Indiana's State Nutrient Reduction Strategy

A framework to reduce nutrients entering Indiana's waters

Version 6 – February 2021

Prepared by:

Indiana State Department of Agriculture

Indiana Department of Environmental Management

With contributions from the Indiana Conservation Partnership:
Indiana State Soil Conservation Board (SSCB)
USDA Natural Resources Conservation Service (NRCS)
USDA Farm Service Agency (FSA)
Indiana Association of Soil and Water Conservation Districts (IASWCD)
Indiana Department of Natural Resources (IDNR)
Purdue Cooperative Extension

And also by members of the:
Indiana State Nutrient Reduction Strategy Workgroup
Indiana Agriculture Nutrient Alliance

This state nutrient reduction strategy is a dynamic document and will be reflected upon/reviewed as necessary.
An update of this document will be provided every five years.
To provide comments and feedback of this strategy document, please use ISDANutrientReduction@isda.in.gov.

Executive Summary

Eutrophication, or nutrient enrichment of waters, is a concern in many areas of the United States as well as around the world. Nutrients are an essential part of the water system for plant and animal life, however when there is an excess of nutrients, it can cause water quality impairments such as hazardous algal blooms and oxygen depleted water. Excess nutrients such as nitrogen and phosphorus come from many sources including waste water treatment plants (WWTPs), failed septic systems, land-disturbing activities, and stormwater runoff from residential areas and agricultural lands. When these excess nutrients enter our waterbodies, they stimulate excessive plant growth or algal blooms. When the plants and algae die, sink, and decompose, oxygen levels are depleted in the water, which is a condition referred to as hypoxia. These hypoxic areas cannot support aquatic life and are often called "dead zones."

The Gulf of Mexico has been for many years experiencing a large hypoxia zone, so the Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF) in 2008 created a priority action plan that calls for each of the major states that drain to the Mississippi River basin to develop a state nutrient reduction strategy to address the issue of excess nitrogen and phosphorus entering their rivers, lakes, streams, aquifers, wetlands, and drinking water supplies. In 2011, the U.S. Environmental Protection Agency (USEPA) released a memo outlining eight (8) *Recommended Elements of a State Framework for Managing Nitrogen and Phosphorus Pollution*, which gave guidance to the 12 states that are a part of the Gulf of Mexico HTF. Indiana is one of those 12 states.

The HTF goal is to reduce the areal extent of the Gulf of Mexico hypoxic zone to less than 5,000 square kilometers by the year 2035, with an agreed upon interim target of a 20% nitrogen and phosphorus load reduction by the year 2025.

The Indiana State Nutrient Reduction Strategy represents the state's commitment to reduce nutrient runoff into Indiana's waters from point sources and nonpoint sources alike. The overall guiding principles of this strategy are:

- **Encourage voluntary, incentive-based, practical, and cost-effective actions**
- **Use and strengthen existing regulatory and non-regulatory programs**
- **Identify existing and additional funds needed and funding sources**
- **Identify research needs**
- **Identify opportunities for innovative, market-based solutions**
- **Follow adaptive management**

More specifically, the main objectives of this strategy include:

- Acknowledgment of the challenges facing the improvement of Indiana's impaired waters;
- Involvement and engaging of stakeholders and partners in the state's efforts to reduce nutrient loads;
- Prioritization of HUC 8 watersheds within Indiana, and further prioritization of smaller HUC 12 watersheds within Indiana's ten major river and lake basins;
- Discussion of the importance of water quality monitoring and regulatory control of point sources;
- The inventory and utilization of resources and practices to achieve their highest impact on nutrient reduction;
- Encouragement of voluntary incentive-based conservation through the many local, state and federal water quality related programs;
- Measuring the impacts of urban and rural conservation best management practices and tracking nutrient load reductions; and
- Serving as a strategic document for addressing milestones and action items, and seeking continued funding sources for current and future efforts concerning water quality in Indiana.

The Indiana State Nutrient Reduction Strategy underscores the importance of continual outreach and education to conservation partnerships and the public regarding stewardship of Indiana's waters. This strategy acknowledges that the great potential to reduce nitrogen and phosphorus entering our waters depends on the cooperation of state, federal and local organizations', ag and urban programs and initiatives, as well as private sector and citizen endeavors. To make a positive difference, it is important to understand the "why" or motivations that drive the choices made by organizations and individuals that ultimately affect water quality. How do knowledge gaps, policy or program directives, incentives or disincentives affect the consideration of water quality impacts when choosing one action over another? This strategy identifies measures such as the proper location and types of conservation practices on productive agricultural ground and at the edge-of-field, efficient nutrient management, septic system maintenance, appropriate residential fertilizer applications, erosion control at construction sites, and urban best management practices (BMPs) such as green infrastructure as being keys to controlling nutrient runoff. It recognizes a continued need for conservation efforts, education, outreach and research in order to see progress.

The State of Indiana recognizes the importance of early involvement of stakeholders and partners in the planning and development of the State Nutrient Reduction Strategy. It provides transparency of the process, allows time for trust to develop, permits incorporating local knowledge, and makes it possible to deal most effectively with misperceptions and manage expectations. All of this helps gain buy-in and cooperation from stakeholders and partners and increases the likelihood of moving toward effective and sustainable solutions. Many agencies and stakeholders were consulted with in the planning and development of the Indiana State Nutrient Reduction Strategy.

Although the Indiana strategy was originally developed as a result of the HTF 2008 Action Plan for the Gulf of Mexico, this strategy encompasses all waters of the state of Indiana that drain to the Mississippi River and the Gulf of Mexico as well as to Lake Michigan and Lake Erie.

Indiana will continue to evaluate the efficacy of the nutrient reduction policies, programs, and practices outlined in this Strategy. Based on that evaluation and new information/data arising from research and monitoring data, Indiana will modify this Strategy as necessary.

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Foreword

The Indiana State Nutrient Reduction Strategy (SNRS) is the product of an inclusive effort of the Indiana Conservation Partnership (ICP) and the SNRS Workgroup[1] under the leadership of the Indiana State Department of Agriculture (ISDA) and the Indiana Department of Environmental Management (IDEM) to capture statewide, present and future endeavors in Indiana which positively impact the State's waters as well as gauge the progress of conservation, water quality improvement and soil health practice adoption in Indiana. Using the principle of adaptive management, this State Nutrient Reduction Strategy is a dynamic document acknowledging that nitrogen and phosphorus in particular, and nutrient pollution in general, is a very complex problem caused by point and non-point sources across many sectors, which requires a multi-dimensional solution.

Since the release of the 2018 Version 5 of Indiana's State Nutrient Reduction Strategy, the following changes and key refinements have been made.

1) An Index of Tables was added.
2) Images and pictures have been added throughout the document.
3) Figures and graphs throughout the document were updated as necessary.
4) Section 1 – Introduction
    a. What About in Indiana? – Added a mention of the Indiana Science Assessment, and how the process of determining nutrient load trends is being done throughout the state of Indiana.
5) Section 2 – Engage Stakeholders and Partners
    a. Added an explanation of the Indiana Chapter of The Nature Conservancy (TNC) as a key stakeholder since they have been engaged and actively involved in conservation work with Indiana and the ICP for many years.
    b. Added the United States Geological Survey (USGS) as another key stakeholder and partner as they provide much needed streamflow and discharge data and water quality monitoring data throughout Indiana, and are involved in numerous projects and studies in the state.
6) Section 3 – Watershed Prioritization and Characterization
    a. Verbiage for re-examining the priority watersheds for the state of Indiana was updated as necessary.
    b. Updates were made as necessary to the USGS information for the Eagle Creek and Sugar Creek projects.
7) Section 4 – Water Quality Monitoring in Indiana's Waters
    a. The monitoring matrix referenced under IDEM Water Monitoring Programs has been removed as an appendix and a website link was added to replace it.

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[1] Members of SNRS Workgroup include the Indiana State Department of Agriculture-Division of Soil Conservation, Indiana Department of Environmental Management-Watershed Assessment and Planning Branch, Indiana Department of Enviromental Management-Drinking Water Branch, USDA-Natural Resources Conservation Service, Soil and Water Conservation Districts, Purdue University, The Nature Conservancy, Indiana Farm Bureau, Indiana Agriculture Nutrient Alliance, Indiana Soybean Alliance and Corn Marketing Council, and Agribusiness Council of Indiana.

b. Under “Harmful Algal Bloom (HAB) Monitoring Data”, the exposure thresholds for human and dog recreation have been updated. Tables showing results of water quality sampling in some State Recreation Areas have been updated.

8) Section 6 – Practices to Reduce Point Source (PS) and Non-Point Source (NPS) Pollution
   a. Examples of nutrient efficiency practices have been added under the Non-Point Source Strategy Objectives, Agricultural landscapes.
9) A new section has been added, Section 7, titled “Development of an Indiana Science Assessment”
10) The title of Section 8 has been changed to add the word *Initiatives* to the title. – “Programs, Projects, and Initiatives Supporting Nutrient Reduction”
    a. Agricultural Initiatives
       i. Added 4R Nutrient Stewardship Program in Indiana.
11) Section 10 – Milestones and Actions Items Table
    a. Updated the list of the key accomplishments and key progress made since the last version.
    b. Updates some of the goals and actions items and added some new goals.
12) The Indiana Science Assessment Strategy document has been added as an Appendix.

Section 1 – Introduction

National Nutrient Load Concerns and Priorities

Gulf of Mexico

Eutrophication, or nutrient enrichment of waters, is a concern in many areas of the United States as well as around the world. Nutrients are an essential part of the water system for plant and animal life, however when there is an excess of nutrients, it can cause water quality impairments such as hazardous algal blooms and oxygen depleted water. Excess nutrients such as nitrogen and phosphorus come from many sources including waste water treatment plants (WWTPs), failed septic systems, land-disturbing activities, and stormwater runoff from residential areas and agricultural lands. When these excess nutrients enter our waterbodies, they stimulate excessive plant growth or algal blooms. When the plants and algae die, sink, and decompose, oxygen levels are depleted in the water, which is a condition referred to as hypoxia. These hypoxic areas cannot support aquatic life and are often called "dead zones".

The dead zone or Hypoxia Zone in the Gulf of Mexico is among the most pressing, where nutrient loads from the Mississippi/Atchafalaya River Basin (Figure 1) are contributing to eutrophication and harmful algal blooms. Since 1985, the National Oceanic and Atmospheric Administration (NOAA) and the Louisiana Universities Marine Consortium (LUMCON) have conducted an annual research cruise to measure the area of hypoxia in the Gulf of Mexico. In 2019, the dead zone covered an area approximately 18,000 square kilometers (6,952 square miles), and was the 8th largest measured since dead zone mapping began (Figure 2). In 2020, the dead zone size was a smaller-than-average size zone and covered an area approximately 5,048 square kilometers (2,117 square miles). (Figure 3) The 2020 zone was predicted to be higher, however Hurricane Hanna moved into the Gulf before the annual cruise and mixed the water column. To see information on current and past cruises visit https://www.epa.gov/ms-htf/northern-gulf-mexico-hypoxic-zone.

Figure 1 – Mississippi/Atchafalaya River Basin
Image source: https://www.epa.gov/ms-htf/mississippiatchafalaya-river-basin-marb

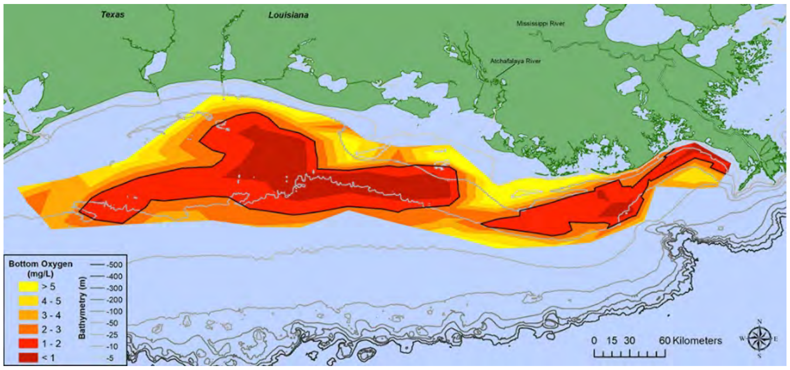

Figure 2 – 2019 Hypoxia Zone in the Gulf of Mexico
Image source: https://gulfhypoxia.net/research/shelfwide-cruise/?y=2019&p=press_release

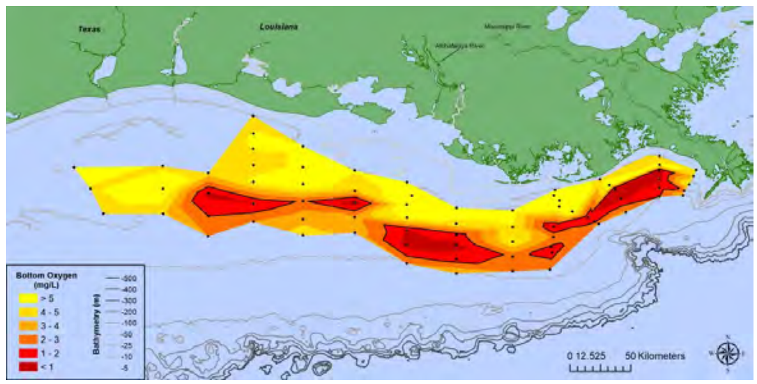

Figure 3 – 2020 Hypoxia Zone in the Gulf of Mexico
Image Source: https://gulfhypoxia.net/research/shelfwide-cruise/?y=2020&p=press_release

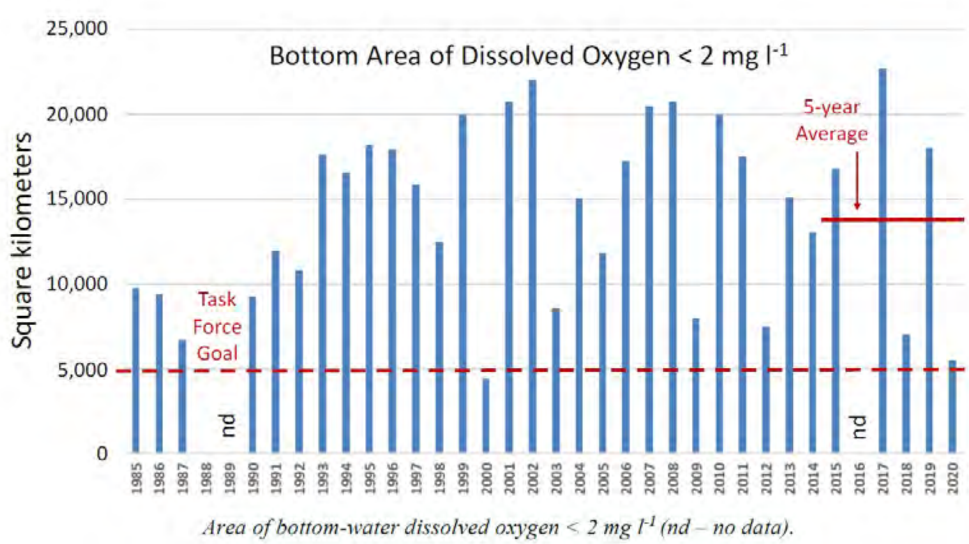

Figure 4 – This graph shows the bottom-water area of the hypoxia zone through 2020.
Image source: https://gulfhypoxia.net/research/shelfwide-cruise/?y=2020&p=press_release

As a result of this issue in the Gulf of Mexico, the Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF) in 2008 created a priority action plan that calls for each of the major states that drain in the basin to develop a state nutrient reduction strategy to address the issue of excess nitrogen and phosphorus entering their rivers, lakes, streams, aquifers, wetlands, and drinking water supplies. In 2011, the U.S. Environmental Protection Agency (USEPA) released a memo outlining eight (8) *Recommended Elements of a State Framework for Managing Nitrogen and Phosphorus Pollution*, which gave guidance to the 12 states[2] that are a part of the Gulf of Mexico HTF. Indiana is one of those 12 states.

The HTF goal is to reduce the areal extent of the Gulf of Mexico hypoxic zone to less than 5,000 square kilometers by the year 2035, with an agreed upon interim target of a 20% nitrogen and phosphorus load reduction by the year 2025 as a milestone toward reducing the hypoxic zone to less than 5,000 square kilometers by the year 2035.

Is Progress Being Made (Basinwide)?

The current method that the HTF uses to track progress toward the HTF goal is the 5-year moving average size of the Gulf hypoxic zone, which is influenced by many factors including stream flow and can cause variability in the overall results because of low flow and high flow years. As a result, the HTF agreed in January of 2018 to adopt the United States Geological Survey's (USGS) Weighted Regressions on Time, Discharge, and Season (WRTDS) Model as an additional reporting metric to assess progress being made in the Mississippi River Basin.

This model and method "normalizes" loads to average flow conditions, providing a trend analysis of flow-normalized loads. It more clearly evaluates changes in nutrient load that are caused by factors other than changes in streamflow, such as land-use, management changes, and hydromodification.

The WRTDS method analyzes water quality data from USGS water quality sampling stations and US Army Corp of Engineers streamflow gages in the lower Mississippi River watershed to assess a trend for the basin. Figure 5 on the next page shows the total nitrogen loading to the Gulf of Mexico using the WRTDS model from 1980 through 2019, and Figure 6 shows the total phosphorus loading to the Gulf. Both of these graphs show the two metrics used by the HTF to assess progress toward the reduction goals – the flow-normalized trend in load and a 5-yr moving average in loads.[3]

Tracking changes in nutrient loads is complex due to many different factors, therefore is it important that more than one method be used to track progress, especially when looking at such a large watershed as the Mississippi River Basin.

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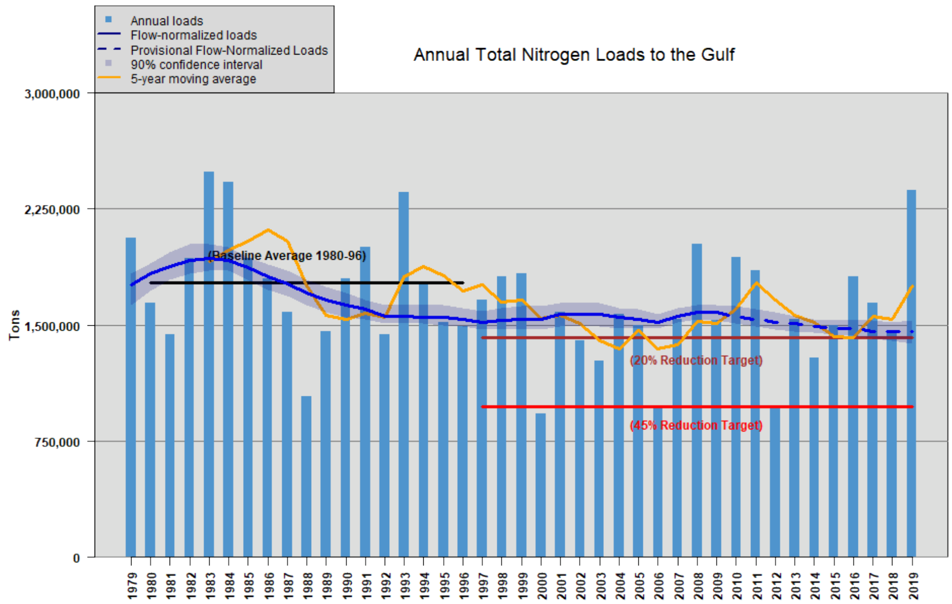
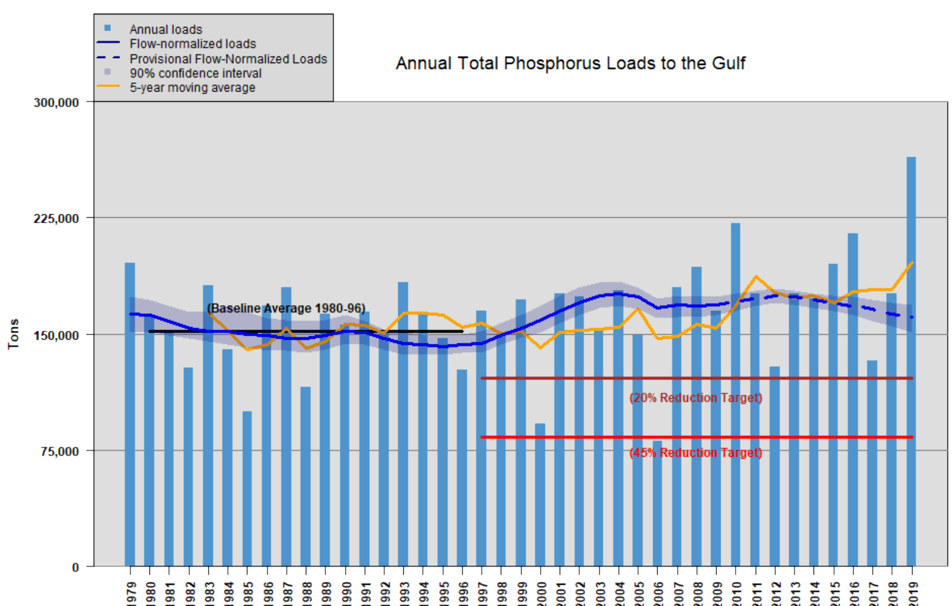
[2] Arkansas, Missouri, Iowa, Tennessee, Minnesota, Indiana, Ohio, Louisiana, Illinois, Mississippi, Kentucky, Wisconsin

[3] https://nrtwq.usgs.gov/mississippi_loads/#/GULF



Trend start period	Trend end year	Trend, in percent change	Lower 90% confidence interval	Upper 90% confidence interval	Trend attributed to changes in streamflow	Trend attributed to other changes in the watershed
1980-1996	2019	-16%	-23%	-9%	1%	-17%

Figure 5 – Annual Total Nitrogen Loads to the Gulf of Mexico from 1980-2019 showing two metrics to assess progress adopted by HTF. https://nrtwq.usgs.gov/nwqn/#/GULF



Trend start period	Trend end year	Trend, in percent change	Lower 90% confidence interval	Upper 90% confidence interval	Trend attributed to changes in streamflow	Trend attributed to other changes in the watershed
1980-1996	2019	7%	-5%	17%	1%	6%

Figure 6 – Annual Total Phosphorus Loads to the Gulf of Mexico from 1980-2019 showing two metrics to assess progress adopted by the HTF. https://nrtwq.usgs.gov/nwqn/#/GULF

What about in Indiana?

Using the same method of "normalizing" loads, WRTDS can provide a trend analysis of flow-normalized loads in Indiana. Water quality data from the USGS water quality sampling station on the Wabash River at New Harmony, IN (Figure 7) was analyzed to assess a trend for Indiana and whether progress is being made in Indiana. The New Harmony USGS location on the Wabash River is the last station on the Wabash River before it flows into the Ohio River, collecting data from the Wabash River watershed as well as the White River Watershed. Figure 8 on the next page shows the total nitrogen loading to the Wabash River from 2002-2012 using the WRTDS model, and Figure 9 shows the total phosphorus loading in the Wabash River from 2002-2012. Based on this data, USGS has identified the watersheds in Indiana as significant contributors of nutrients to the Gulf of Mexico.[4]

This analysis is part of the Indiana Science Assessment, which is explained in Section 7, and more information will be available on this process and the results in 2021. Water quality monitoring data from USGS and IDEM is being analyzed at nine pour points[5] on the state borders and within the major drainage basins. To see the map of pour points, refer to Figures 19 and 20 in Section 7. In addition, this analysis of WQ data at the pour points and within the major drainage basins will be one of the tools to assist with the HUC 8 and HUC 12 prioritization process as explained in Section 3.

Figure 7 – Location of the USGS Water Quality Sampling Station on the Wabash River at New Harmony, IN is shown by the red dot on the map. Station is number 03378500. (map made by Trevor Laureys, ISDA)

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[4] Information on nutrients and sediment loads from Indiana watersheds can be found in "Loads of nitrate, phosphorus, and total suspended solids from Indiana watersheds", by Aubrey Brunch, USGS. https://pubs.er.usgs.gov/publication/70192934.

[5] Definition of pour point: The outlet, or pour point, is the point on the surface at which water flows out of an area. It is the lowest point along the boundary of a watershed.

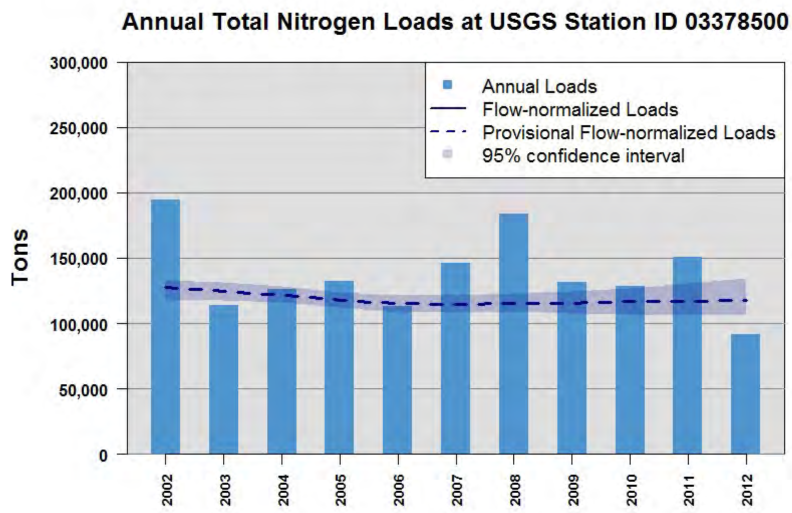

Figure 8 – Annual Total Nitrogen Loads at the New Harmony, IN USGS Station from 2002 – 2012.

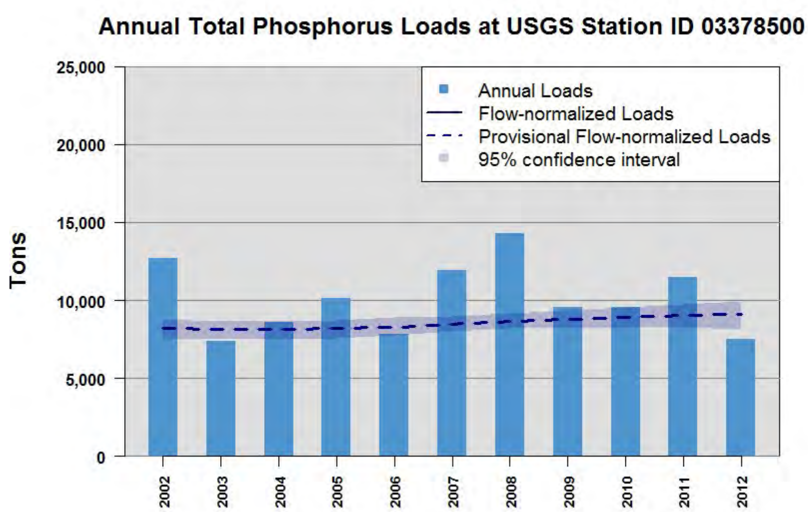

Figure 9 – Annual Total Phosphorus Loads at the New Harmony, IN USGS Station from 2002 – 2012.

While these graphs show a relatively static trend line over the decade between 2002 and 2012, it is important to understand that there is a delay or time-lag, which can be decades, between installation or adoption of conservation practices and positive, statistically significant changes in water quality.[6] According to Meals and Dressing, 2008, land treatment-water quality monitoring projects – even those designed to be "long-term" – may not show definitive results if the lag time exceeds the monitoring period. This is especially true over a large watershed area. Reductions

[6] Donald W. Meals and Steven A. Dressing. 2008. Lag time in water quality response to land treatment. Tech Notes 4, September 2008. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 16 p. Available online at https://www.epa.gov/sites/production/files/2016-05/documents/tech_notes_4_dec2013_lag.pdf

in pollutant loads to streams, rivers and lakes may be seen sooner on a smaller watershed scale, and through agricultural edge-of-field practices and at point source outfalls.
Also, according to Van Meter and Basu, 2017, "Despite the widespread implementation of conservation measures, nitrogen concentrations in rivers and streams are often remaining steady or continuing to increase. Although many attribute this lack of response to stores of legacy nitrogen in soil and groundwater, it remains unclear how much nitrogen is being stored beneath the surface."[7] VanMeter's and Basu's research shows that nitrogen dynamics in the Mississippi River Basin are dominated by legacy nitrogen in the soil, which can result in the time-lag of the effects of conservation practices, that even if agricultural N use became 100% efficient, it would take decades to meet target N loads. Their results also suggest that both long-term commitment and large-scale changes in agricultural management practices will be necessary to decrease Mississippi N loads to meet current goals for reducing the size of the Gulf hypoxic zone.[8] Their research basically says that nitrogen can be in the system for over 80 years. The next step in their research is to look at the legacy of phosphorus.

Nutrient Load Concerns on Indiana's Waters

Indiana's surface and ground waters are adversely affected by excessive nutrient loads from point sources and nonpoint sources to our rivers, streams, lakes and aquifers. This is evident in increasing occurrences of cyanobacteria (also known as blue-green algae) blooms in Hoosier lakes and reservoirs, which can result in the release of toxins. This is having a negative economic impact by increasing the cost of treating public water supplies as well as reducing the recreational use of lakes for swimming. A number of Indiana's drinking water facilities that use surface water find it necessary to add activated carbon to control taste and odor compounds attributed to algal blooms. Several public water systems apply herbicides to their source waters as a means to control algal blooms. The Indiana Department of Natural Resources (DNR) issues recreational alerts due to high cyanobacteria cell counts for public beaches at state parks and state recreation areas weekly during the DNR swimming beach season which runs from Memorial Day through Labor Day. These recreational alerts are issued when the cyanobacteria count exceeds 100,000 cells. In 2019, DNR issued 44 recreational alerts at 16 beaches, and in 2020, 80 recreational alerts at 18 beaches.

In addition, nitrate is one of the most common ground water contaminants found in the State. It represents a threat to drinking water primarily because excess levels can cause methemoglobinemia, or "blue baby" syndrome. Although nitrate levels that affect infants do not pose a direct threat to older children and adults, they do indicate a need for nutrient control.

We must address the health of our water resources in a comprehensive way. Recognizing that what we do on the landscape with urban, rural and agricultural activities and drainage is reflected in our waterways. While regulatory approaches to controlling point sources of nutrients are in place, they remain under continued assessment and improvement, including refining expectations

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[7] "Two centuries of nitrogen dynamics: Legacy sources and sinks in the Mississippi and Susquehanna River Basins", K. J. Van Meter, N. B. Basu, P. Van Cappellen.
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016GB005498
[8] http://science.sciencemag.org/content/early/2018/03/21/science.aar4462

and operations in wastewater treatment facilities and other municipal systems, such as storm water management and the use of green infrastructure for water infiltration and uptake by plants and trees.

There is also an increased interest in promoting non-regulatory approaches for nonpoint sources such as increased technical and financial assistance for coordinated, effective best management practices (BMPs)[9] on agricultural and urban lands. This includes managing agricultural lands to reduce nutrient loads lost to runoff, optimizing nutrients inputs through enhanced management of the timing, rate, form and placement of fertilizers for crop production, managing soil health and water-holding capacity through a system of practices including no-till, never-till, conservation tillage, nutrient management, and cover crops as well as utilizing buffers, filters and other best management practices along waterways in both urban and rural areas.

Indiana Drainage Overview

The State of Indiana has a surface area of approximately 36,532 square miles. There are about 63,000 miles of rivers, streams, ditches and drainage ways in Indiana.

Indiana is made up of three major drainage basins known as 4-digit HUC[10] watersheds (Figure 10). The blue shaded area on the map shows that the majority of the state drains to the Mississippi River Basin, either to Illinois through the Kankakee River System, into the Ohio River along the southern border of Indiana, or through the Wabash River System.

The main rivers that drain Indiana in the Mississippi River Basin are the Wabash River, the Tippecanoe River, the White River, the Kankakee River, the Whitewater, and several smaller tributaries that drain to the Ohio River. This system drains approximately 90% of Indiana's 92 counties and consists of primarily agricultural land with many small towns and some cities located along the rivers.

Figure 10 – Indiana's major drainage basins

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[9] Best Mangement Practice (BMP) means a practice, or combination of practices, that is determined to be an effective and practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals. http://www.ncforestservice.gov/water_quality/what_are_bmps.htm

[10] Hydrologic unit codes (HUC) are a way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units). The term watershed is often used in place of drainage basin. The smaller the HUC number, the larger the drainage area. For example a HUC 8 watershed is larger than a HUC 12.

The yellow and green shaded areas in Northeast and Northwest Indiana drain to two of the Great Lakes; Lake Michigan and Lake Erie.

The green shaded area in northeast Indiana is known as the Western Lake Erie Basin (WLEB) and covers all or part of 6 counties, covering approximately 812,500 acres. The main rivers that drain the WLEB area are the St. Joseph River, the St. Marys River, and the Upper Maumee River. The St. Joseph River and the St. Marys River come together in Fort Wayne, IN to form the Maumee River that drains to and through Ohio and eventually empties into the western basin of Lake Erie at Toledo, Ohio.

The yellow shaded area along the northern border drains to Lake Michigan and covers all or part of 10 Indiana counties, encompassing approximately 1,416,113 acres. The northwest portion is drained through the Grand Calumet and Little Calumet Rivers, Trail Creek, and Salt Creek and is made up of mostly urban areas. The northeast portion drains to Lake Michigan through the St. Joseph River System (different then the St. Joseph River in the WLEB area), the Elkhart River, the Little Elkhart River, Pigeon River and Pigeon Creek. It consists of primarily agricultural land with small towns and cities located in the watershed.

The Great Lakes

The Great Lakes are also experiencing water quality issues due to excessive amounts of nutrients. The 2012 Great Lakes Water Quality Agreement (GLWQA) amendment established the Nutrients Annex 4 binational subcommittee, which is charged with coordinating binational actions to manage phosphorous loadings and concentrations in the Great Lakes and to commence its work with Lake Erie, which is experiencing excessive phosphorus loading that threatens water quality and ecosystem health by contributing to harmful and nuisance algal blooms. Approximately 3.5% of Indiana drains into Lake Erie and Indiana has been an active member of this subcommittee since its establishment in 2013.

In accordance with the Annex 4 GLWQA Lake Ecosystem Objective to "maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health," Indiana's GLWQA Domestic Action Plan (DAP) to reduce phosphorous to the Western Lake Erie Basin (WLEB) was released February 28, 2018. To achieve the above-referenced Lake Ecosystem Objective, a 40 percent reduction in spring-time total phosphorus and soluble reactive phosphorus is needed for the Maumee River. This translates to a flow weighted mean concentration of 0.23 mg/L total phosphorus and 0.05 mg/L soluble reactive phosphorus respectively. Progress toward these target values is being measured on the Maumee River at Antwerp, Ohio, which is 7.6 river miles downstream of the Indiana border and best represents Indiana's phosphorus loading.

The Indiana WLEB DAP is the product of a dedicated Advisory Committee comprised of representatives from different stakeholder sectors and led by the Indiana Department of Environmental Management (IDEM). The Indiana DAP is informed by the intensive planning, research, and steadfast work that is underway in the WLEB by individuals, non-governmental organizations, universities, professional associations, for-profit industries, and governmental entities at the town/municipal, county, state, and federal levels. It is in keeping with the principles and approaches within the Indiana State Nutrient Reduction Strategy. It 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 DAP for the Western Lake Erie Basin is found at: https://www.in.gov/isda/3432.htm.

Indiana also drains into Lake Michigan for which a plan will be developed in accordance with the GLWQA in the coming years.

The development of Indiana's State Nutrient Reduction Strategy is benefitting our state's local waters resources, which in turn will benefit the Gulf of Mexico and the Great Lakes into which Indiana's waterways drain.

Guiding Principles

The Indiana State Nutrient Reduction Strategy represents the state's commitment to reduce nutrient runoff into Indiana's waters from point sources and non-point sources alike.
These six guiding principles are the foundation of this Strategy:

- **Encourage voluntary, incentive-based, practical, and cost-effective actions**
- **Use and strengthen existing regulatory and non-regulatory programs**
- **Identify existing and additional funds needed and funding sources**
- **Identify research needs**
- **Identify opportunities for innovative, market-based solutions**
- **Follow adaptive management**

Specific actions tied to these principles are enumerated in Section 10, the Milestones and Action Table, which will be used to help track progress. As practices, technologies, management systems etc. evolve, those will be added to the Milestone/Action Table. Likewise, if new data and information show that changes are required, adaptations will be made.

Section 2 – Engage Stakeholders and Partners

The State of Indiana recognizes that early involvement of stakeholders and partners provides transparency of the process, allows time for trust to develop, permits incorporating local knowledge, and makes it possible to deal most effectively with misperceptions and manage expectations. All of this helps gain buy-in and cooperation from stakeholders and partners and increases the likelihood of moving toward effective and sustainable solutions. Many agencies and stakeholders were consulted with in the planning and development of the Indiana State Nutrient Reduction Strategy.

Indiana Conservation Partnership (ICP) – One of the most important tasks in this effort is that of engaging and utilizing the Indiana Conservation Partnership. As both a leadership body and as stakeholders in Indiana's water quality, the ICP actively works to address environmental issues across Indiana at local, state and federal levels. Indiana is a national leader in fostering cooperative, progressive and productive state-wide partnerships and has served as a model for other states. The ICP embodies that reputation. http://icp.iaswcd.org/

The ICP is comprised of eight entities, including the:

- State Soil Conservation Board (SSCB)
- USDA Farm Service Agency (FSA)
- USDA Natural Resources Conservation Service (NRCS)
- Indiana Association of Soil and Water Conservation Districts (IASWCD)
- Indiana State Department of Agriculture's Division of Soil Conservation (ISDA-DSC)
- Indiana Department of Natural Resources (IDNR)
- Indiana Department of Environmental Management (IDEM)
- Purdue Cooperative Extension Service (CES)

The mission of the ICP is to provide technical, financial and educational assistance needed to implement economically and environmentally compatible land and water stewardship decisions, practices and technologies. The ICP provides a roadmap for addressing Indiana's conservation issues, and in so doing, functions collectively to touch many other organizations and individuals.

State Soil Conservation Board (SSCB) – The Indiana State Soil Conservation Board is another key group of stakeholders in Indiana's water quality and is a member of the ICP. The SSCB appoints Supervisors as recommended by County Soil and Water Conservation Districts (SWCDs) and sets policy governing programs of the ISDA Division of Soil Conservation (DSC) and the activities of SWCDs. Through ISDA and the policies set by the SSCB, this board serves SWCDs by providing state appropriated funding for SWCD operations, providing technical assistance through ISDA DSC employees, and builds district capacity by facilitating information exchange between the SWCDs through SWCD Annual Conference, publications, workshops, and the efforts of the DSC Resource Specialists.

The SSCB also serves as a body for advice and consultation for ISDA and the SWCDs as well as assists in securing federal and state agency help for district programs. Lastly the board administers Clean Water Indiana, a water quality-related erosion and sediment reduction program.

There are geographical areas within all watersheds of Indiana that have critical natural resource concerns related to soil and water conservation. The SSCB works with the ISDA-DSC, SWCDs and all partners to address these concerns and support federal initiatives. In a strategic effort to address the top resource concerns identified by the ICP, the SSCB developed goals and strategies within its business plan. These goals and strategies are consistent with the Board's general authority and duties outlined in the District Law as well as its specific authority to provide direction to the ISDA-Division of Soil Conservation on the administration of the Clean Water Indiana (CWI) Program. Several of these goals are outlined in the list of action items under Section 10. http://www.in.gov/isda/2361.htm

Soil and Water Conservation Districts (SWCDs) – Indiana's 92 County Soil and Water Conservation Districts are the grassroots partners in Indiana's effort to improve its waters. Districts not only bring a local environmental perspective to land users and economic developers, but act as local hubs for any and all citizens whom they serve to find information regarding conservation issues and programs available to them. SWCDs most often share residence with local FSA and NRCS offices as well as DSC employees, or are located in close proximity. This not only allows for cooperation and shared resources, but ensures that farmers, landowners and developers can access conservation programs and technical support at local, state and federal levels when they respond to outreach from SWCDs or they themselves reach out to any of these partners.

Partners of the Indiana Conservation Partnership and the State Soil Conservation Board all work closely with SWCDs to ensure that information, technical assistance, funding and programs are made available to landowners and the public in Indiana's 92 counties. http://www.in.gov/isda/2368.htm

Agricultural Commodity Groups and Organizations – Indiana Corn, Soybean, Pork, Beef, Dairy and Poultry commodity groups, as well as the Indiana Farm Bureau (INFB), the Agribusiness Council of Indiana (ACI), and Purdue University Extension are actively engaged in identifying and approaching the challenges of nutrient loading and soil health, subsequently improving water quality. These groups with the addition of members from the ICP and The Nature Conservancy, worked to develop what was referred to as the nutrient management and soil health strategy. As a result of this effort, the Indiana Agriculture Nutrient Alliance (IANA) was created in 2018 to further coordinate the efforts of the ag community beyond federal and state cost-share programs.

INDIANA AGRICULTURE NUTRIENT ALLIANCE

In an agricultural state rich with steward-farmers, this partnership is invaluable in addressing water quality and soil health related issues. The Indiana Agriculture Nutrient Alliance will be discussed in more detail later in this strategy as an agricultural initiative under section 8.

