



State of the St. Joseph River

Your Water. Your Future.

ST. JOSEPH RIVER
WATERSHED INITIATIVE



March 18, 2011

Dear Reader,

When you think about the St. Joseph River and its tributaries, what's your vision?

A peaceful way to spend an afternoon canoeing? A muddy brown catchall for the area's pollutants? A haven for wildlife, like bald eagles and endangered mussels?

In fact, the St. Joseph River is all of these--and the primary source of water for over 250,000 people. Few natural resources mean as much to you and your family as this river, so we think you should know more about what's in it and what the St. Joseph River Watershed Initiative is doing to make our river healthier.

Since 1996, the St. Joseph River Watershed Initiative (SJRWI) has been working on your behalf to protect and improve water quality in the St. Joseph River. We have spent countless hours monitoring the quality of the water, conducting education and outreach events, producing and distributing educational materials, studying current conditions in the watershed, and planning for the future. Great strides have been made in understanding and treating water quality concerns. We have identified pollutants of concern and know their sources, identified critical areas where conservation measures are needed, used grant money to install conservation measures, and organized stakeholders to work together to create Watershed Management Plans.

None of our activities would be possible without the dedication of our volunteers, private financial support, grant funding, and our outstanding staff throughout the years. Continued private financial support of our organization is crucial as the availability of grant funding becomes increasingly competitive. Without our efforts, water quality will decline and we will face dire consequences.

Freshwater is the foundation of our society, and the balance between land activities and water **quality is fragile. Our goal in producing this first "State of the St. Joseph River Report" is to help you** gain a better understanding of the complex balance that must exist in order to protect and improve water quality in the St. Joseph River watershed and to help you understand the role you play in protecting this valuable water resource. For many, it is the water you drink.

We are excited to invite you to join us as we strive to meet our goals and ensure clean water for the future!

Sincerely,

Sharon Partridge-Hall

SJRWI Program Manager

Your Water. Your Future.

Three-Year Fundraising Campaign

The quality of the water in the St. Joseph River and its tributaries is the cumulative result of actions by residential, agricultural, corporate, and government consumers. Its future will depend on financial support from those consumers in recognition of the importance of a resource that not only sustains people, animals, and land, but also helps ensure the economic vitality of the region.

"The St. Joseph River is a critical recreational tourism component that helps the region attract businesses and employees. Moreover, taking care of the river ensures that businesses and residents have a stable supply of water for drinking and industrial uses. Finally, it is important to look at the river and the surrounding watershed as a centerpiece for future river-based residential and business development. When we look to encourage business development, the river is one of the key resources we mention."

-- Andi Udris, president of the Fort Wayne-Allen County Economic Development Alliance

To meet the challenges of improving water quality in the St. Joseph River so that we can drink its water, eat its fish, swim its waters, and protect its wildlife, the St. Joseph River Watershed Initiative has embarked on a three-year fundraising campaign to support programs that are critical to preserving the watershed for future generations.

Our \$2.5-million private-sector funding campaign will supplement government grants to reduce sediment, pathogenic microorganisms, nutrients, and pesticides in the river and its tributaries. We have identified five core areas on which to focus:

- \$500,000 for an endowment
- \$350,000 to continue and expand our water quality testing program
- \$300,000 for education and outreach programs
- \$650,000 to implement best management practices
- \$700,000 to cost-share in the upgrade and replacement of septic systems

For 15 years, the St. Joseph River Watershed Initiative has worked to develop volunteer and financial partnerships with agencies, organizations, businesses, and concerned citizens across eight **counties in three states. To continue to improve the water quality in one of the region's greatest** natural resources, it is imperative that these partnerships be nurtured and expanded. By working together, we can write a magnificent success story for a river that has sustained us for centuries.

State of the St. Joseph River

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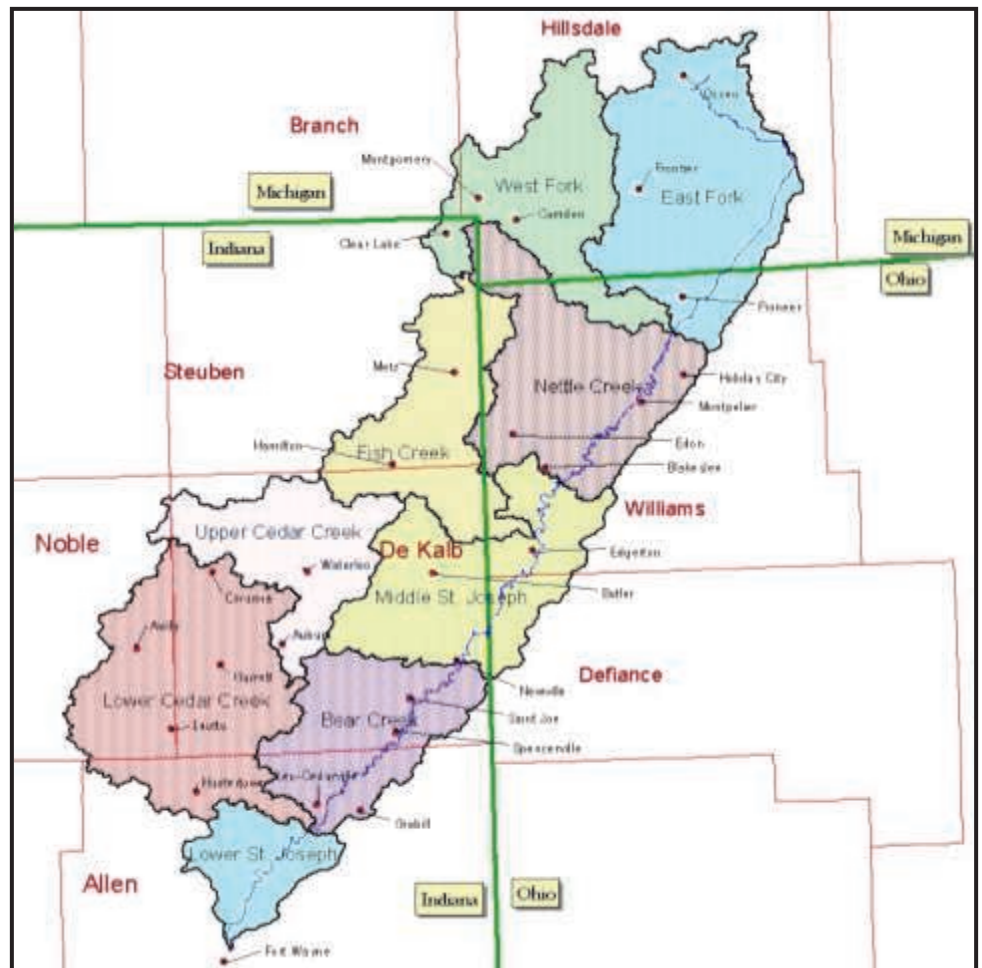
A watershed is the area of land within which all living things are inextricably linked by a common water course, a drainage basin.

The St. Joseph River Watershed

The St. Joseph River watershed encompasses 694,400 acres of land in north-east Indiana, northwest Ohio, and south central Michigan. With its headwaters in Hillsdale County, Michigan, the gentle St. Joseph River flows in a southwesterly direction for over 100 miles until it finally meets the St. Mary's River in Fort Wayne, Indiana. The junction of the St. Joseph and St. Mary's Rivers is the birthplace of the Maumee River, which flows from Fort Wayne to Lake Erie.

Agriculture is the predominant land use activity in the watershed, with approximately 64% in cropland and 15% in pasture or forage. Woodlands and wetlands are found on 10% of the land, while the remaining 11% consist of urban areas, farmsteads, rural residences, airports, golf courses, and other uses.

