MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
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STAFF REPORT

BIOSURVEY OF THE WHITE RIVER WATERSHED OCEANA, MUSKEGON, AND NEWAYGO COUNTIES JUNE AND JULY 2012

Summary

Staff of the Michigan Department of Environmental Quality (MDEQ), Water Resources Division, surveyed the aquatic macroinvertebrate and habitat conditions of 17 sites during June and July 2012 (Figures 1a and 1b). Fourteen of the sites were randomly selected locations to support Michigan's status and trend programs, while the remaining site locations were targeted based on the results of past surveys. The macroinvertebrates and physical habitat were qualitatively assessed using the Surface Water Assessment Section Procedure 51 (MDEQ, 1990). Site locations and results are summarized in Table 1, and shown in detail in Tables 2a and 2b (macroinvertebrates) and 3 (habitat). Overall, the macroinvertebrate communities in the White River were acceptable or excellent, ranging in score from -1 (acceptable) to +8 (excellent) on a scale of -9 to +9. In addition to biological surveys, analyses of 2006-era land cover, human population, and river reach gradient were completed.

Background Information

History and Geography

The study area for this survey included 15, 12-digit Hydrologic Unit Codes (HUC), including all of the White River (Figures 1a and 1b). The human population in 2010 was about 34,300 people, living in an estimated 13,000 housing units (U.S. Census Bureau, 2010a and 2010b). Major urban centers include Whitehall and Montague (near White Lake) and several small towns including New Era, Rothbury, and Hesperia. For the most part, urbanization is concentrated along the Lake Michigan and White Lake shorelines. White Lake is a 2,570-acre coastal drowned river mouth lake and is a federally designated Area of Concern. Priorities of the Area of Concern include contaminated sediment remediation, eutrophication control, wildlife habitat restoration, and former industrial site contamination removal. Facilities that once contaminated the area include Oxy Chem / Hooker Chemical, Koch Chemical, DuPont, a historic tannery site (with contamination dating back to 1866), and Occidental. Dredging to remove the contaminated sediment has been completed.

Water velocity, stream morphology, and flow are influenced by the gradient, or slope, of the stream. Flow conditions of the river at survey sites are a key factor in determining aquatic macroinvertebrate and fish community composition. The gradient, described as meters of elevation change over 1 kilometer of stream length, was calculated within each National Hydrography Dataset reach that contained a survey site (Table 4), using U.S. Geological Survey Digital Elevation Models. Slope of sampled reaches ranged from nearly zero (0.07 meters/kilometer [m/km]) in the South Branch White River, to a maximum of 4.13 m/km in Bear Creek. From its headwaters in the extensive Oxford swamp in north central Newaygo

County to its mouth at Lake Michigan, the river drops about 121 m and has an average slope of 1.1 m/km (6 feet per mile).

The White River was used as a "log float" beginning in the mid-1800s when a man named Heald (namesake of Heald Creek) first floated logs downstream to White Lake, where the first water-powered sawmill was built in 1838 (*link broken, removed*). The last major log drive in the area was in 1903 and the land was left denuded of hemlock and white pine, as well as any large diameter hardwoods (*link broken, removed*). Both the act of logging and ensuing wildfires were responsible for excessive erosion of the sandy soils into the river.

Modifications were made to the White River's structure in order to float harvested logs downstream. These modifications included the regulation of flow by dams, straightening and narrowing of channels by various piers and wing dams, and homogenization of bed substrate by removal of obstructions (Nilsson et al., 2005). Flow of the White River is impeded by a dam in Hesperia, Michigan. The presence of a dam in this location is believed to date back to 1860, supplying electrical power beginning in 1911 (*link broken, removed*). The current dam no longer generates electricity and was built in 1977. The impoundment from the dam has a significant warming effect on the river water and impedes fish passage. The impoundment is considered an asset to the community due to the fact that its excellent warmwater fishery attracts tourism. Another dam is located in White Cloud, and was built in 1872, creating a 50-acre lake.

The White River is the southernmost major coldwater river system in the lower peninsula and roughly 80 percent of the total stream mileage carries a coldwater designation. Coldwater streams have water temperatures appropriate to supporting breeding populations of coldwater-adapted fish, such as trout, and are afforded special protections under Michigan's dissolved oxygen and temperature Water Quality Standards (WQS). Twenty inland lakes, as well as several impoundments, drain to the White River, which has a warming effect on the temperature of the water downstream. Sea lamprey (an exotic, invasive species of fish that parasitizes native fish) is common in the White River system, as the larval phase burrows into the soft sediments that are so common here. The U.S. Fish and Wildlife Service routinely perform lampricide treatments where sea lamprey larva are detected in surveys, mainly in the main stem White River, the North Branch White River, and the lower portions of tributaries downstream of Hesperia, Michigan.

Portions of the White River (about 70 miles of the main stem and 93 miles of tributaries) are designated as a "Natural River" by the State of Michigan. The Michigan Department of Natural Resources has developed a Natural River Plan for the White River (https://www.michigan.gov/-/media/Project/Websites/dnr/Documents/Fisheries/NaturalRivers/White_River_Plan.pdf). The purpose of the natural river designation is to protect the natural flow regime, aesthetics, biological communities, and recreational opportunities afforded by the White River, while protecting residents from flood damage that may occur as a result of the free-flowing nature of the river. Around 23 percent of the watershed is within the Manistee National Forest.

The study area is located in the Southern Lake Michigan Lake Plain, Manistee, and Newaygo Outwash subsections of the Regional Landscape Ecosystem (Albert, 1995). The Manistee and Southern Lake Michigan Lake Plain subsections have a climate that is moderated by Lake Michigan, resulting in a long growing season and protection from late spring frosts, making the area ideal for commercial fruit production. There is no exposed bedrock in the study area. The topography is diverse, including sand dunes, sand lake plains, moraines, and outwash.

The dominant soil texture in the study area is excessively drained sandy soils. Some areas were too sandy to support agriculture and are now abandoned to field succession. The steep eroding banks of the White River are an artifact of the river's natural deep-trenching into the sandy substrate, although in some areas this was exacerbated by historic logging activities. The Newaygo Outwash Plain was dominated by large white pine trees in the presettlement era, which were excessively logged and moved downstream via the White River. Following the deforestation, white pine regeneration was poor and uplands are currently dominated by white oak and black oak. White pines are present in the understory, but are subject to severe browsing by white-tailed deer. Closer to Lake Michigan, in the Manistee and Southern Lake Michigan Lake Plain, hemlock and aspen are more common.

Land Cover

Land cover, or the types of vegetation or anthropogenic uses covering the land, has a bearing on stream hydrology, sediment transport (erosion), and water temperature. For example, agricultural land covers generally lose more topsoil by sheet and gully erosion than a forested land would, while developed land with its impervious surfaces would generally increase runoff and decrease infiltration during precipitation or snow melt events. The 2006-era land cover for the study area is approximately 4 percent developed land, 16 percent cultivated, 4 percent pasture/hay, 62 percent upland forest/grassland, and 13 percent wetland, with less than 1 percent water and bare land (Figure 2 and Table 5) (NOAA, 2008). From land cover data, a swath of agricultural activity occurs in Brayton Drain (43 percent cultivated land cover) and western portions of Black (Delong) Creek. Recognizing that the riparian zone has the greatest impact on aquatic ecosystems, 2006-era land cover was also analyzed within a 100 m buffer of each stream, within each subwatershed. This revealed drastic differences in riparian zone condition among the subwatersheds in the study area (Table 6). More than half (51 percent) of the 100 m riparian zone was occupied by cultivated farmland in the Pierson Drain subwatershed, while the Sand Creek-White River subwatershed had no cultivated land within 100 m of the stream. The remainder of the subwatersheds had between 5 and 27 percent cultivated land in the riparian zone. The Pierson Drain subwatershed also had very little wetland in the riparian zone (5 percent of the buffer area), while the rest of the subwatersheds ranged between 23 and 54 percent. The amount of natural upland land cover (forest and grasslands) ranged from between 20 and 47 percent of the riparian zones in the subwatersheds, with the least in Pierson Drain, and the most in Martin Creek – South Branch White River. Combining the natural condition cover types (wetland and upland) found in the riparian zone, Sand Creek was the most natural (93 percent natural riparian zone) while Pierson Drain had the least natural cover (25 percent) in its riparian zone.

