5.0 Watershed Inventory Summary

Early in 2012, Applied Ecological Services, Inc. (AES) completed a field inventory of Pike River and its tributaries, existing best management practices (BMPs), ravines, brownfields, and wetlands. Additional data regarding agricultural land, floodways, flood problem areas, and groundwater resources within the watershed were also compiled.

5.1 Pike River & Tributaries

North Branch Pike River, South Branch Pike River, and Pike River are the primary streams in Pike River watershed with 30 tributary streams accounting for approximately 62.2 stream and tributary miles. Pike River begins in the north western portion of the watershed and generally flows south for 6.9 miles before joining South Branch Pike River near the intersection of State Highway 31 and County Trunk Highway A. South Branch Pike River begins in the southwest portion of the watershed, south of the Kenosha Regional Airport and generally flows north for about 7.8 miles before joining Pike River. After the confluence of North Branch and South Branch, Pike River flows east and then south for approximately 9.6 miles to Lake Michigan.

Early in 2012, Applied Ecological Services, Inc. (AES) completed a field inventory of Pike River and its tributaries. All streams and tributaries were assessed based on divisions into "Stream Reaches" (Table 15; Figure 41). Reaches are defined as stream segments having similar hydraulic, geomorphic, riparian condition, and adjacent land use characteristics. Methodology included walking all or portions of the stream reaches, collecting measurements, taking photos, and noting channel, streambank, and riparian corridor conditions. The conditions of each reach of the Pike River were often dictated by the condition of the adjoining tributaries. Numerous municipal stormwater point discharges were also encountered during the inventory but were not surveyed due to time and budget constraints. The direct drainage area contains no streams or tributaries due to the developed nature of that portion of the watershed. Any previous drainage patterns were altered during the

Pike River in Petrifying Springs Park

development of the City of Racine and now all drainage consists of stormwater piped infrastructure directly outletting to Lake Michigan. Detailed notes were also recorded related to potential Management Measure recommendations and their corresponding priority for eventual inclusion into the Action Plan section of this report. Results of the inventory and data sheets summarizing each stream reach can be found in Appendix B.

Table 15. Summary of stream and tributary reaches and length.

Stream or Tributary Name	Code	Number of Reaches	Stream Length Assessed (ft)	Stream Length Assessed (mi)
North Branch and Pike River	PR	17	86,268.0	16.3
South Branch Pike River	PC	7	41,059.0	7.8
Airport Branch Tributary of South Branch	PCAB	3	8,168.7	1.5
Bartlett Branch Tributary of North Branch	PRBB	1	13,171.5	2.5
Chicory Creek Tributary of North Branch	PRCC	2	11,357.1	2.2
Kenosha Branch Tributary of Pike River	PRKB	1	4,852.2	0.9
Lamparek Ditch Tributary of North Branch	PRLD	1	14,460.5	2.7
Nelson Creek Tributary of Pike River	PRNC	1	12,048.0	2.3
School Tributary of South Branch	PCST	1	18,138.9	3.4
Somers Branch of South Branch	PCSB	1	13,330.2	2.5
Somers Branch Tributary A	PCSBA	1	6,295.5	1.2
Sorenson Creek Tributary of Pike River	PRSC	1	15,400.8	2.9
Waxdale Creek Tributary of North Branch	PRWC	1	11,371.2	2.2
Unnamed Tributary of Pike River A	PRTA	1	0	0
Unnamed Tributary of Pike River B	PRTB	1	2,598.0	0.5
Unnamed Tributary of Pike River C	PRTC	1	2,473.4	0.5
Unnamed Tributary of Pike River D	PRTD	2	14,446.0	2.7
Unnamed Tributary of Pike River E	PRTE	1	4,594.1	0.9
Unnamed Tributary of Pike River F	PRTF	1	5,338.3	1.0
Unnamed Tributary of Pike River G	PRTG	1	0	0
Unnamed Tributary of Pike River H	PRTH	1	8,753.5	1.7
Unnamed Tributary of Pike River I	PRTI	1	1,638.9	0.3
Unnamed Tributary of Pike River J	PRTJ	1	865.3	0.2
Unnamed Tributary of Pike River K	PRTK	1	0	0
Unnamed Tributary of Pike River L	PRTL	1	1,660.4	0.3
Unnamed Tributary of Pike River M	PRTM	1	5,525.8	1.0
Unnamed Tributary of Pike River N	PRTN	1	2,209.6	0.4
Unnamed Tributary of Pike River O	PRTO	1	6,406.4	1.2
Unnamed Tributary of South Branch P	PCTP	1	1,475.1	0.3
Unnamed Tributary of South Branch Q	PCTQ	1	4,638.4	0.9
Unnamed Tributary of South Branch R	PCTR	2	7,947.2	1.5
Unnamed Tributary of South Branch S	PCTS	1	2,056.0	0.4
Totals		**59**	**328,547.9**	**62.2**

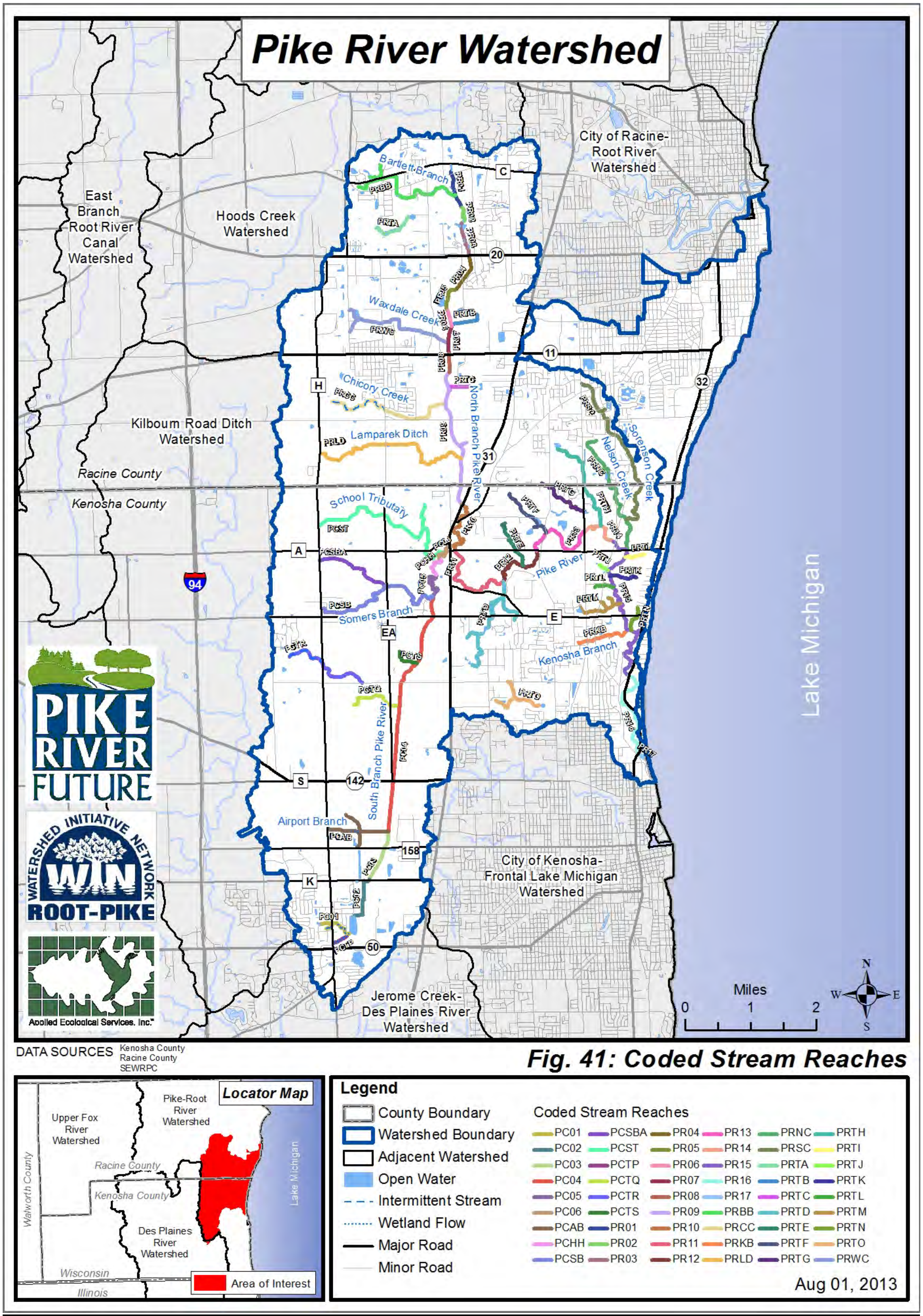


Fig. 41: Coded Stream Reaches

North Branch and Pike River

North Branch Pike River and Pike River (Reach Code PR) were divided into 17 distinct reaches flowing for 16.5 linear miles south/east from the headwaters near County Trunk Highway C to Lake Michigan (Table 15; Figure 41). The majority of the headwaters to KR County Line Rd is owned or under permanent easement and managed by the Village of Mount Pleasant and is part of a large, long-term restoration project begun in 2001. The Pike River Improvements Project has been laid out in nine phases beginning at the headwaters and working its way south. Goals of the project include flood control, removal of properties and structures from the floodplain, ecological and habitat restoration, and recreational corridor development. Phases 1 through 6, which include the first seven reaches of North Branch Pike River and extend approximately 0.5 miles south of State Highway 11, have been completed with phases 6 through 9 progressing to KR still ongoing.

The upper reaches of North Branch Pike River (PR01 through PR05) are bordered by areas of turf, prairie, and wetland areas. Although these reaches are highly channelized, erosion is fairly low in these areas as a result of much of the restoration work that has been done. The channel is roughly 3 to 5 feet wide through these stretches. The channel bottom is comprised of silt and sediment accumulation is low in these reaches. Debris jams are generally not an issue, with the exception of reach PR03. Lower reaches show some invasion by reed canary grass. Reach PR02 is the most sinuous of these upper reaches as it winds its way through a wetland complex, greatly slowing down the flow of the water and reducing downstream erosion.


North Branch Headwaters (PR01)


North Branch Reach 3 (PR03)


North Branch Reach 5 (PR05)

Reaches PR06 and PR07 are bordered by a mix of wetland and old field areas. Conditions of the channel here are similar to the first five reaches with the exception that Reach 6 exhibits moderate levels of erosion. Both reaches show an extensive reed canary grass invasion that needs to be controlled. Reach 7 includes a stretch of land that might be suitable to allow the stream to overtop its banks. Reach PR08 had recently undergone restoration including regarded slopes, riffles, and plantings as part of the Pike River Improvement Project at the time AES completed the field inventory.

Reach PR09 includes a long stretch of the river that runs through agricultural fields and ends where State Highway 31 crosses the Pike River. This reach is highly channelized, with spoil piles on both sides of the banks and moderate levels of erosion throughout. The banks include a very narrow buffer area which is invaded by willows and reed canary grass and the channel is 4 to 6 feet wide.

Between State Highway 31 and County Trunk Highway A lies reach PR10, the last reach of North Branch Pike River before the confluence of South Branch Pike River and Pike River. The riparian area throughout this reach is wooded on both sides of the stream. This reach exhibits no channelization and the stream here is very sinuous, but suffers from excessive amounts of erosion with the banks reaching heights of six feet above the water level in some areas as well as heavy debris loads from fallen trees.



North Branch Reach 8 (PR08) *North Branch Reach 9 (PR09)* *North Branch Reach 10 (PR10)*

Pike River Reach 11 runs the length of Petrifying Springs Park and Reach 12 runs from the end of Petrifying Springs Park to Berryville Road within the University of Wisconsin – Parkside campus. Within PR11, the stream meanders its way south along the western edge of the park and then east along the southern edge. The channel here is about 8 feet wide and the channel bottom changes at this point from being all silt to a mix of silt and sand. The riparian cover is made up of wooded areas with some invasive species present, turf and impervious surfaces. Some erosion control efforts are obvious in some areas, but others areas require stabilization work. This reach exhibits moderate levels of erosion along its banks and low sediment accumulation overall, but there are large variations in bank height due to both the erosion control efforts and the way the stream meanders through the park. Some debris jams are present. The conditions of PR12 and PR13 are very similar to PR11 except the riparian cover for PR12 is made up of mostly wooded land with some wetlands present and reed canary grass has invaded much of the wetland areas, while PR13's riparian cover is a mix of woodland and agricultural fields.

The removal of a dam within Petrifying Springs Park along Pike River Reach 11 was completed late in 2012. The dam was built in 1936, but is no longer being used for its original purpose of irrigating neighboring grounds. Dam removal will allow for fish passage along Pike River as well as alleviate flooding within the park.

Dam at Petrifying Springs prior to removal in 2012.

At Reach 14 the dominant channel substrate changes to mostly sand and remains so as the stream makes its way to the Lake Michigan. Reach 14 runs through the Kenosha Country Club golf course and exhibits moderate levels of erosion and little channelization. No pools or riffles are apparent and both sediment accumulation and debris jams are low. The banks on both sides of the stream for the majority of this reach are mowed turf grass with no other riparian cover.

The Pike River from the Kenosha Country Club golf course to State Highway 32 makes up Reach 15. This reach is moderately channelized and highly eroded with no pool or riffle development.

The channel is approximately 12 feet wide and the riparian cover is made up of a mix of agricultural fields, wooded areas, and mowed turf grass, with many woody non-native species present.

Reach 16 includes the section of the Pike River within Carthage College. Here the channel extends to about 15 feet wide. Bank height and erosion levels vary throughout this section of the reach with some highly eroded sections apparent. Many invasive woody species are present here and debris jams are moderate, mostly from fallen trees within the stream. No riffles were observed and the riparian cover consists mostly of mowed turf grass, with some wetland and wooded areas. In addition, reach 16 and 17 act as an estuary to Lake Michigan.

Pike River Reach 11 (PR11)

Pike River Reach 14 (PR14)

Pike River Reach 16 (PR16)

The last reach of Pike River is Reach 17, which extends from the bridge across State Highway 32 at the southern most boundary of Carthage College to the mouth of the Pike at Lake Michigan. PR17 is moderately channelized and eroded. There are noticeable dredge spoils on either side of the banks which act as levees. The right bank exhibits more erosion due to the riparian cover of turf and impervious cover along the bank as opposed to the left bank which consists more of beach cover. There is quite a bit of sediment accumulation where the mouth connects with Lake Michigan as it receives sediment coming in from the lake due to tidal movement as well as the sediment transported from upstream reaches.

Pike River Reach 17 (PR17). LEFT: Facing upstream toward bridge, RIGHT: The mouth of the Pike at Lake Michigan.

South Branch Pike River

South Branch Pike River (Reach Code PC) begins south of the Kenosha Regional Airport near the intersection of State Highway 50 and County Trunk Highway H in the City of Kenosha and flows north northeast for 7.8 miles before joining Pike River immediately west of Petrifying Springs Park

(Table 15; Figure 41). Six different Reaches (PC01-PC04, PCHH, and PC06) were delineated along South Branch Pike River.

The first small reach of South Branch Pike River (PC01) flows from a wetland complex and is moderately channelized. Streambank erosion and sediment deposition are minimal but the riparian area is small and dominated by invasive plant species or weedy natives, including reed canary grass, box elder, phragmites, and cattails.

South Branch Reach 2, 3, and 4 (PC02, PC03, and PC04) run from Reach 1 to the boundary of the Hawthorn Hollow Nature Sanctuary and are highly channelized with spoil piles evident on both banks and no riffles within the channel. The channel width is about 4 feet with a bottom comprised of silt. The banks are dominated by reed canary grass and the riparian cover includes wetlands, agricultural fields, turf grass, and pavement. Reach 3 has moderate erosion and has high debris loads from fallen trees, while Reach 4 has excessive erosion with bank heights as high as six feet.

