AHNAPEE RIVER WATERSHED
9-KEY ELEMENT PLAN

Kewaunee County Land & Water Conservation Department
April 2020

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9-KEY ELEMENT PLAN - AHNAPEE RIVER WATERSHED

Following the Natural Resources Conservation Service (NRCS) Watershed planning process, the Kewaunee County Land and Water Conservation Department (LWCD) and Wisconsin Department of Natural Resources (WDNR) began a 9-key element plan for the Ahnapee River Watershed, located in northeast Kewaunee County encompassing portions of Lincoln, Ahnapee, Casco, and Pierce Townships. 9-key element plans fall under the Environmental Protection Agency (EPA) Nonpoint Source (Section 319) Program and help to determine the contributing causes and sources of nonpoint sources of pollution, while creating partnerships with all stakeholders to address water quality problems (Figure 1).

For planning purposes, 9-key element plans are based off Hydrologic Unit Code (HUC-12) sub-watersheds, (defined as 35 acres in size). HUC-12 watershed planning helps assess the contributing causes and sources of nonpoint source pollution. This involves key stakeholders, prioritizing restoration and protection strategies to address both surface water and groundwater quality problems, which is the main objective in the Kewaunee County Land & Water Resource Management Plan (LWRMP) update. This 9-key element plan was written to coincide with the 10-year (2020-2029) LWRMP update.

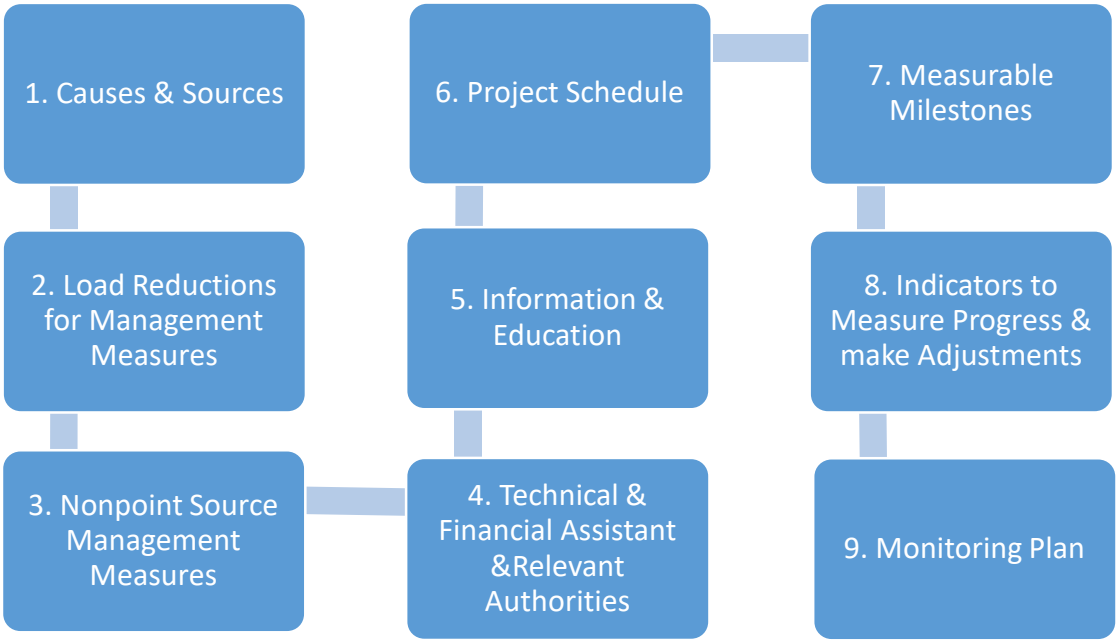


Figure 1. 9-Key Elements for Watershed-Based Plans

AHNAPEE RIVER WATERSHED

The Ahnapee River watershed covers 136 square miles in northeastern Kewaunee County and southern Door County. Approximately 55,890 acres (65%) of the watershed lie within the boundaries of Kewaunee County, including 41.2 miles of streams, creeks, and rivers. Silver Creek is the largest tributary to the Ahnapee River. Three Mile Creek is a small intermittent stream that drains from Krohns Lake to Lake Michigan and is the only creek in the watershed classified as a Class II Trout Water.

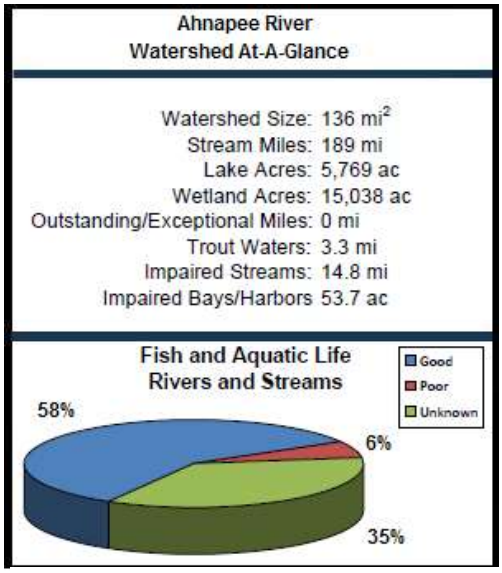
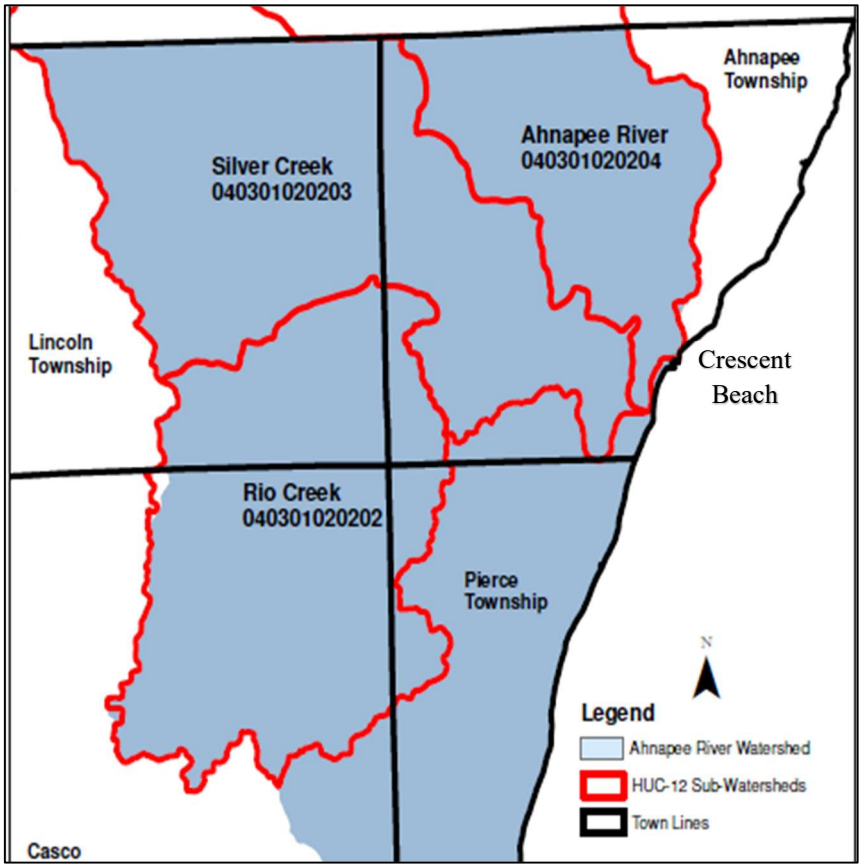


Figure 2. Ahnapee River Watershed At-A-Glance

The Ahnapee River watershed also contains several of Kewaunee County's largest lakes. East Alaska Lake is a 53-acre seepage/drainage lake up to 50-feet deep and fed by an intermittent inlet from West Alaska Lake with overall fair water quality. West Alaska Lake is a 20-acre seepage/drainage lake with a maximum depth of 41 feet. Little is known about the water quality of this lake but both East and West Alaska Lakes are possibly being enriched by polluted runoff. Krohns Lake is 21 acres and has a maximum depth of 38 feet. It is a spring-fed lake with fair to good water quality. Overall, fish and aquatic life in rivers and streams is good, but 35% is classified as unknown (Figure 2) (LWRMP, 2020-2029).

Within the Ahnapee River Watershed, WDNR and LWCD selected Silver Creek (HUC code 040301020203), Ahnapee River (HUC code 040301020204) and Rio Creek (HUC code 040301020202) sub-watersheds (Map 1).



Map 1. 9-Key Element Plan Area – Ahnapee River Watershed HUC-

STEP 1: IDENTIFY THE CAUSES & SOURCES

To identify the causes and sources of nonpoint pollution that need to be controlled to achieve the load reductions, LWCD and WDNR staff worked in a collaborative effort.

To determine the sources within the Ahnapee River Watershed, WDNR used the Pollutant Load Ratio Estimation Tool (PRESTO), a statewide GIS-based tool that compares the average annual phosphorus loads originating from point and nonpoint sources within a watershed. Figures 3-6 delineate the HUC-12 Ahnapee River sub-watersheds including tributary stream types, land cover and phosphorus load estimates.

Table 1 shows the average annual nonpoint phosphorus load in pounds per HUC-12s. Overall, the PRESTO results show the combined average annual nonpoint phosphorus load for the 3 sub-watersheds is 37,982 lbs. per year and the total for Kewaunee County acres is 19,928 lbs. per year. Furthermore, the watershed delineation report estimates 74% of the watershed is agriculture; 13% wetland; 7% forest; and approximately 6% as urban.

For planning purposes this 9-key element plan will focus solely on the watershed acres within Kewaunee County.

Table 1. Average Annual Nonpoint Phosphorus (P) Load per HUC-12

Sub-Watersheds of the Ahnapee River	**Phosphorus (P) Load (pounds)**	
Ahnapee River **TOTAL** Door & Kewaunee HUC: 40301020204	29,854	
Ahnapee River **(Door County)** HUC: 40301020204	17,784	
Ahnapee River **(Kewaunee County)** HUC 40301020204	11,800	
Rio Creek: HUC 40301020202	1,787	
Silver Creek: HUC 40301020203	4,554	
Total P Load (with Door County portion)	**35,925**	
Total P Load in Kewaunee County	**18,141**	

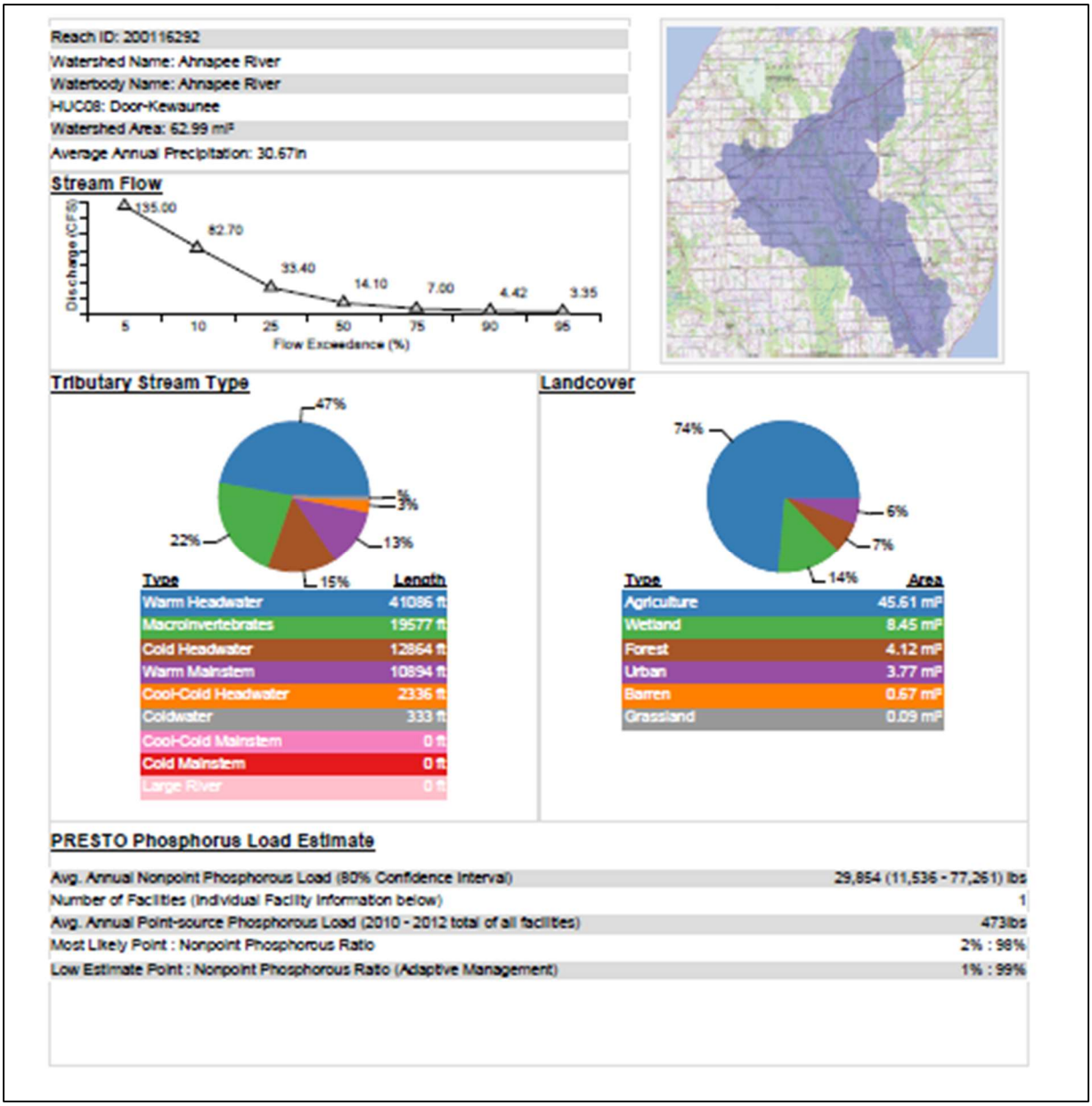


Figure 3. Ahnapee River – Door & Kewaunee County – PRESTO-Lite Watershed Delineation Report, DNR 2019

Ahnapee River – Door & Kewaunee Area
HUC 040301020204

- ► 74% Agriculture
- ► 29,854 pounds on average annual nonpoint phosphorus load

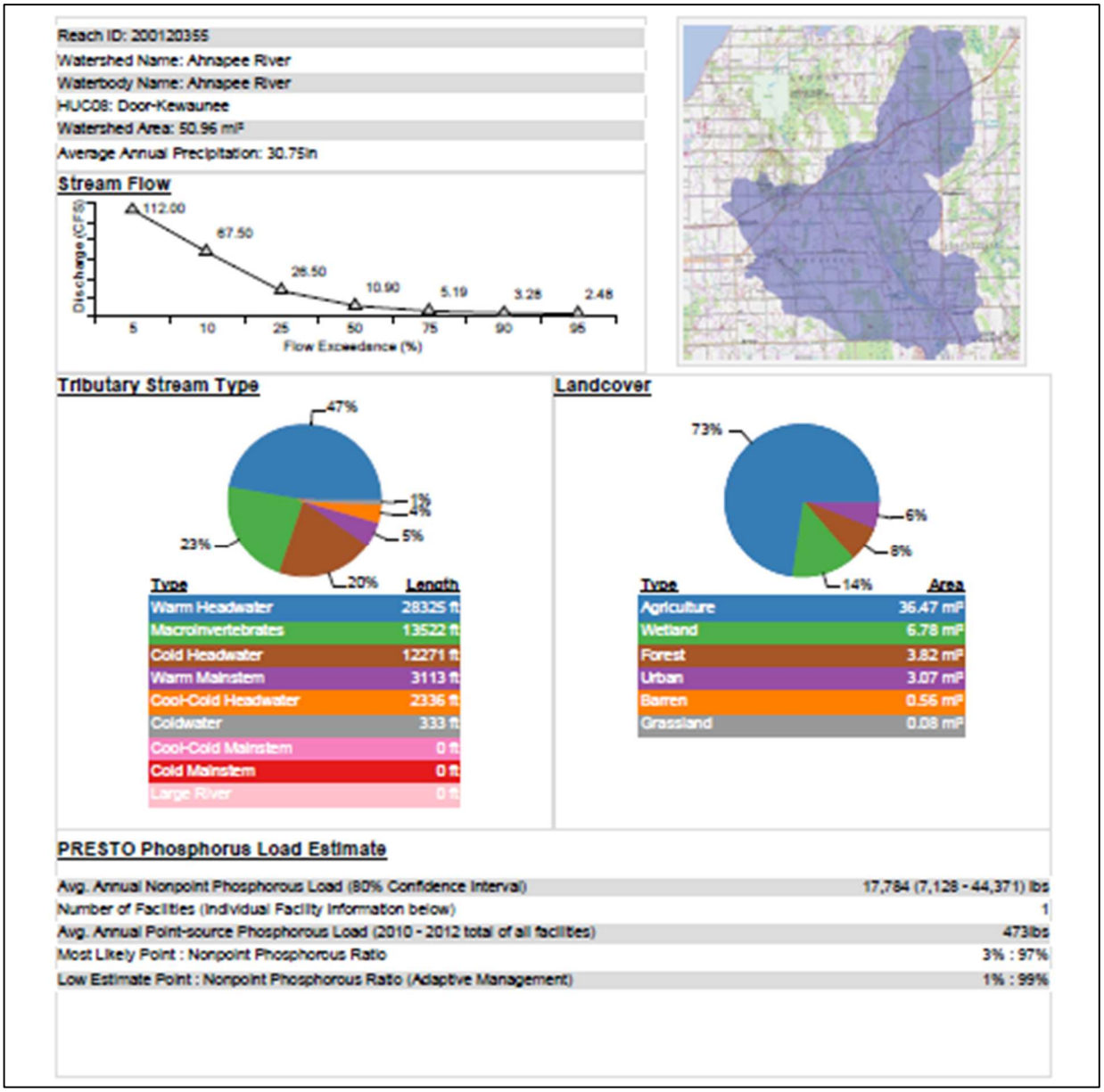


Figure 4. Ahnapee River (Door County) PRESTO-Lite Watershed Delineation Report, DNR 2019

Ahnapee River – Door Area
HUC 040301020204

- 73% Agriculture
- 17,784 pounds on average annual nonpoint phosphorus load

Entire Ahnapee River HUC-12
29,854 pounds (figure 3)
subtract
Door County - 17,784 pounds (figure 4)

= <u>11,800 pounds</u> on average annual nonpoint phosphorus load for <u>Kewaunee County</u>

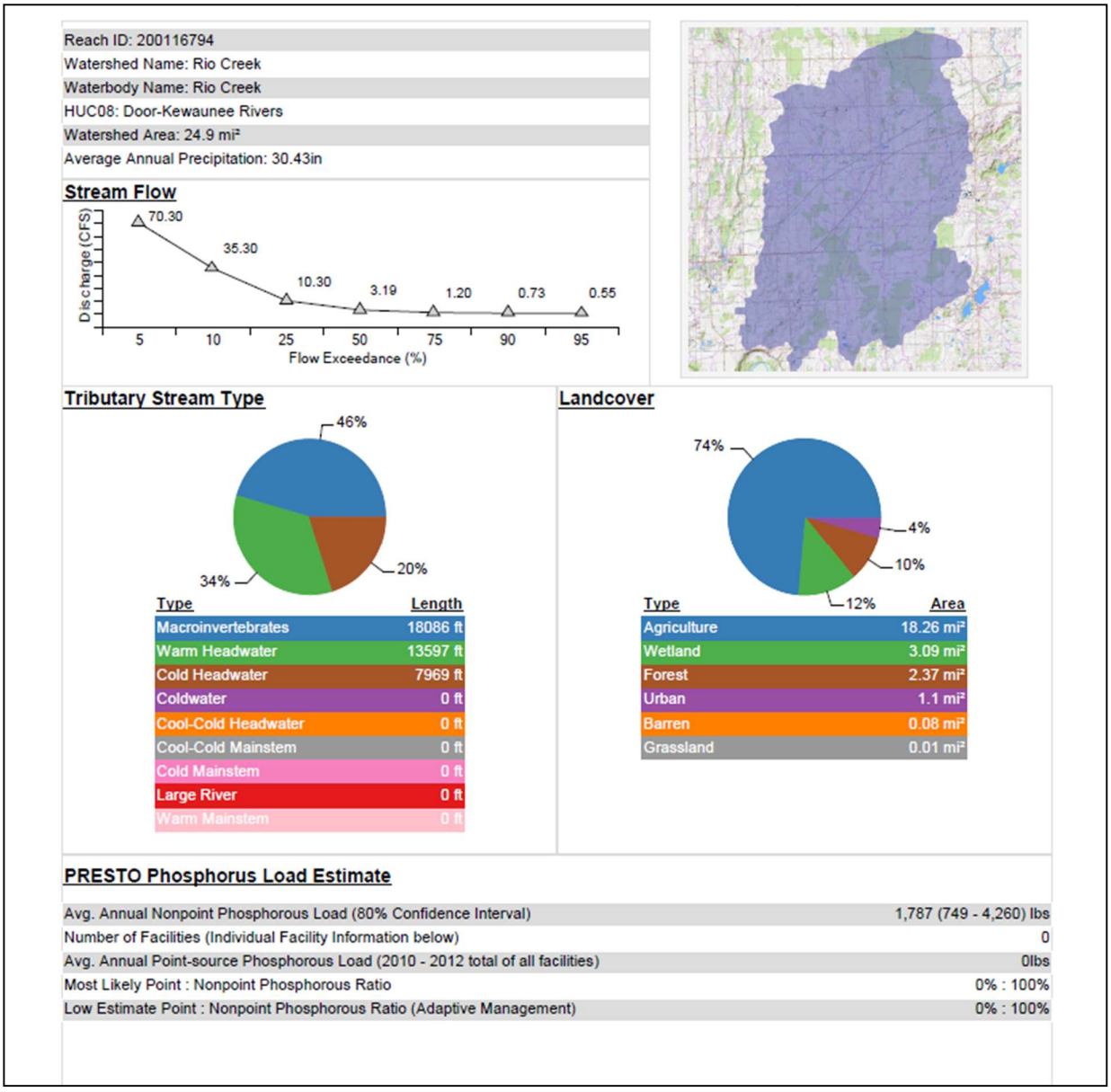
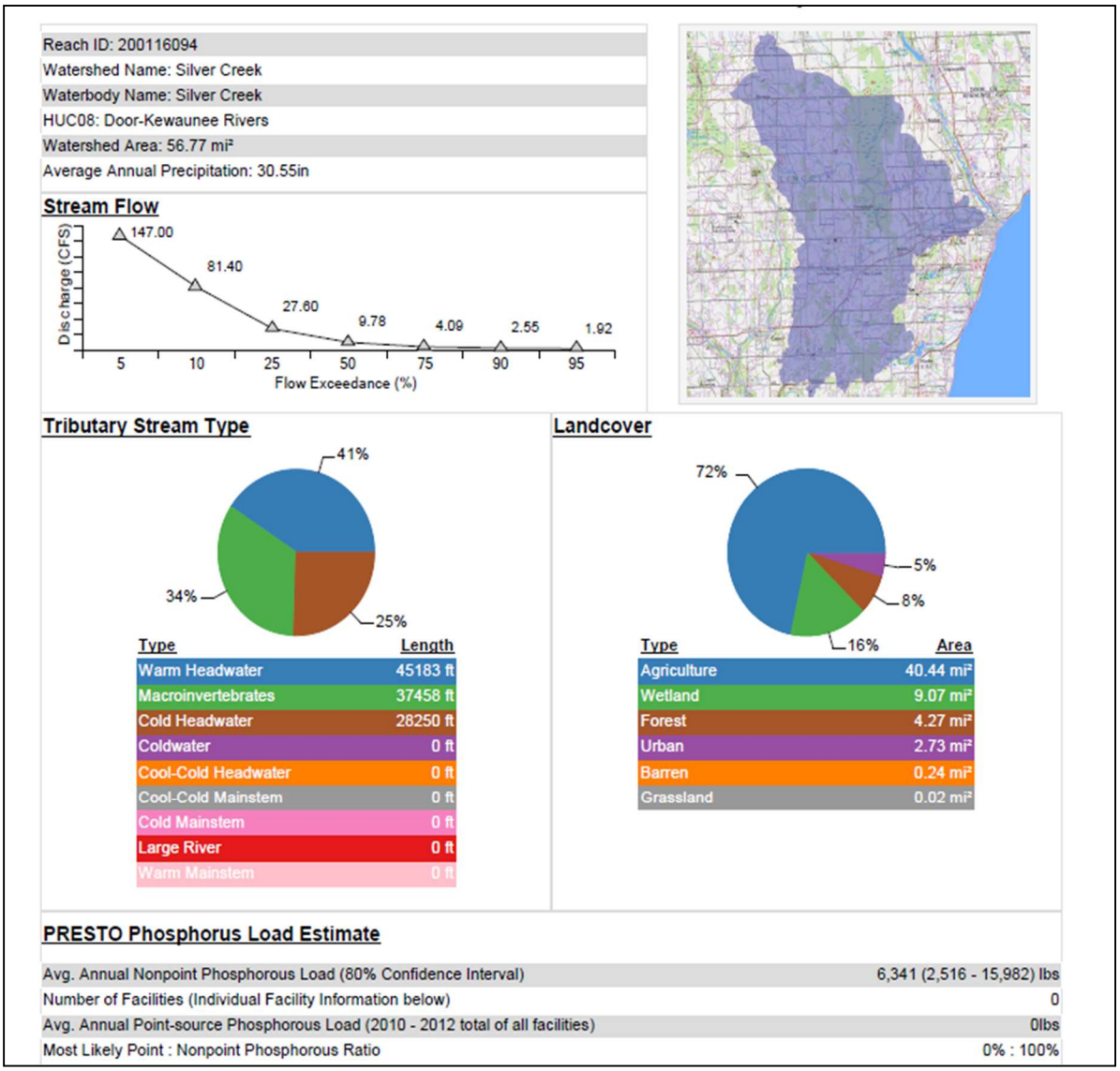


Figure 5. Rio Creek PRESTO-Lite Watershed Delineation Report, DNR 2019

Rio Creek
HUC 040301020202

- 74% Agriculture
- **1,787 pounds** on average annual nonpoint phosphorus load



Reach ID: 200116094
Watershed Name: Silver Creek
Waterbody Name: Silver Creek
HUC08: Door-Kewaunee Rivers
Watershed Area: 56.77 mi²
Average Annual Precipitation: 30.55in

Stream Flow

Tributary Stream Type

Type	Length
Warm Headwater	45183 ft
Macroinvertebrates	37458 ft
Cold Headwater	28250 ft
Coldwater	0 ft
Cool-Cold Headwater	0 ft
Cool-Cold Mainstem	0 ft
Cold Mainstem	0 ft
Large River	0 ft
Warm Mainstem	0 ft

Landcover

Type	Area
Agriculture	40.44 mi²
Wetland	9.07 mi²
Forest	4.27 mi²
Urban	2.73 mi²
Barren	0.24 mi²
Grassland	0.02 mi²

PRESTO Phosphorus Load Estimate

Avg. Annual Nonpoint Phosphorous Load (80% Confidence Interval)	6,341 (2,516 - 15,982) lbs
Number of Facilities (Individual Facility Information below)	0
Avg. Annual Point-source Phosphorous Load (2010 - 2012 total of all facilities)	0lbs
Most Likely Point : Nonpoint Phosphorous Ratio	0% : 100%

Figure 6. Silver Creek PRESTO-Lite Watershed Delineation Report, DNR 2019

Silver Creek
HUC 040301020203

- 72% Agriculture
- **4,554 pounds** on average annual nonpoint phosphorus load

The Ahnapee River watershed is dominated by agriculture and is ranked high for nonpoint sources affecting streams and groundwater. Therefore, WDNR and LWCD staff referenced annual agricultural Nutrient Management Plans (NMPs) for all farms and cash croppers, NR151 walkover data, conservation planning efforts, and analyzed current crop rotations within the 3 sub-watersheds to determine significant pollutant sources. These sources allowed LWCD to estimate the number and location of potential contaminant sources, and to determine background nutrient levels.