Land cover changes over time are difficult to examine due to changes in land cover categories and varying methods of estimation by dataset authors between land cover datasets. One dataset exists (the National Land Cover Dataset Change Product) that has been manipulated to account for these changes in methodology, and it compares land cover in 1992 to land cover in 2001 (U.S. Geological Survey, 2003). According to this dataset, between 1992 and 2001, about 7,000 acres of agricultural land shifted use into forest (5,400 acres), urban (99 acres), and wetlands (1,200 acres). Much of this loss of agricultural land (fields being left fallow) occurred in the Black Creek and Martin Creek subwatersheds. Elsewhere in the watershed, about 1,200 acres of natural upland cover type (forest/grassland) was converted to agriculture, but the result is a net loss of agricultural land for the entire watershed. Urban land cover types gained about 1,400 acres, mainly converted from grassland and forested lands. These changes in land cover are relatively small in comparison with the overall scale of the watershed (344,000 acres), and it is estimated that only 4 percent of the watershed changed land cover type between 1992

and 2001. Since 2001, there was a boom in new housing construction, so developed land cover may have increased during that time at the expense of agricultural and natural land cover types, especially near the cities of Montague and Whitehall.

Methods

Sites for this water quality survey were selected via two methods: targeted sampling to address specific areas of interest; and probabilistic sampling, using stratified, random site selection to address statewide and regional questions about water quality. The probabilistic approach was used to select 14 sites in the White River watershed. Random sample selection was stratified based on stream temperature and flow characteristics, placing streams in two temperature categories (cold and warm) and further classifying them into four size categories (small, medium, large, and very large). In addition to probabilistic monitoring, three sites were selected for targeted monitoring to fulfill specific monitoring requests, and fill gaps in historic surveys.

Procedure 51 describes the methodology for macroinvertebrate and habitat surveys of wadeable streams, and was used to evaluate Sites 1-17. Procedure 51 rates macroinvertebrate communities as poor (-9 to -5), acceptable (-4 to +4), and excellent (+5 to +9) based on the proportions of each taxa found, and the sensitivity of the community assemblage to water quality concerns. Habitat was rated on a scale of poor (<56), marginal (56-104), good (105-154), or excellent (>154), based on in-stream and riparian characteristics and impairments.

Geographic Information Systems was used to analyze land cover, stream slope, and human population patterns at the subwatershed level (12-digit HUCs).

Results

Based on the probabilistic monitoring aspect of this watershed survey, 100 percent of the randomly selected sites supported the other indigenous aquatic life and wildlife designated use component of R 323.1100(1)(e) of the Michigan WQS using Procedure 51 (acceptable or excellent macroinvertebrate score). Percent attainment was calculated by dividing the number of random sites that met WQS by the total number of random locations (14 / 14 = 1.00). Using a 95 percent confidence interval, the lower limit is 81 percent of the watershed attaining. Macroinvertebrate community scores varied from a low of -1 (acceptable) at three sites, to a high of +8 (excellent) at one site (Tables 2a and 2b). Habitat scores ranged from marginal (at two sites) to excellent (at two sites) (Table 3). The majority of sites were rated good for habitat, while the majority of sites scored acceptable for macroinvertebrate community. None of the sites scored poor for either habitat or macroinvertebrate community.

Summary of Results by Subwatershed

Martin Creek – HUC 040601010705

The Martin Creek – South Branch White River subwatershed is very sparsely populated, with only about 1,115 people living in about 421 housing units in rural areas. The resulting density of humans is about 4 people per 100 acres. Sixty-six percent of the land is upland natural vegetation (forest and grassland), and 18 percent is wetland, with only 14 percent in agriculture and 1 percent developed. The macroinvertebrate community was surveyed at Warner Avenue (Site 1T), and rated excellent (+7). Roots and downed branches were the primary in-stream habitat for macroinvertebrates in this very sandy stream. At this site, the creek is buffered on both sides by scrub-shrub alder wetland. Site 1T is a trend site, which will be monitored every

five years. When last monitored in June 2007, this site scored acceptable (+2), while Martin Creek at 3-Mile Road, only about 1 mile downstream, scored excellent (+7) (Rippke, 2008).

The South Branch White River was sampled at Fitzgerald Avenue (Site 14), where the river was about 40-feet wide, substrate was nearly 100 percent sand, little aquatic vegetation was present, and the water temperature measured 71 degrees F. At Site 14, the macroinvertebrate community scored acceptable (+1), with about half of the individual macroinvertebrates being amphipoda (scuds).

South Branch of the White River (Cushman Creek) – HUC 040601010707

Land cover in this subwatershed is more agricultural than many of the others within the South Branch, with 26 percent in agricultural land cover. This subwatershed is sparsely populated, with only about 1,470 people living in about 484 housing units in rural areas. The resulting density of humans is about 5 people per 100 acres. Cushman Creek was sampled at Dickinson Road (Site 16), where it was 8-feet wide and very shallow. About 90 percent of the stream area was covered by watercress and duck weed, and the stream had visually obvious flow through these plants (Figure 3). No cobble or gravel was present, and the substrate was all sand and silt, leaving the aquatic plants as the main habitat for marcroinvertebrates. The macroinvertebrate community scored -1 (acceptable), but was dominated by amphipoda (236 of 359 individuals).

The South Branch White River was sampled at the Fisherman's Trail area (Site 13), where the river was 40-feet wide and the water was a remarkably warm 80 degrees F. This area is classified as a coldwater stream, despite the warm water at the time of our visit, which likely occurs due to upstream impoundment at Hesperia. Cobble and boulders were present for in-stream habitat. Macroinvertebrate community scored +8 (excellent). This was the highest macroinvertebrate community score found in this study, partly due to the large number of Ephemeroptera (mayflies), and Trichoptera (caddis flies). The most dominant taxa were Helicopsychidae (snail case caddis flies) and Hydropsychidae (net spinning caddis flies).

Osborn Creek – North Branch White River – HUC 040601010803-02

Land cover in this subwatershed is 28 percent agricultural land cover. This subwatershed is sparsely populated, with only about 915 people living in about 327 housing units in rural areas. The resulting density of humans is about 6 people per 100 acres. A macroinvertebrate survey was conducted on Osborn Creek at Yonker Road (Site 11), and resulted in a -1 score (acceptable). This was the lowest score found during this study. Stream gradient in this sampled reach was high, 3.6 m/km, but this site is located on a second order stream, fairly near the headwaters, and as a result the flow was low despite the gradient. The channel had been modified and straightened, was wide and shallow, and pools were lacking. The macroinvertebrate scoring revealed an overall lack of diversity and numbers of mayflies, stone flies, and caddis flies, and dominance of amphipoda (179 of the 292 individuals).

Sand Creek – White River - HUC – 040601010901

This subbasin has more upland natural land cover than any other in this study area (82 percent), and only minimal areas used for agriculture (3 percent) and development (1 percent). Sand Creek was not sampled in this study. The White River was sampled at a campground and canoe launch off the end of Kops and Skeels Roads (Site 10). The river in this

location was 45-feet wide, nearly all sandy substrate, and the water temperature measured 68 degrees F. Macroinvertebrate community scored +1 (acceptable).

North Branch White River - HUC – 040601010801

The North Branch White River was surveyed at 196th Street (Site 17), and resulted in a macroinvertebrate community score of +1 (acceptable). The river in this location had been straightened in the past, and was lacking in sinuosity and pools. It was 10-feet wide and shallow, with an estimated velocity of about 0.25 feet per second, which reflects the low gradient of this reach (1 m of elevation change over 1 km in length). The macroinvertebrate scoring reveals that this stream was overall lacking diversity and number of mayflies, stone flies, and caddis flies, and was dominated by amphipoda, which composed 100 of the 249 individuals in the sample.

Figure 3. Cushman Creek at Dickinson Road (Site 16) was almost entirely covered with watercress.

Carlton Creek – HUC 040601010902

Carlton Creek has a higher density of human population than Martin Creek, with about 14 people per 100 acres, for an estimated population of 2,550 people. The villages of Rothbury and New Era are located in the headwaters portion of the Carlton Creek watershed, and have populations of 432 and 451 people, respectively, and probably account for some of the increased population density. Twenty-two percent of the watershed is agricultural, with about 5 percent developed. A large portion of the watershed is wetland (11 percent) and upland natural (60 percent). The macroinvertebrate community in Carlton Creek at Skeels Road (Site 2T) scored high acceptable (+4). Despite finding three stone fly families, the large number of amphipods in the sample (about a third of the individuals) lowered the overall score. The habitat at Site 2T rated good, but was characterized by a lack of pools and riffles. The creek was an average of 35-feet wide. During the 2007 survey of this site, flood plain and bank erosion was noted due to excavation activities in the sandy bank. The eroded area seems to be recovering and was mainly vegetated, although silt curtains were left in place (not present in 2007).

Bear Creek – HUC 040601010804

Bear Creek is a tributary to the North Branch White River. The North Branch White River has a low density of human population at 5 people per 100 acres, for a total of 1,406 people living in about 530 housing units. Sixty-three percent of the land cover is natural upland, and 17 percent is wetland. Eighteen percent of the watershed is agricultural and only 2 percent is developed land. Bear Creek was surveyed where Cleveland Road (144th Avenue) would cross the river; however, there is no road there (Site 3). At Site 3 the stream was 15 feet in average width, meandering naturally and there were several small gravel riffles. The macroinvertebrate community scored excellent (+5). Habitat rated good, but the water level and bank scouring indicated that flow flashiness was an issue. This reach of the creek was the highest gradient stream slope sampled during our survey, with 4.1 meters elevation change per km in length (Table 4), which may account for the evidence of bank scour.