The Hawthorn Hollow Reach of South Branch (PCHH) and South Branch Reach 6 (PC06), unlike the southern reaches of South Branch are not channelized. PCHH and PC06 are both highly eroded and have moderate levels of both sedimentation and debris jams. The channel bottom here consists of a mix of gravel and cobble with a width of 12 to 15 feet and the riparian area is entirely wooded.


South Branch Reach 3 (PC03)


South Branch Reach 4 (PC04)


Hawthorn Hollow Reach (PCHH)

Tributary Streams
Thirty tributary streams join Pike River (Table 15; Figure 41). Together these tributaries total approximately 39.2 miles. Named tributaries of the North Branch and Pike River include Bartlett Branch, Chicory Creek, Kenosha Branch, Lamparek Ditch, Nelson Creek, Sorenson Creek, and Waxdale Creek. Named tributaries of South Branch Pike River include Airport Branch, School Tributary, and Somers Branch. North Branch, South Branch, and Pike River all have additional unnamed tributaries that were labeled as lettered tributaries for ease of reference. Major tributaries are summarized below (see Appendix B for data sheets summarizing all labeled tributaries).

The Bartlett Branch tributary of North Branch (PRBB) is the northwestern most tributary. The immediate area is dominated by turf grass with patches of wetlands and wooded areas. The stream is fairly channelized with a silt bottom and ranges from 2 to 4 feet wide. Erosion here is low, as is sediment accumulation. No pools or riffles are present in the stream and the banks are dominated by reed canary grass.

Waxdale Creek (PRWC), another tributary, is located in the northwestern portion of the watershed and is listed as an impaired stream by the EPA for high amounts of sedimentation and degraded habitat. The channel is 2 to 6 feet wide with a silt substrate. Both channelization and bank erosion are moderate for this stream as well as moderate debris loading in the channel. The riparian cover is mostly wooded with turf and wetland areas also present. One industrial point source was noted on this tributary – S.C. Johnson & Son Inc., located in Mt. Pleasant. The plant discharges to Waxdale Creek. In 1983, a toxic spill resulted in aquatic toxicity and fish kills along Waxdale Creek and the adjoining section of the North Branch. No other fish kills have been noted for this location and the pollutants have since been removed.

Chicory Creek (PRCC) and Lamparek Ditch (PRLD) both join North Branch Pike River along North Branch Reach 9. Both tributaries are highly channelized, have a silt bottom and little sediment accumulation or debris jams. Chicory Creek varies in width from 0.5 to 10 feet wide, widening as it moves downstream, with no erosion upstream, but moderate levels downstream. The riparian area consists of residential lawns, wooded areas, and agricultural fields. Lamparek Ditch has low levels of erosion and a small wooded buffer area with agricultural fields dominating beyond. Channel width is between 2 and 3 feet here.

Barlett Branch (PRBB)

Waxdale Creek (PRWC)

Chicory Creek (PRCC)

On the eastern side of the watershed there are three named tributaries that feed into the Pike River: Nelson Creek, Sorenson Creek, and Kenosha Branch. Nelson Creek is moderately channelized with no pools or riffles. Both the degree of erosion and sediment accumulation for this tributary are low. Moderate levels of debris jams are present and the riparian cover is comprised of a mix of wooded areas, wetlands, row crops, and turf grass.

Sorenson Creek and Kenosha Branch are both moderately channelized and show moderate levels of erosion with a silt bottom. The channel width of both tributaries is between 3 and 6 feet and both exhibit a moderate level of sediment accumulation. Kenosha Branch has a few more pools and riffles than does Sorenson Creek. The riparian cover of Sorenson Creek is mostly wooded with some turf grass sections while the riparian cover of Kenosha Branch is fairly evenly split between wooded, turf grass, and wetland areas.

Nelson Creek (PRNC)

Sorenson Creek (PRSC)

Kenosha Branch (PRKB)

School Tributary, Somers Branch, and Airport Branch are all tributaries of South Branch Pike River in the western and southern portions of the watershed. Somers Branch is moderately channelized with low levels of erosion and sediment accumulation. The channel width is fairly narrow (1 to 2 feet wide) and the dominant substrate is silt. The riparian cover for this reach is predominantly row crops with turf grass and wooded patches making up the balance. Somers Branch has a heavy debris load and the banks are dominated with cattails and reed canary grass.

School Tributary and Airport Branch are both highly channelized, with spoil piles present on both banks of School Tributary. Both exhibit moderate levels of erosion, with no sinuosity or riffle-pool development. Both tributaries also have a silt channel bottom and have low amounts of debris jams and sediment accumulation. The riparian cover of School Tributary is entirely agricultural land with a very small buffer made mostly of reed canary grass. Airport Branch's riparian cover is mostly old field with turf grass and wooded areas filling out the balance.

School Tributary (PCST)

Somers Branch (PCSB)

Airport Branch (PCAB)

Stream Channelization

A pool and riffle sequence in a natural channel refers to the deeper and shallow portions of the channel bottom, respectively. Pools typically develop in the outside of the bend, and riffles between the bends. Riffles and pools are generally associated with naturally meandering streams and benefit the system by providing various habitats while oxygenating the water during low flow or summer heat. Channelized or ditched streams are often void of or have low quality riffles and pools. Berms are also common along channelized streams where landowners typically spoiled soils excavated from the channel. These spoil piles act as a levee and often inhibit natural flooding into adjacent floodplains. All stream reaches in the watershed were characterized as having none to low channelization (highly sinuous, no human disturbance), moderate channelization (some sinuosity but altered), or high channelization (straightened by humans).

Channelization along North Branch Reach 4 (PR04)

According to the stream inventory, 20% (64,809 lf) of stream and tributary length is naturally meandering; approximately 43% (142,836 lf) is moderately channelized; and 37% (120,903 lf) is highly channelized. The most severe channelization is found along North Branch north of State Highway 20 and running south to State Highway 31 (PR03 – PR09, with the exception of PR05), then along South Branch from just southeast of the junction of State Trunk Highways K and H to where it is joined by the Somers Branch. Additionally, several tributaries are highly channelized including Airport Branch, Chicory Creek, School Tributary, Somers Branch, and Unnamed Tributaries B, C, J, L, M, Q, and R.

Channelized areas present opportunities for Management Measure projects such as artificial riffle and pool restoration and regrading or breaking of adjacent spoil piles for reconnection of the stream to adjacent floodplains. Table 16 and Figure 42 summarize and depict the location and severity of channelized stream and tributary reaches in the watershed. The Action Plan section of this report addresses opportunities for improving many of these channelized stream reaches.

Table 16. Degree of stream and tributary channelization.

Stream or Tributary Name	Code	Stream Length Assessed (ft)	None or Low Channelization (ft/%)		Moderate Channelization (ft/%)		High Channelization (ft/%)	
North Branch and Pike River	PR	86,268.0	35,166.4	40.8%	28,187.7	32.7%	22,913.9	26.6%
South Branch Pike River	PC	41,059.0	9,127.1	22.2%	3,611.5	8.8%	28,320.4	69.0%
Airport Branch Tributary of South Branch	PCAB	8,168.7					8,168.7	100.0 %
Bartlett Branch Tributary of North Branch	PRBB	13,171.5			13,171.5	100.0%		
Chicory Creek Tributary of North Branch	PRCC	11,357.1					11,357.1	100.0 %
Kenosha Branch Tributary of Pike River	PRKB	4,852.2			4,852.2	100.0%		
Lamparek Ditch Tributary of North Branch	PRLD	14,460.5			14,460.5	100.0%		
Nelson Creek Tributary of Pike River	PRNC	12,048.0			12,048.0	100.0%		
School Tributary of South Branch	PCST	18,138.9					18,138.9	100.0 %
Somers Branch of South Branch	PCSB	13,330.2			13,330.2	100.0%		
Somers Branch Tributary A	PCSB A	6,295.5					6,295.5	100.0 %
Sorenson Creek Tributary of Pike River	PRSC	15,400.8			15,400.8	100.0%		
Waxdale Creek Tributary of North Branch	PRWC	11,371.2			11,371.2	100.0%		
Unnamed Tributary of Pike River A	PRTA	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River B	PRTB	2,598.0					2,598.0	100.0 %
Unnamed Tributary of Pike River C	PRTC	2,473.4					2,473.4	100.0 %
Unnamed Tributary of Pike River D	PRTD	14,446.0	14,446.0	100.0%				
Unnamed Tributary of Pike River E	PRTE	4,594.1	4,594.1	100.0%				
Unnamed Tributary of Pike River F	PRTF	5,338.3			5,338.3	100.0%		
Unnamed Tributary of Pike River G	PRTG	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River H	PRTH	8,753.5			8,753.5	100.0%		
Unnamed Tributary of Pike River I	PRTI	1,638.9			1,638.9	100.0%		
Unnamed Tributary of Pike River J	PRTJ	865.3					865.3	100.0 %
Unnamed Tributary of Pike River K	PRTK	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River L	PRTL	1,660.4					1,660.4	100.0 %
Unnamed Tributary of Pike River M	PRTM	5,525.8					5,525.8	100.0 %

Stream or Tributary Name	Code	Stream Length Assessed (ft)	None or Low Channelization (ft/%)		Moderate Channelization (ft/%)		High Channelization (ft/%)	
Unnamed Tributary of Pike River N	PRTN	2,209.6			2,209.6	100.0%		
Unnamed Tributary of Pike River O	PRTO	6,406.4			6,406.4	100.0%		
Unnamed Tributary of South Branch P	PCTP	1,475.1	1,475.1	100.0%				
Unnamed Tributary of South Branch Q	PCTQ	4,638.4					4,638.4	100.0 %
Unnamed Tributary of South Branch R	PCTR	7,947.2					7,947.2	100.0 %
Unnamed Tributary of South Branch S	PCTS	2,056.0			2,056.0	100.0%		
Totals		**328,547.9**	**64,808.7**	**19.7%**	**142,836.3**	**43.5%**	**120,903.0**	**36.8%**

*N/A denotes stream reaches for which no assessment was made.

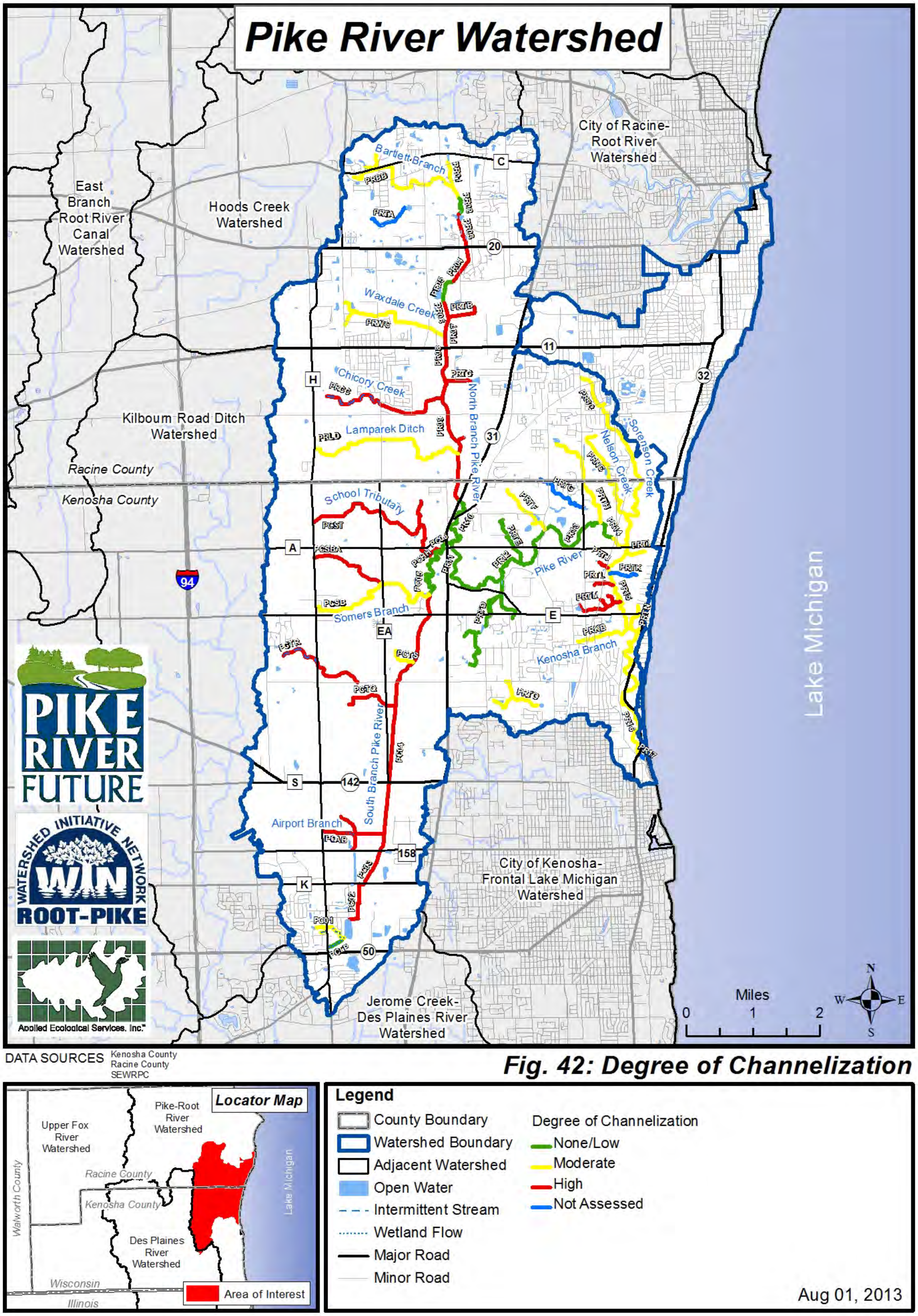


Fig. 42: Degree of Channelization

Streambank Erosion

Although some erosion is a natural stream process, significant streambank erosion generally results following an instability in flow rate or volume in the stream channel, human alteration such as channelization, or change in streambank vegetation. Resulting in stream sediment accumulation and transport downstream can cause significant water quality problems. Streambank erosion in the Pike River Watershed is moderate on average and is a reflection of land use changes resulting in increased impervious cover and stormwater runoff in the watershed. Watershed data indicates that streambank erosion is one of the leading causes of sedimentation in the watershed.

Over the years, Pike River and its tributaries have been channelized, impervious surfaces have increased, and the floodplain has been altered to the extent that the river now takes on larger volumes of water at higher rates with less stream length than it did historically. The photos below, taken at roughly the same location along South Branch at Hawthorn Hollow over seventy years apart depict not only the advances of erosion over time, but the increased channel width and downcutting as well. The riparian area has also been filled in by second growth opportunistic trees and shrubs that historically would have been managed through natural processes such as fire and periodic flooding.

South Branch in Hawthorn Hollow Nature Sanctuary - LEFT: a 1940 photo, courtesy Hawthorn Hollow Nature Sanctuary. RIGHT: the same location in 2012.

Excessive erosion along part of South Branch Reach 4

Approximately 41% (133.907 lf) of the total stream and tributary length exhibits no or low bank erosion while moderate erosion is occurring along 54% (179,236 lf) of streambanks. Highly eroded streambanks are observed along Pike River between State Highway 31 and County Trunk Highway A (PR10) and along the last three reaches of South Branch before it joins Pike River (PC05, PCHH, and PC06) accounting for 5% (15,404 lf) of the total stream length. These reaches are considered "Critical Areas" because they are actively contributing significant sediment loads downstream.