Fort Wayne, Indiana is the largest city in the watershed with over 250,000 residents. Auburn, Indiana is the second largest city. The population is increasing throughout the watershed, especially in southern DeKalb and Noble counties



The greater St. Joseph River watershed has nine sub-watersheds.

and northern Allen County. In all three states, industrial/commercial use of land along interstate and major state highways is increasing.

The St. Joseph River and its tributaries encompass 436 stream miles. The present-day river is a wide and relatively slow stream with an average gradient of 1.6 feet per mile. All tributaries of the St. Joseph River watershed are considered warm water streams, with the exception of a portion of the East Branch of the river from Pittsford Road upstream to Trail Road in Michigan, which is a designated coldwater trout stream. The lower 13.7 miles of Cedar Creek (a tributary of the St. Joseph River), from DeKalb County Road 68 downstream to the confluence with the main stem of the St. Joseph River in Cedarville, Allen County, is designated as an Outstanding State Resource.

The St. Joseph River serves as the drinking water supply for over 250,000 people in Fort Wayne and New Haven, Indiana. Fort Wayne's Three Rivers Water Filtration Plant processes 34 million gallons of water daily from the river.

St. Joseph River Watershed Initiative

In 1995, the Environmental Working Group's report *Weed Killers by the Glass* documented the presence of pesticides in Fort Wayne's tap water. This was a wake-up call that spurred cities, counties, and concerned citizens from across three states to join forces and work together to improve the quality of water in the St. Joseph River. This group became the St. Joseph River Watershed Initiative Partnership (SJRWI) in 1996.

As a not-for-profit organization, the St. Joseph River Watershed Initiative has worked tirelessly to educate stakeholders about water quality and to encourage the installation and use of conservation best management practices. The Initiative has also worked with local communities to create watershed management plans for the Cedar Creek sub-watershed, the Lower St. Joseph/Bear Creek sub-watersheds and an over-arching plan for the entire St. Joseph River watershed. These plans are available on our website, www.sjrwi.org. The SJRWI and its water quality sampling program are recognized by water quality experts across the nation, and even internationally, for excellence.

The SJRWI is the only organized group working on behalf of the entire watershed. Its mission is to protect and improve the quality of the water in the St. Joseph River by promoting economically and environmentally compatible land uses and practices.

Visions of Success

As part of the Initiative's strategic plan, six visions of success were identified: human health, economic sustainability, biodiversity, recreation, aesthetics, and

*SJRWI Mission:
To improve water
quality in the St.
Joseph River
watershed by
promoting
economically and
environmentally
compatible land
uses and
practices*



A great blue heron fishes along the banks of the river. It is just one sample of the wildlife found on the river and its tributaries.



U.S. Fish & Wildlife scientist **searching for white cat's paw** pearly mussels in Fish Creek.

The SJRWI envisions that one day people will be able to drink, swim, and eat fish from the river and its tributaries without harm.

drainage. Three of these visions are discussed below to paint a picture of the current state of the river.

Human Health Vision

At all times, pathogens, agricultural chemicals, and nutrients will be maintained below maximum contaminant levels. The quality of water will support full body contact recreational uses year-round. Fish consumption advisories will be eliminated.

Human health and water are intimately bound. Residents of the watershed should be able to drink, swim, and eat fish from the St. Joseph River and its tributaries without harm.

Providing quality drinking water is the primary responsibility of city and private utilities. However, contaminants, such as suspended sediments, pathogens, herbicides, and nutrients, come from sources in the St. Joseph River watershed far away from water treatment plants. Therefore, efforts to reduce drinking-water pollutants at these sources help reduce the load of contaminants that utility managers deal with in producing quality drinking water.

The idea of bodily contact with the river horrified some people at the 2010 River Fest held on the St. Joseph River in Fort Wayne, Indiana, when a stunt skier fell into the water. However, during hot summer days in the 1930s and 1940s, as many as 7,000 swimmers a day enjoyed swimming in the river at the Municipal Bathing Beach on the St. Joseph River near what is now Johnny Appleseed Park. The Board of Health at that time reported that there was no sewer contamination and no infection or illness was traced to the river. In the mid-1940s, the beach was closed; some think it was due to river pollution and others attribute it to the fear of polio. Most of the St. Joseph River does not meet water quality standards for swimming and recreation, because, like many rivers throughout the country, the St. Joseph is contaminated with fecal bacteria.



On a warm spring evening, take time to look down the river bank and you may see someone casting a streamer fly for smallmouth bass, flipping a jig for crappie, or drifting cut bait in a deep hole to tempt that monster catfish into finally biting. There are restrictions, however, on eating fish caught in the river due to

the presence of PCBs in fish tissue. Those who regularly fish the waters need to be aware of the potential hazards of eating contaminated fish. Our vision is that someday there will be no fish advisories in the St. Joseph River watershed.

Biodiversity Vision

Water quality will allow the continued presence and repopulation of native wildlife and water-based species in their natural habitats, remaining above the stress level for populations living in and adjacent to waterways. Stresses will be identified and methods of alleviation will be developed to remove or lessen the stresses threatening biological species.

Many endangered water-based species are found in the St. Joseph River watershed, especially mussels such as the white cat's paw pearly mussel, northern riffleshell mussel, and club shell mussel. The white cat's paw pearly mussel, listed in 1976 by the U.S. Fish and Wildlife Services as endangered, was discovered in Fish Creek, a tributary of the St. Joseph River. Fish Creek supports the last known population of the white cat's paw pearly mussel in the world. Their continued survival depends a great deal on the successful implementation of the Initiative's watershed management plan.

If you explore the river and its tributaries, you may see bald eagles nesting near Cedarville Reservoir and Indiana University-Purdue University Fort Wayne. You may also see osprey, blue herons, green herons, kingfishers, wood ducks, and owls. In the spring and fall, migrating warblers, egrets, and sandhill cranes are seen in the watershed. Upstream you may scare up a flock of wild turkeys.

Most of the reptiles and mammals found in the watershed are typical of Indiana, but the copperbellied water snake is endangered. River otters play on the banks. Beavers build their dams and lodges in the river and its tributaries. On a sunny day, turtles are seen on fallen logs, and, as the sun sets, bats fly across the water catching insects.

The loss of habitat and habitat fragmentation has had large negative effects on biodiversity. Remaining available habitat along the St. Joseph River and its tributaries consists of isolated woodlots, isolated wetlands, public and private natural areas, riparian areas, aquatic habitat, and fallow land.

Agricultural crops, which require the removal of all native vegetation, are the dominant land use in the watershed. Residential development, such as the rapid development of northern Allen County and southern DeKalb County, often results in the loss of native vegetation.

The removal of vegetation from the banks of the river and its tributaries contributes to bank erosion, and the associated sediments make the water more turbid. Increased turbidity and lack of shade allow more energy from the sun to be

*The last known population of **the white cat's paw pearly mussel** in the world is in Fish Creek, a tributary of the St. Joseph River.*



White cat paw's pearly mussels are found in Fish Creek, likely the most pristine tributary in the Maumee River basin.



Bald eagles nest in several locations on the river. Most practices that reduce water pollution benefit wildlife.

Enjoy the natural beauty of the river, whether paddling, skiing, fishing or hiking.

absorbed by the water and increase its temperature. The primary effects of thermal pollution are direct thermal shock and changes in dissolved oxygen levels, both of which are harmful to aquatic organisms.

Wetlands in the watershed provide a multitude of ecological, economic, and social benefits. They provide habitat for fish, wildlife, and a variety of plants. Wetlands are nurseries for many freshwater fish. Wetlands are also important landscape features because they hold and slowly release flood water and snowmelt, recharge groundwater, act as filters to cleanse water of impurities, recycle nutrients, and provide recreational and wildlife viewing opportunities. It is estimated that 85% of the natural wetlands in the watershed have been destroyed.

