Black River Watershed Management Plan

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Table of Contents

Table of Contents

Table of Contents

List of Tables

List of Figures

1. Project Overview and Introduction

A watershed is defined as all of the land area that drains into a common low point such as a lake or river. Rainwater and snowmelt run over the land and carry pollutants into those lakes and rivers. This form of pollution is referred to as nonpoint source, since it originates from a variety of sources. Watershed management takes a holistic approach to natural resource protection, focusing on all the activities within the watershed boundaries that can impact water quality. This requires working across township, county, and sometimes state and international boundaries. The watershed management planning process also relies heavily on input from stakeholders within the watershed.

This Watershed Management Plan has been completed through a Section 319 grant from the U.S. Environmental Protection Agency and administered by the Michigan Department of Environmental Quality. This grant was awarded to the Van Buren Conservation District in the Fall of 2002. Before this, a locally driven group of individuals and organizations known as the Black River Watershed Assembly had united in efforts to improve and protect the natural resources of the Black River Watershed.

This plan focuses specifically on nonpoint source pollution, a form of pollution that is generally not regulated. The primary aim of this plan is to protect and improve surface water quality in the Black River Watershed. Other goals include educating watershed residents on how they can work to improve and protect water quality, improving recreational opportunities on the river, and developing land use strategies that will protect water quality in the future.

The Black River is a shared resource: people swim in it, and canoe in it; farmers use it for irrigating their crops; people build houses along it to take advantage of picturesque views. South Haven is full of marinas for boaters who moor in the Black River. All of these interests depend to some extent on clean, unpolluted water. The river empties into Lake Michigan, and therefore any pollution problems in the Black River have the potential to impact the Great Lakes. Thus, the citizens of the Black River Watershed have an obligation to do their best to protect and improve the water quality of the Black River, and by extent, Lake Michigan.

2. Literature Review

Water quality is important to people, perhaps more so than any other natural resource protection goals (Weigel et al. 2004, Schueler 2000). The public is concerned with protecting drinking water quality, improving and protecting water quality in lakes, rivers and streams, and protecting watersheds (Weigel et al. 2004). Other complementary concerns include the creation of greenways, waterfront improvements, neighborhood revitalization, and protection from flooding (Schueler 2004).

Rivers are extraordinarily complex systems. Not until relatively recently did scientists begin to fully understand the interrelationships of the processes that occur in a healthy river system (Ward and Tockner 2001). For example, in the past, there was little consideration of floodplains and groundwater as part of the system (Ward and Tockner 2001).

Thus, the overall health of a river system is difficult to determine. Rivers that meet quantitative water quality standards may be lacking in other ways. For example, a waterway that meets water quality standards for chemical criteria may be devoid of mayflies, which are an important food source for trout (Palmer 1994). All portions of the system must be taken into account when researching the condition of a river.

Significant improvements have been made to water quality in many rivers due to point source controls on industrial and municipal discharges (Wolf and Wuycheck 2004). Nonpoint source pollution, on the other hand, remains a problem in many watersheds. Nonpoint source pollution is caused by pollutants that are carried into waterbodies through runoff from roads, parking lots, farms, lawns, and other sources. This form of pollution is difficult to trace due to the diversity of originating sources. One method of managing nonpoint source pollution is through watershed management.

Watershed management is the process of managing land-use activities on upland areas so that impacts on water quality are minimized. Inherent in this process is the recognition of the interrelationships between land use, water, and soil, as well as the connection of upstream and downstream areas (Brooks et al. 1991, Ffolliott et al. 2002). Watershed management recognizes the array of uses of a watershed, including agriculture, wildlife habitat, recreation, and industry (Brooks et al. 1991, Satterlund and Adams 1992), and works to balance the demands that are placed on our water resources. One challenge of watershed management is to protect or improve water quality while maintaining these uses.

Watershed management has been attempted for at least fifty years in the United States, but the science continues to evolve. Thus, many current watershed management efforts are, at least in some part, experimental (National

Research Council 1999). In the 1990s, watershed management became the new paradigm for resolving local environmental problems (Schueler and Holland 2000). Other relatively recent trends in environmental management relevant to watershed management include: a change from end-of-the-pipe pollution control measures to prevention of pollution; increased concerns about 'invisible' threats and chronic effects of pollution; awareness that nonpoint source pollution is now the major contributor to water pollution; and an increase in reliance on education programs to change behavior as it relates to environmental issues (Heathcote 1998).

Watersheds make an ideal planning unit when planning for the protection of ecological processes and habitats (Brody et al. 2004, Schueler and Holland 2000). Ecological processes, like watersheds, generally cross political boundaries. Improvements in downstream water quality can be undone by pollution upstream. However, due to the many political units that may be involved, the watershed boundary may be less useful for political and funding purposes (National Research Council 1999).

Because watershed management occurs across political boundaries, it requires buy-in from diverse agencies. No single entity has jurisdiction over all facets of the watershed, and thus watershed management requires effective collaboration from all of the political units within the watershed as well as state environmental agencies, non-profit organizations, and others. Though watershed management takes a broad geographic view, it is implemented at the local level through local land use policies. Furthermore, many factors that contribute to ecosystem degradation (such as habitat fragmentation and stormwater runoff) arise due to decisions made at the local level. On the other hand, decisions made at the local level to protect and improve ecosystems may be more effective and less expensive than those made at the state or federal level. Local land use decisions that are not made collaboratively have the potential to have a cumulative negative impact on the ecosystem (Brody et al. 2004).

Watershed management can focus on restoring degraded areas, but it can also set forth guidelines that will prevent future degradation to our water resources (Brooks et al. 1991). Beyond preventing future pollution, the most ambitious form of watershed management seeks to *improve* water quality conditions (Schueler 2004). This proactive, rather than reactive, approach will in most cases be more cost effective in the long term (Satterlund and Adams 1992). Additionally, watershed protection tools generally have a positive impact on the local economy (Schueler 2000).

A regulatory approach to an issue like watershed management is often punitive in nature and is costly to administer and enforce. Thus, some researchers feel that regulatory controls should only be used as a last resort after other programs (such as research, education, and technical assistance programs) have failed to achieve improvements (Satterlund and Adams 1992). On the other hand, the threat of future regulatory action is often an important motivator in encouraging collaboration to solve environmental problems in the present. Rather than treating environmental protection from a regulatory standpoint, watershed management strives to facilitate consensus and cooperation and ultimately solve problems relating to nonpoint source pollution and habitat loss (Lubell 2004).

Lubell (2004) argues that support from grassroots stakeholders is crucial to successful collaborative management. Grassroots stakeholders are those such as the fishers, farmers, and tourists: those who actually use the resource, not just elected officials and staff. Similarly, the National Research Council (1999) found that much watershed management in the mid- to late-20th century had been a "top-down" process, but that that approach had left out local-level decision makers. Their recommendation, therefore, was for watershed management to be driven by local stakeholders in a "bottom-up" approach.

Satterlund and Adams (1992) argue that education (particularly of policy makers, resource managers, and landowners) is essential to successfully implementing changes to improve watershed management. The growing population exacts a growing demand on water resources at the same time tourism and outdoor recreation are increasing. This points up the need for educating an urbanizing public about natural resources and rural land use (Satterlund and Adams 1992). Even rural landowners with access to technical assistance or subsidies (such as through programs administered by the Natural Resources Conservation Service) need to be educated about their options and the impacts on natural resources of their management. A study of landowners in Wisconsin found that educational programs had the most significant and long-lasting influence on management (Satterlund and Adams 1992).

The ultimate product of the watershed management planning effort is a watershed management plan. This plan should be a dynamic and flexible document, and should be updated as conditions in the watershed change (Schueler and Holland 2000). Thus, to be successful, plans should be reviewed and updated regularly (Satterlund and Adams 1992, Heathcote 1998). In reality, however, many watershed management plans, once completed, are never read or updated again (Schueler and Holland 2000).

Despite the array of benefits that watershed management can produce, not all planning efforts are successful. These efforts are often constrained by lack of funding, lack of technical expertise, or limited availability of water quality data. Schueler and Holland (2000) interviewed a variety of watershed stakeholders, including municipal officials, environmental planners, consultants, and watershed researchers about the effectiveness of watershed management plans. The general consensus was that many plans had ultimately failed to protect their watersheds. The following were the reasons cited for this failure:

- plan was conducted at too great a geographic scale
- plan was a one-time study rather than a long-term and continuous management commitment
- lack of local ownership in the watershed management process
- plan skirted real issues about land use change in the watershed.
- budget for watershed plan was poor or unrealistic
- plan focused on the tools of watershed analysis rather than their outcomes
- document was too long or complex
- plan failed to critically asses adequacy of existing local programs
- plan recommendations were too general
- plan had no regulatory meaning
- key stakeholders were not involved in developing the management plan

Additionally, the Indiana Department of Environmental Management (2003) noted that watershed partnerships can fail due to conflicts, lack of a clear purpose, vague goals, lack of commitment, and a failure to include all stakeholders.

Schueler and Holland (2000) also made recommendations for creating effective watershed management plans:

- create a watershed management institution
- plan at the subwatershed scale
- commit to a continuous watershed management cycle
- accurately measure and forecast land use
- shift the location and density of future development
- produce integrated resource map for subwatershed
- devise specifies criteria to guide subwatershed development
- emphasize strategic resource-based monitoring
- audit effectiveness of local watershed protection programs
- incorporate priorities from larger watershed management units
- actively engage stakeholders and include public early and often
- promote intra- and inter-agency coordination

Brody et al. (2004) also recommended that watershed management plans must have a factual basis (including a thorough inventory of natural resources and human impacts to these resources), must have clearly specified and measurable goals and objectives, and must define the actions that need to be taken. The plan "conceptualizes a commitment to implementing the final plan… [and] articulates mechanisms and procedures to implement the plan once it is adopted" (Brody et al. 2004, p. 37).

Some of these recommendations may be difficult to implement in real world situations, given the realities of tight budgets, development pressures, and political situations (Schuler and Holland 2000). However, these recommendations have great potential to improve watershed management plans in the future.

Though watershed management planning may be flawed in some cases, the potential benefits are significant. Beyond identifying steps to be taken to improve water quality, a plan can also be used to leverage grant funds, empower the community, and leverage agency support (Indiana Department of Environmental Management 2003). Collaborative relationships built during watershed management planning can carry over into other areas of environmental management. In many instances, collaborative watershed management may be the only method by which to address nonpoint source pollution.

3. Watershed Description

3.1 Geographic Scope

The Black River Watershed encompasses approximately 183,490 acres, or 287 square miles in Allegan and Van Buren Counties in southwestern Michigan. 43.8% of the watershed lies in Allegan County, and 56.2% lies in Van Buren County. A map of the watershed is shown in Figure 1. The primary townships encompassed by the watershed are listed in Table 1.

Table 1: Townships in the Black River Watershed

Townships in Allegan County	Townships in Van Buren County
Casco Cheshire Clyde Ganges Lee	Arlington Bangor Bloomingdale Columbia Covert Geneva South Haven Waverly

The watershed boundary also encompasses small portions of Manlius, Saugatuck, and Valley Townships in Allegan County. However, no streams enter the watershed from these townships. There are also several cities and villages in the Black River Watershed. These are listed in Table 2.

Table 2: Cities and Villages in the Black River Watershed

City or Village	County
Fennville*	Allegan
Bangor	Van Buren
Breedsville	Van Buren
Bloomingdale	Van Buren
South Haven	Van Buren

*Though the boundaries of Fennville are technically within the Kalamazoo River Watershed, the cities' storm sewers drain to the Black River (G. Tuhacek, personal communication, February 17, 2004).

Other unincorporated communities in the watershed include Grand Junction, Pullman, and Lacota.

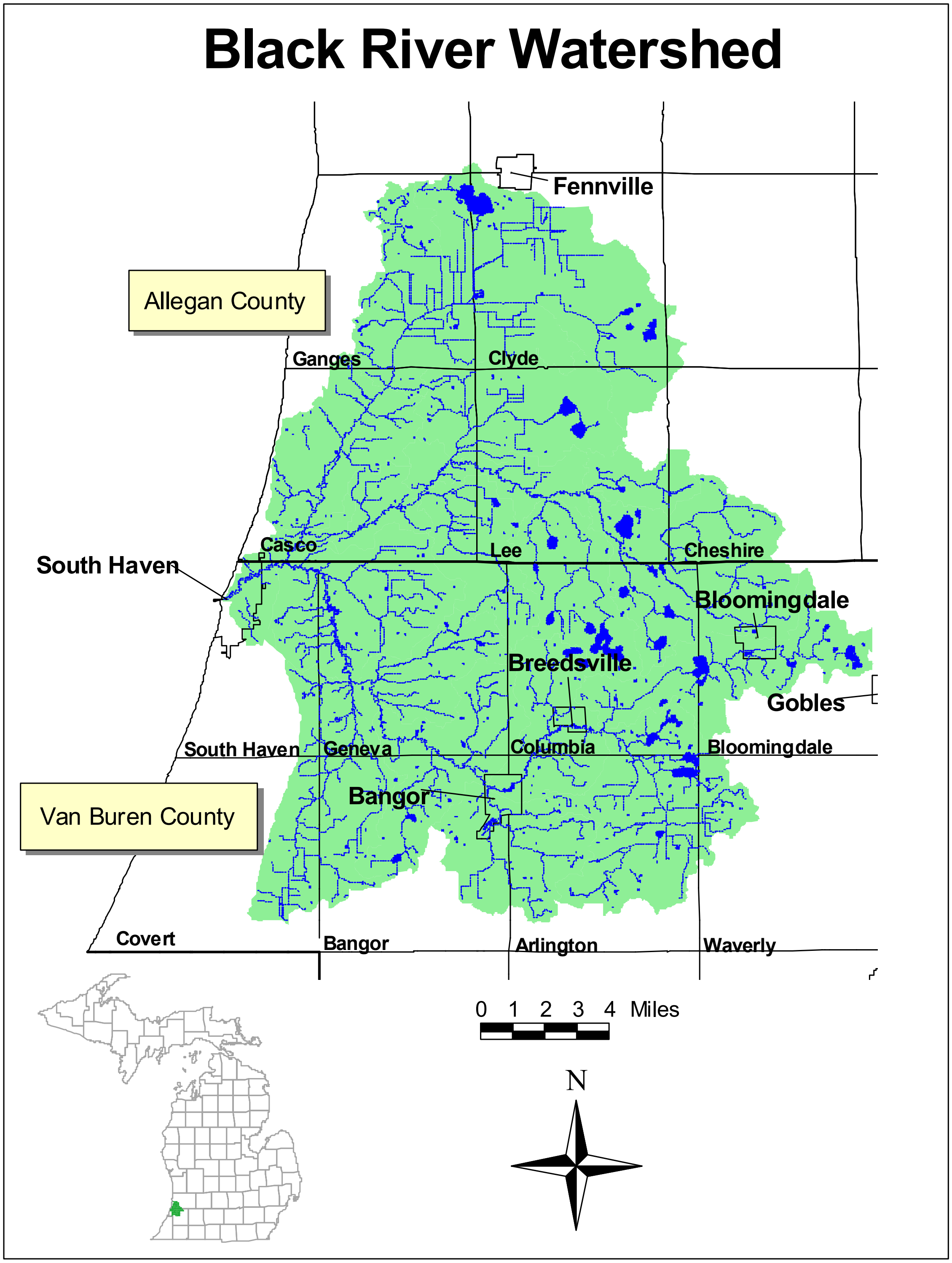

Figure 1: Black River Watershed map

3.2 Topography

Glaciers shaped the landscape of Michigan, and the Black River Watershed is no exception. The surface (or quaternary) geology map (Figure 2) of the area shows that the landscape of the watershed is dominated by lacustrine sand and gravel, fine-textured glacial till, glacial outwash, and end moraines (MNFI and MDNR 1998). The bedrock of the watershed is primarily Coldwater shale, with a small area of Marshall Formation (MDEQ 1987). This bedrock is generally covered with 50 to 350 feet of glacial deposits (Albert 1995). The landscape tends to be flat to gently rolling with some steeper ravines.

Relief varies across the area. The highest elevation in the watershed is 836 feet above sea level, in the far southern portion of the watershed in Arlington Township (Van Buren County). The lowest elevation is representative of local base level, which at the western shores of Lake Michigan is 577 feet above mean sea level. Topographic variations are not significant in Allegan County (USGS 1985).

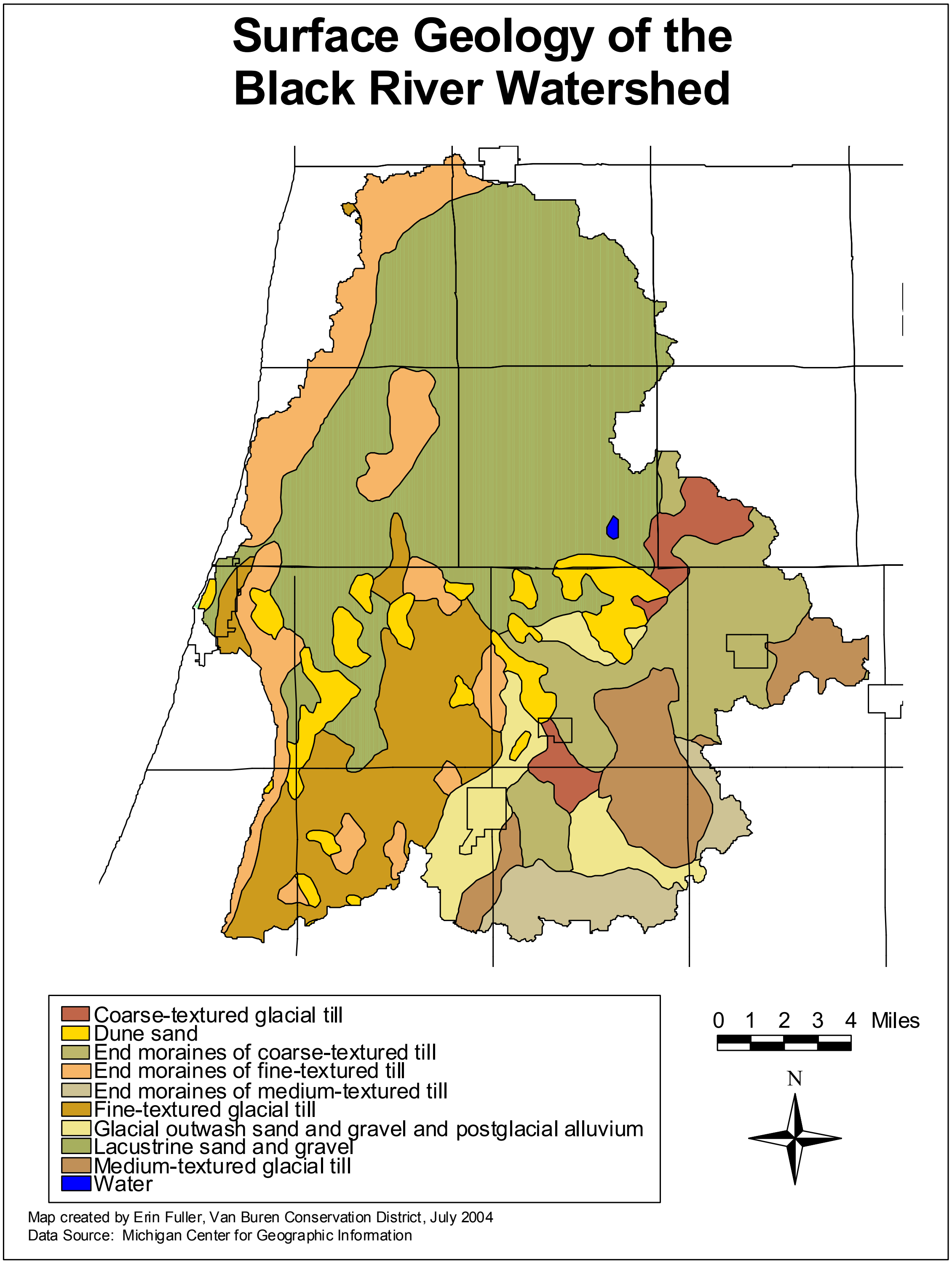

Figure 2: Surface Geology of the Black River Watershed

3.3 Soils

The principal soil associations in the watershed are Capac-Riddles-Selfridge and Gilford-Maumee-Sparta (Figure 3 and Table 3). The most prevalent soil series (in terms of area) in the watershed are Oakville fine sand, Selfridge loamy sand, Capac loam, Pipestone-Kingsville complex, Glendora loamy sand and Chelsea loamy fine sand. The Oakville series is usually well- or moderately well-drained and is found on outwash plains, lake plains, moraines, dunes and beach ridges. It can be poorly suited for crops due to droughtiness and erosion by wind (Knapp 1987). The Selfridge series is a nearly level and somewhat poorly drained soil. It is found on convex plains, knolls and side slopes. This soil is well suited for cropping with corn and soybeans (Bowman 1986). The Capac series is nearly level to undulating and somewhat poorly drained, and is found on flats, low ridges, knolls and foot slopes. These soils are well suited to cropland for corn, soybeans, small grain, hay, apples and pears (Knapp 1987). The Pipestone-Kingsville complex consists of nearly level, somewhat poorly drained soils. They are found on slight knolls, depressions, and natural drainageways. They can be frequently ponded. They are suited mostly for specialty crops, and if drained are well suited for blueberries (Bowman 1986). The Glendora series consists of nearly level, poorly drained soils and is usually found in floodplains. Due to periodic flooding, this soil is typically not used for crops (Knapp 1987). The Chelsea series is found in level to hilly areas on low ridges, knolls, flats and side slopes. It is usually excessively drained, and is typically unsuitable to cropland due to droughtiness and wind and water erosion. Some crops (such as corn, small grain, soybeans, hay, peaches, cherries, potatoes and asparagus) can be grown (Knapp 1987). Tables of the individual soil units are located in Appendix A.

Table 3: General Soil Associations in the Black River Watershed

General Soil Associations	Acres
Capac-Riddles-Selfridge	81,618
Coloma-Spinks-Oshtemo	11,393
Gilford-Maumee-Sparta	34,712
Houghton-Carlisle-Adrian	1,527
Kingsville-Pipestone-Covert	20,277
Marlette-Capac-Spinks	4,790
Oakville-Covert-Adrian	20,540
Urbanland-Parkhill-Capac	8,629

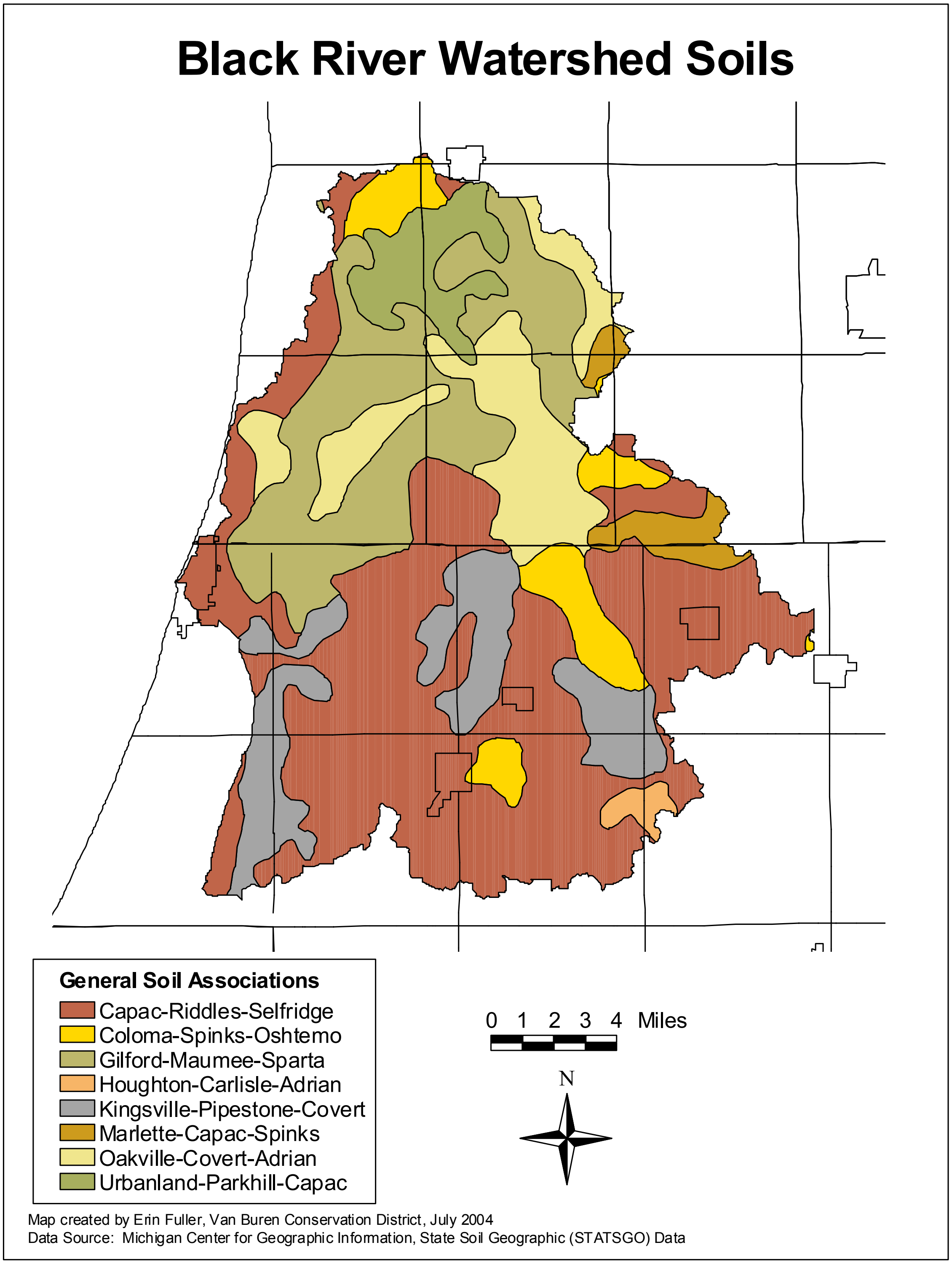

Figure 3: Black River Watershed soil associations

3.4 Ecosystem and Climate

The Black River Watershed is in the Berrien Springs (VI.3.1) and Southern Lake Michigan Lake Plain (VI.3.2) sub-subsections of the Southern Lower Michigan regional landscape ecosystem. This ecosystem has been highly modified by agriculture and development. In addition, the proximity of Lake Michigan and prevailing westerly winds moderate the climate and produce lake effect snow. The climate is influenced by the Maritime Tropical air mass, which tends to be a relatively warm and humid air mass (Albert 1995).

The watershed lies within the Southern Michigan, Northern Indiana Till Plains ecoregion. Ecoregions are delineated by their climates, soils, vegetation, land slope, and land use (Wolf and Wuycheck 2004). Rivers within this ecoregion tend to be of good quality in their headwaters, are typically slow flowing, and are sometimes bordered by extensive wetlands. Drainage ditches and channelized rivers are common in this ecoregion where land is too wet for agriculture or building (Wolf and Wuycheck 2004).

Total annual rainfall is approximately 37 inches. Average winter temperature is 25.6° F and average summer temperature is 69.4° F. Average seasonal snowfall is 85.6 inches (Knapp 1987 and Bowman 1986).

3.5 Land Use and Land Cover

Prior to European settlement of the area in the 1800s, the Black River Watershed was primarily forested (Figure 4). The dominant forest type was Beech-Sugar Maple forest. The complete list of pre-settlement land cover types is shown in Table 4. The forest was used for lumbering beginning in the mid 1800s and continuing until the 1890s. (Pahl n.d.). As soon as the land was cleared of trees, land was cultivated for agriculture (Knapp 1987).

Table 4: Black River Watershed 1800s Land Cover

Land Cover Type	Acres	% of total
Beech-Sugar Maple Forest	98276.2	53.6%
Beech-Sugar Maple-Hemlock Forest	22226.2	12.1%
Mixed Conifer Swamp	19736.5	10.8%
Mixed Hardwood Swamp	12805.5	7.0%
White Pine-Mixed Hardwood Forest	10257.8	5.6%
White Pine-White Oak Forest	7476.4	4.1%
Black Ash Swamp	3382.8	1.8%
Lake/River	3039.0	1.7%
Hemlock-White Pine Forest	2936.8	1.6%
Oak/Pine Barrens	1754.8	1.0%
Shrub Swamp/Emergent Marsh	1031.4	0.6%
Muskeg/Bog	413.1	0.2%
Cedar Swamp	149.7	0.1%
TOTAL	183486.3	100.0%

Source: Michigan Resource Information System 1978

The most current land use/land cover data for the Black River Watershed is from 1992 (Michigan Center for Geographic Information 2002). This shows agriculture (herbaceous planted/cultivated) as the dominant land use, followed by forested upland (Figure 5). The complete list of land cover types in the 1992 land cover map is shown in Table 5.

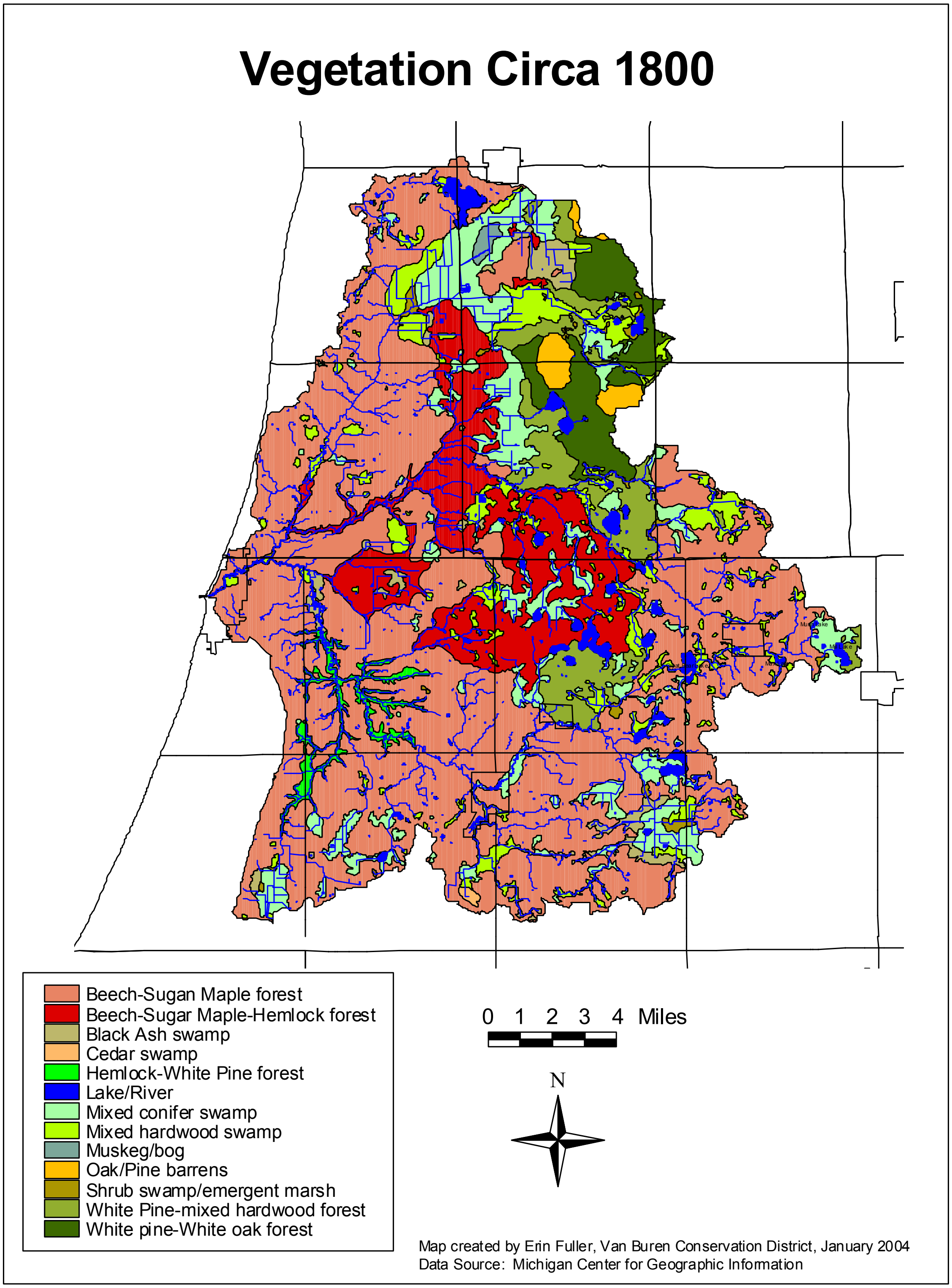

Figure 4: Presettlement vegetation in the Black River Watershed

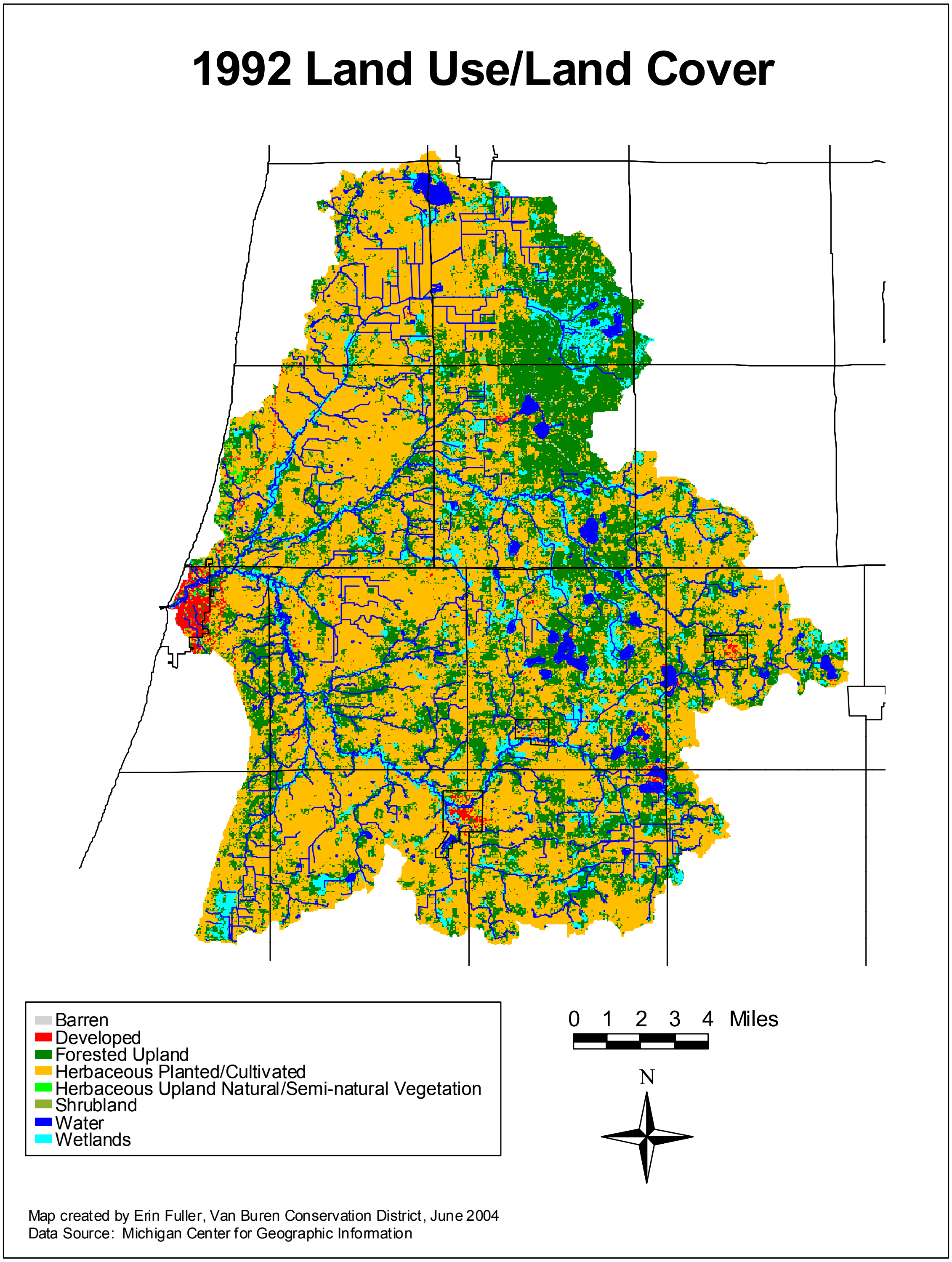

Figure 5: 1992 Land Use

Table 5: Black River Watershed 1992 Land Cover

Land Cover Type	Allegan Acres	Van Buren Acres	Total Acres	% of watershed
Herbaceous Planted/Cultivated	44385.5	60894.8	105280.3	57.4%
Forested Upland	28015.2	32426.1	60441.3	32.9%
Wetlands	5950.2	6374.5	12324.7	6.7%
Water	1160.6	1608.4	2769.0	1.5%
Developed	409.1	1742.3	2151.3	1.2%
Barren	250.1	2.1	252.2	0.1%
Herbaceous Upland Natural/Semi-natural Vegetation	173.2	34.5	207.7	0.1%
Shrubland	61.2		61.2	0.0%
Total	80405.1	103082.7	183487.8	100.0%

Source: Michigan Center for Geographic Information 2002

Land use/ land cover data is also available from 1978 (Michigan Department of Natural Resources 1999) (Figure 6). There is no clear trend in land use change available from an analysis of these two data layers, due to the different methods by which these data were derived. The 1978 data was derived from a visual interpretation of aerial photographs, while the 1992 data was compiled from Landsat satellite Thematic Mapper imagery. A summary of the results of these surveys is shown in Table 6.

Table 6: Black River Watershed Land Use/Land Cover in 1978 and 1992

Land Cover Type	1978	1992
Agricultural Land	54.42%	57.38%
Forested Land	36.51%	32.94%
Developed Land	4.71%	1.17%
Wetlands	2.83%	6.72%
Water	1.48%	1.51%
Other	0.06%	0.28%
Total	100.00%	100.00%

Sources: Michigan Department of Natural Resources 1998 and Michigan Center for Geographic Information 2002

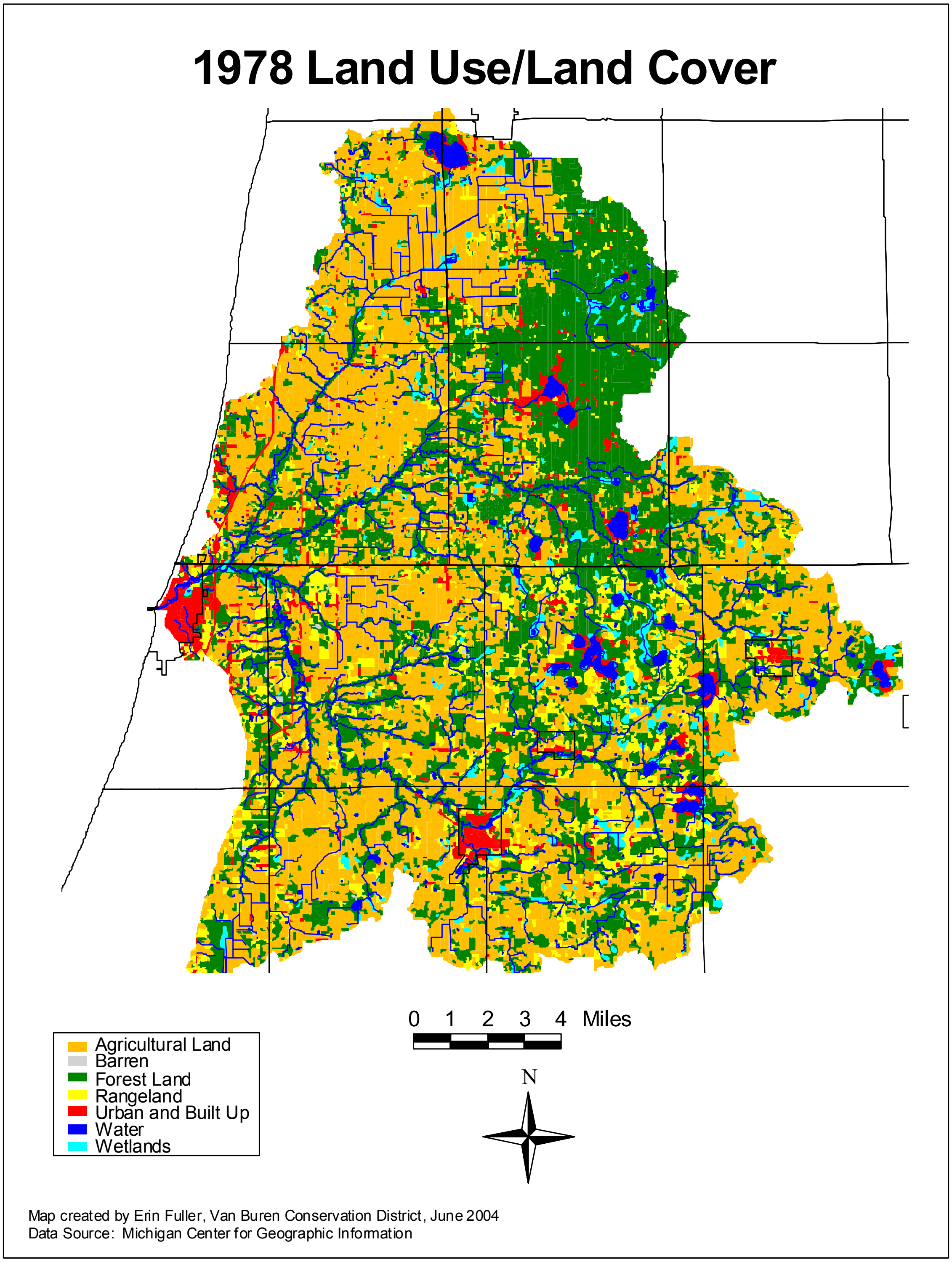

Figure 6: 1978 Land Use

3.6 Hydrology

The Black River Watershed contains approximately 530 miles of rivers, streams, and drains (this number does not include intermittent streams and likely under-represents county drains). The watershed also contains 43 named lakes and numerous (over 500) small, unnamed lakes and ponds. The named lakes are listed in Appendix B. The largest lake in the watershed is Hutchins Lake in Clyde and Ganges Townships (Allegan County), at 379 acres. Other large lakes in the watershed include Saddle Lake in Columbia Township (Van Buren County) at 283 acres, Osterhout Lake in Lee Township (Allegan County) at 172 acres, and Great Bear Lake in Bloomingdale and Columbia Townships (Van Buren County) at 166 acres. Most of these named lakes (and many of the smaller, unnamed ones) are connected by surface water to the Black River through streams and drains.

Based on studies by the Michigan Department of Environmental Quality, lakes in southern lower Michigan tend to have moderate to high nutrient levels, while lakes with lower nutrient levels tend to be located in northern Michigan. This is likely due to the fertility of soils along with higher population density in southern Michigan. The lakes in the Black River Watershed that have been assessed have been determined to be either mesotrophic or eutrophic. Lakes listed as eutrophic in the watershed are Lake Fourteen (Columbia Township), Lower Scott Lake (Lee Township), and Saddle Lake (Columbia Township) (Wolf and Wuycheck 2004).

There are 17 dams on the Black River and its tributaries. Of these dams, 11 are privately owned, 4 are owned by local governments, and 2 are state-owned. Most of these are impassable to fish. The full list of these is shown in Appendix C.

Much of the wetland area in the watershed was drained during settlement to provide land for agriculture (recent wetland inventory maps are shown in section 4.7). Many drains were dug, or streams were straightened in the late 1800s and early 1900s to improve the drainage of water. The majority of the drains are located in the headwaters of the North Branch of the Black River, though drains also exist in the headwaters of both the Middle and South branches. Approximately 65% to 85% of this watershed's wetlands have been converted to other uses since European settlement of the area. Maps of wetland change created by the Michigan Natural Features Inventory (MNFI n.d.) indicate that the area with the most wetland loss is the headwaters area of the North Branch in Ganges and Clyde Townships. The area around inland lakes has also experienced a considerable amount of wetland loss.

Groundwater supplies much of the water in the main stem and tributaries of the Black River. Groundwater seeps are visible along the banks in several locations. This helps keep water temperatures relatively cold, even in the summer. Groundwater and surface water are clearly closely linked, and any contamination of the former has the potential to significantly impact the latter. The predominance of sandy soils and the shallow water table in many portions of the watershed make the groundwater particularly vulnerable to pollution. Sources of groundwater pollution include leaking underground storage tanks and abandoned wells.

Much of the Black River and its tributaries are low gradient. The profile is fairly typical, being steeper in the headwater regions and flatter near the mouth (Fongers 2004). Elevation changes between the headwaters and the mouth generally are not more than 5 feet per linear mile (though some headwaters have higher gradients). Water velocity is generally relatively slow. These factors contribute to the vulnerability of the system to sand and sediment deposition. Sand and sediment is deposited into the stream channel from eroding streambanks, and the stream lacks the energy to flush the deposits from the stream channel (Cooper 1999).

3.7 History of the Region

The rivers in this region of Michigan were the principal source of food and travel for the Native Americans that first inhabited the area. Europeans explorers and fur traders arrived in the early 1600s but the area was not settled until the late 1820s (Pahl n.d. and Bowman 1986). At that point lumbering became a major industry and sawmills and dams (to provide water power to the mills) were located on most of the rivers. This major clearing of land likely contributed a great deal of silt to the Black River. Mrs. A.B. Chase arrived in South Haven as a child in 1852. She recalls:

> We used to go out on the bank and watch the boats until they reached South Haven. We children crossed many a times on the dry sand bar at the mouth of the river, and when the wind went down, Old Mr. Bundy would come down with an ox team and plow through the sand, and in a few hours the river would flow again into the lake (excerpted in Appleyard 1996, p. 76).

The Black River (probably the South Branch) was cleared and widened for a 25-mile stretch to accommodate logs being floated down (Appleyard 1996). An early settler, Agnes Sheffer, recounted some of this history in "The Early History of South Haven":

> A saw mill was built in 1853 on the north side of the river. The river had been dragged for nearly 25 miles. The river was much wider and deeper than at the present time, which made it an easy run for logs from the pines lands up the river (excerpted in Appleyard 1996, p. 8).

By the 1860s, South Haven was a town of approximately 200 people, with a hotel, flour mill, lumber mills, tannery and several stores (Appleyard 1996). The piers at the mouth of the Black River in South Haven were first built in 1861, and a lighthouse was built on these piers in 1871 (Stieve 1977). The building of the piers gave rise to a busy harbor. Many ships were built in South Haven even before the turn of the 20th century. These ships were used for the transportation of products such as lumber, fruit, produce, wood pulp as well as passenger travel. In 1932, South Haven was the busiest foreign port on the Great Lakes (Stieve 1977). Much of the freight was wood pulp and other supplies for paper mills in the Kalamazoo area (Appleyard 1984).

The area was thickly forested and full of game when the settlers arrived. The January 8, 1855 edition of the Paw Paw Free Press contained the following advertisement:

> TO SPORTSMEN!
> All who take pleasure in hunting, will find plenty of amusement here. The woods on Black River and its branches are literally filled with game. Deer, Bear, Wolves and Turkeys are often met with. A good home will be found at the "FOREST HOUSE," which has lately changed hands, and is now kept by Mr. J.F. Withey who is ready and willing at all times to accommodate travelers and make them comfortable and happy.
> South Haven, Van Buren Co., Dec. '54

After the land was cleared during logging it was quickly cultivated for agriculture (Pahl n.d.). By 1921, most of the active logging had ended, and the fruit industry was on the rise (Appleyard 1984). The soils and climate of the region made it especially good for growing specialty crops like blueberries, apples and peaches.

The South Haven area has been a center for a variety of industries, including shipbuilding, tanneries, sawmills and commercial fishing. Fish species such as whitefish, perch and lake trout were all plentiful in the mid- to late-1800s. Sturgeon were also plentiful (Appleyard 1984). Oil was discovered in Bloomingdale in 1938, leading to the drilling of 108 oil wells and the building of two refineries. The oil boom lasted only a few years, and the oil business ended completely in 1963 (Van Buren Community Center n.d.).

The South Haven area became a resort destination in the late 1800s. Visitors arrived via lake steamer and lodging was available in a variety of hotels, farm resorts, family homes and summer cottages. Several parks and resorts arose along the Black River, including Riverside Park, Midway Park, Crescent Park, and Oakland Park. Launches carried resorters up and down the river.

The Bangor area has also been the center for several industries, many of which depended upon the Black River in some way. The first industry in Bangor was a sawmill built in 1846 on the banks of the Black River. Other mills soon followed, including a grist mill and a woolen mill. The Bangor Furnace Company was built in 1872. This blast furnace burned wood into charcoal for the manufacture of pig iron. This industry consumed a significant amount of the local virgin timber: approximately one square mile of local forest was cleared per year. The Bangor Chemical Works was built in 1877 to work in conjunction with the Bangor Furnace Company, producing chemicals that were derived from the furnace operations, including acetate of lime, wood alcohol, and acetic acid. By the mid-1880s both the furnace and chemical company were affected by the dwindling supply of local timber and lack of demand for iron. Both industries had ceased operations in Bangor by 1890. All the land that had been cleared for the operations of the blast furnace was potential farmland, and agriculture became the next major industry in the Bangor area (Emmert 2004).

All of these industries certainly impacted the Black River. The clearing of forests for the furnace and agriculture likely left the banks of the river unvegetated and unstable. Chemical pollutants from the industries were likely discharged into the river, as were pesticides (such as arsenate of lead) (Emmert 2004) and fertilizers from agricultural operations.

4. Natural Features of the Black River Watershed

4.1 Introduction

The landscape of the Black River Watershed has changed dramatically since the 1800s, prior to European settlement. The watershed was at that point nearly entirely forested (including both upland and lowland forest types), while the current forest cover is closer to 35% of the landscape. Wetlands (including marshes and swamps) were also a significant portion of the pre-settlement landscape (20.4 %). Current wetland land cover is between 2.8% and 6.7% of the watershed, representing a 65% to 85% loss from pre-settlement times.

Most of the native habitat remaining in the Black River Watershed consists of a variety of forest types. Most of this forest is deciduous, though there are also areas with evergreen and mixed forests as well. Of the wetlands remaining in the watershed, most are consist of woody vegetation (i.e. swamps), though a few contain herbaceous emergent vegetation (i.e. marshes).

Table 7: Native habitat types remaining in the Black River Watershed

Habitat type	Acres
Central Hardwood	46,846.4
Lowland Hardwood	16,294.5
Pine	3,098.5
Shrub/Scrub Wetland	2,940.4
Lakes	2,606.9
Wooded Wetland	1,472.8
Emergent Wetland	371.2
Aquatic Bed Wetland	255.6
Lowland Conifer	101.5
Aspen, Birch	31.5

Source: MDNR 1999

Many stretches along the Black River have intact riparian forest habitat. A study of bird communities in forested riparian wetlands in southern Michigan (Inman et al. 2002) found that this type of habitat is important breeding habitat for bird species that are not always found in upland areas. Species composition, species richness, and densities of individual species varied markedly between forested wetlands and adjacent uplands. Loss of this type of habitat would thus have a major impact those bird species that depend upon river corridors for food and nesting. Riparian forests also play a critical role in water quality. Deforestation of riparian areas leads to reduced stream habitat for benthic macroinvertebrates and compromises pollutant processing in the stream. Forested stream channels are also more stable than deforested channels (Sweeny et al. 2004).

4.2 Species in the Black River Watershed

As of September 2004, a total of 471 species of plants, 130 species of birds, 70 species of fish, and 67 species of other wildlife (insects, reptiles, etc.) had been recorded for the Black River Watershed. This list was compiled from observations of the watershed coordinator, watershed technician, and other volunteers, as well as from species lists kept by the Southwest Michigan Land Conservancy for four properties under their ownership in the watershed (Appendix D). Fish species were compiled by Kregg Smith, MDNR Fisheries biologist (Appendix E).

4.3 Unique Natural Features

A variety of rare species have been documented in the Black River Watershed. The Michigan Natural Features Inventory (MNFI) maintains a database of threatened and endangered species as well as species of special concern. For the Black River Watershed, this list contains 14 species of animals, 30 species of plants, one community (Coastal Plain Marsh), and one “other” element (Great Blue Heron Rookery). The Great Blue Heron Rookery is especially interesting because it may have existed as early as 1875. A journal article from 1895 recounts a visit to a heron rookery in Van Buren County at the approximate latitude of 42º 20 (Pericles 1895), which is the same latitude as the present rookery. This may also be the largest heron rookery in southwest Michigan.

The watershed contains one species that is federally endangered, the Karner Blue butterfly (*Lycaeides melissa samuelis*). The Eastern Massasauga (*Sistrurus catenatus catenatus*) is a candidate for federal listing under the Endangered Species Act of 1998. Species in the watershed that are listed at the state level as endangered include the migrant Loggerhead Shrike (*Lanius ludovicianus migrans*), Small-fruited Spike-rush (*Eleocharis microcarpa*), and Swamp or Black Cottonwood (*Populus heterophylla*). Other rare species that exist in the watershed include Red-shouldered Hawk (*Buteo lineatus*), Box Turtle (*Terrapene carolina carolina*), and Swamp Rose-mallow (*Hibiscus moscheutos*). A full list of these rare species can be found in Appendix F.