All highly eroded and some moderately eroded streambanks provide excellent opportunities for streambank stabilization projects. The location and severity of streambank erosion in the watershed is summarized in Table 17 and depicted on Figure 43. The Action Plan section of this report addresses and prioritizes opportunities for reducing streambank erosion.

Table 17. Degree of stream and tributary bank erosion.

Stream or Tributary Name	Code	Stream Length Assessed (ft)	None or Low Erosion (ft/%)		Moderate Erosion (ft/%)		High Erosion (ft/%)	
North Branch and Pike River	PR	86,268.0	16,972.9	19.7%	63,018.0	73.0%	6,277.1	7.3%
South Branch Pike River	PC	41,059.0	7,683.4	18.7%	24,248.5	59.1%	9,127.1	22.2%
Airport Branch Tributary of South Branch	PCAB	8,168.7	8,168.7	100.0%				
Bartlett Branch Tributary of North Branch	PRBB	13,171.5	13,171.5	100.0%				
Chicory Creek Tributary of North Branch	PRCC	11,357.1			11,357.1	100.0%		
Kenosha Branch Tributary of Pike River	PRKB	4,852.2			4,852.2	100.0%		
Lamparek Ditch Tributary of North Branch	PRLD	14,460.5	14,460.5	100.0%				
Nelson Creek Tributary of Pike River	PRNC	12,048.0	12,048.0	100.0%				
School Tributary of South Branch	PCST	18,138.9			18,138.9	100.0%		
Somers Branch of South Branch	PCSB	13,330.2	13,330.2	100.0%				

Stream or Tributary Name	Code	Stream Length Assessed (ft)	None or Low Erosion (ft/%)		Moderate Erosion (ft/%)		High Erosion (ft/%)	
Somers Branch Tributary A	PCSB A	6,295.5	6,295.5	100.0%				
Sorenson Creek Tributary of Pike River	PRSC	15,400.8			15,400.8	100.0%		
Waxdale Creek Tributary of North Branch	PRWC	11,371.2			11,371.2	100.0%		
Unnamed Tributary of Pike River A	PRTA	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River B	PRTB	2,598.0	2,598.0	100.0%				
Unnamed Tributary of Pike River C	PRTC	2,473.4			2,473.4	100.0%		
Unnamed Tributary of Pike River D	PRTD	14,446.0	14,446.0	100.0%				
Unnamed Tributary of Pike River E	PRTE	4,594.1			4,594.1	100.0%		
Unnamed Tributary of Pike River F	PRTF	5,338.3			5,338.3	100.0%		
Unnamed Tributary of Pike River G	PRTG	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River H	PRTH	8,753.5			8,753.5	100.0%		
Unnamed Tributary of Pike River I	PRTI	1,638.9			1,638.9	100.0%		
Unnamed Tributary of Pike River J	PRTJ	865.3			865.3	100.0%		
Unnamed Tributary of Pike River K	PRTK	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River L	PRTL	1,660.4			1,660.4	100.0%		
Unnamed Tributary of Pike River M	PRTM	5,525.8			5,525.8	100.0%		
Unnamed Tributary of Pike River N	PRTN	2,209.6	2,209.6	100.0%				
Unnamed Tributary of Pike River O	PRTO	6,406.4	6,406.4	100.0%				
Unnamed Tributary of South Branch P	PCTP	1,475.1	1,475.1	100.0%				
Unnamed Tributary of South Branch Q	PCTQ	4,638.4	4,638.4	100.0%				
Unnamed Tributary of South Branch R	PCTR	7,947.2	7,947.2	100.0%				
Unnamed Tributary of South Branch S	PCTS	2,056.0	2,056.0	100.0%				
Totals		**328,547.9**	**133,907.4**	**40.8%**	**179,236.4**	**54.6%**	**15,404.2**	**4.7%**

*N/A denotes stream reaches for which no assessment was made.

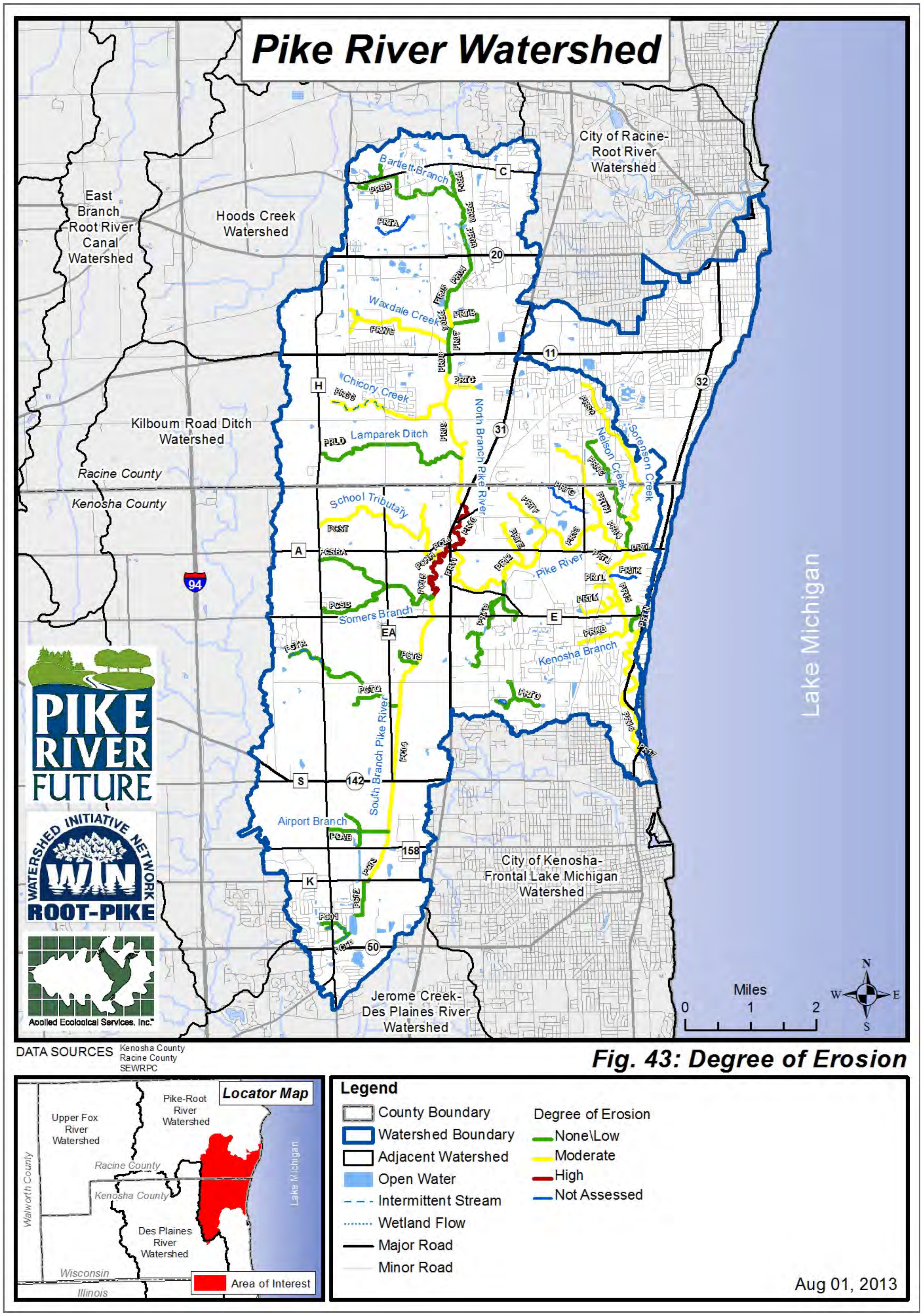


Fig. 43: Degree of Erosion

Riparian Area Condition

Riparian corridors buffer streams and tributaries by filtering pollutants from runoff during flood events and help to protect streambanks by providing a place for floodwater to flow. Buffers also provide beneficial wildlife habitat and extend or connect green infrastructure. The riparian corridor along streams and tributaries was assessed during AES's stream inventory by noting the "Condition" as it relates to riparian area function and quality of plant communities present. Riparian areas in "Good" condition typically connect hydrologically with streams and tributaries during flood events and have higher quality plant communities. Areas in "Average" condition include areas where some filtration and bank stabilization is taking place, but where the plant communities are of lesser quality, including non-native and invasive species. Areas in "Poor" condition are usually found along channelized streams and have either been heavily farmed in the past causing degraded plant communities to establish or consist of mown turf grass or impervious surfaces such as roads to stream edges.

The riparian zone within roughly 100 feet of each streambank along the streams and tributaries in the watershed were assessed (Figure 44). Of the 332,191.2 linear feet of stream for which the riparian area was assessed, 166,922.8 lf (50%) is considered "Poor" ecological quality, 148,445.2 lf (45%) of the riparian area is "Average" ecological quality, and the remaining 16,823.2 lf (5%) is "Good" ecological quality (Table 18, Figure 44). The majority of poor quality areas are located along the western half of the watershed in areas that have experienced the most human alteration due to agricultural uses. Average quality riparian areas are located within the central and eastern portions of the watershed where the land has been less heavily manipulated by humans, but the plant communities remaining have been degraded to some extent, most typically by invasive species. Riparian areas in good condition are all located north of State Highway 11 in areas where ecological restoration has occurred.

LEFT: Restored riparian area along North Branch Reach 4. RIGHT: Virtually nonexistent riparian corridor along South Branch Tributary R.

Altered hydrology and invasive species are the leading causes of degraded conditions in the riparian areas. Common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), sandbar willow (*Salix interior*), box elder (*Acer negundo*), and eastern cottonwood (*Populus deltoids*) are among the most abundant and problematic invasive plants. Fortunately, ecological restoration helps eradicate these species and encourages native plant establishment. The Action Plan section of this report lists and prioritizes opportunities for improving riparian areas through ecological restoration.

Table 18. Summary of stream and tributary riparian area condition.

Stream or Tributary Name	Code	Stream Length Assessed (ft)	Good Riparian Area Condition (ft/%)		Average Riparian Area Condition (ft/%)		Poor Riparian Area Condition (ft/%)	
North Branch and Pike River	PR	86,268.0	16,823.2	19.5%	57,189.7	66.3%	12,255.0	14.2%
South Branch	PC	41,059.0	0	0.0%	12,738.6	31.0%	28,320.5	69.0%
Airport Branch Tributary of South Branch	PCAB	8,168.7					8,168.7	100.0%
Bartlett Branch Tributary of North Branch	PRBB	13,171.5					13,171.5	100.0%
Chicory Creek Tributary of North Branch	PRCC	11,357.1					11,357.1	100.0%
Kenosha Branch Tributary of Pike River	PRKB	4,852.2			4,852.2	100.0%		
Lamparek Ditch Tributary of North Branch	PRLD	14,460.5					14,460.5	100.0%
Nelson Creek Tributary of Pike River	PRNC	12,048.0			12,048.0	100.0%		
School Tributary of South Branch	PCST	18,138.9					18,138.9	100.0%
Somers Branch of South Branch	PCSB	13,330.2					13,330.2	100.0%
Somers Branch Tributary A	PCSB A	6,295.5					6,295.5	100.0%
Sorenson Creek Tributary of Pike River	PRSC	15,400.8			15,400.8	100.0%		
Waxdale Creek Tributary of North Branch	PRWC	11,371.2					11,371.2	100.0%
Unnamed Tributary of Pike River A	PRTA	3,643.2					3,643.2	100.0%
Unnamed Tributary of Pike River B	PRTB	2,598.0					2,598.0	100.0%
Unnamed Tributary of Pike River C	PRTC	2,473.4					2,473.4	100.0%
Unnamed Tributary of Pike River D	PRTD	14,446.0			14,446.0	100.0%		
Unnamed Tributary of Pike River E	PRTE	4,594.1			4,594.1	100.0%		
Unnamed Tributary of Pike River F	PRTF	5,338.3			5,338.3	100.0%		
Unnamed Tributary of Pike River G	PRTG	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River H	PRTH	8,753.5					8,753.5	100.0%
Unnamed Tributary of Pike River I	PRTI	1,638.9			1,638.9	100.0%		
Unnamed Tributary of Pike River J	PRTJ	865.3			865.3	100.0%		
Unnamed Tributary of Pike River K	PRTK	0	N/A	N/A	N/A	N/A	N/A	N/A
Unnamed Tributary of Pike River L	PRTL	1,660.4			1,660.4	100.0%		

Stream or Tributary Name	Code	Stream Length Assessed (ft)	Good Riparian Area Condition (ft/%)		Average Riparian Area Condition (ft/%)		Poor Riparian Area Condition (ft/%)	
Unnamed Tributary of Pike River M	PRTM	5,525.8			5,525.8	100.0%		
Unnamed Tributary of Pike River N	PRTN	2,209.6			2,209.6	100.0%		
Unnamed Tributary of Pike River O	PRTO	6,406.4			6,406.4	100.0%		
Unnamed Tributary of South Branch P	PCTP	1,475.1			1,475.1	100.0%		
Unnamed Tributary of South Branch Q	PCTQ	4,638.4					4,638.4	100.0%
Unnamed Tributary of South Branch R	PCTR	7,947.2					7,947.2	100.0%
Unnamed Tributary of South Branch S	PCTS	2,056.0			2,056.0	100.0%		
Totals		**332,191.2**	**16,823.2**	**5.1%**	**148,445.2**	**44.7%**	**166,922.8**	**50.2%**

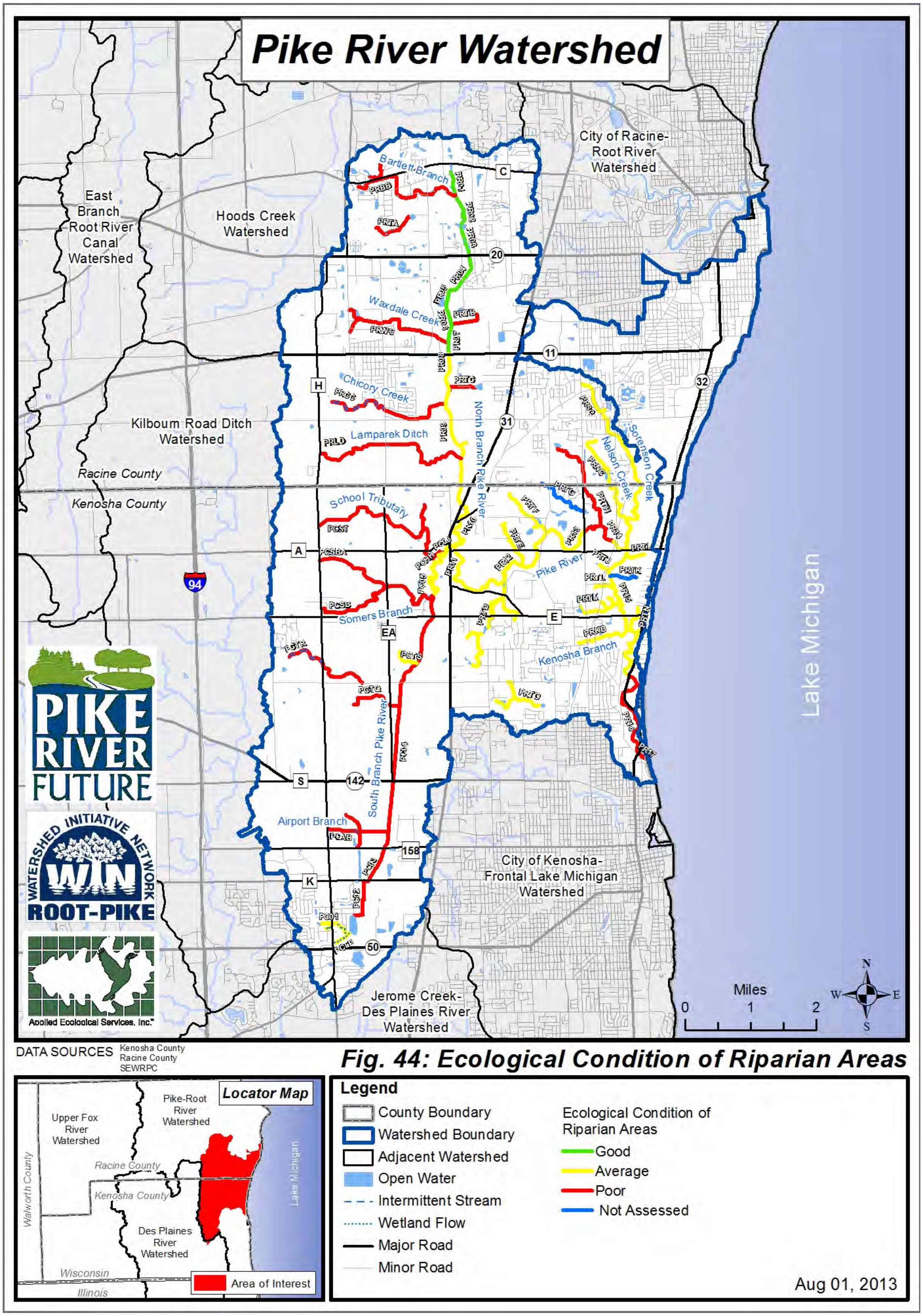


Fig. 44: Ecological Condition of Riparian Areas

5.2 Ponds & Detention Basins

Development throughout the watershed significantly changed the way stormwater flowed across the land. Detention basins are human made structures for the temporary storage of stormwater runoff with a controlled release rate. They are regulated through county and municipal level ordinances. Detention basins can also provide excellent wildlife habitat and improve water quality if designed with the proper configuration, slopes, and water depths then planted with native prairie and wetland vegetation. Today, detention basins capture stormwater runoff from at least 50% of the watershed making the quality of water leaving these basins critically important to the health of the lower reaches of Pike River and its mouth at Lake Michigan.

