Wisconsin Watersheds

West Twin River Watershed

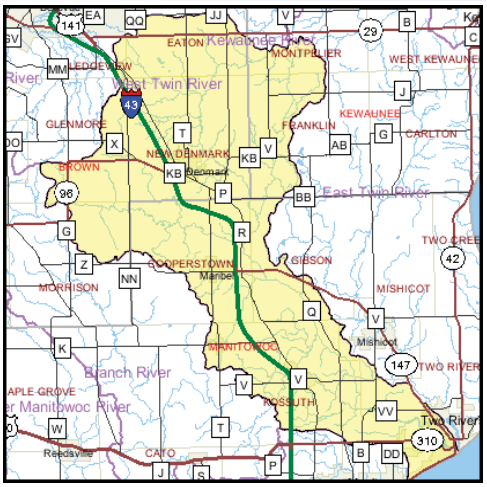
2010 Water Quality Management Plan Update

August 2010

Twin Door Kewaunee Basin, Wisconsin

The West Twin River watershed is one of seven watersheds within the Twin-Door-Kewaunee River Basin. The West Twin River watershed is located in north central Manitowoc and southeastern Brown Counties, with a small portion extending into southwestern Kewaunee County (Map 1).

Twenty-nine (29) rivers and streams cover 130 miles through the watershed. There are five lakes that are 10 acres or larger in the watershed. A number of spring ponds and wetlands are identified as "quality wetlands" by the state's coastal wetland inventory and the USFWS Special Wetlands Inventory Study are also located in the area.



Map 1: West Twin Watershed

Contents

Watershed Details. 1
- Population and Land Use 1
- Hydrology 2
- Ecological Landscapes. 2
- Historical Note 3

Watershed Condition 3
- Priority Issues & Water Quality Goals . .3
- Overall Condition 4
- Lake Health 7
- Wetland Health 8
- Groundwater 8
- Waters of Note 8
- Aquatic Invasives 9

Watershed Actions 9
- Priority Issues 9
- Water Quality Goals 9
- Projects and Grants 10
- Monitoring 11
- Recommendations 12
- Contributors: 15

Appendices 16
- Watershed Map 16
- Outfalls and Dams 17
- Impaired and ORW/ERW Waters . . . 18
- Land Use 19
- Wetlands 20
- Additional Reports 21

Watershed Details

Population and Land Use

This watershed is primarily agricultural, with a smattering of towns and villages throughout the land area (Figure 1) . Shoto, Rockwood, Kellnersville, Maribel, Cooperstown, Francis Creek, Denmark, Shirley and Langes Corners are located in this watershed, and a portion of the city of Two Rivers also lies within the watershed boundaries.

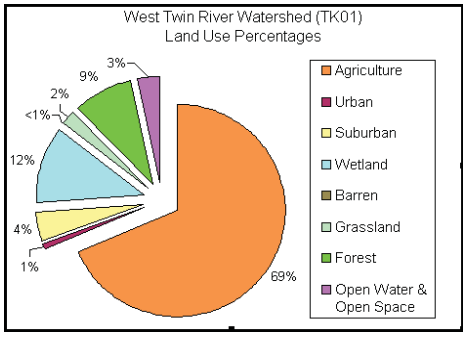


Figure 1: Land Use West Twin Watershed

Agriculture is the primary land use and, despite significant work to improve conditions, the West Twin runs clay brown for at least several days after rainfall events. Rural runoff (i.e. field erosion) is still a major issue in this watershed.

However, significant resources have been expended to install manure storage facilities, reduce streambank pasturing, and increase nutrient management planning. Yet, more work is needed; there continues to be significant runoff pollution from agricultural fields. This issue can be addressed through county conservation programs. However, there are some inadequacies in the programs, and recommendations are included for increasing agricultural runoff program effectiveness.

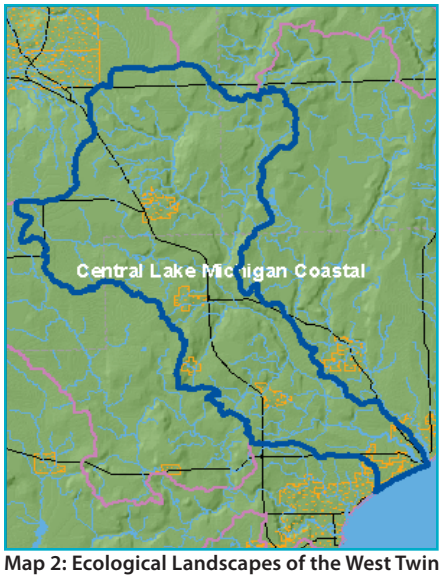
Hydrology

Historic reductions in the percentage of forested and wetland vegetation have resulted in a watershed that lacks adequate opportunities for infiltration and retention of precipitation and snow melt, resulting in flashy runoff which overwhelms existing stream channels and aquatic habitat. This excessive runoff also strips valuable sediments and nutrients from the terrestrial environment and delivers them to our streams and lakes where they result in degraded water quality and poorer habitat. This can kill sensitive and intolerant fish and aquatic invertebrates. Flashy runoff also limits the amount of water available to sustain adequate flows during drought. Restoration efforts should focus on increasing the overall percentage of forested and wetland vegetation in this watershed to restore a more natural hydrologic regime and minimize the impacts of flashy runoff and an altered hydrologic regime.

Soils include gently to steep sloping, well-drained sands and loams, and some clay soils. Throughout the northwestern reaches loamy soils are dominant.