A population of state threatened Sessile Trillium (*Trillium sessile)* (also known as "toadshade") occurs along the South Branch of the Black River. This population is the northernmost population of this species yet discovered, and is one of the largest (B. Martinus, personal communication, May 1, 2004). This species is considered to be rare or uncommon in the state and possibly imperiled due to rarity.

4.4 Biological Surveys

The Michigan Department of Environmental Quality has performed a number of biological surveys in the Black River Watershed. A 1988 survey of the Black River in Bangor found that aquatic habitat quality was low due to the amount of sand and silt, and that discharges into the river may have also contributed to poor habitat quality. Low macroinvertebrate species diversity was discovered downstream of these discharges (Hull 1989). PCBs were also detected in fish in this area in a 1989 study (Gashman 1990).

A 1992 survey determined that biological quality ranged from acceptable to excellent throughout the watershed (though one site above Bangor rated as poor). A lack of cobbles, boulders and woody debris in the substrate, as well as sand and silt eroding from stream banks were cited as contributing to an in-stream habitat rating of 'fair' for much of the watershed (Heaton 1997).

The conclusions were similar in a 1997 survey. In-stream habitat was again reported as being threatened by sediment deposition. This survey reported that "…channelization from various historical dredging events had removed channel diversity, reduced bank stability, and generally contributed to conditions that reduce the quality and quantity of stream biota" (Cooper 1999, p. 2).

The most recent biological survey of the watershed occurred in 2002. Its conclusions were similar to previous surveys:

> In summary, water quality throughout the Black River Watershed was adequate to support acceptable biological communities at locations with suitable riparian and in-stream habitat. Unfortunately, historic channelization and dredging of many streams, wetland drainage, sandy soils, and the current land management activities of riparian owners provides the aquatic biota of streams in the Black River Watershed with limited stable habitat (Walterhouse 2003, p. 2).

4.5 Fishery

Descriptions of the original fish communities for the Black River watershed prior to European settlement are not available. However, currently there have been seventy species of fish identified in the watershed (Appendix E). Nine species of fish have been introduced through management practices or inadvertently by human development in the Great Lakes Basin. Non-native species such as sea lamprey, alewife, and round goby use the Black River for spawning (Goodyear et al. 1982) and have a strong influence on fish communities through predation or competition (K. Smith, personal communication, September 20, 2004).

The Michigan Department of Natural Resources routinely stocks fish in the Black River. These include brown trout, steelhead, chinook salmon, northern pike, rainbow trout, walleye, and muskellunge. Tiger muskellunge were stocked historically, but are no longer stocked (K. Smith, personal communication, September 17, 2004). Stocking locations include the Black River in South Haven, Osterhout Lake (Lee Township), North Scott Lake (Arlington Township), Barber Creek (Lee Township), Three Legged Lake (Bloomingdale Township), and Hutchins Lake (Ganges and Clyde Township) (Michigan Department of Natural Resources 2004).

Portions of the river are designated coldwater streams (Figure 7). These reaches are classified as coldwater streams by the MDNR because they are stocked with coldwater fish species. However, they do not necessarily contain reproducing populations of coldwater (salmonid) species. The fine substrate of North and Middle Branch is not conducive to the reproduction of these species. The coarser substrate of the South Branch has more potential to provide habitat for a reproducing population of salmonids (K. Smith, personal communication, March 2, 2004). However, much of this habitat is currently covered by sediment.

Other species that inhabit the Black River include longnose suckers and white suckers that enter the river to spawn (Goodyear et a. 1982), as well as common carp, largemouth bass, and rock bass (Gashman 1990). Non-native species such as sea lamprey and alewife have also been known to spawn in the Black River (Goodyear et al. 1982).

A fish consumption advisory exists for carp, northern pike and white sucker in the river below the Bangor Dam due to contamination from PCBs and chlordane (Michigan Department of Community Health 2004).

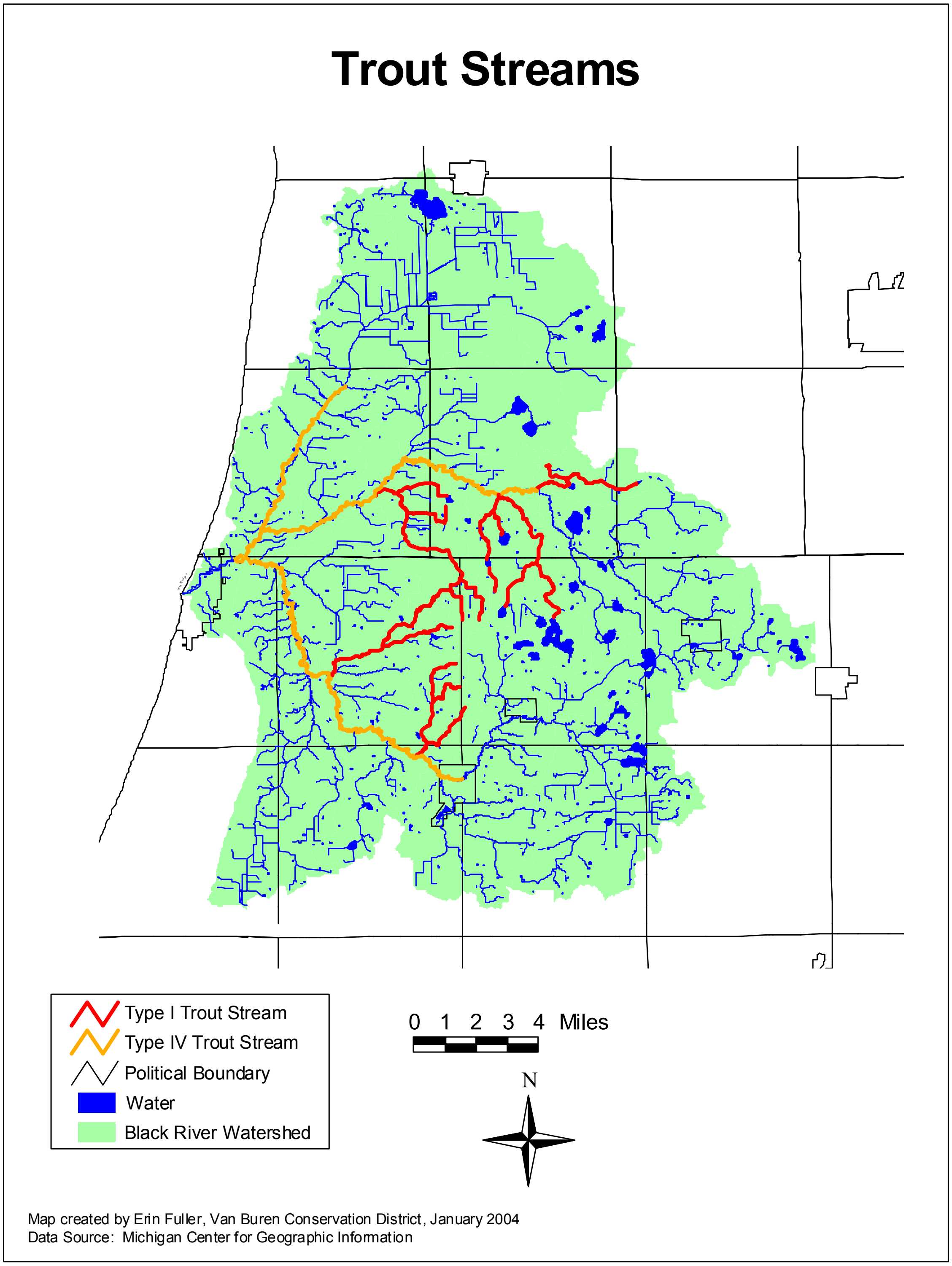

Figure 7: Trout streams in the watershed

4.6 Invasive Species

Invasive species are species that are not native to the habitat that they inhabit, and can out-compete native species. They can destroy habitat for native plants and animals as well as have economic impacts. Invasive species in the wetlands and waterways of the Black River Watershed include Purple Loosestrife (*Lythrum salicaria*), Eurasian Milfoil (*Myriophyllum spicatum*), and Zebra mussels (*Dreissena polymorpha*). Several other invasive species inhabit upland habitats in the watershed, including Garlic Mustard (*Alliaria petiolata*), Spotted Knapweed (*Centaurea maculosa*), and Autumn Olive (*Elaeagnus umbellata*).

Zebra mussels have been found in at least two of the inland lakes in the watershed, Hutchins Lake and Saddle Lake (Michigan Sea Grant 2004). They have also been found in several other lakes outside of the Black River watershed in Allegan and Van Buren Counties. Recent research indicates that beyond clogging water intake pipes and competing with native species for food, these mussels may promote the cyanobacterium (or blue-green algae) *Microcystis aeruginosa* in lakes with low levels of total phosphorus (Raikow et al. 2004). These algae produce a toxin (microcyctins) that can be dangerous to humans, pets, and wildlife. Thus, zebra mussels may contribute to a degradation of water quality in low-nutrient lakes.

Prevention of infestation is the only known method of controlling zebra mussel populations (Hart et al. 2002). Experts expect that most inland lakes in Michigan will eventually be invaded by zebra mussels.

4.7 National Wetlands Inventory

The National Wetlands Inventory is a record of wetlands location and classification as defined by the U.S. Fish & Wildlife Service. These maps were created by interpreting aerial photographs. As such, they are not as accurate as on-the ground wetland delineation. However, they do provide general information on wetlands in the area. The wetland classes identified in the National Wetland Inventory for the Black River Watershed are aquatic bed, emergent, forested, scrub-shrub, unconsolidated bottom, and unconsolidated shore (Figure 8). Some of these wetlands are adjacent to the lakes and rivers in the watershed, while others are geographically isolated from any apparent surface water connection. Forested wetlands are the largest class of wetlands in the watershed, followed by emergent wetlands.

Wetlands play a crucial role in protecting water quality. They trap and filter pollutants and sediment out of surface and groundwater. They also absorb floodwaters, protecting downstream areas from flooding impacts. Wetlands provide habitat for a variety of species, and wetland vegetation helps stabilize shorelines that would otherwise be vulnerable to erosion caused by waves (Cwikiel 1996).

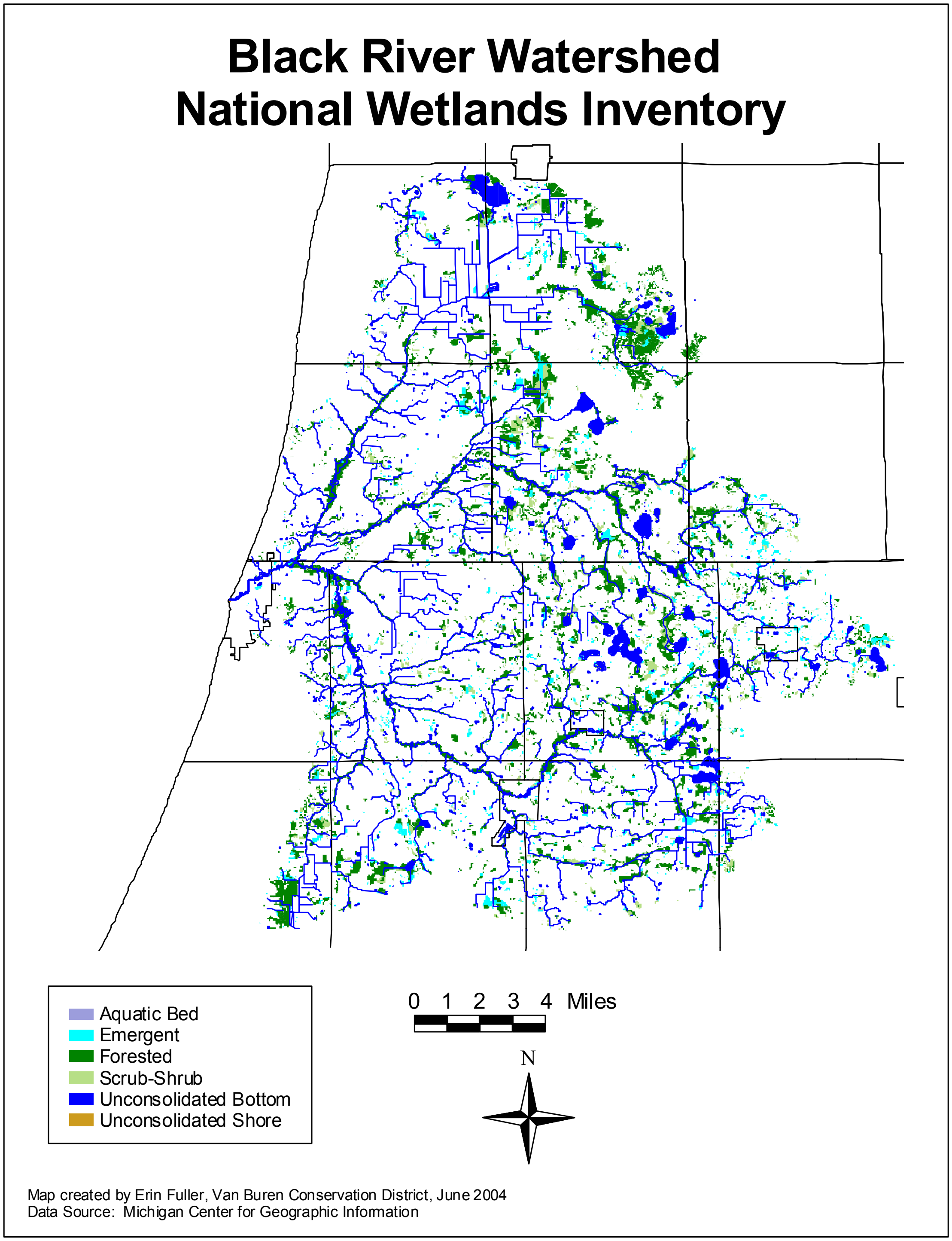

Figure 8: National Wetlands Inventory

4.8 Farmland

The U.S. Department of Agriculture's 2002 Census of Agriculture (Preliminary Data) shows that Michigan had a 0.5% decrease in its number of farms between 1997 and 2002. However, the amount of land in farms has had a steeper decrease: 3.5% between 1997 and 2002. The average size of a farm in Michigan has decreased by 6 acres in the same time period. This contrasts with the national figures. Nationally, the number of farms decreased 4% and the amount of land in farms decreased 1.6%, while the average size of farms increased by 10 acres (from the period between 1997 and 2002) (USDA 2004).

Loss of farmland is a concern in many rural areas, including southwest Michigan. Residential development is expanding into areas that were previously farmland. Both Allegan and Van Buren Counties have pursued Purchase of Development Rights programs and have farmland preservation committees.

4.9 High Quality Natural Areas

Several high quality natural areas exist in the Black River Watershed, including one property owned by the Michigan Nature Association and four properties owned by the Southwest Michigan Land Conservancy. These properties include a variety of habitats, such as wetlands, floodplains and upland forests, and support a diversity of plant and animal life. Additional high quality natural areas likely exist in private ownership.

The State of Michigan also owns a considerable amount of land in the watershed. Most of this is as part of the 45,000 acre Allegan State Game Area (of which approximately 12,200 acres are located in the Black River Watershed, with the remaining acreage located in the Kalamazoo River Watershed). The game area is highly diverse, containing over 800 plant species, and 30 threatened or endangered species (Michigan Department of Natural Resources 1993).

A map showing the approximate locations of lands owned by the State of Michigan, the Southwest Michigan Land Conservancy, and the Michigan Nature Association is shown in Figure 9 (the State ownership data is specific only to the quarter-quarter section).

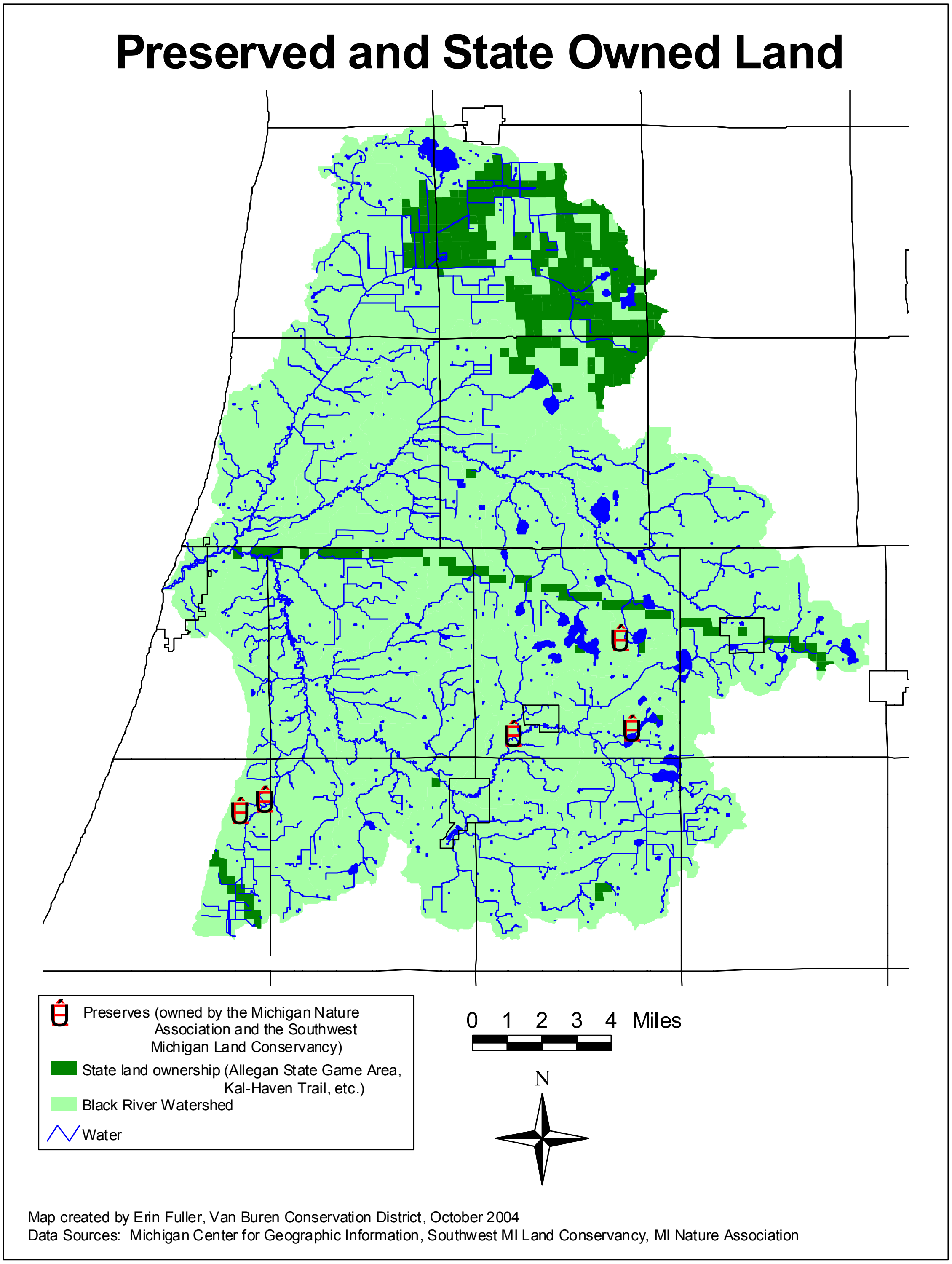

Figure 9: Preserved and state-owned land in the Black River Watershed

5. Community Profile

5.1 Demographics

The Black River Watershed is primarily a rural area. The population is increasing, however (Table 8). The median income in most townships tends to be less than the Michigan average (Table 9).

Table 8: Year 2000 Census data

Category	Allegan County	Van Buren County	Michigan
Population	105,665	76,263	10,079,985
Population, % change, 1990 to 2000	+16.7%	+8.9%	+6.9%
% White persons	93.5%	87.9%	80.2%
% Black or African American persons	1.3%	5.2%	14.2%
% American Indian and Alaskan Native persons	0.5%	0.9%	0.6%
% Asian persons	0.6%	0.3%	1.8%
% Persons reporting some other race	2.8%	3.4%	1.3%
% Persons reporting two or more races	1.3%	2.2%	1.9%
% Persons of Hispanic or Latino origin	5.7%	7.4%	3.3%
% Persons age 25+ who are high school graduates	82.3%	78.9%	83.4%
% Persons age 25+ who have a bachelor's degree or higher	15.8%	14.3%	21.8%
% Persons age 5+ who speak a language other than English in the home	6.8%	8.9%	8.4%
Homeownership rate	82.9%	79.6%	73.8%
Persons per household	2.72	2.66	2.56
Median household income	$45,813	$39,365	$44,667
% Persons below poverty	7.3%	11.1%	10.5%

Source: U.S. Census Bureau 2004 (derived from 2000 census)

Table 9: Demographic profiles for municipalities in the Black River Watershed

City/Township	Population	Sq. Miles	Median Income	% Employed over age 16
Arlington Township	2075	35.0	$36,847	66.8
Bangor Township	2121	33.7	$35,375	62.6
Bloomingdale Township	3364	34.1	$40,488	62.8
Casco Township	3019	38.9	$40,760	67.2
Cheshire Township	2335	34.9	$40,405	64.5
City of Bangor	1933	1.9	$28,165	60.8
City of South Haven	5021	3.4	$35,885	59.5
Clyde Township	2104	35.0	$42,717	66.9
Columbia Township	2714	34.1	$34,389	60.3
Covert Township	3141	35.0	$22,829	55.8
Ganges Township	2524	32.5	$47,143	66.1
Geneva Township	3975	35.3	$34,900	65.6
Lee Township	4114	35.3	$30,875	63.5
Saugatuck Township	3590	25.3	$43,771	64.8
South Haven Charter Township	4046	17.5	$35,000	68.2
Village of Bloomingdale	528	1.1	$35,715	63.6
Waverly Township	2467	34.4	$51,100	69.3

Source: U.S. Census Bureau 2000

5.2 Government Officials

A table of government officials in the watershed is located in Appendix G.

5.3 Planning and Zoning

A variety of different activities occur on the landscape, and these have varying degrees of impact on surface water quality. In attempting to improve and protect water quality, it is therefore necessary to locate these activities in areas where their impacts on water quality will be mitigated. From the watershed perspective, land use activities will not only affect the immediate area in which they occur, but also all downstream areas (Brooks et al. 1991).

An in-depth analysis of planning and zoning in the watershed needs to be completed. This would assist municipalities in making decisions that would affect water quality. Table 10 shows which communities in the watershed have zoning and master plans.

A few municipalities have already adopted or proposed ordinances that are protective of water quality. These include an ordinance that requires inspection of septic systems when a property changes hands and an ordinance creating a resource development district that protects habitat for wildlife and native flora, as well as protecting natural water features.

Table 10: Planning and Zoning in the watershed

Municipality	Zoning?	Master Plan?	Plan Date
Casco Township	Yes	Yes - Casco Township Master Plan	2004 (Draft)
Cheshire Township	Yes	Yes - Cheshire Township Land Use Plan	2001
Clyde Township	Yes	Yes- Clyde Twp. Master Plan	2005 (in the process of being adopted)
Ganges Township	Yes	Yes - Ganges Township Land Use Plan	1999 (currently being updated)
Lee Township	No	No	N/A
Arlington Township	Yes	Yes	
Bangor Township	No	Yes - Bangor Township Master Plan	2001
Bloomingdale Township	No	No	N/A
Columbia Township	Yes	Yes	2002
Covert Township	Yes	Yes	2004
Geneva Township	No	No	N/A
South Haven Township	Yes	Yes - Master Plan for Land Use: South Haven Charter Township	1988 (amended in 1995 and 2001)
Waverly Township	Yes	Yes	1995 (currently being updated)
Bangor City	Yes	Yes - Parks, Recreation, Cultural, and Natural Areas Master Plan	2002 (-2007)
Village of Breedsville	Proposed		
Village of Bloomingdale	No	No	N/A
South Haven City	Yes	Yes - City of South Haven Comprehensive Plan (there is also a 2003 Recreation Plan)	1995

6. Water Quality in the Black River Watershed

6.1 Previous Studies

The Michigan Department of Environmental Quality maintains a list of waterbodies that do not attain water quality standards (the 303 (d) list). Many of the waterbodies on this list are in southern lower Michigan. This is likely due to the higher population density and concentration of development, industry, roads, and prime agricultural lands in this portion of Michigan (Wolf and Wuycheck 2004). The most common causes of nonattainment status are habitat alteration, high concentrations of toxic organic chemicals (like PCBs), pathogens, sediment, and mercury.

The most common sources of pollutants are hydromodification, inconclusive sources (such as atmospheric deposition), and agriculture (Wolf and Wuycheck 2004). The following summarizes the waterbodies in the Black River Watershed that were on the 2002 303(d) nonattainment list.

- Black River Drain, N. Branch
  County: Allegan
  Location: 111th Ave. upstream into Allegan State Game Area to 49th St.; 2.5 miles east of Bakersville.
  Problem: Nutrient enrichment, nuisance plant growths
  Status: Water Quality Standards Nonattainment site

- Haven-Max Lake Drain, Great Bear Lake, Great Bear Lake Drain
  County: Van Buren
  Location: Upstream of Great Bear Lake downstream to Great Bear Lake, downstream via Great Bear Lake Drain to confluence with South Branch Black River.
  Problem: Nutrient enrichment, nuisance algal growths
  Status: Water Quality Standards Nonattainment site

- Silver Lake Inlet
  County: Van Buren
  Location: Silver Lake near Grand Junction
  Problem: Water Quality Standards exceedance for pesticide simazine; macroinvertebrate community rated poor.
  Status: Water Quality Standards Nonattainment site

Significant changes to this list have occurred. Below is a summary of the 2004 303(d) list. This information is excerpted from Wolf and Wuycheck (2004).

Category 2: Water Quality Standards Attainment List (some uses are met but there is insufficient data to determine if remaining uses are met)

- North Branch Black River
  County: Allegan
  Location: Black River confluence upstream to 111th Ave.

- Middle Branch Black River and tributaries
  County: Allegan/Van Buren
  Location: North Branch Black River confluence upstream to Little Bear Lake Drain and Melvin Creek confluence. Including Spicebush Creek, Scott Creek, Barber Creek, Spring Brook, and Little Bear Lake Drain, all inclusive and Melvin Creek to Deer Lake.

- South Branch Black River
  County: Van Buren
  Location: Bangor Dam upstream to Great Bear Lake Drain.

- Butternut Creek
  County: Van Buren
  Location: South Branch Black River confluence upstream

- Cedar Creek
  County: Van Buren
  Location: South Branch Black River upstream to 26th Ave.

- Eastman Creek
  County: Van Buren
  Location: South Branch Black River confluence upstream

- Haven and Max Lake Drain
  County: Van Buren
  Location: Great Bear Lake upstream to Max Lake

- Maple Creek
  County: Van Buren
  Location: Southwest of Bangor. South Branch Black River confluence upstream to 34th Ave.

Category 3: Water bodies requiring further evaluation (insufficient data to determine whether any uses are met)

- Lake Fourteen
  County: Van Buren
  Location: NE of Breedsville, SW of Berlamont

- Osterhout Lake
  County: Allegan
  Location: 5 miles SE of Pullman

- Peterson Drain (Scott Creek Tributary)
  County: Allegan
  Location: a tributary to Scott Creek from 111th Ave to 109th Ave.

Category 4b: Water Quality Standards Nonattainment List for Water Bodies with other control mechanisms (water quality standards nonattained; other corrective action used but unverified water quality standards restoration)

- Black River and South Branch Black River
  County: Van Buren
  Location: Lake Michigan confluence upstream to South Branch Black River confluence, thence, upstream the South Branch to Bangor Dam at Bangor at County Road 681.
  Problem: Fish Consumption Advisory-PCBs, chlordane
  Other corrective action: Sediment Remedial Action Plan (RAP) approved; sediments removed

Category 4c: Water Quality Standards Nonattainment List for highly modified water bodies

- Black River Drain, North Branch
  County: Allegan
  Location: 111th Ave. upstream (Black River Drain) including all tributaries to headwaters

- Black River Extension Drain
  County: Van Buren
  Location: South Branch Black River and Great Bear Lake Drain confluence (upstream of 52nd St.) upstream to Lake Fourteen outlet

- Cedar Creek
  County: Van Buren
  Location: West of Bangor; 26th Ave. upstream to headwaters

- Cedar Drain
  County: Van Buren
  Location: Tributary of South Branch Black River; upstream of 34th Ave., in the vicinity of Bangor upstream to headwaters.

- Great Bear Lake Drain
  County: Van Buren
  Location: South Branch Black River confluence upstream to Great Bear Lake outlet

- Melvin Creek
  County: Allegan
  Location: Lake Moriah confluence (just downstream of 4750th St.) upstream to 40th St.

- Silver Lake Inlet
  County: Van Buren
  Location: Silver Lake near Grand Junction

Category 5: Water Quality Standards Nonattainment list for water bodies requiring TMDLs (Total Maximum Daily Loads (water is impaired or threatened and a TMDL is required)

- Great Bear Lake
  County: Van Buren
  Location: Great Bear Lake proper
  Problem: Nuisance algal growths, phosphorus

The following include excerpts and summaries from previous studies that have been done in the watershed by organizations such as the Michigan Department of Environmental Quality and the Michigan Department of Natural Resources. These studies can help locate current problem areas in the watershed, but some information in them may be outdated (for example, areas in Bangor have undergone remediation for PCBs and heavy metals since these reports were completed). Updated reports will be added to this plan as they become available. Issues of concern are indicated in bold text. Locations of these waterbodies are shown in Figure 10.

6.1.1 Overall Watershed

- Walterhouse 2003

"…water quality throughout the Black River Watershed was adequate to support acceptable biological communities at locations with suitable riparian and in-stream habitat. Unfortunately, **historic channelization and dredging** of many of the streams, wetland drainage, sandy soils, and the current land management activities of riparian owners provides the aquatic biota of streams in the Black River Watershed with limited stable habitat" (p. 2).

6.1.2 North Branch Black River

- MDNR 1976

Bottom substrate of the North Branch was noted as being very **silty** and representative of slow flow. Suspended solid concentrations indicated a problem with **erosion** in this area. Fecal coliforms were generally low during this study. Water quality was **slightly nutrient enriched**. Macroinvertebrate sampling indicated good water quality with a high diversity of species.

- Cooper 1999

Habitat at one location (at 68th St. near 108th Ave.) was ranked as fair due to a **lack of hard bottom substrate and sand sediment**. Macroinvertebrate populations were rated as acceptable, though diversity was considerably lower than comparable locations on the Middle or South Branch.

- Walterhouse 2003

The North Branch has historically been dredged upstream of 111th Ave., creating a relatively **homogenous channel**, lacking meanders and diversity of depths and velocities. The stream channel at some locations was noted as **incised**, and the riparian zone was not functioning as a floodplain. Upstream stream segments have been **channelized** and have a **narrow riparian zone**. They have a low flow and are exposed to sunlight. Nutrients were within acceptable ranges. Macroinvertebrate communities were rated as acceptable at two sites on the North

Branch. Of the two sites, the downstream site (103rd Ave.) had a habitat rating of "good", while the upstream site (113th Ave.) had a "marginal" habitat rating. Substrate was primarily sand.

Black River Drain

- Lakeshore Environmental 1996

Lakeshore Environmental, Inc. completed a study of the Black River Drain in the area of the Allegan State Game Area for the Allegan County Drain Commission. They examined a variety of water quality parameters, including fecal coliform, BOD, nitrate nitrogen, total phosphorus, and conductivity. Fecal coliform, nitrate nitrogen and phosphorus concentrations decreased in a spring sampling event (compared to a fall sampling event, a time at which waterfowl activity in the Allegan State Game Area is high). **Fecal coliform** levels were highest in areas downstream from the central portion of the game area, and these levels were elevated only in fall sampling events. Conductivity and BOD were also in the suspect or problem ranges for all sampling locations and dates.

- Cooper 1999

Cooper reviewed the Lakeshore Environmental (1996) study and nutrient export from the Allegan State Game Area:

> "While it is entirely possible that sediment and nutrient transport may be encouraged by feeding waterfowl, these water quality parameters are also known to degrade from agricultural practices in the watershed and channel dredging itself which promotes sedimentation from bank erosion. In addition, **channelization** increases erosive power of the stream itself during high water evens by the removal/elimination of meanders, bends, and channel debris that reduce bank erosion. Increases in nutrient concentrations in stream channels that have undergone dredging are common and even expected. The very process that lowers the channel bed to promote drainage **also removes critical substrate and flow diversity** that promotes/enables natural biological processes to utilize and thereby remove nutrients from the water column" (p. 4).

Thus, the origin of sediment and nutrients downstream of the Allegan State Game Area is not yet clearly defined.

6.1.3 Middle Branch Black River

- MDNR 1976

This study (with one station on this Branch) noted good gravel substrate and generally clear water. Salmon were observed in November 1975. Nutrients and suspended solid levels were low. **Sodium and chloride concentrations were elevated**, indicating a possible upstream source of wastes.

- Heaton 1997

Macroinvertebrate communities were rated as acceptable, tending toward excellent. The designated use of coldwater fishery was not being met. Habitat was rated as "fair" (moderately impaired), due to a **lack of cobble, boulder, and woody debris instream substrate** and excessive **sand and silt deposition from streambank erosion.** Water quality was within the normal range for streams in this ecoregion.

- Cooper 1999

Habitat was rated good for fish and macroinvertebrates due to the presence of woody debris and stable, undercut banks. High amounts of **sand deposition** were also noted. The macroinvertebrate community was rated as good, tending toward excellent.

- Walterhouse 2003

Macroinvertebrate communities were rated as acceptable, tending toward excellent, and habitat was rated "good." Sand was the predominant substrate, but habitat features such as woody debris, root wads, undercut banks, and deep pools were noted. The stream channel had not been channelized, and was surrounded by a wide wooded floodplain. Water quality was within the normal range for streams in this ecoregion.

Barber Creek (Middle Branch)

- Heaton 1997

The aquatic macroinvertebrate community and the physical habitat were both rated "excellent" (non-impaired). No salmonid species were collected during this study period, and thus, the designated use of coldwater fishery was not being met.

- Macroinvertebrate populations were rated as acceptable, though diversity was low. Populations were dominated by midge or black fly larvae, possible indicators of **nutrient enrichment**. Habitat was slightly impaired due to sediment **deposition, embeddedness, and channel structure lacking in diversity.**

Scott Creek (Middle Branch)

- Heaton 1997

Biological integrity of this creek was rated as acceptable based on aquatic macroinvertebrate communities. However, this acceptable rating tended towards poor downstream of an industrial point source discharge. Physical habitat was rated as "fair" (moderately impaired), due to **lack of available bottom substrate, extensive embeddedness, absence of pool and riffle habitat, and lack of vegetative stability of the streambanks**. Concentrations of **ammonia** were elevated at one site on this stream. Concentrations of **arsenic, chromium, copper, mercury, nickel, lead and zinc** in the sediment were relatively elevated at one station. **Acetone** was detected in the sediment at two sites. **Methyl ethyl ketone, toluene, ethylbenzene and xylene** were detected at one site (downstream of the above mentioned point source discharge).

- Cooper 1999

Riparian conditions were noted as excellent, contributing to good habitat scores. Macroinvertebrate communities were rated as acceptable, though limited by poor bottom substrate due to **deposition and embeddedness**. **High nutrient conditions** may exist as suggested by the high density of midge fly and black fly larvae.

- Walterhouse 2003

This stream has historically been channelized, but dredging had not occurred recently. The riparian zone is well vegetated. Macroinvertebrate community was rated as acceptable. Habitat was rated as marginal due to **absence of riffle habitat and deposition and movement of sand substrate**. Water quality was within the normal range for streams in this ecoregion

Spicebush Creek (Middle Branch)

- Heaton 1997

Biological integrity was rated acceptable based on the aquatic macroinvertebrate community. Physical habitat was rated as "fair" (moderately impaired), due to the **lack of bottom substrate cover, excessive embeddedness due to sand and silt, absence of pool and riffle habitat, and lack of vegetative stability of the streambank**. No salmonid species were collected in Spicebush Creek during this study, and thus the designated use for coldwater fishery was not met. Water quality was within the normal range for streams in this ecoregion.

- Cooper 1999

This creek was noted as being a classic **dredged** channel with a wide, shallow streambed, steep banks, **sedimentation**, and **poor substrate**. The habitat was thus rated as fair. Macroinvertebrate populations were rated as acceptable, though there was a scarcity of species indicative of excellent water quality.

Spring Brook (Middle Branch)

- Walterhouse 2003

Some portions of Spring Brook appear to have been channelized in the past, but now appears to be a natural, wetland bordered, low-gradient stream with fine substrate. The macroinvertebrate community was rated acceptable and the habitat was rated as good. The stream substrate is predominantly sand, and riffle habitat was absent at the sample location.

6.1.4 South Branch Black River

- MDNR 1976

Nutrient levels in this study were low, as were total dissolved and suspended solid concentrations. The only parameters with elevated levels were **iron and fecal coliform** (indicating a possible sanitary or livestock waste source).

- Hull 1989

This study focused primarily on the South Branch of the Black River in the Bangor area, though one station was upstream, immediately below the Breedsville impoundment. Overall aquatic habitat quality was low as a result of **heavy deposition of sand and silt**. Despite the lack of quality habitat, aquatic macroinvertebrates were moderately to highly abundant. Lower species diversity and abundance was found below two **point-source discharges** in Bangor. Effluent from these discharges included heavy metals, PCBs, oil and grease, chlorides and dissolved salts. Substrate downstream of one discharge was described as "oily sludge beds overlain by several inches of silt" (p. 2).

- Gashman 1990

Sediment and fish samples were collected in this study of the South Branch in Bangor, in the area of a **point-source discharge**. PCBs were detected at high levels in fish samples. Elevated levels of PCBs and heavy metals were also found in sediment downstream of the discharge.

- Cooper 1999

Macroinvertebrate populations were rated acceptable at two sites (one upstream and one downstream of Bangor). Habitat was rated good at the upstream site and excellent at the downstream site. Signs of **nutrient enrichment** (such as dense growths of Cladaphora) were noted.

- Heaton 1997

The South Branch of the Black River in some locations was found to not meet its designated use as a coldwater fishery. Much previous sampling of this branch focused on the area of the Bangor Millpond, where elevated levels of PCBs and heavy metals were found. Biological integrity of the South Branch (based on fish collections) ranged from poor to excellent. Habitat was rated as "fair" (moderately impaired) for the majority of the south branch due to **a lack of cobbles, boulders, and large woody debris, as well as due to the excessive sand and silt deposition from stream bank erosion. Phosphorus and ammonia concentrations** were elevated at one location in this study.

- Walterhouse 2003

From the confluence of the Black River upstream to Bangor, the river is primarily a naturally meandering stream bordered by wooded floodplain with good sinuosity. The flow regime may be **flashy**. Sand is the predominant substrate and riffle habitat is infrequent. In this study, the most downstream site (at 70th St.) received a rank of excellent for the macroinvertebrate community (this was the only site rated as excellent in the study). Habitat was rated at good, with such elements as pools, woody debris, root wads, overhanging vegetation, and sand, muck, and detritus substrates. The flashiness of the flow regime was the only poor habitat element at this site.

The South Branch was also evaluated in Lion's Park in Bangor. The macroinvertebrate community was rated as acceptable and the habitat was ranked marginal. Riffle habitat was present (though consisted primarily of unnatural objects like brick and concrete), but the habitat was negatively impacted by the flashiness of the flow regime and **lack of a natural riparian zone** in Lion's Park.

This branch was also evaluated above the Breedsville impoundment (at 52nd St.). The macroinvertebrate community at this site rated as acceptable and the habitat was rated as marginal. Sand was the dominant substrate, and in-stream cover was sparse. **Movement and deposition of sand** at this site (just below the confluence of the Great Bear Lake Drain and the Black River Extension Drain) created a relatively uniform stream channel. Turbidity in the South Branch may be due to spawning and feeding behavior of carp in the Breedsville Impoundment (a large number of carp were documented here in June and July 2002).

- Wolf and Wuycheck 2004

Approximately 26,000 cubic yards of sediment were removed from the South Branch of the river in the area of the Bangor Mill Pond. The sediment was contaminated with PCBs and heavy metals. Restoration and remediation of the area concluded in June 2004 (L. Nielsen, personal communication, June 15, 2004).

Black River Extension Drain (South Branch)

- Cooper 1999

Macroinvertebrate sampling in this drain found very **poor diversity** and noted that the stream channel was **"void of all structure and channel diversity due to channelization"** (p. 2).

Butternut Creek (South Branch)

- Walterhouse 2003

This stream and all of its tributaries have been **channelized**, though dredging of some segments has not occurred for a number of years. The macroinvertebrate community was rated as acceptable, and the habitat was rated as good. Some meanders had reestablished, and the site had deep pools and woody debris. Sand was the predominant substrate. A wide riparian corridor was noted. Water quality results were within the normal range for streams in this ecoregion.

Cedar Creek (South Branch)

- Cooper 1999

Macroinvertebrate samples at two sites on this creek indicated fair to poor habitat and acceptable macroinvertebrate diversity (though relatively low density). **Hard substrate was lacking and excessive sedimentation and embeddedness were noted. Banks were also in poor condition.**

- Walterhouse 2003

This stream and all of its tributaries have been **channelized**, though dredging in some areas has not occurred recently. Streambanks were well vegetated. This stream is **incised** and sand is the dominant substrate. The **riparian zone if often very narrow**, and row crops were found to begin at the edge of the stream banks in many locations. Macroinvertebrates were scored as acceptable and habitat was rated marginal due to the **deposition and movement of sand substrates.**

Cedar Drain (South Branch)

- Cooper 1999

Two sites were sampled for macroinvertebrates (upstream and downstream of the Bangor wastewater sewage lagoons). The upstream site had a poor macroinvertebrate community rating and a **poor habitat** rating. The downstream site had acceptable populations with low density, and habitat was rated as fair.

Eastman Creek (South Branch)

- Cooper 1999

Macroinvertebrate populations were rated acceptable and habitat was rated good tending toward excellent. However, some of the species found were relatively pollution tolerant species.

- Walterhouse 2003

The macroinvertebrate population was rated as acceptable and the habitat was rated as good. Riffle habitat was absent, and sand was the predominant substrate. Portions of this stream have been **channelized** in the past. Streambanks were well-vegetated and were not eroding. The riparian zone was intact. Water quality results were within the normal range for streams in this ecoregion.

Great Bear Lake (South Branch)

- Fusilier 1998

Secchi disk trends show that both basins of Great Bear Lake are getting less clear. A significant **algal bloom** occurred in both the spring and summer of 1997. Surface **phosphorus concentrations** were high in both spring and summer. The north basin appeared to be more affected by nutrient inputs than the south basin.

- Walterhouse 2003b

Sampling results from this and previous studies indicate that phosphorus is the limiting nutrient in Great Bear Lake. Results of this study indicate that water quality may have improved.

- Fusilier 2003

There is no clear trend in phosphorus concentrations in the lake over the past 20 years. However, the phosphorus levels have at times been above 20 µg/L, a level at which excessive algae and aquatic plant growth may occur. The lake experienced a significant algal bloom in April 2000. Both the north and south basins of the lake have experienced a decline in clarity over the past 20 years. A Lake Quality Index (LQI) has been calculated for the lake over the past 20 years and shows no type of trend.

- Walterhouse 2004

The Michigan Department of Environmental Quality developed a Total Maximum Daily Load (TMDL) for phosphorus in Great Bear Lake. This report estimates that 90% of the total annual nonpoint source load comes from agricultural land uses in the Great Bear Lake watershed. The model used does not account for pollution from precipitation or several other sources.

<u>Great Bear Lake Drain (South Branch)</u>

- Cooper 1999

Macroinvertebrate diversity in this drain was low (though this may be due to the close proximity of the sampling site to Great Bear Lake). The habitat was considered fair (moderately impaired) due to **bottom deposition, embeddedness, and lack of streamside cover.**

<u>Haven & Max Lake Drain (South Branch)</u>

- Fusilier 1998

Sampling in the Haven & Max Drain indicated that **nutrients** were added to the drain between CR 388 (38th St.) and 41st St., upstream of Bloomingdale. Both nitrate **nitrogen and phosphorus** concentrations increased between these two road-stream crossings. Denitrification appeared to be occurring in the stream, and little or no nitrates were added below 41st St. The same appears to be the case for phosphorus.

- Cooper 1999

High concentrations of **phosphorus** (and ortho-phosphorus in particular) may indicate an impairment of the biological community and habitat (typically, ortho-phosphorus concentrations are low as a result of biological assimilation).

- DEQ 2000

Photographs and notes taken by DEQ personnel in the summer of 2000 noted **high, steep eroding banks** in a stretch of this drain between CR 388 (near 3850th St.) and the Remington & Powers Drain. **Turbid water, sediment, vegetation, and algae** were also noted in Fritz Drain, which enters Haven & Max Lake Drain in this segment. Downstream of this, (between 45th and 42nd Streets) **steep, eroding banks and heavy sediment deposition** were also noted, though at least one section with cobble substrate was also found. A rust colored matter (bacterial) was prevalent, especially in seep areas.

- Fusilier 2003

The highest phosphorus inputs to this drain come from the Munn Lake Drain.

- Walterhouse 2003b

The highest concentrations of phosphorus upstream of Great Bear Lake were found in Munn Lake Drain (which flows into the Haven & Max Lake Drain near 3850th St.). This study concluded that phosphorus and nitrogen concentrations do not increase downstream of the Bloomingdale Wastewater Treatment Plant.

<u>Maple Creek (South Branch)</u>

- Heaton 1997

Biological integrity was rated as acceptable tending towards excellent. The habitat was rated as good (slightly impaired). **Ammonia and phosphorus concentrations were elevated**, both upstream and downstream of the Bangor wastewater sewage lagoons. Upstream sources of nutrients may be agricultural runoff.

Most of the above-mentioned studies have been entered into a Geographic Information System (GIS) housed at the Van Buren Conservation District.

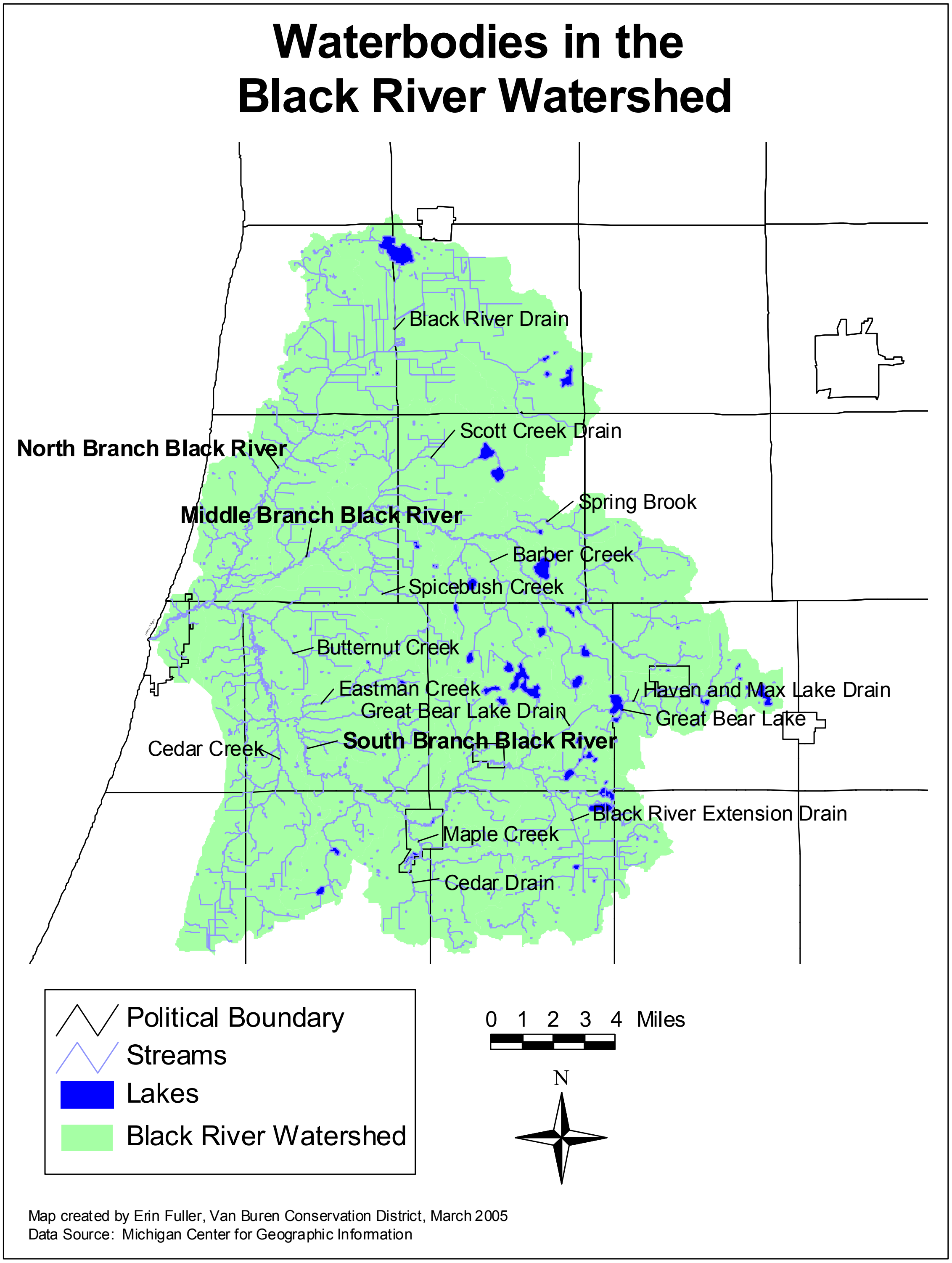

Figure 10: Previously studied waterbodies in the Black River Watershed

6.2 Watershed Inventory

The watershed inventory consisted of road-stream crossing inventories, "windshield" surveys, and canoeing, kayaking, or walking stretches of stream. Aerial photographs were studied extensively to help locate potential problem areas. A road-stream crossing inventory was performed by the Michigan Department of Environmental Quality in 2001. A follow-up survey was performed during the course of the Black River Watershed Project.

6.2.1 Aerial Photograph Review

Aerial photographs were reviewed to determine the approximate number of houses around the lakes in the watershed. This was done to give an estimate of pollutant loadings from septic tanks. A residency rate of 3.5 individuals per dwelling was used, with an estimate of 0.25 pounds of phosphorus/capita/year. This estimate is the amount of phosphorus reaching the lake after treatment and discharge to the drainage field (Walterhouse 2004). This estimate may be off, since many of these lake homes are likely not occupied year round. However, some septic systems may be failing or inadequate and thus contributing greater amounts of phosphorus. The lakes with the greatest estimated phosphorus loads from septic tanks are those with the most adjacent houses, such as Saddle Lake, South Scott Lake (Van Buren County), Hutchins Lake, and Great Bear Lake (Table 11).

Table 11: Estimated phosphorus loading from septic tanks around lakes in the Black River Watershed

Name	Township	Acres	Connected to Black River?	Number of houses within 300 ft. (estimated)	Lbs Phosphorus per year
Saddle Lake	Columbia	282.5	Yes	155	135.6
South Scott Lake	Arlington	118.1	Yes	154	134.8
Hutchins Lake	Ganges/Clyde	378.8	Yes	134	117.3
Great Bear Lake	Bloomingdale/Columbia	166.2	Yes	114	99.8
North Scott Lake	Arlington/Columbia	76.3	Yes	92	80.5
Lower Scott Lake	Lee	119.5	Yes	63	55.1
Osterhout Lake	Lee	171.9	Yes	56	49.0
Mill Lake	Bloomingdale	107	Yes	53	46.4
Upper Jeptha Lake	Columbia	58.8	Yes	42	36.8
Silver Lake	Columbia	50.1	Yes	41	35.9
Upper Scott Lake	Lee	94.4	Yes	29	25.4
North Lake	Columbia	60.6	Yes	25	21.9
S. Branch Black River (Breedsville Mill Pond)	Columbia	7.9	Yes	24	21.0
Munson Lake	Columbia	38.5	No	17	14.9
Lake Eleven	Columbia	53.9	Yes	16	14.0
Merriman Lake	Bangor	27.1	Yes	13	11.4
Lester Lake	Lee	60.4	Yes	12	10.5
Little Bear Lake	Columbia	46.1	Maybe/Wetland	9	7.9
Ely Lake	Clyde	27	Yes	4	3.5
Moon Lake	Geneva	14.6	Yes	4	3.5
Coffee Lake	Columbia	40.4	Yes	3	2.6
Crooked Lake	Clyde	96.9	No	3	2.6
Deer Lake	Columbia	30.4	Yes	3	2.6
Manitt Lake	Casco	0.7	No	2	1.8
Spring Brook Lake	Lee	15.3	Yes	2	1.8
Clear Lake	Lee	19.7	No	1	0.9
Lake Fourteen	Arlington	20.9	Yes	1	0.9

Max Lake	Bloomingdale	28	Yes	1	0.9
Munn Lake	Bloomingdale	12.3	Yes	1	0.9
Picture Lake	Geneva	5	Yes	1	0.9
School Section Lake	Bangor	36.1	Yes	1	0.9
Abernathy Lake	Waverly	4.1	Yes	0	0.0
Lake Fourteen	Columbia	69.5	Yes	0	0.0
Little Tom Lake	Clyde	18.1	Maybe/Wetland	0	0.0
Lower Jeptha Lake	Columbia	55.4	Yes	0	0.0
Max Lake	Waverly	4.4	Yes	0	0.0
Moriah Lake	Columbia	17	Yes	0	0.0
Mud Lake	Cheshire	3.9	Yes	0	0.0
Mud Lake	Clyde	4.4	No	0	0.0
Mud Lake	Columbia	23.4	Yes	0	0.0
S. Branch Black River (Bangor Mill Pond)	Bangor/Arlington	22.7	Yes	5	0.0
Skunk Lake	Bloomingdale	6.6	Yes	0	0.0
Stillwell Lake	Columbia	18.3	Yes	0	0.0

Aerial photographs were also reviewed to examine change in the river channel. Aerials of the watershed in 1938 were compared to more recent aerials of the watershed (1998 aerial photos for Allegan County and 2003 aerial photos for Van Buren County). The river is obscured by vegetation in some portions of these photographs, and thus, not all reaches of the river were analyzed. In general, the North Branch of the Black River has much the same pattern today as it did in 1938. Some portions were straighter in 1938 and are today showing signs of re-meandering, especially a portion in Casco Township north of 109th Avenue. Also, many more drains exist now than in 1938. The Middle Branch has retained a similar pattern since 1938. It is a meandering river, and some meanders have cutoff since 1938. The South Branch has been the most dynamic branch since 1938. The river in Geneva Township especially appears to be straighter and less meandering than it was in 1938. From the confluence of the South Branch and Cedar Creek in southern Geneva Township to the City of Bangor, the river appears to have the same pattern (where it is visible on both sets of aerials). Upstream of Bangor, however, meander cutoffs and oxbows indicate more change.

