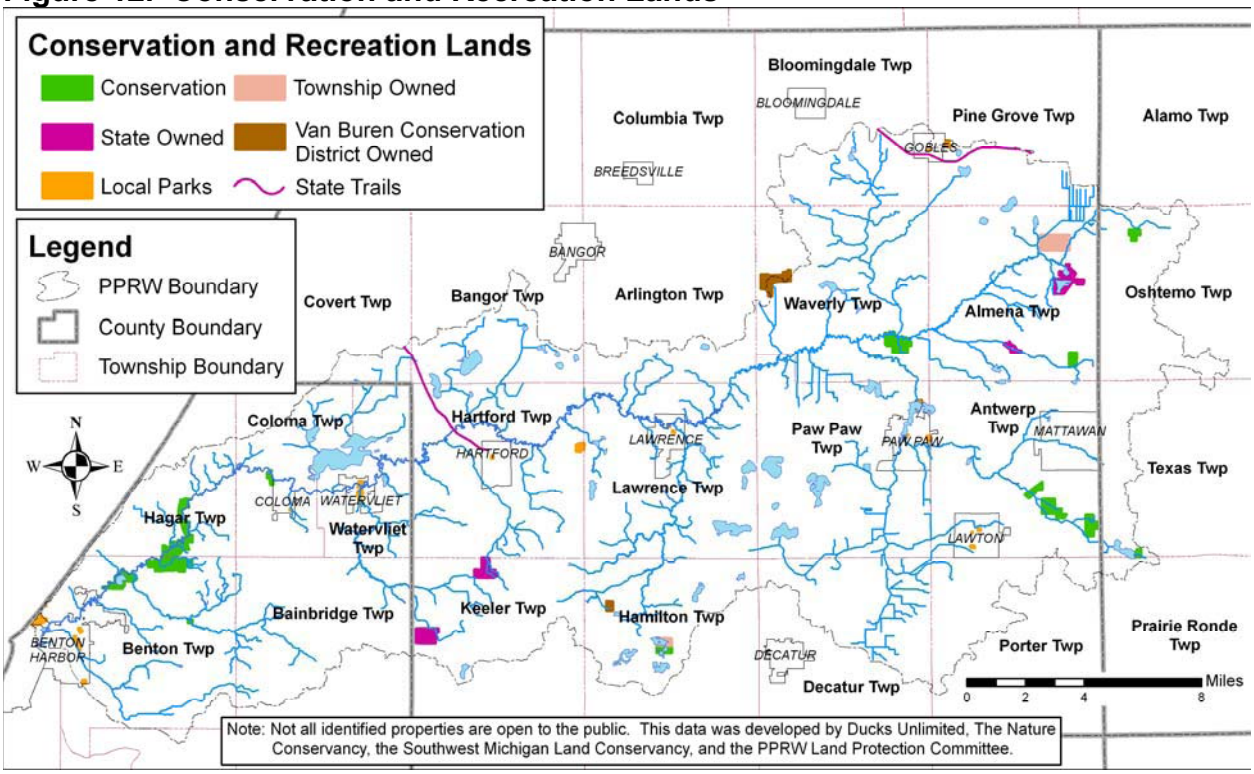
5 Natural Features

The PPRW contains many natural features which provide ecosystem services that benefit humans such as recharging groundwater, cleansing air and water and providing recreational, fishing and hunting opportunities. The Nature Conservancy has identified the Paw Paw River mainstem and certain tributaries as high-quality representative aquatic systems important for conserving freshwater biodiversity in the Great Lakes Basin.

5.1 Protected Lands

Figure 12 shows that over 2,000 acres in the watershed are under some form of protection. These lands include those owned by Sarett Nature Center, Michigan Department of Natural Resources, The Nature Conservancy (TNC), Southwest Michigan Land Conservancy (SWMLC), Michigan Nature Association and cities, villages and townships. The map also includes privately owned lands with conservation easements held by either TNC or SWMLC.

Figure 12. Conservation and Recreation Lands



5.2 Generalized Hydrologic Cycle

The earth's water is one large, continuous feature that exists within a complex and dynamic cycle, and is commonly categorized as distinct features such as surface water, groundwater and wetlands. Although the cycle has no beginning or end, it is convenient to describe the generalized cycle with a starting point of surface water. Water evaporates from oceans, lakes and other surface waters to the atmosphere and is carried over land surfaces, where it condenses and is precipitated onto the land surfaces as rain, snow, etc. Some water will drain across the land as runoff into a water body. The land cover will affect how this water moves across the land. If the surface soil is permeable, some water will infiltrate to the subsurface under the influence of gravity and will saturate the soil and/or rock. This zone of saturation is recognized as groundwater. Due to gravity, groundwater generally moves from areas of higher elevations to lower elevations to locations where it discharges to wetlands and/or surface water (lakes, streams, rivers). Wetlands may be viewed as a transition of groundwater to surface water, and visa-versa.