Ecological Landscapes

The Central Lake Michigan Coastal Ecological Landscape stretches from southern Door County west across Green Bay to the Wolf River drainage, then southward in a narrowing strip along the Lake Michigan shore to central Milwaukee County (Map 2). Owing to the influence of Lake Michigan in the eastern part of this landscape, summers are cooler, winters warmer, and precipitation levels greater than at locations farther inland.



Map 2: Ecological Landscapes of the West Twin Watershed

Dolomite and shale underlie the glacial deposits that blanket virtually all of the Central Lake Michigan Coastal Ecological Landscape. The dolomite Niagara Escarpment is the major bedrock feature, running across the entire landscape from northeast to southwest. Series of dolomite cliffs provide critical habitat for rare terrestrial snails, bats, and specialized plants. The primary glacial landforms are ground moraine, outwash, and lakeplain. The topography is generally rolling where the surface is underlain by ground moraine, variable over areas of outwash, and nearly level where lacustrine deposits are present. Important soils include clays, loams, sands, and gravels. Certain landforms, such as sand spits, clay bluffs, beach and dune complexes, and ridge and swale systems, are associated only with the shorelines of Lake Michigan and Green Bay.

Historically, most of this landscape was vegetated with mesic hardwood forest composed primarily of sugar maple, basswood, and beech. Hemlock and white pine were locally important, but hemlock was generally restricted to cool moist sites near Lake Michigan. Areas of poorly drained glacial lakeplain supported wet forests of tamarack, white cedar, black ash, red maple, and elm. Emergent marshes and wet meadows were common in, and adjacent to, lower Green Bay, while Lake Michigan shoreline areas featured beaches, dunes, interdunal wetlands, marshes, and highly diverse ridge and swale vegetation. Small patches of prairie and oak savanna were present in the southwestern portion of this landscape.

The West Twin watershed harbors two State Natural Areas (SNA): Cherney Maribel Caves State Natural Area, located in a Manitowoc County Park, and forested ridge and swale habitat within the Woodland Dunes Nature Preserve, near the City of Two Rivers.

The Woodland Dunes SNA is of global significance because it is one of only two examples of forested dune (ridge) and swale habitat in this ecological region. It was designated a SNA based on richness of species and importance to both migratory and breeding birds. More than 400 plant and more than 100 breeding bird species populate the preserve, which contains at least five wetland types. The preserve has also received designation as an Important Bird Area (IBA) by the Wisconsin Department of Natural Resources.

Historical Note

The Cherney Maribel Caves are part of the Manitowoc County Park System and are located along the West Twin River in the Town of Cooperstown. The caves were formed primarily by glacial activity. Through millions of years of deposition and change, glaciers wore down the land surface exposing an underlying solid mass of rock called Niagara Dolomite. Thus was formed the naked crags and irregular cliff line of the area. These formations are in contrast to other parts of Wisconsin where rich layers of boulder till were deposited by the glaciers.

Over the years, the rock has decomposed. Springs, the changing seasons, ice and temperature variations broke down the rock. Small caves and openings created by these forces appear in the rock layers of the cliff line. Springs seep from the limestone rock and flow over moss covered rocks and trickle to the river. Cherney Maribel Caves was designated in the 1960's for its floral species richness. Rare ferns, varieties of creeping plants and wild flowers are found among the rocks and within the wooded growth. Terrestrial invasive plant species are a threat, particularly garlic mustard, which has the potential to spread along the river to adjacent areas, with seed dispersed by people, wildlife, and soil erosion.

The Cherney Maribel Caves are part of the Manitowoc County Park System. Photo by Al Schema and Adam Backus,

Watershed Condition

Priority Issues and Water Quality Goals

Priority issues for this watershed include the quantity and quality of agricultural runoff reaching surface waters and groundwater, and its impact on drinking water and surface water quality. Protecting groundwater in this area of fractured dolomite or karstic bedrock is important where agricultural land use and urban development can have potentially serious effects on water resources.

Additional issues for this watershed include invasion by non-native invasive species, the presence of dams and other fish passage barriers, loss of forests and wetlands and the need for riparian vegetation buffers, runoff from urban areas, and the lack of water quality and biological assessment data.

Water quality goals for the watershed include:

- Minimizing agricultural runoff from rural areas
- Minimizing urban stormwater runoff
- Protecting groundwater resources
- Restoring key wetlands and forestlands for water quality improvement and protection
- Establishing riparian buffers to protect water quality
- Monitoring and controlling non-native invasive species
- Minimizing fish passage barriers
- Obtaining water quality and biological monitoring data to adequately assesswater resource conditions
- Increasing citizens' watershed awareness, understanding and stewardship activities

Overall Condition

The West Twin River begins at the confluence of the Neshota River and Devils River and has a combined watershed area of 176 square miles. Land use is largely agricultural but some industries border the river in the city of Two Rivers. Historic reductions in the percentage of forested and wetland vegetation have resulted in a watershed that lacks adequate opportunities for infiltration and retention of precipitation and snow melt resulting in flashy runoff which overwhelms existing stream channels and aquatic habitat.

Point and Nonpoint Sources

Point source dischargers to surface water include the village of Denmark and Kossuth Sanitary District wastewater treatment plants, Land O'Lakes Dairy, Maribel Caves Bottled Water, and Potts Blue Star Cheese. The Francis Creek, Kellnersville and Maribel village wastewater treatment plants, Aurrichio Cheese, Lakeside Packing, S & R Ellisville Dairy, and Stoer Dairy Farms discharge to groundwater.

