KICKAPOO RIVER WATERSHED ASSESSMENT

2000 TO 2010

VALLEY STEWARDSHIP NETWORK

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DECEMBER 2011

EXECUTIVE SUMMARY

This Kickapoo River Watershed Assessment has been created by the Valley Stewardship Network (VSN) to provide a critical look at the health of the watershed based on surface water data. Surface water quality data, while one of many components used to assess the health of a watershed, is among the most informative. Thanks to the extraordinary commitment of citizen monitors VSN has provided a quantity of surface water quality data in the Kickapoo River Watershed that compares to that of the regulatory agencies. This assessment will review both Wisconsin Department of Natural Resources (WDNR) and VSN data since 2000.

Data was analyzed for each watershed, waterbody and station. The Kickapoo watershed was divided into five smaller watersheds as defined by the WDNR; Upper, Middle and Lower Kickapoo Watersheds, West Fork of the Kickapoo Watershed and Reads and Tainter Watershed. For the purpose of this assessment, data was separated into six assessment categories; temperature, core, nutrients, macroinvertebrate, bacteriological and chemical. Data was assessed using WDNR and US Environmental Protection Agency water quality limits and recommendations. In most cases the data available was not extensive enough for a conclusive determination. As such the data was used to provide an indication of the watershed health.

The water quality data shows varying watershed health conditions. Some data shows no degradation, while other data showed evidence of human impact. Only a few streams had values that could be considered impaired by WDNR classification system. Most streams showed temperature ranges that could be classify it as a cold stream. Some streams showed temperatures values outside the characteristic cold stream levels. These were mostly larger streams. Dissolved oxygen was generally at or near saturation, although levels below saturation were found in some streams. Transparency levels did not show degradation in most streams however the Lower Kickapoo did have impacted transparency as did some of the other larger streams. Nutrients and bacteriological data showed the greatest number of values that met impairment levels. A large number of nutrient data points indicated impacts from human activity. Macroinvertebrate data showed a range of stream health from “unlikely” to “very significant” pollution levels; most were in the “slight” to “unlikely” pollution category. Chemical data provided useful information regarding the application of toxicity limits but did not indicate any chemical exceedances in the streams.

The indication of human impact reinforces that responsible land use by all land owners in the watershed is essential. It is vitally important that widespread implementation of agricultural and non-agricultural best management practices occur.

Although this report did not assess groundwater, spring data showed cases where nutrient levels in springs were higher than in the streams they feed. This could be a reflection of the Karst geology of the Driftless region. Further investigation and citizen education on the interconnection of the ground and surface waters is needed. Also the impacts of flooding in the watershed were evident in the water quality data. As such, further examination of the impacts of climate change on the watershed is warranted.

This assessment revealed that continued monitoring by the WDNR and VSN in the watershed fill an important role in assessing the health of the watershed and should be continued and be more comprehensive.

ACKNOWLEDGEMENTS

This assessment has been completed with assistance from a number of contributors.

John Conlon of Verticon provided guidance and expertise in the compilation and manipulation of the large data set. Christina Anderson of the Wisconsin Department of Natural Resources assisted with the data downloads. The Valley Stewardship Network Water Quality Steering Committee provided technical input and VSN Board Members Cynthia Olmstead and Natalie McIntyre proofread the document.

Moral support was provided by Luke and Olive Zigovits and the Staff and Board of the Valley Stewardship Network.

Lastly, VSN thanks the Wisconsin Department of Natural Resources who provided funding for the assessment.

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INTRODUCTION AND BACKGROUND

This Kickapoo River Watershed Assessment has been created by the Valley Stewardship Network (VSN) to provide a critical look at the health of the watershed. There are many components to assessing the health of a watershed not all of which are covered by this assessment. However, surface water quality data is among the most informative. Thanks to the extraordinary commitment of citizen monitors, VSN has provided a quantity of water quality data in the Kickapoo River Watershed that compares to that of the regulatory agencies. This assessment will review both Wisconsin Department of Natural Resources (WDNR) and VSN data since 2000.

ORGANIZATIONS

VALLEY STEWARDSHIP NETWORK

VSN is a watershed advocacy organization working to promote pro-active stewardship in the Kickapoo River watershed and adjacent regions in an effort to create a balance between a healthy environment and strong communities. VSN's geographic area of operation is the Kickapoo River watershed and adjacent regions.

VSN has been managing a citizen-based water monitoring program in the Kickapoo River and adjacent watersheds since 2000. The VSN Water Quality Program receives program and technical support from the Wisconsin Water Action Volunteers (WAV) Program executed by the University of Wisconsin Extension and the WDNR. The VSN operates all levels of the WAV program with staff and volunteer monitors. Operating a WAV program includes hosting and leading water monitoring trainings and providing technical assistance. VSN also acquires and maintains monitoring equipment. Lastly VSN is responsible for quality assurance/quality control of the monitoring and collection of the monitoring data.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

The Wisconsin Department of Natural Resources is the state regulatory agency that is responsible for preserving and enhancing the natural resources and environment of Wisconsin. It manages state fish, wildlife, forests, parks, air and water resources, and environmental protection.

CITIZEN BASED MONITORING

Citizen based monitoring is an effective tool in monitoring the environment. The WAV program has well defined protocols and trains citizens in basic analysis and sampling. WAV Level 1 monitors follow state-wide monitoring protocols to ensure consistency in citizen-monitoring data collection and a standardized level of quality. Level 2 monitors follow the state-wide protocol which uses the same standardized methods as WDNR staff. This ensures Level 2 data can be compared to data collected by the WDNR. Depending on which methodologies were used for the Level 3 project, data will be consistent with either Level 1 or Level 2 data. Level 3 lab samples were sent to a state certified laboratory and therefore will be comparable with data from all state certified laboratories.

Level 1 volunteers collect data for the following parameters:

- Dissolved oxygen (concentration),
- Dissolved oxygen (saturation; derived from concentration and water temperature),
- Water temperature (instantaneous),

- pH,
- Transparency,
- Air temperature (instantaneous),
- Water flow from stream width, depth, and float trails for a given stream distance,
- Habitat Assessment data, and
- Biotic Index samples from cut banks, riffles, snags and debris.

Level 2 volunteers collect data for the following parameters:

- Dissolved oxygen (concentration),
- Dissolved oxygen (saturation),
- Water temperature (instantaneous and continuous),
- pH,
- Transparency, and
- Air temperature (instantaneous).

KICKAPOO RIVER WATERSHED

The Kickapoo River Watershed includes all waters that drain to the Kickapoo River. A general outline of the watershed can be seen in Figure 1.

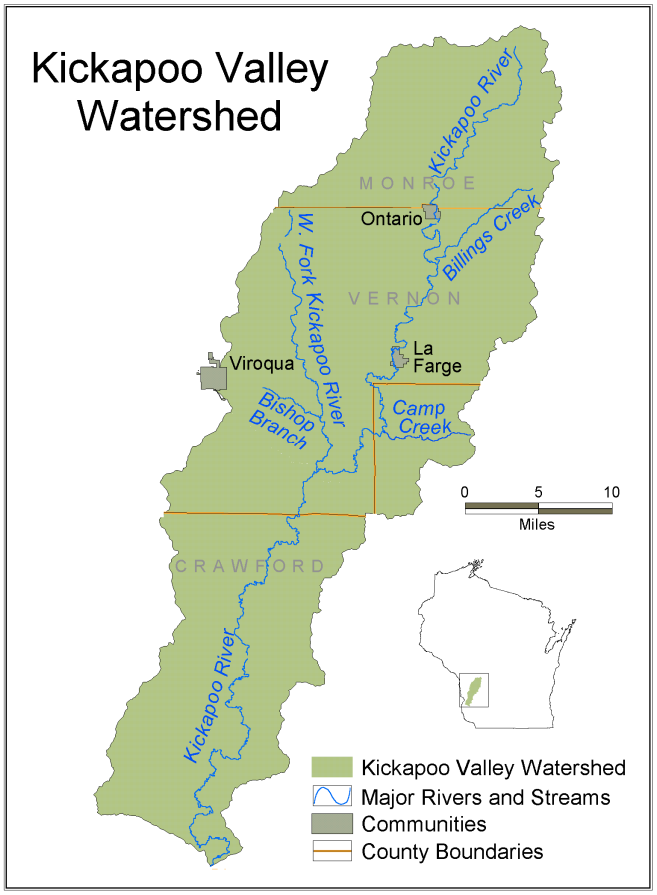


Figure 1 – Kickapoo River Watershed

The WDNR states the following about the Kickapoo River Mainstem.

> "Of all the tributaries to the Wisconsin River, the Kickapoo River is the longest. It begins in south central Monroe County and flows in a southerly direction for 130 miles through Vernon, Richland and Crawford Counties before reaching the Wisconsin River near the Village of Wauzeka. The Kickapoo River lies within a 768-square mile drainage basin in southwest Wisconsin. The entire basin is within the Driftless Area, the portion of the State not flattened by glaciers. Approximately 46% of the basin contains slopes of 15% or greater and another 23% of the basin contains lands with slopes between 8 and 15%.
>
> The name Kickapoo is an Algonquin word meaning "one who goes here, then there" and accurately describes the Kickapoo River which flows in all directions of the compass for portions of its length. The Kickapoo River falls toward the Wisconsin River at an average rate of 5.9 feet per mile; however, the river is relatively steep in Monroe County with a gradient of 22.7 feet per mile compared to the much more gradual 3 feet per mile in Vernon, Richland and Crawford Counties. The meandering character of this river across its floodplain is the result of the relatively flat gradient. As the crow flies, the Kickapoo River extends approximately 60 miles from headwater to mouth, but the river flows for 130 miles, more than double that length." [1]

The WDNR divides the Kickapoo River Watershed in five smaller watersheds; Upper, Middle and Lower Kickapoo Watersheds, West Fork of the Kickapoo Watershed and Reads and Tainter Watershed.

UPPER KICKAPOO WATERSHED

Although spring sourced headwaters exist throughout the Kickapoo River sub-basin, the "true" start of the Kickapoo River lies in the Upper Kickapoo Watershed. The Upper Kickapoo Watershed is an area of 117 square miles situated predominately in southern Monroe County (Township and Ranges 15N01W, 15N02W, 16N01W, 16N02W) including the communities of Norwalk, Wilton and Ontario as seen in Figure 2.

The Kickapoo River gradient in the Upper Kickapoo Watershed averages 22.7 feet per mile. The characteristic steep sandstone cliffs of the Kickapoo River are predominately in the Upper watershed.

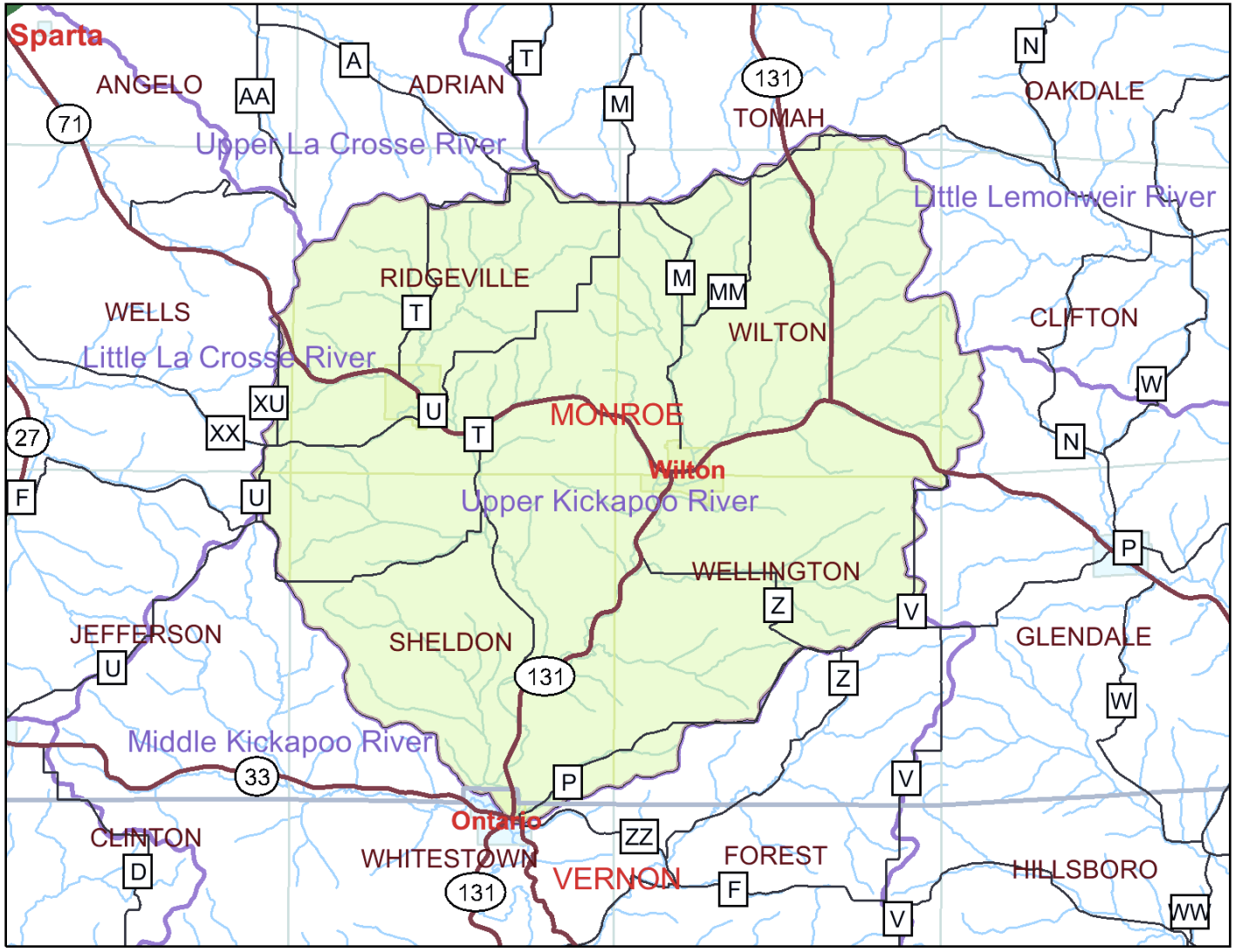
ECO-SYSTEM

The Upper Kickapoo Watershed is categorized as a Western Coulee and Ridges Ecological Landscape. This landscape is defined as highly eroded, driftless topography and relatively extensive forested lands. Soils are generalized as silt loams (loess) and sandy loams over sandstone residuum over dolomite. [2]

The WDNR states the following about current and historic vegetation of the Western Coulee and Ridges Ecological Landscape:

> "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

Figure 2 - Upper Kickapoo Watershed



Legend

Major Highways

- Interstate
- State Highway
- U.S. Highways

County Roads

24K County Boundaries

24K Watersheds

Civil Towns

- Civil Town

100K Open Water

100K Rivers and Streams

Cities and Villages

- Village
- City

0 3.5 7 10.5 mi.

Scale: 1:194,274

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

shagbark hickory. Maple-basswood forests (28%), dominated by sugar maple, basswood and red maple, are common in areas that were not 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." [2]

As of 2009 the Bureau of Endangered Species of the WDNR Wisconsin Natural Heritage Inventory indicates that Alder Thicket, Dry Cliff, Forested Seep, Hemlock Relict, Moist Cliff, Northern Mesic Forest, Pine Relict, Southern Dry-mesic Forest, Southern Mesic Forest, Southern Sedge Meadow natural communities and Bat and Herp Hibernaculum have been observed in the Upper Kickapoo watershed. In addition, Table 1 indicates observations of species that are classified as of concern, threatened or endangered. [3]

Table 1 – Of Concern, Threatened or Endangered Species of the Upper Kickapoo

Plant	Bird	Insect	Fish	Reptile	Mammal
Autumn Coral-root, Beak Grass, Innocence, Musk-root	Acadian Flycatcher, Cerulean Warbler, Flycatcher, Henslow's Sparrow	Bog Beetle	Redside Dace	Blanding's Turtle, Wood Turtle	Northern Long-eared Bat

In 2002 the WDNR listed the streams in the watershed as not capable of sustaining trout due to "higher than desirable water temperatures." These higher temperatures are attributed to geological conditions, "We believe this watershed has less cold water influence to streams due to a unique confining rock layer. This rock layer impedes deep infiltration of rainwater and snowmelt preventing it from cooling adequately before returning to a stream as groundwater or spring."[2] However, six streams are designated class 1 or 2 trout streams.

LAND USE

The land use in the Upper Kickapoo watershed is predominately agricultural and forested.

Table 2 – Land Cover in the Upper Kickapoo Watershed [4]

Land Cover		Percent of Watershed
Agriculture		46.9%
Forest (Total)		36.0%
	Broad-Leaf Deciduous	35.0%
	Coniferous	1.0%
Grassland		14.5%
Wetland (Total)		0.93%
	Emergent/Wet Meadow	0.61%
	Forested	0.25%
	Lowland Shrub	0.07%
Other		1.42%
Development		0.20%

The major public lands in the watershed are Elroy - Sparta State Trail and Monroe County Land.

Census data from 2010 indicated the following populations and growth rates over the previous 10 years; Norwalk 638 (-2.3%), Ontario 554 (16.4%) and Wilton 504 (-3.0%). [5]

WATERS

All waters of the Upper Kickapoo Watershed flow to the river upstream of Ontario from a 117 square mile drainage area. There are a total of 114.4 stream miles throughout this area with 10 listed streams besides the Kickapoo. Approximately 22 miles of the Kickapoo is in the Upper Kickapoo Watershed.

The following information was obtained from the WDNR Upper Wisconsin River Basin Report:

Rivers and Streams

"Cook Creek

Cook Creek, located in south central Monroe County, flows in a southeasterly direction for 5.5 miles before reaching the Kickapoo River near Ontario. This stream has a gradient of 68 feet per mile and drains agricultural land with wooded hillsides. Cook Creek is a Class III trout stream for its entire length. The most recent survey, conducted in 1968, documented brook trout and brown trout as well as numerous forage fish species. The stream bottom was dominated by sand with some gravel… WDNR records indicate that Cook Creek has been stocked with both brook and brown trout consistently since 1960. Access to Cook Creek is from four road crossings.

Morris Creek

Morris Creek, also known as Moore Creek, is located in south central Monroe County. This stream flows in a southeasterly direction for 7.5 miles before reaching the Kickapoo River north of Ontario. Morris Creek has a gradient of 26 feet per mile and drains the Village of Norwalk, agricultural lands with wooded hillsides. Morris Creek receives treated wastewater from the Village of Norwalk and Valley Pride Pack, an animal rendering plant. Morris Creek is not a classified trout stream. The most recent survey, conducted in 1997, documented brook trout and numerous forage fish species. The stream bottom was comprised of equal amounts of gravel, rubble, sand and silt. In-stream cover included woody debris, boulders and some undercut banks… WDNR records indicate that Morris Creek has been stocked with brook trout regularly since 1994. Access to Morris Creek is from six road crossings, Monroe County land, and the Elroy-Sparta State Trail.

Poe Creek

Poe Creek, located in south central Monroe County, flows in a westerly direction for 4.3 miles before reaching the Kickapoo River south of Wilton. This stream has a gradient of 42 feet per mile and drains agricultural valleys with wooded hillsides. Poe Creek is not a classified trout stream. The most recent survey, conducted in 1968, documented a forage fishery and a stream bottom comprised mainly of sand with some gravel and cobble… WDNR records indicate that Poe Creek has not been stocked with trout. Access to Poe Creek is from six road crossings.

Posey Creek

Posey Creek, located in south central Monroe County, flows in an easterly direction for 2.3 miles before reaching the Kickapoo River south of Wilton. This stream has a gradient of 87 feet per mile and drains agricultural land with wooded hillsides. Posey Creek is not a classified trout stream.

The most recent survey, conducted in 1968, documented numerous forage fish species and a stream bottom dominated by sand with some gravel… WDNR records indicate that Posey Creek has not been stocked with trout. Access to Posey Creek is from three road crossings.

Sleighton Creek

Sleighton Creek, located in south central Monroe County, flows in a southerly direction for 5.0 miles before reaching the Kickapoo River in Wilton. This stream has a gradient of 45 feet per mile and drains agricultural land with some wooded hillsides. Sleighton Creek is not a classified trout stream.

The most recent survey, conducted in 1998, documented an abundance of forage fish species. The stream bottom consisted primarily of cobble and sand. In-stream cover included woody debris, some undercut banks and overhanging grasses. Surveys conducted since 1951 have consistently documented only forage fish species in Sleighton Creek… WDNR records indicate that Sleighton Creek has not been stocked with trout. Access to Sleighton Creek is from four road crossings. A rare aquatic species has been found in the creek.

Spring Valley Creek

Spring Valley Creek (Creek 10-2), located in south central Monroe County, flows in an easterly direction for 4.2 miles before reaching Morris Creek. This stream has a gradient of 70 feet per mile and drains agricultural land with forested hillsides. Spring Valley Creek is not a classified trout stream.