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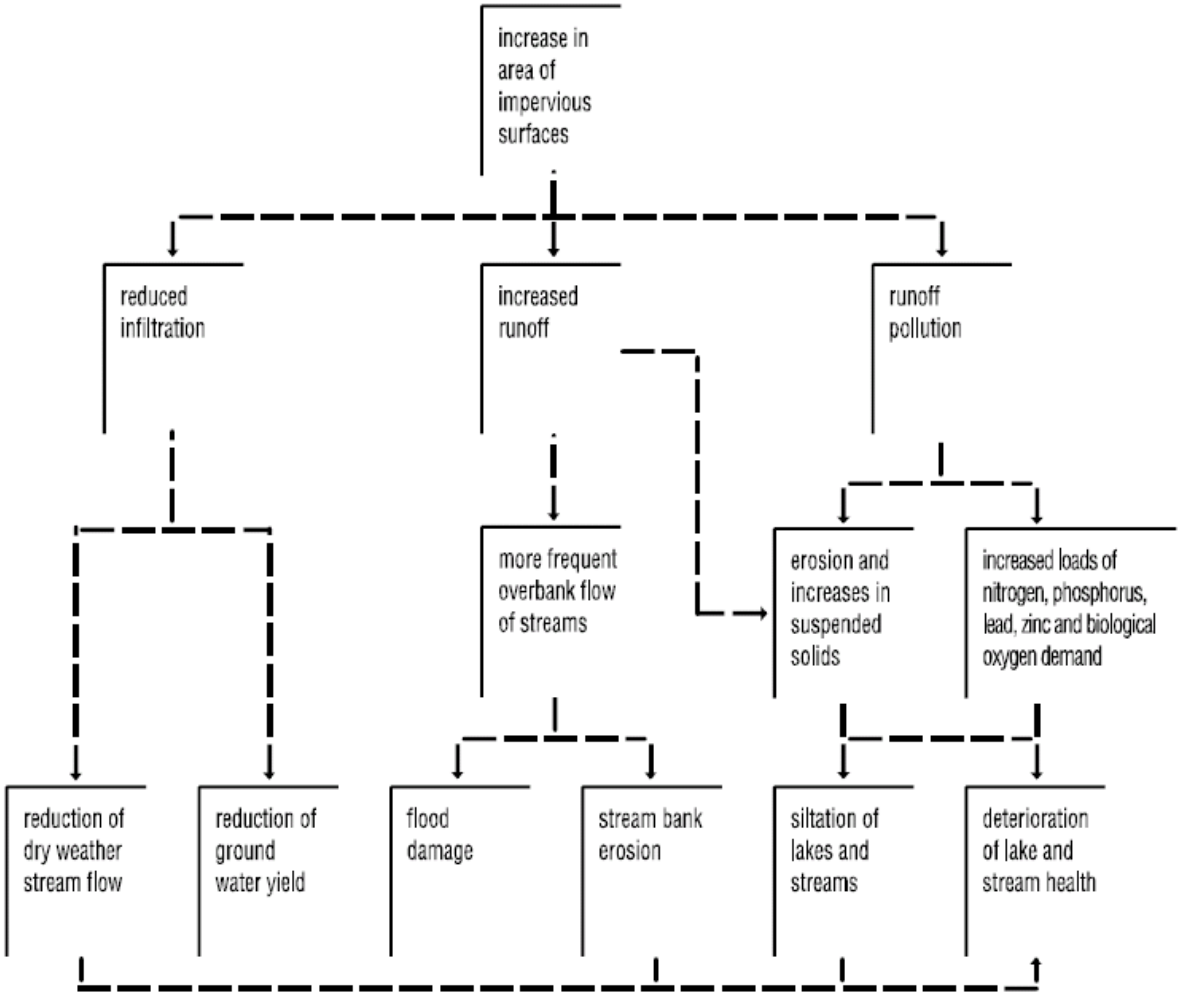
A properly functioning hydrologic cycle is greatly dependant upon the land cover and natural features in the watershed. Natural vegetation, such as forested land cover, usually has high infiltration capacity and low runoff rates. Whereas urbanized land cover has impervious areas (buildings, parking lots and roads) and networks of ditches, pipes and storm sewers, which augment natural stream channels. Impervious surfaces in urban areas reduce infiltration and the recharge of groundwater while increasing the amount of runoff. This runoff carries pollutants contributing to poor water quality. Agricultural lands, including row crops, orchards, vineyards, rangelands and animal farms can also have a significant impact on runoff and groundwater resources. Agricultural lands are often heavily compacted by farm equipment, which lessens their ability to infiltrate water. In addition, many agricultural lands are extensively ditched to move water off of the land as quickly as possible. Further, irrigation can alter the groundwater resources. These activities disrupt the natural hydrologic cycle and negatively impact the functioning of the remaining natural features in the watershed.

Figure 13 illustrates the many impacts of the loss of natural lands and an increase in impervious surfaces on water quality and quantity. The impacts resulting from land use change also negatively impact the fragmented natural areas left in the watershed. Following is a discussion of the different natural communities found in the PPRW and the major threats to their existence and quality. The interdependent natural systems

and communities discussed in this section include rivers, lakes, wetlands, groundwater, floodplain forests, upland forests, oak savanna and prairie remnants and rare species.

Figure 13. Impacts of Impervious Surfaces



5.3 Rivers/Streams

The Paw Paw River is a coolwater system containing tributaries that are both warm and coldwater. Approximately 159,728 acres (56%) of the PPRW drain into designated coldwater streams. The remaining 125,829 acres (44%) drain to warmwater or coolwater water bodies. Figures 14 and 15 show the streams and rivers in the PPRW. These figures also show the watershed area contributing to coldwater streams. Coldwater streams are a unique natural feature providing important spawning habitat and thermal refuge for coldwater aquatic species such as trout.

Coldwater streams contribute to the hydrologic stability of the PPRW because they have large groundwater inputs. Coldwater streams with a July monthly average of 70 degrees Fahrenheit or lower comprise 69% (100 miles) of the river distance within the watershed. Designated trout streams (MDNR Fisheries Division regulations) found in

the watershed are characterized by having fish communities dominated by mottled sculpin, brown trout, and coldwater minnows. Sand Creek, Blue Creek, Mill Creek, Pine Creek, Brush Creek, North Branch Paw Paw River and tributaries above M-40, West Branch and East Branch above M-40 are designated coldwater trout streams within the watershed.

Warmwater streams typically have higher surface water inputs than groundwater inputs and as a result these streams have higher flow variability. Species richness is typically higher in southern Michigan streams, like the Paw Paw River, as a result of the overlap of regions supporting coldwater and warmwater species. The major tributaries in the PPRW that are considered warmwater are Ox Creek, Mud Lake Drain, Hog Creek, Branch Derby Drain and the Brandywine Creek. Table 8 lists primary streams and drains by subwatershed.

Figure 14. Water Bodies in the Paw Paw River Watershed (West)

