetation are not part of the normal crop rotation. They slow surface runoff and trap sediment, significantly reducing sheet and rill erosion and removing pollutants from runoff.

Primary goal addressed: 2. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 53% sediment, 61% P, 53% N
Cost: \$175/acre

Cover crops

Cover crops can provide multiple benefits: preventing erosion, improving soil's physical and biological properties, supplying nutrients, improving the availability of soil water, breaking pest cycles, and suppressing weeds. Planted in the fall and/or spring, they take up unused fertilizer, build soil structure, and release nutrients for the following crop to use. The species of cover crop selected along with its timing and management determine the specific benefits.

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: 15% sediment, 30% P, 30% N
Cost: \$31/acre

Grassed waterways

A grassed waterway is a vegetated channel designed to move stormwater at a non-erosive velocity to reduce soil erosion and flooding. Grassed waterways prevent gully erosion and protect water quality. They are most appropriate for areas where there is soil erosion from concentrated runoff.

Primary goal addressed: 2. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 80% sediment, 45% P, 55% N
Cost: \$8,653/acre

Nutrient Management Plans (NMPs)

A NMP is a strategy for obtaining the maximum return from on- and off-farm fertilizer resources in a manner that protects the quality of nearby water resources. Creating an NMP involves reviewing soil maps, field boundaries, and nutrient uptake of crops to determine nutrient needs for each field and the types and amounts of fertilizers to meet those needs.

Primary goal addressed: 2. Improve Surface Water Quality
ACPF areas identified: Yes
Cost: \$14/acre

Ponds

Ponds are popular features that also have significant pollutant removal benefits when well sited and designed. Also known as wet ponds, stormwater ponds, or wet retention ponds, they are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). As stormwater runoff enters the pond, the sediment settles out and some nutrient uptake takes place. Nitrogen removal via denitrifying bacteria can also occur in ponds.

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: 58% sediment, 48% P, 31% N
Cost: \$15,270/acre

Riparian buffers

Riparian buffers are vegetated zones immediately adjacent to a stream. They protect the stream channel and provide room for streams to move naturally, support habitat, reduce erosion, offer recreational space, and protect water quality. Buffers function as a vegetated filter strip and as overbank erosion protection during peak flows. The vegetation can be native forest, grasses, or shrubs.

Primary goal addressed: 2. Improve Surface Water Quality
Addresses Critical Riparian Areas
Pollution reduction: 53% sediment, 43% P, 38% N
Cost: \$53/acre

Terraces

Terraces consist of ridges and channels constructed perpendicular to the slope of a field to intercept runoff water. Terracing is a soil conservation practice that reduces soil erosion and surface runoff on sloping fields. Terraces may be parallel on fairly uniform terrain or vary from parallel when the terrain is undulating. Over 140,000 feet of terraces have been put in place on farmland in St. Clair County between 2010 and 2015 thanks to the efforts of the Natural Resources Conservation Service (NRCS) and other partners.

Primary goal addressed: 2. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 40% sediment, 31% P, 25% N
Cost: \$3.36/linear foot

Water and Sediment Control Basins (WASCOBs)

WASCOBs are small earthen ridge-and-channel structures or embankments that are built across a small watercourse or area of concentrated flow within a field. They are designed to hold agricultural water so that sediment and sediment-borne phosphorus settle out, reducing the amount of sediment leaving the field and preventing the formation of gullies.

Primary goal addressed: 2. Improve Surface Water Quality
ACPF areas identified: Yes
Pollution reduction: 58% sediment, 35% P, 28% N
Cost: \$366/acre

Wetlands

Wetlands, also known as Nutrient Removal Wetlands, consist of a depression created in the landscape where hydric soils allow aquatic vegetation to become established. They are among the most effective stormwater practices in terms of pollutant removal. Wetlands can easily be designed for flood control by providing flood storage above the level of the permanent pool. The wetlands and surrounding buffers also offer environmental benefits such as increases in wildlife habitat and carbon sequestration. Wetlands can be natural or “constructed,” meaning that they mimic naturally occurring wetlands. Wetland restoration is an important tool for bringing back the ecosystem services of nutrient removal and flood storage to a drainage area. Wetlands that have filled with sediment over time can be dredged to improve flood storage while retaining wildlife habitat.

Primary goal addressed: 2. Improve Surface Water Quality
Addresses Critical Wetland Areas
ACPF areas identified: Yes
Pollution reduction: 78% sediment, 44% P, 20% N
Cost: \$13,163/acre



Wetlands at the Silver Creek Nature Preserve.
Photo: HeartLands Conservancy

Forest Management Measure

Forest stand improvement

Forest stand improvement is an approach to forest management that prioritizes forest health and wildlife habitat. Trees within the stand that are a desirable species, age class, and form are retained while those competing with these trees are “culled” (i.e., cut or girdled). This decreases competition for the desirable trees, increases growth rates, and allows managers to shape the future forest. Forest management can favor trees that produce more hard and soft mast (nuts, seeds and fruit) to support wildlife populations. Additionally, forest stand improvement can help improve water quality by removing undesirable species, including invasive species such as honeysuckle, that increase soil erosion on the forest floor by suppressing ground cover vegetation.

Primary goal addressed: 4. Support Healthy Habitat
Pollution reduction: est.5% sediment, 5% P, 5% N
Cost: \$356/acre

Canteen-Cahokia Creek Watershed Plan

Selected Agricultural Management Measures (Best Management Practices, or BMPs).



Above: Terraces. Photo: NRCS.



Above: Grassed waterways in Upper Silver Creek watershed. Photo: HeartLands Conservancy.



Above: Contour buffer strips. Photo: NRCS.



Above: Cover crops demonstration plot. Photo: HeartLands Conservancy, 2016.

Left: Water and Sediment Control Basin (WASCOB). Photo: Friends of Northern Lake Champaign.

Urban Management Measures

Bioswales

Bioswales are swaled (sloped) drainage courses designed to remove debris and reduce pollution from surface water. The sides of the swale are less than 6% slope and the swale may be filled with vegetation, compost, and/or riprap. The design of the swale should maximize the time water spends there, which aids in infiltration (for groundwater recharge) and pollutant removal. Bioswales are often effective when sited adjacent to parking lots. They can capture and treat stormwater during the “first flush” of rain on the parking lot, which carries substantial automotive pollution.

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 77% sediment, 17% P, 47% N
Cost: \$18/sqft

Detention basins

A detention basin is a constructed basin that receives, temporarily stores, and then gradually releases stormwater. They are designed to store flows during the most critical part of the flood and release the stored water as the flood subsides. While detention does not reduce the total volume of runoff from a flood event, it does reduce the peak flow rate. Many are also designed to treat stormwater by removing sediments, nutrients, and other pollutants.

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 58% (dry) or 60% (wet) sediment, 26% (dry) or 45% (wet) P, 30% (dry) or 35% (wet) N
Cost: \$43,805/acre (dry), \$48,122/acre (wet)

Older detention basins may no longer function properly and would benefit from adding extended detention outlet structures and vegetation, which would remove sediment and alter flow-through patterns. Retrofitting existing detention basins can be cheaper than constructing new basins. New detention basins (dry and wet), retrofits to existing basins (e.g., addition of native vegetation, volume increases), and maintenance of existing basins (e.g., dredging to remove sediment) are recommended in this plan. Detention basins are recommended for municipalities in the 2014 Madison County EMA All-Hazard Mitigation Plan (Appendix E—Management Measures). Large, regional detention basins serving several municipalities/entities may also be an effective option for reducing flood impacts to communities downstream.

Pervious pavement

Pervious pavement, also referred to as porous or permeable pavement, allows infiltration of stormwater into a below-ground storage area through holes in the pavement. It reduces the amount and rate of stormwater runoff over the ground surface and is a useful practice for areas requiring a smooth, paved surface that would normally be covered with impervious concrete or asphalt. Pervious pavement is suitable for parking lots, private roads, fire lanes, residential driveways, sidewalks, and bike paths, where the subsoil is of a suitable composition. Pervious pavement does require periodic cleaning with a vacuum to remain effective over time.

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: 90% sediment, 65% P, 85% N
Cost: \$100,558/acre

Rain gardens

Rain gardens are vegetated basins that temporarily store and infiltrate rain water. Situated near the lowest point of a small drainage area (such as a single residential lot), they

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: 67% sediment, 27% P, 35% N
Cost: \$9.27/sqft

significantly slow the flow of water, improve water quality, and provide food and shelter for birds, butterflies, and insects. Rain gardens can be used in combination with roof downspout disconnection and redirection, so that rainwater from a roof is channeled to the rain garden to infiltrate into the soil, reducing stormwater runoff.

Rainwater collection

Rainwater collection systems gather rainwater in structures such as rain barrels or cisterns, so that it can be used or released at a later time. They are often connected to roofs and gutters. Collecting rainwater in these systems decreases localized stormwater runoff during times of peak flow and reduces household water use and water bills.

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: n/a
Cost: \$237 per barrel/small cistern

Single property flood reduction strategies

Property owners can use a number of practices to reduce flood damage, including many low-cost options. The key to successfully mitigating future damages is to identify the source(s) of flooding at the site scale. It is important to educate property owners about these sources of flooding and appropriate flood reduction strategies. The 2014 Madison County EMA All-Hazard Mitigation Plan recommends several actions to mitigate flood damage: 1) full or partial buyouts to relieve homeowners in frequently flooded areas, 2) elevating structures in frequently flooded areas, 3) making informational materials about the NFIP available, 4) participating in the Community Rating System, and 5) sanitary sewer line repairs to prevent stormwater infiltration and sewer backups in Worden and Marine (Appendix E – Management Measures).

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage
Addresses Critical Flood Areas
Pollution reduction: n/a
Cost: \$2,000 per property

The Illinois Urban Flooding Awareness Act Final Report, published in June 2015, identified typical causes of basement flooding including overland flow, infiltration, and sewer backup. The report identified solutions available to address these causes, such as structural inspections, site grading, overhead sewer installation, drain tile, downspout disconnection, rain gardens, and pervious pavement. Information from this Report is located in Appendix E. Additional mitigation activities include elevating structures in frequently flooded areas and sanitary sewer line repairs to prevent stormwater infiltration and sewer backups (Appendix E – Management Measures).

To aid homeowners in making decisions about flood risk to their homes, materials about the NFIP should be made available by communities. Additionally, communities should consider coordinating with FEMA and IDNR on a home buyout program to relieve homeowners in frequently flooded areas who do not wish to remain.

Stormwater and sanitary sewer system maintenance and expansion

Storm drain systems require regular maintenance to function as planned. Cleaning out culverts, ditches, clogged drains, and storm drain inlets reduces the amount of pollutants, trash, and debris entering receiving waters. In some cases, stormwater infrastructure is not appropriately sized to accommodate the flow it receives due to changes in the upstream drainage area or inappropriate sizing. In some areas, a stormwater pipe designed to convey the 10-year storm based on rainfall data through 1960 would only carry the 6.6-year rainfall estimated from a dataset extending to the 1980s.

Primary goal addressed: 1. Reduce Flooding/Mitigate Flood Damage
Pollution reduction: n/a
Cost: \$81/linear foot (storm drain cleaning)

The 2014 Madison County EMA All-Hazard Mitigation Plan identified several storm drain system improvement projects in municipalities in the watershed including Collinsville, Edwardsville, and Hartford (Appendix A). Culverts, ditches, and detention basins that often overflow should be assessed for potential enlargement. Upgrades should be made in response to storm drain system inspections, citizen complaints, and/or updated modeling of the system.

In addition, sanitary sewer systems should be maintained in order to prevent infiltration and combined sewer overflows. Expansion of sanitary sewers to new development and existing buildings (already a common practice among municipalities) should continue wherever feasible.

Tree planting (e.g., street trees)

Street trees are trees that are planted in the public right-of-way. They are an important component of municipal green infrastructure and provide benefits including reducing stormwater runoff, filtering pollutants in air and water, mitigating high “urban heat island” air temperatures, and providing pleasing aesthetics that increase property values.

Primary goal addressed: 4. Promote Environmentally Sensitive Development

Urban filter strips

Urban filter strips—also referred to as vegetative filter strips—are stable areas of vegetation on gently sloping land that reduce the impacts of overland flow by removing sediments and pollutants and increasing infiltration. They can be used to drain relatively small areas where surface water runoff is discharged as overland sheet flow, and are typically installed between impervious surfaces (e.g., parking lots, roads, sidewalks) and water bodies, swales, or storm sewers.

Primary goal addressed: 2. Improve Surface Water Quality

Pollution reduction:
Cost:

Selected Urban Management Measures (BMPs).



Downspout disconnection, a single property flood reduction strategy. Photo: National Downspout Services.



Storm drain cleaning. Photo: Ann Arundel County, Maryland.

Stream and Lake Measures

Lake and stream dredging

Several lakes and streams in the watershed have filled in with sediment, decreasing the volume of their storage capacity. This is a particular problem for the homes around McDonough Lake, which are flooded when lake levels rise too high. The 1995 FEMA Interagency Hazard Mitigation Team (IHMT) Report covering Madison and St. Clair counties recommended that MESD and the Canteen Creek Levee and Drainage District should maintain the capacities of Harding Ditch and Canteen Creek, with an O&M plan for each channel.

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: n/a
Cost: \$31/linear foot

Logjams—assessment and removal

A logjam is any woody vegetation, with or without other debris, which obstructs a stream channel and backs up stream water. Beaver populations can increase the number of logjams in an area. Reports of beavers along streams in the watershed were made by residents. Logjams occur naturally, providing beneficial stream structure and cover for fish and wildlife and allowing nutrient-rich sediments to be deposited on adjacent floodplain. Adding and maintaining logjams is sometimes a management improvement for fish habitat.

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: n/a
Cost: \$31/linear foot

However, the benefits of logjams can sometimes be outweighed by the drawbacks. Logjams can impact water quality and impede the ability of streams in the watershed to drain and convey water from the land in a timely manner. They increase the impacts of flood events and contribute sediment when water scours the streambanks beside the logjam, taking soil and debris from the bank into the stream channel. Logjams can be beneficial or harmful depending on their size, location, the extent to which they stabilize streambanks, and the condition and land use of the riparian area. The decision to remove a logjam should be made following a thorough site inspection.

Localized assessment is recommended to determine whether logjam removal is appropriate and cost-effective at specific locations. The American Fisheries Society's 1983 "Stream Obstruction Removal Guidelines" are a reliable source for determining what types of logjams should be removed. Two starting points for logjam removal projects are the Critical Logjam Areas and the 2010 Oates Associates report for Madison County, which recommended routine sediment and debris removal from the following stream channels:

- Schnieder Ditch (10,000 linear feet)
- Schoolhouse Branch Creek (15,000 linear feet)
- Cahokia Creek (Cahokia Canal) (12,000 linear feet)
- Canteen Creek (40,000 linear feet)

Shoreline stabilization

The shoreline provides habitat for fish and wildlife, supports recreation for humans, and cleans stormwater runoff before it enters the water. Shoreline erosion is a natural process that occurs on lakes and rivers and along the coast. It is the gradual, although sometimes rapid, removal of sediments from the

Primary goal addressed: 2. Improve Surface Water Quality
Pollution reduction: 58% sediment, 22% P, 15% N
Cost: \$83/linear foot

shoreline. It is caused by a number of factors including storms, wave action, rain, ice, winds, runoff, and loss of trees and other vegetation. Stabilizing the shoreline of lakes in the watershed can reduce sediment erosion and support vegetation and wildlife habitat.

Streambank and channel stabilization and restoration

Streambank and channel stabilization and restoration includes several practices. Streambed erosion (incision) is the first consideration for treatment. Treatment methods include installation of pool-riffle complexes, which consist of areas of rapid water movement over coarse substrate (riffles) and areas with slower stream movement and a smooth surface (pools).

Riffle-pool complexes help support healthy fish and wildlife habitat by increasing water depth and increasing DO.

Streambank stabilization methods use a combination of bioengineering with native vegetation and hard armoring. These practices are typically implemented together, often alongside riparian buffer improvements. They improve water quality by reducing sediment transport and increasing oxygen. Some practices, such as two-stage channels, help to store floodwater during periods of high flow.

Stream channel restoration includes re-meandering channelized streams to their original, more sinuous channels. This slows down flow and allows more aquatic wildlife habitat.

Primary goal addressed: 2. Improve Surface Water Quality

Addresses Critical Stream Reaches

Pollution reduction: 98% sediment, 90% P, 90% N

Cost: \$78/linear foot

Selected Stream Management Measures (BMPs).



Logjam removal. Photo: Downriver Citizens for a Safe Environment, Michigan.



Stone toe protection, which prevents streambank erosion and shoreline erosion. Photo: Montgomery County, Maryland.

SECTION 5: MANAGEMENT MEASURES ACTION PLAN

Management Measure Selection

BMPs for stormwater management and water quality were identified from several sources, including the Association of Illinois Soil and Water Conservation Districts (Illinois Urban Manual) and USEPA (e.g., the Water Quality Scorecard). Full descriptions of Management Measures selected are located in Appendix E.

The Management Measures were selected based on the following factors:

- Performance—Research-based pollutant reduction estimates for each BMP;
- Cost—The costs associated with installation and maintenance of each BMP;
- Public acceptance; and
- Ease of construction and maintenance.

Pollutant load reduction values associated with the Management Measures were identified from several sources, including the USEPA's Region 5 Load Estimation Model Users Manual and the International Stormwater BMPs Database (see Appendix E).

Cost estimates were assembled from several sources, including the Illinois Nutrient Loss Reduction Strategy (2015), experienced local contractors, and other watershed-based plans (see Appendix E).

Levels of public acceptance for various Management Measures were gauged during stakeholder engagement activities. Data on ease of construction and maintenance were collected from sources including NRCS's 2014 National Conservation Practice Standards.

Table 5 shows all Management Measures recommended, with the primary goal addressed by each measure. Secondary and/or tertiary goals addressed are also identified. Estimates of the pollutant load reduction efficiencies of each measure are listed for sediment, TSS, phosphorus, and nitrogen. If implemented, these Management Measures will achieve the goals, objectives, and targets of this plan.

Some BMPs are more effective at pollutant reduction when implemented in a treatment train (e.g., a terrace leading to a wetland). The STEPL can assess the efficiency of several BMP combinations.

Note: All recommendations in this section are voluntary and are not required by any federal, state, or local agency.

Canteen-Cahokia Creek Watershed Plan

All Management Measures recommended

Table 5. All Management Measures recommended, goals addressed (see goal numbers in Section 2), and pollutant load reduction efficiencies.

	Goals addressed			Pollutant load reduction efficiency			
	Primary goal addressed	Secondary goal addressed	Tertiary goal addressed	% sediment removal*	% TSS removal*	% P removal	% N removal
Programmatic Measures							
Conservation Development	3						
Federal and state programs (CRP, CREP, etc.)	2	3	4				
Financial support for stormwater infrastructure	1	5					
Flood Damage Prevention Ordinance	1						
Green infrastructure incentives	3						
In-lieu fee mitigation	2	1	3				
Monitoring (water quality, flow, and stream health)	2	4	6				
Native landscaping	4	3	1				
Open space and natural area protection	3	5					
Private sewage monitoring	2						
Riparian Buffer Ordinance	3	2	5				
Sewage Treatment Plant upgrades	2						
Stream Cleanup Team	4	1					
Watershed plan integrated in community efforts	5						
Site-Specific Management Measures							
Agricultural Management Measures							
Animal waste treatment system	2			75%	75%	70%	65%
Bioreactor	2	4		0%	0%	0%	40%
Comprehensive Nutrient Management Plan (CNMP)	2	1		n/a	n/a	n/a	n/a
Conservation tillage	2			59%	59%	52%	20%
Contour buffer strips	2			53%	53%	61%	53%
Cover crops	2			15%	15%	30%	30%
Grassed waterways	2			80%	80%	45%	55%
Nutrient Management Plan (NMP)	2	1		n/a	n/a	n/a	n/a
Ponds	2	1		58%	67%	48%	31%
Riparian buffers	2	4		53%	53%	43%	38%
Terraces	2			40%	40%	31%	25%
Water and sediment control basins (WASCOBs)	2	1		58%	58%	35%	28%
Wetlands	2	1	4	78%	78%	44%	20%
Forest Management Measures							
Forest stand improvement	4	1		5%	5%	5%	5%
Urban Management Measures							
Bioswales	1	4		77%	77%	17%	47%
Dry detention basins, new	1	1		58%	58%	26%	30%
Wet detention basins, new	1	1		60%	60%	45%	35%
Detention basin retrofits (vegetated buffers, etc.)	1	1	4	53%	73%	45%	40%
Detention basin maintenance (dredging, invasives, etc.)	1	1		n/a	n/a	n/a	n/a
Pervious pavement	1	1		90%	90%	65%	85%
Rain gardens	2	4	1	67%	67%	27%	35%
Rainwater collection	1	2		n/a	n/a	n/a	n/a
Single property flood reduction strategies	1			n/a	n/a	n/a	n/a
Stormwater & sanitary sewer maintenance & expansion	1	2		n/a	n/a	n/a	n/a
Tree planting (e.g. street trees)	1	2		31%	31%	31%	27%
Urban filter strips	1	2		86%	86%	33%	56%
Stream and Lake Management Measures							
Lake dredging	1			n/a	n/a	n/a	n/a
Logjam assessment and removal	2	1	4	n/a	n/a	n/a	n/a
Shoreline stabilization	2			58%	58%	22%	15%
Streambank & channel stabilization and restoration	2	4		98%	90%	90%	90%

*Independently calculated sediment and total suspended solids (TSS) values were used where available. Where only one sediment or TSS value was available, the known sediment and TSS reduction efficiency was used (purple cells).

Summary of Site-Specific Management Measures recommended

Table 6 shows the Site-Specific Management Measures recommended, along with associated costs and estimated pollutant reductions for sediment, TSS, phosphorus, and nitrogen. All recommendations are for implementation by 2050, or the long-term watershed planning horizon.

Agricultural Management Measures include 30 acres of *animal waste storage/treatment systems* for livestock waste management. This represents 0.01% of the approximately 2,721 acres of farms in the watershed with livestock.

Bioreactors are recommended on a total of 10 acres at 40 locations, draining approximately 70 acres per bioreactor, for a total of 2,940 acres drained. The locations of potential sites for bioreactors were determined by the ACPF model, which uses topography and soil type to estimate which fields in the watershed are likely to be tile drained.

Comprehensive Nutrient Management Plans (CNMPs) are recommended for 100 acres of farmland.

Conservation tillage is recommended for 8,024 acres of land, representing 50% of agricultural land in the watershed.

Contour buffer strips are recommended to cover four acres with Critical, Very High, or High runoff risk. This represents 100% of the sites well suited for contour buffer strips identified by the ACPF model, which uses buffer strips 15 feet wide with a 90 foot minimum distance between them.

Cover crops are recommended for 8,024 acres of land. Cover crops are highly compatible with conservation tillage; a farmer planting cover crops will often find it more beneficial to till less or not at all.

Grassed waterways are recommended for 81 acres on agricultural land with Critical, Very High, or High runoff risk, as identified in the ACPF. This figure represents 99% of the grassed waterway locations identified in the ACPF, which are suited for drainage areas greater than six acres. Grassed waterways are a well-known practice among landowners and farmers in the watershed.

Nutrient Management Plans (NMPs) are recommended for 2,000 acres of agricultural land.

Ponds are recommended to cover 100 acres on agricultural land. Ponds are already a popular project for landowners in the watershed, who often use them for recreation and stock them with fish. Ponds are not eligible for funding by the major federal agricultural conservation programs such as CRP, but there appears to be high demand, and they function well as retention basins.

Riparian buffers are recommended for 140 acres along streams (assuming a 100-foot buffer width), or 7.8 miles, representing 50% of streams identified as having poor or moderate riparian condition. The recommended area includes 100% of the Critical Riparian Areas in the watershed (15.64 miles) which are composed of “poor condition” riparian areas identified in the aerial assessment and areas identified in the ACPF as Critical Zones (see Appendix D).

Terraces are recommended for a total length of 20,000 feet. Specific locations where terraces would be well-suited were not identified (and were not included in the ACPF tool), but it is likely that areas suitable for contour buffer strips would also be suitable for terraces.

WASCOBs are recommended for one acre on agricultural land with Critical, Very High, or High runoff risk. This area represents 100% of the WASCOB locations identified by the ACPF. Runoff risk classifications represent the risk of direct runoff contribution to stream channels from agricultural land. Runoff risk categories were assessed by distance to the nearest stream and slope steepness; the closer the stream and the steeper the slope, the greater the runoff risk. See Appendix D for more information on this assessment process.

Wetlands are recommended to be installed or restored on 256 acres in the watershed. This represents 100% of the Critical Wetland Areas identified using the ACPF.

Canteen-Cahokia Creek Watershed Plan

Table 6. Summary of Site-Specific Management Measures recommended, including amount, cost (implementation cost), and pollutant load reduction.

					Cumulative pollutant load reduction			
BMP Name	Amount	Unit	Cost per unit	Total Cost	Sediment (tons/yr)	Total Suspended Solids (lbs/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)
Agricultural management practices								
Animal waste storage/treatment system	30	systems	\$ 260,000	\$ 7,800,000	54	107,258	213	875
Bioreactors	2,800	acres drained	\$ 157.81	\$ 441,870	-	-	-	8,522
Comprehensive Nutrient Mgmt Plans (CNMPs)	100	acres	\$ 54.97	\$ 5,497	-	-	-	-
Conservation tillage	8,024	acres	\$ 58.65	\$ 470,583	1,902	3,803,453	7,198	12,211
Contour buffer strips	4	acres	\$ 175.11	\$ 720	1	1,744	4	17
Cover crops	8,024	acres	\$ 30.54	\$ 245,029	486	972,750	4,141	18,316
Grassed waterways	81	acres	\$ 8,653	\$ 697,396	26	52,110	62	337
Nutrient Management Plans (NMPs)	2,000	acres	\$ 13.83	\$ 27,669	-	-	-	-
Ponds	100	acres	\$ 15,270	\$ 1,527,000	23	54,149	83	236
Riparian buffers	140	acres	\$ 52.65	\$ 7,371	150	300,179	517	2,019
Terraces	20,000	feet	\$ 3.36	\$ 67,188	0	148	0	1
Water and sediment control basin	1	acres	\$ 366.48	\$ 199	0	252	0	1
Wetlands	256	acres	\$ 13,162.50	\$ 3,372,496	81	161,520	194	390
Forest related practices								
Forest stand improvement	25	acres	\$ 356.30	\$ 8,908	1	1,141	2	11
Urban/Other Measures								
Bioswales	100,000	sq. ft.	\$ 18	\$ 1,800,000	1	1,645	1	9
Dry detention basins, new	100	acres	\$ 43,804.80	\$ 4,380,480	27	53,510	51	263
Wet detention basins, new	50	acres	\$ 48,122.10	\$ 2,406,105	14	27,918	45	153
Detention basin retrofits (native vegetation buffers, etc.)	6	acres	\$ 15,236.94	\$ 91,422	1	4,076	5	21
Detention basin maintenance (dredging, mowing, burning, invasives, etc.)	6	acres	\$ 992.09	\$ 5,953	n/a	n/a	n/a	n/a
Pervious pavement	100	acres	\$100,557.50	\$ 10,055,750	42	83,755	129	745
Rain gardens	100,000	sq. ft.	\$ 9.27	\$ 927,200	1	1,431	1	7
Rainwater harvesting and reuse	100	rain barrels/cisterns	\$ 236.93	\$ 23,693	n/a	n/a	n/a	n/a
Single property flood reduction strategies	1,531	properties	\$ 1,053	\$ 1,612,143	n/a	n/a	n/a	n/a
Storm drain system maintenance and expansion	10,000	feet	\$ 80.55	\$805,545	n/a	n/a	n/a	n/a
Tree planting (e.g., street trees)	2,280,000	sq. ft. canopy	\$2.78	\$6,347,000	8	15,100	32	124
Urban filter strips	50,000	sq. ft.	\$2.04	\$102,050	0	919	1	6
Waterways								
Lake dredging	73,194	cubic yards	\$27	\$1,976,408	n/a	n/a	n/a	n/a
Logjam removal	100	feet	\$ 31.20	\$ 3,120	n/a	n/a	n/a	n/a
Shoreline stabilization	2,295	feet	\$ 83.48	\$ 191,550	186.4	372,887.5	303.6	915.8
Streambank & channel stabilization and restoration	93,878	feet	\$ 78.00	\$ 7,322,515	429.1	792,160.1	1,686	7,457.8
TOTAL				\$ 44,004,908	3,432	6,807,190	14,669	52,631
% Reduction From Current Total:					19.6%	19.4%	25.7%	18.2%

Forest Management Measures consist of 25 acres of *forest stand improvement*. This represents 0.001% of the forested area in the watershed (14,203 acres).

Urban Management Measures include 100,000 square feet of *bioswales*. If each bioswale treats an area of 10 acres or less, as is recommended, this represents minimum of 10,000 swales implemented.

New dry detention basins (100 acres) and *wet detention (or retention) basins* (50 acres) are recommended. New detention and retention basins are anticipated to be constructed alongside new residential, suburban, commercial, and industrial development in the watershed.

Detention basin retrofits are recommended for six acres of existing detention/retention basins, which represents 10% of the 58 detention basins identified from aerial photographs in the watershed, assuming an average basin size of one acre. It is anticipated that all existing basins will benefit from upgrades by 2050. Several have already filled with sediment and fallen into disrepair, especially in older subdivisions. *Detention basin maintenance* for those 6 acres of detention/retention basins is also recommended to ensure that appropriate maintenance techniques and schedules are designed and adhered to in future.

Pervious pavement is recommended for 100 acres in the watershed, or 0.7% of the total current urban land cover in the watershed. Pervious pavement is an increasingly popular paving choice, and has been installed at pilot sites in local municipalities.

Storm drain system maintenance and expansion is recommended for 10,000 feet of stormwater ditches and storm sewers in the watershed. This includes cleaning out culverts, ditches, drains, and storm inlets, and expanding stormwater infrastructure to new development and increasing culverts and other features that are not appropriately sized to accommodate the flow received. If divided equally among the ten municipalities in the watershed, the 100,000 feet of maintenance and expansion comes to 1,000 ft per municipality.

Rain gardens are recommended to be installed on 100,000 square feet of urban land in the watershed. Rain gardens are gaining in popularity among homeowners because of their infiltration capacity and wildlife benefits, and they can be attractive community features as well.

Rainwater collection is recommended through the installation of 100 rain barrels or cisterns.

Single-property flood reduction projects are recommended for 1,531 properties. This number is a best estimate of properties with moderate to serious flooding/groundwater issues requiring upgrades by 2050, based on the Flood Survey results (Appendix B). Building owners may wish to update or elevate their properties to reduce flood damage, or alter drainage on their properties by improving basement drainage, altering driveway grade, or other actions.

Tree planting of approximately 20,000 trees is recommended, especially along streets. With an estimated canopy area of 114 sq ft for a 10-year-old mature street tree, this amounts to 2,280,000 sq. ft. of recommended canopy cover – 4% of the “high” and “very high” priority planting areas identified by Davey Resource Group in a 2018 analysis.

Urban filter strips are recommended to be installed on 50,000 square feet of urban land in the watershed to increase infiltration and remove pollutants and sediments from surface water.

Stream and Lake Management Measures recommended include 73,194 cubic yards of lake dredging.

100 feet of *logjam removals*, which represents 0.0025% of the streams in the watershed. Some stream reaches with many trees and unstable streambanks may need to have multiple logjams removed.

Shoreline stabilization is recommended for 2,295 feet of lake shoreline. This represents 0.5% of the total perimeter of the shorelines of named, major lakes in the watershed.

Streambank and channel stabilization and restoration is recommended for 93,878 feet of streams. This number represents 33% of all streams with high streambank erosion, and includes 100% of Critical Stream Reaches (which have high streambank erosion *and* high channelization. Streambank erosion is a major source of sediment and nutrient loading in the watershed.

Locations of Site-Specific Management Measures

Where data was available, Site-Specific Management Measures were recommended for implementation in certain locations. For example, Management Measures associated with Critical Areas are recommended for those areas.

Critical Areas and areas recommended for Management Measures through the USDA's Agricultural Conservation Planning Framework (ACPF) are provided in a spreadsheet with longitude and latitude data in Appendix I. Table 7 summarizes the Site-Specific Management Measures provided in Appendix I by HUC14 subwatershed.

Table 7. Area and length of six Site-Specific Management Measures at known locations, divided by HUC14 subwatershed (summary of Appendix I, but using up-to-date HUC14 codes), alongside four Critical Areas with known locations (summary of Critical Areas information in Section 3). Riparian buffers and wetlands are recommended for the exact locations for which Critical Areas were identified. Greatest values in each category are shown in **bold red font**.

HUC14 (up-to-date)	Bioreactors (sq m)	Contour buffer strips (sq m)	Drainage Management (Acres)	Grassed waterways (feet)	WASCOBs (acres)	Riparian buffers (feet)	<i>Critical Riparian Areas (feet)</i>	Wetlands (acres)	<i>Critical Wetland Areas (acres)</i>	<i>Critical Stream Reaches (miles)</i>	<i>Critical Logjam Areas (miles)</i>
7140101030101	5,625	3,903	1,492	15,736	0	512	14,119	7	6.5	3	1
7140101030102	4,182	0	922	5,075	0	130	7,623	16	15.2	1.44	0
7140101030103	0	12,732	117	11,858	5	450	0	46	45.2	0	2
7140101030104	2,172	0	418	2,866	0	313	13,868	7	7.7	2.63	2.1
7140101030201	4,963	0	295	24,142	0	348	0	13	13.5	0	2.7
7140101030202	1,432	0	85	22,495	0	274	935	11	10.4	0	1.6
7140101030203	0	0	28	4,045	0	255	2,035	24	24.7	0	1.9
7140101030301	1,713	0	310	23,093	0	730	24,779		0.0	4.51	3.4
7140101030302	13,315	0	836	1,302	0	525	19,201	85	80.6	0	0.3
7140101030303	4,228	0	504	16,166	0	677	0	114	52.4	0	0
Grand Total	37,630	16,635	5,007	126,778	5	4,214	82,560	323	256.2	11.58	15

Specific project locations

Thirteen specific project locations were identified by the watershed planning team. These projects address life safety issues and multiple goals of this plan by implementing a variety of Management Measures. A shortlist of these projects will help Madison County in its efforts to help communities and landowners in the watershed address the needs they identified in the stakeholder engagement process, and provide a near-term jumping off point for plan implementation by and for local government.

The locations were identified using the following information:

- Locations of issues identified by stakeholders on both public and private land;
- Critical Areas on public land, identified by cross-referencing the two map files;
- Parcels in which multiple types of Critical Areas are present, on both public and private land;
- Locations of agricultural BMPs identified by the ACPF;
- Road flooding locations identified by stakeholders, especially where floods threaten road access; and
- Madison County Community Flood Survey responses (which were returned with the promise of anonymity, so specific parcels from which a response was sent were not identified as project locations. However, flood issues reported nearby were included in the assessment criteria below).

Once these locations were identified, the following criteria were used to select a shortlist of projects:

- Threats to critical facilities such as water treatment plants, wastewater treatment plants, fire stations, etc. (i.e., threats from flooding);
- Loss of road access to properties as a result of floods overtopping roads (which can harm health and wellbeing when access to hospitals, schools, and other services is curtailed);
- Frequency of flooding (if known);
- Proximity to flood issues identified in the Madison County Community Flood Survey;
- Representation of publicly and privately owned land;
- Estimated potential water quality benefits of the project (if known), based on area/length of project multiplied by the amount of pollution reduced);
- Number and type of Critical Areas the project would address, so that several types of issues are addressed; and
- Geographic distribution, with projects that are located throughout the watershed benefitting multiple municipalities, landowners, and other stakeholders.

For each project location, the problem/issue is explored, along with a description of the problem. Then, potential solutions that might be used to address the issue(s) are discussed. A map of each project location is provided for reference.

It is important to note that these specific project locations are only the sites of potential projects. The types of projects suggested are voluntary, not mandatory, and each one warrants further stakeholder engagement and site assessment to determine feasibility. Individual landowners with a stake in the projects may not have been consulted. These sites are identified here for outreach purposes only, so that the organizations and individuals implementing the Plan have places to begin planning for implementation.

Specific project locations

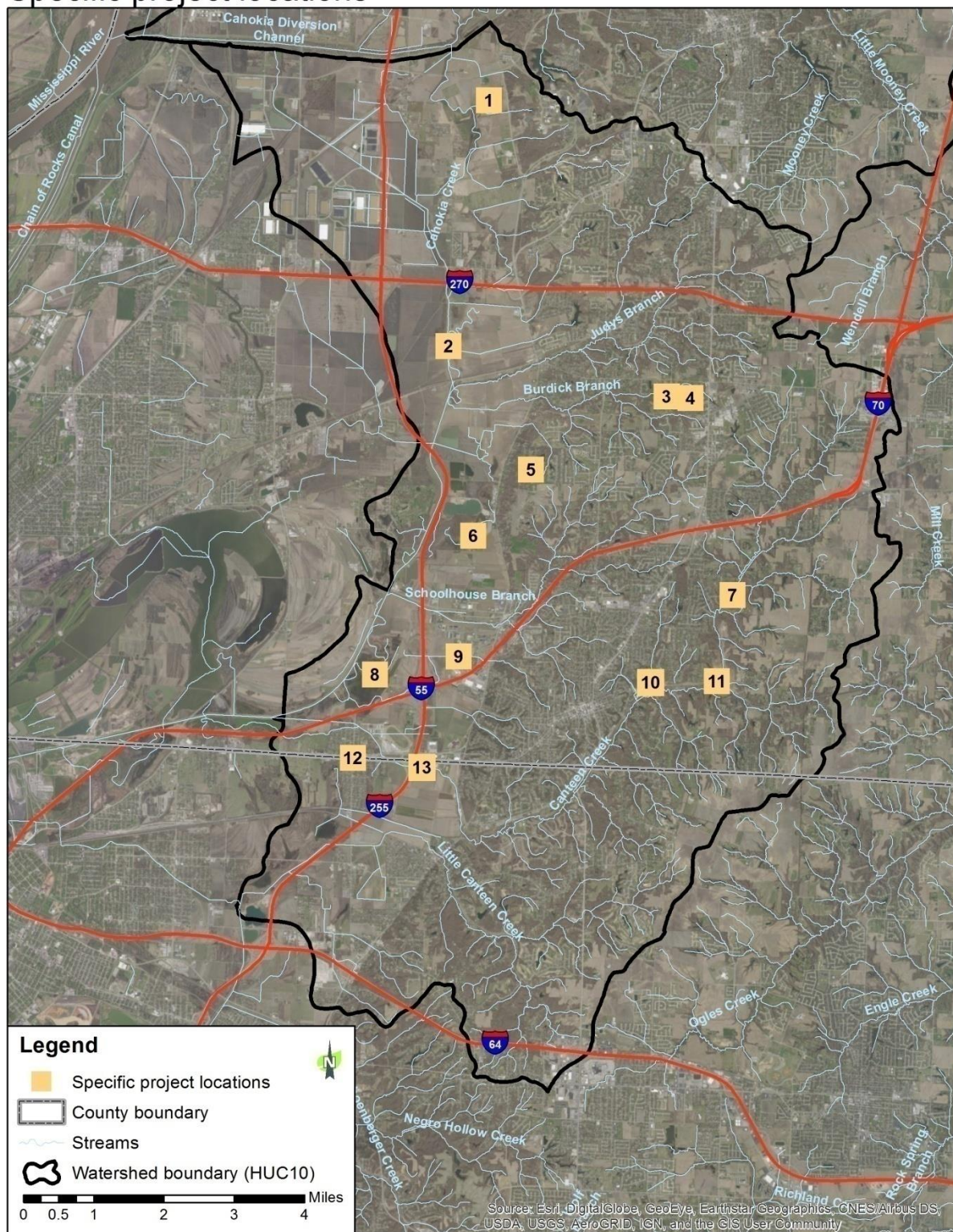


Figure 5. Map of specific project locations. Numbered squares relate to project numbers in the following pages.

List of Specific Project Locations

The following specific project locations are listed and numbered from north to south (not in order of priority).

1. Old Cahokia Creek
2. County Ditch erosion and siltation
3. Retention basin (Maryville)
4. Burdick Branch
5. Sugar Bend subdivision (Collinsville)
6. McDonough Lake flooding
7. Canteen Creek erosion and flooding (Collinsville)
8. Brushy Lake
9. Schnieder Ditch
10. Flooding of Lebanon Rd near Branch Rd
11. Canteen Creek tributary pollution
12. State Park Place flooding
13. Canteen Creek west of Route 157

Project #1: Old Cahokia Creek

Description of problem: A large area south of the Cahokia Diversion Canal and west of the bluff line floods often. This area is home to two Illinois state threatened species, and the soils are sandy and highly erodible. The area used to be sand prairie, and pockets of prairie remnants that remain are very rare. This area was identified as an Action Area (Old Cahokia Creek Action Area) in the East St. Louis and Vicinity Ecosystem Restoration and Flood Damage Reduction Project.

Floodplain: Old Cahokia Creek itself is not in the 100-year floodplain. A large area to the west of it is covered by floodplain.

Critical Areas: Near the northern end of Hartzel Road, a Critical Wetland Area, two Critical Riparian Areas, and a Critical Stream reach were identified along Cahokia Creek and one of its tributaries.

Other: Several archaeologically significant sites have been identified at the northern end of this area near Poag Road. The Illinois Chorus frog and ornate box turtle have been identified as present in this area by the Illinois Department of Natural Resources (IDNR). A stormwater complaint was received by a property on Hartzel Road.

Possible solution: The East St. Louis and Vicinity Ecosystem Restoration and Flood Damage Reduction Project report has the following purpose for this Action Area:

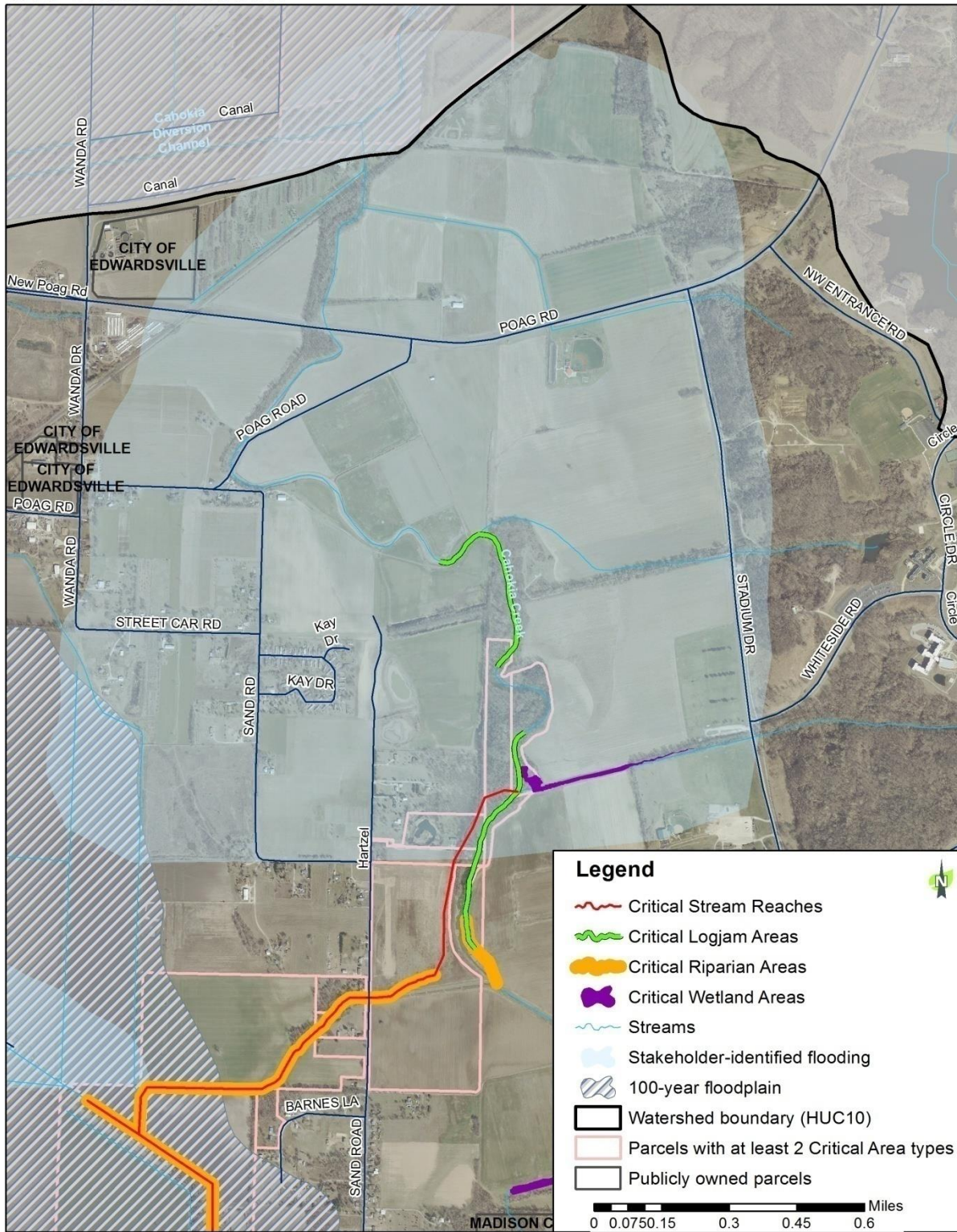
“to restore a portion of Cahokia Creek on the floodplain to a free-flowing stream, with an adjacent forested corridor supporting natural plant and animal communities, and a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the [...] watershed and to incidentally reduce flood damages in the bottoms in the County Ditch watershed, with a focus on Sand Road and vicinity.”

The 2013 Addendum to this report states:

“Segments of historic channel that were filled over the years would be reopened and existing channel areas would be evacuated to remove accumulated sediment to recreate a 2.9-mile floodplain stream. Creation of a continuous forested corridor along the reopened channel. Trees would be planted on both sides of the creek where they currently do not occur. Tributary sediment would be detained within the excavated channel and would be removed with regular maintenance. [...] In the floodplain, about 3.4 miles of historic Cahokia Creek are to be restored to a flowing condition, and a 328-foot (100-meter) wide forested corridor is to be established along both sides of the restored creek channel. Together the restored creek and adjacent forest form a habitat area. About 6.6 miles of tributary streams in the Bluff 1 watershed are to be restored by constructing a series of riffle and pool complexes and building ten tributary stream sediment detention basins at scattered locations. The total footprint of all features is 314 acres, excluding restoration of tributary streams.”

Whatever project is implemented at the Old Cahokia Creek site, it should be sensitive to protecting existing remnant sand prairie, expanding sand prairie habitat, and protecting archaeologically significant sites. This site also provides an excellent opportunity to incorporate recreational trails that connect to the larger county trails system.

Old Cahokia Creek



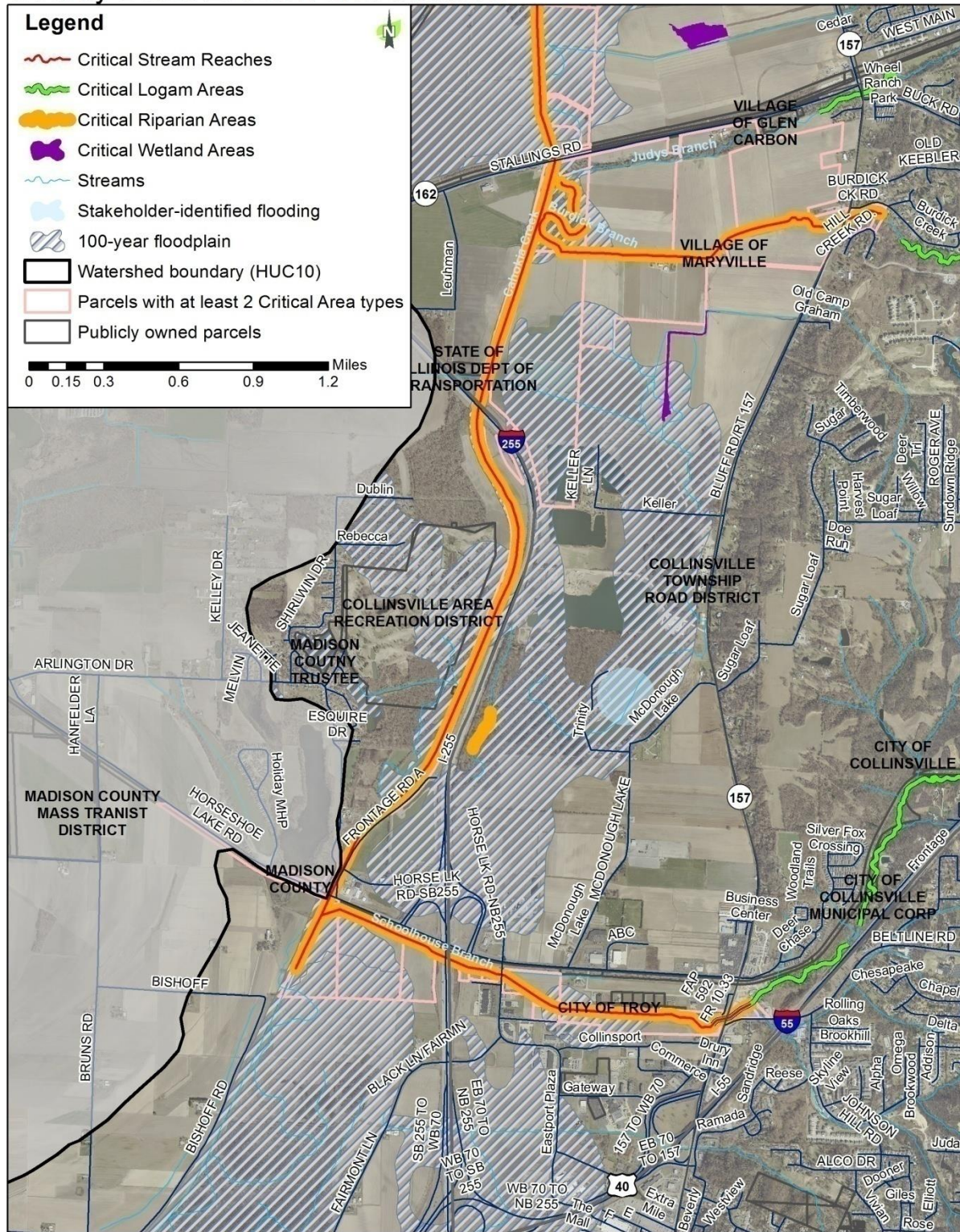
Project #2: County ditch erosion and siltation

Description of problem: The “County Ditch” is a highly channelized segment of Cahokia Creek flowing north to south through Madison County. The ditch channels water from tributaries that flow down from the bluffs to the east and low-lying land to the west, and receives high levels of sediment deposition. The banks of the ditch also lose soil due to the erosive force of water moving through the channel. The length of the ditch south of I-270 is the focus for this specific project location as it has greater erosion and siltation.

Floodplain: The ditch carries water through large swaths of 100-year floodplain.

Possible solution: More frequent maintenance of the ditch, including bank restoration (potentially including more vegetation), dredging of the channel to maintain capacity, and restoration of the creek bed. Investment in maintenance equipment and staff to make this possible. Upstream of the ditch, work with farmers to implement practices such as contour buffer strips, WASCOBs, riparian buffers, and grassed waterways to trap sediment before it leaves land that drains directly to the ditch.

County Ditch Erosion and Siltation



Project #3: Retention basin (Maryville)

Description of problem: A privately owned retention basin behind Mary Drive in Maryville is in a separate parcel owned by an absent landowner. It drains to Burdick Branch. The basin has been silting in for many years, reducing its capacity to retain water, and has also had recurrent algae blooms. The private sewer systems of the neighboring houses are ageing, so there are concerns about potential fecal coliform contamination. Madison County Planning and Development has reached out to the landowner but have not been able to secure a solution yet.

Floodplain: The basin and surrounding neighborhood are not in the 100-year floodplain.

Possible solution: Once the property is sold, the parcel containing the basin could be divided and added to one or more neighboring parcels, thus passing on maintenance requirements to an adjacent landowner. Alternatively, the parcel could be acquired and maintained by the Village of Maryville.

Maryville Retention Basin



Project #4: Burdick Branch

Description of problem: Burdick Branch is a tributary to Cahokia Creek that flows east to west through Maryville. It has issues with bank erosion and sediment deposition throughout its length. The Village of Maryville identified severe streambank erosion along the stream.

At and west of Route 157, Burdick Branch is a highly channelized stream that looks like a canal or ditch. The stream is silting in and caving in at this location, with large amounts of farm topsoil (often erodible loess soil) entering and being deposited. It is also lined by trees and there have been logjams. Collinsville Township is struggling to maintain it.

Floodplain: There is no 100-year floodplain along the creek.

Flood Survey: Four survey respondents in the Burdick Branch subwatershed reported flooding in the Flood Survey.

Critical Areas: A Critical Riparian Area was identified where Burdick Branch crosses Route 157. A Critical Wetland Area was identified at the eastern end of the stream, southwest of the intersection of routes 159 and 162.

Other: Five stormwater complaints were received from addresses in the Burdick Branch subwatershed. One was adjacent to the creek itself and three were adjacent to tributaries.

Possible solution: The stream and its tributaries run through Maryville and the unincorporated county. The western end of the stream is under the jurisdiction of Collinsville Township. These entities are the best placed to coordinate the easements and project work needed to stabilize streambanks and channels and improve riparian vegetation.



Project #5: Sugar Bend subdivision (Collinsville)

Description of problem: The Sugar Bend Estates and Deer Creek subdivisions in the City of Collinsville have had contamination from fecal coliform from improperly maintained private sewer aeration systems. The problem is that they are manifold collection systems so it is difficult to identify which individual system(s) are causing the problem. The city did testing on three small bodies of water that showed untreated human waste was reaching surface waters. They then conducted outreach to residents about maintenance, including putting out signs to remind people to maintain their systems, and they have since seen a large increase in maintenance contracts. The smell is still bad at times in summer, but residents are now largely aware of the issue. Collinsville is working to connect all of these properties to the city sewer system (1,500 feet away).

Floodplain: The subdivision is not in the 100-year floodplain (it is up on the bluff).

Possible solution: Continue to expand the city's private sewer system maintenance outreach and education. Continue the city's efforts to expand its public sewer system, converting older private sewer systems.

Sugar Bend Subdivision



Project #6: McDonough Lake siltation and flooding

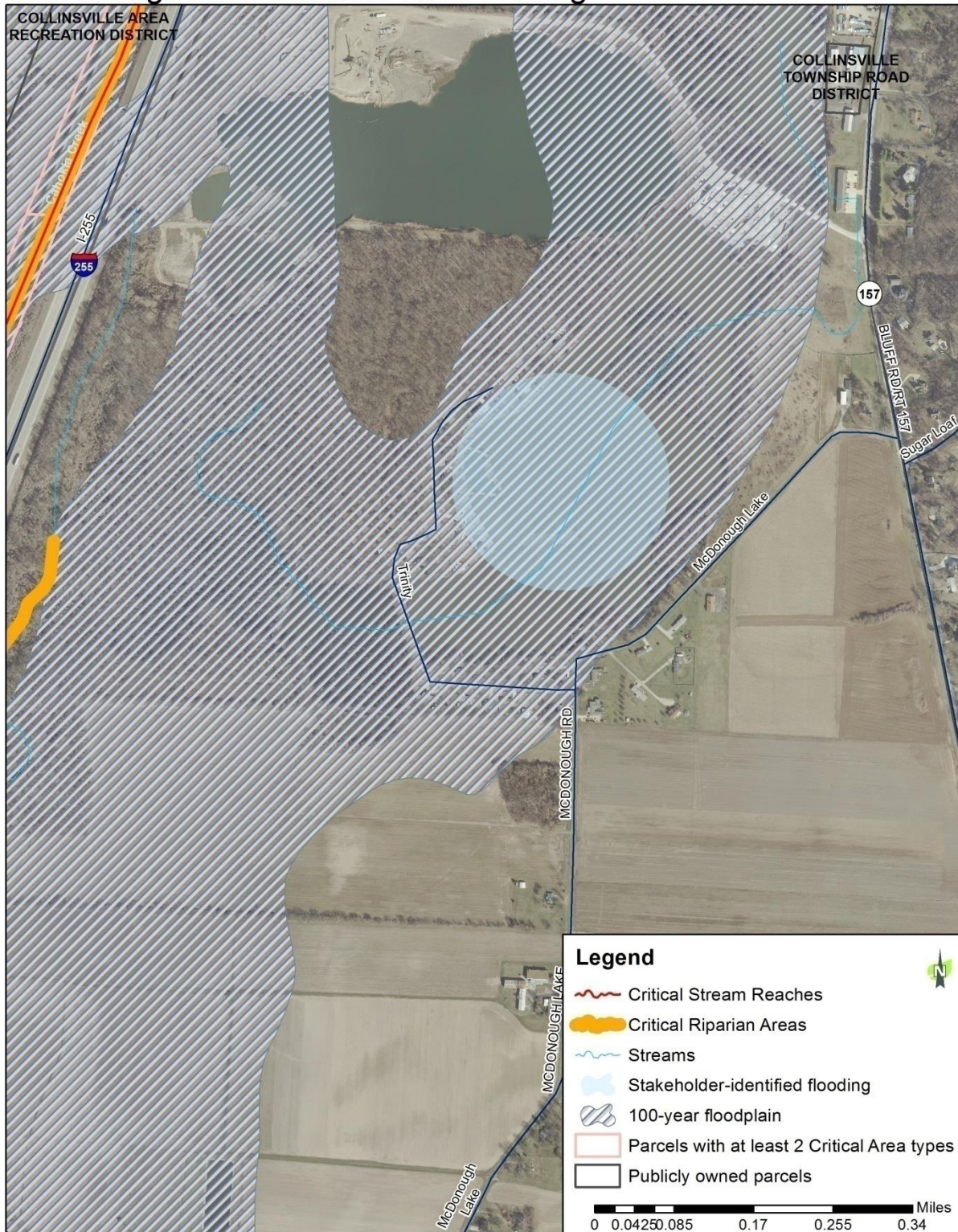
Description of problem: McDonough Lake is a natural lake situated between I-255 and Illinois Route 157, northeast of Horseshoe Lake. Several houses are situated on the south shore of the lake along McDonough Lake Road, Trinity Lane, and McDonough Lakeshore Road. These homes, and the lake itself, are in the 100-year floodplain. Floodwaters overtop the roads and reach some of these homes frequently. The lake has been filling with sediment and silt, losing capacity for water storage, over many years. Groundwater in the area is also high.

Floodplain: The lake and surrounding area are in the 100-year floodplain.

Other: Stormwater complaints have been received from residents around the lake. An archaeologically significant site is located south of the lake.

Possible solution: Dredging of the lake, elevation of surrounding properties, and upstream sediment control practices.

McDonough Lake Siltation and Flooding



Project #7: Canteen Creek erosion and flooding

Description of problem: Canteen Creek has severe streambank erosion and has caused flooding to houses in the area of White Birch Lane in Collinsville.

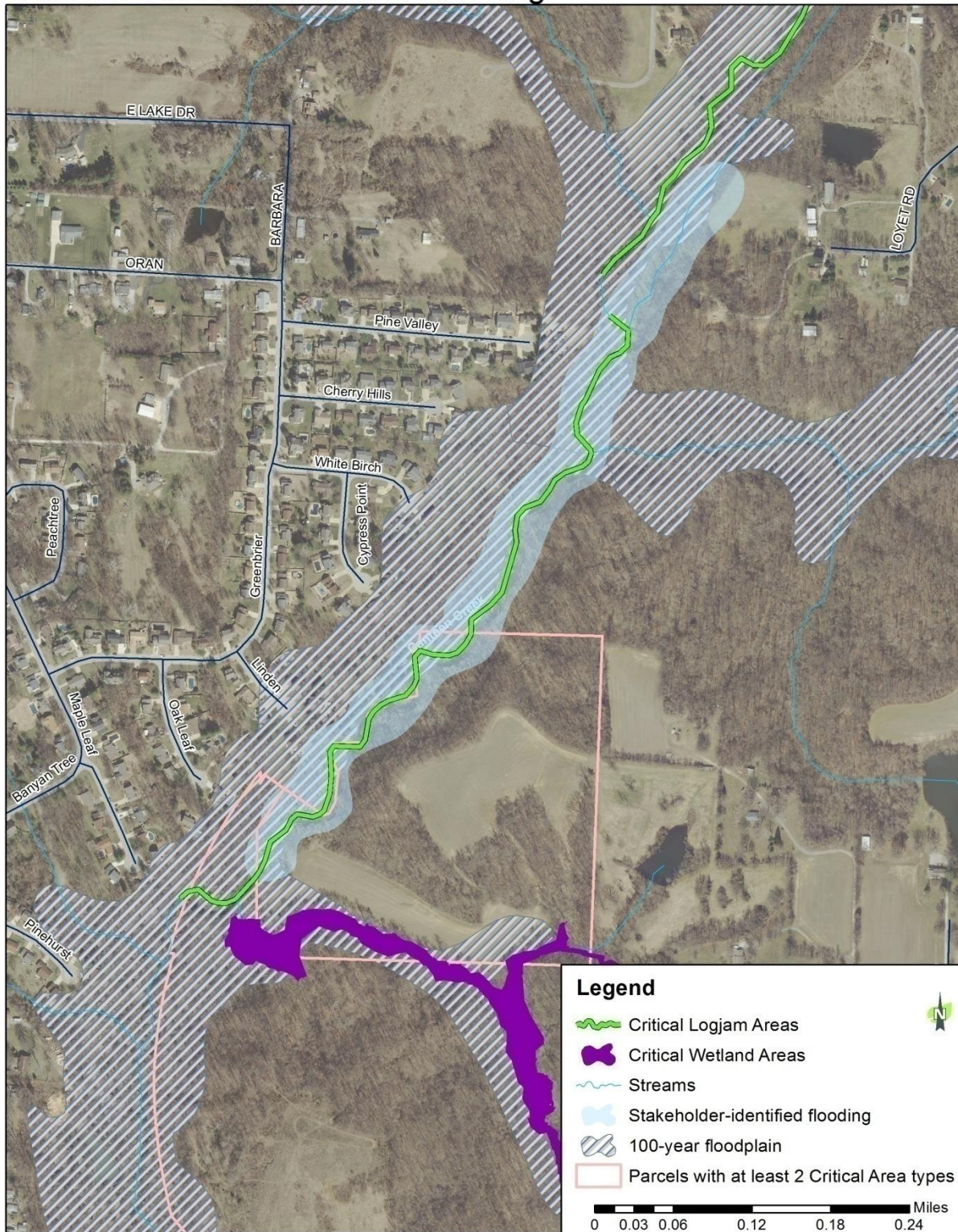
Floodplain: The entire length of the stream in this area is surrounded by the 100-year floodplain. The floodplain appears to cover the residential property, including houses (property-specific map changes resulting from engineering reports and Elevation Certificates are not reflected in this floodplain map).

Other: One stormwater complaint was received from a property on Linden Court adjacent to the stream between 2012 and 2015.

Possible solution: Streambank erosion and channel stabilization projects in Canteen Creek at this location.

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Canteen Creek Erosion and Flooding



Project #8: Brushy Lake

Description of problem: The Brushy Lake Ecological Restoration Area is located in the City of Collinsville in Madison County. The site is within the newly-formed Middle Mississippi River Conservation Opportunity Area (IWAP), contains an Illinois Natural Area Inventory Site (Levee Lake), is specifically identified within the East St. Louis and Vicinity Ecological Restoration and Flood Damage Reduction Project, and is depicted as high quality habitat within the Ecological Approach to Infrastructure Development Initiative. Due to its urban location, the site offers tremendous opportunities for ecological restoration, scientific studies, environmental education, and outreach. Multiple public benefits can be realized at the site, including hiking (recreation), flood storage, water filtration, and improved air quality. Partnership opportunities abound, in that over 75% of the 700 acre site is already protected by a public entity, including 80 acres currently owned by Heartlands Conservancy. Approximately 165 acres remain to be acquired, with 147 of this acreage within the control of one family.

Two centuries ago, Cahokia Creek flowed through this area, which was predominantly forested. A portion of the property is an Illinois Natural Areas Inventory (INAI) site as of 2017—a site that is determined to have significant ecological value. A 1981 Illinois Nature Preserves Commission report states that this area “is probably one of the best examples of the shrub swamp/pond communities left in the Mississippi Bottoms.” The site is a primary focus area in Heartlands Conservancy's Strategic Conservation Plan.

USACE as an Action Area in the East St. Louis and Vicinity Ecosystem Feasibility Study identifies this site as having the potential to store the greatest amount of stormwater than any other project in the study (1,920 acre-feet). The USACE recommendations for the site are given below.

Floodplain: The entire Brushy Lake area is in the 100-year floodplain. A levee runs along the western side of the property just east of Bischoff Rd and the canal adjacent to it.

Critical Areas: Schoolhouse Branch, at the north side of the property, was identified as a Critical Riparian Area. At the south end of the site is a parcel where two to three Critical Areas are present, including a long section of Critical Riparian Area along Canteen Creek.

Other: IDNR recognizes the presence of threatened/endangered species in this location. Also, at least 17 historic mound sites are located to the west, south, and east of the property.

Possible solution: This site, adjacent to I-255 and I-55, could be a regional detention area, holding excess water from Cahokia Creek and freeing up channel space in the creek for drainage from the American Bottom watershed.

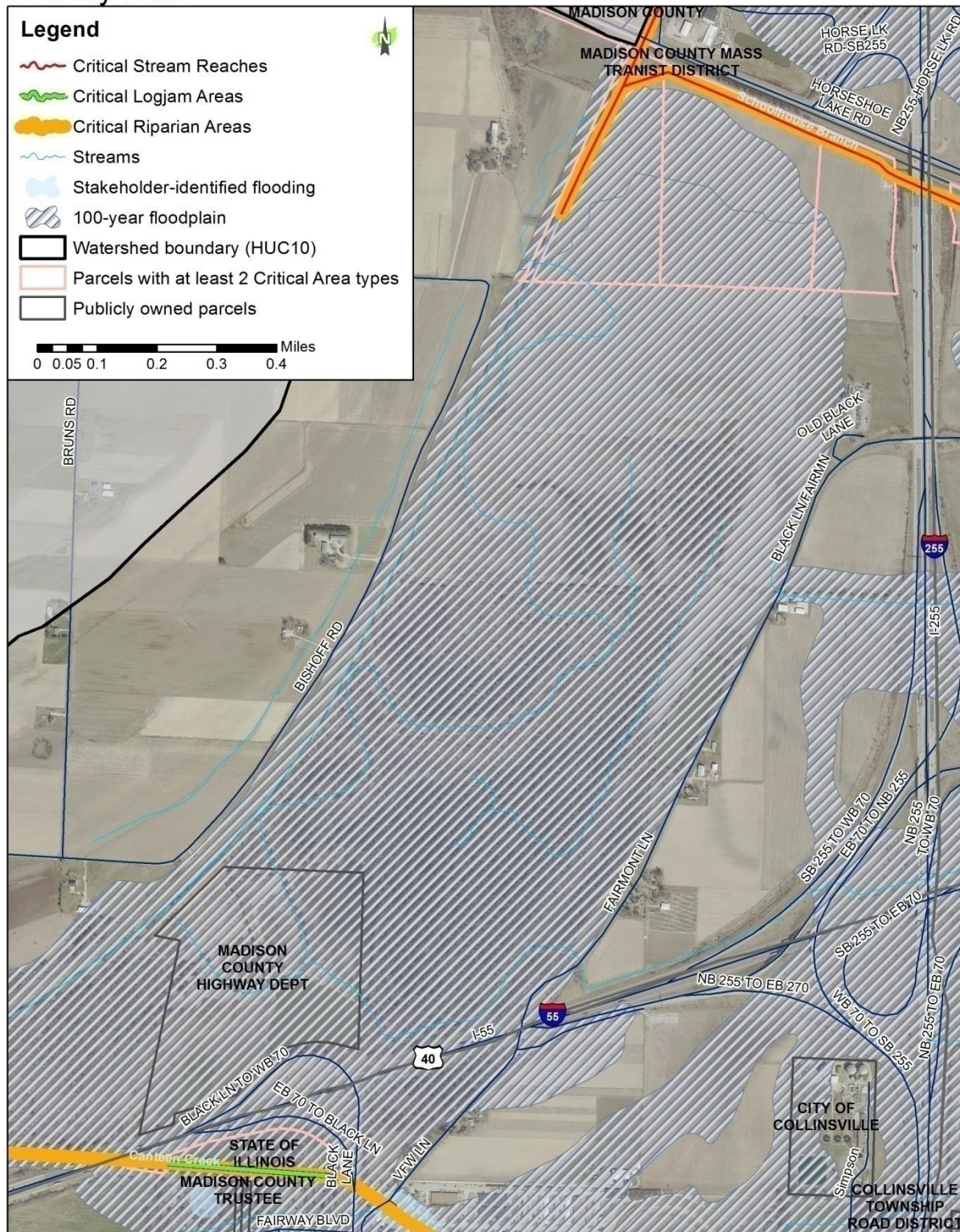
The East St. Louis and Vicinity Ecosystem Restoration and Flood Damage Reduction Project report gives the following purpose for the Brushy Lake Action Area:

“[...] to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to minimize restore [sic] stream resources in Schoolhouse Branch and “Bluff 3” watersheds, and to incidentally reduce flood damages within the Cahokia watershed.”

The 2013 Addendum provides this description of the “preferred plan” for this site:

“A 717-acre forested floodplain habitat area is to be established at the confluence of Cahokia Canal and Schoolhouse Branch. About 25 miles of tributary streams in the Schoolhouse and Bluff 3 watersheds are to be restored by constructing a series of riffle and pool complexes and building 15 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 746 acres, excluding restoration of tributary streams. [...] The creation of a 710-acre forested habitat area on the floodplain to utilize stormwater events delivered by both Schoolhouse Branch and Snyder Creek that would include planting of trees where they do not currently exist. The restoration of the historic Cahokia Creek channel within the habitat area. A floodplain sediment detention basin with a 330-foot (100-meter) wide vegetative buffer would be established in the habitat area outside the detention basin. The buffer would consist of prairie plantings to intercept sediment carried by stormwater overtopping the basin. A type D outlet structure and 40 foot weir will control flow out of the action area to Cahokia Canal.”

Brushy Lake



Project #9: Schnieder Ditch (Collinsville)

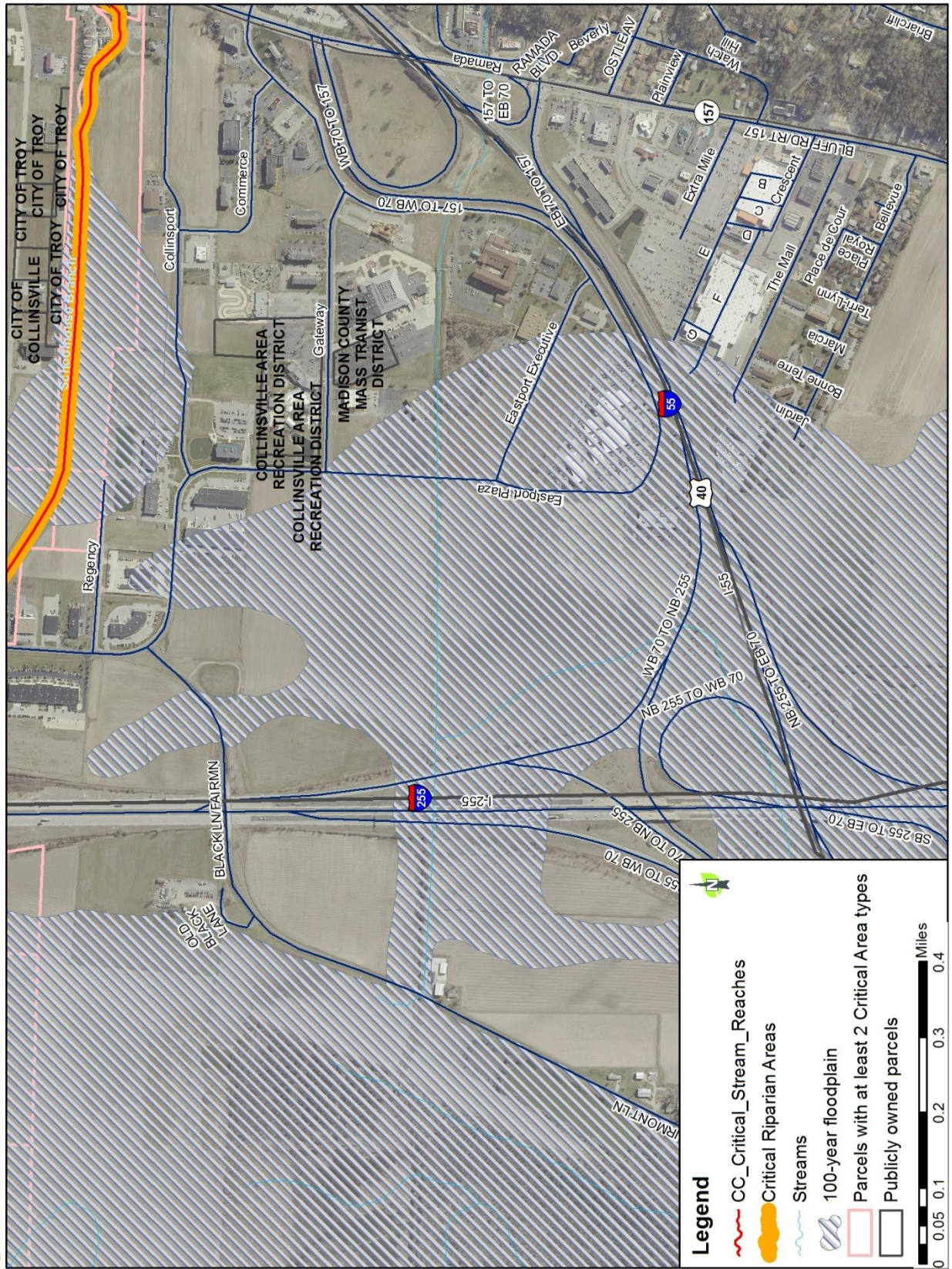
Description of problem: Schnieder Ditch, adjacent to Eastport Plaza Drive, receives large amounts of water; upstream detention is needed. Water is currently pumped up to the ditch by several pumps. The City of Collinsville would prefer to switch to only one pump, and regrade the channels and/or install deeper culverts to allow flow to move more easily. This site is located just east of Brushy Lake, on the other side of I-255, and is hydrologically connected to it. The Canteen Creek Drainage District has jurisdiction over a large portion of the ditch between I-255 and I-55.

Floodplain: The west side of Schnieder Ditch is in the 100-year floodplain.

Other: The City of Collinsville owns land to the north of the ditch, near Eastport Plaza Drive and Gateway Drive (Collinsville Area Recreation District). Madison County Transit also owns a portion of land just north of the ditch.

Possible solution: Increase detention upstream at Brushy Lake, regrade the ditch and related channels, and install one lift station.

Schnieder Ditch



Project #10: Flooding of Lebanon Road near Branch Road (Collinsville)

Description of problem: The intersection of Lebanon Road and Branch Road floods about once every five to 10 years.

Floodplain: The area surrounding the intersection is in the 100-year floodplain.

Flood Survey: One property on the east side of Branch Road returned a response indicating flooding in the last 10 years.

Other: The City of Collinsville owns land on the northwest side of the Lebanon Road-Branch Road intersection.

Possible solution: Increased detention upstream and/or downstream of the intersection, plus an increased culvert size underneath the road.

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Lebanon Road Flooding near Branch Road



Project #11: Canteen Creek water quality

Description of problem: The Collinsville area has a history of mining activity. Coal mines east of the city operated until the 1950s. Besides issues with subsidence, the need for soil lead remediation, and capping the “gob piles” of pyrite, a product of coal expansion, the City of Collinsville has had to monitor the water quality in its creeks. In one section of Canteen Creek, the color of the water changes from clear to orange. Tests by City of Collinsville show that the pH is normal (not acidic). The city will sample again at a different test site in a more accessible location. The slag piles have mostly been capped, but there is one nearby where the adjacent ditch is colored orange—there may be a leak. The banks of Canteen Creek are also highly eroded in places, as noted by both Collinsville and Maryville.

Water samples from stream close to the old (closed) landfill off Lebanon Road, just past Arnotti Lane, have high levels of iron and manganese. The samples also showed impairment by arsenic at one time, but the “acceptable level” of arsenic was changed so the sample was no longer above that level. Canteen Creek is listed as impaired on the 2018 IEPA 303(d) list for causes including barium, manganese, TSS, and phosphorous.

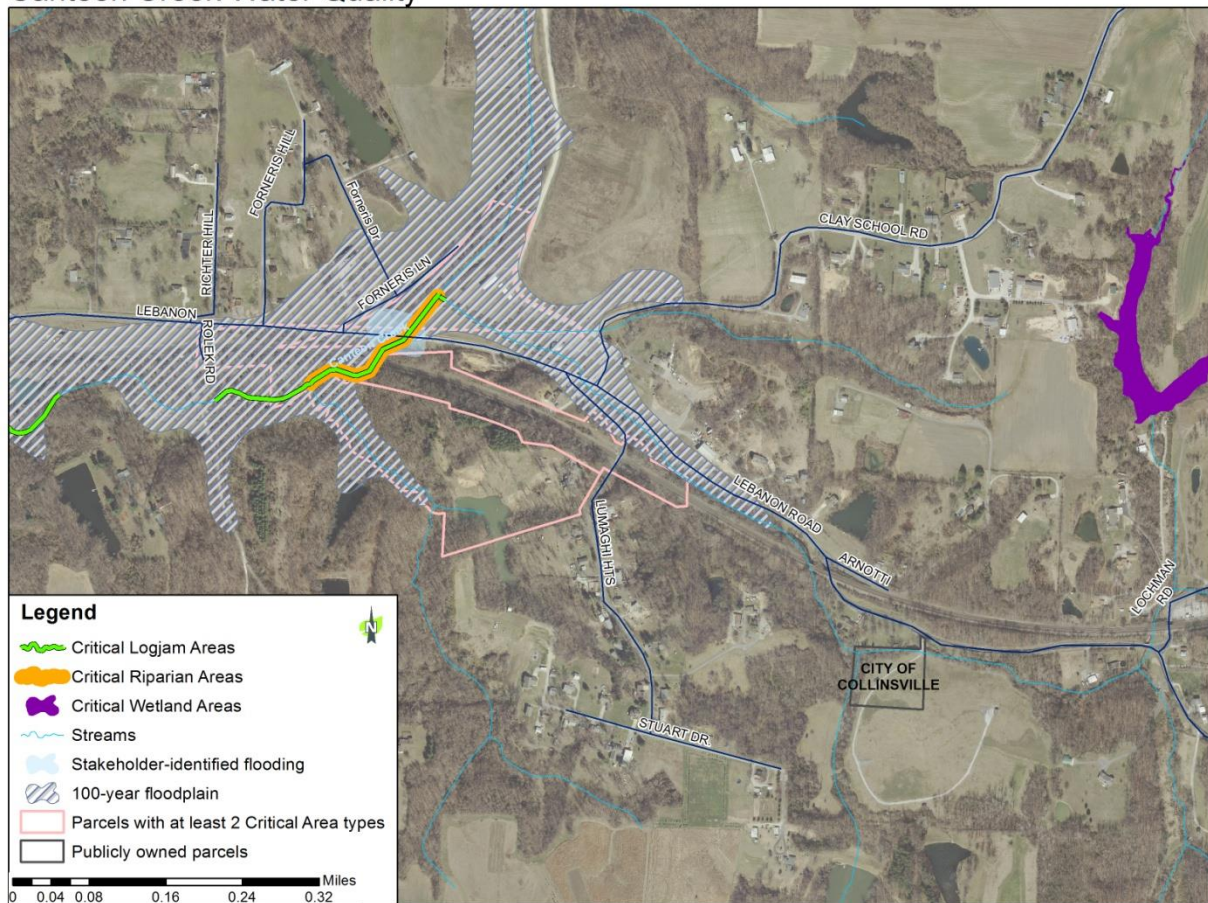
South of the confluence of the tributary and Canteen Creek, the creek crosses Lebanon Road. A stakeholder reported that the bridge floods with two to three feet of water about once every four years.

Floodplain: Canteen Creek and its adjacent tributaries are in the 100-year floodplain. In particular, the floodplain extends along at least 0.67 mile of Lebanon Road.

Critical Areas: Where Canteen Creek crosses Lebanon Road, a Critical Riparian Area was identified. Upstream of the tributary that runs along Lebanon Road, a Critical Wetland Area was identified.

Possible solution: Additional targeted water quality monitoring could help pinpoint the source of pollutants to the creek so that unsealed/uncapped mining wastes and other pollutants can be contained. If the Critical Wetland Area is restored to wetland, it could increase flood storage capacity and reduce the pressure on the creek crossing at Lebanon Road. Re-establishing and restoring the riparian area around the creeks will also help slow the flow of surface runoff to the creeks and filter the water.

Canteen Creek Water Quality



Project #12: State Park Place flooding

Description of problem: State Park Place, a low-lying unincorporated community bordering Collinsville and Cahokia Mounds State Park, often experiences flooding. Particularly severe flooding occurred in State Park Place when Canteen Creek breached its small levees in 1995 and 1998. Further information about these levees and the entity maintaining them has not yet been found. State Park Place also has significant issues with private sewage failures. Canteen Creek runs along the northern border of the community and is highly channelized with significant bank erosion.

Floodplain: State Park Place is almost completely surrounded by, and partly covered by, 100-year floodplain.

Flood Survey: One Flood Survey response indicating flooding in the last 10 years was returned from the Madison County side of State Park Place.

Other: State Park Place is within the Cahokia Mounds State Historic Park acquisition boundary, and the Illinois Historic Preservation Agency owns several parcels within it. There are several historic mound sites (presumably largely destroyed) on the north side of State Park Place.

Possible solution: Drainage solutions for this area need to be explored in further detail. Acquisition and restoration of more property for the State Historic Park would decrease flood risk. A possible solution for this area is a FEMA buy-out of properties as a result of frequent flooding and sewage/water quality issues. These properties could then be used for detention. Restoration of the riparian area along the creek would improve bank stabilization and could incorporate recreational trails that connect to Cahokia Mounds and other regional trails.

State Park Place Flooding



Project #13: Canteen Creek west of Route 157

Description of problem: As identified in Oates Associates' 2010 report for Madison County, "Canteen Creek flooding occurs periodically as a result of localized storms and ponding from hillside runoff. The leveed portion of Canteen Creek west of State Route 157 overtops at a flow of approximately 3,000 cubic feet per second (cfs) causing damage adjacent to the creek. This levee offers no protection from even the 10% annual chance flood." In addition to this report, Collinsville Township reported that the ditch is very deep, making maintenance difficult.

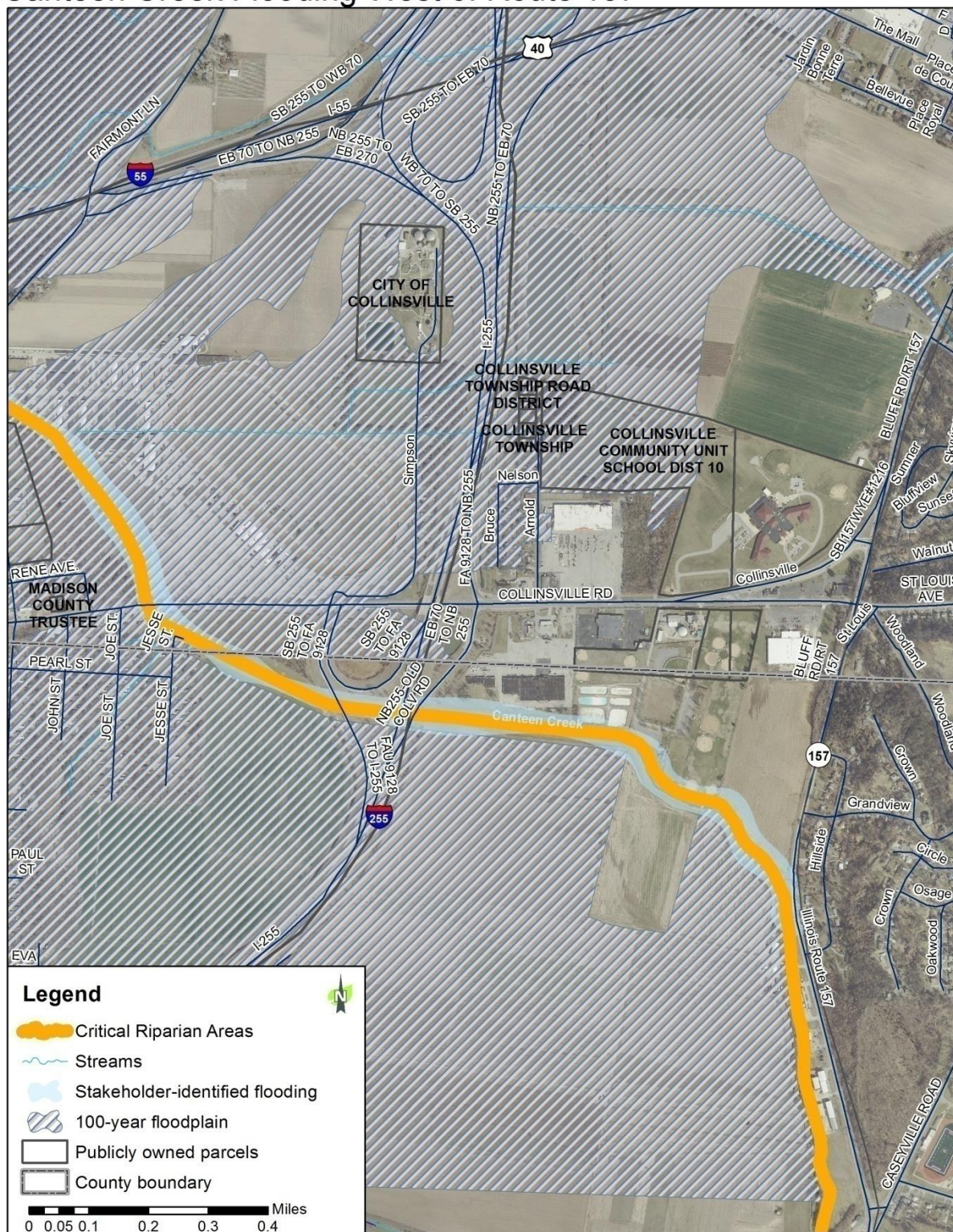
Floodplain: The entire area directly south of the creek is in the 100-year floodplain.

Flood Survey: No responses from the immediate area.

Other: The City of Collinsville owns and operates the new water treatment plant just north of the creek, with drinking wells. A groundwater protection area covers the land around this plant.

Possible solution: Ditch and levee improvements, with additional flood storage where feasible.

Canteen Creek Flooding West of Route 157



Management Measures on Public Land

To increase the ease with which this plan can be implemented when funds become available for the counties and municipalities in the watershed, it is recommended that a shortlist of five to 10 projects are identified for implementation on public land. These projects should improve life safety, address multiple goals of this plan, involve multiple partners, and implement a range of Management Measure types when possible. A shortlist of these projects will help Madison County in its efforts to help communities in the watershed address the needs they identified in the stakeholder engagement process, and provide a near-term jumping off point for plan implementation by and for local government.

DRAFT

SECTION 6: INFORMATION & EDUCATION PLAN

This section is designed to provide an Information and Education component to spark interest in and enhance public understanding of the watershed plan, and to encourage early and continued participation in selecting, designing, and implementing its recommendations. It explores Goal 6 of this plan, “Promote public awareness, understanding, and stewardship of the watershed and the watershed plan.”

The watershed faces challenges and threats from high nutrient and sediment loads, streambank erosion and channelization, widespread flooding, increasing development and land use changes, deteriorating stormwater and sewer infrastructure, invasive species, and more. Key audiences lack the knowledge and resources to make informed decisions and adopt constructive behaviors to mitigate these challenges and threats.

Since a significant amount of the watershed is held as private property, education and outreach efforts to engage landowners and other key stakeholders are needed to improve water quality and achieve other goals of this plan. A single regulatory agency or group working alone cannot be as effective in reducing stormwater pollution as a combined effort with other groups in the watershed all working towards the same goal. Many people will commit to protecting and improving the watershed if they understand what to do and how it will help.

This Information and Education Plan will serve as an outline for outreach that supports achievement of the long-term goals and objectives of the watershed plan. The cumulative actions of individuals and communities across the watershed can accomplish these goals and objectives. County, municipal and township staff, elected officials, and other key stakeholders have tools at their disposal to establish best practices in their activities and procedures. Developers can follow guidelines that consider watershed health, and residents in the watershed can be actively involved in monitoring, protecting, and restoring Cahokia Creek and its tributaries. As these stakeholders become aware of the creek’s location and needs and adopt specific behaviors to improve its health, the threats and challenges in the watershed will decrease. Public information and stakeholder education efforts will ultimately inspire watershed residents and community members to adopt recommended behaviors that improve the water quality and overall health of the watershed.

Information and Education Process

To develop the strategies for the Information and Education Plan, the following questions were asked:

- Who can affect this issue?
- What actions can people take to address it?
- What do people need to know before they can take action?

The list of activities has been divided into three broad timeline categories: short-term, medium-term, and long-term. The full list of objectives and activities can be found in Table 8. A rough estimate of the cost of the outreach activities outlined in this plan is \$20,000, which includes many unforeseeable component costs including staff time and costs for rental and materials.

Target Audiences

Key stakeholder audiences that can effect significant changes in watershed health, and who should be reached by outreach and education, include:

- Madison County government departments and elected officials
- Municipal staff, township staff, and elected officials (including Municipal Separate Storm Sewer System (MS4) Co-Permittee Group Members)
- HOAs
- Developers
- Residents with property adjacent to Cahokia Creek and its tributaries
- Residents throughout the watershed
- Farmers and farm groups
- Local engineering clubs and societies

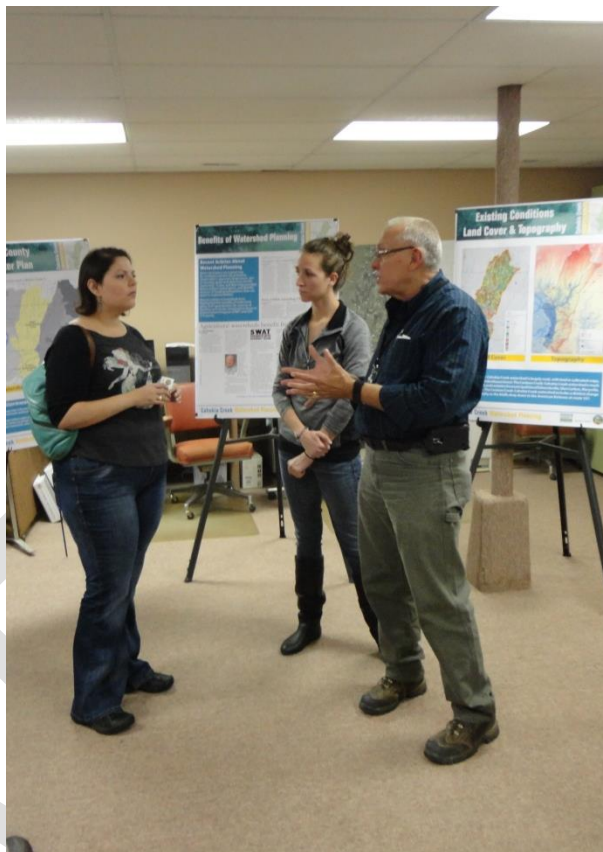
Decision-makers are an important audience that can impact all the other audiences by controlling long-term regulatory actions and policy initiatives. Madison County staff, members of the Technical Committee, and watershed residents can be messengers to reach the decision-maker audience.

Jurisdictions with Phase II MS4s are required to educate their communities on the pollution potential of common activities such as littering, disposing of trash and recyclables, disposing of pet waste, applying lawn chemicals, washing cars, changing motor oil on impervious driveways, and household behaviors like disposing leftover paint and household chemicals.

Some of the HOAs for subdivisions in the area have a shared detention or retention basin. However, these basins are often not covered by a maintenance agreement and after some time will fill up with sediment and deteriorate in function. For new subdivisions, it is important for HOAs to designate funding and a maintenance schedule for management of detention and retention infrastructure. If possible, existing HOAs should adopt maintenance by-laws.

Residents of the watershed often feel a deep connection to their neighborhood and to the land on which they live. Several families in the watershed can trace their ancestry back for generations to European settlers who put down roots in the area in the 1800s. Outreach with messages that emphasize sustaining the rich soil and the landscape for the next generation is likely to resonate with this audience.

Residents with property adjacent to Cahokia Creek and its tributaries will be more willing to make changes to the creek on their property if they understand how it can enhance their property and its value. They should also be made aware of landscaping BMPs along the creek, in terms of beneficial or harmful structures, vegetation, and management practices.



Watershed residents at a 2015 open house event.
Photo: HeartLands Conservancy.

Activities and Tools

Before the plan is complete

Making this watershed plan available to stakeholders, and informing them of its location and contents, is a major component of the Information and Education Plan. To this end, the plan document is available for download on the watershed plan website hosted by HeartLands Conservancy, www.heartlandsconservancy.org/cahokiaticreek.php. Printed copies of the Executive Summary and the full plan will also be shared with key watershed stakeholders. Emails to stakeholders engaged in the planning process provided updates on the plan's progress and point to the website for all plan materials.

Landowner/farmer survey

Another key component of the Information and Education Plan is a survey that was sent out to over 600 landowners in the watershed who own parcels of at least five acres in size. HeartLands Conservancy and Madison County collaborated to send out this survey in 2018 and responses continue to be received. The goal of the survey was to create awareness among landowners about the types of grants that are available to them to implement the BMPs recommended in this watershed plan. This will help in creating a seamless transition between the planning and implementation processes, and will keep momentum going after the plan is complete. See Appendix C for the Landowner/Farmer Survey and its preliminary results.

After the plan is complete

Table 8 outlines each objective followed by recommended strategies that can be implemented to achieve the goals/objectives. For each activity, a target audience, suggested strategies, schedule, lead and supporting agencies, the desired outcomes and issues addressed, and estimated costs to implement is provided. Periodic review of the watershed plan is recommended, with meetings of the plan partners held twice a year at six month intervals. Larger annual meetings may be held to include stakeholders and the public. Plan revision should be considered at five-year intervals.

Canteen-Cahokia Creek Watershed Plan

Table 8. Information and Education Plan recommended programs and strategies. Acronyms used: HLC: Heartlands Conservancy; NGRREC: National Great Rivers Research and Education Center; SWCD: Soil and Water Conservation District; CREP: Conservation Reserve Enhancement Program.

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.1: Identify opportunities to assist local, state, and federal agencies and stakeholders with watershed management and conservation efforts.						
Municipal Outreach	Municipalities	<ul style="list-style-type: none"> • Connect officials and staff to resources about water quality, best practices for stormwater management, floodproofing, and flood damage repair • Provide sample permitting language, ordinances, and lists of preferred practices • Discuss projects for shortlist of Management Measures on public land • Invite FEMA to present about floodplain management and flood insurance. • Share case studies of conservation development • Present at municipal council and committee meetings • Share sample funding structures for infrastructure changes • Share GIS data and maps from the watershed plan to aid municipal decision-making 	Long-Term	Madison County, St. Clair County	<ul style="list-style-type: none"> • Municipalities adopt green infrastructure practices as part of development plans, permits and ordinances. • Developers follow recommended practices in new and retrofitted developments. • More stormwater is infiltrated, water quality is improved, problematic flooding is reduced, and wildlife habitat is preserved. 	Staff time
Watershed Plan Outreach	Watershed residents, developers, municipalities	<ul style="list-style-type: none"> • Mail or e-mail Executive Summary of the watershed plan to municipalities and key stakeholders • Final plan and recommendations on web page. Post progress updates. • Press release announcing completed plan. • Meetings of the watershed plan partners held twice a year, at six month intervals. Possible larger annual meeting to include stakeholders and the public. Plan revision considered at five-year intervals. 	Short-Term	Madison County, HLC, other partners	<ul style="list-style-type: none"> • Majority of watershed residents have knowledge of watershed conditions, possible behavior improvements, and key contacts to get involved and implement projects. • The public begins to alter activities leading to watershed improvement. 	Printing: \$200

Canteen-Cahokia Creek Watershed Plan

Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.2: Connect watershed stakeholders to decision-makers and experts with knowledge about water quality, flooding issues, and solutions.						
Agricultural BMP Workshop	Rural Landowners, Farmers	<ul style="list-style-type: none"> • Host workshop to inform about and demonstrate recommended BMPs. • Provide information about available funding for BMPs. 	Medium-Term	SWCD or HLC	<ul style="list-style-type: none"> • Farmers and landowners learn about and implement BMPs, as well as funding/ program support. 	\$500 Materials + Staff time
BMP or Demonstration Project Tour	Watershed residents, developers, municipalities, farmers	<ul style="list-style-type: none"> • Take participants on a tour of BMPs in this area, such as NGRREC or a farm enrolled in the CRP. • Host a demonstration project event, such as a demonstration on cover crops. 	Short-term	Madison County, NGRREC, Farm Bureau, SWCD	<ul style="list-style-type: none"> • Landowners/stakeholders learn about BMPs and can visualize them on their property. • Increase in landowners implementing BMPs. • Soil erosion is reduced and stormwater is infiltrated. 	\$1,000 per tour
Public Events Booth	Watershed residents	<ul style="list-style-type: none"> • Host a booth with materials about the plan, water quality, stormwater management, flooding, and BMPs at public events, such as county fairs, environmental fests, etc. 	Ongoing	Madison County, HLC, NGRREC	<ul style="list-style-type: none"> • Residents understand importance of healthy watershed. • Property owners in flood-prone areas understand and monitor development upstream to prevent flood problems from increasing. • Residents understand the location of floodplains and why they should obtain flood insurance. 	\$150 per event

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Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Objective 6.3: Offer opportunities for education, training, and participation in watershed matters.						
Field Days	Residents, Students, Non Profits, Volunteer Groups	<ul style="list-style-type: none"> Organize stream cleanup volunteer opportunities. Promote volunteer field days through media, social media, and community groups. “Adopt a Stream” program (similar to Adopt a Road) HOA Basin/Pond Maintenance Field Days Coordinate with local governments to host a Stream Awareness Day, to include activities like stream cleanup, water quality testing, or restoration activities. 	Medium-Term	HLC, Madison County, St. Clair County, Sierra Club, volunteer groups	<ul style="list-style-type: none"> Amount of debris is reduced in streams. People develop an interest in watershed protection and conservation. Invasive species are removed and participants learn how to manage invasives on their own. Leverages in-kind donations for future grants. Riparian area and habitat conditions improve. Stormwater storage features are maintained/capacity is increased. 	\$500 per event
Educational Signs	Residents, Visitors	<ul style="list-style-type: none"> Mark watershed boundaries with signs Post warning signs about littering and illegal dumping Encourage neighborhoods to create stream names for local streams 	Medium-Term	Madison County, St. Clair County	<ul style="list-style-type: none"> People better understand the term “watershed.” Littering and illegal dumping is reduced. Increased awareness of watershed boundaries and streams. 	\$2,500 (25 signs)
School Projects	Students, Parents, Teachers, Administrators	<ul style="list-style-type: none"> Develop age-appropriate project opportunities for schools and colleges such as rain gauge maintenance, rainscaping, wildlife habitat restoration, and geocaching. 	Long-term	Schools and colleges, Madison County, St. Clair County	<ul style="list-style-type: none"> Students and parents develop interest in watershed protection and conservation. Teachers and administrators implement related coursework into curriculum. 	Equipment costs and staff time
Professional Development	Engineers	<ul style="list-style-type: none"> Coordinate with engineering organizations to host professional development opportunities. 	Long-term	Engineering clubs or societies	<ul style="list-style-type: none"> Engineers receive continuing education on green infrastructure and BMPs. 	Staff time
Objective 6.4: Develop public recognition programs focused on the watershed plan’s goals.						

