GLAD Partnership – Greendale, Lawrenceburg, Aurora, and Dearborn County

Regional Water Quality Characterization Report

Historic Aurora Indiana

Lawrenceburg Indiana

City of Greendale Indiana

Dearborn County Indiana

OHM Advancing Communities

Executive Summary

The newly-designated MS4s of Greendale, Lawrenceburg, Aurora, and Dearborn County have joined together to form the GLAD MS4 Partnership. The GLAD Partnership concept was conceived in 2022 when the neighboring communities were officially designated as Municipal Separate Storm Sewer Systems (MS4s) Phase 2 communities by the Indiana Department of Environmental Management (IDEM). The formal partnership was started in early 2023 prior to the official Notice of Intents (NOIs) being submitted to the state, with each community receiving their own permit, so the communities are not co-permittees. The GLAD Partnership provides a forum for developing a coordinated implementation of the MS4 program in the communities.

The Indiana MS4 Phase 2 program provides regulation for communities for non-point source stormwater runoff as an unfunded federally mandated component of the Clean Water Act (CWA), which is managed by the Indiana Department of Environmental Management (IDEM), for the purpose of protecting and improving water quality. These neighboring communities decided to join together to form the GLAD Partnership, in a regional collaborative effort to enhance their MS4 programs in a cost-efficient and effective manner. These communities already have a strong history of collaboration and have made great efforts in permitting compliance by being proactive in building their MS4 programs.

The collaborative partnership goals are still under development, but seek to both educate and get the public involved in contributing to the MS4 program goals of managing water pollution. Adoption and implementation of stormwater ordinances for Illicit Discharge Detection and Elimination, Construction Site Runoff Control, and Post-Construction Stormwater Management are planned for Spring 2024. The regionally-prepared, but individually-adopted, ordinances will seek to improve water quality through efforts to eliminate illicit discharges, improved management of stormwater from construction sites, installation and improved long term operation and maintenance of post-construction structural Best Management Practices (BMPs). Additionally, pollution prevention and good housekeeping procedures will be implemented at municipal facilities and throughout the communities including cleaning and maintaining the stormwater system, periodic street sweeping, and education and training for public employees and citizens.

The findings of this Regional Baseline Characterization were used to recommend the best applicable methods throughout the region as MS4 communities continue to implement the MS4 program, which includes structural and non-structural BMPs. An appendix for each of the GLAD communities is included for information specific to that community. The following additional BMPs are recommended for consideration during the development of activities associated with the Stormwater Quality Management Plans, which are also under development:

- Develop a municipal employee training program and implement training for construction site inspections.
- Continue to enhance education and outreach efforts for public employees, citizens, contractors, developers, engineers, and municipal staff to include the MS4 Program water quality components.
- Map the stormwater systems, with an initial emphasis on mapping outfalls, and post-construction BMPs.

This Regional Water Quality Characterization Report reviews available data, including water quality monitoring data to determine benefits to the region and further guide MS4 programs.

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Table of Revisions

The following table summarizes revisions, additions, deletions, etcetera to the contents of this report:

Date	Revised Pages/Appendices	Summary of Change

1.0 Introduction

1.1 General Information

1.1.1 Acronym List

BMP	Best Management Practice
BOD	Biological Oxygen Demand
CD	Conservancy District
CFU	Colony Forming Unit
CSO	Combined Sewer Overflow
ERU	Equivalent Residential Unit
HUC	Hydrologic Unit Code
IAC	Indiana Administrative Code
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
GLAD	Greendale, Lawrenceburg, Aurora, Dearborn County MS4 Partnership
LTCP	(Combined Sewer Overflow) Long Term Control Plan
MCM	Minimum Control Measure
Mg/l	Milligram per Liter
MOA	Memorandum of Agreement
MS4	Municipal Separate Storm Sewer System
NWI	National Wetland Inventory
ORSANCO	Ohio River Sanitation Commission
RBP	Rapid Bioassessment Protocol
SIC	Standard Industrial Code
SOP	Standard Operating Procedure
SQMP	Stormwater Quality Management Permit
SVAP	Stream Visual Assessment Protocol
SWCD	Soil and Water Conservation District
SWMD	Solid Waste Management District
SWQMP	Storm Water Quality Management Plan
TSS	Total Suspended Solids
UIC	Underground Injection Control
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WH-OL	Wellhead Protection Overlay District
WHPA	Wellhead Protection Area
WHPP	Wellhead Protection Plan

1.2 Location and Description

The Southeastern Indiana MS4 Region consists of five (5) MS4 communities along the Ohio River. These municipal communities include: Dearborn County unincorporated areas, City of Greendale, City of Lawrenceburg, City of Aurora, and the Hidden Valley Lake Conservancy District. The Hidden Valley CDP, located north of Greendale, was a previously designated MS4 and is not included in the Dearborn County MS4 area, nor is it currently a member of the GLAD Partnership. Incorporated areas of Dearborn County not included in the MS4 area include: St. Leon, Moores Hill, Dillsboro, and West Harrison. Figure 1 shows an overview of all the GLAD Partnership community boundaries, and Table 1 shows the total area and populations. The MS4 region encompasses nearly 300 square miles and the total population of the regional MS4 districts is approximately 47,767 with approximately 159 people per square mile (2020 Census).

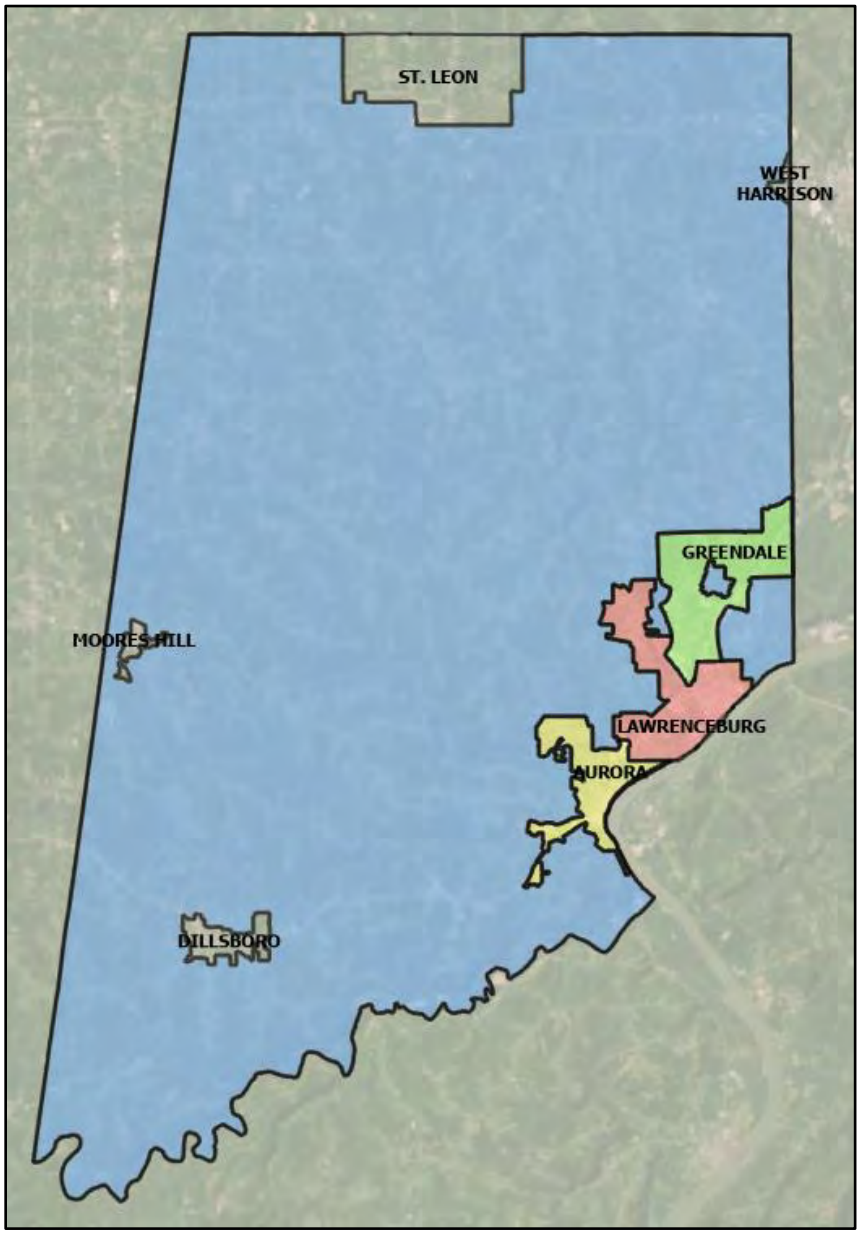

Figure 1. GLAD Partnership MS4 Communities (*not shown Hidden Valley CDP*)

Table 1. Land Area and Population for GLAD Partnership MS4 Communities

Community	Total Land Area (Acres)	Population (2020 Census)
Dearborn County	181,418	34,494*
City of Greendale	3,667	4,579
City of Lawrenceburg	3,509	5,192
City of Aurora	2,255	3,502
Total	**190,849**	**47,767**

Source: U.S Census Bureau (based on 2022 Estimates)

*Not including incorporated areas

1.3 Drainage System Description

The Municipal Separate Storm Sewer System refers to inlets, such as catch basins, storm drains, and manholes, where stormwater enters a system, and the means by which it is transported to creeks, lakes and rivers, such as through pipes, culverts, and ditches. Natural streams are not considered a component of the MS4 system, but the MS4 system often discharges to streams through outfalls.

2.0 Baseline Characterization

Implementing appropriate structural and non-structural best management practices (BMPs) in alignment with the goals established by the MS4 Program, as dictated by the Indiana Department of Environmental Management (IDEM), and the Environmental Protection Agency (EPA), it is necessary to assess the health and quality of all known waters that receive stormwater discharges from the MS4 areas within the GLAD MS4 boundaries. Assessment and characterization occur in the form of a baseline water quality characterization report (WQRC). The WQCRs were developed using the most current data available with additional consideration given to historical data that serves to better describe the chemical, biological and physical condition of the receiving waters of the GLAD MS4 jurisdictional areas. To preserve both detail and clarity, the GLAD MS4 communities will be evaluated and characterized as a single entity in this introductory narrative, with individual community MS4 characterizations in the appendices. The individual WQCRs have been certified and signed by the appropriate signatory authorities.

2.1 Land Use Within the MS4 Areas (Assessment of Land Use)

Although the four GLAD communities are contiguous, they collectively possess a unique combination of environmental, geographical, and geological features as best characterized by the diversity of land usage within the region. The individual WQCRs in the appendices go into greater detail on the land use within each municipality and reflects the standard land cover classifications from the National Land Cover Database (NLCD) adopted by the Multi-Resolution Land Characteristics (MRLC) Consortium. To preserve clarity, these reports focus only on fifteen (15) of the most prevalent land cover classifications found within the MS4 boundaries.

Generally, developed land uses (high, medium, low) tend to occur around the incorporated areas of the county, with forested and agricultural land uses occurring in unincorporated areas Dearborn County. The levels of intensity of developed areas, as defined by the NLCD, are primarily designated by the percent of impervious surface:

- Open Space: Impervious surfaces account for less than 20% of the total area, vegetation is mostly lawn/grass, includes large-lot single-family residences(SFR)/parks/golf courses/recreation areas.
- Low Intensity: 20-49% impervious area, primarily SFR.
- Medium Intensity: 50-79% impervious area, primarily SFR.
- High Intensity: 80-100% impervious area, includes commercial/industrial, apartment complexes, row houses.

Geographically, the GLAD Partnership communities are west of Cincinnati, Ohio on the north side of the Ohio River, with Kentucky located on the opposite bank of the Ohio River. This tri-state area has the potential to offer a unique perspective on MS4 Programs across state and geographic lines. Although geographically relevant, the Ohio River is not included in any additional descriptions or characterizations within this report as it is monitored by the Ohio River Valley Sanitation Commission (ORSANCO).

For further explanation regarding the classification system and individual category descriptions, refer to Appendix A: Table 1. Though the data compiled is the most current land use data available, recent land changes may not be reflected.

3.0 Best Management Practices

3.1 Structural and Non-Structural Best Management Practices –

The Indiana Department of Environmental Management (IDEM) requires that all efforts to improve stormwater quality are categorized in the manner described by Phase II of the National Pollutant Discharge Elimination System (NPDES) program and as outlined below.

The Environmental Protection Agency (EPA) qualitatively defines the successfulness of a MS4 region's efforts to improve stormwater quality based on their ability to implement the six (6) Minimum Control Measures (MCMs). The six (6) MCMs include:

1. Public Education and Outreach
2. Public Participation and Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Stormwater Runoff Controls
5. Post-Construction Stormwater Management
6. Municipal Operations Pollution Prevention and Good Housekeeping

The structural, vegetative, or managerial practices of a MS4 region used to treat, prevent, or reduce stormwater contamination are referred to as Best Management Practices (BMPs) and are often divided into structural and non-structural sub-sections. Successful selection and implementation of BMPs requires identification of specific regional stormwater needs, and as such, BMPs tend to vary considerably between MS4 regions.

These WQCRs include examples of and references to both structural and non-structural BMPs. Actual selection of the BMPs and activities that each MS4 implements will be determined in the Stormwater Quality Management Plans (SWQMPs), which are currently under development and due to IDEM in April 2024. It is

the expectation of IDEM and the EPA that all MS4 areas have a complete and updated inventory of all MS4 owned/operated structural stormwater management measures that are operated for the purpose of stormwater quality, stormwater management, and flood control, including an identification number, geographic coordinate, and structural condition. Additional assessments will occur during this permit term as a requirement of the new Stormwater Quality Management Plans (SWQMPs).

3.2 Structural Best Management Practices

As their classification implies, Structural BMPs involve the implementation of an engineered system used to treat, prevent, or reduce stormwater contamination. As noted above, the relative effectiveness of structural best management practices is contingent upon several sociological and ecological factors, one of which is land use. The examples of structural BMPs listed below in 2 are classified in a manner which also includes the recommended implementation area, as described by the predominate land cover classification or future intended use for a site. The purpose of such classifications is not to discourage communities from implementing any one BMP, but rather help inform the decisions of MS4 communities so they may develop more effective means of preventing and reducing stormwater pollution.

Table 2. Example Structural Management Practices for Stormwater Quality/Management

	Predominate Land Use (Relative Effectiveness)					
Structural Management Practice	**Residential**	**Industrial**	**Recreational**	**Agricultural**	**Forrest**	**Wetlands**
Infiltration Basins and Infiltration Trenches	Good	Moderate	Good	Moderate	Moderate	Poor
Dry Wells	Moderate	Poor	Moderate	Moderate	Moderate	Poor
Rain Barrels	Moderate	Poor	Poor	Moderate	Poor	Moderate
Rain Gardens	Good	Moderate	Good	Good	Good	Good
Pervious Pavement	Moderate	Poor	Poor	Poor	Moderate	Moderate
Subsurface Infiltration Bed	Moderate	Moderate	Good	Moderate	Poor	Poor
Vegetated Swale	Moderate	Poor	Moderate	Moderate	Good	Good
Vegetated Filler Strip	Moderate	Poor	Moderate	Moderate	Good	Good
Constructed Filter	Poor	Good	Poor	Moderate	Moderate	Moderate
Infiltration Berm/Retention Grading	Good	Moderate	Moderate	Moderate	Good	Moderate
Vegetated Roof	Moderate	Moderate	Moderate	Poor	Poor	Poor
Runoff Capture and Reuse	Moderate	Poor	Poor	Moderate	Poor	Poor
Constructed Watershed	Good	Good	Moderate	Moderate	Moderate	Moderate
Wet Pond/Retention Basin	Good	Good	Good	Good	Good	Good
Dry Extended Retention Basin	Moderate	Good	Moderate	Moderate	Moderate	Moderate
Water Quality Filters/Hydrodynamic Devices	Poor	Moderate	Moderate	Moderate	Poor	Poor
Riparian Buffer Restoration	Good	Moderate	Moderate	Good	Good	Good
Landscape Restoration	Moderate	Moderate	Moderate	Poor	Poor	Poor
Soil Amendment Restoration	Good	Moderate	Good	Moderate	Poor	Poor
Floodplain Restoration	Moderate	Poor	Moderate	Moderate	Poor	Moderate
Level Spreader	Moderate	Moderate	Good	Moderate	Poor	Poor
Special Detention Areas	Moderate	Good	Good	Good	Poor	Poor

Further information regarding structural management practices, such as individual descriptions and summaries, can be found in Appendix A: Table 2.

3.3 Non-Structural Best Management Practices

As their classification implies, Non-Structural BMPs involve the implementation of a broader planning and design approach used to treat, prevent, or reduce stormwater contamination. As above, the examples of non-structural BMPs listed below in Table 3 are classified in a manner which also includes the recommended implementation area, as described by the predominate land cover classification. Again, the purpose of such classifications is not to discourage communities from implementing any one BMP, but rather help inform the decisions of MS4 communities so they may develop more effective means of preventing and reducing stormwater pollution.

Table 3. Example Non-Structural Management Practices for Stormwater Quality/Management

	Predominate Land Cover (Relative Effectiveness)					
Non-Structural Management Practice	**Residential**	**Industrial**	**Recreational**	**Agricultural**	**Forrest**	**Wetlands**
Protect Sensitive and Special Value Features	Good	Poor	Good	Good	Good	Good
Protect / Utilize Natural Flow Pathways	Moderate	Moderate	Moderate	Good	Good	Good
Cluster Uses at Each Site / Build on Smallest Area Possible	Moderate	Poor	Moderate	Moderate	Moderate	Moderate
Use Smart Growth Practices	Good	Moderate	Good	Good	Moderate	Moderate
Minimize Total Disturbed Area–Grading	Good	Good	Good	Good	Good	Good
Minimize Soil Compaction	Good	Good	Good	Good	Good	Good
Re-Vegetate and Re-Forest Disturbed Areas	Good	Good	Good	Good	Moderate	Moderate
Reduce Street Imperviousness and Parking Imperviousness	Moderate	Good	Moderate	Moderate	Moderate	Poor
Rooftop Disconnection	Good	Moderate	Moderate	Moderate	Moderate	Poor
Disconnection from Storm Sewers	Good	Moderate	Moderate	Poor	Poor	Poor
Municipal Ordinances	Good	Good	Good	Moderate	Moderate	Moderate
Street Sweeping	Moderate	Moderate	Moderate	Poor	Poor	Poor

Further information regarding non-structural management practices, such as individual descriptions and summaries, can be found in Table 3 in Appendix A.

Decisions on the most appropriate structural and non-structural BMPs will be made during the development of the Stormwater Quality Management Plans.

3.4 Flood Control

Water quantity issues are managed in other ways, especially along the Ohio River, which is subject to flooding with widespread impacts. Additional information specific to communities is included in their portion of the appendices, but general flood control BMPs are included here.

Levees and Floodwalls: The USACE works with levee sponsors to understand the benefits and risks associated with levees, build awareness among the public, and take actions to manage performance. The USACE Levee Safety Program is not a regulatory program; rather it serves as an organizing framework to improve consistency and coordination in how levee-related activities are implemented. Key program activities include levee inspections, risk assessments, and sharing levee information. Levees have been built up along the Ohio River in Dearborn County to protect many of the MS4 Districts that are adjacent to the river.

Flood Insurance: National Flood Insurance Program (NFIP), which makes federally backed flood insurance available for all eligible buildings, whether they are in a floodplain or not. Flood insurance covers direct losses caused by surface flooding, including a river, lake, or stream flowing over its banks and local drainage problems.

4.0 Receiving Waters and Sensitive Areas

4.1 Identification of Receiving Waters, Wetlands, and Lakes

A complete understanding of the hydrological features of a region is crucial to the effective and efficient implementation of structural and non-structural BMPs within an MS4 area. The content of this report reflects only the hydrological characterizations required for completion of the MS4 permitting process such as identification of all receiving waters, including wetlands and lakes, 303(d) listed impaired waters, and Total Maximum Daily Loads (TMDLs) for receiving waters. This report is not intended to serve as a comprehensive evaluation of regional water bodies, but rather supplement the documentation of individual MS4 areas.

4.1.1 Receiving Waters

The following streams or creeks in Table 4 are the streams each MS4 discharges stormwater to through the separate storm sewer system. Figure 2 shows the streams throughout the county.

Table 4. Receiving Waters of GLAD MS4 Communities

Stream Name	Length (miles)
Unnamed Tributaries	147.1
Allen Branch	7.0
Blue Creek	1.8
Bobb Branch	3.8
Boyd Branch	2.8
Brushy Fork	5.0
Burton Branch	3.3
Butternut Run	0.7
Camp Ground Branch	2.4
Cooper Run	2.6
Doublelick Run	4.9
Droege Creek	2.4
East Fork Tanners Creek	14.5
Elk Run	3.7
Ennis Creek	3.3
Flys Run	4.9
Fox Branch	2.4
Fox Run	2.1
Goose Run	2.1
Great Miami River	1.5
Hayes Branch	8.8
Hogan Creek	21.9
Jameson Creek	3.0
Laughery Creek	8.5
Leatherwood Creek	4.0
Little Hogan Creek	7.7
Little Jameson Creek	1.5
Long Branch	2.8
Mahler Creek	1.0
Mud Lick	3.0
Mud Lick Creek	3.9
Norton Run	2.5
Peter Creek	2.0

Pinhook Creek	2.9
Pipe Creek	1.4
Salt Fork	8.2
Sand Run	0.9
Slab Camp Creek	4.1
Soapstone Creek	1.6
South Hogan Creek	16.3
Tanners Creek	11.9

Taylor Creek	2.8
Turkey Run	1.5
West Fork Tanners Creek	11.6
Whitaker Creek	5.1
Whitewater River	8.6
Wilson Creek	5.7
Ziegler Creek	1.6
TOTAL	**372.7**

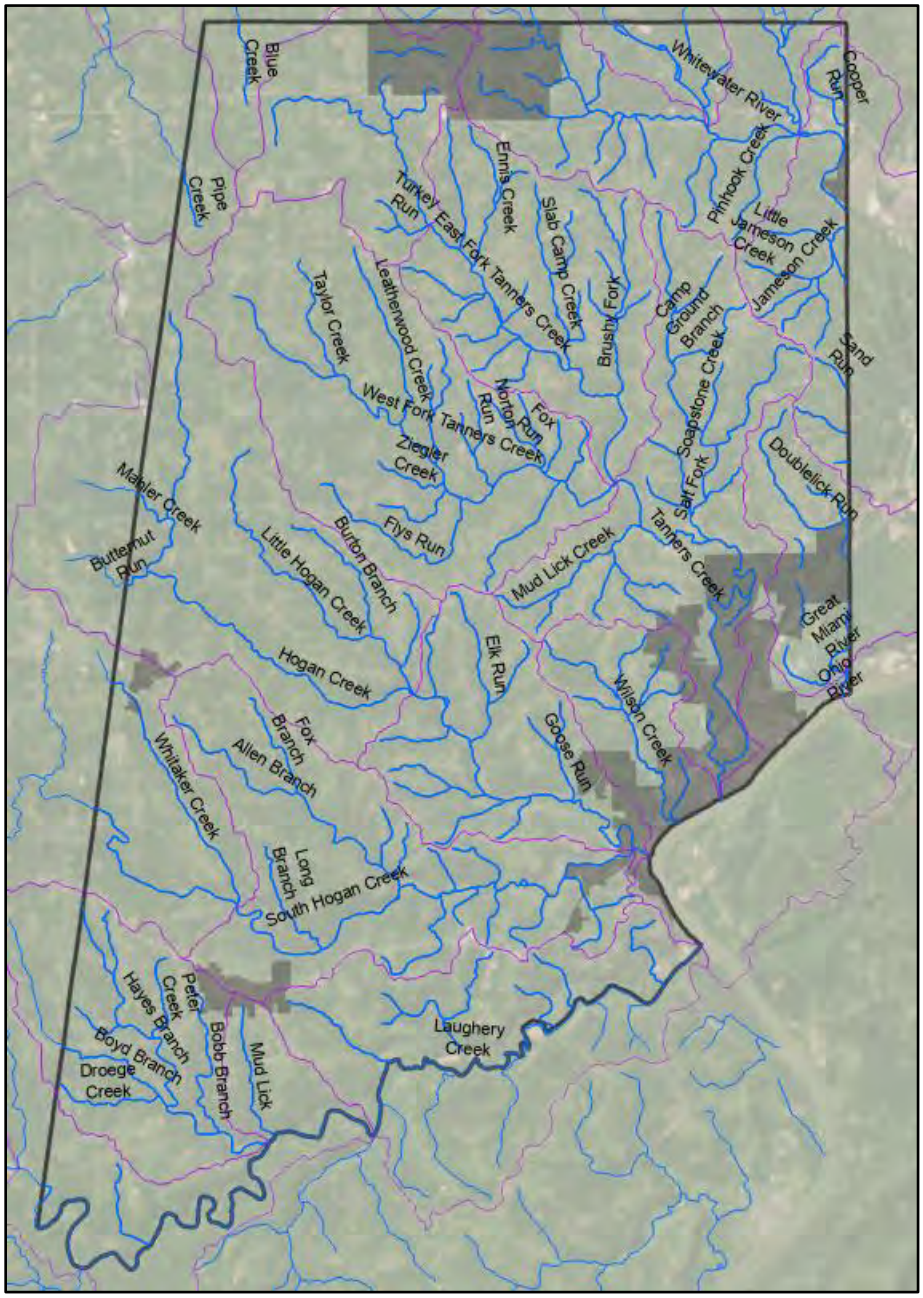

Figure 2. Streams in GLAD Partnership MS4 Area

4.1.2 Identification of Wetlands

Understanding the designation and purpose of identified water bodies within a MS4 area is the best first step when designing and implementing BMPs. As noted in Section 404 of the Clean Water Act, "Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." The continued saturation of these areas is in large part due to stormwater runoff from surrounding areas. As such, wetlands have long been noted for their water quality improvement functions and flood control. However, the prolonged and continual use of natural wetlands as receptacles for non-point sources of pollution by way of runoff from impervious surfaces in urbanized areas is known to have an adverse effect on wetlands and the organisms who inhabit these unique ecological features. As noted in their Guide to Stormwater Best Management Practices, the Office of Water (EPA) found that "wetlands in urban areas can be dramatically altered by uncontrolled runoff resulting from natural drainage to wetland systems." Therefore, successful understanding and identification of these unique bodies of water is the first step in the implementation of Best Management Practices to ensure their prolonged heath and presence in southeastern Indiana.

The GLAD MS4 communities collectively encompass 8,136.6 acres of natural wetlands. Included in the inventory are further subclassifications of natural wetlands which include lacustrine (lake systems), palustrine (wetland and marsh systems), and riverine (river systems). Table 5 shows the different types of wetlands within the GLAD MS4 communities. These data were clipped from the continually released US Fish and Wildlife Service (NFS) National Wetland Inventory (NWI). These data represent the most current natural wetlands data available.

Table 5. Types of Wetlands within the Southeastern GLAD MS4 Areas

Type	Acres
Freshwater Emergent Wetland	585.7
Freshwater Forested/Shrub Wetland	1,970.9
Freshwater Pond	2,046.3
Lake	778.5
Riverine	2,755.2
Total	**8,136.6**

Source: National Wetlands Inventory, NWI (2023)

For a more complete geographical representation the relative size and location of these bodies of water within the GLAD MS4 Communities, see the individual WQCR reports. Though the data compiled is the most current land use data available, more recent land changes may not be reflected.

Successful preservation and protection of wetlands is critical to successful non-point source pollution abatement found within stormwater. The preservation and protection of wetlands should include maintenance of function of existing areas which includes but is not limited to the "vegetative composition and cover, flow characteristics of surface water and ground water, hydrology and geochemical characteristics of substrate, and species composition" through the implementation off structural and non-structural best management practices.

Effective structural and non-structural Best Management Practices for the protection and preservation of local wetlands are included below. The BMP examples and references included in this report are not intended to be

comprehensive. Additionally, the list of BMPs is not all-inclusive, and it does not preclude MS4s from using other technically sound practices. However, the practice or set of practices chosen needs to achieve the minimum measure.

