2020

Indiana Integrated Water Monitoring and Assessment Report to the U.S. EPA

IDEM

Indiana Department of Environmental Manangement

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Note: This appendix is a spreadsheet available in electronic format only.

EXECUTIVE SUMMARY

Section 305(b) of the federal Clean Water Act (CWA) requires states to prepare and submit a report on the water quality condition of state water resources to the U.S. Environmental Protection Agency (U.S. EPA) every two years. States are also required to develop and submit a list of impaired waters to U.S. EPA for approval under CWA Section 303(d). Indiana Department of Environmental Management (IDEM) meets both of these requirements with the submittal of this Integrated Water Monitoring and Assessment Report (IR) to U.S. EPA in even-numbered years.

To develop this report, IDEM used data collected by the agency in accordance with its 2017-2021 *Surface Water Quality Monitoring Strategy* and data from other agencies and organizations where possible. IDEM's strategy describes three primary approaches to monitoring Indiana surface waters. Probabilistic monitoring employs a stratified random sampling design on a nine-year rotating basin schedule, which provides a comprehensive statewide data set for assessments every nine years. Targeted monitoring designs involve the intentional selection of sampling locations based on specific monitoring objectives such as reassessments for Total Maximum Daily Load (TMDL) reports. IDEM's fixed station monitoring is another type of targeted monitoring for which the locations do not change except in rare circumstances. IDEM monitors its fixed station sites year-round, collecting water chemistry samples on a monthly basis.

IDEM reviews all the data it collects for use in making CWA Section 305(b) water quality assessment and Section 303(d) listing decisions and considers existing data from external organizations where it is readily available and meets the agency's data quality requirements. IDEM follows the methods and procedures in its Consolidated Assessment and Listing Methodology (CALM) to make its CWA water quality assessment and listing decisions. The purpose of IDEM's CWA assessments is to determine whether Indiana waters are meeting their designated uses described in Indiana's water quality standards (WQS).

Indiana's WQS provide the basis for the methods and procedures described in the CALM and the water quality criteria that Indiana waters must meet to ensure they are supporting their designated uses. Of the uses designated in the state's water quality standards, IDEM assesses aquatic life use support, recreational use support, and drinking water use support for surface waters that serve as a public water supply. IDEM also evaluates the degree to which Indiana's lakes and its rivers and streams support fish consumption. Indiana's WQS includes other designated uses, however, IDEM limits its assessments to these three uses and fish consumption because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, the criteria used to protect these uses also protect other designated uses covering agricultural and industrial activities, for example.

IDEM completed its first IR in 2002, which provided the first baseline report on water quality throughout the state. IDEM conducts its water quality assessments on a continual basis and updates the IR every two years, submitting the updated reports to U.S. EPA as required by the CWA. The 2020 IR provides the most recent comprehensive report on Indiana water quality to date, including results from IDEM's comprehensive use support assessments. IDEM's Reach Index (the "address book" for streams that allows for mapping them and tracking them for water quality assessment purposes) contains 62,612 miles of streams, which together represent the vast majority of flowing waters in Indiana. Table 1 (Appendix A) summarizes the cumulative results for IDEM's stream-specific assessments. To date, IDEM has assessed approximately 36,814 miles of stream for aquatic life use and has found 67 percent of those to be fully supporting that use. Approximately 27 percent of the 33,599 stream miles assessed support full body contact recreational use. Almost all of Indiana's 67 miles of Lake Michigan shoreline fully supports aquatic life use, while almost none of the shoreline waters support full body contact recreational use.

This report identifies the parameters that IDEM has found to be impairing or indicating impairments of Indiana's flowing waters (rivers and streams) and lakes. The report devotes a separate section for Lake Michigan and another for its shoreline in Indiana. Pathogens continue to be the top cause of stream impairments in Indiana, with impacts to the potential recreational use of more than 24,001 miles of streams. Through its assessments for fish consumption, IDEM has also found that polychlorinated biphenyls (PCBs) in fish tissue affects 4,887 miles of rivers and streams in Indiana while mercury in fish tissue affects 597 miles. IDEM has also found fish with high levels of PCBs and/or mercury in 59 of the 1,578 Indiana lakes that IDEM tracks for assessment purposes, including Lake Michigan. While many of Indiana's rivers and streams support healthy biological communities (fish and aquatic insects), IDEM has found almost 8,816 stream miles that have experienced a measurable adverse response to stressors, many of which remain unknown.

Potential sources affecting Indiana waters include nonpoint sources that affect 13,906 miles of streams, while unknown sources affect at 11,617 miles. IDEM has several programs in place to address nonpoint source pollution. The Nonpoint Source (NPS) Program and the Total Maximum Daily Load (TMDL) Program work towards restoring waters of the State. The NPS Program's watershed specialists promote the holistic watershed approach by working closely with locally led watershed groups.

INTRODUCTION

The federal Clean Water Act (CWA) requires states to prepare and submit a water quality assessment report of state water resources, including a list of impaired waters to the United States Environmental Protection Agency (U.S. EPA) in even-numbered years. Thus, Indiana Department of Environmental Management's (IDEM's) Office of Water Quality (OWQ) publishes the Indiana Integrated Water Quality Monitoring and Assessment Report (IR) every two years. As with previous reports, OWQ prepared the 2020 IR following U.S. EPA guidelines (1997a, 1997b, 2005, 2006b, 2009b, 2011, 2013, 2015, and 2017) to ensure that this report for the 2020 cycle meets all the reporting requirements in Sections 305(b), 303(d) and 314 of the CWA.

Indiana's IR contains two lists, the Consolidated List and the 303(d) List of Impaired Waters. These lists differ in purpose and scope. The Consolidated List provides site-specific water quality assessment information for waterbodies throughout the state of Indiana. The 303(d) List of Impaired Waters provides a subset of these to identify only those waters that are impaired and for which total maximum daily loads (TMDLs) are required per CWA Section 303(d). The IR also provides IDEM's results for its CWA Section 314 assessments of lake trends and trophic state as well as information pertaining to Indiana's ground water and wetland resources.

IDEM bases most of its water quality assessments on data collected by it Watershed Assessment and Planning Branch in the OWQ. IDEM's *Surface Water Quality Monitoring Strategy*, *2017-2021* (WQMS) (IDEM, 2017) describes all of the OWQ monitoring programs that contributed most of the data used to develop this report. Much of that data comes from IDEM's Probabilistic Monitoring Program. The Probabilistic Monitoring Program employs a stratified random sampling (probabilistic) design to generate a representative set of sampling locations for each of nine major watershed management basins defined in IDEM's WQMS (Figure 6, Appendix B). IDEM uses probabilistic results to make comprehensive use support assessments, which are statistically valid statements about the overall water quality within each watershed. IDEM can also use the same data to make site-specific assessments of the individual waterbodies within that basin.

IDEM's targeted monitoring programs also provided much of the data used to develop this report, including results from IDEM's:

- Fixed Station Monitoring Program
- Watershed Characterization Program
- Fish Tissue Contaminant Program
- Performance Measures Monitoring Program
- Cyanobacteria Monitoring Program
- Special Studies Program

IDEM also uses secondary data provided by the Indiana Clean Lakes Program, which conducts sampling on Indiana's lakes and reservoirs through a contractual agreement between IDEM's Nonpoint Source (NPS) Program and Indiana University's O'Neill School of Public and Environmental Affairs.

BACKGROUND

Indiana is located on the eastern edge of the North American great interior plains. The North-South continental divide traverses northern Indiana, dividing the state into two major drainage basins, the Great Lakes basin and the Mississippi River basin. Surface water in the northern one-quarter of the state flows north into the Great Lakes and then through the St. Lawrence River to the Atlantic Ocean. The southern three-quarters of the state drains into the Ohio River or Illinois River, then flows into the Mississippi River, which flows south to the Gulf of Mexico.

Indiana has approximately 63,511 miles of rivers, streams, ditches and drainage ways based on the Indiana Reach Index, which is a map of Indiana waters based on the U.S. Geological Survey's (USGS') high resolution (1:24,000 scale) National Hydrography Dataset (UGSG 2014). Table 2 (Appendix A) provides an atlas of all the different types of waterbodies in Indiana, including those assessed for this report. Appendix C provides the metadata and definitions used in this report.

WATER POLLUTION CONTROL IN INDIANA

Several agencies share authority for controlling water pollution in Indiana. IDEM holds authority to carry out several federal Clean Water Act (CWA) programs, including Sections 402, 305(b), 303(d), 314, and others. The Indiana State Department of Health (ISDH) holds regulatory authority over septic systems, and the Office of the Indiana State Chemist (OISC) regulates pesticides and nutrients. The State Soil Conservation Board (SSCB), Indiana State Department of Agriculture (ISDA), Indiana Department of Natural Resources (IDNR) – including its Lake and River Enhancement (LARE) Program and its Lake Michigan Coastal Program (LMCP) – administer voluntary programs and grant programs to help mitigate various types of nonpoint source pollution. Indiana also collaborates with many federal agencies and nonprofit organizations in order to accomplish its work, including:

- United States Geological Survey (USGS)
- United States Environmental Protection Agency (U.S. EPA)
- United States Department of Agriculture (USDA)
- United States Fish and Wildlife Service (USFWS)
- United States Forest Service (USFS)
- United States Army Corps of Engineers (USACE)
- National Park Service

Universities and other organizations that provide additional research, technical and funding assistance include, Purdue University and its Cooperative Extension Service, Indiana University, The Nature Conservancy, the Indiana Water Monitoring Council, county soil and water conservation districts, and many local non-profit and ad-hoc watershed groups.

IDEM'S WATERSHED APPROACH

The IDEM employs a watershed approach in its CWA programs. This approach is hydrologically defined and geographically focused, providing an effective framework to address water quality issues by taking into account land, air, and water stressors. Key benefits of the watershed approach include the integration of multiple programs through coordination of public, private, and not-for-profit stakeholders and the ability to leverage limited resources to address priority concerns.

The foundation of IDEM's watershed approach is internal and external collaboration across program areas through timely and effective communication and adaptive management. Later sections of this report describe IDEM's work with other state and federal agencies and other external organizations in more detail.

Internally, IDEM's commissioner and other senior staff meet weekly to discuss progress on priorities as well as emerging concerns, and relay this information to IDEM OWQ managers at their weekly meetings. Cross-program teams continually work to develop strategies and work plans that ensure that OWQ focuses its resources on addressing the most significant environmental issues affecting water quality.

IDEM began using a watershed approach in 1996 when the agency adopted a statewide rotating basin approach to watershed monitoring. From 1996-2010, IDEM monitored watersheds throughout the state on a five-year rotation, which provided a complete update for the entire state once every five years.

In 2011, IDEM began using a nine-year rotating basin approach. This approach has provided a comprehensive and updated data set for the entire state as of 2019. The water quality assessments included in this report are cumulative and include all waters assessed to date in every basin of the state. Figure 1 (Appendix B) shows the monitoring locations for all of IDEM's surface water sampling programs and illustrates the sampling density achieved through IDEM's water quality monitoring strategy over the past nine years (2011-2019).

IDEM's OWQ programs work together to protect and improve the quality of Indiana's surface waters. OWQ Water Quality Standards (WQS) program works to develop Indiana's WQS, which provide the foundation for IDEM's implementation of several CWA programs. IDEM's water monitoring programs provide much of the data necessary to conduct CWA Section 305(b) water quality assessments and to support the development of Indiana's 303(d) List of Impaired Waters and total maximum daily loads (TMDLs) required under Section 303(d) of the CWA.

IDEM addresses nonpoint source (NPS) pollution primarily through non-regulatory watershed management planning and implementation projects funded through its NPS Program and supported by the development of TMDLs for impaired waters. The agency's National Pollutant Discharge Elimination System (NPDES) provides a robust regulatory program to control point sources of pollution to Indiana surface waters.

IDEM also works with the Indiana Finance Authority to issue low-cost loans to communities for infrastructure improvements to their wastewater and drinking water facilities. Many of these loans go to municipalities in watersheds where IDEM has identified water quality impairments and where there are TMDLs approved by U.S. EPA. IDEM anticipates that in time, these projects will result in measurable improvements in water quality, and has a water quality monitoring program in place to determine this.

IDEM'S OFFICE OF WATER QUALITY PROGRAMS AND ACTIVITIES

Water Quality Standards Program

IDEM is the state agency responsible for the ongoing development of Indiana's WQS, which can be found online in 327 Indiana Administrative Code (IAC) Article 2 at: www.in.gov/legislative/iac/iac_title?iact=327. Indiana adopted its first WQS in 1986. In 1990, Indiana revised the WQS significantly, adopting numeric criteria for all pollutants for which the United States Environmental Protection Agency (U.S. EPA) had developed federal ambient water quality criteria for the protection of human health and aquatic life.

At that time, Indiana also established the designated uses that Indiana waters should support. Currently, Indiana's WQS designates all waters in the state of Indiana for uses consistent with the requirements of the Clean Water Act or U.S. EPA's implementing regulations, and all have criteria appropriate to determine support of these uses.

With few exceptions, Indiana's WQS have designated all surface waters in the state for warm water aquatic life use, full-body contact recreational use, industrial uses, and agricultural uses. Further, the WQS designate waters that serve as a source water for drinking water treatment facilities as public water supplies. The WQS designate certain waters in Indiana for put-and-take trout fishing where natural temperature conditions will support coldwater fisheries, and 11 stream reaches are designated outstanding state resource waters.

There are 30 reaches of streams in Indiana designated for limited use in Indiana's WQS based on an analyses of an inability to fully support aquatic life use . In 2007, another limited use designation was added to Indiana's WQS and is applicable only to waters receiving wet weather discharges from combined sewer overflows (CSOs) in communities that have an approved CSO Long Term Control Plan (LCTP) in place. Like the limited use designation for aquatic life use, Indiana's WQS require a use attainability analysis prior to changing a waterbody's designation for recreational use to the CSO wet weather limited use. IDEM approved the first use attainability analysis (Indianapolis/CWA Authority) for this use on August 13, 2019. IDEM is currently working on a rulemaking to amend the current use designation in the WQS for the affected waters.

Most waters in Indiana have at least two designated uses or more. Therefore, IDEM uses the most stringent criteria when implementing its programs to ensure that all uses are protected. The most stringent criteria in Indiana's WQS are those established to protect aquatic life use, recreational uses for all Indiana waters and, where applicable, public water supply. IDEM bases its water quality assessments primarily on these uses and the water quality criteria in the WQS established to protect them.

Indiana's surface WQS include both numeric and narrative water quality criteria. Together with designated uses and the state's antidegradation policy and procedures, which Indiana adopted into rule in 2012, Indiana's water quality criteria provide the foundation for the protection of Indiana's water resources. WQS development is an ongoing process, in terms of both the development of numeric water quality criteria and the methods for the implementation of Indiana's narrative criteria.

For example, in the absence of a numeric criterion for polychlorinated biphenyls (PCBs) in fish tissue, IDEM calculated a numeric value for the maximum allowable concentration of PCBs in fish tissue based on U.S. EPA guidance for developing water quality criteria for the protection of human health in 2008. This value allowed IDEM to begin using fish tissue data directly in its assessments of how well Indiana waters support fish consumption instead of relying on the fish consumption advisory published by the Indiana State Department of Health, which is not intended for this purpose. In addition, in 2013, Indiana adopted revised chloride criteria developed by the WQS Program based on hardness and sulfate concentrations.

National Pollutant Discharge Elimination System (NPDES) permits are based, in part, on the procedures and criteria articulated in Indiana's WQS. Indiana made significant revisions to the rules and regulations that guide the implementation of Indiana's WQS through NPDES in 1993. However, these changes resulted in only minor revisions to the water quality criteria expressed in the state's WQS.

With the issuance of the final Great Lakes Water Quality Guidance in 1995, IDEM began the process of revising the WQS and implementation regulations for those waters in Indiana's Great Lakes system. These revisions incorporated the various criteria and procedures identified in the guidance into Indiana's WQS. As a part of this rulemaking, IDEM also developed its original antidegradation policy and procedures applicable to waters in the Great Lakes system. IDEM regulates the drinking water from public water supplies through the Safe Drinking Water Act (SWDA). IDEM defines what constitutes a public water supply based on the SDWA and has established minimum requirements regarding the information included in consumer confidence reports, which public water suppliers deliver to their customers annually. Indiana's surface WQS include criteria to protect public water supplies withdrawn from surface waters (reservoirs, lakes, rivers and streams). However, many public water supplies rely on

water drawn from ground water sources. In 2002, Indiana adopted Ground Water Quality Standards into its WQS to help maintain and protect the quality of Indiana's ground water resources and ensure that exposure to ground water will not pose a threat to human health.

Current Water Quality Standards Development

IDEM is currently working on a rulemaking to revise Indiana's aquatic life and human health ambient water quality criteria for select metals for waters within and outside of the Great Lakes system. The revised criteria reflect updates based on current science, and many are National Recommended Water Quality Criteria (NRWQC) developed under Section 304(a) of the Clean Water Act (CWA).

On March 5, 2014, IDEM issued a first notice in the Indiana Register announcing a rulemaking to incorporate the revised water quality criteria for metals into Indiana's WQS. IDEM issued a Second Notice of Comment Period to seek comments on proposed revised criteria on November 17, 2017. IDEM issued a Notice of Public Hearing to consider preliminary adoption for the draft rule on January 22, 2020. More information about this rulemaking can be found on IDEM's WQS website at: www.in.gov/idem/cleanwater/2329.htm.

IDEM has been evaluating the development of numeric nutrient criteria as requested by the U.S. EPA to support CWA assessments and permit development. U.S. EPA has issued guidance that allows states some flexibility in the development of nutrient criteria if the state and U.S. EPA have agreed on a plan to progress toward this goal. Indiana submitted its nutrient criteria development plan to U.S. EPA in 2009, and U.S. EPA approved it the same year. This plan includes a schedule for criteria development and provides for annual updates to U.S. EPA on IDEM's progress towards meeting nutrient criteria development goals.

IDEM has worked collaboratively with the USGS in Indianapolis over the last 14 years to collect and analyze stream data relevant to the development of nutrient criteria from waters throughout the state. IDEM also contracted with LimnoTech, Incorporated to collect and analyze all available data for Indiana lakes and reservoirs to inform nutrient criteria development. LimnoTech completed its analysis in 2008, after which IDEM performed additional analyses on the data set to refine the nutrient benchmarks developed by LimnoTech. Based on these studies, on June 30, 2010, IDEM issued a first notice in the *Indiana Register* announcing a rulemaking to incorporate numeric water quality criteria for total phosphorus for lakes and reservoirs into Indiana's WQS. Following this first notice, IDEM convened a work group for discussion of a rule. Based on stakeholder concerns regarding impacts of implementing the criteria, the work group determined it was premature to proceed with the second notice.

