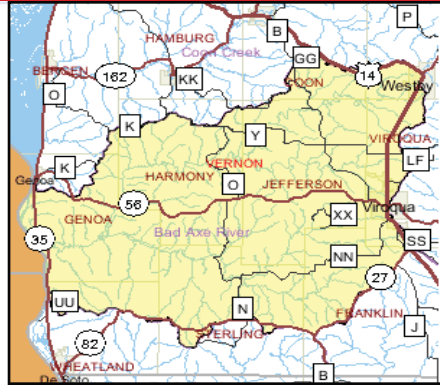


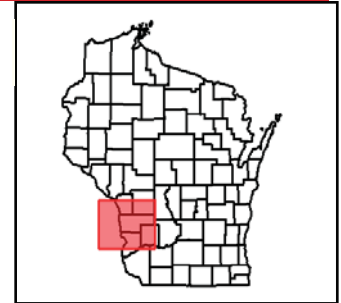
Bad Axe-LaCrosse River Basin, Wisconsin

The Bad Axe River Watershed, which lies entirely within Vernon County, encompasses approximately 200 square miles of steep forested hillsides, ridge top and valley farms.

The only farms with sizable tillable acreage in the basin are located on the upper plateau of the Bad Axe River watershed, west of Westby and Viroqua. The communities of Viroqua, Westby and Genoa are all found within this watershed.



Map 1: Bad Axe River Watershed



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Watershed Details

Population and Land Use

The chart at right shows watershed land use data from the 2001 National Land Cover Inventory dataset, which illustrates the dominance of agriculture and forests in the watershed (Figure 1).

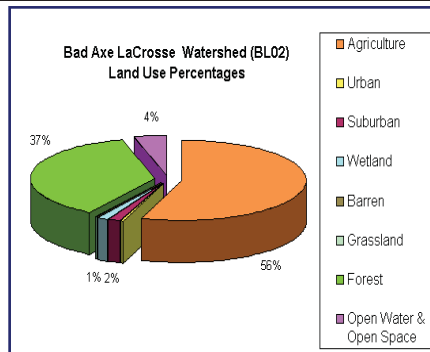


Figure 1: Watershed Land Use

Hydrology

Excessive flooding in the Bad Axe River watershed in the 1950s and 1960s prompted the construction of many flood control structures on numerous streams. Some of these structures are designed to permanently detain water (wet dam) while many others impound water only during rain events (dry dam) then slowly release it over time. Vernon County is responsible for maintaining many of these flood control structures.

These structures were put to the test in August 2007 and again in June 2008. What has been called the "1,000 year flood" occurred on August 18, 2007. All 8 flood control structures in the Bad Axe River Watershed were



Mudslide that moved a house onto HWY 35 in Vernon County during August 18, 2007 flood. WDNR Photo

damaged. Saturated soils on hillsides slumped and created mudslides; bridges and culverts were washed out; roads were flooded; and flood control structures were stressed to their limits. Emergency spillways were compromised at many dams in Vernon County. The waters behind the dam located on the Springville Branch of the Bad Axe River reached its concrete emergency spillway, which was an historic event.

Bad Axe River watershed resulting in overflow to their emergency spillways. Destructive scour by the excess water required extensive repair. The waters behind the Bad Axe 11 – Duck Egg dam (on the Springville Branch of the Bad Axe River) reached a height never before recorded.

Past land use of the steep terrain in this watershed contributed to the reshaping of the land and water resources. Soil washed off hilltops and hillsides down to the streams, which filled the floodplains -- and gave streams nowhere to go with high water. The streams, having to find their new equilibrium, cut down through these long ago eroded soils creating streams with vertical streambanks and no virtually floodplain.

Trout stamp funds have been used over the last 33 years to reshape many of these streambanks through movement of soil and planting of grasses, effectively giving the streams access to a new floodplain. After the floods of 2007 and 2008, those segments of streams where streambank work was done showed no catastrophic changes compared to those segments without reshaped and planted streambanks. Very little repair of the previous streambank work was necessary.