4.1.3 Structural and Non-Structural Best Management Practices for the Protection of Wetlands

The geographic and ecological diversity present within each MS4 area in the GLAD communities makes the recommendation of any single BMP difficult. Rather, it is the responsibility of each community to utilize the numerical and geographic resources within this report and accompanying documents in conjunction with municipal assessment and water quality monitoring to identify the most effective and locally relevant BMPs.

- Acquisition: Obtain easements or full acquisition rights for wetlands and riparian areas along streams, bays, and estuaries.
- Zoning and Protective Ordinances: Control activities with a negative impact on these targeted areas through special area zoning and transferable development rights.
- Water Quality Standards: Almost all wetlands are waters of the United States, as defined in the Clean Water Act. Ensure that State water quality standards apply to wetlands.
- Regulation and Enforcement: Establish, maintain, and strengthen regulatory and enforcement programs. Where allowed by law, include conditions in permits and licenses under CWA §401, §402, and §404; state regulations; or other regulations to protect wetlands.
- Restoration: Programs such as USDA's Conservation Reserve and Wetlands Reserve Program provide opportunities to set aside and restore wetlands and riparian areas. Also, incentives that encourage private restoration of fish and wildlife productivity are more cost-effective than Federal acquisition and can in turn reduce property tax receipts by local government.
- Education and Training: Educate farmers, urban dwellers, and Federal agencies on the role of wetlands and riparian areas in protecting water quality and on best management practices (BMPs) for restoring stream edges.
- Provide a Hydrologic Regime: Restoration of hydrology is a critical factor to gain non-point source benefits and to increase the probability of successful restoration.
- Restore Native Plant Species: When consistent with preexisting wetland or riparian area type, plant a diversity of plant types or manage natural succession of diverse plant types rather than planting monocultures.

4.2 303(d) Impaired Waters and Total Maximum Daily Loads

To remain compliant with federally mandated regulations, designated MS4 areas are required to identify and characterize all impaired waters (rivers, lakes, streams) as described in Section 303(d) of the Clean Water Act. Identification of impaired waters is the responsibility of the Indiana Department of Environmental Management (IDEM) as part of the Integrated Water Monitoring and Assessment Report (ATTAINS data) submitted biannually to the EPA. It is the responsibility of MS4 areas to interpolate and develop appropriate protection measures in the form of BMPs to sufficiently protect these bodies of water from polluted stormwater discharge in the case of a storm event. A table of water quality measurement and standards for Indiana can be found in Appendix A: Table 4. Streams and rivers are assessed and designated in accordance with the Indiana Department of Environmental Management's Consolidated Assessment and Listing Methodology (CALM).

The CALM is revised and updated every two years to continually reflect the most recent changes to federal and state water quality standards. The standards described in this report are reflective of those included in the 2022 CALM published in conjunction with the IDEM 2022 303(d) list. Excerpts from the 2022 IDEM CALM are included in Appendix A: Table 5 for further information regarding the most recent water quality standards for streams and waterways.

The communities represented by the GLAD Partnership contain a total of 258 miles of impaired streams and river within their jurisdictional boundaries. The primary sources of contamination include E. coli and dissolved oxygen. The legacy contaminants of PCBs, mercury, and heavy metals found in fish tissue were also relatively common. Impaired streams included on the 303d list within GLAD MS4 boundaries can be seen in Figure 3. The total length of impaired water bodies as found within individual MS4 areas is in Table 6. Total length based on impairment is shown in Table 7. This data represents the most current submittal's by IDEM to receive approval by the U.S EPA (IDEM, 2022) at the time of this report.

Table 6. 303(d) Impaired Waters within the GLAD MS4 Areas (Length)

Community Name	Length (Miles)
Dearborn County	245.3
City of Greendale	5.8
City of Lawrenceburg	4.7
City of Aurora	2.2
TOTAL:	**258**

Source: IDEM ATTAINS, 2022

Table 7. 303(d) Impaired Waters within the GLAD MS4 Areas (Impairment)

Impairment	Length (Miles)*
E. coli	185.3
Dissolved Oxygen	137.5
PCBs (Fish Tissue)	75.3
Mercury (Hg) in Fish	60
Heavy Metals	29.6
Chloride	6.7
Nutrients	0.0

Source: IDEM ATTAINS, 2022.

*Streams may be impaired for more than one category.

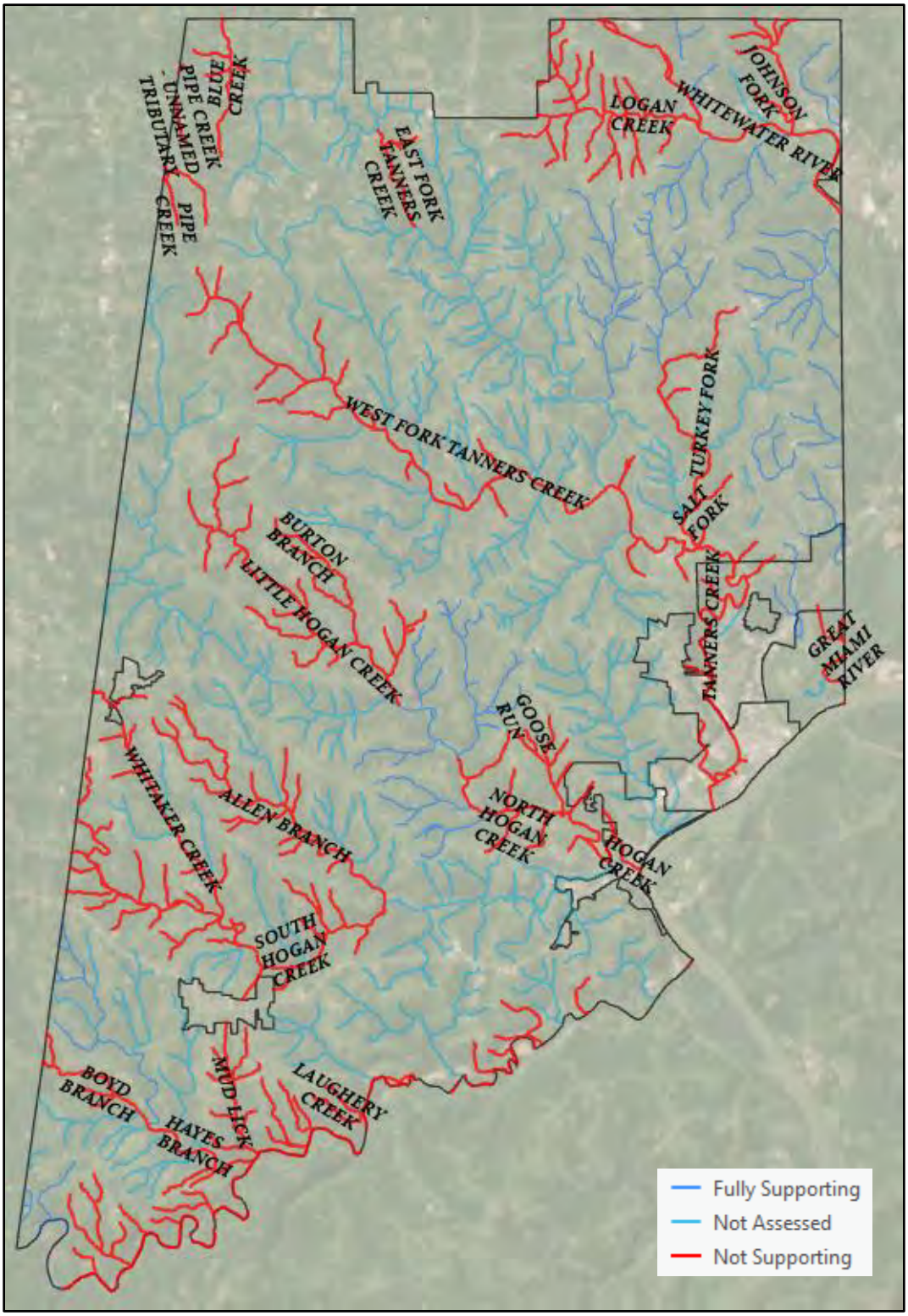

Figure 3. IDEM ATTAINS Water Assessment - 303d Impaired Streams in GLAD Communities

As noted above, the primary causes of waterway impairment are elevated levels of E. coli found throughout Dearborn County, although E.coli wasn't listed on the stream impairments in any of the incorporated MS4s. However, it was noted that excessive nutrient loading was not listed as an impairment for any streams in Dearborn County, although this is a common impairment in other parts of Indiana. Reduced dissolved oxygen levels and legacy contaminants in fish tissue were also common in the county, including in the incorporated areas. The impaired designation is indicative of a sample or series of samples taken within the identified body of water which failed to meet the minimum requirements to ensure the safety of aquatic and human life. The water quality standards relating to the bacteria E. coli and nutrient pollution can be found in Appendix A: Tables 4 and 5, respectively. The process to obtain the measurements of E.coli can also be found in Appendix A: Table 4.

It is important that individual communities work with regional ecologists, environmentalists, and stormwater specialists to identify the potential causes of each impairment as to better identify and implement relevant structural and non-structural BMPs. Below is a non-comprehensive listing of potential sources of E. coli and excessive nutrients. Although nutrient loading was not listed as an issue for Dearborn County MS4s, concurrent activities with other BMPs to manage E. coli also helps to keep nutrient loading from becoming a problem. For further guidance, individual communities are encouraged to reach out independently.

4.2.1 Sources of E. coli in the Environment:

Combined Sewer Overflows - When it rains, those systems can become overburdened and release excess storm water and untreated sewage. Communities must post warning sign near where outfalls are located.

Sanitary Sewer Overflow Bypasses - Separate sanitary sewer and wastewater treatment plants occasionally experience unauthorized discharges of untreated or partially treated wastewater.

Septic Systems - When septic systems fall into disrepair or reach capacity, the sewage can leak into nearby waterways. Because of this, the absorption field, or area over which the discharged sewage is dispersed into the ground, should be located away from waterways and wells.

Straight Pipes - Some individual homes or subdivisions have pipes that transfer untreated waste directly from septic tanks to a river or lake. This illegal practice should be corrected and is punishable by fines if continued.

Wildlife - Waste from ducks, geese, deer, raccoons, and other fauna living on or near water can contaminate waterways with E. coli.

Urban and Agricultural Runoff - Waste from pets, farm animals, and manure application to fields are sources of E. coli.

4.2.2 Sources of Non-Point Source Nutrient Pollution:

Animal Production Operations and Feedlots – Commercial animal production results in centralized accumulation of organic waste rich in nitrogen and phosphorus. If stored incorrectly, these nutrients will enter local streams and water bodies by means of stormwater runoff.

Agricultural Activities – The inappropriate and excess application of chemical fertilizers rich in nitrogen and phosphorus results in a significant amount of agricultural fertilizer being washed from fields and entering local steams and water bodies by means of stormwater runoff.

Stream Bank and Shoreline Erosion – Although a natural process, the continued alteration of the natural landscape by humans and livestock results in modified hydrologic characteristics which increase the frequency and rate stream banks erode, and by extension, the rate at which sediment and nutrients enter the water bodies.

Timber Harvesting – The large-scale harvesting of timber results in the soil's prolonged exposure to sunlight and a documented temperature increase. Together, these ecological changes make the sediment and nutrients within the soil more likely to enter local streams and water bodies by means of stormwater runoff.

Land Disturbance – Recently disturbed land, particularly from earthmoving or construction activities, significantly increases the likelihood of erosion and sediment filled runoff entering local water bodies during a storm event. These sediments are right in nutrients which can pollute and threaten the water body.

Urban, Suburban, and Rural Residential Runoff - When precipitation falls on our cities and towns it runs across hard surfaces - like rooftops, sidewalks, and roads - and carries pollutants, including nitrogen and phosphorus, into local waterways.

As is the case with non-point sources of pollution found within stormwater runoff, there exists no singular solution or prevention practice which will prove to be comprehensive or entirely successful. Rather, recommendations can be made regarding structural and non-structural BMPs which can serve as educated efforts to prevent the further degradation of local streams and waterways. Recognizing that the challenges and regulations faced by GLAD communities exist on a national scale across the US, it is imperative that communities support one another in the compilation of data, information, and solutions as they relate to stormwater runoff. However, communities must also identify unique infrastructural, geographical, geological, and ecological features which require adaptation of previously implemented BMPs to maximize impact.

In their publication "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" the EPA highlights common structural best management practices used for the reduction of E. coli and nutrient loading to streams and water bodies as well as their evaluated effectiveness. Below in Table 8 is an excerpt from the larger example management practice screening matrix depicting more common BMPs used by MS4s.

Table 8. Example Management Screening Practices for E. coli and Nutrient Pollution

Structural Management Practice	Nutrient Pollution (Relative Effectiveness)	Fecal Coliform Bacteria (E. coli) (Relative Effectiveness)
Bioretention	Good, High	Good, High
Conventional Dry Detention	Poor, Low, or No Influence	Good, High
Extended Dry Detention	Moderate	Good, High
Grass Swale	Poor, Low, or No Influence	Poor, Low, or No Influence
Green Roof	Poor, Low, or No Influence	Poor, Low, or No Influence
Infiltration Trench	Good, High	Good, High
Parking Lot Underground Storage	Good, High	Moderate
Permeable Pavement	Poor, Low, or No Influence	Moderate
Sand Filter	Good, High	Moderate
Stormwater Wetland	Good, High	Good, High
Vegetated Filter Strip with Level Spreader	Moderate	Poor, Low, or No Influence
Water Quality Swale	Good, High	Poor, Low, or No Influence
Wet Pond	Good, High	Good, High

It is recommended that individual GLAD communities consider the multifaceted nature of non-point source pollution and the many possible factors which contribute to the contamination of streams. Although certainly important, it is worth noting that implementation of any single or multitude of BMPs will never result in the complete elimination of any one pollutant. Rather, interpreting and understanding the 303(d) listing as presented here is an opportunity for regional improvement, where continued communal efforts will lead to a general water body improvement.

As a component of discovering opportunities for water quality improvement and appropriate actionable steps, communities are required to investigate the Total Maximum Daily Load (TMDL) Reports approved for Indiana by the EPA. TMDL Reports are a combination of water body characterization, contamination sources, analysis summary, required pollutant reduction standards, and actionable items which will reduce pollutant levels. Within the GLAD Boundaries there exists multiple TMDL reports for Dearborn County, which has been expanded upon in the individual Dearborn County WQCR report.

However, even if currently unaffected by published TMDL Reports, individual communities are advised to review the biannual release of the 303(d) and TMDL reports to check for any updates or revisions which directly include or impact their community. As noted above, the data displayed in this report is related to the 2022 303(d) submitted by IDEM and approved by the EPA, and is the most current data available.

4.3 Identification of Known Sensitive Areas

Sensitive areas are defined in Permit INR040000, as:

- Public swimming areas
- Surface drinking water intakes
- Threatened or endangered species or their habitat
- State outstanding resource waters
- Exceptional use waters

For information on public beaches, full body contact recreation area, surface drinking water intakes, and wellhead protection areas, see individual MS4 community WQCRs.

Threatened or Endangered Species or Their Habitat: A list of Threatened, Endangered, and Rare Species within Dearborn County is available from the Indiana Department of Natural Resources. These species are protected under the Federal Endangered Species Act, which is applicable to projects that utilize federal funds and/or require a federal permit.

Outstanding Resource Waters: The Natural Resources Commission is responsible for the identification of rivers and streams which have particular aesthetic or environmental interest to the state of Indiana. Within Dearborn County, the Whitewater River to the north and Laughery Creek on the southern border, are both listed as NRC Outstanding Rivers. The listing is intended to provide guidance rather than to have regulatory application, and there are no predetermined actions associated with the designation. Rather the designation is meant to provide additional information to guide selection and implementation of appropriate management practices to protect these and all water bodies within municipalities MS4 areas.

Exceptional Use Waters: According to IDNR's list of Exceptional Use Waters, there are no exceptional use waters within the MS4 area.

Sinkhole Areas: There are no heavy karst regions near the GLAD MS4 communities.

4.4 Summary of Existing/Available Monitoring Data

As established in the Indiana MS4 General Permit, individual MS4 communities must continue to review and summarize existing and available monitoring data for the MS4s receiving waters, including, as applicable, data that can be correlated from stream reach characterization and evaluation reports, chemical, biological, physical, land use, and compliant data. Individual MS4 community-specific data and summary information has been provided in the community-specific WQCRs as attachments to this report.

5.0 Water Quality Management

5.1 MS4 Program Ordinances

Land use throughout the Southeastern Indiana region has become increasingly more developed throughout the past decade. With the designated as an MS4 Phase 2 community, efforts have been begun to educate residents, students, the construction industry, elected officials, and public employees regarding stormwater pollution management, as well as the requirements and benefits of the MS4 program.

In early 2024, GLAD Partnership communities will adopt and implement ordinances for Illicit Discharge Detection and Elimination, Construction Site Stormwater Management, and Post-Construction Stormwater Management which will meet the requirements of the MS4 permits. These ordinances will serve as the legal mechanism through which the MS4s have implement their MS4 programs and are intended to have a direct impact on improved water quality throughout the region.

5.2 Areas with Potential to Contribute to Poor Water Quality

An evaluation of water pollution potential areas specific to a GLAD Partnership community are described in greater detail in the individual WQCR sections in the appendices of this report.

Elevated bacteria levels in many of the waterways may be attributed to combined sewer overflows or to livestock and fertilizer usage in agriculture areas. PCBs are considered to be legacy contaminants, not actively being added to the streams, and not managed through water quality enhancement efforts as part of the MS4 Program. The combined sewers are known and there have been efforts and investments made to separate these systems. Industrial areas listed as Rule 6 sites for Active Industrial Stormwater Runoff permits were obtained from IDEM in September 2023, and are described in the individual community sections.

5.3 Permitting Entities and Sources of Monitoring Data

Individual MS4 communities are encouraged to search for water quality and related data using publicly accessible reports and databases published by government agencies such as the Indiana Department of Environmental Management (IDEM), Indiana Department of Natural Resources, US Environmental Protection Agency (USEPA), and the United States Geological Survey. Further characterization of these agencies and their capacity to assist in water body characterization can be found below.

Indiana Department of Natural Resources: Works to protect, enhance, preserve, and wisely use natural, cultural, and recreational resources for the benefit of Indiana's citizens through professional leadership, management and

education. The division of water provides water resource information, generates surface and groundwater resource assessments.

United States Geological Survey: Mapping agency that collects, monitors, analyzes and provides science about natural resources. USGS assists by monitoring, assessing, and delivering information on water resources and conditions. This includes information on streamflow, groundwater, water quality, and water use and availability.

Indiana Department of Environmental Management: IDEM issues air, water, and solid and hazardous waste permits that restrict discharges to environmentally safe levels. Staff members inspect and monitor regulated entities; provide compliance and technical assistance; monitor and assess air, land, and water quality; use enforcement actions as necessary to ensure compliance; and respond to incidents involving spills to soil or waters of the state.

US Environmental Protection Agency: Researches the best practices to reduce national environmental risks are based on the best available scientific information. Setting environmental policy and enforcing federal laws protecting human health and the environment are administered and enforced fairly, effectively and as Congress intended. The EPA helps identify and ensure the cleanup of contaminated lands and toxic sites by potentially responsible parties and revitalized. They also ensure that chemicals in the marketplace are reviewed for safety.

5.4 INDOT Non-Traditional MS4 Areas

INDOT has been designated as an MS4 and maintains corridors adjacent to municipal MS4 areas in Indiana. For more detailed information see the INDOT and Stormwater Quality webpage. The most recent SWQMP report was published for the 2020-2021 reporting period.

6.0 Recommendations

An evaluation of findings for GLAD Partnership communities are described in greater detail in the individual WQCR sections.

6.1 Summary

The GLAD Partnership communities have embarked on a newly-formed collaborative effort at developing and starting to implement their MS4 Programs. This partnership is geared towards educating, training, and developing base documents and deliverables, which has allowed each community to focus on kicking-off and effectively implementing their MS4 Programs. A near-future focus will be on training qualified personnel to inspect areas of concern, construction sites, and discharge points to report on water quality and ensure that standards are met with the MS4 Programs. This collaboration will help institute regionally-consistent ordinance requirements, education, and technical standards. The ordinances specific to the MS4 Program requirements will be adopted by each MS4 in Spring 2024, as required by the permit.

Communities continue to develop and invest digital mapping and reporting tools to track reports, complaints, and other information in relationships to the program. This information will be reported to IDEM in an Annual Report, which is now required to be submitted each April 1st.

The contiguous nature of the MS4s means activities in one community have a high potential to impact the communities downstream or surrounding them. Pollutants continue to be an issue from these areas as the population expands and construction projects are in the region. Working together to address pollutants is a primary focus and critical component of the GLAD Partnership.

6.2 Recommendations

The following general recommendations are provided to continue to maintain and further enhance the emerging MS4 Programs in Southeastern Indiana Region:

1. Develop Stormwater Quality Management Plans (SWQMPs) for each community to outline the activities that will guide the implementation of the MS4 Programs.
2. Develop and adopt new Stormwater Ordinances for each community in Spring 2024 to ensure compliance with the MS4 General Permit (INR040000) and Construction Stormwater Runoff General Permit (INRA00000).
3. Develop procedures for reviewing, permitting, and inspecting construction sites and post-construction BMPs. Monitor construction sites ESPC measures in accordance with the regulatory agencies, MS4 General Permit, and Construction Stormwater Runoff General Permit.
4. Potentially develop Stormwater Master Plans for individual communities for comprehensive stormwater management planning, maintenance activities, and capital improvement project development.
5. Develop program and perform dry-weather screening for outfall inspections to locate and eliminate illicit discharges, as well as regularly visually inspect the health of streams through each community.
6. Continue mapping the stormwater systems and maintain the data in a GIS database. A visual inspection component of stormwater system mapping is included in the MS4 General Permit.
7. Train construction site operators, developers, and designers in erosion and sediment control runoff measures, and proper BMP installation procedures. Use of the EPA Construction General Permit training online may be offered as an alternative to regional training.
8. Train municipal employees in IDDE and good housekeeping procedures to minimize risks of pollutants from municipal facilities and maintenance activities.
9. Continue participating in the GLAD Partnership.
10. Partner with the Dearborn County SWCD on education and outreach initiatives.

7.0 References

Environmental Protection Agency (EPA). (1993, January). *Chapter 7: Management Measures for Wetlands, Riparian Areas, and Vegetated Treatment Systems.* Retrieved from https://www.epa.gov/sites/production/files/2015-09/documents/czara_chapter7_wetlands.pdf

Environmental Protection Agency (EPA). (2008, January). *Understanding Impaired Waters and Total Maximum Daily Load (TMDL) Requirements for Municipal Stormwater Programs.* Retrieved from https://www3.epa.gov/npdes/pubs/region3_factsheet_tmdl.pdf

Environmental Protection Agency. (2007, July). *Chapter 5: Streambank and Shoreline Erosion, National Management Measures to Control Nonpoint Source Pollution from Hydromodification.* Retrieved from https://www.epa.gov/sites/production/files/2015-09/documents/efh-frontmatter.pdf

Environmental Protection Agency. (2022, August 11). *Nutrient Pollution: Sources and Solutions.* Retrieved from https://www.epa.gov/nutrientpollution/sources-and-solutions

Indiana Department of Environmental Management, & Indiana State Department of Agriculture. (2021, February). *Indiana State Nutrient Reduction Strategy.* Retrieved from https://www.in.gov/isda/files/Indiana-State-Nutrient-Reduction-Strategy_final-Version-6_small.pdf

Indiana Department of Environmental Management. (n.d.). *E. Coli Fact Sheet.* Retrieved from https://www.in.gov/idem/files/factsheet_owq_sw_e_coli.pdf

Indiana Department of Natural Resources. (2023). Water: About Us. Retrieved from https://www.in.gov/dnr/water/about-us/

Mupepele, A.-C., & Dormann, C. (2016). Influence of forest harvest on nitrate concentration in temperate streams—a meta-analysis. *Forests*, *8*(1), 5. https://doi.org/10.3390/f8010005

Nonpoint Source. (2022). *Total Maximum Daily Load Reports.* Retrieved from https://www.in.gov/idem/nps/resources/total-maximum-daily-load-reports/

Rouge River National Wet Weather Demonstration Project. (n.d.). *Stormwater Management: Best Management Practices (BMPs).* Retrieved January 26, 2023, from https://www.michigan.gov/-/media/Project/Websites/egle/Documents/Programs/WRD/NPS/Savvy/savvy-bmp.pdf?rev=9c8c17b9b0f54a3a9212b530cc8f60ae

Temporary construction erosion and sediment control Temporary Construction Erosion and Sediment Control, Minnesota Stormwater Manual. Minnesota Stormwater Manual. (2022, December 9). Retrieved from https://stormwater.pca.state.mn.us/index.php/Temporary_construction_erosion_and_sediment_contro

United States Deparment of Agriculture, & Enviromental Protection Agency. (2022, October 28). *The Sources and Solutions: Agriculture.* https://www.epa.gov/nutrientpollution/sources-and-solutions-agriculture

US Enviromental Protection Agency. (2008, March). *Handbook for Developing Watershed Plans to Restore and Protect Our Waters: Chapter 10. Identify Possible Managment Strategies.* Retrieved from https://www.epa.gov/sites/production/files/2015-11/documents/2008_04_18_nps_watershed_handbook_ch10.pdf

US Geological Survey. (2023). Water Resources. https://www.usgs.gov/mission-areas/water-resources

IDNR. (1996). *Appendix E.4 IDNR listing of Indiana Special Streams.* Retrieved February 6, 2023, from https://www.in.gov/dnr/water/files/Appdx_E-4.pdf

Appendix A
Tables

Table 1: NLCD Land Use Classification Descriptions

Category	Classification Description
Barren Land	Areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Cultivated Crops	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
Deciduous Forest	Areas dominated by trees generally greater than five (5) meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
Developed, High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. 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.
Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Evergreen Forest	Areas dominated by trees generally greater than five (5) meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
Hay/Pasture	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
Herbaceous	Areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling but can be utilized for grazing.
Mixed Forest	Areas dominated by trees generally greater than five meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
Open Water	Areas of open water, generally with less than 25% cover of vegetation or soil.
Shrub/Scrub	Areas dominated by shrubs; less than five (5) meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Woody Wetlands	Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Source: National Land Cover Database (NLCD)

Table 2: Examples of Structural Management Practices

Infiltration Basins and Infiltration Trenches- Infiltration devices drain or infiltrate water directly into the ground, providing an opportunity for groundwater recharge. Infiltration facilities are below ground; the length of time that water is allowed to be on the surface is determined by municipal codes.

Dry Wells- Dry wells collect and infiltrate roof runoff at gutter downspouts, roof valleys, and other places where large amounts of concentrated water flow off of a roof. The water is conveyed typically through an underground pipe into an excavated pit (the dry well). They help reduce erosion on your property and can reduce ponding and sitting water.

Rain Barrels- A rain barrel is a device to collect rainwater from downspouts. Rain barrels can be purchased or can be made at home. They come in all sizes and shapes. Some benefits of rain barrels include: reduction of stormwater runoff, promotion of local watershed awareness, education of neighbors about stormwater issues, lowered water bill by reducing metered water usage, and water reuse for landscaping, washing, etc.

Rain Gardens- A rain garden is a landscaped area planted with wildflowers and other native vegetation that is used to soak up rainwater from the roof, driveway, and lawn. The water slowly seeps into the ground instead of heading for the nearest storm drain. A rain garden allows for significantly more water to soak into the ground than a conventional lawn.

Pervious Pavement- Porous asphalt, porous concrete, and porous pavers are all types of pervious pavements. These are typically used with infiltration beds below the previous surfaces, which allow for temporary stormwater storage and infiltration into the ground. These technologies are used for stormwater peak rate control.

Subsurface Infiltration Bed- Temporary storage and infiltration can be attained when including subsurface infiltration beds underneath vegetated surfaces. Subsurface infiltration beds are typically filled with stones (for void space) and wrapped in geotextile fabric. Subsurface infiltration beds work well in large and generally flat spaces that are located downhill from impervious areas.

Vegetated Swale- Vegetated swales, also known as bioswales, are broad channels that are densely planted with vegetation. Designed to attenuate and sometimes infiltrate flow, vegetated swales provide peak rate control and also allow for pollutants to settle out, therefore improving water quality. In sloped areas, check dams are needed to enhance the stormwater management functions of vegetated swales.