For the Pike River watershed, Kenosha County, as well as the City of Kenosha, has strong stormwater and detention basin ordinances in place which cover the southern half of the watershed. Racine County does not have a stormwater ordinance and has very little regulation of detention basins. At the municipal level with Racine County, Mount Pleasant and Sturtevant have strong stormwater regulations through their subdivision ordinances, but the City of Racine has almost no regulation of stormwater. The lack of stormwater ordinances, the age of settlement, and level of development within the City of Racine explain why there are almost no detention basins within the Direct Drainage portion of the watershed which overlaps significantly with Racine's municipal boundaries within the watershed.

In summary, the majority, but not all, of the watershed is well-regulated as far as post-construction stormwater detention being captured on-site before it is released back into the watershed. However, none of the local ordinances specify native landscaping requirements.

Basins can be constructed to be wet bottom, wetland bottom, or dry bottom with various types of natural or manicured vegetation. Wet and wetland bottom basins typically hold water that is controlled by the elevation of the outlet structure. Wet bottom basins are usually greater than 3 feet deep and do not have emergent vegetation throughout whereas wetland bottom detentions basins are shallow enough to be dominated by emergent wetland plants. Dry bottom basins are designed to drain completely after temporarily storing stormwater following rain events according to local stormwater ordinance requirements.

Pike River watershed has 238 known detention basins (Figure 45). Applied Ecological Services, Inc. completed a basic assessment of each detention basin in the spring of 2012. Assessment methodology included a visit to each site and collection of data related to existing conditions. Detailed notes were recorded related to existing ecological/water quality improvement condition and potential retrofit Management Measures for eventual inclusion into the Action Plan section of this report. Results of the inventory and data sheet summaries of each detention basin can be found in Appendix B. One hundred twenty (120) wet bottom, 16 wetland bottom, and 8 dry bottom turf grass basins as well as 48 ponds, 4 wetland/marsh areas, and 1 agricultural swale sites were assessed via the inventory (Figure 45). Forty-one (41) detention basins were not assessed due to an inability to access the site.

Far and away, wet bottom detention basins are the most common in the watershed, comprising 61% of the basins that were assessed. Wetland bottom basins comprise another 8% of the basins in the watershed. Wet and wetland bottom detention basins are concentrated in the northwestern-most portion of the watershed, as well as along the southern edges of the watershed boundary.

Typical wet bottom detention basin located southwest of Kr County Line Rd and County Trunk Highway Y.

The typical wet bottom detention basin in Pike River watershed has an inlet and an outlet, fairly steep turf grass side slopes, and does little to improve water quality (See photo, right). Wetland bottom detention basins differ only in that they are shallow enough to be dominated by emergent plants. Typically both types of basins were designed with homeowner aesthetics in mind rather than water quality or wildlife habitat concerns.

The design of and landscaping surrounding detention basins has a direct impact on their ability to improve water quality, filter pollutants, and infiltrate stormwater. At a minimum, a detention basin is designed to hold water temporarily during and immediately following large storm events. When a basin is designed with less steep side slopes (4' to 1' length to height ratio, at a minimum), planted with an emergent shelf at water's edge, and planted to prairie along the side slopes, it can produce water quality benefits and reduce bank erosion in a more effective way, thereby slowing down the volume of water leaving the basin and pollutant loading.

Naturalized detention basin at Hiawatha Crossing in Sturtevant.

Only a handful of the wet and wetland bottom detention basins in the watershed are naturalized with native vegetation. Of these, most are owned by homeowner and business associations that have limited knowledge related to managing naturalized detention basins or hire contractors not qualified to manage natural areas. The result is basins that are overgrown with non-native and invasive species that provide limited ecological and water quality benefits. It is important for homeowner and business associations to begin implementing appropriate management by qualified ecological contractors. Management recommendations for naturalized detention basins are included in the Site Specific Management Measures Action Plan.

Ponds make up another 24% of the detention basins found within the watershed. They are found most predominantly across the central portion of the watershed in older, non-sewered subdivisions.

Typical pond with multiple owners along shoreline found near State Highway 11 and County Trunk Highway X.

In general, the ponds found in Pike River watershed are very similar in character to the wet bottom detention basins, but typically they have multiple owners along the shoreline and were not designed for stormwater capture and usually do not have inlets or outlets. This makes for differing treatments along the water's edge from homeowner to homeowner. For example, one owner might have a stone toe along the waterline of their property, while adjacent properties have a sandy beach at water's edge. They also tend to be used more often for recreation (see photo, right). These factors make pond retrofits difficult to arrange and unlikely to be implemented as it takes the coordination and agreement of all or most of the homeowners along the pond to affect change typically without the assistance of a homeowners association.

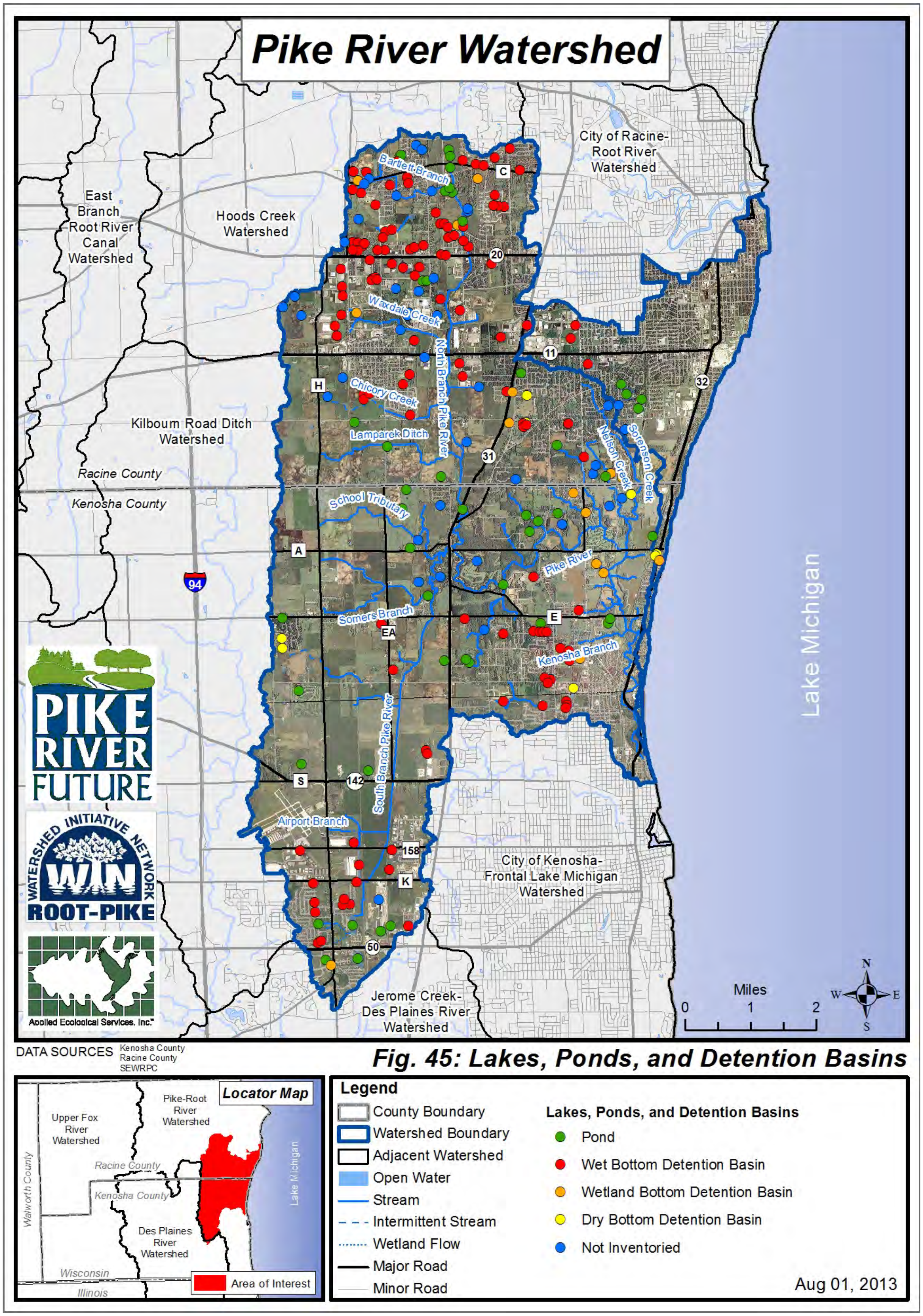


Fig. 45: Lakes, Ponds, and Detention Basins

5.3 Agricultural Land

Agricultural land is the single largest land use in the Pike River watershed, representing 14,174.5 acres or 38.5% of the watershed. It is most heavily concentrated along the central and western portion of the watershed (Figure 46). Agricultural parcels range in size from just a handful of acres to 190 acres, the vast majority of which are privately owned. Crops on those parcels vary from parcel to parcel and from year to year and some of the parcels are leased by owners that live out-of-state. According to the USDA's National Agricultural Statistics Service, crop distribution across the watershed was 38% corn, 26% soybeans, 19% pasture/hay, and 12% winter wheat in 2012, with the remaining 5% consisting predominantly of cabbage and alfalfa.

A harvested corn field in Pike River watershed

While the benefits and profits to be made from agricultural land uses are recognized, the environmental and ecosystem costs have long been difficult to quantify (Golam, 2009). Regardless, the extent of agriculture has contributed to the deterioration of water quality and ecosystem services within the watershed over time. According to the pollutant loading model, the results of which are summarized in Section 7.1, it is estimated that agricultural use contributes 71% of the total nitrogen, 43% of the total phosphorus, and 41% of the total sediment loading to the Pike River.

Intense agriculture has destroyed and divided native habitat for wildlife and pollinator populations (Vanbergen, 2013). Agricultural lands within the Pike River watershed have often been cleared all the way up to streambanks, clearing whole existing ecosystems and often replacing them with monocrops. Heavy manipulation or removal of the natural riparian areas to these streams has also paved the way for non-native invasive species, such as common reed (*Phragmites australis*) and reed manna grass (*Glyceria maxima*). Reed manna grass, often found in areas with high phosphorus and nitrogen levels, has been a particular problem within the Pike River Restoration project areas, apparently spreading from the Bartlett Branch and out-competing native species along the banks (Patti, 2013).

Reed manna grass

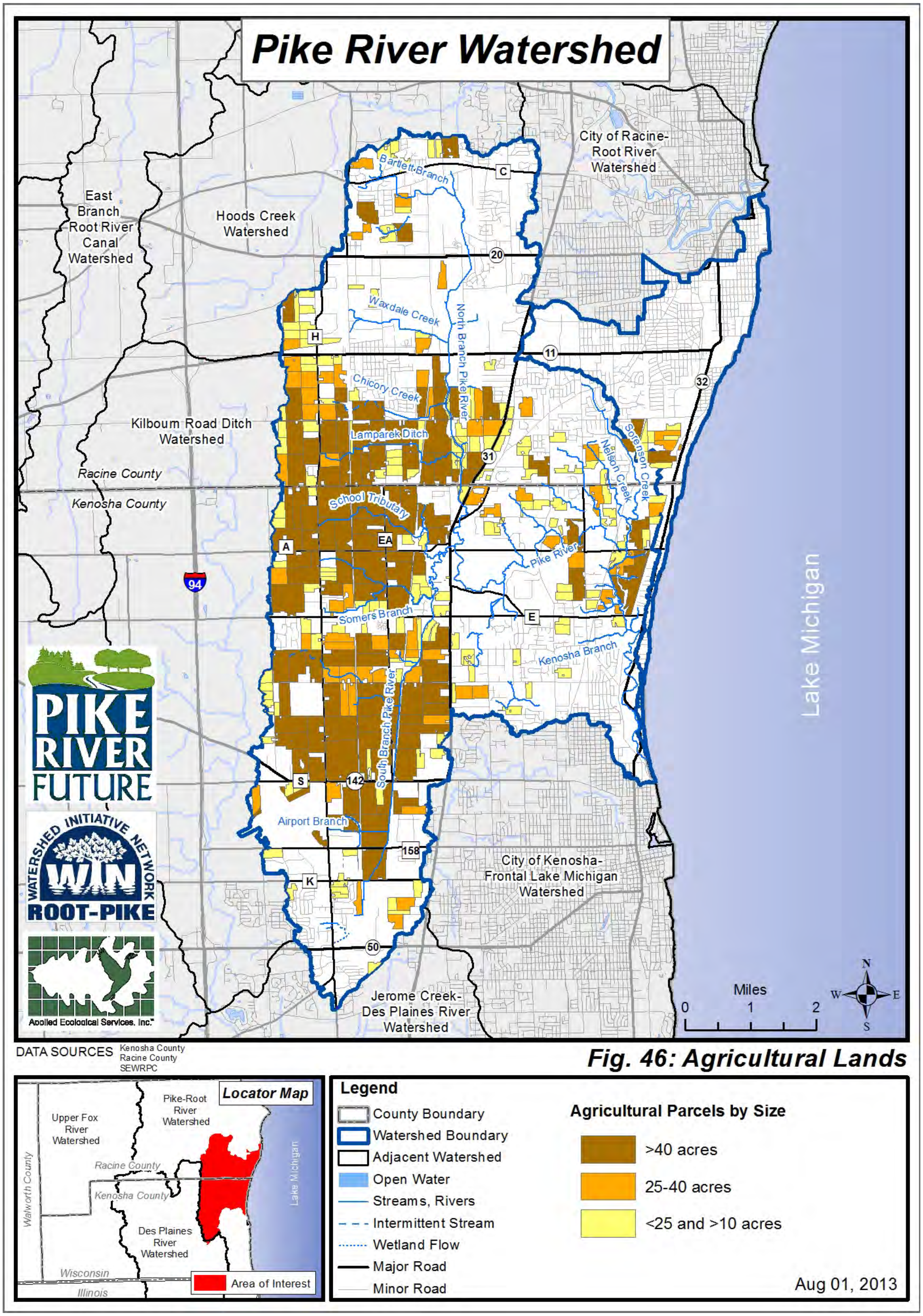


Fig. 46: Agricultural Lands

5.4 Wetlands & Potential Wetland Restoration Sites

Most of the wetlands in Pike River watershed were intact until the 1830's when European settlers began to alter significant portions of the watershed's natural hydrology and wetland processes. Where it was feasible wet areas were drained, streams channelized, woodlands deforested for timber, and savanna and prairie tilled to farm the rich soils. There were approximately 6,965.5 acres of wetlands in the watershed prior to European settlement based on the most up to date hydric soils mapping provided by the USDA Natural Resource Conservation Service (NRCS). According to existing wetland inventories, 1,484.3 acres or 21.3% of the pre-European settlement wetlands remain (Figure 47).