Municipalities – Primarily those with municipal separate storm sewer systems (MS4S), major wastewater treatment plants (WWTP) (greater than 1 million gallons design flow per- MGD), and those with combined sewer overflow systems (CSOs) are actively engaged in implementing their Storm Water Quality Management Plans (SWQMPs), National Pollutant Discharge

Elimination System (NPDES) permits, and Long Term Control Plans (LTCPs) respectively to reduce nutrients and other pollutants to Indiana's waterways.

The Indiana Chapter of The Nature Conservancy (TNC) – The Indiana Chapter of The Nature Conservancy is another key stakeholder and partner in improving Indiana's water quality. The Nature Conservancy focuses on conserving the lands and waters on which all life depends. Utilizing science to develop its conservation targets and approach, TNC has initiated broad, whole system projects to accomplish its mission. One example is that TNC has adopted the Gulf of Mexico Hypoxia Task Force's goal of reducing nutrient loading to the Gulf by 20% by 2025.
TNC has applied this goal to Indiana's waters, and to accomplish this goal, TNC is working with agency, commodity, and academic partners across the state to improve water quality by collaborating and coordinating to consistently promote efforts that will move 50% of row crop acres being managed for soil health, enhance nutrient management and restoring 20,000 acres of floodplains.

TNC is an active member of IANA, a partner of ISDA's Conservation Reserve Enhancement Program, and a participant of the Indiana Science Assessment to support water quality monitoring efforts like the USGS New Harmony Super Gage. https://www.nature.org/indiana

The United States Geological Survey (USGS) – The USGS is another key stakeholder and partner in improving Indiana's water quality by providing streamflow and discharge data and water quality monitoring data throughout key areas of the state. This data and the USGS's cooperation and involvement in many projects and studies is vital to knowing the state of our waters and where more work is needed to improve the water quality.

Section 3 – Watershed Prioritization and Characterization

Prioritize 8-digit Hydrologic Unit Code (HUC) Watersheds

Prioritizing watersheds is an important step in the development of a nutrient reduction strategy in order to optimize limited resources in achieving the greatest impact toward sediment and nutrient reduction loads. As a result, in 2011 ISDA and IDEM determined, along with assistance and feedback from the ICP, specific watersheds where it is believed that most of the nutrients are coming from, which was determined by using a number of different resources. It was agreed on by ISDA, IDEM and members of the ICP that prioritization would begin at the 8-digit HUC level with subsequent prioritization at the 12-digit BMP implementation scale.

The resources used to assist in determining the priority HUC 8 watersheds included the USGS 2002 Spatially Referenced Regressions on Watershed Attributes (SPARROW) model (http://water.usgs.gov/nawqa/sparrow/), which is a modeling tool for the regional interpretation of water-quality monitoring data and is used to approximate nutrient loads from major watersheds. There were limitations with the 2002 SPARROW model and should only be used on a regional scale, so the State of Indiana decided to utilize SPARROW only as a screening level tool and general guidance to improve local impacts. Other resources used in the prioritizing of the HUC 8 watersheds included data analyzed by NRCS to prioritize watersheds for the Mississippi River Basin Initiative (MRBI), IDEM's 303d listings, IDEM 319 approved Watershed Management Plans (WMPs), IDNR Lake and River Enhancement Watershed (LARE) Diagnostic studies, and focus on the Conservation Reserve Enhancement Program (CREP). Also in 2011, NRCS developed a geospatial tool known as the State Resource Assessment (SRA) that complements the prioritization of HUC 8 watersheds in Indiana.

Eight HUC 8 watersheds within the Wabash River System, situated along the Wabash and White Rivers, and the Maumee River watershed in northeast Indiana currently serve as Indiana's eight prioritized watersheds. (Figure 11) These watersheds are:

- Upper Wabash
- Middle Wabash-Deer
- Middle Wabash-Little Vermillion
- Middle Wabash-Busseron
- Lower Wabash
- Upper White
- Lower White
- Maumee

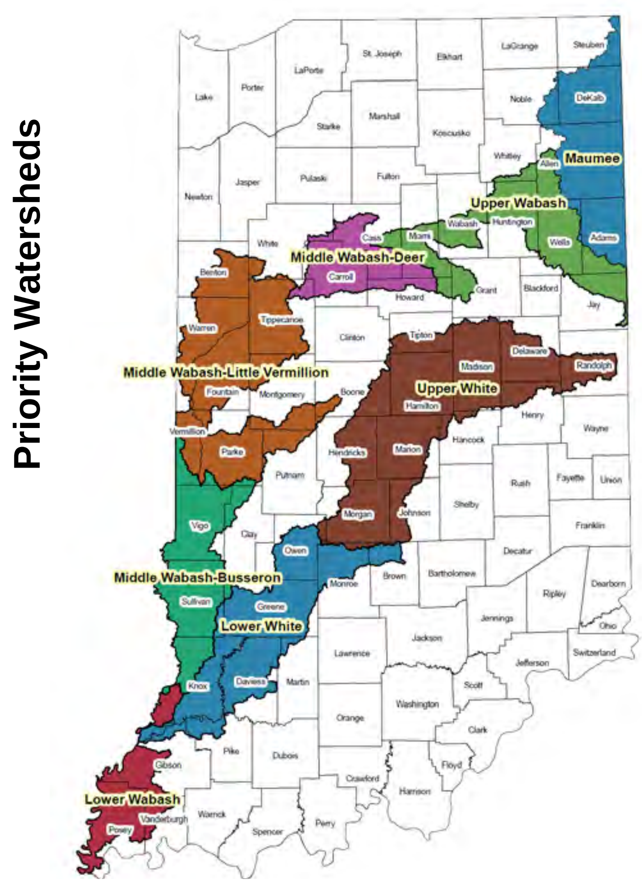


Figure 11 – Indiana's priority HUC 8 watersheds

It has been a decade since the HUC 8 priority watersheds were chosen, so the SNRS Workgroup will re-examine them to validate their priority. It could be that different and/or additional watersheds are identified.

Some of the resources that will be used in re-examining of the HUC 8 priority watersheds will include watersheds with drinking water reservoirs and surface water intakes (Figure 12), as well as the areas of aquifer sensitivity. The Indiana Geological Survey (IGS) has compiled data on aquifer sensitivity for the state of Indiana based on estimated ground water recharge rates in shallow aquifers (Figure 13). Using ArcGIS, it is possible to combine the current eight HUC 8 priority watershed data from the strategy, and the aquifer sensitivity data from IGS to create a map of the aquifer sensitivity of the identified priority watersheds (Figure 14). Component 1 of the Indiana Science Assessment, ascertaining nutrient loads at the state borders, will help further inform the prioritization.

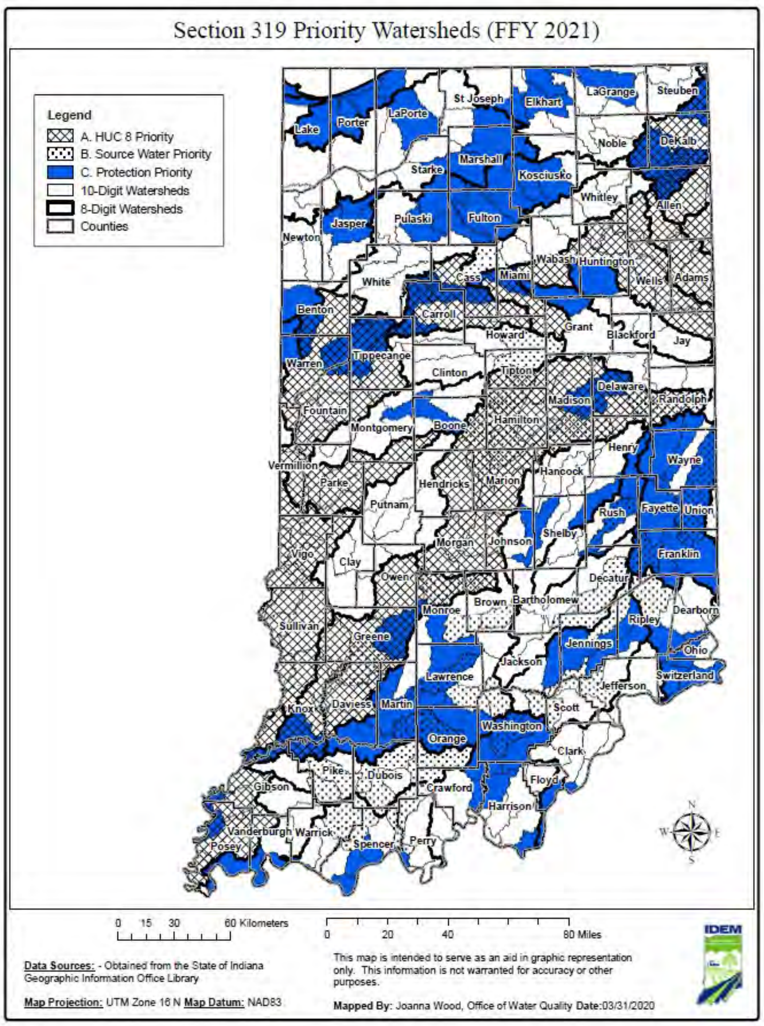


Figure 12 – Source-water priority watersheds for drinking water and surface waters

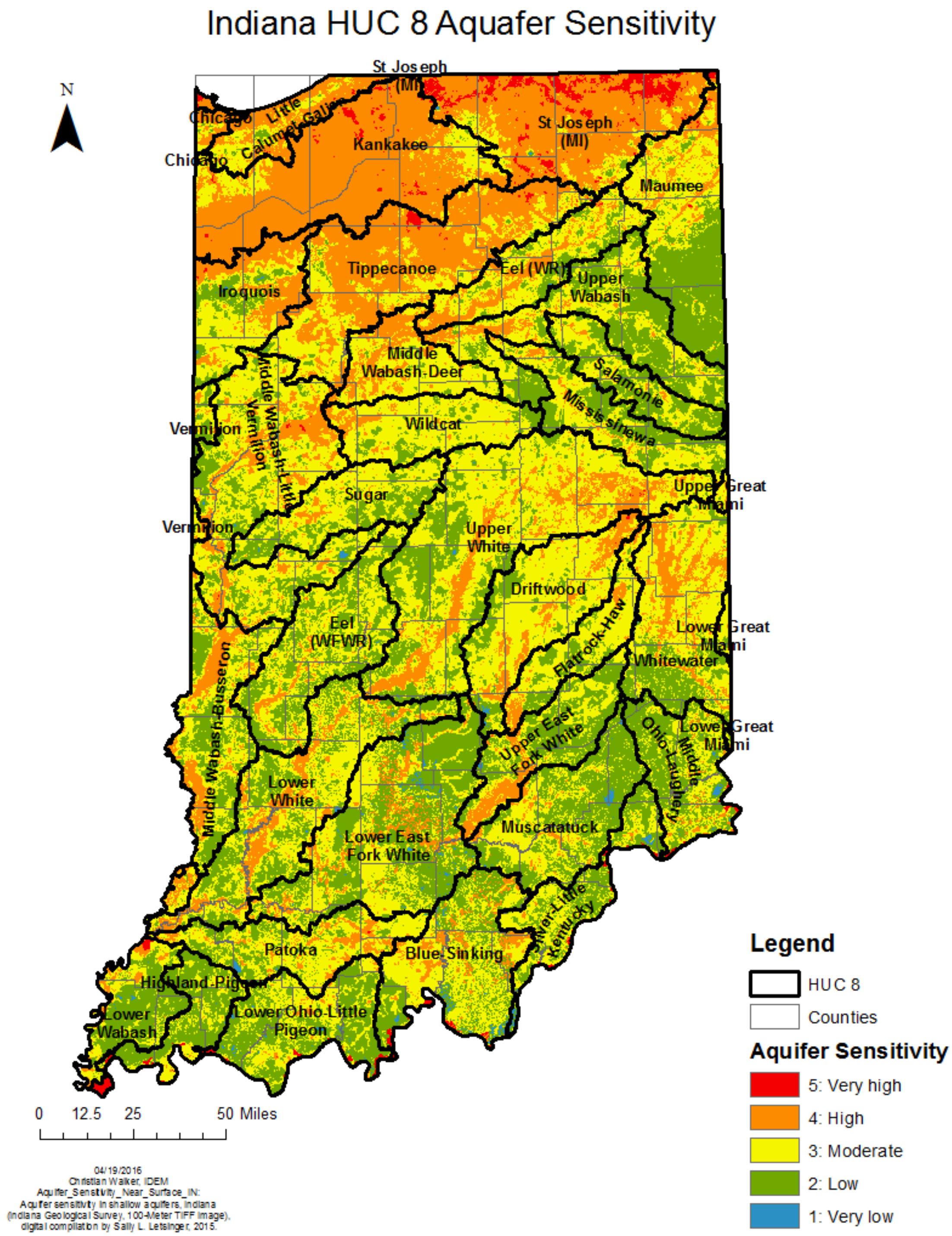


Figure 13 – Aquafer Sensitivity within the state of Indiana

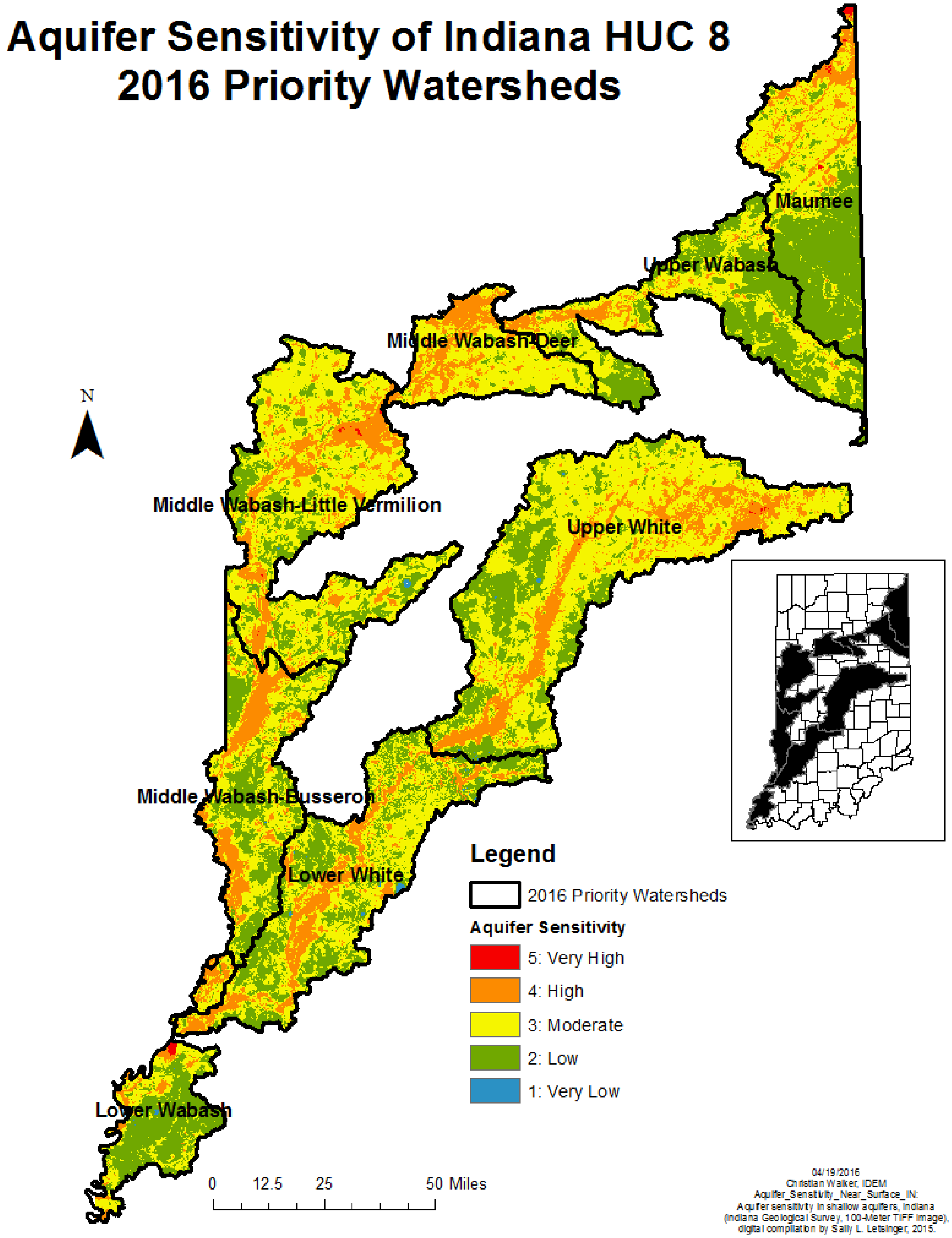


Figure 14 – Aquafer Sensitivity within the Indiana HUC 8 Priority Watersheds

Further Prioritization

Within the HUC 8 prioritized watersheds mentioned above, prioritizing at the 12-digit HUC watershed scale is important because ambient water quality changes occur more quickly at a smaller watershed scale in response to targeted land-based BMPs and reductions in point source discharges. Upon re-examining and verifying the HUC 8 priority watersheds, further prioritization of HUC12 watersheds will be done within them. A HUC12 prioritization process was piloted in the Indiana WLEB watershed, and that process will be used within the HUC 8 priority watersheds throughout the other major watershed basins in Indiana, which are shown on the map below in figure 15.[11] The Great Lakes Basin is furthered divided into the Lake Michigan and Lake Erie watersheds, essentially making 10 river and lake basins. Characterization includes an inventory of land use, analysis of fixed station and other water quality monitoring data, critical areas identified in approved 9-Element WMPs, current social and environmental indicators, as well as current implementation activities.

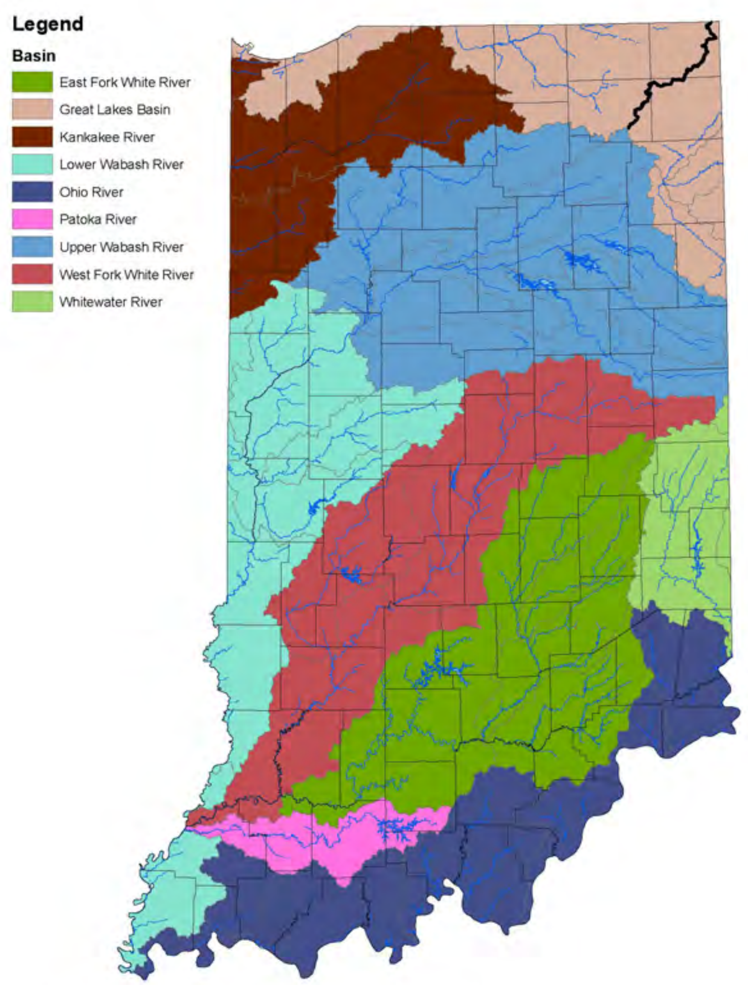


Figure 15 – Ten Major River and Lake Basins in Indiana

[11] The major drainage basins are monitored probabilistically and assessed statistically by IDEM on a nine-year rotating basin schedule to determine if waters are meeting their designated uses and/or water quality standards.

Two HUC-12 watersheds of particular focus have significant amounts of water quality data that serve as baselines for measuring changes over time. The first watershed, Eagle Creek, forms the primary drinking water reservoir for the City of Indianapolis, and the second is a long-term trend site for the USGS National Water Quality Assessment Program. Additionally, the Eagle Creek watershed has had multiple studies, specifically the School Branch watershed nested inside the Eagle Creek watershed, that has on ongoing Edge-of-Field study with a collaboration of many federal, state, and local partners. Below is an overview of the monitoring that has been done in these watersheds:

1. Eagle Creek in central Indiana, which is impounded to form a 1,350 acre reservoir, serves Indianapolis as a drinking water source and recreation area. Eagle Creek is an important tributary of the White River, which drains into the Wabash River, and has had some long-term monitoring within the basin. Eagle Creek is typical of streams in the Tipton till plain physiographic region, with agricultural tile drainage being predominant. The USGS has a continuous water-quality monitoring nitrate supergage at Zionsville (USGS 033532000) that reports water quality (dissolved oxygen, pH, temperature, specific conductance, and turbidity) and nitrate concentrations from an instream sensor. Additionally, the continuous turbidity, along with discrete suspended sediment samples collected across a gradient of streamflows, is used to develop surrogates for continuous suspended sediment as it has done for a several other super-gages in Indiana. The USGS also plans to develop surrogates for total nitrogen and total phosphorus at this gage. Additionally, Eagle Creek at Zionsville was sampled as part of the USGS Midwestern Stream Quality Assessment (MSQA), an 11-state, 100 site, intensive water-quality and ecology survey in 2013, coordinated with USEPA's National River and Streams Assessment. The MSQA sampling at Eagle Creek included weekly samples analyzed for nearly 300 constituents, including nutrients and pesticides between the first week of May through the first week of August. This site was also sampled as part of a nutrient processing study that included streambed water samples, periphyton chlorophyll, and a second set of continuous monitoring sensors with added parameters. The MSQA study included an ecological survey of habitat, algae, fish, and invertebrates. Eagle Creek has had multiple years of small scale stream monitoring for nutrients by Indiana University-Purdue University Indianapolis (IUPUI) Center for Earth and Environmental Sciences (CEES), which conducted a USDA Conservation Effects Assessment Program (CEAP) study in the basin beginning in 2006. This project monitored nutrients in a tile drain, overland flow, and the stream to assess nutrient transport with a best management practice applied to a farmers field.

School Branch Watershed in Indiana

A unique collaboration of federal, state, local, and academic entities along with dedicated conservation minded farmers is ongoing in the School Branch watershed near Indianapolis, Indiana. The School Branch watershed drains into the Eagle Creek Reservoir discussed above. Similar to the CEAP study done by IUPUI-CEES, this project assesses the chemical, physical, and biological impacts of conservation practices at the watershed, sub-watershed, and edge-of- field scales. Water quality is monitored in tile drains, overland flow, stream water, and ground water to assess if soil health management systems in row crop agriculture can decrease the transport of nutrients to streams.

The project builds upon the efforts of the United States Department of Agriculture (USDA) NRCS National Water Quality Initiative, and monitoring and evaluation efforts at different watershed scales from the USGS, IDEM, Marion County Public Health Department (MCPHD), USDA NRCS, IUPUI-CEES, the Indiana Geological and Water Survey (IGWS), and the Office of the Indiana State Chemist (OISC). As with all good collaborations, each group brings a different skill or component to improve the overall study.

School Branch is a small (8.4 square miles) watershed located in northeastern Hendricks County, Indiana. Land use in the watershed is predominately corn and soybean agriculture with interspersed residential and populated areas. School Branch eventually drains into Eagle Creek Reservoir, a primary drinking water source for Indianapolis.

There are two USGS Supergages that continuously collect in-stream water quality parameters including nitrate and orthophosphate; automatic edge-of-field water quality sampling of cropland tile drains and overland flow; biology (macro-invertebrates, fish, and algae) monitoring; groundwater monitoring; and soil moisture monitoring (Figure 16). Additionally, a collaboration between USGS and IDEM was conducted on 24 tile drains to assess the variability of flow, nutrient concentrations and loads, and e.coli coming from these tiles all located between the 2 USGS supergages. All of these efforts will document the water quality benefits of soil health management systems to other farmers and the public in similar landscapes across the Corn Belt of the United States.

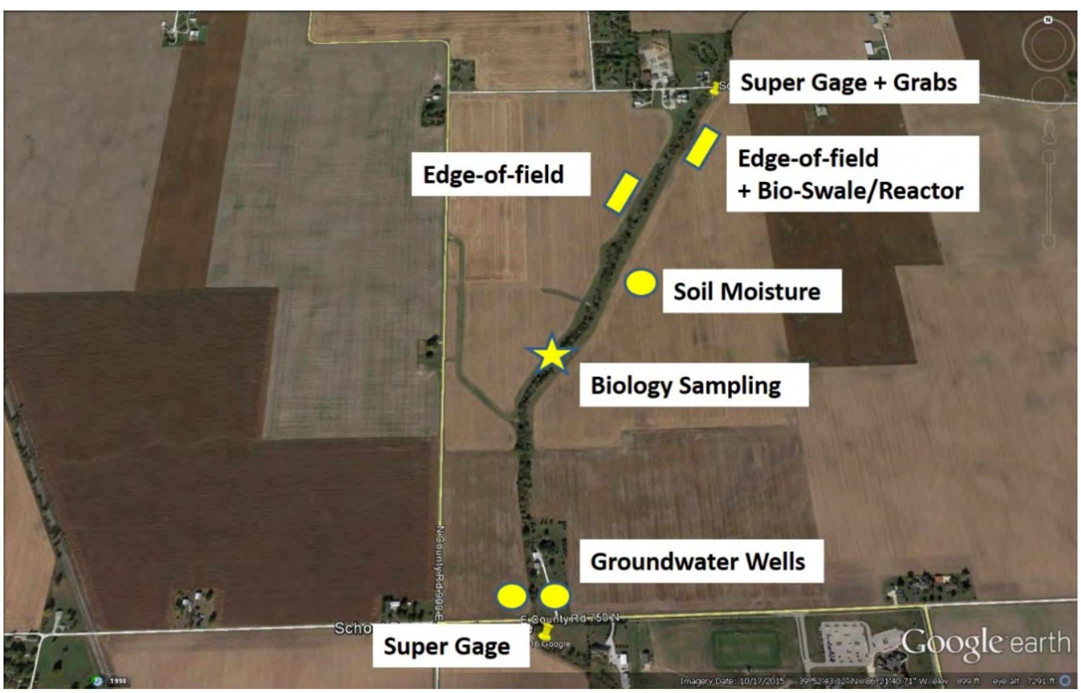


Figure 16 – Aerial view of School Branch projects

2. Sugar Creek in south-central Indiana has a USGS gage (USGS 03361650) at New Palestine that began in 1967. A site just upstream of the town of New Palestine and the gage (USGS 394340085524601), has been a USGS National Water Quality Assessment (NAWQA) Program long-term trends site since 1993. Sugar Creek is typical of streams in the New Castle till plain physiographic province, with agricultural drainage tiles in use. Sugar Creek drains to the White River. The upstream drainage area at the New Palestine gage is 94 square miles.
   This NAWQA site is sampled approximately 26 times per year for a long list of NAWQA constituents including nutrients, suspended sediment, and pesticides. Additionally, this site was sampled for biological communities (algae, invertebrates, and fish) until 2016. This site was also sampled as part of the Midwest Stream Quality Assessment (MSQA), which was sampled approximately weekly between the first week of May and August for nutrients and pesticides in 2013 as a collaboration with the USEPA's National River and Stream Assessment. Sugar Creek and a tributary, Leary Weber Ditch, were intensely sampled as part of the NAWQA Ag Chemical and Transport (ACT) study between 2002-04. The ACT study used autosamplers to collect storm samples from the stream, overland flow, and tile drains to characterize primary pathways of pesticides and nutrients to the stream and ditch. Several wells were also sampled at various depths to monitor movement to groundwater. The NAWQA program has been incorporated into the USGS Water Mission Area and this site will continue to be sampled into the future.

Section 4 – Water Quality Monitoring in Indiana's Waters

The primary goal of the Federal Clean Water Act (CWA) is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Most of the provisions of the CWA are implemented at the state level in Indiana through various CWA programs at IDEM in the Office of Water Quality (OWQ). Over the last few years, IDEM has sought to recognize the nexus between the CWA and the Safe Drinking Water Act in achieving water quality goals; thus, the *Indiana Water Quality Monitoring Strategy 2017-2021* includes the various surface water monitoring programs as well as the ground water monitoring network. Surface water and ground water interactions, including the effects of land use on quantity and quality, are being analyzed to assist with OWQ program decisions and are a factor in prioritizing watersheds for nutrient load reductions. School Branch, the National Water Quality Monitoring project described in Section 3, is an example of coupling at differing scales, surface water and ground water monitoring efforts to characterize a watershed and the effects of different land uses on water quality.

Water Quality Standards

Water Quality Standards (WQS) are the foundation of the water quality based control programs mandated by the Clean Water Act. A standard can consist of either numeric or narrative criteria for a specific physical or chemical parameter and is used as the regulatory target for permitting, compliance, enforcement, and monitoring and assessing the quality of the state's waters. When assessments identify a waterbody as not meeting adopted water quality standards, the assessment may lead to a determination of impairment, initiating further action such as a Total Maximum Daily Load (TMDL) or other regulatory procedure aimed at addressing the impairment.

Water quality standards consist of:

- Designated Uses: identification of how people, aquatic communities and wildlife use our waters (e.g. public water supply, propagation of aquatic life, recreation).
- Water Quality Criteria: numeric or narrative in form and protect the designated uses. Numeric criteria are allowable concentrations of specific pollutants in a water body while narrative criteria are statements of unacceptable conditions in and on the water.
- Antidegradation Policies: protection of existing uses and extra protection for high-quality or unique waters.

IDEM Water Monitoring Programs

Surface Water Monitoring Programs - IDEM's surface water monitoring programs are implemented in the Watershed Assessment and Planning Branch and are guided by the *Indiana Water Quality Monitoring Strategy 2017-2021*, which can be found at https://www.in.gov/idem/cleanwater/2537.htm. IDEM collects surface water quality, biological, and habitat data for the following purposes:

- To fulfill requirements of the CWA §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 water quality (WQ) standards development, National Pollutant Discharge Elimination System (NPDES) permitting, and compliance;
- To support public health advisories and address emerging water quality issues;
- To support watershed planning and restoration activities;
- To determine WQ trends and evaluate performance of programs; and
- To engage and support a volunteer citizen scientist monitoring network across the state.

The following monitoring programs are employed to achieve the above objectives:

- Probabilistic monitoring in one basin/year on a 9-year rotating basin cycle;
- Fixed Station monitoring at 165 sites across the state (2 added in 2014 for NRCS National Water Quality Initiative);
- Fish Tissue and sediment contaminants' monitoring on a 5-year rotating basin cycle;
- Targeted monitoring (watershed characterization) for Total Maximum Daily Load (TMDL) reassessments and document development, watershed baseline planning, and performance measures to determine if best management practices implemented in accordance with an approved 9-Element Watershed Management Plan have improved water quality. (To read about restoration success stories, please go to: http://www.in.gov/idem/nps/3360.htm);
- Cyanobacteria monitoring of 15 swimming beaches at 13 IDNR owned or managed sites and one IDNR dog park lake;
- Special studies such as Hydrograph Controlled Release Facilities, Grand Calumet Beneficial Use Delisting project, etc.;
- Thermal verification studies;
- Reference site monitoring to develop Indiana's biological condition gradient; and
- Hoosier River Watch Program. http://www.in.gov/idem/riverwatch/index.htm

To see the Monitoring Matrix showing the current list of IDEM surface water monitoring projects, visit https://www.in.gov/idem/cleanwater/files/swq_2021_monitoring_matrix.pdf.

Analyzing data from the Fixed Station monitoring program, albeit on primarily larger rivers, serves as a good first cut in prioritizing sub-watersheds for future program actions; an example of this is the Western Lake Erie Basin (WLEB). An analysis of data from the 12 fixed station sites in the WLEB for total phosphorous (TP) from 2008 to 2015 using both the LOADEST model and load duration curves shows that the larger (8-digit hydrologic unit code or HUC) St. Mary's watershed is the most significant contributor of TP loads to the Maumee River. Hence, this served as the starting point from which to prioritize smaller 12-digit HUC watersheds for targeting efforts and defining next actions to develop Indiana's GLWQA Domestic Action Plan. The State of Indiana intends to continue this process of prioritizing sub-watersheds in the other basins within the state as mentioned on page 26 under "Further Prioritization".[12]

[12] Refer to the "Objectives and Goals" under the Watershed Prioritization section of the Milestones and Actions Items Table, Section 10.

Ground Water Monitoring Programs - In 2008, the Indiana Department of Environmental Management (IDEM) Ground Water Section began collecting untreated water samples from ground water wells statewide as part of a Ground Water Monitoring Network (GWMN). A large percentage of Hoosiers drink residential well water that is not regulated by the Safe Drinking Water Act, and this was the impetus for starting the GWMN in Indiana. With the GWMN, IDEM seeks to:

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 ground water contamination, and
3. Practice continual improvement adjusting the GWMN as necessary to best fit resources (monetary/field support) and data gap needs.

The GWMN has grown each year with ground water samples being collected from over 240 public water supply wells and approximately 1200 private residential wells. To date, over 3,400 ground water samples have been collected from the network over multiple rounds of sampling. Samples are analyzed for approximately 200 parameters which include nitrate-nitrite, pesticides and pesticide degradants at each ground water well sampled. In 2020, approximately 250 of the previously sampled residential wells were resampled to collect updated data on ground water chemistry. Once statistically-established ambient ground water conditions have been established for Indiana, comparisons between ground water and surface water data may be made and hypotheses concerning ground water/surface water interactions can be formulated and tested. A main goal of the GWMN is to be able to monitor trends in ground water quality which could be used in monitoring nutrient reduction over time with long-term sampling. On the next page (Figure 17) is the map depicting nitrogen results from the water samples collected. The GWMN website also has maps and information for other parameters that are analyzed.

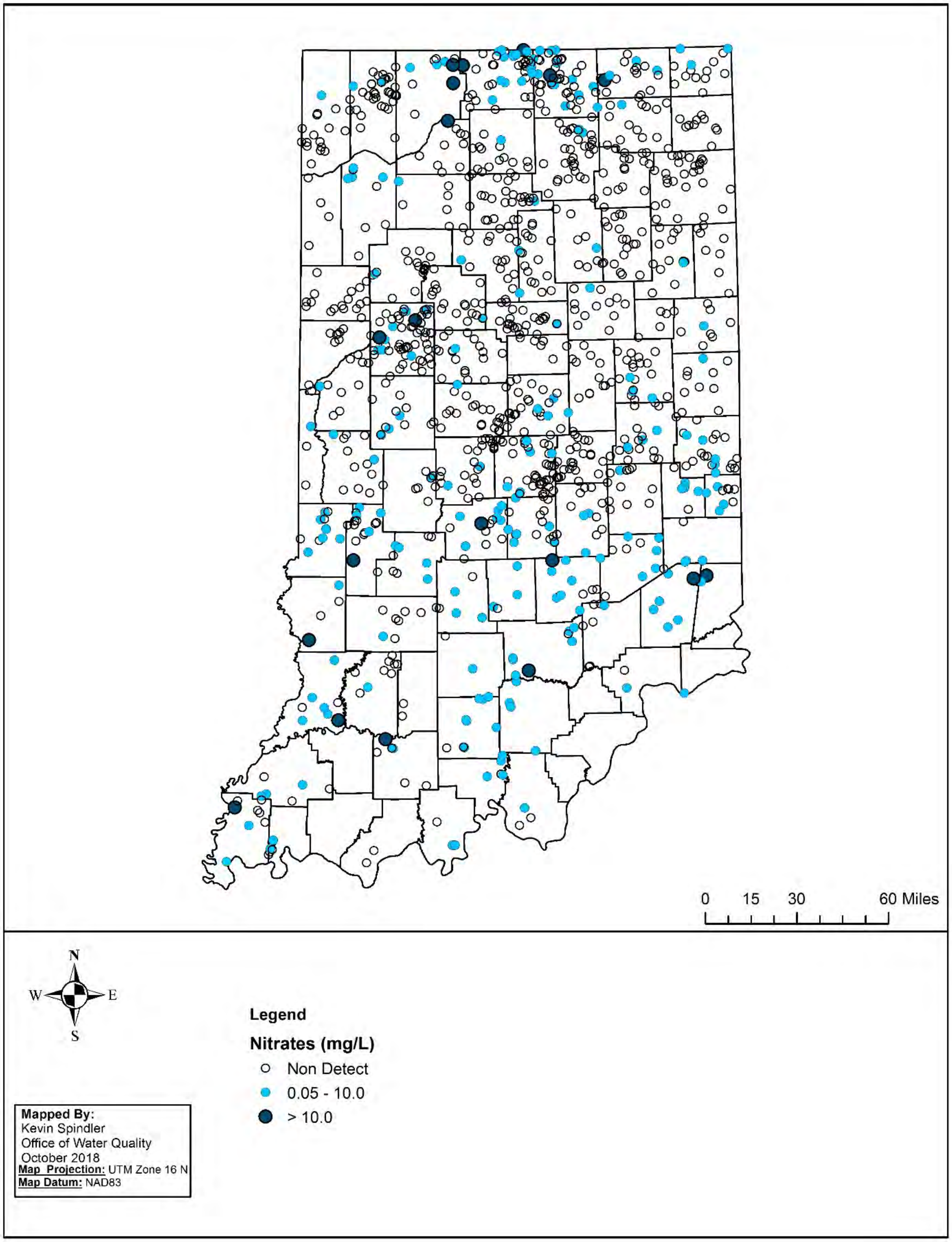


Figure 17 – Nitrogen, Nitrate-Nitrite Concentrations (mg/L) analyzed from wells

Data Sharing and Inventory – There is a wealth of monitoring data available in Indiana from the US Geological Survey (USGS), IDEM, other governmental entities, universities, and non-governmental organizations such as watershed groups, environmental consultants, and conservation organizations. The Indiana Water Monitoring Council (InWMC) was formed to "Maximize resources through improved communication, coordination, data sharing, and collaboration." Specifically, the InWMC:

1) provides a forum for communication among groups that are monitoring water resources,
2) promotes sharing of monitoring information including data, and effective procedures and protocols for sample collection, and
3) facilitates the development of collaborative monitoring strategies.

The InWMC prepared *An Assessment for Optimization of Water-Quality Monitoring in Indiana, 2017* to be used by environmental managers, researchers, and interested citizens who need data from sampling sites that have long periods of record. The goal of this paper is to document existing, ongoing river and stream water quality networks within Indiana, and to identify potential sites of redundancy and where there are gaps in the network of monitoring sites. Indiana strives to optimize its surface water quality monitoring network in order to ensure that all major stream/rivers entering and leaving Indiana borders, as well as major river basins, have water quality monitoring done at co-located stream gages so that nutrient loads and trends can be determined. This whitepaper has been updated and is in the process of being reviewed by USGS.

Building upon the findings of the InWMC's whitepaper, The Nature Conservancy (TNC) and USGS initiated a study in the Fall of 2018 focused on the Upper White River Watershed. The Upper White River, which drains a large portion of central Indiana (including the cities of Indianapolis, Carmel, Noblesville, Fishers, Muncie, and Anderson) has been identified as a major contributor of nutrients (nitrogen and phosphorus), some of which ultimately reaches the Gulf of Mexico. TNC wants to better understand which parts of the Upper White River watershed contributes the most nutrients, to focus efforts and investments that contribute to nutrient-load reduction. USGS, in cooperation with the TNC, will catalog existing nutrient and streamflow data for the Upper White River, test for temporal trends in streamflow and nutrient concentrations at selected locations, select methods suitable for computing nutrient loads with existing data, estimate nutrient loads where possible, and attempt to evaluate the relative contributions of nutrients from urban and agricultural sources.
Another successful outcome of the InWMC Monitoring whitepaper, is the partnership between the USGS, IDEM, ISDA, and TNC who worked together to provide funding and resources to install a supergage on the Wabash River in New Harmony, IN to better capture the nutrient loads in the Wabash River.

Additionally, IDEM's External Data Framework was launched in the last quarter of 2015 and provides acceptance criteria for three "tiers" of data based on data documentation of quality assurance. This qualification of the abundant data collected by the various monitoring entities listed above will be available to the public for different uses.

The Indiana Water Summary report is a publication of the InWMC that summarizes important water-related monitoring and research happening in Indiana. The Indiana Water Summary 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 great communication and collaboration. To read about some of the important work going on in Indiana to better understand, manage, protect, and restore our water resources, you can read the report at: https://www.inwmc.net/resources/indiana-water-report/.