Recent aerial photos (1998 for Allegan County and 2003 for Van Buren County) were also reviewed to locate areas that lack vegetative buffers along the riparian corridor. This review revealed 4595 linear feet lacking buffers in agricultural areas and 4326 linear feet of buffers lacking in residential areas. This is likely an underestimate, since smaller drains and streams are not clearly visible in these photographs.

6.2.2 Road-Stream Crossing Inventory

A Road-stream crossing inventory was performed by Michigan Department of Environmental Quality staff in the spring and summer of 2001. These surveys are completed at approximately 80% of the road-stream crossings in the watershed. These inventories are repeated on a 5-year cycle. Investigators record a variety of information about each site, including physical characteristics and potential pollution sources. This data has been entered into a Geographic Information System (GIS) to facilitate the review of data. Figure 11 shows the rankings of all the sites visited. 212 road-stream crossings were visited in total. Six of these were considered to be in “poor” condition; ten in “fair” condition, and the rest were in “good” condition. Several of the “poor” sites were degraded due to unrestricted livestock access. While this information is certainly useful to help locate problem areas, it may not present an accurate picture of water quality. For example, data on turbidity may not be very useful, as some sites were visited after a rainfall and some were visited during dry periods. Furthermore, the dataset is now several years old and is somewhat incomplete. For example, problems with bridges or culverts were not recorded in this road-stream crossing inventory.

All sites were revisited between June 2003 and April 2004 to take photographs of the sites and note any problem areas. During this period, some road-stream crossings were identified as having problems (such as erosion around a bridge or culvert, or improper culvert sizing and placement). This list will be updated as new areas are found (or problem areas are remediated). Other problem areas were also discovered, including uncontrolled livestock access to streams, streambank erosion, incised stream beds, and areas lacking in a vegetative buffer along the stream.

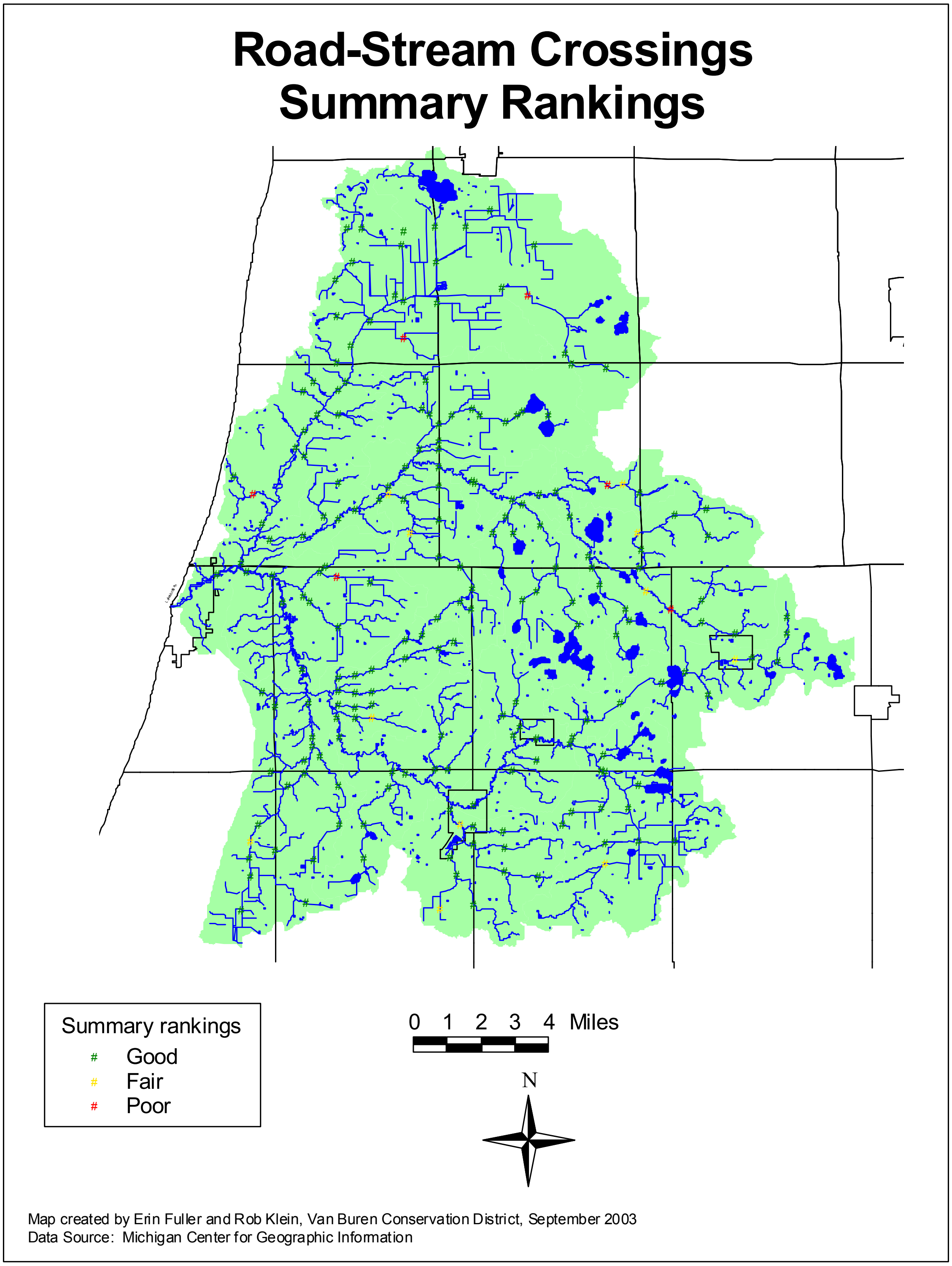

Figure 11: Rankings of Road/Stream Crossings

6.2.3 Canoe and Kayak Trips

Sections of the watershed were visited via canoe, kayak, or by foot. The prevalence of snags and large woody debris makes canoe or kayak passage difficult to impossible in many portions of the river. In addition, the extremely silty substrate of some of the streams makes wading difficult. Thus, not all portions of the watershed were visited. Figure 12 shows the river reaches that were canoed, kayaked or walked during the course of the project. Photos and notes were taken in those reaches that were accessible by boat or foot.

Approximately 14 miles of the Black River were canoed or kayaked by the watershed coordinator and several volunteers. Much of the river is too shallow or is filled with debris dams, making canoeing and kayaking difficult. The sections that were canoed or kayaked were: the North Branch from the crossing at 68th St. downstream to the crossing at 103rd Ave; the North Branch from the confluence with the South Branch upstream to the confluence with the Middle Branch; the Middle Branch from 68th St. downstream to 70th St. in Casco Township; the South Branch from the crossing at CR 388 to the mouth; and the South Branch from Lion's Park in Bangor to approximately 1 mile downstream.

Most of the 14 miles that were canoed or kayaked had a wide buffer of natural vegetation. This buffer is primarily forest, though there are small portions of emergent wetland (Figure 13). The exception is the stretch upstream of the river mouth (approximately 2 miles). The area in South Haven is very developed, with numerous marinas and residential developments to the edge of the river (Figure 14). Once upstream of this section, the river corridor is primarily forested and rural (however, condominiums are being developed along the river approximately 3 miles upstream of the mouth. A 151-slip marina may also be included in this development).

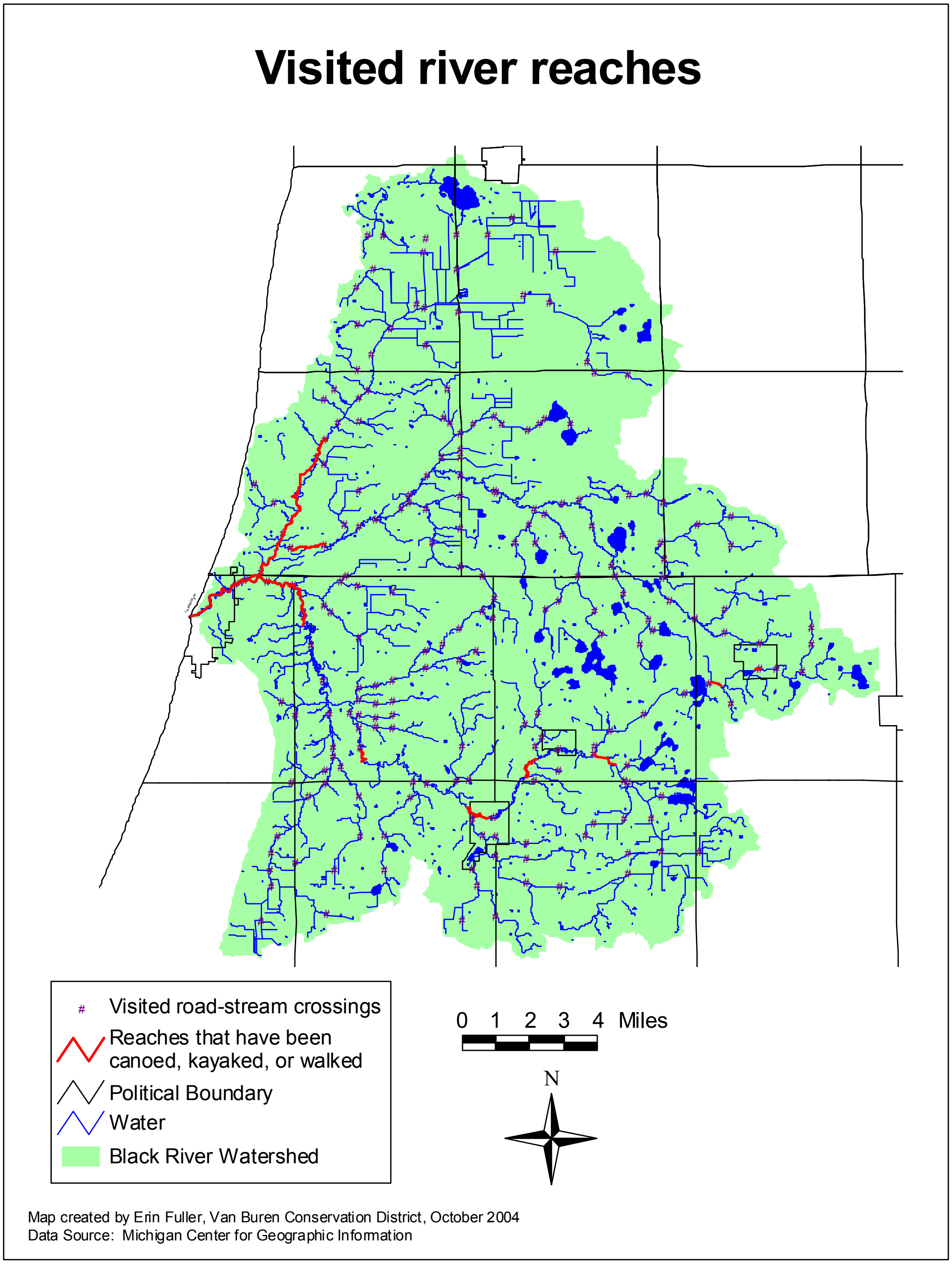

Figure 12: Visited river reaches

Figure 13: Natural vegetation buffer along the North Branch (Casco Twp.)

Figure 14: The Black River in South Haven, near the river mouth

The North Branch of the river downstream of 108th Ave. is primarily forested. Very few houses are visible along the river. The floodplain is wide, and woody debris is prevalent within the channel. The banks appeared stable and well-vegetated. There were a few small emergent wetlands along this stretch, dominated mostly by Reed Canary Grass (Figure 15).

Figure 15: Emergent wetland along the North Branch

The Middle Branch in Casco Township is primarily forested along the river corridor. Some bank erosion is occurring, but is not severe. Some tree roots are exposed along the river bank, but the trees are in many cases adapting to the erosion by growing straight (Figure 16). The substrate is primarily sand, with some gravel areas.

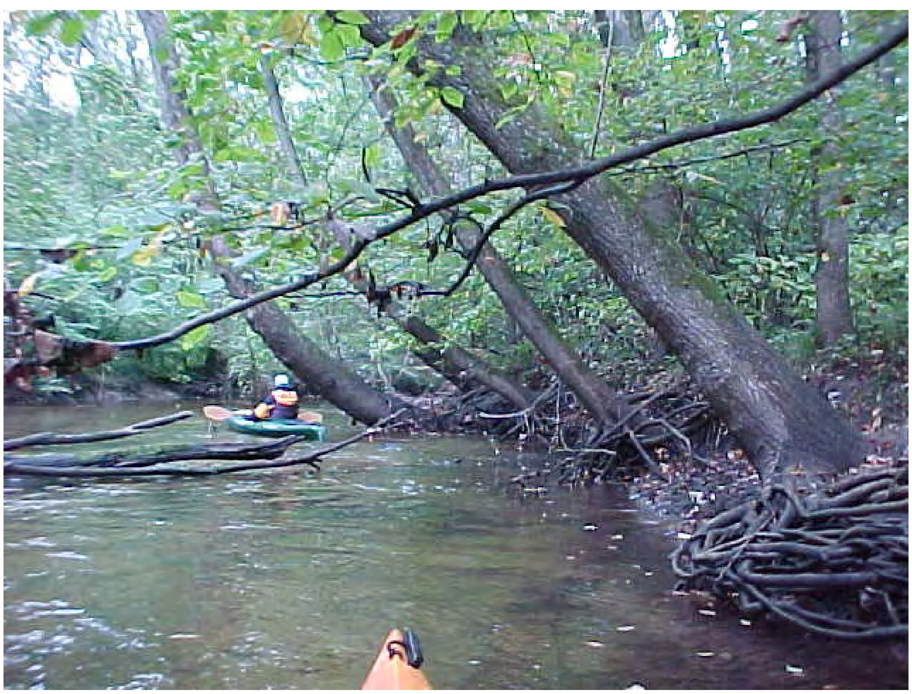

Figure 16: Trees responding to erosion along the Middle Branch

Upstream of the confluence with the North Branch, the banks of the South Branch are in some places quite high and eroding (Figure 17). This is in most cases not a result of current land use practices, as the river is forested along most of these sections.

Figure 17: High, eroding bank along the South Branch

The South Branch between Phoenix St. and 70th St. has high, somewhat unstable banks. Roots of many trees have been undercut, indicating that the channel of the river is changing faster than the vegetation can adapt (Figure 18).

Figure 18: Undercutting of tree roots along the South Branch

The South Branch downstream of Lion's Park in Bangor is very forested. The prevalence of woody debris makes this a slow and difficult paddle (Figure 19).

Figure 19: Canoeists negotiate a large tree across the South Branch, downstream of Bangor

Portions of the watershed were inventoried by foot if they were impassable by canoe or kayak. However, the nature of the river substrate made this difficult and at times impossible. Sections examined by foot (by wading or walking along the banks of the river) were:

- South Branch Black River downstream of Breedsville (Columbia Twp. Section 32).
- Haven and Max Lake Drain upstream of Great Bear Lake (Bloomingdale Twp. Section 19)
- Haven and Max Lake Drain downstream of CR 665 (Bloomingdale Twp. Section 17)
- South Branch Black River upstream of Breedsville (Columbia Twp. Section 34)
- South Branch Black River between Bangor and South Haven (Geneva Twp. Section 33)

6.2.4 Bank Erosion Study

Rates of bank erosion at 8 sites in the watershed were measured using erosion pins. The pins (sections of wooden dowel) were placed in the streambanks in June 2004 and measured throughout the summer to determine how much soil was eroding (or being deposited) around them. Though not enough sites were monitored to draw conclusions about the watershed, it was clear that at least in some areas, the river channel is actively changing. The full report is located in Appendix H.

6.2.5 Impervious Surface Analysis

Impervious surfaces are those surfaces such as roads, parking lots and rooftops that do not allow infiltration of rainwater and snowmelt. As impervious surface areas increase in a watershed, so does runoff. Runoff is usually warmer than groundwater and can carry a variety of pollutants into streams, such as sediment, fertilizers, pesticides, or oil. Recent research also indicates that potentially carcinogenic compounds may leach from asphalt-based and coal tar-based sealants that are used on paved areas (Perkins 2004). In addition, streams surrounded by a high percentage of impervious surfaces will have a "flashy" hydrological regime in which the stream receives floods after rain events and snowmelt, but is deprived of water during the dry season due to decreased infiltration (Wyckoff et al. 2003). Studies have shown that as the land cover of a watershed becomes 8-10% impervious surface, water quality is negatively impacted. Above 10% impervious cover in a watershed, water quality typically begins to degrade

(Wyckoff et al. 2003). High flows from storms scour the banks, causing erosion and loss of vegetation (Perkins 2004). A typical suburban development with homes on 1/3 acre lots is approximately 35% impervious (Perkins 2004).

An online land use analysis tool was used to estimate impervious surface cover in the watershed (Choi and Engel 2004). This model uses 1992 land use/land cover data and estimates the amount of impervious cover associated with that land use (Table 12). Using this model, an average of 2.19% of the Black River Watershed is composed of impervious surfaces. This is below the level at which water quality begins to degrade. However, this is important data to monitor. It is more cost effective to plan ahead to protect water quality by keeping the impervious cover under the 10% threshold than it is to try to restore the river system after it has already been degraded (Wyckoff et al. 2003). Additionally, within the watershed, impervious surface coverage varies widely. High-density areas may have impervious surface coverage of greater than 10% (unfortunately the model only works at the subwatershed level).

Table 12: Impervious cover percentage based on land use category

Land Use Category	Impervious Cover
Agriculture, Pasture/Grass, Forest	1.9%
Water/Wetland	0.0%
Low Density Residential	15.4%
High Density Residential	36.4%
Industrial	53.4%
Commercial	72.2%

Source: Choi and Engel 2004

6.3 Watershed Inventory Sites of Concern

Sites of concern discovered during the watershed inventory were divided into four categories: road stream crossing sites of concern, streambank erosion sites of concern, agricultural sites of concern, and residential and municipal sites of concern.

6.3.1 Road-Stream Crossing Sites of Concern

The primary pollutant entering surface water at road-streams crossings is sediment. Sediment can enter the waterway as a result of erosion around bridges or culverts, or due to incorrect placement of a culvert. Culverts may also be undersized, which increases the velocity of the water as it travels through the culvert. This can increase erosion on the downstream side of the culvert. The slope of the road bed can also direct sediment-laden runoff directly into a waterway. Trash/debris is one pollutant that is found primarily at road-stream crossings, since these are the primary public access point to the river and its tributaries. Much evidence of illegal dumping was found at road stream crossings during the course of the field inventory, and it is recommended that these points be the focus of future river clean-up days. Other pollutants that can be found at road-stream crossings include chemical pollutants like salts, gasoline and oil. Though these parameters were not tested for during the course of this study, it is likely that they are entering the surface water in at least small concentrations.

BMPs for road stream crossing problems include re-orienting culverts, replacing culverts with ones of the correct sizes, cleaning and maintaining blocked culverts, and adding bioengineering or riprap. However, there are few grant programs that cover costs of culvert and bridge replacement or repair. Numerous problem areas were found at road stream crossings. These sites are listed in Table 13 and Figure 20).

Table 13: Road-stream crossing sites of concern

Location	Source	Cause	Pollutant of concern
BR-02	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BR-12	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BR-14	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BR-25	Road-stream crossing	Improper culvert sizing and placement	sediment
BR-34	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-03	Road-stream crossing	Improper culvert sizing and placement	sediment

BRM-15	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-18	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-26	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-27	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-28	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-28	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-29	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-35	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-35	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-43	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-45	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-45	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-48	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-50	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-52	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRM-53	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-55	Road-stream crossing	Improper culvert sizing and placement	sediment
BRM-62	Road-stream crossing	Improper culvert sizing and placement	sediment
BRN-02	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRN-06	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRN-12	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRN-20	Road-stream crossing	Improper culvert sizing and placement	sediment
BRN-31	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRN-32	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRN-37	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-08	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-10	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-13	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRS-14	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-18	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-20	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRS-21	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRS-24	Road-stream crossing	Gravel road grading	sediment
BRS-26	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRS-30	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRS-31	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-45	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-53	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRS-55	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment
BRS-57	Road-stream crossing	Improper culvert sizing and placement; erosion from/around bridge, culvert or road	sediment
BRS-58	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-62	Road-stream crossing	Improper culvert sizing and placement	sediment
BRS-62	Road-stream crossing	Erosion from/around bridge, culvert or road	sediment

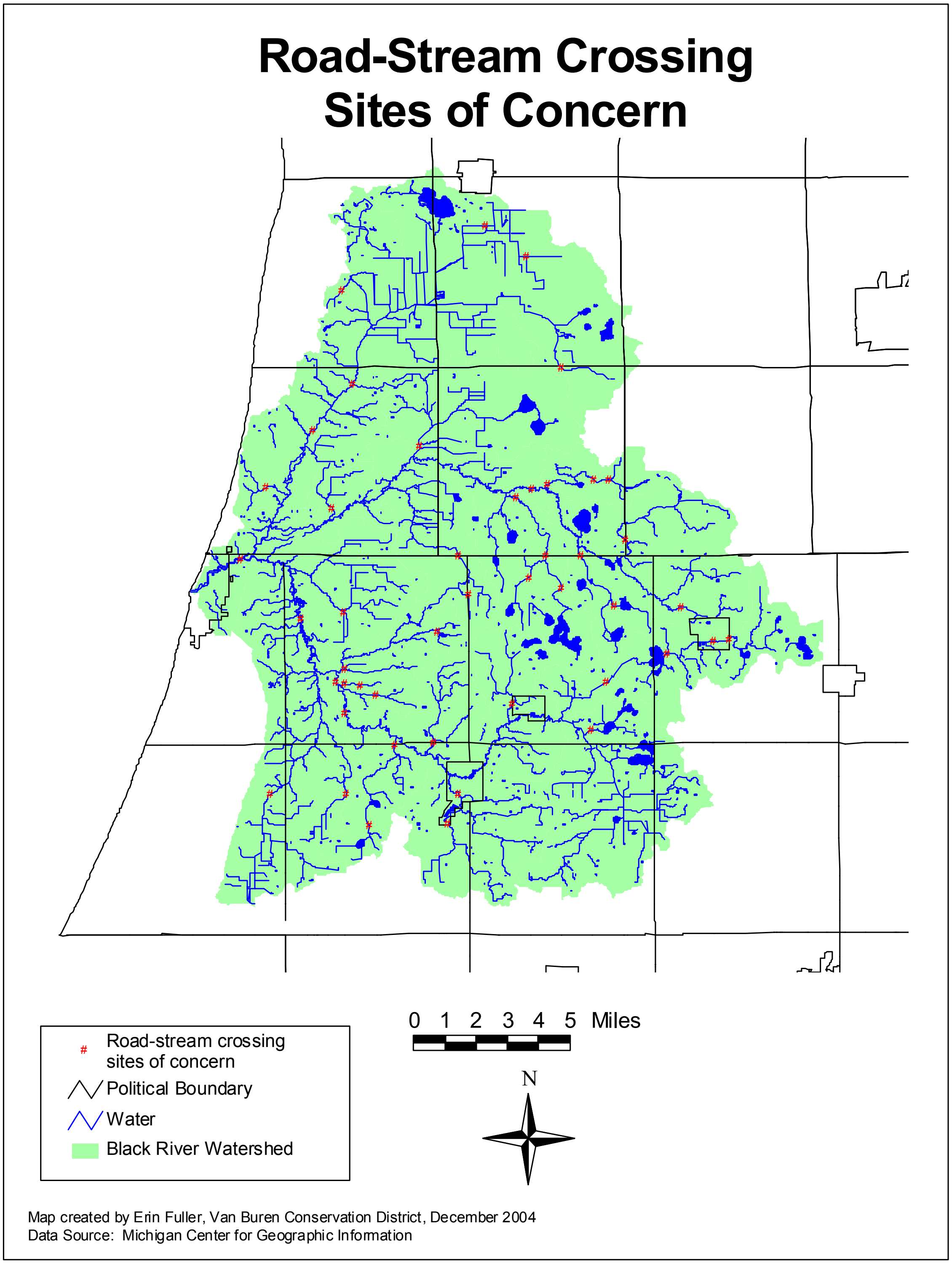

Figure 20: Road-stream crossing sites of concern

6.3.2 Streambank Erosion Sites of Concern

Sedimentation in the Black River Watershed is likely primarily a result of bank erosion. While there are certainly other sources of sedimentation, the banks appear to be eroding in many locations. This can be a result of the land use along the stream bank or changes in hydrology. For example, increased runoff from hardened surfaces results in a higher volume of water in the stream channel that is more erosive. Sediment can carry additional pollutants such as nutrients and heavy metals.

Sites with streambank erosion occurring are shown in Table 14 and Figure 21. At some of these sites, the cause of the erosion is easily determined. At most, however, the causes are not immediately visible and are likely related to past changes in the hydrologic regime (such as channelization and ditching, loss of wetlands, and increase in hardened surfaces resulting in greater runoff). Streambank erosion sites can be addressed with a variety of bioengineering techniques (such as soil lifts, log crib walls and others). However, a more complete understanding of the hydrology of the Black River and the causes of the streambank erosion is necessary before BMPs are implemented at many of these sites. In addition, while most of the eroding sites listed in Table 14 are at road-stream crossings (because those sites are the most accessible and visible in the watershed), there are stretches of streams that are eroding away from road-stream crossings. Besides being difficult to properly inventory the river between road-stream crossings, it would not be feasible to "fix" all of these stretches with structural BMPs. Instead, steps should be taken to improve the hydrology of the river.

Other stretches of river exhibited streambank erosion for long stretches. These include:

- The South Branch, downstream of Phoenix Rd. in Geneva Township (BR-13), to approximately 70th St. (BR-05)
- Much of the Haven & Max Lake Drain
- Drains in Allegan

Table 14: Streambank erosion sites of concern

Location	Source	Causes	Pollutant of concern
BR-02	Streambank erosion	Human access	sediment
BR-03	Streambank erosion		sediment
BR-04	Streambank erosion		sediment
BR-05	Streambank erosion	Removal of streambank vegetation	sediment
BR-05 to BR-13	Streambank erosion		sediment
BR-08	Streambank erosion		sediment
BR-11	Streambank erosion		sediment
BR-13	Streambank erosion		sediment
BR-14	Streambank erosion		sediment
BR-18	Streambank erosion		sediment
BR-19	Streambank erosion		sediment
BR-21	Streambank erosion	Human access	sediment
BR-27	Streambank erosion		sediment
BRM-02	Streambank erosion	Human access	sediment
BRM-04	Streambank erosion		sediment
BRM-08	Streambank erosion		sediment
BRM-14	Streambank erosion		sediment
BRM-21	Streambank erosion		sediment
BRM-25	Streambank erosion		sediment
BRM-32	Streambank erosion		sediment
BRM-36	Streambank erosion		sediment
BRM-65	Streambank erosion	Removal of streambank vegetation	sediment
BRN-01	Streambank erosion		sediment

BRN-03	Streambank erosion	Site development and construction	sediment
BRN-04	Streambank erosion		sediment
BRN-05	Streambank erosion		sediment
BRN-11	Streambank erosion		sediment
BRS-02	Streambank erosion		sediment
BRS-19	Streambank erosion		sediment
BRS-26	Streambank erosion		sediment
BRS-27	Streambank erosion		sediment
BRS-30	Streambank erosion		sediment
BRS-32	Streambank erosion		sediment
BRS-36	Streambank erosion		sediment
BRS-42	Streambank erosion		sediment
BRS-55 to BRS-57	Streambank erosion		sediment
BRS-57	Streambank erosion	Removal of streambank vegetation; human access	sediment
BRS-60	Streambank erosion		sediment
BRS-63	Streambank erosion		sediment
BRS-64	Streambank erosion		sediment
BRS-40.5 (Lion's Park-Bangor)	Streambank erosion	Removal of streambank vegetation; human access	sediment

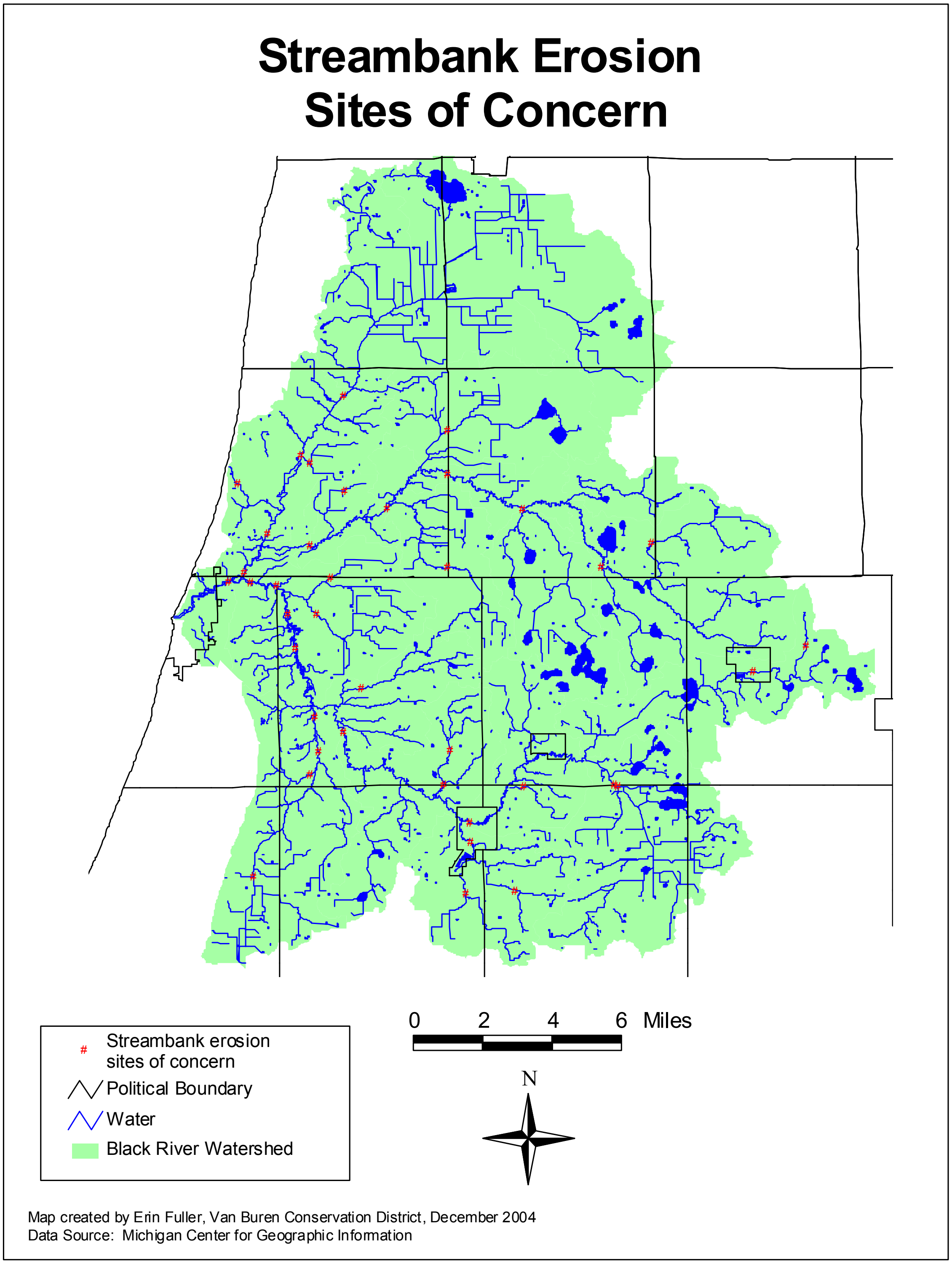

Figure 21: Streambank erosion sites of concern

6.3.3 Agricultural Sites of Concern

Nonpoint source pollution from agricultural sources can include sediment, nutrients (from fertilizer runoff or animal waste), chemical pollutants (from pesticides), and bacteria/pathogens (from animal waste). In addition, silage leachate can have a significant impact on water quality. As little as one gallon of leachate introduced into a river or stream can lower the oxygen content of 10,000 gallons of water to a level at which fish cannot survive (Cropper and Dupoldt 1995). Many agricultural issues can be addressed through programs offered through the Natural Resources Conservation Service, as well as through education. Problem areas identified through the watershed inventory included areas in which livestock have uncontrolled access to streams (leading to eroded banks and livestock waste deposited directly into the waterway) and farm fields with little to no buffer along the waterway. It should be noted, however, that despite the large percentage of agricultural land use in the watershed, relatively few areas are degraded as a direct result of agricultural practices. The main stem (North, Middle and South Branches) of the river is for the most part surrounded by a wide vegetative buffer. Agricultural land use likely has more of an impact on the smaller designated drains.

Agricultural sites of concern are shown in Table 15 and Figure 22.

Table 15: Agricultural sites of concern

Location	Source	Pollutant
BR-09	Livestock	sediment, bacteria/pathogens, nutrients
BR-31	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BR-34	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRM-11	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRM-34	Livestock	sediment, bacteria/pathogens, nutrients
BRM-41	Livestock	sediment, bacteria/pathogens, nutrients
BRM-56	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRM-59	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRM-63	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRM-67	Livestock	sediment, bacteria/pathogens, nutrients
BRN-09	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-13	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-16	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-17	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-17 (downstream)	Livestock	bacteria/pathogens, nutrients
BRN-20	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-21	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-22	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-27	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-28	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-29	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-30	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-31	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-32	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-33	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRN-35	Livestock	sediment, bacteria/pathogens, nutrients
BRS-19	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRS-23	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRS-34	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRS-47	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
BRS-51	Livestock	sediment, bacteria/pathogens, nutrients
BRS-61	Lack of vegetative buffer	sediment, nutrients, chemical pollutants

BRS-65	Lack of vegetative buffer	sediment, nutrients, chemical pollutants
Munn Lk. Drain/3850th St.	Livestock	nutrients, bacteria/pathogens

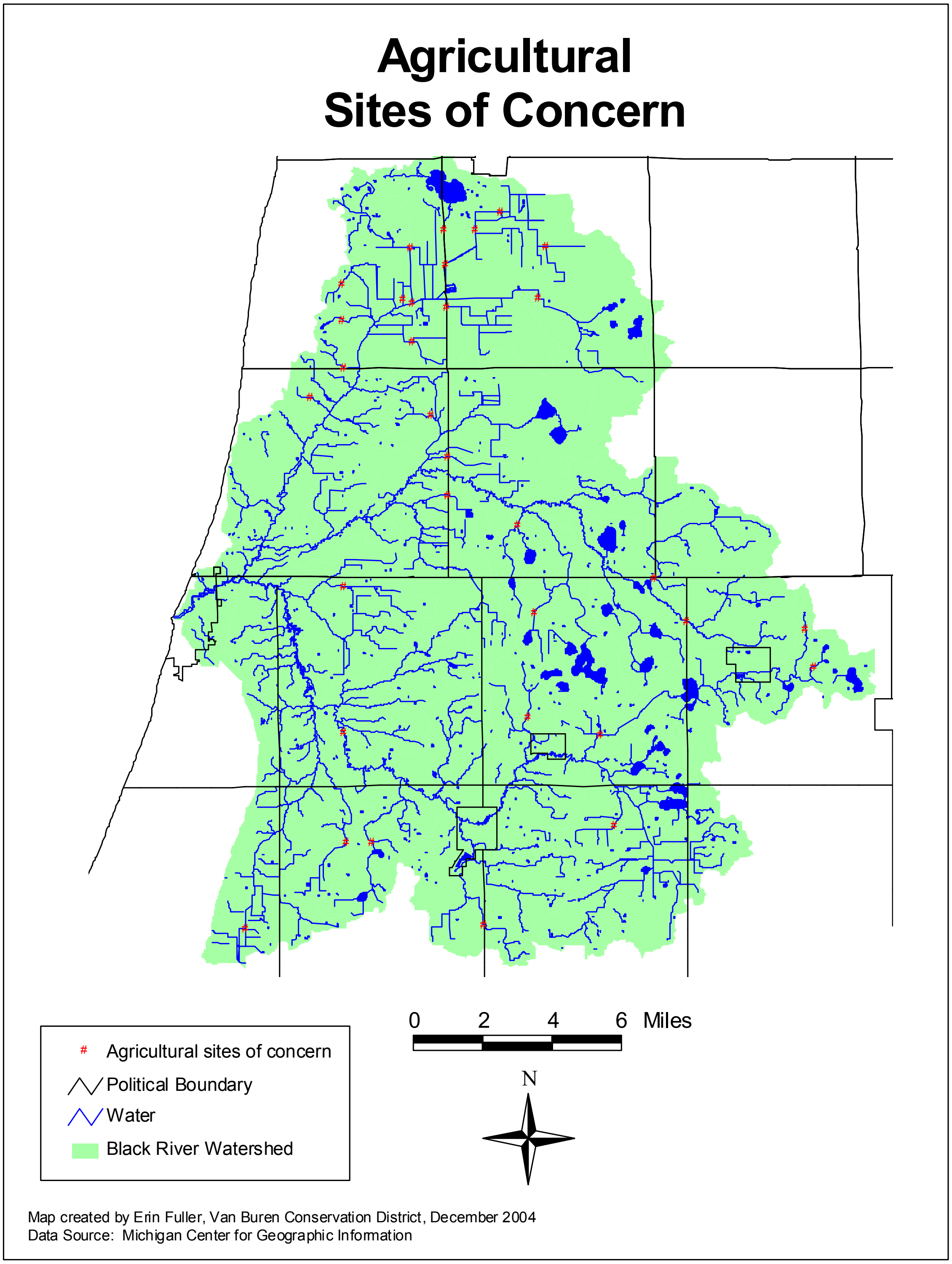

Figure 22: Agricultural Sites of Concern

6.3.4 Residential and Municipal Sites of Concern

Nonpoint source pollutants from residential and municipal sources can include sediment, nutrients, bacteria/pathogens, temperature, chemical pollutants, and trash/debris. These are all potential pollutants, but the degree to which they actually pollute a waterbody varies greatly. Without extensive water testing of the Black River it is impossible to fully ascertain the pollutant load contributed by residential and municipal areas. However, generalizations can be made to locate potential problem areas. For example, lawns that are mowed to the edge of a waterway are indicators of several potential problems: the banks in these areas are not likely to remain stable (as grass has a short root system that fails to provide bank stability), and there is no vegetative filter system in place to remove sediment, nutrients, or chemical pollutants before they reach the waterway.

Sites of concern in residential and municipal areas are shown in Table 16 and Figure 23. These sites were found during field surveys and may not include all problem areas.

Table 16: Residential and municipal sites of concern

Location	Source	Causes	Pollutant of concern
BR-01	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BR-02	Stormwater runoff	Change in hydrology (increase in hardened surfaces)	sediment, nutrients, chemical pollutants
BR-12	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BR-32	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-10	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-13	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-29	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-43	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-64	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-69	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-72	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRM-73	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRN-10	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRS-16	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRS-30	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRS-30	Stormwater runoff	Poor stormwater management practices	sediment, nutrients, chemical pollutants
BRS-40.5	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRS-48	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRS-57	Lack of vegetative buffer	Poorly maintained vegetative buffers	sediment, nutrients, chemical pollutants
BRS-58	Stormwater runoff	Poor stormwater management practices	sediment, nutrients, chemical pollutants

BRS-66	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants
BRS-67	Lack of vegetative buffer	Removal of streambank vegetation	sediment, nutrients, chemical pollutants

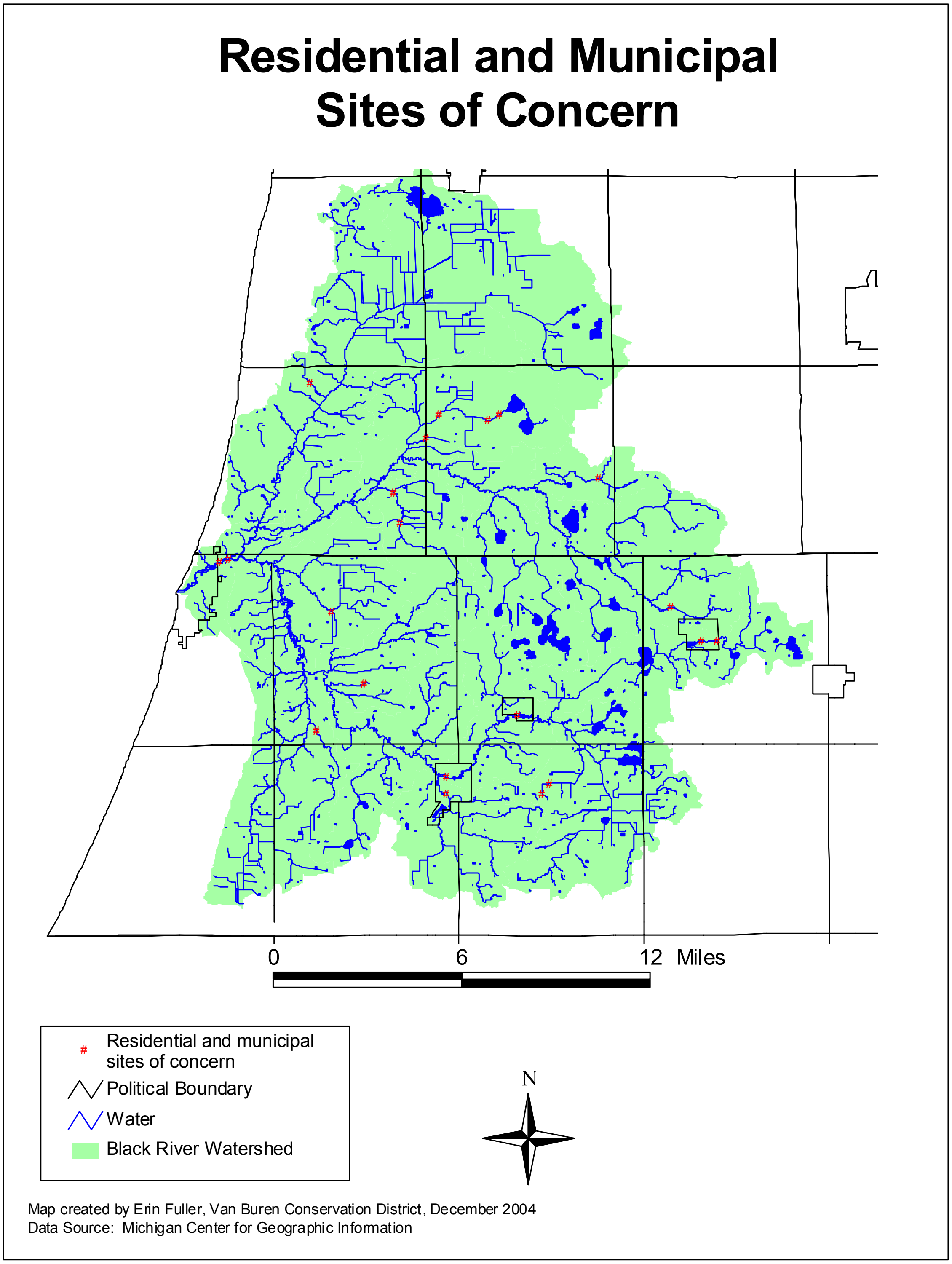

Figure 23: Residential and municipal sites of concern

6.4 Hydrology and Stream Morphology

Historically, many rivers and streams have been straightened and channelized. This was done primarily to increase drainage for the creation or improvement of agricultural land. This straightening results in a concentration of stream power which can lead to incision of the stream channel, leaving the riparian vegetation perched above the stream such that it may never be flooded (Malanson 1993). Thus, the value of flood protection for downstream areas is lost. The increased velocity also increases the river's erosive force (Palmer 1994). In 1984, the U.S. Fish & Wildlife Service estimated that 67% of the nation's degraded stream segments were degraded due to flow alteration (other causes of degradation included chemical pollution and habitat loss) (Palmer 1994).

6.4.1 Hydrology Study

A hydrologic model for the Black River Watershed was developed by the Michigan Department of Environmental Quality during the course of this project (Fongers 2004) (Appendix I). This model compares land use from a circa-1800s scenario with 1978. The model shows that there has been an increase in volume of runoff and peak flows since presettlement times (for both 2-year and 25-year storms). For the 25-year storms, this increase can cause or aggravate flooding. For the 2-year storms, channel-forming flows will increase, which can cause stream instability.

The flows of the three branches of the river were shown to peak at different times after a rain event. This helps to limit flooding effects downstream of the confluence of the three branches. Thus, any land use changes that would result in the branches peaking at the same time should be carefully evaluated for their potential downstream effects.

This model can also be used to evaluate trout habitat based on yield. Yields over a certain amount correspond with impaired or poor habitat for trout. Based on the 1978 land-use scenario, the Great Bear Lake Drain is classified as impaired for trout habitat, and habitat is classified as poor above Great Bear Lake.

6.4.2 Stream Morphology Study

An assessment of the morphology of the Black River was performed at several locations in the watershed (Appendix J). Kregg Smith, MDNR Fisheries Biologist, performed the assessment. The stream reaches were classified according to the methodology described by Rosgen (1996) (Table 17). Data collected on stream dimension, pattern and profile may guide the design criteria for structures to be used for restoring stream function.

Table 17: River delineation data collected at six stream reaches in the Black River Watershed

Waterbody	Location	Entrench-ment ratio	Width/depth ratio	Sinuosity	Slope	Channel Material	Stream type (Rosgen)
North Branch	68th St.	19.7	10.7	1.1	0.002	Glendora Loamy Sand	E5
Middle Branch	60th St.	>2.2	13.39	1.57	0.002	Glendora Loamy Sand	C5
South Branch	Hamilton St., City of Bangor	>2.2	14.83	1.2	0.002	Glendora Sandy Loam	C5
Haven/Max Lake Drain	42nd St.	>2.2	8.41	1.47	0.003	Algansee-Cohoctah	E5
South Branch	Phoenix Rd.	<1.4	6.2	1.13	0.0004	Algansee-Cohoctah	F6
Middle Branch	68th St.	<1.4	11.2	1.32	0.0013	Glendora Loamy Sand	F5

Source: Smith 2004

The E5 stream type is generally low-gradient, highly meandering, and is very stable and efficient with little deposition of materials. The C5 stream type generally has a broad floodplain, a low-gradient channel, and is relatively meandering. F stream types are generally deeply entrenched, meandering, and can experience high levels of bank erosion and sediment transport. F5 channels have a predominantly sandy substrate while F6 channels typically have a silt/clay substrate (Rosgen 1996).

More sites will be assessed in the future, and the previous sites will be revisited to track changes over time.

6.4.3 Channel Incision

Some stretches of the river were determined to be incised, included portions of Cedar Creek, the North Branch, the Black River Drain, the South Branch, and the Haven & Max Lake Drain. Incised channels have downcut their beds to the point at which the river is no longer connected to its floodplain. This results in more scouring of the channel because the water (and its energy) is confined to the channel and cannot escape onto the floodplain to dissipate the energy. It has been estimated that 75 to 80% of the sediment that is moved in the Black River comes from the streambanks as a result of channel incision and an overwide channel (C. Freiburger, personal communication, December 16, 2003).

6.5 Designated Uses

A designated use is a recognized use of water by state and federal water quality programs. All surface waters in the state of Michigan are designated and shall be protected for all of the uses listed below in Table 18. The table also indicates whether the use is currently met, threatened, or impaired in the Black River Watershed.

Table 18: Designated/Existing uses in the Black River Watershed

Designated/Existing Use	General Definition	Designated Use: Met, Threatened or Impaired
Agriculture	water supply for cropland irrigation and livestock watering	Met
Industrial Water Supply	water utilized in industrial processes	Met
Public Water Supply	public drinking water source	N/A*
Navigation	waters capable of being used for shipping, travel, or other transport by private, military, or commercial vessels	-Impaired (for canoes and kayaks on stretches of the North, Middle, and South Branches) -Threatened (South Haven harbor)
Warmwater Fishery	supports reproduction of warm water fish	-Threatened (North & Middle Branches) -Impaired (South Branch)
Coldwater Fishery [†]	supports reproduction of cold water fish	Impaired (South Branch)
Other Indigenous Aquatic Life and Wildlife	supports reproduction of indigenous animals, plants, and insects	Threatened
Partial Body Contact	water quality standards are maintained for skiing, canoeing and wading	Threatened
Total Body Contact	water quality standards are maintained for swimming	Threatened (Insufficient data)

*No communities withdraw drinking water directly from the Black River. The South Haven municipal water intake is located offshore in Lake Michigan, and is rarely affected by flows from the Black River.

[†] The following waterbodies in the Black River Watershed are also regulated as cold water fisheries (MDNR designated trout/salmon streams) (Figure 7):

- Black River Mainstream: From confluence of North and South branches down to Lake Michigan (Allegan and Van Buren Counties)
- Middle Branch Black River: From confluence of Spring Brook Creek (T1N, R15W, Section 22, Allegan County) downstream to confluence of Main Branch Black River
- North Branch Black River: From 111th Avenue (T1N, R16W, Section 3, Allegan County) downstream to confluence with Mainstream
- South Branch Black River: From Hamilton Stream Bridge (T2S, R16W, Section 1, Van Buren County) downstream to confluence with mainstream (T1S, R17W, Section 2, Van Buren County)

The different types of trout streams (shown in Figure 7) are related to stream regulations. For example, Type I streams have an open season from the last Saturday in April to September 30, while Type IV streams are open all year.

6.6 Desired Uses and Stakeholder Concerns

Desired uses for the Black River Watershed have been identified through stakeholder meetings and public participation.

- Maintain the water supply for agricultural uses (cropland uses and livestock watering)
- Maintain the water supply for industrial uses (industrial processes)
- Improve and maintain warm and cold water fishery
- Improve and maintain the habitat for other indigenous aquatic life
- Improve partial body contact (water quality standards for water skiing, canoeing and wading)
- Improve total body contact (water quality standards are maintained for swimming)
- Improve recreation infrastructure along river
    - Signage along river, access sites, remove log jams in portions for canoeing opportunities, canoe stops with bathrooms and picnic areas, remove litter and trash along banks
    - Establish trail/boardwalk along river in Bangor
- Maintain and protect wildlife habitat, specifically Great Blue Heron population near Breedsville
- Increase awareness and stewardship ethic in the Black River Watershed
    - Enhance public involvement (i.e. "Friends of the Black River")

Stakeholder concerns are shown in Table 19. These were identified through public meetings, interviews, and other forms of public participation.