IDEM has developed a non-rule policy to reduce the amount of nutrients entering Indiana waters from certain NPDES facilities. IDEM is now in the last year of a five year permitting cycle (2015-2020) to include a one milligram per liter (mg/L) total phosphorus discharge limitation in all NPDES permits for major sanitary treatment plants with an average design flow of one million gallons per day or more as permits are renewed. IDEM expects this effort to result in a significant reduction in statewide total phosphorus discharged from sanitary treatment plants. In addition, IDEM is now requiring major sanitary dischargers to begin monitoring for total nitrogen beginning with their next NPDES permit renewal. IDEM is also requiring major dischargers to monitor and report total nitrogen concentration and mass discharged to IDEM on a monthly basis. IDEM plans to use the data collected to develop a better understanding of nitrogen loadings in Indiana waters and to aid in future updates of Indiana's nutrient reduction efforts.

In 2017, using federal CWA Section 106 Monitoring Initiative Funds from U.S. EPA, IDEM implemented a pilot study to provide a better understanding of the complex relationships between nutrients, primary productivity, dissolved oxygen fluxes over a 24-hour period and biological community response indicators in wadeable streams. The study concluded in 2019 providing additional information that may help IDEM establish defensible criteria through change-point analysis. IDEM plans to continue collecting more data in this realm with a focus on condition extremes, land uses, and habitat qualities. IDEM is also working to develop algal metrics, which combined with those for fish communities and macroinvertebrates, will provide three different types of stream biota to correlate with water chemistry data to help determine critical levels of nutrients.

U.S. EPA has announced plans to publish draft NRWQC in 2020 to update the ecoregional numeric nutrient criteria for lakes and reservoirs published in 2000 and 2001. The NRWQC will include models and tools to help states derive criteria based on several stressor-response models developed for aquatic life, full body contact recreation, and public water supply uses. U.S. EPA's models and tools allow for the combination of state and national data sets to calculate state-specific recommendations that reflect local conditions. In 2017, U.S. EPA Headquarters selected Indiana as one of several case studies to demonstrate these models and tools. U.S. EPA will use IDEM's data set for inland lakes to develop its case study after its publication of the NRWQC.

IDEM also participates in the Indiana Conservation Partnership (ICP) and has worked closely with the Indiana State Department of Agriculture (ISDA) on the development of *Indiana's State Nutrient Reduction Strategy* discussed in a later section of this report.

NPDES Wastewater Permitting Program

Point source pollution in Indiana is controlled primarily through permits issued by IDEM for discharges to surface water under the NPDES Permit Program in IDEM's Permits Branch. Regulated facilities that discharge to waters of the state must apply for and receive a NPDES permit. Limitations in each permit are derived to protect all designated and existing uses of the receiving water body and/or any more stringent technology-based limitations that may be applicable to the permittee.

The Permits Branch issues individual (municipal, semi-public and industrial) NPDES permits. The program also issues industrial wastewater pretreatment permits to industries that discharge to municipal wastewater treatment plants. In addition, the Permits Branch issues general permits for:

- Hydrostatic testing of commercial pipelines.
- Non-contact cooling.
- Sand and gravel operations.
- Petroleum product terminals.
- Ground water petroleum remediation systems.
- Allen County On-site Discharging Systems.
- Coal mines.
- Temporary Dischargers.

IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. The first five permits listed above were converted/issued in November 2015 and are currently in the process of being renewed. The general permits for Allen County On-site Discharging Systems and for coal mines are still in progress with target issuance dates of 2020 and 2021, respectively. IDEM will issue a new general permit for Temporary Discharges in 2020.

There are currently 1,176 active individual NPDES permits, 196 pretreatment permits, and 240 facilities covered by general permits. The Permits Branch also reviews and approves long-term control plans (LTCPs) submitted by communities to reduce their discharges from combined sewers. All of Indiana's combined sewer overflow communities are under an enforceable mechanism. These mechanisms are in place to ensure implementation of approved LTCPs and/or to develop and implement an approvable LTCP. To date, 55 of Indiana's 109 CSO communities have fully implemented their CSO LTCPs.

NPDES Wastewater Compliance Program

The Compliance Branch works closely with the Permits Branch and staff members from IDEM's OWQ Enforcement Section to ensure that permit limits adequately protect designated uses and dischargers remain in compliance with their permit requirements. For example, when IDEM identifies unpermitted discharges or finds NPDES permit holders to be in violation of permit limitations or conditions, Compliance Program staff members may refer them to the Enforcement Section for appropriate action. Other Compliance Branch responsibilities include:

- Conducting routine inspections of wastewater treatment plants to evaluate NPDES compliance, as well as complaint investigations.
- Evaluation of compliance data, including data quality assurance.
- Conducting informal enforcement actions through the issuance of noncompliance letters, and assisting in the enforcement process.
- Oversight and auditing of municipal pretreatment programs in the 47 municipalities with U.S. EPA-delegated pretreatment programs.
- Providing laboratory assistance, operator technical assistance and training.
- Administration of the Wastewater Certification and Continuing Education Program.
- Recording a wide range of NPDES permit and compliance data into the Federal Integrated Compliance Information System (ICIS).
- Working in concert with other OWQ staff members in automating data flows to ICIS.
- Receiving, recording and tracking reported bypass and overflow events.
- Administration of the sewer ban and early warning program.
- Administering the laboratory proficiency program.
- Making public records available in IDEM's Virtual File Cabinet.

Stormwater Program

Stormwater run-off from urban, industrial, and rural areas contributes to water pollution in Indiana. IDEM's Stormwater programs process permit applications and issue permits, conduct compliance inspections, and conduct audits for three program areas that together help mitigate the impacts of stormwater to Indiana waters:

- Construction/Land Disturbance Stormwater Permitting
- Industrial Stormwater Permitting
- Municipal Separate Storm Sewer Systems (MS4)

The Stormwater Program and the Wetlands Program reside within the same section in OWQ's Surface Water Operations and Enforcement Branch, which has created valuable opportunities for cross training and coordination. As a result, stormwater staff members are now able to conduct compliance inspections related to suspected wetlands violations and to recognize and document violations while inspecting a site.

IDEM uses general permits to regulate most of the activities that discharge stormwater in Indiana. The general permit requirements are contained in Indiana Administrative Code and set by Indiana's Environmental Rules Board through its formal rulemaking process.

Unlike individual permits that IDEM issues to individual permittees when needed, general permits apply universally to all entities required to operate in accordance with the rule. However, IDEM is currently in the process of changing its approach to general permits from permit-by-rule to administrative general permits. IDEM is working to finalize the construction site run-off and MS4 administrative general permits and anticipates issuing them in 2020. IDEM is also developing an administrative general permit for industrial stormwater runoff. However, a timeline for its issuance has not been set.

Construction Site Run-off

Any activity that results in the disturbance of one acre or more of land requires a permit in accordance with 327 IAC 15-5 (commonly known as "Rule 5"). This general permit is intended to reduce pollutant runoff and sedimentation that can result from soil erosion. The permit also covers other activities associated with the construction projects including, concrete washout and fueling. IDEM regulates most construction projects in Indiana through the construction site run-off general permit.

Industrial Stormwater

IDEM manages industrial stormwater through a general permit developed in accordance with 327 IAC 15-6 (commonly known as "Rule 6"). General permit coverageis required for certain categories of industrial activities that are exposed to stormwater and where the runoff is discharged through a point source. The industrial stormwater general permit defines at least 32 categories of industrial activities, which can be found online at www.in.gov/idem/Stormwater/2384.htm.

The industrial stormwater general permit covers most industrial activities in Indiana. However, under certain circumstances, an industrial facility may require an individual stormwater permit. Individual permits are typically required only if a regulated industrial activity category has established effluent limitations under IDEM's NPDES Program or if IDEM determines the stormwater discharge will significantly lower water quality. Industrial facilities may also request or be required to obtain an individual permit that covers both stormwater and wastewater. The Industrial Permits Section issues these permits .

Municipal Separate Storm Sewer Systems

IDEM requires municipal separate storm sewer systems (MS4s) to develop and implement a local stormwater management plan under 327 IAC 15-13 (commonly known as "Rule 13"). During the first phase of its implementation, the federal MS4 rule designated cities (and certain counties) with a population of 100,000 or more as Phase I MS4s. Indianapolis, as the first Phase 1 MS4, has an individual stormwater permit specifically written to address stormwater quality and management. Due to population growth, Fort Wayne and Evansville have also been designated as Phase 1 communities and will be receiving individual permits within the next two years.

Federal Phase II MS4 rules came into effect in 1999 for small, urbanized areas such as cities, towns, universities, colleges, correctional facilities, hospitals, conservancy districts, homeowner's associations and military bases located within urbanized areas. Indiana currently has 186 MS4 permittees implementing Stormwater Quality Management Plans under a general permit. Under the general permit, these MS4s are required to develop a Stormwater Quality Management Plan that addresses six minimum control measures:

- Public education.
- Public involvement.
- Illicit discharged detection and elimination.
- Construction site run-off.
- Post-construction run-off.
- "Good housekeeping" for MS4 owned and operated facilities.

In addition to their regulatory role, IDEM's stormwater staff members provide education and training to the regulated community including local MS4s. Training not only includes education on the rules and regulations, but also technical training related to planning principles, stormwater plan development and review, stormwater quality/quantity measure design and implementation, and monitoring. The program also maintains a technical manual that specifically targets project site planning, construction site stormwater measures, and post-construction measures. *The Indiana Stormwater Quality Manual* is available online at www.in.gov/idem/Stormwater/2363.htm.

Wetlands Program

IDEM regulates the placement of fill materials, excavation (in certain cases) and mechanical clearing of wetlands and other waterbodies through its CWA Section 401 Water Quality Certification (WQC) program and Indiana's State Isolated Wetlands law (Indiana Code (IC)13-18-22), which covers wetlands that are not under federal jurisdiction. IDEM's regulatory authority comes from the federal CWA, a combination of state law and administrative rules for state-regulated wetlands, and from Indiana's water quality standards. IDEM regulates some activities in waterbodies in conjunction with the U.S. Army Corps of Engineers (USACE).

Anyone who wants to place fill materials, use heavy equipment to excavate or dredge, or mechanically clear areas within a jurisdictional wetland, lake, river or stream must obtain a CWA Section 404 permit from the USACE. If the USACE determines a permit is required, the property owner or representative must also obtain a CWA Section 401 WQC from IDEM. Placement of fill into non-jurisdictional wetlands, as determined by the USACE is regulated by Indiana law (IC 13-18-22 and 327 IAC 17).

Currently, if the USACE has determined a Section 404 permit is required for a project, under CWA Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's WQS. The applicant may be required to avoid impacts, minimize impacts, or mitigate for impacts to wetlands and other waters. IDEM may deny the WQC if the activity will cause unmitigated adverse impacts to water quality, the application is deficient, the wetland activities are not necessary, or compensatory mitigation is insufficient . A regulated project may not proceed until it has received a certification from IDEM. A key goal of the program is to ensure that all activities regulated by IDEM meet the national no-net-loss of wetlands policy.

Assumption of the Clean Water Act Section 404 Permit Program

In 2017, IDEM began investigating the resources and different authorities it would need to transfer authority for the federal CWA Section 404 program from the USACE to IDEM under the rules provided for state assumption of the program in CWA Section 404(g). IDEM continues to work on the concept of

assumption among other program efficiencies, collaborating with its state and federal partners – the Indiana Department of Natural Resources (IDNR), the U.S. Fish and Wildlife Service (USFWS), U.S. EPA, and the USACE.

IDEM's Wetland Protection Activities

Wetlands occur in and provide benefits to every county in Indiana. The lack of quantitative information on some aspects of Indiana's wetland resources is an obstacle to improving wetland conservation efforts. The most extensive database of wetland resources in Indiana is the National Wetlands Inventory (NWI) developed by the USFWS. The original NWI maps were produced primarily from interpretation of high-altitude color infrared aerial photographs taken of Indiana during spring and fall 1980-1987. These maps were updated at a much higher resolution during 2008-2009 through a grant to Ducks Unlimited. The updated maps indicate wetlands extent and type, based on the Cowardin, *et al*. classification scheme (Cowardin 1979). The project also included an analysis of the state's wetlands compared with 1986 conditions, which indicated that Indiana has experienced a net loss in:

- The number of emergent, forested, shore, and scrub-shrub wetlands.
- The extent (acres) of forested, scrub-shrub, and shore wetland sub-types.

Currently, IDEM's Wetlands Program uses the updated, higher resolution NWI inventory primarily as a screening tool when evaluating applications for impacts to wetlands and streams as well as to help identify wetland compensatory mitigation or restoration sites. It has also helped IDEM staff set priorities for complaint investigations.

In addition to reviewing applications and issuing Section 401 WQCs and state-regulated wetland permits, IDEM's Wetlands Program conducts inspections to ensure compliance with the certification or permit, including any mitigation required for the project. Section 401 WQC Program staff also conduct outreach events at various locations to promote the importance of wetlands and to educate the public on regulations related to protecting wetlands. The program also works on additional projects devoted to wetland assessment and wetland protection:

- IDEM maintains a web page devoted to wetlands and water quality issues at www.in.gov/idem/wetlands/index.htm. This page includes information on the status of Indiana's wetlands, current laws and rules, conservation programs and links to other regulatory and non-regulatory wetland programs.
- IDEM maintains a web-based mapping tool for potential wetland restoration sites, including opportunities for compensatory mitigation and non-regulatory purposes at www.in.gov/idem/wetlands/pages/mitigation/

Wetlands Program Plan

U.S. EPA provided funding for IDEM to develop the Indiana Wetlands Program Plan (IWPP) to describe the goals and objectives Indiana wants to achieve related to its wetland resources. IDEM developed the IWPP voluntarily. The IWPP does not represent any new federal regulation, nor does it represent any rulemaking or new regulation on the part of IDEM. Rather it serves to establish priorities and future development of IDEM's Wetlands Program.

IDEM was the lead agency in the development of the IWPP,but worked with multiple state and federal partners including, Indiana State Department of Agriculture (ISDA) and IDNR, USACE, USFWS, United State Geological Survey (USGS), U.S. EPA, and the National Resources Conservation Service (NRCS) to gather their input and that of hundreds of stakeholders. The full plan is available online at www.in.gov/idem/wetlands/files/program_plan.pdf.

Total Maximum Daily Load Program

IDEM's Total Maximum Daily Load (TMDL) Program works with IDEM's Nonpoint Source (NPS) Program and stakeholders in watersheds with impaired waters to conduct TMDL evaluations and develop TMDL reports. A TMDL evaluation is a process that quantifies the amount of a specific pollutant that a waterbody can assimilate and still meet WQS. CWA Section 502(6) describes what constitutes a pollutant and includes materials such as sewage, chemical wastes, biological materials, and wastes from industrial, municipal, and agricultural operations in its definition. The definition also encompasses drinking water contaminants regulated under Section 1412 of the Safe Drinking Water Act (SDWA). A TMDL report is a written, quantitative assessment that accomplishes the following:

- Identifies how much of the pollutant is coming from point sources and nonpoint sources.
- Specifies the amount of pollutant reduction necessary from each source in order to meet the WQS set for that pollutant.
- Lays the groundwork for developing and implementing a plan to reduce the amount of the pollutant coming from each source.

As of June 25, 2020, the Total Maximum Daily Load (TMDL) program has developed 2,994 TMDLs for impairments to 2,631 streams and stream reaches, all of which have been approved by U.S. EPA (Appendix D). Appendix D provides an accounting of all TMDLs approved to date. TMDLs completed prior to 2014 focused primarily on *E. coli* impairments. More recently, however, IDEM has been developing TMDLs for other issues related to NPS pollution such as impaired biotic communities and nutrient impairments.

In 2013, the U.S. EPA announced its long term vision to improve implementation of the CWA 303(d) Program through a new framework for managing program responsibilities. In order to achieve the goals of its vision, U.S. EPA required states to develop a new framework for prioritizing impaired waters for TMDL development.

In 2015, IDEM developed its TMDL Program Priority Framework, which describes IDEM's methods for prioritizing waters for TMDL planning and watershed restoration. IDEM's TMDL Program Priority Framework and its Priority Ranking, which identifies the watersheds in which IDEM's TMDL development will focus its efforts now through 2022 is provided in Appendix E. IDEM submitted both to the U.S. EPA on July 8, 2015, which were reviewed and approved on September 16, 2015. IDEM revised the Priority Ranking in Appendix E to reflect its short-term TMDL development schedule, which identifies the watersheds in which TMDL development is planned for the 2022 integrated reporting cycle.

The specific waterbodies identified on IDEM's original Priority Ranking may change based on unanticipated circumstances. Although the specific waterbodies may change, IDEM will continue to follow the methods described in its Program Priority Framework when prioritizing impaired waters for TMDL development to ensure ongoing consistency with U.S. EPA's long term vision.

Nonpoint Source Pollution Program

Several agencies and organizations work together to address NPS pollution in Indiana in many ways. IDEM's Watershed Planning and Restoration (WPR) Section leads the agency's efforts to reduce nonpoint source pollution in Indiana waters in partnership with other agencies and organizations

including the Indiana Association of Soil and Water Conservation Districts (IASWCD), ISDA, IDNR. NRCS, and the Indiana Finance Authority State Revolving Fund (SRF) Loan Program. The WPR Section also leads efforts to restore waters of the state that are identified on the 303(d) List of Impaired Waters through its NPS Program, which provides grant funding and other types of assistance to support locally-led watershed planning and restoration efforts.

IDEM's NPS Program provides the funding for much of this work, which comes from two federal pass-through grant programs aimed at improving water quality in the state, Section 205(j) grants and Section 319(h) grants, both named after the authorizing section of the CWA.

Section 205(j) Grants

The Section 205(j) Grant Program is dedicated to water quality management planning. This funding helps local organizations to determine the nature, extent, and causes of point and nonpoint source pollution problems in their watersheds and to develop plans to solve these problems. In federal fiscal year (FFY) 2018-2019, U.S. EPA allocated $695,516 in 205(j) funds to Indiana. The NPS Program in turn allocated these funds to support the development of watershed management plans for the Lower Kankakee and Flatrock-Auglaize watersheds, which will provide a strong foundation for future watershed restoration efforts.

IDEM also granted 205(j) funds to the USGS to install two streamgages in the St. Marys River watershed, which will help to determine the impact of nonpoint source actions on the St. Marys River. IDEM allocated additional 205(j) funds to the USGS to operate and maintain a continuous water-quality monitoring gage on the Kankakee River for the purposes of developing mathematical surrogates for continuous suspended sediment, total nitrogen, and total phosphorus concentrations in the river. The Ohio River Valley Water Sanitation Commission (ORSANCO) also received funding to assist with monitoring for harmful algal blooms on the Ohio River upstream of Indiana's drinking water intakes on the Ohio River.