River and Stream Condition

There are eighteen streams totaling125 miles of water within the watershed. Streams types range from intermittent to perennially flowing, named streams. Classifications of these streams are also widely variable with multiple classifications found on some streams. Of the 125 stream miles in the basin, 81 miles have had their biological use classified.

According to the "attainable use data" for this watershed, 19 miles of stream are classified as trout waters, 23 miles are classed as warmwater sport fisheries, 23 miles as warmwater forage fisheries, 13 miles as limited forage fisheries and 0 miles of limited aquatic life. Unclassified streams have the default classification of warmwater sport fisheries. Historical information about streams in this watershed indicates that the West Twin River and its tributaries supported a variety of fish species.

In 2002 a fisheries and stream quality assessment was conducted by the WDNR throughout the West Twin River system. Discharge on the West Twin River (including the Neshota River) ranged from a low of 3.42 cubic feet per second (CFS) at Highway KB to a high of 26.1 CFS at Melnick Road. This range of discharge was expected given that KB site was high in the watershed and Melnick Road site was much lower in the watershed. Flow was not judged a problem on the mainstream West Twin River.

Throughout the watershed, pools comprised 41.5% (3.666.4 feet of the 8,833.7 feet) of the measured habitat, while runs accounted for 40.0% and riffles 18.5% of the large-scale habitat features. Cobble, gravel and sand dominated the bottom material (or substrate) in the mainstem West Twin River, although other substrate types were also encountered. In tributaries, cobble and gravel dominated the bottom substrate except at Twin Hill Creek where clay was common. Stream corridors of the West Twin River were well buffered with 33 feet of forest, meadow or shrubs buffers at most study locations. Two sites, Highway KB and Twin Hill Creek, however, show the need for improved buffers due to bank erosion depositing silt or clay in the stream channel and degraded habitat.

Black Creek in Kewaunee County. Credit, Kewaunee County Land and Water Conservation Department

Temperature and dissolved oxygen (DO) measurements, along with invertebrate and fish sampling, were used to evaluate water quality within the watershed. Hilsenhoff Biotic Index (HBI) samples in 2002 showed good to excellent water quality at all sample locations. Results from 2002, compared to those collected in 1996, appear to indicate that the HBI had not changed substantially at the sampled locations. However, although water temperatures remained similar throughout the mainstem of the West Twin River,

dissolved oxygen declined along the continuum of sites as the sites went from downstream to upstream. The decline in DO appeared to be a function of low flow and land use. Readings taken at Highways BB and KB indicate that DO may limit the fish community, although HBI and IBI scores did not indicate a problem at this time.

A total of 34 species of fish were captured during the 2002 surveys on the West Twin River system; historical surveys had identified 58 species in the system. This difference in numbers may be due to the fact that fish may be inhabitiing the lower West Twin River below the Shoto Dam, which was not surveyed in the 2002 study. Fish IBI ratings ranged from fair, at six sites; good, at one site; and excellent, at three sites. However, there is concern due to few warmwater gamefish or intolerant species captured during the survey.

Within the watershed, common shiner, white sucker and creek chub were the dominant species captured during the survey. Other dace, darters and minnows were also commonly captured. Smallmouth bass were caught in larger river sections and stocked brown trout were captured in the West Twin River upstream Melnick Road and one was captured in the Devils River. Yellow perch and green sunfish were captured at several locations during the survey.

Neshota River: Steve Hogler, WDNR

West Twin River (and Neshota River)

The West Twin River begins in Brown County as the Neshota River, just southeast of Green Bay and flows southeast through the county. As the Neshota River enters northern Manitowoc County and joins with Black Creek it is renamed the West Twin River. The river then flows south toward Two Rivers where it joins with the East Twin River before entering Lake Michigan. The West Twin and Neshota Rivers have a combined length of 36 miles. Approximately six miles upstream of Lake Michigan is Shoto Dam, which divides the river into upper and lower sections. The lower section of the West Twin River is influenced by Lake Michigan and experiences annual runs of Lake Michigan fish species, such as chinook and coho salmon, rainbow and brown trout, and white sucker. Warmwater species such as northern pike, smallmouth bass, channel catfish and yellow perch are also common in the river. The river below Shoto is wide and shallow and has a low-to-moderate gradient (4.1 feet per mile). Water quality in the lower sections is fair to poor with turbid water and degraded habitat.

Above Shoto dam the river is narrower, has a steeper gradient, and flows through predominantly agricultural lands. Water quality and habitat measured in a 1994 survey (Bougie and Cleereman 1996) indicated that habitat was good and the biotic index was very good. However, the Biological Oxygen Demand (BOD), ammonia and suspended solids levels were high, indicating that organic enrichment of the river was occurring. This stretch of stream has also had a history of fish kills, including a 1948 spill from a brewery in Denmark that killed hundreds of northern pike and smallmouth bass (Mackenthum 1948) and several manure spills that killed suckers, minnows, smallmouth bass and northern pike (Kernen 1973). The water in this section is turbid and there is evidence of eroding banks and silt deposition in the river. A diverse minnow community dominated by bluntose minnows and common shiners as well as northern pike, yellow perch, rock bass and pumpkinseed was found during a 1974 survey (Heizer 1974).Fish surveys in 2002, 2007 and 2009 found a diverse, warmwater fish community. The dominant species of gamefish included smallmouth bass, northern pike and stocked brown trout. Several species of panfish and an abundant forage community were also captured during these surveys. IBI rankings ranged from excellent just above Shoto Dam to fair in upper sections of the Neshota River.