Black (Delong) Creek and the South Branch White River – HUC 040601010704

Black Creek is sparsely populated, with only about 3,725 people living in about 1,388 housing units in rural areas. The resulting density of humans (about 9 people per 100 acres) is higher than Martin and Bear Creek, but not as high as Carlton Creek. Twenty-one percent of the watershed is agricultural, with about 3 percent developed. Like Martin, Bear and Carlton Creeks, a large portion of the watershed, is wetland (16 percent) and upland natural (59 percent). Black Creek was surveyed in two locations: downstream of Warner Road (Site 4) and upstream of M-20 (Site 8). The most upstream location sampled was Site 4, where the stream averaged only 6-feet wide. At this site the surrounding land cover was agricultural, and vegetated buffers with trees were present, but narrow. In the 100-meter riparian zone of the Black subwatershed, land cover is 18 percent agricultural (pasture and cultivated land combined), but also has a lot of wetland (44 percent of zone). A debris dam made of natural materials had caused the formation of a wide and slow stretch in the creek, upstream and downstream, of which the stream was narrower and there were riffles with sparse gravel and cobble. The macroinvertebrate community scored acceptable (+2) while the habitat rated good. About two river miles downstream from Site 4, at Site 8, the creek had widened to about 18 feet on average and cobble, boulders, and gravel were more common than at Site 4. Bank stability and flow flashiness were noted as an issue at Site 8. The macroinvertebrate community scored acceptable (+3). A large number of amphipoda were found at both sites, while heptageniidae (a mayfly) were common at Site 8, but not found at the upstream Site 4. The water temperature at these two sites was the same (64 degrees) at the time of sampling.

The South Branch White River (Site 9) was sampled upstream of Evergreen Road (also known as M-37), just south of the village of White Cloud and downstream of a railroad trestle bridge. The macroinvertebrate community scored high acceptable (+3) and habitat scored good. Because of the location of this site, between M-37 and a railroad bridge, there was little diversity of flow and depth regime (no slow backwaters or deep pools).

Mullen Creek and South Branch White River – HUC 040601010701

The Mullen Creek and South Branch White River subwatershed is the most sparsely populated of all the subwatersheds in the study area, with only about 964 people living in about 381 housing units in rural areas (about 3 people per 100 acres). Nine percent of the watershed is agricultural, with about 1 percent developed. More than two-thirds of the subwatershed is upland natural (69 percent), and one-fifth is wetland. Mullen Creek at Site 6 (Van Buren Street) was 20-feet wide and 62 degrees F at the time of sampling, and the riparian zone is alder and dogwood dominated wetland. In the stream there was very little aquatic vegetation

(<5 percent). Aquatic macroinvertebrate surveys resulted in an acceptable score of +3, with many taxa found at a low frequency, and about two-thirds of the sample (300 individuals) were amphipoda or chironomidae (midges).

The South Branch White River at Site 15 was 35-feet wide and warmer than Mullen Creek, at 67 degrees F. The survey was conducted both upstream and downstream of 6-mile Road. Aquatic vegetation covered about 80 percent of the substrate at Site 15, including attached algae on most submerged rootwads and large woody debris. The presence of the attached algae likely inhibited aquatic macroinvertebrates from colonizing these in-stream habitat types. The macroinvertebrate score was -1, which was within the acceptable range but also the lowest score found during this study. The macroinvertebrate community here was dominated by corixidae (103 out of 283 individuals). The area surveyed for Site 15 appears to have been modified by dredging and was wide and slow upstream of the road crossing (Figure 4). This river reach had the lowest gradient of all reaches surveyed in this study, with a slope of essentially zero (Table 4), which may help to account for the nutrient expression issues noted in the area. This site was also sampled during a previous survey in 2007, and scored low acceptable (-4) at that time (Rippke, 2008).

Figure 4. Aerial image of the widened area upstream of the South Branch White River at 6-Mile Road (Site 15).

Flinton Creek and South Branch White River – HUC 040601010703

The Flinton Creek and South Branch White River subwatershed has nearly identical land cover characteristics to the Mullen Creek subwatershed; mainly composed of upland natural land cover and wetland. Human population is more dense here, with 3 times as many people per acre (9 people per 100 acres), and 4 times as many housing units per acre, than the Mullen Creek subwatershed. Flinton Creek was sampled at M-20 (Site 7) and the South Branch White River was sampled at Monroe Street (Site 5). Neither site had significant amounts of aquatic vegetation (<1 percent). The South Branch White River had an acceptable macroinvertebrate score of +3, dominated by chironomidae, while Flinton Creek had an

acceptable macroinvertebrate score of +4, dominated by amphipoda. Flinton Creek had an excellent habitat score (Table 3), and from a broader perspective, 86 percent of the 100-meter buffer area in this subwatershed was natural upland and wetland land cover (Table 6).

Fivemile Creek – HUC 040601010702

Fivemile Creek subwatershed is about 20 percent agricultural land use, with 67 percent of the land as upland natural cover type, and 12 percent wetland. Fivemile Creek was sampled at Monroe Street and scored +3 (acceptable). In the area of sampling, the riparian area was a mixed coniferous swamp. The macroinvertebrate habitat was composed of extensive undercut banks, large woody debris, moderate rootwads, and aquatic plants, as well as some cobble and gravel.

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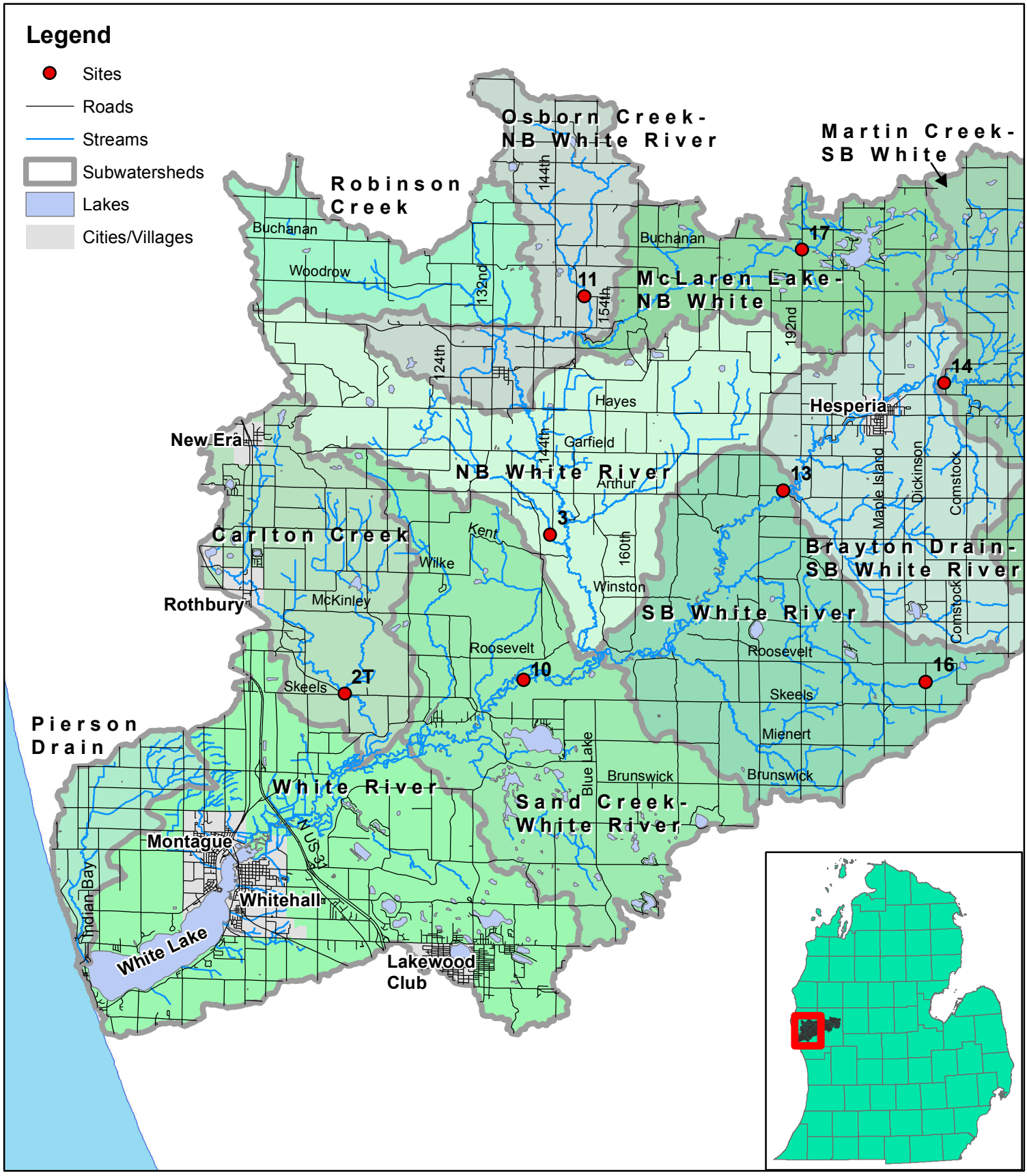

Figure 1a. Locations of biosurvey sites in the western portion of the White River watershed. Locations of major roads, cities, villages, and subwatersheds (12-digit HUCs) are also shown.

