Hogan Creek Watershed Management Plan




Creating public awareness of watershed issues which results in responsible environmental actions.

HOGAN CREEK WATERSHED PROJECT

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EXECUTIVE SUMMARY

The Hogan Creek Watershed Project was initiated in 2005 by the Dearborn County Soil and Water Conservation District.

The purpose of this document is to illustrate the work the Hogan Creek Steering Committee has accomplished within the past 2 years. This document explains the vision and strategy of the committee while providing realistic goals on how to improve the Hogan Creek watershed.

Although improving our environment is a life-long commitment, we continue to challenge ourselves and meet new goals everyday. We invite the community to help us achieve the outlined goals of this management plan and help make a significant difference in the watershed by 2015.

This plan is for the residents of the Hogan Creek watershed, inviting all to become active partners within the watershed project.

November, 2007

The Hogan Creek Watershed Steering Committee is a subcommittee of the Dearborn County Soil and Water Conservation District. Funding for this project has been obtained from a United States Environmental Protection Agency Clean Water Act #205j Grant.

For more information about this project, please contact:

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"To create public awareness of watershed issues which results in responsible environmental actions"

VISION STATEMENT

"To have healthy habitats and pristine waters in harmony with all watershed uses"

INTRODUCTION –
This section describes the process the community went through when developing the plan, lists the parties involved, and summarizes any important issues that influences how the plan emerged.

1.1 Watershed Partnerships
The Dearborn County and Ripley County Soil and Water Conservation Districts (SWCDs) were established in 1957 to educate and assist landowners with natural resource needs. Over the past 48 years the SWCDs have proudly assisted landowners in developing and implementing conservation programs based on set resource priorities. The organizations are governed by a board of supervisors, consisting of three elected supervisors and two appointed supervisors.

In 1998, the Dearborn County SWCD held a series of locally led meetings throughout the county to prioritize resource concerns. The highest resource concern among citizens was water quality and the need to address nutrient and sediment contamination in surface water. The Dearborn SWCD chose the three largest watersheds within the county to address: Tanners Creek, South Laughery Creek and Hogan Creek. The Tanners Creek Watershed Project began in 2000 and four years later the South Laughery Creek Watershed Project started in 2004. In 2005, the Dearborn County SWCD, with support from the Ripley County SWCD, initiated the Hogan Creek Watershed Project (HCWP) with aspiring goals of educating community members about water quality through the development of a Management Plan, water quality testing, and an extensive outreach program.

In January of 2005, a kick-off meeting was scheduled in Dearborn County to introduce the project to local landowners, businesses and government agencies. The goal of the kickoff meeting was to develop the Hogan Creek Steering Committee to guide the watershed project.

The focus of this Steering Committee is to:

1. Develop projects to achieve missions and goals
2. Compose the Hogan Creek Watershed Management Plan
3. Provide direction and leadership to subcommittees and staff
4. Actively relay project information to community and interest groups
5. Attend and support Hogan Creek activities
6. Attend monthly Steering Committee meetings

Local community members were encouraged to attend the kickoff meeting through press releases in Batesville’s *Herald Tribune* and Dearborn County’s *Register* and *Journal Press*. Additionally, a database of key stakeholders located in the watershed was developed and each recipient was sent a formal invitation to attend the January meeting.

1.2 Outreach Efforts
In addition to the kick-off meeting, the group held several meetings and activities to address the project’s needs and to encourage participation from local citizens. These outreach efforts, with the exception of literature, were used as forums for citizens to express their concerns for watershed issues. All issues discussed during outreach efforts were taken back to the Steering Committee for further discussion and development of action items.

1.2.1 Field Days/Workshops

The HCWP holds annual field days/workshops including pond clinics, conservation field days, creek clean-ups, septic system workshops and more to help the public understand important issues going on in the watershed. These field days/workshops provide essential information from local experts and offer valuable literature for participants to take home. Field days/workshops are free to the public and are announced in newspapers, newsletters, public service announcements, and through personal contact.

1.2.2 Literature

The HCWP has generated and distributed an array of publications about the watershed to spark interest in citizens with diverse backgrounds. These publications are free to the public and are made available during field days/workshops, fairs, meetings, or through personal mailings.

1.2.3 Presentations

The watershed coordinator attends public meetings for many local organizations to discuss the watershed project and how it can assist in helping local communities. Presentations are free and are catered to the different needs of each organization.

1.3 Public Participation

Supporters of the HCWP include landowners, environmentalists, educators, and members of local organizations who are interested in preserving the environment in which they live. Each member is on one or more of the following committees:

1.3.1 Committees

1.3.1a Steering Committee

The Hogan Creek Steering Committee is made up of key stakeholders from a variety of backgrounds including landowners, environmental scientists, educators, technical experts, and concerned citizens. The Steering Committee is responsible for setting policies, supervising, and giving program direction to members of three long-term subcommittees. The steering committee meets on the third Thursday of every month and switches locations between Aurora and Milan to accommodate both counties.

1.3.1b Technical Committee

The technical committee is made up of Farm Service Agency (FSA), Natural Resources Conservation Service (NRCS), and Soil and Water Conservation District (SWCD) employees and community members. This committee is responsible for conducting a watershed inventory, providing technical assistance to watershed landowners and administering the state and federal water quality programs.

1.3.1c Water Monitoring Committee

The Water Monitoring committee consists of the watershed coordinator, Gordon and Associate staff, technical personnel, and local citizens. The responsibilities of this committee include data collection and analysis, and recommendation of best management practices.

1.3.1d Education Committee

The Education committee is made up of community residents and agency personnel. The main responsibilities for this committee include publicizing the project’s activities and accomplishments, developing marketing techniques, and educating the overall public through a series of public meetings, educational field days, and school programs.

1.3.2 Stakeholders

To generate public support for the watershed project, citizens must have a vested interest in the outcome of its activities. For this to occur, the public must participate in each phase of the planning process including; research, problem statements, goals and objectives, best management practices, and implementation.

Table 1 includes stakeholders who assisted in the writing of this plan by participating in the planning process. Information taken from these procedures was compiled, analyzed and formed into the Hogan Creek Watershed Management Plan.

Table 1: Key Stakeholders Involved in Planning Process

Name	Title	Agency/Organization
Ault, Barbara	Director	Dearborn County Solid Waste Management
Clark, Allen	Landowner	Aurora
Cutter, Rita	District Coordinator	Dearborn County SWCD
Erickson, Bill	Member	Aurora Parks Board
Grimsley, Don	Landowner	Moores Hill
Hopping, Ray	Landowner	Milan
Hughes, Jennifer	Stormwater Specialist	Dearborn County SWCD
Ingram, John	Town Manager	Town of Milan
Johnston, Ken	Landowner	Aurora
Kruse, John	Board Member	Dearborn County SWCD
Lane, Ken	District Conservationist	NRCS
McHenry, Chris	Director	Dearborn County Historical Society
Pragar, Len and Donna	Landowner	Milan
Reatherford, Becky	District Coordinator	Ripley County SWCD
Schmeltzer, Karla Fry	Director	Main Street Aurora
Schwipps, Tim	District Conservationist	NRCS
Smith, Vickie	District Technician/Educator	Dearborn County SWCD
Stephenson, Terry	Director	Historic Hoosier Hills RC&D
Turner, Randy	Director	Aurora Utilities
Wirth, Heather	District Technician	Ripley County SWCD

THE WATERSHED –
This section describes the features of the watershed which helped the group form their decisions.

2.1 Watershed Location

Hogan Creek flows from its headwaters in northeast Ripley County until it reaches its confluence with the Ohio River, just north of the town of Aurora. Several cities and towns are located within the watershed including: Moores Hill, Dillsboro, Manchester, Milan and Sunman. Refer to map on page 4.

2.2 Description and History

2.2.1 Origin of Name

There does not seem to be a definitive answer to the origin of the name of Hogan Creek, although the name certainly goes back to at least 1802. There were no families by that name in the area at the time, although there may have been some across the Ohio River in Boone County.

One questionable story says it was named for two brothers named Hogan who were killed by Indians. Since Tanners Creek was actually named for a family in Kentucky from which two boys were taken prisoner, one may wonder if this is simply a copy cat story.

A more believable story is that the Morrison family, who arrived in the 1790's at the mouth of Hogan Creek, lived for a time in a crude hut they found already there, and someone had raised a crop in that area[1]. Whether or not the earlier residents could have been named Hogan is unknown. Although the origin of Hogan Creek's name is unknown, other tributaries of Hogan Creek have a history:

- Elk Run and Fox Run refer to animals found in the area;
- Long Branch was named because of its length;
- Allen's Branch is named for an Isaac and Claibourne Allen who settled near the mouth of the branch;
- Whitaker Fork is named for a family by that name who settled in that area in the early 1800's;
- Chance Branch was named after Virgil Chance, a landowner living on this creek;
- Burton Branch is said to be named after a Barton family living on the creek;
- Schooley's Branch is named after Isaac Schooley, who owned several tracts at the head of this branch.
- Blue Lick Stream, a mineral water spring lost in the great flood of 1937, was discovered in 1888 while drilling for natural gas near Hogan Creek.

2.2.2 Climate

The average daily maximum temperature for Dearborn County is 63.6 degrees Fahrenheit. The warmest month is July with an average temperature of 73.4 degrees. The average daily minimum temperature for the county is 39.1 degrees Fahrenheit with the coldest month being January with an average temperature of 27.9 degrees. For every two years over a ten-year

[1] *History of Dearborn and Ohio Counties, Indiana – From Their Earliest Settlement* (Chicago, IL: F.E. Weakley & Co. Publishers, 1885), 427.

period, the watershed may experience a maximum temperature for July, August, and September of 96 degrees. The temperature may go below –12 in January, two out of ten years.[2]

Precipitation in Dearborn County ranges from an average low of 2.29 inches in October to an average high of 4.78 inches in July. The average yearly precipitation is 39.81 inches. Over a 10 year period, there may be two years with total precipitation less than 35.48 inches and there may be two years with more than 43.99 inches.[3]

The average daily maximum temperature for Ripley County is 63.5 degrees Fahrenheit. The warmest month is July with an average temperature of 73.3 degrees. The average daily minimum temperature for the county is 40.5 degrees Fahrenheit with the coldest month being January with an average temperature of 28.6 degrees. For every two years over a ten-year period, the watershed may experience a maximum temperature for July and August of 96 degrees. The temperature may go below –17 in January, two out of ten years.[4]

Precipitation in Ripley County ranges from an average low of 2.35 inches in October to an average high of 4.62 inches in May. The average yearly precipitation is 39.88 inches. Over a 10 year period, there may be two years with total precipitation less than 34.04 inches and there may be two years with more than 45.82 inches.[5]

Table 2: Hogan Creek Weather

	Avg. Max Temp	Avg. Min Temp	Avg. Max Precip.	Avg. Min Precip.	Avg. Yearly Precip.
Dearborn Co.	63.6	39.1	4.78	2.29	39.81
Ripley Co.	63.5	40.5	4.62	2.35	39.88

2.2.3 Natural History

The Hogan Creek watershed is located in the Eastern Broadleaf Forest (Continental) Province ecoregion.[6] This region is dominated by broadleaf deciduous forest, but because of the low precipitation, it favors the oak-hickory association.[7] Prevalent species in this association include American beech, white ash, sugar maple, white oak, chinquapin oak, red oak, shagbark hickory, blue ash, tulip tree, Ohio buckeye, and black walnut with understory species including the flowering dogwood, sassafras, and hophornbeam.[8] Glaciated areas, like Indiana, feature a stronger beech-maple forest defined by the American beech and sugar maple, although oak and hickory are still present on poor sites.[9]

[2] Allan K. Nickell, *Soil Survey of Dearborn and Ohio Counties, Indiana* (Indianapolis, IN: United States Department of Agriculture, Soil Conservation Service, 1981), 98.
[3] Nickell, 98.
[4] Kendall M. McWilliams, *Soil Survey of Ripley County and Part of Jennings County, Indiana* (Indianapolis, IN: United States Department of Agriculture, Soil Conservation Service, 1981), 90.
[5] McWilliams, 90.
[6] Robert G Bailey, "Description of Ecoregions in the US", March 1995, http://www.fs.fed.us/colormap/ecoreg1_provinces.conf?567,245 (8 June 2005).
[7] Bailey
[8] United State Geological Survey, "Hydrologic Benchmark Network Stations in the Midwestern US 1963-95," n.d., http:// (6 June 2005).
[9] Bailey

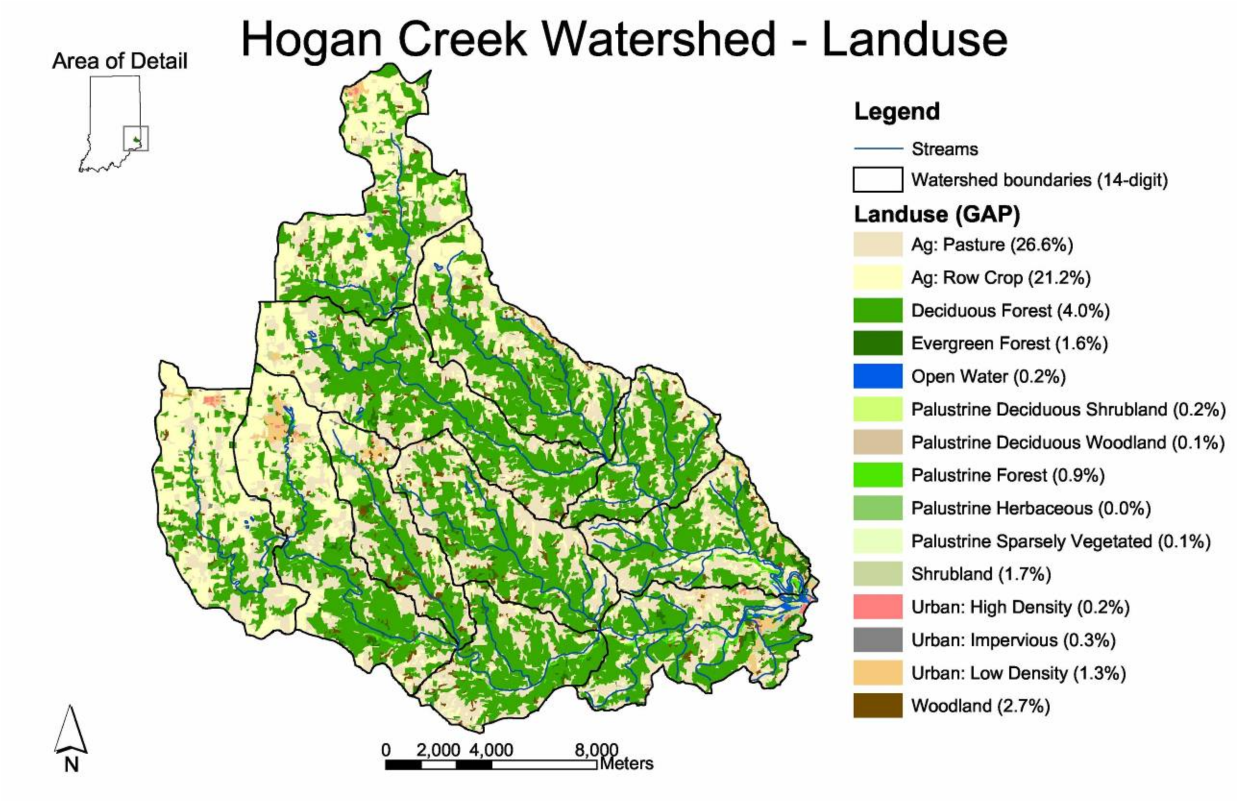
2.2.4 Land Use

The watershed is roughly 82,000 acres, with approximately 63,000 acres in Dearborn County with the remaining acreage in Ripley County. Approximately forty-seven percent of the watershed is agricultural land, fifty percent is woodland, two percent is urban land, and the remaining one percent is water.

Table 3: Hogan Creek Land use per Subwatershed

	*010	*020	*030	*040	*050	*060	*070	*080	*090	*100	*110	TOTAL
Pasture	1794.36	2784.10	1858.96	1257.77	2174.04	1844.13	2326.68	1533.17	1614.24	2443.99	2149.13	21780.57
Row Crop	3157.89	1829.44	1712.44	726.02	856.43	3747.88	2724.00	803.99	431.35	814.69	533.14	17337.27
Deciduous Forest	3465.77	5351.79	4027.21	2628.10	2612.83	2181.17	3645.17	1934.88	2895.79	3545.58	2967.64	35255.93
Evergreen Forest	40.14	171.14	107.82	45.60	202.36	62.93	164.37	88.94	115.26	160.67	190.26	1349.49
Open Water	8.19	14.82		2.56	28.78		5.00		3.74		91.48	91.48
Palustrine Deciduous Shrubland	0.34	2.88	7.10	19.13	19.92	5.65	20.75	2.90	15.30	2.47	49.76	146.2
Palustrine Deciduous Woodland	0.37	5.77	2.63	16.53		6.83	5.66	5.94	6.91	11.90		37.24
Palustrine Forest	95.40	49.80	38.55	9.40	139.33	42.59	117.69	6.05	53.96	31.46	172.82	757.05
Palustrine Herbaceous											4.17	4.17
Palustrine Sparsely Vegetated	7.48	9.20	0.80	7.21	4.99	9.34	5.11	0.21	2.39	6.68		53.41
Shrubland	79.99	168.85	169.84	95.77	130.38	66.06	124.77	72.14	74.37	107.19	299.74	1389.1
High Den. Urban	16.94	1.92				29.83	19.74	7.26			59.74	59.74
Impervious	49.30	19.17	3.79	0.03	8.83	52.76	11.83	35.31	13.62	24.90	15.63	235.17
Low Den. Urban	83.63	28.53	65.88	7.83	142.80	75.05	250.50	81.67	19.58	40.54	247.63	1043.64
Woodland	151.25	259.70	206.17	128.56	143.05	122.87	222.46	286.86	175.14	305.33	227.54	2228.93
Total	8951.05	10697.11	8201.17	4944.50	6463.73	8247.09	9643.73	4859.26	5421.66	7495.38	7008.68	81769.39

Figure 1: Hogan Creek Watershed Land Use



2.2.5 Soils

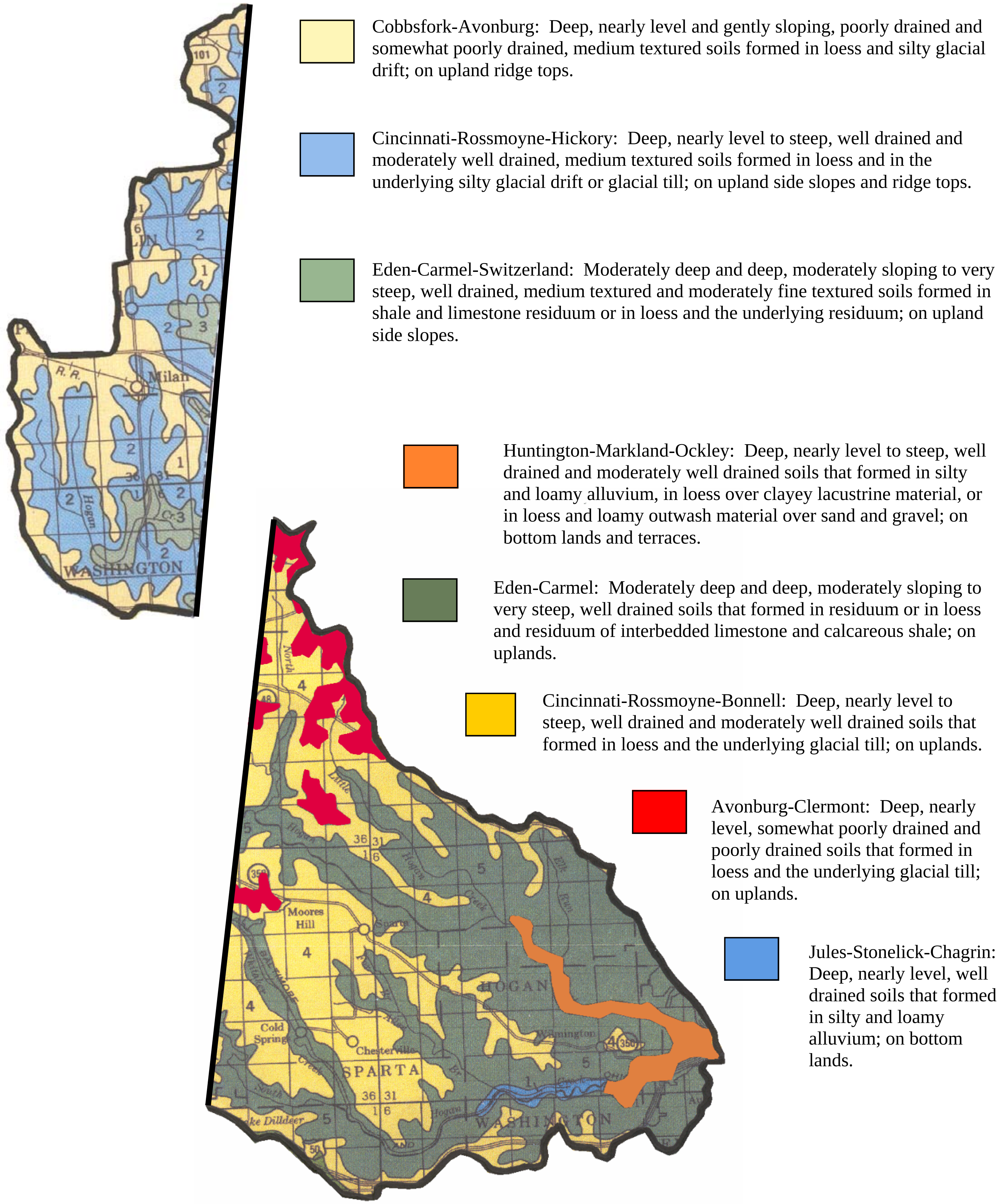
The Hogan Creek watershed is underlain with Ordovician-age shale and limestone, which occurs under the entire area of Dearborn County and partially under Ripley County.[10]

Three soil associations in Ripley County cover the Hogan Creek watershed. See Figure 2.

- Cobbsfork-Avonburg: These soils are classified as poorly drained and nearly level on ridgetops and gently sloping in areas near the head of drainage ways. Although this soil unit has good potential for cultivating crops, artificial drainage is needed to help control wetness. Not suitable for septic systems.[11]
- Cincinnati-Rossmoyne-Hickory: This soil unit is moderately to well drained and is generally located on ridges and side slopes along drainage ways. Although mainly used for crops or pasture/hayland, the steeper areas of this soil unit are best used for woodlands because of heavy erosion areas. Not suitable for septic systems. [12]
- Eden-Carmel-Switzerland: These soils are characterized by their deep, moderately sloping to very steep landscape. Because of its steep terrain, this soil is mostly used for woodlands but in some gentler sloping areas, it is used for crops and hayland. Not suitable for septic systems [13]

[10] United States Geological Survey, "Hydrogeologic Atlas of Aquifers in Indiana," 9 May 2001, http://in.water.usgs.gov/atlasweb/#OHIO%20RIVER%20BASIN (26, January 2005)
[11] McWilliams,
[12] McWilliams,
[13] McWilliams,

Figure 2: Hogan Creek Watershed Soil Associations



Five soil associations in Dearborn County cover the watershed area. See Figure 2.

- Jules-Stonelick-Chargin: These soils are deep and well-drained. They are typically located on the bottom lands adjacent to streams. Although soils are generally used for cropland, flooding is a severe threat to these areas.[14]
- Huntington-Markland-Ockley: Huntington, Markland and Ockley soils are deep and well-drained. Huntington soils are on the lower lying areas adjacent to the Ohio River. Markland are on high terraces along major tributaries of the Ohio River. Ockley soils can be found on outwash terraces. These soils are suitable for crops, pasture, residential, and urban areas but flooding is a major hazard in the lower areas, while erosion is a problem in the hard-sloping terraces.[15]
- Avonburg-Clermont: Avonburg and Clermont soils are deep and somewhat poorly to poorly drained. They have a seasonal high water table and have 0 to 2 percent slopes. These soils are primarily used for cropland.[16]
- Cincinnati-Rossmoyne-Bonnell: The Cincinnati, Rossmoyne and Bonnell soils are deep and range from moderately well to well drained, with slopes ranging from 2 to 8 percent. These soils are primarily used for cropland, pasture, and woodland.[17]
- Eden-Carmel: The Eden and Carmel soils are deep and well drained, with slopes ranging from 12 to 30 percent. These soils are primarily used for pasture and woodlands. For building sites, shrink-swell and slippage of these soils are concerns.[18]

The basis for identifying highly erodible land is the erodibility index of a soil map unit. The erodibility index of a soil is determined by dividing the potential erodibility for each soil by the soil loss tolerance (T) value established for the soil. The T value represents the maximum annual rate of soil erosion that could take place without causing a decline in long-term productivity. A soil map unit with an erodibility index of 8 or more is a highly erodible soil map unit. Highly erodible land (HEL) is land that is very susceptible to erosion, including fields that have at least 1/3 or 50 acres of soils with a natural erosion potential of at least 8 times their T value[19]. Refer to Appendix E for a map of HEL land located within the Hogan Creek watershed.

2.2.6 Topography

The watershed's highest elevation, located just below Pierceville in Ripley County, reaches to 1,020 feet above sea level. The portion of the watershed that is in Ripley County has an average elevation of 980 feet. As the watershed moves southeast, the slope of the land gently declines until it reaches its lowest point, 460 feet above sea level, at the mouth of the creek. The approximate relief of the watershed is 560 feet. See Appendix F for Hogan Creek Topography Map.

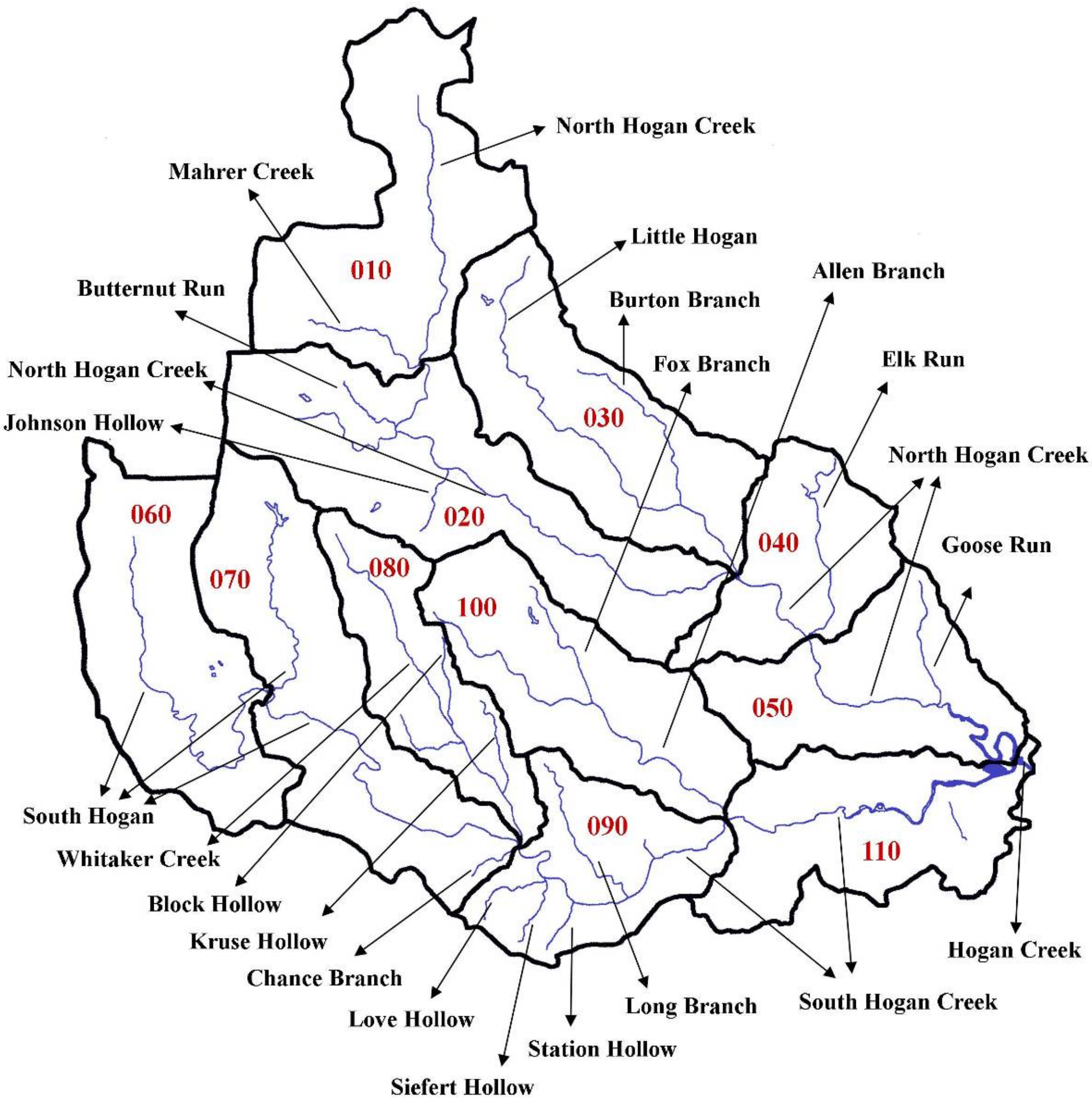
2.2.7 Hydrology

The 11-digit HUC for the Hogan Creek watershed is 05090203040. This is part of a much larger Middle Ohio-Laughery watershed (05090203). The watershed is made up of eleven 14-digit

[14] Nickell, 5
[15] Nickell, 5-6
[16] Nickell, 6
[17] Nickell, 7-8
[18] Nickell, 8-9
[19] http://agriculture.house.gov/info/glossary/hi.htm

subwatersheds. The subwatersheds include: North Hogan-Mahrer Creek (05090203040010), Butternut Run (05090203040020), Little Hogan Creek (05090203040030), North Hogan – Elk Run (05090203040040), North Hogan – Wilmington (05090203040050), South Hogan Creek Headwaters (05090203040060), South Hogan – Milan Tributary (05090203040070), Whitaker Creek (05090203040080) South Hogan – Dillsboro Station (05090203040090), Allen Branch (05090203040100), and South Hogan – Cochran (05090203040110). See Figure 3.