The most recent survey, conducted in 1997, documented only one brook trout and an abundance of forage fish. The stream bottom consisted primarily of gravel and cobble, however silt comprised much of the substrate also. Streambank pasturing and barnyard runoff were contributing sediment and nutrients to this stream. Continuous temperature monitoring of Spring Valley Creek should reveal whether this stream is suitable for trout. WDNR records indicate that Spring Valley Creek has been stocked with brook trout from 1994 to 2001… Access to Spring Valley Creek is from two road crossings. A rare aquatic species has been found in the creek.

Creek 21-6

Unnamed Creek 21-6, located in south central Monroe County, flows in a southeasterly direction for 0.7 miles before reaching the Tri-Creek Impoundment north of Norwalk. This stream parallels the Elroy - Sparta State Trail and has a gradient of 80 feet per mile. Creek 21- 6 drains agricultural land and forested hillsides. Creek 21-6 is a Class I trout stream for its entire length.

The most recent survey, conducted in 1997, documented brook trout and several forage fish species including mottled sculpin. Gravel and cobble dominated the stream bottom. In-stream cover consisted of undercut banks and woody debris. A beaver dam was limiting upstream migration of fish… WDNR stocking records indicate Creek 21-6 was last stocked in 1986 with brown trout, however the downstream impoundment was stocked with brook, brown and rainbow trout from 1999 to present. Access to Creek 21-6 is from Monroe County owned land and the Tri-Creek Impoundment.

Creek 28-16

Unnamed Creek 28-16, located in south central Monroe County, flows in a southeasterly direction for 0.5 miles before reaching Morris Creek on the south side of Norwalk. This stream has a gradient of 40 feet per mile and drains agricultural land and a portion of Norwalk. Creek 28-16 is a Class II trout stream for its entire length.

The most recent survey, conducted in 1997, documented brook trout and brook stickleback. Gravel and cobble dominated the stream bottom. In-stream cover consisted of overhanging grasses, boulders and undercut banks. The lower portion of Creek 28-16 has been ditched. Temperature monitoring should be conducted to document existing stream conditions. WDNR records indicate that Creek 28-16 was last stocked with brown trout in 1986. Access to Creek 28-16 is from one road crossing.

Creek 34-6

Unnamed Creek 34-6, located in south central Monroe County, flows in a southwesterly direction for 0.9 miles before reaching Morris Creek southeast of Norwalk. This stream has a steep gradient of 114 feet per mile and drains agricultural land with forested hillsides. Creek 34-6 is a Class II trout stream for its entire length.

The most recent survey, conducted in 1997, documented brook trout and numerous forage fish species. Gravel and cobble dominated the stream bottom, however overgrazing of livestock on the streambank was contributing silt to the stream. In-stream cover consisted of woody debris, overhanging grasses, boulders and undercut banks. Temperature monitoring should be conducted to document existing stream conditions. WDNR records indicate that Creek 34-6 was last stocked in 1986 with brown trout. Since a brook trout fishery has established itself in this stream, only brook trout should be stocked in the future. Access to Creek 34-6 is from four road crossings.

Lakes and Impoundments

Tri-Creek Impoundment

The Tri-Creek Impoundment is a rare lake resource located in southern Monroe County and is the result of a flood control structure built in the early 1970's on a tributary to Morris Creek.

This 24-acre impoundment is located on Monroe County land just west of Norwalk near the Elroy - Sparta State Trail. Algae blooms and excessive aquatic plant growth plague this impoundment… WDNR records indicate the Tri-Creek Impoundment has been stocked annually since 1976. In the last five years, largemouth bass, brown trout, rainbow trout, and brook trout have been stocked. An unimproved access to the Tri-Creek Impoundment is located on the northwest side of the lake on Monroe County land." [4]

WATER CLASSIFICATIONS

The following information regarding classification of the waters in the Upper Kickapoo Watershed was found at the WDNR website. [2]

Trout Stream Summary

Table 3 is an excerpt of a query from the WDNR Surface Water Information Management System on July 30, 2011.

Table 3 – Trout Report Upper Kickapoo Watershed

Official Waterbody Name	Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class
Kickapoo River	Kickapoo River	1182400	125.85	128.82	CLASS I
Cook Creek	Cook Creek	1199600	0	7.41	CLASS III
Unnamed	Creek 34-6	1200900	0	1.49	CLASS II
Unnamed	Creek 28-16	1201000	0	1.88	CLASS II
Unnamed	Creek 21-6	1201300	0	1.28	CLASS I
Unnamed	Creek 34-8	1200800	0	2.68	CLASS II

Watershed Outstanding & Exceptional Resources

Outstanding Resource Waters (ORW) receive the state's highest protection standards. ORWs typically do not have any point sources discharging pollutants directly to the water (for instance, no industrial sources or municipal sewage treatment plants), though they may receive runoff from nonpoint sources. New discharges may be permitted only if their effluent quality is equal to or better than the background water quality of that waterway at all times—no increases of pollutant levels are allowed. If a waterbody has existing point sources at the time of designation, it is more likely to be designated as an Exceptional Resource Water (ERW). Like ORWs, dischargers to ERW waters are required to maintain background water quality levels; however, exceptions can be made for certain situations when an increase of pollutant loading to an ERW is warranted because human health would otherwise be compromised.

The Upper Kickapoo watershed has no waterways classified as outstanding or exceptional resources.

Wetland Health

"There are few wetland complexes in the watershed. Remaining wetlands are generally small wet meadows, adjacent to streams, which are usually grazed. The Sparta-Elroy bike trail runs through the watershed."

Impaired Waters

The Upper Kickapoo watershed has no waterways classified as impaired.

Discharges

The following Wisconsin Pollutant Discharge Elimination System (WPDES) permit holders were identified from a 2010 list on the WDNR website. [6] The Villages of Norwalk, Wilton and Ontario, and Valley Pride Packing. Both the Village of Wilton and Ontario wastewater treatment plant discharge to the Kickapoo River. The Village of Norwalk and the Valley Pride Pack, Inc. discharge to Morris Creek (aka Moore Creek).

WEST FORK OF THE KICKAPOO WATERSHED

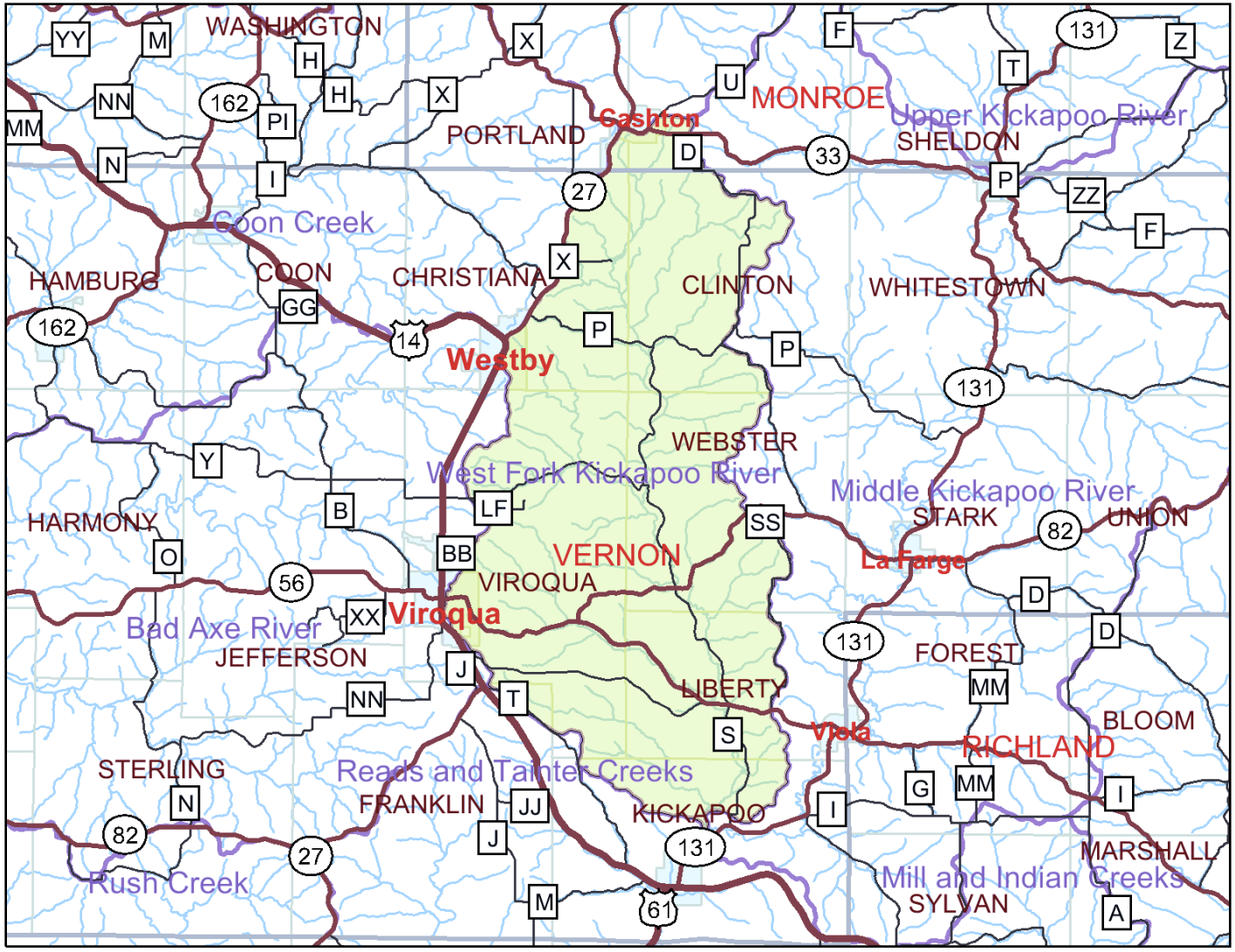
The West Fork of the Kickapoo Watershed is a well know destination of trout fishers. The West Fork watershed has steep valley walls with waters that flow into the West Fork of the Kickapoo. The watershed lies entirely within Vernon County (Township and Ranges 12N03W, 12N04W, 13N03W, 13N04W, 14N03W, 14N04W) as seen in Figure 3. Part of Viroqua, Westby and Cashton are within the West Fork of the Kickapoo Watershed.

ECO-SYSTEM

The West Fork of the Kickapoo Watershed is also categorized as a Western Coulee and Ridges Ecological Landscape. This landscape is defined as highly eroded, driftless topography and relatively extensive forested lands. Soils are generalized as silt loams (loess) and sandy loams over sandstone residuum over dolomite. [7]

As of 2009 the Bureau of Endangered Species of the WDNR Wisconsin Natural Heritage Inventory indicates that Hemlock Relict, Moist Cliff, Pine Relict, Southern Mesic Forest natural communities and Bat Hibernaculum have been observed in the West Fork of the Kickapoo watershed. In addition, Table 4 indicates observations of species that are classified as of concern, threatened or endangered. [3]

Figure 3 - West Fork of the Kickapoo Watershed



0 5.25 10.5 15.75 mi.

Legend

Major Highways
- Interstate
- State Highway
- U.S. Highways

County Roads
24K County Boundaries
24K Watersheds

Civil Towns
- Civil Town

100K Open Water
100K Rivers and Streams

Cities and Villages
- Village
- City

Scale: 1:287,420

Table 4 – Of Concern, Threatened or Endangered Species of the West Fork of the Kickapoo Watershed

Plant	Bird	Fish	Reptile/Snake/Frog	Other
Musk-root, Rock Stitchwort, Northern Wild Monkshood, One-flowered Broomrape, Putty Root, Hill's Thistle	Bald Eagle	Redside Dace	Timber Rattlesnake, Gray Ratsnake	Four-toed Salamander, Northern Cricket Frog

LAND USE

The land use in the West Fork of the Kickapoo watershed is predominately agricultural and forested as defined by the WDNR in 2002.

Table 5 - Land Cover in the West Fork of the Kickapoo Watershed [8]

Land Cover		Percent of Watershed
Agriculture		52.7%
Forest (Total)		34.5%
	Broad-Leaf Deciduous	33.9%
	Coniferous	0.60%
Grassland		10.7%
Wetland (Total)		0.89%
	Emergent/Wet Meadow	0.77%
	Forested	0.11%
	Lowland Shrub	0.01%
Other		0.94%
Development		0.29%

Public lands in the West Fork of the Kickapoo Watershed include the Jersey Valley County Park. "The WDNR owns small tracts of land adjacent to the West Fork of the Kickapoo River, Cook Creek, Maple Dale Creek and Bishop Branch. In addition, WDNR easements are located on Seas Branch, Bishop Branch and West Fork of the Kickapoo River". [8]

Census data from 2010 indicated the following populations and growth rates over the previous 10 years; Cashton 1,102 (9.7%), Viroqua 4,362 (0.6%) and Westby 2,200 (7.6%). [5]

WATERS

The West Fork of the Kickapoo Watershed drains 118 square miles to the West Fork of the Kickapoo until its confluence with the Kickapoo River. There are a total of 80.1 stream miles and 47.6 Trout stream miles.

The following information was obtained from the WDNR West Fork of the Kickapoo River Basin Report:

Rivers and Streams

"Bishop Branch

Bishop Branch, located in central Vernon County, flows in a southeasterly direction for 6.0 miles before reaching the West Fork of the Kickapoo River south of Liberty. This stream has a gradient of 30 feet per mile and drains forested hillsides with agricultural activity limited to the valleys. Bishop Branch is a Class II trout stream from its mouth upstream for five miles and then Class I for the next one mile upstream. It is classified as an Exceptional Resource Water, (ERW).

The most recent survey, conducted in 1995, documented a self-sustaining brown trout population along with only a few brook trout and rainbow trout. At the time, the stream bottom was

dominated by sand with some areas of cobble and gravel. In-stream cover consisted of deep pools, woody debris and LUNKER structures... WDNR records indicate that Bishop Branch was last stocked with brown trout in 1995. Access to Bishop Branch is from WDNR owned land, WDNR easements and one road crossing. A rare aquatic species has been found in this creek.

Cook Creek

Cook Creek, located in central Vernon County, flows for 1.5 miles in an easterly direction before joining with Maple Dale Creek to form Bishop Branch. This stream has a gradient of 73 feet per mile and drains forested hillsides, the eastern portion of Viroqua, a quarry, and an agricultural headwater plateau. Cook Creek is a Class I trout stream for its entire length.

The most recent survey, conducted in 2000, documented brook trout, brown trout, mottled sculpin and brook stickleback. Cobble and gravel dominated the stream bottom... WDNR records indicate that Cook Creek has been stocked with brook trout since 1974 and with wild brook trout since 1998. Access to Cook Creek is from WDNR owned land and one road crossing

Elk Run

Elk Run, located in central Vernon County, flows in a southwesterly direction for 3.0 miles before reaching the West Fork of the Kickapoo River near Liberty. This stream has a steep gradient of 77 feet per mile and drains steep forested hillsides and a once farmed valley that now supports rural homes. Elk Run is not a classified trout stream. The most recent survey was conducted in 1970... WDNR records indicate that Elk Run has not been stocked. Access to Elk Run is from two road crossings.

Hall Creek

Hall Creek, located in north central Vernon County, flows in a southwesterly direction for 2.1 miles before reaching the West Fork of the Kickapoo River near Bloomingdale. The gradient of this stream is a steep 80 feet per mile and drains forested hillsides and an agricultural valley. Hall Creek is not a classified trout stream. The most recent survey was conducted in 1970... WDNR records indicate that Hall Creek has not been stocked. Access to Hall Creek is from two road crossings. A rare aquatic species has been found in this creek.

Harrison Creek

Harrison Creek, located in central Vernon County, flows in a southeasterly direction for 3.5 miles before reaching the West Fork of the Kickapoo River near its mouth. This stream has a gradient of 49 feet per mile and drains forested hillsides and an agricultural valley. Harrison Creek is a Class II trout stream for its entire length.

The most recent survey, conducted in 1998, documented brown trout and numerous forage fish species. The stream bottom was dominated by sand, followed by silt with small amounts of gravel. In-stream cover consisted of undercut banks and woody debris. Problems noted include streambank erosion and overgrazing of livestock... WDNR records indicate that Harrison Creek has been stocked with brown trout since 1960 and with wild brown trout since 1998. Access to Harrison Creek is from four road crossings.

Knapp Creek

Knapp Creek, located in north central Vernon County, flows in a south westerly direction for 4.0 miles before reaching the West Fork of the Kickapoo River north of Bloomingdale. This stream

has a gradient of 34 feet per mile and drains forested hillsides and agricultural valleys and an agricultural headwater plateau. Knapp Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1978, documented brown trout and numerous forage fish species. The stream bottom was dominated by cobble and gravel with the downstream areas containing significant amounts of silt. In-stream cover consisted of boulders and woody debris... WDNR records indicate that Knapp Creek was last stocked with brown trout in 1980. Access to Knapp Creek is from two road crossings. A rare aquatic species has been found in this creek.

Maple Dale Creek

Maple Dale Creek, also known as Pine Hollow Creek and Creek 2-3, is located in central Vernon County. This stream flows in a southerly direction for 2.0 miles before joining with Cook Creek to form Bishop Branch. Maple Dale Creek has a steep gradient of 80 feet per mile and drains forested hillsides, WDNR owned land in its natural state, and an extensive agricultural headwater plateau. An earthen dry dam is located on the WDNR owned land. Water impounds behind this structure only during times of extreme runoff. Maple Dale Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1971, documented a diverse forage fishery. Stocking of wild brook trout was recommended at the time... WDNR records indicate that wild brook trout were stocked in 2001. Access to Maple Dale Creek is from two road crossings and WDNR owned land.

Rocky Run

Rocky Run, located in central Vernon County, flows in a southwesterly direction for 1.4 miles before reaching the West Fork of the Kickapoo River near Liberty. This stream has a gradient of 60 feet per mile and drains forested hillsides and an agricultural valley. Rocky Run is not a classified trout stream.

The most recent survey, conducted in 1990, documented brown trout and several forage fish species. Due to the presence of brown trout in 1990 and the upgrade of the West Fork of the Kickapoo River to Class II trout where Rocky Run meets the river, a fish and habitat survey should document existing conditions to determine if reclassification of Rocky Run is justified. WDNR records indicate that Rocky Run has not been stocked with trout. Access to Rocky Run is from one road crossing.

Seas Branch

Seas Branch, located in central Vernon County, flows in an easterly direction for 4.5 miles before reaching the West Fork of the Kickapoo River near Avalanche. This stream has a gradient of 50 feet per mile and drains forested hillsides, an agricultural valley and an agricultural headwater plateau. A wet flood control structure which creates the 11-acre Seas Branch Pond is located approximately 2.5 miles upstream from the mouth of the stream. Seas Branch is a Class I trout stream for its entire length and an Exceptional Resource Water (ERW).

In 1997, Seas Branch contained a self-sustaining brown trout population throughout its entire length. Water temperatures and habitat in Seas Branch upstream of the flood control structure was conducive to the establishment of a brook trout population. Consequently an experimental stocking of wild brook trout coupled with removal of brown trout from upper Seas Branch was undertaken in 1997. The brown trout removal effort involved shocking the stream and moving

brown trout to Seas Branch downstream of the flood control structure where upstream migration is prohibited. Annual fishery surveys indicate a thriving brook trout fishery upstream of the dam without the competition of brown trout for food and habitat. The brown trout fishery downstream of the flood control structure is also thriving. These findings support the Class I designation for the entire stream.

The most recent survey, conducted in 1997, documented brook trout, brown trout and numerous forage fish species. The stream bottom consisted primarily of cobble and gravel. Instream cover was comprised of LUNKER structures, boulders, and woody debris. Only brook trout and mottled sculpin have been documented upstream of the dam since the brown trout removal effort began in 1998.

WDNR records indicate Seas Branch was stocked with brown trout from 1960 to 1995. Brook trout were stocked from 1988 to 1997. Access to Seas Branch is from one WDNR easement and the county owned flood control structure. A rare aquatic species has been found in this creek.

West Fork Kickapoo River

The West Fork of the Kickapoo River, located in central Vernon County, flows in a southeasterly direction for 24 miles before reaching the Kickapoo River. This river has a gradient of 11 feet per mile and drains forested hillsides and agricultural valleys. A wet flood control structure is located on the upper end of this river creating Jersey Valley Lake. The West Fork of the Kickapoo River is a Class II trout stream from its mouth upstream 15.8 miles to the STH 82 bridge and Class I upstream from this bridge for 8.2 miles.

The most recent survey, conducted in 2000, documented healthy brook trout and brown trout populations as well as a diverse forage fishery. The stream bottom was dominated by cobble and gravel. In order of abundance, in-stream cover consisted of LUNKER structures, woody debris, boulders, undercut banks, and boulders... WDNR records indicate that the West Fork of the Kickapoo River has been stocked with brown trout consistently from 1960 to 1998. Wild brook trout have been stocked yearly since 1999. Access to the West Fork of the Kickapoo River is from 14 road crossings, WDNR owned land and the Vernon County Jersey Valley Park. A rare aquatic species has been found in this creek.

Lakes and Impoundments

Jersey Valley Lake

Jersey Valley Lake is a 56-acre impoundment of the West Fork of the Kickapoo River. The portion of river upstream of the impoundment is locally known as Jersey Valley Creek. This lake has a maximum depth of 18 feet and receives drainage from agricultural and forested land.

