Waupaca River Watershed

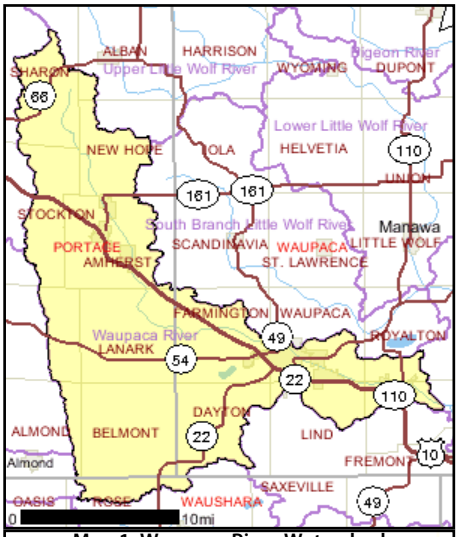
2011 Water Quality Management Plan Update

Wolf River Basin, Wisconsin

December 2011 (May 2015)

The Waupaca River Watershed is 291 square miles and lies almost entirely in Portage and Waupaca counties. A small part of its southwestern portion is in Waushara County. The river's name changes as it flows from Portage County to Waupaca County. In Portage County it is called the Tomorrow River. In Waupaca County, it is the Waupaca River, which in its entirety runs approximately 63 miles.

The Waupaca River's major tributary, the Crystal River, ties into the system from the south and is included within the planning area and is classified as Class II trout waters. The Crystal River is the outlet to the Chain O' Lakes (Long Lake) which is a very prominent recreational and residential area consisting of 22 interconnected lakes.



Map 1: Waupaca River Watershed

Contents

This chain of lakes comprises approximately 725 acres and is considered as part of the Tomorrow/ Waupaca River Priority Watershed Project. Recent changes to the Waupaca County Shoreland Ordinance should improve this resource, from a development standpoint, in the future.

The Waupaca River Watershed was selected as a priority watershed project in 1993 and expired at the end of 2007. A priority watershed plan was prepared cooperatively by WDNR, DATCP, NRCS, University of Wisconsin Extension, Portage County Land Conservation Department, Waupaca County Land and Water Conservation Department, and Waushara County Land Conservation Department.

The soils, geology, and other physical resources of the western 95% of this watershed indicate that this area is highly susceptible to groundwater contamination due to poor land use practices (WDNR and WGNHS, 1987). A data search revealed groundwater samples with contamination, mainly pesticides, in this area.

Watershed Details

Population and Land Use

Almost half (48%) of the total area of the Waupaca River Watershed is reserved for agricultural use. Forest cover accounts for over a third (35%) of the area. Open water and open space and wetlands each amount to six percent of the watershed's area, and grassland covers almost three percent. Suburban and urban landscapes are the least common type of land use in the watershed with only two percent and one-half of one percent of the area, respectively.

Table 1: Waupaca River Watershed Land Use		
Land Use	**Acres**	**Percent of Area**
Agriculture	86,965.06	46.73%
Forest	66,046.82	35.49%
Open Water & Open Space	11,966.18	6.43%
Wetlands	11,836.08	6.36%
Grassland	5,319.68	2.86%
Suburban	2,967.41	1.59%
Urban	873.79	0.47%
Barren	116.98	0.06%
Total Acres in Watershed	186,092	

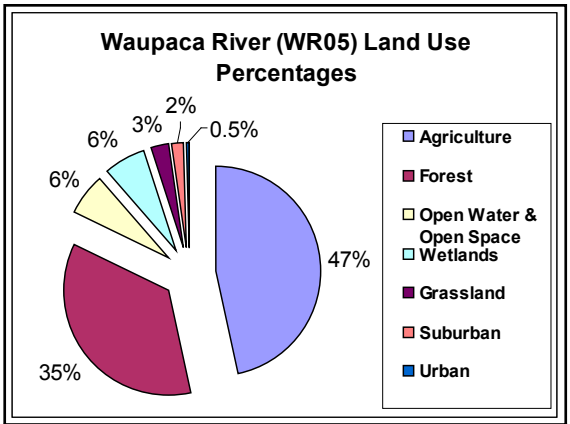


Figure 1: Waupaca River Watershed Land Use Percentages Graph

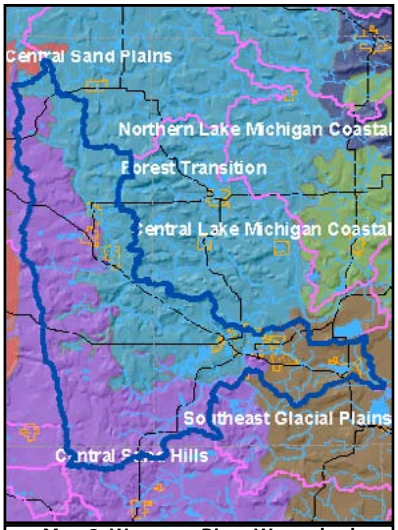
Hydrology

The geology and hydrology of the Waupaca River Watershed are largely influenced by the glacial history of the region. The watershed is located in an area dominated by glacial moraines and outwash plains of sandy soil. The permeable nature of the soils result in the rapid infiltration of precipitation into the groundwater creating a relatively shallow water table that feeds many of the headwater streams, ponds and wetlands in the region.

The shallow, readily available nature of the groundwater has led to much of the watershed being converted to irrigated agriculture. The nature of the agricultural activities in the watershed and the permeability of the soils have created two distinct problems in the region. The intensive groundwater pumping during the growing season can lower the water table and reduce water levels in the groundwater fed lakes and streams of the watershed and the permeable soils readily allow agricultural fertilizers and pesticides to leach into the groundwater and contaminate the aquifer.

Ecological Landscapes

The Waupaca River Watershed is located in both the Forest Transition Ecological Landscape and the Central Sand Hills Ecological Landscape.



Map 2: Waupaca River Watershed Ecological Landscapes

The Forest Transition Ecological Landscape lies along the northern border of Wisconsin's Tension Zone, through the central and western part of the state, and supports both northern forests and agricultural areas. The central portion of the Forest Transition lies primarily on a glacial till plain deposited by glaciation between 25,000 and 790,000 years ago. The eastern and western portions are on moraines of the Wisconsin glaciation. The growing season in this part of the state is long enough that agriculture is viable, although climatic conditions are not as favorable as in southern Wisconsin. Soils are diverse, ranging from sandy loam to loam or shallow silt loam, and from poorly drained to well drained.

The historic vegetation of the Forest Transition was primarily northern hardwood forest. These northern hardwoods were dominated by sugar maple and hemlock, and contained some yellow birch, red pine, and white pine. Currently, over 60% of this ecological landscape is non-forested. Forested areas consist primarily of northern hardwoods and aspen, with smaller amounts of oak and lowland hardwoods. The eastern portion of the ecological landscape differs from the rest of the area in that it remains primarily forested, and includes some ecologically significant areas. Throughout the ecological landscape, small areas of conifer swamp are found near the headwaters of streams, and associated with lakes in kettle depressions on moraines. Ground flora show characteristics of both northern and southern Wisconsin, as this ecological landscape lies along the Tension Zone.

The Central Sand Hills Ecological Landscape is located in central Wisconsin at the eastern edge of what was once Glacial Lake Wisconsin. The landforms in this ecological landscape are a series of glacial moraines that were later partially covered by glacial outwash. The area is characterized by a mixture of farmland, woodlots, wetlands, small kettle lakes, and cold water streams, all on sandy soils. The mosaic of glacial moraine and pitted outwash throughout this ecological landscape has given rise to extensive wetlands in the outwash areas and the headwaters of coldwater streams that originate in glacial moraines. The growing season is long enough for agriculture, but the sandy soils limit agricultural productivity somewhat.

Historic upland vegetation consisted of oak-forest, oak savanna, and tall grass prairie. Fens were common in this ecological landscape and occurred along with wet-mesic prairie, wet prairie, and rare coastal plain marshes. Current vegetation is composed of more than one-third agricultural crops and almost one-fifth grasslands, with smaller amounts of open wetland, open water, shrubs, barren, and urban areas. The major forested type is oak-hickory, with smaller amounts of white-red-jack pine, maple-basswood, lowland hardwoods, aspen-birch, and spruce-fir.

Historical Note

Long before the time of Wisconsin's woodland Indians, Native American mound builders roamed the Waupaca area. Later, the first non-Native American settlers to visit the Waupaca Chain of Lakes found many raised earth mounds. These were often shaped like animals. One early explorer counted 72 mounds. Fifty-two of these were around Taylor Lake and included shapes such as humans, turtles, and catfish.

Figure 2: "Catfish Mound" along Taylor Lake near Waupaca (Photo courtesy of http://www.wisconsinmounds.com/TaylorLakeMound.html)

The first non-Native American settlers came to the Waupaca area in June 1849. They found a beautiful piece of land that the Indians called "The falls" on the Waupaca River. Menominee and Chippewa tribes had campsites throughout the area, including the sites of today's city hall/library and South Park. Other settlers soon followed. By 1852, a post office had been established and the settlement was officially named "Waupaca". The Village of Waupaca became incorporated on May 4, 1857. Early businesses included flour and saw mills. The City of Waupaca was organized on April 6, 1875.

In the early days of automobile travel, the Yellowstone Trail became America's first trans-continental highway, the first highway people could use to drive across the country, from the East Coast to Yellowstone Park. The route was marked with yellow paint on stones, trees, fence posts or other possible visible markers they called "hoodoos". The trail was first made of mud (unpaved). Later it was covered with gravel, and finally paved. It ran along today's Highway 10, right through the center of Waupaca.

Watershed Condition

Overall Condition

The Winnebago Comprehensive Management Plan rated this watershed a medium priority due to critical local surface water problems from animal waste. The highest concentrations of livestock in Portage County occur at Amherst on the Tomorrow River. The greatest overall water quality threat in the watershed is excess nutrients (nitrates) entering groundwater. Sources of nitrate include livestock manure and agricultural fertilizers. Nitrate infiltrates into the groundwater due to the high permeability. Sandy soils pose a risk to vulnerable residents (those under six months old) if furnishing drinking water supplies.

The data search for the Wolf River Basin Plan indicates polluted runoff problems with some habitat degradation and potential impacts from irrigation. The value of these streams (used for irrigation) as a trout fishery and the potential for polluted runoff problems make protective measures the key to good water quality in the future.

Over 54 miles of Exceptional Resource Waters can be found along stretches of Allen Creek, Bear Creek, Carden Feeder,

Mack Creek, Murry Creek, Naylor Creek, Poncho Creek,Spring Creek, Stedman Creek, Stoltenburg Creek, Upper Spring Creek, and Waupaca River. Another 43 miles of Outstanding Resource Waters are located along segments of Emmons Creek, Radley Creek, the Waupaca River, and an unnamed tributary. Columbia Lake and Collins Lake are both listed for high mercury loads from atmospheric deposition. A total of about 72 miles of Class I trout streams are also present along sections of Naylor Creek, Radley Creek, Murry Creek, Emmons Creek, Carden Feeder, Stedman Creek, Upper Spring Creek, Mack Creek, Stoltenburg Creek, Allen Creek, Bear Creek, Poncho Creek, Waupaca River, and Spring Creek. Another 38 miles of Class II trout streams are located within the watershed along segments of the Tomorrow/Waupaca River, Bear Creek, Crystal River, and Hartman Creek.

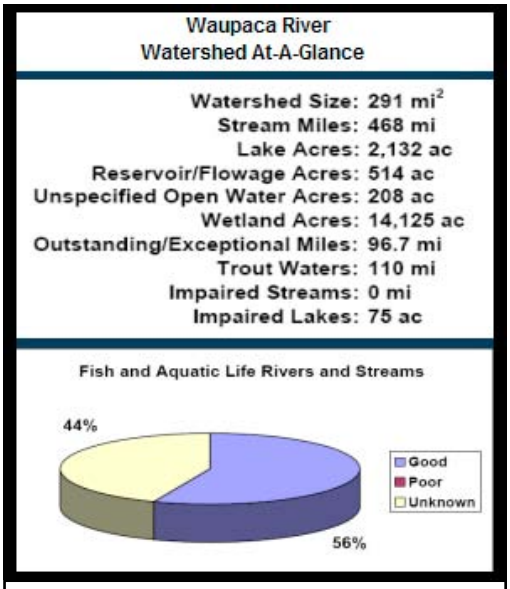


Figure 3: Waupaca River Watershed WAG

River and Stream Condition

According to the WDNR's Register of Waterbodies (ROW) database, there are 468 miles of rivers and streams in the Waupaca River Watershed; 134 miles of which have been entered into the WDNR's assessment database. Of these 134 miles, over half (56%) are meeting Fish and Aquatic Life uses and are specified as in "good" condition. The condition of the remaining stream miles is not known or documented.