Vegetated Filler Strip- Vegetated Filter Strips, also called buffer strips, are areas in between sources of nonpoint source pollutants and the receiving body of water. They can include native or indigenous vegetation such as grasses, shrubs, and trees. Turf grasses are also used sometimes but their functionality in stormwater management is limited. The primary stormwater function of vegetated filter strips is water quality improvement; however, some volume reduction and ground water recharge can occur depending on site conditions such as soil and slope.

Constructed Filter- A constructed stormwater filter is a structure or excavated area that is filled with material that filters stormwater. These devices can be designed to filter floatables, sediments, metals, hydrocarbons, and other pollutants. There are many variations on the constructed filter, including vegetated and non-vegetated, infiltration, contained, subsurface, and linear perimeter filters.

Infiltration Berm/Retention Grading- Infiltration berms are linear landscape features that are parallel to existing site contours in areas with moderate slopes. They are earthen embankments that divert, retain, slow down, divert, and promote the infiltration of stormwater. Berms are most effective in areas that receive runoff from small impervious areas. Retentive grading creates small depressions that store and infiltrate stormwater.

Vegetated Roof- Vegetated Roofs are roofs that are covered with specialized media and planted with vegetation; this enables the roof to hydrologically perform in a manner similar to vegetated surfaces. The media holds water, which is eventually evapotranspired by the plants. The primary function of the vegetated roof in stormwater management is volume reduction. Additional stormwater benefits include water quality improvements and some peak rate control. Environmental benefits beyond stormwater control include building temperature moderation and wildlife habitat.

Runoff Capture and Reuse- Runoff Capture and Reuse refers to the variety of techniques that are used to capture precipitation, store it for a period of time, and reuse the water. Devices used to capture and store stormwater include rain barrels, cisterns, vertical storage mechanisms, and below ground storage systems. These BMPs are most effective for use in controlling small, frequent storm events. Stormwater management benefits of runoff capture and reuse devices include volume reduction, water quality improvements, peak rate control, and groundwater recharge.

Constructed Watershed- Constructed Wetlands (CWs), also known as stormwater wetlands, are shallow aquatic systems planted with emergent vegetation. They are highly effective at removing pollutants from stormwater; they also mitigate peak flow rates and reduce runoff volume. Beyond stormwater management, CWs provide wildlife habitat and aesthetic value. Detention Basins, a basic BMP that temporarily stores stormwater, are often retrofitted into CWs to maximize stormwater management function of the space and obtain the added benefits.

Wet Pond/Retention Basin- Wet Ponds (WPs), also called retention basins, are stormwater basins that include a permanent pool of water, as well as additional capacity for the temporary storage of stormwater. They are very effective at controlling peak stormwater rates and also provide water quality benefits. Beyond stormwater management, WPs can also provide aesthetic and wildlife benefits.

Dry Extended Retention Basin- Dry Extended Detention Basins (DEDBs) are detention basins, which are designed to provide temporary stormwater storage and water quality benefits. The temporary storage of stormwater prevents downstream flooding. Water quality benefits are achieved through sediment settling out of the stormwater while held in the DEDB. DEDBs are often used in conjunction with other BMPs to maximize stormwater management benefits on site. The DEDB is a design enhancement from the Dry Detention Basin, which has been popular since the 1970s. The extended detention of stormwater maximizes water quality benefits.

Water Quality Filters/Hydrodynamic Devices- Water Quality Filters are stormwater inlets that are fitted with devices to filter pollutants from stormwater. Hydrodynamic devices are separate from inlets but serve the same function of filtering pollutants. Both Water Quality Filters and Hydrodynamic Devices rely on some form of settling and filtration to remove pollutants from runoff. There are numerous variations available commercially.

Riparian Buffer Restoration- Riparian Buffer Restoration (RBR) is the restoration of the area surrounding streams, lakes, ponds, and wetlands. The restoration of these areas provides numerous stormwater management benefits, including water quality improvement, volume reduction, groundwater recharge, and peak rate control. Ecological benefits beyond stormwater management are numerous, including providing wildlife habitat and providing aesthetic value.

Landscape Restoration- Landscape Restoration is the term used for the implementation of sustainable landscape practices outside of the Riparian Buffer and/or other specially protected areas. Landscape Restoration can include forest restoration, meadow restoration, and the conversion of turf to meadow. Native plants should be used, and the use of pesticides and herbicides should be eliminated, if possible.

Soil Amendment Restoration- The Soil Amendment & Restoration BMP refers to the process of improving disturbed soils. By reducing compaction and adding organic materials, stormwater infiltration and pollutant removal capacity can be greatly increased. In addition to the added stormwater capacity of the soil itself, soil amendment and restoration improves conditions for growing vegetation, which further improves stormwater management.

Floodplain Restoration- Floodplain Restoration aims to restore a floodplain to conditions present prior to development (pre-1600s). It is a system-based BMP that strives to mimic undisturbed conditions between groundwater, stream base flow, and vegetation. Floodplain Restoration provides substantial water quality and quantity stormwater management benefits.

Level Spreader- Level spreaders are a structural BMP that are designed to reduce the erosive energy of stormwater. Examples of Level Spreaders include earthen berms, level perforated pipes, or concrete curbs. Level spreaders are often used in conjunction with other BMPs such as Filter Strips. Filter Strips function significantly better when stormwater is distributed across the BMP.

Special Detention Areas- The implementation of Special Detention Areas entails using spaces that are not typically utilized for stormwater management, such as parking lots, to temporarily detain stormwater. A flow control structure is typically used to allow runoff to a pond. This BMP is specifically used to control peak rate volume and is more effective when combined with other BMPs that address water quality and volume reduction.

Examples and Explanations Taken Directly From The Southwestern Pennsylvania Commission Water Resource Center (https://spcwater.org/topics/stormwater-management/stormwater-best-management-practices-2/)

Table 3: Example of Non-Structural Management Practices

Riparian Corridors/Buffers - A riparian corridor includes a body of water (stream, river, pond or lake), its lower and upper banks, and the vegetation that stabilizes the area of land adjacent to the body of water. This area of land adjacent to the body of water can also be referred to as a "riparian buffer". This corridor or buffer is important because natural trees and vegetation can filter out air and water pollution, roots from tree and other vegetation can hold the soil in place providing protection from significant erosion and sedimentation, provide cover and shade, provide food and habitat for fish and wildlife, and can provide flood water retention.

Preservation and restoration of riparian corridor/buffers has been identified as one of the most important ways to protect and improve water quality by government and state agencies.

Protect Sensitive and Special Value Features - Special Value Features are those that provide exceptional value stormwater benefits. Examples include riparian areas, wetlands, hydric soils, and floodplains. Sensitive Features are those that are exceptionally vulnerable to stormwater damage. Examples include steep slopes and neighboring properties. Damage to both special value and sensitive features can exacerbate stormwater volume, rate, and quality problems. When developing a site, special attention should be paid to these areas.

Protect / Utilize Natural Flow Pathways in Overall Stormwater Planning and Design - Sites usually have areas where stormwater is being stored and/or conveyed prior to development. These features should be identified and preserved during planning and construction in order to minimize the impacts of stormwater. The preservation of such features can reduce the need for structural BMPs.

Cluster Uses at Each Site and Build on Smallest Area Possible - Through clustering uses at each site and building on the smallest area possible, additional runoff that is generated through the development process is minimized. Additional benefits of this design approach include the preservation of open space, the minimization of impervious areas, and many others. Practical examples of this non-structural BMP include reducing lot size and building vertically.

Use Smart Growth Practices - Smart Growth practices are typically used at the community, municipal, or multi-municipal level. This planning technique guides growth towards parcels that are most desirable for this use. The PA Stormwater BMP Manual describes this particular BMP as "Super Clustering." Smart Growth employs similar methods on a macro scale as clustering does on a micro (site) scale. Tools used in Smart Growth include urban growth boundaries, agricultural zoning, transfer of development rights, donation of conservation easement by owners, and many more.

Minimize Total Disturbed Area–Grading - This design approach works with the existing site topography instead of against it. By reducing the need for site grading, soil disturbance, and removal of vegetation, this planning and development approach aims to prevent the generation of stormwater. Additional benefits of Minimizing Total Disturbed Areas & Grading include reduction of areas that need to be landscaped and maintained.

Minimize Soil Compaction - Minimizing soil compaction and maintaining topsoil quality during construction provides numerous stormwater benefits. Stormwater benefits of this practice include: minimizing runoff and erosion, maximizing water retention capacity, filtering of stormwater, and reducing resources needed to maintain landscaping.

Re-Vegetate and Re-Forest Disturbed Areas - Disturbed areas should be re-vegetated with native plants, grasses, shrubs, and trees. Since these species are adapted to local climate and conditions, they require less fertilizers and pesticides and have better chances of surviving. Stormwater benefits of established native plantings include runoff volume and rate reduction as well as water quality improvements.

Reduce Street Imperviousness and Parking Imperviousness - The benefits of reducing impervious areas for streets and parking through innovative planning are numerous. Benefits include: increased infiltration, decreased stormwater volume, pollutant load reduction, and preservation of natural habitats.

Rooftop Disconnection - Rooftop disconnection is also known as downspout disconnection. Disconnecting rooftop leaders from the storm sewer system and re-directing towards vegetated areas is an effective way to manage stormwater volume. This BMP can be more effective when the flow is directed towards a structural BMP such as a rain garden.

Disconnection from Storm Sewers - Disconnecting stormwater generated from impervious areas, such as roads and driveways, from storm sewers and directing towards structural BMPs, such as bio-infiltration areas, is effective in many ways. Managing the flow near the source instead of sending it downstream via traditional piping allows for increased infiltration and evapotranspiration, increased filtration, and decreased runoff volume.

Street Sweeping – Street Sweeping is a form of source control that is key to ensuring the function of stormwater facilities and keeps local waterways free of debris and other pollutants. In order for street sweeping to be effective, the equipment used should have a vacuum filter.

Examples and Explanations Taken Directly From The Southwestern Pennsylvania Commission Water Resource Center (https://spcwater.org/topics/stormwater-management/stormwater-best-management-practices-2/)

Table 4: Water Quality Measurements and Standards: INDIANA

Physical Monitoring Assessment	Unit	Standard	Source
Turbidity	NTU	Max: 10.4 NTU U.S EPA recommendation	U.S. EPA's proposed nutrient criteria for rivers and streams for ecoregion 55 (Eastern Corn Belt Plains)
Qualitative Habitat Evaluation Index (QHEI)	N/A	>64 Habitat can support a balanced warmwater community. 51-64 Habitat is only partially. supportive of a stream's aquatic life designation <51 Poor habitat	No standard method of interpretation set by IDEM. IDEM interpretation shown here.
Dissolved Oxygen	mg/L or % Saturation	DO levels below 4 mg/L are stressful to most aquatic life. DO levels below 2 mg/L will not support fish. Levels of at least 5 to 6 mg/L are usually required for healthy growth and activity of aquatic life.	Indiana Administrative Code (IAC) 327 IAC 2-1-6 [Non-Great Lakes]
pH	N/A	Must be above 6 and below 9 (A pH range of 6.5 to 8.2 appears to provide protection for most aquatic organisms)	(IAC) 327 IAC 2-1-6 [Non-Great Lakes] IDNR, 2008
Water Temperature	°C	Maximum temperature rises above natural temperatures shall not exceed 5 °F (2.8 °C) in streams	Indiana Administrative Code (IAC) 327 IAC 2-1-6
E. Coli	CFU/100mL	The geometric mean of five (5) equally spaced samples over a 30-day period must be less than 125 CFU/100 mL. All samples must be less than 235 CFU/100 mL	Indiana Department of Natural Resources. Spring 2008. Volunteer Stream Monitoring Training Manual: Hoosier Riverwatch. Indianapolis, IN: Indiana Department of Natural Resources
Orthophosphate	mg/L	SRP concentrations of >0.005 mg/L cause eutrophic or highly productive conditions in lake system	Correll, David L. 1998. The role of phosphorus in the eutrophication of receiving waters: a review. J. Environ. Qual. 27(2):261-266.
Biochemical Oxygen Demand (BOD)	mg/L	1-2 mg/L Clean water with little organic waste 3-5 mg/L Fairly clean with some organic waste 6-9 mg/L Lots of organic material and bacteria 10+ mg/L Very poor water quality; Very large amounts of organic material in water	Hoosier Riverwatch's guidance for Biochemical Oxygen Demand levels

Table 5: Aquatic Life Use Support – Rivers and Streams (IDEM CALM)

<table>
<tr><th colspan="3">Aquatic Life Use Support - Rivers and Stream</th></tr>
<tr><td rowspan="3">Toxicants</td><td colspan="2">Data for dissolved metals (and total metals where dissolved metals data are not available), pesticides, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), free cyanide, and ammonia were evaluated on a site-bysite basis and judged according to the magnitude of the exceedance(s) of Indiana's WQS and the number of times the exceedance(s) occurred. For any one pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three or more measurements.</td></tr>
<tr><td>Fully Supporting</td><td>Not Supporting</td></tr>
<tr><td>No more than one exceedance of the acute or chronic criteria for aquatic life within a three-year period.</td><td>More than one exceedance of the acute or chronic criteria for aquatic life within a three-year period.</td></tr>
<tr><td rowspan="3">Conventional inorganics</td><td colspan="2">Dissolved oxygen, pH, sulfate, and chloride were evaluated for the exceedance(s) of Indiana's WQS. For any one pollutant, the following assessment criteria are applied to data sets consisting of three or more measurements.</td></tr>
<tr><td>Fully Supporting</td><td>Not Supporting</td></tr>
<tr><td>Criteria are exceeded in less than or equal to 10% of measurements.</td><td>Criteria are exceeded in greater than 10% of measurements.</td></tr>
<tr><td>Nutrients</td><td colspan="2">Nutrient conditions were evaluated on a site-by-site basis using the benchmarks described below. In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events:
• Total Phosphorus -- One or more measurements greater than 0.3 mg/L
• Nitrogen (measured as NO3 + NO2) – One or more measurements greater than 10.0 mg/L
• Dissolved Oxygen (DO) – One or more measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/L or values greater than 12.0 mg/L
• pH measurements – One or more measurements exceed the water quality standard of no more than 9.0 pH units or measurements are consistently at/close to the standard, in the range of 8.7- 9.0 pH units
• Algal Conditions -- Algae are described as "excessive" based on field observations by IDEM scientists</td></tr>
<tr><td rowspan="2">Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI) Scores (Range of possible scores are 12-60)</td><td>Fully Supporting</td><td>Not Supporting</td></tr>
<tr><td>mIBI greater than or equal to 36</td><td>mIBI less than 36</td></tr>
<tr><td>Fish community (IBI) Scores (Range of possible scores is 0-60)</td><td>IBI greater than or equal to 36</td><td>IBI less than 36</td></tr>
</table>

Recreation Use Support (Human Health) – All Waters		
IDEM has two different methods for determining recreational use support, depending on the type of data set being used in making the assessment. For data sets consisting of five equally spaced samples over a 30-day period, IDEM applies two tests, both of which are based on the U.S. EPA's Ambient Water Quality Criteria for Bacteria - 1986 (U.S. EPA, 1986), which provides the foundation for Indiana's WQS for recreational use. For data sets with 10 or more grab samples but without the five samples equally spaced over the 30 days required to calculate a geometric mean, the 10% rule is applied. When both types of data sets are available, the assessment decision is based on the data set consisting of five samples, equally spaced over a 30-day period.		
Bacteria (E. coli): at least five equally spaced samples over 30 days. (cfu=colony forming units)	Fully Supporting	Not Supporting
	Geometric mean does not exceed 125 cfu/100mL	Geometric mean exceeds 125 cfu/100mL.
Bacteria (E. coli): grab samples (cfu = colony forming units)	Not more than 10% of measurements are greater than 576 cfu/100ml (for waters infrequently used for full body contact) or 235 cfu/100mL (for bathing beaches). And Not more than one sample is greater than 2,400 cfu/100mL.	More than 10% of samples are greater than 576 cfu/100mL or more than one sample is greater than 2,400 cfu/100mL.
Qualitative habitats use evaluation (QHEI) (Range of possible scores is 0-100)	The Qualitative Habitat Evaluation Index (QHEI) is not used to determine aquatic life- use support. Rather, the QHEI is an index designed to evaluate the lotic habitat quality important to aquatic communities and is used in conjunction with mIBI or IBI data, or both, to evaluate the role that habitat plays in waterbodies where impaired biotic communities (IBC) have been identified. QHEI scores are calculated using six metrics: substrate, instream cover, channel morphology, riparian zone, pool/riffle quality, and gradient. A higher QHEI score represents a more diverse habitat for colonization of aquatic organisms. IDEM has determined that a QHEI total score of <51 indicates poor habitat. For streams where the macroinvertebrate community (mIBI or mHab) or fish community (IBI) scores indicate IBC, QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities, or if there may be other stressors/pollutants causing the IBC.	

Source: 2022 List of Impaired Waters and Consolidated Assessment and Listing Methodology under Section 303(d) of the Clean Water Act

Appendix B
Endangered Species Lists

01/13/2023

Indiana County Endangered, Threatened and Rare Species List

Indiana Department of Natural Resources

Species Name	Common Name	FED	STATE	GRANK	SRANK
Dearborn					
Mollusk: Bivalvia (Mussels)					
Pleurobema clava	Clubshell	E	SE	G1G2	S1
Ptychobranchus fasciolaris	Kidneyshell		SSC	G4G5	S2
Simpsonaias ambigua	Salamander Mussel	C	SSC	G3	S2
Villosa lienosa	Little Spectaclecase		SSC	G5	S3
Insect: Coleoptera (Beetles)					
Cicindela marginipennis	Cobblestone Tiger Beetle		SE	G3	S1
Fish					
Etheostoma variatum	Variegate Darter		SE	G5	S1
Amphibian					
Acris blanchardi	Blanchard's cricket frog		SSC	G5	S4
Ambystoma barbouri	streamside salamander	C	SSC	G4	S3
Cryptobranchus alleganiensis alleganiensis	hellbender	C	SE	G3T2	S1
Reptile					
Crotalus horridus	timber rattlesnake		SE	G4	S2
Opheodrys aestivus	rough green snake		SSC	G5	S3
Terrapene carolina carolina	woodland box turtle		SSC	G5T5	S3
Bird					
Falco peregrinus	Peregrine Falcon		SSC	G4	S2B
Haliaeetus leucocephalus	bald eagle			G5	S3
Lanius ludovicianus	loggerhead shrike		SE	G4	S2B
Nycticorax nycticorax	Black-crowned Night-heron		SE	G5	S1B
Sternula antillarum athalassos	Interior Least Tern		SE	G4T3Q	S1B
Tyto alba	Barn Owl		SE	G5	S2
Mammal					
Taxidea taxus	American Badger		SSC	G5	S2
Vascular Plant					
Diodia virginiana	buttonweed		WL	G5	S3
Juglans cinerea	butternut		ST	G3	S2
Lilium canadense	Canada lily		ST	G5	S3
Ludwigia decurrens	primrose willow		WL	G5	S3
Micranthes virginiensis	Virginia saxifrage		WL	G5	S3
Penstemon canescens	gray beardtongue		SE	G4	S1
Rorippa aquatica	lake cress		SE	G4?	S1
Sida hermaphrodita	Virginia mallow		SE	G3	S1
Trifolium stoloniferum	running buffalo clover		SE	G3	S1
Viburnum molle	softleaf arrow-wood		ST	G5	S3
High Quality Natural Community					

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: E = Endangered; T = Threatened; C = candidate; PDL = proposed for delisting

State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list

GRANK: Global Heritage Rank: G1 = critically imperiled globally; G2 = imperiled globally; G3 = rare or uncommon globally; G4 = widespread and abundant globally but with long-term concerns; G5 = widespread and abundant globally; G? = unranked; GX = extinct; Q = uncertain rank; T = taxonomic subunit rank

SRANK: State Heritage Rank: S1 = critically imperiled in state; S2 = imperiled in state; S3 = rare or uncommon in state; S4 = widespread and abundant in state but with long-term concern; SG = state significant; SH = historical in state; SX = state extirpated; B = breeding status; S? = unranked; SNR = unranked; SNA = nonbreeding status unranked

01/13/2023

Indiana County Endangered, Threatened and Rare Species List

Indiana Department of Natural Resources

Species Name	Common Name	FED	STATE	GRANK	SRANK
Forest - flatwoods bluegrass till plain	Bluegrass Till Plain Flatwoods		SG	G3	S2
Forest - upland dry-mesic Bluegrass	Bluegrass Dry-mesic Upland Forest		SG	GNR	S1
Forest - upland mesic Bluegrass	Bluegrass Mesic Upland Forest		SG	GNR	S3

Indiana Natural Heritage Data Center
Division of Nature Preserves
Indiana Department of Natural Resources
This data is not the result of comprehensive county surveys.

Fed: E = Endangered; T = Threatened; C = candidate; PDL = proposed for delisting

State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern; SX = state extirpated; SG = state significant; WL = watch list

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Dearborn County

Water Quality Characterization Report

MS4 Permit #: INR040160

September 2023

Dearborn County INDIANA

OHM Advancing Communities

Table of Contents

OHM Advisors
400 Missouri Avenue, Suite 100
Jeffersonville, IN 47130
www.OHM-Advisors.com

Table of Revisions

The following table summarizes revisions, additions, deletions, etcetera to the contents of this report:

Date	Revised Pages/Appendices	Summary of Change

Primary MS4 Contact

Dennis Kraus Jr.
County Surveyor
165 Mary Street
Lawrenceburg, IN 47025
812-532-3216

Jim Thatcher
President, Board of Commissioners
165 Mart Street
Lawrenceburg, IN 47025
812-537-8894

WQCR Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Qualified Professional:

Name: Allison Padron, PE

Title: Project Manager, OHM Advisors

Signature:

Date: 9/21/23

MS4 Operator or Designee:

Name: Jim Thatcher

Title: President, BOC

Signature:

Date: 10/3/23

1.0 Purpose

This water quality assessment report is intended to accompany the Greendale, Lawrenceburg, Aurora, and Dearborn County (GLAD) Regional Water Quality Characterization Report (WQCR). This component of the WQCR contains information specific to the Dearborn County as a method for further analyzing water quality within the MS4 boundaries and using that information to guide their MS4 Program as they begin implementing the Indiana MS4 General Permit (INR040000) and Indiana Construction Stormwater General Permit (INRA00000).

2.0 Assessment of Land Use

Dearborn County is located along the eastern edge of Indiana, across the Ohio River from Kentucky and on the outskirts of the Cincinnati Metropolitan Area. It is bounded by the Indiana counties of Franklin, Ripley, and Ohio, and Hamilton County in the state of Ohio. The Dearborn County Municipal Separate Storm Sewer System (MS4) area refers to the entirety of the unincorporated areas of the county as shown in Figure 1, which does not include the incorporated towns and cities of: Greendale, Lawrenceburg, Aurora, St. Leon, Moores Hill, Dillsboro, West Harrison, and Hidden Valley Lake. It measures approximately 307.4 square miles (196,736 acres) in total area, with the MS4 program being administered in 283.5 square miles (181,400 acres) of unincorporated area.

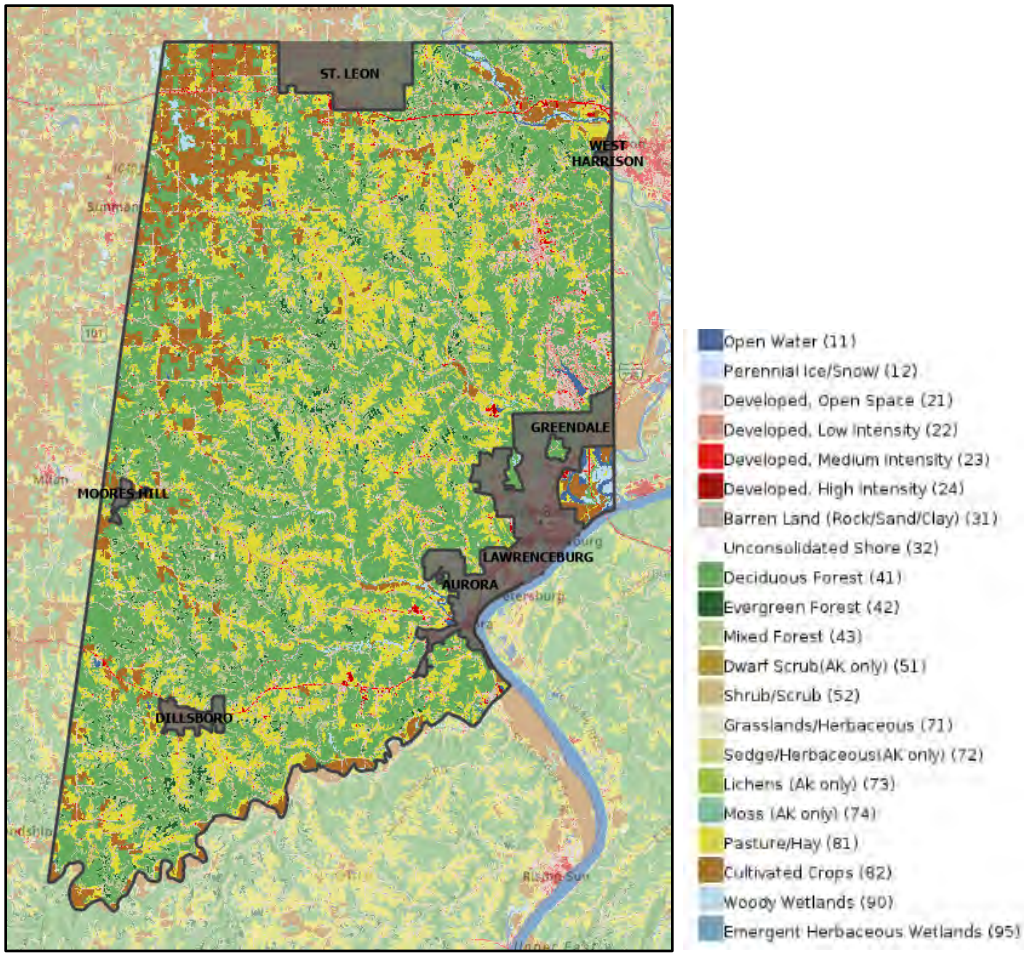


Figure 1. Land Use Map (NLCD, 2021)

Below in Table 1, is a breakdown of land use within Dearborn County, excluding the incorporated communities. The county is primarily wooded and agricultural with forested area making up more than 57% of the total area and pasture/agricultural land making up 31%. Only 9% of the total land use is considered to be developed, although most of that land is still open space.

Table 1: Land Use for Dearborn County MS4 Area

Category	Acres	Percentage
Deciduous Forest	80,655	44.5%
Hay/Pasture	41,923	23.1%
Mixed Forest	20,582	11.3%
Cultivated Crops	14,470	8.0%
Developed, Open Space	11,078	6.1%
Developed, Low Intensity	4,151	2.3%
Evergreen Forest	2,638	1.5%
Open Water	1,487	0.8%
Woody Wetlands	1,378	0.8%
Developed, Medium Intensity	1,257	0.7%
Herbaceous	831	0.5%
Shrub/Scrub	368	0.2%
Developed, High Intensity	278	0.2%
Emergent Herbaceous Wetlands	185	0.1%
Barren Land	119	0.1%
TOTAL	181,400	100%

Source: National Land Cover Database (NLCD, 2021)

3.0 Best Management Practices (BMPs)

The following section describes Dearborn County's efforts to improve stormwater quality through the MS4 program by implementing the six (6) Minimum Control Measures (MCMs), including structural and non-structural BMPs.

3.1 Structural BMPs

Dearborn County is currently in the process of mapping their storm sewer system, to comply with the MS4 General Permit.

3.2 Non-Structural BMPs

3.2.1 Ordinances

Dearborn County is currently in the process of developing and adopting stormwater management ordinances for Illicit Discharge Control, Construction Site Runoff Control, and Post-Construction Runoff Quality Control. The ordinances will establish the legal authority to administer the MS4 program and ensure compliance through adopted ordinances.

The County is also developing Stormwater Technical Standards which includes design specifications and selection guidance for both construction and post-construction BMPs approved for installation by the County.