To determine baseline data, LWCD accessed information from NMPs, conservation plans and NR151 walkover data from calendar year 2017 that included cropland acres with and without an NMP, cropland acres with and without a Conservation Plan and acres with and without a NR151 walkover in each HUC-12. Furthermore, staff determined the number of animal operations without a manure storage or barnyard and/or feed leachate/milk house waste collection and the total operations/animal units within each sub-watershed.

Table 2 outlines the input data requirements for each HUC-12. An average of 79% of the cropland acres have an NMP and 90% have a conservation plan. Thirty-four percent (34%) of the cropland acres need a NR151 walkover, with the Ahnapee River sub-watershed with the highest at 49% or almost half the cropland acres needing a NR151 walkover to determine compliance status.

Table 2. Watershed Inputs

Input Data Requirements	**Rio Creek 40301020202**	**Ahnapee River 40301020204**	**Silver Creek 40301020203**
Acres **WITHOUT** NMP	1056 (13%)	1348 (33%)	1520 (17%)
Acres **with** NMP	6914 (87%)	2737 (67%)	7421 (83%)
Acres **WITHOUT** Conservation Plan	243 (2%)	809 (17%)	1141 (11%)
Acres **with** Conservation Plan	98%	83%	89%
Acres **WITHOUT** NR151 walkover	2356 (24%)	2308 (49%)	2988 (30%)
Acres in compliance with NR151	76%	51%	70%
Number of Farms (with animals)	11	5	9
Total Animal Numbers from 2019 NMPs	6072	227	7753
CAFO Animal Numbers	3100 (2 CAFOs)	0	6758 (1 CAFO & 1 CAFO Heifer Site)
Average Size of Non-CAFO (Animals)	330	45.4	142
# Animal Feeding Operations that **NEED** manure storage, barnyard, milk-house collection and or leachate	All 11 farms HAVE storage and collection	4	5
Acres of bare-lot (feedlot/exercise lot) that **NEED** to be upgraded	17.1	12.3	6.4
Average # of months manure is applied	8	11	9

Source: LWCD & WDNR Communication, 2018

SURFACE WATER QUALITY DATA

According to the WDNR, the watershed overall generally has good water quality, but the Ahnapee River was placed on the impaired waters list for Total Phosphorus (TP) in 2014. In 2016, the WDNR reassessed the Ahnapee River, but continued to document phosphorus impairments (WDNR Watershed Ahnapee River, 2018).

Silver Creek, which outlets into Lake Michigan, has fair to poor water quality and Rio Creek has very poor water quality. Both creeks experience impacts from farmland erosion and other nonpoint sources throughout the watershed. In 2018, Silver Creek was added to the impaired water listing for TP impairments and Rio Creek has not yet been designated (WDNR Watershed Ahnapee River, 2018).

Table 3. WDNR Listed Impaired Waters, Ahnapee River Watershed

Watershed	Waterbody Name	Pollutant	303(d) Listing Year	TMDL Priority
Ahnapee River (TK04)	Ahnapee River	Total Phosphorus	2014	Medium
		PCBs	1998	Low
	East Alaska Lake	Mercury	1998	Low
	Silver Creek (Havel Creek)	Total Phosphorus	2018	Medium

Source: DNR

East Alaska, West Alaska, and Krohns Lakes (all located in the Ahnapee River Watershed) have generally fair water quality as determined by WDNR monitoring in 2017 and 2018 for temperature, dissolved oxygen, TP, and chlorophyll around their deepest points (WDNR Lakes, 2018). A Trophic State Index (TSI), which is a classification system designed to rate bodies of water based on the amount of biological activity they sustain, was assigned to each waterbody.

The TSI of a body of water is rated on a scale from 0-100 and may be defined as:

- **Oligotrophic:** TSI 0–40, having the least amount of biological productivity, "good" water quality
- **Mesotrophic**: TSI 40–60, having a moderate level of biological activity, "fair" water quality)
- **Eutrophic** to **hypereutrophic**: TSI 60–100, having the highest amount of biological activity, "poor" water quality (Wikipedia, 2018).

WDNR determined the TSI score for East Alaska Lake was 46 and Krohns Lake was 48 in 2018, and West Alaska Lake was 45 in 2017; therefore, all falling under mesotrophic.

Shea Lake and Heidmann Lake (located in the East Twin River Watershed) were also monitored by the WDNR for the same parameters. Shea's Lake had a TSI of 62 in 2018 at its deepest area, placing it as eutrophic or "poor" water quality. Lakes that are considered eutrophic can see algae issues and extensive

plant growth. Heidmann Lake (in 2017) at its deepest spot had a TSI score of 43, which is mesotrophic or "fair" water quality (WDNR Lakes, 2018).

Water quality data collected from 2016 to 2018 by WDNR and Water Action Volunteers (WAV) for TP and total suspended solids (TSS) on the Ahnapee River and Silver Creek was incorporated into Step 1 (Figures 7 and 8). Map 17, page 55, shows the location for the Ahnapee River and Silver Creek monitoring sites.

From the 2016-2018 data, the median TP concentration for Silver Creek is 0.097 mg/L and median for Ahnapee River is 0.0549 mg/L. Silver Creek does not meet Wisconsin's TP criterion (0.075 mg/L) and Ahnapee River meets TP criterion (0.100 mg/L). The median TP concentration from 2018's data on the Rio Creek is 0.196 mg/L, which also does not meet Wisconsin's TP criterion (0.075 mg/L).

Silver Creek's Algal Blooms (2018), Kewaunee County
Photo Credit: Engels, LWCD

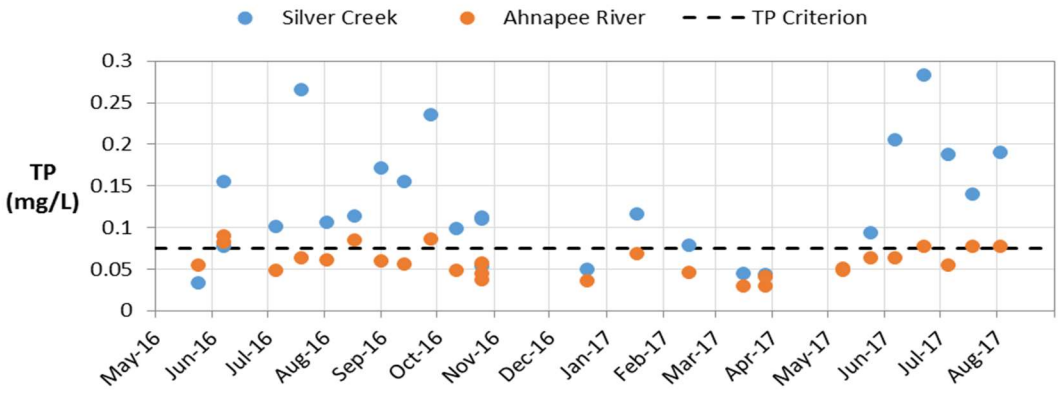


Figure 7. Total Phosphorus - Silver Creek & Ahnapee River (2016-2017)

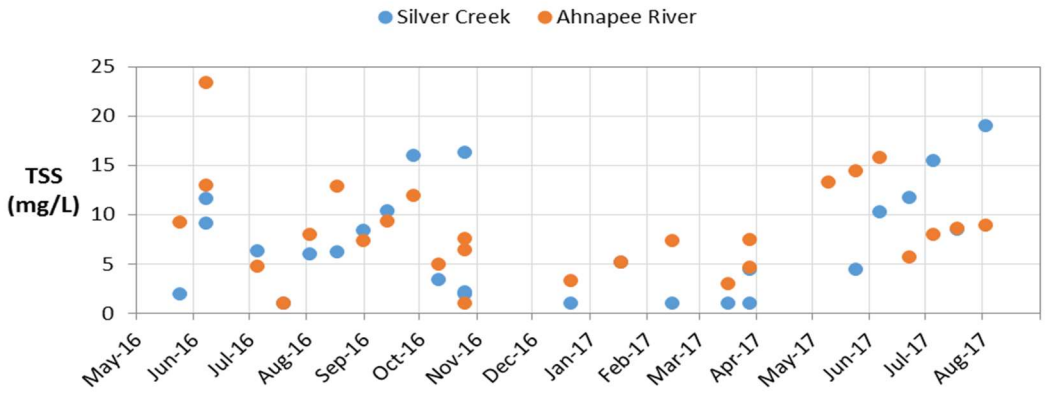


Figure 8. Total Suspended Solids - Silver Creek & Ahnapee River (2016-2017)

NORTHEAST LAKESHORE TMDL

After states establish priority rankings for their impaired waters, the next step is to develop a Total Maximum Daily Load (TMDL). A TMDL establishes the maximum amount of a pollutant allowed in a waterbody and serves as the starting point or planning tool for restoring water quality. A waterway that exceeds water quality standards is often no longer suitable for its designated uses, such as wildlife habitat, fishing, or other recreational activities. The ultimate goal of the TMDL is to improve water quality by reducing pollutants, such as phosphorus and sediment (EPA, 2018). In order to develop the TMDL, the watershed is studied to determine the amount of pollution currently entering the waterway.

In 2018, the Wisconsin Legislature 281.145, passed the Northeast Lakeshore TMDL study. The WDNR "shall conduct a program to monitor and study the introduction of nutrients from point sources and nonpoint sources into the East and West Twin Rivers, the Manitowoc River, the Sheboygan River, and the streams that outlet to Lake Michigan and that lie in and between the Ahnapee River watershed and the Sauk Creek watershed."

WDNR shall seek to do all of the following under this subsection:

- Identify the amounts of nutrients being introduced into these waters.
- Characterize and quantify the nutrients, in particular nitrogen and phosphorus, introduced into these waters from nonpoint sources relative to climate, land-use, soil type, elevation, and drainage.
- Collect water quality information from locations on these waters and from major tributaries and major impoundments to use in evaluating the biological, physical, and chemical properties of the water and to use as data in watershed and river models.
- Use watershed and river models and the information collected under this subsection and from other sources to forecast the effect on water quality of different methods of reducing the amounts of nutrients introduced into these waters.
- Develop tools to use in selecting and implementing methods of reducing the amounts of nutrients introduced into these waters.

The Northeast Lakeshore TMDL is in the initial development phase and is the first TMDL located in Kewaunee County. WDNR began surface water testing in 2016 and along with WAV volunteers continue to collect adequate water quality and flow data to be used to calculate nutrient loading in the Ahnapee River Watershed. Testing in Rio Creek began in May of 2018. WDNR estimates the entire TMDL process to be completed in 2022.

Northeast Lakeshore TMDL anticipated project milestones are (Figure 9):

- November 2019: All stream monitoring to be completed
- Fall 2020: WDNR to present initial watershed model results to stakeholders
- Winter 2021: WDNR to present draft allocations to stakeholders
- Summer 2021: WDNR to conduct TMDL public hearing
- 2022: WDNR to submit TMDL to EPA

Once complete, this 9-key element plan will be modified to reflect additional water quality results and (when complete) Northeast Lakeshore TMDL findings for sources of pollutant loads and necessary load reductions to meet water quality standards in each HUC-12 sub-watershed.

Monitoring locations for the Ahnapee River and Silver Creek are shown as black triangles in the Ahnapee River displayed in the green square on Map 2.

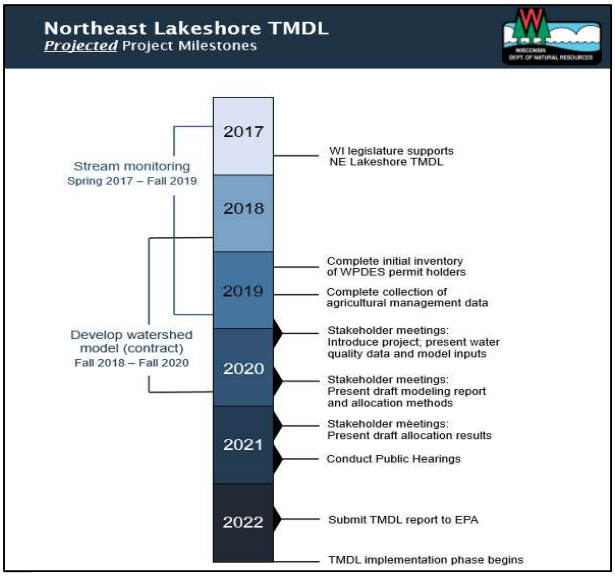
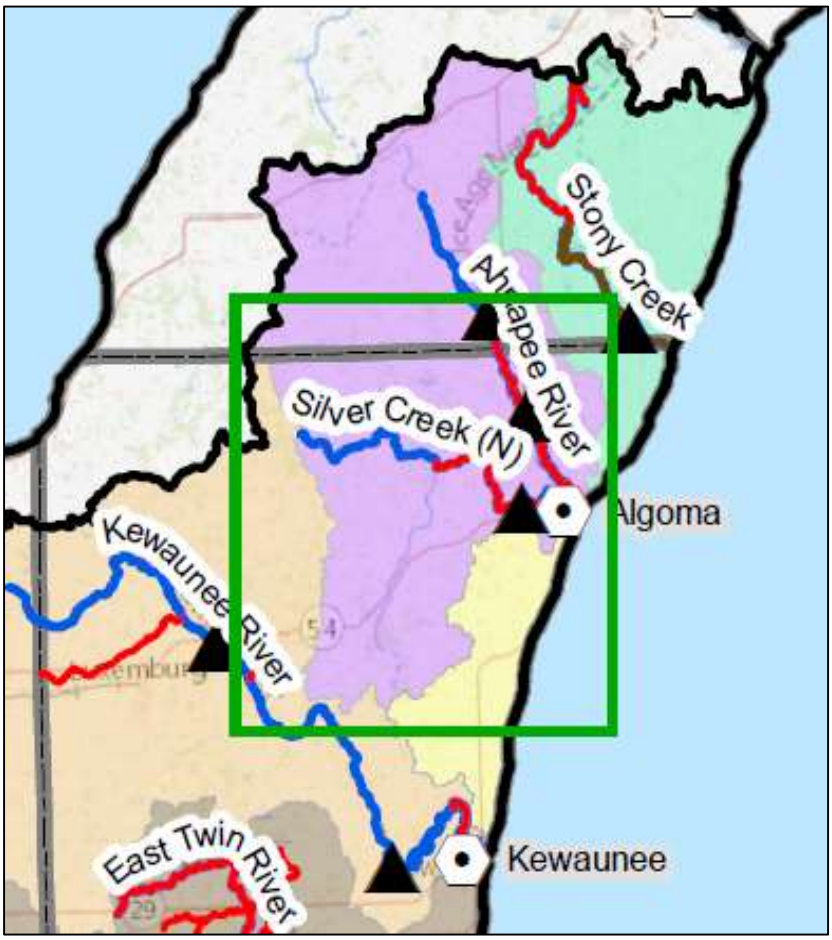
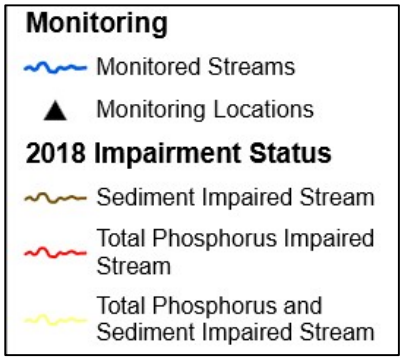


Figure 9. Northeast Lakeshore TMDL Projected Milestones





Map 2. Northeast Wisconsin TMDL and Ahnapee River Watershed

BEACH TESTING

Beach testing also measures surface water quality along Lake Michigan from Memorial Day to Labor Day. Crescent Beach, located in the City of Algoma and is located in the Ahnapee River Watershed. The EPA requires that beaches post an "advisory" sign informing the public of increased health risk when a water sample exceeds 235 colony-forming units (CFU) of *E. coli* per 100 milliliters of water and a "closed" sign when a water sample shows more than 1000 CFU of *E. coli* per 100 mL are present (Wisconsin Beach Health, 2018). Kewaunee County uses a system of red (warning), yellow (advisory), and green (safe) flags for our advisory system, as shown in the picture to the right.

Water Quality Notice, Crescent Beach, Algoma. Photo Credit: LWCD

Table 4 displays the past nine years of closings and advisories for Crescent beach. Closing and warnings can be directly related to the weather patterns and land-use activities. The more rain events during the testing dates can move nutrients from the landscape into surface waters; therefore, causing additional beach closing and warnings. In 2011 and 2014, Kewaunee County saw the highest number of closings and advisories, but then experienced a significant drop in 2015 through 2017.

In 2018, Kewaunee County had the first year since 2010 where no advisories or warnings were posted and that trend continued through 2019.

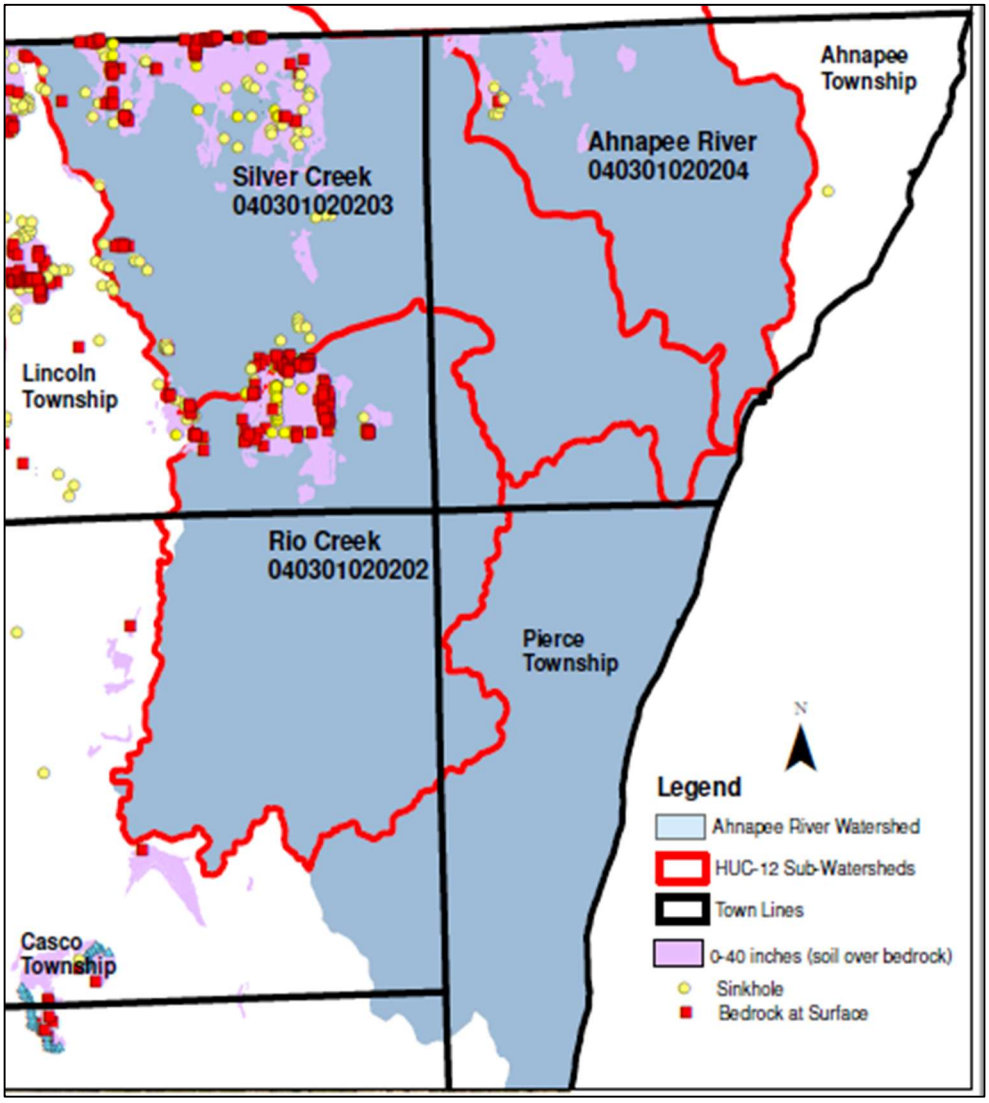
Table 4. Crescent Beach Closings & Advisories

Year	Crescent Beach		
	Beach Closings > 1000 CFU/100mL	**Warning Advisories** > 235 CFU/100mL	**Total Warnings & Closings**
2010	1	4	5
2011	5	9	14
2012	2	2	4
2013	2	3	5
2014	8	7	15
2015	2	2	4
2016	1	3	4
2017	1	2	3
2018	0	0	0
2019	0	0	0

Source: Wisconsin Beach Health, 2019

GROUNDWATER QUALITY DATA

Surface water and groundwater are often inter-connected in karst geology. Roughly 70% of the County's citizens rely on the Eastern Dolomite aquifer for their drinking water; however, in this "karst" geology, surface water and groundwater can be directly connected. Fracture traces, sinkholes, and other direct conduits commonly found in karst settings can provide surface water and any associated nutrients or pathogens direct pathways to groundwater. LWCD has done an extensive job in identifying these karst features (Map 3).



Map 3. HUC-12 Documented Karst Features

Local citizens often talk about their drinking water turning brown in the spring and fall seasons, directly correlating to groundwater recharge. Kewaunee County has worked very hard to document the level of groundwater contamination from coliform bacteria, e-coli bacteria, and nitrates.

Coliform bacteria are present in the environment and feces of all warm-blooded animals and humans, but unlikely to cause illness. However, their presence in drinking water indicates that disease-causing organisms (pathogens) could be in the water supply. Fecal coliform bacteria are a subgroup of total coliform bacteria and exist in the intestines and feces of people and animals. The presence of fecal coliform in a drinking water sample often indicates recent fecal contamination and means there is a greater risk that pathogens are present. *E-coli* is a subgroup of the fecal coliform group. Most *E-coli* bacteria are harmless and exist in the intestines of people and warm-blooded animals. However, some strains can cause illness. The presence of *E-coli* in a drinking water sample usually indicates recent fecal contamination (WDNR Bacterial Contamination, 2017).