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Program	Target Audience(s)	Strategies	Schedule	Lead & Supporting Orgs	Desired Outcomes/Issues Addressed	Est. Cost
Watershed Protection Awareness	All stakeholders	<ul style="list-style-type: none"> Develop messaging based on goals in the watershed plan and disseminate the message using media, social media, collateral (e.g. pencils, bumper stickers, temporary tattoos), and other materials. 	Medium-term	Madison County, St. Clair County, HLC	<ul style="list-style-type: none"> Increased interest and understanding of watershed protection and the watershed plan's goals. Water quality and habitat conditions are improved. 	Cost of materials and ads

Additional resources

The following resources have been compiled either as other successful campaign examples, or as inspiration for ways to implement the activities identified in Table 9.

Table 9. Resources and tools for activities/campaigns.

Activity / Campaign Examples	Activity / Campaign Tools and Resources
"How's My Waterway?"	Quick information about waterways, presented in plain language, from USEPA. http://watersgeo.epa.gov/mywaterway/
Surf Your Watershed	Links and information on streamflow, water quality, and groups working on environmental protection in your watershed, from USEPA. http://cfpub.epa.gov/surf/locate/index.cfm
Storm drain stencilling	Free storm drain stencil kits with directions. http://prairierivers.org/articles/2008/09/stenciling/
Student and citizen monitoring	Illinois RiverWatch and the National Great Rivers Research and Education Center (NGRREC) (http://www.ngrrrec.org/riverwatch/). Stream monitoring manual, kit supply lists, monitoring guidelines, identification keys, biotic index calculator, and volunteer training.
Native plants	List of Illinois native plant species: www.wildflower.org/collections
Flooding	How to prepare for and prevent flooding: www.ready.gov/floods
Green Infrastructure	Chicago Wilderness Green Infrastructure Vision and data: www.cmap.illinois.gov/green-infrastructure
River/stream cleanup	American Rivers: www.americanrivers.org/take-action/cleanup . Living Lands and Waters: http://livinglandsandwaters.org/
Sustainable backyards	Sustainable backyard tours in St. Louis: http://www.sustainablebackyardtour.com/grassrootsgreenstl.com/Home.html Urban farm and chicken coop tour in Alton: http://www.sierraclubppg.org/index.cfm?page=2970&eventID=12083&view=event Conservation@Home program The National Wildlife Federation's Certified Wildlife Habitat program

SECTION 7: IMPLEMENTATION

Implementing the recommendations in this watershed plan will take time and commitment from partners and stakeholders. No single stakeholder has all of the financial or technical resources to implement the plan. Successful implementation will require stakeholders working together, using their individual strengths.

Implementation Schedule

The Implementation Schedule provides a timeline for when the recommended Management Measures should be implemented in relationship to each other, allowing reasonable amounts of time for preparing for and transitioning between projects.

The Management Measures are recommended for the short term (one to 10 years), medium term (10 to 20 years), long-term (20+ years), ongoing (for maintenance activities), or as-needed. The “Information and Education Plan” also uses these schedule options. The schedule is arranged to accommodate practices based on practice type, available funds, technical assistance needs, and timeframe for each recommendation. Higher scheduling priority was given to Management Measures that address an issue in a Critical Area, are recommended in greater amounts, have greater eligibility for state and federal programs, and are more widely known among stakeholders (Table 10).

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Table 10. Implementation schedule for Management Measures, watershed-wide. Acronyms used: NRCS: Natural Resources Conservation Service; SWCD: Soil and Water Conservation District; NGRREC: the National Great Rivers Research and Education Center; IEPA: Illinois Environmental Protection Agency; IDNR: Illinois Department of Natural Resources; USFWS: U.S. Fish and Wildlife Service; FEMA: Federal Emergency Management Agency; HOA: Homeowners Association; HLC: HeartLands Conservancy.

BMP/Management Measure Recommended	Responsible entity/entities	Priority	Sources of Technical Assistance	Implementation Schedule
PROGRAMMATIC MANAGEMENT MEASURES				
Conservation Development	Counties, municipalities, developers	Medium	Urban planners, planning resources, HLC	Medium term
Federal and state programs (e.g. CRP)	Landowners/farmers, NRCS, SWCD	Medium	NRCS, SWCD, NGRREC	Medium term
Financial support for stormwater infrastructure	Counties, municipalities	Medium	Regional/statewide community examples	Long term
Flood Damage Prevention Ordinance	Counties, municipalities	Medium	IDNR, FEMA, HLC	Medium term
Green infrastructure incentives	Counties, municipalities, developers	Low	IEPA, HLC, regional/statewide community examples	Long term
In-lieu fee mitigation	Developers, Counties, NGOs	Medium	USACE, IDNR	Ongoing (as development occurs)
Native landscaping ordinance	Counties, municipalities, developers, residents	Low	IDNR, regional/statewide community examples	Long term
Open space and natural area protection	Counties, municipalities, developers	Medium	IDNR, regional/statewide community examples	Medium term
Private sewage monitoring	Counties, residents, some HOAs	Medium	Counties, IEPA	Ongoing
Riparian Buffer Ordinance	Counties, municipalities	Medium	IDNR, HLC	Medium term
Sewage Treatment Plant upgrades	Municipalities, STP operators	Low	IEPA, contractors	Long term
Stream Cleanup Team	Counties, NGOs, residents	Medium	Madison County, NGOs	Long term
Watershed plan supported and integrated into community plans	Counties, municipalities	Low	Watershed plan partners	Short term
Information and Education Plan	Several entities	High	Counties, IEPA, HLC	Ongoing
Monitoring (water quality, flow, etc.)	USGS, IEPA, NGRREC	High	USGS, IEPA, NGRREC, SIUE, SIU-Carbondale	Ongoing

Canteen-Cahokia Creek Watershed Plan

Table 10, continued.

BMP/Management Measure Recommended	Responsible entity / entities	Priority	Sources of Technical Assistance	Implementation Schedule
SITE-SPECIFIC MANAGEMENT MEASURES				
Agricultural Management Measures				
Riparian buffers	Landowners/ farmers	High: Critical Areas	NRCS, Ecological consultant/ contractor	Short term
Wetlands	Landowners/ farmers	High: Critical Areas	USACE, NRCS, Ecological consultant/ contractor	Short term
Animal waste storage/treatment systems	Landowners/farmers	Medium	NRCS, SWCD, consultant/ contractor	Medium term
Bioreactors	Landowners/farmers	Medium	NRCS, SWCD, contractor	Medium term
CNMPs	Landowners/farmers	Medium	NRCS, SWCD, contractor	Medium term
Conservation tillage	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Ongoing
Contour buffer strips	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Cover crops	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Ongoing
Grassed waterways	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
NMPs	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Ponds	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Terraces	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Long term
Water and sediment control basin	Landowners/ farmers	Medium	NRCS, SWCD, contractor	Medium term
Forest Management Measures				
Forest stand improvement	Landowners, St. Clair County, SAFB, MidAmerica Airport	Low	NRCS, SWCD, IDNR, USFWS, contractor	Long term
Urban Management Measures				
Single property flood reduction strategies	Residents, industry/ commercial	High	FEMA, municipalities, contractors	Short term
Bioswales	Developers, municipalities, HOAs	Medium	SWCD, contractor	Medium term
Dry detention basins, new	Developers, residents, municipalities, HOAs, landowners/farmers	Low	SWCD, contractor	Long term
Wet detention basins, new	Developers, residents, municipalities, HOAs, landowners/farmers	Low	SWCD, contractor	Long term
Detention basin retrofits (native vegetation buffers, etc.)	Municipalities, residents, HOAs, landowners/farmers	Medium	SWCD, contractor	Medium term

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Table 10, continued.

BMP/Management Measure Recommended	Responsible entity / entities	Priority	Sources of Technical Assistance	Implementation Schedule
Urban Management Measures (continued)				
Detention basin maintenance (dredging, mowing, burning, invasives, etc.)	Municipalities, residents, HOAs, landowners/farmers	Medium	SWCD, contractor	Ongoing/As needed
Pervious pavement	Developers, municipalities, residents	Low	NGRREC, IEPA	Long term
Rain gardens	Residents, industry/commercial	Medium	NGRREC, IEPA	Medium term
Rainwater collection	Residents, industry/commercial	Low	NGRREC, IEPA	Long term
Stormwater and sanitary sewer system maintenance and expansion	Municipalities, HOAs	Medium	Municipalities, IEPA, contractors	Ongoing/As needed
Tree planting (e.g. street trees)	Municipalities, townships, HOAs	Medium	Municipalities, Tree City USA, arborist/contractor	Short term
Urban filter strips	Municipalities, townships, HOAs	Medium	Municipalities, NRCS, contractors	Medium term
Stream and Lake Management Measures				
Logjam removal	Landowners/farmers, residents, municipalities	High	Ecological consultant/contractor	Short term
Streambank and channel stabilization and restoration	Landowners/farmers, residents, municipalities	High: Critical Areas	Ecological consultant/contractor	Short term
Shoreline stabilization	Municipalities, landowners, developers	Medium	Ecological consultant/contractor	Medium term

Funding Sources

Many opportunities are available to secure funding for the varied and diverse Management Measures recommended in this plan. Entities such as government agencies, non-profit organizations, and companies that provide funding for watershed improvement projects often require that partnerships are in place and funds are leveraged. Table 11 shows some of the potential funding sources for agricultural and stream and lake BMPs recommended in this plan. Table 12 provides a longer list of funding opportunities for management measures in this plan. More detail about these opportunities is included in Appendix G.

Funds may come from existing grant programs run by public agencies, from partner organizations, or through other avenues. Partners may wish to become involved if the project helps to achieve their objectives, is a priority, or provides networking opportunities. Partnerships are also critical for leveraging assets including political support; partners can leverage valuable goodwill and relationships that have the potential to lead to other assistance.

Identifying suitable partners to support a specific project involves assessing the organizations' jurisdictional, programmatic, and fiscal priorities and limitations. Different partners will be attracted to different projects. It is beneficial to all partners to maintain relationships and communication, with each organization denoting a specific staff member responsible for maintaining these connections. One or two enthusiastic individuals or "champions" who believe that engagement in this process is in the interests of all the partners can make a huge difference in the success of a partnership.

Table 11. Funding sources for agricultural and in-stream BMPs from state and federal programs. CRP: Conservation Reserve Program, from USDA. CPP: Conservation Practice Program, from USDA. EQIP: Environmental Quality Incentives Program, from USDA. CSP: Conservation Stewardship Program, from USDA. WRE: Wetland Reserve Easement program, from USDA. SSRP: Streambank Stabilization and Restoration Program, from the State of Illinois. 319: Illinois EPA funding under Section 319 of the Clean Water Act for addressing nonpoint source pollution.

BMP/Management Measure Recommended	Program(s) for which Practices are Eligible
Agricultural Management Measures	
Animal waste storage/treatment systems	EQIP, CPP, CSP, 319
Bioreactors	EQIP, CPP, CSP, 319
Comprehensive Nutrient Management Plans (NMPs)	EQIP, CPP, CSP, 319
Conservation tillage	EQIP (no-till only), CSP, 319
Contour buffer strips	CRP, CPP, EQIP, 319
Cover crops	EQIP, CPP, CSP, 319
Grassed waterways	CRP, EQIP, CPP, 319
Nutrient Management Plans (NMPs)	EQIP, CPP, CSP, 319
Ponds	EQIP (if sole livestock drinking water source), 319
Riparian buffers	CRP, CREP, EQIP, 319
Terraces	EQIP, CPP, 319
Waste storage structure	EQIP, 319
Water and sediment control basin	EQIP, CPP, CRP (as part of selected other structures), 319
Wetlands	CRP, CREP, WRE, 319
Forest Management Measures	
Forest stand improvement	EQIP, CRP, CPP, CSP, 319
Stream and Lake Management Measures	
Shoreline restoration	EQIP, 319
Streambank & channel restoration	SSRP, 319

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Table 12. Funding sources for management measures recommended. See Appendix G for more information.

Funding Sources	Grant Programs	Currently Funded (As of June 2018)
<i>State/Federal Government</i>		
Illinois Environmental Protection Agency	Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program	Yes
	State Revolving Fund Loan Program, including: <ul style="list-style-type: none"> Public Water Supply Loan Program Water Pollution Control Loan Program 	Yes
	Streambank Cleanup and Lakeshore Enhancement Grants	No. Funding may be reinstated in the future.
Illinois Department of Agriculture	Streambank Stabilization and Restoration Program	No. Funding may be reinstated in the future.
	Conservation Practice Program	No. Funding may be reinstated in the future.
	Sustainable Agriculture Grant Program	Yes
Illinois Department of Natural Resources	Urban Flood Control Program	Yes
Illinois Emergency Management Agency	Flood Mitigation Assistance Program	Yes
	Pre-Disaster Mitigation Program	Yes
	Hazard Mitigation Grant Program	Yes
	Severe Repetitive Loss Program	Yes
Illinois Department of Commerce and Economic Opportunity	Illinois Development Assistance Program	Yes
U.S. Army Corps of Engineers	Continuing Authorities Program (<i>not a grant</i>)	Yes
	Flood Plain Management Services (FPMS) Program (<i>not a grant</i>)	Yes
	Planning Assistance to States (PAS) Program (<i>not a grant</i>)	Yes
U.S. Department of Housing and Urban Development	National Disaster Resilience Competition	No. Funding may be reinstated in the future.
U.S. Environmental Protection Agency	USEPA Source Reduction Assistance Grant Program	Yes
	Environmental Education Grants Program	Yes
	Environmental Justice Small Grants Program	Yes
	Urban Waters Small Grants Program	No. Funding may be reinstated in the future.
	Technical assistance from EPA Regions for: <ul style="list-style-type: none"> Green stormwater management Protection of healthy watersheds 	Yes
U.S. Department of Agriculture	Conservation Reserve Program	Yes
	CRP—Grasslands	Yes
	Conservation Reserve Enhancement Program (CREP)	Yes
	Agricultural Conservation Easement Program, including: Agricultural Land Easements and Wetland Reserve Easements	Yes
	Environmental Quality Incentive Program	Yes
	Conservation Stewardship Program	Yes
	Healthy Forests Reserve Program	Yes
	Regional Conservation Partnership Program	Yes
	Conservation Innovation Grants	Yes
	Water and Waste Water Disposal Loan and Grant Program	Yes
	Forest Legacy Program	Yes
U.S. Fish and Wildlife Service	Partners for Fish and Wildlife Program	Yes

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Table 12, continued. Funding sources for management measures recommended.

Funding Sources	Grant Programs	Currently Funded (As of June 2018)
<i>Non-Governmental Organizations (non-profit organizations, private foundations/companies, other) that support watershed management efforts.</i>		
Ducks Unlimited	Living Lake Initiative	N/A
Pheasants Forever	N/A	N/A
Trees Forever	Working Watersheds: Buffers and Beyond	Yes
The Nature Conservancy	N/A	N/A
The National Fish and Wildlife Foundation	N/A	N/A
The National Wildlife Federation	N/A	N/A
Water Environment Federation	N/A	N/A
Coca-Cola Foundation	Community Support Program	Yes
Illinois American Water	2018 Environmental Grant Program	Yes
In-Lieu Fee Mitigation Program	N/A	N/A
McKnight Foundation	N/A	Yes
Walton Family Foundation	N/A	Yes

Monitoring Timeline

As funding allows, the collection and analysis of monitoring data should be expanded in the watershed. For example, sampling at Cahokia Creek and its tributaries—for example, at the outflow of HUC14 subwatersheds—would provide baseline data for a better understanding of watershed-wide pollutant contributions. This data would also help calibrate and ground-truth the pollutant modeling, such as the STEPL, used in this plan.

Opportunities for continuing or expanding the monitoring program should be evaluated in order to further assess water quality conditions throughout the watershed, the causes and sources of pollution, the impact of nonpoint source pollution, and changes in water quality related to implementation of the watershed plan as well as social indicator data related to the plan's goals and objectives. A monitoring plan was developed with the NGRREC, a project partner with the expertise and capabilities to carry out this monitoring (Appendix F). Monitoring can be conducted on a three- to five-year cycle through the year 2030 (Table 13). Quality Assurance Project Plans (QAPP) should be developed for those monitoring opportunities that are selected for implementation in support of the watershed plan.

Table 13. Water quality monitoring timeline. Monitoring activities likely to be conducted primarily by NGRREC and Illinois RiverWatch. Acronyms: TSS: Total Suspended Solids. TP: Total Phosphorus. TN: Total Nitrogen. SRP: soluble reactive phosphate.

	2019				2020				2021				2022-2030
Monitoring Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Develop Standard Operating Procedures for collection and laboratory analysis of samples													
Sampling near USGS gage site 05594800													
Install continuous monitoring equipment													
Monitor TSS, TP, TN													
Evaluate and adjust continuous monitoring plan													
Monitor TSS, TP, and TN based on revised plan													
Discrete sampling at the HUC14 level													
Identification of HUC14 discrete sampling sites													
Monitor TSS, TP, TN, SRP, NO3-N													
Evaluate and adjust discrete monitoring plan													
Continue discrete monitoring based on revised plan													

MEASURING SUCCESS

The success of the watershed plan can be measured by tracking several indicators at several milestone points in time. Success can be documented in terms of:

- Plan effectiveness: the absolute improvements seen in water quality, flooding, habitat, and other plan goals; and
- Plan implementation: the number and extent of Management Measures implemented, understood as a proxy for absolute improvements.

For both of these dimensions, measurement indicators were identified that would establish the progress made towards each goal of the plan. Interim milestones were established for each indicator so that improvements in effectiveness and extent of implementation could be tracked. Rather than waiting several years to measure the effectiveness of the plan, measuring ongoing improvement allows for more dynamic, directed, and effective implementation.

Measurement indicators

Measurement indicators were established to determine whether and how much progress is being made towards achieving each of the goals of the plan (Table 14).

Interim milestones

Milestones represent time periods or deadlines for meeting watershed plan objectives. Tracking milestones allows for adaptive management; if milestones are not being met, the most current information can be used to implement a course correction or a plan update.

Meetings of the watershed plan partners should be held twice a year, at six month intervals, in order to assess the progress of the plan and address deficiencies in its implementation. The partners may also hold a larger annual meeting to which stakeholders and the public will be invited. The need for a plan revision will be assessed at five-year intervals. When deficiencies in plan implementation are identified, the plan's timeline and focus should be revised to address the issues. The watershed planning process of issue identification, goal-setting, and management measure recommendation should be reiterated, paying special attention to current data and new data sources.

A set of Progress Report Cards was developed for the watershed with milestones for the short-term (one to 10 years; 2018-2028), medium-term (10 to 20 years; 2028 to 2038), and long-term (20+ years; 2038+) timeframes. The milestones and scorecard can be used to identify and track plan implementation and effectiveness. Checking in on the measurement indicators at the appropriate milestones helps watershed partners to make corrections as necessary and ensure that progress is being made towards achieving the plan's goals.

The Progress Report Cards provide for each goal:

1. Summaries of current conditions
2. Measures of progress (Measurement Indicators)
3. Milestones for short-, medium-, and long-term timeframes
4. Sources of data required to evaluate milestones
5. Notes section

Canteen-Cahokia Creek Watershed Plan

Grades for each milestone term should be calculated using the following scale: [adapt/simplify based on short, medium, long term milestones?]

Grade	Percentage milestones met
A	80-100%
B	60-79%
C	40-59%
Fail	<40%

Lack of progress can be demonstrated where water quality monitoring results show no improvement, new environmental problems, lack of technical assistance, or lack of funds. These factors should be explained in the Notes section of the scorecard.

The Progress Report Cards should be used at every biannual meeting of the watershed plan partners, and should be fully filled out and evaluated every five years to determine if sufficient progress is being made and whether remedial actions are needed. The Progress Report Cards can be found in Appendix H.

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Table 14. Measures of success and measurement indicators for each watershed plan goal. Specific interim milestones incorporating these measurement indicators can be found in the Progress Report Cards in Appendix H.

Goal(s) Addressed	Measure of Success	Measurement Indicators
All goals	Projects and Practices Implemented: BMPs to manage stormwater runoff, including those that encourage infiltration, clean water of pollutants, and replenish groundwater.	Number and extent of Management Measures (BMPs) implemented on public and private land, wherever such data is available.
	Financial and Technical Assistance Secured: Sources of funding and technical assistance committed towards plan implementation.	Number of funding sources secured for plan implementation. Number of partnerships developed that provide technical and/or financial assistance.
Surface Water Quality	Use Impairments: The reduction of use impairments as defined by IEPA.	Removal of Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch) from the IEPA 303(d) list.
	Pollutant Loads: A decrease in pollutants observed through water quality monitoring.	Concentrations and loads of in-stream pollutants including phosphorus and sediment (assessed by monitoring), to measure against plan target reductions.
	Point-source Pollution Facility Upgrades: Upgrades to facilities such as sewage treatment plants and others that require a NPDES permit.	Nutrient removal technologies incorporated into upgrades of wastewater treatment plants in the watershed. Measured pollutant loads in effluent.
	Connecting to Public Sewers: Connection of new and existing properties to public sewers so that individual septic systems are no longer needed.	Percentage of new development projects with private sewer. Number of existing on-site treatment systems connected to public sewers.
	Inspection and Maintenance of On-Site Waste Systems: Local government codes and programs for on-site treatment systems.	Number and extent of local ordinances requiring regular inspection and maintenance of on-site sewage systems. Number of county/municipal programs inspecting more frequently than is complaint-driven.
Surface Water Quality / Flooding and Flood Damage	Wetlands: Restoring and creating wetlands, which are very effective at storing and filtering stormwater.	Number and acreage of wetland construction/restoration, enhancement, and protection.
Flooding and Flood Damage	Stream Discharge: Moderate peak flows and adequate minimum stream flows.	Stream flow data from the USGS gauge on Judy's Branch, plus flow data collected from monitoring at other HUC14 locations. Data correlated with rainfall.
	Flood Protection Ordinances: Enaction of local ordinances to restrict construction in floodplains and floodprone areas.	Number and extent of flood damage prevention ordinances, riparian buffer ordinances, and other actions by local governments to restrict construction in floodplains and riparian areas.
Environmentally Sensitive Development Practices	Infiltration: Practices allowing stormwater to infiltrate to groundwater.	Area of impervious surfaces in new development (see NLCD Percent Developed Impervious Surface dataset) and number of detention basins or other stormwater infrastructure constructed and retrofitted to allow more infiltration.

Canteen-Cahokia Creek Watershed Plan

Table 14, continued.

Goal(s) Addressed	Measure of Success	Measurement Indicators
Environmentally Sensitive Development Practices	Land Conservation: Preservation of sensitive lands.	Acreage of land enrolled in conservation easements including CRP, and number of new development proposals using Conservation Development design to protect natural features.
	Green Infrastructure Implementation: Encouragement of green infrastructure and native landscaping, including incentives for developers that design for or implement it.	Number of counties/municipalities implementing green infrastructure incentives (e.g., flexible regulation implementation) fee waivers, tax abatement, and streamlined development review process. Number of ordinance changes allowing/encouraging native landscaping.
	In-Lieu Fee Mitigation: Program that allows and incentivizes wetland and streambank restoration in impactful locations	Number of acres wetland restored and number of feet streambank restored under in-lieu fee mitigation program.
Flooding and Flood Damage/ Fish and Wildlife Habitat	Riparian Buffers: Vegetated, undeveloped buffers adjacent to waterways.	Area and length of restored riparian corridors. Number and area of conservation easements for riparian areas. Number and extent of riparian buffer ordinances adopted by local government.
Fish and Wildlife Habitat	Improvements to Fish and Wildlife Habitat: Protection and restoration of stream areas for fish and wildlife.	Macroinvertebrate sampling results (diversity and stream health indicators) from Illinois RiverWatch volunteers and fish sample data collected by the Illinois Natural History Survey.
	Stream Cleanup Efforts: Programs with funding and resources for stream cleanup.	Number of programs and participants for stream cleanup activities in the watershed.
Flooding and Flood Damage/ Organizational Frameworks	Financial Support for Stormwater Infrastructure: Funding sources directed to infrastructure maintenance and upgrades.	Number of counties/municipalities with dedicated funding for stormwater infrastructure, (e.g. a Stormwater Utility. Dollar amount of revenue.
Organizational Frameworks/ Environmentally Sensitive Development Practices	Protection through Policy: Several aspects of local policy can protect watershed resources, including ordinances and agreements.	Number of watershed partners adopt and/or support (via a resolution) this plan as a “guidance document.” Number and extent of municipal ordinances that support: stormwater, flood management, green infrastructure, wetlands protection (eg in-lieu fee), and native landscaping.
	Open Space and Natural Area Protection and Management: protection of sensitive natural areas/open space, creation of naturalized stormwater management systems, and long-term management of those features.	Number of new and redevelopment projects protecting sensitive natural areas/open space and creating naturalized stormwater systems. Area of land donated to a public agency/conservation organization for long-term management. Number of HOAs with rules about management of the natural areas in their bylaws.
Education & Outreach	Public Involvement: Public awareness, understanding and action, which affect decisions in watersheds where individuals own most of the land.	Number of people reached by and involved in outreach efforts related to this watershed plan. Percent of county residents who know which watershed they live in (survey).
	Education: Effective materials to encourage behavior changes for a healthier watershed.	Percent of attendees at watershed-related presentations and other events, and percent who commit to action or follow-up with the county. Percent of schools that incorporate a watershed-based project or curriculum.

Glossary of Terms

Terms found in the watershed plan and appendices:

100-year floodplain: Land adjoining the channel of a river, stream, watercourse, lake, or wetland that has been or may be inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

303(d) list of impaired waters: The federal Clean Water Act requires states to submit a list of impaired waters to the U.S. Environmental Protection Agency for review and approval every two years using water quality assessment data from the Section 305(b) Water Quality Report. These impaired waters are referred to as “303(d) impaired waters.” States are then required to establish priorities for the development of Total Maximum Daily Load analyses for these waters and a long-term plan to meet them.

305(b): The Illinois 305(b) Water Quality Report is a water quality assessment of the state’s surface and groundwater resources compiled by the Illinois Environmental Protection Agency and submitted as a report to the U.S. Environmental Protection Agency as required under Section 305(b) of the Clean Water Act.

Agricultural Conservation Easement Program (ACEP): Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.

Animal Feeding Operations (AFO): Agricultural operations where animals are kept and raised in confined situations. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures.

Agricultural Conservation Planning Framework (ACPF): A GIS model developed by USDA.

Aquifer: A layer of permeable rock, sand, or gravel through which groundwater flows, containing enough water to supply springs and wells.

Base flow: The flow to which a perennially flowing stream reduces during the dry season. It is commonly supported by groundwater seepage into the channel.

Bedrock: The solid rock that lays beneath loose material, such as soil, sand, clay, or gravel.

Best Management Practices (BMPs): See Management Measures.

Biodiversity: The variety of organisms (plants, animals and other life forms) that includes the totality of genes, species and ecosystems in a region.

Center for Watershed Protection (CWP): Non-profit 501(c)3 corporation founded in 1992 that provides government entities, watershed organizations, and others around the country with the tools to protect streams, lakes, rivers, and watersheds.

Channelization: The artificial straightening, deepening, or widening of a stream or river to accommodate increased stormwater flows, typically to increase the amount of adjacent developable land for urban development, agriculture, or navigation.

Comprehensive Nutrient Management Plans (CNMPs): A strategy for farmers to integrate livestock waste management into overall farm operations.

Conservation Development: A development designed to protect open space and natural resources for people and wildlife while at the same time allowing building to continue. See Appendix E for more detail.

Conservation easement: The transfer of land use rights without the transfer of land ownership. Conservation easements can be attractive to property owners who do not want to sell their land now, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Conservation Practice Program (CPP): Illinois Department of Agriculture program implemented by the Soil and Water Conservation Districts (SWCDs) in Illinois. Cost-share funds are available through the SWCDs for various conservation practices including Filter Strips, Grassed Waterways, No-Till, and Terraces. See Appendix E for more detail.

Conservation Reserve Enhancement Program (CREP): The country's largest private land conservation program, administered by the Farm Service Agency (FSA). An offshoot of the Conservation Reserve Program (CRP), CREP compensates farmers and landowners for removing environmentally sensitive land from production and implementing conservation practices. See Appendix E for more detail.

Conservation Reserve Program (CRP): A land conservation program administered by the FSA, which provides a yearly rental payment for farmers who remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. See Appendix E for more detail.

Conservation Stewardship Program (CSP): U.S. Department of Agriculture program that helps producers maintain and improve existing conservation systems and implement additional activities to address priority resources concerns. See Appendix E for more detail.

Conservation tillage: Any method of soil cultivation that leaves the previous year's crop residue (such as corn stalks or wheat stubble) on fields before and after planting the next crop, to reduce soil erosion and runoff.

Contour Buffer Strip: Strips of perennial vegetation that alternate with strips of row crops on sloped fields. The strips of perennial vegetation, consisting of adapted species of grasses or a mixture of grasses and legumes, slow runoff and remove from it sediment, nutrients, pesticides, and other contaminants. See Appendix E for more detail.

Conveyance: The act or means of carrying or transporting water from place to place.

Cover crops: Crops that protect soil from erosion by covering the ground in the fall and sometimes in the spring. See Appendix E for more detail.

Designated use: Appropriate use of a waterbody as designated by states and tribes. Designated uses are identified by considering the use, suitability, and value of the water body for public water supply; protection of fish and wildlife; and recreational, agricultural, industrial, and navigational purposes. Determinations are based on its physical, chemical, and biological characteristics; geographical setting and scenic qualities; and economic considerations.

Detention basin: A man-made structure for the storage of stormwater runoff with controlled release during or immediately following a storm. Wet detention basins are also known as retention ponds. See Appendix E for more detail.

Digital Elevation Model (DEM): Grid of elevation points used to produce elevation maps.

Discharge (streamflow): The volume of water passing through a channel over a given time period, usually measured in cubic feet per second.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

East-West Gateway Council of Governments (EWG): The metropolitan planning organization (MPO) for the 4,500 square miles encompassed by the City of St. Louis; Franklin, Jefferson, St. Charles, and St. Louis counties in Missouri; Madison, Monroe, and St. Clair counties in Illinois. EWG is a forum for local governments of the bi-state St. Louis area to work together to solve problems that cross jurisdictional boundaries.

Environmental Quality Incentives Program (EQIP): A program that provides financial and technical assistance to agricultural producers, helping them to plan and implement conservation practices that address natural resource concerns and improve natural resources on agricultural land and non-industrial private forestland. See Appendix E for more detail.

Erosion: The displacement of soil particles on land surfaces due to water or wind action.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, coordinates recovery from, and mitigates against natural and man-made disasters and emergencies, including significant floods.

Flash flood: A rapid rise of water along a stream or low-lying area, usually produced when heavy localized precipitation falls over an area in a short amount of time. Flash floods are considered the most dangerous type of flood event because they offer little or no warning time and their capacity for damage, including the capability to induce mudslides.

Flood Damage Prevention Ordinance: Ordinance that imposes certain rules and limitations on development in floodplains in order to reduce the risk of flood damage. See Appendix E for more detail.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Geology: The scientific study of the structure of the Earth, focused primarily on the composition and origins of rocks, soil, and minerals.

Grassed waterways: Vegetated channels designed to prevent gully erosion by slowing the flow of surface water with vegetation. See Appendix E for more detail.

Green infrastructure: Green infrastructure can be defined as our region's natural resources, including open space, woodlands, wetlands, gardens, trees, and agricultural land. It can also be defined as the nodes and corridors of vegetation over the region, or the site-scale structures and landscaping that recreate natural processes. See Appendix E for more detail.

Groundwater recharge: Primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Headwaters: Upper reaches of streams and tributaries in a watershed.

HUC or HUC Code: A Hydrologic Unit Code (HUC) that refers to the division and subdivision of U.S. watersheds. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units). Where two digits follow "HUC," they refer to the length of the HUC code. For example, "HUC14" refers to the lowest-nested subwatershed level with a 14-digit long code, such as HUC 07140204050101.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition and/or growth of plants on those soils.

Hydrologic Soil Groups (HSG): Soil classifications from the Natural Resource Conservation Service based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. A's generally have the smallest runoff potential and D's the greatest.

Hydrology: The scientific study of the properties, distribution, and effects of water in relation to the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hydrophytic vegetation: Plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.

Illinois Department of Natural Resources (IDNR): State government agency established to manage, protect, and sustain Illinois' natural and cultural resources, provide resource-compatible recreational opportunities, and promote natural resource-related issues for the public's safety and education.

Illinois Environmental Protection Agency (IEPA): State government agency established to safeguard environmental quality so as to protect health, welfare, property, and quality of life in Illinois.

Illinois Nature Preserves Commission (INPC): Commission responsible for protecting Illinois Nature Preserves, state-protected areas that are provided the highest level of legal protection, and have management plans in place.

Illinois Pollution Control Board (IPCB): An independent agency created in 1970 by the Environmental Protection Act. The Board is responsible for adopting Illinois' environmental regulations and deciding contested environmental cases.

Impervious Cover Model: Simple urban stream classification model based on impervious cover and stream quality. The classification system contains three stream categories (sensitive, impacted, and non-supporting) based on the percentage of impervious cover.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g., parking lots, roads, houses).

In-lieu fee: A payment made to a natural resource management entity for implementation of projects for wetland or other aquatic resource development, in lieu of (in place of) on-site restoration or site mitigation. See Appendix E for more detail.

Infiltration: Rainfall or surface runoff that moves downward from the surface into the subsurface soil.

Loess: An unstratified loamy deposit, usually buff to yellowish brown, chiefly deposited by the wind and thought to have formed by the grinding of glaciers.

Logjam: Any woody vegetation, with or without other debris, which obstructs a stream channel and backs up stream water like a natural dam.

Low Impact Development: Comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds.

Macroinvertebrates (aquatic): Invertebrates that can be seen by the unaided eye (macro). Most benthic invertebrates in flowing water are aquatic insects or the aquatic stage of insects, such as mayfly nymphs and midge larvae. They also include organisms such as leeches, clams, and worms. The presence of benthic (bottom-dwelling) macroinvertebrates that are intolerant of pollutants is a good indicator of good water quality.

Management Measures: Also known as Best Management Practices (BMPs). Methods or techniques that are the most effective or practical means to achieving objectives including improving water quality, reducing flooding, and improving fish and wildlife habitat. These practices include non-structural practices such as site planning and design aimed to reduce stormwater runoff and avoid adverse development impacts, or structural practices that are designed to store or treat stormwater runoff to mitigate flood damage and reduce pollution.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Missouri Resource Assessment Partnership (MoRAP): Program at the University of Missouri which develops, analyzes, and delivers geospatial data for natural and cultural resource management. MoRAP partnered with the East-West Gateway Council of Governments to deliver mapped data on wetland importance and wetland restoration value.

Mitigation: Measures taken to eliminate or minimize damage from development activities such as construction in wetlands.

Municipal Separate Storm Sewer System (MS4): A system that transports or holds stormwater, such as catch basins, curbs, gutters, and ditches, before discharging into local waterbodies.

National Hydrography Dataset (NHD): Digital database of surface water features, such as lakes, ponds, streams, and rivers. The NHD is used to make hydrology and watershed boundary maps.

National Pollutant Discharge Elimination System (NPDES) Phase II: Permit program authorized by the Clean Water Act requiring smaller communities and public entities that own and operate a Municipal Separate Storm Sewer System (MS4) to apply and obtain a NPDES permit for stormwater discharges to surface water. Permittees must develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. Individual homes that use a septic system, are connected to a municipal system, or do not have a surface discharge do not need an NPDES permit. The NPDES permit program is administered by authorized states. In Illinois, the Illinois EPA administers the program.

National Land Cover Database (NLCD): Database with mapped land cover categories produced by the Multi-Resolution Land Characteristics (MRLC) Consortium with land cover classifications based on Landsat satellite data and ancillary data sources such as topography, census and agricultural statistics, soil characteristics, wetlands, and other land cover maps.

Native landscaping: A landscape that contains native plants or plant communities that are indigenous to a particular region.

Natural Resources Conservation Service (NRCS): Government agency under the U.S. Department of Agriculture (USDA) that provides technical assistance to landowners and land managers.

Nitrogen: A colorless, odorless, unreactive gas that constitutes about 78% of the earth's atmosphere. The availability of nitrogen in soil is important for plant growth and ecosystem processes, and nitrogen is used in many fertilizers.

No-till: No-till farming (also called zero tillage) is a way of growing crops or pasture from year to year without disturbing the soil through tillage. It uses herbicides to control weeds and results in reduced soil erosion and the preservation of soil nutrients. See Appendix E for more detail.

Nonpoint source pollution (NPS pollution): Any source of water pollution that is not from a discrete outflow point. Instead, NPS pollution comes from diffuse sources and is carried into waterways with runoff from the land. Pollutants can include oil, grease, sediment, and nutrients in excess fertilizer.

Nutrients: Substances needed for the growth of plants and animals, such as phosphorous and nitrogen. The addition of too many nutrients to a waterway causes problems to the aquatic ecosystem by promoting nuisance vegetation including excess algae growth.

Nutrient Management Plans (NMPs): A strategy for obtaining the maximum return from on- and off-farm fertilizer resources in a manner that protects the quality of nearby water resources.

Overland flood: Flooding that occurs when rainfall collects on saturated or frozen ground. When surface runoff cannot find a channel, it may flow out over a large area at a somewhat uniform depth in sheet flow or collect in depressions as ponding.

Partners: Key watershed stakeholders who take an active role in the watershed management planning process and implementing the watershed plan.

Pervious pavement: Pavement type (also referred to as porous or permeable pavement) that allows water to infiltrate to the soil or a storage area below. See Appendix E for more detail.

Phosphorus: A nonmetallic element that occurs widely in many combined forms especially as inorganic phosphates in minerals, soils, natural waters, bones, and teeth and as organic phosphates in all living cells.

Point source pollution: Pollution that discharges in water from a single, discrete source, such as an outfall pipe from an industrial plant or wastewater treatment facility.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Private sewage: Sewage systems that are the responsibility of the owners or occupiers of the properties connected to them. These systems can include septic tanks, lagoons, and leach fields.

Rain garden: Vegetated depression that cleans and infiltrates stormwater from rooftops and sump pump discharges, typically planted with deep-rooted native wetland vegetation. See Appendix E for more detail.

Rainwater Harvesting: The accumulation and storing of rainwater for reuse before it reaches an aquifer. See Appendix E for more detail.

Retention basin: A man-made structure with a permanent pool of water for the storage of stormwater runoff. Also known as a wet pond, or wet detention basin.

Retrofit: Modifications to improve problems with existing stormwater control structures such as detention basins and conveyance systems such as ditches and storm sewers. See Appendix E for more detail on detention basin retrofits.

Riparian: The riverside or riverine environment adjacent to the stream channel. For example, riparian, or streamside, vegetation grows next to (and over) a stream.

Riparian Buffer: An undisturbed naturally vegetated strip of land adjacent to a body of water, such as a stream or lake. Riparian buffers have water quality, flooding, and habitat benefits.

Riverine flood: The gradual rise of water in a river, stream, lake, reservoir, or other waterway that results in the waterway overflowing its banks. This type of flooding generally occurs when storm systems remain in the area for extended periods of time, when winter or spring rains combine with melting snow to create higher flows, or when obstructions, such as logjams, block normal water flow.

Runoff: The portion of precipitation that does not infiltrate into the ground and is discharged into streams by flowing over the ground.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Special Flood Hazard Area: The area inundated during the base flood is called the Special Flood Hazard Area or 100-year floodplain.

Special Service Area (SSA): Special taxing districts in counties and municipalities that are established by ordinance. Taxes from SSAs are used to pass on the costs of items such as streets, landscaping, water lines, and sewer systems in new development to homeowners who reside within it. See Appendix E for more detail.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project.

Stream reach: A stream segment having fairly homogenous hydraulic, geomorphic, riparian cover, and land use characteristics.

Streambank stabilization: Techniques used for stabilizing eroding streambanks.

Streambank Stabilization and Restoration Program (SSRP): Illinois Department of Agriculture (IDOA) program designed to demonstrate effective streambank stabilization at demonstration sites using inexpensive vegetative and bio-engineering techniques. See Appendix E for more detail.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Terrace: Ridges and channels constructed across the slope of a field to intercept runoff water, reducing soil erosion. See Appendix E for more detail.

Threatened and endangered species: A “threatened” species is one that is likely to become endangered in the foreseeable future. An “endangered” species is one that is in danger of extinction throughout all or a significant portion of its range.

Topography: The relative elevations of a landscape describing the configuration of its surface.

Total Maximum Daily Load (TMDL): The highest amount of discharge of a particular pollutant that a waterbody can handle safely per day.

Total Suspended Solids (TSS): The organic and inorganic material suspended in the water column greater than 0.45 micron in size.

U.S. Army Corps of Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services for planning, designing, building, and operating water resources and other Civil Works projects. These include flood control and environmental protection projects.

U.S. Department of Agriculture (USDA): Federal government agency that provides leadership on food, agriculture, natural resources, rural development, nutrition, and related issues. The USDA administers several programs to encourage land conservation and agricultural best practices.

U.S. Environmental Protection Agency (USEPA): Federal agency whose mission is to protect human health and the environment. USEPA enforces the Clean Water Act, among other laws.

U.S. Fish and Wildlife Service (USFWS): Federal government agency within the U.S. Department of the Interior dedicated to the management of fish and wildlife and their habitats.

U.S. Geological Survey (USGS): Federal government agency established with the responsibility to provide reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect quality of life.

Urban runoff: Runoff that runs over urban developed surfaces such as streets, lawns, and parking lots, entering directly into storm sewers rather than infiltrating the land upon which it falls.

Wastewater Treatment: Process that treats wastewater to alter its characteristics such as its biological oxygen demand, chemical oxygen demand, pH, etc. in order to meet effluent or water discharge standards.

Water and Sediment Control Basin (WASCOB): Small earthen ridge-and-channel or embankment built across a small watercourse or area of concentrated flow in a field. See Appendix E for more detail.

Watershed: The area of land that contributes runoff to a single point on a waterbody (in this case, the outlet of Canteen Creek from Madison County to St. Clair County).

Watershed-Based Plan: A strategy and work plan for achieving water resource goals that provides assessment and management information for a geographically defined watershed, including the analysis, actions, participants, and resources related to development and implementation of the plan.

Wetland: Lands that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils, and 3) hydrophytic vegetation. A wetland is considered a subset of the definition of the Waters of the United States.

Wetland Reserve Easement (WRE) program: Component of the Agricultural Conservation Easement Program (ACEP) that provides technical and financial assistance to restore, protect, and enhance wetlands. See Appendix E for more detail.



HEARTLANDS

C O N S E R V A N C Y

Investing In The Nature Of Southwestern Illinois



Appendix A : Watershed Resources Inventory for Canteen Creek-Cahokia Creek

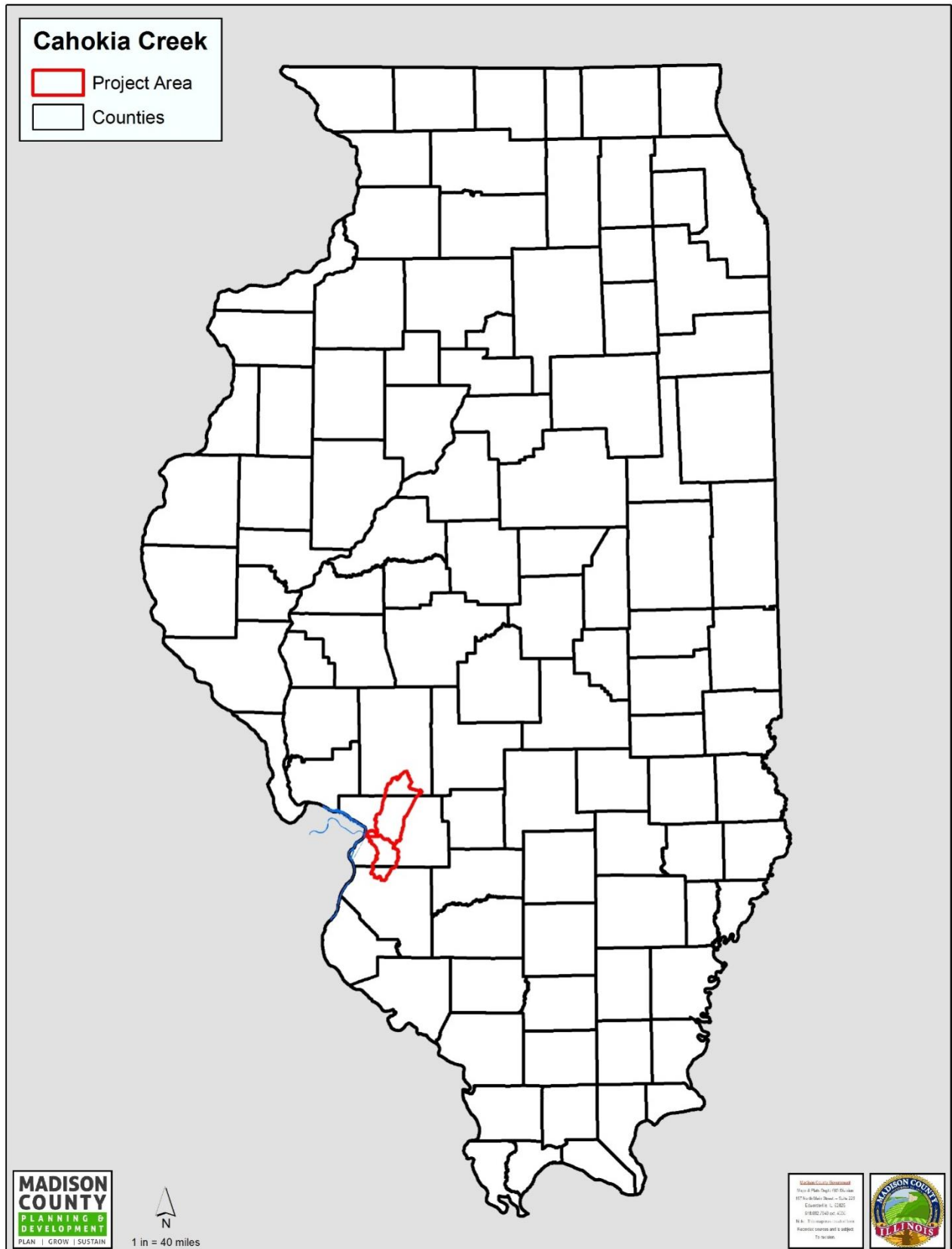
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Figure A.1: Location of the Indian-Canteen-Cahokia Creek watershed in the State of Illinois.



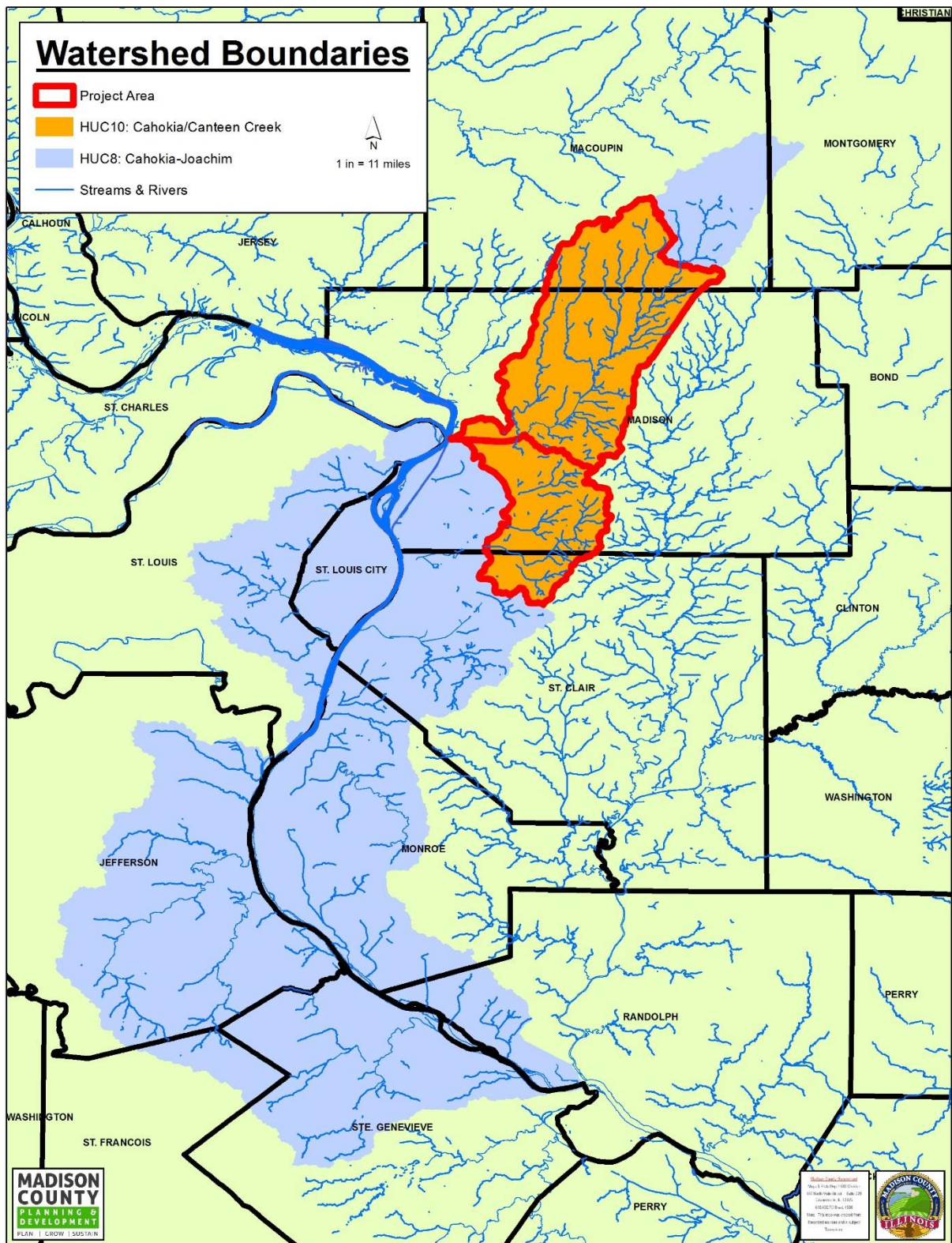
Watershed Boundaries

The U.S. Geological Survey (USGS) has established the hydrologic units system to delineate, locate, and define watersheds in the United States. Starting with Hydrologic Unit Code (HUC) 2 watersheds, which are the largest, down to HUC14 watersheds currently being developed around the country as the smallest. The Canteen-Cahokia Creek Watershed is in the Upper Mississippi River Region (HUC2), Cahokia-Joachim Catalog Unit (HUC8). Two HUC 10 watersheds were planned for at the same time: the Indian-Cahokia Creek watershed and Canteen-Cahokia Creek watershed. The Indian-Cahokia Creek watershed includes southern Macoupin County and drains into Madison County, while the Canteen-Cahokia Creek watershed drains northern St. Clair County and southern Madison County. Table A.1 below shows the contributing area for the HUC 8 and HUC 10 watersheds as well as the project area.

Table A.1: Area of the hydrologic units nested in the Indian-Canteen-Cahokia Creek Watershed Plan project area.

Watershed	Area (acres)
Cahokia-Joachim HUC 07140101 (HUC 8)	1,053,318
Indian-Cahokia Creek HUC 0714010102 (HUC 10)	125,699
Canteen-Cahokia Creek HUC 0714010103 (HUC 10)	57,277
Both watersheds combined	182,976

Figure A.2: The Indian-Canteen-Cahokia Creek Watershed plan project area in context of the Cahokia-Joachim Creek HUC8 watershed.



Subwatersheds

The project area contains numerous smaller subwatersheds, or hydrologic units, including 10 HUC 12s and 37 HUC14s. The HUC14s were delineated for this inventory by The U.S. Army Corps of Engineers, St. Louis District using GeoHMS for ArcGIS and methods employed by the USGS to define watersheds in the Watershed Boundary Database (WBD), a component of the National Hydrography Dataset (NHD). Each HUC12 watershed contains two to six HUC 14s ranging between about 2,000-8,500 acres in size. The following figures and tables show the 10 HUC12s and their component HUC14s.

Table A.2: HUC12 name and numbers with HUC 14 names, numbers, area and municipalities for the Cahokia Creek-Canteen Creek watershed.

HUC12		HUC14		HUC14 Area (acres)	Municipalities Present
Name	Number	Name	Number		
Judy's Branch-Cahokia Creek	071401010301	American Bottoms-Cahokia Creek	07140101030101	8,393	Edwardsville, Hartford, Pontoon Beach, South Roxana
		Pioneer Cemetery-Cahokia Creek	07140101030102	3,671	Edwardsville, Glen Carbon, Pontoon Beach
		Judy's Branch	07140101030103	5,706	Edwardsville, Glen Carbon, Maryville
		Burdick Branch-Cahokia Creek	07140101030104	3,376	Collinsville, Maryville, Pontoon Beach
Canteen Creek	071401010302	Upper Canteen Creek	07140101030201	5,509	Collinsville, Maryville, Troy
		Middle Canteen Creek	07140101030202	5,064	Collinsville, Maryville
		Lower Canteen Creek	07140101030203	3,961	Caseyville, Collinsville
Schoolhouse Branch-Cahokia Creek	071401010303	Schoolhouse Branch-Cahokia Creek	07140101030301	7,157	Collinsville, Maryville, Pontoon Beach
		Canteen Creek-Cahokia Creek	07140101030302	5,911	Caseyville, Collinsville, Fairmont City, Pontoon Beach
		Little Canteen Creek	07140101030303	8,536	Caseyville, Fairmont City, Fairview Heights

Figure A.3: HUC14s in the Judy's Branch-Cahokia Creek HUC12 watershed.

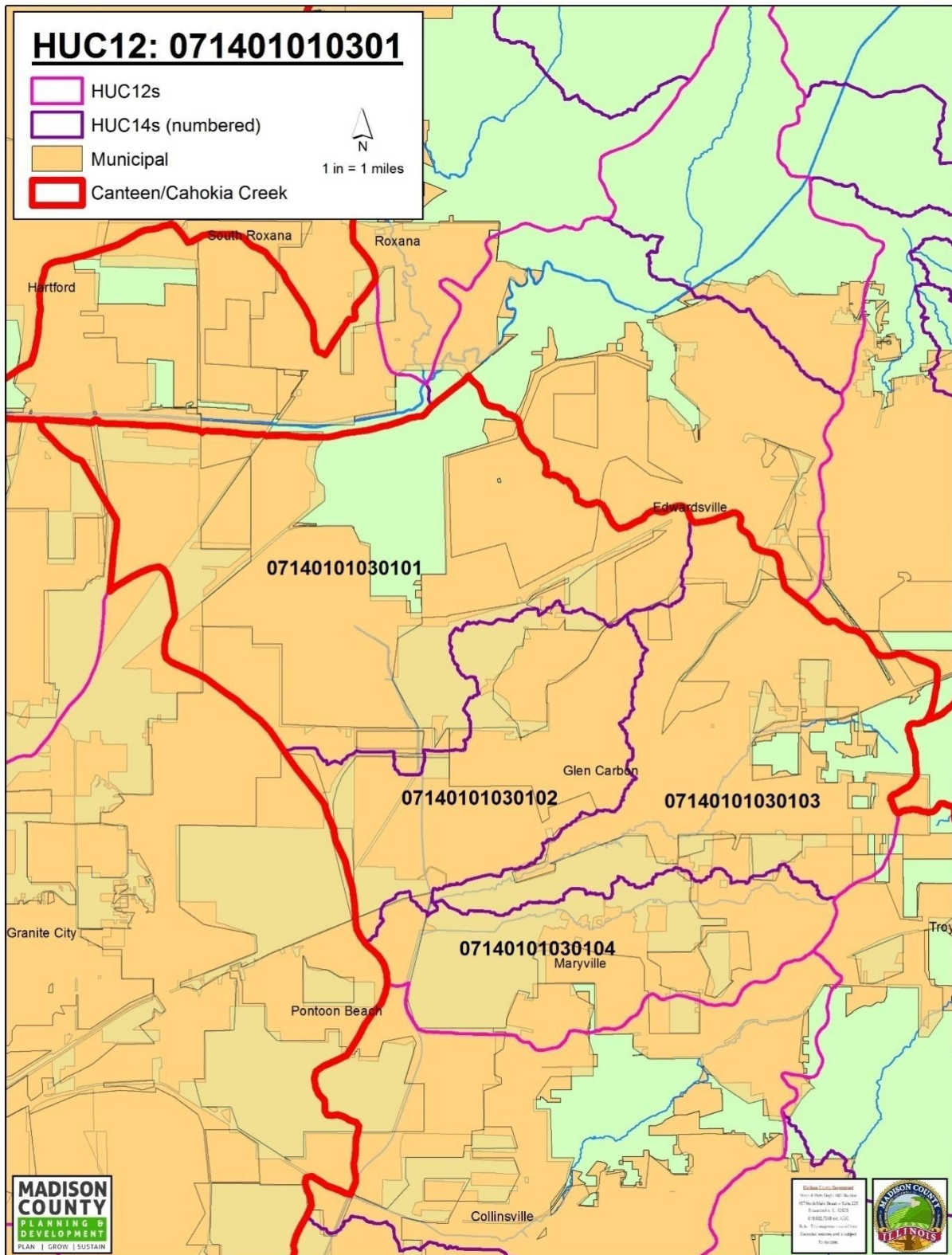


Figure A.4: HUC14s in the Canteen Creek HUC12 watershed.

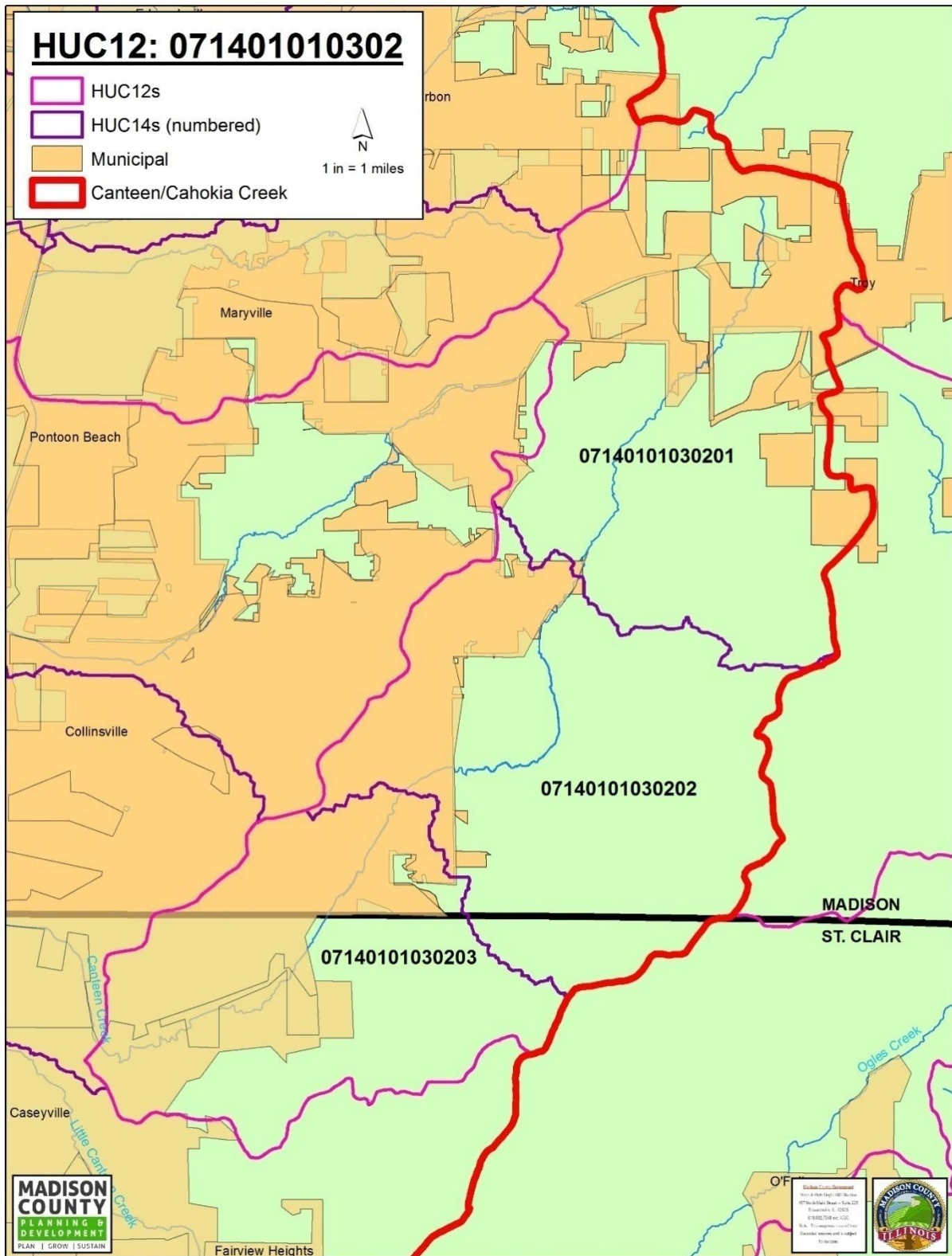
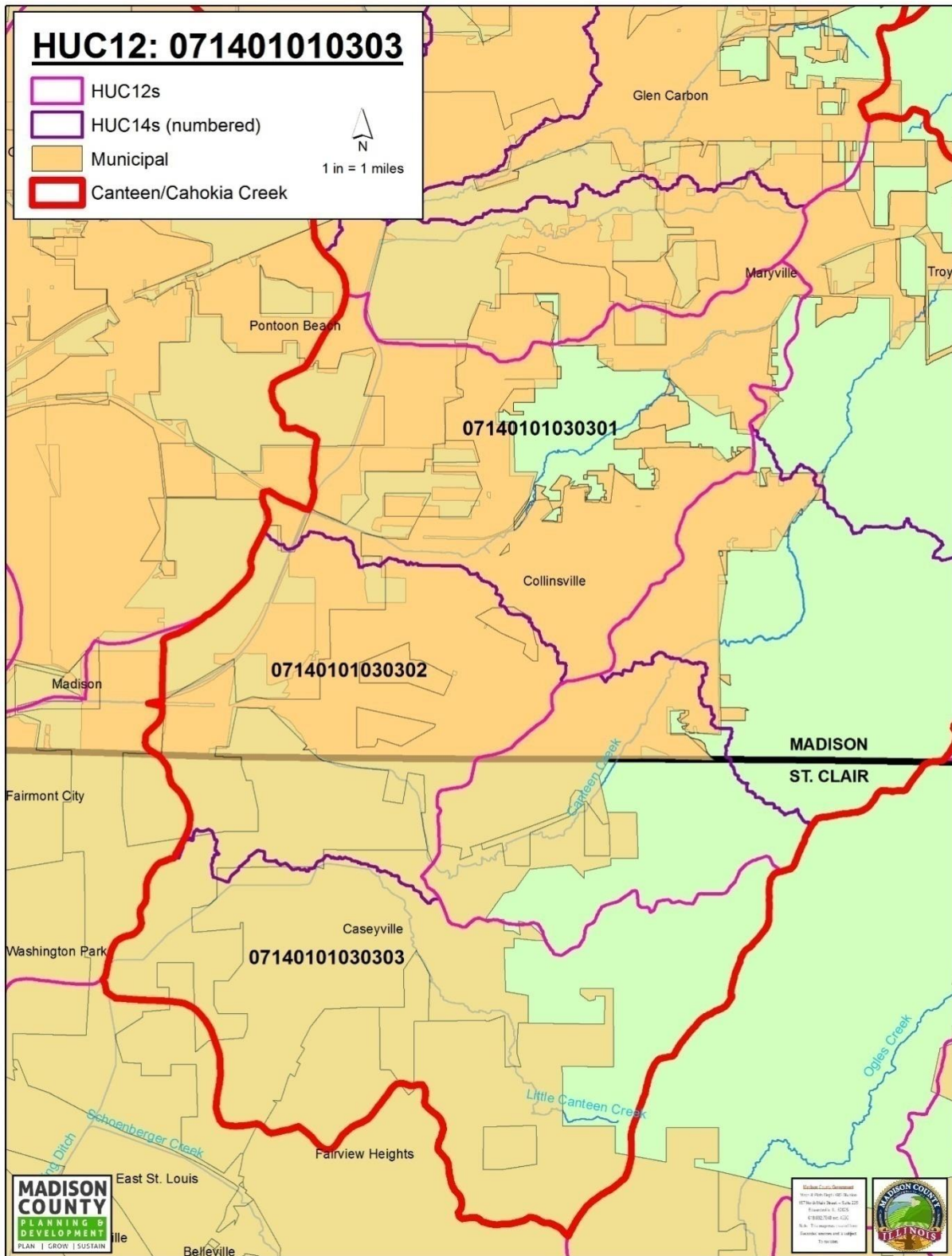


Figure A.5: HUC14s in the Schoolhouse Branch-Cahokia Creek HUC12 watershed.



Stream miles and reach categorizations

There are 754 stream miles in the Indian-Cahokia and Canteen-Cahokia Creek watersheds combined. According to the National Hydrography Dataset (NHD) maintained by the United States Geologic Survey (USGS), 492 of those stream miles are located in the Indian-Cahokia Creek watershed and the remaining 262 miles are in the Canteen-Cahokia Creek watershed. Each stream reach is labeled as one of seven categories in the NHD: artificial path, canal/ditch, coastline, connector, pipeline, stream/river or underground conduit. Of these seven categories, only artificial path, canal/ditch, connector, and stream/river are present in either the Indian-Cahokia Creek or Canteen-Cahokia Creek watersheds.

Direction of flow and major tributaries

In the Canteen-Cahokia Creek watershed, water generally flows east to west, and south to north. Water from the bluffs flows from municipalities such as Fairview Heights, Collinsville, Maryville, Edwardsville, and Glen Carbon to the bottoms area into Caseyville and Pontoon Beach. Water then travels through the American Bottom in the Cahokia Diversion Channel before emptying into the Mississippi River.

Waterbodies

There are 201 waterbodies in the Canteen-Cahokia Creek watershed according to the NHD. These waterbodies include lakes, ponds, swamps, marshes, and one reservoir, and have an average area of six acres. The largest waterbody in the watershed is an unnamed swamp/marsh area in Pontoon Beach and unincorporated Madison County that covers 302 acres.

Topography

Topography in the watershed is fairly flat, with gentle slopes throughout most of the watershed except where the bluff line drops away steeply to the American Bottom. The watershed has slopes ranging between 0% and 107.8%, with an average slope of 6.2% over the majority of the watershed. The standard deviation of the slopes within the watershed is 8.3, meaning that 68.2% of the slopes in the watershed fall between 0% and 14.5%.

The highest point in the watershed has an elevation of 631 feet, in the Schoolhouse Branch-Cahokia Creek HUC12 watershed in St. Clair County. The highest streams in the watershed come into Madison County from St. Clair County from the southern portion of the Schoolhouse Branch-Cahokia Creek watershed.

Figure A.6: Topography/elevation in the Canteen-Cahokia Creek watershed project area, from the Digital Elevation Model (DEM) in the USGS National Elevation Dataset. (1)

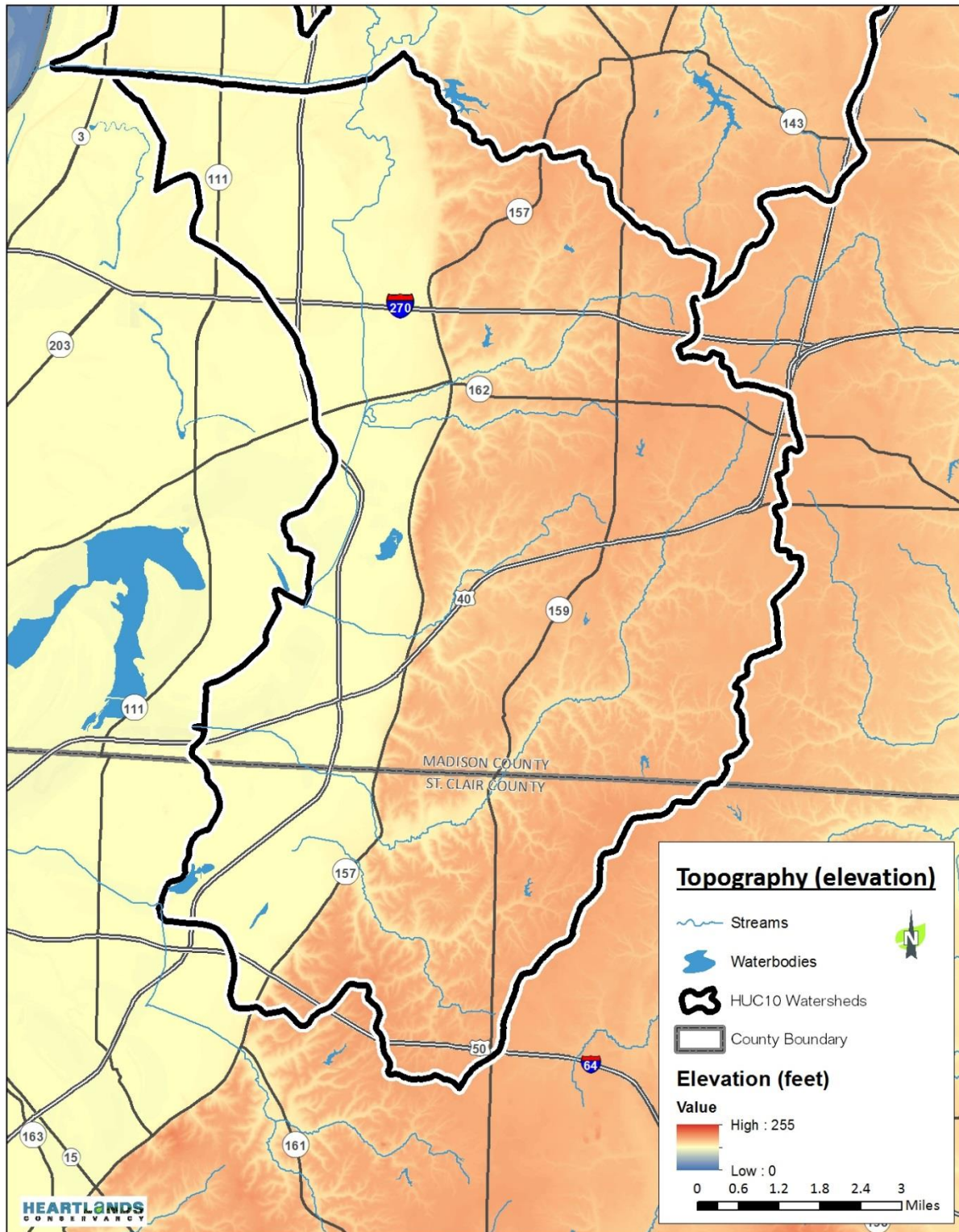
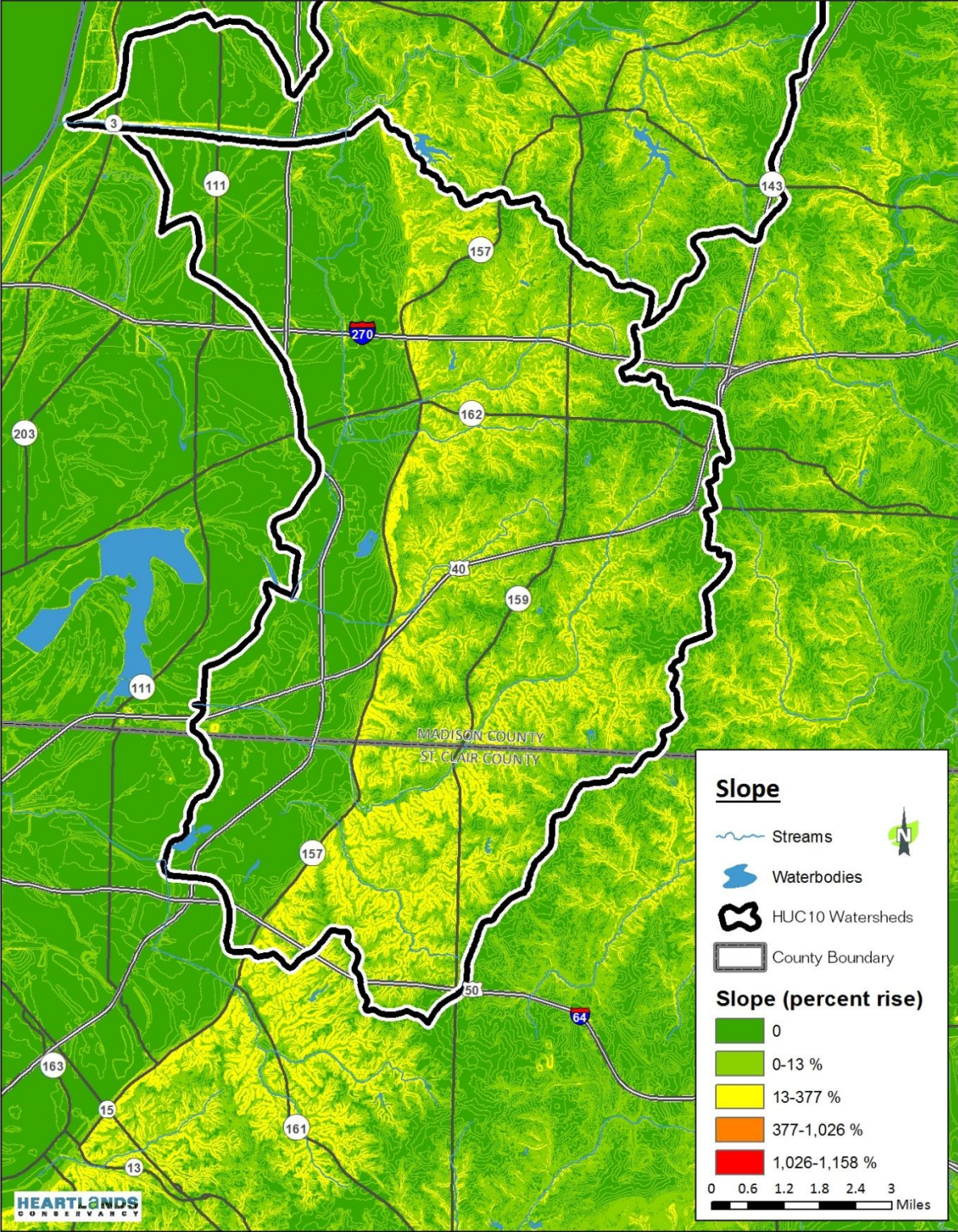


Figure A.7: Slope in the Canteen-Cahokia Creek watershed project area, in percent.



Climate

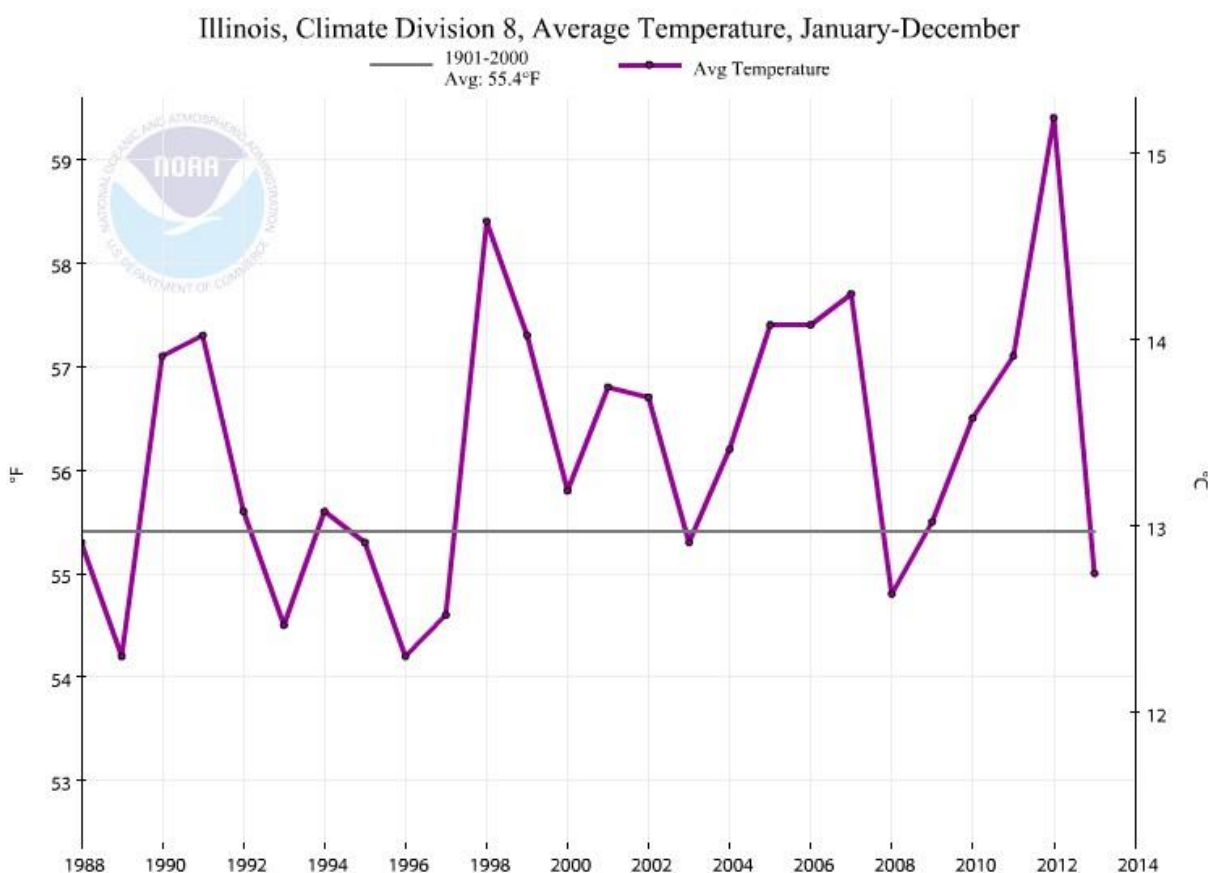
The two watersheds experience typical weather for southwestern Illinois, including great variation in temperature, precipitation, and snowfall from one year to the next.

Temperature

Southern Illinois experiences an average of just over 40 days at or above 90°F and an average 2 days at 100°F or higher every year. The average length of the frost-free growing season in southern Illinois is more than 190 days. The average annual temperature for the region is 55.4°F (measured between 1901 and 2000). Over the past 25 years, the average annual temperature in southwestern Illinois has increased, reaching a 25-year high of approximately 59.5°F in 2012 (Figure A.8).

Between 1988 and 2013, southern Illinois has experienced 853.2 days of maximum temperature equal to or greater than 90°F. This equates to an average of 32.8 days per year of temperatures over 90°F (data from monthly averages from gaging stations in all three counties). The maximum recorded temperature in the three counties between 1988 and 2014 was 106°F in July 2012, recorded in Alton in Madison County. The minimum recorded temperature in the three counties between 1988 and 2014 was -20°F in December 1989 at two gauge stations in Macoupin County. (2)

Figure A.8: Average annual temperatures in southwestern Illinois between 1988 and 2014, from NOAA's Climate At-A-Glance Time Series. The leftmost y axis shows average annual temperature in degrees Fahrenheit. (3)



Precipitation

Average precipitation exceeds 48 inches a year in southern Illinois, which allows farms to rely on precipitation rather than irrigation for much of the year. (4) Precipitation gauge stations in Mount Olive and Edwardsville measured an average annual precipitation of 40.21 inches and 38.73 inches, respectively, between 1971 and 2000, and 40.10 and 44.77 inches between 1981 and 2010. The average annual number of days with 0.1 inch or more of precipitation was 62 days (averaged between recorded data from the two stations between 1971 and 2000), with May as the wettest month and January as the driest. The average annual total snowfall recorded was 18.5 inches (between 1971 and 2000). (5)

Flooding is the single most damaging weather hazard in Illinois. Rainstorms in Illinois produce 40 or more flash floods on average per year across the state, each with four to eight inches of rainfall in a few hours in localized areas. (4) The greatest recorded 24-hour precipitation event was recorded in Edwardsville is 7.05 inches of rain in August 1995 (Table A.3). Flash floods can occur at any time of year in Illinois, but they are most common in the spring and summer months. (6) See Flooding section for more information on occurrences of flash flooding and general flooding.

Table A.3: Highest daily precipitation over 24 hours between 1893 and 2014 at gauge stations located in Edwardsville and Mount Olive. (5)

Rank	Daily Precipitation (inches)	Date	Gauge Station
1	7.05	8/20/1995	Edwardsville
2	6.43	5/26/2009	Edwardsville
3	6.00	7/14/1912	Edwardsville
4	5.97	5/17/1943	Edwardsville
5	5.86	8/16/1946	Edwardsville
6	5.13	4/22/1944	Edwardsville
7	5.10	9/17/1969	Mt Olive*
8	4.87	4/22/1944	Mt Olive*
9	4.63	8/24/1977	Edwardsville
10	4.57	8/10/1961	Edwardsville

*Data from Mount Olive gauge only available from 1940-2014.

Drought

There has been considerable variability in precipitation in the state over time, including major multi-year droughts in the 1930s and 1950s and major multi-year wet periods in the 1970s and 1980s. (4) Madison County experienced four drought events between 1983 and 2012, three of which occurred in 2005 or later. (6) There was one reported drought event in St. Clair County between 1994 and 2008. (7) Extreme heat often accompanied rainfall and surface water shortages during these events.

Tornadoes

Illinois experiences about 29 tornadoes annually, 63% of which occur in peak months April, May, and June. (4) A significant recent tornado struck the city of Mount Olive in May 2013, damaging more than 40 homes and businesses in the downtown area, including City Hall. (8) It was not declared a presidential disaster. (9) In Madison County, 39 tornadoes were reported between 1950 and 2006. In St. Clair County, 28 occurrences were reported between 1950 and 2008. The greatest recorded magnitude among these events was an F4 on the Fujita Scale (one event in Madison County). Typically, the area

impacted by tornadoes in the three counties was less than four square miles. (6) (10) (7)

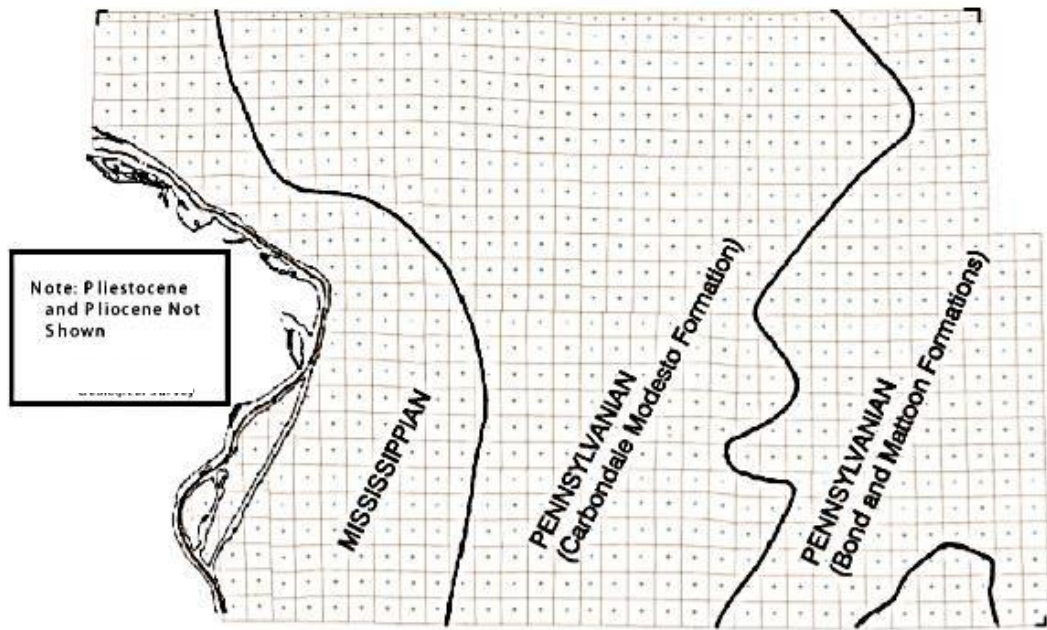
Geology

The bedrock underlying southwestern Illinois is composed of Cambrian, Ordovician, Silurian, Devonian, Mississippian, and Pennsylvanian sedimentary rocks (i.e., sandstone, shale, dolomite, and limestone) resting on crystalline basement rocks consisting mainly of granite. Tilting and folding of the bedrock surface below Madison County resulted in the present bedrock surface topography. Figure A.9 shows the generalized bedrock geology beneath Madison County.

Directly below the glacial drift in the central and eastern portions of the county, including below the Cahokia Creek watershed, are Pennsylvanian rocks. These rocks have relatively low permeability and consist mainly of shales, sandstone, thin limestone, and coal. The water-yielding character of these Pennsylvanian formations is variable but generally very low; the sandstones are the only formations that yield any appreciable amounts of water. The sandstones differ laterally in permeability and are not water-yielding at all sites. In some locations, small, local supplies of suitable groundwater may be obtained from shallow sandstone and creviced limestone, but the probability of obtaining a well in the Pennsylvanian aquifers yielding more than 20 gallons per minute (gpm) is low. Furthermore, as the depth of large aquifers increases, the water's mineral content also increases, limiting the uses of the groundwater.

Blanketing the bedrock are unconsolidated deposits from glacial drift, ranging in thickness from two to 200 feet across Southwestern Illinois. The glacial materials in the watershed and Madison County were deposited during the Pleistocene Epoch by the Illinoian glacial advance. The Illinoian Till Plain comprises much of the area east of the Mississippi River bluffs. A second glacial movement (Wisconsinan) did not advance on the area, but its deposits were widely transported here by wind and water. After the glaciers had receded and the deposits had dried, the wind picked up many of the fine-grained sand, silt, and clay (mostly silt) sediments and deposited them on the uplands in uniform layers known as loess. Since winds were generally from the northwest, the loess deposits are thicker on the uplands adjacent to the Mississippi River flood plain. The thickness of the glacial drift is highly variable.

Figure A.9: Generalized Bedrock Geology in Madison County, Illinois. Data from Illinois State Geological Survey.



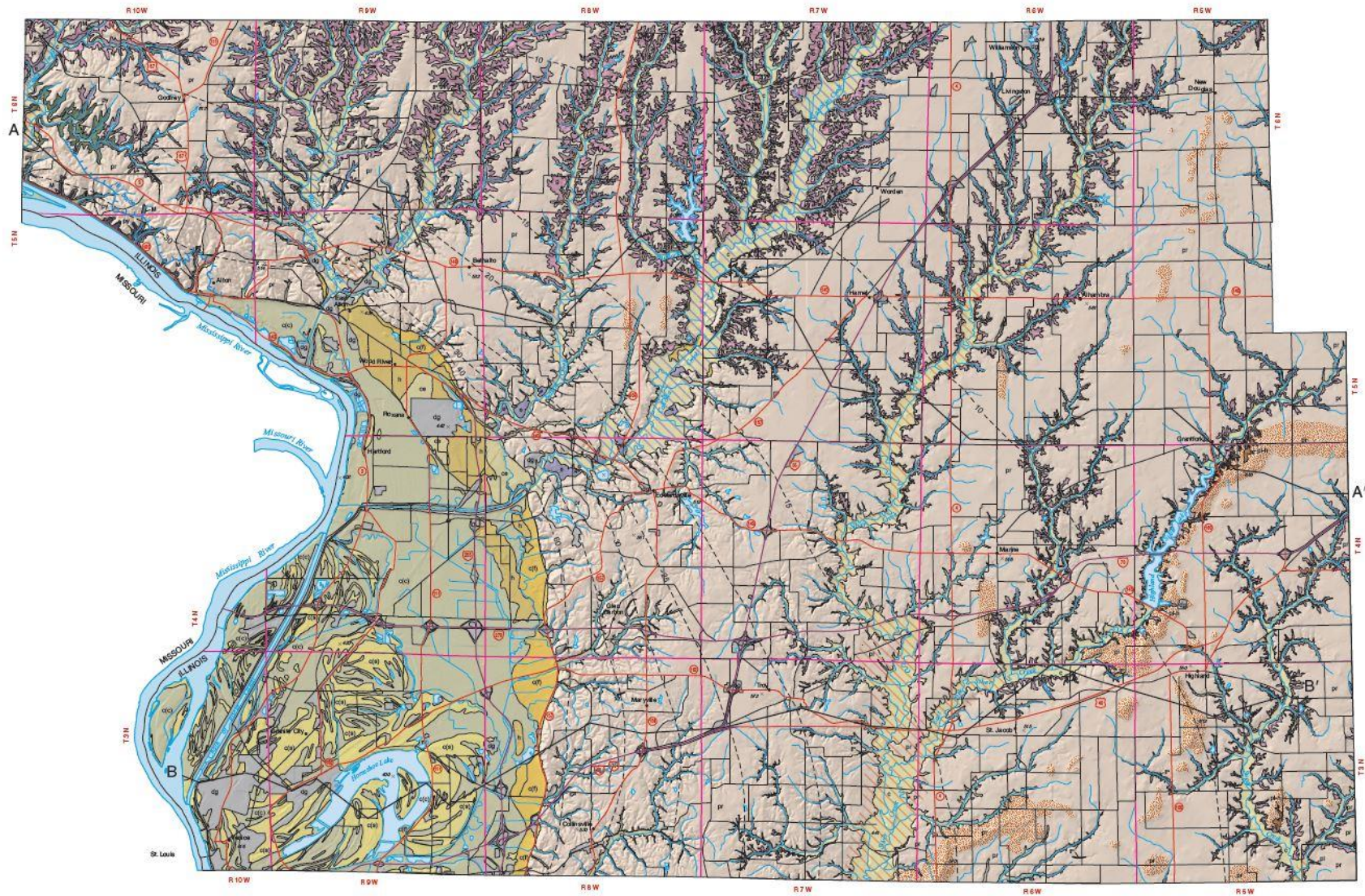
A map of Madison County's surficial geology reveals that the county is largely covered by loess deposits (Figure A.10). Near and in the Cahokia Creek watershed, the deposits are mainly silt, silty clay, and fine sand.

The cross-sections of the landscape at line A in Figure A.11 shows that the rock layers underlying the Cahokia Creek channel are, from bedrock to surface: Pennsylvanian bedrock; Pearl Formation deposits (sand with some gravel); Equality Formation deposits (silt loam to silty clay loam with some fine sand); Cahokia Formation deposits (mainly silt, silty clay, and fine sand); and on the stream banks, silt loam or loess (Wisconsin; loess). The thickness of the loess (windblown silt) is shown on the map as contours. The loess layer becomes thinner as you move eastward from the Mississippi River. The loess thickness is 40 feet thick in the lower part of the Cahokia Creek watershed near Maryville, but only five to 10 feet thick at the northern end of the watershed. (11)

The valley fill material along Cahokia Creek is an important source of groundwater for industries and municipalities on the floodplain. Wells reaching to sand and gravel aquifers in underlying till plain deposits produce moderate amounts of water for small communities and rural households. Drinking water for most rural households using wells comes from low-yielding wells 35 to 150 feet deep. The numerous ponds throughout the watershed supply ample water for livestock and wildlife. (12)

The cross-sections of the landscape at line B in Figure A.11 shows that the rock layers underlying the Canteen Creek channel are, from bedrock to surface: Peoria and Roxana silts, Glasford formation (<5 feet of loess cover), Petersburg silt, Banner Formation (undivided). This strata configuration is relatively consistent throughout the highlands of the watershed, with significantly different geology in the American Bottom, west of Illinois State Route 157.

Figure A.10: Surficial geology of the Cahokia Creek watershed area in Madison County.

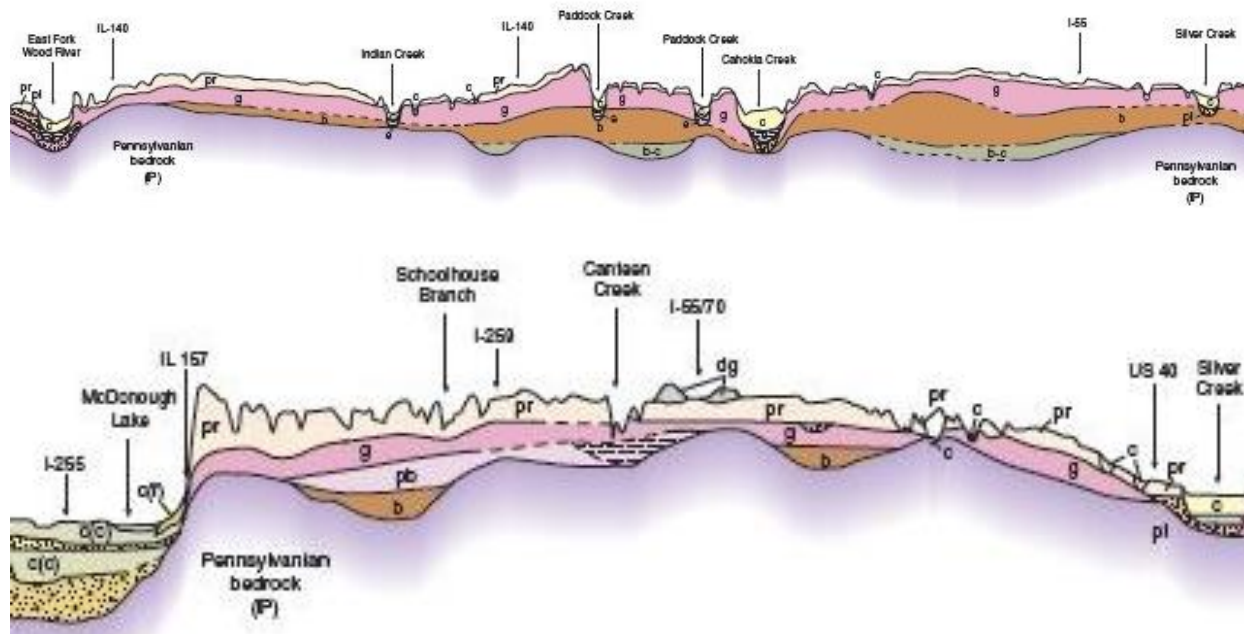


The legend for this figure is found on the following page. Cross-sections at lines A' and B' are shown in Figure A.11.

Figure A.10 Legend. Surficial geology of the Cahokia Creek watershed area in Madison County.



Figure A.11: Cross-sections of surficial geology at lines A and B in Figure A.10. (13)



Cross-section A extends from East Fork Wood River to Silver Creek, including Indian, Paddock and Cahokia Creeks
 Cross-section B extends from McDonough Lake to Silver Creek, including Schoolhouse Branch and Canteen Creek.
 See Figure A.10 for the legend.

Aquifers

There are four types of aquifers in the Cahokia Creek watersheds as defined by the Illinois State Geological Survey: potential shallow aquifers, major sand and gravel aquifers, and two types of deep major bedrock aquifers—those containing 2,500-10,000 mg/L of Total Suspended Solids (TSS) and those containing more than 10,000 mg/L TSS.

Potential aquifers are defined as sand and gravel units at least five feet thick, sandstone at least ten feet thick, and fractured limestone or dolomite at least fifteen feet thick with a lateral extent of at least one square mile. The locations of these potential aquifers were determined by the presence of coarse-grained materials and permeable bedrock including bedrock, sand and gravel, and alluvial units with characteristics that suggest a potential to store or conduct groundwater and yield potable water to wells and springs. Minor aquifers of this type typically yield from five to seventy gallons of potable water per minute.

Major sand and gravel aquifers generally lie within 300 feet of the surface, and the bases occur within 500 feet. Major aquifers are defined as geologic units capable of yielding 70 gallons of potable water per minute. Potable water is defined as containing less than 2,500 milligram per liter total dissolved solids. Major sand and gravel aquifers are commonly separated from shallower aquifers by layers of less permeable till or fine-grained lacustrine deposits.