Section 319(h) Grants

The Section 319(h) Program is one of the primary funding resources for reducing NPS pollution in Indiana. The majority of these funds are used to support the development and implementation of watershed management plans (WMPs). Developing and implementing a comprehensive watershed management plan is an effective way to focus efforts and resources on a watershed and its particular problems and to implement solutions to those problems. In the planning process the watershed group identifies the problems, causes, sources, and critical or target areas in the watershed, then sets goals and chooses measures or best management practices (BMPs) to be implemented to achieve those goals. WMPs now under development must meet the required elements of IDEM's 2009 Watershed Management Plan Checklist before CWA Section 319(h) funds may be used for their implementation. The checklist incorporates EPA's nine required components of a watershed-based plan and provides comprehensive guidance on IDEM's Nonpoint Source Program expectations, as well as examples and direction on how to meet those expectations. More information about IDEM's 2009 Watershed Management Plan Checklist and a description of the U.S. EPA's nine required elements can be found online at www.in.gov/idem/nps/3429.htm.

Indiana's 319(h) Grant Program receives a significantly larger allocation than that under Section 205(j) of the CWA (Table 3, Appendix A). In federal fiscal years (FFYs) 2018 and 2019, U.S. EPA allocated $7,092,000 in Section 319(h) funds to Indiana, which IDEM used to fund 17 projects. Many of these projects are described online at www.in.gov/idem/nps/2947.htm.

Several eligible organizations submit grant proposals for 319(h) funding each year. IDEM convenes an internal review committee comprised of OWQ staff members to select projects for funding based on

the NPS Program's priorities and the quality of the proposal. Much of this funding goes to groups working to develop and/or implement a comprehensive watershed management plan that will lead to implementation of on-the-ground BMPs in critical areas of the watershed.

Many of the projects funded with NPS Program grants include the collection of water quality data for watershed planning and other purposes. In accordance with their grant agreements, these projects must develop a quality assurance project plan (QAPP) to ensure the data they collect will be reliable for their project needs. Once the NPS program's quality assurance officer approves the QAPP, grantees may begin sampling and submitting their data on customized templates designed to facilitate upload of their data into IDEM's Assessment Information Management System (AIMS) database. IDEM has upgraded and continually maintains its AIMS database to make NPS Program data more readily available for internal and external use. Additional information about IDEM's 205(j) and 319(h) grant programs and their different requirements is available online at www.in.gov/idem/nps/.

Watershed Specialists

In addition to providing grant funding, the NPS Program employs six watershed specialists who provide an important link between watershed groups and other interested stakeholders and OWQ programs. In 2018 and 2019, the watershed specialists assisted nearly 149 watershed groups with many tasks including:

- Meeting facilitation.
- Reviewing draft and final watershed management plans.
- Reviewing grant proposals.
- Providing water quality data and watershed maps.
- Connecting them with other local organizations and agencies to complement planning efforts.
- Assisting watershed coordinators with the overall watershed planning and implementation processes.

The watershed specialists also work with the TMDL Program by attending TMDL public meetings to provide information on watershed planning and to build local partnerships to address water quality.

Nonpoint Source Program Priorities

IDEM's NPS Program is built upon the foundation provided by *the Indiana State NPS Management Plan*, which is required by Section 319(b) of the CWA. This plan is a strategic document developed by IDEM and approved by U.S. EPA, which identifies tactical priorities, goals, and milestones to address NPS problems in Indiana more effectively. The plan also provides the basis for funding decisions and programmatic direction for the state program and its partners. The current plan, which was developed in 2019, is available online at www.in.gov/idem/nps/3036.htm. U.S. EPA requires states to update their NPS management plans every five years. The next revision of IDEM's NPS Management Plan will be due in 2023.

Each year, IDEM identifies priority projects for Section 319(h) funds consistent with the goals in the *Indiana State NPS Management Plan* in order to more efficiently meet NPS Program goals, coordinate with TMDL Program efforts to identify and reduce NPS pollution, and focus more funding on impaired waters. For FFYs 2017 through 2019, the NPS Program has focused funding on the following four priorities:

1. Develop a WMP or implement an IDEM approved WMP that will reduce nutrient loads within the following 8-digit Hydrologic Unit Code (HUC) watersheds identified as priorities in Indiana's State Nutrient Reduction Strategy. IDEM and ISDA collaborated on the development of this strategy, which is available online at www.in.gov/isda/2991.htm, to help meet the State NPS Management Plan goal to utilize partnerships to leverage available resources for more effective management of nonpoint source pollution. The following watersheds have been identified in the strategy as priorities for planning and implementation of BMPs to reduce nutrient loadings to lakes and streams:

    - Upper Wabash (05120101).
    - Middle Wabash-Deer (05120105).
    - Middle Wabash-Little Vermillion (05120108).
    - Middle Wabash Busseron (05120111).
    - Lower Wabash (05120113).
    - Upper White (05120201).
    - Lower White (05120202).
    - Maumee River (04100003, 04100005, 04100007, 04100004).

2. Develop a WMP or implement an IDEM-approved WMP that includes a 10-digit HUC watershed with a surface water drinking water intake and one or more waters identified in Category 5A of the Draft 2014 303(d) List of Impaired Waters. IDEM anticipates that this priority will help meet the State NPS Management Plan goal to protect sensitive, vulnerable, and high quality waters of the state so that they may continue to meet their designated uses. The FFY 2019 Solicitation Priority Watersheds map, which is available on the NPS Program web page at: www.in.gov/idem/nps/3363.htm, reflects this priority.

3. Develop a WMP or implement an IDEM approved WMP that includes a 10-digit HUC watershed that impacts outstanding state resource waters and/or waters with endangered, threatened, or rare species. IDEM envisions that this priority, too, will help meet the goal of protecting sensitive, vulnerable, and high quality waters of the state so that they may continue to meet their designated uses. The FFY 2019 Solicitation Priority Watersheds map likewise reflects this priority.

4. Implement a WMP that meets the IDEM 2009 Watershed Management Plan Checklist. As noted earlier in this report, while IDEM now requires all WMPs now under development to meet the required elements of IDEM's 2009 Watershed Management Plan Checklist in order to receive additional 319(h) funding for implementation, most plans developed prior to 2009 do not meet these requirements. However, IDEM may still award funding to groups with older plans on a case-by-case basis, depending on the level of the detail in the original plan. To assist groups with older plans to become more competitive for implementation grants, the NPS Program offers guidance online to help them determine if they need to either revise or totally rewrite their plans: www.in.gov/idem/nps/3454.htm. The program's watershed specialists also provide assistance.

The NPS Program regularly assesses the success of its program in different ways. One important measure of the program's success is the quantity of pollutants, such as sediment, phosphorus, nitrogen,

and *E. coli* that NPS-funded projects are preventing from entering Indiana waters resulting from the implementation of best management practices (BMPs). Most NPS program projects in Indiana use the U.S. EPA Load Estimation Model to estimate the pollutant load reductions for each BMP they implement and provide their results to IDEM as part of their grant agreement. Table 4 (Appendix A) shows the total reported estimated pollutant load reductions in Indiana for FFY 2018 and 2019.

Another program measure (commonly referred to as "WQ-10" or "success stories") tracks the number of waterbodies identified by states as being primarily NPS-impaired that have been partially or fully restored as a result of restoration efforts (Table 5, Appendix A). Later sections of this report will discuss Indiana's FFY 2018 and 2019 Success Stories in more detail.

Volunteer Monitoring Programs

Hoosier Riverwatch

Hoosier Riverwatch (HRW) is a statewide volunteer stream water quality monitoring program with the mission to involve the citizens of Indiana in becoming active stewards of Indiana's water resources. HRW accomplishes this through watershed education, water monitoring, and clean-up activities.

HRW educates citizen volunteers on a variety of watershed and pollution issues and provides them with training and equipment to conduct water quality monitoring. In the last 10-15 years, HRW has trained more than 4,200 citizens in and around Indiana through about 350 full-day workshops. Many of those trained are parents, teachers, and scout leaders who, in turn, have taught and inspired countless youth about water quality and the impacts humans can have on water resources.

HRW also maintains an online database that allows volunteers to enter their own data and view data collected by other volunteers. Volunteers are encouraged to enter their results into the database to make them available to other interested parties such as watershed groups, schools, and IDEM staff members for potential use in various OWQ programs. In addition to basic search functions, the visualization tools of the database allow volunteers to view their data and that collected by others in comparison with state and watershed averages through simple graphics. About one out of every three persons trained in HRW workshops enter the data they collect into the online database.

IDEM's Watershed Assessment and Planning Branch administers the HRW Program. This allows for better coordination with IDEM's Nonpoint Source (NPS) Program, whose grantees commonly use HRW methods to meet the monitoring and outreach components of their funded projects and encourages greater data sharing through IDEM OWQ's External Data Framework (EDF). The HRW and NPS Program are also exploring different ways that volunteer monitoring can become more fully involved in watershed planning and restoration efforts as a whole.

HRW volunteers also have opportunities to interact with their professional counterparts within IDEM OWQ. HRW staff members have worked with OWQ biologists and others to offer training to the program's corps of volunteer instructors in various topics. In 2019, training opportunities with IDEM OWQ included advanced *E. coli* workshops, advanced macroinvertebrate sample collection and processing, and a look at interactive tools and games for use during workshops when weather or water levels keep participants indoors.

More information about Indiana's HRW program can be found online at http://www.in.gov/idem/riverwatch/index.htm.

Clean Lakes Volunteer Monitoring Program

The Indiana University O'Neill School of Public and Environmental Affairs has been working with IDEM's NPS Program since 1989 to administer the Indiana Clean Lakes Program (CLP) with funding provided through CWA Section 319(h). The Indiana CLP provides a comprehensive, statewide public monitoring program for lakes that includes public information and education, technical assistance, citizen science volunteer lake monitoring, and water quality assessment of Indiana lakes.

Indiana has more than 1,500 lakes, reservoirs, and ponds – many of which are under pressure from human activities such as poorly managed agriculture, suburbanization of lakeshores, boating impacts, and septic system discharges. These activities can result in excessive nutrient concentrations reaching lakes, which can lead to accelerated eutrophication and related undesirable effects including nuisance algae, excessive plant growth, murky water, odor, and fish kills. The Indiana CLP, coordinated by O'Neill School staff members and students, includes the following components:

- Annual professional sampling of lakes and reservoirs.
- Training and support of a corps of citizen scientist as volunteer lake monitors.
- Maintenance of the Indiana CLP website.
- Technical assistance and expertise on lake-related issues.

The CLP also works to develop educational materials such as brochures and fact sheets and conducts education and outreach through its biannual newsletter and participation in the Indiana Lakes Management Society Conference each year. The program holds workshops each year to help increase public understanding of the important zones of a lake that provide essential habitat and ecosystem services. Volunteers that participate in the workshops often expand their monitoring efforts becoming even better lake stewards. This program is very popular volunteers, and continues to improve with each workshop. In 2012, the program expanded its volunteer monitoring program to include aquatic invasive species monitoring with the goal of improving early detection and prevention of the spread of invasive species and added zebra mussels in 2014.

Volunteers enter the data they collect on the CLP website at: https://clp.indiana.edu/. Volunteer data reports are available on the website for the years 1999-2019. Information regarding IDEM's use of the data collected by IU-SPEA staff members and students for CWA Section 305(b) and Section 314 assessments can be found in a later section of this report.

COORDINATION AND COLLABORATION WITH OTHER AGENCIES AND ORGANIZATIONS

Nonpoint source (NPS) pollution ranges from urban sources to construction and agricultural run-off making cooperation across political boundaries and disciplines essential. Many local, regional, state, and federal agencies play an important role in addressing NPS pollution, especially at the watershed level. Various agencies in Indiana provide data, technical resources and grants to local watershed groups to assist with planning, infrastructure design review and implementation of BMPs to reduce and prevent NPS pollution. Through coordination and collaboration, the IDEM and other agencies more effectively focus water quality restoration and protection efforts where most needed.

This report describes how IDEM's OWQ works in partnership with individual agencies and organizations on some efforts and in collaboration with multiple agencies to more effectively address Indiana's water resource issues. IDEM employs six watershed specialists that act as liaisons for local, state and federal entities to integrate watershed planning into local level planning efforts. These specialists serve as Section 319(h) project managers assisting in a technical, managerial and financial advisory role for local watershed groups.

IDEM's Wetlands and Stormwater Program staff work cooperatively the following several agencies and other organizations to provide technical assistance and issue Clean Water Act (CWA) 401 water quality certifications, state permits for isolated wetlands, and construction/land disturbance permits to protect water quality:

- U.S. Army Corps of Engineers (USACE)
- Indiana Department of Natural Resources (IDNR)
- U.S. Fish and Wildlife Service (USFWS)
- Local soil and water conservation districts (SWCDs)

Indiana Department of Natural Resources

Division of Reclamation, Abandoned Mine Lands Program

IDEM's TMDL and NPS Programs work with IDNR's Abandoned Mine Lands (AML) Program on TMDL development and potential water quality improvements in watersheds with abandoned coal mines. The AML Program contributes to these efforts by sharing water quality data and information regarding the costs and techniques involved in their reclamation projects. The AML Program has also helped to educate OWQ staff members about areas impacted by acid mine drainage by touring reclamation projects with them at different points in the reclamation process.

Division of Land Acquisition, Indiana Stream and Wetland Mitigation Program

The Indiana Stream and Wetland Mitigation Program (IN SWMP) is a statewide in-lieu fee program that allows permit applicants the option to purchase stream and/or wetland mitigation credits to fulfill compensatory mitigation requirements associated with a Section 404 permit from the USACE, a 401 Water Quality Certification, and/or an Isolated Wetland Permit from IDEM. Permittee applicants may purchase these credits in-lieu of performing mitigation themselves. The IDNR received final approval of their Final Instrument to sponsor an in-lieu fee stream and wetland mitigation program from the USACE and the Interagency Review Team on May 3, 2018. The program must follow the requirements laid out in the federal mitigation rule (33 Code of Federal Regulations (CFR) Section 332.8) for administration and operation of the program. IDNR's in-lieu fee program will utilize data and information when available and applicable from IDEM's Office of Water Quality, Watershed Assessment and Planning Branch, IDNR's Lake and River Enhancement program (LARE), and local watershed and/or conservation plans to assist with the prioritization of potential stream and restoration projects involving wetland mitigation.

Division of Fish and Wildlife, Lake and River Enhancement Program

The goal of the LARE Program in the IDNR Division of Fish and Wildlife is to reduce the amount of sediment and nutrients entering Indiana's lakes and rivers. Coincidental to this goal is an ongoing effort to utilize LARE-funded projects to protect and enhance aquatic habitat for fish and wildlife to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreation.

The LARE Program accomplishes these goals through state grants to eligible sponsoring entities to provide for technical and financial assistance to qualifying projects. These projects range from diagnostic studies of targeted sub-watersheds to determine the design and construction feasibility of measures to reduce erosion and sedimentation in lakes and streams. Indiana law dedicates a portion of LARE funding to the removal of sediment, logjams and other obstructions, and control of invasive aquatic species. The program also provides funding to county SWCDs to assist individual landowners in the use of BMPs in targeted watersheds.

In 2019, LARE grants totaled more than $2.3 million to projects in several counties across the state. Funding for the program comes from a fee paid by boat owners annually to the Bureau of Motor Vehicles. LARE projects leverage these funds to benefit not just boaters but everyone who uses Indiana's publicly accessible lakes and streams. LARE-funded projects also help to improve aquatic habitat and reduce the amount of nutrients entering both the Great Lakes and the Mississippi River through Indiana streams.

Lake Michigan Coastal Program

The purpose of the IDNR's Lake Michigan Coastal Program (LMCP) is to enhance the state's role in planning for and managing natural and cultural resources in the coastal region and to support partnerships between federal, state and local agencies and other organizations. The LMCP annually awards grants through its Coastal Grants Program funded by the federal Coastal Zone Management Act to coastal municipalities, counties, nonprofit groups, and universities for projects that protect and restore natural, cultural and historic resources in Indiana's Lake Michigan coastal region. Examples of how these funds might be used include:

- Protection and restoration of significant natural and cultural resources.
- Programs to prevent the loss of life and property in coastal hazard areas.
- Improved public access for recreational purposes.
- Revitalized urban waterfronts and ports.
- Improved coordination among government agencies when making policy decisions.
- Pollution prevention initiatives, including NPS pollution into coastal waters.

During 2018-2019, the Lake Michigan Coastal Program awarded $114,440.00 in pass-through grants to communities, non-profit organizations, universities and schools specifically for water quality planning, outreach/education, research and improvement projects across the Lake Michigan Watershed.

Section 6217 of the Coastal Zone Act Reauthorization Amendments, which is jointly administered by the National Oceanic and Atmospheric Administration (NOAA) and U.S. EPA, established Indiana's Coastal NPS Pollution Control Program in 1990. The program is part of Indiana's LMCP and received conditional U.S. EPA/NOAA approval in 2008, establishing a set of management measures to help states control and reduce polluted runoff to coastal waters from five main sources:

- Agriculture. In 1990,
- Urban areas.
- Marinas and recreational boating.
- Hydromodification, including shoreline and stream channel modification.
- Wetlands, riparian areas, and vegetated treatment systems.

All coastal and Great Lakes states and territories that participate in the National Coastal Zone Management Program are required to develop nonpoint source pollution control programs for their coastal regions. State authorities ensure implementation.

The LMCP is working closely with IDEM's NPS Program and other NPS program partners to implement management measures specified by U.S. EPA to prevent and mitigate NPS pollution in the Lake Michigan coastal watersheds. IDEM anticipates submitting documentation indicating that Indiana now meets all remaining Coastal NPS Pollution Control Program conditions to U.S. EPA/NOAA on or before May 31, 2020.

Of the 56 measures that Indiana's Coastal NPS Pollution Control Program was required to implement, only one remains to be developed. This measure requires putting processes in place across the coastal watershed to ensure regular inspection and maintenance of septic systems to minimize pollution from failing systems. In 2017, IDEM's NPS Program awarded the Lake Michigan Coastal Program a

Section 319(h) grant to help it move toward approval of this final measure. This grant involves three components:

1. Mapping septic systems within 500 feet of surface waters within Indiana's Lake Michigan Watershed.
2. E. coli monitoring and molecular source tracking to develop a better understanding of the impact of septic system pollution on surface waters.
3. A robust neighborhood-based outreach and education program targeted at homeowners in partnership with neighborhood ambassadors and realtors.