There are some existing current ordinances/codes in Dearborn County related to stormwater showing that some consideration for water quality and stormwater management is already in place (numbers relate to code of ordinances for Dearborn County):

- 37.17 – Investigation of Stormwater Nuisance: details requirements for submitting a request to take care of a stormwater nuisance, which is essentially a blockage in the system
- 50.31 – Pollution: deals with water pollution, primarily sanitary
- 51.19 – Subdivisions: details what plats must show for subdivisions, including locations of streams, storm sewers, sanitary sewers, drainage ditches, etc.
- 94.06 – Erosions and Sediment Control Requirements: details what ESPCs are required on construction sites,
- 150.48 – Drainage: details the requirements for drainage on new construction sites and roadways.

3.2.2 Partnerships

The County actively participates in the Greendale, Lawrenceburg, Aurora, and Dearborn County (GLAD) MS4 Partnership which was started in early 2023 when the neighboring communities were designated as MS4 Phase 2 communities by the Indiana Department of Environmental Management (IDEM). The GLAD Partnership provides a forum for developing a coordinated implementation of the MS4 program in the communities.

The County also partners with the Dearborn County Soil and Water Conservation District as well as the Dearborn County Solid Waste Management District. These partnerships give the County more resources and facilities that can be used to implement and enhance the MS4 program.

3.2.3 MCM 1 & 2 – Public Education and Outreach; Participation and Involvement

Dearborn County already has a very active outreach program through the Soil and Water Conservation District (SWCD), with a number of activities geared towards water quality. The SWCD already goes above and beyond the MS4 Program requirements and hosts a minimum of four (4) events per year, including: an Arbor Day Tree Give-Away, rainbarrel workshops, native plant sales and a cost share program for raingarden installations, and presentations to students using the Stormwater Enviro-scape model. Information is also shared with landowners, commercial agricultural companies, and county commissioners at the Annual Conservation Tillage Meeting and PARP Training held each November.

The SWCD has a website which is currently being expanded that will house information on the MS4 Program for Dearborn County which includes water quality public education and outreach, as well as ways residents can get involved. The website will contain historical information on the MS4 program, teacher resources, water quality impairments, and general information on handouts available.

The website is located at: https://www.dearborncounty.org/topic/subtopic.php?topicid=253&structureid=32

3.2.4 MCM 3 – Illicit Discharge Detection and Elimination

The County is currently working on mapping the system in order to develop the IDDE Plan specific to the MS4 Program.

3.2.5 MCM 4 – Construction Site Stormwater Runoff

The Dearborn County SWCD reviews SWPPPs for submitted construction plans using the IDEM MS4 checklist/criteria.

Construction site inspections are performed by the SWCD using criteria based on the IDEM MS4 checklist. As of the submittal of this report, there were 92 active construction sites that the SWCD personnel inspect on a continual rotation to visit 20-30 sites per month.

Martin Yake with IDEM performs inspections of municipal projects, will continue to do so. IDEM will also continue to review municipal SWPPPs for the municipality.

3.2.6 MCM 5 – Post-Construction Stormwater Runoff

A Technical Review Committee, which incudes County Surveyor and MS4 Coordinator, Dennis Kraus, reviews submitted drainage plans for post-construction stormwater impacts.

3.2.7 MCM 6 - Municipal Operations Pollution Prevention and Good Housekeeping

Dearborn County has identified ten (10) county facilities, which includes: Dearborn County Recycling Center, Dearborn County Jail, Dearborn County Courthouse, Dearborn County Highway Department, YES Home, and five (5) county parks. These facilities will be evaluated for the potential to discharge pollutants, and if required, a SWPPP plan will be developed for the facility, along with quarterly inspections.

Municipal employees are currently being trained in stormwater pollution management using a video developed by the Purdue University Local Technical Assistance Program (LTAP). Additional training will be developed, as needed.

3.2.8 Flood Control

The majority of the flood control facilities for the County are located in the urbanized areas of Lawrenceburg and Aurora along the Ohio River.

4.0 Receiving Waters

Dearborn County has 49 major receiving waters, shown in Figure 2 below, and listed in Table 2 which breaks down the names, lengths, and the total percentage of each receiving water. There is a total of 354.4 miles of natural stream channels within the County MS4 limits. Laughery Creek and the Ohio River form the southern boundary of the county. Aside from a few small portions of streams in the northern portion, nearly all of the streams drain towards the Ohio River, which is the major receiving water in the region. Nearly 40% of the county is drained by unnamed tributaries, with various forks of Tanners Creek, Hogan Creek, and Laughery Creek serving as the primary receiving streams. Tanners Creek and Hogan Creek drain into the urbanized areas of Greendale, Lawrenceburg, and Aurora and are heavily influenced by activities upstream in these watersheds.

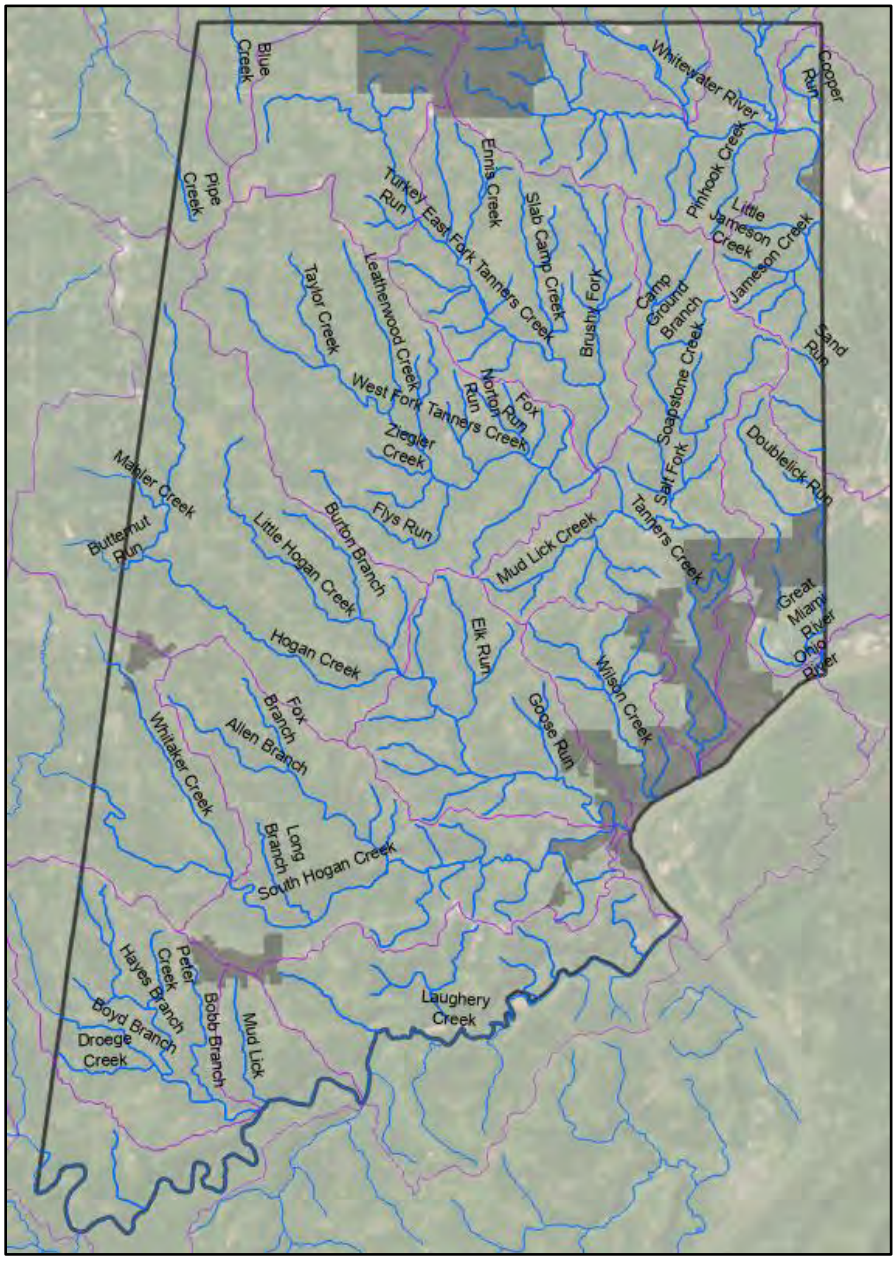


Figure 2. Primary Streams in Dearborn County

Table 2: Dearborn County MS4 Area Receiving Waters

Stream Name	Length (miles)	Percentage
Unnamed Tributaries	140.8	39.7%
Allen Branch	7.0	2.0%
Blue Creek	1.8	0.5%
Bobb Branch	3.8	1.1%
Boyd Branch	2.8	0.8%
Brushy Fork	5.0	1.4%
Burton Branch	3.3	0.9%
Butternut Run	0.7	0.2%
Camp Ground Branch	2.4	0.7%
Cooper Run	2.6	0.7%
Doublelick Run	3.5	1.0%
Droege Creek	2.4	0.7%
East Fork Tanners Creek	14.5	4.1%
Elk Run	3.7	1.0%
Ennis Creek	3.3	0.9%
Flys Run	4.9	1.4%
Fox Branch	2.4	0.7%
Fox Run	2.1	0.6%
Goose Run	2.1	0.6%
Great Miami River	1.5	0.4%
Hayes Branch	8.8	2.5%
Hogan Creek	20.4	5.8%
Jameson Creek	3.0	0.8%
Laughery Creek	8.5	2.4%
Leatherwood Creek	4.0	1.1%
Little Hogan Creek	7.7	2.2%
Little Jameson Creek	1.5	0.4%
Long Branch	2.8	0.8%
Mahler Creek	1.0	0.3%
Mud Lick	3.0	0.8%
Mud Lick Creek	3.9	1.1%
Norton Run	2.5	0.7%
Ohio River	0.0	0.0%
Peter Creek	2.0	0.6%
Pinhook Creek	2.9	0.8%
Pipe Creek	1.4	0.4%
Salt Fork	8.2	2.3%
Sand Run	0.9	0.3%

Slab Camp Creek	4.1	1.2%
Soapstone Creek	1.6	0.4%
South Hogan Creek	15.8	4.5%
Tanners Creek	4.5	1.3%
Taylor Creek	2.8	0.8%
Turkey Run	1.5	0.4%
West Fork Tanners Creek	11.6	3.3%
Whitaker Creek	5.1	1.4%
Whitewater River	8.6	2.4%
Wilson Creek	4.4	1.2%
Ziegler Creek	1.6	0.5%
TOTAL	381.5	100%

Dearborn County drains into twenty (20) HUC-12 watersheds, including ones that extend beyond the boundaries of the county. A list of the watersheds can be found in Table 3 and a map showing the extents of each watershed are shown in Figure 3.

Table 3: Dearborn County HUC-12 Watersheds

HUC-12 Code	Watershed Name	Total Area (Acres)
50800020907	Doublelick Run-Great Miami River	10068
50800030601	Headwaters Pipe Creek	13906
50800030801	Headwaters Blue Creek	11724
50800030805	Blackburn Creek-Whitewater River	11002
50800030806	Johnson Fork-Whitewater River	21045
50800030809	Lee Creek-Dry Fork Whitewater River	14510
50800030810	Jameson Creek-Whitewater River	18614
50902030204	Garrison Creek-Ohio River	16583
50902030301	Turkey Run-East Fork Tanners Creek	10097
50902030302	West Fork Tanners Creek	24130
50902030303	East Fork Tanners Creek	15171
50902030304	Salt Fork-Tanners Creek	18728
50902030401	Headwaters South Hogan Creek	28047
50902030402	Little Hogan Creek-North Hogan Creek	22770
50902030403	Allen Branch-South Hogan Creek	19763
50902030404	Elk Run-North Hogan Creek	11563
50902030603	Hayes Branch	12828
50902030604	Caesar Creek-Laughery Creek	19695
50902030702	Laughery Creek	18743
50902030802	Taylor Creek-Ohio River	17633

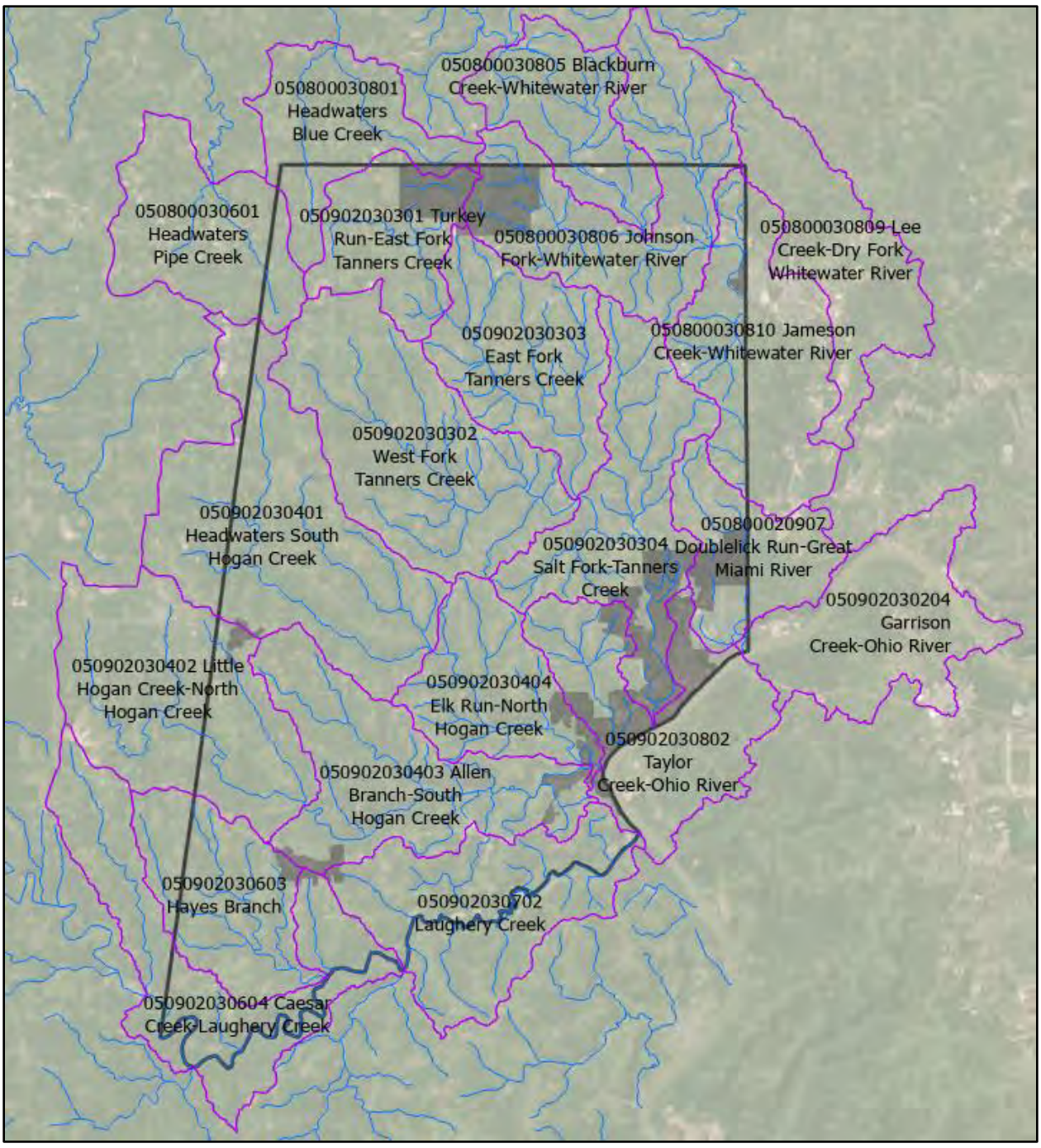


Figure 3. Major HUC-12 Watersheds for Dearborn County

5.0 303(d) Impaired Waters

The 2022 Integrated Water Monitoring and Assessment Report published by IDEM includes the 303(d) List of Impaired Streams for Indiana. Twenty-nine (29) stream segments in the Dearborn County MS4 area were listed on the 2022 303(d) List of Impaired Streams, shown on the map in Figure 4 and in Table 4. There are a total of 245.1 miles of impaired streams and rivers within Dearborn County. Common impairments in Dearborn County include E.coli, low dissolved oxygen (Low D.O.), and the legacy contaminant of PCBs. These impairments affect the recommended usage for the stream, with multiple streams throughout Dearborn County not being recommended for recreational use or consuming fish caught in the stream.

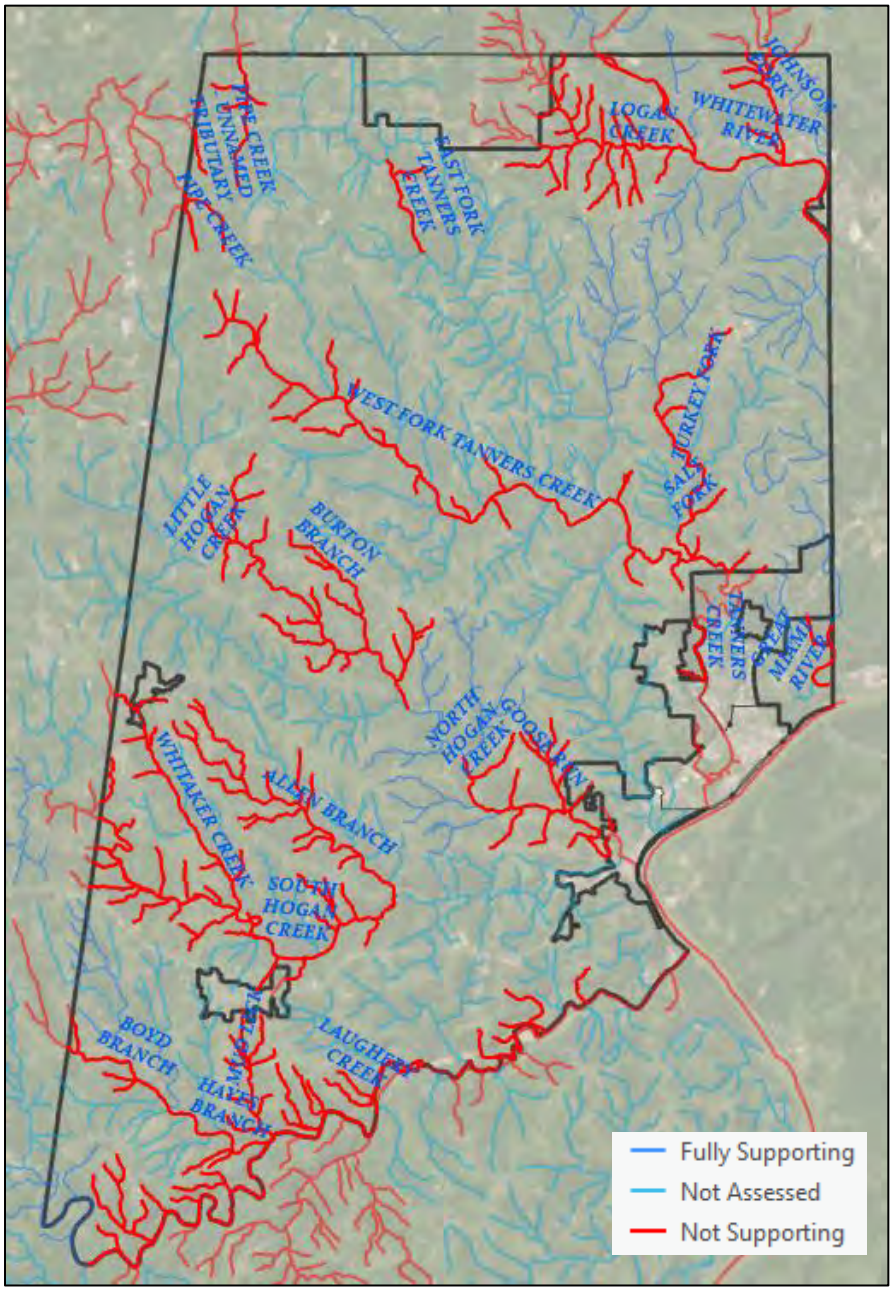


Figure 4. 303(d) Impaired Waters of Dearborn County

Table 4: Dearborn County Impaired 303(d) Waters

Stream Name	Assessment ID(s)	Length (Miles)	Impairment	Usage Impairment(s)	TMDL
Allen Branch	INV0343_T1004 INV0343_T1006	18.2	E. Coli, D.O.	Ecological, Recreational	-
Blue Creek	ING0381_01	4.8	E. Coli, D.O.	Ecological, Recreational	IDEM: Nonpoint Source: Whitewater River Southern
Boyd Branch	INV0363_T1004	4.8	E. Coli	Recreational	-
Burton Branch	INV0341_T1008	5.4	E. Coli	Recreational	-
East Fork Tanners Creek	INV0331_03	3.2	B.I.	Ecological	-
Goose Run	INV0344_T1006	5.0	E. Coli, D.O.	Ecological, Recreational	-
Great Miami River	ING0297_02	2.5	PCBs in Fish	Fish Consumption	-
Hayes Branch	INV0363_03 INV0363_04	5.0	E. Coli	Ecological, Recreational	-
Johnson Fork	ING0386_T1014	5.6	E. Coli	Recreational	IDEM: Nonpoint Source: Whitewater River Southern
Johnson Fork – Unnamed Trib.	ING0386_T1008	1.2	E. Coli	Recreational	IDEM: Nonpoint Source: Whitewater River Southern
Laughery Creek	INV0372_04 INV0372_05 INV0372_06 INV0364_02 INV0364_03	29.6	Mercury (Hg), PCBs, & Heavy Metals in Fish	Ecological, Fish Consumption	-
Laughery Creek – Unnamed Trib.	INV0364_T1006	5.2	Mercury in Fish	Fish Consumption	-
Little Hogan Creek	INV0341_T1006 INV0341_T1007	17.5	E. Coli, D.O.	Recreational	-
Little Hogan Creek – Unnamed Trib.	INV0341_T1005	3.3	E. Coli	Recreational	-
Logan Creek	ING0386_T1010 ING0386_T1011	17.0	E. Coli, D.O., Mercury in Fish	Ecological, Recreational, Fish Consumption	IDEM: Nonpoint Source: Whitewater River Southern
Logan Creek – Unnamed Trib.	ING0386_T1012	4.1	E. Coli	Recreational	IDEM: Nonpoint Source: Whitewater River Southern

Stream Name	Assessment ID(s)	Length (Miles)	Impairment	Usage Impairment(s)	TMDL
Mud Lick	INV0364_T1007	8.2	Hg in Fish	Fish Consumption	-
North Hogan Creek	INV0344_02	11.2	PCBs in Fish	Fish Consumption	-
Ohio River – State Line to Woolper Creek (KY)	INH1_01	0.1	Dioxin, PCBs	Fish Consumption	-
Pipe Creek	ING0361_02	2.9	E. Coli, D.O.	Ecological, Recreational	IDEM: Nonpoint Source: Salt-Pipe Creek WMP 22460
Pipe Creek – Unnamed Trib.	ING0361_T1004	1.1	E. Coli	Recreational	IDEM: Nonpoint Source: Salt-Pipe Creek WMP 22460
Salt Fork	INV0334_T1008	2.8	E. Coli	Recreational	-
South Hogan Creek	INV0342_02 INV0343_01	28.6	E. Coli, D.O.	Ecological, Recreational	-
Tanners Creek	INV0334_01 INV0334_02 INV0334_03 INV0334_05	9.6	E. Coli, D.O., PCBs in Fish	Ecological, Recreational, Fish Consumption	-
Turkey Fork	INV0334_T1005 INV0334_T1011 INV0334_T1012	6.7	Chloride, E. Coli	Ecological, Recreational	-
West Fork Tanners Creek	INV0332_01 INV0332_02 INV0332_03 INV0332_04	23.5	E. Coli, D.O.	Ecological, Recreational	-
Whitaker Creek	INV0342_T1007 INV0342_T1008	8.6	E. Coli	Ecological, Recreational	-
Whitewater River	ING0385_03 ING0385_04 ING0386_01 ING038A_01	9.6	E. Coli, PCBs in Fish	Ecological, Recreational, Fish Consumption	IDEM: Nonpoint Source: Whitewater River Southern

Multiple streams in the northern boundary of Dearborn County have a Total Maximum Daily Load (TMDL) associated with them including: Logan Creek, Whitewater River, Johnson Fork, Blue Creek, and Pipe Creek. The Southern Whitewater River Watershed TMDLs Restoration Plan and Salt-Pipe Creek Watershed Management Plan have been written for these streams to establish pollutant loading standards and examine possible causes of the impairment.

6.0 Known Sensitive Areas

Public Beaches/ Full Body Contact Recreation:

There is one area with public beaches in Dearborn County in Hidden Valley Lake north of Greendale, which has their own MS4 Phase 2 permit, and is not included in the MS4 area of Dearborn County. There are two small beaches along this lake, with designated public swimming areas. Due to the proximity of Salt Fork and Tanner's Creek to the urbanized areas of Greendale, Lawrenceburg, Aurora, and Hidden Valley Lake, as well as their status as impaired streams with measured E. coli and PCBs, these areas of the MS4 should be prioritized.

Boat Launches:

There are a five (5) identified boat launches within all of Dearborn County, including the incorporated areas:

- Lake Dilldear boat ramp (Lake Dilldear)
- Tanner's Creek boat ramp (Lawrenceburg)
- Hidden Valley Lake Marina (Hidden Valley Lake)
- Sunset Bay Marina and Campground (Aurora)
- Water Ways Marina (Aurora)

Surface Drinking Water Intakes: Drinking water sources within the County are derived primarily from local groundwater resources, as can be seen in Table 4 below, which lists every water utility in Dearborn County. According to the Public Water Supply Information System maintained by the IDEM, there are no known surface drinking water intakes in the surrounding area.

Table 5: Drinking Water Systems in Dearborn County

Water System No.	Water System Name	Type	Primary Source of Water
IN5215001	Aurora Utilities	Community	Ground Water
IN2150001	Barber Road Cabins	Non-Community	Ground Water
IN5215003	City Of Greendale Utilities	Community	Ground Water
IN5215002	Dillsboro Water Works	Community	Ground Water (Purchased)
IN5215005	Hogan Water Corporation	Community	Ground Water (Purchased)
IN5215007	L-M-S Conservancy District	Community	Ground Water
IN5215006	Lawrenceburg Municipal Utilities	Community	Ground Water
IN5215008	North Dearborn Water Authority	Community	Ground Water
IN5215009	Tri-Township Water Corporation	Community	Ground Water
IN5215004	Valley Rural Utility Company	Community	Ground Water (Purchased)

Wellhead Protection Areas: There is an established wellhead protection area (WHPA) in the City of Lawrenceburg in Dearborn County. Lawrenceburg Municipal Utilities operates four (4) groundwater wells that

pump an average of 767,000 gallons of water per day. The WPHA in Lawrenceburg extends from the western edge of the downtown area westward bounded to the north and south by US Route 50 and the Ohio River respectively, until just slightly east of Aurora, IN.

IDEM maintains a list of all Community Public Water Supply System with Wellhead Protection Plans, with those in Dearborn County shown in Table 5, all of which are required to be updated every five (5) years. These areas may be within incorporated areas of the County.

Table 6: Water Supply Systems with Wellhead Protection Plans in Dearborn County

Public Water System No.	Water System Name	Population Served	Due Date
5215001	Aurora Utilities	6,415	July 16, 2024
5215003	City Of Greendale Utilities	4,520	November 1, 2023
5215006	Lawrenceburg Municipal Utilities	5,000	August 1, 2027
5215007	L-M-S Conservancy District	5,250	July 16, 2024
5215008	North Dearborn Water Authority	5,595	March 6, 2025
5215009	Tri-township Water Corporation	9,925	December 1, 2025

Sinkhole Areas: Thirteen (13) sinkhole areas were identified in Dearborn County through a review of Indiana Geological Survey (IGS) data. There are three clusters of sinkholes. The first cluster, a group of three, is located in a rural area on the west county line, just south of the intersection of W County Line Rd and E County Road 50 N. Another group of five lie right along Little Hogan Creek in a rural area, in and around where the creek crosses County Farm Rd. The final group of five lie in and around Leatherwood Creek, just East of James Lake Rd, also a rural area.

