7.0 Pollutant Loading Model & Reduction Needs/Targets

A Wisconsin Department of Natural Resources (WDNR) approved modeling tool known as Source Loading and Management Model for Windows (WinSLAMM) version 9.4.0 was used to estimate the existing nonpoint source load of nutrients (nitrogen & phosphorus) and sediment from Pike River watershed by individual Subwatershed Management Unit (SMU) for all categories of land use except agricultural. The model evaluates runoff volume and pollutant loading for each SMU according to its land use, impervious surfaces, and utilizes Milwaukee 1969 rainfall data as compiled by the United States Geological Survey (USGS). WinSLAMM, however, does not account for agricultural areas or streambanks so the EPA approved Spreadsheet Tool for Estimating Pollutant Load (STEPL) model was used in order to model pollutant loading for the agricultural areas and streambanks for each SMU. The models both output average annual pollutant load for each of the land use/cover types. The results of the WinSLAMM and STEPL modeling were then aggregated in order to achieve complete modeling for each SMU. The results of this analysis were used to estimate the total watershed load for nitrogen, phosphorus, and sediment and to identify and map pollutant load "Hot Spot" SMU's.

7.1 Pollutant Loading Analysis

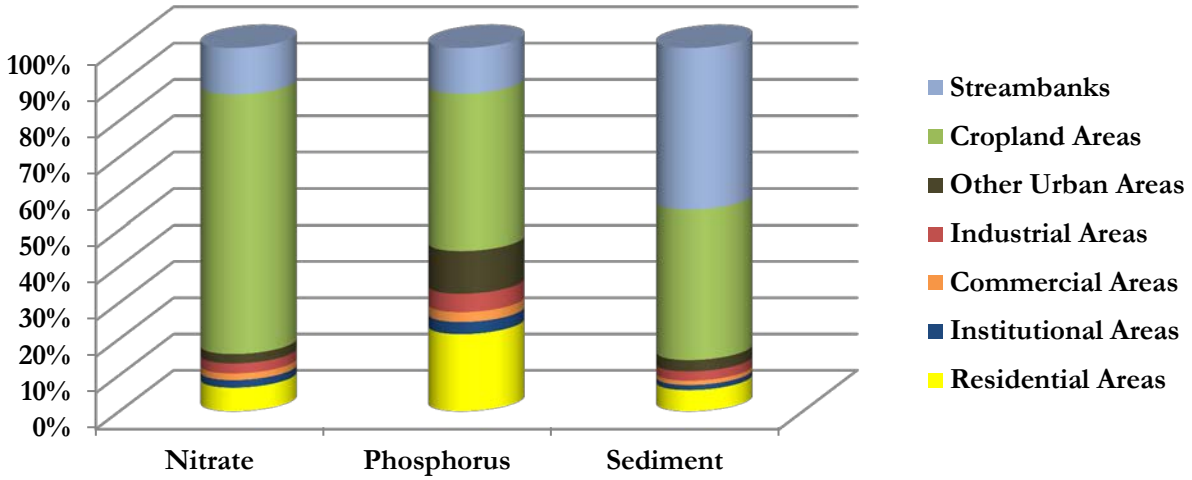
The results of the combined WinSLAMM and STEPL models indicate that existing land use/cover in Pike River watershed produces 134,582 lbs/yr of nitrogen, 52,579 lbs/yr of phosphorus, and 25,046 tons/yr of sediment (Table 31; Figure 57). Cropland land uses contribute the highest load of nitrogen (96,112 lbs/yr: 71%) and phosphorus (22,706 lbs/yr: 43%). This result is expected since agricultural land uses cover nearly 40% of the watershed and are the single largest land use type in the watershed. Residential areas contribute another 21% of total phosphorus. Streambanks contribute the highest sediment load (11,137 tons/yr: 45%). Cropland areas also contribute the second highest sediment load (10,363 tons/yr: 41%). Institutional, commercial, industrial, and other urban areas contribute little to overall pollutant loading. Note: WinSLAMM and STEPL Model results can be found in Appendix C.

Table 31. Estimated existing (2012) annual pollutant load by source at the watershed scale based on combined WinSLAMM and STEPL modeling.

Source	N Load (lbs/yr)	% of Total Load	P Load (lbs/yr)	% of Total Load	Sediment Load (tons/yr)	% of Total Load
Residential Areas	8,798.5	6.5%	11,209.5	21.3%	1,468.2	5.9%
Institutional Areas	2,820.4	2.1%	1,758.4	3.3%	351.3	1.4%
Commercial Areas	2,451.1	1.8%	1,432.6	2.7%	299.0	1.2%
Industrial Areas	3,745.8	2.8%	2,673.9	5.1%	640.4	2.6%
Other Urban Areas	3,480.1	2.6%	6,186.1	11.8%	786.7	3.1%
Cropland Areas*	96,111.7	71.4%	22,706.9	43.2%	10,363.3	41.4%
Streambanks*	17,173.9	12.8%	6,612.0	12.6%	11,136.8	44.5%
Total	**134,581.5**	**100.0%**	**52,579.4**	**100.0%**	**25,045.7**	**100.0%**

NOTE: All results were modeled using WinSLAMM except for * which were modeled using STEPL.

Figure 57. Estimated contributions to existing (2012) loading as a percent of total pollutant load based on combined WinSLAMM and STEPL modeling.



The results of both the WinSLAMM and STEPL models were analyzed at the Subwatershed Management Unit (SMU) scale. This allows for a more refined breakdown of pollutant sources and leads to the identification of pollutant load "Hot Spots". Hot Spot SMUs were selected by examining pollutant load concentration (load/acre) for each pollutant. Next, pollutant concentrations exceeding the 75% quartile were calculated resulting in the pollutant load Hot Spot SMUs. Table 32 and Figure 58 summarize and depict the results of the SMU scale pollutant loading analysis. Seven of the 20 SMUs comprising Pike River watershed are considered pollutant load Hot Spots based on the combined modeling:

- SMUs 7, 9, & 10 comprise 1,409, 1,905, and 2,331 acres, respectively in the center of the watershed adjacent to where South Branch Pike River joins Pike River. Pollutants in these SMUs originate predominantly from cropland land uses that dominate the SMUs and from streambanks that are highly eroded. These three SMUs contribute the highest pollutant loads of nitrogen, phosphorus, and sediment in the watershed.
- SMUs 8 and 12 comprise 1,026 and 1,559 acres, respectively, and are located in the middle western portion of the watershed. These two SMUs are in the top quartile of concentrations for both phosphorus and nitrogen and both have a large percentage of their total acreage devoted to cropland.
- SMUs 16 and 17 comprise 2,617 and 3,180 acres, respectively, and both are in the top quartile for sediment loading due to highly eroded streambanks along Pike River within these SMUs.