Francis Creek

Francis Creek is a 6.8 mile tributary to the West Twin River that has a steep gradient (29.6 feet per mile). Much of the watershed is agricultural. Bottom substrate in the creek consists of gravel, cobble and muck and stream habitat has been rated as fair to good (Bougie and Cleereman 1996). Francis Creek is classified as a warmwater forage fishery due to limited fish habitat and low flow, making establishment of a gamefish population unlikely. Surveys in 2002 found a diverse forage fish community that was dominated by warmwater species such as white sucker and creek chub and several coolwater species represented by brook lamprey and mottled sculpin. A large number of redside dace were also captured, indicating low to moderate stream turbidity. The stream received a fish IBI ranking of good.

Kriwanek Creek

Kriwanek Creek is a 6-mile long stream, with a gradient of 27.8 feet/mile, that flows through mainly agricultural land. The lower section (1 mile) of the stream has numerous groundwater springs that provide substantial input to the base flow of the stream. When groundwater fed streams are rich in clean gravel and rubble substrate with forested stream banks, the area provides excellent trout habitat. This lower section is classified as Class II trout water (WDNR 2001). A poorly placed culvert may be impeding trout migration above Hidden Valley Road and may restrict usage of the next ½ mile of stream by trout. River sections above this point are limited by flow or habitat and are classified as warmwater forage or limited forage fisheries. Culvert placement on Kriwanek Creek may be impeding fish migration and should be addressed.

Stream habitat evaluators ranked habitat in Kriwanek Creek, as good but some erosion and soft deposition areas were noted (Bougie and Cleereman 1996). Invertebrate analysis (HBI scores) indicted that the stream had excellent water quality. Fish surveys in the 1950's (Hacker 1956), 1960's (Hacker 1967) and 1970's (Schultz 1972) indicated that brown trout, sculpin, mud minnows, longnose dace, southern redbelly dace, stone rollers and white sucker reside in the creek. More recent fish surveys in 2002 and 2008 had similar results to what was noted in earlier surveys, with brown trout, sculpin and dace dominating the catch.

Devils River. Credit, Steve Hogler, WDNR.

Devils River

The Devils River is a 12-mile long stream, with a moderate gradient (22.7 feet per mile), that flows through agricultural land in Brown and Manitowoc Counties (WCD 1968, WDNR 1972). The lower 4 miles of the river are classified as a warm water sport fishery. Flow and habitat in that section of stream is good (Bougie and Cleereman 1996). The remainder of the stream is classified as a warmwater forage fishery because low flow and degraded habitat. Water quality in the river was scored as fair because of nutrient enrichment from the surrounding watershed.

Hacker (1956) surveyed the river and found abundant forage minnows (redside dace, longnose dace, blacknose dace, redbelly dace, creek chub, white sucker, and common shiners) and a few gamefish (rock bass and black bullhead). Most of the fish that were captured were caught in lower sections of the river, while many sites in the upper river were dry or were small non-connected pools of water. Peeters (1984 and 1991) observed a similar mix of species when electrofishing to determine the overwintering survival of stocked brown and rainbow trout in the Devils River. Few trout were found and it appeared overwintering survival was low. Hogler and Surendonk (2003) found a diverse warmwater fish community during surveys conducted in 2002. Several species of dace, including redside dace, common shiner and creek chub dominated the catch. Much lower numbers of northern pike and stocked brown trout were captured. IBI scores indicated that the fish population was fair in the Devils River.

Twin Hill Creek
Twin Hill Creek is a 6-mile long tributary to the Neshota River, located southeast of Green Bay. It flows through high intensity agricultural land, and very little information is known about the current condition of this stream. It currently has the default classification of a warm water sport fishery (WDNR 2001). Surveys in 2002 found a fish community dominated by dace, creek chub and white sucker. Stream flow was very low on the date of the survey, and the IBI ranking was fair.

King Creek
King Creek is a 5-mile long tributary to the Neshota River and during dry years can be intermittent (WDNR 1995). Its watershed is highly agricultural, and there is evidence that stream bank pasturing and row cropping contributes large qualities of sediment to the river creating turbid water conditions. Because the current status of the stream is unknown, it has the default classification of a warmwater sport fishery. King Creek was visited as part of the 2002 West Twin Watershed survey but on the date of survey, the stream channel was dry. However it was noted that dead fish, crayfish and mussels could be seen in the channel, indicating seasonal use of the creek by these organisms.

Black (Buck) Creek
Black Creek is a 10-mile long tributary of the West Twin River (WCD 1966). Upper sections of the river can be intermittent during dry years, but can carry large amounts of sediment during storm events due to poor agricultural land use practices in the area. The lower section of the river has a moderate gradient of 13.5 feet per mile and habitat ranking of fair. This section has limited fisheries potential because of habitat degradation due to heavy deposits of sediment in the streambed (Bougie and Cleereman 1996).

A large manure spill in 1987 caused heavy fish mortality in the lower 3 miles of the river. The fish that were observed dead during the investigation of this spill included 15,433 minnows, 2,573 suckers and redhorse, 1,700 stonecat and madtom, 300 rock bass, 19 smallmouth bass and 17 northern pike (Peeters 1987). A 2002 survey found a fish community that was dominated by forage fish including blacknose dace, southern redbelly dace, stoneroller and creek chub. The IBI ranking for the section of river surveyed was very good.