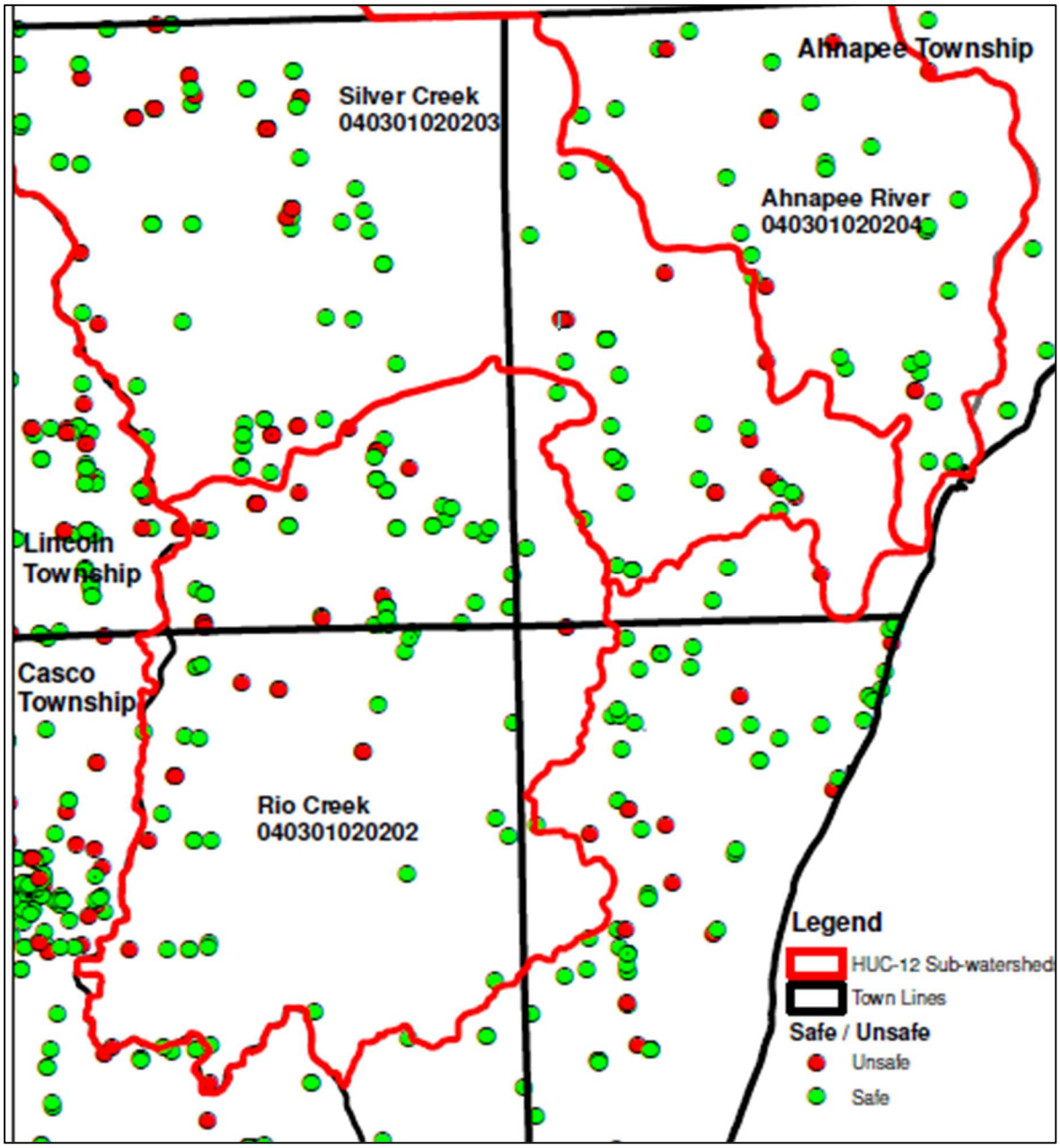
Nitrate-nitrogen is the most widespread groundwater contaminant in Wisconsin and because of its mobility through soils and groundwater, is generally considered to be a good indicator of groundwater susceptibility and land-use impacts. Background or natural levels of nitrate-nitrogen in groundwater are generally less than 1 mg/L (milligrams per liter) or 1 ppm (parts per million). Concentrations above 1 mg/L indicate influence by one or more of the following sources: nitrogen fertilizers, manure or other bio-solids (both application to land-surface or leakage from storage), land application of septage, or septic system drain fields. Nitrate-nitrogen concentrations above the drinking water standard of 10 mg/L should not be consumed by infants or women who are pregnant or expecting to become pregnant, all other persons are encourage to avoid long-term consumption of water greater than 10 mg/L (WDNR, 2014).

In 2004, Kewaunee County LWCD began a voluntary well testing program to educate landowners as well as the county on groundwater quality. Table 5 shows the cumulative well testing results from 2004 to 2018 for landowners who voluntarily tested their well. The number represents different wells tested in the County, and the overall percentage unsafe (bacteria positive and/or nitrates greater than 10 ppm) at 30.17%, of those who tested. Percentages of unsafe "tested" wells do increase in Townships that have a higher amount of shallow karst soils, including Lincoln which is located within this 9-key element plan watershed.

Table 5. Township Cumulative Well Testing Data (2004-2018)

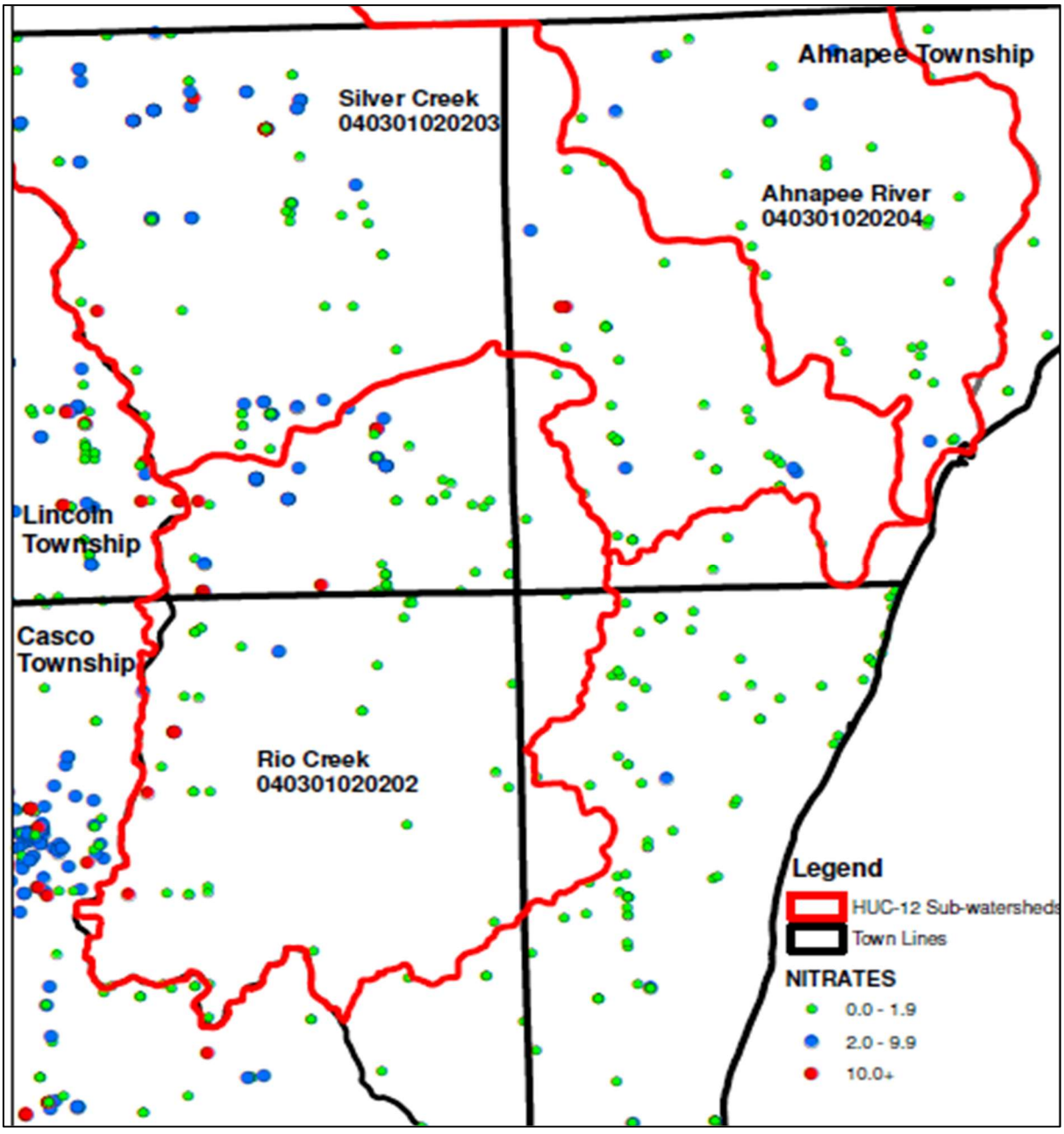
Townships within selected HUC-12s	**Total Number of <u>Tested</u> Wells**	**Total Unsafe Wells** *Bacteria Present and/or Nitrates > 10 ppm*	
		Number	**Percent**
Ahnapee	85	22	25.9%
Casco & Village of Casco	191	50	26.2%
Lincoln	208	69	33.2%
Kewaunee County	**1369**	**413**	**30.17%**

In fact, approximately 30% of tested wells have been identified as being unsafe by nitrogen, bacteria and/or pathogens in Kewaunee County. Map 4 displays the data within Table 5; green dots represent wells that have tested safe and red dots represent wells that are considered unsafe for either bacteria (coliform and/or *E-coli*) and/or nitrates greater than the health standard of 10 parts per million (ppm).



Map 4. HUC-12 Safe or Unsafe Wells Voluntary Testing, 2004-2018, (Bacteria Positive and/or Nitrates Greater than 10 ppm)

Nitrates, as displayed in Map 5, are broken down into three categories. The green dots are nitrates 0.0 - 1.9 ppm which are considered natural background ranges. Blue dots from 2.0 - 9.9 ppm are elevated nitrate levels, indicating human influences are impacting the groundwater and red dots are over the state's health standard of 10 ppm and are considered unsafe.



Map 5. HUC-12 Nitrate Results of Tested Wells, 2004-2018

GROUNDWATER RESEARCH

Previous groundwater research by Muldoon & Bradbury (2010) indicates contamination in the Silurian dolomite aquifer is often a function of the depth of the overlying glacial materials (or soil). Generally, thicker soil provides greater protection and increases the filtration of contaminants before entering the aquifer which is what we see in the voluntary testing results.

Testing private wells provides valuable data on groundwater quality; however, does not analyze or identify the specific source of contamination if a well is unsafe due to bacteria or nitrates greater than 10 ppm. Therefore, to answer this question, in 2015, the DNR funded a research study to evaluate the level of groundwater contamination as it correlates to depth of bedrock, virus contamination, and source of that contamination in Kewaunee County.

The research study conducted under Dr. Mark Borchardt et al had two main objectives: (1) design a county-wide randomized sampling plan, stratified by depth-to-bedrock, for nitrate and indicator bacteria and (2) sample once per season a subset of wells for viruses and fecal markers capable of distinguishing septic versus bovine sources of contamination.

Objective 1: A county-wide randomized sampling of private wells stratified by depth-to-bedrock was done in November of 2015 when groundwater recharge was occurring and again in July 2016 when there was no recharge. Results found were similar to the Kewaunee County voluntary well testing program. The overall percentage of tested wells contaminated by total coliform, *E-coli* or high nitrate (>10 ppm) was 26.4% in November 2015 during recharge event and 27.6% during the July 2016 non-recharge event.

To correlate contamination to depth of bedrock, Figure 10 breaks down the well results by 0-5 feet to bedrock, 5-20 feet to bedrock and 20 feet or greater to bedrock and then by recharge and no recharge events.

In tested wells located in areas with less than 5 feet to bedrock, 50% were unsafe for either total coliform, *E-coli* or high nitrates during the recharge period and 33% during no recharge. In 5-20 feet, 42% of the tested wells were unsafe during recharge and 40% during no recharge. And finally, wells with 20 feet and greater of soil over bedrock still had 23-26% of the tested wells found to be unsafe.

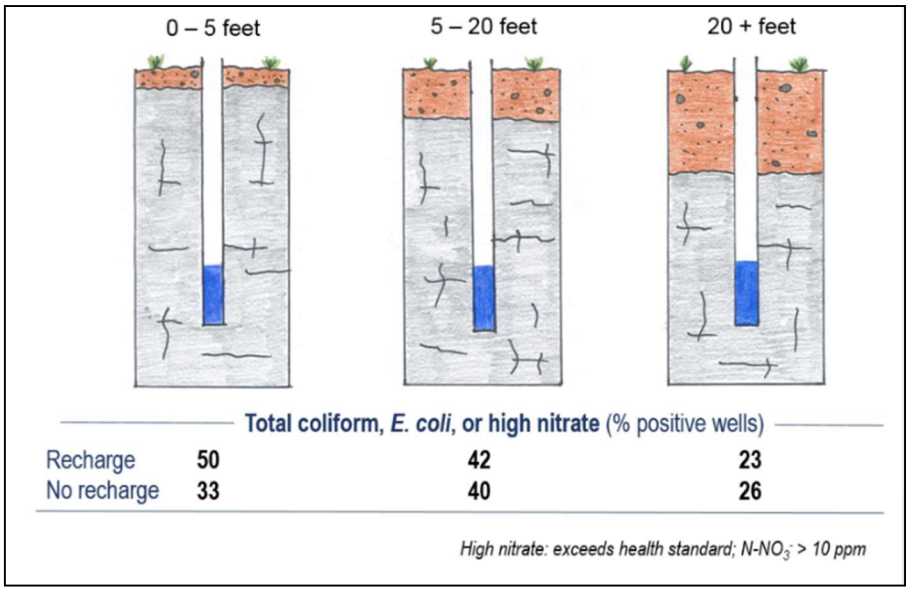


Figure 10. Total Coliform, *E-Coli*, or High Nitrates in Private Wells by Depth of Bedrock, Borchardt et al, 2018

The second objective was to determine the source of fecal contamination, Borchardt et al completed a randomized

stratified sampling of the 234 wells positive for total coliform, *E-coli*, or high nitrate (greater than 10 ppm) found in Objective 1. Five rounds of sampling were completed in April, August and November of 2016; and January and March, 2017 to determine host-specific and host non-specific microbes detected in private household wells. Human specific microbes were detected in 33 wells; bovine or ruminant specific microbes were detected in 44 wells; and no host specificity were detected in 37 wells.

As found, agricultural contamination is not the only source of nitrates, bacteria, or pathogens in Kewaunee County groundwater. Human waste from septic systems and/or the spreading of septage can also contribute to groundwater contamination.

Brown water events and the background well testing data have led to the completion of multiple groundwater studies, development of local ordinances including the Public Health & Groundwater Protection Ordinance and were a contributing factor to the recent update to NR151 with targeted performance standards when applying manure on Silurian bedrock soils within 16 Wisconsin counties, including Kewaunee County, which was locally adopted in November of 2019 as Chapter 39.

ADDITIONAL GROUNDWATER RESOURCES:

Karst Report - 2007
http://www.co.kewaunee.wi.gov/docview.asp?docid=15459&locid=192

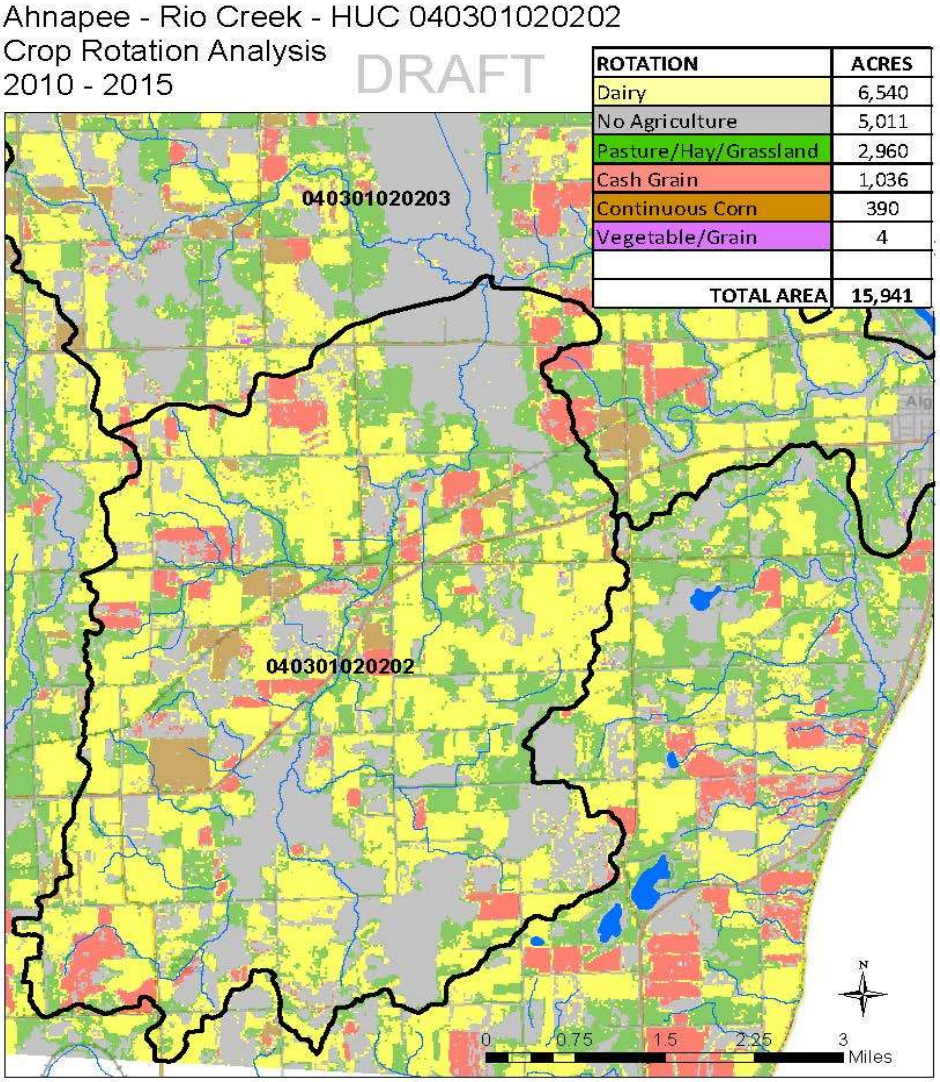
Manure Contamination of Rural Residential Wells
http://www.co.kewaunee.wi.gov/docview.asp?docid=15466&locid=192

Kewaunee County Groundwater Webpage
http://www.co.kewaunee.wi.gov/section.asp?linkid=2374&locid=194
http://www.co.kewaunee.wi.gov/subcategory.asp?linksubcatid=760&linkcatid=1568&linkid=2262&locid=192
http://www.co.kewaunee.wi.gov/docview.asp?docid=25686&locid=192

WDNR – Kewaunee County Groundwater Actions
https://dnr.wi.gov/topic/Groundwater/CollaborationWorkgroup.html
https://dnr.wi.gov/topic/DrinkingWater/manure.html
06/AllAgencyActionsFactSheetKewauneeMeeting.pdf

STEP 2: ESTIMATE POLLUTANT LOADING & EXPECTED LOAD REDUCTIONS

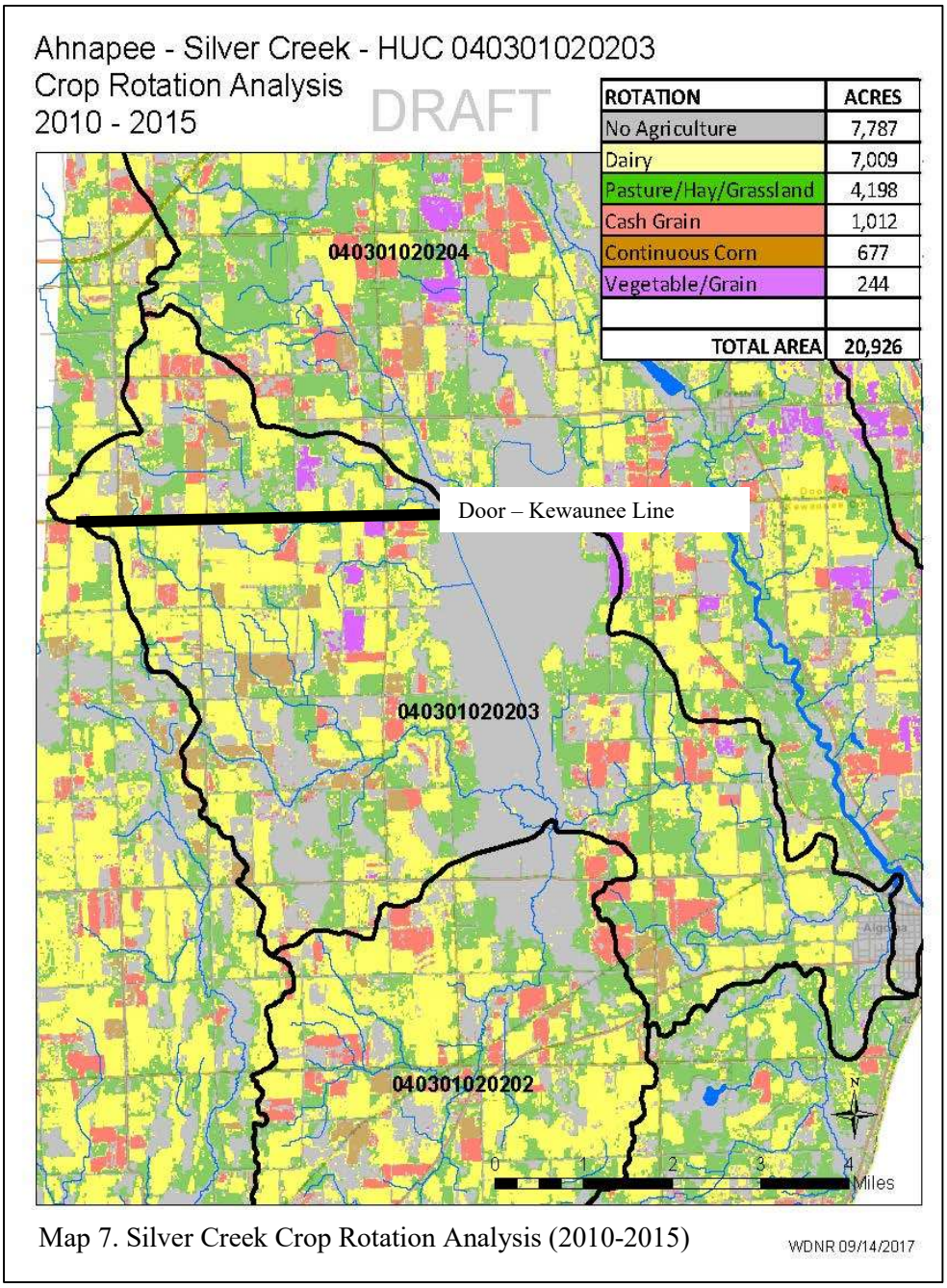
PRESTO reports identified each selected HUC-12 contains approximately 72-74% of land assessed as cropland and is the primary pollution source in the watershed. WDNR staff created crop rotation history Maps (6-8) for each HUC-12 that further identify agricultural causes and sources of pollution in each sub-watershed. These maps display each HUC-12s acres according to no agriculture, dairy, pasture/hay/grassland, cash grain, vegetable grain, and continuous corn. Cash grain acres in all three sub-watersheds have been on the continual rise as milk prices decrease. Continuous corn and vegetables acres remain low throughout Kewaunee County. A typical dairy crop rotation is 3-4 years of corn silage, 2-3 years of alfalfa and possibly a year of soybeans, oats or winter wheat. Cash grain operators run a variety of different rotations with soybeans, corn grain, oats grain and wheat.



Map 6. Rio Creek Crop Rotation Analysis (2010-2015)

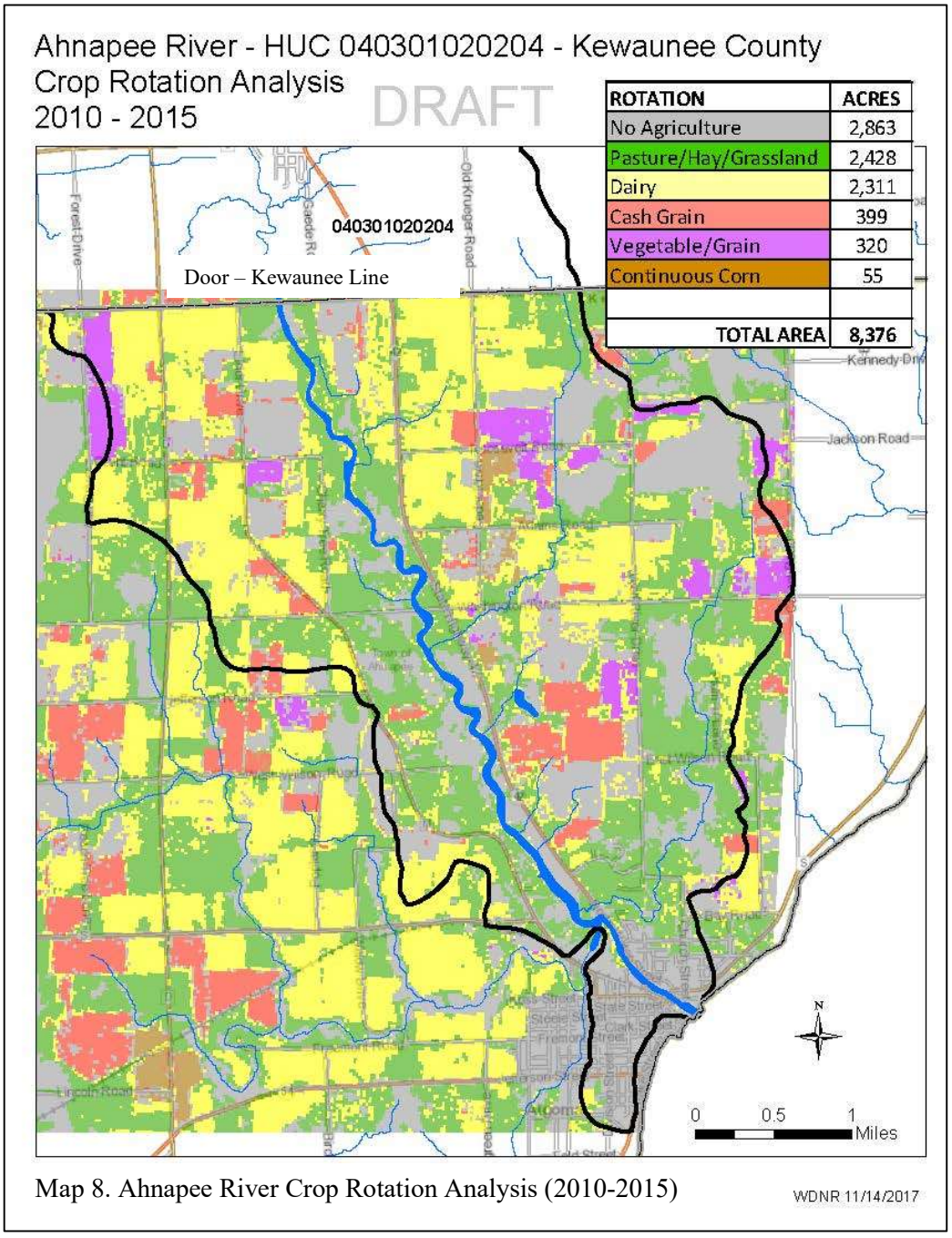
Rio Creek sub-watershed (HUC 040301020202-Map 6) encompasses approximately 15,941 total acres; of which only 5,011 acres or 31% are considered non-agriculture. The largest crop rotation is dairy acres, which represents 41% of the total area.