Table 32. Pollutant load "Hot Spot" SMUs.

Hot Spot SMU*	Size (acres)	N Load (lb/yr)	N Load (lb/yr)/ Acre	P Load (lb/yr)	P Load (lb/yr)/ Acre	Sediment Load (t/yr)	Sediment Load (t/yr)/ Acre
SMU 7	1,409	10,447	7.4	3,469	2.5	3,040	2.2
SMU 8	1,026	6,704	6.5	1,694	1.7	739	0.7
SMU 9	1,905	12,778	6.7	3,376	1.8	1,838	1.0
SMU 10	2,331	14,404	6.2	4,296	1.8	3,001	1.3
SMU 12	1,559	8,972	5.8	2,373	1.5	1,003	0.6
SMU 16	2,617	8,158	3.1	3,606	1.4	2,571	1.0
SMU 17	3,180	9,915	3.1	4,512	1.4	2,437	0.8
Total	**14,028**	**71,379**	**5.8**	**23,327**	**1.6**	**14,630**	**0.8**

*Hot Spot SMUs exceed the 75% quartile: N=5.8, P=1.6, Sediment= 0.8

Also of note is that the Direct Drainage Area, which is the single largest Subwatershed Management Unit (SMU 20), is one of the least contributors of overall pollutant loading in the watershed according to the combined WinSLAMM and STEPL modeling results.

In addition to the non-point source pollutants in the Pike River, there are permitted point sources that are contributing pollutants. According to the WDNR, approximately thirty permitted facilities fall within the Pike River watershed and Direct Drainage Area. However, most of these facilities are Tier 1 or Tier 2 industrial storm water dischargers that are regulated as point sources under the Wisconsin Pollutant Discharge Elimination System (WPDES) permit program. The pollutant load contribution from these facilities is associated with storm water discharges and is already accounted for in the WinSLAMM modeling for "Industrial Areas".

There are no municipal wastewater facilities discharging into the Pike River watershed. However, there are a few industrial facilities that discharge non-contact cooling water on a routine basis. The most significant discharger is the SC Johnson - Waxdale facility with the others discharging a significantly lower flow to the watershed. Table 33 summarizes the expected loadings to the Pike River, via Waxdale Creek, from the facility based on discharge monitoring reports.

Table 33. SC Johnson Waxdale Plant pollutant loading to Waxdale Creek (Source: WDNR).

Pollutant	2011	2012
Phosphorus mass (lbs/day)	88.53	20.33
Ammonia Nitrogen (lbs/day)	<10	<10
Suspended Solids (TSS lbs/day)	<10	<10

The SC Johnson & Son (Waxdale) facility is located at 2512 Willow Road, Mount Pleasant, in Racine County, Wisconsin on an approximately 229 acre site. The facility has four outfalls with the combined flows of approximately 2.82 and 2.44 MGD for 2011 and 2012, respectively. Three outfalls discharge to Waxdale Creek while the fourth outfall discharges directly into the Pike River. The facility discharges under WPDES General Non-Contact Cooling Water Permit WI-0044938 and Storm Water General Permit S067857-03.

The S C Johnson Waxdale facility is the main manufacturing, warehouse and shipping location for S.C. Johnson & Son, Inc. in North America. A wide variety of materials are received at the Waxdale

facility for processing into finished industrial/household products. The major products produced at this facility include polishes, cleaners, waxes, floor sealants, personal care products, space deodorants and fresheners, insect repellants, insecticides, resins and polymers. These products are regularly packaged, stored and shipped by truck and rail. All their industrial wastewater is treated by an on-site pretreatment plant and discharged through sanitary sewers to the City of Racine Wastewater Treatment Plant.