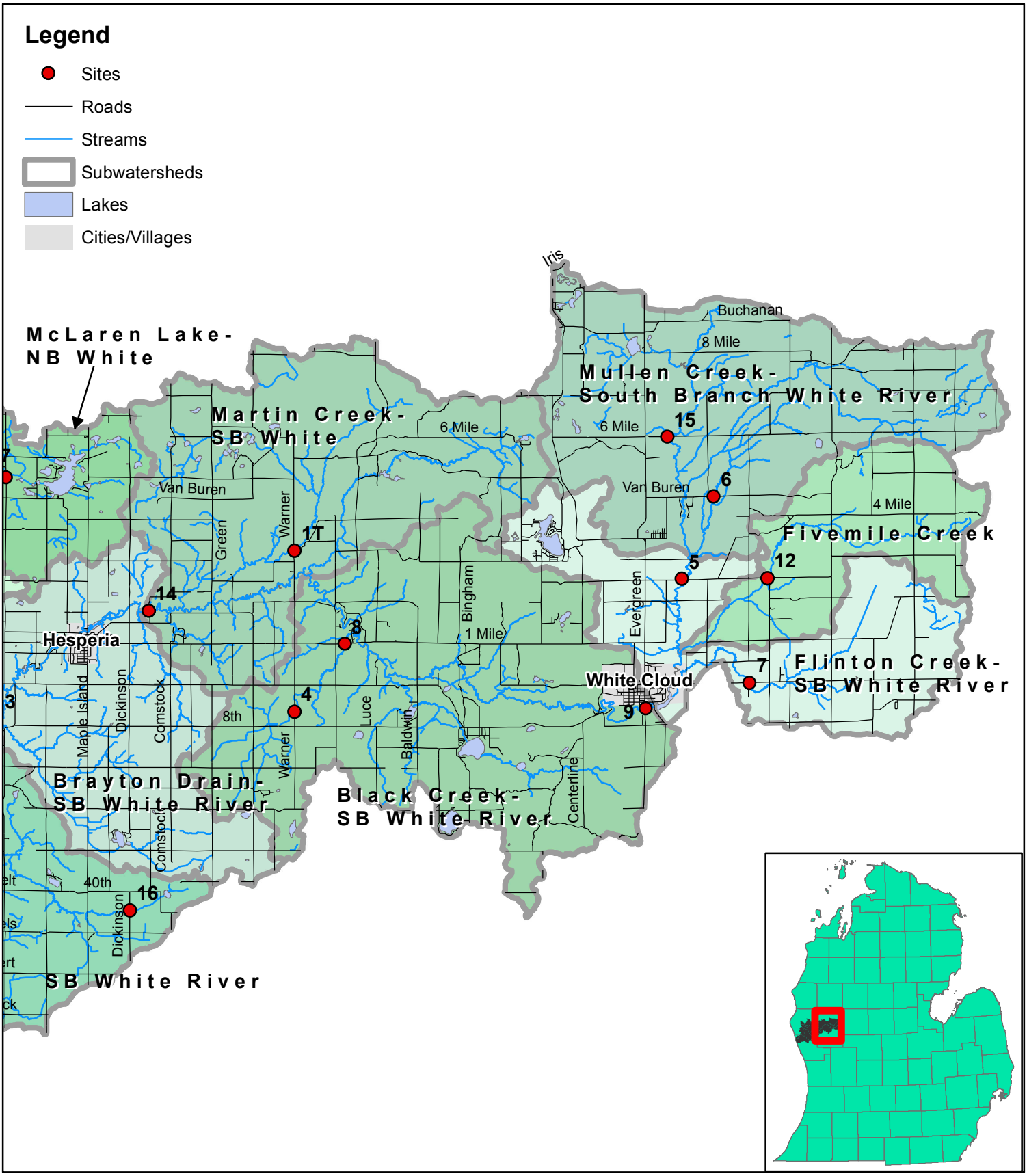

Figure 1b. Locations of biosurvey sites in the eastern portion of the White River watershed. Locations of major roads, cities, villages, and subwatersheds (12-digit HUCs) are also shown.

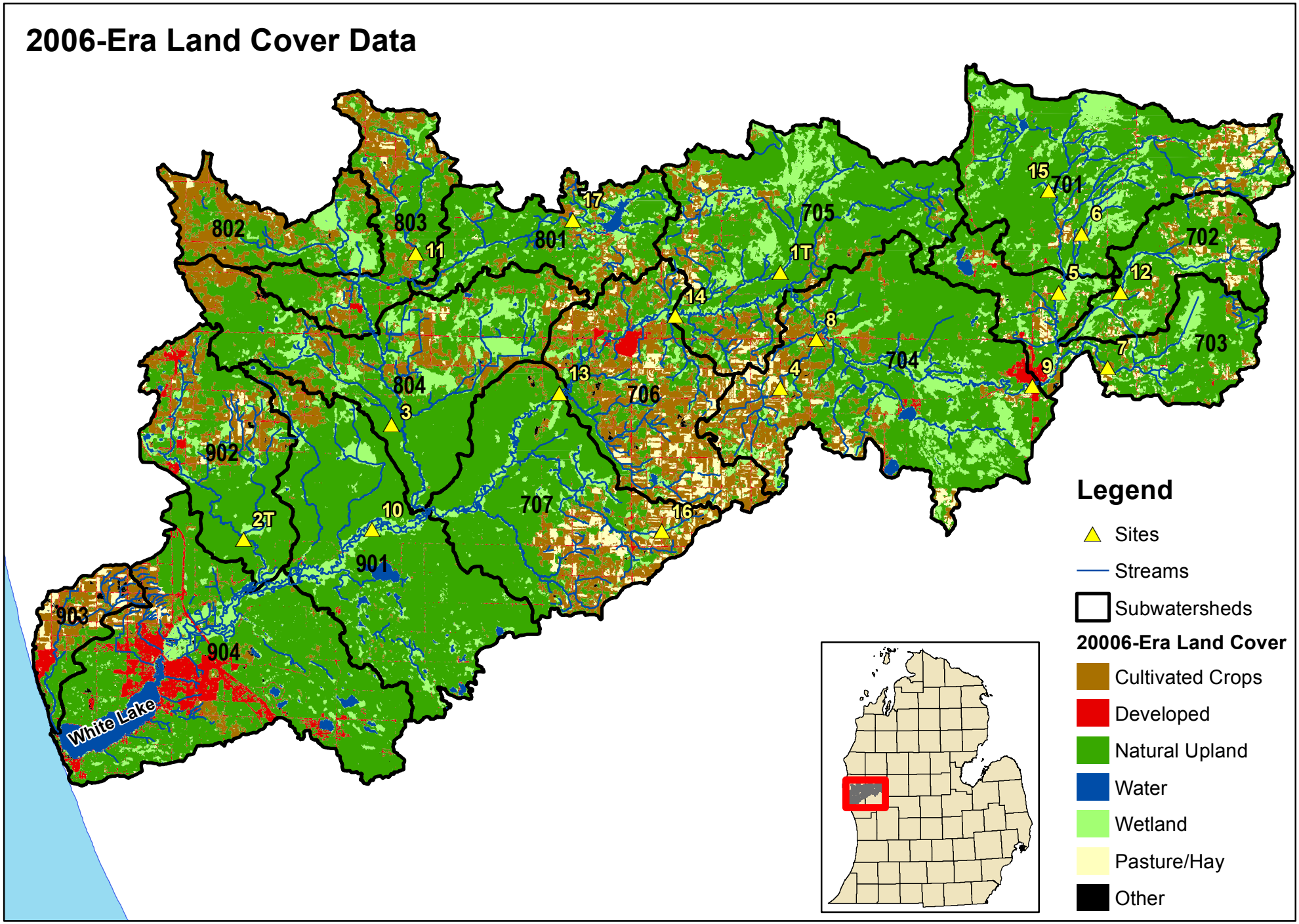

Figure 2. 2006-era land cover data, subwatersheds (labeled with the last 3 digits of the 12-digit HUC), and biosurvey site locations within the White River watershed.

Table 1. Summary of biosurvey site locations and results within the White River watershed.

