CHAPTER 9. PRIORITIZATION PROCESS

9.01 OVERVIEW AND DEFINITIONS

This purpose of this chapter is to describe the process used to formally define priorities identified through stakeholder and public involvement process. The focus is on identifying implementation priorities for the initial five-year increment of plan implementation.

During the process of establishing a methodology, several standard terms were defined to ensure all stakeholders involved in the process were using consistent terminology throughout discussions. These terms are generally described below:

Priority Water Bodies - The actual resource you want to protect or restore. These are typically identified as specific lakes, streams, wetlands, or other unique water resources identified through stakeholder input and existing plans/documents such as: Title 117 State Resource Waters; 303(d) list of impaired waters; areas identified in the State Nonpoint Source Management Plan; Wellhead Protection Areas; Nebraska Game and Park Commission's (NGPC's) Aquatic Habitat Plan; wetland complexes identified by NGPC; and others. These may include areas most susceptible or sensitive to nonpoint source pollution.

Target Areas - The defined areas within a watershed where implementation of BMPs will be focused to improve or protect the water quality of priority water bodies. These are typically based on designated drainage areas or stream corridors, but they are not required to be based on HUC 12 boundaries. The *2015 State Nonpoint Source Management Plan* (NDEQ, 2015b) specifies that target areas may only make up a maximum of 20% of a HUC 8 subbasin area, also known as the 20% Rule. Target areas are often customized to specific drainage areas using GIS analysis, water quality modeling, or other tools. Selection of these areas can be based on varying factors such as pollutant load, pollutant source, achievable results, landowner interest, etc.

Critical Source Areas (CSA) – These are a relatively small fraction of a watershed that generates a disproportionate amount of pollutant load (Meals and others, 2012). Identifying these areas allows better targeting of BMPs to most effectively use financial and technical resources. CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism; therefore, identifying the pollutant of concern, it's source, and understanding hydrology are the first steps in CSA identification**.** These are identified within target areas, which often requires detailed assessments, modeling, GIS analysis, or in-field work to identify and define. Additional details on CSAs can be found in Chapter XX and the individual subbasin chapters (Chapters XX – XX).

Special Priority Areas – Areas determined to have specific, limited, and timely needs that may lie outside of a target area. These areas do not count towards the 20% Rule. Practices are restricted to those necessary to address the specific needs of the special priority area. Examples of these areas are wellhead protection areas or unique landscapes, such as the Eastern Saline Wetlands.

Priority Practices - BMPs identified by the project partners that are key to achieving goals in both the target areas and special priority areas. These are typically screened down from a suite of practices based on agency and public input, such as pollutant treatment efficiency and landowner acceptance. These are typically the BMPs that are included in the water quality modeling efforts and can consist of structural or non-structural practices (see Chapter XX).

Monitoring Priorities - Monitoring is necessary for baseline data, filling in data gaps, and for tracking plan progress. Monitoring priorities may vary, but could include water quality, water quantity, social indicators of change, and BMP tracking over time.

Education & Information Priorities – Each target area has an education and outreach component; however, there can also be stand-alone education and information priorities especially as it relates to specific issues identified by stakeholders, such as source water protection.

9.02 METHODOLOGY

The plan covers a large geographic area, includes multiple HUC 8 subbasins, and has many competing priorities. In order to narrow down the focus of this plan to a scope that is manageable for the LPSNRD to address in the near future, priority water bodies were identified. This process had to recognize the inherent differences in the sources of pollutants for each water body, the scale of contributing areas, and the resources and effort required to address them. The water bodies selected are the focus of the first five-years for plan implementation efforts. The initial list of possible priority water bodies was limited to the following criteria:

- Identified as impaired in the 2016 Integrated Report (NDEQ, 2016b)
- Designated as a high quality or unique resource within the State NPS Plan (NDEQ, 2015b)
- Identified by NGPC as priority wetland areas or regional wetland complexes (LaGrange, 2005)

Water bodies where naturally occurring materials have led to water quality impairments (selenium, chloride, etc.) or where impairments are not caused by nonpoint source pollution (e.g. mercury) were not considered within the prioritization process.

To facilitate the selection of a final list of priority water bodies, a screening process unique to the LPSNRD was utilized. A similar process has been used successfully on comparable plans in Nebraska. The screening process was based on a points system representing various agency and stakeholder interests. There is equal weighting is assigned for each criterion because of the inherent subjectivity of each category. Figure 61 outlines this screening process. Additional details are provided in Appendix XX. Finally, water quality modeling and input from stakeholders and the public were all considered in the final selection of priority water bodies by the LPSNRD.

Once the final priority water bodies were identified, implementation strategies were developed for each resource (see Chapters XX, XX, and XX). These implementation strategies include target areas for treatment, BMPs, quantified pollutant load reductions, and other components. Detailed implementation strategies were only developed for the final list of priority water bodies and special priority areas, as other areas are not anticipated to implement projects in the first five-year increment of the plan.

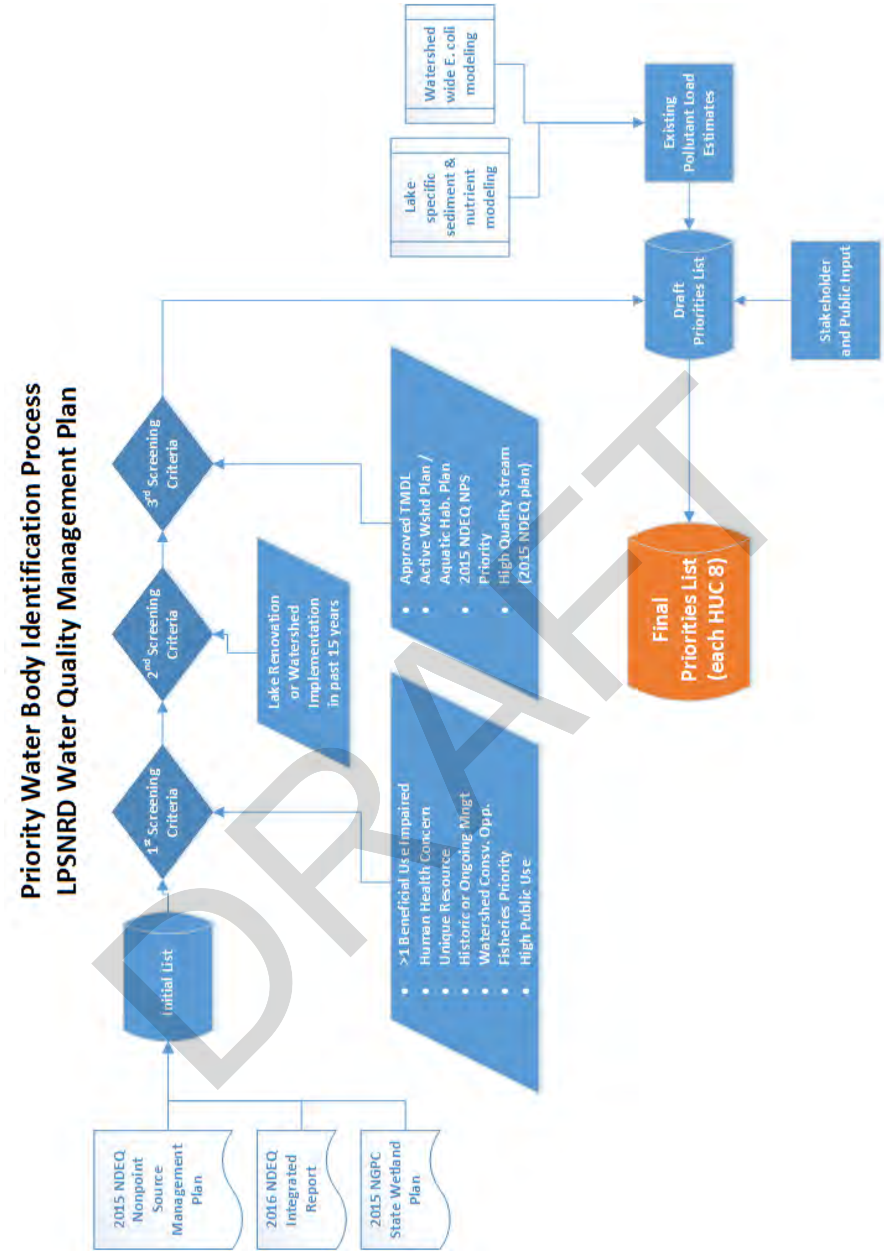

Figure 61: Flow Chart of Water Body Prioritization Process

9.03 PRIORITY WATER BODIES AND TARGET AREAS

After the final screening was completed, five priority water bodies were identified: Pawnee Reservoir and Middle Creek near Malcolm; East and West Twin Reservoirs near Pleasant Dale; Decker Creek near Platte River State Park; and Antelope Creek in Lincoln. A special priority area, the Eastern Saline Wetlands, was also included as it is located primarily within the Upper Little Salt Creek subwatershed. No priority water bodies were identified in the Keg-Weeping Water HUC 8. These priority water bodies are shown in Figure 62, along with their associated target area. Table 46 displays contribution of the target areas towards the 20% rule. The identified target areas are consistent with NDEQ's requirements that less than 20% of an HUC 8 be identified as a target area.

PAWNEE RESERVOIR AND MIDDLE CREEK

Pawnee Reservoir is on the list of upcoming lake renovations and experiences significant blue-green algae blooms on a regular basis, often resulting in beach closings. This is a high-use recreation site near Lincoln. Additionally, Middle Creek is impaired for atrazine.

EAST TWIN AND WEST TWIN LAKES

East Twin Lake, which is significantly larger than its twin to the west, is also subject to a future full lake renovation by NGPC. West Twin Lake is essentially a sediment basin to East Twin Lake. This area is a target for a fishery renovation.

DECKER CREEK

Decker Creek was identified as a priority area due to extremely high levels of *E. coli* bacteria present within the stream. Additionally, it presents an opportunity to address a rural *E. coli* bacteria problem versus an urban area (i.e. Antelope Creek). Decker Creek flows to the Platte River and with its confluence near Platte River State Park.

ANTELOPE CREEK

Antelope Creek is located in the heart of Lincoln and has numerous public spaces along the stream corridor including: Holmes Lake; the Lincoln Children's Zoo; University of Nebraska-Lincoln's City Campus; Innovation Campus (formerly State Fair Grounds); multiple parks; and a fully developed bicycle trail system. The stream is impaired due to *E. coli* bacteria and multiple projects have been completed in recent years following the development of a water quality plan (EA, 2012). The City of Lincoln and LPSNRD both intend to continue implementing projects identified in that plan.

UPPER LITTLE SALT CREEK WATERSHED (EASTERN SALINE WETLANDS)

This target area will leverage the existing *Upper Little Salt Creek Saline Wetlands Plan* (Lincoln Parks and Recreation, 2015) which has identified several actions to restore wetlands. The focus within this plan will be conservation work within the watershed that will limit further degradation of this unique resource by reducing sedimentation to the wetland areas from the watershed.

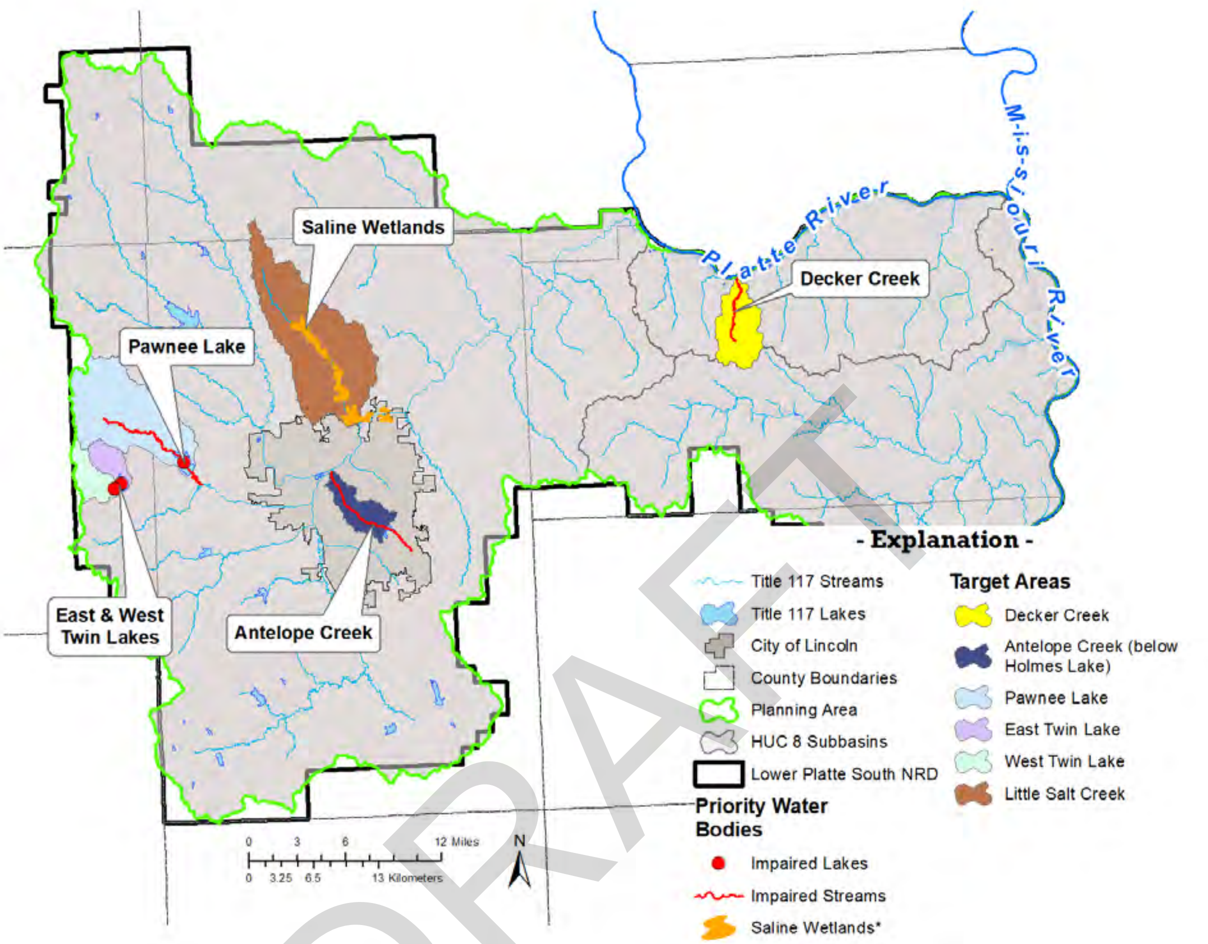

Figure 62: Priority Water Body Locations and Target Areas

Table 46: Priority Water Bodies, Target Areas, and the 20% Rule

HUC 8	Priority Water Body	Target Area & HUC 12 Code	Acres	% of HUC 8
Salt	Pawnee Lake	Pawnee Lake - Middle Creek HUC 12 102002030202	20,963	3%
	Middle Creek			
	East & West Twin Lakes	South Branch - Middle Creek HUC 12 102002030201	6,835	1%
	Antelope Creek	Antelope Creek 102002030304	4,931	1%
	Eastern Saline Wetlands	Little Salt Creek 102002030901	29,326	4%
Salt Creek HUC 8 Total Targeted Area			**62,055**	**9%**
Lower Platte	Decker	Deck Creek-Platte River 102002020203	7,621	7%
Keg-Weeping Water	None	None	N/A	N/A

9.04 SPECIAL PRIORITY AREAS

Special priority areas provide flexibility to address small-scale areas identified with specific, limited, and timely needs that lie outside of the target areas. They address issues that occur widely in the watershed that may affect not only water quality, but also health and safety of humans. Additionally, some BMPs do not have specific targeted land uses or an easily defined subwatershed associated with their implementation and thus do not count towards the 20% Rule.

Some BMPs have a broader appeal and impact on public involvement when implemented on an area-wide basis. Practices are restricted to those necessary to address the specific needs of the special priority area. BMPs address specific issues within areas, many of which cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities. Stakeholders identified the following special priority areas:

WELLHEAD PROTECTION AREAS

NDEQ's Wellhead Protection Program is a voluntary program that helps community water systems protect groundwater through a series of steps including delineation and mapping of the Wellhead Protection (WHP) Areas. This plan recognizes WHP Areas as special priority areas due to the influence a WHP Area has on the management needs of source water aquifers and associated public drinking water systems. WHP areas within the planning area are identified in Chapter XX. Completion of WHP plans and implementing BMPs targeting groundwater quality are priorities. These would include but are not limited to: fertilizer at agronomic rates, irrigation water management, and cover crops.

ON-SITE WASTEWATER TREATMENT SYSTEMS

In 2004 the adoption of new regulations and design standards for on-site wastewater systems offered an opportunity to address potential sources of bacterial and nutrient contamination in waterbodies. The On-site Wastewater System Upgrade practice for Section 319 projects was created to support pumping and inspection of on-site wastewater systems and to replace systems installed before 2004.

SALINE WETLANDS

This area is identified in *2015 State Nonpoint Source Management Plan* (NDEQ, 2015b). This special priority area will leverage the existing *Upper Little Salt Creek Saline Wetlands Plan* (Lincoln Parks and Recreation, 2015) which has identified several actions to restore wetlands. The focus as a special priority area will be to implement BMPs within the existing wetlands to restore hydrology, reduce sedimentation, and improve habitat.

LINCOLN-LANCASTER SALT VALLEY GREENWAY

Greenways in and around the City of Lincoln form linkages between wildlife habitat and natural areas and are primarily situated around waterways. Many projects completed in these areas also will, or have the potential to, reduce nonpoint source pollution and/or improve aquatic habitat. BMPs in these areas will be defined based on the specific pollutant source being addressed, but additional BMPs targeting non-permitted livestock and stream restoration will be considered. Maps and additional information on these this special priority area can be found in the City of Lincoln Watershed Master Plans and the City of Lincoln Comprehensive Plan. These are located at the following webpages:

- https://lincoln.ne.gov/city/pworks/watershed/master-plan/
- http://lincoln.ne.gov/city/plan/long/comp.htm

EXISTING SEDIMENT RETENTION STRUCTURES AT LAKES

Many of the area's reservoirs have undergone aquatic habitat restoration activities in the past two decades. These efforts have often included the installation of sediment basins or other retention structures at the headwaters of each reservoir. BMPs associated with this special priority area include dredging or excavating sediment that has filled these structures. These actions will restore the reservoirs and basins to a functioning level allowing them to protect water quality in the reservoir and downstream aquatic resources.

ANTELOPE COMMONS

Antelope Commons is a series of wetlands constructed in 1995 within the channel of Antelope Creek above Holmes Lake. These wetlands function as BMPs to protect the stream and reservoir from nonpoint source pollution originating from the surrounding urban landuse. This project was installed prior to much of the area's urban development and is thus a likely candidate for renovation to ensure the continued function of this BMP system.

NON-PERMITTED LIVESTOCK FACILITIES

Almost all livestock operations have the potential to adversely affect water quality; however, non-permitted AFOs are not required to maintain BMPs. Non-permitted livestock facilities are identified as a special priority area to provide a pro-active approach to livestock waste treatment while demonstrating appropriate treatment technologies and BMPs. Only operations that are exempted by regulations or are deemed exempt by NDEQ are included. BMPs include all of those identified in Chapter XX under the "Non-permitted AFO Facility BMPs" practice suite.

9.05 OTHER PRIORITIES

In addition to priority water bodies, stakeholders were also able to identify both monitoring and information and education (I&E) priorities. These are activities which would take place separate of any target area activities or pre/post project activities. These priorities are listed below with a brief description of each. Many of these activities are outside of priority areas but may support other implementation actions.

MONITORING PRIORITIES

Existing BMP Treatment Levels –Additional site-specific information on the level of BMP implementation is needed across the planning area. This would ideally include an inventory of existing structural BMPs identified via aerial imagery and/or LiDAR data; and non-structural BMPs, likely identified through surveys.

Jenny Newman Lake – Based on a review of a recent NGPC water quality report (Blank and Jackson, 2017), additional studies are needed to evaluate possible on-site wastewater system influence on runoff to the lake.

Stevens Creek – This watershed immediately east of Lincoln is developing rapidly, and significant efforts have been put in place to protect Stevens Creek from downcutting and degradation. A plan to monitor the changing conditions of the creek, mainly stream bank erosion, will be put into place. This plan will allow for early intervention to ensure the stream remains healthy as it's incorporated into growing neighborhoods.

Pre-project Monitoring – Several years before a project is put into place, pre-project data should be collected in order to enable evaluation of changing conditions during and after project implementation.

Decker Creek – Develop a monitoring plan to identify bacteria sources and levels in the Decker Creek watershed, which are the highest in the district. This additional monitoring data may help to better identify pollutant sources and target implementation efforts.

Impaired Aquatic Communities – Several stretches of streams in the planning area have impaired aquatic communities from unknown causes. It is likely that these causes are related to habitat conditions, however assessments need to be made to confirm this. The LPSNRD will coordinate with NDEQ and other agencies to conduct in-stream biological assessments to identify the cause of the impaired aquatic communities.

Bathymetric Surveys – Most of the reservoirs in the planning area either do not have bathymetric survey data or the data is extremely old. Data should be collected to update sedimentation rate estimates, which is necessary for future planning purposes. The LPSNRD will work with its partners to develop a comprehensive data collection schedule/plan to begin the process of updating bathymetric surveys for area reservoirs.

EDUCATION & INFORMATION PRIORITIES

Beaver Lake – Beaver Lake is a private lake community that uses surface water for its water supply. Utilizing surface water for drinking water poses a unique threat due to the possibly of blue-green algae blooms and associated elevated levels of microcystin toxins, both of which pose human health hazards. The project team prioritized I&E activities for both in-lake and watershed management to mitigate possible eutrophication which often leads to these dangerous algae blooms.

Home Owners Associations – This priority was identified primarily as it relates to the numerous homeowner associations within the City of Lincoln, many of which have stormwater management ponds or other stormwater management facilities. Targeted I&E for management and maintenance activities and responsibilities will be beneficial to the planning area.

LPSNRD Board of Directors – The NRD's Board would benefit from additional education outreach regarding the various water quality issues and priorities identified in this plan. Fully understanding the scope of activities and requirements for implementation will be crucial to making this plan an effective management tool.

Rural Water Districts – These organizations are responsible for providing safe drinking water to many rural citizens outside the purview of municipal or county government structures. The planning team will work with them through targeted I&E efforts related to nonpoint source pollution and source water management.

County Commissioners – These decision makers are responsible for approving funds and projects within their specific county. These entities must fully understand what is in this plan if they are expected to take action on the implementation activities within it.

Village/city governments with WHP areas - These decision makers are responsible for approving funds and projects within their specific jurisdiction. The planning team will work with them through targeted I&E efforts related to nonpoint source pollution and source water management.

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CHAPTER 10. SALT CREEK HUC 8 SUBBASIN

10.01 SUB-BASIN BACKGROUND

The Salt Creek Subbasin (HUC 8: 10200203) is the largest of the three subbasins addressed in this plan. The subbasin is 722,994 acres (entire planning area is 1,048,774 acres) and consists primarily of Lancaster County (Figure 109). This subbasin is the most diverse in land use/land cover compared to the rest of the planning area. A large urbanized area (Lincoln, NE) and many smaller communities and acreages are located within the subbasin. Lincoln's perimeter includes several small towns and acreages which contributes to the area's growing population and expanding urban footprint. Row crop (corn/soybean) production is the dominant agriculture land use (50%), however the western portion of the subbasin includes high amounts of grass/pasture lands (27%). There are many large reservoirs (constructed for flood control) located in the subbasin, most of which are also utilized for recreational purposes. Finally, as discussed in Chapter XX, the majority of Nebraska's saline wetlands are located within this subbasin. All these elements make for unique resource concerns and opportunities within Nebraska and this planning area.

This chapter is intended to focus primarily on the target areas and special priority areas identified within the Salt Creek HUC 8 Subbasin. Little discussion is given to the rest of the subbasin here, as much of that information can be found throughout the rest of this plan. Information on an inventory of subbasin characteristics is found in the following chapters/section within this plan:

- Land Use: Chapter XX
- Existing land treatment (BMPs): Chapter XX
- Irrigation: Chapter XX
- Permitted facilities: Chapter XX
- Water resources: Chapter XX
- Existing resource conditions: Chapter XX

A general discussion of the types and sources of pollutants addressed in this chapter can be found in Chapter XX. This subbasin specific chapter provides information for the contribution of pollutant by source within each target area. Additionally, this chapter provides the following information for each target area (and special priority areas, as applicable):

- Pollutant sources and loads;
- Pollutant load reductions needed to meet water quality standards (load reduction goals);
- Pollutant load reductions as a result of BMP implementation;
- Communication and outreach;
- Schedule and milestones;
- Monitoring; and
- Costs.

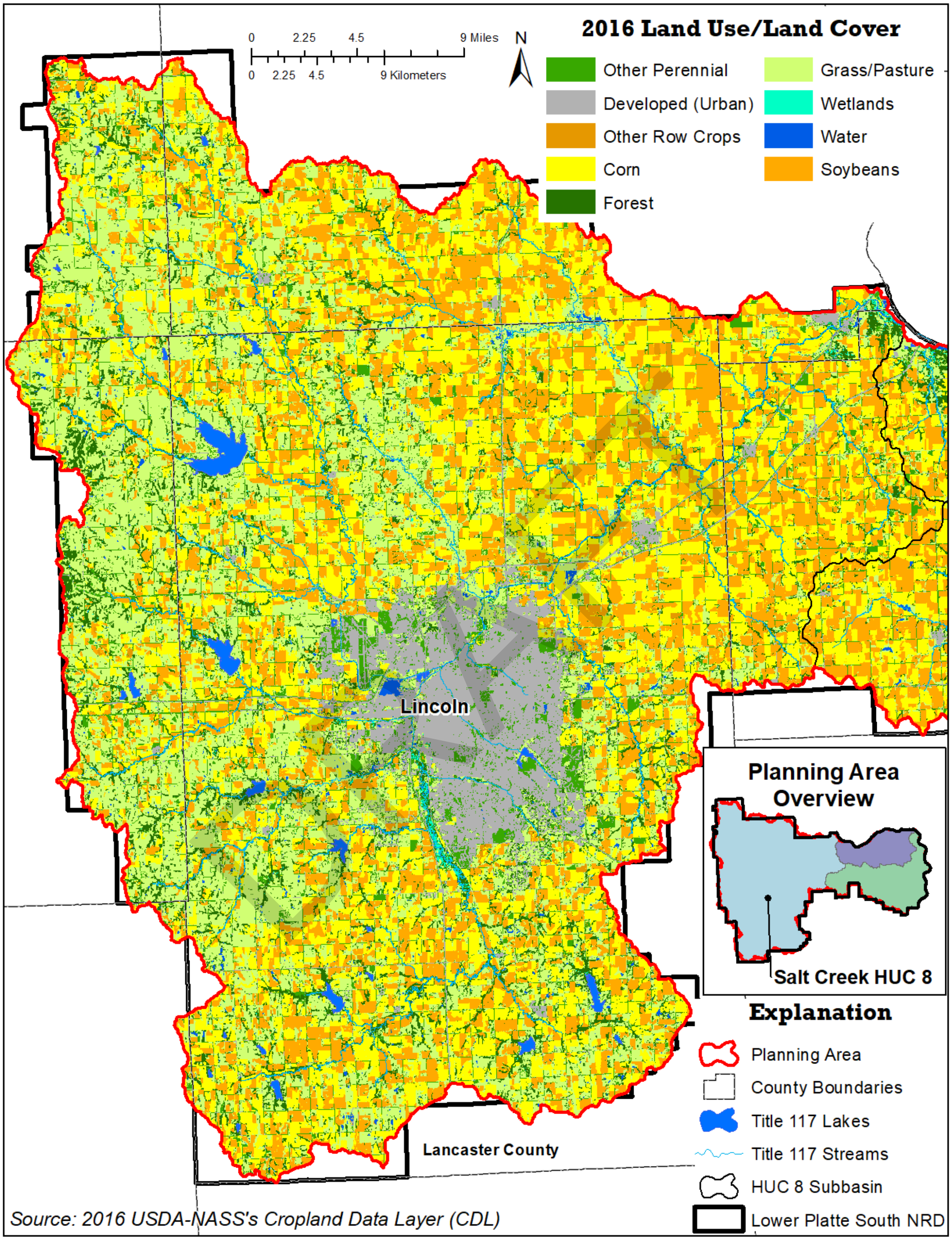


Figure 63: Land Use/Land Cover within the Salt Creek HUC 8 Subbasin

10.02 OVERVIEW OF PRIORITIES

As discussed in Chapter XX, target areas and special priority areas were selected through a review of water quality data and stakeholder input. As shown in Figure 64 and Table 47, the following areas within this subbasin have been selected for focused implementation efforts:

Target Areas

- Pawnee Lake and Middle Creek
- East and West Twin Lakes
- Antelope Creek (below Holmes Lake)
- Little Salt Creek

Special Priority Areas

- On-site Wastewater Treatment Systems (OWTS)
- Non-permitted animal feeding operations (AFOs)
- Wellhead protection areas (WHP areas)
- Saline Wetlands
- Lincoln-Lancaster Salt Valley Greenway
- Existing sediment retention structures
- Antelope Commons

As part of the prioritization process in the development of this plan (Chapter XX), target areas were identified based on the contributing area to each priority waterbody identified. The total size of each target area was calculated through GIS analysis to ensure the sum of the targeted areas equaled less than 20% of the total HUC 8 area which satisfied the NDEQ 20% Rule (NDEQ, 2015a). Within the Salt Creek HUC 8 Subbasin, 62,055 acres are targeted for implementation work, approximately 9% of the HUC 8 area (Table 47). The following sections of this chapter provide information on the implementation strategy for each target area, with additional details and supporting technical information located in Appendix XX.

Table 47: Priority Waterbodies and Associated Target Areas within the Salt Creek HUC 8 Subbasin

Priority Water Body Addressed (Water Body ID)	HUC 12 Subwatershed	Target Area Size (acres)	% of Total HUC 8 Size	Pollutants/Impairments Addressed
Pawnee Lake (LP2-L0160)	102002030202	20,972	3%	Sediment, nutrients, and algal biomass
Middle Creek (LP2-21100)	102002030202	20,963*	*	Atrazine
East Twin Lake (LP2-L0240)	102002030201	2,983	<1%	Sediment and nutrients
West Twin Lake (LP2-L0260)	102002030201	3,852	1%	Sediment and nutrients
Antelope Creek, below Holmes Lake (LP2-20900)	102002030307	4,931	1%	*E. coli* bacteria
Little Salt Creek (LP2-20300)	102002030901	29,326	4%	*E. coli* bacteria, and sediment
Total	**n/a**	**62,055**	**9%**	**n/a**

**Same drainage area as Pawnee Lake, therefore not included in Total Area*

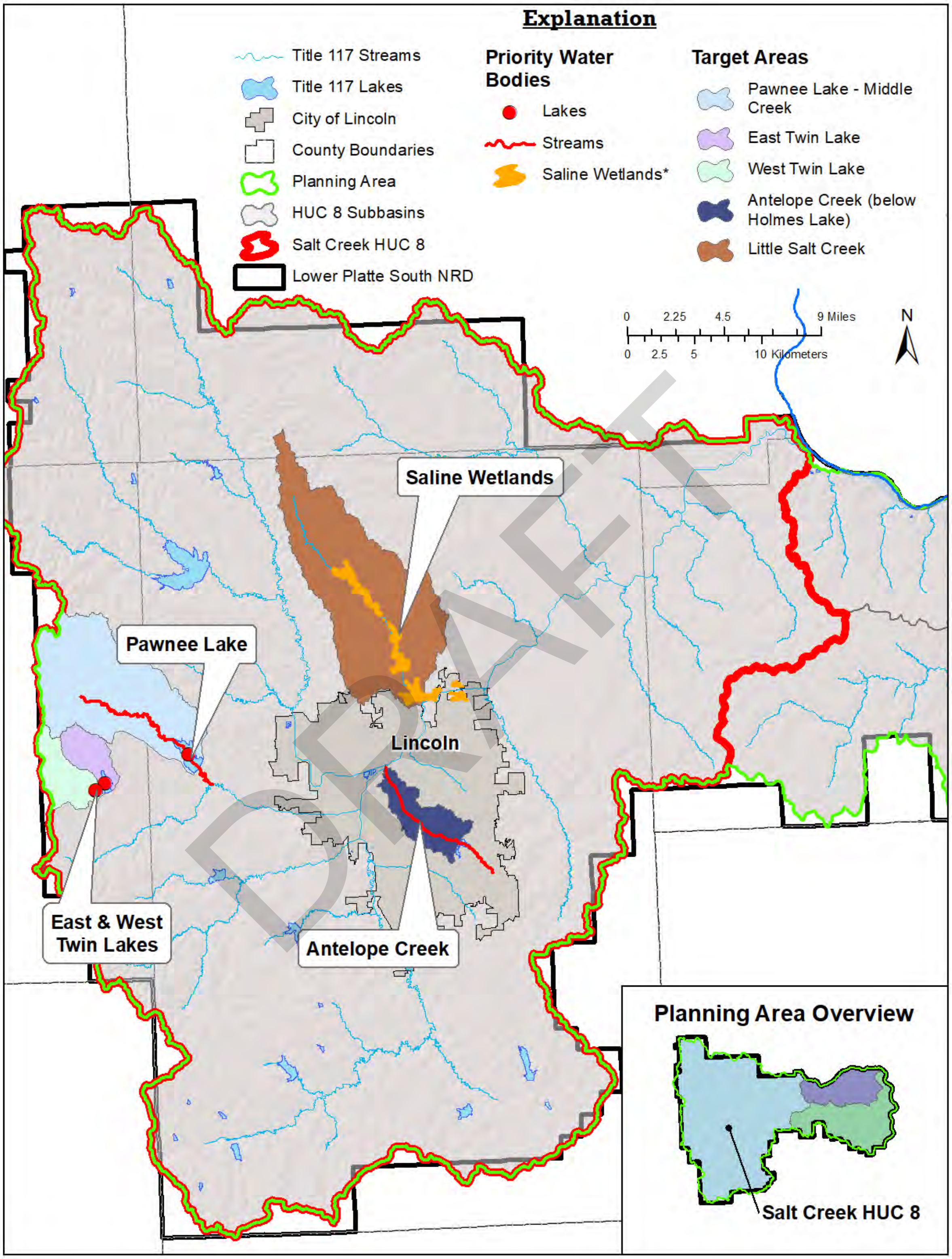


Figure 64: Target Areas and Special Priority Areas within the Salt Creek HUC 8 Subbasin

10.03 PAWNEE LAKE AND MIDDLE CREEK TARGET AREA

INTRODUCTION

NOTE TO READERS

Information in this section is summarized from the *Pollutant Modeling and BMP Implementation Recommendations Summary Report for Pawnee Lake and Middle Creek Subwatershed* (Laketech, 2018a), a copy of which is also provided in Appendix XX. Unless otherwise noted, additional details and background information can be found in that comprehensive document.