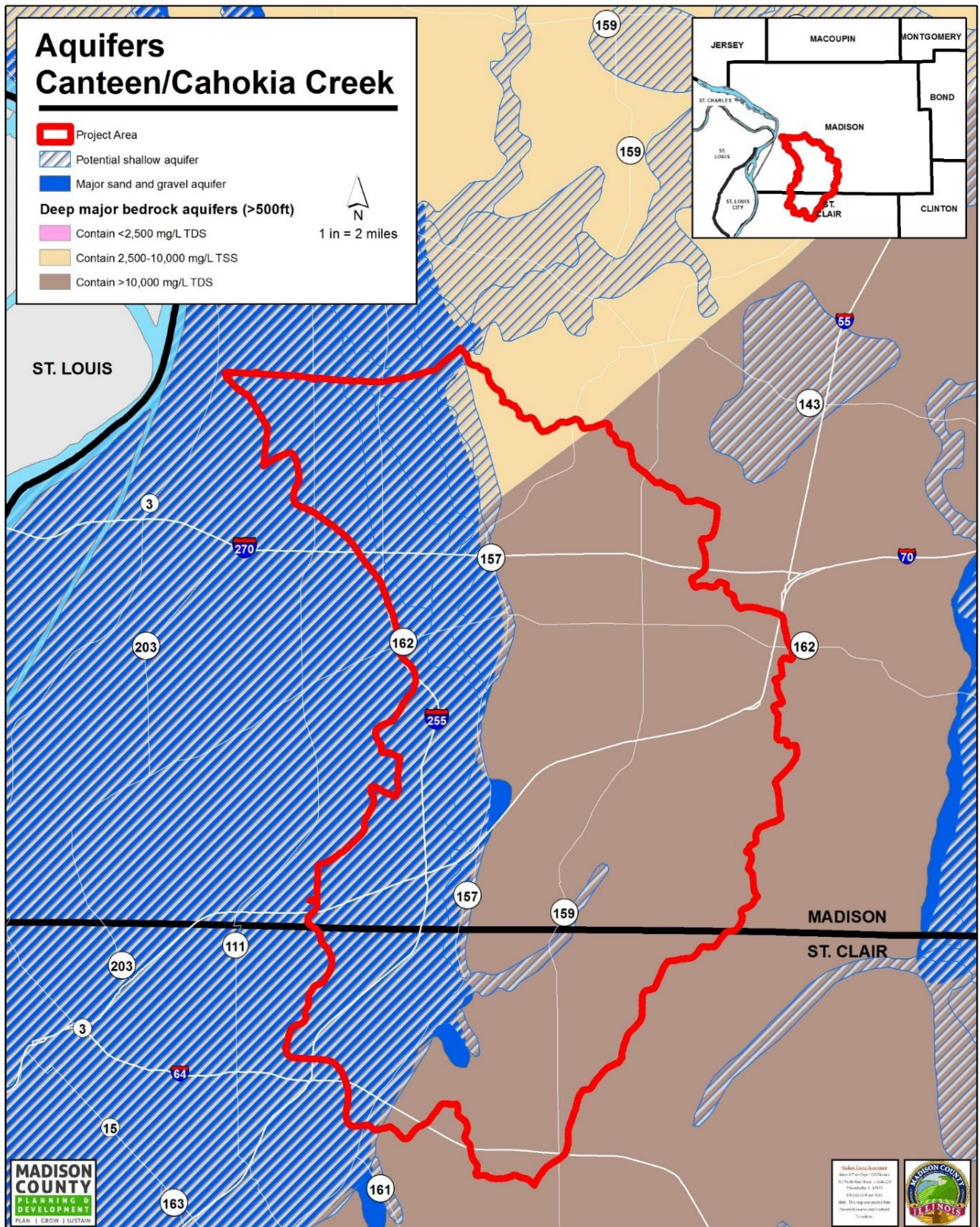
Deep major bedrock aquifers are distributed beneath the entire watershed at depths greater than 500 feet below the ground surface. They are capable of yielding 70 gallons of water per minute. The deep aquifers beneath these watersheds do not yield potable water (containing less than 2,500 milligrams per liter of TSS). Instead, they yield water containing more than 2,500 milligrams per liter of TSS. Deep major bedrock aquifers yielding water containing greater than 10,000 milligrams per liter of TSS are given their own category and are shown in darker brown (Figure A.12).

There is one major sand and gravel aquifer in the western third of the Canteen-Cahokia Creek watershed, shown in dark blue in Figure A.12. It is situated below the confluence of Indian Creek and Cahokia Creek, and also the Cahokia Diversion Channel. It underlies 20,650 acres (36%) of the Canteen-Cahokia Creek watershed, and its volume is unknown.

There may be several potential aquifers 50 ft or less below the ground surface in the watershed, underlying 22,257 acres (38%) of the watershed area, as shown with blue/grey diagonal lines in Figure A.12.

Deep major bedrock aquifers are distributed beneath the entire watershed at depths greater than 500 feet below the ground surface. The deep major bedrock aquifers beneath the watershed yield water containing more than 2,500 milligrams per liter of TSS.

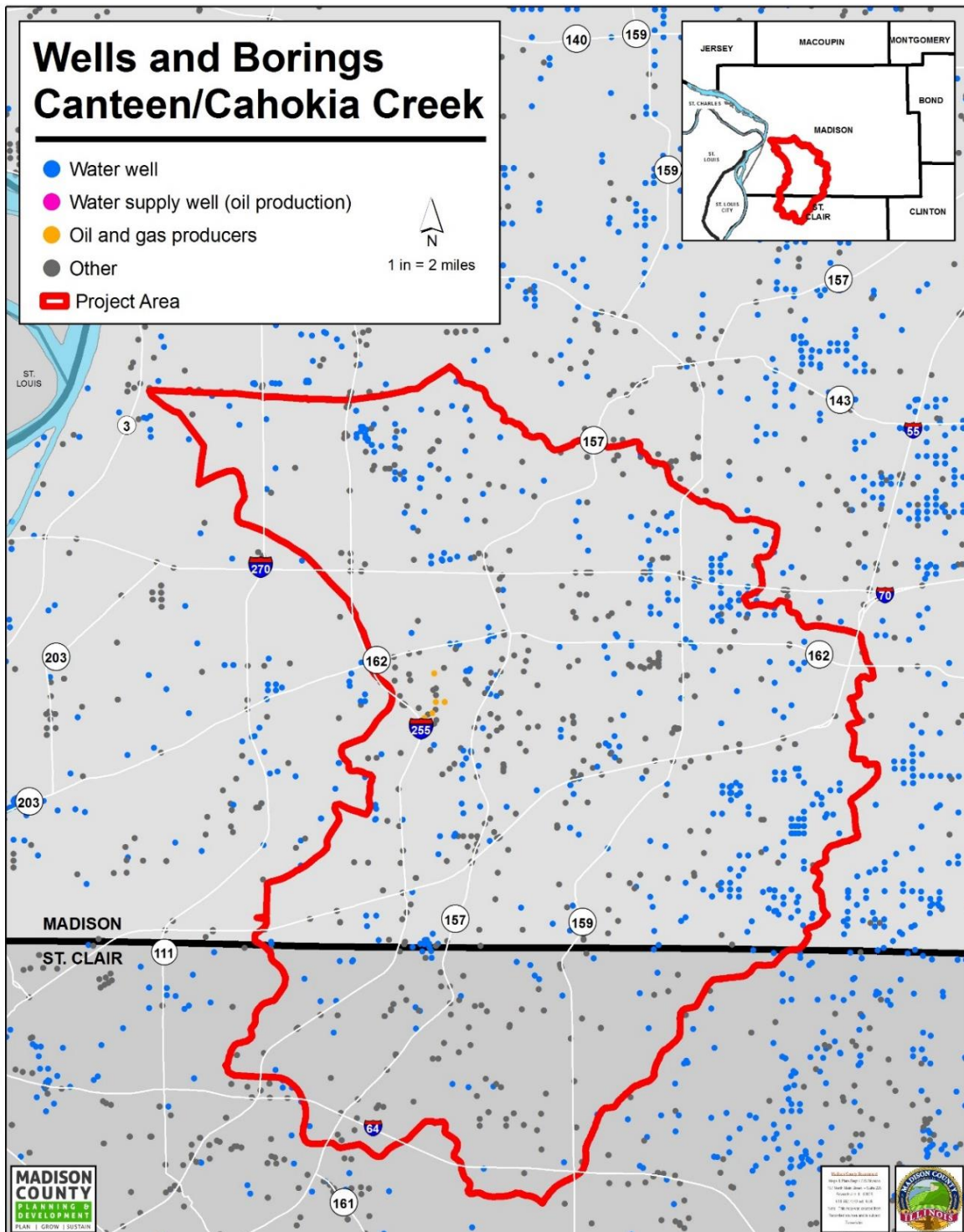
Figure A.12: Known and potential aquifers underlying the Canteen-Cahokia Creek Watershed at various depths. (14) These can be viewed online in Illinois SGS's Water Well Interactive Map. (15)



Wells

Illinois State Geological Survey has documented 1,168 wells and borings in the Canteen-Cahokia Creek watershed, of which 450 are water wells (Figure A.13). Permits for drilling have been issued for one additional well.

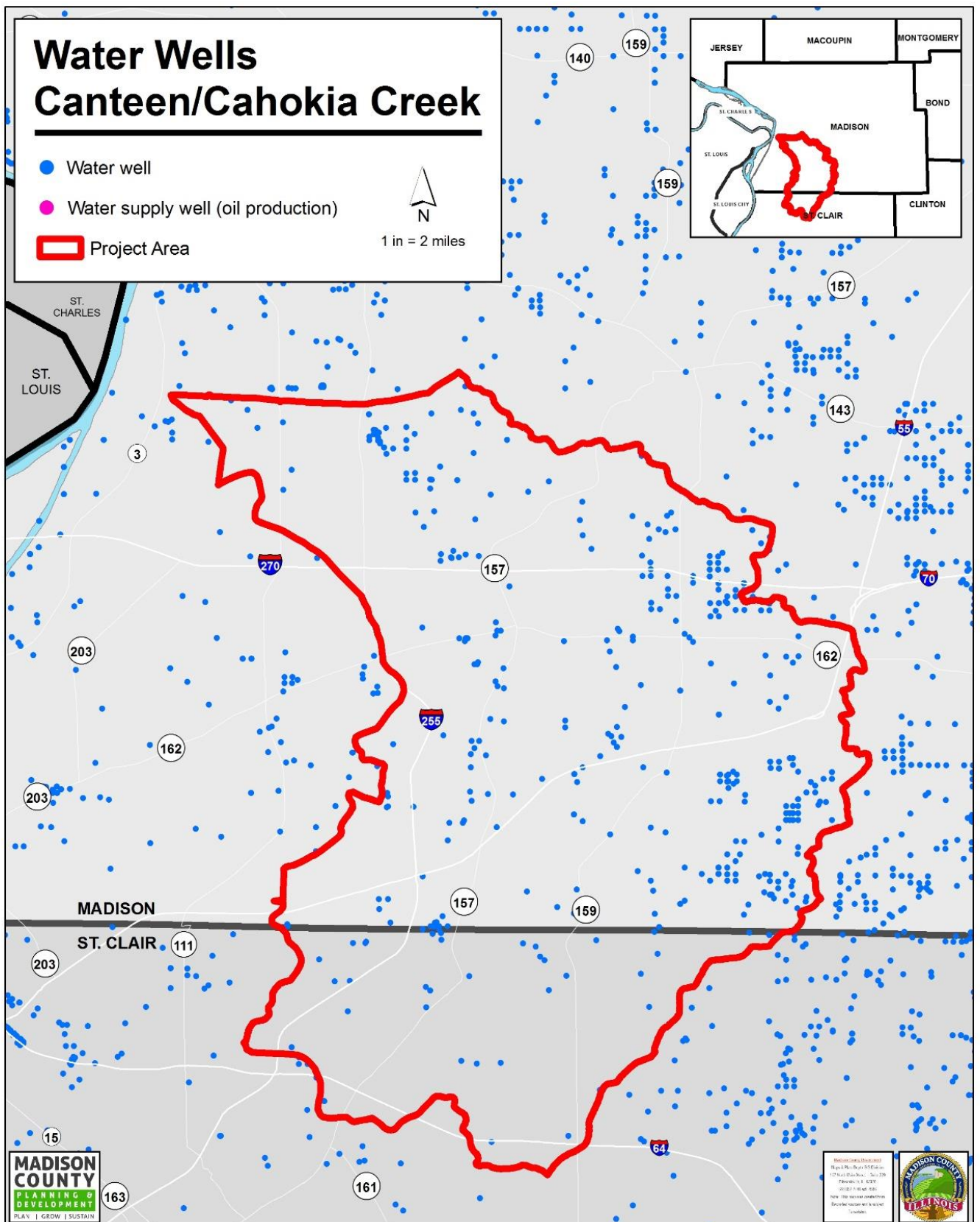
Figure A.13: Wells and borings in the Canteen-Cahokia Creek watershed from ISGS's Wells and Borings Database.



Water Wells

The water wells are fairly evenly distributed across the watershed (Figure A.14). (16) The water wells category includes municipal water supply, irrigation, industrial, commercial, and several types of test wells. More detailed information on well types and specifications is available to order from ISGS for a fee. (17)

Figure A.14: Water wells and water supply wells for gas production from the ISGS Wells and Borings Database.



Drinking water

There are 11 drinking water systems in the Cahokia Creek watersheds that supply community water to nearly 95,000 people. This water comes from both ground water and surface water and supplies the counties of Macoupin, Madison and St. Clair.

Nine out of 19 municipalities obtain their water supply from groundwater from their own wells, most of which are inside the watershed. Only one municipality (Staunton) and one Homeowners Association (Holiday Shores) draw surface water from adjacent reservoirs. The remaining municipalities purchase groundwater or surface water from each other (e.g., Glen Carbon purchases water from Edwardsville) or from water companies such as Illinois American Water, which obtains its supply from the Mississippi River. Private wells supply many individual residences and businesses with water throughout both watersheds, particularly in unincorporated areas.

There are five drinking water supply systems in the Canteen-Cahokia Creek watershed. Four serve Madison County, while the other serves St. Clair County (Table A.4). Nearly 68,000 people are supplied with drinking water from these systems. The SIUE, Glen Carbon, Maryville, and Collinsville water systems rely on groundwater, while the only water supply in the watershed to service a community in St. Clair County, Caseyville, relies on purchased surface water. (18)

Table A.4: Water supply systems with records in USEPA's Safe Drinking Water Information System.

System	Water System ID	Water System Name	County(s) Served	Population Served	Primary Water Source Type*
Community Water	IL1195550	Southern Illinois University - Edwardsville (SIUE)	MADISON	3,500	Ground water Purchased
Community Water	IL1190300	Glen Carbon	MADISON	12,800	Ground water Purchased
Community Water	IL1190750	Maryville	MADISON	9,207	Ground water
Community Water	IL1194280	Collinsville	MADISON	29,500	Ground water
Community Water	IL1630250	Caseyville	ST. CLAIR	12,722	Surface water Purchased

*Water intake locations are unknown; some systems may withdraw water from outside the watershed (especially purchased water).

Soils

A combination of physical, chemical, and biological variables such as topography, climate, drainage patterns, and vegetation have interacted over centuries to form the complex variety of soils found in the Cahokia Creek watershed. Data provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was used to identify the soil types in the watershed. There are 127 soil types present in the watershed, each of which has a designated hydrologic soil group, hydric soil category, and erodible soil category. See full table of soil types and their attributes in the Data Tables section.

Hydrologic soil groups

Soils are classified by the NRCS into Hydrologic Soil Groups (HSGs) based on their infiltration and transmission (permeability) attributes. The ease with which certain soils drain water affects groundwater recharge and the type and location of suitable infiltration management measures (such as detention basins) at a given site.

HSGs are classified into four primary categories (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The soil texture, drainage description, runoff potential, infiltration rate, and transmission rate of the four primary categories are identified in Table A.5. Sandy type A soils drain much better and allow more infiltration than clay type D soils.

Soil type data was acquired from the U.S. Department of Agriculture's Soil Survey Geographic database (SSURGO) file. The SSURGO data for the project area included 127 soil types. The NRCS county level Soil Surveys contain definitions of the soil types and note the HSG of each soil type. This corresponding data was joined to the SSURGO map layer to create maps of the HSG categories of soils in the watershed.

Table A.5: The four primary Hydrologic Soil Groups (HSGs) and their texture, drainage description, runoff potential, infiltration rate, and transmission rate.

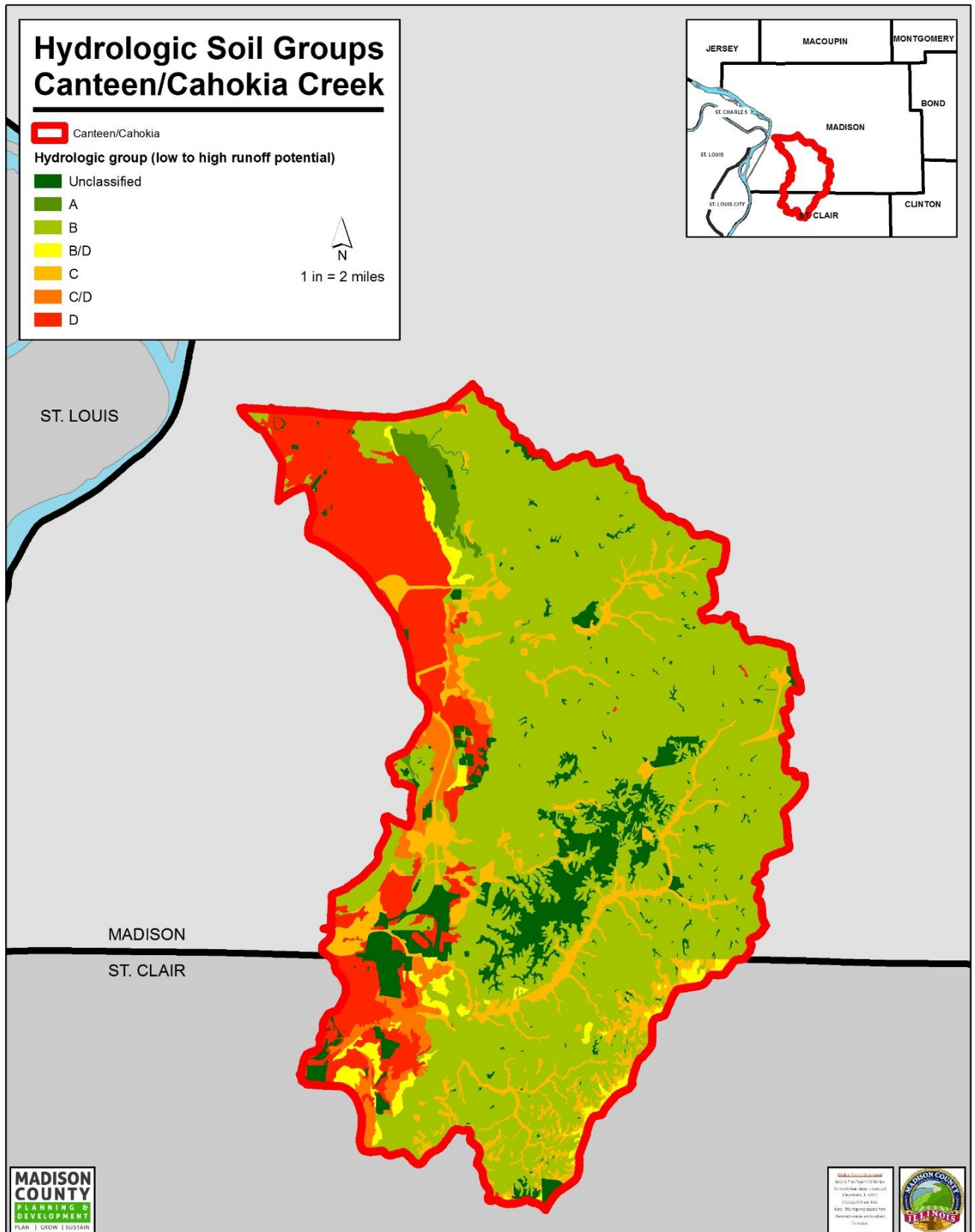
HSG	Soil Texture	Drainage Description	Runoff Potential	Infiltration Rate	Transmission Rate
A	Sand, Loamy Sand, or Sandy Loam	Well to excessively drained	Low	High	High
B	Silt Loam or Loam	Moderately well to well drained	Moderate	Moderate	Moderate
C	Sandy Clay Loam	Somewhat poorly drained	High	Low	Low
D	Clay Loam, Silty Clay Loam, Sandy Clay Loam, Silty Clay or Clay	Poorly drained	High	Very Low	Very low

Hydrologic soil group B, which drains moderately well to well, is the most prevalent HSG in the watershed, covering 59% of its area (Table A.6). See Data Tables section for a breakdown of hydrologic soil groups by HUC14 sub watershed. Group D soils are most prevalent in the western edge of the watershed (Figure A.15). Group B soils cover large swaths of land in the middle of the watershed. Group C soils, which drain somewhat poorly and have low infiltration, are distinctly located along the waterways of Canteen Creek and its tributaries. Unclassified soil group areas include water, miscellaneous water, urban land, or dumps.

Table A.6: Hydrologic soil groups including acreage and percent of watershed. Unclassified soil group areas are listed as water, miscellaneous water, urban land, or dumps. (19)

Hydrologic Soil Groups	Area (acres)	Percent of Waters (%)
Unclassified	1,706	3%
A	755	1%
B	33,497	59%
B/D	2,141	4%
C	10,458	18%
C/D	821	1%
D	7,899	14%
Total	57,277	100%

Figure A.3: Hydrologic soil groups in the Canteen-Cahokia Creek watershed.



Hydric soil types

Hydric soils are soils that are wet frequently enough to periodically produce anaerobic conditions. They generally form over poorly drained clay material associated with marshes and other wetlands. The locations and attributes of existing wetlands are discussed in the Land Use/Land Cover section. The species composition and growth of vegetation growing on hydric soils is distinct from non-hydric soils. Hydric soils not only indicate the presence of existing wetlands but also of drained wetlands where restoration may be possible.

Hydric soils were identified through the three NRCS county level Soil Surveys, which identify hydric soils by soil type. A hydric soil designation was then joined to the SSURGO map layer to identify the acreage and location of hydric soils in the watershed (Figure A.16). Thirteen soil types in the watershed were identified as hydric soils, covering a total area of 10,598 acres (Table A.7). Full data on soil types in the watershed and their hydric status is included in the Data Tables section.

Hydric soils constitute 19% of the soils in the watershed (Table A.8). Soils in areas of water, urban land, and dumps were considered to be non-hydric. See Data Tables section for a breakdown of hydric soils by HUC10 sub watershed.

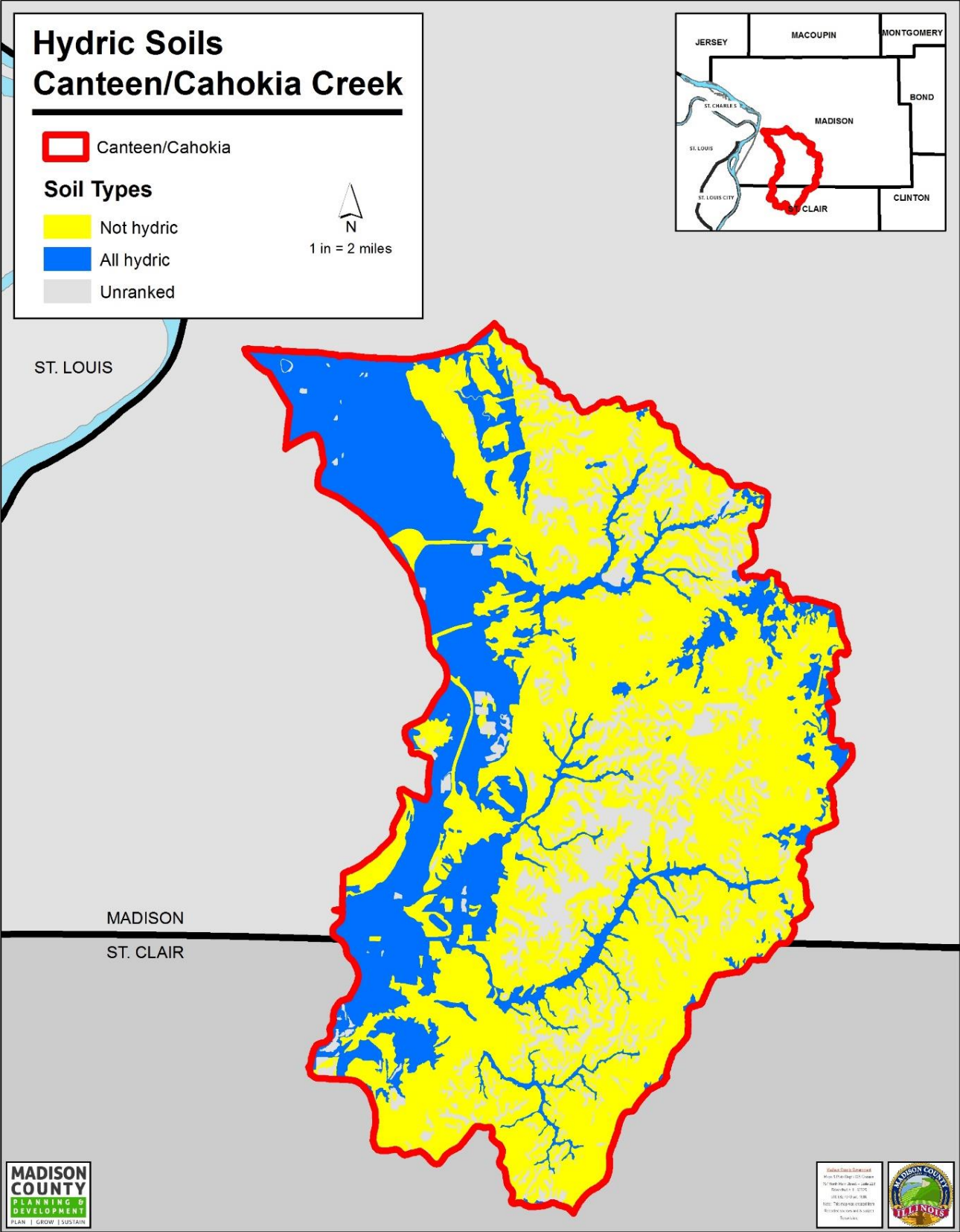
Table A.7: Soil types and their hydric status and acreage in the Canteen-Cahokia Creek Watershed.

Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Hydric Soils area (acres)
1070L	Beaucoup silty clay loam undrained 0-2% slope occasionally flooded long duration	Yes	465
1071A	Darwin silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	Yes	466
165A	Weir silt loam 0-2% slope	Yes	10
2071L	Darwin-Aquents-Urban land complex, 0 to 2 percent slopes, occasionally flooded, long duration	Yes	475
385A	Mascoutah silty clay loam 0-2% slope	Yes	893
50A	Virden silt loam 0-2% slope	Yes	9
8070A	Beaucoup silty clay loam, 0 to 2 percent slopes, occasionally flooded	Yes	480
8071L	Darwin silty clay, 0 to 2 percent slopes, occasionally flooded, long duration	Yes	6,384
8302A	Ambraw silty clay loam, 0 to 2 percent slopes, occasionally flooded	Yes	287
8334A	Birds silt loam, 0 to 2 percent slopes, occasionally flooded	Yes	803
8591A	Fults silty clay, 0 to 2 percent slopes, occasionally flooded	Yes	27
8646A	Fluvaquents, loamy, 0 to 2 percent slopes, occasionally flooded	Yes	23
8831A	Fluvaquents, clayey, 0 to 2 percent slopes, occasionally flooded	Yes	278
Total			10,600

Table A.8: Hydric soils by acreage and percentage.

Hydric Soil	Area (acres)	Percent of watershed
Hydric Soils	10,598	18.5%
Non-Hydric Soils	45,802	80%
Unknown	877	1.5%
Total	57,277	100%

Figure A.16: Hydric and non-hydric soils in the Canteen-Cahokia Creek watershed. (20)



Highly erodible soils

Over time, soils exhibit some degree of risk of erosion from water and wind. Certain soils are highly erodible due to a combination of natural and human-influenced factors. Some of the natural properties of soils that make them susceptible to erosion include low permeability (<0.6 in/hour), high silt content (soil particles that measure between 0.002 to 0.53 mm diameter), significant slope (>5%), and low water holding capacity. Human activities that affect soil erosion include agriculture, especially tillage operations; livestock grazing; urbanization; and construction. No single soil property determines whether or not a soil will erode. Rather, it is a combination of all properties interacting simultaneously. The NRCS uses the Universal Soil Loss Equation (USLE) to calculate a potential average annual rate of sheet and rill erosion. That value is divided by a predetermined soil loss tolerance level (T) to determine if a soil is highly erodible. Variables that are inputted into the USLE include rainfall, the degree to which a soil resists water erosion, slope length, and slope steepness to determine the potential average annual rate of sheet and rill erosion. The T-level represents the maximum annual rate of soil erosion that could occur without causing a decline in long-term productivity.

The Madison County Soil Survey was used as the primary reference for identifying highly erodible soils in the Cahokia Creek watershed. The soil survey is the most authoritative source of soils data for the watershed because it was developed with a considerable amount of field observations combined with GIS modeling. Calculations based solely on GIS modeling can overestimate or underestimate the extent of actively eroding soils. The Madison County Soil Survey identifies which soils are currently classified as eroded or severely eroded. These soils all shared the similar properties of steep slopes (five to 18%) and high silt content (55 to 72%). Several soil types that exhibited these same properties but were not currently classified as eroded or highly eroded were also added to the list of highly erodible soils.

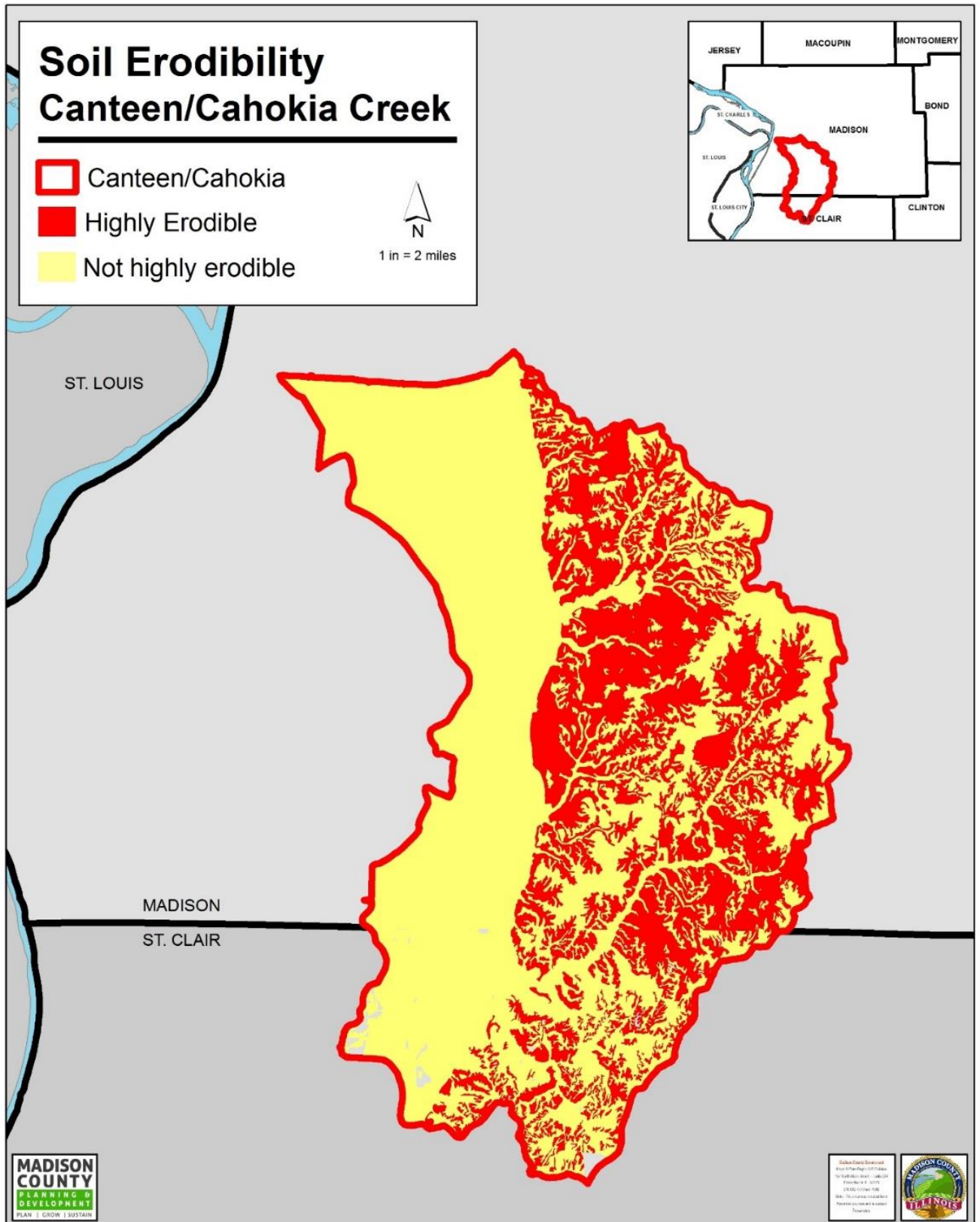
Highly erodible soils are present throughout the watersheds, particularly on steep slopes (Figure A.17). A strong correlation between slope and high erodibility can be seen in the maps for these factors.

All of the soils in the western third (approximately) of the watershed are considered soils that are not highly erodible (Table A.9). In the eastern two thirds of the watershed, highly erodible soils appear to be present in most of the land, excluding streams and creeks. In the southern portion of the watershed where highly erodible soils are present, they cover a smaller percentage of the land than in the northern portion of the watershed (Figure A.17).

Table A.9: Soil erodibility by area and percentage in the watershed

Erodibility	Acres	Percentage of Watershed (%)
Not Erodible	42,368	74%
Erodible	13,397	23%
Unknown	1,355	3%
Total	57,120	100%

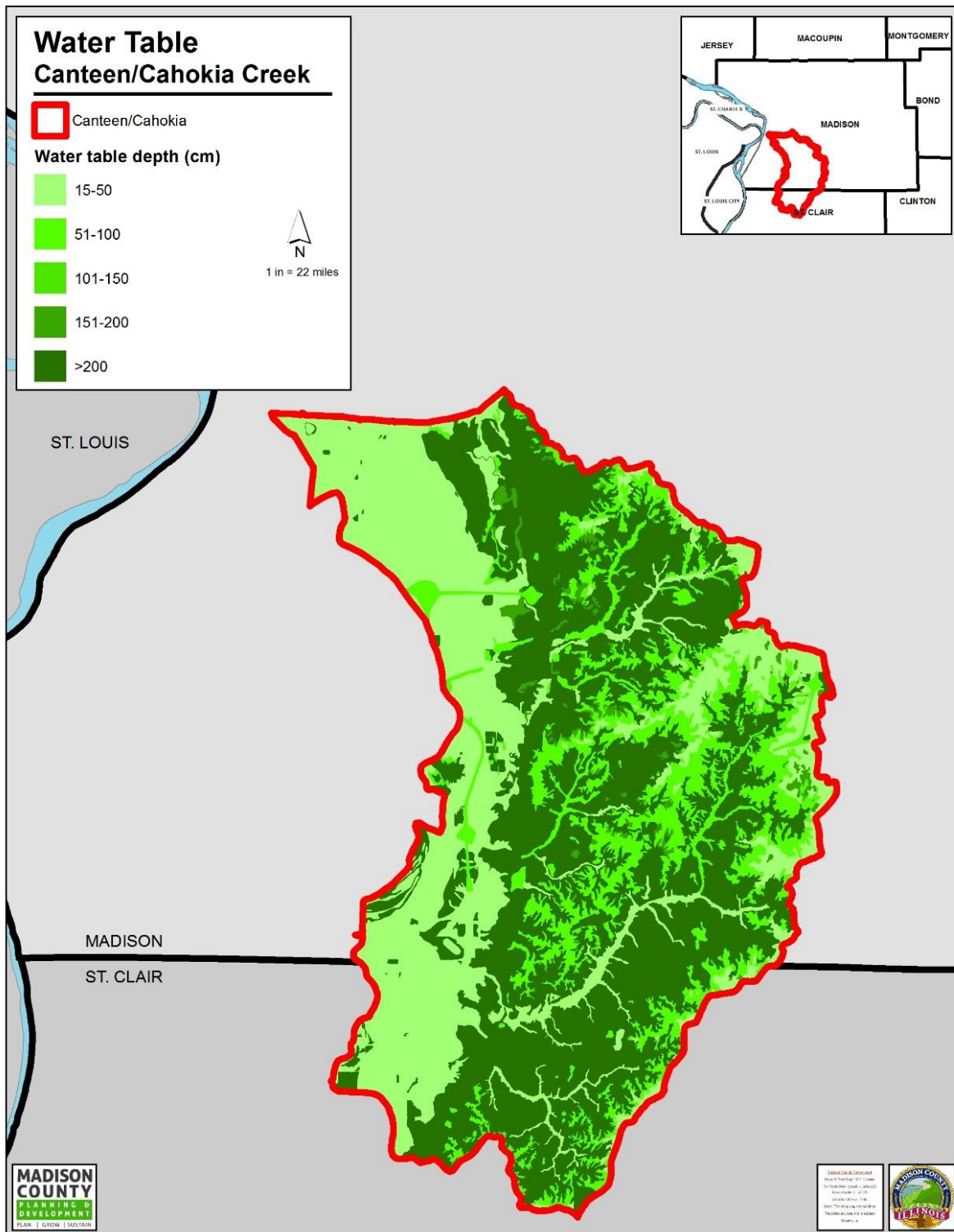
Figure A.17: Highly erodible soils identified using erodibility classifications from the Madison County Soil Survey for the Canteen-Cahokia Creek watershed.



Water Table

The depth of the water table is <50 cm in the soils covering 48% of the watershed (Figure A.18). The soils in 27% of the watershed have a water table 200 cm or more below the surface. (12) (19)

Figure A.18: Water table depths by soil type according to Madison County soil surveys for the Canteen-Cahokia Creek watershed.



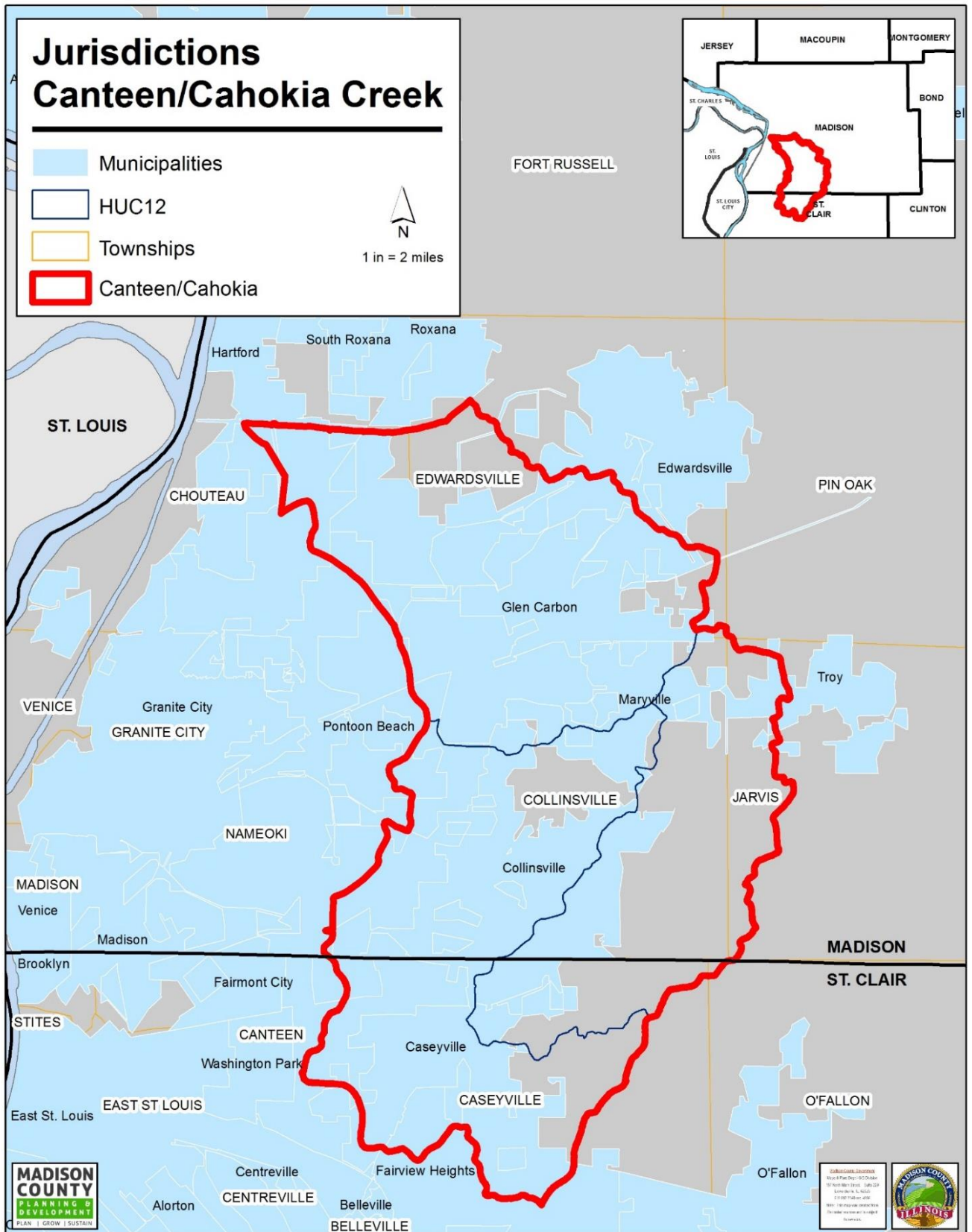
Watershed Jurisdictions

The Canteen-Cahokia Creek watershed is located in two counties, nine townships, and 10 municipalities (Table A.10 and Figure A.19).

Table A.10: County, township, unincorporated, and municipal jurisdictions within the watershed.

Jurisdiction	Area (acres)	Area within watershed (acres)	% of Watershed
County (inclusive of municipalities)	905,339	57,277	100%
St. Clair	431,274	13,752	24%
Madison	474,065	43,525	76%
Municipalities	45,807	28,146	49%
Caseyville	4,046	3,528	6%
Collinsville	8,786	8,489	15%
Edwardsville	9,004	3,755	7%
Fairview Heights	7,146	2,494	4%
Glen Carbon	4,805	4,491	8%
Hartford	2,527	51	0%
Maryville	3,032	3,032	5%
Pontoon Beach	5,590	2,018	4%
South Roxana	871	288	1%
Troy	2,668	588	1%
Unincorporated Areas	791,394	29,131	51%
St. Clair County	453,575	22,620	39%
Madison County	337,819	6,511	11%
Township	185,379	57,279	100%
Canteen (St. Clair County)	8,664	2,836	5%
Caseyville (St. Clair County)	22,185	10,998	19%
Chouteau	20,715	4,244	7%
Collinsville	22,894	22,795	40%
Edwardsville	22,962	11,214	20%
Jarvis	22,770	2,992	5%
Nameoki	18,983	2,147	4%
O'Fallon	22,755	50	0%
Pin Oak	23,451	3	0%

Figure A.19: County, township, unincorporated and municipal jurisdictions within the Canteen-Cahokia Creek watershed.



Jurisdictional roles

Several government entities at federal, state, and local levels have jurisdiction over watershed protection.

Federal and State Entities

The U.S. Army Corps of Engineers (USACE) regulates wetlands through Section 404 of the Clean Water Act. Buffers or wetland mitigation are commonly required for developments that impact wetlands. USACE also regulates land development affecting water resources (rivers, streams, lakes, wetlands, and floodplains) when “Waters of the U.S.” are involved, a category that includes any wetland or stream/river that is hydrologically connected to navigable waters. Counties also regulate wetlands and other aspects of stormwater management through county Stormwater Ordinances. (21)

The U.S. Fish and Wildlife Service (USFWS), Illinois Department of Natural Resources (IDNR), Illinois Nature Preserves Commission (INPC), and Forest Preserve Districts play a critical role in protecting high quality habitat and threatened and endangered species, often on land that contains wetlands, lakes, ponds, and streams.

The Illinois Environmental Protection Agency (IEPA) Bureau of Water regulates wastewater and stormwater discharges to streams, rivers, and lakes through the National Pollutant Discharge Elimination System (NPDES). The NPDES Phase I Stormwater Program applies to large and medium-sized Municipal Separate Storm Sewer Systems (MS4’s), several industrial categories, and construction sites hydrologically disturbing five acres of land or more. The NPDES Phase II program covers additional MS4 categories, additional industrial coverage, and construction sites hydrologically disturbing more than one acre of land. Under the NPDES Phase II program, all municipalities with small, medium, and large MS4’s are required to complete a series of Best Management Practices (BMPs) and measure goals for six minimum control measures, including public education and participation, illicit discharge detention, construction site runoff control, and pollution prevention. (22)

For construction sites over one acre in size, which are covered by the NPDES Phase II Program, the developer or owner must comply with all requirements including developing a Stormwater Pollution Prevention Plan (SWPPP) that shows how the site will be protected to control erosion and sedimentation and completing final stabilization of the site. Several municipalities and companies in the Cahokia Creek watersheds have been issued NPDES permits by Illinois for stormwater discharges to MS4’s.

The county Soil and Water Conservation Districts (SWCDs), under the Natural Resources Conservation Service (NRCS), influence watershed protection through soil and sediment control and pre and post-development site inspections. They also provide technical assistance to regulatory agencies and the public.

Local Government

Watershed protection in Madison and St. Clair counties is primarily the responsibility of county and municipal level government. County Boards oversee decisions made by county governments and have the power to adopt, override, and alter policies and regulations. County departments, especially those with functions of planning, zoning, and development, help shape the policies enacted in the unincorporated areas. Local municipalities also have ordinances that address other natural resource issues, which can include conservation development, Special Service Area (SSA) or watershed protection fees, and native landscaping.

Land development in unincorporated Madison County is regulated by the Madison County Planning and Development Department. Madison County enforces floodplain development regulations in its Zoning Ordinance, construction and fill activities in its Fill Ordinance, future development in its Land Use Plan, regulations on new housing subdivisions in its Subdivision Ordinance, and stormwater management regulations in its Stormwater Ordinance. Madison County is also a member of the National Flood Insurance Program (NFIP). Madison County's Stormwater Ordinance (amended in 2007) regulates development activities which alter stormwater flows and enable the County to comply with National Pollutant Discharge Elimination System (NPDES) regulations. The ordinance requires several types of development activity proposed in the unincorporated area of the county to obtain a permit, including any land disturbing activities if the activity is within 25 feet of a river, lake, pond, stream, sinkhole, or wetland. Madison County is also currently in the process of adopting a Stormwater Plan, which will guide future stormwater management activities.

Several municipalities in Madison County have passed similar ordinances. Alhambra, Edwardsville, Glen Carbon, Marine, and Troy have passed Subdivision Ordinances and Zoning Ordinances. Alhambra, Edwardsville, and Troy have also passed Drainage Ordinances. Other municipalities in Madison County may have passed these ordinances as well; these were the participating jurisdictions in the draft Madison County Multi-Jurisdictional All Hazards Mitigation Plan. (6) Many municipalities in the watershed are also members of the NFIP and have passed floodplain ordinances (see Flooding section for more information). The Madison County All-Hazard Mitigation Plan also includes a summary of planning documents in effect for the county and municipalities (Table A.11).

St. Clair County does not have a Subdivision Ordinance, nor a separate Zoning Ordinance or Drainage Ordinance. It does have a Floodplain Zoning Ordinance, adopted in 2003, and it is a member of the NFIP. The county also maintains maps of existing land use and infrastructure. (7)

Table A.11: Existing planning documents by jurisdiction, of the municipalities in the Canteen-Cahokia Creek watershed that participated in the Hazard Mitigation Plan, excerpt from Table 7 in that plan.

Existing Planning Documents	Madison County	Edwardsville	Glen Carbon	Hartford	South Roxana
Plans					
Comprehensive Plan	X	X	X		
Emergency Management Plan	X	X			
Land Use Plan	X	X	X		
Codes and Ordinances					
Building Codes	X	X	X		
Drainage Ordinances	X	X			
Historic Preservation Ordinance	X	X			
Subdivision Ordinance(s)	X	X	X		
Zoning Ordinances	X	X	X		
Maps					
Existing Land Use Map	X	X	X		
Infrastructure Map	X	X	X		
Zoning Map	X	X	X		
Flood-Related					
Flood Ordinance(s)	X	X	X		
Flood Insurance Rate Maps (FIRMs)	X	X			
Repetitive Flood Lost List	X	X			
Elevation Certificates for Buildings	X	X			

Potential projects throughout the watershed

A 2010 Oates Associates report generated for Madison County was used to develop a flooding assessment to advise the Stormwater Commission and contribute to the county Stormwater Plan. The flooding assessment used GIS data review and analysis, community data requests, meetings with individual communities, and FEMA's Flood Insurance Study for the county and flood maps to identify stormwater-related problems. The assessment identified several projects that municipalities had identified to improve their drainage, in categories such as maintenance, dam safety, localized flooding, stream channel flooding, combined sewers, and roadway overtopping.

Table A.12. Oates Associates Project Summary project locations in the Canteen Creek-Cahokia Creek watershed.

ID	Project Name	Municipality/ Township	Project Type	Project Description	Recommended Solution
C-1	Schnieder Ditch	Collinsville	Maintenance	Sediment and debris accumulation resulting in reduced flow capacity and localized flooding.	Routine debris and sediment removal - 10,000 LF of stream channel.
C-2	Schoolhouse Branch Creek	Collinsville	Maintenance	Sediment and debris accumulation resulting in reduced flow capacity and localized flooding.	Routine debris and sediment removal - 15,000 LF of stream channel.
C-3	Cahokia Canal	Collinsville	Maintenance	Sediment and debris accumulation resulting in reduced flow capacity and localized flooding.	Routine debris and sediment removal - 12,000 LF of stream channel.
C-4	Canteen Creek	Collinsville	Maintenance	Sediment and debris accumulation resulting in reduced flow capacity and localized flooding.	Routine debris and sediment removal - 40,000 LF of stream channel.
ED-3	Old Troy Road Flooding	Edwardsville	Localized Flooding	Runoff from commercial areas in Glen Carbon, Edwardsville, and undeveloped farmland resulting in flooding of low-lying driving range, stream flooding, and roadway overtopping.	Provide additional detention and enlarge existing pipe culverts and drainage channels.
ED-7	Sand Road Overtopping	Edwardsville	Stream Channel Flooding	Roadway overtopping	Provide additional detention and enlarge existing collection system and drainage channels.
HF-1	East Rand Avenue	Hartford	Localized Flooding	Roadway flooding and subgrade failure	Provide expanded collection system and/or raise roadway profile.
NT-1	Dobrey Slough	Nameoki Township	Localized Flooding		

Stakeholder Outreach to Municipalities

The planning team met with more than 80 individuals from 33 governmental and non-governmental organizations in fall 2015. Municipalities were asked about their drinking water source(s), wastewater treatment system(s), and flooding, as well as other issues such as erosion, siltation, and water quality. Other stakeholders were asked about these issues in their jurisdiction or on their property.

Wastewater treatment

Municipal wastewater treatment in the Indian-Canteen-Cahokia Creek watershed is largely conducted at facilities within municipal boundaries. At least seven of the 19 municipalities have their own wastewater treatment facility. At least four municipalities send their wastewater to a facility in another jurisdiction for treatment (Maryville, Glen Carbon, Fairview Heights, and Hartford).

Hartford has combined sewers (sanitary and stormwater system combined). Several other municipalities acknowledged that leaks in the sanitary sewer infrastructure may inadvertently be creating combined sewers by letting stormwater seep in. Edwardsville indicated that the city treats much more wastewater than it provides as water supply (1.85 times the amount of water supplied, based on 2014 data). This shows that a lot of rainwater/groundwater is entering its sanitary sewer system, and it illustrates the huge impact of inflow and infiltration on the sewer infrastructure.

Private sewage systems, such as septic systems, are commonplace within municipal boundaries, and several municipalities indicated plans to extend public sewer lines to these properties in future. Outside of municipal boundaries, nearly all properties have individual private sewage treatment systems. Municipalities and Open House attendees reported occasional bad smells from private sewage systems, which may indicate malfunctioning systems.

Flooding

Urban flooding was probably the most important issue to the municipalities interviewed, and all had experienced at least some flooding in developed areas. Several municipalities and other stakeholders reported flooding in their jurisdictions, on their properties, and on the roads around them. Parts of several municipalities are in the 1% annual chance exceedance floodplain (more so in areas that lie west of the bluff line in the American Bottom area). Several individuals reported more frequent, intense storms, beavers, and logjams as contributing factors to flooding. Hartford has flooding problems when the Mississippi River rises and the gravity drains through the levee are closed. Since the gravity drains are the only feature allowing drainage from Hartford to the river, once the gravity drains close, interior water is unable to discharge to the river, contributing to flooding in Hartford.

Glen Carbon commissioned and received a Stormwater Management Preliminary Drainage Analysis report in 2014 from Gonzalez Companies, LLC. (23) The report provides preliminary investigation and analysis of sites that have experienced stormwater-related issues. The village solicited information on resident concerns through the use of surveys and a public meeting, and kept lists of complaints from problem areas. The report outlines a prioritized plan for the village to address these issues. Gonzalez also reviewed existing Village of Glen Carbon ordinances and policies related to stormwater and proposed ordinance updates in appendices. Preliminary analysis was conducted at 28 sites, and a total construction cost of \$2.45 million was estimated for these sites.

Erosion

Several municipalities highlighted soil erosion issues within their municipal boundaries along creeks and ditches. Collinsville Township reports severe erosion in Burdick Branch which has changed the shape of the channel. Fairview Heights reported bank erosion on the northwest side of the city. Glen Carbon reports erosion on Judy Creek. Maryville has identified streambank erosion along all of Burdick Branch and some of Canteen Creek, and noted that loess soil exacerbated the erosion. St. Clair County also identified streambank erosion along Canteen Creek.

At one new development in Edwardsville, the developer/builder failed to implement adequate erosion prevention measures for excavated soils, resulting in significant erosion. Glen Carbon reports severe erosion in a ravine on a city lot, and minor erosion around lakes maintained by HOAs.

Logjams

Two counties and several municipalities and landowners mentioned logjams as an issue in the watersheds. St. Clair County identified logjams along the railroad.

Siltation and Sedimentation

Siltation was an issue for several communities who noticed reduction in the capacity of retention basins and lakes as a result of increasing silt and sediment deposition.

Jarvis Township reports pipes silting in and blocking drainage underneath roads. Maryville identified siltation at Fishing Club Lake.

Surface water quality issues

Water quality issues were noted in seven communities. Several property owners who attended open house events noted litter or trash as an issue within the watershed. (24)

Recreation

Water-based recreation takes place on and around several of the larger lakes and ponds in the watersheds. The Watershed Nature Center, situated on over 40 acres with prairie, forest, and wetland, offers recreational trails, bird- and wildlife watching, and environmental education events. Southern Illinois University-Edwardsville (SIUE) has miles of bike trails connecting to Madison County Transit (MCT) trails spanning the county.

The I-55 Plan speaks to future recreation in its planning area of approximately 4,800 acres in the I-55 corridor north of its intersection with I-270. Edwardsville has purchased 70 acres for parks in the planning area.

The input from municipalities can be found in Table A.13. (25)

Table A.13: Summary of municipal input from stakeholder engagement. Information on water supply and wastewater treatment for communities not met with is from Safe Drinking Water Information System (SDWIS) and the Integrated Compliance Information System (ICIS) from USEPA.

	Drinking water supply				Wastewater treatment systems			Flooding		Other issues			
Municipality	Municipal Groundwater (wells)	Municipal surface water	Purchased groundwater	Purchased Surface water	Municipal WWTP	Private Sewage	Combined Sewers	Urban flooding	Riverine flooding	Erosion	Siltation	Surface water quality issues	Water-based recreation
Caseyville	X			X	X**				X				
Collinsville	X				X	X		X				X	
Edwardsville	X*				X	X	maybe	X		X		X	X
Fairmont City													
Fairview Heights				X		X		X		X		X	
Glen Carbon			X			X		X		X			X
Hartford	X						X	X					
Maryville	X							X		X	X		
Pontoon Beach				X									
South Roxana			X										
Troy	X												
Collinsville Township	n/a	n/a	n/a	n/a	n/a	n/a	n/a	X		X			
Jarvis Township	n/a	n/a	n/a	n/a	n/a	n/a	n/a	X		X	X		
SIUE			X										

*Wells are located outside the watershed

**Surface water source is outside the watershed

Demographics

Population

St. Clair County is the most populous of the two project area counties, with more than 270,056 people as of 2010, followed by Madison at 269,282.

The 2010 U.S. Census found a population of approximately 64,487 in the Canteen-Cahokia Creek watershed.

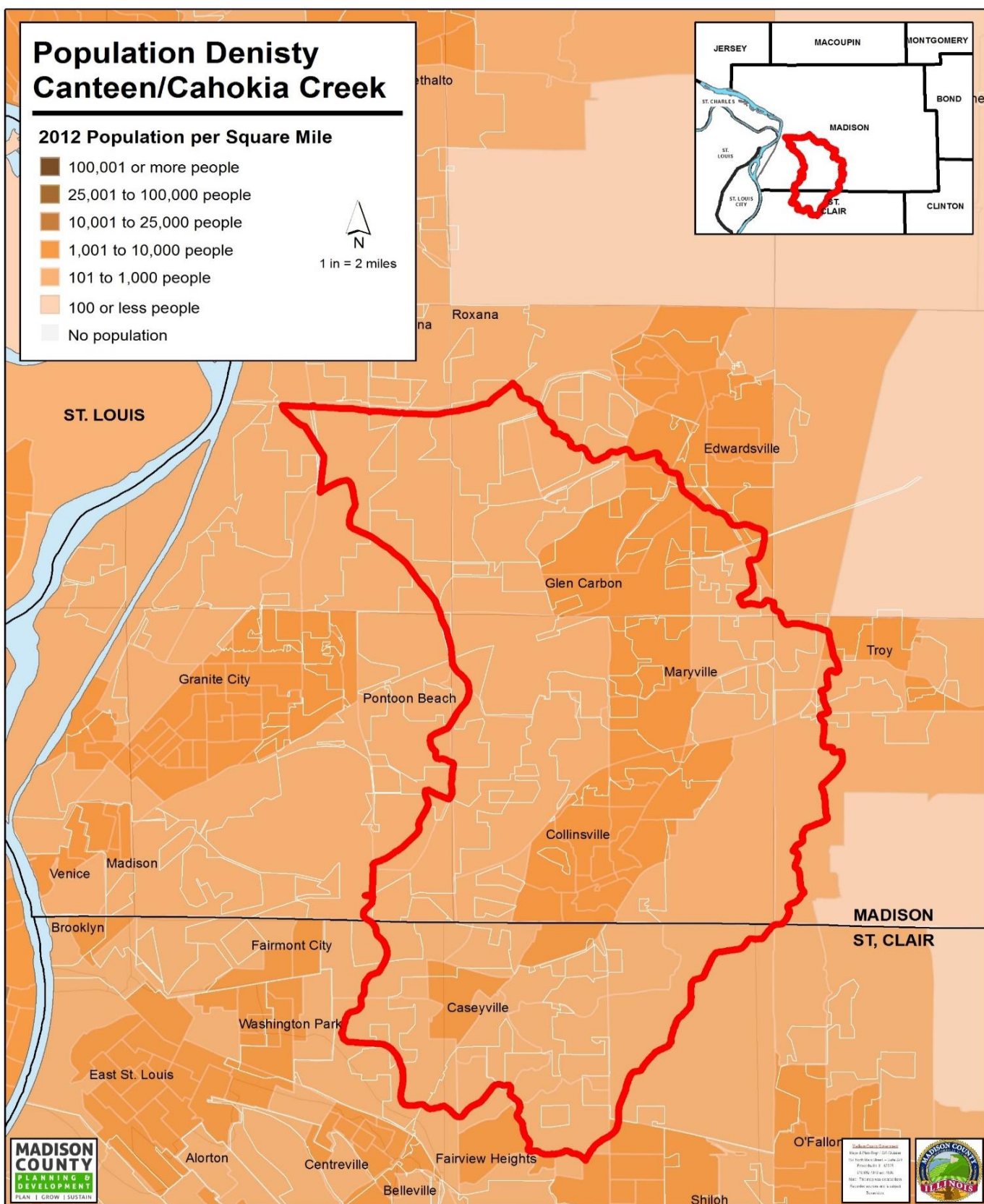
Of the municipalities represented within the project area, Collinsville has the largest population, with 25,579 people as of the 2010 Census. Edwardsville, Fairview Heights, and Glen Carbon are the next most populous municipalities, respectively. The least populous municipalities in the project area include Hartford, South Roxana, and Caseyville. Collinsville has the largest number and the largest proportion of its population in the watershed (Table A.14).

Population density varies throughout the watershed. The average population density within the project area is 100 or fewer people per square mile. The lowest population density is 101 to 1,000 people per square mile in several of the municipalities, and the highest population density is 1,001 to 10,000 people in Glen Carbon, Collinsville, Maryville and Caseyville. (Figure A.20). (26)

Table A.14: Population of the municipalities represented in the project area from the 2010 Census, official 2015 population estimate, and approximate population in each municipality living in the watershed

Municipality	Population (2010 Census)	Population (2015 Estimate)	Approx. Population in the watershed (2010 Census)
Caseyville	4,245	4,045	3,700
Collinsville	25,579	24,754	25,000
Edwardsville	24,293	24,992	8,000
Fairview Heights	17,078	16,827	5,000
Glen Carbon	12,934	12,966	12,500
Hartford	1,429	1,382	200
Maryville	7,487	7,902	7,487
Pontoon Beach	5,836	5,637	800
South Roxana	2,053	1,997	300
Troy	9,888	10,036	1,500

Figure A.20: Population density by census block in the Canteen-Cahokia Creek watershed, according to 2012 estimates. (27)



Population Change

St. Clair County saw a population growth rate of 5.2% between 2000 and 2010. The county saw the greatest recent population growth in the watershed.

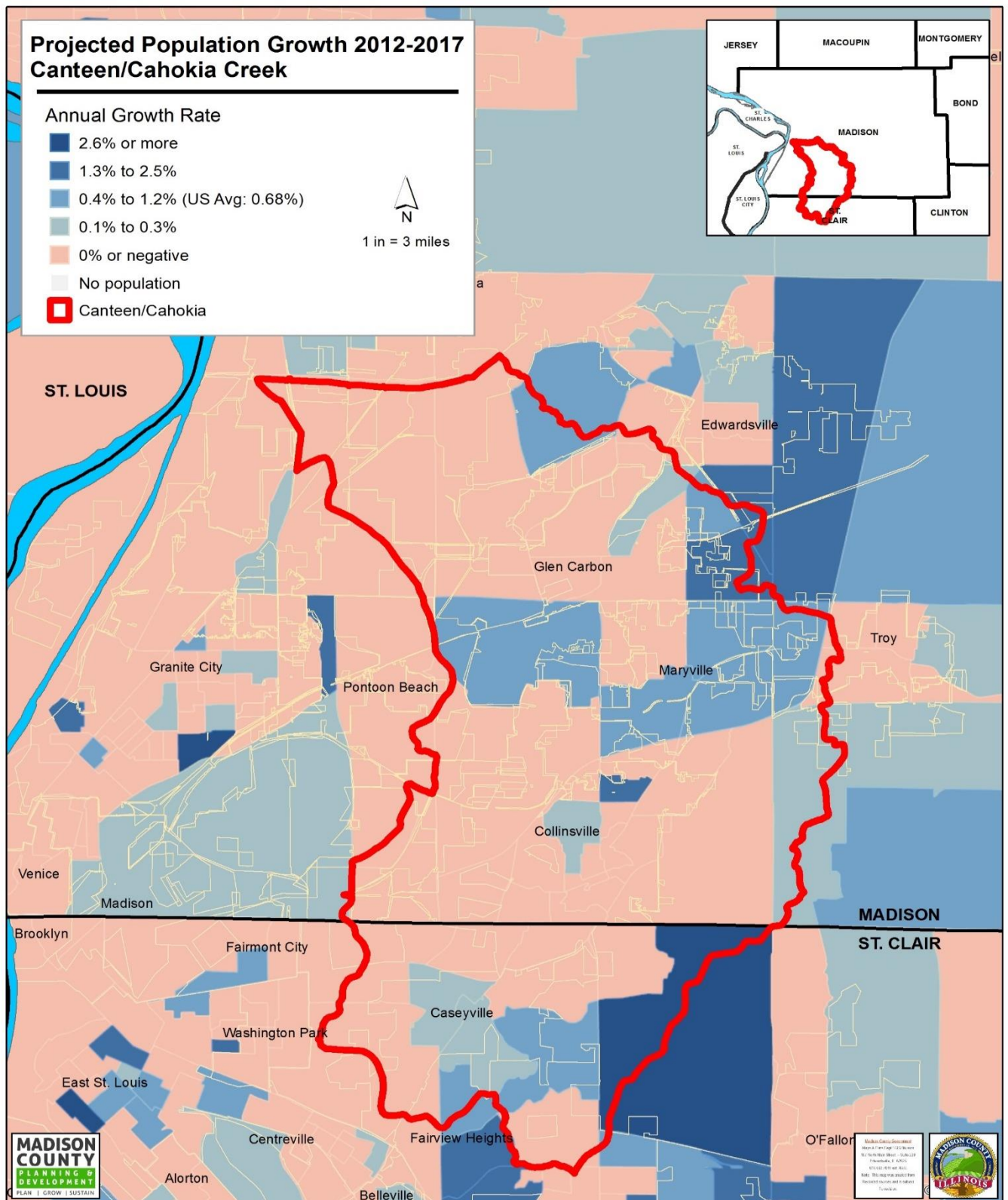
According to U.S. Census projections, two-thirds of the counties in the project area are expected to increase in population by the year 2025. Madison County is projected to experience the largest actual growth (more than 6,778 people) and is projected to experience the greatest percentage increase in population (Table A.15). A different estimate of Madison County's population growth under a slow-growth scenario by the East-West Gateway Council of Governments puts Madison County's population at 290,143 in 2030, a smaller 8.6% increase from 2013.

Ten-year population growth estimates show -2.0% to 2.5% population growth between 2015 and 2025 over much of the project area (Figure A.21). This growth estimate follows the national average annual growth rate for this time period (0.68%). Some parts of the watershed will experience higher growth of 1.0% to 2.5%, while other areas are expected not to grow or to lose population.

Table A.15: Population of the counties represented in the project area from the 2000 and 2010 Censuses, with official 2015 population estimates and 2025 population forecasts, and percent change between 2015 and 2025. (17) (27)

Total Population	2000 Census	2010 Census	2015 Estimate	2025 Forecast	Change from 2015-2025 (# of people)	Percent Change from 2015-2025
Madison County	259,391	269,282	266,209	272,987	6,778	2.5%
St Clair County	256,082	270,056	264,052	266,648	2,596	1.0%

Figure A.21: Projected population growth between 2012 and 2017 in the Canteen-Cahokia Creek watershed from the U.S. Census 5-year population estimates. (28)



Median Income

Median income can be an indicator of financial ability to make improvements to property, such as improved septic systems. The median family income in Madison County is \$52,756. In St. Clair County, the median family income is \$50,728 (Table A.16).

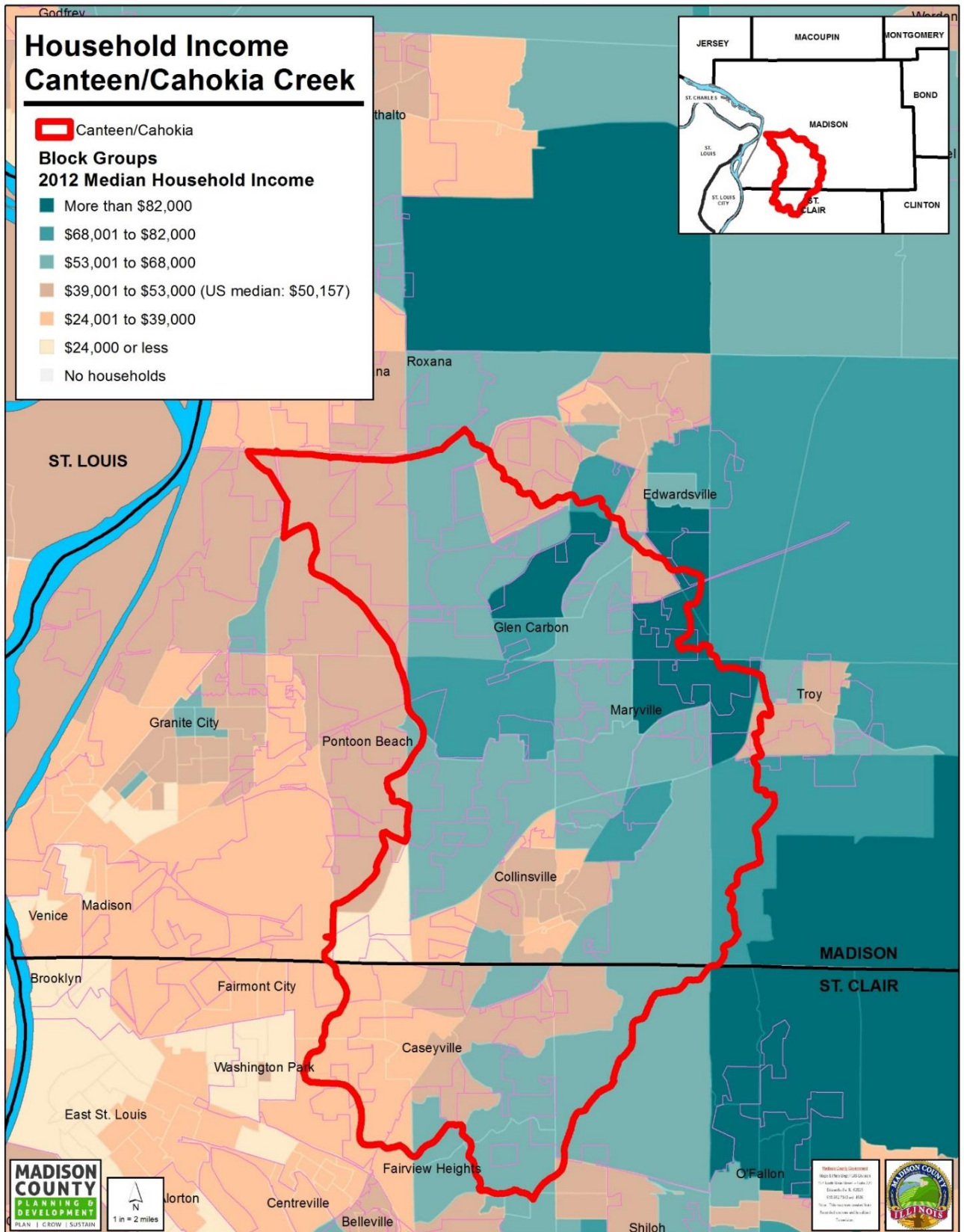
The municipalities with the highest median family income (upwards of \$70,000) are Troy, Maryville, Glen Carbon, and Edwardsville. The municipalities with the lowest proportion of people with income below the poverty level are Caseyville Fairview Heights, Glen Carbon, Maryville, and Troy, each with 10% or less (Table A.16).

The municipalities with the lowest median family income (less than \$46,000) are Hartford and South Roxana. Williamson, Pontoon Beach, and South Roxana had the highest percentages of people with income below the poverty level.

*Table A.16: Median family income and poverty in the municipalities and counties in the project area.*⁶¹

Community	Median Family Income (2014 inflation-adjusted dollars)	Percentage of people whose income in the past 12 months is below the poverty level (2014)
Caseyville	\$62,171	9.5%
Collinsville	\$58,919	11.8%
Edwardsville	\$70,791	12.1%
Fairview Heights	\$60,427	7.7%
Glen Carbon	\$69,419	9.8%
Hartford	\$42,169	12.2%
Maryville	\$80,504	7.3%
Pontoon Beach	\$47,121	22.5%
South Roxana	\$40,107	25.9%
Troy	\$69,467	7.7%
AVERAGE	\$60,109.50	12.65%
Madison County	\$52,756	13.9%
St Clair County	\$50,728	17.8%
AVERAGE	\$51,742.00	15.85%

Figure A.22: Median household income by census block in the Canteen-Cahokia Creek watershed.



Employment

Employment can be an indicator of future growth and development in an area. Madison County experienced a 3.0% increase in the number of jobs between 2010 and 2014 (Table A.17). In 2014, the three industry sectors with the largest number of jobs were government (17,053 jobs), retail trade, (15,011 jobs), and health care/social assistance (14,944 jobs). From 2010 to 2014, jobs in service industries grew 4.8%. The sectors that added the most new jobs were transportation and warehousing (1,546 new jobs), administrative and waste services (1,078 new jobs), and manufacturing (1,063 new jobs). The number of government jobs was relatively static, decreasing -1.8%. Jobs in non-service industries shrank -0.3%, from 21,557 to 21,485 jobs.

St. Clair County experienced a slight decrease in the number of jobs (-0.3%) between 2010 and 2014. The greatest decrease was in government, which shrank from 25,936 to 24,361 (a -6.1% decrease). Jobs in service industries grew from 89,629 to 90,545 (a 1.0% increase), and non-service industries grew from 11,230 to 11,358 (a 1.1% increase). The sectors with the most new jobs were retail trade (585 new jobs) other services, except public administration (562 new jobs), and educational services (279 new jobs). (29)

Table A.17: Percentage of the workforce working in non-services, services, and government sectors in 2010 and 2014, and percentage change in that time. (29)

	Madison County			St. Clair County		
	2010	2014	% Change 2010-2014	2010	2014	% Change 2010-2014
Percent of Total			3.0%			-0.3%
Non-Services Related	17.2%	16.6%	-0.3%	~8.8%	~9.0%	~1.1%
Farm	1.1%	0.9%	-16.4%	0.7%	0.6%	-18.0%
Forestry, Fishing & Related Activities	0.1%	0.1%	-3.4%	N/A	N/A	N/A
Mining (including fossil fuels)	0.3%	0.4%	31.0%	N/A	N/A	N/A
Construction	6.4%	5.4%	-12.8%	4.2%	4.1%	-0.7%
Manufacturing	9.2%	9.8%	9.2%	4.0%	4.2%	6.5%
Services Related	68.9%	70.2%	4.8%	70.5%	71.4%	1.0%
Utilities	0.3%	0.4%	25.6%	0.4%	0.4%	6.4%
Wholesale Trade	2.7%	2.8%	5.2%	2.4%	2.5%	4.9%
Retail Trade	11.8%	11.6%	1.9%	11.8%	12.3%	3.9%
Transportation & Warehousing	4.8%	5.9%	25.6%	5.4%	5.5%	2.7%
Information	0.8%	0.7%	-10.3%	1.2%	1.0%	-20.7%
Finance & Insurance	5.3%	5.0%	-2.7%	4.2%	4.3%	0.8%
Real Estate, Rental & Leasing	3.5%	3.2%	-5.5%	2.9%	2.8%	-2.4%
Professional & Technical Services	4.8%	4.8%	1.9%	6.1%	5.7%	-7.2%
Management of Companies & Enterprises	0.8%	0.6%	-21.8%	0.5%	0.5%	-8.4%
Administrative & Waste Services	4.0%	4.7%	21.5%	3.7%	3.7%	-0.3%
Educational Services	1.2%	1.1%	-1.3%	1.7%	2.0%	12.6%
Health Care and Social Assistance	11.8%	11.6%	0.7%	13.1%	13.2%	0.5%
Arts, Entertainment & Recreation	2.4%	2.3%	-3.0%	2.2%	2.2%	-1.1%
Accommodation & Food Service	8.1%	8.6%	9.0%	7.6%	7.7%	0.7%
Other Services (except public admin.)	6.6%	7.0%	8.4%	7.3%	7.8%	6.0%
Government	13.9%	13.2%	-1.8%	20.4%	19.2%	-6.1%

All employment data are reported by place of work. Estimates for data that were not disclosed are indicated with tildes (~).55

Home Values

Investment and development in the Cahokia Creek watershed has brought more people to buy homes here to be near their place of work, local schools, and other amenities. Home values are an indication of a location's desirability, the income of community residents, and the tax base local governments have to support themselves and their activities, among other things. Changes in home values over time can show movement from a buyer's to a seller's market, or vice versa.

Estimates mapped by ESRI in 2012 show that median home values in the watershed are generally higher in the northern part of the watershed than in the south (Figure A.23). (30) According to data from housing website Zillow.com, the average median home price in the municipalities in the project area is \$121,350 (Table A.18). Most of the municipalities experienced an increase in home values over the past year, and the prediction for next year is a 2.11% increase.

Few homes in the watershed have negative equity, meaning the market value of the property has fallen below the outstanding amount of the mortgage secured on it. The percentage is similar to the U.S. average of 0.1% (as of June 2016). Approximately 0.0% of homes are delinquent on their mortgages in the three counties, which is the same as the 0.0% U.S. average (as of June 2016).

Table A.18: Home values, recent and predicted change in home values, and percentages of homes with negative equity and that are delinquent on their mortgages. (31)

Community	Median home value (as of 5/14)	Change in home values 5/13 to 5/14	Predicted change in home values 5/14 to 5/15	Homes with negative equity	Delinquent on mortgage
Caseyville	\$73,600	8.20%	3.80%	0.20%	0.10%
Collinsville	\$111,200	2.10%	2.30%	0.20%	0.00%
Edwardsville	\$172,900	2.00%	2.40%	0.10%	0.00%
Fairview Heights	\$105,900	4.20%	2.90%	0.30%	0.10%
Glen Carbon	\$181,500	4.90%	3.10%	0.10%	0.00%
Hartford	\$47,200	-7.30%	1.00%	0.30%	0.30%
Maryville	\$188,800	2.90%	2.60%	0.10%	0.00%
Pontoon Beach	\$104,000	0.00%	1.20%	No data	No data
South Roxana	\$55,400	0.40%	2.30%	0.30%	0.10%
Troy	\$173,000	3.70%	2.60%	0.10%	0.00%
AVERAGE	\$121,350.00	2.11%	2.42%	0.19%	0.07%
Madison County	\$105,200	3.50%	2.30%	0.20%	0.00%
St Clair County	\$89,200	4.70%	2.30%	0.30%	0.00%
AVERAGE	\$97,200.00	4.10%	2.30%	0.25%	0.00%

Home Values
Canteen/Cahokia Creek

Block Groups
2012 Median Home Value

- More than \$348,000
- \$274,001 to \$348,000
- \$200,001 to \$274,000
- \$127,001 to \$200,000 (US median: \$167,749)
- \$53,001 to \$127,000
- \$53,000 or less
- No homes

Canteen/Cahokia

MADISON COUNTY
PLANNING & DEVELOPMENT
PLAN | GROW | SUSTAIN

1 in = 3 miles

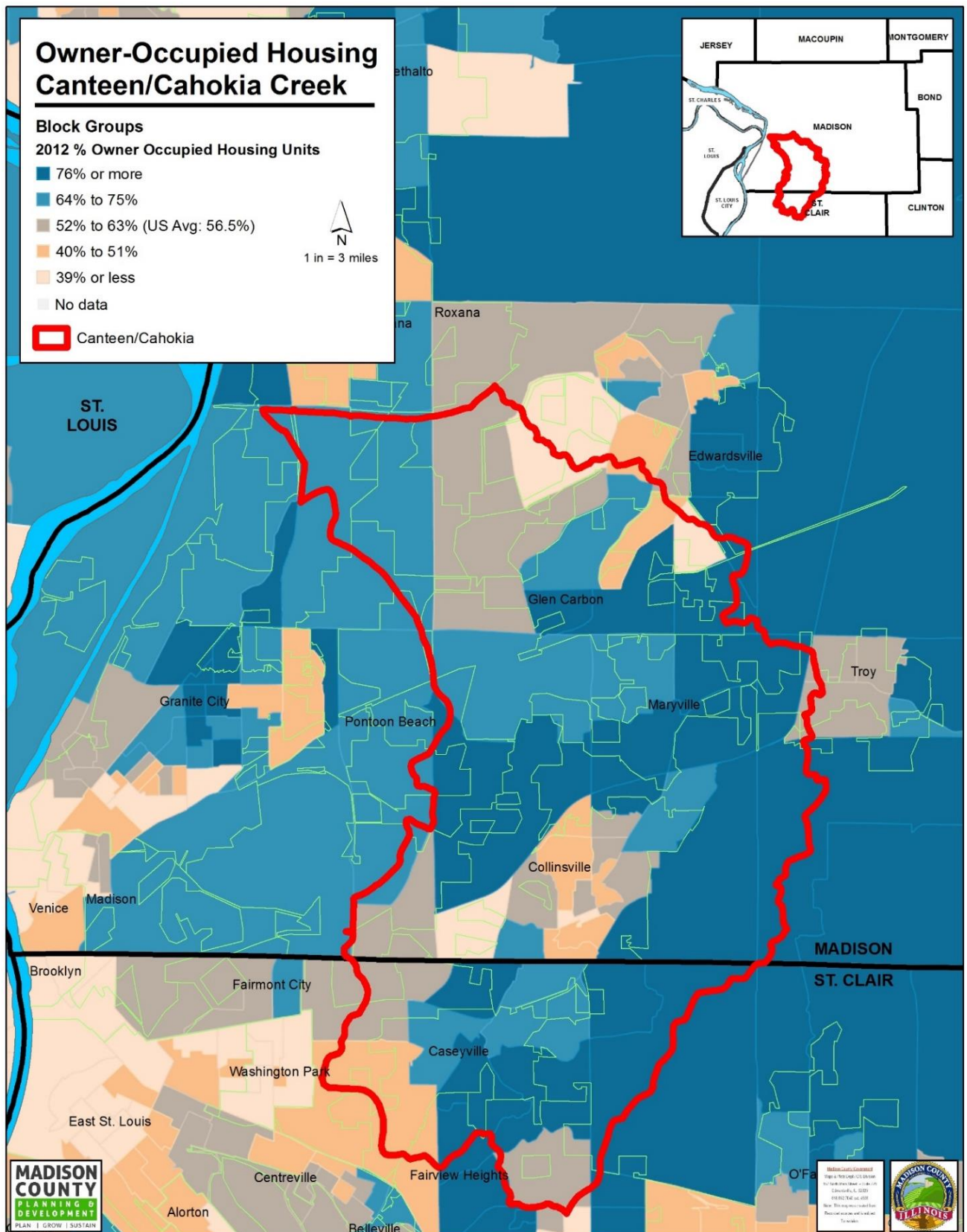
MADISON COUNTY
ILLINOIS

Owner-Occupied Housing

Homeownership rates can indicate transience or financial stability in a population. The U.S. Census Bureau defines the homeownership rate as the percentage of homes that are occupied by the owner and presents homeownership data for states and major metropolitan areas. In Illinois, homeownership rates have declined over the past 10 years. This change followed national trends associated with the economic recession and housing market collapse of the mid-2000s and the tendency for the millennial generation to rent homes instead of purchasing.

Owner occupied housing rates are at 64% or more across most of the watersheds as of 2012, which is higher than the national average of 57%. The St. Louis Metropolitan Area average is 71.2%. Rates are lower in municipalities, such as Edwardsville, and Collinsville, presumably as a result of the increased availability and demand for rental housing available in more urbanized areas (Figure A.24). (32)

Figure A.24: Percent of owner occupied housing in 2012 by census block in the Canteen-Cahokia Creek watershed. (32)



Land Use/Land Cover

Land use/land cover data for the Canteen-Cahokia Creek watershed was collected from the 2011 National Land Cover Database (NLCD). Cultivated crops are the most common land use in the watershed at 13,425 acres or 24% (Table A.19). The second most common land use in the watershed, deciduous forest, accounts for 22% of the total watershed area, or approximately 12,188 acres. Other common land uses include developed, open space (9,865 acres, 18%), developed, low intensity (9,136 acres, 17%), and developed, medium intensity (3,544 acres, 6%). Urbanized areas are distributed throughout the watershed, but the largest urbanized area is located in the center portion of the watershed (Figure A.25) around Collinsville. Other land use areas that are a small percentage of the total watershed include high intensity development, open water, barren land, grassland/herbaceous, pasture/hay, woody wetlands, and emergent herbaceous wetlands.

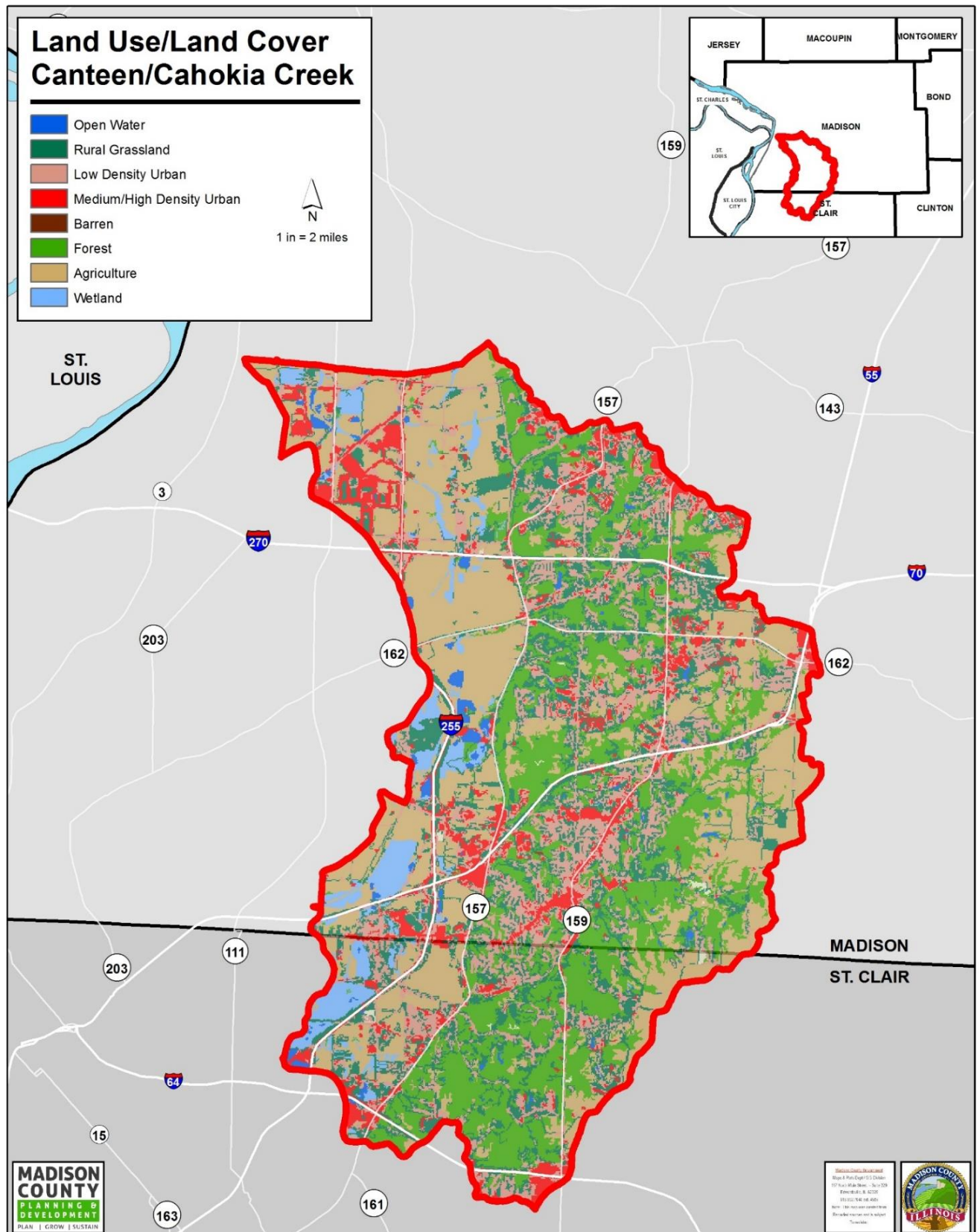
See Data Tables section for a detailed breakdown of land use by HUC14.

Table A.19: 2011 land use/land cover classifications and acreage in the Canteen-Cahokia Creek Watershed.

Land Use	Description	Area (acres)	Percent of watershed (%)
Cultivated Crop	Areas used for the production of annual crops, such as corn and soybeans. Crop vegetation accounts for greater than 20% of total vegetation. Includes all land being actively tilled.	13,425	24%
Deciduous Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of tree species shed foliage with seasonal change.	12,188	22%
Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces cover <20% area. These areas most commonly include large-lot single family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	9,865	18%
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 20-40%	9,136	17%
Developed, Medium	Areas with a mixture of constructed materials and vegetation. E.g. single family houses. Impervious surfaces cover 50-79%	3,544	6%
Hay/Pasture	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed of hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for >20% of total vegetation.	2,623	5%
Woody wetlands	Areas where forest or shrub land vegetation accounts for >20% of vegetative cover and the soil or substrate is periodically saturated or covered with water.	2,015	4%
Developed, High Intensity	Highly developed areas where people reside or work in high numbers. E.g. apartment complexes, row houses, commercial /industrial. Impervious surfaces cover 80-100% area.	1,257	3%
Open Water	Areas of open water, generally with <25% of vegetation or	678	1%

Land Use	Description	Area (acres)	Percent of watershed (%)
Barren Land	Areas of bedrock, desert pavement, scarps, and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	9	0%
Emergent herbaceous wetlands	Areas where perennial herbaceous vegetation accounts for >80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	216	0%
Evergreen forest	Areas dominated by trees generally greater than 5 meters tall, and >20% of total vegetation cover. More than 75% of the tree species maintain leaves all year. Canopy is never	8	0%
Herbaceous	Areas dominated by graminoid or herbaceous vegetation, generally >80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be	88	0%
Mixed forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of	0	0%
Shrub/Scrub	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation.	0	0%
Grand Total		55,052	100.00%

Figure A.25: Land use/land cover categories in the Canteen-Cahokia Creek watershed. (33)



Forest

Mixed, deciduous forest in the watershed contains a wide variety of tree species. On the uplands, dominant species include oaks and hickories. In the floodplains, water-tolerant species such as silver maple, cottonwood, sycamore, pecan, box elder and ash tend to dominate. Forest currently covers approximately 21% of the Canteen-Cahokia Creek watershed. (12)

Davey Resource Group conducted an analysis of tree cover in Madison and St. Clair counties in 2018 as part of a U.S. Urban Forestry grant with Heartlands Conservancy. This analysis included an assessment of "priority planting locations", created in GIS 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. The remaining planting space was ranked into five (5) classes ranging from Very Low to Very High planting priority. The ranking criteria used included proximity to hardscape, canopy fragmentation, slope soil permeability, and soil erosion factor (K-factor). In the Canteen-Cahokia Creek watershed, there were 489,657,257 sq ft of "high" and "very high" priority planting areas, with 111,154,205 sq ft of these within municipal boundaries. (34)

Wetlands

Historically, Illinois lost 90% of its wetlands between the 1780s and 1980s, primarily as a result of farmland being drained for agriculture. The National Wetlands Inventory (NWI) represents the current extent—the approximate location and type of wetlands in the United States—as determined using aerial imagery. Figure A.26 shows the wetlands in the Canteen-Cahokia watershed as reported in the NWI.

In the future, this area may be covered by NWIPlus, an enhanced National Wetlands Inventory database that includes attributes related to ecological functions. These functions include surface water detention, streamflow maintenance, sediment and particulate retention, carbon sequestration, shoreline stabilization, and provision of fish and shellfish habitat.

Wetlands mitigation importance values and wetland restoration importance values were created for the watershed by the Missouri Resource Assessment Partnership (MoRAP). Several layers of data—especially topography, soil type, and land cover—were used to create maps of existing wetlands (which it is highly important to protect) and areas that were formerly wetlands (which it would be highly beneficial to restore). This work has been done previously for other areas in this region, as seen in the 2013 report by MoRAP, "Ecological Approach to Infrastructure Development: Wetlands Mapping and Analysis for the Mississippi and Mississippi River Floodplains."

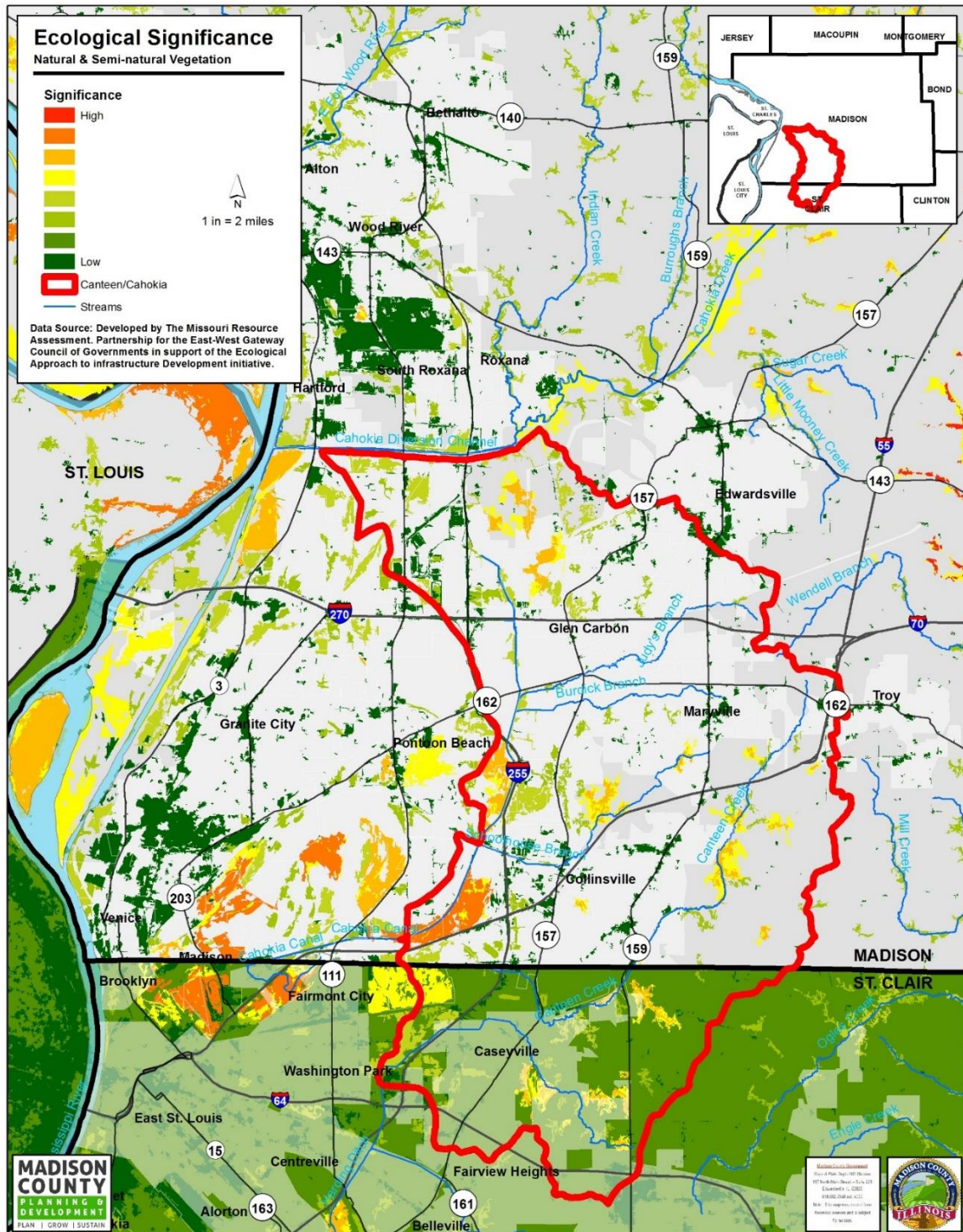
According to the NWI, freshwater forested/shrub wetland is the most prevalent wetland type in the project area (Figure A.26), with a few lakes and freshwater emergent wetlands present as well. Field checks are needed to more accurately assess the extent of wetlands in the watershed and support the general inventory provided by the NWI. Approximately 2,659 acres of the Canteen-Cahokia Creek watershed currently contains wetlands.

Ecological Significance

MoRAP and the East-West Gateway Council of Governments (EWG) created an ecological significance GIS data layer for EWG's eight-county planning region in 2010. The attribute variables important to ecological significance included the results of existing aquatic conservation assessments, vegetation type, vegetation patch size, natural diversity, occurrence of rare species, and land ownership (public/private). Eight tiers of importance were identified from high to low ecological significance.

In the Canteen-Cahokia Creek watershed, areas of moderate to low ecological significance exist throughout the watershed in both Madison and St. Clair Counties. There are a few locations of higher ecological significance in the watershed, most noticeably in the southwestern portion (Figure A.27). (36)

Figure A.27: Ecological significance attributes (out of eight tiers of importance) calculated by the MoRAP and EWG for the Canteen-Cahokia Creek watershed.



Threatened and Endangered Species

Ten animal and plant species are listed as threatened, endangered, or proposed as threatened in the counties included in the study area. The most likely present species include the Northern long-eared bat, the decurrent false aster, and the eastern prairie fringed orchid. A full list of species is shown below in Table A.20.

Table A.20: Threatened and endangered species listed by the U.S. Fish and Wildlife Service as being present in one or more of the counties in the Indian-Canteen-Cahokia watershed. (37)

Species	Status	Range	Habitat
Mammals			
Indiana Bat (<i>Myotis sodalist</i>)	Endangered	Potential habitat statewide; Known occurrences in 28 counties in Illinois, including Madison & St. Clair	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)
Northern long-eared bat (<i>Myotis septentrionalis</i>)	Threatened	Statewide	Hibernate in caves and mines – swarming in surrounding wooded areas in autumn; Roosts and forages in upland forests and woods
Birds			
Least Tern (<i>Sterna antillarum</i>)	Endangered	10 counties in Illinois, including St. Clair	Bare alluvial and dredged spoil islands
Reptile			
Eastern Massasauga (<i>Sistrurus catenatus</i>)	Proposed as Threatened	7 counties in Illinois, including Madison	Graminoid dominated plant communities (fens, sedge meadows, peatlands, wet prairies, open woodlands, and shrublands)
Fish			
Pallid Sturgeon (<i>Scaphirhynchus albus</i>)	Endangered	7 counties in Illinois, including Madison & St. Clair	Large rivers
Mussels			
Spectaclecase mussel (<i>Cumberlandia monodonta</i>)	Endangered	6 counties in Illinois, including Madison	Large rivers in areas sheltered from the main force of the current
Crustaceans			
Illinois cave amphipod (<i>Gammarus acherondytes</i>)	Endangered	2 counties in Illinois, including St. Clair	Cave streams in Illinois sinkhole plain
Plants			

Species	Status	Range	Habitat
Decurrent false aster (Boltonia decurrens)	Threatened	20 counties in Illinois, including Madison & St. Clair	Disturbed alluvial soils
Eastern prairie fringed orchid (Platanthera leucophaea)	Threatened	82 counties in Illinois, including Madison & St. Clair	Mesic to wet prairies
Leafy prairie clover (Dalea foliosa)	Endangered	9 counties in Illinois, including Madison	Prairie remnants on thin soil over limestone

Vegetation

The American Bottom River Corridor Resource Inventory developed by Southwestern Illinois RC&D, Inc., Southwestern Illinois GIS Resource Center, Greenway Network, St. Charles Rivers & Streams Project with funding provided through the IDNR C2000 Ecosystem Partnership Program, included a vegetation survey at McDonough Lake (Canteen-Cahokia Creek watershed). (38) This data is shown in Table A.21.