IDEM Lake Monitoring Data

The Indiana Clean Lakes Program was created in 1989 as a program within the Indiana Department of Environmental Management's (IDEM) Office of Water Management. The program is administered through a grant to Indiana University's School of Public and Environmental Affairs (SPEA) in Bloomington. The Indiana Clean Lakes Program is a comprehensive, statewide public lake management program founded on three overall objectives:

1. Lake Water Quality Assessment
    - Lake water quality assessments are conducted annually on 70-80 publicly accessible lakes randomly distributed throughout the state of Indiana.
    - These data are used to update the lake classification system and management plan as well as to update Sections 305(b) and 303(d) listing of impaired waterbodies to the U.S. EPA.
2. Citizen Science – Volunteer Lake Monitoring
    - The Volunteer Lake Monitoring expands upon the water quality assessments of the statewide program by training volunteer citizen scientists to collect data on the lake where they live or most frequently recreate.
    - Data from citizen scientists allow the Indiana Clean Lakes Program to track more long term trends in specific lakes than would be cost effective for the statewide monitoring program.
    - The program has multiple levels of monitoring available depending on the needs of the lake community and the volunteer's time commitment.
3. Outreach and Education
    - *Water Column* Newsletters
    - Sponsor and present at the annual Indiana Lakes Management Society
    - Trainings and workshops: Lake Science 101, Aquatic Macrophyte ID and Mapping, Aquatic Invasive Species Monitoring, etc.
    - Lake Association programs and assistance: technical assistance on their lake and data interpretation, develop programs and workshops for the specific needs of these groups, etc.

Harmful Algal Bloom (HAB) Monitoring Data

IDEM's blue-green algae (cyanobacteria) surveillance program samples eighteen swimming beaches at fifteen IDNR owned or managed sites and analyzes those samples for the type and quantity of blue-green algae present and for the following toxins which may be produced by certain types of blue-green algae: microcystin, cylindrospermopsin (only done if species that produce it are present), anatoxin-a, and saxitoxin.

In 2017, IDEM commenced sampling at the Ft. Harrison State Park Dog Park Lake. For protection of human health from exposure to the algae and any of the toxins, cyanobacteria will be compared to the World Health Organization (WHO), United States Environmental Protection Agency (EPA) and Ohio Department of Health (ODH) guidelines. WHO guidelines recommend using an action level of 100,000 cells/ml of cyanobacteria to post recreational advisory signs. IDNR's advisory states, *"Swimming and boating permitted. Avoid contact with algae. Avoid swallowing water while swimming. Take a bath or shower with warm soapy water after coming in contact with lake water. Do not use lake water for cooking or bathing. Do not allow your pets to swim or drink water where algae are present."*

For cyanotoxin exposure for dogs, the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment has developed action levels for microcystin, anatoxin-a and cylindrospermopsin. The Oregon Health Authority Public Health Division has set an action level for saxitoxin. A warning to dog owners using the Fort Harrison State Park Dog Park lake will occur whenever any cyanotoxins are detected, and the lake will be closed to dogs if levels in the table below are met.

EXPOSURE THRESHOLDS

Exposure Reference Values ppb (µg/l)	Microcystin	Cylindrospermopsin	Anatoxin a	Saxitioxin
Human Recreation Advisory	8.0	15.0	80.0	0.8
Human Recreation Prohibited	20.0	20.0	300.0	3.0
Dog Recreation Prohibited	0.8	1.0	0.4	0.05

Table 1 – Exposure thresholds for human and dog recreation.

Toxin results will be posted if they meet those threshold numbers. Exact cell counts and toxin levels can be found in the Test Results section of the web site at https://www.in.gov/idem/algae/2343.htm. Swimming areas will stay on the High Cell Count Alert until the cell counts fall below 100,000.

The Blue-Green Algae home page is found at: http://www.in.gov/idem/algae/.

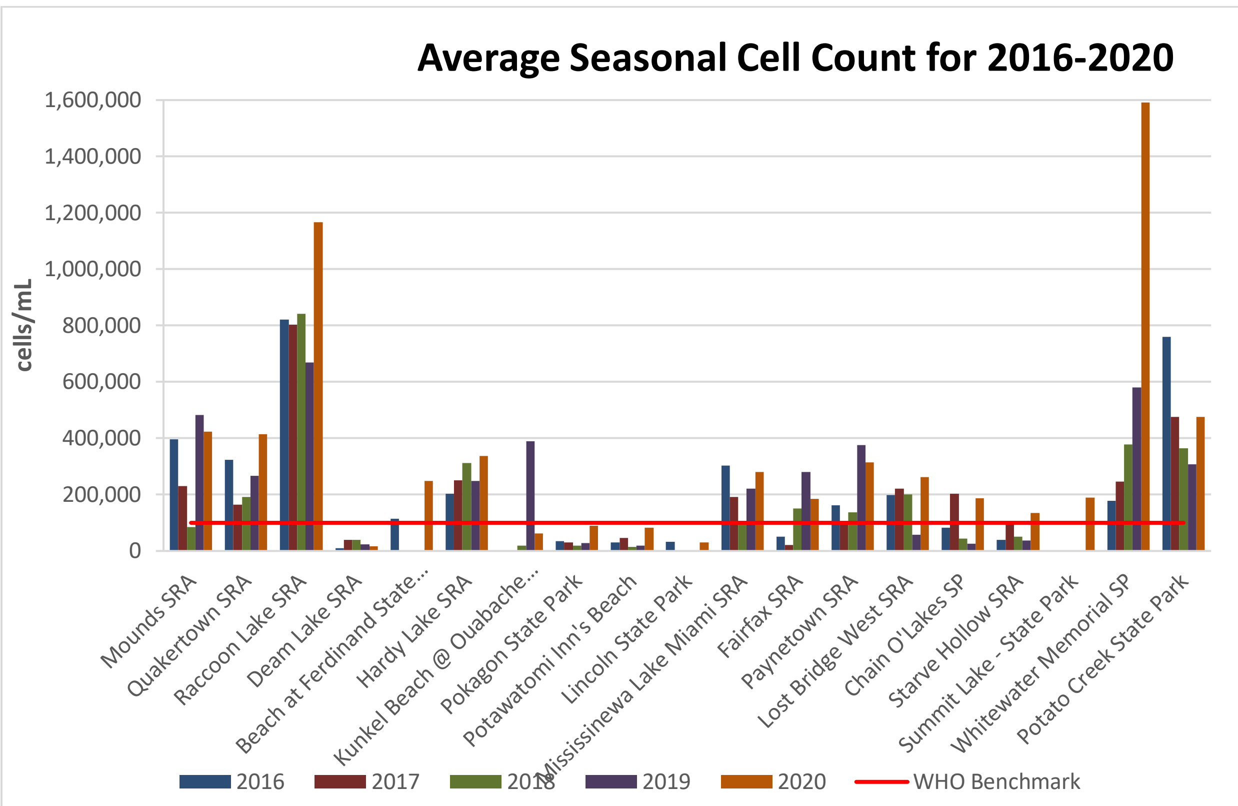
Following are the tables and a figure showing results of the sampling over the last three years.

Cell Count Summary

Recreation Advisory Issued at 100,000 Cells

Year Sampled	2018	2019	2020
# Lakes	14	13	19
# Samples	94	88	130
Highest Cell Count	2.0 million	1.3 million	3.4 million
% Over 100,000	41%	50%	60%
% Over 1 million	3.2%	3.4%	9.2%

Table 2 – Cell Count Summary for lake sampling.



Note: This average seasonal cell count graph does not show data from the Ft. Harrison Dog Park Lake, Patoka State Recreation Area Beach, or Cagles Mill Beach sites. Scrolling over the bars will give the actual average cell count numbers.

Figure 18 – Average Seasonal Cell Count for 2016-2020 in sampled State Recreation Areas (SRAs) and State Parks.

Microcystin Toxin Summary

Year Sampled	2018	2019	2020
Samples Analyzed	101	91	136
% at or above MRL of 0.3 ppb	4.0%	6.6%	1.5%
Highest Concentration (ppb)	0.34	16.4	4.13
Average Concentration (ppb)	0.11	0.72	0.14

Anatoxin-a Toxin Summary

Year Sampled	2018	2019	2020
Samples Analyzed	100	88	136
% at or above MRL of 0.4 ppb	13.0%	2.3%	2.2%
Highest Concentration (ppb)	2.99	1.12	0.90
Average Concentration (ppb)	0.24	0.09	0.12

Saxitoxin Toxin Summary

Year Sampled	2018	2019	2020
Samples Analyzed	100	88	136
% at or above MRL of 0.05 ppb	27.0%	17.0%	7.4%
Highest Concentration (ppb)	0.357	0.198	1.84
Average Concentration (ppb)	0.011	0.017	0.012

Cylindrospermopsin Toxin Summary

Year Sampled	2018	2019	2020
Samples Analyzed	64	43	87
% at or above MRL of 0.15 ppb	26.6%	14.0%	6.9%
Highest Concentration (ppb)	10.0	1.10	7.52
Average Concentration (ppb)	1.41	0.06	0.22

Table 3 – Results of sampling for Microcystin, Anatoxin-a, Saxitoxin, and Cylindrospermopsin toxin for 2018-2020.

CWA 305(b) Water Quality Assessments

CWA 305(b) requires states to assess water quality conditions of all waters of the state. IDEM conducts two types of CWA 305(b) assessments. Comprehensive basin assessments are based on statistical analyses of data collected by IDEM's Probabilistic Monitoring program and reflect overall water quality conditions throughout a given basin. Waterbody-specific assessments are based on data collected by both the Probabilistic and Targeted Monitoring programs and are representative of conditions in a given waterbody. Both assessment types are based on Indiana's water quality standards (WQS), which provide narrative and numeric water quality criteria that Indiana waters must meet to ensure they support their designated uses – the activities that we as a society want those waters to support and the benefits that we want them to provide (e.g. public water supply, propagation of aquatic life, recreation). Indiana's WQS may be found online at: http://www.in.gov/idem/cleanwater/2329.htm.

To make waterbody-specific 305(b) assessments, IDEM follows the processes outlined in its *Consolidated Assessment and Listing Methodology* (CALM), which describes the designated uses IDEM assesses, types and amount of data needed to make each type of assessment, and the water quality criteria used to make them. The CALM also explains IDEM's Consolidated Listing Process, which places all Indiana waters into one or more of five categories depending on what is known about their water quality and the extent to which they are meeting their designated uses. IDEM's most recent CALM is available online in the Notice of Public Comment Period for the 2020 303(d) list: https://www.in.gov/idem/nps/files/ir_2020_apndx_g_calm.pdf

Notable as water quality indicators for determining support of public water supply use is IDEM's assessment methodology for waters designated for public water-supply, which includes cyanobacterial toxins, cylindrospermopsin and microcystin-LR, for which U.S. EPA has issued drinking water health advisory values.

Public Water Supply Use Support – All Waters		
Chemical Toxicants	Minimum of three measurements collected within the same year at least one month apart	Most recent five consecutive years
Cyanobacterial Toxins	Minimum of one measurement Or One consumption and use notification issued by a water treatment facility based on cyanobacterial toxin concentrations in treated drinking water	Most recent five consecutive years
Conventional Inorganics	Minimum of three measurements collected within the same year at least one month apart	Most recent five consecutive years
Bacteria	All Level 1 and/or Level 2 assessments performed in accordance with the Revised Total Coliform Rule (RTCR)	Most recent five consecutive years

Table 4 – Public Water Supply Use Support – All Waters

Indiana is committed to prioritizing drinking water sources and reducing nutrients to them.

The 303(d) List of Impaired Waters

CWA Section 303(d) requires states to develop a list of impairments identified through IDEM's 305(b) assessments for which a Total Maximum Daily Load (TMDL) must be developed. IDEM's 303(d) program develops the 303(d) List of Impaired Waters as part of its Consolidated List and publishes both in the Indiana Integrated Water Monitoring and Assessment Report every two years. IDEM's most recent Integrated Report can be found online at: https://www.in.gov/idem/nps/2639.htm

The 303(d) list is a subset of IDEM's Consolidated List. The Consolidated List includes assessment information for all waters of the state while the 303(d) list includes just those water that are known to be impaired.

IDEM relies primarily on data collected by the Watershed Assessment and Planning Branch monitoring programs for its CWA 305(b) assessments, which are how most impairments are identified. However, IDEM also solicits additional data and information from external parties to develop its list, including state and federal agencies, colleges and universities and local organizations, such as county health departments, cities and towns, and watershed management groups, to develop its 303(d) list.

IDEM publishes the draft 303(d) list and the CALM every two years for a 90-day public comment period in order to lend transparency to its assessment and listing processes and to give the public an opportunity to provide input regarding these processes and any additional information that might be useful for developing the 303(d) list. U.S. EPA also provides comments during this time. After the public comment period ends, IDEM reviews all comments received, makes any necessary revisions, and works with U.S. EPA to get formal approval of the 303(d) list.

Total Maximum Daily Loads (TMDLs)

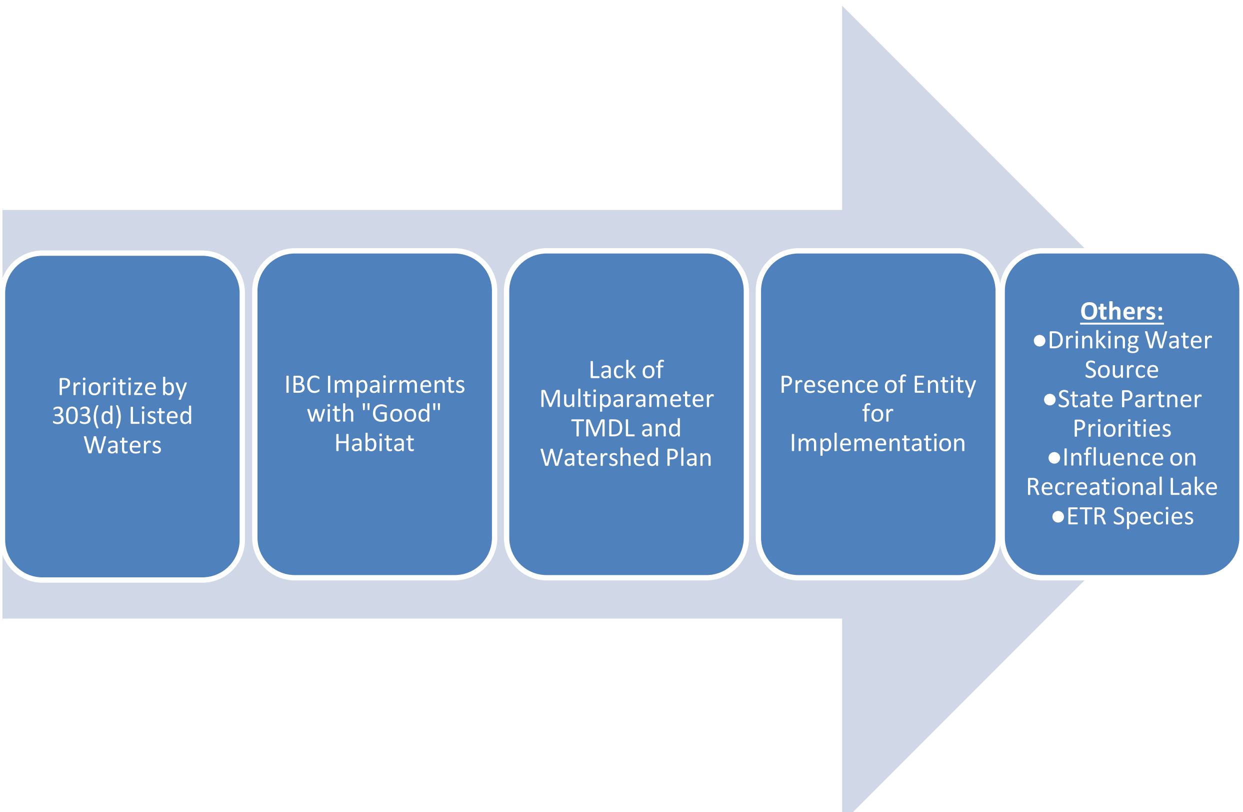
CWA Section 303(d) requires states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting their WQS and have been placed on the state's 303(d) list for one or more impairments. A TMDL is a report that identifies the maximum amount of pollutant that a waterbody can receive and still meet water quality standards, and allocates that amount among the sources of the pollutant in the watershed. The TMDL also provides information that can be used to guide restoration activities in the watershed aimed at mitigating the impairment(s) identified and restoring water quality.

The completion of a TMDL report is just the first step in remedying an impairment. Once a TMDL report is completed, IDEM works with local watershed groups wherever possible to implement the recommendations in the TMDL document, which are intended to help restore the waterbody to the point at which it meets water quality standards. More information on the TMDL program, including completed TMDL reports and those still in progress may be found online at: https://www.in.gov/idem/nps/2652.htm.

IDEM's TMDL Program Priority Framework, which EPA approved in 2016, identifies a prioritization process that addresses nutrient pollution by focusing on impaired biotic communities where the habitat is good. TMDLs will be developed for streams and rivers with impaired biotic communities and *E. Coli* impairments caused by one or more of the following conditions:

- Dissolved oxygen
- Algae
- Total Suspended Solids
- Phosphorus

The following graphic illustrates the secondary filters or considerations for prioritizing TMDLs:



Section 5 – Nutrient Criteria

The quantitative measure of the state's progress in nutrient reduction will be addressed in sections to follow.

Narrative Limits

The state of Indiana currently has narrative limits found at 327 IAC 2-1-6 regarding minimal criteria for water quality. Those state:

"All surface waters at all times and at all places, including waters within the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:

(A) Will settle to form putrescent or otherwise objectionable deposits.
(B) Are in amounts sufficient to be unsightly or deleterious.
(C) Produce:
(i) color;
(ii) visible oil sheen;
(iii) odor; or
(iv) other conditions;
in such degree as to create a nuisance.
(D) Are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to such degree as to:
(i) create a nuisance;
(ii) be unsightly; or
(iii) otherwise impair the designated uses

Numeric Criteria

The development of numeric criteria is a requirement of Section 303(c) (33 U.S.C. 1313(c)) of the CWA which directs states to adopt water quality standards for their navigable waters. Section 303(c)(2)(A) and EPA's implementing regulations at 40 CFR part 131 require, among other provisions, that state water quality standards include the designated use or uses to be made of the waters and criteria that protect those uses. Nutrient criteria are also necessary to support 303(d) listing decisions, to develop Total Maximum Daily Loads (TMDLs), and to determine permit limits. Indiana envisions that the codification of numeric nutrient criteria may be a driving force for water quality trading between point sources and agricultural producers, from which ecological benefits beyond just the reduction in nutrients will be realized. Indiana is one of three states, along with Ohio and Kentucky, to participate in the Electrical Power Research Institute's pilot water quality nutrient trading program for the Ohio River, and has been an integral part of helping to develop it. http://wqt.epri.com/

With that said, the development of numeric nutrient criteria for Indiana waters continues to present difficult and complex challenges. How these challenges are addressed has profound effects on the assessment and management of water quality. The precise cause and effect relationships of nutrients in the aquatic environment are not well quantified leading to uncertainties in the development of scientifically sound numeric nutrient criteria. IDEM continues to study these relationships in Indiana waters.

After analyzing existing total phosphorus data for rivers and streams, IDEM identified data gaps that are important in determining relationships between nutrient loads, excessive nutrients and their impact on biological communities. In 2017, IDEM implemented a pilot study in rivers and streams to better understand the relationships between nutrients, primary productivity, diel dissolved oxygen flux, and biological community matrices. While statistically significant relationships that would support numeric nutrient criteria for key variables were not determined from this small study, clear trends suggested that the dissolved oxygen regime may play a key role in these complex nutrient relationships. IDEM continues to collect data to further investigate these relationships to support the development of scientifically sound numeric nutrient criteria for key variables.

Regarding nutrient criteria for inland lakes and reservoirs, U.S. EPA proposed updated numeric nutrient criteria in 2020. These criteria are models to protect designated uses for either recreation, aquatic life, or drinking water, based on the needs of a state for a particular lake/reservoir or subset of lakes/reservoirs. IDEM submitted Indiana data to U.S. EPA for a pilot project to combine Indiana data with the national data set to develop an Indiana-specific model. This model proposes numeric nutrient criteria for chlorophyll α to protect recreational users from the harmful effects of microcystin, an algal toxin associated with cyanobacteria blooms in these waters. Once U.S. EPA finalizes the proposed criteria, IDEM will consider this model, and the other U.S. EPA criteria models to consider which numeric nutrient criteria models for chlorophyll a, Total Phosphorus and Total Nitrogen are appropriate for protecting designated uses for lakes and reservoirs, or a subset of lakes and reservoirs, before determining whether it is appropriate to adopt these criteria.

Currently, Indiana uses the following nutrient benchmarks, which are monitored by the IDEM and are considered alongside the state’s narrative limits in nutrient TMDLs:

Total Phosphorus	Not to exceed 0.3 mg/L
Nitrate+Nitrite	Not to exceed 10 mg/L (current Drinking Water standard)
Dissolved Oxygen	Not to be below 4.0 mg/L or consistently in the range of 4.0 to 5.0 mg/L
pH Values	Not to be above 9.0 or consistently close to the standard (8.7 or above)
Algae Growth	Should not be “excessive” based on field observations by trained staff

Section 6 – Practices to Reduce Point Source and Non-Point Source Pollution

Point Source Pollution

Point Source (PS) pollution is defined as water pollution that comes from a single, discrete place, typically a pipe. The Clean Water Act specifically defines a "point source" as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture."

It is important to remember that not all pipes create point source pollution. Federal and state laws exist that require permits and place limits on many different types of businesses, cities, and industry that may discharge water containing pollutants to a pipe that, in turn, may flow to a river, stream or lake. These limits are set at levels protective of both aquatic life and recreational use in the waters which receive the discharge. The National Pollution Discharge Elimination System (NPDES) program will be discussed further in the next section on programs.

Point Source (Regulated) Strategy Objectives

Urban/Suburban and Rural

- Wastewater Treatment Plants (WWTPs) and Publicly Owned Treatment Works (POTWs) will seek to employ optimization techniques by analyzing their current operation and maintenance processes to seek better nutrient removal.
- Combined Sewer Overflow (CSO) communities will implement their long term control plans (LTCPs) and associated schedules and track progress. Nutrient load reductions will be quantified via modeling and, where possible, by ambient water quality monitoring as projects and practices are implemented.
- Stormwater management:
    - Municipal Separate Storm Sewer System (MS4)[13] communities will implement their stormwater quality management plans (SWQMPs) and track progress.
    - Construction site sediment runoff controls will be implemented according to the Notice of Intent(NOI) and living stabilization covers will be used that minimize nutrient inputs.
    - Industrial site runoff controls will be implemented according to the Notice of Intent (NOI).
- Local health departments and communities will continue to identify failing residential septic systems and seek to put infrastructure in place to replace them or connect them to WWTPs.

[13] Municipal Separate Storm Sewer Systems (MS4s) are defined as a conveyance or system of conveyances owned by a state, city, town, or other public entity that discharges to waters of the United States and is designed or used for collecting or conveying storm water. Regulated conveyance systems include roads with drains, municipal streets, catch basins, curbs, gutters, storm drains, piping, channels, ditches, tunnels and conduits. It does not include combined sewer overflows and publicly owned treatment works. https://www.in.gov/idem/stormwater/2333.htm

Non-Point Source Pollution

Non-Point Source (NPS) pollution means that the source of pollution cannot be traced back to a single point or location, and its source is usually unidentifiable. It can come from oil, pet waste, pesticide, herbicide, fertilizer, road salt, bacteria, sediment, and any other contaminant that ends up on the ground naturally or from human activity. Rainwater and snowmelt picks up these contaminants as it washes over yards, sidewalks, driveways, parking lots, and fields and deposits them into Indiana's lakes and streams as nonpoint source pollution. Common sources of nonpoint source pollution in Indiana include:[14]

- Animal production operations and feedlots;
- Agricultural activities;
- Stream bank and shoreline erosion;
- Timber harvesting;
- Land disturbance;
- Urban, suburban, and rural residential runoff;
- On-site sewage diposal units;
- Solid waste disposal landfills;
- Transportation-related facilities;
- Coal mining;
- Oil and gas production;
- Non-energy mineral extraction; and
- Atmospheric deposition

Non-Point Source Strategy Objectives

The overall goals are to enhance nutrient management, promote soil health practices, and restore more natural hydrology and ecological functions by promoting drainage water management, floodplain restoration, and wetland restorations (rather than moving water off the landscape quickly) and emphasizing the importance of allowing water to infiltrate where it falls.

Hydromodification is the alteration of the natural flow of water through a landscape that reduces precipitation infiltration and changes drainage patterns causing rainfall to discharge into streams more quickly with higher energy. Large flow events occur more frequently and local drought and flood cycles may be exacerbated. The US EPA indicates that hydromodification is one of the leading sources of water quality degradation in our nation's waters.[15]

> *The US EPA indicates that hydromidification is one of the leading sources of water quality degradation in our nation's waters.*

[14] https://www.in.gov/idem/nps/2368.htm

[15] National Management Measures to Control Nonpoint Source Pollution from Hydromodification, EPA 841-B-07-002, July 2007.

Examples of hydromodification include channelization and dredging; streambank denuding; removal of riparian corridors, wetlands and floodplains; stream relocation; dams; streambank and shoreline hardscapes; subsurface drainage (agricultural and residential); and conversion of open landscape to roads, buildings, parking lots, and other impervious surfaces. These changes to flow result in higher sedimentation and nutrient loading to our waterways as well as higher water temperatures, lower dissolved oxygen, degradation of aquatic habitat structure and declines in biological communities.

Opportunities for mitigation include but are not limited to the following approaches:

Urban landscapes: create a green infrastructure (GI) paradigm by seeking incentives and opportunities for it.[16]

- Support practices that promote infiltration, bio-retention, and more natural water release.
- Seek the installation of larger, regional or multipurpose GI practices that are often more cost-effective.
- Ensure that the maintenance of GI practices is included in cost estimates and budgets.
- Provide technical and financial support to install rain gardens, green roofs, rain barrels, and porous pavement in industrial, commercial and residential settings.

Rural landscapes:

- Restore stream sinuosity and riparian buffers.
- Restore and reconnect riparian wetlands and floodplains.
- Employ practices from the *Indiana Drainage Handbook* for the maintenance of legal drains such as retaining native vegetation on one streambank while staging maintenance equipment on the side with easier drain access.
- Install 2-stage ditches where feasible on both regulated and non-regulated drains.
- Install drainage water management BMPs and saturated buffers on working lands.
- Restore natural wetland areas with hydric soils

Agricultural landscapes:

- Ensure compliance with the Confined Feeding Operation (CFO) and Fertilizer Certification rules via routine inspections.
- Timely investigate reports of nutrient mismanagement or runoff from regulated farms and spills from unregulated farms.
- Repair broken sub-surface drainage tile that create blow-holes that allow surface water to enter sub-surface drainage systems. Consider adding blind inlets in place of tile risers.
- **Promote nutrient management**:
  - Optimize inputs and uptake by crops through employing nutrient efficiency practices of the "4 Rs" specific to the cropping system namely, applying the right nutrient source at the right rate at the right time in the right place.
    - Examples of some nutrient efficiency practices includes:

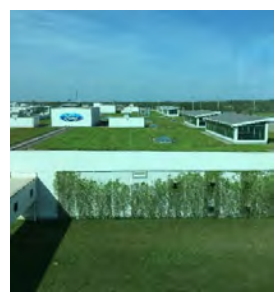
[16] U.S. EPA's website for Green Infrastructure is a great resource for design and implementation measures as well as funding sources, and Indiana's manual entitled the *Planning and Specification Guide for Effective Erosion and Sediment Control and Post-Construction Water Quality* shows pollutant removal expectations for the various BMPs.

        - No fall application of nitrogen is recommended, but if fall application is done, it should not be in any form of nitrate and after soil temperatures are below 50°.
        - Type of nitrogen and placement – do when it can be most efficient for the crop, for the environment, and for economics.
        - Split applications of nitrogen can reduce input costs and prevent over-application of nutrients.
        - Apply sulfur to make nitrogen and phosphorus more available to plants (sulfur increases/improves nitrogen and phosphorus efficiency).
        - Use nitrogen stabilizers in the soil to extend the availability of nitrogen in the root zone during critical growth stages. It keeps N in the form ($NH4$) that is available to the plant instead of the form ($NO3$) that is lost through leaching into groundwater or denitrification into the atmosphere.
    - Increase outreach on manure management to livestock farms.
    - Increase outreach to and adoption by farmers of performing regular soil sampling to determine nutrient management needs on ag land.
- **Emphasize soil health**: Healthy soil with a higher organic matter content reduces erosion, requires less nutrient inputs, ameliorates the effects of flood and drought, and reduces nutrient and sediment loading to streams and rivers. The four key principles to increasing organic matter and building healthy soils are:
    - Minimize disturbance through no till or conservation tillage practices.
    - Maximize soil cover.
    - Keep living roots growing as long as possible.
    - Grow a variety of plants.

<u>Practices to Reduce Non-Point Source Pollution</u>

<u>Urban/Suburban practices</u>: below are some examples and recommendations of BMPs that can be used in urban and suburban landscapes to address non-point source pollution.

- Curb Cuts: curb cuts are spaces cut into parking lot curbs to allow storm water to flow onto a pervious surface. In areas with large parking lots, curb cuts are a good option for reducing storm water runoff, and can be especially valuable if combined with the parking islands that contain a rain garden.
- Green Roof: green roofs are where plants and small shrubs are planted on top of buildings. Green roofs lower the temperature of a building, filter pollution and reduce the amount of runoff from rain. They can also reduce the heat island effect in cities.



- Porous pavement: porous pavement refers to any surfacing material that allows storm water to move through it rather than run off.
- Rain Barrel: a rain barrel is a large 40-60 gallon container that collects rainwater from a roof. The barrel is placed at the base of a downspout which directs the water into the barrel during rain and a hose attached to the bottom of the barrel can be used to water lawns and gardens.
- Rain Garden: a rain garden is a planted depression that collects rainwater runoff from impervious urban areas, such as roofs, driveways, walkways and compacted lawn areas, and allow the water to absorb into the ground. This reduces rain runoff by diverting rainfall away from storm drains.

- Swale: a swale is very similar to a rain garden. Both are depressions where storm water is allowed to infiltrate deep into the ground. Swales are usually larger and longer that rain gardens, and are able to treat greater amounts of storm water.

Agricultural practices: below are some examples and recommendations of BMPs that can be used on agricultural lands to address non-point source pollution.

An important factor to consider on agricultural lands is sub-surface drainage. The use of sub-surface drainage tile on agricultural lands is important for high production of agricultural crops, however sub-surface drainage is associated with an increase in nitrate loads to streams and rivers that drain to the Gulf of Mexico and the Great Lakes, where it contributes to the low oxygen hypoxic zone. One way to reduce nitrate loads would be to reduce the amount of drained land, but this is unlikely due to the important role of drainage in Midwestern agriculture. Instead focus should be on ways that cropping systems and drainage systems can be managed to reduce nitrate loads, while maintaining high agricultural productivity. [17]

One way to reduce nitrate loads would be to reduce the amount of drained land, but this is unlikely due to the important role of drainage in Midwestern agriculture. Instead focus should be on ways that cropping systems and drainage systems can be managed to reduce nitrate loads, while maintaining high agricultural productivity.

The following ten practices are BMPs that can be used in managing nitrate loads thus improving water quality from agricultural-drained cropland and comes from the University of Illinois, Purdue University, Iowa State University and the University of Minnesota publication titled "Ten Ways to Reduce Nitrogen Loads from Drained Cropland in the Midwest".

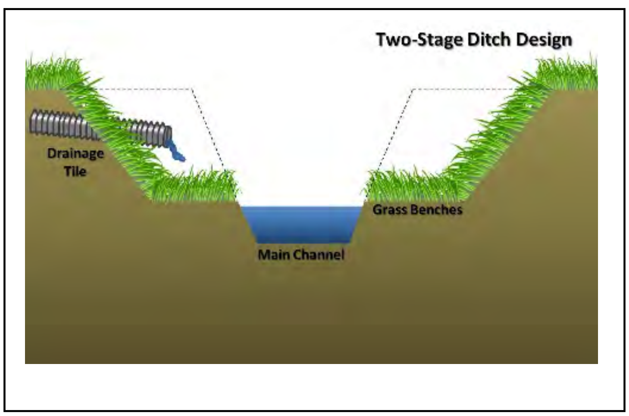
Nitrogen Reduction Practices

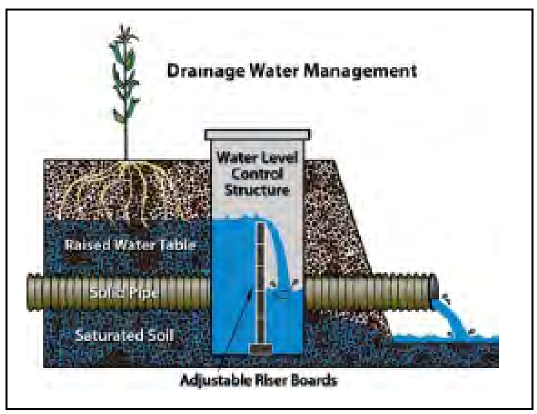
- Improved nitrogen management – applying nitrogen at the rate needed by the crop and in spring or summer as close as possible to the time it is needed can reduce nitrate loads in subsurface drainage water.
- Winter cover crops – cover crops, such as cereal rye, that are planted in the fall and cover the soil during the winter reduce nitrate losses by taking up water and nitrate from the soil after the main crop is harvested, and cover crops that overwinter can also take up nitrate before the main crop starts growing in the spring.
- Increasing perennials in the cropping system – Perennials are plants that can grow for two or more years without re-planting, such as hayland. They reduce nitrate loads by

[17] "Ten Ways to Reduce Nitrogen Loads from Drained Cropland in the Midwest", L.E. Christianson, J. Frankenberger, C. Hay, M.J. Helmers, and G. Sands, 2016. Pub. C1400, University of Illinois Extension.

extending the season during which water and nitrates are removed from the soil, and are the least "leaky" cropping system.

- Controlled Drainage (Drainage Water Management) – Drainage water can be managed through the use of adjustable water control structures placed in the drainage system that allow the outlet level (or water depth) to be adjusted. Water can be held in the field reducing the overall amount of drainage water and nitrogen that moves downstream.
- Reduced Drainage Intensity – Installing drainage pipes either with wider spacing or closer to the soil surface can reduce the total water drained, and thus, result in less nitrate transported from the field.
- Drainage Water Recycling – Capturing and storing drainage water in a pond or reservoir and then returning it to the soil through irrigation can reduce or even potentially eliminate nitrate loss by reducing the water that leaves the site.
- Bioreactors – bioreactors are trenches filled with woodchips through which drainage water is routed, allowing water to be treated by enhancing the natural, biological process of denitrification.[18]
- Constructed Wetlands – Constructed wetlands remove nitrate through denitrification, plant uptake, and reduction in flow due to seepage and evaporation.
- Two-Stage Ditches – this practice consists of a small main channel that accommodates low flow conditions and a second low, grassed floodplain that accommodates high flows within the ditch. This creates a zone of plants and soil that absorbs part of the nitrate load through plant uptake and denitrification, and can also reduce flow, as well as decrease costs of ditch maintenance.
- Saturated Buffers – this is an edge-of-field practice that allows drainage water to be distributed through a riparian buffer via a shallow perforated drain pipe that extends laterally along the buffer. As the drainage water seeps through the buffer soil, denitrification is increased and the roots take up the drainage water and nitrate.

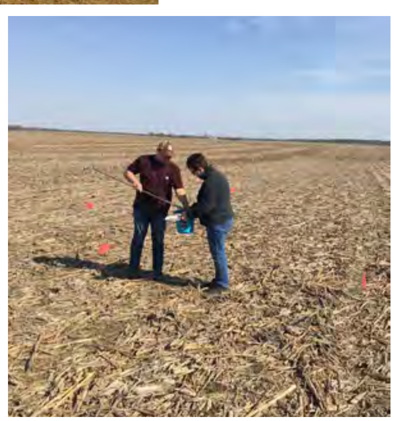




[18] Denitrification is defined as the part of the nitrogen cycle where nitrate is converted to a gaseous form of nitrogen, typically either dinitrogen gas or nitrous oxide. The soil microbes responsible for this process require a carbon source and anaerobic (low oxygen) conditions in addition to a supply of nitrate.

Phosphorus Reduction Practices: The following BMPs can also be used to reduce phosphorus loads from agricultural lands, and are practices that help keep soil in place to prevent erosion.

- Conservation Tillage Practices – No-till, strip-till, ridge till and mulch till are practices that leave crop residues on the soil surface to reduce soil erosion by water, and can increase organic matter content of the soil allowing for many benefits including increased infiltration.
- Cover Crops – cover crops can hold the soil in place to prevent erosion and the transport of particulate phosphorus attached to sediment. Also, because cover crops increase infiltration of water, this reduces surface water runoff with dissolved phosphorus.
- Conservation Buffers – Strips of land planted with trees and/or grasses help control pollutants by slowing water runoff, preventing erosion, trapping sediment and fertilizers, and enhancing infiltration within the buffer area. Buffers can include riparian areas, grass filter strips, and grassed waterways.
- Perennial Crops – long-term planted crops help keep soil in place to reduce erosion and allow for infiltration of water to reduce runoff.
- Grade Stabilization Structures – these are practices that hold soil in place to prevent excessive erosion in high flow areas.
- Blind Inlets – using blind inlets in place of tile risers in the field can filter excess water and P loss to tile drains.
- Soil Testing – conducting a soil test provides an opportunity to check the nutrient levels in the soil, thereby allowing accurate nutrient recommendations and management to be made for the field.
- Nutrient Management – using the right sources of fertilizers and manures at the right rate at the right time and in the right place allows for good management of nutrients and can improve the efficiency of the plants that are using the nutrients, thus decreasing the amount that is transported off the field.



Section 7 – Development of an Indiana Science Assessment

Estimating nutrient reduction from individual conservation practices is critical for tracking water quality improvement but is very scientifically challenging. Indiana has made substantial progress in tracking sediment and nutrient load reductions statewide. Starting in 2013, the EPA Region 5 Sediment and Nutrient Load Reduction Model was adopted by the ICP to model the conservation practices that are implemented through assistance of all the ICP partnership staff. The current method that Indiana uses to capture sediment and nutrient load reductions from the conservation practices applied is explained further in Section 9 – “Measuring Impacts”. While this method has worked for Indiana, it has some limitations and it would benefit from using the most recent research and by including more parameters such as dissolved nutrients and practices such as nutrient management. The Indiana Conservation Partnership would like to strengthen the current method in order to capture more accurate reductions and to better assess the progress being made on improving water quality.

In November of 2018, Indiana held a workshop titled “Nutrient Reduction Estimation Framework”, that invited and convened researchers, conservation agency staff, and others to discuss how Indiana’s framework for establishing nutrient reduction estimates from the implementation of conservation practices could be enhanced, including adding the component of dissolved nutrients. The goal of the workshop was to:

- Determine how we can capture nutrient load reductions from dissolved components;
- Better model our nutrient load reductions from conservation practices, and better determine the impact of various practices on water quality; and
- To use the workshop as one of the tools toward the development of a science assessment for Indiana.

It was agreed upon at the workshop that Indiana needs a science assessment to determine a load reduction method based on observed reductions in Indiana and similar regions in the Midwest. Additional goals to achieve would be determining the current or baseline load which can be used to set goals and provide an additional method for assessing progress, provide agreed-upon reduction estimates that could be used beyond the state’s Nutrient Reduction Strategy, provide a foundation for speaking with one voice about conservation priorities, and determining the efficiency of various conservation practices on the reduction of nitrogen and phosphorus loads to improve water quality.

Tracking nutrient loading in Indiana’s waterways is important for highlighting the accomplishments of all conservation practice implementation efforts around the state. Monitoring efforts statewide have been increasing in recent years as well, yet gaps in the data remain, making it challenging to tie modeled data to observed effects downstream. Without an Indiana focused science assessment, national models sometimes based on extrapolation are used, which may not highlight progress made in Indiana. A science assessment can provide a systematic, inclusive, widely accepted assessment of Indiana’s nutrient loads during the baseline period and in future years.

A Core Team of partners from the Indiana State Department of Agriculture (ISDA), Indiana Department of Environmental Management (IDEM), the Indiana Natural Resources Conservation Service (NRCS), the Indiana Chapter of The Nature Conservancy (TNC), the

Indiana Agriculture Nutrient Alliance (IANA), and the Purdue University College of Agriculture has developed an overall strategy to guide the Science Assessment, which was finalized in September of 2019. See the Assessment strategy in Appendix C or visit https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/indiana-science-assessment/.

Components of the Indiana Science Assessment

The Science Assessment consists of two critical needs to move the State Nutrient Reduction Strategy forward.

1. **Component 1: Determine historic and ongoing nutrient loads leaving the state, and also by watershed basins in the State Nutrient Reduction Strategy.**

Through Component 1, water quality monitoring data at key locations around the state has been identified, analyzed and is being used to determine the trend of nutrient loads leaving the state at the pour points on the state borders, and at pour points within the major river basins in the state. Analysis and trend results at the New Harmony, IN location is work that was done previously by USGS and is published work.[19] All other data included in the trend analysis is from USGS's streamflow and discharge data and IDEM's Fixed Station water quality and nutrient concentration data. In addition, although the site locations identified at the pour points are determined to be key locations, some may change based on insufficient data. The USGS WRTDS model (as explained on page 11) is the method that is being used to process concentrations and flows into loads.

Partners and stakeholders within the state that are a part of the sub-committee for Component 1 include staff from the Indiana State Department of Agriculture, the Indiana Department of Environmental Management, the United States Geological Survey, and the Indiana Chapter of The Nature Conservancy.