An aquatic plant survey, conducted in 1995, documented a total of 19 aquatic plant species, 13 of which were submerged plant species, three floating leaf species and three emergent plant species. This diverse plant community inhabited nearly the entire shore of the lake to a depth of greater than 10 feet. Healthy aquatic plant communities improve water quality in many ways: they trap nutrients, debris, and pollutants entering a water body; they may absorb and break down pollutants; they reduce erosion by stabilizing banks and shorelines, stabilizing bottoms and reducing wave action; they remove nutrients that would otherwise be available for algae blooms. Cover for fish and aquatic insects are also another important function of aquatic plants.

The watershed draining into Jersey Valley Lake is at least 80% agricultural. Runoff from these lands may be contributing nutrients to this impoundment. Evidence of excessive nutrients in the

lake are the summer algae blooms that plague this lake. WDNR should consider Jersey Valley Lake a high priority to receive a lake planning grant and a lake protection grant.

Over the years, Jersey Valley Lake has been stocked with brook trout, rainbow trout, largemouth bass, walleye, and sauger. The primary function of this lake is flood control, but the lake and surrounding land also provides recreational opportunities to a region of the state with very few lakes. Jersey Valley County Park is a 370-acre tract of land, located 3 miles north of Westby on County Highway X. This park offers swimming, hiking, fishing and picnicking. Additionally, Jersey Valley offers a handicap accessible fishing dock."[8]

WATER CLASSIFICATIONS

The following information regarding classification of the waters in the West Fork of the Kickapoo Watershed was found at the WDNR website. [7]

Trout Stream Summary

Table 6 is an excerpt of a query from the WDNR Surface Water Information Management System on July 30, 2011.

Table 6 – Trout Report West Fork of the Kickapoo Watershed

Official Waterbody Name	Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class
West Fork Kickapoo River	West Fork Kickapoo River	1187900	0	10.34	CLASS II
Harrison Creek	Harrison Creek	1188000	0	7.25	CLASS III
Bishop Br	Bishop Branch	1188500	0	4.2	CLASS I
Maple Dale Creek	Maple Dale Creek (Creek 2-3)	1188800	0	3.49	CLASS I
Cook Creek	Cooks Creek	1189000	0	3.87	CLASS I
Seas Branch	Seas Branch	1189800	2.7	6.06	CLASS I
Knapp Creek	Knapp Creek	1191400	0	7.47	CLASS III
Bishop Br	Bishop Branch	1188500	4.21	5.58	CLASS I
Unnamed	Creek 2-3 (Pine Hollow Creek)	3000228	0	1.42	CLASS III
Unnamed	Creek 19-3	1189700	0	2.49	CLASS I
Unnamed	Creek 7-8	1190500	0	1.53	CLASS I
Unnamed	Jersey Valley Creek	3000414	0	1.71	CLASS III
Unnamed	Creek 35-10 (Pine Hollow Creek)	1188900	0	2.43	CLASS I
Seas Branch	Seas Branch	1189800	0	2.7	CLASS I
West Fork Kickapoo River	W. Fork Kickapoo River	1187900	10.34	25.28	CLASS I

Watershed Outstanding & Exceptional Resources

Table 7 below lists the outstanding and exceptional waters in the West Fork of the Kickapoo River Watershed. This information is an excerpt from data queried from the WDNR Surface Water Information Management System on July 31, 2011.

Table 7 – ORW/ERW Report West Fork of the Kickapoo Watershed

Official Waterbody Name	Local Waterbody Name	WBIC	ORW/ERW	Start Mile	End Mile
Bishop Br	Bishop Branch	1188500	/ERW	0	4.2
Bishop Br	Bishop Branch	1188500	/ERW	4.21	5.58
Seas Branch	Seas Branch	1189800	/ERW	2.7	6.06

Impaired Waters

The West Fork of the Kickapoo watershed has no waterways classified as impaired.

Discharges

Only K & K CHEESE LLC was listed as a WPDES permit holder on the 2010 list on the WDNR website. [6]

MIDDLE KICKAPOO WATERSHED

The Middle Kickapoo Watershed in the largest watershed in the Kickapoo Valley sub-basin with an area of approximately 247 sq. mi. The Middle Kickapoo Watershed encompasses lands in Monroe and Crawford counties but primarily in Vernon County (Township and Ranges 12N03W, 13N01W, 13N02W, 13N03W, 14N01W, 14N02W, 14N03W, 15N01W, 15N02W, 15N03W) as seen in Figure 4. The Villages of Ontario, La Farge, and Viola are a part of the Middle Kickapoo Watershed.

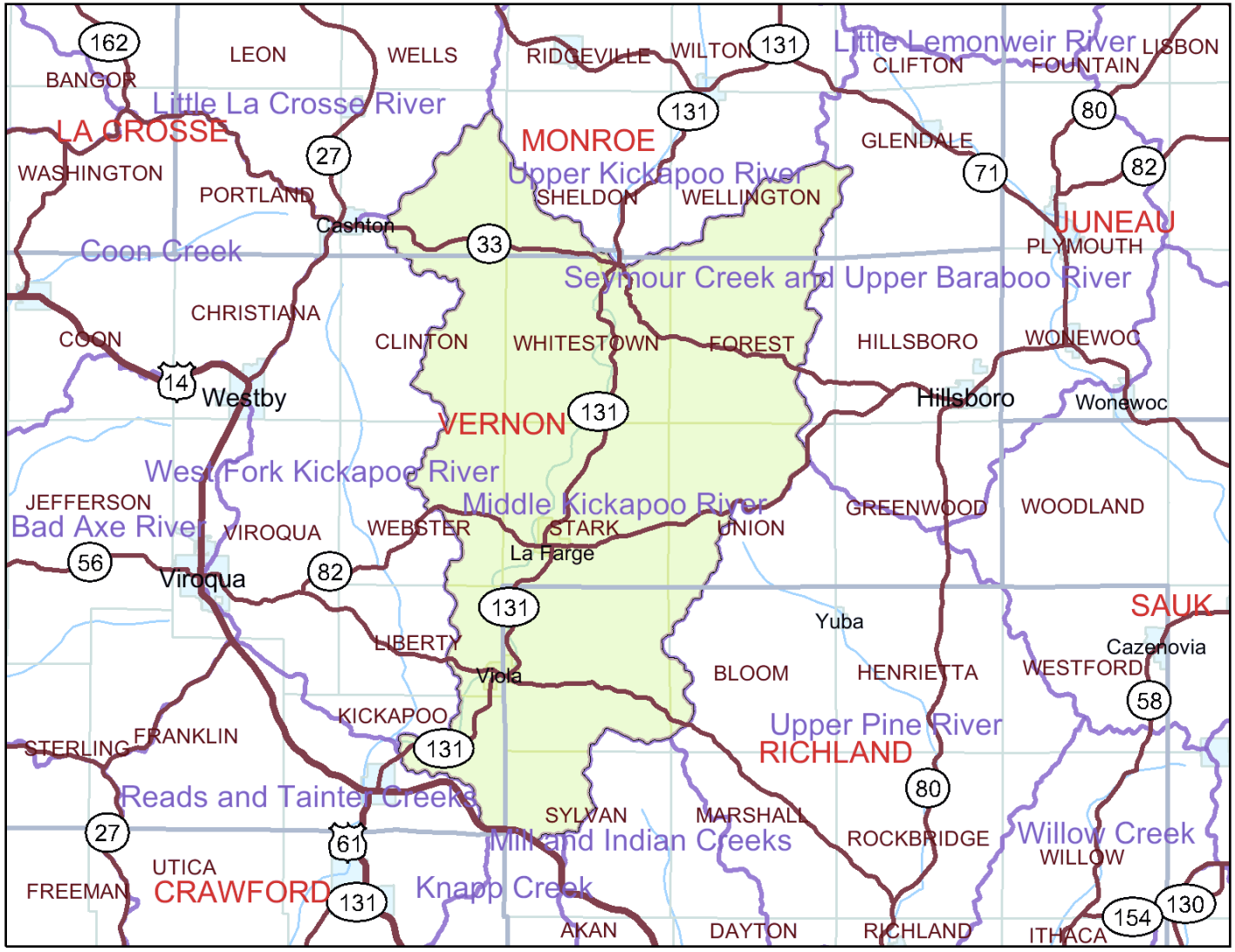
Unlike the Upper Kickapoo Watershed the Middle and Lower Kickapoo River gradient is low at an average of 3 feet per mile. In 1989 the Middle Kickapoo Watershed was designated as a priority watershed project under the Wisconsin Nonpoint Source Water Pollution Abatement Program. "The goal of the program is to improve and protect the water quality of streams, lakes, wetlands and groundwater by reducing pollutants from urban and rural nonpoint sources." [9]

ECO-SYSTEM

As with the Upper Kickapoo Watershed the Middle Kickapoo Watershed is categorized as a Western Coulee and Ridges Ecological Landscape. This landscape is defined as highly eroded, driftless topography and relatively extensive forested lands. Soils are generalized as silt loams (loess) and sandy loams over sandstone residuum over dolomite. [9]

As of 2009 the Bureau of Endangered Species of the WDNR lists the Dry Cliff, Forested Seep, Hemlock Relict, Moist Cliff, Northern Mesic Forest, Pine Relict, Southern Dry-mesic Forest, Southern Mesic Forest, Floodplain Forest, Hardwood Swamp, Northern Dry-mesic Forest, Southern Hardwood Swamp, Southern Sedge Meadow natural communities and Bat Hibernaculum as being observed in the Wisconsin Natural Heritage Inventory of the Middle Kickapoo watershed. In addition, Table 8 indicates observations of species that are classified as of concern, threatened or endangered. [3]

Figure 4 - Middle Kickapoo Watershed



Legend

Major Highways

- Interstate
- State Highway
- U.S. Highways

24K County Boundaries

24K Watersheds

Civil Towns

- Civil Town

2M Open Water

2M Rivers and Streams

Cities and Villages

- Village
- City

N

Scale: 1:384,627

Table 8 – Of Concern, Threatened or Endangered Species of the Middle Kickapoo Watershed

Plant	Bird	Insects/Snails	Fish	Reptile/Amphibian
Autumn Coral-root, Beak Grass, Innocence, Musk-root, Snowy Campion, Upland Boneset, Yellow Gentian, Catfoot, Shadowy Goldenrod, Northern Wild Monkshood, Putty Root, Sweet-scented Indian-plantain, Drooping Sedge, Laurentian Bladder Fern, Cliff Cudweed, Rock Clubmoss, Hooker Orchis, Bird's-eye Primrose, Roundstem Foxglove, Lapland Azalea, Nodding Pogonia	Acadian Flycatcher, Cerulean Warbler, Henslow's Sparrow, Red-shouldered Hawk, Worm-eating Warbler, Kentucky Warbler, Louisiana Waterthrush, Bald Eagle	Bog Beetle, Cherrystone Drop Snail, Dull Gloss Snail	Redside Dace, Silver Chub	Blanding's Turtle, Wood Turtle, Four-toed Salamander, Gray Ratsnake, Northern Cricket Frog, Timber Rattlesnake

LAND USE

The land use in the Upper Kickapoo watershed is predominately agricultural and forested as defined by the WDNR in 2002.

Table 9 - Land Cover in the West Fork of the Kickapoo Watershed [10]

Land Cover		Percent of Watershed
Agriculture		37.7%
Forest (Total)		45.9%
	Broad-Leaf Deciduous	44.5%
	Coniferous	1.4%
Grassland		13.6%
Wetland (Total)		2.1%
	Emergent/Wet Meadow	1.4%
	Forested	0.6%
	Lowland Shrub	0.1%
Other		0.6%
Development		0.09%

There is an abundance of public land in the Middle Kickapoo Watershed. Wildcat Mountain State Park is 3,646 acres and the Kickapoo Valley Reserve is 8,569 acres. The Kickapoo Valley Reserve has a unique history. Land that was originally purchased by the U. S. Army Corps of Engineers as a dam site has been turn over to the State of Wisconsin and the Ho-Chunk Nation. The Kickapoo River flows through portion Wildcat Mountain State Park and the Kickapoo Valley Reserve.

Census data from 2010 indicated the following populations and growth rates over the previous 10 years; Ontario 554 (16.4%), LaFarge 746 (-3.7%) and Viola 669 (0.3%). [5]

WATERS

The Middle Kickapoo Watershed encompasses all the streams that flow into the Kickapoo following the Upper Kickapoo Watershed (i.e. draining into the Kickapoo at the south end of Ontario and beyond) until the Kickapoo meets with the West Fork of the Kickapoo. This is a basin of approximately 247 sq mi with

a total of 206 stream miles, 222 lake acres and 1,867 wetland acres. Roughly 47 miles of the Kickapoo is in the Middle Kickapoo Watershed.

The following information was obtained from the WDNR Lower Wisconsin River Basin Report:

Rivers and Streams

"Bear Creek

Bear Creek, located in central Vernon County, flows in a westerly direction for 1.6 miles before reaching the Kickapoo River just south of La Farge. Bear Creek is just the smallest segment of the Bear Creek drainage system that includes North, South and Middle Bear Creeks. The 1.6 mile Bear Creek begins at the confluence of North Bear and South Bear Creeks. This stream has a gradient of 20 feet per mile and drains forested hillsides and valley agricultural lands. Bear Creek is a Class III trout stream for its entire length.

The most recent biological survey, conducted in 1990, documented brown trout and a healthy, diverse forage fishery. The stream bottom was dominated by sand and in-stream cover consisted of overhanging grasses and undercut banks... WDNR records indicate Bear Creek has been stocked yearly with brown trout since 1960. Access to Bear Creek is from one road crossing.

Billings Creek

Billings Creek begins in south central Monroe County and then flows into north central Vernon County. This stream flows in a southwesterly direction for 11.3 miles before reaching the Kickapoo River south of Ontario. Billings Creek has a gradient of 35 feet per mile and drains forested hillsides with agricultural activities in both valleys and ridgetops. Billings Creek is a Class II trout stream for its entire length.

The most recent survey, conducted in 2000, documented brown, rainbow and brook trout as well as numerous forage fish species. The stream bottom was dominated by sand and gravel and in-stream cover consisted of LUNKER structures, overhanging grasses, natural undercut banks, woody debris and boulders... WDNR records indicate Billings Creek has been stocked yearly with brown trout since 1960. Rainbow trout were last stocked in 1995. Access to Billings Creek is from nine road crossings, and Wildcat Mountain State Park and the Kickapoo Valley Reserve.

Brush Creek

Brush Creek begins in south central Monroe County and then flows into north central Vernon County. This stream flows in a southeasterly direction for 10.2 miles before reaching the Kickapoo River at Ontario. Brush Creek has a gradient of 42 feet per mile and drains one of the most intensely farmed areas of the Middle Kickapoo River Watershed. Brush Creek is a Class III trout stream for 7.7 miles in Monroe County and non-trout in Vernon County.

The most recent survey, conducted in 1990, documented brown trout and numerous forage fish species. The stream bottom is dominated by sand and silt with gravel found in the upstream reaches. In-stream cover consisted primarily of woody debris and deep pools. Streambank erosion is common along much of Brush Creek, some of which is naturally occurring and some of which is exacerbated by overgrazing of livestock… WDNR records indicate Brush Creek has been stocked yearly since 1961 with brown trout. Access to Brush Creek is from six road crossings.

Bufton Hollow Creek

Bufton Hollow Creek, located in northwest Richland County, flows in a westerly direction for 1.5 miles before reaching Camp Creek. This stream has a gradient of 91 feet per mile and drains forested hillsides, ridgetop agriculture and recreational valley land. Bufton Hollow Creek is a

Class I trout stream for its entire length and is designated as an Exceptional Resource Water, (ERW). Access to Bufton Hollow Creek is from one road crossing and WDNR owned land.

Camp Creek

Camp Creek, located in northeastern Richland County, flows in a westerly direction for 5.5 miles before reaching the Kickapoo River near Viola. This stream has a gradient of 33 feet per mile and drains forested hillsides and an agricultural headwater plateau. Camp Creek is a Class I trout stream and an Outstanding Resource Water, (ORW), for its entire length.

The most recent survey, conducted in 1990, documented brown trout and seven forage fish species. The stream bottom was dominated by sand and gravel. In-stream cover consisted of undercut banks, boulders and aquatic vegetation... Maintenance of WDNR owned lands adjacent to Camp Creek must include tree and brush removal from streambanks to reduce beaver colonization. Access to Camp Creek is from five road crossings and WDNR owned land.

Chadwick Hollow Creek

Chadwick Hollow Creek, located in central Vernon County and northwest Richland County, flows in a southeasterly direction for 2.0 miles before reaching the Kickapoo River north of Viola. This stream drains forested hillsides and an agricultural valley. Chadwick Hollow Creek is a Class II trout stream for the one mile located in Vernon County.

An abbreviated fishery survey, conducted in December 2001, documented young of the year brook trout, a few brown trout and several forage fish species… WDNR records indicate that Chadwick Hollow Creek has never been stocked.

Cheyenne Valley Creek

Cheyenne Valley Creek, located in north central Vernon County, flows in a westerly direction for 6.0 miles before reaching Billings Creek south of Ontario. This stream has a gradient of 46 feet per mile and drains forested hillsides and agricultural valleys and hilltops. Cheyenne Valley Creek is a Class II trout stream and designated as an Exceptional Resource Water, (ERW), for its entire length.

The most recent biological survey, conducted in 1998, documented brook trout, brown trout and numerous forage fish species. The stream bottom was dominated by sand and cobble. Instream cover consisted of overhanging grasses, boulders, woody debris and undercut banks... WDNR records indicate that Cheyenne Valley Creek has been stocked with wild brook trout since 1998. Access to Cheyenne Valley Creek is from six road crossings, a WDNR owned easement and Wildcat Mountain State Park.

Elk Creek

Elk Creek, located in central Vernon County and northwest Richland County, flows in a northwesterly direction for 4.4 miles before reaching the Kickapoo River between Viola and Readstown. This stream has a gradient of 46 feet per mile and drains forested hillsides and agricultural valleys. Elk Creek is a Class I trout stream for its entire length in both Richland (2.8 miles) and Vernon (1.6 miles) Counties. The Richland County portion of Elk Creek is also designated as an Outstanding Resource Water, (ORW). The most recent biological surveys, conducted in 1987 and 1990, documented brown trout, rainbow trout, brook trout and numerous forage fish species. The stream bottom was dominated by gravel and sand. In-stream cover consisted of boulders, overhanging grasses and aquatic vegetation. Streambank grazing of livestock was contributing sediment to the stream… WDNR records indicate that Elk Creek was

stocked regularly with brown trout until 1988. Access to Elk Creek is from three road crossings and WDNR owned land.

Goose Creek

Goose Creek, located in northwest Richland County, flows in a westerly direction for 3.0 miles before reaching the Kickapoo River between La Farge and Viola. This stream has a gradient of 81 feet per mile and drains forested hillsides and an agricultural valley. Goose Creek is a Class II trout stream for its entire length. The most recent survey, conducted in 1990, documented very few brown trout and several forage fish species. The stream bottom consisted primarily of silt and gravel. In-stream cover was scarce... WDNR records indicate that Goose Creek is stocked annually with brown trout. Access to Goose Creek is from one road crossing.

Indian Creek

Indian Creek, located in north central Vernon County, flows in a southeasterly direction for 2.2 miles before reaching the Kickapoo River south of Rockton. This stream has a gradient of 59 feet per mile and drains forested hillsides with some ridgetop agriculture. Indian Creek is not a classified trout stream.

The most recent survey, conducted in 1990, documented numerous forage fish species but no trout. The stream bottom was dominated by gravel and in-stream cover consisted primarily of woody debris... WDNR records indicate that Indian Creek has not been stocked with trout. Access to Indian Creek is from the Kickapoo Valley Reserve.

Jug Creek

Jug Creek, located in central Vernon County, flows in a northwesterly direction for 3.6 miles before reaching the Kickapoo River north of La Farge. This stream has a gradient of 71 feet per mile and drains forested hillsides with agricultural valleys. Jug Creek is not a classified trout stream.

The most recent survey, conducted in 1990, documented numerous forage fish species and no trout. The stream bottom was dominated by gravel... WDNR records indicate that Jug Creek has not been stocked with trout. Access is from three road crossings and the Kickapoo Valley Reserve.

Kickapoo River

A total of 46.9 miles from Ontario to Readstown flows through the Middle Kickapoo River Watershed. A majority of the wetlands in this watershed are found adjacent to these 46.9 miles of Kickapoo River. This section of the Kickapoo River is a Class II trout water. There are USGS gauging stations on the river at La Farge and on Highway 33 at Ontario.

Middle Bear Creek

Middle Bear Creek, located in central Vernon County, flows in a westerly direction for 2.3 miles before reaching South Bear Creek. This stream has a gradient of 70 feet per mile and drains forested hillsides, an agricultural valley and an agricultural headwater ridgetop. An aquaculture operation is also located adjacent to this stream. Middle Bear Creek is a Class II trout stream upstream of CTH D for 0.5 miles and a Class III trout stream downstream of CTH D for 1.8 miles.

