7. STRUCTURAL BMP IMPLEMENTATION PLAN

Through this watershed management planning process, pollutants, with a variety of sources and causes, have been identified across the Red Cedar River Watershed (RCRW), which are known or suspected to be negatively impacting water quality. Best Management Practices (BMPs) that could be implemented to reduce the impact of these pollutants and meet pollutant reduction goals in the highest priority areas are identified in this chapter. This chapter also further defines priority locations for preservation, critical sites and areas for restoration, priority subwatersheds, and corresponding BMPs that align with the pollutants, sources, and causes found at these locations.

Though BMPs are encouraged to be implemented wherever possible in the watershed, due to limited resources, priority subwatersheds, and critical and priority areas have been identified. This chapter includes recommendations for:

- Protecting existing high quality lands or important features
- Restoring Critical Sites
- Restoring Critical Areas
- Subwatershed prioritization for general preservation and restoration activities

7.1 Pollutant Loadings and Reduction Goals to Meet TMDL Goals

Total Maximum Daily Load (TMDL) reports completed by the Michigan Department of Environmental Quality (MDEQ) (2012c, 2013b) address the water bodies currently listed as impaired due to excessive *Escherichia coli* (*E. coli)* pollution and dissolved oxygen (DO) deficiencies and are discussed in detail throughout this WMP.

Because the *E. coli* TMDL is concentration-based rather than load-based, the goal is also equal to 130 *E. coli* per 100 mL as a 30-day geometric mean; 300 *E. coli* per 100 mL as a daily maximum for total body contact recreation (TBC); and 1,000 *E. coli* per 100 mL as a daily maximum for partial body contact (PBC) recreation. As such, reduction goals for this project are based upon the relationship between existing *E. coli* concentrations and the water quality standards (WQS). The goal is to ultimately have all water bodies meet the WQS for *E. coli*.

The MDEQ draft TMDL report for DO identified the Mud Creek subwatershed as impaired due to low levels of DO. The goal is to meet the WQS for DO: a minimum of 5 mg/L of DO for warmwater fisheries. To accomplish this, total suspended solids (TSS) should be reduced by 51%. In the Mud Creek subwatershed, the HIT model (described in Chapter Three) estimates pollutant loading at 1,171 tons/acre/year.

Previous studies of agricultural watersheds suggest that significant reductions in *E. coli* concentrations are possible through implementation of physical BMPs. Horizon (2010) reports 58% reductions as a result of site-specific wetland restoration in the Tyler Creek watershed in Kent County, MI. It is appropriate to assume then, that if enough BMPs are installed on a watershed scale, that large-scale reductions in *E. coli* concentrations are feasible.

The feasible and attainable goals for BMP implementation were determined to be approximately 10% of the practices in 5 years and 20% by 2020. The pollutant loadings should be monitored after BMP implementation so progress toward reduction goals can be evaluated. Implementation schedules and practices should then be adjusted to ensure that the TMDL goals will be met.

7.2 Pollutant Loading and Reduction Goals for Other Pollutants

Targeted reduction values for sediment and nutrients are discussed in this section, even though TMDLs have not been established to address them in the RCRW. Criteria for these other pollutants are compared to values in Table 3.2 and summarized below. Sediment reduction goals are based upon meeting Michigan's WQS for total dissolved solids (TDS), established by Part 4 Rules issued in accordance with Part 31 of NREPA, and an informal target for TSS. Rule 323.1051 states that TDS must not exceed a concentration of 500 milligrams per liter as a monthly average or no more than 750 milligrams per liter at any time, as a result of controllable point sources. Furthermore, while Michigan's WQS do not include numerical limits for TSS, an informal target of 80 mg/L is recommended. The goal is to meet these standards for TDS and TSS.

Nutrient reduction goals are based on data from the EPA Ecoregion VII or the Southern Michigan/ Northern Indiana Drift Plains Ecoregion (SMNIDP). The target for total Kjeldahl nitrogen is 0.24 mg/L, as noted in the U.S. EPA's Ambient Water Quality Criteria Recommendations (2000). The goal for ammonia as nitrogen is 0.042 mg/L, which is the SMNIDP Ecoregion mean concentration (Lungdren, 1994 as cited in MDEQ, 2013a). For total phosphorous, the goal is 0.32mg/L, the median value reported for Michigan from 250 sites between 2005 and 2009. The target for total organic carbon (TOC) is <10 mg/L, derived from the SMNIDP Ecoregion median concentration from 2000-2008 (Roush, 2013 as cited in MDEQ, 2013a). The goal is to meet these concentrations for nitrogen, phosphorus and TOC.