Steep hillsides became unstable with the excessive rain and many slumped or slid down to the lowest spot destroying some buildings and roads in the process (See photo upper right). Many stream miles and structures were unharmed due to the effectiveness of these flood control structures during both the 2007 and 2008 flood events.

Ecological Landscapes

This watershed, located in the Western Coulee and Ridges Ecological Landscape in southwestern and west central Wisconsin, is characterized by highly eroded, driftless topography and extensive forested landscape. Soils are silt loams (loess) and sandy loams over sandstone residuum over dolomite. The Wisconsin, Mississippi, Chipewewa, Kickapoo and Black rivers flow through or border this Ecological Landscape (Map 2).

Historical vegetation consisted of southern hardwood forests, oak savanna, scattered prairies, and floodplain forests and marshes along the major rivers. With Euro-American settlement, most of the land on ridgetops and valley bottoms was cleared of oak savanna, prairie, and level forest for agriculture. The steep slopes between valley bottom and ridgetop, unsuitable for raising crops, grew into oak-dominated forests after the ubiquitous presettlement wildfires were suppressed. Current vegetation is a mix of forest (40%), agriculture, and grassland with some wetlands in the river valleys.

The primary forest cover is oak-hickory (51%) dominated by oak species and shagbark hickory. Maple-basswood forests (28%), dominated by sugar maple, basswood and red maple, are common in areas that were not



Floodwaters flowing over the emergency concrete spillway of the Springville Dam on the Springville Branch of the Bad Axe River. August 20, 2007.



Aftermath of floodwater scour of the Runge Hollow Lake Dam emergency spillway on the North Fork of the Bad Axe River. August 23, 2007.



Map 2: Ecological Landscapes of the Bad Axe River Watershed

subjected to repeated presettlement wildfires. Bottomland hardwoods (10%) are common in the valley bottoms of major rivers and are dominated by silver maple, ashes, elms, cottonwood, and red maple. Relict conifer forests including white pine, hemlock and yellow birch are a rarer natural community in the cooler, steep, north slope microclimates.

Other Details

Recreation

Major Public Lands in the Bad Axe LaCrosse Watershed include the Upper Mississippi River Fish and Wildlife Refuge, Sidie Hollow County Park, Duck Egg County Park, and Esofea County Park.

Recreational parks surround two flood control structures: Sidie Hollow County Park on Sidie Hollow Creek and Coe Hollow Creek and Duck Egg County Park on the Springville Branch. Many miles of trout streams have WI DNR streambank easements which allow public angler access. A boat landing and fishing pier are available to the public on Runge Hollow Lake.

Fisheries

Generally, the North Fork of the Bad Axe River contains warmer water than the South Fork, consequently more of the South Fork is classified as trout water. However, the North Fork contains a very diverse fishery below Runge Hollow Lake. The Bad Axe River only totals five miles in length and contains a fishery more similar to the Mississippi River rather than the North and South Forks that feed it. Smallmouth bass, brown trout, and brook trout are found in the many miles of streams in this watershed.

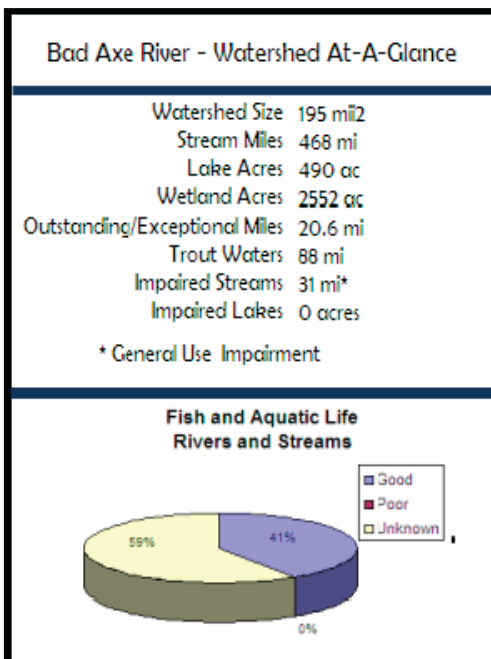
Historical Summary

Vernon County is set in the driftless southwestern corner of Wisconsin; an area that was untouched by the receding glaciers 15,000 years ago and thus an area of deep carved valleys, or coulees, drained by hundreds of cold-water streams, was left.