Table 19: Stakeholder Concerns

Nutrients	Farms improperly spreading manure
	Farms with inadequate stream buffers
	Runoff from agricultural land
	Inadequate on-site septic systems
	Residential landscaping
	Overpopulation of Canada Geese in the Allegan State Game Area
	Waterfowl activity
	Excessive algae blooms
	Lake weed growth
Aquatic Wildlife	Lake weed growth impacting fish habitat
	Fish habitat lacking or degraded
	Dams and other barriers to fish runs
	Pollution has impacted fishery
	Exotic plants invading lakes and streams
	Largemouth Bass virus impacting bass and perch (Lower Scott Lake)
General Wildlife	Overpopulation of Canada Geese in Allegan State Game Area
	Exotic fauna such as zebra mussels and rusty crayfish may invade river and lakes
	Introduction of non-native species
	Reduction of biological diversity
	Loss of wildlife habitat
Development Issues	Wetland protection needed
	Lack of coordination between municipal governments and non-governmental economic development promoters
	Coordination of zoning regulations, incentives, etc. are necessary for watershed protection
	Lack of planning and zoning communication/coordination
	Headwater protection
	Areas of the watershed are in need of economic development

	Development needs to occur with river protection
	Region needs to capitalize on the amenity provided by the river for recreation and tourism
	Riverfront sites (esp. in Bangor) are available to residential or commercial development
	Impermeable surfaces and channelized waterways result in a pulse pattern of runoff and flow rather than even runoff sustained over a longer period of time
Recreation	Lack of canoeing opportunities
	Fisheries on the river are degraded
Sedimentation	Increase in sedimentation from short-sighted land-use practices
	Sediment from road runoff
	Sediment from Kal-Haven Trail
	Improper drain maintenance procedures
Chemical Pollutants	Possibility of cyanide from former Breedsville tannery
	Industrial runoff and dumping resulting in PCBs, cyanide and other toxins in the water and sediments
	Petroleum pollution from outboard motors and personal watercraft
	Road commissions using herbicides near/over water and culverts
Water Levels	River and lakes suffer from low water levels
	Wells and pumping diminishing the surface aquifers
Other	Garbage/debris entering river from dumping, littering and runoff

6.7 Sources and Causes of Pollution and Water Quality Impairments

Sources for water pollution are broken down into two categories: point source pollution and nonpoint source pollution. Point source pollution is the release of a discharge from a pipe, outfall or other direct input into a body of water. Common examples of point source pollution are factories and wastewater treatment facilities. Point source pollution discharges are monitored under the Clean Water Act and source discharges are required to obtain a permit to ensure compliance with water quality standards under the act. This permitting process assists in the restoration of degraded waterbodies and drinking water supplies. Water quality has improved significantly in many areas due to point source controls on industrial and municipal discharges (Wolf and Wuycheck 2004). The National Pollution Discharge Elimination System (NPDES) is the permitting process for point source discharges. The facilities holding NPDES permits in the Black River Watershed are listed in Appendix K. These facilities are required to report to the Michigan Department of Environmental Quality on a regular basis.

Though not the focus of this plan, point source pollution has had significant impact on the Black River. A previous study identified contaminants such as arsenic, chromium, copper, mercury, nickel, lead, zinc, acetone, methyl ethyl ketone, tolulene, ethylbenzene and xylene in Scott Creek, a tributary of the Middle Branch (Heaton 1997). The Bangor Mill Pond area has also had chemical contamination as a result of point source discharges. Pollutants such as heavy metals, PCBs, oils, chlorides and dissolved salts have all been found in this area (Hull 1989, Gashman 1990, Heaton 1997, Wolf and Wuycheck 2004). A major clean-up of this area was undertaken to resolve this issue (Wolf and Wuycheck 2004, L. Nielsen, personal communication, June 15, 2004).

Nonpoint source pollution, the greatest water resource concern within the Black River Watershed, is not as easily identified. Nonpoint source pollution is caused when rain, snowmelt, wind, or gravity carries pollutants off the land and into the waterbodies. Roads, parking lots and driveways, farms, home lawns, golf courses, storm sewers, and businesses collectively contribute to nonpoint source pollution. Nonpoint source pollution is often overlooked because it can be a less visible form of pollution. Common forms of nonpoint source pollution are discussed below.

6.7.1 Sediment

Sediment is soil, sand, and minerals that can take the form of bedload, suspended or dissolved material. The first problems with sedimentation within the Black River likely began during the logging period when the river was used for log transportation, and the land was deforested. This likely resulted in large amounts of sediment washing into the river. While logging is no longer the primary cause, sedimentation is still the greatest water pollution concern within the Black River Watershed (as well as the rest of the country).

Impacts:

- Sediment harms aquatic wildlife by altering the natural streambed and increasing the turbidity of the water, making it "cloudy". Sedimentation may result in gill damage and suffocation of fish, as well as having a negative impact on spawning habitat. Increased turbidity from sediment affects light penetration that may result in changes in oxygen concentrations and water temperature that could affect aquatic wildlife.
- Sediment can also affect water levels by filling in the stream bottom, causing water levels to rise. Lakes, ponds and wetland areas can be greatly altered by sedimentation. As this occurs habitat for macroinvertebrates (as well as spawning habitat for fish) is covered.
- Certain pollutants, such as phosphorus and metals, can bind themselves to the finer sediment particles and will eventually enter the waterway or waterbody.

6.7.2 Nutrients

Although certain nutrients are required by aquatic plants in order to survive, an overabundance can be detrimental to the aquatic ecosystem. Nitrogen and phosphorus are generally available in limited supply in an unaltered watershed but can quickly become abundant in a watershed under development. In abundance, nitrogen and phosphorus accelerate the growth rate of aquatic plants and speed up the natural aging process of a waterbody. This is referred to as "cultural eutrophication" when the addition of nutrients is related to human activities. Sources of these nutrients include fertilizers and organic waste carried within water runoff.

Impacts:

- Excessive nutrients increase weed and algae growth impacting recreational use on the waterbody.
- Decomposition of the increased weeds and algae lowers oxygen levels resulting in a negative impact on aquatic wildlife and reducing fishing opportunities.
- Exotic species can better compete with natural plants when nutrients are found in abundance.

6.7.3 Temperature

Change in temperature is often a forgotten pollutant. Heated runoff from impermeable surfaces alters the normal temperature range for the waterways affecting the aquatic wildlife. Impermeable surfaces, such as parking lots and driveways, and reduced infiltration on other land use types (such as lawns) lead to an increased amount of runoff. In addition, removal of streambank vegetation decreases the shading of a waterbody and can lead to an increase in temperature. Impounded areas can also have a higher water temperature relative to a free-flowing stream.

Temperature was only measured in one previous study of the Black River. In that study (MI/DEQ/WD-03/067), temperature does not appear to be increased. In fact, temperature at all sites measured was within the parameters for a coldwater fishery.

Impacts:

- Surges of heated water during rainstorms can shock and stress aquatic wildlife that have adapted to the "normal" temperature conditions.
- A change in temperature can affect the rate of photosynthesis by aquatic plants as well as the metabolic rate of aquatic organisms (Earth Force 2004).

6.7.4 Bacteria/Pathogens

Bacteria and pathogens may enter surface water from improper manure management, improper disposal of pet wastes, poorly maintained septic systems, or even from high populations of waterfowl. Fecal coliform bacteria are often monitored because they can be an indicator of high levels of pathogens. In the last study of fecal coliform bacteria in the Black River Drain (North Branch of the Black River), two sample locations had fecal coliform in excess of 550. However, this testing may now be outdated.

Impacts:

- High levels of pathogens can lead to human illnesses and diseases, and thus can impair body contact recreation in a waterbody.

6.7.5 Chemical Pollutants

Chemical pollutants such as gasoline and oil can enter surface water through runoff from roads and parking lots, or from boating. Other sources can be approved processes such as permitted application of herbicides to inland lakes to prevent the growth of aquatic nuisance plants. Other chemical pollutants consist of pesticides and herbicide runoff from commercial, agricultural, municipal or residential uses.

Impacts:

- Impacts of chemical pollutants vary widely with the chemical; however, chemical pollution can cause a variety of health risks to humans and wildlife.

6.7.6 Trash and Debris

Trash can enter the river through direct dumping from an uninformed or uncaring public. Natural debris such as trees fall into the river as part of a natural process. This natural debris is an important part of the ecology of a stream. However, too much natural debris in the river can cause impairments

Impacts:

- Trash can be hazardous to aquatic wildlife
- Trash and litter along the river is visually unappealing
- Debris jams can cause impairments to navigation
- Debris jams can cause streambank erosion if they divert the flow of water against the banks
- Debris jams can block flow and exacerbate local flooding

6.8 Designated Uses, Threats, and Pollutants

Rankings for Table 20, Table 21 and Table 22 were derived from meetings and discussion with stakeholders, the Steering Committee and the Technical Committee.

Table 20: Designated Uses, Threats, and Pollutants

Designated Use	Designated Use: Met, Threatened, or Impaired?	Pollutants causing threat or impairment	Ranking
Agriculture	Met	N/A	N/A
Industrial Water Supply	Met	N/A	N/A
Public Water Supply	Met	N/A	N/A
Navigation	Impaired and Threatened	Trash/debris	1
		Nutrients	2
		Sediment	3
		Invasive species	4
Warmwater Fishery	Threatened	Sediment	1
		Nutrients	2
		Pathogens/bacteria	3
		Temperature	4
Coldwater Fishery	Threatened	Sediment	1
		Temperature	2
		Nutrients	3
		Pathogens/bacteria	4
Other Indigenous Aquatic Life and Wildlife	Threatened	Sediment	1
		Nutrients	2
		Temperature	3

Partial Body Contact	Threatened	Pathogens/bacteria	1
		Nutrients	2
		Sediment	3
Total Body Contact	Threatened	Pathogens/bacteria	1
		Nutrients	2
		Sediment	3

Table 21: Pollutants of concern and their sources

Pollutants* and Rankings	Source
Sediment (k) Rank: 1	Streambank Erosion
	Road-Stream crossings
	Storm water runoff
	Livestock access
Nutrients (k) Rank: 2	Storm water runoff
	Septic systems
	Direct inputs
	Streambank erosion
	Livestock access
	High waterfowl population
	Fertilizer use (residential, commercial, agricultural, municipal)
Bacteria/Pathogens (k) Rank: 3	Septic systems
	Storm water runoff
	Livestock access
	High waterfowl population
Temperature (s) Rank: 4	Storm water runoff
	Lack of vegetative buffer
Trash/debris (k) Rank: 5	Direct inputs
Chemical pollutants (Oils, pesticides, herbicides, salts, etc.) (k) Rank: 6	Storm water runoff
	Direct inputs
	Impervious surfaces (roads, parking lots)
	Storm drains
	Road-stream crossings
Invasive Species (k) Rank: 7	Non-native species' adaptability and lack of predators

**k = known and s = suspected*

Table 22: Sources and causes of pollutants of concern

Sources *	Causes	Rank
Stream Bank Erosion/Stream Channel Erosion (k)	Removal of streambank vegetation (k)	1
	Change in hydrology (channelization/ditching, wetland loss, etc.) (k)	2
	Lack of agricultural erosion control measures (k)	3
	Improper culvert sizing and placement (k)	4
	Site development and construction (k)	5
	Livestock access (k)	6
	Human access (k)	7
Road Stream Crossings (k)	Improper culvert sizing and placement (k)	1
	Erosion from/around bridges, culverts and roads (k)	2
	Gravel road grading (s)	3
	Poorly installed or lack of erosion control measures (k)	4
	Winter road salting (s)	5
Direct Inputs (k)	Improper disposal of grass clippings, brush (k)	1
	Boating (k)	2
	Poor pollution prevention practices (s)	3
	Improper boat fueling practices (s)	4
	Houseboat septage (s)	5
Stormwater Runoff (k)	Change in land use (increase in hardened surfaces causing higher volumes of runoff) (k)	1
	Insufficient land use planning (k)	2
	Poor storm water management practices (k)	3
Livestock (k)	Improper manure management practices (s)	1
	Unrestricted access (k)	2
Septic Systems (s)	Poorly maintained, designed, or sited septic systems (s)	1
	Lack of education (k)	2
High Waterfowl Population (k)	Management for Canada Geese in the Allegan State Game Area (k)	1
	Unrestricted access (k)	2
Lack of (or removal of) Vegetative Buffer (k)	Insufficient land use planning (k)	1
	Lack of education on importance of vegetative buffers (k)	2
	Poorly maintained vegetative buffers (s)	3
Impervious/hardened surfaces (k)	Decreased infiltration due to change in land use (k)	1
	Insufficient land use planning (k)	2
	Increase in roads and parking lots from development (k)	3
Fertilizer use (residential, commercial, agricultural, municipal) (s)	Improper application (s)	1
	Lack of vegetative buffer (s)	2
Pesticide use (residential, commercial, agricultural, municipal) (k)	Improper application (k)	1
	Lack of vegetative buffer (s)	2
Storm Drains (s)	Improper oil disposal and vehicle maintenance (s)	1
	Illicit connections (s)	2

**k = known and s = suspected*

7. Critical Areas

Critical areas are those portions of the watershed that have the most ability to influence water quality. These areas may be considered critical because they must be preserved so they can continue to have a positive impact on water quality (as in riparian zones and wetlands). Other critical areas are those with potential to have a negative impact on water quality (such as high density areas and non-attainment sites). These critical areas, potential pollutants and locations are shown in Table 23.

Table 23: Critical Areas

Critical Areas	Potential Pollutants	Potential pollutants filtered	Location
MDEQ Non-Attainment Sites (2004 list)	Nutrients	N/A	Great Bear Lake
Former MDEQ Non-Attainment Sites (2002 list)	Bacteria Sediment Nutrients Chemical pollutants	N/A	Black River Drain (N. Branch) Haven & Max Lake Drain/Great Bear Lake
High Density Population Areas	Sediment Nutrients Temperature Bacteria/Pathogens Chemical Pollutants Trash/Debris	N/A	City of Bangor City of South Haven Village of Breedsville Village of Bloomingdale Highly populated inland lakes
Riparian/Lacustrine (Lake & Stream) Zones	Sediment Nutrients Temperature Bacteria/Pathogens Chemical Pollutants Trash/Debris	Sediment Nutrients Temperature Bacteria/Pathogens Chemical Pollutants Trash/Debris	Black River, all tributaries and lakes
Wetlands	N/A	Sediment Nutrients Chemical Pollutants	Throughout the watershed

7.1 DEQ Non-Attainment Sites

These locations are from the Michigan Department of Environmental Quality's 2002 and 2004 lists of waterbodies that do not attain water quality standards. The list changed significantly from between 2002 and 2004, with the primary change being that waterbodies considered to be "highly modified" (those that have been straightened and channelized) are now in a separate category from natural streams (and are a lower priority to receive funding for remediation projects). Some of these, however, are still of concern.

The Black River Drain (North Branch) has been ditched and channelized extensively, and is likely hydrologically unstable. This factor, combined with agricultural practices in the area and a high (though seasonal) waterfowl population make this an area with great potential to contribute pollutants.

The Haven & Max Lake Drain/Great Bear Lake area has been the focus of water quality concerns for at least 26 years (Thinnes 1978). The drain has steep, eroding banks that may contribute a great deal of sediment (and nutrients) to Great Bear Lake. A sediment trap has recently been installed on the drain just upstream of Great Bear Lake, though it is too soon to determine if it will help improve water quality in the lake. Great Bear Lake suffers nuisance algal blooms due to excess phosphorus.

7.2 High Density Population Areas

High density areas include the cities and villages in the watershed as well as areas that may grow in the future. Densely populated inland lakes may also be included in this category. High density areas are considered critical because they have significant potential to impact water quality in the future. These are frequently the areas with the highest percentage of impervious surface, which can lead to water quality problems. A significant issue around densely populated inland lakes may be nutrient and bacteria input from improperly maintained septic systems.

7.3 Riparian Zones

The riparian zone encompasses the land that is adjacent to and is influenced by the river. This zone helps absorb floodwaters, stabilize streambanks, and filter sediment and polluted runoff. Some researchers have reported that a forested floodplain in the Midwest can filter sediment at the rate of ten to twenty tons per acre per year (Palmer 1994). This riparian zone is also critical habitat for a variety of species, including neotropical migrant songbirds (Palmer 1994). Riparian areas are important for water quality, plant species, wildlife species, and fisheries (Gregory et al. 1991).

Riparian vegetation can shade the river (thus helping to regulate water temperatures), contributes nutrients and provides habitat for both riverine and terrestrial species (Doppelt et al. 1993). Debris from riparian vegetation provides habitat for aquatic invertebrate species (Gregory et al. 1991). Riparian areas can also filter out excess nutrients (e.g., runoff of fertilizer from agricultural areas) before they reach the waterway (Gregory et al. 1991). In addition, the roots of riparian vegetation can help limit erosion along the riverbank (Gregory et al. 1991), and vegetation introduces structure into the river system that influences other hydrogeomorphological processes (Ward et al. 2002).

While a river is a continuous landscape feature, the riparian corridor may not be (Malanson 1993). In many areas, the riparian zone can be quite fragmented. Where the corridor is intact, it can serve as a corridor for movement of animals as well as dispersal of plants (Gregory et al. 1991). Riparian zones are rich in species (Malanson 1993). A mosaic of habitat types can result from natural flood regimes, and thus, the riparian zone is usually more heterogeneous than the surrounding landscape. Relatively high species diversity in riparian areas can be attributed to this mosaic (Gregory et al. 1991).

This riparian zone also has the potential to negatively impact water quality, given improper land-use activities (such as fertilizing too close the channel or removing riparian vegetation). It has been estimated that in the U.S., 70-90% of riparian vegetation has been altered by human activities (Doppelt et al. 1993).

7.4 Wetlands

Wetlands may be the most biologically productive habitats in temperate regions (Cwikiel 2003). For the period 1986 to 1997, wetlands were estimated to be lost at the rate of 58,500 acres annually in the United States (Dahl 2000). While this is a large improvement over the past, the goal of no net wetland loss has not been met (Dahl 2000). Forested wetlands have experienced the greatest declines, leaving the U.S. with the least amount of forested wetlands in the nation’s history (Dahl 2000). Analysis of wetland loss indicates that urban and rural development, agriculture and silviculture are primarily responsible (Dahl 2000). It has been estimated that Michigan has lost 50% of its original wetland habitats (Cwikiel 2003).

Wetlands act as filters, and have the ability to filter pollutants such as sediment, nutrients, and chemical pollutants. Wetlands filter these pollutants out of surface and groundwater through several pathways, including uptake by plant life and adsorption into sediments (Cwikiel 2003). Wetlands also store floodwaters and release them slowly, significantly reducing downstream flooding (Cwikiel 2003).

Significant wetland loss has occurred in the Black River Watershed. Further loss should be prevented, and any wetland restoration or reconstruction should be encouraged.

7.5 Priority Areas for Implementation

The areas for implementing water quality improvements were prioritized in the following manner (Figure 24):

- Priority Area 1 (critical): Michigan Department of Environmental Quality non-attainment sites and high density population areas
- Priority area 2 is directly adjacent to the river corridor, and a 30-meter (≈100 feet) corridor along the river
- Priority area 3 is a band of land 400 meters (≈¼ mile) wide beyond priority area 2
- Priority area 4 consists of the remaining land area of the watershed

Locations in priority area 1 were chosen because they either have past histories of pollution issues or a strong potential for future problems. For example, Great Bear Lake has been struggling with water quality issues for at least 25 years. Articles published in the Kalamazoo Gazette in 1978 and 1980 point out many of the issues that continue to be problems today, such as inadequate septic systems and runoff of livestock waste (Thinnes 1987 and Betwee 1980). Activities in priority area 1 should focus on utilizing existing programs and organizations (i.e. the Natural Resources Conservation Service) to address existing problem areas and stabilizing streambanks in a few selected areas. Hydrology should also be improved in this area with the restoration or reconstructing of wetlands and possible raising the bed of the river in locations where it has become incised. Further research will be needed on the best locations for this to occur.

Priority area 2 encompasses the portion of the watershed with the greatest potential for negative impact to water quality. The greatest threats to water quality in the Black River Watershed are sediment and nutrients, and these pollutants generally enter surface water due to adjacent land-use practices. 30 meters (≈100 feet) is a recommended width for riparian buffers to protect water quality (Fischer and Fischenich 2000).

Priority area 3, while not having as great an impact on water quality as Priority area 1 or 2, is still close enough to surface water that water quality can be affected by activities in that area.

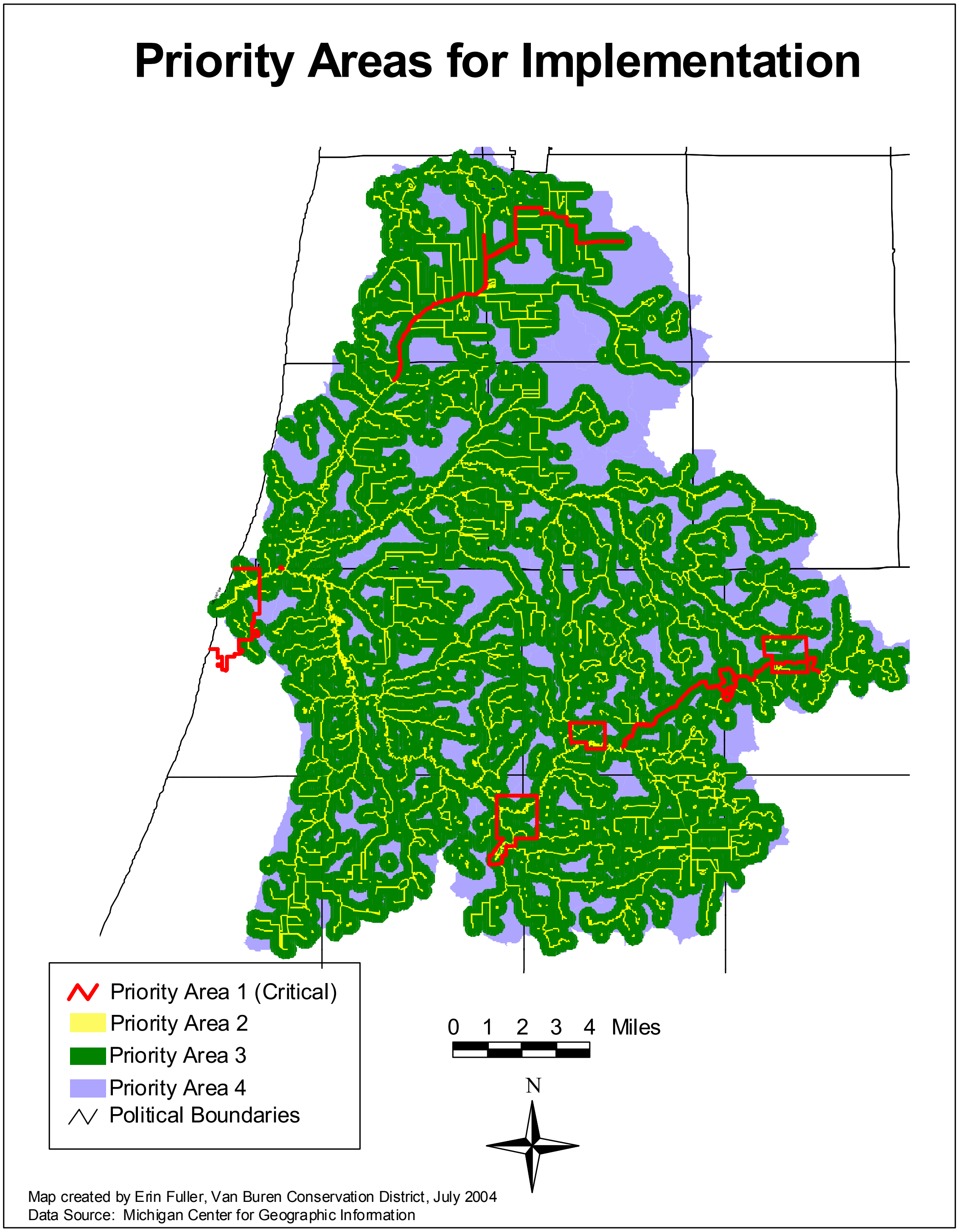

Figure 24: Priority areas for implementation

7.6 Pollutants Reduced

It is hoped that with the implementation of this management plan, all of the pollutants affecting the Black River will be reduced. Sedimentation and nutrients were considered to be the two pollutants that have the greatest impact on the water quality of the Black River, so these pollutants will have the greatest reductions.

Many of the pollutant reductions are difficult, if not impossible, to measure. For example, improvements brought about by changes in land use are difficult to quantify, but will have a long-term impact on water quality. Other measures (such as land conservation) do not necessarily reduce pollutants, but prevent water quality degradation in the future.

8. Implementation Strategies

Many of the water quality concerns in the Black River Watershed could be improved through education and land-use planning. Watershed residents need to be educated on how their actions can affect water quality. This education needs to be provided in a variety of formats: workshops for local residents, booths at local fairs and events, and presentations to township boards, lake associations, city and village councils, and other organizations. This education will help provide the foundation for long-range land use planning. Residents will need to understand the importance of master plans and ordinances for the protection of water quality for them to be effective. The themes of education and land-use planning are found throughout the goals and objectives for implementing this plan.

8.1 Goals and Objectives for the Black River Watershed

A variety of goals and objectives for the Black River Watershed have been identified through stakeholder meetings and meetings of the Steering, Technical, and Information and Education Committee (Table 24). Some of the objectives will accomplish more than one goal. For example, stabilizing priority streambank erosion sites will help achieve Goal 1, Goal 3 and Goal 4. Additionally, not all problem areas will be targeted for on-the-ground work. Instead, these areas may be addressed through other methods such as landowner education, or by creating ordinances that will address water quality issues.

The overall goals of this watershed management plan can be classified into four main categories (after Schueler 2004):

Water Quality
• Improve water quality and habitat for fish, indigenous aquatic life and wildlife in the watershed by reducing the amount of nutrients, sediment, and chemical pollutants entering the system • Continue/ increase watershed monitoring efforts and stewardship
Hydrological and Morphological Condition
• Improve the hydrology and morphology of the river
Community Concerns
• Provide long term protection of the Black River through improved local land use policies and conservation practices • Improve the navigability of the Black River for canoes, kayaks and other self-propelled watercraft, by reducing sedimentation and reducing excess woody debris • Enhance recreational access sites to prevent the degradation of water quality • Increase knowledge and understanding in the community of nonpoint source pollution and means of prevention
Biological Diversity
• Prevent or reduce the introduction and spread of invasive species

Table 24: Goals and objectives

Goals	Objectives
1. Improve water quality and habitat for fish, indigenous aquatic life and wildlife in the watershed by reducing the amount of nutrients, sediment, and chemical pollutants entering the system	1 A. Stabilize priority streambank erosion sites through the installation of corrective measures
	1 B. Establish a road/stream crossing improvement program to correct identified problems
	1 C. Assist drain commissioners in identifying areas to improve (and limit erosion)
	1 D. Work to limit or control direct livestock access to the river and tributaries
	1 E. Install corrective measures to reduce runoff at agricultural sites of concern
	1 F. Encourage farmers to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
	1 G. Reestablish greenbelts/conservation buffers at sites in critical areas
	1 H. Work with communities to reduce polluted stormwater entering local waterways
	1 I. Identify and improve failing septic systems
	1 J. Encourage the creation of local sanitary sewer systems on densely populated inland lakes
2. Continue/increase watershed monitoring efforts and stewardship	2 A. Perform water quality monitoring for potential pollutants to monitor the current quality of the river as well as to monitor changes over time
	2 B. Continue monitoring stream bank erosion with bank pins
	2 C. Continue geomorphologic assessments of river
	2 D. Perform hydraulic / hydrologic analysis of river
3. Improve the hydrology and morphology of the river	3 A. Restore or re-create wetlands to replace those that have been lost
	3 B. Restore river to decrease incision
4. Provide long term protection of the Black River Watershed through improved local land use policies and conservation practices	4 A. Assess the current adequacy level of local community planning and zoning controls
	4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
	4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
	4 D. Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases

	4 E. Support efforts to protect prime farmland from development
	4 F. Promote Low Impact Development (LID) techniques
5. Improve the navigability of the Black River for canoes, kayaks, and other self-propelled watercraft, by reducing sedimentation and reducing excess woody debris	5 A. Remove or cut through downed trees that inhibit navigation by canoes and kayaks and increase bank erosion
	Stabilize priority streambank erosion sites through the installation of corrective measures (see objective 1 A)
	Establish a road/stream crossing improvement program to correct identified problems (see objective 1 B)
	Work to limit or control direct livestock access to the river and tributaries (see objective 1 D)
6. Enhance recreational access sites to prevent the degradation of water quality	6 A. Increase the number of legal access sites
	6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
7. Increase knowledge and participation in programs regarding nonpoint source pollution and means of prevention	7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
	7 B. Develop educational tools for the citizens of the watershed
	7 C. Develop and implement a school education program
	7 D. Promote existing programs that provide education and training on water quality to watershed residents and businesses
	7 E. Prevent harmful substances from entering waterways via storm drains
	7 F. Reduce fertilizer use on residential lawns
	7 G. Establish education programs for septic system users
8. Prevent or reduce the introduction and spread of invasive species	8 A. Establish invasive species control programs to prevent the spread of exotics

Goal 1: Improve water quality and habitat for fish, indigenous aquatic life and wildlife in the watershed by reducing the amount of nutrients, sediment, and chemical pollutants entering the system

Objective 1A:	Stabilize priority streambank erosion sites through the installation of corrective measures
Tasks	1. Work with engineering firm to design appropriate stabilization techniques (soil lifts, regrading, cross vanes, coir logs, native vegetative buffers) 2. Acquire funding from local sources 3. Acquire necessary permits and permissions 4. Coordinate process for stabilizing streambank
Milestones	800 linear feet of streambanks stabilized by Year 3
Timeline	Short-term*
Priority	High
Location	Priority area 1: Bloomingdale (Bloomingdale Park) and Bangor (Lion's Park)
Coordinating agencies	Conservation Districts
Pollutants reduced	Sediment, nutrients
Evaluation	Before and after bank pin erosion study; before and after photos
Costs	≈ $110,000

Objective 1 B:	Establish a road/stream crossing improvement program to correct identified problems
Tasks	1. Work with road commissions to initiate this program 2. Distribute list of problem areas (Table 13) to road commissions 3. Develop a plan for road/culvert/bridge issues
Milestones	Tasks 1-3 completed by year 3
Timeline	Short-, Mid-, and Long-term*
Priority	Medium
Location	Priority areas 1 & 2
Coordinating agencies	Road commissions, MDOT, Conservation Districts, municipalities
Pollutants reduced	Sediment, chemical pollutants
Evaluation	Visual survey; before and after photos; before and after bank erosion pin studies where appropriate
Costs	Agency staff time $14-$45/hour (varies); watershed coordinator staff time

Objective 1 C:	Assist drain commissioners in identifying areas to improve (and limit erosion)
Tasks	1. Work with drain commission staff in training for proper drain maintenance techniques (natural channel design) 2. Include recommendations from watershed hydrology study in drain commission site plan reviews
Milestones	Hold one meeting/workshop per year
Timeline	Short-, Mid-, and Long-term*
Priority	High
Location	Priority areas 1 & 2
Coordinating agencies	County drain commissions, Conservation Districts, municipalities
Pollutants reduced	Sediment
Evaluation	Before and after surveys, follow-up survey
Costs	Agency staff time $14-$45/hour (varies); watershed coordinator staff time; $900 for workshops

Objective 1 D:	Work to limit or control direct livestock access to the river and tributaries
Tasks	1. Contact livestock farmers with access issues 2. Locate sources of funding for improving livestock access to water 3. Coordinate process for improving livestock access at 4 sites in the watershed
Milestones	Improve livestock access at 4 sites by year 3 of project
Timeline	Short-term*
Priority	High
Location	Priority areas 1 & 2
Coordinating agencies	Natural Resources Conservation Service
Pollutants reduced	Sediment, nutrients, bacteria/pathogens
Evaluation	Visual survey; document number of sites improved
Costs	$3/foot for fencing; $6/ square foot for stream crossing; staff time

Objective 1 E:	Install corrective measures to reduce runoff at agricultural sites of concern
Tasks	1. Contact farmers in sites of concern 2. Locate sources of funding for reducing agricultural runoff 3. Coordinate process
Milestones	Tasks 1 and 2 completed by year 1; task 3 completed by year 3
Timeline	Short-term*
Priority	Medium
Location	Priority areas 1 & 2 / 4595 linear feet lacking buffers in agricultural areas
Coordinating agencies	Natural Resources Conservation Service, Conservation Districts
Pollutants reduced	Sediment, Nutrients
Evaluation	Visual survey; before and after photos; track and report acres of corrective measures installed
Costs	$350/acre

Objective 1 F:	Encourage farms to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP) program
Tasks	1. Identify facilities by their commodity 2. Contact producers to initiate progressive planning process for MAEAP verification
Milestones	25% within 3 years, 50% within 6 years….etc. Final goal 100%
Timeline	Short- to long -term*
Priority	Medium
Location	All
Coordinating agencies	Natural Resources Conservation Service, Conservation Districts, Michigan Department of Agriculture
Pollutants reduced	Sediment, Nutrients
Evaluation	Number of facilities environmentally assured
Costs	Staff time (varies)

Objective 1 G:	Reestablish greenbelts/conservation buffers at sites in critical areas
Tasks	1. Contact riparian landowners in urban/residential critical areas 2. Provide education 3. Work with landowners and municipalities to install
Milestones	Linear feet of greenbelts or buffers installed
Timeline	Mid-term*
Priority	Medium
Location	Priority areas 1 and 2 / 4326 linear feet of buffers lacking in residential areas
Coordinating agencies	Conservation Districts, municipalities
Pollutants reduced	Sediment, nutrients, temperature, chemical pollutants
Evaluation	Before and after photos; before and after erosion rate calculations
Costs	$1-$50 per square foot for vegetation + design and labor; staff time

Objective 1 H:	Work with communities to reduce polluted stormwater entering local waterways
Tasks	1. Determine which municipalities know locations of storm drain inlets and outlets, and which municipalities have these mapped 2. Map storm drain system, including inlets and outlets; map surrounding land use of inlets and rank for risk 3. Work with communities (as well as developers and businesses) to use bioinfiltration and other on-site stormwater treatment methods 4. Locate and fix illicit connections 5. Replace inlet covers with ones with imprinted "Don't dump – drains to stream" message (see http://www.ejiw.com/products.phtml?catid=36) 6. Coordinate with Objective 7E
Milestones	Complete tasks one and two by year 2; Complete tasks 3, 4, 5, and 6 by year 3
Timeline	Short- to long-term*
Priority	Medium
Location	Priority area 1
Coordinating agencies	Municipalities, Conservation Districts
Pollutants reduced	All
Evaluation	Before-and after survey; track and report reduction of stormwater outlets
Costs	Staff time; mapping software

Objective 1 I:	Identify and improve failing septic systems
Tasks	1. Work with Health Departments to identify failing septic systems 2. Offer "free" septic system inspections to waterfront property owners
Milestones	10 "Free" septic inspections performed by year 3
Timeline	Short- to long-term*
Priority	High
Location	Priority area 1 & 2
Coordinating agencies	Health departments, Conservation Districts
Pollutants reduced	Nutrients
Evaluation	Follow-up surveys to determine if change in practice has occurred; estimate pollutants reduced
Costs	Staff time; educational materials; ≈ $92.50 per inspection

Objective 1 J:	Encourage the creation of local sanitary sewer systems on densely populated inland lakes
Tasks	1. Contact lake associations to determine level of interest/ feasibility 2. Contact municipalities to determine level of interest/ feasibility 3. Provide education
Milestones	Complete tasks 1, 2 and 3 by year 2
Timeline	Short- to long-term*
Priority	Medium
Location	Priority area 1 & 2
Coordinating agencies	Health departments, Conservation Districts
Pollutants reduced	Nutrients
Evaluation	Before and after knowledge surveys
Costs	Staff time

Goal 2: Continue/increase watershed monitoring and stewardship efforts

Objective 2 A:	Perform water quality monitoring to examine the current quality of the river as well as to monitor changes over time
Tasks	1. Coordinate with agencies to perform studies (road-stream crossing surveys, macroinvertebrate studies, water quality monitoring, and others) 2. Devise quality assurance project plans (QAPP) 3. Contact landowners to obtain permission to access river 4. Train volunteers 5. Carry out study
Milestones	Quality assurance project plans (QAPP) devised for all studies by year 1; data collection commences by year 1
Timeline	Short- to Long-term*
Priority	High
Location	Priority areas 1 & 2
Coordinating agencies	Michigan Department of Environmental Quality, Michigan Department of Natural Resources, Black River Watershed Assembly, schools, lake associations
Pollutants reduced	N/A
Evaluation	Success of studies will be determined in their final reports
Costs	Undetermined; materials for bank erosion study ≈ $100

Objective 2 B:	Continue monitoring stream bank erosion with bank pins
Tasks	1. Devise quality assurance project plan 2. Contact landowners to obtain permission to access river 3. Train volunteers 4. Carry out study
Milestones	Tasks 1, 2, and 3 completed by year 1, task 4 begun by year 1, continued in years 2 and 3
Timeline	Short- to Long-term*
Priority	High
Location	Priority areas 1 & 2
Coordinating agencies	Michigan Department of Environmental Quality, Michigan Department of Natural Resources, Black River Watershed Assembly
Pollutants reduced	N/A
Evaluation	The success of this study will be determined in its final report
Costs	Staff time; minimal materials costs (≈ $100)

Objective 2 C:	Continue geomorphologic assessments of river
Tasks	1. Work with Michigan Department of Natural Resources to develop assessment plan 2. Assist Michigan Department of Natural Resources in carrying out assessments
Milestones	Assess six sites per year by year 2
Timeline	Short- to Long-term*
Priority	High
Location	Priority areas 1 & 2
Coordinating agencies	Michigan Department of Environmental Quality, Michigan Department of Natural Resources
Pollutants reduced	N/A
Evaluation	The success of this study will be determined in its final report
Costs	Staff time

Objective 2 D:	Perform hydraulic/hydrologic analysis of river
Tasks	1. Work with Michigan Department of Environmental Quality and Michigan Department of Natural Resources to develop assessment plan 2. Research hiring a contractor to complete work
Milestones	Work with Michigan Department of Environmental Quality and Michigan Department of Natural Resources in year 1 to develop a plan for analysis
Timeline	Short- to Long-term*
Priority	High
Location	Priority areas 1 & 2
Coordinating agencies	Michigan Department of Environmental Quality, Michigan Department of Natural Resources
Pollutants reduced	N/A
Evaluation	The success of this study will be determined in its final report
Costs	Staff time; cost of hiring independent contractor ≈ $70,000

Goal 3: Improve the hydrology and morphology of the river

Objective 3 A:	Restore or recreate wetlands to replace those that have been lost
Tasks	1. Locate landowners interested in recreating wetlands on their properties 2. Locate funding for wetland restoration projects 3. Work with environmental engineer/consultant to develop viable wetland restoration projects
Milestones	Complete tasks 1, 2 and 3 by year 1
Timeline	Short- to Long-term*
Priority	High
Location	Priority areas 1, 2 & 3
Coordinating agencies	Michigan Department of Environmental Quality, Michigan Department of Natural Resources, Conservation Districts
Pollutants reduced	Sediment, nutrients, chemical pollutants
Evaluation	Acres of wetlands restored or recreated; hydrology study
Costs	≈ $20,000 per acre

Objective 3 B:	Restore river to decrease incision
Tasks	1. Work with riparian landowners, drain commissioners, Michigan Department of Environmental Quality and Michigan Department of Natural Resources to locate appropriate stretches for restoration 2. Contract with environmental engineer/consultant, Michigan Department of Environmental Quality and Michigan Department of Natural Resources to develop viable plan to decrease incision 3. Research funding opportunities 4. Carry out work
Milestones	Tasks 1, 2, and 3 completed by year 4; task 4 completed by year 10
Timeline	Long-term*
Priority	Medium
Location	Priority areas 1 & 2
Coordinating agencies	Michigan Department of Environmental Quality, Michigan Department of Natural Resources, Conservation Districts
Pollutants reduced	Sediment
Evaluation	Stream morphology studies
Costs	Undetermined

Goal 4: Provide long term protection of the Black River Watershed through improved local land use policies and conservation practices

Objective 4 A:	Assess the current adequacy level of local community planning and zoning controls
Tasks	1. Contact local communities and request participation in ordinance and master plan review process 2. Compare existing controls against standards and language developed in previous objective 3. Perform build-out analysis 4. Identify areas needing improvement based on assessment results and local potential for problems 5. Notify communities of these results
Milestones	Task 1 completed in year 1, tasks 2 and 3 completed in year 2, tasks 4 and 5 completed by year 4
Timeline	Short-term*
Priority	High
Location	Priority areas 1, 2, 3 & 4
Coordinating agencies	All municipalities, county and regional planning agencies, MSU Extension
Pollutants reduced	All
Evaluation	Number of partnerships formed
Costs	Time & material: $5,997.73 per municipality (SW MI Commission estimate)

Objective 4 B:	Develop model ordinances and language for adoption into existing master plans and zoning ordinances in the following areas: 1. Stormwater management 2. Setback provisions 3. Greenbelts 4. Site plan review requirements 5. Lot size 6. Septic systems 7. Funneling/keyholing 8. Wetlands 9. Other water quality protection programs
Tasks	1. Obtain examples of ordinance language and master plans that address identified problems 2. Conduct an alignment check with County/State planning requirements 3. Verify that proposed examples will address known problems 4. Obtain necessary support and permission 5. Prepare standard ordinances and recommended language in an organized form that is easily transmittable (i.e. by e-mail)
Milestones	Develop at least 7 model ordinances in year 1
Timeline	Short-term*
Priority	High
Location	Priority areas 1, 2, 3 & 4
Coordinating agencies	All municipalities, county and regional planning agencies, MSU Extension
Pollutants reduced	All
Evaluation	Track total number of ordinances developed over the life of the project
Costs	Staff time and materials: $9,863.34 per municipality (SW MI Commission estimate)

Objective 4 C:	Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
Tasks	1. Prepare "how to" outlines to use as examples of how changes should take place 2. Prepare examples that will demonstrate benefits to local communities 3. Conduct workshops for local community leaders 4. Identify grants and other funding sources for local communities 5. Provide assistance to local communities with grant applications 6. Sponsor workshops and training sessions to increase local understanding of regulations
Milestones	Work with all municipalities to adopt ordinances or update master plans in years 2 and 3, task 6 undertaken in years 1-4
Timeline	Short-term*
Priority	High
Location	Priority areas 1, 2, 3 & 4
Coordinating agencies	All municipalities, county and regional planning agencies, MSU Extension
Pollutants reduced	All
Evaluation	Track and report changes being made in communities; track number of master plans that include water quality provisions/number of water quality ordinances adopted in the watershed; track and report attendance at workshops and training sessions
Costs	Staff time; workshops ≈ $1,400

Objective 4 D:	Permanently protect sensitive areas through conservation easements, purchase of development rights, and land purchases
Tasks	1. Perform GIS-based natural resource assessment to identify and assess sensitive areas 2. Plan and prioritize sites for protection 3. Contact landowners in sensitive areas (headwaters, wetlands, and riparian zone) 4. Hold workshops on different methods of land protection 5. Obtain commitment from landowners to protect land 6. Work with local land conservancy to coordinate projects 7. Coordinate with municipalities to include information in master plans and site review process
Milestones	At least 100 acres protected by year 4
Timeline	Short- to Mid-term*
Priority	High
Location	Headwaters, wetlands, and riparian zones within priority areas 1 & 2
Coordinating agencies	Southwest Michigan Land Conservancy, Conservation Districts, Michigan Nature Association, MDNR, other conservation organizations
Pollutants reduced	Pollutants prevented/preventing future degradation
Evaluation	Track and report landowner contacts; track and report acreages that have been enrolled in land conservation programs
Costs	$20,000/year for 3 years = $60,000

Objective 4 E:	Support efforts to protect prime farmland from development
Tasks	1. Work with Allegan and Van Buren County Purchase of Development Rights (PDR) programs 2. Provide education on the PDR programs
Milestones	Tasks 1 and 2 carried out in years 1-6
Timeline	Short- to Mid-term*
Priority	Moderate
Location	All
Coordinating agencies	MSU Extension, County Farm Bureaus, Conservation Districts, Allegan and Van Buren PDR programs, SWMLC
Pollutants reduced	Limits changes in hydrology
Evaluation	Acreage enrolled in PDR programs; before and after knowledge surveys
Costs	Staff time; educational materials

Objective 4 F:	Promote Low Impact Development (LID) techniques
Tasks	1. Work with Southwest Michigan Commission to develop newsletter 2. Workshops: give 1 workshop per year for three years
Milestones	Newsletters distributed by year 2; workshops given in years 1, 2, and 3
Timeline	Short- to Long-term*
Priority	Medium
Location	All
Coordinating agencies	Conservation Districts, SW Michigan Commission
Pollutants reduced	Potentially all
Evaluation	Before and after knowledge surveys; track and report LID techniques installed in the watershed
Costs	Workshops ≈ $1350; Newsletters ≈ $2500

Goal 5: Improve the navigability of the Black River for canoes, kayaks, and other self-propelled watercraft, by reducing sedimentation and reducing excess woody debris

Objective 5 A:	Remove or cut through downed trees that inhibit navigation by canoes and kayaks
Tasks	1. Locate snags that are impassable by canoe/kayak 2. Train volunteers on proper methodology for cutting through snags based on woody debris best management practices 3. Contact riparian landowners
Milestones	At least 15 miles navigable by canoe or kayak by year 2; 21 miles navigable by year 4
Timeline	Short-term*
Priority	Medium
Location	South Branch Black River from Bangor to South Haven/21 river miles
Coordinating agencies	Bangor/South Haven Heritage Water Trail Association
Pollutants reduced	Trash/debris, sediment
Evaluation	Document river miles made accessible to canoe/kayak
Costs	≈ $4200 worth of staff and volunteer time

Objective	Stabilize priority streambank erosion sites through the installation of corrective measures (see Goal 1)

Objective	Establish a road/stream crossing improvement program to correct identified problems (see Goal 1)

Objective	Work to limit or control livestock access to the river (see Goal 1)

Goal 6: Enhance recreational access sites to prevent the degradation of water quality

Objective 6 A:	Increase the number of legal access sites
Tasks	1. Work with local governments to locate potential legal access points 2. Assist in design of access points to minimize river sedimentation
Milestones	Task 1 completed by year 2; task 2 carried out over 10 years
Timeline	Long-term*
Priority	Low
Location	Priority areas 1& 2
Coordinating agencies	Bangor/South Haven Heritage Water Trail Association, lake associations
Pollutants reduced	Sediment (well-designed, stable access points will limit informal access points that lead to streambank erosion)
Evaluation	Number of legal access sites added
Costs	Varies

Objective 6 B:	Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
Tasks	1. Work with Bangor/South Haven Heritage Trail Association and lake associations 2. Locate sites for kiosks and obtain permission from landowners 3. Develop language and signs for kiosks
Milestones	Kiosks and signage added by year 5
Timeline	Mid-term*
Priority	Medium
Location	Priority areas 1& 2
Coordinating agencies	Bangor/South Haven Heritage Water Trail Association, lake associations, Black River Watershed Assembly
Pollutants reduced	All
Evaluation	Track number of kiosks added
Costs	Varies

Goal 7: Increase knowledge and participation in programs regarding nonpoint source pollution and means of prevention

Objective 7 A:	Hire staff to implement watershed management plan, including a project manager and a land use planner
Tasks	1. Post job announcement 2. Interview and hire staff
Milestones	Staff hired in year 1
Timeline	Short- to Long-term*
Priority	High
Location	All
Coordinating agencies	Conservation Districts
Pollutants reduced	All
Evaluation	N/A
Costs	$40,000-$60,000/year

Objective 7 B:	Develop educational tools for the citizens of the watershed to: 1. Reduce erosion and sedimentation 2. Reduce nutrient and pesticide runoff from lawn care, agricultural, and wastewater practices 3. Reduce the introduction and spread of invasive species
Tasks	1. Create brochures and flyers 2. Create and distribute I & E packets for distribution to realtors, developers, builders, and new watershed homeowners 3. Follow "Information and Education Product Plan" (see Appendix L) 4. Develop educational workshops on these topics 5. Hold workshops throughout the watershed for developers, contractors, local governments and their personnel on Low Impact Development 6. Conduct tours of model best management sites 7. Distribute watershed newsletter 8. Write and distribute press releases and newspaper articles
Milestones	Brochures, flyers, press releases and newsletters created and distributed by year 1; educational workshops developed and given by year 2; site tours held by year 4
Timeline	Short- to Long-term*
Priority	High
Location	All
Coordinating agencies	NRCS, MSUE, Conservation Districts, Black River Watershed Assembly
Pollutants reduced	All
Evaluation	Track and report attendance at workshops; track production and distribution of materials; before and after surveys of the public's understanding of watershed issues
Cost	Staff time; printing and distribution costs

Objective 7 C:	Develop and implement a school educational program
Tasks	1. Contact teachers to learn what their needs are/ how to fit into benchmarks 2. Evaluate existing curriculum 3. Develop handouts 4. Create program
Milestones	Give 4 programs/year by year 4 of the program
Timeline	Mid-term*
Priority	Medium
Location	All
Coordinating agencies	Intermediate School District, Allegan County Math & Science Center, Conservation Districts, MSUE
Pollutants reduced	All
Evaluation	Document number of students reached through the program; before and after surveys; evaluate student communication post-program
Costs	Staff time; materials

Objective 7 D:	Promote existing programs that provide education and training on water quality to watershed residents and businesses (Farm*A*Syst, Home*A*Syst, Lake*A*Syst, Greenhouse*A*Syst, Turf*A*Syst, Clean Marinas Program, MAEAP, etc.)
Tasks	1. Catalog existing programs 2. Contact agencies to coordinate programs 3. Develop collaborative relationships
Milestones	Tasks 1 and 2 completed by year 2, task 3 ongoing
Timeline	Ongoing
Priority	High
Location	All
Coordinating agencies	MSU Extension, Groundwater Stewardship Program, Health Departments, Conservation Districts
Pollutants reduced	All
Evaluation	Track number of programs given to watershed residents; track number of collaborations achieved
Costs	Staff time; materials

Objective 7 E:	Prevent harmful substances from entering waterways via storm drains
Tasks	1. Establish education program 2. Work with pre-existing programs to recycle Household Hazardous Waste 3. Locate volunteers 4. Mark storm drains with "don't dump – drains to waterway" message
Milestones	Educational materials developed by year 2; 250 storm drains marked by year 3
Timeline	Short-term*
Priority	Medium
Location	Priority area 1 (Fennville, South Haven, and Bangor)
Coordinating agencies	Conservation Districts, Black River Watershed Assembly, schools, MSU Extension
Pollutants reduced	Chemical pollutants
Evaluation	Document number of storm drains marked, stream monitoring
Costs	Staff time; materials ≈ $250

Objective 7 F:	Reduce fertilizer use on residential lawns
Tasks	1. Incorporate with objectives 7A, 7B and 7C 2. Contact lawn-care professionals 3. Establish education program 4. Give workshops throughout watershed on proper lawn management (for both residents and lawn-care professionals) 5. Host a free soil test day for watershed residents
Milestones	Workshops developed and given by year 2, task 5 begun by year 3
Timeline	Short-term*
Priority	High
Location	All
Coordinating agencies	MSU Extension, Groundwater Stewardship Program, Conservation Districts
Pollutants reduced	Nutrients
Evaluation	Before and after knowledge surveys
Costs	Staff time; materials

Objective 7 G:	Establish education programs for septic system users
Tasks	1. Incorporate with Objectives 7A, 7B, 7C, and 1 H 2. Create educational program (workshops, brochures, articles, etc.) 3. Give programs throughout the community 4. Distribute educational materials
Milestones	Workshops/collateral materials produced and distributed by year 2
Timeline	Short-term*
Priority	High
Location	All
Coordinating agencies	County health departments, Groundwater Stewardship Program, MSUE, Conservation Districts
Pollutants reduced	Nutrients, Bacteria/pathogens
Evaluation	Before and after knowledge surveys; reporting attendance at workshops
Costs	Staff time; materials; workshops ≈ $800

Goal 8: Prevent or reduce the introduction and spread of invasive species

Objective 8 A:	Establish or work with existing invasive species control programs to prevent the spread of exotic species in the watershed
Tasks	1. Research existing invasive species control programs 2. Work with coordinating agencies to develop or support invasive species control programs 3. Create educational programs and materials
Milestones	Contact coordinating agencies and develop programs and materials by year 5
Timeline	Mid-term*
Priority	Medium
Location	Priority areas 1 & 2
Coordinating agencies	Michigan Department of Natural Resources, Southwest Michigan Land Conservancy, MSU Extension
Pollutants reduced	Invasive species
Evaluation	Number of brochures distributed; before and after knowledge surveys
Costs	Staff time; materials; workshops ≈ $800

* Short-term = 1 to 3 years
Mid-term = 3 to 7 years
Long-term = 7 to 15 years

8.2 Recommendations for Implementation

The ultimate vision of this project is to better help people understand their impact on water quality and learn what they can do to improve and protect water quality. Many of the problems associated with current water quality are related to a lack of understanding about nonpoint source pollution and basic river morphology and hydrology. The problems that exist are primarily not ones that can be easily fixed with 'band-aid' Best Management Practices (BMPs), so we have not made BMPs a focus of this plan. Instead, we focus on improved land use planning and a wide-ranging information and education plan. We will work with existing programs (through organizations such as the Natural Resources Conservation Service) to implement BMPs in some locations. We plan to also implement a few well-placed BMPs in critical areas that will be very visible to the public (e.g. in public parks in the watershed), and thus help enforce the educational goals of the project.

Due to limitations in the planning grant, additional studies will be needed to determine the best locations and scope of many of the recommendations contained within this plan. For example, we recommend wetland restoration and re-creation to improve water quality, due to the significant loss of wetlands within the watershed. However, the best location and size for these restorations cannot be determined without a more complete hydrologic study. Objectives of this management plan are organized by area below.