Additional uses for which the waters are evaluated include Fish Consumption, General Uses, Public Health and Welfare, and Recreation. As Table 2 shows, these uses have not been directly assessed for the watershed. However, a general fish advisory for potential presence of mercury is in place for all waters of the state.

Table 2: Designated Use Support Summary for Waupaca River Watershed Rivers and Streams (all values in miles)

Use	Supporting	Fully Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption				133.5	133.5
Fish and Aquatic Life	45.28	29.66		58.56	133.5
General				133.5	133.5
Public Health and Welfare				133.5	133.5
Recreation				133.5	133.5

Perennial streams, which have a combined length of about 170 miles, maintain at least a small continuous flow throughout most of the year. The Tomorrow/Waupaca (63 miles) is the longest perennial stream in the watershed. While sections of the Tomorrow/Waupaca River supports a warm water sport fishery, the watershed contains approximately 129 miles of cold water streams, including 110 miles of classified trout waters. The Tomorrow/Waupaca River and many other streams are not reaching their highest potential use due to pollution from nonpoint sources.

Allen Creek

Allen Creek is a four-mile, Class I brook and brown trout stream that discharges to Hartman Creek. Allen Creek is designated as an Exceptional Resource Water, as well (From: Bougie, Cheryl A., Kosmond, Lisa D., and Watermolen, Dreux J. 1996. Wolf River Basin Water Quality Management Plan. Wisconsin Department of Natural Resources, Madison, WI). In 2014, DNR Water Resources staff conducted a fish survey at the headwaters of Allen Creek above County Hwy D. No fish were caught during the survey. Although flow was observed throughout the majority of the 2014 growing season at County Hwy D, the creek "dried up" downstream before reaching Hartman Creek. This is typical for Allen Creek in recent history. Over the 3.7 miles of Allen Creek, little habitat is available to any fish and aquatic life due to the low/no flow conditions. The average water temperature in August 2014 in Allen Creek at County Hwy D was 56.5 F.

Bear Creek
Bear Creek is a seven-mile, hardwater, spring-fed trout stream flowing east out of Adams Lakes into the Tomorrow River. The first two miles of the stream is managed as a Class II brook and brown trout stream. The remaining 5.3 miles are Class I brook and brown trout waters and designated as an Exceptional Resource Water. Recent surveys indicate Bear Creek is in good condition based on macroinvertebrate IBI values; total phosphorus package values covering the past 10 years shows the creek to be "clearly meeting" phosphorus water quality standards.

Crystal River
The Crystal River is the outlet of the Chain O' Lakes at Long Lake and extends for 13 miles before running into the Waupaca River. The entire length of stream above Cary Pond (near Waupaca) is classified as Class II trout stream. The river is known for good fishing, kayaking, and canoeing. A five mile reach of the river has improved due to a carp control project. There is some concern that heavy use by canoe-type boats could disturb the streambed and increase turbidity in the water. In addition to waters supplied by the lakes, several named tributaries feed into the river, including Emmons, Naylor, Hartman, Allen, Murry, and Radley/Pearl creeks (From: Bougie, Cheryl A., Kosmond, Lisa D., and Watermolen, Dreux J. 1996. Wolf River Basin Water Quality Management Plan. Wisconsin Department of Natural Resources, Madison, WI). Water temperature data collected at four locations in 2014 had an average August temperature between 68F and 72F. The water temperatures were warmer the closer to Long Lake the data was collected. Some cooling affect was observed from the cold water of Radley Creek meeting the Crystal River. The water temperatures at Sanders Road were similar to the temperatures recorded at County Hwy K.

Emmons Creek
Emmons Creek is a nine-mile, clear, hardwater, Class I brook and brown trout stream designated as an Outstanding Resource Water. The upper reaches are in the Emmons Creek State Fishery Area. Emmons Creek discharges to Long Lake in the Chain O' Lakes.

Hartman Creek
Hartman Creek originates in Hartman Creek State Park and empties into the Chain O' Lakes. Intensive agriculture is in the area. Although this two-mile long stream is listed in the Wisconsin Trout Streams book, Hartman Creek does not contain trout.

Mack (Brown Spring) Creek
Mack Creek is a Class I trout stream that empties into the Spring Lake. Several trout holding areas have been degraded by heavy siltation from upstream agricultural erosion (From: Bougie, Cheryl A., Kosmond, Lisa D., and Water- molen, Dreux J. 1996. Wolf River Basin Water Quality Management Plan. Wisconsin Department of Natural Resources, Madison, WI). Sedimentation and warmer water temperatures likely limit the productivity and spawning habitat available to native brook trout and other aquatic life in Mack Creek.

Murry Creek (North Fork Radley Creek)
Murry Creek, a four-mile long Class I trout stream, is the major feeder stream of Radley Creek. Murry Creek is a major brown and brook trout spawning stream. No known water quality problems exist on this stream although there is some concern for ground- water contamination potential from herbicides and fertilizers since agricultural irrigation occurs near this stream (From: Bougie, Cheryl A., Kosmond, Lisa D., and Watermolen, Dreux J. 1996. Wolf River Basin Water Quality Management Plan. Wisconsin Department of Natural Resources, Madison, WI).

Naylor Creek
Naylor Creek is a small 1.6-mile, Class I brook and brown trout stream that discharges to the Crystal River upstream of the Little Hope impoundment. Naylor Creek is an Exceptional Resource Water.

Poncho Creek
Poncho Creek is a four-mile, clear, hardwater Class I brook and brown trout stream that enters the Tomorrow River about two miles north of Nelsonville. Designated an Exceptional Resource Water, the creek is located within the Tomorrow River State Fishery Area. Macroinvertebrate values at Poncho Creek at CTY TR Z (site 463) indicate "good" water quality conditions.

Radley (Pearl) Creek
Pearl Creek turns into Radley Creek at the Waupaca County line. This premier trout stream is in a fisheries stream improvement and acquisition project. Currently there are 2.5 miles of shoreline in public ownership. The Class I portion of Radley Creek is listed in NR 102 as an Outstanding Resource Water. This stream is tributary to the Crystal River. Irrigation and feedlots near this stream may affect water quality. Macroinvertebrate monitoring indicates "good" condition at twostations on the creek.

Spring (Howard) Creek
Spring Creek is a five-mile-long tributary to the Tomorrow River, originating at the outlet of Spring Lake. An impoundment upstream of County Hwy A divides the fishery into predominantly bass, panfish, and forage fish above the dam, and a brown trout fishery below, as a result of the cooling effect of springs below the dam and proximity to the Tomorrow River . The one-mile reach above the dam exhibits some warming from Spring Lake and is also affected by agricultural runoff and cattle in the stream. A fish survey at County Hwy D in 2014 captured a diverse fish community, including multiple species intolerant of environmental degradation.

Stedman Creek
Stedman Creek is a two-mile, clear hardwater, Class I brook trout stream. This stream is an Exceptional Resource Water. and appears to be fairly well-buffered, flowing through woodlands, wetland forest, open fields and some agricultural lands (Klosiewski, 1994). Recent macroinvertebrate surveys at CTH D indicate "good" fish and aquatic life condition.

Stoltenberg Creek
The first 0.6 miles of this stream are Class I trout waters. Stoltenburg Creek empties into the Tomorrow River at Nelsonville. The Nelsonville Millpond dam has been removed (From: Bougie, Cheryl A., Kosmond, Lisa D., and Watermolen, Dreux J. 1996. Wolf River Basin Water Quality Management Plan. Wisconsin Department of Natural Resources, Madison, WI). The baseflow and water quality of Stoltenburg Creek has been affected drought and regional groundwater pumping (Kraft et. al. 2010 Groundwater Pumping Effects on Groundwater Levels, Lake Levels, and Streamflows in the Wisconsin Central Sands) (Figure 3).


Figure 4: Stoltenburg Creek near Nelsonville, August 2012

Tomorrow/Waupaca River
The section of the Tomorrow/Waupaca River from its mouth to Lake Weyauwega is included in this watershed. The Waupaca/Tomorrow River flows for about 63 miles in this watershed. Above the city of Waupaca, the river is classified as Class II trout waters with portions of the Tomorrow River classified as Class I, while below the city the river contains warm water species and forage fish. The Tomorrow River portion is one of the best trout streams in the area and is listed in NR 102 as an Outstanding Resource Water for the Class I trout portions. In addition to the fishery, this stream is important for its recreational potential. The major tributary is the Crystal River. Fisheries managers indicate that agricul- tural runoff from feedlots and streambank erosion from cattle pasturing in/near the river has negative impact on river water quality. The impacts from erosion include impairment of fish spawning areas, as well as turbidity and low dis- solved oxygen levels. Fisheries Management has done extensive fish habitat work on the lower reaches of the Waupaca River. The Stewardship Program is recommended to continue to improve and compliment the fisheries streambank and habitat improvement work that has been completed.

The Waupaca Foundry in Waupaca discharges to the Waupaca River. The facility has consistently exceeded categorical, total phenolic limits since start-up of the new plant in 1986. The Nelsonville Dam was removed in 1988 to improve water quality and the Tomorrow River trout fishery. The Amherst Dam should also be considered for removal when feasible to improve water quality and the trout fishery in the Tomorrow River (From: Bougie, Cheryl A., Kosmond, Lisa

D., and Watermolen, Dreux J. 1996. Wolf River Basin Water Quality Management Plan. Wisconsin Department of Natural Resources, Madison, WI).

Table 3: Streams in the Watershed

Local Name	Start M	End M	OFFICIAL_NAM	COUNTY	Monitored	Condition	O/ERW	Trout	WATER_SIZE
Allen Creek	0	3.72	Allen Creek	Portage, Waupaca	2014	Unknown	ERW	CLASS I	3.7 Miles
Bear Creek	1.94	7.23	Bear Creek	Portage	2014	Good	ERW	CLASS I	5.3 Miles
Bear Creek	0	1.94	Bear Creek	Portage	2011	Good		CLASS II	1.9 Miles
Carden Feeder Creek	0	0.9	Carden Feeder	Portage		Unknown	ERW	CLASS I	0.9 Miles
Crystal River	2.43	12.2	Crystal River	Waupaca	2014	Excellent		CLASS II	9.8 Miles
Crystal River	0	2.43	Crystal River	Waupaca	2012	Unknown			2.4 Miles
Emmons Creek	0	7.74	Emmons Creek	Portage, Waupaca	2014	Good	ORW	CLASS I	7.7 Miles
Hartman Creek	0	1.61	Hartman Creek	Waupaca	2015	Unknown		CLASS II	1.6 Miles
Mack (Brown. Spring) Creel	0	1.96	Mack Creek	Portage	2014	Unknown	ERW	CLASS I	2.0 Miles
Murry Creek (N Fork Radley	0	5.09	Murry Creek	Portage, Waupaca	2014	Unknown	ERW	CLASS I	5.1 Miles
Naylor Creek	0	1.62	Naylor Creek	Waupaca		Unknown	ERW	CLASS I	1.6 Miles
Poncho Creek	0	4.24	Poncho Creek	Portage	2010	Excellent	ERW	CLASS I	4.2 Miles
Radley Creek	0	11.51	Radley Creek	Portage, Waupaca	2014	Good	ORW	CLASS I	11.5 Miles
Spring (Howard) Creek	2.82	4.46	Spring Creek	Portage	2013	Unknown			1.6 Miles
Spring (Howard) Creek	0	2.82	Spring Creek	Portage	2012	Unknown	ERW	CLASS I	2.8 Miles
Stedman Creek	0	2.45	Stedman Creek	Portage	2012	Unknown	ERW	CLASS I	2.5 Miles
Stoltenberg Creek	0	0.63	Stoltenburg Creek	Portage	2004	Unknown	ERW	CLASS I	0.6 Miles
Stoltenberg Creek	0.63	2.8	Stoltenburg Creek	Portage		Unknown			2.2 Miles
Tomorrow/Waupaca River	32.77	38.58	Waupaca River	Portage, Waupaca	2014	Unknown	ORW	CLASS I	5.8 Miles
Tomorrow/Waupaca River	38.58	45.98	Waupaca River	Portage, Waupaca	2014	Unknown	ERW	CLASS II	7.4 Miles
Tomorrow/Waupaca River	46.86	48.17	Waupaca River	Portage, Waupaca	2014	Unknown	ERW	CLASS II	1.3 Miles
Tomorrow/Waupaca River	48.17	50.07	Waupaca River	Portage, Waupaca	2014	Unknown	ORW	CLASS I	1.9 Miles
Tomorrow/Waupaca River	51.07	64.9	Waupaca River	Portage, Waupaca	2014	Good	ORW	CLASS I	13.8 Miles
Tomorrow/Waupaca River	0	1.76	Tomorrow River	Portage		Unknown	ORW	CLASS I	1.8 Miles
Upper Spring (Upper Howa	0	1.19	Upper Spring Cree	Portage		Unknown	ERW	CLASS I	1.2 Miles
Waupaca River	17.25	32.77	Waupaca River	Portage, Waupaca	2015	Good	ERW	CLASS II	15.5 Miles
Waupaca River	0	17.25	Waupaca River	Portage, Waupaca	2014	Good			17.3 Miles

Fish and Aquatic Life Condition: Rivers/Streams

The table above shows FAL conditions for rivers monitored in the past ten years.