Wetlands: Wetland areas are considered to be environmentally sensitive features and are protected by the Clean Water Act. National Wetland Inventory (NWI) was used to estimate the extent and locations of wetlands and deep waters in Dearborn County. Based on these data, there are more than 7,230 acres of wetlands and deep-water habitats within the County MS4 area, not including the riverine habitat directly along the Ohio River. The following map and table shows the different types of wetlands within the MS4. The majority of wetlands and ponding areas are located in the urbanized portion of the County in the southeast and northeast, especially along major roadway corridors. Streams that drain into the Ohio River are subject to backwater conditions from the larger river. Wetlands and ponding areas serve a critical role in floodplain management.

Table 7: Types of Wetlands in Dearborn County

Type	Acres
Freshwater Emergent Wetland	375
Freshwater Forested/Shrub Wetland	1,844
Freshwater Pond	1,930
Lake	587
Riverine (Interior)*	2,496
TOTAL	**7,232**

*Does not include the Riverine area on the Ohio River.

Source: National Wetland Inventory (NWI, 2023).

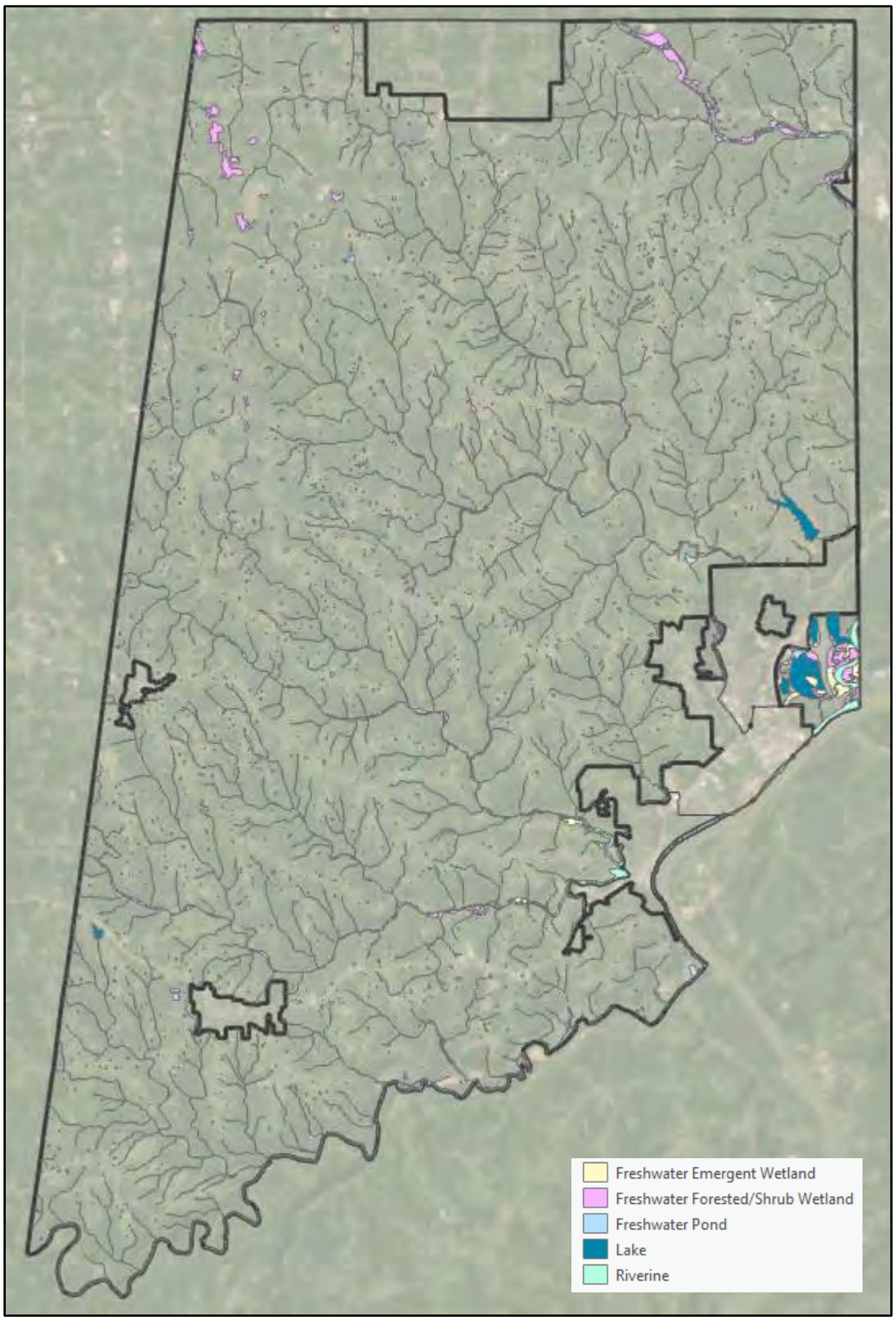


Figure 5. Wetlands and Lakes of Dearborn County MS4 Area

7.0 Existing and Available Monitoring Data

Five (5) sub-watersheds in Dearborn County have Watershed Management Plans (WMPs) that have been developed: Whitewater River (2016), Salt-Pipe Creek (2019), Tanner's Creek (2003), Hogan Creek (2007), and South Laughery Creek (2006). Two (2) watersheds have a TMDL: Whitewater River (2015), and Salt Pipe Creek (2019). A review of these reports and plans has been included below:

Table 8: HUC-12 Sub-watersheds within Dearborn County with TMDL or WMP

Sub-Watershed Name (HUC-12)	Sub-Watershed ID#	TMDL Report	Watershed Management Plan (WMP)
Headwaters Blue Creek	0508000308	IDEM: Nonpoint Source: Whitewater River Southern	IDEM: Nonpoint Source: Whitewater River WMP 3-119
Johnson Fork – Whitewater River	0508000308	IDEM: Nonpoint Source: Whitewater River Southern	IDEM: Nonpoint Source: Whitewater River WMP 3-119
Blackburn Creek-Whitewater River	050800030809	IDEM: Nonpoint Source: Whitewater River Southern	IDEM: Nonpoint Source: Whitewater River WMP 3-119
Lee Creek-Dry Fork Whitewater River	050800030809	IDEM: Nonpoint Source: Whitewater River Southern	IDEM: Nonpoint Source: Whitewater River WMP 3-119
Jameson Creek-Whitewater River	050800030810	IDEM: Nonpoint Source: Whitewater River Southern	IDEM: Nonpoint Source: Whitewater River WMP 3-119
Headwaters Pipe Creek	050800030601	IDEM: Nonpoint Source: Whitewater River Southern	IDEM: Nonpoint Source: Salt-Pipe Creek WMP 22460
Turkey Run-East Fork Tanners Creek	050902030301	None	IDEM: Nonpoint Source: Tanners Creek WMP 00-198
East Fork Tanners Creek	050902030303	None	IDEM: Nonpoint Source: Tanners Creek WMP 00-198
Salt Fork-Tanners Creek	050902030304	None	IDEM: Nonpoint Source: Tanners Creek WMP 00-198
Doublelick Run-Great Miami River	050800020907	None	None
Garrison Creek-Ohio River	050902030204	None	None
Taylor Creek-Ohio River	050902030802	None	None
West Fork Tanners Creek	050902030302	None	IDEM: Nonpoint Source: Tanners Creek WMP 00-198
Little Hogan Creek-North Hogan Creek	050902030401	None	IDEM: Nonpoint Source: Hogan Creek WMP 5-71
Headwaters South Hogan Creek	050902030402	None	IDEM: Nonpoint Source: Hogan Creek WMP 5-71
Allen Branch-South Hogan Creek	050902030403	None	IDEM: Nonpoint Source: Hogan Creek WMP 5-71
Elk Run-North Hogan Creek	050902030404	None	IDEM: Nonpoint Source: Hogan Creek WMP 5-71
Laughery Creek	050902030702	None	IDEM: Nonpoint Source: Laughery Creek (Southern) WMP 3-748
Hayes Branch	050902030603	None	IDEM: Nonpoint Source: Laughery Creek (Southern) WMP 3-748
Caesar Creek-Laughery Creek	050902030604	None	IDEM: Nonpoint Source: Laughery Creek (Southern) WMP 3-748

Complete Tanner's Creek Watershed Management Plan (2003): The Tanner's Creek Watershed Steering Committee, a subcommittee of the Dearborn County Soil and Water Conservation District (SWCD), received a Nonpoint Source Section 319 Grant from IDEM in 2000 to develop a watershed management plan for the Tanner's Creek Watershed. The study was completed and approved in June 2003. This watershed is almost entirely contained within Dearborn County; all six water monitoring sites were therefore located in Dearborn County. The main water quality concerns identified by the Committee were:

- High phosphorous counts
- High E. coli levels

The data for all six sites are listed in the table below. The most direct source of these pollutants was cattle with unfettered access to creeks. Evidence of cattle access to streams was found in Salt Fork and Brushy Fork, both of which had highly elevated E. coli levels and phosphorous. These data suggest that controlling cattle in this section of the watershed, by preventing their access to streams and limiting runoff potential, can go a long way towards improving water quality. With that having been said, these data do not show that monitoring the MS4 in this watershed will have a significant impact on its water quality; thus, this area is not a high priority.

Table 8: Results from Tanners Creek Watershed Management Plan (2003)

Site 1:	Date	D.O.	% Saturation	E-Coli	pH	BOD 5	Temp Change	Phosphate	Nitrate	Turbidity
	06/29/2000	8.7	100		7.7	3	-1.1	6	0.79	
	07/28/2000	2.83	33.33	927.6	7.03	1.33	0	9.67	0.85	24.62
	08/30/2000	4.8	55	765.9	8	2.2	0	50	0.02	25.67
	09/20/2000	2.79	28	666	8.2	1.5	0.1	7	0.1	23
Site 2:	**Date**	**D.O.**	**% Saturation**	**E-Coli**	**pH**	**BOD 5**	**Temp Change**	**Phosphate**	**Nitrate**	**Turbidity**
	04/06/2000	19	140	0	8	2	2.3	0.1	0.001	0
	06/06/2000	10	120	166.5	8	2	3.9	7.75	0	
	07/26/2000	5.5	65	149.85	7.3	3.83	0	1.55	11.65	
	08/16/2000	7	80	882.5	7.8	2.1	-0.6	1	0.57	8
	09/26/2000	8.71	88.4	316.35	8.1	5	-1.7	5	1.76	42
	10/09/2000	9.65	85	1332	7.97	2.88	-0.8	3.5	0	12.82
	11/07/2000	8.26	74.83	390	7.97	2.92	-5.3	4.5	0.05	2.78
Site 3:	**Date**	**D.O.**	**% Saturation**	**E-Coli**	**pH**	**BOD 5**	**Temp Change**	**Phosphate**	**Nitrate**	**Turbidity**
	05/31/2000	9.75	122		7.6	0.85	0	0	0	
	06/30/2000	9.5	120		7.9	0	0	0	2.64	
	08/25/2000	10	120	316.35	8	3.77	0.6	1	3	21.33
	09/29/2000	9.07	90	0	8.17	6.57	-0.36	4.33	0.07	15.52
	10/20/2000	8.13	76.27	2497.5	8	3.57	-1.9	3.33	6.17	10.37
	11/07/2000	9.29	85.2	833	7.9	4.73	-2.7	3.5	0	5.94
Site 4:	**Date**	**D.O.**	**% Saturation**	**E-Coli**	**pH**	**BOD 5**	**Temp Change**	**Phosphate**	**Nitrate**	**Turbidity**
	04/29/2000	15	140		8.1	3	0	0	0	
	06/28/2000	11	130	110	8.5	1.5	-0.6	0	0.48	
	07/14/2000	7	95	366.3	8.47	5	0	0	0.25	
	08/15/2000	11.5	125		7.1		3	0.6	0.007	6
	09/17/2000	20	140	0	6.53	13	-0.25	0.16	14.3	
	10/19/2000	4.5	44		7.5		1	0.52	0	19
Site 6:	**Date**	**D.O.**	**% Saturation**	**E-Coli**	**pH**	**BOD 5**	**Temp Change**	**Phosphate**	**Nitrate**	**Turbidity**
	05/08/2000	6.33	75		8.5	3.3	0	0.05	0	
	06/20/2000	8.83	96.67		8.3	2.3	0	0.25	15.18	
	07/18/2000	4.5	53	99.9	8.5	2	-3.3	0	0	13.5
	08/19/2000	7.5	85	649	7.43	5	0	3	0.07	21.5
	09/26/2000	9.4	84	283	8.1	3.4	-1.1	5	0.15	45
	10/23/2000	12.15	123.87	3912.5	8.43	3.01	-0.33	3.5	1.47	1.34
	11/15/2000	12.9	105	3263.5	8	4.95	-1.27	2	0.45	4.69
Site 7:	**Date**	**D.O.**	**% Saturation**	**E-Coli**	**pH**	**BOD 5**	**Temp Change**	**Phosphate**	**Nitrate**	**Turbidity**
	05/11/2000	13.2	140		8.3	3.2	-1	0.3	0	
	06/19/2000	9	97.5	199	8.2	2.35	0	0.01	0.44	
	07/21/2000	8	95	682.5	8.2	3.25	3.4	0.4	2.5	16
	08/22/2000	6	65	1548.5	8.1	0.9	-0.37	0.2	3	15
	09/24/2000	9	95	0.01	8.2		0	3	0.44	

Complete Laughery Creek Watershed Management Plan (2006): The Dearborn County Soil and Water Conservation District submitted an application to IDEM in fall of 2002 for a Section 319 grant, which was awarded a year later in the fall of 2003. The study was completed and approved in July 2006. Only the northern part of this watershed lies within Dearborn County; in addition, of the 13 testing sites, only 5 were located in Dearborn County. Areas of concern were identified in the watershed, but none fell within County borders.

The Dearborn County SWCD found that elevated E. coli levels were a major issue throughout this watershed. The listed probable causes were from cattle and CSOs (Combined Sewer Overflows). It is unlikely that MS4 monitoring would result in decreases in E. coli levels, given the nature of the causes for this impairment. However, education for farmers would go a long way towards improving this condition, since cattle grazing near streams is one of its main causes.

Complete Hogan Creek Watershed Management Plan (2007): The Dearborn County Soil and Water Conservation District initiated the third WMP in a series of three in 2005. The series of WMPs were in response to meetings in 1998 held throughout the county, which identified water quality, including nutrient and sediment contamination, as a priority within the county. The WMP was completed and approved in December 2007.

E. coli continued to be an issue in this watershed; levels were highly elevated above EPA acceptable levels. Common water quality issues that plagued the first two WMPs, high phosphorous and nitrogen levels from agricultural runoff, were largely not a problem in this watershed. In lieu of the continually worsening E. coli results, further testing was suggested to discover its sources, be it animal or human waste. The only combined sewer system in the watershed was in Aurora, while the rest of the watershed had many rural / agricultural areas; both are the main culprits for elevated E. coli levels.

Complete Whitewater River Watershed Management Plan (2016): The Dearborn County Soil and Water Conservation District applied for a 319 Grant from the EPA in November 2013. The plan was approved by IDEM and the EPA in August 2016. The WMP lists major water quality concerns within the watershed as:

- E. coli
- Impaired biological communities
- Dissolved oxygen
- PCBs / Mercury in fish tissue

The Dearborn County SWCD also lists urbanization as a growing concern in this report, citing the nearby growth of Cincinnati as a cause of the accelerating urbanization in the county / watershed.

The major causes of E. coli in this watershed come down to rural sources, including cattle in streams and agricultural runoff. Much of the southern portion of the Whitewater River watershed (the part containing Dearborn County) has E. coli concerns, and much of the land use is forested or agricultural. In addition, another major contributor to high E. coli levels is failing septic systems. This comes down to the land in and around Dearborn County being unsuitable for septic system use; the soil does not support them. However, since most of the county is rural in nature, most homeowners have no other option.

There were some biological integrity concerns in the Jameson Creek sub-watershed, meaning that many pollution-sensitive species were not present under inspection. Furthermore, the Blackburn Creek sub-watershed was found to contain the variegated darter, an endangered species of fish. Data for some of these sites are listed below in Table 10: the target geometric mean for E. coli is 125 cfu/mL, and the target for Nitrates is 1.0 mg/L. These data point towards the northeastern portion of the county being a priority area for E. coli and nitrate reduction. In the Johnson Fork subwatershed, E. coli levels exceeded state standards at all testing sites in this location, which are attributed to failing septic systems in the area. In the Jameson Creek subwatershed, nitrate issues were identified at both testing sites. The Whitewater River sub-watersheds within Dearborn County should be considered a priority area within County for managing the MS4 Program.

Table 10: Results from Whitewater River Watershed Management Plan (2016)

Figure 120: Site OH5- Whitewater River at State Street Bridge Water Quality Analysis

Parameter	Mean/Score	Unit	# of Times Does Not Meet Target	% Does Not Meet Target
Nitrates	2.61	mg/L	4/9	44%
pH	8.08	SU	0/9	0%
Total Phosphorus	0.35	mg/L	6/8	75%
E. coli (Geomean)	147.70	cfu/mL	3/9	33%
Turbidity	90.53	NTU	2/9	22%

Figure 121: Site OH6- Whitewater River at 7777 Lawrenceburg Rd. Water Quality Analysis

Parameter	Mean/Score	Unit	# of Times Does Not Meet Target	% Does Not Meet Target
Nitrates	2.81	mg/L	7/9	78%
pH	8.01	SU	0/9	0%
Total Phosphorus	0.38	mg/L	8/8	100%
E. coli (Geomean)	10.94	cfu/mL	3/9	33%
Turbidity	100.237	NTU	2/9	22%

Figure 73: Site P8 Water Quality Analysis – Johnson Fork Subwatershed

Parameter	Mean/Score	Unit	# of Times Does Not Meet Target	% Does Not Meet Target
Nitrates	0.077	mg/L	0/3	0%
E. coli (Geomean)	200.4	CFU / 100mL	2/5	40%
Temperature	21.34	Celsius	0/10	0%
Dissolved Oxygen	7.05	mg/L	1/10	10%
pH	7.748	-	0/10	0%
Total Phosphorus	0.03	mg/L	0/3	0%
TKN	0.307	mg/L	0/3	0%
Turbidity	9.05	NTU	0/10	0%
TSS	5	mg/L	0/3	0%
QHEI (fish)	67/76	-	0/2	0%
Fish IBI	54/48	-	0/2	0%
QHEI (macro)	55	-	0/1	0%
Macro mIBI	36	-	0/1	0%

TMDL Report for Whitewater River (2020): Two public kickoff meetings were held by IDEM in 2013 and 2015 for the TMDL for the Whitewater River watershed. The report was completed and submitted in 2015 but was subsequently approved in 2020. The TMDL endeavors to place an upper limit on the amount of selected pollutants that can enter a target watershed. The target values are listed in the table below; these values determine which streams/areas of the watershed to target for pollution reduction.

Table 11: Results from Whitewater River TMDL Report (2016)

Parameter	Target Value
Total nitrogen	No value should exceed 10.0 mg/L
Total phosphorous	No value should exceed 0.30 mg/L
Total Suspended Solids	No value should exceed 30.0 mg/L
Total Suspended Solids (Protected Areas)	No value should exceed 25.0 mg/L
E. coli	No value should exceed 235 cfu/100mL
Dissolved Oxygen	No value should be below 4.0 mg/L

Jameson Fork, Johnson Fork, and Blackburn Creek were ranked as the top three on the list of sub watersheds in the Southern Whitewater River watershed in need of pollutant reductions. All three of these sub watersheds reside in Dearborn County. In addition, the variegated darter, an endangered fish species in Indiana, lives solely in the waters of the Whitewater River watershed. Thus, the northeastern portion of Dearborn County should be given special consideration during MS4 inspections, due to the delicate wildlife and high priority given to it in this TMDL.

Complete Salt-Pipe Creek Watershed Management Plan (2019): The Decatur County and Franklin County Soil and Water Conservation District (SWCD) decided to produce a WMP for Salt/Pipe Creek in lieu of the 2015 TMDL, which included both of these watersheds. They applied for a 205(j)/319 Grant from the EPA in 2016, which was awarded in 2017. The plan was approved by IDEM and the EPA in July 2019. Major concerns for this watershed include:

- E. coli
- Erosion
- Nutrients
- Dissolved oxygen
- Impaired biotic communities

Only the eastern-most part of this watershed is included in Dearborn County which contains the headwaters of Pipe Creek. There is a small segment of Pipe Creek within Dearborn County which is on the 303d list of impaired waterways. It is listed as being impaired for dissolved oxygen, indicative of nutrient overload from agricultural runoff. This is consistent with all previous WMPs performed in the area; however, this area of the watershed is not a major priority for MS4 inspections.

8.0 Areas with Potential to Contribute to Water Quality Issues

The summaries of the Watershed Management Plans and TMDL Reports for Dearborn County were provided in the previous section. Throughout the County, a number of the water quality issues stems from agricultural activities and natural soil conditions which are easily eroded. Several sites along the waterways showed evidence of livestock access which increases the E. coli and nutrient loading. Removing direct access to streams for cattle through fencing, water crossings, vegetative buffers around pastures, and off-stream water supplies for livestock can greatly reduce the E. coli, phosphorus, and nitrogen within waterways.

For monitoring purposes, based on available data, the Whitewater River Watershed and areas upstream of urbanized areas along Tanners Creek are considered to be priority areas for Dearborn County.

Within the entire area of Dearborn County, including incorporated areas, there are eight (8) facilities that are permitted to discharge stormwater from industrial stormwater activities under Rule 6 (IDEM, 2023), shown in Table 7. These facilities have addresses in Lawrenceburg, Greendale, and Aurora and may be within the MS4 boundary of those cities. One of the facilities permits expired in 2022 and does not appear to have been renewed.

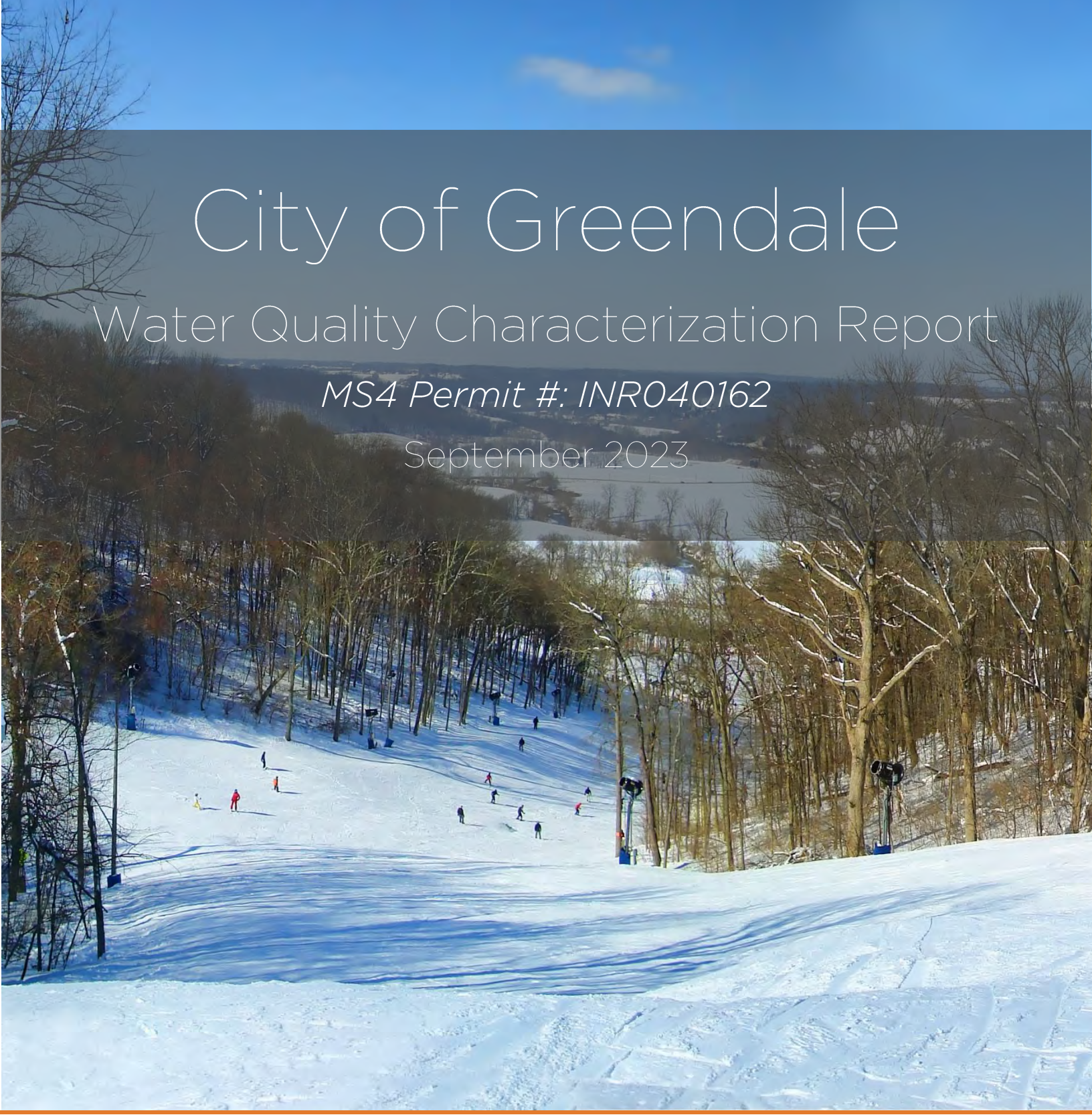
Table 12. NPDES Active Industrial Stormwater Permits in Dearborn County

NPDES ID	Permit Name	Effective Date	Expiration Date	Location Address	SIC	Permit SIC Description
INRM00311	Hardintown Salvage	4/8/2019	4/7/2024	1505 Water St	3714	Motor Vehicle Parts And Accessories
INRM00717	Best Way of Indiana Dearborn County Transfer Station	12/4/2017	12/3/2022	17282 Main St	4953	Refuse Systems
INRM01017	Core Metals Group LLC (MPM Facility)	9/16/2019	9/15/2024	133 Franklin St	3295	Minerals, Ground Or Treated
INRM01478	Consolidated Grain & Barge	3/8/2022	3/7/2027	210 George St	5153	Grain And Field Beans
INRM01787	Anchor Glass Container Corporation	4/17/2019	4/16/2024	200 W Belleview Dr	3221	Glass Containers
INRM01903	Matthews Aurora LLC	9/15/2020	9/14/2025	10944 Marsh Rd	3995	Burial Caskets
INRM02629	Stedman Machine Company	7/1/2019	6/30/2024	129 Franklin St	3532	Mining Machinery
INRM02701	Batesville Products Incorporated	8/17/2020	8/16/2025	10367 Randall	3365	Aluminum Foundries

9.0 Recommendations

Based on the findings discussed, Dearborn County plans to implement and enhance the MS4 program. The following additional BMPs are recommended for consideration.

- Develop a Stormwater Quality Management Plan (SWQMP) as a component of the MS4 Program to outline activities, measurable goals, and tracking for stormwater quality measures.
- Develop a County ordinance to prohibit and enforce illicit discharge detection and elimination.
- Develop County ordinances to detail how construction and post-construction stormwater runoff should be handled.
- Continue mapping and screening the County's stormwater system for illicit discharges, condition assessments, and stormwater collection system connectivity.
- Create employee training programs and routine facility inspections aimed at elevating the County's municipal operations pollution prevention and good housekeeping activities.
- Add a dedicated stormwater section on the County website informing people about stormwater best management practices and upcoming events.
- Educate residents about water quality activities. This may include partnering with the Dearborn County Soil and Water Conservation District and neighboring communities.
- Continue working with the GLAD Partnership to build and enhance the MS4 Program.



City of Greendale

Water Quality Characterization Report

MS4 Permit #: INR040162

September 2023

City of Greendale
Indiana

OHM
Advancing Communities

Table of Contents

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Table of Revisions

The following table summarizes revisions, additions, deletions, etcetera to the contents of this report:

Date	Revised Pages/Appendices	Summary of Change

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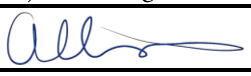
WQCR Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Qualified Professional:

Name: Allison Padron, PE

Title: Project Manager, OHM Advisors

Signature: 

Date: 9/21/23

MS4 Operator or Designee:

Name: _____

Title: _____

Signature: _____

Date: _____

1.0 Purpose

This water quality assessment report is intended to accompany the Greendale, Lawrenceburg, Aurora, and Dearborn County (GLAD) Regional Water Quality Characterization Report (WQCR). This component of the WQCR contains information specific to the City of Greendale as a method for further analyzing water quality within the MS4 boundaries and using that information to guide their MS4 Program as they begin implementing the Indiana MS4 General Permit (INR040000) and Indiana Construction Stormwater General Permit (INRA00000).