Private land trusts and government conservation programs have been used to directly or indirectly increase the amount of fish and wildlife habitat in the watershed. Through the efforts of ACRES Land Trust, for example, 26 nature preserves protecting 963 acres of land have been established within the watershed. **The Nature Conservancy's Upper St. Joseph River Project focuses on protection of Fish Creek and the East Branch of the St. Joseph River, the location of the only known population of white cat's paw pearly mussels. Government** programs administered by the Natural Resources Conservation Service also protect and restore natural areas. These include the Conservation Reserve Program, the Environmental Quality Incentive Program, the Wetlands Reserve Program, the Wildlife Habitat Incentives Program, State Acres for Wildlife Enhancement, and the Ohio Grassland and Wetland Complexes Program.

Recreation Vision

The water quality of the St. Joseph River will support adequate habitat for all game fish once native to the river. The water quality of the river will invite increased recreational activities, such as sport fishing, canoeing, and boating. Water clarity will improve with the reduction of sedimentation.

Boating, paddling, fishing, and hiking are all ways to enjoy the St. Joseph River and its tributaries. It is amazing how quiet, secluded, and natural the river is **once you are on the water, even in urban areas. Many people, though, aren't** even aware of this natural resource as they zip over it on concrete bridges.

Instead of heading for "The Lake" on a warm summer's day, some people hit "The River." Cedar Creek is a fun run for paddlers and the St. Joseph River in Williams County, Ohio has been cleared of logjams so paddlers can enjoy it. The Cedarville Reservoir draws boaters on jet skis, ski boats, pontoons, and fishing boats to enjoy a day on the river.

If only carp comes to mind when you think of fish in the river, you may not be aware that 17 miles of the river in Michigan are classified as a cold-water trout

stream. Game fish in the river include largemouth and smallmouth bass, bluegill, crappie, and perch, but water pollutants limit the number you can eat.

The Indiana departments of Health, Natural Resources, and Environmental Management and Purdue University collaborate to produce the annual *Indiana Fish Consumption Advisory*. Unless listed in the chart below, consumption of fish, other than carp, caught in the St. Joseph River is limited to one meal a week. Based on residues in tissues, PCBs are the main concern. Although the manufacture, distribution, and use of PCBs have been banned in the U.S. since 1979, they are very persistent in the environment. Before 1995, the river did not exceed the U.S. FDA action levels for PCBs. In 1995, the first fish advisory was issued for the river, based on new state standards. The 1996 and the 2002 advisories were even more restrictive. By 2007, however, advisories were relaxed for several species, indicating some improvement in the residual levels of PCBs. Because the primary sources for PCBs in the St. Joseph River and its tributaries are atmospheric and contaminated sediments from years past, natural degradation should reduce PCB concentrations in fishes over time.

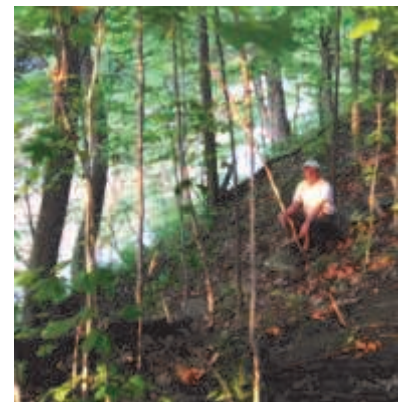
PCBs are the primary reason for restricting the consumption of fish caught in the St. Joseph River and its tributaries.

Species	Fish Size	Limits*
Black Crappie	9-11"	One meal per month
Black Crappie	11"+	One meal every 2 mos.
Black Redhorse	13-16 "	One meal per month
Black Redhorse	16"+	One meal every 2 mos.
Carp	up to 20"	One meal per week
Channel Catfish	16"+	One meal per month
Golden Redhorse	12-13"	One meal every 2 mos.
Golden Redhorse	13+	One meal every 2 mos.
Largemouth Bass	Up to 11"	Unrestricted
Rock Bass	7-9"	One meal per month
Rock Bass	9"+	One meal every 2 mos.
Spotted Sucker	up to 14"	Unrestricted
White Crappie	up to 11"	Unrestricted

*Limits are more restrictive for sensitive individuals

There are numerous public access sites on the St. Joseph River, from Johnny Appleseed Park and Shoaff Park in Fort Wayne, to the Leo, Spencerville and St. Joe sites north of Fort Wayne. Cedar Creek can be accessed on Coldwater Road, Hursh Road and Highway 1, and flows through two Allen County parks.

You can enjoy the river and its tributaries without launching a watercraft by hiking the watershed's many parks, nature preserves, and greenways. These are scattered throughout the watershed, from the river's headwaters in Michigan to Fort Wayne.



This hiker is taking a break on a steep bank of the middle St. Joseph River. This wooded bank provides a buffer zone to prevent river pollution.

Water Quality Sampling Program



For 15 years, the SJRWI has assessed the water quality of the river and its tributaries.

Each year, the SJRWI samples water quality at 24 sites weekly from April through October. This data is available online at www.sjrwi.org.

To help assess the water quality of the St. Joseph River, the SJRWI has partnered with Fort Wayne City Utilities to manage a water quality monitoring program since 1996. Samples are collected weekly at 24 tributary sites from April through October. Sampling sites are located at the headwaters and near the confluences of important tributaries and the St. Joseph River. (See map on page 11.) This watershed approach to water quality monitoring allows the Initiative to identify sources of problems. Water is analyzed for several physical and chemical parameters and for herbicides, *Escherichia coli* (*E. coli*), and nutrients.

Measurements and Analytical Parameters		
Physical/Chemical Measurements	Herbicides and Bacteria	Nutrients
Water Temperature	Atrazine	Total Phosphorus
pH	Metolachlor	Nitrate (NO ₂ + NO ₃)
Specific Conductance	Alachlor	
Total Dissolved Solids	<i>E. coli</i>	
Dissolved Oxygen		
Turbidity		

Test results are used to identify priority areas of the watershed that need attention and to support assessment of the effectiveness of actions to improve water quality. Each year, a water quality report is written based on the results of water analyses. **The reports are available on the Initiative's web site (www.sjrwi.org).** Data from our sampling program are compared to human health and aquatic life criteria and reference values.

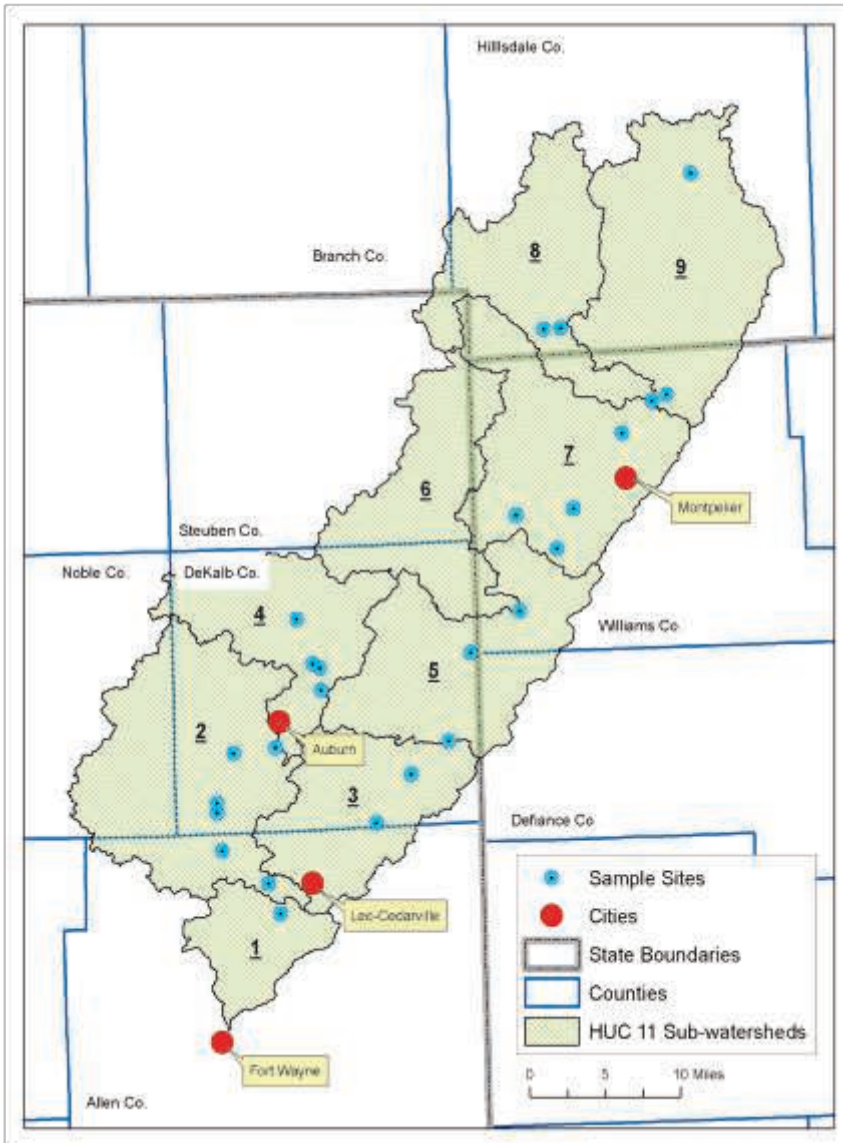
The 2009 report notes that concentrations of pesticides were detected at all sites; concentrations of *E. coli* frequently exceeded the human health criterion for recreational uses at all sites; and concentrations of phosphorus and nitrates along with levels of turbidity regularly exceeded standards for protection of aquatic life at most sites.