Figure 3: Hogan Creek Watershed Hydrology



According to the Natural Resources Commission, Hogan Creek is a navigable waterway beginning at the Ohio River for 0.4 miles. North Hogan extends for another 4.9 miles and South Hogan extends for another 5.0 miles.[20]

There are two dams located in the Hogan Creek Watershed. One is located in the Dillsboro Station subwatershed, 05090203040090, at the headwaters of the Long Branch tributary. The second dam is located in the Allen Branch subwatershed, 05090203040100, in the middle of the Fox Branch tributary.[21]

2.2.8 Land Ownership

Gladys Russell Wildlife Habitat – The Gladys Russell Wildlife Refuge on Whites Plains Road, Manchester Township in Dearborn County offers three hiking trails, a fishing lake, a historic barn and lush grasslands.

Waterways Park – The Waterways Park is located on Moore and Manchester Street in Aurora. This small park offers a basketball court, tennis court, picnic areas, shelters, playground equipment, fishing, and an ample supply of ducks to feed.

Mary Stratton Park – Located on Fifth Street in downtown Aurora, the Mary Stratton Park offers playground facilities, benches, and a gazebo style shelter.

Aurora City Park – Aurora's largest and most utilized park is home to an outdoor swimming facility, playground equipment, horseshoe courts, fishing in Hogan Creek, a pavilion with kitchen, open shelters, a civic center and round barn.

Sunman Community Park – The Sunman Community Park is located on Fitch Avenue in the town of Sunman. The park includes shelters with electricity, community building, playground facilities, softball field, picnic tables, tennis courts, basketball goals, and horseshoe pits.

Milan Community Park – Located just off of State Road 101 in Milan, this community park offers a shelter house, pine tables, and ball fields.

2.2.9 Endangered Species

According to the Indiana Department of Natural Resources – Division of Nature Preserves, the following endangered species were reported as seen in the Hogan Creek watershed.

Figure 4: Nothern Ravine Salamander

2.2.8a Amphibians

Northern Ravine Salamander[22] – The Northern Salamander is the most slender salamander in the region with almost half of its length made up by its tail. When identifying the Northern

[20] Natural Resources Commission, "Roster of Indiana Waters Declared Navigable or nonnavigable." 3 November 2002, http://www.state.in.us/nrc/policy/III.html#H (26 January 2005)
[21] Indiana Geological Survey, "A GIS Atlas for Indiana." n.d., http://129.79.145.5/arcims/statewide/viewer.htm (5 May 2005)
[22] OhioAmphibians.com, "Ravine Salamander – Plethodon Electromorphus." 29 March 2005, http://www.ohioamphibians.com/salamanders/Ravine_Salamander.html (4 May 2005)

Ravine, look for a dark brown to black body with silvery white or brassy flecks along the back. Northern Ravines are typically found under rocks on forested hillsides and slopes.

The lifecycle of the Northern Ravine begins in summer when the eggs are deposited under rocks. The larval stage is completed totally within the egg. Eggs hatch in late summer to early fall and the amphibian remains underground until the following spring.

Destruction of forestland by logging and development is a major threat to these endangered salamanders. Likewise, as with all lungless salamanders, pollution, including that from pesticides and herbicides, are easily absorbed and very toxic to the amphibians.

2.2.8b Birds

Barn Owl[23] – The Barn Owl is usually identified by its white, heart-shaped face. The body of the owl is primarily white with long feathers that are buff, yellow, and tawny shadings, freckled with dark spots. Barn Owls generally grow to 15-20 inches in height.

Figure 5: Barn Owl

The Barn Owl is more nocturnal than most other owls and chooses its nesting site almost anywhere, including old buildings, hollow trees, or in or on the ground. They hunt in areas rich in rodents, along ravines where tree for perching are available.

Loggerhead Shrike[24] – The Loggerhead Shrike is a masked, hook-billed songbird known for its habit of impaling prey on thorns or barbed wire. It is a gray, black and white bird, with a slim tail, large head, hooked black beak and distinctive black mask. When a shrike flies, you can see two white wing patches. Males and females are similar in size and color. The song of loggerhead shrikes is an often repeated medley of low warbles and harsh, squeaky notes and phrases. The bird's call is a harsh "*shack-shack*."

The Loggerhead Shrike prefers an "edge" habitat, usually along roadsides and hedgerow in agricultural regions. They prefer living in tree species with thorns such as the hawthorn, locust, crabapple, or osage orange.

2.2.8c Mammals

American Badger[25] – The American Badger can be identified by its flat body, small ears, and short legs with long, sharp front claws. The badger has a triangular face with a long, pointed, tipped-up nose. Their fur is brown or black with white stripes on both cheeks and a one running from the nose to the back of its head.

The badger lives in open areas including plains, prairies, farmland and the edge of woods. While mostly feeding on small burrowing animals such as ground squirrels, rats, gophers, and mice, the badger is also known to eat snakes, birds, and reptiles.

[23] Desert USA, "Common Barn Owl – Tito Alba." June 1997, http://www.desertusa.com/june97/du_barnowl.html (5 May 2005)
[24] Wisconsin Department of Natural Resources, "Loggerhead Shrike – Lanius Ludovicianus." 17 January 2003, http://www.dnr.state.wi.us/org/land/er/factsheets/birds/shrike.htm (4 May 2005)
[25] Nature Works, "American Badger – Taxidea taxus." n.d., http://www.nhptv.org/natureworks/americanbadger.htm (4 May 2005)

Bobcat[26] – The Bobcat has an average weight of 15-20 pounds and can be identified by its long legs, large paws, and short, black tail with a white tip. Bobcats have a healthy appetite of rabbit, ground squirrels, mice, pocket gophers and wood rats.

Bobcats favor rocky, brushy hillsides to live and hunt. They make their homes in caves or crevices, if available. However, if there are no caves or crevices for the bobcats, they will den in a dense thicket of brush or sometimes even choose a hollow log or tree.

2.2.8d Reptiles

Timber Rattlesnake – The Timber Rattlesnake is a heavy-bodied snake with a broad head that is distinct from its narrow neck. The top of the head is unmarked and usually yellow to light gold in color. Adult timber rattlers average 35 to 50 inches in total length. They have a yellow, brown, rust-orange, or in rare cases gray ground color with black or dark brown crossbands extending along the back. There is a dark brown stripe behind each eye, and there may be a rust-colored middorsal stripe from the neck to the tail. The tail is short and thick, all black, and tipped with a tan rattle. Juvenile timber rattlers are marked like the adults.

2.2.8e Vascular Plants

Lake Cress – The Lake Cress is a herbaceous perennial plant commonly located in quiet waters of lakes and streams. The plant is usually located in full sun with the stems submerged and flowers and fruits immersed. Fruiting of this plant typically occurs in June through September. Decline of this plant is typically related to the destruction of suitable shoreline environments through mechanical disturbance of habitat, sudden changes in water level, and/or the overgrowth by other vegetation.

Virginia Saxifrage – The Virginia Saxifrage is a herbaceous plant commonly located along the shallow soils near rock outcroppings. This plant typically reaches about 12 inches tall and has toothed or lobed basal leaves that reach 3 inches in length.

The white flowers on Virginia Saxifrage are characterized by five regular parts that are up to a half inch wide. The flowers generally bloom in early spring and continue to bloom until mid-spring.

Figure 6: Virginia Saxifrage

[26] Desert USA, "Bobcat." April, 1996, http://www.desertusa.com/april96/du_bcat.html (4 May 2005)

TESTING PARAMETERS –
This section explains the chemical and biological tests which were monitored on Hogan Creek and its many tributaries throughout the project.

3.1 Chemical Parameters

3.1.1Phosphorus

Phosphorus is an essential ingredient in the successful growth of plants and animals. When given the right amount, plankton and aquatic plants thrive, providing food for fish and other aquatic animals. In this particular situation, water quality is considered excellent.

The problem arises when an excessive amount of phosphorus enters our waterbodies. As phosphorus enters a stream, lake, pond or other body of water, it gets consumed by various living creatures. However, once the supply of phosphorus exceeds the demand, the process of eutrophication begins.[27] This excess of nutrients increases growth of algae and other aquatic plant populations. Once the aquatic plants die, they expend a substantial amount of dissolved oxygen (DO), causing the DO to decrease and fish to die.[28] Although phosphorus can be deadly to fish if received in excess amounts, phosphorus in not toxic to humans or animals unless extraordinarily high.

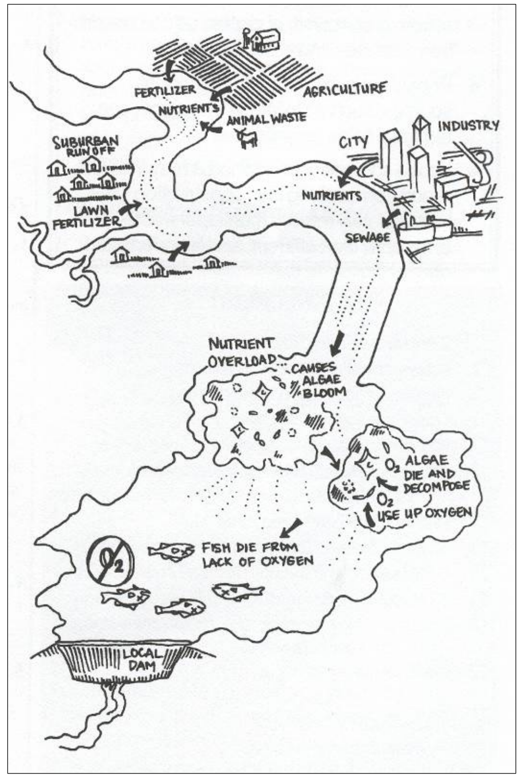


Figure 7: Process of Eutrophication

Phosphorus enters our water in three different forms[29]:

- Orthophosphates: sewage and natural processes.
- Polyphosphates: Used for treating boiler waters and present in detergents. Polyphosphates change to the orthophosphate form in water.
- Organic Phosphates: Breakdown of organic pesticides that contain phosphates.

Phosphorus enters our waterbodies several different ways. It can attach itself to soil or manure, dissolve in runoff carried over agricultural or urban areas, or enter through wastewater or septic systems.[30] Because phosphorus cycles between bottom sediments and water long after the source is eliminated, focus on phosphorus should not be in treating waterbodies, but preventing it from entering our waterbodies.

3.1.2 Nitrogen

Nitrogen and phosphorus are very similar. They are both much needed nutrients which assist in plant growth, and when given too much, eutrophication can occur. There is, however, one major

[27] KY Water Watch, "Phosphorus and Water Quality," n.d., <http://kywater.org/ww/ramp/rmpo4.htm> (27 January 2005)
[28] KY Water Watch, "Phosphorus and Water Quality,"
[29] KY Water Watch, "Phosphorus and Water Quality,"
[30] John A Lory, "Agriculture Phosphorus and Water Quality," April 1999, <http://muextension.missouri.edu/explore/agguides/soils/g09181.htm> (27 January 2005)

difference between nitrogen and phosphorus. While phosphorus is relatively harmless to humans, nitrogen can cause serious illness to newborn babies called "Blue Baby Syndrome (BBS)."[31] BBS is the result of nitrates (NO3) reacting with hemoglobin in humans. The reaction occurs when nitrates oxide hemoglobin in the red blood cells and converts the hemoglobin to a compound known as methemoglobin.[32] Methemoglobin then actively destroys the ability of red blood cells to transfer oxygen properly to the body, often resulting in death.[33] Nitrogen also causes a similar effect in fish called "Brown-blood Disease (BBD)." As nitrates enter through the gills, it turns the blood to a dark brown color. Methemoglobin also develops in the fish and restricts oxygen flow[34]. As with babies, this disease can cause sudden death, but more often the fish live until they over exert themselves.[35] Fish that have BBD are often seen gasping at the surface or swimming near aeration equipment.[36]

Nitrogen enters our waterbodies from human and animal wastes (including birds and fish), septic tanks, municipal and industrial wastewater, feed lots, and attaches itself to soil particles.

3.1.3 Suspended Solids and Turbidity

Turbidity is a measure of cloudiness in water which is caused by suspended matter including clay, silt, organic matter, plankton, and microscopic organisms.[37] This matter interferes with the passage of light through the water by absorbing and scattering it, rather than allowing it to shine through the water column in a straight line[38]. When light is unable to shine through water, photosynthesis can be limited. Additionally, water temperature can increase as the floating particles absorb heat from the sun. Heating of the water will lower dissolved oxygen levels, making it difficult for aquatic organisms to survive. Likewise, particles can kill fish and aquatic invertebrates by clogging their gills and smothering their habitat. Turbidity should not be confused with color since darkly colored water can still be clear and not turbid.

Water can become turbid through a number of methods including:

- Erosion and runoff of soils from fields, parking lots, or streambanks;
- Construction activities where proper erosion control measures are not utilized;
- Effluent from wastewater treatment centers;
- Bottom-feeding fish stirring up sediments as they remove vegetation; and
- Algal blooms

3.1.4 pH

pH is the measure of a solution's acidic or basic level. Because organisms are so sensitive to pH levels, it is one of the most common tests performed in water monitoring.[39]

[31] KY Water Watch, "Nitrogen and Water Quality," n.d., <http://kywater.org/ww/ramp/rmnox.htm> (27 January 2005)
[32] KY Water Watch, "Nitrogen and Water Quality,"
[33] Purdue University, "Nitrite Toxicosis in Freshwater Fish or Brown Blood Disease," n.d., <http://www.addl.purdue.edu/newsletters/1998/spring/nitrate.shtml> (27 January 2005)
[34] H. Steven Killian, "Brown-blood Disease," n.d., <http://www.uaex.edu/aquaculture2/FSA/FSA9000.htm> (27 January 2005)
[35] Purdue University, (27 January 2005)
[36] Killian (27 January 2005)
[37] Shelia Murphy, "General information on Turbidity," n.d., http://bcn.boulder.co.us/basin/data/NUTRIENTS/info/Turb.html (1 November 2005)
[38] Hartman and Burk, 62
[39] Hartman and Burk, 48.

Although adult aquatic organisms can frequently live in water with a low or high pH, offspring will most likely not survive. According to the Hoosier Riverwatch training brochure, the optimum level for most organisms is between the range of 6.5 to 8.2.[40] Kentucky Water Watch suggests the optimum range for fish eggs is between 6.0 and 7.2.[41] See chart below for more limiting values.

Table 4: Limiting pH Values

Minimum	Maximum	Effects
3.8	10.0	Fish eggs can be hatched, but deformed young are often produced
4.0	10.1	Limits for the most resistant fish species
----	4.3	Carp die in five days
4.5	9.0	Trout eggs and larvae develop normally
5.0	9.0	Tolerable range for most fish
----	8.7	Upper limit for good fishing waters
5.4	11.4	Fish avoid waters beyond these limits
6.0	7.2	Optimum range for fish eggs
----	1.0	Mosquito larvae are destroyed at this pH value
3.3	4.7	Mosquito larvae live within this range
7.5	8.4	Best range for the growth of algae

* Taken from the "pH Water Quality Information" website: http://www.state.ky.us/nrepc/water/wcpph.htm

Many processes affect the pH balance of water. For instance, a higher temperature of water generally produces a lower pH value.[42] Because some heavy metals can dissolve more readily in water with lower pH levels, the chance of aquatic life being harmed is much greater.[43]

In addition, waterbodies with frequent algae blooms may have a pH range of 9 or higher because algae are removing carbon dioxide during photosynthesis.[44] As previously stated, raising the pH level above 8.2 puts unnecessary stress on aquatic organisms and could cause that organism to perish.

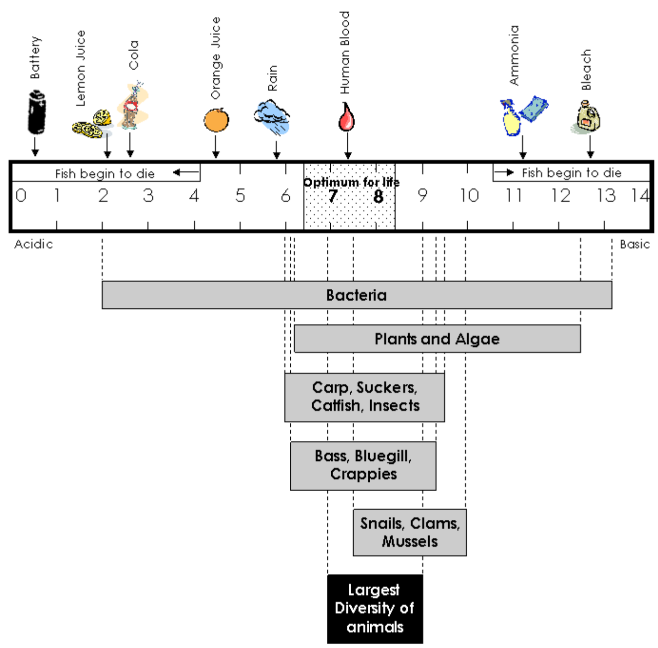


Figure 8: Optimal pH Levels for Aquatic Organisms

[40] Hartman and Burk, 48.
[41] KY Water Watch, "pH Water Quality Information" n.d., <http://www.state.ky.us/nrepc/water/wcpph.htm> (27 January 2005)
[42] Hartman and Burk, 48.
[43] Hartman and Burk, 48.
[44] Hartman and Burk, 48.

3.1.5 E.coli

One of Dearborn and Ripley County's great treasures, valued by residents and visitors alike, is its recreational waters. Maintaining the quality of these waters in view of increasing demands on surface waters and adjacent lands is essential. Of particular concern is fecal contamination of recreational waters and the associated risks to human health. *Escherichia coli* (*E. coli*) is a bacterium commonly used as an indicator of water quality for freshwaters. E. coli's natural habitat is the intestinal tract of warm-blooded animals, and although typically non-pathogenic, its presence in water indicates fecal contamination and the potential for waterborne disease.

The presence of E. coli in surface waters is often attributed to fecal contamination from agricultural and urban/residential areas. E. coli concentrations at a particular site may vary depending on the baseline bacteria level already in the stream, inputs from other sources, dilution with precipitation events, and die-off or multiplication of the organism within the stream and sediments.[45] The concentration of E. coli in surface water depends for the most part on the runoff from various sources of contamination and is thus related to the land use and hydrology of the watersheds.

Sediments may affect the survival and often act as a reservoir of E. coli in streams. Sedimentation and adsorption, which offer protection from bacteriophages and microbial toxicants, can lead to higher concentrations of E. coli in sediments than in the overlying water column[46]. As a result, the sediment often acts as a reservoir for E. coli in the stream. In addition, fecal bacteria may persist in stream sediments and contribute to concentrations in overlying waters for months after initial contamination[47].

3.1.6 Dissolved Oxygen

As with most all animals, oxygen is an essential need for aquatic organisms but it is released in a much different form. The amount of oxygen found in water is called dissolved oxygen (DO) because it dissolved readily into the water from the atmosphere until the water is saturated[48]. Likewise, aquatic plants, algae, and phytoplankton also produce oxygen as a by-product of photosynthesis.

DO is an important testing factor when monitoring a stream. If too little oxygen is present, below 3ppm, the waterbody will not be able to support many aquatic organisms such as fish and macroinvertebrates. Conversely, water may hold too much oxygen which can be harmful to organisms by causing "gas bubble disease," a condition similar to "the bends," most commonly found when deep sea divers surface too fast.[49]

Factors affecting the amount of DO present in a waterbody include:

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[45] Deb Sargent, University of Vermont School of Natural Resources, Bacterial Water Quality, February 2, 2000 http://www.uvm.edu/~envnr/sal/ecoli/pages/waterqu.htm (June 6, 2006).

[46] Burton, G. A., D. Gunnison, and G. R. Lanza. 1987. Survival of pathogenic bacteria in various freshwater sediments. Applied and Environmental Microbiology 53 (4): 633-638.

[47] Sherer, Brett M., J. Ronald Miner, James A. Moore, and John C. Buckhouse. 1992. Indicator bacterial survival in stream sediments. Journal of Environmental Quality 21: 591-595.

[48] Hartman and Burke, 42.

[49] Hartman and Burke, 42.

- Temperature – Water temperature and dissolved oxygen are directly related. Colder water can hold much more oxygen then warm water. DO concentrations at one location will most likely be higher in the winter than in summer months.

- Altitude/Atmospheric Pressure – Oxygen is more easily dissolved into water at low altitudes than at high altitudes, because of higher atmospheric pressure.

- Turbulence – In fast moving streams, where water is running quickly over rocks and boulders, the water is aerated by bubbles, introducing more oxygen. When streams are stagnant, the oxygen can only be dissolved in the top layer of the water, causing deeper water to have lower concentrations of DO.

- Plant growth - During photosynthesis, plants release oxygen into the water. During respiration, plants remove oxygen from the water. Bacteria and fungi use oxygen as they decompose dead organic matter in the stream. The type of organisms present (plant, bacteria, fungi) affect the DO concentration in a water body. If many plants are present, the water can be supersaturated with DO during the day, as photosynthesis occurs. Concentrations of oxygen can decrease significantly during the night, due to respiration. DO concentrations are usually highest in the late afternoon, because photosynthesis has been occurring all day.[50]

- Amount of decaying organic material – Organic wastes including leaves, grass clippings, dead plants and animals, animal wastes and sewage are decomposed by bacteria in the water. As the bacteria breathe, they decrease levels of oxygen in the water. As more organic material becomes available, more bacteria will grow, decreasing levels of DO in the waterbody.

3.1.7 Salinity

Salinity is the measurement of concentrated salts in water. All natural waters, including freshwater, contain dissolved salts at various concentrations. This is because dissolved salts originated primary from the chemical and physical weathering of rocks and minerals contained in the Earth's crust.[51] Rocks and minerals are dissolved by precipitation and can be transferred to lakes, rivers and oceans.

Freshwater salinity < 0.5ppt
Estuary salinity > 0.5 and < 30ppt
Ocean salinity > 30ppt

The concentration of salinity in water is important because it not only affects where aquatic animals can live, but it also can affect dissolved oxygen levels. As the salinity in water increases, dissolved oxygen decreases.[52]

[50] Sheila Murphy, City of Boulder, General Information on Dissolved Oxygen, June 15, 2002, http://bcn.boulder.co.us/basin/data/COBWQ/info/DO.html, (December 7, 2005)
[51] http://www3.csc.noaa.gov/scoysters/html/elearn/pdf/understanding/Understanding_Salinity.pdf
[52] http://www3.csc.noaa.gov/scoysters/html/elearn/pdf/understanding/Understanding_Salinity.pdf

3.1.8 Conductivity

Conductivity is the measurement of the ability of water to carry an electrical current. Negatively and positively charged ions including chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, iron, and aluminum are strong conductors in water while oils, alcohol, and sugars are not considered good conductors.[53]

Conductivity is a beneficial test to perform because it can indicate a discharge or source of pollutant in the water. Because streams have a relatively constant conductivity rate, when significant changes appear in testing, we can make the assumption that a pollutant has entered the waterbody. Discharges from failing sewage can increase the conductivity of water because it contains a chloride, phosphate and nitrate load, while oil spills can reduce conductivity since it is a poor conductor. Additionally, temperature may affect conductivity. As the temperature increases, so does conductivity.

Conductivity is affected by the geology of the area. Streams that run though granite bedrock have a lower conductivity while those that run through clay soils, such as the Hogan Creek landscape, have a higher conductivity because of the presence of materials that ionize when washed into the water.[54] Studies show that inland freshwaters, like lakes, rivers, and streams, have healthy fish diversity when conductivity ranges are between 150-500 micromhos per centimeter. Outside this range could indicate water not suitable for certain fish. Conductivity rates in national rivers range from 50-1500 micromhos per centimeter. Industrial waters can range as high as 10,000 micromhos per centimeter[55].

3.2 Biological Parameters

3.2.1 – Macroinvertebrates

Macroinvertebrates are organisms that lack a backbone and are large enough to see with a naked eye. Some of the more commonly known macroinvertebrates include stonefly nymph, mayfly nymph, caddisfly larvae, dragonfly nymph, water pennies, riffle beetles, leeches, blackfly larvae and aquatic worms.

According to Hoosier Riverwatch, biological monitoring focuses on the aquatic organisms that live in streams and rivers. Biological stream monitoring is based on the fact that different species react to pollution in different ways. Pollution-sensitive organisms such as mayflies, stoneflies, and caddisflies are more susceptible to the effects of physical or chemical changes in a stream than other organisms. These organisms act as indicators of the absence of pollutants. Pollution-tolerant organisms such as midges and worms are less susceptible to changes in physical and chemical parameters in a stream. The presence or absence of such indicator organisms is an indirect measure of pollution. When the stream becomes polluted, pollution-sensitive organisms decrease in number or disappear; pollution-tolerant organisms increase in variety and number.

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[53] U.S. EPA , "Monitoring and Assessing Water Quality – 5.9 Conductivity," 9 September 2003, http://www.epa.gov/owow/monitoring/volunteer/stream/vms59.html (1 November 2005).
[54] U.S. EPA , "Monitoring and Assessing Water Quality – 5.9 Conductivity," 9 September 2003, http://www.epa.gov/owow/monitoring/volunteer/stream/vms59.html (1 November 2005).
[55] U.S. EPA , "Monitoring and Assessing Water Quality – 5.9 Conductivity," 9 September 2003, http://www.epa.gov/owow/monitoring/volunteer/stream/vms59.html (1 November 2005).

Additional benefits of monitoring for macroinvertebrates include:

- They are easy to sample.

- They generally do not relocate. They spend a large part of their life cycle in the same part of the stream so catastrophic events occurring in that segment of the stream will have a direct effect on the organisms and can be documented.

- They are continuous indicators of environmental quality. Because they spend a majority of their time in the same place, environmentalists can see the progression or deterioration of macroinvertebrate species. These organisms give a picture of the stream over a period of time, unlike chemical tests, which only describes the condition of the water at that particular moment in time.

- They are a critical part of the food chain. The condition of the macroinvertebrate community helps to indicate the diversity if the waterbody.

ESTABLISHING BENCHMARKS –
This section identifies waterbody impairments, water quality threats and baseline data for water quality and biological community parameters.

4.1 IDEM previous watershed basin surveys

Every five years, representatives from the Indiana Department of Environmental Management (IDEM) perform water quality tests at four locations within the Hogan Creek watershed: North Hogan Creek at Cross Road, South Hogan Creek at Dillsboro Station, South Hogan Creek at County Road 50N, and Allen Branch at Castleline Road. Table 5 represents data collected in 2000 and 2005.

E. Coli counts in the Hogan Creek Watershed violated the total body contact standard of 235 colonies/100ml on a frequent and widespread basis. Violations were greatest and most frequent in Allen Branch and South Hogan Creek at County Road 50N. South Hogan Creek was in violation three of the five testing periods, while Allen Branch was in violation three of four testing periods.

Hogan Creek experiences depressions of percent saturation of dissolved oxygen during much of the testing period on Allen Branch. This may be a result of low water levels leading to warmer water temperatures during June and July. Table 5 shows testing result details.