7.3 Priority Areas for Preservation and Protection

Preserving high quality or important lands and features is an important component of watershed planning. Priority Areas within the RCRW were identified using several methods. First, the Michigan Natural Features Inventory (MNFI) evaluated potential conservation areas (PCAs) in a study of Clinton, Eaton, and Ingham Counties (Hyde et al., 2009). The results of the MFNI study were reviewed, and it was determined that the areas scoring in the highest PCA category are those most worthy of protection and are designated as Priority Areas for preservation in this plan.

In addition, for reasons discussed throughout this plan, all existing wetlands should be considered Priority Areas. Many wetlands are currently protected by state or local jurisdictions. It is recommended that all local municipalities consider developing a wetland ordinance with preservation in mind.

Because it has been shown that *E. coli* from livestock operations and sediment from cropland erosion are problems in the watershed, a methodology was developed for identifying the highest priority wetlands for protection. First, a radius was assigned to specific livestock operations based upon the number of animals and the estimated amount of land needed for disposal of manure. The following categories were developed based on the results of the windshield survey:

- 1-4 animals: 1/8 mile radius
- 5-30 animals: 1/4 mile radius
- 31-150 animals: 1/2 mile radius
- 151-300 animals: 3/4 mile radius
- 301-500 animals:1 mile radius
- 501-700 animals: 1 1/2 mile radius
- 701+ animals: 2 mile radius

Using the MDEQ Landscape Level Wetland Functional Assessment (LLWFA) (MDEQ, 2012b), existing wetlands with a pathogen removal function, which are located within these radii, were identified. Next, a buffer was created around the two highest High Impact Targeting (HIT) model categories to identify existing wetlands with a sediment removal function. Using the categories listed above, the existing wetlands that fell within a farm or HIT buffer were identified as the highest priority for wetland protection.

In total, about 17,254 acres of wetland in the RCRW are considered Priority Areas for conservation. The map of those areas is shown in Figure 7.1.