Lake Health

Within the West Twin River watershed, there are five named lakes that have 89 surface acres of water and a sixth lake, Shoto Lake, is a 55 acre impoundment of the West Twin River. The lakes named Lilly, Middle, Third, Hidden and Tuma are likely affected by surrounding land use; however, data is limited. Fish survey data is available for only Tuma and Lily Lakes; very little data exists for the other lakes.

A 1994 study determined that Tuma Lake was mesotrophic with good water quality. In the winter of 2008-09 the lake experienced a winter kill. Before the winterkill, the fish community was dominated by panfish and largemouth bass.

Lilly Lake
Lilly lake is a seepage lake, having moderately clear water and a well buffered shoreline. There are no residents on the lake but there is a Brown County Park on the north end with two fishing platform. Due to the limited number of lakes in Brown County, there is substantial recreational usage. The lake has a no gasoline motor restriction or history of winterkill. An aerator is now used to maintain dissolved oxygen levels during the winter. Water chemistry sampling conducted during 2008 and 2007 indicated Lilly lake to be mesotrophic, with concerns about declining water quality and increasing summer algal blooms. Using a series of lake planning grants (sponsored by the Town of Eaton), the Brown County Planning Commission collected data and developed a Comprehensive lake Management Plan which was submitted in December 2009. DNR research conducted a point intercept aquatic plant survey on Lilly Lake on August 21, 2008. Neither Eurasian watermilfoil (EWM) or curly-leaf pondweed (CLP) were found at the time of the survey.

In the fall of 2008, a DNR fish management team conducted a two-night electroshock survey and population estimate for Lilly Lake. They found a large number of largemouth bass, but only one fish greater than 14 inches, which suggests a heavy harvest of legal fish 14 inches or larger (Rowe, 2008).

Historical records indicate that largemouth bass and panfish generally dominate the fisheries in these lakes. Addition-

ally there are a number of spring ponds and wetlands that are identified as "quality wetlands" through the state's coastal wetland inventory and the USFWS Special Wetlands Inventory Study.

Wetland Health

Wetland Status
Wetlands compromise 8% of the current land uses in the watershed. It is estimated that about 49% of the original wetlands in the watershed currently exist. Of these wetlands, forested wetlands (73%), emergent wetlands (12%), which include wet meadows and marshes, and shrub wetlands (12%) dominate the landscape.

Wetland Condition
Little is known about the condition of the remaining wetlands but estimates of reed canary grass infestations, an opportunistic aquatic invasive wetland plant, into different wetland types has been estimated based on satellite imagery. This information shows that reed canary grass dominates 75% of the existing emergent wetlands, which include wet meadows and marshes, and 12% of the remaining forested wetlands. Reed canary grass domination inhibits successful establishment of native wetland species.

Wetland Restorability
Of the 9,070 acres of estimated lost wetlands in the watershed, approximately 91% are considered potentially restorable based on modeled data, including soil types, land use and land cover (Chris Smith, DNR, 2009). However, this does not take into account the overwhelming challenges in re-establishing native vegetation, due to reed canary grass invasion and dominance throughout much of the watershed.

Groundwater

In areas where the depth to the bedrock is shallow -- or in other words when the underlying bedrock is close to the surface -- the groundwater quality in the silurian dolomite is highly susceptible to contamination. Groundwater contamination can travel quickly through fractured dolomite to reach surface waters and potable water supplies.

Waters of Note

Exceptional and Outstanding Resources Waters

Wisconsin has designated many of the state's highest quality waters as Outstanding Resource Waters (ORWs) or Exceptional Resource Waters (ERWs). Waters designated as ORW or ERW are surface waters which provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities. ORW and ERW status identifies waters that the State of Wisconsin has determined warrant additional protection from the effects of pollution. These designations are intended to meet federal Clean Water Act obligations requiring Wisconsin to adopt an "antidegradation" policy that is designed to prevent any lowering of water quality – especially in those waters having significant ecological or cultural value. There are no designated outstanding or exceptional resource waters in the West Twin Watershed.

Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class
West Twin River	87000	15.41	15.76	CLASS II
West Twin River	87000	17.13	18.44	CLASS II
Kriwanek Creek	88000	0	0.75	CLASS II

Table 1 Trout Waters

Trout Waters
Two waters are considered partially naturally reproducing trout waters in the watershed: The West Twin River from mile 15 up to mile 18 and the Kriwanek Creek, for a very small portion of its length (less than one mile). See Table 1.

Impaired and Related Waters in the watershed

Impaired waters in this watershed include: the West Twin River, from the river mouth at Lake Michigan to mile 18.44,

Name / Detail	Local Name / Map	Start Mile	End Mile	WBIC	Water Type	County	Pollutant	Impairment
Lake Michigan	Memorial Drive Wayside Beach, Lake Michigan			20	Great Lakes Beach	Manitowoc	E. coli	Recreational Restrictions - Pathogens
Two Rivers Harbor	Two Rivers Harbor			47	Bay/Harbor	Manitowoc	Unknown Pollutant	Chronic Aquatic Toxicity
West Twin River	West Twin River	0	5.90	87000	River	Manitowoc	Total Phosphorus	Low DO
West Twin River	West Twin River	5.90	15.41	87000	River	Manitowoc	Total Phosphorus	Low DO
West Twin River	West Twin River	15.41	15.76	87000	River	Manitowoc	Total Phosphorus	Low DO
West Twin River	West Twin River	15.77	17.12	87000	River	Manitowoc	Total Phosphorus	Low DO
West Twin River	West Twin River	17.13	18.44	87000	River	Manitowoc	Total Phosphorus	Low DO

Table 2 Impaired Waters

which is impaired for low dissolved oxygen due to excess phosphorus loading; Two Rivers Harbor, which is impaired for chronic aquatic toxicity, and Memorial Drive Wayside Beach, Lake Michigan, which is listed for recreational use impairments due to *E. coli. (See Table 2, next page for details on these water listings).*

Aquatic Invasives

There has not been a comprehensive inventory of aquatic invasive species in this watershed; however, there is some data based on surveys conducted on individual waterbodies.