Lake Health

The WDNR's ROW database shows that there are over 2,132 acres of lakes and ponds in the Waupaca River Watershed. Rainbow Lake, Long Lake, and Lake Emily are the largest lakes in the watershed at over one hundred acres in size, each. There are also over 514 acres of reservoirs and flowages and another 208 acres of unspecified open water in the watershed. Weyauwega Lake is the largest impoundment in the watershed at over 250 acres in size.

A total of 2,788 lake acres has been entered into the state's assessment database. Of these 2,788 acres, over half (56%) are indicated as supporting Fish and Aquatic Life uses; while another 13% are indicated as not supporting Fish and Aquatic Life uses. The remaining lake acres within the watershed have not been assessed for Fish and Aquatic Life use support. Over 10 acres of impoundments have also been entered into the assessment database, but none have been assessed for Fish and Aquatic Life use or any other uses.

In addition, 75 lake acres within the watershed are indicating as not supporting Fish Consumption use; while the

remaining lake acres have yet to be assessed for this use designation. Due to the large number of lakes, only those lakes that have been monitored and assessed are described below.

Table 4: Designated Use Support Summary for Waupaca River Watershed Lakes (all values in acres)					
Use	Supporting	Fully Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption			75	2712.83	2787.83
Fish and Aquatic Life	948.37	606.15	142	1091.31	2787.83
General				2787.83	2787.83
Public Health and Welfare				2787.83	2787.83
Recreation				2787.83	2787.83

Adams Lake

Adams Lake is a clear, hard water spring fed lake located about five miles west of Amherst. Littoral bottom materials consist primarily of marl, along with lesser amounts of sand. The lake has an intermittent inlet and a small outlet (Bear Creek). The lake is best known for its trout fishing with brooks, browns, and rainbows all being present. Largemouth bass and bluegills are also common. Other fish species include perch, black crappie, rock bass, green sunfish, and yellow bullheads. The lake develops a midsummer thermocline at about 14 feet. Developments include cottages and a public access with parking. An boat launch site is available at the access. Aesthetically the lake is very beautiful. However, cattle watering on the southwest side has resulted in some trampling of the shoreline and light erosion. Wildlife use is quite limited. A few ducks use the lake during their spring and fall migrations (Source: 1972, Surface Water Resources of Portage County Adams Lake, T23N, R9E, Section 26, Surface Acres-30.4, S.D.F.-1.12, Maximum Depth-51 feet). Recent monitoring (including data From 2003 to 2012)

Collins (Fish) Lake

This soft water seepage lake is located three miles southwest of Rosholt. The water is light brown in color, and develops a thermocline at eleven feet. WDNR Long Term Trends water quality data shows that the lake consistently falls within the mesotrophic range (40-50) by using various TSI metrics. Littoral bottom materials consist of sand, gravel, muck, and marl with rubble and boulder also present, but limited. The shoreline is very steep limiting the littoral zone of the lake. Two artificial ditches from the north and east drain agricultural lands discharge to the lake. There is also an outlet to the west that ultimately drains to the Tomorrow River. There are many wetlands that were once farmed that are artificially drained by these ditches. Northern pike, perch, largemouth bass, and bluegills are the most common fish species. Walleyes, black crappie, pumpkinseed, green sunfish, brown and yellow bullhead, and white sucker are present also. Overall fishing pressure on this lake is light. A large county park and campground is present on the north side, including grills, a picnic area, a beach, toilets, and a playground. A boat launching area is present at the west end of the park. Other development includes cottages. Wildlife use is limited (Source: 1972, Surface Water Resources of Portage County Fish (Collins) Lake, T25N, R10E, Section 31, Surface Acres-49.4, S.D.F.-1-72, Maximum Depth-56 feet). Recent monitoring indicates that Collins Lake exceeds the recreational use threshold for Chlorophyll a but is meets the state's threshold for fish and aquatic life use.

Fountain Lake

Fountain Lake is a 16.49 acre lake that falls in Portage County. This lake is managed for fishing and swimming and is currently not considered impaired. The lake was assessed for chlorophyll a results from the past 10 years and found to meet both recreational and fish and aquatic life uses. The lake is a clear, hard water spring pond, located two miles southwest of Hartmans Creek State Park. A small dam at the outlet maintains the lake level about five feet higher than the natural basin. Emmons Creek, the outlet, flows into the Chain O'Lakes in Waupaca County. The lake has a marl bottom along with small areas of sand. It is best known for its trout fishing with brook and rainbow trout being present. Perch, largemouth bass, bluegills, and white suckers are also present. The lake has very few developments. Most of the shoreline and adjoining woodlands are operated as a private shooting preserve. Two cottages and a permanent home are the only dwellings. A public access, with a boat launching ramp badly in need of repair, and with very little parking space is present near the outlet. The lake may be used by migrating waterfowl, but no broods were noted. This is one of the more scenic lakes in the county.

Emily Lake
Lake Emily is one of the more popular recreational lakes in Portage County. It is a moderately hard water seepage lake located one-half mile west of Amherst Junction. It is four times as long as it is wide. Marl and sand are the primary bottom materials in the littoral zone with gravel and rubble areas also present. The bottom drops off very rapidly resulting in large areas of deep water. About 23 percent of the lake is greater than 20 feet deep. The water is clear but subject to mild algae blooms. There is one intermittent inlet from. Mud Lake to the west. There is no outlet. Northern pike, walleye, perch, largemouth bass, bluegill, and black crappie are common. Rock bass, pumpkinseed, green sunfish, yellow bullhead, and white sucker are also present. Ducks use the lake for nesting and resting.

Facilities on the lake include a large county park with a sand beach, change houses, concession stand, picnic area, campground with electricity, playground, and deer pen. Boat launching areas are present on the east and the southwest shores. One boat livery and two resorts are also present. Recent monitoring indicates the lake meets both recreational and fish and aquatic life uses.

Lime Lake
Lime Lake is a clear, moderately hard water seepage lake five miles southwest of Amherst. Littoral bottom materials consist of sand and marl. Marl has been mined in the past. Largemouth bass, perch, bluegills, and black crappies are the most common fish present. Northern pike, bullheads, white sucker, mudminnows, and golden shiners are also present. One teal brood was noted and migrating waterfowl also stop in relatively small numbers. Muskrats are present. There is no public access and developments are limited to six dwellings. Lime Lake has preliminary monitoring results indicating recreational and fish and aquatic life uses are being met but more data is needed to make a definitive decision.

Long Lake
Long Lake is a 104-acre deep lowland lake and is part of the Chain O' Lakes system in Farmington and Dayton in Waupaca County. The lake was last monitored in 2010, but its general condition remains unknown. Preliminary monitoring results indicating recreational and fish and aquatic life uses are being met but more data is needed to make a definitive decision.

Marl Lake
Marl Lake is a 14-acre deep headwater lake and is part of the Chain O' Lakes system in Farmington and Dayton in Waupaca County. The lake was last monitored in 2010 and was found to be in excellent condition. Additional data collected in 2012 through 2014 indicate that the lake clearly meets water quality standards based on chlorophyll a thresholds.

Old Taylor Lake
This lake lies in a basin virtually landlocked, except for a small inlet stream that drains a nearby marsh and shallow pond. There is no outlet. Old Taylor Lake contains two distinct basins connected by a wide channel. Both basins are about 15 feet deep but the largest basin to the west contains a more extensive littoral zone. Sand, gravel, and detritus are the major littoral bottom types. The seepage fed water is clear and soft. Fish present are perch and yellow bullhead. Winterkill is the major factor limiting the fish management potential. Waterfowl use is limited to resting and feeding by migrant puddle ducks. Initial monitoring indicates that the lake may have good chlorophyll a levels but more monitoring is needed.


Figure 5: Stratton Lake Aeral Photo

Pickerel Lake
Pickerel Lake is a clear, hard water seepage lake located one-half mile north of Blaine. It has a sand bottom with a gentle slope to the center of the lake. The lake is surrounded by a popple and hardwood forest. At one time, this lake offered good fishing for bass and panfish; however, several severe winterkills, coupled with low water levels, has reduced the fishery to bullheads and suckers. Severe algae blooms turn the lake pea green by late summer and it has been chemical treated several times for this condition. Oxygen depletion and corresponding fish kills during the summer are not uncommon due to the algae problem. Most of the shoreline is owned by Asbury Acres, a Methodist church camp. The land is also a wildlife refuge. Boating and swimming by the camp are the major recreation uses of the lake. Between 2012 and 2014 the lake was monitored for

chlorophyll a and based on extensive analysis, both recreational and fish and aquatic life uses are being met.

Rainbow Lake
Rainbow Lake is a 116-acre deep headwater lake and is part of the Chain O' Lakes system just west of the city of Waupaca. The lake was monitored in 2010; chlorophyll a monitoring in 2007 was insufficient to determine if fish and aquatic life and recreational uses are met.

Spring Lake
Spring Lake is a clear, hard water lake located five miles southwest of Amherst. One inlet, Mack Creek, and numerous springs provide a good supply of cold water to the lake. Mack Creek and Spring Creek, the outlet, are both important trout streams. Large portions of the lake bottom are covered with marl which appears to have been mined at one time. Sand, silt, and rubble compose the remainder of the littoral bottom materials. The lake is managed for both warm and cold water species. Brook, brown, and rainbow trout make up the cold water fishery. Perch, largemouth bass, bluegills, rock bass, pumpkinseed, white sucker, and forage fish are the warm water species present. Several broods of mallard and teal have been observed at this lake, as well as migratory waterfowl. Recent monitoring (2012 - 2014) of chlorophyll a indicates recreational and fish and aquatic uses are currently met.

Stratton Lake
Northern pike, perch, largemouth bass, bluegill, white crappie, rock bass, pumpkinseed, green sunfish, and white sucker populate this lake. Stratton Lake is considered as a sterile marl lake with limited fish productivity. Because of a high degree of development, waterfowl use is limited. Hunting is not allowed. Stratton Lake contains clear, hard water fed primarily by springs. Water levels are maintained in part by a wooden dam about eight feet high. The lake has no inlet, but there is a fairly large outlet to Radley Creek. The major littoral bottom material is marl. The marl deposits found in the lake have been mined commercially as a source of agricultural lime. Access with adequate parking is available from State Highway 22. Fifty cottages and homes and one private camp are located on the lake. Water skiing hours are restricted on this lake.

Wolf Lake
Wolf Lake is a clear, hard water seepage lake five miles northeast of Almond. Marl and sand are the basic bottom materials. The lake is subject to chronic winterkill. Northern pike, perch, and bluegills are the species stocked after each winterkill. The lake also has an abundant population of large crayfish. A county park occupies almost one-third of the shoreline. Facilities include a sand beach, picnic area, toilets, and a boat launching site. Recent monitoring (2012-2014) indicates that chlorophyll a levels suggest that the recreational use standard may be met while the fish and aquatic life use standard is clearly met.