There are nine proposed locations around the state border where monitoring data has been collected and trends are being calculated and determined for Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Solids (TSS).
These proposed locations include: (see Figure 19 on the next page)

1. Wabash River at New Harmony, IN (Wabash River Basin)
2. Blue River near White Cloud, IN (Ohio River Basin)
3. Whitewater River at Brookville, IN (Whitewater River Basin to the Ohio River)
4. Maumee River at New Haven, IN (Lake Erie Basin)
5. St. Joseph River at Niles, MI (Lake Michigan Basin)
6. Trail Creek at Michigan City, IN (Lake Michigan Basin)
7. Burns Ditch at Portage, IN (Lake Michigan Basin)
8. Kankakee River at Shelby, IN (Kankakee River/Illinois River Basin)
9. Iroquois River near Iroquois, IL (Kankakee River/Illinois River Basin)

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[19] https://www.sciencebase.gov/catalog/item/582c7affe4b04d580bd37805

Figure 19 – Pour points at the state border with WQ monitoring data being used to determine nutrient loads and trends in WRTDS.

There are three pour points that are entering the state of Indiana and are also included in the analysis. These sites are located along the northeast border of Indiana and include: (see Figure 20 on the next page)

1. Mississinewa River near Ridgeville, IN (Wabash River Basin)
2. Wabash River at Linn Grove, IN (Wabash River Basin)
3. St. Joseph River near Newville, IN (Lake Erie Basin)

At this time, locations within the state's major river basins that are being looked at for analysis include: (see Figure 20 on the next page)

1. Wabash River at Lafayette, IN (Upper Wabash Basin)
2. Wildcat Creek near Lafayette, IN (Middle Wabash Basin)
3. White River at Newberry, IN (West Fork White River)
4. East Fork White River at Shoals, IN (East Fork White River)
5. Patoka River at Winslow, IN (Patoka River Basin)
6. White River at Petersburg, IN (White River Basin)
7. Wabash River at Riverton, IN (Middle and Lower Wabash Basins)

As mentioned before, although the site locations identified at the pour points are determined to be key locations, some may change based on insufficient data. In addition, this analysis of WQ data at the pour points and within the major drainage basins will be one of the tools to assist with the HUC 8 and HUC 12 prioritization process as explained in Section 3.

A report on the results of the analysis will be available in 2021.

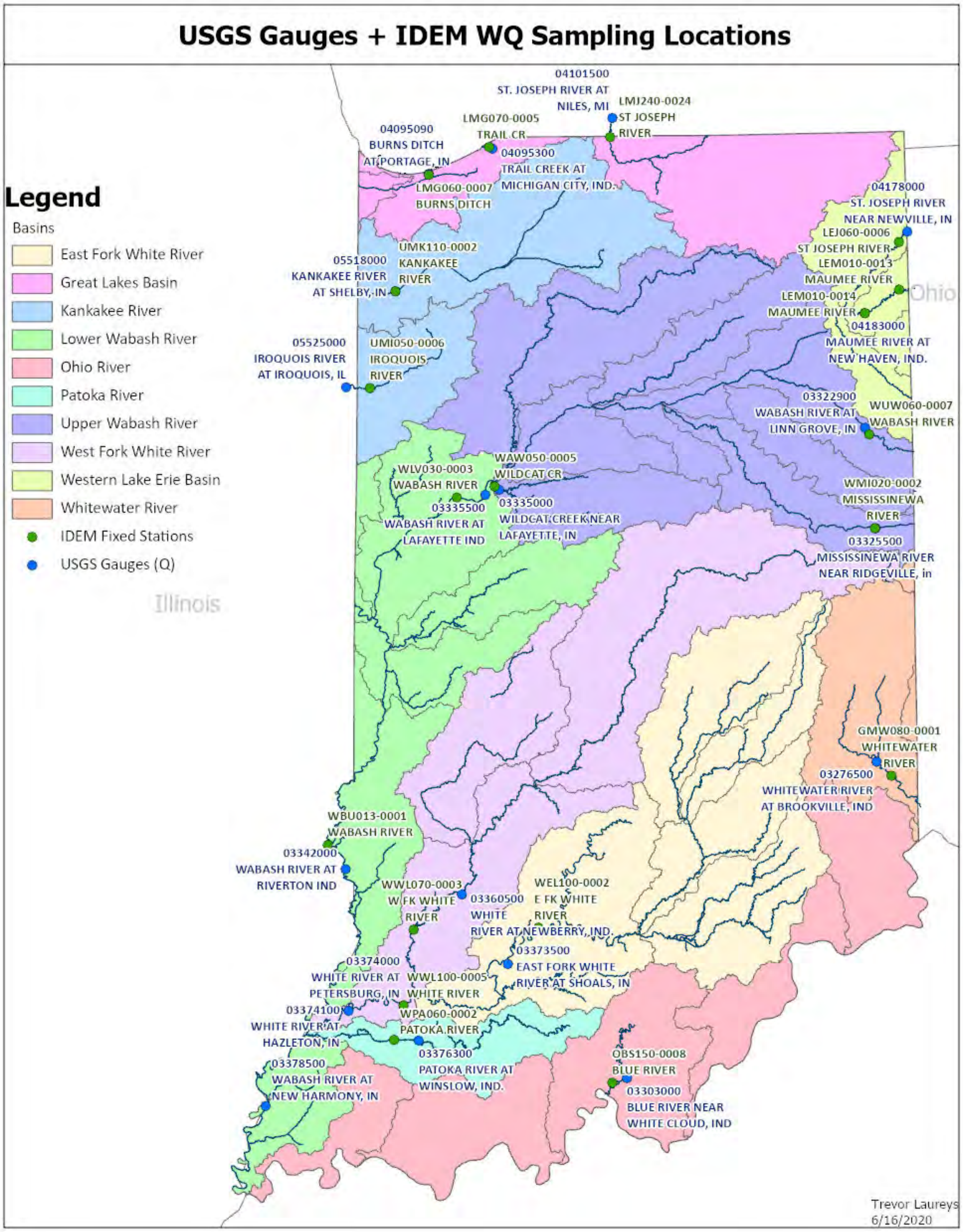


Figure 20 – Indiana map showing all proposed locations with water quality monitoring data and discharge data being used to determine nutrient loads in WRTDS.

2. **Component 2: Improve method to quantify nutrient reductions from conservation practices, including dissolved nutrients, and determine efficiency of practices in reducing loads.**

Monitoring conducted around the Midwest and in Indiana provides new understanding of the effectiveness of in-field and edge-of-field conservation practices in reducing nitrogen and phosphorus loads from agricultural fields. This research will be compiled, reviewed and be used to improve the current method that Indiana uses to calculate reductions in sediment, nitrogen, and phosphorus loads by identifying or developing a standardized tool and procedure for calculating nutrient load reductions from conservation practices, and be used in determining the percent efficiency of certain conservation practices on reducing the nitrogen and phosphorus loads. Drawing from available science that can apply to Indiana cropland, this will allow for more consistent communication of the value of practices to those involved in implementation, as well as uncover knowledge gaps that need to be addressed with future research.

This component will also include having a collective list and consistent definitions of conservation practices while considering their estimated nitrogen and phosphorus loss reductions, as well as the economic and agronomic feasibility of the practices.

The Science Assessment Core Team determined a list of 10 practices that will be part of Phase 1 of the project, and began discussion on the next list of practices for Phase 2.
The first ten practices will be:

Soil Health

1. No-Till
2. Reduced Tillage
3. Cover Crops

Nutrient Management

4. Nitrogen Rate
5. Phosphorus Rate (based on soil test P)
6. Nitrogen Timing
7. Subsurface P application

Edge-of-Field

8. Drainage Water Management
9. Filter Strips/Riparian Buffers
10. Grassed Waterways

To help carry out this component, Indiana received a grant from EPA through the Gulf of Mexico Hypoxia Task Force to help advance the state's nutrient reduction strategy. Through this grant, a research associate has been hired to compile and analyze research, develop a standardized tool, and determine percent efficiencies of conservation practices. The research associate is working out of Purdue University, and will be advised by a group of scientists at Purdue and other Indiana universities with experience and insight on nutrient processes and the effects of conservation practices, as well as by the Science Assessment Core Team.

The goal for completion of Component 2 of the Indiana Science Assessment is by the end of calendar year 2022. Following the completion of the Indiana Science Assessment, the list of practices and their associated load reductions and percent efficiencies will be reviewed each year to improve accuracy of the Science Assessment.

To see the specific steps that are a part of the Indiana Science Assessment, see the strategy in Appendix C or visit https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/indiana-science-assessment/.

Benefits of the Indiana Science Assessment

The Science Assessment will lead to:

- Improved documentation showcasing statewide progress towards nutrient reduction goals
- Prioritization of the most effective conservation practices based on Indiana conditions, to improve program implementation
- More accurate assessment of Indiana's contributions to downstream water quality issues
- Alignment of communication by researchers, agencies, and others throughout Indiana about conservation practices effectiveness
- Enhanced transparency and accuracy for Indiana's water quality improvement quantifications
- A bolstered set of reportable goal-tracking parameters that includes dissolved nutrients
- A scientifically sound understanding of the nature of nutrient loading in Indiana waterways
- Determining the scale of conservation needed by running a series of scenarios based on economic feasibility and on load reductions needed to reach a certain reduction goal.

Section 8 – Programs, Projects, and Initiatives Supporting Nutrient Reduction

Opportunities exist to reduce nutrient inputs from both urban and rural landscapes, including both point and nonpoint sources. Emphasis is on using existing regulatory and non-regulatory programs, and implementing voluntary BMPs.

Point Source/Regulatory Programs

National Pollutant Discharge Elimination Systems (NPDES) - NPDES permit requirements ensure that, at a minimum, any new or existing point source must comply with technology-based treatment requirements that are contained in 327 IAC 5-5-2. According to 327 IAC 5-2-2, "Any discharge of pollutants into waters of the State as a point source discharge, except for exclusions made in 327 IAC 5-2-4, is prohibited unless in conformity with a valid NPDES permit obtained prior to discharge." This is the most basic principal of the NPDES permit program.

To reduce significantly the discharge of nutrients to surface waters of the state and to protect downstream water uses, IDEM set a practical state treatment standard of 1.0 mg/l of total phosphorus (TP) for sanitary wastewater dischargers with design flows of 1 million gallons/day (MGD) or greater. This policy became effective January 1, 2015. Applying the 1mg/l TP limit will amount to a nearly 45-50% reduction of TP loads from major sanitary dischargers over the next few permit renewal cycles.[20]

Additionally, IDEM will implement TMDL load reductions as written and approved for total phosphorous upon the renewal of any affected permit, and IDEM will continue to implement phosphorus removal as required by 327 IAC 5-10-2. See figures in Appendix B for facilities with water quality monitoring for ammonia and phosphorus, including facilities with permit limit notations.

IDEM's position is that applying the state treatment standard of 1 mg/l total phosphorus to this limiting nutrient sufficiently addresses potential water quality impacts from point sources to fresh water systems; thus, there is no need to interpret Indiana's narrative criteria into water quality-based effluent limits at this time.

The State of Indiana is entering the third year of a plan to initiate a statewide monitoring requirement for total nitrogen in NPDES permits for major sanitary dischargers. To implement the process of total nitrogen data collection, IDEM is requiring all major sanitary dischargers with average design flow ratings of 1.0 MGD or greater to begin monitoring and reporting for total nitrogen as a requirement of their next NPDES permit renewal. This effort started with permittees required to submit NPDES renewal applications or applications for modification of an effective NPDES permit after January 1, 2019. IDEM is proposing that total nitrogen be

[20] In the 2016 SNRS, the estimated TP load reduction post NPD implementation was overestimated at 60%. With more monitoring data and actual discharge data,it appears to be closer to 45-50%- still significant.

monitored and reported to IDEM on a monthly basis, both as monthly average of concentration (mg/l) and monthly average mass discharged (lbs./day).

The data collected will be used to garner a better understanding of nitrogen loadings in Indiana waters and aid the State of Indiana with future updates of the State of Indiana's nutrient reduction efforts.

Non-Point Source/Regulated Programs

IDEM Wellhead Protection Program - IDEM's Wellhead Protection Program is an essential educational awareness program focusing on source water protection and promoting the resource value of ground water. Community Water Systems (CWS), which utilize ground water as their source of drinking water, are responsible for planning for the prevention of ground water to become contaminated through the implementation of their Wellhead Protection Plan. CWS planning activities include educating the public on pollution prevention, identifying potential sources of contamination within their Wellhead Protection Area, and promoting the value of the ground water resources. As mentioned earlier, IDEM developed the Ground Water Monitoring Network (GWMN) to gather ground water quality information across Indiana to be able to establish a baseline of ground water quality within Indiana's aquifers. Together, Indiana's Wellhead Protection Program and the GWMN are essential steps in Indiana's protection, characterization and improvements of ground water quality.

Confined Feeding Operations (CFOs) – All regulated animal feeding operations in Indiana are considered confined feeding operations (CFO). To be regulated under the Confined Feeding Control Law in Indiana, you must meet the following size of any one livestock group listed below:

- 300 or more cattle
- 600 or more swine or sheep
- 30,000 or more poultry (chicken, turkey or ducks
- 500 horses in confinement

Concentrated Animal Feeding Operations (CAFOs) - The concentrated animal feeding operation (CAFO) designation is strictly a size designation in Indiana. Farms of this size are permitted under the CFO rule, but have a few added requirements under Indiana regulations. A CFO that meets the size classification as a CAFO is a farm that meets or exceeds an animal threshold number in the U.S. Environmental Protection Agency's definition of a large CAFO, which is:

- 700 mature dairy cows
- 1,000 veal calves
- 1,000 cattle other than mature dairy cows
- 2,500 swine above 55 pounds
- 10,000 swine less than 55 pounds
- 500 horses
- 10,000 sheep or lambs
- 55,000 turkeys

- 30,000 laying hens or broilers with a liquid manure handling system
- 125,000 broilers with a solid manure handling system
- 82,000 laying hens with a solid manure handling system
- 30,000 ducks with a solid manure handling system
- 5,000 ducks with a liquid manure handling system

IDEM's Role

Anyone who plans to operate or start construction or expansion of a farm that meets the requirements of Indiana's Confined Feeding Control Law (Indiana Code 13-18-10) must submit an application and receive a permit from IDEM prior to beginning construction or expansion of an operation. No one may operate or start construction or expansion of a CFO without IDEM's prior approval. The laws and rules that govern IDEM's Confined Feeding Operation Program are found in 327 Indiana Administrative Code (IAC) 19 (CFO Rule) and 327 IAC 15-16 (NPDES CAFO Rule). IDEM's permitting, compliance, and enforcement sections implement the rules and the requirements of the laws:

Permitting

The CFO Permits staff reviews applications for CFO permit approvals. IDEM permit managers, engineers and geologists review designs and drawings and conduct inspections prior and during construction of new buildings and manure storage structures. The CFO permit manager is a good point of contact for any question regarding a new permit or modification, renewal, or construction for an existing permit.

Compliance

The CFO Compliance staff conducts routine and complaint-based inspections to assure compliance with operational requirements in the rules. New farms may receive an initial compliance assistance visit and will be inspected at least once in their first year of operation.

Enforcement

The Enforcement Section staff follows up with an enforcement action when a CFO has a serious or unresolved violation.

The CFO rule requires that CFO operations apply manure to their fields on the basis of the nitrogen needs for the crop to be grown or the soil's phosphorus content. Previously, manure was applied to fields based only on nitrogen needs for the coming crop. Fields with soil test phosphorus levels of 0 to 50 parts per million (ppm) may use nitrogen based manure application levels. Current regulations require that manure application on soils with soil test phosphorus levels greater than 50 ppm and not to exceed 200 ppm be based on the phosphorus content of the manure, soil, and on the crop to be grown on the field. If soil test phosphorus levels are greater than 200 ppm, manure from a CFO may not be applied to that land. That means that farmers will need to monitor soil phosphorus concentrations and work to begin the gradual process of reducing the phosphorus content of their fields. Additionally, there are rules specific to CFO operators regarding winter manure application and soil phosphorus. Under these regulations, manure application on frozen or snow-covered ground is not permitted with exceptions for emergency situations. Operators can apply for special permits that allow for winter application if a farm was previously permitted with less than 120 days of manure storage. CAFO sized operations are prohibited from spreading manure on frozen or snow-covered ground unless they get an Individual NPDES permit under 327 IAC15-16. https://www.in.gov/idem/cfo/

Fertilizer and Detergent Regulations - Thirty-five years ago, Indiana became the first state in the nation to protect its lakes and waterways by prohibiting the use of laundry detergents containing phosphorous under IC 13-18-9 and, in 2012, the state legislature extended the phosphorus ban to detergents used in residential automatic dishwashers. On July 28, 2010, the Indiana rule, *Certification for Distributors and Users of Fertilizer Materials,* 355 IAC 7-1.1, went into effect. The date for full compliance with the requirements of this rule was January 1, 2012. The purpose of this rule is to ensure that fertilizer users are competent to apply and handle these materials safely and effectively and in a manner that minimizes negative impacts on water quality and the environment.

Storm Water Runoff Programs

- Municipal Separate Storm Sewer Systems (MS4s)
  MS4s are required to develop Storm Water Quality Management Plans (SWQMPs) as part of their permit requirements. As part of their Public Education component, MS4s have taken an active role to educate the general public and commercial industry on the use of fertilizer, including the use of phosphorous free options. In addition to these education efforts, MS4s are required to address this issue on those facilities that they own and/or operate. The rule specifically states "minimization of pesticide and fertilizer use." While this is a basic non-descriptive requirement, MS4s have incorporated this element into their SWQMPs. As the Storm Water Program re-evaluates future requirements, this topic will continue to be assessed and where appropriate and applicable, provisions and requirements will become part of the regulation.

- Construction Site Run-off
  There are no specific regulatory requirements in the Rule regarding the application of nutrients on active construction sites during the stabilization of the site. However, the technical standards and specifications in the *Indiana Storm Water Quality Manual* encourages utilization of soil tests and lower application rates for fertilizer. Additionally, the premise of the Construction Site Run-off regulation is reducing sediment discharges, which in turn reduce the discharge of nutrients (phosphorous).

- Industrial Site Run-off
  Due to the diversity and uniqueness of industrial facilities, it is problematic to develop a "one size fits all" approach. Therefore, IDEM deals with such facilities on a case-by-case basis. Issues that are considered in such an approach include, but are not limited to, concentration and loading of the discharge, the applicable aspects (flow, impairments, downstream uses, etc.) of the receiving stream, and the facilities' treatment capabilities.

Non-Point Source/Non-Regulated (Voluntary) Programs

Indiana has an impressive infrastructure in place that serves to educate conservation partners and the public. This infrastructure, which exists in the form of state and federal entities, is the most important tool we have in our "toolbox". By organizing educational and outreach events, helping to leverage state and federal funds, offering technical assistance and expertise, and providing cost-share programs to those wishing to put conservation practices on the ground, state and federal employees are directly promoting grass roots solutions to environmental issues by empowering agri-business, educational institutions, farmers, landowners, watershed groups and other environmental organizations to be a part of the solution. While the majority of these programs and initiatives directly improve water quality by reducing sediment and/or nutrient loss or runoff, many others have similar benefits through wildlife habitat improvement and soil health improvements.

The State departments of the ISDA, IDNR and IDEM are all invested in the continued growth and promotion of grants and programs that improve the state's water quality. Such efforts include the Conservation Reserve Enhancement Program (CREP), INfield Advantage (INFA), Indiana's own Clean Water Indiana (CWI) funds, the Lake and River Enhancement Program (LARE), and the Healthy Rivers Initiative (HRI). Other programs, practices and grants include those funded by the CWA Sections 106, 319(h) and 205j monies awarded to the State by the US Environmental Protection Agency (EPA).
Federal Farm bill programs are also available through the USDA NRCS and the FSA which offer cost-share of best management practices that reduce runoff, increase nutrient uptake and improve the health of our soils.
These and other grant-funded or cost-share programs are described below.

Indiana State Department of Agriculture (ISDA)

INDIANA STATE DEPARTMENT OF AGRICULTURE

Conservation Reserve Enhancement Program (CREP) - The Conservation Reserve Enhancement Program (CREP) is a voluntary federal and state natural resource conservation program that aims to improve water quality and address wildlife issues by reducing erosion, sedimentation and nutrients, and enhancing wildlife habitats within specified watersheds in the Wabash River System. This program is designed to help alleviate some of the concerns of high nonpoint source sediment, nutrient, pesticide, and herbicide losses from agricultural lands by restoring grass and riparian buffers and wetlands to improve water quality, as well as to protect land from frequent flooding and excessive erosion by planting hardwood trees in floodplain areas along rivers and streams. CREP continues to address a major milestone of the ISDA and the USDA Farm Service Agency (FSA), showcasing Indiana's progressive and meaningful implementation of conservation practices to protect Indiana's soil, water and related natural resources, and to help alleviate hypoxia in the Gulf of Mexico.

CREP in Indiana was first announced in 2005 across three HUC 8 watersheds in the state. The program expanded in 2010 to include eleven HUC 8 watersheds in Indiana, covering a total of 65 Indiana counties. (Figure 21)

As of December 2020, over 20,019 acres of buffers, wetlands and trees have been implemented in floodplains and along bodies of water protecting to date over 919 linear miles of water ways. Over 21,800 acres have been enrolled in the program. The ISDA, and its partners have invested over $8.8 million in state funds to implement these conservation practices, and for every state dollar that is invested, $4-$13 federal dollars are matched through the Conservation Reserve Program (CRP) incentives available through the FSA. The goal of the program is to enroll 26,250 acres of buffer land, and to protect a minimum of 3,000 linear miles of waterbodies in the Wabash River System. Within the next couple of years, the State does intend to expand the CREP program by: 1) increasing the enrollment goal beyond 26,250 acres in the Wabash watershed, and 2) possibly add a new CREP program targeting the Kankakee watershed.

ISDA employs a CREP Program Manager and has staff in each watershed that focus on expanding the program in order to get more buffers, wetlands and floodplain tree plantings established and to reach the water quality goals of the program. Promotional materials have been developed and are used by ISDA staff and conservation partnership staff in the eligible watersheds. The State Soil Conservation Board supports the CREP by appropriating $660,000 each year to get the remaining acres of buffers, trees and wetlands installed. In 2017, The Nature Conservancy (TNC) committed $300,000 over the next 5 years in support of expanding the Indiana CREP program. In 2020, the Indiana Wildlife Federation and the American Electric Power Company supported CREP by providing $500,000 from a settlement to go toward the implementation of buffers and wetlands to benefit wildlife and water quality.

Information about the Conservation Reserve Enhancement Program can be found here: http://www.in.gov/isda/2377.htm.

Through CREP, program participants receive financial incentives from the ISDA and the FSA to voluntarily enroll in the program and implement conservation practices on environmentally sensitive land. Eligible practices include:

- Permanent Native Grasses
- Hardwood Tree Planting
- Wildlife Habitat
- Riparian Forest Buffers
- Grassed Filter Strips
- Bottomland Timber Establishment
- Wetland Restoration

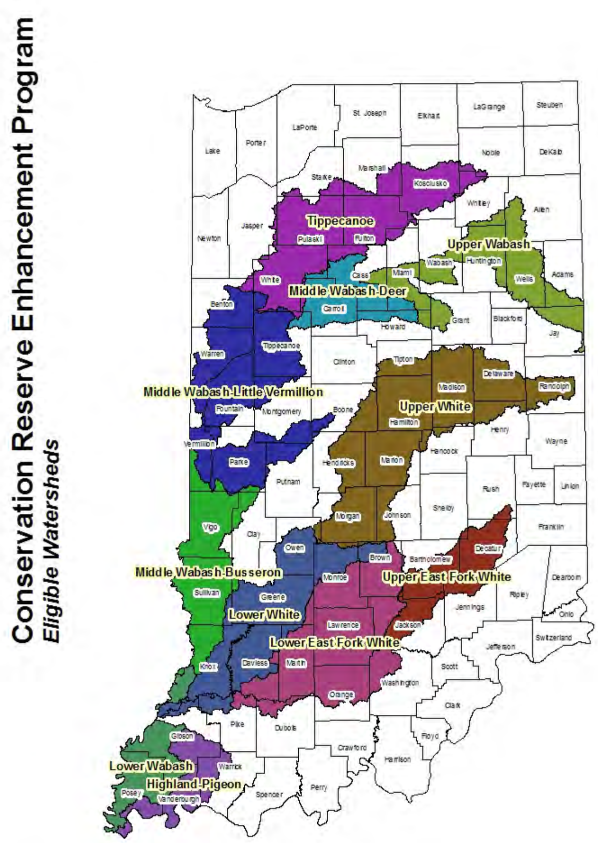


Figure 21 – Indiana CREP Watersheds

INfield Advantage (INFA) - INfield Advantage is a proactive, collaborative opportunity for farmers to collect and understand personalized, on-farm data to optimize their management practices to improve their bottom line and benefit the environment.

In 2019, the program received a CIG grant from the NRCS which allowed for a more conservation focused approach than was previously possible. The program works with various partners in the agricultural field throughout Indiana to promote practices to broader audiences and provide more knowledge of the conservation work to its participants. The program itself is comprised of split-field trials surrounding cover crop impacts, nitrogen management, and tillage practice impacts. Participating farmers use precision agriculture tools, protocols, and technologies such as aerial imagery, soil testing, and agronomic benching software to track changes. It also allows participating growers to better comprehend how conservation practices make an impact environmentally and economically on their operations. Participants will also receive soil sampling and soil health assessments for the field(s) they enroll into the program, which with results from the trials, will be used to analyze overall impact of the program.

INFA is funded through the Indiana Corn Marketing Council and the Indiana Soybean Alliance with checkoff funds, and is being offered at no additional charge to producers.

Information about the INfield Advantage program can be found at http://www.infieldadvantage.org/.

The program started in 2010 as a pilot project in Jasper County in northwest Indiana, and included 15 producers, 39 fields and 2,700 acres. For the next 8 years, it expanded to include many areas of the state and the program had enrolled over 1,000 fields in more than 60 counties. In 2018, there were 33 groups statewide including approximately 400 producers, 1,080 fields, and about 75,000 acres. In 2019, the program went through some major changes as explained above. The goal for 2021 is to enroll at least 100 growers and 5,000 acres.

Clean Water Indiana (CWI) - The Clean Water Indiana (CWI) Program was established to provide financial assistance to landowners and conservation groups. The financial assistance supports the implementation of conservation practices that reduce nonpoint sources of water pollution through education, technical assistance, training, and cost sharing programs. The program is responsible for providing local matching funds as well as competitive grants for sediment and nutrient reduction projects through Indiana's SWCDs. CWI also contributes critical state matching funds for Indiana's CREP. Furthermore, the (CWI) Program has supported non-SWCD led grants such as the Conservation Cropping Systems Initiative (CCSI) which focuses on a management systems approach to crop production that results in improved soil and water quality as well as profitability on Indiana cropland, and the Southern Indiana Cooperative Invasives Management.

In 1999, the Clean Water Indiana Program was created by a unanimous vote of the Indiana General Assembly by amending the Indiana District Law to add this program authority (IAC-14-32-8). The purpose of the CWI Program is to provide assistance to help protect and enhance Indiana's streams, rivers and lakes by reducing the amount of polluted storm water runoff from urban and rural areas entering surface and ground water. The CWI program did not receive funding to carry out the program until 2001. The CWI is supported by a portion of the Indiana Cigarette Tax Revenue on a biannual basis.

The ISDA-Division of Soil Conservation administers the CWI dollars appropriated by Indiana legislators under the direction of the SSCB. For the competitive grants, the soil and water conservation districts are required to submit a CWI Project(s) proposal for approval by the SSCB on an annual basis with the intention for the grant money to be used within two years from approval. Each SWCD has an assigned District Support Specialist through ISDA to provide support in developing CWI projects, as well as to aid in district capacity building, including grant writing assistance, developing business plans, and sharing marketing opportunities.

Since the start of the program funding in 2001, millions of CWI dollars have been utilized by the SWCDs to implement local projects, also resulting in thousands of dollars of cash and in-kind support. The districts use the grant money in three areas: Cost Share, Professional Assistance, and Adult Education. Examples of past projects include using the funds for:

1) cost-share/incentives for applying conservation practices, such as cover crops;
2) purchase of equipment for the purpose of renting it to land users for applying conservation practices, such as warm season grasses;
3) contracting for technical assistance to survey, design, and oversee construction of engineered conservation practices, such as grassed waterways and grade stabilization structures; and
4) non-point source pollution prevention related information materials, planning assistance and projects.

Information on past and current CWI projects can be found on the ISDA website at https://www.in.gov/isda/divisions/soil-conservation/clean-water-indiana/. Successful projects such as those listed on the website, and the continued support of current and local CWI projects mean that the goals and objectives of the SSCB Business Plan, as mentioned in Section 9, are being addressed and accomplished.

Indiana Department of Natural Resources (IDNR)

Lake and River Enhancement (LARE) Grant - http://www.in.gov/dnr/fishwild/2364.htm

The Lake and River Enhancement program is part of the Aquatic Habitat Unit of the Fisheries Section in the Division of Fish and Wildlife, Indiana Department of Natural Resources (IDNR). The LARE program goals include operating a scientifically-effective program in a cost-efficient manner to protect and enhance aquatic habitat for fish and wildlife, and to insure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through grant projects that reduce non-point sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards.

LARE grants are prioritized towards activities involving publicly accessible lakes and rivers, and involve organizations having the resources and ability to properly administer the funds. This includes non-profit organizations such as formally established lake associations, and governmental entities including cities, counties, conservancy districts, soil and water conservation districts, as well as other local units of government.

Approved grant funding may be used for one or more of the following purposes:

1. Investigations to determine what problems are affecting a lake/lakes or a stream segment.
2. Evaluation of identified problems and effective action recommendations to resolve those problems.
3. Cost-sharing with land users in a watershed above/upstream from a project lake or stream for installation or application of sediment and nutrient reducing practices on their land.
4. Matching federal funds for qualifying projects.
5. Feasibility studies to define appropriate lake and stream remediation measures.
6. Engineering designs and construction of remedial measures.
7. Water quality monitoring of public lakes.
8. Management of invasive aquatic vegetation
9. Sediment removal from qualifying lakes.
10. Logjam removal from qualifying rivers.

Participation in the program requires the submittal of an application form for each program element. There are five different kinds of LARE grants awarded annually by the Director of IDNR:

Biological and Engineering Project Grants

These “traditional” LARE grants, awarded since 1989, are available on a competitive basis for several actions that can address the ecology and management of lakes and rivers and their watersheds. Depending on the needs of the waterbody, funds can be granted for:

1) Lake or River Watershed Diagnostic Study,
2) Engineering feasibility study of proposed measures,
3) Design and/or construction projects for specific sediment or nutrient control measures,
4) Bioengineering for bank stability, and
5) Biomonitoring.

Watershed Land Treatment Project Grants
Grants are awarded to Soil and Water Conservation Districts (SWCD's) who work with local landowners to install or adopt various conservation measures directly on the land in targeted watersheds. Technical assistance in the design and installation is provided by personnel of NRCS, ISDA and the SWCD's.

Sediment Removal Plan Development or Sediment Removal Grants
Grant funds may be used to contract for the production of a sediment removal plan or, if such a plan has already been prepared, for funds to be used for a sediment removal project. A sediment removal plan is a prerequisite to acquiring grant funds for actual sediment removal projects.

Exotic Plant or Animal Control Grants
Grant funds may be used for the development of aquatic vegetation management plans or, if such a plan has already been prepared, for actual control of invasive vegetation in lakes or rivers. An aquatic vegetation management plan is a prerequisite to acquisition of grant funds for actual vegetation control. Efforts are limited to management and control of invasive vegetation, not native plants that are considered a nuisance.

Logjam Removal Grants
Grant funds may be used to remove logjams from qualifying rivers.

Information on past and current LARE projects can be found on the IDNR website at https://www.in.gov/dnr/fishwild/3304.htm. The funds used to pay costs incurred by the IDNR in implementing the LARE projects is paid by Indiana boat owners in their annual registration. The state of Indiana will continue to push for continued funding appropriated to the LARE Program by the State Legislature so that the program grants can be used to target nutrient reduction efforts and to meet IDEM's water quality targets in watersheds throughout Indiana.

Healthy Rivers Initiative (HRI) **–** The Healthy Rivers Initiative, led by Indiana DNR, includes a partnership of resource agencies and organizations who are working with willing landowners to permanently protect nearly 70,000 acres of habitat along 3 notable waterways. This initiative sets out to preserve 43,000 acres located in the floodplain of the Wabash River and Sugar Creek in west-central Indiana and another 26,000 acres of the Muscatatuck River bottomlands in southeast Indiana (Figure 22).

Healthy Rivers INitiative

From the launch of the initiative in 2010, eight key objectives were identified:

- Provide a model that balances forests, farmed lands and natural resources conservation.
- Connect separated parcels of public land to benefit wildlife.
- Restore and enhance areas of land along the Wabash River, Muscatatuck River and Sugar Creek.
- Protect important habitat for wildlife.
- Open land to the public for recreational activities, such as fishing, hunting, trapping, hiking, canoeing, bird watching and boating.

- Protect important rest areas for migratory birds.
- Establish areas for nature tourism.
- Provide clean water and protection from flooding to landowners downstream.

These objectives have shaped the strategy for HRI projects that include the protection and restoration of riparian, floodplain, wetland and aquatic habitats for the wildlife species that depend on them including migratory birds and waterfowl and many threatened and endangered species. These projects also benefit local citizens and surrounding communities by providing flood protection, increasing public access to recreational opportunities, and leaving a legacy for future generations by providing a major conservation destination for Hoosiers and out-of-state visitors.

To date, the two major mechanisms for permanently protecting habitat through this initiative have been working with landowners on DNR land purchases and USDA-NRCS Wetland Reserve Easements (WRE), previously Wetland Reserve Program (WRP). As of 2020, 37,848 acres of land are under permanent protection within the HRI project boundaries, over half of the overall goal of 70,000 protected acres.
In the Wabash River and Sugar Creek project areas this includes 12,131 acres purchased by IDNR and 4,052 acres enrolled in NRCS WREs on private land, both of which complement the 12,723 acres of state-owned protected land in the project area prior to the launch of HRI. In the Muscatatuck River Project Area, 4,405 acres have been purchased by IN DNR and 2,048 acres have been enrolled in WRE on private lands, complementing 2,489 acres of existing state-owned or otherwise protected land.

Since June 2010, nearly 14,000 acres of new public land is now accessible to Hoosiers in the Sugar Creek, Wabash River and Muscatatuck River project areas for outdoor recreation.

For more information, visit www.HealthyRivers.IN.gov

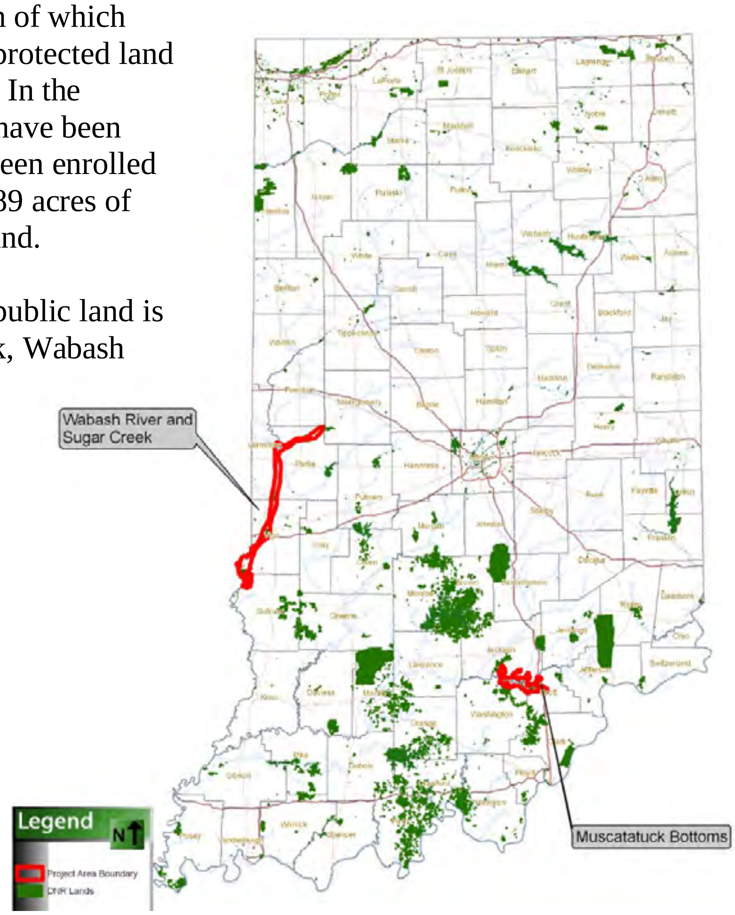


Figure 22 – HRI areas are shown in red

Indiana Department of Environmental Management (IDEM)

IDEM Section 319 (h) Grant Funding - The Federal Clean Water Act (CWA) Section 319(h) provides funding for various types of projects that work to reduce nonpoint source water pollution. The Indiana State Nonpoint Source Management Plan guides the usage of the CWA Section 319 funds received by IDEM from the EPA. Funds may be used to conduct assessments, develop and implement TMDLs and watershed management plans, provide technical assistance, demonstrate new technology, and provide education and outreach. Organizations eligible for funding include nonprofit organizations, universities, and local, State or Federal government agencies. A 40 percent (non-federal) in-kind or cash match of the total project cost must be provided. (Figure 23)

Projects are administered through grant agreements that spell out the tasks, schedule and budget for the project. Projects are normally two to three years long and work to reduce nonpoint source (NPS) pollution and improve water quality in the watershed primarily through:

- Education and outreach designed to bring about behavioral changes and best management practice (BMP) implementation that leads to reduced nonpoint source pollution;
- The development of watershed management plans that meet EPA's required nine elements; and,
- The implementation of watershed management plans through a cost-share program focusing on BMP implementation that address water quality concerns.

As a requirement of the 319 program, IDEM submits a NPS Program Annual Report to EPA. This is a comprehensive report that includes input from and cooperation with state, federal, local, and private partners, which is critical to Indiana's NPS Program's success. IDEM's NPS Program utilizes multiple partnerships to reach diverse stakeholder groups and further NPS management goals in Indiana. Annual reports including the most recent may be found at http://www.in.gov/idem/nps/3475.htm.

IDEM Section 205j Grant Funding – (http://www.in.gov/idem/nps/2525.htm) The federal Clean Water Act Section 205(j) provides funding for water quality management planning, which is then allocated by each state. The act states that the grants are to be used for water quality management and planning, including, but not limited to:

- Identifying most cost effective and locally acceptable facility and non-point source measures to meet and maintain water quality standards;
- Developing an implementation plan to obtain state and local financial and regulatory commitments to implement measures developed under subparagraph A;
- Determining the nature, extent, and cause of water quality problems in various areas of the state. In previous cycles, grants have been awarded to municipal governments, county governments, regional planning commissions, and other public organizations.

Projects are administered through grant agreements that spell out the tasks, schedule, and budget for the project. For both 205j and 319h projects, IDEM project manager's work closely with the project sponsors to help ensure that the project runs smoothly and the tasks of the grant agreement are fulfilled. Site visits are conducted at least quarterly to touch base on the project, provide guidance and technical assistance as needed, and to work with the grantee on any issues that arise to ensure a successful project closeout. (Figure 23)

In recent years, Indiana has generally received around three and a half million dollars each year for 319 grant funding. Since 1994, Indiana has directed over 66 million dollars of its USEPA 319 nonpoint source grant funding to projects related to reducing nutrient loads to Indiana's surface waters.

Figure 23 - NPS Water Quality Improvement Projects funded by 319(h) and 205(j) through 2020.

Clean Water Act (CWA) Section 106 Supplemental Funding - The federal Clean Water Act (CWA) Section 106 provides funding for a wide range of water quality activities identified in *Indiana's Water Quality Monitoring Strategy 2017-2021* as representing monitoring needs that have not been met or one that warrants enhancing. These activities may include water quality planning and assessments, ambient monitoring of surface water and wetlands, or monitoring ground water to name a few. IDEM utilizes CWA Section 106 Supplemental funding to support many water quality activities, including the Ground Water Monitoring Network (GWMN), which is first mentioned on page 32, and is managed through IDEM's Drinking Water Branch, Ground Water Section.

The long-term goals of the statewide GWMN include:

- Determining the quality of ground water in the state's 20 aquifer represented hydrogeologic settings;
- Identifying areas of notable contamination, which would include nonpoint source nutrients of concern such as nitrate-nitrite, pesticides and pesticide degradants;
- Determine potential nonpoint source pollution ground water to surface water pathways;
- Work with stakeholder groups to reduce ground water to surface water nonpoint source pollution to below a level of significance, and;
- Monitor ground water quality trends statewide within the state's 20 hydrogeologic settings.

The statewide GWMN will meet these goals through:

- Analysis of the ground water information gathered for the GWMN, which includes analysis for analytes such as nitrate-nitrite, pesticides and pesticide degradants in ground water; and identifying areas where ground water could contribute to nutrient rich surface waters;
- Identification and determining possible migration pathways of nutrient impaired ground water contributing to impaired surface waters;
- Defining appropriate stakeholders to assist in future land management practice decisions to manage nutrients that may infiltrate from the surface down to ground water;
- Begin the conversation with partner stakeholders to find long-term mitigation measures to improve urban and rural nutrient management practices;

Understanding the nutrient contributions of ground water into the overall hydrologic cycle will assist Indiana in addressing the primary goal of the Federal Clean Water Act (CWA) to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The ground water component to this cycle of water plays a fundamental role in this vast effort. The statewide GWMN goals and data collected to date for the statewide GWMN effort can be viewed at http://in.gov/idem/cleanwater/2453.htm.