Vernon County was originally named Bad Axe County, but was renamed Vernon County in 1862. The largest city in the county, and also the county seat, is Viroqua, with a population of 4,400. The Downtown District of the city was named to both the Wisconsin and National Register of Historic places in 2003 due to the merits of the buildings in the district which are largely intact.

Viroqua is the center of one of the greatest organic farming regions in the United States and each Saturday from late May to late October, the Farmers Market is a lively and busy place full of colorful produce. Local Amish families also sell their handmade wooden items and beautiful rugs and quilts.

The city of Westby is located in the northeast corner of the watershed. Westby was named after general store owner and Civil War Union soldier, Ole T. Westby, of Biri Norway. Many Norwegians settled in the area and the local economy was built on agriculture, with a strong tradition of cooperative businesses. With seven cooperatives still functioning, Westby has been referred to as "Co-op City".



Watershed Condition

Priority Issues

Priority issues for this watershed include the quantity and quality of stormwater reaching surface waters, and the impacts on surface water temperature from stormwater water runoff. A related but distinct priority is identifying and reducing urban and agricultural nonpoint source pollution in addition to stormwater runoff.

Water Quality Goals

Water Quality Goals for the Watershed Include:

- Conducting comprehensive stream surveys on impaired or potentially impaired streams;
- Installing in-stream habitat where habitat is a limiting factor for biological condition; and
- Continuing work to conduct continuous water temperature monitoring on key streams where temperature may be a limiting factor for biological response.

Overall Condition

The Bad Axe Watershed's waters are generally in good condition with three exceptional resource waters in Vernon County: Cox Creek, 5.79 miles, Hornby Creek, 9.59 miles, and Frohock Creek (Creek 15-14), 5.24 miles, and many miles of trout waters throughout the area. Waters recently monitored and found to be in overall good condition include Coe Hollow Creek, Bad Axe River, Springville Branch, Hornby Creek, and Sidie Hollow Creek. Esofea Branch was indicated as possibly fair condition with a need for more monitoring. The only impaired water in this watershed is the Mississippi River, which forms the western edge of the land area.



Fish Shocking on the North Fork of the Bad Axe LaCrosse River. WDNR Photo.

Aquatic Invasive Species Infestations

A few aquatic invasive species have been documented including Curly Leaf Pondweed on Coe Hollow Creek, Runge Hollow Lake, Sidie Hollow Lake, and North Fork Bad Axe River. Eurasian Watermilfoil is found on Runge Hollow Lake. Rusty Crayfish is found on Springville Branch.

Lakes and Rivers with Aquatic Invasives - Vernon County

Waterbody Name	Waterbody ID Code (WBIC)	Species
Battle Slough	725700	Zebra Mussel
Jersey Valley Lake	1191600	Curly-Leaf Pondweed, Eurasian Water-Milfoil
Pool Eight 64700	726205	Eurasian Water-Milfoil
Runge Hollow Lake	1642400	Curly-Leaf Pondweed, Eurasian Water-Milfoil
Sidie Hollow Lake	1641400	Curly-Leaf Pondweed
Springville Br Bad Axe River	1642200	Rusty Crayfish

Point and Nonpoint Sources

Viroqua WWTP Study

Above the large spring that provides the initial flow for the Springville Branch Bad Axe River, the stream channel is a dry run classified as limited aquatic life in ch. NR 104. Below the spring, the Springville Branch is managed as a Class I trout stream. This study involves evaluating various alternatives for wastewater effluent from the city of Viroqua. The city operates a 0.600 million gallons per day (MGD) wastewater treatment facility that discharges to the dry run upstream of the Springville Branch of the Bad Axe River. The wastewater effluent flows over karstic rock (an area of irregular limestone in which erosion has produced fissures, sinkholes, underground streams, and caverns) for approximately 2.75 miles upstream of the Springville spring. Investigations by the WDNR and the City have determined that the vast majority of the wastewater is lost to groundwater either through swallets or flow directly over exposed fractured bedrock prior to reaching the

spring. Discharge of treated wastewater into fractured bedrock is an unacceptable practice. Alternatives include:

1. Treating effluent to groundwater standards.
2. Piping the effluent to surface water.
3. Constructing a catchment structure upstream of exposed bedrock and piping effluent around the area of exposed bedrock to surface water.
4. Modify the streambed to reduce infiltration

A solution of how to treat or route the effluent of the Viroqua WWTP will be decided before the next permit term.

Winter Manure Runoff Study, Conducted in 2007

Department staff monitored various flowages and mainstem tributaries to understand and document agricultural runoff entering the flowages during active snowmelt events. The study design includes collecting pre-runoff data from all flowages and their main stem tributaries. Dissolved oxygen and temperature profiles in the impoundments were conducted approximately every three weeks to document stratification prior to a runoff event. Water chemistry samples were collected in the zone of anoxia (or no oxygen) -- if found -- to understand and document water quality conditions prior to runoff.

Rivers and Streams

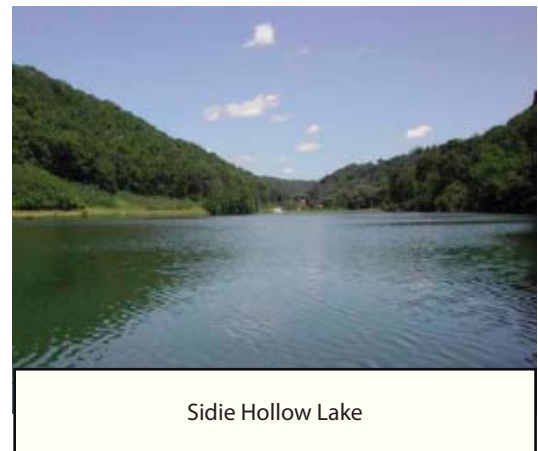
This 195 square mile watershed has over 468 stream miles and 490 lake acres. Over 2,550 wetland acres are also located in this watershed. Of the rivers and streams in the area, more 41 percent of waters assessed are considered in "good" condition for Fish and Aquatic Life Use ("fishable/swimmable") and 59% of the stream miles are "unassessed".

Lake Health

Sidie Hollow Lake

Sidie Hollow Lake is one of the few lakes in this watershed. Sidie Hollow Lake is 35 acres, with a maximum depth of 22 feet. This lake is located just south of Viroqua near the headwaters of the South Fork of the Bad Axe River and surrounded by Vernon County land known as Sidie Hollow Park. This lake was assessed for Fish and Aquatic Life uses in 2009 and considered "fair" based on satellite derived trophic state index data. The lake is considered "eutrophic". Historical reports indicate that Sidie Hollow Lake is an impoundment constructed under the PL-566 conservation program. In the 1970's the water was clear, hard, alkaline, and considered to have moderate transparency. Today the lake is documented as "murky", although it drains to the South Fork of the Bad Axe River, a class III trout water. A 2003 fish survey of Sidie Hollow Lake documented largemouth bass, bluegill, brown trout, brook trout, yellow perch, black crappie and white sucker. Netting also documented both painted and snapping turtles.

Aquatic plant surveys were conducted on Sidie Hollow Lake in 1994 and again in 2005. From these surveys it was noted that the aquatic plant growth is distributed throughout Sidie Hollow Lake, over 66% of the lake, to a maximum rooting depth of 15 feet. The plant community is characterized by a fair diversity of plant species, and above average quality plant community for Wisconsin lakes, and a very high quality for the Driftless Region lakes. Filamentous algae increased in the lake since 1994 and the dominant plant species was