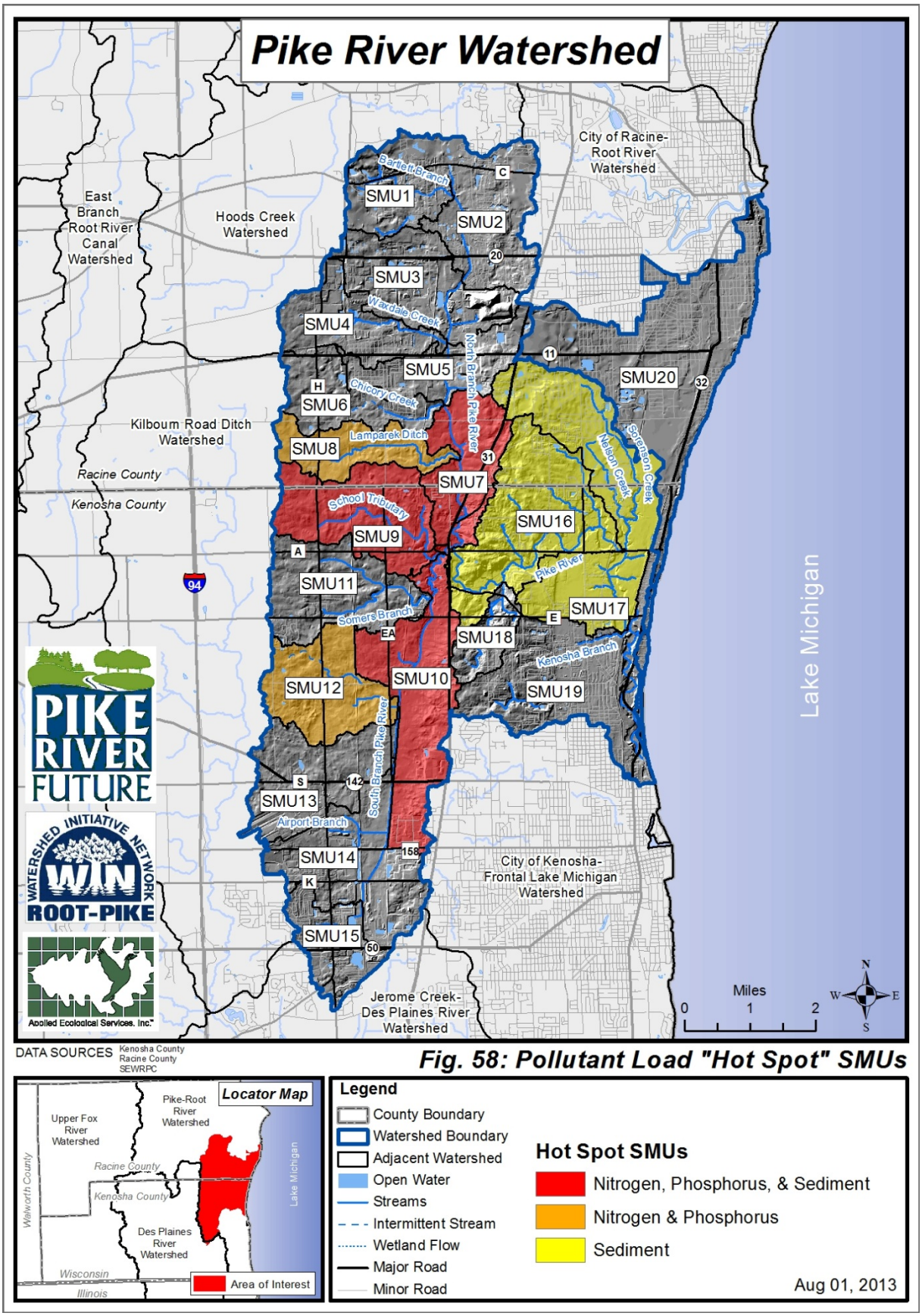


Fig. 58: Pollutant Load "Hot Spot" SMUs

7.2 Causes & Sources of Impairment

The Pike River is impaired for water quality. According to WDNR's Draft 2012 303(d) (WDNR 2012) list, Pike River and Waxdale Creek are 303(d) listed, as well as Alford Park Beach and Pennoyer Park Beach along Lake Michigan. The main stem of the Pike River from the mouth at Lake Michigan to the junction of Pike River and South Branch Pike River is proposed to be newly 303(d) listed because of excessive amounts of phosphorus resulting in a degraded biological community. North Branch Pike River from the junction of South Branch Pike River to the headwaters of Pike River is 303(d) listed for an unknown pollutant and for sediment/total suspended solids resulting in chronic aquatic toxicity and degraded habitat. Waxdale Creek is 303(d) listed for an unknown pollutant that has since been removed as well as sediment/total suspended solids resulting in chronic aquatic toxicity and degraded habitat.

Causes and sources of impairment are based on WDNR's 303(d) impaired waters information for Pike River and its tributaries, items identified during the watershed characteristics inventory, and input from Root-Pike Watershed Initiative Network stakeholders who met one time during the planning process to discuss the topic. Table 34 includes a summary of the known or potential causes and sources of watershed impairment.

Table 34. Known and potential causes and sources of watershed impairment.

Impairment	Cause of Impairment	Known or Potential Source of Impairment
Pike River and Tributaries		
Water Quality/Fish & Aquatic Life	Nutrients: (phosphorus and nitrogen)	Agricultural activities Fish passage issues Atmospheric deposition Industrial point source discharge Streambank erosion Residential and commercial lawn fertilizer
Water Quality/Fish & Aquatic Life	Total Suspended Solids: ((TSS)/turbidity/sediment)	Streambank erosion Agricultural activities Industrial point source discharge Discharges from municipal storm sewer systems (MS4) Construction sites Existing & future urban runoff
Water Quality/Fish & Aquatic Life	Chlorides (salinity)	Deicing operations on roads & other pavement Industrial source Residential and business de-icing
Chronic Aquatic Toxicity	Unknown Pollutant	Industrial point source discharge
Degraded Habitat	Invasive and/or non-native plant species	Spread from existing and introduced populations
Degraded Habitat	Lack of habitat characteristics	Stream channelization Streambank modification Wetland loss Inappropriate land management Lack of stream buffers Inadequately sized culverts and bridge spans Loss of natural management mechanisms (i.e. fire)
Hydrologic and Flow Changes	Impervious cover	Existing & future urban runoff Wetland loss

Impairment	Cause of Impairment	Known or Potential Source of Impairment
Structural Flood Problems	Encroachment in 100-year floodplain	Existing and future urban impervious surfaces Inadequately sized culverts/bridge spans Groundwater interaction Channelized streams Wetland loss
Pike River Beaches		
Recreational Restrictions	E. coli	Waterfowl/animal waste Stormwater runoff Sewage bypass from wastewater treatment plants Septic system failures Illicit sewage discharges

7.3 Critical Areas & Management Measures

For this watershed plan a "Critical Area" is best described as a particular place or area of the watershed where causes/sources of impairment or function are relatively worse than other areas of the watershed. Critical Areas also include open space parcels within the Green Infrastructure Network that, if protected and restored to natural conditions or developed using Conservation Design standards, would greatly reduce impairments compared to existing land use conditions or development using typical/traditional standards. Eight Critical Area types were identified in Pike River watershed and are described below. Table 35 includes descriptions of each individual Critical Area (by type) as well as recommended Management Measures and their estimated nutrient and sediment load reduction efficiency. The list of Critical Areas is derived from a comprehensive list of measures found in the Action Plan section of this report. Figure 59 maps each Critical Area.