The Middle Creek HUC 12 subwatershed (102002030202) is a tributary of Salt Creek located in Seward and Lancaster counties (Figure 65). The creek is comprised of two segments (LP2-21000 and LP2-21100), which flows approximately 20 miles to the southeast towards Salt Creek (NDEQ, 2016b). Middle Creek has one perennial tributary, South Branch Middle Creek (LP2-21010) The South Branch Middle Creek tributary extends approximately 15 miles before entering Middle Creek below Pawnee Lake.

Middle Creek's assigned beneficial uses include: Aquatic Life; Aesthetics; and Agricultural Water Supplies (NDEQ, 2014). The lower portion of Middle Creek (LP2-21000) is fully supporting the assigned beneficial uses, whereas the South Branch Middle Creek has not been assessed. The headwaters of Middle Creek (LP2-21100) above Pawnee Lake is listed as impaired (Aquatic Life use) from atrazine in the 2016 Integrated Report (IR) prepared by NDEQ (NDEQ, 2016b). The Middle Creek drainage area above Pawnee Lake consists of 20,972 acres.

Pawnee Lake was constructed on Middle Creek in 1966 (USACE, 2018). The lake is located only a few miles from the city limits of Lincoln in Lancaster County. As-built records indicate the lake comprised 734 surface acres and had a conservation pool volume of 8,695 acre-feet. The dam was constructed by the U.S. Army Corp of Engineers (USACE) for the primary purpose of flood control, with recreation as a secondary benefit. Recreational activities are managed by the Nebraska Game and Parks Commission (NGPC). Pawnee Lake, which has a State Park designation, is the second largest lake in the Salt Valley system. The lake has two swimming beaches and is used extensively for all types of passive and active recreation. The lake and park area accommodated 327,727 visitors in 2017 (NGPC, personal communication, April, 4, 2018).

Pawnee Lake's assigned beneficial uses include: Primary Contact Recreation; Aquatic Life; Aesthetics; and Agricultural Water Supplies (NDEQ, 2014). Pawnee Lake is listed as impaired from sediment (Aesthetics use), nutrients (Aquatic Life use), and algae density (Aquatic Life use) in the 2016 IR.

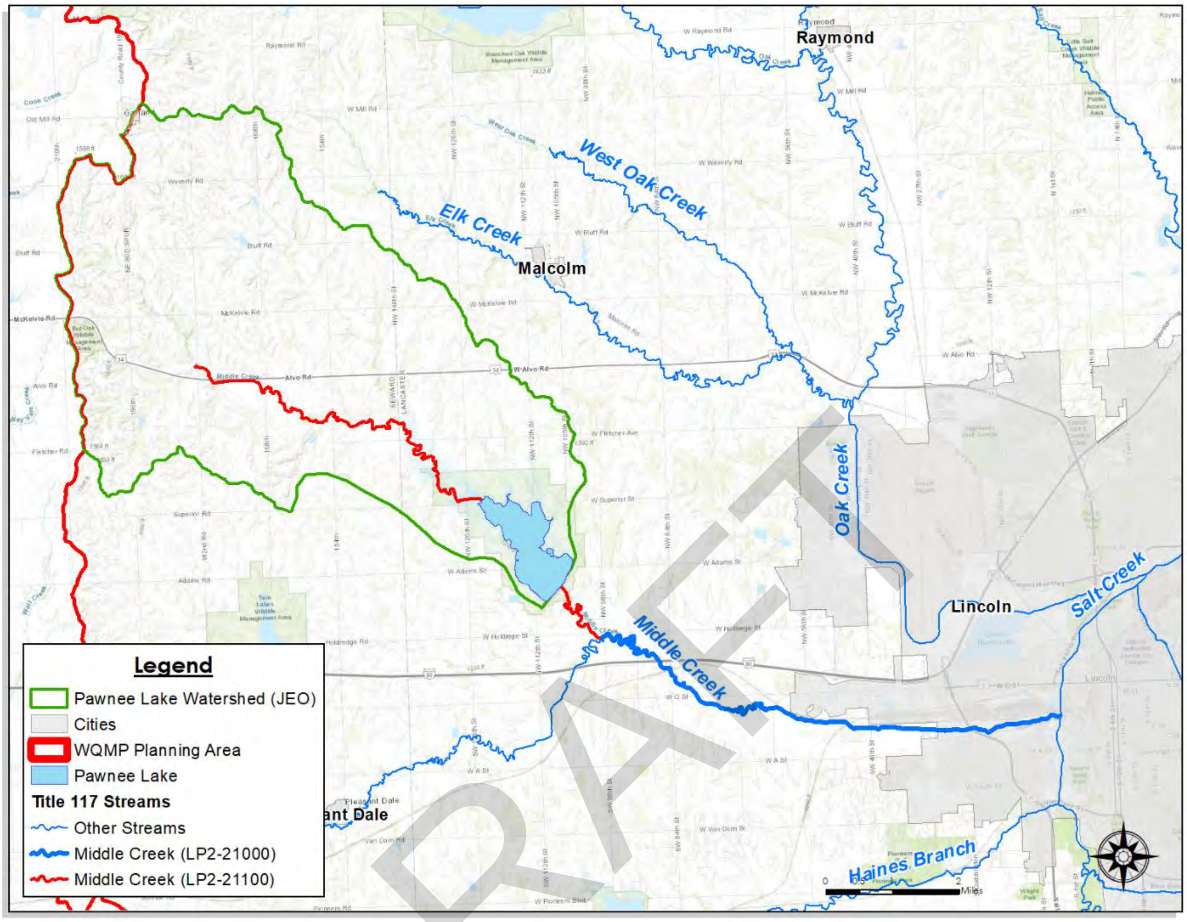


Figure 65: Location of the Pawnee Lake and Middle Creek Target Area

IMPAIRMENTS

Middle Creek – Atrazine

Middle Creek (LP2-21100) was first listed as impaired for atrazine in the 2006 IR and carries the same listing in the 2016 IR (NDEQ, 2016b). In 2007, NDEQ developed a Total Maximum Daily Load (TMDL) to address this concern (NDEQ, 2007a). Atrazine data used to develop the TMDL (2002-2004) and post-TMDL atrazine data (2007-2008) were collected as part of the Salt Valley Lakes Runoff Monitoring program coordinated by NDEQ. All samples were collected from a single station (SLP2MDCLR203) located approximately 1.5 miles above Pawnee Lake.

The 2007 atrazine TMDL was based on runoff data collected from Middle Creek during the months of May and June from 2002 through 2004. Of the seven runoff samples collected during this time period, five exceeded the chronic water quality standard of 12.00 µg/L. No samples exceeded the acute atrazine criteria of 330 µg/L. Three May-June samples collected by NDEQ in 2007 and

2008 were added to the sample pool. Of the ten total atrazine samples collected, six exceeded the chronic water quality standard (Figure 66). Based on NDEQ assessment procedures, a sample size of ten only allows for two deviations from the chronic water quality standard, with three being the threshold for impairment. While the data is not current, it does support the stream impairment listing for atrazine.

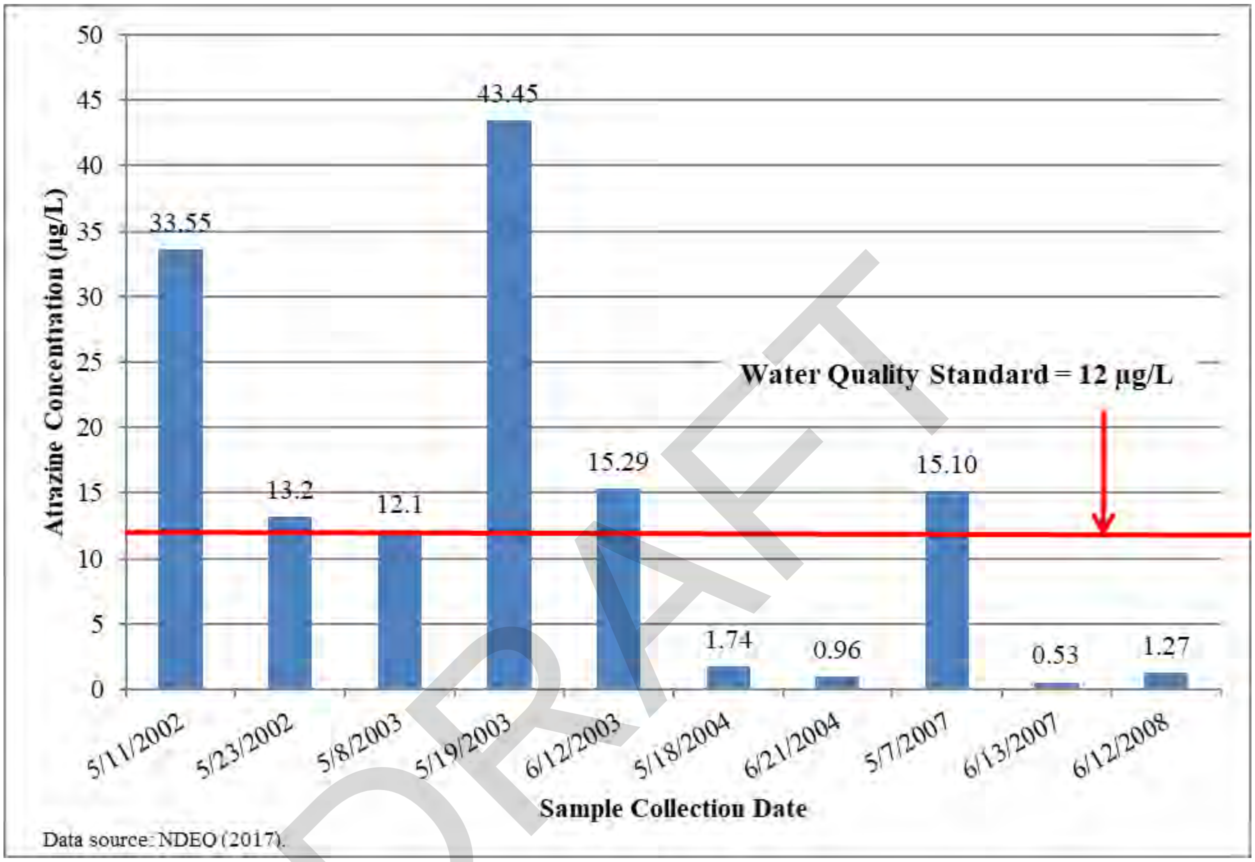


Figure 66: Atrazine Concentrations in Middle Creek (LP2-21100) under runoff conditions

Pawnee Lake – Nutrients and Algae Density

The Aquatic Life use in Pawnee Lake is currently impaired due to high concentrations of total phosphorus and total nitrogen, as well as excessive algae growth (NDEQ, 2016b). Current nutrient concentrations and algae biomass (chlorophyll-*a*) were determined from water quality sampling conducted by the USACE from 2012 through 2016 (USACE, 2017). Mean growing season (May-September) total nitrogen and total phosphorus concentrations, in addition to algae biomass, support the 2016 IR impairment designation for Aquatic Life use (Table 48).

Table 48: Pawnee Lake Nutrient Concentrations and Algae Biomass

Parameter	Data Period	N	Growing Season Mean	Water Quality Standard
Total Phosphorus (µg/L)	2012-2016	25	138.8	50.0
Total Nitrogen (µg/L)	2012-2016	25	1,555	1,000
Chlorophyll-*a* (mg/m3)	2012-2016	25	48	10

Source: USACE, 2017

Pawnee Lake – Sediment

Pawnee Lake's aesthetics use is currently impaired due to the amount of conservation pool storage volume the lake has lost since construction (NDEQ, 2016b). The as-built conservation pool volume for Pawnee Lake was estimated to be 8,695 ac-ft. As of 2016, Pawnee Lake has lost an estimated 28.3% of that volume, which is slightly above the NDEQ sedimentation assessment criterion of 25% (Table 49).

The current average annual sedimentation rate to the conservation pool is estimated to be 49.2 ac-ft/year. This results in an average conservation pool volume loss of 0.57% per year, which falls below NDEQ assessment criteria of 0.75% per year (USACE, 2018).

Table 49: Estimated Conservation Pool Volume Loss due to Sedimentation for Pawnee Lake

Pawnee Lake	#
Volume (ac-ft.)	
Original (1966)	8,695
Estimated (2016)	6,235
Total conservation pool loss (difference)	2,640
Percentage (%)	
Total conservation pool loss	28.3
Criterion (%)	
NDEQ assessment criterion	25.0

Source: USACE, 2018

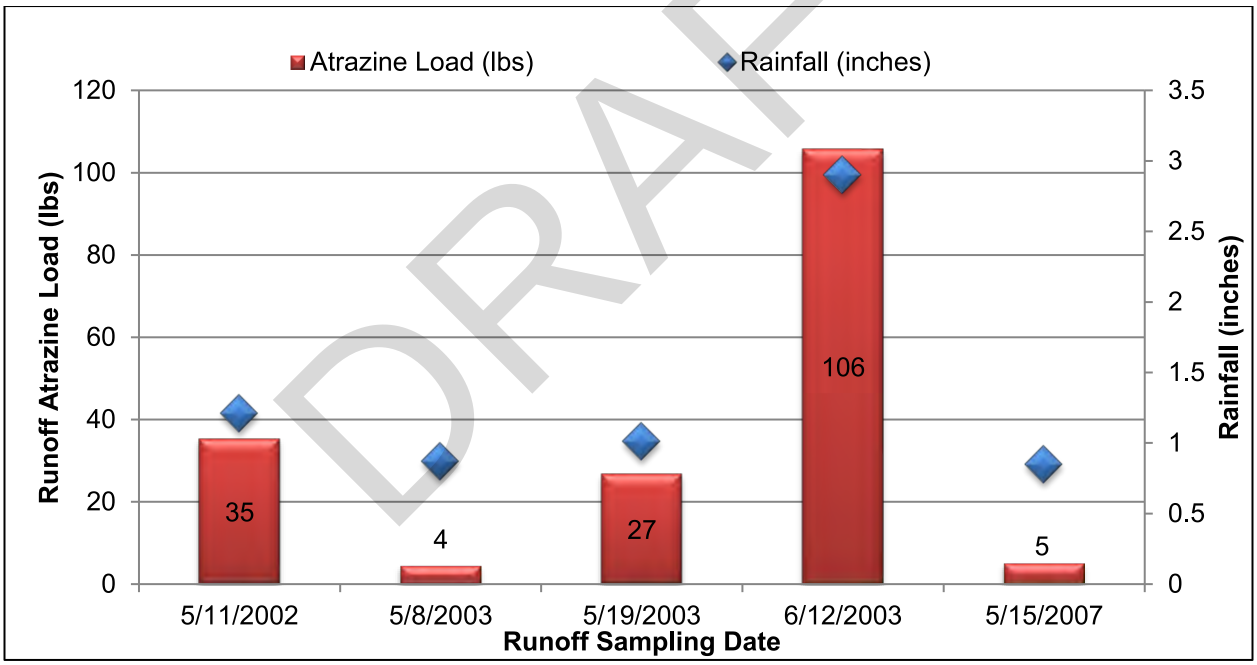
POLLUTANT SOURCES AND LOADS

Pollutant loads and source contributions were estimated using multiple methods, including a combination of mathematical calculations and water quality modeling. Additional details such as a summary of data, data sources, and methods can be found in the modeling/implementation report in Appendix XX.

Middle Creek – Atrazine

Atrazine is a triazine herbicide currently registered for use on broadleaf and grassy weeds. Although atrazine can be used for a variety of purposes, it is primarily used on corn and sorghum (USEPA, 2018). As sorghum was only grown on 3.1 acres (<1%) of the Middle Creek drainage above Pawnee Lake in 2016, the majority of atrazine was presumed to be used on land with corn production. For the purpose of this plan, the entire atrazine load to upper Middle Creek (LP2-21100) has been allocated to land used for corn production (2,256 acres in 2016).

Due to the influence of Pawnee Lake dam on downstream transport of pollutants, as well as the current full support status for all beneficial uses, the lower portion of the Middle Creek (i.e. below Pawnee Lake dam) was not included in the atrazine loading assessment. To remain consistent with the 2007 TMDL, only samples collected in the months of May and June that exceeded the standard were assessed. To calculate total atrazine loads, measured atrazine concentrations and storm event water yield estimates from the drainage area above Pawnee Lake were used (Figure 4). For the five storm events assessed, atrazine loads ranged from 4.4 pounds (May 8, 2003) to 105.8 pounds during the May 19, 2003 runoff event.



Source: NDEQ, 2017a

Figure 67: Precipitation and Atrazine Runoff Loads to Middle Creek (LP2-21100)

Pawnee Lake

To fully account for pollutant sources, contributions from external and internal sources were quantified. External sources of nutrients to Pawnee Lake include runoff from the drainage area and atmospheric deposition through precipitation directly on the lake. While internal loads of phosphorus were estimated, the lack of literature and data prevented an estimation of internal nitrogen loads. The annual phosphorus load from bottom sediment release, bottom sediment re-suspension, and waterfowl waste were estimated. Due to a lack of data, re-suspension and waterfowl waste inputs were amassed as one load. Although waterfowl use numbers were unavailable for Pawnee Lake, it is assumed they contribute a small portion of the phosphorus load, relative to other sources.

Pawnee Lake – Phosphorus

The total gross phosphorus load to Pawnee Lake is estimated to be 29,483 lbs/yr. (Table 50). Approximately 60% of the total load stems from external phosphorus sources, with the remaining 40% of the load contributed from internal sources. The largest contributor of phosphorus to Pawnee Lake is from lake bottom sediment resuspension/waterfowl waste, which constitutes 35% of the total load. Runoff from uncontrolled non-permitted open lots used for animal feeding and holding contributes 19% of the total load to the lake, whereas ground used for corn and soybean production contributes 16% of the total load. Figure 68 shows the remaining phosphorus load sources and amounts.

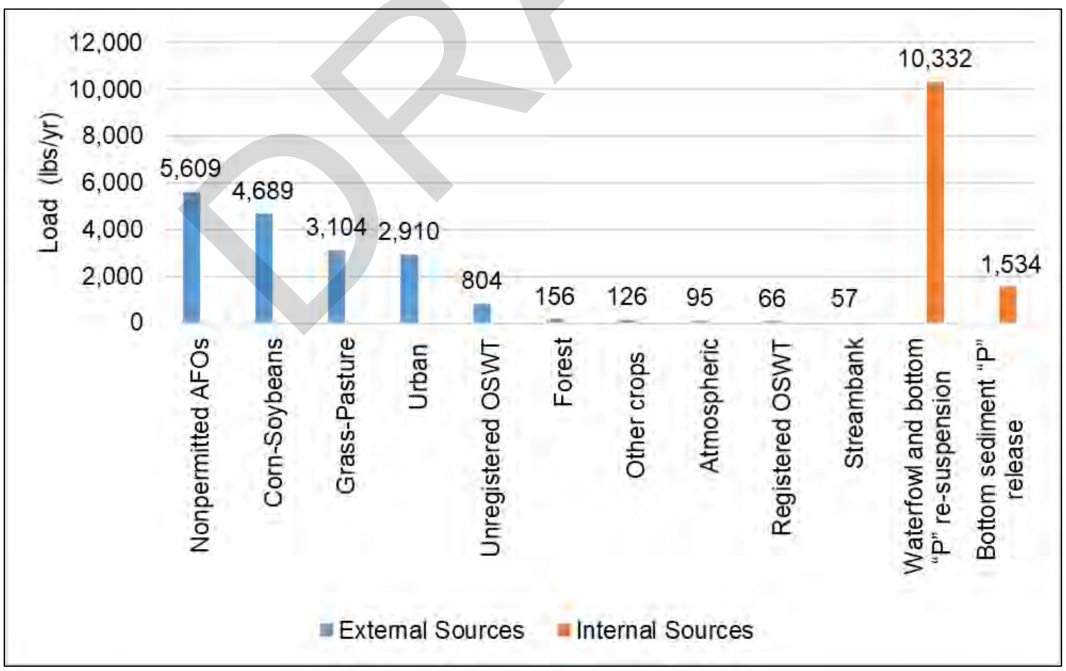


Figure 68: Phosphorus Sources and Annual Average Loads to Pawnee Lake

Pawnee Lake – Nitrogen

The total gross nitrogen load to Pawnee Lake is estimated to be 69,817 lbs/yr. This estimate only accounts for external sources of nitrogen, which includes drainage area runoff and nitrogen contributed through precipitation falling directly on the lake surface. The largest external source of nitrogen to Pawnee Lake is non-permitted AFOs, which account for approximately 40% of the load (Figure 69).

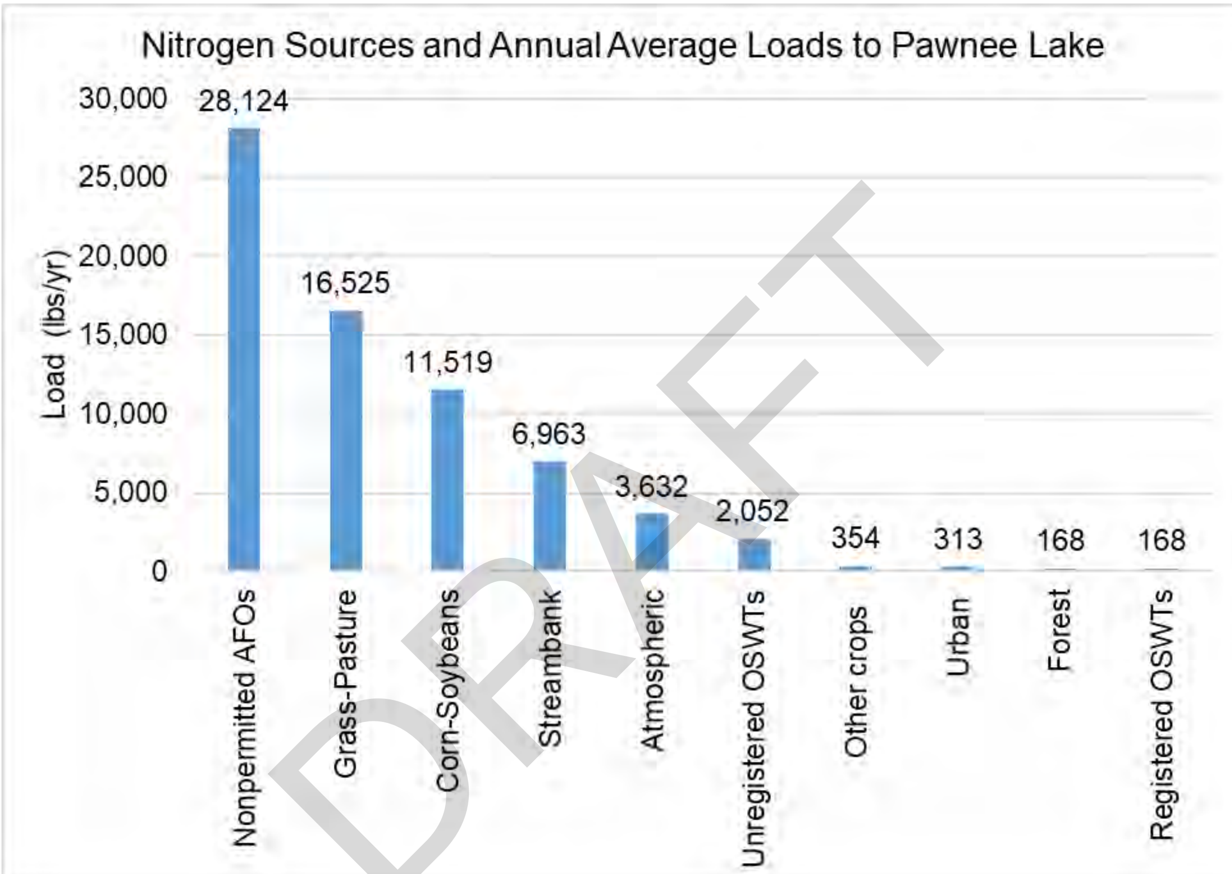


Figure 69: Nitrogen Sources and Annual Average Loads to Pawnee Lake

Pawnee Lake – Sediment

The total sediment load to Pawnee Lake is estimated to be 7,714 tons/yr. Of this amount, watershed runoff (external sources) contributes approximately 84%, while shoreline erosion (internal source) contributes the remaining 16%. The largest source of sediment to Pawnee Lake is from land used for corn and soybean production, contributing 2,624 tons/yr. or 34% of the sediment load (Figure 70). Approximately 39% of the total sediment load to Pawnee Lake stems from streambank and lake shoreline erosion. Only those sources with contributing loads are shown on the figure.

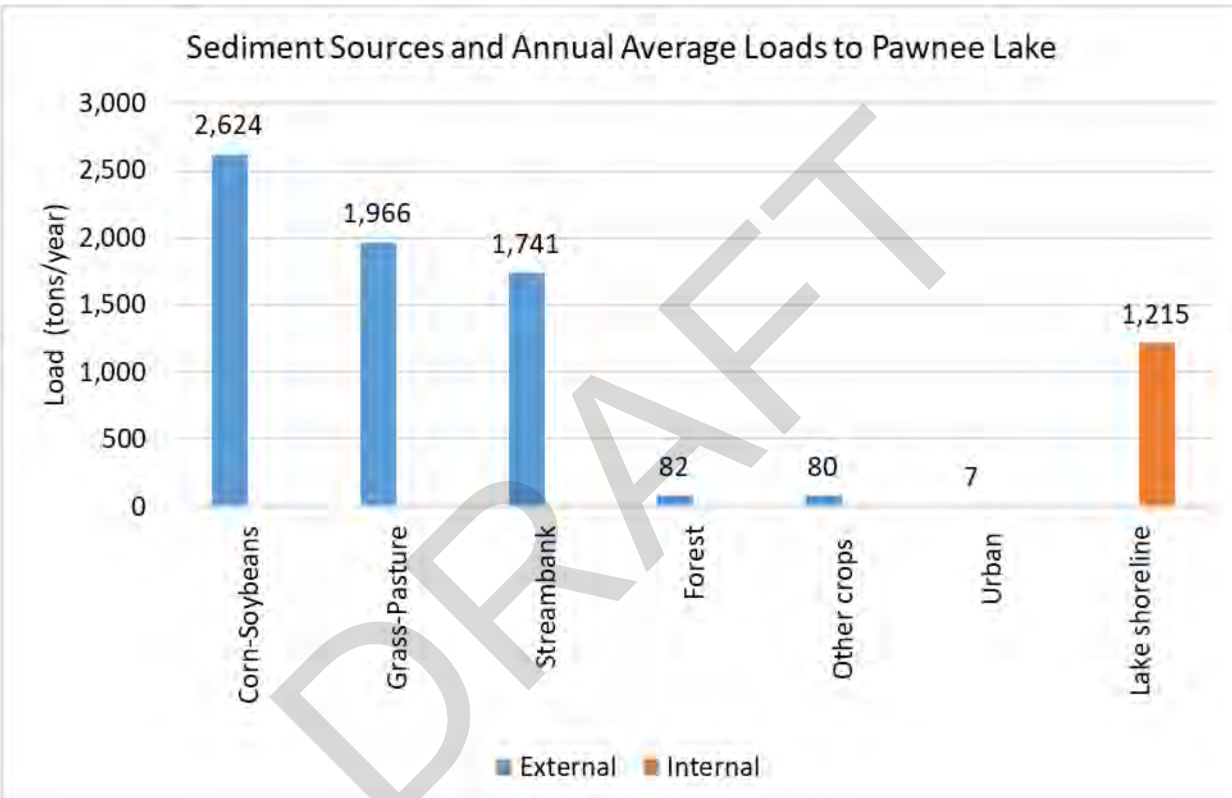


Figure 70: Sediment Sources and Annual Average Loads to Pawnee Lake

REQUIRED POLLUTANT LOAD REDUCTIONS

Middle Creek – Atrazine

The 2007 Atrazine TMDL was based on reducing in-stream atrazine concentrations, rather than the total atrazine load (mass per unit time). In order to provide the maximum protection to the stream, the TMDL targeted the highest measured concentration between 2002 and 2004 as the basis for determining reductions. The maximum measured concentration of 44 µg/L (May 19, 2003) requires a 73% reduction to meet the chronic standard of 12 µg/L.

In order to develop an atrazine load reduction target, loading capacities and associated reductions were determined for sampling dates that exhibited atrazine concentrations above the chronic standard of 12 µg/L (Figure 71). The May 23, 2002 storm event did not produce runoff; therefore, this event was not included. The May 19, 2003 runoff event that was targeted for the TMDL produced an atrazine load of 27 lbs., which would need to be reduced to approximately seven pounds to meet the chronic water quality standard.

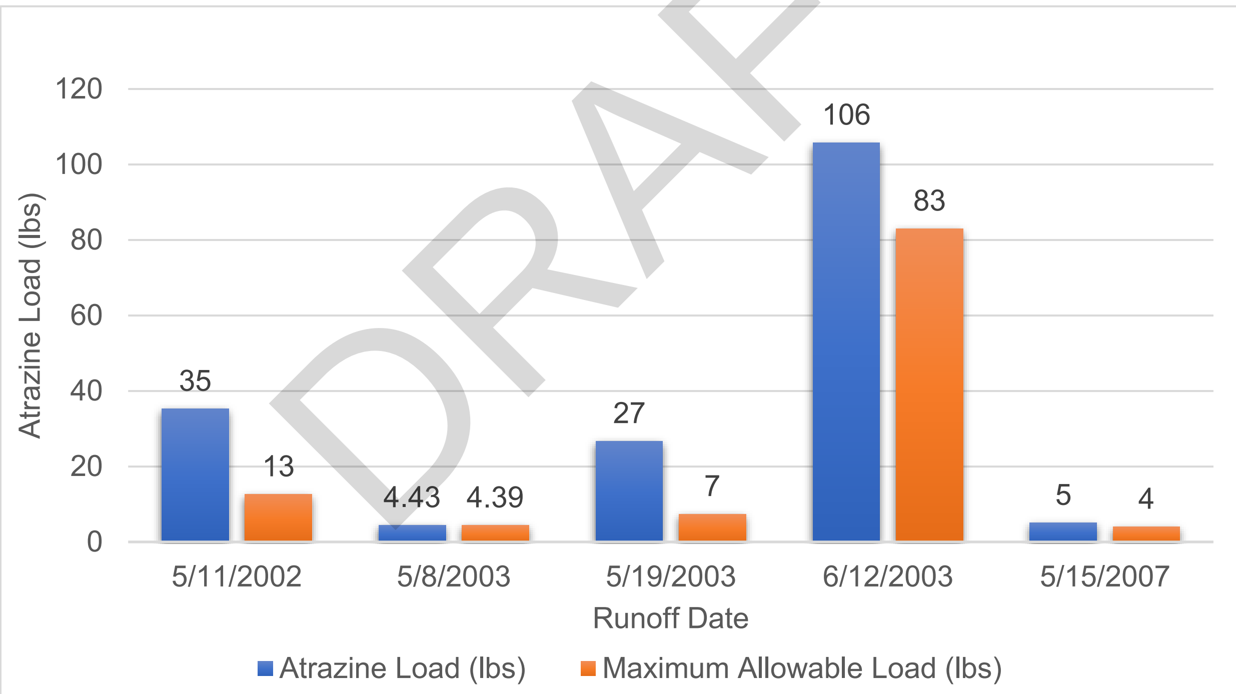


Figure 71: Upper Middle Creek (LP2-21100) Atrazine loads and loading capacities.

Pawnee Lake – Phosphorus and Nitrogen

The total phosphorus loading capacity for Pawnee Lake was determined from the Canfield-Bachmann lake loading regression equation (Canfield & Bachmann, 1981). The current in-lake phosphorus concentration of 139 µg/L will need to be reduced by 64% to meet the water quality standard of 50 µg/L (Table 50). The phosphorus load capacity associated with an in-lake concentration of 50 µg/L is approximately 3,892 lbs/yr. To meet the water quality standard, the current annual phosphorus load of 29,483 lbs. will need to be reduced by 25,591 lbs/yr. or 87%.

The load reduction target for total nitrogen was based on the required in-lake concentration reduction of 36%. Applying a 36% reduction to the current load of 69,817 lbs/yr. would result in an annual loading target of 44,683 lbs/yr (Table 51). In order to determine the extent of load reductions that can be achieved from controlling anthropogenic sources of pollutants, natural background loads of phosphorus and nitrogen were determined for the Pawnee Lake drainage area. Estimated annual natural background loads constitute approximately 76% of the phosphorus loading capacity and 87% of the annual nitrogen loading target. These numbers indicate an aggressive nutrient reduction strategy will need to be implemented in order for Pawnee Lake to meet phosphorus and nitrogen targets.