2.0 Assessment of Land Use

The City of Greendale is located in the eastern portion of southern Indiana near the Ohio River. The City is bounded to the south and the west by the City of Lawrenceburg, to the north by the private residential community of Hidden Valley, and the state of Ohio and the nearby City of Cincinnati to the east. The City encompasses approximately 5.73 square miles (3,667 acres). The City of Greendale's Municipal Separate Storm Sewer System (MS4) area refers to the entirety of the City's municipal boundaries, shown in Figure 1.

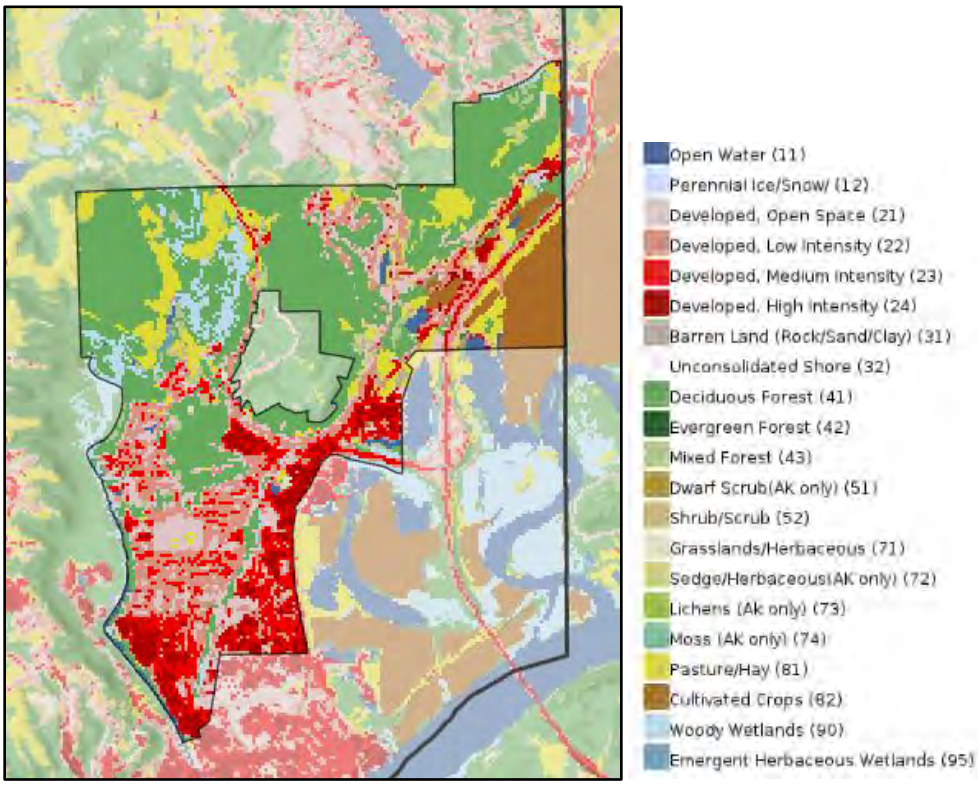


Figure 1. Land Use Map (NLCD, 2021)

Below in Table 1, is a breakdown of land use within the City of Greendale. The city's municipal boundary contains a large percentage of deciduous forest to the north, which makes up more than one-third of the total land area. Less than 15% of the area is agricultural land.

The levels of intensity of developed areas, as defined by the NLCD, are primarily designated by the percent of impervious surface:

- Open Space: Impervious surfaces account for less than 20% of the total area, vegetation is mostly lawn/grass, includes large-lot single-family residences(SFR)/parks/golf courses/recreation areas.
- Low Intensity: 20-49% impervious area, primarily SFR.
- Medium Intensity: 50-79% impervious area, primarily SFR.
- High Intensity: 80-100% impervious area, includes commercial/industrial, apartment complexes, row houses.

Within the City of Greendale, the portion to the south contains the majority of the developed area which makes up 40% of the total area, mostly considered to be low/medium intensity development. Additional development occurs along U.S. Route 50.

Table 1: Land Use for Greendale MS4 Area

Category	Acres	Percentage
Deciduous Forest	1,339.7	36.5%
Developed, Low Intensity	529.0	14.4%
Developed, Medium Intensity	403.0	11.0%
Developed, Open Space	354.9	9.7%
Hay/Pasture	349.2	9.5%
Cultivated Crops	196.5	5.4%
Developed, High Intensity	186.0	5.1%
Woody Wetlands	136.9	3.7%
Mixed Forest	96.6	2.6%
Open Water	47.6	1.3%
Herbaceous	10.2	0.3%
Shrub/Scrub	7.3	0.2%
Emergent Herbaceous Wetlands	5.1	0.1%
Barren Land	4.9	0.1%
TOTAL	**3,667**	**100%**

Source: National Land Cover Database (NLCD, 2021)

3.0 Best Management Practices (BMPs)

The following section describes the City of Greendale's efforts to improve stormwater quality through the MS4 program by implementing the six (6) Minimum Control Measures (MCMs), including structural and non-structural BMPs.

3.1 Structural BMPs

The City of Greendale is currently in the process of mapping their storm sewer system, to comply with the MS4 General Permit.

3.2 Non-Structural BMPs

3.1.1 Ordinances

The City of Greendale is currently developing ordinances to establish the legal authority to administer the MS4 program and ensure compliance through adopted ordinances. These ordinances will include management of illicit discharges, construction stormwater runoff, and post-construction stormwater runoff.

Currently, the City of Greendale utilizes the following ordinances:

- Discharges Limited to Storm/Combined Sewers (Ord 53.17)

3.1.2 Partnerships

The City actively participates in the Greendale, Lawrenceburg, Aurora, Dearborn County (GLAD) Partnership which provides a forum for public education, outreach, participation and involvement as well as coordinated implementation of the MS4 program in the communities. The City also partners with the Dearborn County Soil and Water Conservation District as well as the Dearborn County Solid Waste Management District. These partnerships give the City more resources and facilities that can be used to implement and enhance the MS4 program.

3.1.3 MCM 1 & 2 – Public Education and Outreach; Participation and Involvement

The Dearborn County Solid Waste Management District has made hazardous household waste disposal available and free to all Dearborn County residents. Residents are able to use the District's drive-thru recycling center Monday through Friday during their business hours and this is to encourage residents to properly dispose of waste and prevent it from entering the stormwater system.

3.1.4 MCM 3 – Illicit Discharge Detection and Elimination

The City is currently working on mapping the system in order to develop the IDDE Plan specific to the MS4 Program.

3.1.5 MCM 4 – Construction Site Stormwater Runoff

The City will develop a process for reviewing SWPPPs for submitted construction plans within the City, issuing permits, and performing construction site inspections.

3.1.6 MCM 5 – Post-Construction Stormwater Runoff

The City will develop a process to review submitted drainage plans for post-construction stormwater impacts.

3.1.7 MCM 6 - Municipal Operations Pollution Prevention and Good Housekeeping

A list of facilities within Greendale with the potential to discharge pollutants is being developed, with plans to perform quarterly and annual inspections. Municipal training in storm water pollution management is planned for 2024.

3.1.8 Flood Control

Floodwall – The Lawrenceburg Conservancy District (LCD) is responsible for maintaining 1.39 miles of earth levee and flood control management within the city boundaries. The City itself is not responsible for flood control management.

4.0 Receiving Waters

The City of Greendale has three (3) receiving waters, shown in Table 2 below, which breaks down the names, lengths, and the percentage of each receiving water. There are a total of 9.7 miles of natural stream channels within the City of Greendale MS4 limits. With the majority of the residential and industrial areas of Greendale located near receiving waters, the City has a significant ability to influence water quality in the receiving waters. Shown in Figure 3 are the major receiving waters and watersheds that are impacted by Greendale. Tanners Creek, which runs along the western edge of the city drains much of the City's stormwater infrastructure. Tanners Creek is also influenced by Dearborn County and Lawrenceburg. The City drains into three (3) HUC-12 watersheds: Salt Fork-Tanners Creek (050902030304), Taylor Creek-Ohio River (050902030802), and Doublelick Run-Great Miami River (05080002907). A portion of the City also drains directly the Ohio River. Water quality in Greendale along the eastern portion containing Doublelick Run is also influenced by the State of Ohio with the Doublelick Run-Great Miami River watershed crossing state line boundaries in this location.

Table 2: City of Greendale Receiving Waters

Receiving Water	Total Length (miles)	Percentage
Tanners Creek	5.5	57%
Unnamed Tributaries	2.8	29%
Doublelick Run	1.4	14%
TOTAL	9.7	100%

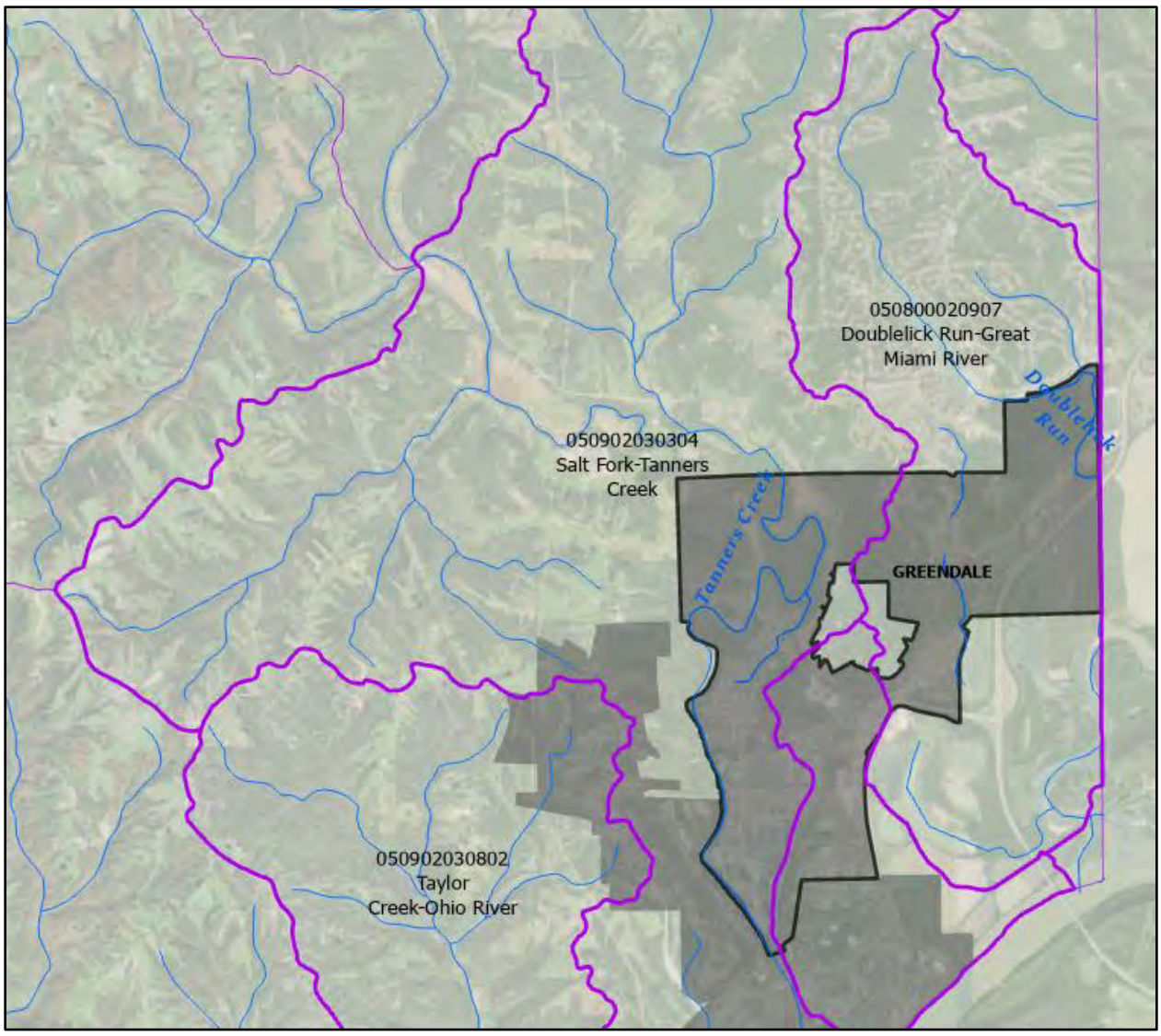


Figure 2. Major Receiving Waters and Watersheds for the City of Greendale

5.0 303(d) Impaired Waters

The 2022 Integrated Water Monitoring and Assessment Report published by IDEM includes the 303(d) List of Impaired Streams for Indiana. Three (3) stream segments in the Greendale MS4 area were listed on the 2022 303(d) List of Impaired Streams, shown on the map in Figure 4 and in Table 3. There are a total of 5.8 miles of impaired streams within the City of Greendale. The primary impaired stream sections are a part of Tanners Creek, with a small segment on the Great Miami River. All segments of stream impairments are due to the levels of PCBs, and Tanners Creek is also assessed for low dissolved oxygen. The downstream section near US-50 is impaired due to the level of PCBs present. Tanners Creek is considered to not be supporting ecological functions, however, all waterways are considered to support recreational uses.

Table 3: City of Greendale Impaired 303(d) Waters

Stream Name	Assessment ID	Length (miles)	Impairment	TMDL
Tanners Creek	INV0334_02, INV0334_03, INV0334_04	5.7	PCBs, Low DO	None
Great Miami River	ING0297_02	0.1	PCBs	None

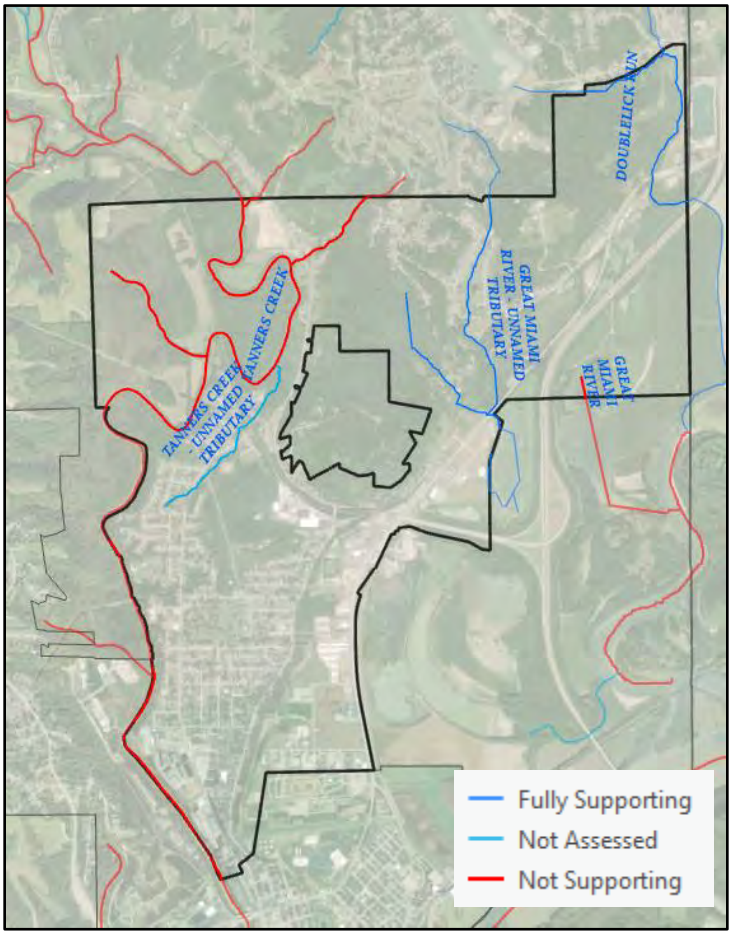


Figure 3. 303(d) Impaired Waters of the City of Greendale

6.0 Known Sensitive Areas

Public Beaches/ Full Body Contact Recreation: There are no beaches or lakes with public swimming or recreational facilities other than enclosed public swimming pools. The City is currently not aware of any locations within the MS4 area where full body contact recreation occurs.

Boat Launches: There is a kayak launch behind the City swimming pool, Greendale Pool, along Tanner's Creek within the City.

Wetlands: Wetland areas are considered to be environmentally sensitive features and are protected by the Clean Water Act. The National Wetland Inventory (NWI) was used to estimate the extent and locations of

wetlands and deep waters in Greendale. Based on these data, there are nearly 236 acres of wetlands and deep-water habitats within the City. The following map and table shows the different types of wetlands within the MS4, as classified by the NWI. The majority of wetlands and ponding areas are located along major roadways. Tanners Creek drains into the Ohio River and is subject to backwater conditions from the larger river. Wetlands and ponding areas serve a critical role in floodplain management.

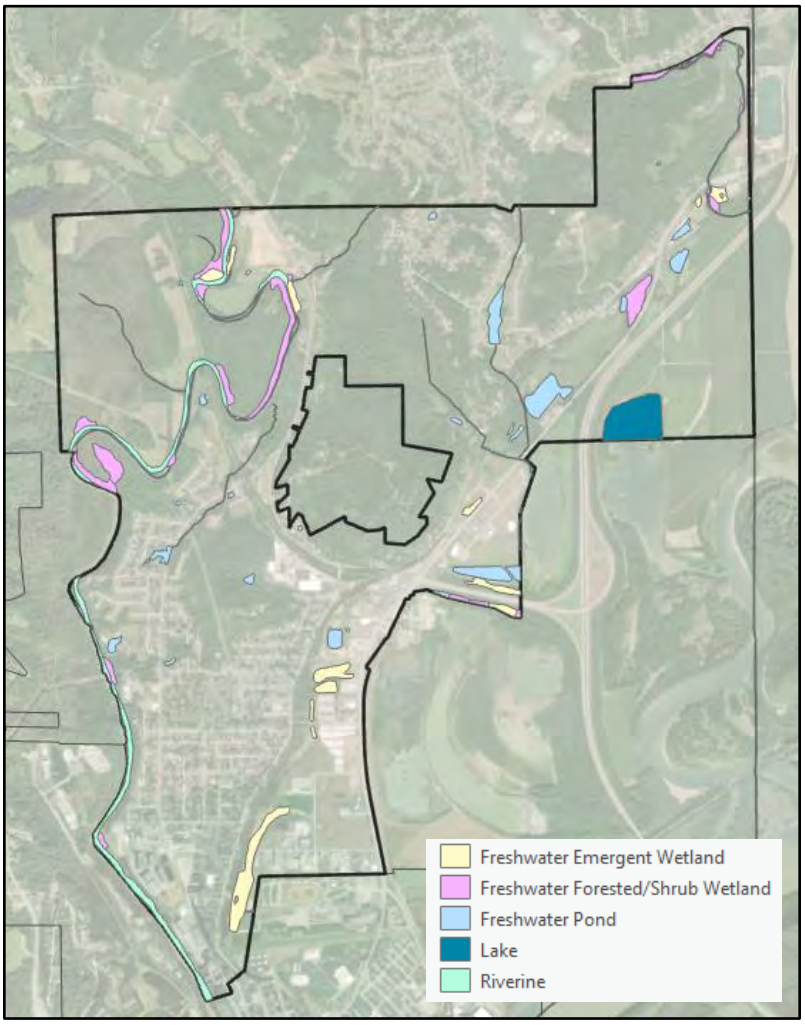


Figure 4. Wetlands and Lakes of the City of Greendale

Table 4: Types of Wetlands in Greendale

Type	Acres
Freshwater Emergent Wetland	42.6
Freshwater Forested/Shrub Wetland	53.2
Freshwater Pond	44.6
Lake	25.9
Riverine	69.6
TOTAL	235.9

Source: National Wetland Inventory (NWI).

Wellhead Protection Areas: There is an established wellhead protection area (WHPA) in the City of Greendale. The City of Greendale Utilities operates three (3) groundwater wells that pump approximately 1.1 million gallons of water per day. The WHPA in Greendale is bounded to the north and south by Dorman Avenue and Rudolph Way respectively. It is bounded to the west by Ludlow Street and to the east by US-50.

Surface Drinking Water Intakes: Drinking water sources within the City are derived primarily from wells that pull drinking water from local groundwater resources. There are no known surface drinking water intakes in the surrounding area.

Sinkhole Areas: There are no known sinkhole area in Greendale after a review of Indiana Geological Survey (IGS) data.

7.0 Existing and Available Monitoring Data

Complete Tanners Creek Watershed Management Plan (2003): The Dearborn County Soil and Water Conservation District (SWCD) received a Nonpoint Source Section 319 Grant from IDEM in 2000 to develop a watershed management plan for the Tanners Creek Watershed. The study was completed and approved in June 2003. Tanners Creek flows 20 miles prior to discharging into the Ohio River, with Lawrenceburg as the discharge location. The report stated that there were higher than normal levels of phosphorus in the water leading to algal blooms in the creek that is likely attributing to the unhealthy dissolved oxygen levels. The report also states that during visual inspection by SWCD and USDA staff it was noted that Tanners Creek has problems with nutrient loading, construction site issues, and urban runoff issues. The closest data collection site to Greendale was west of Downtown Greendale near Schenley Place. The following data was collected at this site:

- Habitat Assessment (QHEI): 70.5 – Good to Excellent

Table 5: Results from Tanners Creek Watershed Management Plan Study (2003) for Site West of Greendale

Date	6/29/2000	7/28/2000	8/30/2000	9/20/2000
Dissolved Oxygen (mg/L)	8.7	2.83	4.8	2.79
Nitrate (mg/L)	0.79	0.85	0.02	0.1
pH (SU)	7.7	7.03	8	8.2
Biological Oxygen Demand (mg/L)	3	1.33	2.2	1.5
Saturation (%)	100	33.33	55	28
E. coli (CFU/100mL	-	927.6	765.9	666
Turbidity (NTU)	-	24.61	25.67	23

USGS (2005): Physical, chemical, and bacterial monitoring data were collected from Tanners Creek at Schenley Place, USGS Monitoring Site 390707084521701. Nine (9) samples were collected in June, August and October of 2005. The data is summarized in Table 6 below. The data is summarized in Table 6 below.

These data show acceptable levels of dissolved oxygen, temperature, pH, and conductivity as well as potentially elevated levels of *E. coli*.

Table 6. Water Quality Data Summary for Tanners Creek at Schenley Place

Parameter	USGS Data Range	Indiana Water Quality Criterion
Temperature (°C)	18.8 to 30.6	Less than 32.2
Dissolved Oxygen (mg/L)	4 to 11.3	Greater than or equal to 4.0
pH (SU)	7.5 to 8.5	Between 6.0 and 9.0
Specific Conductivity (µS/cm)	470 to 564	1,200
Inorganic C Suspended Sediment (mg/L)	< 0.12	None
Organic C Suspended Sediment (mg/L)	0.7 to 2.84	None
Particulate N Suspended (mg/L)	0.107 to 0.48	None
Pheophytin a phytoplankton (µg/L)	3.3 to 14.1	None
Chlorophyll a phytoplankton (µg/L)	14.1 to 36	None

Sources: USGS, 2000; 327 IAC 2

A search more recent (last 5 years) for water quality and related data was performed using publicly accessible reports and databases published by the Indiana Department of Environmental Management (IDEM), Indiana Department of Natural Resources (IDNR), United States Environmental Protection Agency (USEPA), and the United States Geological Survey (USGS). No monitoring data or reports for streams in the City of Greendale were found by IDNR and USEPA. These agencies had not published more recent water quality data for streams in the City of Greendale.

8.0 Areas with Potential to Contribute to Water Quality Issues

As part of the Tanners Creek Watershed Management Plan (WMP), Hoosier Riverwatch data collected in 2000 showed unhealthy levels of dissolved oxygen as well as elevated levels of E. coli bacteria. As part of the WMP, for the area specifically within Greendale, urbanization is a leading cause of water quality degradation. Some activities and solutions for managing stormwater quality within the MS4 include: Monitor erosion control practices and educate the construction community on proper EPSC practices.

A number of the water quality issues within the Tanners Creek Watershed stems from upstream agricultural activities and natural soil conditions which are easily eroded. Several sites along the waterway showed evidence of livestock access which increases the E. coli and nutrient loading. Removing direct access to streams for cattle through fencing, water crossings, vegetative buffers around pastures, and off-stream water supplies for livestock can greatly reduce the E. coli, phosphorus, and nitrogen within waterways.

The industrial area of Greendale is mostly consolidated in the southwestern part of the city on the bank of Tanners Creek. Greendale has one (1) facility that is permitted to discharge stormwater from industrial stormwater activities under Rule 6 (IDEM, 2023). The facility is listed in Table 7 and should be periodically monitored at outfall locations, although the facility is not directly adjacent to a primary waterway.

NPDES ID	Permit Name	Effective Date	Expiration Date	Location Address	SIC	Permit SIC Description
INRM01787	Anchor Glass Container Corporation	4/17/2019	4/16/2024	200 W. Belleview Dr.	3221	Glass Containers

9.0 Recommendations

Based on the findings discussed, the City of Greendale plans to implement and enhance the MS4 program. The following additional BMPs are recommended for consideration.

- Develop a Stormwater Quality Management Plan (SWQMP) as a component of the MS4 Program to outline activities, measurable goals, and tracking for stormwater quality measures.
- Develop a city ordinance to prohibit and enforce illicit discharge detection and elimination.
- Develop city ordinances to detail how construction and post-construction stormwater runoff should be handled.
- Continue mapping and screening the City's stormwater system for illicit discharges, condition assessments, and stormwater collection system connectivity.
- Create employee training programs and routine facility inspections aimed at elevating the city's municipal operations pollution prevention and good housekeeping activities.
- Add a dedicated stormwater section on the city website informing people about stormwater best management practices and upcoming events.
- Educate residents about water quality activities. This may include partnering with the Dearborn County Soil and Water Conservation District and neighboring communities.
- Continue working with the GLAD Partnership to build and enhance the MS4 Program.

City of Lawrenceburg

Water Quality Characterization Report

MS4 Permit #: INR040163

September 2023

Photo from Downtown Lawrenceburg Org

Lawrenceburg
INDIANA

OHM
Advancing Communities

Table of Contents

OHM Advisors
400 Missouri Avenue, Suite 100
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Table of Revisions

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Date	Revised Pages/Appendices	Summary of Change

Primary MS4 Contact

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Kelly Mollaun
Mayor
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Phone: 812-532-3550

WQCR Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Qualified Professional:

Name: Allison Padron, PE

Title: Project Manager, OHM Advisors

Signature: 

Date: 9/21/23

MS4 Operator or Designee:

Name: _____

Title: _____

Signature: _____

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1.0 Purpose

This water quality assessment report is intended to accompany the Greendale, Lawrenceburg, Aurora, and Dearborn County (GLAD) Regional Water Quality Characterization Report (WQCR). This component of the WQCR contains information specific to the City of Lawrenceburg as a method for further analyzing water quality within the MS4 boundaries and using that information to guide their MS4 Program as they begin implementing the Indiana MS4 General Permit (INR040000) and Indiana Construction Stormwater General Permit (INRA00000).

2.0 Assessment of Land Use

The City of Lawrenceburg is located in the eastern portion of Southern Indiana along the north shore of the Ohio River and West of Interstate 275. The City is bound to the north by the City of Greendale, to the south by the City of Aurora, to the west by unincorporated land in Dearborn County, and to the east by the Ohio River. Lawrenceburg is the largest city in Dearborn County and encompasses approximately 5.54 square miles (3,548 acres). The City of Lawrenceburg's Municipal Separate Storm Sewer System (MS4) area refers to the entirety of the City's municipal boundaries as shown in Figure 1.