Pollutant load reduction is evaluated for the majority of the Critical Area Management Measures based on efficiency calculations developed for the USEPA's Region 5 Model. This model uses "Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (Michigan Department of Environmental Quality, 1999) to provide estimates of sediment and nutrient load reductions from the implementation of *agricultural* Management Measures. Estimate of sediment and nutrient load reduction from implementation of *urban* Management Measures is based on efficiency calculations developed by Illinois EPA. Pollutant load reduction worksheets are located in Appendix C.

Critical Stream Reaches

Critical stream reaches are those with highly eroded streambanks or highly degraded channel conditions that are likely part of the source of high total suspended solids (sediment) carrying attached nutrients. Moderately eroded stream reaches that also have highly channelized banks, poor riparian area conditions, or ones for which modeling indicates high pollutant loads are also Critical Areas. Streambank stabilization and installation of artificial riffles in these reaches will greatly reduce sediment and nutrient transport downstream while improving habitat and increasing oxygen levels. Seven stream reaches (PR09, PR10, PR11, PC04, PC05, PC06, and PCHH) totaling 55,588 linear feet of streambank were identified as Critical Areas. Section 5.0 includes a complete summary of streams and tributaries in the watershed.

Critical Ravines

Four critical ravines were identified within the watershed through the watershed characteristics inventory. Ravine 32B, just east of RCOC park in Mount Pleasant is approximately 440 lf and highly eroded and dominated by invasive shrubs. Ravine 39A, just east of Lakeshore Dr and immediately south of the Racine/Kenosha border is 1,359 lf. This is another highly eroded ravine with steep banks, concrete debris along its bottom, and fed by a large culvert under State Highway 32. School Tributary Ravine (42G) is contributing high amounts of pollutants from adjacent cropland into School Tributary just upstream of where it joins South Branch Pike River. This includes a total of approximately 423 linear feet of ravine on private land north of Hawthorn Hollow. Finally, South Branch Pike River Reach 5 Ravine (42H) south of Hawthorn Hollow and just west of South Branch Pike River Reach 5 is 394 lf of steep and heavily eroded ravine draining a wetland. Section 5.5 includes a brief summary of ravines identified within the watershed.

Critical Brownfields

One critical brownfield site was identified within the watershed through the watershed characteristics inventory. Case Brownfield Site (25A) is a large brownfield consisting of predominantly paved surface immediately adjacent to Lake Michigan. The site is nearly 97 acres that could serve as a valuable addition to the green infrastructure network. Section 5.5 includes a brief summary of brownfield sites identified within the watershed.

Critical Detention Basins

A detention basin inventory was completed as part of this plan that identifies basins needing water quality improvement retrofits (Appendix B). Fourteen (14) basins meet the criteria of a Critical Area based on their location, function, and size. Several critical area detention basins drain large residential areas near the headwaters of various tributaries. Other Critical Area basins include those in defunct subdivisions or basins located adjacent to stream corridors that if retrofitted with natural vegetation and other means, have the potential to improve water quality and extend the Green Infrastructure Network. A summary of the detention basins in the watershed is included in Section 5.2.

Critical Drained Wetlands

Eighteen (18) drained wetland areas totaling 895 acres are critical area wetland restoration sites based on their location, size, and restoration potential. Most of these critical drained wetlands lie along a stream channel and all of them fall within the Green Infrastructure Network. A detailed summary of the extent of drained wetlands and potential wetland restoration opportunities in the watershed is included in Section 5.4.

Critical Riparian Areas

As part of the stream inventory, an assessment of the quality of the riparian areas was completed (Appendix B). Critical riparian areas are select natural areas adjacent to stream reaches that are in poor ecological condition but have excellent ecological restoration and remediation potential to improve water quality and habitat conditions and reduce flooding downstream. Six (6) reaches of Pike River and its tributaries were identified as Critical Riparian Areas totaling 11.4 stream miles. These include Pike River Tributaries B and C (PRTB and PRTC), School Tributary of South Branch Pike River (PCST), Chicory Creek (PRCC), Lamparek Ditch (PRLD), and Waxdale Creek (PRWC) Section 5.1 includes a summary of all the riparian areas in the watershed.

Critical Agricultural Land

Forty-five (45) agricultural parcels totaling 4,317.8 acres were identified as Critical Area sites based on their size and location. Critical agricultural lands are those for which application of agricultural BMPs (such as no-till farming and agricultural filter strips) would greatly reduce pollutant loading for the Pike River. All of the parcels were 70 acres or greater in total size. Additionally, most of the critical agricultural land lies within a Critical SMU and/or the Green Infrastructure Network. A detailed summary of agricultural lands in the watershed is included in Section 5.3.

Critical Green Infrastructure Protection Areas

Information obtained from the watershed characteristics inventory, existing and predicted future land use data, and green infrastructure sections of this report led to identification of eight Critical Green Infrastructure Priority Protection Areas totaling 3,276 acres. GI06 and GI10 are areas that should be acquired and restored to natural vegetation in order to augment and protect the Green Infrastructure Network and represent a total of 75 acres. GI08 and GI15-17, totaling 2,435 acres, are larger corridors of land that are currently under agricultural production, but are slated for more future development. Conservation Design standards are recommended as these areas become more developed. GI03 and GI09, totaling 766 acres, should either be acquired or be developed under Conservation Design standards, depending on how development proceeds in the future.

Table 35. Critical Areas, Management Measures, & estimated nutrient & sediment load reductions.