Table 5: IDEM Testing Results, 2000 & 2005

Stream	Date	Dissolved Oxygen	Temp	% Saturation	pH	Specific Conductivity	Turbidity	E. coli
HUC 14 – 050, Dearborn County								
N Hogan Cr	5/9/2000	3.63	22.12	**43.29**	7.13	484	37	-
N Hogan Cr	5/30/2000	10.55	18.37	110	8.1	440	6.8	153
N Hogan Cr	6/5/2000	7.33	21.59	80	7.98	457	5.4	100
N Hogan Cr	6/12/2000	7.16	26.35	85	7.9	484	6.23	10
N Hogan Cr	6/19/2000	8.53	20.29	95	8	356	26.1	**450**
N Hogan Cr	6/26/2000	6.7	25.45	80	7.96	411	18.39	**260**
N Hogan Cr	8/22/2000	3.94	21.27	**46.7**	7.4	440	**59.2**	**-**
N Hogan Cr	10/3/2000	6.32	15.84	**66.5**	7.57	476	N/A	-
HUC 14 – 070, Ripley County								
S Hogan Cr	6/6/2005	7.52	25.43	90	7.89	558	10.9	-
S Hogan Cr	6/7/2005	7.4	22.82	89.3	8.03	545	11.7	99
S Hogan Cr	6/8/2005	5.66	22.08	**63**	7.84	549	10.3	-
S Hogan Cr	6/14/2005	7.17	23.32	87.2	7.92	413	**48**	**2481**
S Hogan Cr	6/21/2005	7.8	20.02	88.4	8.04	483	17.6	**291**
S Hogan Cr	6/28/2005	5.65	23.86	**68.8**	7.92	513	10.7	**770**
S Hogan Cr	7/6/2005	6.21	22.36	73.3	7.85	633	25.5	236
S Hogan Cr	7/20/2005	8.58	27.48	105	8.15	459	8.2	-
S Hogan Cr	10/5/2005	6.41	17	**67**	7.86	505	7.2	-
HUC 14 – 090, Dearborn County								
S Hogan Cr	5/8/2000	8.15	25.1	102.19	7.86	410	12	-
S Hogan Cr	5/30/2000	11.07	20.2	**120**	**8.51**	394	8.38	198
S Hogan Cr	6/5/2000	9.85	22.52	110	**8.35**	407	3.2	63
S Hogan Cr	6/12/2000	10.54	24.57	**125**	**8.43**	421	2.92	170
S Hogan Cr	6/19/2000	8.99	22.07	100	8.18	354	40.45	**1500**
S Hogan Cr	6/26/2000	12.11	25.71	**>140**	**8.46**	434	4.55	76
S Hogan Cr	8/2/2000	8.57	23.56	103.3	8.06	432		-
S Hogan Cr	9/11/2000	8.03	20.88	93.9	8.05	296	744	-
HUC 14 – 100, Dearborn County								
Allen Br	6/6/2005	5.76	23.9	**68**	7.85	557	**42.8**	**-**
Allen Br	6/7/2005	7.63	22.28	87.9	8.08	551	0	152
Allen Br	6/8/2005	7.1	21.58	80	7.91	556	33	-
Allen Br	6/14/2005	6.83	22.08	79.4	8.02	510	**138**	**1986**
Allen Br	6/21/2005	3	17.95	**33.5**	7.81	545	**55**	**249**
Allen Br	6/28/2005	3.1	23.4	**39.2**	7.79	524	35.8	**488**
Allen Br	7/6/2005	3.8	21.84	**44.1**	7.79	480	26.1	-
Allen Br	7/20/2005	5.45	25.66	**65**	7.7	507	20.9	-

4.2 303(d) list of impaired waters

The Hogan Creek Watershed is listed on the 2006 Indiana Department of Environmental Management's 303(d) Impaired Waterbodies List. The impaired waterbody is identified as South Hogan Creek and is located in the "South Hogan, Whitaker Creek – 080" subwatershed and the "South Hogan, Dillsboro Station – 090" subwatershed. The impairments cited are:

- Impaired Biotic Community: An Impaired Biotic Community (IBC) means that a waterbody's aquatic life differs from the expectation of water that was unaffected by human activity. Measuring aquatic life is an excellent way to measure overall stream health, more accurate than by chemically testing for pollutants alone. Because of this, the presence of an IBC means that the waterbody is not healthy.[56]

- E. Coli: E. coli is a bacteria found in human and animal waste. Certain strains can lead to infection (symptoms are severe diarrhea and stomach cramping) and even kidney failure and death in some cases. One source of infection is contact with contaminated water.[57]

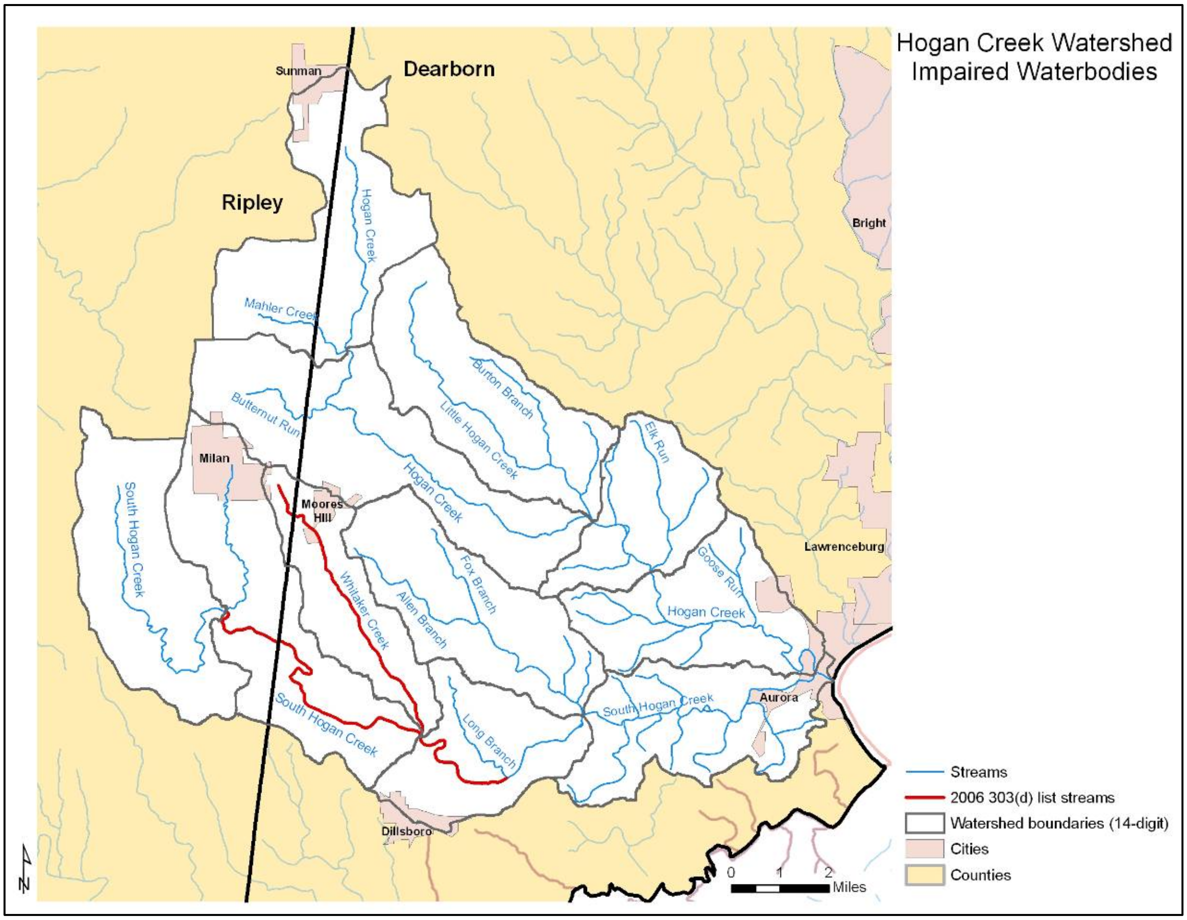

Figure 9: 303 (d) Impaired Waterbodies

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56 Indiana Department of Environmental Management Website: http://www.in.gov/idem/soe2003/data/topics/303dtbl.html

57 Indiana Department of Environmental Management Website: http://www.in.gov/idem/soe2003/data/topics/303dtbl.html

4.3 Fish Consumption Advisory

Although Hogan Creek is not listed on the Indiana State Department of Health's "Indiana Fish Consumption" Report, Hogan Creek and its tributaries still must abide by the carp advisory for all counties in Indiana. The advisory states that "women of child bearing years, nursing mothers, and children under the age of 15 should NOT eat carp over 15 inches in length. All other populations may eat one carp meal per month if the carp is between 15 and 20 inches, one meal per two months if the carp is between 20 and 25 inches and no carp if the fish is over 25 inches long." A meal is considered an 8 ounce, uncooked fish for a 150 pound person or a 2 ounce, uncooked fish for a 40 pound child.[58]

4.4 Unified Water Assessments

According to the Environmental Protection Agency's (EPA) *Surf Your Watershed* website[59], the Middle-Ohio Laughery watershed (MOLW) is listed as having serious problems in the following Condition Indicators (indicators designed to show existing watershed health):

I. Designated Use Attainment – States adopt water quality standards that include designated uses and criteria to protect those uses including: drinking water supplies, aquatic life use support, fish and shellfish consumption, primary and secondary contact recreation and agriculture.

II. Fish and Wildlife Consumption Advisories – Recommendations by the state to restrict consumption of locally harvested fish or game due to the presence of contaminants.

III. Ambient Water Quality Data: Four Conventional Pollutants – Ambient water quality data showing an accession of national criteria levels, over a six year period of Ammonia, Dissolved Oxygen, Phosphorus and pH.

IV. Wetland Loss Index – Percentage losses of wetlands over a historic period and more recently.

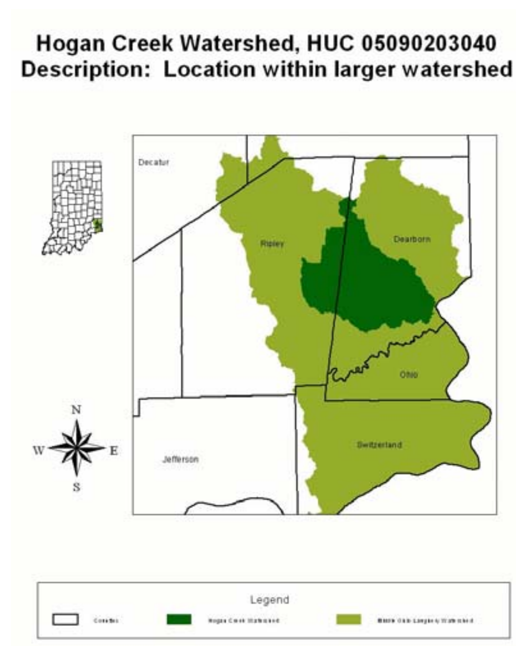

Figure 10: Hogan Creek Within Middle Ohio Laughery Watershed

The EPA also listed the MOLW as "High Vulnerability" in the following Vulnerability Indicators (indicators designed to indicate where pollution discharges and other activities put pressure on the watershed).

I. Urban Runoff Potential – Potential for urban runoff impacts based on percentage of impervious surface in the watershed.

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[58] Indiana State Department of Health Website: http://www.in.gov/isdh/dataandstats/fish/2004/carp-advisory.htm
[59] EPA Surf Your Watershed Website

II. Index of Agriculture Runoff – Composite index comprised of nitrogen runoff potential, modeled sediment delivery to rivers, and pesticide runoff potential.

III. Air Deposition – Information from the National Atmospheric Deposition Program/National Trends Network depicting nitrogen deposition estimates.

Although the Hogan Creek watershed is a component of the MOLW, these indicators may not illustrate the condition of the Hogan Creek watershed. For a more accurate depiction of the current water quality, please refer to *Sections 3.5 Hogan Creek Watershed Project Diagnostic Study, 3.6 United States Geological Survey Study,* and *3.7 Other Water Quality Studies and Results.*

4.5 Hogan Creek Watershed Project Diagnostic Study
In December of 2005, the Hogan Creek Watershed Project hired Gordon and Associates, a water testing consulting firm located in Bentonville Indiana, to perform a one year water quality study on Hogan Creek and its tributaries (see appendix A for testing locations). Testing was done on a monthly basis on one waterbody located within each of the eleven subwatersheds (see appendix B for complete water quality data). Testing parameters included:

- Phosphorus
- Nitrogen
- Suspended solids
- pH
- Temperature
- Dissolved Oxygen
- Turbidity
- Salinity
- Conductivity
- E. Coli
- Flow rate
- Macroinvertebrates

Per the Indiana Administrative Code (327 IAC2), the following water quality standards exists for most of the state's rivers and streams:

Table 6: Water Quality Standards

Parameter	Target Concentration
TSS*	< 80 mg/L
N**	< 10 mg/L
P*	< 0.3 mg/L
E. Coli***	< 235 cfu/ml

* Recommended guidelines
** State standard for nitrate nitrogen in drinking water
*** State standard for E. Coli (single sample)

4.5.1 Phosphorus
Phosphorus met the state requirement of less than 0.3 mg/l on 131 of the 132 tests. Likewise, phosphorus levels were below detection levels 64% of the sampling period. Site 9 had one test result of 0.33mg/l, violating the recommended standard by 0.03 mg/l. This concentration was recorded in November of 2006 may be the result of nutrient runoff from nearby agricultural land.

4.5.2 Nitrogen

Nitrogen met the state standards of <10mg/l on 131 of the 132 tests. Site 6 had one test result of 14.99mg/l, 4.99mg/l over the recommended standard. This concentration was recorded in November of 2006 and may be the result of nutrient runoff from nearby agricultural land.

4.5.3 Total Suspended Solids

Total suspended solids met the target value 97 percent of the sampling period. On four occasions the concentration went over the 80mg/l target concentration. Site 11 had high readings in January 2006 and May 2, 2006. Sites 4 and 5 also had high readings on May 2, 2006. This may be the result of runoff from a rainstorm that produced 1.36 inches of rain which occurred on May 1, 2006.

4.5.4 E. coli

E.coli concentrations met state standards only 16% of the time. Highest concentrations were taken in January, May and July of 2006. High concentrations correlated with rainfall events which can indicate both the failing of septic systems and runoff from agricultural land. The committee will be investigating the source of E.coli further with genetic E.coli testing. This testing will be able to break out the percentage of human waste and percentage of animal waste in a given sample. Determining whether the E.coli loading is coming from failing septic systems or livestock runoff is a high priority of the committee.

4.6 Other water quality studies and results

The Dearborn SWCD staff began testing Hogan Creek in 1997. From the initial start in 1997 to 1999, trained staff found the following data:

- Nitrate counts averaging 8.5ppm with the highest reading of 13.2ppm at the main stem of North Hogan Creek (it is suggested in the Hoosier Riverwatch Manual that unpolluted waters have nitrate levels below 4ppm. Higher levels of nitrates can contribute to increased plant growth and eutrophication).

- Supersaturation of dissolved oxygen was discovered 89% of the sampling time. Supersaturation is often caused by high levels of photosynthesis in streams overloaded with aquatic plants and algae.

- Biological testing showed a decrease of rating from ‘good’ in 1997 to ‘poor’ in 1999.

- E.coli testings were considered ‘high’ 68% of the sampling time. These readings could be caused by livestock in the streams or septic system failures.

4.7 Windshield Surveys

Members of the Hogan Creek Technical Committee performed a windshield survey in spring of 2006 to obtain visual assessments of the watershed land and stream health. The windshield survey was taken specifically to obtain more information about livestock access to the creek and pasture conditions. Below is a brief summary of the survey.

4.7.1 North Hogan Creek Watershed

- Twenty eight documentations of farms with livestock. On three of these farms, livestock has direct access to a tributary of Hogan Creek.
- Thirteen pastures were documented as overgrazed.

4.7.2 South Hogan Creek Watershed

- Twenty seven documentations of farms with livestock. On seven of these farms, livestock has direct access to a tributary of Hogan Creek. In one instance, three horses are fenced *into* the creek.
- Seventeen pastures were documented as overgrazed.

IDENTIFYING PROBLEMS, CAUSES, AND STRESSORS –
This section identifies the thought process of the groups known or probable causes of water quality impairments and threats.

5.1 Identifying Local Concerns
During the March 9, 2005 Hogan Creek Steering Committee Meeting, members of the committee discussed local concerns, perceived and real, within the watershed. From that meeting, the following list was developed (numbers correspond to list below):

a. Erosion of cropland (4)
b. Lack of Conservation Practices (4,7)
c. Dumping on road and streambank (2)
d. Failed sewage and septic systems (3)
e. Landslides
f. Decreasing wildlife diversity (6)
g. Wildlife habitat preservation (6)
h. Urbanization (development) (5)
i. Overgrazing (7)
j. Livestock Access to Creek (1,7)
k. Erosion by boat wakes (8)
l. Alternative Agriculture
m. Lack of recreation (9)
n. Sedimentation (4,8,10)
o. Streambank erosion (7,8)
p. Water Quality/303d List (1)
q. Lack of green space (5,9)
r. Lack of forestland (10)

The committee then combined similar items and after an extended period of discussion, the group prioritized their top ten concerns as followed (word in italics corresponds to stressor listed in Table 7):

1. Water Quality/303d List *(E.coli)*
2. Dumping *(Garbage)*
3. Failed septic systems *(E.coli)*
4. Erosion of cropland (*Sediment/Nutrients)*
5. Urbanization *(Sediment./Nutrients /Chemicals/E.coli/Temp./Flow)*
6. Decreasing wildlife & fish diversity (*habitat*)
7. Livestock management *(E.coli/Sediment)*
8. Streambank erosion (*Sediment*)
9. Lack of recreational areas (*Recreation*)
10. Lack of forestland (*Sediment/habitat)*

5.2 Identifying Stressors and Developing Problem Statements
The United States Environmental Protection Agency defines an aquatic stressor as "*any physical, chemical, or biological entity or phenomenon that can induce an adverse effect [on aquatic systems] either directly or as one step in a chain of causation.*"

In order to make the planning process run smoothly, the group categorized their concerns by potential stressor. Table 7 depicts the stressors, causes, problem areas and problem statements developed by the group.

Table 7: Stressors, Causes, and Problems

Stressor	Cause	Problem Area	Problem Statement
Sedimentation and Excess Nutrients	Improper stormwater pollution prevention (5)	Urbanization	Contractors using inadequate erosion control practices on construction sites can lead to excess soil loss entering nearby waterbodies. Sedimentation can lead to increased turbidity which can increase water temperature through heat absorbed particles, thus lowering dissolved oxygen. Sediment may also kill aquatic life by clogging gills or smothering habitats.
	Lack of riparian buffers (4, 10)	Agriculture	Livestock with uncontrolled access to waterbodies and the lack of protective riparian groundcover may increase sediment in local waterbodies
	Trampling of banks from livestock (8)		
	Lack of conservation tillage (4)	Agriculture	Farmlands not using a high residue cropping system may cause an increase of sedimentation in local waterbodies from storm runoff.
	Boat wakes and other recreational vehicles (8)	Recreation	Inappropriate use of boats and/or recreational vehicles can lead to unstable streambanks, resulting in increased sedimentation.
	Improper Nutrient Management (4)	Agriculture ~~and Urbanization~~	Improper nutrient management on farmland and ~~suburban lawns~~ can lead to nutrient overload in nearby waterbodies which can lead to increased algal blooms, thus decreasing dissolved oxygen.
Hazardous Chemicals (ie – oil, gas, pesticides, herbicides)	Increased Impervious Areas (5)	Urbanization	Hazardous chemical runoff from parking lots, roads, ~~industrial buildings and suburban lawns~~ entering local waterbodies increases pollutants harmful to aquatic and human life.
	~~Malfunctioned Industrial Areas~~		
	~~Suburban Lawns~~		
	Landfills	Urbanization	Leaching of heavy metals and toxins from landfills may lead to the contamination of soil, groundwater, and surface water.
	Improper application of herbicides and pesticides (1,4)	Agriculture	Improper application of agricultural chemicals may enter waterbodies through runoff and lead to endocrine disruption.
	Inadequate boating maintenance (1)	Recreation	Inadequate boating maintenance can lead to a discharge of oil, gas or other harmful chemicals into waterbodies.

E. Coli	Combined Sewer Overflows (1)	Urbanization	An increase in population will lead to more wastewater, which could result in more sewer overflows during rain events.
	Failing septic systems (1,3)	Urbanization and Agriculture	Ripley and Dearborn County soils are not conducive to septic systems, causing systems to fail and pathogens from human waste to enter waterbodies cause digestive and other health problems in humans.
			Improper maintenance of septic systems leads to failure causing pathogens to enter nearby waterbodies and leading to health problems in humans.
	Livestock access to creek (1,7)	Agriculture	Livestock with uncontrolled access to waterbodies may lead to an increase in pathogens from animal waste which can result in digestive and other health problems for humans.
	~~Incorrect boat pump out~~	~~Recreation~~	~~Incorrect boat pump out procedures can lead to untreated sewage entering local waterbodies causing health risks for humans and aquatic life.~~
Elevated Temperature	Increased Impervious Areas (5)	Urbanization	Runoff from impervious areas ~~and discharge from industrial buildings~~ may cause an increase of temperature, lowering dissolved oxygen levels in nearby waterbodies
	~~Malfunctioned Industrial Areas~~		
	Lack of Riparian Buffers	Agriculture	The lack of protective riparian canopy from tree cover may increase water temperature in local streams
Increased Flow Rate	Increased Impervious Areas (5)	Urbanization	An increase of impervious areas reduces groundwater recharge, which increases flow rate, causing streams to flood more frequently and banks to erode quicker.
Garbage	Improper disposal (1,2)	Recreation	Improper disposal of garbage in parks, marinas, and other areas causes unsightly views and health risks for humans and aquatic life.
Limited recreation and wildlife habitat	Increase in development (6,9)	Urbanization	An increase in development leads to a decrease in wildlife habitat
	Limited access to water (9)	Recreation	Limited access to local waterbodies keeps community members from enjoying the many recreational benefits Hogan Creek and its tributaries offer.

Words that are red with strikethrough were researched by the committee and found not to be a significant problem within the Hogan Creek watershed.

IDENTIFYING SOURCES –
This section identifies the sources of the stressors and threats.

6.1 Sedimentation

6.1.1 Improper Storm Water Pollution Prevention

While construction projects provide jobs, homes, recreation, education and safer roads, they can also have a significant negative impact on water quality if not properly managed. As storm water flows over a construction site, it picks up pollutants like sediment, debris and chemicals. As this polluted storm water runs into a nearby waterbody, it can harm or kill fish and other wildlife.

These environmental effects have led to the formation of "Rule 5" by the USEPA. The stormwater program requires operators of constructions sites with one acre or larger (including smaller sites that are part of a larger common plan of development) to obtain authorization to discharge storm water under an NPDES construction storm water permit. In Indiana, the NPDES program is implemented by IDEM, with the help of the IDNR and the local Soil & Water Conservation Districts. This permit requires the developer to write a Storm Water Pollution Prevention Plan (SWPPP) and then implement the plan in the field. This plan is designed to keep all forms of pollutants that come from construction to remain on the construction site. It also requires that there be structures in place to collect pollution on site after the construction site is finished and in operation.

The Hogan Creek watershed currently has 24 active construction sites totaling 1071 acres with 305 disturbed acres. Jennifer Hughes, Dearborn County Stormwater Coordinator, estimates that approximately 60 percent of the developers are not readily following erosion control plans until a written warning is provided. From the time the construction has started to the time the written warning is provided, runoff from the construction site is possible during heavy rain periods, causing increased sedimentation in nearby waterbodies. See Table 8 for a detailed report of sites within the watershed.

Table 8: Watershed Construction Projects

Project Name	Total Acres	Disturbed Acres	Receiving Waters
Crossbow Trails	18	11	-
Dearborn Heights Subdivision	81	9	Allen Branch & Block Hollow
Eden Gardens	32	10	South Hogan Creek
First Baptist Church of Aurora	12	4	Hogan Creek
Hill Springs Acres	8	3	-
Hogan Heights	74	-	North Hogan to Little Hogan
Indian Ridge Estates	62	25	Hogan Creek
Aurora to Lawrenceburg Trail	22	7	Hogan Creek
Long Branch Ridge Subdivision	99	8	Long Branch Creek
Miller Farm Subdivision	48	25	South Hogan Creek
Oak Hill	25	6	Whitaker Creek
Pleasant Run Subdivision	28	5	Allen Branch Creek
Somerset Subdivision	28	6	Allen Branch Creek
South Dearborn School	125	42	North Hogan Creek
Three Mile Ridge	10	9	-
Trailside Meadows PI & PII	59	21	North Hogan Creek

Willmington Hills	5	5	-
Westmiller Addition	17	11	North Hogan Creek
Chapmans Subdivision	7	2	Hogan Creek Tributary
McKittrick/Roberts Subdivision	66	12	South Hogan Creek
Lakeside Estates and Golf Course	210	70	Milan Lake
Old Milan Subdivision	14	4	North Hogan Creek
Milan Wastewater Treatment Plt.	2	2	Hogan Creek
Winner's Circle Subdivision	19	8	North Hogan Creek
TOTAL	**1071**	**305**	

6.1.2 Lack of Riparian Buffers

Riparian buffers are defined as strips of grass, shrubs, and/or trees along the banks of river and streams which filter polluted runoff and provide a transition zone between water and human land use. They provide several benefits to water quality such as preserving a streams natural characteristic, improving wildlife and aquatic habitat, cooling water temperature and catching and filtering sediment, nutrients, and debris. According to the Connecticut River Joint Commission, depending on the width, fifty to one hundred percent of sediments and nutrients will attach to filter strips, preventing them from entering waterbodies.[60]

After researching the location of riparian buffers within the watershed through aerial photos and windshield surveys, it was determined that of the 113 miles of streams: 72 miles, or about 64 percent, are sufficiently buffered; 25 miles, or about 22 percent, are moderately buffered; and 16 miles, or about 14 percent, are poorly buffered.

The "South Hogan – Cochran" subwatershed 110 and the "North Hogan – Wilmington" subwatershed 050 have the highest percentage of poorly buffered streams within the watershed, while the "Butternut Run" subwatershed 020, "Little Hogan" subwatershed 030, "South Hogan – Dillsboro Station" subwatershed 090, and "Allen Branch" subwatershed 100 have over eighty percent of well buffered streams. See Table 9 for a breakdown of each subwatershed.

Table 9: Riparian Buffers in Watershed

Subwatershed	Good	Percent	Moderate	Percent	Poor	Percent	Total
010	4.6	64	2.4	33	0.2	3	7.2
020	11.6	88	1.2	9	0.5	3	13.3
030	9.2	83	1.2	11	0.7	6	11.1
040	4.0	64	1.4	22	0.9	14	6.3
050	1.5	16	4.0	44	3.6	40	9.1
060	5.6	71	1.8	23	0.5	7	7.9
070	8.6	78	2.2	20	0.3	2	11.1
080	8.3	75	1.5	14	1.3	11	11.1
090	10.6	86	1.0	8	0.7	6	12.3
100	7.8	84	0.8	8	0.7	8	9.3
110	0.3	2	7.8	54	6.3	44	14.4
TOTAL	**72.1**		**25.3**		**15.7**		**113.1**

*Buffers are measured in miles.

[60] Connecticut River Joint Commission, "Riparian Buffers." N.d., http://www.crjc.org/riparianbuffers.htm (29 June 2005).

6.1.3 Livestock Access to Stream

Direct access of livestock to streams can be a problem if the streambank is not well vegetated. Not only do cattle and hogs cause problems by "direct depositing" manure into the water, they can also overgraze and trample streambanks, leading to erosion problems. Trampled banks damage fish habitat, destroying overhangs used for shelter and compacting stream bottoms that are used for spawning and feeding.

Heavy Grazing removes vegetation that covers the soil. Vegetation protects the soil from the erosive energy of raindrops and acts as a sediment trap. Likewise, vegetation increases the infiltration rate, getting water into the ground where it can replenish aquifers rather than running off, leading to the erosion of land. Sediment is detached in the uplands by surface runoff and may eventually find its way to a stream, or it may settle out in a new location and be stabilized by vegetation. Sediment is also detached from streambanks by the erosive force of flowing water or the collapse of unstable banks.

Hoof impacts can destroy streambank vegetative cover and physically breakdown streambanks. These impacts occur when livestock concentrate repeatedly or in large numbers in a small area for water, shade, or other streamside attractions. Unstable streambanks may slough off into the stream channel. In addition to adding sediment to the waterbody, this may lead to channel widening or down cutting. Channel widening and down cutting can result in shallower and warmer streams degrading aquatic habitat and destroying important streamside wildlife habitat.

While the exact number and location of livestock with access to the creek is unknown and continually changing, visual observations noted livestock with access to a tributary 19% of the time and overgrazed fields 52% of the time.

Table 10: Livestock Access to the Stream

Hydrologic Unit Number	# of farms with livestock sited	# of farms with livestock access to tributary	# of farms with overgrazed pastures
020	3	0	1
030	6	1	3
040	10	1	6
050	8	1	3
080	5	2	4
090	11	3	6
100	11	1	5
110	4	2	2
TOTAL	**58**	**11**	**30**

6.1.4 Lack of Conservation Tillage

The rolling topography of Southeastern Indiana and the thin fragile layer of top soil covering most crop fields, make conservation tillage an important part of a successful cropping system.

Typically a conservation tillage system is defined as any system that leaves at least 30% residue on the surface after planting. This can be somewhat misleading, if slope or length of slope is too high, 30% residue will not be sufficient to prevent soil erosion from occurring. To be certain a residue level is adequate for erosion control, a Soil Conservationist will complete a computation using the Revised Universal Soil Loss Equation. Another important factor for residue to be effective in erosion control is that it needs to be evenly distributed over the surface and not left in piles.