Wetland Health

Wetland Status:
The Waupaca River Watershed is located almost entirely in Portage and Waupaca counties. An estimated six percent of the current land uses in the watershed are wetlands. Currently, only 73% of the original wetlands in the watershed are estimated to exist. Of these wetlands, the majority include forested wetlands (66%), scrub wetlands (20%), and emergent wetlands (13%), 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 32% of the existing emergent wetlands, 21% of existing shrub habitat, and three percent of the remaining forested wetlands. Reed canary grass domination inhibits successful establishment of native wetland species.

Wetland Restorability:
Of the 4,269 acres of estimated lost wetlands in the watershed, approximately 87% are considered potentially restorable based on modeled data, including soil types, land use, and land cover (Chris Smith, DNR, 2009).

Figure 6: Forested Wetlands (Photo courtesy of WDNR)

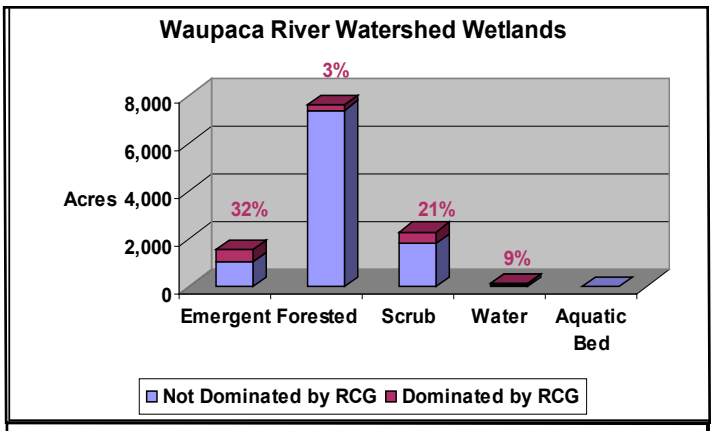


Figure 7: RCG Domination of Waupaca River Watershed Wetlands

Groundwater

Groundwater quality in the Tomorrow/Waupaca River Watershed is generally considered poor due to high nitrate + nitrite and pesticides. Samples analyzed for nitrate + nitrite showed concentrations as high as 55 parts per million or milligrams per liter (mg/L).

From 1994 through 1998, the Tomorrow/Waupaca River Priority Watershed Project worked with willing landowners to establish "Complete Containment Barnyards" (directing barnyard runoff into manure storage) within the watershed with the aim of reducing nitrogen (N) and phosphorus (P) from reaching surface and groundwater. Traditional filter strips were not used for barnyard runoff because they do not reduce N loading to groundwater, they do not reduce P loading in winter and spring months, and they are rarely maintained properly. These "containment" systems also eliminate P and N from reaching surface and groundwater via winter spread manure, which concentrates and flows to surface water and internally drained areas (direct conduits to groundwater when frost leaves) during spring thaw. Also, these systems eliminate P and N losses to surface and groundwater during summer stockpiling of manure when farmers can't spread because crops are in the fields. Without very costly water quality monitoring, it is impossible to quantify improvements.

Nutrient management using UW nutrient recommendations for N will not provide groundwater protection below the EPA enforcement standard because they are based on economics and not water resource protection (i.e. their recommendations call for more N on loamy sands to make up for the leaching of N). Working with (mostly dairy) farmers, the Department of Natural Resources is implementing nutrient management plans on approximately 17,700 acres and demonstrating profitability, while applying nutrients below UW recommendations. The irrigated vegetable growers have not shown any interest in working with the department to implement nutrient management plans. The high levels of nitrates in groundwater are due to the inefficiency of crops to utilize applied N. Groundwater studies have shown that approximately half of the N applied to cropland is lost to groundwater on crops on loamy sands. Because NR120 does not offer Best Management Practices (BMPs) to address this issue, we need to develop a market for groundwater friendly crops (e.g. Alfalfa pelletization plant, soy oil extraction plant, biofuel processing plant, and/or more dairy livestock) (Source: Bradley, Steve. Priority Watershed and Priority Lake Program Final Report, 12/30/08).

The following groundwater information is for Portage and Waupaca Counties (from Protecting Wisconsin's Groundwater through Comprehensive Planning website, http://wi.water.usgs.gov/gwcomp/), which roughly approximates to the Waupaca River Watershed. The municipal water systems of Amherst, Waupaca, and Weyauwega all have wellhead protection plans in place. Amherst and Waupaca have also developed wellhead protection ordinances. Portage County and Waupaca County have both adopted animal waste management ordinances, as well.

Groundwater Use

From 1979 to 2005, total water use in Portage County has increased from about 40.0 million gallons per day to about

132 million gallons per day. The increase in total water use over this period is due primarily to increases in irrigation and industrial uses. The proportion of county water use supplied by groundwater has declined from 97% to 89% during the period 1979 to 2005.

During the same time period, total water use in Waupaca County has increased from about 9.6 million gallons per day to about 19.2 million gallons per day. The increase in total water use over this period is due to increases in domestic, irrigation, and commercial uses, as well as public use and losses through 2000. By 2005, slight decreases in water use occurred across all categories, except for industrial use, which increased. The proportion of county water use supplied by groundwater has decreased from about 99% to 92% during the period 1979 to 2005.

Private Wells

A 2002 study estimated that 36% of private drinking water wells in the region of Wisconsin that includes Portage and Waupaca counties contained a detectable level of a herbicide or herbicide metabolite. Pesticides occur in groundwater more commonly in agricultural regions, but can occur anywhere pesticides are stored or applied. A total of 45,527 acres of land in Portage County and 6,490 acres of land in Waupaca County are in atrazine prohibition areas. One hundred percent of 30 private well samples collected in Waupaca County met the health standard for arsenic. No arsenic data were available for Portage County private wells.

Potential Sources of Contamination

There is one Concentrated Animal Feeding Operation (CAFO) located within the Waupaca River Watershed. This dairy CAFO can be found in Nelsonville. One licensed landfill can be found within the watershed in Waupaca. No Superfund sites are located within the watershed.

WDNR's Remediation and Redevelopment (RR) Program oversees the investigation and cleanup of environmental contamination and the redevelopment of contaminated properties. The RR Program provides information about contaminated properties and other activities related to the investigation and cleanup of contaminated soil or groundwater in Wisconsin through its Bureau for Remediation and Redevelopment Tracking System (BRRTS) database (WDNR 2010e).

The database shows that there are 13 sites in the Waupaca River Watershed that are classified as "open", meaning "contamination has affected soil, groundwater, or more and the environmental investigation and cleanup need to begin or are underway." These sites include four Leaking Underground Storage Tank (LUST) sites and nine Environmental Repair (ERP) sites. A summary of these sites is included in the table below.

Table 5: Open-status Bureau for Remediation and Redevelopment Tracking System (BRRTS) sites in the Waupaca River Watershed

WDNR BRRTS #	Site Name, Location	Start Date	Activity Type	Remediation Activities	Waste Activities	Substance
250554527	Tomorrow River Drum (R&B Glodowski Property), Amherst	12/02/2009	ERP	2	0	Petroluem - Unknown Type
250550910	Newman Appraisal Service, Amherst	02/06/2008	ERP	1	0	Perchloroethylene & Chlorinated Solvents (VOC)
350286051	O'Brien Residence, Amherst Junction	01/10/2002	LUST	1	0	Petroluem - Unknown Type; Fuel Oil (Petroleum)
269282961	Dayton Town Landfill, Township of Dayton	07/30/2001	ERP	1	2	Volatile Organic Compounds (VOC)
369252758	Wellers Store, Township of Dayton	04/06/2000	LUST	2	0	Unspecified Soil Contamination within 100 ft. of private well
269218956	Wisconsin Central LTD (Canadian National Railroad), Waupaca	02/26/1999	ERP	2	3	Diesel Fuel and Gasoline (Petroleum)
269194579	Schroeder Oil Bulk Plant, Waupaca	08/11/1998	ERP	1	0	Petroleum - Unknown Type, Diesel Fuel, and Gasoline (Petroleum)
269265284	Waupaca Foundry Boneyard Site (Thyssen Krupp Waupaca Inc. - Plants 2 & 3), Waupaca	06/15/1998	ERP	10	5	Chlorinated Solvents (VOC)

369102548	Holiday Station #146, Waupaca	06/11/1996	LUST	1	2	Unspecified Groundwater and Soil Contamination (Transferred to Commerce)
369001905	H & P of Waupaca - Weyauwega Station 76 Site, Weyauwega	08/24/1994	LUST	1	1	Petroleum - Unknown Type
250000509	FS Coop, Amherst Junction	05/31/1994	ERP	2	0	Pesticides, Herbicides and Insecticides (Agricultural Chemicals) (Transferred to DATCP)
250000391	FS Coop, Amherst Junction	09/05/1991	ERP	7	1	Petroleum - Unknown Type (Transferred to DATCP)
269000092	J & J Cleaners - Waupaca Well #4 (Everclean Fabric Care Center), Waupaca	04/05/1982	ERP	2	4	Chlorinated Solvents (VOC)

The Petroleum Environmental Cleanup Fund Award (PECFA) program was created in response to enactment of federal regulations requiring release prevention from underground storage tanks and cleanup of existing contamination from those tanks. PECFA is a reimbursement program returning a portion of incurred remedial cleanup costs to owners of eligible petroleum product systems, including home heating oil systems. As of May 31, 2007, $12,979,777 has been reimbursed by the PECFA fund to clean up 137 petroleum-contaminated sites in Portage County. This equates to $192 per county resident, which is less than the statewide average of $264 per resident. In Waupaca County, over $15 million has been spent to clean up 126 petroleum-contaminated sites , which equates to $286 per county resident.

Point and Nonpoint Pollution

The Tomorrow/Waupaca River Priority Watershed Project plan assessed the nonpoint sources of pollution in the Tomorrow/Waupaca River Watershed and guides the implementation of nonpoint source control measures. These control measures are needed to meet specific water resource objectives for Tomorrow/Waupaca River and its tributaries. The primary objective of the project is to reduce nonpoint source pollution to the Tomorrow/Waupaca River, and to enhance and protect the water quality of streams in the Tomorrow/Waupaca River Watershed.

The Tomorrow/Waupaca River Priority Watershed Project exceeded one hundred percent of its goals relative to sediment and phosphorus loading into surface water. However, it continues to struggle with its groundwater goals on the loamy sands and sandy loams within the watershed. It is impossible to determine in the short term if BMPs are reducing N and Soluble P in groundwater because of the inherent variability of groundwater flow. The project continues to work with UWSP to gather water quality data to try and determine BMP effectiveness (Source: Bradley, Steve. Priority Watershed and Priority Lake Program Final Report, 12/30/08).

Point Sources

There are four industrial point source dischargers and four municipal point source dischargers in the Waupaca River Watershed: Village of Amherst, City of Waupaca, Wisconsin DVA Veterans Home, Waupaca Foundry Inc. (plants 1, 2, and 3), City of Weyauwega, Weyauwega Milk Products, and the Weyauwega Star Dairy.

CAFOs

Gordondale Farms runs a Concentrated Animal Feeding Operation (CAFO) at 9845 Highway 161 in Nelsonville. This dairy farm has a permit to discharge animal waste water to groundwater.

Fishkill Investigations

On May 1, 2008, Tom Meronek conducted fishkill investigations #1107 and #1108 on Wolf Lake and Pickerel Lake, respectively. In both cases the cause of the fishkill was found to be low dissolved oxygen levels due to natural conditions.

Waters of Note

Trout Waters

Class I trout streams are high quality trout waters that have sufficient natural reproduction to sustain populations of wild trout, at or near carry capacity. Consequently, streams in this category require no stocking of hatchery trout. These streams or stream sections are often small and may contain small or slow-growing trout, especially in the headwaters.

Class II trout streams may have some natural reproduction, but not enough to utilize available food and space. Therefore, stocking is required to maintain a desirable sport fishery. These streams have good survival and carryover of adult trout, often producing some fish larger than average size (http://dnr.wi.gov/fish/species/trout/streamclassification.html).