The LMCP completed mapping septic systems in early 2019 through a partnership with the Northwestern Indiana Regional Planning Commission. The mapping included identification of target neighborhoods for the neighborhood outreach campaign. The program also completed its neighborhood-based outreach and education task in 2019, with signage and materials distributed by Neighborhood Ambassadors. In 2018 and 2019, the Governor issued a proclamation designating SepticSmart Week in the State of Indiana, and the LMCP created a comprehensive web-based outreach campaign with a social media component, with resources available online: https://www.in.gov/dnr/lakemich/10025.htm.

In 2019, the LMCP submitted an additional IDEM Section 319 grant application for funding to continue its work with county health departments on building capacity for septic system inspection and maintenance tracking should ordinances be developed that require inspections and maintenance at point of sale.

Indiana's Low Head Dam Removal Initiative

Low-head dams have a long and diverse history in Indiana . A low-head dam is defined as a man-made obstruction typically built within a river or stream channel and spanning from bank to bank (IDNR 2019). Thousands of low-head dams exist in many variations on streams and rivers throughout the United States. But, they generally have water flowing across the entire length of the top of the dam, are from one to about 15 feet tall (although taller ones exist on very large streams), store a minimal amount of water below the stream bank level, within the channel, and do not typically provide flood reduction storage. Most were built during the latter 19th and early 20th centuries to provide water to power grain mills, water retention for drinking water, water diversion for the cooling water intake structures for electrical generating stations, navigation, and so on. The IDNR has cataloged more than 150 low-head dams across Indiana. Many low-head dams are aged, require expensive repair or maintenance, and no longer serve their original purpose.

Low-head dams result in hydrologic alteration of streams and rivers that impedes the natural flow regime necessary to maintain a healthy aquatic biota. Ecologically, low-head dams inhibit the movement and migration of aquatic fauna, particularly fish. This inhibited movement has a direct impact on the movement and distribution of Unionid mussels in Indiana streams because of their dependence on the fish community. Low-head dams may be responsible in part for the long-term decline of Unionid mussel distributions and diversity in Indiana. They have interrupted riverine connectivity, altered hydrologic regimes, caused adjacent flooding, altered natural habitats, and altered the flow and transport of sediments, which is important for the natural replenishment of downstream ecosystems.

Low-head dams are also deceptively dangerous, especially from upstream. Under certain flow conditions, low-head dams may create recirculating currents and hydraulic forces on the downstream side of the dam, which pose hazards to recreational boaters, swimmers and anglers by swamping boats and trapping and drowning victims. Indiana ranks 10th in the nation for the highest number of fatalities at low-head dams. In 2017 alone, Indiana recorded deaths on the West Fork White River, Eel River, and Big Walnut Creek.

Removal of low-head dams restores natural river ecology, re-establishes river continuity and maintains public safety. However, removal of these structures is costly, complicated, and requires review and permitting by state and federal agencies. The process for permitting requirements among the various agencies often created confusion for applicants in early Indiana dam removal projects.

In order to clarify and streamline the low-head dam removal process for applicants, IDEM OWQ and the Office of Land Quality collaborated with the IDNR to establish a joint guidance document to promote removal of these structures and to aid sponsors in the permitting process. IDEM and IDNR have also created an online map so staff can identify possible "red flag" components that may complicate the dam removal, such as potentially contaminated sediment, invasive species, or historical significance, so that information can be communicated to applicants.

This initiative developed a process for early coordination clarifying what information will be required for permits. As a result, IDEM and IDNR have been able to review and process applications for removal faster than earlier applications. To date, approximately 350 river miles have been opened up on four major streams through the removal of 12 low-head dams and two modifications, including the construction of one fish passageway. One stream where low-head dams were removed has been successfully restocked with state and federally endangered Unionid mussels, and another will extend the habitat for state endangered Eastern Hellbenders. Four additional low-head dams either are in the permitting process or proposed for removal in the future. Removal of these additional low-head dams would open up approximately 411 additional river miles.

Indiana Conservation Partnership

IDEM is a member of the Indiana Conservation Partnership (ICP) – a partnership comprised of eight state and federal agencies and other organizations committed to the goal of promoting conservation. The ICP provides technical, financial, and educational assistance needed to implement conservation practices that are environmentally and economically compatible and promote good stewardship of Indiana's soil and water resources. IDEM serves on the ICP with the following agencies and organizations:

- U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS).
- U.S. Department of Agriculture Farm Service Agency (USDA-FSA).
- State Soil Conservation Board.
- Indiana State Department of Agriculture (ISDA).
- Indiana Department of Natural Resources (IDNR).
- Indiana Association of Soil and Water Conservation Districts (IASWCD).
- Purdue University Extension.

The ICP prepares an annual work plan that defines objectives for up to four conservation focus areas and includes the actions, responsible entities and deadlines for achieving them. Additionally, the ICP meets bimonthly for partner updates and, where possible, to collaborate for optimizing its resources for achieving water quality objectives. The ICP places particular emphasis on delivering technical training to partner staff and coordinating the various cost-share and grant programs.

In June of 2019, the ICP updated its soil health philosophy to underscore the widely accepted definition of soil health as "the capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans" (Pankhurst et al., 1997). The four key soil health principles that apply to all land uses include:

- Minimize disturbance
- Maximize soil cover
- Maximize biodiversity
- Maximize continuous living roots

To be successful in fully implementing a soil health system, the following objectives must continually be part of every management decision and field operation:

- Increasing organic matter
- Increasing water infiltration
- Improving nutrient use efficiency
- Increasing aggregate stability
- Increasing water-holding capacity
- Enhancing and diversifying soil biology and habitat.

The ICP works with producers to help them implement a "systems" approach to improve the health of their soil. A system is a suite of practices and management methods that when implemented results in additional improvement to soil health that can help address Indiana's primary resource concerns.

State Nutrient Reduction Strategy

Indiana's State Nutrient Reduction Strategy, which is available online at https://www.in.gov/isda/2991.htm, provides a framework for reducing nutrients entering Indiana waters, is a collaborative effort between ISDA, the lead agency and Gulf Hypoxia Task Force member, and IDEM with contributions from other ICP partners. It is on a two-year revision or "updating" cycle and was revised in 2018. As part of this strategy, the ICP has committed to report load reductions of sediment, nitrogen, and phosphorus achieved by the practices installed under the various funding authorities of its participating agencies. ISDA technicians use the U.S. EPA Region 5 model to calculate load reductions. Cumulative load reductions for calendar years 2013-2019 follow:

- Sediment – 1,667,979 tons
- Nitrogen – 3,518,499 pounds
- Phosphorus – 1,737,256 pounds

Indiana's State Nutrient Reduction Strategy along with watershed story maps and ICP accomplishments can be found at www.in.gov/isda/2991.htm. More detailed information about the ICP and its activities can be found at http://wordpress.iaswcd.org/icp/.

U.S. Department of Agriculture, Natural Resource Conservation Service

National Water Quality Initiative

USDA annually targets Farm Bill dollars to the NRCS National Water Quality Initiative (NWQI) to promote the implementation of conservation practices. IDEM worked closely with NRCS to prioritize watersheds for the NWQI using the decision criteria of watersheds with impaired waters, high-risk natural resource areas, active local watershed groups or conservation interests, and baseline water quality data. As a partner on the NWQI, the U.S. EPA requires IDEM in its role as the state agency in Indiana charged with implementing the CWA, to contribute monitoring resources to at least one NWQI watershed.

The watershed selected for NWQI monitoring is the School Branch watershed, a small (8.4 square miles) watershed located in northeastern Hendricks County, Indiana. School Branch is nestled within the Eagle Creek watershed, which is located in the larger Upper White River Watershed. Land use in the watershed is predominately agricultural with interspersed residential areas. In the School Branch watershed, soils are predominantly poorly drained and extensively tiled to improve the drainage in many areas. School Branch eventually drains into Eagle Creek Reservoir, which is a primary drinking water source for Indianapolis.

School Branch, Eagle Creek, and the Upper White River watersheds are on Indiana's 303d List of

Impaired Waters due to high levels of nutrients. The size of the Eagle Creek and Upper White River watersheds (163 and 2,718 square miles, respectively) and the variety in land uses at these scales has made it difficult to evaluate the effects of conservation and land management strategies. Therefore, focusing on the much smaller School Branch watershed, in which 80 percent of the land use is agricultural, will allow researchers to adequately isolate water quality impacts from agriculture versus other sources. Previous attempts to document water quality improvements from agricultural conservation practices at the watershed scale have proven particularly difficult due to the number of issues that could hinder the ability to attribute improvements to specific practices. These issues include:

- Insufficient baseline data.
- Incomplete separation of agricultural influences from non-agricultural sources.
- Inadequate sampling duration and intensity to account for "lag time", seasonal influences, and storm events.
- Insufficient adoption of complete conservation systems within watersheds.

The collaboration of federal, state, local, and academic entities, along with dedicated conservation-minded farmers in the School Branch watershed, has provided a unique monitoring opportunity to assess the chemical, physical, and biological impacts of conservation practices.

Currently, the project is measuring water quality associated with conservation cropping systems that improve soil health in predominantly corn and soybean row crop agriculture. The data collected through this effort will allow evaluation of how production agriculture can complement sustainable water resources. In addition, because the School Branch watershed lies within two successively larger watersheds of similar land use and hydrology, the project is monitoring and can model impacts of conservation at multiple scales including watershed, sub-watershed, and edge-of-field. Historical data is also available to enhance the assessment of improvements over time.

Monitoring and evaluation efforts continued in 2018 and 2019. Different partners in this effort, including IDEM, the USGS, the Indiana Geological and Water Survey (IGWS), the Marion County Health Department, USDA-NRCS, and the Center for Earth and Environmental Services at Indiana University-Purdue University, Indianapolis, are conducting monitoring and evaluation at different scales and expect to publish a report in 2020 covering the first three years of data.

These agencies and organizations are conducting this monitoring to measure streamflow and ground water levels by collecting continuous water data from School Branch through three stream gauges and four ground water wells. Two studies, a synoptic study of tile drains and an isotope and major ion study were conducted to gain a better understanding of the hydrology and nutrient transport within the study area. The partners are also monitoring soils to determine their moisture levels, water-holding capacity, and nutrient content. They are also using supplementary biological indicators to evaluate factors affecting water quality and conducting nutrient source tracking to determine impacts from field, in-stream bed and bank, and residential sources and have analyzed sediment characteristics. Monitoring efforts will continue through 2021.

Thanks to conservation-minded farmers participating in this study, the research partners collaborating on this project will be better able to distinguish between the water quality effects associated with complete conservation cropping systems from other agricultural and non-agricultural sources of sediment and nutrients.

Indiana Water Monitoring Council

The Indiana Water Monitoring Council (InWMC) (http://www.inwmc.net/) is a broad-based, statewide organization whose primary mission is to enhance the communication, collaboration and coordination of professionals, organizations, and individuals monitoring, managing, protecting, and/or restoring Indiana's water resources. As a charter member, IDEM has remained actively involved with the InWMC, maintaining a presence on the board of directors and participating in committees to assist with activities that:

- Provide a forum for communication among groups involved in monitoring Indiana waters.
- Promote the sharing of monitoring data and information on effective procedures and protocols for sample collection.
- Facilitate the development of collaborative monitoring strategies.

The InWMC supports communication, collaboration, and coordination about monitoring across the full spectrum of water resources – both surface water and ground water – from multiple perspectives including water quality, water quantity, ecology, and human health.

Shortly after the InWMC's formation, its Data Optimization Committee convened the Integrated Water Monitoring Network Optimization Taskforce to work toward a better understanding of water quality monitoring efforts throughout the state.

Multiple state, federal, and local agencies and organizations monitor water quality within Indiana, each with its own mandate or reason for monitoring. Although each agency and organization is collecting potentially valuable data on Indiana's water resources, the lack of coordination can lead to duplication of efforts and overlooking of important information due to the lack of data sharing. Members of the InWMC have overwhelmingly cited the need for a shared understanding of existing, active monitoring networks within Indiana among the water resources community as being critical to effective management of water resources throughout the state.

In 2017, the InWMC published the findings of the taskforce on the InWMC website in a paper entitled, *An Assessment for Optimization of Water-Quality Monitoring in Indiana* – a study of ongoing monitoring networks throughout Indiana to help environmental managers, researchers, and interested citizens find data from sampling sites with long periods of record. The study is available at http://www.inwmc.net/resources/monitoring-network-optimization/ and highlights the existing river and stream water quality monitoring networks, including IDEM's, that can provide data and identify new sites that may be needed to augment existing networks and/or eliminate sites that are currently being monitored by more than one group.

The InWMC also publishes the annual *Indiana Water Report,* which is available at http://www.inwmc.net/resources/indiana-water-report/ and describes current water-related monitoring and research going on throughout the state. The report is intended to help those working to manage water resources in Indiana do so more effectively and with a fuller understanding of how their efforts fit into the larger picture and to support greater communication and collaboration wherever possible.

Indiana Finance Authority

The Indiana Finance Authority administers the Indiana State Revolving Fund (SRF) Loan Programs, which offers two different loan programs that provide low-interest loans to Indiana communities, one for projects that improve drinking water and the other for wastewater infrastructure projects. The purpose of these programs is to protect public health and the environment. Cities, towns, counties, regional sewer/water districts, conservancy districts are eligible to apply for either program. Private and not-for-profit public water systems and water authorities are eligible for drinking water SRF loans.

Eligible projects include those that abate water pollution problems, provide greater protection for public health or ensure compliance with either the CWA or the Safe Drinking Water Act. Wastewater projects may include wastewater treatment plant construction or improvements, sewer line extensions to existing unsewered areas, decentralized treatment systems, combined sewer overflow elimination and infiltration/inflow corrections. Drinking water projects may include treatment plant construction and improvements, water storage facilities, water distribution systems and water supply. The program provides additional financial incentives to projects to include green technology, a Brownfields program project or a sustainable infrastructure component.

Both SRF Loan Programs can offer up to a 35-year fixed rate loan term. Interest rates on these loans use a base interest rate, which resets on the first business day of each January, April, July and October. The base rate is calculated by using 90 percent of the average 20-year AAA-rated, general obligation bond Municipal Market Data composite index for the most recent calendar month. The program is able to further discount the base rate based upon a borrower's median household income from the current American Community Survey data five-year estimate and projected user rates. To encourage participants to pursue projects that further improve public and environmental health, the SRF Loan program offers four incentive programs. By integrating lead line replacement, green/sustainable infrastructure components, NPS project components, or a Brownfield project, the SRF Program may reduce the interest rate on a loan by up to 0.5 percent. The program has established a floor of two-percent for the lowest interest rate, including any reductions that a loan may receive.

The SRF Loan Programs coordinate with state and federal programs, including IDEM's OWQ, to identify additional ways in which the assistance they provide to Indiana communities might help to achieve common goals. For example, the Clean Water SRF ranking and scoring gives additional points for projects that remove a pollutant source from an impaired stream. This method of scoring increases the likelihood that projects with a water quality benefit will rank high on the SRF project priority list. The funds loaned for these removal projects can be documented as a match for projects submitting grant proposals to the NPS Program. Projects eligible for match must provide water quality benefits to their respective communities and may include, but are not limited to, one or more of the following:

- Wetland restoration/protection.
- Erosion control measures.
- Ground water remediation.
- Repair or replacement of failing septic systems or connection to sewer.
- Stormwater BMPs.
- Source water and wellhead protection.
- Conservation easements.
- Agricultural and waste management BMPs.

The SRF Loan Programs also serve on the Indiana Rural Wastewater Task Force's Environmental Infrastructure Working Group, which allows the SRF Loan Programs the opportunity to provide input and offer financing options to communities for their drinking water and/or wastewater infrastructure needs. The SRF Loan Programs work with communities addressing combined sewer overflows, enforcement issues or those with or nearing a sewer ban.

Over the State Fiscal Years (SFYs) 2018 and 2019, ten projects with a NPS component saved an additional $40,910,550 over the term of their loans. While these savings are realized over the longer term, these projects are typically completed within two years, and the water quality benefits are achieved much sooner than 20 years.

Indiana's Great Lakes Water Quality Agreement Domestic Action Plan

Indiana's Great Lakes Water Quality Agreement (GLWQA) Domestic Action Plan (DAP) to reduce phosphorous to the Western Lake Erie Basin was finalized on February 28, 2018 and emphasizes:

- Using existing programs and optimizing partnerships.
- Effecting the most change with the least cost.
- Prioritizing resources to areas with the most phosphorus export and/or reduction potential.
- Seeking to engage citizens who are not participating in conservation efforts.
- Making use of social indicators to guide actions and employing adaptive management.

Indiana's goal is to meet the springtime phosphorus targets identified in the DAP for the Maumee River as it flows across the border into Ohio. Since 2018, Indiana and Ohio have collaborated with the U.S. EPA to provide funding for the USGS to install and operate three auto-samplers on their border. To determine phosphorus loads coming into Indiana from Ohio, auto-samplers were installed on the St. Joseph River and the St. Mary's River, each of which flows into Indiana from Ohio. At their confluence, these rivers form the Maumee River that flows eastward from Indiana into Ohio. Another auto-sampler was installed on the Maumee River on the Indiana side of the border to characterize phosphorus loads going into Ohio from Indiana. The data from this monitoring network will be instrumental in guiding actions to reduce phosphorus. The DAP is available online at https://www.in.gov/isda/files/Lake%20Erie%20Domestic%20Action%20Plan%20_Final.pdf.

COST/BENEFIT ASSESSMENT

Water is a vital component of the economic health of Indiana, which is diverse in its agriculturial, industrial, and environmental resources. Creating the benefits associated with a robust economy, high quality of life, and healthy ecosystems requires finding the right balance between often-competing needs. However, the finances available to restore, enhance, and protect our water resources is limited in comparison to the work needed to ensure that balance. The following is a discussion of some of the revenue sources available to state, regional, and local entities to achieve the objectives of the CWA as well as case studies that illustrate improvements in water quality and their resulting benefits.

Funding Water Quality Improvements through Better Infrastructure

Since 1992, the State Revolving Fund (SRF) Programs have provided more than $5.7 billion dollars for more than 862 wastewater (Figure 2, Appendix B) and drinking water (Figure 3, Appendix B) infrastructure improvement projects. SRF Program assistance to communities is expected to result in water quality benefits for many Indiana rivers and streams.

In state fiscal years (SFYs) 2018 and 2019, the Wastewater SRF Program closed 62 loans totaling approximately $679 million. This provided an estimated savings (compared to open market interest rates) of more than $137 million. In SFYs 2018 and 2019, the Drinking Water SRF Program closed on 27 loans totaling over $ 214 million with savings to Indiana communities estimated at more than $42 million (Table 6, Appendix A.)