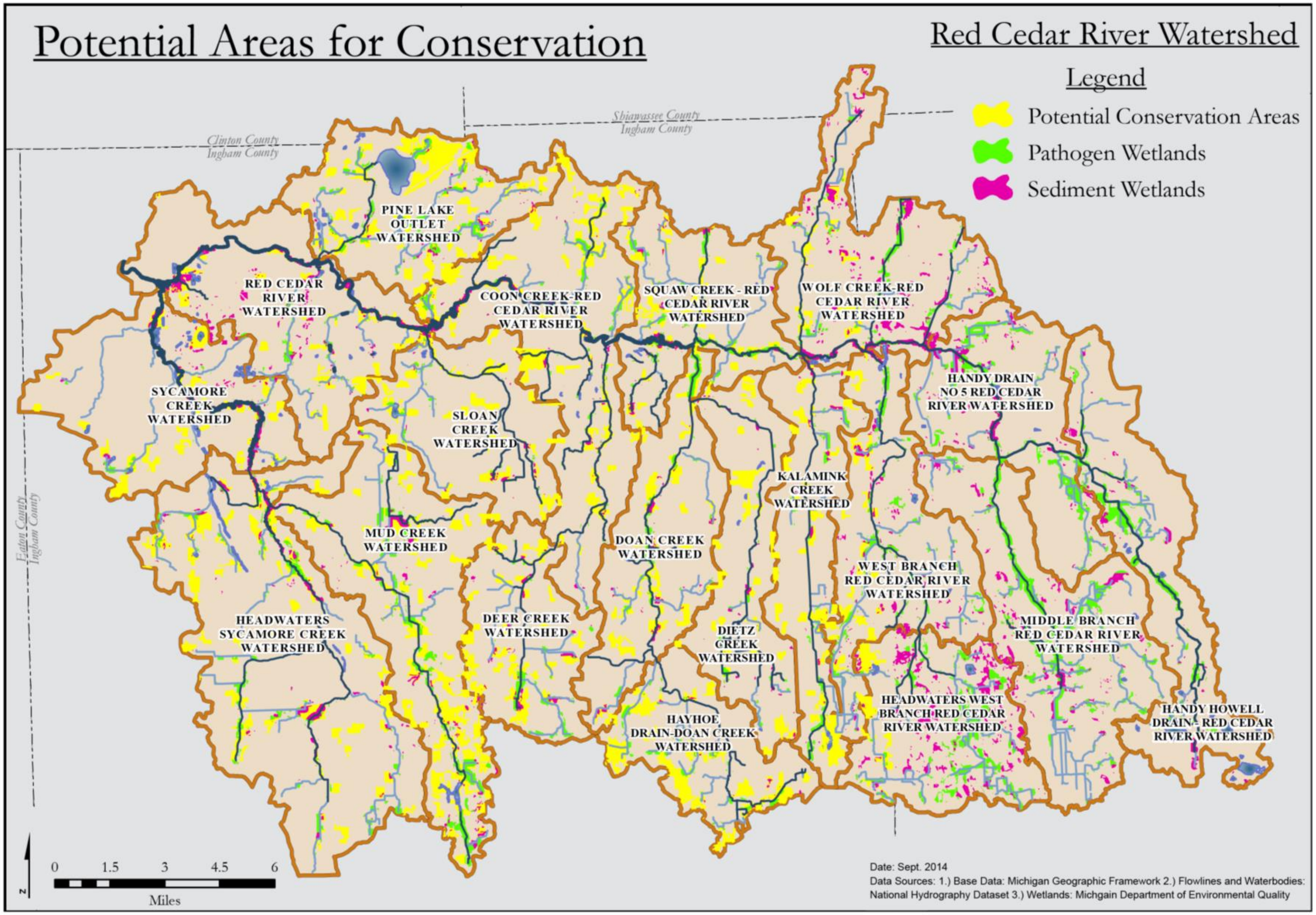

Figure 7.1 Priority Areas for Conservation

7.4 Restoring Critical Sites

Critical sites that have been identified throughout the watershed are summarized in Table 7.1 and shown in the map in Figure 7.2. These sites are considered the highest priority of issues to address in the short term.

These sites are a subset of the sites that were mapped in Chapter Six (Figure 6.2), with known or suspected pollution from livestock access, improper manure storage, streambank erosion, overland runoff and septic inputs. They are sites with known sources of pollution, or with a strong suspicion of pollutant loadings based upon stakeholder input.

Table 7.1. Critical Sites for Restoration

Livestock in the Stream	Overland Runoff from Developed Land	Eroded Streambank	Improper Manure Management	Septic/Sewerage Issues
Wolf Creek (4N3ES19, k)	Lansing and Maple Street in Headwaters Sycamore Creek (s)	3 areas eroded streambanks in Red Cedar (k)	Ingham County Fairground (s)	Potter Park Zoo in Red Cedar (k)
Suggested BMP: Exclusion Fencing and Alternative Water sources or Controlled Access	Suggested BMP: Retrofit and regrade parking lot; Rain gardens	Suggested BMP: Stream Restoration; Streambank Stabilization	Suggested BMP: Contained Manure Storage Areas	Suggested BMP: Work with zoo on maintaining buffers and managing and eliminating zoo animal and wildlife waste contamination
Doan Creek (windshield survey 2N1ES1, k)				Lamb and Hagadorn Roads Intersection in Mud Creek (s)
Suggested BMP: Exclusion Fencing and Alternative Water sources or Controlled Access				Suggested BMP: Illicit Connection Detection and Repair
Hayhoe Drain (2N1ES25, k)		Eroded areas on Deer Creek in the Coon Creek Subwatershed (k)		Van Atta and Grand River in Coon Creek (s)
Suggested BMP: Exclusion Fencing and Alternative Water sources or Controlled Access		Suggested BMP: Stream Restoration; Streambank Stabilization		Suggested BMP: Illicit Connection Detection and Repair