A total of about 72 miles of Class I trout streams are present along sections of Naylor Creek, Radley Creek, Murry Creek, Emmons Creek, Carden Feeder, Stedman Creek, Upper Spring Creek, Mack Creek, Stoltenburg Creek, Allen Creek, Bear Creek, Poncho Creek, Waupaca River, and Spring Creek. Another 38 miles of Class II trout streams are located within the watershed along segments of the Tomorrow/Waupaca River, Bear Creek, Crystal River, and Hartman Creek.

Table 6: Waupaca River Watershed Trout Waters

WADRS ID	Official Waterbody Name	Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class	Trout ID	Counties
315637	Allen Creek	Allen Creek	263300	0	3.72	CLASS I	61	Waupaca, Portage
10313	Bear Creek	Bear Creek	267400	0	1.94	CLASS II	1551	Portage
315668	Bear Creek	Bear Creek	267400	1.94	7.23	CLASS I	66	Portage
10296	Carden Feeder	Carden Feeder Creek	262000	0	0.9	CLASS I	60	Portage
10287	Crystal River	Crystal River	258200	2.43	12.2	CLASS II	1549	Waupaca
10295	Emmons Creek	Emmons Creek	261300	0	7.74	CLASS I	59	Waupaca, Portage
10298	Hartman Creek	Hartman Creek	263000	0	1.61	CLASS II	1550	Waupaca
10312	Mack Creek	Mack (Brown. Spring) Creek	267300	0	1.96	CLASS I	65	Portage
10293	Murry Creek	Murry Creek (N Fork Radley Cr)	260200	0	5.09	CLASS I	58	Waupaca, Portage
10290	Naylor Creek	Naylor Creek	259000	0	1.62	CLASS I	55	Waupaca
315786	Poncho Creek	Poncho Creek	269600	0	4.24	CLASS I	68	Portage
10291	Radley Creek	Radley Creek	259300	0	11.51	CLASS I	56, 57	Waupaca, Portage
1496022	Spring Creek	Spring (Howard) Creek	266800	0	2.82	CLASS I	63	Portage
10307	Stedman Creek	Stedman Creek	266700	0	2.45	CLASS I	62	Portage
10317	Stoltenburg Creek	Stoltenberg Creek	268700	0	0.63	CLASS I	67	Portage
315909	Waupaca River	Tomorrow/Waupaca River	257400	32.77	38.58	CLASS I	54	Portage
315930	Waupaca River	Tomorrow/Waupaca River	257400	38.58	45.98	CLASS II	2897	Portage
315949	Waupaca River	Tomorrow/Waupaca River	257400	46.86	48.17	CLASS II	2897	Portage
1493970	Waupaca River	Tomorrow/Waupaca River	257400	48.17	50.07	CLASS I	53	Portage
1493981	Waupaca River	Tomorrow/Waupaca River	257400	51.07	64.9	CLASS I	52	Portage
1493645	Unnamed	Tomorrow/Waupaca River Headwaters)	270400	0	1.76	CLASS I	51	Portage
10310	Upper Spring Creek	Upper Spring (Upper Howard) Creek	267100	0	1.19	CLASS I	64	Portage
315887	Waupaca River	Waupaca River	257400	17.25	32.77	CLASS II	1548	Waupaca

Outstanding and Exceptional Resource Waters

Wisconsin has designated many of the state's highest quality waters as Outstanding Resource Waters (ORWs) or Exceptional Resource Waters (ERWs). Waters designated as ORW or ERW are surface waters which provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities. ORW and ERW status identifies waters that the State of Wisconsin has determined warrant additional protection from the effects of pollution. These designations are intended to meet federal Clean Water Act obligations requiring Wisconsin to adopt an "antidegradation" policy that is designed to prevent any lowering of water quality – especially in those waters having significant ecological or cultural value.

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 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 (http://dnr.wi.gov/org/water/wm/wqs/orwerw/).

A total of 43 miles of Outstanding Resource Waters are located along segments of Emmons Creek, Radley Creek, the Waupaca River, and an unnamed tributary. Over 54 miles of Exceptional Resource Waters can also be found along stretches of Allen Creek, Bear Creek, Carden Feeder, Mack Creek, Murry Creek, Naylor Creek, Poncho Creek,Spring Creek, Stedman Creek, Stoltenburg Creek, Upper Spring Creek, and Waupaca River.

Table 7: Waupaca River Watershed Outstanding and Exceptional Resource Waters

WADRS ID	Official Name	Local Name	WBIC	ORW/ ERW	ORW/ ERW ID	Start Mile	End Mile	Code Reference	Counties
10295	Emmons Creek	Emmons Creek	261300	ORW	738	0	7.74	102.10(1)(d)22	Waupaca, Portage
10291	Radley Creek	Radley Creek	259300	ORW	728	0	11.51	102.10(1)(d)22, 102.10(1)(d)29	Waupaca, Portage
1493645	Unnamed	Tomorrow/Waupaca River Headwaters)	270400	ORW	89	0	1.76	102.10(1)(d)22	Portage
315909	Waupaca River	Tomorrow/Waupaca River	257400	ORW	89		38.58	102.10(1)(d)22	Portage
1493970	Waupaca River	Tomorrow/Waupaca River	257400	ORW	89		50.07	102.10(1)(d)22	Portage
1493981	Waupaca River	Tomorrow/Waupaca River	257400	ORW	89		64.9	102.10(1)(d)22	Portage
315637	Allen Creek	Allen Creek	263300	ERW	746	0	3.72	102.11(1)(a)	Waupaca, Portage
315668	Bear Creek	Bear Creek	267400	ERW	776	1.94	7.23	102.11(1)(a)	Portage
10296	Carden Feeder	Carden Feeder Creek	262000	ERW	743	0	0.9	102.11(1)(a)	Portage
10312	Mack Creek	Mack (Brown. Spring) Creek	267300	ERW	775	0	1.96	102.11(1)(a)	Portage
10293	Murry Creek	Murry Creek (N Fork Radley Cr)	260200	ERW	732	0	5.09	102.11(1)(a)	Waupaca, Portage
10290	Naylor Creek	Naylor Creek	259000	ERW	727	0	1.62	102.11(1)(a)	Waupaca
315786	Poncho Creek	Poncho Creek	269600	ERW	797	0	4.24	102.11(1)(a)	Portage
1496022	Spring Creek	Spring (Howard) Creek	266800	ERW	774	0	2.82	102.11(1)(a)	Portage
10307	Stedman Creek	Stedman Creek	266700	ERW	772	0	2.45	102.11(1)(a)	Portage
10317	Stoltenburg Creek	Stoltenberg Creek	268700	ERW	787	0	0.63	102.11(1)(a)	Portage
10310	Upper Spring Creek	Upper Spring (Upper Howard) Creek	267100	ERW	87	0	1.19	102.11(1)(a)	Portage

315887	Waupaca River	Waupaca River	257400	ERW	726		32.77	102.11(1)(d)41	Waupaca
315930	Waupaca River	Tomorrow/Waupaca River	257400	ERW	725		45.98	102.11(1)(c)12	Portage
315949	Waupaca River	Tomorrow/Waupaca River	257400	ERW	725		48.17	102.11(1)(c)12	Portage

Impaired Waters

Columbia Lake and Collins Lake are on the 303(d) list for mercury from atmospheric deposition since 1998 and 2002, respectively.

Table 8: Waupaca River Watershed Impaired Waters

Waterbody Name	Local Waterbody Name	WBIC	County	Pollutant	Impairment	303 Status	Priority
Columbia Lake	Cary Millpond	262400	Waupaca	Mercury	Contaminated Fish Tissue	303(d) Listed	Low
Collins Lake	Collins (Fish) Lake	270200	Portage	Mercury	Contaminated Fish Tissue	303(d) Listed	Low

Fish Consumption

In addition to being on the state's 303(d) Impaired Waters list, Collins Lake has a specific fish consumption advisory in effect for mercury. The Wolf River upstream to the Shawano Dam has a fish consumption advisory for polychlorinated biphenyls (PCBs).

Mercury and PCBs differ in where they come from, where they accumulate in fish, and how they affect human health. Contaminants such as PCBs and mercury build up in the body over time. Studies indicate the people exposed to PCBs are at greater risk for a variety of health problems. Infants and children of women who have eaten a lot of contaminated fish may have lower birth weights and be delayed in physical development and learning. PCBs may affect reproductive function and the immune system and are also associated with cancer risk. Once eaten, PCBs are stored in body fat for many years. Each time you ingest PCBs the total amount of PCB in your body increases.

Mercury affects the human nervous system. Mercury can damage developing brains of children and may affect a child's behavior and ability to learn. While mercury can be eliminated from the body, frequent ingestion of fish with high levels of mercury results in bioaccumulation (Proposed Guidance For the Classification, Assessment, & Management of Wisconsin Surface Waters, Lowndes & Helmuth, March 12, 2007).

Aquatic Invasive Species

Banded mystery snail and Eurasian water-milfoil are pervasive throughout the watershed and can be found in numerous lakes. Chinese mystery snail can be found in Bear Lake, Collins Lake, Lime Lake, Hartman Lake (Allen), and Pope Lake. Curly-leaf pondweed have been verified and vouchered in Emily Lake, Long Lake, Weyauwega Lake, Spring Lake, Amherst Millpond, and Sunset Lake. Furthermore, rusty crayfish have invaded the waters of Columbia Lake (Waupaca Chain), Crystal River, Waupaca River, Amherst Millpond, and Lake Emily. Lake Emily is also home to a milfoil hybrid species.

Rare Carniverous Pitcher Plant
Photo by K. Kirck (WDNR)

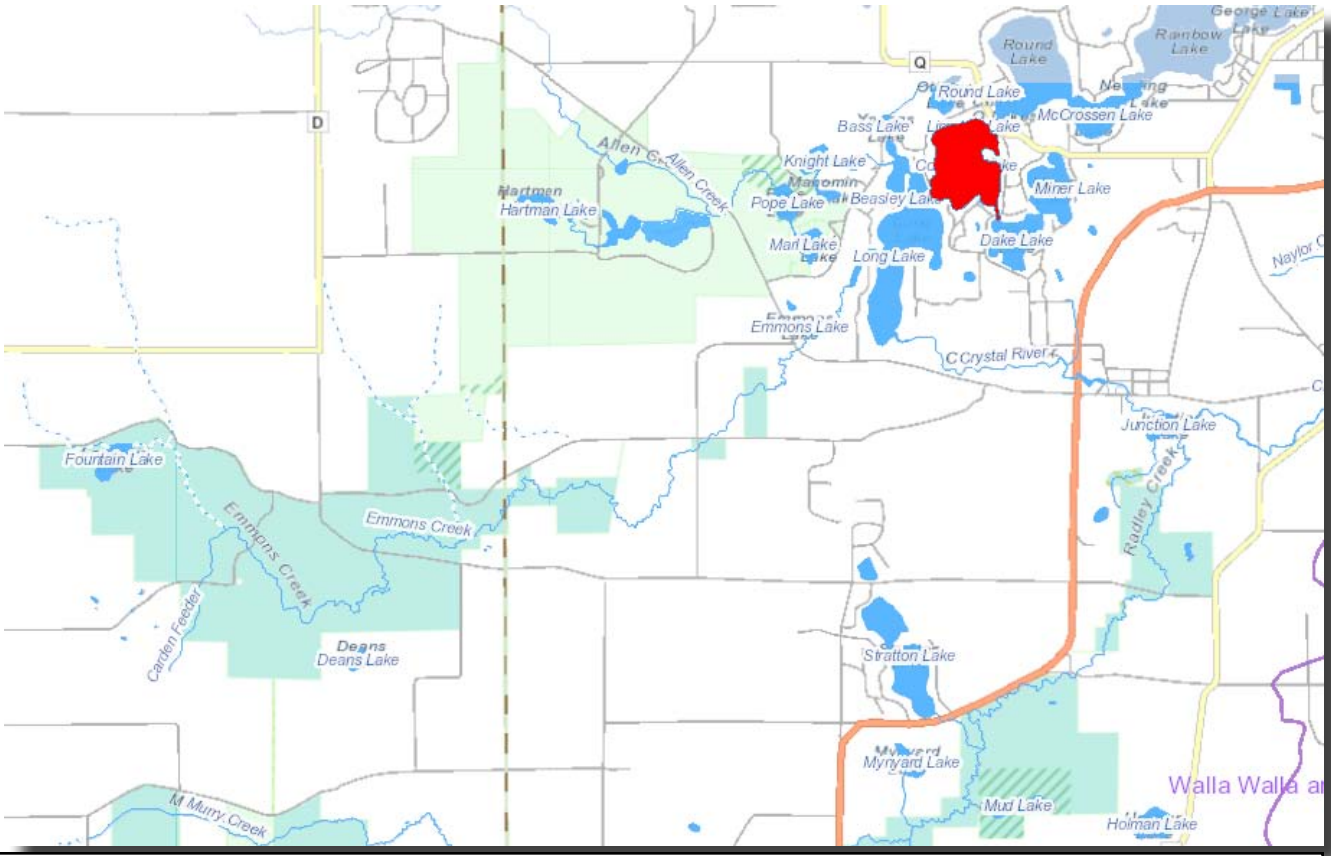
Species of Special Concern

The following table contains federally-listed Threatened, Endangered, Proposed, and Candidate species found in Waupaca, Portage, and Waushara counties, in which the Waupaca River Watershed is located. A full list of special concern plants and animals for this watershed can be found on the state's Natural Heritage Inventory (NHI).