Successes in Water Quality Improvement through Strategic Measures

IDEM has reported improvements in water quality in more than 260 miles of streams in 15 different watersheds since 2007 to the U.S. EPA to meet measures outlined in U.S. EPA's strategic plan (Table 5). Measure WQ-10a is a performance measure that requires states to develop Nonpoint Source (NPS) Program "Success Stories" and submit them to U.S. EPA for the purposes of tracking how NPS restoration efforts are improving water quality. To meet this measure, IDEM must identify nonpoint source-impaired waters with improvements resulting from watershed restoration efforts undertaken in whole or in part by IDEM's NPS Program.

In 2018 and 2019, IDEM reported water quality improvements in South Fork Wildcat Creek and Boyles Ditch watersheds. U.S. EPA's Nonpoint Source Success Stories website at https://www.epa.gov/nps/nonpoint-source-success-stories-indiana highlights these and other successes in water quality restoration.

<u>Aquatic Life Use Restored in a Tributary to South Fork Wildcat Creek</u>

This unnamed tributary to the SFWC (assessment unit INB0738_T1002) is a small headwater stream in the Wildcat Creek watershed in Clinton County, Indiana (Figure 4, Appendix B). It is in the eastern portion of the highly agricultural Jenkins Ditch-SFWC watershed. Most of the land use in this watershed consists of cultivated cropland, and while the land along the main stem of the SFWC is forested, most of its headwaters have no riparian buffer. Water quality sampling performed by IDEM in 1998 revealed a low index of biotic integrity (IBI) score, indicating that the stream was unhealthy.

Various partners have implemented several projects in the greater SFWC watershed over the years (Table 7, Appendix A). In the late 1990s, the IASWCD undertook efforts to provide strategic planning and technical assistance to the larger Wildcat Creek watershed using $189,500 in CWA section 319 funding. The Wildcat Creek Watershed Alliance took over implementation of the Wildcat Creek Watershed Management Plan in 2006 using $150,000 in CWA section 319 funds.

The U.S. Department of Agriculture's Natural Resources Conservation Service provided further funding and technical assistance through a variety of programs in the Jenkins Ditch–SFWC watershed between 2004 and 2017, totaling $7,951,224. Between 2001 and 2017, the Clinton County SWCD used a variety of funding sources (including private funds and CWA section 205(j) and 319 funds) to write a nine-element plan specific to the SFWC watershed and to provide cost share on BMP installations in the watershed, at a cost of $754,628.

IDEM returned to the SFWC tributary for follow-up monitoring in 2017. This monitoring showed an improved IBI score of 46 at the mouth of the stream, which exceeds the minimum IBI of 36 needed to indicate support of a well-balanced aquatic community. The habitat showed marked improvements in reduction of silt, as well as deeper pools, less embedded riffles, and a bank that had recovered from severe erosion. Based on these results, IDEM removed the stream from its 2020 impaired waters list.

Implementing Agricultural Best Management Practices Revitalizes the Fish Community in Boyles Ditch

Boyles Ditch is a small stream in the northern portion of the Kilmore Creek subwatershed, which is in the SFWC watershed in Clinton County (Figure 5, Appendix B). Boyles Ditch is surrounded by cultivated crops. While the main stem of Kilmore Creek contains a substantial amount of forested stream buffer, Boyles Ditch remains largely unbuffered from NPS runoff. According to the 2012 SFWC WMP, roughly 14 of the 21.5 miles of waterways in the Kilmore Creek subwatershed are listed as impaired, including all of Boyles Ditch and downstream portions of Kilmore Creek. In 2004, IDEM conducted a biological study on the SFWC watershed. Three sampling sites on Boyles Ditch had failing index of biotic integrity (IBI) scores indicating that the stream was not supporting a well-balanced aquatic community.

In 2005, the Clinton County Soil and Water Conservation District (SWCD) received a CWA section 319 grant to create the SFWC–Blinn Ditch and Kilmore Creek–Boyles Ditch WMP, which IDEM approved in 2008. In 2005–2012, organizations in the watershed collaborated to conduct education and outreach through stakeholder meetings, public workshops, field days, newsletters, and community cleanups. Workshop topics included the use of cover crops, proper septic system management, and soil health maintenance.

Various partners implemented projects in the SFWC watershed (Table 7, Appendix A). In the late 1990s, IASWCD undertook efforts to provide strategic planning and technical assistance to the larger Wildcat Creek watershed using $189,500 in CWA section 319 funding. In 2006, the Wildcat Creek Watershed Alliance assumed implementation of the Wildcat Creek WMP using $150,000 in CWA section 319 funding. The U.S. Department of Agriculture's (USDA's) Natural Resources Conservation Service provided additional funding and technical assistance through programs in the Kilmore Creek subwatershed in 2004–2017, totaling $7,017,438. The USDA Farm Services Agency's Conservation Reserve Program (CRP) provided $6,185 in funding for various conservation practices and floodplain restoration. Between 2001 and 2017, the SWCD used funding sources ($754,628 from private funds and CWA section 205(j) and 319 funds) to write a nine-element plan specific to the SFWC watershed and to provide cost share for best management practices (BMPs). Lastly, the SWCD used $337 in local funds to decommission a well.

IDEM conducted follow-up monitoring on Boyles Ditch in 2017 and found that the fish IBI score improved to 54, a significant increase from the score of 34 seen in 2004 and well above the minimum IBI score of 36 needed to indicate support. Additionally, the Qualitative Habitat Evaluation Index (QHEI) score was 69 in 2017, up from 47 in 2004 (QHEI scores below 51 indicates poor habitat). Based on these results, IDEM removed Boyles Ditch from its 2020 impaired waters list

Grand Calumet River Indiana Harbor Ship Canal Area of Concern Remedial Action Plan

The Grand Calumet River, located in Lake County in far northwestern Indiana, is a complex river system heavily modified by 200 years of industrialization and other human activities. The Grand Calumet is comprised of two east-west oriented branches that meet at the southern end of the Indiana Harbor Ship Canal (IHSC). The IHSC, in turn, extends north from its junction with the East and West branches of the Grand Calumet River to the Indiana Harbor. The Lake George Branch is a two-mile east-west branch of the IHSC.

Prior to the adoption of strict environmental regulations under the federal Clean Water Act, industries and municipal sanitary districts commonly discharged chemicals and contaminants directly into the Grand Calumet River and the IHSC. Such pollution, which consisted of oils and greases, heavy metals, human waste, and other industrial chemicals, accumulated in the sediments at the river bottom and along the adjacent wetlands. This accumulated pollution caused significant harm to the ecosystem and reduced the ability of the river system to provide several beneficial ecosystem services, such as clean water for drinking, wading, and industrial use; heathy fish and wildlife; and healthy, aesthetically pleasing environments.

By the 1970s, new environmental regulations changed how municipalities and industries could operate. This drastically reduced the amount of contaminants discharged into the river. However, even with new operational standards, legacy contaminants – those discharged prior to the change in regulations – continued to cause great harm to the river. Moreover, through its connection to Lake Michigan at the Indiana Harbor, the impairments to the Grand Calumet River had the potential to negatively impact water quality in the Great Lakes. The Grand Calumet River watershed, which also includes Wolf Lake, Lake George, and portions of the Indiana Lake Michigan shoreline, also faced numerous threats to native habitat from non-native invasive species. This combination of factors led the International Joint Commission (IJC), a binational organization made up of representatives of the United States and Canada, to list the region as one of 43 designated Areas of Concern (AOCs) within the Great Lakes Basin.

Under the 1987 Great Lakes Water Quality Agreement (GLWQA), the United States and Canada required the development of a Remedial Action Plan (RAP) for all AOCs including the Grand Calumet River/Indiana Harbor Ship Canal AOC to serve as a blueprint for the restoration of critical ecosystem services. The goal of the RAP is to identify the remedial actions necessary for removing each of the following 14 designated beneficial use impairments (BUIs):

1. Restrictions on fish and wildlife consumption.
2. Tainting of fish and wildlife flavor.
3. Degradation of fish and wildlife populations.
4. Fish tumors or other deformities.
5. Bird or animal deformities or reproduction problems.
6. Degradation of benthos (bottom-dwelling organisms).
7. Restriction on dredging activities.
8. Eutrophication or undesirable algae.
9. Restrictions on drinking water consumption, or taste and odor problems.
10. Beach closings.
11. Degradation of aesthetics.
12. Added costs to agriculture and industry.
13. Degradation of phytoplankton and zooplankton populations.
14. Loss of fish and wildlife habitat.

In Indiana, IDEM took the lead in developing the RAP for the Grand Calumet River AOC and appointed a group of individuals representing a diverse set of regional stakeholders to the Citizens Advisory for the Remediation of the Environment (CARE) Committee. Since 1990, the CARE Committee has provided valuable input into the RAP planning process.

The RAP identifies key projects needed to remove the 14 BUIs impacting the Grand Calumet River AOC. These include management of contaminated sediment for the entire river system, restoration of approximately 900 acres of native dune and swale and wetland habitat, and reduction of *E. coli* sources resulting in beach closures at AOC beaches. To date, funding for projects that support the removal of BUI impairment has been provided by the Great Lakes Legacy Act (GLLA), Great Lakes Restoration Initiative (GLRI), Natural Resource Damages Co-Trustees, and other state and local sponsors.

As a result of these partnerships, significant progress has been made toward the RAP sediment management goals. Since 2002, more than 3.0 million cubic yards of contaminated sediments containing heavy metals, oil and grease, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) have been removed. To date, 1.3 million cubic yards have been contained in-place using a reactive cap. In addition, federal, state, and local partners have begun a project to manage contaminated sediment within the Lake George Branch of the IHSC.

The Clean Water Act and Indiana law require the abatement of combined sewer overflows (CSOs). Municipalities with CSO discharges into the Grand Calumet River have committed to reduce these discharges through state and federal enforceable mechanisms. The reduction of CSOs in the system has led to enhanced water quality and aesthetics along the West Branch of the Grand Calumet River. Hammond, Gary, and East Chicago are required by their NPDES permits to fully implement long-term control plans (LTCPs) to abate CSO discharges.

Habitat restoration has also been a priority for the RAP partnerships, with GLLA projects completing restoration of 84 acres of wetland and riverine marshes, including Roxana Marsh in East Chicago, Indiana and Seidner Dune and Swale Nature Preserve in Hammond, Indiana. In addition, the GLRI is funding the restoration of approximately 900 acres of State- and locally-managed habitat throughout the AOC. Managed properties such as Clark and Pine Nature Preserve, DuPont Natural Area, and Gibson Woods Nature Preserve protect globally rare dune and swale habitats and others where some of the largest concentrations of threatened and endangered species in the state are found.

Monitoring throughout the restoration process is essential to ensure work stays on track to meet restoration goals. IDEM has implemented monitoring projects to assess plant, fish, benthic, and plankton communities, water chemistry, and aesthetics within the AOC. In addition, the agency has provided GLRI funds to universities and federal agencies to conduct microbial source tracking at AOC beaches.

In 2011 and 2012, respectively, BUI #12 (Added costs to agriculture and industry) and BUI #9 (Restrictions on drinking water consumption, or taste and odor problems) were removed from the list of beneficial use impairments for the Grand Calumet River AOC. IDEM and the CARE Committee continue to work diligently to identify and implement the remaining management actions necessary to remove the 12 remaining BUIs and eliminate the Grand Calumet River/Indiana Harbor Ship Canal AOC from the list of Great Lakes AOCs maintained by the IJC, a process known as BUI delisting.

SPECIAL STATE CONCERNS AND RECOMMENDATIONS

Reductions in federal and state resources for data collection and analysis coupled with increased federal directives and competing policy and program objectives continue to strain the ability of the IDEM to optimize its limited resources to monitor Indiana waters in support of OWQ programs and emerging state priorities.

IDEM acknowledges that fiscal responsibility may necessitate reductions in funding and staffing levels. In light of these constraints, IDEM recommends the following actions:

- Increase states' flexibility to allocate the federal funding it receives to take advantage of and optimize other funding sources.
- Combine supplemental and base funding to states provided through CWA Section 106 funds so that in lean times, the U.S. EPA may consider maintaining current monitoring efforts a valid use of supplemental funds.
- Acknowledge the continuum of progress demonstrated by social indicators or other factors in addition to measurable water quality improvements.

SURFACE WATER MONITORING AND ASSESSMENT

The IDEM conducts most of its surface water monitoring through various programs in the Watershed Assessment and Planning Branch (WAPB). This section includes a discussion of IDEM's surface water monitoring strategy, a description of the assessment methodology for classifying all surface waters according to the degree to which they meet their designated uses, and the most current assessment results available. This section also provides an analysis of surface water quality trends and information on public health issues.

IDEM'S SURFACE WATER MONITORING STRATEGY

The mission of the OWQ at the IDEM is to monitor, protect, and improve Indiana's water quality to ensure its continued use as a drinking water source, habitat for wildlife, recreational resource and economic asset. The OWQ has developed a water quality monitoring strategy (WQMS) to support this mission and to facilitate an adaptive management process that helps to ensure that its monitoring programs are providing the data required by OWQ's programs and to meet emerging concerns.

The U.S. EPA recommends ten elements that states should include in their water monitoring strategies in order to meet prerequisites of the federal Clean Water Act (CWA) Section 106 (U.S. EPA, 2003). The *Indiana Water Quality Monitoring Strategy*, *2017-2021* refines the previous *Indiana Water Quality Monitoring Strategy 2011-2019*, which marked a significant change in monitoring designs. An interdisciplinary work group comprised of staff members from several programs within the OWQ, including monitoring staff members responsible for collecting the water quality data needed to meet IDEM water management needs, developed the strategy to cover the following OWQ monitoring activities:

- Probabilistic monitoring in one basin per year on a nine-year rotating basin cycle (Figure 6, Appendix B).
- Fixed Station monitoring at 165 sites across the state (two added in 2014 to support the Natural Resource Conservation Service National Water Quality Incentive program).
- Fish tissue and sediment contaminants monitoring on a five-year rotating basin cycle.
- Targeted (watershed characterization) monitoring for total maximum daily load (TMDL) reassessments and development, watershed baseline planning, and performance measures determinations.
- Cyanobacteria monitoring of 16 beaches at 12 lakes, one dog park lake, and lakes used for training public safety dogs.
- Special studies, reference site monitoring, and remediation follow-up sampling.
- Thermal verification studies.
- Hoosier Riverwatch (HRW) program citizen volunteer monitoring.

OWQ contracts with the Indiana University School of Public and Environmental Affairs to administer the Indiana Clean Lakes Program (CLP). The Indiana CLP, which is discussed in more detail earlier in this report, provides most of the lakes data OWQ needs for its programs.

Through its surface water monitoring programs, OWQ collects surface water quality data, biological community and habitat data to help meet one or more of the following objectives, which are included in the WQMS (Table 8, Appendix A):

- To fulfill requirements of the CWA Sections 305(b), 303(d) and 314 to assess all waters of the state to determine if they are meeting their designated uses and to identify those waters that are not.
- To support OWQ programs including WQS development, NPDES permitting, and compliance.
- To support public health advisories and address emerging water quality issues.
- To support watershed planning and restoration activities.
- To determine water quality trends and to evaluate the performance of programs.
- To engage and support a volunteer monitoring network across the state.

IDEM ranks the monitoring activities related to U.S. EPA priorities or requirements and those related to the protection of human health as the agency's primary priorities and ranks all others as secondary priorities based on resource constraints and other factors including the degree to which they meet the OWQ mission.

DATA QUALITY ASSURANCE AND QUALITY CONTROL

To ensure the quality of the data used in the IDEM's Clean Water Act Section 305(b) assessments, all surface water monitoring is conducted in accordance with IDEM's quality assurance project plan (QAPP) for its surface water monitoring programs. This QAPP is part of IDEM's overall quality management plan approved by the U.S. EPA and complies with U.S. EPA guidance (U.S. EPA, 2002). IDEM revised its surface water monitoring QAPP most recently in March 2017.

The QAPP outlines specific data quality objectives and serves as a tool for planning for the collection of environmental data to support IDEM Office of Water Quality needs. Additionally, the QAPP describes a well-defined data quality assessment process for reviewing analytical data and categorizing analytical results in one of four levels of data quality. IDEM uses these data quality levels to determine the usability of the data for water quality assessments and other decisions.

DATA MANAGEMENT

Management of Water Quality Monitoring Data

The Watershed Assessment and Planning Branch (WAPB) in IDEM's OWQ maintains its surface water quality data in the Assessment Information Management System (AIMS) database. AIMS houses several types of data including surface water chemistry data, fish and macroinvertebrate community data, assessments of habitat quality, results from algal monitoring, and fish tissue and sediment contaminant data.

IDEM uploaded water chemistry and fish community results collected by OWQ's water quality monitoring programs prior to 2017 into the new U.S. EPA EnviroFacts Data Warehouse through the Water Quality Exchange (WQX). IDEM continues to make modifications to the AIMS database to improve quality control and usability of results uploaded through the WQX.

Recent modifications to the AIMS database now allow for more efficient datasheet upload and retrieval with additional search functions for faster query building through a user-friendly interface for staff members. AIMS also now allows for storage of additional water quality data from NPS projects (including estimated load reductions) and third-party datasets for potential use in assessing waters for the integrated report. IDEM also receives data from NPS Program projects for import into the AIMS database. IDEM is currently developing standard operating procedures for receiving, assessing, and importing water quality data from third-party sources to make them more readily available for potential use in IDEM's water quality assessments.

Table 4 of this report shows load reduction estimates provided by the NPS project sponsors, which are housed in AIMS and reported to U.S. EPA through its Grants Reporting and Tracking System. These load reductions are estimated using models and help to inform the evaluation of water quality sampling data collected by the project sponsors and IDEM WAPB staff members.

Management of Water Quality Assessment Information

IDEM maintains its water quality assessment information in U.S. EPA's Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS). CWA Section 305(b) assessment decisions made based on water monitoring data (physical, chemical and biological monitoring results) stored in the AIMS database.

In ATTAINS, water quality assessment information is associated with a specific waterbody assessment unit (AU), which is assigned a unique assessment unit identifier (AUID). IDEM uses a process called reach indexing to define the geographical extent and location of each AU within a given watershed based on its 12- or 14-digit HUC for mapping purposes. Reach indexing uses tools that work

within geographical information systems (GIS) software to associate one or more reaches of a given waterbody to a single AU and to "key" these AUs to the National Hydrography Dataset (NHD)[1]. IDEM calls this "key" its Reach Index. By associating the information in ATTAINS to its geographic location, the Reach Index allows IDEM to display assessment information on a map using GIS software.