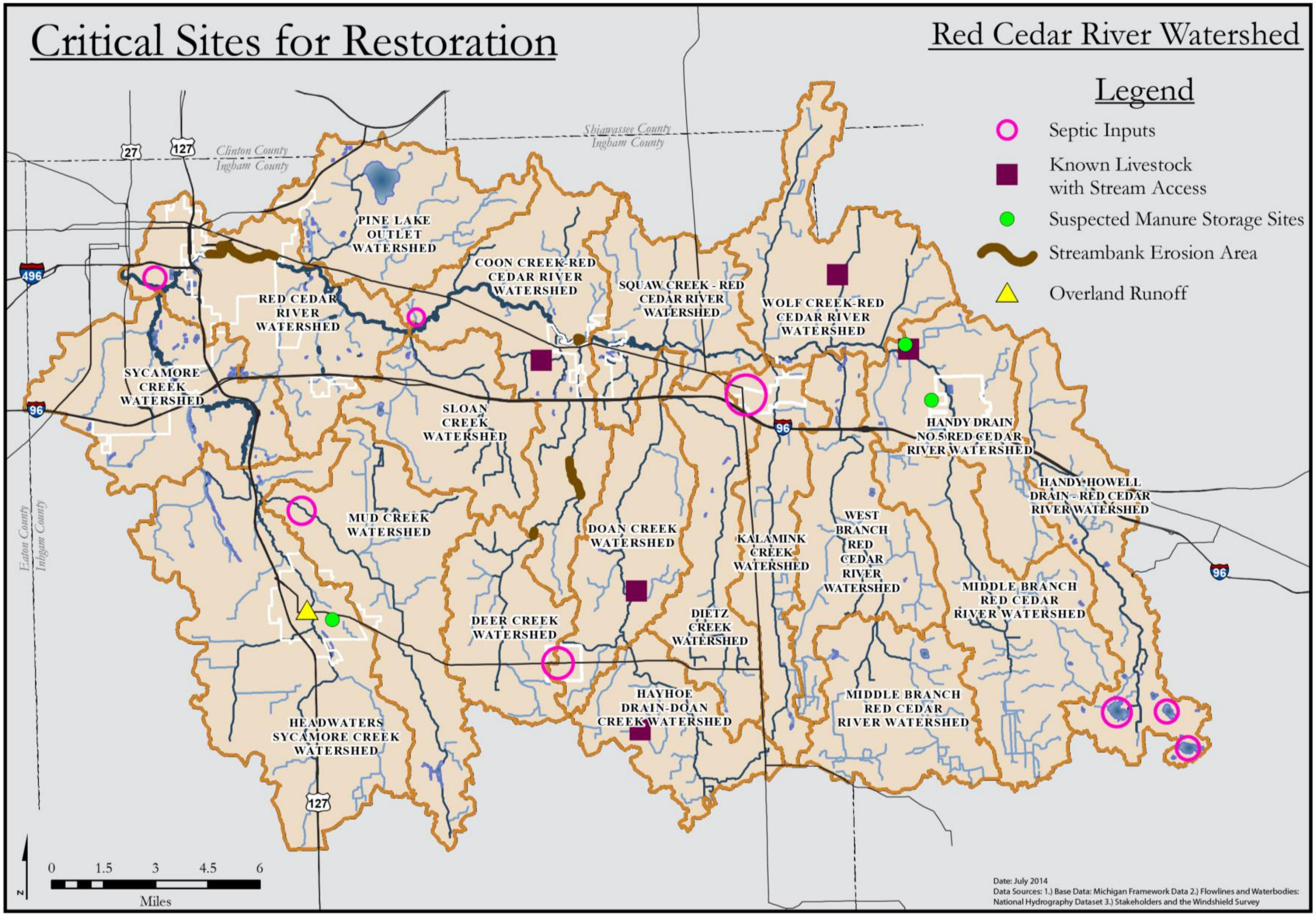

Figure 7.2 Critical Sites for Restoration

7.5 Restoring Critical Areas

The second highest priority for restoration activities are the critical areas outlined below and categorized by pollutant source:

Livestock *E.coli*

As previously discussed, livestock waste is a known overland source of pollution in the watershed. The number of farms and animals at each facility has been estimated. Thus, these areas should be considered for reducing manure inputs (and associated pollutant loading including *E. coli,* nutrients, etc.) to streams and drains within the watershed. Wetland restoration is considered an important BMP since wetlands historically covered much of the watershed, wetlands receive overland flow inputs, and because wetlands are effective systems for *E. coli* removal.