Table A.21: Vegetation Survey Compilation Matrix – McDonough Lake, 2000s.

	McDonough Lake
Species	
Prickly lettuce	X
Henbit	X
Dandelion	X
Plantain	X
Corn Salad	X
Thistle	X
Dock	X
Mullein	X
Buttercup	X
Ragweed	X
Milkweed	X
Hydrophylaceae sp.	X
Bladder Campion	X
Yellow Hop Clover	X
Yellow Sweet Clover	X
White Sweet Clover	X
White Clover	X

Wildlife

The American Bottom River Corridor Resource Inventory developed by Southwestern Illinois RC&D, Inc., Southwestern Illinois GIS Resource Center, Greenway Network, St. Charles Rivers & Streams Project with funding provided through the IDNR C2000 Ecosystem Partnership Program, included a wildlife survey at McDonough Lake (Canteen-Cahokia Creek watershed). (38) This data is shown in Table A.22. The report also contains a cumulative wildlife habitat assessment matrix for McDonough Lake.

Table A.22: Wildlife Survey Compilation Matrix for McDonough Lake, 2000s.

	McDonough Lake
BIRDS: Species	
Blue Wing Teal	X
Widgeon	X
Canada Goose	X
Red Winged Black Bird	X
MAMMALS: Species	
White Tailed Deer	X
REPTILES & AMPHIBIANS: Species	
Bull Frog	X
Chorus Frog	X
Leopard Frog	X
MACROINVERTEBRATES: Species	
Midge Fly Larvae	X
Scuds	X
Dragon Fly	X
Right Handed Snail	X
Leeches	X
Mosquito Larvae	X
Caddisfly	X

Fish

The Illinois Natural History Survey (INHS) keeps records of fish sampling in Illinois. Samples were taken in the Indian-Cahokia Creek watershed at three locations each on the Cahokia Canal and Indian Creek, two locations on Cahokia Creek, and one location each on the Cahokia Diversion Canal and Canteen Creek. Sampling occurred in 1966, 1973, 1978, 1998, 2005 and 2007. (39) Twenty-one species of fish were found, and 124 individuals collected. Six of the 16 species are tolerant of various environmental perturbations, three are moderately tolerant, and two are moderately intolerant (the other five were not rated by U.S. EPA). (40)

The 2005 Mississippi South Central Basin Fish Community Survey collected data on fishes, macroinvertebrates, habitat, and water quality at 18 sites on 15 streams in Macoupin, Madison, St. Clair, Monroe, and Randolph counties in southwestern Illinois. (41) Cahokia Creek, Cahokia Canal, Cahokia Diversion Channel, Indian Creek, and Canteen Creek were sampled. Table A.23 shows the fish sample data for these sites in 2005, and Index of Biotic Integrity (IBI) scores for 2005 and 1998.

Sample locations:

- Cahokia Canal – JN-02 (Sand Prairie Rd Br., 3 mi. W Collinsville)
- Canteen Creek – JNA-01 (Sand Prairie Rd Br., 3 mi. W Collinsville)
- Canteen Creek – JNA-02 (Rte 157 Br., Caseyville)
- Cahokia Creek – JQ-03 (Renken Rd. Br., 4 mi. NE Prairietown)
- Cahokia Creek – JQ-05 (Old Alton-Edwardsville Rd. Br., NW edge Edwardsville)
- Cahokia Diversion Channel – JQ-07 (Oldenburg Rd. N of New Poag Rd., 2 mi. S Hartford)
- Indian Creek – JQA-01 (Rt. 143 br., 2.5 mi. E Roxana)

Table A.23. Fishes collected by all methods in the Mississippi South Central Basin in 2005, with IBI scores from 2005 and 1998.

COMMON NAME	STATION CODE						
	JN-02	JNA-01	JNA-02	JQ-03	JQ-05	JQ-07	JQA-01
Gizzard shad					2	143	
Carp		2		1	7	11	7
Golden shiner				1			
Creek chub	5	69	94	64			1
Central stoneroller				376	87		
Suckermouth minnow				24	19		
Spotfin shiner					7		
Red shiner	2	54	30	62	232		7
Red shiner x Spotfin shiner hybrid					29		4
Red shiner x Notropis sp. hybrid			1				
Fathead minnow	1	3					
Bluntnose minnow				60	10		6
Emerald shiner			2				
Bigmouth shiner		211	4	644			
Sand shiner		1575	121	290	96		11
White sucker	113	272	27	20	1		25
Shorthead redhorse					19	7	
Golden redhorse				2	7	4	
Yellow bullhead		3	8	4	2		2
Flathead catfish					6	2	
Blackstripe topminnow				12	12	1	1
Mosquitofish		1	2		2		
White crappie					5		
Largemouth bass	6	1		3	27	17	3
Green sunfish	5	1	19	5	14	9	12
Bluegill x Green sunfish hybrid	1				1	2	
Green sunfish x Orangespotted sunfish hybrid						2	
Bluegill	8	5		1	13	10	4
Pumpkinseed				3			
Orangespotted sunfish					2	24	
Walleye	1						
Slenderhead darter					16	1	
Logperch				2	24		1
Orangethroat darter							
Freshwater drum						4	1
Total	142	2197	308	1574	640	237	85
IBI score (2005)	17	29	35	46	54	41	27
IBI score (1998)	18	NA	23	26	32	NA	24

Note: IDNR data from 2015 shows the presence of Asian carp species (grass carp, bighead carp, and silver carp) in streams in the watershed – an increase from 0 in 1998 and 2005.

Crustaceans

The INHS Crustacean Collection database keeps records of crustaceans sampled in Illinois. Crustaceans were sampled at seven locations in the Cahokia Creek watershed. Sampling occurred in 1973, 1974, 1975, and 1977. Four species of crustaceans were found and 10 individuals collected. (42) Due to the age of this data, additional research is needed to confirm or refute the presence of crustaceans in the watershed.

Mussels

The INHS Mussel Collection database keeps records of mussels sampled in Illinois. Mussels were sampled at five locations in the Cahokia Creek watershed. Sampling occurred in 1999, 2005, and 2010. Eight species were found, and more than 12 individuals collected. (43) Illinois RiverWatch volunteers found no Zebra mussels at the sites they monitored in the watershed between 1996 and 2014; however, they did find Native mussels and Finger Nail Clams. (44)

Livestock and Domestic Animals

Animal (livestock) data is available from the USDA 2012 Agricultural Census database at the county level (Table A.32). (45) The watersheds have no Concentrated Animal Feeding Operations (CAFOs) according to the IEPA data layer in the Resource Management Mapping Service (RMMS). (46)

Table A.2: Livestock in Madison and St. Clair Counties as of 2012.

Livestock	Madison County		St. Clair County	
	Farms	Head	Farms	Head
Cattle and calves	285	11,044	142	7,280
Hogs and pigs	14	8,885	114	4,438
Sheep and lambs	33	413	40	729
Goats	30	542	40	
Equine	170	1,065	97	942
Poultry	87		65	

Agricultural Land Use/Land Cover

Illinois, and the Cahokia Creek watersheds, lie at the heart of the “Corn Belt.” The area’s gentle topography, moderate, wet climate, and location adjacent to the Mississippi River support agricultural success. Furthermore, the thick layer of loess on uplands in the watershed provides abundant farmland. Besides mineral content, much of the soils’ richness comes from layers of organic matter from the area’s historic vegetation, forest, and tallgrass prairie. As a result of intensive row crop agriculture on upland fields, most of the original top soil has been lost to erosion. It is common in many crop fields to find that 50 to 90% of the original top soil layer is gone, and farmers are increasingly farming the heavier clay subsoils. (17) The delivery of sediment to downstream water bodies is an ongoing water quality problem. Some farmers in the watershed have enrolled in land conservation programs such as the Conservation Reserve Program (CRP) to protect highly erodible soils.

The pressures of urbanization have led to encroachment on/conversion of farmland in Illinois over time. There are fewer farms and fewer acres in agricultural production in the state than at any time since the 1982 USDA’s Agricultural Census. Between 1997 and 2003, 50,000 acres was converted to urban use in the Metro Area of St. Louis, which includes Madison County, however the portion of farmland converted to urban use in Madison County is unknown. The population, while relatively stagnant in overall size, shifted eastward onto larger lots and “farmettes,” but often did not take up farming. (12) The Cahokia Creek watersheds appear to have a lower proportion of owner-farmers than southwestern Illinois as a whole, as much of the land is rented out to be farmed (based on anecdotal information).

The Howard G. Buffett Foundation and Conservation Technology Information Center conducted a Cropping Decisions Survey in September 2010, sending a questionnaire about crop cultivation activities to farmers in many states. (47) Of all the states, the heaviest concentration of responses from this survey came from Illinois (111 responses). The following are data from the Illinois participants that likely hold true for the farm activities in the Cahokia Creek watersheds.

- 76% of participants had never used cover crops; only 7% currently use cover crops.
- One third of participants are not interested in trying cover crops.
- Many participants doing continuous no-till thought they are doing enough.
- Soil erosion control is major reason to consider cover crops and characteristic most desired in a cover crop.
- Time required for increased management and cost of cover crop seed are predominant challenges to managing cover crops.
- Narrow window to get planted is a major barrier to using cover crops; many are concerned about the soil not drying out in the spring.

- Top trusted sources for information about cover crops are: a successful farmer using cover crops, extension and agribusiness.

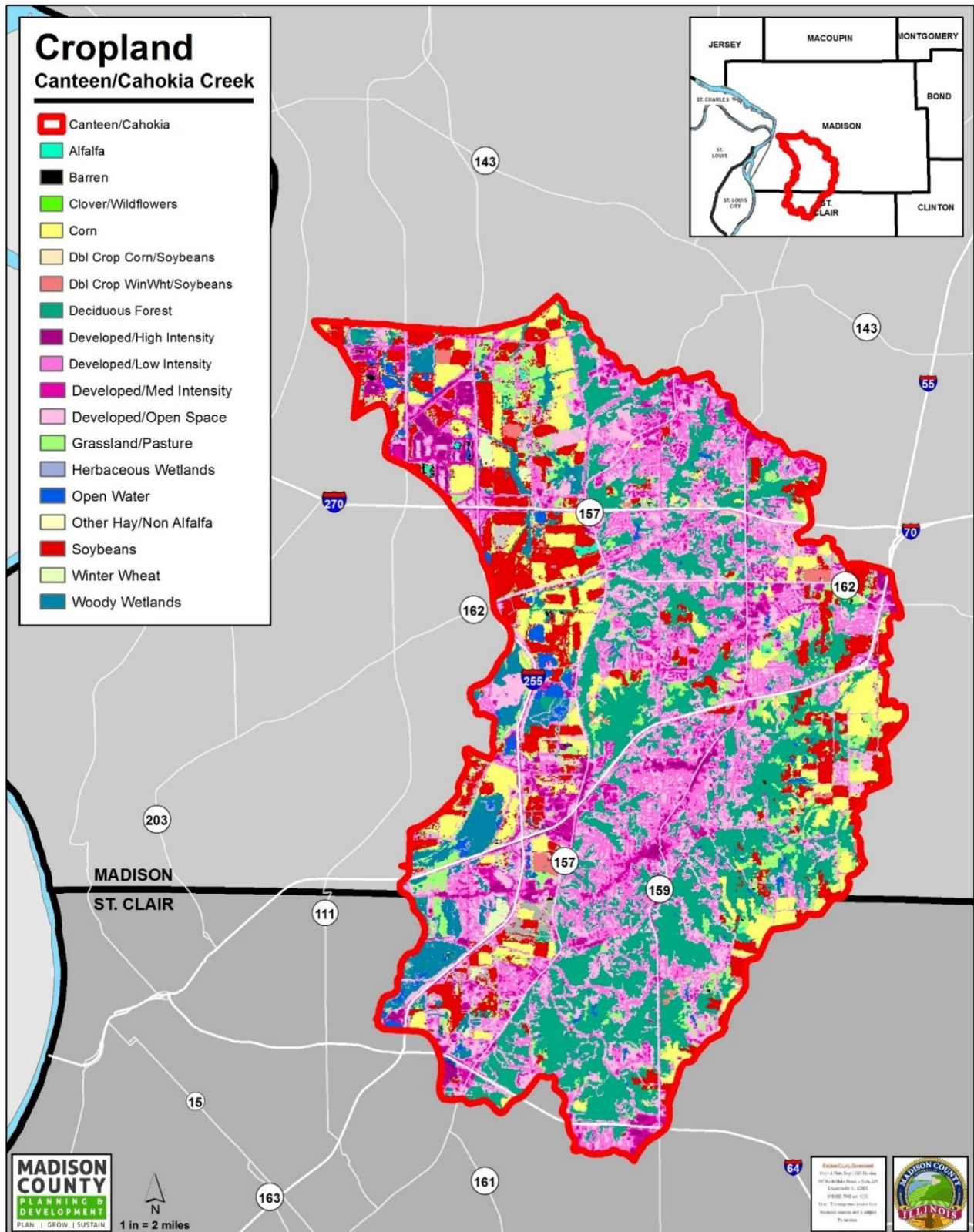
The Canteen Creek-Cahokia watershed acreage of land in agricultural use is 16,048 acres (29%), of which 24% is used for cultivated crops and 5% is used for hay/pasture (Table A.24). Corn, soybeans, and wheat are grown extensively in the watershed. Sorghum, horseradish, sweet corn, tomatoes, onions, potatoes, berries, and fruits are also grown. The average farm size in the two counties (Madison and St. Clair) is 330 acres while the median size is 92 acres, indicating that there are a few very large farms. Madison County farms are typically smaller than farms in the other two counties.

Table A.24: Data about agriculture in Madison, and St. Clair counties.

Land Use	Madison	St. Clair
Farms	1,110	732
Land in farms (acres)	307,135	251,931
Average size of farms (acres)	277	344
Median size of farms (acres)	66	94
Total cropland (acres)	276,513	227,432
Irrigated land (acres)	2,364	24
Avg market value of ag products sold per farm (dollars)	\$127,692	\$162,816
Average net farm cash income (dollars)	\$31,474	\$39,797
Farms harvesting corn for grain	491	390
Acres farmed for corn for grain	116,881	98,610
Farms with hired farm labor	286	283
Number of hired farm labor workers	1,328	932
Farms enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs	179	124
Land enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs (acres)	3,785	2,661

In 2011 (the most recent year for which detailed data is available), corn and soybeans were the major crops grown in the watershed, followed by double cropped winter wheat and soybeans and grassland/pasture (Figure A.28). The USDA-NASS Cropland Data Layer from 2011 also shows large areas of developed land and deciduous forest in the watershed. (45)

Figure A.28: Cropland types and land use from the 2011 USDA-NASS Cropland Data Layer for the Canteen-Cahokia Creek watershed. (48)



Open space

There are no federally owned areas of open space in the watershed. However, there are 135 areas of open space covering 5,888 acres (2.6% of the watershed). These open spaces include municipal parks, bike trails, campgrounds, and athletic fields. There are also four golf courses in the watershed, as well as the Cahokia Mounds State Historic Site which is located within the Canteen-Cahokia Creek watershed immediately east of Fairmont City. (49)

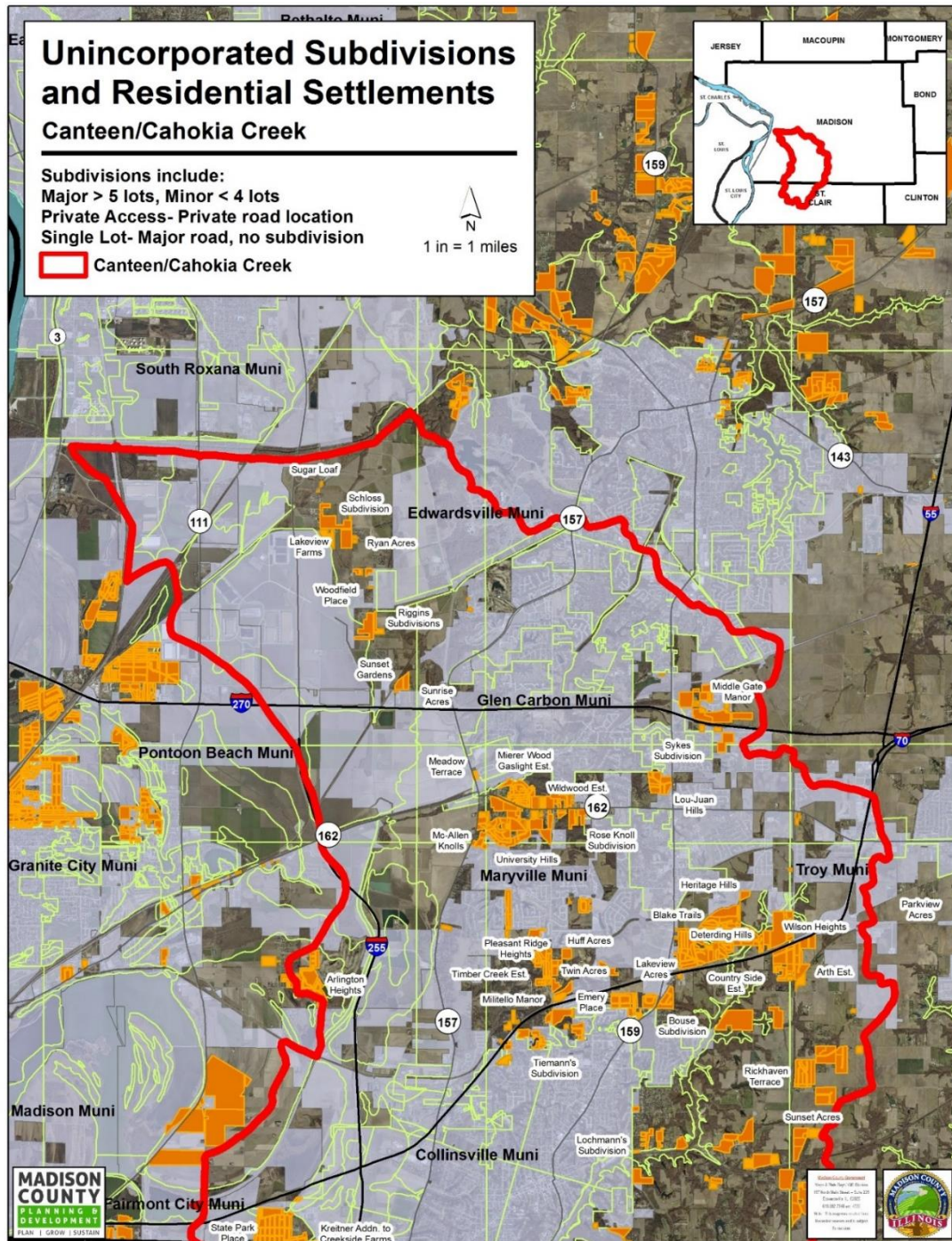
Subdivisions

Madison County is currently working on assembling data on all subdivisions in the unincorporated area, with a particular focus on those subdivided in the last 10 years. The term “developed” area includes major and minor subdivisions, private access subdivisions, single lot subdivisions, and single lot additions. Plat years are recorded for some, but not all, major and minor subdivisions.

Canteen-Cahokia Creek Watershed

The total “developed” area in the watershed in Madison County is 24,547 acres (43%), as shown in Figure A.29. (50)

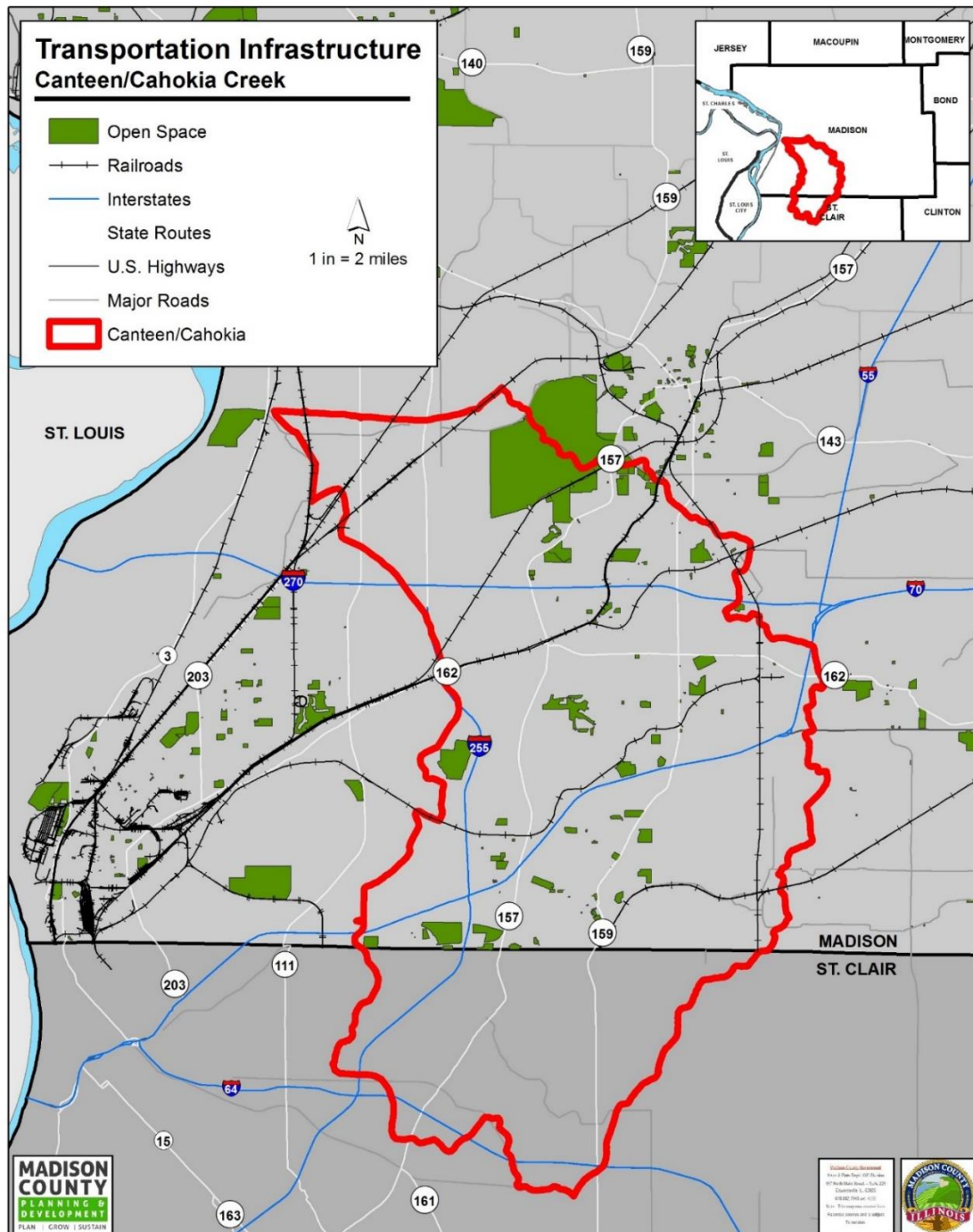
Figure A.29: Subdivisions in the Canteen-Cahokia Creek watershed in Madison County.



Transportation Infrastructure

The watershed contains several important components of southern Illinois' transportation network, including railroads, state routes and Interstates 55, 64, 70 and 255, (Figure A.29). State Routes 157, 159, and 162 run through the watershed, as well as multiple railroad lines. Railroads and open spaces identified by the East-West Gateway Council of Governments are only available for Madison County. Some railroads are not currently in use.

Figure A.29: Transportation infrastructure and open space in the Canteen-Cahokia Creek watershed.



Cultural/Historic Resources

Cahokia, a pre-Columbian Native American city, covered about six square miles at its population peak (1200s CE) and was the largest and most influential urban settlement in Mississippian culture. Many earthen mounds were built by those peoples in and around Cahokia, including some in the Cahokia Creek watersheds. They were identified by Heartlands Conservancy in “The Mounds – America’s First Cities: A Feasibility Study” in 2014, which mapped over 550 mound sites in the St. Louis region. Many mound sites were identified by this study in these two watersheds. (51)

The primary mound center in the watershed is located in Mitchell, Illinois, and is currently designated as a National Registered Historic Site. It is owned privately and by the State of Illinois (Illinois Department of Transportation). In ancient times, the town of Mitchell was a large, residential and religious node that encompassed the core of surrounding communities. It was a place where people lived, interacted, worshiped, and died.

Table A.25: Information about the Priority Mound Site in Mitchell.

National Park Service (NPS) criteria as related to Priority Mound Sites	Priority Mound Site: Mitchell, IL
Current designation	National Registered Historic Site
Potential NPS designation	Part of National Trail with Cahokia
Ownership	Private/State (IDOT)
Opportunities	Route 66, existing mound interpretation
Primary challenge	Programming, land acquisition

Route 66, also known as the Mother Road, was one of the original highways in the U.S. highway system. First established in 1926, the highway became one of the most famous roads in America and was a major route for those migrating west during the Dust Bowl of the 1930s. Today, much of the road has been designated as a National Scenic Byway and given the name “Historic Route 66.” The road ran through the watershed, passing through Collinsville and Troy. The route changed considerably over the years, including and excluding these places at different times. Many municipalities still make the most of this history, welcoming motorists through the year and in mid-June for the Illinois Route 66 Mother Road Tour. Historic Route 66 also passes through Edwardsville. Edwardsville marked this heritage with “The Edwardsville Route 66 Conference” in October 2015. (52)

Mound sites are scattered throughout the Canteen-Cahokia creek watershed. There are 31 distinct mound sites, either wholly or partially located in the watershed, with a higher concentration in the western portion.

Landfills

There are 26 landfills in the Canteen-Cahokia Creek watershed, according to the data layer hosted by the Illinois Resource Management Mapping Service (2018). Six of these are in the subwatershed that drains to Little Canteen Creek, that drains to Schoenberger Creek North (Harding Ditch), where the Illinois EPA 303(d) listed impairment "cause" of landfills was identified in 2018. (53)

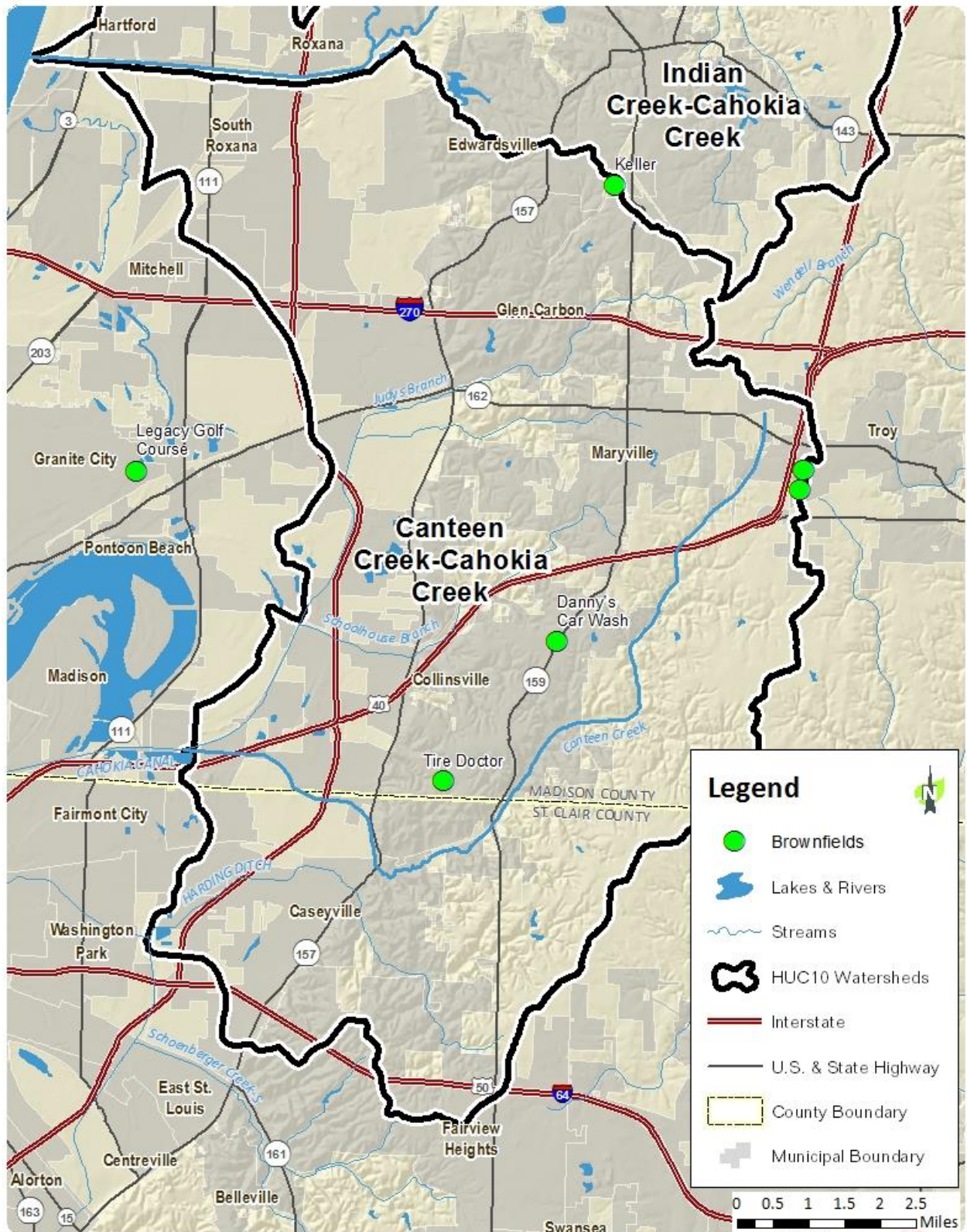
Brownfields

Five brownfield sites were identified by Madison County in 2016 in the Canteen-Cahokia watershed. The locations of these sites are shown in Figure A.30. Only three of these sites had business names and other information associated with them – see Table A.26.

Table A.26. Brownfield sites in the Canteen-Cahokia Creek watershed.

SITE	ADDRESS	CURRENT USE	PAST USE	EOI #	GRANT TYPE	GRANT PHASE	GRANT HOLDER	DATE CREATED
Danny's Car Wash	1713 Vandalia St			4140.01	PP	Phase I	SWIDA	2/17/2016
Tire Doctor	535 Saint Louis Rd			4140.02		Phase I	SWIDA	2/17/2016
							MCCD	4/13/2016
							MCCD	4/13/2016
Keller	6507 Center Grove Rd.	Keller Construction			HS	Phase I	MCCD	10/17/2016

Figure A.30: Brownfield sites identified by Madison County. Data delivered 2016.



Future land use/land cover predictions

Changes to land use/land cover in the watershed were projected from municipal Comprehensive Plans, where available. Using these plans, percentages of the different land uses under a future build-out scenario were estimated for the 1.5-mile zone outside each municipality. A 1.5-mile buffer around the municipalities was created in ArcGIS, a Geographic Information System (GIS) software program, and the new land use/land cover percentages were applied to the buffer. Land use/land cover percentage changes were assumed to be consistent throughout the county. The remaining land outside the 1.5-mile zone was considered to retain its current land use/land cover designations. The resulting land use/land cover predictions represent a full build-out scenario for the municipalities in the watershed, while retaining a conservative estimate of zero land use/land cover change in the unincorporated area.

The largest predicted change in land use/land cover pertains to agricultural land, with a 26,156 acre or 50% decrease in cultivated crops and a 6,199 acre or 33% decrease in hay/pasture across the Canteen Creek watershed. Deciduous forest is expected to shrink by 40%. In total, approximately 46,133 acres of existing agricultural lands, wooded/herbaceous wetland, and forest is expected to be lost to development. Much of the new development will likely occur in the 1.5-mile zones around municipalities in the watershed. See Data Tables section for a detailed breakdown of future land use/land cover by HUC14.

Table A.27: Existing and predicted future land use/land cover in the Canteen-Cahokia Creek watershed.

Land Use/Land Cover Description	Land Use Code	Current Area (acres)	Current Area (%)	Predicted Area (acres)*	Predicted Area (%)	Change (acres)	Percent Change
Barren Land	31	26	0%	0	0%	-26	-100%
Cultivated crop	82	52676	42%	26520	21%	-26156	-50%
Deciduous forest	41	31453	25%	18878	15%	-12575	-40%
Developed, High Intensity	24	727	1%	2317	2%	1590	219%
Developed, Low Intensity	22	8265	7%	26343	21%	18078	219%
Developed, Medium Intensity	23	2186	2%	6968	6%	4782	219%
Developed, Open Space	21	9913	8%	31596	25%	21683	219%
Emergent herbaceous wetlands	95	30	0%	5	0%	-25	-83%
Evergreen forest	42	9	0%	5	0%	-4	0%
Hay/Pasture	81	18527	15%	12328	10%	-6199	-33%
Herbaceous	71	266	0%	148	0%	-118	-44%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	1183	1%	627	0%	-556	-47%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	475	0%	1	0%	-474	-100%

*predicted land use/land cover is based on zoning identified in the Comprehensive Plans of municipalities in the watershed for the 1.5-mile zone outside their current boundaries.

Impervious cover

Impervious cover is the surfaces of an urban landscape that prevent infiltration of precipitation and runoff into the ground. Imperviousness is a useful indicator of the impacts of urban land use/land cover on water quality, hydrology, and flooding. Runoff over impervious surfaces warms the water and collects pollutants causing receiving stream to experience a shift in plant, macroinvertebrate, and fish communities. Sensitive species can no longer thrive, and pollution-tolerant species begin to dominate. Higher impervious cover also translates to greater runoff volumes, resulting in changes to stream hydrology.

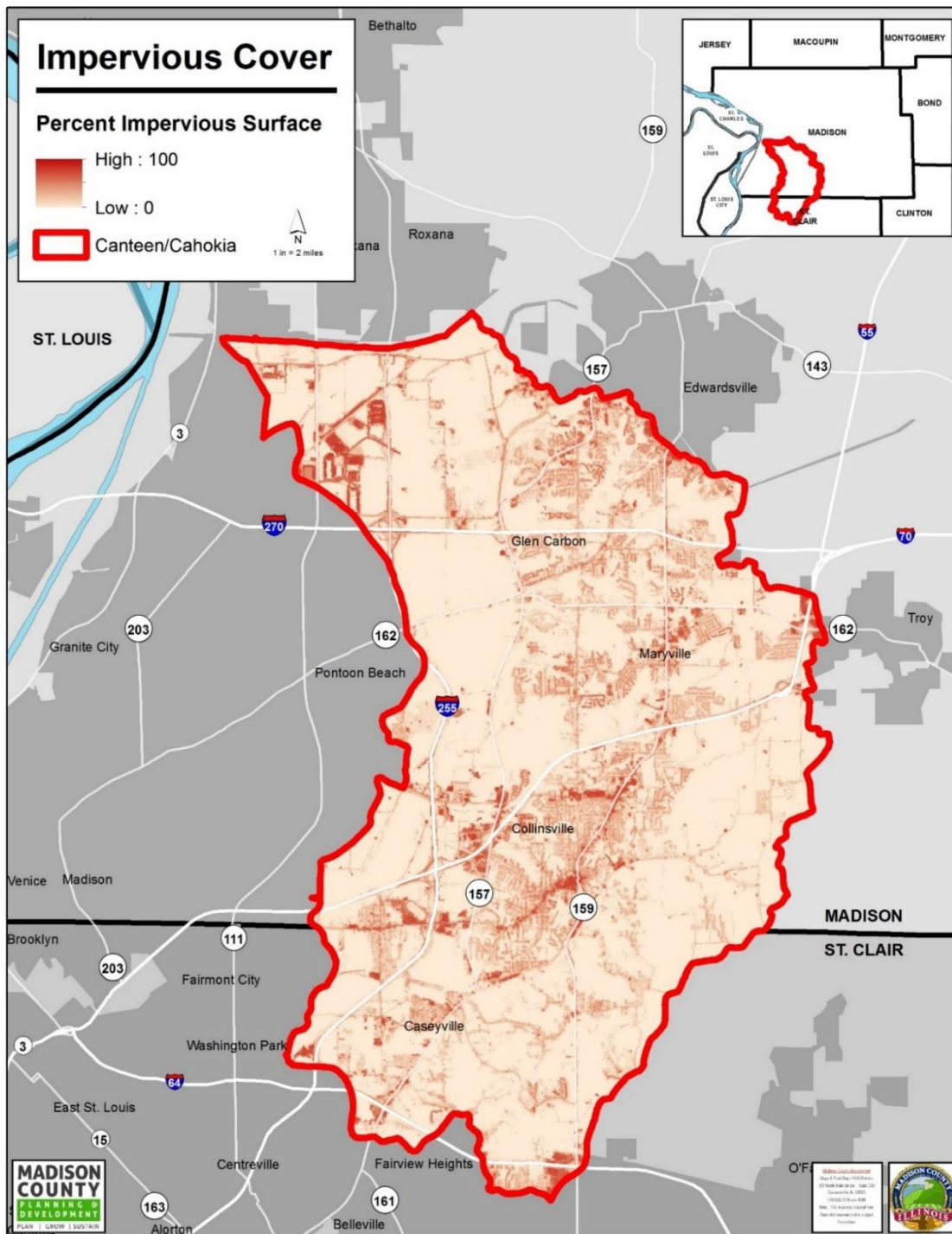
The National Land Cover Database (NLCD) Percent Developed Impervious Surface file provides nationally consistent estimates of the amount of man-made impervious surfaces present over a given area. The values are derived from Landsat satellite imagery, using classification and regression tree analysis. Values range from zero to 100 percent, indicating the degree to which the area is covered by impervious features.

In the Canteen-Cahokia Creek watershed, the mean imperviousness is 31.3% with a standard deviation of 23.6% (Table A.28). Most of the watershed is not highly impervious. However, selected areas have a lot of impervious cover, up to 100% (Figure A.31). These areas correlate with developed land use/land cover as seen in Figure A.49.

Table A.28: Existing impervious cover by HUC 14 in the Canteen-Cahokia Creek watershed, as assessed from the NLCD Percent Developed Impervious Surface dataset.

HUC14	Existing Impervious %
07140101030101	40.2%
07140101030102	30.1%
07140101030103	28.6%
07140101030104	27.0%
07140101030201	30.2%
07140101030202	27.4%
07140101030203	27.5%
07140101030301	31.9%
07140101030302	34.7%
07140101030303	29.9%
Average for whole watershed	31.3%

Figure A.31: Impervious cover in the Canteen-Cahokia Creek watershed.



Watershed Drainage

Stream Delineation

The stream reaches used in assessing stream conditions are from the National Hydrography Dataset (NHD). A reach is a continuous piece of surface water with similar hydrologic characteristics. The NHD catalogs stream reaches, giving each reach a unique 14-digit Reach Code. The first eight digits are the same as the HUC8 code for the Cahokia-Joachim watershed (07140101). The next six digits are sequential numbers that are unique within the HUC8 watershed.

The segments are listed as perennial or intermittent streams/rivers, with the exception of certain “artificial path” or “connector” segments, which represent non-specific connections between non-adjacent segments. A full table of NHD stream reaches in the watersheds can be found in the Data Tables section. In this assessment/project, the NHD stream reaches were utilized for the study’s stream units. The reaches were not subdivided further, as there was no way to assess homogenous stream conditions on a smaller scale than the NHD within the bounds of the project.

There is little existing information about the condition of the streams in the project area. To gather information about the stream reaches, geo-referenced video footage was taken on low level helicopter flights over the larger streams in the watershed. Fostaire Helicopter was selected to gather the flight data, using Red Hen software to collect and store the video in a GIS database. The video was collected during the winter (February 2016) when leaf cover was absent and vegetation was dormant in order to increase the visibility of the streams flown. A total of 134.2 miles or 17.8% of the total stream miles in the watershed were flown and videotaped. Streams named in the NHD were flown under the assumption that they were larger and represented a large portion of the drainage area of each watershed. Since these streams were larger, it was also assumed that instances of erosion, channelization, riparian area, and logjams would be easier to see on aerial imagery.

Limitations on visibility affected the collection of streambank erosion, channelization, and riparian condition data from the flight video. The video imaging works best on larger streams and streams with poor woody riparian areas. Those streams where the tree canopy completely covered the stream offered limited visibility of the stream condition, even with no leaf cover. In some instances no data was collected from the video imaging due to the inability to see the streambanks, and in others, data collection was incomplete or questionable due to poor visibility. Due to the long stream length assessed for erosion, channelization and riparian condition, field assessment was not a viable option for the watershed.

The video images were then viewed to assess five different parameters for each stream. These parameters were streambed erosion, streambank erosion, degree of channelization, condition of the riparian area, and logjams.

There are 459 NHD stream reaches in the Canteen-Cahokia Creek watershed, comprising 261.3 miles of streams. The average length of a Canteen-Cahokia Creek NHD stream reach is 0.5 miles, while the range of stream lengths is 0.0032 miles to 4.4 miles.

Streambank Erosion

As the video from the aerial survey was reviewed, areas of eroding streambank were identified and catalogued in a feature table in a GIS database. The feature table includes the degree of erosion based on Illinois EPA (IEPA) guidelines (Table A.29), the estimated length, and the location of each stream sections

determined to be eroding at a moderate or severe rate. Lengths with slight bank erosion were then determined by subtracting the length of severe and moderate erosion sections from the entire stream segment length.

The slight, moderate, and severe erosion categories were based on IEPA's guidelines for lateral recession from the IEPA Load Reduction Worksheet. (53) The very severe erosion category was not used in this assessment.

Table A.29: Lateral recession category guidelines used in classifying streambank erosion in the assessment of the video footage of aerial assessment. (54)

Lateral Recession Rate* (ft/year)	Category	Description
0.01-0.05	Slight	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang.
0.06-0.2	Moderate	Bank is predominantly bare with some rills and vegetative overhang
0.3-0.5	Severe	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross-section becomes more U-shaped as opposed to V-shaped
0.5+	Very Severe	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains and culverts eroding out and change in cultural features as above. Massive slips or washouts common. Channel cross-section is U-shaped and stream course or gully may be meandering.

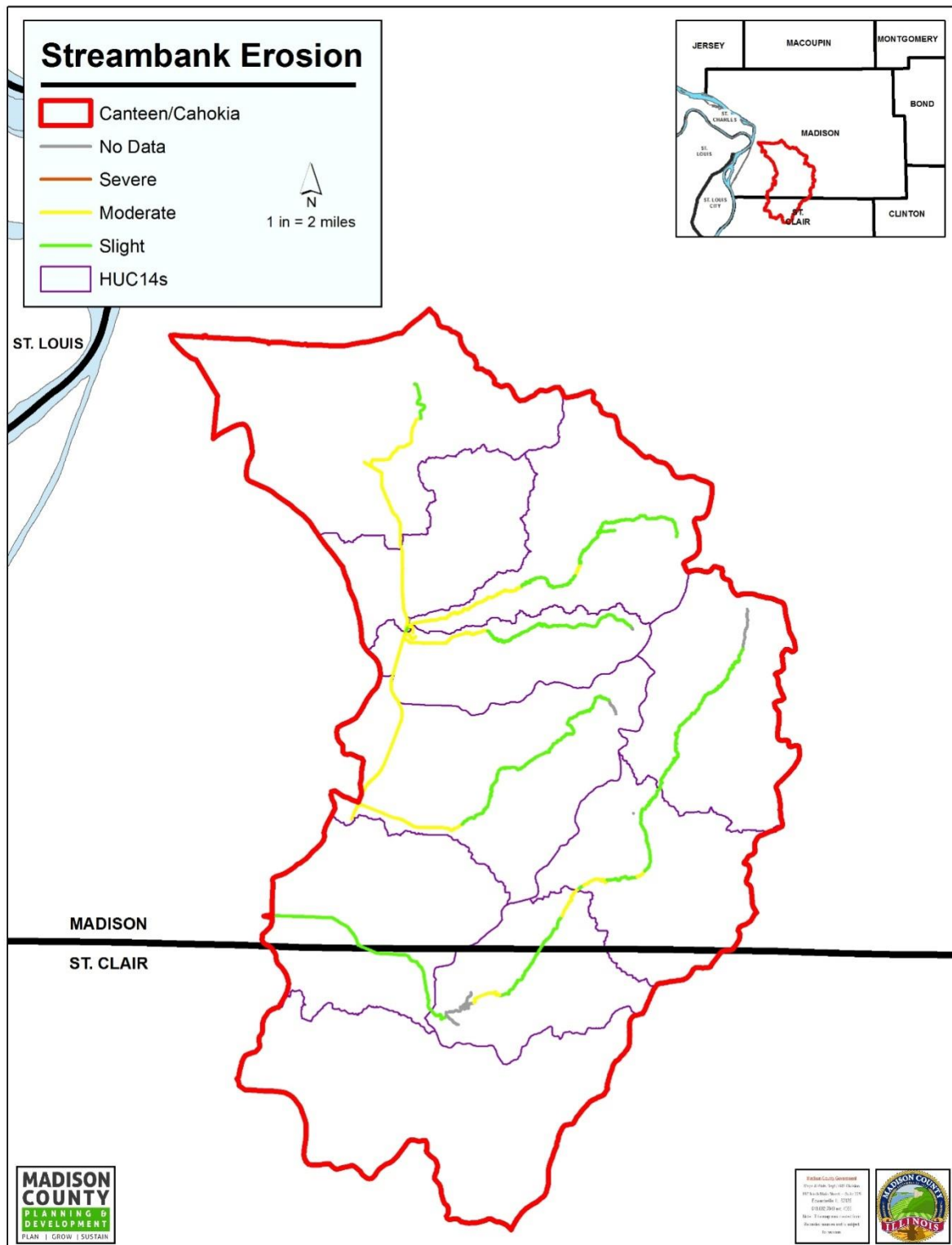
In total, 43.5 miles of streams were successfully assessed for streambank erosion using geo-referenced video footage. Of the assessed length, 60% had none or low/slight erosion, 40% had moderate erosion, and 0% had high/severe erosion (Table A.30).

Lengths of moderate and severe streambank erosion were identified throughout the watershed in tributaries and on the main branches (Figure A.32). Many headwater streams show up as having "none or low" erosion, which may be because they were left unmarked in several instances where visibility was poor and no erosion category could be assigned. Headwater streams often have a steeper gradient and may in fact have a higher degree of bank erosion due to higher velocities, even though flow is low.

Table A.30: Streambank erosion along assessed stream reaches in the Canteen-Cahokia Creek watershed.

	Stream Length Assessed (miles)	None or Low Erosion		Moderate Erosion		High Erosion	
		ft	%	ft	%	ft	%
Total	209,616	125,136		84,480		0	
Average			60		40		0

Figure A.32: Streambank erosion conditions assessed from video footage of an aerial survey of the Canteen-Cahokia Creek watershed.



Degree of Channelization

Changes in stream channelization were identified from the video and geo-referenced in a feature table. The degree of channelization between geo-referenced points was then marked the same for the sections between marked locations. Lengths of high, moderate, and low channelization were then determined by measurement between marked boundaries, using criteria based on stream straightness and evidence of man-made modifications (Table A.31).

Table A.31: Criteria used to assess degree of channelization.

Condition	Description
Low	Natural meandering stream with no obvious evidence of modification
Moderate	Not “straight” but evidence of modification to planform by human activity
High	Straight or nearly straight channelized stream segment

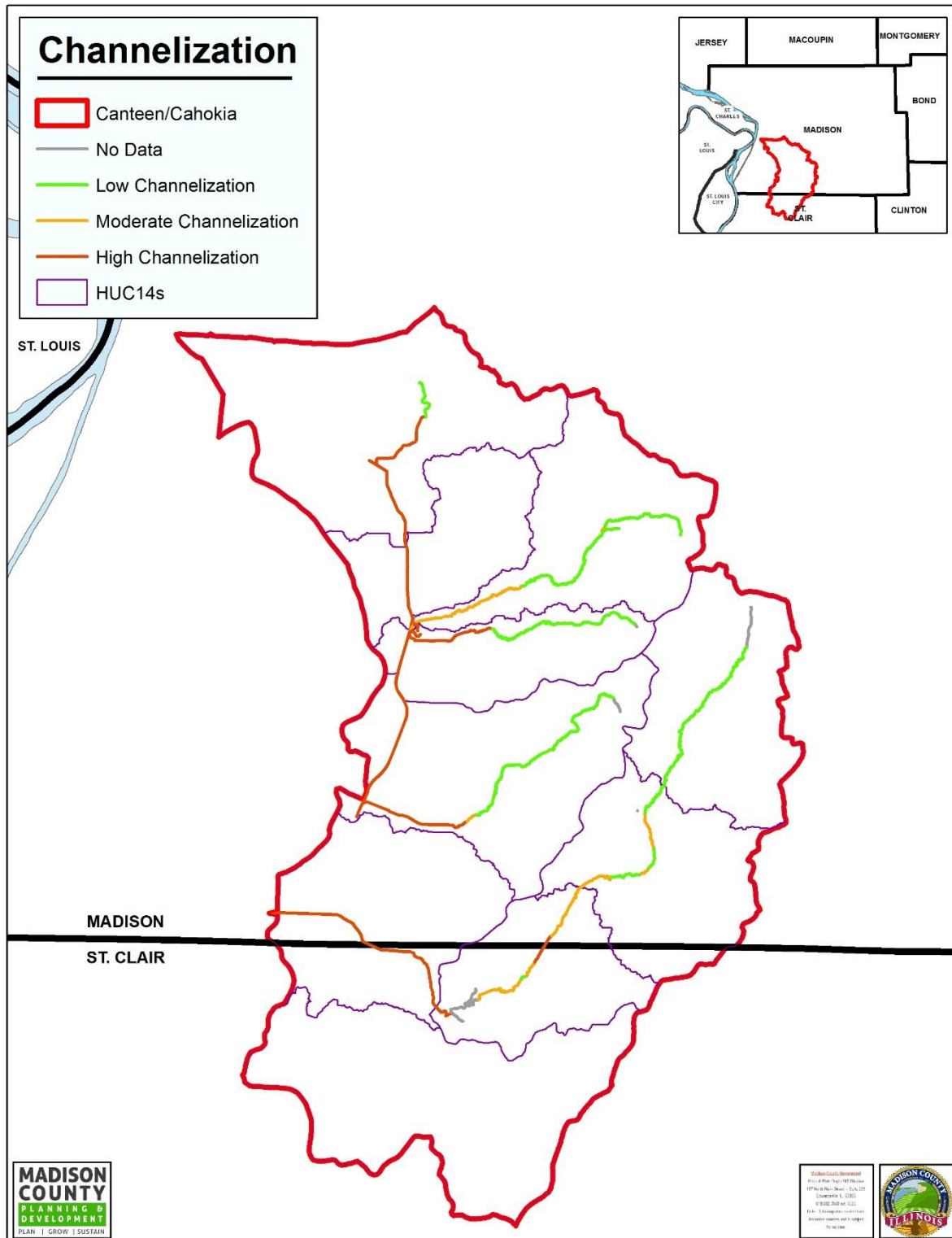
In total, 43.5 miles of streams were successfully assessed for streambank erosion using geo-referenced video footage. Of the assessed length, 43% had none or low channelization, 16% had moderate channelization, and 41% had high channelization (Table A.32).

Lengths of moderate and high channelization were identified throughout the watershed (Figure A.33). The headwaters often showed high channelization, likely because of their beginnings in farm fields as drainage ditches, where stream size is much smaller and channelization less expensive. Moderately and highly channelized streams appear to be interspersed elsewhere with lengths of low channelization.

Table A.32: Degree of channelization along assessed stream reaches in the Canteen-Cahokia Creek watershed.

	Stream Length Assessed (ft)	None or Low Channelization		Moderate Channelization		High Channelization	
		ft	%	ft	%	ft	%
Total	39.7	17.1		6.2		16.4	
Average			43		16		41

Figure A.33: Channelization condition assessed from video footage of an aerial survey of the Canteen-Cahokia Creek watershed.



Riparian Condition

Riparian condition was assessed from the video review by geo-referencing in a feature table each location where type and extent of woody cover changed. The riparian area between geo-referenced points was then considered the same for the area between marked locations. Lengths of good, fair, and poor riparian area were then determined by measurement between marked boundaries. The criteria used to assess riparian condition are based on width of vegetative cover on both sides of the waterway, extent of vegetative cover, and type of vegetation (Table A.33).

Table A.33: Criteria used to assess riparian condition.

Condition	Description
Good	Wide (minimum of two stream widths) vegetative cover with woody plants on both banks
Fair	Narrow (less than two stream widths) vegetative cover of woody plants or grass cover on both banks
Poor	No woody vegetation with narrow (< 10 feet) of grass or herbaceous cover on one or both banks

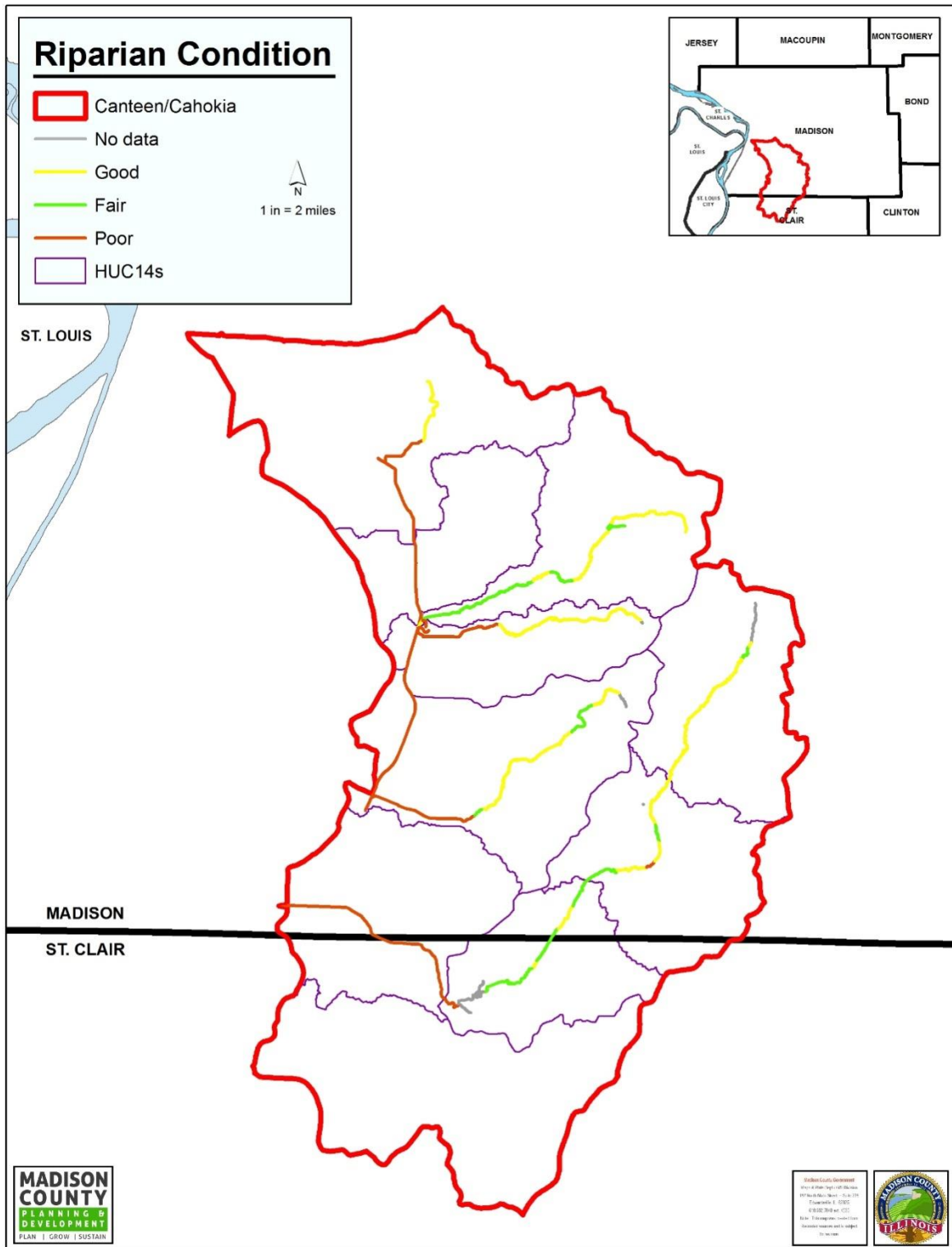
In total, 43.5 miles of streams were successfully assessed for riparian condition using geo-referenced video footage. Of the assessed length, 42% had good riparian condition, 19% had fair riparian condition, and 39% had poor riparian condition (Table A.34).

The stream lengths with good and fair riparian conditions are spread throughout the watershed (Figure A.34). Vegetative and tree cover is poor wherever farm fields or urban development extend out to or close to the streambank.

Table A.34: Riparian condition along assessed stream reaches in the Canteen-Cahokia Creek watershed.

	Stream Length Assessed (miles)	Good Condition		Fair Condition		Poor Condition	
		miles	%	miles	%	miles	%
Total	39.6	16.5		7.6		15.5	
Average			42		19		39

Figure A.34: Riparian condition assessed from video footage of an aerial survey of the Canteen-Cahokia Creek watershed.



Streambed Erosion

Streambed erosion was assessed from the video review by geo-referencing in a feature table each location where type and extent of erosion changed. Lengths of low, moderate and high streambed erosion were then determined by aerial video assessment per the conditions described in Table A.35.

Table A.35: Criteria used to assess degree of streambed erosion.

Degree of streambed erosion	Description
Low	Bedload material found deposited in stream cross-over points with evidence of frequent out-of bank flow in the adjacent floodplain. Absence of residual bed material exposed anywhere except in bottom of pools.
Moderate	Bedload material not found consistently in stream cross over locations with some evidence of residual material exposed or very near the surface in cross over locations. Evidence of out of bank flow very hard to identify (few or no trash lines over top of bank).
High	Little or no bedload found in stream cross over locations. Large areas of residual material exposed in the streambed. Trash lines primarily confined to upper portion of the bank with no evidence of out of bank flow except on rare occasions of very large storm events.

Streams in the watershed were assessed for the degree of streambed erosion during aerial assessment. There were 32 stream locations assessed in the Canteen-Cahokia Creek watershed, 81% had low streambed erosion, 16% had moderate streambed erosion, and 3% had high streambed erosion.

Table A.36: Degree of streambed erosion along assessed stream reaches in the watershed.

	Canteen-Cahokia Creek
Low Streambed Erosion	
Locations (#)	26
%	81
Moderate Streambed Erosion	
Locations (#)	5
%	16
High Streambed Erosion	
Locations (#)	1
%	3

Debris Blockages (Logjams)

Logjams alter stream hydrology, increasing the scouring effect of flow on the streambank and streambed as water is channeled around the blockage. If the logjam spans the channel, the stream is more likely to overtop and flood nearby land during times of high flow. Logjams were identified in video footage from the aerial survey.

Table A.37 and Figure A.71 identify the number and location of logjams in the Canteen-Cahokia Creek watershed, organized by HUC14.

Table A.37: Logjams identified in the Canteen-Cahokia Creek in video footage from the aerial survey (February 2016).

HUC14	Logjams identified in aerial survey (number)
07140101030101	19
07140101030102	16
07140101030103	18
07140101030104	16
07140101030201	4
07140101030202	8
07140101030203	11
07140101030301	7
07140101030302	9
07140101030303	6
Total	114

Figure A.35: Logjams in the Canteen-Cahokia Creek watershed as identified from video footage from the aerial survey (February 2016).

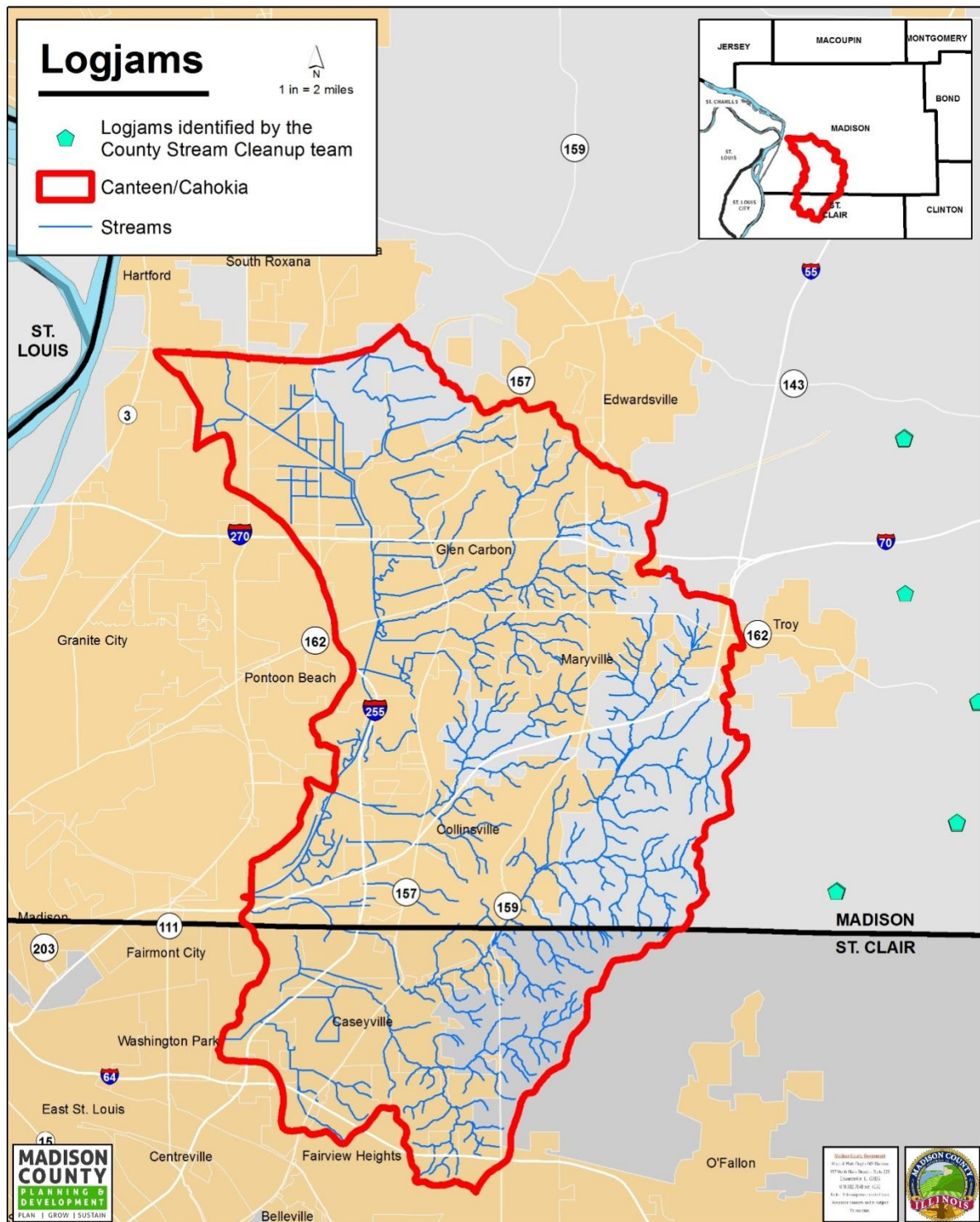


Figure A.43b. Logjams in the Cahokia Creek watershed identified by the Madison County Stream Cleanup team (2008-2009).

Ephemeral/Gully Erosion

The Illinois Department of Agriculture's periodic Soil Conservation Transect Survey gathers information about conservation tillage practices in the state. Its measure of ephemeral erosion indicates the extent of gully erosion by county, as surveyors identify fields in which ephemeral or gully erosion has occurred or is likely to occur in areas of concentrated surface water flow. According to the 2015 transect survey, St. Clair County has low ephemeral erosion (3%) while Madison County has a higher than state average (12.6%) rate of 45% as shown in Table A.37. (55)

Table A.37: Percent and number of fields with indicated ephemeral/gully erosion by county as of 2015.

County	Yes		No		Total
	%	Number	%	Number	
Madison	45	162	55	202	364
St. Clair	3	9	97	301	310
Total		171		503	674

Shoreline Erosion

There are 1,231 acres of waterbodies in the NHD in the watershed. Nine lakes in the watershed are named, covering 194 acres. The named lakes in the watershed include Pine Lake, Maryville Fishing Club Lake, Bauers Lake, and McDonough Lake. No shoreline erosion data was available for these lakes. However, the City of Maryville reported shoreline erosion on Maryville Fishing Club Lake and the City of Collinsville identified shoreline erosion on Pine Lake and the lake in nearby Woodland Park.

Levees

There are 11.87 miles of levees in the Canteen-Cahokia Creek watershed, 4.43 miles of which are sponsored and maintained by the U.S. Army Corps of Engineers (56). There are six levee systems in the watershed, the majority of which are in St. Clair County (Figures A.36 and A.37 below).

Canteen-Cahokia Creek Watershed Levee Systems: North of Edwardsville

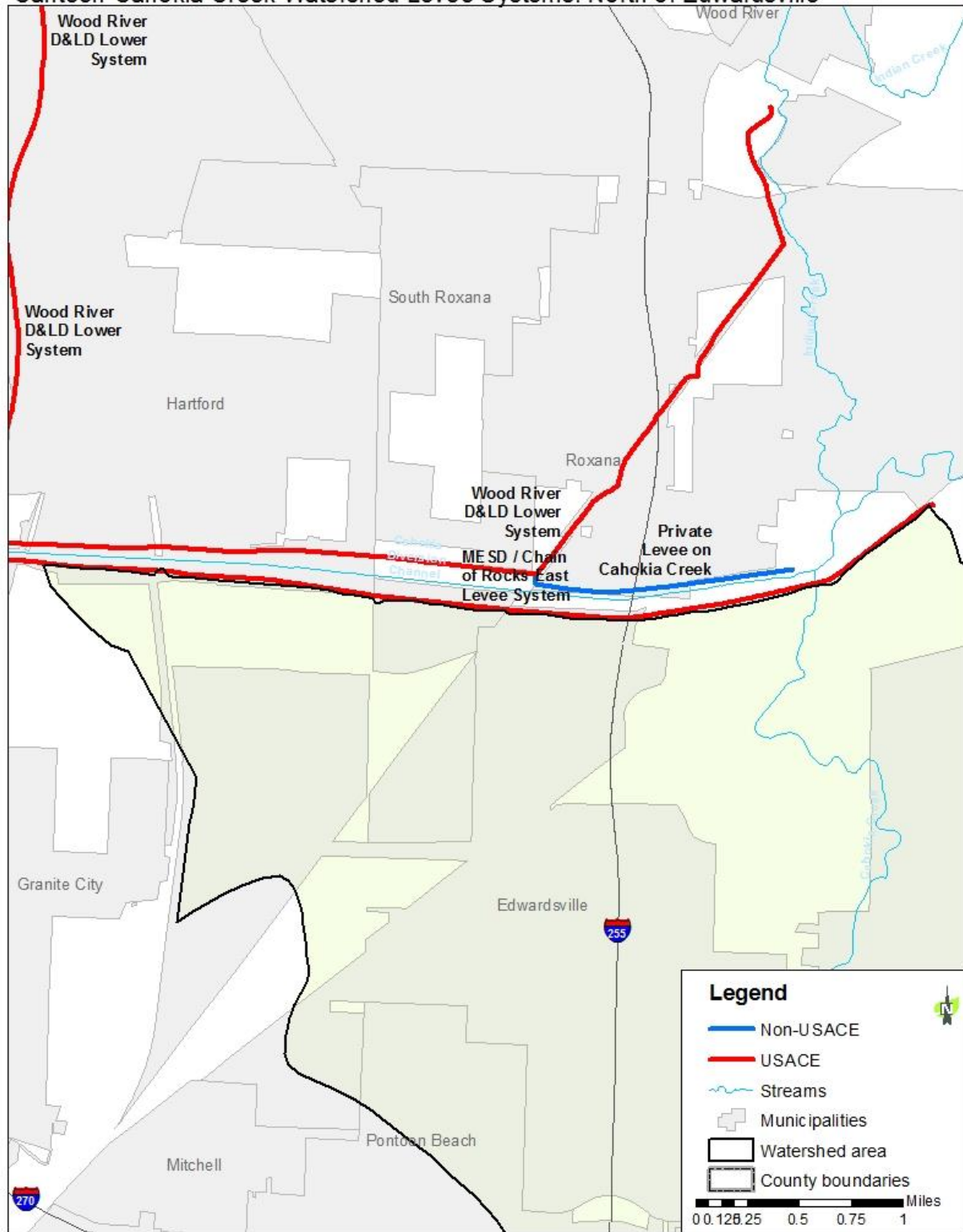


Figure A.36: Levees in the northern portion of the Canteen-Cahokia Creek watershed.

Canteen-Cahokia Creek Watershed Levee Systems: near Caseyville



Figure A.37: Levees in the southern portion of the Canteen-Cahokia Creek watershed.

Detention and Retention Basins

The U.S. Army Corps of Engineers looked at National Agriculture Imagery Program (NAIP) aerial photographs of the watershed, along with USGS topographic maps and the National Hydrography Dataset, to identify detention and retention basins. A detention basin is a low lying area that is designed to temporarily hold water while slowly draining to another location. A retention pond is designed to hold a specific amount of water indefinitely, usually leading to another location when the water level exceeds the design capacity. (56) A point was created for each basin located in or very close to a group of five or more buildings. This was in order to avoid classifying natural ponds as detention basins. With significant developed area near the basin, there was a higher likelihood that the basin had been engineered or altered by man in some way. It should be noted that detention and retention basins on agricultural land are very common, but they were not included in this inventory, partly because the Agricultural Conservation Planning Framework (ACPF) used to identify BMPs also identifies likely detention locations.

The data gathered includes whether the detention basin is in a subdivision, along with the year the subdivision was first developed and the year of latest development (from plat information from Madison County). Also noted was the presence of standing water, the number of visible inlets/outlets, whether the basin was “on-line” (on a stream or at the start of a stream) or “off-line” (outside the waterway), the type of side slope vegetation, whether the basin was already in the National Hydrography Dataset, and the accessibility of the basin from nearby roads or public land.

Site visits were made on August 15, 2016 to 13 of the 107 accessible sites identified in the two watersheds in order to determine the basins’ conditions. The sites were selected by geographic location, distributed somewhat evenly throughout the watershed, and by prioritizing basins about which the Madison County Stormwater Coordinator received complaints. On the site visits, location, type and condition of the basins were confirmed. The condition of the basin was rated and is shown in Table A.38. These ratings are somewhat subjective and based on the factors listed in Table A.39. The factors listed in Table A.39 are intended to be somewhat comprehensive and as a result, some issues such as trash, submerged inlet pipe and others show no sites with these issues within either watershed. This does not mean that there aren’t trash issues in the watersheds; however, none were observed in the few basins visited. Basins visited ranged in size between 54 acres and 2.10 acres, with an average area of 1.65 acres. All 13 retention basins were wet and no dry detention basins were visited.

Figure A.38: Images from four detention basins from site visits on August 15, 2016. Note that Madison and St. Clair counties experienced precipitation for the past 24 hours and a flash flood warning was issued.



Fifty eight (58) detention or retention basins were identified in the watershed, with the majority occurring in the eastern portion of the watershed (Table A.38, Figure A.39). Most of the basins have water in them (93.1%) and are scattered relatively evenly throughout the basin. It was much easier to identify basins containing water than dry basins, so wet basins may be overrepresented. Over half (51.7%) of the basins were already in the National Hydrography Dataset as “Lake/Pond, perennial.” Turf is the most common vegetation on the side slopes of the basins, present in 44.8% of the basins identified. Trees are present on 34.5% of the basins’ side slopes, and rock is present on 20.7% of the side slopes.

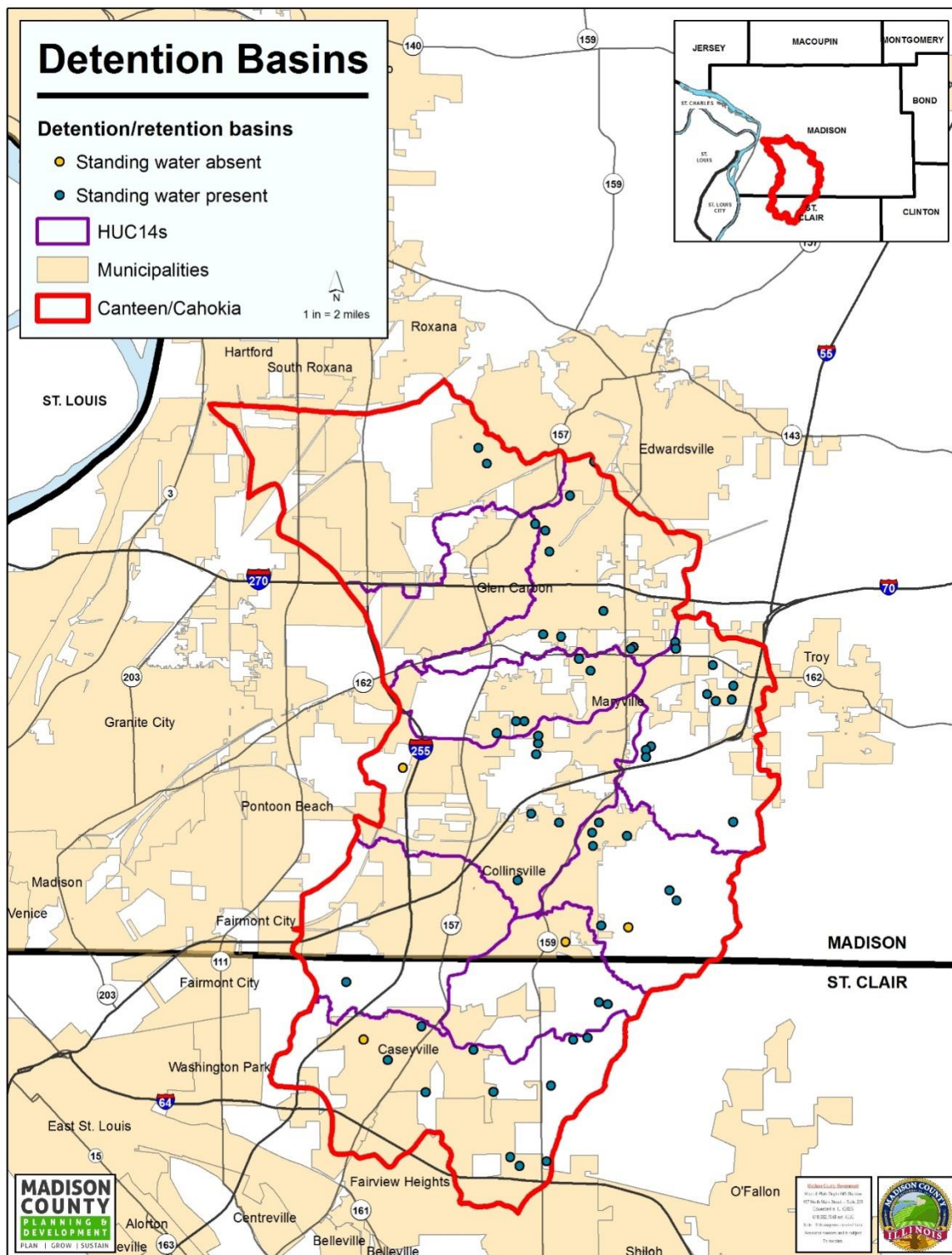
Table A.38: Number of detention and retention basins identified in each HUC14 in the Canteen-Cahokia Creek watershed.

HUC14	Number of basins identified	Number of basins visited	Condition of basins visited
07140101030104	5		
07140101030103	8	1	GOOD
07140101030102	1	1	GOOD
07140101030101	2		
07140101030201	11	3	AVERAGE
07140101030202	8		
07140101030203	3		
07140101030301	7	2	AVERAGE
07140101030302	1		
07140101030303	12	1	AVERAGE
Total	58	8	2 Good 3 Average

Table A.39: Summary of location, type, and condition of detention and retention basins inspected on site visits.

Issue	Number of Sites
Algae (submerged or on surface)	1
Sediment (reduced basin capacity)	2
Bank erosion	0
Trash	0
Blocked culvert under road leading to basin, road floods	0
Murky, milky water appearance	3
Outlet pipe leads towards power station – potentially unsafe	0
Scouring of outlet channel	2
Submerged inlet pipe	0

Figure A.39: Location of detention and retention basins in the Canteen-Cahokia Creek Watershed, identified by aerial imagery assessment.



Flooding

Flooding Types and Contributing Factors

A flood is defined by FEMA as a general or temporary condition where two or more acres of normally dry land or two or more properties are inundated by:

- overflow of inland or tidal waters;
- unusual and rapid accumulation or runoff of surface waters from any source;
- mudflows; or
- a sudden collapse or subsidence of shoreline land.

The severity of floods are determined by a number of factors, including topography, ground cover, precipitation and weather patterns, recent soil moisture, the presence of streams and other waterbodies, as well as a location's relationship to the watershed. Floods can cause utility damage and outages, infrastructure damage, structural damage, crop loss, decreased land values, loss of life, and impediments to travel, including emergency access.

Two main types of flooding affect the Indian-Cahokia and Canteen-Cahokia watersheds: flash flooding and general flooding. A flash flood is a rapid rise of water along a stream or low-lying area, usually produced when heavy localized precipitation falls over an area in a short amount of time. Flash floods are considered the most dangerous type of flood event because there is often little or no warning time, and because of their capacity for damage, including the capability to induce mudslides. Vulnerability to flash flooding changes most often with a change in land use. As impervious surface area increases, the risk of flash flooding increases, as rain and snowmelt can no longer infiltrate the ground slowly and flows quickly downstream.

General flooding can be broken down into two categories: riverine flooding and shallow or overland flooding. A riverine flood is the gradual rise of water in a river, stream, lake, or other waterway that results in the waterway overflowing its banks. This type of flooding generally occurs when storm systems remain in the area for extended periods of time, when winter or spring rains combine with melting snow to create higher flows, or when obstructions such as logjams block normal water flow. One famous example of a riverine flood is The Great Flood of '93 where intense rainfall events, coupled with already saturated ground surfaces and spring snow melt in northern states, resulting in the Mississippi River flooding out of its banks for months on end.

A shallow or overland flood is the pooling of water outside of a defined river or stream (e.g., in sheet flow or ponding). An overland flood generally occurs when rainfall collects on saturated or frozen ground. When surface runoff cannot find a channel, it may flow out over a large area at a somewhat uniform depth in sheet flow or collect in depressions and low-lying areas, creating a ponding effect.

Vulnerability to riverine flooding in the National Flood Insurance Program (NFIP) member communities is low as long as existing floodplain ordinances are enforced. Floodplain ordinances are the major mechanism for ensuring that new structures either are not built in flood-prone areas or are elevated or protected from floodwaters to severely limit their potential flood damage.

The general definition of a floodplain is any land area susceptible to being inundated or flooded by water from any source (such as a river or stream). A regulatory or base floodplain is defined as the land area that is covered by the floodwaters of the base flood. This land area is subject to a 1% chance of flooding in any given year. (6) For the following sections, the regulatory definition of a floodplain will be

used.

Extent of the Floodplain

A total of 10,903 acres in the watershed are in the 100-year floodplain - 19% of the watershed area. Of this, 7,623 acres of floodplain are in Madison County (17.5% of the area of the watershed in Madison County), and 3,280 acres of floodplain are in St. Clair County.

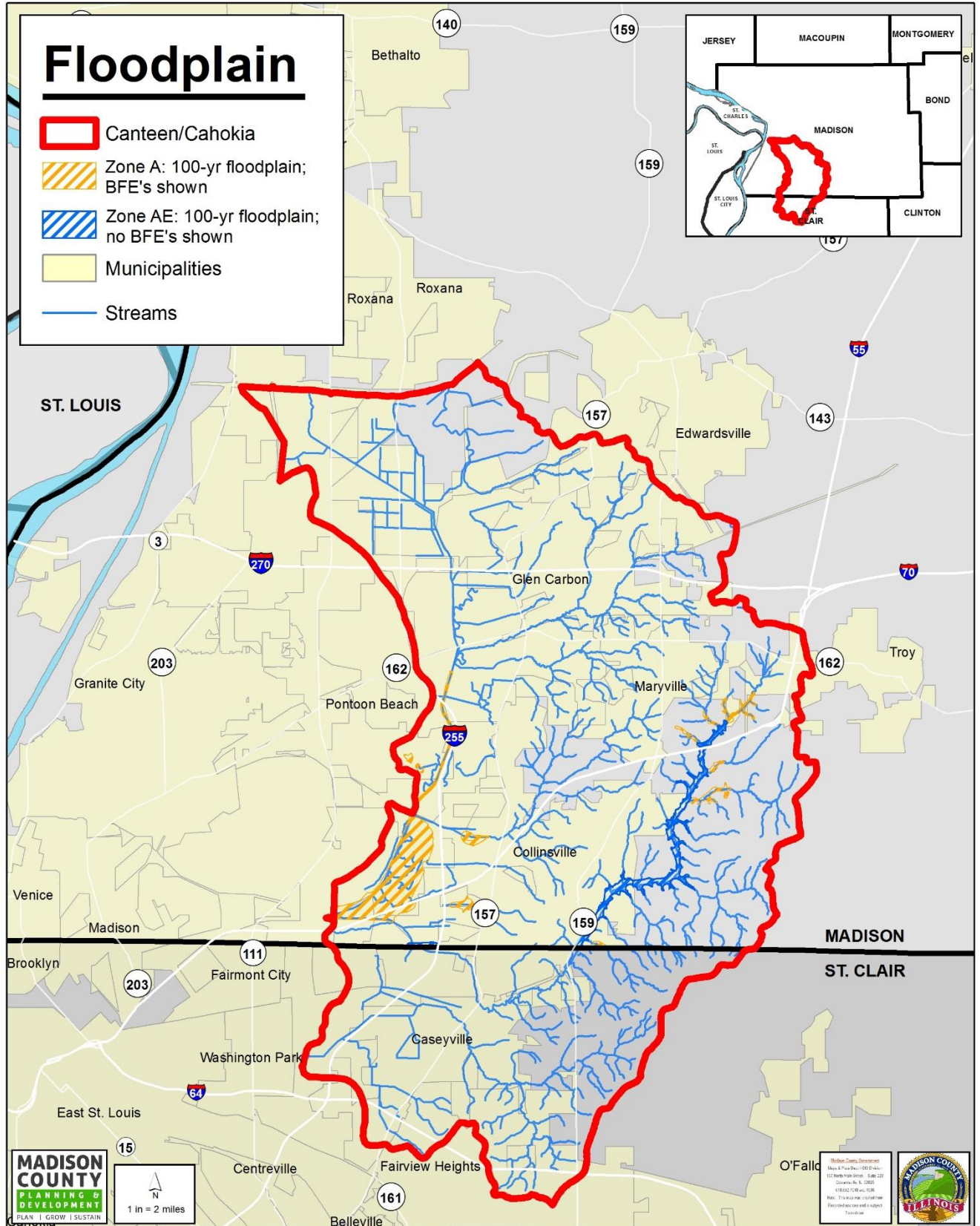
Development in the Floodplain

In the Canteen-Cahokia Creek watershed, 215 structures in municipalities are at least partially located in the 1% chance FEMA floodplain. In the watershed area covering Fairmont City and Hartford, there are no structures in the floodplain. Most of the watershed's structures in municipalities (78%) at risk are located in Collinsville (Table A.40). All of the communities are fully covered by Flood Insurance Rate Maps (FIRM), so the number of structures at risk from a 1% chance flood is comprehensive of the municipality. (57) (58)

Table A.40: Number of Structures Partially or Wholly within the Floodplain in the Canteen-Cahokia Creek Watershed.

Municipality	Number of Structures
Collinsville	168
Edwardsville	9
Fairmont City	0
Glen Carbon	2
Hartford	0
Maryville	5
Pontoon Beach	31
South Roxana	0
Troy	0
Total	215

Figure A.40: FEMA designated floodplain in the Canteen-Cahokia Creek watershed.



Repetitive Loss Structures in the Watershed

FEMA defines a repetitive loss structure as one covered by flood insurance under the NFIP which has suffered flood damage on two occasions during a 10-year period that ends on the date of the second loss, in which the cost to repair the flood damage is at least 25% of the market value of the structure at the time of each flood loss.

Of the 14 municipalities in Madison County and the Indian-Cahokia and Canteen-Cahokia watersheds, four contain repetitive loss structures. Of the unincorporated areas of Madison County within these watersheds there are 11 repetitive loss properties, which have made 30 claim payments. The exact locations of these properties are kept on file with FEMA and are not eligible for publication. A breakdown of buildings and number of losses by municipality are shown below in Table A.41.

Table A.41: Repetitive loss information for portions of Madison County.

City	Buildings	Losses	Claims	Total Claim Amount
Bethalto	1	2	6	\$61,382.16
Collinsville	2	6	12	\$100,721.25
Pontoon Beach	2	5	28	\$152,833.16
Wood River	3	6	24	\$165,644.00
Unincorporated Madison County	11	30	184	\$1,951,001.77
Total	19	49	254	\$2,431,582.34

For the unincorporated parts of Madison County, the data provided by FEMA includes all areas within the county, not just those in the watershed boundary. The City of Troy does not participate in the NFIP and therefore flood insurance is not available to structures within the city limits. The Village of Maryville currently participates in the emergency phase of the NFIP and no flood hazard information is available within the city limits.

In St. Clair County there are 13 buildings with repetitive losses, totaling 32 claims, distributed as shown below in Table A.42.

Table A.42: Repetitive loss information for portions of St. Clair County.

City	Buildings	Losses	Claims	Total Claim Amount
Caseyville	2	4	17	\$117,294.79
Unincorporated St. Clair County	11	28	156	\$873,251.12
Total	13	32	173	\$990,545.91

These numbers include all of the unincorporated portions of St. Clair County, not just the portion within the watershed boundary. (59)

Critical Facilities

Some structures are particularly vulnerable to floods and require special protection to protect vulnerable populations and public health. FEMA recognizes these critical facilities under two categories:

1. At-risk essential facilities: Facilities that are vital to flood response activities or critical to the health and safety of the public before, during, and after a flood, such as a hospital, emergency

operations center, electric substation, police station, fire station, nursing home, school, vehicle and equipment storage facility, or shelter.

2. At-risk critical facilities: Facilities that, if flooded, would make the flood's impacts much worse, such as a hazardous materials facility, power generation facility, water utility, or wastewater treatment plant.

According to the Illinois Natural Hazard Mitigation Plan, Madison County has the most critical facilities in the 1% chance floodplain of any county in Illinois. Facilities at risk include schools, police stations, wastewater treatment plants and communication facilities.

According to FEMA's "Hazard" multi-hazard risk assessment tool, the Canteen-Cahokia Creek watershed has 356 critical facilities. A further breakdown of the quantity of each type of facility in the watershed is given in Table A.43.

Table A.43: Critical facilities in the Canteen-Cahokia Creek watershed.

Facility Type	Canteen-Cahokia Creek
Beef cattle feedlots	1
Biological products (except diagnostics)	0
Chemical Plant	
Industrial products	9
Nitrogen fertilizers	3
Pharmaceutical preparations	3
Communication cellular tower	0
Education	
Private school	9
Public school	15
Emergency	
EMS	5
Fire Station	10
Local Emergency Operations Center	0
Shelter	16
Energy	
Electrical power generator	0
Propane	14
Energy substation	4
Cities/Townships/Villages	5
Law Enforcement	
Police Department	7
Jail	0
Mail – US Postal Service	5
Manufacturing	
Wood product manufacturing	12
Natural Historic Site	0
Public Venue	
Library	8
Park	10
Place of worship	14
Transportation	
Airport	1
Railroad bridge	202
Water Supply	
Wastewater treatment plant	3

Infrastructure in the Floodplain

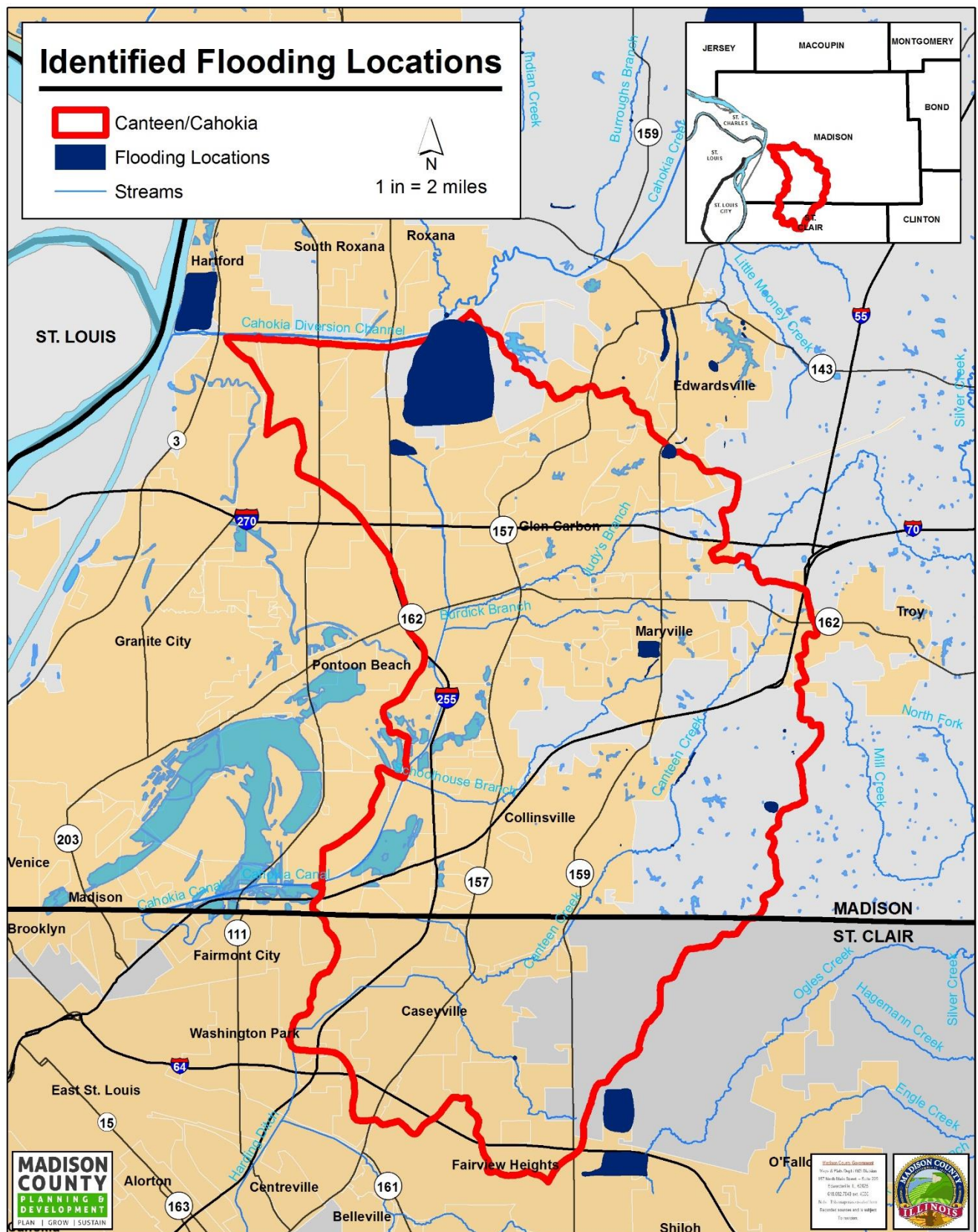
Roads, bridges, and buried power and communication lines are located within or adjacent to floodplains throughout the watershed. Nearly the entire watershed is vulnerable to both flash flooding and interior flooding from either overloaded storm sewer systems or improper drainage. A majority of the buildings, infrastructure, and critical facilities that may be impacted by flooding are located outside of the base floodplain (for a count of facilities within each watershed, see “Critical Facilities” section). Stakeholder outreach conducted for this plan helped to highlight several other instances of flooding outside of floodplains.

Locations Affected by Floods

Flooding Locations Identified at Stakeholder Meetings

While introducing the Cahokia Creeks Watershed Plan to residents, two stakeholder meetings were held in the fall of 2015 to get input from attendees, mostly local residents. Meeting attendees were invited to identify flooding locations within the watershed (Figure A.41). They looked at maps which included roads, municipalities, structures, and FEMA floodplains to identify locations that typically flood, either by a point or area designation. This input was then digitized to show flooding “hot spots” within the watershed.

Figure A.41: Flooding locations identified at stakeholder meetings for the Canteen-Cahokia Creek watershed.



Flooding Locations Identified in the Community Flood Survey

The Madison County Community Flood Survey was created by HeartLands Conservancy and the Madison County Planning and Development office and distributed to residents and businesses in the fall of 2015. Surveys were sent out for both the Indian-Cahokia Creek watershed and Canteen-Cahokia watershed at the same time. The intent of the survey was to gather information regarding the location, extent, impacts and causes of flooding in each watershed. The results of each community flood survey are shown in the Flood Survey Report in Appendix B. It should be noted that these survey responses were received prior to the winter flood that occurred around Christmas 2015 and the 2016 New Year. Many areas within the watershed flooded during this winter event that had not flooded recently.

A total of 452 surveys were completed from residents and business owners in the Canteen-Cahokia watershed, out of 2,400 mailed out, giving a response rate of 19%. This total also includes surveys filled out online. Nearly half (47%) of respondents were from the Collinsville and Glen Carbon zip codes.

Survey responses showed that 11% of respondents experienced flooding in the last 10-years, with 6% of respondents noting flooding at least once per year in the past 10-years. On average, those who were flooded experienced 1.3 floods per year. The respondents with the highest proportions of flooding were in the Glen Carbon, Collinsville, and Maryville zip codes.

An assessment was made of flooding “hotspot” locations in the watershed based on four attributes: 1) percentage of respondents who said they had been flooded, 2) flood frequency, 3) percentage who said that neighbors had been flooded, and 4) monetary loss as a result of flooding.

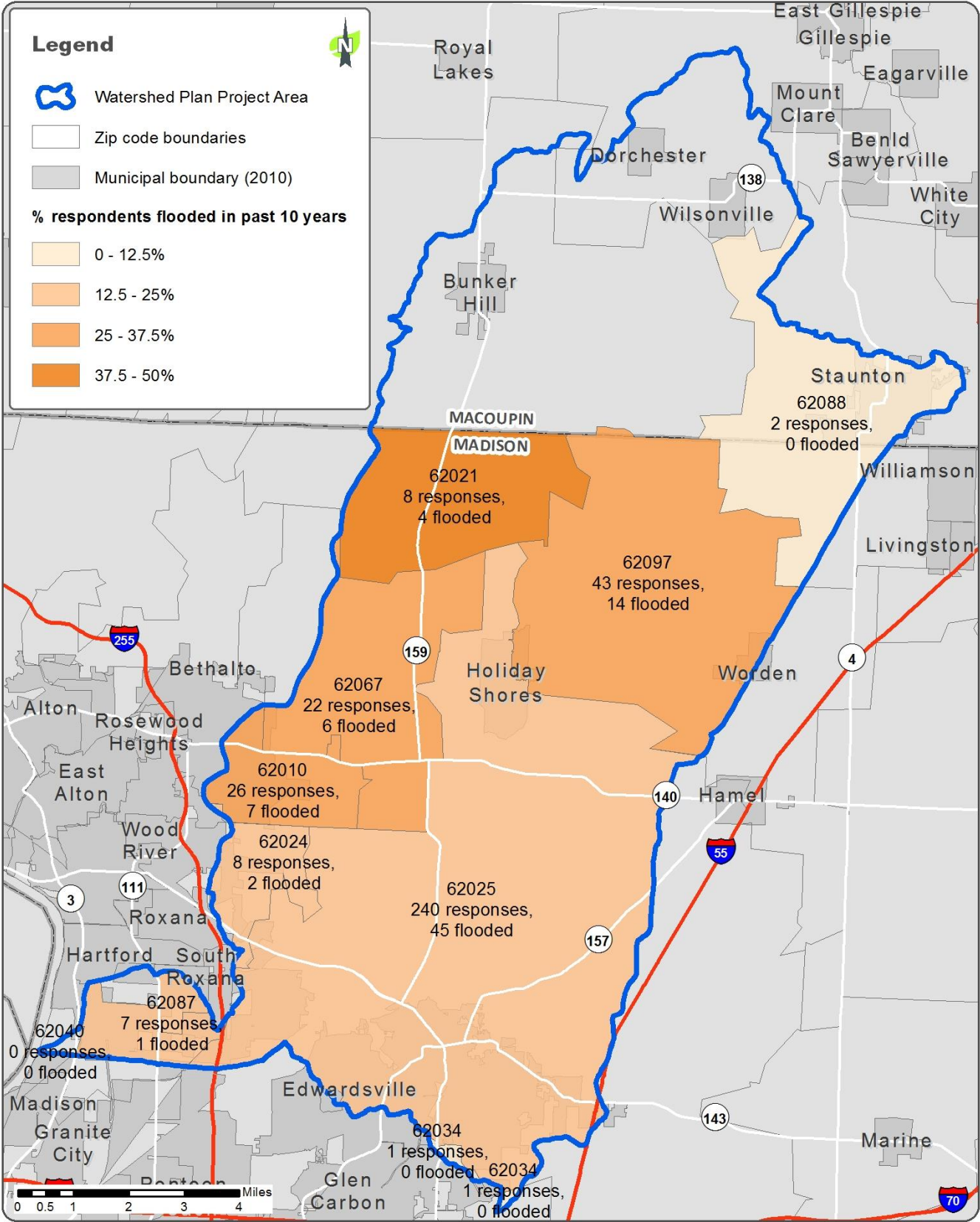
The top three flooding hotspots, based on flooded area, from the survey results are listed below:

1. South of the Cahokia Diversion Channel, encompassing parts of Edwardsville and Pontoon Beach
2. South of Canteen Creek on both sides of Interstate 255, southwest of Collinsville in St. Clair County
3. Area between Collinsville Road, Conrail Road and Princeton in Fairmont City, northern edge of St. Clair County

Table A.44: Responses to the flood survey question, “Have you experienced flooding in the last 10 years?” (60)

Response	Percent of Responses
Yes	11%
No	86%
No Answer	3%

Figure A.42: Percent of respondents flooded in the Canteen-Cahokia Creek watershed.