Silver Creek (HUC 040301020203-Map 7) extends into Door County. The total area represents approximately 20,926 acres; of which 33% represent dairy acres. Unlike, Rio Creek sub-watershed, non-agricultural land represents the largest land area with 37% of the total area because of the Black Ash Swamp wetland complex.



Map 7. Silver Creek Crop Rotation Analysis (2010-2015)

The Ahnapee River (HUC 040301020204-Map 8) also extends into Door County, but the map below only represents the Kewaunee County portion. This smaller sub-watershed represents approximately 8,376 acres; of which 27% represent dairy acres and 29% represent pasture/hay/grassland. Similar to Silver Creek sub-watershed, non-agricultural land represents the largest land area at 34%



Map 8. Ahnapee River Crop Rotation Analysis (2010-2015)

The rotations pulled from Maps 6-8 were also used, in part, for inputting data into a Spreadsheet Tool for Estimating Pollutant Loads (STEPL) to set baseline or current pollutant load conditions and to set milestones for future practices.

Therefore, to accurately estimate pollutant loading, LWCD staff calculated (using NMPs) the percent of cropland using different tillage (conventional, no-till, chisel) and conservation practices (cover crops, edge filters, farming on contour, and strip cropping) currently being applied to the cropland acres within the HUC-12 sub-watersheds. From these data inputs, WDNR ran STEPL modeling (Figure 11) to calculate the current loading of Nitrogen (N), Phosphorus (P), Biological Oxygen Demand (BOD), and sediment within each HUC-12 sub-watershed.

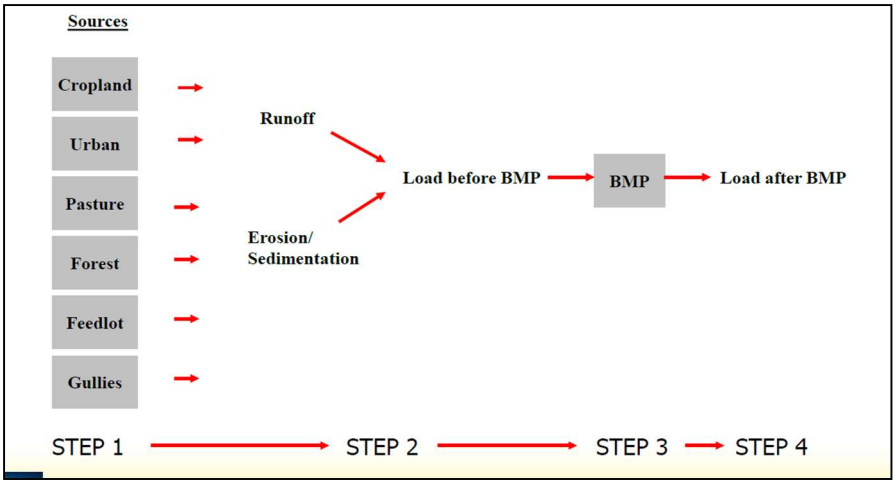


Figure 11. STEPL Model

STEPL's first step is to input the contributing sources (urban, cropland, pastureland, forest, feedlots, septic, gully, streambank and groundwater) with their relative loading equivalents. For each HUC-12, the annual nutrient loadings were calculated using STEPL model derived values for runoff volume and pollutant concentrations in runoff water, which are based upon STEPL inputs that capture watershed conditions (tillage intensity, average soil P concentration, soil erodibility, soil hydrologic group, current management practices, etc.). The annual sediment load from sheet and rill erosion was calculated based off USLE (Universal Soil Loss Equation) and the sediment delivery ratio. The sediment and pollutant load reductions were generated from adoption of new or additional BMPs using STEPL derived BMP efficiencies (EPA, 2018).

Table 6 identifies the current sources STEPL analyzed and the corresponding combined N, P, BOD, and sediment loadings for all three HUC-12 sub-watersheds. Total current loadings are approximately 206,000 pounds of N; 46,000 pounds of P; 451,000 pounds of BOD; and 6,000 tons of sediment every year.

Table 7 separates the total loadings in Table 6 per their HUC-12 sub-watershed. When compared, the STEPL baseline P load (46,207 lbs./P/yr.) was similar to the PRESTO P annual load estimate (34,180 lbs./P/yr.). PRESTO is based upon measured flow and TP concentration stream data; STEPL model results are not.

Table 6. Current Total Load by Land-Use (with BMP)

Sources	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)
	lbs./year	lbs./year	lbs./year	tons/year
Urban	1,693.85	261.21	6,669.12	38.69
Cropland	138,453.62	36,869.61	267,418.24	5,338.27
Pastureland	45,455.92	4,317.62	146,217.71	378.51
Forest	2,958.24	1576.8	7,245.32	93.93
Feedlots	16,982.44	2,915.32	21,699.78	0.00
Septic	435.24	170.47	1,777.21	0.00
Gully	116.88	96.42	233.75	73.05
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Totals:	**206,096**	**46,207**	**451,261**	**5,922**

Source: WDNR Communication, 2018

Table 7. Current Loading by HUC-12 Watershed

HUC-12 Watersheds	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)
	lbs./year	lbs./year	lbs./year	tons/year
Silver Creek	90,368.4	20,278.5	197,291.5	2378.8
Rio Creek	74,673.1	17,267.4	160,797.2	2201.3
Ahnapee River	41,054.7	8,661.6	93,172.4	1342.3
Totals:	**206,096**	**46,207**	**451,261**	**5,922**

Source: WDNR Communication, 2018

The estimated loading reductions from the above practices are assumed to also have some reduction in nitrogen loading to the fractured Silurian bedrock aquifers within the three HUC-12 sub-watersheds. Currently, there are no groundwater-based models available to estimate current and future nitrate loads to groundwater aquifer within the watershed, after adoption of various nutrient management practices.

Agricultural land excluded from manure application due to NR151.075 or local ordinance requirements in the watershed, will have an estimated reduction of up to 10 lbs. N/1,000 gallons for a typical application for a dairy slurry, in addition to mitigating contamination from pathogens (UW-Madison, 2016).

This reduction estimate assumes:

- excluded fields will not receive commercial fertilizer application to replace manure nutrients.
- a fraction of total manure nitrogen applied to fields with shallow bedrock can leach below the crop root zone and reach the aquifer each year.

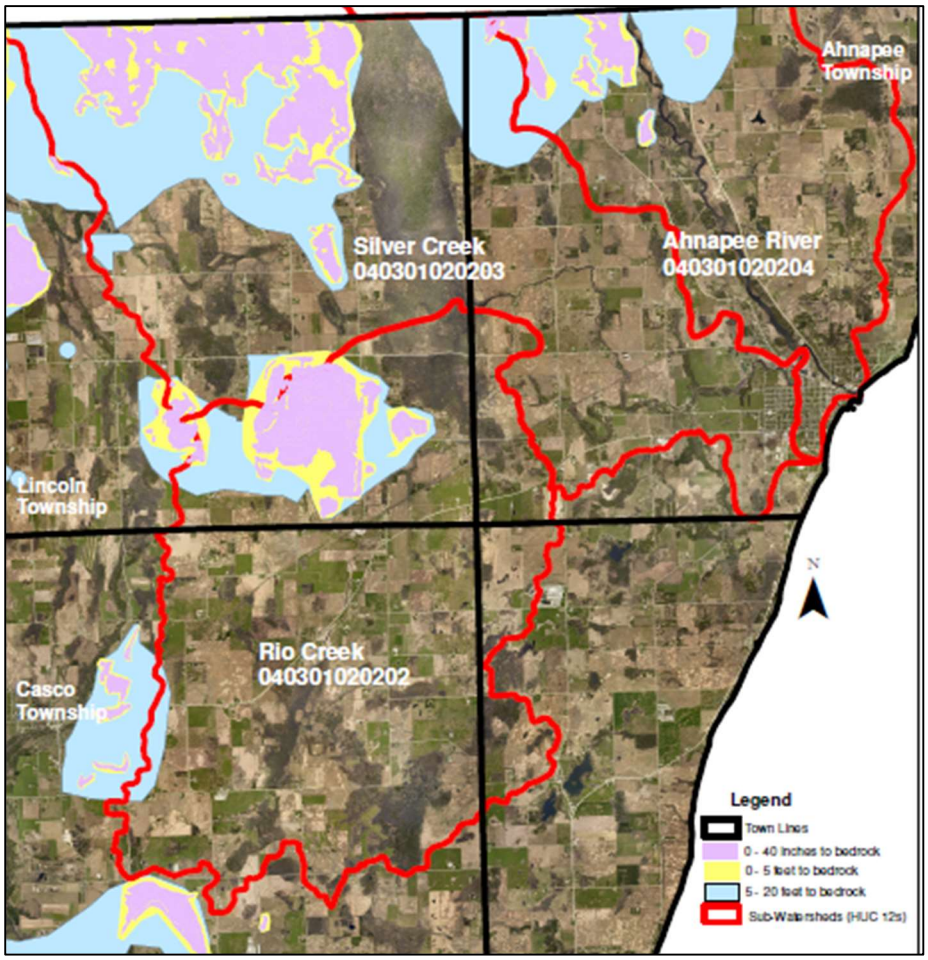
Under the new NR151.075 Silurian Dolomite Standards, to protect the groundwater aquifer, less than 24 inches to bedrock can no longer receive any manure applications; and new rates and restrictions were established for bedrock at 2-3 feet, less than 5 feet and 20 feet or less. To determine the less than 24 inches to bedrock layer, LWCD staff is hand probing all 0-40-inch soils. Some of these acres were already prohibited

from receiving manure due to NR243 (CAFO restriction); but that number could not be easily identified. Table 8 identifies the approximate acres impacted by NR151.075 where soil depths with less than 40 inches to bedrock (identified in pink on Map 9), 40 inches to 5 feet (yellow) and 5 feet to 20 feet (blue).

Table 8: HUC-12 - Bedrock Depths Acres & Percentages

HUC-12 Sub-Watersheds	Total Acres in HUC-12	Bedrock at 0-40 inches (pink)		Bedrock at 40 inches to 5 feet (yellow)		Bedrock at 5 feet to 20 feet (blue)		Total Bedrock at 0-20 feet	
		Acres	%	Acres	%	Acres	%	Acres	%
Silver Creek	17,923	1,913	10.7	741	4.1	3,744	20.9	6,398	35.7
Rio Creek	15,941	804	5.0	444	2.8	890	5.6	2,138	13.4
Ahnapee River	8,376	280	3.3	170	2.0	1,158	13.8	1,608	19.2
Totals:	**42,240**	**2,997**	**7.1**	**1,355**	**3.2**	**5,792**	**13.7**	**10,144**	**24.0**

Silver Creek sub-watershed contains the highest amount of shallow soils over bedrock, mostly located in Lincoln Township at 35% or approximately 6,000 acres. Overall, 24% of the acres in the Ahnapee River watershed have soils less than 20 feet to bedrock and therefore have newly associated Silurian Dolomite manure spreading restrictions.



Map 9. NR151 Silurian Dolomite Standards; Depth to Bedrock

STEP 3: IDENTIFY REASONABLE GOAL ADOPTION OF FUTURE CROPLAND PRACTICES

Cropland practices that participating agencies have the ability to cost-share and implement through state, federal, and local programs will be used to meet or exceed NR151 agricultural performance standards reduce N, P, BOD, and sediment loads. Common practices used within STEPL modeling in this plan includes: cover crops, residue management, no-till, grass buffers and filters, grassed waterways to fix gully erosion, waste management collection, nutrient management plans, and conservation plans.

CROPLAND BEST MANAGEMENT PRACTICES

Table 9 identifies the 10-year implementation goals (2020-2029) per Best Management Practice (BMP) and for each HUC-12 sub-watershed. Overall, this plan will focus upon reducing the primary causes and sources of pollutants within each HUC-12 sub-watershed to improve water quality by increasing the number of acres with cover crops, cropland residue management (residue1), grass filter strips and/or buffers and grassed waterways and achieve 75% implementation of the NMPs.

Implementation of NMPs refer to verifying the planned crops, manure applications, and tillage to reduce soil erosion and phosphorus losses are actually being implemented consistently on existing cropland in each HUC-12 sub-watershed. For livestock facilities, the goal is to properly manage and/or collect feedlot, manure, and wastewater runoff from entering waters of the state or groundwater resources.

Table 9. 10-year BMP Implementation Goals & Milestones

Best Management Practices (BMPs)	**HUC-12 watersheds of the Ahnapee River Watershed**		
	Silver Creek	**Rio Creek**	**Ahnapee River**
Cover Crops + NMP	500 acres	500 acres	500 acres
Residue1 + NMP	1000 acres	1000 acres	1000 acres
Grass Filter + NMP	200 acres	200 acres	200 acres
75% NMP Implementation	All NMP acres	All NMP acres	All NMP acres
Feedlots with Waste Management System	2 acres	2 acres	2 acres
Grassed Waterways (GWW)	1000 feet	1000 feet	1000 feet
BMPs associated with fish and wildlife (plantings, ponds, etc.) and flooding	30 acres	30 acres	30 acres
BMPS associated with beach restorations (plantings, beach-shoreline erosion)	N/A	N/A	Crescent Beach
Revise NMPs on selected farms to reflect NR 151.075 and Kewaunee County groundwater ordinance	Finish in 2020 on current NMP acres Fall 2020: Work on with new NMPs	Finish in 2020 on current NMP acres Fall 2020: Work on with new NMPs	Finish in 2020 on current NMP acres Fall 2020: Work on with new NMPs

Source: WDNR Communication, 2018.

Table 10 takes the 10-year BMP overall goals from Table 9 and outlines an implementation strategy by milestones (0-3 years, 3-7 years and 7-10 years) with applicable funding sources and the agency to oversee/verify implementation.

Table 10. 10-year Implementation Strategy of BMPs

Recommendations of BMPs	Indicators	Milestones (in years)		
		0-3	3-7	7-10
Conservation practices to cropland: including cover crops, no-till, residue management in priority areas	# of acres & practices installed	150 acres Cover Crops + NMP 300 acres residue + NMP	150 acres Cover Crops + NMP 400 acres residue + NMP	200 acres Cover Crops + NMP 300 acres residue + NMP
Installation of GWW	# of linear feet	250 feet	500 feet	250 feet
Installation of grass filter strips + NMP along perennial/intermittent streams	# acres installed	50 acres	75 acres	75 acres
Nutrient Management - 75% Implementation	Acres verified	30% NMP acres	50% NMP acres	75% NMP acres
Feedlots with Waste Management System	Acres constructed	0.5 acres	1.0 acres	0.5 acres
Enforcement of NR 151.03 standard for tillage setbacks from surface waters	% of fields meeting	25%	50%	75%
Revise NMPs on selected farms to reflect NR 151.075 and County Groundwater Ordinance Practices	% of acres revised	100%	Continue to Field Verify	Continue to Field Verify

Agencies associated to implement practices:

- LWCD
- WDNR
- NRCS

Potential Funding Sources to implement recommended BMPs identified in Table 10:

- Environmental Quality Incentive Program (EQIP)
- Targeted Runoff Management Program (TRM)
- Soil Water Runoff Management Program (SWRM)
- Conservation Reserve Program (CRP)
- Great Lakes Restoration Initiative (GLRI)
- Conservation Resource Enhancement Program (CREP)

LOAD REDUCTIONS

If the BMPs identified in Table 9 are implemented and maintained over the 10-year schedule (Table 10), STEPL (outlined in Table 11 and by HUC-12s in Table 12) estimates an approximate reduction of 180,693 pounds of N; 36,795 pounds of P; 447,630 pounds of BOD; and 5,351 tons of sediment each year in the watershed. This equates to a 12% reduction in N, a 20% reduction of P, a 1% reduction in BOD and a 10% reduction in sediment loading from the baseline conditions in the watershed (Table 13). The largest area for improvement is associated to cropland and pastureland management practices. Therefore, these two areas will be the highest priority.

Table 11. Future Total Load by Land-Use (with 10-year installed BMPs)

Sources	**N Load (with BMP)**	**P Load (with BMP)**	**BOD (with BMP)**	**Sediment Load (with BMP)**
	lbs./year	lbs./year	lbs./year	tons/year
Urban	1,693.85	261.21	6,669.12	38.69
Cropland	119,820.83	28,750.36	263,740.98	4,763.69
Pastureland	45,455.92	4,317.62	146,217.71	378.51
Forest	2,958.24	1,576.8	7,245.32	93.93
Feedlots	20,289.46	1,603.42	21,699.78	0.00
Septic	435.24	170.47	1,777.21	0.00
Gully	140.24	115.63	280.31	76.17
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Totals:	**180,693**	**39,795**	**447,630**	**5,351**

Source: WDNR Communication, 2018

Table 12. Future Total Load by Land-Use (with 10-year installed BMPs) by HUC-12

HUC-12 Watersheds	**N Load (with BMP)**	**P Load (with BMP)**	**BOD (with BMP)**	**Sediment Load (with BMP)**
	lbs./year	lbs./year	lbs./year	tons/year
Silver Creek	80,164.1	16,239.2	196,186.9	2,203.7
Rio Creek	66,453.9	14,040.4	159,724.8	2,032.1
Ahnapee	34,075.7	6,515.9	9,718.8	1,115.2
Totals:	**180,693**	**36,795**	**447,630**	**5,351**

Source: WDNR Communication, 2018

Table 13. 10-year STEPL Reductions

Sub-Watersheds	**N Load (with BMP)**	**P Load (with BMP)**	**BOD (with BMP)**	**Sediment Load (with BMP)**
	lbs./year	lbs./year	lbs./year	tons/year
Silver Creek	10,204.3	4,039.4	1,104.7	175.1
Rio Creek	8,219.2	3,226.9	1,072.5	169.2
Ahnapee	6,978.9	2,145.6	1,453.6	227.1
Totals:	**25,402**	**9,411**	**3,630**	**571**
Total Reduction	**12.3%**	**20.4%**	**0.8%**	**9.6%**

Source: WDNR Communication, 2018

Achieving these reductions will not only assist in making progress towards meeting water quality standards in Silver Creek, Rio Creek and the Ahnapee River, but also will help meet the future reduction goals established within the Northeast Lakeshore TMDL project expected to be complete in 2023.

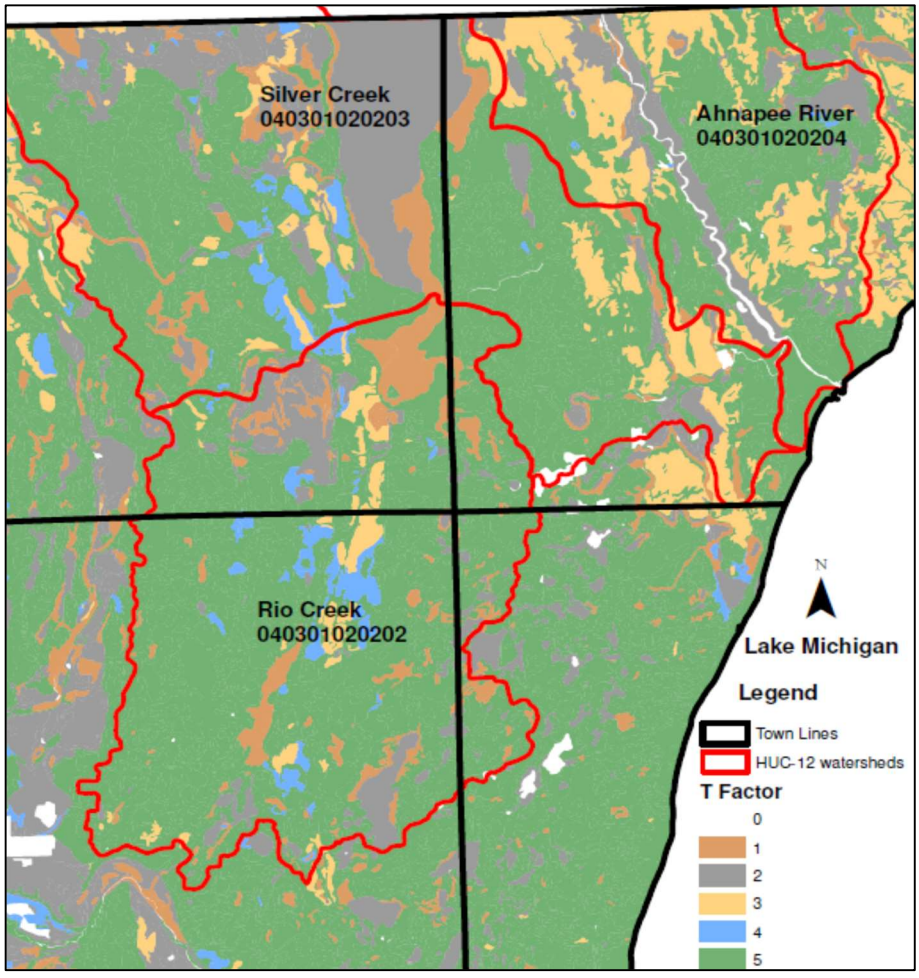
Depending on the decreases needed to support the TMDL findings, BMPs may need to be re-evaluated for effectiveness. The "National Management Measures for the Control of Nonpoint Pollution from Agriculture" (EPA-841-B-03-004) provides insight into how agricultural non-point pollution sources (NPS), can affect both surface and groundwater and discusses the concept of addressing water quality problems at a watershed level (EPA, 2019). This document also includes a general discussion of BMPs to protect both surface and groundwater in Chapter 3 of the LWRMP.

CRITICAL AREAS

The following Maps (10-15) display the HUC-12 sub-watershed boundaries for the Silver Creek, Rio Creek and Ahnapee River and reflect critical areas for the adoption of practices in Table 9 and Table 10.

TOLERABLE SOIL LOSS

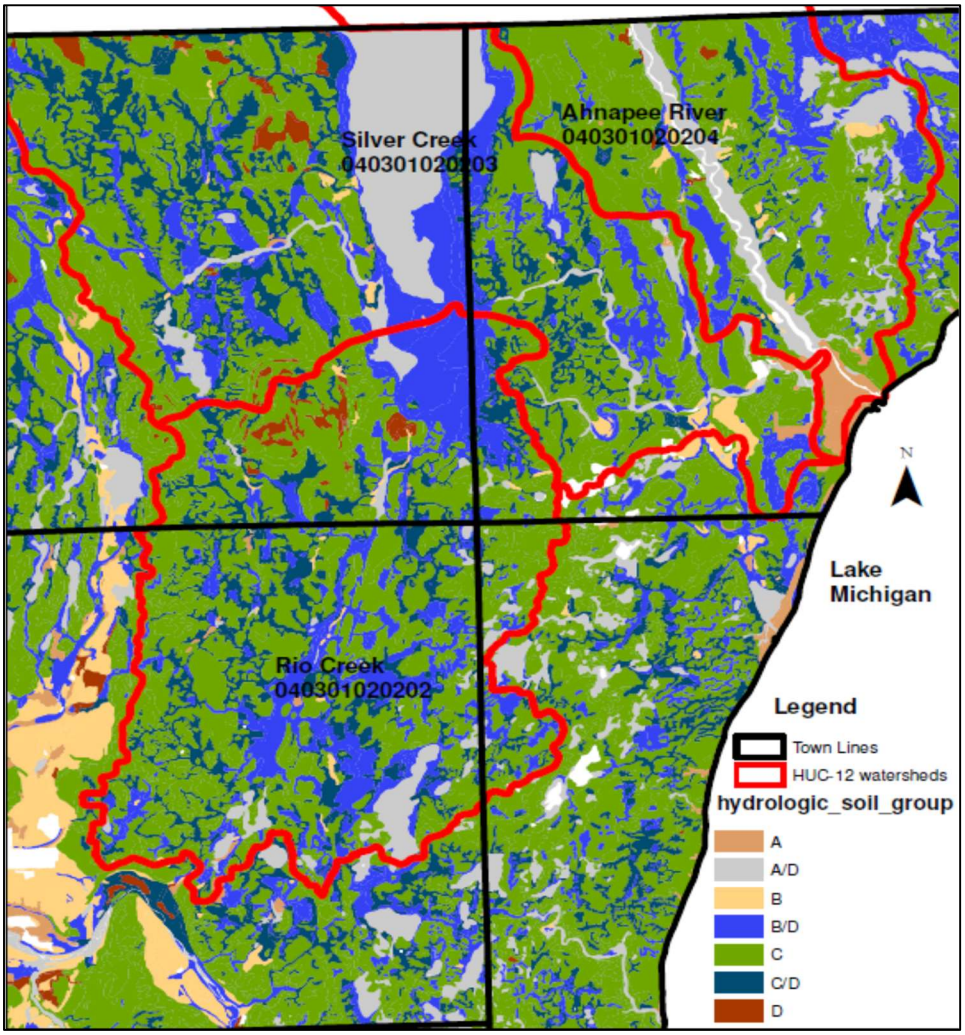
Map 10 displays the Tolerable Soil Loss, or T value, per sub-watershed. Refer to pages 50-52 of the LWRMP description of T values. Fields with T values of 2 or less in each sub-watershed will initially be used as critical areas in this plan.