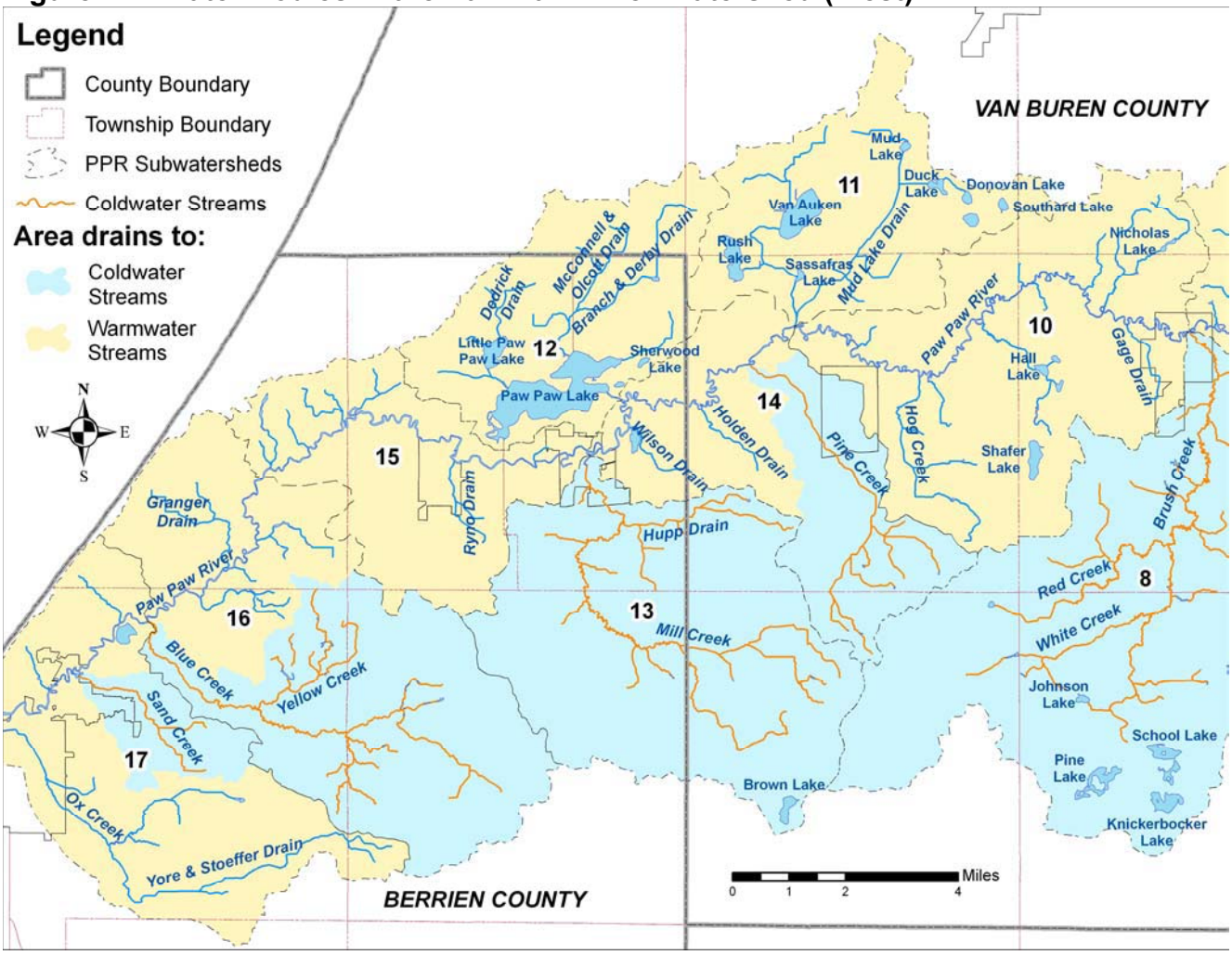
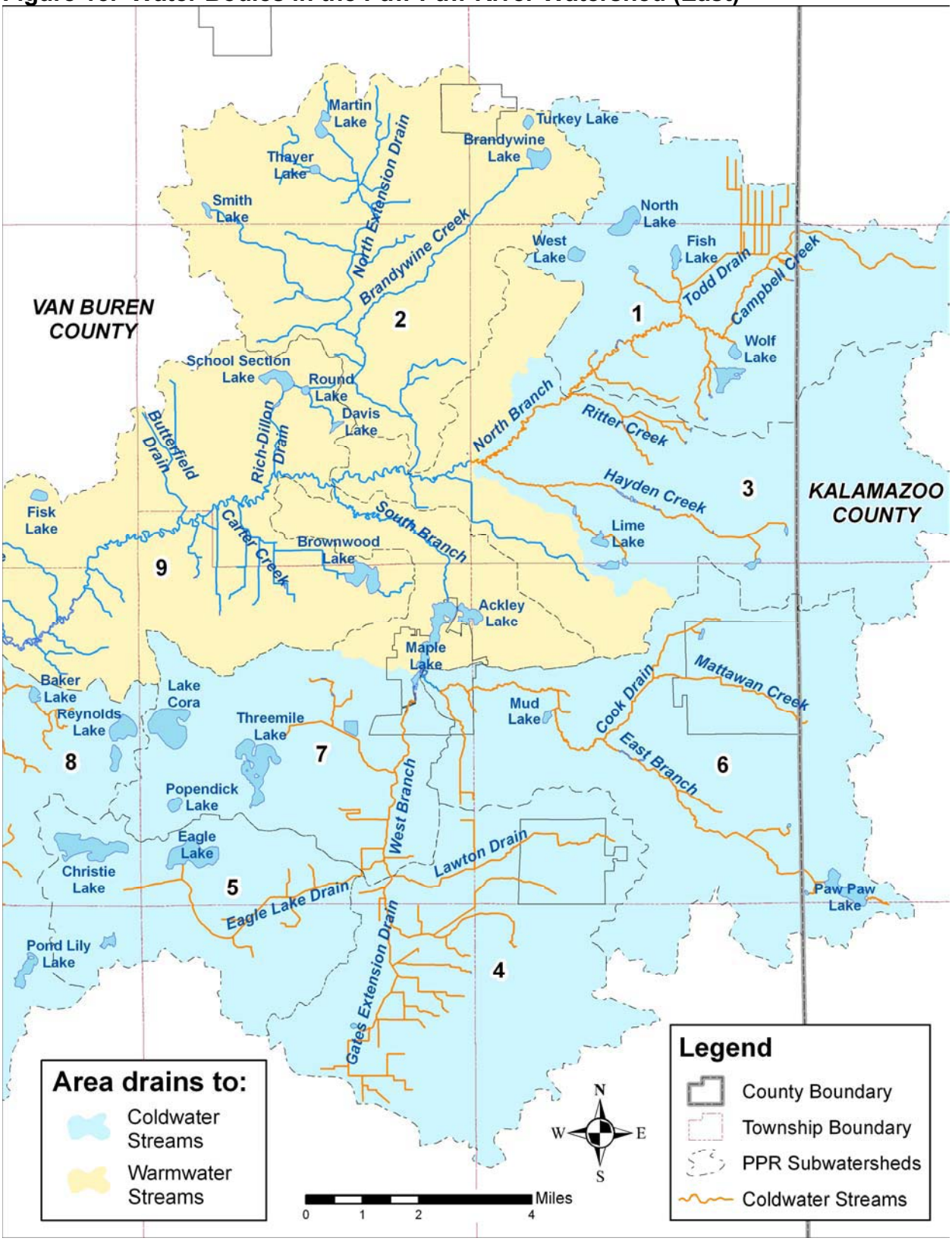


Figure 15. Water Bodies in the Paw Paw River Watershed (East)



The Paw Paw River and its tributaries can be characterized in terms of ecologically similar subwatersheds. Similarities within each subwatershed include soil types, surface geology and landscape patterns that relate to groundwater inflow and fish species composition. An MDNR report classifying the Paw Paw River subwatersheds on the basis of ecologically similar conditions is available online at www.swmpc.org/downloads/pprw_dnr_report.pdf.

Table 8. Streams in the Paw Paw River Watershed

Subwatershed ID #	Primary Streams & Drains
1	North Branch*, Campbell Creek*, Todd Drain
2	Brandywine Creek*, North Extension Drain, Martin Lake Drain
3	North Branch*, Hayden Creek*, Ritter Creek
4	West Branch*, Lawton Drain, Gates Extension Drain
5	Eagle Lake Drain*
6	East Branch*, Cook Drain, Mattawan Creek
7	West Branch*, South Branch*, Three Mile Lake Drain
8	Brush Creek*, Red Creek*, White Creek
9	Paw Paw Mainstem*, Carter Creek*, Butterfield Drain, Rich-Dillon Drain
10	Paw Paw Mainstem*, Hog Creek*, Gage Drain
11	Mud Lake Drain*, Van Auken Lake Drain, Rush Lake Outlet
12	Branch & Derby Drain*, McConnell & Olcott Drain, Dedrick Drain
13	Mill Creek*, Hupp Intercounty Drain
14	Paw Paw Mainstem*, Pine Creek*, Wilson Intercounty Drain, Holden Drain
15	Paw Paw Mainstem*, Ryno Drain
16	Paw Paw Mainstem*, Blue Creek*, Yellow Creek, Granger Drain
17	Paw Paw Mainstem*, Ox Creek*, Sand Creek*, Yore & Stoeffer Drain

*Additional information can be found in Appendix 4.

Threats

As discussed at the beginning of this chapter, water pollution and hydrologic alterations from changes in land use are a major threat to rivers and streams. This management plan is intended to address the major threats to surface water. Detailed information on water pollutants, their sources and causes can be found in Appendices 4 and 9.