USDA, Natural Resources Conservation Service (NRCS)

Private citizens own over 90 percent of the land in Indiana which includes nearly 15 million acres of farmland and about 4 million acres of forestland, making stewardship and conservation absolutely critical to the health of our environment. The following Farm Bill programs available through the USDA, Natural Resources Conservation Service and the USDA, Farm Service Agency offer cost-share assistance for best management practices that reduce runoff, increase nutrient uptake and improve the health of our soils.

USDA
United States Department of Agriculture

Conservation Stewardship Program (CSP) - The Conservation Stewardship Program (CSP) is a voluntary program that encourages agricultural producers to improve conservation systems by improving, maintaining, and managing existing conservation systems and adopting additional conservation activities to address priority resource concerns, including soil, air and habitat quality, water quality and quantity, and energy conservation. The Natural Resources Conservation Service administers this program and provides financial and technical assistance to eligible producers. CSP is available on Tribal and private agricultural lands and non-industrial private forestland on a continuous application basis. Participants can earn CSP payments for conservation performance – the higher the performance, the higher the payment. For more information visit the Indiana NRCS CSP website at:
https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/financial/csp/

Environmental Quality Incentives Program (EQIP) -The EQIP program is a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as national goals. EQIP offers financial and technical assistance to farmers to address natural resource concerns through the development of a conservation plan on their farm(s), and financial assistance to install conservation management practices on eligible agricultural land, such as soil health practices like cover crops and no-till, nutrient management, livestock/animal waste systems, livestock watering facilities, pastureland management, wildlife enhancement and forestry management. For more information visit the Indiana NRCS EQIP website at https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/financial/eqip/

NRCS Easement Programs

Agricultural Conservation Easements Program (ACEP) – The Agricultural Conservation Easement Program provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect and enhance enrolled wetlands. The ACEP consolidates three former programs – the Wetlands Reserve Program, Grassland Reserve Program, and the Farm and Ranchland Protection Program. https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/easements/

- ***Agricultural Land Easements (ALE)*** **–** NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Eligible partners include American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland or grassland protection programs.

- ***Wetland Reserve Easements (WRE*)** **–** The Wetland Reserve Easements program is voluntary conservation program that allows landowners to enroll sensitive land to help restore, protect and enhance wetland restorations. It is the Nation's premier wetlands restoration program. WRP provides habitat for fish and wildlife, including threatened and endangered species, improves water quality by filtering sediments and chemicals, reduces flooding, recharges groundwater, protects biological diversity and provides opportunities for educational, scientific and limited recreational activities. Through this program landowners can enroll eligible land through Permanent Easements, 30-year Easements, Term Easements or 30-year Contracts.

    - ***Wetland Reserve Enhancement Program (WREP)*** **–** WREP is a special enrollment option under the Agricultural Conservation Easement Program's Wetland Reserve Easement component. Through WREP, states, local units of governments, non-governmental organizations and American Indian tribes collaborate with NRCS through cooperative and partnership agreements. These partners work with tribal and private landowners who voluntarily enroll eligible land into easements to protect, restore and enhance wetlands on their properties.

To see videos of Indiana NRCS Easements, visit https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/easements/acep/.

NRCS Program Initiatives

Regional Conservation Partnership Program (RCPP) - The Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. Assistance is delivered in accordance with the rules of EQIP, CSP, ACEP and HFRP; and in certain areas the Watershed Operations and Flood Prevention Program. (Figures 24 and 25) To learn more about the program and to see the RCPP projects that have been approved in Indiana, visit: https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/farmbill/rcpp/

Mississippi River Basin Initiative (MRBI) - To improve the health of the Mississippi River Basin, including water quality, wetland restoration, and wildlife habitat, the NRCS has established the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through this Initiative, NRCS and its partners will help producers voluntarily implement conservation practices in targeted watersheds within the Mississippi River Basin. (Figures 24 and 25) To learn more about the program and to see MRBI projects in Indiana, visit: https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/landscape/NRCS144P2_031031/

National Water Quality Initiative (NWQI) - The National Water Quality Initiative will assist producers to address high-priority water resource concerns in watersheds identified as impaired by the Environmental Protection Agency (EPA). NRCS works with local partnerships and state water quality agencies to identify priority watersheds. The program provides a separate funding pool through EQIP. To learn more about the program and see the three projects that have a current funding allocation, refer to Figures 24 and 25, and visit the website at https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/landscape/nrcs144p2_031016/

Great Lakes Restoration Initiative (GLRI) - The Great Lakes Restoration Initiative (GLRI) was launched in 2010 with NRCS as one of a number of federal agency partners. GLRI helps NRCS accelerate conservation efforts on private lands located in targeted watersheds throughout the Great Lakes region. Through GLRI, NRCS works with farmers and landowners to combat invasive species, protect watersheds and shorelines from non-point source pollution, and restore wetlands and other habitat areas. Indiana GLRI funds are targeted in the Western Lake Erie Basin. (Figures 24 and 25)
https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/landscape/NRCSEPRD390813/

Joint Chiefs Landscape Restoration Partnership - The goal of this Initiative is to improve the health and resiliency of forest ecosystems where public and private lands meet through a partnership between the Forest Service and NRCS. Indiana NRCS worked closely with the Forest Service and the Indiana Department of Natural Resources, Division of Forestry to select targeted priority forested watersheds to deliver by leveraging technical and financial resources through EQIP and coordinating activities on adjacent lands.
https://www.nrcs.usda.gov/wps/portal/nrcs/in/programs/landscape/f907ec3b-dcd9-4739-b66a-7dc74caffe59/

Each year, Indiana NRCS approves millions of dollars to landowners to conserve natural resources. Below are a few of the program dollars spent in 2020. To see past and future Indiana NRCS Annual reports showing accomplishments, visit https://www.nrcs.usda.gov/wps/portal/nrcs/in/newsroom/factsheets/.

ACEP 21 new applications statewide on 2,231 acres

CSP $8.1 million spent impacting 74,117 acres

EQIP $25.4 million spent impacting 146,607 acres

RCPP $609,435 spent impacting 5,530 acres

Figure 24 – NRCS Special Projects/Initiatives in fiscal year 2021.
* The key to this map is located on the next page.

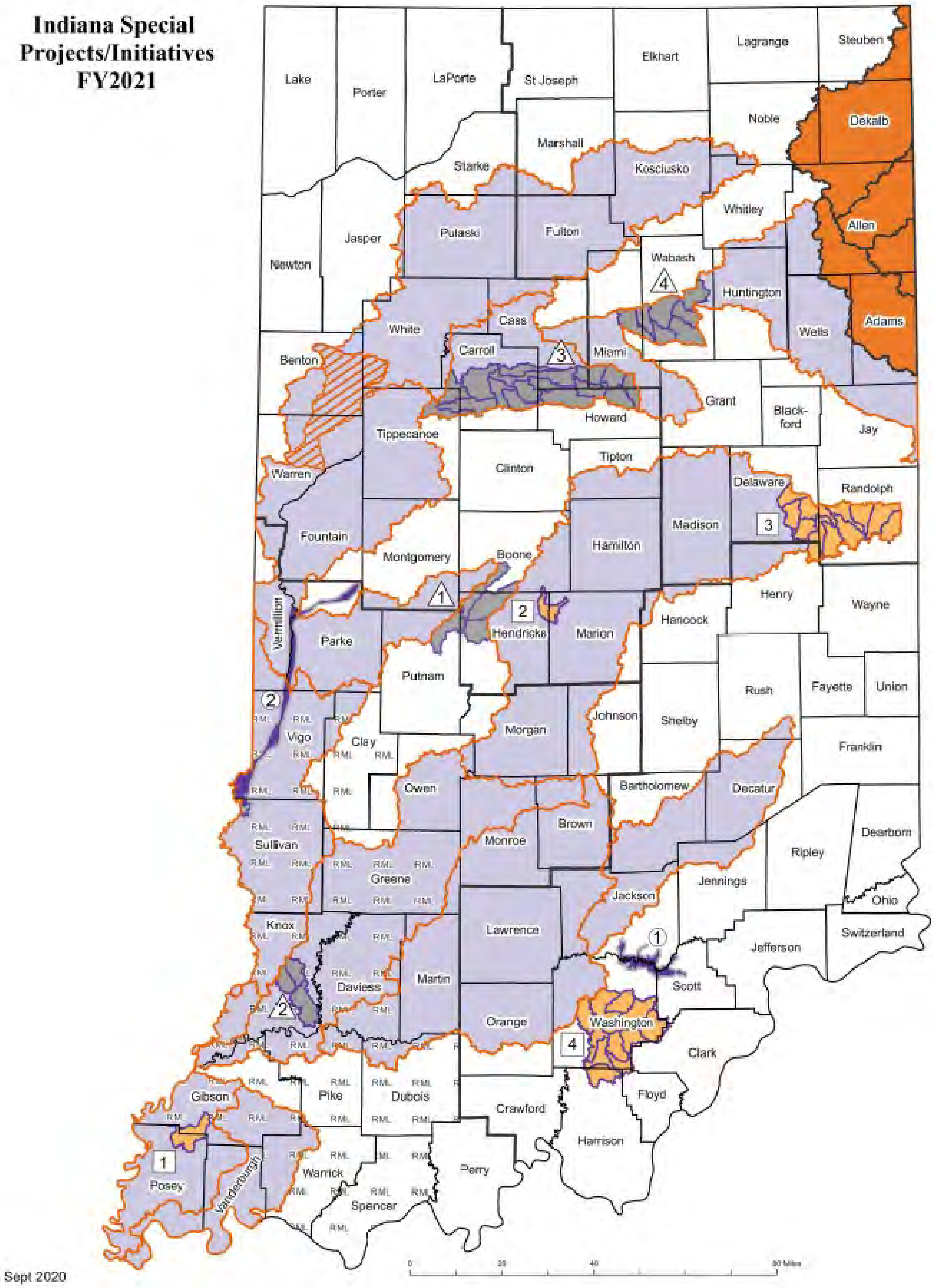
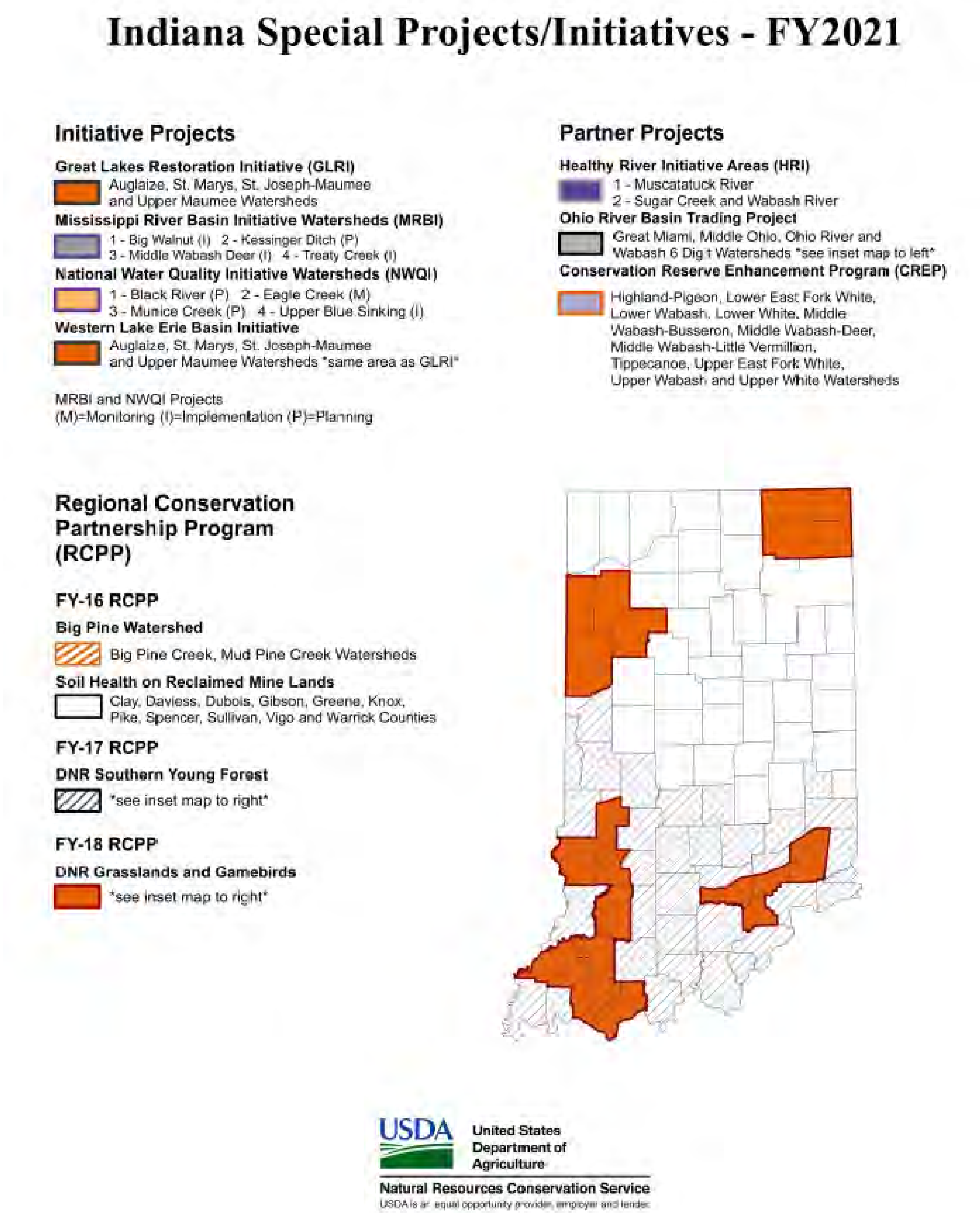


Figure 25 – NRCS Special Projects/Initiatives map key



USDA, Farm Service Agency (FSA)

Conservation Reserve Program Funding - The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and Tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation (CCC). CRP is administered by the Farm Service Agency, with NRCS and other ICP technical staff providing technical land eligibility determinations, Environmental Benefit Index Scoring, and conservation planning.

The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as native grasses, wildlife plantings, trees, filter strips, riparian buffers or wetlands. Farmers receive an annual rental payment for the term of a multi-year, 10-15 year contract. Cost sharing is provided to establish the vegetative cover practices.
http://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/in/programs/financial/?cid=stelprdb1119594

Conservation Reserve Enhancement Program (CREP) – The Conservation Reserve Enhancement Program is a component of the CRP and is a voluntary program available under the CRP continuous sign-up, and is done in partnership with the State of Indiana as mentioned on page 62-63. The aim of the program is to improve water quality and address wildlife issues by reducing erosion, sedimentation and nutrients, and enhancing wildlife habitats within specified watersheds in the Wabash River System. Contracts with landowners under CREP are 15-year contracts. (Figures 24 and 25)

Safe Acres for Wildlife Enhancement (SAFE) – This initiative is a voluntary program also available under the Conservation Reserve Program (CRP), designed to address state and regional high priority wildlife objectives. This program targets habitat restoration for specific wildlife species designated by the U.S. Fish and Wildlife Service as threatened or endangered including the lesser prairie chicken, the New England cottontail, bobwhite quail, and grassland birds. Producers within a SAFE area can submit offers to voluntarily enroll acres in CRP contracts for 10-15 years. In exchange, producers receive annual CRP rental payments, incentives and cost-share assistance to establish, improve, connect or create higher-quality habitat.
http://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2015/CRPProgramsandInitiatives/State_Acres_for_Wildlife_Enhancement_SAFE_Initiative.pdf

Agricultural Initiatives

The many programs and initiatives mentioned above are resources that can be used to encourage voluntary use of incentive based and cost-shared conservation by landowners both rural and urban to achieve a positive impact on nutrient reduction. In addition, there are many other agricultural initiatives and efforts taking place in Indiana by the ICP and other conservation organizations, and by non-governmental organizations that are practical and cost-effective.

For example, the NRCS soil health campaign consists of diligent outreach and education concerning the benefits of cover crops paired with no-till or reduced tillage systems to improve tilth and water infiltration as boons to soil health. While this campaign is directed at soil health rather than water quality, the impacts on the latter are both direct and positive through their reduction of surface erosion (through reduced rain impact on exposed soil) and nutrient loss (through improved nutrient uptake from living cover as well as increased infiltration due to greater soil porosity and increased organic matter). There are many efforts by NRCS and the ICP partners to advance this Soil Health Campaign toward addressing Indiana's primary resource concerns such as the ICP Soil Health Philosophy, and the concept of a System's Approach of Conservation Practices, which are methods used by ICP staff to promote and advance the use of soil health, nutrient management and a conservation cropping systems approach to farming.

Indiana's Conservation Partnership Soil Health Philosophy

http://www.in.gov/isda/files/ICP_Soil_Health_Philosophy_final.pdf
The Indiana Conservation Partnership (ICP) includes eight Indiana agencies and organizations that share a common goal of promoting conservation. To accomplish this goal, the ICP members provide technical, financial and educational assistance to support and implement economically and environmentally compatible land and water stewardship decisions, practices and technologies. The ICP and our primary customers – Indiana farmers – are recognized as national leaders in our collaborative efforts to incorporate soil health management systems into conservation planning, education activities and farm management.

Indiana's soil health strategy and priority focus has achieved tremendous success in addressing the state's primary natural resource concerns. The ICP endorses these four key **Soil Health Principles** for all lands:

- Minimize Disturbance
- Optimize Soil Cover
- Optimize Biodiversity
- Provide Continuous Living Roots

Regenerating soil health is a journey. Meeting the **Objectives of Soil Health Improvement** should be part of an overall approach to management decisions and field operations. To fully implement a *conservation cropping system* that improves soil health we will help farmers understand the importance of continually working toward the following objectives:

- Increas**ing** organic matter
- Increas**ing** aggregate stability
- Increas**ing** water infiltration
- Increas**ing** water-holding capacity
- Improv**ing** nutrient use efficiency
- Enhanc**ing** and diversify**ing** soil biology

The ICP works with farmers to help them implement a conservation cropping systems approach to improve the health of their soil. This "system" of practices and management results in improvements to soil health that helps to address Indiana's primary natural resource concerns. Although implementing a single management practice may slow the degradation of soil function, it will rarely achieve the broad improvements of our resource objectives.

The elements of a conservation cropping system go beyond the minimum standards. It is critical to emphasize descriptive adjectives associated with each practice element, such as:

- **Quality** No-till/Strip till
- **Adaptive** Nutrient Management
- **Integrated** Weed and Pest Management
- **Diverse** and **Strategic** Cover Crop Integration
- **Diverse** Conservation Crop Rotations
- **Precision** Farming Technology
- **Prescriptive** Conservation Buffers

These practices when incorporated into a profitable and sustainable soil health system can help farmers go beyond simply maintaining the soil to actually improving its health. Since the benefits achieved through this system can begin to degrade if the application of the system stops, soil health is a never-ending journey towards constantly improving the soil over time.

For many farmers, implementing a conservation cropping system may require significant changes in their operations and management. Building a successful conservation cropping system can take time, even years. The ICP commits to providing support for our customers through ongoing education, support and financial and technical assistance so that soil health improvement is possible across all agricultural sectors and becomes the management system of choice.

A System's Approach of Conservation Practices

One of the most wide-scale and effective efforts in Indiana on water quality improvement is the education and promotion of soil health systems and conservation cropping systems in agriculture. ISDA, NRCS, SWCDs and the other members of the ICP are actively promoting a total *conservation cropping systems* approach to farming which focuses on soil health and function. Soil health practices include no-till (never-till), conservation tillage, using diverse cover crops, adaptive nutrient management, integrated weed and pest management, diverse crop

rotations, precision farming technology and prescriptive buffers. (Figure 26)
https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_030628.pdf

Conservation Tillage Practices, such as no-till, strip-till, ridge till and mulch till, are practices that leave crop residues on the soil surface to reduce soil erosion by water. Cover Crops are crops grown between regular cash crops like corn and soybeans so that there is a living root growing all year long. Cover crops reduce soil compaction; they cover the soil and protect it from erosion; improve soil structure; increase soil organic matter; fix nitrogen and scavenge nitrogen depending on the species of cover crop used; and can produce forage or pasture.

Figure 26 – "Soil Health is the Goal", an NRCS publication

Conservation Cropping Systems Initiative (CCSI)

The Conservation Cropping Systems Initiative is a program of the ICP with a mission of improving soil health on Indiana cropland. This mission is accomplished primarily through education and outreach efforts that are based on farmer-proven management practices and peer-reviewed agronomic and social science.

Developed in partnership with technical experts from USDA-NRCS, Purdue University, and expert farmers, CCSI's full training curriculum is central to ICP soil health education, including Indiana NRCS's Long-Term Soil Health Strategy (03/2018). Since CCSI's inception in 2009, over 830 unique individuals have attended at least one soil health training event. These trainings have been instrumental in the delivery of consistent soil health information and technical assistance by conservation staff and ag professionals.

CCSI is also a resource for ICP partners, including Indiana's 92 Soil and Water Conservation Districts (SWCDs), in developing and supporting their own soil health outreach and education efforts. Via presentations by CCSI staff, engaging expert speakers, facilitating farmer panels, event promotion, and logistical support, CCSI workshop activities and events have reached approximately 37,650 attendees.

The unique multi-agency structure of CCSI has enabled the program to facilitate and support partnerships that span geographic, organizational, and expertise boundaries. These types of complex networks have been shown to facilitate the flow of ideas and spur innovative thinking. These networks have also enabled ICP and partner organizations to leverage both financial and human resources to help increase the adoption of soil health practices in Indiana.

CCSI research efforts from 2013-2018 on 17 different field-scale sites have provided insight ino the potential usefulness of commercially-available soil health tests. More importantly, this research has provided guidance to other groups across the nation in development of their own protocols to further much needed soil health research.

More information on the Conservation Cropping Systems Initiative may be found at www.CCSIN.org.

Indiana Agriculture Nutrient Alliance (IANA)

Agricultural commodity groups in Indiana, including those of Corn, Soybean, Pork, Beef, Dairy and Poultry commodity groups, as well as the Indiana Farm Bureau (INFB), the Agribusiness Council of Indiana (ACI), and Purdue University Extension are actively engaged in identifying and approaching the challenges of nutrient loading and soil health, subsequently improving water quality. These groups with the addition of members from the ICP and The Nature Conservancy, worked to develop what was referred to as the nutrient management and soil health strategy, which complemented Indiana's state nutrient reduction strategy and was used as an agricultural industry implementation plan. As a result of this effort, the Indiana Agriculture Nutrient Alliance (IANA) was created in 2018 to further coordinate the efforts of the ag community beyond federal and state cost-share programs. The formation of IANA from the nutrient management/soil health strategy workgroup is an example of a key refinement of adaptively managing our needs.

The Indiana Ag Nutrient Alliance is dedicated to keeping Indiana at the forefront of proactive nutrient management and soil health practices that improve farm viability and ultimately reduce nutrient loss to water. Across the state, a large number of public and private sector agencies and organizations are working toward the same goal – reducing nutrient loss and improving water quality. IANA will focus on bridging multi-partner efforts to create practical, cohesive and significant effect across Indiana. www.inagnutrients.org

IANA Partners include:

- Agribusiness Council of Indiana
- Indiana Farm Bureau
- Indiana Soybean Alliance
- American Dairy Association of Indiana
- Indiana Beef Cattle Association
- Indiana Corn Marketing Council
- Indiana Dairy Producers
- Indiana Pork
- Indiana Poultry Association
- Indiana State Department of Agriculture
- Indiana Association of SWCDs
- USDA-NRCS
- Purdue University College of Agriculture
- The Nature Conservancy of Indiana

Healthy Soil
Clean Water
Viable Farms

To further the adoption and implementation of practices that optimize nutrient use efficiency and enhance soil health, IANA will focus on 4 main areas:

1. Foundation: Shared Goals – Establish goals for statewide practice adoption that encourage fertilizer and nutrient loss reductions.
2. Collaboration: Shared Opportunities – Communicate IANA partnership organizations' efforts to strengthen synergies and maximize awareness, support and implementation of strategic objectives.
3. Education: Shared Information – Develop best management practice educational materials for our farmers and stakeholders to encourage fertilizer and nutrient loss reductions.
4. Research: Shared outcomes – Assist partners with pursuing collaborative nutrient-focused research, identifying synergies and compiling outcomes.

IANA Goals by 2025 are shown in the table below:

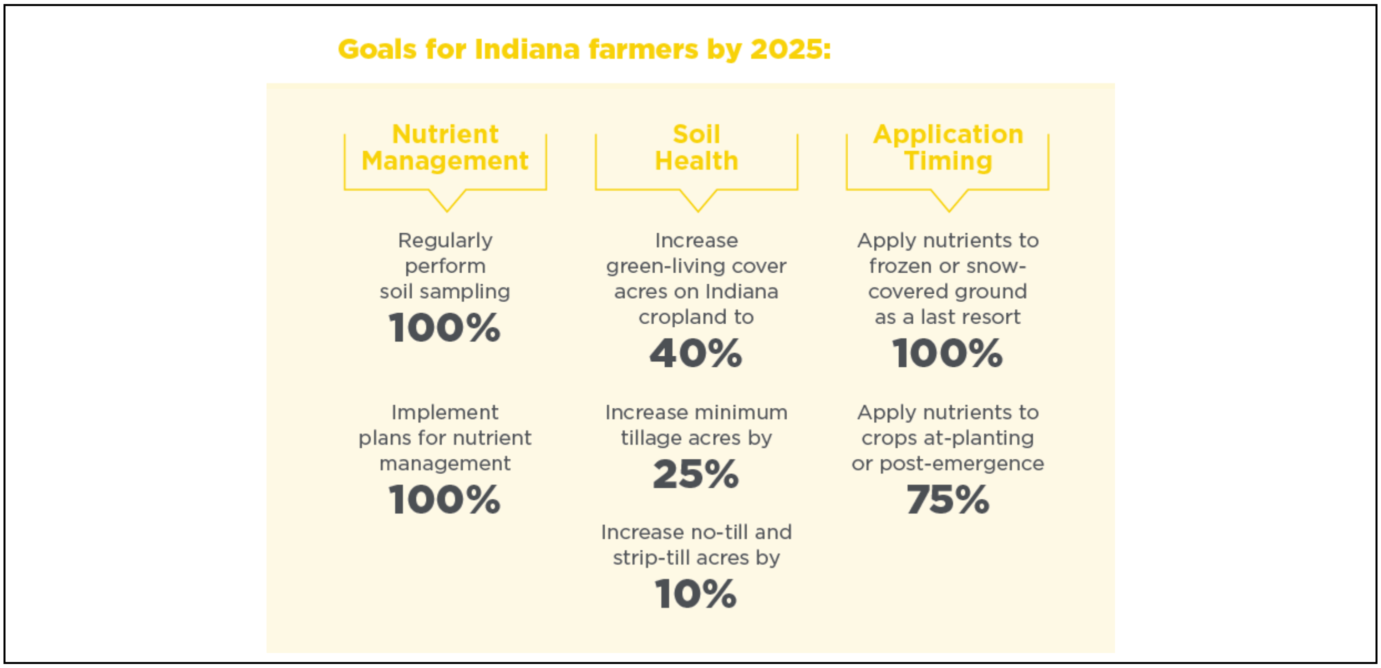


Figure 27 – Indiana Agriculture Nutrient Alliance Goals

IANA is supporting work being done in the Upper White watershed, which is coordinated under a "Keep it Midwest" campaign (www.keepitmidwest.com). Through this campaign, farmers are made aware through mailings of the importance of protecting their soil and water quality; Indiana Corn/Soy has a cover crop project in partnership with Beck's; and IANA, TNC and the ISDA are partnering together to offer a crop insurance incentive pilot program for cover crop use in the watershed as well. To learn more, visit the www.keepitmidwest.com website.

4R Nutrient Stewardship Program in Indiana

The 4R Nutrient Stewardship Certification Program is a voluntary program for ACI members that encourages agricultural retailers, nutrient service providers and other independent crop consultants to adopt proven best practices through the 4Rs, which refers to using the **Right Source** of nutrients at the **Right Rate** at the **Right Time** in the **Right Place**. This approach provides a science-based framework for plant nutrition management and sustained crop production while considering specific individual farms' needs. It is a proactive, responsible commitment aimed at the long-term improvement of water quality.

4R Nutrient Stewardship provides a framework to achieve cropping system goals, such as increased production, increased farmer profitability, enhanced environmental protection and improved sustainability.

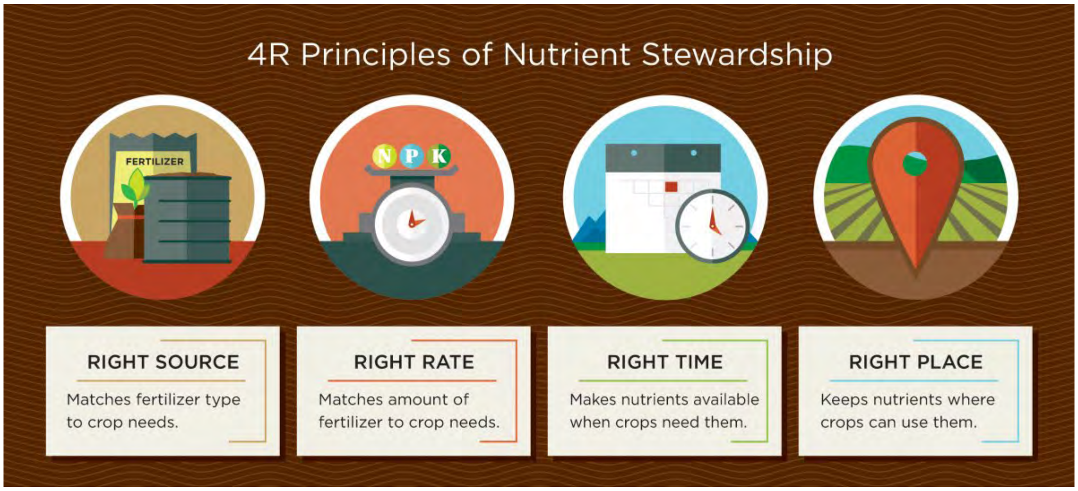


Figure 28 – 4R Principles of Nutrient Stewardship

The Indiana Ag Nutrient Alliance was instrumental in helping ACI get the program up and running and to create a framework for the new Indiana 4R Certification Program. The 4R program was launched statewide in November of 2020 with 5 companies in the state that went through the pilot audit process. It is available to all Indiana-based agricultural retailers and nutrient service providers, and provides them the opportunity to participate in efforts to improve nutrient management and efficiencies and to improve water quality in Indiana and beyond.

The Certification program occurs on a 3-year certification cycle where a retail location is audited on a set of standards developed by Indiana's Nutrient Stewardship Council. This set of standards outlines best practices (program requirements) to be implemented. Each requirement is evaluated during each audit period by a private, third party auditor via an in-person audit to earn or maintain certification. Depending on the services provided by the Nutrient Service Provider, some criteria will not be applicable. There are three sections to the program which include:

- Initial Training and Ongoing Education
- Monitoring of 4R Implementation; and
- Nutrient Recommendations and Application.

More information on the Indiana 4R Certification Program may be found at https://www.inagribiz.org/Indiana4RCertification.

Market-Based Agricultural Initiative

Ohio River Basin Water Quality Trading Project: Pilot Trading Plan by the states of Indiana, Kentucky and Ohio (Figure 29) – In August 2012, representatives from the states of Indiana, Kentucky, and Ohio signed an agreement to create the Ohio River Basin Water Quality Trading Program (http://wqt.epri.com/), a pilot program allowing farmers and industrial facilities to trade pollution credits to reduce fertilizer run-off and nutrient discharges. It is aimed at

achieving water quality standards in watersheds along the Ohio River by allowing dischargers to purchase pollution reductions from other sources. The project was conceived by Electric Power Research Institute (EPRI) in conjunction with the states of Indiana, Ohio, Kentucky, the U.S. Department of Agriculture Natural Resources Conservation Service, American Farmland Trust, the Ohio Farm Bureau, and ORSANCO. It was initially funded by a Conservation Innovation Grant (CIG) to the EPRI and is now privately funded and supported by over a dozen organizations and utilities like AEP and Duke Power with technical support from local, state and federal agencies.
In Phase 1 of the project, five Indiana counties participated including Wayne, Dearborn, Ripley, Ohio, and Switzerland. The ISDA-DSC District Support Specialist for the region has been serving as an advisor and representative for the project and works with EPRI, American Farmland Trust, DSC Resource Specialists, participating County SWCDs, and USDA-NRCS District Conservationists.

The Electric Power Research Institute's Ohio River Basin Trading Pilot Project is a first-of-its-kind inter-state trading program with participation from Indiana, Ohio and Kentucky. A total of $100,000 in cost-share monies for each of the three partner states were distributed to farmers for implementation of approved water quality Best Management Practices. In Indiana, practices for cover crops, heavy use protection areas for livestock, and cropland to hayland conversion were approved. Indiana had 12 five year contracts, in five counties that removed 25,530 lbs. total nitrogen (TN) and 6,880 lbs. total phosphorus (TP) per year. All practices that were installed were inspected and verified by DSC staff.

In Phase 2 of the project, in the fall of 2017, ISDA-DSC entered into another funding contract with EPRI to provide cost share to forestry practices and conservation practices for the entire Ohio River Basin Watershed in Indiana.

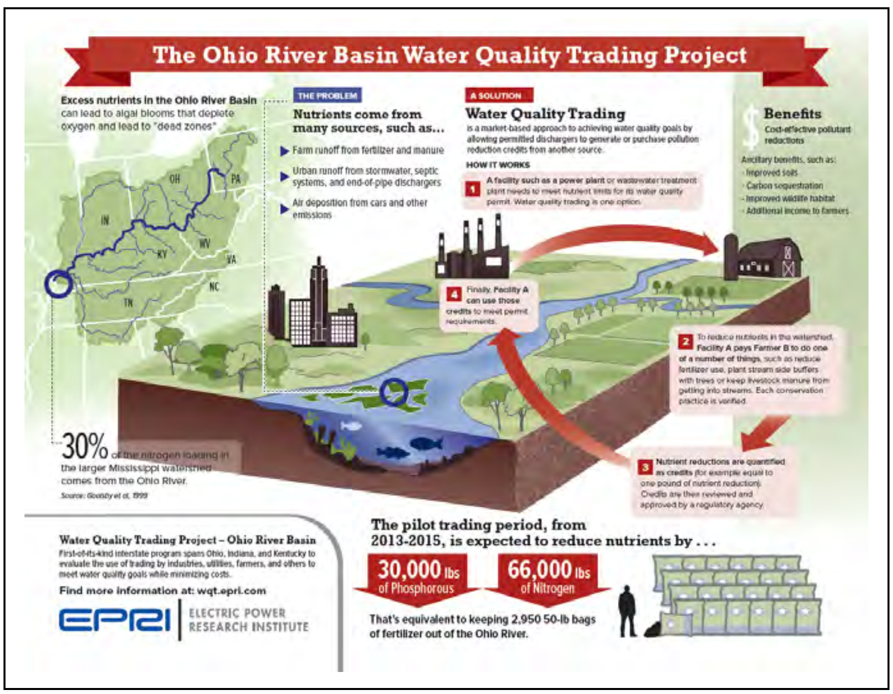


Figure 29 – Ohio River Basin WQ Trading Project Diagram

Agricultural Landowner Educational Resources Available Online

Indiana NRCS has also developed many publications that are available on their website that provide sound advice on many different topics and issues related to phosphorus and nitrogen management, soil health, cover crops, drainage tile and drainage water management, pest management, forage and feed management and many more.
There are:

- Guide Sheets and Fact Sheets,
- Agronomy "Crib" Notes,
- "Grazing Bites",
- Soil Health Resources & Publications,

Online education and resources are also available through CCSI, IANA and the 4R Certification Program:

- https://www.ccsin.org/soil-health-practices
- https://inagnutrients.org/blog/
- https://www.inagribiz.org/4r-resources

Section 9 – Measuring Impacts

Best management practices within the regulatory framework and proactive, voluntary conservation measures matter. They matter because of the impact that conservation practices have on water quality both within the state of Indiana and in the water bodies outside of our state. They matter because the impact of the conservation practices results in reductions of nutrient loads. The many state and federal conservation programs, initiatives and actions illustrate the means by which the state can provide reports and accountability of assisted conservation practices reported by staff in the Indiana Conservation Partnership. These impacts are shown in a number of ways:

1. Continuation of the use of the Indiana Tillage and Cover Crop Transects and corresponding reports,
2. The use of the EPA Region 5 Nutrient Load Reduction Model as a means to annually estimate and track sediment, nitrogen and phosphorus load reductions from BMP implementation across Indiana on a watershed-wide scale,
3. An annual preparation of one page load reduction reports for significant waterbodies within Indiana,
4. The use of a GIS Story Map for each of the ten major river and lake basins in Indiana that tell the story of conservation going on in Indiana,
5. Instream water quality monitoring for performance measures to look for watershed improvements and trend analysis of data, and
6. Reviewing Edge-of-Field (EOF) monitoring data.

Regulatory framework nutrient reduction best management practices:

1. Publicly Owned Treatment Works (POTW) discharge monitoring reports are submitted monthly and will be graphed annually,
2. Pertinent information from MS4 annual reports will be compiled and reported annually,
3. Long-Term Control Plans (LTCP) pertinent progress will be reported annually.

Indiana's Tillage and Cover Crop Transects

The tillage transect is a cropland survey conducted each spring following planting in each Indiana county by ICP personnel and Earth Team volunteers. Using a predetermined route, staff look at farm fields in their county collecting data on tillage methods, plant cover, residue, etc. in order to tell the story of conservation efforts in Indiana. The survey uses GPS technology and provides a statistically reliable method for estimating farm management and related annual trends. Transects are usually conducted bi-annually in the spring after crops are planted. ISDA maintains tillage transect reports dating back to 1990 on their website at http://www.in.gov/isda/2383.htm which includes the most recent transect results.

A fall cover crop and tillage transect is also conducted each year after harvest, and results of the fall transect go back to the fall of 2014. This is also done as part of a collaborative effort between ISDA, NRCS, Indiana's 92 SWCDs and other members of the ICP.

Due to the efforts through the tillage and cover crop transects, Indiana can track tillage trends back to 1990 and cover crop trends back to 2011.

- Since 1990, Indiana landowners increased no-till acres on corn and soybean fields by 440%, and conservation tillage acres on corn and soybean fields by 332%.
- According to the most recent spring tillage transect conducted in 2019, approx. 23% of Indiana's corn acres were no till or strip till acres, and for Indiana's soybeans, approximately 51% of soybean acres had residues and soils undisturbed.
- Since 2011, Indiana landowners increased cover crop acres on corn and soybean fields by 359%.
- In 2019, Indiana farmers planted 950,000 acres of living cover crops. Also, cover crops planted into fallow ground were tracked due to the increased number of prevent-plant ground seen in 2019. The data found that a total of 230,000 acres had prevent-plant.

The ICP will continue the fall and spring cover crop and tillage transects in future years. To review reports and maps from the transect data showing acres, percentages and trends of conservation tillage and cover crops, visit the Cover Crop and Tillage Transect Data page on the ISDA website.

To see the trends in the usage of no-till and conservation tillage in Indiana, and in cover crop adoption in Indiana, refer to Figures 31, 32, and 33.