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
Stream Reaches			
North Branch Reach 9 (PR09)	24,048 lf of stream with moderate erosion, high channelization, and poor riparian area adjacent to cropland	Remeander stream channel where possible, restore streambanks using bioengineering techniques and improve channel using riffles	TN= 2,989 lbs/yr TP= 1,495 lbs/yr TSS= 1,495 tons/yr
North Branch Reach 10 (PR10)	12,554 lf of stream with highly eroded streambanks and heavy debris jams	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 1,537 lbs/yr TP= 768 lbs/yr TSS= 768 tons/yr
Pike River Reach 11 (PR11)	16,308 lf of stream with high, moderately eroded banks within Petrifying Springs Park	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 1,054 lbs/yr TP= 527 lbs/yr TSS= 527 tons/yr
South Branch Pike River Reach 4 (PC04)	40,008 lf of stream south of County Highway E to Airport Branch with highly channelized and moderately eroded streambanks, moderate debris jams and no floodplain connection	Remeander stream channel where possible, restore streambanks using bioengineering techniques and improve channel using riffles	TN = 2,387 lbs/yr TP = 1,194 lbs/yr TSS = 1,194 tons/yr
South Branch Pike River Reach 5 (PC05)	8,019 lf of stream just south of Hawthorn Hollow with highly eroded streambanks, moderate debris jams and some floodplain connection	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 859 lbs/yr TP= 429 lbs/yr TSS= 429 tons/yr
South Branch Pike River Reach 6 (PC06)	5,685 lf of stream just north of Hawthorn Hollow with highly eroded streambanks, moderate debris jams and some floodplain connection	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 532 lbs/yr TP= 266 lbs/yr TSS= 266 tons/yr

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
South Branch Pike River Hawthorn Hollow Reach (PCHH)	4,551 lf of stream within Hawthorn Hollow with highly eroded streambanks, moderate debris jams and some floodplain connection	Restore streambanks using bioengineering techniques and improve channel using riffles	TN= 487 lbs/yr TP= 244 lbs/yr TSS= 244 tons/yr
Ravines			
Ravine just east of RCOC Park (32B)	440 lf of heavily eroded ravine east of RCOC Park and draining directly into Lake Michigan	Restore/stabilize ravine banks using bioengineering techniques	TN= 438 lbs/yr TP= 219 lbs/yr TSS= 219 tons/yr
Ravine east of Lakeshore Dr (39A)	1,359 lf of heavily eroded ravine east of Lakeshore Dr and draining directly into Lake Michigan	Restore/stabilize ravine banks using bioengineering techniques	TN= 1,334 lbs/yr TP= 667 lbs/yr TSS= 667 tons/yr
South Branch Pike River Reach 5 Ravine (42H)	394 lf of steep and heavily eroded ravine draining a wetland west of Hawthorn Hollow into South Branch Pike River	Restore/stabilize ravine banks using bioengineering techniques	TN= 422 lbs/yr TP= 211 lbs/yr TSS= 211 tons/yr
School Tributary Ravine (42G)	423 lf of heavily eroded ravine north of Hawthorn Hollow draining cropland into School Tributary	Restore/stabilize ravine banks using bioengineering techniques	TN= 324 lbs/yr TP= 162 lbs/yr TSS= 162 tons/yr
Brownfields			
Case Brownfield Site (25A)	97 acre former Case site located along Lake Michigan and draining approximately 500 acres	Remove impervious remnants and naturalize site	TN= 1,728 lbs/yr TP= 235 lbs/yr TSS= 112 tons/yr
Detention Basins			
20C, 20D, 21C, 28B, 29A, 30A	Six various non-naturalized detention basins along northern branch of Pike River	Convert dry detention to wet; Retrofit all with a native vegetation buffer and emergent plants along the shoreline	TN= 1,197 lbs/yr TP= 293 lbs/yr TSS= 167 tons/yr
32A	Large industrial area lacking detention but with ample space to accommodate detention basins	Install naturalized wetland detention on site	TN= 550 lbs/yr TP= 130 lbs/yr TSS= 94 tons/yr
37D, 51I	One pond and one detention basin, both wet bottom/turf grass sideslope basins along the main stem of the Pike River	Retrofit with a native vegetation buffer on sideslopes and emergent plants along shoreline	TN= 296 lbs/yr TP= 86 lbs/yr TSS= 31 tons/yr
56A, 57A, 57G	Two wet bottom/turf grass sideslope detention basins and one dry bottom turf detention along tributaries of main stem of Pike River	Convert dry detention to wet; Retrofit all with a native vegetation buffer and emergent plants along the shoreline	TN= 438 lbs/yr TP= 110 lbs/yr TSS= 55 tons/yr
59A	Large pond in cropland draining surrounding cropland and residential areas	Retrofit with a native vegetation buffer on sideslopes and emergent plants along shoreline	TN= 143 lbs/yr TP= 26 lbs/yr TSS= 17 tons/yr
Drained Wetlands			
W01	22.3 acres of drained wetland on private land at headwaters of Pike River, draining roughly 78 acres	Incorporate wetland restoration into future development plans by recreating as wetland detention	TN= 76 lbs/yr TP= 19 lbs/yr TSS= 13 tons/yr