Water pollution comes from all land uses in the watershed including residential, commercial, industrial and agricultural.

Invasive species such as zebra mussels also threaten aquatic communities in the Paw Paw River. Although zebra mussels need lakes or impoundments to persist long-term, they can colonize river and stream segments downstream from these water bodies indefinitely. Other invasive species threatening the Paw Paw River include round gobies and sea lampreys. The US Fish and Wildlife Service treats the lower Paw Paw River for sea lampreys every three years with lampricide TFM (3-trifluoromethyl-4-nitrophenol). The chemical treatment itself, however, may be a significant threat because it can cause indirect mortality of native reptiles, amphibians, fish and mollusks.

5.4 Lakes

The PPRW includes approximately 5,818 acres of lakes and ponds. There are 78 lakes greater than 10 acres in size that comprise 4,659 acres within the watershed. Paw Paw Lake in Berrien County is the largest lake in the watershed covering 920 acres. The only lakes in the PPRW with municipal sewer service are Paw Paw (Berrien County), Little Paw Paw, Brownwood, Maple and Ackley Lakes. Table 9 contains information on lakes greater than 5 acres in the PPRW. The maps of PPRW water bodies (Figures 14 and 15) label the names of all lakes greater than 10 acres.

Bluegill-largemouth bass communities dominate fish assemblages in lake environments in southern Michigan watersheds including the PPRW. Largemouth bass are found in most lakes in the watershed and are the primary predator on bluegill, which is the most abundant fish in these lakes. Fish communities in the watershed are comprised of a diverse number of other fish, averaging 20 species in each lake. In the PPRW, there are two rare fish species, lake herring (listed as state threatened) and spotted gar (a species of special concern) commonly found in lake environments. Two-story fisheries that support both coldwater fish (trout and lake herring) and coolwater fish (black bass and northern pike) are rare resources in southwest Michigan. They occur in Little Paw Paw Lake (Kalamazoo County) and Shafer Lake (Van Buren County). (Kregg Smith, MDNR, 2007)

A "two-story" fishery is a lake capable of providing two different types of fisheries. In the PPRW, the two-story fishery lakes contain coolwater and coldwater fish populations.

Table 9. Lakes in the Paw Paw River Watershed

Name	Sub watershed ID	County	Area (Acres)	Elevation	**Surface Water Connection	Maximum Depth (Approx.)	Public Access	Sewer System?
Ackley Lake	7	Van Buren	63	715	Outflow	15	Yes	Yes
Baker Lake	8	Van Buren	25	678	Throughflow	50		
Brandywine Lake*	2	Van Buren	73	771	Throughflow	25	Yes	
Brown Lake	13	Van Buren	50	768	Isolated	60		
Brownwood Lake	9	Van Buren	124	696	Throughflow	44	Yes	Yes
Carroll Lake	10	Van Buren	9	710	Outflow			
Christie Lake	5	Van Buren	238	756	Bidirectional		Yes	
Cornwall Lake	10	Van Buren	10		Outflow			
Davis Lake	9	Van Buren	12		Outflow	20		
Donovan Lake	11	Van Buren	18	669	Outflow	80		
Duck Lake	11	Van Buren	31		Bidirectional	40	Yes	
Dustin Lake	3	Kalamazoo	10	845	Isolated			
Eagle Lake*	5	Van Buren	196	755	Outflow		Yes	
East Lake	1	Van Buren	8		Outflow	22		
Fish Lake*	1	Van Buren	34	718	Throughflow		Yes	
Fisk Lake	9	Van Buren	30		Bidirectional			
Hall Lake*	10	Van Buren	21	695	Throughflow		Yes	
Hawk Lake	1	Van Buren	11		Outflow			
Hemlock Lake	1	Van Buren	12	774	Throughflow			
Hillocher Lake	10	Van Buren	7		Outflow			

Name	Sub watershed ID	County	Area (Acres)	Elevation	**Surface Water Connection	Maximum Depth (Approx.)	Public Access	Sewer System?
Johnson Lake	8	Van Buren	16		Outflow	20		
Kibler Lake	16	Berrien	11		Isolated			
Knickerbocker Lake	8	Van Buren	82	770	Bidirectional			
Lake Cora*	7	Van Buren	234	751	Bidirectional	60	Yes	
Lime Lake	3	Van Buren	28		Throughflow	40		
Little Paw Paw Lake	12	Berrien	101	624	Throughflow	29		Yes
Lower Reynolds Lake	8	Van Buren	40	756	Bidirectional			
Lyle Lake	2	Van Buren	6		Isolated			
Maple Lake*	7	Van Buren	166		Throughflow	15		Yes
Martin Lake*	2	Van Buren	44	747	Throughflow	35	Yes	
Mud Lake	11	Van Buren	15	656	Bidirectional	20		
Mud Lake	6	Van Buren	15		Outflow	50	Yes	
Mud Lake	4	Van Buren	5		Outflow			
Nelson Lake	9	Van Buren	7		Throughflow			
Nicholas Lake	10	Van Buren	11		Throughflow			
Paw Paw Lake*	12	Berrien	920	621	Throughflow	90	Yes	Yes
Paw Paw Lake*	6	Kalamazoo	123	871	Throughflow	56	Yes	
Pine Lake	8	Van Buren	96		Bidirectional			
Pond Lily Lake	8	Van Buren	66		Bidirectional			
Popendick Lake	7	Van Buren	29	757	Bidirectional	35	Yes	
Red Lake	8	Van Buren	6		Outflow			
Round Lake	9	Van Buren	12	685	Throughflow	40	Yes	
Rush Lake*	11	Van Buren	121	645	Bidirectional	56	Yes	
Sand Lake	6	Van Buren	19	754	Bidirectional	25	Yes	
Sassafras Lake	11	Van Buren	14		Throughflow			
School Lake	8	Van Buren	63		Bidirectional			
School Section Lake*	9	Van Buren	79	685	Throughflow	45	Yes	
Shafer Lake*	10	Van Buren	72	739	Throughflow	67	Yes	
Shaw Lake	9	Van Buren	10	683	Bidirectional	45		
Sherwood Lake	12	Berrien	12		Bidirectional			
Simmons Lake	2	Van Buren	13		Outflow	40		
Smith Lake	2	Van Buren	15		Throughflow	12		
Southard Lake	11	Van Buren	20	690	Bidirectional	40		
Tamarack Lake	1	Van Buren	12		Throughflow	30		
Thayer Lake	2	Van Buren	15	742	Throughflow	50		
Threemile Lake*	7	Van Buren	258	754	Bidirectional	40	Yes	
Turkey Lake	2	Van Buren	20	771	Bidirectional			
Upper Reynolds Lake*	8	Van Buren	96	756	Bidirectional	40	Yes	
Van Auken Lake*	11	Van Buren	252	650	Bidirectional	60	Yes	

Name	Sub watershed ID	County	Area (Acres)	Elevation	**Surface Water Connection	Maximum Depth (Approx.)	Public Access	Sewer System?
West Lake	1	Van Buren	37	748	Bidirectional	45		
Wolf Lake	1	Van Buren	25	718	Outflow	40	Yes	

*Additional water quality information in Appendix 4.