Table 50: Phosphorus Reduction Targets for Pawnee Lake

Phosphorus Levels and Targets	#
Concentration	
Current in-lake phosphorus (µg/L)	138.8
Target in-lake phosphorus (µg/L)	50.0
Target reduction (µg/L)	88.8
Target reduction (%)	64
Sum of External and Internal Loads	
Current gross load (lbs/yr.)	29,483
Load capacity (lbs/yr.)	3,892
Target reduction (lbs/yr.)	25,591
Target reduction (%)	87

Table 51: Nitrogen Reduction Targets for Pawnee Lake

Nitrogen Levels and Targets	#
Concentration	
Current in-lake nitrogen (µg/L)	1,555
Target in-lake nitrogen (µg/L)	1,000
Target reduction (µg/L)	555
Target reduction (%)	36
Sum of External and Internal Loads	
Current gross load (lbs/yr.)	69,817
Target load (lbs/yr.)	44,683
Target reduction (lbs/yr.)	25,134
Target reduction (%)	36

Pawnee Lake – Sediment

The most current bathymetric survey of Pawnee Lake was completed by the NGPC in 2002 (NGPC, 2017b). The conservation pool storage capacity (measured in 2002) and current sedimentation rates were used to determine current conservation pool storage volume (USACE, 2018). Pawnee Lake is currently losing 0.57% of the original conservation pool volume annually, well below the 0.75% criterion used by NDEQ to determine impairment (Table 52). Although the annual rate of sedimentation is below NDEQ assessment criterion, the lake has lost approximately 28.3% of its original conservation pool volume. This loss is slightly above the NDEQ assessment criterion of 25%. A 3.3% increase in conservation pool volume (or 287 ac-ft) would be needed to meet criterion. Whereas an increase of 2,460 ac-ft. would be needed to fully reclaim the as-built conservation pool storage of 8,695 ac-ft.

Table 52: Sedimentation Rates and Volume Loss for Pawnee Lake (1966-2016)

Pawnee Lake	#	NDEQ Criteria
Conservation Pool Storage Volume (ac-ft.)		
Original storage volume (1966)	8,695	
2002 Storage Volume	6,924	
Estimated current storage volume (2016) [1]	6,235	
Total conservation pool storage volume loss (1966-2016)	2,460	
Conservation Pool Storage Volume Loss		
Total conservation pool loss (%)	28.3	25
Average annual conservation pool loss (%/yr.)	0.57	0.75
Necessary Storage Volume Increase		
Storage capacity increase needed to meet 25% (ac-ft.)	287	

Source: USACE, 2018

[1]*Based on 2002 bathymetric data.*

IMPLEMENTATION STRATEGY

The implementation strategy for the drainage area above Pawnee Lake includes multiple practices that target pollutant sources through the ACT approach (avoid, control, trap), also known as a “treatment train”. All pollutant sources will be addressed with the exception of atmospheric loading, as this plan only address nonpoint source pollution from surface water runoff. The identification of management practices, suites of practices, and best suited locations were determined from the ACPF Toolbox software, which provides field level recommendations of conservation opportunities (possible sites for BMPs) to inform local watershed planning efforts. Additional opportunities were found through analysis of aerial photography to identify nonpermitted AFOs and rural residences that may have unregistered OWTSs. It is assumed that these facilities are meeting all legal requirements; however, they are also possible sources of pollutant loads. In all cases, only willing landowners will be included in this voluntary implementation strategy.

The implementation strategy presented in this plan should be used as a guide for practice implementation and may be subject to revision as new information becomes available and as willing landowners are identified. Although avoidance practices are not part of the ACPF, they are an important part of the pollutant reduction strategy for Pawnee Lake. A multitude of avoidance practices apply to the Pawnee Lake drainage. For a detailed description of these and other practices provided below, refer to Chapter XX of the WQMP.

Water quality assessments indicate Pawnee Lake exhibits a significant load of sediment and nutrients from internal sources. Given the size of the lake and extent of in-lake work required, only a general accounting of appropriate measures and costs is provided here. Specific measures and accurate costs should be determined through a feasibility/design study with results included in a future revision of this plan.

A VOLUNTARY PLAN

The implementation of this plan is based entirely on the voluntary actions of landowners and citizens. Individuals must decide if it is an advantage to participate, and it is the responsibility of the LPSNRD and other stakeholders to find ways to make participation advantageous.

To provide an accurate load reduction estimate from practice implementation, recommended practices were used to develop a “treatment train” (following ACT methodology) that follows the flow of pollutants from the source to the receiving waterbody (Figure 72). The drainage area treatment train is comprised of seven levels of treatment, beginning with education/outreach and avoidance practices, and ending with in-lake management measures.

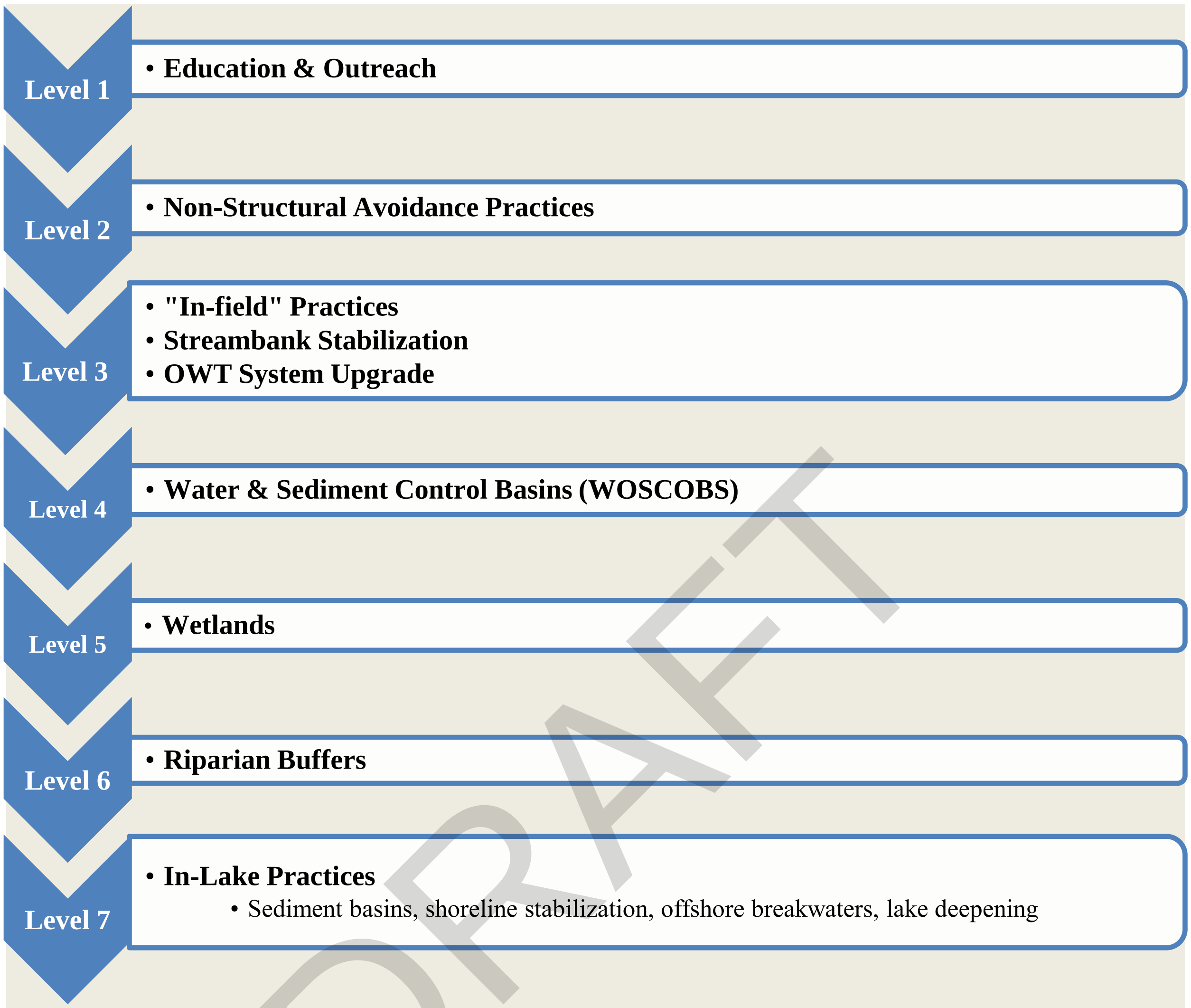


Figure 72: Implementation of Priority BMPs through a "Treatment Train" Approach

BMP TARGETING

Drainage Area Treatment

A suite of structural and non-structural management practices was selected based on stakeholder input and the results of technical analysis. In addition to structural practices, education/outreach and avoidance practices were added to the suite of recommendations for the Pawnee Lake drainage (Table 53). Ground used for corn and soybean production is targeted for the largest number of practices. All land cover types and pollutant sources were targeted for education and outreach activities except for water and wetlands, which were not classified as pollutant sources. Figure 73 and Figure 74 provide an overview of conceptual locations where BMPs could be placed. These maps are not “planned” locations, but instead provide a starting point for discussions with willing landowners and enable managers methods to develop this WQMP. Detailed map books can be found in Appendix XX of the WQMP.

Table 53: Priority BMPs and Targeted Pollutant Sources

Land Cover Type/ Pollutant Sources	Current Acres	BMP	Acres Targeted
All	20,159[a]	Education & Outreach	20,159
Corn-Bean	4,547	Avoidance	3,183
		Terraces - cover crops - no till	214
		Contour buffer - cover crop - no till	468
		Cover crops-contour buffer	640
		Cover crops	2,316
		WASCOBS	580
		Wetlands	2,107
		Riparian buffers	678
Non-permitted AFOs	187	Avoidance	187
		WASCOBS	70
Pasture	11,619	Grazing management	5,903
		WASCOBS	1,002
		Wetlands	7,631
Other Crops	320	WASCOBS	31
		Wetlands	320
Forest	3,263	WASCOBS	198
		Wetlands	2,085
Urban	223	Wetlands	128
Streambank Stabilization (miles)	15	Bank stabilization (miles)	8.9
OWT Systems	270	Unregistered system upgrade (#)	57

Note: Grassed waterways, and conceptual locations, were also identified as a priority BMP, however they were represented/ grouped with wetlands in the water quality modeling, due to technical limitations.

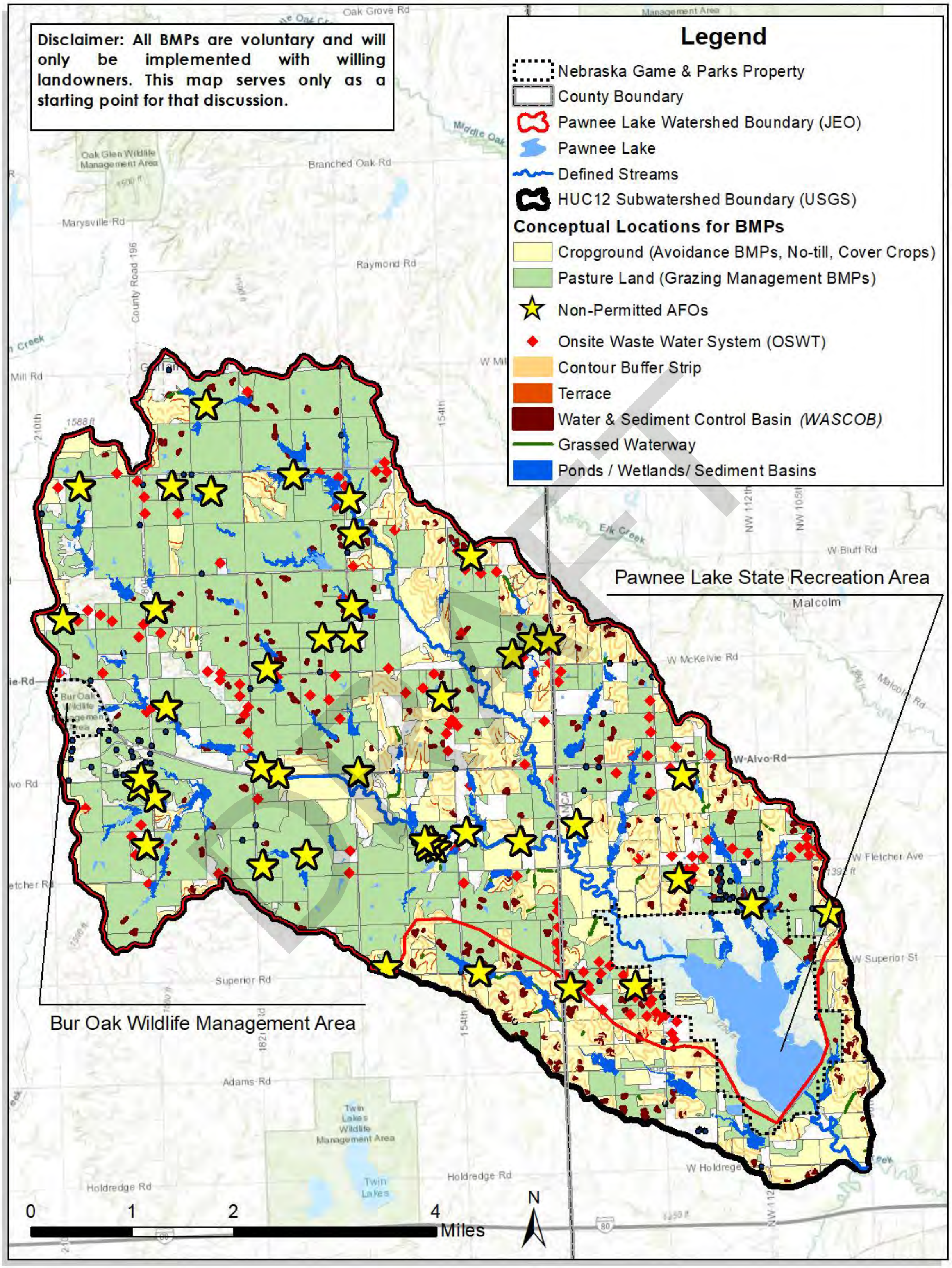


Figure 73: Conceptual locations of in-field and edge-of-field BMPs

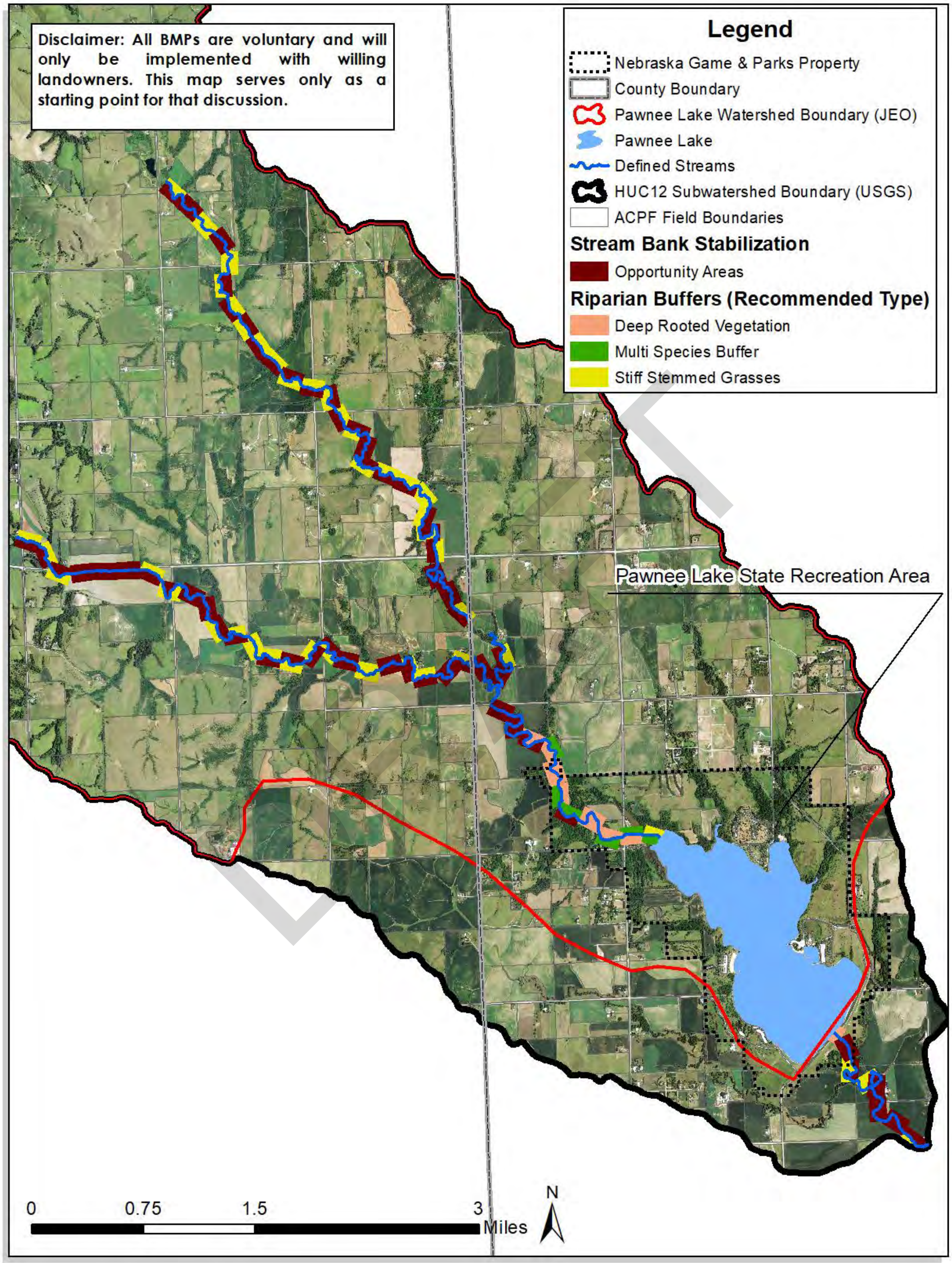


Figure 74: Conceptual locations of in-stream and riparian BMPs

In-lake Management Measures

The proposed implementation strategy for the Pawnee Lake drainage area will achieve the nitrogen load reduction target of 36%. In contrast, it does not achieve the phosphorus loading reduction target of 87% because of the large contribution (i.e., 40%) from in-lake sources. Therefore, in-lake management practices will be required to achieve load reduction goals. Additionally, sediment removal from the lake will be required to address the current aesthetics impairment. Several in-lake management measures are recommended to reduce internal pollutant loads. Although conceptual locations for each practice have been identified (Figure 75), it is recommended that all in-lake management measures be further evaluated to facilitate development of conceptual designs and accurate cost estimates. The following management measures were identified:

1) SEDIMENT REMOVAL

Sediment removal from the Pawnee Lake will reduce bottom sediment re-suspension and increase the reservoirs ability to attenuate nutrients. In order for Pawnee Lake to achieve a full support for the Aesthetics beneficial use, the conservation pool storage volume will need to be increased by 3.3% (or 287 ac-ft.). Returning the lakes conservation pool to the as-built volume requires an increase of 28.3% (or 2,460 ac-ft.). In order to meet the water quality standard for lake phosphorus, the conservation pool storage volume would need to be returned to as-built conditions.

2) IN-LAKE SEDIMENT BASIN

Water quality basins are an important component of reservoir sedimentation management, primarily through decreasing sediment and nutrient impacts to Pawnee Lake. Three in-lake basins have been identified to address pollutant loads from four tributaries contributing the greatest pollutant loads.

3) LAKE SHORE (BANK) STABILIZATION

Shoreline erosion and sediment/nutrient resuspension are significant contributors to the water quality issues at Pawnee Lake. Shoreline erosion accounts for 16% of the total sediment load to Pawnee Lake while bottom sediment resuspension accounts for 35% of the total phosphorus load. Problems are associated with soil types, bank height, lake orientation, lake fetch, lake depth, and recreational activities such as power boating. The sediment basins could be configured to address most of this shoreline area, with the remaining erosion prone areas addressed with offshore breakwaters. A combination of vegetation and hard armoring will be used.

4) NUTRIENT INACTIVATION

Based on the phosphorus load assessment and estimated benefits of proposed management measures for Pawnee Lake, nutrient inactivation may be required to meet the in-lake standard of 50 µg/L. Nutrient inactivation should only be used after external pollutant load reduction targets have been achieved and in-lake monitoring data suggests that additional reductions are necessary.

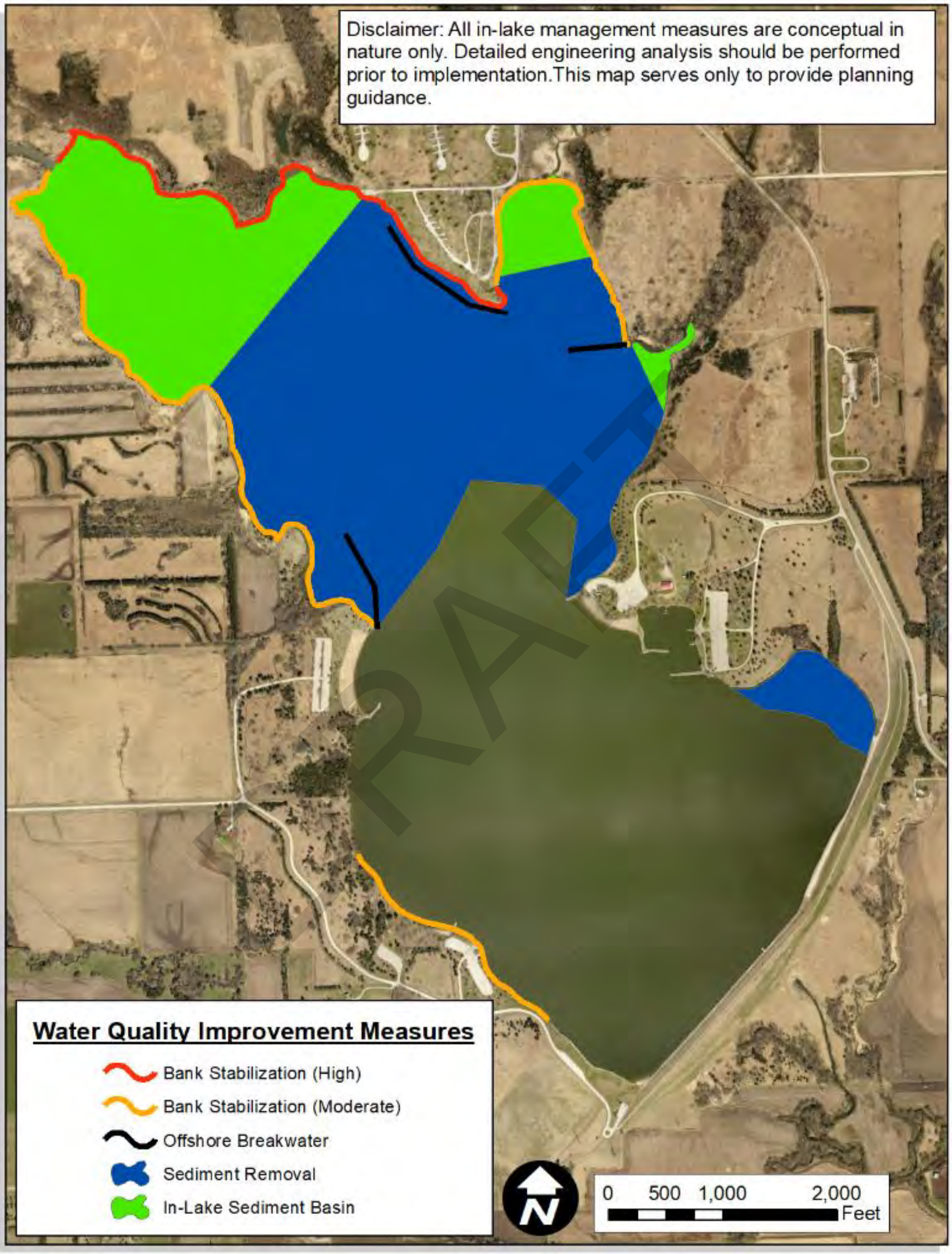


Figure 75: Conceptual locations for in-lake management measures at Pawnee Lake

CRITICAL SOURCE AREAS

Critical Source Areas (CSA) are a relatively small fraction of a watershed that generates a disproportionate amount of pollutant load (Meals, 2012). As discussed in Chapter XX, CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism. Identifying CSAs allows for the prioritization of fields where BMPs are likely most needed and allows for financial and technical resources to be used most efficiently.

CSAs in the Pawnee Lake and Middle Creek Target Area were identified using the field runoff risk assessment in the ACPF Toolbox. This assessment provides a relative risk rating (not an absolute risk rating) and is based on a cross-reference of two factors:

- Slope steepness – Steeper fields have a higher risk of generating runoff
- Distance to stream – The closer a field is to a waterbody, the higher the risk a pollutant will be delivered to waterbody

Once the assessment is complete, each field receives a relative classification, ranging from A (highest risk – most critical), to B (very high), C (high), and other ('present'). One limitation of this tool is that only agriculture landuses (cropland or pasture land) are included. These other land uses (typically rural residences or other natural areas) are identified as "unknown" in the assessment. "Unknown" areas may still have an elevated runoff risk (especially for pollutants such as manure application or failing OWTS's). A "present" or "unknown" classification does not mean that a BMP would not provide benefits to a given field, but rather indicates that other fields have a greater potential to deliver pollutants to a waterbody via surface runoff. In future updates to this plan, an assessment of all fields for runoff risk is recommended.

For the purposes of this plan, areas identified as A or B through the runoff risk assessment have been identified as CSAs. In the Pawnee Lake and Middle Creek Target Area (Figure 76), there are 3,115 acres of CSAs (13% of the Target Area), which are broken down as follows:

- Highest Risk CSA: 1,030 acres
- Very High Risk CSA: 2,085 acres

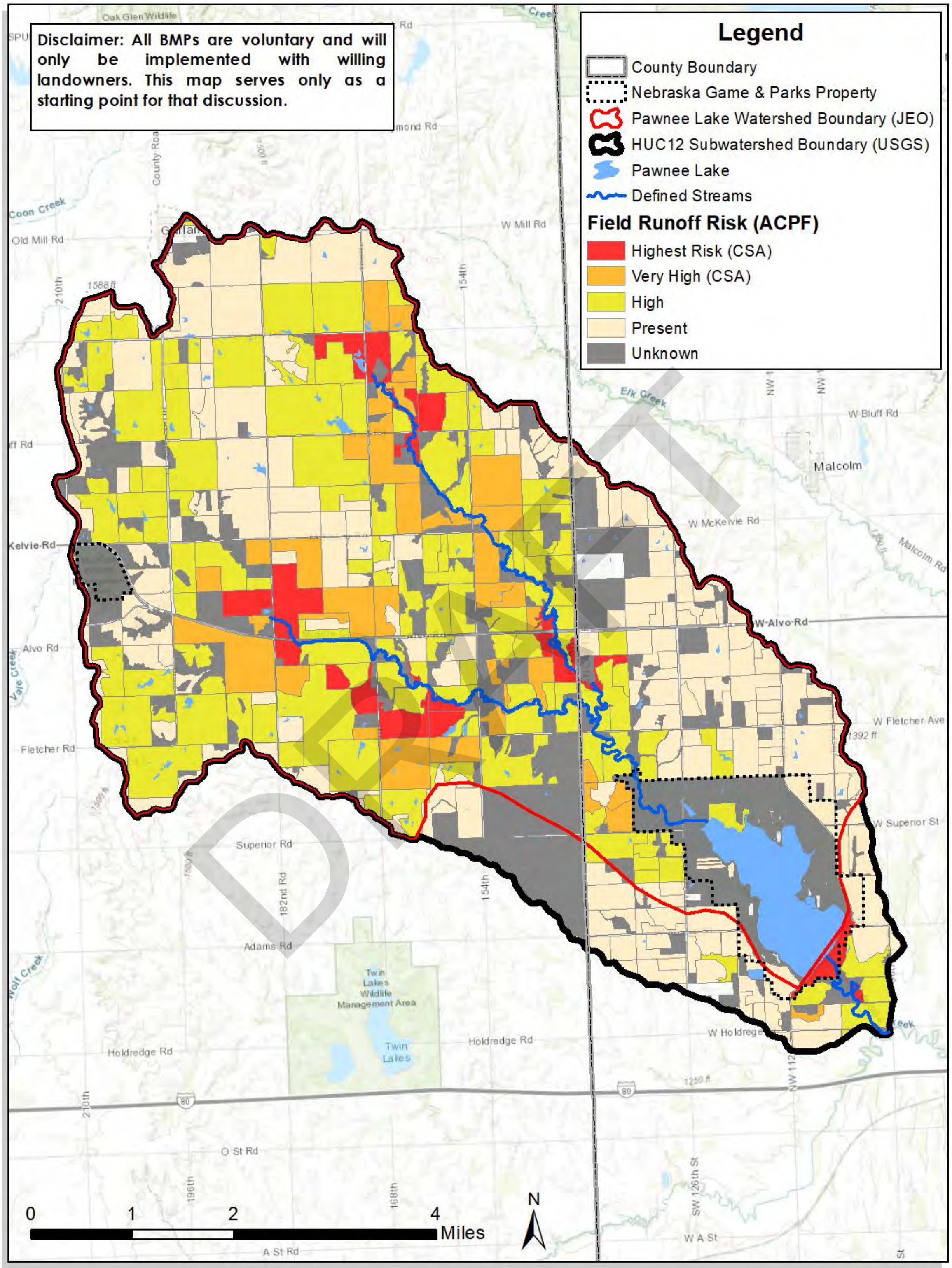


Figure 76: Critical Source Areas at Pawnee Lake as identified with the ACPF Tool

MEETING WATER QUALITY STANDARDS

Pawnee Lake – Sediment and Nutrients

Implementing a comprehensive strategy for Pawnee Lake that includes management practices for both external and internal pollution control measures will result in the lake meeting water quality standards for in-lake nitrogen and phosphorus loads (). It is assumed that if lake nutrient concentrations meet the water quality standard, algae biomass will also meet the standard. Additionally, a full support status will be achieved for the aesthetics use by increasing lake storage capacity. Reduction targets for phosphorus and nitrogen will be attained. No load reduction target for sediment was required. Additional details can be found in the summary report located in Appendix XX.

Table 54 and Table 55). It is assumed that if lake nutrient concentrations meet the water quality standard, algae biomass will also meet the standard. Additionally, a full support status will be achieved for the aesthetics use by increasing lake storage capacity. Reduction targets for phosphorus and nitrogen will be attained. No load reduction target for sediment was required. Additional details can be found in the summary report located in Appendix XX.

Table 54: Estimated Phosphorus Reductions and Water Quality Targets for Pawnee Lake

Phosphorus Amount	Load (lbs/yr.)	In-Lake Concentration (µg/L)
Beginning total phosphorus load	29,483	138.8
External total phosphorus reductions	12,947	29.8
Internal load reductions/improvements	13,882	59.7
Total phosphorus reductions	26,829	89.5
Expected conditions	2,654	49.3
Phosphorus loading capacity & water quality standard	3,892	50.0

Table 55: Estimated Nitrogen Reductions and Water Quality Targets for Pawnee Lake

Nitrogen Amount	Load (lbs/yr.)	In-Lake Concentration (µg/L)
Beginning total nitrogen load	69,817	1,555
External total nitrogen reductions	43,141	960
Internal load reductions/improvements	14,672	282
Total nitrogen reductions	57,813	1,242
Expected conditions	12,004	311
Nitrogen loading capacity & water quality standard	44,683	1,000

Although nutrient reduction benefits for implementing external and internal management practices have been estimated and provide a path to meeting water quality standards, cumulative benefits of implementing a comprehensive plan are difficult to accurately project. Thus, a sound monitoring and data collection network will be critical to adaptively manage Pawnee Lake.

Middle Creek – Atrazine

Several management practices targeted for reducing sediment and nutrient loss from corn ground will reduce atrazine loads carried to receiving streams as runoff. Those practices in addition to BMP's developed specifically for Nebraska (Franti and others, 2003), were used to develop a treatment train specific for atrazine.

Avoidance practices, such as reducing application rates and using crop rotations, will result in the largest atrazine load reduction to Middle Creek (Table 56). Atrazine load reductions associated with using the treatment train approach will reduce in-stream concentrations by approximately 92%, exceeding the load reduction target of 78%. The May 19, 2003 storm event produced an atrazine concentration of 43.45 µg/L. If the benefits from the proposed management measures were applied to that concentration, the expected concentration would be 9.76 µg/L, far below the chronic standard of 12.00 µg/L. Additional details can be found in the summary report located in Appendix XX.

Table 56: Expected Atrazine Reductions and Water Quality Targets in Middle Creek

Beginning Atrazine Conditions (5/19/2003 Runoff Event)	Practice Efficiency (%)	Acres Applied	Load (lbs)	Concentration (µg/L)
Atrazine Load/Concentration	-	-	26.71	43.45
Reduction due to BMP Train				
Level 1 - Reduced application rates/timing	69	2,256	18.43	29.98
Level 2 - Soil incorporation-band application	67	2,256	5.55	9.02
Level 3 - Contour buffers	30	1,108	0.40	0.65
Level 3 - Terraces	40	214	0.09	0.14
Level 4 - Water/Sediment control basins	30	580	0.17	0.28
Expected Conditions				
Total reduction	-	-	24.64	40.07
Final load/expected concentration	-	-	2.07	3.38
Loading capacity/chronic standard	-	-	7.38	12.00

Source: [1] Franti and others, (2003); [2] Nebraska Department of Agriculture (NDA), 2016

MONITORING

The LPSNRD will follow the established protocol and procedures to: develop sound, defensible monitoring strategies and networks: properly manage data: and disseminate information to decision makers and other stakeholders. Monitoring goals can only be achieved through partnerships with other resource agencies such as NDEQ and NGPC. Steps will be taken to ensure collection of scientifically valid data, which may include the development of Quality Assurance Project Plans (QAPP) for state and federal review. Additional guidance and references are located in Chapter XX of the WQMP.

To adequately design monitoring networks that facilitate water resource management, it is critical to use data for its intended purposes. Thus, it is necessary to establish specific monitoring goals and objectives. A set of monitoring goals and objectives has been developed for Middle Creek and Pawnee Lake. Targeted parameters, monitoring sites, and monitoring frequency have been defined to meet each objective. Monitoring goals and objectives provided below in *italics* may require expanded or new monitoring efforts, whereas objectives and parameters in plain text are currently being addressed. Detailed monitoring actions for each objective are located in the summary report located in Appendix XX.

Monitoring Goal 1: Evaluate the water quality condition of Pawnee Lake.