Functional wetlands do more for water quality improvement and flood reduction than any other natural resource. In addition, wetlands typically provide habitat for a wide variety of plant and animal species. They also provide groundwater recharge and discharge, filter sediments and nutrients, and maintain water levels in streams during drought periods. Wetland information and mapping is available for the entire Pike River watershed via wetland inventories and advanced identification of wetland disposal areas (ADID) studies conducted by the United States Environmental Protection Agency (USEPA) in conjunction with the United States Army Corps of Engineers (USACE) and the Wisconsin Department of Natural Resources (WDNR), with further technical assistance provided by Southeastern Wisconsin Regional Planning Commission (SEWRPC). The wetland data was used to map and describe the existing wetlands in the watershed and to locate potential wetland restoration sites.

Part of a wetland complex at the northern edge of the watershed just south of County Trunk Highway C.

Racine and Kenosha County ADID Wetland Inventories

Both the regional and ADID wetland inventories for Racine and Kenosha County were completed in 2005. The wetland features were delineated according to the definitions of the Wisconsin Wetland Inventory Classification Guide, with the addition of special features such as drained wetlands and drainage ditches. ADID wetlands and waters include all aquatic resources located within primary environmental corridors and natural areas as identified by SEWRPC and categorized as either wetlands, lakes/ponds, or natural area wetlands.

Of the 1,484 total acres of wetlands in Pike River watershed, 395 acres have been identified as ADID wetlands by SEWRPC (Table 19). These include 368 acres of ADID Wetlands, 19 acres of ADID Lakes/Ponds, and 8 acres of ADID Natural Area Wetlands. All of the ADID Natural Area Wetlands for Pike River watershed fall within Sanders Park.

Table 19. Kenosha & Racine Counties ADID wetlands and attributes.

ADID Category	Acres	ADID Attributes
Wetlands	368.0	The intersection of 2005 wetlands and primary environmental corridors
Lakes/Ponds	19.6	Generally all deep water features within primary corridors and natural areas that are to be protected
Natural Area Wetlands	7.7	Additional wetlands outside of the primary corridors but within natural areas and that are to be protected

Source: Kenosha and Racine County ADID Wetland Inventories

Most of the existing wetlands in Pike River watershed were inspected by AES in the spring of 2012 during reconnaissance of the watershed (Appendix B: Field Inventory). In general, the wetlands in the watershed were disturbed by farming practices or urban development at some point in the last 150 years to the extent that hydrology has changed and invasive species such as common reed and reed canary grass now dominate.

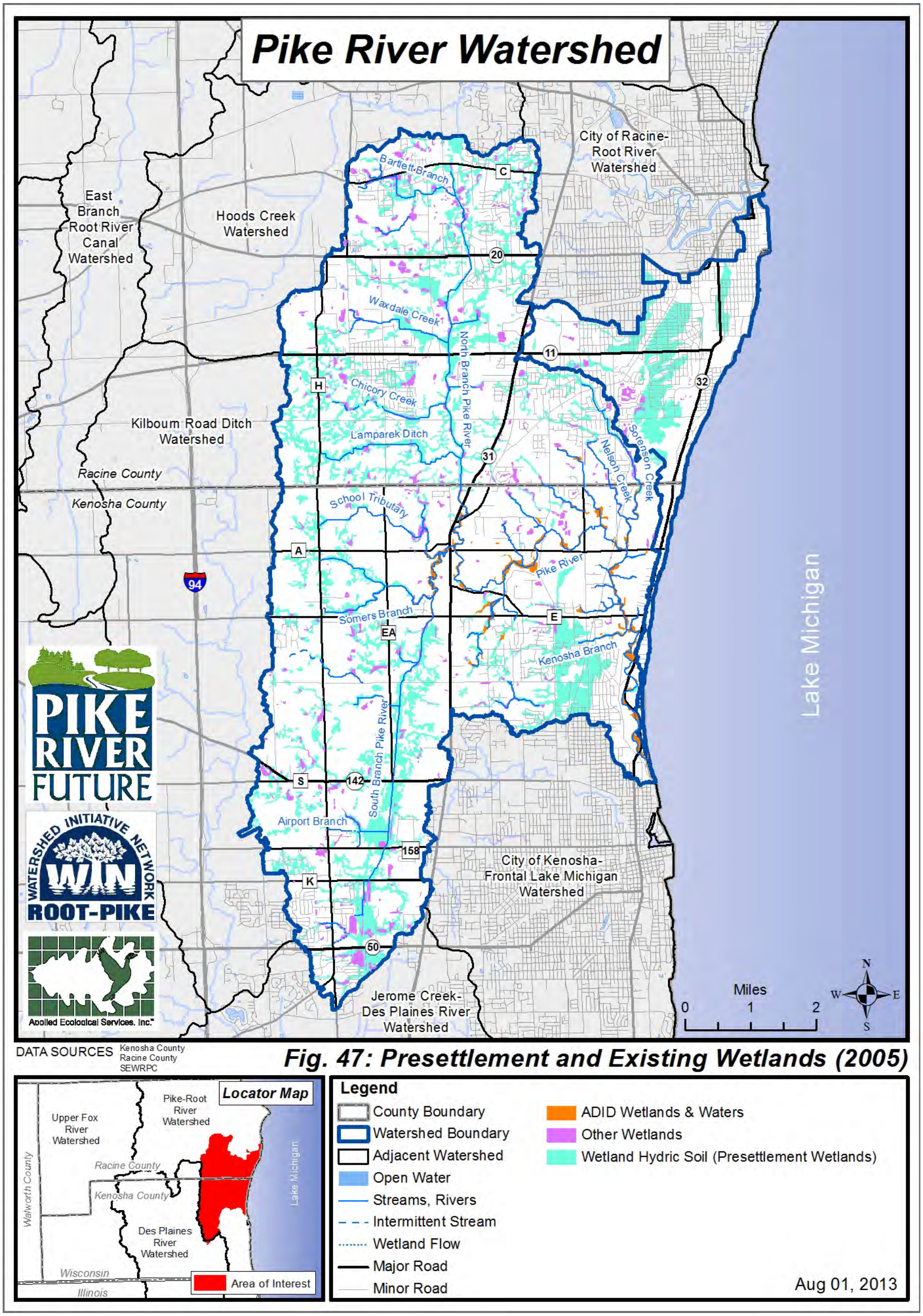


Fig. 47: Presettlement and Existing Wetlands (2005)

Potential Wetland Restoration Sites

Wetland restoration projects are among the most beneficial in the context of improving watershed conditions. They are beneficial in improving basic environmental functions that historic wetlands once served such as storing water during flood events, increasing biodiversity, creating green infrastructure, and improving water quality. Wetland restoration projects can also be completed as part of a Wetland Mitigation Bank where developers are able to buy wetland credits for wetland impacts occurring elsewhere in the watershed.

Wetland restoration sites are those where wetlands once existed but no longer exist because of human impacts such as tile draining, filling, or dewatering via stream channelization. Some of these sites can be restored. Potential Wetland Restoration Sites were identified using a Geographic Information Systems (GIS) exercise and specific criteria determined to be essential for restoration of a functional and beneficial wetland. The criterion used to identify potential sites is that it has to be a Site with at least 20 acres of drained hydric soils located on an open parcel.

The initial GIS analysis resulted in 80 sites meeting the above criteria. However, the extent of development in Pike River watershed limits the number and size of potentially feasible wetland restoration sites. Only 37 of the original 80 sites were determined to be potentially feasible or have at least limited feasibility after careful review of each site using 2010 aerial photography, open space inventory results, existing land use, and field visits where appropriate (Table 20; Figure 48). Two sites that were just under 20 acres were also added because they were noted as important potential wetland restoration sites during the field inventory. Most of the sites that were eliminated as potential wetland restorations were found in areas where existing development simply would not allow for wetland restoration. Note: A feasibility study beyond the scope of this project will need to be completed prior to the planning and implementation of any potential wetland restoration site.

To summarize, the GIS analysis resulted in 29 "Potentially Feasible" and 8 "Limited Feasibility" sites. The overwhelming majority of potentially feasible wetland restoration sites are located in the western portion of the watershed where agriculture is common and former wetlands have been drained by agricultural drainage tiles. The largest sites include Site #'s 9, 12, 15, 20, 21, 24, 28, 30, and 37, ranging in size from 60.9 to 129.2 acres. Six of these sites are potentially feasible while 3 are considered to have limited feasibility based on extending over multiple parcels with varying owners which typically requires extensive coordination.

Potential wetland restoration sites are included in the Action Plan section of this report. Site #'s 1, 10, 13, 18, 19, 30 and 37 are discussed in more detail below because of location, size, or potential to remediate watershed problems.

Site #1: Potential wetland restoration at headwaters of North Branch Pike River.

- Site #1 (photo, right) is 22.3 acres located at the headwaters of North Branch Pike River in an area identified for future residential development, making it an excellent location to incorporate wetland restoration as part of the residential development surrounding the site. It lies on agricultural land that is likely drained by tiles and is part of the Green Infrastructure Network.

- Site #10 (photo, right) is a 67.7 acre drained wetland complex located at the headwaters of Lamparek Ditch. This relatively large site is a good candidate for a future wetland restoration and would also extend the Green Infrastructure Network to include the headwaters of this tributary.

Site #10: Potential wetland restoration at headwaters of Lamparek Ditch.

- Site #13 (photo, below left) is a 19.3 acre potential wetland restoration site also located near the headwaters of Lamparek Ditch north of County Line Rd and west of County Highway H. Wetland restoration on this site would also extend the Green Infrastructure Network for Pike River.

- Site's #18 (photo, below right) and 19 are 29.9 and 39.8 acres, respectively. These historic wetland complexes are located along Somers Branch Tributary A and are part of the Green Infrastructure Network. Both potential wetland restoration sites include portions of lands that are reserved for open space on future land use maps.

LEFT: Site #13 near the headwaters of Lamparek Ditch. RIGHT: Site #18 along Somers Branch Tributary A.

- Site #30 is one of the largest potential wetland restoration sites in the Pike River watershed at 127.9 acres. This historic wetland complex is a potentially feasible site north of County Highway 158 and west of the Union Pacific railway, draining Airport Branch and parts of South Branch. This site is adjacent to existing wetlands, is part of the Green Infrastructure Network, and includes areas slated for industrial land uses according to future land use. This site provides an excellent location where existing features of the land can be used to incorporate large scale wetland restoration and/or wetland bottom detention basins as part of future land use changes within this area.

- Site #37 is a 61.0 acre potential wetland restoration site within the Direct Drainage portion of the watershed located south of Chicory Rd and west of State Highway 32. The site is currently agricultural land but is designated for industrial land uses according to future land use. This site provides a good opportunity to leverage existing features of the land into large scale wetland restoration and/or wetland bottom detention basins when land use changes occur.

Table 20. Potential Wetland Restoration Sites.

ID #	Area (Acres)	Feasibility	Existing Condition
1	22.3	Potentially Feasible	Located on private agricultural land that is likely tile drained. This area is within the headwaters of North Branch Pike River.
2	23.2	Potentially Feasible	Located predominantly on private agricultural land and includes areas along both sides of Bartlett Branch.
3	30.8	Limited Feasibility	Located in private corporate/commercial area adjacent to existing wetland.
4	26.6	Potentially Feasible	Located on private agricultural land that is likely tile drained. Adjacent to Waxdale Creek.
5	33.7	Potentially Feasible	Located at the headwaters of Chicory Creek on private agricultural land.
6	39.2	Potentially Feasible	Located at the headwaters of Chicory Creek on private agricultural land.
7	21.3	Potentially Feasible	Located at the headwaters of Chicory Creek on private agricultural land adjacent to existing wetlands.
8	44.2	Potentially Feasible	Located at the headwaters of both Chicory Creek and Lamparek Ditch on private agricultural land.
9	60.9	Potentially Feasible	Historic wetland complex located at the headwaters of Chicory Creek on private agricultural land adjacent to existing wetlands.
10	67.7	Potentially Feasible	Located at the headwaters of Lamparek Ditch on private agricultural land.
11	50.4	Potentially Feasible	Located along both sides of stream channel on Lamparek Ditch
12	129.2	Limited Feasibility	Large historic wetland complex located along both sides of Lamparek Ditch adjacent to existing wetlands. Extends across multiple private owners requiring extensive cooperation.
13	19.3	Potentially Feasible	Located at the headwaters of Lamparek Ditch on private agricultural land.
14	54.9	Limited Feasibility	Located along both sides of Lamparek Ditch adjacent to existing wetlands. Extends across multiple smaller private owners requiring extensive cooperation.
15	113.5	Potentially Feasible	Large historic wetland complex located along the North Branch Pike River from Chicory Creek south to Lamparek Ditch and adjacent to existing wetlands. Located across agricultural land that is likely tile drained.
16	27.7	Potentially Feasible	Historic wetland complex at headwaters of School Tributary. Located adjacent to existing wetlands on private agricultural land.
17	52.0	Potentially Feasible	Large historic wetland complex at headwaters of Somers Branch. Located adjacent to existing wetlands on private agricultural land.
18	29.9	Potentially Feasible	Historic wetland complex along both sides of Somers Branch Tributary A. Located on private agricultural land.
19	39.8	Potentially Feasible	Historic wetland complex along both sides of Somers Branch Tributary A. Located adjacent to existing wetlands on private agricultural land.