8.2.1 Recommendations for Priority Area 1

- 1 A. Stabilize priority streambank erosion sites through the installation of corrective measures
- 1 B. Establish a road/stream crossing improvement program to correct identified problems
- 1 C. Assist drain commissioners in identifying areas to improve (and limit erosion)
- 1 D. Work to limit or control direct livestock access to the river and tributaries
- 1 E. Install corrective measures to reduce runoff at agricultural sites of concern
- 1 F. Encourage farmers to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
- 1 G. Reestablish greenbelts/conservation buffers at sites in critical areas
- 1 H. Work with communities to reduce polluted stormwater entering local waterways
- 1 I. Identify and improve failing septic systems
- 1 J. Encourage the creation of local sanitary sewer systems on densely populated inland lakes
- 2 A. Perform water quality monitoring for potential pollutants to monitor the current quality of the river as well as to monitor changes over time
- 2 B. Continue monitoring stream bank erosion with bank pins

- 2 C. Continue geomorphologic assessments of river
- 2 D. Perform hydraulic / hydrologic analysis of river
- 3 A. Restore or re-create wetlands to replace those that have been lost
- 3 B. Restore river to decrease incision
- 4 A. Assess the current adequacy level of local community planning and zoning controls
- 4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
- 4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
- 4 D. Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases
- 4 E. Support efforts to protect prime farmland from development
- 4 F. Promote Low Impact Development (LID) techniques
- 5 A. Remove or cut through downed trees that inhibit navigation by canoes and kayaks and increase bank erosion
- 6 A. Increase the number of legal access sites
- 6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
- 7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
- 7 B. Develop educational tools for the citizens of the watershed
- 7 C. Develop and implement a school education program
- 7 D. Promote existing programs that provide education and training on water quality to watershed residents and businesses
- 7 E. Prevent harmful substances from entering waterways via storm drains
- 7 F. Reduce fertilizer use on residential lawns
- 7 G. Establish education programs for septic system users
- 8 A. Establish invasive species control programs to prevent the spread of exotics

8.2.2 Recommendations for Priority Area 2

- 1 B. Establish a road/stream crossing improvement program to correct identified problems
- 1 C. Assist drain commissioners in identifying areas to improve (and limit erosion)
- 1 D. Work to limit or control direct livestock access to the river and tributaries
- 1 E. Install corrective measures to reduce runoff at agricultural sites of concern
- 1 F. Encourage farmers to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
- 1 G. Reestablish greenbelts/conservation buffers at sites in critical areas
- 1 I. Identify and improve failing septic systems
- 1 J. Encourage the creation of local sanitary sewer systems on densely populated inland lakes
- 2 A. Perform water quality monitoring for potential pollutants to monitor the current quality of the river as well as to monitor changes over time
- 2 B. Continue monitoring stream bank erosion with bank pins
- 2 C. Continue geomorphologic assessments of river
- 2 D. Perform hydraulic / hydrologic analysis of river
- 3 A. Restore or re-create wetlands to replace those that have been lost
- 3 B. Restore river to decrease incision
- 4 A. Assess the current adequacy level of local community planning and zoning controls
- 4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
- 4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
- 4 D. Permanently protect identified sensitive areas through conservation easements, purchase of development rights, and land purchases
- 4 E. Support efforts to protect prime farmland from development
- 4 F. Promote Low Impact Development (LID) techniques
- 5 A. Remove or cut through downed trees that inhibit navigation by canoes and kayaks and increase bank erosion
- 6 A. Increase the number of legal access sites

- 6 B. Provide educational kiosks and signage at launch sites that educate people about the watershed and good river etiquette
- 7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
- 7 B. Develop educational tools for the citizens of the watershed
- 7 C. Develop and implement a school education program
- 7 D. Promote existing programs that provide education and training on water quality to watershed residents and businesses
- 7 F. Reduce fertilizer use on residential lawns
- 7 G. Establish education programs for septic system users
- 8 A. Establish invasive species control programs to prevent the spread of exotics

8.2.3 Recommendations for Priority Area 3

- 1 F. Encourage farmers to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
- 3 A. Restore or re-create wetlands to replace those that have been lost
- 4 A. Assess the current adequacy level of local community planning and zoning controls
- 4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
- 4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
- 4 E. Support efforts to protect prime farmland from development
- 4 F. Promote Low Impact Development (LID) techniques
- 7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
- 7 B. Develop educational tools for the citizens of the watershed
- 7 C. Develop and implement a school education program
- 7 D. Promote existing programs that provide education and training on water quality to watershed residents and businesses
- 7 F. Reduce fertilizer use on residential lawns
- 7 G. Establish education programs for septic system users

8.2.4 Recommendations for Priority Area 4

- 1 F. Encourage farmers to participate in the Michigan Agriculture Environmental Assurance Program (MAEAP)
- 4 A. Assess the current adequacy level of local community planning and zoning controls
- 4 B. Develop model ordinances and language for adoption into existing master plans and zoning ordinances
- 4 C. Assist local communities in updating master plans and/or adopting ordinances or "smart growth" techniques that will protect water quality
- 4 E. Support efforts to protect prime farmland from development
- 4 F. Promote Low Impact Development (LID) techniques
- 7 A. Hire staff to implement watershed management plan, including a project manager and a land use planner
- 7 B. Develop educational tools for the citizens of the watershed
- 7 C. Develop and implement a school education program
- 7 D. Promote existing programs that provide education and training on water quality to watershed residents and businesses
- 7 F. Reduce fertilizer use on residential lawns
- 7 G. Establish education programs for septic system users

Other recommendations for improving water quality are listed below.

8.2.5 Lakes

Many of the lakes in the watershed are facing (or will face in the future) cultural eutrophication, or aging that is caused by excessive nutrient input from human activities. Several steps can be taken to limit or slow this cultural eutrophication process. We recommend that lake associations promote techniques for landscaping for water quality, including improving shoreline buffers and limiting fertilizer use near lakes. We also recommend that lake residents have their septic systems inspected and pumped regularly. Lake residents should also attempt to maintain as much existing wetland around lakes as possible, as wetlands act as natural filters of pollutants like sediment and nutrients.

8.2.6 Septic Systems

Septic systems may contribute a great deal of nutrient pollution to our surface waters. It is likely that more residents of the watershed utilize septic systems than public sewers, due to the rural nature of the watershed. However, it is difficult to determine how much pollution septics may contribute to the watershed, or how many septic systems may be failing in the watershed. Therefore, it is recommended that septic systems be inspected every three to five years and be pumped regularly. Some municipalities have (or are considering) ordinances that require septic systems to be inspected periodically (when a home is sold, e.g.). In addition, if hookup to a public sewer system is a feasible alternative, this should be given serious consideration, especially in lakefront communities.

8.2.7 Riparian Corridor

We recommend that efforts be made to maintain or restore forests along waterways in the Black River Watershed. Forests dominated the land cover of the watershed prior to European settlement, and much of the river corridor remains in a forested, natural state. This corridor serves to protect and improve water quality by filtering out pollutants, stabilizing streambanks, and providing habitat for a variety of species. A forested corridor keeps river temperatures cool, which benefits the fishery. Natural debris that falls into the river from overhanging trees provides food and habitat for aquatic organisms. Forest buffers help prevent nonpoint source pollution from reaching waterways, and forested streams are better able to process the pollutants that do reach them than deforested streams (Sweeney et al. 2004). Deforested stream corridors also often have increased temperatures and less beneficial woody debris (Sweeney et al. 2004).

This forested corridor is a key feature to protecting the water quality on the Black River. Any activities which would diminish or fragment this corridor should be discouraged. The generally shallow depth of the river and amount of natural debris has served to limit use of the river to self-propelled watercraft. This has maintained the tranquil and rural nature of the river, as well as protecting the banks from erosion caused by boat-wakes.

8.2.8 Stormwater Management

Given the rural nature of the watershed, stormwater pollution is likely not a great contributor to nonpoint source pollution. However, the small cities still certainly have some impact. The cities also have the potential to grow into larger cities with more complex stormwater pollution issues. Thus, we recommend that the cities and villages take a proactive approach to stormwater pollution. One method is to replace storm drains with ones that are imprinted with the message "Don't dump—drains to stream." As the municipalities replace old storm drains, these could be inserted. These are minimally more expensive than the traditional storm drains, and the cost could be considered local match for the Black River Watershed Project.

8.2.9 Wetland Protection

We feel that every effort should be made to protect the remaining wetland areas in the watershed. In addition, any effort to create additional wetland acreage would be encouraged. Wetlands provide a wide variety of benefits, from filtering pollutants to mitigating flooding effects. Much wetland acreage has been lost in the watershed. Though it is not feasible that all of the original wetland areas in the watershed will be restored, any increased wetland acreage will benefit water quality in the Black River and its lakes and tributaries. Non-regulated wetlands should be of particular focus for protection efforts.

8.2.10 Low Impact Development

Low Impact Development (LID) is an innovative approach to land use planning. LID techniques focus on managing stormwater on-site to keep it from running off impermeable surfaces and carrying pollutants into nearby waterways. LID techniques can be used very effectively with new developments to reduce their impact on water quality. In addition, existing developments can use LID techniques during renovations, or to retrofit existing infrastructure. We recommend that these techniques be used whenever possible. Development will continue to occur in the watershed, but use of LID techniques will protect water quality. LID techniques include: rain gardens, porous pavement, green roofs, vegetative filter strips, and much others.

8.2.11 Information and Education

Many water quality issues are traceable to a lack of education about water quality issues. For this reason, we hope to initiate a variety of water quality education programs. These programs will consist of classroom visits as well as workshops for adults. In addition, a variety of brochures and letters will be distributed targeting specific groups (see Appendix L). A watershed newsletter will be sent to stakeholders to keep them informed and updated on the progress of the project. A website will also be maintained that will contain a variety of information about the project, including upcoming events, past successes, and ideas to help watershed residents protect water quality.

We recommend that informational packets be distributed to newcomers to the watershed. These packets would welcome residents to the watershed and would contain information about such things as riparian buffers, stormwater management, septic systems, etc. This would help not only educate new residents, but would encourage buy-in to the Black River Watershed project. These packets could be distributed through local realtors or through the county assessor's office when the affidavit of property transfer is distributed. Local Newcomer's Clubs could also be enlisted to help with this effort.

8.2.12 Long Term Land Use Planning

The importance of land-use planning cannot be overestimated. Many land use plans are outdated, or do not contain information relevant to protection of water quality. We hope that with the implementation of this plan, support can be provided to municipalities to undertake improvements to their master plans and/or zoning ordinances that will help improve water quality in the future.

9. Evaluation

9.1 Evaluation of Planning Phase

Evaluations forms were passed out at several public meetings and workshops during the planning phase. Responses on these forms were typically very positive. Attendees overwhelmingly felt that the meetings or workshops were useful, and many noted that they learned things that will change their behavior in the future.

A number of individuals and organizations have been crucial to the creation of this watershed management plan (Table 25). Many committed local match to the project and gave project support above and beyond expectations.

Not included in the following list are agencies and their staff that did not provide a written commitment of local match but nonetheless provided significant assistance to this project. These include: the Natural Resources Conservation Service (Jeff Douglas, Stacy Kimble and Jean Brokish), the Michigan Department of Natural Resources (Jay Wesley, Chris Freiburger and Kregg Smith), and the Michigan Department of Environmental Quality (Julia Kirkwood, Joe Rathbun, and Dave Fongers). Patricia Bizoukas of the Van Buren Conservation District was also a crucial member of the planning process.

Table 25: Local partners

Name/Organization	Tasks
VBCD Directors	Attended monthly VBCD board meetings; general grant administration; read and commented on watershed management plan
Sauk Trails RC&D Council	Participated in committee meetings; gave grant for purchase of Information & Education (I & E) materials
Allegan Co. Road Commission	Participated in Steering and Technical Committee meetings
Allegan Co. Drain Commission	Participated in Steering Committee and Stakeholder meetings
MSUE - Allegan County	Participated in meetings
Allegan Conservation District	Participated in Steering Committee and Stakeholder meetings
Columbia Township	Provided meeting space; participated in meetings
MSUE - Van Buren County	Staff participated in I & E Committee meetings; attended Stakeholder meetings; donated prizes for photo contests; wrote articles for newsletter; printed newsletter
Watershed Assembly*	
Casco Township Hall	Provided meeting space

City of Bangor	Staff participated in I & E committee, Steering Committee, and Technical committee meetings; attended Stakeholder meetings; wrote articles for newsletter; attended trainings for water quality monitoring; participated in bank erosion study; provided publicity for the project
Bangor City Hall	Provided meeting space
Lee Township Hall	Provided meeting space
Michigan Lake and Stream Associations	Participated in Stakeholder and Steering Committee meetings; contributed to management plan
Van Buren Co. Land Management Dept.	Provided data for project Geographical Information System (GIS)
Volunteers	Helped with bank erosion study; created project website; helped create project GIS; data entry; office help
Steering Committee	Participated in Steering committee meetings
I&E Committee	Participated in I & E committee meetings; donated prizes for photo contests; wrote articles for newsletter
Technical Committee	Participated in Technical committee meetings
Watershed Assembly (general)	Attended public meetings; participated in committee meetings; provided meeting space; wrote articles for newsletter; donated prizes for photo contests; donated stream survey kit

* The Watershed Assembly was a catch-all category for groups that did not commit specific amounts of local match, but gave a great deal of time and support to this project.

9.2 Implementation Phase Evaluation

As this plan is implemented, we anticipate a variety of benefits to water quality. Tangible evidence of water quality improvements include: reduced need for dredging in South Haven Harbor, reduced need for dredging Great Bear Lake sediment trap, reduced algae blooms in inland lakes, the drafting and implementation of ordinances that are protective of water quality, and the establishment of a sustainable, non-profit group to advocate for continued improvement of water quality in the Black River Watershed. In addition, we anticipate that the fishery of the Black River will be improved.

Evaluation methods for on-site improvements will include photographic documentation, visual surveys, bank erosion measurements, stream morphology studies, macroinvertebrate surveys, and embeddedness measurements.

The progress of the Information and Education (I & E) campaign can be gauged through knowledge surveys, follow-up surveys (to determine if a change in practice has occurred), tracking production and distribution of I & E materials, tracking number of contacts generated by publicity in local media outlets, tracking number of students reached through classroom visits, and tracking attendance at meetings, workshops and training sessions.

9.3 Feasibility of Management Plan Goals and Objectives

The goals and objectives of this plan have been written with their feasibility in mind. The objectives that will likely be the most difficult to undertake are those that require significant outlays of resources, or will involve much research. For example, the goal of improving the hydrology and morphology of the river by decreasing incision and restoring wetlands will be a significant and costly undertaking, and one that will require a good deal of research before any work occurs. However, with meaningful participation from agencies like county drain commissions, the Michigan Department of Environmental Quality and the Michigan Department of Natural Resources, this goal could be achieved.

A major concern of any watershed stakeholder is that of the economics of watershed protection. However, a variety of studies have shown that despite the investment required in watershed protection efforts, there can be an overall net gain in terms of improved water quality, increased recreational outlets, higher quality of life, and even an increase in property values (Schueler 2000). In addition, a variety of grant programs are available to provide at least some of the funding necessary to undertake many of the proposed actions.

Resistance to planning and zoning in this region is significant, and may be a real barrier to implementing portions of this watershed management plan. Some municipalities may be more willing than others to implement progressive planning and zoning measures. If these efforts are successful and well-received, other municipalities may be more willing to attempt them. Furthermore, new grant opportunities may encourage advancements in local planning and zoning initiatives (Partnerships for Change grant, e.g.). Regional planning agencies are also active in this watershed and will help facilitate this goal. The importance of education in implementing new planning and zoning techniques should not be overlooked.

Overall, the feasibility of implementing this plan depends on the ability of local stakeholders to truly collaborate and work for these goals. This will require strong leadership and significant time commitments.

10. Sustainability

The Black River Watershed Project has a long history. As long as twenty years ago, residents had concerns with water quality and began investigating solutions. Many entities have applied for grants to improve water quality and have continued to work for improved water quality even when those grants were not awarded. This tenacity speaks to the ability for this project to succeed in the future. A group of citizens, the Black River Watershed Assembly, has come together to try to keep the watershed management plan moving forward, even if no funding is immediately available for an implementation phase. In addition, the Van Buren Conservation District is exploring creating a Certified Watershed Steward Program, in which volunteers will be trained in watershed issues and required to donate 30 hours of community service. This will create a pool of knowledgeable volunteers to continue to work on watershed issues long into the future. The educational aspects of this project will build the capacity of interested citizens to continue to advocate for water quality improvements in the Black River Watershed.

One aim of this watershed management plan is to provide information for stakeholders to take steps on their own to improve water quality. Municipalities and other groups interested in protecting the Black River will be able to use this plan to leverage funding for local projects.

This plan should be reviewed and updated yearly. This will ensure that as conditions in the watershed change, the plan will continue to be useful.

10.1 Other Projects and Programs

A variety of agencies have cooperated with and provided input to the Black River Watershed Project thus far, and it is our hope that they will continue to do so. These agencies include: Michigan State University Extension, Natural Resources Conservation Service, Conservation Districts, regional planning agencies, Southwest Michigan Land Conservancy, Michigan Association of Conservation Districts, county road commissions, county drain commissions, county health departments, the Michigan Department of Environmental Quality, the Michigan Department of Natural Resources, the Bangor/South Haven Heritage Water Trail Association, the Allegan County Math & Science Center, and municipalities within the watershed. In addition, we hope to work more in the future with the Michigan Department of Transportation, county Purchase of Development Rights programs, Intermediate School Districts, and the Michigan Groundwater Stewardship Program. All attempts should be made in the future to continue to build relationships with these and other organizations.

There are a wide variety of grant programs that may also be tapped into by local communities and organizations to support water quality protection efforts. This watershed management plan will provide background and support for other grant application efforts.

10.2 Long Term Project Goals

Certainly the overarching goal of this project is to improve water quality in the Black River Watershed. Furthermore, we hope to approach this task holistically, rather than relying on short-term “band-aid” solutions. Thus, the most emphasis is placed on long-term land use planning and education. On-the-ground restoration efforts will be implemented at a few highly visible public sites. Other best management practices will be implemented through coordination with existing programs, such as those offered through the Natural Resources Conservation Services.

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12. Glossary of Acronyms

BMP – Best Management Practice
GIS – Geographic Information System
GSP – Groundwater Stewardship Program
I & E – Information and Education
LID – Low Impact Development
MAEAP – Michigan Agriculture Environmental Assurance Program
MDA – Michigan Department of Agriculture
MDEQ – Michigan Department of Environmental Quality
MDNR – Michigan Department of Natural Resources
MDOT – Michigan Department of Transportation
MSUE – Michigan State University Extension
NRCS – Natural Resources Conservation Service
PDR – Purchase of Development Rights
SWMLC – Southwest Michigan Land Conservancy
USDA – United States Department of Agriculture
VBCD – Van Buren Conservation District

Appendix A: Soils in the watershed

Table 26: Soils in the Allegan County portion of the watershed

Soil	Acres
Adrian muck	2432.7
Algansee loamy sand, protected, 0 to 3% slopes	1040.1
Aquents and Histosols, ponded	477.9
Aquents, sandy and loamy	61.2
Belleville loamy sand	228.7
Belleville-Brookston complex	54.7
Blount silt loam, 1 to 4% slopes	450.6
Brady sandy loam, 0 to 3% slopes	576.9
Brookston loam	140.0
Capac loam, 0 to 6% slopes	3462.7
Capac-Wixom complex, 1 to 4% slopes	339.3
Chelsea loamy fine sand, 0 to 6% slopes	5274.5
Chelsea loamy fine sand, 12 to 18% slopes	26.4
Chelsea loamy fine sand, 18 to 30% slopes	1.8
Chelsea loamy fine sand, 6 to 12% slopes	561.9
Cohoctah silt loam	191.0
Cohoctah silt loam, protected	289.8
Colwood silt loam	152.9
Corunna sandy loam	55.6
Covert sand, 0 to 4% slopes	3439.2
Glendora loamy sand	2628.8
Glendora loamy sand, protected	4126.1
Glynwood clay loam, 1 to 6% slopes	39.8
Glynwood clay loam, 6 to 12% slopes	2.7
Granby loamy sand	1987.2
Houghton muck	1999.3
Kibbie fine sandy loam, 0 to 3% slopes	191.0
Marlette loam, 12 to 18% slopes	53.5
Marlette loam, 18 to 35% slopes	14.4
Marlette loam, 6 to 12% slopes	395.7
Marlette-Capac loams, 1 to 6% slopes	1128.5
Martherton loam, 0 to 3% slopes	17.2
Martisco muck	110.2
Metamora sandy loam, 1 to 4% slopes	434.3
Metea loamy fine sand, 1 to 6% slopes	1589.5
Metea loamy fine sand, 6 to 12% slopes	174.3
Morocco fine sand, 0 to 3% slopes	4429.0
Morocco-Newton complex, 0 to 3% slopes	4605.6
Napoleon muck	54.4
Newton mucky fine sand	1796.6
Oakville fine sand, 0 to 6% slopes	16168.4

Oakville fine sand, 18 to 45% slopes	18.5
Oakville fine sand, 6 to 18% slopes	2663.0
Oakville fine sand, loamy substratum, 0 to 6% slopes	299.4
Ockley loam, 1 to 6% slopes	48.6
Ockley loam, 18 to 30% slopes	3.8
Ockley loam, 6 to 12% slopes	12.4
Oshtemo-Chelsea complex, 0 to 6% slopes	2081.4
Oshtemo-Chelsea complex, 12 to 18% slopes	94.2
Oshtemo-Chelsea complex, 18 to 35% slopes	70.2
Oshtemo-Chelsea complex, 6 to 12% slopes	527.1
Palms muck	216.7
Pewamo silt loam	48.2
Pipestone sand, 0 to 4 percent slopes	3154.6
Pits	67.8
Riddles loam, 1 to 6% slopes	119.4
Riddles loam, 6 to 12% slopes	1.4
Rimer loamy sand, 0 to 4% slopes	2877.6
Sebewa loam	109.9
Seward loamy fine sand, 1 to 6% slopes	1075.1
Sloan silt loam	64.1
Tedrow fine sand, 0 to 4% slopes	1053.7
Tekenink loamy fine sand, 12 to 18% slopes	6.5
Tekenink loamy fine sand, 2 to 6% slopes	351.9
Tekenink loamy fine sand, 6 to 12% slopes	76.9
Thetford loamy fine sand, 0 to 4% slopes	2982.2
Udipsamments, nearly level to gently sloping	53.6
Water	1129.5

Table 27: Soils in the Van Buren portion of the watershed

Soil	Acres
Adrian muck	783.5
Algansee-Cohoctah complex	4376.2
Aquents and Histosols, ponded	628.1
Belleville loamy sand	1286.4
Blount silt loam, 0 to 4% slopes	2659.6
Brems sand, 0 to 2% slopes	4214.2
Bronson sandy loam, 0 to 3% slopes	763.3
Capac loam, 1 to 5% slopes	10208.2
Coloma loamy sand, 0 to 6% slopes	3843.3
Coloma loamy sand, 6 to 12% slopes	1743.4
Colwood silt loam	3340.2
Covert sand, 0 to 4% slopes	675.8
Edwards muck	346.5
Gilford sandy loam	2185.2
Glendora sandy loam	1787.0
Grattan sand, 0 to 6 percent slopes	218.7
Houghton muck	4757.0

Kalamazoo loam, 2 to 6% slopes	35.9
Kalamazoo loam, 6 to 12% slopes	98.8
Kingsville loamy sand	4839.5
Matherton loam, 0 to 2% slopes	634.1
Metea loamy fine sand, 1 to 6% slopes	2207.6
Metea loamy fine sand, 6 to 12% slopes	515.9
Morocco loamy sand, 0 to 2% slopes	2336.5
Napoleon mucky peat	277.1
Oakville fine sand, 2 to 12% slopes	33.7
Oakville fine sand, 25 to 60% slopes	1.4
Ormas loamy sand, 0 to 6% slopes	228.3
Ormas loamy sand, 6 to 12% slopes	27.2
Oshtemo sandy loam, 0 to 6% slopes	498.4
Oshtemo sandy loam, 6 to 12% slopes	183.2
Oshtemo-Coloma loamy sands, 12 to 18% slopes	438.4
Oshtemo-Coloma loamy sands, 18 to 25% slopes	248.8
Ottokee loamy fine sand, 0 to 3% slopes	1461.4
Palms muck	977.8
Pewamo silt clay loam	607.0
Pipestone-Kingsville complex, 0 to 3% slopes	8593.6
Pits	76.0
Plainfield sand, 0 to 6% slopes	3107.3
Plainfield sand, 6 to 12% slopes	633.0
Riddles sandy loam, 1 to 6% slopes	4083.0
Riddles sandy loam, 12 to 18% slopes	471.6
Riddles sandy loam, 18 to 25% slopes	141.9
Riddles sandy loam, 6 to 12% slopes	1887.5
Selfridge loamy sand, 0 to 3% slopes	12921.1
Sloan loam	2147.8
Spinks loamy sand, 0 to 6% slopes	1800.3
Spinks loamy sand, 6 to 12% slopes	372.6
Spinks-Oshtemo complex, 0 to 6% slopes	38.3
Spinks-Oshtemo complex, 6 to 12% slopes	229.1
Thetford loamy sand, 0 to 2% slopes	2692.1
Tuscola silt loam, 0 to 4% slopes	1674.5
Udipsamments and Udorthents, 0 to 4% slopes	383.7
Urban land - Brems complex, 0 to 4% slopes	301.0
Urban land - Coloma complex, 0 to 6% slopes	240.2
Water	1841.0

Appendix B: Lakes in the Black River Watershed

Name	Township	County	Acres	Connected to Black River?
Abernathy Lake	Waverly	Van Buren	4.1	Yes
Clear Lake	Lee	Allegan	19.7	No
Coffee Lake	Columbia	Van Buren	40.4	Yes
Crooked Lake	Clyde	Allegan	96.9	No
Deer Lake	Columbia	Van Buren	30.4	Yes
Ely Lake	Clyde	Allegan	27.0	Yes
Great Bear Lake	Bloomingdale/Columbia	Van Buren	166.2	Yes
Hutchins Lake	Ganges/Clyde	Allegan	378.8	Yes
Lake Eleven	Columbia	Van Buren	53.9	Yes
Lake Fourteen	Arlington	Van Buren	20.9	Yes
Lake Fourteen	Columbia	Van Buren	69.5	Yes
Lester Lake	Lee	Allegan	60.4	Yes
Little Bear Lake	Columbia	Van Buren	46.1	Maybe/Wetland
Little Tom Lake	Clyde	Allegan	18.1	Maybe/Wetland
Lower Jeptha Lake	Columbia	Van Buren	55.4	Yes
Lower Scott Lake	Lee	Allegan	119.5	Yes
Manitt Lake	Casco	Allegan	0.7	No
Max Lake	Bloomingdale	Van Buren	28.0	Yes
Max Lake	Waverly	Van Buren	4.4	Yes
Merriman Lake	Bangor	Van Buren	27.1	Yes
Mill Lake	Bloomingdale	Van Buren	107.0	Yes
Moon Lake	Geneva	Van Buren	14.6	Yes
Moriah Lake	Columbia	Van Buren	17.0	Yes
Mud Lake	Cheshire	Allegan	3.9	Yes
Mud Lake	Clyde	Allegan	4.4	No
Mud Lake	Columbia	Van Buren	23.4	Yes
Munn Lake	Bloomingdale	Van Buren	12.3	Yes
Munson Lake	Columbia	Van Buren	38.5	No
North Lake	Columbia	Van Buren	60.6	Yes
North Scott Lake	Arlington/Columbia	Van Buren	76.3	Yes
Osterhout Lake	Lee	Allegan	171.9	Yes
Picture Lake	Geneva	Van Buren	5.0	Yes
S. Branch Black River (Bangor Mill Pond)	Bangor/Arlington	Van Buren	22.7	Yes
S. Branch Black River (Breedsville Mill Pond)	Columbia	Van Buren	7.9	Yes
Saddle Lake	Columbia	Van Buren	282.5	Yes
School Section Lake	Bangor	Van Buren	36.1	Yes
Silver Lake	Columbia	Van Buren	50.1	Yes
Skunk Lake	Bloomingdale	Van Buren	6.6	Yes
South Scott Lake	Arlington	Van Buren	118.1	Yes
Spring Brook Lake	Lee	Allegan	15.3	Yes
Stillwell Lake	Columbia	Van Buren	18.3	Yes
Upper Jeptha Lake	Columbia	Van Buren	58.8	Yes
Upper Scott Lake	Lee	Allegan	94.4	Yes

Data source: Michigan Center for Geographic Information, 2003

Appendix C: Dams in the Black River Watershed

Dam Name	County	Owner	Year Built	Fish Passable?	River or stream name
Saddle Lk. Level Control Structure	Van Buren	Private	1932	No	Barber Creek
Great Bear Lk. Level Control Structure	Van Buren	Local Govt.	1964	Yes	Black River
Yacht Harbor Dam	Allegan	Private		No	Black River
Lower Scott Lk. Dam	Allegan	Private	1920	No	Lower Scott Lake Creek
Black River Dam (Hamlin Dam)	Allegan	Private	1967	No	N. Branch Black River
Bangor Dam	Van Buren	Local Govt.	1975	No	S. Branch Black River
Breedsville Dam	Van Buren	Local Govt.	1837	No	S. Branch Black River
Denofrio's Pond Dam	Allegan	Private		No	Spicebush Creek
Scott Lk. Level Control Structure	Van Buren	Local Govt.	1967	No	Tributary to Black River
Harry Dam	Allegan	Private	1968	No	Tributary to Black River
Osterhout Lk. Level Control Structure	Allegan	Private	1975	No	Tributary to Black River
Lafler Dam	Van Buren	Private	1958		Tributary to Black River
Effner Dam	Van Buren	Private	1967		Tributary to Great Bear Lake
Ely Lk. Flooding Dam	Allegan	State	1985		Tributary to Utter Drain
Barden Dam	Allegan	Private	1963	No	Tributary to N. Branch Black River
Crooked Lk. Dam (Structure #4)	Allegan	State	1962	No	Utter Drain
Surprenant Dam	Allegan	Private	1964	No	Wolf Drain

Appendix D: List of Species

Name	Type
American Crow	Bird
American Goldfinch	Bird
American Kestrel	Bird
American Redstart	Bird
American Robin	Bird
American Tree Sparrow	Bird
Bald Eagle	Bird
Baltimore Oriole	Bird
Bank Swallow	Bird
Barn Swallow	Bird
Belted Kingfisher	Bird
Black and White Warbler	Bird
Black Tern	Bird
Blackburnian Warbler	Bird
Black-capped chickadee	Bird
Blackpoll Warbler	Bird
Black-throated Green Warbler	Bird
Blue Jay	Bird
Blue-gray gnatcatcher	Bird
Blue-winged Teal	Bird
Blue-winged Warbler	Bird
Bobolink	Bird
Bonaparte's Gull	Bird
Brown Thrasher	Bird
Brown-headed Cowbird	Bird
Bufflehead	Bird
Canada Goose	Bird
Cape May Warbler	Bird
Cedar Waxwing	Bird
Cerulean Warbler	Bird
Chimney Swift	Bird
Chipping Sparrow	Bird
Cliff Swallow	Bird
Common Grackle	Bird
Common Loon	Bird
Common Snipe	Bird
Common Yellowthroat	Bird
Cooper's Hawk	Bird
Cuckoo spp.	Bird
Downy Woodpecker	Bird
Eastern Bluebird	Bird
Eastern Kingbird	Bird
Eastern Meadowlark	Bird
Eastern Phoebe	Bird
Eastern Screech Owl	Bird
Eastern Towhee	Bird
Eastern Wood Pewee	Bird
European Starling	Bird
Falcon spp.	Bird
Field Sparrow	Bird
Grackles	Bird
Gray Catbird	Bird
Great Blue Heron	Bird
Great Crested Flycatcher	Bird
Great Egret	Bird
Great Horned Owl	Bird
Green Heron	Bird
Herring gull	Bird
House Finch	Bird
House Sparrow	Bird
House Wren	Bird
Indigo Bunting	Bird
Killdeer	Bird
Lesser Scaup	Bird
Lincoln's Sparrow	Bird
Louisiana Waterthrush	Bird
Magnolia Warbler	Bird
Mallard	Bird
Mourning Dove	Bird
Mute Swan	Bird
Nashville Warbler	Bird
Northern Bobwhite	Bird
Northern Cardinal	Bird
Northern Flicker	Bird
Northern Harrier	Bird
Northern Rough-winged Swallow	Bird
Northern Shoveler	Bird
Northern Waterthrush	Bird
Osprey	Bird
Ovenbird	Bird
Palm Warbler	Bird
Pied-billed Grebe	Bird
Pileated Woodpecker	Bird
Purple Martin	Bird
Red-bellied Woodpecker	Bird
Red-breasted Merganser	Bird
Red-eyed Vireo	Bird
Red-shouldered Hawk	Bird
Red-tailed Hawk	Bird
Red-winged Blackbird	Bird
Ring-billed Gull	Bird

Ring-necked duck	Bird
Ring-necked Pheasant	Bird
Rock Dove	Bird
Rose-breasted Grosbeak	Bird
Ruby-crowned Kinglet	Bird
Ruby-throated Hummingbird	Bird
Ruffed Grouse	Bird
Sandhill Crane	Bird
Sandpiper sp	Bird
Savannah Sparrow	Bird
Scarlet Tanager	Bird
Sedge Wren	Bird
Short-eared Owl	Bird
Solitary Sandpiper	Bird
Song Sparrow	Bird
Sora	Bird
Spotted Sandpiper	Bird
Swainson's Thrush	Bird
Tennessee Warbler	Bird
Tern sp	Bird
Tree Swallow	Bird
Tufted Titmouse	Bird
Turkey Vulture	Bird
Upland Sandpiper	Bird
Veery	Bird
Vesper Sparrow	Bird
Warbling Vireo	Bird
White-breasted nuthatch	Bird
White-throated Sparrow	Bird
Wild Turkey	Bird
Willow Flycatcher	Bird
Wood Duck	Bird
Wood Thrush	Bird
Woodcock	Bird
Yellow Warbler	Bird
Yellow-bellied Sapsucker	Bird
Yellow-billed cuckoo	Bird
Yellow-rumped Warbler	Bird
Yellow-throated Vireo	Bird
Appalachian Brown	Butterfly
Azure, Spring	Butterfly
Cabbage White	Butterfly
Common Buckeye	Butterfly
Eastern-tailed Blue	Butterfly
Eyed Brown	Butterfly
Fritillary, Aphrodite	Butterfly
Fritillary, Great Spangled	Butterfly
Fritillary, Silver-bordered	Butterfly

Fritillary, Varigated	Butterfly
Little Wood Satyr	Butterfly
Monarch	Butterfly
Mourning Cloak	Butterfly
Northern Broken Dash	Butterfly
Pearl Crecent	Butterfly
Red Admiral	Butterfly
Red-spotted Purple	Butterfly
Sulphur, Clouded	Butterfly
Sulphur, Orange	Butterfly
Swallowtail, Black	Butterfly
Swallowtail, Eastern Tiger	Butterfly
Swallowtail, Spicebush	Butterfly
Swallowtail, Zebra	Butterfly
Viceroy	Butterfly
Wood Nymph, Common	Butterfly
Clam	Clam
Damselfly, Ebony	Damselfly
Variable Dancer	Damselfly
Black Saddlebags	Dragonfly
Meadowhawk, Ruby	Dragonfly
Pennant, Calico	Dragonfly
Pennant, Halloween	Dragonfly
Pondhawk, Eastern	Dragonfly
Skimmer, 12-spotted	Dragonfly
Skimmer, Widow	Dragonfly
Whitetail, Common	Dragonfly
Alewife	Fish
American brook lamprey	Fish
Black bullhead	Fish
Black crappie	Fish
Blackchin shiner	Fish
Blacknose dace	Fish
Blacknose shiner	Fish
Blackside darter	Fish
Bluegill	Fish
Bluntnose minnow	Fish
Bowfin	Fish
Brassy minnow	Fish
Brook silverside	Fish
Brook stickleback	Fish
Brook trout	Fish
Brown bullhead	Fish
Brown Trout	Fish
Carp	Fish
Central mudminnow	Fish
Channel catfish	Fish
Chestnut lamprey	Fish

Chinook salmon	Fish
Common Carp	Fish
Common shiner	Fish
Creek chub	Fish
Emerald shiner	Fish
Freshwater Drum	Fish
Gizzard Shad	Fish
Golden Redhorse	Fish
Golden shiner	Fish
Grass pickerel	Fish
Greater redhorse	Fish
Green sunfish	Fish
Hornyhead chub	Fish
Iowa darter	Fish
Johnny darter	Fish
Jonny darter	Fish
Lake chubsucker	Fish
Largemouth bass	Fish
Logperch	Fish
Longnose dace	Fish
Longnose sucker	Fish
Long-nosed Gar	Fish
Mottled sculpin	Fish
Muskellunge	Fish
Northern brook lamprey	Fish
Northern hogsucker	Fish
Northern longear sunfish	Fish
Northern pike	Fish
Pirate perch	Fish
Pugnose shiner	Fish
Pumpkinseed	Fish
Rainbow darter	Fish
Rainbow Trout/ Steelhead	Fish
Rockbass	Fish
round goby	Fish
Sand shiner	Fish
Sea lamprey	Fish
Shorthead redhorse	Fish
Smallmouth bass	Fish
Spotfin shiner	Fish
Spottail shiner	Fish
Spotted gar	Fish
Spotted sucker	Fish
Stonecat	Fish
Striped shiner	Fish
Tadpole madtom	Fish
Tiger Muskellunge	Fish
Walleye	Fish

Warmouth	Fish
White sucker	Fish
Yellow bullhead	Fish
Yellow perch	Fish
Bullfrog	Frog
Eastern Gray Treefrog	Frog
Green Frog	Frog
Northern Leopard Frog	Frog
Northern Spring Peeper	Frog
Western Chorus Frog	Frog
Wood Frog	Frog
Water Striders	Insect
Eastern Chipmunk	Mammal
Eastern Cottontail	Mammal
Fox Squirrel	Mammal
Meadow Jumping Mouse	Mammal
Muskrat	Mammal
Opossum	Mammal
Raccoon	Mammal
White-tailed Deer	Mammal
Woodchuck	Mammal
Mapleleaf (*Quadrula quadrula*)	Mussel
Agalinis, Slender	Plant
Agrimony, Tall Hairy	Plant
Alder, Speckled	Plant
Alumroot	Plant
American Bellflower	Plant
Amur River Privet	Plant
Anemone, Wood	Plant
Angelica	Plant
Arrow Arum	Plant
Arrowglass, Slender	Plant
Arrowhead, Common (Wapato)	Plant
Ash, Black	Plant
Ash, Prickly	Plant
Ash, Red	Plant
Ash, White	Plant
Asparagus, Garden	Plant
Aspen sp	Plant
Aspen, Large-toothed	Plant
Aster, Flat-topped	Plant
Aster, Lake Ontario	Plant
Aster, Large-leaved	Plant
Aster, Panicled	Plant
Aster, Purple-stemmed	Plant
Aster, Side-flowering	Plant
Autumn Olive	Plant
Avens, White	Plant

Baneberry, Red	Plant
Baneberry, White	Plant
Bartonia	Plant
Basswood	Plant
Beaked willow	Plant
Beak-Rush	Plant
Bebb's Sedge	Plant
Bedstraw	Plant
Bedstraw, Fragrant	Plant
Bedstraw, Stiff Marsh	Plant
Beech, American	Plant
Beechdrops	Plant
Beggar-ticks, Leafy-bracted	Plant
Bellflower, Marsh	Plant
Bellwort, Perfoliate	Plant
Bergamot	Plant
Bindweed, Hedge	Plant
Birch, Yellow	Plant
Bittercress, Hairy	Plant
Bittercress, Pennsylvanian	Plant
Bittersweet, Oriental	Plant
Black Willow	Plant
Blackberry, Common	Plant
Black-eyed Susan	Plant
Bladderwort, Flat-leaved	Plant
Blazing Star, Marsh (Dense)	Plant
Blue Flag Iris	Plant
Blue Flag, Southern	Plant
Blueberry sp	Plant
Blueberry, Highbush	Plant
Blueberry, Highbush	Plant
Blueberry, Hillside	Plant
Blue-joint	Plant
Blunt Broom Sedge	Plant
Boneset, Common	Plant
Bottle Brush Sedge	Plant
Bottlebrush Grass	Plant
Brambles	Plant
Bright-green Spike-rush	Plant
British Soldiers	Plant
Brome sp	Plant
Broom-sedge	Plant
Brown-eyed susan	Plant
Buckthorn, Alder-leaved	Plant
Bugleweed, Northern	Plant
Bulrush, Dark-green	Plant
Bur-Marigold, Nodding	Plant
Buttercup, Small-flowered	Plant

Butternut	Plant
Button Bush	Plant
Canada Bluegrass	Plant
Canadian St. John's-wort	Plant
Capillary Beak-rush	Plant
Cardinal Flower	Plant
Cat's-ear	Plant
Cattail, Common	Plant
Centaury, Forking	Plant
Cherry, Black	Plant
Chickweed, Mouse-eared	Plant
Chokeberry, Black	Plant
Cicely, Sweet	Plant
Ciliate-leaved Paspalum	Plant
Cinquefoil, Common	Plant
Cinquefoil, Rough-fruited	Plant
Cinquefoil, Shrubby	Plant
Clearweed	Plant
Clover, Little Hop	Plant
Clover, Red	Plant
Club Moss, spp	Plant
Clubmoss, Stiff	Plant
Common Flat Brocade Moss	Plant
Coontail	Plant
Coral-root, Autumn	Plant
Coral-root, Spotted	Plant
Cottonwood, Eastern	Plant
Cress, Common Winter	Plant
Cress, Spring	Plant
Cress, Water	Plant
Crowfoot, Hooked	Plant
Cucumber Root, Indian	Plant
Currant sp.	Plant
Cushion Moss	Plant
Daisy, Ox-eye	Plant
Dandelion, Common	Plant
Day-Lily, Canada	Plant
Delicate Fern Moss	Plant
Dewberry sp	Plant
Dissected Grape Fern	Plant
Dock, Curly	Plant
Dodder, Common	Plant
Dogbane, Spreading	Plant
Dogwood, Alternate-leaved	Plant
Dogwood, Flowering	Plant
Dogwood, Gray	Plant
Dogwood, Gray	Plant
Dogwood, Pale	Plant

Dogwood, Red Osier	Plant
Dryad Saddle	Plant
Duckweed, Lesser	Plant
Dutchman's Breeches	Plant
Dwarf Raspberry	Plant
Eastern Red Cedar	Plant
Elder, Common	Plant
Elder, Red-berried	Plant
Elm sp	Plant
Elm, American	Plant
Elm, Siberian	Plant
Enchanter's Nightshade	Plant
Fern Evergreen Wood	Plant
Fern, Bracken	Plant
Fern, Cinnamon	Plant
Fern, Clinton's Wood	Plant
Fern, Grape	Plant
Fern, Lady	Plant
Fern, Marsh Shield	Plant
Fern, New York	Plant
Fern, Rattlesnake	Plant
Fern, Royal	Plant
Fern, Sensitive	Plant
Fern, Shield	Plant
Fern, Spinulose Wood	Plant
Figwort, Eastern	Plant
Flat-tufted Feather Moss	Plant
Flax, Wild	Plant
Fleabane, Annual	Plant
Fleabane, Daisy	Plant
Fly Agaric	Plant
Four Tooth Moss	Plant
Fox Sedge	Plant
Foxglove Beard-tongue	Plant
Fungus	Plant
Fungus	Plant
Fungus	Plant
Garlic mustard	Plant
Gerardia, Purple	Plant
Giant Reed Grass	Plant
Ginseng, Large	Plant
Golden Ragwort	Plant
Goldenrod, Canada	Plant
Goldenrod, Common Flat-topped	Plant
Goldenrod, Ohio	Plant
Goldenrod, Rough-leaved	Plant
Goldenrod, Rough-stemmed	Plant
Goldenrod, Tall	Plant

Goldthread	Plant
Gooseberry sp.	Plant
Gooseberry, Prickly	Plant
Graceful Sedge	Plant
Grape Fern, Leather	Plant
Grape, Fox	Plant
Grape, River-bank	Plant
Grape, Wild	Plant
Grass, Blue-eyed	Plant
Grass, Cut	Plant
Grass, Deer-tongue	Plant
Grass, Fowl Manna	Plant
Grass, Orchard	Plant
Grass, Reed Canary	Plant
Grass-pink	Plant
Green Dragon	Plant
Green Sedge	Plant
Green Silk Moss	Plant
Greenbrier sp	Plant
Greenbrier, Bristly	Plant
Green-headed coneflower	Plant
Ground Cedar	Plant
Ground-cherry, Clammy	Plant
Groundsel, Common	Plant
Gum, Sour	Plant
Hardstem Bulrush	Plant
Hawkweed, Orange	Plant
Hawthorn sp	Plant
Hemlock, Eastern	Plant
Hepatica, Round-lobed	Plant
Hickory sp	Plant
Hickory, Pignut	Plant
Highbush Cranberry	Plant
Hog Peanut	Plant
Honewort	Plant
Honeysuckle, Glaucous	Plant
Hornbeam, American (Blue-beech)	Plant
Hornbeam, Hop	Plant
Horse-nettle	Plant
Horsetail	Plant
Horsetail, Field	Plant
Horsetail, Meadow	Plant
Indian-hemp	Plant
Inland Sedge	Plant
Iris, Yellow	Plant
Ironweed, Missouri	Plant
Ivy, Poison	Plant

Appendix E: List of Fish Species

Name	Status
Alewife	introduced
American brook lamprey	common
Black bullhead	present
Black crappie	common
Blackchin shiner	common
Blacknose shiner	common
Blacknose dace	present
Blackside darter	present
Bluegill	common
Bowfin	common
Bluntnose minnow	present
Brassy minnow	present
Brook stickleback	present
Brook silverside	present
Brook trout	rare
Brown Trout	introduced
Brown bullhead	common
Central mudminnow	common
Channel catfish	present
Chestnut lamprey	present
Chinook salmon	introduced
Common Carp	introduced
Common shiner	common
Creek chub	present
Emerald shiner	present
Freshwater Drum	present
Gizzard Shad	present
Golden Redhorse	common
Golden shiner	present
Grass pickerel	present
Greater redhorse	present
Green sunfish	common
Hornyhead chub	common
Iowa darter	present
Johnny darter	common
Lake chubsucker	present
Largemouth bass	common
Logperch	common
Longnose dace	present
Longnose sucker	present
Mottled sculpin	present
Muskellunge	introduced
Northern brook lamprey	common
Northern hogsucker	present
Northern longear sunfish	present
Northern pike	common
Pirate perch	rare
Pugnose shiner	rare
Pumpkinseed	common
Rainbow Trout/ Steelhead	introduced
Rainbow darter	present
Rockbass	common
round goby	introduced
Sand shiner	unknown
Sea lamprey	introduced
Shorthead redhorse	common
Smallmouth bass	common
Spotfin shiner	present
Spottail shiner	present
Spotted gar	present
Spotted sucker	rare
Stonecat	unknown
Striped shiner	rare
Tadpole madtom	rare
Tiger Muskellunge	introduced
Walleye	common
Warmouth	common
White sucker	common
Yellow bullhead	common
Yellow perch	common

Appendix F: Threatened, Endangered, and Special Concern Species and Communities in the Black River Watershed

Scientific Name	Common Name	Federal Status	State Status	Type
Acris crepitans blanchardi	Blanchard's Cricket Frog		SC	Animal
Clemmys guttata	Spotted Turtle		T	Animal
Elaphe obsoleta obsoleta	Black Rat Snake		SC	Animal
Emys blandingii	Blanding's Turtle		SC	Animal
Erynnis persius persius	Persius Duskywing		T	Animal
Ictiobus niger	Black Buffalo		SC	Animal
Incisalia irus	Frosted Elfin		T	Animal
Lanius ludovicianus migrans	Migrant Loggerhead Shrike		E	Animal
Lycaeides melissa samuelis	Karner Blue	LE	T	Animal
Microtus pinetorum	Woodland Vole		SC	Animal
Notropis anogenus	Pugnose Shiner		SC	Animal
Notropis texanus	Weed Shiner		X	Animal
Sistrurus catenatus catenatus	Eastern Massasauga	C	SC	Animal
Terrapene carolina carolina	Eastern Box Turtle		SC	Animal
Coastal plain marsh	Infertile Pond/marsh, Great Lakes Type			Community
Great blue heron rookery	Great Blue Heron Rookery			Other
Adlumia fungosa	Climbing Fumitory		SC	Plant
Agrimonia rostellata	Beaked Agrimony		SC	Plant
Carex albolutescens	Greenish-white Sedge		T	Plant
Carex festucacea	Fescue Sedge		SC	Plant
Cyperus flavescens	Yellow Nut-grass		SC	Plant
Eleocharis melanocarpa	Black-fruited Spike-rush		SC	Plant
Eleocharis microcarpa	Small-fruited Spike-rush		E	Plant
Eleocharis tricostata	Three-ribbed Spike-rush		T	Plant
Fuirena squarrosa	Umbrella-grass		T	Plant
Hemicarpha micrantha	Dwarf-bulrush		SC	Plant
Hibiscus moscheutos	Swamp Rose-mallow		SC	Plant
Hydrastis canadensis	Goldenseal		T	Plant
Linum virginianum	Virginia Flax		T	Plant
Ludwigia alternifolia	Seedbox		SC	Plant
Lycopodium appressum	Northern Prostrate Clubmoss		SC	Plant
Panax quinquefolius	Ginseng		T	Plant
Platanthera ciliaris	Orange or Yellow Fringed Orchid		T	Plant
Polygala cruciata	Cross-leaved Milkwort		SC	Plant
Polygonum careyi	Carey's Smartweed		T	Plant
Populus heterophylla	Swamp or Black Cottonwood		E	Plant
Potamogeton bicupulatus	Waterthread Pondweed		T	Plant
Psilocarya scirpoides	Bald-rush		T	Plant
Pygarctia spraguei	Sprague's Pygarctia		SC	Plant
Rhexia virginica	Meadow-beauty		SC	Plant
Rhynchospora macrostachya	Tall Beak-rush		SC	Plant
Rotala ramosior	Tooth-cup		SC	Plant
Scirpus torreyi	Torrey's Bulrush		SC	Plant
Scleria reticularis	Netted Nut-rush		T	Plant

Sisyrinchium atlanticum	Atlantic Blue-eyed-grass		T	Plant
Strophostyles helvula	Trailing Wild Bean		SC	Plant

LE: Listed Endangered
C: Candidate for federal status under the Endangered Species Act of 1998
SC: Special concern
T: Threatened
E: Endangered
X: Probably Extirpated
Source: Michigan Natural Features Inventory, 2003

Appendix G: Officials in the Watershed

Name	Address	City	Zip	Phone	Position
The Honorable Patricia Birkholz	PO Box 30036	Lansing	48909	(517) 373-3447	State Senator - 24th Dist (Allegan, Barry, Eaton)
David Bly	00080 3850 St	Bloomingdale	49026	(269) 521-3800	Bloomingdale Twp (Van Buren) Supervisor
Dale Bradford	PO Box 323	Grand Junction	49056	(269) 434-6227	Columbia Twp (Van Buren) Supervisor
Bill Colgren	43129 CR 215	Lawrence	49064	(269) 674-8420	Arlington Twp (Van Buren) Supervisor
Mark DeYoung					Allegan County Commissioner - District 4
Orrin Dorr	219 E Paw Paw St	Paw Paw	49079	(269) 657-8241	Van Buren County Drain Commissioner
Richard Freestone	31002 60th Avenue	Bangor	49013	(269) 427-7674	Van Buren County Commissioner - District 4
Tommy Giles	2386 58th St	Fennville	49408	(269) 561-5214	Clyde Twp (Allegan) Supervisor
T. Wayne Hammond	295 E Main St	Breedsville	49027	(269) 427-7281	Village of Breedsville President
John Herbert					Ganges Twp (Allegan) Supervisor
The Honorable Peter Hoekstra	31 E 8th St	Holland	49423	(616) 395-0030	US Congressman - 2nd District
Regina Hoover	68129 34th Ave	Covert	49043	(269) 427-8965	Bangor Twp (Van Buren) Supervisor
The Honorable Ron Jelinek	PO Box 30036	Lansing	48909	(517) 373-6960	Senator - 21st Dist (Van Buren)
Tom Jessup	6717 108th Avenue	South Haven	49090	(269) 637-3374	Casco Twp (Allegan) Supervisor
Harold Johnson					Van Buren County Commissioner - District 2
Norm Johnson	257 W. Monroe St.	Bangor	49013		Mayor, City of Bangor
The Honorable Carl Levin	110 Michigan NW, #134	Grand Rapids	49503	(616) 456-2531	MI - US Senator
Dale Lewis	539 Phoenix St	South Haven	49090	(269) 637-0700	City of South Haven Mayor
Dennis Martin	PO Box 666	Fennville	49408	(269) 561-8321	Mayor, City of Fennville
Bill Miller	109 E Kalamazoo, PO Box 236	Bloomingdale	49026	(269) 521-3222	Village of Bloomingdale President

Sally Moore	5589 South St.	Pullman	49450	(269) 236-5450	Lee Twp. (Allegan) Supervisor
James Ray					Van Buren County Commissioner - District 3
Wayne Rendell	45187 Blue Star Hwy	Coloma	49038	(269) 849-2074	Covert Twp (Van Buren) Supervisor
Rebecca Rininger	113 Chestnut	Allegan	49010	(269) 673-0440	Allegan County Drain Commissioner
The Honorable Tonya Schuitmaker	N1099 House Office Bld., PO Box 30014	Lansing	48909	(517) 373-0839	State Representative - 80th District
The Honorable Fulton Sheen	N1192 House Office Building, POB 30014	Lansing	48909	(517) 373-0836	State Representative - 88th Dist (Allegan)
The Honorable Debbie Stabenow	3230 Broadmoor St, Suite B	Grand Rapids	49512	(616) 975-0052	MI - US Senator
Ross Stein	14149 73rd St	South Haven	49090	(269) 637-6746	South Haven Twp (Van Buren) Supervisor
Tom Tanczos	71040 2nd Avenue	South Haven	49090	(269) 637-1990	Van Buren County Commissioner - District 1
John Tapper	PO Box 175	Paw Paw	49079	(269) 657-4261	Van Buren County Commissioner - District 5
Troy Tooker	473 40th St	Allegan	49010	(269) 521-3277	Cheshire Twp (Allegan) Supervisor
Sally Troutman	PO Box 108	Pullman	49450	(269) 236-5450	Lee Twp (Allegan) Supervisor
The Honorable Fred Upton	157 S Kalamazoo Mall, Suite 180	Kalamazoo	49007	(269) 385-0039	US Congressman - 6th District
Kimberlee VanLangevelde					Allegan County Commissioner - District 5
Nancy Ann Whaley	63133 16th Ave	Bangor	49013	(269) 427-7607	Geneva Twp (VB) Supervisor
Bernard Wilfong	42114 M-43	Paw Paw	49079	(269) 657-6847	Waverly Twp (Van Buren) Supervisor

Appendix H: Black River Watershed Bank Erosion Study

Monitoring Stream Bank Erosion with Bank Pins in the Black River Watershed (Allegan and Van Buren Counties)

Final Report
3/12/05

Black River Watershed Project

(Tracking code 2002-0067)

Project Partners:
Van Buren Conservation District
Michigan Department of Environmental Quality

Prepared by:
Erin Fuller
Black River Watershed Coordinator
Van Buren Conservation District
1035 E. Michigan Avenue
Paw Paw, MI 49079

Table of Contents

List of Figures

Acknowledgements

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-Erin Fuller

Introduction

Black River Watershed Project staff and volunteers monitored stream bank erosion at various locations in the Black River Watershed in Allegan and Van Buren Counties. Erosion and sedimentation have been determined to be critical issues in the watershed, but data on the rate of bank erosion in the watershed is lacking. In addition to helping locate sites where erosion is most critical and providing information with which to estimate of sediment loading in the watershed, this study helps provide a baseline against which to evaluate best management practice (BMP) effectiveness in the future.