As one of the national leaders in the use of cover crops, nutrient management and advocating of soil health and productivity, Indiana is a great example in the nation for the benefits that improving soils' nutrient uptake and water-holding capacities can do to reduce nutrient loss and excessive runoff from agricultural and other managed lands. (Figure 30)

United States Cover Crop Acreage: 2017

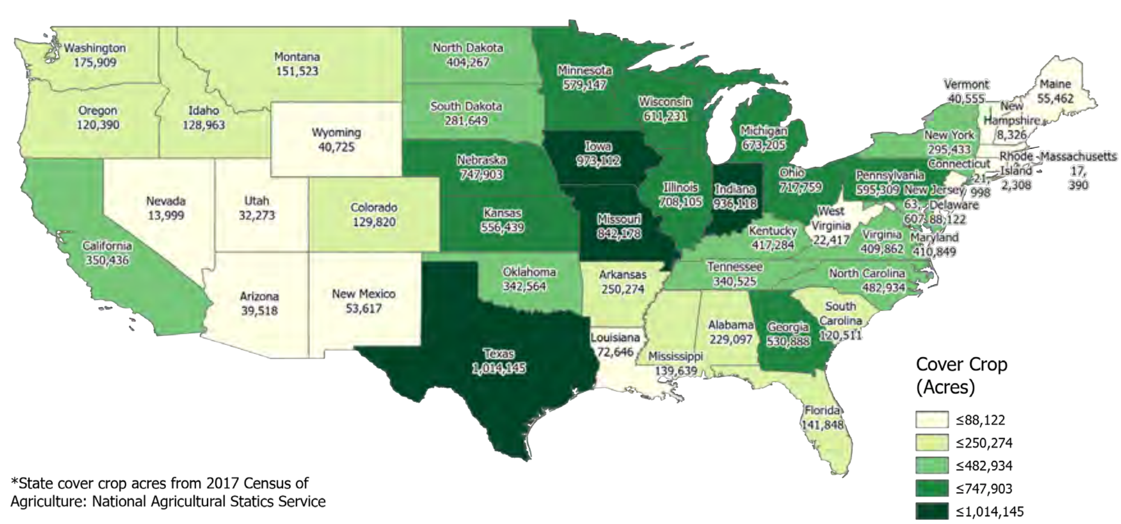
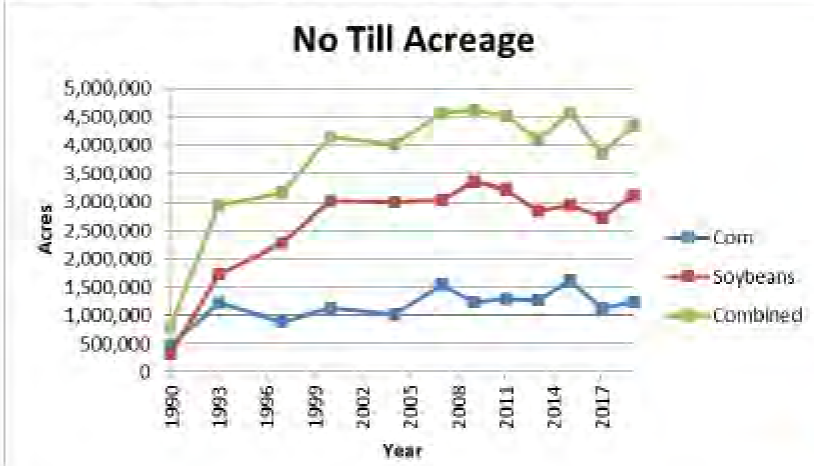


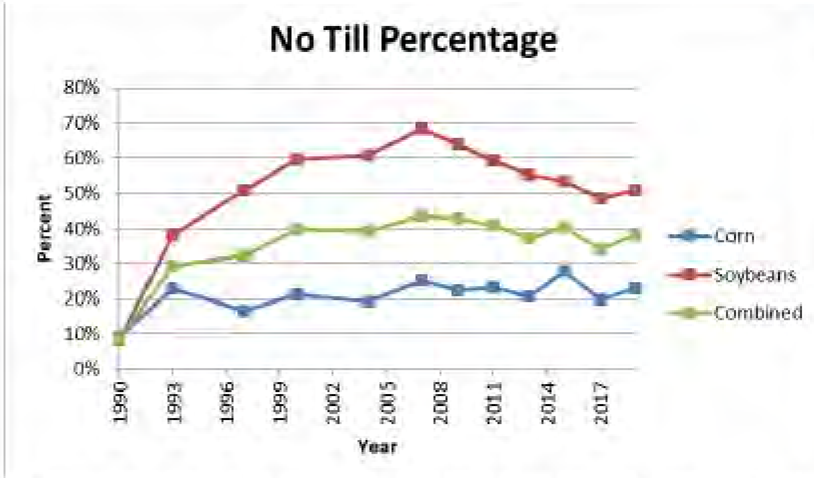
Figure 30 – Cover crops acres by state according to the NASS 2017 Ag Census Data

Indiana Statewide Tillage: 1990-2019

No Till: Any direct seeding system, including site preparation, with minimal soil disturbance (includes strip & ridge till).



*Note: Darker colors had a greater percent increase in total no till acres (corn and soybeans) from 1990-2019



* Please note that not all counties have data for all years. No tillage data is collected for Marion county.

No Till Percentage Change 1990-2019		
	Percentage Point Change	Percent Change
Corn	14	156%
Soybeans	43	538%
Combined	30	375%

No Till Acreage Change 1990-2019		
	Acres	Percent Change
Corn	751,225	157%
Soybeans	2,797,827	855%
Combined	3,549052	440%

No Till Implementation

Acreage	1990	1993	1997	2000	2004	2007	2009	2011	2013	2015	2017	2019
Corn	479,255	1,211,769	891,962	1,120,174	1,011,467	1,542,152	1,244,400	1,296,300	1,266,700	1,621,000	1,134,432	1,230,480
Soybeans	327,249	1,726,956	2,270,370	3,023,134	3,002,974	3,032,493	3,375,300	3,225,400	2,845,300	2,941,600	2,726,477	3,125,076
Combined	806,504	2,938,725	3,162,332	4,143,308	4,014,441	4,574,645	4,619,700	4,521,700	4,112,000	4,562,600	3,860,909	4,355,556

Percentage	1990	1993	1997	2000	2004	2007	2009	2011	2013	2015	2017	2019
Corn	9%	23%	18%	21%	19%	25%	23%	23%	21%	28%	20%	23%
Soybeans	8%	38%	51%	60%	61%	69%	64%	59%	55%	54%	49%	51%
Combined	8%	29%	32%	40%	39%	44%	43%	41%	37%	40%	34%	38%

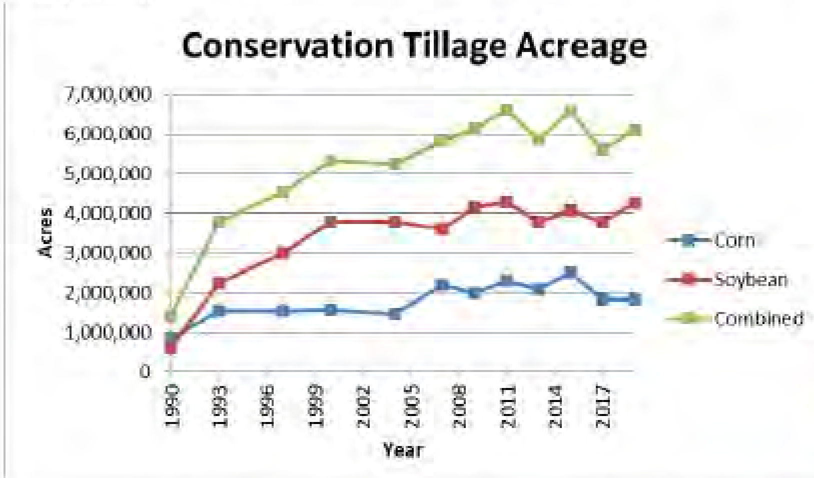
For more information please see: http://www.in.gov/isda/2383.htm

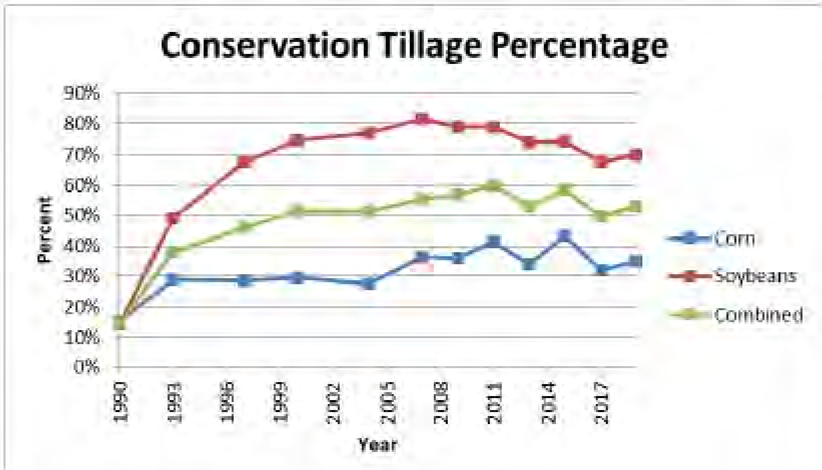
October 10, 2019
Leah Harmon, ISDA Director of Information Systems

Figure 31 – No-Till Trends from 1990-2019

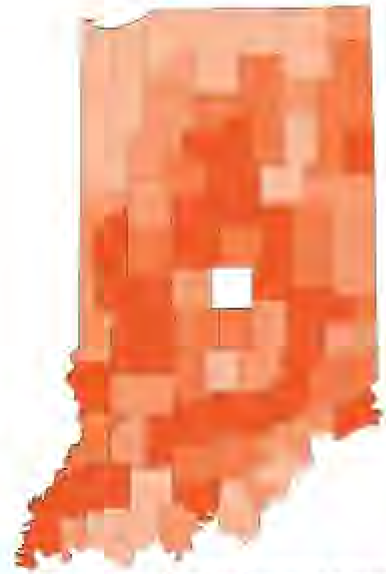
Indiana Statewide Tillage: 1990-2019

Conservation Tillage: any system that leaves at least 30% residue cover after planting





* Please note that not all counties have data for all years. No tillage data is collected for Marion county.



*Note: Darker colors had a greater percent increase in total conservation tillage acres (corn and soybeans) from 1990-2019

Conservation Tillage Percentage Change 1990-2019		
	Percentage Point Change	Percent Change
Corn	20	133%
Soybeans	56	400%
Combined	38	271%

Conservation Tillage Acreage Change 1990-2019		
	Acres	Percent Change
Corn	1,011,693	122%
Soybeans	3,677,082	625%
Combined	4,688,775	332%

Conservation Tillage Implementation

Acreage	1990	1993	1997	2000	2004	2007	2009	2011	2013	2015	2017	2019
Corn	824,200	1,536,438	1,528,779	1,558,708	1,455,828	2,202,153	1,988,000	2,304,200	2,086,900	2,507,600	1,816,156	1,835,893
Soybeans	588,159	2,244,690	3,009,387	3,781,933	3,797,671	3,613,545	4,156,160	4,296,000	3,796,600	4,065,500	3,797,793	4,265,241
Combined	1,412,359	3,781,128	4,538,166	5,340,641	5,253,499	5,815,697	6,144,160	6,600,200	5,883,500	6,573,100	5,613,949	6,101,134

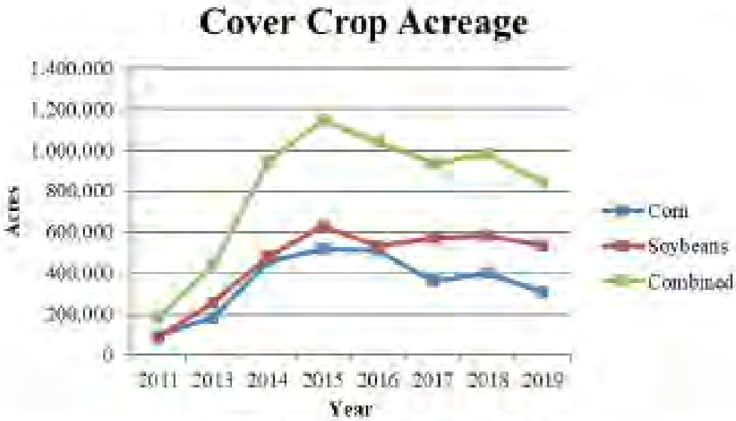
Percentage	1990	1993	1997	2000	2004	2007	2009	2011	2013	2015	2017	2019
Corn	15%	29%	29%	29%	28%	36%	36%	41%	34%	40%	32%	35%
Soybeans	14%	49%	67%	75%	77%	82%	79%	79%	74%	79%	68%	70%
Combined	15%	N/A	N/A	52%	52%	55%	57%	60%	52%	58%	50%	53%

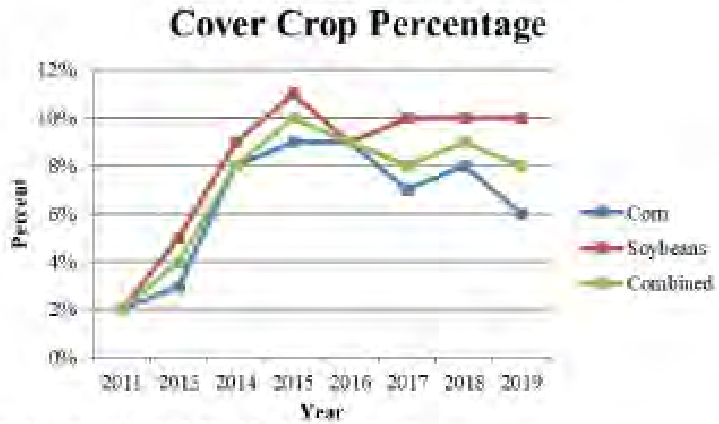
For more information please see: http://www.in.gov/isda/2383.htm

October 10, 2019
Leah Harmon, ISDA Director of Information Systems

Figure 32 – Conservation Tillage Trends from 1990-2019

Indiana Cover Crops: 2011-2019





*Note: Darker colors indicate counties that reported a greater percentage of combined corn and soybean acres utilizing cover crops in 2019.

* Data is not collected for Marion County.
* 2011 and 2013 cover crop data was collected during the spring tillage transect. Figures collected in this manner may not be a true reflection of cover crop implementation because of winter kill and other factors.
* A fall cover crop transect has been completed annually since 2014. Data from these transects are included.
* Due to the COVID 19 pandemic, not all transects were completed. These surveys were supplemented using 5-year averages.
* A wet spring in 2019 made planting season a challenge. Subsequently, many landowners sowed cover crops in fields which had no cash crop. These fields are not reflected in this data.

Cover Crop Acreage Change 2011-2019		
	Acres	Percent Change
Corn	213,090	222%
Soybeans	448,615	511%
Combined	661,705	359%

Cover Crop Percentage Change 2011-2019		
	Percentage Point Change	Percent Change
Corn	4	200%
Soybeans	8	400%
Combined	6	300%

Cover Crop Implementation								
Acreage	2011	2013	2014	2015	2016	2017	2018	2019
Corn	96,200	183,100	461,081	518,808	510,925	362,494	402,101	309,290
Soybeans	87,800	258,000	483,280	628,722	530,117	573,349	581,018	536,415
Combined	184,000	441,100	944,361	1,147,530	1,041,042	935,843	983,119	845,705
Percentage	2011	2013	2014	2015	2016	2017	2018	2019
Corn	2%	3%	8%	9%	9%	7%	8%	6%
Soybeans	2%	5%	9%	11%	9%	10%	10%	10%
Combined	2%	4%	8%	10%	9%	8%	9%	8%

For more information about the transect program, including county level transect data, please see: http://in.gov/isda/2383.htm

December 7, 2020
Leah Harmon, ISDA Director of Information Systems

Figure 33 – Cover Crop Trends from 2011-2019

EPA Region 5 Nutrient Load Reduction Modeling and Mapping: Watershed-Wide

In 2011, ISDA adopted the use of the Region 5 Nutrient Load Reduction Model developed by EPA for three 319 funded watersheds, the Tippecanoe River, Upper Eel River, and the Upper Wabash River watersheds, in which three DSC staff were located to assist with the installation of conservation practices on the ground. IDEM utilizes this Region 5 model for all of its 319 funded projects as required by EPA.

This model estimates sediment, nitrogen and phosphorus load reductions from individual BMPs on the ground. ISDA saw the value of using this model as a means to measure the load reductions coming from all technical assisted projects in Indiana that was being done by all of our staff, not just by the three staff working in the 319 funded watersheds. Its use has been standardized by ISDA, and the Region 5 model was adopted by the Indiana Conservation Partnership in 2013 and is now used statewide to model all the conservation practices that are implemented through assistance of all the ICP partnership staff. Cooperation in this effort by local, state and federal partners in the ICP allows for conservation tracking and load reduction estimation at an order of magnitude greater than any single agency or entity could achieve alone. There is much data that goes into the preparation of the final reports, and Figure 34 shows the methodology by which we work through, and the process is explained in the Methodology report.

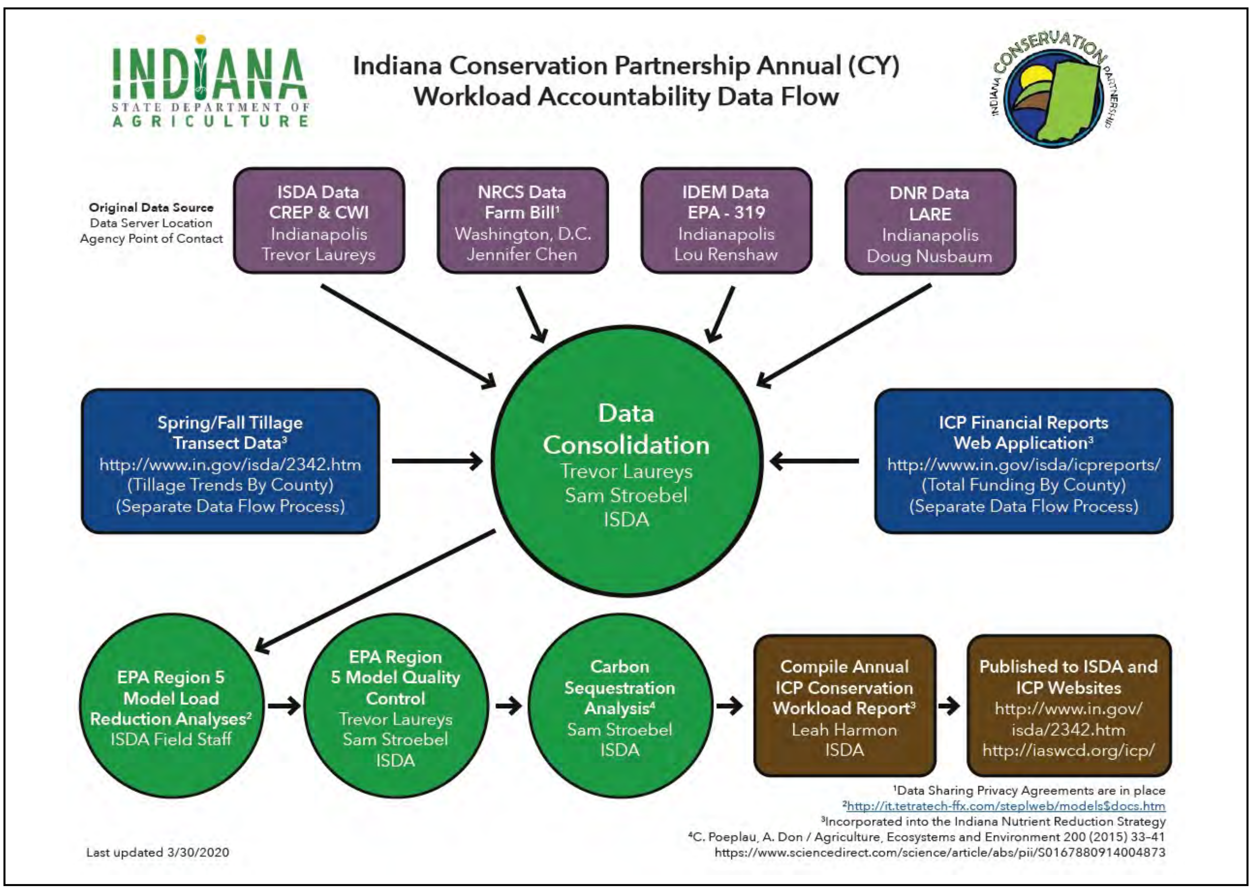


Figure 34 – Methodology Chart

Indiana collects conservation practice data such as type of practice, practice locations, measurements and other necessary parameters from ICP partners for all federal, state and local programs, and through the process of data collection, we can see the impact of the number of conservations practices that are implemented annually. The collected data is then run through the Region 5 model to analyze the sediment, nitrogen and phosphorus load reductions for specific practices. Figures 35-38 illustrate the cumulative sediment, nitrogen, and phosphorus load reductions from all assisted conservation practices reported by staff in the ICP from 2013-2019. These maps show the number of BMPs actively reducing loads in a given calendar year regardless of the year of practice installation.

While this model is project-specific, it provides a valuable perspective on a larger scale when showing the collective reductions of practices across several programs. The accountability/verification and annual reporting on implementation are current expectations among Indiana's Conservation Partner's and are regularly being refined and improved. The ICP utilizes the end products of this process to measure load reduction trends by watershed for each calendar year, and serves as a tangible component of the Indiana State Nutrient Reduction Strategy.

An Annual Accomplishments report is prepared each year and can be found on the ISDA State Nutrient Reduction Strategy webpage: https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/.

Strengthening and Improving Our Method

The Region 5 model is used to determine nitrogen and phosphorus load reductions that are tied directly to sediment. As a result, nutrients that are dissolved and carried by runoff waters are not accounted for in the model; therefore we are missing the dissolved nutrients such as nitrate and dissolved phosphorus. Also, there are several practices that can't be run through the model due to the practice not being tied to sediment, such as nutrient management. The ICP would like to strengthen and improve this existing method of capturing nutrient load reductions so that we can capture dissolved nutrients and other practices not tied to sediment, which will lead to more accurate reductions and better assess the progress being made on improving water quality.

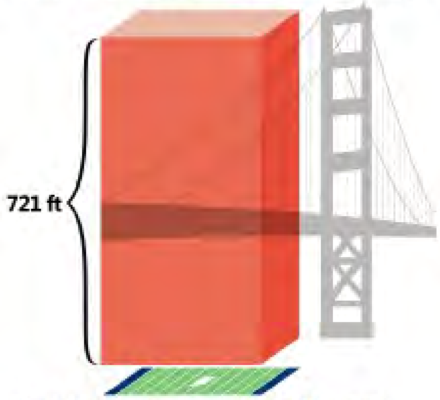
This is being done through Component 2 of the Indiana Science Assessment as explained in Section 7. Monitoring conducted around the Midwest and in Indiana provides new understanding of the effectiveness of in-field and edge-of-field conservation practices in reducing nitrogen and phosphorus loads from agricultural fields. This research will be compiled, reviewed and be used to improve the current method that Indiana uses to calculate reductions in sediment, nitrogen, and phosphorus loads by identifying or developing a standardized tool and procedure for calculating nutrient load reductions from conservation practices, and be used in determining the percent efficiency of certain conservation practices on reducing the nitrogen and phosphorus loads.

This component will also include having a collective list and consistent definitions of conservation practices while considering their estimated nitrogen and phosphorus loss reductions, as well as the economic and agronomic feasibility of the practices.

2019 Cumulative Sediment Load Reductions

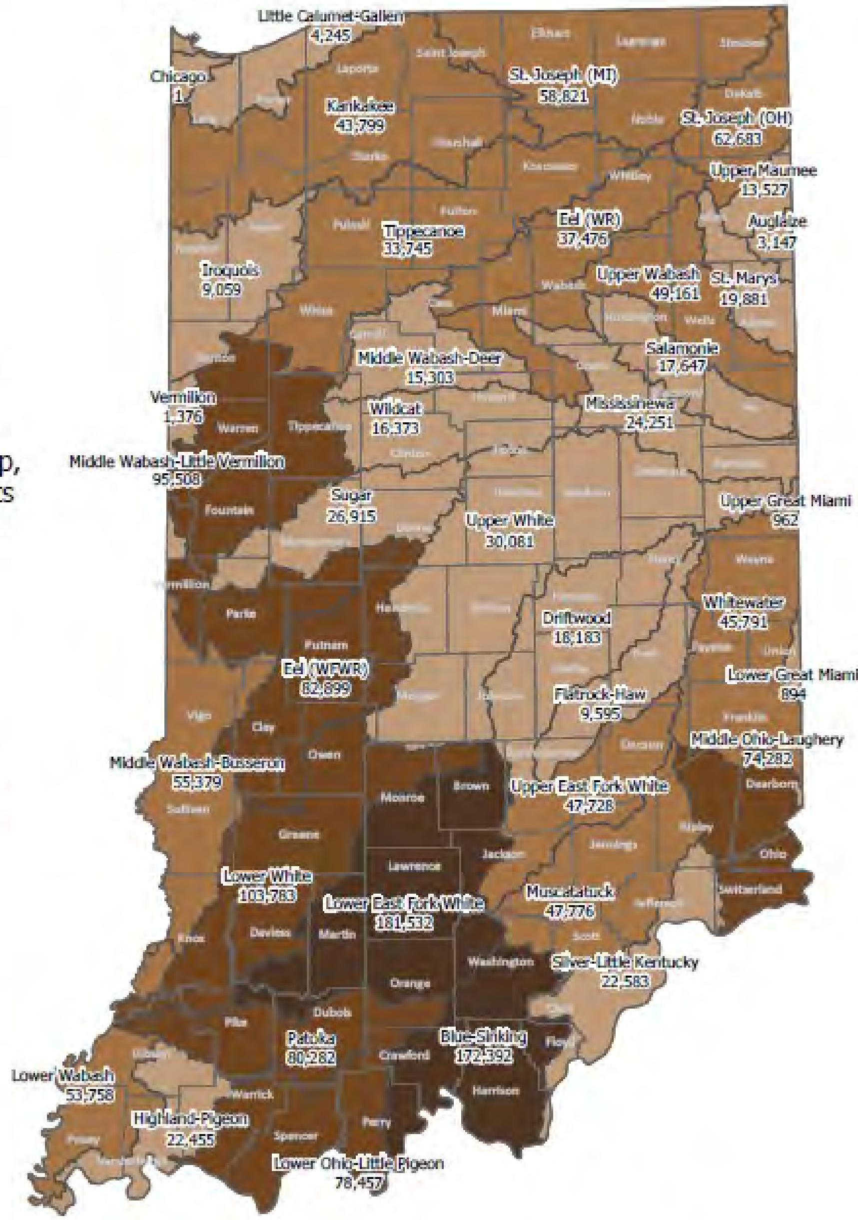
1,661,729 Tons

Since 2013, voluntary conservation efforts from Indiana's private landowners, with support from the Indiana Conservation Partnership, have reduced sediment and nutrients from entering Indiana's waterways.



1,661,729 tons of sediment

If you were to stack that soil on a football field, it would be as tall as the golden gate bridge!



Based on EPA Region 5 Model analyses conducted on 31,421 conservation practices installed by the Indiana Conservation Partnership January 2013 thru December 2019. This effort does not include the many unassisted practices designed and installed solely by a private landowner without ICP assistance.

The cumulative analysis encompassed a breakdown of 2013 thru 2018 conservation practices by lifespan including 1, 5, 10, 15, 20 and 40 years. The map reflects all of the practices minus the 2013 thru 2018 practices with a lifespan of one year and 2013 practices with a lifespan of five years.

Reductions in dissolved nutrients, such as dissolved reactive phosphorus (DRP) and nitrate (NO3), are not accounted for by the Region 5 Model.

To learn more about Indiana's Nutrient Reduction Strategy visit:http://www.in.gov/isda/2991.htm
For questions and comments email ISDANutrientReduction@isda.in.gov

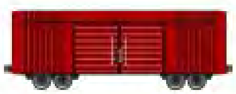
Last Updated: 4/13/2020
Trevor Laureys, ISDA

Figure 35 – Cumulative Sediment Load Reductions from 2013-2019

2019 Cumulative Nitrogen Load Reductions

3,504,426 pounds

Since 2013, voluntary conservation efforts from Indiana's private landowners, with support from the Indiana Conservation Partnership, have reduced sediment and nutrients from entering Indiana's waterways.



x 17.5

3,504,426 pounds of Nitrogen
That's enough to fill over 17 standard freight cars!

One would need **42 billion gallons** of water to dilute this amount of nitrogen to meet drinking water standards.

Nitrogen (lbs/yr)
Aggregated by HUC8

- ≤44,520
- ≤113,300
- ≤216,197
- ≤332,441

Based on EPA Region 5 Model analyses conducted on 31,421 conservation practices installed by the Indiana Conservation Partnership January 2013 thru December 2019. This effort does not include the many unassisted practices designed and installed solely by a private landowner without ICP assistance.

The cumulative analysis encompassed a breakdown of 2013 thru 2018 conservation practices by lifespan including 1, 5, 10, 15, 20 and 40 years. The map reflects all of the practices minus the 2013 thru 2018 practices with a lifespan of one year and 2013 practices with a lifespan of five years.

Reductions in dissolved nutrients, such as dissolved reactive phosphorus (DRP) and nitrate (NO3), are not accounted for by the Region 5 Model.

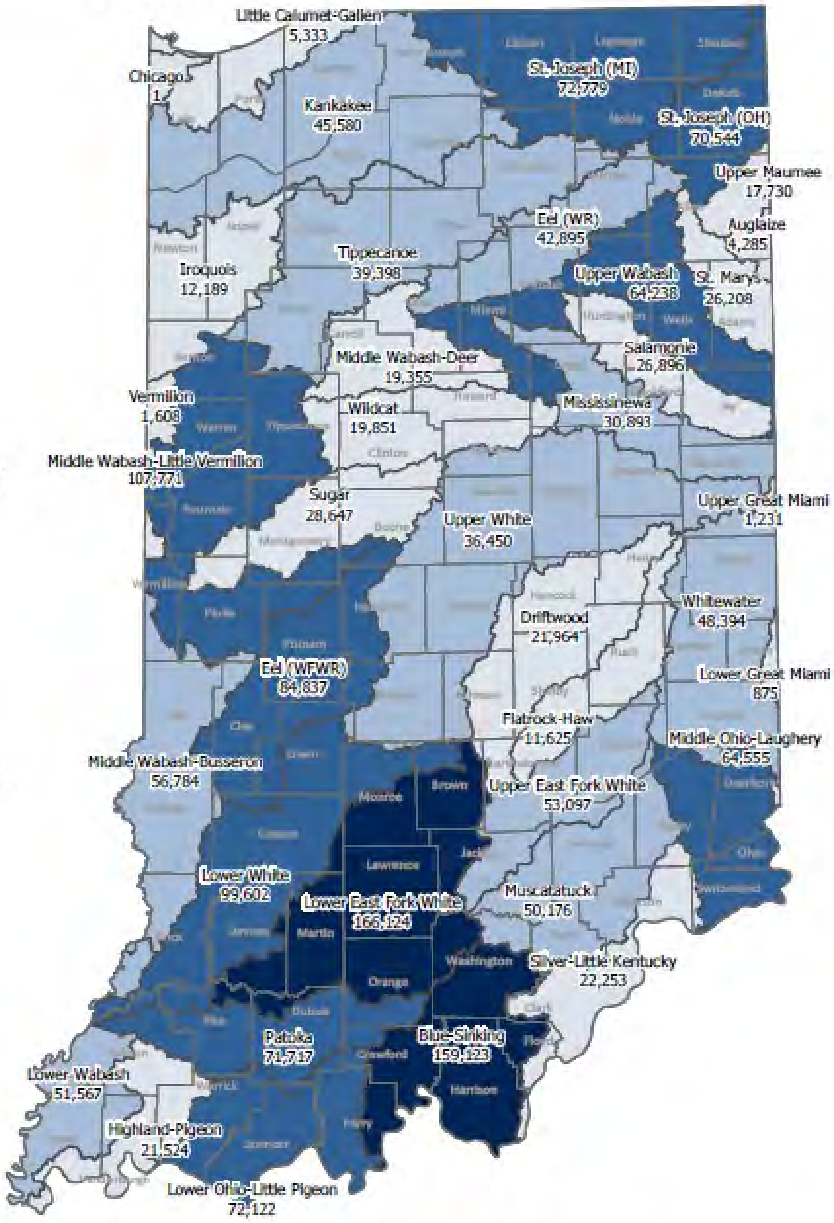
To learn more about Indiana's Nutrient Reduction Strategy visit:http://www.in.gov/isda/2991.htm
For questions and comments email ISDANutrientReduction@isda.in.gov

Last Updated: 4/13/2020
Trevor Laureys, ISDA

Figure 36 – Cumulative Nitrogen Load Reductions for 2013-2019 Practices

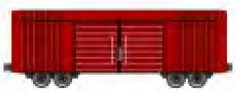
2019 Cumulative Phosphorus Load Reductions

1,730,218 pounds



Since 2013, voluntary conservation efforts from Indiana's private landowners, with support from the Indiana Conservation Partnership, have reduced sediment and nutrients from entering Indiana's waterways.

icp.iaswcd.org/



x 8.5

1,730,218 pounds of Phosphorus
That's enough to fill over 8 standard freight cars!

This reduction is enough to prevent over **850,000,000 pounds** of surface algae from growing.

Based on EPA Region 5 Model analyses conducted on 31,421 conservation practices installed by the Indiana Conservation Partnership January 2013 thru December 2019. This effort does not include the many unassisted practices designed and installed solely by a private landowner without ICP assistance.

The cumulative analysis encompassed a breakdown of 2013 thru 2018 conservation practices by lifespan including 1, 5, 10, 15, 20 and 40 years. The map reflects all of the practices minus the 2013 thru 2018 practices with a lifespan of one year and 2013 practices with a lifespan of five years.

Reductions in dissolved nutrients, such as dissolved reactive phosphorus (DRP) and nitrate (NO3), are not accounted for by the Region 5 Model.

Phosphorus (lbs/year)

Aggregated by HUC8

- ≤28,647
- ≤56,784
- ≤107,771
- ≤166,124

To learn more about Indiana's Nutrient Reduction Strategy visit:http://www.in.gov/isda/2991.htm
For questions and comments email ISDANutrientReduction@isda.in.gov

Last Updated: 4/13/2020
Trevor Laureys, ISDA

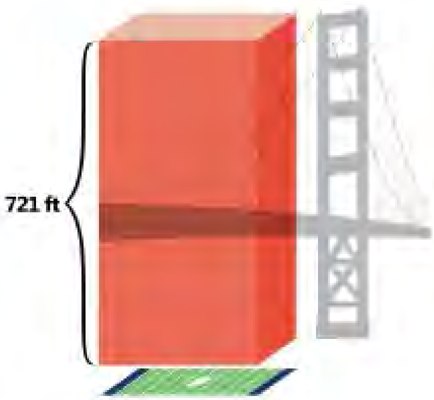
Figure 37 – Cumulative Phosphorus Load Reductions for 2013-2019 Practices

Indiana Nutrient and Sediment Load Reductions

Voluntary conservation efforts from private landowners in Indiana with support from the Indiana Conservation Partnership have reduced nutrients and sediment from entering Indiana's waterways. The figures below represent these efforts in 2019 from conservation practices installed since 2013.*

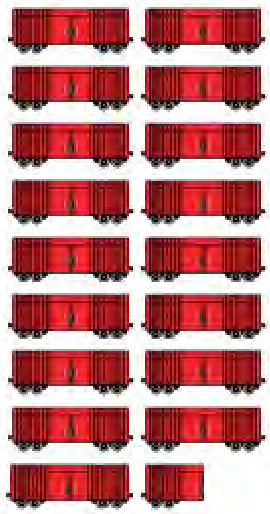
Load Reductions

Sediment
A football field covered to a depth of 721 feet, which is almost as tall as the Golden Gate Bridge!



Reduction:
1,661,729 Tons

Nitrogen
17.5 freight cars



Reduction:
3,504,426 Pounds

Phosphorus
8.5 freight cars

Reduction:
1,730,218 Pounds

Top Conservation Practices

Top practices are represented by frequency rather than acreage. For more information visit: nrcs.usda.gov

- Cover Crops
- No Till
- Habitat Development
- Conservation Cover
- Grassed Waterway
- Forage and Biomass Planting
- Heavy Use Area Protection
- Water and Sediment Control Basin

Indiana Conservation Partnership

Data is collected by Indiana Conservation Partnership Agencies and aggregated using the USEPA's Region 5 Model to show total nutrient and sediment reductions.

DNR Indiana Department of Natural Resources
USDA United States Department of Agriculture Natural Resources Conservation Service
Indiana State Department of Agriculture Division of Soil Conservation
Indiana Conservation Partnership icp.iaswcd.org/
Indiana Association of Soil and Water Conservation Districts
IDEM
With Support From United States Environmental Protection Agency

This effort does not include the many unassisted practices designed and installed solely by a private landowner without Indiana Conservation Partnership assistance.

Updated: April 13, 2020

For more information about Indiana's Nutrient Reduction Strategy, please see isda.in.gov

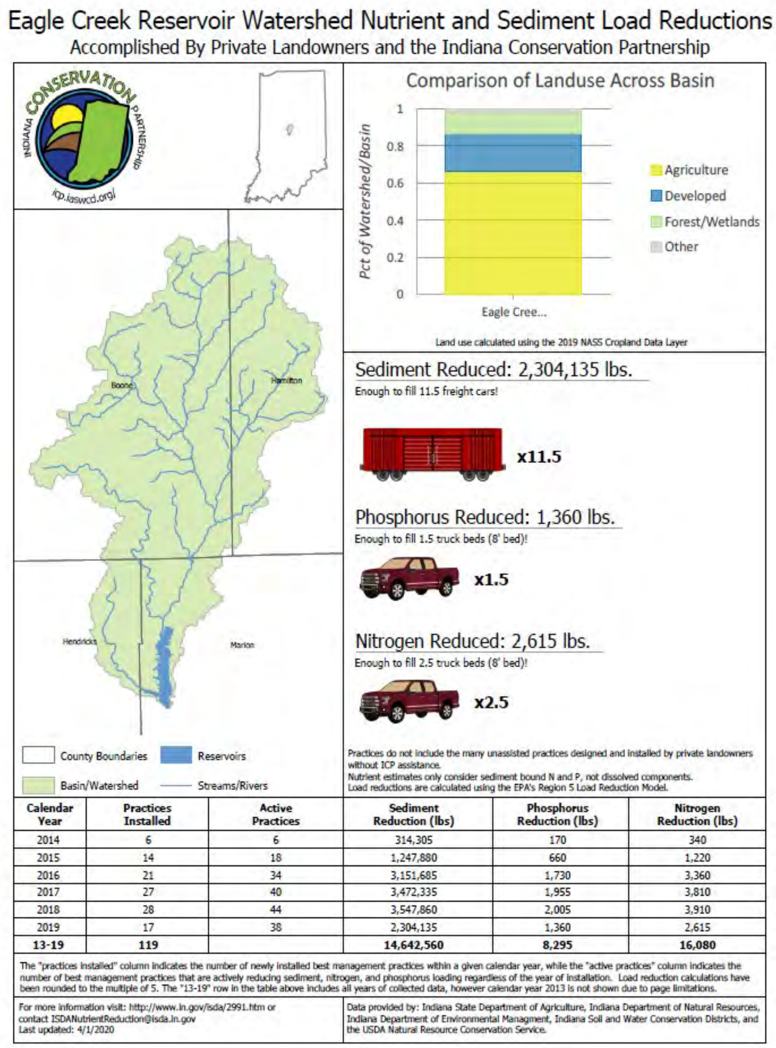
Figure 38 – Indiana Nutrient Load Reductions Info-graph

Significant Waterbodies

ISDA currently prepares one page reports for several significant waterbodies in Indiana based on the Region 5 Load Reduction modeling efforts taking place. The ICP focuses on reporting the positive impacts of conservation practices to key drinking water sources throughout the state that have significant percentages of agricultural land use within their watershed. These reports are available for viewing on the Indiana State Nutrient Reduction Strategy webpage on the ISDA website at https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/. Below is an example of one these reports.

Significant Waterbody reports are prepared for:

- Eagle Creek Reservoir
- Geist Reservoir
- Kankakee River Basin
- Mississippi River Basin
- Morse Reservoir
- Patoka-White River Basin
- Wabash River Basin
- Western Lake Erie Basin



Eagle Creek Reservoir Watershed Nutrient and Sediment Load Reductions
Accomplished By Private Landowners and the Indiana Conservation Partnership

Sediment Reduced: 2,304,135 lbs.
Enough to fill 11.5 freight cars!

Phosphorus Reduced: 1,360 lbs.
Enough to fill 1.5 truck beds (8' bed)!

Nitrogen Reduced: 2,615 lbs.
Enough to fill 2.5 truck beds (8' bed)!

Practices do not include the many unassisted practices designed and installed by private landowners without ICP assistance.
Nutrient estimates only consider sediment bound N and P, not dissolved components.
Load reductions are calculated using the EPA's Region 5 Load Reduction Model.

Calendar Year	Practices Installed	Active Practices	Sediment Reduction (lbs)	Phosphorus Reduction (lbs)	Nitrogen Reduction (lbs)
2014	6	6	314,305	170	340
2015	14	18	1,247,880	660	1,220
2016	21	34	3,151,685	1,730	3,360
2017	27	40	3,472,335	1,955	3,810
2018	28	44	3,547,860	2,005	3,910
2019	17	38	2,304,135	1,360	2,615
13-19	**119**		**14,642,560**	**8,295**	**16,080**

The "practices installed" column indicates the number of newly installed best management practices within a given calendar year, while the "active practices" column indicates the number of best management practices that are actively reducing sediment, nitrogen, and phosphorus loading regardless of the year of installation. Load reduction calculations have been rounded to the multiple of 5. The "13-19" row in the table above includes all years of collected data, however calendar year 2013 is not shown due to page limitations.

For more information visit: http://www.in.gov/isda/2991.htm or contact ISDANutrientReduction@isda.in.gov
Last updated: 4/1/2020

Data provided by: Indiana State Department of Agriculture, Indiana Department of Natural Resources, Indiana Department of Environmental Managment, Indiana Soil and Water Conservation Districts, and the USDA Natural Resource Conservation Service.

Figure 39 – Eagle Creek Reservoir Watershed Sediment and Nutrient Load Reductions

GIS Story Maps for Indiana's Ten Major River and Lake Basins

The purpose of the GIS Basin Story Map applications is to showcase Indiana's efforts to enhance water quality within the ten major river and lake basins in Indiana (Figure 15), as well as educate landowners, both rural and urban, about local, state and federal cost-share programs, educational opportunities, and rural and urban conservation practices. The story maps feature interactive maps which allow users to click on watersheds, water monitoring locations along with links to water quality data, and educational sites to view detailed information about each basin. There is also information about local watershed groups and organizations, the number of conservation practices in specific subwatersheds, nutrient load reductions from BMPs, and links to active grants. The development and purpose of these GIS story maps is making Indiana's nutrient reduction strategy more interactive. https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/.