Map 10. HUC-12 Tolerable Soil Loss "T" Factor

HYDROLOGIC SOIL GROUPS

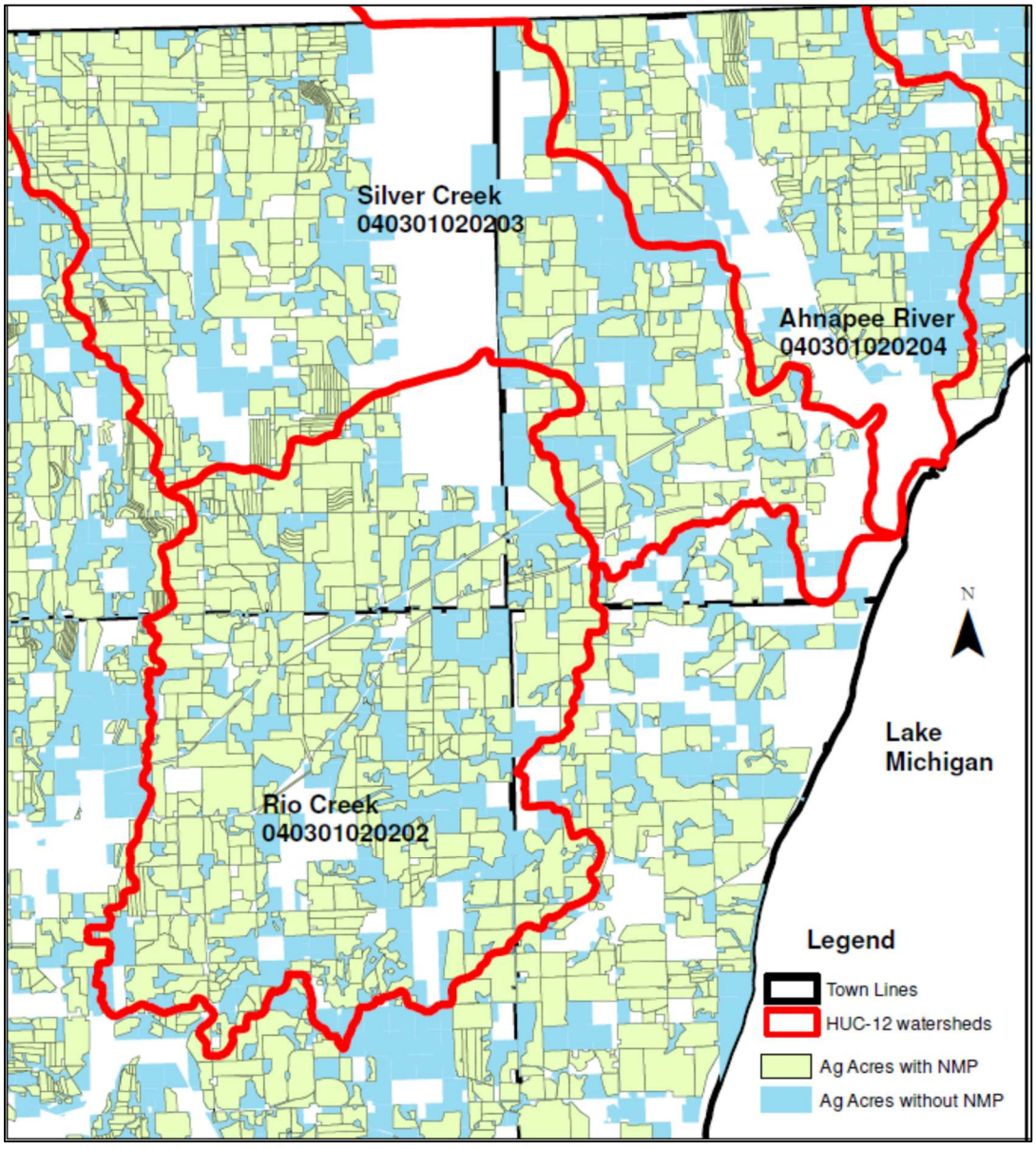
Map 11 displays the Hydrologic Soil Groups per HUC-12 sub-watershed. The majority of soils are considered to be Group C, which have a low infiltration rates when thoroughly wetted. Refer to pages 50-52 in LWRMP for a description of hydrologic soil groups. Fields with hydrologic group values D or C/D in each sub-watershed will initially be used as critical areas in this plan.



Map 11. HUC-12 Hydrologic Soil Groups

NUTRIENT MANAGEMENT

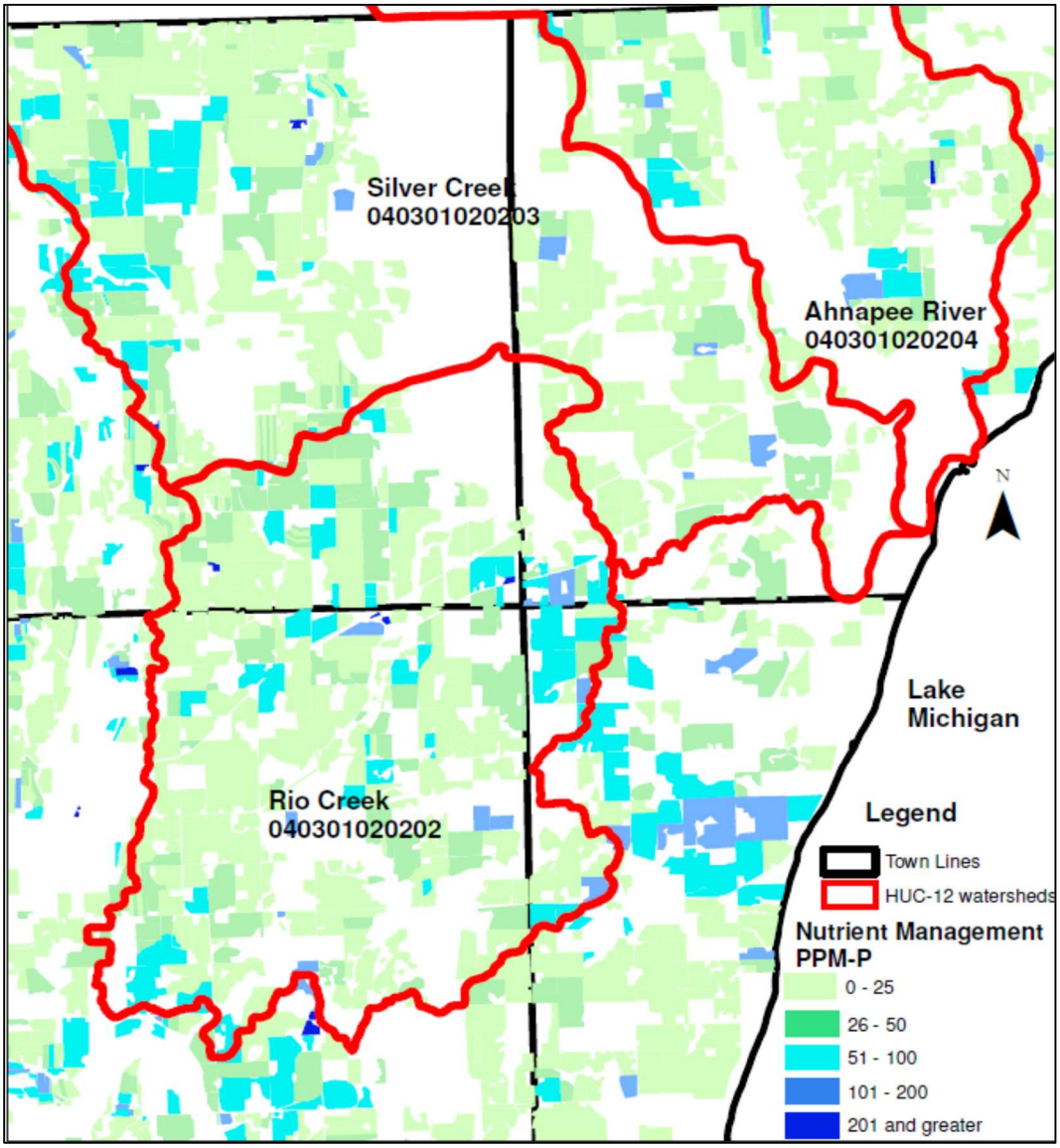
Map 12 displays Nutrient Management on the landscape within the HUC-12 sub-watersheds. Yellow indicates the LWCD has a 2018-2019 NMP in the office for that parcel/field and blue represents no NMP, which is approximately 4,000 acres (Table 2). Therefore, the blue areas will be critical areas to develop nutrient management plans on acres that are not currently covered and the yellow areas are critical to verify implementation of current NMP.



Map 12. HUC-12 Acres with and without Nutrient Management

PHOSPHORUS SOIL LEVELS

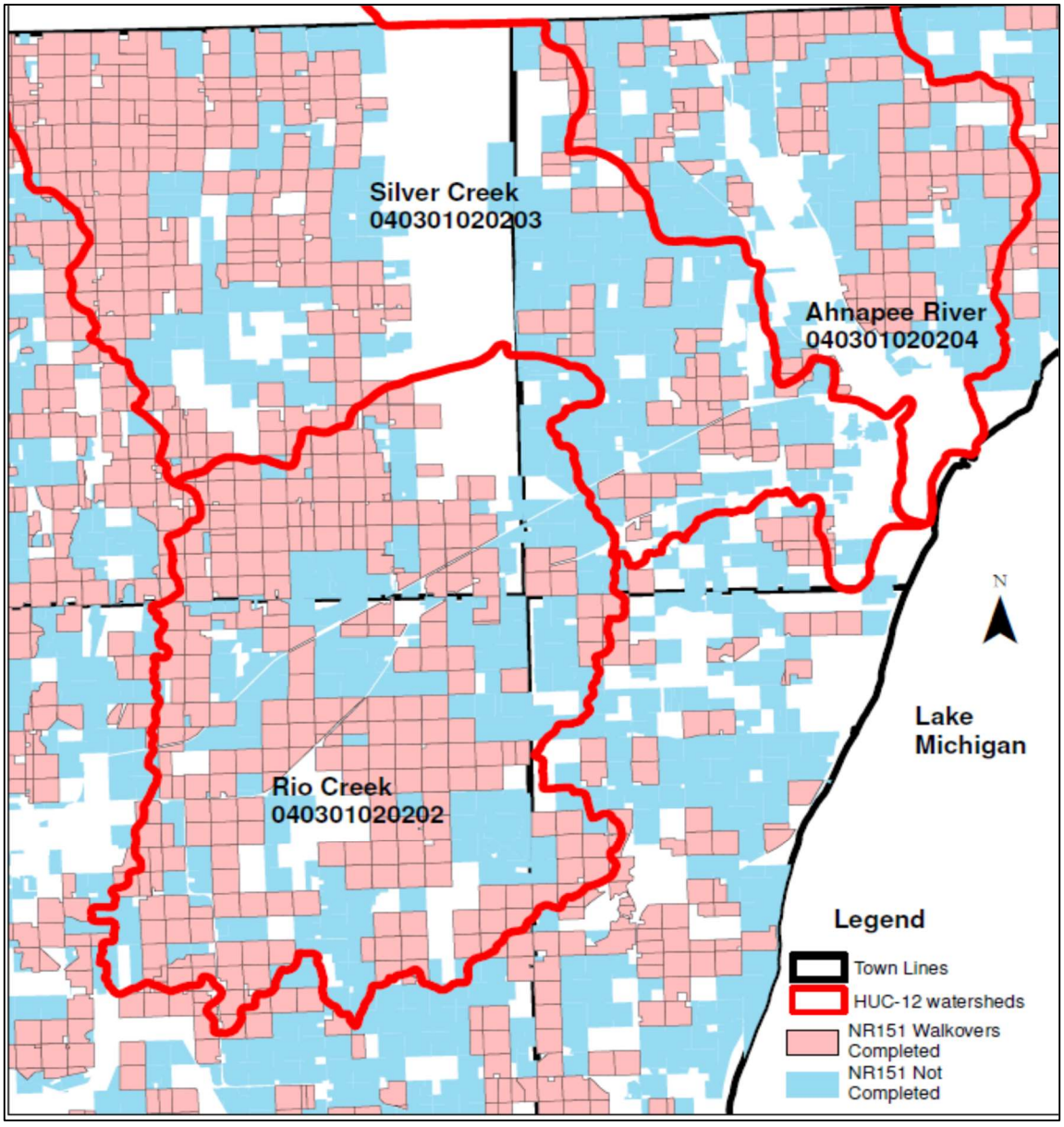
Map 13 displays the areas under Nutrient Management and the associated phosphorus (P) levels according to soil samples. The blue areas indicate higher levels of phosphorus in the soil and will be critical areas for this plan. If erosion occurs in the blue areas, the phosphorus attached can significantly impact surface water. These areas will be targeted for establishing crop rotations that drawn down phosphorus levels and implement multiple conservation practices.



Map 13. HUC-12 Nutrient Management Phosphorus Levels

NR151 WALKOVERS

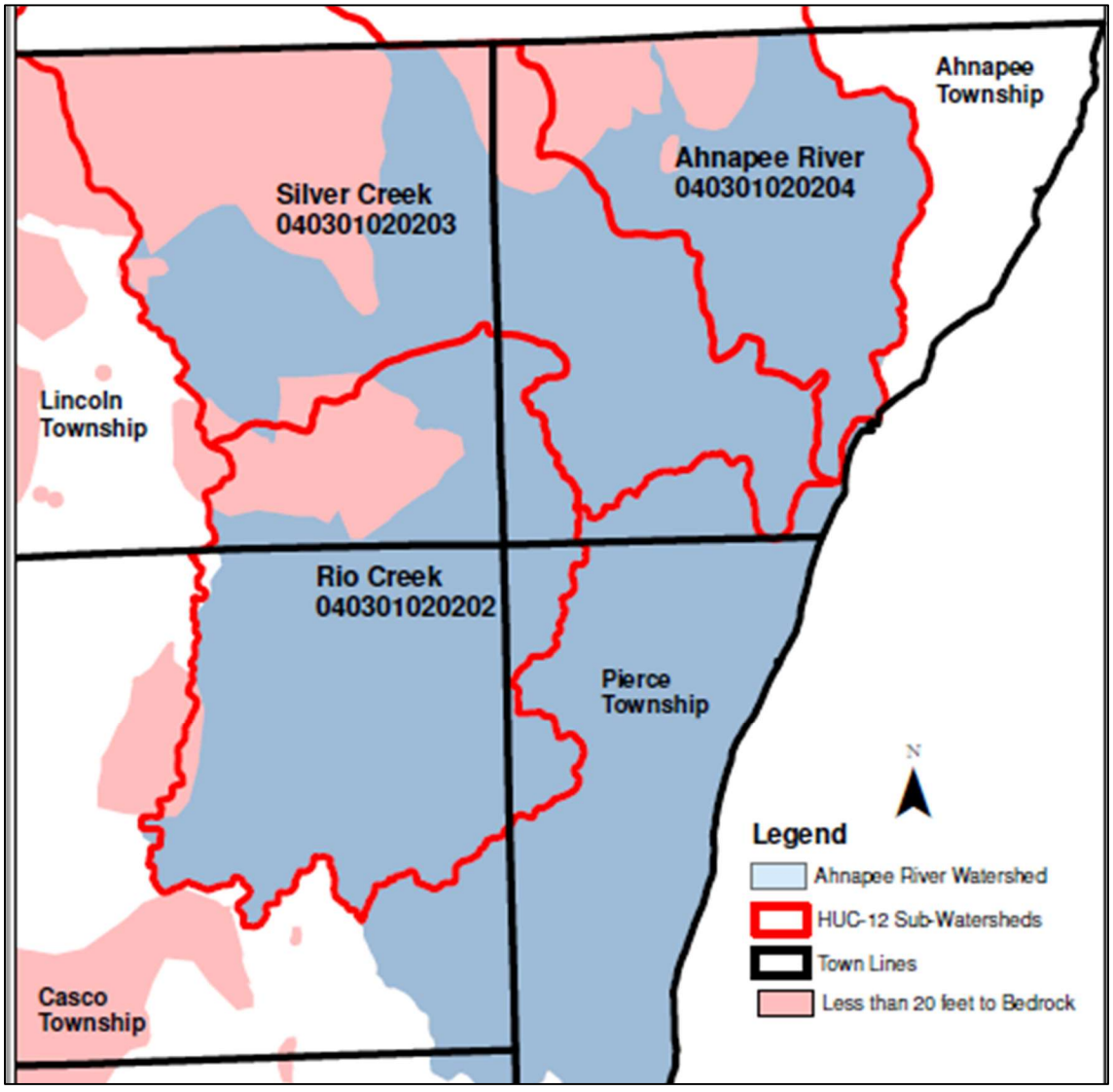
Map 14 displays where Kewaunee County LWCD has conducted NR151 walkovers within the HUC-12 sub-watersheds. Pink indicates the LWCD has conducted a compliance walkover for that parcel and the blue indicates the approximately 7,600 acres of agricultural land that has not been walked for NR151 compliance. The blue areas are critical areas in this plan for determining NR151 compliance status; while the pink will be critical areas to maintain compliance.



Map 14. HUC-12 Acres with and without a NR151 Walkover

COUNTY PRIORITY AREAS

Areas to be targeted for Kewaunee County's Public Health & Groundwater Protection Ordinance (no spreading or stacking of any waste from January 1st to April 15th on less than 20 feet to bedrock) and for the NR151.075 targeted performance standard updates are shown in Map 14. In addition to the requirements of these regulations, identified areas will also be targeted for implementation of other groundwater protective BMPs to further reduce nitrate loading. Table 8 previously identified that approximate 10,000 acres of less than 20 feet to bedrock in the entire Ahnapee River watershed.



Map 15. HUC-12 Bedrock Acres less than 20 feet

WATERSHED ANALYSIS

Kewaunee County consulted with WDNR extensively when developing this plan. Part of our consultation was the option to work with WDNR staff to use the Erosion Vulnerability Assessment Agricultural Lands (EVAAL) and Normalized Data Tillage Index (NDTI) tools within the watershed too help further identify critical areas for agricultural practices and evaluate plan implementation by estimating crop residue levels across the watershed.

Milestone:

- Within one year of plan approval, work with WDNR to use EVAAL and NDTI tools for the watershed and incorporate the results/findings into the plan. Continue using NDTI tool annually to determine crop residue levels across each HUC-12 sub-watershed to guide and evaluate plan implementation. Share NDTI results with watershed stakeholders at planned education and outreach events.

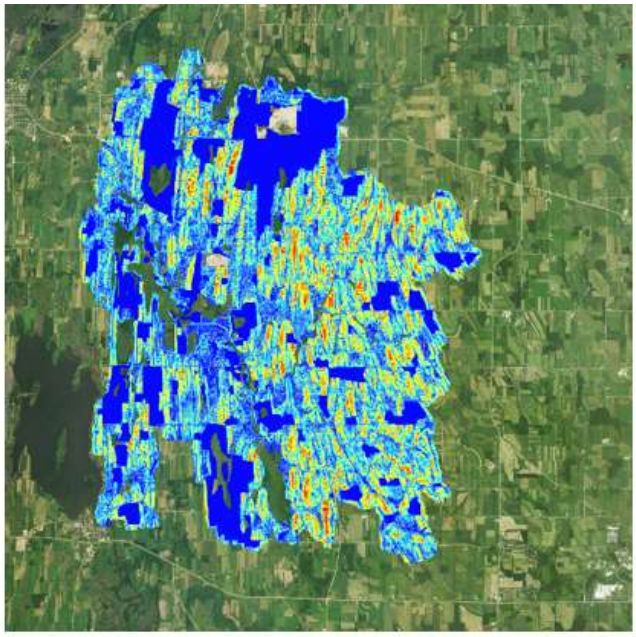
EROSION VULNERABILITY ASSESSMENT AGRICULTURAL LANDS (EVAAL)

EVAAL is a GIS-based tool that uses readily-available elevation, soils, and land use information to assess vulnerability of agricultural lands to erosion and nutrient export. It was developed to support the prioritization and implementation of agricultural best management practices for improving surface water quality. EVAAL evaluates locations of relative vulnerability to sheet, rill, and gully erosion using information about topography, soils, rainfall, and land cover.

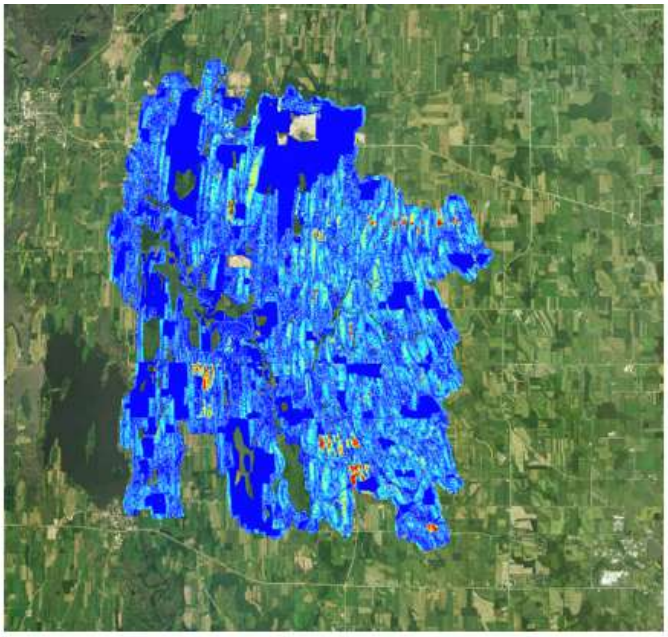
EVAAL estimates vulnerability by separately assessing the risk for sheet and rill erosion (using the Universal Soil Loss Equation, USLE), and gully erosion (using the Stream Power index, SPI), while deprioritizing those areas that are not hydrologically connected to surface waters (also known as internally drained areas, IDA). These three pieces are combined to produce an erosion vulnerability index (EVI) value that can be assessed at the grid scale or aggregated to areas, such as field boundaries (DNR, http://dnr.wi.gov/topic/Nonpoint/EVAAL.html).

Figure 12 shows example outputs/descriptions of two erosion vulnerability indexes. On the left uses a soil loss index with a High C factor and on the right a Low C Factor. Red are high risk areas; yellow are medium risks; green represent a low risk for soil erosion; and solid blue are internally drained areas.

**On March 1, 2020, the WDNR started working on the EVAAL analysis for the 3 HUC-12 watersheds in this 9-key element plan. The results will be included in Appendix 3 when completed (April – May 2020).



Erosion Vulnerability Index (Using Soil Loss Index With High C Factor):



Erosion Vulnerability Index (Using Soil Loss Index With Low C Factor):

Figure 12. Erosion Vulnerability Index

NORMALIZED DATA TILLAGE INDEX (NDTI)

Tillage conditions within watersheds change over time. Accordingly, this plan will employ a new method of analyzing crop residue levels and tillage intensity from readily available satellite imagery. Since tillage takes place at different times, a series of Landsat 8 satellite images[1] will be selected for analysis in spring and fall months to calculate a minimum NDTI (minNDTI) for the watershed. The NDTI estimates crop residue levels based on shortwave infrared wavelengths.

The example image below (Figure 13) displays the mean minNDTI values per agricultural field in the watershed. The mean minNDTI can help to better identify areas in the watershed that would be good candidates for implementation of reduced tillage practices and cover crops. This analysis of imagery can also be used as a way to track implementation of cropping practices as more years of imagery is collected, since satellites regularly circle the earth.