Site ID	Water body	Location	Longitude	Latitude	AUID*	Macroinvertebrate Score (Rating)	Habitat Score (Rating)
1T	Martin Creek	Warner Avenue	-85.93990	43.60100	040601010705-03	+7(Excellent)	149(Good)
2T	Carlton Creek	Skeels Road (two-track)	-86.29867	43.47070	040601010902-02	+4(Acceptable)	135(Good)
3	Bear Creek	Cleveland Road (144th Ave)	-86.19990	43.52660	040601010804-01	+5(Excellent)	139(Good)
4	Black (Delong) Creek	Warner Road	-85.94005	43.54466	040601010704-02	+2(Acceptable)	113(Good)
5	South Branch White River	Monroe Street	-85.75360	43.59090	040601010703-01	+3(Acceptable)	147(Good)
6	Mullen Creek	Van Buren Street	-85.73809	43.61958	040601010701-02	+3(Acceptable)	137(Good)
7	Flinton Creek	M-20	-85.72111	43.55442	040601010703-03	+4(Acceptable)	157(Excellent)
8	Black (Delong) Creek	M-20	-85.91582	43.56834	040601010704-02	+3(Acceptable)	152(Good)
9	South Branch White River	Evergreen Road	-85.77120	43.54546	040601010704-01	+3(Acceptable)	144(Good)
10	White River	campground at end of Kops/Skeels	-86.21266	43.47571	040601010901-04	+1(Acceptable)	146(Good)
11	Osborn Creek	Yonker Road	-86.18389	43.61000	040601010803-02	-1(Acceptable)	126(Good)
12	5 Mile Creek	Monroe Street	-85.71240	43.59102	040601010702-01	+3(Acceptable)	153(Good)
13	South Branch White River	White River Trail (end)	-86.08780	43.54220	040601010707-03	+8(Excellent)	159(Excellent)
14	South Branch White River	Fitzgerald Avenue	-86.01018	43.57991	040601010705-01	+1(Acceptable)	104(Marginal)
15	S B White River	6-mile Road	-85.76031	43.64050	040601010701-01	-1(Acceptable)	130(Good)
16	Cushman Creek	Dickinson Road	-86.01920	43.47520	040601010707-02	-1(Acceptable)	110(Good)
17	N B White River	194th Avenue	-86.07890	43.62650	040601010801-02	+1(Acceptable)	93(Marginal)

* 2012 Assessment Unit Identifier - used in the federal Clean Water Act Section 303(d), 305(b), and 314 Integrated Report (see www.michigan.gov/waterquality)

Table 2A. Qualitative macroinvertebrate sampling results for sites in the White River.

TAXA	Martin Creek Warner Avenue 6/27/2012 **STATION 1T**	Carlton Creek Skeels Road (2-track) 7/16/2012 **STATION 2**	Bear Creek Cleveland / 144th Avenue 7/16/2012 **STATION 3**	Black (Delong) Creek Downstream Warner 6/28/2012 **STATION 4**
PLATYHELMINTHES (flatworms)				
Turbellaria				4
ANNELIDA (segmented worms)				
Hirudinea (leeches)		1		
Oligochaeta (worms)		6	7	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	49	131	88	206
Decapoda (crayfish)	8	1	1	1
Isopoda (sowbugs)		4		
Arachnoidea				
Hydracarina			2	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	28	39	5	25
Caenidae	11			
Ephemerellidae	2		2	1
Ephemeridae	1			
Heptageniidae	12	4	3	
Tricorythidae	1			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2		3	1
Cordulegastridae		1	1	
Gomphidae	4			
Zygoptera (damselflies)				
Calopterygidae	19	6	4	1
Plecoptera (stoneflies)				
Leuctridae			1	
Perlidae	1	1		
Perlodidae		1	3	
Pteronarcyidae		1		
Hemiptera (true bugs)				
Corixidae	1			5
Gerridae	5	1	1	8
Mesoveliidae	16			
Megaloptera				
Corydalidae (dobson flies)		1	1	
Sialidae (alder flies)	3		1	2
Trichoptera (caddisflies)				
Brachycentridae	54	39	15	
Glossosomatidae		1		1
Hydropsychidae	23	34	15	2
Lepidostomatidae		1	19	
Leptoceridae		1	4	
Limnephilidae	2	1	6	3
Molannidae				1
Philopotamidae	16			6
Polycentropodidae		1		
Coleoptera (beetles)				
Dytiscidae (total)		2		
Dryopidae	1		1	
Elmidae		2	7	1
Diptera (flies)				
Athericidae	1		15	
Ceratopogonidae	2		2	
Chironomidae	24	33	48	52
Simuliidae	2	12	7	5
Tabanidae	2	1	6	1
Tipulidae			2	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)			1	
Physidae	1	3	2	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	1	1	1
TOTAL INDIVIDUALS	292	330	274	328

Table 2B. Macroinvertebrate metric evaluation of sites in the White River watershed.

	STATION 1T Martin Creek Warner Avenue 6/27/2012		STATION 2 Carlton Creek Skeels Road (2-track) 7/16/2012		STATION 3 Bear Creek Cleveland / 144th Avenue 7/16/2012		STATION 4 Black (Delong) Creek Downstream Warner 6/28/2012	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	28	1	28	1	31	1	21	1
NUMBER OF MAYFLY TAXA	6	1	2	0	3	0	2	1
NUMBER OF CADDISFLY TAXA	4	0	7	1	5	1	5	1
NUMBER OF STONEFLY TAXA	1	1	3	1	2	1	0	-1
PERCENT MAYFLY COMP.	18.84	1	13.03	0	3.65	0	7.93	0
PERCENT CADDISFLY COMP.	32.53	1	23.64	0	21.53	0	3.96	-1
PERCENT DOMINANT TAXON	18.49	1	39.70	-1	32.12	0	62.80	-1
PERCENT ISOPOD, SNAIL, LEECH	0.34	1	2.42	1	1.09	1	0.00	1
PERCENT SURF. AIR BREATHERS	7.53	0	0.91	1	0.36	1	3.96	1
TOTAL SCORE		7		4		5		2
MACROINV. COMMUNITY RATING		EXCELLENT		ACCEPT.		EXCELLENT		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for sites in the White River.

TAXA	South Branch White River Monroe Road 6/27/2012 **STATION 5**	Mullen Creek Van Buren Road 6/27/2012 **STATION 6**	Flinton Creek M20 6/27/2012 **STATION 7**	Delong (Black) Creek M-20 6/28/2012 **STATION 8**
ANNELIDA (segmented worms)				
Oligochaeta (worms)	15	12		2
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	13	94	106	169
Decapoda (crayfish)	1	1	3	2
Arachnoidea				
Hydracarina	7	5	2	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	29	18	10	8
Caenidae		5	5	
Ephemerellidae	11		2	4
Ephemeridae		1	1	
Heptageniidae	4	1	8	24
Tricorythidae	24		7	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae			1	1
Cordulegastridae			1	
Libellulidae				1
Zygoptera (damselflies)				
Calopterygidae		1	21	13
Plecoptera (stoneflies)				
Perlidae			2	1
Hemiptera (true bugs)				
Corixidae	6			
Gerridae	2	3	8	3
Mesoveliidae		2	1	1
Megaloptera				
Corydalidae (dobson flies)	1		1	1
Sialidae (alder flies)			1	
Trichoptera (caddisflies)				
Brachycentridae	2	43	16	4
Glossosomatidae	15			1
Hydropsychidae	19	10	20	22
Lepidostomatidae		3		
Leptoceridae	2		4	
Limnephilidae	4	1	3	1
Philopotamidae	1	2		15
Coleoptera (beetles)				
Dryopidae			10	
Elmidae	9			12
Diptera (flies)				
Athericidae	2			8
Ceratopogonidae		1		
Chironomidae	72	106	33	13
Simuliidae	141	2	2	
Tabanidae	2	3	3	1
Tipulidae	2			
MOLLUSCA				
Gastropoda (snails)				
Physidae	1	1		1
Pelecypoda (bivalves)				
Sphaeriidae (clams)		7		
TOTAL INDIVIDUALS	385	322	271	309

Table 2B. Macroinvertebrate metric evaluation of sites in the White River watershed.

	STATION 5 South Branch White River Monroe Road 6/27/2012		STATION 6 Mullen Creek Van Buren Road 6/27/2012		STATION 7 Flinton Creek M20 6/27/2012		STATION 8 Delong (Black) Creek M-20 6/28/2012	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	24	0	22	0	25	1	24	0
NUMBER OF MAYFLY TAXA	4	1	4	1	6	1	3	0
NUMBER OF CADDISFLY TAXA	6	1	5	1	4	0	5	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	1	1	1	1
PERCENT MAYFLY COMP.	17.66	0	7.76	0	12.18	0	11.65	0
PERCENT CADDISFLY COMP.	11.17	0	18.32	0	15.87	0	13.92	0
PERCENT DOMINANT TAXON	36.62	0	32.92	0	39.11	-1	54.69	-1
PERCENT ISOPOD, SNAIL, LEECH	0.26	1	0.31	1	0.00	1	0.32	1
PERCENT SURF. AIR BREATHERS	2.08	1	1.55	1	3.32	1	1.29	1
TOTAL SCORE		3		3		4		3
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for sites in the White River.