Tuma Lake (Ording, 1993) and Lake Michigan (1978) have Eurasian water-milfoil infestations; rusty crayfish are found in the Neshota River, Black Creek, Devils River, Francis Creek, and West Twin River; round goby are found below the Shoto Dam (Ward, 2010); and zebra mussels are found in Lake Michigan.

Shoto Lake has a major infestation of Japanese knotweed in the floodplain. In addition, *phragmites* (reed canary grass) is threatening the estuaries at the mouth of the river and wetlands and shorelands throughout the watershed and northeast Wisconsin in general. Consistent with much of the state, reed canary grass is well established in many wetlands and wet forests, making restoration of native vegetation difficult.

Watershed Actions

Priority Issues

Priority issues for this watershed include the quantity and quality of agricultural runoff reaching surface waters and groundwater, and its impact on drinking water and surface water quality. Protecting groundwater in this area of fractured dolomite or karstic bedrock is important where agricultural land use and urban development can have potentially serious effects on water resources.

Additional issues for this watershed include invasion by non-native invasive species, the presence of dams and other fish passage barriers, loss of forests and wetlands and the need for riparian vegetation buffers, runoff from

urban areas, and the lack of water quality and biological assessment data.

Water Quality Goals

Water quality goals for the watershed include:

- Minimizing agricultural runoff from rural areas
- Minimizing urban stormwater runoff
- Protecting groundwater resources
- Restoring key wetlands and forestlands for water quality improvement and protection
- Establishing riparian buffers to protect water quality
- Monitoring and controlling non-native invasive species
- Minimizing fish passage barriers
- Obtaining water quality and biological monitoring data to adequately assesswater resource conditions
- Increasing citizens' watershed awareness, understanding and stewardship activities

Projects and Grants

Kewaunee County's Land and Water Resource Plan 2010-2019

http://www.kewauneeco.org/lwcd_web_site/index.htm

Nonpoint Source Grants
Targeted Runoff - Rural Construction - Devils River. 01/01/2003. Complete.
Town of Morrison: Cost-share well abandonments.

Targeted Runoff - Rural Construction. Unnamed. 01/01/2003. Complete.
Kewaunee County: Manure Storage Retrofit: cost-share at 70 percent retrofit of manure storage unit on a local farm.

Targeted Runoff - Rural Construction. Unnamed. 08/10/2005. Complete.
Kewaunee County: Manure Storage: To cost-share installation of manure runoff practices to bring the farm into compliance with NR 151 performance standards.

Lake Planning Grants
2009. The Town of Eaton received three lake planning grants from the DNR to assess the condition of Lilly Lake and for the development of a comprehensive lake management plan. Brown County Planning Commission, 2009.

To read the report, go to:
http://www.co.brown.wi.us/i_brown/d/facility_and_park_management/lily_executive_summary.pdf

Manitowoc County's Land and Water Resource Management Plan 2008-2012

http://www.co.manitowoc.wi.us/

Lake Protection Grants
2003. Surface Water Resources of Manitowoc County (LPT-089). Manitowoc County Soil and Water Conservation Department received a lake protection grant to identify water and land use protection and improvement practices and develop a classification system for all the surface water resources in the county.

River Protection Grants
2006. Citizen Based Stream Monitoring (CBSM) and Water Action Volunteers (WAV) – (RP-134-07).Woodland Dunes Nature Center received a DNR river grant to organize, educate and sustain a stewardship group which routinely monitors the West Twin River at two locations. (Woodland Dunes, 2009)

2008. Rivers at Risk Education and Capacity Building Project (RP-169-09) – Woodland Dunes Nature Center in cooperation with local watershed stewardship groups and the UWEX Basin Education Initiative, raised awareness about local

water resources through development of an "Explore and Restore" brochure for the West Twin River and hosted many educational events and opportunities for citizens to participate in river protection and restoration. (Woodland Dunes, 2009)

2009. Explore and Restore Project (RP-188-10). Woodland Dunes Nature Center received a DNR river grant to build on previous work by partners to raise public awareness and participation in water stewardship. Specifically, Woodland Dunes will develop "Explore and Restore" signs and place them at city parks along four rivers, host litter clean-up events, and provide information and education about the rivers and water quality to citizens through fliers, newsletters, websites, and direct mailings. The overall project goals are to enhance the Wisconsin Maritime Museum and Woodland Dunes watershed stewardship groups existing within the project area by building their capacity to reach and engage local citizens and officials, provide individual citizens and officials with opportunities to participate in protecting and restoring the rivers, and raise citizens' and officials' awareness and understanding of the threats to rivers in the project area.

2007. Lakeshore River Basin Partnership Initiative Project (RP-152-09). Lakeshore Natural Resources Partnership received a DNR river grant to hold a series of seminars called "We all Live on the Water" seminar series and to develop and distribute a basin-wide newsletter. (Lakeshore Natural Resources Partnership, 2008)

Aquatic Invasive Species (AIS) Grants

2007 and 2009. Utilizing the DNR AIS grant program (AEPP-11-08 and AEPP-248-10), Manitowoc County Lakes Association hired an AIS coordinator for Manitowoc County. The coordinator does extensive education efforts regarding the spread and management of invasive species. In close cooperation with UW Extension and Wisconsin Sea Grant, education efforts focus on working with resource professionals and citizens statewide to teach boaters, anglers, and other water users how to prevent transporting aquatic invasive species when moving their boats. Additional initiatives include monitoring and control programs.