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
W02	23.2 acres of drained wetland near headwaters of Bartlett Branch, draining approximately 256 acres	Incorporate wetland restoration into future development plans by recreating as wetland detention	TN= 130 lbs/yr TP= 31 lbs/yr TSS= 14 tons/yr
W07, W09, W11, W15	4 drained wetlands covering 246.1 acres of drained wetland on mostly private land along Chicory Creek, Lamparek Ditch, and Pike River between those two tributaries, draining roughly 2,888 acres combined	Incorporate wetland restoration into future development plans by recreating as wetland detention	TN= 2,130 lbs/yr TP= 380 lbs/yr TSS= 246 tons/yr
W16	27.7 acres of drained wetland at headwaters of School Tributary draining approximately 288 acres	Incorporate wetland restoration into future development plans by recreating as wetland detention	TN= 138 lbs/yr TP= 23 lbs/yr TSS= 17 tons/yr
W17, W18, W19	3 drained wetlands covering 121.6 acres of drained wetland on mostly private land along Somers Branch, draining approximately 977 acres combined	Incorporate wetland restoration into future development plans by recreating as wetland detention	TN= 476 lbs/yr TP= 82 lbs/yr TSS= 56 tons/yr
W23, W24, W25, W28, W29, W30, W31, W32	8 drained wetlands covering 454.2 acres of drained wetland on mostly private land along South Branch Pike River, draining approximately 6,827 acres combined	Incorporate wetland restoration into future development plans by recreating as wetland detention	TN= 6,156 lbs/yr TP= 1,413 lbs/yr TSS= 980 tons/yr
Riparian Areas			
R1	11.9 degraded riparian acres along both banks of Pike River Tributary B (PRTB)	Restore degraded riparian area using a natural ecological restoration approach	TN= 9 lbs/yr TP= 1 lbs/yr TSS= 1 tons/yr
R2	52.2 degraded riparian acres along both banks of Waxdale Creek (PRWC)	Restore degraded riparian area using a natural ecological restoration approach	TN= 13 lbs/yr TP= 2 lbs/yr TSS= 1 tons/yr
R3	11.4 degraded riparian acres along both banks of Pike River Tributary C (PRTC)	Restore degraded riparian area using a natural ecological restoration approach	TN= 3 lbs/yr TP= 0 lbs/yr TSS= 0 tons/yr
R4	52.1 degraded riparian acres along both banks of Chicory Creek (PRCC)	Restore degraded riparian area using a natural ecological restoration approach	TN= 22 lbs/yr TP= 3 lbs/yr TSS= 1 tons/yr
R5	66.4 degraded riparian acres along both banks of Lamparek Ditch (PRLD)	Restore degraded riparian area using a natural ecological restoration approach	TN= 19 lbs/yr TP= 2 lbs/yr TSS= 1 tons/yr
R6	83.3 degraded riparian acres along both banks of School Tributary (PCST)	Restore degraded riparian area using a natural ecological restoration approach	TN= 23 lbs/yr TP= 2 lbs/yr TSS= 1 tons/yr
Agricultural Areas			
AG01-09	9 privately owned cropland parcels totaling 734.4 acres located along Chicory Creek and Lamparek Ditch	Utilize no-till soil conservation practice and install agricultural filter strips on private cropland	TN= 3,740 lbs/yr TP = 1,906 lbs/yr TSS = 1,367 tons/yr
AG10-18	9 privately owned cropland parcels totaling 851.1 acres situated along School Tributary	Utilize no-till soil conservation practice and install agricultural filter strips on private cropland	TN= 3,636 lbs/yr TP = 1,854 lbs/yr TSS = 1,272 tons/yr
AG19-22, AG24-26	7 privately owned cropland parcels totaling 711.0 acres situated along Somers Branch	Utilize no-till soil conservation practice and install agricultural filter strips on private cropland	TN= 3,093 lbs/yr TP = 1,577 lbs/yr TSS = 1,087 tons/yr
AG23	89.4 acres of privately owned cropland located east of the main stem of Pike River	Utilize no-till soil conservation practice and install agricultural filter strips on private cropland	TN= 479 lbs/yr TP= 244 lbs/yr TSS= 177 tons/yr

Critical Area	Existing Condition/Description	Recommended Critical Area Management Measure	Nutrient & Sediment Load Reduction
AG27-45	19 privately owned cropland parcels totaling 1,931.9 acres situated along South Branch Pike River	Utilize no-till soil conservation practice and install agricultural filter strips on private cropland	TN= 7,604 lbs/yr TP = 3,876 lbs/yr TSS = 2,606 tons/yr
Green Infrastructure Protection Areas			
GI03	(also, Brownfield 25A) 97 acre former Case site located along Lake Michigan and draining approximately 500 acres	Acquire, naturalize, and protect parcel as natural area/open space or incorporate conservation design standards in future development plans	Pollutant reduction cannot be assessed via modeling
GI06	34.4 acres currently in private use as cropland located northeast of the intersection of Old Green Bay Rd and County Highway X	Aquire and restore prairire with trails adjacent to James Turck Park and protect parcel as natural area/open space	Pollutant reduction cannot be assessed via modeling
GI08	802 acres (9 parcels) of private cropland within Green Infrastructure Network along School Tributary; future land use predicted to change to more intense land uses	Incorporate Conservation Design standards into future development plans	Pollutant reduction cannot be assessed via modeling
GI09	668.9 acres (13 parcels) of private cropland within Green Infrastructure Network along Somers Branch; future land use predicted to change to more intense land uses	Acquire, naturalize, and protect parcel as natural area/open space or incorporate conservation design standards in future development plans	Pollutant reduction cannot be assessed via modeling
GI10	40.4 acres of private cropland immediately west of Hawthorn Hollow	Acquire, naturalize, and protect parcel as natural area/open space	Pollutant reduction cannot be assessed via modeling
GI15	669.7 acres (13 parcels) of private cropland within Green Infrastructure Network along PCTR and PCTQ west of Cty Hwy EA; future land use predicted to change to more intense land uses	Incorporate Conservation Design standards into future development plans	Pollutant reduction cannot be assessed via modeling
GI16	431.7 acres (7 parcels) of private cropland within Green Infrastructure Network along South Branch Pike River between 18th St and Cty Hwy S; future land use predicted to change to more intense land uses	Incorporate Conservation Design standards into future development plans	Pollutant reduction cannot be assessed via modeling
GI17	532.1 acres (7 parcels) of private cropland within Green Infrastructure Network along South Branch Pike River south of Cty Hwy S; future land use predicted to change to more intense land uses	Incorporate Conservation Design standards into future development plans	Pollutant reduction cannot be assessed via modeling