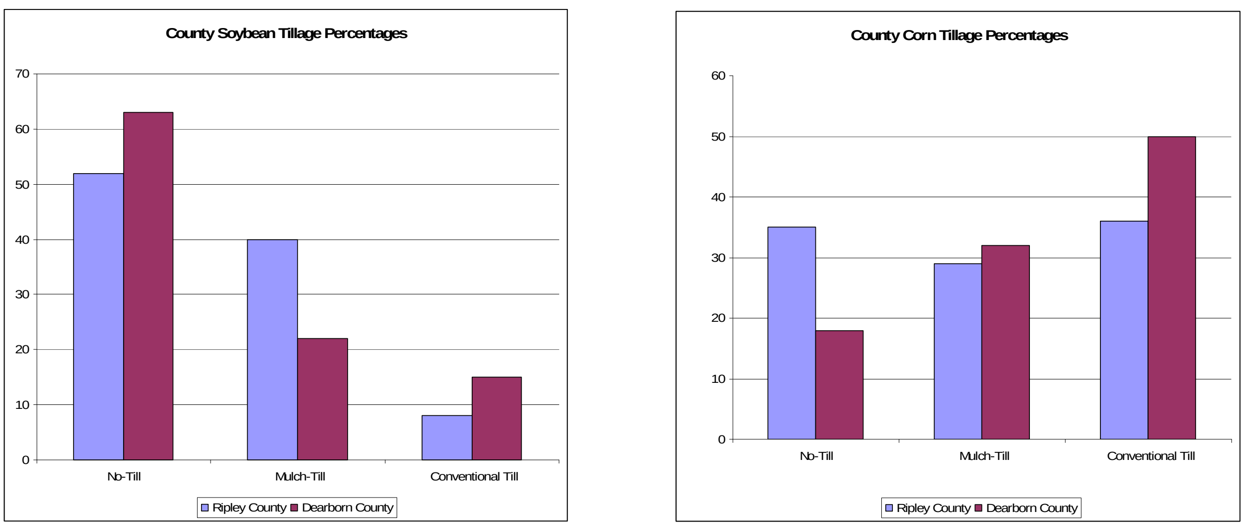
Once an adequate residue level is reached the benefits of conservation tillage are numerous. The most obvious advantage is reducing the splash and runoff effect since residue serves to protect the soil particle from detachment and reduces the velocity and volume of runoff from the field.

Residue also minimizes surface sealing of the soil and allows more water to soak into the profile. This is particularly important during periods of drought since a reservoir of water has been stored in the soil that is available for plant use. In systems that disturb a minimum amount of residue, such as no-till, earthworm populations increase significantly.

There are approximately 17,337 acres of row crop within the Hogan Creek watershed. Of those 17,337 acres, approximately 7,271 acres are planted in corn and 10,066 acres are planted in soybeans.

According to the IDNR 2004 Tillage Transect data, Ripley County has a much higher percentage of conservation tillage than that of Dearborn County. Figure one compares the percentage of conservation tillage in each of the counties.

Figure 11: County Tillage Comparison



When looking at the watershed as a whole, it is estimated that 27 percent of the corn planted within the watershed is no-till, 30 percent is mulch-till, and the remaining 43 percent is conventional tillage. Likewise, soybeans are estimated to have a 57 percent no-till rating, 32 percent mulch-till rating, and 11 percent conventional tillage rating.

Because conservation tillage efforts are being made with soybeans, the watershed group will focus conservation efforts with landowners planting corn.

6.1.5 Boat Wakes

Shoreline erosion can have several consequences on our environment including habitat destruction, increase in sedimentation, increase in turbidity, release of nutrients, and loss of land. One such way that can contribute to shoreline erosion is by wakes produced by boats.

There are many factors that contribute to boat wakes. The most significant factor is the size of the channel. Wakes that occur in larger channels have relatively little impact on our banks, as they make up only about 2-5% of annual energy dissipated against banks. The opposite is true for smaller streams where wakes account for 95-98% of the energy.[61]

Speed of the water craft is also a significant factor in boating wakes. Waves that have an estimated height of 12.5 cm do not typically cause damage to the banks. These wakes are generally created by boats operating at speeds less than 10km/hr. A wave that is 25 cm high is five times more destructive than a 12.5 cm wave; 62.5 cm high wavers are thirty times more destructive.[62]

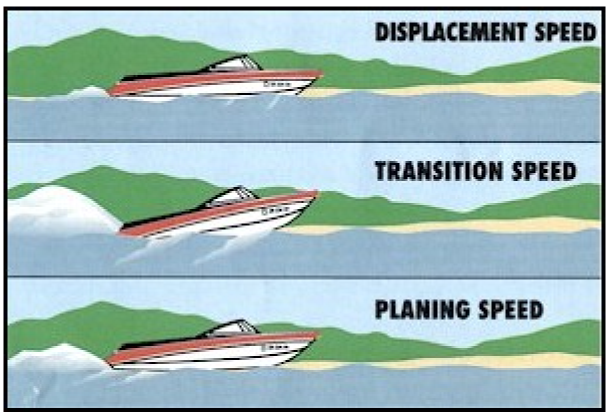


Figure 12: Watercraft Speed

When a water craft is moving at its displacement speed (slowest speed) boating wakes are at their lowest. As the boat moves to its transition speed (the power while attempting to get on plane) the bow rises, causing the stern to plow through the water. This speed creates the largest wake. During the planing speed, the bow drops back down and only a little of the hull contacts the water. This speed creates fewer wakes than the transition speed, but more than the displacement speed. Small motorboats typically product waves that are 25 cm high when at planing speeding. Yachts and other larger boats that do not plane can generate waves that can easily reach heights of 62.5 cm or more.[63]

Other factors that contribute to shoreline erosion include: boat's size, passenger load, shape of its hull, distance from shore, and water depth.

Several boating events are held throughout the year at the Tanners Creek boat ramp (see Table 3 for 2006 events). Connie Cleary, Events Coordinator for the Dearborn County Visitor Center, estimates that 100 boats are entered in each of these tournaments, making the total number of boats in one year over 2,200.

While Tanners Creek and the Ohio River are heavily utilized at these events, anglers also venture out to nearby Hogan Creek. Assuming that 90% of anglers at these tournaments use Hogan Creek, it is estimated that 1,980 boats are traveling on Hogan Creek throughout the year. Additionally, Hogan Creek is used during the weekdays and weekends throughout the year. If we can assume there is an average of 5 boats on Hogan Creek everyday throughout the year, not

[61] "Shoreline Erosion Caused by Boat Wake" n.d. no author, July 25, 2005, www.marinfo.gc.ca/Doc/Erosion/Erosion_des_berges_En.pdf
[62] "Shoreline Erosion Caused by Boat Wake" n.d. no author, July 25, 2005, www.marinfo.gc.ca/Doc/Erosion/Erosion_des_berges_En.pdf
[63] "Watching your Wake – A Boater's Guide" Oregon State Marine Board, n.d. 7/25/05, www.boatwashington.org/watching_your_wake.htm

including tournament play, there are an additional 1,825 boats on Hogan Creek, making the total annual traffic along Hogan Creek over 3,800 boats.

William Erickson, Hogan Creek Watershed Committee Member, performed a windshield survey of Hogan Creek during bass tournament events and everyday use. His findings suggest tournament boats are not a significant source of streambank erosion because a majority of boats entered in the tournament obey the "No Wake" zones. Erickson found the general public not entered in weekly tournaments was a bigger problem, failing to obey the "no wake" signage.

Hazardous Chemicals

6.2.1 Increase in Impervious Areas

Impervious surface consists of two major factors, the rooftops under which we live, work, and shop, and the transportation system connecting the rooftops such as roadways and parking lots. In most cases impervious area related to the transportation system exceeds those related to the rooftops (house, building, etc.)[64]. Hazardous chemical runoff from impervious areas can greatly affect watershed ecosystems. While precipitation may get infiltrated in the ground in forested areas, those applied or discharged on impervious areas are unable to percolate through the soil, naturally filtering itself. Each time it rains, pollutants such as used automotive oil, gasoline or improperly applied yard chemicals are transported by storm water directly to nearby storm drains. The storm drainage system, which is composed of the open drainage grates along the roadside, carries untreated storm water runoff from roofs, roads, sidewalks and parking lots directly to the nearest waterbody.

While hazardous chemical runoff within the watershed has not been greatly observed, the committee still feels this issue needs to be addressed because of the potential development in the future.

Using data from IDEM, the following table was constructed to determine the subwatersheds that have the most acreage of impervious area. Studies have shown that even relatively low impervious surface ratio (10-15%) in the classification of watershed based on impervious surface ratio could work unfavorably to the quality of a river and cause change in the ecosystem. Once impervious surface ratio exceeds 25%, a river would become ecologically unsustainable in the aspects of stability, water quality, or biological diversity. [65]

Table 11: Urban Acreage per Subwatershed

Subwatershed	High Density Urban (acres)	Low Density Urban (acres)	Impervious Area (acres)	Total (acres)
010	17	84	49	160
020	2	29	20	71
030	0	66	4	100
040	0	8	0	48
050	0	143	9	202
060	30	75	53	158

[64] The Development of Imperviousness Index for Effective Watershed Management, http://eng.kei.re.kr/04_pub/sum_report_main.asp?PRJ_NO=03_RE11&lan=

[65] The Development of Imperviousness Index for Effective Watershed Management, http://eng.kei.re.kr/04_pub/sum_report_main.asp?PRJ_NO=03_RE11&lan=

070	20	250	12	282
080	7	82	35	124
090	0	20	14	34
100	0	41	25	66
110	60	48	16	124
			Total	**1,369**

6.2.2 Industrial Areas

After researching the National Pollution Discharge Elimination System (NPDES) permits, none of the permits had violations for hazardous chemicals. While the committee initially included “industrial areas” as a source of hazardous chemical contamination, after further investigation, the committee concluded that because industrial discharge is regulated under the Indiana Department of Environmental Management and there were currently no violations for hazardous chemicals, no action by the Hogan Creek Watershed Committee is needed.

6.2.3Agricultural Land

Pesticides are used to stop or limit any undesirable organism (insect, animal or weed) from damaging crops and products we use everyday. Many of the pesticides we use make our lives easier, like the pesticides in wood furniture, which stop the pests from creating holes in these objects. Furthermore, when used agriculturally, pesticides allow us to increase our harvest and feed more people[66].

In an ideal world, the pesticides would remain in the environment long enough to control the pests and then breakdown into harmless compounds. Unfortunately, in practice, pesticides are often transported into water supplies before they have enough time to breakdown. Because these pesticides are reaching our water supplies, it’s important for us to understand just how much is contaminating our water sources.

To get an idea of how much pesticide could be entering Hogan Creek and its many tributaries, a rough estimation was calculated using the Purdue Extension’s Guide for Watershed Partnerships.[67] Using the data given in the Middle Ohio-Laughery Watershed Restoration Action Strategy, the following table was set up to estimate the pesticides applied within the watershed.

[66] Duke University, Department of Chemistry website: www.chem.duke.edu/~jds/cruise_chem/pest/pestintro.html
[67] Alyson Faulkenburg and Jane Frankenberger. Watershed Inventory Tool for Indiana: A Guide for Watershed Partnerships. Department of Agricultural and Biological Engineering, Purdue University

Table 12: Estimated Pesticides Applied in Watershed

Crop	Acres		Pesticide Type	Fraction of acres treated in state		Average rate of application (lbs/acre)		Estimated amt. of pesticides applied (lbs)
Corn	7,271	X	Atrazine	0.89	X	1.36	=	8,801
			Metolachlor	0.42		2.04		6,230
			Acetochlor	0.32		1.97		4,584
			Primisulfuron	0.14		0.03		31
			Cyanazine	0.13		1.43		1,352
Soybeans	10,066		Glyphosate	0.55		0.85		4,706
			Chlorimuron-ethyl	0.27		0.02		54
			2,4-D	0.26		0.39		1,021
			Imazethapyr	0.25		0.04		101
			Paraquat	0.19		0.89		1,702

6.2.4 Boating Maintenance

Whether for water sports, fishing, or a pleasant ride on a sunny summer day, boating is a large part of recreational water activities. However, boats can have some negative impacts on the aquatic environment if care is not taken. Recreational boaters use a variety of cleaners, finishes, and antifouling compounds when taking care of their boats and are often responsible for discharging petroleum products into our waterways when filling up.

According to United States Environmental Protection Agency, individual boats and marinas usually release only small amounts of pollutants. Yet, when multiplied by thousands of boaters and marinas, they can cause distinct water quality problems in lakes, rivers, and streams. The U.S. Environmental Protection Agency has identified the following potential environmental impacts from boating and marinas: high toxicity in the water; increased pollutant concentrations in aquatic organisms and sediments; increased erosion rates; increased nutrients, leading to an increase in algae and a decrease in oxygen (eutrophication); and high levels of pathogens.[68] In addition, construction at marinas can lead to the physical destruction of sensitive ecosystems and bottom-dwelling aquatic communities.

While there is only one active marina on Hogan Creek, spills from refueling and chemicals from cleaning are still a concern for the group.

6.3 E. coli

6.3.1 Combined Sewer Overflows

In Aurora, like many older cities, sewer pipes carry both wastewater (used water and sewage that goes down the drain in homes and businesses) and stormwater (rain or snow that washes off streets and parking lots) to a sewage treatment plant. In many parts of Aurora, the mixed wastewater and stormwater flow together in a single pipe. This is called a Combined Sewer System.

The Combined Sewer System was built as Aurora grew during the early 1900s, as an economical

[68] "Managing Nonpoint Source Pollution from Boating and Marinas" n.d. no author, September 27, 2006, http://www.epa.gov/OWOW/NPS/facts/point9.htm

way to handle wastewater and stormwater.   One advantage of this system was that most of the time when rainfall is low to moderate, both the stormwater and wastewater go to the treatment plant before being discharged to the Ohio River. However, if significant wet weather occurs, so does a problem. During significant wet weather conditions, the sewer system overflows, sending both wastewater and stormwater into the Ohio River.   When this happens, it's called a Combined Sewer Overflow (CSO).

The City of Aurora has installed Combined Sewer Overflow signs to warn people of the dangers of swimming or fishing in water that might be polluted because of a sewer pipe overflowing in the area during and after heavy rain. Bacteria and chemicals from CSOs can increase the risk of getting sick from swallowing the water or eating the fish. Public Health recommends that people not go in the water near these signs for 48 hours after a heavy rain.

Animals are usually not affected, but if your pet does go in the water during an overflow, be sure to give it a good bath as soon as possible. If your pet is very young or old, it could be at higher risk. If your animal develops diarrhea, you should withhold food, and consult your veterinarian about what to do next.

6.3.2 Failing Septic Systems

A septic system is a natural method of treatment and disposal of household wastes for those homeowners who are not part of a municipal sewage system. A septic system works by allowing waste water to separate into layers and begin the process of decomposition while being contained within the septic tank. Bacteria, which are naturally present in all septic systems, begin to digest the solids that have settled to the bottom of the tank, transforming up to 50 percent of these solids into liquids and gases[69]. When liquids within the tank rise to the level of the outflow pipe, they enter the drainage system. This outflow, or effluent, is then distributed throughout the drain field through a series of subsurface pipes. Final treatment of the effluent occurs here as the soil absorbs and filters the liquid and microbes break down the rest of the waste into harmless material.

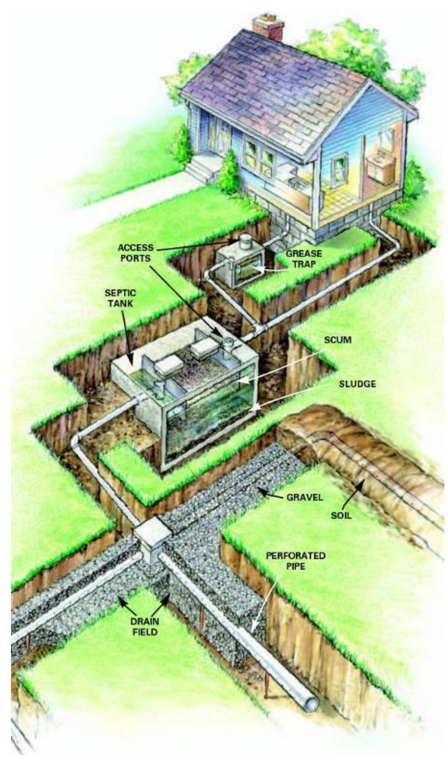


Figure 13: Septic System Illustration

Septic systems cannot dispose of all the material that enters the system. Solids that are not broken down by bacteria begin to accumulate in the septic tank and eventually need to be removed. The most common reason for system failure is not having these solids removed on a regular basis[70]. When the holding tank is not pumped out frequently enough, the solids can enter the pipes leading to and from the tank. This can cause sewage to back up into the house or cause the drainage system to fail as the pipes and soil become congested. These problems are often costly to fix, pose a danger to public

[69] “Septic System Maintanence” October 1996. Virginia Cooperative Extension, October 26, 2006, http://www.ext.vt.edu/pubs/housing/448-400/448-400.html#L1

[70] “Septic System Maintanence” October 1996. Virginia Cooperative Extension, October 26, 2006, http://www.ext.vt.edu/pubs/housing/448-400/448-400.html#L1

health, and are a significant source of water pollution. Seepage from inadequate or failing septic systems can contaminate both ground and surface waters.

In addition to proper maintenance, there are two very important considerations when installing a septic system: proper soil type and adequate separation distance from water tables and/or impermeable soil. According to John Grace, Dearborn County Health Department Inspector, the best soils for a leach field are those that are deep, well-drained, and strong to moderate structured soils such as silt loam or loam soil types. The Dearborn County and Ripley County Soil Surveys indicate that each of the soil associations found in the Hogan Creek watershed are not suitable for septic tank absorption fields. Placing septic systems in soils unsuitable for leach fields have a high chance of malfunctioning, leading to the contamination of both land and water.

Table 13: Hogan Creek Watershed Soil Ratings for Septic Systems

Soil Type	County	Rating	Reason
Avonburg	Dearborn/Ripley	Severe	Wetness, percolates slowly
Bonnell	Dearborn	Severe	Percolates slowly
Carmel	Dearborn/Ripley	Severe	Percolates slowly
Chagrin	Dearborn	Severe	Floods
Cincinnati	Dearborn	Severe	Percolates slowly
Clermont	Dearborn	Severe	Wetness, percolates slowly
Cobbsfork	Ripley	Severe	Ponding, percolates slowly
Eden	Dearborn/Ripley	Severe	Slope, percolates slowly, depth to rock
Hickory	Ripley	Moderate – Severe	Percolates slowly, slope
Huntington	Dearborn	Severe	Floods
Jules	Dearborn	Severe	Floods
Markland	Dearborn	Severe	Wetness, percolates slowly, slope
Ockley	Dearborn	Moderate	-
Rossmoyne	Dearborn/Ripley	Severe	Wetness, percolates slowly
Stonelick	Dearborn	Severe	Floods
Switzerland	Ripley	Severe	Percolates slowly

There are approximately 800,000 septic systems in Indiana, and the Indiana State Department of Health (ISDH) estimates that approximately 200,000 of these residential wastewater disposal systems are inadequate and have failed or are failing to protect human and environmental health[71]. The most commonly reported cause of septic system failures is soil wetness (seasonally high water table), according to a survey of Indiana county sanitarians and environmental health specialists[72]. Other common causes were undersized systems, system age, and limited space for the soil absorption field.

According to John Grace, Dearborn County Health Department, the rate of failure for septic systems is approximately 50%. This number varies with wet/dry season with higher failure in wet season. Code change in 1990 introduced upslope drains in which soils were factored in to a greater degree. Residences before 1972 were not required to hold a septic system permit and percent failure among them may be much higher due to straight pipes and improperly installed systems.

[71] "Septic System Failure" Brad Lee, Don Jones, Heidi Peterson, September, 2005
[72] Taylor, C., J. Yahner, and D. Jones. 1997. An Evaluation of Onsite Technology in Indiana. A report to the Indiana State Department of Health. Purdue University, West Lafayette, IN.

6.3.3 Livestock Access to Creek

Manure from animals is a significant source of Nitrogen, Phosphorus, and more importantly, E.coli. E.coli is a specific species of fecal coliform bacteria commonly found in polluted waters. Some strains of E.coli can lead to illness in humans. While not all strains of E.coli are pathogenic themselves, they occur with other intestinal tract pathogens that may be dangerous to human health. The bacterium is able to enter the body through the mouth, nose, eyes, ears, or cuts in the skin[73].

To estimate the amount of manure potentially entering Tanners Creek or one of its tributaries, we first determined how many head of livestock is in the watershed. We obtained the number of livestock from the 2004-2005 Indiana Agricultural Statistics publication[74] and multiplied this number by the fraction of the county.

Table 14: Livestock within the Watershed

Livestock	# of Animals		Avg. Amt. of Manure produced		Amt. of manure produced (lbs/day)
Swine	2,901	X	11.7 lb/day	=	33,942
Dairy Cattle	147		115 lb/day		16,905
Beef Cattle	3,816		75 lb/day		286,200
Poultry	230		0.18 lb/day		41
Total amount of manure produced (lbs/day)					**337,088**

According to the windshield survey, there were fifty-five farms sited with livestock. Of those fifty-five farms, eleven had unrestricted access to Hogan Creek or one of its tributaries. The highest percentage of access occurs in the 110 subwatershed with fifty percent, while the lowest occurrence was in the 100 subwatershed with only nine percent.

Table 15: Livestock with Access to Tributary

Hydrologic Unit Number	# of farms sited with livestock	# of farms sited with livestock access to tributary	Percent occurrence with access to tributary in HUC
020	0	0	0
030	6	1	17
040	10	1	10
050	8	1	13
080	5	2	40
090	11	3	27
100	11	1	9
110	4	2	50
TOTAL	**55**	**11**	**20**

[73] Lyn Hartman and Mandy Burk (November 2000). Hoosier Riverwatch Volunteer Stream Monitoring Training Manual. Indiana Department of Natural Resources, Purdue University

[74] Indiana Agricultural Statistics 2004-2005. Issued by United States Department of Agriculture and Purdue University.

* Number is estimated by the Dearborn County Farm Service Agency

6.4 Excess Nutrients

6.4.1 Livestock

Direct runoff of manure from fields or manure storage facilities that have been inadequately constructed or maintained are important nutrient management concerns. If a rain occurs after manure is spread on crop or hay fields, the phosphorus may run off into nearby waterways instead of sinking into the ground. This is especially problematic during the spring, when manure spread over the winter is washed away by the spring snowmelt. Since this manure is delivered directly into waterways, this can be a major contributor of nitrogen and phosphorus to the streams and lakes. Likewise, manure storage facilities need to be structurally sound and have enough capacity to handle the manure generated at the farm, to avoid leaks or overtopping.

Likewise, livestock waste concentration can be a source of nutrient pollution, especially if they concentrate in or near streams. A large proportion of the nitrogen and phosphorus ingested by livestock during feeding returns to the environment in feces and urine. If these wastes are well distributed in the watershed, there is a better chance that natural processes will remove or dilute nutrient pollutants. If large amounts of these nutrients enter directly into a waterway, they can stimulate algae growth that uses up dissolved oxygen, reducing fish reproduction and survival[75].

Manure potentially entering Hogan Creek is estimated using “The Watershed Inventory Tool for Indiana.” Livestock numbers were taken from the “2004-2005 Indiana Agricultural Statistics” and multiplied by the percentage of the watershed in each county and then added together for a grand total. The *average amount of manure produced* for each livestock animal is taken from the MWPS -18, Livestock Waste Facilities Handbook.

Table 16: Estimated Manure Produced by Livestock in the Watershed

Livestock	**# of Animals**		**Avg. Amt. of Manure produced**		**Amt. of manure produced (lbs/day)**		**Fraction of nutrients in a pound of mature**			**Lbs of N in manure**	**Lbs of P in manure**
							N	**P**			
Swine	2,901	**X**	11.7 lb/day	**=**	33,942	**X**	0.0045	0.004	=	153	136
Dairy Cattle	147		115 lb/day		16,905		0.0045	0.002		76	34
Beef Cattle	3,816		75 lb/day		286,200		0.008	0.0065		2,290	1,860
Poultry	230		0.18 lb/day		41		0.026	0.026		1	1
Total amount of manure produced (lbs/day)					**337,088**	**Total amount of nutrients in the manure (lbs/day)**				**2,520**	**2,031**

6.4.2 Agricultural Lands

Fertilizers are generally defined as "any material, organic or inorganic, natural or synthetic, which supplies one or more of the chemical elements required for the plant growth"[76]. Most fertilizers that are commonly used in agriculture contain the three basic plant nutrients: nitrogen, phosphorus, and potassium. Some fertilizers also contain certain "micronutrients," such as zinc

[75] “Nonpoint Source Pollutions on Rangeland” July 1995. UC Cooperative Extension and USDA Natural Resources Conservation Service., January 5, 2007, http://californiarangeland.ucdavis.edu/Publications%20pdf/FS3.pdf
[76] Utah State University Extension, “Fertilizer Management.” N.d., http://extension.usu.edu/cooperative/waterquality/index.cfm/cid.813/tid.2148/ (July 18, 2006).

and other metals that are necessary for plant growth. Fertilizers are applied to replace the essential nutrients for plant growth to the soil after they have been depleted.
Excess amounts of fertilizers may enter streams creating sources of nonpoint pollution.

An important characteristic of phosphorus that has significant implications for water quality is its tendency to bind to soil particles. Because of this, when phosphorus is applied to fields it stays relatively immobilized and stable on land as long as the soil remains intact. However, when land suffers from erosion, soil is washed into waterways and the phosphorus attached to it is then released into the water. Once phosphorus enters the water, the algae bloom cycle begins. Because of this process, erosion and runoff are key issues that need to be addressed for good phosphorus management.

Fertilizers potentially entering Hogan Creek are estimated using "The Watershed Inventory Tool for Indiana." Crop acres were taken from the "2004-2005 Indiana Agricultural Statistics" and multiplied by the percentage of the watershed in each county and then added together for a grand total. The *fraction of acres treated in the state* and *average rate of application* are recorded by the Indiana Agricultural Statistics Service.

Table 17: Estimated Fertilizer Applied to Agricultural Land

Crop	Acres		Fertilizer Type	Fraction of acres treated in state		Average rate of application (lbs/acre)		Estimated amt. of fertilizer applied (lbs)
Corn	7,271	X	Nitrogen	1.00	X	145	=	1,054,295
			Phosphorus	0.97		59		416,119
Soybean	10,066		Nitrogen	0.15		29		437,871
			Phosphorus	0.26		46		120,389
					Total amount of nitrogen			**1,492,166**
					Total amount of phosphorus			**536,508**

6.5 Increases in Temperature and Flow Rate

6.5.1 Increase in Impervious Areas

As discussed earlier in this plan, impervious areas can contribute significantly to hazardous chemical pollution. Another concern with an increase in impervious areas for watersheds is the increase in temperature and flow rate. Water that would normally be filtered through soil has no where to go when increasing the impervious areas in a watershed. Thus, instead of infiltrating, the water must find another way to enter a waterbody. This water moves rapidly over hard surface areas and finds the nearest ditch or storm drain. While the surface water runs off the scorching blacktopped areas, the rainwater's temperature increases, sending hot discharged water into the nearest waterbody. Thermal pollution threatens the balance of aquatic systems by lower dissolved oxygen levels, increasing the rate of photosynthesis, and changing the metabolic rate of aquatic organism.[77] Although flow rate is not considered a water pollutant, it can be considered a water nuisance as an increase in flow can cause major flooding in areas.

[77] Hoosier Riverwatch

While increases in temperature and flow within the watershed have not been significantly observed, the committee still feels this issue needs to be addressed because of the potential development in the future.

Using data from IDEM, the following table was constructed to determine the subwatersheds that have the most acreage of impervious area.

Table 18: Impervious Acres in Subwatersheds

Subwatershed	High Density Urban (acres)	Low Density Urban (acres)	Impervious Area (acres)	Total (acres)
010	17	84	49	160
020	2	29	20	71
030	0	66	4	100
040	0	8	0	48
050	0	143	9	202
060	30	75	53	158
070	20	250	12	282
080	7	82	35	124
090	0	20	14	34
100	0	41	25	66
110	60	48	16	124
			Total	**1,369**

6.6 Garbage

6.6.1 – Improper Disposal

According to the Ohio River Sanitation Commission (ORSANCO), the improvements in water quality over the last decade have increased the number of citizens using the Ohio River and its tributaries for recreation.[78] Because of this increase in recreation, communities are also seeing an increase in litter on the banks of the river and creeks. To help alleviate this problem and raise awareness to locals, the HCWP takes part in the Ohio River Sweep each year and cleans up nearly 2 tons of trash along the Hogan Creek banks. Clean-ups in the Hogan Creek watershed have found interesting items along Hogan Creek and its tributaries. From refrigerators and couches to tires and plastic bottles, trash along the banks is an unappealing sight for all landowners.