ID #	Area (Acres)	Feasibility	Existing Condition
20	85.7	Limited Feasibility	Large historic wetland complex at headwaters of South Branch Unnamed Tributary S. Located adjacent to existing wetlands across multiple private agricultural parcels requiring coordination among landowners.
21	96.5	Limited Feasibility	Large historic wetland complex along South Branch between County Highway E and 18^{th} Street and adjacent to existing wetlands. Located on private agricultural land.
22	19.4	Limited Feasibility	Located within Maplecrest Country Club and adjacent to existing wetlands. Site is now mostly golf course features such as fairway and rough areas.
23	38.7	Potentially Feasible	Located along the west banks of South Branch from just north of 18^{th} Street to 31^{st} Street on private agricultural land.
24	93.1	Potentially Feasible	Large historic wetland complex along Union Pacific railway between 18^{th} Street and 31^{st} street. Located on private agricultural land and adjacent to existing wetlands.
25	21.0	Potentially Feasible	Located west of 88^{th} Avenue just south of Maplecrest Country Club. This site is located adjacent to existing wetlands on private agricultural land.
26	24.5	Potentially Feasible	Located east of 100^{th} Avenue between Lichter Rd and County Highway S. Adjacent to existing wetland and situated on private agricultural land.
27	42.1	Potentially Feasible	Located northwest of the intersection of County Highways Ea and S. Adjacent to existing wetlands on private agricultural land.
28	75.0	Potentially Feasible	Large historic wetland complex draining to South Branch north of County Highway S and east of the Union Pacific railway. Located on private agricultural land adjacent to existing wetlands.
29	27.0	Potentially Feasible	Wetland complex draining to South Branch south of County Highway S and east of the Union Pacific railway. Located on private agricultural land and some residential lots adjacent to existing wetlands.
30	127.9	Potentially Feasible	Large historic wetland complex north of County Highway 158 and west of the Union Pacific railway, draining Airport Branch and South Branch. Adjacent to existing wetlands and on private agricultural land that is likely tile drained.
31	40.6	Potentially Feasible	Historic wetland between County Highways 158 and K west of the Union Pacific railway. Located on private agricultural land, likely tile drained.
32	31.0	Potentially Feasible	Historic wetland complex South of Highway K mostly on Leona's Rolling Meadows Homeowner's Association property. Adjacent to existing wetlands and draining southernmost portions of South Branch.
33	24.6	Limited Feasibility	Located south of County Highway K and east of Union Pacific railway. Located adjacent to existing wetlands across multiple private agricultural parcels requiring coordination among landowners.
34	31.3	Potentially Feasible	Historic wetland located southeast of County Highway E and 30^{th} Avenue. On private agricultural land adjacent to existing wetlands.
35	35.3	Limited Feasibility	Historic wetland located predominantly on the campus of UW – Parkside. Located adjacent to existing wetlands across multiple public and private parcels requiring coordination among landowners.
36	31.1	Potentially Feasible	Historic wetland located west of Hansche Rd and State Highway 32 on private agricultural land in the Direct Drainage portion of the watershed.
37	61.0	Potentially Feasible	Historic wetland located south of Chicory Rd and west of State Highway 32 on private agricultural land in the Direct Drainage portion of the watershed.

Note: A feasibility study will need to be completed prior to the planning and restoration of any potential wetland restoration site.

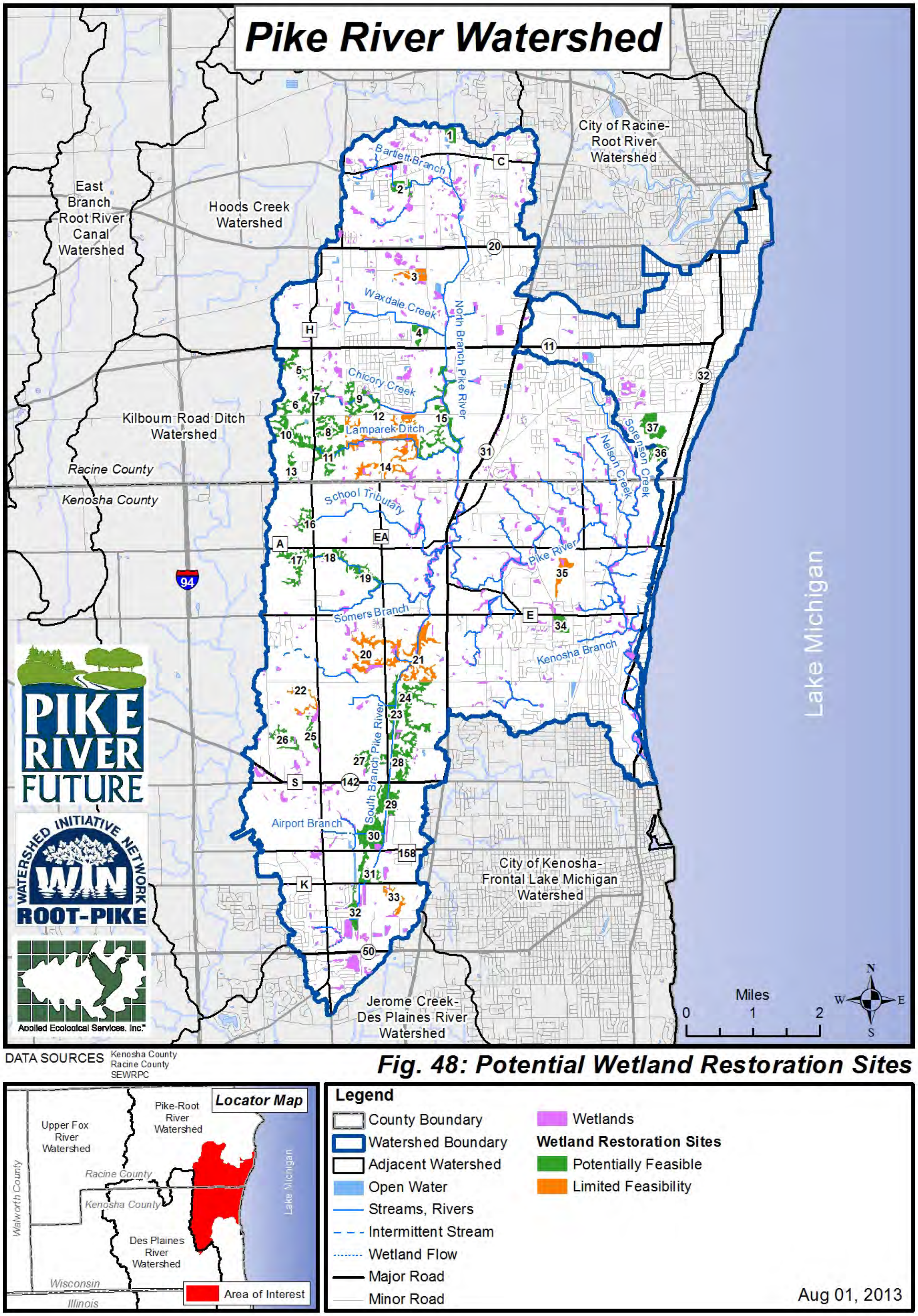


Fig. 48: Potential Wetland Restoration Sites

5.5 Ravines, Brownfields, and Potential Restoration Sites

Ravines and Potential Ravine Restorations

Ravines are part of the natural landscape of Pike River watershed. They are created as part of the natural forces of erosion as running water carves away sediment to form a small canyon or crevice with a stream channel at the bottom. These streams may be perennial or intermittent and some flow to the Pike River while others drain directly into Lake Michigan.

Over time, urban development and the increase in impermeable surfaces over much of the Pike River watershed has increased both the amount and force of water being released into many of these ravines. Particularly in the urban development along the coast of Lake Michigan in both Racine and Kenosha Counties, stormwater outfalls have often been diverted directly into ravines. The force and volume of water moving through these ravines can often cause headcutting (also known as knickpoints) where there is a sudden change in stream elevation and exacerbating erosion downstream, eventually leading to channel blowouts. Unless stabilized, headcuts can migrate upstream over time, causing additional damage and erosion.

Five potential ravine restoration sites have been identified within Pike River watershed (Figure 49). The first potential ravine restoration is for a Ravine just east of RCOC Park in Mount Pleasant (AES ID # 32B). This ravine is fed by a two-foot diameter pipe that drains most of a nearby critical industrial area to the northwest across State Highway 32 and outfalls directly into Lake Michigan. The slopes of this ravine are steep, heavily eroded and dominated by invasive shrubs.

Potential ravine restoration sites. LEFT: Ravine east of RCOC Park (32B), RIGHT: Ravine east of Lakeshore Dr (39A).

Another potential ravine restoration site lies just east of Lakeshore Dr, immediately south of the Racine/Kenosha border (39A). The water in this ravine comes from a large culvert under State Highway 32, presumably as drainage from a large industrial site west of State Highway 32, and drains directly into Lake Michigan. The ravine has steeply eroded banks and large chunks of concrete debris along the ravine bottom.

There are also three ravines located in the center of the watershed close to where South Branch joins Pike River. The first of these ravines, Hawthorn Hollow Ravine (42F), is located off the west bank of South Branch Hawthorn Hollow Reach (PCHH) and drains from an adjacent agricultural field. The stream downcutting has caused moderate erosion in this ravine. North of this ravine off of School Tributary to South Branch (PCST) is another ravine – the School Tributary Ravine (42G). This ravine actually drains the same agricultural field as Hawthorn Hollow Ravine. This ravine begins as two channels that combine to form one highly eroded ravine with a headcut already formed. This ravine contributes large amounts of sediment from the adjacent agricultural field to South Branch.

Just south of these two ravines is another along South Branch Reach 5 (42H). This was formed as wetland 42C overflows and finds its way to South Branch. Downcutting of the channel is occurring and moderate amounts of sediment are being sent downstream from this ravine.


Hawthorn Hollow Ravine (42F)


School Tributary Ravine (42G)


South Branch Reach 5 Ravine (42H)

Brownfields and Potential Brownfield Restorations

Brownfield sites are sections of lands that once housed industrial or commercial uses but have since been vacated. These sites often contain remnants of infrastructure and may have contaminated soils depending on what was located there previously and can be difficult to appropriately reuse. Nevertheless, the conversion of former brownfield sites into natural areas, parks, or open space can be a great way to reintroduce green spaces into highly urbanized areas.

Four brownfield opportunities exist within Pike River watershed, all of which fall within the City of Racine in the Direct Drainage area (Figure 49). The first is a vacant lot located along the west side of Clark Street between 14th Street and 15th Street. The Clark Street Brownfield Site (16A) abuts the railroad tracks and consists of spotty areas of turf grass and bare dirt.

Another brownfield opportunity, Phillips Avenue Brownfield Site (16C) can be found where 18th Street and Phillips Avenue meet, just off the northwest corner of South Memorial Drive and De Koven Avenue. This site includes the area between South Memorial Drive and Phillips Avenue as well as an adjacent field immediately west of Phillips Avenue. This site includes spotty grass, bare dirt, and a depressional area holding water at the time of the site visit in spring of 2012. Just west of this site, is another potential brownfield opportunity located northeast of the intersection of Taylor

Ave and 18th Street. The 18th Street Brownfield Site (16D) extends eastward along the south end of the Racine County Workforce lot and consists of bare grass and areas of old concrete.

Clark Street Brownfield Site (16A)

Phillips Ave Brownfield Site (16C)

18th Street Brownfield Site (16D)

The last of the brownfield opportunity sites is located between Sheridan Road and Lake Michigan and 25th Street and Larson Street. The Case Corporation produced agricultural and construction equipment here at one time, but currently the site is vacant. By far the largest brownfield opportunity at around 80 acres, the Case Brownfield Site (25A) is covered with old paved surfaces leftover from its former use with only sporadic bits of weedy vegetation. The eastern side of this site, adjacent to Lake Michigan sits on fill; it is apparent that this area used to be a ravine.

Case Brownfield Site (25A) along Lake Michigan.

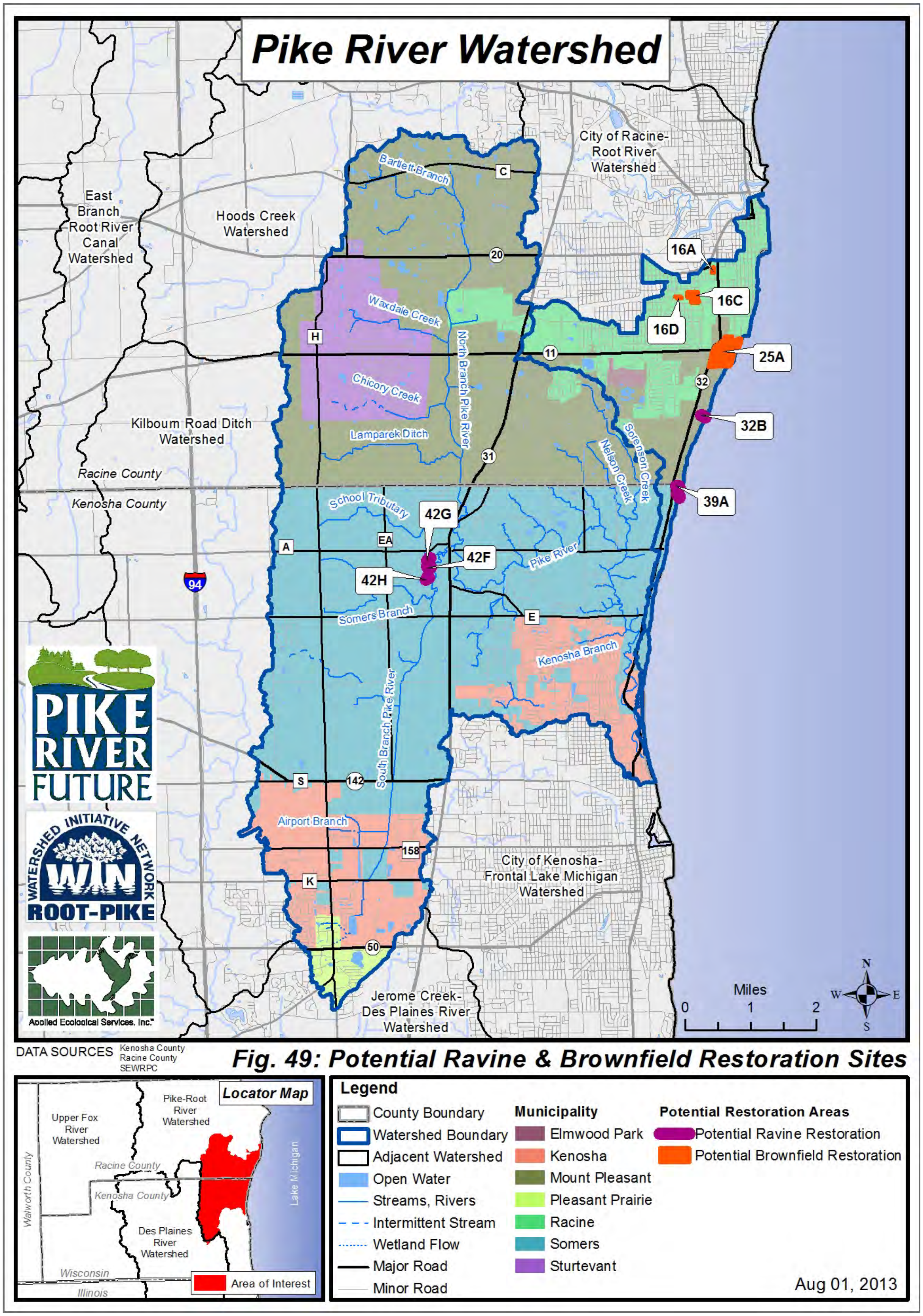
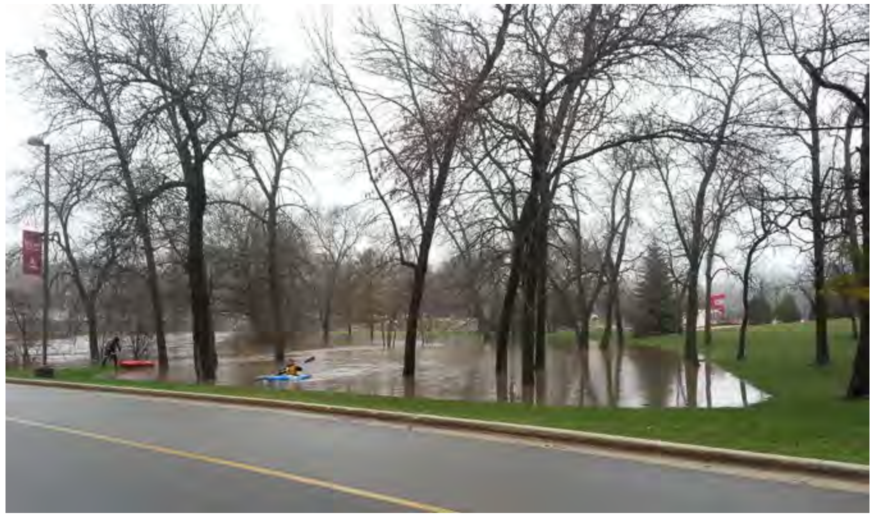


Fig. 49: Potential Ravine & Brownfield Restoration Sites

5.6 Floodplain & Flood Problem Areas


Flooding in April 2013 along Pike River on Carthage College Campus. Source: Matthew Gundlach.