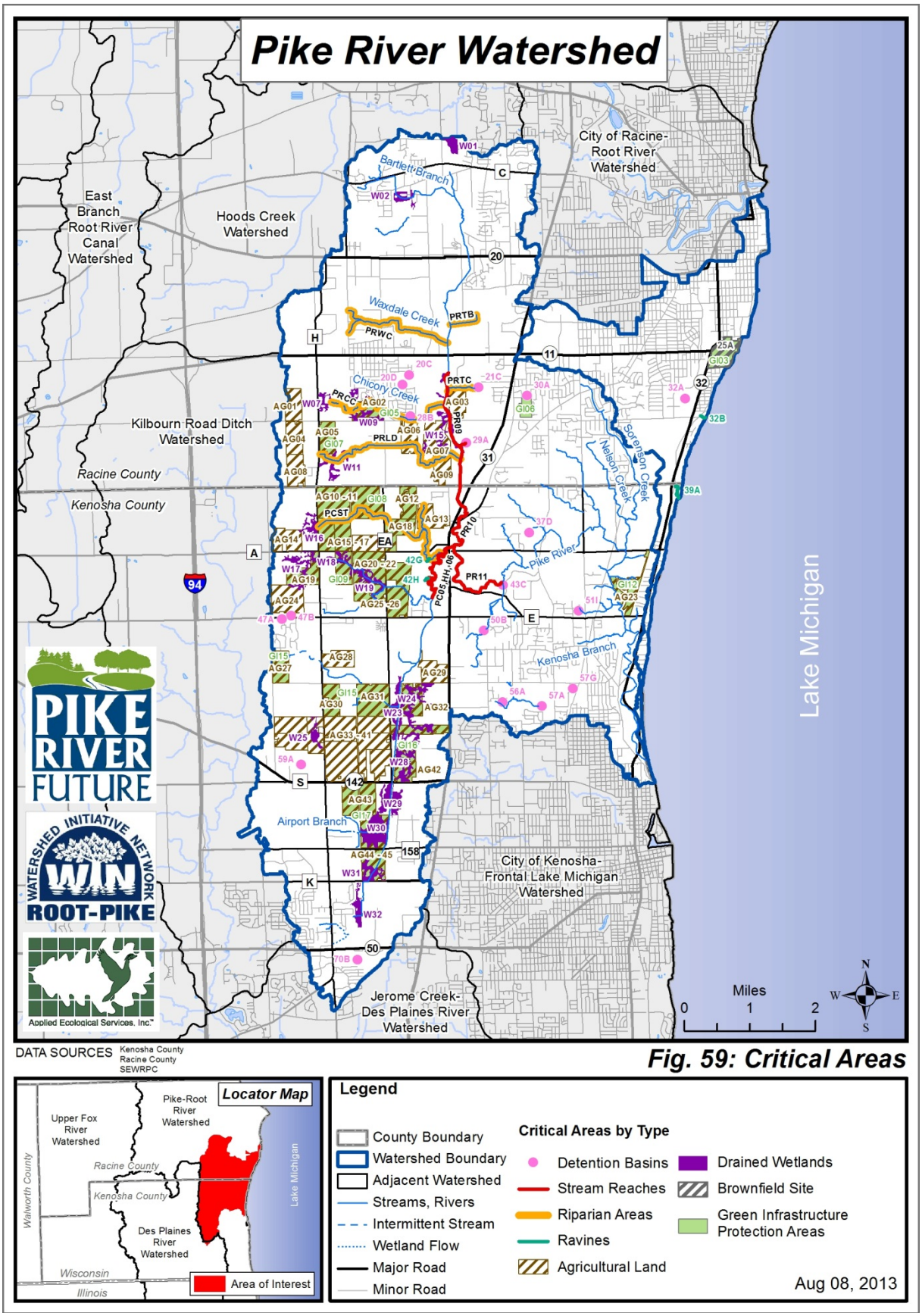


Fig. 59: Critical Areas

7.4 Estimated Impairment Reduction Targets

Establishing "Reduction Targets" is important because these targets provide a means to measure how implementation of Management Measures at "Critical Areas" is expected to reduce watershed impairments. Table 36 summarizes the basis for *known* impairments and Reduction Targets in Pike River watershed as derived from Table 34. Reduction Targets listed in Table 36 are based on documented information, modeling results, best professional judgment, and/or water quality standards and criteria set by the Wisconsin Department of Natural Resources (2012), USEPA (1988, 2000, 2009, 2012), and USGS (2006). It is important to note that for nitrogen, phosphorus and sediment reduction targets the assumption is made that the percent decrease in sample concentration needed is approximately equal to the percent reduction in annual load needed. Additionally, reduction targets have also been adjusted to reflect the approximate pollutant loading from nonpoint sources alone since addressing loading from WPDES permitted sites that fall within Pike River watershed is beyond the scope of this plan. Identified point source loading is summarized in Section 7.1 of this plan.

Table 36 also includes columns summarizing the overall impairment reduction expected after addressing Critical and High Priority Areas. According to the pollutant reduction calculations the sediment and phosphorus Reduction Target would be attained by addressing Critical and High Priority Areas. However, the nitrogen Reduction Target cannot currently be attained by addressing only Critical and High Priority Areas. Addressing all critical and high priority areas would achieve 82% of the Reduction Target goal.

Additional impairment reduction targets were laid out for chlorides, habitat degradation, hydrologic flow changes, and structural flood problems. The impairment reduction target for chlorides and structural flood problem areas cannot be analyzed via modeling, but will be addressed in the Action Plan section of the report. The impairment reduction targets for habitat degradation and hydrologic flow changes can all be achieved by addressing the Critical Areas identified in the plan.

Table 36. Basis for known impairments, Reduction Targets, & impairment reduction from Critical Areas and High Priority Areas.