Critical areas for wetland restoration were developed, taking into account the historic and existing wetlands, potential for wetland restoration, livestock demands on the land, and cropland erosion. Similar to methods described earlier for identifying high priority wetlands for protection, the radii around livestock operations were used to identify historic wetlands for restoration. These are the wetlands that have the greatest potential for pathogen removal and are located around the known sources of pollution. The critical areas for wetland restoration are shown in Figure 7.3.

Where wetland restoration is not possible or may not be the most appropriate BMP, buffers or similar BMPs aimed at capturing overland manure runoff should be installed. In addition, other structural and managerial BMPs suggested for livestock pollutant contributions (reviewed in Chapter Six) should be installed.

Cropland

Sediment is a known source of overland pollution in the watershed. Critical areas for sediment pollution from cropland runoff were identified using HIT model results along with the LLWFA. Cropland was determined to be the largest contributor of sediment to the RCRW and its tributaries, and wetland restoration is considered a critical BMP on cropland since wetlands are effective systems for sediment removal.

Where wetland restoration is not possible or may not be the most appropriate BMP, buffers or similar BMPs aimed at reducing and capturing overland sediment should be installed. In addition, other structural and managerial BMPs suggested for cropland sediment pollutant contributions reviewed in Chapter Six should be installed.

Critical areas for wetland restoration were developed, taking into account the historic and existing wetlands, potential for wetland restoration, livestock demands on the land, and cropland erosion. The highest priority wetlands for treating cropland runoff are recommended in this plan to be restorable wetlands located within 500 feet of a stream and within a buffer of the highest two HIT categories. These wetlands are identified, mapped, and considered to be the critical wetland restoration areas for sediment removal and are shown in Figure 7.3.

Urban Sediment

The neighborhood source assessment (NSA) did not identify specific urban areas as being more critical than other urban areas. BMPs to reduce sediment inputs from urban areas should be installed, including those listed in Chapter Six.