TAXA	South Branch White River Evergreen Road (M37) 6/29/2012 **STATION 9**	White River two-track off end of Kops/Skeels Road 6/29/2012 **STATION 10**	Osborn Creek Yonker Road 6/28/2012 **STATION 11**	5 Mile Creek Monroe Street 6/27/2012 **STATION 12**
PLATYHELMINTHES (flatworms)				
Turbellaria	8			
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1		
Oligochaeta (worms)	6		9	3
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	92	124	179	166
Decapoda (crayfish)	12	40	4	
Isopoda (sowbugs)	4		12	3
Arachnoidea				
Hydracarina	2			
Insecta				
Ephemeroptera (mayflies)				
Baetidae	17		36	15
Caenidae	2			6
Ephemerellidae	4		1	4
Ephemeridae		12		1
Heptageniidae	3	9	1	2
Isonychiidae		1		
Tricorythidae	3			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae			1	
Cordulegastridae				1
Gomphidae	1	3		
Zygoptera (damselflies)				
Calopterygidae	1	1	7	6
Plecoptera (stoneflies)				
Perlidae		6		
Hemiptera (true bugs)				
Corixidae	1	25		
Gerridae	1	1	1	
Mesoveliidae		3		
Nepidae		1		
Megaloptera				
Corydalidae (dobson flies)	1		1	1
Sialidae (alder flies)				2
Trichoptera (caddisflies)				
Brachycentridae		29	4	12
Glossosomatidae	1			
Helicopsychidae	3			
Hydropsychidae	40	7	2	2
Lepidostomatidae			2	3
Leptoceridae	3	3		2
Limnephilidae	5		2	5
Philopotamidae		1		14
Polycentropodidae				1
Coleoptera (beetles)				
Dytiscidae (total)			1	1
Gyrinidae (adults)			1	1
Dryopidae	3	2		
Elmidae	13		2	
Diptera (flies)				
Athericidae			1	
Ceratopogonidae		1	1	1
Chironomidae	8	4	6	18
Simuliidae	20		10	10
Tabanidae		1	1	1
Tipulidae	1		1	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1		1	
Physidae	7	8	3	
Planorbidae				1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	16			
Unionidae (mussels)	1		2	
TOTAL INDIVIDUALS	281	283	292	282

Table 2B. Macroinvertebrate metric evaluation of sites in the White River watershed.

	STATION 9 South Branch White River Evergreen Road (M37) 6/29/2012		STATION 10 White River campground and canoe launch off end of Kops/Skeels Road 6/29/2012		STATION 11 Osborn Creek Yonker Road 6/28/2012		STATION 12 5 Mile Creek Monroe Street 6/27/2012	
METRIC	Value	Scor	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	31	1	22	0	27	1	26	1
NUMBER OF MAYFLY TAXA	5	1	3	0	3	0	5	1
NUMBER OF CADDISFLY TAXA	5	1	4	0	4	0	7	1
NUMBER OF STONEFLY TAXA	0	-1	1	1	0	-1	0	-1
PERCENT MAYFLY COMP.	10.32	0	7.77	0	13.01	0	9.93	0
PERCENT CADDISFLY COMP.	18.51	0	14.13	0	3.42	-1	13.83	0
PERCENT DOMINANT TAXON	32.74	0	43.82	-1	61.30	-1	58.87	-1
PERCENT ISOPOD, SNAIL, LEECH	4.63	0	3.18	1	5.48	0	1.42	1
PERCENT SURF. AIR BREATHERS	0.71	1	10.60	0	1.03	1	0.71	1
TOTAL SCORE		3		1		-1		3
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for sites in the White River.

TAXA	South Branch White River White River Trail (End) 7/16/2012 **STATION 13**	South Branch White River Fitzgerald Avenue 6/28/2012 **STATION 14**	South Branch White River 6 Mile Road 6/27/2012 **STATION 15**	Cushman Creek Dickinson Road 6/28/2012 **STATION 16**
ANNELIDA (segmented worms)				
Hirudinea (leeches)			2	1
Oligochaeta (worms)	9		3	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	40	122	18	236
Decapoda (crayfish)	4	18		
Isopoda (sowbugs)		2		1
Arachnoidea				
Hydracarina			8	
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae		2		
Baetidae	19	1	36	22
Caenidae	4		5	
Ephemerellidae	3		2	
Ephemeridae	13	2	1	
Heptageniidae	13	11		
Isonychiidae	1			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		2		1
Gomphidae		2		
Zygoptera (damselflies)				
Calopterygidae		2	3	1
Coenagrionidae				1
Plecoptera (stoneflies)				
Perlidae	11	3		
Pteronarcyidae	4			
Hemiptera (true bugs)				
Corixidae		13	103	
Gerridae		3		
Mesoveliidae				1
Notonectidae		1		
Trichoptera (caddisflies)				
Brachycentridae	6	11	1	1
Hydropsychidae	76	6	1	1
Lepidostomatidae				1
Leptoceridae	1	25		
Limnephilidae	3	1		
Philopotamidae	8			
Polycentropodidae	2			
Coleoptera (beetles)				
Dytiscidae (total)			1	3
Haliplidae (adults)		1		
Hydrophilidae (total)		1		
Dryopidae	5			
Elmidae	27	3		
Psephenidae (larvae)	5			
Diptera (flies)				
Athericidae	5			
Ceratopogonidae			2	
Chironomidae	12		56	62
Simuliidae	1		40	17
Tabanidae			1	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	3	1		
Physidae		7	1	5
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1			4
Unionidae (mussels)	1			
TOTAL INDIVIDUALS	277	240	284	359

Table 2B. Macroinvertebrate metric evaluation of sites in the White River watershed.

	STATION 13		STATION 14		STATION 15		STATION 16	
	South Branch White River White River Trail (End) 7/16/2012		South Branch White River Fitzgerald Avenue 6/28/2012		South Branch White River 6 Mile Road 6/27/2012		Cushman Creek Dickinson Road 6/28/2012	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	26	1	23	0	18	0	17	0
NUMBER OF MAYFLY TAXA	6	1	4	1	4	1	1	0
NUMBER OF CADDISFLY TAXA	6	1	4	0	2	0	3	0
NUMBER OF STONEFLY TAXA	2	1	1	1	0	-1	0	-1
PERCENT MAYFLY COMP.	19.13	1	6.67	0	15.49	0	6.13	0
PERCENT CADDISFLY COMP.	34.66	1	17.92	0	0.70	-1	0.84	-1
PERCENT DOMINANT TAXON	27.44	0	50.83	-1	36.27	0	65.74	-1
PERCENT ISOPOD, SNAIL, LEECH	1.08	1	4.17	0	1.06	1	1.95	1
PERCENT SURF. AIR BREATHERS	0.00	1	7.92	0	36.62	-1	1.11	1
TOTAL SCORE		8		1		-1		-1
MACROINV. COMMUNITY RATING	EXCELLENT		ACCEPT.		ACCEPT.		ACCEPT.	

Table 2A. Qualitative macroinvertebrate sampling results for sites in the White River.

TAXA	North Branch White River 194th 6/28/2012 **STATION 17**
PLATYHELMINTHES (flatworms)	
Turbellaria	4
ARTHROPODA	
Crustacea	
Amphipoda (scuds)	104
Decapoda (crayfish)	5
Insecta	
Ephemeroptera (mayflies)	
Baetidae	4
Heptageniidae	30
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	5
Gomphidae	9
Zygoptera (damselflies)	
Coenagrionidae	1
Hemiptera (true bugs)	
Gerridae	1
Mesoveliidae	13
Trichoptera (caddisflies)	
Brachycentridae	1
Glossosomatidae	1
Hydropsychidae	13
Limnephilidae	5
Philopotamidae	3
Diptera (flies)	
Ceratopogonidae	1
Chironomidae	9
Simuliidae	7
Tabanidae	1
MOLLUSCA	
Gastropoda (snails)	
Planorbidae	1
Viviparidae	1
Pelecypoda (bivalves)	
Sphaeriidae (clams)	29
Unionidae (mussels)	1
TOTAL INDIVIDUALS	249

Table 2B. Macroinvertebrate metric evaluation of sites in the White River watershed.