The most recent survey, conducted in 1990, documented brown trout and rainbow trout as well as numerous forage fish species. The stream bottom was dominated by gravel and cobble. In-stream cover consisted of woody debris, boulders, overhanging grasses and some undercut banks...

WDNR records indicate that Middle Bear Creek has been regularly stocked with brown trout since 1960. Access to Middle Bear Creek is from two road crossings.

North Bear Creek

North Bear Creek, located in central Vernon County, flows in a westerly direction for 5.3 miles before meeting with South Bear Creek to form Bear Creek near La Farge. This stream has a gradient of 48 feet per mile and drains forested hillsides and agricultural valleys. North Bear Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1990, documented brown trout and numerous forage fish species. The stream bottom was dominated by gravel and cobble. In-stream cover consisted of undercut banks and boulders… WDNR records indicate that North Bear Creek has been regularly stocked with brown trout since 1960. Access to North Bear Creek is from five road crossings.

Otter Creek

Otter Creek, located in central Vernon County, flows in a southeasterly direction for 4.5 miles before reaching the Kickapoo River at La Farge. This stream has a gradient of 43 feet per mile and drains forested hillsides with agricultural activity in both valleys and ridgetops. Otter Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1990, documented no trout but an abundance of forage fish species. The stream bottom contained equal proportions of silt, sand and gravel. In-stream cover consisted of boulders, overhanging grasses and aquatic vegetation. Otter Creek should be resurveyed after conclusion of the Middle Kickapoo River Priority Watershed Project in 2004. WDNR records indicate that Otter Creek was last stocked in 1999 with brown trout. Access to Otter Creek is from six road crossings.

South Bear Creek

South Bear Creek, located in central Vernon County and northwest Richland County, flows in a northerly direction for 4.1 miles before joining with North Bear Creek to form Bear Creek. This stream has a gradient of 52 feet per mile and drains forested hillsides with agricultural activity in both valleys and ridgetops. South Bear Creek is a Class II trout stream for its entire length in both Vernon (2.5 miles) and Richland (1.6) Counties. This stream is designated as an Exceptional Resource Water, (ERW), in Richland County.

The most recent biological survey, conducted in 1990, documented brown trout and numerous forage fish species. The stream bottom was dominated by sand and in-stream cover consisted of undercut banks and overhanging vegetation. South Bear Creek should be resurveyed after conclusion of the Middle Kickapoo River Priority Watershed Project in 2004. WDNR records indicate that South Bear Creek was last stocked with brown trout in 1998. Access to South Bear Creek is from two road crossings.

South Jug Creek

South Jug Creek, located in central Vernon County, flows in a northwesterly direction for 2.0 miles before reaching Jug Creek. This stream has a steep gradient of 100 feet per mile and drains forested hillsides and an agricultural valley. The most recent survey, conducted in 1973, documented an abundance of forage fish species but no trout. South Jug Creek is not a classified trout stream. South Jug Creek should be surveyed after conclusion of the Middle Kickapoo River Priority Watershed Project in 2004…

Tenny Spring Creek

Tenny Spring Creek, located in south central Vernon County, flows in a northerly direction for 1.4 miles before reaching Elk Creek. This stream has a steep gradient of 100 feet per mile and drains forested hillsides and a small amount of ridgetop agricultural activity. Tenny Spring Creek is a Class I trout stream for its entire length.

The most recent survey, conducted in 1987, documented a self-sustaining brown trout population. A 1972 survey documented several forage fish species present in the stream… WDNR records indicate Tenny Spring Creek has never been stocked. Access to Tenny Spring Creek is from three road crossings.

Twentyfour Valley Creek

Twentyfour Valley Creek, located in central Vernon County, flows in a southerly direction for 2.0 miles before reaching Weister Creek. This stream has a gradient of 88 feet per mile and drains forested hillsides and agriculture in both the valley and ridgetops. Twentyfour Valley Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1990, documented brown trout and numerous forage fish species. The stream bottom was dominated by gravel and cobble. In-stream habitat consisted of boulders, woody debris, LUNKER structures and some natural undercut banks... WDNR records indicate that Twentyfour Valley Creek was regularly stocked with brown trout from 1960 until 1996. Brook trout have been stocked since 1998. Access to Twentyfour Valley Creek is from two road crossings.

Upper Brush Creek

Upper Brush Creek, located in south central Monroe County, flows in an easterly direction for 2.6 miles before reaching Brush Creek east of Ontario. This stream has a gradient of 46 feet per mile and drains forested hillsides and agricultural valleys. Upper Brush Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1990, documented rainbow trout and few forage fish species. The stream bottom was dominated by sand and gravel. In-stream cover consisted of undercut banks and overhanging grasses. Upper Brush Creek should be resurveyed after conclusion of the Middle Kickapoo River Priority Watershed Project in 2004. WDNR records indicate Upper Brush Creek has not been stocked with trout. The rainbow trout documented in the 1990 survey were likely escapees from a trout pond adjacent to the stream. Access to Upper Brush Creek is from two road crossings.

Warner Branch

Warner Branch, located in central Vernon County, flows in a northwesterly direction for 3.0 miles before reaching Warner Creek. This stream has a gradient of 60 feet per mile and drains forested hillsides with agricultural activity in both the valleys and ridgetops. Warner Branch is a Class III trout stream for its entire length.

The most recent survey, conducted in 1990, documented brown trout and numerous forage fish species. The stream bottom was dominated by sand and gravel. In-stream cover consisted of undercut banks, overhanging grasses and woody debris... WDNR records indicate Warner Branch has been regularly stocked with brown trout since 1977. Access to Warner Branch is from three road crossings.

Warner Creek

Warner Creek, located in central Vernon County, flows in a westerly direction for 8.6 miles before reaching the Kickapoo River between Ontario and La Farge. This stream has a gradient of 32 feet per mile and drains forested hillsides, agricultural valleys and ridgetops as well as a portion of the Kickapoo Valley Reserve. Wetlands surround the lower segment of Warner Creek in the Reserve. Warner Creek is a Class II trout stream for its entire length.

The most recent survey, conducted in 1990, documented brown trout and numerous forage fish species. The stream bottom was dominated by sand and gravel. In-stream cover consisted of woody debris, undercut banks and overhanging grasses... WDNR records indicate Warner Creek has been stocked with brown trout regularly since 1960. Access to Warner Creek is from ten road crossings and the Kickapoo Valley Reserve.

Weister Creek

Weister Creek, located in central Vernon County, flows in a southeasterly direction for 7.8 miles before reaching the Kickapoo River north of La Farge. This stream has a gradient of 39 feet per mile and drains forested hillsides, agricultural valleys and ridgetops as well as a portion of the Kickapoo Valley Reserve. Wetlands surround the lower segment of Weister Creek within the Reserve. Weister Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1990, documented brown trout and numerous forage fish species. The stream bottom was dominated by sand and gravel. In-stream cover consisted of woody debris and undercut banks... WDNR records indicate that Weister Creek has been regularly stocked with brown trout since 1960. Access to Weister Creek is from six road crossings and the Kickapoo Valley Reserve." [10]

WATER CLASSIFICATIONS

The following information regarding classification of the waters in the Middle Kickapoo Watershed was found at the WDNR website. [9]

Trout Stream Summary

Table 10 is an excerpt of a query from the WDNR Surface Water Information Management System on July 30, 2011.

Table 10 – Trout Report Middle Kickapoo Watershed

Official Waterbody Name	Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class
Kickapoo River	Kickapoo River	1182400	61.1	108	CLASS II
Tenny Spring Creek	South Jug Creek	1191900	0	2.5	CLASS I
Bufton Hollow Creek	Bufton Hollow Creek	1193100	0	2.78	CLASS I
Goose Creek	Goose Creek	1193400	0	3.41	CLASS II
South Bear Creek	South Bear Creek	1193600	2.49	4.43	CLASS II
Middle Bear Creek	Bear Creek (Middle)	1193700	0	2.17	CLASS III
Twentyfour Valley Creek	Twenty-Four Valley Creek	1195000	0	3.44	CLASS III
Warner Creek	Warner Creek	1195700	0	10.59	CLASS II
Warner Br	Warner Branch	1196200	0	5.27	CLASS III
Billings Creek	Billings Creek	1196900	0	15.2	CLASS II
Upper Brush Creek	Upper Brush Creek	1199000	0	5.02	CLASS III
Unnamed	Creek 35-7 (Trib To Upper Brush Creek)	1199100	0	2.96	CLASS III
Weister Creek	Weister Creek	1194900	0	9.05	CLASS I
Hoke Creek	Hoke Creek	1192100	0	2.11	CLASS I
Camp Creek	Camp Creek	1192700	0	8.28	CLASS I
Unnamed	Creek 22-14	1193000	0	2.25	CLASS II
Chadwick Hollow Creek	Chadwick Hollow Creek	1193300	.57	2.59	CLASS II
Bear Creek	Bear Creek (Lower)	1193500	0	1.92	CLASS III
Middle Bear Creek	Middle Bear Creek	1193700	2.17	3.64	CLASS II
North Bear Creek	North Bear Creek	1194100	0	6.44	CLASS III
Otter Creek	Otter Creek	1194200	0	7.32	CLASS III
Unnamed	Creek 23-1	1195300	0	2.28	CLASS III
Unnamed	Creek 4-12	1196300	0	3.35	CLASS III
Cheyenne Valley Creek	Cheyenne Valley Creek	1197000	0	7.6	CLASS II
Elk Creek	Elk Creek	1191700	0	1.91	CLASS I
Hay Valley Creek	Creek 22-8 (Hay Valley Creek)	1198200	0	3.02	CLASS I
Unnamed	Creek 25-11	3000026	0	2.29	CLASS I
Unnamed	Creek 6-1c	3000025	0	2.33	CLASS I
Unnamed	Creek 5-10	3000027	0	2.17	CLASS I
Unnamed	Creek 1-5	1191800	0	2.06	CLASS I
South Bear Creek	South Bear Creek	1193600	0	2.49	CLASS II
South Bear Creek	South Bear Creek	1193600	4.43	6.46	CLASS II
Elk Creek	Elk Creek	1191700	1.91	6.2	CLASS I
Brush Creek	Brush Creek	1198300	2.83	12.83	CLASS III

Watershed Outstanding & Exceptional Resources

Table 11 below lists the outstanding and exceptional waters in the Middle Kickapoo River Watershed. This information is an excerpt from data queried from the WDNR Surface Water Information Management System on July 31, 2011.

Table 11 – ORW/ERW Report Middle Kickapoo Watershed

Official Waterbody Name	Local Waterbody Name	WBIC	ORW/ERW	Start Mile	End Mile
Bufton Hollow Creek	Bufton Hollow Creek	1193100	/ERW	0	2.78
Camp Creek	Camp Creek	1192700	ORW/	0	8.28
Cheyenne Valley Creek	Cheyenne Valley Creek	1197000	/ERW	0	7.6
Elk Creek	Elk Creek	1191700	ORW/	1.91	6.2
South Bear Creek	South Bear Creek	1193600	/ERW	2.49	4.43

Impaired Waters

Jug Creek is the only water listed as an impaired water in the Middle Kickapoo Watershed. Jug Creek was listed for Sediment/Total Suspended Solids impacting for Fish and Aquatic Life. Jug Creek's current use is listed as a Warmwater Forage Fishery. The following notes are a part of the WDNR listing.

> "Jug Creek, a 3.6 miles long stream located in Vernon County is listed as impaired on the 1998 Wisconsin 303(d). Jug Creek is located in the driftless area of southwestern Wisconsin about 25 miles east of the Mississippi. Jug Creek flows in a westerly direction and spills into the Kickapoo River inside the Army Corps of Engineers land just south of the village of Rockton. It has a high gradient of 71 feet per mile. Land use in the 5.2 square mile Jug Creek Watershed is 27% agricultural, 62% woodland, and 11% grassland, roads, quarries, and wetland. The agricultural land is located either along the stream or on ridge tops; typical of the "two-story" farming in the coulee area. Jug Creek was listed as a medium priority for TMDL development. Jug Creek is specifically listed as impaired due to the lack of trout or other sport fish in the stream. Minnows and other species dominate the fish community in Jug Creek. The 1990 fish survey found 14 species of minnow and other forage species, but the species are generally "pollution tolerant" species. The temperatures of the stream are adequate to support a coldwater fishery. Based on the Hilsenhoff Biotic Index (HBI) of 4.28 – indicating "slight organic pollution" – dissolved oxygen is unlikely to be a concern. Water clarity is good. The stream habitat is rated as "good". The stream bottom is generally coarse or fine gravel with some sand. Near the mouth of Jug Creek the stream bottom is 40% silt. However, at a mid-stream location, only 10% of the stream bottom is covered with silt. The runs and riffle are clean of silt and one pool shows about 0.1 feet of deposited sediment. The typical embeddedness is less than 5%. There is no aquatic vegetation and instream cover is generally scare and limited to non-woody debris. However, the overall stream habitat shows a tendency to be unstable. This situation compares very closely to the habitat of Reads Creek a similarly sized class I trout stream tributary to the Kickapoo River north of Jug Creek. Reads Creek, however, has more in-stream cover."

Discharges

The Villages of Ontario, La Farge and Viola hold WPDES for discharges to the Kickapoo River as identified from a 2010 list on the WDNR website. [6]

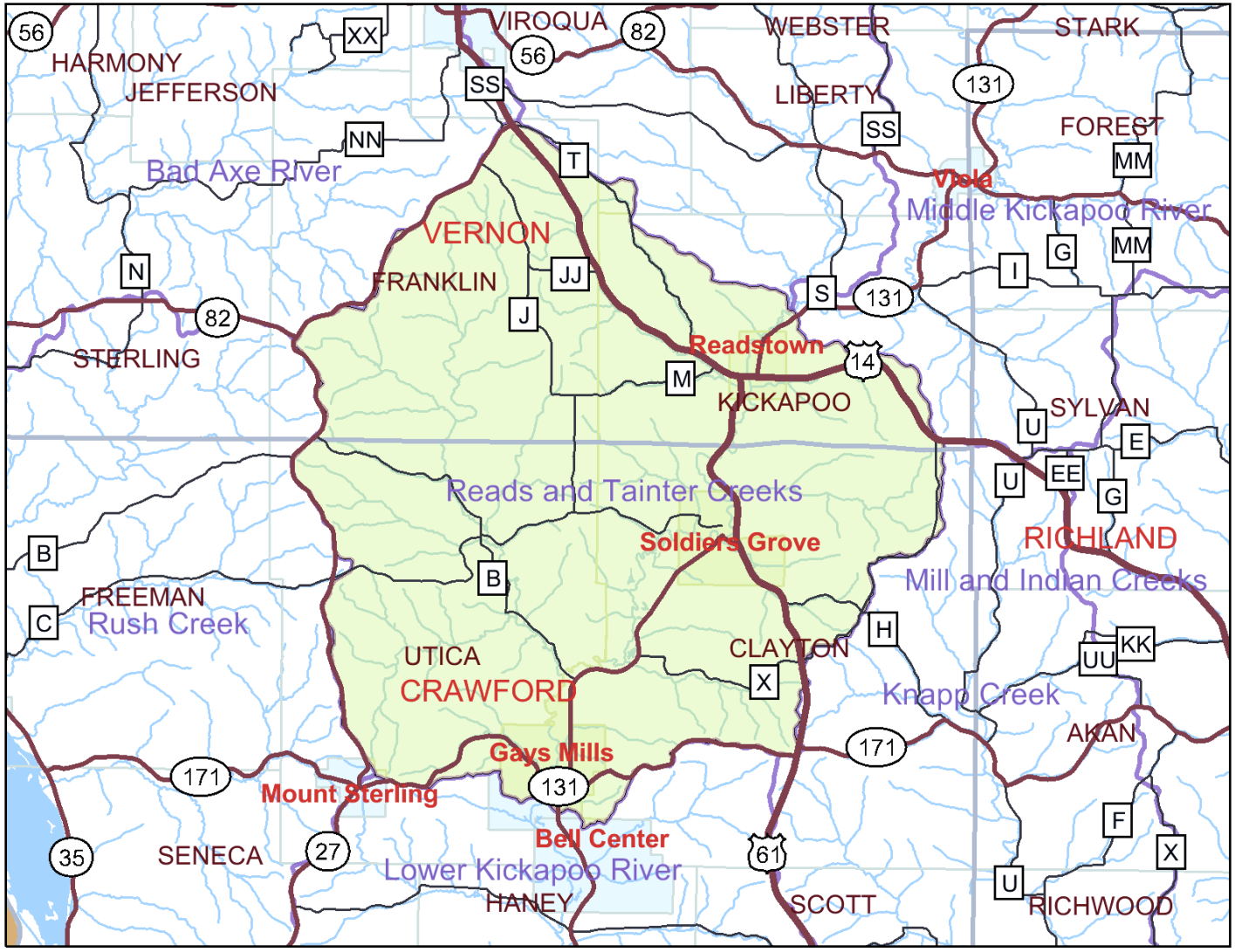
READS AND TAINTER CREEK WATERSHED

The Reads and Tainter Creek Watershed lies between the Middle and Lower Kickapoo Watersheds. Similar to what is seen throughout the greater Kickapoo watershed, the Reads and Tainter Creek watershed has steep valley walls resulting in high gradient tributaries. The watershed lies within Vernon and Crawford county (Township and Ranges 10N03W, 10N04W, 10N05W, 11N03W, 11N04W, 11N05W, 12N04W) as seen in Figure 5. Readstown, Soldiers Grove, and part of Gays Mills are in the Reads and Tainter Creek Watershed.

ECO-SYSTEM

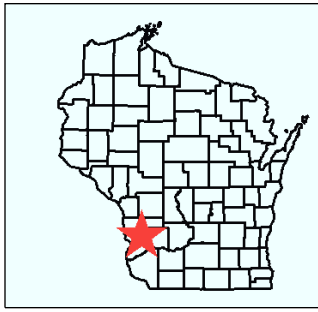
The Reads and Tainter Creek Watershed is also categorized as a Western Coulee and Ridges Ecological Landscape. This landscape is defined as highly eroded, driftless topography and relatively extensive forested lands. Soils are generalized as silt loams (loess) and sandy loams over sandstone residuum over dolomite. [11]

Figure 5 - Reads and Tainter Watershed



0 4 8 12 mi.

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.



Legend

Major Highways

- Interstate
- State Highway
- U.S. Highways

County Roads

24K County Boundaries

24K Watersheds

Civil Towns

Civil Town

100K Open Water

100K Rivers and Streams

Cities and Villages

Village

City

N

Scale: 1:227,870

As of 2009 the Bureau of Endangered Species of the WDNR Wisconsin Natural Heritage Inventory indicates that Dry Prairie, Moist Cliff, Southern Dry-mesic Forest, Southern Mesic Forest natural communities and Bat Hibernaculum have been observed in the Reads and Tainter watershed. In addition, Table 12 indicates observations of species that are classified as of concern, threatened or endangered. [3]

Table 12 – Concerned, Threatened or Endangered Species of the Reads and Tainter Watershed

Plant	Bird	Fish	Reptile/Snake/Frog	Other
Hill's Thistle, Upland Boneset, Yellow Gentain, Limestone Oak Fern, Nodding Pogonia, Yellow Giant Hyssop, Glade Mallow, Christmas Fern, Snowy Campion	Bald Eagle, Upland Sand Piper	Weed Shiner, Silver Chub	Timber Rattlesnake, Wood Turtle	Four-toed Salamander, Eastern Pipistrelle Bat

LAND USE

The land use in the Reads and Tainter watershed is predominately agricultural and forested as defined by the WDNR in 2002.

Table 13 - Land Cover in the Reads and Tainter Watershed [12]

Land Cover		Percent of Watershed
Agriculture		44.6%
Forest (Total)		40.4%
	Broad-Leaf Deciduous	39.6%
	Coniferous	0.75%
Grassland		11.2%
Wetland (Total)		2.15%
	Emergent/Wet Meadow	1.70%
	Forested	0.40%
	Lowland Shrub	0.05%
Other		1.32%
Development		0.28%

Census data from 2010 indicated the following populations and growth rates over the previous 10 years; Gays Mills 491 (-21.4%), Readstown 415 (5.1%) and Soldiers Grove 669 (2.5%). [5]

WATERS

The Reads and Tainter Watershed drains 136 square miles to the Kickapoo River. There are a total of 83.4 stream miles and 59.9 Trout stream miles. Approximately 21 miles of the Kickapoo River is in the watershed.

The following information was obtained from the WDNR Lower Wisconsin River Basin Report:

> **Rivers and Streams**
>
> *"Baker Creek*
>
> Baker Creek, located in northeast Crawford County, flows in a northwesterly direction for 2.4 miles before reaching the Kickapoo River in Soldiers Grove. This stream has a gradient of 44 feet per mile and drains forested hillsides and agricultural valleys as well as a small portion of Soldiers Grove. Baker Creek is a Class II trout stream for its entire length.

The most recent survey, conducted in 1978, documented brown trout and numerous forage fish species as well as a few northern pike. At the time, the stream bottom consisted of gravel, cobble and boulders with lesser amounts of sand and silt. In-stream cover consisted of undercut banks, boulders and woody debris... WDNR records indicate Baker Creek has not been stocked. Access to Baker Creek is from a park in Soldiers Grove and four road crossings.