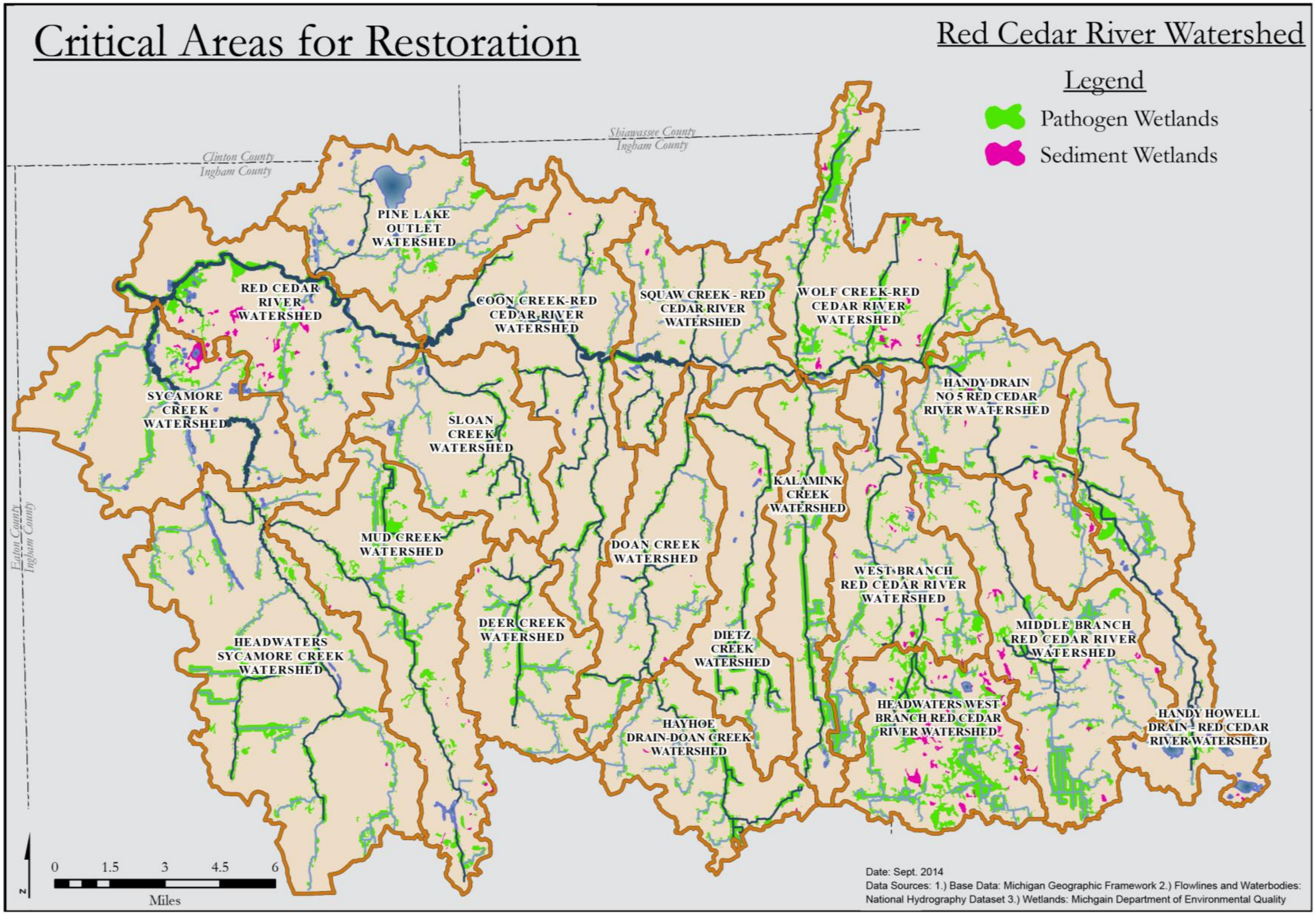

Figure 7.3 Critical Areas for Wetland Restoration

Human *E. coli*
Critical areas for human waste entering the environment from improperly maintained or failing septic or sewer systems were identified using a variety of means, including results of work with scent-trained canines, well and septic records, meetings with health department personnel and personal reports. The results of this information gathering indicate that the following areas should be targeted for BMPs or additional data collection, due to known or suspected pollution from onsite wastewater treatment systems:

Known
Coon Creek
Handy Howell Drain
Headwaters Sycamore Creek
Sloan Creek
Wolf Creek

Suspected
Homes near the intersection of Sherwood and Meridian- Coon Creek
Village of Webberville
Village of Dansville
Triangle Lake
Cedar Lake
Pleasant Lake

Potential (subwatersheds with the highest density of septic systems)
Coon Creek
Headwaters Sycamore Creek
Handy-Howell
Middle Branch
Mud Creek
Sloan Creek
Sycamore Creek
Septic systems in areas with poor soils

To address *E. coli* from human sources in these critical areas, additional source tracking is recommended. In addition, illicit septic connections should be corrected, and septic systems should be maintained, repaired, and/or replaced.

7.6 Subwatershed Prioritization
It was determined that a prioritization of subwatersheds was necessary to help guide future watershed activities due to the large amount of data that exists, the distribution of willing project partners and the various pollutants, sources and causes identified across a very large watershed region. While this is meant to be a prioritization, it does not mean that implementation activities in lower priority subwatersheds are not meaningful or necessary. It is simply meant to be a guide for determining the wisest use of limited funds and resources.

Using the data and information collected and described in this WMP, subwatersheds were prioritized into four tiers from highest piority (Tier I) to lowest priority (Tier IV). Specifically, the following information was used to develop the ranking matrix presented in Table 7.2:

1. Animal density
2. Known or suspected septic problems
3. TMDL priority
4. *E. coli* monitoring results
5. HIT model results
6. Wetland loss
7. Partners interested in developing and implementing BMPs

This tiered list is intended to be updated over time to plan for and implement work in additonal subwatersheds as more funding becomes available. Watershed priority tiers are listed in Table 7.3 and depicted in Figure 7.4.