[1] https://landsat.usgs.gov/landsat-8

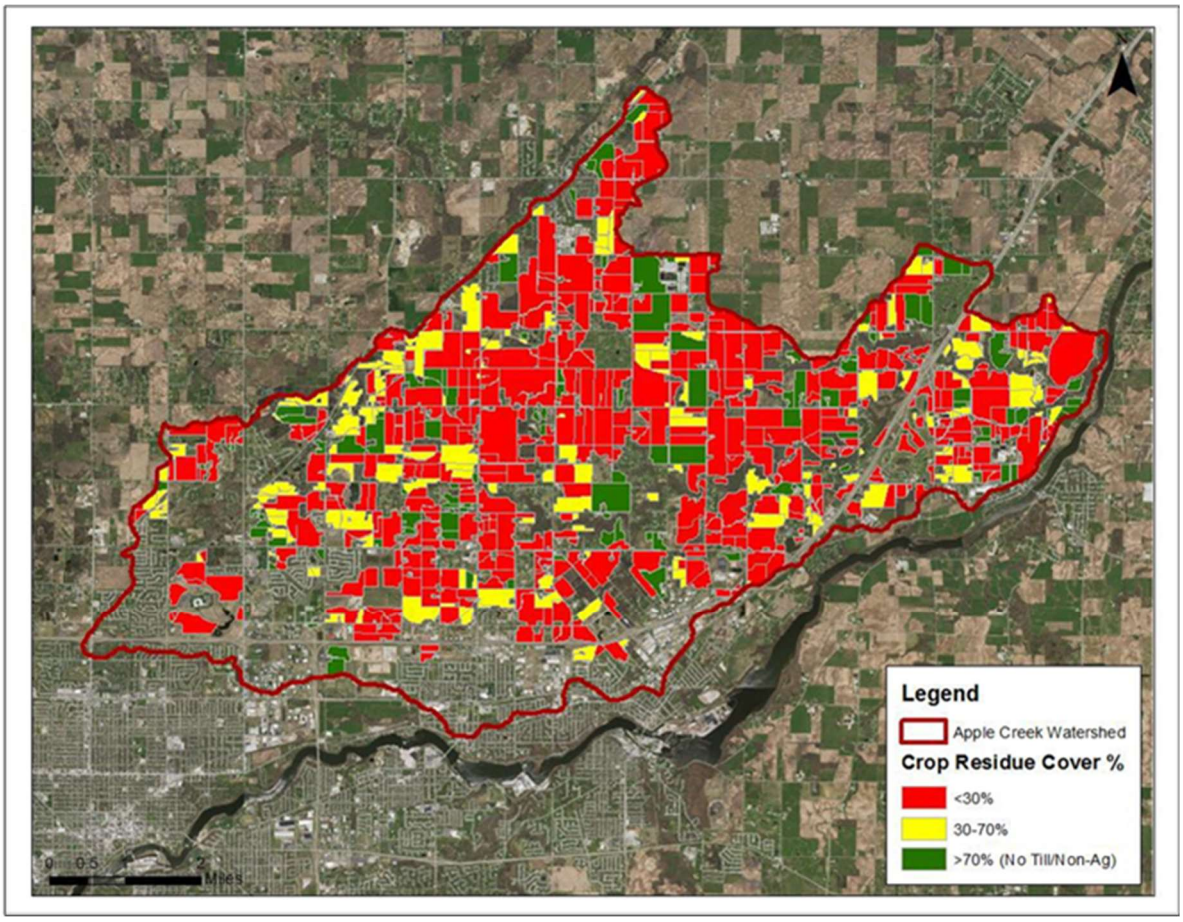


Figure 13. Crop Residue Cover Estimates based on Normalize Difference Tillage Index (March 2015, May 2015, Oct 2015

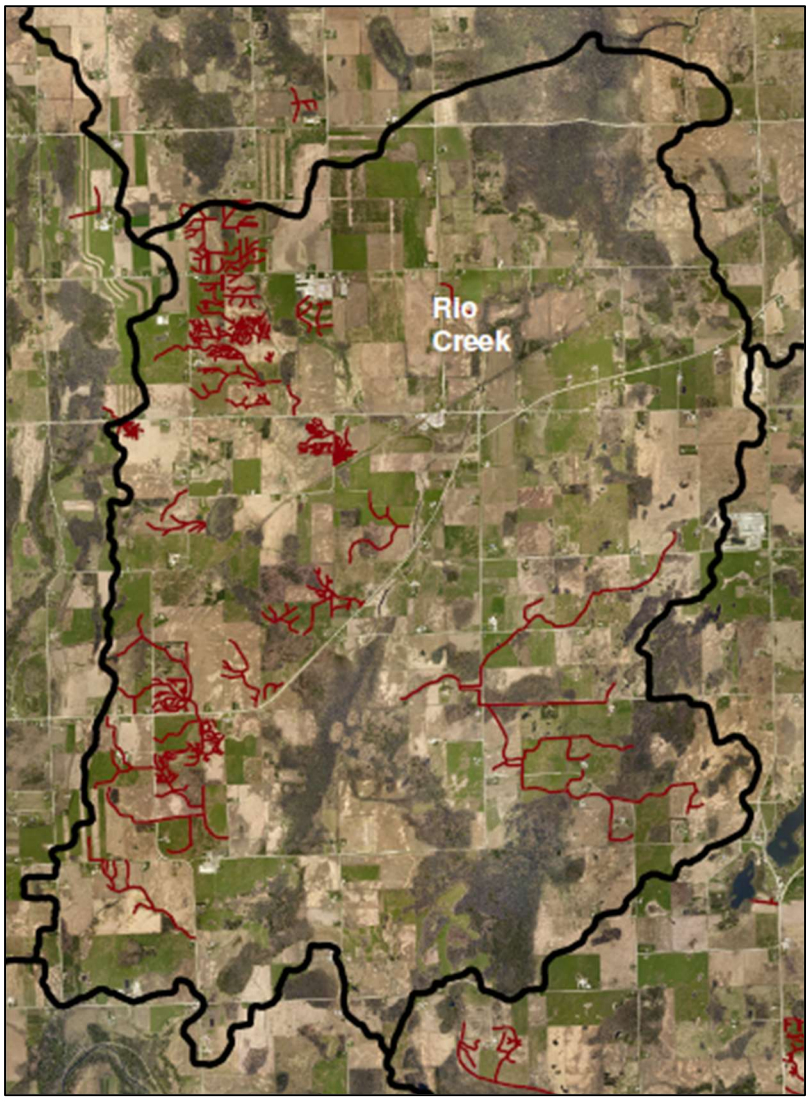
TILE DRAINAGE

Kewaunee County recognizes that tile lines do exist within the Ahnapee River watershed, however, many tile lines were installed prior to any initiative to map or locate these tile lines. Map 16 shows some tiles (in red) that have been mapped in the Rio Creek sub-watershed. By year 2-3, a milestone for this plan will be to assess tile line locations and their functionality in each HUC-12 sub-watershed. Then, an update to this 9-key element plan will be completed and may include development and adoption of new plan milestones to reduce tile line drainage-based sources of pollution in the watershed.

Tile drains in fields can act as a conduit for nutrient transport to streams if not managed properly. An average of 0.9 lbs. P/acre/yr. and 240 lbs. sediment/acre/yr. was found to be leaving via tile drainage on a UW-Discovery Farm study in Kewaunee County, Wisconsin (Cooley et al, 2010). The UW-Discovery Farm study compared surface phosphorus loss to tile phosphorus loss and found that the tile drainage was 34% of the total phosphorus lost (Cooley et al, 2010). Treating tile drainage at the outlet and better management of nutrient/manure applications on fields can reduce the amount of phosphorus reaching rivers and streams.

Additional options for treating tile drainage at the outlet include constructing a treatment wetland, saturated buffers, phosphorus removal structures, and installation of water control structures to stop the flow of drainage water during poor conditions. Once the extent and condition of tile drains is complete, one or more of these practices may be selected for implementation in the watershed.

There are many alternative and new conservation technologies and methods currently being developed and evaluated to reduce agricultural nonpoint source pollutant loads (which include, but are not limited to drain tile losses and treating manure using digesters and or other nutrient treatment systems). If the plans management measures are not implemented or as shown to not be effective as expected, incorporation of new and alternative technologies and management methods into this plan may be necessary to achieve this plan's reduction goals. New conservation technologies and practices may also prove be more cost effective than current recommended BMPs. During this plan's 10-year schedule, newer practices as described above, will need to be evaluated for effectiveness and feasibility before incorporation into the plan.



Map 16. Known Tile Lines in Rio Creek HUC-12

STEP 4: ASSISTANCE & AUTHORITIES

Financial and technical assistance are essential to farms, operators and landowners to implement the best management practices. Landowners **not** in full compliance with NR151 Standards & Prohibitions will be notified during their NR151 walkovers and if eligible, will receive a schedule of compliance, technical assistance and potential cost-share opportunities

Financial assistance is the associated costs to implement this 9-key element plan and include the following costs: implementation of the best management practices, technical assistance, and surface and groundwater monitoring.

FINANCIAL COSTS: IMPLEMENTATION OF BEST MANAGEMENT PRACTICES

The BMPs described in this plan are broken down in Table 14. Each BMP quantity to carry out the 9-key element plan is listed with its associated unit cost that was based on current NRCS-EQIP cost-share rates, incentives payments, and current conservation project installation rates to determine total costs.

Landowners will be responsible for their percentage of installation (usually around 30% of total project costs) and any/all maintenance and operation costs associated with installed practices. The total cost to implement the BMP over the 10-year period is estimated around 2.2 million dollars.

Table 14. Cost-Estimates for Implementing BMPs

BMP	Quantity	Cost/Units	Total Cost
Conservation Practices including: no-till, residue management	3000 acres	No-Till ($16.66/acre)	$49,980
Cover Crops + NMP	1500 acres	1-species - $51.18 / acre Multi-species - $57.25 / acre	$76,770 $85,875
Grassed Waterways	3000 feet	$5.00 / foot	$15,000
Grass Filter + NMP	600 acres	$117.12 / acre	$70,272
Nutrient Management	3924 acres	$10.00 / acre	$39,240
Feedlots with Waste Management System	9 Farms	$200,000 / each	$1,800,000
Revise NMPs to reflect NR 151.075 and Kewaunee County groundwater ordinance practices	10,144 acres (Table 8)	$10.00 / acre	$101,440
Total Costs for Implementing BMPs:			**$2,152,702 $2,161,807**

**Costs for drain tile Best Management Plans are not included as the plan states these BMPs need to be evaluated first for both performance and cost to design, implement and maintain

TECHNICAL ASSISTANCE COSTS

Technical assistance for BMP implementation will be a combination of Kewaunee County LWCD and NRCS. The NRCS staff availability will coincide with the implementation of the NRCS Watershed Plan. To implement the necessary BMPs, Table 15 estimates that 2.5 additional staff members will be needed (Conservation Technician/Specialist and an Agronomist) with a total cost-estimate over the 10-year plan of $2.4 million.

Table 15. Cost-Estimates for Technical Assistance for Implementation

Technical Assistance	Quantity	Cost/Year	Total Cost (10-years)
Conservation Technician/Specialist	1	$96,000	$960,000
Agronomist	1	$96,000	$960,000
LWCD staff time for KC Ordinance & NR151.075 implementation	0.5	$48,000	$480,000

SURFACE WATER QUALITY MONITORING COSTS

Table 16 lays out the cost-estimates for the surface water quality monitoring that will continue throughout the life span of this 9-key element plan. WDNR staff recommend monitoring monthly from May-October on an annual basis for TP, TSS, and TN; 6 monthly samples per stream site. WDNR also suggests sampling for macroinvertebrates in Silver Creek and Rio Creek (one location in each stream) in years 3, 7 and 10. Total cost of approximately $14,070.

Table 16. Cost-Estimate for Surface Water Quality Monitoring

HUC-12s and Sampling Parameters / Duration		Total Cost
Rio Creek:	TP, TN, TSS: 6 months/annually for 10 years	$4560
	Macroinvertebrate: 3x/10 years	$195
Silver Creek:	TP, TN, TSS: 6 months/annually for 10 years	$4560
	Macroinvertebrate: 3x/10 years	$195
Ahnapee River:	TP, N, TSS: 6 months/annually for 10 years	$4560
Total Surface Water Testing for Ahnapee River Watershed:		**$14,070**

GROUNDWATER QUALITY MONITORING COSTS

Since Kewaunee County does not have private well locations mapped in the County; the best guess is that every mapped septic (which are mapped in GIS) has a correlating private well. Therefore, Rio Creek sub-watershed contains 231 septic systems; Silver Creek sub-watershed has 277 septic systems and the Ahnapee sub-watershed has 170. Currently, LWCD's voluntary well testing program is done in partnership with UW-Stevens Point. Table 17 provides the cost estimates if every private well was tested for the homeowner's

package that includes nitrate/bacteria. Annually, every homeowner should be testing for nitrates and bacteria at a minimum.

Table: 17. Cost-Estimate for Groundwater Water Quality Monitoring

HUC-12s and Sampling Parameters / Duration	Total Cost
Rio Creek: Home Owners Package @ $54.00 * 231 septic systems * 10 years	$124,740
Silver Creek: Home Owners Package @ $54.00 * 277 septic systems * 10 years	$149,580
Ahnapee River: Home Owners Package @ $54.00 * 170 septic systems * 10 years	$91,800
Total Well Sampling for Ahnapee River Watershed:	**$366,120**

SUMMARY OF COSTS

Summary of costs for the Ahnapee River 9-key element plan are itemized in Table 18 and total approximately 5 million dollars.

Table 18. Summary of Total Costs to Implement 9-Key Element Plan

Cost Category:	Costs:
BMP Implementation	$2,161,807
Technical Assistance	$2,400,000
Surface Water Quality Monitoring	$14,070
Groundwater Quality Monitoring	$366,120
Education & Information	$36,800
Legacy Phosphorus	TBD
Approximate Total Costs:	**$4,941,997**

OPERATION & MAINTENANCE

The 9-key element plan will require a landowner to agree to a 10-year operation and maintenance agreement for installed practices, including grassed waterways and waste management systems. For annual practices that require re-installation of management each year such as conservation tillage, cover crops, and nutrient management, landowners are required to maintain the practice for each period that cost-sharing is available. Therefore, annual assistance may be required for certain practices.

RELEVANT AUTHORITIES

NR151 provides the guidelines and foundation for implementing and enforcement the agricultural runoff management standards and prohibitions. This 9-key element plan recommends enforcement of the state

standards when implementing the plan. NR151.005 (performance standard for TMDLs) states that a crop producer or livestock producer subject to this chapter shall reduce discharges of pollutants from a livestock facility or cropland to surface waters if necessary, to meet a load allocation in an EPA and state approved TMDL. NR151.075 specifies targeted performance standards for Silurian bedrock soils in the state to reduce the risk for bacterial contamination of groundwater. It requires all crop producers and livestock producers that mechanically apply manure directly or through contract or other agreement to cropland or pasture areas that meet the definition of Silurian bedrock under s. NR151.015 (17) must comply with specific nutrient management and manure application practices.

Local ordinances, including Chapter 18 (Animal Waste Ordinance) and Chapter 39 (Agricultural Performance Standards – NR151) will be used to implement conservation practices and enforce compliance. Kewaunee County LWCD and NRCS will work with landowners to implement conservation practices to protect both surface and groundwater quality. Landowners will be educated on programs and funding available to them as well as current state and local agricultural regulations.

Verifying and documenting NR151 compliance in the three sub-watersheds is a critical aspect for meeting Element 4 and tracking implementation of this plan (Elements 7 and 8).

MILESTONE:

- Annually meet with WDNR Nonpoint Source and TMDL staff to review and discuss NR151 implementation efforts in the watershed.

POSSIBLE REVIEW ITEMS:

1. Do planned implementation efforts for agricultural cropland/operations in the watershed reflect the following priorities?

    - Priority 1: Achieve compliance with NR151 performance standards on a majority (>70%) of agricultural acres/operations in the watershed*

    - Priority 2: After a majority of agricultural cropland or operations in the watershed* are found in compliance with existing NR151 standards, then adoption of additional practices on agricultural acres/operations already in compliance with NR151 is completed to further reduce pollutant loads from agricultural sources in watershed.

    * NR151 implementation/compliance rates may vary within the watershed and require dividing the watershed into sub-basins.

2. If item 1 is not met, then how and when will implementation efforts change to meet item 1?

3. Review annual watershed inventory to determine current number agricultural cropland acres/farms - out of total number of cropland acres/farms in watershed - that are complying with NR151.

4. Identify how many cropland acres/farms in watershed have been documented in compliance with NR151 Standards & Prohibitions via a letter.

5. Provide copies of NR151 compliance letters with WDNR staff.

6. Summarize NR151 priorities, compliance inventory and documentation efforts within annual 9-key element plan progress reports.

STEP 5 & 6: INFORMATION/EDUCATION & PROJECT SCHEDULE

The information and education strategy of the Ahnapee River 9-key element plan will follow Table 19 that includes three milestone time periods and reflects this plan's ten-year schedule. Estimated costs of implementing all the planned activities within the next 10 years is $37,500.

Table 19. Information & Education Implementation Activities

Activity	Timeline (in years)			Cost	Implementation
	1-3	3-7	7-10		
Conduct a Ahnapee River Watershed Survey	1			$500	LWCD
Issue a post-project survey to measure project success			1	$500	LWCD, WDNR
Develop project wide newsletter	2	2	2	$6000	LWCD, WDNR
Distribute Fact sheets for NR151	100	100	100	$3000	LWCD
Project kick-off meeting to introduce project with watershed landowners and ag producers	1			$500	LWCD, WDNR
Distribute Fact sheets for BMPs	100	100	100	$3000	LWCD
Annual "Progress to Date" meeting with watershed landowners and ag producers	1	3	3	$3500	LWCD, WDNR
Project wrap up meeting with watershed landowners and ag producers			1	$500	LWCD, WDNR
Plan &/or partner to hold Field Days for soil health and/or meeting NR 151.075 targeted standards with farmers in the watershed	2	2	2	$10,000	NRCS, Demo-Farms, PPF, LWCD, UW-EX
Conduct one-on-one landowner meetings to encourage soil and water conservation practices	50	50	50	$5000	LWCD w/ NR151 walkovers, WDNR
Conduct one-on-one landowner meetings to review/confirm NMPs on farms with Silurian Bedrock soils reflect NR 151.075 and Kewaunee County groundwater ordinance practices	50	50	50	$5000	LWCD w/ NR151 walkovers, WDNR

YEARS 1-3

In years 1-3, some of the key activities would include hosting a kick-off meeting to introduce the project with watershed landowners and agricultural producers and conducting a watershed survey to gather information on the knowledge of conservation and water quality issues, willingness to participate in conservation programs, and where landowners obtain their information. Moreover, many landowners of all

farm sizes possibly do not recognize the severity of water quality issues impacting Lake Michigan and its river tributaries and the extent to which agricultural sources contribute to nutrient and sediment loadings. In response to this survey, the LWCD can provide information (newsletters, mailings, fact sheets) on available conservation programs, technical assistance, and education will be a very critical component of implementing the management plan. Furthermore, one-on-one landowner meetings will be initiated throughout the sub-watersheds following the NR151 walkover schedule.

YEARS 3-7

Activities in years 3-7 including continuing to implement conservation practices, one-on-one walkovers, providing information and education to the public and starting to monitor any reductions in phosphorus, nitrogen, and/or sediment.

YEARS 7-10

Activities in years the final years of the 9-key element plan mimic and build off the work done in years 1-7, but doing more analysis and monitoring of reductions in the watershed. And, in year 10, a wrap up meeting to determine the successes of the plan.

INFORMATION & EDUCATION STRATEGY

Goals for the information and education strategy will be based, in part, on survey results and prior conservation programs/efforts in the watershed. An effective Information and Education Plan includes the following components as referenced in USEPA's "Handbook for Developing Watershed Plans to Restore and Protect our Waters" (EPA 2008):

- Define information & education goals and objectives
- Identify and analyze the target audiences
- Create the messages for each audience
- Package the message to various audiences
- Distribute the message
- Evaluate the information & education program

Goals for the information and education milestones are to create public awareness of water quality issues in the watershed, increase public involvement in watershed stewardship, and increase communication and coordination among municipal officials, businesses, and agricultural community.

Implementing Table 19 milestones will/should achieve the following objectives:

1. Educate local officials about the watershed plan. Encourage amendments to municipal comprehensive plans, codes, and ordinances.

2. Develop targeted educational materials to appropriate audience in the watershed.

3. Host workshops, meetings, and events that landowners can attend to learn about conservation practices.

4. Increase landowners' adoption of conservation practices.

5. Inform public of current water quality issues in the Ahnapee River Watershed basin and how the HUC-12 sub-watersheds contribute.

6. Determine if local high schools and colleges can become involved in watershed activities.

TARGET AUDIENCE

There are multiple target audiences that will need to be addressed in this watershed. Target audiences in this watershed will be agricultural land owners and operators, local government officials, private land owners, home owners, local agricultural organizations/businesses, and schools. Focused attention will be on agricultural land owners and operators since the main source of pollutant loading in the watershed is from agricultural land.

Non-operator agricultural landowners are an important subset of this group as they are usually not focused on and are less likely to participate in conservation programs. The 1999 Agricultural Economics and Land Ownership survey showed that 34% of farmland in Wisconsin was owned by non-operator landlords (USDA 1999). Studies have shown that non-operators tend to be older, less likely to live on the farm, and less likely to participate in conservation programs (Nickerson, et al 2012).

*Non-operator land*owners in the watershed area are addressed as landowners not operators are responsible for compliance to receive Farmland Preservation tax credits.

EXISTING EFFORTS IN WATERSHED

Watershed efforts for conservation methods have already begun in the Ahnapee River Watershed. Projects (discussed below) have already started to engage landowners, residents, non-profits, agricultural producers with partners from local, state, and federal agencies.

FRIENDS OF CRESCENT BEACH

Friends of Crescent Beach (FOCB) formed as part of the Lakeshore Natural Resource Partnership (LNRP) in May of 2015 in response to citizen concerns. Those concerns included: storm drain outfalls emptying directly onto the beach; accumulations of algae; invasive plants; loafing birds; and litter. After conducting strategic planning sessions with community leaders and other stakeholders, an all-volunteer steering

committee was formed to lead the organization, more formally known as the steering committee (https://www.friendsofcrescentbeach.org/).

FRIENDS OF THE AHNAPEE TRAIL

The Friends of the Ahnapee, a nonprofit organization, was created exclusively for the promotion, development and maintenance of the Ahnapee State Trail. The Friends partner with Kewaunee and Door County and the Wisconsin Department of Natural Resources in developing and maintaining the trail (https://ahnapeestatetrail.com/friends-of-the-ahnapee-trail/).

DOOR KEWAUNEE DEMONSTRATION FARMS

The Door-Kewaunee Watershed Farm Network, a collaboration between USDA-Natural Resources Conservation Service, the Wisconsin Department of Agriculture, Trade and Consumer Protection, and Peninsula Pride Farms was formed to show how different conservation practices can be used to protect surface and groundwater.

The three demonstration farms in Kewaunee County:

- Augustian Farms LLC
- Deer Run Dairy LLC
- Kinnard Farms LLC

Through the partnership, participating farms are implementing different conservation practices and demonstrate the effectiveness of those practices in reducing soil erosion and nutrient runoff while increasing organic matter and soil health. While no Demonstration Farm is actually located in the Ahnapee River Watershed, land operated by each farm is located within the three HUC-12 sub-watersheds. Also, through tours and field days, farms, landowners and operators are adopting new conservation practices and applying them to their land throughout the County (dkdemofarms.org).

PENINSULA PRIDE FARMS

In spring 2016, farmers and supportive businesses came together to address agriculture's role in improving water quality in Kewaunee and southern Door counties in northeastern Wisconsin. These individuals formed Peninsula Pride Farms, an organization led by farmers to leverage the ingenuity of the agricultural community, university research and scientists to meet water quality challenges. This is the first local collaboration of its kind in an area dealing with decades-long water quality issues. Today, the growing group has 50 farmers, with farms of all sizes, representing half of the cows and tillable acres in the region, in addition to 10 business members. Some participating farms have land within the three HUC-12 sub-watersheds (https://peninsulapridefarmsinc.org/).

SAVE THE BAY

In 2015, then Congressman Reid Ribble (WI-08) hosted a summit on phosphorus in the waters of Green Bay, which began conversations on reducing the levels of phosphorous in the bay. Congressman Mike Gallagher is continuing the initiative and hosted his first Save the Bay meeting in February 2017. Save the Bay is a Northeast Wisconsin collaborative initiative in which agriculture, academia, industry, government and nonprofit leaders identify, share and promote conservation practices to reduce phosphorus, nitrogen and sediment flowing into the waters of Green Bay and Lake Michigan (https://gallagher.house.gov/issues/save-bay).

NRCS AHNAPEE & KEWAUNEE RIVER WATERSHED PLAN

In September of 2018, Kewaunee County LWCD and the NRCS finalized and approved the "Ahnapee & Kewaunee River Watershed Plan." This document represents a summary of the conservation planning activities to address priority resource concerns within these two watersheds.

STEP 7: INTERIM, MEASURABLE MILESTONES

The following sections of plan describe the plan's interim, measurable milestones:

- Tables 9 & 10: 10-year BMP overall goals and implementation strategy by milestones (0-3 years, 3-7 years and 7-10 years).
- Table 19: Milestones for the information and education strategy for the watershed.
- Pages 35 & 42: Milestones for NR151 implementation and using EVAAL and NDTI tools in watershed.
- Table 20: Interim milestones for the 3 water quality monitoring stations (Silver Creek: ID 10020779, Ahnapee River: ID 10044953 & Rio Creek: ID 10011683) in the Ahnapee River Watershed that are currently being tested in the watershed – refer to Map 17 on page 54. Each monitoring station results (2016-2018) were summarized to determine the median TP and TSS values. Target values and interim milestones were established by WDNR. Macro-invertebrate Index of Biological Integrity (IBI) was also included, although testing will not begin until year 3.

Table 20 will be updated periodically after additional sampling is completed in the watershed over the plan's 10-year schedule. This plan recognizes that current data may not be available for all water quality monitoring stations and therefore, this plan has milestones to collect and include information as data becomes available.