- Assess the suitability of Pawnee Lake for primary contact recreation.
- Evaluate beneficial use support and water quality trends for Pawnee Lake.
- *Document current atrazine concentrations in Middle Creek.*

Monitoring Goal 2: Estimate pollutant loads and source contribution to Middle Creek and Pawnee Lake.

- Quantify sediment, nutrient, and atrazine runoff loads for the drainage area above Pawnee Lake.
- *Estimate sediment, nutrient, and atrazine runoff loads from catchments above Pawnee Lake.*
- *Quantify external phosphorus, nitrogen, and sediment loads to Middle Creek and Pawnee Lake from specific land cover types.*
- *Verify sediment and nutrient loads stemming from streambank erosion.*
- *Quantify internal phosphorus, nitrogen, and sediment loads to Pawnee Lake from specific sources.*
- *Estimate the current lake conservation pool storage volume.*
- *Quantify annual lake retention of phosphorus, nitrogen, and sediment.*

Monitoring Goal 3. Gather data needed to complete pre-implementation planning.

- *Evaluate spatial sediment deposition in Pawnee Lake.*

COMMUNICATION AND OUTREACH

Chapter 6 of this plan provides a broad, programmatic approach that the LPSNRD and its partners will take to address nonpoint source pollution through communication and outreach activities. Specifically, within a target area there are certain pieces of information necessary for successful communication and outreach efforts which will, in turn, support the implementation of BMPs. Those items specific to the Pawnee Lake and Middle Creek Target Area were identified via stakeholder and public input, and are as follows:

- Identified Target Audiences
  - Recreational water users of Pawnee Reservoir
  - Land managers, residents, and property owners within Pawnee Reservoir drainage area
  - Producers with existing BMPs who may be interested in implementing more
  - Rural homeowners on private wells and septic systems
- Methods
  - Utilize parcel ownership information, along with the detailed BMP location maps created with the ACPF Tool, to contact specific landowners about BMPs applicable to their properties
    - A postcard mass mailing followed up by phone calls will help start initial implementation efforts and/or increase attendance at public meetings
  - Work with NDEQ and NGPC to develop targeted blue-green algae information kiosks at highly visible locations at Pawnee Lake (i.e. public beaches, entrances to Pawnee lake, or boat ramps)
  - Build a unifying logo, tagline, or message around protecting and restoring Pawnee Lake. This would be included on signage and other documents
  - Develop signage to be used at project demonstration sites, key watershed entrances or landmarks, and other highly visible areas
  - Utilize locations within the Village of Malcolm for the following:
    - Post flyers, distribute press releases, and advertise at local events
    - Hold targeted coffee shop meetings, tailgate sessions, and other informal/casual informational exchanges to build relationships and to learn more about the constraints and hurdles to BMP adoption
  - Piggy back on existing events - Training and demonstration field days, information booths, recognition picnics, etc.
    - Such as the BBQ and Blues Fest held annually in Malcolm, nitrogen certification training events, etc.
  - Hold an outdoor recreation clinic (kayaking, fishing, etc.) at Pawnee Lake

Plan and project sponsors will utilize these target audiences and outreach methods when building project level communication and outreach plans, typically as part of a Project Implementation Plan (PIP). The PIP will identify the specific and tailored actions for each target audience, as discussed in Chapter 6.

SCHEDULE

The timeframe for implementing general actions is provided in Table 57. Actions are subject to approval by the LPSNRD Board of Directors, USACE, and NGPC, and may change as the plan is implemented. Phase I activities will include the initiation of external management practice implementation and the evaluation of in-lake measures. Phase II will begin upon the five-year revision of this plan. A summary of progress achieved during Phase I will be included in the plan revision.

Table 57: Schedule for Implementing Pawnee Lake and Middle Creek Target Area

Activity	Phase I						Phase II
	2018	2019	2020	2021	2022	2023	2024-2028
EPA approval of the plan	■						
Monitoring (ongoing)	■	■	■	■	■		
Develop PIP for Watershed BMPs		■					
Organize stakeholder group		■					
Watershed BMP implementation		■	■	■	■	■	
Project evaluation						■	
Final reporting						■	
In-lake BMP feasibility study					■	■	
Update HUC8 watershed plan							■
Continue watershed BMP Implementation							■
Initiate in-lake BMP implementation							■

MILESTONES

Major milestones that pertain to monitoring, planning, and management practice implementation are provided in Table 58. Milestones will be used to gauge progress in meeting the desired project schedule. As the implementation of this plan is initiated, milestones will be adjusted accordingly to address changes in the schedule.

Table 58: Implementation Milestones for Pawnee Lake and Middle Creek Target Areas

Activity		Phase I						Phase II
		2018	2019	2020	2021	2022	2023	2024-2028
Monitoring	Coordinate with NDEQ	■	■	■	■	■		
	Finalize strategies and QAPPs		■					
	Assess data (annually)	■	■	■	■	■		
Planning	Develop PIP for BMP implementation		■					
	Apply for funding assistance grants		■					■
	Evaluate progress in meeting goals						■	
	Identify additional BMP needs						■	
	Prepare final report(s)						■	
	RFP for In-lake BMP feasibility study					■		
	Complete in-lake feasibility study						■	
	Revise watershed plan as needed							■
Information /Education	Develop stakeholder group		■					
	Work one-on-one with producers		■	■	■	■	■	
Implementation	Initiate BMP implementation		■					
	Complete Phase I BMP implementation						■	

COST

The preliminary opinion of total cost for implementing the nonpoint source pollution control strategy for Pawnee Lake and Middle Creek is estimated to be $47,064,689 (Table 59). This does not include costs for bathymetric surveys or final designs as these costs may be included through existing staff or agency budgets or would be contingent on project scoping. When possible, costs were determined from the 2018 USDA-NRCS EQIP practice payment schedule (USDA, 2018). Costs estimated for in-lake measures were based on average unit prices from a wide range of past project costs and should only be used for general planning purposes. These cost estimates are subject to change based on final design of the rehabilitation, inflation, bidding climate at the time of construction, project size, and/or complexity.

Table 59: Implementation Costs for the Pawnee Lake and Middle Creek Target Area

Practice	Units	Units Targeted	Unit Cost	Total Cost
Education/Information*	Years	5	$10,000	$50,000
Avoidance practices*	Acres	3,183	$108	$343,764
Contour (filter) buffers	Acres	110	$500	$55,000
Terraces	Feet	62,083	$4	$248,332
Cover crops	Acres	3,638	$133	$483,854
No-till	Acres	682	$20	$13,640
Water and Sediment Control Basins (WASCOB)	Feet	54,600	$4	$218,400
Wetlands	#	80	$35,000	$2,800,000
Riparian buffers	Acres	279	$1,650	$460,350
Grazing management	Acres	5,903	$42	$247,926
OWTS Inspection & Retrofits	#	57	$5,500	$313,500
Non-Permitted AFO Facility BMP	Units	31	$20,000	$620,000
Grassed Waterways	Acres	8	$6,575	$49,313
Sub-Total (Watershed Treatment)				**$5,904,079**
Streambank/Channel Stabilization & Restoration	Feet	93,625	$150	$14,043,750
Sub-Total (In-Stream Work)				**$14,043,750**
Lake deepening/Sediment removal**	Acre-feet	2,460	$8,000	$19,680,000
Shoreline Stabilization	Linear-feet	2,316	$110	$254,760
Jetties and Breakwaters	Linear-feet	6,043	$500	$3,021,500
In-lake Sediment Basins	Acres	90	$30,000	$2,700,000
Nutrient Inactivation	Acres	623	$2,200	$1,370,600
In-lake Feasibility/Design Study	Each	1	$40,000	$40,000
Sub-Total (In-Lake Work)				**$27,066,860**
Updates to Watershed Plan	Each	0	$-	$-
Additional Monitoring	Years	5	$10,000	$50,000
Sub-Total (Planning/Monitoring)				**$50,000**
Total				**$47,064,689**

**Based on estimated costs during the first 5-year increment only*

***Based on returning the lake to originally constructed conservation pool volume*

10.04 EAST & WEST TWIN LAKES TARGET AREA

INTRODUCTION

NOTE TO READERS

Information in this section is summarized from the *Pollutant Modeling and BMP Implementation Recommendations Summary Report for Twin Lakes* (Laketech, 2018b), a copy of which is also provided in Appendix XX. Unless otherwise noted, additional details and background information can be found in that comprehensive document.

East and West Twin lakes, collectively known as Twin Lakes, are located in Seward County (Figure 77). The lakes lie on unnamed tributaries of the South Branch Middle Creek (LP2-21010) and are connected at conservation pool elevation by a narrow, shallow channel extending approximately 0.25 miles (Figure 78). Given this connection and the lack of an outflow structure at West Twin, the U.S. Army Corp of Engineers (USACE) operates and refers to these lakes as the singular 'Twin Lakes' system (USACE, 2018). As-built conditions from 1966 indicate that Twin Lakes comprised 245 surface acres and had a conservation pool volume of 2,561 acre-feet (Table 60). The dam was constructed for the primary purpose of flood control, with recreation as a secondary benefit. The lakes and park area are designated as a Wildlife Management Area (WMA) by the Nebraska Game and Parks Commission (NGPC). Both lakes and their drainages comprise approximately 26% of the South Branch Middle Creek HUC12 subwatershed (102002030201).

Current records indicate that East Twin Lake (LP2-L0240) encompasses 149 surface acres (NDEQ, 2016b). Approximately 2,986 acres drain directly to East Twin Lake with the northern border of the drainage adjacent to the Pawnee Lake drainage. East Twin Lake is managed as a no-wake lake, limiting watercraft to five miles per hour (mph).

Current records indicate that West Twin Lake (LP2-L0260) encompasses approximately 45 surface acres (NDEQ, 2016b). While West Twin Lake is significantly smaller than East Twin Lake, it has a larger drainage area consisting of 3,836 acres. The drainage area to lake area ratio for East Twin Lake is approximately 20:1, while West Twin Lake's ratio is 107:1. The lake and surrounding park serve as a more primitive area, with no vehicle access or recreational facilities. In 2002, West Twin Lake had a maximum depth of only four feet at times and the lake has been completely dry as recently as 2007.

Beneficial uses assigned to both lakes include: Primary Contact Recreation, Aquatic Life, Aesthetics, and Agricultural Water Supplies (NDEQ, 2014). The 2016 Integrated Report (2016 IR) lists East Twin Lake as being impaired from total phosphorus, total nitrogen, and algae biomass (NDEQ, 2016b). Although West Twin Lake is currently identified as impaired from total phosphorus, total nitrogen, ammonia, and algae biomass, it has not been sampled since 2005. The South Branch Middle Creek has no impaired beneficial uses.

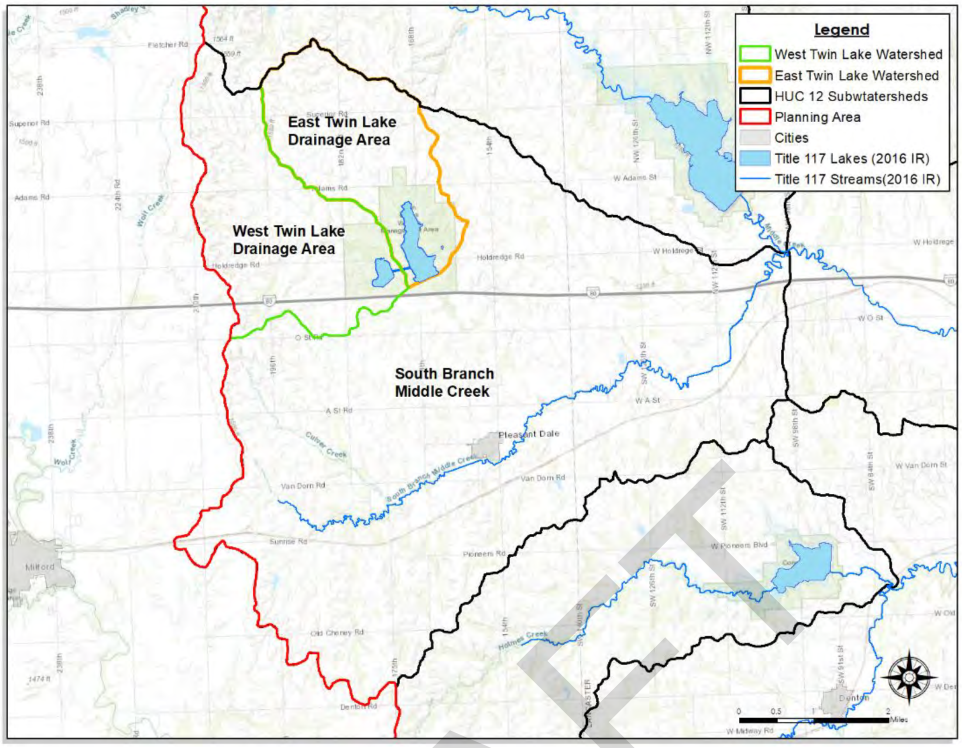


Figure 77: Location of Twin Lakes

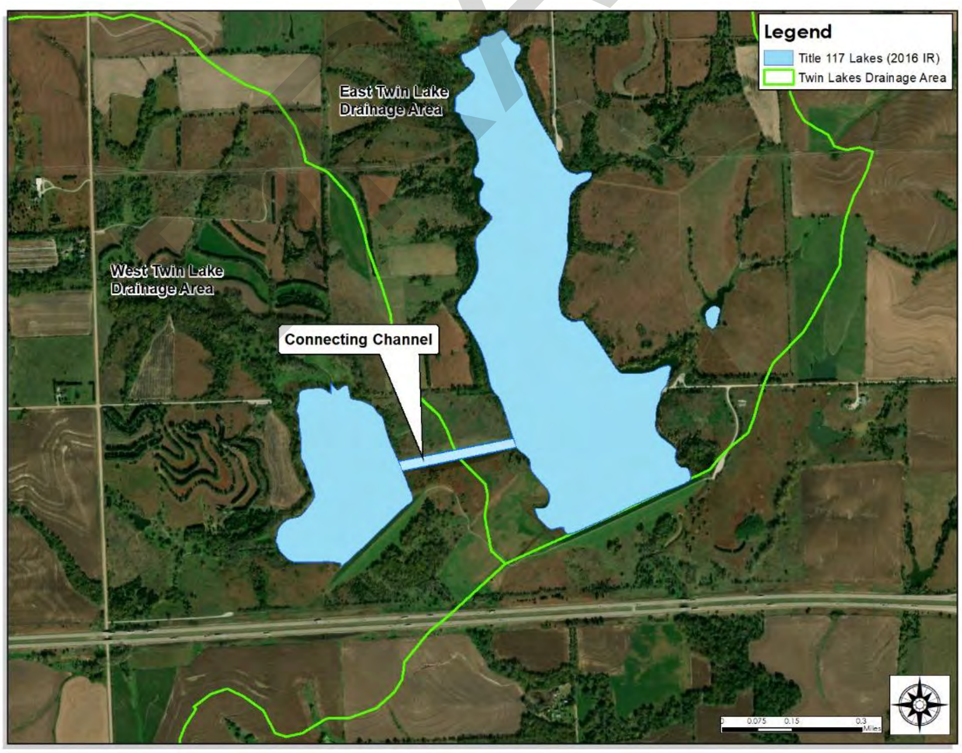


Figure 78: Channel Connecting West Twin and East Twin Lakes

Table 60: Background Information for Twin Lakes

Variable	Twin Lakes
General	
Dammed stream	South Branch Middle Creek
Conservation pool elevation (top)	1,341.0 feet-mean sea level (ft-msl)
Date of dam closure	26-Sep-1965
Drainage area[1]	6,820 ac.
Drainage area to lake area ratio	28:1
"As-Built" Conditions	1966
Lowest reservoir bottom elevation	1,316 ft-msl
Surface area at top of conservation pool (1966)	245 ac
Capacity of conservation pool (1966)	2,561 ac-ft
Mean depth at top of conservation pool (1966)	10.5 ft
Operational Details	(1968-2016)
Maximum recorded pool elevation	1,346.9 ft-msl
Minimum recorded pool elevation	1,332.1 ft-msl
Average annual pool elevation	1,339.4 ft-msl
Current inflow (2012-2016)	2,417 ac-ft
Outlet Works	
Ungated outlets	2; 24" x 63" 1,341.0 ft-msl
Gated outlets (low-level)	1; 42" x 54" 1,333.0 ft-msl

Source: USACE, 2017 [1] = USDA, 2017a

IMPAIRMENTS

Nutrients and Algae Density

East Twin and West Twin lakes are both listed in the 2016 Integrated Report (IR) as having Aquatic Life impairments due to excessive phosphorus, nitrogen, and algal biomass as measured from chlorophyll *a* (NDEQ, 2016b). Although current data was available for East Twin Lake (2012-2016), the most current period of record for West Twin Lake data is from 2002-2005. Mean growing season (May-September) total nitrogen and total phosphorus concentrations, as well as algae biomass, support the 2016 IR impairment designation for the Aquatic Life use (Table 61 and Table 62).

Table 61: East Twin Lake Nutrient Concentrations and Algae Biomass

Parameter	Data Period	N	Growing Season Mean	Water Quality Standard
Total Phosphorus (µg/L)	2012-2016	25	99	50
Total Nitrogen (µg/L)	2012-2016	25	1,509	1,000
Chlorophyll *a* (mg/m3)	2012-2016	25	32	10

Source: USACE, 2017

Table 62: West Twin Lake Nutrient Concentrations and Algae Biomass

Parameter	Data Period	N	Growing Season Mean	Water Quality Standard
Total Phosphorus (µg/L)	2002-2005	18	361	50
Total Nitrogen (µg/L)	2002-2005	10	3,727	1,000
Chlorophyll *a* (mg/m3)	2002-2005	17	43	10

Source: USACE, 2017

The Aquatic Life use for West Twin Lake is also listed as being impaired from ammonia. Fourteen total ammonia samples were collected from West Twin Lake from 2003-2005. Samples were collected from two depths on two of the days sampled (5/18/2004 and 7/1/2004). Samples values, water temperature, and pH measurements were averaged for each of these dates.

While it is unknown how the data set was used for the impairment listing, three of the 12 ammonia concentrations assessed were equal to or above the chronic water quality standard, with two of those violations occurring in 2005 (Figure 79). Due to the age of the data age and the current physical condition of West Twin Lake, ammonia will not be a priority in this Plan.

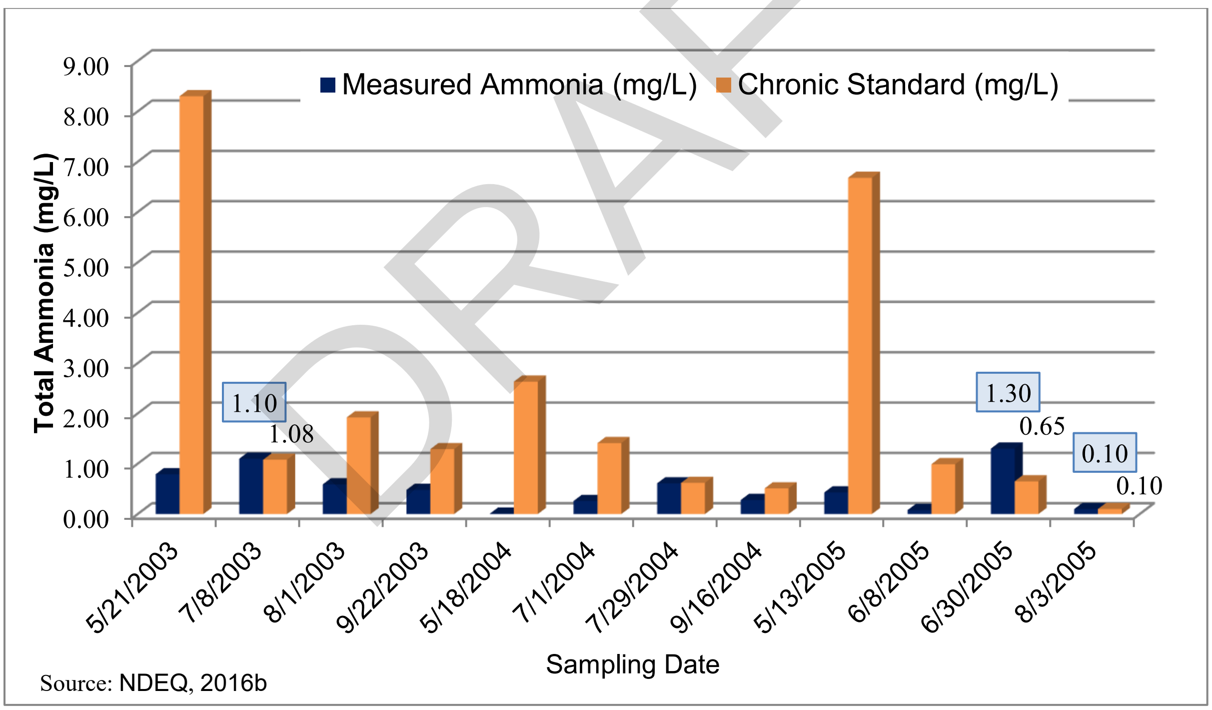


Figure 79: Total Ammonia Concentrations in West Twin Lake

Sediment

Neither East Twin Lake or West Twin Lake are listed as impaired from sediment; however, conservation pool volume loss as estimated by the USACE in 2016 indicate that impairment may exist. The most current bathymetric survey completed on Twin Lakes was in 2002 and was conducted by NDEQ and the United States Geological Survey (USGS). The USACE utilized the results of this survey, as well as an earlier survey they completed in 1994, to provide a range for conservation pool storage capacity loss and sedimentation rates. As reported, Twin Lakes is losing between 0.56% to 0.82% of the original conservation pool volume annually (USACE, 2018). The high end of this range falls slightly above the 0.75% volume loss criteria used by NDEQ to determine impairment. The total loss of volume in the Twin Lakes conservation pool since construction is estimated between 28% and 41%. The low end of this range falls above NDEQ assessment criteria of 25% indicating impairment. Current data is needed to verify lake storage volumes.

Atrazine

Although there are no stream impairments due to atrazine, high concentrations have been measured at the runoff monitoring locations above each lake (Figure 80). Atrazine concentrations exceeded the chronic water quality standard in 45% of the samples collected above East Twin Lake and 43% of the samples collected above West Twin Lake from 2002-2008 (Table 63).

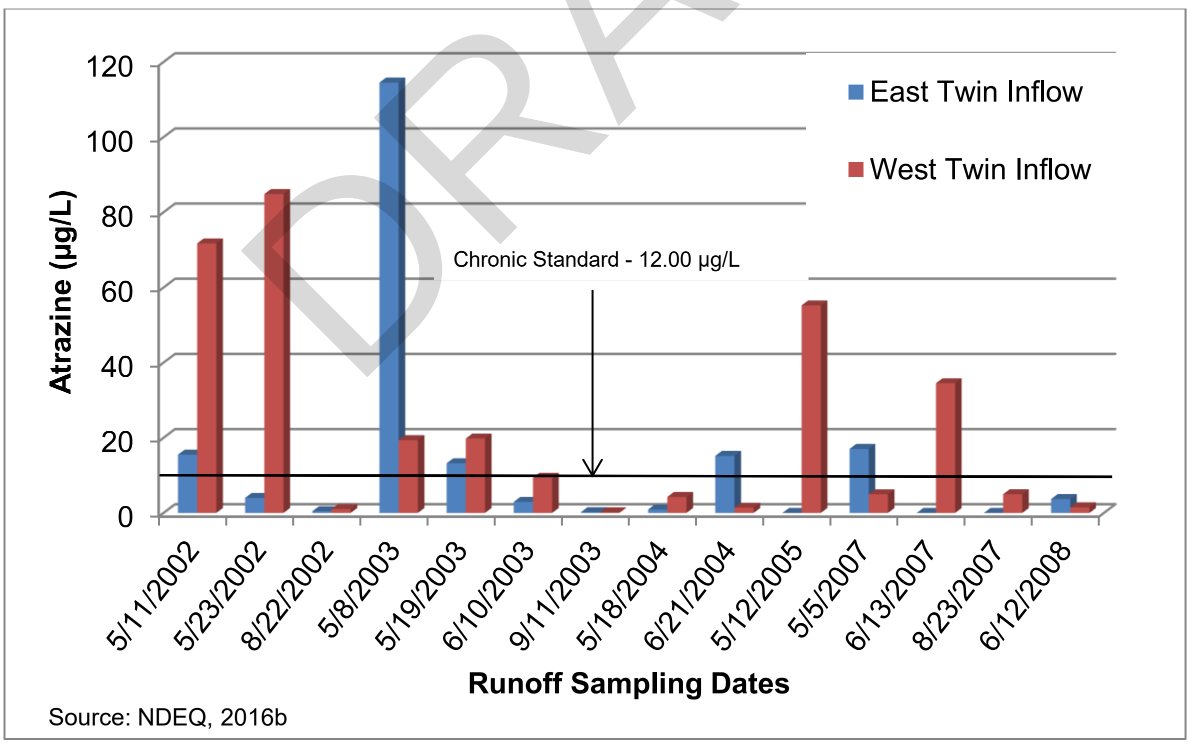


Figure 80: Atrazine Concentrations in Runoff Samples from Twin Lakes Tributaries

Table 63: Summary of Atrazine Samples Collected Above East and West Twin Lakes

Data Period	East Twin	West Twin
Number of runoff samples	11	14
Number >12.00 µg/L	5	6
% > 12.00 µg/L allowed	45	43
Mean concentration (µg/L)	17.06	22.36
Median concentration (µg/L)	4.00	7.16

POLLUTANT SOURCES AND LOADS

Pollutant loads to East and West Twin lakes were estimated for the following parameters of concern: phosphorus, nitrogen, and sediment. Pollutant loads and the contribution from primary sources were estimated from the Statistical Tool for Estimating Pollutant Load (STEPL) model (TetraTech, 2007), Sediment Phosphorus Release Regression Equation (Dzialowski & Carter, 2012), and data calculations. A summary of data, data sources, and assessment methods can be found in the modeling/implementation report in Appendix XX.

To fully account for pollutant sources, contributions from external and internal sources were quantified to the extent possible. Due the lack of lake depth and excessively high nutrient concentrations in West Twin Lake, lake response models were not applicable to estimate loads from internal sources. While internal loads of phosphorus were estimated for East Twin Lake, the lack of literature and data prevented the estimation of internal nitrogen loads. Due to lack of data, internal phosphorus loads to East Twin Lake from three sources—waterfowl waste, bottom re-suspension, and phosphorus transferred from West Twin Lake—were reported as one load. External sources of nutrients to each lake include runoff from the drainage area, as well as atmospheric deposition through precipitation directly on the lake.

Phosphorus Loads

The current average annual phosphorus load to West Twin Lake is estimated at 6,609 lbs/yr (Table 64). Land used for corn and soybean production, the largest phosphorus load contributor, contributes approximately 46% of the total (Figure 81). Although land in permanent grass contributes 20% of the phosphorus load, it comprises 52% of the drainage area. Because West Twin Lake has no outflow structure, loads are either retained or transferred to East Twin Lake.

Table 64: Phosphorus Sources and Average Annual Loads to West Twin Lake

Sources	Area	Phosphorus Load	Total
External			
Grass-pasture	1,989	1,481	20
Corn-soybeans	1,131	2,818	46
Forest	500	38	1
Other crops	74	83	1
Urban	64	21	<1
Open lots-Animal feeding/holding[1]	16	693	10
Streambank erosion (miles)	6.1	1,304	20
Registered on-site wastewater (#)	6	4	<1
Unregistered on-site wastewater (#)	33	161	2
Atmospheric deposition (lake area)	45	7	<1
Internal			
Lake shoreline (area loss per year)	-	NE	-
Bottom sediment "P" release	-	NE	-
Waterfowl and bottom "P" re-suspension	-	NE	-
Total Gross Load		6,609	100

Note. NE = Not estimated. [1]Pertains to non-permitted animal feeding operations.

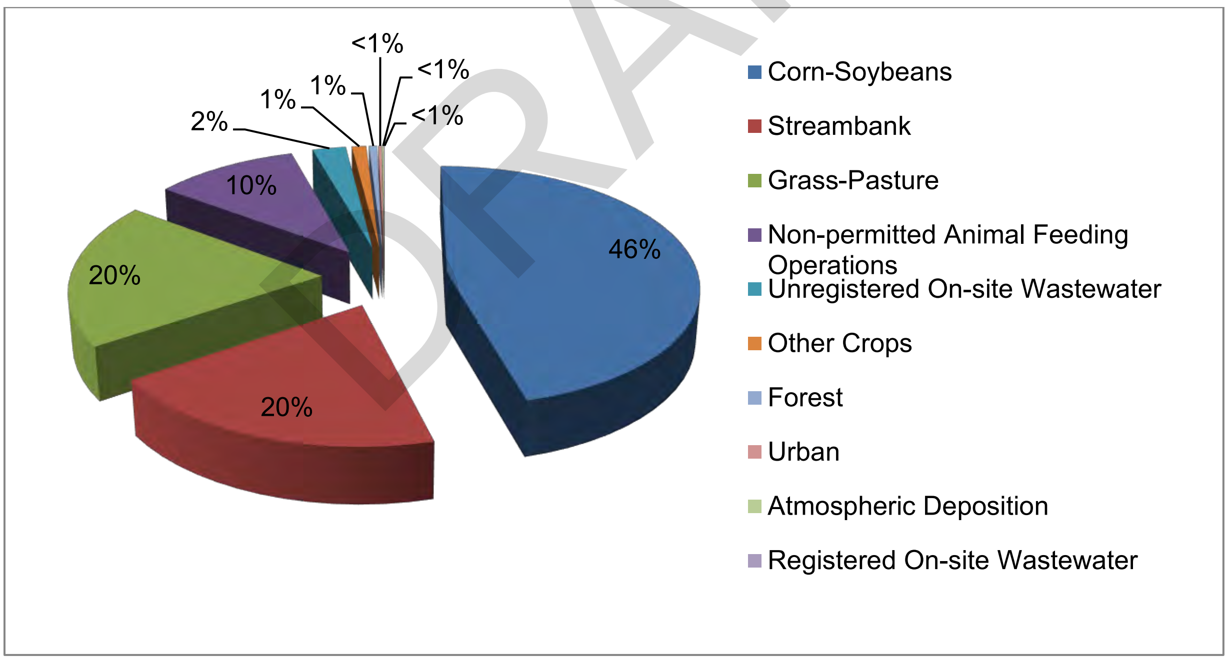


Figure 81: Source Contributions of Phosphorus to West Twin Lake

The current average annual gross phosphorus load to East Twin Lake is estimated at 5,111 lbs/yr. (Table 65). Of this amount, external sources account for approximately 3,886 lbs (or 76%) of the total load. Streambank erosion, which comprises 23% of the overall load, contributes 1,151 pounds of phosphorus to the lake annually (Figure 82). Approximately 17% of the phosphorus load stems from waterfowl waste, bottom sediment re-suspension, and transfer from West Twin Lake.

Table 65: Phosphorus Sources and Average Annual Loads to East Twin Lake

Sources	Area (acres)	Phosphorus Load (lbs/yr)	Total (%)
External			
Grass-pasture	1,541	460	9
Corn-soybeans	828	1,634	32
Other crops	203	16	0
Forest	220	100	2
Urban	8	439	9
Open lots-Animal feeding/holding[1]	12.6	3	0
Streambank erosion (miles)	3.58	1,151	23
Registered on-site wastewater (#)	2	1	0
Unregistered on-site wastewater (#)	12	58	1
Atmospheric deposition (lake area)	149	23	0
Internal			
Lake shoreline (area loss per year)	149	NE	-
Bottom sediment "P" release	149	339	7
Transfer from West Twin, waterfowl, and bottom "P" re-suspension	149	886	17
Total Gross Load		**5,111**	**100**

Note. NE = Not estimated. [1]Pertains to non-permitted animal feeding operations.

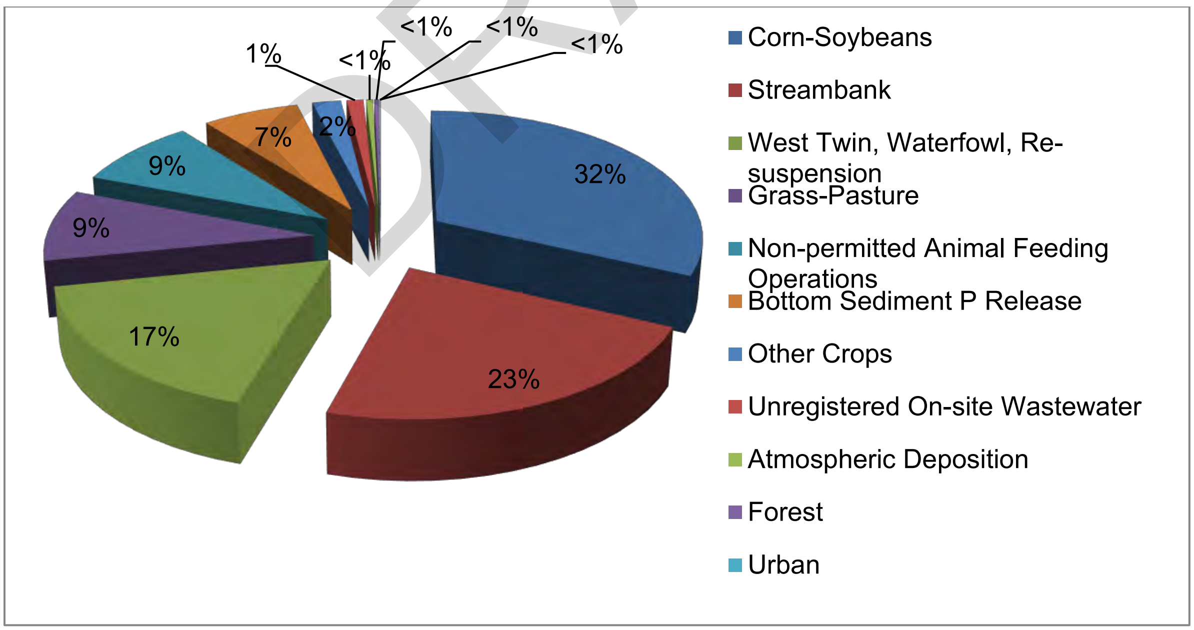


Figure 82: Source Contribution of Phosphorus to East Twin Lake

Nitrogen Loads

The total gross nitrogen load to West Twin Lake is approximately 31,085 lbs/yr. (Table 66). This estimate was determined as the sum of the drainage area runoff load (30,823 lbs/yr.) and nitrogen contributed through precipitation falling directly on the lake surface (262 lbs/yr.). Land used for corn and soybean production contributes the largest nitrogen load to the lake at 42%.