Brown County's Land and Water Resource Management Plan 2009-2013

http://www.co.brown.wi.us/

2007. Woodland Dunes Nature Center received a DNR Aquatic Invasive Species grant (AIRR-021-07) in 2007 to locate, map and chemically treat *phragmites* along the West Twin River. Woodland Dunes is also working to educate adjacent landowners about Phragmites impacts and control.

Monitoring

Water Quality

Biological, chemical, and physical monitoring in recent years on the West Twin River was collected for the purpose of developing a TMDL for the West Twin River. A USGS gauging station on the West Twin River at CTH Q collected discharge data from April 2006 to December 2007, 2002 Stream assessment. West Twin River system. WDNR. Hogler and Surendonk.

Fisheries Surveys (WDNR)

- 2002 Fisheries inventory of the West Twin River system (Hogler and Surendonk).
- 2007 West Twin trout and smallmouth bass survey (Hogler and Surendonk)
- 2008 Lily Lake survey (David Rowe).
- 2009 Neshota River smallmouth bass survey (Hogler and Surendonk).

Citizen Monitoring

Citizen Lake Monitoring - Water Quality - Lilly Lake - Deepest Part

The Citizen Lake Monitoring Network, the core of the Wisconsin Lakes Partnership, involves over 1000 citizen volunteers statewide. The goals are to collect high quality data, to educate and empower volunteers, and to share this data and knowledge. A volunteer routinely measures water clarity on *Lilly Lake,* using the Secchi Disk method, as an indicator of water quality. This information is then used to determine the lakes trophic state.

Citizen-based Monitoring Grant
Woodland Dunes Nature Center, 2010. This project will allow the nature center to continue and enhance its Citizen Science program which will include water quality monitoring.

Great Lakes Beaches
Great Lakes Beaches - 2002 Pilot Project. Monitoring for pathogens at Great Lakes to help assess beach quality under the state's recreational use designation.

County Conservation Department Projects

Kewaunee County
In 2009, Kewaunee Co. updated its land and water management plan. The county has not previously focused on the West Twin watershed due to funding priorities focusing on other watersheds. According to its plan, in 2010 the County will focus on the West Twin watershed and intends to:

- Begin NR151 compliance checks in West Twin (Black Creek) watershed
- Conduct transect surveys for tillage
- Offer cost sharing in this watershed for nutrient management
- Apply soil and water resource management funding from DATCP to this watershed
- Apply TRM funding from WDNR to this watershed
- Conduct compliance checks on Farmland Preservation claims.

Manitowoc County
The Manitowoc County Land and Water Resource Management Plan was updated in 2008. Conservation practices established to date throughout the watershed include:

- 35 manure storage facilities built (1-2 more needed)
- 40 wetland restoration projects totaling 76 acres
- 44.8 acres of conservation buffers established, but 600 more acres are needed for a100 ft. buffer from stream.
- 14,959 acres covered with nutrient management plans, out of 36,292 total acres of cropland in the watershed

Protection of sinkholes:
In 2007, Manitowoc County Ordinance Chapter 19 Animal Waste Management was passed by the county board and each town by referendum vote. It sets limitations and prohibitions on application of manure near sinkholes and within watersheds that drain to a sinkhole. Operators must incorporate manure within 48 hours if land is spread with manure near where the land drains to a sinkhole.

In the Town of Cooperstown in 2008, there was a groundwater contamination problem. The SWCD worked with landowners in the township to increase acres covered with nutrient management planning, to build diversions from sinkholes and septic systems, and to establish an industrial waste prohibition area.

Through a grant from the Great Lakes Commission in 2009, Manitowoc County implemented a West Twin River riparian landowner project. As a result, 24 landowner visits were made, crop rotation changes were initiated on 312 acres, new reduced tillage was implemented on 182 acres, and conservation buffers were initiated on 13.7 acres adjacent to streams, covering 5,685 linear feet of stream frontage. In addition, 3,000 feet of grassed waterways were installed in 2009, with another 950 feet to be installed in 2010. Three reinforced livestock and equipment crossings were installed in 2009, 115 acres of rotational grazing are to be installed in 2010 and 1 milk house waste collection system was installed in 2009. The project's final report is provided in the appendix.

City of Two Rivers – Stormwater Management
In October of 2006, the City of Two Rivers received its NR 216 Municipal Separate Storm Sewer System (MS4) Permit from the Wisconsin Department of Natural Resources (DNR). This MS4 Permit requires the City of Two Rivers to develop a municipal storm water program that manages urban non-point source pollution and protects natural resource features such as the West Twin River, East Twin River, Lake Michigan and other environmentally sensitive areas. For more information,

see the City's website at: http://www.ci.two-rivers.wi.us/stormwater/tr_storm_water.htm

Recommendations

These recommendations are based on analysis of the WATERS database and discussions with contributors to this document. These recommendations do not reflect the WDNR's current work plan priorities or resource capabilities.