Table 9: Federally-Listed Threatened, Endangered, Proposed, and Candidate Species in Waupaca, Portage, and Waushara Counties			
Species	**Status**	**Habitat**	**Taxa**
Gray wolf (Canis lupus)	Endangered	Northern forested areas	Mammal
Snuffbox (Epioblasma triquetra)	Proposed as Endangered	St. Croix, Wolf, Embarrass, Little Wolf Rivers and Willow Creek	Mussel
Snuffbox (Epioblasma triquetra)	Proposed as Endangered	St. Croix, Wolf, Embarrass, Little Wolf Rivers and Willow Creek	Mussel
Karner blue butterfly (Lycaeides melissa samuelis)	Endangered	Prairie, oak savanna, and jack pine areas with wild lupine	Insect
Fassett's locoweed (Oxytropis campestris var. chartaceae)	Threatened	Open sandy lakeshores	Plant
Whooping crane (Grus americanus)	**Non-essential experimental population	Open wetlands and lakeshores	Bird

**Whooping Crane - On June 26, 2001, a non-essential experimental population of the whooping crane was designated in a 20-state area of the eastern United States. The first release of birds occurred in Wisconsin in 2001, and the counties listed are those where the species has been observed to date. It is unknown at this time which counties the species will occupy in the future, as the birds mature and begin to exhibit territorial behavior. For purposes of section 7 consultation, this species is considered as a proposed species, except where it occurs within the National Wildlife Refuge System or the National Park System, where it is treated as a threatened species (http://www.fws.gov/midwest/endangered/lists/wisc-spp.html).

State Natural and Wildlife Areas



Map 3: DNR Managed Lands in WR05

Emmons Creek Barrens
Located on sandy glacial outwash, Emmons Creek Barrens supports a semi-open oak savanna with scattered open-grown bur and white oaks. The dense patches of wild lupine, which dominate the groundlayer, provide favorable habitat for the federally-endangered Karner blue butterfly (Lycaeides melissa samuelis). Wild lupine is the only known larval food plant of the Karner blue. Other species include Pennsylvania sedge, little blue-stem, silky aster, cream wild indigo, prairie coreopsis, western sunflower, June grass, slender beardtongue, and showy goldenrod. Emmons Creek Barrens is owned by the DNR and was designated a State Natural Area in 2002.

Emmons Creek Fishery Area
Emmons Creek Fishery Area is approximately 1,500 acres in size and is located in southeastern Portage County and southwestern Waupaca County. Access is off County Highway D by way of Fountain Lake Road or Stratton Lake Road. The property lies along the southern edge of Hartman Creek State Park. The property follows the 4.5-mile meandering path of Emmons Creek. It is regarded as a cold water trout fishery. The creek originates at the 15.4-acre Fountain Lake and has inputs from five feeder streams and two spring ponds. There is a fair amount of bottomland shrub floodplain adjacent to the creek and its feeder streams. Strongly rolling upland surrounds the Emmons Creek corridor. Open areas from historical farming operations and Red Pine stands intermix with upland hardwoods in the rolling hills. The Ice Age Trail passes through the property giving easy access to viewing all the different habitats.

Parcels in the project area were acquired starting in 1957 to protect the Emmons Creek corridor. Today, numerous trout stream improvements occur annually throughout the property. The endangered Karner blue butterfly can be found in the natural and manmade openings, where its larval food source, Lupine, grows. Old fields from past farming practices, many of which have been planted with native grasses and forbs (including Lupine) now support the endangered Karner blue butterfly.

Mud Lake - Radley Creek Savanna
Mud Lake is a shallow, hard water lake in a wilderness setting, having no access or human-made developments. The lake covers nearly 11 acres and is only three feet deep. The water is clear and quite fertile, with the major sources being seepage and springs. There is no inlet, but the lake does have a short outlet to Radley Creek. Wild rice dominates the emergent aquatics. Surrounding the lake is a forest of tamarack and poison sumac. The absence of black spruce makes this site very unusual for this locality. The understory is rich in northern wet forest herbs; sundew and pitcher plant are especially numerous. To the north the land rises into an open forest dominated by white and bur oaks, which has several groundlayer species that are more typical of prairie. Mud Lake-Radley Creek Savanna is owned by the DNR and was designated a State Natural Area in 1989.

Pickerel Lake
Pickerel Lake is a hard water seepage lake with a fluctuating shoreline and a sand bottom that gently slopes to the center. The water flux has limited the lake's value as a fishery due to severe winter kills during periods of low water. In summer, oxygen depletion and corresponding fish kills are not uncommon due to dense blooms of algae. While the fluctuating water inhibits the fishery, it provides ideal conditions for some specialized plants by flooding out competing plants and killing trees when water is high and providing habitat when water is low. The lower beach contains mostly mats of needle spike-rush and slender flat sedge. The middle beach has semi-open vegetation with boneset, Kalm's lobelia, heart's-ease, silver-weed, common false foxglove, and eastern willow-herb. The surrounding upland is wooded with oaks of varying sizes and ages. Scattered throughout the oaks are small patches with prairie species, indicating this area was once a savanna. Pickerel Lake is owned by the DNR and was designated a State Natural Area in 1990.

Pope Lake
Pope Lake is a 14-acre undeveloped lake with a diversity of aquatic vegetation. It is the only undeveloped water body in the heavily developed Chain O' Lakes. The marl-bottomed hard water lake has a maximum depth of 40 feet and contains chara, spatterdock, wild celery, and a good variety of pondweeds. Most of the adjacent wetlands are a northern wet forest of tamarack, poison sumac, and winterberry, but alder thicket is also found along the channels and the lake shore. Several upland islands support a northern dry-mesic forest of white pine and white and red oaks. Common bird species found near the lake are green-backed heron, great blue heron, sora, great crested flycatcher, eastern wood peewee, black-capped chickadee, and goldfinch. Pope Lake is owned by the DNR and was designated a State Natural Area in 1984.

Radley Creek Fishery Area
Radley Creek Fishery Area is located 10 miles southwest of Waupaca on Highway 22 in Waupaca County. All Wildlife Areas are open to a full range of traditional outdoor recreational uses. These include hunting, fishing, trapping, hiking, nature study, and berry picking.

Richard J. Hemp Fishery Area
Richard J. Hemp Fishery Area is a 1,372-acre property located three miles north of Nelsonville. Access is off of River Road, Highway Z, and Highway I. The property consists of a trout stream corridor, lowland forest (swamp conifer and bottomland hardwoods), and mixed hardwood forest. The state began purchasing property to protect the Tomorrow River and Poncho Creek corridors in 1958. Along with the trout stream protection that the purchases achieved, many acres of upland and lowland forest were protected as well as their associated wildlife.

Watershed Actions

Grants/Projects

Aquatic Invasives - Bear Lake 05/09/2008 - Complete
Portage County LCD: Bear EWM-Weevils: Portage County proposed to work with the U.W. Stevens Point to assess and stock weevils to control Eurasian water-milfoil in Bear Lake in Portage County. Major project elements included: 1) GPS survey of EWM presence, 2) collection of samples for analysis, 3) macrophyte monitoring, 4) weevil rearing and release, and 5) development of final report.

Aquatic Invasives - Stratton Lake 04/18/2007 - Complete
Stratton Lake Property Owners Association: Stratton Lake EWM Control Project: The Stratton Lake Association proposed to control Eurasian water-milfoil (EWM) in Stratton Lake by implementing control measures during the period 2007 through 2009. The project elements and deliverables are specified in the Stratton Lake Association's Aquatic Invasive Species Control Grant application, dated February 1, 2007, and revised on April 18, 2007. The project included conducting pre- and post-treatment surveys and mapping the extent of EWM, controlling EWM with aquatic herbicide treatments, implementing an aquatic invasive species prevention strategy that included developing an information & education program, and conducting watercraft inspections. Annual progress reports and a final report summarizing the three-year project were provided to DNR. Watercraft inspection records were entered into the state's online Watercraft Inspection Database. Publications produced as part of the project incorporated the "Stop Aquatic Hitchhikers!"\ FFFD brand (partnership details can be found at: http://www.protectyourwaters.org). DNR was provided both paper and electronic PDF copies of the final report along with, or prior to, submission of grantee's final payment request.

Aquatic Invasives Education - Stratton Lake 04/01/2007 - Complete
Town of Dayton: Stratton Lake AIS Education, Prevention & Planning Project: The Town of Dayton, on behalf of the Stratton Lake Association, proposed to develop an Aquatic Plant Management (APM) Plan in 2007, which would focus on native plant protection and prevention, and control of aquatic invasive species (AIS). The project elements and deliverables are specified in the Town of Dayton Aquatic Invasive Species Control Grant application, dated February 1, 2007, and revised on April 18, 2007. The project included using aquatic plant survey data generated by Department of Natural Resources staff; determining the extent, distribution and density of Eurasian water-milfoil and any other AIS; preparing and developing an APM Plan consistent with DNR guidelines, including an AIS prevention and control plan; educating lake users of native plant protection and AIS prevention and control measures; and implementing the "Clean Boats, Clean Waters" watercraft inspection program. Watercraft inspection records were entered into the State's online Watercraft Inspection Database. The final report included the Stratton Lake Association Aquatic Plant Management Plan that conforms to guidance found in the DNR/UW-Extension publication, "Aquatic Plant Management in Wisconsin". DNR received both paper and electronic PDF copies of the final report along with, or prior to, submission of grantee's final payment request.

Aquatic Invasives Education - Lake Emily 04/01/2007 - Complete
Golden Sands RC&D: Emily EWM-Crayfish: Golden Sands RC&D, in conjunction with the Friends of Lake Emily, proposed to implement a Clean Boats, Clean Waters program with paid field staff who also organized EWM hand-pulling parties, mapped EWM concentrations with GPS, produced an end-of-season map for comparison with past years, and issued news releases and news letters to enhance community awareness. Field staff also conducted a study of rusty crayfish in

conjunction with the UW Stevens Point Invasives and Exotic Species class.

Aquatic Invasives Education - Unnamed 04/01/2007 - Complete
Town of Dayton: Stratton Lake AIS Education, Prevention & Planning Project: The Town of Dayton, on behalf of the Stratton Lake Association, proposed to develop an Aquatic Plant Management (APM) Plan in 2007, which would focus on native plant protection and prevention, and control of aquatic invasive species (AIS). The project elements and deliverables were specified in the Town of Dayton Aquatic Invasive Species Control Grant application, dated February 1, 2007, and revised on April 18, 2007. The project included using aquatic plant survey data generated by Department of Natural Resources staff; determining the extent, distribution and density of Eurasian water-milfoil and any other AIS; preparing and developing an APM Plan consistent with DNR guidelines, including an AIS prevention and control plan; educating lake users of native plant protection and AIS prevention and control measures; and implementing the "Clean Boats, Clean Waters" watercraft inspection program. Watercraft inspection records were entered into the State's online Watercraft Inspection Database. The final report included the Stratton Lake Association Aquatic Plant Management Plan that conforms to guidance found in the DNR/UW-Extension publication, "Aquatic Plant Management in Wisconsin". DNR received both paper and electronic PDF copies of the final report along with, or prior to, submission of grantee's final payment request.