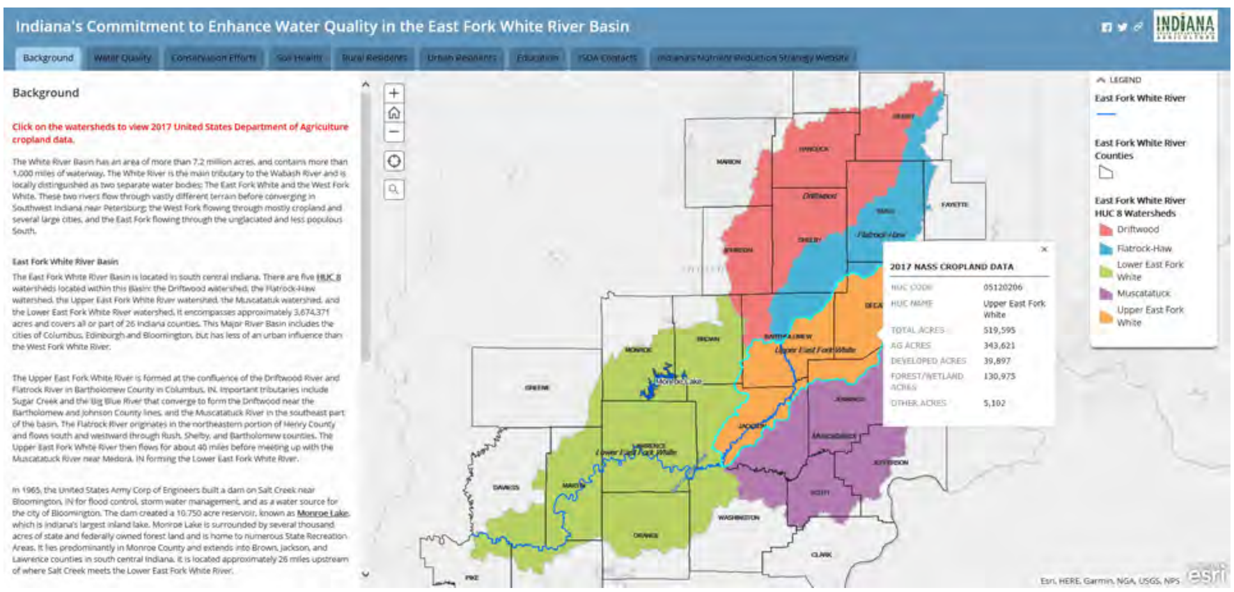


Figure 40 – Image of Background tab on the East Fork White River Basin Story Map

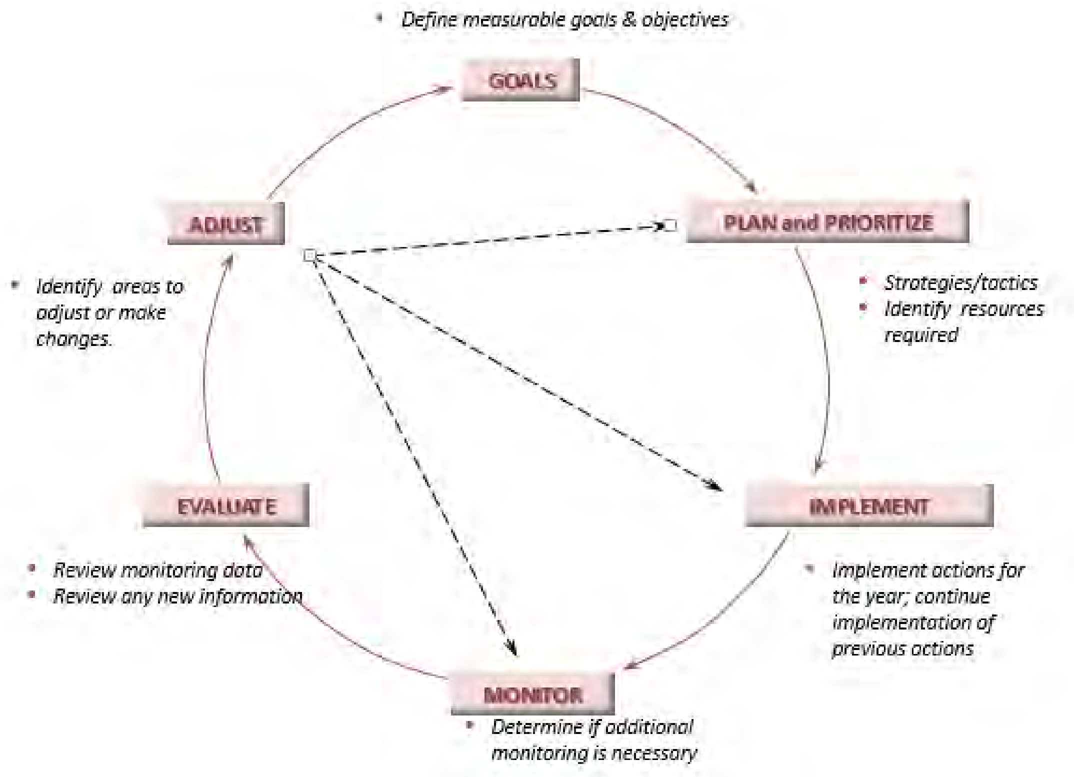
Performance Measures Monitoring

To determine if the BMPs installed are resulting in water quality improvements, IDEM conducts follow-up (performance measures) in-stream ambient water quality monitoring. IDEM consults with other members of the ICP to identify 12-digit HUCs where conservation practices have been in place for at least five years. The parameters sampled are based on the water quality impairments for which the stream is listed on the 303(d) List of Impaired Waters; most are for impaired biotic communities. IDEM's monitoring is showing that the watershed approach employed by the ICP is resulting in water quality improvements. Watershed success stories are found at http://www.in.gov/idem/nps/3360.htm.

Adaptive Management

Vital to Indiana's success in implementing this State Nutrient Reduction Strategy is an adaptive management approach that tests the hypotheses put forth in the Strategy and applies the lessons learned therefrom to future management decisions.

Figure 41 – Adaptive Management



Indiana will continue to evaluate the efficacy of the nutrient reduction policies, programs, and practices outlined in this Strategy. Based on that evaluation and new information/data arising from research and monitoring data, Indiana will modify this Strategy as necessary.

Section 10 – Milestones and Action Items

The current and on-going actions to address the issue of nutrient pollution and water quality impairment are outlined in the Milestones and Action Items table on the following pages. It includes actions or activities associated with certain Objectives/Goals, the responsible parties, along with timeframes and target dates where applicable. This table will be reviewed and amended periodically. To see the Milestones and Action Items table, including future updates, visit the SNRS webpage at https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/.

Some of the key accomplishments and key progress made since the previous version include:

1) The creation of the Indiana Science Assessment Core Team and the development of the Indiana Science Assessment Strategy. https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/indiana-science-assessment/
2) Under the Indiana Science Assessment, Component 1, a sub-committee of members from USGS, IDEM, ISDA, and TNC was formed to discuss water quality monitoring locations and data that could be used in determining nutrient load trends in Indiana. Analysis was conducted at pour points at the state border and within the major river and lake basins using the USGS model known as WRTDS. Results of this work and analysis will be available in 2021.
3) ISDA received a grant from U.S.EPA through the Gulf of Mexico Hypoxia Task Force to work with Purdue University, College of Ag and the other members of the Science Assessment Core Team to help carry out Component 2 of the assessment. A research associate has been hired to work at Purdue to compile, review and and analyze research that will be used to identify or develop a standardized tool for calculating nutrient load reductions and be used to determine the percent efficiency of certain conservation practices on reducing the nitrogen and phosphorus loads, which will improve the existing method that the ICP uses to track water quality improvement through the implementation of conservation practices.
4) The 4R Nutrient Stewardship Certification Program was launched statewide in November of 2020. It is a voluntary program for Indiana Agribusiness Council members that encourages agricultural retailers, nutrient service providers and other independent crop consultants to adopt proven best management practices through the 4Rs, which refers to using the Right Source of nutrients at the Right Rate at the Right Time in the Right Place. It was launched with 5 companies in the state that went through the pilot audit process. To learn more about this program, refer to page 83 and 84.
5) Launch of the new Cover Crop Premium Discount Program in partnership between ISDA, TNC and the USDA Risk Management Agency. The goal of the program is to expand cover crop use among farmers in the Upper White watershed in Randolph, Madison, Delaware, Henry, Hamilton, and Tipton counties. Focus is to target first time cover crops users but others are eligible as well. Eligible growers can receive a $5.00/acre premium discount on the following year’s crop insurance invoice for verified acres. https://www.in.gov/isda/divisions/soil-conservation/cover-crop-premium-discount-program/

Indiana's State Nutrient Reduction Strategy – Milestones and Action Items Table

Last updated on February 26, 2021

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Party	Timeframe	Target Date	Status & Results (as applicable)
Provide an update of the SNRS every five years	Updates of SNRS will be prepared as necessary; keep track of accomplishments and adaptive management changes	-SNRS -Annual ICP Accomplishment Reports	ISDA; IDEM; and SNRS Workgroup	12/2020 - 12/2025	12/2025	On-going
Update Milestones and Action Items table	SNRS Workgroup will meet at least annually to review and discuss this table and make necessary changes.	-SNRS -Milestones and Action Items table -Partnership efforts	ISDA; IDEM; and SNRS Workgroup	Annually	Dec. 2021-Dec. 2025	On-going
Watershed Prioritization						
Watersheds with drinking water reservoirs	Map Drinking water areas	GIS	IDEM	NA	NA	Completed
Groundwater sources	Groundwater Vulnerability Maps	Ground Water Monitoring Network (GWMN); GW staff	IDEM GW staff	NA	NA	Completed -Page 23-24 of SNRS
Watershed Prioritization within the nine major river basins	-Analyze fixed station data for the period of the last 10 years for each of the nine basins in this order: 1. Great Lakes a. Lake Erie b. Lake Michigan 2. Upper Wabash 3. White River, West Fork 4. White River, East Fort 5. Lower Wabash 6. Upper Illinois 7. Ohio River Tributaries 8. Great Miami 9. Patoka -Analyze USGS water quality monitoring data and discharge data	- P and N data from AIMS II will be modeled for the period of the last 10 years using Load Duration Curves and LOADEST - WQ monitoring data - Drinking water maps - GW Vulnerability maps - State Resource Assessment (SRA) - WQ Monitoring Data from USGS and other organizations - Results of nutrient load trends from WRTDS model - Indiana Science Assessment	IDEM WAPB staff; ISDA; USGS; monitoring agencies	September 2019 – December 2021	December 2022	1(a) 100% completed 1(b) in process 2-9: in process

Indiana's State Nutrient Reduction Strategy – Milestones and Action Items Table

Last updated on February 26, 2021

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Party	Timeframe	Target Date	Status & Results (as applicable)
Select critical watersheds at the HUC 12 level within the nine basins.	Identify the intersection of monitoring data, maps of critical areas from WMPs, NRCS modeling, etc. to determine the 12 digit HUC priority areas.	- Monitoring Data - IDEM Watershed Management Plans (WMPs) - Drinking water maps - GW Vulnerability maps - Modeling Data - Nutrient load trends Indiana Science Assessment	SNRS Workgroup; Indiana Conservation Partnership (ICP)	On-going	December 2022	On-going
Measuring Impacts						
List what type of management will <u>need</u> to be done in the newly selected HUC12 critical areas/priority watersheds to address issues	Identify BMPs that could be implemented based on type of management needed to address resource issues	- Monitoring Data - IDEM WMPs - Drinking water maps - GW Vulnerability maps - Modeling Data - Indiana Science Assessment	SNRS Workgroup; ICP	On-going	On-going	On-going
Inventory the new BMPs that <u>are</u> implemented in the newly selected critical areas/priority watersheds at the HUC 12 level, and show impacts of this BMP implementation.	-IDEM CWA 319 funds -IDEM CWA 205j funds -Use Region 5 Model to analyze and show sediment and nutrient load reductions	- Performance Measures Monitoring - Region 5 Model	ICP	Annually	December 2025	On-going http://www.in.gov/idem/nps/3360.htm
Continue to inventory BMPs implemented through conservation programs and show impacts of the *assisted* BMP implementation statewide.	Use Region 5 Model to analyze and show sediment and nutrient load reductions	- Region 5 Model - Tillage Transects - Cover Crop Transects	ICP	On-going annually	March of every year	ICP Accomplishments Report and Load Reduction maps
Continue to conduct the spring tillage transect survey statewide, and to use the data results from these transects.	Partnership staff in each county will conduct this transect in the spring following planting on a bi-annual basis.	Conservation Partnership Staff	ICP	Every two years April-June	NA	Cover Crop and Tillage Transect Data website
Continue to conduct the fall cover crop and tillage transect survey statewide, and to use the data results from these transects.	Partnership staff in each county will conduct this transect in the fall following harvest each year.	Conservation Partnership Staff	ICP	Annually from Oct-December	NA	Cover Crop and Tillage Transect Data website

Indiana's State Nutrient Reduction Strategy – Milestones and Action Items Table

Last updated on February 26, 2021

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Party	Timeframe	Target Date	Status & Results (as applicable)
Monitoring						
Use monitoring gaps determined by the InWMC Whitepaper titled *An Assessment for Optimization of Water-Quality Monitoring in Indiana, 2017* to prioritize new monitoring sites (statewide)	Determine scale of new monitoring sites: compare the SNRS 12-digit priority HUCs with 8-digit pour points	*Integrated Water Monitoring Network Optimization Taskforce*; *An Assessment for Optimization of Water-Quality Monitoring in Indiana, 2017*; GIS; HUC maps	InWMC; ISDA; IDEM; and USGS	On-going	NA	On-going
Determine funding needs for the new priority monitoring sites	Identify various funding sources	Federal, State and Local funding; Foundation funding; NGO funding	SNRS Workgroup; ICP	On-going	NA	On-going
Determine existing monitoring locations that need continued funding in order to continue long-term water quality monitoring.	USGS, IDEM and ISDA staff discuss locations with this need and work with the Hypoxia Task Force Monitoring Workgroup and GLWQA Annex 4 Sub-Committee to determine and discuss location and funding needs.	Existing monitoring data sets; USGS and IDEM data; Indiana Science Assessment;	USGS; IDEM; ISDA	On-going	NA	On-going
Add capacity to sample for DRP in the following areas: 1. Laboratory analysis 2. Monitoring resources beginning in the WLEB with Fixed Stations	1. Secure laboratory equipment for the ISDH; 2. Investigate necessary resources for collecting and analyzing for DRP	1. MOU between IDEM & ISDH; IDEM lab account funding 2. Time/travel study	IDEM & ISDH	October 2016 – June 2017	1. 1/2017 2. 3/2017	1. 100%-Funds secured, 100% complete 2. Complete
Diurnal Dissolved Oxygen Pilot project planning for development of TP multi-parameter numeric criteria	Develop work plan and secure funding for sampling in 2017	Scientific literature; OH EPA personnel; USGS personnel; equipment manufacturers	IDEM and USGS	April 2016 – December 2016	December 31, 2016	100% complete
Implement Diurnal Oxygen Pilot project	Monitoring of approximately 28 sites	IDEM and USGD staff and equipment	IDEM	March 2017 - Oct. 2017	October 2017	100% complete
Plan the project for Performance Measures monitoring for 2017 to determine if BMP implementation has improved water quality	Based on information/data from ICP and the AIMS II database, determine the 12-digit HUC for follow-up sampling	AIMS II database; cost-share information from ICP; Region 5 model outputs	IDEM	October 2016 – Feb. 2017	February 2017	100% complete
Implement performance measures monitoring	Develop work plan, conduct recon	GIS mapping; AIMS II database; field survey	IDEM	April 2017 – Oct. 2017	October 2017	100% complete

Indiana's State Nutrient Reduction Strategy – Milestones and Action Items Table

Last updated on February 26, 2021

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Party	Timeframe	Target Date	Status & Results (as applicable)
Increase no-till implementation statewide based on tillage transect results	-Provide technical assistance -Work with those who have a negative opinion of no-till. High residue systems have benefits. -Increase the promotion of strip-till since it has many of the same benefits as no-till and can get nutrients injected below ground. -Assess results of Tillage Transect done by ICP.	-Tillage Transect data by ICP -Federal Farm bill programs; State Conservation Programs; Technical assistance -IANA support -CCSI support	SSCB; ICP; IANA	On-going	NA	On-going, Link to Transect Data; Link to ICP Accomplishments Report
Increase conservation tillage implementation statewide based on tillage transect results	-Provide technical assistance -This practice can be used as a transition to the use of cover crops and not-till. -Use Tillage Transects done by ICP to look at trends and past accomplishments	-ICP Tillage Transect data -Federal Farm bill programs; State Conservation Programs; Technical assistance -IANA support -CCSI support	SSCB; ICP; IANA	On-going	NA	On-going. Link to Transect Data; Link to ICP Accomplishments Report
Increase acres of wetland restorations	-Provide technical assistance -Look at trends and past accomplishments	CREP; HRI; Federal Farm Bill Programs; Technical Assistance	ICP	On-going	NA	On-going -CREP Annual Report
Increase acres of floodplain restorations (tree plantings)	-Provide technical assistance -Look at trends and past accomplishments	CREP; HRI; Federal Farm Bill Programs; Technical Assistance	ICP	On-going	NA	On-going -CREP Annual report -HRI website
See a measurable increase in the number of joint sediment and nutrient reduction projects among SWCDs funded through CWI.	SWCDs apply for CWI funding; this is a goal of the State Soil Conservation Board (SSCB)	CWI funding; ISDA District Support Specialists; ISDA Resource Specialists	SSCB	On-going	NA	On-going CWI website
Increase the amount of regular soil sampling performed by Indiana farmers that aid in nutrient management on ag land	-Get 100% of farmers to adopt soil sampling practices -Provide technical assistance -Explore funding opportunities to assist farmers	Statewide Social Survey data; 4R Nutrient Stewardship Certification Program	IANA	On-going	NA	On-going
See an increase in the use and implementation of nutrient management plans by Indiana farmers	-Get 100% of farmers to use and implement NMPs -Provide technical assistance -Explore funding opportunities to assist farmers	Statewide Social Survey data; 4R Nutrient Stewardship Certification Program	IANA	On-going	NA	On-going

Indiana's State Nutrient Reduction Strategy – Milestones and Action Items Table

Last updated on February 26, 2021

Objectives/Goals	Action/Activity	Tools/Resources	Responsible Party	Timeframe	Target Date	Status & Results (as applicable)
Assess the Funding needs and Research needs and gaps within Indiana.	-For monitoring needs and costs, both surface and groundwater; -Edge-of-field Research -Science Assessment	-WQ Monitoring Strategy -Ground Water Monitoring Network (GWMN) -University Research -HTF Research Needs Workgroup	ICP; SNRS Workgroup	January 2021 – December 2022	December 2022	In process
Work with the State Department of Health on addressing septic tank issues throughout the state.	-Understand issues related to septic tank failures in the state	Indiana State Department of Health; educational materials; County Health Departments	ISDA, Water Quality Initiatives Program Manager; ISDH; IDEM	January 2021- December 2021	December 31, 2021	On-going

Section 11 – "What You Can Do to Protect Water Quality in Indiana"

How can you protect and improve Indiana's water quality? Recall that a watershed is the area of land that drains to a body of water. As a Hoosier, you live in a watershed that drains either to the Gulf of Mexico or to the Great Lakes. It is important to understand that the quality of water coming from your lawn, roof, driveway, neighborhood streets, etc. has an effect on the water quality in the local streams and rivers, as well as on local storm drain systems, which eventually flow to the Gulf of Mexico or the Great Lakes. What you do on a day-to-day basis has an impact on the water quality in your watersheds. You play a role, and you can make a positive difference!

State and local governments, volunteer groups, water quality professionals, and concerned citizens are working together to clean up our lakes, rivers, streams, and wetlands. You can help! Whether you live in a big city or in the country, you can prevent nonpoint source pollution by taking simple actions on your property or in your community. The following are some simple solutions to a big problem (http://www.in.gov/idem/nps/2487.htm):

- **Dispose of oil and household chemicals properly**
  Keep oils and chemicals out of local streams by utilizing and supporting local toxic drop-off sites, maintaining vehicles to reduce leaks and never pouring any materials down a storm drain.

- **Maintain septic tanks**
  Just like any other tool or appliance, a septic tank needs to be maintained to function properly, and a properly working septic system should not release anything that is harmful to you or the environment. Pump it out regularly-at least once every three years-to avoid overload or failure.

- **Create and enhance riparian corridors**
  Riparian corridors are the buffer zones between used land and a stream, most often planted with vegetation. A well-established riparian corridor can help regulate water temperature, protect the bank from erosion, and filter pollutants from storm water. You can start improving your riparian corridor by allowing natural growth, rather than mowing along the stream bank. Allowing native plants to take over the area, as well as adding trees and bushes will help increase the function of your corridor.

- **Pick up pet waste**
  It is simple to reduce nonpoint source pollution from pet waste - just pick up after your pet. Pet waste contributes to nutrient and E. coli nonpoint source pollution. Pet stores and large retail stores carry small plastic bags for picking up pet waste. Biodegradable bags are even available for purchase.

- **Take care of big issues on small farms**
  Depending on the type and number of animals you have, there are many options for reducing the impact of your hobby farm. First, consider isolating animals from water bodies and providing alternative drinking water sources. Animals trample vegetation on stream banks and deposit feces in the water. If you pasture animals, create a rotational grazing system that reduces pasture erosion and allows the vegetation time to grow. For other ideas more specific to your operation, contact your local Soil and Water Conservation District.

- **Read the label – Use lawn and garden fertilizer wisely**
  Fertilizer is composed of nitrogen, phosphorus, and potassium. The content of each is usually listed as a string of three numbers on the fertilizer bag. Although garden plants need varying levels of each chemical to grow properly, Indiana's soil provides plenty of phosphorus for established lawns. Using fertilizer with low or no phosphorous for established lawns will keep it green and minimize the impact on water quality. Starter fertilizer should only be used when growing grass from seeds. When you apply fertilizers, make sure you follow the directions. Over-application and sloppy application leads to fertilizer washing from lawns, sidewalks, and streets into storm drains.

- **Think before you dig**
  Construction sites that disturb one acre or more of land are required to use best management practices (BMPs) to keep sediment out of water bodies. Although it is likely your backyard project will not come close to the one acre size limit, it is still a good idea to avoid leaving bare soil on your property. If you need to disturb the soil for any reason, reseed and replant bare ground as soon as possible to keep soil on your yard and out of streams, rivers, and lakes.

- **Plant a rain garden**
  Rain gardens catch and infiltrate excess storm water as it flows across your yard.

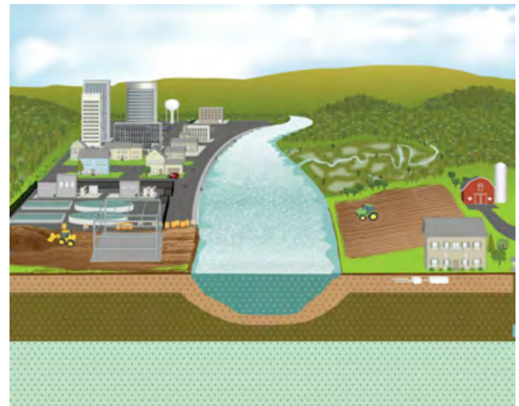
- **Connect your downspouts to rain barrels**
  Rain barrels catch excess water from you rooftops. Use that water to irrigate landscape during dry periods. Make sure the barrel's overflow goes to a pervious surface like a garden or yard instead of your impervious driveway.

- **Use Porous pavement**

  When it's time to replace your driveway, use some type of porous pavement. These materials allow storm water to soak through and infiltrate into the ground. If you cannot afford a whole driveway of porous pavement, consider using it at the driveway's apron where it meets the street.

- **Responsible car washing**
  Use a commercial car washing facility that collects the waste water that can be cleaned through a waste water treatment plant before it gets released to the local streams and rivers.

Interactive Online Resources



You, Me, and Water Quality - The Indiana Department of Environmental Management (IDEM) has an interactive website that looks at how our activities impact water quality, and how we can change things for the better. Visit the *You, Me, and Water Quality* website to view a graphic with items that the user can move over to learn more about everyday actions that change our water quality.
http://www.in.gov/idem/nps/pages/watercycle/

Clear Choices Clear Water program - *Clear Choices Clean Water* is a campaign to increase public awareness about the choices we make and the impacts they have on our streams, lakes and ground water. Water quality friendly practices such as landscaping with native plants, maintaining septic systems, using less fertilizer on lawns, managing yard and pet wastes, fostering soil health, and using less water all help to protect our precious water resources. By educating individuals on these and other important actions and giving them the tools needed to make behavior changes, *Clear Choices Clean Water* empowers everyone to do their part for water quality and conservation. This program has action-oriented campaigns centered on water quality practices such as those mentioned above. On the *Clear Choices Clean Water* website, citizens can read educational information about the choices they make and can take pledges toward good water quality actions. The focus of this effort began in Indiana but is now spreading across the country.

An electronic version of this strategy can be found on the ISDA website at https://www.in.gov/isda/divisions/soil-conservation/indiana-state-nutrient-reduction-strategy/

To submit questions, comments or feedback about this strategy, please use ISDANutrientReduction@isda.in.gov.

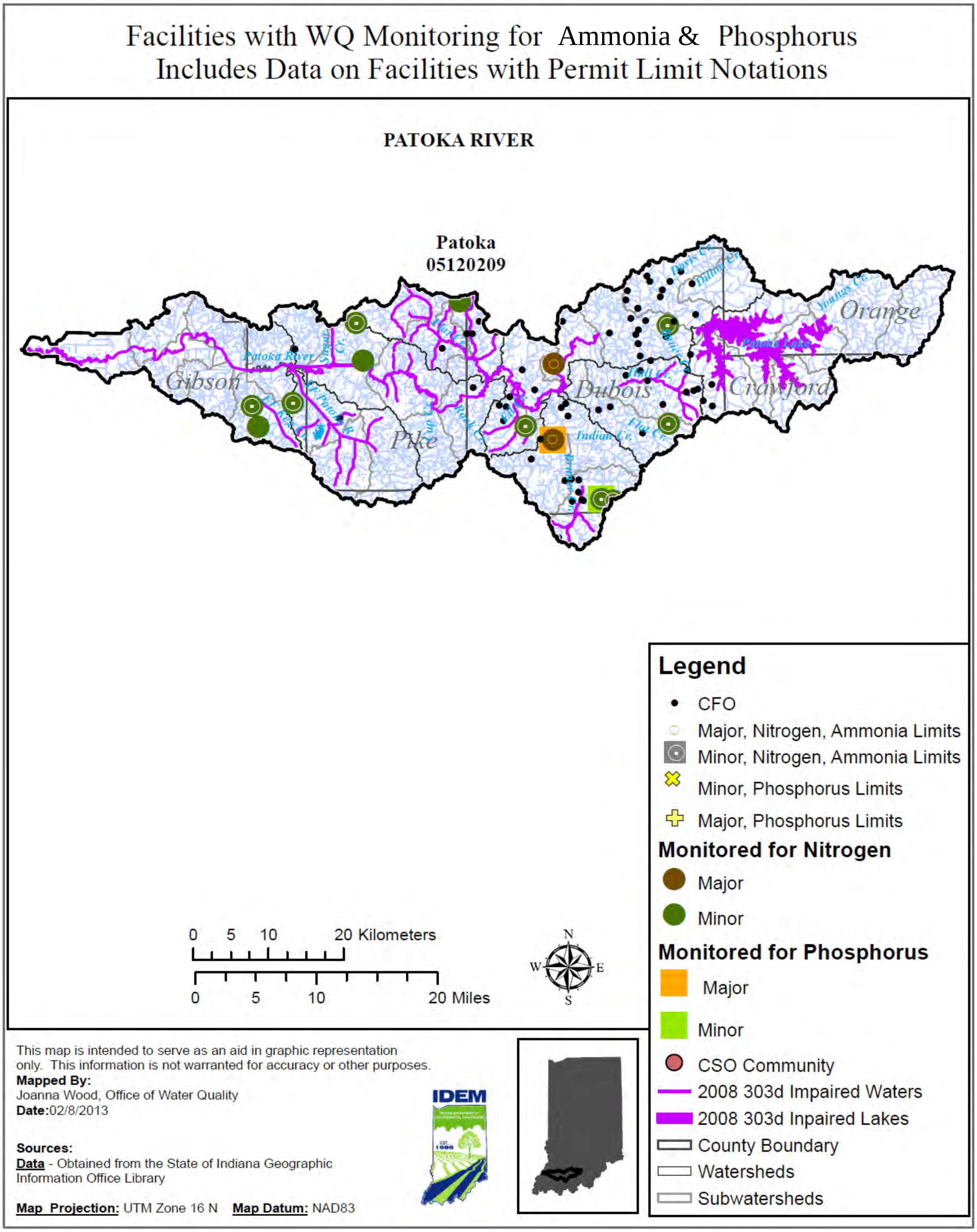
Appendix A – Acronyms

ACEP	Agricultural Conservation Easements Program
ACI	Agribusiness Council of Indiana
ALE	Agricultural Land Easements
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CALM	Consolidated Assessment and Listing Methodology
CC	Cover Crop
CCA	Certified Crop Adviser
CCSI	Conservation Cropping Systems Initiative
CEES	Center for Earth and Environmental Services (IUPUI)
CES	Cooperative Extension Service (Purdue University)
CFO	Confined Feeding Operation
CIG	Conservation Innovative Grant
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
CSP	Conservation Stewardship Program
CWA	Clean Water Act
CWI	Clean Water Indiana
CWS	Community Water Systems
DAP	Domestic Action Plan
DMR	Discharge Monitoring Report
DRP	Dissolved Reactive Phosphorus
DSC	Division of Soil Conservation (ISDA)
DSS	District Support Specialist (ISDA)
EOF	Edge-of-Field
EPA	Environmental Protection Agency
EPRI	Electrical Power Research Institute
EQIP	Environmental Quality Incentive Program
4Rs	Right Source, Right Rate, Right Time, Right Place
FSA	Farm Service Agency (USDA)
GIS	Geographic Information System
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
GW	Ground Water
GWMN	Ground Water Monitoring Network
HAB	Harmful Algal Bloom
HFRP	Healthy Forest Reserve Program
HRI	Healthy Rivers Initiative (IDNR)
HTF	Hypoxia Task Force (Gulf of Mexico)
HUC	Hydrologic Unit Code
IANA	Indiana Agriculture Nutrient Alliance
IASWCD	Indiana Association of Soil and Water Conservation Districts
IAC	Indiana Administrative Code

ICP	Indiana Conservation Partnership
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IGS	Indiana Geological Survey
INFA	INfield Advantage
INFB	Indiana Farm Bureau
InWMC	Indiana Water Monitoring Council
ISDA	Indiana State Department of Agriculture
ISDH	Indiana State Department of Health
IUPUI	Indiana University-Purdue University Indianapolis
LARE	Lake and River Enhancement (IDNR)
LOADEST	Load Estimator
LTCP	Long-Term Control Plans
LUMCON	Louisiana Universities Marine Consortium
MARB	Mississippi/Atchafalaya River Basin
MCPHD	Marion County Public Health Department
MGD	Million Gallons/day
MOU	Memorandum of Understanding
MRBI	Mississippi River Basin Initiative
MS4	Municipal Separate Storm Sewer Systems
MSQA	Midwestern Stream Quality Assessment
NASS	National Agricultural Statistics Service
NAWQA	National Water Quality Assessment
NGO	Non-governmental Organization
NLR	Nutrient Load Reduction
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPD	Non-rule Policy Document
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NRCS	Natural Resources Conservation Service (USDA)
NREF	Nutrient Reduction Estimation Framework
NWQI	National Water Quality Initiative
OISC	Office of Indiana State Chemist
OWQ	Office of Water Quality (IDEM)
ORSANCO	Ohio River Valley Water Sanitation Commission
POTW	Publicly Owned Treatment Works
PU	Purdue University
PS	Point Source
RCPP	Regional Conservation Partnership Program
RS	Resource Specialist (ISDA)
SAFE	State Acres for Wildlife Enhancement
SNRS	State Nutrient Reduction Strategy
SPARROW	Spatially Referenced Regressions on Watershed Attributes
SPEA	School of Public and Environmental Affairs, (IU)
SRA	State Resource Assessment

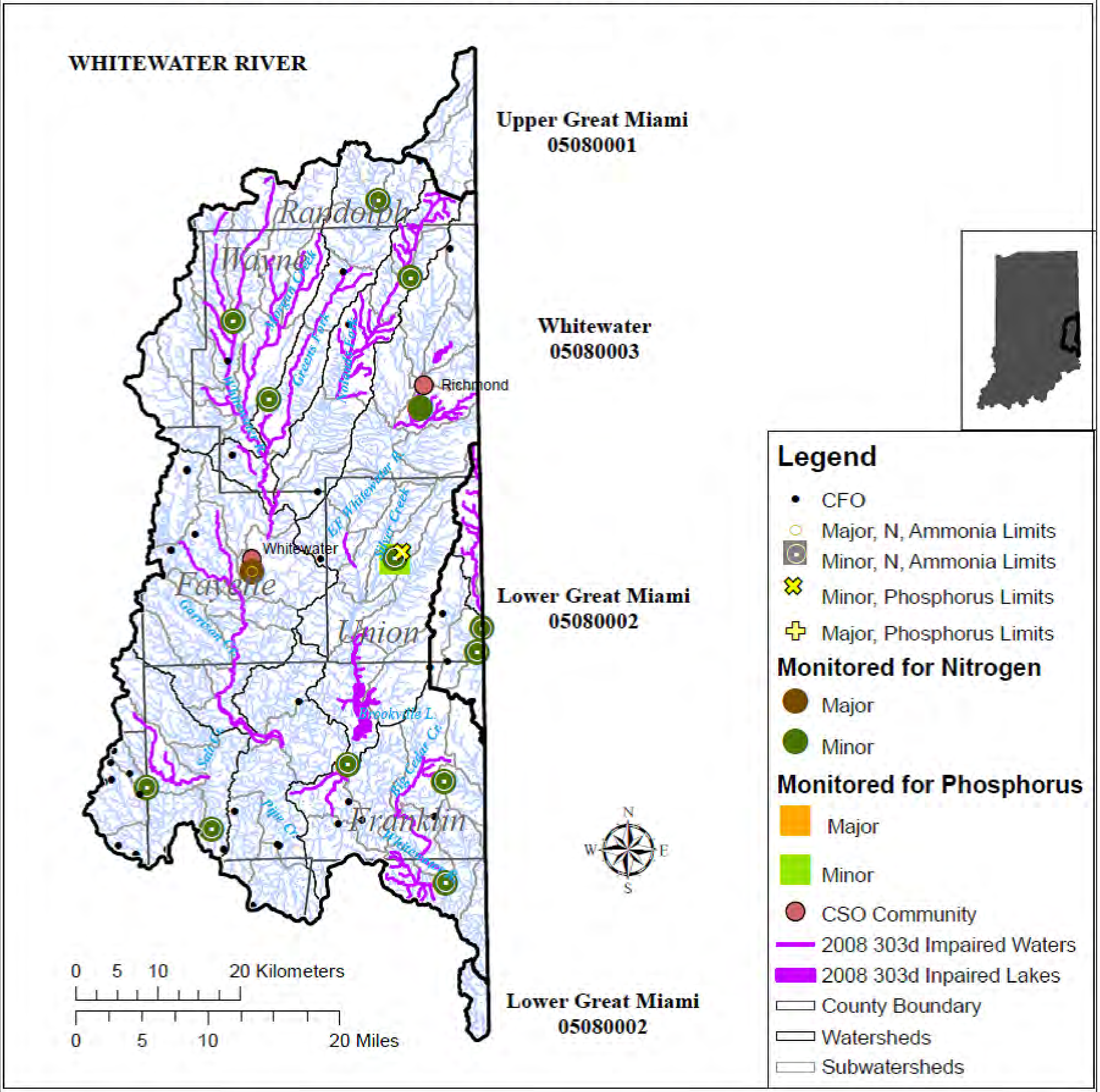
SRAs	State Recreation Areas
SSCB	State Soil Conservation Board
SWCD	Soil and Water Conservation District
SWQMP	Stormwater Quality Management Plan
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TNC	The Nature Conservancy
TP	Total Phosphorus
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WHO	World Health Organization
WLEB	Western Lake Erie Basin
WMP	Watershed Management Plan
WQ	Water Quality
WQS	Water Quality Standards
WREP	Wetland Reserve Enhancement Program
WRP	Wetland Reserve Program
WRTDS	Weighted Regressions on Time, Discharge, and Season
WWTP	Waste Water Treatment Plant

Appendix B – Permitted Facilities with Water Quality Monitoring for Ammonia and Phosphorus



Ammonia &

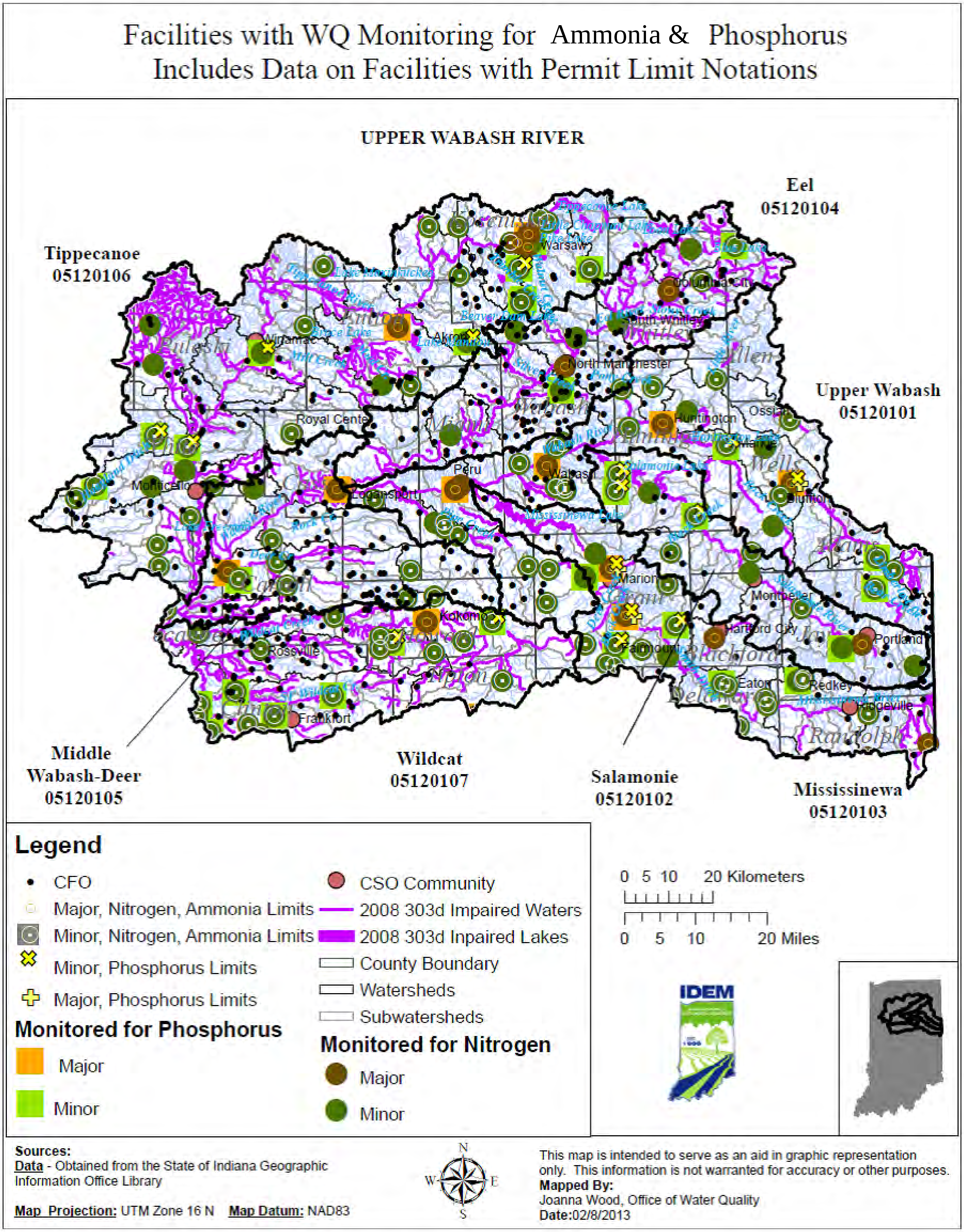
Facilities with WQ Monitoring for Ammonia & Phosphorus
Includes Data on Facilities with Permit Limit Notations



Sources:
Data - Obtained from the State of Indiana Geographic Information Office Library

Map Projection: UTM Zone 16 N **Map Datum:** NAD83

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.
Mapped By:
Joanna Wood, Office of Water Quality
Date:02/8/2013