The primary concerns for water quality in the St. Joseph River that have been identified by the SJRWI are total suspended solids and turbidity, pathogenic microorganisms, nutrients (nitrate and phosphorus), and pesticides.

Total Suspended Solids and Turbidity

Sources

Total suspended solids (TSS) and turbidity are both expressions of the degree to which water loses its transparency due to the presence of suspended par-



Water quality sampling sites are located at the headwaters and near the confluences of important tributaries and the St. Joseph River.

ticulates. The more total suspended solids in the water, the murkier water seems and the higher the turbidity. There are many things influencing the cloudiness of water. Some of these are silt and clay particles, plankton, algae, fine organic debris, waste discharge, and resuspended sediments from the bottom. Sources of suspended solids include natural sources and industrial discharges, sewage, road runoff, and soil erosion. TSS from nonpoint sources increase dramatically after major rain events.

Problems

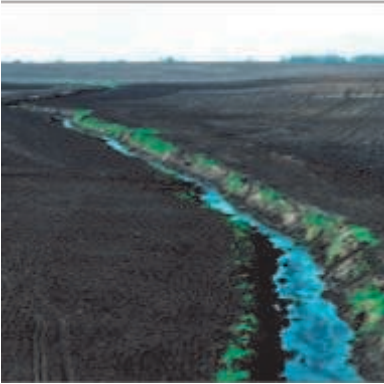
Suspended solids have an economic impact if they have to be filtered out of surface water that is used as a drinking water source. Large amounts of TSS increase turbidity, which reduces water clarity and light availability for plant

At all sampling sites, pesticides were detected and E. coli frequently exceeded the criterion for recreational uses. At most sites, phosphorus, nitrates, and turbidity regularly exceeded standards for protection of aquatic life.



Runoff from a heavy rain carries topsoil from a crop field. This type of erosion can be prevented by planting a grassed waterway.

Photo: Natural Resources Conservation Service (NRCS), USDA



A buffer strip would prevent erosion on this stream bank.
Photo: NRCS

Streams without conservation buffers offer no wildlife habitat, run higher risks of bank erosion, and risk contamination with farm chemicals and sediments.

growth. Sediments can clog fish gills, smother spawning areas, and degrade substrate habitat for macroinvertebrates. High TSS can cause an increase in water temperature and increase levels of nutrients, bacteria, metals, and pesticides since many pollutants attach to sediment. Finally, they contribute to a negative perception of the river by recreational users.

Testing Results for Total Suspended Solids

Concentrations of TSS during 2006-2010 regularly exceeded the criterion to protect freshwater life (20-25 mg/L) in tributaries and in the St. Joseph River, with the exception of Cedar Creek and Fish Creek.

Total Suspended Solids (mg/L)				
Site	No. Samples	Max	Median	% Samples Exceeded Criterion
Cedar Creek ^a	27	85	11	16
Fish Creek ^a	69	216	9	17
St. Joseph River ^a	107	856	26	51
Tributaries of the St. Joseph River ^b	666	5038	48	65

^a Data from IDEM, 2006-2010 for sites in the St. Joseph River and two main tributaries, Cedar Creek and Fish Creek
^b transformed from turbidity values among all sites in 2010

Criteria and Standards

Most people consider water with a TSS concentration less than 20 milligrams/liter (mg/l) to be clear. Water with TSS levels between 40 and 80 mg/l tends to appear cloudy, while water with concentrations over 150 mg/l usually appears dirty. Municipal wastewater treatment plants must provide treatment to meet TSS limits of 30 mg/l as a monthly average and 45 mg/l as a 7-day average. Concentrations of suspended solids below 25 mg/l and resulting turbidity should have little to no negative effect on aquatic life.

SJRWI's Testing Results for Turbidity

Turbidity levels in most samples during 2009 (51-100%) were above reference conditions to protect aquatic life at all sites. (See chart on next page.)

Criteria and Standards

For water treatment systems that use conventional or direct filtration, turbidity in drinking water cannot exceed 1 nephelometric turbidity unit (NTU). Samples for turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the samples in any month. Indiana law also requires that discharges of substances attributable to human activities shall not increase the turbidity of receiving streams by more than 15 NTUs. The USEPA regional criterion for turbidity for the St. Joseph River to protect aquatic life is 10.4 NTU.

Turbidity Aquatic Life Protection	
Confluence Sites	% Samples Exceeded Criterion (2009)
East Branch	100
West Branch	100
Nettle Creek	79
Fish Creek	84
Middle St Joe	59
Bear Creek	67
Cedar Creek	75
Headwater Sites	
East Fork	80
West Fork	52
Lower Cedar	72
Garrett City Ditch	60
Diehl/Peckhart Ditch	84
Upper Cedar	51
Matthews Ditch	48

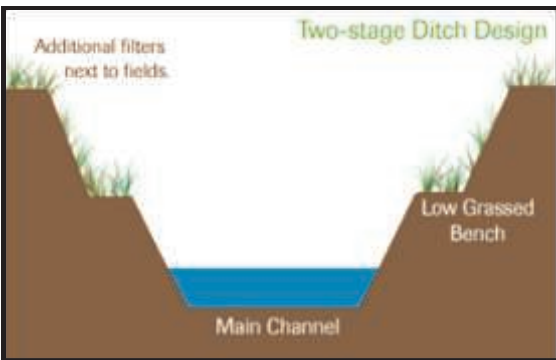
Solutions

Control measures in agricultural, urban, and suburban landscapes can be implemented to reduce suspended solids and turbidity. For example, farming practices such as no-till and soil conservation measures such as buffer strips minimize soil erosion. For construction sites, controls such as silt fences and sedimentation basins prevent eroding soils from reaching surface waters. In urban and suburban areas, remediation and removal of CSOs, use of storm water retention ponds, rain gardens, and regularly scheduled street sweeping may be effective in reducing the quantity of suspended solids in storm water run-off.

What We Have Done

The Initiative has promoted the use of agricultural best management practices to improve water quality, such as cover crops, no-till, manure management, filter strips, riparian area restoration, wetland restoration, rotational grazing, and equipment modifications.