Flooding Outside the Floodplains

Both Madison and St. Clair counties have experienced flash floods and riverine floods, which are discussed in their countywide hazard mitigation plans. St. Clair County has received federal disaster aid for 14 declared disasters since 1969, 13 of which have been from either flooding and/or torrential rain. (7) Madison County has had 11 federally declared disasters since 1965, nine of which have been due, at least in part to flooding. (6)

FEMA designated floodplains cover 17.3% of the total acreage of the Canteen-Cahokia Creek watershed in Madison County. Of the flood surveys received from Madison County in this watershed, 4% came from parcels wholly or partly within these floodplains. Of all survey respondents, 11 (2.4%) unknowingly live on a property that is at least partially in the floodplain.

Survey respondents reported approximately 697 events per year taking place outside of FEMA designated floodplains over the last 10 years. Within floodplains, approximately 30 parcels per year were flooded. (60)

Table A.45: Frequency and location of flooding in and outside of floodplains, according to the mapped locations of responses.

Flood Frequency over 10 year period	Average times per year	Parcels in floodplain		Parcels outside floodplain	
		Number	Number of times flooded per year	Number	Number of times flooded per year
1-3 times	0.2	1	0.2	14	2.8
4-6 times	0.5	0	0	11	5.5
7-9 times	0.8	1	0.8	10	8
10-49 times	1.95	1	2.0	12	23.4
50 or more times	5	0	0	6	30
Total	1.69 (average)	3	3	53	69.7

Flooding on Roads

Besides several road overtopping locations identified at stakeholder meetings, a 2010 Oates Associates report generated for Madison County was used to assess road overtopping as well. This report was used to develop a flooding assessment to advise the Stormwater Commission and contribute to the county Stormwater Plan. The flooding assessment used GIS data review and analysis, community data requests, meetings with individual communities, and FEMA's Flood Insurance Study for the county and flood maps to identify stormwater-related problems. The assessment identified several projects that municipalities had identified to improve their drainage, in categories such as maintenance, dam safety, localized flooding, stream channel flooding, combined sewers, and roadway overtopping.

Sixteen road overtopping locations were identified from FEMA's 2008 Draft Flood Insurance Rate Maps (D-FIRMs) and the associated 2003 Flood Insurance Study (FIS) for Madison County, locations are shown below in Table A.46. Of these, nine were considered to have "major" flood severity, meaning that the stream profile indicated water was overtopping the roadway at a structure crossing in either the 100-year or 500-year storm event. Seven road overtopping location was considered to have "minor" flood severity, indicating merely a significant increase in the water surface elevation upstream of the road crossing structure. (61)

Table A.46: Road overtopping locations identified in the Canteen-Cahokia Creek watershed in the 2010 Oates Associates Flooding Assessment report.

ID	Waterway Name	FEMA Stream Profile Number	Watershed	Crossing	Approximate Flowline Elevation (NAVD)	Flood Severity
3	Canteen Creek	10P	Canteen Creek	Railroad & IL-157	439.8	Major
4	Canteen Creek	10P	Canteen Creek	Lakeside Drive	448.0	Major
5	Canteen Creek	11P	Canteen Creek	Railroad & Lebanon Road	490.0	Major
6	Canteen Creek	12P	Canteen Creek	I-55/Troy Road	515.5	Major
21	Judy's Branch	32P	Judy's Branch-Cahokia Creek	Private Drive	523.0	Major
22	Judy's Branch Tributary 5A	34P	Judy's Branch-Cahokia Creek	State Route 159	520.0	Major
23	Judy's Branch Tributary 5A	35P	Judy's Branch-Cahokia Creek	State Route 159	518.0	Major

24	Judy's Branch Tributary 9	37P	Judy's Branch-Cahokia Creek	Culvert upstream of E Ingle Drive	495.0	Major
25	Judy's Branch Tributary 9A	38P	Judy's Branch-Cahokia Creek	Public Works Entrance	502.0	Major
15	Judy's Branch	29P	Judy's Branch-Cahokia Creek	Abandoned railroad	460.0	Minor
16	Judy's Branch	29P	Judy's Branch-Cahokia Creek	Collinsville Street	459.0	Minor
17	Judy's Branch	29P	Judy's Branch-Cahokia Creek	Abandoned railroad	461.5	Minor
18	Judy's Branch	30P	Judy's Branch-Cahokia Creek	Abandoned railroad	484.0	Minor
19	Judy's Branch	31P	Judy's Branch-Cahokia Creek	E Ingle Drive	496.0	Minor
20	Judy's Branch	31P	Judy's Branch-Cahokia Creek	Private Drive	513.0	Minor
26	Judy's Branch Tributary 9A	38P	Judy's Branch-Cahokia Creek	Ash Road	513.5	Minor

Flooding and Drainage Complaints

The Madison County Stormwater Coordinator keeps a record of complaints received about drainage issues. Between 2012 and 2016, a total of 72 stormwater complaints were recorded in the Cahokia Creek's watershed. A breakdown of complaints in each watershed over time is given below.

There were 42 complaints logged with Madison County in the Canteen-Cahokia Creek watershed from 2012-2016. The majority of these complaints (71%) were logged at addresses within Collinsville and Glen Carbon. Since these two municipalities comprise a large percentage of the watershed, these complaints seem to accurately represent the watershed. The most complaints were logged in 2014 followed by 2015 and 2013. This watershed shows a relatively balanced number of complaints over the five-year period. (62)

Table A.47: Number of complaints received by year and municipality from 2012 to 2016 in the Canteen-Cahokia Creek watershed.

Municipality	2012	2013	2014	2015	2016	Total
Collinsville	1	3	5	7	2	18
Edwardsville	1		1		1	3
Glen Carbon	2	5	2	2	1	12
Granite City		1			1	2
Maryville			3			3
Troy	3			1		4
	7	9	11	10	5	42

History of Flooding in the Watershed

All three counties in the project area have identified flooding as a major hazard in their County Hazard Mitigation Plans. St. Clair County has received federal aid for 14 declared disasters from 1969 until the

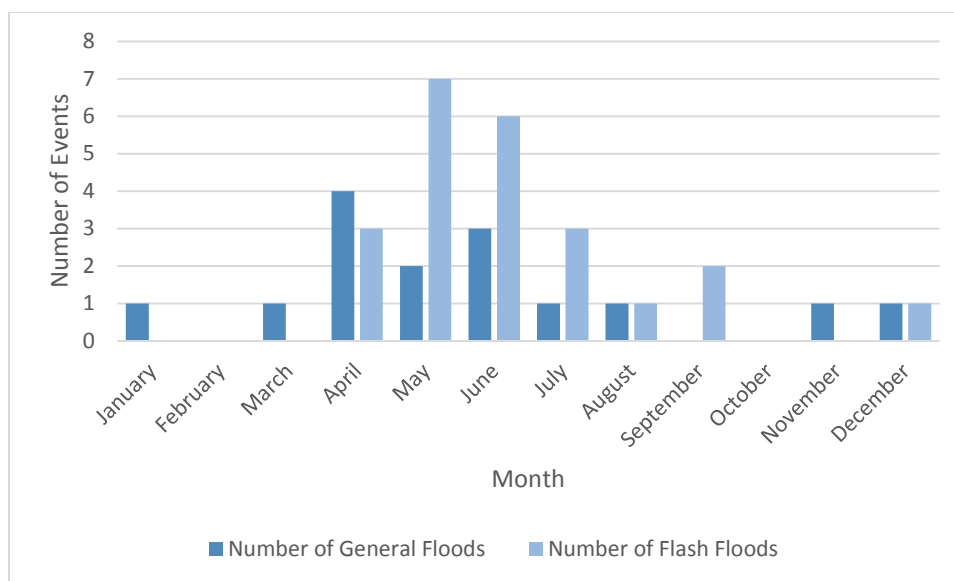
publication of their countywide hazard mitigation plan. Of the 14 disasters in St. Clair County, 12 of those have been due, at least in part, to flooding (Table A.48). Madison County's Hazard Mitigation Plan, finalized in June 2006, lists five events where major flooding occurred in the St. Louis Metropolitan region, including Madison County: July 1947, July 1951, April 1973, August 1993 and May 1995. Since the publication of the countywide plan, the St. Louis region has also experienced flooding in 2008, 2011, 2013, 2014, and most recently during the winter of 2015-2016. All of the general flood events in Madison County, with one exception, were considered countywide events. No specific jurisdictions in Madison County experienced flash floods only in one municipality.

The greatest risk for flooding in the Cahokia Creek watershed is in the spring and summer. The most likely month for flash floods in Madison County is May (historically 60.5% of events), and the most likely month for general floods is April (historically 39.5% of flood events) as shown in Figure A.43.

Table A.48: Occurrences of floods and most likely months for flooding to occur in the three counties in the project area.

	Madison County (1993-2012)	St. Clair County (1993-2008)
Number of General Floods Reported	16 (1973-2012)	7
Number of Flash Floods Reported	23	24
Total Number of Floods Reported	≥ 23	36

Figure A.43: Reported flood events in Madison County by month. Multi-month events are shown only in the month they began.



Impacts of Floods

Injury and Death

In Illinois, flooding causes an average of four deaths per year. Historically, the number of injuries and deaths in Madison County from flooding has been very low. No injuries or deaths were reported as a result of any of the 16 recorded general floods from 1973 to 2012. However, as there is often little-to-no warning for flash flood events, the risk to public health and safety is elevated.

The major cause of death during floods is drowning with nearly half of all flash flood deaths occurring as vehicles are swept downstream. According to FEMA, six inches of water will reach the bottom of most passenger cars, causing loss of control and potential stalling, a foot of water will float many vehicles, and two feet of rushing water will carry away most vehicles, including SUVs and pickup trucks. The United States Geologic Survey (USGS) reports that one foot of water typically exerts 500 pounds of lateral force on a vehicle. Floodwaters also damage roadways, bridges, and other transportation structures, affecting mobility including evacuation routes.

Floodwaters not only pose harm through the volume of water transported but also in the potential contaminants in the water. Biological and chemical contaminants in floodwater also pose a risk to public health and safety. Wastewater treatment plants are often located either in or near floodplains, and high water events can allow for untreated sewage to mix with stormwater and be transported onto streets, yards, parks, and into buildings. If left untreated, these locations can serve as breeding grounds for bacteria and other disease causing agents. If underground utilities are disrupted by flood events, gasoline, oil, and other contaminants can also contaminate floodwaters. Depending on the time of year that flooding occurs, agricultural chemicals can also be seen in high concentrations in flood water. Once floodwaters recede, mold and mildew can pose health risks to young children, the elderly and those with asthma or allergies. (6) (10) (7)

Financial Impacts

Flooding has caused an estimated \$257 million per year in damages across Illinois since 1983, making it the single most financially damaging natural hazard in the state. Structural damage to property accounts

for a large portion of these financial damages and can include foundation, flooring, drywall and framing damage as well as damages to buildings contents. Losses in agricultural, commercial, and industrial productivity, as well as tourism are also impacted by floods.

Between 1978 and 2013, the NFIP paid out more than \$3 million to Madison County policy holders alone, an average of nearly \$86,000 annually. Six of the 16 general flood events in Madison County between 1973 and 2012 caused \$12.5 million in crop damages and nearly \$37 million in property damage. (63) Four of these six events were federally declared disasters. Madison County has experienced 23 flash flood events between 1993 and 2012, six of which caused \$95,000 in crop damage and nearly \$7.3 million in property damage. Damage information was unavailable for the remaining 17 reported flash floods. (6)

The Madison County Community Flood Survey questioned residents on flood frequency and costs of flood damage in the watershed. Table A.49 below shows a statistical breakdown of financial impacts as reported by residents in the flood survey.

Table A.49: Key financial impact results from the community flood survey.

	Canteen-Cahokia Creek Watershed
Respondents whose home, business or property has flooded in the last 10-years	6.0
Number of floods experienced annually	1.3
Of respondents who experienced flooding in the last 10 years:	
No monetary loss	37%
< \$5,000	35%
\$5,001-\$20,000	19%
\$20,001-\$50,000	8%
\$50,001-\$100,000	2%
Total costs due to flooding in the last 10 years (low estimate)	\$180,033

Other Impacts

Stress was the most commonly reported impact from flooding besides financial losses. Other effects include lack of access to property and major routes to/from homes, lost business income, crop damage, and repair and replacement costs of goods and structures. (64) (60)

The National Flood Insurance Program (NFIP)

The NFIP was created by Congress in 1968 through the National Flood Insurance Act. Communities participating in the NFIP agree to adopt a floodplain management ordinance to reduce flood risks to new construction in Special Flood Hazard Areas (SFHAs), which are subject to inundation by the “base flood,” also known as the “1 percent chance flood,” the “100-year flood,” or “regulatory flood,” as designated on Flood Insurance Rate Maps (FIRMs). In return, the NFIP makes flood insurance available within the community as a financial protection against flood losses. Four percent of U.S. households in 22,000 communities participated in the NFIP as of 2010. The NFIP is managed within the Federal Emergency Management Agency (FEMA)’s Mitigation Division. Illinois is in Region V. (65)

Communities Enrolled in the NFIP and Their Policies

In the Cahokia Creeks watershed area within Madison County, ten municipalities participate in the NFIP. Madison County also participates in the program, so unincorporated portions of the county that are within a FEMA designated SFHA are also eligible for flood insurance. Holiday Shores is included in the unincorporated Madison County area.

The county has 1,184 policies in effect covering over \$246 million in assets. The communities of Wood River and Pontoon Beach have the most policies in effect of all municipalities within the watersheds. Table A.50 gives a breakdown of the policies in the watershed, including the entirety of municipalities wholly or partially within the watershed.

Table A.50: NFIP policies in effect in the Cahokia Creeks watershed as of the end of 2013.

Municipality	Policies in Force	Premium	Insurance in Force	Closed Losses	Cost of Closed Paid Losses	Adjustment Expense
Bethalto	4	\$2,081	\$836,800	5	\$14,264	\$1,170
Collinsville	36	\$36,490	\$9,077,000	10	\$77,735	\$4,450
Edwardsville	15	\$11,010	\$3,239,400	2	\$38,359	\$2,050
Fairmont City	17	\$9,030	\$2,458,800	0	\$0.00	\$0.00
Glen Carbon	12	\$4,551	\$3,150,000	0	\$0.00	\$0.00
Hartford	52	\$27,375	\$14,762,000	14	\$22,873	\$3,070
Pontoon Beach	143	\$111,943	\$17,983,500	17	\$75,017	\$8,670
Roxana	7	\$2,720	\$1,505,000	0	\$0.00	\$0.00
South Roxana	13	\$9,217	\$2,758,800	0	\$0.00	\$0.00
Unincorporated Madison County*	722	\$552,866	\$163,270,400	168	\$1,609,990	\$70,224
Wood River	163	\$123,233	\$27,808,200	22	\$138,146	\$7,902
Total	1184	\$890,516	\$246,849,900	238	\$1,976,384	\$97,536

*this area includes large portions outside of the watershed boundary

Terms included in Table A.50 are defined below:

- **Policies In Force:** Policies in force on the "as of" date of the report
- **Insurance In Force:** The coverage amount for policies in force
- **Closed losses:** Losses that have been paid

Madison County is currently undergoing review of new floodplain maps for the county. (66)

In St. Clair County, within the project boundary, unincorporated portions of the county are currently in the NFIP.

Six percent of respondents in the Canteen-Cahokia Creek watershed (25 responses) reported having insurance. (60)

Table A.51: Communities in the Canteen-Cahokia Creek watershed enrolled in the NFIP.

Community	Initial FIRM	Effective FIRM Date
Collinsville	02/18/1981	02/18/1981
Edwardsville	01/18/1984	01/18/1984
Fairmont City	11/05/2003	11/05/2003
Glen Carbon	N/A	N/A
Hartford	05/01/1979	05/01/1979
Pontoon Beach	04/15/1982	04/15/1982
South Roxana	11/26/1982	11/26/1982
Unincorporated St. Clair County	11/05/2003	11/05/2003
Unincorporated Madison County	04/15/1982	04/15/1982

Communities Not Enrolled in the NFIP

The City of Troy does not participate in NFIP. The Village of Maryville is currently enrolled in the emergency phase of the NFIP. (67)

When the NFIP began, separate areas of government jurisdiction were shown on separate FIRMs. This is the case for several communities with FIRMs created in the 1980s. Some communities were not mapped, and as a result, do not face any sanctions for being flood prone while not enrolled. The term “sanctions” includes penalties for no flood insurance, no federal mortgage insurance, and no federal grants or loans for development. These communities may join the NFIP at any time.

Since the 1990s, FEMA has mapped all areas of a county on the same map to eliminate gaps and outdated information as municipalities grow and communities incorporate. (68) When the next FIRMs are created, current “holes in the map” will be eliminated and the entire county will be covered.

Impacts of Recent Federal Flood Insurance Reform

The Biggert-Waters Flood Insurance Reform Act (Biggert-Waters, H.R.1309), passed in June 2012, is a landmark bill that aims to improve the NFIP’s financial solvency, ensure flood insurance reflects real flood risks, and encourage floodproofing and mitigation activities. Biggert-Waters extended the NFIP for five years (until 2017) and made a number of changes related to flood insurance, flood risk mapping, and flood mitigation programs. For a fuller description of Biggert-Waters’ reforms, see the H.R. 4348 Conference Report Summary. (69)

The Homeowner Flood Insurance Affordability Act of 2014 (HFIAA, H.R. 3370) was signed by President Obama on March 21, 2014. (70) The HFIAA made changes to several provisions of Biggert-Waters and also created new policies for the NFIP.

The greatest changes to the NFIP under these pieces of legislation affect subsidized flood insurance policies. In Madison County, most subsidized policies cover structures built before the communities’ first Flood Insurance Rate Maps (FIRMs) were released (usually between 1978 and 1984). (66) (71) Subsidies for non-primary residences (including businesses and second homes) began to be phased out from October 2013 as the policies came up for renewal. The remaining subsidized structures, all primary residences, were allowed to keep their lower rates until a “trigger event” occurs, such as substantial damage or the sale of the property.

Since the HFIAA rates are not publicly available, it is impossible to determine its final effects on property owners in the Cahokia Creek watershed. However, it may be possible to make some generalized

conclusions based on the trends in the two Acts and the number of NFIP policies affected in the county. For example, the rate increases under Biggert-Waters that were not repealed by the HFIAA may stunt the growth of local housing markets and economies over the medium term. New structures may cost more to build as developers must elevate them in order to make manageable flood insurance rates available, and certain older properties will prove more difficult to maintain or sell as premiums rise. However, these effects will likely not be highly pronounced in the Cahokia Creek watershed, as not many subsidized policies are located there (they are more commonly clustered along the Mississippi River and in the American Bottoms). Furthermore, as premiums increase to actuarially-based levels, development and habitation will be redirected away from floodprone areas while flood mitigation activities are incentivized there, reducing flood risk to life and property.

See the recent Heartlands Conservancy report “Impacts of Federal Flood Insurance Reform Legislation on Madison County, Illinois” for more information on potential impacts to Madison County. (72)

Future Development and Flood Ordinances

The 2008 Hazard Mitigation Plan for Madison County predicted little flood risk in current development trends in Madison County, as most residential growth was occurring in regions not prone to bottomland flooding, and development planned on the fringe of major drainage features would be discouraged by floodplain regulations. (6) The current St. Clair County floodplain ordinance, which is dated December 31, 2003, states that the county Zoning Director is responsible for ensuring that all future development that occurs in the floodplain does not induce flood heights on surrounding properties. Any future construction placed at an elevation at or above the 1% chance base flood elevation is not subject to this ordinance. (73) However, all three counties remain vulnerable to flash flooding depending on the amount of precipitation received, topography, land use, and other factors.

Prioritizing Floods among Other Natural Hazards

St. Clair County has a Risk Priority Index (RPI) for nine hazards: flooding, tornado, transportation hazardous material release, thunderstorms/high winds/hail/lightning, winter storms, subsidence, earthquake, fire/explosion, and dam/levee failure. For each community and each hazard, a probability value and a magnitude/severity value was assigned, resulting in a RPI value. In St. Clair, flooding ranks as the number five hazard to the county and levee or dam failure as number six. The county has also assessed each of these risks for each municipality and of the three located in the Canteen-Cahokia Creek watershed, flooding was ranked as the number five hazard for Collinsville and Caseyville and number two hazard in Fairmont City. (7)

No such hazard ranking assessment has been done in Madison County’s most recent Draft Multi-Jurisdictional All Hazards Mitigation Plan. (6)

Water Quality

Impaired Waters

Under Section 305(b) of the Clean Water Act, Illinois EPA (IEPA) must submit to the USEPA a biennial report of the quality of the state’s surface and groundwater resources. The report, called the Illinois Integrated Water Quality Report and Section 303(d) List, must describe how Illinois waters meet or fail to meet water quality standards appropriate for certain “Designated Uses” assigned to them. There are six Designated Uses in Illinois, of which four have been assigned to streams in the Canteen-Cahokia Creek watershed in 2018:

- **Aquatic Life:** the waterway's ability to support fish and aquatic macroinvertebrates.
- **Fish Consumption:** the waterway's ability to support fish that are suitable for consumption (i.e., are free of contamination from mercury and polychlorinated biphenyls).
- **Primary Contact:** the waterway's ability to support activities such as swimming and water skiing.
- **Aesthetic Quality:** a watershed free from impairments such as sludge, bottom deposits, floating debris, visible oil, odor, etc.

When a designated use cannot be met, a waterbody is determined to be impaired, and IEPA must list the potential causes and sources for impairment in the 303(d) impaired waters list. The Canteen-Cahokia Creek watershed at the HUC10 level (HUC 0714010103) has four impairments as of the 2018 Illinois Integrated Water Quality Report (Table A.52). The impairments occur at the following stretches of waters in the Canteen-Cahokia Creek watershed: Cahokia Canal (Cahokia Creek in the National Hydrography Dataset), Canteen Creek, and Schoenberger Creek North, which is also known as Harding Ditch (Figure A.44).

Causes of impairments in the Canteen-Cahokia Creek watershed have changed over time (Table A.53). In 2006, there were eight causes: total phosphorous, sedimentation/siltation, total suspended solids, manganese, total fecal coliform, alteration in stream-side or littoral vegetative covers, copper, and total dissolved solids. In 2018, the number of causes has increased to eighteen. Total phosphorus, total suspended solids (TSS), manganese, and alteration in stream-side or littoral vegetative covers have been constant impairments over the last 12 years. Some impairments disappeared in the last 12 years, including copper and total dissolved solids. Iron was listed as a new impairment for 2018. (74)

Impaired Waters in the Canteen-Cahokia Creek Watershed

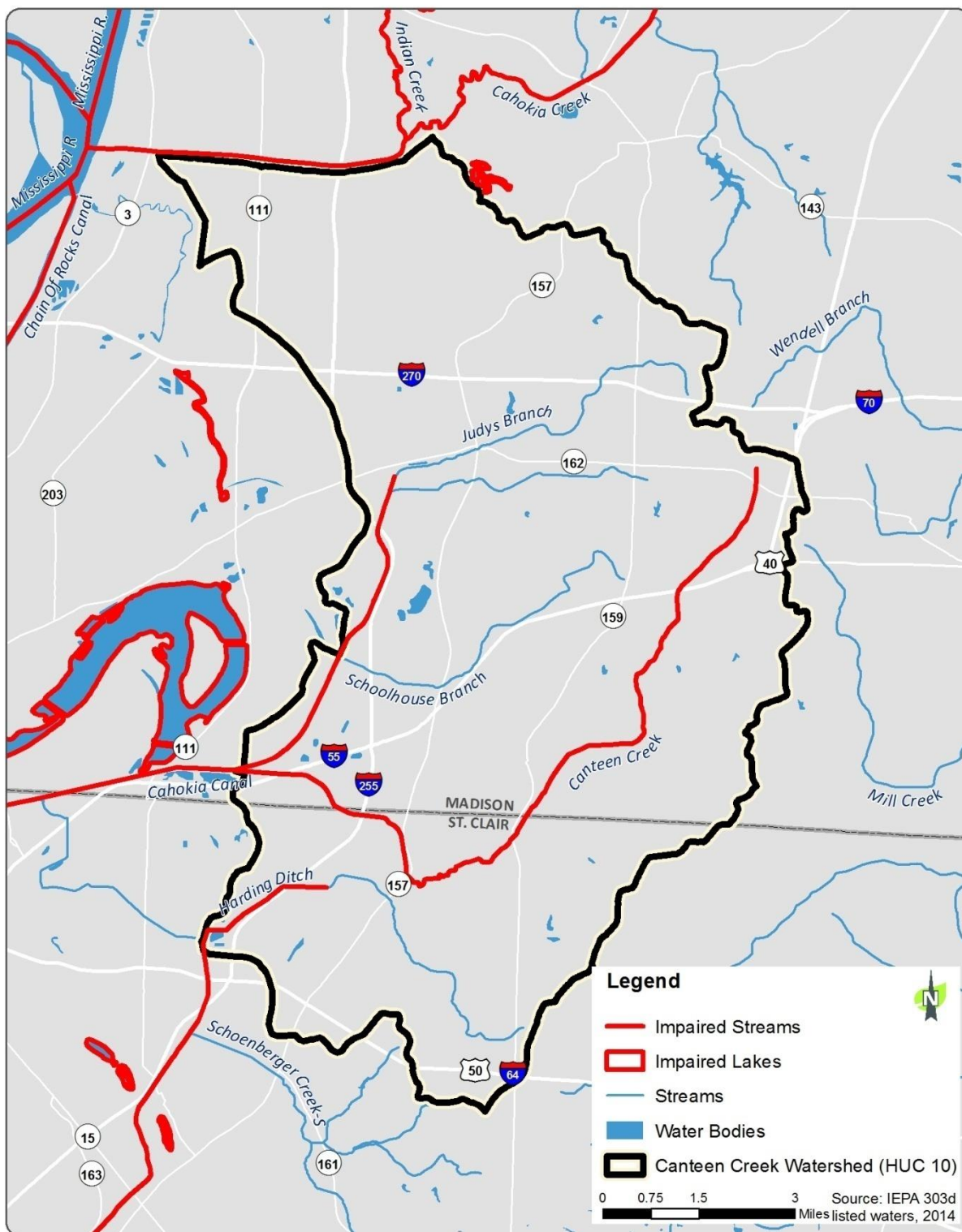


Figure A.44: Impaired waters in the Canteen-Cahokia Creek watershed.

Table A.52: 2018 Illinois EPA 303(d) Designated Uses and impairments for stream reaches in the Canteen-Cahokia Creek watershed.

Name	Assessment Unit ID	Size (mi)	Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Burdick Branch	IL_JNC	5.04	Any	Not Assessed	No	No Source Identified	No Source Identified
Cahokia Canal (Cahokia Creek in the NHD)	IL_JN-02	15.35	Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers, iron, manganese, dissolved oxygen, sedimentation/siltation, total suspended solids (TSS), phosphorus (total), changes in stream depth and velocity patterns, loss of instream cover	Channelization, urban runoff/storm sewers, combined sewer overflows, loss of riparian habitat, municipal point source discharges, sanitary sewer overflows, crop production (crop land or dry land), agriculture, site clearance
			Fish Consumption	Not Assessed			
			Aesthetic Quality	Fully Supporting			
Canteen Creek	IL_JNA-01	4.52	Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers, barium, manganese, total suspended solids (TSS), phosphorus (total), changes in stream depth and velocity patterns, loss of instream cover	Channelization, urban runoff/storm sewers, site clearance, crop production (crop land or dry land), municipal point source discharges
			Fish Consumption	Not Assessed			
			Aesthetic Quality	Fully Supporting			
	IL_JNA-02	10.28	Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers, barium, changes in stream depth and velocity patterns	Channelization, Loss of riparian habitat, streambank modifications/destabilization, urban runoff/storm sewers
			Fish Consumption	Not Assessed			
			Primary Contact	Not Assessed			
			Aesthetic Quality	Not Assessed			
Judy's Branch	IL_JND	6.34	Any	Not Assessed	No	No Source Identified	No Source Identified
Little Canteen Creek	IL_JMACA	5.47	Any	Not Assessed		No Source Identified	No Source Identified
Schoenberger Creek North	IL_JNG	3.82	Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers, manganese, ammonia (total), dissolved oxygen, changes in stream depth and velocity patterns, loss of instream cover, color, turbidity, phosphorous (total), bottom deposits, aquatic plants, aquatic algae, sludge, odor	Channelization, combined sewer overflows, contaminated sediments, highway/road/bridge runoff (non-construction), landfills, loss of riparian habitat, municipal point source discharges, sanitary sewer overflows, streambank modifications/destabilization, urban runoff/storm sewers
			Fish Consumption	Not Assessed			
			Primary Contact	Not Assessed			
			Aesthetic Quality	Not Supporting			
Schoolhouse Branch	IL_JNB	6.42	Any	Not Assessed	No	No Source Identified	No Source Identified

Table A.53: Impairments for the Canteen-Cahokia Creek watershed (HUC 0714010103) between 2006 and 2018.

Year	Impairment																				
	DO	P	Sedimentation/ Siltation	T S S	Mn	Total Fecal Coliform	Alteration in stream- side or littoral vegetative covers	Changes in stream depth and velocity patterns	Loss of instream cover	Ba	Total amm onia (NH3)	Color	Turbidity	Bottom Deposits	Aquatic Plants	Aquatic Algae	Sludge	Odor	Cu	Total Dissol- ved Solids	Fe
2018	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X			X
2016	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X			
2014	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
2012	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
2010		X		X	X	X	X	X	X	X											
2008	X	X		X	X	X	X	X	X												
2006		X	X	X	X	X	X												X	X	

"DO" is dissolved oxygen

"P" is total phosphorous

"TSS" is total suspended solids

"Mn" is magnesium

"Ba" is barium

"NH3" is ammonia

"Cu" is copper

"Fe" is iron

Once IEPA determines that a waterbody is impaired, it must establish priorities for the development of Total Maximum Daily Loads (TMDLs)—the highest amount of discharge of a particular pollutant that a waterbody can handle safely per day—and a long-term plan to meet them. The TMDL endpoints (75) for the impaired segments of the Canteen-Cahokia Creek watershed are listed in Table A.54 below. These endpoints were established based on the protection of aquatic life in Canteen Creek.

Table A.54. TMDL endpoints and average observed concentrations for impaired constituents in the Canteen-Cahokia Creek watershed.

Impaired Segment	Constituent	TMDL Endpoint	Average Observed Value on Impaired Segment
Canteen Creek, JNA01	Manganese	1,000 ug/L	423 ug/L
Cahokia Canal, JN02	DO	6.0 mg/L (16 hours of any 24-hour period). 5.0mg/L instantaneous minimum	8.2 mg/L

Water Quality Indicators and Research

Water quality in the Canteen-Cahokia Creek Watershed is impacted by agriculture and development. Agriculture, primarily cultivated crops account for 23.4% of the land cover in the Canteen-Cahokia Creek watershed, the largest of any single land cover type in the watershed. Developed land in the watershed—including open space, low, medium, and high intensity areas—account for 45.3% of the watershed's area. As expected, the developed land in the watershed is concentrated around major municipalities including Edwardsville, South Roxana, Pontoon Beach, Glen Carbon, Maryville, Troy, and Collinsville. Urbanization is expected to increase by 11% in Madison County during the next 15 years due to its location in the Metro East area of the St. Louis metropolitan region.

Sources of Data

Water quality monitoring in the Canteen-Cahokia Creek watershed was carried out at various times from 1930 to 2014 by the U.S. Geological Survey -Illinois Water Science Center (USGS-IWSC) and IEPA. A gauge is located in the Canteen-Cahokia Creek watershed (Schoolhouse Branch-Cahokia Creek watershed) between Collinsville and Fairmont City near the southern boundary of Madison County.

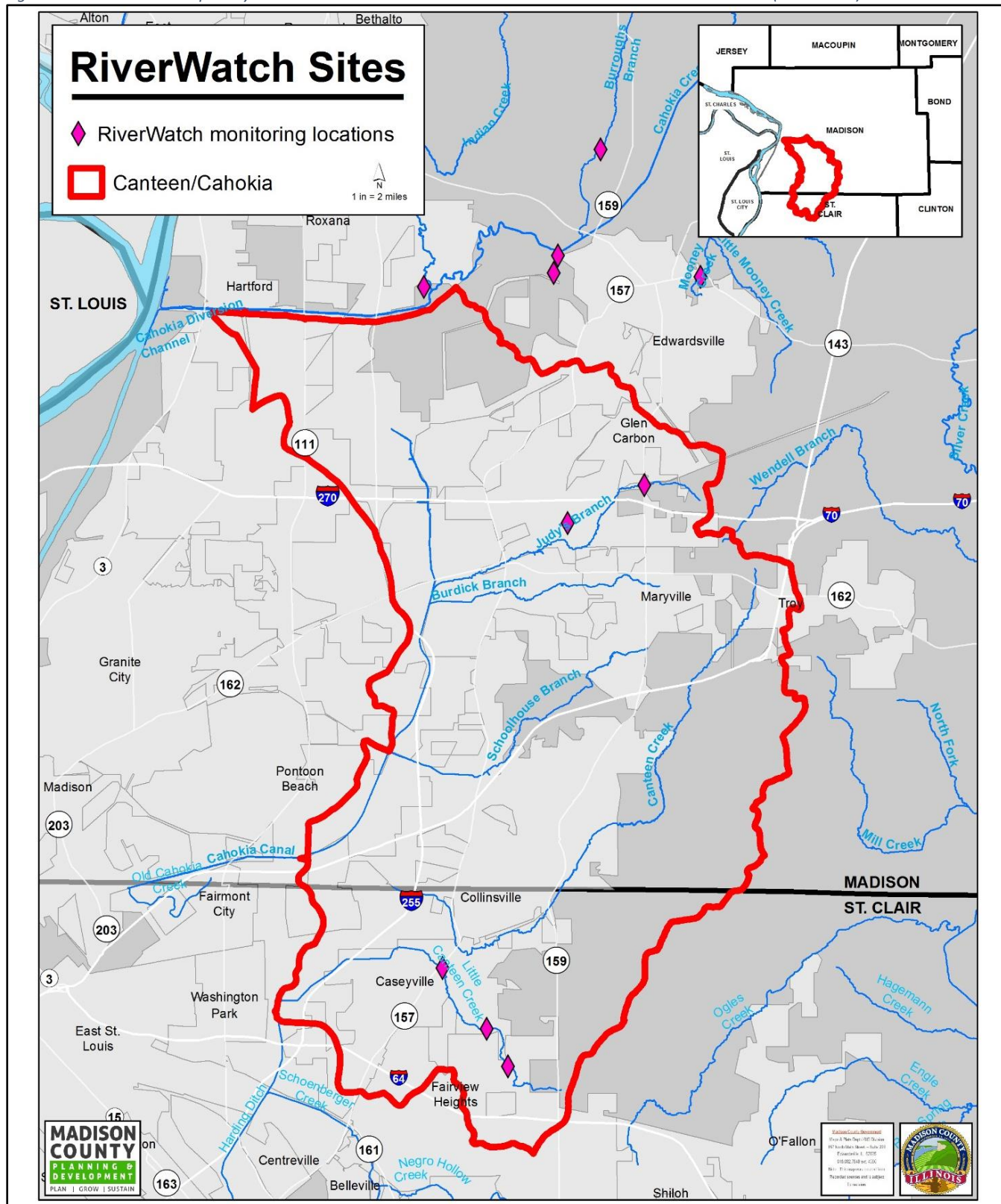
In general, USGS-IWSC monitoring was conducted from the late 1970s until 1997. After a gap of several years in monitoring, IEPA began monitoring at the same site from 1999 to 2014. Most of the same parameters were monitored by both agencies.

A third data source is the data gathered by Illinois RiverWatch volunteers at two sites in the watershed between 1998 and 2015 (Table A.55, Figure A.45). RiverWatch volunteers are trained and tested in gathering data on various metrics of water quality through the RiverWatch program. The local chapter of this program is hosted at the National Great Rivers Research and Education Center (NGRREC) in East Alton. Data collected by RiverWatch volunteers in the watershed includes stream width, average stream velocity and discharge, water appearance, air and water temperature, turbidity, percent algal coverage, channelization, and the presence of macroinvertebrates. (74) (76)

Table A.55: Location, date, and number of volunteers at RiverWatch sampling sites in the Canteen-Cahokia Creek watershed.

Stream Sampled	# Times Sampled	Years sampled	Number of Volunteers
St. Clair	1	2014	1-3
St. Clair	3	2012-2014	1-3
Indian Creek	5	1996-1998, 2001 and 2003	
Indian Creek	1	1998	1-3
Judy's Branch	6	1997-2002	1-3
Little Canteen Creek	5	1996-2001	1-3
Little Canteen Creek	1	2015	1-3
Miner Park Creek	3	1999, 2010 and 2015	1-3
Mooney Creek	10	1997-2000, 2002-2004, 2006, 2007, and 2015	1-3

Figure A.45: Locations sampled by Illinois RiverWatch volunteers in the Canteen-Cahokia Creek watershed (1998-2015).



Stream Flow

RiverWatch volunteers measured average stream discharge and peak discharge at all sites in the Canteen-Cahokia Creek watershed. Table A.56 below summarized stream discharge at each creek and branch. The highest peak discharge occurred in Judy's Branch, while the highest peak velocity occurred in Little Canteen Creek. Figures A.46 through A.48 show the annual peak streamflow, annual mean discharge and mean daily discharge (respectively) for the USGS gauge on Judy's Branch at Route 157 in Glen Carbon. This gauge has a drainage area of 8.33 square miles, which means it may not necessarily be representative of the 89.5 square mile basin. The Judy's Branch gauge also has a short period of record, which should be considered when looking for trends in streamflow. (77)

Table A.56: Summary of stream discharge and velocity in the Canteen-Cahokia Creek Watershed (1998-2015).

Waterbody	Avg. Discharge	Peak Discharge	Avg. Velocity	Peak Velocity	Latitude	Longitude
Little Canteen Cr (Harding Ditch)	5.64	11.6	0.86	1.31	38.6303	-90.0192
Little Canteen Creek	0.20	0.20	0.10	0.10	38.6067	-89.9953
Judy's Branch	3.63	16.16	0.54	1.22	38.7661	-89.9658

Figure A.46: Annual peak streamflow measured at USGS gauge 05588720 in the Canteen-Cahokia Creek watershed (2001-2011).

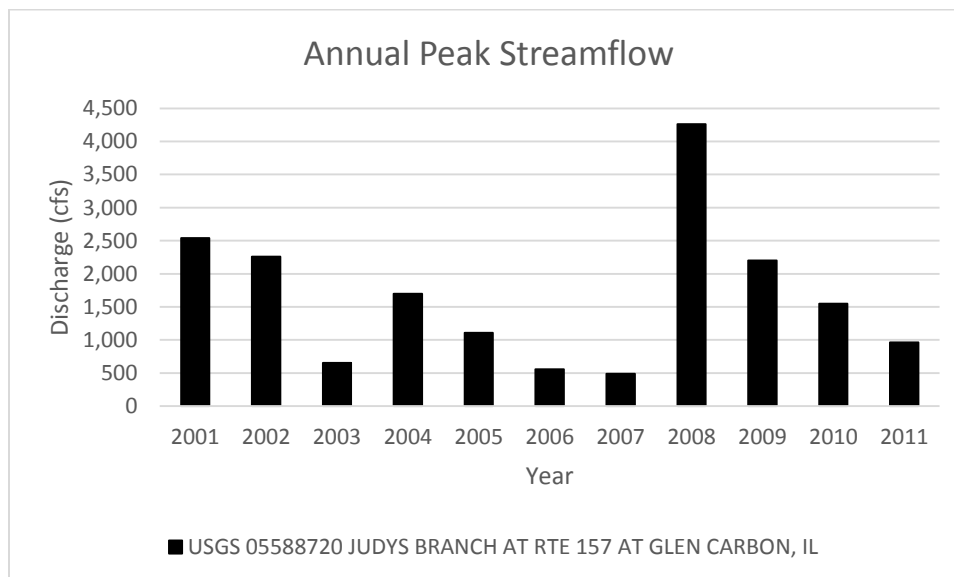


Figure A.47: Annual mean discharge for the Judy's Branch gauge in Glen Carbon (2005-2010).

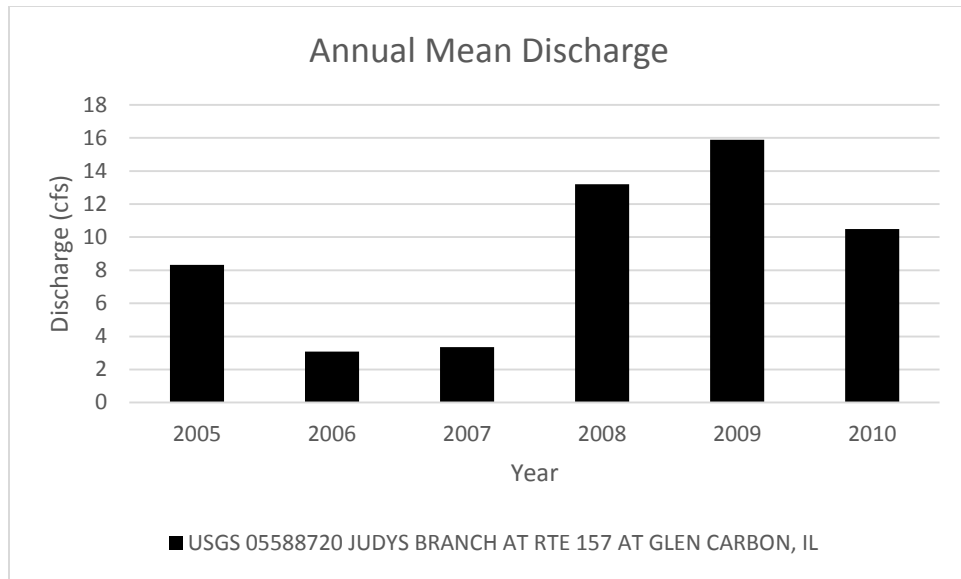
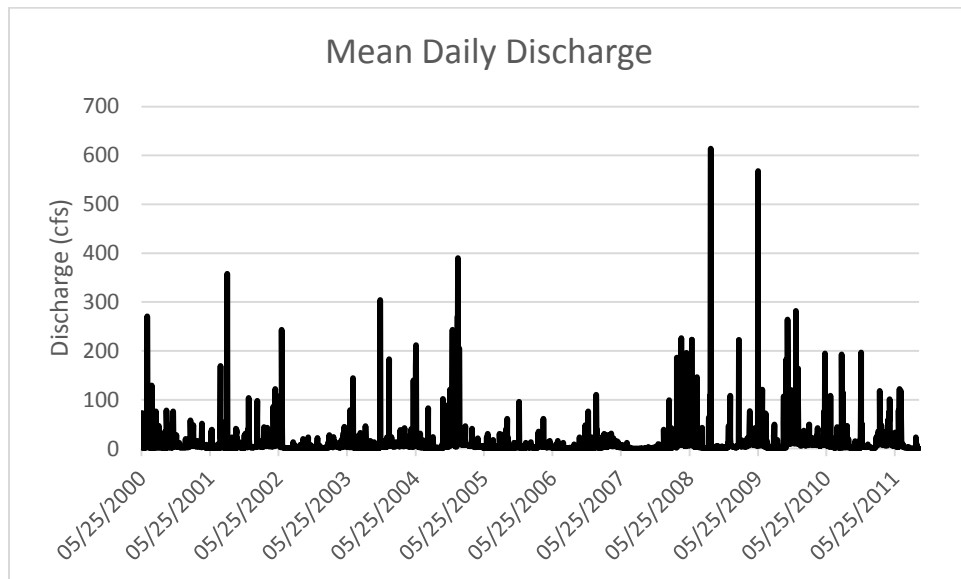


Figure A.48: Mean daily discharge measured at USGS gauge in the Judy's Branch watershed in Glen Carbon (2000-2011).



Biological Indicators of Water Quality

Aquatic macroinvertebrate communities are indicators of water quality. Macroinvertebrates are organisms without a backbone that are visible to the naked eye. Those that live in streams include the immature and adult stages of many flies, beetles, stoneflies, caddisflies, mayflies, dragonflies, aquatic worms, snails, and leeches. Illinois RiverWatch volunteers conducted surveys of macroinvertebrates 71 times at 20 sites in the watershed between 1997 and 2015. The volunteer groups counted the number of individuals of different types of macroinvertebrate in the riffles of the stream sites and calculated several metrics to describe the communities found.

These are:

- **Taxa richness** – Taxa richness measures the abundance of a variety of different organisms as determined by the total number of taxa represented in a sample. Generally, taxa richness increases as water quality, habitat diversity, and habitat suitability increase. Low taxa richness generally indicates low water quality.
- **EPT taxa richness** – Ephemeroptera, Plecoptera, and Trichoptera (EPT) are the three most pollution-sensitive insect orders. The abundance of these orders in a population is an indicator of water quality. The lower the EPT taxa richness, the lower the number of EPT insects sampled, and the worse the water quality.
- **MBI** – Macroinvertebrate Biotic Index, a measure of water quality based on taxa richness, EPT taxa richness, and number of organisms sampled, as calculated through Illinois RiverWatch criteria. (79)

The metrics from the RiverWatch data indicate that the macroinvertebrate species richness, habitat, and associated water quality at the 20 sites sampled is typically poor to fair (Table A.57). Taxa richness at the sites was typically poor/very poor, while EPT taxa richness ranged between poor and very poor over time. Macroinvertebrate diversity in Cahokia Creek is good among three most abundant taxa spread proportionally between many creeks and branches.

The average MBI scores indicated fair water quality, but those scores increased to high, “very poor” water quality ratings from time to time over the monitoring period.

Table A.57: Metrics based on macroinvertebrate populations sampled in the Canteen-Cahokia Creek watershed.

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
Judy's Branch	6/26/2002	11	3	1	5.77
Judy's Branch	5/12/2001	190	5	0	6.41
Judy's Branch	6/11/2000	46	4	0	8.00
Judy's Branch	6/24/1999	8	4	0	4.88
Judy's Branch	6/30/1998	21	1	0	6.00
Judy's Branch	5/29/1997	50	2	0	5.40
Average		54.3	3.2	0.2	6.1
Description of average			Very Poor	Very Poor	Poor
Range			1 – 5	0 – 1	4.88 – 6.41
Description of range			Very Poor - Very Poor	Very Poor - Very Poor	Very Poor - Good
Little Canteen Creek R0717301	6/4/1996	27	3	0	6.00
Average		27	3	0	6
Description of average			Very Poor	Very Poor	Poor
Range			3	0	6.00
Description of range			Very Poor - Very Poor	Very Poor - Very Poor	Poor
Little Canteen Creek R0717302	6/30/2001	55	6	1	6.06
Little Canteen Creek R0717302	6/19/1999	20	6	2	5.63
Little Canteen Creek R0717302	6/12/1998	3	2	2	7.33
Little Canteen Creek R0717302	6/6/1997	123	9	1	8.00
Little Canteen Creek R0717302	6/16/1996	90	6	0	4.39
Average		58.2	5.8	1.2	6.3
Description of average			Very Poor	Poor	Very Poor
Range			5.8 – 5.8	1.2 – 1.2	6.3 – 6.3
Description of range			Very Poor – Fair	Very Poor – Poor	Very Poor - Good
Little Canteen Creek R0717303	6/15/2015	93	6	1	6.03
Average		93.0	6.0	1.0	6.0
Description of average			Very Poor	Very Poor	Poor
Range			6	1	6.03

STREAM NAME	FIELD DATE	# ORGANISMS SAMPLED	TAXA RICHNESS	EPT TAXA RICHNESS	MBI
Description of range			Very Poor - Very Poor	Very Poor - Very Poor	Poor - Poor
Mooney Creek	6/11/2015	107	8	3	5.30
Mooney Creek	5/17/2007	45	8	1	5.10
Mooney Creek	5/15/2006	120	10	3	5.50
Mooney Creek	5/6/2004	102	11	3	6.50
Mooney Creek	5/19/2003	53	10	1	5.79
Mooney Creek	5/20/2002	68	10	2	6.08
Mooney Creek	6/11/2000	109	11	3	6.35
Mooney Creek	5/1/1999	120	10	4	6.32
Mooney Creek	5/31/1998	184	7	0	5.91
Mooney Creek	6/21/1997	135	10	3	5.75
Average		104.3	9.5	2.3	5.9
Description of average			Fair	Poor	Poor
Range			7 – 11	0 - 4	5.10 – 6.50
Description of range			Poor – Fair	Very Poor – Good	Very Poor - Fair

Agriculture and Water Quality

Grain agriculture requires the use of nitrogen and phosphorus fertilizers. This results in the annual addition of soluble nutrients to the watershed. A 2010 study published in the Journal of Environmental Quality reported that 75% of the nitrogen inputs into Madison County were a result of fertilizer applications, with another 9.3% from manure, 6.7% from the atmosphere, and 8.6% from human activities (sewage). (81) Similarly, a 2011 study in the Journal of Environmental Quality reported that 73% of phosphorus inputs into Madison County came from fertilizer, 21.2% from manure, and 5.6% from sewage. (82) The tillage practices associated with grain production result in annual disturbance of the soil surface making it more susceptible to sheet and rill erosion during precipitation events. The 2012 Illinois Department of Agriculture Soil Conservation Transect Survey reported that 75% of corn and 37% of soybeans in Madison County are produced using conventional tillage practices that result in significant soil disturbance. (55) These values are much higher than the state averages of 49.1% for corn and 21.5% for soybean. Inversely, the amount of no till crop production is 1% for corn and 7% for soybean, which is much lower than the state averages of 10.8% for corn and 38.6% for soybean. It is apparent that row crop agriculture in Madison County has the greatest impact on surface water quality.

Urbanization and Water Quality

The greatest detriment to water quality from urbanization is an increase in the amount of impervious surfaces such as asphalt. Impervious surfaces prevent the natural process of rain infiltration into the soil. Instead, rainfall is rapidly directed into stormwater sewer systems that deliver the water directly to streams, unless a special effort is made to capture sediment prior to discharge. The rapid increase in runoff volume induces severe streambank and streambed erosion in the ephemeral streams that initially receive the water. Another impact of urbanization on water quality is the use of fertilizers by homeowners. Urban landowners are more likely to apply excessive amounts of nitrogen and phosphorus fertilizers on a unit of land. Although each homeowner controls a small amount of land, the cumulative effect of residential landscape fertilization can be significant in densely populated areas. Surface runoff from urban landscapes reaches streams more quickly than from agricultural or natural landscapes due to the prevalence of impervious surfaces.

McDonough Lake

The American Bottom River Corridor Resource Inventory developed by Southwestern Illinois RC&D, Inc., Southwestern Illinois GIS Resource Center, Greenway Network, St. Charles Rivers & Streams Project with funding provided through the IDNR C2000 Ecosystem Partnership Program, provided water quality data averaged from two field surveys at McDonough Lake. (38) This data is shown in Table A.58. High levels of phosphates, conductivity, and fecal coliform were observed.

Table A.58: Water Quality Average Matrix. Values are an average of two field surveys. Shaded boxes indicate values outside of acceptable standards.

Site Number & Location	Water Temp. (Degrees C)	Dissolved Oxygen (mg/L)	Nitrates (mg/L)	Phosphates (mg/L)	Conductivity (uS)	Turbidity (NTU)	pH	Fecal coliform (CFU/100ml)	BOD
19. McDonough Lake	15.5	6.25	0.26	1.52	862	5.87	8.3	445	7.55

*these values are reported in parts per million (ppm)

NPDES Permitted Discharges

There are six facilities with National Pollution Discharge Elimination System (NPDES) permits to discharge into the Canteen-Cahokia Creek watershed (Table A.59). Two of them are water, wastewater, or sewage treatment plants. Several other facilities in the watershed have been issued NPDES permits in the past which have now expired. None of the facilities have exceeded the capacity for which they were designed. The permit limits can be downloaded from the Discharge Monitoring Report (DMR) Pollutant Loading Tool.

Several pollutants are required to be monitored at these facilities, including residual chlorine, biological oxygen demand, fecal coliform, ammonia nitrogen, suspended solids, pH, dissolved oxygen, and total flow. Suspended solids monitored at the facilities are shown in Table A.60. Two of the six permitted facilities monitored total suspended solids, and the average total of the total suspended solids from these seven facilities was 139.8 lb/d. Translated into a yearly value, that's 25.5 t/year.

The Stone Meadow Sewage Treatment Plant (STP) is the only facility in the watershed to track nitrogen, or phosphorus discharge from 2009-2016 (Table A.61). These pollutants are not subject to limits in the permit. (22)

Table A.59: NPDES Permitted Discharges into the Canteen-Cahokia Creek watershed.

HUC 12	Site Name	Permit Number	Permit Exp. Date	Design Flow (MGD)	Average Daily Flow (MGD)
071401010301	Edwardsville WTP	IL0026310	December 31, 2019	9.27	2.41
071401010301	Southern Illinois University	IL0075311	May 31, 2018		0.459
071401010301	Stone Meadows MH Community	IL0046914	August 31, 2017	0.175	0.041
071401010301	Maryville, Village of	ILG640139	April 30, 2017		0.012
071401010302	Econolodge – Rodeway Inn STP	IL0047058	December 31, 2018	0.025	0.0056
071401010302	City of Collinsville	ILR400316	March 31, 2016	9.95	4.98

Table A.60: Total suspended solids as averages from measurements from the PCS/ICIS for the Canteen-Cahokia Creek watershed.

HUC 12	Site Name	Permit Number	Average Total Suspended Solids Discharge (lb/d)	Dates of data used
071401010301	Edwardsville WTP	IL0026310	279.25	31-JAN-2015 - 31-MAY-2016
071401010301	Stone Meadows MH Community	IL0046914	0.275	31-DEC-2012 - 31-MAY-2016

Table A.61: Pollutant loads of nitrogen and phosphorus from Stone Meadow STP.

Chemical Name	Total Discharged (lbs/year)								Average (lbs/year)
	2009	2010	2011	2012	2013	2014	2015	2016	
Nitrogen	166	225	127	258	66	873	445	23	21,119
Phosphorus	-	-	-	-	21,070	37,107	79,474	46,278	45,982

Outfalls

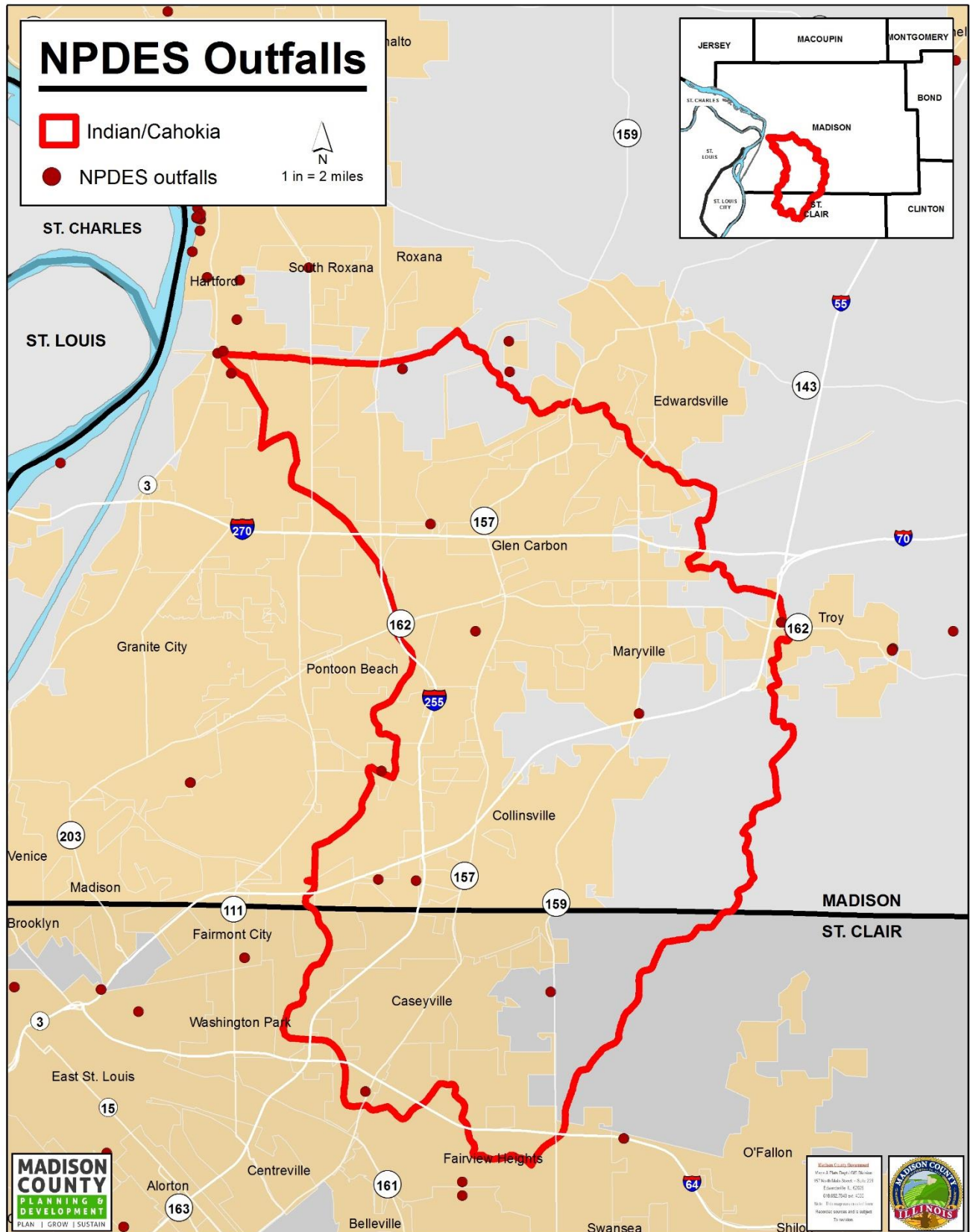
According to the federal definition, “outfall” means a point source at the point where a municipal separate storm sewer discharges to waters of the United States, as defined by 40 CFR 122.2. Outfalls do not include open conveyances connecting two municipal storm sewers, or pipes, tunnels, or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States.²¹³ NPDES outfall locations are available to download from Illinois’ Resource Management Mapping Service (RMMS). Madison County also created a georeferenced outfalls file covering the county some years ago, but it is not clear that the makers of this file used the federal definition of outfalls, and the file is not accompanied by metadata that could explain its attributes.

There are 11 outfalls within the watershed. Four of the outfalls are within municipal boundaries, as indicated by an asterisk by the facility name in Table A.62 (Figure A.49).

Table A.62: NPDES Outfalls in the Canteen-Cahokia Creek watershed.

HUC14	Facility Name	NPID	Description
07140101030302	Collinsville STP*	IL0028215	Excess flow (>7.5 MGD)
07140101030201	St. Louis East Truck Plaza	IL0032638	Quarterly Reporting
07140101030303	Safety Kleen Corp-Caseyville*	IL0072095	Stormwater runoff for retention
07140101030101	Edwardsville STP	IL0026310	SSP Lift Station #11
07140101030201	Econolodge*	IL0047058	STP Outfall
07140101030201	St. Louis East Truck Plaza	IL0032638	Washdown water, SW FR FUEL ISL
07140101030302	Collinsville STP	IL0028215	STP Outfall
07140101030104	Maryville WTP	IL0063151	Filter backwash
07140101030101	Edwardsville STP	IL0026310	EHB-Equalization lagoon outfall
07140101030101	Stone Meadows MHP*	IL0046914	STP Outfall
07140101030303	Willow Woods MHP STP	IL0042218	STP Outfall

Figure A.49: NPDES outfall locations in the Canteen-Cahokia Creek watershed.



Pollutant Loading Analysis

Estimating Pollutant Loads by Source

Nutrient (total nitrogen and total phosphorus) and sediment loads (sheet and rill erosion) for the Canteen-Cahokia Creek watershed were calculated using the Spreadsheet Tool for Estimating Pollutant Load (STEPL), a tool developed by the USEPA. (83) STEPL employs simple algorithms to calculate nitrogen, phosphorus, and sediment loads from different land uses.

Inputs required by the model include land uses, animal operations, precipitation, soil types and Universal Soil Loss Equation (USLE) parameters, septic systems, and direct discharges. Land use data was identified from the most recent National Land Cover Database (NLCD 2011). Animal (livestock) data was obtained from the USDA 2012 Agricultural Census database at the county level. (45) Runoff volumes were based on long-term precipitation records from the Southern Illinois University weather station at Belleville. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. USLE parameters were from the Madison County Soil Survey. Data related to septic systems was obtained from the U.S. Census Bureau and the USEPA. The remaining user input parameters were obtained from the online STEPL Input Data Server. (83)

Sediment loads due to streambank erosion were calculated with the STEPL tool. It was assumed that the average impaired streambank location included moderate lateral recession and an average erosional height of five feet on both sides of the river within the impaired stream length.

Table A.63: Estimated current annual pollutant load by source at the watershed scale.

Sources	N Load		P Load		Sediment Load	
	(lb/yr)	(%)	(lb/yr)	(%)	(t/yr)	(%)
Cropland	107,490	37.3	26,288	46.0	6,264	35.7
Pastureland	14,617	5.1	1,316	2.3	221	1.3
Forest	2,747	1.0	1,346	2.4	77	0.4
Urban	151,088	52.4	23,316	40.8	3,469	19.8
Feedlots	0	0	0	0.0	0	0
Septic	584	0.1	229	0.4	0	0
Streambank	11,896	4.2	4,615	8.1	7,491	42.8
Total	288,422	100	57,110	100	17,522	100

The STEPL model for Canteen-Cahokia Creek watershed calculated nutrient loads for each of the primary land uses as used in the NLCD (Table A.63). Cropland and Urban land were by far the greatest sources of nutrients and sediments in the watershed. Cultivated cropland accounts for 25.8% of the total land surface in the watershed, but contributes 37.3% of the nitrogen load, 46.0% of the phosphorus load, and 35.7% of the sediment load. Developed urban land accounts for 46.2% of the total land surface in the watershed and contributes 52.4% of the nitrogen load, 40.8% of the phosphorus load, and 19.8% of the sediment load. A trend towards increasing urbanization indicates that urban sources of pollutants will account for a greater portion of pollutant loads in the future. Hay and pastureland cover 5.0% of the land surface in the watershed but contribute much smaller amounts of nutrients and sediments due to protection of the soil surface by a permanent vegetative cover. Forest also covers 23.0% of the watershed but only contributes approximately 1% of the nutrient and sediment loads. Streambank erosion is also large contributor of sediments (42.8%) in the watershed based on the observations and

calculations conducted for this report.

Estimated Pollutant Loads by Subwatershed

Additional insight into the impact of land use on pollutant loads can be discerned by examining pollutant loads and land use/land cover by HUC12 subwatershed (Table A.64). It should be noted that while other sections of this report evaluate information from the Cahokia Creek watershed at the HUC14 level, the information available for the STEPL tool was only available at the HUC 12 level.

Table A.64: Annual pollutant loads by subwatershed and area of cropland in acres.

HUC12	Total Area	Cropland	N Load	P Load	N Load	P Load	Sediment Load
	(acres)		(lb/year)		(lb/acre/year)		(ton/year)
071401010301	20,241	6,565	123,733	24,951	6.1	1.2	7,433
071401010302	14,397	3,400	61,725	13,207	4.3	0.9	6,703
071401010303	19,639	4,042	103,054	18,951	5.2	1.0	3,386
TOTAL	54,277	14,007	288,512	57,108	5.3	1.1	17,522

The relationship between nutrient loads and crop acreage is very strong, as is the relationship between sediment load and cropland. The correlation between total nutrient and sediment loads and all other land uses was weak or nonexistent and are not shown in Table A.64. This does not indicate that other nutrient and sediment sources are unimportant but rather that the amounts contributed by non-crop land sources are relatively small compared to cropland.

The HUC12 with the greatest nitrogen loading is 071401010301, with 123,733 lb/year. The same HUC12 also has the most phosphorus loading (24,951 lb/year), and the most sediment loading (7,433 tons/year). It is important to note that 071401010301 is also the largest subwatershed in the project area. Even when adjusted for area, it produces the most nitrogen per acre, with 6.1 lb/acre/year.

The pattern is the same for phosphorus loading (Figure A.51), with HUC12 071401010301 producing the most phosphorus in total and per acre (1.2 lb/acre/year). The amount of phosphorus loading is much smaller than the nitrogen loading in terms of pounds.

Areas of high sediment loading are distributed somewhat evenly throughout the watershed with the highest loading in HUC 071402010301 and the lowest loading in 071401010303.

Figure A.50: Nitrogen loads by HUC 14 in the Canteen-Cahokia Creeks watershed, as modeled using STEPL.

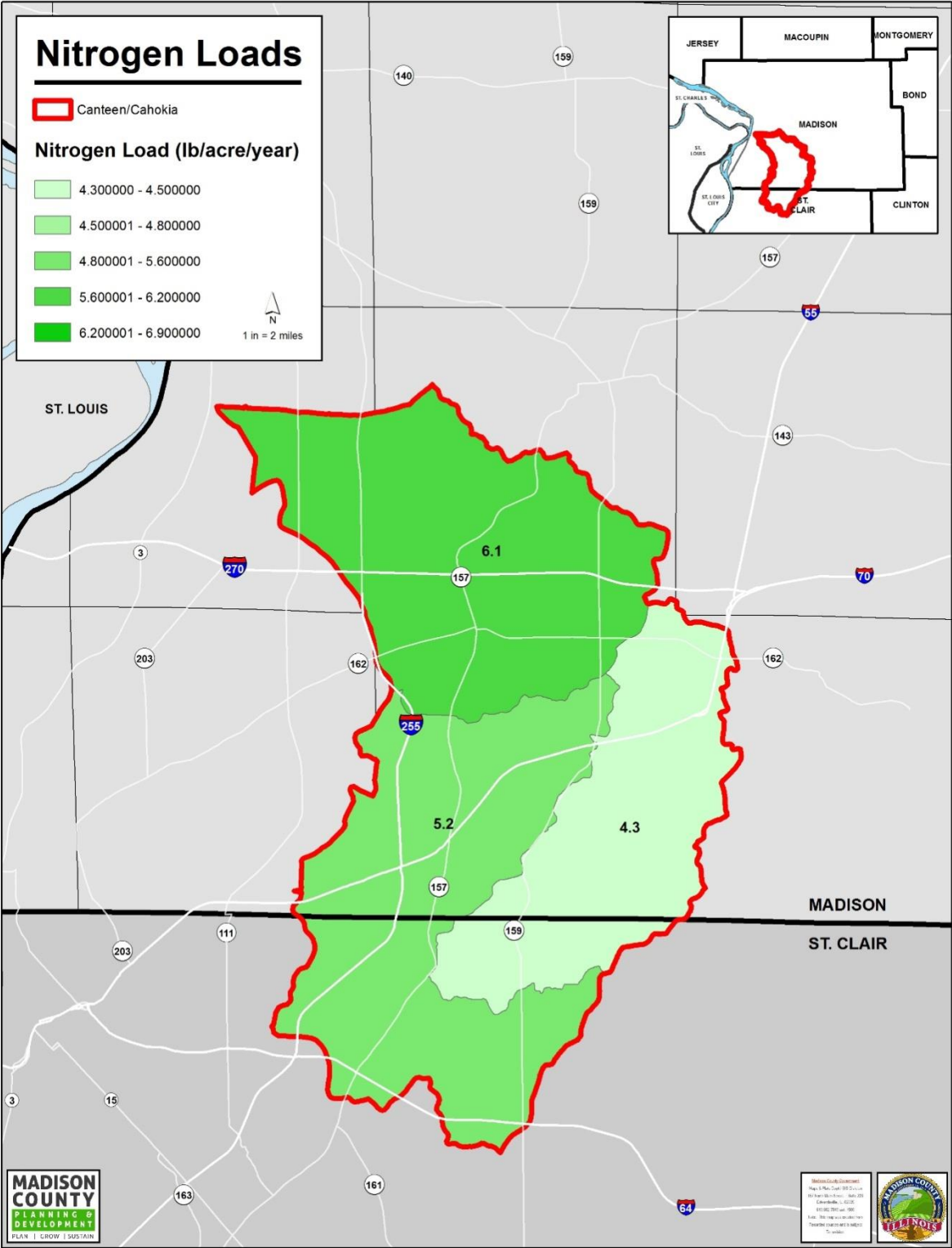


Figure A.51: Phosphorus loads by HUC 14 in the Canteen-Cahokia Creeks watershed, as modeled using STEPL.

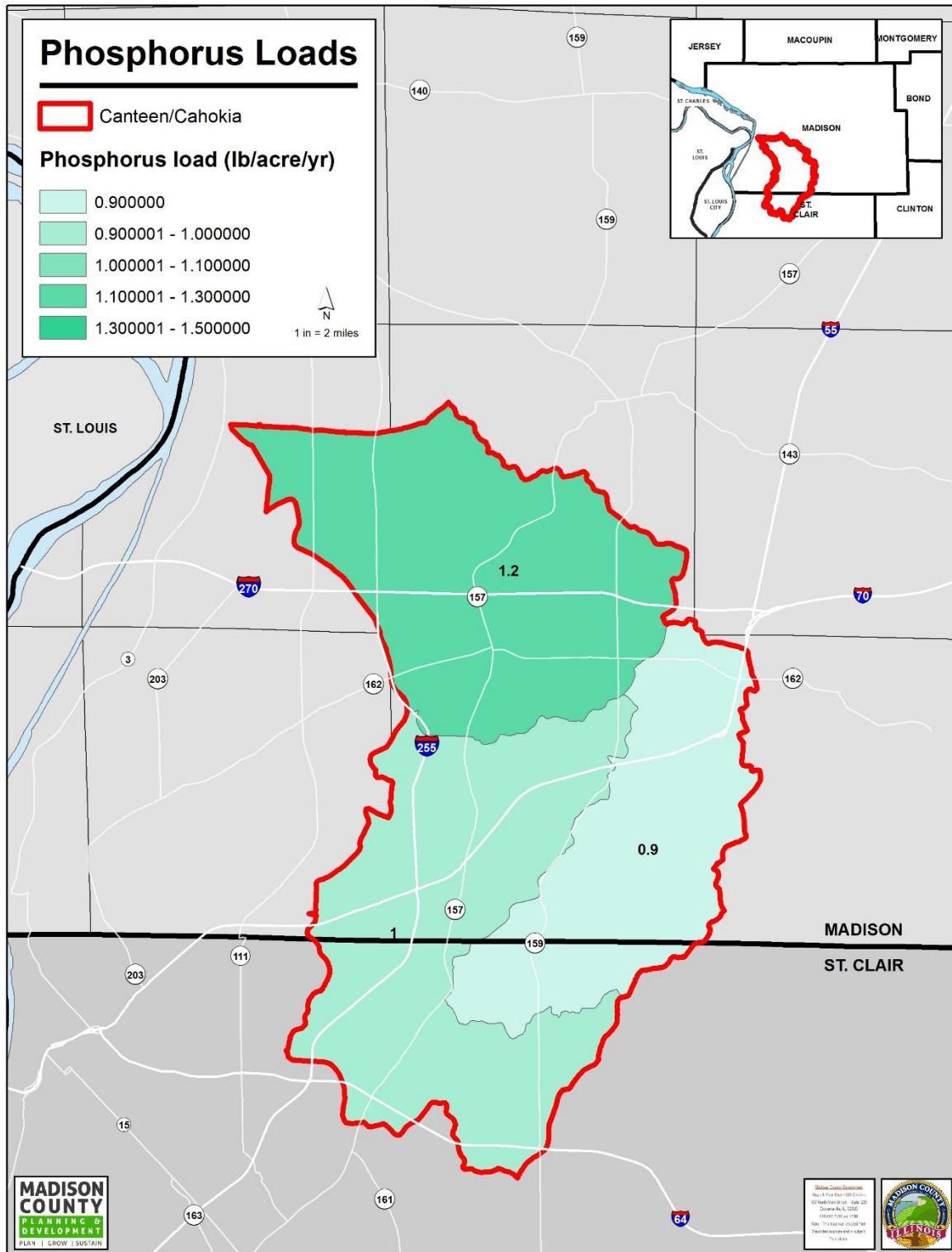
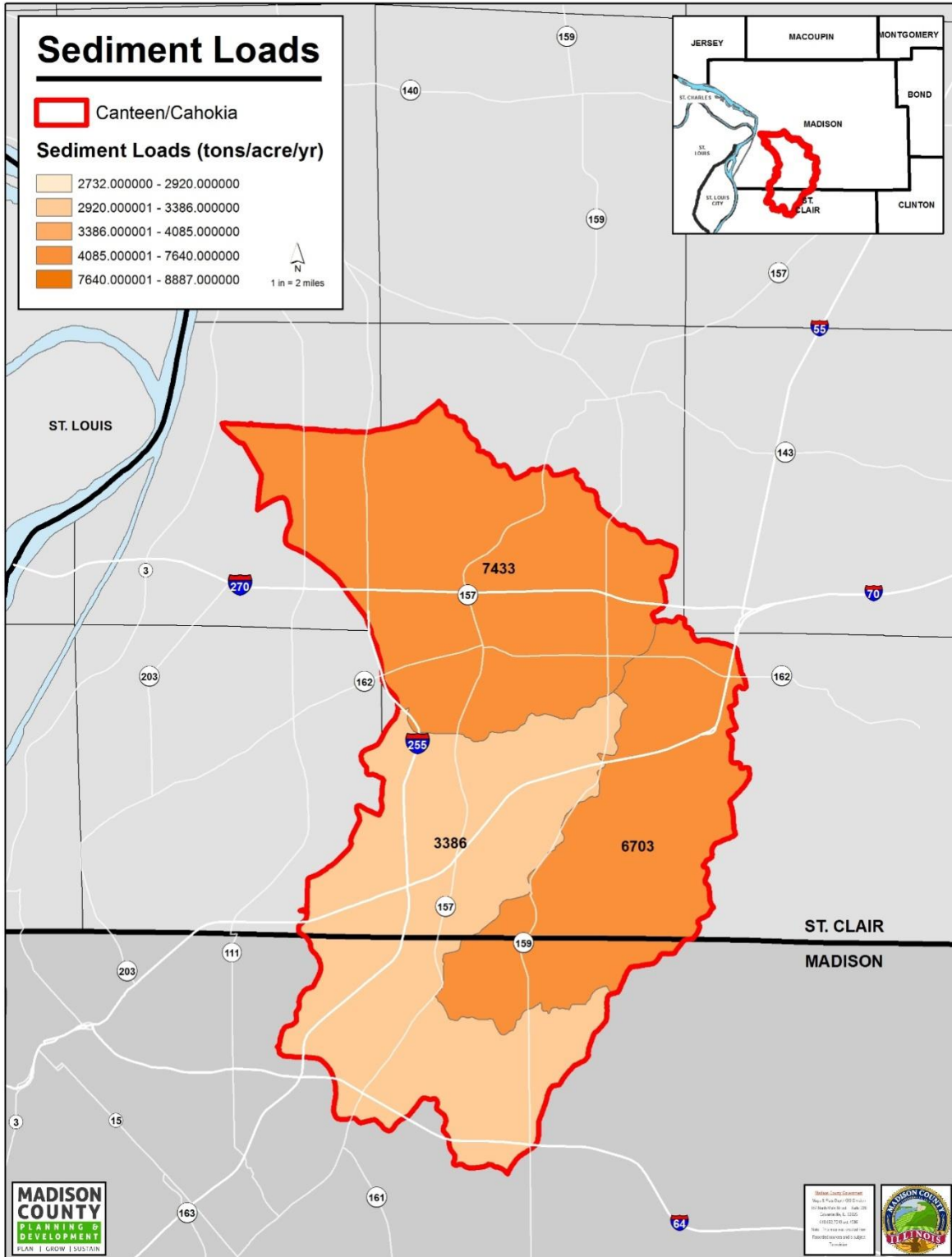


Figure A.52: Sediment loads by HUC 14 in the Canteen-Cahokia Creeks watershed, as modeled using STEPL.



Glossary of Terms

100-year floodplain: Land adjoining the channel of a river, stream, watercourse, lake, or wetland that has been or may be inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

303(d) Impaired Waters: The federal Clean Water Act requires states to submit a list of impaired waters to the U.S. Environmental Protection Agency for review and approval every two years using water quality assessment data from the Section 305(b) Water Quality Report. These impaired waters are referred to as “303(d) impaired waters.” States are then required to establish priorities for the development of Total Maximum Daily Load analyses (TMDLs) for these waters and a long-term plan to meet them.

305(b): The Illinois 305(b) Water Quality Report is a water quality assessment of the state’s surface and groundwater resources compiled by the Illinois Environmental Protection Agency and submitted as a report to the U.S. Environmental Protection Agency as required under Section 305(b) of the Clean Water Act.

Aquifer: A layer of permeable rock, sand, or gravel through which groundwater flows, containing enough water to supply springs and wells.

Base flow: The flow to which a perennially flowing stream reduces during the dry season. It is commonly supported by groundwater seepage into the channel.

Bedrock: The solid rock that lies beneath loose material, such as soil, sand, clay, or gravel.

Center for Watershed Protection (CWP): Non-profit 501(c)3 corporation founded in 1992 that provides government entities, watershed organizations, and others around the country with the tools to protect streams, lakes, rivers, and watersheds.

Channelization: The artificial straightening, deepening, or widening of a stream or river to accommodate increased stormwater flows, typically to increase the amount of adjacent developable land for urban development, agriculture, or navigation.

Designated use: Appropriate use of a waterbody as designated by states and tribes. Designated uses are identified by considering the use, suitability, and value of the water body for public water supply; protection of fish and wildlife; and recreational, agricultural, industrial, and navigational purposes. Determinations are based on its physical, chemical, and biological characteristics; geographical setting and scenic qualities; and economic considerations.

Digital Elevation Model (DEM): Grid of elevation points used to produce elevation maps.

Discharge (streamflow): The volume of water passing through a channel over a given time period, usually measured in cubic feet per second.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

Erosion: The displacement of soil particles on land surfaces due to water or wind action.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, coordinates recovery from, and mitigates against natural and man-made disasters and emergencies, including significant floods.

Flash flood: A rapid rise of water along a stream or low-lying area, usually produced when heavy localized precipitation falls over an area in a short amount of time. Flash floods are considered the most dangerous type of flood event because they offer little or no warning time and their capacity for damage, including the capability to induce mudslides.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Geology: The scientific study of the structure of the Earth, focused primarily on the composition and origins of rocks, soil, and minerals.

Headwaters: Upper reaches of streams and tributaries in a watershed.

HUC or HUC Code: A Hydrologic Unit Code (HUC) that refers to the division and subdivision of U.S. watersheds. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units). Where two digits follow “HUC,” they refer to the length of the HUC code. For example, “HUC14” refers to the lowest-nested subwatershed level with a 14-digit long code, such as HUC 07140204050101.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition and/or growth of plants on those soils.

Hydrology: The scientific study of the properties, distribution, and effects of water in relation to the earth’s surface, in the soil and underlying rocks, and in the atmosphere.

Hydrologic Soil Groups (HSG): Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups, A, B, C and D, based on the soil’s runoff potential. A’s generally have the smallest runoff potential and D’s the greatest.

Hydrophytic vegetation: Plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.

Illinois Department of Natural Resources (IDNR): State government agency established to manage, protect, and sustain Illinois’ natural and cultural resources, provide resource-compatible recreational opportunities, and promote natural resource-related issues for the public’s safety and education.

Illinois Environmental Protection Agency (IEPA): State government agency established to safeguard environmental quality so as to protect health, welfare, property, and quality of life in Illinois.

Illinois Nature Preserves Commission (INPC): Commission responsible for protecting Illinois Nature Preserves, state-protected areas that are provided the highest level of legal protection, and have management plans in place.

Impervious Cover Model: Simple urban stream classification model based on impervious cover and stream quality. The classification system contains three stream categories (sensitive, impacted, and non-supporting) based on the percentage of impervious cover.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g. parking lots, roads, houses, etc.).

Infiltration: Rainfall or surface runoff that moves downward from the surface into the subsurface soil.

Loess: An unstratified loamy deposit, usually buff to yellowish brown, chiefly deposited by the wind and thought to have formed by the grinding of glaciers.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Municipal Separate Storm Sewer System (MS4): A system that transports or holds stormwater, such as catch basins, curbs, gutters, and ditches, before discharging into local waterbodies.

National Flood Insurance Program (NFIP): Federal program created by Congress in 1968 to help provide a means for property owners to financially protect themselves from flood risk.

National Hydrography Dataset (NHD): Digital database of surface water features, such as lakes, ponds, streams, and rivers. The NHD is used to make hydrology and watershed boundary maps.

National Pollutant Discharge Elimination System (NPDES) Phase II: Permit program authorized by the Clean Water Act requiring smaller communities and public entities that own and operate a Municipal Separate Storm Sewer System (MS4) to apply and obtain a NPDES permit for stormwater discharges to surface water. Permittees must develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. Individual homes that use a septic system, are connected to a municipal system, or do not have a surface discharge do not need an NPDES permit. The NPDES permit program is administered by authorized states. In Illinois, the Illinois EPA administers the program.

National Wetland Inventory (NWI): U.S. Fish and Wildlife Service program that provides information on the characteristics, extent, and status of U.S. wetlands and deepwater habitats.

Native vegetation/plants: Plant species that have historically been found in a given area.

Natural Resources Conservation Service (NRCS): Government agency under the U.S. Department of Agriculture (USDA) that provides technical assistance to landowners and land managers.

Nitrogen: A colorless, odorless, unreactive gas that constitutes about 78% of the earth's atmosphere. The availability of nitrogen in soil is important for plant growth and ecosystem processes, and nitrogen is used in many fertilizers.

Nonpoint source pollution (NPS pollution): Any source of water pollution that is not from a discrete outflow point. Instead, NPS pollution comes from diffuse sources and is carried into waterways with runoff from the land. Pollutants can include oil, grease, sediment, and nutrients in excess fertilizer.

Nutrients: Substances needed for the growth of plants and animals, such as phosphorous and nitrogen. The addition of too many nutrients to a waterway causes problems to the aquatic ecosystem by promoting nuisance vegetation including excess algae growth.

Open space parcel: Any parcel of land that is not developed and is set aside for recreation or conservation purposes.

Overland flood: Flooding that occurs when rainfall collects on saturated or frozen ground. When surface runoff cannot find a channel, it may flow out over a large area at a somewhat uniform depth in sheet flow or collect in depressions as ponding.

Point source pollution: Pollution that discharges in water from a single, discrete source, such as an outfall pipe from an industrial plant or wastewater treatment facility.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Riparian: The riverside or riverine environment adjacent to the stream channel. For example, riparian, or streamside, vegetation grows next to (and over) a stream.

Riverine flood: The gradual rise of water in a river, stream, lake, reservoir, or other waterway that results in the waterway overflowing its banks. This type of flooding generally occurs when storm systems remain in the area for extended periods of time, when winter or spring rains combine with melting snow to create higher flows, or when obstructions, such as logjams, block normal water flow.

Runoff: The portion of precipitation that does not infiltrate into the ground and is discharged into streams by flowing over the ground.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Sedimentation: The process that deposits soils, debris, and other materials either on other ground surfaces or in bodies of water.

Special Flood Hazard Area: The area inundated during the base flood is called the Special Flood Hazard Area or 100-year floodplain.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project.

Stream reach: A stream segment having fairly homogenous hydraulic, geomorphic, riparian cover, and land use characteristics.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Threatened and endangered species: A “threatened” species is one that is likely to become endangered in the foreseeable future. An “endangered” species is one that is in danger of extinction throughout all or a significant portion of its range.

Topography: The relative elevations of a landscape describing the configuration of its surface. Also, the study and depiction of the distribution, relative positions, and elevations of natural and man-made features of a particular landscape (e.g. on a map).

Total Maximum Daily Load (TMDL): The highest amount of discharge of a particular pollutant that a waterbody can handle safely per day.

Total Suspended Solids (TSS): The organic and inorganic material suspended in the water column greater than 0.45 micron in size.

United States Army Corps of Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services for planning, designing, building, and operating water resources and other Civil Works projects. These include flood control and environmental protection projects.

U.S. Fish and Wildlife Service (USFWS): Federal government agency within the U.S. Department of the Interior dedicated to the management of fish and wildlife and their habitats.

United States Geological Survey (USGS): Federal government agency established with the responsibility to provide reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect quality of life.

Urban runoff: Runoff that runs over urban developed surfaces such as streets, lawns, and parking lots, entering directly into storm sewers rather than infiltrating the land upon which it falls.

Watershed: The area of land that contributes runoff to a single point on a waterbody.

Watershed-Based Plan: A strategy and work plan for achieving water resource goals that provides assessment and management information for a geographically defined watershed, including the analysis, actions, participants, and resources related to development and implementation of the plan.

Wetland: Lands that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils, and 3) hydrophytic vegetation. A wetland is considered a subset of the definition of the Waters of the United States.

Data Tables

Hydrologic soil groups by HUC14

Table A.65: Area of hydrologic soil group by HUC14 in the Canteen-Cahokia Creek watershed.

HUC14	Area of Hydrologic Soil Group (acres)							Total area (acres)
	Unclassified	A	B	B/D	C	C/D	D	
07140101030101	90	700	4,233	233	716	0	7,334	13,306
07140101030102	76	36	3,098	206	1,685	243	8,352	13,696
07140101030103	52	6	6,811	0	532	243	0	7,644
07140101030104	83	0	5,037	0	2,193	1,328	2,286	10,927
07140101030201	106	0	8,626	0	423	0	7	9,162
07140101030202	500	0	11,165	0	645	0	0	12,310
07140101030203	1,033	0	23,895	0	2,739	0	0	27,667
07140101030301	561	34	12,152	54	1,768	1,179	1,157	16,905
07140101030302	4,182	0	9,811	0	5,007	543	1,427	20,970
07140101030303	2,818	0	5,361	9	1,329	0	898	10,415
Total	9,501	776	90,189	502	17,037	3,536	21,461	143,002

Soil types with hydric category and hydrologic group

Table A.66: Soil types in the Canteen-Cahokia Creek watershed with their hydric category and hydrologic group.

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
	533	Urban land		449		449
	536	Dumps		97		97
	865	Pits, gravel		47		47
	866	Dumps, slurry		6		6
C/D	1070L	Beaucoup silty clay loam, undrained, 0 to 2 percent	Yes		367	367
D	1071A	Darwin silty clay loam, undrained, 0 to 2 percent	Yes		466	466
D	165A	Weir silt loam, 0 to 2 percent slopes	Yes		10	10
D	2071L	Darwin-Aquents-Urban land complex, 0 to 2	Yes		475	475
B	2079D	Menfro-Orthents-Urban land complex, 8 to 15	No	345		345
B/D	2384B	Edwardsville-Urban land complex, 1 to 4 percent	No	20		20

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
C	2477B	Winfield-Orthents-Urban land complex, 2 to 8	No	2,196		2,196
D	267A	Caseyville silt loam, 0 to 2 percent slopes	Yes		263	263
B/D	267B	Caseyville silt loam, 2 to 5 percent slopes	No	261		261
C	283B	Downsouth silt loam, 2 to 5 percent slopes	No	709		709
C	283C2	Downsouth silt loam, 5 to 10 percent slopes, eroded	No	149		149
B/D	3333A	Wakeland silt loam, 0 to 2 percent slopes, frequently	No	1,531		1,531
B/D	3336A	Wilbur silt loam, 0 to 2 percent slopes, frequently	No	399		399
C	3415A	Orion silt loam, 0 to 2 percent slopes, frequently	No	423		423
B	35F	Bold silt loam, 18 to 35 percent slopes	No	35		35
B	37A	Worthen silt loam, 0 to 2 percent slopes	No	451		451
B	37B	Worthen silt loam, 2 to 5 percent slopes	No	387		387
B/D	384A	Edwardsville silt loam, 0 to 2 percent slopes	No	1,142		1,142
B/D	384B	Edwardsville silt loam, 2 to 5 percent slopes	No	14		14
D	385A	Mascoutah silty clay loam, 0 to 2 percent slopes	Yes		1,040	1,040
B	441B	Wakenda silt loam, 2 to 5 percent slopes	No	180		180
B	441C2	Wakenda silt loam, 5 to 10 percent slopes, eroded	No	14		14
C	477B	Winfield silt loam, 2 to 5 percent slopes	No	2,709		2,709
C	477B2	Winfield silt loam, 2 to 5 percent slopes, eroded	No	3		3
C	477B3	Winfield silty clay loam, 2 to 5 percent slopes,	No	49		49
C	477C2	Winfield silt loam, 5 to 10 percent slopes, eroded	No	466		466
C	477C3	Winfield silty clay loam, 5 to 10 percent slopes,	No	512		512
C	477D3	Winfield silty clay loam, 10 to 18 percent slopes,	No	836		836

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
C/D	50A	Virden silt loam, 0 to 2 percent slopes	Yes		9	9
B	630D3	Navlys silty clay loam, 10 to 18 percent slopes, severely	No	436		436
B	7037A	Worthen silt loam, 0 to 2 percent slopes, rarely	No	1,098		1,098
B/D	7037B	Worthen silt loam, 2 to 5 percent slopes, rarely	No	330		330
A	7053B	Bloomfield loamy fine sand, 2 to 5 percent slopes,	No	549		549
B/D	7075B	Drury silt loam, 2 to 5 percent slopes, rarely	Yes		234	234
C/D	7081A	Littleton silt loam, 0 to 2 percent slopes, rarely	Yes		302	302
C/D	7122B	Colp silt loam, 2 to 5 percent slopes, rarely	No	20		20
C/D	7122C	Colp silty clay loam, 5 to 10 percent slopes, severely	No	5		5
A	7150A	Onarga sandy loam, 0 to 2 percent slopes, rarely	No	309		309
A/D	7151A	Ridgeville fine sandy loam, 0 to 2 percent slopes,	No	135		135
D	7338A	Hurst silty clay loam, 0 to 2 percent slopes, rarely	No	23		23
B	7430A	Raddle silt loam, 0 to 2 percent slopes, rarely	No	504		504
C	7445A	Newhaven loam, 0 to 2 percent slopes, rarely	No	59		59
B	75B	Drury silt loam, 2 to 5 percent slopes	No	113		113
A	7741B	Oakville fine sand, 2 to 5 percent slopes, rarely	No	144		144
A	7741C	Oakville fine sand, 5 to 10 percent slopes, rarely	No	46		46
B	79B	Menfro silt loam, 2 to 5 percent slopes	No	4143		4143
B	79C2	Menfro silt loam, 5 to 10 percent slopes, eroded	No	1,249		1,249
B	79C3	Menfro silty clay loam, 5 to 10 percent slopes, severely	No	130		130
B	79D2	Menfro silt loam, 10 to 18 percent slopes, eroded	No	926		926
B	79D3	Menfro silty clay loam, 10 to 18 percent slopes,	No	1,894		1,894

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
B	79F	Menfro silt loam, 18 to 35 percent slopes	No	4,357		4,357
B	79F3	Menfro silty clay loam, 18 to 35 percent slopes,	No	181		181
B	79G	Menfro silt loam, 35 to 60 percent slopes	No	635		635
B	801B	Orthents, silty, undulating	No	183		183
C	801D	Orthents, silty, hilly	No	1,011		1,011
C	802B	Orthents, loamy, undulating	No	129		129
B/D	8070A	Beaucoup silty clay loam, 0 to 2 percent slopes,	Yes		502	502
D	8071L	Darwin silty clay, 0 to 2 percent slopes,	Yes		9,219	9,219
B	8078A	Arenzville silt loam, 0 to 2 percent slopes,	No	224		224
C/D	8180A	Dupo silt loam, 0 to 2 percent slopes,	No	1,641		1,641
C/D	8183A	Shaffton clay loam, 0 to 2 percent slopes,	Yes		356	356
B/D	81A	Littleton silt loam, 0 to 2 percent slopes	No	288		288
B/D	826D	Orthents, silty, acid substratum, rolling	No	30		30
B/D	8284A	Tice silty clay loam, 0 to 2 percent slopes,	No	777		777
C/D	8302A	Ambraw silty clay loam, 0 to 2 percent slopes,	Yes		287	287
A	8304B	Landes very fine sandy loam, 2 to 5 percent	No	352		352
B	8331A	Haymond silt loam, 0 to 2 percent slopes,	No	588		588
B/D	8333A	Wakeland silt loam, 0 to 2 percent slopes,	No	322		322
C/D	8334A	Birds silt loam, 0 to 2 percent slopes,	Yes		879	879
B/D	8415A	Orion silt loam, 0 to 2 percent slopes,	No	168		168
D	8591A	Fults silty clay, 0 to 2 percent slopes,	Yes		9	9
D	8592A	Nameoki silty clay, 0 to 2 percent slopes,	No	18		18

Hydrologic Soil Group	Map Symbol Code	Soil Type (SSURGO map unit name)	Hydric Soil?	Non-Hydric Soils area (acres)	Hydric Soils area (acres)	Total area (acres)
B/D	8646A	Fluvaquents, loamy, 0 to 2 percent slopes,	Yes		23	23
B	8674A	Dozaville silt loam, 0 to 2 percent slopes,	No	262		262
D	8831A	Fluvaquents, clayey, 0 to 2 percent slopes,	Yes		277	277
B/D	90A	Bethalto silt loam, 0 to 2 percent slopes	No	739		739
B	962D2	Sylvan-Bold silt loams, 10 to 18 percent slopes,	No	1,578		1,578
B	962F2	Sylvan-Bold silt loams, 18 to 35 percent slopes,	No	4,969		4,969
B	962G	Sylvan-Bold silt loams, 35 to 60 percent slopes	No	391		391
	W	Water		815		815
	Total			45,205	14,716	59,921

Highly erodible soils by HUC14

Table A.67: Area of highly erodible and non-highly erodible soils by HUC14 in the Canteen-Cahokia Creek watershed.

HUC14	Highly erodible soils (acres)	Not highly erodible soils (acres)	Unclassified	Total area (acres)
07140101030101	12,305	1,280	240	13,825
07140101030102	4,586	1,339	115	6,040
07140101030103	6,459	2,868	82	9,409
07140101030104	4,144	1,319	86	5,549
07140101030201	6,713	2,198	142	9,053
07140101030202	5,773	2,319	224	8,316
07140101030203	3,593	2,822	92	6,507
07140101030301	7,614	3,784	3,740	15,138
07140101030302	8,516	794	385	9,695
07140101030303	10,335	3,211	455	14,001
Total	70,038	21,934	5,561	97,533

Land use/land cover by HUC14

Table A.68: Land use/land cover in the HUC14s of the Canteen-Cahokia Creek watershed.

HUC14		7140101030101	7140101030102	7140101030103	7140101030104	7140101030201	7140101030202	7140101030203	7140101030301	7140101030302	7140101030303	Grand Total
Barren Land	Acres	5	0	0	0	0	0	0	5	0	10	10
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cultivated crop	Acres	3287	1648	478	950	1910	665	185	1048	1640	12988	12,988
	%	39%	45%	8%	28%	36%	16%	5%	15%	28%	23%	23%
Deciduous forest	Acres	598	465	1504	794	899	1498	1729	1413	332	11987	11,987
	%	7%	13%	26%	24%	17%	37%	44%	20%	6%	21%	21%
Developed, High Intensity	Acres	429	32	81	32	83	65	64	171	205	1378	1,378
	%	5%	1%	1%	1%	2%	2%	2%	2%	3%	2%	2%
Developed, Low Intensity	Acres	1082	516	1525	546	813	628	791	1529	1088	9824	9,824
	%	13%	14%	27%	16%	15%	15%	20%	21%	18%	18%	18%
Developed, Medium Intensity	Acres	790	215	468	167	295	131	193	654	546	3984	3,984
	%	9%	6%	8%	5%	6%	3%	5%	9%	9%	7%	7%
Developed, Open Space	Acres	1095	575	1508	699	770	633	909	1553	1001	10432	10,432
	%	13%	16%	26%	21%	14%	16%	23%	22%	17%	19%	19%
Emergent herbaceous wetlands	Acres	4	1	0	0	0	0	2	51	59	218	218
	%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%
Evergreen forest	Acres	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hay/Pasture	Acres	510	62	118	45	523	370	0	236	265	2375	2,375
	%	6%	2%	2%	1%	10%	9%	0%	3%	4%	4%	4%
Herbaceous	Acres	0	3	5	3	3	41	7	4	8	94	94
	%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Mixed forest	Acres	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Open Water	Acres	108	54	15	96	32	52	6	154	53	680	680
	%	1%	1%	0%	3%	1%	1%	0%	2%	1%	1%	1%
Shrub/Scrub	Acres	0	0	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wood wetlands	Acres	468	97	9	40	0	0	0	334	704	2035	2,035
	%	6%	3%	0%	1%	0%	0%	0%	5%	12%	4%	4%
Total Area (Acres)		8,376	3,668	5,711	3,372	5,328	4,083	3,886	7,152	5,901	8,528	56,005

Future land use/land cover by HUC14

Table A.69: Existing and predicted future land use/land cover by HUC14 in the Canteen-Cahokia Creek watershed. Predicted land use/land cover is based on zoning identified in the Comprehensive Plans of municipalities in the watershed for the 1.5-mile zone outside their current boundaries.