Table 7. 2 Subwatershed Ranking Matrix

Subwatershed	**Animal density** (0-10 = 1; 11-30 = 5; 31-100 = 10; 101+ = 15)	**Known or suspected Septic** (no = 0; yes = 10)	**TMDL priority** (*E. coli* and DO) (Priority = 10; TMDL = 5; no TMDL = 0)	***E .coli* results** (%PBC exceedence) (0-39% = 1; 40-70% = 5; 71-100% = 10)	**HIT** (Category 1 = 0; Category 2 = 2; 3 = 4; 4 = 6)	**Wetland loss** (0-30% = 1; 31-70% = 5; 71%+ = 10)	**Partner interest** (0-2 partners = 1; 3-5 partners = 5; 6+ partners = 10)	**TOTAL SCORE**	**No. of partners**	**Partners**
Sloan Creek	15	10	10	10	4	5	1	55	2	DC, CD
Wolf Creek-Red Cedar River	10	10	5	10	2	10	1	48	2	DC, CD
Red Cedar River	10	10	10		0	5	10	45	7	DC, CD, MSU, Lansing, E. Lansing, Lansing Twp, Meridian Twp
Headwaters Sycamore Creek	10	10	10		4	5	5	44	5	DC, CD, HD, Delhi, Mason
Mud Creek	5	10	10	5	4	5	5	44	3	DC, CD, HD
Middle Branch Red Cedar River	5	10	0	5	4	5	5	34	3	DC, CD, Marion Twp
Coon Creek-Red Cedar River	1	10	5	5	2	5	5	33	5	DC, CD, HD, Williamston, Williamstown Twp
Dietz Creek	10		5	5	6	5	1	32	2	DC, CD
Doan Creek	10		5	5	6	5	1	32	2	DC, CD
Squaw Creek-Red Cedar River	1		10	5	4	5	5	30	4	DC, CD, Williamston, Williamstown Twp
Handy Howell Drain-Red Cedar River	1	10	5	1	2	1	5	25	4	DC, CD, HD, Marion Twp
Kalamink Creek	5		10	1	2	5	1	24	2	DC, CD
Sycamore Creek	1		10	1	0	1	10	23	6	DC, CD, HD, Delhi Twp, Lansing, Lansing Twp
Hayhoe Drain-Doan Creek	5		0		6	10	1	22	2	DC, CD
West Branch Red Cedar River	1		5	10	2	1	1	20	2	DC, CD
Handy Drain No 5-Red Cedar River	5		5		0	5	5	20	4	DC, CD, HD, Marion Twp
Deer Creek	1		0	5	6	5	1	18	2	DC, CD
Headwaters West Branch Red Cedar River	5		5		0	5	1	16	2	DC, CD
Pine Lake Outlet	5		0		0	5	5	15	5	DC, CD, Meridian Twp, Williamston, Williamstown Twp

Table 7.3 Subwatershed Tier Prioritization

Tier I	Tier II	Tier III	Tier IV
Sloan Creek	Middle Branch	Handy Howell	Deer Creek
Wolf Creek	Coon Creek	Kalamink Creek	Headwaters West Branch
Red Cedar River	Dietz Creek	Sycamore Creek	Pine Lake Outlet
Headwaters Sycamore	Doan Creek	Hayhoe Drain	
Mud Creek	Squaw Creek	West Branch	
		Handy Drain No. 5	