Bear Creek

Bear Creek, located in northeast Crawford County, flows in a westerly direction for 3.6 miles before reaching the Kickapoo River between Gays Mills and Soldiers Grove. This stream has a gradient of 45 feet per mile and drains forested hillsides and agricultural valleys. Bear Creek is a Class II trout stream for its entire length.

The most recent survey, completed in 1978, documented brown trout and numerous forage fish species. The stream bottom primarily consisted of sand with lesser amounts of gravel, cobble and silt. In-stream cover for adult fish was scarce… WDNR records indicate that Bear Creek has not been stocked. Access to Bear Creek is from two road crossings.

Day Creek

Day Creek, located in southeast Vernon County, flows in a westerly direction for three miles before reaching the Kickapoo River in Readstown. This stream has a gradient of 58 feet per mile and drains forested hillsides and an agricultural valley as well as a portion of Readstown. Day Creek is a Class I trout stream for its entire length.

The most recent survey, completed in 1997, documented a naturally reproducing brook trout population as well as numerous forage fish species. Approximately 50% of the stream sampled contained a sand bottom with lesser amounts of silt, cobble and gravel. In-stream cover consisted primarily of woody debris with some undercut banks… WDNR records indicate that Day Creek was last stocked with wild brook trout in 1989. Access to Day Creek is from three road crossings.

Hincks Creek

Hincks Creek, located in south central Vernon County, flows in a southerly direction for 1.1 miles before reaching Tainter Creek. This stream has a steep gradient of 100 feet per mile and drains forested hillsides and an extensive agricultural headwater plateau. Hincks Creek is a Class III trout stream for its entire length.

The most recent survey, conducted in 1975, documented a diverse forage fishery but no trout. The stream bottom consisted mostly of gravel and cobble with some sand. Brook trout were last stocked in Hincks Creek in 1975. Access to Hincks Creek is from one road crossing.

Kickapoo River

A total of 21.1 miles of the Kickapoo River flow through the Reads and Tainter Creeks Watershed.

Nederlo Creek

Nederlo Creek, also known as Johnstown Creek, is located in north central Crawford County. This stream flows in a north easterly direction for 4.1 miles before reaching Tainter Creek north of Gays Mills. Nederlo Creek has a gradient of 27 feet per mile and drains forested hillsides and

agricultural valleys. Nederlo Creek is a Class II trout stream upstream of Freeman Road for 2.1 miles and Class III downstream of Freeman Road for 2.0 miles.

The most recent survey, conducted in 1998, documented a small brown trout population and a very diverse community of forage fish species. At the time, sand and silt made up nearly 50% of the stream bottom followed by cobble (41%) and small amounts of gravel and boulder. The majority of in-stream cover consisted of aquatic vegetation and some boulders… WDNR records indicate that Nederlo Creek was stocked with brown trout yearly from 1959 to 1995. Brook trout have been stocked since 1999. Access to Nederlo Creek is from one road crossing and a WDNR easement.

North Branch of Nederlo Creek

North Branch of Nederlo Creek, also known as Creek 12-3, is located in north central Crawford County. This stream flows in a south easterly direction for 1.6 miles before reaching Nederlo Creek. North Branch Nederlo Creek has a steep gradient of 110 feet per mile, drains forested hillsides and a narrow agricultural valley and is a Class II trout stream for its entire length.

The most recent survey, conducted in 1998, documented brook stickleback and mottled sculpin. The majority of the stream bottom was comprised of cobble and gravel. Numerous springs were also noted during the survey. A concrete spillway prevents the upstream migration of fish... WDNR records indicate that North Branch of Nederlo Creek has never been stocked. Access to this stream is from a WDNR easement.

Reads Creek

Reads Creek, also known as Black Bottom Creek, is located in southeast Vernon County. This stream flows parallel to HWY 14/61 in a southeasterly direction for 6.6 miles before reaching the Kickapoo River at Readstown. Reads Creek has a gradient of 56 feet per mile and drains forested hillsides with agricultural activities largely found on the upper headwater plateau. Reads Creek is a Class I trout stream for its entire length and an Exceptional Resource Water, (ERW).

The most recent survey was conducted in July 2000 to determine the effects of a flood that occurred the previous month when more than four inches of rain fell on already saturated ground. The erosive action of this large volume of water moved the stream channel in some locations, destroyed culverts and bridges and scoured clean the rocky substrate. Coincidentally during the July survey another catastrophic flood hit Reads Creek, this time approximately six inches of rain fell in a 24 hour period. Once again the stream channel moved in spots, culverts were blown out and the rocky substrate was scoured clean of algae and aquatic insects. The July survey surprisingly documented healthy brook trout and brown trout populations with several year classes represented. Additionally, a diverse forage fishery was also documented. The fishery successfully survived two major floods within 30 days. The stream bottom was dominated by cobble and gravel followed by sand. In-stream cover consisted of undercut banks, deep pools, woody debris and overhanging vegetation… WDNR records indicate that Reads Creek was stocked with brown trout from 1975 to 1997 and wild brook trout from 1998 to present. Access to Reads Creek is from five road crossings and one WDNR easement.

Sheridan Creek

Sheridan Creek, located in northeast Crawford County, flows in a westerly direction for 0.7 miles before reaching Baker Creek near Soldiers Grove. This stream has a gradient of 62 feet per mile.

Sheridan Creek is not a classified trout stream. A fish and habitat survey should be conducted of Sheridan Creek to determine its existing condition.

Sherry Creek

Sherry Creek, located in southeastern Vernon County, flows in an easterly direction for 1.7 miles before reaching Reads Creek near Readstown. This stream has a gradient of 33 feet per mile and drains forested hillsides and an agricultural valley. Sherry Creek is a Class II trout stream for its entire length.

The most recent survey, conducted in 1998, documented brook and brown trout as well as numerous forage fish species. The stream bottom consisted primarily of cobble, gravel and boulder with lesser amounts of silt and sand. In-stream habitat was largely woody debris and overhanging grasses. Abundant watercress, an indicator of groundwater influence, was also noted. Sherry Creek would benefit from the purchase of streambank easements from willing sellers and the restoration of in-stream habitat. WDNR records indicate that Sherry Creek has not been stocked. Access to Sherry Creek is from two road crossings.

Tainter Creek

Tainter Creek begins in south central Vernon and flows into north central Crawford County. This stream flows in a south easterly direction for 6.8 miles until it reaches the Kickapoo River north of Gays Mills. Tainter Creek has a rather steep gradient of 50 feet per mile through Vernon County, but a more gentle gradient of 15 feet per mile through Crawford County. This stream drains forested hillsides and agricultural valleys as well as the agricultural headwater plateau. Tainter Creek is a Class II trout stream upstream of CTH B and an exceptional water resources for 4.8 miles and Class III downstream for the remaining two miles.

The most recent survey, conducted in 1985, documented a fairly substantial brown trout population. A 1974 survey documented not only brown trout, but also a very diverse forage fishery. The stream bottom consisted primarily of cobble and gravel in the upper reaches and gradually more sand further downstream. In-stream cover included undercut banks, boulders, and woody debris. Much of Tainter Creek contains a stream channel incised into the valley floor resulting in vertical raw streambanks which consistently contribute sediment to the stream... WDNR records indicate that Tainter Creek was stocked with brown trout from 1973 to 1997. From 1998 to present both wild brook trout and wild brown trout have been stocked. Access to Tainter Creek is from six road crossings, WDNR owned land and WDNR easements.

Trout Creek

Trout Creek, located in northeast Crawford County, flows in a westerly direction for 3.8 miles before reaching the Kickapoo River near Soldiers Grove. This stream has a gradient of 44 feet per mile and drains forested hillsides and agricultural valleys. Trout Creek is a Class I trout stream for its entire length.

The most recent survey, conducted in 1998, documented a naturally reproducing brown trout population and numerous forage fish species. The stream bottom consisted primarily of cobble with lesser amounts of boulder, gravel and sand. Woody debris, boulders and deep pools made up the majority of in-stream cover... WDNR records indicate that Trout Creek has been stocked with brown trout consistently since 1967. Access to Trout Creek is from three road crossings." [12]

WATER CLASSIFICATIONS

The following information regarding classification of the waters in the Middle Kickapoo Watershed was found at the WDNR website. [11]

Trout Stream Summary

Table 13 titled is an excerpt of a query from the WDNR Surface Water Information Management System on July 30, 2011.

Table 13 – Trout Report Reads and Tainter Watershed

Official Name	Local Name	WBIC	Start Mile	End Mile	Water Size	Trout Class
Baker Creek	Baker Creek	1186900	0.00	4.06	4.1 Miles	CLASS II
Bear Creek	Bear Creek	1186600	0.00	5.14	5.1 Miles	CLASS II
Day Creek	Day Creek	1187800	0.00	4.65	4.7 Miles	CLASS I
Kickapoo River	Kickapoo River	1182400	43.81	60.80	17.0 Miles	CLASS II
Nederlo Creek	Nederlo Creek	1185700	0.00	2.75	2.8 Miles	CLASS III
Nederlo Creek	Nederlo Creek	1185700	2.75	6.65	3.9 Miles	CLASS II
Reads Creek	Reads Creek (Black Bottom Cr)	1187400	0.00	8.87	8.9 Miles	CLASS I
Sheridan Creek	Sheridan Creek	1187000	0.00	1.00	1.0 Miles	
Sherry Creek	Sherry Creek	1187500	0.00	4.02	4.0 Miles	CLASS II
Tainter Creek	Tainter Creek	1185500	0.00	2.45	2.5 Miles	CLASS II
Tainter Creek	Tainter Creek	1185500	2.45	15.03	12.6 Miles	CLASS I
Trout Creek	Trout Creek	1187200	0.00	5.43	5.4 Miles	CLASS I
Unnamed	Tributary to the Kickapoo River	1187810	0.00	0.69	0.7 Miles	
Unnamed	Unnamed Creek 12-3	1185900	0.00	2.15	2.2 Miles	CLASS I
Unnamed	Creek 6-11 T11n R3w	1187600	0.00	3.22	3.2 Miles	CLASS I
Unnamed	Hinck's Creek (Creek 5-11)	1186800	0.00	3.91	3.9 Miles	
Unnamed	Hincks Creek	1186500	0.00	4.43	4.4 Miles	CLASS III
Unnamed	Mcgraw Cr (18-3)(T11nr4w18-13)	1186400	0.00	4.59	4.6 Miles	CLASS I

Watershed Outstanding & Exceptional Resources

Table 14 below lists the outstanding and exceptional waters in the Reads and Tainter Watershed. This information is an excerpt from data queried from the WDNR Surface Water Information Management System on July 31, 2011. The Code Reference indicates what State code qualifies it as an ORW or an ERW.

Table 14 – ORW/ERW Report West Fork of the Kickapoo Watershed

Official Waterbody Name	Local Waterbody Name	WBIC	ORW/ERW	Start Mile	End Mile
Reads Creek	Reads Creek (Black Bottom Cr)	1187400	/ERW	0	8.87
Tainter Creek	Tainter Creek	1185500	/ERW	2.45	15.03
Unnamed	Creek 6-11 T11n R3w	1187600	/ERW	0	3.22

Impaired Waters

No waters in the Reads and Tainter Watershed are listed as impaired.

Discharges

The Villages of Readstown, Soldiers Grove and Gays Mills hold WPDES for discharges to the Kickapoo River as identified from a 2010 list on the WDNR website. [6]

LOWER KICKAPOO WATERSHED

The Kickapoo River in Lower Kickapoo Watershed is distinguishable in comparison to the upstream watersheds. Here the river is deeper and wider and the floodplain contains extensive wetlands. The Lower Kickapoo watershed is medium sized in the sub-basin with an area of approximately 150 square miles. The Lower Kickapoo Watershed consist of all waters that flow to the Kickapoo River between Gays Mills and Wauzeka and lies entirely within Crawford county (Township and Ranges 7N04W, 8N04W, 8N05W, 9N03W, 9N04W, 9N05W, 10N03W, 10N04W, 10N05W) as seen in Figure 6. The Villages of Soldiers Grove, Gays Mills, Steuben and Wauzeka are a part of the Lower Kickapoo Watershed.

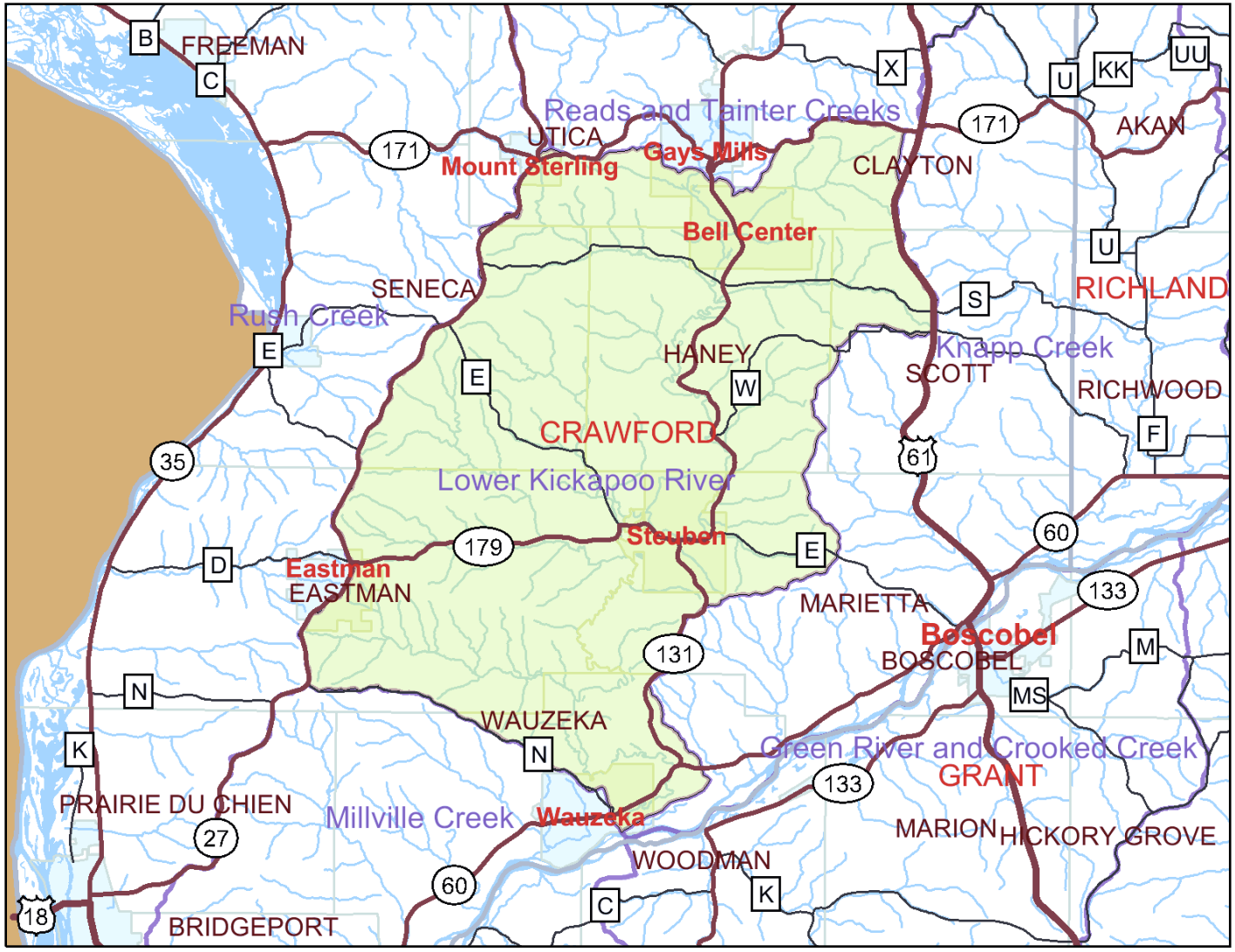
The Kickapoo River in the Lower watershed has a gradual slope, averaging 3 feet per mile in the Middle and Lower Kickapoo Watersheds. However the tributaries on the Lower Watershed have steep gradients due to the steep valley walls and therefore much of this area are woodlands.

ECO-SYSTEM

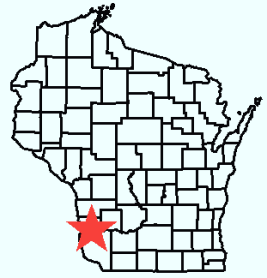
The Lower Kickapoo Watershed is also categorized as a Western Coulee and Ridges Ecological Landscape. This landscape is defined as highly eroded, driftless topography and relatively extensive forested lands. Soils are generalized as silt loams (loess) and sandy loams over sandstone residuum over dolomite. [13]

As of 2009 the Bureau of Endangered Species of the WDNR lists the Wet-mesic Prairie, Southern Dry-mesic Forest, Southern Mesic Forest, Southern Dry Forest, Floodplain Forest, Southern Sedge Meadow, Dry Prairie, Emergent Marsh natural communities and Bat Hibernaculum and Mussel Bed as being observed in the Wisconsin Natural Heritage Inventory of the Lower Kickapoo watershed. In addition, Table 15 indicates observations of species that are classified as of concern, threatened or endangered. [3]

Figure 6 - Lower Kickapoo Watershed



0 4.75 9.5 14.25 mi.



Legend

Major Highways
- Interstate
- State Highway
- U.S. Highways

County Roads
24K County Boundaries
24K Watersheds

Civil Towns
- Civil Town

100K Open Water
100K Rivers and Streams

Cities and Villages
- Village
- City

N

Scale: 1:260,978

Table 15 – Concerned, Threatened or Endangered Species of the Lower Kickapoo Watershed

Plant	Bird	Insects	Fish/Mussels	Reptile/ Amphibian	Mammal
Snowy Campion, Upland Boneset, Yellow Gentian, Sweet-scented Indian-plantain, Nodding Pogonia, Yellow Giant Hyssop, Hill's Thistle, Glade Mallow, Christmas Fern, Prairie Indian Plantain, Richardson Sedge, Upland Boneset, Glade Fern, Purple Milkweed, Beak Grass, Glade Fern, Purple-stem Cliff-brake	Acadian Flycatcher, Cerulean Warbler, Red-shouldered Hawk, Kentucky Warbler, Bald Eagle, Bell's Vireo, Yellow-billed Cuckoo, Least Bittern, Yellow-crowned Night-heron, Prothonotary Warbler	Ottoe Skipper, Prairie Leafhopper, Regal Fritillary, River Mayfly, Swamp Darner Dragonfly, Plains Clubtail Dragonfly, Cyrano Darner Dragonfly, Smokey Shadowfly Dragonfly, Small Minnow Mayfly, Wallace's Deepwater Mayfly, Russet-tipped Clubtail Dragonfly	Silver Chub, Weed Shiner, Elktoe Mussel, Flate Floater, Pirate Perch, Rock Pocketbook, Blue Sucker, Butterfly Mussel, Lake Chubsucker, Mud Darter, Western Sand Darter, Starhead Topminnow, Ebony Shell Mussel, Goldeye, Black Buffalo, Higgins' Eye Mussel, Shoal Chub, Weed Shinner, Ozark Minnow, Pallid Shiner, Pugnose Minnow, Mississippi Grass Shrimp, Bullhead Mussel, Round Pigtoe Mussel, Monkeyface Mussel, Salamander Mussel, Buckhorn Mussel	Blanding's Turtle, Wood Turtle, Gray Ratsnake, Northern Cricket Frog, Timber Rattlesnake, North American Racer, Gophersnake	Eastern Pipistrelle Bat

LOWER KICKAPOO WATERSHED LAND USE

The land use in the Lower Kickapoo watershed is predominately agricultural and forested as defined by the WDNR in 2002.

Table 16 - Land Cover in the Lower Kickapoo Watershed [14]

Land Cover		Percent of Watershed
Agriculture		39.8%
Forest (Total)		47.7%
	Broad-Leaf Deciduous	47.2%
	Coniferous	0.58%
Grassland		7.34%
Wetland (Total)		3.81%
	Emergent/Wet Meadow	2.18%
	Forested	1.47%
	Lowland Shrub	6.25%
Other		1.2%
Development		0.14%

Public lands in the Lower Kickapoo Watershed include the Kickapoo River Wildlife Area -

Wauzeka Unit and the Kickapoo River Wildlife Area - Bell Center Unit totaling over 7,000 acres of WDNR owned land and WDNR easements which offers fishing, hunting, and birdwatching opportunities.

Census data from 2010 indicated the following populations and growth rates over the previous 10 years; Gays Mills 491 (-21.4%), Bell Center 117 (0.9%), Steuben 117 (12.0%) and Wauzeka 711 768 (-7.4%). [5]

WATERS

The Lower Kickapoo Watershed is the last area of the Kickapoo Watershed prior to the Wisconsin River. All drainage to the Kickapoo River south of State Highway 171 is within the Lower Kickapoo. The watershed is approximately 150 sq mi with a total of 96.5 stream miles. Roughly 34 miles of the Kickapoo is in the Lower Kickapoo Watershed.