METRIC	STATION 17 North Branch White River 194th 6/28/2012 Value	Score
TOTAL NUMBER OF TAXA	23	0
NUMBER OF MAYFLY TAXA	2	0
NUMBER OF CADDISFLY TAXA	5	1
NUMBER OF STONEFLY TAXA	0	-1
PERCENT MAYFLY COMP.	13.65	0
PERCENT CADDISFLY COMP.	9.24	0
PERCENT DOMINANT TAXON	41.77	-1
PERCENT ISOPOD, SNAIL, LEECH	0.80	1
PERCENT SURF. AIR BREATHERS	5.62	1
TOTAL SCORE		1
MACROINV. COMMUNITY RATING	ACCEPT.	

Table 3. Habitat evaluation for sites in the White River; June-July, 2012.

Station ID	**1T**	**2**	**3**	**4**	**5**
Waterbody	Martin Creek	Carlton Creek	Bear Creek	Black (Delong) Creek	South Branch White River
Location	Warner Avenue	Skeels Road (2-track)	Cleveland / 144th Avenue	Downstream Warner	Monroe Road
Type	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	13	10	13	13	15
Embeddedness (20)*			8	11	18
Velocity/Depth Regime (20)*			10	14	13
Pool Substrate Characterization (20)**	8	8			
Pool Variability (20)**	5	8			
Channel Morphology					
Sediment Deposition (20)	15	10	8	10	19
Flow Status - Maint. Flow Volume (10)	10	9	6	10	9
Flow Status - Flashiness (10)	10	8	6	5	8
Channel Alteration (20)	18	16	19	11	13
Frequency of Riffles/Bends (20)*			13	11	8
Channel Sinuosity (20)**	10	15			
Riparian and Bank Structure					
Bank Stability (L) (10)	10	9	9	5	8
Bank Stability (R) (10)	10	9	9	5	8
Vegetative Protection (L) (10)	10	10	10	6	7
Vegetative Protection (R) (10)	10	6	10	6	7
Riparian Veg. Zone Width (L) (10)	10	10	10	2	7
Riparian Veg. Zone Width (R) (10)	10	7	8	4	7
TOTAL SCORE (200):	149	135	139	113	147
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	6/27/2012	7/16/2012	7/16/2012	6/28/2012	6/27/2012
Weather:	Sunny	Sunny	Sunny	Sunny	Sunny
Air Temperature:	90 Deg. F.	80 Deg. F.	85 Deg. F.	75 Deg. F.	85 Deg. F.
Water Temperature:	62 Deg. F.	60 Deg. F.	64 Deg. F.	63 Deg. F.	66 Deg. F.
Ave. Stream Width:	15 Feet	35 Feet	15 Feet	6 Feet	25 Feet
Ave. Stream Depth:	1.25 Feet	0.75 Feet	1 Feet	0.3 Feet	1 Feet
Surface Velocity:	0.5 Ft./Sec.	0.5 Ft./Sec.	0.5 Ft./Sec.	1 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	9.375 CFS	13.125 CFS	7.5 CFS	1.8 CFS	25 CFS
Stream Modifications:	None	Canopy Removal	None	Canopy Removal	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	620300	610754	640324	620297	620295
Stream Name:	Martin Creek	Carlton Creek	Bear Creek	Black (Delong) Creek	South Branch White River
Road Crossing/Location:	Warner Avenue	Skeels Road (2-track)	Cleveland / 144th Avenue	Downstream Warner	Monroe Road
County Code:	62	61	64	62	62
TRS:	14N14W13	12N17W01	13N16W10	13N14W02	14N12W21
Latitude (dd):	43.601	43.47088	43.5266	43.54574	43.5909
Longitude (dd):	-85.9399	-86.29842	-86.1999	-85.93897	-85.7536
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Warmwater	Coldwater
USGS Basin Code:	4060101	4060101	4060101	4060101	4060101

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

Table 3. Habitat evaluation for sites in the White River; June-July, 2012.

Station ID	**6**	**7**	**8**	**9**	**10**
Waterbody	Mullen Creek	Flinton Creek	Delong (Black) Creek	South Branch White River	White River
Location	Van Buren Road	M20	M-20	Evergreen Road (M37)	two-track off end of Kops/Skeels Road
Type	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN	RIFFLE/RUN	GLIDE/POOL
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	8	13	15	16	11
Embeddedness (20)*			17	18	
Velocity/Depth Regime (20)*			15	8	
Pool Substrate Characterization (20)**	13	13			8
Pool Variability (20)**	5	8			13
Channel Morphology					
Sediment Deposition (20)	5	13	16	18	11
Flow Status - Maint. Flow Volume (10)	10	10	7	9	9
Flow Status - Flashiness (10)	10	8	4	9	7
Channel Alteration (20)	16	20	18	11	18
Frequency of Riffles/Bends (20)*			16	8	
Channel Sinuosity (20)**	10	16			18
Riparian and Bank Structure					
Bank Stability (L) (10)	10	9	5	10	8
Bank Stability (R) (10)	10	9	5	10	8
Vegetative Protection (L) (10)	10	9	8	8	8
Vegetative Protection (R) (10)	10	9	8	8	8
Riparian Veg. Zone Width (L) (10)	10	10	10	3	9
Riparian Veg. Zone Width (R) (10)	10	10	8	8	10
TOTAL SCORE (200):	137	157	152	144	146
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON-IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	6/27/2012	6/27/2012	6/28/2012	6/29/2012	6/29/2012
Weather:	Sunny	Sunny	Sunny	Sunny	Sunny
Air Temperature:	87 Deg. F.	75 Deg. F.	87 Deg. F.	85 Deg. F.	75 Deg. F.
Water Temperature:	62 Deg. F.	58 Deg. F.	63 Deg. F.	73 Deg. F.	68 Deg. F.
Ave. Stream Width:	20 Feet	12 Feet	18 Feet	40 Feet	45 Feet
Ave. Stream Depth:	0.5 Feet	0.7 Feet	0.75 Feet	0.7 Feet	2.5 Feet
Surface Velocity:	0.7 Ft./Sec.	0.5 Ft./Sec.	1 Ft./Sec.	1.5 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	7 CFS	4.2 CFS	13.5 CFS	42 CFS	112.5 CFS
Stream Modifications:	None	None	None	Dredged	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	620294	620325	620256	620306	640342
Stream Name:	Mullen Creek	Flinton Creek	Delong (Black) Creek	South Branch White River	White River
Road Crossing/Location:	Van Buren Road	M20	M-20	Evergreen Road	campground off end of Kops/Skeels Road
County Code:	62	62	62	62	64
TRS:	14N12W10	14N12W35	14N13W03	13N12W05	13N16W34
Latitude (dd):	43.6195	43.55442	43.56834	43.54546	43.47571
Longitude (dd):	-85.7379	-85.72111	-85.91582	-85.7712	-86.21266
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Warmwater	Coldwater	Coldwater
USGS Basin Code:	4060101	4060101	4060101	4060101	4060101

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

Table 3. Habitat evaluation for sites in the White River; June-July, 2012.

Station ID	**11**	**12**	**13**	**14**	**15**
Waterbody	Osborn Creek	5 Mile Creek	South Branch White River White River Trail	South Branch White River	South Branch White River
Location	Yonker Road	Monroe Street	(End)	Fitzgerald Avenue	6 Mile Road
Type	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN	GLIDE/POOL	GLIDE/POOL
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	13	17	18	5	5
Embeddedness (20)*	13	11	18		
Velocity/Depth Regime (20)*	8	15	16		
Pool Substrate Characterization (20)**				8	11
Pool Variability (20)**				10	3
Channel Morphology					
Sediment Deposition (20)	13	10	16	11	11
Flow Status - Maint. Flow Volume (10)	10	10	9	9	10
Flow Status - Flashiness (10)	7	10	6	4	10
Channel Alteration (20)	6	15	16	11	15
Frequency of Riffles/Bends (20)*	6	11	15		
Channel Sinuosity (20)**				10	10
Riparian and Bank Structure					
Bank Stability (L) (10)	9	10	6	5	10
Bank Stability (R) (10)	9	10	6	5	10
Vegetative Protection (L) (10)	7	10	7	6	8
Vegetative Protection (R) (10)	7	10	7	6	8
Riparian Veg. Zone Width (L) (10)	9	10	9	9	10
Riparian Veg. Zone Width (R) (10)	9	4	10	5	9
TOTAL SCORE (200):	126	153	159	104	130
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON-IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	6/28/2012	6/27/2012	7/16/2012	6/28/2012	6/27/2012
Weather:	Sunny	Sunny	Sunny	Sunny	Sunny
Air Temperature:	90 Deg. F.	80 Deg. F.	90 Deg. F.	95 Deg. F.	90 Deg. F.
Water Temperature:	64 Deg. F.	54 Deg. F.	80 Deg. F.	71 Deg. F.	67 Deg. F.
Ave. Stream Width:	10 Feet	15 Feet	40 Feet	40 Feet	35 Feet
Ave. Stream Depth:	0.3 Feet	0.75 Feet	2 Feet	2 Feet	1.25 Feet
Surface Velocity:	1 Ft./Sec.	0.5 Ft./Sec.	1 Ft./Sec.	0.5 Ft./Sec.	0.25 Ft./Sec.
Estimated Flow:	3 CFS	5.625 CFS	80 CFS	40 CFS	10.9375 CFS
Stream Modifications:	Dredged	None	None	Dredged	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	640343	620326	640317	620327	620293
Stream Name:	Osborn Creek	5 Mile Creek	South Branch White River White River Trail	South Branch White River	South Branch White River
Road Crossing/Location:	Yonker Road	Monroe Street	(End)	Fitzgerald Avenue	6 Mile Road
County Code:	64	62	64	62	62
TRS:	14N16W14	14N12W23	13N15W03	14N14W29	15N12W33
Latitude (dd):	43.61	43.59102	43.5422	43.57991	43.6405
Longitude (dd):	-86.18389	-85.7124	-86.0878	-86.01018	-85.76
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060101	4060101	4060101	4060101	4060101

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

Table 3. Habitat evaluation for sites in the White River; June-July, 2012.