6.7 Land Use

6.7.1 – Lack of recreational opportunities

According to the 2006-2010 Statewide Comprehensive Outdoor Recreation Plan (SCORP), benefits are endless when it comes to outdoor recreation; people have better health and qualities of life, crime can be reduced because individuals can expel energy and emotion while performing outdoor activities, property values may increase because there are ample outdoor leisure opportunities, the economy benefits by providing an attraction for tourism, and awareness of the environment is heightened because people are spending more time in nature.

[78] www.orsanco.org

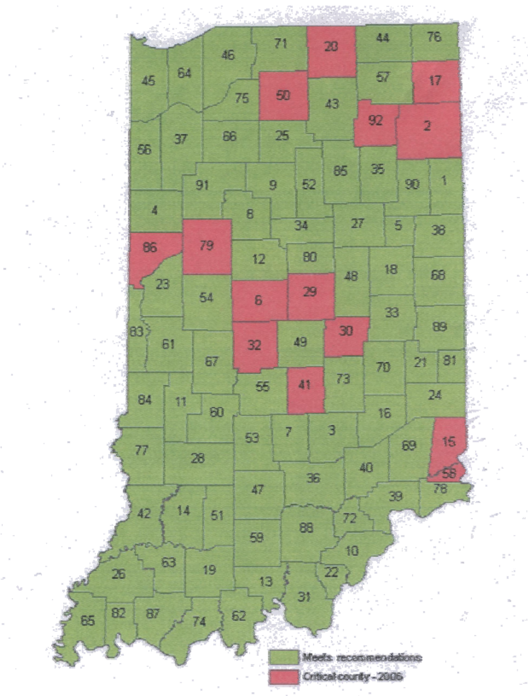


Figure 14: 2006 DOR Critical Counties

The Division of Outdoor Recreation (DOR) believes assessing local outdoor recreation acres at the county level may be the best way to identify counties that need more assistance in improving their outdoor recreation supply.

The DOR assessed the critical counties within Indiana that do not have the recommended outdoor recreation supply acreage of 55 acres per 1,000 population and has a population growth rate that is higher than the 2000-2005 population growth rate of 3.1% for county[79]. While Ripley County meets the needs of the current population, Dearborn County is considered a "critical county."

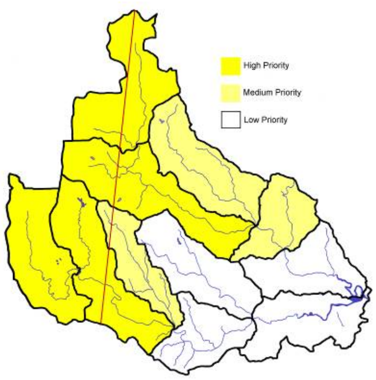
[79] Indiana Statewide Outdoor Recreation Plan 2006-2010

IDENTIFYING CRITICAL AREAS –
This section provides information on targeted areas within the watershed where the stressors are causing the most damage, and where applying treatment measures will have the greatest effect.

7.1 Sedimentation Critical Areas

7.1.1 – Riparian Buffers and Boat Wakes

While the committee believes streams throughout the Hogan Creek Watershed are sufficiently buffered, they expressed greatest concern for the areas in subwatersheds 110 and 050 highlighted in the map to the right. This area is greatly influenced by boat wakes from local bass tournaments and leisure and has the highest probability of causing sedimentation. Although it may be difficult to establish buffers in this area due to flooding, the group would like to develop a plan for flood-resistant trees, plants and grasses to plant in this area.

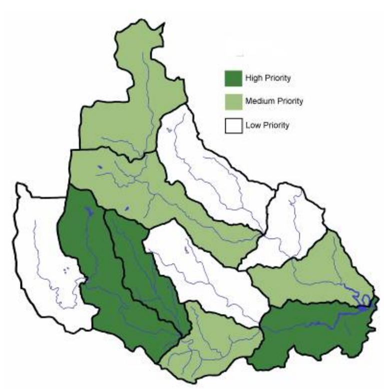


7.1.2 – Conservation Tillage

The committee analyzed IDNR 2004 Tillage Transect data and prioritized the subwatersheds by percentage of row crop. Subwatersheds which have a land use of row crops greater than 15% were given a "high priority" rating; subwatersheds which have a land use of row crops between 10% and 15% were given a "medium priority" rating; and subwatersheds with a land use of row crops lower than 10% received a "low priority" rating. The map to the left shows each subwatershed's rating in color.

7.1.3 – Livestock Access

The committee prioritized this source by pasture percentage and livestock access in each subwatershed. Subwatersheds with pasture greater than 40% were ranked with a high score of 3; 35-40% was given a 2; and less than 35 % is given a 1. Subwatersheds with livestock access greater than 40% were given a score of 3; those with 10-40% were given a 2; and less than 10% were given a 1. Scores were combined to find critical areas. High priority had a combined score of 5 or more, medium had a combined score of 3 or 4 and low had a combined score of 2.



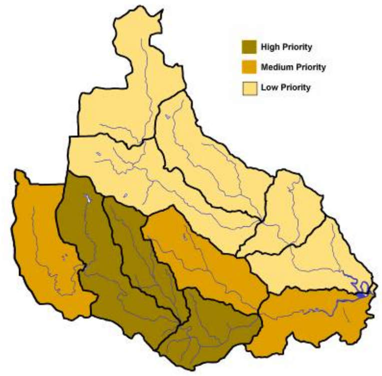
7.1.4 – Construction Projects

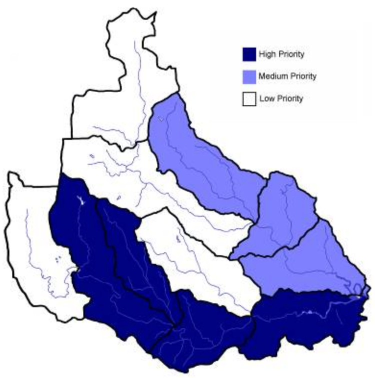
Because of its close proximity to Cincinnati, the committee anticipates a boost in population in the Hogan Creek watershed. According to STAT Indiana, statisticians confirm this idea. Ripley County is expected to increase in population by 7.7% from 1990 to 2010 while Dearborn County will see an 18.7% increase in population (12th largest increase in Indiana) by 2010. The committee prioritized this source by current construction projects going on in the watershed and areas that have already seen a significant rise in population such as Milan, Moores Hill and Aurora. Refer to the map at the left for a detailed illustration or prioritized areas.

7.2 E. Coli Critical Areas

7.2.1 – Septic Systems

After speaking with Dearborn and Ripley County Health Department representatives, it is apparent that the most severe problem with septic systems comes from the South Hogan Creek Watershed. The committee chose to put emphasis on the three subwatersheds listed on the 303(d) list for E.coli as a high priority with the South Hogan Creek Watershed as a medium priority area. While the South Hogan subwatersheds are most critical, the committee feels the whole watershed should be investigated. Refer to the map at the right for a detailed illustration.





7.2.2 – Livestock Access

Because it is difficult to pinpoint where livestock has access to the creek, the committee prioritized this source by the results of the windshield survey. Subwatersheds which consisted of 40% or higher of livestock access were given a "high priority" ranking; subwatersheds which have between 10% and 40% were given a "medium priority" ranking; and those subwatersheds with less than 10% livestock access were given a "low priority" ranking. Additionally, the committee has given a high priority to the subwatersheds that have waterbodies that are listed on the 303(d) list for E.Coli. Refer to the map on the left for a detailed illustration.

7.2.3 – Combined Sewer Overflows

Because the City of Aurora is the only town in the watershed with a combined sewer overflow problem, the subwatersheds closest to Aurora are recommended as the critical areas. Although the areas affected by combined sewer overflows in the subwatersheds may be minimal, the committee continued with the theme of selecting subwatersheds opposed to specific areas within the subwatershed.

7.3 Hazardous Chemicals Critical Areas

7.3.1 – Impervious Areas

The committee determined the critical areas of impervious surfaces by analyzing Table 18 on page 35. The committee determined the subwatersheds with the highest acreage of impervious surface should be high priority. Subwatershed with more than 100 acres of impervious surface would be given a medium priority and those containing less than 100 acres would be considered a low priority.

7.3.2 – Agricultural land

While the committee has performed windshield and land surveys, it is often difficult to determine areas where pesticide runoff is occurring without testing the nearby waterbody. Since testing for pesticides in not a parameter tested by the project, the committee based their critical area for agricultural hazardous chemicals by riparian buffers. Those areas not adequately buffered were given a high priority (050 and 110). Areas that are moderately buffered were given medium priority (040 and 010). Areas that are moderate/high buffered were given a low priority (060, 070, and 080).

7.3.3 – Boat Maintenance

According to the Natural Resources Commission, Hogan Creek is a navigable waterway beginning at the Ohio River for 0.4 miles. North Hogan extends for another 4.9 miles and South Hogan extends for another 5.0 miles.[80] Since subwatersheds 110 and 050 are the only subwatersheds which have marinas or can be traveled by motorized boats, the committee believes these two subwatersheds should have a "high priority" ranking while the rest of the watershed should have a "low priority" ranking. Refer to the map on the right for a detailed illustration.

[80] Natural Resources Commission, "Roster of Indiana Waters Declared Navigable or nonnavigable." 3 November 2002, http://www.state.in.us/nrc/policy/III.html#H (26 January 2005)

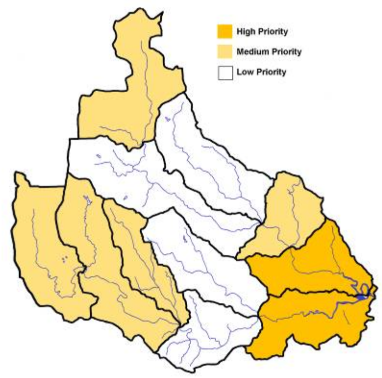
7.4 Excess Nutrients Critical Areas

7.4.1 – Livestock Access

The committee prioritized this source by pasture percentage and livestock access in each subwatershed. Subwatersheds with pasture greater than 40% were ranked with a high score of 3; 35-40% was given a 2; and less than 35 % is given a 1. Subwatersheds with livestock access greater than 40% were given a score of 3; those with 10-40% were given a 2; and less than 10% were given a 1. Scores were combined to find critical areas. High priority had a combined score of 5 or more, medium had a combined score of 3 or 4 and low had a combined score of 2.

7.4.2 – Agricultural Lands

While the committee has performed windshield and land surveys, it is often difficult to determine areas where fertilizer runoff is occurring. Because test results for nitrogen and phosphorus show minimal concentrations, the committee based their critical area for excess nutrients by riparian buffers. Those areas not adequately buffered were given a high priority (050 and 110). Areas that are moderately buffered were given medium priority (040 and 010). Areas that are moderate/high buffered were given a low priority (060, 070, and 080).



SETTING GOALS AND SELECTING INDICATORS –
This section states the water quality improvement or protection goals that were agreed on by the group. The goals include specific, realistic targets for reducing pollutants or mitigating impacts, and identify time-frames for accomplishment.

8.1 Sedimentation Goal – Reduce sediment loading by 1,000 tons by the year 2012 with emphasis on subwatersheds 010, 020, and 110

Objective	Action - Cost	Target Audience	Performed By	Time Schedule	Indicator
Problem Statement One: The lack of riparian groundcover may increase sediment in local waterbodies					
Preserve existing riparian buffers throughout the watershed	Education through workshops - $$ Education through field days - $$ Education through publications - $	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD staff, Ripley SWCD staff	Ongoing	✔ # of people attending workshops ✔ # of publications distributed
Enlarge existing buffers in subwatershed 110 and subwatershed 050	Develop strategy for developing flood resistant trees, plants and grasses - $$ Provide financial assistance to landowners installing riparian buffers - $$$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	5 years (by 2012)	✔ # of landowners enrolled in cost-share programs ✔ # of feet of buffers installed ✔ Reduction of sediment
Problem Statement Two: Contractors using inadequate erosion control practices on construction sites can lead to excess soil loss entering nearby waterbodies.					
Promote "smart growth" to contractors and developers	Provide "smart growth" workshops - $$ Distribute literature about benefits of "smart growth" - $ Initiate storm drain marking program - $	Contractors and Developers	Watershed Coordinator, Dearborn SWCD Stormwater Coordinator, Ripley SWCD technician	Ongoing	✔ # of people attending workshops ✔ # of publications distributed ✔ # of volunteers for marking ✔ # of markers placed

Encourage discussion among zoning board members to consider changing zoning codes in environmentally sensitive areas	Give presentations to Zoning Boards - $ Encourage removal of abandoned impervious areas - $$$	Dearborn and Ripley Zoning Boards	Watershed Coordinator, Dearborn SWCD Stormwater Coordinator, Ripley SWCD technician	5 years (by 2012)	✔ # of acres of abandoned impervious area converted
Problem Statement Three – Farmlands not using a high residue cropping system may cause an increase in sedimentation in waterbodies from stormwater runoff					
Increase conservation tillage for corn and soybeans in Dearborn County by 30% and Ripley County by 15%	Provide financial assistance to implement conservation tillage measures - $$$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	5 years (by 2012)	✔ # of landowners enrolled in cost-share programs ✔ # acres of farmland converted from conventional tillage to no-till ✔ Reduction of sediment
Educate landowners about the effects of sedimentation from croplands	Hold conservation field days - $$ Educate through workshops - $$ Distribute publications - $ Develop conservation tillage billboards - $$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	Ongoing	✔ # of people attending field days and workshops ✔ # of publications distributed
Problem Statement Four – Inappropriate use of boats can lead to unstable streambanks, resulting in increased sedimentation					
Educate boating community about consequences of reckless boating	Post more visible “no wake” signs along creek - $ Hold Boating Safety Courses - $ Work with boat dealers to hand out literature with each sale - $	General Public, Marinas	Watershed Coordinator	Ongoing	✔ # of people attending boating workshops ✔ # of people participating in low-powered fishing tournament

	Hold fishing tournament for limited horse power boats - $$				✔ # of brochures distributed ✔ Increase in # of boaters obeying "no wake" signs
	Send literature to organizations holding fishing tournaments – S				
Problem Statement Five – Livestock with uncontrolled access to waterbodies may increase sediment in local waterbodies by trampling of streambanks					
Educate agricultural community about effects of livestock with access to creek	Distribute brochures to 4-H and other organizations - $	Agricultural landowners and operators	Watershed Coordinator, Dearborn County Technician, Ripley County Technician	Ongoing	✔ # of people attending field days and workshops ✔ # of publications distributed
	Speak at 4-H and club meetings - $				
	Provide information to feed supply businesses - $				
	Research mature fermentation for energy production - $				
	Educate through field days - $$				
	Develop conservation practice publications - $				
Provide financial incentives to landowners through local cost-share program	Reseed 2,500 acres of pasture/Hayland through local cost-share program - $$$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	5 years (by 2012)	✔ # of pasture acres reseeded ✔ # of cattle fenced out of creek ✔ # of feet of interior fence installed ✔ # of alternative watering systems installed ✔ Reduction of sediment
	Fence livestock out of creek - $$$				
	Implement rotational grazing systems - $$$				
	Install alternative watering systems - $$$				

8.2 – Nutrient Management Goal – Reduce nutrient loading by 40% by the year 2010 with emphasis on subwatersheds 050, 060, 090, and 110

Objective	Action - Cost	Target Audience	Performed By	Time Schedule	Indicator
Problem Statement Six: Improper nutrient management on farmland can lead to nutrient overload in nearby waterbodies which can lead to increased algal blooms, thus decreasing dissolved oxygen					
Educate community about the effect of over fertilization	Education through workshops - $$ Distribute publications at local co-ops - $ Hold conservation field days - $$ Record public service announcements on local radio stations - $ Write news articles for newsletters and newspapers - $	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD staff, Ripley SWCD staff	Ongoing	✔ # of people attending field days and workshops ✔ # of publications distributed
Offer financial assistance to landowners through local cost-share program	Implement rotational grazing systems - $$$ Establish riparian buffers - $$$ Promote conservation tillage - $$$ Install heavy use protection areas - $$$ Tree establishment - $$$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	3 years (by 2010)	✔ # of landowners signing up for cost-share ✔ # of acres of riparian buffers ✔ Increase in conservation tillage ✔ # of acres of tree establishment ✔ # of feet of interior fencing installed

8.3 – Hazardous Chemical Goal – Increase knowledge of potential harm from hazardous chemical loading.

Objective	Action - Cost	Target Audience	Performed By	Time Schedule	Indicator
Problem Statement Seven: Hazardous chemical runoff from parking lots, roads, industrial buildings and suburban areas entering local waterbodies					
Provide financial assistance to landowners through local cost-share program	Incentives for alternatives to concrete - $$$	General public, urban areas	Watershed Coordinator, Dearborn County Storm Water Coordinator	3 years (by 2010)	✔ # of square feet of concrete alternatives installed ✔ # of rain gardens established. ✔ Reduction in chemical loading
	Incentives for rain gardens - $$$				
Educate urban community and contractors about benefits of stormwater runoff protection	Hold annual contractors workshops highlighting stormwater runoff BMPs - $$	Contractors, Developers, General public, urban areas	Watershed Coordinator, Dearborn County Storm Water Coordinator	Ongoing	✔ # of people attending workshops ✔ # of publications written ✔ # of visitors to demonstration site
	Develop quarterly articles about stormwater pollution and household BMPs - $				
	Construct and maintain backyard conservation demonstration site highlighting urban BMPs - $$$				
Problem Statement Eight – Improper application of agricultural chemicals may enter waterbodies through runoff and lead to endocrine disruption					
Provide financial assistance to landowners through local cost-share program	Promote conservation tillage - $$$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	3 years (by 2010)	✔ # of landowners signing up for cost-share ✔ # of acres of riparian buffers
	Establish riparian buffers - $$$				

	Tree establishment - $$$				✔ Increase in conservation tillage ✔ # of acres of tree establishment ✔ Reduction of chemical loading
Problem Statement Nine – Inadequate boating maintenance can discharge of oil, gas, or other harmful chemicals into waterbodies					
Educate boating community about effects of inadequate maintenance	Hold Boating Safety Courses - $ Work with local boat dealers to hand out literature with each sale - $	General Public, Marinas	Watershed Coordinator, Dearborn County Technician, Ripley County Technician	Ongoing	✔ of people attending boating workshops ✔ # of brochures distributed

8.4 – E.coli Goal – Reduce E.coli loading to reach the EPA standard of 235 colonies/100ml by the year 2015 with special emphasis on South Hogan subwatersheds.

Objective	Action - Cost	Target Audience	Performed By	Time Schedule	Indicator
Problem Statement Ten: An increase in population will lead to more wastewater and impervious areas, which could result in more sewer overflows during rain events					
Work with City of Aurora to inform residents of effects	Develop annual brochure on current status of sewer system - $ Submit articles to newsletters - $ Hold storm drain marking events - $$	General public	Watershed Coordinator, City of Aurora Utilities Director, City of Milan Manager	Ongoing	✔ # of people attending workshops ✔ # of publications distributed ✔ # of volunteers for marking ✔ # of markers placed
Problem Statement Eleven: Improper maintenance of septic systems leads to failure causing pathogens to enter nearby waterbodies, leading to health problems.					
Collaborate with local officials to increase awareness of septic system issues	Hold annual workshop with health department - $ Work with regional sewer district to get rural residents hooked on to city sewer - $ Submit articles to newsletters and newspapers - $ Demonstration site for alternatives to septic systems - $$$	General public on septic system	Watershed Coordinator, City of Aurora Utilities, Dearborn and Ripley County Health Departments, City of Milan Utilities, Regional Sewer Districts	Ongoing	✔ # of people attending workshops ✔ # of publications distributed ✔ Increase in # of household hooked up to sewer system ✔ Development of alternative septic system site ✔ Reduction in E.Coli

Problem Statement Twelve: Livestock with uncontrolled access to waterbodies may lead to an increase in pathogens from animal waste which can result in digestive and other health problems for humans or wildlife in contact with waterbodies					
Provide financial incentives for landowners	Install Streambank fencing - $$$ Install Interior fencing - $$$ Stream crossings - $$$ Alternative watering systems - $$$ Roof runoff management - $$$ Reseed 2,500 acres of pasture - $$$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	8 years (by 2015)	✔ # of feet of streambank fencing installed ✔ # of feet of interior fencing installed ✔ # of acres of reseeded pasture ✔ Reduction in E.Coli
Educate agricultural community about effects of livestock with access to creek	Distribute brochures to 4-H and other organizations - $ Speak at 4-H and club meetings - $ Provide information for feed supply businesses - $ Educate through field days - $$ Develop conservation practice publications - $	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician	Ongoing	✔ # of people attending workshops ✔ # of publications distributed

8.5 – Temperature Goal – Maintain normal temperature levels in Hogan Creek and its tributaries

Objective	Action - Cost	Target Audience	Performed By	Time Schedule	Indicator
Problem Statement Thirteen: Runoff from impervious areas may cause an increase in temperature, lowering dissolved oxygen levels in nearby waterbodies.					
Promote “smart growth” to contractors and developers	Develop demonstration site - $$$ Provide “smart growth” workshops - $$ Distribute literature about benefits of “smart growth” - $ Initiate storm drain marking program - $$	Contractors and Developers	Watershed Coordinator, Dearborn SWCD Stormwater Coordinator, Ripley SWCD technician	Ongoing	✔ # of people attending workshops ✔ # of publications distributed ✔ # of volunteers for marking ✔ # of markers placed
Encourage discussion among zoning board members to consider changing zoning codes in environmentally sensitive areas	Give presentations to Zoning Boards - $ Encourage removal of abandoned impervious areas - $	Dearborn and Ripley Zoning Boards	Watershed Coordinator, Dearborn SWCD Stormwater Coordinator, Ripley SWCD technician	5 years (by 2012)	✔ # of acres of abandoned impervious area converted
Problem Statement Fourteen: The lack of protective riparian canopy from tree cover may increase water temperature in local streams					
Preserve existing riparian buffers throughout the watershed	Education through workshops - $$ Education through field days - $$ Education through publications - $	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD staff, Ripley SWCD staff	Ongoing	✔ # of people attending workshops ✔ # of publications distributed
Enlarge existing buffers in subwatershed 110 and subwatershed 050	Develop strategy for developing flood resistant trees, plants and grasses - $$	Agricultural landowners and operators	Watershed Coordinator, Dearborn SWCD technician, Ripley SWCD technician, NRCS staff	5 years (by 2012)	✔ # of landowners enrolled in cost-share programs ✔ # of feet of buffers installed

8.6 – Recreation and Wildlife Habitat Goal – Expand number of recreational opportunities, including wildlife areas, within the watershed

Objective	Action - Cost	Target Audience	Performed By	Time Schedule	Indicator
Problem Statement Fifteen: An increase in development leads to a decrease in wildlife habitat areas					
Promote "smart growth" to contractors and developers	Provide "smart growth" workshops with emphasis on maintaining natural areas in subdivisions - $$	Contractors and Developers	Watershed Coordinator, Dearborn SWCD Stormwater Coordinator, Ripley SWCD technician	Ongoing	✔ # of people attending workshops ✔ # of publications distributed
	Distribute literature about benefits of "smart growth" - $				
	Provide opportunities for landowners to place conservation easement on acreage - $$$	General Public			✔ # of acres in conservation easements ✔ # of landowners holding conservation easements
Problem Statement Sixteen: Limited access to local waterbodies keeps community members from enjoying recreational benefits					
Collaborate with local organizations to introduce new recreational opportunities	Design and construct Canoe Ramp - $$$	General Public	Watershed Coordinator, City of Aurora	Ongoing	✔ # of people using canoe ramp ✔ # of people involved in event
	Assist City of Aurora with River Run - $$				
	Implement watershed triathlon utilizing canoe ramp and bike trails - $$				
	Hold fishing tournament for limited horse power boats - $$				

$: $0.00 – $1,500.00
$$: $1,500.00 - $5,000.00
$$$: > $5,000.00

APPLYING MEASURES –
This section describes what needs to be implemented or changed to achieve the goals of the watershed plan.

During a series of Technical Committee meetings, committee members reviewed information gathered for the plan and agreed on fifteen best management practices they would like to see offered to landowners throughout the watershed. The best management practices selected are as followed:

9.1 Alternative Watering Systems

9.1.1 – Spring Developments

Spring developments utilize springs and seeps to provide water for livestock. These are placed in areas where spring or seep development will provide a dependable supply of suitable water for the planned times of use, and where the intended purpose can be achieved by using this practice alone or combined with other conservation practices.

9.1.2 - Ponds

A pond is a water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout. The purpose is to provide water for livestock, fish and wildlife, and other related uses, and to maintain or improve water quality.

9.2 Conservation Tillage

This refers to any tillage and planting system that leaves at least 30 percent of the soil surface covered by “crop residue.” Conservation tillage results in less soil disturbance than traditional cultivation, reducing soil loss and energy use while maintaining crop yields and quality. This practice may be applied as part of a conservation management system to support one or more of the following:

1. reduce sheet and rill erosion;
2. reduce wind erosion;
3. maintain or improve soil organic matter content;
4. conserve soil moisture;
5. manage snow cover to reduce blowing and drifting; and
6. provide food and escape cover for wildlife.

9.3 Critical Area Planting

Critical area planting includes planting vegetation such as trees, shrubs, vines, grasses or legumes on highly erodible or critically eroding areas. The vegetation provides a filtering effect on runoff and will improve water quality by reducing erosion rates and the movement of sediment carried by runoff from construction sites. The purposes of critical area planting are to:

1. stabilize areas with existing or expected high rates of soil erosion by wind or water; and
2. restore degraded sites that cannot be stabilized through normal methods.

9.4 Filter Strips
Filter strips are areas of herbaceous vegetation situated between cropland, grazing land, or disturbed land (including forest land) and environmentally sensitive areas.[81] The purposes of filter strips are to:

1. reduce sediment, particulate organic matter, and sediment adsorbed contaminant loading in runoff;
2. reduce dissolved contaminant loading in runoff;
3. restore, create or enhance herbaceous habitat for wildlife and beneficial insects; and
4. maintain or enhance watershed functions and values.

9.5 Forest Stand Improvement
Forest stand improvement is the manipulation of species composition, stand structure, and stocking by cutting or killing selected trees and understory vegetation. The purposes of forest stand improvement are to:

1. initiate forest stand regeneration;
2. improve forest health reducing the potential of damage from pests and moisture stress;
3. restore natural plant communities;
4. improve aesthetic, recreation, and open space values;
5. improve wildlife habitat; and
6. alter water yield.

9.6 Heavy Use Protection Area
A heavy use protection area is the stabilization of areas frequently and intensively used by animals or vehicles by establishing vegetative cover, surfacing with suitable materials, and/or installing needed structures. The purposes of this practice are to:

1. reduce soil erosion;
2. improve livestock health;
3. improve water quantity and quality; and
4. minimize nutrient loading.

9.7 Interior Fencing
Interior fences (or cross fences) are used to subdivide fields into smaller areas called paddocks for effective grazing management. Interior fences may be constructed from permanent, semi-permanent, or temporary fencing materials. Temporary fencing can be used to enclose areas for temporary grazing.

9.8 Pasture/Hayland Reseeding
Pasture/Hayland reseeding consists of establishing and/or re-establishing long-term stands of adapted species of perennial, biennial, or reseeding forage plants. This includes pasture and hayland renovation but does not include grassed waterways or outlets on cropland. The purposes of pasture/hayland reseeding are to:

1. reduce erosion;
2. produce high-quality forage; and
3. adjust land use.

[81] Natural Resources Conservation Service Field Office Technical Guide, Section 6.

9.9 Riparian Forest Buffers
Riparian buffers are areas of trees and other vegetation consisting of two zones located in areas (adjoining and up gradient from surface waterbodies) designed to intercept surface runoff, and subsurface flows from upland sources prior to entry into surface waters and/or groundwater recharge areas. The purposes of riparian buffers are to:

1. reduce excess amounts of sediment, organic material, nutrients, pesticides, and other pollutants in surface runoff;
2. reduce excess nutrients and other chemicals in shallow groundwater flow;
3. create shade to lower water temperatures to improve habitat for fish and other aquatic organisms;
4. provide a source of detritus and large woody debris for fish and other aquatic organisms; and
5. provide riparian habitat and corridors for wildlife.

9.10 Roof Runoff Management
A roof runoff system is a structure used to collect, control and transport precipitation from rooftops. It is typically used in areas were roof runoff water may come in contact with wastes or cause soil erosion. The purposes of this practice are to:

1. reduce soil erosion;
2. increase infiltration;
3. prevent flooding; and
4. improve drainage.

9.11 Streambank Crossing
A streambank crossing is a trail or travel way constructed across a stream to allow livestock, equipment, or vehicles to cross with minimal disturbance to the stream ecosystem. The purposes of this practice are to:

1. prevent or minimize water degradation from sediment, nutrient and organic loading;
2. protect the watercourse from degradation and adverse hydrological impacts; and
3. reduce streambank and streambed erosion.

9.12 Streambank Fencing
This practice is applied to facilitate the application of conservation practices by providing a means to control movement of animals and people. Permanent exterior fences are used to exclude livestock from all areas needing permanent protection or be used to regulate or restrict access to areas by people. Material used in permanent fence shall have a minimum life expectancy of 20 years.