**Surface water connections were identified as part of the MDEQ Wetland Functional Assessment; groundwater linkages and hydrological relationships to wetlands and other water bodies are more complex than what could be determined by the simple visual assessment of surface water conditions performed by MDEQ.

Isolated – receives precipitation and runoff from adjacent areas with no apparent outflow

Outflow – water flows out of the water body, but does not flow in from another water body

Throughflow – water flows through water body, often coming from a stream or uphill sources

Bidirectional – inflow and outflow patterns are subject to the rise and fall of lake or reservoir levels

Threats

Threats to lake environments within the watershed are primarily related to shoreline development and land uses. Residential development around lakes with no connection to municipal wastewater treatment facilities can increase nutrient levels and bacteria counts in the lake. The only lakes within the PPRW that have municipal sewer systems are Paw Paw (Berrien County), Little Paw Paw, Brownwood, Maple and Ackley Lakes. With residential development, coarse woody material abundance and shoreline habitat diversity strongly declines while nutrient loading increases. Aquatic plant assemblages are also influenced by residential development, and interestingly, reproductive success of black bass nests declines almost two fold with increasing residential development. (Kregg Smith, MDNR Fisheries Division, 2007)

Human activities negatively affect inland lake ecosystems through alterations in water quality and physical habitat. For example, increased nutrient loadings from lawn fertilizers can increase algae and aquatic vegetation to nuisance levels and decrease concentrations of dissolved oxygen when excess algae and vegetation decompose. In addition, the quantity and quality of physical habitat available to fishes in the area between high and low water marks is altered by removal of coarse woody debris, by an increase or decrease (via chemical or mechanical removal) of aquatic plants, and by homogenization of the shoreline through erosion control efforts (e.g., rip-rap and sheet piling). Such changes in water quality and habitat features have been shown to negatively impact fish growth (Schindler et al. 2000), limit natural reproduction of certain fish species (Rust et al. 2002), and reduce fish species richness while shifting assemblage structure towards more tolerant species (Jennings et al. 1999).

Invasive species are also a big concern in lakes. One nuisance aquatic invasive species is the zebra mussel. Through human activity such as boating, zebra mussels have the potential to spread. Zebra mussels attach to any hard surface and can clog water intake pipes. They can become a nuisance on docks and piers and they may compete with resident aquatic species that filter algae and zooplankton for food. Zebra mussels also kill native mussel species through suffocation and starvation. Zebra

mussels can improve water clarity. Eurasian milfoil and curly leaf pondweed are two widespread nuisance plants in lakes. Boats and trailers can transfer these species to water bodies, so special care should be taken by boaters to limit the possibility.

5.5 Wetlands

Wetlands provide critical ecosystem services such as cleansing water, storing water and providing wildlife habitat. The wetland resource base in the PPRW has undergone significant disruption in the 200 years since Michigan was settled, losing approximately 50% of its total wetland area, and in some cases up to 62% of its wetland functionality. There is evidence to suggest that the result of these losses is reduced surface water quality and total loss of some fisheries. The watershed itself has been extensively ditched since pre-settlement, and this has resulted in the destruction, degradation, and vegetative conversion of many of the wetlands and waterways that originally existed. Forested wetlands have been the most affected, with silviculture and drainage for agriculture responsible for most of the impact. Because of ineffective drainage and/or forestry practices, there has been a sharp increase in the amount of emergent and scrub-shrub wetland acreage over time. According to the MDEQ Landscape Level Wetland Functional Assessment report for the PPRW, several wetland functions were reduced in capacity by 50% or more in the watershed as a whole; retention of sediment and other particulates lost 51% capacity, fish and shellfish habitat was reduced by 61%, and conservation of biodiversity by 62%. Other functions fell just below that mark, with streamflow maintenance, nutrient transformation, and other wildlife habitat all estimated to have lost 44-45% of their original capacity. No wetland functions have increased in the last 200 years.

A few large intact wetland complexes can be found in the watershed. One is located in the headwaters of the North Branch known as the Almena Swamp. Another is in Waverly Township north of the Paw Paw River. These wetlands perform functions that protect water quality and provide habitat for many species.

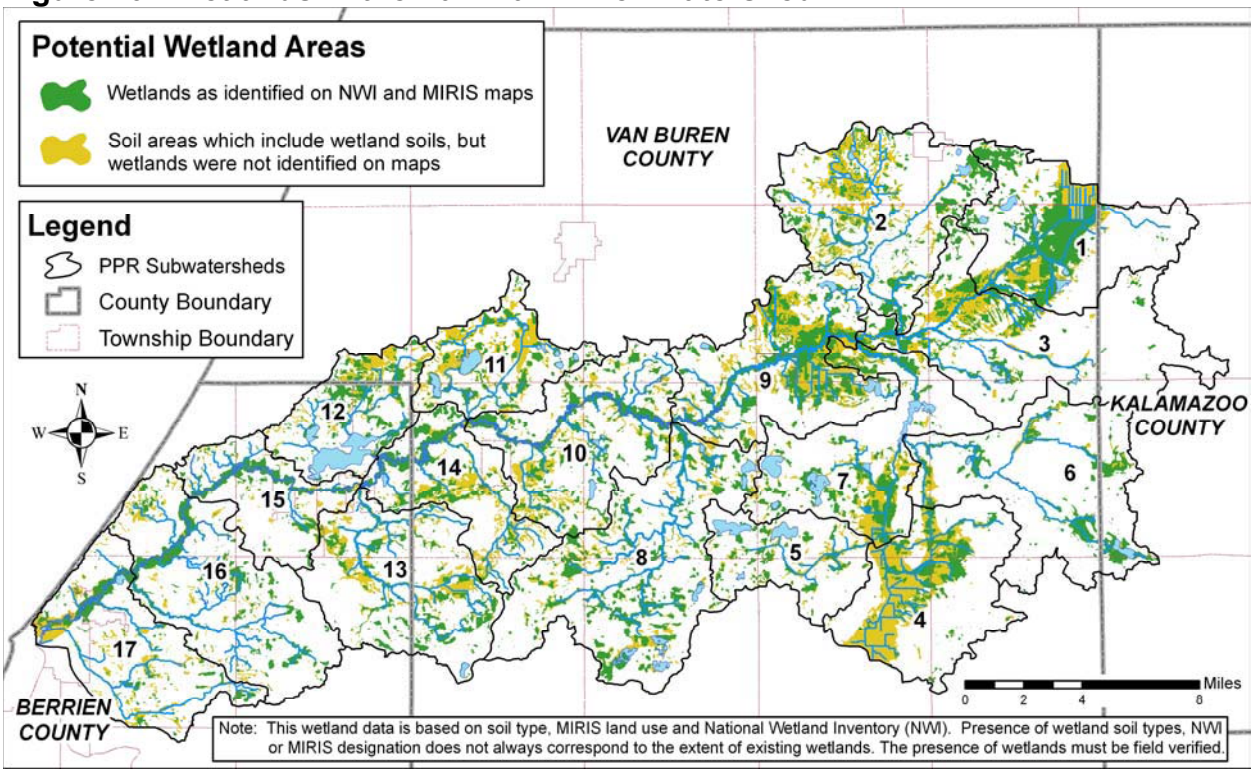
Still a few large intact wetland complexes can be found in the watershed. One is located in the headwaters of the North Branch known as the Almena Swamp. Another is in Waverly Township north of the Paw Paw River. (See Figure 16.) These wetlands perform functions that protect water quality and provide habitat for many species.