The following information was obtained from the WDNR Lower Wisconsin River Basin Report:

Rivers and Streams

"Citron Creek

Citron Creek, located in central Crawford County, flows in a southeasterly direction for 4.6 miles before reaching the Kickapoo River near Steuben. This stream has a gradient of 42 feet per mile and drains wooded hillsides and agricultural valleys. Many large springs enter Citron Creek at several places. Citron Creek is a Class III trout stream for its entire length.

The most recent biological survey, conducted in 1982, documented few brown trout and numerous forage fish species. In-stream cover for fish was limited to few undercut banks, rocks and woody debris. A fish and habitat survey should be conducted on Citron Creek to document existing conditions… Citron Creek was stocked with brown trout between 1960 to 1996 and exclusively brook trout since 1998. Access to Citron Creek is from two road crossings.

Crow Hollow Creek

Crow Hollow Creek, also known as Creek 10-11, is located in west central Crawford County. This stream flows in a westerly direction for 4.2 miles before reaching the Kickapoo River near Bell Center. Crow Hollow Creek has a gradient of 42 feet per mile and drains wooded hillsides with agricultural activities found in the valleys. Crow Hollow Creek is a Class I trout stream for its entire length.

The most recent survey, conducted in 1998, documented a naturally reproducing brown trout population and numerous forage fish species. Beaver dams were present and causing some siltation problems. In-stream cover for fish was not abundant but consisted of undercut banks, boulders and woody debris... Wild brook trout were stocked in 1998. Access to Crow Hollow Creek is from three road crossings.

Duffy Creek

Duffy Creek, located in central Crawford County, flows in a southeasterly direction for approximately 2.0 miles before reaching Citron Creek. Duffy Creek is not a classified trout stream. A fish and habitat survey of Duffy Creek should be conducted to determine existing conditions.

Halls Branch

Halls Branch, located in central Crawford County, flows in an easterly direction for five miles before reaching the Kickapoo River near Bell Center. This stream has a gradient of 43 feet per mile and drains wooded hillsides and agricultural valleys. Halls Creek is a Class III trout stream for two miles from its mouth up to Zintz Road and Class II upstream of Zintz Road for three miles.

The most recent survey, conducted in 1998, documented a cool, clear stream with a bottom comprised mainly of sand with a balance of silt, gravel, cobble, and boulders. Adequate instream cover was available for the brook and brown trout found in the stream. Numerous forage fish species were also documented. Unrestricted cattle access to the steep banks of Halls Branch was also documented as a pervasive source of sediment… WDNR records indicate Halls Branch has been stocked with brown trout since 1961, while brook trout have only been stocked intermittently since 1996. Access to Halls Branch is from four road crossings and WDNR owned land. A state threatened species has been found in this creek.

Otter Creek

Otter Creek, located in central Crawford County, flows in an easterly direction for five miles before reaching Pine Creek near Steuben. This stream has a gradient of 22 feet per mile and drains forested hillsides and agricultural valleys. Otter Creek is not a classified trout stream. The most recent survey, conducted in 1975, documented numerous forage fish species.

Siltation derived from streambank erosion and streambank pasturing of livestock were noted as reducing available habitat for trout. It was also suggested that Otter Creek's water temperatures may not support a trout fishery. A fish and habitat survey should be conducted of Otter Creek to determine existing conditions... WDNR records indicate that Otter Creek has never been stocked. Access to Otter Creek is from WDNR easements and one road crossing.

Pine Creek

Pine Creek, located in central Crawford County, flows in a southeasterly direction for 6.5 miles before reaching the Kickapoo River near Steuben. This stream has a gradient of 24 feet per mile and drains forested hillsides and agricultural valleys. Pine Creek is a Class II trout stream for its entire length. The most recent survey, completed in 1997, documented brown trout and numerous forage fish species. In-stream cover consisted of undercut banks, log tangles and aquatic vegetation.

Silt was the primary bottom type, followed by rubble and sand. This stream has potential to become a quality trout stream, however flooding, streambank grazing of livestock and beaver dams are negatively affecting the habitat and consequently the fishery of Pine Creek… WDNR records indicate Pine Creek has been stocked with brown trout consistently since 1960, but with wild brown trout only since 2001. Access to Pine Creek is from WDNR easements and five road crossings.

Plum Creek

Plum Creek, located in southern Crawford County, flows in an easterly direction for 5.2 miles before reaching the Kickapoo River near Wauzeka. This stream has a gradient of 35 feet per mile and drains forested hillsides and agricultural valleys. Plum Creek is a Class I trout stream for its entire length and an Exceptional Resource Water, (ERW).

A series of fish and habitat surveys have been conducted on Plum Creek since 1997. Both brook and brown trout are naturally reproducing and a healthy and diverse forage fish community inhabits Plum Creek. With the assistance of the Prairie Rod and Gun Club, restoration of in-stream habitat began in 1999 with the addition of LUNKER structures, boulder retards, and streambank stabilization. Yearly fish and habitat surveys are tracking changes to the fish community over time in response to the restoration of in-stream habitat. Problems noted during recent surveys include beaver activity, streambank grazing of livestock, streambank erosion, and lack of permanent in-stream cover for adult trout.

Additional in-stream habitat development in Plum Creek would benefit the trout fishery. This stream would also benefit from the purchase of additional streambank easements from willing sellers. Continued fish and habitat surveys should be conducted to track fishery population changes in response to additional in-stream habitat restoration. WDNR records indicate that Plum Creek was last stocked with brook trout in 1996. The naturally reproducing populations of brown and brook trout have eliminated the need for further stocking. Access to Plum Creek is from two road crossings, WDNR owned land and WDNR easements.

Sand Creek

Sand Creek, located in northern Crawford County, flows in a westerly direction for five miles before reaching the Kickapoo River in Bell Center. This stream has a gradient of 44 feet per mile and drains forested hillsides, recreational land, and some agricultural land. Sand Creek is not a classified trout stream.

The most recent survey, conducted in 1978, documented many forage fish species, one brook trout and two brown trout. Flooding and eroding streambanks were contributing to problems with in-stream habitat for trout… WDNR records indicate that Sand Creek was last stocked in 1970 with brook trout. Access to Sand Creek is from one road crossing."[14]

WATER CLASSIFICATIONS

The following information regarding classification of the waters in the Middle Kickapoo Watershed was found at the WDNR website. [13]

Trout Stream Summary

Table 17 is an excerpt of a query from the WDNR Surface Water Information Management System on July 30, 2011.

Table 17 – Trout Report Lower Kickapoo Watershed

Official Waterbody Name	Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class
Otter Creek	Otter Creek	1183100	0	4	CLASS I
Citron Creek	Citron Creek	1183200	0	8.29	CLASS III
Halls Br	Halls Branch	1184300	0	1.97	CLASS III
Halls Br	Halls Branch	1184300	5.16	7.74	CLASS II
Pine Creek	Pine Creek	1183000	0	11.22	CLASS I
Sand Creek	Sand Creek	1184800	0	5.99	CLASS I
Halls Br	Halls Branch	1184300	1.97	5.16	CLASS II
Unnamed	Creek 9-13 (Steuben Springs)	1183400	0	3.95	CLASS II
Plum Creek	Plum Creek	1182700	0	9.24	CLASS I
Unnamed	Creek 10-11 (Crow Hollow)	1184000	0	4.9	CLASS I

Watershed Outstanding & Exceptional Resources

Plum Creek is the only waters in the Lower Kickapoo Watershed listed as outstanding or exceptional. The designation is exceptional resource water for the entire length of the stream.

Wetland Health

The WDNR says the following about wetland health in the Lower Kickapoo Watershed.

> "Less than four percent of the current land uses in the watershed are wetlands. Currently, about 87% of the original wetlands in the watershed are estimated to exist. Of these wetlands, the majority include forested wetlands (60%) and emergent wetlands (35%), which include marshes and wet meadows.
>
> *Wetland Condition:*
> Little is known about the condition of the remaining wetlands but estimates of reed canary grass (RCG) 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 42% of the existing emergent wetlands and eight percent of the remaining forested wetlands. Reed canary grass domination inhibits successful establishment of native wetland species.
>
> *Wetland Restorability:*
> Of the 530 acres of estimated lost wetlands in the watershed, approximately 95% are considered potentially restorable based on modeled data, including soil types, land use, and land cover (Chris Smith, DNR, 2009)."

Impaired Waters

Kickapoo River and Hall Branch are listed as impaired waters in the Lower Kickapoo Watershed. Sand Creek was originally listed as a mistake and then delisted.

Table 18 – Impaired Waters Lower Kickapoo Watershed

Local Name	Start Mile	End Mile	Pollutant	Impairment	303 Status	Priority
Halls Branch	1.97	5.16	Sediment/Total Suspended Solids	Degraded Habitat	303d Listed	Low
Kickapoo River	19.05	25.45	Mercury	Contaminated Fish Tissue	303d Listed	Low
Sand Creek	0.00	5.99	Sediment/Total Suspended Solids	Degraded Habitat	Water Delisted	Delisted 2002

The following notes are a part of the WDNR listing.

Kickapoo River

Since 1998 the Kickapoo has been listing for a restriction on fish consumption due to contaminated Fish Tissue. "Water is impaired due to one or more pollutants and associated quality impacts. Kickapoo River is on the 303(d) list for mercury. In addition, this segment of river was assessed during the 2012 listing cycle, and total phosphorus sample data exceed 2012 WisCALM listing criteria for the fish and aquatic life use; however, available biological data do not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category)."

Halls Branch

Since 1998 Halls Branch has been listed for degraded habitat for fish and aquatic life due to sediment and total suspended solids. "Water is impaired due to one or more pollutants and associated quality impacts. Halls Branch is on the 303d list due to total suspended solids in the water. This water is also on 1980 trout streams list (class 2)."

"Fishery Survey 1967 - Documented a brown trout fishery that justified the classifications of Cold II on the upper 3.0 miles and Cold III on the lower 2.0 miles. Fishery Survey 1998 - Documented very few brown trout throughout the entire stream. This survey indicated that the upper 3.0 miles of Halls Branch Creek was not meeting its codified use of Cold II. Fishery Survey 2007 - Documented very few brown and brook trout throughout entire stream. Browns last stocked in 2001. Survey found 18. In May 2007, a total of 600 Brook trout were stocked and 14 were found one month later."

Sand Creek

"Sand Creek was never codified as a trout stream. The 1994 Lower Wisconsin River Water Quality Management Plan states that the stream was not meeting its potential as a trout stream, but it was meeting its codified use of fish and aquatic life. Consequently, Sand Creek was erroneously listed as an impaired water in 1998. The 2001 fish and habitat survey documented a self-sustaining brown trout population that was not established by stocking. In 2001 Land use in the Sand Creek watershed was nearly entirely recreation land with very few active farms. Delisted from 303(d) List in 2002 due to its fully meeting aquatic life uses. It should not have originally been listed."

DISCHARGES

The Villages of Gays Mills and Wauzeka hold WPDES for discharges to the Kickapoo River as identified from a 2010 list on the WDNR website. [6]

METHODOLOGY

This assessment was performed by analyzing all the surface water data collected by the WDNR and VSN since 2000.

DATA MANAGEMENT

A total of 212,346 data points were analyzed in this assessment. As such data management was extremely important including the collection and manipulation of the data.

DATA COLLECTION

Only data collected by VSN and the WDNR since 2000 was used in this assessment. This data was gathered from a number of sources as described below.

WAV Database

All WAV Level 1 data can be viewed and downloaded from the WAV database hosted by the University of Wisconsin Extension at http://www.uwex.edu/erc/wavdb/. VSN WAV Level 1 program data was downloaded on February 16, 2011.

SWIMS Database

The Surface Water Integrated Monitoring System (SWIMS) is a data system operated by the WDNR to ensure that staff and management have access to high quality surface water, sediment and aquatic invasives data in an accessible format. All surface water quality and non-fish aquatic life data is stored in this database.

Both WDNR and VSN data was downloaded from the SWIMS database. VSN WAV Level 2 and some Level 3 special project data are entered in the SWIMS database. Data from the SWIMS database was downloaded on March 30, 2011.

VSN Data

There have been a number of VSN special projects where data was not inputted into the WAV or SWIMS database. This data was organized in a spreadsheet and uploaded to the assessment database.

DATA MANIPULATION

All data was uploaded into an open source relational database, Apache Derby. Data was manipulated into summary tables and charts using Eclipse Business Intelligence and Reporting Tools (BIRT). BIRT is an open source integrated development environment for building and deploying reports.

Data was sorted by waterbody then by station. All waterbodies in the state are assigned a water body index code (WBIC) that is a unique numeric identifier. Further, each monitoring location is identified by a unique station number. Both of these numbers are assigned by the WDNR. All data analyzed was related to a station number and each station number was related to a WBIC. Reports were created for each station for six categories of parameters.

PARAMETERS AND ANALYSIS

The limitations of this assessment should be noted when reviewing this report. Analysis can be made only for data that has been collected. If no data has been collected for a specific parameter it does not

indicate that degradation is present, nor does it indicate that degradation is not present. In most cases the data sets are not conclusive enough to make impairment designations. As such, this analysis looks at what data indicated rather than making conclusive determinations. Lastly, it is important to remember that environmental conditions vary. Samples could have been collected under altered conditions such as during storm events, or during seasonal fluctuations such as periods of high water.

PARAMETERS

Many different types of water quality data have been collected. For the purpose of this assessment, data was broken down to six assessment categories; temperature, core, nutrients, macroinvertebrate, bacteriological and chemical. The following table lists the possible parameters in each category.

Table 19 – Parameter Categories

	Temperature	Core	Nutrients	Macro	Bacterial	Chemical
Parameters	Temperature instantaneous and continuous	Dissolved Oxygen, Percent Saturation, pH, turbidity, conductivity, stream flow	Ammonia, Nitrate and Nitrite, Phosphorus	Hilsenhoff Biotic Index, Index of Biotic Integrity, Family Biotic Index, Shannon Diversity Index, Species Richness, Genera Richness	Fecal Coliform, *E.coli,* Heterotrophic Plate Count, PCR analysis	Hardness, Magnesium, Calcium, Triazine, Atrazine, Arsenic

TEMPERATURE

Temperature governs the kinds of aquatic life that can exist in a stream. Fish and other aquatic organisms have a specific temperature range they require for proper life cycle functioning. Temperature also affects water chemistry such as the rate of chemical reactions. Certain compounds are more toxic to aquatic life at higher temperature. The saturation content of a constituent in water is also affected by temperature. For example, oxygen is dissolved more readily in cold water than warm water. [15]

The WDNR's Guidelines for Designating Fish and Aquatic Life Uses categorizes streams based on presence of fish and other aquatic life and the temperature of the stream. The cold stream category, which should apply to most waters in the greater Kickapoo Watershed, requires a stream to have a maximum daily mean temperature of approximately 22°C and an instantaneous maximum temperature of approximately 25°C. [16] The WDNR Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) designates impairment with a minimum data of 20 discrete daily values collected by a thermistor hourly. Further 10% of the mean daily values must exceed the specified maximum. [17]

DISSOLVED OXYGEN

Oxygen is required for respiration of fish and other aquatic animals. Microscopic bubbles of oxygen gas in water are called dissolved oxygen (DO). A certain minimum amount of oxygen must be present to

sustain aquatic life. In addition, oxygen is also used for the decomposition of organic matter and other biological processes. Therefore, degraded oxygen levels also indicate contamination when high levels of organic matter, such as manure, are present. [15]

The WDNR WisCALM indicates an impairment threshold for dissolved oxygen. Depending on the category of the stream, minimum DO levels range between 1.0 mg/L and 7.0 mg/L. For WisCALM impairment designation, 3 days of continuous measurement no less than 1 hour apart is required. The data must display DO limit exceedance for 10% or more of the values. [17] Due to the nature of the waters in the watershed, the cold water limit of 7.0 mg/L during spawning and 6.0 mg/L during normal conditions was compared against DO data. Saturation of dissolved oxygen levels was also used to determine degradation in DO levels.

pH

The pH is a measure of the concentration of hydrogen ions. The pH scale is logarithmic and ranges from 0, most acidic, to 14, most basic. The pH of most natural waters ranges between 6.5 and 8.5. In the greater Kickapoo Watershed the pH values tend to be on the high side from 7.5 to 8.5. "The pH of water determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (e.g., phosphorus, nitrogen, and carbon) and heavy metals (e.g., lead, cadmium, copper). For example, in addition to determining how much and what form of phosphorus is most abundant in the water, pH also determines whether aquatic life can use it. Heavy metals tend to be more toxic at lower pH because they are more soluble and more bioavailable." [15]

The WisCALM impairment threshold for pH is outside the range of 6.0 to 9.0 or if the change is greater than 0.5 units outside the natural seasonal maximum and minimum. [17]

Turbidity/Transparency

Turbidity and transparency is a measurement of the water clarity. Transparency can be empirically converted into a turbidity level in Nephelometric turbidity units (NTU). Turbidity is caused by sediment entering the water column and in some case is caused but excessive nutrient causing algal growth. [15] Due to limitation of testing, turbidity data can only be verified down to 10 NTU. In general, within these watersheds values of turbidity above 10 NTU indicate degradation.

Conductivity

Conductivity is a measure of the drop in voltage caused by the resistance of the water. Each stream tends to have a relatively constant range of conductivity. Significant changes in conductivity can be an indicator that a discharge or some other source of pollution has entered a stream. [18]

Nutrients

Nutrients are essential for growth. Streams often contain excessive levels of nutrients, which results in additional algae and other plant growth. "The main nutrients of concern are phosphorus and nitrogen. Both elements are measured in several forms. Phosphorus can be measured as total phosphorus (TP), or orthophosphate, TP that is soluble or available to organisms for growth. Nitrogen can be measured as total nitrogen (TN), total Kjeldahl nitrogen (TKN), nitrate-nitrite nitrogen, or ammonia nitrogen. TKN

represents the fraction of TN that is unavailable for growth or bound up in organic form, it also includes NH_4. The remaining fractions nitrate-nitrite and ammonia represent bioavailable forms of nitrogen." [16]

Phosphorus and nitrogen in excess amounts can accelerate eutrophication, causing dramatic increases in aquatic plant growth and changes in the types of plants and animals that live in the stream. "This, in turn, affects dissolved oxygen, temperature, and other indicators. Excess nitrates can cause hypoxia (low levels of dissolved oxygen) and can become toxic to warm-blooded animals at higher concentrations (10 mg/L) or higher) under certain conditions." [19]

Ammonia

Ammonia is a form of nitrogen that can cause toxicity. Ammonia is present in human and animal waste and therefore can indicate fecal contamination. The WDNR WisCALM toxicity threshold for ammonia is related to hardness and pH levels. For acute toxicity, ammonia levels are between 2.14mg/L (200 mg/L hardness) and 30.64mg/L (50 mg/L hardness) depending hardness and aquatic use category. Chronic toxicity levels are lower, between 0.55 (pH 8.5) and 46.29 (pH 7.5) depending on pH and aquatic use category. [17]

Nitrate and Nitrite

Nitrates and Nitrites can be created by microorganisms converting ammonia. The drinking water quality limit for nitrates in Wisconsin is 10 mg/L. [17] However, naturally occurring levels in surface water streams should be lower that this limit. In general naturally occurring nitrate and nitrite levels should be less than 1 mg/L. That being said the EPA ambient nutrient criteria document reviewed data from 1990 to 1999 and provided a reference condition of 0.5 mg/L for the entire ecoregion and a 1.7 mg/L for the Driftless sub-ecoregion. [20] This means that based on 1990 to 1999 data the ambient nitrate and nitrite levels were three times higher than what was found in the ecoregion as a whole. Historically data, prior to 1990, needs to be reviewed to determine if these higher levels are occurring naturally or are caused by human impact. Pre-1990 historical data was not analyzed in this assessment.

Phosphorous

The WDNR WisCALM provides an impairment threshold for phosphorus of 0.075 mg/L. In order to make this determination, 10 base flow values need to be measured with at least 10% of the values exceeding 0.075 mg/L. [17] The EPA provided a reference condition of 0.33 mg/L for the entire ecoregion and a 0.70 mg/L for the Driftless sub-ecoregion. [20] Again the 1990 to 1999 data shows that the ambient levels in the sub-ecoregion are higher than occurring in the ecoregion as a whole.

MACROINVERTEBRATES

"Macroinvertebrates are organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate). They inhabit all types of running waters, from fast flowing mountain streams to slow moving muddy rivers." [19]

Aquatic macroinvertebrates are good indicators of stream quality because they are affected by the physical, chemical, and biological conditions of the stream. They can't escape pollution and show the effects of short- and long-term pollution events. They may show the cumulative impacts of pollution and habitat loss not detected by traditional water quality assessments. They are a critical part of the stream's food web. Some are very intolerant of pollution. Lastly, they are relatively easy to sample and identify. [19]

Index of Biotic Integrity (IBI)

WisCALM general assessment thresholds are listed below in Table 20.