Table 20. Water Quality Monitoring Indicators & Interim Milestones

Monitoring Locations & Recommendations	**Indicators**	**Current Value Median**	**Target Value***	**Interim Milestones***		
				Short Term (3 yrs.)	**Medium Term** (7 yrs.)	**Long Term** (10 yrs.)
Silver Creek at Brumerville Park/Willow Dr.	2016-2018 Median TP (mg/L)	0.097	0.075	0.09	0.085	0.075
Ahnapee River at Washington Road		0.0549	0.075	0.05	0.05	0.05
Rio Creek at Hwy S	2018 Median TP (mg/L)	0.196	0.075	0.156	0.116	0.075
Silver Creek at Brumerville Park off Willow Dr.	2016-2018 Median TSS (mg/L)	6.0	TBD	TBD	TBD	TBD
Ahnapee River at Washington Road		7.33	TBD	TBD	TBD	TBD
Rio Creek at Hwy S	2018 Median TSS (mg/L)	5.67	TBD	TBD	TBD	TBD
Silver Creek at Brumerville Park off Willow Dr.	Macro-invertebrate Index of Biological Integrity	N/A	Good	TBD	TBD	TBD
Ahnapee River at Washington Road		N/A	Good	TBD	TBD	TBD
Rio Creek at Hwy S		N/A	Good	TBD	TBD	TBD

Private Well Sampling	Nitrate	See table 5, page 15	< 10 ppm	< 2ppm	< 2ppm	< 2ppm
	Bacteria		Negative	Negative	Negative	Negative
Crescent Beach	E-Coli Bacteria	See table 4, page 13	> 235 CFU/100 mL	Zero Advisories or Closings		
Acres of compliance with the spreading ordinance and NR 151.075.			100%	75%	90%	100%

Source: WDNR & Kewaunee County LWCD, 2019

* The agricultural practices described in this plan are estimated to achieve a 20% TP reduction in the watershed. This amount of TP reduction may not be enough to meet the TP target values and interim WQ milestones shown in Table 20. When the NE Lakeshore TMDL is complete in 2022-23, the amount of TP reduction needed to meet WQ standards in the watershed will be determined and this plan will need to be revised to reflect NE Lakeshore TMDL findings.

Revising selected farm NMPs to meet NR 151.075 Silurian bedrock standards and Kewaunee County Public Health & Groundwater Protection Ordinance over the plan's ten-year schedule will help reduced the risk for bacteria and, in some cases, nitrate contamination of groundwater within the watershed.

Funding for monitoring recommendations in Table 20 would potentially come from WDNR and GLRI sources and all implementation would be done in correlation with WDNR, WAV and Kewaunee County LWCD.

STEP 8: INDICATORS TO MEASURE PROGRESS

The indicators that will be used to measure progress are documented in the interim milestones discussed in Step 7, Table 20 and also the progress and success reports and minimum progress criteria described below. Kewaunee County LWCD will be responsible for tracking progress of the plan and will work with NRCS staff to track progress and implement projects.

To evaluate the progress and success of the Ahnapee River 9-key element plan, the Kewaunee County LWCD will annually complete the following 5 reports: Information and Education; Tracking installed BMPs, Pollutant Reduction Evaluation for BMPs installed, Water Quality Monitoring and an Administrative Review.

INFORMATION & EDUCATION

Report to Include:

1. Number of landowners/operators in the watershed plan area
2. Number of eligible landowners/operators in the watershed plan area
3. Number of landowners/operators contacted
4. Number of cost-share agreements signed
5. Number and type of information and education activities held
    a. Agency/agencies involved in activity
    b. Number of individuals invited
    c. Number of attendees
    d. Measurable results
6. Number of informational flyers/brochures distributed
7. Number of one-on-one contacts made with landowners
8. Number of radio broadcasts and newspaper articles
9. Percent change in attendance at information and education activities held
10. Comments or suggestions for future activities

TRACKING INSTALLED BEST MANAGEMENT PRACTICES

Report to Include:

1. BMPs mapped in ArcGIS and in landowners Conservation Plans through Took-kit and/or ArcGIS
2. Pollution reductions will be evaluated using STEPL and Snap-Plus for upland practices; the Wisconsin Barnyard Runoff Model (BARNY) for barnyard practices or the Annual Phosphorus Loss Estimator (APLE-Lots) to model phosphorus loss from outdoor cattle lots.
3. Installation dates, design specifications, operation and maintenance periods, practice inspections, estimated load reductions and cost share sources/amounts will also be tracked in a GIS and/or Excel database

4. All implemented practices and corresponding reductions will be referenced back to the Northeast Lakeshore TMDL
5. Number of NMPs/acres meeting NR 151.075 targeted performance standards and Kewaunee County groundwater ordinances.

The methods outlined in the US EPA technical memo, "Adjusting for Depreciation of Land Treatment When Planning Watershed Projects" will be used when evaluating BMP effectiveness and identifying factors that may affect BMP performance levels and implementation. For additional information on BMP depreciation see https://www.epa.gov/sites/production/files/2015-10/documents/tech_memo_1_oct15.pdf.

POLLUTANT REDUCTION EVALUATION

Report to Include:

1. Planned and completed BMPs
2. Pollutant load reductions and percent of goal planned and achieved
3. Cost-share funding source of planned and installed BMPs
4. Number of compliance checks for management plans
5. Number of compliance checks for practices that include operation and maintenance plans
6. Number of new and alternative technologies and management measures assessed for feasibility, used, and incorporated into plan
7. Changes in land-use or land management in watershed that may impact BMP effectiveness
8. Variations in weather that may have influenced implementation of BMPs or effectiveness of installed BMPs.

WATER QUALITY MONITORING

Report to Include:

1. TP, TSS and TN monitoring results (as they become available through either WDNR and/or WAV)
2. Macroinvertebrate Index of Biotic Integrity monitoring results
3. Reports assessing private well contamination developed by Kewaunee County and external partners
4. Well testing maps, including bacteria/nitrates results
5. Well testing percentages of unsafe wells by Township

ADMINISTRATIVE REVIEW

Report to Include:

1. Status of grants
2. Status of project administration including data management, staff training, and BMP monitoring
3. Status of NMPs

4. Number of cost-share agreements
5. Total amount ($) on cost-share agreements
6. Total amount reimbursed to landowner(s)
7. Staff salary and fringe benefits expenditures
8. Staff travel expenditures
9. Information and education expenditures
10. Equipment, materials, and supply expenses
11. Professional services and staff support costs
12. Total expenditures for the county
13. Total amount paid for installation of BMP's and amount encumbered for cost-share agreements
14. Review compliance status with NR 151.075 and Kewaunee County Public Health & Groundwater Protection Ordinance against measured pathogen and nitrogen content in well-water. Reassess approach if no improvements identified over the plan's ten-year schedule.

MINIMUM PROGRESS CRITERIA FOR REVISITING PLAN MILESTONES

This plan contains several milestones that will be carefully tracked and monitored to determine if sufficient progress is being made to meet plan goals/pollutant reductions.

The following criteria will be used to determine when plan milestones and reduction goals should be revised due to minimal progress achieved:

1. Less than 20% of planned landowner participation is achieved by year 3
2. Less than 25% of planned cropland practices or estimated load reductions are met by year 3
3. Less than 25% of funding is available/awarded to implement plan by year 3
4. Less than 25% of funding for conservation staff is awarded/available by year 3
5. Conservation staff shortages occur and technical assistance resources are limited for two years between years 1-5

LEGACY PHOSPHORUS AND SEDIMENT

A challenge that presents itself in restoring TP impaired waters is legacy phosphorus in the soil and in stream. In recent years, scientists and watershed managers are finding that water quality is not responding as well as expected to implemented conservation practices. They are attributing this slower and smaller response to legacy phosphorus. Legacy phosphorus is used to describe the accumulated phosphorus that can serve as a long-term source of P to surface waters. Legacy phosphorus in a soil occurs when phosphorus in soils builds up much more rapidly than the decline due to crop uptake. In stream channels, legacy phosphorus can result from sediment deposition of particulate phosphorus, sorption of dissolved phosphorus onto riverbed sediments or suspended sediments, or by incorporation into the water column (Sharpley et al 2013).

Legacy instream sediment may need to be evaluated as a significant source of phosphorus. In 2014, Dane County partnered with WDNR to research legacy phosphorus and sediment in Dorn Creek after

improvement in water quality in the Yahara Chain of Lakes was not occurring after years of working with producers on conservation practice implementation.

The study found that phosphorus concentrations in the stream sediment of Dorn Creek was seven times greater than that of nearby crop fields and it was estimated that it would take almost 100 years to see a 50 percent reduction in phosphorus if the sediments remained. The county has since started a $12 million initiative to remove sediment from 33 miles of streams in the Yahara River Watershed that is expected to remove 870,000 pounds of phosphorus.

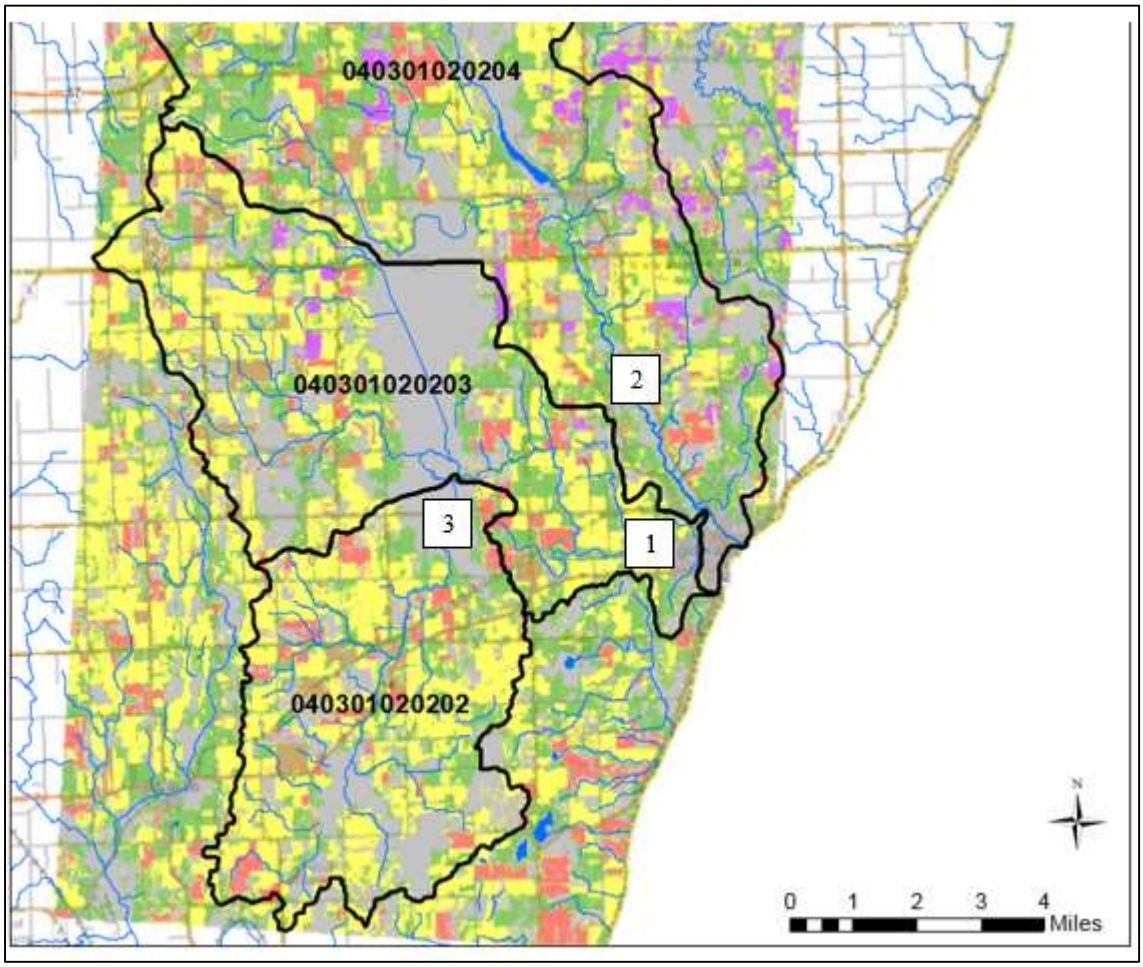
The project will collect additional sediment samples from each stream reach, dredge and then complete water quality sampling up and downstream of dredged stream areas for 5-10 years to confirm if the project reduces TP concentration in the streams, over time. An analysis of legacy sediment and phosphorus, like the Dane County study, may be necessary within this watershed if management goals are being met but improvements in water quality are not occurring.

STEP 9: MONITORING

Step 1 – Causes and Sources, page 3, describes the existing WQ monitoring stations and sampling results from the watershed. Map 17 below shows the Ahnapee River, Silver Creek and Rio Creek WQ monitoring station locations. These three stations will be monitored over the plan's ten-year schedule and evaluated against the interim milestones shown in Step 7, Table 20 of this plan.

Table 21: Water Quality Monitoring Stations

Location	Station ID Number
Silver Creek at Brumerville Park off Willow Dr. (#1)	10020779
Ahnapee River at Washington Road (#2)	10044953
Rio Creek at Hwy S (#3)	10011683



Map 17. Water Quality Monitoring Locations

WATER QUALITY MONITORING PROGRESS EVALUATION

This implementation plan recognizes that estimated pollutant load reductions and expected improvement in water quality or aquatic habitat may not occur immediately following implementation of practices due to several factors (described below) that will need to be taken into consideration when evaluating water quality data. These factors can affect or mask progress that plan implementation has made elsewhere. Consultation with the WDNR and Water Quality Biologists will be critical when evaluating water quality or aquatic habitat monitoring results.

If the reduction target values/goals in this plan are not being achieved, the water quality targets or timetable for pollutant reduction will need to evaluated and adjusted as necessary.

The following criteria will be evaluated when water quality and aquatic habitat monitoring is completed after implementation of practices:

1. Changes in land-use or crop rotations within the same watershed where practices are implemented.
    a. Increase in cattle numbers, corn silage acres, and/or urban areas can negatively impact stream quality and water quality efforts

2. Location in watershed where land-use changes or crop rotations occur.
    a. Where are these changes occurring in relation to implemented practices?

3. Watershed size and location where practices are implemented and location of monitoring sites.

4. Climate, precipitation and soil conditions that occurred before and during monitoring periods.
    a. Climate and weather patterns can significantly affect growing season, soil conditions, and water quality.

5. Frequency and timing of monitoring.

6. Percent of watershed area (acres) or facilities (number) meeting NR151 performance standards and prohibitions.

7. Percent of watershed area (acres) or facilities (number) that maintain implemented practices over time.

8. Extent of gully erosion on crop fields within watershed over time.
    a. How many are maintained in perennial vegetation versus plowed under each year?

9. Stability of bank sediments and how much this sediment may be contributing P and TSS to the stream.

10. How “Legacy’ sediments already within the stream and watershed may be contributing P and sediment loads to stream?

11. Presence and extent of drain tiles in watershed area in relation to monitoring locations.
    a. Do these drainage systems contribute significant P and sediment loads to receiving streams?

12. Does monitored stream meet IBI and habitat criteria, but does not meet TMDL water quality criteria?

13. Are there identifiable reductions in well contamination?
    a. Reduced brown water events
    b. Reduced concentration of N
    c. Reduced/elimination of pathogens

14. Are targets reasonable?
    a. Load reductions predicted by models could be overly optimistic.

APPLICABILITY WITH LWRMP

Throughout this 9-key element plan there are several areas applicable to the Kewaunee County 2019 LWRMP and need to be crossed referenced to further define causes and sources of pollution within the HUC-12 sub-watersheds as well as possible critical areas for adoption of future cropland practices. Table 22 identifies these areas and the associated page numbers in the LWRMP.

Table 22. Applicable LWRMP Pages / Cross Reference Document

Reference:	**Page Number(s)**
Tolerable Soil Loss T	23, 103
Hydrologic Soil Groups	21, 104
NR151 Compliance Walkovers	55-56, 107
Soil Phosphorus ppm	52, 106
NRCS Watershed Plan (includes entire Ahnapee River Watershed (Surface Water & Groundwater and Soil Health)	79
DFC / Goals / Action Items	82-86
Local Advisory Goals & Objectives (includes entire County)	
Surface Water & Groundwater	128-130
Soil Health & Quality	131-132

APPENDIX 1: CURRENT BMPS, EFFICIENCIES AND MANURE SPREADING FREQUENCY

SILVER CREEK

Estimate an area-weighted combined efficiency of multiple BMPs (in parallel) across a watershed

Enter total treated land use area (acre) 8941.00 Cropland

Update BMP List

Enter the subarea treated by each selected BMP type (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	Select a BMP Type	N	P	BOD	Sediment	E. coli
combo - Contour+NMP2	616.00	Combined BMPs-Calculated	0.460	0.740	0.000	0.340	0.000
2	5873.00	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.560	0.000	0.000	0.000
combo - NMP2+ Residue1	627.00	Combined BMPs-Calculated	0.360	0.717	0.000	0.403	0.000
combo - Grass Filter + NMP 2	100.00	Combined BMPs-Calculated	0.502	0.751	0.000	0.533	0.000
Combo - NMP2+Cover2	205.00	Combined BMPs-Calculated	0.395	0.591	0.000	0.100	0.000
6		0 No BMP	0.000	0.000	0.000	0.000	0.000
7		0 No BMP	0.000	0.000	0.000	0.000	0.000
8		0 No BMP	0.000	0.000	0.000	0.000	0.000
9		0 No BMP	0.000	0.000	0.000	0.000	0.000
10		0 No BMP	0.000	0.000	0.000	0.000	0.000
11		0 No BMP	0.000	0.000	0.000	0.000	0.000
12		0 No BMP	0.000	0.000	0.000	0.000	0.000
13		0 No BMP	0.000	0.000	0.000	0.000	0.000
14		0 No BMP	0.000	0.000	0.000	0.000	0.000
15		0 No BMP	0.000	0.000	0.000	0.000	0.000
16		0 No BMP	0.000	0.000	0.000	0.000	0.000
17		0 No BMP	0.000	0.000	0.000	0.000	0.000
18		0 No BMP	0.000	0.000	0.000	0.000	0.000
19		0 No BMP	0.000	0.000	0.000	0.000	0.000
20		0 No BMP	0.000	0.000	0.000	0.000	0.000
Total Land Use Area	7421.00	Enter the calculated value in Table 7. located in "BMPs" tab, under the appropriate watershed -->	0.282	0.592	0.000	0.072	0.000

Estimate an area-weighted frequency of application based on varying manure application across a watershed

Enter total land use area 8,941.00 acres

Enter the subarea and its corresponding number of months of manure application below (upto 20 varying frequency of treatment allo

Treatment	Area (ac)	# of Months Manure Applied in a Year	
1	5,364.00	9	
2	3,576.00	0	
3	-	0	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total Land Use Area	8,940.00	5	<--- Enter the calculated value in Table 2. located in "Input" tab, und

Total Area check: Check to ensure total treatment area matches the total land use area

Estimate an area-weighted combined efficiency of multiple BMPs (in parallel) across a watershed

Enter total treated land use area (acre) 7970.00 Cropland

Update BMP List

Enter the subarea treated by each selected BMP type (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	Select a BMP Type	N	P	BOD	Sediment	E. coli
combo - Contour+NMP2	1059.00	Combined BMPs-Calculated	0.460	0.740	0.000	0.340	0.000
2	5490.00	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.560	0.000	0.000	0.000
combo - NMP2+ Residue1	265.00	Combined BMPs-Calculated	0.360	0.717	0.000	0.403	0.000
combo - Grass Filter + NMP 2	100.00	Combined BMPs-Calculated	0.502	0.751	0.000	0.533	0.000
5		0 No BMP	0.000	0.000	0.000	0.000	0.000
6		0 No BMP	0.000	0.000	0.000	0.000	0.000
7		0 No BMP	0.000	0.000	0.000	0.000	0.000
8		0 No BMP	0.000	0.000	0.000	0.000	0.000
9		0 No BMP	0.000	0.000	0.000	0.000	0.000
10		0 No BMP	0.000	0.000	0.000	0.000	0.000
11		0 No BMP	0.000	0.000	0.000	0.000	0.000
12		0 No BMP	0.000	0.000	0.000	0.000	0.000
13		0 No BMP	0.000	0.000	0.000	0.000	0.000
14		0 No BMP	0.000	0.000	0.000	0.000	0.000
15		0 No BMP	0.000	0.000	0.000	0.000	0.000
16		0 No BMP	0.000	0.000	0.000	0.000	0.000
17		0 No BMP	0.000	0.000	0.000	0.000	0.000
18		0 No BMP	0.000	0.000	0.000	0.000	0.000
19		0 No BMP	0.000	0.000	0.000	0.000	0.000
20		0 No BMP	0.000	0.000	0.000	0.000	0.000
Total Land Use Area	6914.00	Enter the calculated value in Table 7. located in "BMPs" tab, under the appropriate watershed -->	**0.288**	**0.596**	**0.000**	**0.075**	**0.000**

Estimate an area-weighted frequency of application based on varying manure application across a watershed

Enter total land use area 7,970.00 acres

Enter the subarea and its corresponding number of months of manure application below (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	# of Months Manure Applied in a Year	
1	4,782.00	9	
2	3,188.00	0	
3	-	0	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total Land Use Area	7,970.00	5	*<--- Enter the calculated value in Table 2. located in "Input" tab, under the appropriate*

Total Area check: OK

... Gully&Streambank | Total Load | Graphs | **ManureApplication** | C ...

Estimate an area-weighted combined efficiency of multiple BMPs (in parallel) across a watershed

Enter total treated land use area (acre) 4085.00 Cropland

Update BMP List

Enter the subarea treated by each selected BMP type (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	Select a BMP Type	N	P	BOD	Sediment	E. coli
combo - Contour+NMP2	110.00	Combined BMPs-Calculated	0.460	0.740	0.000	0.340	0.000
2	2269.00	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.560	0.000	0.000	0.000
combo - NMP2+ Residue1	110.00	Combined BMPs-Calculated	0.360	0.717	0.000	0.403	0.000
combo - Grass Filter + NMP 2	248.00	Combined BMPs-Calculated	0.502	0.751	0.000	0.533	0.000
5		0 No BMP	0.000	0.000	0.000	0.000	0.000
6		0 No BMP	0.000	0.000	0.000	0.000	0.000
7		0 No BMP	0.000	0.000	0.000	0.000	0.000
8		0 No BMP	0.000	0.000	0.000	0.000	0.000
9		0 No BMP	0.000	0.000	0.000	0.000	0.000
10		0 No BMP	0.000	0.000	0.000	0.000	0.000
11		0 No BMP	0.000	0.000	0.000	0.000	0.000
12		0 No BMP	0.000	0.000	0.000	0.000	0.000
13		0 No BMP	0.000	0.000	0.000	0.000	0.000
14		0 No BMP	0.000	0.000	0.000	0.000	0.000
15		0 No BMP	0.000	0.000	0.000	0.000	0.000
16		0 No BMP	0.000	0.000	0.000	0.000	0.000
17		0 No BMP	0.000	0.000	0.000	0.000	0.000
18		0 No BMP	0.000	0.000	0.000	0.000	0.000
19		0 No BMP	0.000	0.000	0.000	0.000	0.000
20		0 No BMP	0.000	0.000	0.000	0.000	0.000
Total Land Use Area	2737.00	Enter the calculated value in Table 7. located in "BMPs" tab, under the appropriate watershed -->	**0.283**	**0.591**	**0.000**	**0.078**	**0.000**

Estimate an area-weighted frequency of application based on varying manure application across a watershed

Enter total land use area 4,085.00 acres

Enter the subarea and its corresponding number of months of manure application below (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	# of Months Manure Applied in a Year
1	750.00	11
2	3,250.00	0
3	-	0
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
Total Land Use Area	4,000.00	2

<--- Enter the calculated value in Table 2. located in "Input" tab, under the

Total Area check: Check to ensure total treatment area matches the total land use area

... Gully&Streambank | Total Load | Graphs | ManureApplication | C ...

STEPL FILE – CURRENT – INPUT VALUES – SILVER, RIO AND AHNAPEE HUC 12 WATERSHEDS

State	County	Weather Station	Calculate Manure Application Months:
Wisconsin	Kewaunee	WI-Kewaunee_Mean	Manure Application

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors	0.843	0.441
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1 - Silver	150	8941	4198	7500	0	4	0-24%	20793	29	103	0.548
W2 - Rio	10	7970	2960	5000	0	3	0-24%	15943	29	103	0.548
W3 - Ahnapee	200	4085	2428	2600	0	5	0-24%	9318	29	103	0.548
W4	0	0	0	0	0	0	0-24%	0	29	103	0.548

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1 - Silver	300	7000	0	0	0	0	0	0	5	0
W2 - Rio	300	3100	140	0	0	0	0	0	5	0
W3 - Ahnapee	100	250	0	0	0	0	0	0	2	0
W4	0	0	0	0	0	0	0	0	0	0
Total	700	10350	140	0	0	0	0	0		

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1 - Silver	300	2.43	2	0	0
W2 - Rio	300	2.43	2	0	0
W3 - Ahnapee	100	2.43	2	0	0
W4	0	2.43	2	0	0

County AVERAGES		LAND USE	Ravg	Kavg	LSavg	Cavg	Pavg
Kewaunee	Wisconsin	Cropland-cul	90	0.34	0.445	0.14	0.96
Kewaunee	Wisconsin	Cropland-noı	90	0.35	0.66	0.08	0.94
Kewaunee	Wisconsin	Pastureland	90	0.33	0.921	0.01	1
Kewaunee	Wisconsin	Forest land	90	0.31			

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1 - Silver	90.000	0.340	0.445	0.140	0.960	90.000	0.330	0.920	0.010	1.000	90.000	0.310	0.522	0.003	1.000
W2 - Rio	90.000	0.340	0.445	0.140	0.960	90.000	0.330	0.920	0.010	1.000	90.000	0.310	0.522	0.003	1.000
W3 - Ahnapee	90.000	0.340	0.445	0.140	0.960	90.000	0.330	0.920	0.010	1.000	90.000	0.310	0.522	0.003	1.000
W4	90.000	0.337	0.522	0.200	0.958	90.000	0.337	0.522	0.040	1.000	90.000	0.337	0.522	0.003	1.000

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%	Soil E. coli conc. (#/100mg)
W1 - Silver	○	○	◉	○	C	0.080	0.066	0.160	0.000
W2 - Rio	○	○	◉	○	C	0.080	0.066	0.160	0.000
W3 - Ahnapee	○	○	◉	○	C	0.080	0.066	0.160	0.000
W4	○	◉	○	○	B	0.080	0.031	0.160	0.000

User Defined				
R	K	LS	C	P
90.000	0.337	0.522	0.109	1.000
90.000	0.337	0.522	0.109	1.000
90.000	0.337	0.522	0.109	1.000
90.000	0.337	0.522	0.109	1.000

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportatic	98	98	98	98
Multi-Family	77	85	90	92
Single-Famil	57	72	81	86
Urban-Cultiva	67	78	85	89
Vacant-Devel	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)

Land use	N	P	BOD	E. coli
1. L-Cropland	**1.9**	**0.3**	**4**	0
1a. w/ manure	8.1	2	12.3	0
2. M-Cropland	**2.9**	**0.4**	**6.1**	0
2a. w/ manure	12.2	3	18.5	0
3. H-Cropland	**4.4**	**0.5**	**9.2**	0
3a. w/ manure	18.3	4	24.6	0
4. Pastureland (see Table 10 for default values with manure)				
5. Forest	**0.2**	**0.1**	**0.5**	0
6. User Define	**0**	**0**	**0**	0

7a. Nutrient concentration in shallow groundwater (mg/l) and E. coli (MPN/100ml)(may be modified)

Landuse	N	P	BOD	E. coli
Urban	1.5	0.063	0	0
Cropland	1.44	0.063	0	0
Pastureland	1.44	0.063	0	0
Forest	0.11	0.009	0	0
Feedlot	6	0.07	0	0
User-Defined	0	0	0	0

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated %	Vacant (developed)	Open Space %	Total % Area
W1 - Silver	150	15	10	10	5	15	30	5	5	5	100
W2 - Rio	10	15	10	10	10	10	30	5	5	5	100
W3 - Ahnapee	200	15	10	10	10	10	30	5	5	5	100
W4	0	15	10	10	10	10	30	5	5	5	100

Input | BMPs | Gully&Streambank | Total Load | Graphs | BMPLi ...