9.13 Tree Establishment
Tree establishment is the process of introducing woody plants to an area by planting seedlings or cuttings, direct seeding, or natural regeneration. The purposes of tree establishment are to:

1. provide wildlife habitat;
2. long-term erosion control and improvement of water quality;
3. decreasing flow from land;
4. improving or restoring natural diversity; and
5. enhancing aesthetics.

9.14 Waterways

Grassed waterways are natural or constructed channels that are shaped or graded and established with suitable vegetation. The purposes of grassed waterways are to:

1. convey runoff without causing erosion flooding or ponding;
2. reduce gully erosion; and
3. protect or improve water quality.

9.15 Wildlife Habitat

Wildlife habitat is an area that offers feeding, roosting, breeding, nesting, and refuge areas for a variety of bird and mammal species native to the area. The purposes of installing wildlife habitat areas include:

1. reduction of soil erosion;
2. decrease in water flow;
3. enhancing aesthetics;
4. improving or restoring natural diversity; and
5. providing wildlife habitat.

Table 19: Measures that may be Applied

Problem	Measure that may be used
Sedimentation	1. Conservation Tillage 2. Interior Fencing 3. Streambank Fencing 4. Heavy Use Protection 5. Critical Area Planting 6. Pasture/Hayland Reseeding 7. Filter Strips 8. Grassed Waterways 9. Streambank Crossing 10. Roof Runoff Management 11. Riparian Tree Buffers
E. Coli	1. Interior Fencing 2. Streambank Fencing 3. Heavy Use Protection Area 4. Alternative Watering Systems 5. Pasture/Hayland Reseeding 6. Streambank Crossing
Chemicals	1. Conservation Tillage 2. Pasture/Hayland Reseeding 3. Filter Strips

Chemicals cont.	4. Grassed Waterways 5. Riparian Tree Buffers
Nutrients	1. Conservation Tillage 2. Interior Fencing 3. Streambank Fencing 4. Heavy Use Protection 5. Critical Area Planting 6. Pasture/Hayland Reseeding 7. Filter Strips 8. Grassed Waterways 9. Streambank Crossing 10. Roof Runoff Management 11. Riparian Tree Buffers
Flow	1. Tree Establishment 2. Riparian Forest Buffers 3. Roof Runoff Management 4. Grassed Waterways 5. Filter Strips 6. Critical Area Planting 7. Heavy Use Protection Area
Temperature	1. Tree Establishment 2. Riparian Forest Buffers
Land Use	1. Tree Establishment 2. Forest Stand Improvement 3. Filter Strips 4. Riparian Forest Buffers

LOAD REDUCTIONS –
This section estimates the anticipated load reductions for the management measures identified earlier in the plan.

Projects developing watershed management plans and wanting to secure Section 319 funds to implement a cost-share program are required to include estimates for existing pollutant loads within the watershed, as well as estimated pollutant load reduction that may result from the implementation of best management practices outlined in the watershed plan.

In order to put the current load estimates in the context of water quality, target loads were calculated using State water quality standards, or recommended guidelines from literature if a State standard did not exist. The target loads listed below represent the amount of pollutants that the stream can assimilate (at the average flow) and still meet the State standards or recommended guidelines.

Table 20: Water Quality Standards

Parameter	Target Concentration
TSS*	80 mg/L
N**	10 mg/L
P*	0.3 mg/L
E. Coli***	235 cfu/ml

* Recommended guidelines
** State standard for nitrate nitrogen in drinking water
*** State standard for E. Coli (single sample)

The following nutrient concentrations were collected on a monthly basis over a twelve month timeframe. Values on the table include the average concentration and the maximum concentration taken over the twelve month testing period. Concentrations highlighted in red indicate values over the recommended target concentration.

Table 21: Average and High Nutrient Concentrations

Site - Watershed	Total Suspended Solids Concentration (mg/L)		Nitrogen Concentration (mg/L)		Phosphorus Concentration (mg/L)		E.coli Concentration (colonies/100ml)	
	Average	High	Average	High	Average	High	Average	High
1 – W5	6.42	34	0.08	0.33	0.02	0.27	1,806	14,400
2 – W4	6.67	48	0.09	0.18	0.09	0.19	2,040	16,100
3 – W3	10.25	68	0.11	0.36	0.03	0.19	1,949	18,700
4 – W2	13.17	104	0.09	0.34	0.03	0.19	1,988	17,900
5 – W1	15.17	84	0.26	0.44	0.04	0.24	3,640	19,800
6 – W6	8.42	34	1.67	14.99	0.01	0.16	1,546	8,500
7 – W7	8.92	41	0.58	3.37	0.03	0.18	3,007	18,000
8 – W8	5.33	13	0.58	1.47	0.01	0.11	2,987	27,000
9 – W9	10.25	66	0.32	1.44	0.05	0.33	3,176	17,400
10 – W10	10.58	47	0.11	0.75	0.02	0.14	2,122	14,600
11 – W11	17	88	0.21	0.76	0.04	0.26	4,675	20,800

Load reduction percentages were calculated by the following equation:

Load Reduction percentage = (Target Concentration-Concentration)/Concentration

The following table shows the subwatersheds and parameters within those subwatersheds that need to be reduced. Cells that have a " – " symbol do not need to reduce loads because current load falls below target load.

Table 22: Percent Load Reduction Needed per Watershed

Site - Watershed	Total Suspended Solids Percent Load Reduction		Nitrogen Percent Load Reduction		Phosphorus Percent Load Reduction		E.coli Concentration Percent Load Reduction	
	Average	High	Average	High	Average	High	Average	High
1 – W5	-	-	-	-	-	-	87%	98%
2 – W4	-	-	-	-	-	-	88%	99%
3 – W3	-	-	-	-	-	-	88%	99%
4 – W2	-	23%	-	-	-	-	88%	99%
5 – W1	-	5%	-	-	-	-	94%	99%
6 – W6	-	-	-	33%	-	-	85%	97%
7 – W7	-	-	-	-	-	-	92%	99%
8 – W8	-	-	-	-	-	-	92%	99%
9 – W9	-	-	-	-	-	9%	93%	99%
10 – W10	-	-	-	-	-	-	89%	98%
11 – W11	-	9%	-	-	-	-	95%	99%

Due to complications in testing, flow rate was only collected during the last two testing periods. Thus, current loads for total suspended solids, nitrogen and phosphorus were identified using IDEM's STEPL program. This program incorporates each subwatershed's land use, precipitation, agricultural animals, septic systems, soil loss, and soil hydrologic group to determine current loading. Because it does not estimate E.Coli current loading, the committee took the average E.Coli concentration per site and multiplied it by the average flow rate.To estimate the total tons per year reduction needed for each nutrient, the "percent load reduction" was multiplied by the nutrient concentration.

Table 23: Load Reduction Needed per Subwatershed

Site - Watershed	TSS Current Load ton/yr	TSS Load Reduction ton/yr	N Current Load lbs/yr	N Load Reduction lbs/yr	P Current Load lbs/yr	P Load Reduction lbs/yr	E. Coli Current Load cfu/yr	E. Coli Load Reduction cfu/yr
1 – W5	1253.8	-	51,031.8	-	12,618.6	-	4.18E+14	3.636E+14
2 – W4	1020.7	-	44,650.3	-	10,020.8	-	4.05E+13	3.583E+13
3 - W3	2286.5	-	35,096.3	-	8,128.6	-	6.57E+13	5.778E+13
4 - W2	2087.5	480.1	19,878.9	-	4,554.5	-	2.5E+14	2.202E+14
5 - W1	4878.7	243.9	28,815.3	-	5,926.2	-	1.25E+14	1.1694E+14
6 - W6	5807.3	-	56,134.2	18,524.3	13,767.5	-	1.23E+14	1.043E+14
7 - W7	3859.1	-	48,470	-	10,931.4	-	6.95E+14	6.407E+14
8 - W8	1348.8	-	27,129.2	-	6,580.5	-	9.85E+13	9.075E+13
9 - W9	750	-	17,328.1	-	3,189.7	287.1	5.57E+14	5.158E+14
10 - W10	1206.7	-	32,331.6	-	6,981.8	-	9.94E+13	8.84E+13
11 - W11	937.5	84.4	28,565.5	-	6,023.5	-	1.30E+15	1.2346E+15
TOTAL	25436.3	808.4	389,434	18,524.3	88,723.2	287.1	3.7721E+15	3.4681E+15

Load reduction estimates were determined by technical committee members using the Indiana Department of Environmental Management Load Reduction Worksheet. Refer to Table 20 for estimated load reductions per best management practice. While the estimated load reductions may be higher than the project's goals, the committee plans to revisit each of the goals annually and make any necessary changes as more data is collected.

Table 24: Estimated Load Reduction per Practice

	Sediment Reduction	**Nitrogen Reduction**	**Phosphorus Reduction**
Changing from conventional tillage with 0% residue after planting to a no-till system with 60% residue after planting on 1,000 acres	2,824 tons/year	2,706 lbs/year	5,412 lbs/year
Managing ten farms with approximately 25 head of beef cattle/farm from entering waterbodies - Estimation is based on 12,775 lbs/year/cow of manure deposited in the stream.	-	25,550 lbs/year	12,775 lbs/year
Improving quality of pasture/hayland areas on 2,500 acres of poorly managed land. Estimated load reduction is based on 2.82 tons/acre/year with a "C" factor of 0.12 beginning at 60% cover and going to 0.003 at 70% cover.	2,654 tons/year	7,071 lbs/year	3,538 lbs/year
Enlarge existing buffers by 16 acres in subwatershed 110 and 050	18 tons/year	56 lbs/year	28 lbs/year

FUTURE PLANS –
This section describes the planned order of implementation, the time requirements for implementing the plan, who is responsible for carrying out tasks, and what milestones the committee will be checking.

Table 25: Future Plans

Task	Time Required	Person Responsible	Milestones	Financial Assistance
1. Develop and submit 319 Implementation Grant	2 months	Watershed Coordinator	• Receiving implementation grant	Dearborn County SWCD
2. Develop Hogan Creek Watershed Cost-share Program highlighting BMPs introduced in this plan	1 month	Hogan Creek Technical Committee Watershed Coordinator	• Developing cost-share program that addresses resource concerns outlined in plan	Dearborn County SWCD 319 Grant
3. Implement cost-share program	On-going	Dearborn SWCD technician Ripley SWCD technician Watershed Coordinator	• Number of landowners applying for cost-share • Number of conservation practices installed within the watershed community • Nitrogen, Phosphorus and Sediment saved from entering Hogan Creek • Need for additional funding	319 Grant EQIP WHIP LARE Dearborn County SWCD
4. Develop and Implement Education Program	On-going	Hogan Creek Education Committee Watershed Coordinator	• Increased participation during events • Distribution of publications	319 Grant Dearborn County SWCD Local Grants Individual Donations
5. Reapply, as needed, for additional funding for education and cost-share programs	On-going	Watershed Coordinator	• Receiving additional funding	319 Grants Dearborn County SWCD Local Grants Individual Donations

MONITORING INDICATORS –
This section describes how indicators will be monitored to evaluate the effectiveness of implementation.

12.1 Social Indicators

Social indicators are measures that describe the context, capacity, skills, knowledge, values, beliefs, and behaviors of individuals, households, organizations, and communities at various geographic scales[82].

Social indicators are typically used to assess current conditions or attainment of social goals related to human health, housing, education levels, recreational opportunities, social equity issues and the like. For our purposes, they will most often be used to measure intermediate outcomes that we anticipate will lead to the goal of improved water quality. Intermediate social outcomes reflect a set of NPS program activities that influence social change, such efforts that emphasize building awareness, supporting watershed organizations, and building local capacity for planning and problem solving.

Social Indicators will be used to monitor:

- increased knowledge of watershed issues;
- increased concern of watershed issues;
- increased knowledge of conservation practice importance
- Changed attitudes of taking action to improve water quality

12.2 Environmental Indicators

Environmental indicators are measurements of water quality, habitat or some other criterion that tells you something about the health of the environment[83]. Indicators may include levels of a contaminant found in water, species population, or mercury content in fish tissue. Although these indicators require more time than social or administrative indicators, the are often more accurate and better for evaluating progress of watershed actions.

Environmental Indicators will be used to monitor:

- reduction of sediment entering waterbodies by installing conservation practices;
- reduction of E. Coli entering waterbodies by installing conservation practices;
- reduction of phosphorus and nitrogen entering waterbodies by installing conservation practices;
- change in pollutant concentrations in waterbodies;
- change in macroinvertebrate diversity

12.3 Administrative Indicators

Administrative Indicators are measurements in which the committee can easily quantify. They may include number of people attending a function, feet of fence installed along a stream, number of acres converted to a no-till system, and so on. These indicators are useful when

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[82] Great Lakes Regional Water Program "Developing a Social Component for the NPS Evaluation Framework", July 27, 2006. http://www.uwex.edu/ces/regionalwaterquality/Flagships/Indicators.htm. (December 11, 2006).
[83] Indiana Department of Environmental Management. "Indiana Watershed Planning Guide" August 2003.

reporting increased participation in programs, but are often indirect indicators of more useful information, such as a decrease in nutrient loading.

Administrative Indicators will be used to track:

- attendance at education field days;
- distribution of publications;
- news article submitted to newspaper and newsletters;
- number of conservation practices installed; and
- volunteer recruitment numbers

12.4 Monitoring Plan

The Watershed Coordinator will develop a database to track social and administrative indicators. This database will be updated after each event or survey. The information will be compiled at the end of each calendar year and reviewed by the steering committee to make sure the group is having a positive effect within the watershed.

In addition to the social and administrative indicator database, a separate database will be compiled with environmental indicators. This database will updated after best management practices are applied within each subwatershed. It will be reviewed every six months to ensure best management practices are being installed in critical subwatersheds.

EVALUATING AND ADAPTING THE PLAN –
This section describes when the watershed plan will be re-evaluated, who will do it, who is responsible for revisions and where citizens can obtain copies of the plan.

13.1 Distribution of the Plan
A master copy of the current watershed plan will be located at the Dearborn County Soil and Water Conservation Office. In addition, the plan will be distributed to these locations:

Ripley County SWCD Office
1981 South Industrial Park Road, Suite 2
Versailles, IN 47042

Aurora Public Library
414 Second Street
Aurora, IN 47001

Dillsboro Public Library
10151 Library Lane
Dillsboro, IN 47018

Carnegie Community Library
14687 Main Street
Moores Hill, IN 47032

Milan Public Library
112 Franklin Street
Milan, IN 47031

Dearborn County Purdue Extension
233 Main Street
Aurora, IN 47001

Ripley County Purdue Extension
525 West Beech Street
Osgood, IN 47037

Lawrenceburg Public Library
123 West High Street
Lawrenceburg, IN 47025

13.2 Evaluating Responsibility
The Hogan Creek Watershed Management Plan will be evaluated at the end of each calendar year during a quarterly steering committee meeting. Each member of the committee will receive a copy of the plan in which they will be encouraged to evaluate with the current focus of the group. Members will be asked to bring revisions to the quarterly meeting where each revision will be discussed and voted upon. If any revisions are necessary, the coordinator will be responsible for making changes to the management plan and distributing changes to individuals and organizations who received original copies of the plan.

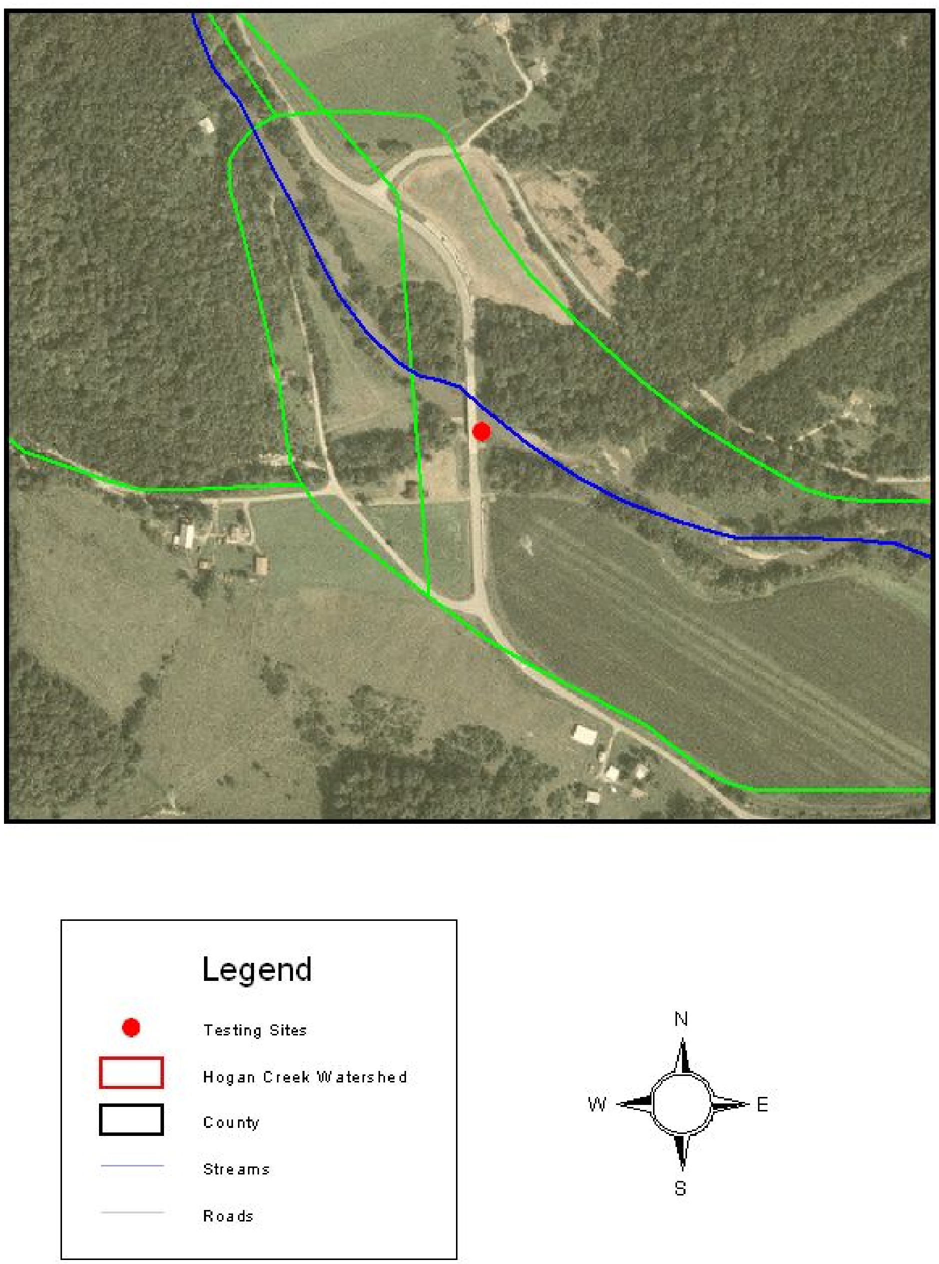
13.3 Practical Matters
For future reference, all management plan records and documents will be kept at the Dearborn County SWCD office. If you would like additional information about the Hogan Creek Watershed Project or its Management Plan, please contact the coordinator:

Kris Vance
10729 Randall Avenue, Suite 2
Aurora, IN 47001
Phone: 812-926-2406 ext 3
Fax: 812-926-4412
E-mail: kris-streb@iaswcd.org
Website: www.dearbornswcd.org/Hogan.htm

APPENDIX A – HOGAN CREEK TESTING SITES

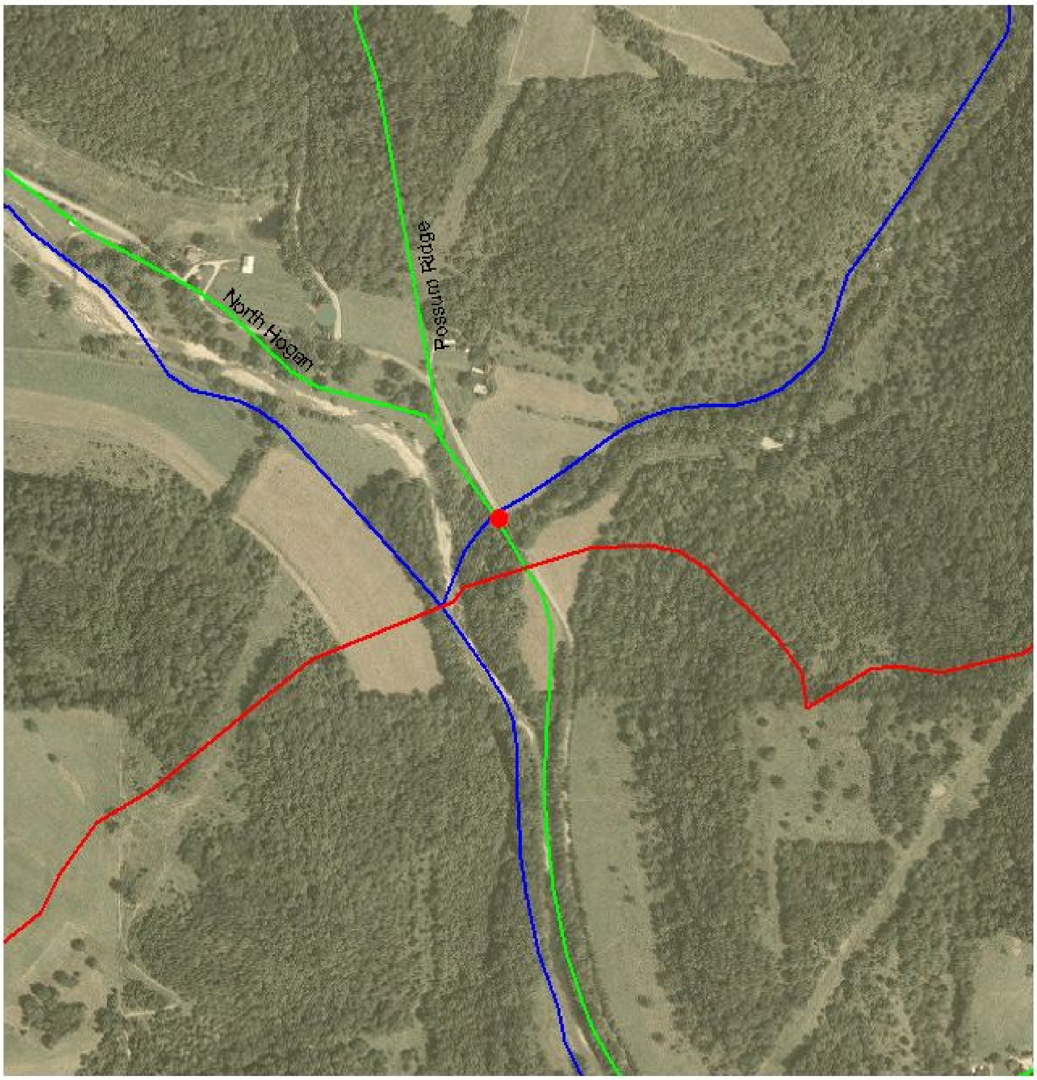
Hogan Creek Testing Sites

Site 1: North Hogan Road
(off the new bridge)



Hogan Creek Watershed Project

Testing Site Two - North Hogan Road
(Located at bridge south of Possum Ridge)



Legend

Testing Sites

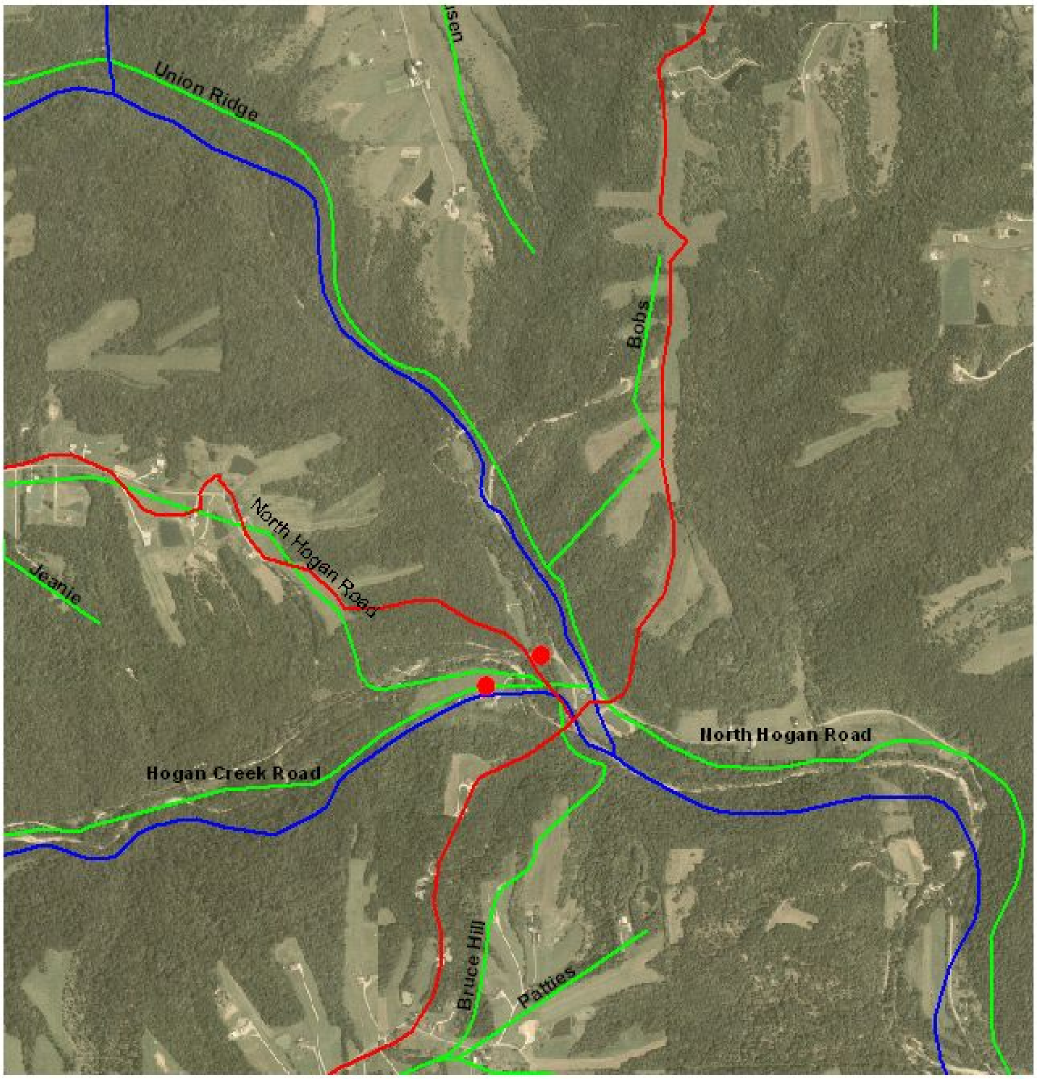
Hogan Creek Watershed

Streams

Roads

Hogan Creek Watershed Project

Testing Sites Three and Four
North Hogan Road (Hilton) and Bruce Hill Road (Lane)

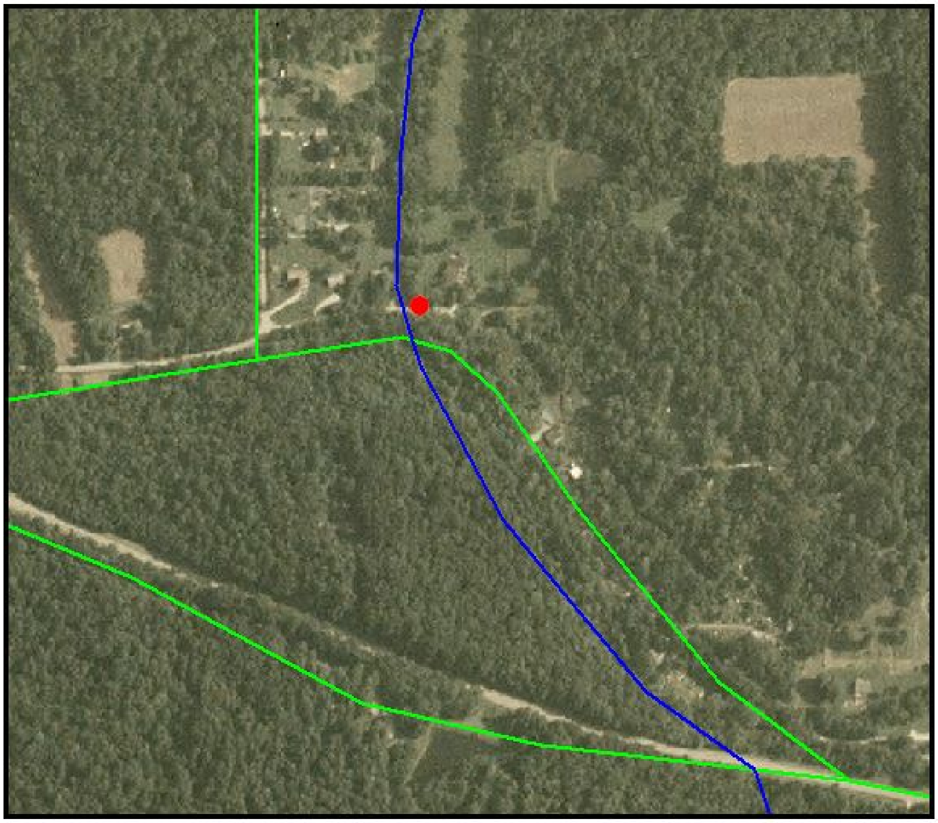


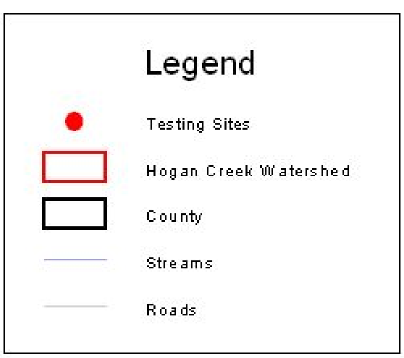
Legend

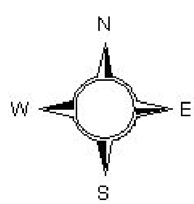
Testing Sites | Hogan Creek Watershed | Streams | Roads