Station ID	**16**	**17**
Waterbody	Cushman Creek	North Branch White River
Location	Dickinson Road	194th
Type	GLIDE/POOL	GLIDE/POOL
HABITAT METRIC		
Substrate and Instream Cover		
Epifaunal Substrate/ Avail Cover (20)	6	3
Embeddedness (20)*		
Velocity/Depth Regime (20)*		
Pool Substrate Characterization (20)**	10	6
Pool Variability (20)**	8	3
Channel Morphology		
Sediment Deposition (20)	15	5
Flow Status - Maint. Flow Volume (10)	7	9
Flow Status - Flashiness (10)	9	5
Channel Alteration (20)	13	11
Frequency of Riffles/Bends (20)*		
Channel Sinuosity (20)**	8	5
Riparian and Bank Structure		
Bank Stability (L) (10)	6	9
Bank Stability (R) (10)	8	9
Vegetative Protection (L) (10)	8	7
Vegetative Protection (R) (10)	8	7
Riparian Veg. Zone Width (L) (10)	2	6
Riparian Veg. Zone Width (R) (10)	2	8
TOTAL SCORE (200):	110	93
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	6/28/2012		6/28/2012	
Weather:	Sunny		Sunny	
Air Temperature:		Deg. F.	95	Deg. F.
Water Temperature:	61	Deg. F.	71	Deg. F.
Ave. Stream Width:	8	Feet	10	Feet
Ave. Stream Depth:	0.3	Feet	0.3	Feet
Surface Velocity:	1	Ft./Sec.	0.25	Ft./Sec.
Estimated Flow:	2.4	CFS	0.75	CFS
Stream Modifications:	Canopy Removal		Dredged	
Nuisance Plants (Y/N):	N		N	
Report Number:				
STORET No.:	620308		640344	
Stream Name:	Cushman Creek		North Branch White River	
Road Crossing/Location:	Dickinson Road		194th	
County Code:	62		64	
TRS:	13N14W32		14N15W03	
Latitude (dd):	43.4752		43.6265	
Longitude (dd):	-86.0192		-86.0789	
Ecoregion:	SMNITP		SMNITP	
Stream Type:	Coldwater		Coldwater	
USGS Basin Code:	4060101		4060101	

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

Table 4. The river gradient is described as meters of elevation change over 1 kilometer of stream length, and was calculated within each National Hydrography Dataset (NHD) reach that contained a survey site.

Site ID	Water Body Name	Location	Reach Length (km)	NHD Reach Code	Slope (meters per kilometer)
1T	Martin Creek	Warner Avenue	3.89	04060101000333	1.34
2T	Carlton Creek	Skeels Road (two-track)	1.34	04060101005620	1.41
3	Bear Creek	Cleveland Road (144th Ave)	2.84	04060101000860	4.13
4	Black (Delong) Creek	Warner Road	2.94	04060101000806	2.25
5	South Branch White River	Monroe Street	1.98	04060101000077	1.51
6	Mullen Creek	Van Buren Street	2.23	04060101000827	1.25
7	Flinton Creek	M20	8.08	04060101000321	2.09
8	Black (Delong) Creek	M20	3.74	04060101000806	1.82
9	South Branch White River	M37	5.39	04060101000072	1.66
10	White River	two-track off end of Kops/Skeels Road	0.85	04060101000049	1.66
11	Osborn Creek	Yonker Road	3.40	04060101000306	3.60
12	5 Mile Creek	Monroe Street	4.60	04060101000817	2.24
13	South Branch White River	White River Trail (end)	2.36	04060101000054	1.70
14	South Branch White River	Fitzgerald Avenue	0.63	4060101000064	0.18
15	S B White	6-mile Rd	0.95	04060101000079	0.07
16	Cushman Creek	Dickinson Rd	0.84	04060101000313	3.13
17	N B White	194th	0.39	04060101000090	1.05

Table 5. The 2006-era land cover, 2010 U.S. Census Bureau data, and overall land area of 12-digit hydrologic unit codes (HUCs) within the study area.

HUC (12-digit)	HUC Name	Area	Occupied Housing Units		Human Population		Cultivated Land	Pasture/ Hay	Wetland	Upland Natural	Developed Land
		(acres)	units	Density	people	Density	(percent)	(percent)	(percent)	(percent)	(percent)
040601010701	Mullen Creek-South Branch White River	29,732	381	0.01	964	0.03	5%	4%	20%	69%	1%
040601010702	Fivemile Creek	11,947	153	0.01	435	0.04	12%	8%	12%	67%	1%
040601010703	Flinton Creek-South Branch White River	18,791	695	0.04	1744	0.09	8%	5%	14%	69%	3%
040601010704	Black Creek-South Branch White River	39,374	1388	0.04	3725	0.09	16%	5%	16%	59%	3%
040601010705	Martin Creek-South Branch White River	31,683	421	0.01	1115	0.04	12%	2%	18%	66%	1%
040601010706	Brayton Drain-South Branch White River	21,775	1214	0.06	3158	0.15	43%	12%	8%	30%	5%
040601010707	South Branch White River	27,880	484	0.02	1470	0.05	19%	7%	10%	63%	2%
040601010801	McLaren Lake-North Branch White River	14,799	367	0.02	900	0.06	13%	1%	14%	67%	1%
040601010802	Robinson Creek	11,002	207	0.02	565	0.05	38%	1%	15%	43%	2%
040601010803	Osborn Creek-North Branch White River	14,514	327	0.02	915	0.06	26%	2%	10%	57%	3%
040601010804	North Branch White River	29,243	528	0.02	1406	0.05	17%	1%	17%	63%	2%
040601010901	Sand Creek-White River	30,915	719	0.02	1939	0.06	3%	0%	12%	82%	1%
040601010902	Carlton Creek	17,843	957	0.05	2554	0.14	20%	2%	11%	60%	5%
040601010903	Pierson Drain	5,651	285	0.05	727	0.13	42%	14%	1%	27%	12%
040601010904	White River	39,013	5069	0.13	12694	0.33	5%	1%	8%	64%	14%
Total for Study Area		344,160	13195		34312		16%	4%	13%	62%	4%

Table 6. The 2006-era land cover within the riparian zone of 100 meters, for all streams included in each 12-digit hydrologic unit code (HUC).

HUC (12-digit)	HUC Name	Cultivated Land	Developed Land	Natural Upland Vegetation	Wetlands (all types)	Pasture/Hay	Other*
040601010701	Mullen Creek-South Branch White River	5%	1%	43%	47%	3%	1%
040601010702	Fivemile Creek	7%	1%	38%	49%	4%	1%
040601010703	Flinton Creek-South Branch White River	7%	2%	41%	45%	3%	2%
040601010704	Black Creek-South Branch White River	14%	2%	35%	44%	4%	2%
040601010705	Martin Creek-South Branch White River	10%	1%	47%	38%	2%	2%
040601010706	Brayton Drain-South Branch White River	27%	4%	38%	23%	6%	1%
040601010707	South Branch White River	19%	2%	36%	38%	5%	0%
040601010801	McLaren Lake-North Branch White River	11%	1%	44%	32%	1%	11%
040601010802	Robinson Creek	8%	2%	38%	53%	0%	0%
040601010803	Osborn Creek-North Branch White River	13%	3%	39%	43%	1%	1%
040601010804	North Branch White River	11%	2%	39%	46%	0%	0%
040601010901	Sand Creek-White River	0%	0%	40%	54%	0%	5%
040601010902	Carlton Creek	16%	2%	38%	37%	3%	3%
040601010903	Pierson Drain	52%	9%	20%	5%	11%	0%
040601010904	White River	12%	12%	27%	32%	4%	12%

* Includes open water, bare land, and unconsolidated shore. Note that the wider the river channel, the more open water will be present in the land cover area.