Bank erosion pins were placed at eight sites throughout the watershed. The methods followed the standard operating procedure cited in Appendix A. Embeddedness was also analyzed using the procedure described in the Michigan Department of Environmental Quality's Great Lakes and Environmental Assessment Section Procedure #51 (May 2002). Volunteers were engaged to perform measurements of the bank pins and embeddedness at several of the sites. The Black River Watershed Coordinator monitored bank pins at the remaining sites and acted as project manager.

Methods

The methodology for this study was derived from the standard operating procedure "Monitoring Stream Bank Erosion with Erosion Pins," (Appendix A) devised by Joe Rathbun of the Michigan Department of Environmental Quality (MDEQ). This procedure has been used by MDEQ in similar studies in the Rouge River watershed in southeast Michigan (J. Rathbun, personal communication).

Sites for placement of bank erosion pins were chosen by selecting road-stream crossing sites with visible signs of erosion. Sites with obvious human-induced erosion were eliminated. Sites were distributed on both tributary streams and on the three main branches of the river. Some sites were on natural reaches and some were on previously channelized reaches. All sites had natural vegetation adjacent to the streambank. Fifteen sites were initially chosen that met these criteria. Landowners were contacted by phone or mail and permission was granted to access eight of the fifteen sites. These eight sites are shown in Figure 25.

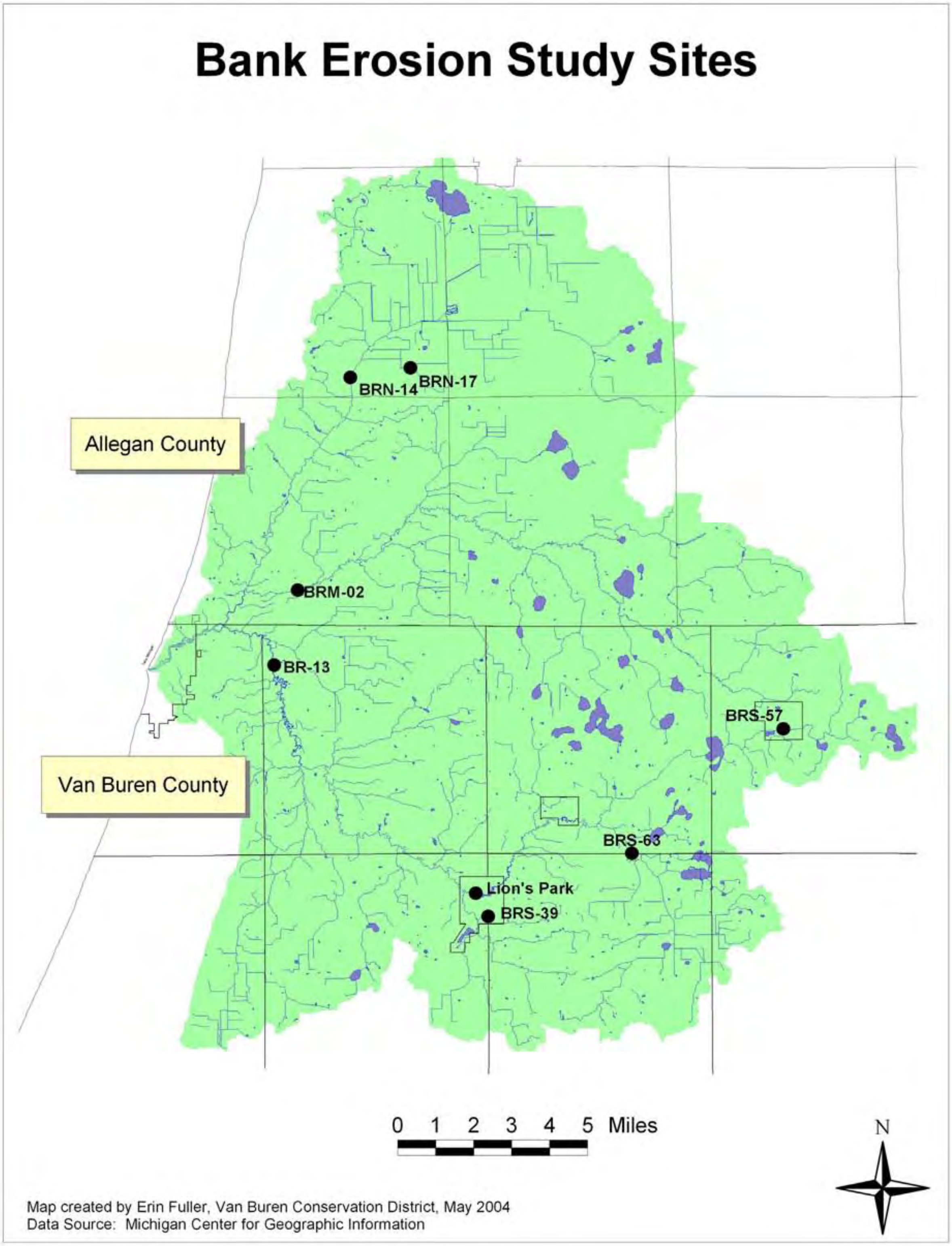
Pins were installed on June 9, 2004. The pins were 1/8 inch-diameter wooden dowels spray-painted fluorescent orange. Where conditions permitted, pins were installed in two locations at each site (denoted as the "upstream" location and the "downstream" location), and on both the left and right banks. This was not always feasible due to bank height, substrate, and vegetative cover. Several pins (the number depended on bank height) were installed at each of these locations, typically in a vertical arrangement on the bank. Photographs were taken of the sites, and each site was marked with orange flagging tape. At the time of installation of the erosion pins, bricks were placed in the channel for the purpose of estimating embeddedness at those sites lacking natural cobble substrate.

Volunteers were all trained individually on the proper methodology for measuring bank pins and embeddedness. Measurements of bank pins were taken from June 9, 2004 to November 18, 2004. Sites were visited shortly after major storms (a major storm was defined as any event in which rainfall of 0.25" or more occurred in any 24-hour period). The project manager contacted and alerted volunteers to take measurements. Precipitation information was obtained from the Michigan Automated Weather Network website at <http://www.agweather.geo.msu.edu/mawn/> from sites in the watershed (Grand Junction in Van Buren County and Fennville in Allegan County).

Measurements were taken in the following manner: a washer was placed over the dowel and pushed toward the bank until it touched the bank. The distance from the washer to the end of the bank pin was measured with a ruler, in millimeters. Measurements were recorded on the "Black River Watershed Bank Pin and Embeddedness Inspection Form" (Appendix B). The washer was used to improve accuracy of the measurement.

Embeddedness was estimated by grasping and removing a brick or existing cobbles and estimating the percentage that they were buried in the sediment. This estimate was scored on the "Black River Watershed Bank Pin and Embeddedness Inspection Form" (Appendix B).

Figure 25: Bank Erosion Study Sites



Results

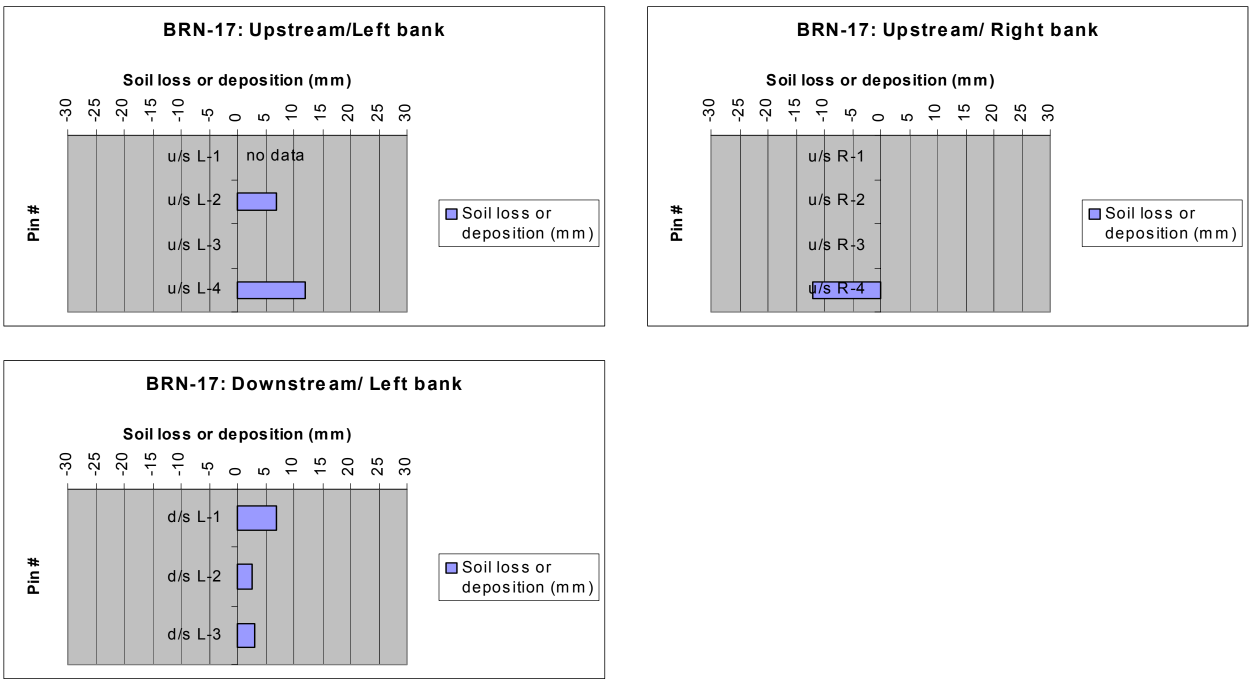
Measurement precision for this type of study has previously been established as approximately ± 1 or 2 mm (see Appendix A). Thus, any changes in measurements that were less than 2 mm were recorded as "no change." The site with the most soil loss over the course of the study was BR-13, with a loss of 29 mm of soil recorded from the lowermost pin (L-6). The site with the most soil deposition over the course of the study was BRN-14, with 9.5 mm of soil deposited over the course of the study at the downstream/left bank location (pin # L-2). Other locations at the same site, however, also had soil loss. The full results of the study are below.

Site number: BRN-17

This site is located on the Black River Drain, a narrow, previously channelized tributary of the North Branch of the Black River. The surrounding land use is agriculture and forest. Pins were placed in three locations at this site.

Average embeddedness: 9.75 (Marginal)

Figure 26: BRN-17

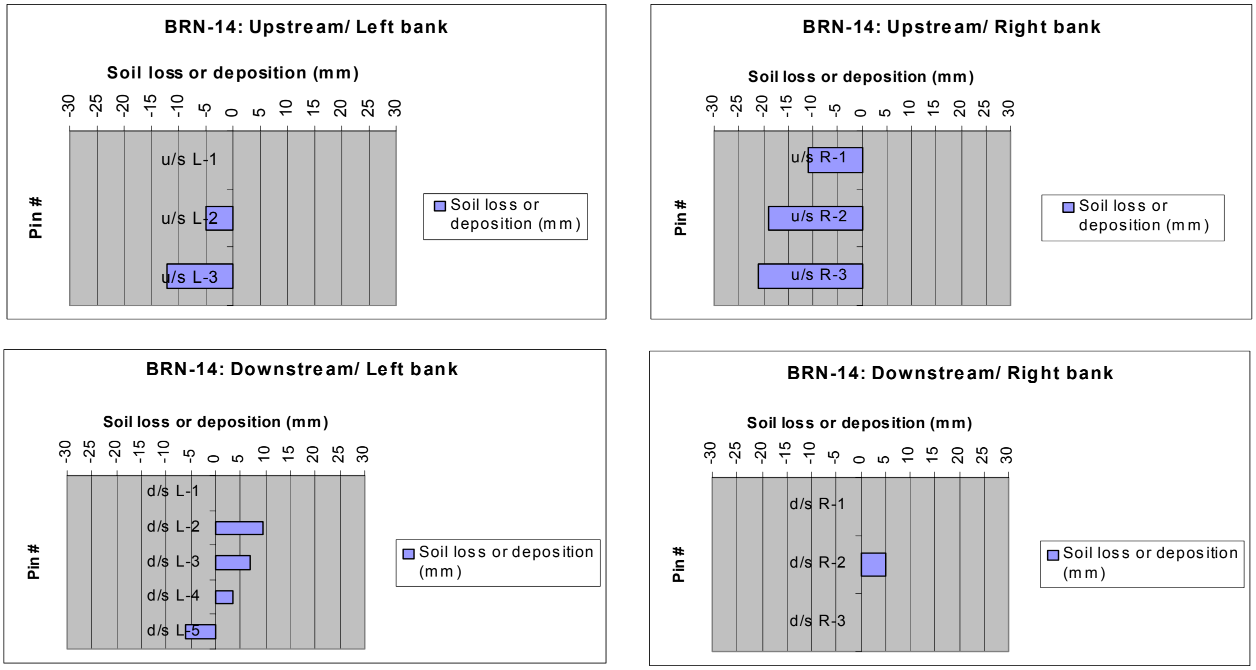


Site number: BRN-14

This site is located in a shallow section of the main stem of the North Branch of the Black River (this section is also technically considered part of the Black River Drain). The surrounding land use is forest. Pins were placed in four locations at this site.

Average embeddedness: 0.7 (Poor)

Figure 27: BRN-14

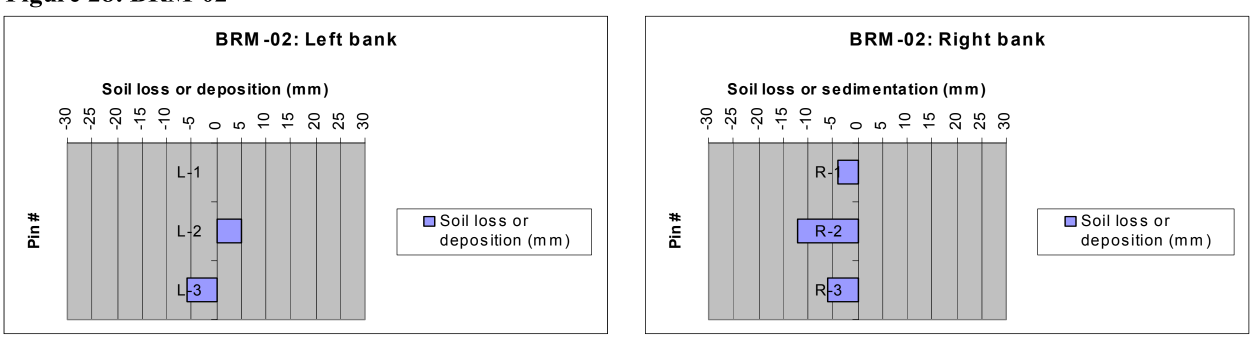


Site number: BRM-02

This site is located in a shallow section of the main stem of the Middle Branch of the Black River. The surrounding land use is forest. Pins were located on both the left bank and right bank. Due to the short height of the streambanks at this site, pins were placed on a horizontal axis approximately 5 feet apart. Pin #1 was the farthest pin upstream and pin #3 was the farthest downstream.

Average embeddedness: no data

Figure 28: BRM-02

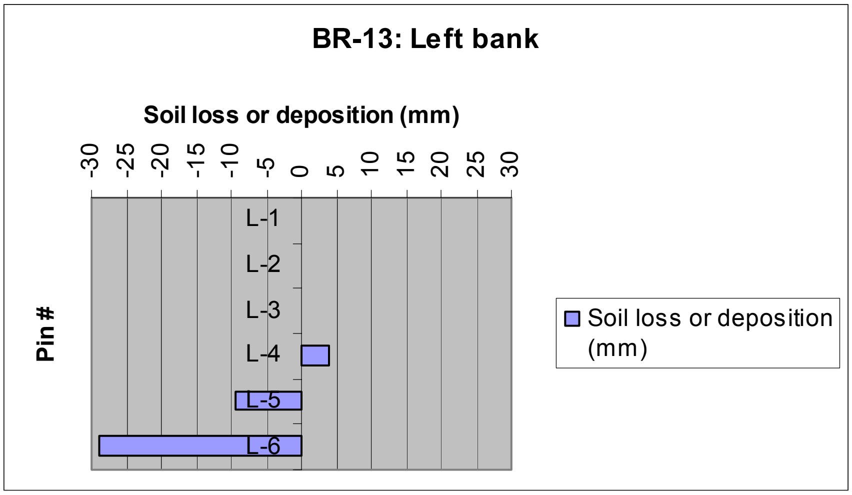


Site number: BR-13

This site is located in a section of the South Branch of the Black River. The surrounding land use is forest. Pins were placed in one location at this site.

Average embeddedness: 1 (poor)

Figure 29: BR-13

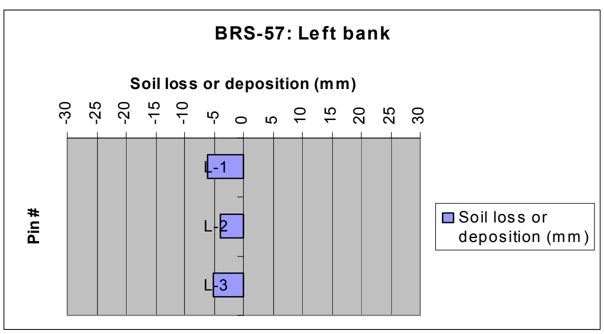


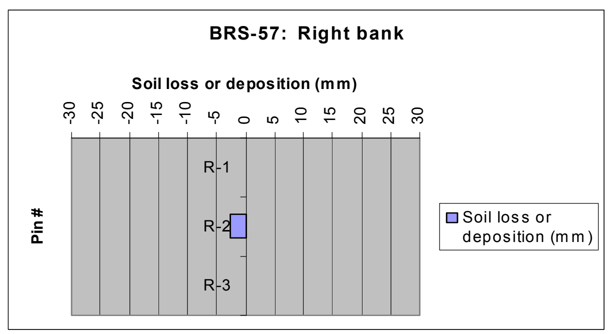
Site number: BRS-57

This site is located on the Haven & Max Lake Drain, a small tributary of the South Branch of the Black River. This drain has been channelized in the past, but is recovering. The site is just downstream of a park in the Village of Bloomingdale. The surrounding land use is forest and parkland. Pins were placed at two locations at this site.

Average embeddedness: 16.4 (excellent)

Figure 30: BRS-57



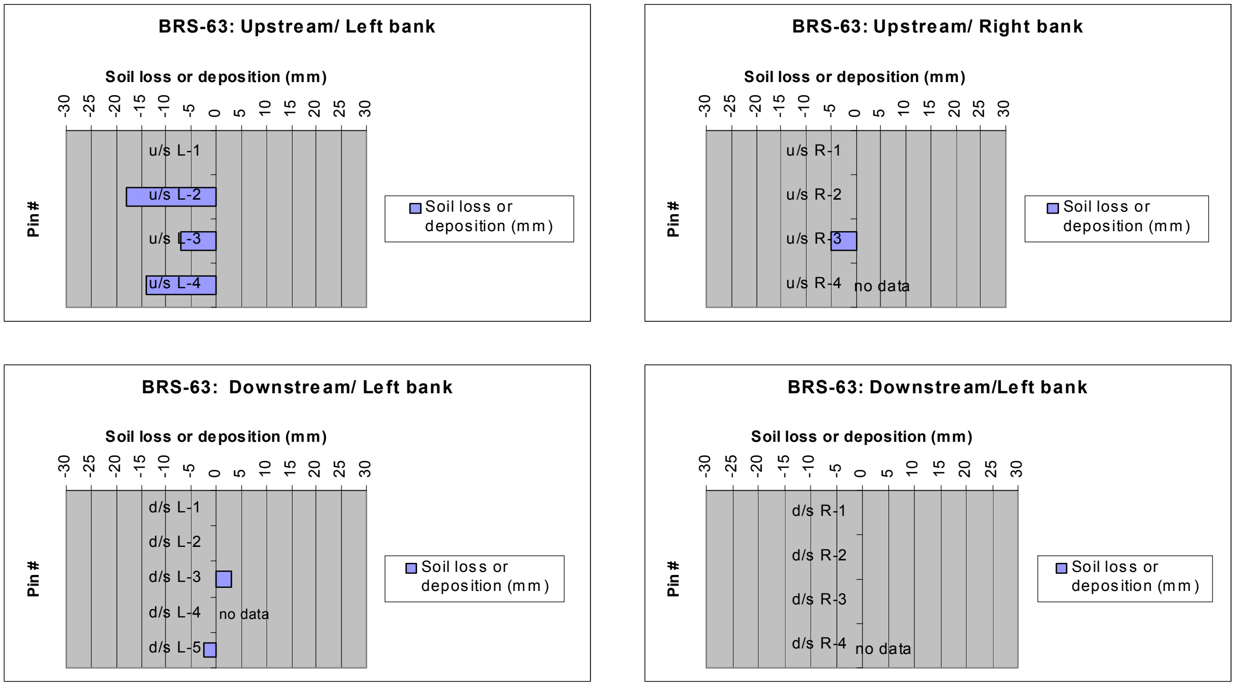


Site number: BRS-63

This site is located on the Black River Extension Drain, a tributary of the South Branch of the Black River. The surrounding land use is forest (a road also parallels this site). Pins were placed in four locations at this site.

Average embeddedness: 12 (good)

Figure 31: BRS-63

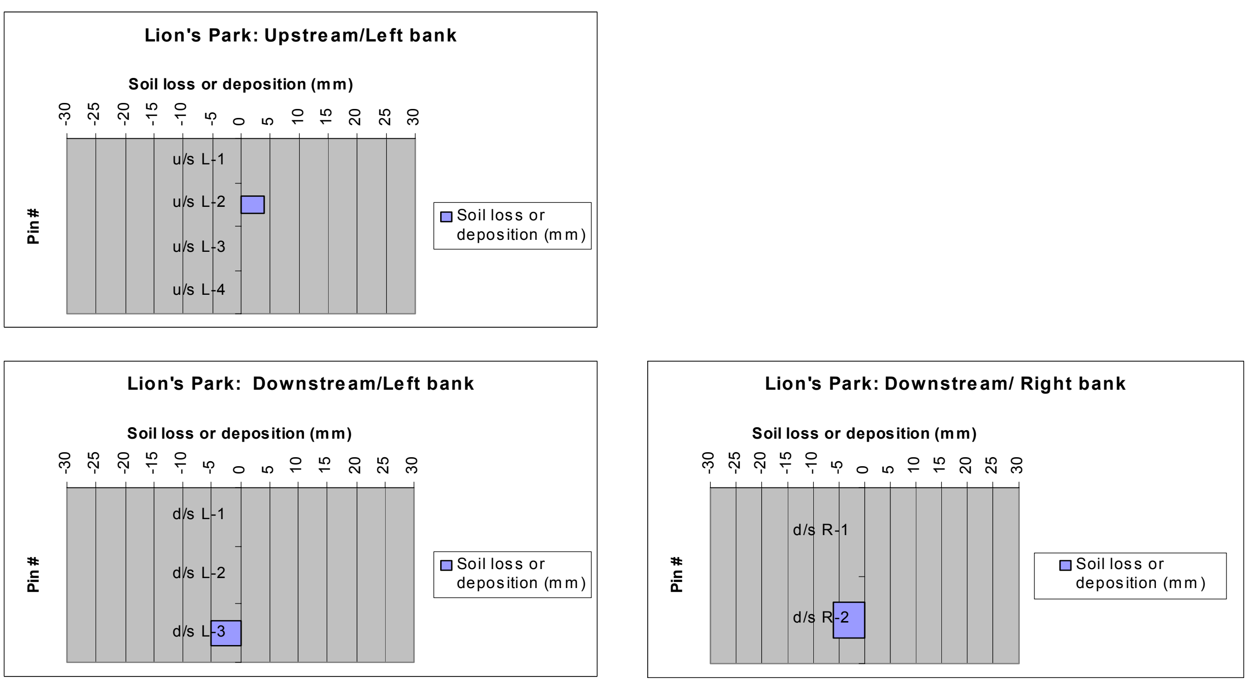


Site number: Lion's Park

This site is located on the South Branch of the Black River, in Lion's Park in the City of Bangor. The surrounding land use is forest and park land. Several foot paths run along the river. Significant disturbance occurred at this site (to both the vegetation and the erosion pins) during the fall fishing season. Pins were placed in three locations at this site.

Average embeddedness: 4 (poor)

Figure 32: Lion's Park

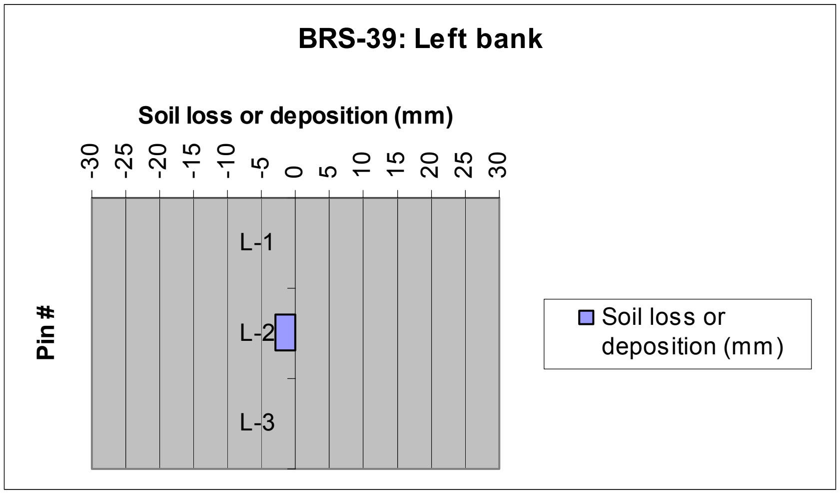


Site number: BRS-39

This site is located on the Boyer Drain, a small tributary of the South Branch that runs through the City of Bangor. The surrounding land use is forest and residential. Due to the short height of the streambanks at this site, pins were placed on a horizontal axis approximately 5 feet apart. Pin #1 was the farthest pin upstream and pin #3 was the farthest downstream.

Average embeddedness: 16.8 (excellent)

Figure 33: BRS-39



Discussion

At some sites, the river channel appears to be quite actively changing, while other sites appeared relatively stable. Sites in which high levels of bank erosion were expected (Lion's Park and BRS-57, for example) did not always exhibit this. Other sites that appeared relatively stable had higher rates of erosion than expected (such as BRM-02). The precise location of the pins at each site certainly influenced the measurements. For example, at BRN-14, a relatively straight-channeled reach, measurements of the upstream set of pins demonstrated soil loss on the left bank, while measurements on the downstream set of pins on the left bank demonstrated soil deposition (with the exception of the lowest pin, L-5, which lost 6 mm of soil over the course of the study). This is due to many factors, including the vegetation surrounding the pins, water currents, and streambank soil composition.

Embeddedness was also highly variable, ranging from a low score of 0.7 (poor: gravel, cobble and boulder particles [or bricks] are more than 75% surrounded by fine sediment) at BRN-14 to a high of 16.8 (excellent: gravel, cobble and boulder particles [or bricks] are 0-25% surrounded by fine sediment) at BRS-39.

Many pins broke over the course of this study, which certainly limited data collection. Several bank pins were sited in areas frequented by wildlife such as deer and raccoons (BRN-14 and BRN-17 especially). These locations suffered from high amounts of pin breakage, likely as a result of wildlife interference. Deer and raccoon tracks were found in close proximity to the pins and human interference at these sites was considered unlikely due to their remote locations. Some pins likely broke in high water events when debris was washed against them. Other pins likely broke due to human interference (especially the two sites that were in parks, BRS-57 and Lion's Park).

Related to pin breakage, another issue that hampered this study was the difficulty of determining a pin's number if pins above or below it had been broken. For example, site BR-13 had 6 pins in a vertical arrangement. On 7/9/04, the volunteer in charge of the site reported a pin missing. Due to fluctuations in water level, it was impossible to determine if the pin was L-5 or L-6. In future studies, pins should be labeled with their number (or possibly color-coded).

In the future, more sites should be monitored if at all possible. The small sample size makes it impossible to draw conclusions for the watershed (or even a specific branch or tributary of the river). However, one of the most difficult aspects of this study was receiving landowner permission for accessing the river. Many landowners simply never responded to phone calls or letters. Access to sites can be physically difficult as well, given the steep banks in many areas, as well as the prevalence of poison ivy and stinging nettles. Safety is certainly concern for staff and volunteers monitoring these sites (most sites were monitored by one person rather than a team). Deeper sections of river may not be safely monitored by one person.

Overall, this was a useful pilot study. It brought out some aspects that should be improved upon in future studies. This is a simple, relatively inexpensive study that can be undertaken by volunteers. Before-and-after bank pin studies should be useful in monitoring effectiveness of streambank remediation efforts in the future.

Appendix A

STANDARD OPERATING PROCEDURE

MONITORING STREAM BANK EROSION WITH EROSION PINS

Joe Rathbun
Michigan Department of Environmental Quality – Water Division
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rathbunj@michigan.gov

1.0 Overview

Stream bank erosion is a natural process that occurs in every watershed. Bank erosion rates, however, are known to change when either the stream discharge pattern and/or volume changes, or when the sediment loading to the stream changes. Both stream discharge and sediment loading usually change in urbanizing watersheds (e.g., Whipple et al., 1981), sometimes drastically. Many stream channel assessment studies or restoration projects require estimates of stream channel stability, and this standard operating procedure (SOP) describes a technique for measuring stream bank erosion rates, using erosion pins.

Many erosion pin studies employ metal pins (e.g., Neller, 1988), but this SOP recommends wooden dowel rods. Excessively high rates of bank erosion can result in the loss of pins, and wooden pins will eventually decompose.

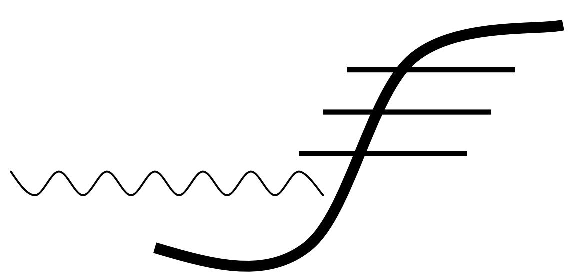
2.0 Procedure

1. Cut wooden dowel rods (1/8" or 3/16" diameter) into 12" to 18" lengths.

2. Paint one end a bright color (orange or red), for visibility.

3. Drive into the stream bank with a hammer, leaving ~ 2" protruding from the bank (see schematic, next page).

   - The number and pattern of erosion pins at any one location will vary depending on the purpose of the study. A typical installation involves 3 or 4 pins in a vertical arrangement up the bank, with the lowest pin being within a few inches of the waterline at base flow and the highest pin being within a few inches of the top of the bank.
   - The number of stations monitored will also depend on the purpose of the study. If monitoring the performance of a stream bank stabilization BMP, it is often desirable to install pins at nearby, similar banks that lack the BMP, in addition to monitoring the specific location of interest.



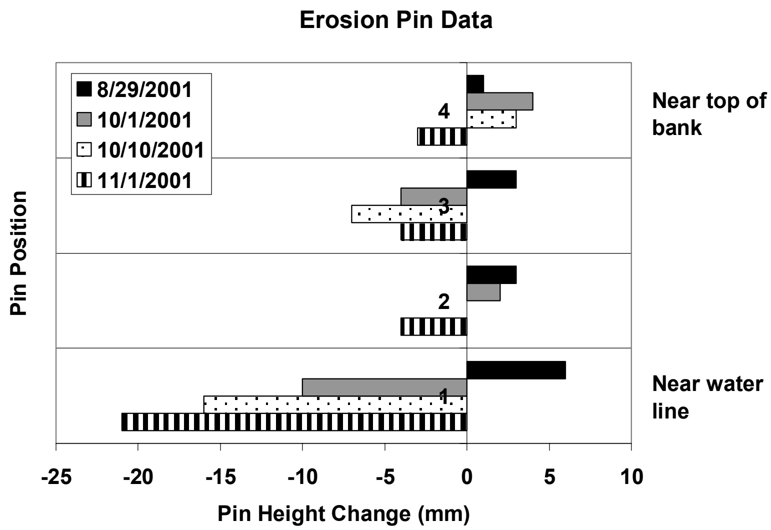
4. Measure the height of the erosion pins on the day they are installed ("Day 0" data) and again at periodic intervals, to the nearest millimeter.

   - Measurement frequency depends on the purpose of the study. Recommended intervals include monthly, or after every major rain event, or a combination of both.
   - Note that erosion pins will record soil or sediment deposition as well as erosion. If soil deposition is likely, greater than 2" should be left protruding from the bank on Day 0.

Note: if erosion pins are left in the bank over a winter, their heights should be measured early in the spring to check for frost-heave.

3.0 Data Calculation and Interpretation

(1) Pin heights recorded on the day the pins are installed are considered "Day 0" data, and all subsequent measurements are compared to these data. Measurements of bank erosion are typically expressed as negative numbers (subtracted from the Day 0 data), while bank deposition is expressed as positive numbers (added to the Day 0 data; see figure, below).



(2) Based on preliminary field studies by the author, the expected precision of careful erosion pin measurements is approximately ± 1 or 2 mm. Consequently, pin height changes of this amount or less should be interpreted as indicating 'no change.'

(3) The mass of eroded bank soil can be calculated from erosion pin data if the length and average height of the monitored bank is known, and if the bulk density of the bank soil is measured or estimated. Example bulk density figures are below.

Texture	Bulk Density (g/cc)
Sand	1.6
Loam	1.2
Clay	1.05

(Univ. of Saskatchewan)

4.0 References

Neller, R.J. 1988. A Comparison of Channel Erosion in Small Urban and Rural Catchments, Armidale, New South Wales. *Earth Surface Processes and Landforms.* 13:1-7.

Whipple, W., J.M. DiLouie, and T. Pytlar. 1981. Erosional Potential of Streams in Urbanizing Areas. *Water Resources Bulletin.* 17(1):36-45.

Appendix B

Black River Watershed Bank Pin and Embeddedness Inspection Form

1. Date & Time________________________________2. Site #_________________________

3. Your name____

4. Are any pins shifted from their original position (perpendicular to the bank)? If so, please list which pins have shifted, using the naming convention shown on the back side of this sheet.

____

5. Are any of the pins missing or loose? If so, please list which pins are missing or loose, using the naming convention shown on the back side of this sheet.

____

6. Measurements

- Bank Pins: There are two sets of pins at each site. Record measurements of the upstream set in the box below to the left. Record measurements of the downstream set in the box below to the right. (Place a washer over the dowel and push it toward the bank until it touches the bank but is oriented at 90° (see diagram on the back side of this sheet). Measure from the washer to the end of the bank pin, in millimeters.

- Embeddedness: Grasp and remove a few existing cobbles or bricks and estimate the average depth that they are buried in the sediment. Estimate embeddedness and circle the appropriate score in the box below.

Upstream

Pin Length (mm)	
L-1_______	R-1_______
L-2_______	R-2_______
L-3_______	R-3_______
L-4_______	R-4_______

Downstream

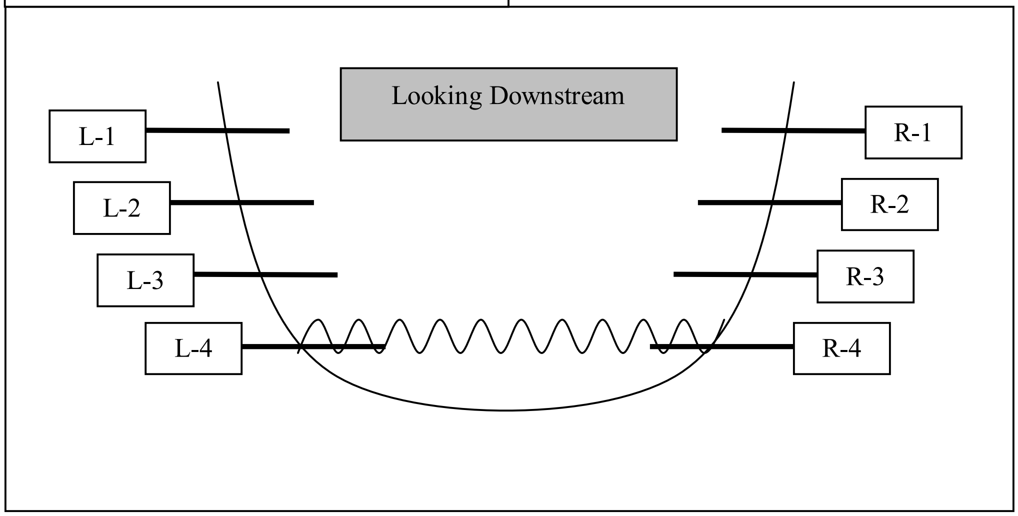
Pin Length (mm)	
L-1_______	R-1_______
L-2_______	R-2_______
L-3_______	R-3_______
L-4_______	R-4_______

Embeddedness

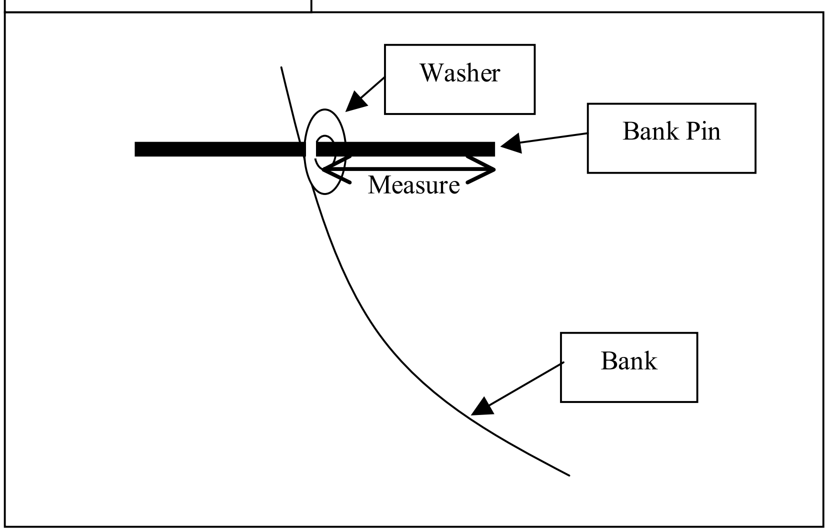
	Excellent	Good	Marginal	Poor
Embeddedness (Riffle/run stream)	Gravel, cobble and boulder particles (or bricks) are 0-25% surrounded by fine sediment.	Gravel, cobble and boulder particles (or bricks) are 25-50% surrounded by fine sediment	Gravel, cobble and boulder particles (or bricks) are 50-75% surrounded by fine sediment	Gravel, cobble and boulder particles (or bricks) are more than 75% surrounded by fine sediment
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Black River Watershed Bank Pin and Embeddedness Inspection Form

Bank Pin Naming Convention



How to measure



Return this form within 2 days of your measurement to:

Erin Fuller
Van Buren Conservation District
1035 E. Michigan Ave.
Paw Paw, MI 49079
Phone: (269) 675-4030 x5
Fax: (269) 675-4925
erin-fuller@mi.nacdnet.org

Appendix I: Black River Watershed Hydrologic Study

Michigan's Nonpoint Source Program

Dave Fongers
Hydrologic Studies Unit
Land and Water Management Division
Michigan Department of Environmental Quality
October 11, 2004

Table of Contents

For comments or questions relating to this document, contact Dave Fongers at:

MDEQ, LWMD, P.O. Box 30458, Lansing, MI 48909
fongersd@michigan.gov
517-373-0210

DEQ Michigan's Nonpoint Source Program

The Black River hydrologic study was funded by a Part 319 grant from the United States Environmental Protection Agency to MDEQ's Nonpoint Source program. For more information, go to www.michigan.gov/deqnonpointsourcepollution.

Summary

A hydrologic model of the Black River watershed was developed by the Hydrologic Studies Unit (HSU) of the Michigan Department of Environmental Quality (MDEQ) using the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS). The hydrologic model was developed to help determine the effect of land use changes on the Black River's flow regime and to provide design flows for streambank stabilization Best Management Practices (BMPs). Watershed stakeholders may combine this information with other determinants, such as open space preservation, to decide what locations are the most appropriate for wetland restoration, stormwater detention, in-stream BMPs, or upland BMPs. Local governments within the watershed could also use the information to help develop stormwater ordinances.

The hydrologic model has two scenarios corresponding to land uses in 1800 and 1978. General land use trends are illustrated in Figure 1. More detailed land use information is provided in Table 1 in the Watershed Description and Model Parameters section of this report.

Because of the land use changes, the model shows increases in runoff volumes and peak flows from 1800 to 1978 for the 50 percent chance (2-year) and 4 percent chance (25-year) 24-hour design storms, as shown in Figures 8 through 11. Additional flow details are in the Model Results section of this report. Increases in the runoff volume and peak flow from the 4 percent chance, 24-hour storms could cause or aggravate flooding problems unless mitigated through the use of effective stormwater management techniques. Increases in the 50 percent chance, 24-hour storm will increase channel-forming flows. The channel-forming flow in a stable stream usually has a one- to two-year recurrence interval. These relatively modest storm flows, because of their higher frequency, have more effect on channel form than extreme flood flows.

Hydrologic changes that increase this flow can cause the stream channel to become unstable. Stream instability is indicated by excessive erosion at many locations throughout a stream reach. Stormwater management techniques used to mitigate flooding can also help mitigate projected channel-forming flow increases. However, channel-forming flow criteria should be specifically considered in the stormwater management plan so that the selected BMPs will be most effective. For example, detention ponds designed to control runoff from the 4 percent chance, 24-hour storm may do little to control the runoff from the 50 percent chance, 24-hour storm, unless the outlet is specifically designed to do so.

One way to compare runoff from different subbasins is to calculate the yield, which is the peak flow divided by the drainage area. The area-weighted average yield from the 50 percent chance (2-year), 24-hour storm for the Black River watershed is 0.006 cubic feet per second per acre (cfs/acre) for 1978 land use scenario. This value may be used to guide stakeholders' fish habitat and stream stability management decisions. The area-weighted average yield from the 4 percent chance (25-year), 24-hour storm for the Black River watershed is 0.03 cfs/acre for 1978 land use scenario. This value may be used to guide stakeholders' flood control management decisions. Additional details are shown in Figures 12 and 13 and in the Model Results section of this report.

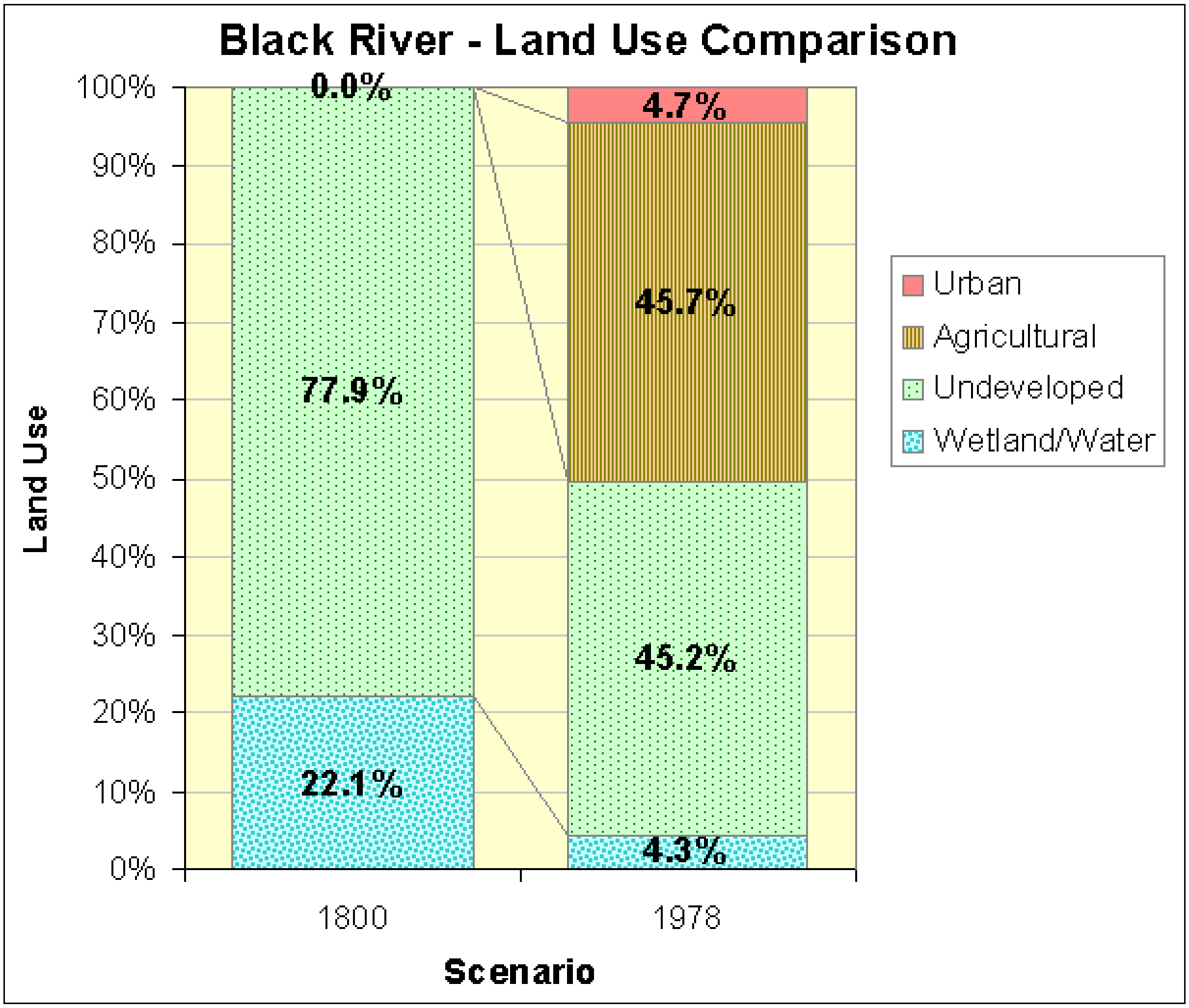


Figure 1: Land Use Comparison

Project Goals

The Black River hydrologic study was initiated in support of the Black River Watershed Planning project, which is funded in part by a United States Environmental Protection Agency (USEPA) Part 319 grant administered by the MDEQ. The goals of this Black River study are:

- To better understand the watershed's hydrologic characteristics and the impact of hydrologic changes in the Black River watershed
- To facilitate the selection and design of suitable BMPs
- To provide information that can be used by local units of government to develop or improve stormwater ordinances
- To help determine the watershed management plan's critical areas – the geographic portions of the watershed contributing the majority of the pollutants and having significant impacts on the waterbody

Watershed Description and Model Parameters

The 286 square mile Black River watershed, Figure 2, outlets to Lake Michigan at South Haven and is located in Allegan and Van Buren counties. Black River's profile, Figure 3, is typical - steeper in the headwaters, flattening out toward the mouth.

This Black River study divides the watershed into 24 subbasins, as shown in Figure 4.
Our analysis of the watershed uses the curve number technique to calculate surface runoff volumes and peak flows. This technique, developed by the Natural Resources Conservation Service (NRCS) in 1954, represents the runoff characteristics from the combination of land use and soil data as a runoff curve number. The curve numbers for each subbasin, listed in Appendix A, were calculated from digital soil and land use data using Geographic Information Systems (GIS) technology.

Runoff curve numbers were calculated from the land use and soil data shown in Figures 5 through 7. Land use maps based on the MDEQ GIS data for 1800 and 1978 are shown in Figures 5 and 6, respectively. The 1800 land use information is provided at the request of the Black River project manager. The MDEQ Nonpoint Source program does not expect or recommend that the flow regime calculated from 1800 land use be used as criteria for BMP design or as a goal for watershed managers.

The NRCS soils data for the watershed is shown in Figure 7. Where the soil is given a dual classification, B/D for example, the soil type was selected based on land use. In these cases, the soil type is specified as D for natural land uses or the

alternate classification (A, B, or C) for developed land uses. The runoff curve numbers calculated from the soil and land use data are listed in Appendix A. The percent impervious field is left at 0.0, because it is already incorporated in the curve numbers. The initial loss field is left blank so that HEC-HMS uses the default equation based on the curve number.
The time of concentration for each subbasin, which is the time it takes for water to travel from the hydraulically most distant point in the watershed to the design point, was calculated from the United States Geological Survey (USGS) quadrangles. The storage coefficients, which represent storage in the subbasin, were iteratively adjusted to provide a peak flow reduction equal to the ponding adjustment factors described further in Appendix A.

The reach routing method is the lag method. Lag is the travel time of water within each section of the stream. The method translates the flood hydrograph through the reach without attenuation. It is not appropriate for reaches that have ponds, lakes, wetlands, or flow restrictions that provide storage and attenuation of floodwater. Lag values for each reach were calculated using USGS quadrangles and are listed in Appendix A.

The selected precipitation events were the 50 and 4 percent chance (2- and 25-year), 24-hour storms. Design rainfall values for these events are tabulated in *Rainfall Frequency Atlas of the Midwest*, Bulletin 71, Midwestern Climate Center, 1992, pp. 126-129, and summarized for this site in Appendix A. These values have been multiplied by 0.914 to account for the size of the watershed.

These parameters were then incorporated into a HEC-HMS model to compute runoff volume and flow.