FEMA 100-Year Floodplain

Functional floodplains along stream and river corridors perform a variety of green infrastructure benefits such as flood storage, water quality improvement, passive recreation, and wildlife habitat. The most important function however is the capacity of the floodplain to hold water during significant rain events to minimize flooding downstream. The 100-year floodplain is defined by the Federal Emergency Management Agency (FEMA) as the area that would be inundated during a flood event that has a one percent chance of occurring in any given year (100 – year flood). 100-year floods can and do occur more frequently, however the 100-year flood has become the accepted national standard for floodplain regulatory purposes and was developed in part to guide floodplain development to lessen the damaging effects of floods. The City of Kenosha is currently in the process of doing a Letter of Map Revision for an area located within the watershed.

The 100-year floodplain also includes the floodway. The floodway is the portion of the stream or river channel that comprises the adjacent land areas that must be reserved to discharge the 100-year flood without increasing the water surface. Figure 50 below depicts the 100-year floodplain and floodway in relation to a hypothetical stream channel. Figure 51 depicts the 100-year floodplain which occupies 3,739 acres or 10.1% of Pike River watershed. The largest area of floodplain is in the southern portions of the watershed, adjacent to South Branch.

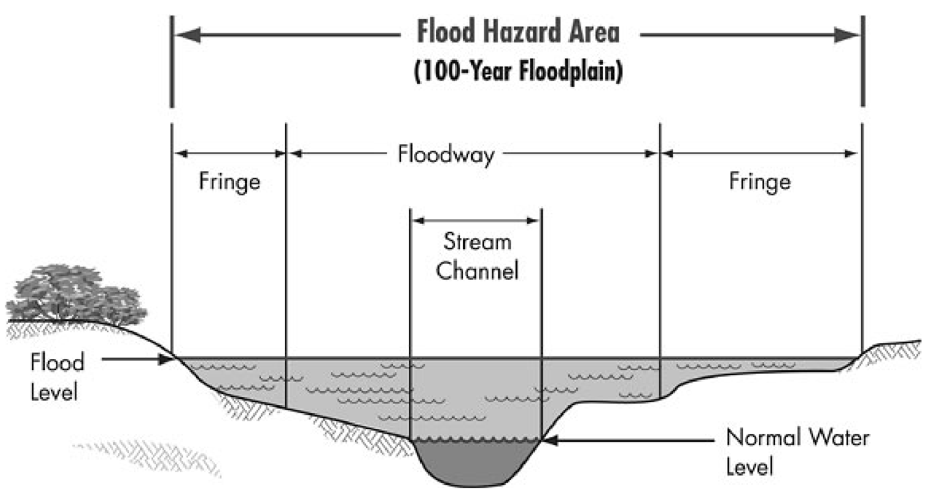


Figure 50. 100-year floodplain and floodway depiction. (Source: New Hampshire Floodplain Learning Center)

Documented Flood Problem Areas

For this report, a Flood Problem Area (FPA) is defined as a location where documented flooding can or does occur and may cause structural damage. Information about the location and condition of documented FPAs was gathered during the "Places of the Heart" exercise during stakeholder meetings and follow up communication with the Advisory Group.

The 100 year flood plain area as documented by FEMA is the current information available. FEMA and the City of Kenosha are currently conducting a Letter of Map Revision (LOMR) for the South Branch from Highway E to Highway 50. More detailed information in terms of topography and hydrology is now available and therefore much of the area designated by floodplain in this area will change.

Seven documented FPAs were identified in the Pike River watershed (Figure 51). Information about each FPA is included in Table 21. The majority of flood issues are within the floodplain, however several cases are located at bridge crossings. The bridge or culvert span was not sized or located in the floodplain and therefore the volume of water cannot pass through the space, causing water to back up behind the bridge. The bridge should be sized to accommodate the floodplain or retrofitted with culverts in the abutments that allow the floodwater to move within the floodplain.

Table 21. Documented Flood Problem Areas.

Flood Problem Area #	Cause of Flooding	Location/Description	Potential Mitigation Measures
1	Floodplain	New bridge on Highway 31 south of KR and to the old bridge on Old 31 (Highway M)	Ensure bridge spans are adequate for floodplain.
2	Floodplain	NW Corner of 7th and Wood Road.	Maintain floodplain
3	Flood Erosion and Improperly sized bridge	Somers and Mt. Pleasant holding ponds, 6 lane Green Bay Road run-off and flow constrictions at bridge on 7th Street near Wood Road. Flood water exiting bridge causes a lot of erosion	Install check dams and naturalize swale along Green Bay Road to slow water, properly size bridge for entire floodplain, including fringe areas.
4	Floodplain	Waxdale Creek, Sturtevant (Fireman's Park) east to North Branch Pike River. 90 degree turns put into creek by homeowner and flooding from culvert back up.	Ensure floodplain remains or increases in size with additional public purchase of floodplain property.
5	Flood water back up behind bridge	County Highway E, 1/3 mile west of Highway 31 at the Pike River bridge.	Ensure proper bridge sizing of floodplain and/or retrofit culverts in floodplain to accommodate flood flow.
6	Floodplain	Stream that runs under RR tracks from west to east in Sturtevant (Waxdale Creek)	Ensure floodplain remains or increases in size with additional public purchase of floodplain property.
7	Roadway Flooding	Petrifying Springs Park: internal roadways flood.	Remove dam, ensure roads are out of the floodplain and add additional storage to floodplain if possible.

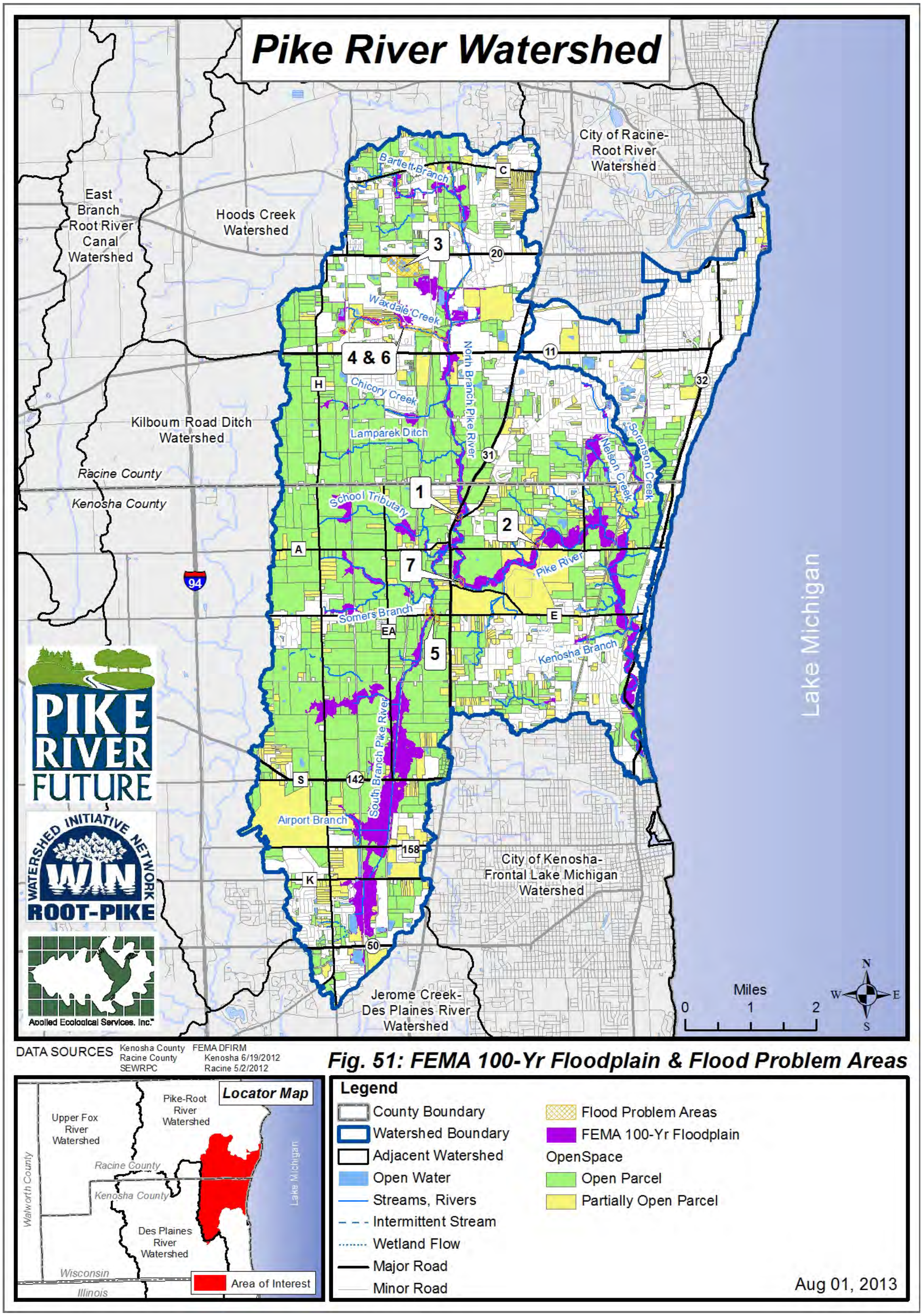


Fig. 51: FEMA 100-Yr Floodplain & Flood Problem Areas

5.7 Groundwater Aquifers, Recharge, Contamination Potential & Community Water Supply

Groundwater Aquifers and Recharge

Groundwater is water that saturates small spaces between sand, gravel, silt, clay particles, or crevices in underground rocks. Groundwater is found in aquifers or underground formations that provide readily available quantities of water to wells, springs, or streams. Groundwater sources available to Southeastern Wisconsin are found in shallow, unconfined aquifer units and deep, semi-confined or confined aquifer units (Figure 52).

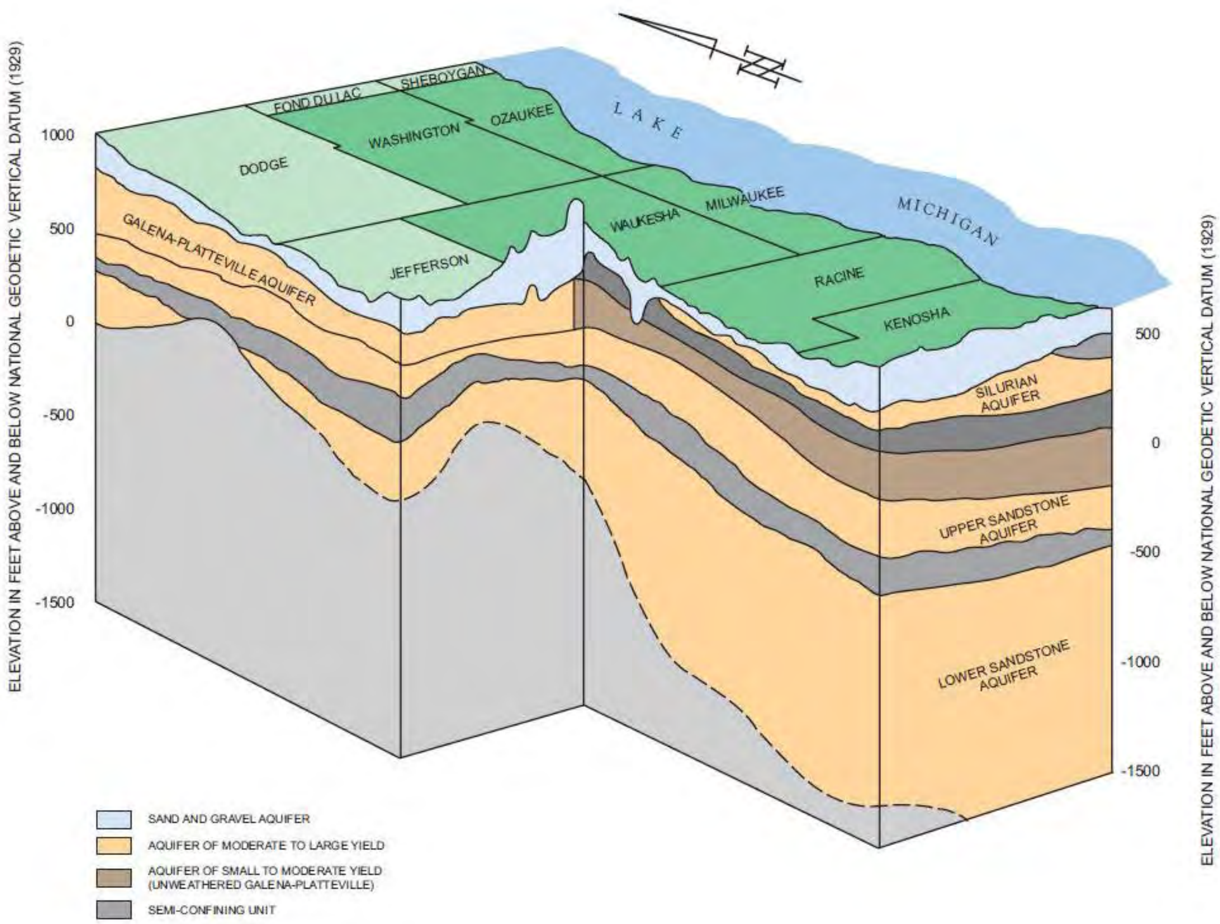


Figure 52. Aquifer Systems in Southeastern Wisconsin. Source: SEWRPC, 2002.

The hydrogeology of Pike River watershed falls within the Silurian dolomite aquifer. This aquifer, formerly known as the Niagara dolomite aquifer, is the uppermost bedrock aquifer in the area, hydraulically connected to the adjacent sand and gravel aquifer, and generally falls under water table conditions. Along with surface water, it is the primary source of most public water supplies and wells within the watershed. Below the Silurian dolomite aquifer are the upper and lower sandstone aquifers. The upper sandstone aquifer includes sandstone and dolomite of the Ancell and Prairie du Chien Groups, while the lower sandstone aquifer is made up of the thick sedimentary sequences of Cambrian sandstone (SEWRPC, 2002).

Groundwater modeling studies conducted by SEWRPC for the Southeastern Wisconsin region in 2010 suggest that deep water aquifers in the region are experiencing excessive drawdown centered on the area of eastern Waukesha County (see Figure 53, left image). Drawdowns in this area exceed 400 feet. This is part of a larger general drawdown occurring in Milwaukee and Chicago and the area between them. Simulated drawdowns within the shallow aquifer (see Figure 53, right image), however, appear much smaller in size and extent. This is because of the unconfined nature of the aquifer and its connection to surface water bodies. "Under natural conditions, most ground water recharge to the shallow aquifer flows through the shallow aquifer and discharges to surface water bodies as baseflow. Pumping the shallow aquifer can reduce the natural ground-water discharge, intercepting it before it reaches surface water bodies and then discharging it to those few rivers that receive wastewater effluent (SEWRPC, 2010)." Rather than result in large drawdowns, groundwater deficits in the shallow aquifer effectively reduce groundwater baseflow (SEWRPC, 2010).