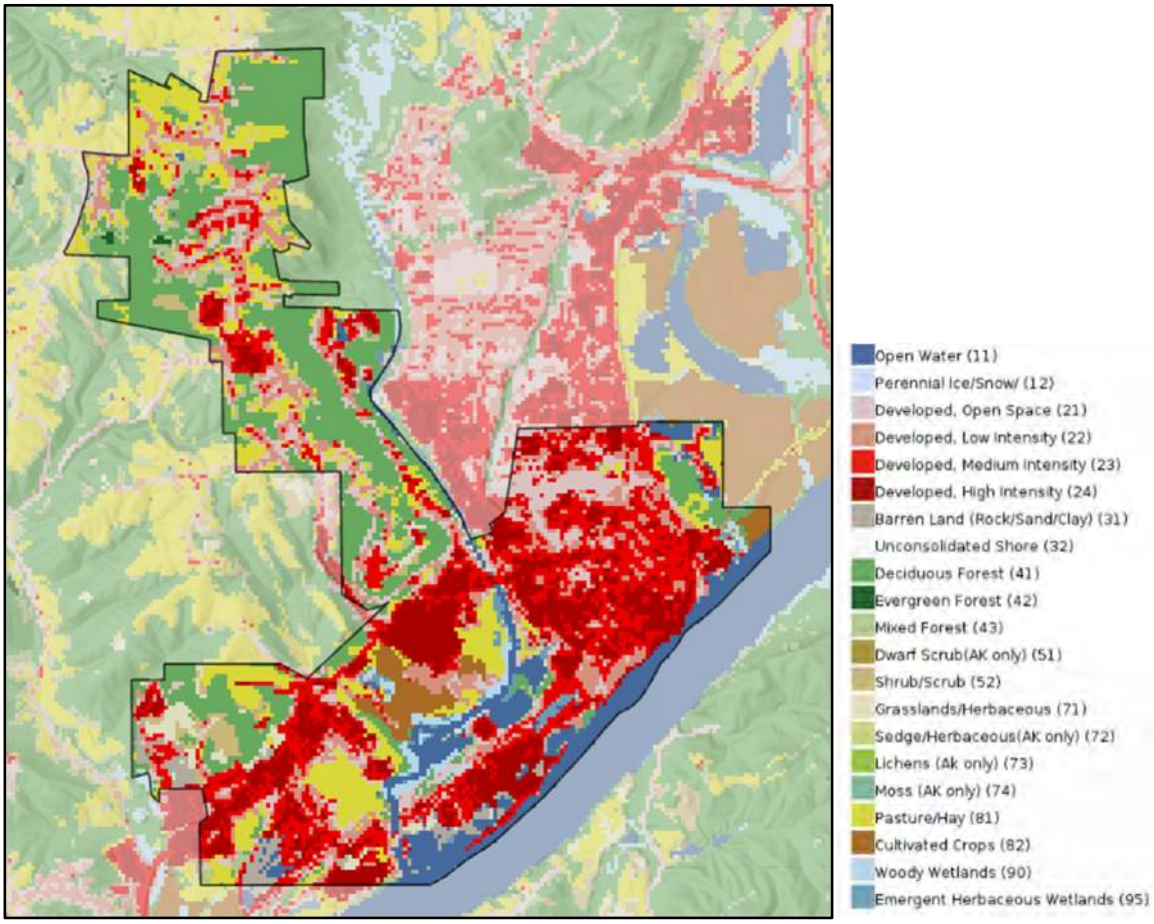


Figure 1. Land Use Map (NLCD, 2021)

Below in Table 1, is a breakdown of land use within the City of Lawrenceburg. The City is primarily developed with more than 50% of the total land already developed. Another 20% is forested within the municipal boundary, and 13% is agricultural land. A portion of the Ohio River along the northwest bank and ponding areas along Tanners Creek account for more than 7% of the total land use.

Table 1: Land Use for Lawrenceburg MS4 Area

Category	Acres	Percentage
Deciduous Forest	719.6	20.3%
Developed, Medium Intensity	588.5	16.6%
Developed, High Intensity	476.5	13.4%
Developed, Low Intensity	437.2	12.3%
Hay/Pasture	397.5	11.2%
Developed, Open Space	305.0	8.6%
Open Water	257.1	7.2%
Cultivated Crops	70.8	2.0%
Mixed Forest	69.0	1.9%
Barren Land	64.3	1.8%
Herbaceous	49.2	1.4%
Woody Wetlands	42.4	1.2%
Shrub/Scrub	37.0	1.0%
Emergent Herbaceous Wetlands	30.6	0.9%
Evergreen Forest	3.3	0.1%
TOTAL	**3,548**	**100%**

Source: National Land Cover Database (NLCD, 2021)

3.0 Best Management Practices (BMPs)

The following section describes the City of Lawrenceburg's efforts to improve stormwater quality through the MS4 program by implementing the six (6) Minimum Control Measures (MCMs), including structural and non-structural BMPs.

3.1 Structural BMPs

The City of Lawrenceburg is currently in the process of mapping their storm sewer system, to comply with the MS4 General Permit.

3.2 Non-Structural BMPs

3.1.1 Ordinances

Lawrenceburg is currently in the process of developing and adopting stormwater management ordinances for Illicit Discharge Control, Construction Site Runoff Control, and Post-Construction Runoff Quality Control. The ordinances will establish the legal authority to administer the MS4 program and ensure compliance through adopted ordinances.

The City is also developing Stormwater Technical Standards which includes design specifications and selection guidance for both construction and post-construction BMPs approved for installation by the City.

There are some existing current ordinances/codes in Lawrenceburg related to stormwater showing that some consideration for water quality and stormwater management is already in place (numbers relate to code of ordinances for Lawrenceburg):

- Discharging Stormwater, Unpolluted Waters and the Like (Ord. 52.003)
- Discharge of Untreated Sewage or Other Polluted Wastes to Natural Outlets (Ord. 52.005)
- Sources of Surface Runoff or Groundwater (Ord. 52.052)

3.1.2 Partnerships

The City actively participates in the Greendale, Lawrenceburg, Aurora, Dearborn County (GLAD) Partnership which provides a forum for public education, outreach, participation and involvement as well as coordinated implementation of the MS4 program in the communities. The City also partners with the Dearborn County Soil and Water Conservation District as well as the Dearborn County Solid Waste Management District. These partnerships give the City more resources and facilities that can be used to implement and enhance the MS4 program.

3.1.3 MCM 1 & 2 – Public Education and Outreach; Participation and Involvement

The City has resources and information available on its main website (thinklawrenceburg.com) and contains: "PIPE UP!" a children's activity game, information/flyers on local river sweeps, and information on stormwater improvement grants that the city has received. The City also offers free trash and recycling collection services for all of its residents helping to decrease the amount of pollution in the city that could potentially end up in the stormwater system.

The Dearborn County Solid Waste Management District has made hazardous household waste disposal available and free to all Dearborn County residents. Residents are able to use the District's drive-thru recycling center Monday through Friday during their business hours and this is to encourage residents to properly dispose of waste and prevent it from entering the stormwater system.

3.1.4 MCM 3 – Illicit Discharge Detection and Elimination

The City has published a public notification on protecting drinking water in the city. This notification contains information on potential sources of water contamination as well as contact information for various departments who should be notified.

3.1.5 MCM 4 – Construction Site Stormwater Runoff

The City will develop a process for reviewing SWPPPs for submitted construction plans within the City, issuing permits, and performing construction site inspections.

Martin Yake with IDEM currently performs inspections of municipal projects, will continue to do so. IDEM will also continue to review municipal SWPPPs for the municipality.

There are some existing current ordinances/codes in Lawrenceburg related to construction stormwater showing that some consideration for water quality and stormwater management is already in place:

- Ordinance 151.20 Responsibility for Drainage and Sedimentation Control
- Ordinance 151.51 Erosion and Sedimentation Control Principles
- Ordinance 151.52 Grading for Drainage
- Ordinance 151.53 Excavation and Fills

3.1.6 MCM 5 – Post-Construction Stormwater Runoff

The City will develop a process to review submitted drainage plans for post-construction stormwater impacts.

3.1.7 MCM 6 - Municipal Operations Pollution Prevention and Good Housekeeping

A list of facilities within Lawrenceburg with the potential to discharge pollutants is being developed, with plans to perform quarterly and annual inspections. Municipal training in storm water pollution management is planned for 2024.

3.1.8 Flood Control

Floodwall – The Lawrenceburg Conservancy District is responsible for maintaining the flood control system, consisting of earthen levee and concrete wall. There are five pumping stations, seven movable closures and numerous drainage structures in the city. The City itself is not responsible for flood control management.

4.0 Receiving Waters

The City of Lawrenceburg has two (2) primary receiving waters, shown in Table 2 below, which breaks down the names, lengths, and the percentage of each receiving water. There is a total of 6.44 miles of natural stream channels within the City MS4 limits. The majority of the waterways within City limits are unnamed tributaries draining to the primary streams. With the majority of Lawrenceburg consisting of residential, commercial, and industrial areas, the City has a significant ability to influence water quality in the receiving waters. Shown in Figure 2 are the major receiving waters and watersheds that are impacted by Lawrenceburg. Tanners Creek, which runs along the eastern edge and central portion of the City drains much of the City's stormwater infrastructure. The City drains to the Ohio River through two HUC-12 watersheds: Salt Fork-Tanners Creek (050902030304) and Taylor Creek-Ohio River (050902030802) which is split by the confluence with Tanners Creek, or directly to the Ohio River.

Table 2: City of Lawrenceburg Receiving Waters

Receiving Water	Total Length (miles)	Percentage
Tanners Creek	2.7	42%
Wilson Creek	0.24	4%
Unnamed Tributaries	3.5	54%
TOTAL	6.44	100%

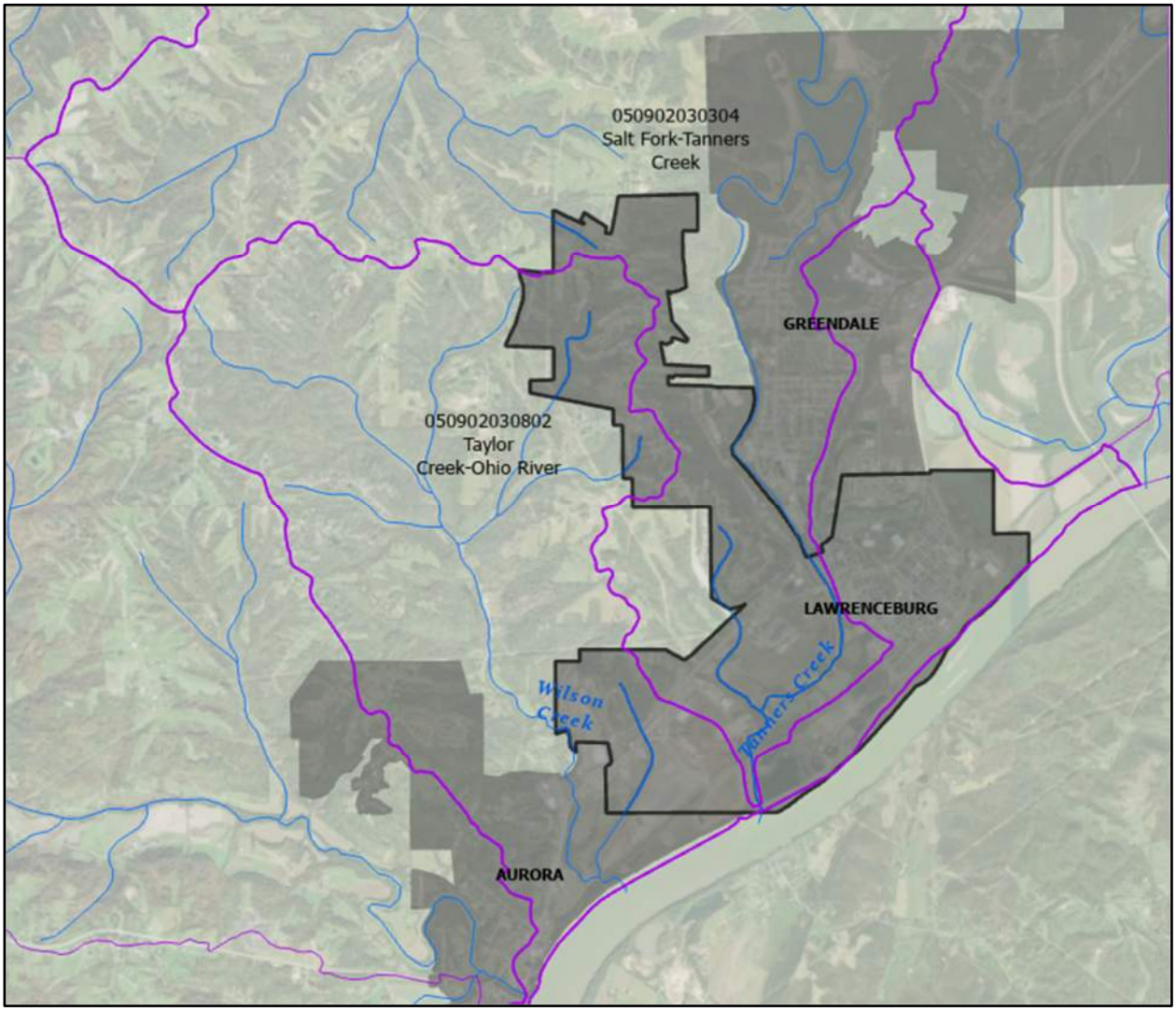


Figure 2. Major Receiving Waters and Watersheds for the City of Lawrenceburg

5.0 303(d) Impaired Waters

The 2022 Integrated Water Monitoring and Assessment Report published by IDEM includes the 303(d) List of Impaired Streams for Indiana. Two (2) stream segments in the Lawrenceburg MS4 area were listed on the 2022 303(d) List of Impaired Streams, shown on the map in Figure 3 and in Table 3. There are a total of 4.7

miles of impaired streams within the City of Lawrenceburg. Tanners Creek is impaired due to the level of PCBs present, with one segment (_03) also assessed for low dissolved oxygen. This segment is considered impaired for ecological, but is still fully supporting recreational usage.

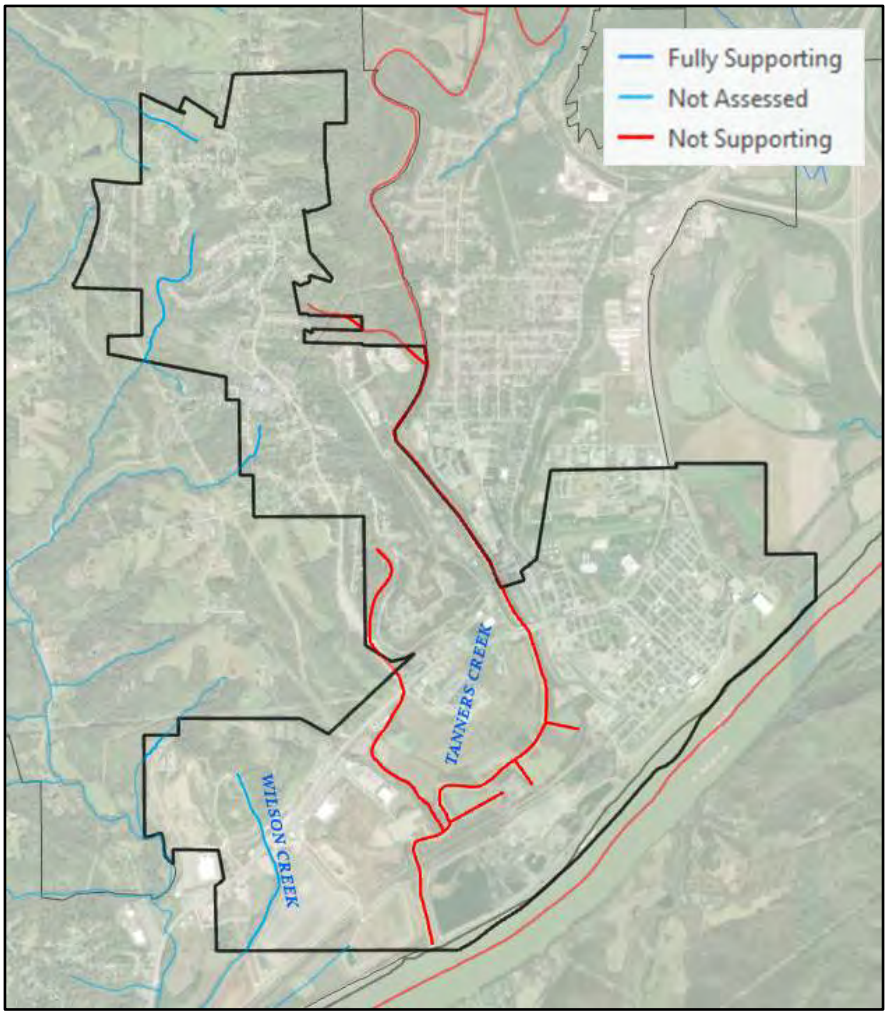


Figure 3. 303(d) Impaired Waters of the City of Lawrenceburg

Table 3: City of Lawrenceburg Impaired 303(d) Waters

Stream Name	Assessment ID	Length (miles)	Impairment	TMDL
Tanners Creek	INV0334_03, INV0334_04, INV0334_05	4.7	PCBs, Low DO	None

6.0 Known Sensitive Areas

Public Beaches/ Full Body Contact Recreation: There are no beaches or lakes with public swimming or recreational facilities other than enclosed public swimming pools. The City is currently not aware of any locations within the MS4 area where full body contact recreation occurs. Due to the proximity and location of the Tanners Creek boat launch as discussed below, this is a priority within the MS4 area.

Boat Launches: There is one (1) known boat launch within the City of Lawrenceburg South of US Route 50 on South Tanners Creek Drive.

Wetlands: Wetland areas are considered to be environmentally sensitive features and are protected by the Clean Water Act. The National Wetland Inventory (NWI) was used to estimate the extent and locations of wetlands and deep waters in Lawrenceburg. Based on these data, there are 435.2 acres of wetlands and deep-water habitats within the City limits, not including the riverine habitat directly along the Ohio River. The following map and table shows the different types of wetlands within the MS4, as classified by the NWI. The majority of wetlands and ponding areas are located in the industrial portion of the City, especially in the vicinity of the Lawrenceburg Power Station on Tanners Creek. Tanners Creek drains into the Ohio River and is subject to backwater conditions from the larger river. Wetlands and ponding areas serve a critical role in floodplain management.

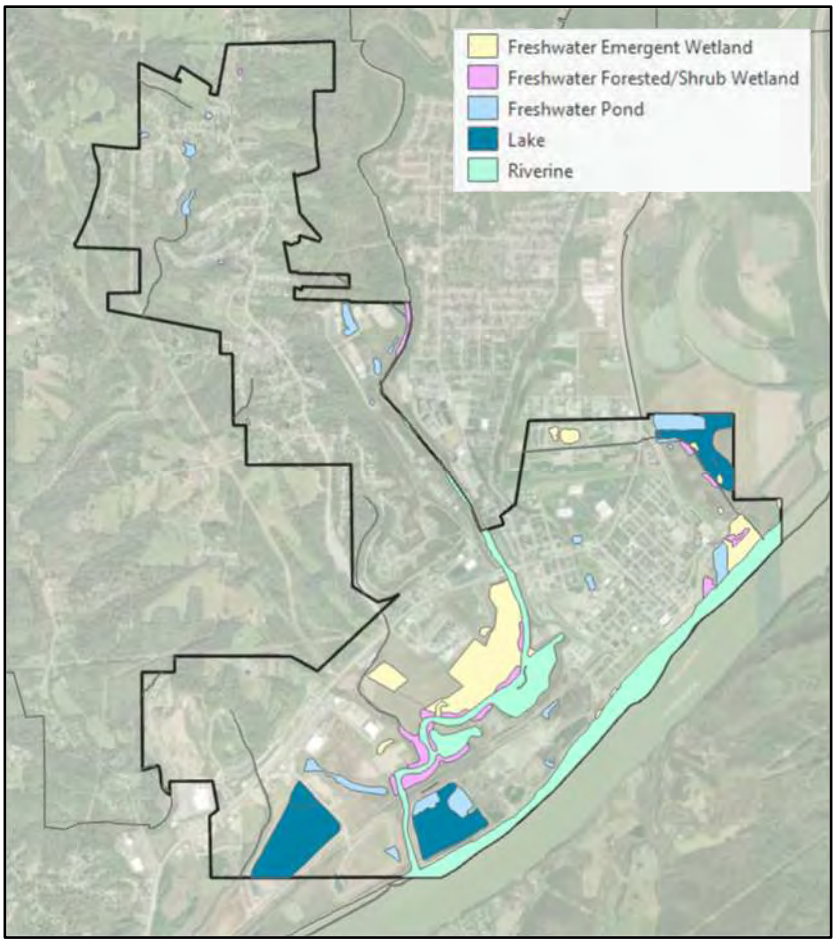


Figure 4. Wetlands and Lakes of the City of Lawrenceburg

Table 4: Types of Wetlands in Lawrenceburg

Type	Acres
Freshwater Emergent Wetland	109.8
Freshwater Forested/Shrub Wetland	38.2
Freshwater Pond	59.9
Lake	129.6
Riverine (Interior)*	97.7
TOTAL	435.2

*Does not include the Riverine area on the Ohio River.

Source: National Wetland Inventory (NWI).

Surface Drinking Water Intakes: Drinking water sources within the City are derived primarily from wells that pull drinking water from local groundwater resources. There are no known surface drinking water intakes in the surrounding area.

Wellhead Protection Areas: There is an established wellhead protection area (WHPA) in the City of Lawrenceburg. Lawrenceburg Municipal Utilities operates four (4) groundwater wells that pump an average of 767,000 gallons of water per day. The WPHA in Lawrenceburg extends from the western edge of the downtown area westward bounded to the north and south by US Route 50 and the Ohio River respectively, until just slightly east of Aurora, IN.

Sinkhole Areas: There are no known sinkhole areas in Lawrenceburg after a review of Indiana Geological Survey (IGS) data.

7.0 Existing and Available Monitoring Data

Complete Tanners Creek Watershed Management Plan (2003): The Dearborn County Soil and Water Conservation District (SWCD) received a Nonpoint Source Section 319 Grant from IDEM in 2000 to develop a watershed management plan for the Tanners Creek Watershed. The study was completed and approved in June 2003. Tanners Creek flows 20 miles prior to discharging into the Ohio River, with Lawrenceburg as the discharge location. The report stated that there were higher than normal levels of phosphorus in the water leading to algal blooms in the creek that is likely attributing to the unhealthy dissolved oxygen levels. The report also states that during visual inspection by SWCD and USDA staff, it was noted that Tanners Creek has problems with nutrient loading, construction site issues, and urban runoff issues. The closest data collection site to Lawrenceburg was west of Downtown Greendale, just upstream of Lawrenceburg. The following data was collected at this site:

- Habitat Assessment (QHEI): 70.5 – Good to Excellent

Table 5: Results from Tanners Creek Watershed Management Plan Study (2003) for Site West of Greendale

Date	6/29/2000	7/28/2000	8/30/2000	9/20/2000
Dissolved Oxygen (mg/L)	8.7	2.83	4.8	2.79
Nitrate (mg/L)	0.79	0.85	0.02	0.1
pH (SU)	7.7	7.03	8	8.2

Biological Oxygen Demand (mg/L)	3	1.33	2.2	1.5
Saturation (%)	100	33.33	55	28
E. coli (CFU/100mL	-	927.6	765.9	666
Turbidity (NTU)	-	24.61	25.67	23

USGS (2005): Physical, chemical, and bacterial monitoring data were collected from Tanners Creek at Schenley Place, USGS Monitoring Site 390707084521701, near the City of Lawrenceburg. Nine (9) samples were collected in June, August, and October of 2005. The data is summarized in Table 6 below. These data show acceptable levels of dissolved oxygen, temperature, pH, and conductivity as well as potentially elevated levels of *E. coli*.

Table 6. Water Quality Data Summary for Tanners Creek at Schenley Place

Parameter	USGS Data Range	Indiana Water Quality Criterion
Temperature (°C)	18.8 to 30.6	Less than 32.2
Dissolved Oxygen (mg/L)	4 to 11.3	Greater than or equal to 4.0
pH (SU)	7.5 to 8.5	Between 6.0 and 9.0
Specific Conductivity (µS/cm)	470 to 564	1,200
Inorganic C Suspended Sediment (mg/L)	< 0.12	None
Organic C Suspended Sediment (mg/L)	0.7 to 2.84	None
Particulate N Suspended (mg/L)	0.107 to 0.48	None
Pheophytin a phytoplankton (µg/L)	3.3 to 14.1	None
Chlorophyll a phytoplankton (µg/L)	14.1 to 36	None

Sources: USGS, 2000; 327 IAC 2

A search more recent (last 5 years) for water quality and related data was performed using publicly accessible reports and databases published by the Indiana Department of Environmental Management (IDEM), Indiana Department of Natural Resources (IDNR), United States Environmental Protection Agency (USEPA), and the United States Geological Survey (USGS). No monitoring data or reports for streams in the City of Lawrenceburg were found by IDNR and USEPA. These agencies had not published more recent water quality data for streams in the City of Lawrenceburg.

8.0 Areas with Potential to Contribute to Water Quality Issues

As part of the Tanners Creek Watershed Management Plan (WMP), Hoosier Riverwatch data collected in 2000 showed unhealthy levels of dissolved oxygen as well as elevated levels of E. coli bacteria. As part of the WMP, for the area specifically within Lawrenceburg, urbanization is a leading cause of water quality degradation. Some activities and solutions for managing stormwater quality within the MS4 include: Monitor erosion control practices and educate the construction community on proper EPSC practices.

A number of the water quality issues within the Tanners Creek Watershed stems from upstream agricultural activities and natural soil conditions which are easily eroded. Several sites along the waterway showed evidence of livestock access which increases the E. coli and nutrient loading. Removing direct access to streams for cattle through fencing, water crossings, vegetative buffers around pastures, and off-stream water supplies for livestock can greatly reduce the E. coli, phosphorus, and nitrogen within waterways.

Lawrenceburg does not have any facilities that are permitted to discharge stormwater from industrial stormwater activities under Rule 6 (IDEM, 2023). Two industrial facilities permitted to discharge stormwater with a Lawrenceburg address are actually located in the Dearborn County unincorporated area. There is also an inactive coal fired power plant within City limits that includes restricted waste landfill sites and fly ash ponds. This area should be periodically monitored at outfall locations.

9.0 Recommendations

Based on the findings discussed, the City of Lawrenceburg plans to implement and enhance the MS4 program. The following additional BMPs are recommended for consideration.