The Initiative co-sponsored two Day at the Bay tours. More than 100 attendees learned about dredging operations in the Lake Erie Toledo Bay area and the lower Maumee River and the confined disposal facilities used to store the sediment, among other activities. The St. Joseph River contributes to the Lake Erie sediment problems.



Two-stage ditch—an example of an innovative agricultural best management practice that mimics natural flood plains.

With assistance from the Maumee River Basin Commission and through implementation of the Cedar Creek Management Plan, SJRWI installed a two-stage drainage ditch to demonstrate a design that controls flooding, reduces erosion, improves water quality, and protects wildlife habitat. The 1.3 mile ditch crosses two counties and replaced a ditch that contributed significant amounts of sediment to Cedar Creek.

The Initiative's efforts to implement best management practices to reduce turbidity have targeted farmers, but we plan to expand these efforts to residents and businesses.



Grassed waterways stabilize gullies and prevent erosion. Photo: NRCS



Nuisance geese across the watershed contribute to river pollution.

A study funded by SJRWI to determine the sources of bacteria in the river found that wildlife, particularly geese, make a significant contribution to its bacterial contamination.

In 2010, the Initiative began working in cooperation with Purdue University on a Great Lakes Restoration Initiative grant that will demonstrate through computer modeling the cumulative impacts of implementing best management practices.

As part of our public educational efforts, the Initiative developed and distributed a comprehensive watershed curriculum, *Where My River Runs*, targeted to upper elementary grades.

Projects That Need Funding

Given that most of the watershed is agricultural, continued efforts to identify, fund, and implement agricultural best management practices are critical to the restoration of watershed health. Targeted education and outreach efforts must intensify to reach those unaware of and/or reluctant to participate in conservation programs. Watershed management plans must be developed for the sub-watersheds that haven't been researched to date so that critical issues and areas can be identified. Crop field erosion must be minimized and stream banks must be stabilized to reduce sediment problems.

We need to expand this effort beyond farmers to encourage more residents and businesses to adopt best management practices. Urban centers should be targeted with non-point source educational programs that encourage actions that improve water quality. Demonstration sites for continuing education should be established.

The Initiative supports the creation and use of innovative best management drainage practices, both for agriculture and urban areas. We would like to develop a program to encourage the conversion of eroding drainage ditches to two-stage ditches, building on the success of our demonstration site.

Pathogenic Microorganisms

Sources

Pathogenic microorganisms include bacteria, viruses, and protozoa that harm human health. Utility agencies monitor pathogenic organisms in source water and treat accordingly. Agencies also monitor surface waters for bacteria that indicate fecal contamination to protect against exposure from direct contact (swimming) and secondary contact (boating and fishing). *E. coli* is a bacterium that is found in human and animal fecal material. Concentrations of *E. coli* are monitored as an indicator of fecal contamination in streams, rivers, and lakes. Sources of fecal bacteria include waste water discharges from sewage treatment plants, drainage from septic tanks, runoff from agricultural fields and feedlots, stormwater runoff, and wildlife.

Problems

Most waters throughout the U.S. are contaminated with microorganisms. Some strains can lead to illness in humans. The microorganisms can enter the body through the mouth, nose, eyes, ears, or cuts in the skin when a person comes in contact with contaminated water.

SJRWI Testing Results

Concentrations of *E. coli* regularly exceeded the criterion for infrequent full body contact. None of the sites sampled in 2009 in the St. Joseph River watershed supported recreational use.

<i>E. coli</i> Infrequent Body Contact	
Confluence Sites	% Samples Exceeding Criterion (2009)
East Branch	32
West Branch	12
Nettle Creek	31
Fish Creek	28
Middle St Joe	32
Bear Creek	76
Cedar Creek	32
Headwater Sites	
East Fork	20
West Fork	40
Lower Cedar	31
Garrett City Ditch	56
Diehl/Peckhart Ditch	52
Upper Cedar	39
Matthews Ditch	36

Criteria and Standards

Fecal coliform bacteria levels are expressed as the number of colonies per 100 milliliters of water. No fecal coliform bacteria, including *E. coli*, are permitted in public drinking water supplies. The EPA uses criteria for *E. coli* to assess whether designated uses for recreational waters are being met. Bodies of water do not support recreational use if more than 10% of samples tested exceed the infrequent full body contact recreation criteria of 576 CFU/100 mL. If recreational use is not met, then swimming, boating, and fishing may increase the risk of illness from exposure to harmful microorganisms.

Solutions

Protecting surface waters from contamination with fecal bacteria must include management of wastewater discharge, CSOs, failed septic systems, runoff from livestock operations, and wildlife. Failing septic systems must be repaired or replaced. Livestock facilities must be safely managed to ensure that manure does not run off into tiles, ditches, and streams. CSOs must be minimized or eliminated. Nuisance geese populations must be controlled.

What We Have Done

To identify the sources of fecal bacterial contamination, the Initiative sponsored a Bacteria Source Tracking study by Dr. Deborah Ross, Indiana University-Purdue University Fort Wayne. Dr. Ross found that wildlife, particularly geese, make a significant contribution to the bacterial pollution in the St. Joseph River. Other sources of bacteria contamination discovered include human, domestic

Prevention of fecal bacteria contamination requires managing wastewater discharges, CSOs, failed septic systems, livestock waste, and wildlife.



Manure overflows this storage area and threatens nearby streams with degraded water quality. Photo: NRCS

SJRWI piloted a cost-share program in the Cedar Creek sub-watershed to replace discharging septic systems and to demonstrate alternative systems. To reduce bacterial contamination, this program needs to be expanded across the watershed.



Paddling, or not, on Cedar Creek is a great way to spend a hot summer day.

pets, cattle, swine, and horses. The Initiative completed a livestock inventory to pinpoint potential problem areas as a follow-up to this study.

The Initiative received funding from an IDEM Water Quality grant to pilot a septic system replacement project in the Cedar Creek sub-watershed. Cost-share assistance was provided to participating homeowners. As part of this same grant, the Initiative developed and distributed a DVD, *Septic Systems: Out of Sight, Not Out of Mind*.

As part of our education and outreach efforts, the SJRWI hosted a free conservation field day for the Maumee River Basin Partnership of Local Governments and the public. Participants had a full tour of the Bridgewater Dairy operation in Williams County, Ohio, where they learned about the dairy's state and federal permit requirements, the manure biodigester, and how the dairy runs on methane gas produced by the biodigester. Several participants also took advantage of the optional two-stage ditch tour.

Projects That Need Funding

We need to expand the water quality sampling program, particularly the locations and contaminants measured. We are planning a project to expand analysis of the data and another project to improve the interface between the database and our website to make it easier for the public to access this information.

We need to continue to offer educational programs and cost-share assistance to livestock producers to ensure that manure is not entering tiles, ditches, and streams.

To confirm the major sources of fecal contamination, a follow-up Bacterial Source Tracking study is needed with samples from various locations over time. The original study indicated geese were the major source, so we need to meet with businesses and homeowner associations to share how to modify habitat around detention ponds and other ways to discourage nuisance geese.

We gained experience in running a cost-share program to replace failing septic systems with the Cedar Creek pilot project. We plan to expand this program as funds permit. We will also offer educational programs on septic system care and maintenance in conjunction with local health departments.

Nutrients—Nitrate and Phosphorus

Characteristics and Sources

Nitrate is the primary form of nitrogen dissolved in streams and groundwater and the most common source of nitrogen used by plants. Phosphorus is usually bound to sediment and generally includes dissolved phosphates and particu-

late organic phosphorus (mostly from plant material). The most readily available form of phosphorus for plants is dissolved phosphate, which typically constitutes the majority of the dissolved phosphorus in natural water. Natural sources of nutrients provide surface waters with adequate nitrogen and phosphorus to promote healthy plant growth. A recent study by the United States Geological Survey (USGS) reported estimated background concentrations of nutrients in streams of the U.S.