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Pollutant Reduction from Critical Areas	Pollutant Reduction from High Priority Areas	Target Attainable?
Water Quality/Fish & Aquatic Life: Nutrients - nitrogen	134,581.5 lbs/yr of nitrogen loading based on combined WinSLAMM/STEPL model & 5.406 mg/L total calculated nitrogen in water quality samples	**>54.5% or 73,346.9 lbs/yr** reduction in nitrogen loading to achieve 2.461 mg/L total calculated nitrogen USEPA numeric criteria for streams in Ecoregion VI	7% or 9,845 lbs/yr reduction of total nitrogen loading from critical stream reaches	2% or 2,257 lbs/yr reduction of total nitrogen loading from high priority stream reaches	
			3% or 4,246 lbs/yr reduction of total nitrogen loading from critical ravines and brownfields	<1% or 485 lbs/yr reduction of total nitrogen loading from high priority ravines and brownfields	
			2% or 2,624 lbs/yr reduction of total nitrogen loading from critical detention basins	<1% or 252 lbs/yr reduction of total nitrogen loading from high priority detention basins	
			7% or 9,106 lbs/yr reduction of total nitrogen loading from critical drained wetlands	1% or 1,073 lbs/yr reduction of total nitrogen loading from high priority drained wetlands	
			14% or 18,641 lbs/yr reduction of total nitrogen loading from critical riparian areas, agricultural land, and other projects	9% or 11,821 lbs/yr reduction of total nitrogen loading from high priority riparian areas, agricultural land, and other projects	
		TOTAL	**33% or 44,462 lbs/yr reduction of total nitrogen loading from all Critical Areas combined**	**12% or 15,888 lbs/yr reduction in nitrogen loading from all High Priority Areas combined**	**No**
Water Quality/Fish & Aquatic Life: Nutrients - phosphorus	52,579.4 lbs/yr of phosphorus loading based on combined WinSLAMM/STEPL model & 0.22 mg/L TP in water quality samples from the preliminary study results conducted by Racine Health Department	**>47.8% or 25,133.0 lbs/yr** reduction in phosphorus loading to achieve 0.075 mg/L TP USEPA numeric criteria for streams in Ecoregion VI	9% or 4,923 lbs/yr reduction of total phosphorus loading from critical stream reaches	2% or 1,129 lbs/yr reduction of total phosphorus loading from high priority stream reaches	
			3% or 1,494 lbs/yr phosphorus reduction from critical ravines and brownfields	<1% or 98 lbs/yr reduction of total phosphorus loading from high priority ravines and brownfields	
			1% or 645 lbs/yr reduction of total phosphorus loading from critical detention basins	<1% or 67 lbs/yr reduction of total phosphorus loading from high priority detention basins	
			4% or 1,948 lbs/yr reduction of total phosphorus loading from critical drained wetlands	1% or 203 lbs/yr reduction of total phosphorus loading from high priority drained wetlands	
			18% or 9,467 lbs/yr reduction of total phosphorus loading from critical riparian areas, agricultural land, and other projects	11% or 5,971 lbs/yr reduction of total phosphorus loading from high priority riparian areas, agricultural land, and other projects	
		TOTAL	**35% or 18,477 lbs/yr reduction of total phosphorus loading from all Critical Areas combined**	**14% or 7,468 lbs/yr reduction of total phosphorus loading from all High Priority Areas combined**	**Yes**
Water Quality/Fish & Aquatic Life: Total Suspended Solids - ((TSS)/turbidity/sediment)	25,045.7 tons/yr of sediment loading based on combined WinSLAMM/STEPL model & 20.8 mg/L TSS in water quality samples; 14,175 acres (39%) of watershed devoted to cropland; 377,558.7 linear feet of moderate or highly eroded streambank contributing 10,618 tons/yr of sediment loading based on STEPL model; 166,922.8 linear feet (50%) of riparian area is currently in poor ecological condition; 5,481.2 acres (79%) of wetlands lost since pre-settlement	**>40% or 10,018.3 tons/yr** reduction in sediment loading to achieve 19 mg/l TSS based on USGS numeric criteria in Great Lakes Region	20% or 4,923 tons/yr reduction of total sediment loading from critical stream reaches	5% or 1,129 tons/yr reduction of total sediment loading from critical stream reaches	
			5% or 1,371 tons/yr reduction of total sediment loading from critical ravines and brownfields	<1% or 82 tons/yr reduction of total sediment loading from high priority ravines and brownfields	
			2% or 364 tons/yr reduction of total sediment loading from critical detention basins	<1% or 33 tons/yr reduction of total sediment loading from high priority detention basins	
			5% or 1,326 tons/yr reduction of total sediment loading from critical drained wetlands	<1% or 144 tons/yr reduction of total sediment loading from high priority drained wetlands	
			26% or 6,514 tons/yr reduction of total sediment loading from critical riparian areas, agricultural land, and other projects	16% or 3,967 tons/yr reduction of total sediment loading from high priority riparian areas, agricultural land, and other projects	
		TOTAL	**58% or 14,498 tons/yr reduction of total sediment loading from all Critical Areas combined**	**21% or 5,355 tons/yr reduction of total sediment loading from all High Priority Areas combined**	**Yes**
Water Quality/Fish & Aquatic Life: Chlorides (salinity)	313.9 mg/L Chlorides based on water quality sample	**>26.73% reduction** in road salt usage to achieve 230 mg/L USEPA Ambient Water Quality Criteria for Chloride	Not Applicable**	Not Applicable**	**Not Applicable**
Degraded Habitat: Lack of habitat characteristics	241,806 lf of streambank is highly channelized	**>25% or 60,0452 linear feet** of highly channelized stream length enhanced;	**26% or 64,056 linear feet of highly channelized streambank enhanced via improvements to critical stream reaches**	**12% or 27,813 linear feet of highly channelized streambank enhanced via improvements to high priority stream reaches**	**Yes**
Degraded Habitat: Invasive and/or non-native plant species in riparian area	749 riparian acres are currently in poor ecological condition	**>25% or 187 acres** of poor quality riparian areas ecologically restored	**37% or 277 acres of areas in poor ecological condition restored by addressing critical riparian areas**	**34% or 254 acres of areas in poor ecological condition restored by addressing high priority riparian areas**	**Yes**
Hydrologic and Flow Changes: Impervious cover	5,482 acres (79%) of wetlands lost since pre-settlement.	**>10% or 548 acres** of critical drained wetlands restored	**13% or 895 acres of critical wetland restored by addressing critical drained wetlands**	**8% or 421 acres of critical wetland restored by addressing critical drained wetlands**	**Yes**

Impairment: Cause of Impairment	Basis for Impairment	Reduction Target	Pollutant Reduction from Critical Areas	Pollutant Reduction from High Priority Areas	Target Attainable?
Structural Flood Problems: Encroachment in 100-year floodplain	7 flood problem areas	**100% or 7** structural flood problem areas addressed	Not Applicable**	Not Applicable**	**Not Applicable**

NOTE: Reduction targets have been adjusted to reflect only nonpoint source pollutant loading by removing the percent of each pollutant that is assumed to be a result from point source discharges since these are beyond the scope of this plan.
*Available water quality data indicates that TSS exceeds the target, but is most likely understating the issue due to timing of samples; target is based on professional judgment.
**Addressed in Action Plan section of report