Wetlands of special interest in the PPRW include Great Lakes marsh and prairie fens. Great Lakes marsh is an herbaceous wetland community restricted to the shoreline of the Great Lakes and their major connecting rivers. Great Lakes Marsh exist from the City of Benton Harbor upstream to the Brown Sanctuary of Sarett Nature Center. Species of interest in these wetlands include the Swamp Rose Mallow (Hisbiscus moscheutos) and the Blanding's turtle (Emydoidea blandingii). For more information on Great Lakes Marsh visit www.swmpc.org/downloads/great_lakes_marsh.pdf.

Prairie fens are geologically and biologically unique wetlands found only in the glaciated Midwest. In Michigan, they occur in the southern three to four tiers of counties. The groundwater springs, which characterize prairie fens, are very rich in calcium and magnesium. Typical plants found in prairie fens are switchgrass, Indiangrass, big

bluestem, sedges, rushes, Indian-plantain, and prairie dropseed. The wettest part of a prairie fen, which is usually found near the water source, is called a "sedge flat" because members of the sedge family dominate the vegetation. The "fen meadow" is the largest part and is more diverse with many lowland prairie grasses and wildflowers. Slightly elevated areas, especially around the upland edge, also support tamarack, dogwood, bog birch and poison sumac. In the PPRW, prairie fens are found in the Blue Creek watershed, at Sarett Nature Center, near Lime Lake, in the Paw Paw Prairie Fen Preserve and around Paw Paw Lake in Kalamazoo County.

Figure 16. Wetlands in the Paw Paw River Watershed



Threats

Historically the PPRW contained 65,254 acres of vegetated wetland or 23% of the total watershed area. By 1998, the total wetland area had been reduced to 57% of its original extent. Conversion to farmland was the main reason for wetland loss. Conversion of forested wetland to emergent/scrub-shrub wetland due to logging practices and drainage also played a role in the cumulative impact of wetland functional loss. (Fizzell, 2007)

Current threats to wetlands include filling or draining to accommodate industrial, residential, agricultural or recreational land uses. Altered hydrology is a significant threat to most wetland types, whether it is due to a change in groundwater contributions to a fen or diversion of the water that feeds a swamp or marsh due to new road construction. Exotic species invasion, altered fire regime and polluted runoff with sediment, nutrients and chemicals also threaten wetlands.

5.6 Floodplains

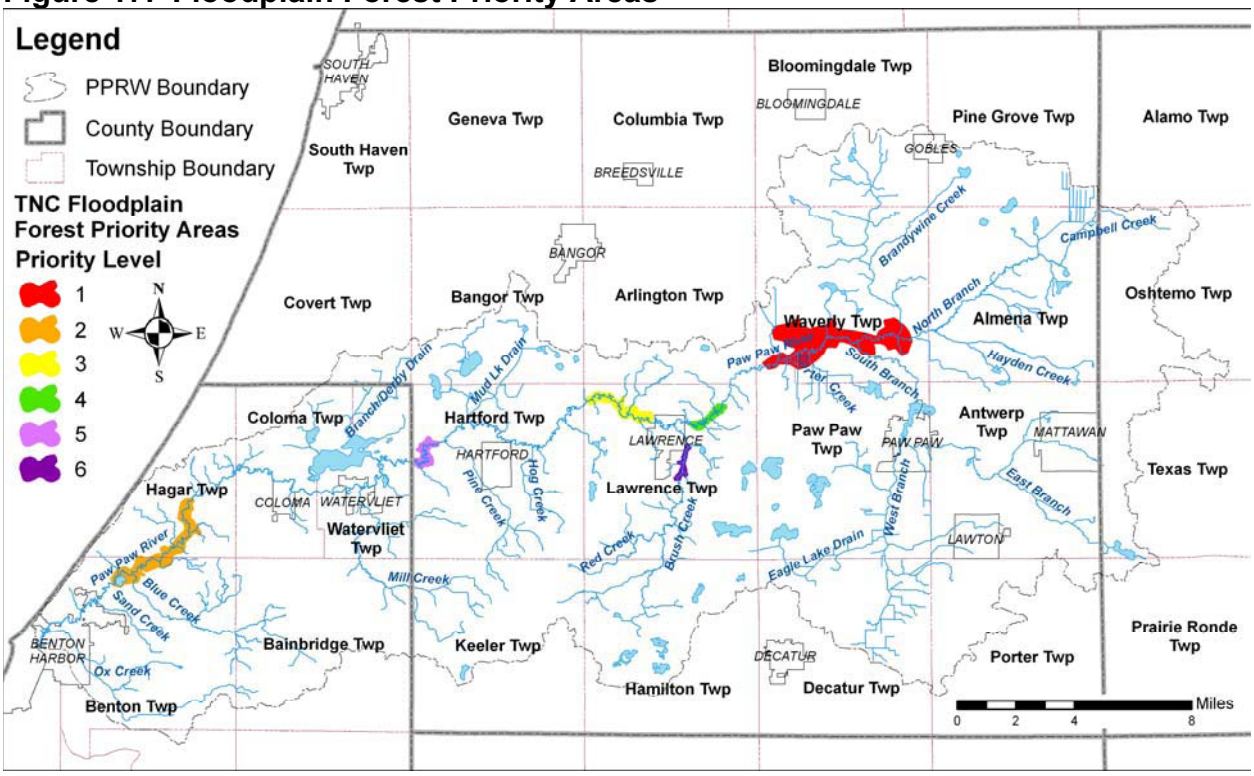
A river, stream, lake, or drain may on occasion overflow their banks and inundate adjacent land areas. The land that is inundated by water is defined as a floodplain. In Michigan, and nationally, the term floodplain has come to mean the land area that will be inundated by the overflow of water resulting from a 100-year flood (a flood which has a 1% chance of occurring any given year). Often, floodplains are forested with silver maple (Acer saccharinum) and red ash (Fraxinus pennsylvanica) being the major over-story dominant trees. These dynamic forested systems represent an interface between terrestrial and aquatic ecosystems and are extremely valuable for storing floodwaters, allowing areas for sediment to settle and providing wildlife habitat.

The forested floodplain along the Paw Paw River from Sarett Nature Center to the Paw Paw River Preserve in Waverly Township is largely intact.

The forested floodplain along the Paw Paw River from Sarett Nature Center to the Paw Paw River Preserve in Waverly Township is largely intact. This intact forest is important for migratory birds. Bird species of interest along the mainstem include the Prothonotary warbler (Protonotaria citrea), Wood thrush (Hylochichla mustelina) and the Cerulean warbler (Dendroica cerulea). For general information on floodplain forests visit www.swmpc.org/downloads/floodplain_forest.pdf.

For more specific information, a report on the prioritization of forested floodplain areas in the PPRW completed by The Nature Conservancy in 2006 is available online at www.swmpc.org/downloads/pprw_tnc_floodplain.pdf. Figure 17 is from the TNC report.