Estimates of Background Concentrations of Nutrients in U.S. (USGS 2010)			
	Total Nitrogen	Nitrate	Total Phosphorus
Number of Sites Sampled	88	108	84
Median Concentration (mg/L)	0.58	0.24	0.034

Adding to natural sources of nutrients, point sources of nutrients come from municipal and industrial discharges and from concentrated animal feeding operations. The primary nonpoint sources of nutrients include applications of manure on farms, commercial fertilizers on agricultural and residential lands, and nutrients from livestock and pet wastes and from septic systems. Nutrients derived from nonpoint sources can be transported to streams in runoff, with inflowing groundwater, or through drainage ditches and subsurface tile-drain systems. High concentrations of nutrients in streams and rivers of the Midwest are influenced by the extent of agricultural lands and the prevalence of tile drains, which facilitate water movement from fields to streams. However, some of the highest concentrations of nitrate in urban streams are downstream of wastewater-treatment facilities.

Problems

High concentrations of nitrate in drinking water can cause methemoglobinemia or “blue-baby syndrome” in newborns, a disorder in which the oxygen-carrying capacity of the blood is compromised. Intake of nitrates and nitrites in drinking water also has been implicated in other human health problems, including specific cancers and reproductive problems. Objectionable taste and odor are secondary issues related to nutrient-induced algal blooms that, while not a health hazard, are costly for drinking-water managers. Elevated nutrients can cause algal blooms and over-growth of aquatic plants, which can cause aesthetic impairment and interfere with recreational swimming and boating. In 2004, 51 percent of the waters surveyed were too contaminated for basic uses, such as fishing and swimming, because of their nutrient content (USEPA 2009). According to a recent study by the USGS, most streams with concentrations of nitrate greater than the drinking water standard drained agricultural watersheds. Nearly 30 percent of agricultural streams had one or more samples with a nitrate concentration greater than the maximum contaminant level (MCL) compared to about 5 percent of the streams draining urban land.



Algal blooms, like this one in Lake Erie off the mouth of the Maumee River, can be the result of excess nutrients.
Photo: NOAA

Natural sources provide surface water with adequate nutrients for healthy plant growth. The problem is excess nutrients from human activity.



A forested buffer zone planted along a waterway reduces water pollution.
Photo: NRCS

Riparian forest buffers intercept sediment, nutrients, pesticides, and other materials in surface runoff and reduce nutrients and other pollutants in shallow subsurface water flow.

Excessive levels of nutrients in streams can lead to eutrophic conditions, characterized by increased plant growth. Increased plant biomass can cause a wide range of problems including a reduction in levels of dissolved oxygen, decrease in quality of habitat, decrease in water clarity, enhancement of the growth of invasive species and toxic algae, and overall decline in ecological health. Excessive plant growth can also reduce stream velocity, causing deposits of fine sediments that degrade the quality of streambed habitat for aquatic life. According to the USGS, concentrations of nitrogen and phosphorus are substantially greater than USEPA-recommended nutrient criteria to protect aquatic life in most agricultural and urban streams. Specifically, median concentrations of nitrogen and phosphorus typically are 2 to more than 10 times higher than recommended nutrient criteria in streams of the U.S.

SJRWI Testing Results

Total phosphorus

Concentrations of total phosphorus exceeded the criterion for impaired aquatic life in 4-60% of water samples among all sites in 2009.

Nitrate

Nitrate concentrations in 2009 exceeded the MCL for drinking water in only 1-4% of samples at several sites. However, 28% of samples from Garrett City Ditch exceeded the MCL. Nitrate concentrations in 2009 exceeded the MCL for aquatic life at most sites in all years.

Criteria and Standards

The USEPA has set a MCL of 10 mg/L for nitrate in drinking water to safeguard human health. For the protection of aquatic life in surface waters, it has recommended that total nitrogen and total phosphorus be limited to 2.18 mg/L and 0.76 mg/L respectively.

Total Phosphorus and Nitrate			
	% Samples Exceeding Criterion (2009)		
	To Protect Aquatic Life		Drinking Water
	Total Phosphorus	Nitrate	Nitrate
Confluence Site			
East Branch	8	16	0
West Branch	4	16	0
Nettle Creek	23	40	3
Fish Creek	4	12	0
Middle St Joe	16	60	2
Bear Creek	24	12	0
Cedar Creek	12	52	0
Headwater Sites			
East Fork	8	16	0
West Fork	8	4	0
Lower Cedar	7	33	0
Garrett City Ditch	28	100	28
Diehl/Peckhart Ditch	24	44	4
Upper Cedar	23	1	1
Matthews Ditch	60	4	4

Total Nitrogen

Concentrations of TN during 2006-2010 regularly exceeded the regional criterion for TN (30-51%) in the St. Joseph River Watershed.

Total Nitrogen (mg/L)				
Site	Number of Samples	Maximum	Median	Percent of Samples Exceeding Criterion
Cedar Creek	41	6.8	2.2	51
Fish Creek	80	6.8	1.7	30
St. Joseph River	118	6.5	1.9	42
Data from IDEM, 2006-2010 for sites in the St. Joseph River and two main tributaries, Cedar Creek and Fish Creek				

Solutions

Reducing inputs of nutrients to receiving streams requires multiple strategies. The most effective strategy is prevention—keeping chemicals that contain or can generate nutrients out of the water. Legislation, initiated in 1972, resulted in major improvements to wastewater-treatment plants and to reductions in industrial sources of nutrients. Greater efforts are needed, however, to reduce inputs from combined sewer overflows, failed septic systems, and from manure and animal waste lagoons. It has been estimated that more than 90 percent of nitrogen and phosphorus released to the environment originates from nonpoint sources. However, limiting nutrients from nonpoint sources is difficult because these sources are widespread and difficult to identify. Implementation of best management practices (BMPs) is necessary to reduce nutrient inputs from agricultural and urban sources. BMPs reduce nutrient losses to streams through management of nutrient inputs on the land surface and through curtailment of erosion and runoff of nutrients from the land surface to streams. Three common agricultural BMPs are conservation tillage, nutrient management plans, and conservation buffers. Nutrient contributions from urban and suburban areas can be minimized with proper application of lawn fertilizers.

What We Have Done

In 2010, we completed a U.S. Fish and Wildlife grant that allowed us to provide cost-share assistance to 17 landowners to reforest 146 acres and establish wetlands on 30.5 acres. In prior years, reforestation was part of the Cedar Creek Watershed Management Plan Implementation grant. Projects like these remove agricultural land from production, eliminating the potential for nutrient runoff problems.

As part of another IDEM grant to reduce sediment, nutrients, and pesticides in runoff, we developed an equipment rental cost-share program to encourage no-till crops. It is estimated that this program reduced the annual sediment load on

In 2010, SJRWI provided cost-share programs to watershed landowners to create conservation buffers, both wetlands and forests.



Restoring marginal cropland to wetlands improves the quality of river water.
Photo: NRCS



For the last 10 years, the Tri-State Conservation Farming Expo sponsored by the SJRWI has shared conservation farming and water resource information to farmers across the

SJRWI completed a comprehensive assessment of the watershed as part of Congress' efforts to clean up the Great Lakes. The assessment includes potential actions and associated costs.

3,031 acres by over 1.5 tons and almost 4,400 pounds of nitrogen and almost 2,500 pounds of phosphorus are saved each year.

To determine where conservation buffers are most needed, we partnered with The Nature Conservancy and the Ohio Department of Natural Resources to conduct a rapid watershed assessment. The result was a ranking of sub-watersheds by need, which will help us determine where to allocate resources for buffers.

As part of the Cedar Creek implementation grant, the Initiative installed seven rain gardens and a level spreader in Rieke Park as well as a pervious concrete demonstration project in Eckhart Park, both in Auburn, Indiana.