Table 20 – WDNR WisCALM IBI Assessment Thresholds

Condition Gradient	Management Recommended	IBI
Excellent	Consider Outstanding and Exceptional Listing	7.5-10.0
Good	Maintain Condition	5.0-7.4
Fair	Restoration	2.6-4.9
Poor	Consider Impairment Listing	0-2.6

Hilsenhoff Biotic Index (HBI)

The HBI is a weighted pollution tolerance value. Corresponding water quality ratings can be seen in Table 21 below. HBI Max-10 is the HBI index allowing a maximum of 10 of each species to be counted.

Table 21 - Water quality ratings for HBI values

HBI Value	Water Quality Rating	Degree of Organic Pollution
≤ 3.50	Excellent	None Apparent
3.51-4.50	Very Good	Possible Slight
4.51-5.50	Good	Some
5.51-6.50	Fair	Fairly Significant
6.51-7.50	Fairly Poor	Significant
7.51-8.50	Poor	Very Significant
8.51-10.00	Very Poor	Severe

[21]

Family Biotic Index (HBI)

The FBI is also a weighted pollution tolerance value. Corresponding water quality ratings can be seen in Table 22 below.

Table 22 - Water quality ratings for FBI values

HBI Value	Water Quality Rating	Degree of Organic Pollution
≤ 3.75	Excellent	Unlikely
3.76-4.25	Very Good	Possible Slight
4.26-5.00	Good	Some Probable
5.01-5.75	Fair	Fairly Substantial
5.76-6.50	Fairly Poor	Substantial
6.51-7.25	Poor	Very Substantial
7.26-10.00	Very Poor	Severe

[21]

BACTERIOLOGICAL

"Fecal coliform bacteria are microscopic organisms that live in the intestines of warm-blooded animals. They also live in the waste material, or feces, excreted from the intestinal tract. When fecal coliform bacteria are present in high numbers in a water sample, it means that the water has received fecal matter from one source or another. Although not necessarily agents of disease, fecal coliform bacteria may indicate the presence of disease-carrying organisms, which live in the same environment as the fecal coliform bacteria." [16]

Escherichia coli (E.coli) is a surrogate analysis for fecal coliform bacteria. Values for *E.coli* will provide a good indication of fecal contamination. Heterotrophic Plate count as known as background bacteria indicates the "background" noise of the sample.

WisCALM limits *E.coli* only under recreational use. In general the recreational use limit for *E.coli* is 126 cfu/100 mL as a long-term geometric mean. The single instantaneous maximum is 235 cfu/100 mL. However the WDNR considers that flowing rivers and streams in Wisconsin do not provide comparable recreational activities for full body immersion and therefore has set an additional limit of 200 cfu/100 mL for the geometric mean and 400 cfu/100 mL.

Polymerase chain reaction (PCR) is a presence/absence test that isolated DNR from human and animal sources and can be used to distinguish fecal contamination sources.

CHEMICAL

Various chemicals can be used to analyze the health of a watershed. For the purposes of this study magnesium, calcium, alkalinity, hardness, triazine, atrazine, and arsenic has been assessed.

Magnesium, Calcium, Alkalinity and Hardness

Magnesium and calcium can be used to calculate hardness. In this assessment hardness is used to determine what level of ammonia is considered toxic. For those data sets where magnesium and calcium was available but not hardness, hardness was calculated. The following calculation was used to calculate hardness:

Hardness (mg/L) = [Calcium (mg/L) x 2.5] + [Magnesium (mg/L) x 4.12].

"Alkalinity is a measure of the capacity of water to neutralize acids (see pH description). Alkaline compounds in the water such as bicarbonates (baking soda is one type), carbonates, and hydroxides remove H+ ions and lower the acidity of the water (which means increased pH). They usually do this by combining with the H+ ions to make new compounds. Without this acid-neutralizing capacity, any acid added to a stream would cause an immediate change in the pH. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It's one of the best measures of the sensitivity of the stream to acid inputs." [18]

Triazine and Atrazine

Triazine is a group of compounds that includes atrazine. Atrazine does not occur naturally in the environment and therefore any presence indicates human impact. "… the Agency determined that concentrations of atrazine and its degradates in raw water below an average of 37.5 ppb over a 90-day period ensures protection of pregnant women and all others, and concentrations of atrazine in finished water that do not exceed 3 ppb as an annual average to protect consumers from longer term chronic effects." [22]

Arsenic

Arsenic occurs naturally in rocks and soil, water, air, and plants and animals. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks, and forest fires, or through human actions. Natural arsenic levels are generally highest in groundwater. [23] The United State Geological Survey indicates that the driftless region generally sees arsenic levels less than 10 µg/L.

DATA AND ANALYSIS

All data collected by the WDNR and VSN since 2000 was uploaded from VSN records, the University of Wisconsin Extension WAV database and the WDNR SWIMS in March 2011. The data has been broken down for each WDNR watershed; Upper, Middle and Lower Kickapoo, the West Fork of the Kickapoo and Reads and Tainter Watershed. It is important to note that an assessment can only made on data that is available. Therefore, lack of data for a specific parameter or timeframe does not provide any indication the quality of the water is good or poor.

UPPER KICKAPOO WATERSHED

The data in the Upper Kickapoo Watershed was collected by the WDNR and VSN. The VSN data was largely from the Kickapoo River *E.coli* Monitoring program but also the WAV program and other VSN staff data collection. The data collected is summarized in Table 23 below and can be seen in detail in Appendix A – Upper Kickapoo Watershed Analysis. The following key is used to interpret Table 23; N – no degradation, D – degraded and X – exceeds limit.

GAP ANALYSIS

Looking at all of the named creeks in the Upper Kickapoo Watershed no data was collected by the WDNR or VSN for Posey Creek and Spring Valley Creek nor for the notable Unnamed creeks distinguished as 21-6, 28-16 and 34-6. We recommend that, at a minimum some monitoring should occur in Posey and Spring Valley Creek for core and macroinvertebrate data.

As seen in Table 23 and Appendix A, no nutrient data is available for the Upper Kickapoo River. Moore, Sleighton and Poe Creeks all show high levels of nutrients, in particular phosphorus, and should continue to be monitored. Bacteriological data for the Kickapoo River and Moore, Sleighton and Poe Creeks all show high levels of *E.coli* and should also continue to be monitored to determine current conditions.

CREEK SUMMARY

Sleighton Creek

Sleighton Creek data demonstrates a need for deeper review of the health of this waterbody. *E.coli* data from 2005 through 2008 indicate elevated levels throughout the creek with the highest values observed nearest the mouth of the stream. In addition, nitrate/nitrite and phosphorous levels were high the phosphorus limit was exceeded. Macroinvertebrate data showed significant pollution issues, including an IBI determination of "poor" in the data from 2010.

Continued monitoring of core, nutrient biological and macroinvertebrate the creek is suggested. The WDNR or Monroe County should lead the monitoring or response due to the quantity of data that indicates degradation of this waterbody.

Table 23 – Upper Kickapoo Watershed Analysis Data Summary

Branch	Waterbody	Temp.	Core	Nutrients	Macro.	Bact.	Chemical	Comments
Sleighton Creek	Sleighton Creek	N	N	N, D, X	D, X	X	N	Human and COW DNA
Poe Creek	Poe Creek	N		N, D, X	D	X		Varying results, but 2008 data showed high P
Moore Creek	Unnamed Tributary to Liberation Creek	N	D		D			Low DO levels, WAV BI of "fair"
	Moore Creek	N	N, D	D, X	N, D	X		Most data is from the early part of the 2000s
Brey Valley Creek	Brey Valley Creek			N, D	N			One data point was the "deep hole", all data from 2003
Upper Kickapoo River	Unnamed Creek (Creek 7-12)				X			
	Cook Creek				N			
	Kickapoo River	N, D	N, D		D	X		All *E.coli* data was high, all PCR was animal

Poe Creek
Data was collected throughout the stream length and in different years. Macroinvertebrate data shows varying results; nutrient data shows human impact and a high level of phosphorus in 2008, and bacteriological data shows high levels of *E.coli*. It would be valuable to do further bacteriological and nutrient testing to determine if contamination is still present. Further investigation is warranted by the WDNR and Monroe County.

Moore Creek
Temperature, core, nutrient and macroinvertebrate data was collected for Moore creek. The macroinvertebrate data was rated acceptable but indicated concern for water quality. The nutrient data showed elevated levels particularly for phosphorous which exceeded limits in most samples. Continued monitoring of this creek is warranted with focus on nutrient and macroinvertebrate data.

Brey Creek
Data for both stations was similar, showing no abrupt change in water quality between the two stations. The macroinvertebrate data showed excellent IBI, HBI and FBI data but this was not reflected in the diversity and richness indicators. Nutrient data showed impact from human activity. Since this data is from 2003, currently macroinvertebrate and nutrient monitoring is warranted. Additionally, temperature and core monitoring would provide a better review of the stream health.

Upper Kickapoo River
The majority of the data from the Upper Kickapoo River was collected by the VSN during the *E.coli* monitoring program. As such temperature, core and bacteriological data is available and one macroinvertebrate sample. To provide a more diverse analysis of the river nutrient and chemical sampling should be performed.

Looking at the temperature and core data, only slight degradation can be noted. Some of the temperature data measured above the limit allowed for cold stream classification. Thermistor data is necessary to collect samples at the frequency needed to perform a proper analysis. Turbidity data was generally less than 10 NTU with only a handful of samples above 10 NTU.

All samples from the *E.coli* monitoring were elevated. In all cases the values either met or exceeded the flowing rivers and streams limit of 400 cfu/100 mL as a single maximum. All PCR testing indicated the presence of cow or ruminant DNA and not human. This indicates that farming operations are likely the source of the *E.coli* contamination observed in the Upper Kickapoo River. Because of the *E.coli* data was collected from 2004 through 2006, more updated testing is warranted. Further implementation of agricultural and land best management practices and comprehensive and standardized monitoring program executed by or in cooperation with the WDNR and Monroe County Land Conservation is needed.

Upper Kickapoo Watershed Summary
Data collected since 2000 indicates impacts from human activity in particular with regards to nutrient and bacteriological quality, some data even indicated possible impairment. Further monitoring is warranted as well as implementation of improved agricultural and land management practices.

WEST FORK OF THE KICKAPOO WATERSHED

The data from the West Fork of the Kickapoo Watershed was collect by the WDNR and VSN. The VSN data was from the WAV one and two monitoring, special projects such as work surrounding the Jersey Valley fish kill in 2005, the thermistor data collection with the WDNR and the Karst Pilot Project. The data collected is summarized in Table 24 below and can be seen in detail in Appendix B – West Fork of the Kickapoo Watershed Analysis. The following key is used to interpret Table 24; N – no degradation, D – degraded, X – exceeds limit and S - spring.

GAP ANALYSIS

The West Fork of the Kickapoo is well monitored. The only named tributary not monitored since 2000 was Rocky Run. VSN should monitor a new WAV site on this creek.

In general there is very little bacteriological data for the West Fork of the Kickapoo.

CREEK SUMMARY

Knapp Creek

The data from Knapp creek indicates the temperature is too warm during the summer months to be considered a cold stream. DO, pH and turbidity do not indicate impairment. Nutrient and *E.coli* monitoring would verify the indication of no degradation.

Hall Creek

Based on the information collected by VSN from 2009 Hall Creek qualifies as a cold stream. Core parameters indicate no degradation of DO or excessive fluctuations in pH. Since all data is from 2009 continued monitoring of temperature and core parameters is justified. Nutrient, macroinvertebrate and bacteriological data should also be collected to verify the health of the stream.

Seas Branch

VSN has a significant role in monitoring Seas Branch and should continue this effort. VSN could ensure macroinvertebrate data is collected. Nutrient data from 2004 indicates high nutrient levels and therefore further nutrient monitoring both upstream and downstream of the dam is warranted. Additionally this data can be use to assess the relationship of groundwater nutrient contamination and surface water nutrient levels. No biological data has been collected on Seas Branch. Due the volume of flow contribution by Seas Branch to the West Fork and proximity to recreational areas near Avalanche, monitoring of bacteriological parameters is justifiable. Lastly, with arsenic concentrations of 10 µg/L found in the old pond chemical analysis for arsenic and other heavy metals will reveal current conditions.

Elk Run Creek

The only site monitored on Elk Run Creek is a VSN WAV site. Based on the available data it appears that Elk Run creek is not degraded. Macroinvertebrate and nutrient data would further verify this assumption. Continued WAV monitoring will ensure knowledge of the stream health.

Table 24 – West Fork of the Kickapoo Watershed Analysis Data Summary

Branch	Waterbody	Temp.	Core	Nutrients	Macro.	Bact.	Chemical	Comments
Knapp Creek	Knapp Creek	N, D	N					Thermistor study
Hall Creek	Hall Creek	N	N		D			WAV BI of "fair"
Seas Branch	Crume Spring	S	S	S		S		High nitrates and nitrites
	Seas Branch	N	N	D, X	N			High nitrates in 2004 and higher and 2008.
	Seas Branch Pond			X			D	Deep hole with very high TKN and arsenic
Elk Run	Elk Run	N	N					
Bishop Branch	Cook Creek	S	S	S, D	N	S		Nutrient data showed higher nitrate and nitrite in the spring than in Cook Creek
	Unnamed Creek	S	S	S		S		Nitrate and nitrites where high
	Pierce Hill Road Creek			N, D	N, D			
	Maple Dale Creek	N, S	N, S	S	N			Nitrogen and phosphorous vales are high
	Bishop Branch	N	N	N, D	D			High nutrients
Harrison Creek	Harrison Creek	N		D	N, D			Elevated nutrients
West Fork of the Kickapoo	Unnamed tributaries	S, N	S, N	S	D, S			Elevated nitrates
	West Fork	N	N, D	D, X	N, D	X	N	Jersey Valley fish kill in 2005

Cook Creek

The 2000 macroinvertebrate data shows "excellent" water quality for aquatic habitat. None of the nutrient values exceed the impairment limits however did indicate impact from human activities. The spring headwaters did show high nutrient levels and likely contribute to elevate nutrient levels downstream.

As such nutrient monitoring would be beneficial as well as additional core, macroinvertebrate, bacteriological nearer the confluence with Maple Dale Creek.

Maple Dale Creek

While data from a headwater spring shows levels of nutrients that indicate human impacts, the macroinvertebrate data implies the streams aquatic habitat is in good condition. Additional monitoring of core and nutrient data would be informative to shed light on surface water quality downstream of the headwaters. Bacteriological testing is also warranted.

Bishop Branch

Looking at data throughout Bishop Branch water quality does not exhibit habitat degradation. Nutrient levels do not exceed impairment limits but indicate impact from human activity. No biological data is available and therefore, both biological and further nutrient monitoring is warranted. VSN monitoring of the Starr property is valuable and should continue.

Harrison Creek

In the last ten years no temperature, bacteriological or core data was collected by WDNR or VSN. Monitoring of the temperature, macroinvertebrate and bacteriological parameters would be informative; however additional nutrient and core parameter data is warranted given the indications of elevated levels of nutrients.

West Fork of the Kickapoo

Data from the West Fork shows high nutrient levels. The data was from 2000-2007 and therefore new nutrient testing would be informative to confirm the current health of the stream. Additionally, Jersey Valley Lake was also monitored by stations along the West Fork. A fish kill occurred in March 2005 followed by drawing down the lake. Many of the data is focused around verifying the excessive nutrient in the system.

There is excellent temperature and core data on the West Fork from VSN and it shows no degradation of DO and pH levels. In addition the turbidity measurements showed good transparency in the stream.

West Fork of the Kickapoo Watershed Summary

In general the West Fork of the Kickapoo has elevated nutrient levels indicating impact from human activity. Nutrient monitoring was mostly performed before 2007. Given the history of elevated nutrient, monitoring of nutrients is warranted. Nutrients are also high in the springs. As such analysis of the relationship of the high nutrient levels in the groundwater and surface could help understand the root of the nutrient issues.

There was very little bacteriological data and therefore it was difficult to determine the impact of *E.coli* on stream water quality. More bacteriological testing should be performed.

Temperature and core data indicates high DO levels and good transparency. As such the high nutrient levels seem to have little effect on the West Fork Watershed and more impact downstream of the watershed.

MIDDLE KICKAPOO WATERSHED

The data from the Middle Kickapoo Watershed was collect by the WDNR and VSN. The VSN data was from WAV Level I and II monitoring and special projects such as the thermistor data collection with the WDNR and *E.coli* studies. The data collected is summarized in Table 25 below and can be seen in detail in Appendix C – Middle Kickapoo Watershed Analysis. The following key is used to interpret Table 25; N – no degradation, D – degraded and X – exceeds limit.

GAP ANALYSIS

The Middle Kickapoo Watershed is the largest watershed in the greater Kickapoo Watershed. There are many sites and waterbodies monitored in the watershed however there were a number of waterbodies that did not have any data since 2000 including Chadwick Hollow Creek, Cheyenne Valley Creek, Goose Creek, Tenny Spring Creek, Twentyfour Valley Creek and Upper Brush Creek. VSN should collect core and macroinvertebrate data for these creeks.

Of the data collected, there was very little bacteriological, nutrient and macroinvertebrate data in the Middle Kickapoo watershed.

CREEK SUMMARY

Brush Creek

Brush Creek saw extensive monitoring which provided a number values indicating possible degradation. The WAV BI was "good" and "fair" which are high ratings for this index in the Kickapoo watershed. No data is available for Upper Brush Creek. It would be worth taking a few core analyses to ensure the water quality hasn't dramatically changed since 2005.

Billings Creek

In general the water quality appears in good condition, however data has not been collected since 2005. An additional testing of core and macroinvertebrate parameter would verify the current state of the creek.

Hay Valley Creek

Station 10029101 sampled in 2008 revealed some human impact but no impairment from the limited single data set. However, two years earlier at station 10033422, a site further downstream, VSN data showed high temperature levels, occasions of poor transparency and numerous data points with high *E.coli* levels. It is recommended that temperature and bacteriological testing be performed downstream of the both sites to determine it the impact is still present and the samples from station 10029101 were upstream of the contamination or if contamination issues have been resolved. Additional nutrient and macroinvertebrate testing would also be informative.

Table 25 – Middle Kickapoo Watershed Analysis Data Summary

Branch	Waterbody	Temp.	Core	Nutrients	Macro.	Bact.	Chemical	Comments
Brush Creek	Brush Creek	N, D	N, D		D			WAV BI of "fair"
Billings Creek	Billings Creek	N, D	N	N	N	D, X	N	
Hay Valley Creek	Hay Valley Creek	N, D	N	N	N	X		
Warner Branch	Warner Branch			N, D, X	D			High ammonia and P exceedances in 2001
	Warner Creek	N	N	N, D, X	N, D			Two very different macroinvertebrate results
Indian Creek	Indian Creek				N, D			Two very different macroinvertebrate results
Jug Creek Branch	South Jug Creek	N	N					Thermistor study
	Jug Creek	N	N, D		N			Listed as impaired due to sediment
Weister Creek	Weister Creek	N	N, D	N, D	D			DO degradation and turbidity spike on one event
Bear Creek	Unnamed Tributary to North Bear Creek				D			IBI – good, HBI & FBI – excellent and HBI Max-10 – very good
	North Bear Creek	N	N					Thermistor study
	Middle Bear Creek	N	N					Thermistor study
	South Bear Creek	N	N, D					May not fully saturated and 17 NTU turbidity
	Bear Creek	N	N, D		D			2010 data showed degraded DO but right in confluence with Kickapoo so not a good indication of Bear Creek
Otter Creek	Otter Creek	N	N, D					Some elevated turbidity data
Camp Creek	Bufton Hollow Creek	N	N, D					Beaver dam formed near monitoring site
	Unnamed tributary	N	N, D					Thermistor study
	Camp Creek	N	N	N	N, D			Variation in macroinvertebrate rating within the same sample
Elk Creek	Unnamed Tributary			N	N, D			All data from 2003
	Elk Creek			N, D	N			
Middle Kickapoo River	Unnamed Creek				N, D			
	Middle Kickapoo River	N, D	N, D	D, X	D	X	N, D	A station with high P

Warner Creek and Branch
The testing performed on Warner Creek and branch indicated high nutrient loading. 2009 data showed less nutrients than in 2001. Further nutrient and macroinvertebrate testing is warranted. Collection of temperature and core sample would provide further assessment to be possible.

Indian Creek
Indian Creek had two macroinvertebrates samples and no other monitoring since 2000. The biotic ratings were very different with an excellent rating in November. Core and macroinvertebrate sampling is warranted to determine the current condition.

South Jug Creek
No impairment was indicated. Nutrient, macroinvertebrate and further core monitoring would confirm this assumption.

Jug Creek
While temperature data indicated the stream could be classified as cold, dissolved oxygen was not fully saturated which merits further monitoring. Nutrient and sediment monitoring is warranted given the impairment listing for high sediment levels. More current macroinvertebrate sampling would help assess the impairment listing. Note: this study did not look into Fish Biotic Indices which is also important to assess.

Weister Creek
Temperature, core and macroinvertebrate data indicate that Weister Creek is not impaired however does have human impact. Nutrient levels were typical for the Driftless sub-ecoregion. It Most of the data was collected in 2009, as such nutrient should be further monitored as well as additional temperature, core and macroinvertebrate analyses.