IDEM's Reach Index for streams maps all Indiana streams visible on the NHD's high-resolution (1:24,000-scale) dataset, while the Reach Index for Indiana's lakes remains mapped at medium resolution (1:100,000-scale).

IDEM tracks all the Indiana lakes included in the Reach Index and Lake Michigan individually in ATTAINS with a unique AUID based on the 12-digit watershed in which they are located. IDEM has divided Indiana's Lake Michigan shoreline into five separate AUs with AUIDs based on the 8-digit HUC in which each shoreline reach is located.

When developing its Reach Index for streams, IDEM defined reaches of varying sizes. IDEM divided the Ohio River into 69 AUs ranging in size between 2-14 miles and with AUIDs associated with the 8-digit HUCs in which they are located. IDEM divided or combined other Indiana rivers and streams in the Reach Index into one or more AUs, assigning each an AUID based on the 12-digit HUC in which it is located. The length of a stream AU can vary, and a single AU may or may not represent the entire stream to which it is associated. For example, for its Reach Index, IDEM divided large rivers into smaller, separate AUs and grouped many smaller streams together into individual "catchment" AUs based on hydrology and other factors that can affect water quality.

In this report, IDEM provides assessment information for Indiana lakes in terms of lake acres. IDEM reports information for Lake Michigan in terms of acres and the information for its shoreline reaches in miles. IDEM reports assessment information for streams in terms of miles.

WATER QUALITY ASSESSMENTS

Indiana's water quality standards (WQS) provide the basis for the IDEM's CWA Section 305(b) water quality assessments and are set to protect the designated uses for Indiana waters. IDEM's water quality assessments determine the degree to which Indiana's waterbodies are supporting aquatic life use, recreational uses, and fish consumption uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply or which influence a ground water supply serving as a source water. There are additional uses for Indiana waters described in the state's WQS. However, IDEM limits its assessments to these four because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these uses, other uses such as agricultural and industrial uses are also protected.

[1] The NHD is a database created by the U.S. EPA and the United States Geological Survey that provides a comprehensive coverage of hydrographic data for the United States. It uniquely identifies and interconnects the stream segments that comprise the nation's surface water drainage system and contains information for other common surface waterbodies such as lakes, reservoirs, estuaries, and coastlines.

Water Quality Data Used to Make Designated Use Assessments

IDEM considers all existing and readily available data in its CWA Section 305(b) water quality assessment process, including data collected by IDEM's water quality monitoring programs as well as external sources whenever possible. Internally, IDEM draws from the following monitoring programs:

- Probabilistic Monitoring Program.
- Fixed Station Monitoring Program.
- Contaminants Monitoring Program.
- Performance Measures Monitoring Program.
- Special Studies Program.
- Watershed Characterization Program.

In addition to the water quality data IDEM collects, the agency reviews data from other sources for potential use in its CWA assessments, including data collected through partnerships with other state and federal agencies and by IDEM's Nonpoint Source Program grant projects, including the Indiana Clean Lakes Program.

IDEM is committed to making greater use of external data not only in its CWA Section 305(b) assessments but wherever possible in all its OWQ programs. IDEM's External Data Framework (EDF) provides a systematic, transparent, and voluntary means for external organizations to share the water quality data they collect with IDEM for possible use in its CWA assessment and listing processes and other OWQ programs.

Currently, IDEM is working to create a new tool to make developing a quality assurance project plan (QAPP) – a document that provides all the information IDEM needs to perform a thorough data quality review – easier for organizations interested in sharing their water quality data through the EDF.

IDEM's QAPP Tool will provide a series of forms online that participants can work through in one or more sessions and which, when completed will provide a fully developed QAPP to support their monitoring efforts and provide all the information needed to determine the quality of the data they collect. Here are a few of the features this new tool will include:

- An online library full of materials linked to relevant sections of the QAPP that participants can use to better understand the content required in that section.
- An automated messaging system that streamlines communications so that participants can ask questions that are automatically keyed to the specific section of the QAPP they're working on so IDEM can more quickly address them.
- A user-friendly interface with the ability to save the QAPP in progress and a one-click submittal of the QAPP for IDEM review.

By making it easier for EDF participants to develop the documentation needed to evaluate their data, IDEM expects the QAPP Tool to facilitate greater participation in the EDF potentially resulting in more water quality data available for CWA 305(b) assessments. When its development is complete, IDEM will make the QAPP Tool freely available on its website for organizations in Indiana and elsewhere for use in documenting their data quality. External organizations can learn more about the EDF and how to submit their data on the agency's EDF website at www.in.gov/idem/cleanwater/2485.htm.

Water Quality Assessments at Two Spatial Scales

Much of the data IDEM collects and receives from external sources are reach-specific, meaning the results can be applied only to the waterbodies from which the samples were collected and for which they are representative. However, IDEM's Probabilistic Monitoring Program provides data that can be used to make water quality assessments of rivers and streams at two spatial scales – reach-specific assessments and basin-wide assessments.

Reach-specific Use Support Assessments

IDEM uses the data collected by the Probabilistic Monitoring Program to make use support assessments of the stream or stream reach from which they were collected and any other reaches for which the results are representative. For these assessments, IDEM compares sampling results to applicable water quality criteria to determine whether the reach or reaches assessed are supporting their designated uses. The "Rivers and Streams Water Quality Assessment" section of this report summarizes the results from IDEM's reach-specific assessments for streams. In addition to data collected through the Probabilistic Monitoring Program, IDEM also uses data collected by the agency's other water monitoring programs to make reach-specific assessments and may use data from external sources if they meet the necessary data quality requirements.

Comprehensive Use Support Assessments

Comprehensive assessments are statistical calculations that allow IDEM to predict with reasonable certainty the percentage of Indiana's rivers and streams within a given area that are either impaired or supporting their designated uses. IDEM calculates its comprehensive use support assessments solely based on the reach-specific assessment results from data collected by the Probabilistic Monitoring Program because, unlike data collected through other IDEM monitoring programs and most external organizations, IDEM employs a probability-based sampling design for site selection, which is necessary to make statistically valid calculations.

IDEM's comprehensive use support assessments and its reach-specific assessments of designated use support provide water quality information in two very different ways, and IDEM uses both types of assessments to meet CWA requirements. The agency's comprehensive assessments provide statistically valid statements about the overall water quality throughout Indiana on a basin level, which allows IDEM to meet the CWA requirement to assess all the waters of the state.

IDEM reports its comprehensive assessment results in terms of the percentage of the total stream miles in each basin meeting their designated uses and the percentage that are impaired. IDEM derives these percentages using statistical methods and therefore cannot apply them to specific streams or stream reaches. Given this, comprehensive assessments do not identify where specific impairments exist as required by Section 303(d) of the CWA. IDEM's reach-specific assessments provide this information, identifying the specific location of impairments. IDEM uses data collected from a variety of sources including IDEM's Probabilistic Monitoring Program to make its reach-specific assessments.

This integrated report provides comprehensive assessments for watersheds in all of Indiana's major basins (Appendix H) and summary results from IDEM reach-specific assessments in keeping with CWA Section 305(b) (Appendix A). It also includes the 2020 finalized 303(d) List of Impaired Waters (Appendix L), which identifies waters impaired for one or more designated uses as required by CWA Section 303(d).

This report builds on the water quality assessment results reported in the 2018 Indiana Integrated Water Monitoring and Assessment Report and includes updated assessments for the Upper Illinois River Basin monitored in 2017 and the Great Lakes Basin monitored in 2018. This report also contains

assessment information based on targeted monitoring for total maximum daily loads (TMDLs) or watershed characterization studies, performance measures determinations, and special studies developed in other basins throughout Indiana.

Water Quality Assessment Methodology

IDEM conducts its CWA Section 305(b) water quality assessments in accordance with its Consolidated Assessment and Listing Methodology (CALM) (Appendix G). For each designated use and waterbody type, IDEM compares the available data with the applicable WQS following the methods articulated in the CALM. IDEM enters the results of its water quality assessments into U.S. ATTAINS and then uses the data to compile its 303(d) List of Impaired Waters (Appendix L) and Consolidated List (Appendix M).

Assessment Methods for the Ohio River

IDEM collaborates with the Ohio River Sanitation Commission (ORSANCO) to conduct water quality assessments of the Ohio River reaches that border Indiana. ORSANCO is an interstate water pollution control agency established for the Ohio River through a compact agreement between member states and approved by Congress. Under the terms of the compact, member states cooperate in the control of water pollution in the Ohio River Basin.

ORSANCO collects most of the data used to make water quality assessments and works with the states in the compact to determine the degree to which the Ohio River is meeting its designated uses. Based on the results of this collaborative assessment, ORSANCO produces a CWA Section 305(b) water quality assessment report for the Ohio River every two years. Member states then incorporate those results into their individual CWA 303(d) lists in accordance with their individual 303(d) listing methods. IDEM's CALM (Appendix G) provides a more detailed discussion of Ohio River assessments.

Although the assessment methodology for the Ohio River differs somewhat from the methods IDEM uses to assess other Indiana rivers and streams, IDEM combines the assessment results for all rivers and streams in Indiana, including the Ohio River for the purposes of this report.

Assessment Methods for Public Water Supply

In 2018, IDEM finalized methods for determining use support of waters serving as a source water for public water supply facilities. To date, IDEM has made few new assessments of use support on Indiana source waters, primarily due to the lack of data available for assessment. IDEM knew when developing the methods that there were very little existing and readily available data to implement them, but proceeded based on the expectation that previously unidentified data may become available through the EDF.

IDEM currently lacks the resources to support a new monitoring program dedicated to monitoring source waters for public water supplies. However, the agency continues to explore strategies for increasing the amount of available data for source water assessments and is working with its Drinking Water Branch to identify ways to potentially partner with drinking water facilities to facilitate the collection of data that may be used for the assessment of their source water.

IDEM believes that its new public water supply assessment methods, coupled with more readily available data for assessments, will result in greater protection of surface waters that serve as source waters for Indiana's public water supplies going forward.

REPORTING WATER QUALITY ASSESSMENT RESULTS

Indiana's Consolidated List

For the purposes of Clean Water Act (CWA) 305(b) reporting, the Indiana Department of Environmental Management (IDEM) employs a multi-category approach in which every waterbody is placed into one of five categories (or subcategories) for each of the following designated uses: aquatic life use, recreational use, fish consumption[2], and public water supply[3].

The state's Consolidated List (Appendix M) provides a full inventory of Indiana waters for the purposes of assessment including information regarding the degree to which they are supporting their designated uses.

IDEM assesses a waterbody as fully supporting a designated or other use when it finds it to be meeting the water quality standards (WQS) applicable to that use. When a waterbody is not meeting one or more of the applicable standards, IDEM considers it impaired, meaning it is not fully supporting the designated use. Figure 7 (Appendix B) illustrates the decision-making process IDEM uses to determine the appropriate category for each designated use. IDEM's Consolidated Assessment and Listing Methodology (CALM) (Appendix G) provides a more detailed explanation of the five categories and their subcategories summarized here:

Category 1	The available data and/or information indicate that the waterbody is supporting all of its designated uses and that no use is threatened.
Category 2	The available data and/or information indicate that the waterbody is supporting the individual designated use under consideration.
Category 3	The available data and/or other information are insufficient data to determine if the waterbody is supporting the individual designated use under consideration.
Category 4	The available data and/or information indicate that the waterbody is not supporting the individual designated use (that the use is impaired or threatened), but a total maximum daily load (TMDL) is not required.
Category 5	The available data and/or information indicate the waterbody is not supporting the individual designated use (that the use is impaired or threatened), and a TMDL is required.

The 303(d) List of Impaired Waters is a subset of the Consolidated List and includes only Category 5 waters – those for which a TMDL is required. The CWA Section 303(d) List of Impaired Waters is subject to approval by the United States Environmental Protection Agency (U.S. EPA).

On May 8, 2013, U.S. EPA partially approved Indiana's 2010 303(d) List of Impaired Waters. U.S. EPA based its partial approval on concerns regarding IDEM's methods for evaluating metals data for the purposes of determining impairment. On May 9, 2019, U.S. EPA notified IDEM that it had consolidated its review of Indiana's 2012, 2014, 2016, and 2018 303(d) lists. In its approval letter, U.S. EPA concluded that IDEM has met the requirements of Section 303(d) of the federal Clean Water Act and all applicable requirements in the Code of Federal Regulations for all waters submitted on its 303(d) lists to date. However, U.S. EPA has deferred action on certain waters with regard to metals' issues that U.S EPA and IDEM have yet to resolve. More detailed information regarding U.S. EPA's consolidated approval

[2] Fish consumption is not a designated use in Indiana's WQS. IDEM assesses Indiana waters for fish consumption pursuant to current U.S. EPA policy and in keeping with CWA goals, which are reflected in Indiana's WQS (327 IAC 2-1-1.5 and 2-1.5-3).
[3] Applicable only to waters that serve as a routine or emergency source of water for a public water system.

can be found online at https://www.in.gov/idem/nps/2647.htm.

While the issues delaying full approval by U.S. EPA remain unresolved, IDEM continues to conduct water quality assessments and remains committed to reporting the results of its assessments to the public in a timely manner.

To ensure that Indiana's 303(d) list contains the most up-to-date assessment information, each 303(d) list builds upon the list developed for the previous two-year reporting cycle. Therefore, the 2020 303(d) list included with this report reflects the cumulative results of IDEM's CWA assessments to date.

The draft 303(d) list for 2020 was prepared and published in the Indiana Register for a state-required 90-day public comment period beginning on January 29, 2020 and ending on April 29, 2020. No comments were received during this time. However, IDEM did receive comments from U.S. EPA regarding the draft 303(d) list and the CALM. The narrative portion of the public notice is provided in Appendix J. IDEM's responses to U.S. EPA's comments can be found in Appendix K. All the materials for Indiana's finalized 2020 303(d) list (included in Appendix L of this report) can be found on the Office of Water Quality Web site at: www.in.gov/idem/nps/2647.htm.

CLEAN WATER ACT SECTION 305(B) ASSESSMENTS

The following sections of this report provide summary assessment results indicating designated use support for waters throughout Indiana based on waterbody type. Each section provides a table in Appendix A summarizing the total number of stream miles and lake acres supporting and not supporting their individual designated uses. It should be noted that these values are not additive because a single waterbody has 3-4 designated uses and can have one or more impairments for a single use. For example, adding together the mileage values for two different impairments on the same stretch of stream would result in an inaccurate picture of impairment by doubling the size of the actual stream reach.

Appendix A provides summary results regarding the parameters causing or indicating impairments, and their potential sources for each type of waterbody. As with the values in the summary tables for designated use support, the summary values in each table are not additive. Summing them would artificially inflate the number of miles or acres actually impaired.

Causes of impairment identified in the summary tables are those pollutants or other stressors that contribute to the impairment of the designated uses of a waterbody. In some cases, IDEM was able to identify only the symptom(s) of impairment. For example, the IDEM may have evidence that one or more of the biological communities (fish or aquatic insects and other macroinvertebrates) in a waterbody are impaired, but often the data are insufficient to determine the actual pollutant or stressor causing the impairment. In these cases, the biological integrity of the waterbody is impaired[i], which is really a symptom of one/more unknown sources.

The sources shown in the summary tables in Appendix A represent activities that may be contributing the pollutant(s) or creating other stressors that result in impairment of a designated use. For most assessments, IDEM was unable to identify precisely the sources of a given impairment. This is because most of the water quality monitoring IDEM conducts and the assessment methods the agency uses to evaluate the results of that monitoring are designed to identify impairments not sources.

Accurately attributing a given impairment to specific sources is difficult at best without more detailed and resource intensive sampling and analyses and is often impossible to do with an acceptable degree of certainty. Based on its limited resources, IDEM typically reserves this more resource-intensive monitoring for TMDL development, which requires the identification of sources in order to develop recommended loadings to support its restoration. In contrast, the sources IDEM identifies during its initial designated use assessments represent those determined by IDEM staff members to be the most likely but not proven sources given a variety of factors, which include but are not limited to the following:

- Land uses (as indicated by field observations and land use data from published sources such as the U.S. Geological Survey Gap Analysis Program, aerial photography, etc.).
- Field observations of potential sources such as illegal straight pipes, tillage to the stream's edge, livestock in the stream, etc.
- The presence of permitted facilities within close proximity of the impaired waterbody in cases where the waterbody is impaired for something that one might reasonably expect to be associated with the discharge of those facilities.
- Naturally occurring conditions that could contribute to impairment.

IDEM believes that by using best professional judgment, scientists can distinguish the most likely sources of impairment in the watershed and provide a starting point for a TMDL, watershed planning or other activities aimed at restoring the waterbody.

Rivers and Streams Water Quality Assessment

IDEM assesses Indiana's rivers and streams for support of aquatic life use, recreational uses, and fish consumption. Where there is sufficient data, rivers and streams that serve as a source water for a public water supply, IDEM can also determine the degree to which they support that use.

Table 9 (Appendix A) shows the number of stream miles in Indiana that IDEM has assessed to date, and the number of miles fully supporting and impaired are shown for each individual use.

Table 10 (Appendix A) represents the total miles of streams affected by each cause/stressor in Indiana. These tables include identified causes of impairment and symptoms of other observed effects such as impaired biotic communities and low dissolved oxygen. For these and other observed effects, the substance(s) and/or stressors remain unknown. Table 11 (Appendix A) includes all the potential sources that may be contributing to one or more of the impairments in Table 10, and the total stream miles impaired due to each. The metadata for this report, which in included in Appendix C, provides IDEM's definitions for all potential sources are shown in Table 10 and include agricultural sources and those resulting from urban activities and land development. Illicit connections identify "straight pipes" from buildings in unsewered areas that flow into state waters with little or no treatment. Contaminated sediments are largely due to polychlorinated biphenyls (PCBs) that correlate with elevated PCB levels in fish tissue.

Great Lakes Shoreline Water Quality Assessment

IDEM has assessed Indiana's entire portion of the Lake Michigan shoreline as fully supporting of aquatic life use and fully supporting of its use as a public water supply for the 35 miles so designated. IDEM has found all 67 miles of the shoreline in Indiana to be impaired for recreational use and fish consumption. The U.S. EPA approved the required TMDLs IDEM developed for the impairments of recreational use along Lake Michigan's shoreline in 2004: www.in.gov/idem/nps/2856.htm. As a result, IDEM has placed the shoreline reaches impaired for *E. coli* in Category 4 of Indiana's Consolidated List while the fish consumption impairments for PCBs and mercury in fish tissue remain in Category 5 (Indiana's 303(d) list).

Table 12 (Appendix A) provides summarizes IDEM's assessment results for the Lake Michigan shoreline. Table 13 (Appendix A) identifies the specific causes of impairment and the potential sources that may be contributing to them are summarized in Table 14.