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
07140101030101		10754	100%	10754	100%	0	
Barren Land	31	5	0%	0	0%	-5	-100%
Cultivated crop	82	4914	46%	0	0%	-4914	-100%
Deciduous forest	41	703	7%	0	0%	-703	-100%
Developed, High Intensity	24	448	4%	1224	11%	776	173%
Developed, Low Intensity	22	1225	11%	3347	31%	2122	173%
Developed, Medium Intensity	23	878	8%	2399	22%	1521	173%
Developed, Open Space	21	1385	13%	3784	35%	2399	173%
Emergent herbaceous wetlands	95	4	0%	0	0%	-4	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	551	5%	0	0%	-551	-100%
Herbaceous	71	0	0%	0	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	108	1%	0	0%	-108	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	533	5%	0	0%	-533	-100%
07140101030102		6506	100%	6506	100%	0	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	3751	58%	0	0%	-3751	-100%
Deciduous forest	41	538	8%	0	0%	-538	-100%
Developed, High Intensity	24	43	1%	145	2%	102	237%
Developed, Low Intensity	22	760	12%	2562	39%	1802	237%
Developed, Medium Intensity	23	280	4%	944	15%	664	237%
Developed, Open Space	21	847	13%	2855	44%	2008	237%
Emergent herbaceous	95	1	0%	0	0%	-1	-100%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
wetlands							
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	99	2%	0	0%	-99	-100%
Herbaceous	71	3	0%	0	0%	-3	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	62	1%	0	0%	-62	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	122	2%	0	0%	-122	-100%
07140101030103		9074	100%	9074	100%	0	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	2936	32%	0	0%	-2936	-100%
Deciduous forest	41	1591	18%	0	0%	-1591	-100%
Developed, High Intensity	24	124	1%	258	3%	134	108%
Developed, Low Intensity	22	1828	20%	3808	42%	1980	108%
Developed, Medium Intensity	23	567	6%	1181	13%	614	108%
Developed, Open Space	21	1837	20%	3827	42%	1990	108%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	134	1%	0	0%	-134	-100%
Herbaceous	71	5	0%	0	0%	-5	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	30	0%	0	0%	-30	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	22	0%	0	0%	-22	-100%
07140101030104		7911	100%	7911	100%	0	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	3816	48%	0	0%	-3816	-100%
Deciduous forest	41	1324	17%	0	0%	-1324	-100%
Developed, High Intensity	24	48	1%	157	2%	109	227%
Developed, Low Intensity	22	1131	14%	3696	47%	2565	227%
Developed, Medium Intensity	23	235	3%	768	10%	533	227%
Developed, Open	21	1007	13%	3291	42%	2284	227%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Space							
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	123	2%	0	0%	-123	-100%
Herbaceous	71	3	0%	0	0%	-3	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	175	2%	0	0%	-175	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	49	1%	0	0%	-49	-100%
07140101030201		7096	100%	7096	100%	0	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	2403	34%	2403	34%	0	0%
Deciduous forest	41	1312	18%	1165	16%	-147	-11%
Developed, High Intensity	24	105	1%	112	2%	7	7%
Developed, Low Intensity	22	1069	15%	1143	16%	74	7%
Developed, Medium Intensity	23	351	5%	375	5%	24	7%
Developed, Open Space	21	1136	16%	1214	17%	78	7%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	682	10%	646	9%	-36	-5%
Herbaceous	71	3	0%	3	0%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	35	0%	35	0%	0	0%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101030202		7724	100%	7724	100%	0	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	1479	19%	775	10%	-704	-48%
Deciduous forest	41	2352	30%	1969	25%	-383	-16%
Developed, High Intensity	24	213	3%	302	4%	89	42%
Developed, Low Intensity	22	1747	23%	2481	32%	734	42%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Developed, Medium Intensity	23	239	3%	339	4%	100	42%
Developed, Open Space	21	945	12%	1342	17%	397	42%
Emergent herbaceous wetlands	95	0	0%	0	0%	0	0%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	655	8%	423	5%	-232	-35%
Herbaceous	71	41	1%	41	1%	0	0%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	53	1%	51	1%	-2	-4%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101030203		7319	100%	7319	100%	0	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	886	12%	0	0%	-886	-100%
Deciduous forest	41	2589	35%	0	0%	-2589	-100%
Developed, High Intensity	24	139	2%	273	4%	134	97%
Developed, Low Intensity	22	2104	29%	4137	57%	2033	97%
Developed, Medium Intensity	23	316	4%	621	8%	305	97%
Developed, Open Space	21	1163	16%	2287	31%	1124	97%
Emergent herbaceous wetlands	95	2	0%	0	0%	-2	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	107	1%	0	0%	-107	-100%
Herbaceous	71	7	0%	0	0%	-7	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	6	0%	0	0%	-6	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	0	0%	0	0%	0	0%
07140101030301		12155	100%	12155	100%	0	
Barren Land	31	5	0%	0	0%	-5	-100%
Cultivated crop	82	2576	21%	0	0%	-2576	-100%
Deciduous forest	41	1937	16%	0	0%	-1937	-100%
Developed, High	24	398	3%	732	6%	334	84%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Intensity							
Developed, Low Intensity	22	3318	27%	6103	50%	2785	84%
Developed, Medium Intensity	23	892	7%	1641	13%	749	84%
Developed, Open Space	21	2000	16%	3679	30%	1679	84%
Emergent herbaceous wetlands	95	51	0%	0	0%	-51	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	383	3%	0	0%	-383	-100%
Herbaceous	71	12	0%	0	0%	-12	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	244	2%	0	0%	-244	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	339	3%	0	0%	-339	-100%
07140101030302		7672	100%	7672	100%	0	
Barren Land	31	0	0%	0	0%	0	0%
Cultivated crop	82	2000	26%	0	0%	-2000	-100%
Deciduous forest	41	809	11%	0	0%	-809	-100%
Developed, High Intensity	24	219	3%	467	6%	248	113%
Developed, Low Intensity	22	1628	21%	3473	45%	1845	113%
Developed, Medium Intensity	23	686	9%	1464	19%	778	113%
Developed, Open Space	21	1063	14%	2268	30%	1205	113%
Emergent herbaceous wetlands	95	62	1%	0	0%	-62	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	268	3%	0	0%	-268	-100%
Herbaceous	71	9	0%	0	0%	-9	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	53	1%	0	0%	-53	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	875	11%	0	0%	-875	-100%
07140101030303		7672	100%	7672	100%	0	
Barren Land	31	0	0%	0	0%	0	0%

Land Use/Land Cover Description	Land Use Code	Current Area (Acres)	Current Area (%)	Predicted Area (acres)	Predicted area (%)	Change (acres)	Percent Change
Cultivated crop	82	2000	26%	0	0%	-2000	-100%
Deciduous forest	41	809	11%	0	0%	-809	-100%
Developed, High Intensity	24	219	3%	467	6%	248	113%
Developed, Low Intensity	22	1628	21%	3473	45%	1845	113%
Developed, Medium Intensity	23	686	9%	1464	19%	778	113%
Developed, Open Space	21	1063	14%	2268	30%	1205	113%
Emergent herbaceous wetlands	95	62	1%	0	0%	-62	-100%
Evergreen forest	42	0	0%	0	0%	0	0%
Hay/Pasture	81	268	3%	0	0%	-268	-100%
Herbaceous	71	9	0%	0	0%	-9	-100%
Mixed forest	43	0	0%	0	0%	0	0%
Open Water	11	53	1%	0	0%	-53	-100%
Shrub/Scrub	52	0	0%	0	0%	0	0%
Wood wetlands	90	875	11%	0	0%	-875	-100%

Stream reach data

Table A.70: NHD stream reaches in the Canteen-Cahokia Creek watershed with length in feet and the corresponding HUC14. Some reaches are present in more than one HUC14.

HUC 14 & Reach Code	Length (ft)
07140101030101	169051
07140101000577	1093
07140101000578	6846
07140101000580	6512
07140101000587	4517
07140101001518	5323
07140101001520	4562
07140101001521	1946
07140101001522	3289
07140101001523	3006
07140101001524	442
07140101001525	2877
07140101001526	5298
07140101001527	5443
07140101001988	8212
07140101002019	3912
07140101002020	5437
07140101002022	5257
07140101002067	4990
07140101002068	3237
07140101002069	16
07140101002082	2714
07140101002468	5936
07140101002469	5247
07140101003131	162
07140101003137	450
07140101003142	2565
07140101003148	2835
07140101003152	1041
07140101003154	2052
07140101003159	1526
07140101003160	1575
07140101003161	5529
07140101003162	376
07140101003163	5006
07140101003164	237
07140101003165	2193
07140101003166	2227

HUC 14 & Reach Code	Length (ft)
07140101003167	1289
07140101003171	764
07140101003173	1156
07140101003177	1130
07140101003179	4164
07140101003180	9492
07140101003181	1859
07140101003194	2936
07140101003202	1038
07140101003203	1046
07140101003204	812
07140101003208	1419
07140101003209	1417
07140101005291	6046
07140101005295	7720
07140101005301	479
07140101005305	2398
07140101030102	68786
07140101000319	9
07140101000591	5668
07140101001513	3903
07140101001514	10364
07140101001515	5992
07140101001518	345
07140101002021	13411
07140101002069	3737
07140101002480	434
07140101003210	2846
07140101003265	2859
07140101005314	6218
07140101005315	1055
07140101005316	9807
07140101005319	2136
07140101000319	9
07140101000591	5668
07140101001513	3903
07140101001514	10364
07140101001515	5992
07140101001518	345
07140101002021	13411
07140101002069	3737

HUC 14 & Reach Code	Length (ft)
07140101002480	434
07140101003210	2846
07140101003265	2859
07140101005314	6218
07140101005315	1055
07140101005316	9807
07140101005319	2136
07140101030103	125227
07140101000319	14274
07140101000320	5310
07140101000321	13784
07140101001504	412
07140101001509	2616
07140101001510	7495
07140101001511	6691
07140101001512	17693
07140101003169	1647
07140101003184	2039
07140101003207	4521
07140101003216	1970
07140101003217	4879
07140101003219	2284
07140101003220	3663
07140101003234	1323
07140101003238	1806
07140101003239	542
07140101003241	1036
07140101003242	1572
07140101003243	1671
07140101003244	915
07140101003245	4886
07140101003246	1632
07140101003247	1232
07140101003248	1035
07140101003250	2193
07140101003251	1718
07140101003253	1582
07140101003254	1441
07140101003258	2244
07140101003261	1343
07140101003271	589

HUC 14 & Reach Code	Length (ft)
07140101006820	303
07140101006821	793
07140101006822	104
07140101006823	1017
07140101006824	185
07140101006825	1147
07140101006826	2880
07140101006849	758
07140101030104	93088
07140101000319	122
07140101000556	5714
07140101000557	14057
07140101000621	76
07140101001504	12980
07140101001505	4365
07140101001506	8837
07140101001507	5998
07140101001508	6550
07140101001513	160
07140101003268	1438
07140101003273	1590
07140101003276	1593
07140101003282	597
07140101003289	1756
07140101003290	4518
07140101003302	1956
07140101003305	1081
07140101003310	1378
07140101003311	1806
07140101003313	2103
07140101003315	2318
07140101003316	3566
07140101003318	1347
07140101003319	1121
07140101003325	1018
07140101003326	3462
07140101003327	529
07140101003329	1054
07140101030201	128838
07140101000273	1142
07140101000274	1361

HUC 14 & Reach Code	Length (ft)
07140101000275	6708
07140101000276	11883
07140101001480	14571
07140101001482	12053
07140101001483	5202
07140101003272	947
07140101003274	2488
07140101003279	2906
07140101003283	2654
07140101003284	1152
07140101003285	473
07140101003286	1389
07140101003287	524
07140101003291	1971
07140101003296	2471
07140101003299	2271
07140101003307	2223
07140101003320	3301
07140101003321	2137
07140101003322	2322
07140101003323	762
07140101003330	3167
07140101003334	1927
07140101003336	2486
07140101003348	525
07140101003349	149
07140101003350	1063
07140101003356	1253
07140101003357	1870
07140101003368	2946
07140101003372	6511
07140101003377	1176
07140101003378	1251
07140101003390	2096
07140101003396	463
07140101003397	1798
07140101003402	3331
07140101003403	528
07140101003404	979
07140101003406	5836
07140101003412	1685

HUC 14 & Reach Code	Length (ft)
07140101003414	1099
07140101003415	597
07140101003416	2384
07140101003417	2100
07140101003418	1810
07140101003425	2022
07140101003431	2365
07140101003435	3830
07140204003755	940
07140101030202	155404
07140101000265	15
07140101000266	675
07140101000267	6593
07140101000268	3197
07140101000269	1633
07140101000270	493
07140101000272	2628
07140101000273	21
07140101001476	10869
07140101001477	7180
07140101001478	7360
07140101001479	6797
07140101001480	45
07140101001484	6097
07140101001485	4708
07140101002490	2246
07140101002496	298
07140101003422	2850
07140101003423	936
07140101003424	1434
07140101003430	1969
07140101003432	1503
07140101003436	2828
07140101003437	3708
07140101003440	2842
07140101003447	3715
07140101003452	2121
07140101003453	1817
07140101003454	2136
07140101003458	1373
07140101003460	1427

HUC 14 & Reach Code	Length (ft)
07140101003461	2621
07140101003462	3975
07140101003463	2965
07140101003467	3639
07140101003468	2344
07140101003469	1041
07140101003470	274
07140101003471	1234
07140101003473	1116
07140101003474	1039
07140101003476	6373
07140101003478	813
07140101003487	1478
07140101003488	2072
07140101003490	1040
07140101003494	1003
07140101003500	1568
07140101003504	576
07140101003505	686
07140101003506	1746
07140101003507	623
07140101003509	1062
07140101003510	2471
07140101003512	1925
07140101003525	1848
07140101003526	2207
07140101003527	991
07140101003530	999
07140101003531	149
07140101003535	1551
07140101003536	1588
07140101003540	2854
07140101003541	1742
07140101003550	1608
07140101003551	2027
07140101003552	2640
07140101030203	117213
07140101000259	4203
07140101000260	863
07140101000261	7530
07140101000262	688

HUC 14 & Reach Code	Length (ft)
07140101000263	2764
07140101000264	2534
07140101000265	2790
07140101001470	6460
07140101001471	10045
07140101001472	6881
07140101001473	1483
07140101001474	4658
07140101001475	7575
07140101001486	5771
07140101001487	7056
07140101003515	734
07140101003532	1618
07140101003539	1311
07140101003542	567
07140101003543	134
07140101003553	1307
07140101003557	2872
07140101003558	776
07140101003560	2481
07140101003562	822
07140101003563	657
07140101003566	1263
07140101003571	346
07140101003572	3913
07140101003573	1854
07140101003581	857
07140101003582	2379
07140101003583	3095
07140101003585	2953
07140101003586	1272
07140101003589	1044
07140101003590	1083
07140101003592	1966
07140101003595	4308
07140101003597	2211
07140101003599	1394
07140101003608	842
07140101003609	915
07140101003612	937
07140101030301	168154

HUC 14 & Reach Code	Length (ft)
07140101000315	15
07140101000620	5745
07140101000621	6982
07140101001488	1
07140101001490	5841
07140101001491	1217
07140101001492	17000
07140101001493	1220
07140101001494	8581
07140101001495	7076
07140101001496	3913
07140101001497	2408
07140101001501	508
07140101001502	9307
07140101001503	5969
07140101001986	3758
07140101002072	1388
07140101002483	672
07140101002485	512
07140101002486	2888
07140101002487	787
07140101003331	2191
07140101003332	1424
07140101003333	1681
07140101003335	540
07140101003345	1234
07140101003346	1216
07140101003347	1475
07140101003351	2054
07140101003352	3545
07140101003361	1341
07140101003362	1991
07140101003366	1531
07140101003367	1476
07140101003369	3256
07140101003373	1609
07140101003374	1812
07140101003375	1366
07140101003384	1892
07140101003385	1132
07140101003386	267

HUC 14 & Reach Code	Length (ft)
07140101003388	1553
07140101003391	1462
07140101003395	112
07140101003399	2380
07140101003401	970
07140101003405	988
07140101003408	6568
07140101003409	3989
07140101003411	530
07140101003421	1828
07140101003433	1346
07140101003434	1677
07140101003438	3812
07140101003439	2461
07140101003441	2358
07140101003443	6025
07140101003455	1571
07140101003465	2653
07140101003483	2026
07140101003484	1678
07140101005332	1715
07140101005333	1632
07140101030302	127065
07140101000259	19191
07140101000315	10718
07140101000613	6030
07140101000616	6431
07140101000617	9728
07140101001488	11842
07140101002498	17
07140101003459	1776
07140101003475	402
07140101003479	513
07140101003482	4156
07140101003497	1577
07140101003498	10142
07140101003516	1816
07140101003517	2760
07140101003518	42
07140101003519	1288
07140101003520	1066

HUC 14 & Reach Code	Length (ft)
07140101003522	4153
07140101003537	338
07140101003538	362
07140101003554	1545
07140101003578	3602
07140101003579	7865
07140101005332	13
07140101006832	3391
07140101006833	392
07140101006834	2420
07140101006835	11329
07140101006836	1782
07140101006837	377
07140101030303	214692
07140101000370	222
07140101000371	11982
07140101000373	6876
07140101000374	4258
07140101000375	1069
07140101000376	11995
07140101000643	9240
07140101001435	807
07140101001461	6503
07140101001462	2553
07140101001463	4054
07140101001464	5360
07140101001465	4319
07140101001466	7013
07140101001467	6869
07140101001468	5188
07140101002528	335
07140101003602	1481
07140101003604	3387
07140101003605	1482
07140101003606	842
07140101003611	743
07140101003616	3930
07140101003617	1148
07140101003619	455
07140101003620	694
07140101003621	1048

HUC 14 & Reach Code	Length (ft)
07140101003624	1473
07140101003625	1194
07140101003626	417
07140101003628	904
07140101003629	1053
07140101003631	336
07140101003632	4888
07140101003633	973
07140101003634	2490
07140101003636	2777
07140101003638	4966
07140101003639	678
07140101003641	256
07140101003644	3188
07140101003646	2507
07140101003649	3507
07140101003650	1534
07140101003651	1676
07140101003653	1576
07140101003654	2216
07140101003657	2344
07140101003658	1767
07140101003659	1880
07140101003661	1480
07140101003662	2480
07140101003664	2085
07140101003666	3089
07140101003668	3907
07140101003669	1104
07140101003670	1309
07140101003673	3998
07140101003674	944
07140101003678	1296
07140101003679	678
07140101003680	1534
07140101003681	8146
07140101003683	1866
07140101003684	2220
07140101003685	770
07140101003687	1964
07140101003690	1786

HUC 14 & Reach Code	Length (ft)
07140101003691	2685
07140101003692	1672
07140101003693	1620
07140101005353	4153
07140101005359	5093
07140101005361	800
07140101006828	1708
07140101006834	221
07140101007081	4964
07140101007082	2667

Streambank erosion by stream reach

Table A.71: Streambank erosion along stream reaches in the Canteen-Cahokia Creek watershed.

GNIS Name	Reach Code	Streambank Erosion
Canteen Creek	07140101000259	Null
Canteen Creek	07140101000259	None/Low
Canteen Creek	07140101000259	None/Low
Canteen Creek	07140101000259	None/Low
Canteen Creek	07140101000260	Null
Canteen Creek	07140101000261	Null
Canteen Creek	07140101000261	None/Low
Canteen Creek	07140101000261	None/Low
Canteen Creek	07140101000261	None/Low
Canteen Creek	07140101000261	None/Low
Canteen Creek	07140101000261	Moderate
Canteen Creek	07140101000262	None/Low
Canteen Creek	07140101000263	None/Low
Canteen Creek	07140101000263	None/Low
Canteen Creek	07140101000264	None/Low
Canteen Creek	07140101000264	None/Low
Canteen Creek	07140101000265	Moderate
Canteen Creek	07140101000266	None/Low
Canteen Creek	07140101000267	None/Low
Canteen Creek	07140101000267	Moderate
Canteen Creek	07140101000267	Moderate
Canteen Creek	07140101000272	None/Low
Canteen Creek	07140101000273	None/Low
Canteen Creek	07140101000273	None/Low
Canteen Creek	07140101000274	None/Low
Canteen Creek	07140101000275	None/Low
Canteen Creek	07140101000275	None/Low
Canteen Creek	07140101000276	Null
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Judys Branch	07140101000319	None/Low
Judys Branch	07140101000319	None/Low
Judys Branch	07140101000319	Moderate
Judys Branch	07140101000319	Moderate
Judys Branch	07140101000320	None/Low
Judys Branch	07140101000320	None/Low
Judys Branch	07140101000320	None/Low

GNIS Name	Reach Code	Streambank Erosion
Judys Branch	07140101000320	Moderate
Judys Branch	07140101000320	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
	07140101000577	Moderate
Cahokia Creek	07140101000620	Moderate
Cahokia Creek	07140101000621	Moderate
Cahokia Creek	07140101000621	Moderate
Cahokia Creek	07140101000621	Moderate
Canteen Creek	07140101001484	None/Low
Canteen Creek	07140101001484	None/Low
Canteen Creek	07140101001484	None/Low
Canteen Creek	07140101001484	None/Low
Canteen Creek	07140101001484	None/Low
	07140101001487	Null
Schoolhouse Branch	07140101001490	None/Low
Schoolhouse Branch	07140101001490	None/Low
Schoolhouse Branch	07140101001490	None/Low
Schoolhouse Branch	07140101001491	None/Low
Schoolhouse Branch	07140101001491	None/Low
Schoolhouse Branch	07140101001492	Null
Schoolhouse Branch	07140101001492	Null
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Burdick Branch	07140101001504	None/Low
Burdick Branch	07140101001504	Moderate
Burdick Branch	07140101001505	None/Low
Burdick Branch	07140101001505	None/Low
Burdick Branch	07140101001505	None/Low
Burdick Branch	07140101001506	Null
Burdick Branch	07140101001506	None/Low
Burdick Branch	07140101001506	None/Low
Cahokia Creek	07140101001513	Moderate
Cahokia Creek	07140101001518	Moderate
Cahokia Creek	07140101001518	Moderate
Cahokia Creek	07140101002019	None/Low
Cahokia Creek	07140101002082	Moderate
Cahokia Creek	07140101003179	Moderate

GNIS Name	Reach Code	Streambank Erosion
Cahokia Creek	07140101003179	Moderate
Cahokia Creek	07140101003194	Moderate
Cahokia Creek	07140101003194	Moderate
Cahokia Creek	07140101003194	Moderate
	07140101003219	None/Low
	07140101003271	Null
Cahokia Creek	07140101003316	Moderate
	07140101003430	Null
Schoolhouse Branch	07140101003438	Moderate
Schoolhouse Branch	07140101003443	Moderate
	07140101003597	Null
Cahokia Creek	07140101005315	Moderate
Cahokia Creek	07140101005319	Moderate
	07140101005332	Moderate

Channelization by stream reach

Table A.72: Degree of channelization along assessed stream reaches in the Canteen-Cahokia Creek watershed.

GNIS Name	Reach Code	Channelization
Canteen Creek	07140101000259	Null
Canteen Creek	07140101000259	High
Canteen Creek	07140101000259	High
Canteen Creek	07140101000259	High
Canteen Creek	07140101000260	Null
Canteen Creek	07140101000261	Null
Canteen Creek	07140101000261	Moderate
Canteen Creek	07140101000261	Moderate
Canteen Creek	07140101000261	None/Low
Canteen Creek	07140101000261	Moderate
Canteen Creek	07140101000261	Moderate
Canteen Creek	07140101000262	Moderate
Canteen Creek	07140101000263	High
Canteen Creek	07140101000263	High
Canteen Creek	07140101000264	Moderate
Canteen Creek	07140101000264	Moderate
Canteen Creek	07140101000265	Moderate
Canteen Creek	07140101000266	Moderate
Canteen Creek	07140101000267	None/Low
Canteen Creek	07140101000267	Moderate
Canteen Creek	07140101000267	Moderate
Canteen Creek	07140101000272	None/Low
Canteen Creek	07140101000273	None/Low
Canteen Creek	07140101000273	None/Low
Canteen Creek	07140101000274	None/Low
Canteen Creek	07140101000275	None/Low
Canteen Creek	07140101000275	None/Low
Canteen Creek	07140101000276	Null
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Canteen Creek	07140101000276	None/Low
Judys Branch	07140101000319	None/Low
Judys Branch	07140101000319	Moderate
Judys Branch	07140101000319	None/Low
Judys Branch	07140101000319	Moderate
Judys Branch	07140101000320	None/Low
Judys Branch	07140101000320	None/Low

GNIS Name	Reach Code	Channelization
Judys Branch	07140101000320	None/Low
Judys Branch	07140101000320	None/Low
Judys Branch	07140101000320	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	None/Low
Judys Branch	07140101000321	Moderate
	07140101000577	High
Cahokia Creek	07140101000620	High
Cahokia Creek	07140101000621	High
Cahokia Creek	07140101000621	High
Cahokia Creek	07140101000621	High
Canteen Creek	07140101001484	None/Low
Canteen Creek	07140101001484	None/Low
Canteen Creek	07140101001484	None/Low
Canteen Creek	07140101001484	Moderate
Canteen Creek	07140101001484	Moderate
	07140101001487	Null
Schoolhouse Branch	07140101001490	None/Low
Schoolhouse Branch	07140101001490	None/Low
Schoolhouse Branch	07140101001490	Moderate
Schoolhouse Branch	07140101001491	None/Low
Schoolhouse Branch	07140101001491	None/Low
Schoolhouse Branch	07140101001492	Null
Schoolhouse Branch	07140101001492	Null
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Schoolhouse Branch	07140101001492	None/Low
Burdick Branch	07140101001504	None/Low
Burdick Branch	07140101001504	High
Burdick Branch	07140101001505	None/Low
Burdick Branch	07140101001505	None/Low
Burdick Branch	07140101001505	None/Low
Burdick Branch	07140101001506	Null
Burdick Branch	07140101001506	None/Low
Burdick Branch	07140101001506	None/Low
Cahokia Creek	07140101001513	High
Cahokia Creek	07140101001518	High
Cahokia Creek	07140101001518	High
Cahokia Creek	07140101002019	None/Low

GNIS Name	Reach Code	Channelization
Cahokia Creek	07140101002082	High
Cahokia Creek	07140101003179	High
Cahokia Creek	07140101003179	High
Cahokia Creek	07140101003194	High
Cahokia Creek	07140101003194	High
Cahokia Creek	07140101003194	High
	07140101003219	None/Low
	07140101003271	Null
Cahokia Creek	07140101003316	High
	07140101003430	Null
Schoolhouse Branch	07140101003438	High
Schoolhouse Branch	07140101003443	High
	07140101003597	Null
Cahokia Creek	07140101005315	High
Cahokia Creek	07140101005319	High
	07140101005332	High

Riparian condition by stream reach

Table A.73: Riparian condition along assessed stream reaches in the Canteen-Cahokia Creek watershed.

GNIS Name	Reach Code	Riparian
Canteen Creek	07140101000259	Null
Canteen Creek	07140101000259	Poor
Canteen Creek	07140101000259	Poor
Canteen Creek	07140101000259	Poor
Canteen Creek	07140101000260	Null
Canteen Creek	07140101000261	Null
Canteen Creek	07140101000261	Good
Canteen Creek	07140101000261	Good
Canteen Creek	07140101000261	Fair
Canteen Creek	07140101000261	Fair
Canteen Creek	07140101000261	Fair
Canteen Creek	07140101000262	Fair
Canteen Creek	07140101000263	Fair
Canteen Creek	07140101000263	Fair
Canteen Creek	07140101000264	Good
Canteen Creek	07140101000264	Good
Canteen Creek	07140101000265	Fair
Canteen Creek	07140101000266	Fair
Canteen Creek	07140101000267	Good
Canteen Creek	07140101000267	Fair
Canteen Creek	07140101000267	Poor
Canteen Creek	07140101000272	Good
Canteen Creek	07140101000273	Good
Canteen Creek	07140101000273	Good
Canteen Creek	07140101000274	Good
Canteen Creek	07140101000275	Good
Canteen Creek	07140101000275	Good
Canteen Creek	07140101000276	Null
Canteen Creek	07140101000276	Good
Canteen Creek	07140101000276	Good
Canteen Creek	07140101000276	Good
Canteen Creek	07140101000276	Good
Canteen Creek	07140101000276	Good
Canteen Creek	07140101000276	Good
Canteen Creek	07140101000276	Good
Canteen Creek	07140101000276	Fair
Judys Branch	07140101000319	Good
Judys Branch	07140101000319	Good
Judys Branch	07140101000319	Fair
Judys Branch	07140101000319	Fair
Judys Branch	07140101000320	Good
Judys Branch	07140101000320	Good

GNIS Name	Reach Code	Riparian
Judys Branch	07140101000320	Good
Judys Branch	07140101000320	Good
Judys Branch	07140101000320	Fair
Judys Branch	07140101000321	Good
Judys Branch	07140101000321	Good
Judys Branch	07140101000321	Good
Judys Branch	07140101000321	Good
Judys Branch	07140101000321	Good
Judys Branch	07140101000321	Fair
	07140101000577	Poor
Cahokia Creek	07140101000620	Poor
Cahokia Creek	07140101000621	Poor
Cahokia Creek	07140101000621	Poor
Cahokia Creek	07140101000621	Poor
Canteen Creek	07140101001484	Good
Canteen Creek	07140101001484	Good
Canteen Creek	07140101001484	Good
Canteen Creek	07140101001484	Good
Canteen Creek	07140101001484	Fair
	07140101001487	Null
Schoolhouse Branch	07140101001490	Good
Schoolhouse Branch	07140101001490	Good
Schoolhouse Branch	07140101001490	Fair
Schoolhouse Branch	07140101001491	Good
Schoolhouse Branch	07140101001491	Good
Schoolhouse Branch	07140101001492	Null
Schoolhouse Branch	07140101001492	Null
Schoolhouse Branch	07140101001492	Good
Schoolhouse Branch	07140101001492	Good
Schoolhouse Branch	07140101001492	Good
Schoolhouse Branch	07140101001492	Good
Schoolhouse Branch	07140101001492	Fair
Schoolhouse Branch	07140101001492	Fair
Burdick Branch	07140101001504	Good
Burdick Branch	07140101001504	Poor
Burdick Branch	07140101001505	Good
Burdick Branch	07140101001505	Good
Burdick Branch	07140101001505	Good
Burdick Branch	07140101001506	Null
Burdick Branch	07140101001506	Good
Burdick Branch	07140101001506	Good
Cahokia Creek	07140101001513	Poor
Cahokia Creek	07140101001518	Poor
Cahokia Creek	07140101001518	Poor
Cahokia Creek	07140101002019	Good

GNIS Name	Reach Code	Riparian
Cahokia Creek	07140101002082	Poor
Cahokia Creek	07140101003179	Good
Cahokia Creek	07140101003179	Poor
Cahokia Creek	07140101003194	Poor
Cahokia Creek	07140101003194	Poor
Cahokia Creek	07140101003194	Poor
	07140101003219	Fair
	07140101003271	Null
Cahokia Creek	07140101003316	Poor
	07140101003430	Null
Schoolhouse Branch	07140101003438	Poor
Schoolhouse Branch	07140101003443	Poor
	07140101003597	Null
Cahokia Creek	07140101005315	Poor
Cahokia Creek	07140101005319	Poor
	07140101005332	Poor

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Appendix B

COMMUNITY FLOOD SURVEY REPORT 2016



CANTEEN CREEK - CAHOKIA
CREEK WATERSHED
MADISON COUNTY, ILLINOIS

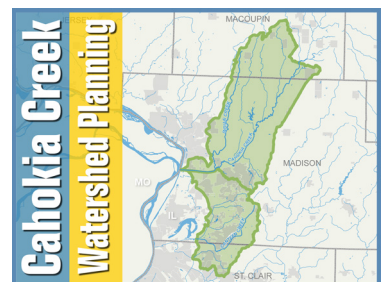


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EXECUTIVE SUMMARY

This report summarizes the findings of the Community Flood Survey for the Canteen Creek-Cahokia Creek watershed (HUC 0714010103), which was distributed to residents and business owners to gather information about the location, extent, impacts, and causes of flooding in the watershed.

A total of 452 surveys were completed from within the study area out of 2,400 mailed out, giving a response rate of 19%. Some of these were collected via an online survey.

A watershed is an area that drains to a defined point. Watersheds are defined at a variety of scales for different purposes. The Canteen Creek-Cahokia Creek watershed (Canteen-Cahokia) is a 57,283-acre area that drains to a point on Cahokia Creek south of Roxana, and the south side of Edwardsville, south and west towards the Mississippi River through Collinsville and Caseyville.

Smaller subwatershed boundaries within the Canteen-Cahokia watershed have not yet been delineated, so for this report, zip codes and Census block groups were used to group the survey responses. 47% of responses were from the Collinsville zip code (62234), followed by Glen Carbon (62034; 25%).

Key Findings

- **PREVALENCE:** 11% of respondents experienced flooding in the last 10 years.
- **FREQUENCY:** 6% of respondents with flooding experienced flooding at least once per year in the last 10 years. On average, respondents with flooding experience 1.3 floods per year.
- **EXTENT OF DAMAGE:** Of those who had been flooded in the last 10 years:
 - 24% said that the flooding had damaged their primary home or business;
 - 7% had damage to fences, auxiliary buildings, and other structures; and
 - 22% had damage to yards and landscaping.
- **NEIGHBORS:** 14% of all survey respondents were aware of flooding on one or more of their neighbors' properties. Of the survey respondents who had been flooded, 67% said that their neighbors had also been flooded.
- **TOP FOUR CAUSES OF FLOODING:**
 1. Heavy rainstorms
 2. Water draining from a neighboring property
 3. Lack of drainage facilities (swales, ditches, storm sewers, etc.) to drain water from this property
 4. Pipe, culvert, or ditch that was blocked or needs maintenance.
- **REPORTING:** Over half of respondents who had flooding did not report it to anyone. Those that did report it were most likely to contact their city or village (16%) or their insurance company (10%).
- **EFFECTS FROM FLOODING:** Stress was the most commonly reported impact from flooding. Others included loss of access to property, including loss of access to major entry/exit routes to their homes; lost business income; crop damage; and repair and replacement costs of goods and structures.
- **MONETARY LOSS:** Thirty-three percent of respondents who experienced flooding said it caused them no monetary loss. Another 32% said their monetary loss over 10 years was less than \$5,000. 18% said that their loss was between \$5,000 and \$20,000. One respondent (2% of those who answered) said his/her losses were between \$100,000 and \$500,000.

AVERAGE

1.3

FLOODS PER YEAR



14% of Neighbors
Flooded Too



DIDN'T REPORT
FLOODING

Flooding over the last 10 years has cost the survey respondents an estimated total loss of at least \$180,033. The estimated average amount lost per respondent is \$11,667 over 10 years. It is estimated that \$13,128,468 was lost in total due to flooding in the entire Canteen-Cahokia Creek watershed over the last 10 years.

- **RELATIONSHIP TO FLOODPLAINS:** Floodplains designated by the Federal Emergency Management Agency (FEMA) constitute 17% of the total acreage in the Canteen - Cahokia Creek Watershed within Madison County, and 4% of the survey responses came from parcels wholly or partly within a FEMA-designated floodplain. However, 2.4% of survey respondents did not know that they lived on or owned property in a FEMA designated floodplain.
- **FLOODING OUTSIDE OF THE FLOODPLAIN:** Flooding mostly occurs outside of floodplains in the watershed. Respondents reported that approximately 697 events per year occur outside of FEMA-designated floodplains in the watershed. Within floodplains, approximately 30 flood events per year were reported.
- **FLOOD INSURANCE:** Six percent of respondents (25 responses) have flood insurance.
- **FLOOD INSURANCE CLAIMS:** Sixteen percent (16%) of people who have flood insurance (4 respondents) have made one or more claims in the last 10 years. Of those respondents who have flood insurance, 21 (4.6%) have it on structures that are not in a floodplain.
- **DOWNSPOUTS:** Eighty (80%) of respondents said their downspouts flow out onto their lawn or other ground surface. Nine percent (9%) said their downspouts were connected to storm sewers, and 1% said their downspouts were connected to cisterns, rain barrels, or other rainwater harvesting storage.
- **ACTIONS TAKEN TO PREVENT FLOODING:** 106 respondents made one or more improvements to try to prevent or reduce flooding on their properties.
- **CROPLAND FLOODING:** None of the survey respondents own cropland that has flooded.
- **VALUING WATER MANAGEMENT:** Respondents to the survey place high value on clean drinking water, prevention of flood damage, healthy ecosystems, and water-based recreation (in that order).

\$13.1 Mill

**LOST DUE TO
FLOODS IN LAST
10 YEARS**

**96% FLOODS
OUTSIDE A
FLOODPLAIN**

5%

**USE RAINWATER
HARVESTING**

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INTRODUCTION

This section provides a brief overview of the survey and its purpose.

Overview

Several areas in Madison County regularly experience flooding. Some of this flooding occurs in floodplains designated by the Federal Emergency Management Agency (FEMA), which cover almost 15 percent of the county's area (approximately 110 square miles) and contain at least 4,128 structures with a total value of more than \$213 million.¹ A great deal of flooding also occurs outside of floodplains. During heavy storms, inadequate drainage or stormwater infrastructure, coupled with large expanses of impervious surfaces, can cause flooding almost anywhere. Although structures in designated floodplains have been identified, and their owners made aware of their flood risk through the National Flood Insurance Program (NFIP), there is no data or notification system for structures outside of floodplains in Madison County.

Madison County promotes flood-safe development practices and the protection of existing development from flood risk. To determine how to best allocate resources and address flood problems, the locations, causes, and extents of flooding need to be identified. Map-based data and other data gathered by government agencies and organizations are useful to identify flood problems. However, a survey of homeowners and businesses is the most direct way to reveal the location, cause, and extent of flood problems they face.

The economic, social, and environmental consequences of flooding can be substantial to people and communities. Chronically wet houses and land result in higher insurance rates and deductibles, and industry experts estimate that wet basements decrease property values by 10-25 percent.² Almost 40 percent (40%) of small businesses never reopen their doors following a flooding disaster.³ In the streams, rivers, lakes, and ponds that collect floodwater, erosion becomes a significant problem and water quality declines as sediment and other pollutants enter the water supply.

The Illinois Department of Natural Resources (IDNR) conducted a survey on urban flooding in 2015, as directed by the Urban Flooding Awareness Act.⁴ Urban flooding is defined in the Act as “the inundation of property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers. ‘Urban flooding’ does not include flooding in undeveloped or agricultural areas.” Using this definition, the Madison County Community Flood Survey has collected data on urban flooding as well as non-urban flooding.

Survey Area: Canteen Creek - Cahokia Creek Watershed

The Canteen Creek-Cahokia Creek watershed is located 10 miles northeast of St. Louis, Missouri in southwestern Illinois. The majority of the watershed is in Madison County; the remaining 24% is to the south in St. Clair County. Cahokia Creek, the largest stream in the watershed, flows southwest through the project area to join the Mississippi River through the Cahokia Canal west of Collinsville. Several other large streams in the watershed join with Cahokia Creek, including Canteen Creek and Judy's Branch.

Much of the watershed's population lives in urban or suburban incorporated areas. Collinsville and Maryville lie entirely within the watershed, along with large portions of Edwardsville, Glen Carbon, and Caseyville. All or portions of eleven (11) municipalities are included in the watershed.

Cahokia Creek, Canteen Creek, and the Cahokia Canal have been identified as impaired waters by the Illinois Environmental Protection Agency (IEPA). The causes of impairment include phosphorus, sedimentation/siltation, iron, manganese, and barium. In addition, the watershed experiences flooding inside and outside of its 100-year floodplains, causing damage to property and threatening life safety.

The Cahokia Creek Community Flood Survey ("the Survey") was conducted in the fall of 2015 to get a better understanding of flooding issues in the Canteen Creek-Cahokia Creek watershed and the Indian Creek-Cahokia Creek watershed at the same time. The findings of the Survey will be incorporated in the Canteen-Cahokia Creek Watershed Plan. When completed, the Plan will provide recommendations for improving water quality and reducing flood damage.

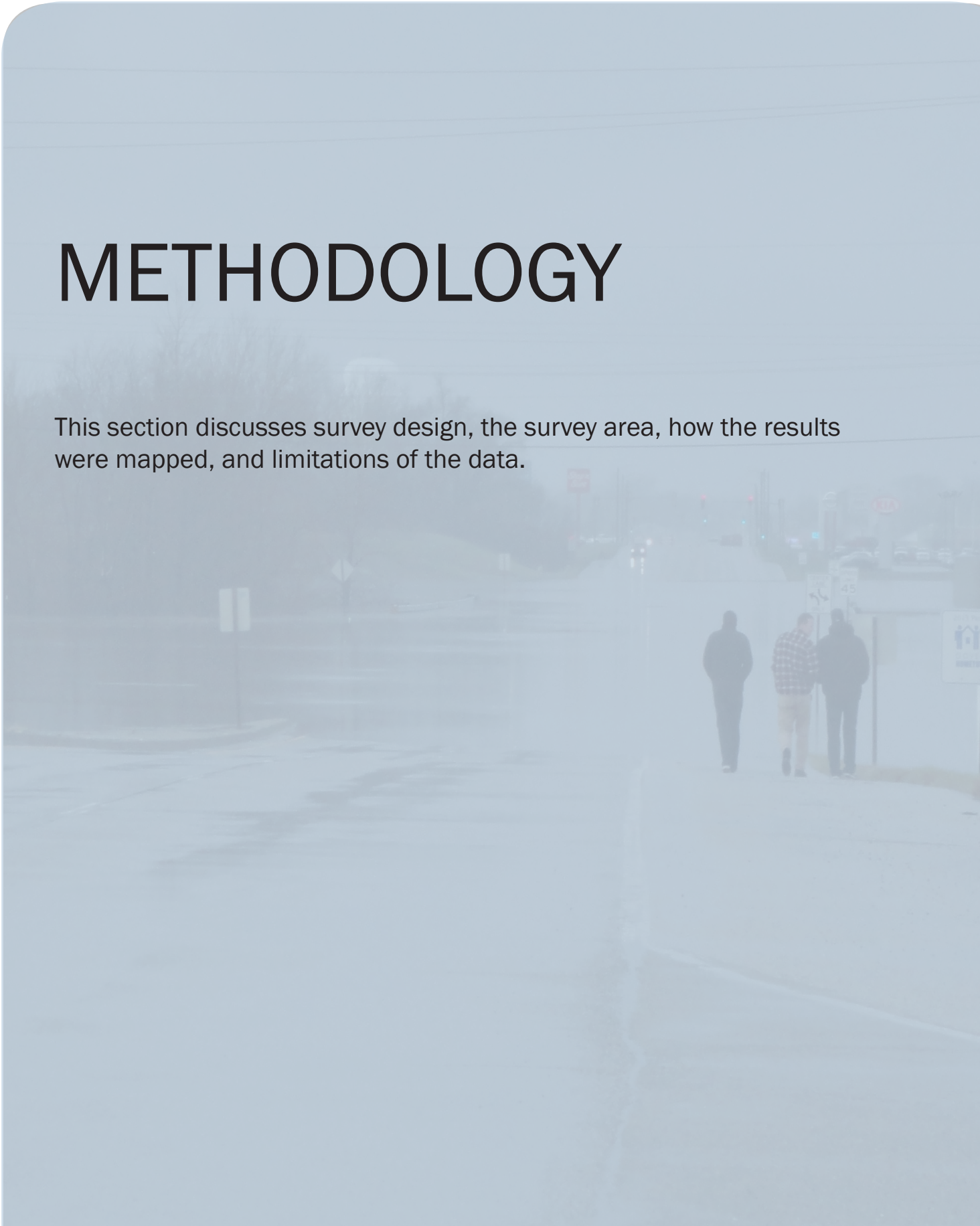


FIGURE 1. CANTEEN CREEK-CAHOKIA CREEK PROJECT AREA

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METHODOLOGY

This section discusses survey design, the survey area, how the results were mapped, and limitations of the data.



Survey Area

The survey was mailed to recipients in the Canteen-Cahokia Creek watershed, which encompasses 57,283 acres. This watershed extends from the middle of the Southern Illinois University – Edwardsville (SIUE) campus in the north to Fairview Heights in the south, and from I-255 in the west to I-55 in the east. The survey was also available online for community members in the watershed. Some survey respondents provided addresses outside the watershed. These responses were not considered in the results of this report.

Subwatersheds

A watershed is an area that drains to a defined point. Watersheds are defined at a variety of scales for different purposes. As the watershed planning process for the Canteen-Cahokia Creek watershed progresses, it will be divided into smaller hydrologic units for management and analysis purposes. Each subwatershed will have a unique 14-digit hydrologic unit code (HUC), to be informally known as HUC14 subwatersheds or “HUC14s”. The delineation process will follow the procedure employed by the United States Geological Survey (USGS) to define watersheds in the Watershed Boundary Dataset (WBD), a component of the National Hydrography Dataset (NHD), a nationwide database of waterways and waterbodies.

Zip Codes & Block Groups

Since HUC14 subwatershed boundaries are not yet available, zip codes and 2010 Census Block Groups were used to break down data geographically (see Figure 2). There are 14 zip codes in the watershed. Survey responses were received from 7 of these, and from 316 Census Block Groups.

Survey Design

The Canteen-Cahokia Creek Community Flood Survey consisted of sixteen (16) questions covering a variety of flooding topics, including frequency of flooding, causes of flooding, the extent and costs of flood damage, flood insurance coverage, and personal values about water quality. A full copy of the survey is available in the Appendix.

Questions were created using best practices to maximize survey response, such as:

- **Powerful purpose:** The survey stated that Madison County is trying to identify and solve flooding problems to make it safer to invest and live in Madison County.
- **Simple to return:** The survey was made as easy to return as possible, with a stamped, self-addressed envelope enclosed. For those wishing to take the survey online, a QR code directed phone users directly to the survey on the website.
- **Privacy assurance:** Survey respondents feel more comfortable providing information when they know how it will be used and that it will be kept private. The first question included a disclaimer that addresses will be kept confidential.

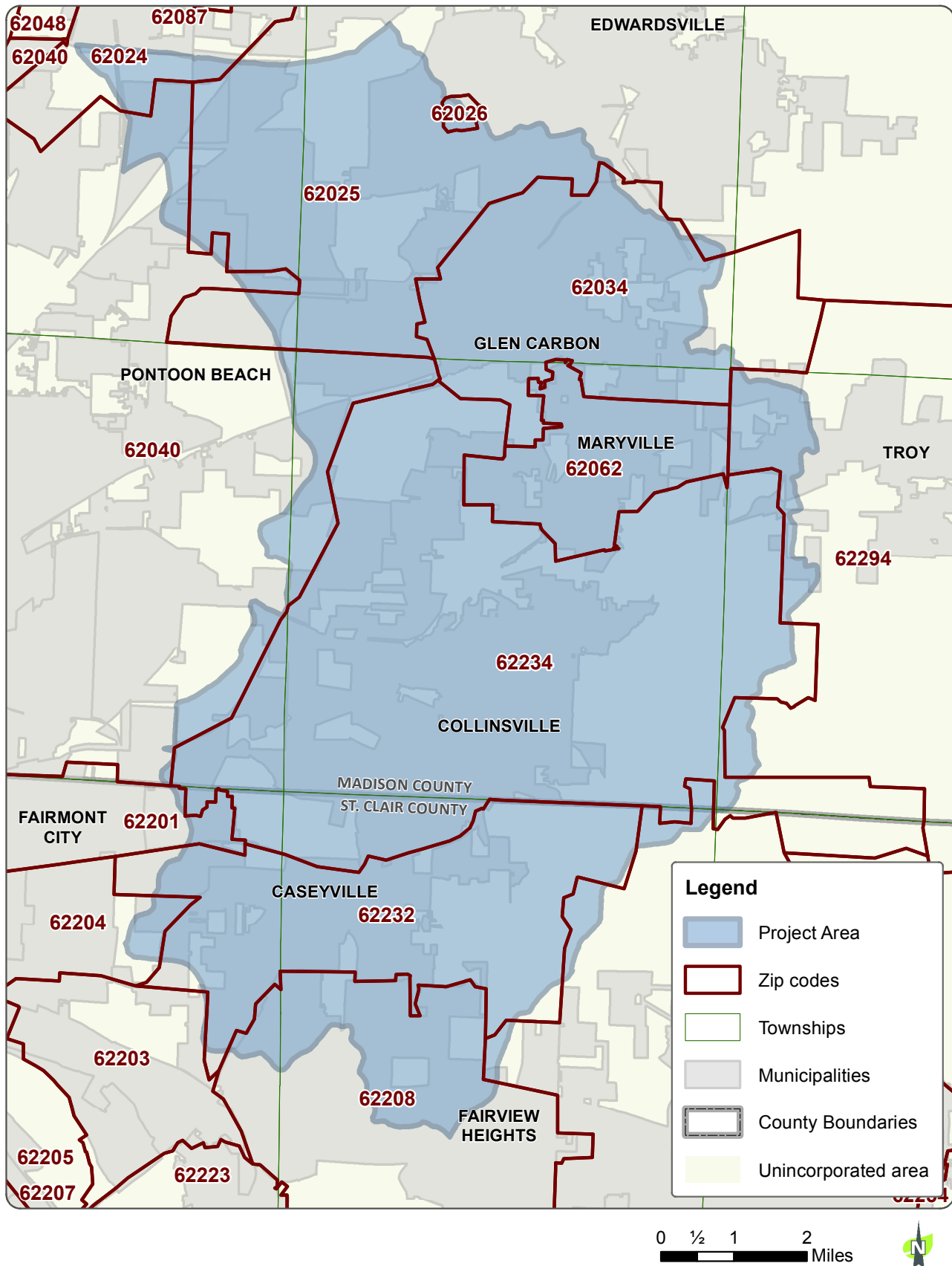


FIGURE 2. CANTEEN - CAHOKIA CREEK WATERSHED PROJECT AREA WITH ZIP CODES AND LOCAL JURISDICTIONS.

Survey Distribution and Outreach

Twenty-four hundred (2,400) surveys were mailed to randomly selected addresses in Madison County in the Canteen-Cahokia Creek Watershed. The randomized list of addresses was created by assigning a number to each parcel in the watershed, and then generating 1,600 random addresses within the range to correspond to the parcels. Duplicate addresses and names were omitted, as were P.O. Box addresses and addresses outside the watershed. These filters resulted in a mailing list of residents, businesses, and property owners currently living or working in the watershed. Madison County printed and mailed the surveys, received the returned responses, and entered the response data.

The survey was also available on the web via SurveyMonkey.com. The mailed survey contained a link to the online survey so recipients could fill it out online instead of by hand. The survey link was also sent to email addresses of interested people and organizations. Some of the recipients of the emailed link may have forwarded it to others.

The survey was publicized at individual and group stakeholder meetings, public open houses, and other meetings for the Cahokia Creek watershed planning process.

Survey Results Mapping

For those respondents who provided an address, the parcel number associated with that address was identified so that the responses could be mapped. Parcel numbers were found using data files from Madison County and the County Assessor's online database.

The response data was grouped and mapped by zip code and Census block group. Further geographic breakdown of the response data, such as by Census block, was not possible while maintaining the privacy of respondents' locations.

Data Limitations

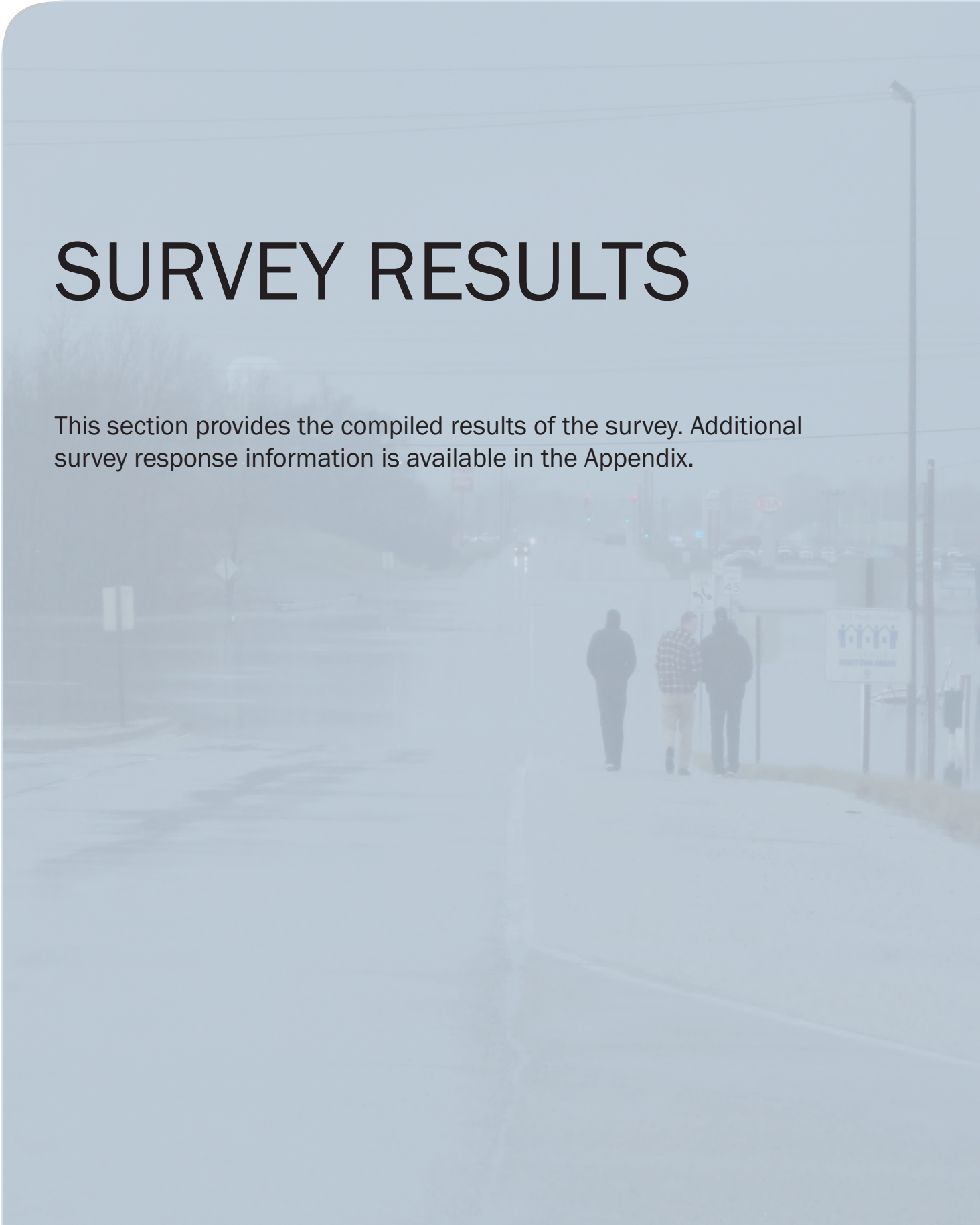
It is likely that people who have experienced flooding were more likely to reply to the survey than those who have not experienced flooding. Of those who did complete the survey, some may not have owned the property for all of the previous 10 years, meaning their estimates are underestimates of frequency and cost. Poor handwriting may also have led to data entry errors. For example, there were at least 44 typos/misinterpretations among responses in the “address” field.

Urban areas were geographically overrepresented in this survey because of the randomized parcel selection process; urban parcels are smaller and more numerous than rural parcels. This effect is compounded because a single property owner in a rural area often owns several parcels, and duplicate names were removed in the address selection process causing fewer rural parcels to be on the list. However, the cost of flood losses from rural areas may have been proportionally higher than the cost reported from urban areas because farmers are used to keeping track of flood damage for crop insurance claims. A geographically representative sample, or one that gave greater weight to answers from rural parcels based on their larger size, would have looked very different.

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SURVEY RESULTS

This section provides the compiled results of the survey. Additional survey response information is available in the Appendix.



Response Rate

Of the 2,400 surveys sent out, a total of 452 unique surveys were completed and returned from within the Canteen-Cahokia Creek Watershed project area.

The number of responses exceeded the initial goal of 400 surveys. With this sample size and a population size of 32,961 households, the survey results are accurate within +/-5% at the 95% confidence level.

The response rate of surveys within the watershed is 19%. Most surveys were returned in hard copy by mail, a few were returned at open house events, and other responses were entered online.

Survey responses were received from throughout the watershed. Just under half of the survey responses came from the Collinsville zip code (62234). The number of respondents in each zip code replying that they had been flooded ranged between one (1) (e.g., Caseyville) and 22 (e.g., Collinsville, 62234).

The total land area of the parcels from which surveys were returned is 551 acres (1.0% of the overall project area). Parcel sizes ranged between 0.03 and 74 acres, with an average of 0.95 acres.

TABLE 1. ZIP CODE OF SURVEY RESPONDENTS

ZIP CODE	RESPONDENTS IN WATERSHED	
Collinsville (62234)	211	47%
Glen Carbon (62034)	114	25%
Maryville (62062)	78	17%
Troy (62294)	16	4%
Edwardsville (62025)	14	3%
Granite City (62040)	9	2%
Caseyville (62232)	1	0%
O'Fallon (62269)	1	0%
Other	3	1%
(blank)	5	1%
TOTAL	477	100%

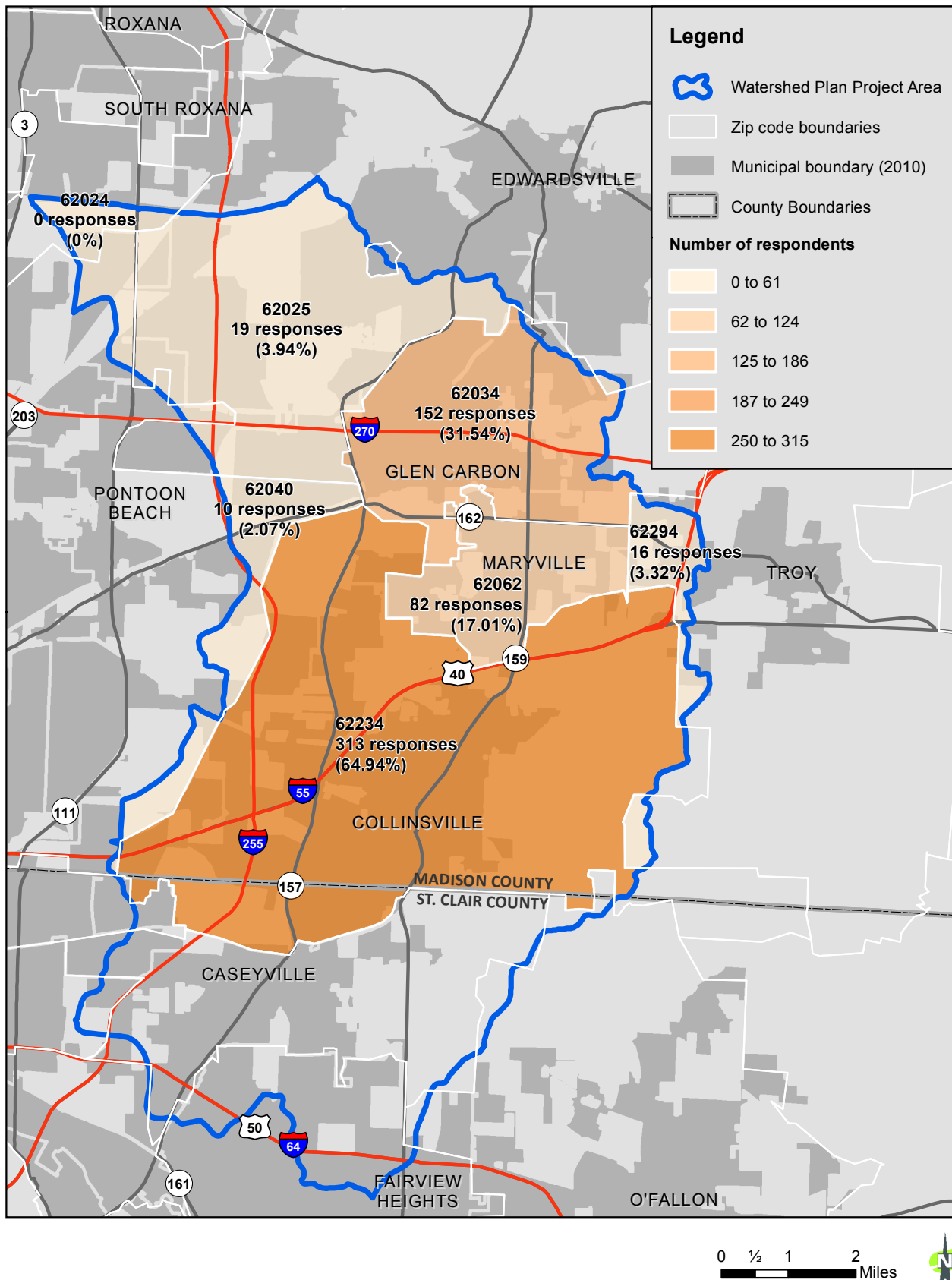


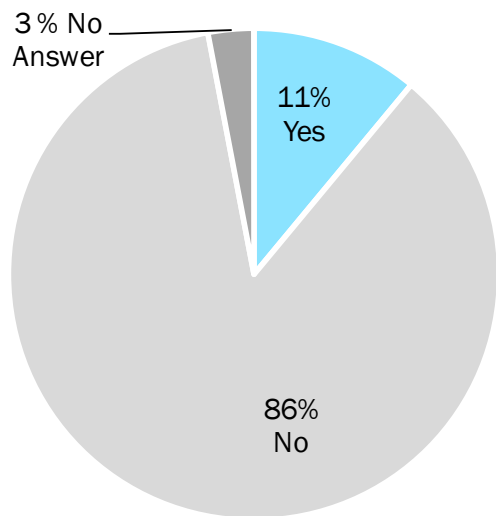
FIGURE 3. SURVEY RESPONSE RATE BY ZIP CODE

Note: Several respondents' properties were within two or more zip codes and were counted in all of them.

Prevalence

Eleven percent of respondents (11%) replied that they had experienced flooding in the last 10 years.

FIGURE 4. PERCENT OF RESPONDENTS WITH FLOODING IN THE LAST 10 YEARS



The highest proportions of respondents with flooding were found in the Glen Carbon, Collinsville, and Maryville zip codes. Glen carbon (62034) had the greatest proportion of respondents flooded (18%).

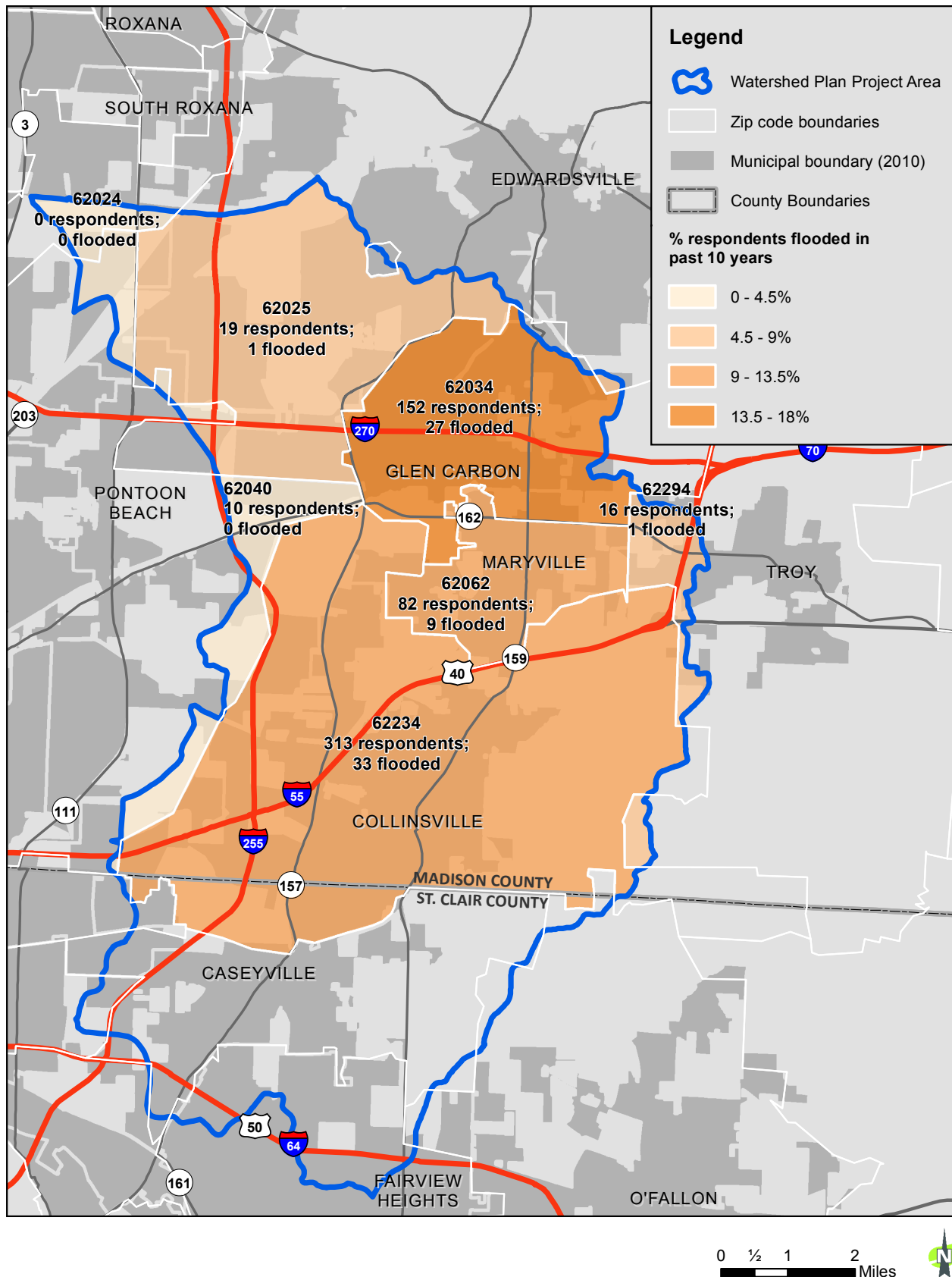


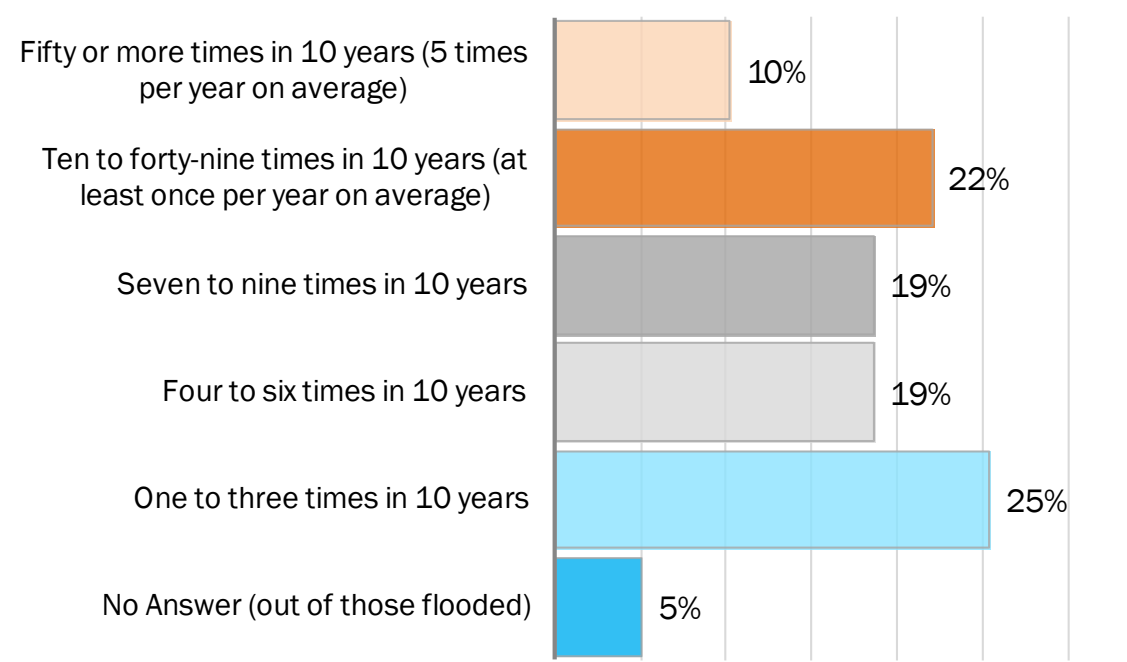
FIGURE 5. PERCENT OF RESPONDENTS FLOODED BY ZIP CODE

Note: Several respondents' properties were within two or more zip codes and were counted in all of them.

Frequency

Of the respondents who had experienced flooding in the last 10 years, 32% experienced flooding at least once per year in the last 10 years. The two most popular responses regarding flooding frequency were one to three times in 10 years (25%), and 10 to 49 times per year (22%). The greatest frequency of flooding reported by respondents on their property is shown in Figure 6.

FIGURE 6. FREQUENCY OF RESPONDENTS' FLOODING OVER 10 YEARS



Respondents reported a total of 727 flood events over the last ten years. Multiple respondents may have reported the same flood events, and, therefore, they may appear twice or more in the results.

TABLE 2. FREQUENCY OF FLOODING

FLOODING FREQUENCY	AVG. TIMES PER YEAR	RESPONSES		AVG. FREQUENCY x RESPONSES
1-3 Times in 10 Years	0.2	15	25%	3
4-6 Times in 10 Years	0.5	11	19%	5.5
7-9 Times in 10 Years	0.8	11	19%	8.8
10-49 Times in 10 Years	1.95	13	22%	25.4
50 or more Times in 10 Years	5	6	10%	30
No Answer	–	3	5%	–
TOTAL		56		72.7

On average, respondents with flooding experience 1.3 floods per year across the watershed (72.7/56).

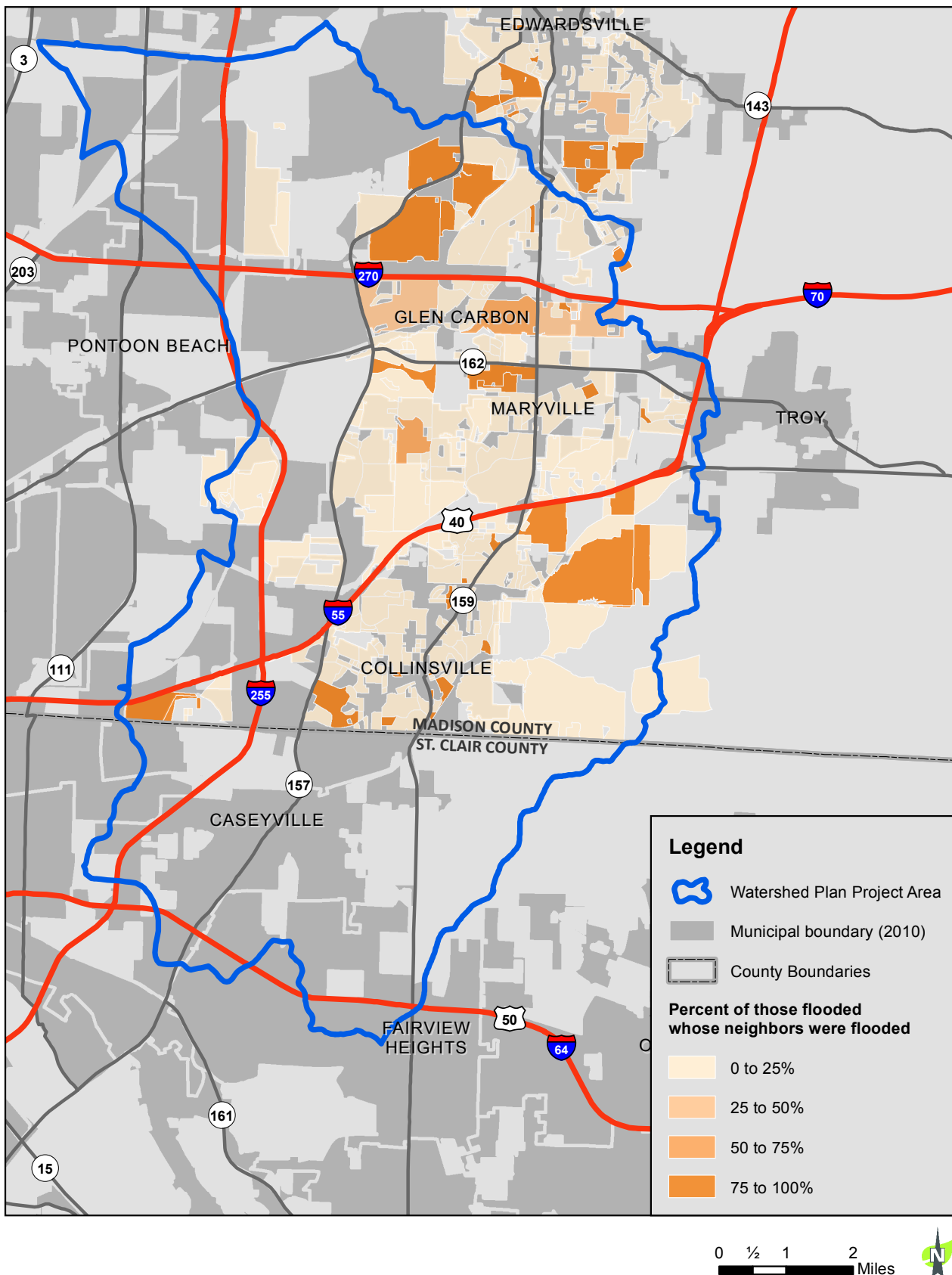


FIGURE 7. FREQUENCY OF FLOODING BY BLOCK GROUP

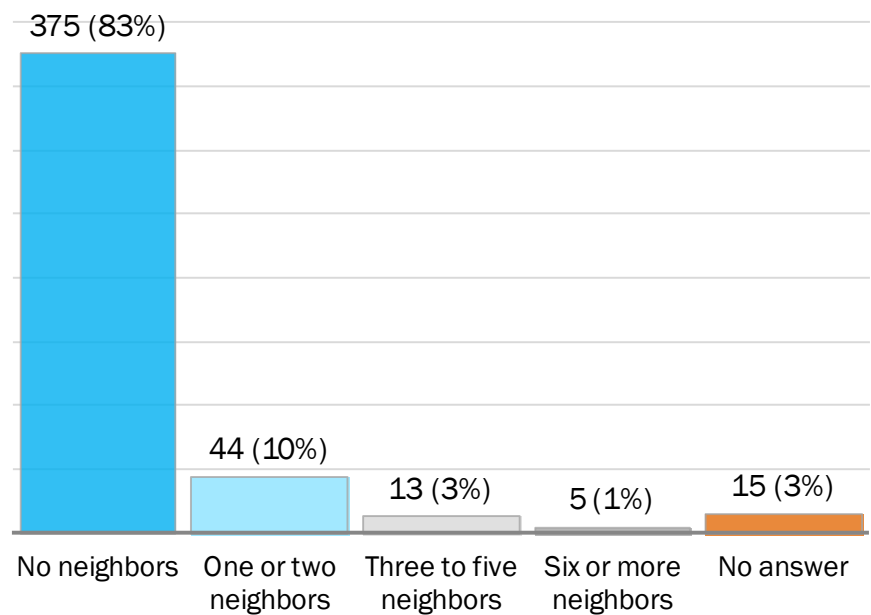
Note: Several respondents' properties were within two or more block groups and were counted in all of them.

Neighbors with Flooding

Sixty-seven percent (67%) of the respondents who had experienced flooding on their own property said their neighbor(s) had also been flooded.

14% of all survey respondents were aware of flooding on one or more neighboring properties.
10% of respondents were aware of flooding on one to two neighboring properties.

FIGURE 8. RESPONDENTS' NEIGHBORS THAT ALSO HAD FLOODING IN THE LAST 10 YEARS



Note: Although only 50 respondents reported flooding on their own properties, 437 people responded to this question about their neighbors, which is about 97% of all survey respondents.

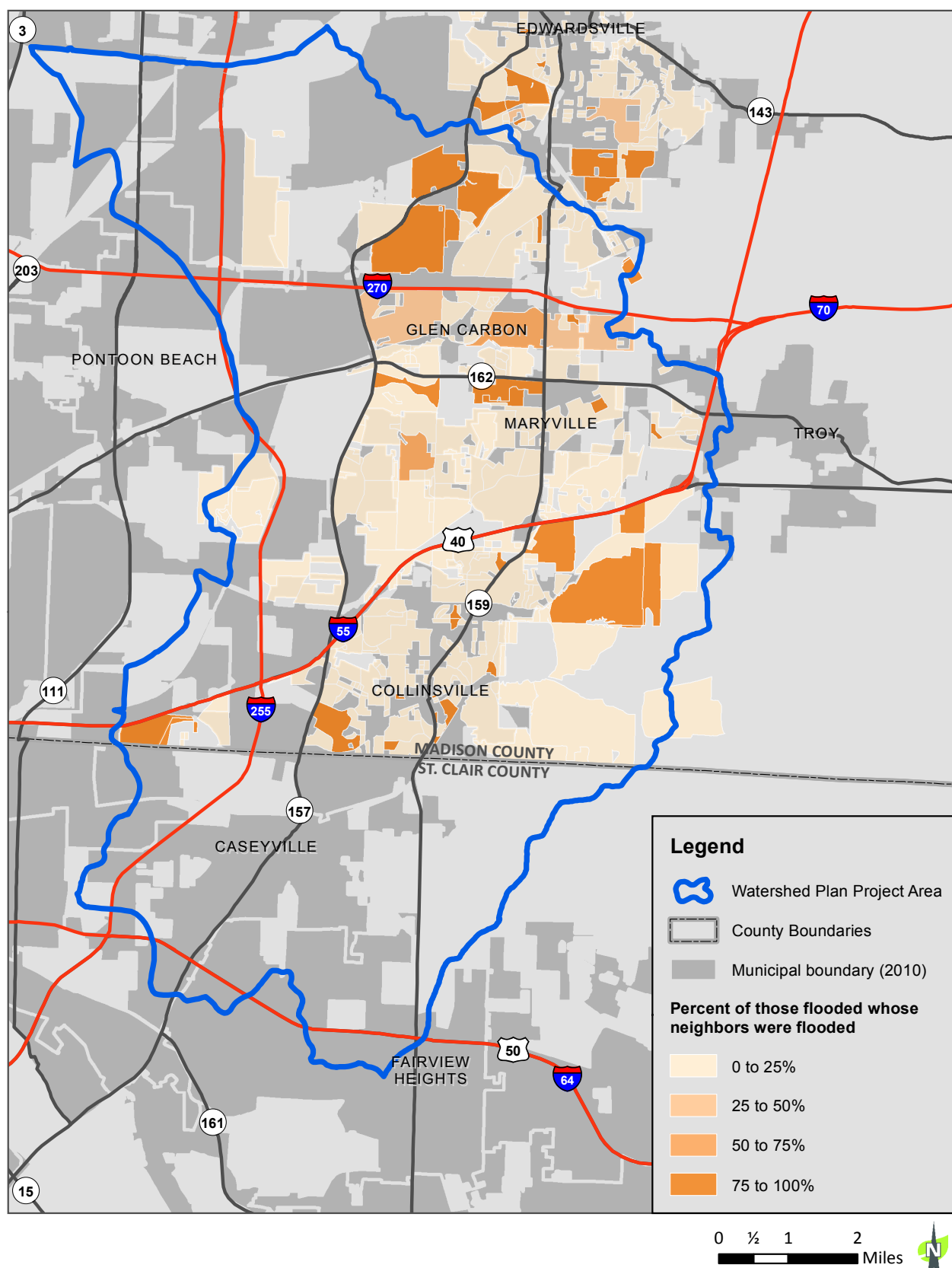


FIGURE 9. RESPONDENTS WITH AT LEAST ONE NEIGHBOR WITH FLOODING BY BLOCK GROUP

Note: Several respondents' properties were within two or more block groups and were counted in all of them. Map shows the percentage of respondents who had been flooded and who said that at least one of their neighbors had been flooded in the last 10 years, as a weighted average, by block group.

Extent of Flood Damage

Of those who had been flooded in the last 10 years, 40% had little to no yard damage; 24% said that the flooding had damaged their primary home or business; 22% had damage to yards and landscaping; and 7% had damage to fences, auxiliary buildings, and other structures.

Out of the respondents who said their primary home or business had been damaged by floods, 93% said the flooding reached the basement, and 7% (2 respondents) said it reached the first floor or habitable space.

FIGURE 10. EXTENT OF FLOOD DAMAGE IN THE LAST 10 YEARS
Note: Respondents could select more than one answer to this question

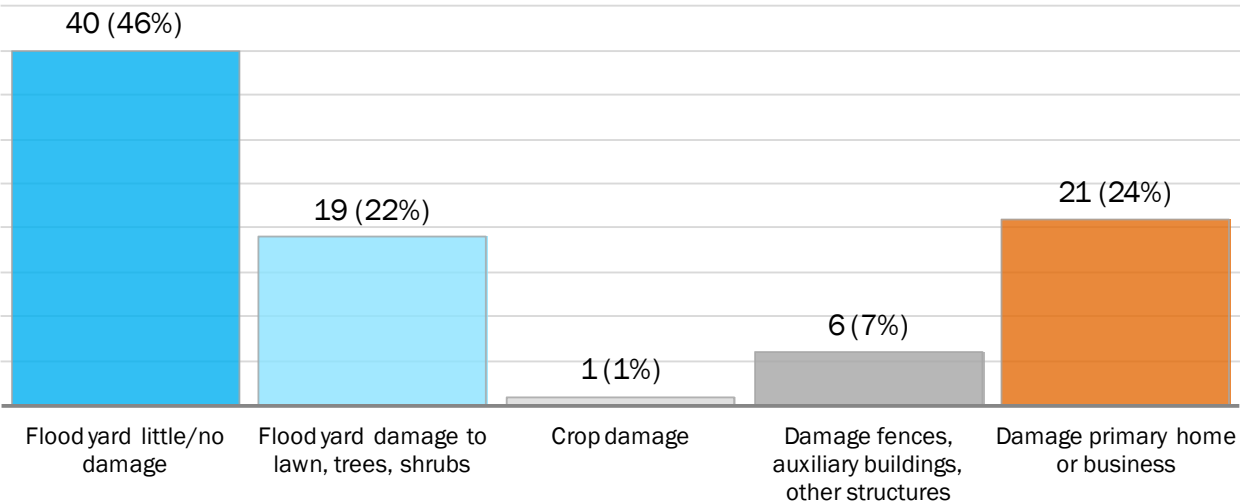
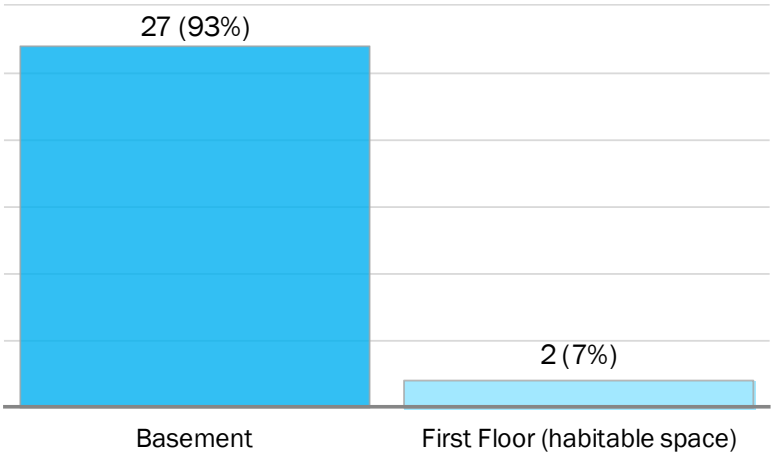


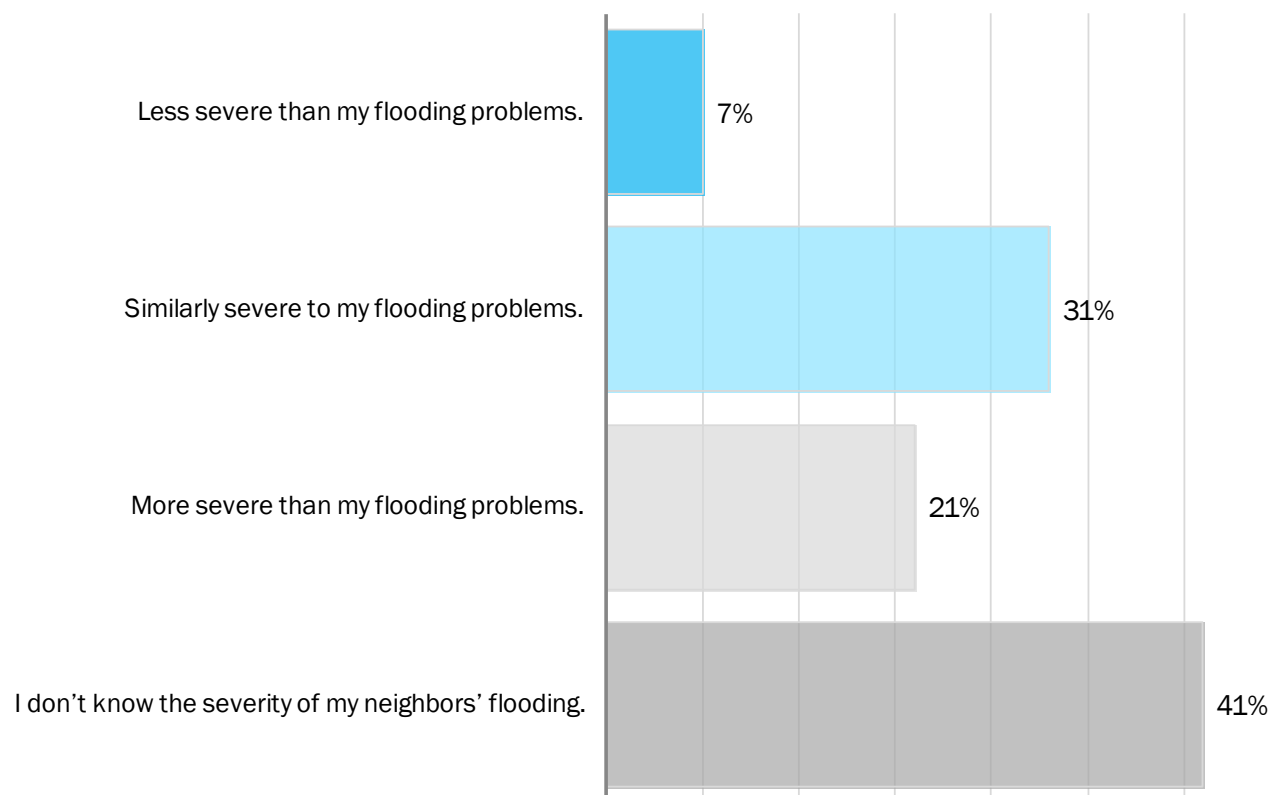
FIGURE 11. LOCATION OF DAMAGE TO PRIMARY HOME OR BUSINESS
Note: Respondents could select more than one answer to this question



Severity of Neighbors' Flood Damage

67% of the respondents who had been flooded said that their neighbors had also been flooded. Of these, 31% said that the extent of their neighbors' flooding was similar to their own. Another 21% said their neighbors' flooding was more severe than their own, while 7% said it was less severe. This indicates that the flood damage reported by respondents about their own property may be representative or an understatement of the wider effects of flooding on their communities.

FIGURE 12. EXTENT OF NEIGHBORS' FLOODING IN THE LAST 10 YEARS



Causes of Flooding

Almost all respondents who had been flooded said that heavy rainstorms were a cause of their flooding. Other causes selected were water draining from a neighboring property (57%); a lack of drainage facilities (swales, ditches, storm sewers, etc.) (28%); flooding from a nearby river, stream, lake, ditch, or pond (15%); and a blocked or unmaintained pipe, culvert, or ditch (20%). For this question, respondents could choose more than one answer, so these responses were not mutually exclusive.

TABLE 3. CAUSES OF RESPONDENTS' FLOODING

CAUSE	RESPONSES	
Heavy Rainstorm	55	92%
Water Draining from Neighboring Property	34	57%
Lack of Drainage Facilities to Drain Water From Property	17	28%
Pipe, Culvert, or Ditch that was Blocked/Needs Maintenance	12	20%
Flooding from nearby river, stream, lake, ditch, or pond.	9	15%
Log-Jam or Other Obstruction in Nearby Watercourse/Waterbody	2	3%
Sewer Backup	2	3%
I Don't Know	1	2%
Other (see Appendix)	15	25%

Fifteen (15) respondents listed other causes of flooding such as a levee breach (Canteen Creek), obstructions in the waterway, and sump pump failure or inadequacy. The full list is provided in the Appendix.

Reporting

At least 62% of respondents who were flooded did not report their flooding to anyone. Respondents that did report it were most likely to contact their city/village (16%), their insurance company (10%), or their township (5%).

TABLE 4. HOW RESPONDENTS REPORTED FLOODING

REPORTED FLOODING TO:	RESPONSES	
I did not report my flooding to anyone	38	62%
My city/village	10	16%
My insurance company	6	10%
My township	3	5%
The Madison County Stormwater Hotline (618-296-7788)	1	2%
Federal Emergency Management Agency (FEMA)*	1	2%
Friends, family, and neighbors*	1	2%

* Written in under "Other"

Impacts and Effects from Flooding

The most commonly reported impact from flooding was stress. Monetary loss was second; related costs of having to take time off work were also noted. Respondents identified other specific effects under “Other” including the presence of mosquitoes in floodwater and erosion due to floodwater.

TABLE 5. EFFECTS FLOODING HAD ON RESPONDENTS

EFFECT FROM FLOODING	RESPONSES	
It caused stress	34	57%
Monetary loss due to repair of flood damage	24	40%
Time off work to clean up	19	32%
No significant effect	12	20%
Monetary loss due to lost valuables or equipment	10	17%
Partial loss of access to property	8	13%
It affected the physical health of someone in your household or business	3	5%
Breeding ground for mosquitoes created*	1	2%
Purchase of wetvac equipment*	1	2%
Erosion of the yard*	1	2%
Loss of trees, shrubs, & grass due to water damage*	1	2%
Mold*	1	2%
Loss of crops	0	0%
Lost business income (e.g. business closed, lost productivity)	0	0%

* Written in under “Other”

Costs from Flooding

Of those who said they had been flooded, 33% reported no monetary loss. 32% said that their loss was less than \$5,000 over the last 10 years; and another 18% said that the loss was between \$5,001 and \$20,000. One respondent (2% of those who answered) said his/her loss was between \$100,000 and \$500,000.

FIGURE 13. COSTS ASSOCIATED WITH RESPONDENTS' FLOODING OVER THE LAST 10 YEARS

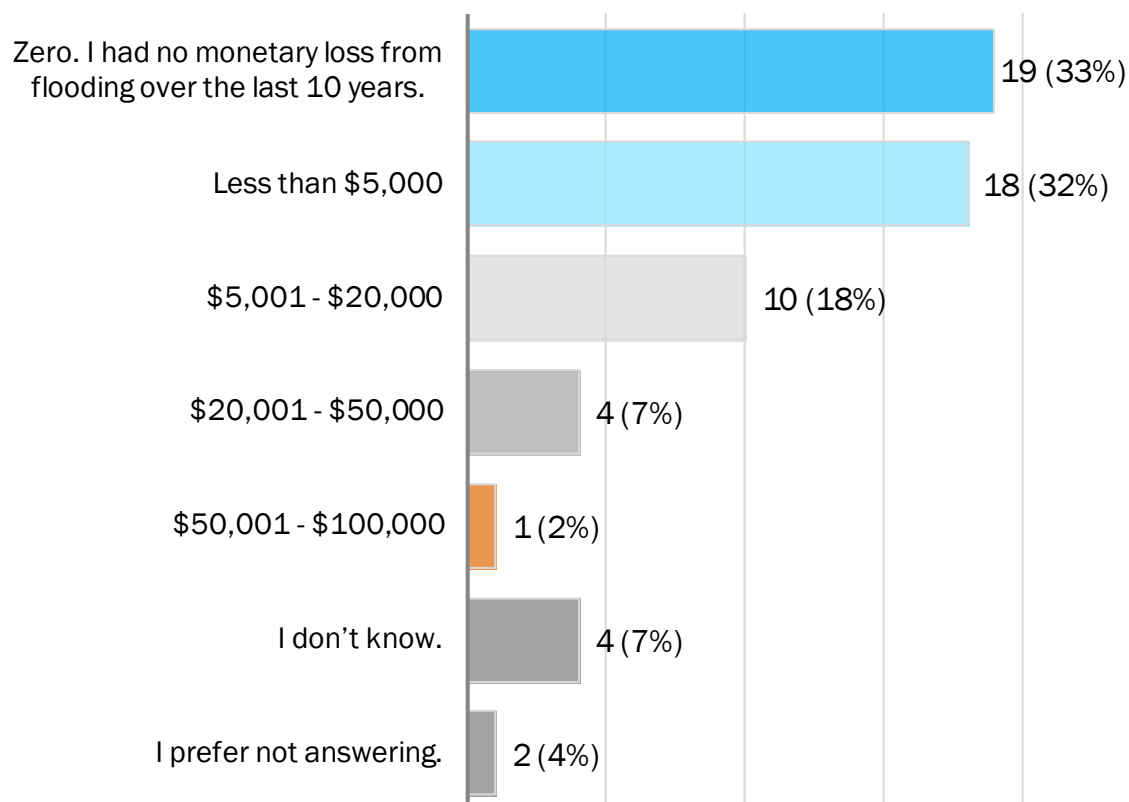


TABLE 6. COSTS ASSOCIATED WITH RESPONDENTS' FLOODING OVER THE LAST 10 YEARS

COST OVER 10 YEARS	RESPONSES*		LOWEST COST IN CATEGORY	LOWEST COST x RESPONSES	AVG. COST IN CATEGORY	AVG. COST x RESPONSES
Zero	19	37%	\$0	-	\$0	-
Less than \$5,000	18	35%	\$1	\$18	\$2,500	\$45,000
\$5,001 - \$20,000	10	19%	\$5,001	\$50,010	\$12,500	\$125,000
\$20,001 - \$50,000	4	8%	\$20,001	\$80,004	\$35,000	\$140,000
\$50,001 - \$100,000	1	2%	\$50,001	\$50,001	\$75,000	\$75,000
I don't know	4	-	-	-	-	-
I prefer not answering	1	-	-	-	-	-
No Answer	396	-	-	-	-	-
TOTAL	452		LOW ESTIMATE:	\$180,033	HIGH ESTIMATE:	\$385,000

* Percent = percentage of respondents who answered with a cost

The lowest estimate of the total costs reported by respondents is \$180,033 over the last 10 years. Divided by the 33 respondents who reported a cost in this question, each respondent lost an average of \$5,456 over 10 years.

Using the average cost for each response category, the high estimate for total costs reported by respondents is \$385,000 over the last 10 years; or an average of \$11,667 lost per respondent over 10 years.

Using the lower estimate of costs, and extrapolating to the 32,961 households in the watershed (estimated using 2010 U.S. Census Bureau population map data), i.e., multiplied by 73 [32,961/452], an estimated \$13,128,468 of monetary loss has occurred due to flooding over the last 10 years in the Canteen-Cahokia watershed.

Note: the monetary loss estimate for the Upper Silver Creek Flood Survey Report used population rather than number of households, and also did not account for a “zero monetary loss” option in the question – the lowest category for monetary loss was “Less than \$5,000”. These factors led to a much higher overall monetary loss estimate for the Upper Silver Creek watershed.

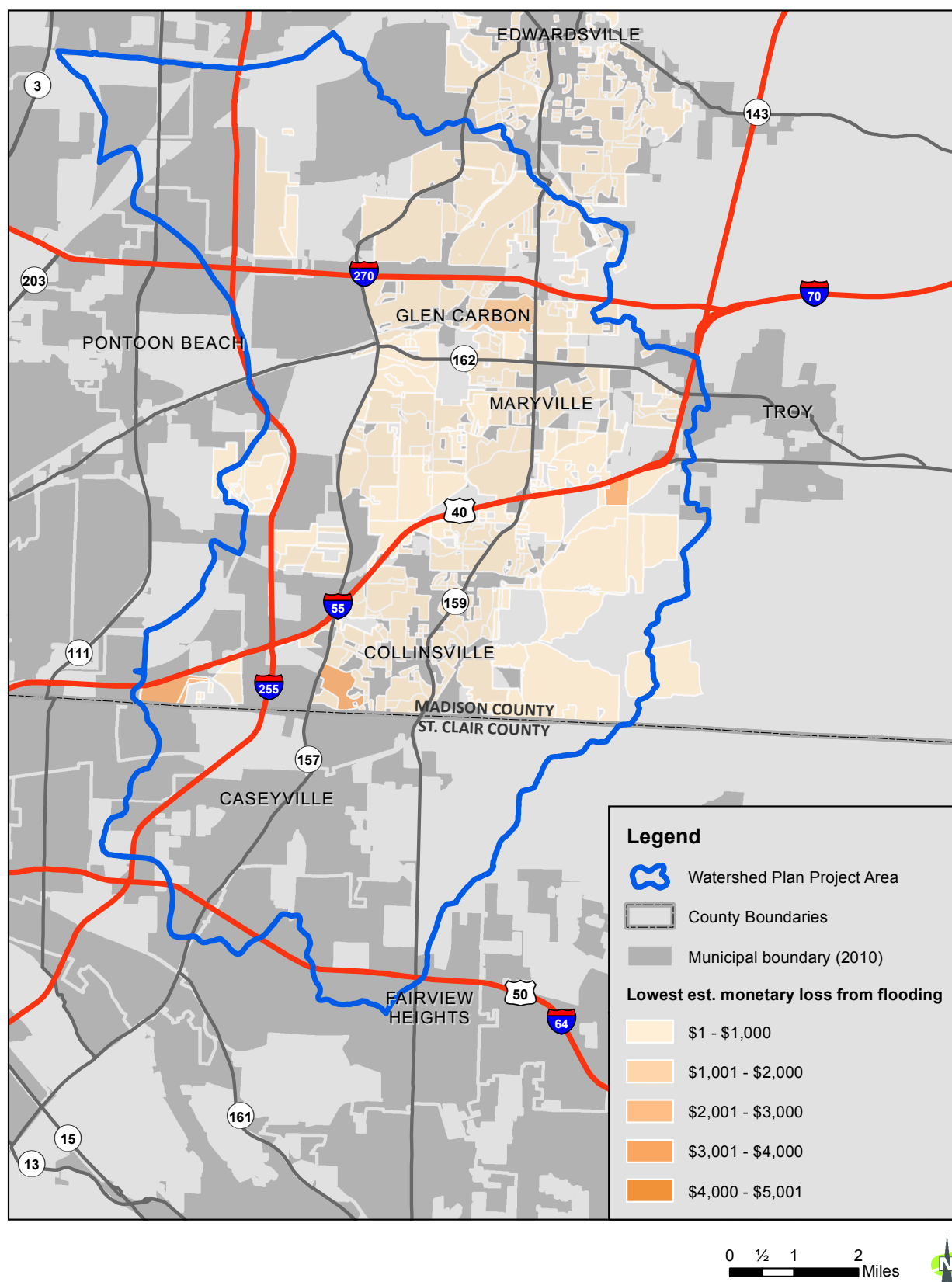


FIGURE 14. MONETARY LOSS FROM FLOODING BY BLOCK GROUP (USING LOW ESTIMATE)

Note: Several respondents' properties were within two block groups and were counted in both.