Hogan Creek Testing Sites

Site 5: Burns Road
(Located off the stream crossing)

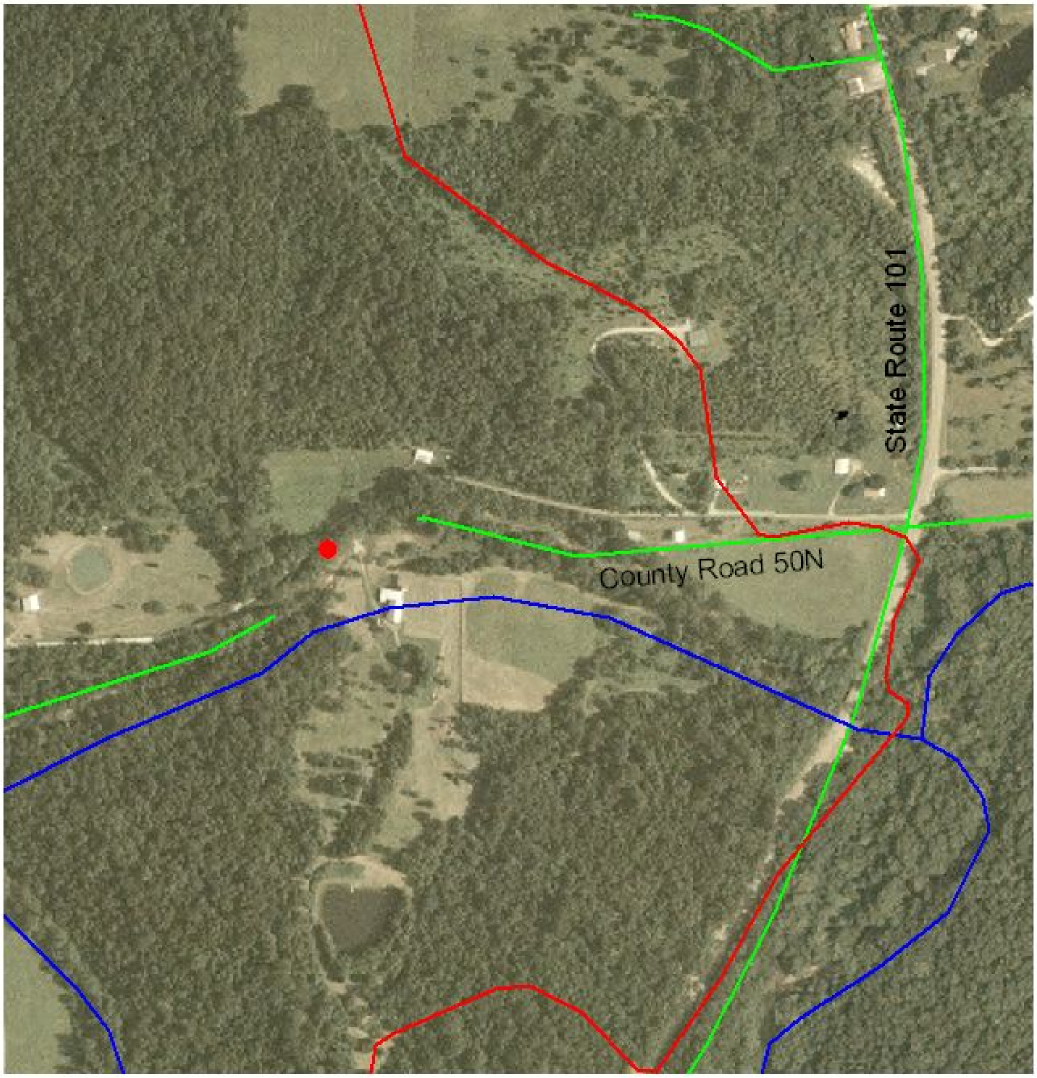






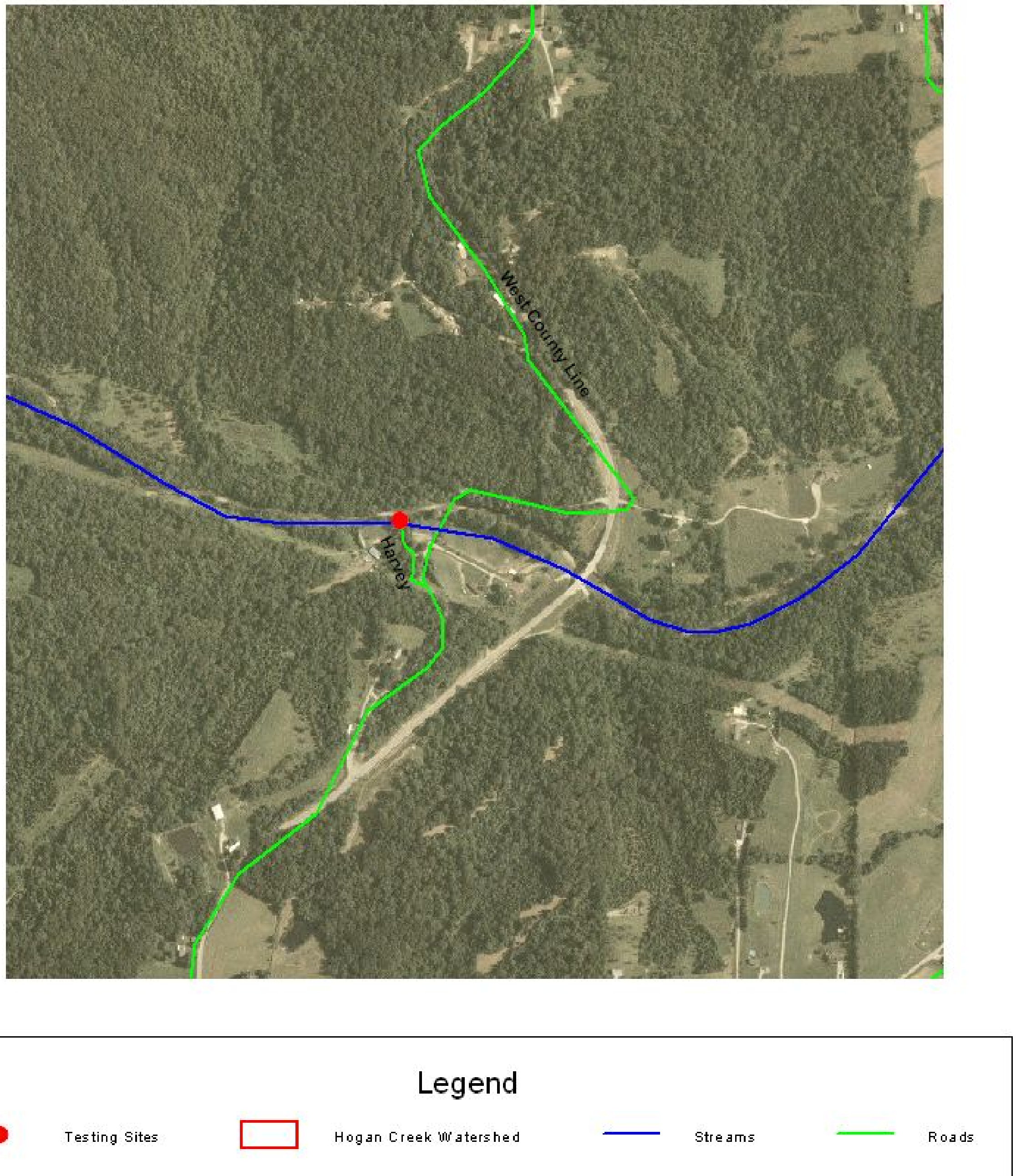
Hogan Creek Watershed Project

Testing Site Six - County Road 50N
(Located on ford on southside of road)



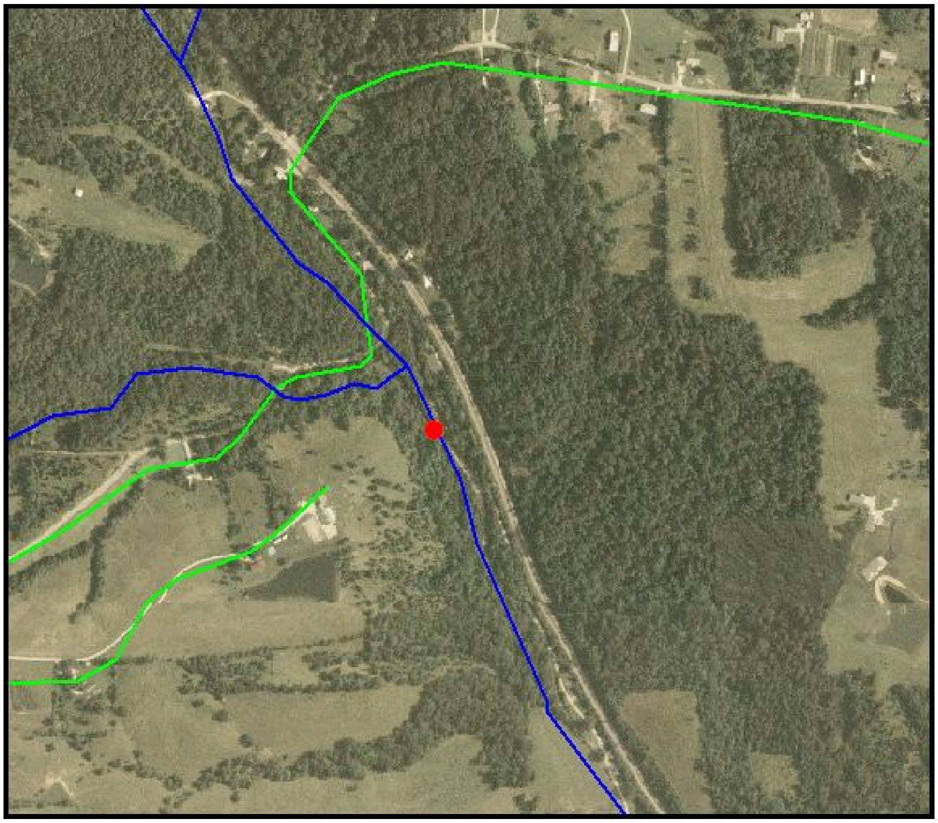
Hogan Creek Watershed Project

Testing Site Seven - West County Line Road
(Located off of Harvey Road)



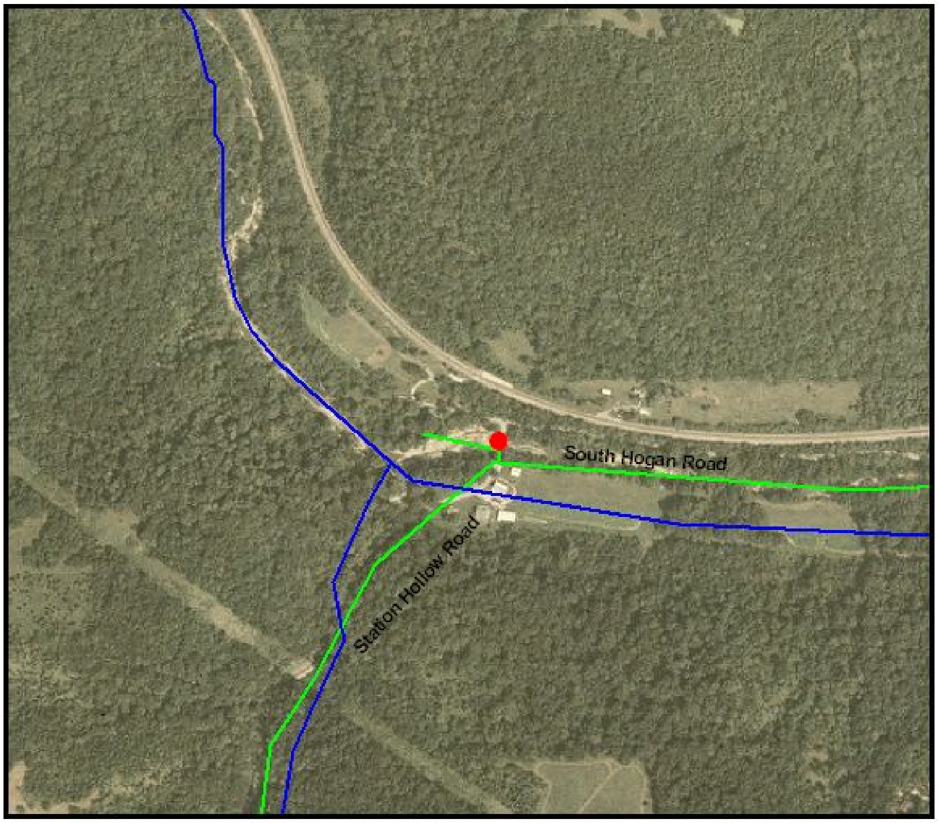
Hogan Creek Testing Sites

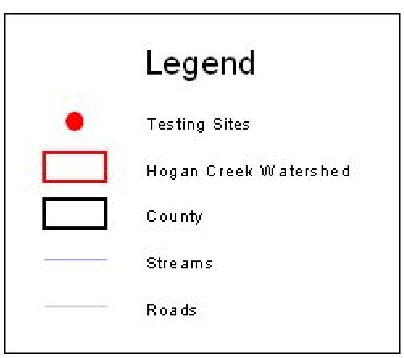
Site 8: Ted Chipman's Drive
(Located off Cold Springs Road)

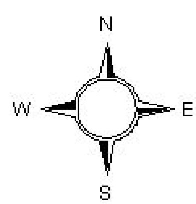


Hogan Creek Testing Sites

Site 9: Station Hollow Road
(on the bridge before turning right onto S Hogan)

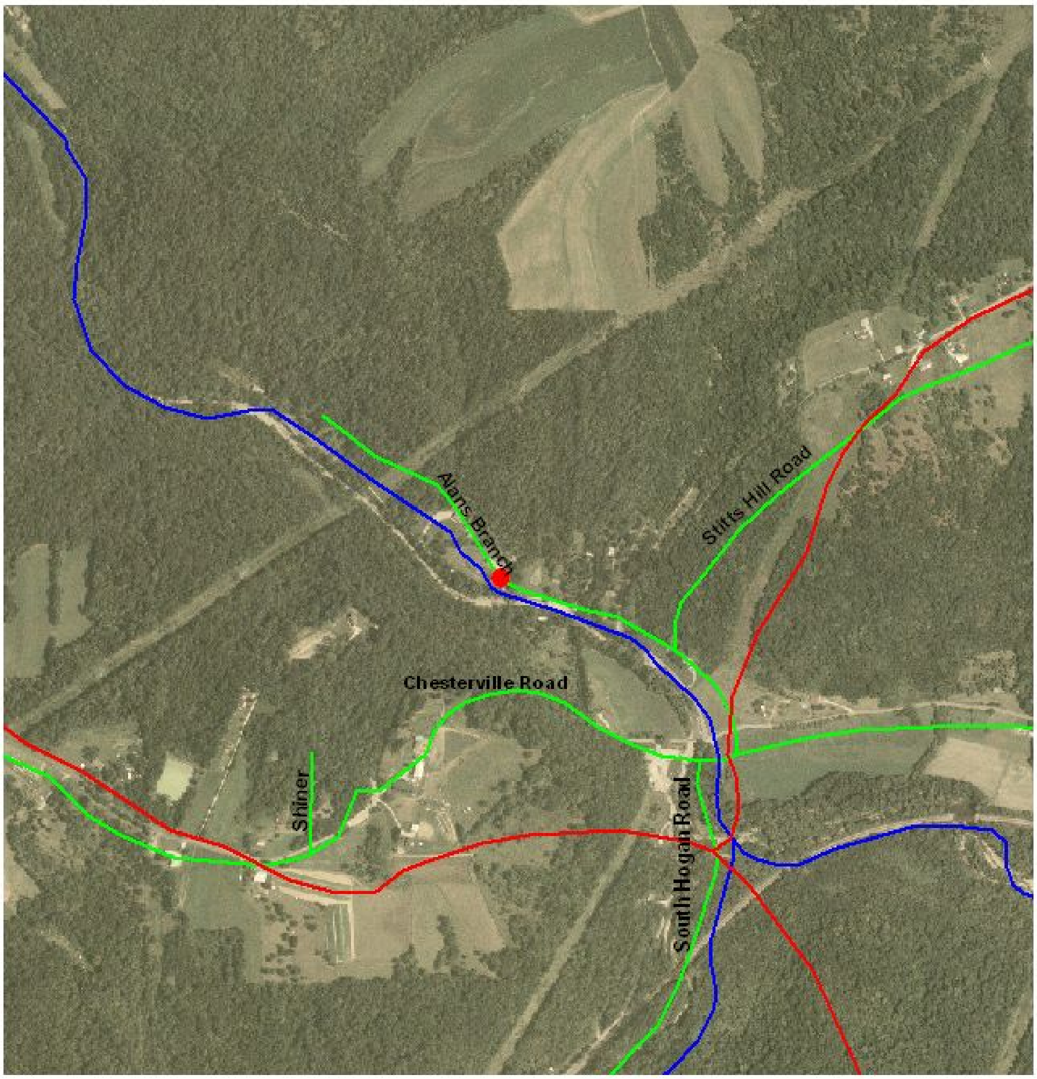






Hogan Creek Watershed Project

Testing Site Ten - Alans Branch Road
(Located off of Stitts Hill Road)

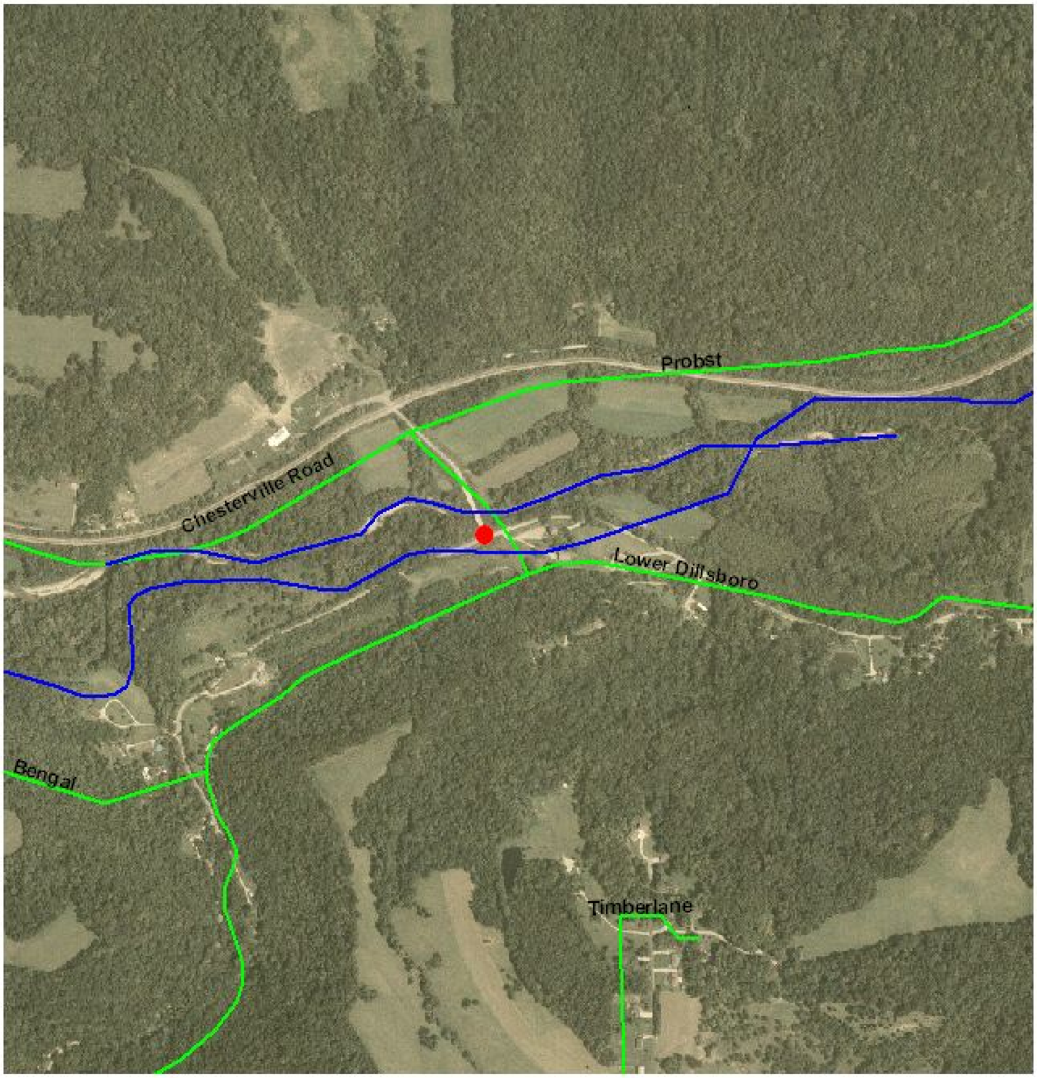


Legend

Testing Sites | Hogan Creek Watershed | Streams | Roads

Hogan Creek Watershed Project

Testing Site Eleven - Lower Dillsboro Road
(Located off of Chesterville and Probst Road)



Legend

Testing Sites | Hogan Creek Watershed | Streams | Roads

APPENDIX B – GORDON AND ASSOCIATES DATA

SITE ONE	12/5/2005	1/4/2006	2/1/2006	3/1/2006	4/4/2006	5/2/2006	6/5/2006	7/5/2006	8/1/2006	9/5/2006	10/3/2006	11/7/2006
Conductivity mS/cm	0.449	0.352	0.442	0.468	0.349	0.280	0.374	0.378	0.365	0.367	0.438	0.451
Dissolved Oxygen mg/L	15.49 112%	12.16 100	15.53 120	12.21 98	13.03	9.80	7.98	6.42	6.93	7.37	9.47	10.56
Flow Rate ft./sec.	E.F.*	2.98	2.69	1.82	4.37	5.97	0.48	0.21	0.26	0.17	8.94**	42.91**
pH	8.10	8.23	8.52	8.52	8.36	8.20	8.75	8.51	7.98	7.97	8.03	7.95
Salinity %	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Temperature °C	1.7	7.3	3.9	6.3	9.2	15.0	22.3	25.4	30.5	21.5	18.7	9.6
Turbidity NTU	E.F.*	19	4	3	15.08	82.31	7.70	12.01	10.35	21.66	8.71	2.41
Nitrate + Nitrite mg/L	0.22	0.33	0.07	BDL*	0.16	0.10	BDL*	BDL*	BDL*	0.06	BDL*	BDL*
Total Phosphorus mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	0.27	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*
E. coli col/100ml	400	630	1000	80	450	14400	660	1010	1750	410	680	200
Total Suspended Solids mg/L	BDL*	4	2	3	6	34	BDL*	10	BDL*	10	8	BDL*

BDL* - Below Detection Limits, E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE TWO	12/5/2005	1/4/2006	2/1/2006	3/1/2006	4/4/2006	5/2/2006	6/5/2006	7/5/2006	8/1/2006	9/5/2006	10/3/2006	11/7/2006
Conductivity mS/cm	0.547	0.475	0.528	0.608	0.459	0.350	0.572	0.525	0.538	0.600	0.576	0.556
Dissolved Oxygen mg/L	14.34	10.71	14.13	13.17	12.09	10.00	7.41	7.15	6.78	2.49	9.69	10.64
Flow Rate ft./sec.	E.F*	0.72	0.28	0.21	1.12	1.73	0.12	BDL*	0.12	0.00	0.72**	3.73**
pH	8.27	8.27	8.47	8.52	8.34	8.30	8.60	8.62	7.88	7.68	7.91	7.97
Salinity %	0.02	0.02	0.02	0.02	0.01	0.00	0.02	0.02	0.02	0.02	0.02	0.02
Temperature °C	2.1	7.4	4.5	6.3	8.7	15.0	17.5	21.2	24.9	18.3	16.3	9.7
Turbidity NTU	E.F*	10	3	2	6.70	65.86	7.34	7.62	2.59	7.47	1.67	1.61
Nitrate + Nitrite mg/L	0.13	0.18	0.08	BDL*	0.09	0.13	0.07	0.12	0.08	0.10	0.08	BDL*
Total Phosphorus mg/L	BDL*	0.12	BDL*	0.11	0.12	0.19	0.13	0.12	BDL*	0.14	BDL*	0.14
E. coli col/100ml	700	300	2000	60	130	16100	1330	2190	400	540	630	100
Total Suspended Solids mg/L	BDL*	BDL*	BDL*	6	9	48	BDL*	1	4	10	2	BDL*

BDL* - Below Detection Limits
E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE THREE	12/5/2005	1/4/2006	2/1/2006	3/1/2006	4/4/2006	5/2/2006	6/5/2006	7/5/2006	8/1/2006	9/5/2006	10/3/2006	11/7/2006
Conductivity - mS/cm	0.500	0.382	0.436	0.465	0.339	0.240	0.49	0.457	0.578	0.542	0.541	0.466
Dissolved Oxygen mg/L	14.44	13.32	15.48	15.86	12.49	10.00	9.00	7.57	7.38	9.09	10.02	11.96
Flow Rate ft./sec.	E.F.*	0.69	0.35	0.61	2.15	3.22	0.27	0.32	0.10	BDL*	0.63**	6.92**
pH	8.35	8.47	8.54	8.83	8.62	8.10	8.2	8.41	7.87	7.84	7.91	8.07
Salinity %	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.01
Temperature °C	1.7	8.0	3.7	6.6	12.1	15.0	18.0	22.4	26.2	18.4	15.8	9.4
Turbidity NTU	E.F.*	17	0	5	10.67	82.10	7.66	8.88	8.06	7.89	1.55	1.00
Nitrate + Nitrite mg/L	0.24	0.36	0.16	BDL*	0.10	0.18	0.06	0.11	0.07	0.05	BDL*	BDL*
Total Phosphorus mg/L	BDL*	BDL*	BDL*	0.11	BDL*	0.19	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*
E. coli col/100ml	300	400	1000	90	150	18700	480	810	250	720	420	70
Total Suspended Solids mg/L	BDL*	BDL*	4	8	11	68	4	10	6	8	2	2

BDL* - Below Detection Limits
E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE FOUR	12/5/2005	1/4/2006	2/1/2006	3/1/2006	4/4/2006	5/2/2006	6/5/2006	7/5/2006	8/1/2006	9/5/2006	10/3/2006	11/7/2006
Conductivity mS/cm	0.444	0.342	0.392	0.404	0.311	0.240	0.359	0.348	0.327	0.357	0.433	0.413
Dissolved Oxygen mg/L	14.53	13.67	16.62	15.41	12.97	9.80	10.86	9.29	10.35	11.01	10.61	12.66
Flow Rate ft./sec.	E.F.*	1.40	1.07	1.19	3.00	3.95	0.57	0.82	0.51	0.31	6.21**	22.19**
pH	8.34	8.52	8.81	8.90	8.58	8.10	8.81	8.67	8.20	8.25	8.18	8.37
Salinity %	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Temperature °C	1.7	8.2	3.5	7.3	12.0	15.0	20.0	23.8	29.0	19.6	16.9	9.8
Turbidity NTU	E.F.*	26	0	5	15.35	106.90	5.10	7.45	8.48	6.96	4.28	1.90
Nitrate + Nitrite mg/L	0.28	0.34	0.12	BDL*	0.15	0.15	BDL*	0.07	BDL*	BDL*	BDL*	BDL*
Total Phosphorus mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	0.19	BDL*	BDL*	BDL*	BDL*	BDL*	0.11
E. coli col/100ml	600	1000	600	50	130	17900	260	1070	600	530	1060	50
Total Suspended Solids mg/L	BDL*	4	8	3	14	104	4	3	5	4	6	3