Because West Twin Lake has no outflow structure, loads are either retained or transferred to East Twin Lake. The current average annual external nitrogen load to East Twin is 21,212 lbs/yr. (Table 67). This estimate was determined as the sum of the drainage area runoff load (20,343 lbs/yr.) and nitrogen contributed through precipitation falling directly on the lake surface (869 lbs/yr.).The largest contributor of nitrogen is from land used for corn and soybean production (Figure 83).

Table 66: Nitrogen Sources and Average Annual Loads to West Twin Lake

Sources	Area	Nitrogen Load	Total
External			
Grass-pasture	1,989	10,398	33
Corn-soybeans	1,131	12,952	42
Other crops	500	41	<1
Forest	74	332	1
Urban	64	96	<1
Open lots-Animal feeding/holding[1]	16	3,465	11
Streambank erosion (miles)	6.1	3,120	10
Registered on-site wastewater (#)	6	9	<1
Unregistered on-site wastewater (#)	33	410	1
Atmospheric deposition (lake area)	45	262	1
Internal			
Lake shoreline (area loss per year)	-	NE	-
Bottom sediment release	45	NE	-
Waterfowl and bottom re-suspension	45	NE	-
Total Gross Load		**31,085**	**100**

Note. NE = Not estimated. [1]Pertains to non-permitted animal feeding operations.

Table 67: Nitrogen Sources and Average Annual Loads to East Twin Lake

Sources	Area (acres)	Nitrogen Load (lbs/yr)	Total (%)
External			
Grass-pasture	1,541	7,051	33
Corn-soybeans	828	7,598	36
Other crops	203	31	<1
Forest	220	542	3
Urban	8	2,197	10
Open lots-Animal feeding/holding[1]	12.6	17	<1
Streambank erosion (miles)	3.58	2,755	13
Registered on-site wastewater (#)	2	3	<1
Unregistered on-site wastewater (#)	12	149	1
Atmospheric deposition (lake area)	149	869	4
Internal			
Lake shoreline (area loss per year)	149	NE	-
Bottom sediment release	149	NE	-
Transfer from West Twin, waterfowl, and bottom re-suspension	149	NE	-
Total Gross Load	**-**	**21,212**	**100**

Note. NE = Not estimated. [1]Pertains to non-permitted animal feeding operations.

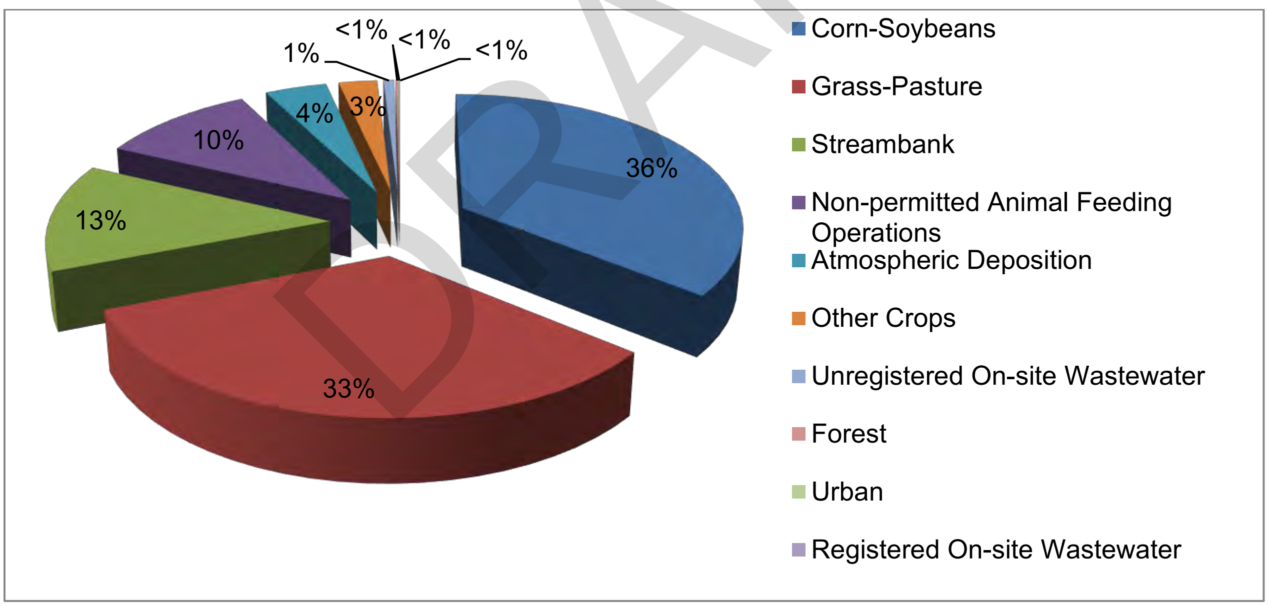


Figure 83: Source Contribution of Nitrogen to East Twin Lake

Sediment Loads

Sources of sediment to Twin Lakes include watershed runoff (external) and shoreline erosion (internal). Shoreline erosion at West Twin Lakes was not estimated due to the lack of historical data. The total gross sediment load to West Twin Lake is estimated to be 2,309 t/yr. (Table 68). The largest source of sediment to the lake is from land used for corn and soybean production, which contributes 43% of the total sediment load. Streambank erosion is the second largest contributor of sediment to the lake and delivers 34% of the total load.

The largest source of sediment to East Twin Lake is from streambank erosion which contributes 689 t/yr (or 42%) of the total sediment load (Table 69). Lake shoreline erosion contributes the second largest sediment load, accounting for 32% of the total load.

Table 68: Sediment Sources and Average Annual Loads to West Twin Lake

Sources	Area	Sediment	Total
External			
Grass-pasture	1,989	489	21
Corn-soybeans	1,131	992	43
Forest	500	18	1
Other crops (e.g., rye, alfalfa, oats, winter wheat)	74	28	1
Urban	64	2	<1
Open lots-Animal feeding/holding	16	0	0
Streambank (miles)	6.1	780	34
Registered on-site wastewater (#)	6	0	0
Unregistered on-site wastewater (#)	33	0	0
Atmospheric deposition (lake area)	45	0	0
Internal			
Lake shoreline (area loss per year)	45	NE	-
Bottom sediment release	45	NE	-
Waterfowl and bottom sediment re-suspension	45	NE	-
Total Gross Load		**2,309**	**100**

Note. NE = Not estimated.

Table 69: Sediment Sources and Average Annual Loads to East Twin Lake

Sources	Area	Sediment	Total
External			
Grass-pasture	1,541	130	8
Corn-soybeans	828	250	15
Forest	220	3	0
Other crops (e.g., rye, alfalfa, oats, winter wheat)	203	26	2
Feedlots	12.6	0	0
Urban	8	0.4	<1
Streambank (miles)	3.58	689	42
Registered on-site wastewater systems: 5% failure (#)	2	0	0
Unregistered on-site wastewater systems: 40% failure (#)	12	0	0
Atmospheric deposition (lake area)	148	0	0
Internal			
Lake shoreline (area loss per year)	148	524	32%
Bottom sediment release	148	-	-
Transfer from West Twin, waterfowl, and bottom re-suspension	148	-	-
Total Gross Load	**-**	**1,622**	**100**

REQUIRED POLLUTANT LOAD REDUCTIONS

Phosphorus and Nitrogen

No loading capacities were determined for West Twin Lake because it lacks an outflow and is connected to East Twin Lake at conservation pool elevation. The total phosphorus loading capacity for East Twin Lake was determined from the Canfield-Bachmann lake loading regression equation (Canfield & Bachmann, 1981).

Based on the Canfield-Bachmann results, the current in-lake phosphorus concentration of 98.8 µg/L will need to be reduced by 49% to meet the water quality standard of 50 µg/L (Table 70). The gross phosphorus load capacity associated with an in-lake concentration of 50 µg/L is approximately 1,572 lbs/yr. In order to meet this water quality standard, the current annual phosphorus load of 5,111 lbs/yr will need to be reduced by 3,539 lbs/yr (69%).

The current in-lake nitrogen concentration of 1,509 µg/L will need to be reduced by 34% to meet the water quality standard of 1,000 µg/L. This in-lake reduction was used as the nitrogen load reduction target. Applying a 34% reduction to the current load of 21,212 lbs/yr would result in a reduction target of 14,057 lbs/yr.

In order to determine the extent of load reductions that can be achieved from controlling anthropogenic sources of pollutants, natural background loads of phosphorus and nitrogen were determined for the Twin Lakes drainage area. Estimated annual natural background loads constitute approximately 69% of the phosphorus loading capacity and 84% of the annual nitrogen loading target. These numbers indicate an aggressive nutrient reduction strategy will need to be implemented in order for East Twin Lake to meet phosphorus and nitrogen targets.

Table 70: Phosphorus and Nitrogen Reduction Targets for East Twin Lake

Targets	Phosphorus	Nitrogen
Amount		
Current in-lake phosphorus (µg/L)	98.8	1,509
Target in-lake phosphorus (µg/L)	50.0	1,000
Target reduction (µg/L)	48.8	509
Target reduction (%)	49	34
Sum of External and Internal Load		
Current load (lbs/yr)	5,111	21,212
Load capacity (lbs/yr)	1,572	7,155
Target reduction (lbs/yr)	3,539	34
Target reduction (%)	69	14,057

Sediment

Bathymetric surveys of Twin Lakes were completed in 1992 and 2002 (USACE, 2017). Sedimentation rates from historic surveys were used to estimate the current storage capacity of the conservation pool of 1,861 ac-ft. (Table 71). As reported, Twin Lakes is losing 0.56% to 0.82% of the original conservation pool volume annually. The high end of this range falls slightly above the 0.75% criterion used to determine impairment. Because the mid-point of the reported range (0.69%) falls below the NDEQ sedimentation assessment criterion, no load reduction targets were established. However, the implementation strategy targeted for phosphorus and nitrogen load reductions will also result in significant reductions to current sediment loads. Collection of current reservoir volume information should be conducted to solidify volume loss and annual sedimentation estimates.

Based on an as-built conservation pool volume of 2,561 ac-ft. and a current volume of 1,861 ac-ft., the loss to the conservation pool is estimated to be 700 ac-ft. or 27.3%. However, the USACE assessment indicates that volume loss could be as high as 41%. The low end of this range falls above the NDEQ assessment criterion of 25%. For planning purposes, the mid-point of the reported range (33.7%) will be used. Based on this loss, approximately 223 acre-feet of conservation pool storage or 8.7% will need to be reclaimed to meet the loss criterion. Although individual lake volumes are not available, observations indicate that West Twin Lake has lost nearly 100% of its conservation pool storage capacity.

Table 71: Sedimentation Rates and Conservation Pool Storage Volume Loss for Twin Lakes

Twin Lakes	Range (Midpoint)	NDEQ
Conservation Pool Storage Volume (ac-ft.)		
Original storage volume (1966)	2,561	
Current storage volume	1,861	
Conservation pool storage volume loss (difference)	700	
Conservation Pool Storage Volume Loss		
Conservation pool loss (ac-ft/yr.)	14.3-20.9	
Average annual conservation pool loss (%/yr.)	0.56-0.82	0.75
Total conservation pool loss (%)	27.3-41.0: Mid-point	25
Necessary Storage Volume Increase		
Storage capacity increase needed to meet 25% (ac-	223	

Source: USACE, 2018

IMPLEMENTATION STRATEGY

The implementation strategy for the drainage area above Pawnee Lake includes multiple practices that target pollutant sources through the ACT approach (avoid, control, trap), also known as a "treatment train". All pollutant sources will be addressed, except for atmospheric loading, as this plan only addresses nonpoint source pollution from surface water runoff.

A VOLUNTARY PLAN

The implementation of this plan is based entirely on the voluntary actions of landowners and citizens. Individuals must decide if it is an advantage to participate, and it is the responsibility of the LPSNRD and other stakeholders to find ways to make participation advantageous.

The implementation strategy presented in this plan should be used as a guide for practice implementation and may be subject to revision as new information becomes available and willing landowners are identified. For a detailed description of discussed provided below, refer to Chapter XX.

Water quality assessments indicate in-lake management measures will be needed for East Twin Lake to meet water quality standards and sedimentation assessment criteria. Given the extent of in-lake work required, only a general accounting of appropriate measures and costs are provided. Specific measures and accurate costs should be determined through a feasibility/design study with results included in a future revision of this plan.

To provide an accurate load reduction estimate from practice implementation, recommended practices were used to develop a "treatment train" (following ACT methodology) that follows the flow of pollutants from the source to the receiving waterbody (Figure 84). The drainage area treatment train is comprised of seven levels of treatment, beginning with education/outreach and avoidance practices, and ending with in-lake management measures.

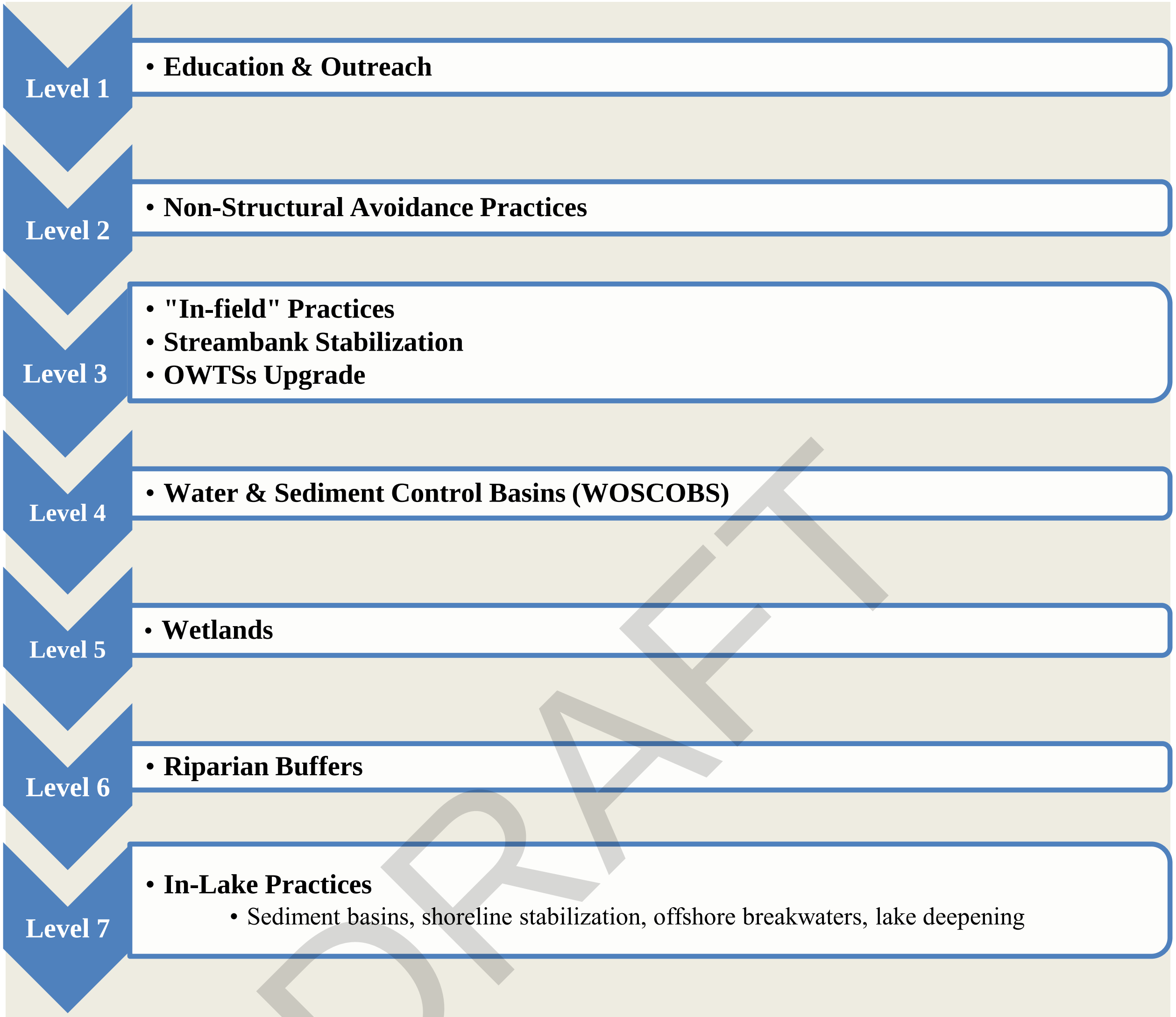


Figure 84: Water Quality Treatment Train for Twin Lakes

BMP TARGETING

Drainage Area Management Measures and Reductions

A suite of structural and non-structural management practices was identified using aerial assessments and the ACPF toolbox. In addition to these practices, education/outreach and avoidance practices were added to the suite of recommendations for the Twin Lakes drainage (Table 72). Ground used for corn and soybean production is targeted for the largest number of practices. All land cover types and pollutant sources were targeted for education and outreach activities except for water and wetlands, which were not classified as pollutant sources. Figure 85 and Figure 86 present the number and location of acres targeted for individual and groups of practices, as well as areas best suited for those practices. These maps are not "planned" locations, but instead provide a starting point for discussions with willing landowners and enable managers methods to develop this WQMP. Detailed map books can be found in Appendix XX of the WQMP.

Table 72: Land Cover Types Targeted for Management Practices in the Twin Lakes Drainage

Land Cover Type/ Pollutant Source	Current Acres (Both Drainages)	BMP	Acres Targeted East Twin/West Twin
All	6,587[a]	Education & Outreach	2,813/3,774
Corn-Bean	1,060	Avoidance	580/792
		Terraces - cover crops - no till	64/93
		Contour buffer - cover crop - no till	60/77
		Cover crops-contour buffer	182/202
		Cover crops	356/533
		WASCOBS	113/110
		Wetlands	594/451
		Riparian buffers	127/163
AFOs Non-permitted	29	Avoidance	9/11
		WASCOBS	12/9
Pasture	3,192	Grazing management	771/995
		WASCOBS	221/187
		Wetlands	747/825
Other Crops	278	WASCOBS	104/6
		Wetlands	203/102
Forest	720	WASCOBS	46/82
		Wetlands	84/241
Urban	73	Wetlands	4/24
Streambanks (miles)	9.7	Bank stabilization (miles)	0.96/2.6
OWT Systems (#)	53	Unregistered system upgrade (#)	4/12

Note. [a] *Does not include water or wetlands. WASCOBS = Water and Sediment Control Basins.*

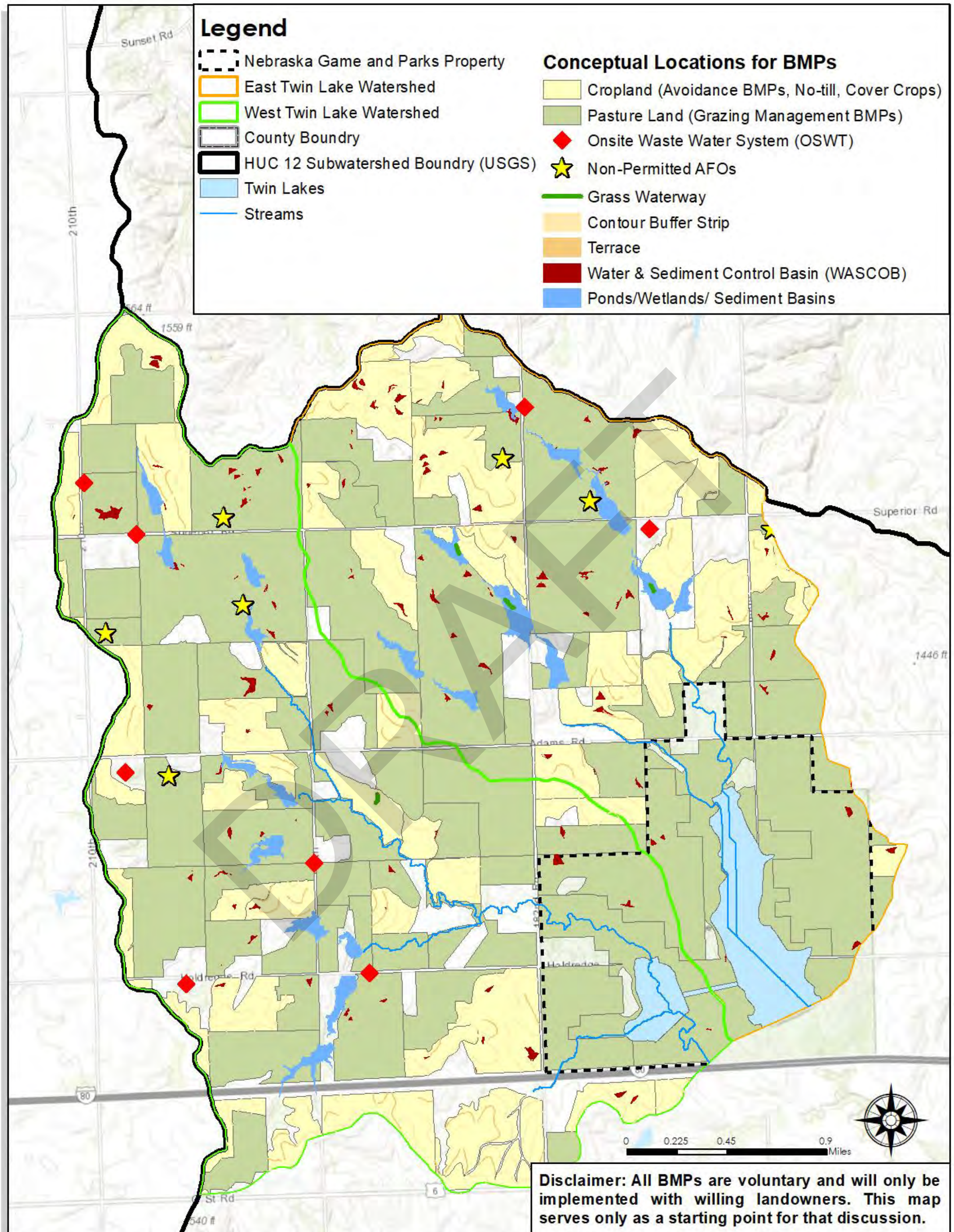


Figure 85: Conceptual locations of in-field and edge-of-field BMPs

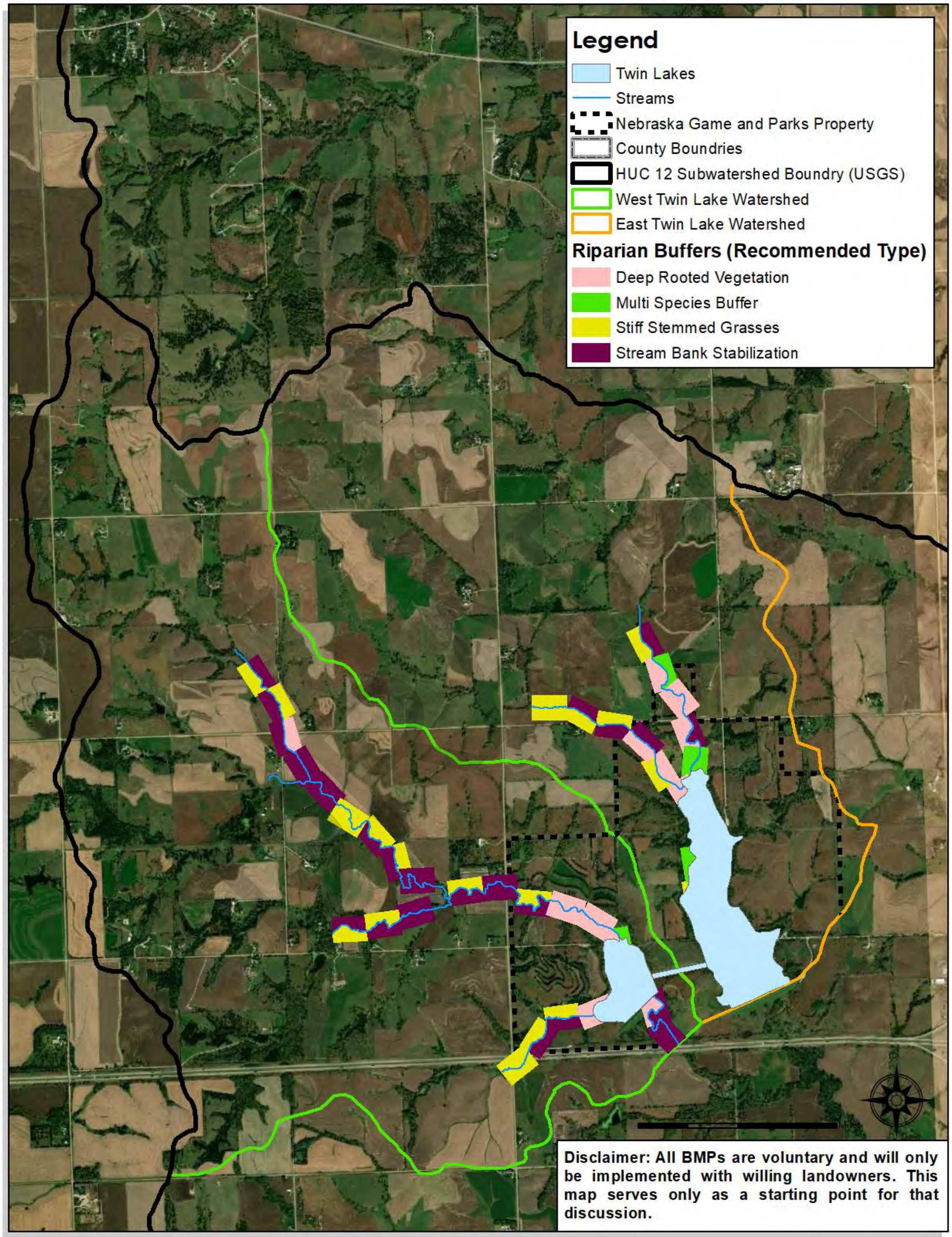


Figure 86: Conceptual locations of in-stream and riparian BMPs

In-Lake Management Measures and Reductions

The proposed implementation strategy for the Twin Lakes drainage area will achieve the nitrogen load reduction target of 34%. In contrast, because of contributions from in-lake sources, it does not achieve the phosphorus loading reduction target of 69%. Therefore, in-lake management practices will be required to achieve load reduction goals. Sediment removal from the lake will be required to address the current aesthetics impairment.

Several in-lake management measures are recommended to reduce internal pollutant loads. Although the conceptual locations for each practice have been identified, it is recommended that all in-lake management measures be further evaluated to facilitate development of conceptual designs and accurate cost estimates. The following management measures were identified and are illustrated in Figure 87.

Sediment Removal

Sediment removal from the East Twin and West Twin lakes will reduce bottom sediment re-suspension and increase the ability of both to attenuate nutrients. In order for Twin Lakes to achieve a full support for the Aesthetics beneficial use, the conservation pool storage volume will need to be increased by approximately 8.7% (223 acre-feet). Because the USACE treats the lakes as one system (Twin Lakes), quantities were not identified for individual lakes; however, water quality and aquatic life would benefit from removing greater quantities of sediment. Areas of East Twin Lake that are less than 12-feet deep are considered to be a higher priority for deepening (Figure 87). Areas identified for deepening are based on 2002 bathymetric data and should be verified with new data. Specific areas targeted for sediment removal and removal quantities should be defined in a sediment removal plan.

In-Lake Sediment Basins

Water quality basins are an important component of reservoir sedimentation management, primarily through decreasing sediment and nutrient impacts to the lake. Water quality basins identified for the drainage area should be supplemented with in-lake basins in East Twin Lake to further decrease sediment impacts to the main body of the lake. Three in-lake basins have been identified to address pollutant loads from four tributaries contributing the greatest pollutant loads.

Shoreline (Baink) Stabilization

Shoreline erosion accounts for 32% of the total sediment load to East Twin Lake. While, sediment loads are currently below target, addressing this source will allow for easier attainment of load reduction goals and will benefit aquatic habitat. Approximately 1,971 linear feet of shoreline were determined to have a high potential for erosion, whereas 754 linear feet of shoreline were determined to have a moderate erosion potential. The wetland/sediment basin targeted for the primary inflow could be configured to address all of this shoreline area. Any areas not addressed by basins will still require stabilization. A combination of vegetation and hard armoring will be used.

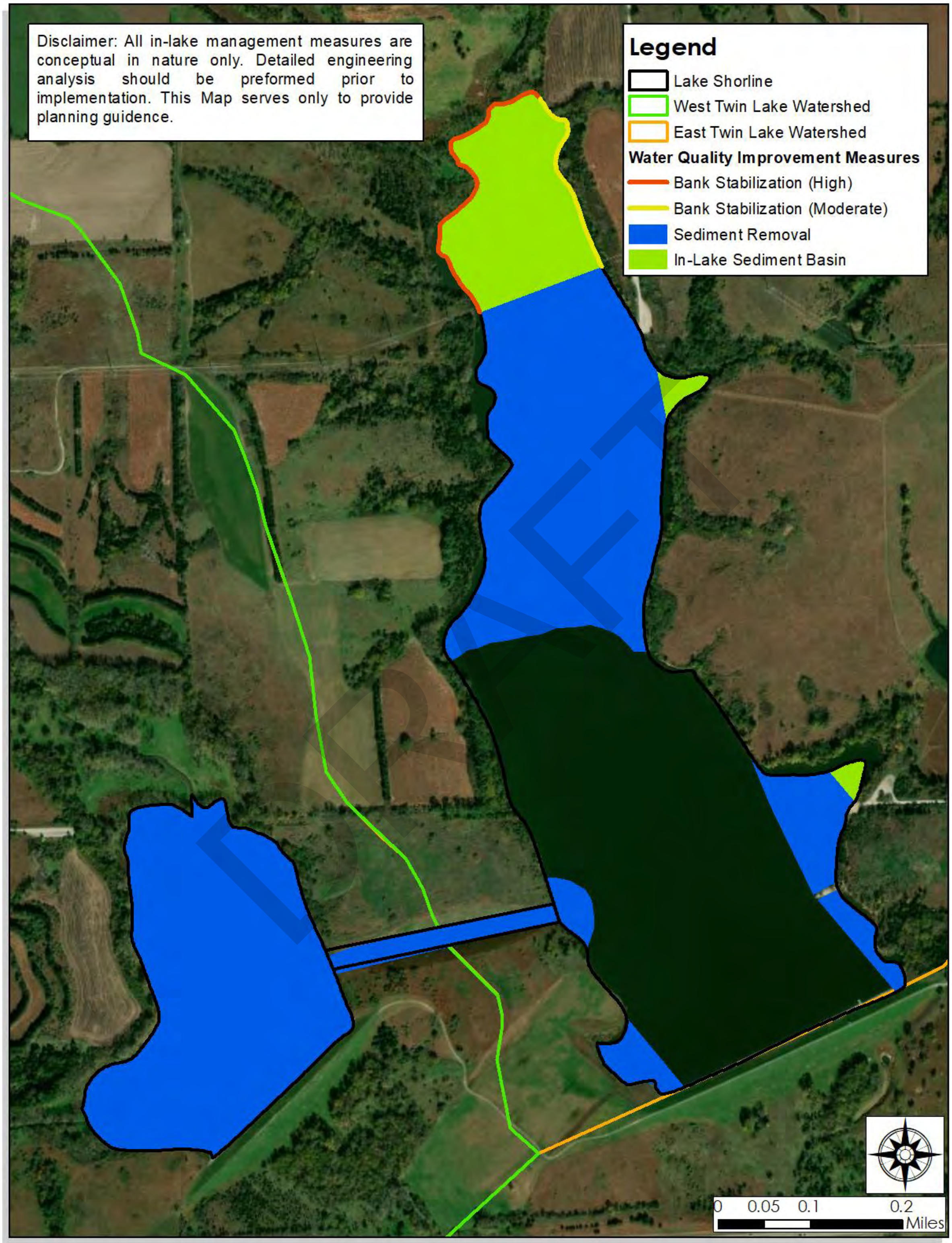


Figure 87: Conceptual Locations for In-Lake Management Measures at Twin Lakes

CRITICAL SOURCE AREAS

Critical Source Areas (CSA) are a relatively small fraction of a watershed that generates a disproportionate amount of pollutant load (Meals, 2012). As discussed in Chapter XX, CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism. Identifying CSAs allows for the prioritization of fields where BMPs are likely most needed and allows for financial and technical resources to be used most efficiently.

CSAs in the Twin Lakes Target Area were identified using the field runoff risk assessment in the ACPF Toolbox. This assessment provides a relative risk rating (not an absolute risk rating) and is based on a cross-reference of two factors:

- Slope steepness – Steeper fields have a higher risk of generating runoff
- Distance to stream – The closer a field is to a waterbody, the higher the risk a pollutant will be delivered to waterbody

Once the assessment is complete, each field receives a relative classification, ranging from A (highest risk – most critical), to B (very high), C (high), and other ('present'). One limitation of this tool is that only agriculture landuses (cropland or pasture land) are included. These other land uses (typically rural residences or other natural areas) are identified as "unknown" in the assessment. "Unknown" areas may still have an elevated runoff risk (especially for pollutants such as manure application or failing OWTS's). A "present" or "unknown" classification does not mean that a BMP would not provide benefits to a given field, but rather indicates that other fields have a greater potential to deliver pollutants to a waterbody via surface runoff. In future updates to this plan, an assessment of all fields for runoff risk is recommended.