The U.S. Congress charged the Army Corps of Engineers to determine what would be needed to clean up the Great Lakes. In 2009, as part of this project, the Initiative completed a comprehensive assessment of the St. Joseph River watershed, including information from federal, state, and local governments and other non-profit organizations. This assessment includes potential actions and associated costs by potential sponsors.

Since 2001, the Initiative has sponsored the annual Tri-State Conservation Farming Expo, reaching more than 2,000 attendees with conservation farming and water resource information. The Expo is funded in part by exhibitors and sponsors and a cost-share equipment rental program used for no-till farming.

Projects That Need Funding

The Initiative must continue to offer educational programs such as the Tri-State Conservation Expo so that agricultural producers have all of the information they need to make wise land use choices.

Cost-share programs must be available that allow land owners to convert row crop acres to restored and enhanced wildlife areas and wooded stream corridors and wetlands.

Outreach programs will be developed to educate landowners and developers about the economic, recreational, and environmental value of protecting existing habitat and creating buffer zones by waterways.

Pesticides

Characteristics and Sources

Almost 1 billion pounds of conventional pesticides are used each year in the United States to control weeds, insects, and other pests. Pesticides are

released into the environment primarily through their application to agricultural lands and for nonagricultural pest control on lawns and gardens, commercial areas, and rights-of-way. Pesticides are transported from land into streams primarily by runoff or drainage. Thus, pesticide concentrations in stream water vary through the year, usually characterized by long periods with low or undetectable concentrations of most pesticides, punctuated by seasonal pulses of much higher concentrations. The timing and magnitude of seasonal pulses are correlated with the timing and intensity of pesticide applications, the frequency and magnitude of runoff, and the timing and distribution of land-management practices such as irrigation and artificial drainage.

Problems

Pesticides commonly detected in surface waters of the U.S. are toxic to humans and aquatic life. Humans are exposed to pesticides from water almost exclusively through drinking water. However, treatment methods exist to reduce concentrations of pesticides below the MCL. Aquatic organisms are exposed to pesticides from water, food, and sediments. The toxic potential of a pesticide depends on the active ingredient. The risk of effects from exposure depends on the toxicity of the chemical and the amount of exposure the organism receives.

Pesticides Detected Most Frequently in Stream Water		
Agricultural Herbicides	Nonagricultural Herbicides	Insecticides
atrazine	simazine	diazinon
acetochlor	prometon	chlorpyrifos
metolachlor	tebuthiuron	carbaryl
alachlor	2,4-D	
cyanazine	diuron	

Source: USGS national study from 1996-2006

A USGS national study reported that, from 1992-2001, 57 percent of agricultural streams and 83 percent of urban streams had concentrations of at least one pesticide that exceeded one or more aquatic life benchmarks at least one time during the year. Of the herbicides monitored, atrazine accounted for 18 percent and alachlor comprised 15 percent of exceedances for aquatic life criteria.

SJRWI Testing Results

Concentrations of atrazine regularly exceeded the drinking water MCL at most sites in 2009, but did not exceed criteria to protect aquatic life. Concentrations of alachlor rarely exceeded the drinking water MCL in 2009 and occasionally exceeded criteria to protect aquatic life. Concentrations of metolachlor never exceeded human health criteria for drinking water and were well below standards to protect freshwater life. See chart on page 22.

Criteria and Standards

The USEPA has established human health criteria (MCL) for drinking water and criteria to protect freshwater life based on toxicity studies. The MCL for



This rain garden in Rieke Park in Auburn was part of SJRWI's recent Cedar Creek project

Rain gardens improve water quality by filtering nutrients and sediments from storm water run-off.



Deep-rooted native plants in rain gardens encourage storm water to infiltrate into the ground instead of running off to pollute waterways.

Concentrations of atrazine, a widely-used herbicide, regularly exceeded the drinking water maximum contamination level at most sites tested by the SJRWI in 2009, but did not exceed criteria to protect aquatic life.

herbicides commonly detected in the St. Joseph River watershed are 3.0 ug/L for atrazine, 2 ug/L for alachlor, and 50 ug/L for metolachlor.

Aquatic life benchmarks to protect freshwater life from atrazine are 18 ug/L for aquatic vascular plants and 62 ug/L for invertebrates and fishes. Benchmarks for alachlor are 1.64 ug/L for aquatic vascular plants, 110 ug/L for invertebrates, and 187 ug/L for fishes. Aquatic life benchmarks for metolachlor are 780 ug/L for fishes and 12550 ug/L for invertebrates.

Atrazine in Drinking Water	
Confluence Sites	% Samples Exceeding Criterion (2009)
East Branch	8
West Branch	20
Nettle Creek	19
Fish Creek	4
Middle St Joe	14
Bear Creek	12
Cedar Creek	8
Headwater Sites	
East Fork	4
West Fork	8
Lower Cedar	3
Garrett City Ditch	4
Diehl/Peckhart Ditch	4
Upper Cedar	8
Matthews Ditch	12

Solutions

Keeping drinking water free of excessive concentrations of pesticides involves a multiple-barrier approach. The most effective strategy is prevention—keeping pesticides out of the water. This means managing agricultural and other land-use operations to minimize application of fertilizer and to minimize runoff of pesticides that are applied.

Implementation of best management practices (BMPs) is necessary to reduce pesticide inputs from agricultural, non-point sources. BMPs reduce pesticide losses to streams through integrated management of pesticide inputs on the land surface and through curtailment of erosion and runoff of pesticides from the land surface to streams. Three common BMPs are conservation tillage, integrated pesticide management plans, and conservation buffers (U.S. Environmental Protection Agency, 2008).

What We Have Done

Through our water quality monitoring program, we have gained an understanding of seasonal spikes in pesticide levels and identified critical areas where these spikes occur.

Our BMP implementation projects have helped reduce agricultural pesticide inputs by taking agricultural land out of production and filtering runoff.

Projects That Need Funding

We need to partner with agricultural businesses to educate farmers on the dangers of pesticide runoff and develop related BMP cost-share programs.



The fragrant flowers of the native basswood found along the river and its tributaries produce nectar from which choice honey is made.

We need to stay abreast of current research on pesticides in surface water and share our data with the scientific community and the general public.

Educational programs will help eliminate non-point source pollution. Seminars, print material and a speakers bureau will help educate homeowners and farmers on practices they can adopt to reduce polluted run-off from their land.

In Summary

How healthy is the St. Joseph River?

Some sections of the St. Joseph River and some of its tributaries are listed as impaired on the 303(d) List of Impaired Waters in Indiana, Ohio, and Michigan for pathogens, fish consumption advisories for mercury and PCBs, impaired biotic communities, habitat alterations, algal growth, total dissolved solids, siltation, and nutrients. Care should be taken when coming in contact with the water in these areas.

Causes of water quality problems have been determined through water quality sampling and research combined with land use mapping. Since the St. Joseph River watershed covers such a large area, sources of pollution vary widely. Several towns and cities have wastewater treatment plants that discharge into surface water, while others have regional sewer treatment facilities and combined sewer overflow systems. Failed septic systems contribute to high *E. coli* and nitrogen levels. It is well documented that the soil types throughout the watershed are not suitable for septic systems. Problems associated with failed systems continue to worsen. Much of the watershed contains soils that are highly erosive. Without the use of conservation farming methods that protect soil from erosion, pollution from this non-point source is extensive. Pesticides enter the waters of the St. Joseph River primarily via runoff from agricultural fields and, secondarily, from urban/suburban lawns.

How do we affect water quality?

The water quality issues affecting the river are the cumulative result of actions by land users, whether residential, agricultural, or business. Improvements in water quality will be the cumulative result of actions by these same land users. There are very few natural conditions that degrade water quality.