Sidie Hollow Lake

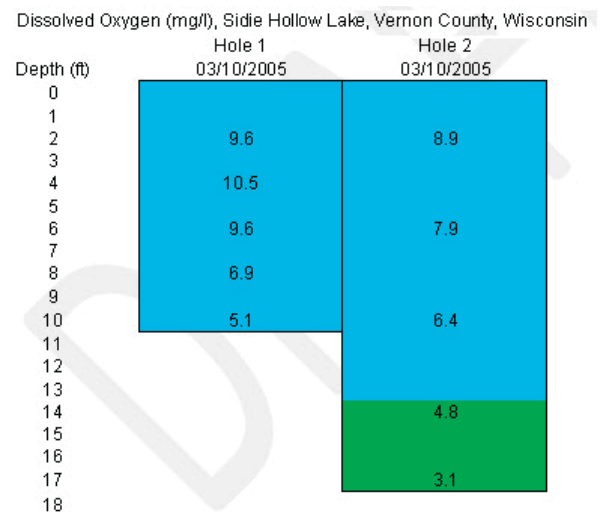


Figure 2. Sidie Hollow Lake Profile, 3/05

coontail (*Ceratophyllum demersum*) in both 1994 and 2005.

An early spring snowmelt event took place on March 8-9, 2005 in south western Wisconsin. Manure spreading of farm fields was prevalent during this unusually early warm spell. Runoff of snowmelt with recently applied manure caused a major fish kill of Jersey Valley Lake, an impoundment in a neighboring watershed. This event prompted monitoring of Sidie Hollow Lake. The lake did have an area of depressed dissolved oxygen (3.1 mg/l) at the deepest point, but no fish kill (Figure 2, previous page).

Runge Hollow Lake

Runge Hollow Lake is a 45 acre impoundment at river mile 18 of the North Fork of the Bad Axe River. The 15 foot deep lake is sandwiched between two hills with an earthen dam (PL-566 structure) transecting the valley. A 2005 plant survey of this lake reported existence of Eurasian watermilfoil. Since the lake levels can be manipulated at the dam structure, the lake was drawn down over the winter of 2005-06 to expose this invasive plant species and the sediments it grows in to freezing temperatures. A re-survey of this lake in 2006 after the water levels were returned to normal did not document Eurasian watermilfoil. This lake is a popular fishing lake for area citizens. The land surrounding Runge Hollow Lake is all privately owned. An easement was given for a parking lot, fishing pier and boat launch at Runge Hollow Lake. A 2003 fish survey documented largemouth bass, bluegill, black crappie, green sunfish, carp, and white sucker.

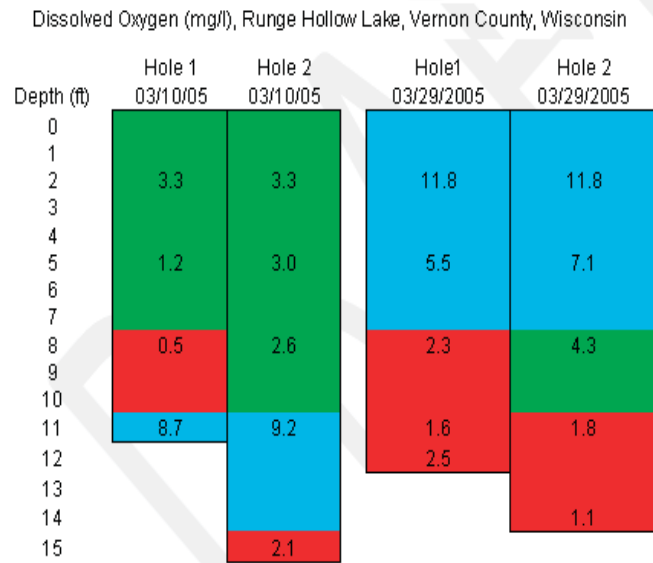


Figure 3. Runge Hollow Lake Profile, 3/05

An early spring snowmelt event took place on March 8-9, 2005 in south western Wisconsin. Manure spreading of farm fields was prevalent during this unusually early warm spell. Runoff of snowmelt with recently applied manure caused a major fish kill of Jersey Valley Lake, an impoundment in a neighboring watershed. This event prompted monitoring of Runge Hollow Lake. On March 10, 2005 Runge Hollow Lake did contain areas of very low dissolved oxygen, however there was a zone of refuge for fish containing between 8 and 9 mg/l of dissolved oxygen. A follow up survey on March 29, 2005 showed a larger area of low dissolved oxygen but also a larger total area of adequate levels. The watershed of Runge Hollow Lake is much larger than Sidie Hollow Lake and contains a larger percentage of farm fields that may have been spread with manure prior to the snowmelt. Runge Hollow Lake is certainly susceptible to winterkill due to manure laden snowmelt, but did not kill during this March 2005 event (see Figure 3).