For the purposes of this plan, areas identified as A or B through the runoff risk assessment, have been identified as CSAs. In the Twin Lakes Target Area (Figure 88), there are 2,220 acres of CSAs (approximately 32% of the Target Area), which are broken down as follows:

- Highest Risk CSA: 365 acres
- Very High Risk CSA: 1,855 acres

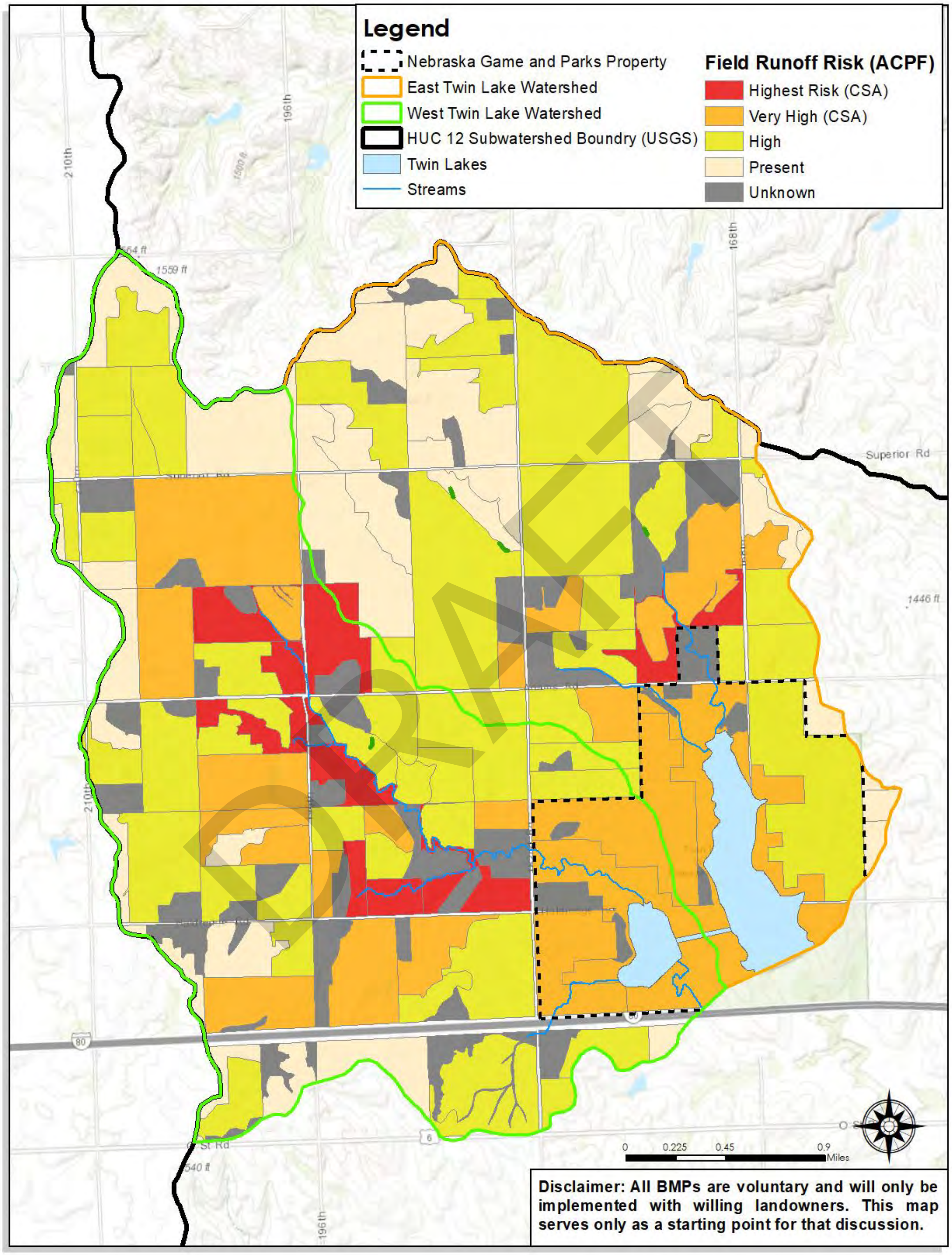


Figure 88: Critical Source Areas at Pawnee Lake as identified with the ACPF Tool

MEETING WATER QUALITY STANDARDS

Implementing a comprehensive strategy for Twin Lakes that includes both external and internal management practices will result in Twin Lakes meeting water quality standards for in-lake nitrogen and phosphorus. It is assumed that if lake nutrient concentrations meet the water quality standard, algae biomass will also meet the standard. Additionally, a full support status will be achieved for the aesthetics use by increasing lake storage capacity. Although no load reduction target for sediment was required, reduction targets for phosphorus and nitrogen will be attained (No load reduction target for sediment was required. Additional details can be found in the summary report located in Appendix XX.

Although nutrient reduction benefits of implementing external and internal management practices have been estimated and provide a path to meeting water quality standards, cumulative benefits of implementing a comprehensive plan are difficult to accurately project. Thus, a sound monitoring, and data collection network will be critical to adaptively manage Twin Lakes.

Table 73, Table 74, and

Table 75No load reduction target for sediment was required. Additional details can be found in the summary report located in Appendix XX.

Although nutrient reduction benefits of implementing external and internal management practices have been estimated and provide a path to meeting water quality standards, cumulative benefits of implementing a comprehensive plan are difficult to accurately project. Thus, a sound monitoring, and data collection network will be critical to adaptively manage Twin Lakes.

Table 73: Estimated Sediment and Nutrient Reductions and Targets for East Twin Lake

Pollutant Amount	Sediment (t/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)
Beginning load	1,622	5,111	21,212
External load reductions	558	2,583	13,424
Internal load reductions	952	1,769	4,284
Total reductions	1,510	4,353	17,707
Reduction targets	NA	3,539	7,155

Table 74: Estimated Phosphorus Reductions and Water Quality Targets for East Twin Lake

Phosphorus Amount	Load	In-Lake
Beginning total phosphorus load	5,111	98.8
External total phosphorus reductions	2,586	27.4
Internal load reductions/improvements	1,768	26.7
Total phosphorus reductions	4,353	54.1
Expected conditions	758	44.7
Phosphorus loading capacity & water quality standard	1,572	50.0

Table 75: Estimated Nitrogen Reductions and Water Quality Targets for East Twin Lake

Nitrogen Amount	Load	In-Lake
Beginning total nitrogen load	21,212	1,509
External total nitrogen reductions	13,424	955
Internal load reductions/improvements	4,284	305
Total nitrogen reductions	17,707	1,260
Expected conditions	3,505	249
Nitrogen loading target & water quality standard	7,155	1,000

MONITORING

The LPSNRD will follow established protocol and procedures to: develop sound, defensible monitoring strategies and networks: properly manage data: and disseminate information to decision makers and other stakeholders. Monitoring goals can only be achieved through partnerships with other resource agencies such as NDEQ, USACE, and NGPC. Steps will be taken to ensure collection of scientifically valid data, which may include the development of Quality Assurance Project Plans (QAPP) for state and federal review.

A broad set of monitoring goals and objectives has been developed for East Twin and West Twin lakes. Targeted parameters, monitoring sites, and monitoring frequency have been defined to meet each objective. Monitoring objectives provided below in *italics* may require expanded or new monitoring efforts, whereas objectives and parameters in regular text are currently being addressed through established monitoring sites and current monitoring networks coordinated by NDEQ and USACE. In some cases, objectives can be achieved by adding a parameter or additional sites to current networks. In other cases, specialized studies will need to be conducted to meet the objective. Although in many cases priorities depend on funding, other considerations should also be accounted for, including confidence in current assessments, short term data/information needs, and available staff.

East Twin Lake and Drainage

Monitoring Goal 1: Evaluate the water quality condition of East Twin Lake.

- Evaluate beneficial use support and water quality trends for East Twin Lake.

Monitoring Goal 2: Estimate or verify average annual pollutant loads to East Twin Lake.

- Verify runoff loads of nutrients, sediment, and *atrazine* from the drainage area above East Twin Lake.
- *Quantify nutrient and sediment loads to East Twin Lake from specific land cover types.*
- *Verify sediment and nutrient loads stemming from streambank erosion.*
- *Quantify internal nutrient and TSS loads to East Twin Lake from specific sources.*
- *Quantify sediment and nutrient loads from West Twin Lake.*
- *Estimate current lake conservation pool storage volume.*
- *Quantify annual lake retention of nutrients and sediment.*

Monitoring Goal 3. Gather data needed to complete pre-implementation planning.

- *Evaluate spatial sediment deposition in East Twin Lake.*

West Twin Lake and Drainage

Monitoring Goal 1: Estimate or verify average annual pollutant loads to West Twin Lake.

- *Verify runoff loads of sediment, nutrients, and atrazine from the drainage area above West Twin Lake.*

COMMUNICATION AND OUTREACH

Chapter 6 of this plan provides a broad, programmatic approach that the LPSNRD and its partners will take to address nonpoint source pollution through communication and outreach activities. Specifically, within a target area there are certain pieces of information necessary for successful communication and outreach efforts, which will in turn support the implementation of BMPs. Those items specific to the Twin Lakes Target Area were identified via stakeholder and public input, and are as follows:

- Identified Target Audiences
    - Recreational water users of East and West Twin Lakes
    - Land managers, residents, and property owners within Twin Lakes drainage area
    - Producers with existing BMPs who may be interested in implementing more
    - Rural homeowners on private wells and septic systems
- Methods
    - Utilize parcel ownership information, along with the detailed BMP location maps created with the ACPF Tool to contact specific landowners about BMPs applicable to their properties
        - A postcard mass mailing followed up by phone calls will help start initial implementation efforts and/or increase attendance at public meetings
    - Build a unifying logo, tagline, or message around protecting and restoring Twin Lakes. This would be included on signage and other documents
    - Develop signage to be used at project demonstration sites, key watershed entrances or landmarks, and other highly visible areas
    - Utilize locations within the Villages of Malcolm or Pleasant Dale for the following:
        - Post flyers, distribute press releases, and advertise at local events
        - Hold targeted coffee shop meetings, tailgate sessions, and other informal/casual informational exchanges to build relationships and to learn more about the constraints and hurdles to BMP adoption
    - Piggy back on existing events - Training and demonstration field days, information booths, recognition picnics, etc.
        - Such as the BBQ and Blues Fest held annually in Malcolm, nitrogen certification training events, etc.
    - Hold an outdoor recreation clinic (kayaking, fishing, etc.) at Twin Lakes

Plan and project sponsors will utilize these target audiences and outreach methods when building project level communication and outreach plans, typically as part of a Project Implementation Plan (PIP). The PIP will identify the specific and tailored actions for each target audience, as discussed in Chapter 6.

SCHEDULE

The timeframe for implementing general actions are provided in Actions are subject to approval by the LPSNRD Board of Directors, NGPC, and USACE, and may change as the plan is implemented. Phase I activities will include the initiation of external management practice implementation and the evaluation of in-lake measures. Phase II will begin upon the five-year revision of this plan. A summary of progress achieved during Phase I will be included in the plan revision.

Table 76. Actions are subject to approval by the LPSNRD Board of Directors, NGPC, and USACE, and may change as the plan is implemented. Phase I activities will include the initiation of external management practice implementation and the evaluation of in-lake measures. Phase II will begin upon the five-year revision of this plan. A summary of progress achieved during Phase I will be included in the plan revision.

Table 76: Schedule for Implementing Twin Lakes Management Strategy

Activity	Phase I						Phase II
	2018	2019	2020	2021	2022	2023	2024-2028
EPA approval of the plan	■						
Monitoring (ongoing)	■	■	■	■	■		
Develop PIP for Watershed BMPs		■					
Organize stakeholder group		■					
Watershed BMP implementation		■	■	■	■	■	
Project evaluation						■	
Final reporting						■	
In-lake BMP feasibility study					■	■	
Update HUC8 watershed plan							■
Continue watershed BMP Implementation							■
Initiate in-lake BMP implementation							■

MILESTONES

Major milestones that pertain to monitoring, planning, and management practice implementation are provided in Table 77. Milestones will be used to gauge progress in meeting the desired project schedule. As the implementation of this plan is initiated, milestones will be adjusted accordingly to address changes in the schedule.

Table 77: Implementation Milestones for Twin Lakes

	Activity	Phase I						Phase II
		2018	2019	2020	2021	2022	2023	2024-2028
Monitoring	Coordinate with NDEQ	■	■	■	■	■		
	Finalize strategies and QAPPs		■					
	Assess data (annually)	■	■	■	■	■		
Planning	Develop PIP for BMP implementation		■					
	Apply for funding assistance grants		■					■
	Evaluate progress in meeting goals						■	
	Identify additional BMP needs						■	
	Prepare final report(s)						■	
	RFP for In-lake BMP feasibility study					■		
	Complete in-lake feasibility study						■	
	Revise watershed plan as needed							■
Information /Education	Develop stakeholder group		■					
	Work one-on-one with producers		■	■	■	■	■	
Implementation	Initiate BMP implementation		■					
	Complete Phase I BMP implementation						■	

COST

The preliminary opinion of total cost of implementing the nonpoint source pollution control strategy for Twin Lakes is estimated to be $10,552,076 (Table 78). This does not include costs for bathymetric surveys or final designs as these costs may be included through existing staff or agency budgets or would be contingent on project scoping. When possible, costs were determined from the 2018 USDA-NRCS EQIP practice payment schedule (USDA, 2018). Costs estimated for in-lake measures were based on average unit prices from a wide range of costs from other past projects and should only be used for general planning purposes. These costs are subject to change based on final design of the rehabilitation, inflation, bidding climate at the time of construction, and project size and complexity.

Table 78: Estimated Cost of Implementing Twin Lakes Management Strategy

Practice	Units	Units Targeted	Unit Cost	Total Cost
Education/Information*	years	5	$ 10,000	$ 50,000
Avoidance practices*	acres	1,372	$ 108	$ 148,176
Contour buffer strips (filter strips)	acres	3	$ 500	$ 1,500
Terraces	feet	45,578	$ 4	$ 182,312
Cover crops	acres	1,567	$ 133	$ 208,411
No-till	acres	294	$ 20	$ 5,880
Water and Sediment Control Basins (WASCOB)	feet	29,900	$ 4	$ 119,600
Wetlands	#	21	$ 35,000	$ 735,000
Riparian buffers	acres	157	$ 1,650	$ 259,050
Grazing management	acres	1,766	$ 42	$ 74,172
OWTS Inspection & Retrofits	#	16	$ 5,500	$ 88,000
Non-Permitted AFO Facility BMP	#	22	$ 20,000	$ 440,000
Grassed Waterways	acre	3	$ 6,575	$ 19,725
SubTotal (Drainage Area Treatment)				**$ 2,331,826**
Streambank/channel stabilization & Restoration	feet	37,310	$ 150	$ 5,596,500
SubTotal (In-Stream Work)				**$ 5,596,500**
Lake deepening / Sediment Removal	acre-feet	223	$ 8,000	$ 1,784,000
Shoreline stabilization	linear feet	2,725	$ 110	$ 299,750
Jetties and breakwaters	linear feet	-	$ 500	$ -
In-lake Sediment Basins	acres	15	$ 30,000	$ 450,000
Nutrient inactivation	acres	-	$ 2,200	$ -
In-lake feasibility/design study	each	1	$ 40,000	$ 40,000
SubTotal (In-Lake Work)				**$ 2,573,750**
Updates to WQMP	each	-	$ -	$ -
Additional monitoring*	years	5	$ 10,000	$ 50,000
SubTotal (Planning/Monitoring)				**$ 50,000**
Total				**$10,552,076**

**Based on estimated costs during first 5-year increment only*

10.05 LITTLE SALT CREEK TARGET AREA

INTRODUCTION

The Little Salt Creek Subwatershed is located north of the City of Lincoln, with much of the subwatershed north of I-80 (Figure 89). The headwaters begin just north of West Ashland Road, and the stream flows southeast to its confluence with Salt Creek near I-80 and 27th Street. The subwatershed drains approximately 29,312 acres. A multitude of studies and planning efforts have been conducted in the Little Salt Creek subwatershed, particularly in respect to the Eastern Saline Wetlands located there. Most of this work was either associated with, or is included in, three primary planning documents: *Little Salt Creek Watershed Master Plan* (Intuition Logic, 2009), *Implementation Plan for the Conservation of Nebraska's Eastern Saline Wetlands* (LaGrange and others, 2003), and *Upper Little Salt Creek Saline Wetlands Plan* (Flatwater, 2015b). These plans address water quality concerns in Little Salt Creek and include identification of priority activities to restore and protect the Eastern Saline Wetlands and their unique biology. This WQMP will serve to facilitate a comprehensive implementation of the priority projects found in those documents. The improvement and protection of wetlands throughout this drainage area will require a holistic management approach. BMP implementation will take place in targeted locations across the subwatershed as well as specific projects within the saline wetland properties.

NOTE TO READERS

Information in this section is summarized from the pollutant modeling files and from the *Bacteria Load Estimate Report* (WWE, 2018), a copy of which is also provided in Appendix XX. Unless otherwise noted, additional details and background information can be found in that comprehensive document.

Little Salt Creek (LP2-20300) is protected for the following beneficial uses: aquatic life, aesthetics, and agricultural water supplies (NDEQ, 2014). The aquatic life use is currently impaired from selenium, copper, and ammonia and aquatic community assessments also indicate impairment. Additionally, NDEQ has indicated that addressing *E. coli* within this subwatershed is a priority. While Little Salt Creek is not assessed for primary contact recreation or identified as impaired due to *E. coli*, NDEQ did provided *E. coli* loading goals in the 5-alt assessment (NDEQ, 2017b). There are no point source discharges in the Little Salt Creek drainage. This plan has not been designed to address heavy metal or ammonia impairments to Little Salt Creek. This plan is focused on the restoration and protection of the Eastern Saline Wetlands, which are impacted by sedimentation; and the reduction of *E. coli* bacteria loads.

The Eastern Saline Wetlands are assigned the following beneficial uses: aquatic life, agricultural water supply, and aesthetics (NDEQ, 2014). These wetlands are a unique resource and support rare species, including: saltmarsh aster, Texas dropseed, saltwort, and the Salt Creek tiger beetle. The *Strategic Plan and Guidance for Implementing the Nebraska Nonpoint Source Management*

Program – 2015 through 2030 identifies the Eastern Saline Wetlands as a priority for both restoration and protection actions (NDEQ, 2015c).

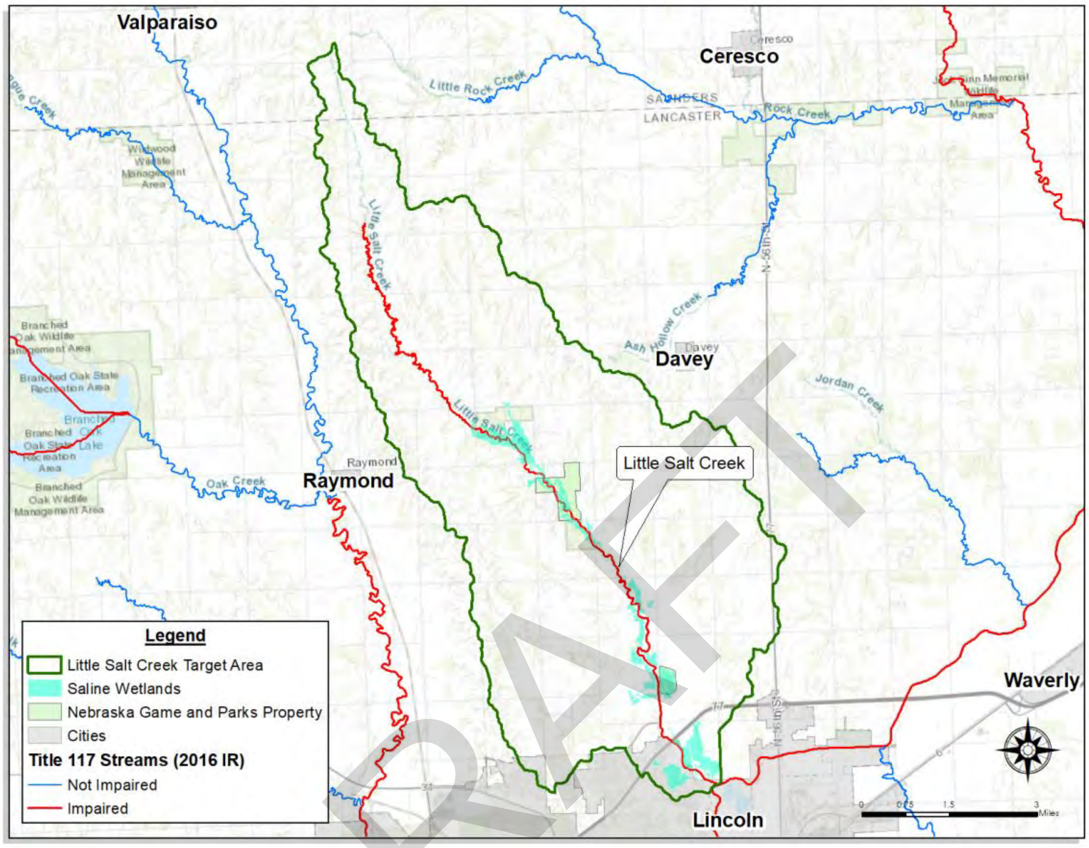


Figure 89: Location of the Little Salt Creek Subwatershed and Saline Wetlands

Little Salt Creek Watershed Master Plan

The City of Lincoln (City) and the Lower Platte South Natural Resources District (LPSNRD) are in the process of developing a watershed master plans for HUC 12 subwatersheds within the City and its future growth areas. Since the early 2000's, plans for watershed management have been written singularly. Watershed master plans are planning tools and should be used in conjunction with proposed development and as a guide in the preparation of future capital improvement projects. The *Little Salt Creek Watershed Master Plan* was completed in 2009 (Intuition Logic, 2009). The Master Plan outlines long-term planning tools and improvement projects to address water quality, flood management, and stream stability for development in or near the watershed. The Master Plan also includes a discussion of potential impacts to sensitive natural resources, including the saline wetlands and the federally listed endangered species Salt Creek Tiger Beetle.

Implementation Plan for the Conservation of Nebraska's Eastern Saline Wetlands

The *Implementation Plan for the Conservation of Nebraska's Eastern Saline Wetlands* was completed by the Saline Wetlands Conservation Partnership (SWCP) in 2003 (LaGrange and others, 2003). The SWCP includes the City of Lincoln, Lower Platte South Natural Resources District, Nebraska Game and Parks Commission, and the Nebraska Chapter of Pheasants Forever, Inc. The plan is a holistic watershed approach designed to preserve both wetlands and their surrounding watersheds. The plan's implementation involves local, state, and federal agencies working in tandem with private individuals and organizations to develop additional strategies and programs that encourage saline wetland conservation. The plan established restoration targets for the conservation of about 4,000 acres of saline wetlands using comprehensive strategies that address:

- Natural Resource Management
- Wetland Protection
- Stream Restoration
- Wetland Buffer Management and Development
- Research
- Private Lands

Upper Little Salt Creek Saline Wetlands Plan

The SWCP recently finished a more detailed planning project titled the *Upper Little Salt Creek Saline Wetlands Plan* (Flatwater, 2015b). This plan focused future efforts on the wetland properties owned and managed by the SWCP in the upper portion of the Little Salt Creek subwatershed and their contributing drainage areas. The planning boundary was divided into three groups: saline wetland preservation and rehabilitation area; buffer area; and the watershed protection area. Based on the results of the analysis and planning process, various improvement projects utilizing BMPs were identified for each property. Following completion of this plan, conceptual designs for the Norder Tract property were developed with additional details on the BMPs and costs of each (Flatwater, 2015a).

IMPAIRMENTS

Easter Saline Wetlands - Sedimentation

Early inventory and assessment work documented impacts and threats to the Eastern Saline Wetlands including: wetland losses from the City of Lincoln expansion and agricultural activities; draining and filling; sedimentation; stream-bed degradation; and water quality (LaGrange and others, 2003). Nonpoint source impacts to the Eastern Saline Wetlands are addressed in Title 117, Subsection 004.01B1: "Any human activity causing water pollution which would cause a significant adverse impact to an identified "key species" is a violation of these Standards." Key aquatic species are defined as those that are threatened or endangered. For the Eastern Saline Wetlands those include Saltwort (*Salicornia rubra*) and the Salt Creek Tiger Beetle (*Cincindela* *nevadica lincolniana*) (NDEQ, 2014). For the purposes of the WQMP, the focus is on the impacts sedimentation has on the saline wetlands.

Little Salt Creek – *E. Coli* bacteria

Within the stream, the aquatic life use is currently impaired due to selenium, copper, and ammonia. Aquatic community assessments also indicate impairment to the aquatic life use. As discussed in Chapter XX, these pollutants are not addressed in this WQMP; however NDEQ has indicated that addressing *E. coli* within this subwatershed is a priority. While Little Salt Creek is not assessed for primary contact recreation or identified as impaired due to *E. coli*, NDEQ did provided *E. coli* loading goals in the 5-alt assessment (NDEQ, 2017b). Therefore, for the purposes of the WQMP, we also focus on *E. coli* bacteria.

POLLUTANT SOURCES AND LOADS

While the main threat to the Eastern Saline Wetlands is from sediment, sediment-associated nutrients (phosphorus and nitrogen) can also cause issues. Therefore, identifying sources and loads of these pollutants are also included in this plan. Current pollutant sources and loads for sediment and nutrients were estimated using the STEPL model (TetraTech, 2007) and *E. coli* bacteria sources and loads utilized a spreadsheet model. Additional details such as a summary of data, data sources, and methods can be found in the modeling/implementation reports in Appendix XX.

Nutrients and Sediment

The average annual phosphorus load carried by Little Salt Creek is estimated to be 35,878 lbs/yr. The largest contributor of phosphorus to Little Salt Creek is from land used for corn and soybean production, which constitutes 48% of the total load (Figure 90). The average annual nitrogen load carried by Little Salt Creek is 146,285 lbs/yr. The largest contributor of nitrogen to Little Salt Creek is also from land used for corn and soybean production, which constitutes 47% of the total load (Figure 91). The average annual sediment load carried by Little Salt Creek is estimated to be 18,965 t/yr. The largest contributor of sediment is from land used for corn and soybean production, which constitutes 49% of the total load (Figure 92). Streambank erosion contributes a significant amount of phosphorus (31%) and sediment (35%) to Little Salt Creek.

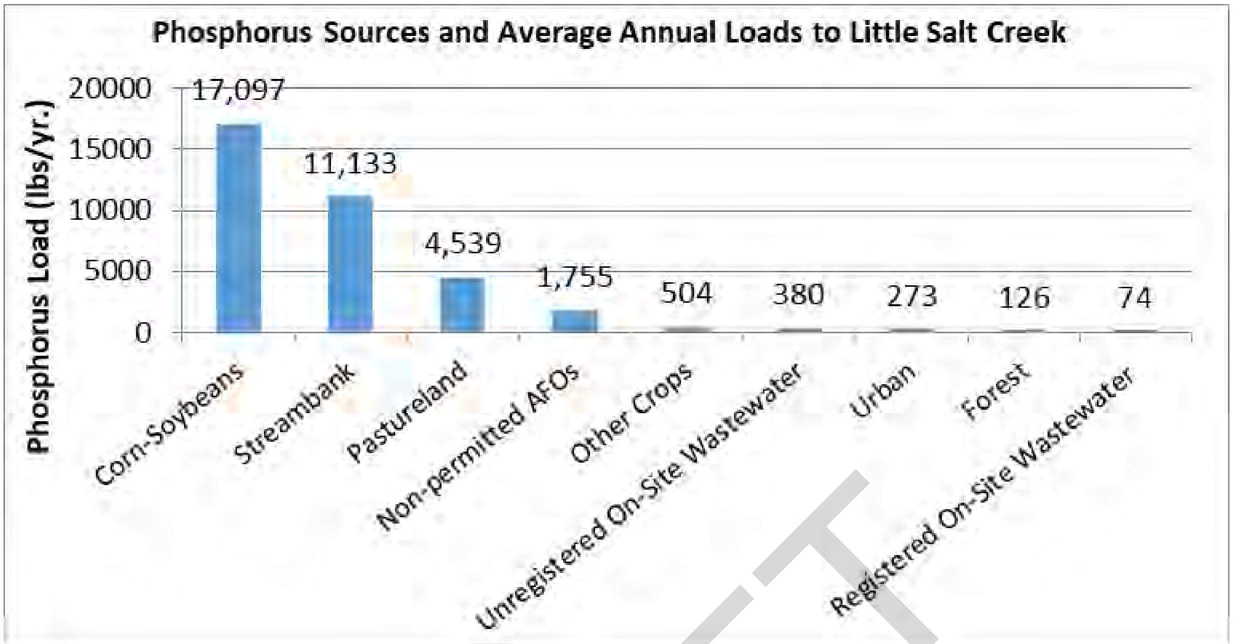


Figure 90: Phosphorus Sources and Annual Average Loads to Little Salt Creek

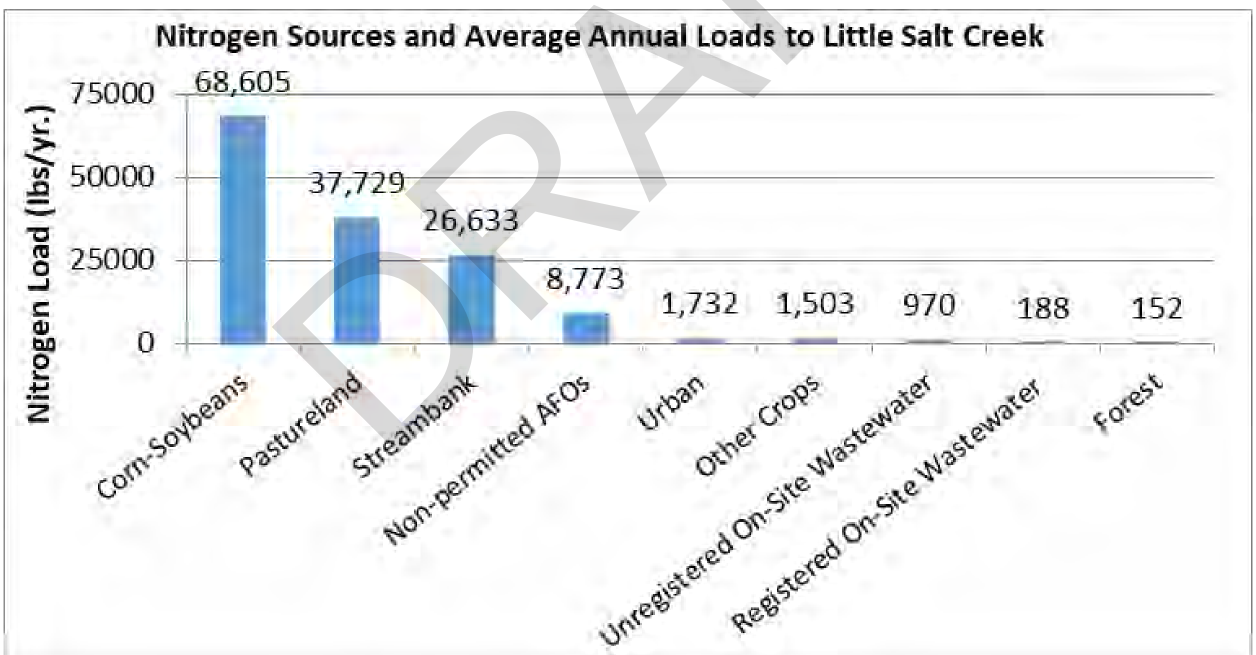


Figure 91: Nitrogen Sources and Annual Average Loads to Little Salt Creek

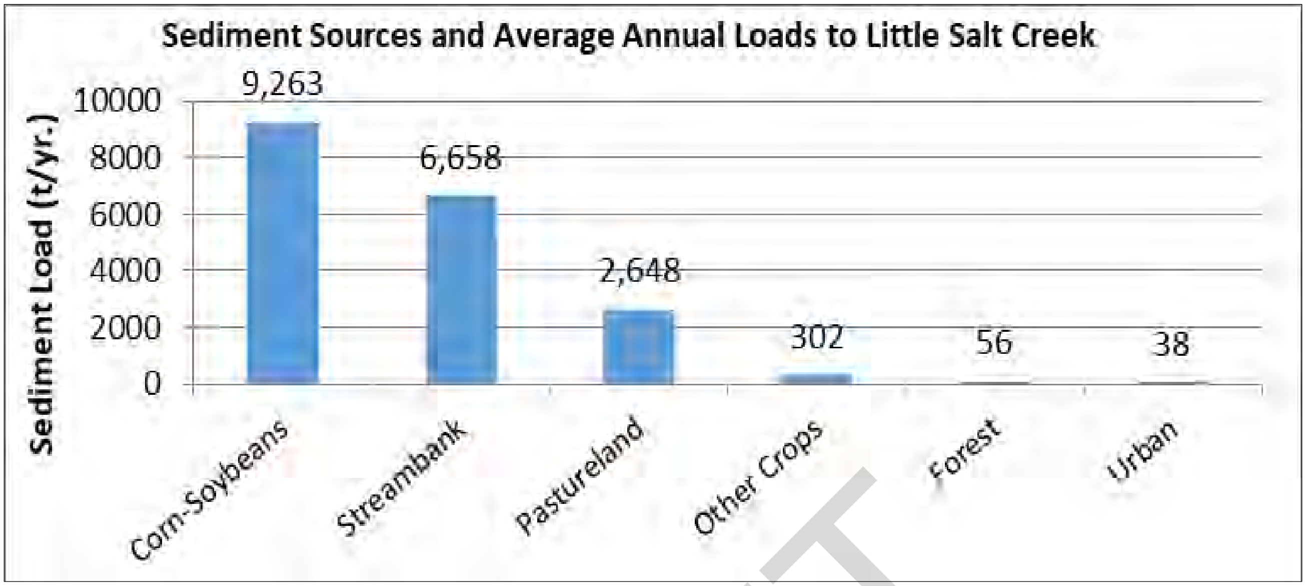


Figure 92: Sediment Sources and Annual Average Loads to Little Salt Creek

E. coli Bacteria

The average annual *E. coli* load carried by Little Salt Creek is estimated to be 318,249 billion colony forming units (cfu)/100mL. The largest contributors of bacteria to Little Salt Creek are from developed landuse (61%) and pasture ground (26%). Readers should note that the majority of urban landuses in this subwatershed include a small portion of the City of Lincoln, numerous acreages and farmsteads, and streets and roads.