Figure 17. Floodplain Forest Priority Areas



Threats

Current threats to floodplains include conversion to industrial, residential, or recreational uses, wetland or floodplain fill or drainage, exotic species invasion, chemical pollution, sedimentation, and nutrient loading from agriculture and other land uses. Almost all rivers and their floodplains are subject to multiple hydrologic alterations, such as changes in land use, human-made levees, impoundments, channelization, and dams. The Nature Conservancy stated in the 2006 prioritization floodplain forest report, “even at the best floodplain forest sites, there is a serious threat from invasive species, because the forests here have extensive boundaries along agricultural lands offering numerous routes for invasion. Additional buffering of these core floodplain forest areas with more native upland forest would benefit them.”

5.7 Groundwater

Groundwater is the water that saturates the tiny spaces between soil and rock. Most groundwater is found in aquifers, which are underground layers of porous rock that are saturated from above or from structures sloping toward it. For water to reach the aquifer, it must be able to infiltrate through the soil.

Groundwater and surface water are fundamentally interconnected. In fact, it is often difficult to separate the two because they "feed" each other. Aquifers feed streams and provide a stream's baseflow. Those streams with a high baseflow are often coldwater streams. Often groundwater can be responsible for maintaining the hydrologic balance of streams, springs, lakes and wetlands.

Most of the PPRW is underlain with Coldwater Shale bedrock, which contains no aquifers. The only groundwater source is the water located in the coarse textured drift material left by the glaciers. These glacial sources typically yield high amounts of groundwater (20-1,400 gallons per minute) and are very vulnerable to groundwater pollution.

Overall, groundwater in southwest Michigan is very vulnerable to groundwater pollution.

Threats

Increased groundwater withdrawal to meet the demands of a growing population is a threat. Despite a general abundance of groundwater in the PPRW, there is growing concern about the availability of good quality groundwater for municipal, industrial, agricultural and domestic use, and for adequate baseflow to our lakes, streams and wetlands. Increased withdrawal can cause groundwater overdraft, which occurs when water removal rates exceed recharge rates. This depletes water supplies and may even cause land subsidence (the gradual settling or sudden sinking of the land surface from changes that take place underground).

In addition to groundwater withdrawals, increases in impervious surface and soil compaction limit infiltration and reduce groundwater recharge. These land use changes along with improvements in drainage efficiency (adding drain tiles, storm drains and ditches) further reduce groundwater recharge (see figure 18). The reduction in infiltration alters the hydrology of surface water causing increased flooding and streambank erosion.

Groundwater contamination can often be linked to land use. What goes on the ground can seep through the soil and turn up in drinking water, lakes, rivers, streams and wetlands. Activities in urban areas that pose significant threats to groundwater quality include industrial and municipal waste disposal, road salting, and the storage of petroleum products and other hazardous materials. In rural areas, different threats to groundwater quality exist such as animal waste, septic systems, fertilizers and pesticides. Table 10 lists common groundwater contaminant sources. Table 11 lists known areas of groundwater contamination in the PPRW.

Figure 18. Effects of Impervious Cover

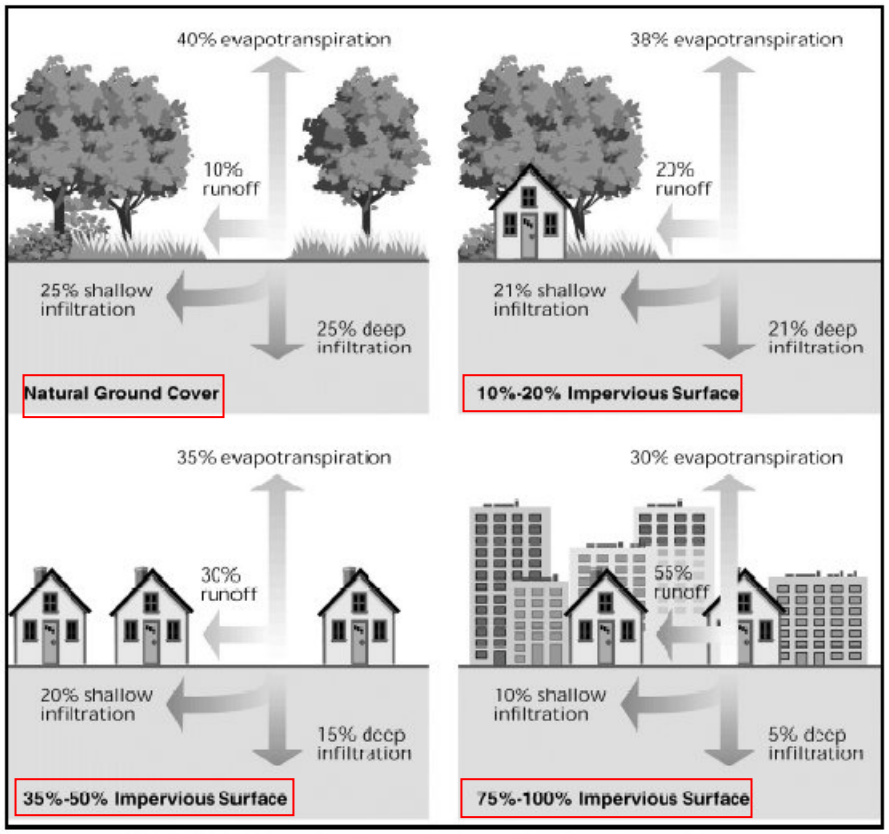


Table 10. Common Groundwater Contaminant Sources

Source	Contaminant	Source	Contaminant
Salting practices & storage	Chlorides	Solid waste landfills	Hazardous materials, Metals
Snow dumping	Chlorides	Industrial uses	Hazardous materials
Agricultural fertilizers	Nitrates	Households	Hazardous materials
Manure handling	Nitrates, pathogens	Gas stations	Hydrocarbons, Solvents
Home fertilizer	Nitrates	Auto repair shops	Hydrocarbons, Solvents
Septic systems	Nitrates, pathogens	Recycling facilities	Hydrocarbons, Solvents
Urban landscapes	Hydrocarbons, pesticides, pathogens	Auto salvage yards/junk yards	Hydrocarbons, Solvents
Agricultural dealers	Hydrocarbons, pesticides, nitrates	Underground storage tanks	Hydrocarbons
Agricultural feedlots	Nitrates, pathogens	Industrial floor drains	Hydrocarbons, Solvents