River Planning - Emmons Creek 07/01/2006 - Complete
- Golden Sands RC&D: Emmons Creek Watershed Initiative: Golden Sands RC&D Council, Inc. in cooperation with the UW Oshkosh Biology and Microbiology Department proposed to: 1) conduct routine nutrient monitoring in Emmons Creek to determine if nutrient concentrations in the stream are increasing, decreasing, or remaining relatively stable through time, and 2) to establish a self-sustaining Friends of the Emmons Creek citizen-based conservation group. The project elements and deliverables were completed as described in the project proposal submitted to the Department and dated May 1, 2006.

Aquatic Invasives Control - Thomas Lake 04/01/2006 - Complete
- Portage County LCD: Portage County Weevils: Portage County, in cooperation with Golden Sands RC&D and the U.W. Stevens Point, proposed to implement a revised milfoil weevil treatment program in an attempt to control Eurasian water-milfoil growth in Thomas Lake, Lake Jonas, and Springville Pond. Major project elements included: 1) EWM mapping, 2) Weevil stocking, 3) Weevil density surveys, and 4) Final report.

River Planning - Waupaca River 07/01/2005 - Complete
- Golden Sands RC&D: Tomorrow River Awareness: Golden Sands RC&D proposed to administer a grant on behalf of Friends of the Tomorrow/Waupaca River, the funding was used for public information, involvement and planning designed to enhance FOTWR's capacity to facilitate river protection. Major project elements included: 1) River Clean-up Day, 2) Development of a newsletter, 3) Water quality monitoring training for volunteers, 4) Informational signs along roadways, 5) Educational materials regarding conservation easements to landowners, and 6) Strategic planning.

Aquatic Invasives Control - Taylor Lake 04/01/2005 - Complete
- Waupaca Chain O' Lakes Public Inland Lake P&R: Waupaca Chain O' Lakes AIS Prevention, Education & Control Project: The Waupaca Chain O' Lakes Protection and Rehabilitation District proposed to implement elements from its Aquatic Invasive Species Information, Education and Prevention Strategic Plan and Aquatic Plant Management Plan during the period 2005 through 2007. The project elements and deliverables are specified in the Waupaca Chain O' Lakes Protection and Rehabilitation District's Aquatic Invasive Species Grant application, dated January 31, 2005. The project included developing and implementing an information and education program, volunteer boat monitoring program, aquatic invasive species monitoring and mapping program, and conducting a study to determine the potential fiscal and economic impact of aquatic invasive species on the local economy. Additionally, the project sought to control established infestations by conducting annual aquatic invasive plant surveys, treating areas infested with Eurasian water-milfoil and curly-leaf

Richard J. Hemp Fishery Area

pondweed with aquatic herbicides, and using biocontrol methods on areas infested with purple loosestrife. Incremental and final project reports were shared with local stakeholders and were provided to the University of Wisconsin - Extension. Annual progress reports and a final report summarizing the three-year project were provided to DNR. DNR received both paper and electronic PDF copies of the final report along with, or prior to, submission of grantee's final payment request.

Aquatic Invasives Education - Lake Emily 04/01/2004 - Complete

- Portage County LCD: Portage County EWM Map-Plan: Portage County proposed to work with Golden Sands RC&D to identify and map EWM and curly-leaf pondweed infestation in McDill Pond and Lake Emily and to develop and distribute recommendations for control of these aquatic invasives. A final report was presented to pertinent lake management units and protection groups. Paper and electronic PDF copies of this report were provided to the Department prior to or in conjunction with submission of the final payment request.

Aquatic Invasives Education - Lake Emily 04/01/2004 - Complete

- Portage County LCD: Portage County EWM Weevil Survey: Portage County proposed to work with the Golden Sands RC&D to conduct surveys of four lakes to estimate populations of EWM controlling weevils (E. lecontei) and to formulate EWM control plans based, in part, on this information. Major project elements included: 1) random stem sample collection and microscopic analysis for weevil damage and presence of eggs, pupae and/or adult weevils, 2) GPS coordinates and water quality sampling (temp., DO, Secchi depth) at sample locations, and 3) development and distribution of a final report summarizing results and recommendations. The final report was presented to pertinent lake management and protection groups. Paper and electronic PDF copies of the report were provided to the Department prior to or in conjunction with submission of a final payment request.

Aquatic Invasives Education - Taylor Lake 04/01/2004 - Complete

- Waupaca Chain O' Lakes Public Inland Lake P&R: Waupaca Chain O' Lakes Aquatic Invasive Species Study: The Waupaca Chain O' Lakes District proposed to develop a strategic plan for the prevention and control of Aquatic Invasive Species. The project included the development of a stakeholder group consisting of lake residents, county and town officials, business owners, and other interested parities. A second objective was to implement educational strategies throughout the strategic planning process. Educational signage at public and private boat launchings was updated to include information on aquatic invasive species. Local public service announcements were aired by the local media. A public information open house was held to establish community relations. The draft strategic plan was prepared by August of 2005 and approved at the lake district annual meeting. The plan was shared with lake residents via newsletters and the DNR was provided with a draft plan and a final approved plan. Amendment #1 included educational literature containing information about aquatic invasive species which was developed for distribution from the updated signs and other outlets.

Lakes Small Scale Lake Planning - Columbia Lake, Dake Lake, Limekiln Lake, Long Lake, 10/01/2003 - Complete

- Chain O' Lakes Public Inland Lake Protection & Rehabilitation: West Chain APM Plan: The Waupaca Chain O' Lakes District proposed to conduct a small-scale lake planning grant to develop an aquatic plant management plan for the West Chain of the Waupaca Chain O' Lakes. Approximately 15 transects were used, duplicating a survey from 1994. A lake by lake visual inspection was conducted to determine the presence of Eurasian water-milfoil, purple loosestrife, and adult zebra mussels. The field work was conducted during the summer months of 2004, with the aquatic plant management plan developed by December 31, 2004. The plan was used to direct aquatic plant management activities on the Waupaca Chain O' Lakes. The plan was approved by the Department of Natural Resources Aquatic Plant Manager. The plan was provided to lake residents, Waupaca Chain O' Lakes District, Waupaca Chain O' Lakes Association, Waupaca County Land and Water Conservation Department, and Wisconsin DNR. The plan is available both in bound form and electronic copy.

NPS Targeted Runoff Urban Construction - Waupaca River 01/01/2003 - Complete

- City of Waupaca: Waupaca River Streambank Protection: State cost-shared (@ 70%) construction & construction management expenses for streambank protection along the municipal sewer plant on the Waupaca River.

Lakes Large Scale Lake Planning - Mirror Lake 10/01/2002 - Complete

- Fox Wolf Watershed Alliance: Mirror Lake Water Quality Evaluation & Management Plan Development: The

Fox-Wolf Watershed Alliance proposed to conduct a water quality evaluation and develop a management plan for Mirror Lake. Specifically, in-lake water quality and algae community monitoring, water quality and volume from lake inlets and outlets, groundwater quality assessment including inflow and outflow monitoring, lake modeling, and a shoreline and watershed assessment were conducted. A lake celebration, meetings, workshops, and other citizen educational opportunities were held. A lake district advisory committee was developed. The Department of Natural Resources was provided with both a paper copy and electronic copy of the final lake management plan.

Lakes Large Scale Lake Planning - Shadow Lake 10/01/2002 - Complete

- Fox Wolf Watershed Alliance: Shadow Lake Water Quality Evaluation & Management Plan Development: The Fox-Wolf Watershed Alliance proposed to conduct a water quality evaluation and develop a management plan for Shadow Lake. Specifically, in-lake water quality and algae community monitoring, water quality and volume from lake inlets and outlets, groundwater quality assessment, including inflow and outflow monitoring, lake modeling, and a shoreline, and watershed assessment were conducted. A lake celebration, meetings, workshops, and other citizen educational opportunities were held. A lake district advisory committee was developed. The Department of Natural Resources was provided with both a paper copy and electronic copy of the final lake management plan.

Lakes Large Scale Lake Planning - Weyauwega Lake 04/01/1999 - Complete

- City of Weyauwega: Lake Weyauwega Survey & Plan Development Phase 3: The City of Weyauwega proposed to conduct the final phase of management planning, which was designed to pull together all the pieces of previous and current work into a comprehensive management plan for Lake Weyauwega. This project was the third phase of studies conducted in Weyauwega Lake. Phases one an two defined physical properties of the resource, seasonal variation in water chemistry, aquatic plant populations and nonpoint source nutrient loading. The objectives of this project were to: 1) include public involvement programs, 2) conduct water quality monitoring, 3) conduct an aquatic plant survey/development of an aquatic plant management plan (and budget), and 4) present a report of the above information. The DNR was provided with both a paper copy and an electronic copy of the final report. Information was disseminated to the public via a start-up meeting prior to planning work to inform those concerned of project goals and objectives, semi-annual newsletters, presentations at membership and/or board meetings, local news releases and a summary brochure, and report at the end of the project.

Figure 8: Lake Weyawega Drawdown (2011)

Lakes Large Scale Lake Planning - Stratton Lake 10/01/1997 - Complete

- Waupaca County: Stratton Lake - Waupaca Co. Phase 1: Waupaca County Water Quality Committee proposed to determine the present conditions of Stratton Lake, and determine the conditions of the groundwater inflow to the lake and how it affects plant growth and speciation of aquatic macrophytes in the lake. Project activities included: lake water testing, groundwater testing and an aquatic plant survey. This was phase one of a two part study, with both parts needed for the complete picture. When both parts were completed the Department of Natural Resources was provided with both a paper copy and an electronic copy of the final report. The project results were disseminated to the public by news letter and fact sheet mailing, public meeting, and local newspaper articles.

Lakes Large Scale Lake Planning - Stratton Lake 10/01/1997 - Complete

- Waupaca County: Stratton Lake Water Quality Study - Phase 2: Waupaca County Water Quality Committee proposed to determine the present conditions of Stratton Lake, and determine the conditions and specific nature of the bottom sediments in the lake. Project activities included: more lake water testing, some private well testing, and sedimentation mapping. This was phase two of a two part study, with both parts needed for the complete picture. The Department of Natural Resources was provided with both a paper copy and an electronic copy of the final report. The project results were disseminated to the public by news letter and fact sheet mailing, public meeting, and local newspaper articles.

Lakes Large Scale Lake Planning - Old Taylor Lake 10/01/1996 Complete

- Old Taylor Lake Advancement Association: Old Taylor Lake Management Planning - Phase 1: The Old Taylor Lake Advancement Association proposed to collect and analyze physical, chemical, and biological data about Old Taylor Lake and its watershed. Project activities included an historic data review, water quality monitoring, and an aquatic plant survey. The sponsor provided the Department of Natural Resources with a paper copy and an electronic copy of the final report discussing the project results. Information about the project was disseminated to the public by newsletter mailing, public meeting, and local newspaper article.

Lakes Large Scale Lake Planning - Wolf River 10/01/1996 - Complete

- Wolf River Preservation Association: Wolf River Watershed Management Planning - Phase 2: The Wolf River Preservation Association proposed to continue watershed management planning activities. Phase two project activities included continuing water quality monitoring, conducting a recreational use survey, continuing to assess erosional areas, continuing to identify exotic species, and preparation of a report summarizing the data collected and analyses performed. The sponsor provided the Department of Natural Resources with both a paper copy and an electronic copy of the report. Information about the results of phase two activities was disseminated to the public by a newsletter, fact sheet, public meeting, and local newspaper article.

Lakes Large Scale Lake Planning - Cary Pond 11/11/1993 - Complete

- Waupaca Inland P & R District: Cary Mill Pond Water Quality Monitoring and Data Collection: 1) Conducted water quality and flow monitoring on schedule and for parameters listed under Work Element 3 of the application; 2) Examined sediment and nutrient inputs and land use in the watershed; 3) Determined depths of soft sediment in pond; 4) Reviewed existing information on the pond, the Crystal River, and the pond's watershed; and 5) Prepared a final report.

Lakes Large Scale Lake Planning - Weyauwega Lake 10/25/1993 - Complete

- City of Weyauwega: Weyauwega Lake Water Quality Monitoring & Sedimentation Study: Conducted water quality monitoring. Identified areas within watershed that are prone to nutrient and/or sediment runoff. Conducted in-lake sediment sampling and developed a sediment removal feasibility study. Conducted a feasibility study to reduce adverse impacts of storm sewer discharges. Disseminated information to the public by newsletter, local newspaper articles, fact sheet, public meetings, and report mailings.