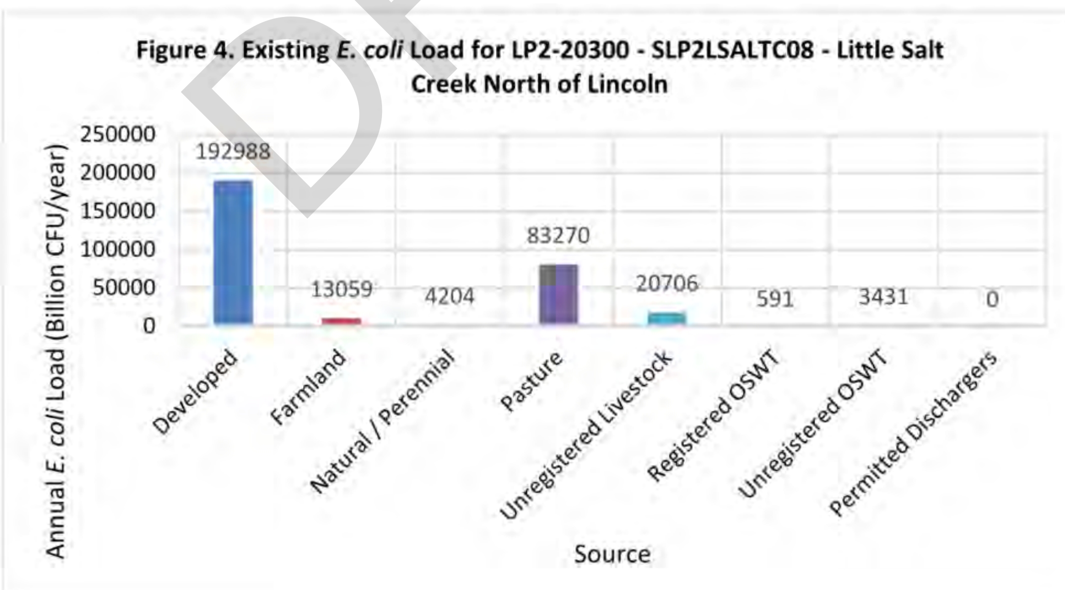


Figure 93: *E. coli* Bacteria Sources and Loads to Little Salt Creek

REQUIRED POLLUTANT LOAD REDUCTIONS

The Eastern Saline Wetlands have not exhibited numerical violations to water quality standards; therefore, pollutant load reduction targets for sediment and nutrients were not determined.

Required *E. coli* load reductions were based on 5-alt assessment data (NDEQ, 2017b) which identified a 62% reduction from 293 cfu/100mL to 111 cfu/100mL. This goal is below the water quality standard of 116 cfu/100mL to account for a margin of safety (Table 79).

Table 79: *E. coli* Pollutant Load Reduction Goals for Little Salt Creek

Stream Segment	Seasonal Geometric Mean (#/100mL)	*E.coli* Above Water Quality Standard (#/100mL)	Reductions needed to meet Water Quality Standards	Expected Geometric Mean with the Margin of Safety (#/100mL)
LP2-20300	293	167	62%	111

Source: NDEQ, 2017b

IMPLEMENTATION STRATEGY

The implementation strategy for the Little Salt Creek subwatershed includes multiple practices which target pollutant sources through the ACT approach, also known as a “treatment train”. All nonpoint source pollutant sources are addressed. It is assumed that AFOs and OWTSs are meeting all legal requirements; however, they are also possible sources of pollutant loads. In all cases, only willing landowners will be included in this voluntary implementation strategy. The identification of BMPs was identified through multiple sources:

- **ACPF tool** – The ACPF tool was used to identify the best suited locations for various BMPs throughout the subwatershed.
- **Aerial analysis** –Additional opportunities for BMPs were found through analysis of aerial photography to identify nonpermitted AFOs and rural residences that may have unregistered OWTSs.
- **Review of existing SWCP planning documents** – the continuation of specific projects identified by the SWCP will be beneficial to holistically improving water quality within the target area.

The implementation strategy presented in this plan should be used as a guide for BMP implementation and may be subject to revision as new information becomes available and willing landowners are identified. Although avoidance practices are not part of the ACPF, they are an important part of this strategy. For additional details about the BMPs identified, please refer to Chapter XX, Appendix XX, or the referenced planning documents previously discussed.

A VOLUNTARY PLAN

The implementation of this plan is based entirely on the voluntary actions of landowners and citizens. Individuals must decide if it is an advantage to participate, and it is the responsibility of the LPSNRD and other stakeholders to find ways to make participation advantageous.

To provide an accurate load reduction estimate from implementation efforts, recommended practices were used to develop a “treatment train” that follows the movement of pollutants from the source to the receiving waterbody (Figure 94). The drainage area’s treatment train comprises six levels of treatment, beginning with education/outreach and avoidance practices and ending with near stream improvements (i.e. riparian buffers).

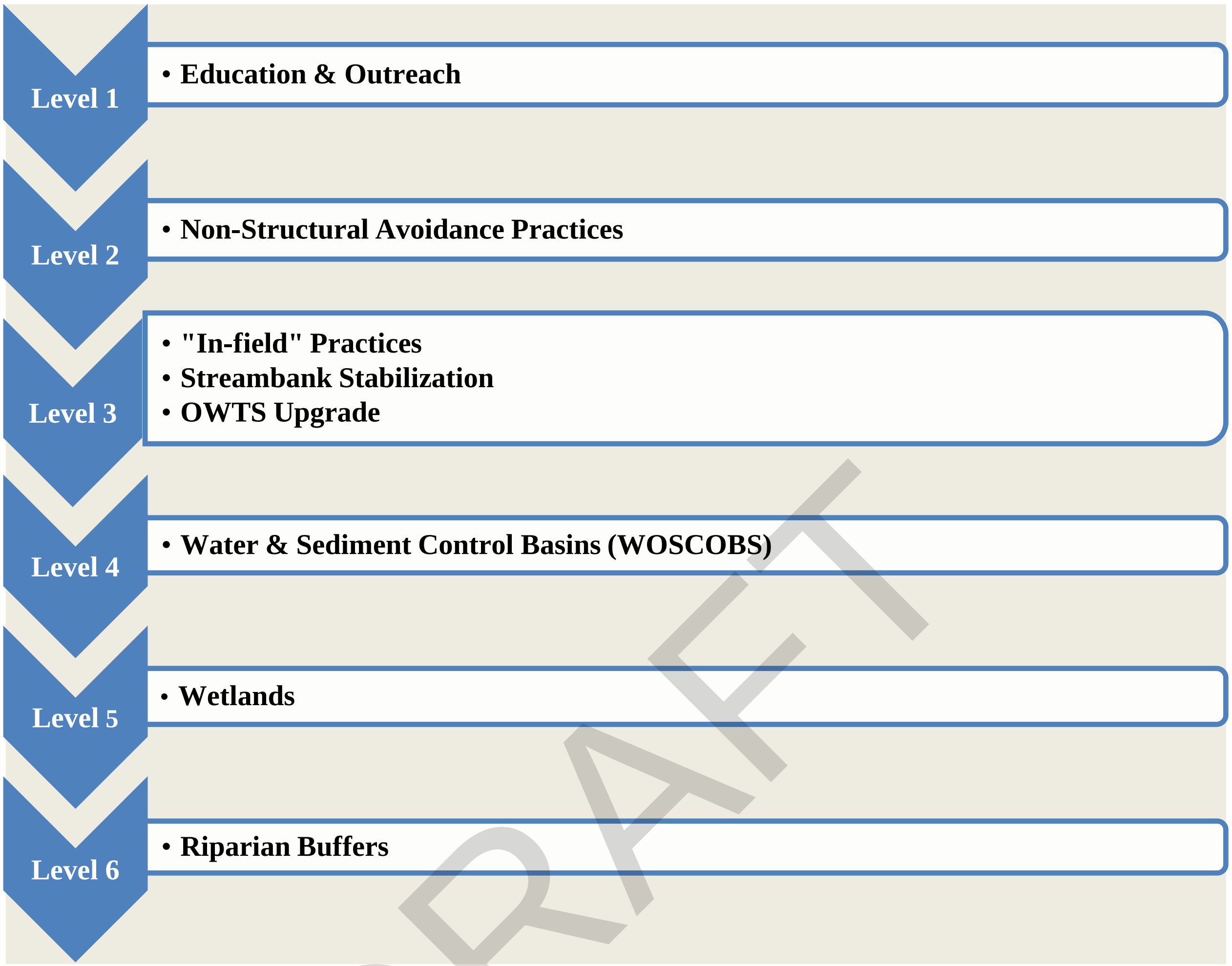


Figure 94: Implementation of Priority BMPs through a "Treatment Train" Approach

BMP TARGETING

Subwatershed BMP Recommendations

BMPs for the Little Salt Creek subwatershed were identified to supplement the targeted projects listed in the *Little Salt Creek Watershed Master Plan* (Intuition Logic, 2009) and the SWCP documents. These practices are targeted at reducing erosion and sediment deposition in the Eastern Saline Wetlands, as well as reducing *E. coli* loads to Little Salt Creek. By implementing these practices in the subwatershed, effectiveness of downstream projects and BMPs will be increased. A suite of structural and non-structural management practices were selected based on stakeholder input and the results of technical analysis. Additionally, education/outreach and avoidance practices were added to the suite of recommendations (provide an overview of locations where BMPs could potentially be placed. While the locations identified in these maps are not finalized locations, they provide a starting point for discussion with willing landowners and assisted in the development of this plan. Detailed map books can be found in Appendix XX.

Table 80). Land used for corn and soybean production is targeted for the largest number of practices, but all pollutant sources are targeted by at least one BMP practice. Figure 95 and Figure 96 provide an overview of locations where BMPs could potentially be placed. While the locations identified in these maps are not finalized locations, they provide a starting point for discussion with willing landowners and assisted in the development of this plan. Detailed map books can be found in Appendix XX.

Table 80: Priority BMPs and Targeted Pollutant Sources for the Little Salt Creek Subwatershed

Land Cover Type/ Pollutant Sources	Current Acres	BMP	Acres Targeted
All	29,023	Education & Outreach	29,023
Corn-Bean	12,830	Avoidance	8,981
		Terraces - cover crops - no till	460
		Contour buffer - cover crop - no till	1,465
		Cover crops-contour buffer	3,037
		Cover crops	5,302
		WASCOBS	2,169
		Wetlands	5,461
		Riparian buffers	2,208
Non-permitted AFOs	55	Avoidance	39
		WASCOBS	55
Pasture	12,710	Grazing management	6,355

		WASCOBS	988
		Wetlands	4,430
Other Crops	967	WASCOBS	149
		Wetlands	908
Forest	1,784	WASCOBS	298
		Wetlands	295
Urban	677	Wetlands	228
OWT Systems	199	Unregistered system upgrade (#)	27

Note: Grassed waterways, and conceptual locations, were also identified as a priority BMP, however they were represented/ grouped with wetlands in the water quality modeling, due to technical limitations.

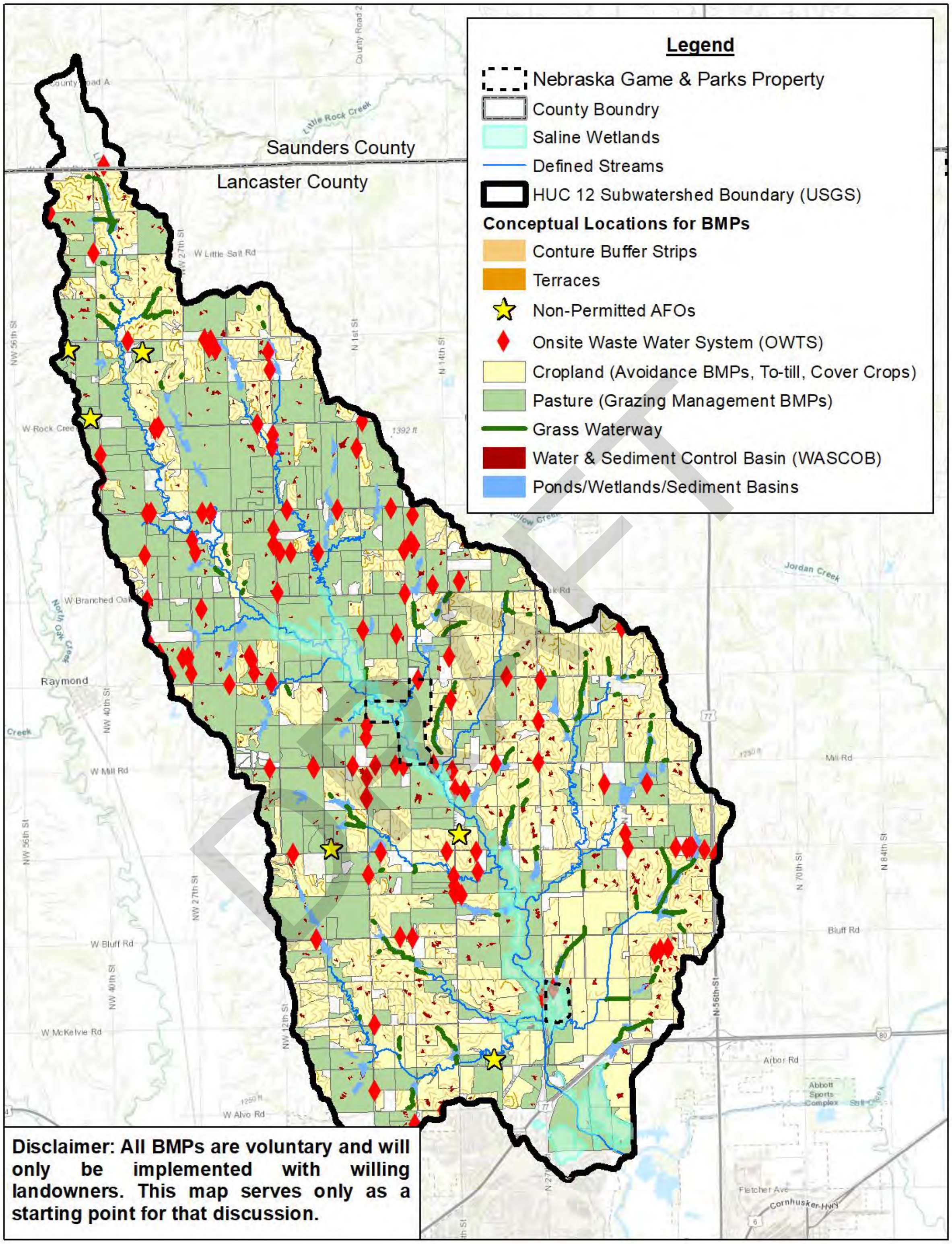


Figure 95: Conceptual location of in-field and edge-of-field BMPs

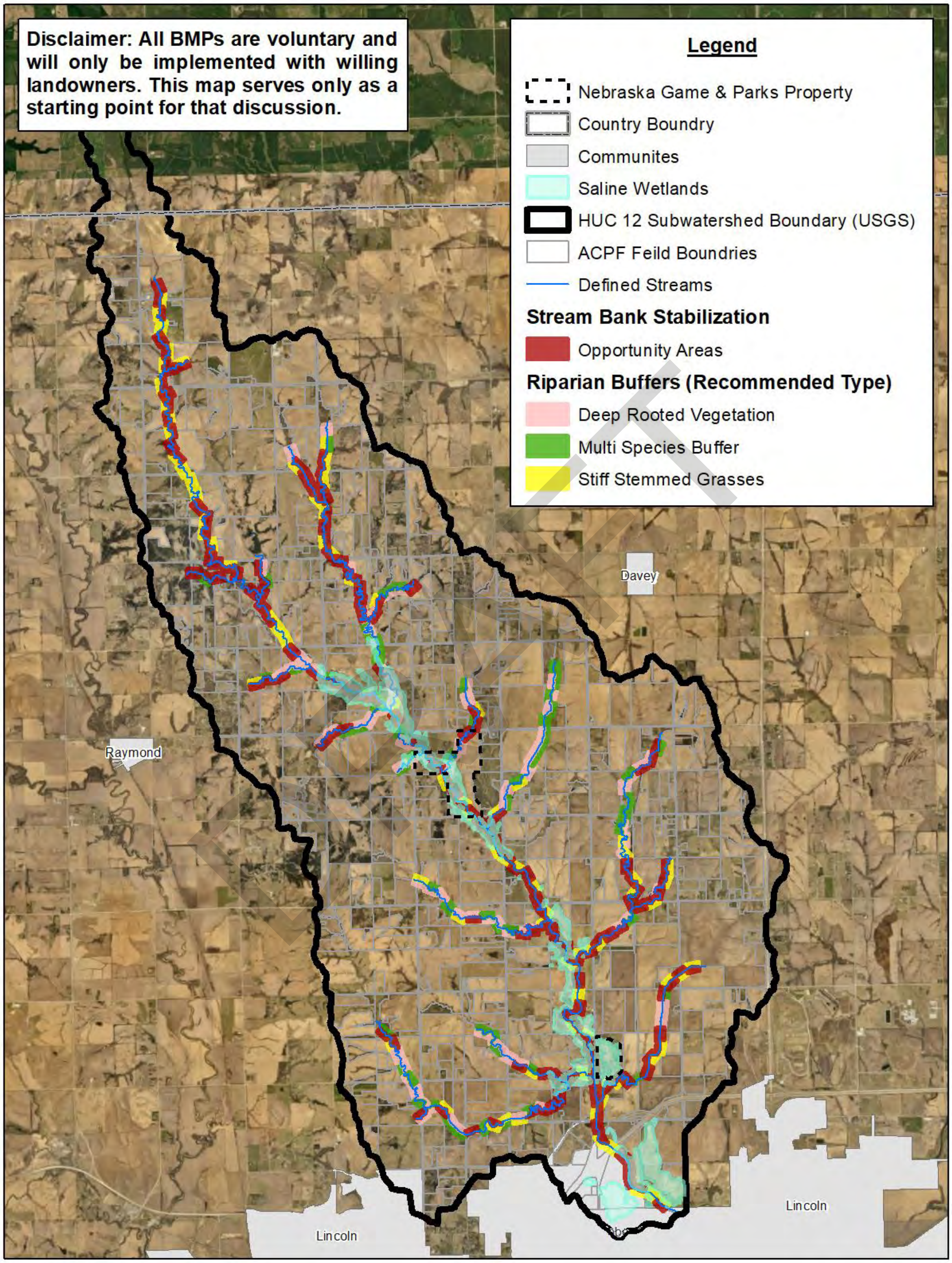
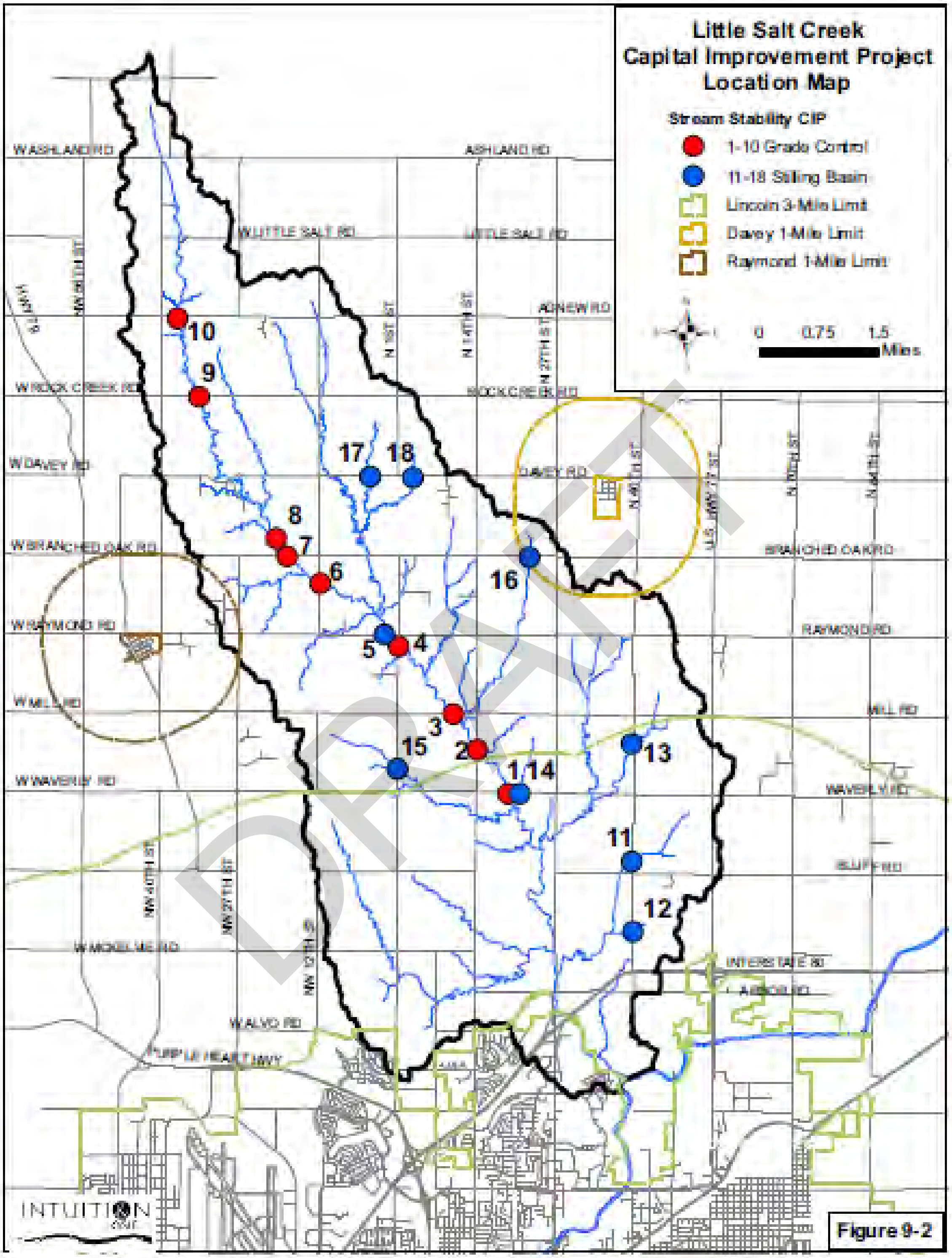


Figure 96: Conceptual locations of in-stream and riparian BMPs

Grade Stabilization on Little Salt Creek

Sediment released from incision and subsequent bank failures along Little Salt Creek negatively impact in-stream aquatic habitat and downstream wetlands. A total of ten priority grade stabilization projects were identified in the *Little Salt Creek Watershed Master Plan* (Intuition Logic, 2009). These grade control practices are targeted at bridge crossings along the main stem of Little Salt Creek to stop incision at these locations (*Source: Intuition Logic, 2009*

Figure 97). The grade controls will eliminate incision at each bridge and substantially limit the propagation and depth of incision between each structure. Each structure could be constructed with a combination of rock, sheet pile, and/or natural materials such as locked logs and root wads. Grade control structures made of natural materials and shaped to mimic natural stream structures offer additional water quality and ecological benefits compared to sheetpile weirs. Locations and site conditions will determine final designs. Additional details and descriptions for each of the sites can be found in the *Little Salt Creek Watershed Master Plan*.



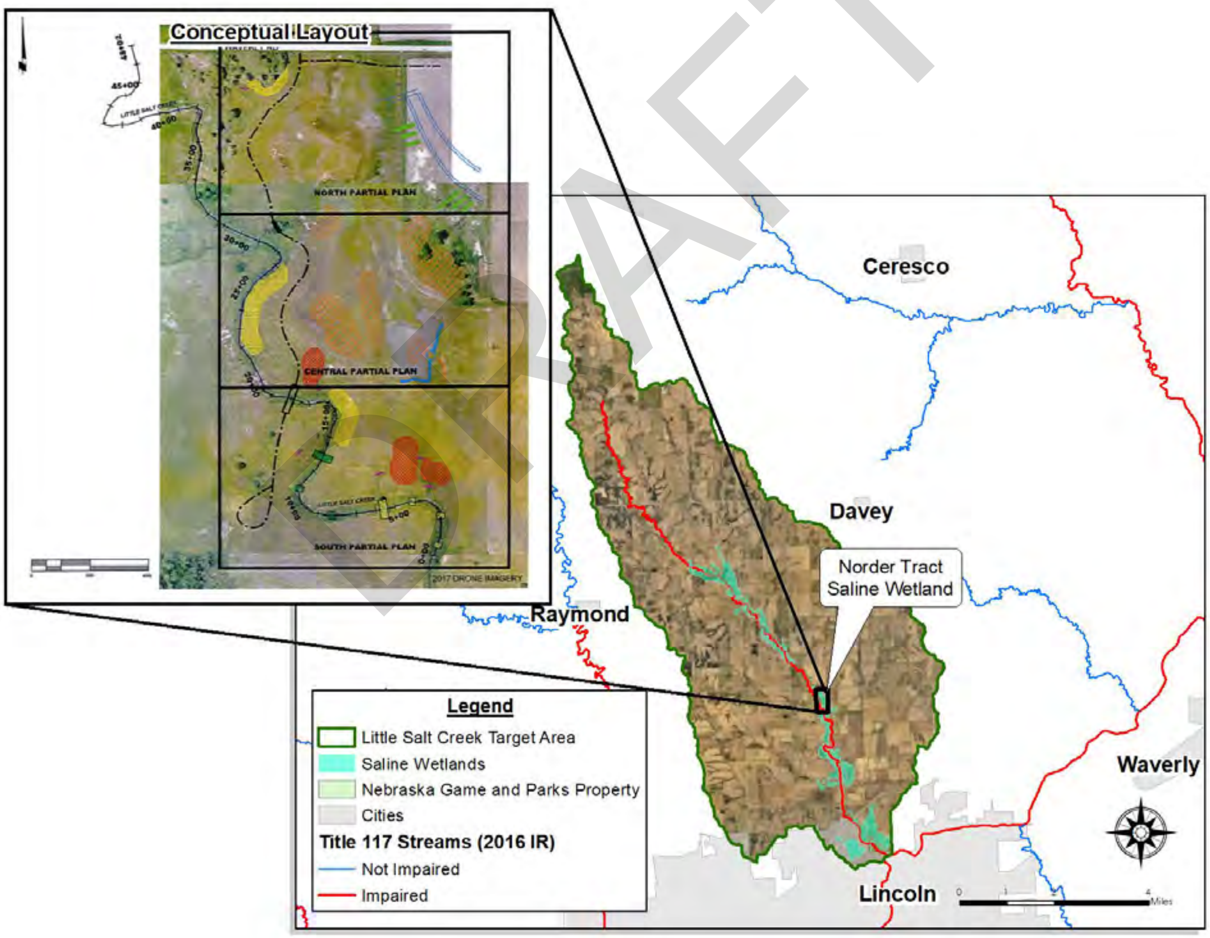
Source: Intuition Logic, 2009

Figure 97: Location of Priority In-stream BMPs on Little Salt Creek

Norder Wetland Restoration

The City of Lincoln's Norder Tract Wetland is located within the Little Salt Creek Subwatershed and has been identified as a priority for restoration by the SWCP. This is a unique 79-acre property purchased by the City in 2014 and contains a diverse landscape of saline wetlands, salt flats, stream channel, open water, freshwater wetland, and grassland area habitats (Flatwater, 2018).

Recently, as a supplement to the *Upper Little Salt Creek Saline Wetlands Plan,* a conceptual restoration design memo was developed which identified BMPs on the Norder Tract Wetland to restore the function of the wetland. The BMPs were identified and categorized into three priority groups: grade control, aquatic habitat improvement, and public access/education. An overview of these BMPs is shown in Figure 98. Many of these BMPs address water quality and/or public education priorities identified in this WQMP and are thus included in the implementation approach for the Little Salt Creek Target Area. Additional details on each can be found in the *Norder Wetland Restoration Design Memorandum* (Flatwater, 2018).



Source: Flatwater, 2018.

Figure 98: BMP Concepts for the Norder Wetland Restoration

CRITICAL SOURCE AREAS

Critical Source Areas (CSA) are a relatively small fraction of a watershed that generates a disproportionate amount of pollutant load (Meals, 2012). As discussed in Chapter XX, CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism. Identifying CSAs allows for the prioritization of fields where BMPs are likely most needed and allows for financial and technical resources to be used most efficiently.

CSAs in the Twin Lakes Target Area were identified using the field runoff risk assessment in the ACPF Toolbox. This assessment provides a relative risk rating (not an absolute risk rating) and is based on a cross-reference of two factors:

- Slope steepness – Steeper fields have a higher risk of generating runoff
- Distance to stream – The closer a field is to a waterbody, the higher the risk a pollutant will be delivered to waterbody

Once the assessment is complete, each field receives a relative classification, ranging from A (highest risk – most critical), to B (very high), C (high), and other ('present'). One limitation of this tool is that only agriculture landuses (cropland or pasture land) are included. These other land uses (typically rural residences or other natural areas) are identified as "unknown" in the assessment. "Unknown" areas may still have an elevated runoff risk (especially for pollutants such as manure application or failing OWTS's). A "present" or "unknown" classification does not mean that a BMP would not provide benefits to a given field, but rather indicates that other fields have a greater potential to deliver pollutants to a waterbody via surface runoff. In future updates to this plan, an assessment of all fields for runoff risk is recommended.

For the purposes of this plan, areas identified as A or B through the runoff risk assessment, have been identified as CSAs. In the Little Salt Creek Target Area (Figure 99), there is a total of 5,803 acres of CSAs (approximately 20% of the Target Area), which are broken down as follows:

- Highest Risk CSA: 1,855 acres
- Very High Risk CSA: 3,948 acres

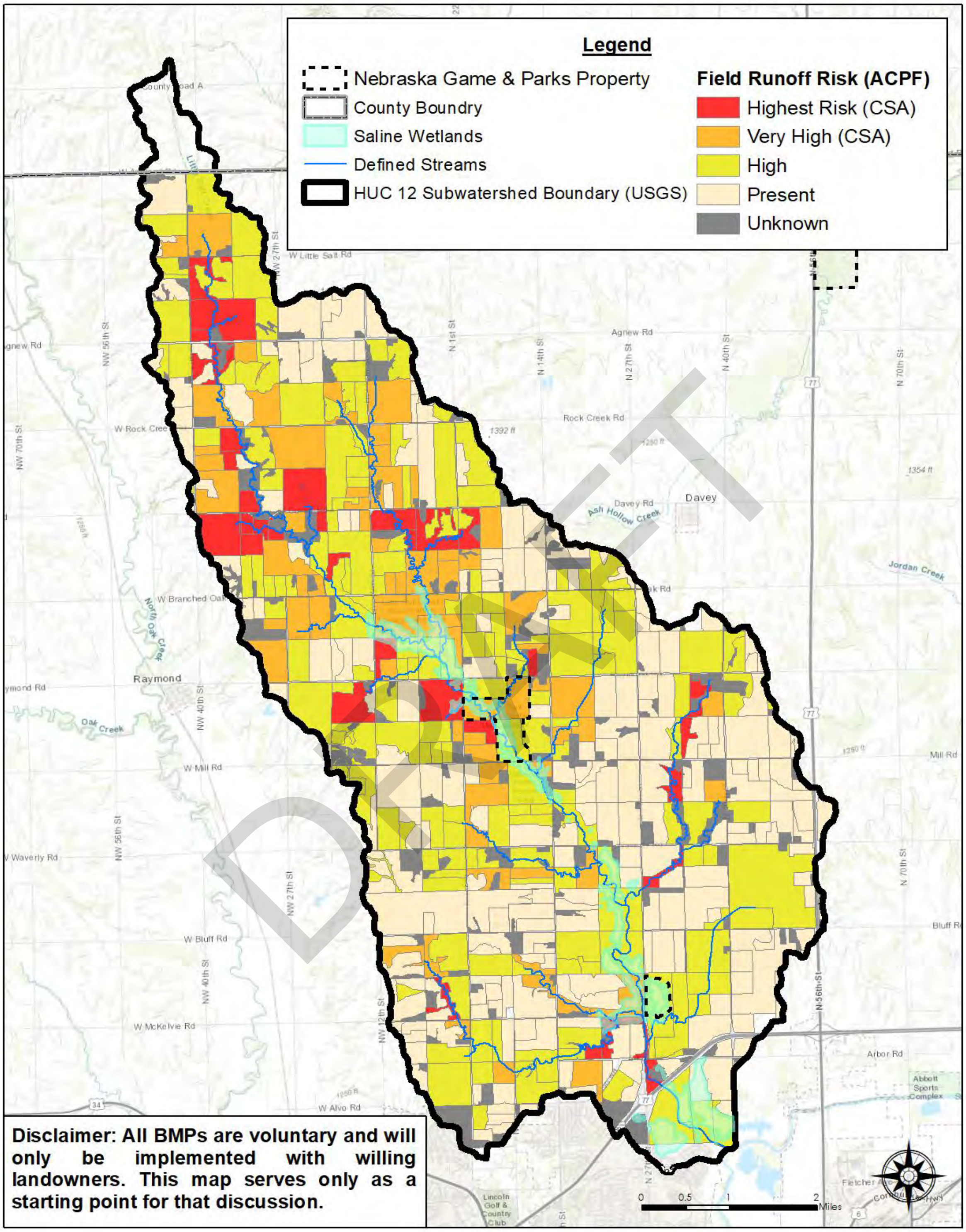


Figure 99: Critical Source Areas at Little Salt Creek as identified with the ACPF Tool

MEETING WATER QUALITY STANDARDS

The Eastern Saline Wetlands are assessed under narrative water quality standards under Nebraska WQS, thus numerical concentration and load reduction targets were not identified. Average annual load reductions associated with subwatershed area BMP implementation were estimated for *E. coli* bacteria, sediment, phosphorus, and nitrogen (Table 81). Sediment, the primary pollutant of concern, would be reduced by approximately 55%. While the focus of this plan is not on ammonia violations in Little Salt Creek, the reduction in annual total nitrogen load (66%) would also reduce ammonia concentrations. While Little Salt Creek is not designated for Primary Contact Recreation, a 68% reduction to the *E. coli* bacteria load will benefit downstream segments of Salt Creek that are impaired due to bacteria. Additionally, by reducing the *E. coli* load, Little Salt Creek will meet its pollutant load reduction goal for an in-stream concentration (111 cfu/100mL) (Table 82).