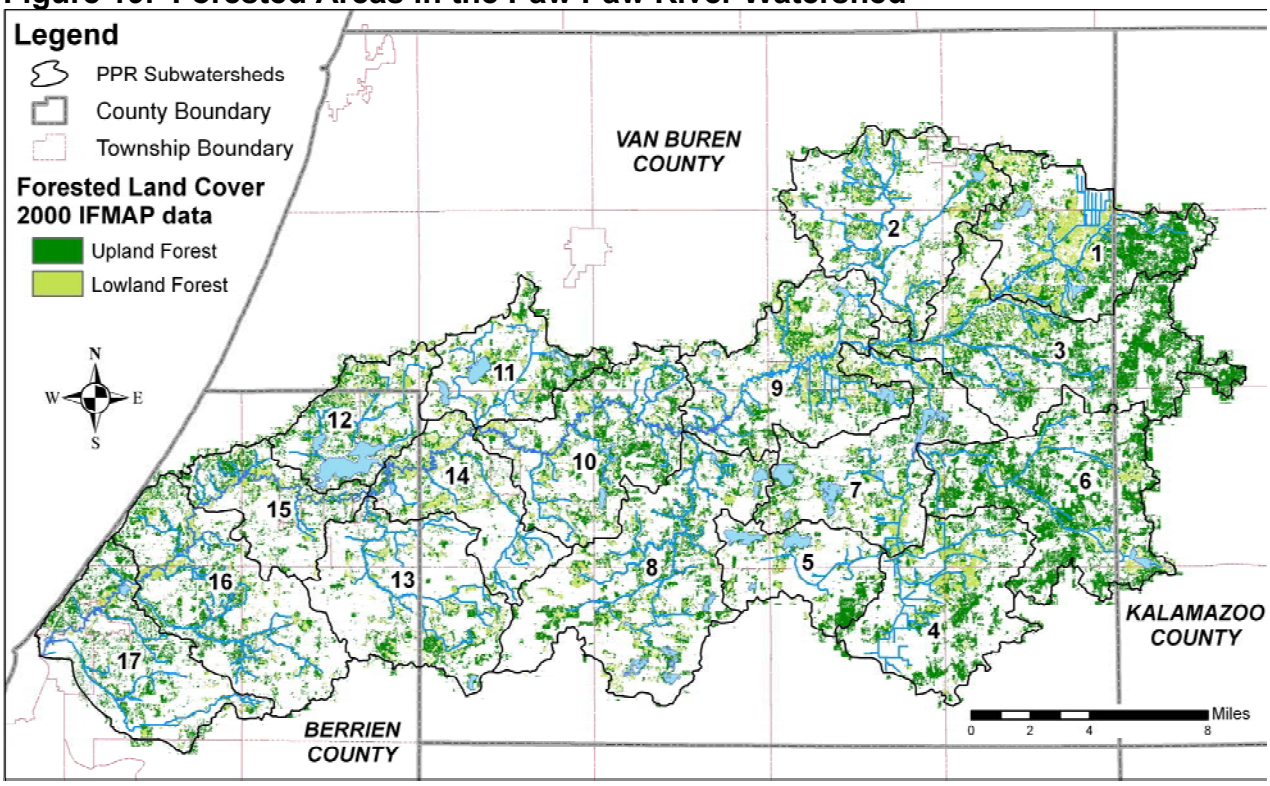
Table 11. Known Groundwater Contamination Areas

Area	Contaminant	Source
Coloma Township area	Dacthal®, a pre-emergent herbicide	Unknown
Ox Creek	trichloroethylene and hexavalent chromium	Harbor Plating, an abandoned chrome plating company
Oshtemo Township area	organic compounds, including chloroform, trichloroethylene, and perchloroethylene	West KL Avenue Landfill Superfund Site
Hartford	Heavy metals such as chromium, lead, and nickel	Burrows Sanitation Superfund Site
Benton Harbor	VOCs trichloroethene (TCE) and tetrachloroethene (PCE) and their breakdown products: 1,1-dichloroethene (1,1-DCE), vinyl chloride, and cis-1,2-dichloroethene (cis-1,2-DCE)	Aircraft Components Superfund Site

5.8 Forests

Forest lands protect rivers and streams and provide habitat for many species. Forest tress and the underlying organic humus layer intercept and help to infiltrate rainfall runoff contributing to the stability of the hydrologic cycle. According to Figure 19, the most intact forested areas are located along streams and rivers and in the PPRW headwaters area. Woodlands of southern Michigan that are dominated by beech and sugar maple also contain red oak, basswood, white ash, tulip tree, black cherry, black walnut and bitternut hickory. Upland forests on drier soils are generally an oak and hickory composition with black, red, white, and bur oaks, shagbark and pignut hickories, black cherry, black walnut and red maple.

Figure 19. Forested Areas in the Paw Paw River Watershed



Threats

The largest threats to natural forest communities in the PPRW are continued fragmentation and invasive species (e.g., garlic mustard). Fragmentation often results in nest predation and nest parasitism (mainly by cowbirds), which accounts for population declines of forest birds, especially neotropical migrants. Fragmentation also increases the ability of invasive species to penetrate forested areas. Invasive species can disrupt the forest's role in managing water and the hydrologic cycle. For more information on forests visit www.swmpc.org/downloads/mesic_southern_forest.pdf.

5.9 Savanna and Prairie Remnants

The PPRW has oak savanna and prairie remnants. Southwest Michigan is part of the tallgrass prairie region, which is dominated by grasses such as big bluestem and Indian grass. The tallgrass prairie vegetation sometimes reaches a height of 10 feet or more. Oak savannas, characterized by a grassy prairie-type ground cover underneath an open tree canopy, are common in areas that border the prairies. Prairies and oak savannas are fire-dependent systems.

Oak savanna and prairies support many species such as the Eastern box turtle and the Great Plains spittlebug. These systems in the PPRW also support plants that are rare in Michigan and indicative of high-quality savannas, including Rattlesnakemaster, prairie coreopsis, sand grass, and black haw. The savannas with their native plants play an integral part of the hydrologic cycle by providing areas where water can easily infiltrate the soil. For more information on oak savannas visit www.swmpc.org/downloads/oak_barrens.pdf.

Threats

The largest threat to savanna areas is the conversion to developed uses. Developing these natural areas can disrupt the natural water infiltration capacity of these areas. In addition, invasive alien plants have become extensively established in oak savanna and prairie remnants. These aggressive species are encouraged by the conversion of open lands to homes. Development creates large amounts of disturbed open ground and roadways that are new invasion routes for invasive species. Increased human recreational and other activities connected to development also tend to spread invasive plants' seeds further into natural areas. Suppression of natural fire regimes in developed areas further encourages the dominance of invasive over native plants, which are often adapted to recurring fire. Invasive plant species can actually result in reduced groundwater recharge, which disrupts the hydrologic cycle.

5.10 Rare Features

A variety of rare species and communities have been documented in the PPRW. The Michigan Natural Features Inventory (MNFI) maintains a list of threatened, endangered, and special concern species/communities in Michigan. Twenty-three species of animals, 46 species of plants, 7 communities, and one "other" element (Great Blue Heron Rookery) are listed as either federally endangered, a candidate for federal status under the Endangered Species Act of 1998, state special concern, state threatened, state endangered or probably extirpated for the PPRW. The list of species and communities can be found in Appendix 5.

Threats

The major threat to rare species and features is habitat loss and fragmentation. As natural habitats become more fragmented and disrupted, invasive species can be accidentally or deliberately introduced into high quality habitat areas. Invasive species can displace or eliminate native species, particularly rare species that have specific habitat requirements. Invasive species can substantially alter the structure and functioning of high quality natural communities including an alteration of the amount of water that is infiltrated. Further, new construction can affect groundwater infiltration rates and consequently reduce the amount of water discharging from a spring. An altered hydrologic cycle can change the conditions necessary for the continued health of rare species populations and some natural communities such as prairie fens.