Wetland Health

Wetland Status

The Bad Axe LaCrosse Basin, in the driftless area of the state, has few wetland resources. Only about 2% of the current land uses in the watershed are wetlands. However, 81% of original wetlands in the watershed are estimated to exist (Figure 4). Of these wetlands, the majority are forested wetlands (51%) and emergent wetlands (40.9%) which include marshes and wet meadows.

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 domi-

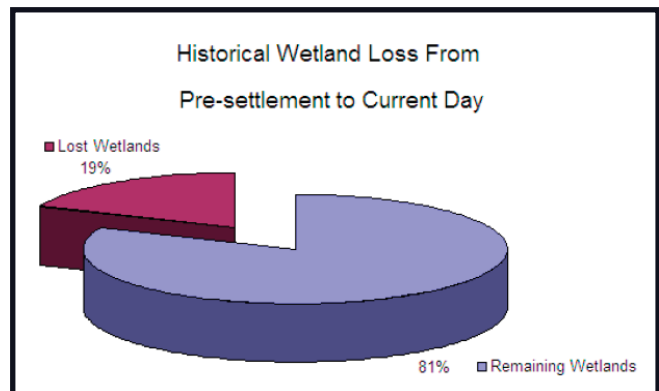


Figure 4: Historical Wetland Losses

nates 77% of the existing emergent wetlands and 18% of the remaining forested wetlands (see Figure at right). Reed Canary Grass domination inhibits successful establishment of native wetland species.

Wetland Restorability

Of the 533 acres of estimated lost wetlands in the watershed, approximately 90% are considered potentially restorable based on modeled data, including soil types, land use and land cover (Chris Smith, DNR, 2009).

Groundwater

This watershed contains areas where there is direct and obvious groundwater/surface water interactions, such as the Springville Branch of the Bad Axe River. The presence of dolomite and karst topography in this region is not uncommon.

Waters of Note

Outstanding and Exceptional Resource Waters

The Bad Axe Watershed's streams are generally in good condition. The following three exceptional resource waters are located in the watershed in Vernon County: Cox Creek, 5.79 miles, Hornby Creek, 9.59 miles, and Frohock Creek (Creek 15-14), 5.24 miles.

Trout Waters

There are 35 miles of Class I trout streams in the watershed including: Bad Axe River Springville Branch, Norwegian Hollow Cr., Coe Hollow Creek, Frohock Creek (Creek 15-14), and Hornby Creek. Two additional streams are Class II Trout waters, meaning some propagation occurs, but the streams are partially self-sustaining: Esofea Branch, Sidie Hollow Creek, and there are about 28 miles of Class III trout waters, which do not exhibit natural reproduction: an Unnamed stream, South Fork Bad Axe River, and Cox Creek.

Impaired Waters

The Mississippi River's Pool 9 [(Mississippi (Reach 4) Coon-Yellow - Pool 9 portion - LD 9 to LD 8)] considered part of this watershed, is on the state's impaired waters list for Contaminated Fish Tissue, Water Quality Use Restrictions due to polychlorinated biphenyls (PCBs) and Water Quality Use Restrictions due to ambient Mercury concentrations in the water column.