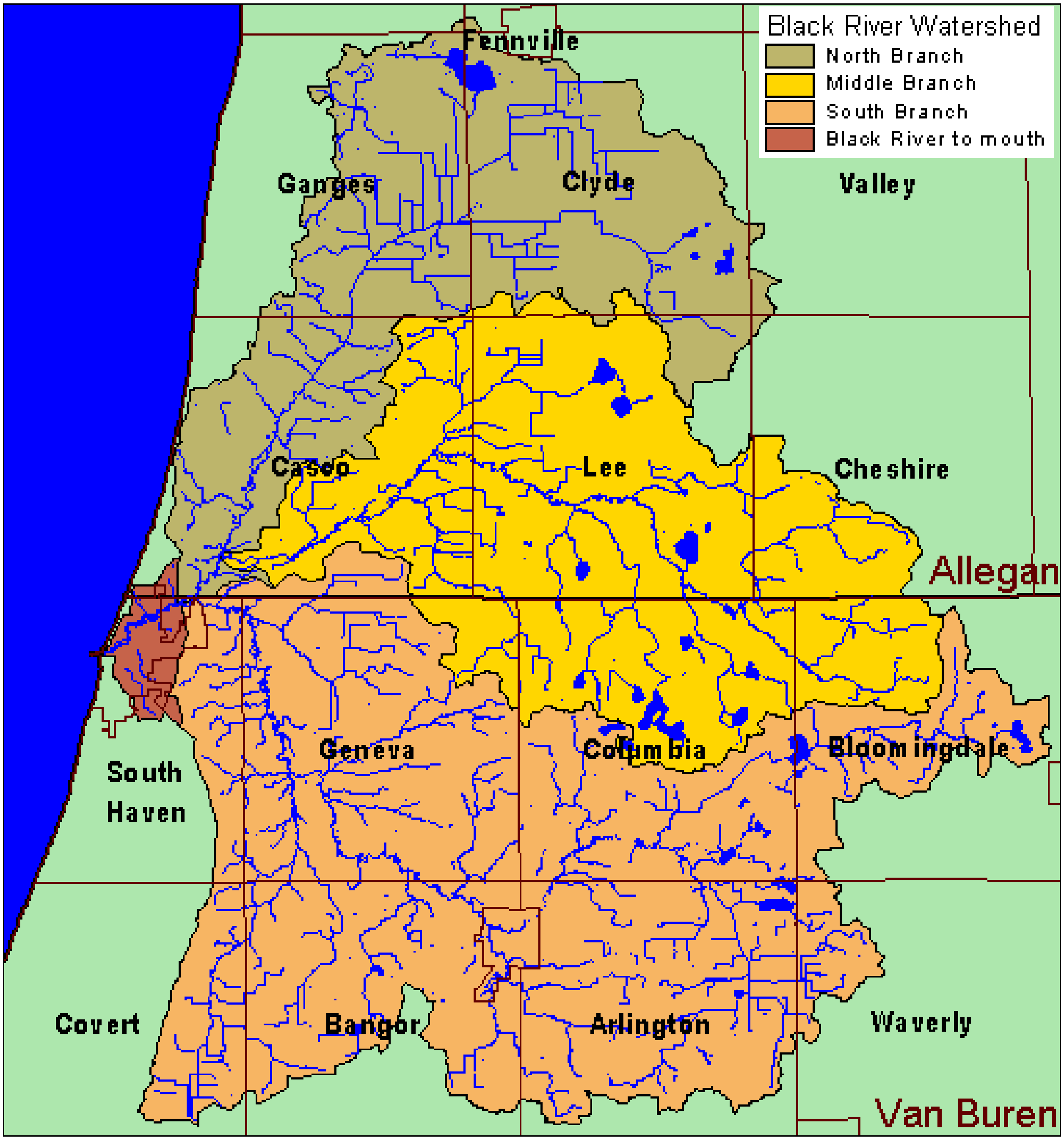


Figure 2: Delineated Black River Watershed

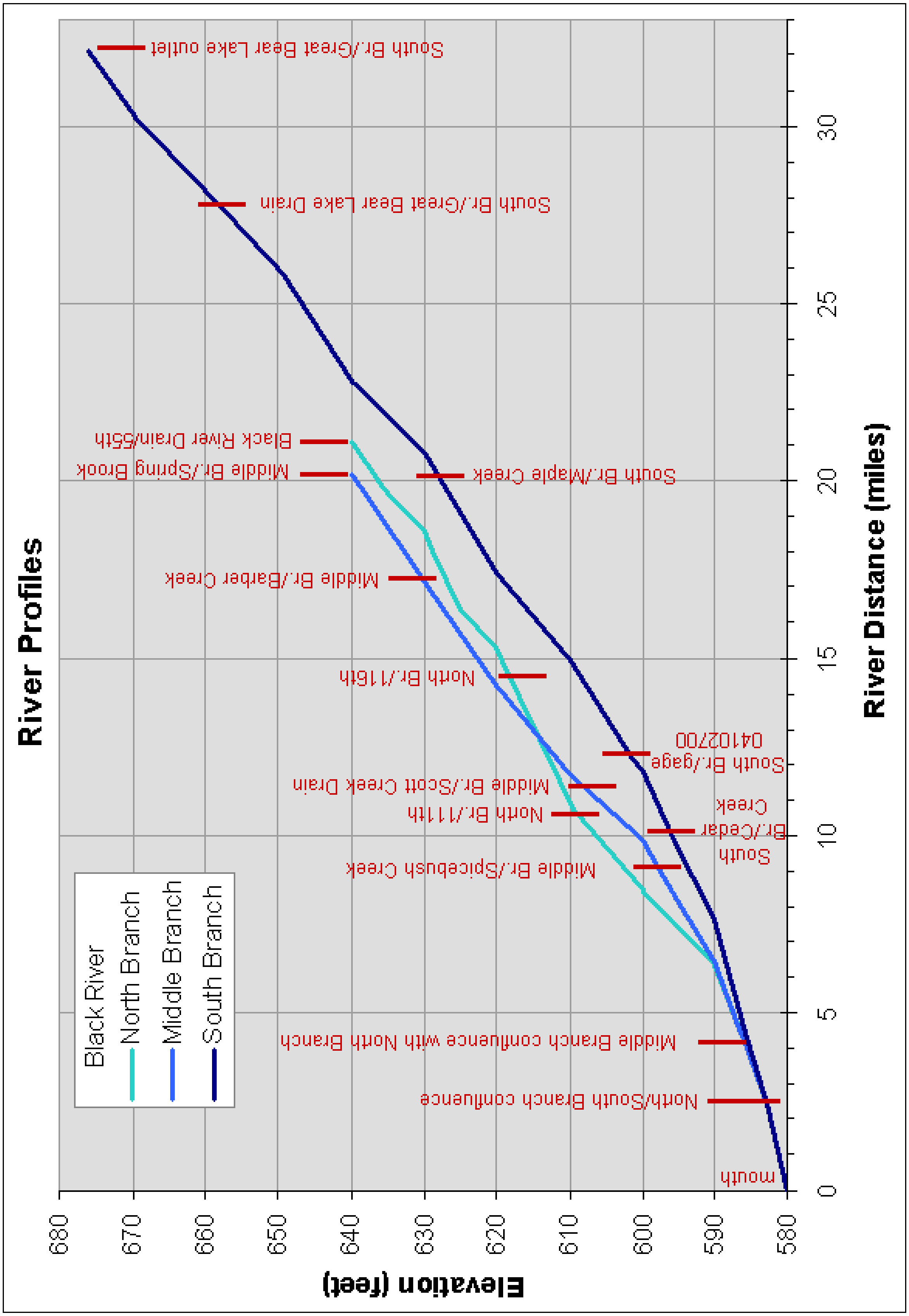


Figure 3: Black River Profile

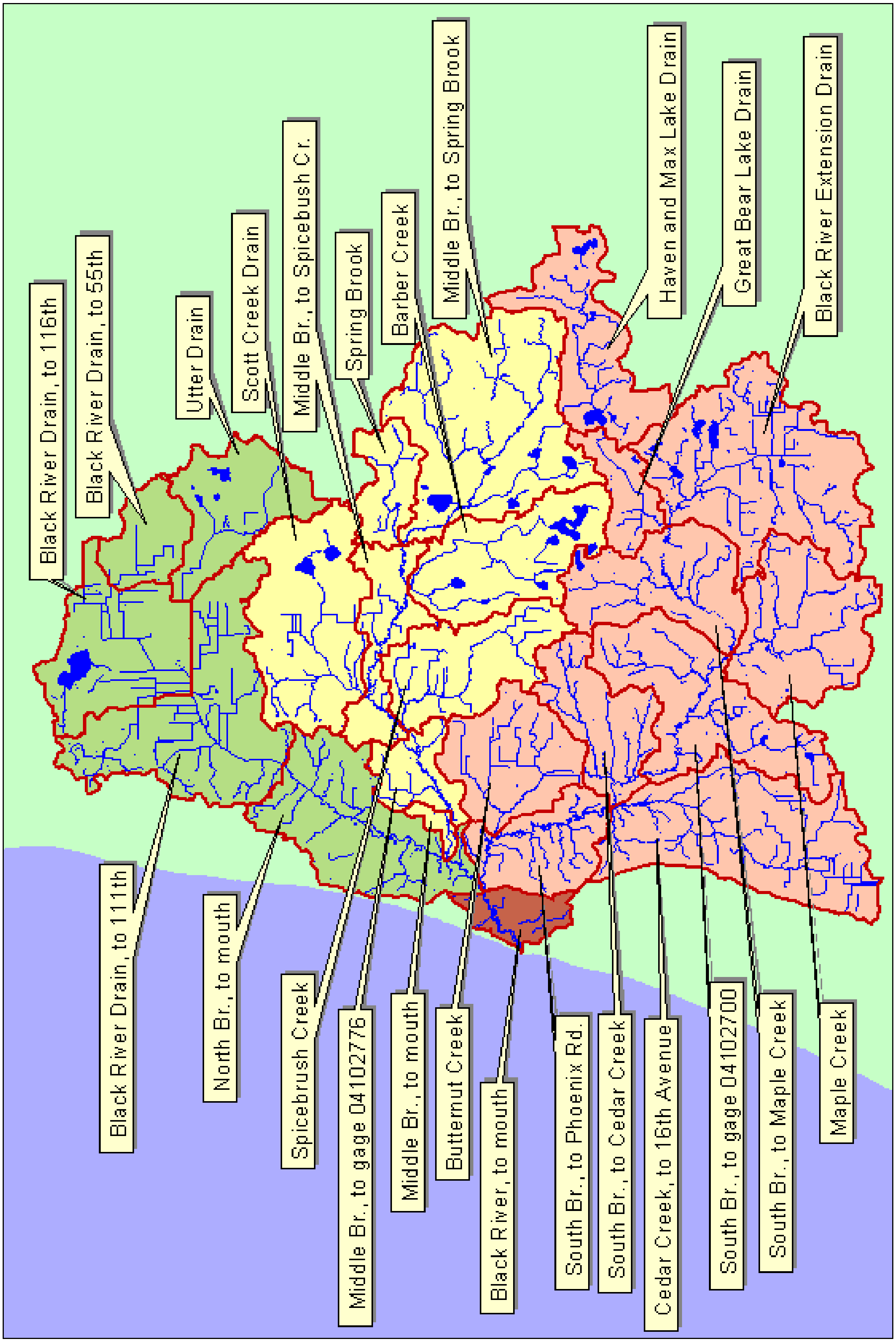

Black River Drain, to 116th
Black River Drain, to 55th
Utter Drain
Scott Creek Drain
Middle Br., to Spicebush Cr.
Spring Brook
Barber Creek
Middle Br., to Spring Brook
Haven and Max Lake Drain
Great Bear Lake Drain
Black River Extension Drain
Black River Drain, to 111th
North Br., to mouth
Spicebrush Creek
Middle Br., to gage 04102776
Middle Br., to mouth
Butternut Creek
Black River, to mouth
South Br., to Phoenix Rd.
South Br., to Cedar Creek
Cedar Creek, to 16th Avenue
South Br., to gage 04102700
South Br., to Maple Creek
Maple Creek

Figure 4: Subbasin Identification

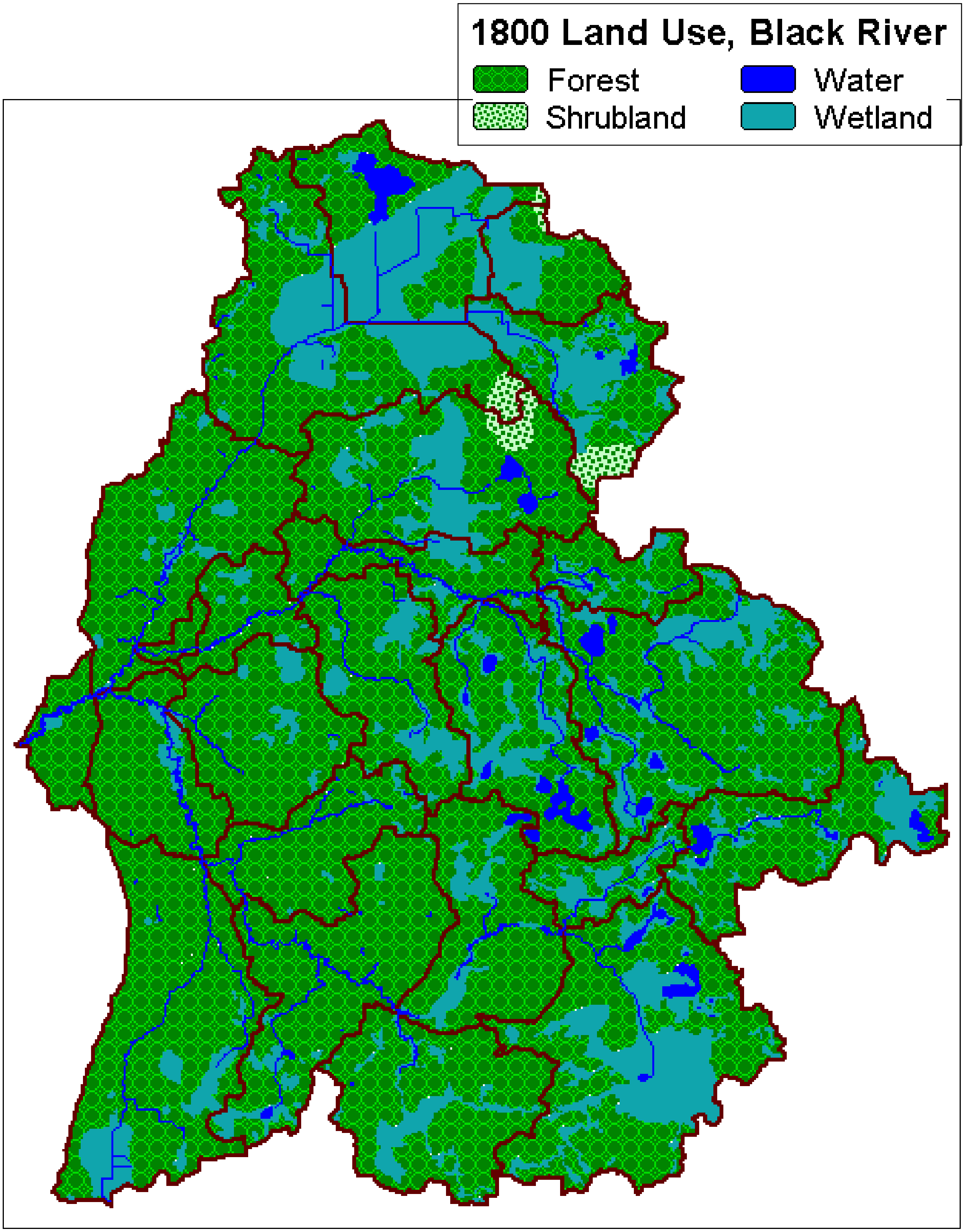


Figure 5: 1800 Land Use Data

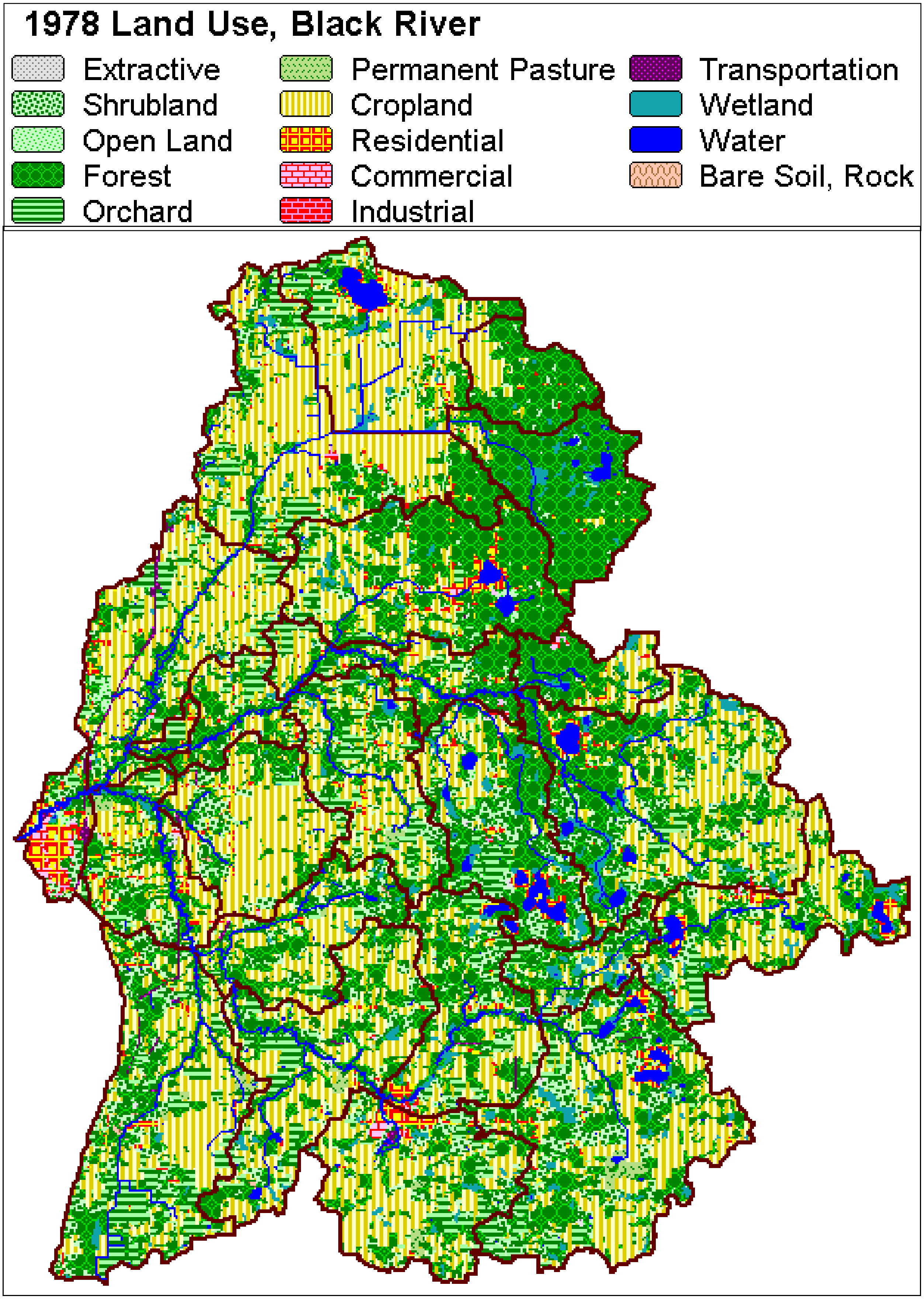


Figure 6: 1978 Land Use Data

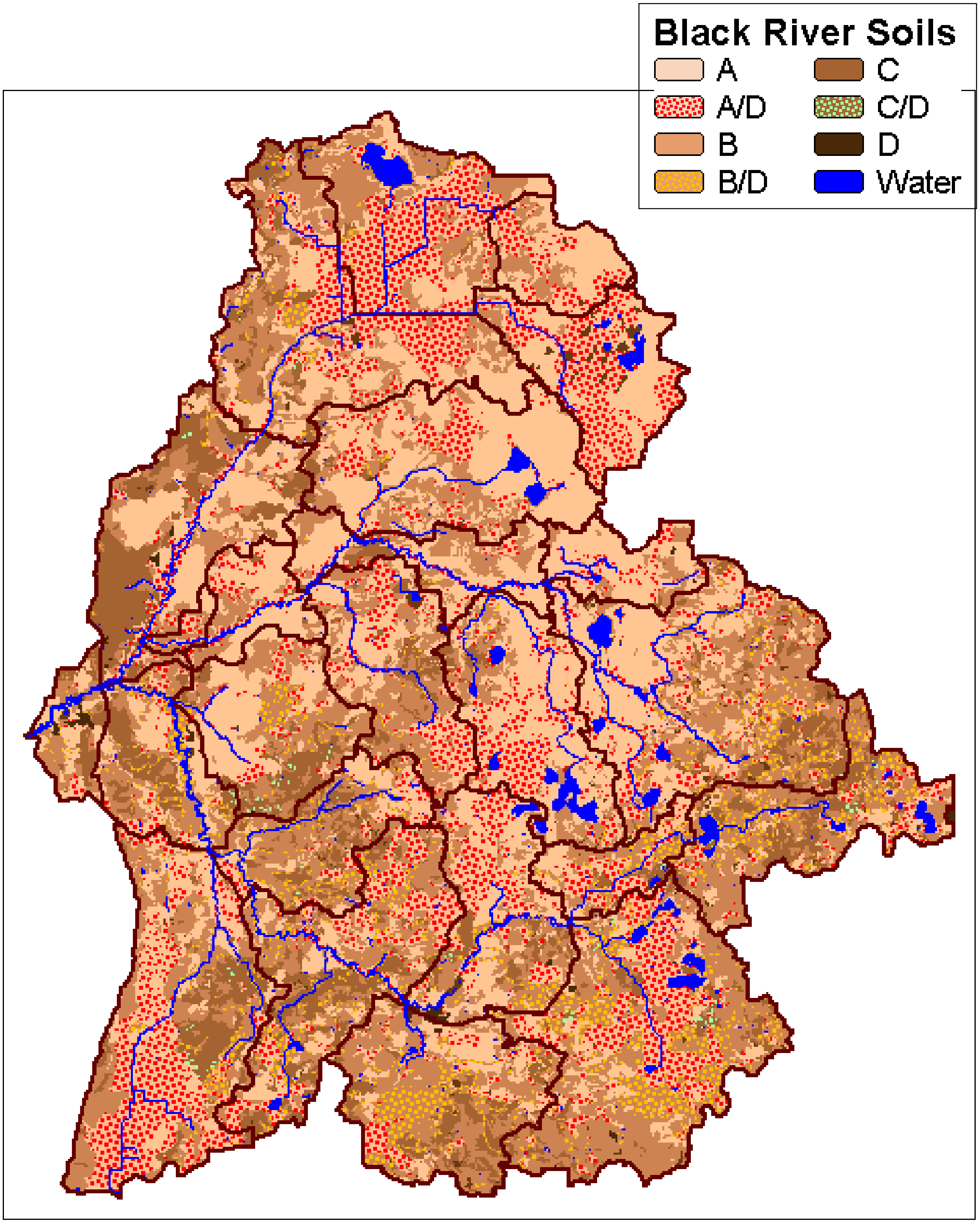


Figure 7: NRCS Soils Data

Table 1: Land Use by Subbasins (Land uses less than 0.5 percent are not listed because all percentages are rounded to the nearest percent)

Description	Scenario	Residential	Commercial	Industrial	Utilities	Gravel Pit	Cemeteries, Outdoor Rec.	Cropland	Orchard	Pasture	Herbaceous Openland	Forest	Water	Wetland
B1	1800											94%	3%	3%
	1978	32%	10%	3%	7%	1%	5%	4%	6%	1%	15%	13%	3%	1%
BM1	1800											100 %		
	1978	9%						18%	26%		7%	40%		
BM2	1800											92%		8%
	1978	3%						30%	13%		6%	46%		1%
BM2SC	1800											80%		20%
	1978	3%						38%	18%	1%	8%	30%		2%
BM3	1800											85%		15%
	1978	3%	1%					26%	11%		5%	51%		1%
BM3aSCD	1800										5%	71%	2%	23%
	1978	6%					1%	23%	6%		4%	55%	2%	3%
BM3bBC	1800											71%	6%	22%
	1978	4%				1%		16%	9%		13%	44%	5%	6%
BM4	1800											75%	3%	22%
	1978	2%						36%	3%	1%	10%	41%	3%	5%
BM4SB	1800											83%	1%	17%
	1978	2%	2%					27%	1%		3%	60%		4%
BN1	1800											94%		6%
	1978	3%			3%		1%	51%	12%		4%	23%		1%
BN2	1800										3%	66%		31%
	1978	2%						54%	11%		4%	25%		2%
BN3	1800										1%	43%	6%	50%
	1978	3%						55%	9%		6%	17%	4%	5%
BN4	1800										10%	52%	2%	37%
	1978	1%						5%			1%	85%	2%	5%
BN4UD	1800										3%	60%		36%
	1978	1%						20%			5%	73%		1%
BS1	1800											91%	1%	8%
	1978	7%	1%		1%			33%	6%	2%	12%	36%		1%
BS1aBC	1800											91%		9%
	1978	3%						58%	4%		11%	22%		
BS2	1800											96%		3%
	1978	1%						40%	4%		10%	42%		2%
BS2CC	1800											87%		13%
	1978	2%			1%			37%	18%	1%	12%	28%		1%
BS3	1800											92%	1%	7%
	1978	1%						42%	12%	1%	7%	33%	1%	2%
BS3MC	1800											84%		15%
	1978	4%	1%		1%			45%	10%	1%	10%	24%		3%

Description	Scenario	Residential	Commercial	Industrial	Utilities	Gravel Pit	Cemeteries, Outdoor Rec.	Cropland	Orchard	Pasture	Herbaceous Openland	Forest	Water	Wetland
BS4	1800											85%	1%	14%
	1978	4%						29%	11%		11%	39%	1%	3%
BS5ed	1800											64%	3%	34%
	1978	3%						34%	8%	2%	15%	32%	2%	3%
BS5GBLD	1800											69%	1%	31%
	1978							19%	7%	3%	18%	42%	1%	10%
BS6GBL	1800											74%	4%	22%
	1978	4%		1%				37%	8%		8%	32%	4%	4%

Model Results

Model results are illustrated in Figures 8 through 17 and detailed in Tables 2 and 3. Table 2 and Figures 8 and 10 show the computed peak flows and runoff volumes from each subbasin. These values represent the peak flow contribution from the subbasins, not the flow in the river. Table 3 and Figures 9 and 11 show the computed peak flows and runoff volumes at locations in the river.

The increases in stormwater runoff volume and peak flows conditions from 1800 to 1978 are due to changes in land use and loss of storage. The hydrologic model shows significant increases in runoff volumes and peak flows for both design storms. Peak flows and runoff volumes from the 50 percent chance 24-hour storm are predicted to increase more, on a percentage basis, than flows from the 4 percent chance, 24-hour storm. Increases in runoff volumes and peak flows from the 50 percent chance storm increase channel-forming flows, which will increase streambank erosion. Channel-forming flow is the flow that is most effective at shaping the channel. In a stable stream, the channel-forming flow has a one- to two-year recurrence interval and is the bankfull flow. Increases in runoff volumes and peak flows from the 4 percent chance storm will aggravate flooding. These projected increases can be moderated through the use of effective stormwater management techniques.

A model stormwater ordinance adopted by nearby Kent County, which is also being considered for adoption by other local units of government, calls for a maximum release rate of 0.05 cfs/acre for runoff from the 50 percent chance, 24-hour storm for Zone A areas, the most environmentally sensitive of the three management zones. Currently, the area-weighted average yield from this storm for the Black River Watershed is 0.006 cfs/acre, with no subbasin greater than 0.012 cfs/acre, as shown in Figure 12. The ordinance also calls for a maximum release rate of 0.13 cfs/acre for runoff from the 4 percent chance, 24-hour storm for Zones A and B. Currently, the average yield from this storm is 0.03 cfs/acre, with no subbasin greater than 0.08 cfs/acre, as shown in Figure 13. Additional details are listed in Table 2. If the Black River watershed stakeholders use the

Kent County model ordinance as a basis for a Black River stormwater ordinance, they should consider whether the Kent County model ordinance standards will adequately protect the Black River and its tributaries.

Significant portions of the Black River and its tributaries are designated trout streams, as shown in Figure 14. In our Pigeon River watershed study, we compared the flows from the 50 percent chance, 24-hour storm to flows based on a target yield of 0.0075 cfs/acre. This target yield was selected as criteria for a good trout fishery based on Mike Wiley and Paul Seelbach's November 1998 report titled "*An ecological assessment of opportunities for fisheries rehabilitation in the Pigeon River, Ottawa County*." Although clearly not the sole factor determining fish habitat quality, the good quality trout habitat there corresponds to the locations with yields less than the target yield. Impaired habitat corresponds to locations with yields less than about 1.4 times the target yield. Locations with higher yields generally did not have trout. These same thresholds were applied to the Black River results. For the 1800 scenario, all 17 river locations would be good. For the 1978 scenario, Black River would be impaired above the Great Bear Lake Drain and poor above the Great Bear Lake. Complete results are shown in Figure 15 and listed in Table 9.

The Black River has three main tributaries – the North, Middle, and South Branches. In the Macatawa River watershed, a hydrologic study revealed that the three main tributaries peaked at about the same time (page 8, *A Hydrologic Study of the Macatawa River Watershed*, MDEQ's Hydrologic Studies Unit). A project to alter the timing of one of the three tributaries, and reduce downstream flooding, is in progress. In the Black River, the three tributaries do not peak at the same time, as shown in Figures 16 and 17. Projects that reduce this timing differential have the potential to disproportionately increase peak flows in the main stem of the Black River.