BDL* - Below Detection Limits
E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE FIVE	12/6/2005	1/3/2006	2/1/2006	3/2/2006	4/4/2006	5/2/2006	6/5/2006	7/5/2006	8/1/2006	9/5/2006	10/3/2006	11/7/2006
Conductivity mS/cm	0.504	0.248	0.394	0.394	0.264	0.171	0.35	0.407	0.412	0.439	0.456	0.430
Dissolved Oxygen mg/L	15.14	11.99	14.92	13.33	12.47	9.31	8.9	7.32	6.88	9.25	7.99	10.66
Flow Rate ft./sec.	E.F.*	2.07	1.80	0.80	2.02	3.44	0.58	0.5	0.47	0.29	1.40**	6.29**
pH	7.55	7.79	8.34	8.26	8.05	7.53	8.0	8.07	7.93	7.55	7.73	7.86
Salinity %	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Temperature °C	-0.1	7.0	3.9	7.6	7.9	15.4	18.0	21.6	25.9	17.4	16.4	9.9
Turbidity NTU	E.F.*	45	9	3.96	27.45	75.07	6.94	7.74	4.69	5.54	2.10	5.36
Nitrate + Nitrite mg/L	0.39	0.37	0.36	0.08	0.27	0.13	0.44	0.28	0.36	0.16	0.15	0.18
Total Phosphorus mg/L	BDL*	0.14	BDL*	BDL*	BDL*	0.24	BDL*	BDL*	0.11	BDL*	BDL*	BDL*
E. coli col/100ml	1230	3900	7400	2980	780	19800	930	1260	550	1790	1570	1490
Total Suspended Solids mg/L	BDL*	17	11	7	21	84	8	9	1	16	2	6

BDL* - Below Detection Limits
E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE SIX	12/6/2005	1/3/2006	2/2/2006	3/2/2006	4/5/2006	5/3/2006	6/5/2006	7/5/2006	8/2/2006	9/5/2006	10/3/2006	11/8/2006
Conductivity mS/cm	0.508	0.214	0.373	0.378	0.299	0.260	0.381	0.313	0.330	0.292	0.361	0.414
Dissolved Oxygen mg/L	15.40	11.62	13.06	13.05	12.34	11.00	10.31	8.97	4.59	6.53	9.96	10.76
Flow Rate ft./sec.	E.F.*	2.69	0.97	0.57	1.41	1.93	0.27	0.34	0.09	BDL*	1.88**	15.99
pH	8.06	7.81	8.39	8.31	8.29	8.50	8.78	8.76	7.58	8.49	7.98	8.11
Salinity %	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Temperature °C	-0.1	7.7	4.1	7.7	8.0	19.0	22.2	23.7	27.7	21.3	19.9	10.2
Turbidity NTU	E.F.*	87	7	4.04	17.01	21.35	6.70	11.86	3.74	4.44	2.50	6.79
Nitrate + Nitrite mg/L	1.32	0.61	0.93	0.49	0.63	0.45	0.19	0.26	0.08	0.05	BDL*	14.99
Total Phosphorus mg/L	BDL*	0.16	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*
E. coli col/100ml	620	8500	1800	850	150	1900	590	2090	310	810	430	500
Total Suspended Solids mg/L	BDL*	34	4	3	8	14	14	11	6	4	2	1

BDL* - Below Detection Limits
E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE SEVEN	12/6/2005	1/3/2006	2/2/2006	3/2/2006	4/5/2006	5/3/2006	6/7/2006	7/6/2006	8/2/2006	9/6/2006	10/4/2006	11/8/2006
Conductivity mS/cm	0.481	0.234	0.389	0.390	0.322	0.280	0.425	0.363	0.435	0.409	0.425	0.449
Dissolved Oxygen mg/L	16.11	4.83	14.15	14.24	12.85	11.00	8.40	7.88	5.25	6.21	7.66	11.26
Flow Rate ft./sec.	E.F.*	2.86	1.31	0.54	0.81	1.29	0.17	0.26	0.15	BDL*	5.71**	46.09**
pH	8.22	7.99	8.65	8.55	8.43	8.60	8.69	8.70	7.70	8.49	7.73	8.17
Salinity %	0.02	0.00	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.01
Temperature °C	0.4	7.9	5.1	8.1	9.4	17.0	20.5	21.0	27.6	18.5	17.7	10.5
Turbidity NTU	E.F.*	107	7	2.97	15.67	24.77	6.87	5.22	6.25	3.57	1.90	4.74
Nitrate + Nitrite mg/L	1.00	0.56	0.74	0.13	0.45	0.37	0.06	0.10	0.1	0.07	BDL*	3.37
Total Phosphorus mg/L	0.11	0.18	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	0.12	BDL*
E. coli col/100ml	440	11200	660	510	380	2000	170	18000	890	870	630	330
Total Suspended Solids mg/L	BDL*	41	2	4	13	12	15	1	6	6	7	BDL*

BDL* - Below Detection Limits, E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE EIGHT	12/6/2005	1/3/2006	2/2/2006	3/2/2006	4/5/2006	5/3/2006	6/7/2006	7/6/2006	8/2/2006	9/6/2005	10/4/2006	11/8/2006
Conductivity mS/cm	0.559	0.337	0.452	0.409	0.377	0.370	0.474	0.397	0.480	0.516	0.529	0.452
Dissolved Oxygen mg/L	16.17	12.35	14.98	14.28	13.07	11.00	8.17	7.80	6.54	6.37	8.95	12.09
Flow Rate ft./sec.	E.F.*	1.81	0.982	0.31	1.14	1.10	0.13	0.24	0.13	BDL*	1.24**	6.15**
pH	8.48	8.36	8.63	8.64	8.53	8.60	8.65	8.44	7.70	8.82	7.9	8.38
Salinity %	0.02	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.02	0.02	0.01
Temperature °C	0.7	7.6	4.8	8.7	9.9	16.0	19.7	19.5	27.0	18.1	18.2	11.0
Turbidity NTU	E.F.*	33	7	3.32	14.18	13.40	4.07	3.92	4.44	3.89	2.31	5.14
Nitrate + Nitrite mg/L	1.47	0.86	0.81	0.38	0.51	0.36	0.07	0.13	0.14	BDL*	0.14	2.12
Total Phosphorus mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	0.11	BDL*
E. coli col/100ml	260	3000	7100	720	70	900	350	20700	760	980	710	290
Total Suspended Solids mg/L	BDL*	10	BDL*	11	13	13	2	2	1	10	2	BDL*

BDL* - Below Detection Limits, E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE NINE	12/6/2005	1/3/2006	2/1/2006	3/2/2006	4/5/2006	5/3/2006	6/7/2006	7/6/2006	8/2/2006	9/6/2006	10/4/2006	11/8/2006
Conductivity mS/cm	0.496	0.228	0.383	0.389	0.337	0.300	0.416	0.398	0.425	0.411	0.424	1/0/1900
Dissolved Oxygen mg/L	15.50	12.04	15.27	14.8	12.76	10.90	9.90	8.04	7.48	7.84	10.15	11.83
Flow Rate ft./sec.	E.F.*	3.84	1.81	1.54	4.21	1.84	0.18	0.27	BDL*	BDL*	3.25**	36.05
pH	8.21	8.10	8.86	8.71	8.82	8.70	8.58	8.96	8.08	9.10	8.04	8.37
Salinity %	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Temperature °C	-0.1	7.9	4.9	10.9	13.1	17.0	23.6	23.2	30.4	20.3	18.7	10.5
Turbidity NTU	E.F.*	190	7	2.52	14.49	19.02	5.43	8.40	4.88	22.01	1.96	3.43
Nitrate + Nitrite mg/L	0.77	0.49	0.53	BDL*	0.24	0.26	BDL*	0.07	0.06	BDL*	BDL*	1.44
Total Phosphorus mg/L	BDL*	0.23	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	0.33
E. coli col/100ml	430	17400	500	360	80	2100	360	14300	350	1580	400	250
Total Suspended Solids mg/L	BDL*	66	4	5	11	13	3	6	2	13	BDL*	BDL*

BDL* - Below Detection Limits, E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE TEN	12/5/2005	1/3/2006	2/1/2006	3/2/2006	4/5/2006	5/3/2006	6/7/2006	7/6/2006	8/2/2006	9/6/2006	10/4/2006	11/8/2006
Conductivity mS/cm	0.461	0.316	0.427	0.451	0.400	0.390	0.494	0.439	0.514	0.507	0.497	0.466
Dissolved Oxygen mg/L	14.69	12.38	14.85	13.32	13.11	11.20	8.4	8.69	4.77	7.49	9.90	11.20
Flow Rate ft./sec.	E.F.*	2.63	1.48	0.60	1.64	2.52	0.48	0.34	0.14	BDL*	0.89**	9.61
pH	8.30	8.16	8.84	8.68	8.62	8.50	8.19	8.79	7.75	8.97	8.10	8.27
Salinity %	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.02	0.02	0.02	0.01
Temperature °C	2.4	7.1	5.7	10.8	10.9	16.0	19.4	22.8	29.1	19.9	19.5	10.8
Turbidity - NTU	E.F.*	47	4	4.14	9.20	15.10	4.76	6.29	17.43	7.05	6.87	4.05
Nitrate + Nitrite mg/L	0.11	0.30	BDL*	BDL*	BDL*	0.06	BDL*	0.05	0.10	BDL*	BDL*	0.75
Total Phosphorus mg/L	BDL*	0.14	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	0.12	BDL*	BDL*
E. coli col/100ml	500	6200	1600	260	60	900	160	14600	220	400	260	300
Total Suspended Solids mg/L	BDL*	4	8	4	13	11	9	6	47	18	7	BDL*

BDL* - Below Detection Limits, E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

SITE ELEVEN	12/5/2005	1/3/2006	2/1/2006	3/2/2006	4/5/2006	5/2/2006	6/7/2006	7/6/2006	8/2/2006	9/6/2006	10/4/2006	11/8/2006
Conductivity mS/cm	0.453	0.242	0.404	0.424	0.365	0.290	0.462	0.400	0.465	0.424	0.437	0.453
Dissolved Oxygen mg/L	14.52	11.67	15.59	14.42	13.58	9.50	8.40	8.81	9.12	10.03	10.59	11.35
Flow Rate ft./sec.	E.F.*	3.04	1.35	0.78	1.90	2.90	0.22	0.21	0.17	BDL*	3.65**	58.75
pH	8.09	8.02	8.57	8.41	8.53	8.30	8.14	8.69	7.96	9.04	8.02	8.18
Salinity %	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Temperature °C	2.4	7.9	4.9	10.1	11.7	17.0	21.9	25.1	33.0	23.9	21.8	10.6
Turbidity NTU	E.F.*	238	8	2.25	11.85	92.74	4.21	3.84	4.24	5.82	4.13	21.33
Nitrate + Nitrite mg/L	0.55	0.42	0.32	BDL*	0.15	0.33	BDL*	BDL*	BDL*	BDL*	BDL*	0.76
Total Phosphorus mg/L	BDL*	0.26	BDL*	BDL*	BDL*	0.21	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*
E. coli col/100ml	600	20800	2500	300	80	15700	150	12500	190	1860	1090	330
Total Suspended Solids mg/L	BDL*	88	4	2	15	82	BDL*	BDL*	3	7	3	BDL*

BDL* - Below Detection Limits, E.F.* - Equipment Failure
** - Denotes Flow Volume in ft^3/sec

APPENDIX C – HISTORICAL WATER TESTING DATA

United States Geological Survey Study for South Hogan Creek Watershed
The following report details one of the approximately 50 stations in the Hydrologic-Benchmark Network (HBN) described in the four-volume U.S. Geological Survey Circular 1173.

Historical Water Quality Data
The data set for the South Hogan Creek HBN Station includes 189 water quality samples that were collected from October 1968 through May 1993. Samples were collected on a monthly basis from 1969 through 1982 and quarterly from 1983 though 1993.

The major ions in the stream water were calcium and alkalinity. The high concentrations of these ions in stream water are attributed to the dissolution of carbonate minerals in the limestone bedrock and glacial till.

The median chloride concentration in stream water was 390meq/L compared to the VWM concentration of 4.2 meq/L in precipitation. This large difference in concentration indicates that most stream-water chloride is derived from sources in the basin. Although some chloride may be derived from bedrock sources, most is probably derived from human activities. A number of point and nonpoint sources of chloride exist in the basin, including discharge from two wastewater treatment plants and road salt and fertilizer applications. Likewise, sulfate concentrations were considerably higher in stream water then in precipitation, leading us to believe sulfate loads are coming from a source in the basin, most likely the weathering of calcium sulfate minerals in the sedimentary rocks.

Although stream-water nitrogen concentrations are low compared to concentrations considered indicative of human-related pollution, the nitrate concentrations were substantially higher than at most other stations in the HBN, indicating human activities have some effect on nutrient concentration in stream water at this station. Nitrates are primarily transported during periods of high flow, probably due to surface runoff from agricultural lands and livestock yards.

Table XX: Physical Properties and Major Dissolved Constituents Measured From October 1968- May 1993 at South Hogan Creek Station #03276700

Parameter	Stream Water						Precipitation VWM[a]
	Minimum	First Quartile	Median	Third Quartile	Maximum	N	
Discharge	0.0003	0.045	0.25	0.76	64	187	--
Spec. cond.,	120	420	470	520	720	188	28
pH, field	6.4	7.8	8.1	8.3	9.5	187	4.3[b]
Calcium	750	3,000	3,300	3,800	6,000	189	6.9
Magnesium	220	850	1,070	1,150	1,920	189	2.0
Sodium	78	400	480	610	1,260	188	3.2
Potassium	31	67	85	110	190	188	0.5
Ammonium	<0.7	1.4	2.1	2.9	11	57	16
Alkalinity	700	2,800	3,320	3,760	5,500	188	--
Sulfate	310	960	1,200	1,410	2,500	189	57
Chloride	120	340	390	540	1,210	188	4.2
Nitrogen	<0.7	7.1	24	71	220	130	24[c]
Silica	0.7	55	88	110	200	189	--

* Concentrations in units of micro equivalents per liter, discharge in cubic meters per second, specific conductance in micro siemens per centimeter at 25 degrees Celsius, pH in standard units, and silica in micromoles per liter.
** N = Number of Stream Samples, Spec. Cond. = Specific Conductance, VWM = Volume-Weighted Mean
[a] Data are volume-weighted mean concentrations for 1984-95.
[b] Laboratory pH
[c] Nitrate only

Synoptic Water-Quality Data

Results of the surface water synoptic sampling in the South Hogan Creek watershed on November 5 and 6, 1991, are listed in Table XX.

Table XX: Physical Properties and Major Dissolved Constituents Measured from November 5-6, 1991 in South Hogan Creek Watershed

Site	Q	SC	pH	Ca	Mg	Na	K	Alk	SO_4	Cl	NO_3	Si	Criteria	Remarks
1	0.0096	720	8.2	4,650	1,200	1,090	160	4,000	2,040	1,320	0.7	110	--	Gaging Station
2	--	670	8.5	4,600	1,280	830	62	3,540	2,710	850	0.4	120	MT	Downstream from Moores Hill
3	0.0079	650	8.1	3,800	1,040	1,130	200	3,700	1,440	730	0.6	87	MT, BG	Limestone bedrock
4	--	590	7.6	3,900	1,200	370	250	4,700	400	560	3.4	170	MT, BG	Glacial Till
5	--	660	8.2	3,500	2,000	780	160	5,300	500	730	3.5	160	BG	Glacial Till
6	--	320	7.8	1,850	620	130	200	2,480	180	160	0.6	63	BG	Glacial Till
7	--	640	7.9	3,350	2,000	870	460	5,620	520	510	3.4	230	BG	Glacial Till
8	0.0017	100	8.0	4,100	1,680	3,740	240	5,680	1,650	1,940	590	270	LU	Downstream from WWTP
9	0.0059	830	7.4	2,650	960	3,000	440	1,520	1,480	2,510	1,710	120	LU	Downstream from WWTP
10	0.0006	560	7.7	3,300	1,120	610	150	2,780	1,400	760	29	110	LU	Upstream from WWTP

* Q = Discharge in cubic meters per second, SC = specific conductance in micro siemens per centimeters at 25 degrees Celsius, Ca = Calcium, Mg = Magnesium, Na = Sodium, K = Potassium, Cl = Chloride, NO3 = Nitrate, SO4 = Sulfate, Alk = Alkalinity, Si = Silica, WWTP = Wastewater Treatment Plant, -- = Not Reported
** Criteria used in selection of sampling sites: BG = Bedrock Geology, MT = Major Tributary, LU = Land use
*** Concentrations in micro equivalents per liter, except silica in micromoles per liter.

The following summary was taken from the U.S. Geological Survey's "Environmental characteristics and water quality of Hydrologic Benchmark Network stations in the West-Central United States[84]:"

> *During the sampling period, discharge at the gaging station was about 0.01 m³/s compared to the median discharge of 0.15 m³/s for November, indicating that the basin was sampled during low-flow conditions for that time of year. Because of the low-flow conditions, solute concentrations measured at site 1 were greater than the third-quartile concentrations reported for the HBN station during the entire period of record (table 1). The tributary streams were similar in composition to stream water collected at the gaging station (site 1); calcium and magnesium were the predominant cations, and bicarbonate and sulfate were the predominant anions. Ion balances for the synoptic samples were around zero (range -2.4 to 2.4 percent), indicating that unmeasured constituents, such as organic anions, did not seem to be an important component of stream water during the sampling period.*
>
> *Considerable spatial variability in stream chemistry was measured in the South Hogan Creek Basin, particularly for sodium, chloride, and nitrate, which seems to be related to wastewater discharge from treatment facilities in the towns of Milan and Moores Hill. For example, chloride concentrations in tribu-*

[84] Mast, M.A., and Turk, J.T., 1999, Environmental characteristics and water quality of Hydrologic Benchmark Network stations in the West-Central United States, 1963-95: U.S. Geological Survey Circular 1173-B, 130p.

taries sampled downstream from the towns of Moores Hill (site 8) and Milan (site 9) were 1,940 and 2,510 meq/L (table 2), respectively, compared to the average concentration of 580 meq/L at background sites in the basin (sites 3-7, 10). Sodium concentrations were 3,740 and 3,000 meq/L at sites 8 and 9, respectively, compared to the average background concentration of 650 meq/L. The most substantial difference in concentration was measured for nitrate, which had a concentration of 590 meq/L at site 8 and 1,710 meq/L at site 9 compared to the average background concentration of less than 10 meq/L. The synoptic samples also demonstrate that the water quality downstream at the HBN station was impacted by the wastewater-treatment facilities based on the elevated chloride concentration measured at site 1. By contrast, the nitrate concentration measured at site 1 was similar to background concentrations, implying that, at least during low-flow conditions, the biota were capable of consuming excess nitrate upstream from the HBN station. In contrast to sodium, chloride, and nitrate, the concentration patterns of the weathering-derived constituents were more uniform across the basin. For example, calcium concentrations ranged from 1,850 to 4,600 meq/L, and magnesium ranged from 620 to 2,000 meq/L. This pattern not only reflects the widespread presence of carbonate minerals in the glacial till and bedrock, but indicates that the towns of Milan and Moores Hill did not greatly affect the concentrations of these constituents in surface water. Sulfate concentrations were much lower in tributaries in the western one-half of the basin compared to the eastern one-half. For example, the average sulfate concentration at sites 4, 5, 6, and 7 was 400 meq/L compared to the average concentration of 1,740 meq/L at sites 2, 3, 8, 9, and 10. One explanation for this spatial pattern is a difference in bedrock mineralogy between these two areas of the basin. The streams in the northwestern part of the basin drain areas covered by glacial till, whereas drainages in the southeastern part of the basin are incised into the Ordovician bedrock, which, in places, contains evaporite beds of gypsum and anhydrite.

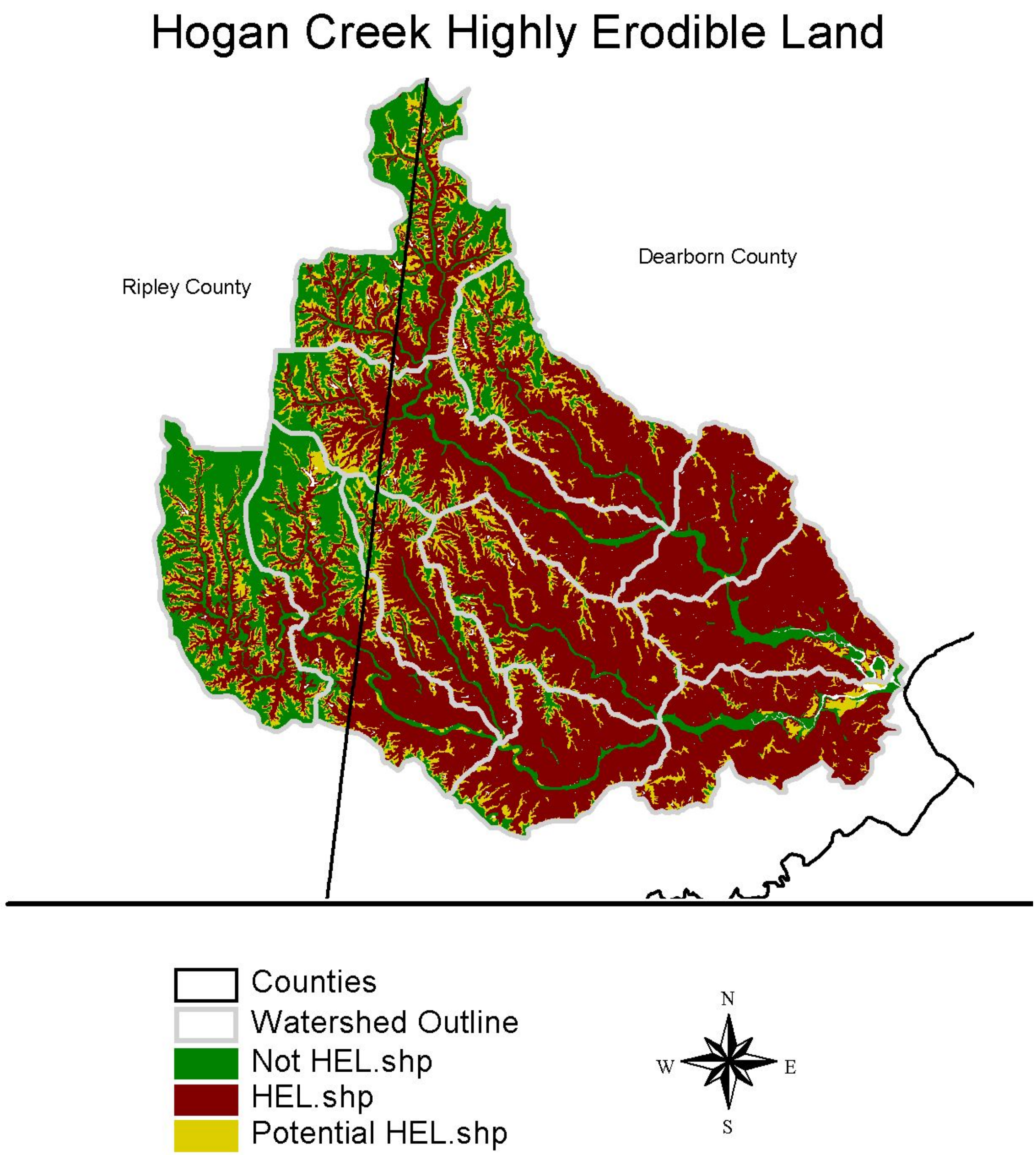
APPENDIX D: DEARBORN COUNTY FISHING TOURNAMENTS

Table 3: 2006 Dearborn County Fishing Tournaments

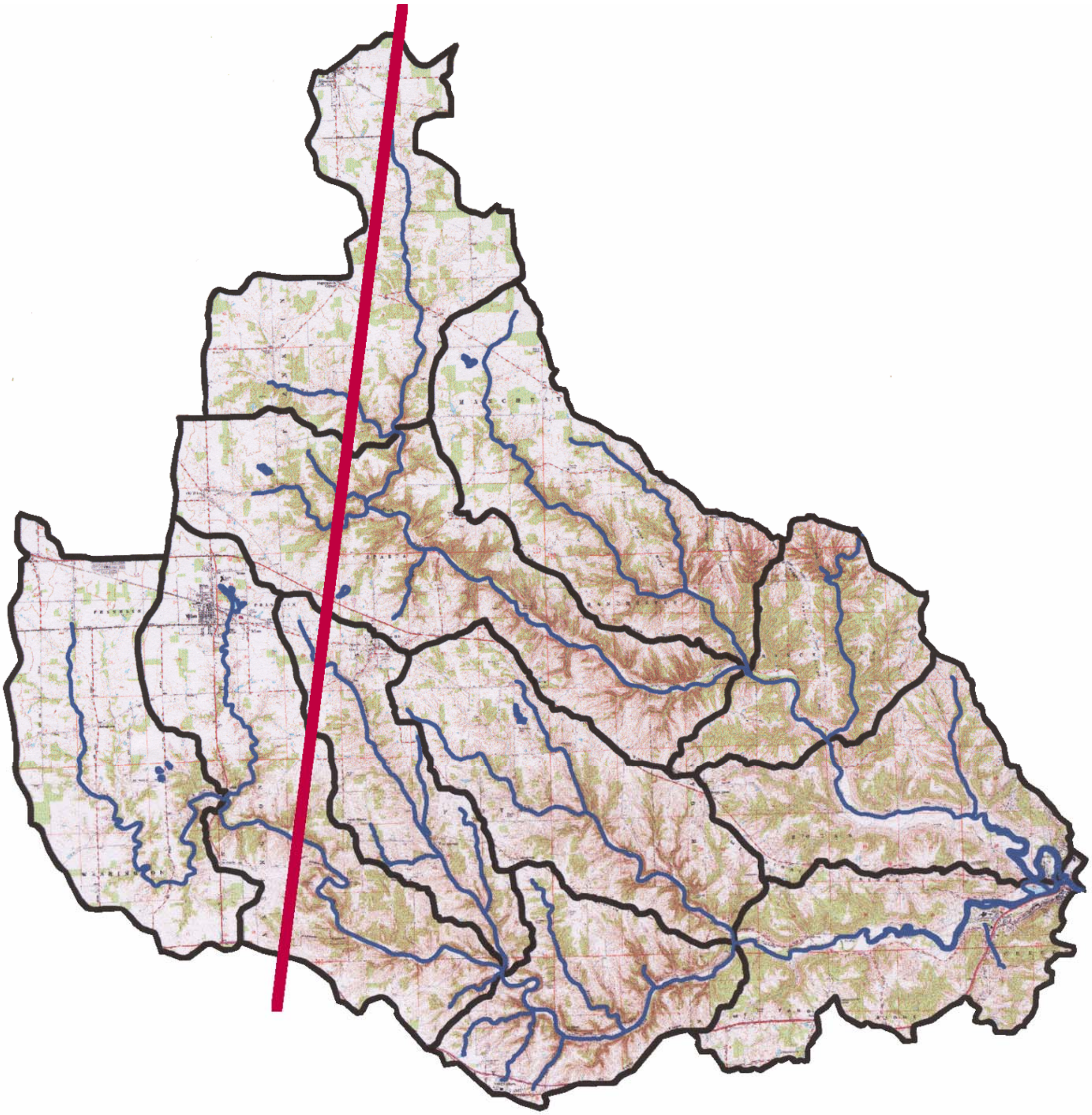
Date	Tournament Name
April 20	Dixie Marine Sr. Series
May 4	Dixie Marine Sr. Series
May 6	Mainville Bass Club
May 7	Dixie Marine Team Tour
May 27	Dixie Marine Classic
May 28	Dixie Marine Classic
June 22	Dixie Marine Sr. Series
June 25	Dixie Marine Central Team Tournament
July 1	Dixie Marine – Adopt a Bass
July 9	Dixie Marine Central Team Tournament
July 16	Ohio Bass Buddy
July 27	Dixie Marine Sr. Series
August 5	Fisher of Men
August 19	FLW Outdoors
August 20	Dixie Marine Team Tournament
August 24	Dixie Marine Sr. Series
September 14	Dixie Marine Sr. Series
September 23	Billy Backman Tournament
September 24	Billy Backman Tournament
September 30	Dixie Marine Appreciation Tournament
October 8	West Side Bass Club
October 22	West Side 4-Man Dream Team

* Source: Dearborn County Visitors Center

APPENDIX E: HIGHLY ERODIBLE LAND



APPENDIX F – TOPOGRAPHY MAP



Appendix G: Acronyms

BBD	Brown-blood Disease
BBS	Blue Baby Syndrome
CSO	Combined Sewer Overflow
DO	Dissolved Oxygen
DOR	Division of Outdoor Recreation
E.coli	Escherichia coli
FSA	Farm Service Agency
HBN	Hydrologic Benchmark Network
HCWP	Hogan Creek Watershed Project
HEL	Highly Erodible Land
HUC	Hydrologic Unit Code
IBC	Impaired Biotic Communities
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
MOLW	Middle Ohio Laughery Watershed
NO3	Nitrate
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
ORSANCO	Ohio River Sanitation Commission
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SWCD	Soil and Water Conservation Districts
SWPPP	Storm Water Pollution Prevention Plan
USEPA	United States Environmental Protection Agency
VWM	Volume-weighted Mean