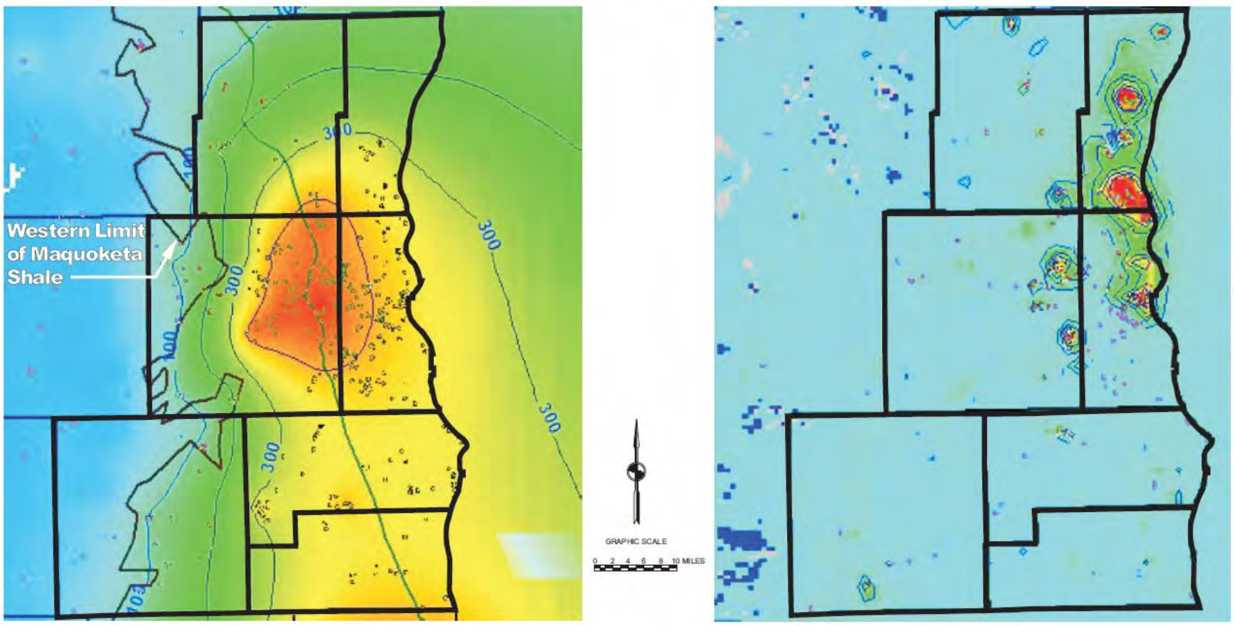


Figure 53. Simulated drawdowns for SEWRPC Region between 1860 and 2000. Left image depicts deep aquifers and right image depicts the shallow aquifer. Source: SEWRPC, 2010.

Groundwater recharge of the deep sandstone aquifer occurs mostly along the main branch of the Pike River and the western portion of the watershed (Figure 54). As the pumping of the deep aquifers and subsequent drawdowns has progressed, water from the shallow aquifer has been diverted downwards toward the deep aquifers. Protecting groundwater recharge areas is crucial to maintaining this flow of water into the deep sandstone aquifer and slowing the extent of drawdown (SEWRPC, 2008). These recharge areas were taken into account during the parcel prioritization used to determine the Green Infrastructure Network (see Section 3.1).

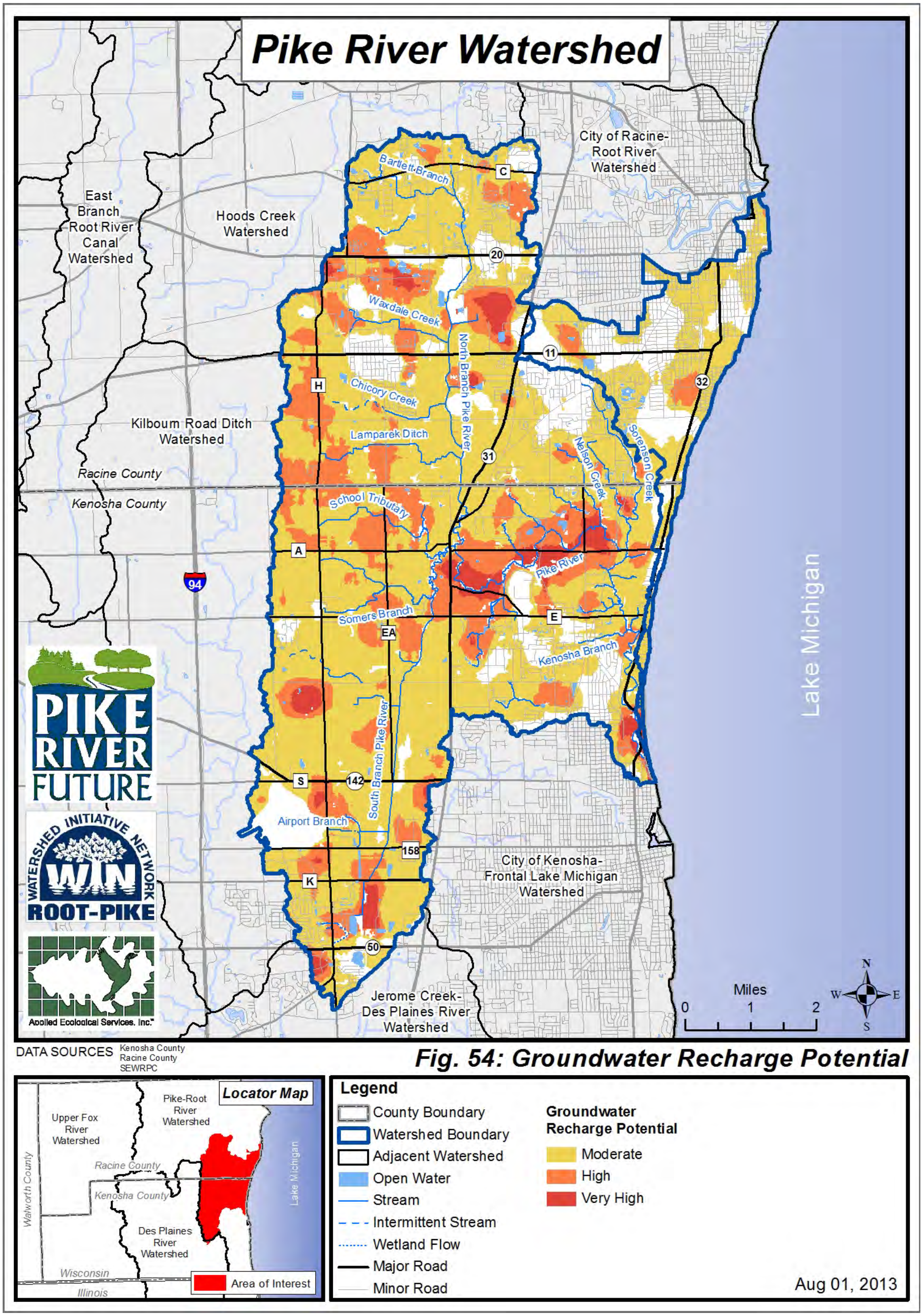


Fig. 54: Groundwater Recharge Potential

Groundwater Contamination Potential

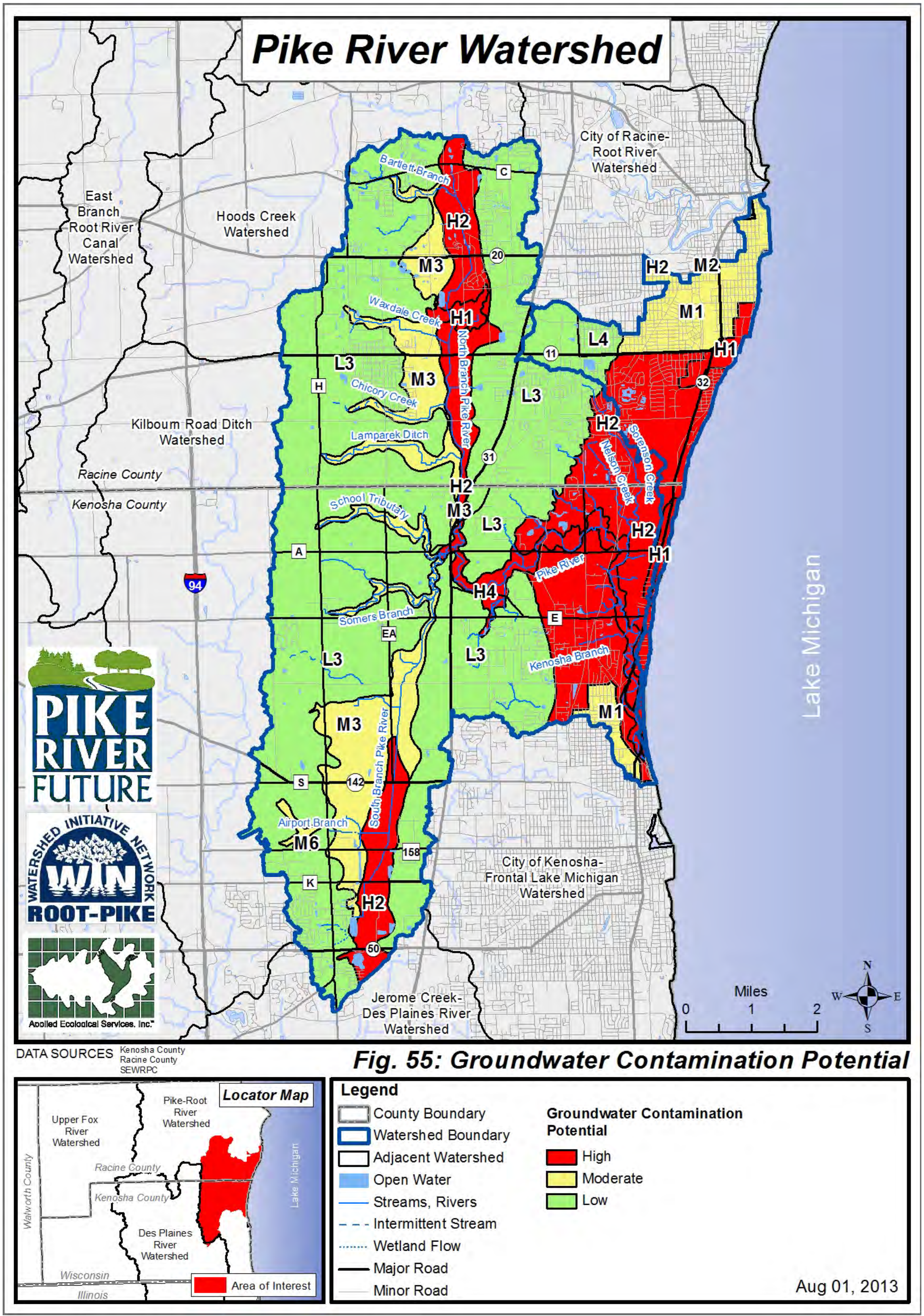
In SEWRPC's research into groundwater resources, they determined areas in which shallow groundwater resources were potentially susceptible to contamination. They did this by measuring three parameters: 1) distance from the land surface to the aquifer, 2) properties of materials through which contaminants have to pass to reach the aquifer, and 3) rates at which such contaminants can travel (SEWRPC, 2002).

SEWRPC also identifies areas which should be targeted for groundwater protection measures. These areas are also referred to as special management areas and include naturally vulnerable areas, potential problem areas, and wellhead protection areas. Naturally vulnerable areas include those identified as being vulnerable to contamination or critical groundwater recharge areas, either to deep or shallow groundwater aquifers. Much of the eastern-most portions of Mount Pleasant, Somers, and Racine were determined by the study to include areas that are highly vulnerable to potential contamination (Figure 55), due predominantly to shallow depth to aquifer or where low soil percolation compensates for shallow depths to aquifer. Additionally, the areas surrounding the North Branch and South Branch of the Pike River were determined to be highly to moderately vulnerable to potential contamination. The potential vulnerability of groundwater contamination was taken into account during the parcel prioritization used to determine the Green Infrastructure Network (see Section 3.1).

Potential problem areas are places where naturally vulnerable areas overlap areas where potential contaminant sources are located. For the Pike River watershed, the eastern portion of the watershed and the area surrounding the North Branch fall within this category.

Finally, wellhead protection areas can be determined in order to protect municipal wells within the shallow aquifer. Wisconsin Administrative Code NR 881 requires a Wellhead Protection Plan for all municipal water supply wells built since 1992, with voluntary compliance for existing wells prior to that date. These plans are meant to delineate and protect the area of land that supplies groundwater to a well, as determined by hydrogeologic analysis (SEWRPC, 2002).

Well contamination is a real concern for Southeastern Wisconsin. In January of 2013, WDNR began investigating the extent of well contamination in the region, which included parts of Caledonia within the adjacent Wind Point watershed. Both public and private wells were affected by molybdenum and boron levels exceeding the state groundwater standard (Bergquist, 2013). WDNR completed an initial investigation into the sources of the contaminants and could not identify the source of the molybdenum or the boron (WDNR, 2013).


Pike River Watershed
City of Racine-Root River Watershed
East Branch Root River Canal Watershed
Hoods Creek Watershed
Kilbourn Road Ditch Watershed
Racine County
Kenosha County
City of Kenosha-Frontal Lake Michigan Watershed
Jerome Creek-Des Plaines River Watershed
Lake Michigan
Bartlett Branch
Waxdale Creek
Chicory Creek
Lamparek Ditch
School Tributary
Somers Branch
Airport Branch
North Branch Pike River
South Branch Pike River
Pike River
Kenosha Branch
Nelson Creek
Sorenson Creek
H1
H2
H4
M1
M2
M3
M6
L3
L4
PIKE RIVER FUTURE
WATERSHED INITIATIVE NETWORK
WIN
ROOT-PIKE
Applied Ecological Services, Inc.
Miles
0
1
2
N
S
E
W
DATA SOURCES Kenosha County
Racine County
SEWRPC
Fig. 55: Groundwater Contamination Potential
Locator Map
Upper Fox River Watershed
Pike-Root River Watershed
Des Plaines River Watershed
Walworth County
Racine County
Kenosha County
Lake Michigan
Wisconsin
Illinois
Area of Interest
Legend
County Boundary
Watershed Boundary
Adjacent Watershed
Open Water
Streams, Rivers
Intermittent Stream
Wetland Flow
Major Road
Minor Road
Groundwater Contamination Potential
High
Moderate
Low
Aug 01, 2013

Community Water Supply

While much of the drinking water in the watershed comes from publically supplied surface water, both shallow and deep aquifers are tapped and used by private and public users and municipalities.. According to Wisconsin Department of Natural Resources well inventory, there are 800 private drinking water wells with depths ranging from 43 to 1,525 feet, with an average depth of 183 feet. Four (4) public water supply wells are located within Pike River watershed but only two are active (Table 22).

Table 22. Public water supply wells within Pike River watershed.

Well ID	Facility	Depth (ft)	Well Status	Casing Diameter
DR875	True Life Ministries Inc.	240	Inactive	6
DS613	Nudi Auto Sales	161	Active	6
FG799	Truesdell Mini Mart	N/A	Permanently Filled	6
PT271	American Insurance	N/A	Active	N/A

Source: Wisconsin Department of Natural Resources – Well Inventory