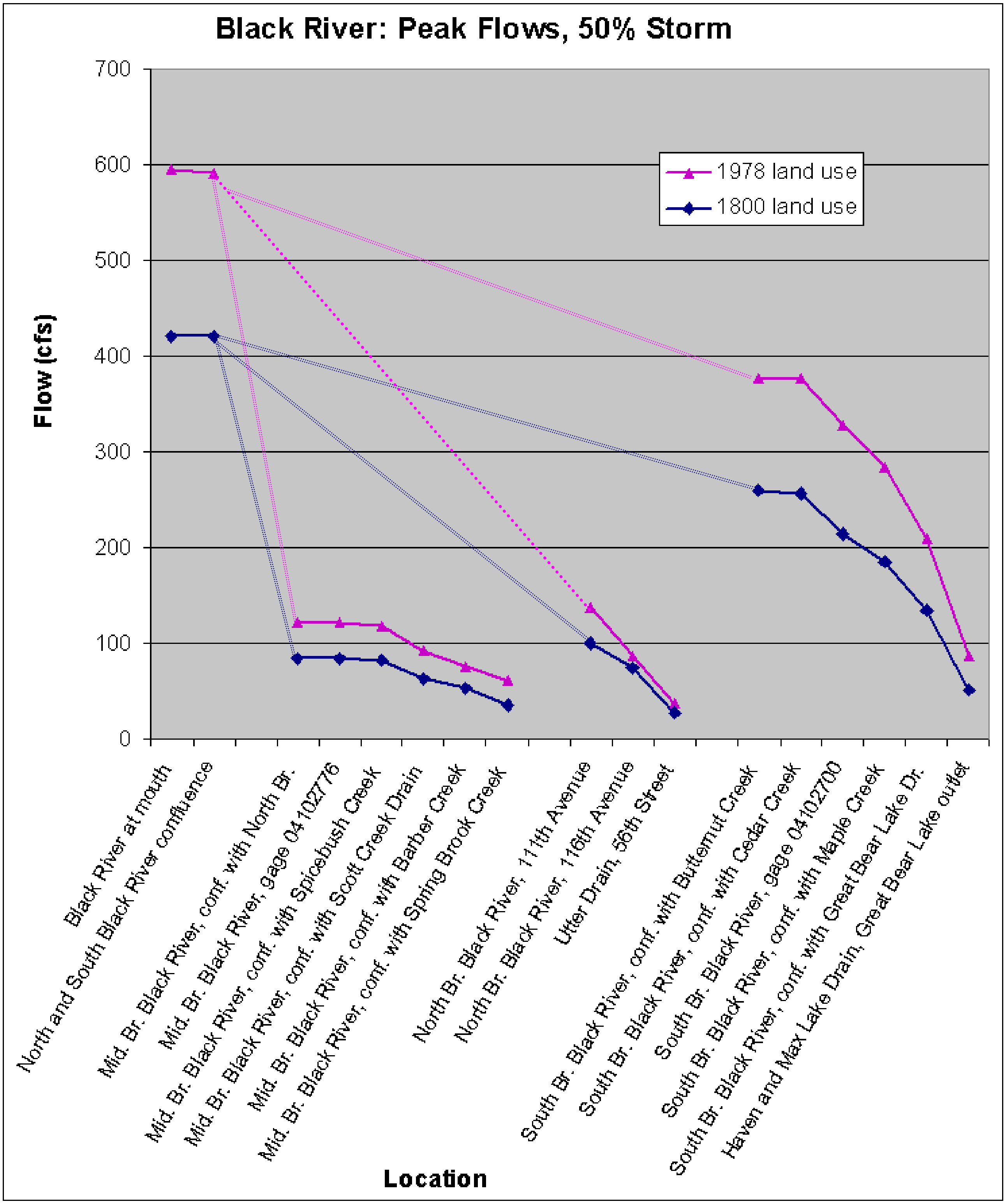


Figure 8: Predicted peak flows for river locations, 50 percent chance storm

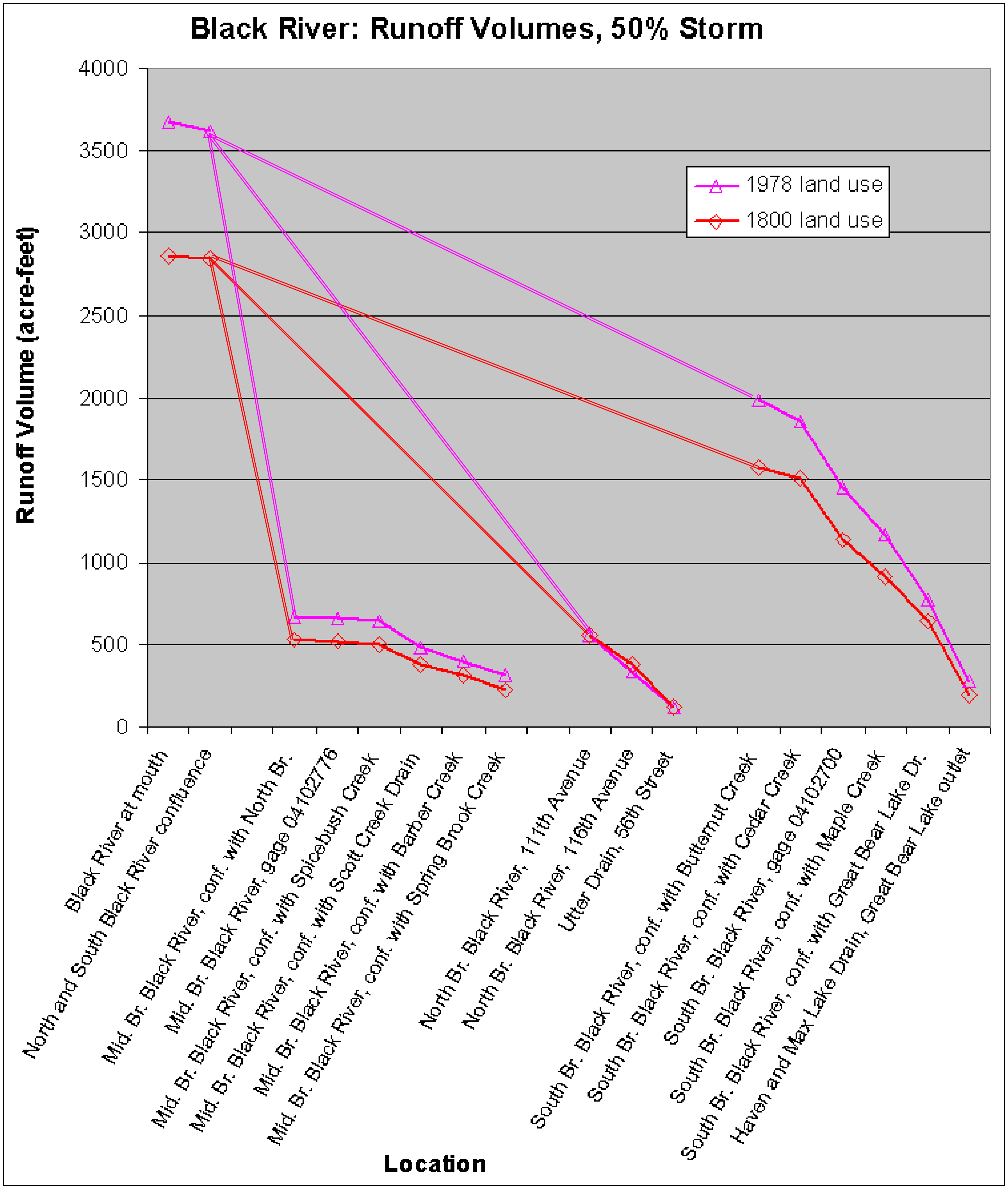


Figure 9: Predicted runoff volumes, 50 percent chance storm

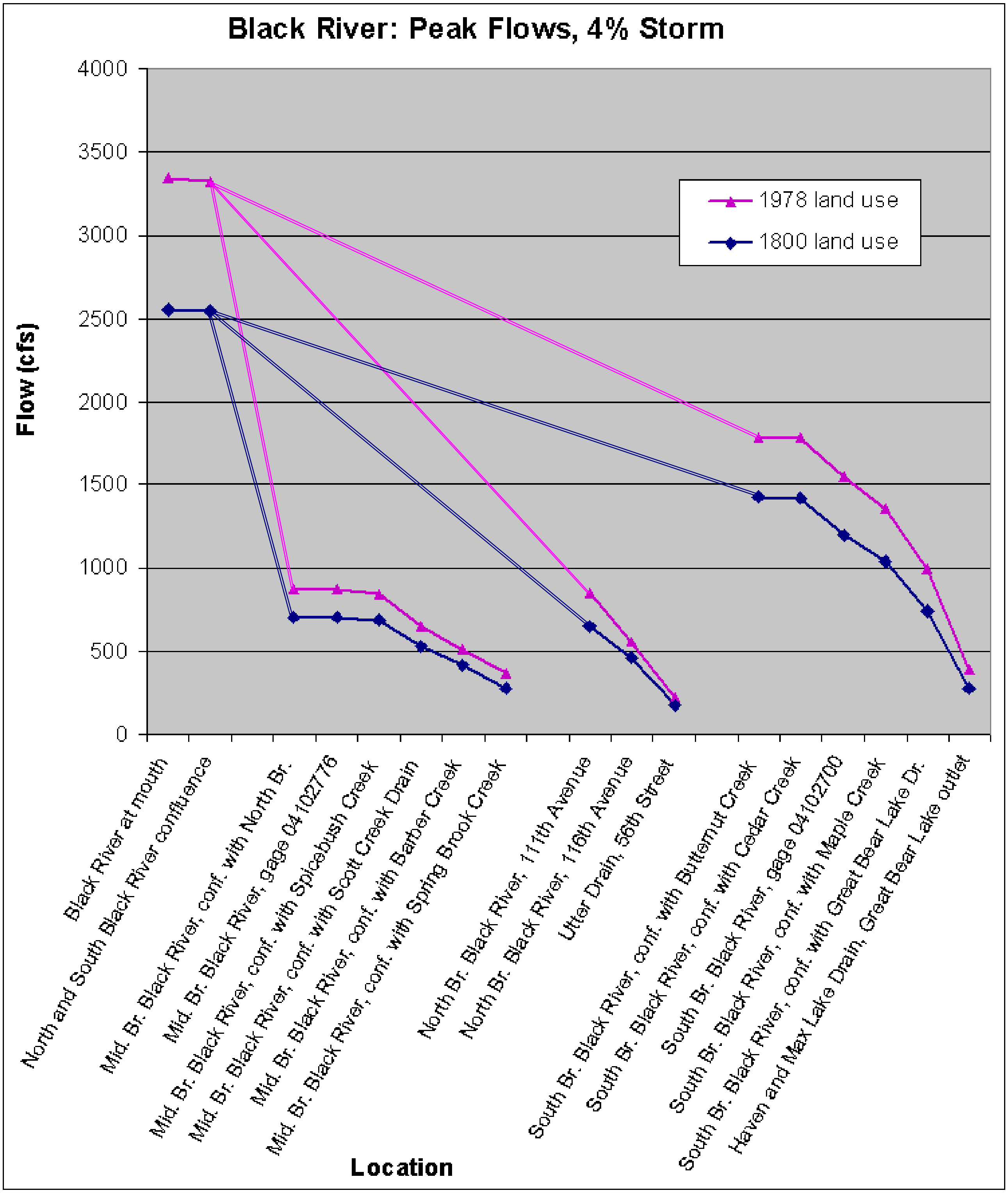


Figure 10: Predicted peak flows for river locations, 4 percent chance storm

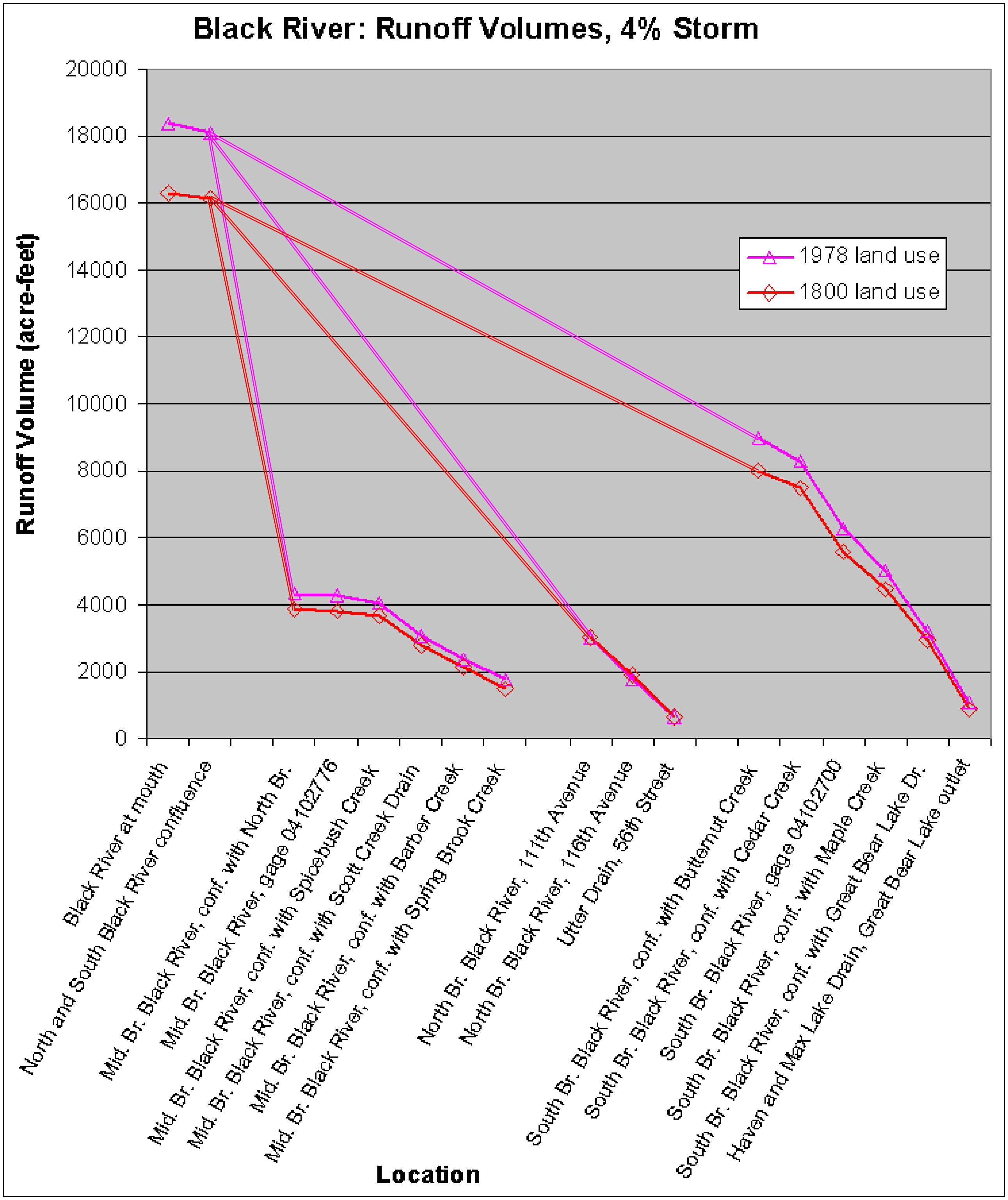


Figure 11: Predicted runoff volumes, 4 percent chance storm

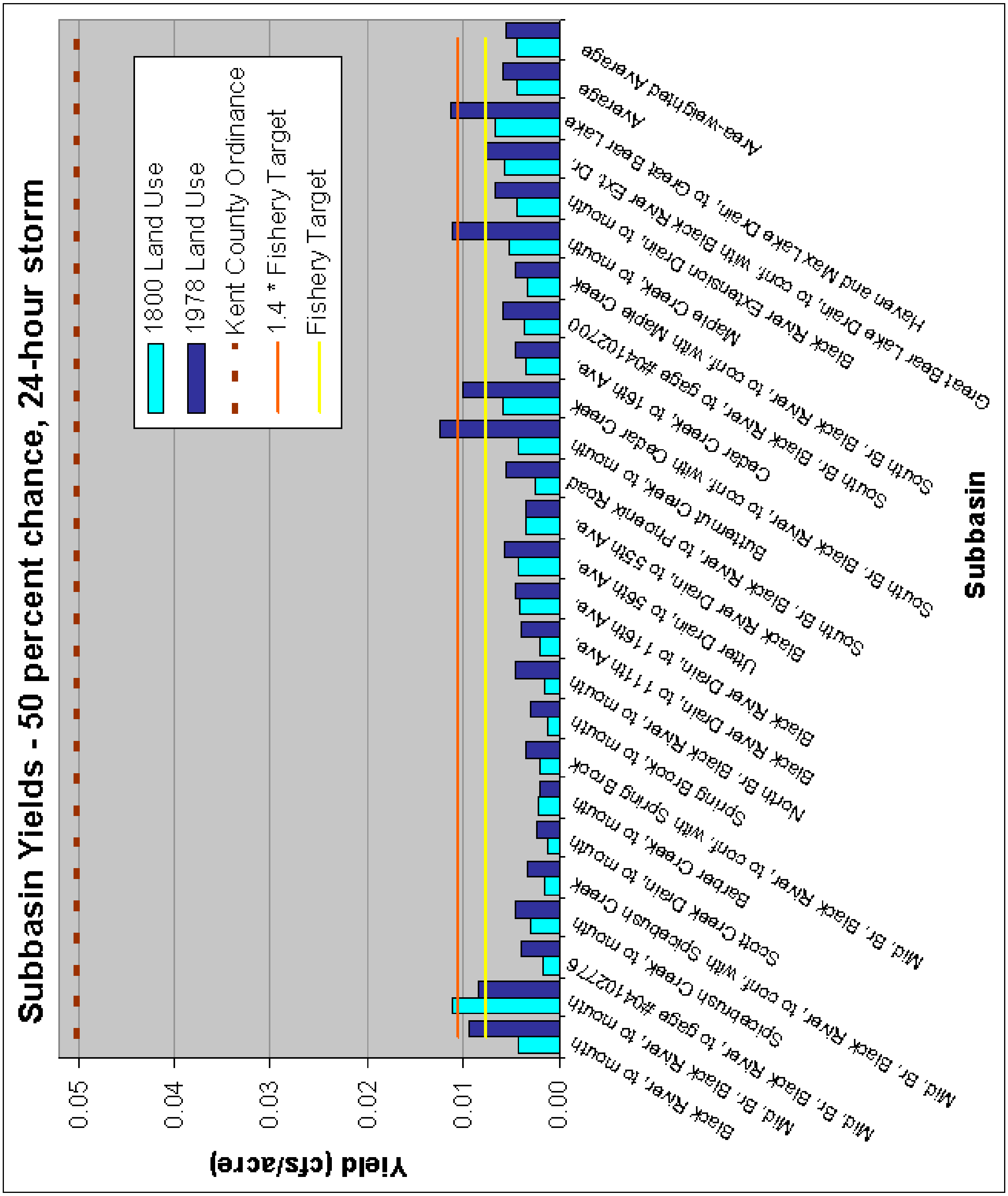


Figure 12: Subbasin Yields, 50 percent chance, 24-hour storm

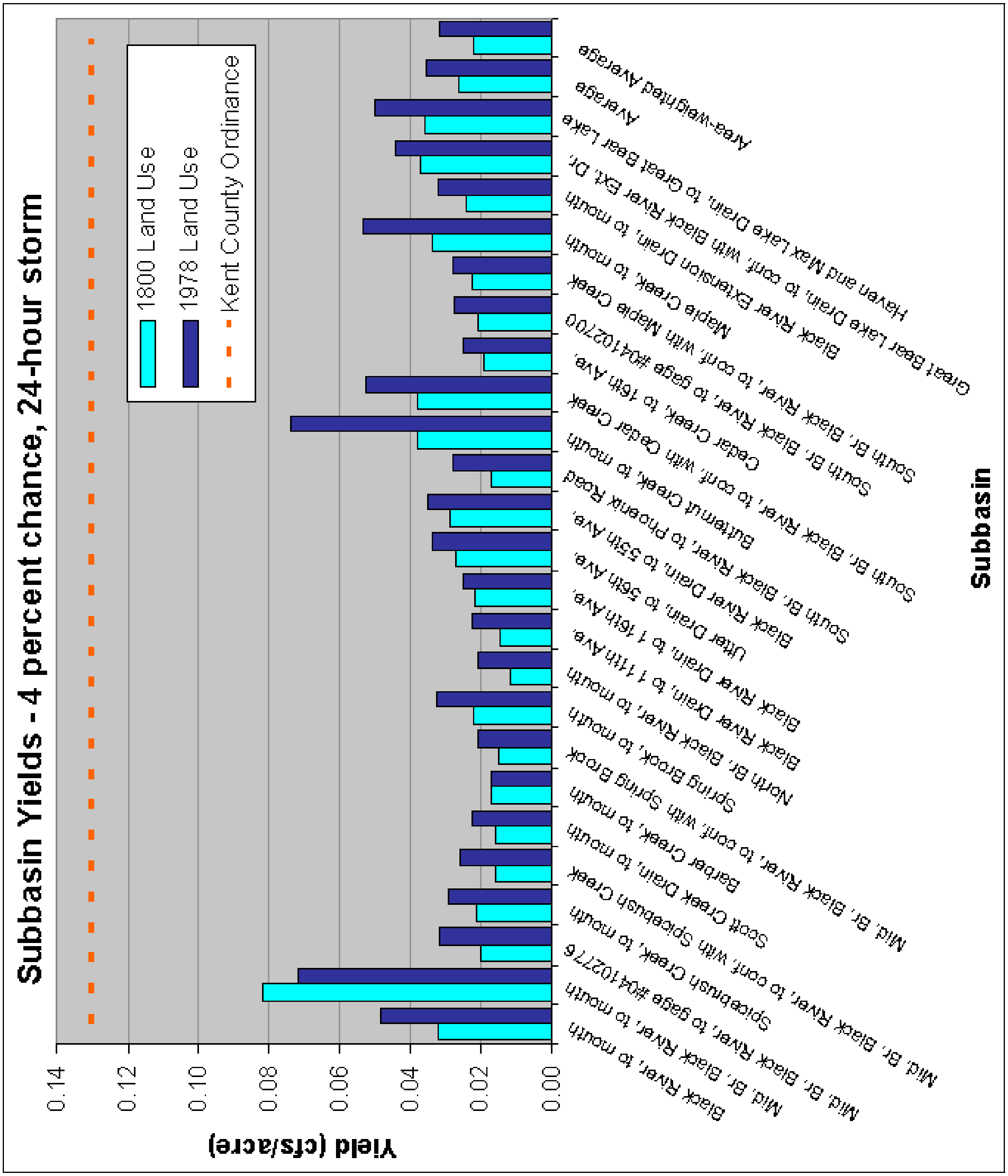


Figure 13: Subbasin Yields, 4 percent chance, 24-hour storm

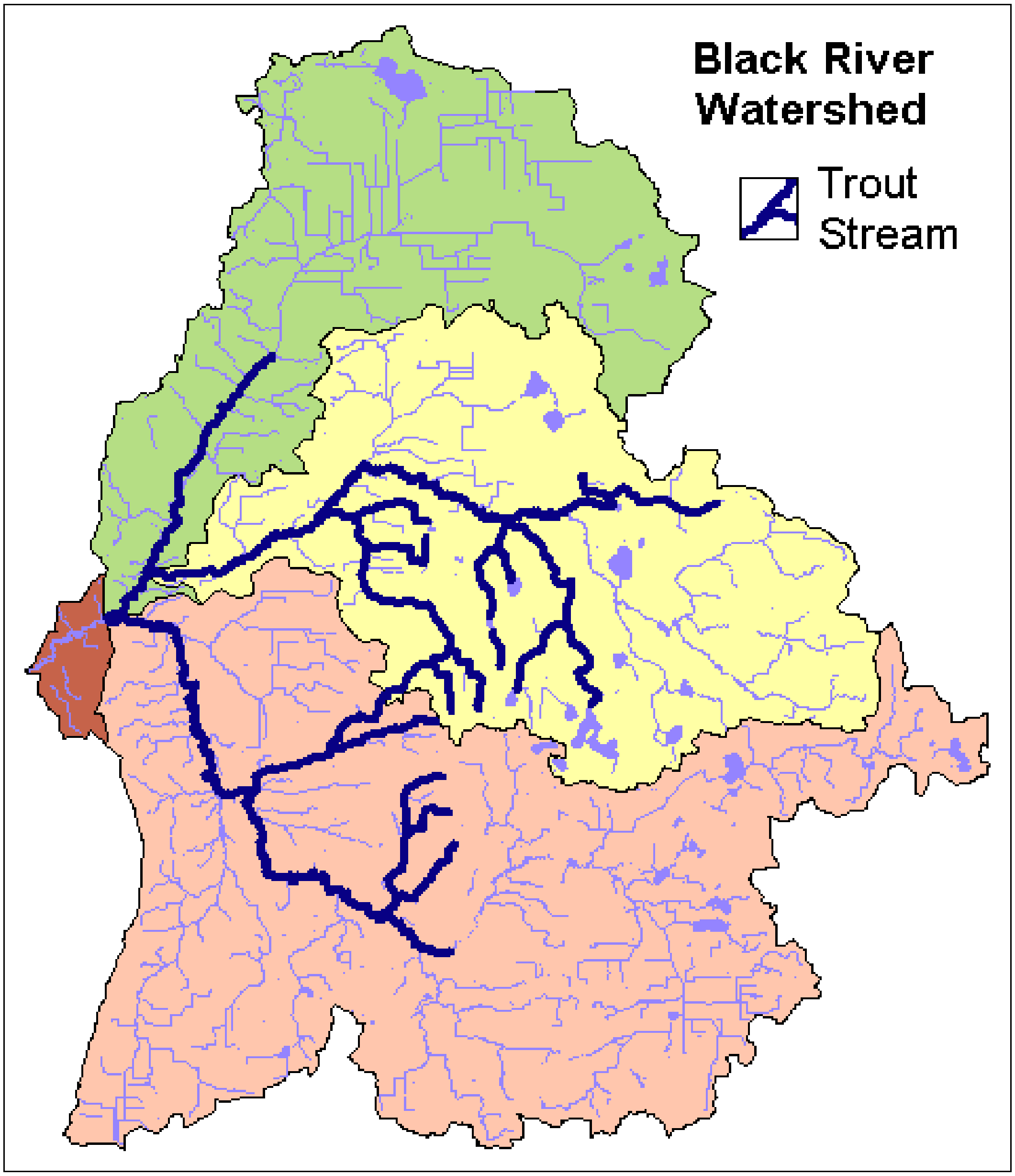


Figure 14: Black River Watershed Trout Streams

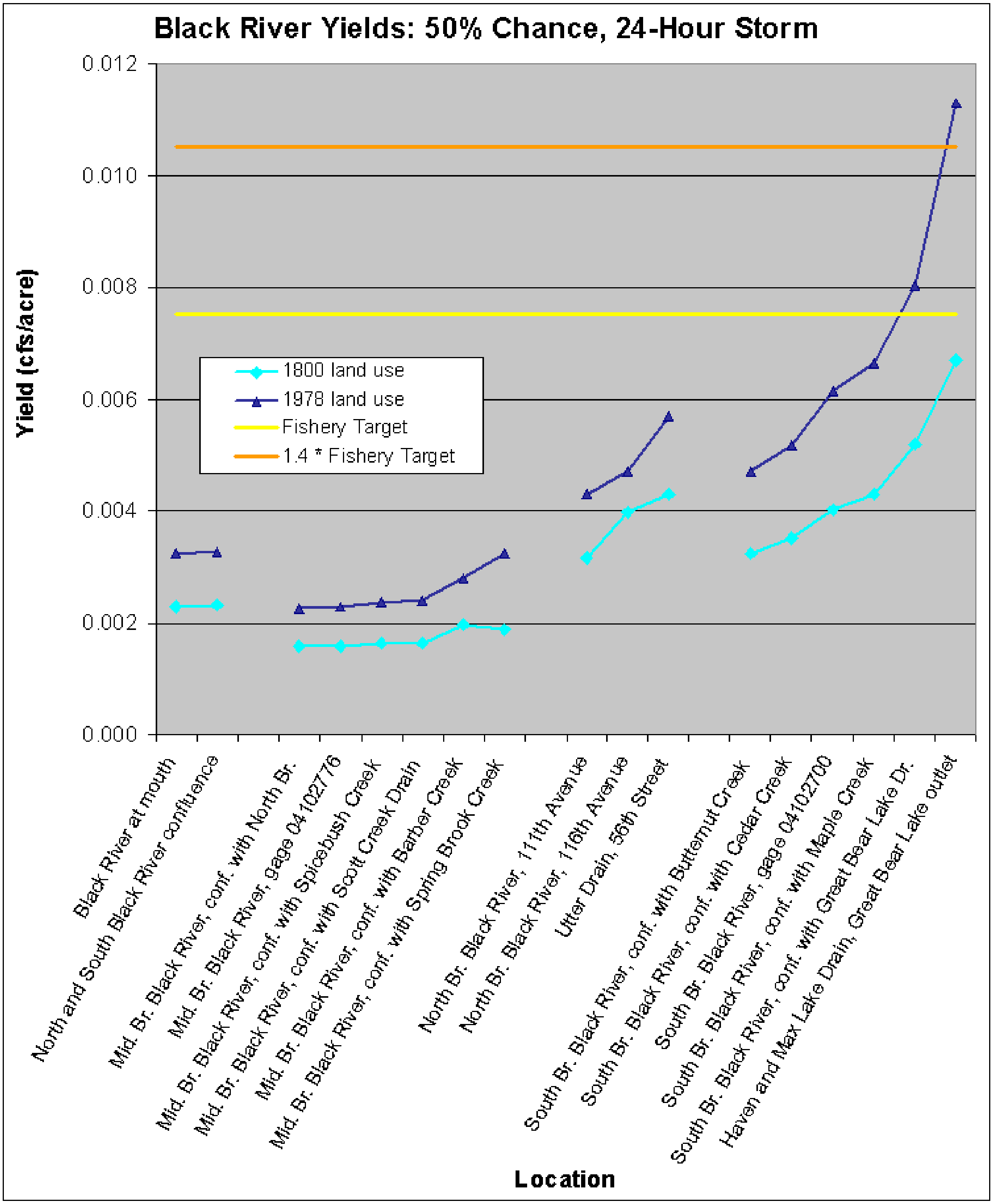


Figure 15: Black River Yields, 50 percent chance, 24-hour storm

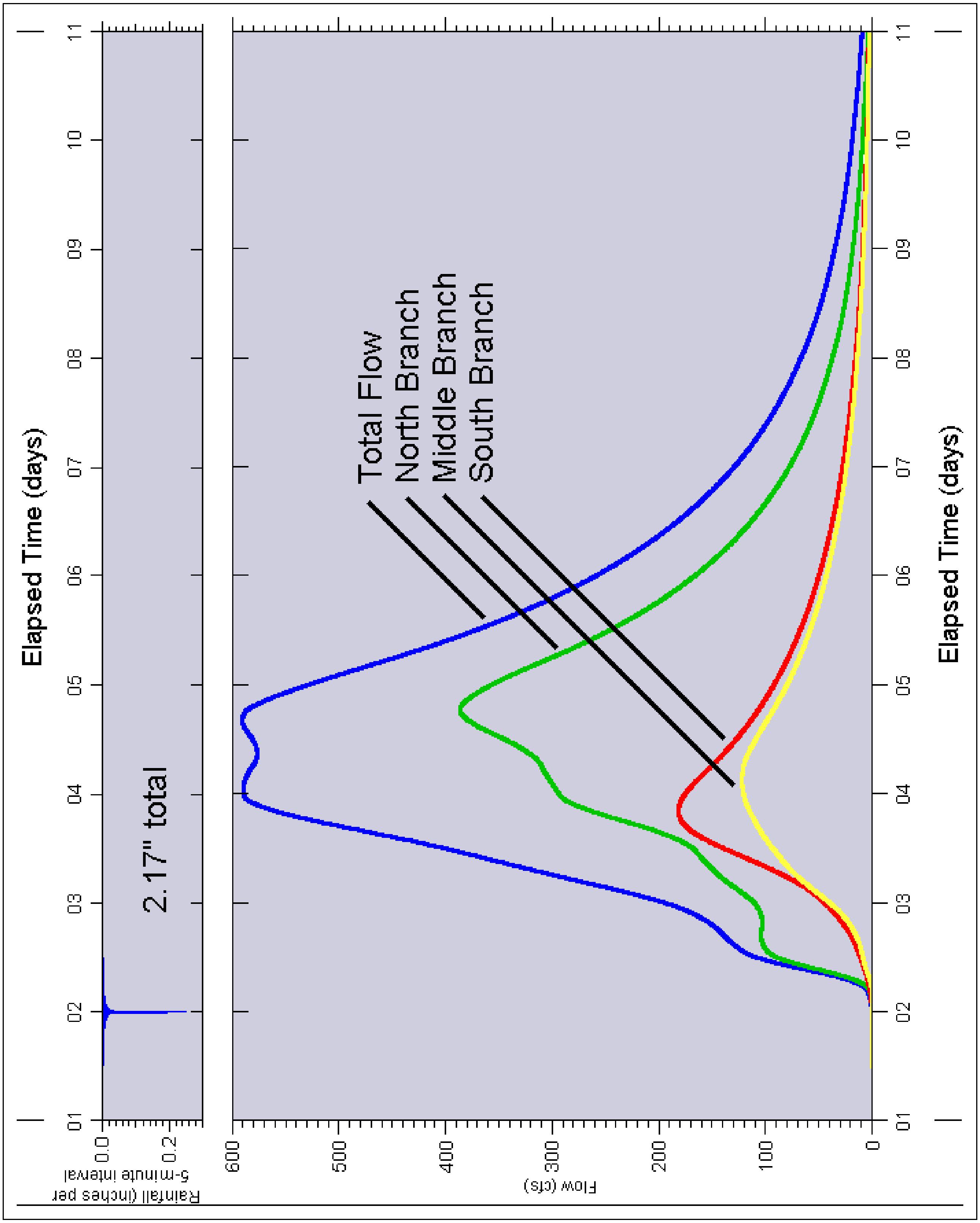


Figure 16: 50 percent chance, 24-hour storm hydrograph for Black River

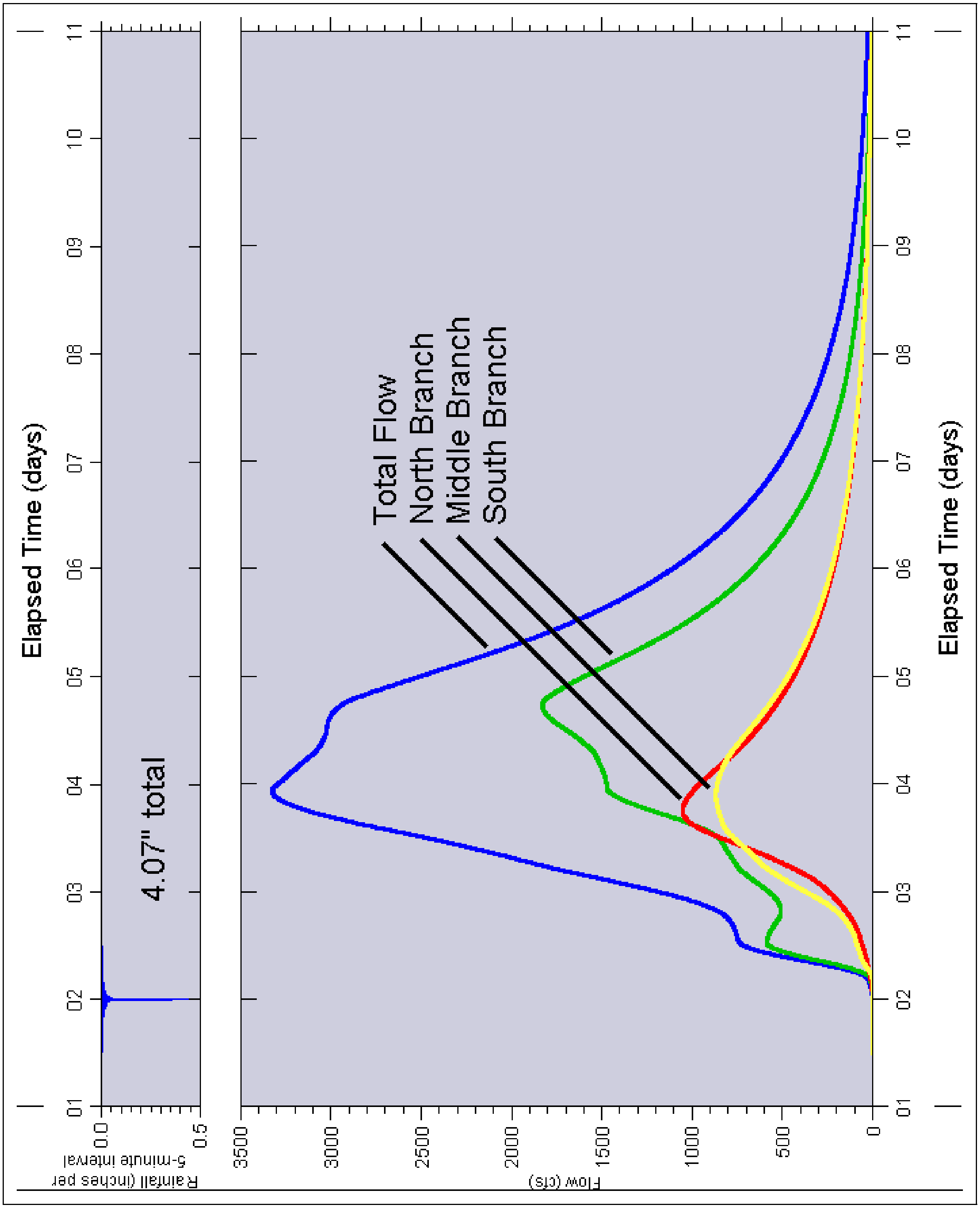


Figure 17: 4 percent chance, 24-hour storm hydrograph for Black River

Table 2: Peak flows and runoff volumes per subbasin

Subbasin			Land Use	Peak Flow (cfs)		Yield (cfs/acre)		Runoff Volume (acre-feet)	
ID	Description	Area (sq. mi.)		50%	4%	50%	4%	50%	4%
B1	Black River, to mouth	3.6	1800	10	75	0.004	0.03	28	186
			1978	22	113	0.009	0.05	60	267
BM1	Mid. Br. Black River, to mouth	0.9	1800	7	49	0.011	0.08	8	50
			1978	5	43	0.008	0.07	6	45
BM2	Mid. Br. Black River, to gage #04102776	4.6	1800	5	59	0.002	0.02	16	169
			1978	11	92	0.004	0.03	27	206
BM2SC	Spicebush Creek, to mouth	11.2	1800	21	151	0.003	0.02	98	606
			1978	33	209	0.005	0.03	110	640
BM3	Mid. Br. Black River, to conf. with Spicebush Creek	7.1	1800	7	72	0.001	0.02	30	284
			1978	16	119	0.003	0.03	48	343
BM3aSCD	Scott Creek Drain, to mouth	17.1	1800	14	174	0.001	0.02	60	637
			1978	26	247	0.002	0.02	85	728
BM3bBC	Barber Creek, to mouth	13.3	1800	19	148	0.002	0.02	101	677
			1978	17	147	0.002	0.02	77	601
BM4	Mid. Br. Black River, to conf. with Spring Brook	24.7	1800	33	239	0.002	0.02	210	1318
			1978	56	326	0.004	0.02	300	1563
BM4SB	Spring Brook, to mouth	4.9	1800	4	70	0.001	0.02	11	158
			1978	10	103	0.003	0.03	21	195
BN1	North Br. Black River, to mouth	16.0	1800	16	116	0.002	0.01	116	786
			1978	47	214	0.005	0.02	283	1217
BN2	Black River Drain, to 111th Ave.	20.6	1800	26	192	0.002	0.01	173	1094
			1978	51	299	0.004	0.02	226	1236
BN3	Black River Drain, to 116th Ave.	13.7	1800	35	189	0.004	0.02	218	995
			1978	40	220	0.005	0.03	185	910
BN4	Utter Drain, to 56th Ave.	10.3	1800	28	178	0.004	0.03	126	650
			1978	37	222	0.006	0.03	126	650
BN4UD	Black River Drain, to 55th Ave.	5.4	1800	12	99	0.003	0.03	41	274
			1978	12	121	0.004	0.04	23	214
BS1	South Br. Black River, to Phoenix Road	8.3	1800	14	92	0.003	0.02	80	469
			1978	29	146	0.006	0.03	124	579
BS1aBC	Butternut Creek, to mouth	10.9	1800	30	263	0.004	0.04	73	523
			1978	86	514	0.012	0.07	133	689
BS2	South Br. Black River, to conf. with Cedar Creek	9.1	1800	34	221	0.006	0.04	89	516
			1978	58	304	0.010	0.05	135	633
BS2CC	Cedar Creek, to 16th Ave.	21.6	1800	48	264	0.003	0.02	287	1426
			1978	64	347	0.005	0.03	264	1367
BS3	South Br. Black River, to gage #04102700	16.4	1800	39	216	0.004	0.02	220	1090
			1978	62	286	0.006	0.03	295	1263
BS4	South Br. Black River, to conf. with Maple Creek	12.0	1800	26	174	0.003	0.02	118	685
			1978	35	215	0.005	0.03	132	723

Subbasin			Land Use	Peak Flow (cfs)		Yield (cfs/acre)		Runoff Volume (acre-feet)	
ID	Description	Area (sq. mi.)		50%	4%	50%	4%	50%	4%
BS4MC	Maple Creek, to mouth	14.1	1800	47	303	0.005	0.03	156	851
			1978	100	481	0.011	0.05	254	1088
BS5ED	Black River Extension Drain, to mouth	24.2	1800	70	373	0.005	0.02	391	1770
			1978	103	500	0.007	0.03	434	1858
BS5GBLD	Great Bear Lake Drain, to conf. with Black River Ext. Dr.	4.4	1800	16	104	0.006	0.04	54	281
			1978	21	126	0.008	0.04	60	295
BS6GBL	Haven and Max Lake Drain, to Great Bear Lake	12.2	1800	52	280	0.007	0.04	200	894
			1978	88	390	0.011	0.05	281	1071
	Average		1800			0.004	0.026		
			1978			0.006	0.036		
	Area-weighted Average		1800			0.004	0.022		
			1978			0.006	0.032		

Table 3: Peak flows and runoff volumes in Black River

River Location			Land Use	Peak Flow (cfs)		Yield (cfs/acre)		Runoff Volume (acre-feet)	
ID	Description	Area (sq. mi.)		50%	4%	50%	4%	50%	4%
J1	Black River at mouth	286	1800	421	2555	0.002	0.014	2864	16281
			1978	594	3340	0.003	0.018	3676	18358
J2	North and South Black River confluence	283	1800	420	2544	0.002	0.014	2847	16126
			1978	591	3325	0.003	0.018	3620	18102
JM1	Mid. Br. Black River, conf. with North Br.	84	1800	84	705	0.002	0.013	528	3883
			1978	122	869	0.002	0.016	671	4313
JM2	Mid. Br. Black River, gage 04102776	83	1800	84	705	0.002	0.013	521	3834
			1978	122	869	0.002	0.016	665	4268
JM3	Mid. Br. Black River, conf. with Spicebush Creek	78	1800	82	684	0.002	0.014	507	3671
			1978	119	846	0.002	0.017	640	4066
JM3a	Mid. Br. Black River, conf. with Scott Creek Drain	60	1800	63	529	0.002	0.014	379	2783
			1978	92	647	0.002	0.017	482	3083
JM3b	Mid. Br. Black River, conf. with Barber Creek	43	1800	53	417	0.002	0.015	321	2151
			1978	77	511	0.003	0.019	398	2358
JM4	Mid. Br. Black River, conf. with Spring Brook Creek	30	1800	36	279	0.002	0.015	221	1476
			1978	61	375	0.003	0.020	321	1758
JN2	North Br. Black River, 111th Avenue	50	1800	100	654	0.003	0.020	557	3011
			1978	138	853	0.004	0.027	560	3011
JN3	North Br. Black River, 116th Avenue	29	1800	74	464	0.004	0.025	385	1919
			1978	88	561	0.005	0.030	333	1775
JN4a	Upper Black River Drain, 55th Street	5	1800	12	99	0.003	0.029	41	274
			1978	12	121	0.004	0.035	23	214
JN4b	Utter Drain, 56th Street	10	1800	28	178	0.004	0.027	126	650
			1978	37	222	0.006	0.034	126	650
JS1	South Br. Black River, conf. with Butternut Creek	125	1800	260	1430	0.003	0.018	1574	8003
			1978	376	1783	0.005	0.022	1986	8986
JS2	South Br. Black River, conf. with Cedar Creek	114	1800	257	1420	0.004	0.019	1509	7499
			1978	376	1783	0.005	0.024	1855	8298
JS3	South Br. Black River, gage 04102700	83	1800	214	1198	0.004	0.022	1135	5560
			1978	329	1549	0.006	0.029	1455	6297
JS4	South Br. Black River, conf. with Maple Creek	67	1800	184	1040	0.004	0.024	917	4476
			1978	284	1355	0.007	0.032	1161	5034
JS5	South Br. Black River, conf. with Great Bear Lake Dr.	41	1800	135	739	0.005	0.028	645	2945
			1978	209	993	0.008	0.038	775	3224
JS6	Haven and Max Lake Drain, Great Bear Lake outlet	12	1800	52	280	0.007	0.036	200	894
			1978	88	390	0.011	0.050	281	1071

Appendix

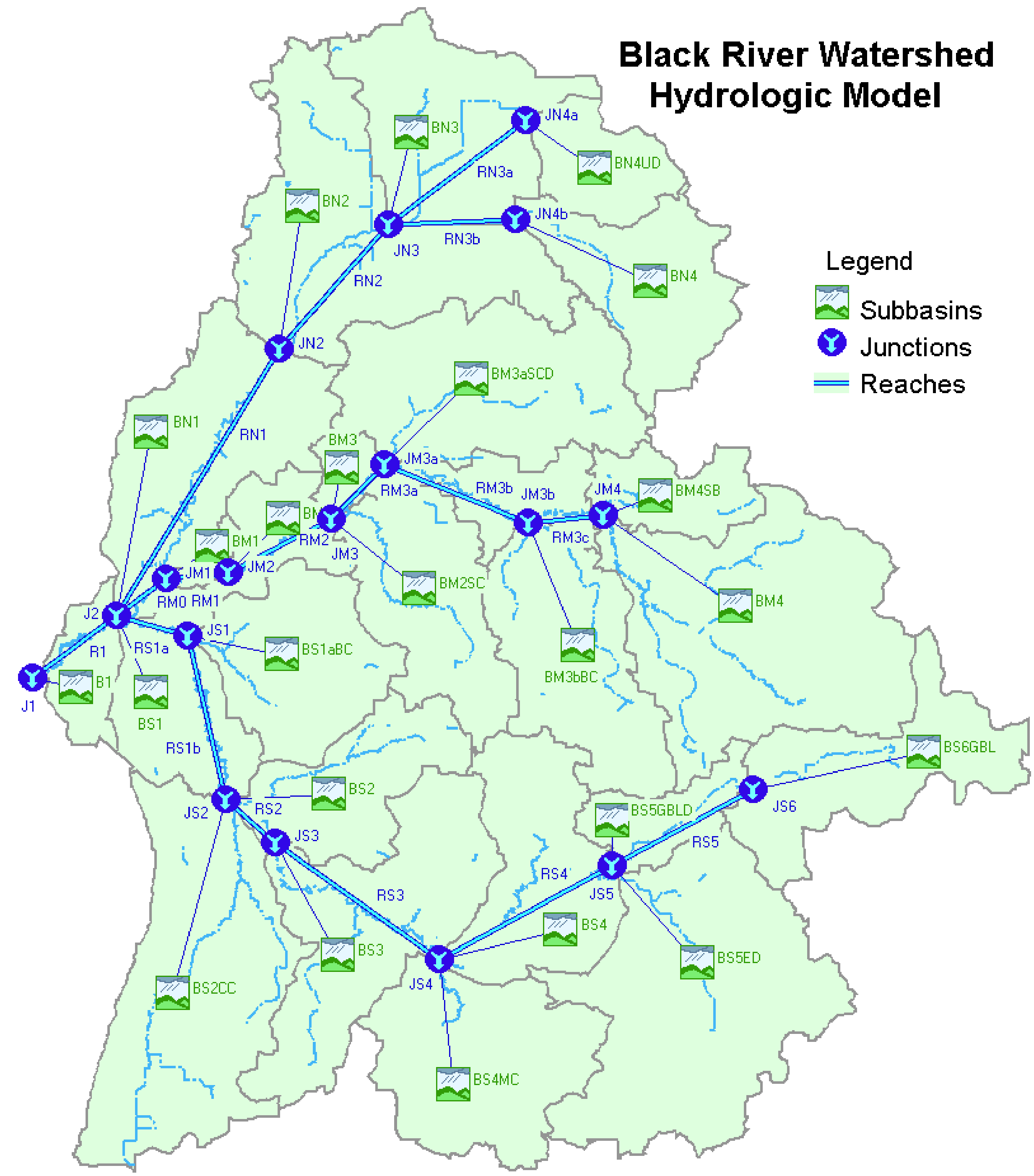
Appendix A: Black River Hydrologic Model Parameters

This appendix is provided so that the model may be recreated. Table A1 provides the design rainfall values specific to the region of the state where the Black River is located. Figure A1 summarizes the hydrologic elements in the HEC-HMS model. Tables A2 and A3 provide the parameters that were specified for each of these hydrologic elements. The initial loss field in HEC-HMS is left blank so that the default equation based on the curve number is used. Table A4 provides the reach parameters for the lag routing method. HEC-HMS was run for a ten-day duration using a five-minute computation interval.

Table A1: Design Rainfall Values

SCS Type II Precipitation Event	Precipitation	Area-adjusted Precipitation*
50% chance (2-year), 24-hour storm	2.37 inches	2.17 inches
4% chance (25-year), 24-hour storm	4.45 inches	4.07 inches

*standard values were multiplied by 0.914 to account for the watershed size



B1, Black River, to mouth
BM1, Mid. Br. Black River, to mouth
BM2, Mid. Br. Black River, to gage #04102776
BM2SC, Spicebrush Creek, to mouth
BM3, Mid. Br. Black River, to conf. with Spicebush Creek
BM3aSCD, Scott Creek Drain, to mouth
BM3bBC, Barber Creek, to mouth
BM4, Mid. Br. Black River, to conf. with Spring Brook
BM4SB, Spring Brook, to mouth
BN1, North Br. Black River, to mouth
BN2, Black River Drain, to 111th Ave.
BN3, Black River Drain, to 116th Ave.
BN4, Utter Drain, to 56th Ave.
BN4UD, Black River Drain, to 55th Ave.
BS1, South Br. Black River, to Phoenix Road
BS1aBC, Butternut Creek, to mouth
BS2, South Br. Black River, to conf. with Cedar Creek
BS2CC, Cedar Creek, to 16th Ave.
BS3, South Br. Black River, to gage #04102700
BS4, South Br. Black River, to conf. with Maple Creek
BS4MC, Maple Creek, to mouth
BS5ED, Black River Extension Drain, to mouth
BS5GBLD, Great Bear Lake Drain, to conf. with Black River Ext. Dr.
BS6GBL, Haven and Max Lake Drain, to Great Bear Lake

Figure A1: Hydrologic Elements defined for HEC-HMS model

Table A2: Subbasin Parameters – Area, Curve Number, Initial Loss

Subbasins		Drainage Area (sq. mi.)	Runoff Curve Number		Initial Loss
ID	**Description**		**1800**	**1978**	
B1	Black River to mouth	3.64	63	70	
BM1	Middle Branch Black River to mouth	0.93	64	62	Default
BM2	Middle Branch Black River at gage #04102776	4.56	58	61	Default
BM2SC	Spicebush Creek to mouth	11.23	64	65	Default
BM3	Middle Branch Black River at confluence with Spicebush Creek	7.14	59	62	Default
BM3aSCD	Scott Creek Drain to mouth	17.14	58	60	Default
BM3bBC	Barber Creek to mouth	13.28	63	61	Default
BM4	Middle Branch Black River to confluence with Spring Brook	24.70	64	67	Default
BM4SB	Spring Brook to mouth	4.91	56	59	Default
BN1	North Branch Black River to mouth	15.96	63	71	Default
BN2	Black River Drain to 111th Avenue	20.55	64	66	Default
BN3	Black River Drain to 116th Avenue	13.66	70	68	Default
BN4	Utter Drain to 56th Avenue	10.26	67	67	Default
BN4UD	Black River Drain to 55th Avenue	5.38	63	59	Default
BS1	South Branch Black River to Phoenix Road	8.27	65	69	Default
BS1aBC	Butternut Creek to mouth	10.87	62	67	Default
BS2	South Branch Black River to confluence with Cedar Creek	9.05	65	69	Default
BS2CC	Cedar Creek to 16th Avenue, gage #04102720	21.58	68	67	Default
BS3	South Branch Black River to Gage #04102700	16.42	68	71	Default
BS4	South Branch Black River to confluence with Maple Creek	12.01	65	66	Default
BS4MC	Maple Creek to mouth	14.14	66	71	Default
BS5ed	Black River Extension Drain to mouth	24.16	70	71	Default
BS5GBLD	Great Bear Lake Drain to confluence with Black River Extension Drain	4.43	67	68	Default
BS6GBL	Haven and Max Lake Drain to Great Bear Lake	12.18	70	74	Default
	Total	286			

Table A3: Subbasin Parameters – Times of Concentration and Storage Coefficients

Subbasin ID	Land Use Scenario	Time of Concentration (hours)	Storage Coefficient	
			50% chance, 24-hour storm	4% chance, 24-hour storm
B1	1800	11.18	23.41	19.03
	1978		21.52	18.03
BM1	1800	5.35	5.35	5.35
	1978		5.35	5.35
BM2	1800	12.53	27.61	22.86
	1978		17.72	15.99
BM2SC	1800	17.18	43.30	35.40
	1978		27.21	24.43
BM3	1800	17.33	40.97	34.23
	1978		24.36	22.21
BM3aSCD	1800	14.48	39.35	31.66
	1978		27.59	23.55
BM3bBC	1800	18.95	51.28	41.44
	1978		42.29	35.68
BM4	1800	24.39	62.28	51.51
	1978		49.19	42.41
BM4SB	1800	7.64	22.19	16.65
	1978		16.53	12.80
BN1	1800	37.51	72.77	63.45
	1978		51.83	48.03
BN2	1800	24.40	65.81	53.76
	1978		38.01	34.64
BN3	1800	20.03	63.21	49.65
	1978		42.17	36.15
BN4	1800	13.58	41.29	31.97
	1978		28.53	23.77
BN4UD	1800	9.38	31.23	22.56
	1978		12.44	11.19
BS1	1800	25.45	53.09	45.74
	1978		34.58	32.13
BS1aBC	1800	7.37	19.25	13.91
	1978		8.73	8.00
BS2	1800	11.03	20.61	17.51
	1978		17.14	14.96
BS2CC	1800	25.98	57.45	49.38
	1978		33.77	31.72
BS3	1800	25.86	52.01	45.08
	1978		40.92	37.40
BS4	1800	17.52	40.94	34.26
	1978		31.88	27.83
BS4MC	1800	11.30	28.41	22.70
	1978		19.56	16.95
BS5ed	1800	19.16	54.25	43.65
	1978		36.68	31.66
BS5GBLD	1800	9.43	29.44	21.62
	1978		22.97	17.89

Subbasin ID	Land Use Scenario	Time of Concentration (hours)	Storage Coefficient	
			50% chance, 24-hour storm	4% chance, 24-hour storm
BS6GBL	1800	12.46	34.33	27.09
	1978		26.73	22.19

Table A4: Channel Reach Parameters

ID	Reach	Lag (minutes)
R1	Black River, to mouth	398
RN1	North Branch Black River, to confluence with South Branch	924
RN2	North Branch Black River, to 111th Avenue	454
RN3a	North Branch Black River, to 116th from Upper Black River Drain	562
RN3b	North Branch Black River, to 116th from Utter Drain	194
RM0	Middle Branch Black River, to confluence with South Branch	238
RM1	Middle Branch Black River, to confluence with North Branch	71
RM2	Middle Branch Black River, to gage 04102776	533
RM3a	Middle Branch Black River, to confluence with Spicebush Creek	200
RM3b	Middle Branch Black River, to confluence with Scott Creek Drain	564
RM3c	Middle Branch Black River, to confluence with Barber Creek	225
RS1a	South Branch Black River, to confluence with North Branch	299
RS1b	South Branch Black River, to confluence with Butternut Creek	809
RS2	South Branch Black River, to confluence with Cedar Creek	247
RS3	South Branch Black River, to gage 04102700	788
RS4	South Branch Black River, to confluence with Maple Creek	738
RS5	South Branch Black River, to confluence with Great Bear Lake Drain	380

Appendix J: Black River Morphology Report

Black River Morphology Report
Kregg Smith, Michigan Department of Natural Resources
April 2005

For most of Michigan's streams, the physical and ecological processes that determine channel conditions have been degraded by human activities to the detriment of the aquatic resource. Most watersheds have been perturbed to some extent. Civilization's modern requirements for a host of different resource uses have placed great stress on many flowing river systems. Balancing these resource activities of the river and the ability to predict the response of the river to imposed damage requires reliable predictions to clearly understand the functions of the river and the physical variables which influence river behavior. Clearly, it is impossible to restore entire river systems to their conditions prior to initial settlement of the watershed. However, restoration can be defined as movement of an ecosystem toward an approximation (not necessarily a re-creation) of its condition prior to disturbance.

An assessment of the morphological stability of a river system is an important step in selecting remediation techniques for water quality and fisheries impairments. Morphologically described stream types based on field measurements are described by Rosgen (1994, 1996). The use of reference reach data, characteristic of the stable channel morphology in a particular valley type, can provide design variables for applications in stream restoration. Rosgen describes an assortment of stream types delineated by slope, channel material, width/depth ratios, sinuosity, and entrenchment ratio. Entrenchment ratio is the ratio of the width of the flood-prone area to the surface width of the bankfull channel, and provides a quantitative description of the vertical containment of the river. Sinuosity is the measurement of a streams meandering pattern and defined as the ratio of stream length to valley length. Width/depth ratios are described as the ratio of the bankfull surface width to the mean depth of the bankfull channel and an important variable to understand the distribution of available energy within a channel. Width/depth ratios are the most sensitive and positive indicator of trends in channel stability and can be used to interpret shifts in channel stability following disturbances to channels or watersheds. The stream types are described at the morphological description stage (Level II) of Rosgen's hierarchical classification system. This classification system groups variables of similar stream morphology to reduce statistical variance between the groups. Rosgen utilizes four fundamental principles of river systems: bankfull discharge; stream channel dimension, pattern, and profile.

Several objectives of the Black River Watershed Management Plan and watershed stakeholders involve achievement of a natural stream channel to restore the Black River to a functioning river system. The stability of a stream is a major determinant of its condition and a prerequisite for its optimum functioning. Stream stability as defined by Rosgen (1996) as the ability of the stream to maintain, over time, its dimension, pattern, and profile in such a manner that it is neither aggrading nor degrading. Therefore we used the Rosgen classification system to describe the current state of six locations of the Black River in Allegan and Van Buren Counties. An assessment of condition was determined by the level III and IV Rosgen methodology. The study design was established to assist in the assessment of cumulative watershed impacts, provide a method to utilize sediment data, bank erosion, and stability predictions for future implementation phases and will be integrated with inventories of fish habitat potential.

We used the Shield's threshold of motion equation to calculate the sediment particle size that would be transported given bankfull discharges. The following equation summarizes our calculations:

$$Ds = t / ((p_s - p)\ g\ 0.06)\ (304.8)$$

Ds=diameter sediment particle (mm)
t=shear stress= (pg) (depth) (slope) (lb/ft2) (N/m2)
p_s =density of sediment (5.15 slugs/ft3) or (2560 kg/m3)
p=density of water (1.94 slugs/ft3) (1000 kg/m3)
g=gravitational acceleration (32.2 ft/s2) (9.81 m/s2)
0.06 = Shield's parameter typically in the range of 0.04 to 0.07
Conversion Constant 304.8 mm/ft or 1000 mm/m

The first site selected was in the North Branch Black River near the 68th Street and 108th Avenue intersection. This location is in section 16 of Casco Township, Allegan County. The second location was in the Middle Branch Black River near the 60th Street and 106th Avenue intersection. The second location is centrally located between Casco and Lee Townships, Allegan County. The third location was in the South Branch Black River below Hamilton Street in the city of Bangor, Van Buren County. These three locations were surveyed on the 13 and 14 May, 2004. During the fall of 2004 three additional sites were surveyed. Another location in the Middle Branch at 68th Street was surveyed in section 27 of Casco Township, Allegan County. A stream reach in the Haven and Max Lake Drain located in section 16 of Bloomingdale Township, Van Buren County was also surveyed. The third fall survey was conducted in the South Branch at the Phoenix Road crossing in section 6 of Geneva Township, Van Buren County.

Spring Reaches:

The North Branch reach was classified as E5 (Table 1). This reach is located within a lacustrine valley dominated by small sediment particle sizes. Stream types with an E classification are defined as the developmental "end-point" of channel stability and fluvial process efficiency for certain alluvial streams undergoing a natural dynamic sequence of system evolution (Rosgen, 1996). It should be noted that these classifications have been widely justified in other parts of the U.S. but has not been justified for Michigan streams and therefore the following descriptions are based on Rosgen's delineative criteria. The E stream types are typically slightly entrenched with an entrenchment ratio greater than 2.2, these streams exhibit low channel width/depth ratios (<12), and display very high channel sinuosity (>1.5). The North Branch was slightly entrenched (19.7) as it flowed through a forested floodplain. The width/depth ratio was 10.7 with a lower channel sinuosity (1.1) than is typical for this type of stream. The slope (0.002) and channel bed material (Glendora Loamy Sand) classify the stream as E5. Rosgen (1996) notes that the E5 stream type are hydraulically efficient channel forms and they maintain a high resistance to form adjustment that results in channel stability without significant downcutting. Shear stress calculated for this stream reach indicated a high (0.77 lbs/ft. sq.) near bank stress rating (Table 1). At the measured channel slope and average bankfull depth, the particle diameter mobilized at bankfull discharges was calculated at 25 mm. Stream channels of type E are stable unless compromised by disturbances that change sediment supply or streamflow. A hydrology study currently being done could provide valuable information to the validity of these findings.

Both the Middle (60th Street) and South Branch (Hamilton St.) reaches were classified as C5 (Table 1). The Middle Branch flows through a lacustrine valley dominated by sand, while the South Branch reach was located in a valley with surface geology types consisting of fine textured glacial till and end Moraines of fine textured till. Upstream of this reach in the South Branch Black River coarser material of glacial till and end moraines are found, where presently the Bangor and Breedsville Dams are located. Rosgen describes the C stream type as having a well developed floodplain, relatively sinuous, and having a low relief channel. The South Branch reach had a slope of 0.0028, while the Middle Branch had a slope of 0.003. These stream reaches had lower than average width/depth ratios of 13.39 for the Middle Branch and 14.83 for the South Branch. Sinuosity's for both reaches were also lower than average for the Middle Branch (1.57) and particularly the South Branch (1.2). The Middle Branch reach was dominated by channel bed material of the Glendora Loamy Sand association identifying this reach as C5. The downstream section of the South Branch reach was dominated by channel bed materials associated with the Glendora Sandy Loam association, however, evidence of cobble was observed at the upstream section of the reach below the Hamilton Street Bridge. Shear stress calculations for the South Branch (0.45 lbs/ft.sq.) and Middle branch (0.47 lbs/ft.sq.) reaches indicated a moderate near bank stress rating (Table 1). At the measured channel slope and average bankfull depth, the particle diameter mobilized at bankfull discharges was calculated at 22 and 23 mm, respectively. Stream channels with a classification of C5 typically have a higher width/depth ratio than preceding C stream types because of the depositional nature of these streambed materials and the susceptibility for active lateral migration. Rates of lateral migration are influenced by the presence and condition of the riparian vegetation, in which sediment supply could be high unless stream-banks are in a very low erodibility condition. Maintenance of the riparian vegetation along this stream reach is important. Establishing a native prairie buffer would reduce sediment supply and therefore reduce the abrasive power applied to the eroding streambank locations. Attempts to stabilize the eroding banks at Lion's Park in the city of Bangor would be best accomplished using the information and data collected during this survey. According to the stream channel dimension and profiles in this reach, appropriate structures include a cross-vane, soil lifts, and regrading. The C5 stream type is very susceptible to changes in lateral and vertical stream stability caused by direct channel disturbances that change the flow and sediment regimes of the watershed.
Restoring natural stability using design criteria collected during this initial survey will ensure that channel adjustments will be limited to the predicted conditions of the stream channel characteristics and existing flow regime.

Fall Reaches:

Haven and Max Lake Drain flows within a valley with surface geology consisting of coarse textured glacial till. This reach was classified as E5 (Table 1). Shear stress calculations indicated a moderate near bank stress rating (0.54 lbs/ft. sq.). At the measured channel slope and average bankfull depth, the particle diameter mobilized at bankfull discharges was calculated at 27 mm. Width to depth ratio for this stream was measured at an expected low ratio (<12) for this stream type. Stream reaches with lower width to depth ratios generally do not experience stress placed within the near bank region. Sinuosity for this reach was normal for a type E stream classification. Evidence of lateral migration of the stream bank was present at this site, but could be related to anthropogenic factors. Stream bank stabilization structures that are engineered to restore the natural stability of this stream reach would allow for the function of the stream to be achieved along with reaching societal values at the land use site. Information and data collected during this survey can be used to determine the departure of existing conditions from previous conditions and to determine the channel dimensions that need to be restored. Appropriate structures that we propose to achieve the stability at this stream reach are soil lifts and stone toe protection wrapped in natural materials and seeded with native grass plantings. Several land use problems located at this site could be preventing the stream from achieving a stable form, including an inappropriately designed road crossing structure at 42nd Street and the parking lot adjacent to the stream. Most of the instream changes in stream channel design could be a result of stormwater runoff that is transporting excess sediment to the Haven and Max Lake Drain. Wetland filters and native prairie buffers would allow for the infiltration of stormwater runoff and deposit sediment so that it does not enter the stream at excessive rates.

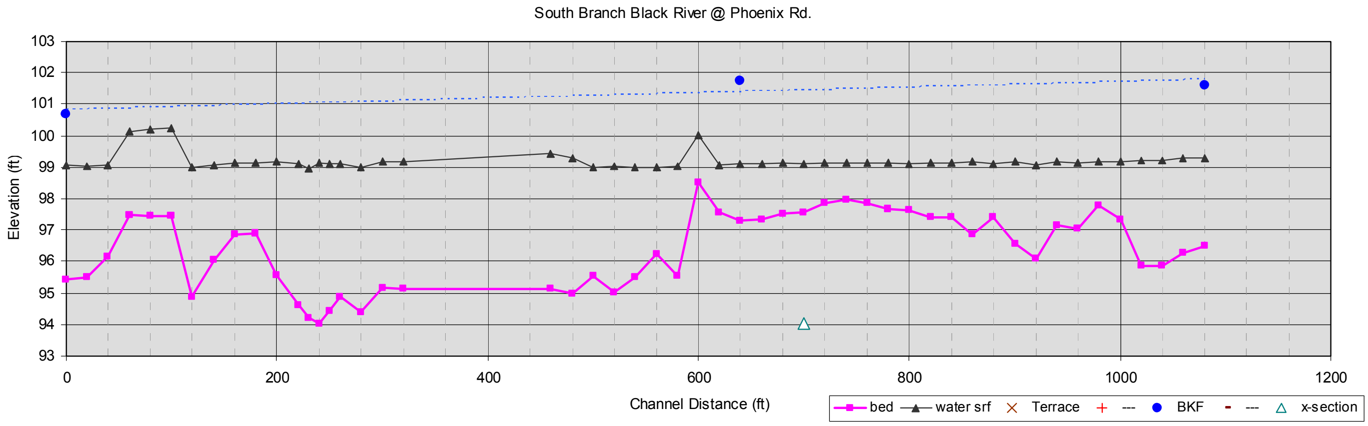
The Middle Branch reach at 68th Street was confined as it flowed through a valley with surface geology consisting of lacustrine sand. This stream reach was classified as a type F5 (Table 1). The F5 stream type is sand dominated, entrenched, meandering channel, resulting in the abandonment of former floodplains. Sediment supply in this stream type is generally moderate to high. Therefore, the ecology of this stream reach depends on downstream floodplains to dissipate stream power and deposit its suspended sediment load. Width to depth ratios in this stream reach were moderate (11.2) with moderate sinuosity measured at 1.32. Shear stress calculations for this reach were 0.57 lbs./ft^2. Stream bank erosion rates can be moderate to high in this reach as side slope rejuvenation and mass-wasting processes attempt to enhance the fluvial entrainment of eroded bank materials. At the measured channel slope and average bankfull depth, the particle diameter mobilized at bankfull discharges was calculated at 19 mm. This particle size can be easily transported with only minor changes to the hydrology in the watershed.

The South Branch reach at Phoenix Road flows through a valley with lacustrine sand deposits. This stream reach was classified as an F6 stream type (Table 1). Upstream of the measured channel reach the streambed sediment consists of cohesive sand deposits. However, the measured stream reach consisted of unconsolidated silts and sands, likely a result of anthropogenic disturbance. The F6 stream type is associated with depositional soils involving a combination of river downcutting and/or uplift of the valley walls (Rosgen 1996). F6 stream systems produce relatively low bedload, but high suspended load, sediment yields because of the lack of coarse material in the channels. Shear stress calculations at this reach were 1.17 lbs./ft^2, indicating a high erodibility force. At the measured channel slope and average bankfull depth, the particle diameter mobilized at bankfull discharges was calculated at 12 mm. This stream reach illustrates the impacts that poor land use practices have on stream profile and dimension. The stream crossing at Phoenix Road has a steel sheet-piling wall that directs the stream flow under the structure. The longitudinal profile illustrates an example of unstable streambed conditions typically called a dune and anti-dune effect (Figure 1). This condition results in excessive stream sediment transport as the streambed attempts to recover after disturbance. These stream types are very sensitive to disturbance and adjust rapidly to changes in flow regime and sediment supply from the watershed. Future data collection at this site will allow for the determination of impacts to stream habitat and changes in stream profile after disturbance.

Table 1. River delineation data collected at six stream reaches in the Black River watershed.

Waterbody	location	Entrenchment Ratio	Width/depth Ratio	Sinuosity	Slope Ft./ft.	Channel Material	Stream Type	Shear Stress Lbs./ft.sq.
North Branch	68 St.	19.7	10.7	1.1	0.002	Glendora Loamy Sand	E5	0.77
Middle Branch	60St.	>2.2	13.39	1.57	0.002	Glendora Loamy Sand	C5	0.47
South Branch	Hamilton St.	>2.2	14.83	1.2	0.002	Glendora Sandy Loam	C5	0.45
Haven/Max Lake Drain	42 St.	>2.2	8.41	1.47	0.003	Algansee-Cohoctah	E5	0.54
South Branch	Phoenix Rd.	<1.4	6.2	1.13	0.0004	Algansee-Cohoctah	F6	1.17
Middle Branch	68 St.	<1.4	11.2	1.32	0.0013	Glendora Loamy Sand	F5	0.57

Figure 1. Longitudinal profile of the South Branch Black River at Phoenix Road.



Appendix K: National Pollutant Discharge Elimination System (NPDES) Permits

Name	City	County	Expiration Date	Permit Type
Organic/LaGrange Inc	Fennville	Allegan	10/1/2008	NPDES
Fennville WWSL	Fennville	Allegan	4/1/2009	NPDES
MDEQ-RRD-Pullman	Pullman	Allegan	10/1/2003	NPDES
Inverness Castings-Bangor	Bangor	Van Buren	10/1/2008	NPDES
Bangor Electronics-Bangor	Bangor	Van Buren	4/1/2008	NPDES
Bangor WWSL	Bangor	Van Buren	4/1/2009	NPDES
Pullman Ind Inc-Bloomingdale	Bloomingdale	Van Buren	4/1/2008	NPDES
CECO-Palisades Power Plant	Covert	Van Buren	10/1/2003	NPDES
Covert Gen Co/South Haven WTP	Covert	Van Buren	10/1/2003	NPDES
Covert Public Schools WWSL	Covert	Van Buren	4/1/2009	NPDES
Country Holiday Estates MHP	Paw Paw	Van Buren	4/1/2009	NPDES
South Haven WWTP	South Haven	Van Buren	10/1/2003	NPDES
Trelleborg YSH Inc-S Haven	South Haven	Van Buren	10/1/2008	NPDES
MDEQ-RRD-Jericho	South Haven	Van Buren	10/1/2008	NPDES
Application Engineering Inc	South Haven	Van Buren	4/1/2008	NPDES
Mich Aluminum Alloys LTD	South Haven	Van Buren	4/1/2008	NPDES
Port of Call West MHC	South Haven	Van Buren	4/1/2009	NPDES
Bangor Electronics-Bangor	Bangor	Van Buren	4/1/2009	NPDES Stormwater
Michigan Slip-Bangor	Bangor	Van Buren	4/1/2009	NPDES Stormwater
Bangor Plastics-Bangor	Bangor	Van Buren	4/1/2009	NPDES Stormwater
Covert Generating Company	Covert	Van Buren	4/1/2009	NPDES Stormwater
All Seasons Marine-South Haven	South Haven	Van Buren	4/1/2007	NPDES Stormwater
B & K Machine Prod-South Haven	South Haven	Van Buren	4/1/2009	NPDES Stormwater
Consumers Concrete-224-S Haven	South Haven	Van Buren	4/1/2009	NPDES Stormwater
Consumers Concrete-7-S Haven	South Haven	Van Buren	4/1/2009	NPDES Stormwater
Clarion Tech Inc-South Haven	South Haven	Van Buren	4/1/2004	NPDES Stormwater
Epworth Mfg Co Inc	South Haven	Van Buren	4/1/2004	NPDES Stormwater
M-140 Auto Parts-South Haven	South Haven	Van Buren	4/1/2009	NPDES Stormwater
Pullman Ind Inc-South Haven	South Haven	Van Buren	4/1/2009	NPDES Stormwater
South Haven Regional Airport	South Haven	Van Buren	4/1/2009	NPDES Stormwater
Howard Motors-S Haven	South Haven	Van Buren	4/1/2009	NPDES Stormwater
Mich Aluminum Alloys LTD	South Haven	Van Buren	4/1/2009	NPDES Stormwater
DSM Pharma Chem-South Haven	South Haven	Van Buren	4/1/2009	NPDES Stormwater

Source: MDEQ 2004

Appendix L: Information & Education Product Plan

Review Process
Step 1: Draft created by Watershed Coordinator or I & E committee
Step 2: Draft reviewed by I & E committee
Step 3: Revisions made as per I & E committee
Step 4 (if necessary): Final review by I & E committee
Step 5: Department of Environmental Quality review

Products

1. Letters
    a. Targets townships, municipalities, groups (lake associations, realtors, farmers, homebuilders, developers, etc.
    b. Solicits buy-in/creates a sense of ownership
2. Brochures
    a. Targets all residents of the watershed
    b. Creates awareness of and interest in the project
    c. Educates residents about the watershed
3. Fact Sheets
    a. Targets specific groups (townships, lake associations, etc.)
    b. Gives specific information on what those groups can do to protect water quality (educates)
    c. Targets/responds to identified concerns in the watershed
    d. Ideas include landscaping for water quality, properly maintaining septic systems, recognizing and dealing with invasive species, soil testing/lawncare, agriculture, critical pollutants, etc.
4. Informational packets
    a. Targets new watershed residents
    b. Gives information about the watershed, includes information about maintenance of septic systems, riparian buffers, stormwater management, etc.
5. Informational packets
    a. Targets realtors, builders, developers, etc.
    b. Gives basic watershed information
    c. Raises watershed awareness
    d. Gives information on how they can protect the water quality of the river

Other I & E Ideas

1. Create a Black River Watershed trivia quiz (to post online and pass out at events)
2. Create “choose-your-own-watershed-adventure” interactive computer game (on PowerPoint) to take to events
3. Hold an “eco-challenge”: scavenger hunt for plants and animals in the watershed
4. Hold a watershed color tour
5. Hold photo contests
6. Adopt-a-watershed: have student groups adopt different portions of the watershed
7. Update and maintain watershed website
8. Have mugs, t-shirts, totes, etc. imprinted with watershed logo
9. Hold “Watershed Clean-up” days
10. Participate in local festivals (Fish Fest, Blueberry Fest, Apple Fest, Earth Day festivities, etc.)
11. Hold a “Carp Rodeo” –fishing day for carp to reduce their population
12. Storm-drain labeling: affix decals to storm drains with “Don’t Dump—Drains to River” message
13. Hold activities that are specific to each branch of the river
14. Student Stream Monitoring (esp. macroinvertebrates)
15. Compile information on the history of the watershed
16. Educational programs for schools
17. Watershed video for distribution to schools