1. Minimize agricultural runoff from rural areas

- Provide funding needed for nutrient management programs.
- This watershed has the more traditional, smaller farms, so perhaps it would be a good one for encouraging grazing, fence rows, cover crops and other habitat enhancements.
- Provide funding for manure storage.
- Adjust NRCS manure storage program so that each pit is eligible for up t o $50,000 rather than only one or two per county getting $100,000.
- In Manitowoc County's portion of the watershed, two more manure storage facilities are needed. The old Priority Watershed program had lots of benefits and it has not been replaced with anything comparable.
- Increase funding for nutrient management. For example Manitowoc County used to receive $150,000 per year from DATCP, now it receives $22,000 annually.
- More funding is needed for nutrient management planning - $250,000 is critical, $500,000 would be excellent.
- Address the spreading of industrial waste from cheese and packing plants.
- In Manitowoc County, three of the five active barnyards in the watershed within 300 feet of a mapped stream need runoff control improvements. One needs to remove livestock access from stream.

2. Minimize urban stormwater runoff

- Provide guidance to the City of Two Rivers in fulfilling its MS4 permit requirements.
- Provide encouragement and guidance to Denmark and the Village of Francis Creek for conducting stormwater BMPs voluntarily

3. Protect groundwater resources

- Increase private well testing.
- Conduct an inventory of unused wells.
- Increase groundwater protection work. Groundwater concerns are what drew Manitowoc County to focus on the West Twin.
- Increase funding for proper abandonment of unused wells.
- Conduct groundwater sampling to determine whether herbicide and pesticide contamination exists in the Village of Francis Creek.

3. Restore key wetlands and forestlands to improve and protect water quality

- Restore wetlands for lake and stream water quality protection.
- Increase funding to Counties to restore wetlands.

4. Establish riparian buffers to protect water quality

- In Manitowoc County's portion of the watershed, establish 600 more acres of conservation buffers.

5. Monitor and control non-native invasive species

- Clean Boats/Clean Waters volunteers monitor lake and stream public access sites to educate water users of aquatic invasive species prevention steps.
- Brown and Kewaunee Counties hire an aquatic invasive species coordinator similar to Manitowoc County's coordinator.

6. Minimize fish passage barriers

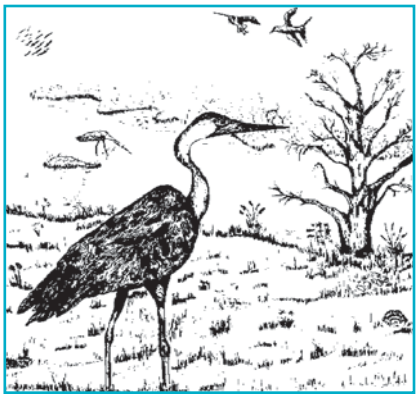
- Assess culvert placement in the watershed to determine if culverts are impeding fish migration.

7. Obtain water quality and biological monitoring data to adequately assess water resource conditions

- All lakes in the West Twin River Watershed (except Lilly Lake) collect updated water quality data to assess the current overall lake health. These data could be collected by Citizen Lake Monitors.
- Make water quality data accessible to county staff
- Accept citizen monitoring data (or data from other sources) into the WDNR system as credible data and increase citizen monitoring programs.
- Conduct a fish community survey and assess water condition status in the Devils River. Last survey was in 2002.
- Monitor inverts and fish in the upper reaches of Devils River (use warmwater IBI).
- Assess condition of Kriwanek Creek to confirm natural community and water condition status. Confirm aquatic life use designation (LFF Survey from 1975).
- Monitoring to evaluate aquatic life condition in Black Creek should be conducted when possible. USGS has a long-term monitoring station on this stream. WDNR would like to obtain this data and analyze for condition/ trend summarization (use warmwater IBI).
- Stream hydrology is the limiting factor of King Creek. Monitoring is needed because in 2002, no fish were found in stream.
- Monitor stream to evaluate fish community and water condition of Francis Creek (use warmwater IBI).
- Conduct assessment monitoring on streams in the West Twin River watershed (TK01) to further define nonpoint source problems. Assessment monitoring should include stream habitat surveys (Simonson et al., 1993) to help identify stream segments that are degraded because of the lack of adequate buffers and vegetative filter strips. This information will help guide CREP, the Targeted Runoff Management (TRM) Program, and other conservation funding programs to the areas of greatest need.
- WDNR staff should analyze resident fish from selected waters for PCB and mercury contamination.

Increase citizens' watershed awareness, understanding and stewardship

- Establish and support more watershed groups through outreach and capacity grants
- Seek funding for distributing (mailing) the West Twin River System "Explore and Restore" brochure in Kewaunee and Brown counties.
- Seek funding and expand partnerships to continue "Explore and Restore" programming and exhibit development throughout the watershed.
- Encourage and promote the formation of lake and river management organizations through outreach and capacity grants for rivers, lakes and runoff program opportunities.
- Encourage and promote comprehensive management planning and implementation of management recommendations to protect, enhance, and restore water quality and habitat of the water resources in this watershed.
- Educate riparian residents about waterfront owner stewardship, the value and protection of shoreline habitat and native aquatic plant species.
- Educate residents and users of the water resources in the watershed about preventing the spread of nuisance exotic species that threaten native species and habitat.
- Provide funding for county staff to spend more time making individual contacts with landowners.



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Twin River in Manitowoc County (above the Shoto Dam). Credit: Debbie Beyer, UWEX

Wisconsin DNR's mission involves preserving, protecting, and restoring natural resources. Watershed Planning provides a strategic review of water condition to enhance awareness, partnership outreach, and the quality of natural resource management.

West Twin River Watershed