Lakes Large Scale Lake Planning - Long Lake 12/07/1992 - Complete

- Chain O' Lakes Protective Association: Water Quality Monitor, Land Use Inventory-Little Waupaca Chain, Upper, Middle, Lower, and East Waupaca Chains: Continued water quality monitoring on schedule at depths and for parameters described in application. Developed a water budget for the watershed. Inventoried land use of upper watershed. Identified land use objectives and developed recommendations on lake recreational uses. Information was

disseminated to the public by newsletter, fact sheet, local newspaper articles and public meetings. Project results were reposited at Town of Dayton, Town of Farmington, Waupaca County Courthouse, and DNR Lake Michigan District office.

Lakes Large Scale Lake Planning - Long Lake 04/01/1991 - Complete

- Chain O' Lakes Protective Association: Waupaca Lower Chain O Lakes Management Planning: 1) Reviewed existing data on Lower Chain O' Lakes (Columbia, Beasley, Bass, Long, Ottman, and Youngs lakes) and watershed to define data gaps and assess data gathering needs. 2) Initiated public involvement/information program that included workshop, public meetings, newsletters, local media, and fact sheet distribution. 3) Performed water quality monitoring as described in application attachment. 4) Conducted macrophyte survey as described in application. 5) Prepared base maps of lakes and watershed; mapped land uses including soil disturbing uses, nonpoint pollution problems, and environmentally sensitive areas. Final lake management plan included summary of tasks above and management recommendations.

Lakes Large Scale Lake Planning - Long Lake 04/01/1991 - Complete

- Chain O' Lakes Protective Association: Waupaca Middle Chain O' Lakes Management Planning: Reviewed existing data to define data gaps. Initiated public involvement/information program. Performed water quality monitoring. Conducted literature search on methods to control swimmer's itch. Prepared base maps of lake and watershed. Draft and final lake management plans were developed. Project results were reposited at the Town of Dayton Hall, Town of Farmington Hall, Shawano County Court House, and DNR Lake Michigan District.

Lakes Large Scale Lake Planning - Long Lake 04/01/1991 - Complete

- Chain O' Lakes Protective Association: East Waupaca Chain O Lakes Management Planning: 1) Reviewed existing data on East Chain O' Lakes (Dake and Miner lakes) and watershed to define data gaps and assess data gathering needs. 2) Initiated public involvement/information program, which included public meetings, workshops, local media, newsletters, and fact sheets. 3) Performed water quality monitoring as described in application. 4) Conducted macrophyte survey during late spring and mid to late summer. 5) Prepared base maps of lakes and watershed. Mapped land use including soil disturbing uses, nonpoint pollution problems, and environmentally sensitive areas. 6) Final lake management plan included summary of data gathered, public involvement activities, base and land use maps, and management recommendations.

Lakes Large Scale Lake Planning - Long Lake 04/01/1991 - Complete

- Chain O' Lakes Protective Association: Little Waupaca Chain O Lakes Management Planning: 1) Reviewed existing data on Little Chain O' Lakes (Knight, Orlando, Pope, Marl, and Manomin lakes) and watershed to define data gaps and assess data gathering needs. 2) Initiated public involvement/information program, which included workshops, public meetings, newsletters, local media, and a fact sheet. 2) Monitored water quality at sites as described in application. 4) Initiated development of water quality maintenance program (landowner based program investigating methods to protect the Little Chain's high water quality. 5) Prepared base maps of lakes and watershed. Mapped land use including soil disturbing uses, nonpoint pollution problems, and environmentally sensitive areas. 6) Final lake management plan included summary of data gathered, public involvement activities, base and land use maps, and management recommendations.

Lakes Large Scale Lake Planning - Long Lake 04/01/1991 - Complete

- Chain O' Lakes Protective Association: Upper Waupaca Chain O' Lakes Management Planning: Review existing data on lakes and watershed to define data gaps. Initiated public involvement/information program. Performed water quality monitoring. Prepared analysis of recreational use management techniques in practice at the time. Base maps of lake and watershed were prepared. Draft and final lake management plans were developed.

Lakes Large Scale Lake Planning - Weyauwega Lake 12/20/1990 - Complete

- City of Weyauwega: Weyauwega Lake Water Quality Sampling, Data Collection: Assembled and reviewed existing data on the lake and watershed to define data gaps. Additional data gathering included: 1) Water quality in two sites, including all or some of parameters in table 1 of application, 2) Three different storm sewers sampled twice and analyzed for suspended solids, TP, ammonia N, NO3-NO2,BOD5, 3) One sediment sample analyzed for percentage of organics, total solids, TP, ammonia N, and Kjeldahl N. Developed and implemented public involvement program. Pre-

pared land use map for lake and watershed. Identified and evaluated existing ordinances related to nonpoint pollution control. Developed draft report for public review and comment. Prepared and distributed a lake management plan. Information was disseminated to the public by newsletter mailings, fact sheet distributions, public meetings, summary report mailings, and local newspaper articles. The project results were reposited at the Weyauwega City Hall and the Waupaca County Courthouse.

Monitoring

Lakes Baseline and Trends Monitoring

- River Monitoring to comply with Clean Water Act implementation - water quality standards: use designations, criterion, permit issuance and compliance, assessments, and impaired waters management.
- Fisheries projects include a wide variety of "baseline" monitoring and targeted fieldwork to gain specific knowledge related to Wisconsin's fish communities. In close cooperation with UW Extension and Wisconsin Sea Grant, education efforts focus on working with resource professionals and citizens statewide to teach boaters, anglers, and other water users how to prevent transporting aquatic invasive species when moving their boats. Additional initiatives include monitoring and control programs.

Volunteer Monitoring

The Citizen Lake Monitoring Network, the core of the Wisconsin Lakes Partnership, involves over 1,000 citizen volunteers statewide. The goals are to collect high quality data, to educate and empower volunteers, and to share this data and knowledge. Volunteers measure water clarity, using the Secchi disk method, as an indicator of water quality. This information is then used to determine the lakes trophic state. Volunteers may also collect chemistry, temperature, and dissolved oxygen data, as well as identify and map plants, watch for the first appearance of Eurasian water-milfoil near boat landings, or alert officials about zebra mussel invasions on Wisconsin lakes. Monitoring work in this watershed consists of lake monitoring and surveys for water quality, aquatic plants, aquatic invasive species, and ice observations.

Stream Monitoring - Water Action Volunteers

Nine Volunteer stations have been monitored by eight volunteers from 2005 through 2010 in WR05-Waupaca River Watershed. Five stations are monitored for biotic index, flow, dissolved oxygen, instantaneous temperature and transparency using Level 1 procedures, and entered in the WAV database (http://www.uwex.edu/erc/wavdb/). Two of the stations are monitored for dissolved oxygen, pH, instantaneous and continuous temperature and transparency using Level 2 procedures including: The remaining two stations are only monitored to assess continuous temperature. All Level 2 data are entered into the SWIMS database (http://prodoasjava.dnr.wi.gov/swims/welcome.do). On average, stations in the watershed were monitored monthly from May through October.

Volunteers collect macroinvertebrates twice a year (the first and last sampling event of the season) to determine a biotic index for each stream monitored. Streams are considered in poor quality if biotic index is between 1.0-2.0, fair quality if between 2.1-2.5, and in good quality if the index is between 2.6-3.5. Generally, biotic index values in the watershed rated streams in fair to good quality (ranging from 2.25-3.2). Stations along the Waupaca River have a higher flow rate than the nearby creeks with measurements on average of 133.6 cubic feet per second (cfs) and ranging from 58.3-427.4 cfs. Bear and Emmons Creeks measured lower flow throughout the season with an average of 19.7 cfs, ranging from 7.9-34 cfs. From 2005 through 2010, volunteers recorded dissolved oxygen levels in the watershed sufficient to sustain aquatic life. Levels ranged from 8-15mg/l. Throughout the

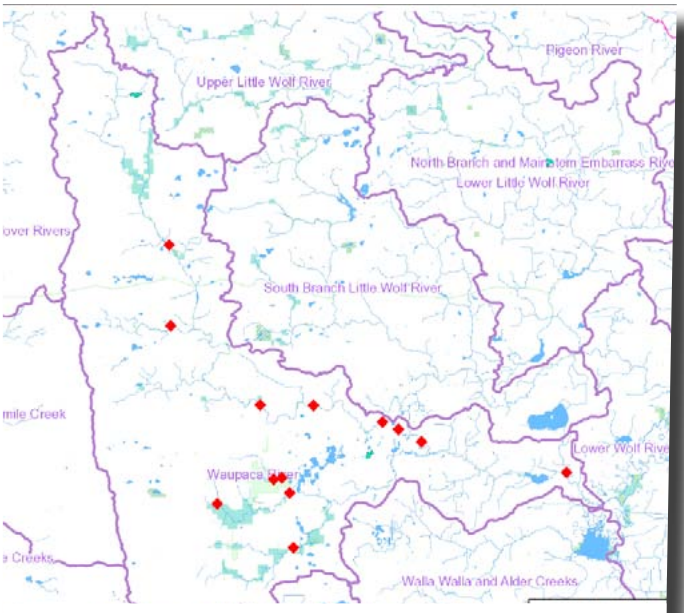


Figure 9: Volunteer Stream Monitoring Sites

monitoring seasons, volunteers collected pH measurements primarily within state standards (which range from 6 to 9) ranging from 7.77 to 8.65.

Temperature measurements, used to classify streams as cold, cool or warm water habitats, and which are indicative of the ability of a habitat to sustain aquatic species were manually recorded at all Level 1 stations and two of the Level 2 stations. Generally, maximum instantaneous temperatures were below 25°C for all streams using this method; suggesting they may be cold water streams. Waupaca River at Hwy 22 and the Riverside Park, due west of parking lot, CBSM-10020691 and Waupaca River, 3.2 miles W of Hwy 54/10 & Waupaca, 50 yds downstream from Hwy 10, CBSM-10020689 each had one field event with a temperature reaching 28.9°C on July 31, 2006; suggesting they may be warm water streams. Continuously recorded temperatures were collected at all of the Level 2 stations. Continuously measured temperatures indicated a transition between cool and warm water stream with maximum daily temperatues ranging from 23-25°C between yearly data.

Basin/Watershed Partners

- Waupaca County Land and Water Conservation Department
- Portage County Land and Water Conservation Department
- Waushara County Land and Water Conservation Department
- Central Wisconsin Trout Unlimited and CWTU River Keepers
- Fox Valley Chapter Trout Unlimited
- Hornberg Chapter Trout Unlimited
- Shawpaca Chapter Trout Unlimited
- East Central Wisconsin Regional Planning Commission
- Fox-Wolf Watershed Alliance
- Friends of the Tomorrow Waupaca River
- River Alliance of Wisconsin

Priority Issues

- Streambank erosion contributing sediment and nutrient loads to the Waupaca River Mainstem.
- Decreased baseflow in the streams of the watershed from drought and groundwater withdrawal increases water temperatures, degrades water quality, and reduces habitat for fish and aquatic life.
- Impacts of impoundments on the temperatures, water quality, and fish communities of the Crystal and Waupaca Rivers.
- Condition and future plans for the Little Hope and Amherst Dams, the millponds, and the Crystal and Waupaca Rivers.
- Groundwater quality degraded by excessive nutrients and pesticides leaching through the highly permeable soils of the Waupaca River Watershed.

Recommendations

- WRM should evaluate and monitor regularly the water quality of the Waupaca River below the Waupaca Foundry discharge.
- District WRM and Fisheries Management should review the trout stream classification of Hartman Creek.
- Recommend as necessary partial or whole lake drawdowns on Lake Weyauwega to improve or maintain water and habitat quality of the lake and the Waupaca River.
- Re-evaluate the nitrate and atrazine levels in groundwater and surface waters within the Waupaca River Watershed.
- Continued assessment of water quality impacts from regional groundwater withdrawal on the streams and rivers in the Waupaca River Watershed.

Recommendations

- Biologists should monitor the water quality of the Waupaca River below the Waupaca Foundry discharge to ensure ambient conditions are maintained.
- Water Quality biologists and fisheries biologists should review the trout stream classification of Hartman Creek.

Contributors

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Figure 10: Waupaca River Near Waupaca

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

Waupaca River Watershed