Reed Canary Grass

WADRS ID	Official Waterbody Name	Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class	Trout ID
13970	North Fork Bad Axe River	Esofea Branch	1641700	12.15	31.17	CLASS II	2262
893324	Springville Br Bad Axe River	Bad Axe River, Springville Branch	1642200	0	12.3	CLASS I	2263
893831	Unnamed	Unnamed	1641000	.01	1.86	CLASS III	3075
894342	Norwegian Hollow Creek	Norwegian Hollow Cr.	1640600	0	5.16	CLASS I	3074
894400	Sidie Hollow Creek	Sidie Hollow Creek	1641500	0	3.62	CLASS II	2261
13967	South Fork Bad Axe	South Fork Bad Axe River	1639900	0	22.03	CLASS III	3073
949126	Coe Hollow Creek	Coe Hollow Creek	1641200	0	3.67	CLASS I	1004
949133	Cox Creek	Cox Creek	1641800	0	5.79	CLASS III	3076
949141	Unnamed	Frohock Creek (Creek 15-14)	1640400	0	5.24	CLASS I	1001
949680	Hornby Creek	Hornby Creek	1640700	0	9.59	CLASS I	1002

Watershed Actions

Grants and Projects:

No rivers, streams or runoff grants are on record as having been issued for waters in this watershed.

Monitoring Studies

- Citizen Lake Monitoring - Water Quality - Sidie Hollow Lake; Deep Hole
- Ice Observations on Sidie Hollow Lake, Vernon County

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. Volunteers measure water clarity, using the Secchi Disk method, as an indicator of water quality. This information is then used to determine the lakes trophic state. Volunteers may also collect chemistry, temperature, and dissolved oxygen data, as well as identify and map plants, watch for the first appearance of Eurasian Water Milfoil near boat landings, or alert officials about zebra mussel invasions on Wisconsin lakes.

- WCR - Natural Community Stream Reference Sites -- 2008, 2009 Active
This study involves reference site selection and monitoring using the 2008 Streams Natural Communities dataset, which was based on stream flow and temperature modeled by WDNR Integrated Science Services and USGS Region V States. This study evaluates highest quality streams representative of each of the eleven proposed natural communities. The purpose of the study is to provide the range of biological and ecological conditions for specific communities through determining the “potential biological use” of each and to gather information that will provide insight into the value of the 11 distinct natural communities for state assessment and water quality standards work.
- WCR Watershed Rotation Sites 2006 Active
Stream water quality monitoring covering primarily biological, chemical, and habitat related monitoring to determine ambient conditions at “pour point” locations for each of state’s 330 watersheds.
- West Central Region Clean Water Act Study 2007 Complete
West Central Region portion of a statewide Clean Water Act monitoring study of biology, chemistry and habitat in streams. Sixty-four (64) stations were sampled with over 140 fieldwork events completed. The results of this statewide study are in development.

Recommendations:

- The South Fork of the Bad Axe River fishery would benefit from the reduction of streambank erosion.
- The Springville Branch fishery would benefit from the removal of beaver dams, the reduction of non-point source pollution and the continued proper operation of the Viroqua Wastewater Treatment Plant.
- WDNR regional staff should continue to encourage communities to develop wellhead protection plans in the Black- Buffalo-Trempealeau River Basin (BBT).
- A fish and habitat survey should be conducted on Bull Run to update biological and physical data
- Fish and habitat surveys should be conducted on Cox Creek, Frohock Creek, Hornby Creek, Norwegian Hollow Creek, Sidie Hollow Creek, Bad Axe River, and Unnamed Creek 28-16.
- The North Fork of the Bad Axe River fishery would benefit from improved in-stream habitat and reduced stream-bank erosion.
- The Cox Creek and Frohock Creek fisheries would benefit from improved in-stream habitat.
- Runge Hollow Lake is considered a high priority to receive a lakes planning grant to assess the impacts of nonpoint source pollution to the lake.
- Sidie Hollow Lake is considered a high priority to receive a lakes planning grant to assess the impacts of nonpoint source pollution to the lake.
- The WDNR should seek a citizen lake monitoring (self-help) volunteer monitor for Sidie Hollow Lake.
- The City of Viroqua should pursue the development and implementation of a stormwater management plan for their community.



Stream Habitat Restoration, Bad Axe River. WDNR Photo, 2010.

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DNR PUB WT-933

UW
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Basin Education Initiative

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Bad Axe River Watershed