Lake Michigan Water Quality Assessment

To date, fish consumption is the only designated use for which IDEM has had sufficient data upon which to make water quality assessments for Lake Michigan. IDEM has treated Lake Michigan as a single assessment unit for the purposes of this assessment, which means that any impairment identified in any part of the lake applies to all 154,176 acres of Lake Michigan within Indiana's borders. Assessments of Indiana waters of Lake Michigan indicate impairment for mercury and PCBs in fish tissue. Tables 15-17 (Appendix A) reflect the results of these assessments.

Water Quality Assessments of Other Lakes

IDEM conducts two types of assessments on Indiana Lakes. CWA Section 314 requires States to report on the trophic status and trends of all publicly owned lakes in Indiana, and CWA Section 305(b) requires States to report on the degree to which Indiana's lakes and reservoirs are supporting their designated uses. IDEM's Consolidated Assessment and Listing Methodology (CALM) (Appendix G) describes both types of assessments and the methods IDEM uses to conduct them.

IDEM evaluates lakes primarily for recreational uses and fish consumption for the purposes of CWA Section 305(b) assessments. While IDEM monitors several lakes for fish consumption, other types of monitoring for determining designated use support assessments of Indiana lakes is limited. As a result, IDEM's assessments have relied primarily on external data collected through the Indiana Clean Lakes Program (CLP) for the purposes of CWA Section 314 assessments.

The monitoring conducted by the Indiana CLP provides results for all the parameters necessary to calculate Carlson's Trophic State Index (TSI) (Carlson, 1977) scores, which allows IDEM to make both CWA Section 314 trophic state assessments and some CWA Section 305(b) assessments for recreational use. However, IDEM does not consider the individual parameter results or the TSI scores sufficient for determining the condition of biological communities for the purposes of determining aquatic life use support.

Use support assessments of lakes for public water supply are also limited but for different reasons. Compared to other designated uses, which apply to all waters of the state, these assessments are made only for the relatively few lakes and reservoirs in Indiana that are used directly or indirectly as source water for public water supplies.

IDEM's CALM (Appendix G) provides a detailed description of the agency's assessment methods for CWA Section 305(b) assessments of lakes and reservoirs. Table 18-20 (Appendix A) provides summary assessment results for the 2020 cycle.

CWA SECTION 314 ASSESSMENTS

Section 314 of the federal Clean Water Act (CWA) requires States to report on the tropic status and trends of all publicly owned lakes in Indiana. To determine the trophic state for a given lake (the amount of biomass present at the time the measurement is taken), the IDEM uses Carlson's TSI, which can be calculated for three variables – Secchi depth, total phosphorus (TP), and Chlorophyll-*a* (CHL). Each of these variables provide independent indicators of the trophic state of the lake or reservoir in question. Together, they help understand the potential drivers of trophic condition. However, while any of the three can be used to determine trophic state, IDEM uses the TSI for CHL to make its trophic state assessments because CHL concentrations provide a more direct measure of phytoplankton abundance than Secchi depth or TP.

IDEM classifies lakes based on their trophic condition as indicated by TSI (CHL) scores. Higher scores are an indicator of nutrient enrichment, which can come from both natural sources and sources related to human activities. IDEM's CALM (Appendix G) provides more details on how the TSI (CHL) scores are calculated.

For the purposes of CWA Section 314, IDEM reports only on the lakes it has assessed, placing each into one of four classes based on its trophic state. Table 21 (Appendix A) provides the definition for the different trophic classes. Table 22 (Appendix A) provides a summary of the trophic status information for all lakes assessed to date. , and Table 23 summarizes trends in the trophic condition for Indiana lakes, which are determined based on changes in the trophic state over time. Approximately 19 percent of the lakes assessed to date (20 percent of the acres assessed) show some water quality improvement as measured by a reduction in their trophic scores. Forty-one percent of the lakes assessed (23 percent of the acres assessed) appear to have relatively stable trophic conditions. Thirty-six percent of the lakes assessed to date (53 percent of the acres assessed) show an increase in their trophic scores indicating that the trophic conditions are degrading.

The water quality trend appears to be fluctuating for four percent of the lakes (four percent of the acres assessed). For these lakes, the lack of detectable trend may be due to abnormal seasonal effects or changing activities in the surrounding watershed. In cases where the available data are insufficient to determine a trend, IDEM reports the trend as unknown. Appendix I provides all of IDEM's waterbody-specific results for trend and trophic status and trends for Indiana's lakes and reservoirs.

PUBLIC HEALTH/AQUATIC LIFE CONCERNS

Toxic substances, including some that are currently in use as well as "legacy" contaminants, can be found in surface waters throughout the United States. Some toxins occur naturally in the environment. Regardless of the source, the release of toxic materials into the aquatic environment can threaten public health by contaminating drinking water supplies, fish and shellfish, and recreational waters. Their impacts can include:

- Contaminants present in acutely toxic amounts may kill fish or other aquatic organisms directly.
- Substances present in lesser, chronically toxic amounts can reduce densities and growth rates of aquatic organisms and/or become concentrated in their body tissues.
- Human beings can inadvertently ingest toxins through the consumption of affected organisms, which can in turn, accumulate in our bodies potentially cause disease.
- Toxic materials in the water can potentially affect human health by contaminating public water supplies.

Fish Consumption

In the last several years, advances in analytical capabilities and techniques and the generation of more frequent and higher quality toxicity information on chemicals have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. Many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water column. IDEM collected much of the data on toxic substances used for fish consumption assessments in this report through its Fish Tissue Contamination and Sediment Contaminants Monitoring Programs in the OWQ.

A number of studies have shown that contaminants of emerging concern are increasingly detected at low levels in surface water around the country. As a result, there is growing concern about the potential negative impacts that these compounds might have on aquatic life. Scientists do not yet fully understand the risk that emerging contaminants pose to human health and the environment. Many of these contaminants come from personal care products and pharmaceuticals. The U.S. EPA has also identified per-and polyfluoroalkyl substances (PFAS) as a group of contaminants of emerging concern. Due to their resistance to degradation, PFAS persist in the environment making them detectable at low concentrations.

In 2017, IDEM began analyzing fish tissue samples for 13 different PFAS in order to characterize their concentrations across the state. To date, IDEM has analyzed 66 sites for PFAS. Similar to observations in other states, perfluorooctane sulfonate (PFOS) is the primary PFAS compound that accumulates in fish tissue. IDEM found PFOS in 100 percent of samples analyzed, which accounts for 91% of the total PFAS in fish. IDEM will continue to monitor for these chemicals each year until the agency has sufficient data to determine current background conditions throughout the state, can determine potential sources, and develop a better understanding of the risks they pose to human health and the environment.

In 2016, the U.S. EPA published the final national chronic aquatic life criterion for selenium in fresh water. The criterion reflects the most current scientific knowledge, which indicates that selenium's toxicity to aquatic life occurs primarily through an organism consuming selenium-contaminated food rather than by being exposed to selenium dissolved in water (U.S. EPA, 2016). The criterion has two components based on the concentration of selenium in fish tissue (eggs and ovaries, and whole-body or muscle) and two components based on the concentration of selenium in the water-column (two 30-day chronic values and an intermittent value). IDEM has been collecting selenium in fish tissues since 2007 and currently has a dataset consisting of more than 2,300 records. In comparing these results to U.S. EPA's 2016 water quality criterion for selenium, IDEM has found that, generally, levels of selenium in Indiana wild and sport fish are not of concern. However, IDEM did find higher levels in some isolated waterbodies.

IDEM actively participates in the development of the Indiana Fish Consumption Advisory (FCA) by conducting the monitoring necessary for its development and actively participating in the Indiana Interagency FCA Work Group, whose mission is to:

- Maintain the health benefit of fish consumption.
- Minimize the potential for consumer toxic chemical exposure.
- Use credible and understandable science.
- Present information in a manner conductive to maximal voluntary compliance.

With this mission in mind, the work group has spent several years updating rules that guide the development of consumption advisories. Using this new guidance and better technology, the work group's 2018 update to the FCA contained major improvements, which included making advisories accessible through an interactive map application. IDEM's Contaminants Monitoring Program continues to target the fish found in Indiana's major river systems, known contaminated areas, waterbodies on

public properties, major reservoirs and natural lakes, waterbodies requested by other agencies or program areas, and a set of "core" stations that have been sampled since 1979. The Indiana FCA, information on the benefits of eating fish, recipes, information on contaminants, taxonomy guides, and the Statewide Safe Eating Guide is available on the Indiana State Department of Health (ISDH) website at: www.in.gov/isdh/23650.htm.

It is important to note that citizens with concerns related to risks associated with eating the fish that they catch from Indiana waters should always refer to the FCA. Neither this report nor the 303(d) list of impaired waters it contains are designed to provide public health information. The FCA is developed specifically for that purpose and is far more reliable for use in deciding the amount of fish that might safely be consumed from a given waterbody.

Cyanobacteria and Algal Toxins

Blue-green algae (cyanobacteria) continue to be a concern in Indiana lakes and reservoirs both with respect to recreational uses and to public water supplies for drinking water. Blue-green algae are natural and common constituents of algal communities in lakes. However, during optimal conditions for growth, many "bloom" to produce visible surface scums, flocculent colonies, or algal mats. Cyanobacteria in these conditions can produce potent toxins, known as "cyanotoxins", which are recognized as a potentially serious threat to human and animal health due to their role as neurotoxins, hepatotoxins, and/or dermatoxins.

In 2010, IDEM piloted a targeted monitoring effort to support the development of an interagency process for the development of public health advisories for blue green algae and algal toxins. IDEM monitored 14 swimming areas throughout the state that are owned or managed by the Indiana Department of Natural Resources (IDNR) on a monthly basis from May through August. IDEM increased its sampling frequency every other week for lakes where cyanobacteria densities exceeded 100,000 cells per milliliter, as recommended by the World Health Organization. When the two-year grant period for the pilot project ended, IDEM incorporated a blue-green algae monitoring program into its overall water monitoring strategy.

IDEM now conducts this monitoring routinely at 16 state-owned sites throughout the recreational season (April 1 through October 31). IDEM also conducts weekly sampling at the Ft. Harrison Dog Park Lake. IDEM scientists identify and count the number of cyanobacterial cells in each sample using microscopy, and determine the concentrations of Microcystin, Cylindrospermopsin, Anatoxin-a, and Saxitoxin in the laboratory. IDEM provides these results to IDNR, which issues a High Cell Count Advisory when cyanobacterial cell counts are 100,000 cells/mL or greater. IDNR issues toxin-based recreational advisories and beach closures if toxin concentrations are above certain threshold values (Table 24, Appendix A). These thresholds were developed based on guidance from the World Health Organization, the U.S. EPA, and the Ohio Environmental Protection Agency. Beginning with the 2020 sampling season, IDEM will be adding an additional four beach sites (at four unique lakes) to the sampling roster for a total of 20 sites, allowing for greater coverage of IDNR-operated State Recreational Area and State Park Beaches across the State.

The www.algae.IN.gov website and the IDNR site help to keep the public informed of the status of the swimming areas sampled at each property. The IDNR also posts test results to its social media pages, increasing engagement and awareness of hazards and advisories. IDEM's website incorporates public health information related to blue-green algae from the ISDH and the Board of Animal Health as well as other relevant information from government agencies and educational institutions. In addition, signs are posted at each swimming area as well as at the Ft. Harrison Dog Park Lake, displaying the current risk at each individual property.

IDEM does not use information collected through these monitoring programs to make 305(b) assessments due to the lack of understanding within the scientific community at large about the environmental factors that influence the occurrence and production of algal toxins and there are no federal drinking water standards for blue-green algae. U.S. EPA's Office of Water has listed cyanobacteria and cyanotoxins on its drinking water contaminant candidate list (CCL) for the first time in 1998. Moreover, in 2009, U.S. EPA specifically included Anatoxin-a, Cylindrospermopsin, and Microcystin-LR, on CCL 3 and again on CCL 4 in 2016. The U.S. EPA began CCL5 development in October 2018, and IDEM expects that algal toxins will remain an issue of concern. U.S. EPA uses CCLs to prioritize federal research and data collection efforts to help determine whether a specific contaminant warrants regulation. More information on U.S. EPA's CCL is available online at www.epa.gov/ccl.

In 2015, U.S. EPA developed Health Advisories for Cylindrospermopsin and Microcystin and updated them in 2019. IDEM anticipates that as more scientific information becomes available, including the development of federal water quality criteria for algal toxins, it may be possible to develop water quality assessment methods that will allow IDEM to determine the impact that algal toxins may be having on the designated uses of Indiana waters.

Fish Kills and Chemical or Other Spills

IDEM considers a diverse and healthy fish community an indication of good water quality. Dead and dying fish can create serious public concern when they are found in large numbers in Indiana waters because fish kills are sometimes evidence of a severe water quality problem. Fish kills also have the potential to impair the use of the waterbody in the short or long term. A fish kill can result from:

- An accidental or intentional spill of a toxic compound or oxygen-depleting substance into the aquatic environment.
- A continuous industrial or municipal discharge due to a system upset which can result in releases of atypical or unusually high concentrations of pollutants.
- Natural causes such as disease, extreme draught or depletion of dissolved oxygen from extreme weather conditions.

IDEM's Office of Land Quality tracks spills and fish kills reported to IDEM or discovered by agency staff members. Table 25 (Appendix A) shows the total number of phone calls IDEM received regarding possible environmental emergencies, chemical spills, and fish kills between 1998 and 2019.

GROUND WATER ASSESSMENT

In order to be eligible for Clean Water Act (CWA) Section 106 grant funds, Indiana is required to have the means to monitor water quality (and to annually update water quality data and include the results in their biennial IR to U.S. Environmental Protection Agency (EPA). While U.S. EPA's integrated reporting requirement pertains primarily to surface waters, U.S. EPA guidance suggests that state updates should also include ground water to the extent practicable. This section provides a summary of Indiana's ground water monitoring and protection programs, ground water/surface water interactions within Indiana, ground water quality, and ground water contamination sources.

Ground water is an important resource for Indiana citizens, agriculture, and industry. Much of Indiana's population relies on ground water for drinking water and other household uses. The Indiana Department of Environmental Management's (IDEM's) 2018 Annual Compliance Report for Indiana public water supply systems is online at:
https://www.in.gov/idem/cleanwater/files/dw_compliance_report_2018.pdf.

MAJOR SOURCES OF GROUND WATER CONTAMINATION

Table 26 (Appendix A) identifies the major contaminant sources affecting Indiana ground water which are listed by general activity types. All sources listed are a potential threat to ground water. The degree to which the source is a threat to ground water depends on several factors with the most significant being hydrogeologic sensitivity. Other major risk factors include location of the contaminant source relative to drinking water sources, the toxicity of the contaminant, and the size of the population at risk. All risk factors listed in Table 26 were considered in the selection of ten priority contaminant sources, and those risk factors relevant to the highest priorities are identified. Classes of contaminants commonly associated with each high priority contaminant source are also given. Due to resource constraints, IDEM has been unable to update this information since the 2000 305(b) report. However, anecdotal evidence indicates the same major contaminant sources are affecting Indiana ground water now as they were at that time.

Sources of Nitrate

Nitrate is a potential contaminant that can be introduced into the environment from a variety of sources, including commercial fertilizer and animal manure applications to farmland, and septic systems – all of which are considered high priority sources of potential contamination to Indiana ground water. Nitrate is a highly mobile and soluble contaminant and is most frequently detected in ground water in rural areas. However, determining the source of nitrates detected in ground water can be difficult and costly.

Fertilizers

When applied at the proper rate and time, commercial fertilizer poses little threat of contamination to ground water. Purdue University Cooperative Extension Service staff members, Natural Resource Conservation Service staff members, and private consultants assist crop producers in developing nutrient management plans that focus on meeting the nutrient needs of their crops using only the amount of fertilizer necessary.

On July 28, 2010, the state rule requiring certification for distributors and users of fertilizer materials (355 IAC 7-1-1) became effective, and the Office of the Indiana State Chemist (OISC) is responsible for its administration. A variety of agricultural groups and other stakeholders supported the rule, viewing the rulemaking as an opportunity for fertilizer material applicators and distributors to demonstrate their competency to handle and apply these materials safely and effectively. The rule indeed achieves this and in addition, provides a statewide standard for applicator certification and training.

The rule defines “fertilizer material” to mean both commercial fertilizer and manure from a confined feeding operation (CFO). Any person hired to apply, handle, or transport fertilizer material for purposes of producing an agricultural crop must be certified and licensed by OISC. Alternatively, he or she must be trained and supervised by a certified applicator, and be working for a licensed fertilizer business. Any person applying manure from a CFO (in excess of 10 cubic yards or 4,000 gallons per year) to his/her own property must be certified by OISC as a private fertilizer applicator. Any person, partnership, corporation, or business that distributes but does not use fertilizer material must obtain a fertilizer distributor business license.

Confined Feeding Operations

Livestock and poultry confined feeding operations (CFOs) exist throughout Indiana and are an integral component of Indiana’s agricultural economy. The primary concerns associated with CFOs are

the proper storage and land application of the large volumes of manure produced by these operations. Manure applied to farmland helps to recycle the nutrients in the soil to fertilize crops. However, manure contains ammonia-nitrogen, which is converted to nitrate through biological processes in the soil. Consequently, the rate of manure application to farmland is a major concern when the amount applied to the land provides more nitrogen than crops can use. Because excess nitrogen can move beyond the crop root zone and potentially into underlying aquifers, Indiana's current regulations for CFOs require the proper design and construction of manure storage structures and the application of manure to land in a manner that protects ground and surface water quality. Crop nutrients contained in manure are available at a slower rate than commercial fertilizer nutrients due to the rate of decomposition of the manure. Therefore, when applied at the proper agronomic rate, manure poses little threat of contamination to ground water.

Septic Systems

Properly constructed and maintained septic systems provide satisfactory on-site treatment of domestic wastewater in rural and unsewered suburban areas of Indiana. However, improperly constructed or poorly maintained septic systems, as well as systems operating in areas of high seasonal water tables or other ground water sensitive areas, are also of concern as a source of nitrate contamination to ground water.

Landfills and Underground Storage Tanks

Landfills and underground storage tanks are a high priority concern for ground water due to practices or activities that occurred prior to construction standards and legislation established for its protection. Landfills constructed after 1988 have been required to adhere to stringent construction standards. Since then, IDEM's Underground Storage Tank (UST) in its Office of Land Quality closely reviews all underground storage tank registrations, upgrades, closures, and site assessments.