Facilities with WQ Monitoring for Ammonia & Phosphorus
Includes Data on Facilities with Permit Limit Notations
UPPER WABASH RIVER
Eel 05120104
Tippecanoe 05120106
Upper Wabash 05120101
Middle Wabash-Deer 05120105
Wildcat 05120107
Salamonie 05120102
Mississinewa 05120103
Warsaw
Columbia City
South Whitley
Akron
Winamac
North Manchester
Royal Center
Huntington
Ossian
Markle
Peru
Wabash
Monticello
Logansport
Bluffton
Marion
Montpelier
Kokomo
Hartford City
Portland
Rossville
Fairmount
Eaton
Redkey
Ridgeville
Frankfort
Legend
CFO
Major, Nitrogen, Ammonia Limits
Minor, Nitrogen, Ammonia Limits
Minor, Phosphorus Limits
Major, Phosphorus Limits
CSO Community
2008 303d Impaired Waters
2008 303d Inpaired Lakes
County Boundary
Watersheds
Subwatersheds
Monitored for Phosphorus
Major
Minor
Monitored for Nitrogen
Major
Minor
0 5 10 20 Kilometers
0 5 10 20 Miles
IDEM
Sources:
Data - Obtained from the State of Indiana Geographic Information Office Library
Map Projection: UTM Zone 16 N Map Datum: NAD83
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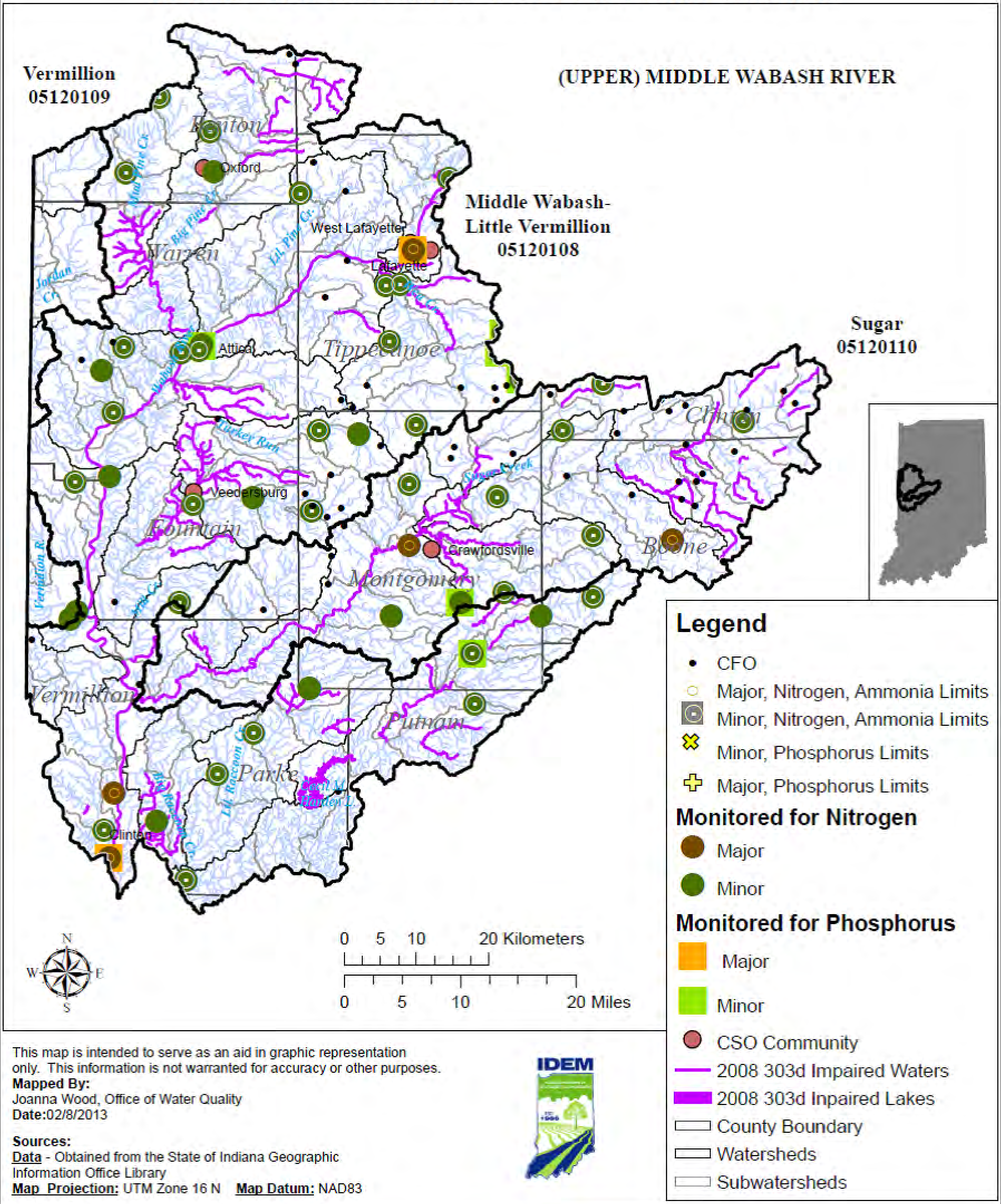
This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.
Mapped By:
Joanna Wood, Office of Water Quality
Date:02/8/2013

Facilities with WQ Monitoring for Ammonia & Phosphorus
Includes Data on Facilities with Permit Limit Notations



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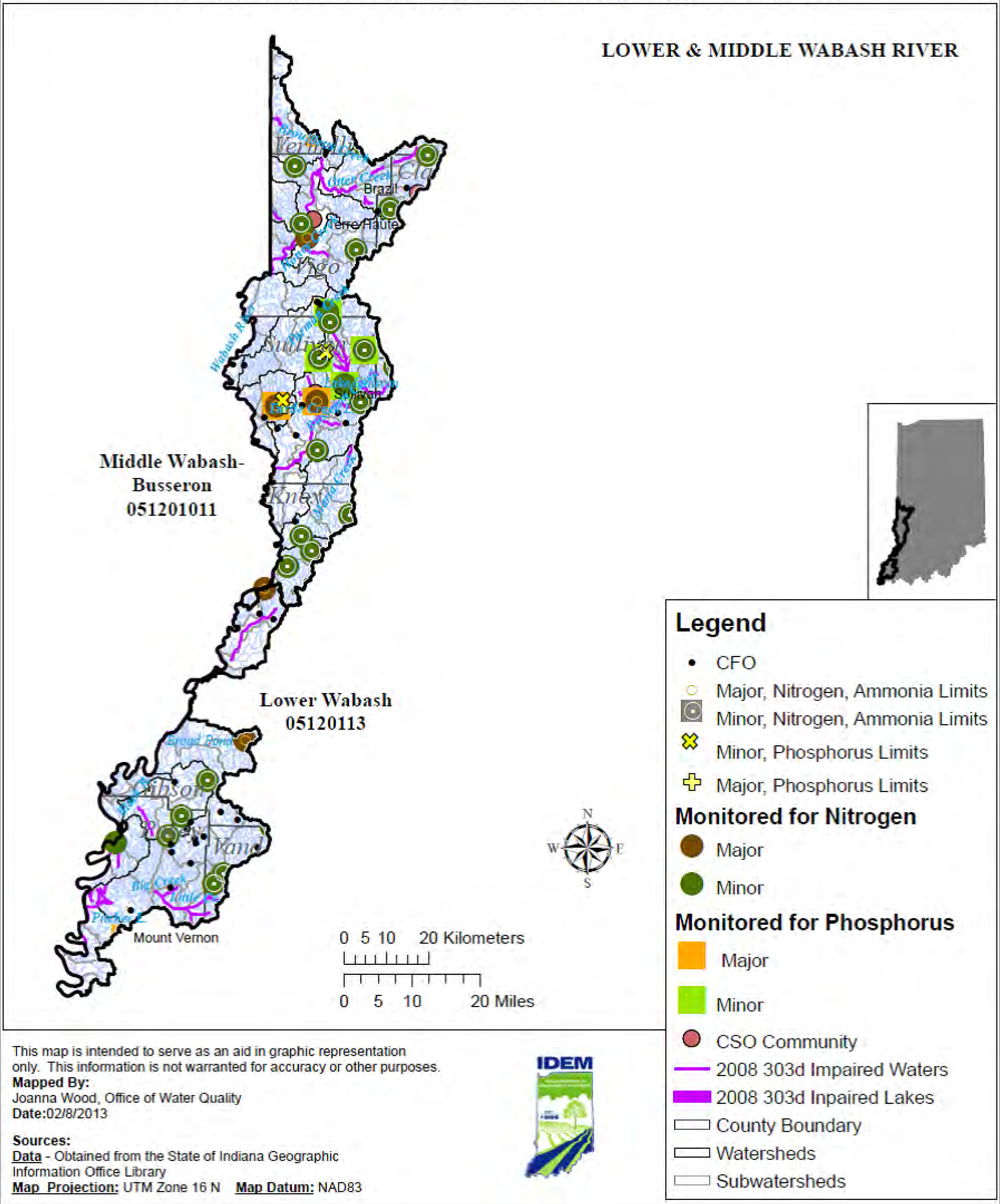

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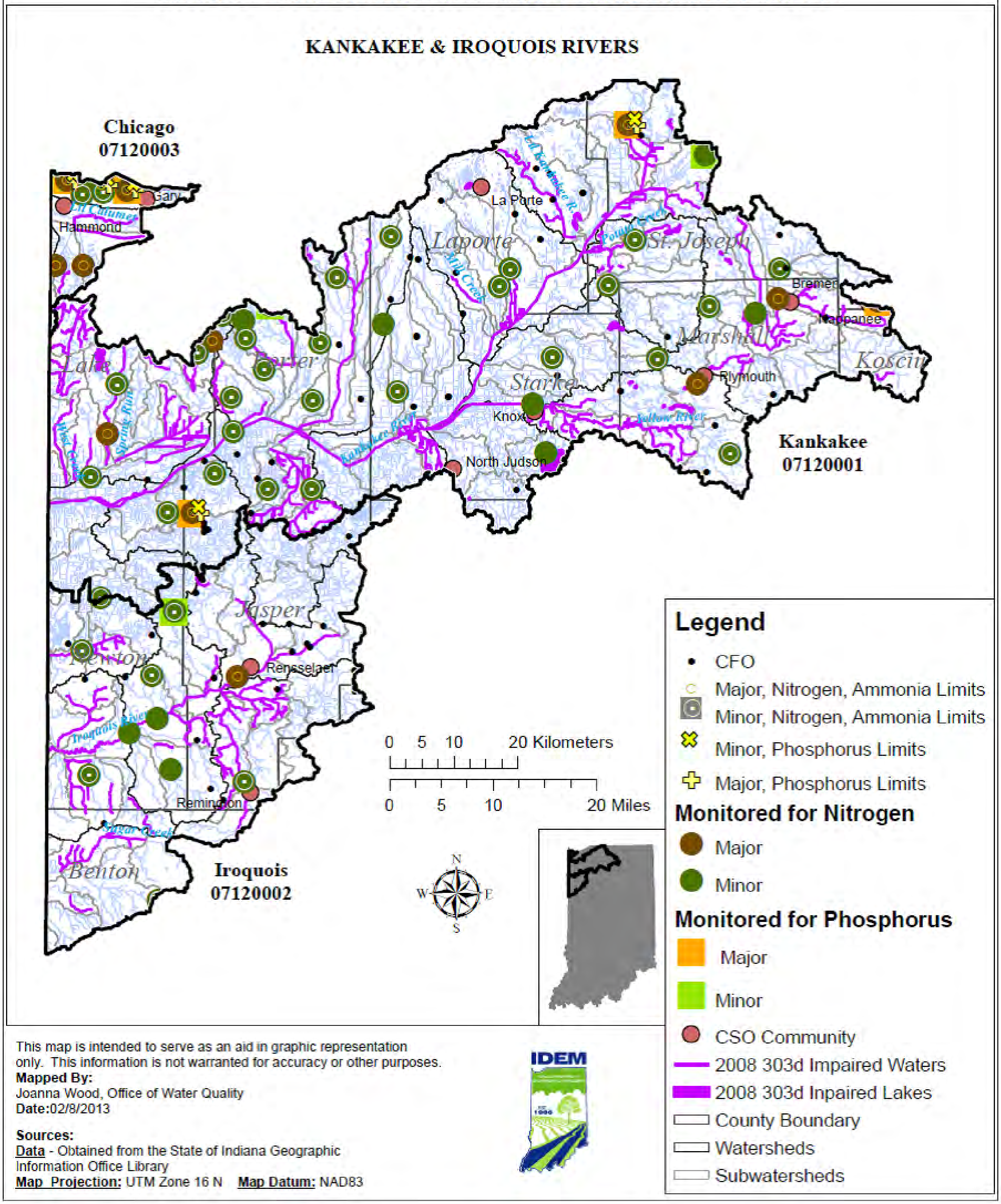

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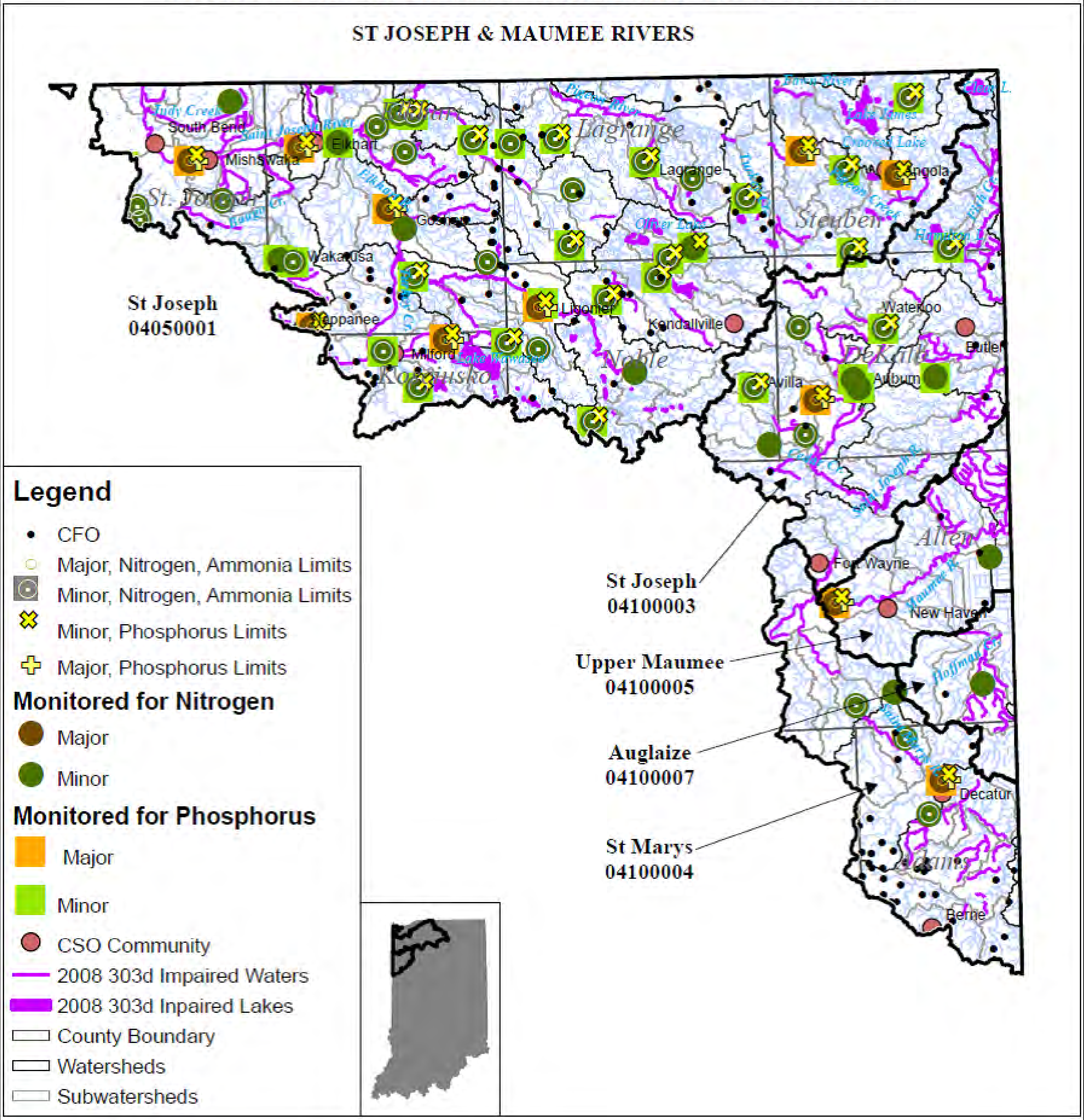
Includes Data on Facilities with Permit Limit Notations



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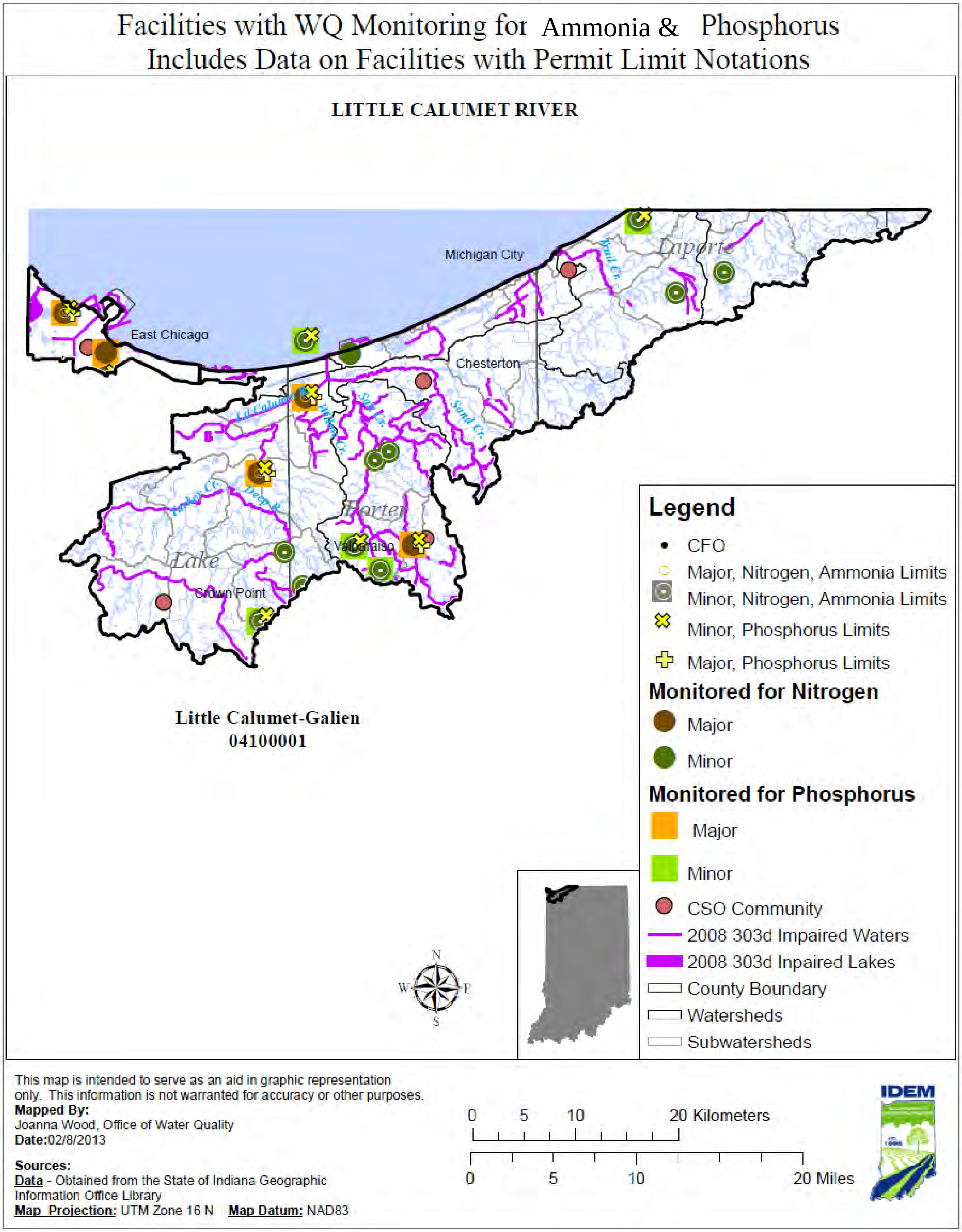
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

N W E S

0 5 10 20 Kilometers

0 5 10 20 Miles

IDEM


Facilities with WQ Monitoring for Ammonia & Phosphorus
Includes Data on Facilities with Permit Limit Notations
LITTLE CALUMET RIVER
Michigan City
East Chicago
Chesterton
Laporte
Porter
Lake
Valparaiso
Crown Point
Little Calumet-Galien
04100001
Legend
CFO
Major, Nitrogen, Ammonia Limits
Minor, Nitrogen, Ammonia Limits
Minor, Phosphorus Limits
Major, Phosphorus Limits
Monitored for Nitrogen
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Monitored for Phosphorus
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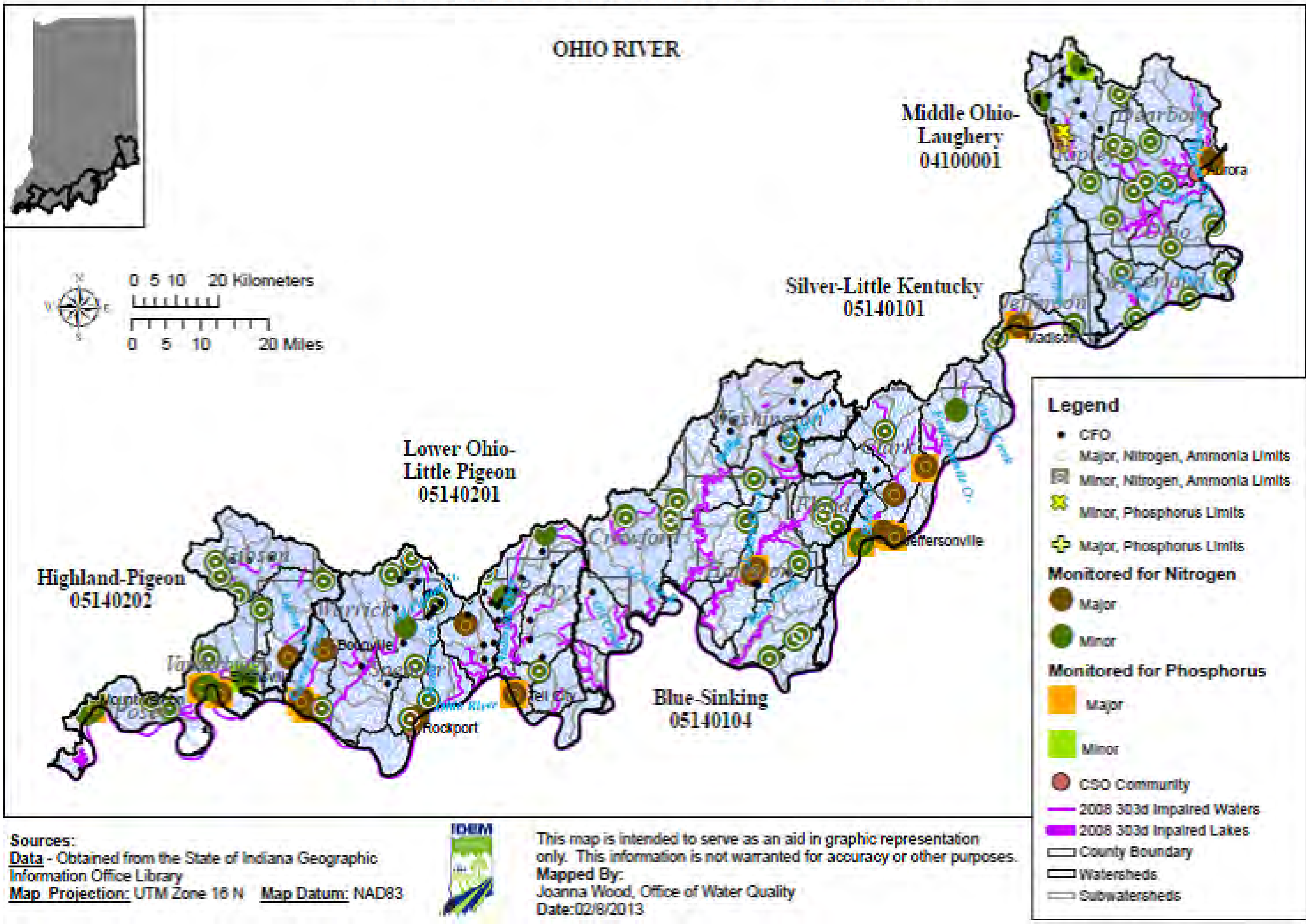

Appendix C – Indiana Science Assessment Strategy

Strategy for development of an Indiana Science Assessment
to Support the Indiana State Nutrient Reduction Strategy
September 2019

Background/Purpose

Indiana has developed a State Nutrient Reduction Strategy[1] (SNRS) to capture statewide, present and future endeavors in Indiana that positively impact the State's waters, as well as gauge the progress of conservation, water quality improvement and soil health practice adoption in Indiana. The Strategy has provided a foundation for nutrient reduction efforts across Indiana Conservation Partnership agencies and others, and has enhanced collaboration in conservation implementation.

This collaboration is demonstrated by Indiana's leadership in sharing conservation practice information among agencies within the Indiana Conservation Partnership[2] (ICP), which has allowed results of the Strategy and efforts across agencies to showcase the impacts of conservation practices. However, quantifying the nutrient load reductions and water quality improvement from individual conservation practices is scientifically challenging, and the current Indiana method for determining nutrient load reductions would benefit from using the most recent research and by including more parameters such as dissolved nutrients.

Indiana has made substantial progress in tracking sediment and nutrient load reductions statewide. Starting in 2013, the EPA Region 5 Sediment and Nutrient Load Reduction Model was adopted by the ICP to model the conservation practices that are implemented through assistance of all the ICP partnership staff. The Region 5 model is a model used to determine nitrogen and phosphorus load reductions that are tied directly to sediment. As a result, nutrients that are dissolved and carried by runoff waters are not accounted for in the model, therefore dissolved nutrients such as nitrate and dissolved phosphorus are missing in the load calculations. Also, there are several practices that cannot be run through the Region 5 model due to the practice not being tied to sediment, such as nutrient management. The ICP would like to strengthen and improve this existing method of capturing nutrient load reductions so that dissolved nutrients and other practices not tied to sediment can be captured in the load calculations.

In November of 2018, Indiana held a workshop titled "Nutrient Reduction Estimation Framework" to coordinate the discussion on improving this method of nutrient load reduction estimation and tracking. The workshop included representatives from five agencies, five Indiana universities and colleges, as well as numerous agricultural and conservation organizations. The workshop had several goals, and it was agreed upon that Indiana needs a science assessment to:

1) Determine historic and ongoing nutrient loads leaving the state and also by basins, which can be used to set goals and provide an additional method for assessing progress,
2) Determine a load reduction method based on observed reductions,

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[1] https://www.in.gov/isda/2991.htm

[2] The Indiana Conservation Partnership is comprised of eight agencies including the State Soil Conservation Board (SSCB), USDA Farm Service Agency (FSA), USDA Natural Resources Conservation Service (NRCS), Indiana Association of Soil and Water Conservation Districts (IASWCD), Indiana State Department of Agriculture's Division of Soil Conservation (ISDA-DSC), Indiana Department of Natural Resources (IDNR), Indiana Department of Environmental Management (IDEM), and the Purdue Cooperative Extension Service (CES).

3) Provide agreed-on reduction estimates for conservation practices that could be used beyond the state's Nutrient Reduction Strategy,
4) Provide a foundation for speaking with one voice about conservation practices and priorities, and
5) Establish common statewide criteria for determining the efficiency of various conservation practices on the reduction of nitrogen and phosphorus loads to improve water quality.

Tracking nutrient loading in Indiana's waterways is important for highlighting the accomplishments of all conservation practice implementation efforts around the state. Monitoring efforts statewide have been increasing in recent years as well, yet gaps in the data remain, making it challenging to tie modeled data to observed effects downstream. Without an Indiana focused science assessment, national models sometimes based on extrapolation are used, which may not highlight progress made in Indiana. A science assessment can provide a systematic, inclusive, widely accepted assessment of Indiana's nutrient loads during the baseline period and in future years.

In other Midwest states (Illinois, Iowa, and Minnesota), science assessments have provided a strong scientific basis for their nutrient reduction strategies and led to a common voice describing needs and opportunities for nutrient reduction. A Science Assessment is critical for moving the Indiana's nutrient reduction strategy forward as well, and much work has been done in 2019 to move the Indiana Science Assessment forward. A Core Team of representatives from different conservation agencies around the state are working together to determine the scope of and components needed within the Assessment. The Core Team is made up of partners from the Indiana State Department of Agriculture (ISDA), the Indiana Natural Resources Conservation Service (NRCS), the Indiana Chapter of The Nature Conservancy (TNC), the Indiana Agriculture Nutrient Alliance[3] (IANA), the Indiana Department of Environmental Management (IDEM), and the Purdue University College of Ag. Refer to the organizational chart in Appendix A for more information on the partners involved and the components within the Indiana Science Assessment.

Components of the Science Assessment

The proposed Science Assessment would address two critical needs to move the State Nutrient Reduction Strategy forward.

1. **Component 1: Determine historic and ongoing nutrient loads leaving the state, and also by watershed basins used in the State Nutrient Reduction Strategy.** [4]

   Streamflow and nutrient concentrations collected at key locations will be combined using a statistically sound method for calculating the total load (in lbs. and concentration) and flow-weighted mean concentration leaving the state in each major river, and within each basin in the state.

[3] Partners of the Indiana Agriculture Nutrient Alliance include Agribusiness Council of Indiana, Indiana Farm Bureau, Indiana Soybean Alliance, Indiana Corn Marketing Council, Indiana Dairy Producers, American Dairy Association of Indiana, Indiana Pork, Indiana Poultry Association, Indiana Beef Cattle Association, USDA-NRCS, Indiana Association of SWCDs, Indiana State Department of Agriculture, Purdue University College of Agriculture, and The Nature Conservancy of Indiana.
[4] https://www.in.gov/isda/2991.htm - Version 5, page 25. The 10 major river and lake basins in the state are delineated to be consistent with IDEM's Probabilistic Water Quality Monitoring Strategy, with the exception of the Great Lakes Basin being split between Lake Erie and Lake Michigan watersheds.

The USGS Weighted Regressions on Time, Discharge, and Season (WRTDS)[5] model will be our method of processing concentration and flows into loads. The baseline period that we will use will be from 1980 – 1996 period, mirroring the Gulf of Mexico Hypoxia Task Force baseline period.

Action Steps (in no particular order):

A. Identify and use all relevant monitoring data, including USGS flow gages, USGS super gages, IDEM fixed stations, and USGS nutrient monitoring data where available, and possibly data from municipalities and local watershed groups.

B. IDEM will analyze the fixed-station network data for flow and concentration.

C. Data will be put into a consistent format that can be run through WRTDS.

D. Consensus by the Core-Team is that the computations of the monitoring data will be run through ISDA, similar to what was done at the New Harmony site in the Indiana SNRS.[6]

E. Analyzing water quality monitoring information to determine loads within each of the basins in the state will further help in prioritizing watersheds for more targeted conservation efforts in the future.

F. Communicate to conservation agencies and organizations, researchers, scientists are other important stakeholders on the monitoring data that is pulled together and explain the planned process of using the WRTDS and invite comments.

G. Secure and coordinate long-term monitoring support for identified key locations to illustrate progress towards SNRS and DAP efforts.

Key People: Mike Dunn (TNC), Julie Harrold and Trevor Laureys (ISDA), Marylou Renshaw (IDEM), and Jeff Fry (USGS)

2. **Component 2: Improve method to quantify nutrient reductions from conservation practices, including dissolved nutrients, and determine efficiency of practices in reducing loads.**

Monitoring conducted around the Midwest and in Indiana provides new understanding of the effectiveness of in-field and edge-of-field conservation practices in reducing nitrogen and phosphorus loads from agricultural fields. This research will be compiled, reviewed and be used to develop a standardized tool for calculating nutrient load reductions, and be used in determining the percent efficiency of certain conservation practices on reducing the nitrogen and phosphorus loads.

This component will also include having a collective list and consistent definitions of conservation practices while considering their estimated nitrogen and phosphorus loss reductions, as well as the economic and agronomic feasibility of the practices.

[5] https://nrtwq.usgs.gov/mississippi_loads/#/
[6] https://www.in.gov/isda/2991.htm - Version 5, pages 12-14

Action Steps (in no particular order):

A. Determine and agree on definitions of conservation practices using the definitions in the NRCS Practice Standards as a starting point. May need to further define some of the definitions (example: types of nutrient management practices).

B. Determine and agree on the initial list of conservation practices that will be included under the Component #2 Work Plan for the EPA funds (described below). This selection will be based on past implementation data, and on the practices that tend to give the highest in load reductions. There is already a list of Ag practices/BMPs within the Indiana SNRS that are considered to be the most effective for nitrogen reduction and phosphorus reduction.[7]

C. Explore and compare existing models and calculators that could be used in determining nitrogen and phosphorus nutrient load reductions, including dissolved nutrients. Then use the outputs from these models, and compare the outputs and efficiencies. This will lead us to adopting a better, more scientific sound model for determining nutrient load reductions.

D. Have an "estimator" or "calculator" for determining reductions in tons and/or lbs., etc. that will be applied to practices implemented in Indiana. This will be implemented in a spreadsheet or similar computer software so that it is scalable to apply to thousands of practices. The method must also use good science, giving values that are "as real as possible".

E. The tool must be transparent, meaning a person with adequate expertise and exerting some effort can understand how reductions are determined. The tool must address both dissolved and particulate nutrients, transported through all key processes (attached to eroded soil, surface runoff, tile drains, etc.).

F. The ICP wants to continue to be able to use/show the data at many levels like we do now: by county, watershed, legislative district, significant waterbody, etc. – to share load reductions of conservation practices.

G. Need to also tie in in-field and edge-of-field monitoring data on conservation practices to help determine percent efficiencies of practices. This will help to ground truth the percent efficiencies.

H. The percent efficiencies determined from the models and the percent efficiencies determined from the in-field and edge-of-field monitoring studies can be compared.

I. Develop a table with a percent reduction (or range, or other format) for each practice. After determining the nutrient load reduction of a practice (through our adopted method), this will help determine what the efficiency is of that practice. Use the before and after load calculations for practices to determine a percentage.

J. This process will allow for prioritization of conservation practices on future conservation efforts.

[7] https://www.in.gov/isda/2991.htm - Version 5, Section 6, pages 44-49.

K. Following the completion of the Indiana Science Assessment, the list of practices and their associated load reductions and percent efficiencies will be reviewed each year to improve accuracy of the Science Assessment.

L. Communicate to conservation agencies and organizations, researchers, scientists are other important stakeholders on the information that has been found and compiled to enhance collaboration, and transparency and accuracy of the Indiana Science Assessment.

M. Determine the economic and agronomic feasibility of installing conservation practices by first determining the costs associated with installing certain conservation practices. This will lead us to understanding the dollars it will take to get a certain needed reduction, or a certain number of acres needed of a particular practice. We want to determine the scale of conservation needed in the state in order to reach a certain reduction in nutrient loading.

Key People: Julie Harrold (ISDA), Jane Frankenberger (Purdue University), Ben Wicker (IANA), Jill Reinhart (NRCS)

Benefits of the Indiana Science Assessment

The Science Assessment will lead to:

- Improved documentation showcasing statewide progress towards nutrient reduction goals
- Prioritization of the most effective conservation practices based on Indiana conditions, to improve program implementation
- More accurate assessment of Indiana's contributions to downstream water quality issues
- Alignment of communication by researchers, agencies, and others throughout Indiana about conservation practices effectiveness
- Enhanced transparency and accuracy for Indiana's water quality improvement quantifications
- A bolstered set of reportable goal-tracking parameters that includes dissolved nutrients
- A scientifically sound understanding of the nature of nutrient loading in Indiana waterways
- Determining the scale of conservation needed by running a series of scenarios based on economic feasibility and on load reductions needed to reach a certain reduction goal.

Budget Narrative/Implementation Plan

Component #1 will be funded and carried out internally my members of the Core Team and the USGS. The goal for completion of Component #1 is to complete analysis and trends by the end of calendar year 2020, with a written report by the middle of calendar year 2021.

Budget needs within the Indiana Science Assessment are for carrying out Component #2. Within the Indiana Science Assessment, we seek to improve the existing method used by the ICP to calculate sediment, nitrogen and phosphorus loads reductions from implemented conservation practices, and to identify and list the efficiency of in-field and edge-field practices in reducing nutrient loads from agricultural sources to water. Drawing from available science that can apply to Indiana cropland, this will allow for more consistent communication of the value of practices to those involved in implementation, as well as uncover knowledge gaps that need to be addressed with future research.

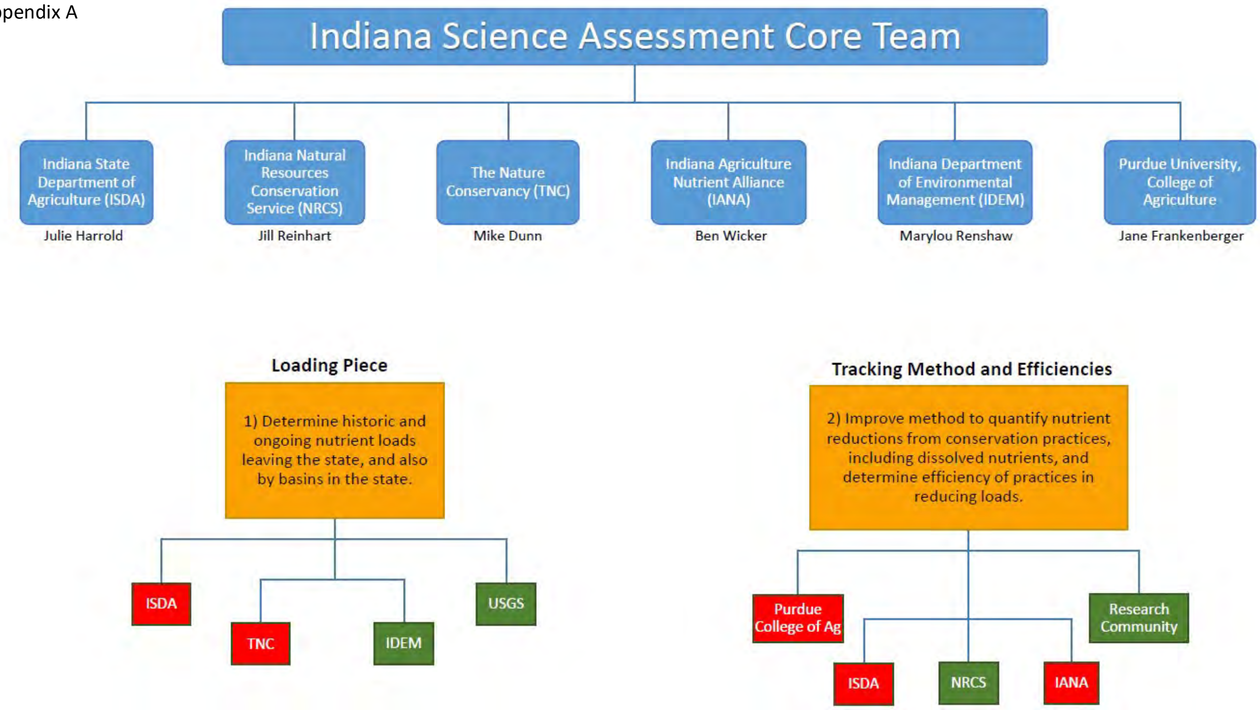
Needs for Component #2 include:

1. To compile the definitions of the conservation practices in the Science Assessment.
2. Conduct a literature review and meta-analysis of sediment and nutrient load reduction models, estimators, and/or calculators, which should include how to capture reductions from dissolved nutrients, as well as research and studies related to this topic.
3. Conduct a literature review and meta-analysis of water quality monitoring research and studies on conservation practice effectiveness, including in-field and edge-of-field research projects.
4. Compare analyses done on items 3 and 4 above to determine reductions of conservation practices in tons or lbs. and determine percent efficiencies of conservation practices.
5. Assist in the creation of a table that will show the reduction of conservation practices in tons or lbs. and in percent reduction for each practice.
6. Determine the costs associated with installing certain conservation practices and the economic feasibility of installing needed conservation practices (in order to reach a certain reduction in nutrient loading in the state).

Component #2 will initially be funded with EPA dollars that were supplied to the state to support efforts within the Indiana State Nutrient Reduction Strategy. A work plan was submitted to EPA to hire a research associate who will work on the specific needs of Component #2 (further details are provided in the work plan). This individual will be interviewed and hired by the Core Team, and will work at Purdue University and be supervised by Dr. Jane Frankenberger. The goal for completion of Component #2 is by the end of calendar year 2022.

Throughout the development of the Indiana Science Assessment, the Core-Team will interact with the research associate and other stakeholders, making any modifications to ensure the assessment meets the State's needs, and makes the final product easily implementable and accessible in future years.

Appendix A



Indiana Science Assessment Core Team
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Indiana Natural Resources Conservation Service (NRCS)
Jill Reinhart
The Nature Conservancy (TNC)
Mike Dunn
Indiana Agriculture Nutrient Alliance (IANA)
Ben Wicker
Indiana Department of Environmental Management (IDEM)
Marylou Renshaw
Purdue University, College of Agriculture
Jane Frankenberger
Loading Piece
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