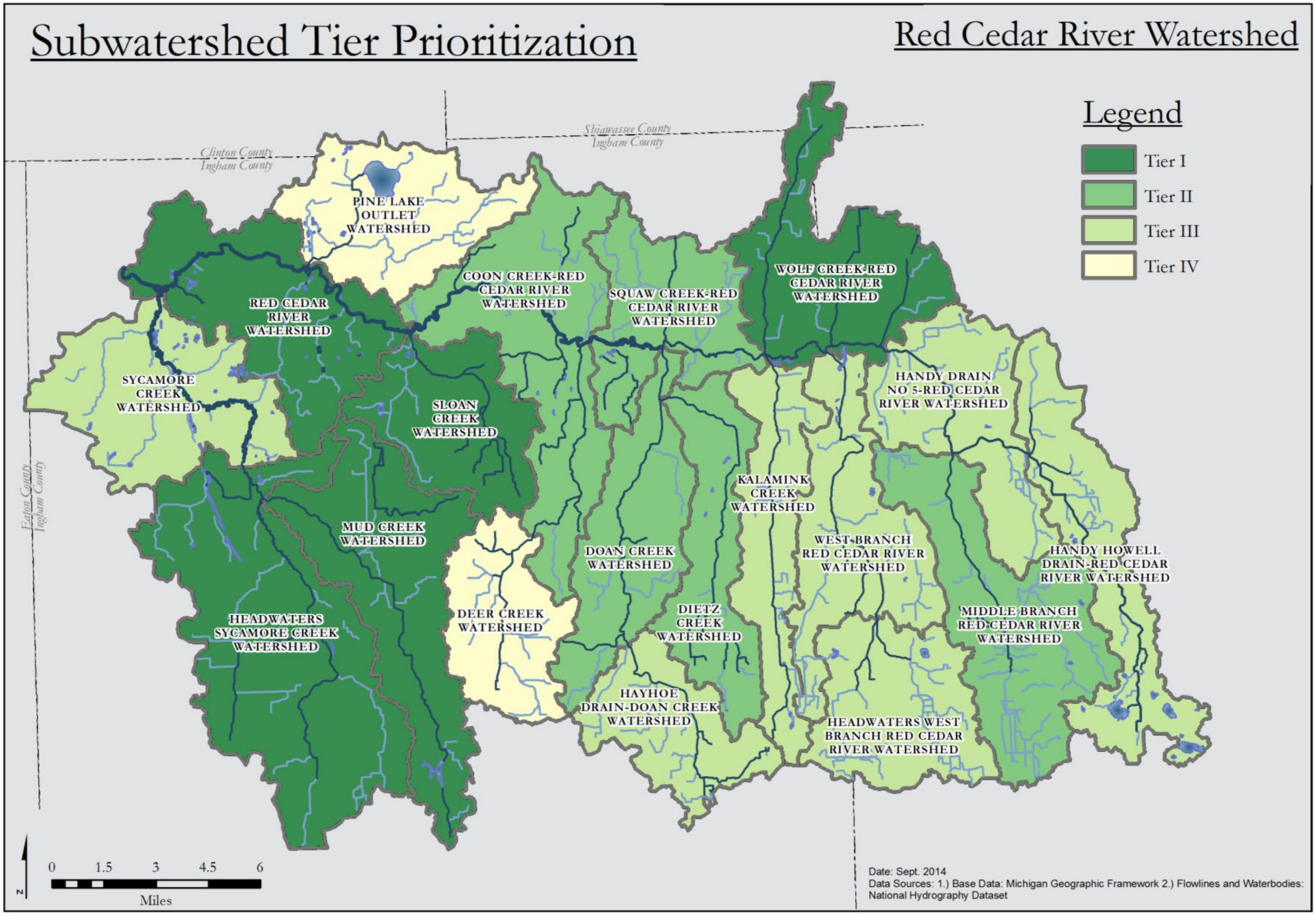

Figure 7.4 Subwatershed Tier Prioritization

7.7 Funding BMPs

A variety of funding sources currently exist for water quality improvements, but opportunities change over time and must be tracked accordingly. This makes it especially important to use all of the funding resources available, rather than continue to rely on one or two particular sources. Examples of financial sources include EPA Section 319 implementation funds, Clean Michigan Initiative, several programs with the United States Fish and Wildlife Service, Great Lakes Basin Program, Sustain Our Great Lakes, the Natural Resources Conservation Service, local governments and private funding provided by foundations.

7.8 Implementation Schedule and Milestones

Table 6.2 in Chapter Six includes short and long-term milestone goals for implementation. However, it is recommended that implementation of this plan begin immediately and is fueled by momentum established during this planning project. Many partners have been identified and are excited to begin implementation of recommendations for measureable water quality improvements.

As progress is made toward the goals and objectives established as part of this planning project, an update to the WMP will be warranted. It is suggested that updates to the WMP are made at least every five years to ensure that information used to make management decisions remains relevant and dependable.