Seemingly innocuous activities, such as fertilizing your lawn and garden, washing your car in the driveway, and not picking up pet waste, leave residues of pollutants that may run off into storm drains or waterways when it rains, especially if there is no buffer strip of native plants, bushes, grasses, and trees. In a natural environment, only 10% of rainfall runs off into the waterways. However, in urban, suburban, and heavily paved environments, as much as 55% of rain



The historic Hursttown Bridge on Van Zile Road in Allen County is a unique and beautiful example of a truss bridge.

To prevent pesticide pollution, apply the minimum amount and then minimize the run-off through conservation tillage, use of buffers, and an integrated pesticide management approach.



The rumbling of a freight train passing over the St. Joseph River breaks the stillness of this hot summer day on the river.

Soil type and wildlife contribute to river pollution, but human activity contributes even more. Every individual, family, business and farm can make significant contributions to improved water quality in the St. Joseph River and its tributaries.

fall is run-off, carrying with it fertilizer, herbicides, pet and wildlife waste, eroded soil, and other solid matter.

The watershed is subject to significant flood risks, with the ability to wash out valuable habitat, erode stream banks, increase pollutants in receiving water bodies, and impair aquatic communities. When flooding occurs, debris from multiple sources is mobilized (e.g., damaged infrastructure and buildings; oils, grease, and toxins from submerged vehicles and septic systems; and common chemicals and solvents present in most homes), adversely affecting water quality. **While flood control is not part of the Initiative's mission, the result of flooding on water quality is our mission.**

Surface drainage means that sediment and phosphorus run into the river and its tributaries, as well as pesticides attached to soil particles. On the other hand, the use of sub-surface tile drains may result in the presence of water soluble nutrients, such as nitrates, in the drainage water. Drainage issues **aren't limited to agricultural land. As development increases in northern Allen County and southern DeKalb County, it is an issue that municipalities, engineers, surveyors, developers, and residential homeowners must address.**

The decisions we make daily affect water quality. Do we...

- Insure septic systems are working properly?
- Properly dispose of hazardous materials?
- Apply herbicides and pesticides according to label recommendations?
- Support municipal projects to eliminate Combined Sewer Systems?
- Consider wildlife habitat needs when designing new developments?
- Install conservation best management practices?
- Practice conservation farming methods?
- Avoid construction in floodplains?

What can we do to insure that future generations enjoy clean water?

The future health of the river is in our hands, and together we can maintain economic viability while giving full consideration to the environment. If every individual, family, business, and farm assume responsibility and do their part, the resulting improvements to water quality will benefit everyone, including wildlife.

The SJRWI has worked to improve water quality through grant-supported programs for over 15 years. The Initiative has taken a whole watershed approach to improving water quality by focusing its efforts on non-point pollutants. However, managing non-point pollutants is more difficult because sources are not discrete, surface runoff is often unpredictable, and land use changes regularly.

St. Joseph River Watershed Initiative
State of the River

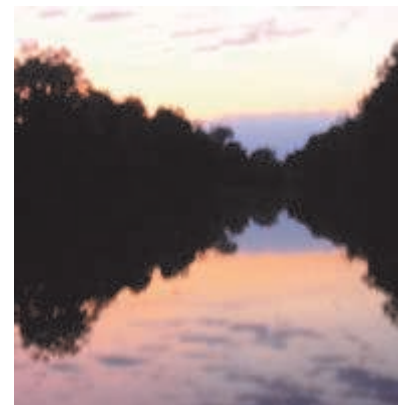
The Initiative will continue to collect and evaluate water quality data, evaluate land use to watch for problem areas, implement watershed management plans, and offer cost-share assistance for conservation measures (as funding allows). The overall vision of these efforts is to reduce pollutant loads to meet EPA water quality standards throughout the year, thus protecting human health, watershed biodiversity, and the aesthetic and economic value of the river.

The initiative will continue its efforts to partner with local citizens and agencies to meet its goals. We will offer workshops, field days and published materials to help citizens make wise choices. Our success depends upon the on-going ability to secure funding to support our staff and our projects.

Please support the efforts of the St. Joseph River Watershed Initiative, which is working on your behalf to protect this valuable resource.

It's your water. It's your future.

*The ability to secure funding for programs and operations is **critical to SJRWI's** ability to achieve its vision of clean water.*



The sun sets over the river.

Resource List

Watershed Management Plans and Assessments

Western Lake Erie Basin Study, St. Joseph Watershed Assessment. Aug. 3, 2009, www.sjrwi.org.
Lower St. Joe-Bear Creek Watershed Management Plan, March, 2008, www.sjrwi.org.
St. Joseph River Watershed Management Plan, Feb. 28, 2006, www.sjrwi.org.
Cedar Creek Watershed Management Plan, Sept. 9, 2005, www.sjrwi.org.
Maumee River Basin Commission Master Plan. www.mrbc.org/.

Research and Testing

Annual St. Joseph River Watershed Water Quality Reports, 2004 - 2009, www.sjrwi.org.
SJRWI On-Line Water Quality Database. www.sjrwi.org.
Hoosier Riverwatch on-line database. www.hoosieriverwatch.com.
Report on the Bacteria Source Tracking Project, October 30, 2004. Dr. Deborah D. Ross and Jane A. Loomis. www.sjrwi.org.

Resources for Educators

Where My River Runs, Exploring the St. Joseph River and Its Watershed, 2008, an educational resource for teachers available at the SJRWI office.
Allen County Partnership for Water Quality. www.acwater.org

Fish, Wildlife and Recreation

Indiana Fish Consumption Advisory, Office of Water Quality, Indiana Department of Environmental Management. www.in.gov/isdh/files/2010_FCA.pdf.
U.S. Fish and Wildlife's report on White Cat's Paw Pearly Mussel. [www.fws.gov/midwest/Endangered/The St. Joseph River \(Fort Wayne\)](http://www.fws.gov/midwest/Endangered/The%20St.%20Joseph%20River%20(Fort%20Wayne).htm). Indiana Department of Natural Resources. www.in.gov/dnr/outdoor/4480.htm

Water Quality References

USGS 2006. Gilliom and others, 2006, *The Quality of Our Nation's Waters—Pesticides in the Nation's Streams and Ground Water, 1992–2001*: U.S. Geological Survey Circular 1291, 172 p.

USGS 2009. Sullivan, D.J., Vecchia, A.V., Lorenz, D.L., Gilliom, R.J., and Martin, J.D., 2009, Trends in pesticide concentrations in corn-belt streams, 1996–2006: U.S. Geological Survey Scientific Investigations Report 2009–5132, 75 p.

USGS 2010. Dubrovsky, N.M., Burow, K.R., Clark, G.M., Gronberg, J.M., Hamilton P.A., Hitt, K.J., Mueller, D.K., Munn, M.D., Nolan, B.T., Puckett, L.J., Rupert, M.G., Short, T.M., Spahr, N.E., Sprague, L.A., and Wilber, **W.G., 2010, The quality of our Nation's waters—Nutrients in the Nation's streams and groundwater, 1992–2004**: U.S. Geological Survey Circular 1350, 174 p.

USEPA 2008. U.S. Environmental Protection Agency, 2008, State adoption of numeric nutrient standards 1998–2008: U.S. Environmental Protection Agency, Office of Water, EPA 821-F-08-007.

U.S. Environmental Protection Agency, 2009, National Water Quality Inventory—Report to Congress. 2004 reporting cycle: U.S. Environmental Protection Agency, Office of Water, EPA 841-R-08-001, 37 p.

St. Joseph River Watershed Initiative

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The staff and board of the St. Joseph River Watershed Initiative gratefully acknowledges the support of our partners.

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Natural Resources Conservation Services
Ohio Department of Natural Resources
Soil & Water Conservation Districts in the watershed
The Nature Conservancy
United States Fish and Wildlife Service

The public is invited to attend all Board meetings. Contact the office for dates, times and location.

*This report was prepared by the St. Joseph River Watershed Initiative
and authored by Martha Bishop Ferguson, Sharon Partridge-Hall, and Bob Gillespie.*

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