Correlation with Floodplains

FEMA-designated floodplains cover 17.3% of the total acreage in the Canteen-Cahokia Creek Watershed within Madison County. 4% of surveys came from parcels wholly or partly within these floodplains. A similar percentage of survey respondents (2%, or 9 people) responded that they lived in a FEMA-designated floodplain. Eleven (11) respondents, or 2.4% of survey respondents, unknowingly own or live on property that is wholly or partly in a floodplain.

FIGURE 15. RESPONDENTS' PROPERTY WITHIN OR OUTSIDE A FLOODPLAIN

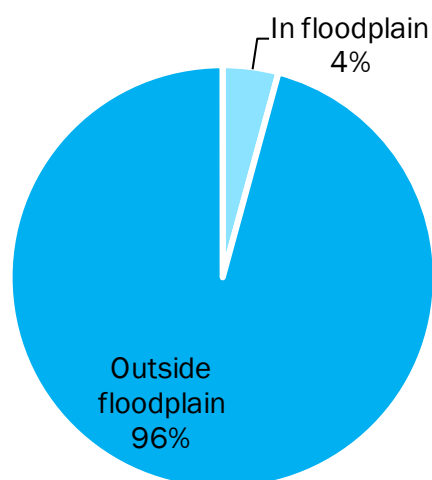
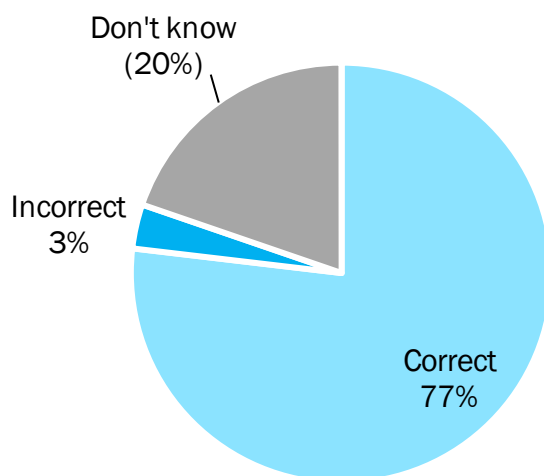


FIGURE 16. RESPONDENTS' KNOWLEDGE ABOUT WHETHER THEIR PROPERTY IS IN A FLOODPLAIN



Note: In the Community Flood Survey for the upper Silver Creek watershed, the data about whether respondents knew their property was in a floodplain was presented differently, only representing those whose property was in a floodplain.

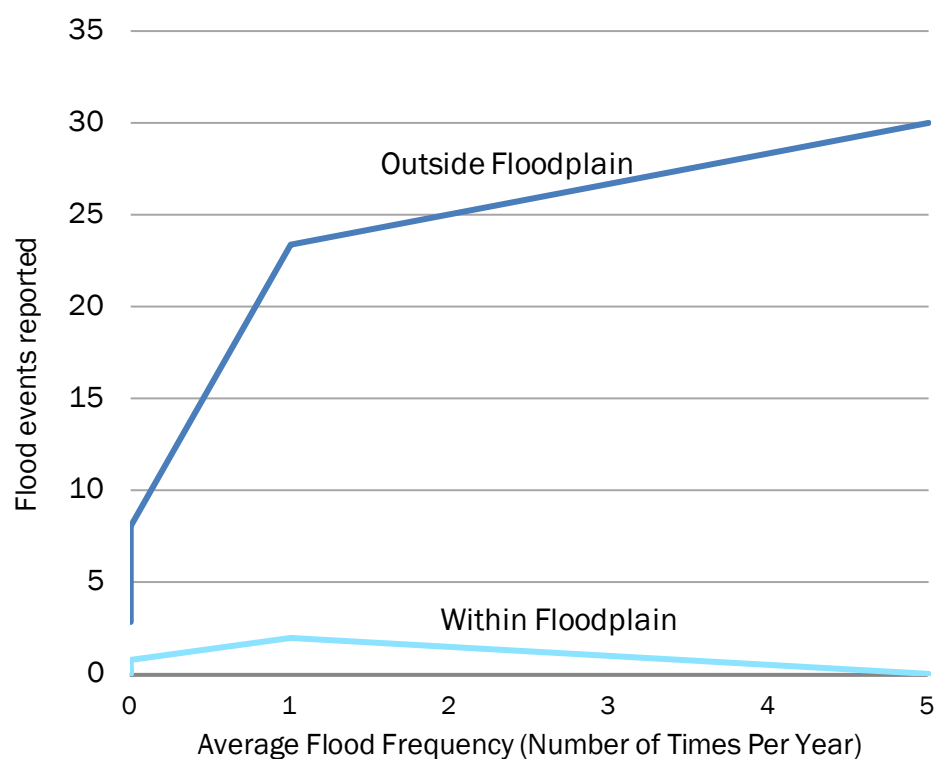
Respondents reported a total of approximately 697 events per year taking place outside of FEMA designated floodplains over the last 10 years (96% of the flooding reported). Within floodplains, approximately 30 parcels were flooded per year.

TABLE 7. FLOOD FREQUENCY BY PROPERTY LOCATION

FLOOD FREQUENCY	AVG. TIMES PER YEAR*	PARCELS IN FLOODPLAIN		PARCELS OUTSIDE FLOODPLAIN	
		NUMBER	NUMBER OF TIMES FLOODED PER YEAR	NUMBER	NUMBER OF TIMES FLOODED PER YEAR
1-3 Times in 10 Years	0.2	1	0.2	14	2.8
4-6 Times in 10 Years	0.5	0	0	11	5.5
7-9 Times in 10 Years	0.8	1	0.8	10	8
10-49 Times in 10 Years	1.95	1	2.0	12	23.4
50 or more Times in 10 Years	5	0	0	6	30
TOTAL		3	3.0	53	69.7

*except for the 50 or more times category, where the lowest possible frequency is used

FIGURE 17. FLOOD FREQUENCY BY PROPERTY LOCATION WITHIN OR OUTSIDE OF A FLOODPLAIN



Flood Insurance Coverage

Madison County, St. Clair County, and ten communities in the watershed are enrolled in the National Flood Insurance Program (NFIP), allowing floodplain residents to purchase flood insurance for their properties. The average flood insurance premium paid by Madison County residents is \$732 per year.⁵ Nationwide, approximately 20% of NFIP claims are for properties located outside floodplains, some of which are from flooding caused by local drainage problems.⁶

Six percent (6%) of respondents (25 people) said that they have flood insurance. Of these respondents, four (2%) made a claim in the watershed in the last 10 years.

Twenty-one (21), or 4.6%, of the survey respondents have flood insurance on structures that are not in a floodplain.

FIGURE 18. RESPONDENTS' FLOOD INSURANCE COVERAGE

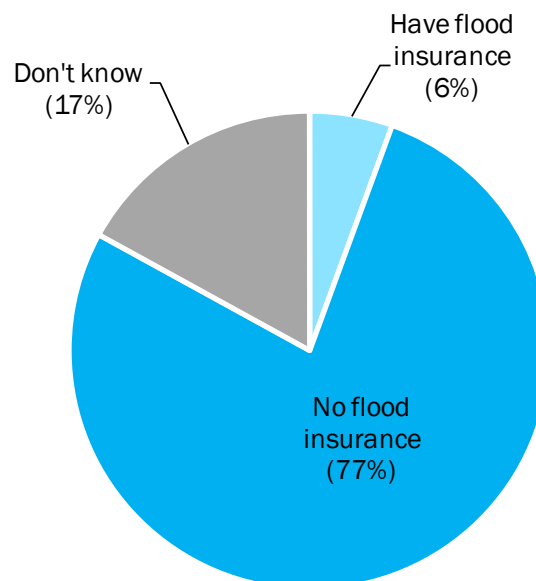
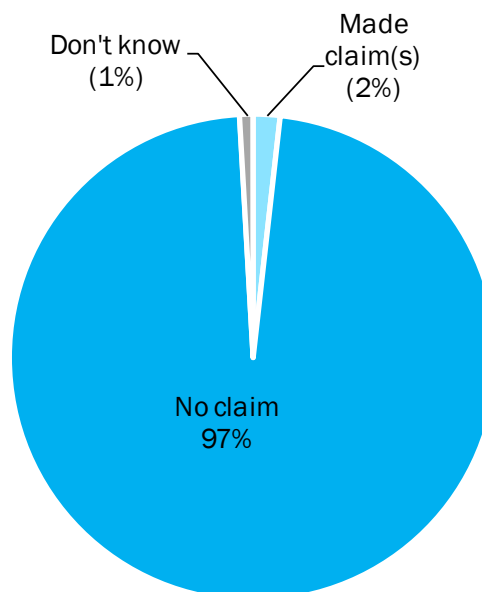


FIGURE 19. RESPONDENTS' FLOOD INSURANCE CLAIMS

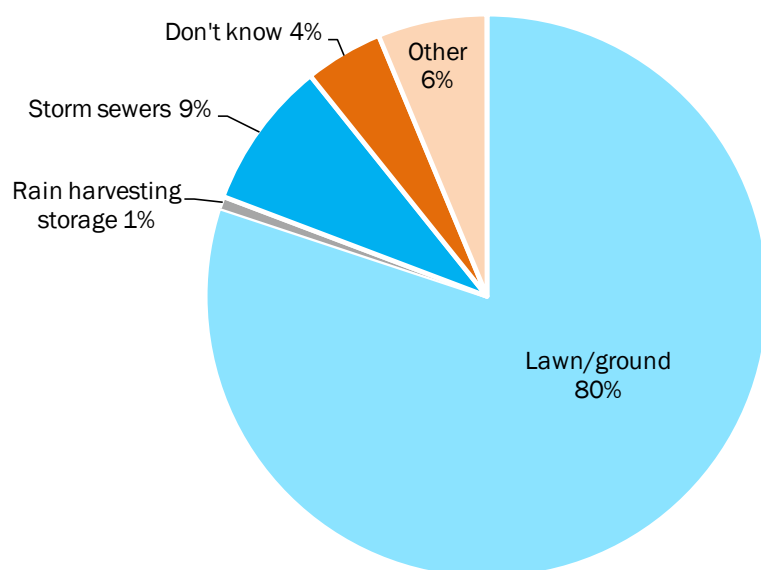


Downspout Connections

When downspouts are connected directly to a sanitary sewer system or private sewer system, heavy rainfall can lead to sewer backups into the building. When downspouts open out onto a lawn or other ground surface, the imperviousness and slope of the surface determines where and how fast the water flows. If there is inadequate infiltration, floodwaters can accumulate quickly around a building. A direct connection between downspouts and a storm sewer system quickly transports the water away from the building and into a detention pond or local waterway. Rainwater harvesting methods such as rain barrels or cisterns collect runoff from the roof, preventing it from contributing to flooding around the building or downstream. This is the optimal downspout connection scenario, as it does not allow stormwater to accumulate by the structure or downstream. Rainwater harvesting also allows for reuse of the water in, for example, gardening.

The majority of respondents said that their downspouts flowed out onto their lawn or other ground surface. Much smaller proportions of respondents said their downspouts were connected to storm sewers (9%) or to cisterns, rain barrels, or other rainwater harvesting storage (1%). Under “Other”, respondents wrote in that their downspouts drained to a nearby drainage ditch, buried extension (e.g. French drain), stream, pond, or waterbody.

FIGURE 20. WHERE RESPONDENTS' DOWNSPOUTS CONNECT



Measures to Prevent Future Flooding

One hundred six (106) respondents, or 23%, said they had made one or more improvements in an attempt to prevent future flooding/flood damage. Four percent (4%) said they planted native vegetation or buffer strips, or another conservation measure. Several respondents (3%) said they installed or enlarged swales or ditches as a flood mitigation improvement. Creating or enlarging ponds, detention, or retention basins was the next most popular option, at two percent (2%) of respondents. Respondents were given the option to write in other improvements they had made. Several noted that they had added French drains, graded the landscape, installed sump pumps, extended their downspouts, and added rock/riprap to an existing swale/ditch. See Appendix for full list of “Other” responses to improvements.

TABLE 8. TOP ACTIONS TAKEN BY RESPONDENTS TO PREVENT FUTURE FLOODING

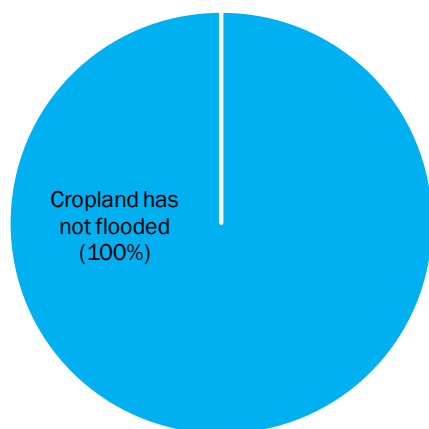
ACTION TAKEN	RESPONSES	
Planted native vegetation, buffer strips, or other conservation measures	19	4%
Installed or enlarged swales and/or ditches	15	3%
Created or enlarged a pond, detention, or retention basin	7	2%
Added rock/riprap to existing swale/ditch*	5	1%
Added French drain system*	4	1%
Extended drain lines from downspouts*	4	1%
Graded landscape*	4	1%
Installed rain garden	3	1%
Installed drainage tile*	3	1%
Installed permeable paving	2	<1%
Installed perimeter foundation drains*	2	<1%
Sealed/resealed basement*	2	<1%
Connected downspout(s) to rain barrel*	1	<1%
Installed retaining wall*	1	<1%
Installed sump pump*	1	<1%
Installed larger gutters*	1	<1%

* Written in under “Other”

Cropland

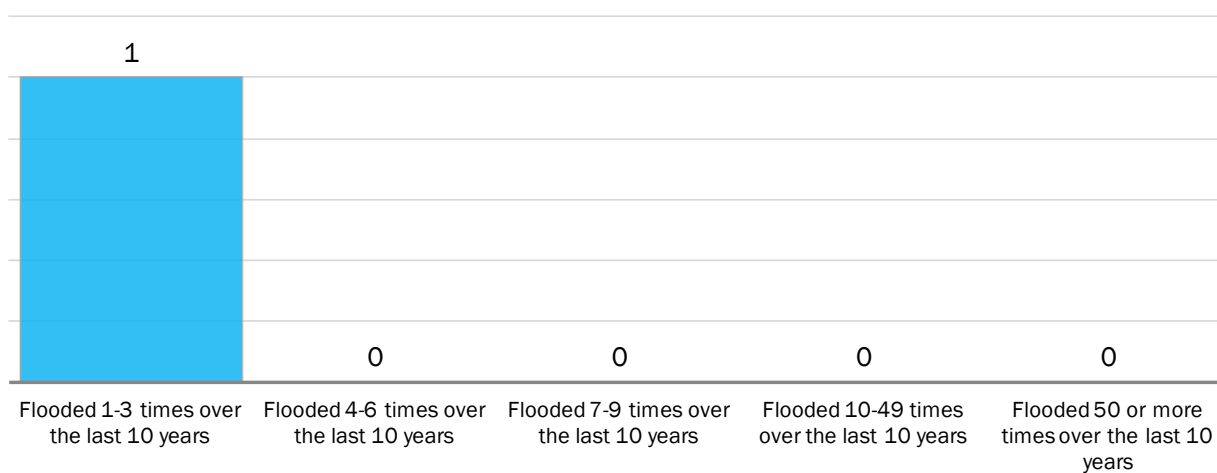
Only three (3) respondents said they owned agricultural land at the address given. None of them said that their land flooded in the last 10 years.

FIGURE 21. FLOODING OF RESPONDENTS CROPLAND



Under a different question, however, one respondent noted that his/her crops had been damaged when flooding had occurred between 1 and 3 times in the last 10 years.

FIGURE 22. FREQUENCY OF FLOODING CROPLAND

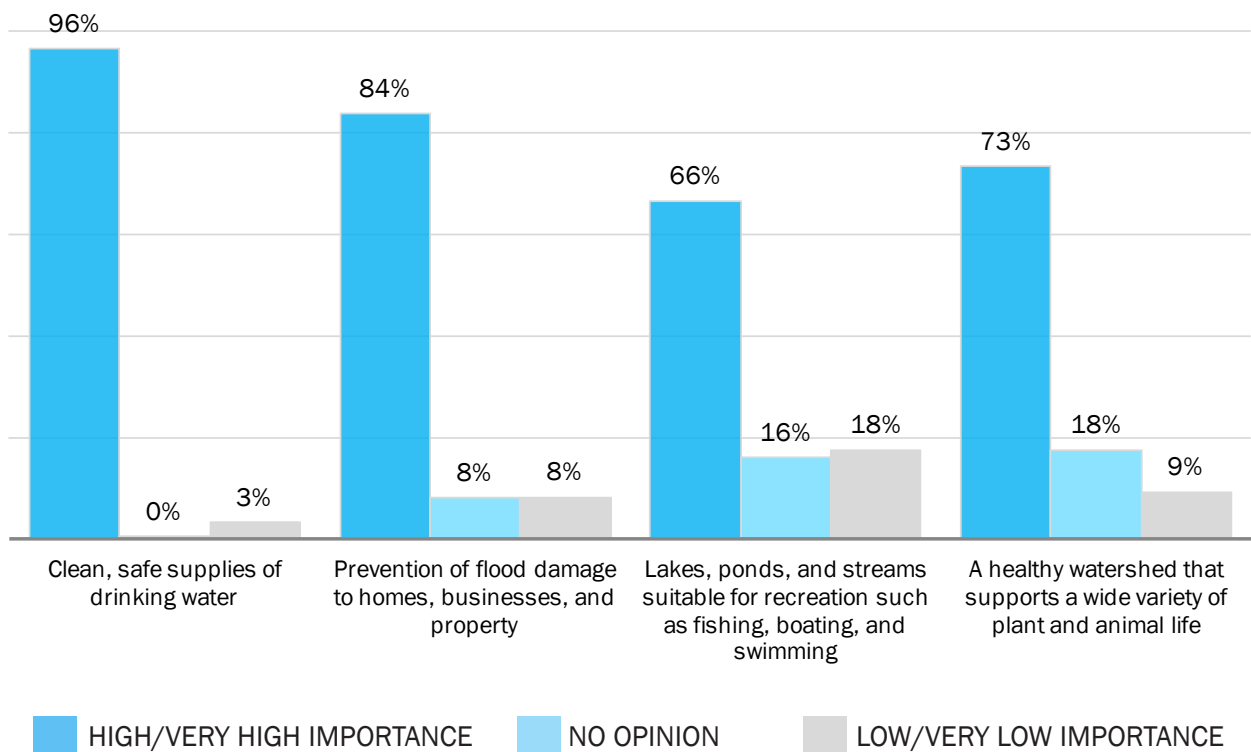


Importance of Water Management

Most respondents replied to the question about their values on water-related issues, whether or not they had experienced flooding. The question asked how important four (4) issues were to respondents on an importance scale with five (5) options, from very low importance to very high importance.

Respondents placed the highest importance on “clean, safe supplies of drinking water”, followed by “prevention of flood damage to homes, businesses, and property”; then “a healthy watershed that supports a variety of plant and animal life.”; and finally “lakes, ponds and streams suitable for recreation such as fishing, boating, and swimming”.

FIGURE 23. IMPORTANCE OF WATER MANAGEMENT OUTCOMES



NEXT STEPS



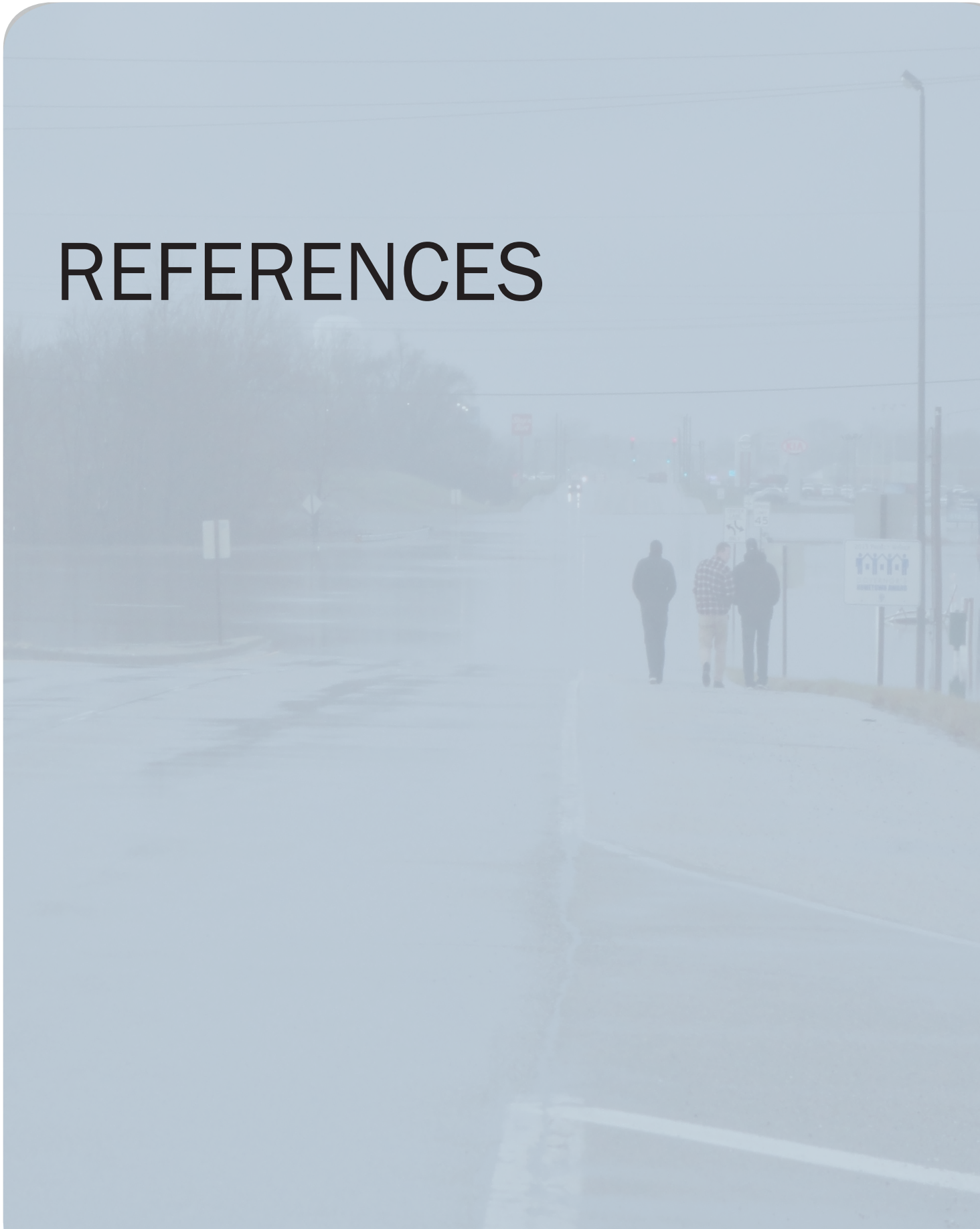
Next Steps

The findings of this survey will be incorporated into the Canteen Creek-Cahokia Creek Watershed Plan. Some data about the location and extent of flooding in the watershed has already been gathered from interviews with stakeholders including mayors, township highway road commissioners, property owners, and landowners. The results of this survey will be considered alongside this data as recommendations for mitigating water quality and flooding issues. Additionally, the survey results will be considered alongside those from the Upper Silver Creek Watershed Community Flood Survey and the results from the Indian-Cahokia watershed to assess flood impacts across multiple watersheds.

More community flood surveys may be undertaken in other watersheds in Madison County and the region as further watershed planning takes place. Having more extensive knowledge about flooding problems in multiple areas will help county and municipal governments prioritize flood mitigation and protection projects across their entire jurisdictions.

Further research into flooding issues and their solutions may include gathering data from private insurers about flood insurance claims. Insurance data would allow for the calculation of the distribution of flood insurance and the costs of flooding through verified policies and claims, rather than best estimates.

REFERENCES



- ¹ Madison County Planning and Development Department and Madison County Emergency Management Department, Madison County Hazard Mitigation Plan, June 2006, http://www.state.il.us/iema/planning/Documents/Plan_MadisonCounty.pdf
- ² Center for Neighborhood Technology, The Prevalence and Cost of Urban Flooding, May 14, 2013, <http://www.cnt.org/resources/the-prevalence-and-cost-of-urban-flooding/>
- ³ FEMA, as cited in Center for Neighborhood Technology, The Prevalence and Cost of Urban Flooding, May 14, 2013, <http://www.cnt.org/resources/the-prevalence-and-cost-of-urbanflooding/>
- ⁴ Illinois Department of Natural Resources (IDNR), June 2015, https://www.dnr.illinois.gov/Water-Resources/Documents/Final_UFAA_Report.pdf
- ⁵ FEMA, Policy Statistics by state as of 9/30/2013, <http://bsa.nfipstat.fema.gov/reports/1011.htm>
- ⁶ FEMA, National Flood Insurance Program Community Rating System Coordinator's Manual, FIA-15/2013, OMB No. 1660-0022, expires: September 30, 2013, http://www.fema.gov/media-library-data/20130726-1557-20490-9922/crs_manual_508_ok_5_10_13_bookmarked.pdf

Photo Credit: Madison County

APPENDIX

The Appendix includes:

- Causes of flooding written in by respondents under “Other”
- Improvements made to prevent future flooding, written by respondents under “Other”
- A copy of the Madison County Community Flooding Survey for the Cahokia Creek watershed

Other Causes of Flooding

Causes written in by respondents under “Other”, by response keyword (corresponds to Table 3 on Page 22):

TABLE 9. OTHER CAUSES OF FLOODING

OTHER CAUSE	RESPONSES
Improperly designed infrastructure	3
Sump pump failure or inadequacy	2
Hydrostatic pressure	1
Hydrostatic pressure AND Sump pump failure or inadequacy	1
Levee breach	1
Obstructions in the waterway	1

Other Actions Taken to Prevent Flooding

Improvements written in by respondents under “Other”, by response keyword (corresponds to Table 8 on page 32):

TABLE 10. OTHER ACTIONS TAKEN TO PREVENT FLOODING

OTHER ACTIONS	RESPONSES	
Added rock/riprap to existing swale/ditch	5	1%
Added French drain system	4	1%
Extended drain lines from downspouts	4	1%
Graded landscape	4	1%
Installed drainage tile	3	1%
Installed perimeter foundation drains	2	<1%
Sealed/resealed basement	2	<1%
Connected downspout(s) to a rain barrel	1	<1%
Installed retaining wall	1	<1%
Installed sump pump	1	<1%
Installed larger gutters	1	<1%

Madison County Community Flood Survey- Cover



We Need Your Input!

Thank you in advance for taking the time to fill out this survey regarding the impact of floods on homes, businesses, and property in Madison County. Your response is greatly appreciated. This survey is part of a larger planning effort for the two watersheds that drain to Cahokia Creek. Your response will help determine strategies and recommendations for addressing flooding problems in the Cahokia Creek watersheds.

What is a Watershed Plan?

A Watershed Plan identifies strategies to improve water quality and reduce the impacts of flooding. Watershed Plans for Cahokia Creek will:

- Document existing conditions.
- Develop recommended strategies to improve water quality and address flooding, as a roadmap for communities, agencies, and landowners to implement future improvements.
- Help reduce costs for homeowners, businesses, and taxpayers.

This watershed planning effort is an important component of Madison County's Stormwater Plan, and part of a larger effort to create plans for all of Madison County's major watersheds. Multiple partners are involved in this effort, including Madison County, HeartLands Conservancy, the U.S. Army Corps of Engineers, and the Madison County Soil and Water Conservation District.

Please complete and return this survey by
October 30, 2015.

Your time and input is greatly appreciated!

If you have questions about the survey or the Cahokia Creek Watershed Planning process, visit:

www.HeartLandsConservancy.org/CahokiaCreek

or contact:

Janet Buchanan at HeartLands Conservancy,
 (618) 566-4451 ext. 25
janet.buchanan@heartlandsconservancy.org



You can complete this survey in two ways:

1. Fill out and return the survey via the enclosed return envelope.
2. Fill out the survey on-line at:
www.surveymonkey.com/s/CahokiaCreek

Two Open Houses will be held in October to gather more information for the Cahokia Creek Watershed Plans. Be sure to provide your email address if you want to be notified when the Open House dates & locations are set.



**Turn Page to
Start Survey**

Madison County Community Flood Survey- Page 1

Start Survey

1. Please provide your address: (Note: Addresses will be kept confidential, unless you request follow-up information below. By giving your address, it allows the planning team to identify locations of flooding.)

Address: _____ City: _____ Zip: _____

- ☐ Check here if you would like to be put on our mailing list to receive updates and more information.
Provide your name, phone, and e-mail below:

Name: _____ Phone: _____

E-mail: _____

2. What type of property is at this address? It will be referred to for the rest of the survey as "this property."

- ☐ Residential, lot smaller than 5 acres ☐ Agricultural
☐ Residential, lot larger than 5 acres ☐ Industrial
☐ Business/Commercial ☐ Civic / Institutional / Non-profit
☐ Other (please explain): _____

3. Has this property been flooded in the last 10 years? ☐ Yes ☐ No (If NO, skip to Question #9)

	Number of times over the last 10 years...				
	1-3	4-6	7-9	10 - 49 (1-4.9/year)	50 or more (at least 5/ year)
Extent of Flood Damage					
Yard/Open green space was flooded, with little/no damage					
Yard/Green space was flooded, with damage to lawn, trees, and shrubs					
Crops were damaged					
Fences, auxillary buildings (sheds, etc.), or other structures were damaged					
Primary home/business was damaged					

4. If flooding damaged the primary home or business, how far did the floodwater penetrate into your home or business (furthest extent)?

- i. Basement ☐ Yes ☐ No
 ii. First floor (habitable space) ☐ Yes ☐ No

5. What was the cause of the flooding that affected this property? (Select all that apply)

- ☐ Heavy rainstorm.
☐ Water draining from neighboring property.
☐ Flooding from nearby river, stream, lake, ditch, or pond.
☐ Log-jam or other obstruction in nearby river, stream, lake, ditch, or pond.
☐ Pipe (not sewer), culvert, or ditch that was blocked or needs maintenance.
☐ Lack of drainage facilities (swales, ditches, storm sewers, etc.) to drain water from this property.
☐ Sewer backup.
☐ I don't know.
☐ Other (please explain): _____

Madison County Community Flood Survey- Page 2

6. Did you report your flooding to anyone? *(Select all that apply)*

- ☐ My city/village.
- ☐ My township.
- ☐ The Madison County Stormwater Hotline (618-296-7788).
- ☐ My insurance company.
- ☐ I did not report my flooding to anyone.
- ☐ Other (please explain): _____

7. How have you been affected by flooding on this property? *(Select all that apply)*

- | | |
|--|--|
| <input type="checkbox"/> Monetary loss due to repair of flood damage. | <input type="checkbox"/> Partial loss of access to property. |
| <input type="checkbox"/> Monetary loss due to lost valuables or equipment. | <input type="checkbox"/> It affected the physical health of someone in your household or business. |
| <input type="checkbox"/> It caused stress. | <input type="checkbox"/> Lost business income (e.g., business closed, lost productivity) |
| <input type="checkbox"/> Time off work to clean up. | <input type="checkbox"/> Loss of crops. |
| <input type="checkbox"/> Other (please explain): _____ | <input type="checkbox"/> No significant effect. |

8. If you suffered a monetary loss due to flooding over the last 10 years (such as damage to structures or buildings, lost valuables or equipment, lost wages or income, etc.), please estimate your total, cumulative loss in dollars.

- | | |
|---|--|
| <input type="checkbox"/> Zero. I had no monetary loss from flooding over the last 10 years. | <input type="checkbox"/> \$50,001 - \$100,000. |
| <input type="checkbox"/> Less than \$5,000. | <input type="checkbox"/> \$100,001 - \$500,000. |
| <input type="checkbox"/> \$5,001 - \$20,000. | <input type="checkbox"/> Over \$500,000. |
| <input type="checkbox"/> \$20,001 - \$50,000. | <input type="checkbox"/> I don't know. |
| | <input type="checkbox"/> I prefer not answering. |

9. Have any of your nearby neighbors experienced flooding at their home, business, or property in the last 10 years? *(Choose one)* NOTE: If you have neighbor who experienced flooding, please let them know about this survey and have them visit www.surveymonkey.com/s/cahokiaticreek

- ☐ YES. One or two neighboring properties.
- ☐ YES. Three to five neighboring properties.
- ☐ YES. Six or more neighboring properties.
- ☐ NO. I don't know of any neighbors who have experienced flooding on their home or property. *(If NO, Skip to question 11)*

10. If you answered YES above, what was the severity of your neighbors' flooding? *(Choose one)*

- ☐ Less severe than my flooding problems.
- ☐ Similarly severe to my flooding problems.
- ☐ More severe than my flooding problems.
- ☐ I don't know the severity of my neighbors' flooding.

Madison County Community Flood Survey- Page 3

11. Is this property in a FEMA-designated floodplain? NOTE: If you were required to purchase flood insurance when you purchased your property, it is in a floodplain.

☐ Yes ☐ No ☐ I don't know.

12. Is your property at this address covered by a flood insurance policy? (Note: Flood insurance is typically not included in a standard home insurance policy).

☐ Yes ☐ No ☐ I don't know.

13. Have you ever made a flood insurance claim?

☐ Yes ☐ No ☐ I don't know.

14. Where do your roof downspouts connect to? (Choose one)

- ☐ They connect to the storm sewers.
☐ They flow out onto my lawn or other ground surface.
☐ They are connected to cisterns, rain barrels, or other rain harvesting storage.
☐ I don't know.
☐ Other (please explain): _____

15. Have you made any improvements to your property to help reduce stormwater or flood impacts? (Select all that apply) NOTE: If you would like to find out more about these or other improvements, visit www.heartlandsconservancy.org/cahokiakreek

- ☐ Installed a rain garden.
☐ Created or enlarged a pond or detention/retention basin.
☐ Installed or enlarged swales and/or ditches.
☐ Installed permeable paving.
☐ Planted native vegetation, buffer strips, or other conservation measures.
☐ Other (please explain): _____

17. How important are the following water issues to you?

	Very Low Importance	Low Importance	No Opinion	High Importance	Very High Importance
A. Clean, safe supplies of drinking water:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Prevention of flood damage to homes, businesses, and property:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Lakes, ponds, and streams suitable for recreation such as fishing, boating, and swimming:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. A healthy watershed that supports a wide variety of plant and animal life:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. Any other comments or questions? _____

Thank you for completing this survey! Your time and input is greatly appreciated.
 Survey responses will be used to help shape the recommendations of Cahokia Creek Watershed Planning.
 Please return this survey by **October 30, 2015** via the enclosed envelope or to:
 Cahokia Creek Survey - Madison County Planning and Development
 157 North Main Street, Suite 254 Edwardsville, IL 62025



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Appendix C - Landowner/Farmer Survey Results

In the spring of 2018, HeartLands Conservancy and Madison County Planning and Development collaborated to mail a survey to over 600 landowners and farmers who own parcels of land greater than or equal to five acres in size in the Indian-Cahokia Creek watershed and the Canteen-Cahokia Creek watershed. The survey was also made available online at www.surveymonkey.com. The goal of the survey was to increase awareness among rural landowners about the types of grants available for BMP implementation assistance following the completion of the watershed plans. The survey included information about the watershed plans, the types of grants available for BMP implementation, and a list of BMPs that may be eligible for grant funding.

Sixty-six people have replied to the survey as of July 2018. A summary of landowner responses is included in the table below.

Table C1. A summary of the 2018 Cahokia Creek Watershed Landowner/Farmer Survey results (as of July 2018).

Which of these issues have you noticed on your land/cropland?		
Soil erosion		61.90%
Gullies getting deeper		50.79%
Loss of topsoil/thin topsoil		26.98%
Ponds/detention basins filling up with sediment		26.98%
Cropland floods		11.11%
Other issues*		36.51%
*Example responses included poor water quality, invasive species, and increased runoff.		
Which of these issues have you noticed in the creeks and streams on or adjacent to your land?		
Muddy water		67.27%
Unstable streambanks		49.09%
Overtopping/stream flooding out of its banks		49.09%
Streams getting deeper		43.64%
Logjams		40.00%
Other issues*		12.73%
*Example responses included flooding on property, clogged drainage canals, and none.		
Which of the following is present on your land?		
Forested areas		77.19%
Steep slopes		59.65%
Highly erodible soil		47.37%
Wetlands/marsh/swamp/bog		26.32%
Floodplain		22.81%
Which of the following program areas are you participating in? And which program(s) might you be interested in participating in?		
<i>Program:</i>	<i>Participating in:</i>	<i>Interested in:</i>
Agricultural Conservation Easement Program	0%	100%
Conservation Reserve Program	9.09%	90.91%
Conservation Stewardship Program	14.29%	90.48%
Environmental Quality Incentives Program	0%	100%
Streambank Stabilization and Restoration Program	3.85%	96.15%
EPA 319 Grant	0%	100%

Table C1, continued. A summary of the 2018 Cahokia Creek Watershed Landowner/Farmer Survey results (as of July 2018).

<i>If you are aware of any or all of the programs above, what concerns prevented you from applying/participating?</i>	
My costs would be too high	31.91%
The problems on my land aren't that severe	29.79%
Too much time and paperwork to enroll	27.66%
I didn't want to take cropland out of production	8.51%
The project/BMP wouldn't have a big enough impact	0%
Other* *Example responses included not knowing about opportunities, enrollment denial, and it not being worth the hassle for smaller properties.	44.68%
<i>What type(s) of projects might you be interested in implementing on your land?</i>	
Streambank/stream channel restoration	40.35%
Pond	35.09%
Pollinator habitat	33.33%
Cover crops	29.82%
Grassed waterways	22.81%
Filter strips	19.30%
Riparian buffer	15.79%
Water and sediment control basins	14.04%
Conservation tillage	14.04%
Wetland/wetland restoration	10.53%
Terraces/contour farming	10.53%
Other* *Example responses included riprap, tree/shrub establishment, and raingardens or bioswales.	59.65%

At the end of the survey, landowners were given the opportunity to note any additional issues on their land that they would like assistance in resolving. Examples given included invasive species management, community education/outreach about watershed issues (e.g., fertilizer use), and BMP recommendations. Landowners were also asked whether they would like HeartLands Conservancy and Madison County to follow up about the survey and potential project funding, to which 69.09% replied yes.

Appendix D - Critical Areas

This appendix includes descriptions of the source data used to delineate Critical Areas, and maps of each Critical Area. Maps of Best Management Practices (BMPs) as outputs from the Agricultural Conservation Planning Framework (ACPF) are also included.

How locations were identified

Several sources of information were used to identify Critical Area locations. These include wetland restoration ranking values from the Missouri Resource Assessment Partnership (MoRAP) and results from the U.S. Department of Agriculture (USDA) ACPF tools.

Wetland restoration ranking values

Wetland restoration ranking values and wetland importance values were created for the watershed by the MoRAP. Several layers of data—especially topography, soil type, and land cover—were used to create maps of existing wetlands, which it is highly important to protect, and areas which were formerly wetlands which it would be highly beneficial to restore.

Agricultural Conservation Planning Framework (ACPF)

The ACPF is a set of GIS-based tools developed by the USDA Research Service (USDA-ARS) that can substantially enhance watershed planning capabilities on agricultural land. The ACPF is currently available for Minnesota, Iowa, and Illinois, and uses new high-resolution data sources, such as soils, land use, crop rotations, and elevation (from LiDAR). The tools determine slope, flow accumulation, and other factors by HUC12, allowing analysis at watershed and field scales. Among the outputs of the tools are possible beneficial locations for different types of practices placed in fields, at field edges, and in riparian zones. No recommendations are made. The aim is to create a planning resource to use in watershed planning and consultation with landowners.

The BMPs recommended by the model include grassed waterways, contour buffer strips, drainage water management, appropriate riparian vegetation, and nutrient management wetlands. Many of the tools within the ACPF have parameters that can be adjusted by the user to change their output. For example, the user can define the width of contour buffer strips generated and the minimum distance between buffer strips. Table D.1 shows the user-defined or modifiable values used for this assessment.

Table D.1. Values entered into ACPF tools to generate BMP locations for user-defined or modifiable parameters.

ACPF BMP	Values used for user-defined or modifiable parameters
Edge-of-Field Bioreactors	No modifiable parameters
Contour buffer strips	Buffer strip width: 15 feet Minimum distance between buffer strips: 90 feet (default)
Drainage water management	Tile-drained agricultural fields where a 1 meter (3.3 ft) contour interval comprises more than 30% of the field (representing the addition of 2 control gate structures on the tile drain), with a default minimum of 20 acres
Grassed waterways – SPI Threshold	Drainage threshold: >6 acres Standard deviations: 2
Nutrient Removal Wetlands	Suggested spacing distance: 250 meters (default) Impoundment height: 0.9 meters (default) Buffer height: 1.5 meters (default) Road file used to avoid roads: Madison County roads shapefile
WASCOBs	Embankment height: 1.5 meters (default) Road file used to avoid roads: Madison County roads shapefile WASCOB basin depth raster (optional): left blank
Riparian function assessment	No modifiable parameters

The data analysis capabilities of the model also allow for further, independent assessment of different BMPs. Planning scenarios can be generated from the results and compared/evaluated in a simple way without additional input.

The results of the ACPF modeling were combined into one map in ArcMap. They were printed on 30 x 40 inch zoomed-in maps covering the whole watershed. These maps will be useful for the county Soil and Water Conservation Districts and Natural Resources Conservation Service (NRCS) staff to explore BMP options with farmers interested in implementing a soil conservation or waterway protection project. The ACPF results were also useful in setting the numeric targets for this watershed plan.

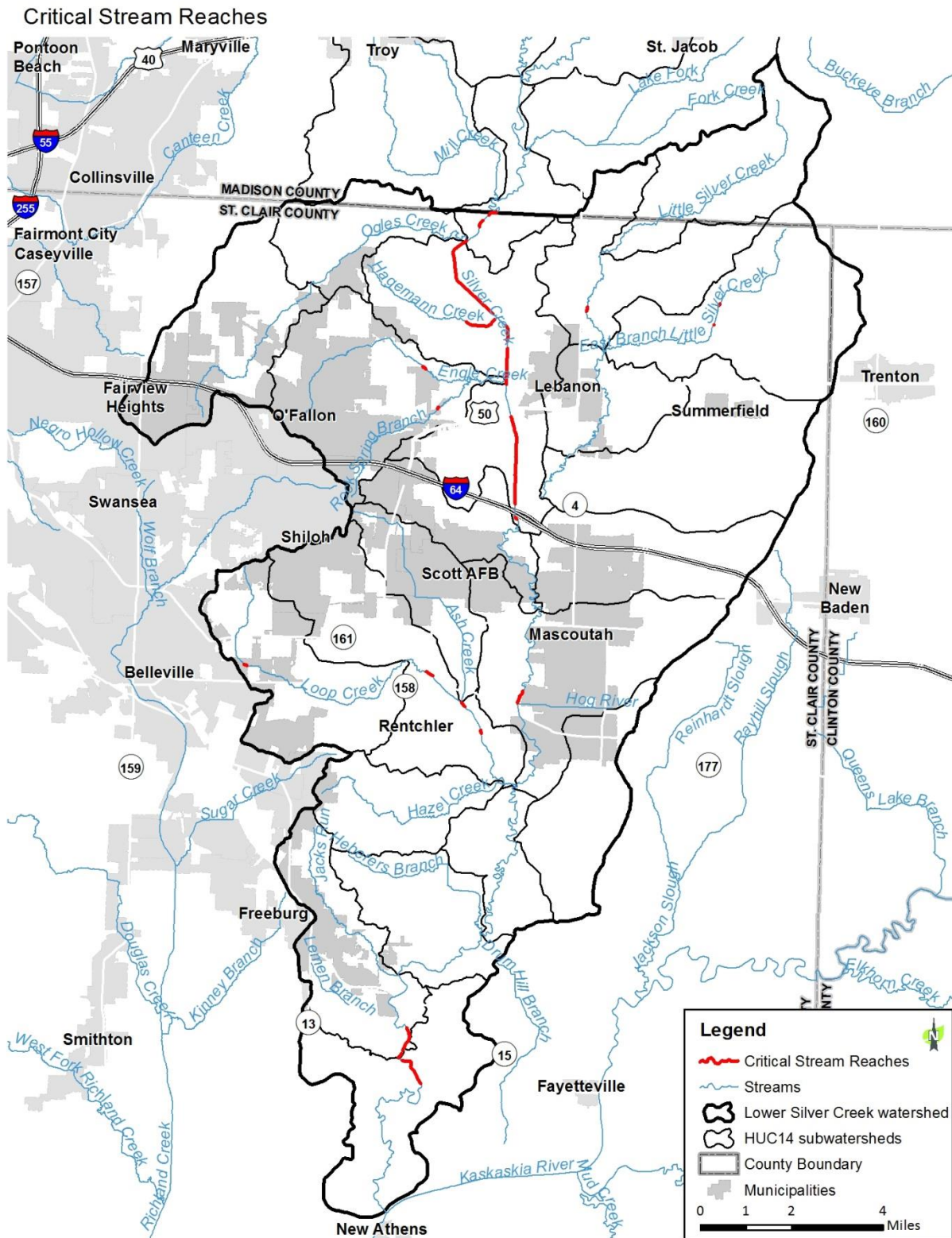
The ACPF is focused on reducing runoff and preventing nutrient pollution from farmlands. It focuses on the value of wetlands as nutrient sinks and for flood control (as compared with the MoRAP assessment, which considers wetland value as potential for restoration). Together, the ACPF and the MoRAP wetlands mitigation importance values will overlap in several places, showing wetlands of extremely high restoration and protection importance.

The following table (Table D.2) and maps show the ACPF results for several BMPs.

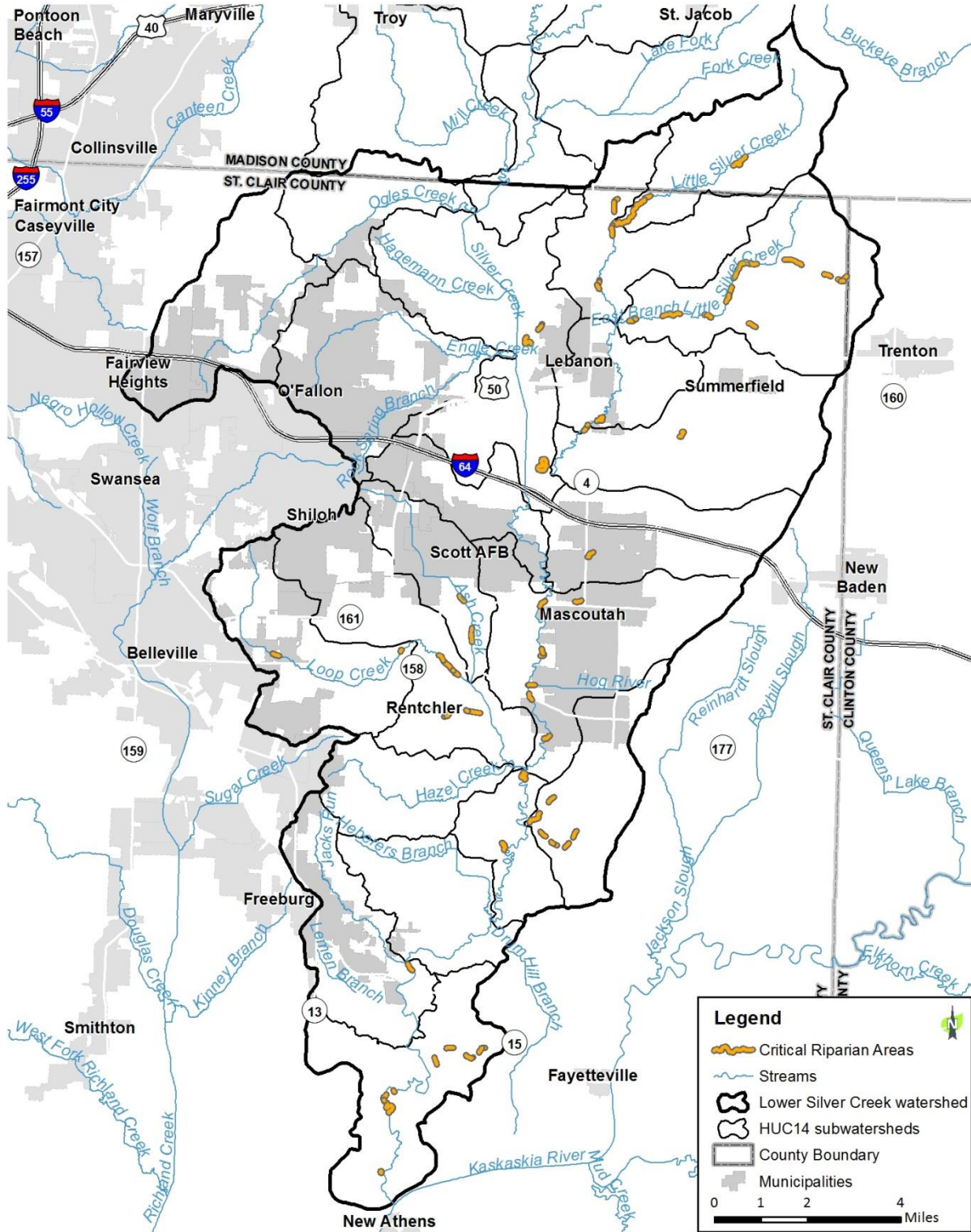
Table D.2. Summary data for the ACPF results by HUC14.

ACPF Results	HUC14 (last three digits)										
	101	102	103	104	201	202	203	301	302	303	TOTAL
# bioreactors	5	4	0	2	5	2	0	3	12	5	38
Total area bioreactors (sq m)	5,625	4,182	0	2,172	4,963	1,432	0	1,713	13,315	4,228	37,630
# contour buffer strips	3	0	11	0	0	0	0	0	0	0	14
Total area contour buffer strips (sq m)	3,903	0	12,732	0	0	0	0	0	0	0	16,635
Grass waterways total length (m)	4,796	1,547	3,614	874	7,358	6,856	1,233	7,039	397	4,927	38,642
# drainage management polygons	38	21	4	13	13	5	1	12	36	25	168
Area drainage management fields (sq m)	6,037,910	3,731,202	473,482	1,691,586	1,193,823	343,983	113,312	1,254,525	3,383,172	2,039,616	20,262,610
# nutrient removal wetlands	4	6	12	4	4	4	10	0	2	17	63
Nutrient removal wetlands area (wetland & buffers) (sq m)	28,328	64,750	186,155	28,328	52,609	44,515	97,125	0	343,983	461,342	1,307,135
Wetland area only (sq m)	12,141	32,375	93,078	20,234	20,234	24,281	48,562	0	76,890	101,171	428,967
Area draining to nutrient removal wetlands (sq m)	26,337	61,554	182,797	31,363	54,498	41,896	100,043	0	342,711	461,593	1,302,792
Riparian area: # Critical Zone segments (CZ)	3	0	0	1	0	0	0	0	0	0	4
Riparian area: # Multi Species Buffer (MSB)	17	4	1	2	0	0	1	6	3	5	39
Riparian area: # Stiff Stemmed Grasses (SSG)	3	2	22	6	24	18	19	17	7	24	142
Riparian area: # Deep Rooted Vegetation (DRV)	49	9	1	4	0	0	0	18	29	18	128
Riparian area: # Stream Bank Stabilization (SBS)	16	7	56	42	38	30	25	84	50	71	419
# WASCObS	0	0	6	0	0	0	0	0	0	0	6
Area WASCObS basins when filled (sq m)	0	0	20,234	0	0	0	0	0	0	0	20,234

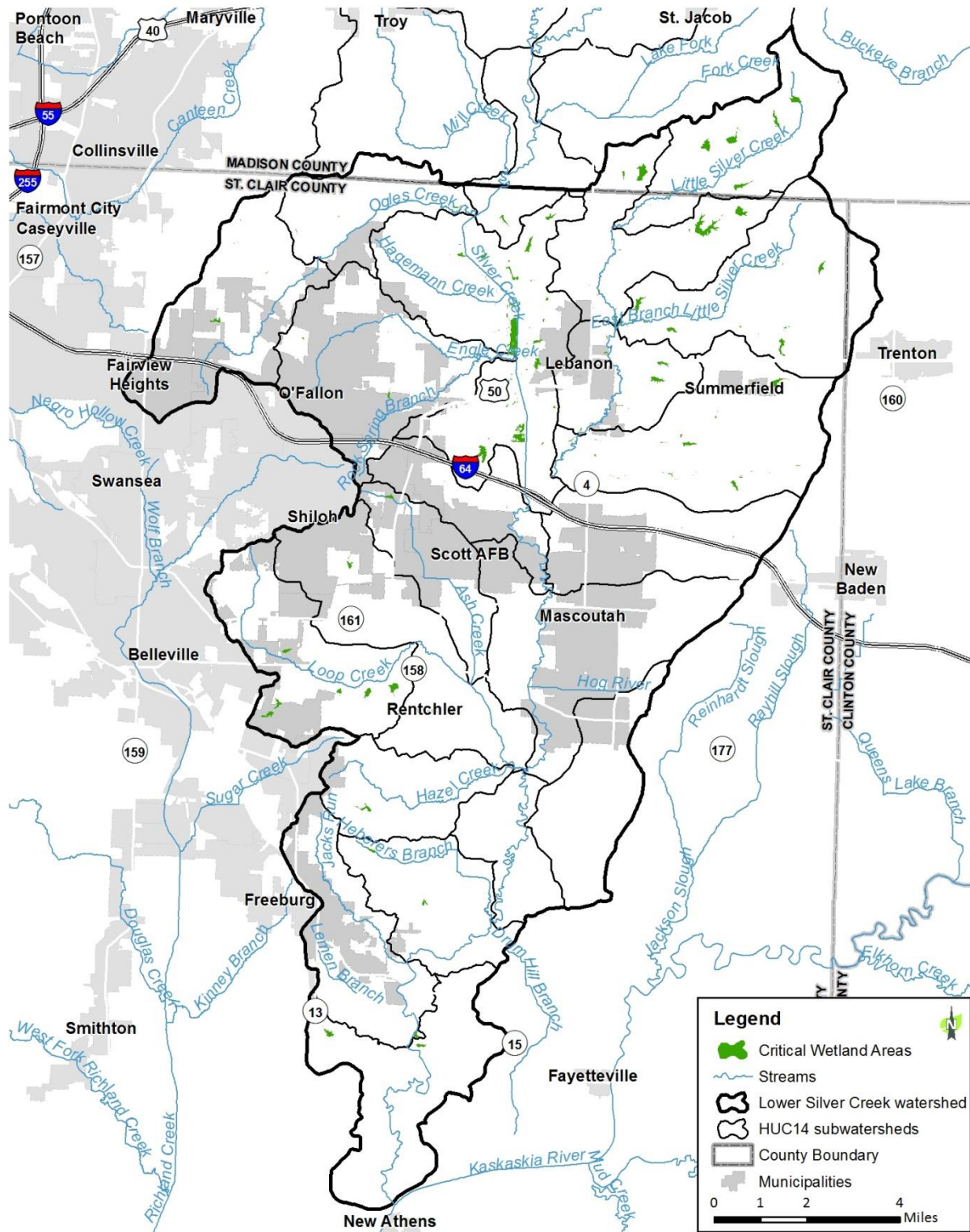
Critical Areas Maps – watershed-wide



Critical Riparian Areas



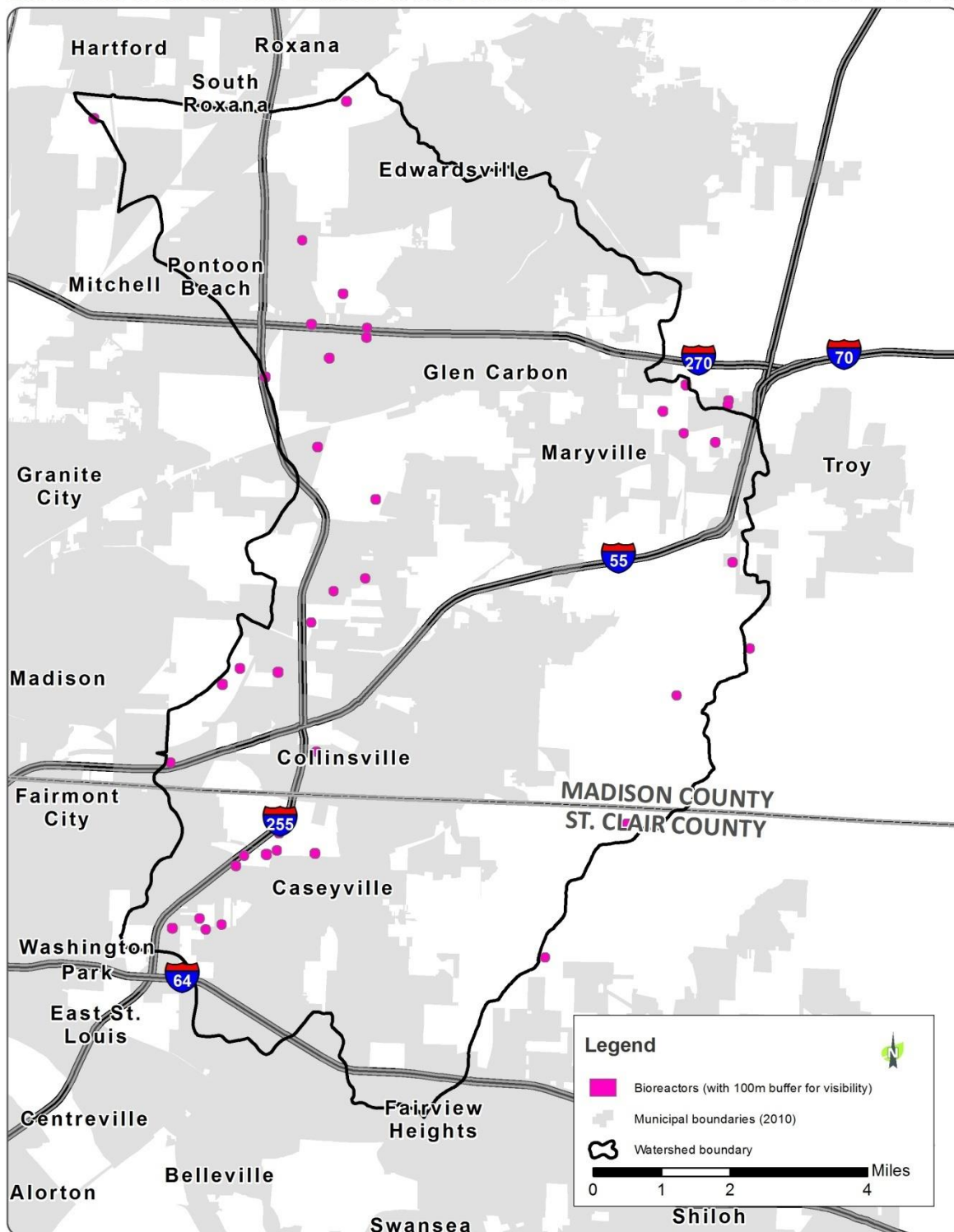
Critical Wetland Areas



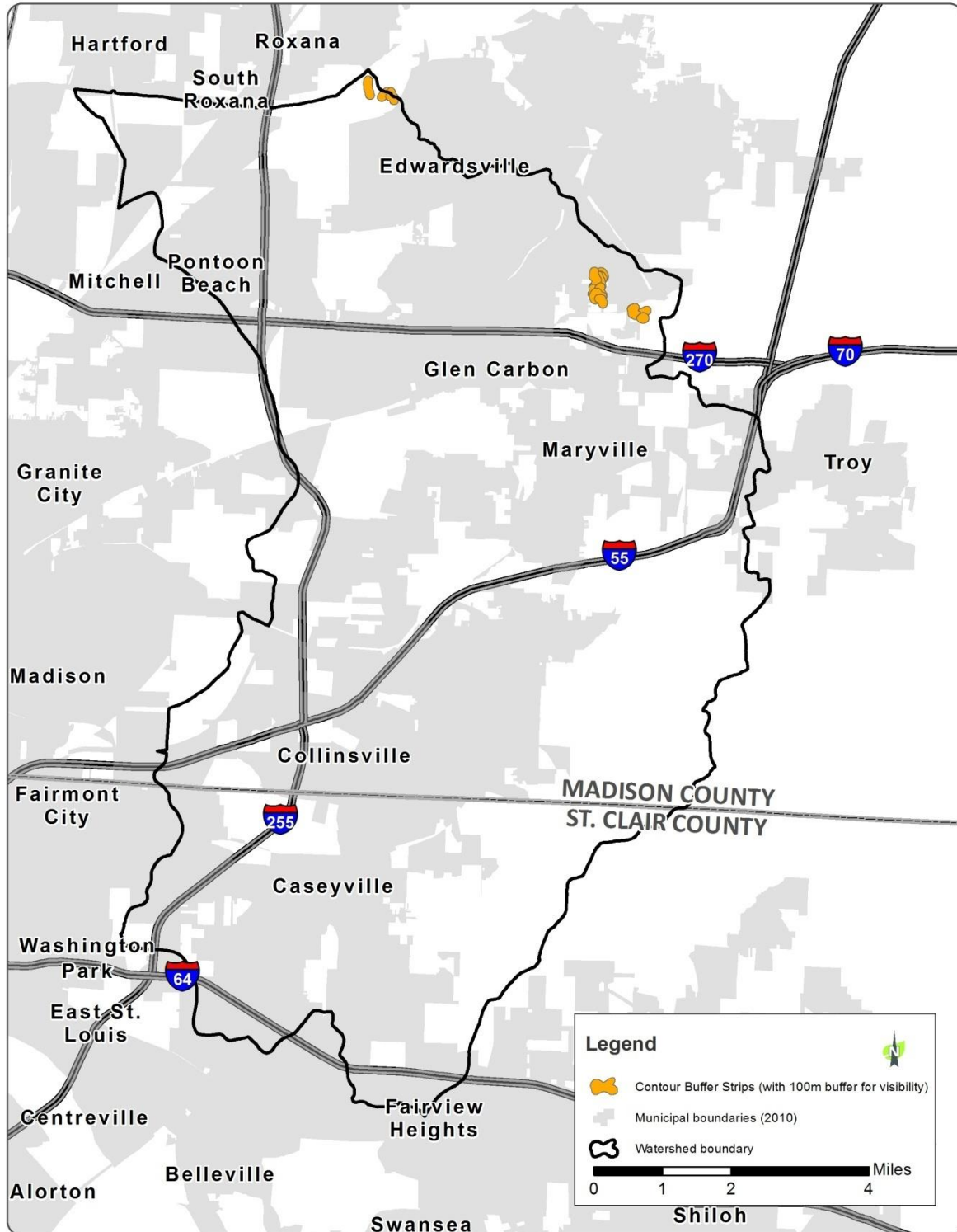
Agriculture Conservation Planning Framework (ACPF) output maps – BMPs

Bioreactors in the Canteen-Cahokia Creek Watershed

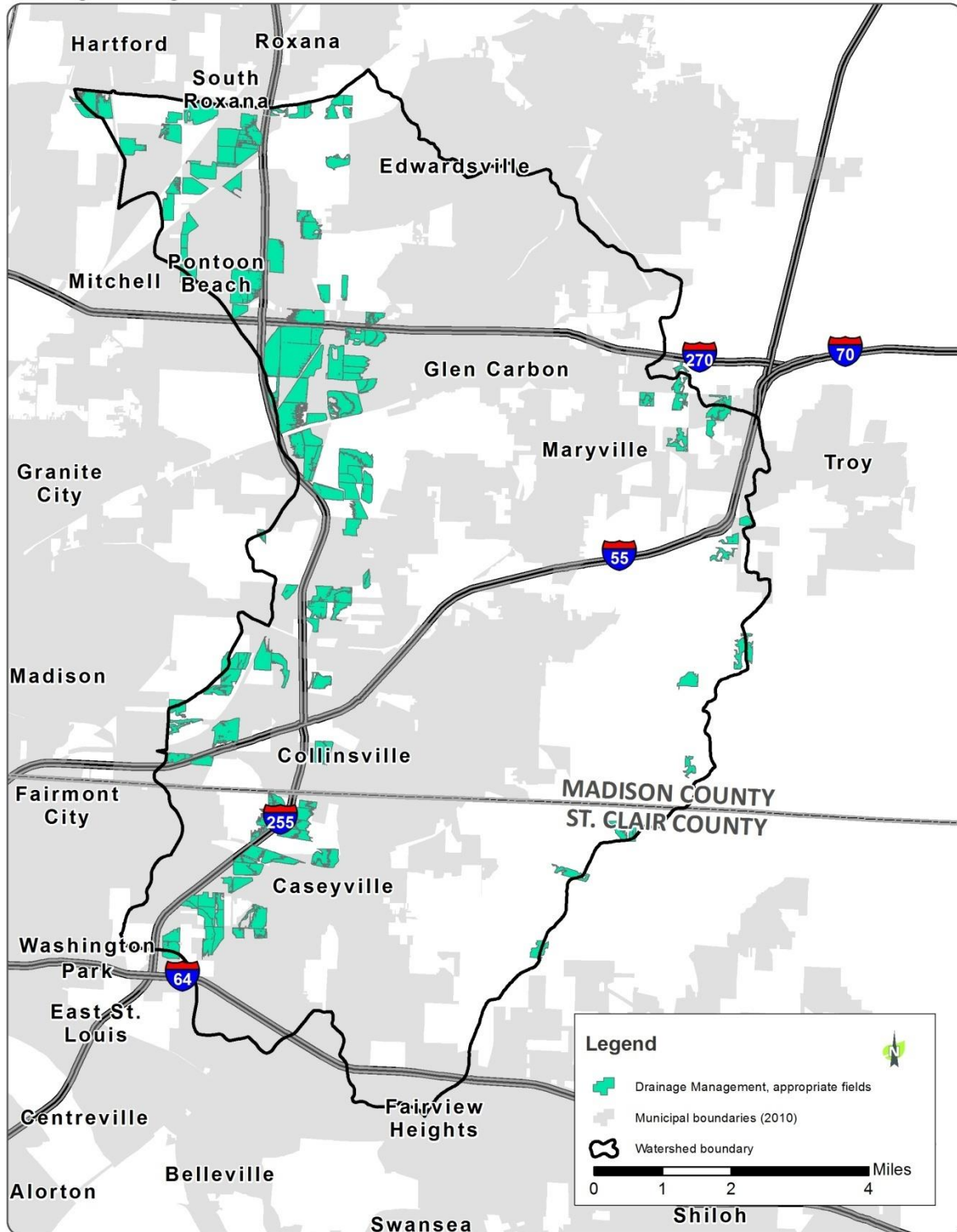
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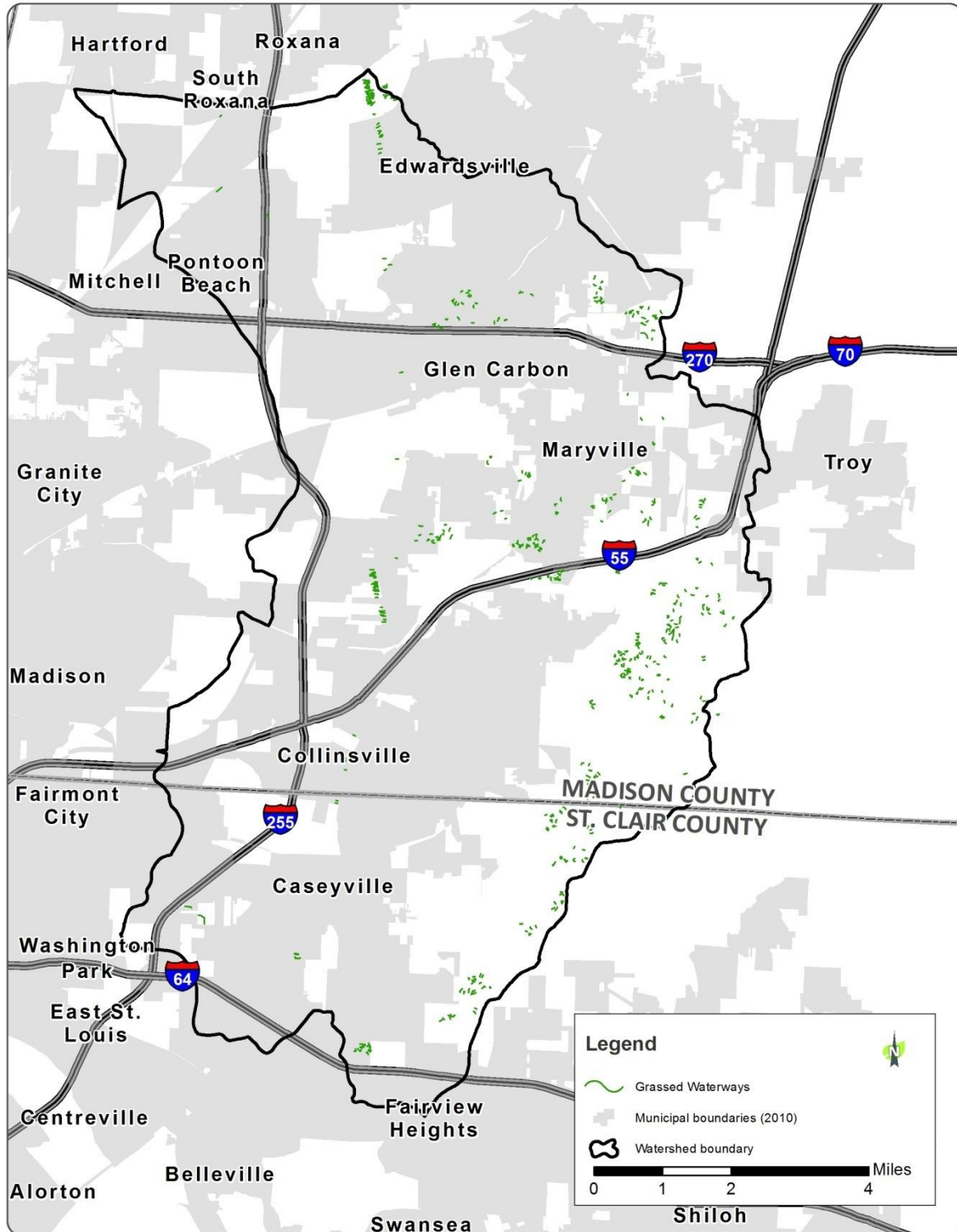
Contour Buffer Strips in the Canteen-Cahokia Creek Watershed

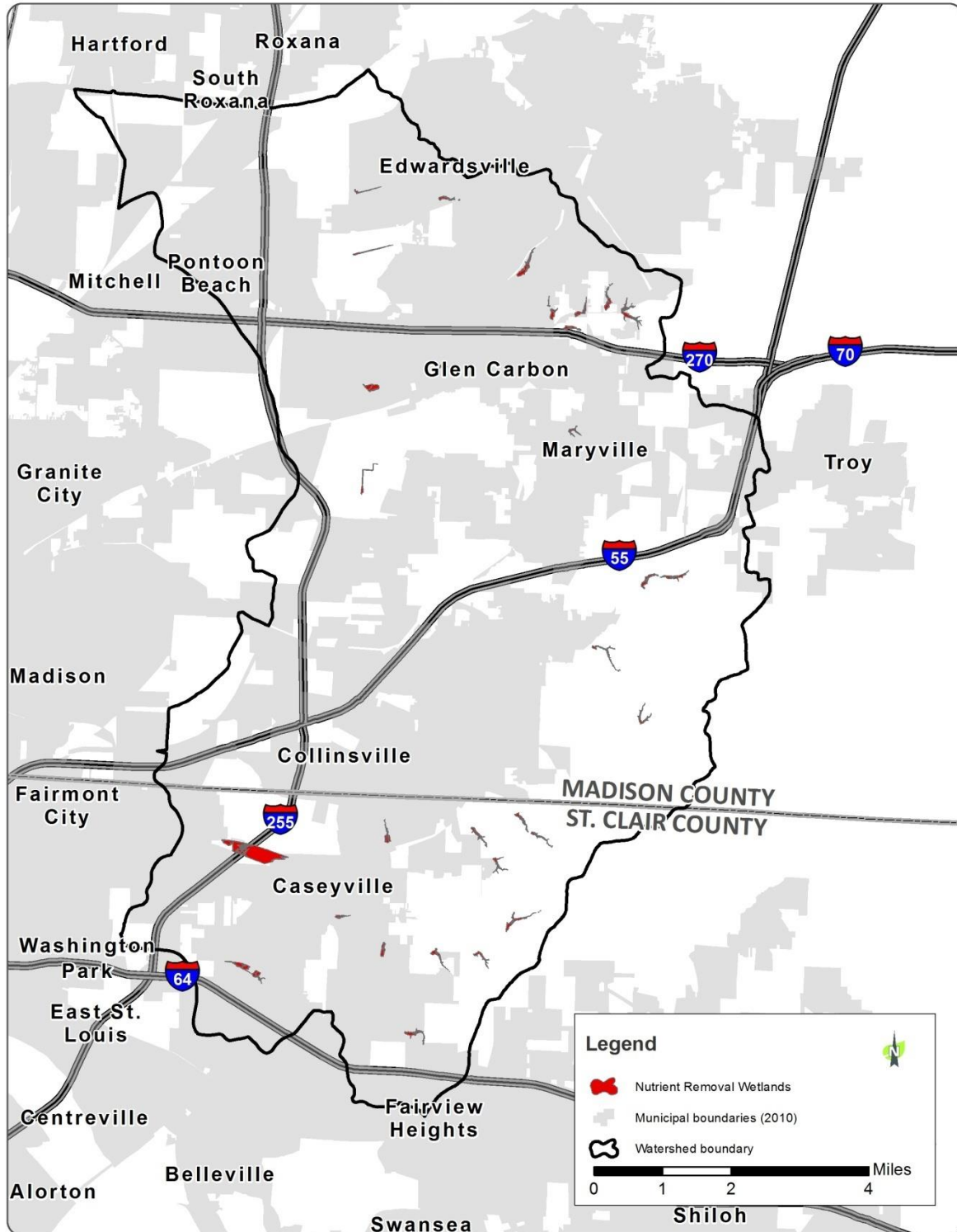


Drainage Management in the Canteen-Cahokia Creek Watershed

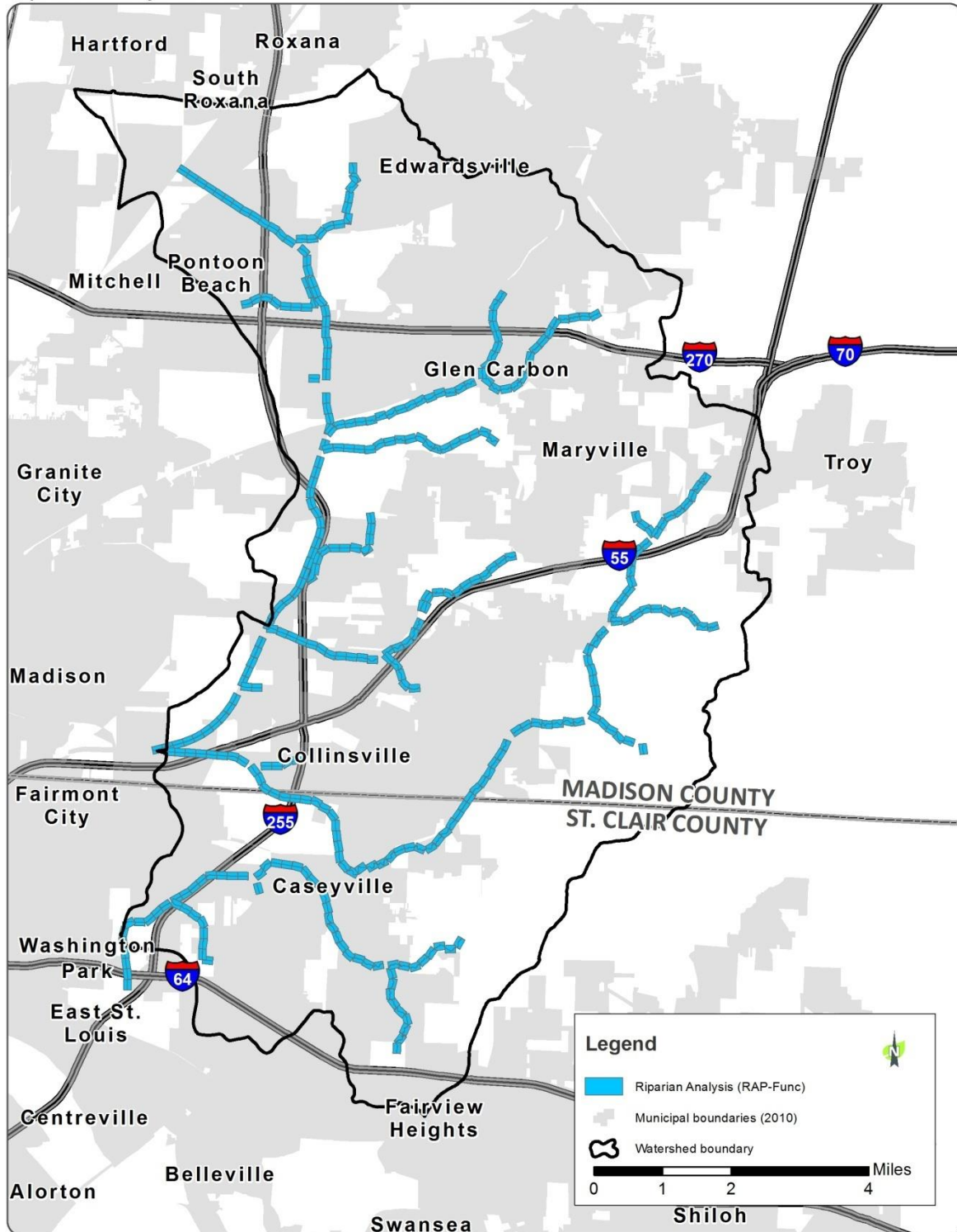


Grassed Waterways in the Canteen-Cahokia Creek Watershed

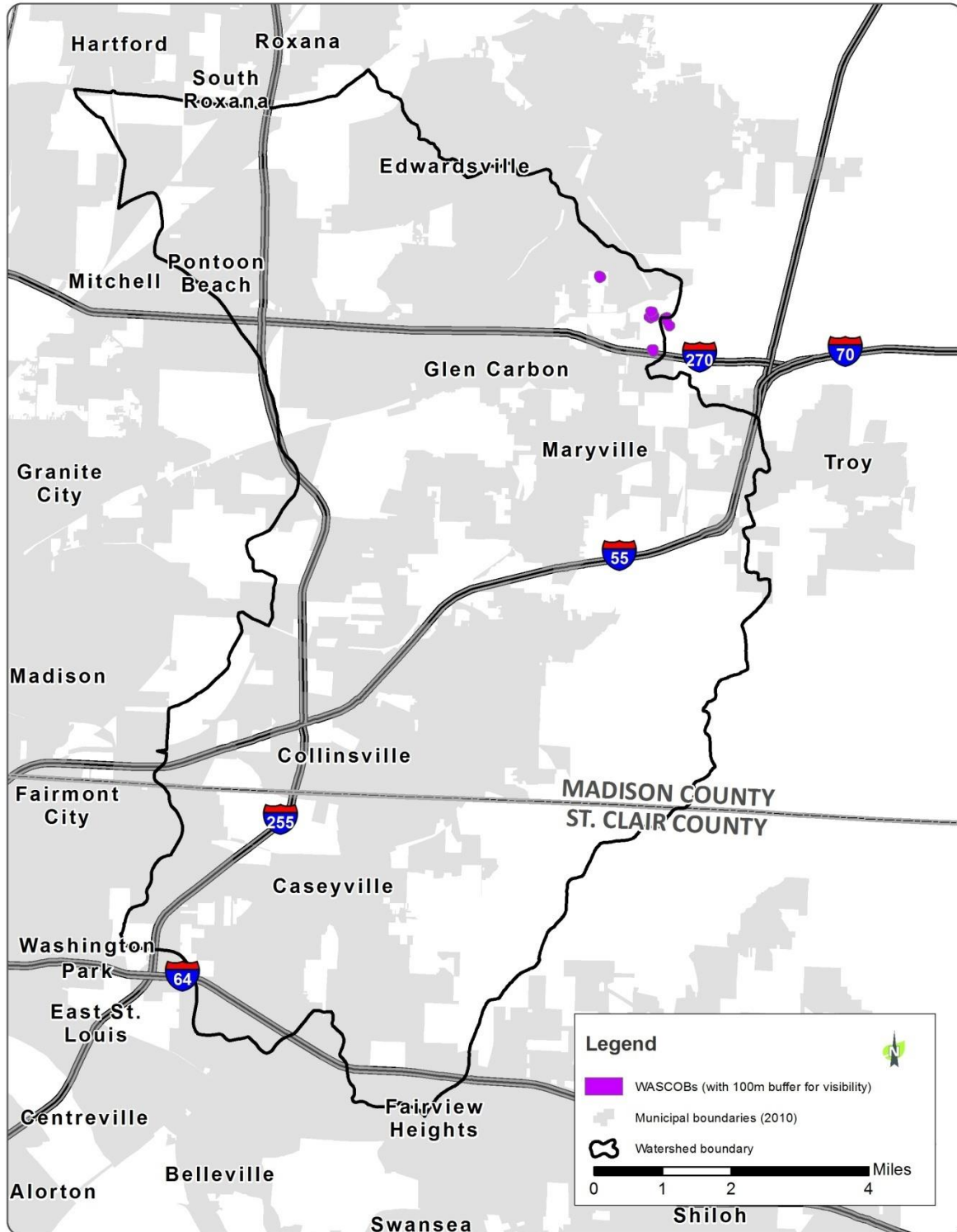




Riparian Analysis in the Canteen-Cahokia Creek Watershed



Water and Sediment Control Basins (WASCOBs)
in the Canteen-Cahokia Creek Watershed



Appendix E - Management Measures

Quantifying the impacts of potential management measures

Quantifying pollutant reduction

Several sources were used to identify typical pollutant and flow reduction associated with each Best Management Practice (BMP) recommended, where possible. These include:

- Andreas Consulting cost for one large flushing and treatment system on dairy farm, 2016. Also see this NRCS factsheet for more detail - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012400.pdf
- Green Values National Stormwater Management Calculator, http://greenvalues.cnt.org/national/cost_detail.php
- Illinois Nutrient Loss Reduction Strategy (2015)
- Illinois Urban Flooding Awareness Act report, 2015, https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
- International Stormwater BMPs Database Pollutant Category Summary Statistical Addendum: Total Suspended Solids, Bacteria, Nutrients, and Metals, www.bmpdatabase.org, linked to by USEPA
- Iowa Nutrient Reduction Strategy, Table 2 and Table 3
- Long Run Creek Watershed Plan, Table 40, Table 41
- Low Impact Development Urban Design Tools website, <https://www.lid-stormwater.net/>
- Minnesota Department of Transportation - Table 2.2 in the report: "Comparing Properties of Water Absorbing/Filtering Media for Bioslope/Bioswale Design," 2017 <http://www.dot.state.mn.us/research/reports/2017/201746.pdf>
- National Pollutant Removal Performance Database, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Pigeon Creek Watershed Plan, Table 67 (Waste Basin Treatment System)
- Southwestern Illinois Resource Conservation District, (SWIRCD), Thinking Outside the Pipe, seen in Lower Meramec Watershed Plan, Table 20
- Spreadsheet Tool for Estimating Pollutant Loads (STEPL) 4.4 BMP calculator, available at [http://it.tetrattech-ffx.com/steplweb/models\\$docs.htm](http://it.tetrattech-ffx.com/steplweb/models$docs.htm)
- Stormwater Management Center fact sheets, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- USEPA Region 5 Load Estimation Model Users Manual, Figure E6-2

Quantifying the costs of management measures

The implementation costs of the management measures recommended were assembled from several sources, including the following primary sources:

- Andreas Consulting cost for one large flushing and treatment system on dairy farm, 2016. Also see this NRCS factsheet for more detail - https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012400.pdf

- EPA Urban Stormwater Preliminary Data Summary. Costs and Benefits of Stormwater BMPs, https://www3.epa.gov/npdes/pubs/usw_d.pdf
Further information available at https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012173.pdf
- Green Values National Stormwater Management Calculator, http://greenvalues.cnt.org/national/cost_detail.php
- Illinois EPA Lake Notes publication, <http://www.epa.state.il.us/water/conservation/lake-notes/lake-dredging.pdf>
- Illinois Nutrient Reduction Strategy (2015), Page B-3, B-4, B-7
- Illinois Urban Flooding Awareness Act report, 2015, https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
- International Stormwater BMP Database Pollutant Category Summary Statistical Addendum: TSS, Bacteria, Nutrients, and Metals, www.bmpdatabase.org, linked to by USEPA
- Iowa Nutrient Reduction Strategy, Table 2 and Table 3
- Iowa Rain Garden Design and Installation Manual, 2008 https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf
- Iowa State University, 2011, 'Woodchip Bioreactors for Nitrate in Agricultural Drainage,' page 2
- Long Run Creek Watershed Plan, Table 41 and Table 42
- Low Impact Development Urban Design Tools website, <https://www.lid-stormwater.net/>
- National Pollutant Removal Performance Database, seen in Lower Meramec Watershed Plan, Table 20 and Table 21
- Natural Resources Conservation Service (NRCS) Practice Component List FY2014
- Olympia WA Pipe Evaluation and Replacement Options, <http://olympiawa.gov/city-utilities/storm-and-surface-water/policies-and-regulations/~media/Files/PublicWorks/Water-Resources/SSWPAAppendix%20J.ashx>
- Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion, 2016, https://www.chesapeakebay.net/documents/Urban_Tree_Canopy_EP_Report_WQGIT_approved_final.pdf
- Southwestern Illinois Resource Conservation District (SWIRCD), Thinking Outside the Pipe, seen in Lower Meramec Watershed Plan, Table 20
- Stormwater Management Center fact sheets, seen in Lower Meramec Watershed Plan, Table 20 & Table 21
- Technical estimates from Midwest Streams Inc and Andreas Consulting Inc., 2017
- USEPA BMPs page, 2015, Ferguson et al (1997)
- USEPA BMPs webpage, 2015, now archived at <https://castlehillstx.files.wordpress.com/2015/07/dry-detention-ponds--best-management-practices--us-epa.pdf>
- Water Environment Research Federation Low Impact Development Best Management Practices Whole Life Cost Model, 2007

Since these costs were assembled, an additional valuable resource for costs was identified: the Green Values National Stormwater Management Calculator, available online at http://greenvalues.cnt.org/national/cost_detail.php. This site includes information on construction costs, maintenance costs, and component lifespan.

The final costs used, and their sources, are shown in Table E.1. The costs were adjusted for inflation to 2018 dollars using the conversion rates given in Table E.2 from www.usinflationcalculator.com.

Table E.1. Costs of recommended BMPs and sources of cost data.

Management measure	Cost	Cost unit	Cost data source(s)	URL
Animal waste/storage treatment system	\$260,000	/acre	2016 Andreas Consulting cost for one large flushing and treatment system on dairy farm, 2016. Also see this NRCS factsheet for more detail.	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012400.pdf
Bioreactors (denitrifying)	\$157.81	/acre drained	2011 Iowa State University PDF, 2011, 'Woodchip Bioreactors for Nitrate in Agricultural Drainage'. Cost is \$7k to \$10k for treating 30 to 100 acres, so average of \$8,500 per bioreactor treating an average of 65 acres, so $8,500/65 = \$130.76/\text{acre}$ in 2011, adjusted for inflation is \$142.30 in 2017.	https://store.extension.iastate.edu/product/13691
Comprehensive Nutrient Management Plans (CNMPs)	\$54.97	/acre planned for	2017 Mike Andreas (Andreas Consulting), 2017. Further information available at the NRCS webpage (\$32 average annual per animal or \$6,748 average annual cost of implementation)	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_012173.pdf
Conservation tillage	\$58.64		2017 Andreas Consulting, professional estimate	
Contour buffer strips	\$175.11	/acre	2015 Iowa State University fact sheet, cost example table on page 2, sum of costs except foregone income cost	http://www.nutrientstrategy.iastate.edu/documents
Cover crops	\$30.54	/acre	2015 Illinois Nutrient Reduction Strategy, page B-6 under "Planting Cover Crops"	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Grassed waterways	\$8,653	/acre	2017 Andreas Consulting, professional estimate	
Nutrient Management Plan (NMP)	\$13.82	/acre	2017 Andreas Consulting, professional estimate	
Ponds	\$15,270	/acre	2017 Andreas Consulting, professional estimate	
Riparian buffers	\$52.65	/acre	2015 Illinois Nutrient Reduction Strategy, page B-3 - B-4 under "Installing Stream Buffers", cost of planting grass only	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Terrace	\$3.36	/linear foot	2017 Andreas Consulting, professional estimate	
Water and sediment control basin (WASCOB)	\$366.48	/acre	2017 Andreas Consulting, professional estimate	
Wetlands	\$13,162.50	/acre	2015 Illinois Nutrient Reduction Strategy, page B-7, "Constructing Wetlands", upfront cost (no design cost and not amortized)	http://www.epa.illinois.gov/Assets/iepa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf
Forest stand improvement	\$356.30	/acre	2017 Andreas Consulting, professional estimate	
Bioswales	\$18	/acre	2007 Water Environment Research Federation Low Impact Development Best Management Practices Whole Life Cost Model, as listed in Green Values National Stormwater Management Calculator	http://greenvalues.cnt.org/national/cost_detail.php

Dry detention basins, new	\$43,804.80	/acre	2015 USEPA BMPs webpage, now archived at the following link	https://castlehillstx.files.wordpress.com/2015/07/dry-detention-ponds-_best-management-practices-_us-epa.pdf
Wet detention basins, new	\$48,122.10	/acre	2015 USEPA BMPs webpage, no longer available	http://water.epa.gov/polwaste/npdes/swbmp/Wet-Ponds.cfm
Detention basin retrofits (native vegetation buffers, etc.)	\$15,236.94	/acre	2014 Long Run Creek Watershed-Based Plan, Table 41	http://www.longruncreek.org/watershedplan
Detention basin maintenance (dredging, mowing, burning, invasives, etc.)	\$992.09	/acre	2014 Long Run Creek Watershed-Based Plan, Table 42	http://www.longruncreek.org/watershedplan
Pervious pavement	\$100,557.50	/acre	2002, LID Stormwater Center, seen in Lower Meramec Watershed Plan, Table 21	http://www.ewgateway.org/environment/waterresources/Watersheds/LowerMeramec/lowermeramec.htm
Rain gardens	\$9.27	/sq. ft.	2008, Iowa Rain Garden Design & Installation Manual - midway value between estimates on page 15, also used in Upper Silver Creek plan from 4 cost sources, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_007154.pdf
Rainwater collection	\$236.93	per barrel/s mall cistern	2015, Low Impact Development Urban Design Tools website	https://www.lid-stormwater.net/
Single property flood reduction strategies	\$1,053	per property	2015 Approximately, based on 2015 Illinois Urban Flooding Awareness Act report	https://www.dnr.illinois.gov/waterresources/documents/final_ufaa_report.pdf
Storm drain system cleaning and expansion	\$80.55	/linear foot	2015 US EPA BMPs page, Ferguson et al (1997) \$3.90 estimate for cleaning, added to \$72.60 2001(?) Olympia WA Pipe Evaluation and Replacement Options	http://olympiawa.gov/city-utilities/storm-and-surface-water/policies-and-regulations/~media/Files/PublicWorks/Water-Resources/SSWPAAppendix%20J.ashx
Tree planting	\$2.78	/sq. ft. tree canopy	Center for Neighborhood Technology mid value estimate PER TREE, MULTIPLIED BY 114 sq ft/tree at 10 years old (from Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion report)	http://greenvalues.cnt.org/national/cost_detail.php https://www.chesapeakebay.net/documents/Urban_Tree_Canopy_EP_Report_WQGIT_approved_final.pdf
Urban filter strips	\$2.04	sq. ft.	1997 EPA Urban Stormwater Preliminary Data Summary. Costs and Benefits of Stormwater BMPs. Cost given in Table 6.1 is by cubic ft. Assumes 6 inches of storage in the filter strip. The [highest] cost assumes that sod was used to establish the filter strip. Adapted from SWRPC (1991). https://www3.epa.gov/npdes/pubs/usw_d.pdf	https://www3.epa.gov/npdes/pubs/usw_d.pdf

Lake dredging	\$27	/cubic yard dredged	1998 Illinois EPA Lake Notes publication, giving estimates of between \$5 and \$30 per cubic yard dredged	http://www.epa.state.il.us/water/conservation/lake-notes/lake-dredging.pdf
Logjam removal	\$31.20	/linear foot	2016 Midwest Streams, professional estimate	
Shoreline stabilization	\$83.48	/foot	2017 Andreas Consulting, professional estimate	
Streambank & channel restoration	\$78	/linear foot	Midwest Streams, professional estimate	

Table E.2. Inflation rates used to convert BMP costs to 2018 U.S. dollars from www.usinflationcalculator.com, accessed May 2018.

Inflation rates to convert to 2018 dollars (usinflationcalculator.com)	
1997	57.0%
1998	54.3%
2001	41.0%
2002	38.7%
2007	20.8%
2008	15.9%
2010	15.4%
2011	10.9%
2012	8.7%
2014	5.4%
2015	5.3%
2016	4.0%
2017	1.8%

Descriptions of Management Measures (Best Management Practices, or BMPs)

Programmatic Management Measures

Conservation Development

Conservation Development is a design method that attempts to mitigate the environmental impacts of urbanization by conserving natural areas and their functions. In a Conservation Development subdivision, the aim is to allow for the maximum number of residences permitted under zoning laws, while disturbing as little land area as possible. This is especially important in areas containing floodplains, groundwater recharge areas, wetlands, woodlands, and streams. Developers assess the natural topography, natural drainage patterns, soils and vegetation on the site in the design stage. The result is compact, clustered lots surrounding a common open space.

The open space is typically preserved or restored natural areas that maintain natural hydrological processes and are integrated with newer natural stormwater features and recreational trails. This allows residents to feel like they have larger lots because most lots adjoin the open space. Conservation Development can also be used to integrate agricultural land uses harmoniously into the subdivision design.

The steps below are generally followed when designing a Conservation Development site:

1. Identify all natural resources, conservation areas, open space areas, physical features, and scenic areas and preserve and protect these areas from negative impacts from the development.
2. Locate building sites to take advantage of open space and scenic views by requiring smaller lot sizes or cluster housing in a way that protects the development rights of the property owner and maximizes the number of occupancy units permitted by zoning.
3. Design the transportation system. Roads should provide access to building sites, allow movement throughout the site and onto adjoining lands, and should not cross sensitive natural areas. Street design focuses on narrower widths, infiltration opportunities, eliminating curbs and gutters, adjusting the vehicular level of service (LOS), creating LOS for other modes of transportation, and designing connected street networks to support multiple uses.
4. Prepare engineering plans to show how each building site can be served by essential public utilities.

Conservation Development also provides provisions for long-term and permanent resource protection. Mechanisms such as conservation easements and transfer of development rights can ensure that measures protecting the open space are more than just temporary.

The St. Clair County Stormwater Control Code includes measures to protect the landscape from erosion, by avoiding areas of steep slopes (greater than 3:1) and retaining existing natural watercourses, lakes, ponds, sinkholes, and wetlands wherever possible.¹

33-4-47 SOIL EROSION AND SEDIMENT CONTROL.

The following principles shall apply to all development or redevelopment activities within the County and to the preparation of the submissions required under this Code:

(A) Development or redevelopment shall be related to the topography and soils of the site so as to create the least potential for erosion. Areas of steep slopes greater than three to one (3:1) where high cuts and fills may be required are to be avoided wherever possible, and natural contours should be followed as closely as possible.

(B) Natural vegetation shall be retained and protected wherever possible. Areas immediately adjacent to natural watercourses, lakes, ponds, sinkholes, and wetlands are to be left undisturbed wherever possible.

Many communities' zoning ordinances do not yet permit Conservation Development design, because of code requirements for features such as minimum lot sizes, setbacks, and frontage distances. These ordinances should be amended to allow for Conservation Development design.

Federal and state programs

Federal and state agricultural easement and working lands programs such as the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program (CREP), the Environmental Quality Incentives Program (EQIP), and the Agricultural Conservation Easement Program (ACEP) are designed to recompense farmers and landowners for practices that protect soil and water health. More information on these programs is available in Appendix E, Funding Sources.

Financial support for stormwater infrastructure

Stormwater infrastructure, including green infrastructure, does not have a dedicated funding mechanism in many of the communities in the watershed. Maintenance and replacement of ageing infrastructure is a significant concern for these communities, and infrastructure failures such as pipe bursts can end up costing them more than timely repairs and replacement would have cost.

Consistent funding at an appropriate level enables communities to create stormwater management programs that reduce urban flood risk and improve water quality. There are several policy options that assign dedicated funding for stormwater infrastructure that prevents flooding and allows infiltration. With all of these options, a certain amount of public resistance can be expected—people generally don't like paying taxes and fees. This is why public outreach and education, and input, is important. Where there is a demonstrated need for infrastructure investment, the benefits can be shown to outweigh the costs and people will understand the need for the program.

For **counties**, the State of Illinois Counties Code (55 ILCS 5/) allows “management and mitigation of the effects of urbanization on stormwater drainage” in St. Clair County, Madison County, and seven other counties (55/ILCS 5/5-1062.2) (see below). Stormwater Plans created by these counties can include elements such as rules for floodplain and stormwater management, fees or taxes from new development, and incentives for using green infrastructure and other approved drainage structures. Illinois **municipalities** also have the authority to adopt stormwater plans (65 ILCS/ Art 11 prec Div 110 – Flood Control and Drainage).