IDEM has ensured that all regulated UST owners and operators properly registered, upgraded and/or closed existing UST systems in accordance with state requirements. Currently, IDEM inspects all USTs systems at least once every three years to ensure that systems are properly designed and operated for corrosion protection, spill and overfill protection, and leak detection in order to prevent releases or ensure early detection of any releases. IDEM also inspects UST systems that are no longer in use to ensure they are properly closed. In addition, IDEM ensures that all confirmed releases of petroleum and hazardous substances into the environment, including ground water, are cleaned up as necessary to protect human health.

Underground Injection Wells

Class V underground injection wells are widespread throughout the state and occur in high concentration in several areas, including some areas where ground water is highly sensitive to contamination. Most Class V wells are shallow wells used by businesses and individuals to dispose of a wide variety of non-hazardous fluids into the ground. The United States Environmental Protection Agency (U.S. EPA) regulates Class V wells because they can release a wide variety of waste fluids into the ground. Under current regulation, Class V wells may be used to dispose of non-hazardous fluids only. However, this was not always the case.

Prior to 2000, when the U.S. EPA passed more intensive rules and enforcement mechanisms for Class V wells, they were sometimes used to dispose of potentially hazardous fluids. These older wells create the potential for ground water contamination if the fluids they contain are hazardous and leach into or above aquifer supplying drinking water. The U.S. EPA regulates these wells directly through its Class V Underground Injection Control Program, which targets the wells that pose the greatest environmental

risk.

Industrial Activities

IDEM has documented several cases of ground water contamination due to industrial facilities or their ancillary operations in Indiana. Although many contamination events occurred prior to the development of regulations for the storage and handling of industrial materials, ground water contamination still occurs due to accidents and intentional dumping of waste. In 1998, Indiana's Secondary Containment of Above-Ground Storage Tanks Containing Hazardous Materials Rule (327 Indiana Administrative Code (IAC) 2-10) was adopted. This rule requires that new facilities provide secondary containment for storage of 660 gallons or more of hazardous wastes if the facility is located outside an approved delineated wellhead protection area. However, if the facility is located within a wellhead protection area, secondary containment is required for any tank storing 275 gallons or more of hazardous materials.

The secondary containment rule along with IDEM's outreach and education programs have helped to prevent further ground water contamination from the storage and handling of industrial materials. However, these activities continue to be a potential source of contamination to ground water in Indiana.

Road Salts

The storage and extensive use of salt as a deicing agent during the winter months has an impact on ground water, and IDEM has documented contamination from road salt in Indiana. The Indiana Department of Transportation (INDOT) is now building any new salt storage facilities only in areas where ground water is not sensitive to contamination and making efforts to upgrade existing facilities to protect ground water. Currently all INDOT salt storage facilities are covered by domes or canopies, and several new facilities have been built to contain all surface runoff on-site to reduce ground water contamination. In addition, INDOT and many local municipalities have been successful at reducing their road salt use and application rates over the past several years through computerized weather forecasting and roadway temperature sensors.

Spills

Ground water contamination resulting from spills can be avoided or minimized if they are reported promptly to IDEM's Spill Line, which helps to ensure that they are handled and cleaned up quickly and properly. Indiana havsa rule in place to help ensure that spills with the potential to contaminate ground water are reported in a timely manner and managed in a way that minimizes their impact (327 IAC 2-6.1).

GROUND WATER PROTECTION PROGRAMS

Programs that conduct monitoring to evaluate and protect ground water resources in Indiana occur at all levels of government. Several ground water protection programs and activities have been implemented or are in the process of being implemented at the state level. Table 27 (Appendix A) lists key ground water protection programs and activities in Indiana, developmental stage of the program or activity, and the agency or agencies responsible for the program's implementation and/or enforcement.

Classification of Indiana's Ground water Resources

Indiana's ground water quality standards became effective in March 2002. The language of the rule includes numeric standards that provide ground water protection to wells and allows for the classification of ground water. The rule states that all ground water of the state shall be classified as drinking water class ground water unless it is classified as limited class ground water or impaired drinking water class ground water. IDEM may classify ground water as limited when ground water is shown to have a yield of less than 200 gallons per day or a total dissolved solids concentration of more than 10,000 parts per million (ppm). Additionally, ground water that is in the crop root zone, in a coal mined area, or in an injection zone of a permitted Class I, II or III injection well or gas storage well may be considered limited. IDEM may classify ground water as impaired when specific conditions are met. These conditions include, but are not limited to:

- The ground water is not in a state approved wellhead protection area established pursuant to 327 Indiana Administrative Code (IAC) 8-4.1.
- The ground water has one or more contaminant concentrations above the numeric criteria established in the rule.
- The commissioner has approved a ground water remediation, closure, cleanup or corrective action plan that describes the nature and extent of contaminants exceeding the criteria.

Source Water Assessment Program

In 2000, U.S. EPA approved Indiana's Source Water Assessment Program, which was developed by IDEM in consultation with Indiana stakeholders. IDEM has prepared source water protection plans (SWAPs) for all public water systems that use surface water as their primary source of water. Additionally, systems that utilize ground water are required by the Indiana Wellhead Protection Rule (327 IAC 8.4.1) to prepare a wellhead protection plan for each well or well field that provides water to the public. Since 2000, source water areas for more than 3,600 public water systems have been delineated. The potential sources of contamination of these source water areas have been inventoried and IDEM has assessed water system susceptibility to contamination. By the end of 2008, IDEM had distributed susceptibility determinations for Indiana's public water systems to their owners. As a result, , IDEM's Source Water Assessment Program is completely implemented and satisfies the requirements of the Source Water Assessment Program as defined by IDEM and accepted by U.S. EPA.

The Indiana Wellhead Protection Rule (327 IAC 8-4.1) became effective in March 1997, which is implemented by IDEM's Wellhead Protection Program (part of IDEM's Source Water Assessment Program) to protect public water supplies from contamination. The Wellhead Protection Rule outlines the minimum requirements community public water supplies must meet to comply with the Indiana Wellhead Protection Rule. As of March 2020, close to 96 percent of Indiana's community water systems using ground water as their source of drinking water have an approved phase 1 wellhead protection plan with ongoing update efforts as required by the rule. Having an approved wellhead protection plan indicates that a community has met the requirements of the Indiana Wellhead Protection Rule and has developed strategies to protect their community water supplies from becoming contaminated.

Other Programs Working to Protect Indiana's Ground water Resources

In addition to regulatory programs and other structured ground water protection activities listed in Table 27 (Appendix A), there are several educational programs conducted in Indiana that place an emphasis on ground water protection. The Purdue University Extension Service's Safe Water for the Future Program serves as an umbrella program for several other programs that provide resources on drinking water protection for individuals and communities. The Farm*A*Syst and Home*A*Syst Programs are essentially wellhead protection programs for rural and domestic private wells. A series of

publications and brochures on wellhead protection are also available to assist communities working on wellhead protection. "Watershed Connections" brings together local contacts to produce a community specific publication on water resources and their protection.

The IDNR's Project WET (Water Education for Teachers) and Purdue University Extension Service's "Water Riches" Program are two general water education programs that provide information about ground water protection.

GROUND WATER MONITORING FOR PUBLIC WATER SUPPLIES

The Compliance Section of the Drinking Water Branch at IDEM receives ground water compliance monitoring results reported by public water systems for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), nitrates (NO_3), and radionuclides.

Radionuclide monitoring consists of analysis for gross alpha particle activity. Public water supply systems collect samples from various points within their system including after water is treated and before it enters the distribution system. Samples may be collected from a single well or blended from two or more wells. Other parameters monitored by public water systems depend on the type of system. There are three types of public water systems: community, non-transient non-community, and transient non-community. The three types of public water systems are defined below:

- A community system is defined as a system that serves water to the public and has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. Examples of community water systems are municipal systems, mobile home parks, nursing homes and homeowners associations. Along with regular bacteria sampling, community systems are required to test for thirty regulated SOCs, 21 VOCs, 12 regulated IOCs, sodium, and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminates detected. As of February 2020, there are 778 community systems in Indiana.
- A non-transient non-community water system is defined as a public water system that is not a community water system that regularly serves the same 25 or more persons at least six months per year. Examples of non-transient non-community water systems could include restaurants, factories, daycares and schools. Along with regular bacteria sampling, non-community non-transient systems are required to test for 30 regulated SOCs, 21 VOCs, 11 regulated IOCs (except sodium and fluoride), and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on levels of contaminates detected. As of February 2020, there are 580 non-transient non-community systems in Indiana.
- A transient non-community is defined as a non-community water system that serves an average of 25 individuals at least 60 days per year. Examples of transient non-community water systems include restaurants, rest stops and gas stations. Along with regular bacteria sampling, transient non-community systems are required to test for radionuclides. As of February 2020, there are 2,677 transient non-community systems in Indiana.

Compliance monitoring results reported by public water systems are considered "treated water" and may not represent "source" or "raw water" results. The public can view the information public water systems report to IDEM through the Safe Drinking Water Information System at www.myweb.in.gov/IDEM/DWW/.

Statewide Ground water Monitoring Network

The Ground Water Section of the Drinking Water Branch manages a statewide ground water monitoring network (GWMN). The GWMN seeks to establish a statistical model of ambient ground water quality across the state to determine how to best protect source water and drinking water supplies and

evaluate ground water/surface water interactions. The GWMN employs the following strategy to meet these goals:

1. Collect ground water samples from public water supply (PWS) wells and private residential wells within distinct hydrogeologic areas of the state with the overall goal to determine the quality of ground water in the state's aquifers.
2. Identify and expand sampling in areas with notable contamination.
3. Practice continual improvement adjusting the GWMN as necessary to fit resource needs (monetary/field support) and gaps in the data.

IDEM has conducted sampling for the GWMN every year since 2006 when the network was established. Although IDEM has revisited many of the sampling sites over multiple sampling rounds, the number of sites sampled each year varies based on site suitability, participant interest, availability of resources, and previous sampling results.

Beginning in 2013, IDEM adjusted the design of the GWMN to provide more statistical power to the dataset by randomly selecting sites proportionally distributed across the state based on hydrogeologic settings. The Indiana Geological and Water Survey (IGWS) has divided the state into hydrogeologic settings to "provide a conceptual model to help interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to … the surface and subsurface environment" (Fleming, 1995). The IGWS has identified more than 240 individual hydrogeologic settings across the state. For the purposes of developing the GWMN, IDEM scientists grouped these into 20 generalized settings that are common throughout Indiana.

Based on the 20 generalized hydrogeologic settings, IDEM determined that it needs approximately 398 samples to accurately represent ambient ground water quality across the state for each sampling round in the GWMN. These sampling sites were proportionally distributed throughout the 20 generalized hydrogeologic settings using a weighting procedure (known as stratified sampling) based on the percentage of located wells in that setting. The weighted number of samples in the generalized settings ranged from one to 154 samples. IDEM conducted three rounds of sampling (using unique sites in each sampling round) from May 2013 to November 2016. Figure 8 (Appendix B) shows the locations of the wells sampled during these rounds.

As a part of its implementation of the GWMN, IDEM Ground Water Section staff :

- Randomly selected sampling sites in each general hydrogeologic setting from a pool of residential well owners that volunteered to participate in the GWMN.
- Collected ground water samples from drinking water wells for analysis at IDEM's contract laboratories.
- Reviewed analytical sampling results.
- Distributed sampling results to GWMN participants.
- Developed a program report.

IDEM's Ground Water Section collected most samples from May to September. IDEM generally collects samples from outdoor spigots with untreated water or, in the case of public water supplies, from source water sample taps. IDEM analyzes these samples for more than 200 parameters, including alkalinity, anions/cations, metals, nitrogen as nitrate-nitrite (N+N), synthetic organic compounds, volatile organic compounds, and pesticide degradates.

Table 28 (Appendix A) shows summary statistics for the analytical parameters that were detected in the ground water samples collected during the three sampling rounds. Disinfection byproducts and plasticizers were not included in this analysis. If a particular analyte was not detected in the sample, IDEM did not include it in the table. Maximum Contaminant Levels (MCLs) Secondary Maximum Contaminant Levels (SMCLs), or Recommended Levels are provided where applicable.

For all samples collected during this study, analytes that had the most occurrences above a MCL included arsenic and nitrogen as nitrate-nitrite (hereafter referred to as simply "nitrogen"). Parameters for which there were occurrences above the SMCL or U.S. Environmental Protection Agency (U.S. EPA) Recommended Levels included iron, manganese, sodium, sulfate, and strontium. IDEM detected VOC contamination in several samples, including petroleum contamination (found in seven wells) and chlorinated solvents (found in three wells). Table 29 (Appendix A) shows the VOC contamination detected in the GWMN samples.

Summary Results for Nitrogen as Nitrate-Nitrite

During GWMN sampling, 330 samples (about 28 percent) contained detectable levels of Nitrogen. Nineteen of those samples exceeded the MCL of 10 milligrams per liter, and the highest reported concentration was 22 milligrams per liter (mg/L). The locations of the sites sampled for nitrogen are shown on an aquifer sensitivity map developed by Letsinger (2015) (Figure 9, Appendix B). In highly sensitive areas, surficial infiltration can rapidly recharge ground water, allowing potential contaminants (including nitrates and pesticides) found at the ground surface or shallow subsurface to be transported into the aquifer. Summary statistics were calculated for the nitrogen data for Indiana's generalized hydrogeologic settings (Table 30, Appendix A).

Average nitrogen concentrations for each hydrogeologic setting were also calculated for well type and depth, aquifer conditions, and aquifer sensitivity (Table 31, Appendix A). Higher nitrogen concentrations were generally found in shallow wells screened in unconsolidated material. Aquifers with "High" or "Very High" sensitivities also contained the highest average nitrogen concentrations. Oxidizing aquifers had significantly greater nitrogen levels and higher average concentrations than reducing aquifers. Previous studies (Freeze & Cherry, 1979) have shown that ground water redox conditions can influence the distribution and mobility of nitrogen within aquifers.

Summary Results for Arsenic

Arsenic is a naturally occurring element found primarily in rocks, soil, water, and plants in many areas of the United States, including Indiana. Natural events, such as infiltration of water, dissolution of minerals from clay, and erosion of rocks can release arsenic into water. Arsenic can also be released into the environment as a byproduct of industrial activities, such as wood preservation, mining, and smelting (IDEM, 2015).

In the most recent round of sampling, 517 samples (around 44 percent) contained detectable levels of arsenic. One hundred twenty seven of those samples (11 percent) contained arsenic concentrations above the MCL (10 micrograms per liter (ug/L)). The highest reported concentration was 130 ug/L. Figure 10 (Appendix B) shows the location of the arsenic samples by hydrogeologic setting. Table 32 (Appendix A) shows summary statistics for arsenic samples by hydrogeologic setting, and Table 33 (Appendix A) provides a comparison between settings.

Around 48 percent of samples from unconsolidated wells contained detectable levels of arsenic, compared to 36 percent of samples from bedrock wells. Approximately 13 percent of unconsolidated wells contained arsenic above the MCL, compared to 7 percent of bedrock samples. Unconsolidated wells had a higher average Arsenic concentration (4.77 µg/L) than bedrock wells (3.2 µg/L). Wells screened in the 50- to 100-foot and the 100- to 150-foot depths had the highest average concentrations of Arsenic and the highest percentage of samples exceeding the MCL.

Reducing aquifers (as determined by negative values for oxidation-reduction potential) had higher average Arsenic concentration (5.31 µg/L) than oxidizing aquifers (1.60 µg/L). Of the 127 samples, 123 exceeded the MCL for Arsenic were from reducing aquifers. Previous studies of glacial aquifers in the northern US (including Indiana) have shown that Arsenic concentrations are higher in aquifers under reducing conditions (Thomas, 2007).

Summary Results for Pesticides and Pesticide Degradates

IDEM found several pesticides in their parent form in samples collected for the GWMN. Pesticides detected include Alachlor (one sample at 0.3 ug/L), Atrazine (four samples, 0.1 ug/L max), Endrin (one sample at 0.02 ug/L), Lindane (two samples, 0.03 ug/L max), and Simazine (two samples, 0.15 ug/L max). None of these detections exceeded or approached the MCL for that compound.

IDEM also analyzed GWMN samples for breakdown products for several common agricultural herbicides. Many of the herbicides used in Indiana to control broadleaf and grassy weeds in corn and soybeans can produce one/more of the following substances as they break down in the environment into Ethanesulfonic Acids (ESA) or Oxanilic Acids (OA):

- Acetochlor ESA.
- Acetochlor OA.
- Alachlor ESA.
- Alachlor OA.
- Metolachlor ESA.
- Metolachlor OA.

These breakdown products – ESAs and OAs – are generally more water soluble and mobile than the parent herbicide. As a result, there is greater potential for these degradates to be found in ground water or surface water (Shoemaker, 2003). To date, there are no established MCLs or health recommendation for these pesticide degradates.

Detectable levels of these degradates were found in 205 of the GWMN samples (17.6 percent), with a highest reported concentration of 7.8 µg/L of Metolachlor ESA. Figures 11, 12, and 13 (Appendix B) show the GWMN pesticide degradate results for Acetochlor ESA and OA, Alachlor ESA and OA, and Metolachlor ESA OA, respectively. Of the 205 samples that contained detectable levels of pesticide degradates, 91 (43 percent) contained more than one type of degradate compound, and 98 of the samples (48 percent) were located in areas of high or very high hydrogeologic sensitivity. Only 36 of the samples (17.5 percent) were in low or very low sensitivity areas.

Additional Arsenic Studies

IDEM conducted additional investigation into the high levels of arsenic observed during the first three rounds of GWMN sampling in 2018. IDEM collected ground water samples from 215 of the sampling sites that previously contained an arsenic concentration of 5.0 ug/L or above so that the geochemical species of the arsenic could be determined. Trivalent arsenic (As III) is typically more mobile in ground water, more toxic, and harder to remove through conventional treatment than pentavalent arsenic (As V). The study showed that on average, around 80% of the dissolved arsenic in

Indiana ground water is in the form of As III. The study also showed that fluctuations in arsenic levels over time were common, with 56% of the samples showing higher levels of arsenic than in the previous sampling event.

In 2019, IDEM conducted a pilot study to evaluate the spatial variability of arsenic levels observed during the statewide sampling for the GWMN. For this study, IDEM collected samples from a neighborhood in Nappanee, Indiana (Elkhart County) with known arsenic contamination in ground water. The residents in this area rely on private water wells as their drinking water source, and most of the wells in the area had a water well log available in the Indiana Department of Natural Resources database. Samples collected from this area contained arsenic at concentrations ranging from 13 ug/L to 140 ug/L. This shows that arsenic levels are highly variable, even within a 30-acre area. IDEM plans to conduct some additional studies in 2020 to determine, if possible, the geological and geochemical conditions responsible for this variability.

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