Best Management Practice Select an appropriate BMP except "Combined BMPs-Calculated" for each subwatershed in each land use table using the pull-down list-box if interactions between BMPs are not considered. Select "Combined BMPs-Calculated" if multiple BMPs and their interactions in the subwatersheds are considered; use BMP calculator (under STEPL menu) to obtain the combined BMP efficiencies and enter them in Table 7.

Urban BMP Tool | Gully and Streambank Erosion | Calculate Combined BMP Efficiency

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data

Watershed	Cropland						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1 - Silver	0.1183361	0.2484873	0	0.0303311	0	Combined BMPs-Calculated	42
W2 - Rio	0.1351926	0.2802846	0	0.0353591	0	Combined BMPs-Calculated	47
W3 - Ahnapee	0.0962906	0.2008892	0	0.0265732	0	Combined BMPs-Calculated	34
W4	0	0	0	0	0	0 No BMP	0

2. BMPs and efficiencies for different pollutants on PASTURELAND, ND=No Data

Watershed	Pastureland						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0

3. BMPs and efficiencies for different pollutants on FOREST, ND=No Data

Watershed	Forest						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0

4. BMPs and efficiencies for different pollutants on USER DEFINED land use, ND=No Data

Watershed	User Defined						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0

5. BMPs and efficiencies for different pollutants on FEEDLOTS, ND=No Data

Watershed	Feedlots						
	N	P	BOD	Sediment	E. coli	BMPs	%Area BMP Applied
W1	0	0	ND	ND	ND	Waste Storage Facility	0
W2	0	0	ND	ND	ND	Waste Storage Facility	0
W3	0	0	ND	ND	ND	Waste Storage Facility	0
W4	0	0	0	0	0	0 No BMP	0

6. BMPs and efficiencies for different pollutants on URBAN

To change/set BMP/LID for urban land uses, click the 'Urban BMP Tool' button on the top-left of this sheet.

7. Combined watershed BMP efficiencies from the BMP calculator

Watershed	Watershed Combined BMP Efficiencies					
	N	P	BOD	Sediment	E. coli	BMPs
W1-Crop - Silver	0.2817526	0.5916364	0	0.0722168	0	Combined BMPs
W2-Crop - Rio	0.2876439	0.5963502	0	0.0752321	0	Combined BMPs
W3-Crop - Ahnapee	0.2832075	0.5908506	0	0.0781564	0	Combined BMPs
W4-Crop	0	0	0	0	0	Combined BMPs
W1-Pasture	0	0	0	0	0	Combined BMPs
W2-Pasture	0	0	0	0	0	Combined BMPs
W3-Pasture	0	0	0	0	0	Combined BMPs
W4-Pasture	0	0	0	0	0	Combined BMPs

SILVER CREEK

Estimate an area-weighted combined efficiency of multiple BMPs (in parallel) across a watershed

Enter total treated land use area (acre) 8941.00 Cropland

Update BMP List

Enter the subarea treated by each selected BMP type (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	Select a BMP Type	N	P	BOD	Sediment	E. coli
combo - Contour+NMP2	616.00	Combined BMPs-Calculated	0.460	0.740	0.000	0.340	0.000
2	4173.00	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.560	0.000	0.000	0.000
combo - NMP2+ Residue1	1627.00	Combined BMPs-Calculated	0.360	0.717	0.000	0.403	0.000
combo - Grass Filter + NMP 2	300.00	Combined BMPs-Calculated	0.502	0.751	0.000	0.533	0.000
combo - NMP2+CoverCrop2	705.00	Combined BMPs-Calculated	0.395	0.591	0.000	0.100	0.000
6		0 No BMP	0.000	0.000	0.000	0.000	0.000
7		0 No BMP	0.000	0.000	0.000	0.000	0.000
8		0 No BMP	0.000	0.000	0.000	0.000	0.000
9		0 No BMP	0.000	0.000	0.000	0.000	0.000
10		0 No BMP	0.000	0.000	0.000	0.000	0.000
11		0 No BMP	0.000	0.000	0.000	0.000	0.000
12		0 No BMP	0.000	0.000	0.000	0.000	0.000
13		0 No BMP	0.000	0.000	0.000	0.000	0.000
14		0 No BMP	0.000	0.000	0.000	0.000	0.000
15		0 No BMP	0.000	0.000	0.000	0.000	0.000
16		0 No BMP	0.000	0.000	0.000	0.000	0.000
17		0 No BMP	0.000	0.000	0.000	0.000	0.000
18		0 No BMP	0.000	0.000	0.000	0.000	0.000
19		0 No BMP	0.000	0.000	0.000	0.000	0.000
20		0 No BMP	0.000	0.000	0.000	0.000	0.000
Total Land Use Area	7421.00	Enter the calculated value in Table 7. located in "BMPs" tab, under the appropriate watershed -->	0.314	0.620	0.000	0.148	0.000

Total Area check: Check to ensure total treatment area matches the total land use area

10 year Practice Goals	Additional Amt
Cover Crops + NMP	500 ac
Residue1+NMP	1000 ac
Grass Filter+NMP	200 ac
75% NMP Implementation	all NMP acres
edlots - 50% with waste manag system	2 ac
Grassed Waterways	1000 ft

Estimate an area-weighted frequency of application based on varying manure application across a watershed

Enter total land use area 8,941.00 acres

Enter the subarea and its corresponding number of months of manure application below (upto 20 varying frequency of treatment allo

Treatment	Area (ac)	# of Months Manure Applied in a Year
1	5,364.00	9
2	3,576.00	0
3	-	0
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
Total Land Use Area	8,940.00	5

<--- *Enter the calculated value in Table 2. located in "Input" tab, und*

Total Area check: Check to ensure total treatment area matches the total land use area

RIO CREEK

Estimate an area-weighted combined efficiency of multiple BMPs (in parallel) across a watershed

Enter total treated land use area (acre) 7970.00 Cropland

Update BMP List

Enter the subarea treated by each selected BMP type (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	Select a BMP Type	N	P	BOD	Sediment	E. coli
combo - Contour+NMP2	1059.00	Combined BMPs-Calculated	0.460	0.740	0.000	0.340	0.000
2	3790.00	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.560	0.000	0.000	0.000
combo - NMP2+ Residue1	1265.00	Combined BMPs-Calculated	0.360	0.717	0.000	0.403	0.000
combo - Grass Filter + NMP 2	300.00	Combined BMPs-Calculated	0.502	0.751	0.000	0.533	0.000
combo - NMP2+CoverCrop2	500.00	Combined BMPs-Calculated	0.395	0.591	0.000	0.100	0.000
6		0 No BMP	0.000	0.000	0.000	0.000	0.000
7		0 No BMP	0.000	0.000	0.000	0.000	0.000
8		0 No BMP	0.000	0.000	0.000	0.000	0.000
9		0 No BMP	0.000	0.000	0.000	0.000	0.000
10		0 No BMP	0.000	0.000	0.000	0.000	0.000
11		0 No BMP	0.000	0.000	0.000	0.000	0.000
12		0 No BMP	0.000	0.000	0.000	0.000	0.000
13		0 No BMP	0.000	0.000	0.000	0.000	0.000
14		0 No BMP	0.000	0.000	0.000	0.000	0.000
15		0 No BMP	0.000	0.000	0.000	0.000	0.000
16		0 No BMP	0.000	0.000	0.000	0.000	0.000
17		0 No BMP	0.000	0.000	0.000	0.000	0.000
18		0 No BMP	0.000	0.000	0.000	0.000	0.000
19		0 No BMP	0.000	0.000	0.000	0.000	0.000
20		0 No BMP	0.000	0.000	0.000	0.000	0.000
Total Land Use Area	6914.00	Enter the calculated value in Table 7. located in "BMPs" tab, under the appropriate watershed -->	0.322	0.627	0.000	0.156	0.000

Total Area check: Check to ensure total treatment area matches the total land use area

10 year Practice Goals	Additional Amt
Cover Crops + NMP	500 ac
Residue1+NMP	1000 ac
Grass Filter+NMP	200 ac
75% NMP Implementation	all NMP acres
eedlots - 50% with waste manag system	2 ac
Grassed Waterways	1000 ft

Estimate an area-weighted frequency of application based on varying manure application across a watershed

Enter total land use area 7,970.00 acres

Enter the subarea and its corresponding number of months of manure application below (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	# of Months Manure Applied in a Year	
1	4,782.00	9	
2	3,188.00	0	
3	-	0	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
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17			
18			
19			
20			
Total Land Use Area	7,970.00	5	<--- Enter the calculated value in Table 2. located in "Input" tab, under the appropriate

Total Area check: OK

... Gully&Streambank | Total Load | Graphs | ManureApplication | C ...

Estimate an area-weighted combined efficiency of multiple BMPs (in parallel) across a watershed

Enter total treated land use area (acre) 4085.00 Cropland

Update BMP List

Enter the subarea treated by each selected BMP type (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	Select a BMP Type	N	P	BOD	Sediment	E. coli
combo - Contour+NMP2	110.00	Combined BMPs-Calculated	0.460	0.740	0.000	0.340	0.000
2	569.00	Nutrient Management 2 (Determined Rate Plus Additional Considerations)	0.247	0.560	0.000	0.000	0.000
combo - NMP2+ Residue1	1110.00	Combined BMPs-Calculated	0.360	0.717	0.000	0.403	0.000
combo - Grass Filter + NMP 2	448.00	Combined BMPs-Calculated	0.502	0.751	0.000	0.533	0.000
combo - NMP2+CoverCrop2	500.00	Combined BMPs-Calculated	0.395	0.591	0.000	0.100	0.000
6		0 No BMP	0.000	0.000	0.000	0.000	0.000
7		0 No BMP	0.000	0.000	0.000	0.000	0.000
8		0 No BMP	0.000	0.000	0.000	0.000	0.000
9		0 No BMP	0.000	0.000	0.000	0.000	0.000
10		0 No BMP	0.000	0.000	0.000	0.000	0.000
11		0 No BMP	0.000	0.000	0.000	0.000	0.000
12		0 No BMP	0.000	0.000	0.000	0.000	0.000
13		0 No BMP	0.000	0.000	0.000	0.000	0.000
14		0 No BMP	0.000	0.000	0.000	0.000	0.000
15		0 No BMP	0.000	0.000	0.000	0.000	0.000
16		0 No BMP	0.000	0.000	0.000	0.000	0.000
17		0 No BMP	0.000	0.000	0.000	0.000	0.000
18		0 No BMP	0.000	0.000	0.000	0.000	0.000
19		0 No BMP	0.000	0.000	0.000	0.000	0.000
20		0 No BMP	0.000	0.000	0.000	0.000	0.000
Total Land Use Area	2737.00	Enter the calculated value in Table 7. located in "BMPs" tab, under the appropriate watershed -->	0.370	0.668	0.000	0.283	0.000

Total Area check: Check to ensure total treatment area matches the total land use area

10 year Practice Goals	Additional Amt
Cover Crops + NMP	500 ac
Residue1+NMP	1000 ac
Grass Filter+NMP	200 ac
75% NMP Implementation	all NMP acres
eedlots - 50% with waste manag system	2 ac
Grassed Waterways	0 ft

Estimate an area-weighted frequency of application based on varying manure application across a watershed

Enter total land use area 4,085.00 acres

Enter the subarea and its corresponding number of months of manure application below (upto 20 varying frequency of treatment allowed)

Treatment	Area (ac)	# of Months Manure Applied in a Year
1	750.00	11
2	3,250.00	0
3	-	0
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
Total Land Use Area	4,000.00	2

<--- Enter the calculated value in Table 2. located in "Input" tab, under the

Total Area check: Check to ensure total treatment area matches the total land use area

... Gully&Streambank | Total Load | Graphs | ManureApplication | C ...

STEPL FILE – FUTURE – INPUT VALUES – SILVER, RIO AND AHNAPEE HUC 12 WATERSHEDS

State: Wisconsin | County: Kewaunee | Weather Station: WI-Kewaunee_Mean | Calculate Manure Application Months: Manure Application

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors 0.843	0.441	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1 - Silver	150	8941	4198	7500	0	4	0-24%	20793	29	103	0.548
W2 - Rio	10	7970	2960	5000	0	3		15943	29	103	0.548
W3 - Ahnapee	200	4085	2428	2600	0	5		9318	29	103	0.548
W4	0	0	0	0	0	0		0	29	103	0.548

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pasturela nd
W1 - Silver	300	7000	0	0	0	0	0	0	5	0
W2 - Rio	300	3100	140	0	0	0	0	0	5	0
W3 - Ahnapee	100	250	0	0	0	0	0	0	2	0
W4	0	0	0	0	0	0	0	0	0	0
Total	700	10350	140	0	0	0	0	0		

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1 - Silver	300	2.43	2	0	0
W2 - Rio	300	2.43	2	0	0
W3 - Ahnapee	100	2.43	2	0	0
W4	0	2.43	2	0	0

County AVERAGES		LAND USE	Ravg	Kavg	LSavg	Cavg	Pavg
Kewaunee	Wisconsin	Cropland-cul	90	0.34	0.445	0.14	0.96
Kewaunee	Wisconsin	Cropland-noı	90	0.35	0.66	0.08	0.94
Kewaunee	Wisconsin	Pastureland	90	0.33	0.921	0.01	1
Kewaunee	Wisconsin	Forest land	90	0.31			

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1 - Silver	90.000	0.340	0.445	0.140	0.960	90.000	0.330	0.920	0.010	1.000	90.000	0.310	0.522	0.003	1.000
W2 - Rio	90.000	0.340	0.445	0.140	0.960	90.000	0.330	0.920	0.010	1.000	90.000	0.310	0.522	0.003	1.000
W3 - Ahnapee	90.000	0.340	0.445	0.140	0.960	90.000	0.330	0.920	0.010	1.000	90.000	0.310	0.522	0.003	1.000
W4	90.000	0.337	0.522	0.200	0.958	90.000	0.337	0.522	0.040	1.000	90.000	0.337	0.522	0.003	1.000

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%	Soil E. coli conc. (#/100mg)
W1 - Silver	○	○	◉	○	C	0.080	0.066	0.160	0.000
W2 - Rio	○	○	◉	○	C	0.080	0.066	0.160	0.000
W3 - Ahnapee	○	○	◉	○	C	0.080	0.066	0.160	0.000
W4	○	◉	○	○	B	0.080	0.031	0.160	0.000

User Defined				
R	K	LS	C	P
90.000	0.337	0.522	0.109	1.000
90.000	0.337	0.522	0.109	1.000
90.000	0.337	0.522	0.109	1.000
90.000	0.337	0.522	0.109	1.000

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportatio	98	98	98	98
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban-Cultiva	67	78	85	89
Vacant-Deve	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)

Land use	N	P	BOD	E. coli
1. L-Cropland	**1.9**	**0.3**	**4**	0
1a. w/ manure	8.1	2	12.3	0
2. M-Cropland	**2.9**	**0.4**	**6.1**	0
2a. w/ manure	12.2	3	18.5	0
3. H-Cropland	**4.4**	**0.5**	**9.2**	0
3a. w/ manure	18.3	4	24.6	0
4. Pastureland (see Table 10 for default values with manure)				
5. Forest	**0.2**	**0.1**	**0.5**	0
6. User Define	**0**	**0**	**0**	0

7a. Nutrient concentration in shallow groundwater (mg/l) and E. coli (MPN/100ml)(may be modified)

Landuse	N	P	BOD	E. coli
Urban	1.5	0.063	0	0
Cropland	1.44	0.063	0	0
Pastureland	1.44	0.063	0	0
Forest	0.11	0.009	0	0
Feedlot	6	0.07	0	0
User-Defined	0	0	0	0

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated	Vacant (develope	Open Space %	Total % Area
W1 - Silver	150	15	10	10	5	15	30	5	5	5	100
W2 - Rio	10	15	10	10	10	10	30	5	5	5	100
W3 - Ahnapee	200	15	10	10	10	10	30	5	5	5	100
W4	0	15	10	10	10	10	30	5	5	5	100

Input | BMPs | Gully&Streambank | Total Load | Graphs | BMPLi ...

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APPENDIX 3 & 4

TO BE INSERTED WHEN COMPLETED BY DNR

APPENDIX 5: NRCS AHNAPEE & KEWAUNEE RIVER WATERSHED CONSERVATION PLAN

As indicated in Chapter 4 the NRCS Watershed Planning process identified and ranked 10 resource concerns. The top 5 resource concerns identified (Table 21) were associated with water quality (both surface and groundwater) and soil erosion, which mimic the results of the public survey for this LWRMP update.

Table 21. NRCS Watershed Plan - Top 5 Priority Resource Concerns

Priority Ranking Order	Resource Concerns
1	Water Quality Degradation – Excess Nutrients in Surface & Groundwater
2	Water Quality Degradation – Excess Pathogens and Chemicals from Manure, Bio-solids or Compost Applications
3	Water Quality Degradation – Excessive Sediment in Surface Waters
4	Soil Erosion – Concentrated Flow
5	Soil Erosion – Sheet, Rill & Wind

The Planning Team then established Desired Future Conditions (DFC) and Action Items based off practices commonly used throughout NRCS and LWCD that are associated with the top 5 resource concerns. These practices include: Nutrient Management, Conservation Planning, Soil Quality, NR151 Standards & Prohibitions, Surface Water and Groundwater. The following DFC and Action Items were approved in September 2018.

*Caveat, the following DFC & Action Items under this planning effort were only set for the Kewaunee and Ahnapee River Watersheds. However, they were included and discussed by the LWRMP Local Advisory Committee because they could be representative of Kewaunee County as a whole.

DESIRED FUTURE CONDITIONS & ACTION ITEMS

NUTRIENT MANAGEMENT

Resource Concerns that can be addressed include: Groundwater and Surface Water Quality; Cropland Erosion; Soil Quality Degradation; as well as the overall Soil Health and Quality.

Desired Future Conditions:

1. All NMPs currently submitted to the LWCD are to follow the NRCS 2015 Standard by 2019. Note: Counties could not require landowners to follow the 2015 updated NMP standard until ATCP 50 passed in February 2018.

2. By 2018, have 91% of all watershed acres under an NMP; 2019 – 94%; 2020 – 97% and 2021 – 100%. Note: This will require landowner participation and cost sharing dollars

3. Reduce Soil phosphorus (P) ppm by 10ppm over 10 years

Current Conditions (Ahnapee): Average 28 ppm P
Current Conditions (Kewaunee): Average 36 ppm P

4. Have all fields under NMP to have a Phosphorus Index (PI) of 2 or less
   Current Conditions (Ahnapee): 75% of fields < 2
   Current Conditions (Kewaunee): 74% of fields < 2

** 3 & 4 are based on 2016 NMPs submitted to LWCD93*

Action Items:

1. Confirm that NMP are not only planned but implemented by field verifying the following:
   a. Planned crop rotations match what is being planted
   b. Farming on contour or on strips to meet field T
   c. Setbacks
   d. Cover crops
   e. Manure hauling gallons/fields/analysis matches NMP
   f. Concentrated flow channels are all vegetated

2. Promote outreach and education through farmer led workgroups and agencies

CONSERVATION PLANNING

Resource Concerns that can be addressed include: Groundwater and Surface Water Quality; Cropland Erosion; Wildlife Habitat Fragmentation; Soil Quality Degradation; Air Quality; and Excess Water.

Desired Future Conditions:

1. By 2018 – 85% of all watershed acres under a Conservation Plan; 2019 – 90%; 2020 – 95% and 2021 – 100%. Note: This will require landowner participation

2. A 10% reduction in soil loss in 5 years; 20% reduction in 10 years
   Current Conditions (Ahnapee): 73% of fields < 2.0
   Current Conditions (Kewaunee): 71% of fields < 2.0
   Note: Current Conditions are based on 2016 NMPs submitted to LWCD

3. Address odor issues to meet the National Air Quality Site Assessment Tool

Action Items:

1. Conservation plan is truly implemented and matches the landowner/operators Nutrient Management Plan (i.e. crop rotations, tillage, buffers, management & structural practices)

2. Promote outreach and education through farmer led workgroups and agencies

3. Work with farms on adopting a Conservation System Approach suitable to their farming needs

SOIL QUALITY & CONSERVATION MANAGEMENT PRACTICES

Resource concerns that can be addressed include: Groundwater and Surface Water Quality; Cropland Erosion; Soil Quality Degradation; and Excess Water.

Desired Future Conditions:

1. Increase percent of Cover Crops on Soybean and Corn Silage acres

2. Decrease the percent of Fall Conventional tillage (use transect survey to record data)

3. Increase farming operations that adopt the "voluntary" recommendations outlined in the Best Management Practices DNR workgroup

4. Decrease the compaction in the plow pan layer

5. Improve overall soil health, soil structure, and soil organic matter

Action Items:

1. Continue to increase adoption of cover crops / no-till practices

2. Continue to partner with the Peninsula Pride Farms (PPF) and the three established NRCS funded demonstration farms, which have launched initiatives and field days to educate farmers/landowners about soil health and cover crops.

3. Educate the use of manure irrigation and composting to reduce compaction and increase soil health and track the number of farms using composting and irrigation

4. Partner with NRCS & PPF to establish a way to document acres of Cover Crops

5. Identify framework to establish baseline data for bulk density and organic matter

WISCONSIN NR151 AGRICULTURAL COMPLIANCE STANDARDS AND PROHIBITIONS

Resource concerns that can be addressed include: Groundwater and Surface Water Quality; Cropland Erosion; Wildlife Habitat Fragmentation; and Soil Quality Degradation.

Desired Future Conditions:

1. All farms that currently take FPP credits to be in full compliance with NR151 Standards and Prohibitions by 2021

2. Determine which farms are eligible, but currently not taking the FPP credit, and work with them towards compliance

3. No unvegetated concentrated flow channels, which will reduce nutrients and sedimentation into our Groundwater and Surface Water

4. Have all farms/operations in both watersheds meeting NR151 Performance Standards on their facilities and cropland

5. Increase adoption of buffers to provide connectivity for wildlife

Action Items:

1. Increase the number of eligible participants claiming FPP and complete a NR151 walkover

2. Research alternatives to Manure Management (technologies like separation, reverse osmosis, etc.)

SURFACE WATER

Resource concerns that can be addressed include: Surface Water Quality and Groundwater Quality

Desired Future Conditions:

1. No Impaired Rivers for Total Phosphorus (on DNR/EPA list)

2. Restore Trout Streams & Fish Habitats

3. Zero Beach Closings7

4. Zero Manure Spills

5. Decrease the intensity and number of algal blooms on Lake Michigan and inland lakes

6. Zero fish kills from high nutrient loads or manure spills

7. Reduce sedimentation transport from farm fields

8. Reduce transport of Nitrogen (N) & Phosphorus (P) to surface waters from tiles

Action Items:

1. Promote education to manure haulers about spreading and manure transport to reduce the number of spills in the County
2. Use Irrigation as a tool to spread nutrients (manure, leachate) during the growing season
3. Investigate new technology on Phosphorus removal systems in tile lines
4. Establish Total Maximum Daily Loads on the Kewaunee River and Ahnapee River
5. Identify the framework to establish baseline data for Total Suspended Solids (TSS), Total Phosphorus (TP), and Total Nitrogen for all waterbodies in both Watersheds
6. Increase the implementation of buffers

GROUNDWATER

Resource concerns that can be addressed include: Groundwater Quality & Surface Water Quality

Desired Future Conditions:

1. All wells that provide drinking water to be bacteria (total coliform and e-coli) absent and nitrates less than the state standard of 10ppm
2. All wells that provide drinking water to be free of microbes and viruses

Action Items:

1. Properly abandon all unused wells in the County
2. Update all existing septic systems to current standards

****Full copy of the NRCS Ahnapee & Kewaunee River Watershed Plan can be found at the Kewaunee County Land & Water Conservation Department, 625 Third Street, Luxemburg, WI 54217

REFERENCES

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