The 2015 Illinois Report for the Urban Flooding Awareness Act prepared by IDNR includes the following USEPA recommendations for stormwater management financing options:²

- Stormwater utility (or service fees),
- Property taxes/general funds,
- Sales tax,
- Special assessment districts,

- System development charges,
- Municipal bonds and state grants, and
- Low-interest loans.

A *stormwater utility* is dedicated to recover the costs of stormwater infrastructure regulatory compliance, planning, maintenance, capital improvements, and repair and replacement. The utility imposes its fees based on how much stormwater is being generated from a parcel, which can be readily calculated from the amount of impervious surface on the parcel and the annual average precipitation. Stormwater diverted from the sewer system through infiltration or temporary retention (e.g., into a rain garden or rain barrels) can be given a credit against the utility fee equal to the volume of water averted and its treatment costs. This system offers the public greater transparency as to the true societal costs of managing stormwater runoff, and offers them an economic incentive to employ practices that divert more stormwater from the stormwater collection system.

As of 2015, 21 communities in Illinois have utility fee assessments. This is a smaller number than in many neighboring Midwestern states. The communities include home rule and non-home rule communities. The Illinois Municipal Code allows communities to operate utilities, and townships also have the ability to create a stormwater program and assess a user fee per Public Works Statutes, Article 205 of the Township Code in the Illinois Compiled Statutes (60 ILCS).

A small proportion of *property taxes or general funds* can be set aside for stormwater management. An additional *sales tax*, or a proportion of an existing sales tax, can also be used.

A *special assessment district*, also known as a special service area (SSA), is set up to benefit a specific portion of a municipality or county where there are specific problems to be addressed. Fees assessed only to those properties within that area. The district is often a small portion of a municipality or county. Special assessment districts can be created to address problems with stormwater, flooding, and other issues.

Low-interest loans may be secured under the **Water Pollution Control Loan Program**, which funds both wastewater and stormwater projects. Funding for the loan program comes from the state revolving fund. Eligible projects include upgrading or rehabilitating existing infrastructure, stormwater-related projects that benefit water quality, and a wide-variety of other projects that protect or improve the quality of Illinois's rivers, streams, and lakes. The **Water & Waste Water Disposal Loan & Grant Program** provides funding drinking water systems, sanitary sewage systems, and stormwater drainage to households and businesses in eligible rural areas. The program assists applicants who are not otherwise able to obtain commercial credit on reasonable terms for these projects. Areas served must be rural or towns populated with 10,000 people or fewer. Long-term, low interest loans are the primary funding type available. Grants may be combined with a loan if necessary and if funds are available.

Flood Damage Prevention Ordinance

St. Clair County and eight communities in the watershed are members of the National Flood Insurance Program (NFIP). Madison County and Clinton County are also members. As NFIP members, these communities have a Floodplain Ordinance in effect. Several features of the floodplain ordinances are based on Illinois Department of Natural Resources' Model Flood Damage Prevention Ordinance (a previous or current version).

Further steps can be taken to update communities' floodplain ordinances to protect residents and businesses from flood risk and unnecessary mitigation costs. Heartlands Conservancy prepared a draft Flood Damage Prevention Ordinance for Madison County containing options for strengthening existing floodplain codes to protect property owners and communities, based on FEMA's Community Rating System (CRS). These options include:

- Requiring applicants for a development permit to obtain all other required local, state, and federal permits before the development permit is issued.
- Defining "substantial improvement" (which triggers compliance) as development which equals or exceeds 50% of the market value of the building before the improvement or repair is started, or increases the floor area of a building by more than 20%.
- Requiring two feet of freeboard (height above the Base Flood Elevation, or BFE) for structures in the floodplain.
- Allowing accessory structures in floodplain that are non-habitable, if they are used only for the storage of vehicles and tools (and follow several other requirements).
- Requiring all new and substantially improved critical facilities to be located outside the floodplain, unless infeasible, in which case they must be elevated or flood proofed to the 500-year flood elevation. Access routes must also be elevated to the BFE. Toxic substances must be sealed off from floodwaters.

The State of Illinois also has a Model Stormwater Management Ordinance that is intended to be an independent, stand-alone, self-sufficient ordinance for Illinois communities to adopt. For local governments without independent stormwater ordinances, the model stormwater provisions can be added to their subdivision ordinance, building code, or zoning ordinance, excluding language which is redundant with existing local government codes.³

Green infrastructure incentives

Green infrastructure is a vital concept that incorporates and informs many of the recommended practices in this Watershed-Based Plan. Green infrastructure can be defined as our region's natural resources, including open space, woodlands, wetlands, gardens, trees, and agricultural land. It can also be defined as the nodes and corridors of vegetation over the region, or the site-scale structures and landscaping that recreate natural processes. A regionally connected system of green infrastructure results in a higher diversity of plants and animals, removal of non-point source pollution, infiltration of stormwater, and healthier ecosystems. Corridors of green infrastructure along streams are extremely important because they provide biological conduits between hubs. However, most parcels forming corridors are not ideal green infrastructure until landowners and residents embrace the idea of managing stream corridors or creating backyard habitats.

Various regulatory incentives can be used to encourage the design and implementation of green infrastructure in new development. These incentives can include flexible implementation of regulations, fee waivers, tax abatement, access to municipal utilities, and a streamlined development review process. The incentives can be granted on a case-by-case basis.

In-lieu fee ecological mitigation

In-lieu fee mitigation is an opportunity to assist developers in meeting their mitigation needs while directing mitigation to high quality sites in the watershed. Under an in-lieu fee program, a developer can pay a fee in lieu of having to restore or protect wetlands on the development site, or to mitigate losses of those sites by protecting or restoring wetlands off-site. The fee goes to a third-party organization

which can direct the funds to high quality ecological sites for which restoration efforts will have the most environmental impact.

Long-term management of natural areas

Conservation Development promotes the protection of sensitive natural areas and open space in new development, as well as incorporating green infrastructure into stormwater systems. In “traditional” development, too, there is often a piece of land set aside for a detention basin. Once set aside, this land can sometimes lose its ecosystem functions (such as water filtration, recreational value, and floodwater holding capacity) due to lack of maintenance.

Developers should be encouraged to donate those natural areas and systems to a public agency or conservation organization for long-term management. Donation can be by either fee simple purchase of undeveloped land, or by acquisition of the development rights and establishing a conservation easement. If a local government takes on ownership or maintenance of the land, it can choose to fund it through mechanisms such as Development Impact Fees and Special Service Area (SSA) taxes.

Alternatively, Homeowners Associations (HOAs) can explicitly take on the management of the natural areas, writing rules about maintenance and fees into their bylaws. The members of the HOA will then share in the costs and decisions about maintenance of the natural area. For detention basins, Madison County recently began the best practice of including the transfer of authority for maintenance of the detention basin from the developer to the Homeowners Association once a new subdivision is 90% complete. From then on, the HOA has a maintenance responsibility for the detention basin. (See “Detention basins.”)

Monitoring

Appendix D - Monitoring Plan outlines an appropriate strategy for water quality monitoring in the watershed.

Native landscaping

Weed control ordinances, whose purpose is primarily to maintain a pleasing aesthetic in community landscaping, often directly or inadvertently discourage or prohibit the use of native plants. Native landscaping can look “messier” than traditional landscaping, depending on the plants used. But when native plants are well chosen and well maintained, planting areas look very pleasing and offer many water quality and wildlife benefits. Garden nurseries and other native plant providers can be involved in educating customers and displaying the different “look” that native plants offer. Weed control ordinances can be amended to allow and encourage the use of these plants and provide guidance on species and maintenance.

Open space and natural area protection

Several actions can be taken to encourage the protection of natural areas and open space in new development. Some are regulatory, including the following practices from the U.S. EPA Water Quality Scorecard:

- Establish a dedicated source of funding for open space acquisition and management (e.g., bond proceeds, sales tax).
- Adopt regulations to protect steep slope, hillsides, and other sensitive natural lands (e.g., by limiting development on slopes > 30% or requiring larger lot sizes in sensitive areas).

- Create agriculture resource zoning districts (e.g., minimum lot size of 80 acres and larger) to preserve agricultural areas.
- Adopt neighborhood policies and ordinances that work to create neighborhood open space amenities that are within 0.25-mile to 0.5-mile walking distance from every residence.

Other actions are non-regulatory:

- Provide financial support to or collaborate with land trusts or other conservation organizations to acquire critical natural areas.
- Adopt a community-wide open space and parks plan.
- Identify key natural resource areas for protection in jurisdiction's parks and open space plan.
- Allow and encourage retrofits of abandoned or underutilized public lands to serve as permanent or temporary open space and green infrastructure sites.

Private sewage monitoring

Private, residential septic systems are often not maintained properly, leading to failure. The U.S. Census Bureau has indicated that at least 10% of septic systems have stopped working. Failed septic systems can leach bacteria and nutrients into ground water or allow these contaminants to be exposed at the surface and washed into receiving streams during storm events. Currently, inspections and enforcement of private septic systems are complaint-driven—there is no plan or resources for further enforcement.

Septic inspections are required during real estate transactions, but these are often many years apart. More regular inspections should be considered by the counties and municipalities, regardless of property ownership turnover. A rule in Jefferson County, Missouri requires that homeowners annually have their sewer system serviced and submit certification of it to the county.

Private sewage data on violations and water quality parameter exceedences should be collected and mapped. Additionally, an intensive inspection of private septic systems should be considered to determine the location of any illicit discharges and to assess the condition of all septic systems in the watershed. This effort, commonly referred to as a sanitary sweep, could be eligible for grant funding. Following the identification of failing septic systems a course of action to correct these systems will need to be coordinated with the landowners, municipalities, counties, and relevant state agencies.

The U.S. EPA provides an excellent guide for septic system owners called “A Homeowner’s Guide to Septic Systems” (USEPA, 2005), which explains how septic systems work, why and how they should be maintained, and what makes a system fail.

Riparian buffer ordinance

“Riparian,” in its most general sense, means “adjoining a body of water.” A riparian buffer is an undisturbed naturally vegetated strip of land adjacent to a body of water, such as a stream or lake. Among their many benefits, riparian buffers store floodwater, allow lateral stream movement, reduce streambank erosion, trap and remove sediment in runoff, mitigate stream warming through shade, provide habitat for wildlife, and increase property values. The literature indicates that forest provides more benefits in a riparian buffer than grassland does—with benefits including more wildlife habitat, stream shading and temperature control, and more debris as a food source for the stream—so oak-hickory forest should be the first choice in riparian buffer vegetation.

A riparian buffer ordinance protects a riparian area of a certain width from new development and other disturbances, and promotes revegetation/reforestation. As a graduate student intern, Janet Buchanan (one of the authors of this Watershed-Based Plan) created a draft Riparian Buffer Ordinance for Madison County that would protect the riparian area in the unincorporated area of the county from certain kinds of development and activities. The ordinance has not yet been passed.

A riparian buffer ordinance may restrict the following activities and structures in the riparian buffer:

- Buildings, accessory structures, roads, parking lots, driveways, and other impervious surfaces
- Disturbance of vegetation (through clearing, construction, or other practices)
- Disturbance of soil (through grading, stripping of topsoil, plowing, cultivating, or other practices)
- Grazing of animals
- Filling or dumping
- Storage of hazardous materials

Sewage Treatment Plant upgrades/advanced treatment

Sewage treatment plants (STPs) are subject to National Pollutant Discharge Elimination System (NPDES) permit requirements. Upgrades to wastewater treatment plants in the watershed should be installed so that the limits set in these permits are not exceeded. According to recent studies, upgrades can reduce total phosphorus in plant effluent to below 1.0 mg/l and reduce total nitrogen in plant effluent to less than 5.5 mg/L. These would be significant improvements over the existing phosphorus and nitrogen concentrations in effluent from several of the sewage and wastewater treatment plants in the watershed. Funding for sewage treatment plant upgrades may be available from USEPA's Source Reduction grant program.

USEPA has published a report on advanced wastewater treatment methods to reduce phosphorus in effluent ("Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus"). The most effective treatment is the addition of aluminum- or iron-based coagulants followed by tertiary filtration, which reduces the final phosphorus level in effluent to near or below 0.01 mg/L. This treatment is affordable; monthly residential sewer fees charged by the facilities ranged between \$18 and \$46. Other pollutants such as BOD, TSS, and fecal coliform were also significantly reduced. Another treatment is enhanced biological nutrient removal (EBNR) in the secondary treatment process, which can often reduce total P to 0.3 mg/L or less prior to tertiary filtration. The process reduces operating costs for the tertiary filtration process and removes other pollutants as well.

Additionally, nutrient credit trading is a way to reduce overall nutrient discharge from the vicinity of the treatment plant. The plant pays for a conservation easement that reduces nutrient discharge from agricultural land, thus offsetting the plant's discharge. The two parties can agree with the state (Illinois EPA) that this amount of nutrient reduction can count against the treatment plant's discharge. These agreements have been made at several locations across the U.S.A., including Lancaster County, PA and the American Farmland Trust 3-state pilot project (Ohio, Indiana, and Kentucky). The agreement typically lasts for 10 years.

Stream Cleanup Team

A Stream Cleanup Team operated between 2008 and 2009 in Madison County and removed debris from selected streams in the county about which they received complaints. The cleanup team therefore contributed to improving water quality, reducing flooding, and monitoring stream health. The work was funded by a grant from the U.S. Department of Housing and Urban Development; the team was

comprised of paid workers. During the course of the cleanup operations, logjam locations were entered into a handheld GPS unit, and later processed by the county's IT department. Many county residents were vocal in their support of the Stream Cleanup Team, and said they would like to see a reprise of the program.

The program could be replicated and expanded from its previous scope into St. Clair County. The program could include an education component and opportunities for volunteer involvement, mimicking other cleanup programs such as Missouri Stream Team, the Open Space Council's Operation Clean Stream, or Missouri River Relief Trash Bash.

Watershed plan supported and integrated into community plans

Copies of this Watershed-Based Plan will be made available to communities in the watershed. However, for maximum effectiveness, the plan should be adopted and/or supported (via a resolution). The plan will be most effective when its goals, objectives, and recommended actions are integrated with community policy.

Agricultural Management Measures

Animal waste storage/treatment system

Proper livestock waste management is very important in maintaining water quality, especially for bacteria levels. Writing a Comprehensive Nutrient Management Plan helps farmers to integrate waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff.

The following is a general approach to addressing bacterial pollution in streams as a result of animal manure.

- Identify known sources of bacteria to waterbodies (e.g., areas where livestock have access to streams), using local knowledge, windshield surveys, interviews with landowners, etc.
- Conduct monitoring of stream reaches, adding additional monitoring to help pinpoint potential sources of bacteria.
- Promote good manure application practices such as:
 - Using manure injection rather than surface application;
 - Applying manure to relatively dry fields;
 - Avoiding steep slopes;
 - Avoiding areas near waterbodies or drain tile intakes;
 - Avoiding areas prone to flooding; and
 - Avoiding application on frozen soil.

See the NRCS "Agricultural Waste Management Field Handbook" (AWMFH) for specific guidance on planning, designing, and managing systems that involve agricultural wastes.

Bioreactors (denitrifying)

Bioreactors, also known as denitrifying bioreactors, are ditches filled with wood chips that contain denitrifying bacteria. The bioreactor is placed at the outlet of a tile drainage system, and the bacteria remove nitrogen from water leaving the system. Research has shown an estimated bioreactor lifespan of 15 to 20 years, after which the woodchips would be replaced if treatment was to be continued.

Comprehensive Nutrient Management Plans (CNMPs)

A CNMP is a strategy for farmers to integrate livestock waste management into overall farm operations. Such a plan can recommend waste storage structures and strategies that increase waste storage time, eliminate unwanted runoff, incorporate manure nutrients into crop nutrient budgets, and efficiently apply manure to cropland without runoff (e.g., manure injection). When these structures and strategies are in place, manure is a useful asset to cropland that provides benefits to soil health.

Conservation tillage

Converting intensive tillage to conservation tillage consists of switching from moldboard to chisel plowing, which leaves at least 30% crop residue on the fields before and after planting to reduce soil erosion. Converting conservation tillage to no-till consists of switching existing chisel plowing to no-till where the ground is not tilled so as to not disturb the soil. This increases water infiltration, organic matter retention, and nutrient cycling, and reduces soil erosion.

Farmers may find that, initially, less tilling leads to growth of glyphosate-resistant (Roundup-resistant) weeds. Approximately ten species of weeds in the U.S. are known to have become resistant to the herbicide. To avoid this, crop rotation and diversification is the best strategy to disrupt the weeds' emergence, following a long-term weed management plan. This plan should focus on the proper use of each herbicide, using diverse herbicide modes of action (MOA), and the rotation of both herbicides used and crops planted. See the Penn State Extension webpage for more information about how this can be achieved⁴.

Contour buffer strips

Contour buffer strips are strips of perennial vegetation that alternate with strips of row crops on sloped fields. Contour buffers strips are usually narrower than the cultivated strips. The strips of perennial vegetation, which consist of adapted species of grasses or a mixture of grasses and legumes, slow runoff and remove from it sediment, nutrients, pesticides, and other contaminants. Buffer strips can also provide food and habitat (e.g., nesting cover) for wildlife. Contour buffer strips are most suited to uniform, non-undulating slopes of between four and eight percent, but can also be used on steeper land. Contour buffer strips should be mown to maintain appropriate vegetative density and height for trapping sediment, and/or for providing habitat for target wildlife species. They should not be mown during critical erosion periods.

Cover crops

Cover crops provide both annual and long-term benefits to agricultural land. On an annual basis, they protect soil from water and wind erosion by providing a vegetative cover between the fall harvest and spring planting. They take up residual fertilizer nutrients and then release them back into the soil for the subsequent spring crop. Cover crops also suppress winter annual weeds. With consistent use of cover crops, the soil organic matter content will increase, and this provides many benefits to the soil, including improved soil tilth and health, increased porosity and infiltration, and sustained biological activity. Cereal grains, annual rye grass, and radish are common cover crops for this purpose, but many other types are available. Some crops, such as radish and turnips, are selected to help break through compacted soil layers. Cover crops are often planted as a mix of multiple species that mutually provide a range of benefits⁵.

Grassed waterways

Grassed waterways are vegetated channels designed to prevent gully erosion by slowing the flow of surface water with vegetation. Grassed waterways should be used where gully erosion is a problem.

These areas are commonly located between hills and other low-lying areas on hills where water concentrates as it runs off the field. Grassed waterways trap sediment entering them via field surface runoff and in this manner perform similarly to riparian buffer strips.

The size and shape of a grassed waterway is based on the amount of runoff that the waterway must carry, the slope, and the underlying soil type. NRCS design standards for grassed waterways specify that the minimum capacity convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Enough freeboard above the designed depth should be provided to prevent damage to crops. The vegetation in the channel should be native plants suited to the site conditions and intended uses.

Nutrient Management Plans (NMPs)

A NMP is a strategy for obtaining the maximum return from on- and off-farm fertilizer resources in a manner that protects the quality of nearby water resources. Creating an NMP involves reviewing soil maps, field boundaries, and nutrient uptake of crops to determine nutrient needs for each field and the types and amounts of fertilizers to meet those needs.

Ponds

Ponds are popular features that also have significant pollutant removal benefits when well sited and designed. Also known as wet ponds, stormwater ponds, or wet retention ponds, they are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). As stormwater runoff enters the pond, the sediment settles out and some nutrient uptake takes place. Nitrogen removal through denitrification (i.e., reduction of nitrates via anaerobic bacteria) can also occur in ponds.

Riparian buffers

A riparian buffer is a vegetated area along a shoreline, wetland, or stream where development and row cropping is restricted. The buffer physically protects and separates the waterbody from future disturbance or encroachment, and reduces the amounts of pollutants that reach it. If properly designed, a buffer can sustain the integrity of stream ecosystems and habitats. As conservation areas, aquatic buffers are part aquatic ecosystem and part urban forest.

Different grading and vegetation at different locations can affect water quality in different ways. Where vegetation roots can interact with the water table, carbon cycling and denitrification may be enhanced. In areas where the water table depth exceeds the rooting depth, and overland runoff is high, stiff-stemmed grasses may be beneficial to intercept and reduce runoff and sediment from reaching the stream. Where appreciable amounts of neither runoff nor groundwater can be intercepted, streambank stabilization has great benefits. Locations where these practices would be most suitable were identified by using USDA's ACPF model.

A riparian buffer ordinance is an important tool that communities can use to restrict new development in buffer areas in order to ensure that land adjacent to streams continues to protect water quality and moderate stormwater flow.

Terraces

Terraces are a soil conservation practice applied to prevent rainfall runoff on sloping land from accumulating and causing serious erosion. The term "terraces" often brings to mind "contour terraces" such as those in various mountainous regions of the world that follow contours in wavy lines. However, parallel terraces are the type of terrace used most commonly on agricultural land in the U.S. They are

constructed parallel to each other in straight lines, and parallel to the direction of field operations as much as possible. Some terraces are constructed with steep backslopes that are kept in grass, but most are broad-based with gently sloped ridges that are cultivated as part of the field. Parallel terraces that discharge runoff through subsurface tile drains are known as parallel tile outlet (PTO) terraces. With this setup, water that accumulates behind a terrace ridge is discharged through a surface inlet into a subsurface drain. Some of the runoff is temporarily stored for long enough that sediment settles out of the water, but not so long as to damage the crop.

The major benefit of terraces is the conservation of soil and water, which in turn allows more intensive cropping than would otherwise be possible. There are additional benefits for PTO terraces: the total area can be farmed (no grassed waterways are needed); no interruptions in tilling or applying herbicide because there are no grassed waterways; reduced peak discharges; and the settling out of sediment and other contaminants before it reaches a receiving waterbody. Terraces are best suited to fields with long, fairly-uniform slopes that are not too steep (generally less than eight percent), and where the soil is not too shallow (more than six inches). See the Purdue University Cooperative Extension Service page⁶ for more information on terraces.

Water and Sediment Control Basins (WASCOBs)

WASCOBs are small earthen ridge-and-channel or embankments built across a small watercourse or area of concentrated flow in a field. WASCOBs hold field runoff that would otherwise create a gully or leave the field without sediment settling out. WASCOBs are usually straight, vegetated with grass, and just long enough to bridge an area of concentrated flow. The water detained in a WASCOB is released slowly via infiltration or a pipe outlet and tile line. The ACPF model identified locations where WASCOBs would be the most effective.

Wetlands

Wetlands, or Nutrient Removal Wetlands, provide significant water quality benefits. Wetland plants, soils, and microbes cleanse the water entering the wetland, removing approximately 78% sediment, 44% phosphorus, and 20% nitrogen from runoff, according to USEPA's STEPL tool. This is achieved through settling and biological uptake by wetland plants and organisms. They also recharge groundwater, store stormwater, reduce high water flows, provide food and habitat for wildlife, and increase carbon sequestration. They are appropriate for agricultural and semi-urban land only, where there is limited development.

Natural wetlands should be protected from increased stormwater runoff from development, so as to continue functioning. Wetland vegetation should consist of native aquatic plant species.

Constructed wetlands are shallow, vegetated ponds that are engineered and constructed to mimic the structure, water quality function, wildlife habitat, and aesthetic value of naturally occurring wetlands. In some cases, they occur on sites that were historically wetlands, and can be considered wetland restoration projects. Since constructed wetlands need a somewhat constant water level to sustain their functions, the soils underlying the wetland must allow limited infiltration.

Wetland restoration is the rehabilitation of a degraded wetland or the re-establishment of a wetland so that the soils, hydrology, vegetative community, and habitat are an approximation of the original natural condition that existed prior to historic modification.

The USDA's ACPF tool identified suitable locations for nutrient removal wetlands in areas with high runoff risk in the Canteen-Cahokia Creek watershed. The MoRAP assessment of wetland restoration ranking identified wetland areas suitable for wetland restoration.

Forest Management Measure

Forest stand improvement

Forest stand improvement is an approach to forest management that prioritizes forest health and wildlife habitat. Trees within the stand that are a desirable species, age class, and form are retained while those competing with these trees are "culled" (i.e., cut or girdled). This decreases competition for the desirable trees, increases growth rates, and allows managers to shape the future forest. Forest management can favor trees that produce more hard and soft mast (nuts, seeds and fruit) to support wildlife populations. Additionally, forest stand improvement can help improve water quality by removing undesirable species, including invasive species such as honeysuckle, that increase soil erosion on the forest floor by suppressing ground cover vegetation.

Urban Management Measures

Urban runoff management is somewhat different from agricultural settings in that the larger areas of impervious surfaces cause higher runoff volumes and, often, high nutrient concentrations. Structural infrastructure designed and constructed to collect, store, infiltrate, and treat storm water are some of the most expensive watershed improvement tools to implement and require consistent maintenance. According to Schueler and Holland (2000), the cost to maintain a storm water practice over 20 to 25 years can be equal to the initial construction costs. Nevertheless, structural storm water practices can be effective tools for pollutant removal, runoff reduction, and peak flow reduction when properly designed, constructed, and maintained.

Many of these Urban Management Measures fall under the definitions/categories of Low Impact Development (LID) and green infrastructure. They include design, construction, and post-construction (retrofit) practices. The following practices have been recommended for the Canteen-Cahokia Creek watershed.

Bioswales

Bioswales are swaled (sloped) drainage courses designed to remove debris and reduce pollution from surface water. The sides of the swale are less than six percent slope and the swale may be filled with vegetation, compost, and/or riprap. The design of the swale should maximize the time water spends there, which aids in infiltration (for groundwater recharge) and pollutant removal. Bioswales are often effective when sited adjacent to parking lots. They can capture and treat stormwater during the "first flush" of rain on the parking lot, which carries substantial automotive pollution.

In 2012, the City of O'Fallon, Illinois and HeartLands Conservancy conducted a feasibility study to determine optimal locations for implementing bioswales—including retrofitting existing concrete swales and identifying future installation areas—to reduce the volume of stormwater runoff and related pollutants and sediments. In order to analyze potential vegetative swale sites, the planning area was split into two smaller watersheds and then analyzed using two tools, Long Term Hydrological Impact Analysis and ArcGIS, to determine the potential benefits of implementation. In addition, the city studied two pilot locations for a six-month period to establish baseline flow data in existing concrete roadside swales. To encourage participation, regulatory barriers were removed that could potentially impede private property owners, the city, and developers from voluntarily implementing green infrastructure.

Marketing strategies were also developed to facilitate the introduction of bioswales to the community. Overall, O’Fallon and HeartLands Conservancy recommended:

- Encouraging the implementation of bioswales and other stormwater BMPs in areas of new development, particularly in residential parcels.
- Ensuring that city ordinances allow for the utilization of BMPs for both existing and new development.
- Retrofitting existing concrete swales with bioswales in high-priority areas (i.e., residential streets), specifically when the current infrastructure is being repaired or replaced to cut costs.

Detention basins

Detention basins are human-made depressions for the temporary storage of stormwater runoff with controlled release following a rain event. Wet bottom basins are essentially ponds planted with turf grass on their side slopes. Dry detention ponds (i.e., dry ponds or extended detention basins) are designed to detain stormwater runoff for some minimum time (e.g., 24 hours) to allow particles and associated pollutants to settle, but do not have a large permanent pool of water. They are often lined with concrete. These basins do not provide much, if any, infiltration, wildlife habitat, or water quality improvements.

When designed for multiple functions, however, detention basins can improve water storage, wildlife habitat, natural aesthetics, and water quality. According to USEPA, properly designed wet bottom basins designed to have wetland characteristics reduce total suspended solids (sediment) by 77.5%, total phosphorus by 44% and total nitrogen by 20%. Dry bottom infiltration basins reduce total suspended solids (sediment) by 75%, but have lower nutrient removal reduction of total phosphorus (65%), and total nitrogen (60%).

New basins should be:

- Located in natural depressions or drained hydric soil areas (especially when native vegetation is used);
- Located adjacent to existing green infrastructure (especially when native vegetation is used);
- Oriented/located so that outlets do not enter sensitive ecological areas.
- Designed to serve multiple development sites, so that several smaller basins are not needed;
- Designed with shallow side slopes and appropriate native vegetation;
- Designed with a shelf planted with native wet prairie vegetation, if a wet bottom basin; and
- Planted with mesic or wet-mesic prairie, if a dry bottom basin.

The St. Clair County Stormwater Control Code protects wetlands, streams, and steep slopes in new development and redevelopment (see *Conservation Development*). The Madison County Stormwater and Erosion Control Ordinance contains several requirements for new detention basins in floodplains, floodways, and connected to wetlands, rivers, streams, and ponds.

Retrofits to existing basins can also attain these benefits, through minor engineering changes, addition of extended detention basins/ponds, and the use of native vegetation. Many of the dry, wet, and wetland bottom basins in the watershed present excellent retrofit opportunities. Generally speaking, three years of management are needed to establish native plant communities. During the first two growing seasons following seeding, mowing and spot herbicide applications are needed to reduce

annual and biennial weeds and eliminate problematic non-native/invasive species such as thistle, reed canary grass, and emerging unwanted saplings. In addition, the inlet and outlet structures should be checked for erosion and clogging during every site visit.

Maintenance of detention basins is of vital importance in sustaining their functions and extending the life of the infrastructure. Maintenance practices include regular dredging, mowing or burning (an in-place controlled burn of native grasses) of the vegetation, and removal of invasive species. These practices are recommended in the watershed plan, and will be referenced for these sites as they are proposed for new projects.

For existing subdivisions and areas already developed, it is unusual to have a long-term maintenance agreement in place. When detention basins get full of sediment, there is no clearly identified party responsible for dredging and maintenance. Outreach is needed to educate HOAs about taking on responsibility for dredging and other maintenance, and potentially change their byelaws to reflect this responsibility. For new development, Madison County recently began the best practice of including the transfer of authority for maintenance of the detention basin from the developer to the Homeowners Association once the subdivision is 90% complete. The HOA then has a maintenance responsibility for the detention basin for the life of the project. Alternatively, developers should be encouraged to donate naturalized detention basins and other natural areas to a local municipality or conservation organization for long term management that can be funded by a mechanism such as a SSA tax.

Regional detention basins collecting stormwater from a large area may be an effective option for reducing flood impacts to Scott Air Force Base in particular. Partners including the Village of Shiloh and others in the Community Partnership Group may be able to move forward with detention facilities that slow the flow of water to the base during heavy storms so that the flood impacts are reduced. Further hydrologic analysis of the discharge and direction of runoff to the base would be needed to set this planning in motion.

Pervious pavement

Pervious pavement is also referred to as porous or permeable pavement. Areas paved with pervious pavement allow water to infiltrate through small holes to a below-ground storage area, or to a pipe that leads to such an area. Pervious pavements reduce runoff rates and volumes from traditional impervious pavements, and can be used in almost every capacity in which traditional asphalt, concrete, or pavers are used. Below ground, the stormwater can be treated through soil biology and chemistry, and the water is returned to groundwater and aquifers rather than increasing flows in streams. It is important to note that there are limitations to using pervious pavement based on subsoil composition, and that it requires annual maintenance (such as vacuuming with a specialized machine) to remain effective over time.

Design options for pervious pavement include:

- Porous pavement with underground storage/recharge beds;
- Concrete pavers infilled with soil/gravel and vegetated with grass; or
- Plastic or metal grid infilled with gravel or equivalent.

Rain gardens

Rain gardens, vegetated depressions that clean and infiltrate stormwater from rooftops and sump pump discharges, have become popular garden features. They work best when located in existing depressions

or near gutters and sump pump outlets, and are typically planted with deep-rooted native wetland vegetation. Rain gardens significantly slow the flow of water, improve water quality, and provide food and shelter for birds, butterflies, and insects.

Rain gardens work well in combination with the disconnection of roof downspouts and the redirection of that water to the garden. This results in a significant increase in the infiltration of rainwater over a direct connection to the storm drain or to impervious surfaces.

Bioretention facilities are sometimes referred to as rain gardens, but the term rain garden is typically used to describe a small, planted depression on an individual homeowner's property, while a bioretention facility typically describes larger projects in community common areas as well as non-residential applications.

See "Thinking Outside the Pipe" from HeartLands Conservancy for more specifics on rain garden design and bioretention facilities.

Rainwater collection

Rainwater collection and re-use via rain barrels and cisterns is a straightforward and useful way to decrease the amount and intensity of stormwater runoff in a watershed and reduce the amount of water consumed from municipal sources. On most homes and buildings, rainwater flows from roofs into downspouts and then onto streets or into storm sewers. Reconnecting the downspouts to either rain barrels or cisterns can reduce the flood levels in local streams and make water available to the building owner for irrigation and other uses. Water re-use differs based on the type of storage and water treatment.

Rain barrels sit above ground, and are connected to downspouts. A typical rain barrel stores 55 gallons of water. The water collected is often used for irrigation, which can result in significant cost savings; in many areas, residential irrigation can account for almost 50 percent of residential water consumption. Car washing and window cleaning are other common uses of the collected rainwater.

Cisterns are larger, sealed tanks that can sit above or below ground, and also collect rooftop runoff from downspouts. If installed below ground, a cistern requires a pump to bring the water up. With appropriate sanitation treatments, the "gray water" from cisterns can be reused for toilets, housecleaning, dishwashers, laundry, and even showers. Cisterns and rain barrels both reduce water demand in the summer months by reducing the potable water used for irrigation or other household uses.

Single property flood reduction strategies

A number of practices can be used to reduce flood damage on single properties. The key to successfully mitigating future damages is to identify the source(s) of flooding at the site scale. It is important to educate property owners about possible sources of flooding, flood mitigation practices, and the costs of those practices. Coordination with local community officials is often required to identify and confirm the most appropriate flood reduction strategy.

The Illinois Urban Flooding Awareness Act Final Report, published in June 2015, identified typical causes of basement flooding (overland flow, infiltration, or sewer backup), and mitigation options available to address these causes. Table E.3 is taken from this report, and shows these causes, along with mitigation options and their costs.

Table E.3. Flood damage mitigation options and the causes of flooding that they address, along with estimated costs. From the IDNR Urban Flooding Awareness Act report (June 2015), Table 9.1.

Mitigation Options	Cause of Flooding			Damage reduction	Estimated Cost
	Overland	Infiltration	Sewer backup		
Structural Inspection					\$250-\$800 each
Raise utilities and other valuable items				x	
Insurance				x	Based on coverage
Gutter maintenance	o	x	o		
Downspout disconnection			x		
Site grading, downspout extension	o	x			
Rain gardens	o				\$3-40 per square foot
Permeable/porous pavement	x				\$2-\$10 per square foot
Exterior drain tile		x			\$185 per foot
Interior drain tile		x	x		\$40-50 per foot
Seal wall and floor cracks		x	o		\$300-\$600 each
Sump pump with check valve	x	x	x		\$400-\$1,000 each
Sewer backup valves			x		\$3,000-\$5,000
Overhead sewer installation			x		\$2,000-\$10,000
x - primary reduction o - secondary reduction					

Stormwater and sanitary sewer system maintenance and expansion

Storm drain systems are vital for the timely removal of stormwater from areas where it would cause damage if it accumulated. When clogged, storm drains, culverts, and other stormwater infrastructure can cause overflows that lead to erosion and property damage. Cleaning this infrastructure increases dissolved oxygen and reduces levels of bacteria in the receiving waters. Cleaning storm drains by flushing is more successful for pipes smaller than 36 inches in diameter. Wastewater must be collected and treated once flushed through the system. For larger pipes, long pipes (700 feet or more), areas with relatively flat grades, and areas with low flows, flushing may be less effective.

In some cases, stormwater infrastructure is found to be too small to accommodate the flow it receives. Often, new development upstream has altered the watershed hydrology in some way, often increasing the amount of impervious surface and surface runoff flowing to it. In such cases, existing infrastructure such as road culverts and detention basins should be assessed and resized to accommodate the

increased flows. The Madison County Stormwater and Erosion Control Ordinance requires that culvert crossings are sized to “consider entrance and exit losses as well as tailwater conditions” (3.4.12.3).

The 2011 St. Clair County Multi-Hazard Mitigation Plan identified storm drain system improvement projects. Culverts, ditches, and detention basins that often overflow should be assessed for potential enlargement. Upgrades should be made in response to storm drain system inspections, citizen complaints, and/or updated modeling of the system. In addition, sanitary sewer systems should be maintained in order to prevent infiltration and combined sewer overflows. Expansion of sanitary sewers to new development and existing buildings (already a common practice among municipalities) should continue wherever feasible.

Tree planting (e.g., street trees)

Street trees are trees that are planted in the public right-of-way. They are an important component of municipal green infrastructure and provide benefits including reducing stormwater runoff, filtering pollutants in air and water, mitigating high “urban heat island” air temperatures, and providing pleasing aesthetics that increase property values.

When planting new street trees, site evaluations should be conducted to evaluate site considerations. Then, a suitable native tree species is selected. Factors such as growth rate, ornamental traits, size, canopy shape, shade potential, wildlife benefits, and leaf litter production should all be considered when choosing a tree species.⁷

Municipalities with a strong tree program can become a member of Tree City USA, a program operated by the Arbor Day Foundation. It is a nationwide movement that provides the necessary framework to manage and expand public tree inventory. Cities can achieve Tree City USA status by meeting four core standards of sound urban forestry management: (1) maintaining a tree board or department, (2) having a community tree care ordinance, (3) spending at least \$2 per capita on urban forestry, and (3) celebrating Arbor Day.

Pollutant removal efficiencies for specific types of trees planted can be estimated with the Pollutant Load Reduction Credit Tool developed by the Center for Watershed Protection in 2017.⁸ More general pollutant reduction efficiencies were calculated or cited by the Chesapeake Bay Program⁹ and the Pigeon Creek Watershed Plan.¹⁰

Urban Filter Strips

Urban filter strips—also referred to as vegetative filter strips—are stable areas of vegetation on gently sloping land that reduce the impacts of overland flow by removing sediments and pollutants and increasing infiltration. They can be used to drain relatively small areas where surface water runoff is discharged as overland sheet flow, and are typically installed between impervious surfaces (e.g., parking lots, roads, sidewalks) and water bodies, swales, or storm sewers.

Urban filter strip drainage areas should be no greater than five acres, and the strips should have slopes of 15 percent or less. However, filter strips perform best with slopes of five percent or less. Native prairie vegetation should be used or preserved in the strip if possible, and the area should be cleared of materials that are likely to interfere with strip installation (e.g., trees, rocks, stumps).¹¹

Stream and Lake Management Measures

Lake and stream dredging

Dredging is performed to remove sediments and debris from water bodies. Dredging routinely prevents sedimentation from filling in stream channels.

The 2010 Oates Associates report for Madison County recommended routine sediment and debris removal from the following stream channels:

- Schnieder Ditch (10,000 LF of stream channel)
- Schoolhouse Branch Creek (15,000 LF of stream channel)
- Cahokia Canal (12,000 LF of stream channel)
- Canteen Creek (40,000 LF of stream channel)

Logjams

A logjam is any woody vegetation, with or without other debris, which obstructs a stream channel and backs up stream water like a natural dam. Logjams occur naturally, providing beneficial stream structure and cover for fish and wildlife and allowing nutrient-rich sediments to be deposited on adjacent floodplain. However, logjams also impede the ability of streams in the watershed to drain and convey water from the land in a timely manner.

Logjams commonly form when a relatively large object, often a tree, falls into a stream channel and becomes wedged or blocked across the streambed. Populations of beavers in the watershed also contribute to the felling of trees in riparian areas. Sometimes human activities induce stream obstructions, like when yard trimmings or large appliances and other litter are dumped in a stream or left in a floodplain and subsequently are carried into the stream.

Logjams contribute to flooding by making less natural storage available in the stream channel, elevating the water out of its banks during periods of high flow. This can be significant to farm fields and residences in the floodplain and to particularly low-lying, flood-prone areas. A logjam can also lengthen the duration of inundation during these floods, which can have a significant impact on crops planted in floodplain fields. However, this does not make a big difference to overall flood elevation during large-scale floods. Removing logjams is generally only considered an effective measure to mitigate small-scale flooding.

Water quality is also affected when a logjam is created. As sediment is deposited behind the obstruction, the water that flows on down the stream has less total suspended solids. Water is oxygenated as it stirs and mixes while cascading over, around, and through the logjam. However, not all the water quality impacts are beneficial. As the water moves around the logjam along the route of least resistance, it scours away the streambanks, introducing more sediment and debris to the water. When the stream flow is powerful enough, a streambank "blow-out" can occur around it, taking large amounts of soil and debris from the bank into the stream channel as the stream creates a new path.

Stream channel changes resulting from water being redirected around a logjam can lead to the creation of a series of meanders. In an area where the riparian zone is vegetated, and development or cropland is not directly adjacent to the stream, this meandering and stream relocation is not really a problem. In developed or row cropped areas, these changes can inflict significant property damage and necessitate an expensive channel restoration project.

Logjams affect the habitat of species living in and near the stream. When a logjam forms, it slows the flow behind the obstruction, allowing sediment suspended in the water to settle out. The sediment adds to the obstruction and causes additional debris to become trapped there as well, enlarging and compacting the obstruction. This can create new habitat for fish and aquatic plants and macroinvertebrates. However, a tightly packed stream obstruction can act as a barrier to fish migration.

Determining whether a certain logjam should be removed requires these factors to be taken into account. Where logjams and potential channel changes would be detrimental to riparian property owners and stream water quality, property owners should be prepared to conduct routine stream inspections twice a year and after significant storm events to identify obstructions that need to be removed. The easiest way to deal with logjams is to remove them before significant sediment and debris has been deposited. A useful source for determining whether a logjam should be removed is "Stream Obstruction Removal Guidelines," prepared by the Stream Renovation Guidelines Committee, The Wildlife Society, and the American Fisheries Society in 1983¹².

Shoreline stabilization

The shoreline provides habitat for fish and wildlife, supports recreation for humans, and cleans stormwater runoff before it enters the water. Shoreline erosion is a natural process that occurs on lakes and rivers and along the coast. It is the gradual, although sometimes rapid, removal of sediments from the shoreline. It is caused by a number of factors including storms, wave action, rain, ice, winds, runoff, and loss of trees and other vegetation. Stabilizing the shoreline of lakes in the watershed can reduce sediment erosion and support vegetation and wildlife habitat.

A shoreline's natural vegetation acts as a filter, preventing sediment and unnecessary nutrients from entering the waterbody. This runoff leads to poor water quality and upsets the balance needed for a healthy shoreline habitat. In the case of lawns, this runoff can include fertilizers, pesticides, lawn clippings, and pet waste. Geese are attracted to lawns, and their waste can add to this runoff.

Shorelines can provide excellent habitat for fish and wildlife. Fish and frogs often spawn in the silt in shallow water at the shore. Shoreline vegetation provides nesting spots for birds and food for insects, waterfowl and aquatic mammals. Fallen logs and branches provide shelter and hunting areas for fish and mammals, while turtles use them to sunbathe.

Shoreline stabilization methods should include deep-rooted native vegetation (particularly trees), gentle slopes to absorb the energy of waves, and "soft armoring" of live plants, logs, root wads, vegetative mats, and other methods (to complement unavoidable "hard armoring," such as rock rip-rap, stone blocks, sheet-pile or other hard materials) where possible.

Streambank and channel restoration

Streambank and channel restoration includes streambank stabilization and stream channel improvements. These practices are typically done together alongside riparian buffer improvements. The USEPA reports that as much as 90% of sediment, phosphorus, and nitrogen can be reduced following stream restoration. Bank stabilization helps to preserve the stream environment in a natural state, building a strong, long-lasting natural system of deep rooted vegetation that will protect the topsoil from heavy wind and rain.

"Traditional" or "hard" methods of stabilization involve materials such as rip-rap, concrete, and steel. By utilizing bioengineering (natural mimicry or "soft") methods that incorporate vegetation, the project is

often cheaper, provides more effective stabilization, and reduces overall pollution going into the stream. Targeting the outer bends of stream sections with poor riparian vegetation cover where most stream erosion occurs increases the effectiveness of streambank stabilization practices. Streambank bioengineering, which uses vegetative materials in combination with structural tools such as rock at the toe of the streambank, are most needed in areas of excessive streambank erosion or loss of farmland.

Streambank and channel restoration practices appropriate for the streams in this watershed include:

- Vegetative bioengineering;
- Stone toe protection;
- Two-stage channels;
- Riffle/pool complexes;
- Rock riprap; and
- Gabions (rock and wire baskets).

Stream restoration projects present some challenges for those implementing them. First, the development patterns that created the problem are not addressed. Second, the solutions are often technical and expensive, requiring permitting and construction from a qualified contractor. And third, routine maintenance is often not maintained as landowners lack the knowledge or capability to do the needed work. Several resources are available to landowners to help them navigate these challenges. St. Clair County NRCS has helped implement 938 ft of streambank and shoreline restoration between 2010 and 2015.

it should also be noted that the 1995 FEMA Interagency Hazard Mitigation Team (IHMT) Report covering Madison and St. Clair counties had the following site-specific recommendations for streams:

- MESD and the Canteen Creek Levee and Drainage District should maintain the capacities of Harding Ditch and Canteen Creek, with an O&M plan for each channel.
- Initiate implementation of a planned \$1.5 million rehabilitation project on Canteen Creek (presumably the USACE project identified in the St. Louis and Vicinity Ecosystem Feasibility Study).

¹ St. Clair County , County Code of Ordinances, Stormwater Control Code (PDF), available at <http://www.co-st-clair.il.us/government/Pages/Ordinances.aspx>

² Illinois Department of Natural Resources, June 2015, Report for the Urban Flooding Awareness Act (PDF), available at https://www.dnr.illinois.gov/WaterResources/Documents/Final_UFAA_Report.pdf

³ Illinois Department of Natural Resources, Model Stormwater Management Ordinance (PDF), 2015, https://www.dnr.illinois.gov/WaterResources/Documents/IL_Model_Stormwater_Ordinance.pdf

⁴ Penn State Extension, Forage and Food Crops, available at <http://extension.psu.edu/plants/crops/soil-management/no-till/preventing-herbicide-resistant-weeds-in-a-no-till-system>

⁵ Natural Resources Conservation Service, Cover Crops and Soil Health, available at <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238>

⁶ Terracing as a 'Best Management Practice' for Controlling Erosion and Protecting Water Quality, Agricultural Engineering, Purdue University. 2001. Available online at <https://www.extension.purdue.edu/extmedia/ae/ae-114.html>

⁷ United States Environmental Protection Agency (USEPA), September 2016, Stormwater Trees: Technical Memorandum, PDF, available at https://www.epa.gov/sites/production/files/2016-11/documents/final_stormwater_trees_technical_memo_508.pdf

⁸ Center for Watershed Protection, December 2017, Pollutant Load Reduction Credit Tool, downloadable Excel spreadsheet, available at <https://owl.cwp.org/mdocs-posts/pollutant-load-reduction-credit-tool/>

⁹ Karen Cappiella, Sally Claggett, Keith Cline, Susan Day, Michael Galvin, Peter MacDonagh, Jessica Sanders, Thomas Whitlow, and Qingfu Xiao, September 2016, Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion, PDF, available at https://www.chesapeakebay.net/documents/Urban_Tree_Canopy_EP_Report_WQGIT_approved_final.pdf

¹⁰ Northwater Consulting, 2014, Pigeon Creek Watershed Management Plan, PDF, available at https://www.in.gov/idem/nps/files/wmp_pigeoncreek_2014_sects_1-4.pdf

¹¹ Natural Resources Conservation Service, Illinois Urban Manual, Practice Standard, Filter Strip (acre), Code 835, available at <http://www.aiswcd.org/wp-content/uploads/2013/06/urbst83511.pdf>

¹² Stream Renovation Guidelines Committee, The Wildlife Society, American Fisheries Society, 1983, Stream Obstruction Removal Guidelines, available at <https://www.fws.gov/southeast/pdf/guidelines/stream-obstruction-removal-guidelines.pdf>

Appendix F - Monitoring Plan

This monitoring plan for the Canteen-Cahokia Creek watershed outlines the monitoring activities that will provide ongoing water quality data to assess stream health, and by extension, watershed health.

Monitoring will be used to assess the effectiveness of agricultural and urban best management practices that are implemented as part of the watershed management plan. Continuous monitoring at or near the U.S. Geological Survey (USGS) gage 05588720, located on Judy's Branch at Route 157 in Glen Carbon, will provide an assessment of the effect of land management practices throughout the watershed on surface water quality throughout the year.

In addition to continuous monitoring at the USGS gage, secondary monitoring stations will be added upstream from the USGS gage in order to identify the relative contributions of subwatersheds to overall water quality in the larger watershed. Sampling will be conducted from bridges during major stormflow conditions when the majority of nutrients and sediments are transported through the watershed.

Sample collection scheduling, monitoring equipment, and protocols

The sampling schedule begins in spring 2019 following installation of the continuous sample collection equipment at the USGS gage and the identification of bridges suitable for discrete sample collection from subwatersheds. The exact timing of sample collection and the number of samples collected will depend on the frequency and intensity of precipitation events in the watershed. Furthermore, the location of the discrete sample collection sites may be modified during the second and third years of the monitoring plan to better capture the impact of best management practices that are implemented in the watershed. Continuous collection of water samples at the USGS gage 05588720 will continue in the second year and third years with most of the samples being collected during major hydrological events.

The collection and analysis of monitoring data should be continued on a three- to five-year cycle through the year 2030, as funding allows. Opportunities for continuing or expanding the monitoring program should be evaluated periodically in order to further assess water quality conditions throughout the watershed, the causes and sources of pollution, the impact of nonpoint source pollution, and changes in water quality related to implementation of the watershed-based plan as well as social indicator data related to the watershed-based plan's goals and objectives. Quality Assurance Project Plans (QAPP) should be developed for those monitoring opportunities that are selected for implementation in support of the watershed-based plan.

Continuous monitoring at the USGS gage will use a programmable, automatic sampler (e.g., Isco 6712) for collecting water samples. The automatic sample works in combination with a depth sensor (e.g., Isco 720 module) to determine the timing and intensity of sample collection. Most sediments and nutrients are transported during periods of elevated flow following major precipitation events. Therefore, sample collection will be more frequent during periods of elevated flow and less frequent during periods of baseflow. The automatic sampler can collect up to 24 samples of 1L volume. Each sample can consist of a single sampling event or a composite of multiple sampling events. Samples will be preserved in the bottles using standard U.S. Environmental Protection Agency (USEPA) methods until they can be retrieved and transported to the laboratory for chemical analysis.

Discrete water samples at the sub-watershed level will be collected from bridges by lowering either a Van Dorn or depth-integrated sampler into the stream. Instantaneous discharge at each discrete sampling site will be measured at the same time the discrete water sample is collected by using an Equal Width Increment (EWI) method. The EWI method requires multiple measurements of stream velocity and stream depth. Stream velocity will be measured with an area-velocity meter mounted on a bridgeboard allowing it to be lowered from the bridge into the stream regardless of flow conditions. Stream depth for each width increment will be measured with a sounding reel and weight. Discrete water samples will be preserved at 4°C and transferred to the laboratory on the same day of collection.

Parameters to be monitored

Discharge

The USGS gage 05588720 continuously monitors stream depth (ft) and discharge (ft³/min) and records that information at 15-minute intervals. The drainage area for discharge at this location is 8.33 square miles, which means it may not necessarily be representative of the 89.5 square mile basin. The Judy's Branch gauge also has a short period of record, which should be considered when looking for trends in streamflow. The National Great Rivers Research & Education Center (NGRREC) receives daily updates of instantaneous discharge at the USGS gage. Additionally, the data is available online at the following website: http://waterdata.usgs.gov/nwis/uv/?site_no=05594450.

Stream discharge at the discrete sample collection sites will be measured using the Equal Width Increment method described in a previous section. However, when stream conditions at the discrete monitoring sites are suitable for wading, a FlowTracker Acoustic Doppler Velocimeter will be used to calculate discharge.

Sediment and Nutrients

Water samples collected by NGRREC will be analyzed in the Center's Environmental Chemistry Laboratory. Each water sample will be analyzed for those pollutants which have been identified by the Illinois Environmental Protection Agency (IEPA) as impairments. Samples collected with the Isco 6712 automatic sampler will be analyzed for total suspended sediments (TSS), total phosphorus (TP), and total nitrogen (TN). In addition to the above-mentioned parameters, the samples collected from the sub-watersheds will also be analyzed for soluble reactive phosphorus (SRP), nitrite+nitrate-nitrogen (NO₂+NO₃-N), and ammonium-nitrogen (NH₄-N). NGRREC will maintain a dataset of this data.

Biological data

Biological data related to macroinvertebrate populations in wadeable streams will be collected by Illinois RiverWatch citizen scientists at three pre-existing monitoring locations in the Canteen-Cahokia Creek watershed. There are six potential sites where RiverWatch citizen scientists have collected biological data in previous years. Each of these locations is a perennial stream with flow year-round, at which a 200-ft reach is monitored. Data collected by RiverWatch volunteers is vetted by a professional aquatic biologist. It is then entered into and maintained in the Illinois RiverWatch database.

Monitoring schedule

Table F.1 shows the monitoring activities and month/year of monitoring activities to be undertaken by NGRREC and RiverWatch volunteers.

Future phased monitoring

If this initial monitoring reveals a need for further monitoring, another phase may be added. Smaller tributaries may be monitored to better pinpoint areas of high water pollution, or stream reaches that can be assessed to evaluate the performance of BMP implementation or restoration efforts on pollutant loading. Additionally, USEPA should be encouraged to resume water quality monitoring at the USGS gage 05588720 near Glen Carbon, Illinois.

Table F.1. Timeline for water quality monitoring in the Canteen-Cahokia Creek watershed.

	2019				2020				2021				2022-2030
Monitoring Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Develop Standard Operating Procedures for collection and laboratory analysis of samples													
Sampling near USGS gage site 05594800													
Install continuous monitoring equipment													
Monitor TSS, TP, TN													
Evaluate and adjust continuous monitoring plan													
Monitor TSS, TP, and TN based on revised plan													
Discrete sampling at the HUC14 level													
Identification of HUC14 discrete sampling sites													
Monitor TSS, TP, TN, SRP, NO3-N													
Evaluate and adjust discrete monitoring plan													
Continue discrete monitoring based on revised plan													

Appendix G - Funding Sources

The following funding sources are available for watershed management efforts. All the sources listed here are linked to one or more of the issues identified in and practices recommended for this watershed.

These funding sources are summarized in Table G.2 at the end of this appendix.

State/federal government

Illinois Environmental Protection Agency (IEPA)

The **Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program** implements Illinois' Nonpoint Source Management Program with federal funds through section 319(h) of the Clean Water Act. The funds can be for watershed planning, implementation of Best Management Practices (BMPs), or monitoring of water quality. Projects that address nonpoint source (NPS) pollution in Illinois waters that have impaired water quality are given priority. The Upper Silver Creek watershed is one of IEPA's High Priority Watersheds for funding the implementation of BMPs in FY2016.

The **State Revolving Fund Loan Program** includes the Public Water Supply Loan Program (PWSLP) for drinking water projects and the **Water Pollution Control Loan Program (WPCLP)** for wastewater and stormwater projects. Eligible projects include upgrading or rehabilitating existing infrastructure, stormwater-related projects that benefit water quality, and a wide-variety of other projects that protect or improve the quality of Illinois's rivers, streams, and lakes. Funds can be provided for flood relief if the projects are tied to water quality improvements. Green infrastructure projects such as street tree or urban forestry programs, stormwater harvesting programs, downspout disconnection projects, and street drainage practices that mimic natural hydrology may be funded.

Streambank Cleanup and Lakeshore Enhancement (SCALE) grants from EPA have been available in previous years (2013-2016) to support cleanup efforts under Section 319 of the Clean Water Act. The funds were paid to groups that "have already established a recurring streambank or lakeshore cleanup," and used for dumpster rental, landfill fees, and safety attire. Recipients such as Alton Marketplace/Main Street and the Village of Swansea received \$500 (or more if more participants were involved). This program may be funded again in future.

Illinois Department of Agriculture (IDOA)

The **Streambank Stabilization and Restoration Program (SSRP)** is designed to demonstrate effective streambank stabilization at demonstration sites using inexpensive vegetative and bio-engineering techniques. Program funds may be used for labor, equipment, and materials. Recipients of the cost-share and project funding must maintain the streambank stabilization project for at least 10 years. This program is not currently funded, but funding may be reinstated in future.

The **Conservation Practice Program (CPP)** is implemented by the Soil and Water Conservation Districts (SWCDs) in Illinois. Cost-share funds are available through the SWCDs for various conservation practices including Filter Strips, Grassed Waterways, No-Till, and Terraces. A CPP-Special Project cost share

program funds practices that meet local natural resource priorities but are not on the state-wide list of practices, such as stream crossings, rain gardens, and heavy area livestock use area protection. Applications received are prioritized based on tons of soil saved, acres benefited, cost per acre of practice, and cost per ton of soil saved. This program is not currently funded, but funding may be reinstated in future.

The **Sustainable Agriculture Grant Program** funds research, education, and on-farm demonstration projects that address one or more purposes related to sustainable farming. These purposes include minimizing environmental degradation, clarifying the connections between specific agricultural practices and types of pollution, testing approaches to on-farm research, and identifying critical research and education needs related to sustainable agriculture.

Illinois Department of Natural Resources (IDNR)

The **Urban Flood Control Program** has been implemented for many years under the authority of the Flood Control Act of 1945. IDNR's Office of Water Resources (OWR) has typically applied the program to out-of-bank riverine flooding, and to the development and construction of projects that provide an outlet for stormwater systems.

Illinois Emergency Management Agency

The **Flood Mitigation Assistance (FMA) program** is a cost-share program (75% federal, 25% local match) through which communities can receive grants for the development of a comprehensive flood mitigation plan and the implementation of flood mitigation projects. Communities must be members of the National Flood Insurance Program (NFIP). (See Table G.1.)

The **Pre-Disaster Mitigation (PDM) program** makes grants available to state and local governments to implement cost-effective hazard mitigation activities that complement a comprehensive mitigation program. Funding is awarded for the development of an all-hazards mitigation plan or for a cost-effective hazard mitigation project. (See Table G.1.)

The **Hazard Mitigation Grant (HMG) program** makes grants available to state and local governments as well as eligible private, non-profit organizations to implement cost-effective, long-term mitigation measures following a major disaster declaration. A project does not have to be in a declared county to be eligible; every community that is vulnerable to natural hazards should consider applying. (See Table G.1.)

The **Severe Repetitive Loss program** provides funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss structures insured under the NFIP. These structures are residential properties insured under the NFIP that have had two or more large claims (see the Federal Emergency Management Agency website for details). (See Table G.1.)

Illinois Department of Commerce and Economic Opportunity (DCEO)

The **Illinois Community Development Assistance Program** administers funds through the Federal Community Development Block Grants: Small Cities program. The Community Development Assistance Program is designed to help communities meet their greatest economic and community development needs, with a focus on communities with low- to moderate-income populations. The public infrastructure component of the program is used to mitigate conditions that are detrimental to public health and welfare, primarily in residential areas. These projects can include the design and construction of storm sewers. (See Table G.1.)

The following table shows Illinois EMA and DCEO funding sources with their associated program outputs, participation requirements, and funding limits (Table G.1.).

Table G.1. Sources of funding, program outputs, and participation requirements for various types of flood hazard mitigation identified in the IDNR Urban Flooding Awareness Act draft report (adapted from Table 6.1 in that report).

	IDNR/OWR UFC	IEMA FMA	IEMA PDM	IEMA HMGP	Direct Legislative Action	DCEO CDAP PI and Emergency PI	DCEO CDP PI + Design	IEPA Revolving Loan
Types of Projects/Outcomes								
Storm Sewer Improvements		x	x	x	x	x	x	x
Combined Sewer Improvements					x	x	x	x
Conveyance Improvements	x	x	x	x	x			
Levees	x				x			
Detention Basins	x	x	x	x	x			
Projects on Private Property		x	x	x				
Individual Basement Mitigation								
Repetitive Loss Structure Buyouts		x	x	x				
Planning Reports	x	x	x	x	x			
Program Outputs								
Project Specific Planning Documents	x				x		x	
Construction Documents	x				x	x	x	
Construction Funding	x	x	x	x	x	x	x	
Construction Engineering	x				x	x	x	
Local Participation Requirements								
Operation and Maintenance	x	x	x	x	x	x	x	x
Utility Relocations	x							
Land Rights Acquisition	x							
NFIP Participation	x	x	x	x		x	x	
Emphasis on Low to Moderate Income						x	x	
Pre-approved Planning		Mitigation PI	Mitigation PI	Mitigation PI		x		x
Program Funding								
Federal Disaster Declaration Required				x				
Local Cost Share		25%	25%	25%		25%	25%	Low interest loan
B/C Ratio	≥ 1.0	≥ 1.0	≥ 1.0	≥ 1.0	None	None	None	None
Funding Limits						\$450,000 or \$200,000 for Emergency	\$450,000 max with \$150,000 Design Included	

Acronyms used in Table G.1:

IDNR/OWR – Illinois Department of Natural Resources, Office of Water Resources

IEMA – Illinois Emergency Management Agency

FMA – Flood Mitigation Assistance program

PDM – Pre-Disaster Mitigation program

HMG – Hazard Mitigation Grant program

DCEO – Department of Commerce and Economic Opportunity

CDAP PI and Emergency PI – Community Development Assistance Program – Planning and Emergency Planning

CDP PI + Design - Community Development Assistance Program – Planning and Design

IEPA – Illinois Environmental Protection Agency

NFIP – National Flood Insurance Program

B/C ratio – Benefit/Cost ratio

Mitigation PI – Mitigation Plan

U.S. Army Corps of Engineers

The **Continuing Authorities Program** is a group of 10 legislative authorities under which the Secretary of the Army, acting through the Chief of Engineers, is authorized to plan, design, and implement certain types of water resources projects without additional project specific congressional authorization. Water resource related problems that can be evaluated include bank instability that compromises public property or infrastructure, aquatic ecosystem degradation, and overbank flooding and structural damages. These problems are evaluated through a cost shared partnership addressed in two phases to include study and implementation. If you think you have a water resources problem that may fit into the stated examples, please contact the St. Louis District. The Continuing Authorities Program Manager will speak with you and, if warranted, will visit your problem area to ascertain whether or not your problem fits within this authority.

The **Flood Plain Management Services (FPMS) Program** provides the full range of technical services and planning guidance needed to support effective floodplain management. The program's authority stems from Section 206 of the 1960 Flood Control Act (PL 86-645), as amended. Its objective is to foster public understanding of the options for dealing with flood hazards and to promote prudent use and management of the Nation's flood plains. The program develops or interprets site-specific data on obstruction to flood flows, flood formation and timing; flood depths or stages; and flood water velocities.

Every year, each state, local government and tribe can provide the Corps its request for studies under the **Planning Assistance to States Program**, and the Corps then accommodates as many studies as possible within the funding allotment. Typical studies are only planning level of detail; they do not include detailed design for project construction. Section 22 of the Water Resources Development Act (WRDA) of 1974, as amended, provides authority for the Corps of Engineers to assist the States, local governments, Native American Tribes and other non-Federal entities, in the preparation of comprehensive plans for the development and conservation of water and related land resources. PAS studies are cost shared on a 50 percent federal — 50 percent non-federal basis. Also, all or a portion of the non-federal cost may be performed as in-kind work rather than having to pay all cash. This must be negotiated before the study agreement is finalized.

U.S. Department of Housing and Urban Development (HUD)

The **National Disaster Resilience Competition**, announced in June 2014, invited communities that have experienced natural disasters to compete for funds to help them rebuild and increase their resilience to future disasters. The competition supports innovative resilience projects at the local level while encouraging communities to adopt policy changes and activities that plan for the impacts of extreme weather and climate change. All states with counties that experienced a Presidentially Declared Major Disaster in 2011, 2012, or 2013, which includes Illinois, were eligible to apply. This competition may be renewed in future years.

U.S. Environmental Protection Agency

The **USEPA Source Reduction Assistance grant program** supports pollution prevention projects that will provide an overall benefit to the environment by preventing pollutants at the source (i.e., not treatment or cleanup programs). Applicants must demonstrate new or innovative techniques for education or training that promote pollution prevention and source reduction efforts. State and local governments and non-profits are eligible to receive funds or cooperative agreements.

The **Environmental Education Grants Program** supports environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. Grants are issued to organizations including local education agencies, state schools, colleges, and nonprofit organizations.

The **Environmental Justice Small Grants Program** supports communities working on solutions to local environmental and public health issues through collaborative partnerships. One focus of successful applications is community-based preparedness and resilience efforts, particularly for climate resiliency.

The **Urban Waters Small Grants Program** improves coordination among federal agencies and collaborates with community-led revitalization efforts to improve the Nation's water systems. Funds go to research, investigations, training, surveys, studies, and demonstrations that will advance the restoration of urban waters by improving water quality through activities that also advance community priorities. Sponsored projects receive support in a number of different ways. There is currently no open Request for Proposals.

EPA Regions will engage a contractor to provide technical assistance to states or local communities for pilot projects on two topics: (1) green stormwater management (low impact development/green infrastructure), and (2) protection of healthy watersheds. Funds are provided to the selected EPA Region for the Region to contract services to explore integrating the topics into local or state FEMA hazard mitigation plans.

U.S. Department of Agriculture

The **Conservation Reserve Program (CRP)** is a federally funded voluntary program that contracts with agricultural producers so that environmentally sensitive land, such as wetland and floodplain, is not farmed or ranched, but instead used for conservation benefits. In the Upper Silver Creek watershed, at least 44 parcels in the floodplain are already enrolled in the CRP, as of 2013. Farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species such as native prairie grasses that will improve environmental health and quality, in exchange for a yearly rental payment. The land must be eligible for one or more conservation practices, including grass waterways, filter strips, wetland restoration, riparian buffers, flood control structures, and sediment retention. Contracts for land enrolled in CRP are 10 to 15 years in length. The long-term goals of the program are to reestablish valuable land cover that will help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

The **CRP – Grasslands** program is part of the CRP program. It conserves working grasslands, rangeland, and pastureland while maintaining the areas as livestock grazing lands. Participants who establish long-term, resource-conserving plant covers (i.e., approved grasses or trees) are provided with annual rental payments up to 75 percent of the grazing value of the land. Cost-share assistance also is available for up to 50 percent of the covers and other practices, such as cross fencing to support rotational grazing or improving pasture cover to benefit pollinators or other wildlife. Participants may still conduct common grazing practices, produce hay, mow, or harvest for seed production, conduct fire rehabilitation, and construct firebreaks and fences.

The **Conservation Reserve Enhancement Program (CREP)** is an offshoot of the CRP that addresses high priority environmental problems in a partnership between the state and federal government. It funds the removal of environmentally sensitive land (such as wetlands and highly erodible land) from crop

production, and the introduction of conservation practices. The Kaskaskia River Watershed is eligible for CREP agreements.

The **Agricultural Conservation Easement Program (ACEP)** is a Natural Resources Conservation Service (NRCS) program. It repeals the Farm and Ranch Lands Protection Program (FRPP), the Grassland Reserve Program (GRP), and the Wetlands Reserve Program (WRP) and consolidates the purposes of these programs into one easement program. The two easement enrollment components of ACEP are agricultural land easements (ACEP-ALE) and wetland reserve easements (ACEP-WRE).

- Agricultural Land Easements (ALEs) prevent the conversion of productive farmland to non-agricultural uses. Land eligible for agricultural easements includes cropland, rangeland, grassland, pastureland and nonindustrial private forest land. NRCS will prioritize applications that protect agricultural uses and related conservation values of the land and those that maximize the protection of contiguous acres devoted to agricultural use.
- Wetland Reserve Easements (WREs) provide habitat for wildlife, improve water quality, and reduce flooding. Technical and financial assistance is provided to restore, protect, and enhance wetlands. Land may be enrolled in easements for various time periods. Land eligible for wetland reserve easements includes farmed or converted wetland that can be successfully and cost-effectively restored. NRCS will prioritize applications based the easement's potential for protecting and enhancing habitat for migratory birds and other wildlife.

The **Environmental Quality Incentive Program (EQIP)**, run by NRCS, provides financial and technical assistance to individuals and entities to address soil, water, air, plant, animal and other related natural resource concerns on their land. Funding can be provided for the implementation of structural and management practices, including conservation tillage, on eligible agricultural land.

The **Conservation Stewardship Program (CSP)** helps producers maintain and improve existing conservation systems and implement additional activities to address priority resources concerns. Payments made are based on performance of the practices. Two types of payments are provided through five-year contracts: annual payments for installing new conservation practices and maintaining existing practices, and supplemental payments for adopting a resource-conserving crop rotation.

The **Healthy Forests Reserve Program (HFRP)** aims to assist landowners in restoring, enhancing, and protecting forestland resources on private land through easements, 30-year contracts, and 10-year cost-share agreements. The land must restore, enhance, or measurably increase the recovery of threatened or endangered species, improve biological diversity, or increase carbon storage.

The **Regional Conservation Partnership Program (RCPP)** encourages partnerships with producers on installing and maintaining conservation projects that increase the restoration and sustainable use of soil, water, wildlife, and related natural resources. Contracts and easement agreements are implemented through other NRCS programs: ACEP, EQIP, CSP, or HFRP. The RCPP essentially provides more funding through these programs. There are three funding pools within the program: state, federal, and Critical Conservation Areas (CCAs). The Upper Silver Creek watershed is within the Mississippi River CCA.

Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies in agricultural production. The program allows NRCS to work with other public and private entities to accelerate technology transfer and adoption. There have been funding opportunities at the national and state level.

The **Water & Waste Water Disposal Loan & Grant Program** provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and stormwater drainage to households and businesses in eligible rural areas. The program assists applicants who are not otherwise able to obtain commercial credit on reasonable terms for these projects. Areas served must be rural or towns populated with 10,000 people or fewer. Long-term, low interest loans are the primary funding type available. Grants may be combined with a loan if necessary and if funds are available.

The **Forest Legacy Program** protects environmentally sensitive “working forests” that protect water quality, provide habitat, forest products, opportunities for recreation, and other public benefits. It is designed to encourage the protection of privately owned forest lands through conservation easements. Program participants must prepare a multiple resource management plan for the land.

U.S. Fish and Wildlife Service

The **Partners for Fish and Wildlife Program** is run by the U.S. Fish and Wildlife Service (USFWS) under the Department of the Interior (DOI). The Partners for Fish & Wildlife program works with private landowners to improve fish and wildlife habitat on their lands through voluntary, community-based stewardship. Noting that more than 90% of land in the Midwest is in private ownership, the program promotes high quality habitat through partnerships with private conservation organizations, state and federal agencies, and tribes to reach private landowners. Funding, materials, equipment, labor and expertise can be shared to meet shared restoration and conservation goals.

Non-Governmental Organizations (NGOs)

Several NGOs have programs or missions that support the recommendations in this plan.

Environmental non-profit groups

The following groups may have funds to help carry out their missions at any given time:

- **Ducks Unlimited (DU)** – DU’s Living Lake Initiative is established to provide support in enhancing shallow lake complexes.
- **Pheasants Forever** – Local Chapters often provide food plot and native grass seed to landowners.
- **Trees Forever** – The Working Watersheds: Buffers and Beyond program provides a 50% cost share (up to a maximum of \$2,000) to implement a water quality project or demonstration site. Riparian buffer plantings are the main focus of the program, but other innovative projects are also considered.
- **The Nature Conservancy (TNC)** – TNC works to protect diverse natural habitats including wetlands and forests.
- **The National Fish and Wildlife Foundation (NFWF)** – NFWF provides grants on a competitive basis to projects that support fish and wildlife. Its program areas include protecting critical habitat, capacity building for partner organizations, and wetland and forest stewardship.
- **The National Wildlife Federation (NWF)** – The NWF supports projects that protect and restore fish and wildlife habitat.
- **Water Environment Federation (WERF)** – The Water Environment Research Foundation funds water quality research and facilitates collaboration among partners. Currently, an open Request for Proposals solicits research projects on integrating water services planning with urban planning. Past projects have included innovative wastewater treatment plant upgrades.

Private Foundations/Companies

Companies such as Coca-Cola and Patagonia often have foundations or grant programs to support environmental missions. Some of these companies/foundations include:

- **Coca-Cola Foundation** – Coca-Cola’s Community Support program supports funding for program areas including water stewardship and education.
- **McKnight Foundation** – The McKnight Foundation’s environmental grantmaking is divided into projects that revolve around restoring water quality in the Mississippi River and that improve climate resilience in the Midwest.
- **Walton Family Foundation** – The Walton Foundation supports projects including freshwater projects that sustain healthy communities in the Mississippi River Basin.
- **Illinois American Water’s 2018 Environmental Grant Program** – Illinois American Water supports innovative, community-based environmental projects that improve, restore or protect watersheds through partnerships. Watershed cleanups, reforestation efforts, biodiversity projects, wellhead protection and hazardous waste collection efforts are supported through grants of up to \$10,000.

Other

In-Lieu Fee Mitigation Program

In-lieu fee mitigation is a type of mitigation banking that can be used to compensate for unavoidable impacts to wetlands while directing funds to sites with high ecological value. A permittee pays a fee to a third party instead of conducting project-specific mitigation or buying credits from a wetland mitigation bank. The fee represents the estimated cost of replacing the wetland functions lost or degraded as a result of the permittee’s project. The in-lieu fee mitigation program gathers several such fees and uses them to finance an extensive mitigation project. Heartlands Conservancy is in the final stages of becoming an Approved Program Sponsor within the American Bottoms and Lower Kaskaskia River watersheds. Once approved, project implementation should begin in 2016. Mitigation sites will include both wetlands and streams, so fees will go towards both wetland and stream restoration.

Table G.2. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
<i>State/Federal Government</i>				
Illinois Environmental Protection Agency	Section 319(h) Nonpoint Source Pollution Control Financial Assistance Program	Local units of government and other organizations.	Watershed planning, implementing BMPs, or water quality monitoring.	Yes
	State Revolving Fund Loan Program, including: <ul style="list-style-type: none"> Public Water Supply Loan Program Water Pollution Control Loan Program 	Communities and public or private entities.	Infrastructure upgrades, stormwater projects that benefit water quality, projects that improve Illinois' rivers, streams, and lakes.	Yes
	Streambank Cleanup and Lakeshore Enhancement Grants	Groups that have established a recurring streambank or lakeshore cleanup.	Dumpster rental, landfill fees, safety attire.	No. Funding may be reinstated in the future.
Illinois Department of Agriculture	Streambank Stabilization and Restoration Program	Landowners with severely eroded streambanks.	Labor, equipment, materials.	No. Funding may be reinstated in the future.
	Conservation Practice Program	N/A	Conservation practices including filter strips, grassed waterways, no-till, and terraces.	No. Funding may be reinstated in the future.
	Sustainable Agriculture Grant Program	Organizations, governmental units, educational institutions, non-profit organizations, and individuals.	Research, education, and on-farm demonstration projects that address sustainable farming.	Yes
Illinois Department of Natural Resources	Urban Flood Control Program	Citizens or local, state, or federal officials.	Out-of-bank riverine flooding initiatives and projects that provide an outlet for stormwater.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
<i>State/Federal Government (continued)</i>				
Illinois Emergency Management Agency	Flood Mitigation Assistance Program	Communities that are members of the NFIP.	Development of a comprehensive flood mitigation plan, or implementation of flood mitigation projects.	Yes
	Pre-Disaster Mitigation Program	State and local governments.	Creation of an all-hazards mitigation plan or a cost-effective hazard mitigation project.	Yes
	Hazard Mitigation Grant Program	State and local governments and non-profit organizations.	Cost-effective, long-term mitigation measures following a major disaster.	Yes
	Severe Repetitive Loss Program	Residential properties insured under the NFIP that have had two or more large claims.	Initiatives that reduce or eliminate the long-term risk of flood damage.	Yes
Illinois Department of Commerce and Economic Opportunity	Illinois Development Assistance Program	Communities with low- to moderate-income populations.	Implementation of mitigation measures, primarily in residential areas, to address issues that are detrimental to public health and welfare (e.g., design and construction of storm sewers).	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
<i>State/Federal Government (continued)</i>				
U.S. Army Corps of Engineers	Continuing Authorities Program <i>(not a grant)</i>	U.S. Army Corps of Engineers	Planning, design, and implementation of certain types of water resources projects to address problems including bank instability that compromises public property or infrastructure, aquatic ecosystem degradation, and overbank flooding and structural damages. Cost share required.	Yes
	Flood Plain Management Services (FPMS) Program <i>(not a grant)</i>	U.S. Army Corps of Engineers	Develops or interprets site-specific data on obstruction to flood flows, flood formation and timing; flood depths or stages; and flood water velocities.	Yes
	Planning Assistance to States (PAS) Program <i>(not a grant)</i>	U.S. Army Corps of Engineers	Studies produced to a planning level of detail to assist States, local governments, Native American Tribes and other non-Federal entities in the preparation of comprehensive plans for the development and conservation of water and related land resources.	Yes
U.S. Department of Housing and Urban Development	National Disaster Resilience Competition	States with counties that experienced a Presidentially Declared Major Disaster in 2011, 2012, or 2013.	Innovative resilience projects at the local level that encourage the adoption of policy changes, and activities that prepare for impacts of extreme weather and climate change.	No. Funding may be reinstated in the future.
U.S. Environmental Protection Agency	USEPA Source Reduction Assistance Grant Program	State and local governments and non-profit organizations.	Pollution prevention projects that will benefit the environment by eliminating pollution at the source.	Yes
	Environmental Education Grants Program	Local education agencies, state schools, colleges, and non-profit organizations.	Environmental education projects that promote awareness and stewardship.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
<i>State/Federal Government (continued)</i>				
U.S. Environmental Protection Agency (continued)	Environmental Justice Small Grants Program	Communities and community-based organizations.	Solutions to local environmental and public health issues (e.g., climate resiliency, community preparedness) through collaborative partnerships.	Yes
	Urban Waters Small Grants Program	Communities and community-based organizations.	Research, training, surveys, and demonstrations that advance the restoration of urban waters by improving water quality through activities that also advances community priorities.	No. Funding may be reinstated in the future.
	Technical assistance from EPA Regions	EPA Regions collaborate with FEMA and states or local communities.	Pilot projects that can be integrated into a state or local hazard mitigation plan on the topics of green stormwater management (low impact development/green infrastructure) and the protection of healthy watersheds.	Yes
U.S. Department of Agriculture	Conservation Reserve Program	Landowners or farmers with environmentally sensitive land (e.g., wetland, floodplain). Land must be eligible for one or more conservation practices, including grass waterways, wetland restoration, riparian buffers, and flood control structures.	Reestablish valuable land cover that will improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.	Yes
	CRP—Grasslands	Landowners and operators.	Initiatives to conserve working grasslands, rangeland, and pastureland while maintaining livestock grazing land.	Yes
	Conservation Reserve Enhancement Program (CREP)	Farmers and ranchers that live in a state with a CREP agreement in place with the Farm Service Agency (FSA).	Removal of environmentally sensitive land (e.g., wetlands) from crop production and introduction of conservation practices.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
<i>State/Federal Government (continued)</i>				
U.S. Department of Agriculture (continued)	Agricultural Conservation Easement Program, including: <ul style="list-style-type: none"> Agricultural Land Easements Wetland Reserve Easements 	Agricultural Land Easement eligibility: cropland, rangeland, grassland, pastureland, and nonindustrial private forest.	Prevention of productive farmland conversion to non-agricultural uses.	Yes
		Wetland Reserve Easement eligibility: farmed or converted wetland that can be successfully and cost-effectively restored.	Habitat creation, water quality improvement, flood reduction.	
	Environmental Quality Incentive Program	Individuals and entities.	Structural and management practices that address natural resource concerns on agricultural land.	Yes
	Conservation Stewardship Program	Landowners in compliance with highly erodible land and wetland conservation requirements with current farm records with FSA.	Assistance in maintaining and improving existing conservation systems. Implementation of additional activities to address priority resource concerns.	Yes
	Healthy Forests Reserve Program	Any landowner whose land restores, enhances, or increases the recovery of threatened or endangered species.	Restoration, enhancement, and protection of forestland resources on private lands through easements.	Yes
	Regional Conservation Partnership Program	Partners of the Natural Resources Conservation Service.	Partnerships with producers to install and maintain conservation projects that increase the restoration and sustainable use of soil, water, wildlife, and related natural resources.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
<i>State/Federal Government (continued)</i>				
U.S. Department of Agriculture (continued)	Conservation Innovation Grants	Public and private entities.	Development and adoption of innovative conservation approaches and technologies in agricultural production.	Yes
	Water and Waste Water Disposal Loan and Grant Program	Rural areas or towns populated with 10,000 people or fewer.	Creation of clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and stormwater drainage to households and businesses.	Yes
	Forest Legacy Program	Environmentally sensitive “working forests” that protect water quality, provide habitat, and public benefits. Must prepare a multiple resources management plan for the land.	Protect privately owned forest lands through conservation easements.	Yes
U.S. Fish and Wildlife Service	Partners for Fish and Wildlife Program	Private landowners	Improvements to fish and wildlife habitat through voluntary, community-based stewardship.	Yes

Table G.2., Continued. Funding Sources for Watershed Management Efforts.

Funding Sources	Grant Programs	Eligible Entities	Types of Practices Funded	Currently Funded (As of June 2018)
<i>Non-Governmental Organizations (non-profit organizations, private foundations/companies, other) that support watershed management efforts.</i>				
Ducks Unlimited	e.g. Living Lake Initiative	N/A	Support and enhance shallow lake complexes.	N/A
Pheasants Forever	N/A	Landowners	Local chapters provide food plot and native grass seed.	N/A
Trees Forever	Working Watersheds: Buffers and Beyond	Iowa landowners	Fifty-percent cost share to implement a water quality project or demonstration site.	Yes
The Nature Conservancy	N/A	N/A	Protect diverse natural habitats, including wetlands and forests.	N/A
The National Fish and Wildlife Foundation	N/A	N/A	Critical habitat protection, capacity building for partner organizations, and wetland and forest stewardship.	N/A
The National Wildlife Federation	N/A	N/A	Protection and restoration of fish and wildlife habitat.	N/A
Water Environment Federation	N/A	N/A	Water quality research and facilities collaboration among partners.	N/A
Coca-Cola Foundation	Community Support Program	Individuals, organizations, communities.	Water stewardship and education.	Yes
Illinois American Water	2018 Environmental Grant Program	Communities that have a source water or watershed protection need.	Community-based projects that improve or protect watersheds through partnerships. Watershed cleanups, reforestation, biodiversity, wellhead protection and hazardous waste collection are supported through grants of up to \$10,000.	Yes
In-Lieu Fee Mitigation Program	N/A	N/A	Mitigation banking that can be used to compensate for unavoidable impacts to wetlands while directing funds to sites with high ecological value.	N/A
McKnight Foundation	N/A	Organizations that are invited to apply or that fit with funding strategies.	Projects that restore water quality in the Mississippi River and improve climate resilience in the Midwest.	Yes
Walton Family Foundation	N/A	Projects that match the foundation's funding criteria and priorities.	Freshwater projects that sustain healthy communities in the Mississippi River Basin.	Yes

Appendix H - Progress Report Cards

PM = Progress made; A = Achieved

Goal 1: Reduce Flooding and Mitigate Flood Damage

Existing Conditions

19% of land in the watershed (10,903 acres) are in the 100-year floodplain. Flooding in this area is common.

11% of Flood Survey respondents experienced flooding in the last 10 years. 27% of these reported monetary loss of >\$5,000 over that time due to flooding.

Major roads have been inundated with floodwater during heavy rain events.

Thousands of acres of wetlands have been lost since pre-settlement; the associated loss of ecosystem functions has been great since that time.

Watershed Impairment Reduction Targets and recommendations

New dry detention basins installed

New wet detention basins installed

Retrofits & maintenance on existing detention basins

Critical Flooding Areas prioritized

100% Critical Wetlands Areas restored

Stream flow reduced peak discharge during storm events

Programmatic changes regarding flood damage prevention ordinances, riparian buffer ordinances, and stormwater infrastructure funding

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	46.67	93.33	140	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	SWCD, NRCS, farmers, contractors	
	85.33	170.67	256	... acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	3,333.33	6,666.67	10,000	... feet storm drain system maintenance (cleaning) and expansion	Municipalities, contractors	
Flow data collected under the Monitoring Plan at other HUC14 locations. Data correlated with rainfall.	PM	PM	A	No measured increase in mean peak stream discharge / Measured reductions in peak stream discharge	USGS National Water Information System, NGRREC (monitoring results)	
Number and extent of flood damage prevention ordinances, riparian buffer ordinances, and other actions by local governments to restrict construction in floodplains and riparian areas.	PM	PM	A	Counties adopt updated Flood Damage Prevention Ordinance and Riparian Buffer Ordinance All municipalities engaged to inform about the ordinances and encourage adoption	Counties, municipalities, townships	

Number of counties/municipalities with dedicated funding for stormwater infrastructure, eg a Stormwater Utility. Dollar amount of revenue streams.	PM	PM	A	Counties adopt a mechanism for dedicated funding for stormwater infrastructure All municipalities engaged to inform about stormwater infrastructure funding options	Counties, municipalities	
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Goal 2: Improve Surface Water Quality

Existing Conditions

57,110 lbs/year of phosphorus, 17,522 tons/year of sediment, and 288,422 lbs/yr of nitrogen enter the Canteen-Cahokia Creek watershed every year, based on the STEPL model. Cahokia Creek (Cahokia Canal) and Schoenberger Creek North (Harding Ditch) impaired for dissolved oxygen in 2018 and previous years.

Average of 423 µg/L manganese observed value on impaired segment of Canteen Creek, from 2009 Cahokia Canal Watershed TMDL Report.

Over 2,000 private sewage systems are present in the watershed. Given a national estimated failure rate of 10%, 200 systems are currently failing. The actual number may be higher because many of these systems are older.

Watershed Impairment Reduction Targets and recommendations

Decrease overall pollutant loading to Canteen-Cahokia Creek and its tributaries. **Removal** of Burdick Branch, Cahokia Creek, Canteen Creek, Judy's Branch, Little Canteen Creek, Schoenberger Creek North, and Schoolhouse Branch from the Illinois EPA 303(d) list.

25% reduction in phosphorus loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy.

20% reduction in sediment loading by 2030, based on estimated impacts of proposed BMPs.

15% reduction in nitrogen loading by 2030, based on the Illinois Nutrient Loss Reduction Strategy.

No DO samples lower than the minimum concentration in streams: March – July: 5.0 mg/L at any time, 6.0 mg/L as a daily mean averaged over 7 days; August – February: 3.5 mg/L at any time, 4.0 mg/L as a daily mean averaged over 7 days, 5.5 mg/L as a daily mean averaged over 30 days. Based on 35 Ill. Adm. Code 302.

Create a strategy to improve the assessment and maintenance of private sewage systems (i.e., septic tanks) for correct functioning.

Monitor the watershed's water quality to identify trends and evaluate the success of watershed management activities.

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10- 20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	1.3	2.67	4	... acres contour buffer strips (100% of locations identified by the ACPF) (cumulative)	SWCD, NRCS, farmers, contractors	
	2,674.67	5,349.33	8,024	... acres cover crops (50% of total agricultural land area) (cumulative)		
	27	54	81	... acres grassed waterways (100% of locations identified by the ACPF) (cumulative)		
	33.33	66.67	100	... acres ponds (cumulative)		
	2,674.67	5,349.33	8,024	... acres conservation tillage (conservation tillage/no-till) (10% of total agricultural land area) (cumulative)		
	46.67	93.33	140	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)		

	6,666.67	13,333.33	20,000	... feet terraces (cumulative)		
	10	20	30	... acres waste storage structures/waste management systems (cumulative)		
	0.33	0.67	1	... acres Water and Sediment Control basins (100% of locations identified by the ACPF) (cumulative)		
	85.33	170.67	256	... acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	166.67	333.33	500	... acres new dry detention basins (cumulative)	Counties, municipalities, SWCD	
	50	100	150	... acres new wet detention basins (cumulative)		
	2	4	6	... acres detention basin retrofits (native vegetation buffers, etc.) (approximately 10% of existing basins) (cumulative)		
	2	4	6	... detention basins maintained (dredging, mowing, burning, invasives, etc.) (approximately 10% of existing basins) (cumulative)		
	33.33	66.67	100	... acres pervious pavement (cumulative)	Counties, municipalities, contractors	
	33,333.33	66,666.67	100,000	... square feet rain gardens (cumulative)		
	33.33	66.67	100	... barrels/small cisterns for rainwater harvesting and reuse (cumulative)		
	510.33	1,020.67	1,531	... properties use single property flood reduction strategies (cumulative)		
	31,292.67	62,585.33	93,878	... feet streambank and channel restoration, including 100% Critical Stream Areas (cumulative)	NRCS, SWCD, contractors	
	33.33	66.67	100	... feet logjam removal sites		
Removal of Cahokia Creek (Cahokia Canal), Canteen Creek, and Schoenberger Creek North (Harding Ditch) from Illinois EPA 303(d) list.	PM	PM	A	All streams in the watershed removed from the 303(d) list	Illinois EPA 303(d) list	
Concentrations and loads of in-stream pollutants	PM	PM	A	Measured reductions in in-stream phosphorus, sediment, and nitrogen (see Monitoring Plan). Measured increases in in-stream dissolved oxygen (see Monitoring Plan).	NGRREC (water quality monitoring results)	
Nutrient removal technologies incorporated into upgrades of wastewater treatment plants	PM	PM	A	All wastewater treatment plants meet NPDES permit requirements; upgrades implemented as needed.	Individual treatment plants; US EPA Discharge Monitoring Report	

					(DMR) Tool	
Percentage of new development projects with private sewer. Number of existing on-site treatment systems connected to public sewers.	10%	20%	30%	... new development projects have public sewer. Also, 200 on-site treatment systems connected to public sewers (~10% of private sewage systems in the watershed)	County, municipal records	
Number and extent of local ordinances and programs requiring regular inspection and maintenance of on-site sewage systems.	6	8	10	... municipalities and 3 counties require regular private sewage inspections (beyond complaint-based program)	Counties, municipalities	
Enrollment of land in conservation easements including CRP and CREP	1.5	2	2.5	... times the 2015 acreage enrolled in CRP and CREP	NRCS	

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Goal 3: Promote Environmentally Sensitive Development Practices

Existing Conditions

Current 31.3% impervious cover; current 9,865 acres developed open space (2011 NLCD) or 5,888 acres open space (recognized parks etc.)

Thousands of acres of wetlands lost since pre-settlement; loss of ecosystem functions

Regulations and common practices in new development have not and generally still do not prioritize the protection of open space or natural features.

Watershed Impairment Reduction Targets and recommendations

Preservation of open space and infiltration measures in all new and redevelopment

Increase in rain gardens

Increase in pervious surfaces in new and redevelopment

Decrease in impervious surfaces in new and redevelopment

Increase in land in conservation easements

Programmatic changes including use of Conservation Development design, local ordinances, green infrastructure, and in-lieu fee mitigation

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	166.67	333.33	500	... acres new dry detention basins (cumulative)	Counties, municipalities, SWCD	
	50	100	150	... acres new wet detention basins (cumulative)	Counties, municipalities, SWCD	
	2	4	6	... acres detention basin retrofits (native vegetation buffers, etc.) .) (approximately 10% of existing basins) (cumulative)	Counties, municipalities, SWCD	
	2	4	6	... detention basins maintained (dredging, mowing, burning, invasives, etc.) (approximately 10% of existing basins) (cumulative)	Counties, municipalities, SWCD	
	33.33	66.67	100	... acres pervious pavement (cumulative)	Counties, municipalities, contractors	
	33,333.33	66,666.67	100,000	... square feet rain gardens (cumulative)	Counties, municipalities, contractors	
Area of impervious surfaces in new development	PM	PM	A	2% or less annual increase in impervious cover in the overall watershed	NLCD Percent Developed Impervious Surface dataset	

Enrollment of land in conservation easements including CRP and CREP	1.5	2	2.5	... times the 2018 acreage enrolled in CRP and CREP	NRCS	
Number of new development proposals using Conservation Development design to protect natural features.	20%	40%	60%	... of subdivision and other development proposals contain design elements from Conservation Development design, eg protection of open space	Counties, municipalities	
Number and extent of municipal ordinances that support: stormwater, flood management, green infrastructure, wetlands protection through in-lieu fee mitigation, and native landscaping.	PM	PM	A	Counties adopt updated Flood Damage Prevention Ordinance and Riparian Buffer Ordinance All municipalities engaged to inform about the ordinances and green infrastructure, in-lieu fee mitigation programs to encourage adoption	Municipalities	
Number of counties and municipalities implementing green infrastructure incentives. Number of ordinance changes to allow or encourage native landscaping.	2	4	6	... municipalities offer green infrastructure incentives such as flexible implementation of regulations, fee waivers, tax abatement, and streamlined development review process All municipalities allow and encourage native plants (eg changes to weed control ordinances)	Counties, municipalities	
Number of acres wetland restored and number of feet streambank restored under in-lieu fee mitigation program	PM	PM	A	In-lieu fee mitigation program established, covering the entire watershed Critical Wetland and Critical Stream Areas prioritized for restoration under in-lieu fee program	HeartLands Conservancy, US ACE	

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Goal 4: Support Healthy Fish and Wildlife Habitat

Existing Conditions

15.5 miles of streams were identified as having poor riparian conditions (identified by aerial assessment).

The riparian areas along 39% of streams assessed (15.1 miles) are in poor condition. Of this, 82,579 ft are Critical Riparian Areas. 15.02 miles Critical Logjam Areas noted.

Thousands of acres of wetlands have been lost since pre-settlement; the associated loss of ecosystem functions has been great since that time.

Watershed Impairment Reduction Targets and recommendations

100% Critical Riparian Areas restored

Majority of riparian areas in poor condition restored

100% Critical Wetlands Areas restored

Macroinvertebrate& fish samples showing increased stream health

Programmatic changes regarding stream cleanup activities

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number and extent of Management Measures (BMPs) implemented	46.67	93.33	140	... acres of riparian areas ecologically restored, including 100% Critical Riparian Areas (cumulative)	NRCS, SWCD, contractors	
	85.33	170.67	256	... acres wetlands restored, enhanced, or created (100% of Critical Wetland Areas) (cumulative)		
	33.33	66.67	100	... feet logjam removal sites		
Macroinvertebrate sampling results (diversity and stream health indicators) from RiverWatch volunteers and fish sample data collected by the Illinois Natural History Survey.	PM	PM	A	All Illinois RiverWatch samples indicate "Good", "Fair", or "Excellent" Taxa Richness, EPT Taxa Richness, and MBI water quality scores No decrease in water quality indicated by Illinois Natural History Survey fish sampling	Illinois RiverWatch, Illinois Natural History Survey	
Number of programs and participants for stream cleanup activities in the watershed.	PM	PM	A	Stream Cleanup Team (or similar program) established Over 20 participants annually	Counties, municipalities, non-profit organizations	
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Goal 5: Develop Organizational Frameworks to Implement Watershed Goals

Existing Conditions

There are several potential partners in the region dedicated to different aspects of water quality and stormwater management, including federal agencies, state agencies, non-profits, land trusts, and local governments.

Several potential partners have funding available for projects that would further the mission of more than one group.

Watershed Impairment Reduction Targets and recommendations

Continued support from watershed partners and stakeholders, including funding.

Programmatic changes regarding local development ordinances, and open space protection.

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number of watershed partners adopt and/or support (via a resolution) the Canteen-Cahokia Creek Watershed Plan as a "guidance document".	PM	PM	A	All watershed partners adopt and/or support (via a resolution) the Canteen-Cahokia Creek Watershed Plan as a "guidance document". Municipalities engaged and encouraged to adopt the Plan as a "guidance document".	Counties, municipalities, townships, other partners	
Number and extent of municipal ordinances that support: stormwater, flood management, green infrastructure, wetlands protection (in-lieu fee mitigation), native landscaping.	PM	PM	A	Counties adopt updated Flood Damage Prevention Ordinance and Riparian Buffer Ordinance. All municipalities engaged to inform about the ordinances and green infrastructure, in-lieu fee mitigation programs to encourage adoption.	Municipalities	
Number of new and redevelopment projects protecting sensitive natural areas/open space and creating naturalized stormwater systems. Area of land donated to a public agency/conservation organization for long-term management. Number of HOAs with rules about management of the natural areas in their bylaws.	20%	40%	60%	... of subdivision and other development proposals contain design elements from Conservation Development design, eg protection of open space and creating naturalized stormwater systems (green infrastructure)	HOAs, counties, communities, HeartLands Conservancy	
	10%	20%	30%	... new development projects donate land to a public agency/conservation organization		
	33%	67%	100%	... new HOAs' bylaws include rules about management and fees for natural areas		
	17%	33%	50%	... existing HOAs change their bylaws to include rules about management and fees for natural areas		

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Goal 6: Conduct Education and Outreach

Existing Conditions

The public engagement process for the watershed plan revealed a need for education on water quality and flooding for the general public.

Many landowners came to meetings requesting technical support and assistance with obtaining funding to implement BMPs on their land. Municipalities also need access to resources and funding to implement projects in city limits.

Watershed Impairment Reduction Targets and recommendations

Increase in number of people effectively reached by outreach efforts

Increase in resident/property owner participation watershed improvements

Measurement Indicator	Milestone				Data source	Achieved?
	Short-term (1-10 years)	Medium-term (10-20 years)	Long-term (20+ years)			
Number of people reached by and involved in outreach efforts related to this Watershed-Based Plan.	PM	PM	A	1,200 people (2 times the ~600 people reached in the Watershed Planning process) engaged in implementation/outreach activities annually.	Counties, municipalities, townships, NGRREC, SWCD, other partners	
Percent of education/outreach session attendees who rate presentations and other activities and good or excellent.	75%	85%	95%	... of surveyed participants each year who rated outreach session(s) or presentation(s) as good or excellent.		
Percent of education/outreach session attendees who commit to action or follow-up with a watershed partner.	25%	50%	75%	... of surveyed participants who indicate a commitment to action or contact the county, SWCD, NGRREC, HLC or other partner to make improvements on their land.		
Percent of schools that incorporate a watershed-based project or learning session.	10%	20%	30%	... of schools that included at least one Silver Creek watershed-related learning experience or project each year.	Schools, School Districts, Counties	

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