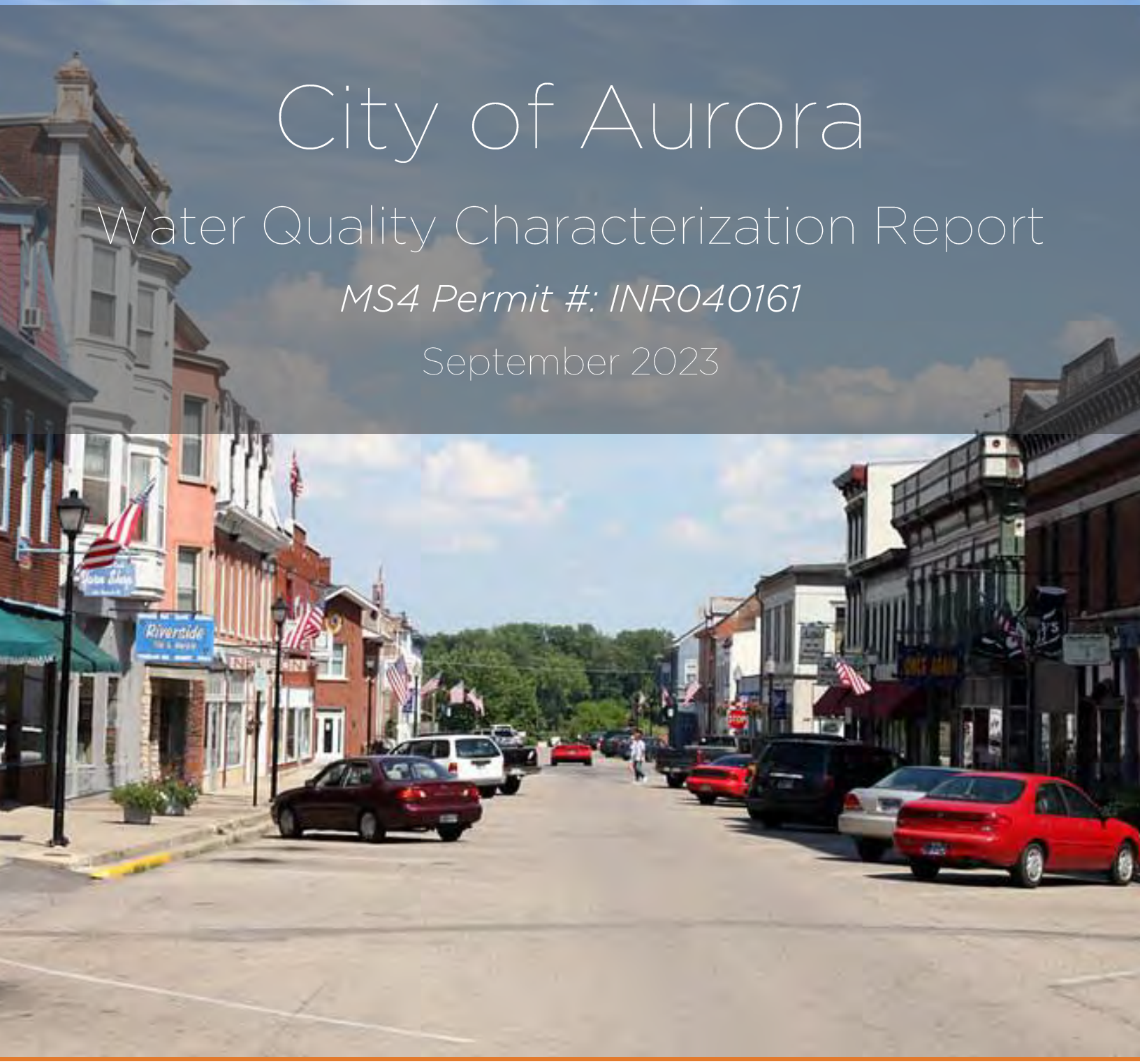
- Develop a Stormwater Quality Management Plan (SWQMP) as a component of the MS4 Program to outline activities, measurable goals, and tracking for stormwater quality measures.
- Develop a city ordinance to prohibit and enforce illicit discharge detection and elimination.
- Develop city ordinances to detail how construction and post-construction stormwater runoff should be handled.
- Continue mapping and screening the City's stormwater system for illicit discharges, condition assessments, and stormwater collection system connectivity.
- Create employee training programs and routine facility inspections aimed at elevating the city's municipal operations pollution prevention and good housekeeping activities.
- Add a dedicated stormwater section on the city website informing people about stormwater best management practices and upcoming events.
- Educate residents about water quality activities. This may include partnering with the Dearborn County Soil and Water Conservation District and neighboring communities.
- Continue working with the GLAD Partnership to build and enhance the MS4 Program.

City of Aurora

Water Quality Characterization Report

MS4 Permit #: INR040161

September 2023



HISTORIC AURORA
INDIANA

OHM
Advancing Communities

Table of Contents

OHM Advisors
400 Missouri Avenue, Suite 100
Jeffersonville, IN 47130
www.OHM-Advisors.com

Table of Revisions

The following table summarizes revisions, additions, deletions, etcetera to the contents of this report:

Date	Revised Pages/Appendices	Summary of Change

Primary MS4 Contact

Austin Woods
City Manager
235 Main Street
Aurora, IN 47001
Phone: 812-926-1777

WQCR Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Qualified Professional:

Name: Allison Padron, PE

Title: Project Manager, OHM Advisors

Signature: 

Date: 9/28/23

MS4 Operator or Designee:

Name: AUSTIN WOODS

Title: CITY MANAGER

Signature: 

Date: 10-11-23

1.0 Purpose

This water quality assessment report is intended to accompany the Greendale, Lawrenceburg, Aurora, and Dearborn County (GLAD) Regional Water Quality Characterization Report (WQCR). This component of the WQCR contains information specific to the City of Aurora as a method for further analyzing water quality within the MS4 boundaries and using that information to guide their MS4 Program as they begin implementing the Indiana MS4 General Permit (INR040000) and Indiana Construction Stormwater General Permit (INRA00000).

2.0 Assessment of Land Use

The City of Aurora is located in the eastern portion of southern Indiana along the north shore of the Ohio River and bisected by US Highway 50. The City of Lawrenceburg is located to the north, unincorporated areas of Dearborn County border the west and south, and the Ohio River lies along the entire eastern portion of the city. Aurora's incorporated area encompasses approximately 3.5 square miles (2,255 acres). The City of Auroraa's Municipal Separate Storm Sewer System (MS4) area refers to the entirety of the City's municipal boundaries as shown in Figure 1.

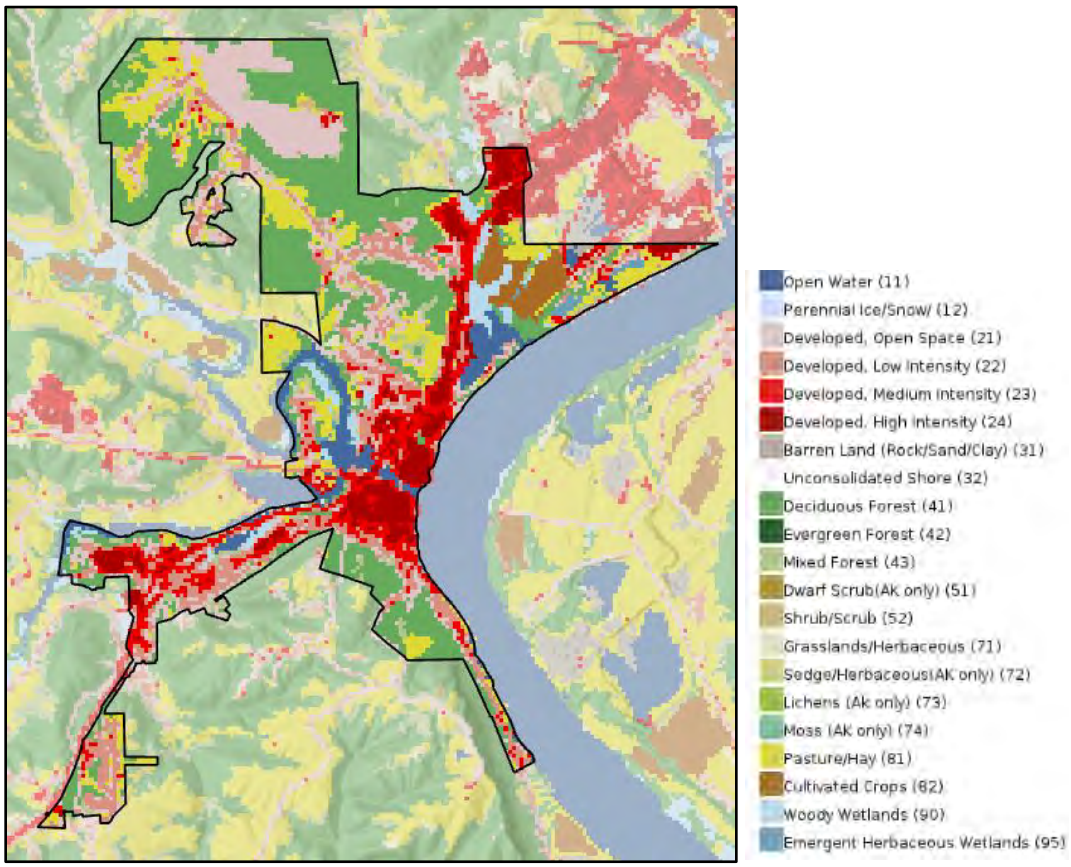


Figure 1. Land Use Map (NLCD, 2021)

Below in Table 1, is a breakdown of land use within the City of Aurora. The city is primarily urbanized property with more than 45% of the total land area considered to be developed. More than 31% is forested and nearly 15% is used for agricultural purposes.

Table 1: Land Use for Aurora MS4 Area

Category	Acres	Percentage
Deciduous Forest	637.3	28.3%
Developed, Open Space	339.9	15.1%
Developed, Low Intensity	304.6	13.5%
Hay/Pasture	271.6	12.0%
Developed, Medium Intensity	219.2	9.7%
Developed, High Intensity	158.6	7.0%
Open Water	109.0	4.8%
Mixed Forest	75.8	3.4%
Cultivated Crops	57.3	2.5%
Woody Wetlands	52.4	2.3%
Emergent Herbaceous Wetlands	17.6	0.8%
Herbaceous	4.7	0.2%
Barren Land	4.2	0.2%
Shrub/Scrub	2.7	0.1%
TOTAL	**2,255**	**100%**

Source: National Land Cover Database (NLCD, 2021)

3.0 Best Management Practices (BMPs)

The following section describes the City of Aurora's efforts to improve stormwater quality through the MS4 program by implementing the six (6) Minimum Control Measures (MCMs), including structural and non-structural BMPs.

3.1 Structural BMPs

The City of Aurora is currently in the process of mapping their storm sewer system, to comply with the MS4 General Permit.

3.2 Non-Structural BMPs

3.1.1 Ordinances

The City of Aurora is currently developing ordinances to establish the legal authority to administer the MS4 program and ensure compliance through adopted ordinances. These ordinances will include management of illicit discharges, construction stormwater runoff, and post-construction stormwater runoff.

3.1.2 Partnerships

The City actively participates in the Greendale, Lawrenceburg, Aurora, and Dearborn County (GLAD) MS4 Partnership which was started in early 2023 when the neighboring communities were designated as MS4 Phase 2 communities by the Indiana Department of Environmental Management (IDEM). The GLAD Partnership provides a forum for developing a coordinated implementation of the MS4 program in the communities.

The City also partners with the Dearborn County Soil and Water Conservation District as well as the Dearborn County Solid Waste Management District. These partnerships give the City more resources and facilities that can be used to implement and enhance the MS4 program.

3.1.3 MCM 1 & 2 – Public Education and Outreach; Participation and Involvement

The Dearborn County Solid Waste Management District has made hazardous household waste disposal available and free to all Dearborn County residents. Residents are able to use the district's drive-thru recycling center Monday through Friday during their business hours and this is to encourage residents to properly dispose of waste and prevent it from entering the stormwater system. Also, brochures are available at Main Street Aurora, who partakes in the Hard Hat Hangout where MS4 was briefly mentioned in 2023. For 2024, MS4/Stormwater will have its own informational booth at the event.

The City of Aurora had an event called the Aurora River Sweep where 60 contract bags of garbage, debris, and frontage were cleaned up alongside the river. We also had an event called the City-Wide Cleanup where around 25 Rumpke dumpsters were filled with garbage from the city in 2023.

3.1.4 MCM 3 – Illicit Discharge Detection and Elimination

The City is currently working on mapping the system in order to develop the IDDE Plan specific to the MS4 Program. The utility department has someone on staff assisting in mapping, and the county has offered their assistance in getting a ground level base mapped out. Water and sewage are currently mapped.

3.1.5 MCM 4 – Construction Site Stormwater Runoff

The City will develop a process for reviewing SWPPPs for submitted construction plans within the City, issuing permits, and performing construction site inspections.

Martin Yake with IDEM currently performs inspections of municipal projects, will continue to do so. IDEM will also continue to review municipal SWPPPs for the municipality.

3.1.6 MCM 5 – Post-Construction Stormwater Runoff

The city will develop a process to review submitted drainage plans for post-construction stormwater impacts.

3.1.7 MCM 6 - Municipal Operations Pollution Prevention and Good Housekeeping

A list of facilities within Aurora with the potential to discharge pollutants is being developed, with plans to perform quarterly and annual inspections. Municipal training in storm water pollution management is planned for 2024.

3.1.8 Flood Control

The City of Aurora is directly adjacent to the Ohio River and heavily impacted by this major river's dynamics. The City is also bisected by Hogan Creek which discharges into the Ohio River and is subject to backwater conditions from the larger river. A large percentage of the City is located in the designated FEMA floodplain Zone AE, along with portions on the Ohio River in the FEMA Floodway.

4.0 Receiving Waters

The City of Aurora has three (3) primary receiving waters, shown in Table 2 below, which breaks down the names, lengths, and the percentage of each receiving water. There is a total of 3.7 miles of natural stream channels within the City MS4 limits. A portion of the City also drains directly into the Ohio River. Shown in Figure 2 are the major receiving waters and watersheds that are impacted by Aurora. The City drains four (4) watersheds: Taylor Creek-Ohio River (050902030804), Elk Run-North Hogan Creek (050902030802), Allen Branch-South Hogan Creek (050902030404), and a very small portion in Laughery Creek (050902030802). Aurora's waterways are heavily influenced from upstream communities in Dearborn County and, to a lesser extent, by Lawrenceburg.

Table 2: City of Aurora Receiving Waters

Receiving Water	Total Length (miles)	Percentage
Wilson Creek	1.1	30%
Hogan Creek	1.5	41%
South Hogan Creek	0.5	13%
Unnamed Tributaries	0.6	16%
TOTAL	3.7	100%

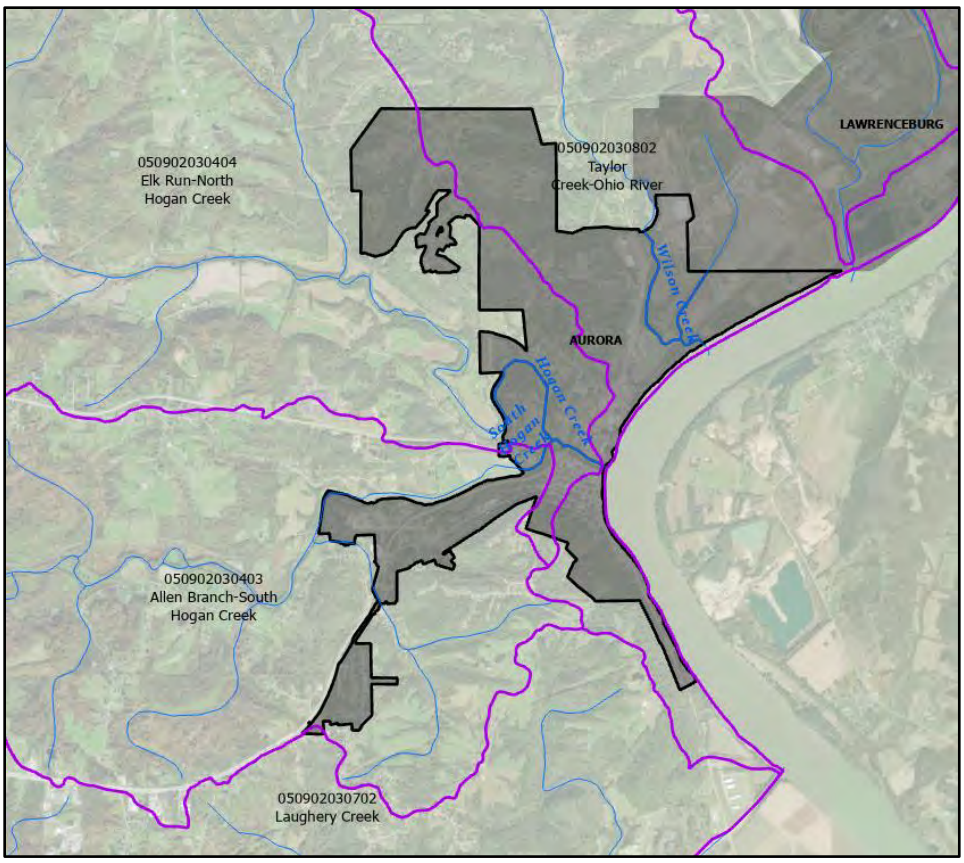


Figure 2. Major Receiving Waters and Watersheds for the City of Aurora

5.0 303(d) Impaired Waters

The 2022 Integrated Water Monitoring and Assessment Report published by IDEM includes the 303(d) List of Impaired Streams for Indiana. Two (2) stream segments in the Aurora MS4 area were listed on the 2022 303(d) List of Impaired Streams, shown on the map in Figure 3 and in Table 3. There are a total of 2.2 miles of impaired streams within the City of Aurora. Both stream segments are impaired due to the level of PCBs present, which is a legacy contaminant, and are considered to be fully supporting their ecological functions and recreational uses.

Table 3: City of Aurora Impaired 303(d) Waters

Stream Name	Assessment ID	Length (miles)	Impairment	TMDL
Hogan Creek	INV0344_03	0.4	PCBs	None
North Hogan Creek	INV0344_02	1.8	PCBs	None

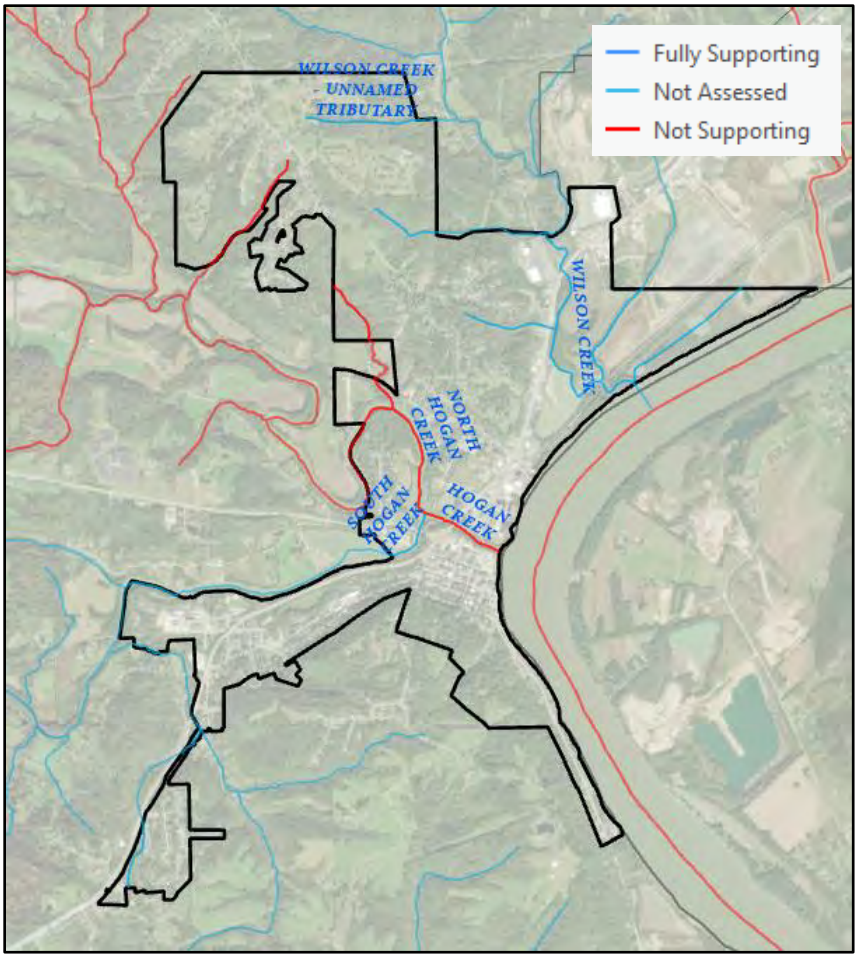


Figure 3. 303(d) Impaired Waters of the City of Aurora

6.0 Known Sensitive Areas

Public Beaches/ Full Body Contact Recreation: There are no beaches or lakes with public swimming or recreational facilities other than enclosed public swimming pools. The City is currently not aware of any locations within the MS4 area where full body contact recreation occurs. Due to the proximity and location of the marinas and boat launches as discussed below, this is a priority within the MS4 area.

Boat Launches: There are two (2) known boat launches inland within the City of Aurora including the Sunset Bay Marina and Campground on South Hogan Creek and the Waterways Marina on Hogan Creek. There are at least two (2) additional boat launches along the Ohio River, including at Lesko Park, and the intersection of 3rd Street and the Ohio River Scenic Byway.

Wetlands: Wetland areas are considered to be environmentally sensitive features and are protected by the Clean Water Act. The National Wetland Inventory (NWI) was used to estimate the extent and locations of wetlands and deep waters in Lawrenceburg. Based on these data, there are 233.5 acres of wetlands and deep-water habitats within the City limits, not including the riverine habitat directly along the Ohio River. The following map and

table shows the different types of wetlands within the MS4, as classified by the NWI. The majority of wetlands and ponding areas are located along roadway corridors and low-lying ponding areas adjacent to the Ohio River. Hogan Creek and South Hogan Creek drains into the Ohio River and is subject to backwater conditions from the larger river. Wetlands and ponding areas serve a critical role in floodplain management.

Table 4: Types of Wetlands in Aurora

Type	Acres
Freshwater Emergent Wetland	58.3
Freshwater Forested/Shrub Wetland	35.5
Freshwater Pond	11.8
Lake	36.0
Riverine	91.9
TOTAL	233.5

Source: National Wetland Inventory (NWI).

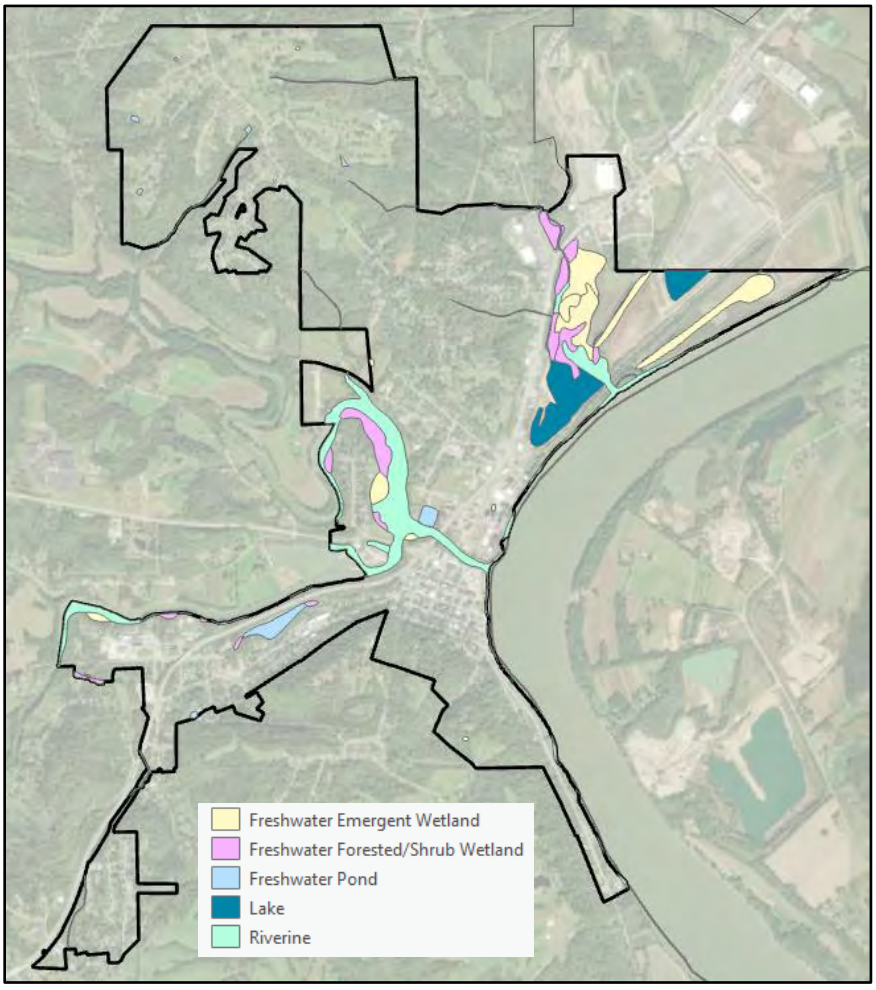


Figure 4. Wetlands and Lakes of the City of Aurora

Wellhead Protection Areas: There is an established wellhead protection area (WHPA) in the City of Aurora. The City has partnered with the Lawrenceburg-Manchester-Sparta (LMS) Conservancy District to implement the Wellhead Protection Plan (WHP). The WPHA in Aurora extends from the western edge of the downtown Lawrenceburg area westward bounded to the north and south by US Route 50 and the Ohio River respectively, until just slightly east of Aurora, IN.

Surface Drinking Water Intakes: Drinking water sources within the City are derived primarily from wells that pull drinking water from local groundwater resources. There are no known surface drinking water intakes in the surrounding area.

Sinkhole Areas: There are no known sinkhole areas in Aurora after a review of Indiana Geological Survey (IGS) data.

7.0 Existing and Available Monitoring Data

Complete Hogan Creek Watershed Management Plan (2007): The Dearborn County Soil and Water Conservation District initiated a Watershed Management Plan (WMP) study in 2005. The series of WMPs were in response to meetings in 1998 held throughout the county, which identified water quality, including nutrient and sediment contamination, as a priority within the county. The WMP was completed and approved in December 2007.

E. coli continued to be an issue in this watershed; levels were highly elevated above EPA acceptable levels. Common water quality issues, such as high phosphorous and nitrogen levels from agricultural runoff, were largely not a problem in this watershed. In lieu of the continually worsening E. coli results, further testing was suggested to discover its sources, be it animal or human waste. The only combined sewer system in the watershed was in Aurora, while the rest of the watershed had many rural / agricultural areas; both are likely the main sources for elevated E. coli levels.

A search more recent (last 5 years) for water quality and related data was performed using publicly accessible reports and databases published by the Indiana Department of Environmental Management (IDEM), Indiana Department of Natural Resources (IDNR), United States Environmental Protection Agency (USEPA), and the United States Geological Survey (USGS). No monitoring data or reports for streams in the City of Aurora were found by IDNR and USEPA. These agencies had not published more recent water quality data for streams in the City of Aurora.

8.0 Areas with Potential to Contribute to Water Quality Issues

The combined sewer system area of Aurora should be monitored regularly for potential overflows and should be considered a priority area for illicit discharge inspections.

A number of the water quality issues within the Hogan Creek Watershed likely stems from upstream agricultural activities. Several sites along the waterway showed evidence of livestock access which increases the E. coli and nutrient loading. Removing direct access to streams for cattle through fencing, water crossings, vegetative buffers around pastures, and off-stream water supplies for livestock can greatly reduce the E. coli, phosphorus,

and nitrogen within waterways. Since the upstream jurisdiction falls under Dearborn County, combined efforts could be used to target the elevated E.coli.

Lawrenceburg has six (6) facilities that are permitted to discharge stormwater from industrial stormwater activities under Rule 6 (IDEM, 2023). These facilities are shown in Table 7. These facilities should be periodically monitored at outfall locations.

Table 7. NPDES Active Industrial Stormwater Permits in the City of Aurora

NPDES ID	Permit Name	Effective Date	Expiration Date	Location Address	SIC	Permit SIC Description
INRM01017	Core Metals Group LLC (MPM Facility)	9/16/2019	9/15/2024	133 Franklin St	3295	Minerals, Ground Or Treated
INRM01478	Consolidated Grain & Barge	3/8/2022	3/7/2027	210 George St	5153	Grain And Field Beans
INRM01903	Matthews Aurora LLC	9/15/2020	9/14/2025	10944 Marsh Rd	3995	Burial Caskets
INRM02231	Smyrna Ready Mix Concrete LLC Plant #212	7/14/2022	7/13/2027	10513 Morgans Branch Rd	3273	Ready-Mixed Concrete
INRM02629	Stedman Machine Company	7/1/2019	6/30/2024	129 Franklin St	3532	Mining Machinery
INRM02701	Batesville Products Incorporated	8/17/2020	8/16/2025	10367 Randall	3365	Aluminum Foundries

9.0 Recommendations

Based on the findings discussed, the City of Aurora plans to implement and enhance the MS4 program. The following additional BMPs are recommended for consideration.

- Develop a Stormwater Quality Management Plan (SWQMP) as a component of the MS4 Program to outline activities, measurable goals, and tracking for stormwater quality measures.
- Develop a City ordinance to prohibit and enforce illicit discharge detection and elimination.
- Develop City ordinances to detail how construction and post-construction stormwater runoff should be handled.
- Continue mapping and screening the City's stormwater system for illicit discharges, condition assessments, and stormwater collection system connectivity.
- Create employee training programs and routine facility inspections aimed at elevating the City's municipal operations pollution prevention and good housekeeping activities.
- Add a dedicated stormwater section on the City website informing people about stormwater best management practices and upcoming events.
- Educate residents about water quality activities. This may include partnering with the Dearborn County Soil and Water Conservation District and neighboring communities.
- Continue working with the GLAD Partnership to build and enhance the MS4 Program.