North Bear Creek
While macroinvertebrate data from the tributary may have indicated degradation, no data from North Bear Creek indicates degradation. All data was collected in 2008 and 2010. Further monitoring of core parameters and monitoring of nutrient and macroinvertebrate parameter can help verify this conclusion.

Middle Bear Creek
All data was collected in 2010 and provided no indication of impairment. As with North Bear Creek further monitoring of core parameters and monitoring of nutrient and macroinvertebrate parameters can help verify this conclusion.

South Bear Creek
Although temperature data did not indicate any degradation, DO and turbidity data indicated some degradation. Further testing would provide more information regarding the condition of the creek. Core, nutrient and macroinvertebrate testing is warranted.

Bear Creek
Bear Creek receives water from a large agricultural area with many potential point sources of pollution. Data collected shows impact of DO, turbidity and macroinvertebrate. This degradation is not uncommon for receiving bodies of a larger system. However, the data is mostly from 2005 and further monitoring of

core and macroinvertebrate parameters is warranted in addition to nutrient and bacteriological testing which is not currently available.

Otter Creek

Otter creek data does shows elevated levels of turbidity in some data points. As such elevated sediment is likely an issue for the creek. The other core parameters did not indicate degradation. Continued core testing is beneficial as well as nutrient and macroinvertebrate monitoring.

Bufton Hollow Creek

Temperature and pH data did not indicate impairment however DO data was not fully saturated. This was likely a result of the beaver dam forming just upstream of the monitoring site. Further core and macroinvertebrate monitoring downstream of the beaver dam is warranted to access the impacts of this habitat.

Camp Creek

The tributary to Camp Creek show no signs of degradation. The macroinvertebrate data for shows variability amongst the sample but in general appear to not be degraded. Nutrient levels were typical for the Driftless sub-ecoregion. It is recommended to monitor temperature, core and macroinvertebrate conditions in the future.

Elk Creek

For the tributary only nutrient and macroinvertebrate data has been collected in this stream. Nutrient data shows possible human impact an however stayed relatively constant between the two sites. Macroinvertebrate data showed the aquatic habitat to be in good condition however the values worsened notably in the station at the mouth of the stream. Testing of core parameters would determine if these differences in stations are consistent. The creek itself showed elevated nitrogen levels but the macroinvertebrate indices were excellent. As with the tributaries core testing would be helpful at this site.

Middle Kickapoo River

The tributary on Ames Road demonstrated higher macroinvertebrate integrity upstream then downstream. Further sampling could indicate if this change in water quality is consistent and the source of the degradation. Temperature is high to be classified as a cold stream. DO is not saturated but also not at impaired levels as expected at this point in the Kickapoo River. Only one station was monitored for nutrients and illustrated high nutrient levels particularly with P. *E.coli* levels were elevated and positive for both human and cow DNA. Atrazine testing only revealed one data point that was above the drinking water limit. It is apparent that human activity has impact on the Kickapoo River.

Middle Kickapoo River Watershed Summary

In general it appears that the tributaries to the Kickapoo River are in good condition. There are a number of tributaries that have degraded DO, transparency and nutrients levels. The Kickapoo itself shows degraded levels of all parameters tested including high P and *E.coli*. Further testing of nutrients and bacteriological parameters is warranted as well as monitoring at the creeks with no data since 2000.

READS AND TAINTER WATERSHED

The data from the Reads and Tainter Watershed was collect by the WDNR and VSN. The VSN data was from WAV Level I and II monitoring and special projects such as the Voyageur journey. The data collected is summarized in Table 26 below and can be seen in detail in Appendix D – Reads and Tainter Watershed Analysis. The following key is used to interpret Table 26; N – no degradation, D – degraded and X – exceeds limit.

GAP ANALYSIS

There are many sites and waterbodies monitored in the Reads and Tainter watershed however no data has been collected for Bear Creek, Hincks Creek and Sheridan Creek since 2000. VSN should collect core and macroinvertebrate data for these creeks.

Of the data collected, there was very little bacteriological and nutrient data in the Reads and Tainter Watershed.

CREEK SUMMARY

Day Creek

Day Creek has only been tested for one macroinvertebrate sample that showed excellent ratings. Testing periodically for macroinvertebrate and core parameters is warranted to monitor the health of the creek.

Sherry Creek

Testing at Sherry Creek showed no signs of degradation except the 85% saturation DO level. Further monitoring of core and macroinvertebrate parameters should be performed to ensure no degradation is occurring in the creek.

Reads Creek

Temperature data was high for classification of a cold stream. There were a number of cases of lowered transparency which may be a result of storm events that commonly impact this stream. WAV biotic index and IBI both indicated degradation. *E.coli* data revealed elevated levels.

Trout Creek

Data from 2003-2010 indicates that no degradation is present. One DO value showed lower saturation but not to impairment levels. Turbidity had a few data points of low transparency.

Johnson Creek

Johnson Creek data shows no degradation. All sampling was performed in 2006. Periodic core monitoring would be useful to verify the health of the creek.

Conway Creek

Conway Creek had no signs of impairment. Further testing of core and macroinvertebrate data could be performed to verify current and future creek conditions.

Nederlo Creek

Data indicated human activities may impact nutrient levels. Monitoring of the nutrients, macroinvertebrates and core parameters should be continued.

Table 26 – Reads and Tainter Watershed Analysis Data Summary

Branch	Waterbody	Temp.	Core	Nutrients	Macro.	Bact.	Chemical	Comments
Day Creek	Day Creek				N			
Sherry Creek	Sherry Creek	N	N					One sample 10 mg/L but only 85% saturation
Reads Creek	Reads Creek	D	N, D		D	D	N	WAV Biotic Index and poor IBI
Trout Creek	Trout Creek	N	N		D			WAV Biotic Index
Johnson Creek	Johnson Creek	N	N					
Tainter Creek	Unnamed Creek			N, D	N, D			
	Conway Creek	N	N					
	Nederlo Creek			N, D	N, D			"Good" macroinvertebrate ratings just below "excellent" threshold
	Tainter Creek	N	N, D	N, D	D			Macroinvertebrate sample IBI "fair" in 2002
Kickapoo River	Unnamed Creek	N	N					
	Kickapoo River	N	N, D			D, X		High turbidity notable

Tainter

For the unnamed tributary nutrient data indicated impact from human activity. No significant issue is apparent however further testing could be completed to ensure no current degradation. For the mainstem core and temperature data showed the creek in good condition. Nutrient levels were typical for the Driftless sub-ecoregion. Macroinvertebrate data from 2002 rated as "fair". Further monitoring is warranted to see if the macroinvertebrate data still indicates degradation. Continuation of the new WAV site is an important assessment tool.

Kickapoo River (Reads and Tainter segment)

The unnamed tributary indicated good water quality as monitored in 2004. The mainstem shows consistently elevated turbidity indicating possible elevated sediment levels. The data from the VSN Voyageur journey provides a good look at the impacts of flooding events which significantly dropped the DO, changed in pH and elevated turbidity. Bacteriological testing indicates elevated *E.coli* levels. No nutrients have been tested. Monitoring of core, nutrient, macroinvertebrate and bacteriological parameters could be informative however the main Kickapoo River monitoring station is just downstream of this segment.

Reads and Tainter Watershed Summary

In general the smaller tributaries were not degraded. However, all of the creeks with nutrient sampling showed typically levels of nutrients in the sub-ecoregion. Reads and Tainter creeks both showed degradation of turbidity. More monitoring of Reads Creek is needed. The Kickapoo River shows reduced levels of DO and transparency which is likely the result of sediment and nutrient loading from the feed waters. More nutrient sampling in the entire watershed is warranted.

Lower Kickapoo Watershed

The data from the Lower Kickapoo Watershed was collect by the WDNR and VSN. The main WDNR monitoring site of the Kickapoo is at Bridge Street in Stueben. The VSN data was from WAV Level I and II monitoring and special projects such as the VSN Voyageur journey. The data collected is summarized in Table 27 below and can be seen in detail in Appendix E – Lower Kickapoo Watershed Analysis. The following key is used to interpret Table 27; N – no degradation, D – degraded and X – exceeds limit.

Gap Analysis

All waterbodies in the Lower Kickapoo Watershed have some data collected since 2000 except for Duffy Creek. VSN should collect core and macroinvertebrate data for this creek. There is not a lot of bacteriological data in this watershed.

Creek Summary

Caswell Hollow Creek

Caswell Hollow Creek was monitored in 2000 to the beginning 2002 for temperature and core parameters. All data indicated good stream health. Further monitoring of core parameters for current data would verify the health of the stream.

Table 27 – Lower Kickapoo Watershed Analysis Data Summary

Branch	Waterbody	Temp.	Core	Nutrients	Macro.	Bact.	Chemical	Comments
Caswell Hollow	Caswell Hollow	N	N					
Halls Branch	Halls Branch	N	N, D					Long term WAV monitoring site
Sand Creek	Unnamed Creek			N				
	Unnamed Creek 2			N	N, D			
	Sand Creek	N	N, D		N, D			Thermistor study
Crow Hollow	Unnamed Creek	N	N					Thermistor study
	Unnamed Creek 2	N	N					Thermistor study
	Crow Hollow	N	N, D					Only one sample DO saturation at 80%
Citron Creek	Citron Creek				N			Only one sample in 2001
Plum Creek	Plum Creek	N	N	N, D	N	D	N	
Kickapoo River	Kickapoo River	N, D	N, D	N, D, X		D, X	N	

Halls Branch
There is excellent data for Halls Branch. In general, the DO levels were extremely saturated with only occasional drops to levels near 80%. Data also indicated seasonal fluctuations in DO. Transparency also had the occasional degraded values likely attributed to storm events. Halls Branch is listed as impaired for habitat degradation. Continued monitoring of Halls Branch ensures the health of the stream is observed.

Sand Creek
Both of the monitored Sand Creek tributaries had nutrient levels were typical for the Driftless sub-ecoregion. The downstream tributary has macroinvertebrate data that shows different index values from "good" to "very good". The main stem shows low temperature throughout the thermistor study at both sites located near the headwaters. Some slight degradation of DO saturation was seen down to 87% but DO levels were well above impairment levels. Macroinvertebrate data is also variable with a 2001 IBI of "excellent" but only a "good" rating in 2004. Further testing of macroinvertebrate is warranted. Continued period monitoring of core and nutrient parameters will ensure any changes in stream health are recorded and should be taken near the mouth of the stream.

Crow Hollow Creek
Two tributaries were monitored on Crow Hollow under the thermistor study. Temperature levels were low and core parameters showed no sign of degradation. Only one sample was taken on the mainstem itself and was taken in 2005. It showed DO levels below saturation at 80%. Further monitoring of Crow Hollow main stem is warranted for core as well as nutrient and macroinvertebrates.

Citron Creek
Only one sample was taken in Citron Creek since 2000 and that was macroinvertebrate data indicating excellent water quality in 2001. Additional monitoring to determine the current condition of the creek is warranted for macroinvertebrate parameters as well as core and nutrients.

Plum Creek
All Plum Creek data is from 2000. Macroinvertebrate data rated "excellent" and core parameter indicated no degradation. Nutrient data was somewhat elevated as was bacteriological data. Further testing of creek is warranted to determine the current condition of the waterbody.

Lower Kickapoo
The station at Bridge Street in Steuben is the most heavily monitored site on the Kickapoo River. The WDNR takes monthly samples for a wide range of parameters. The WDNR and VSN data indicates that DO levels were not fully saturated which is expected with the nutrient and sediment loadings from upstream. Turbidity levels verify the sediment loading with over half the samples over 10 NTU. Nutrient levels were also elevated in particular the P loading which exceed the 0.075 mg/L impairment limit. Ammonia values are close to the chronic toxicity level for the water hardness. *E.coli* levels were in general just under the recreational limit but do exceed the 400 cfu/100 mL maximum instantaneous limit. Data at this site shows obvious impacts from human activity.

Lower Kickapoo River Watershed Summary

The tributaries in the lower watershed are in good health. Sand Creek should be tested near the mouth of the creek to check on slightly degraded DO levels. Most named creeks could be monitored further in particular Crow Hollow and Duffy Creek. The Kickapoo shows impact from human activity with elevated nutrients, in particular phosphorous, sediment and *E.coli*. Extensive testing by the WDNR in Steuben provides the best assessment of the Kickapoo River conditions.

Kickapoo River Watershed

Looking at all five watersheds as a whole provides a perceptive of all waters that drain to the Kickapoo River.

Gap Analysis

Tables 28 and 29 provide a summary of the quantity of data collected by the WDNR and VSN in the Kickapoo Watershed from 2000 to the time the data was compiled in February and March 2011. Note that the numbers below indicate the number of data points. For example, it counts each temperature measurement individually. As seen in the charts below VSN has a significant hand in the collection of water quality data in the watershed, in particular with temperature, core and bacteriological data.

Table 28 – Kickapoo Watershed Data, WDNR and VSN Combined

	Total	Number of Waterbodies with Data	Number of Stations with Data
Temperature	209091	56	126
Core	1471	59	129
Macroinvertebrate	136	45	77
Chemical	158	7	15
Bacteria	589	15	39
Nutrients	890	57	98
Total	**212346**		

Table 29 – Comparison of VSN and Combined Data

	Combined WDNR and VSN	VSN	VSN %
Temperature	209091	207800	99%
Core	1471	1252	85%
Macroinvertebrate	136	53	39%
Chemical	158	22	14%
Bacteria	589	467	80%
Nutrients	890	70	8%
Total	**212346**	**209668**	**99%**

Kickapoo River Watershed Summary

Some of the water quality data shows evidence of human impact however, only a few streams had values that could be considered impaired by WDNR WisCALM. Most streams showed temperature ranges that could be considered cold, with mostly the larger streams showing temperatures outside characteristic cold stream levels. Dissolved oxygen was generally at or near saturation although levels below saturation

were found in some streams. Transparency levels did not show degradation in most streams however the lower Kickapoo did have impacted transparency as did some of the larger streams. Nutrients and bacteriological data showed the greatest number of values that could meet impairment levels. A large number of data points indicated impacts from human activity was present. The spring data revealed high nitrogen values compared to stream data. Macroinvertebrate data was showed a range of stream health from unlikely pollution to severe pollution levels. Chemical data provided useful information regarding the application of toxicity limits but did not indicate any chemical exceedances in the streams.

CONCLUSIONS AND RECOMMENDATIONS

The Kickapoo Watershed, comprised of the Upper, Middle and Lower Kickapoo, the West Fork of the Kickapoo and Reads and Tainter watersheds, was examined in this assessment. Only surface water quality data from the WDNR and VSN was analyzed. No fish survey, fish tissue or groundwater data was analyzed but should be reviewed for a more conclusive assessment. There is a large amount of surface water quality data for the watershed that provides a good indication of the health of the watershed. In this assessment 212,346 data points were analyzed from 2000 to 2010, most of which were temperature data. VSN had a large role in this data collection, providing most of the temperature, core and bacteriological data.

There was a wide range of data available for the streams in the watershed. Most streams did not have data in all of the data categories. The majority of streams did have temperature and core data. Of the named streams in the watershed, the following creeks have no data from the 2000 to 2010 timeframe; Posey Creek, Spring Valley Creek, Rocky Run, Chadwick Hollow Creek, Cheyenne Valley Creek, Goose Creek, Tenny Spring Creek, Twentyfour Valley Creek, Upper Brush Creek, Bear Creek, Hincks Creek, Sheridan Creek and Duffy Creek.

While most streams showed characteristic levels of temperature, dissolved oxygen and pH, the data indicated that human activity has impacted the watershed, particularly seen with nutrient and bacteriological levels. As such, responsible land use by all land owners in the watershed is essential. Although is it vitally important that widespread implementation of agricultural best management practices occurs, non-agricultural best management practices are also required.

Although this report did not assess groundwater, spring data showed cases where nutrient levels in springs were higher than in the streams they feed. This could be a reflection of the Karst geology of the Driftless region. As such groundwater quality needs to carefully reviewed, pollution prevention measured reinforced and the susceptibility of the groundwater better understood. The citizens of the watershed need to be further educated on the interconnection of the ground and surface waters.

The impacts of flooding in the watershed were evident in the water quality data. Most parameters are negatively impacted by flood events from excessive runoff and erosion. The Kickapoo watershed is prone to major flooding and therefore it is essential that the impacts of climate change are not ignored. Further examination of the impacts of climate change on the watershed is warranted.

This assessment shows that continued monitoring by the WDNR and VSN in the watershed fill an important role in assessing the health of the watershed.

REFERENCES

1. Kickapoo River Mainstem Plan. Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/basin/lowerwis/watersheds/kickapoo%20river%20main%20stem.pdf. Accessed December 18, 2011.
2. Watershed - Upper Kickapoo River (LW06). Wisconsin Department of Natural Resources.http://dnr.wi.gov/water/watershedDetail.aspx?code=LW06&Name=Upper%20Kickapoo%20River. Accessed December 18, 2011.
3. Natural Heritage Inventory Township Data by County. Wisconsin Department of Natural Resources. http://dnr.wi.gov/org/land/er/nhi/countyData/. Accessed December 18, 2011.
4. Upper Kickapoo Watershed (LW06) Plan. Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/basin/lowerwis/watersheds/lw06.pdf. Accessed December 18, 2011.
5. American Fact Finder, Profile of General Population and Housing Characteristics: 2010, 2010 Demographic Profile Data. United States Census Bureau. http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none. Accessed December 18, 2011.
6. Current WPDES Wastewater Permit Holders. Wisconsin Department of Natural Resources. http://dnr.wi.gov/org/water/wm/ww/permlists.htm. Accessed December 18, 2011.
7. Watershed - West Fork Kickapoo River (LW04). Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/watershedDetail.aspx?code=LW04&Name=West%20Fork%20Kickapoo%20River. Accessed December 18, 2011.
8. West Fork of the Kickapoo Watershed (LW04) Plan. Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/basin/lowerwis/watersheds/lw04.pdf. Accessed December 18, 2011.
9. Watershed - Middle Kickapoo River (LW05). Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/watershedDetail.aspx?code=LW05&Name=Middle%20Kickapoo%20River. Accessed December 18, 2011.
10. Middle Kickapoo River (LW05) Plan. Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/basin/lowerwis/watersheds/lw05.pdf. Accessed December 18, 2011.
11. Watershed - Reads and Tainter Creeks (LW03). Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/watershedDetail.aspx?code=LW03&Name=Reads%20and%20Tainter%20Creeks. Accessed December 18, 2011.
12. Reads and Tainter Creeks (LW03) Plan. Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/basin/lowerwis/watersheds/lw03.pdf. Accessed December 18, 2011.
13. Watershed - Lower Kickapoo River (LW02). Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/watershedDetail.aspx?code=LW02&Name=Lower%20Kickapoo%20River. Accessed December 18, 2011.
14. Watershed - Lower Kickapoo River (LW02) Plan. Wisconsin Department of Natural Resources. http://dnr.wi.gov/water/basin/lowerwis/watersheds/lw02.pdf. Accessed December 18, 2011.

15. A Citizen's Guide to Understanding and Monitoring Lakes and Streams, Chapter 3 – Streams. Department of Ecology, State of Wisconsin. http://www.ecy.wa.gov/programs/wq/plants/management/joysmanual/streamtemp.html. Accessed December 19, 2011.
16. State of Wisconsin, Guidelines for Designating Fish and Aquatic Life Uses for Wisconsin Surface Waters. 2004. Wisconsin Department of Natural Resources. First Edition.
17. Wisconsin 2010 Consolidated Assessment and Listing Methodology Guidance. 2009. Wisconsin Department of Natural Resources.
18. River and Streams, Monitoring and Assessment. US Environmental Protection Agency. http://water.epa.gov/type/rsl/monitoring. Accessed December 19, 2011.
19. Volunteer Stream Monitoring: A Methods Manual. 1997. US Environmental Protection Agency. http://water.epa.gov/type/rsl/monitoring/stream_index.cfm. Accessed December 19, 2011.
20. Ambient Water Quality Criteria Recommendations Information Supporting the Development of State and Tribal Nutrient Criteria, Rivers and Streams in Nutrient Ecoregion VII. 2000. US Environmental Protection Agency. http://water.epa.gov/scitech/swguidance/standards/criteria /nutrients/upload/2007_09_27_criteria_nutrient_ecoregions_rivers_rivers_7.pdf. Accessed December 19, 2011.
21. Macroinvertebrate Data Interpretation Guidance Manual. 2003. Wisconsin Department of Natural Resources.
22. Pesticide Reregistration, Atrazine Update. US Environmental Protection Agency. http://www.epa.gov/oppsrrd1/reregistration/atrazine/atrazine_update.htm#triazine. Accessed December 19, 2011.
23. Fact Sheet: Drinking Water Standard for Arsenic. US Environmental Protection Agency. http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/regulations_factsheet.cfm. Accessed December 19, 2011.

APPENDIX A – UPPER KICKAPOO WATERSHED

APPENDIX B – WEST FORK OF THE KICKAPOO WATERSHED

APPENDIX C – MIDDLE KICKAPOO WATERSHED

APPENDIX D – READS AND TAINTER WATERSHED

APPENDIX E – LOWER KICKAPOO WATERSHED