Table 81: Estimated Pollutant Load Reductions due to BMP Implementation in the Little Salt Creek Subwatershed

	E. coli (cfu/100mL)	Sediment (t/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)
Beginning load	329,000	18,965	35,878	146,285
BMP Load Reductions	224,000	10,384	21,583	86,918
Expected conditions	105,000	8,581	14,295	59,367
BMP Load Reductions (%)	68%	55%	60%	59%

Table 82: Estimated In-stream *E. coli* Concentration After BMP Implementation

Stream Segment	Existing Seasonal Geometric Mean (#/100mL)	Water Quality Target (#/100mL)	Expected post-implementation Seasonal Geometric Mean (#/100mL)
LP2-20300	293	111	94

MONITORING AND EVALUATION

The LPSNRD will follow the established protocol and procedures to: develop sound, defensible monitoring strategies and networks; properly manage data; and disseminate information to decision makers and other stakeholders. Monitoring goals can only be achieved through partnerships with other resource agencies such as NDEQ, NGPC, and the City of Lincoln. Steps will be taken to ensure collection of scientifically valid data, which may include the development of Quality Assurance Project Plans (QAPP) for state and federal review. Additional guidance and references are located in Chapter XX.

To adequately design monitoring networks that facilitate water resource management, it is critical to use data for its intended purposes. Thus, it is necessary to establish specific monitoring goals and objectives. A set of monitoring goals and objectives has been developed for the Little Salt Creek Subwatershed. Targeted parameters, monitoring sites, and monitoring frequency have been defined to meet each objective. Monitoring goals and objectives provided below in *italics* may require expanded or new monitoring efforts, whereas objectives and parameters in plain text are currently being addressed.

Monitoring Goal 1: Evaluate the water quality condition of Little Salt Creek.

- Evaluate beneficial use support and water quality trends for Little Salt Creek.
- Monitoring Parameters: heavy metals, pesticides, nutrients, *E. coli,* and field measurements
- Monitoring Frequency: (Annual) Weekly Monthly January-September
- Monitoring Site: Little Salt Creek North of Lincoln, NE (SLP2LSALTC08)

Monitoring Goal 2: Continue existing hydrology monitoring programs in place

Monitoring Goal 3: Evaluate effectiveness of existing BMPs on SWCP properties

- *Monitor changes in composition of salt tolerant species vegetation and/or soil salinity over time*
- *Monitor changes in vegetative communities over time*

COMMUNICATION AND OUTREACH

Chapter 6 of this plan provides a broad programmatic approach that the LPSNRD and its partners will take to address nonpoint source pollution through communication and outreach activities. Specifically, within a target area there are certain pieces of information necessary for successful communication and outreach efforts, which will in turn support the implementation of BMPs. Those items specific to the Little Salt Creek Target Area were identified via stakeholder and public input, and are as follows:

- Identified Target Audiences
  - Recreational water users of public lands along Little Salt Creek
  - Pheasants Forever – Cornhusker Chapter
  - Land managers, residents, and property owners within the Little Salt Creek Subwatershed
  - Producers with existing BMPs who may be interested in implementing more
  - Rural homeowners on private wells and septic systems
  - SWCP member organizations
- Methods
  - Utilize parcel ownership information, along with the detailed BMP location maps created with the ACPF Tool, to contact specific landowners about BMPs applicable to their properties
    - A postcard mass mailing followed up by phone calls will help start initial implementation efforts and/or increase attendance at public meetings
  - Utilize the existing knowledge and awareness around the Salt Creek Wetlands to build a message around improving watershed conditions
  - Develop signage to be used at project demonstration sites, key watershed entrances or landmarks, and other highly visible areas
  - Utilize the existing publicly owned lands for the following:
    - Post flyers, distribute press releases, and advertise at local events
    - Hold targeted coffee shop meetings, tailgate sessions, and other informal/casual informational exchanges to build relationships and to learn more about the constraints and hurdles to BMP adoption
  - Hold an "Wine and Conservation" at, or in tandem with, local wineries (James Arthur Vineyards, Windcrest, etc) to focus on water quality and agricultural BMPs
  - Piggy back on existing events - Training and demonstration field days, information booths, recognition picnics, etc.
    - The communities of Raymond, Davey, and Ceresco could all be targeted
  - Hold an outdoor recreation clinic (hiking, birdwatching, etc.) on public lands

Plan and project sponsors will utilize these target audiences and outreach methods when building project level communication and outreach plans, typically as part of a Project Implementation Plan (PIP). The PIP will identify the specific and tailored actions for each target audience, as discussed in Chapter 6.

SCHEDULE

A timeframe for implementing general actions is provided in Actions are subject to approval by the LPSNRD Board of Directors, USACE, and NGPC, and may change as the plan is implemented. Phase I activities will include the initiation of drainage area BMPs, completion of the Norder Wetland Restoration, and completion of grade stabilization projects on Little Salt Creek. Phase II will begin upon the five-year revision of this plan and will include any implementation that was not completed in Phase I. A summary of progress achieved during Phase I will be included in the plan revision.

Table 83. Actions are subject to approval by the LPSNRD Board of Directors, USACE, and NGPC, and may change as the plan is implemented. Phase I activities will include the initiation of drainage area BMPs, completion of the Norder Wetland Restoration, and completion of grade stabilization projects on Little Salt Creek. Phase II will begin upon the five-year revision of this plan and will include any implementation that was not completed in Phase I. A summary of progress achieved during Phase I will be included in the plan revision.

Table 83: Schedule for Implementation within the Little Salt Creek Subwatershed

Activity	Phase I						Phase II
	2018	2019	2020	2021	2022	2023	2024-2028
EPA approval of the plan							
Monitoring (ongoing)							
Organize stakeholder groups							
Drainage area BMP Implementation							
Norder Wetland Restoration							
Grade Stabilization Implementation							
Project evaluation							
Final reporting							
Update HUC8 subbasin plan							
Continue implementation as needed							

MILESTONES

Major milestones that pertain to monitoring, planning, and management practice implementation are provided in Table 84. These milestones will be used to gauge progress in meeting the desired project schedule. As the implementation of this plan is initiated milestones will be adjusted accordingly to for changes to the schedule.

Table 84: Milestones for Implementation within the Little Salt Creek Subwatershed

Activity		Phase I						Phase II
		2018	2019	2020	2021	2022	2023	2024-2028
Monitoring	Coordinate with NDEQ	■	■	■	■	■		
	Finalize strategies and QAPPs		■					
	Assess data (annually)	■	■	■	■	■		
Planning	Drainage area BMP PIP		■		■			
	Funding Assistance		■		■			
	Norder Wetland Restoration Final Engineering			■	■			
	Grade Stabilization – Final Engineering			■	■			
	Norder/Grade Stabilization PIP				■			
	Apply for funding assistance grants				■			■
	Evaluate progress in meeting goals						■	
	Identify additional BMP needs						■	
	Prepare final report(s)						■	
	Revise WQMP plan as needed							■
Information/ Education	Develop stakeholder group		■					
	Work one-on-one with producers		■	■	■	■	■	
Implementation	Drainage Area BMPs		■	■	■	■	■	
	Norder Wetland Restoration					■	■	
	Grade Stabilization					■	■	

COST

Chapter 7: The preliminary opinion of total cost of implementing the nonpoint source pollution control strategy for the Little Salt Creek Target Area is estimated to be $51,393,947 (Table 85). This does not include costs for final designs of engineering projects as these costs would be contingent on project scoping. When possible, costs were determined from the 2018 USDA-NRCS EQIP practice payment schedule (USDA, 2018). These costs are subject to change based on final designs, inflation, bidding climate at the time of construction, and project size and complexity.

Table 85: Implementation costs for the Little Salt Creek Subwatershed

Practice	Units	Units Targeted	Unit Cost	Total Cost
Education/Information*	years	5	$ 10,000	$ 50,000
Avoidance practices*	acres	9,020	$ 108	$ 974,160
Contour buffer strips (filter strips)	acres	450	$ 500	$ 225,000
Terraces	feet	133,485	$ 4	$ 533,940
Cover crops	acres	10,264	$ 133	$ 1,365,112
No-till	acres	1,925	$ 20	$ 38,500
Water and Sediment Control Basins (WASCOB)	feet	119,600	$ 4	$ 478,400
Wetlands	#	88	$ 35,000	$ 3,080,000
Riparian buffers	acres	1,200	$ 1,650	$ 1,980,000
Grazing management	acres	6,355	$ 42	$ 266,910
OWTS Inspection & Retrofits	#	78	$ 5,500	$ 429,000
Non-Permitted AFO Facility BMP	#	6	$ 20,000	$ 120,000
Grassed Waterways	acre	3	$ 6,575	$ 19,725
SubTotal (Drainage Area Treatment)				**$ 9,560,747**
Streambank/channel stabilization & Restoration	feet	265,788	$ 150	$ 39,868,200
Grade Control at Bridges**	#	10	$ 92,000	$ 920,000
SubTotal (In-Stream Work)				**$ 40,788,200**
In-Stream Grade Control Structures (3ft Elev)	cost	1	$218,000	$ 218,000
Head-Cut Repair / Monitoring	cost	1	$36,000	$ 36,000
In-Stream Grade Control Structures (6ft Elev)	cost	1	$195,000	$ 195,000
Stream-Side Saline Habitat Shelves	cost	1	$140,000.00	$ 140,000
Shallow Excavation w/ Dendritic Channels	cost	1	$37,000.00	$ 37,000
Shallow Excavations	cost	1	$63,000.00	$ 63,000
Pond Berm and Outlet Improvements	cost	1	$8,000.00	$ 8,000
Excavation Test Plots	cost	1	$15,000.00	$ 15,000
Grassed Terraces / Waterways	cost	1	$7,000.00	$ 7,000
Public Access (trail, bridge, crossing) [I&E]	cost	1	$ 276,000	$ 276,000
SubTotal (Norder Wetland Restoration)* **				**$ 995,000**
Updates to WQMP	each	-	$ -	$ -
Additional monitoring*	years	5	$ 10,000	$ 50,000
SubTotal (Planning/Monitoring)				**$ 50,000**
Total				**$51,393,947**

**Based on estimated costs during first 5-year increment only*

***As identified in the City of Lincoln Upper Little Salt Creek Master Plan (Intuition Logic, 2009)*

****As identified in the Conceptual Norder Wetland Restoration Design Memorandum (Flatwater, 2018)*

10.06 ANTELOPE CREEK TARGET AREA

This target area was delisted from the impaired waters list during the development of this plan. Discussions among project partners are currently determining how to proceed with including it in the plan.

10.07 SPECIAL PRIORITY AREAS

Special priority areas provide flexibility in addressing identified small-scale areas with specific, limited, and timely needs. They address issues that occur widely in the subbasin that may affect not only water quality, but also the health and safety of humans. Additionally, some BMPs do not have specific targeted land uses or an easily defined subwatershed associated with their implementation; thus, these areas do not count towards the 20% Rule.

Some BMPs have a broader appeal and impact on public involvement when implemented on an area-wide basis. Practices are restricted to those necessary to address the specific needs of the special priority area. BMPs address specific issues within areas, many of which cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities. The following special priority areas are relevant to the Salt Creek Subbasin.

DISTRICT-WIDE SPECIAL PRIORITY AREAS

The following special priority areas were identified as special priority areas for the entire district, therefore, they are discussed in more detail in Chapter 13. No additional discussion is provided in this chapter.

- On-site Wastewater Treatment Systems (OWTS)
- Non-permitted Animal Feeding Operations (AFOs)
- Wellhead Protection Areas (WHP areas)

SALINE WETLANDS

Saline wetlands within the Salt Creek Subbasin were identified as a special priority area by project stakeholders. As discussed in multiple chapters of this plan, these areas are unique to the planning area (Figure 100). In addition to the actions targeting the saline wetlands within the Little Salt Creek Target Area, the following activities have been identified by the SWCP as a priority in the coming years:

- Haines Branch - Stream stabilization and wetland restoration within the Pioneers Park Nature Center
- Little Salt - Stream and wetland improvements to enhance ecological connection between habitats
- Rock Creek - Post-project review and planning for addition habitat improvements
- Salt Creek – Saline wetland and salt marsh meadow enhancements at Warner Wetlands

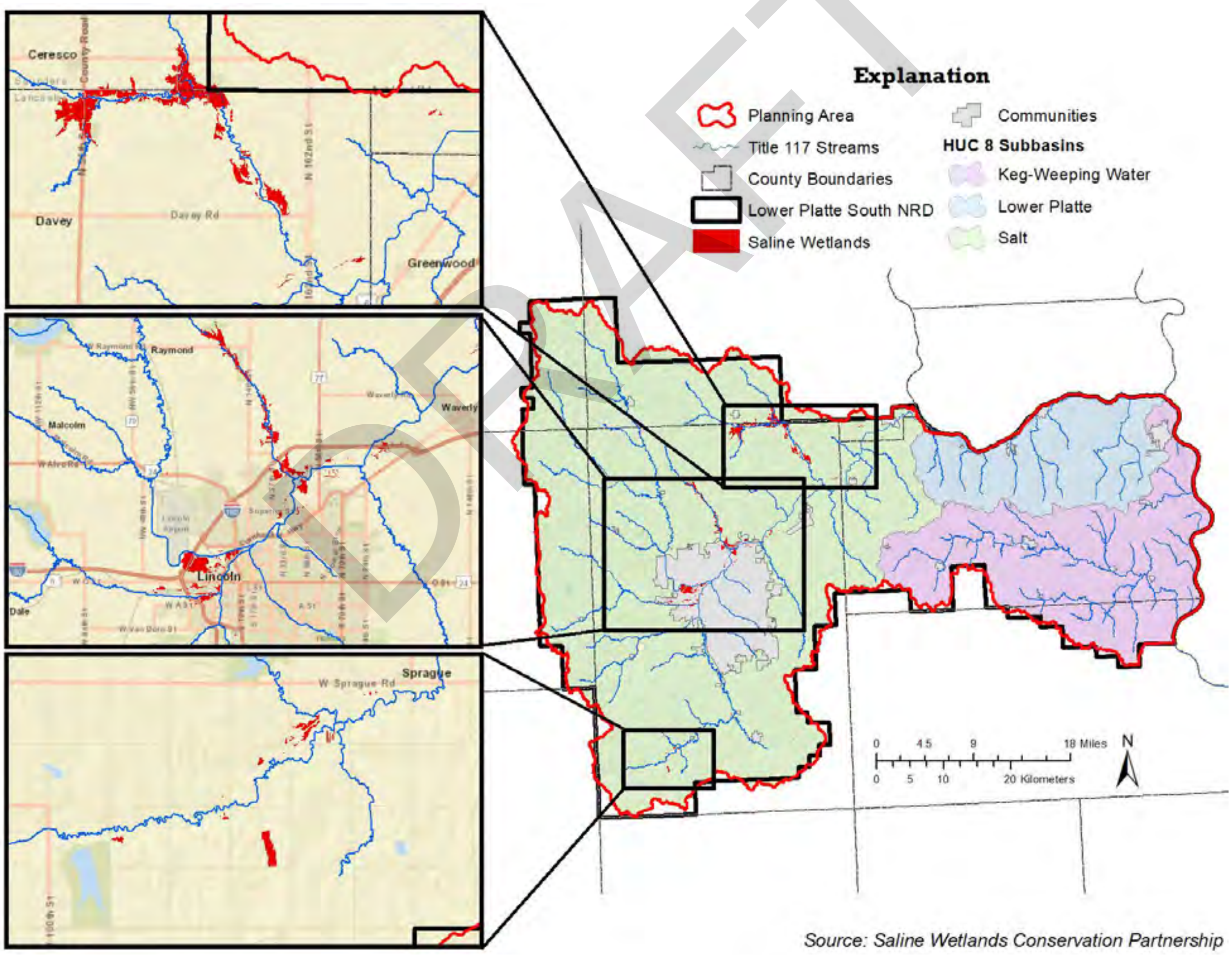


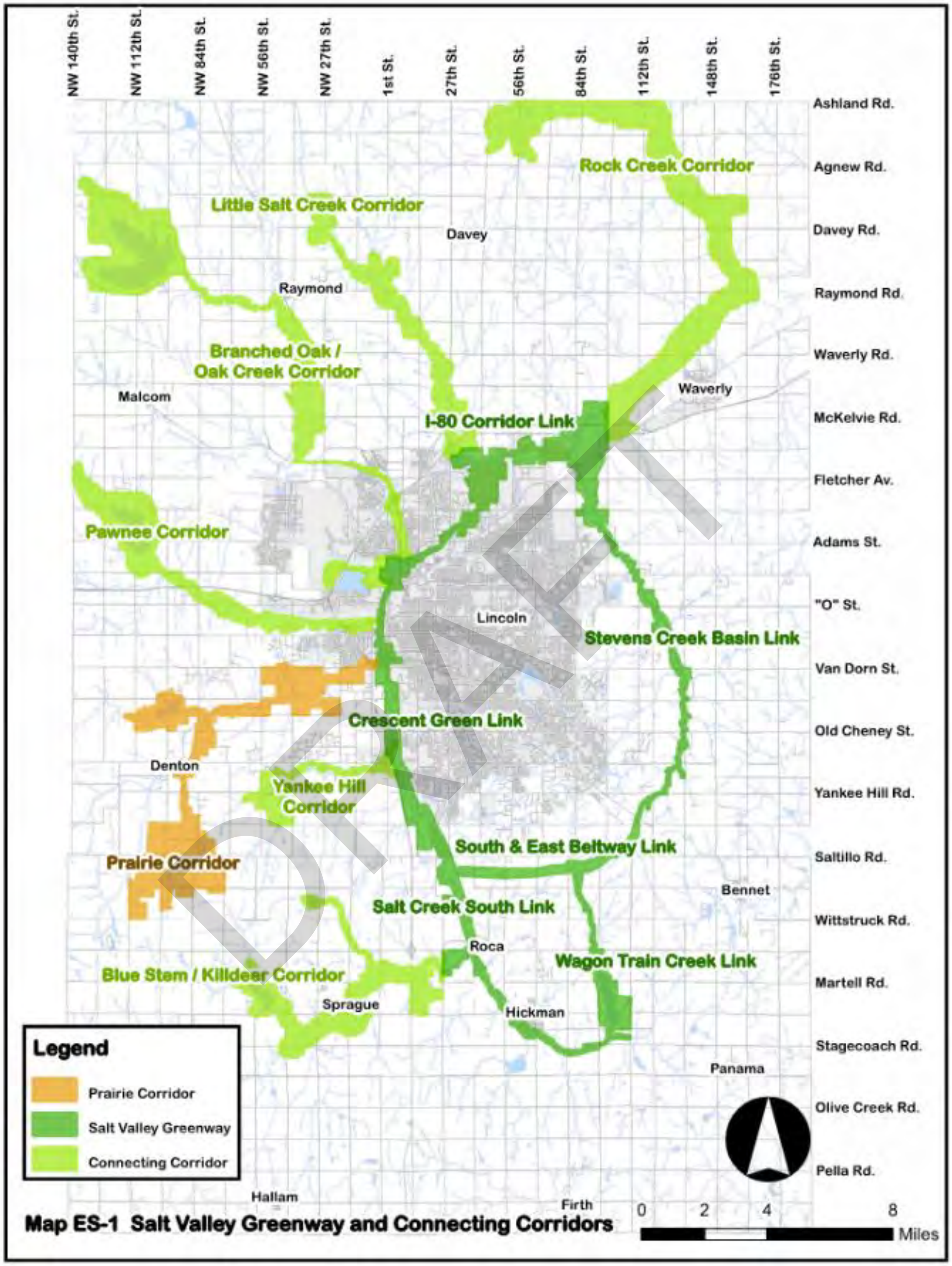
Figure 100: Saline Wetlands Location Map

SALT VALLEY GREENWAY

A greenway is a strip of undeveloped land near an urban area, set aside for recreation or environmental protection. Over the last few decades the City of Lincoln and Lancaster County governments have been working towards the vision of a greenway that provide these benefits within the Salt Creek Subbasin area. This vision is more formally outlined in the *Salt Valley Greenway and Prairie Corridor Master Plan* (Flatwater, 2012). The Salt Valley Greenway is a ribbon of open space and greenway links between the Salt Valley drainage basin and the Prairie Corridor on Haines Branch (Figure 101). This area provides opportunities to protect and enhance stream corridors, wetlands, and native prairies for multiple beneficial uses.

The *Salt Valley Greenway and Prairie Corridor Master Plan* outlines many priorities and possible projects to be completed towards realizing the vision of enhanced natural resources. Many of these either directly benefit water quality or could include elements that enhance water quality. This area has been recognized as a special priority area where the LPSNRD or other project partners may capitalize on project opportunities from the *Salt Valley Greenway and Prairie Corridor Master Plan* to further the goals of the WQMP. Many projects completed in these areas also will, or have the potential to, reduce nonpoint source pollution and/or improve aquatic habitat. BMPs in these areas will be defined based on the specific pollutant source being addressed, but BMPs targeting non-permitted livestock and stream restoration will be considered. These projects may consist of:

- Land acquisition
- Conservation easements
- Prairie restoration and management
- Wetland restoration or enhancement
- Riparian zone restoration or enhancement
- Public access and educational opportunities via trail development



Source: Flatwater, 2012

Figure 101: Salt Valley Greenway and Connecting Corridors

ANTELOPE COMMONS

Antelope Commons is a series of wetlands constructed in 1995 within the channel of Antelope Creek above Holmes Lake (Figure 102). These wetlands function as BMPs to protect the stream and reservoir from nonpoint source pollution originating from the surrounding urban development. This project was installed prior to much of the area's urban development and is thus a likely candidate for renovation to ensure the continued function of this BMP system. BMPs targeted to this area include:

- Urban Stormwater BMPs
- Pet waste education
- Riparian buffers
- Restoration of ponds / wetlands

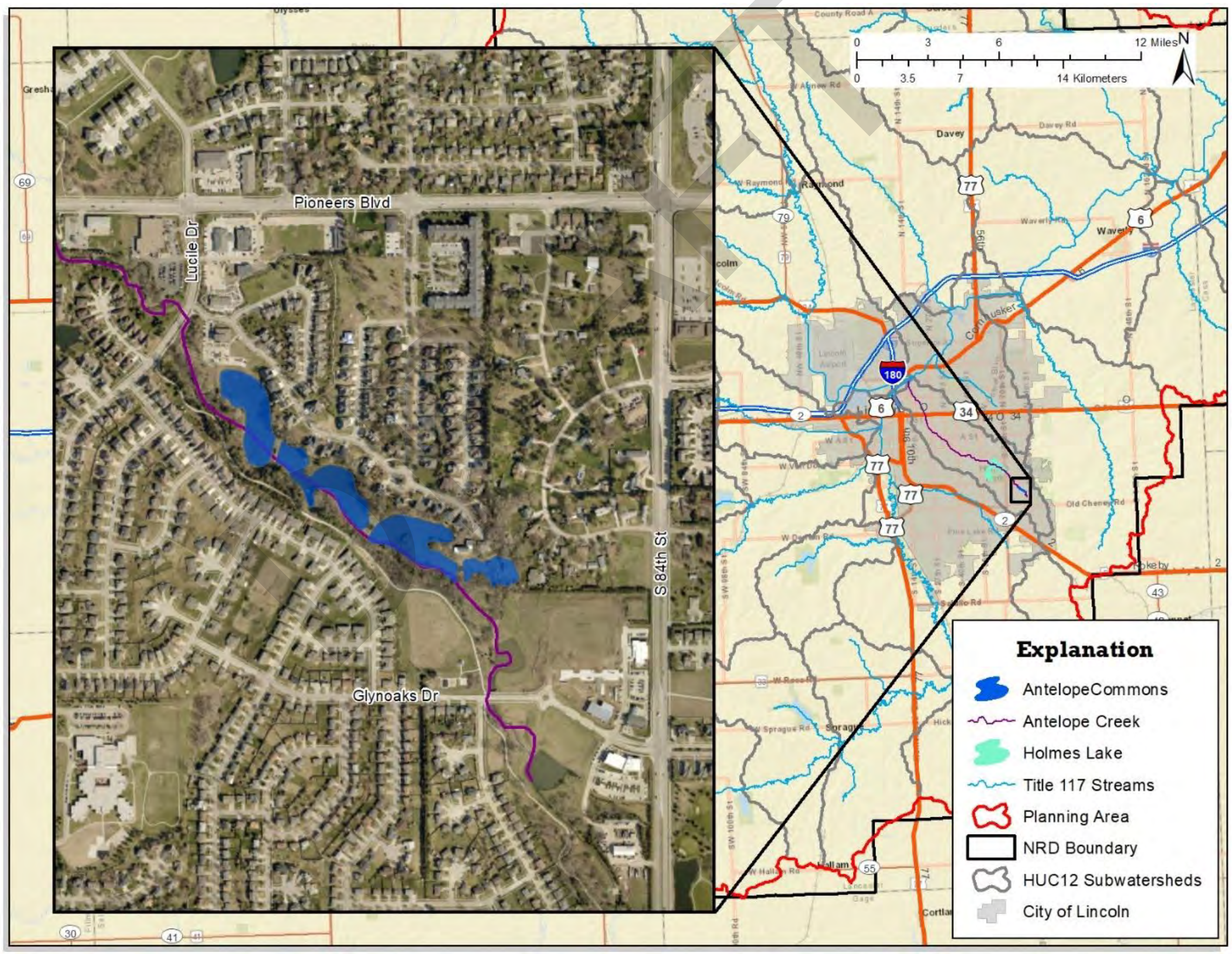


Figure 102: Location of Antelope Creek Commons Special Priority Area

EXISTING SEDIMENT RETENTION STRUCTURES

As previously discussed, controlling sedimentation into a reservoir or lake is critical to maintaining water quality within the waterbody. This is necessary even with significant BMP implementation within the drainage area. This is most commonly accomplished with the installation of sediment retention basins in or directly above reservoirs. If properly designed, basins providing extended wet detention of runoff which can reduce nitrogen, phosphorus, and sediment loads by 55%, 69%, and 72% respectively (TetraTech, 2007). The LPSNRD and partners have previously incorporated water quality basins into the design of existing reservoirs within this subbasin, which include:

- Wagon Train Lake (Lancaster County)
- Yankee Hill Lake (Lancaster County)
- Wildwood Lake (Lancaster County)
- Conestoga Lake (Lancaster County)
- Olive Creek Lake (Lancaster County)
- Meadowlark Lake (Seward County)
- Hedgefield Lake (Lancaster County)

While watershed management and the removal of deposited sediment in the main body of a reservoir are both important aspects of achieving water quality goals, maintaining storage capacity in established water quality basins also plays an important role. To maintain the effectiveness of these basins, it is necessary to periodically clean out collected sediment. Because many of these existing structures were built 10-20 years ago it is likely they need sediment removal. Stakeholders identified these structures as special priority areas because of the effectiveness in reducing pollutant loads and the immediate opportunity to protect existing waterbodies.

To maintain their pollutant trapping effectiveness, all established basins should be evaluated for storage volume loss and prioritized for sediment removal activities. This will allow resource managers to plan and budget for maintenance activities well into the future. The primary methods used to remove deposited sediment include dredging and dry excavation. While all options should be evaluated for each site, dry excavation has been the most commonly used technique on reservoirs in the planning area.

10.08 MONITORING PRIORITIES

Stakeholders identified monitoring priorities. While many of these activities may provide general support towards target area implementation, they would take place separately of any target area implementation or pre/post project monitoring activities. Below are lists of these priorities along with a brief description of each.

DISTRICT-WIDE MONITORING PRIORITIES

The following monitoring priorities are applicable to the entire district; therefore, they are discussed in more detail in Chapter 13. Additionally, other supporting information may be found in Chapter 4. No additional discussion is provided in this chapter.

- Existing BMP Treatment Levels
- Pre-project Monitoring

STEVENS CREEK

This subwatershed is located immediately adjacent to the eastern corporate limits of Lincoln and is slated for urban development. Much of this development pressure has already begun, thus stakeholders identified the need for additional monitoring as a priority. Monitoring would primarily consist of documenting the natural conditions of streambanks, stream bed elevations, and the condition of the riparian corridor. This will help managers identify or track degradation of these critical areas over time, allowing for early detection and intervention opportunities.

IMPAIRED AQUATIC COMMUNITIES

NDEQ periodically conducts stream biological monitoring to assess the overall health of a stream ecosystem (see Chapter XX). Within the planning area, monitoring results identified five stream sites with impaired aquatic life. Stakeholders believe it is likely that degraded physical habitat conditions (not chemical water quality conditions) are the cause of these impairments. Due to the nature of this impairment, it was not possible to evaluate it during the development of this plan. In order to identify the true cause of the impairments, a priority action was identified to conduct further stream assessments in the following stream segments:

- Salt Creek (LP2-20000)
- Little Salt Creek (LP2-20300)
- Oak Creek (LP2-20600)
- Salt Creek (LP2-30000)
- Olive Branch (LP2-40300)

BATHYMETRIC SURVEYS

Sediment management in respect to lakes involves controlling erosion at the source, trapping sediment before it reaches the lake, and reclaiming lost storage capacity in the lake and upstream sediment basins. The loss of reservoir conservation pool storage capacity can result in deteriorated water quality and the loss of aquatic habitat. Information gathered from bathymetric surveys can be used for several water quality planning purposes such as: (a) tracking reservoir sedimentation rates over time, (b) determining sediment trapping efficiencies of wetland/ sediment basins, (c) estimating reservoir and sediment basin maintenance requirements and financial needs, and (d) planning for in-lake management measures.

Current bathymetric information is lacking for most of the larger or recreational lakes in the planning area. The identification of priorities for future surveys was based on (a) sites that have had completed nonpoint source projects, (b) sites that are a priority in this plan, or (c) sites that serve as major public recreation areas (Table 26). Sediment basins would be best surveyed every three to five years, as opposed to every seven to ten years for reservoirs. Significant dry or wet periods might warrant longer or shorter intervals between survey periods. To ensure data comparability, it is critical to maintain consistent boundaries across survey periods. The measurement of soft sediment thickness should accompany bathymetric surveys at sites where in-lake improvements are planned. This information is valuable to develop strategies for re-claiming lost lake storage capacity and for locating in-lake sediment control structures.

Table 86: Priority Sites for Bathymetric Surveys

Waterbody	Last Survey Completed	Justification
Pawnee Lake	2002	Plan Priority Area
Twin Lakes	2002	Plan Priority Area
Branched Oak	2003	Largest Lake in planning area
Conestoga	2004	Lake Renovation in Progress
Wagon Train	2002	Lake Renovation-Sediment Basin Construction-Watershed Treatment Completed 2002
Yankee Hill	2005	Lake Renovation-Sediment Basin Construction-Watershed Treatment Completed 2005
Wildwood	2003	Lake Renovation-Sediment Basin Construction-Watershed Treatment Completed 2003

10.09 COMMUNICATION AND OUTREACH PRIORITIES

Stakeholders identified communication and outreach priorities. While many of these activities may provide general support towards target area implementation, they would take place separately of any target area communication and outreach activities. Below are lists of these priorities along with a brief description of each.

DISTRICT-WIDE COMMUNICATION AND OUTREACH PRIORITIES

The following communication and outreach priorities are applicable to the entire district; therefore, they are discussed in more detail in Chapter 13. Additionally, other supporting information may be found in Chapter 6. No additional discussion is provided in this chapter.

- LPSNRD Board of Directors
- Rural Water Districts
- County Commissioners
- Village/city governments with WHP areas

HOME OWNERS ASSOCATION

Defining Maintenance responsibility for BMP facilities, identifying who is responsible for maintenance of BMPs, and ensuring that an adequate budget is allocated for maintenance is critical to the long-term success of BMPs. Within the planning area many BMPs are owned and/or maintained by government entities such as the LPSNRD or the City of Lincoln. However, there are also many other BMPs distributed throughout residential areas that are privately owned.

These privately owned BMPS are typically maintained by the property owner or a neighborhood homeowner’s association (unless a different ownership/maintenance arrangement has been approved by the City of Lincoln). BMPs must be maintained according to the guidelines in the City of Lincoln Drainage Criteria Manual, and as specified in maintenance plans. However, many of these associations are not aware of this responsibility and may lack an understanding of maintenance required for BMPs to function properly.

Addressing this issue was identified as a priority communication and outreach action. The City of Lincoln will lead the development of information materials and actions targeted at homeowner’s associations with stormwater BMPs. This may include, but is not limited to:

- Targeted mailings
- 1-on-1 meetings with association leaders
- Townhall style meetings with targeted neighborhoods
- Brochures outlining overall responsibilities
- Brochures outlining the benefits and functions of stormwater BMPs
- Installation of signage outlining the benefits and functions of stormwater BMPs
- Development of a “BMP Maintenance Guide for Homeowners Associations and Property Owners”

10.10 COST SUMMARY FOR TARGET AREAS

The preliminary opinion of total cost for implementing the nonpoint source pollution control strategy for the three target areas is estimated to be $109,013,999 (Table 87). This does not include costs for bathymetric surveys or final designs of engineering projects. When possible, costs were determined from the 2018 USDA-NRCS EQIP practice payment schedule (USDA, 2018). Costs estimated for in-lake measures were based on average unit prices from a wide range of past project costs and should only be used for general planning purposes. These costs are subject to change based on final design of the rehabilitation, inflation, bidding climate at the time of construction, and project size and complexity. Additionally, costs for the Norder Wetland Restoration and Little Salt Creek stream stabilization came from existing documents as previously discussed.

Major costs vary between the target areas, with the greatest being for in-lake work for Pawnee and Twin Lakes. In-lake work includes such items as sediment removal, shoreline stabilization, construction of jetties and breakwaters, in-lake sediment basins, and nutrient inactivation.

On the surface, in-stream work is a relatively expensive option. This is because, historically, few major or widescale conservation programs have existed to address stream restoration or riparian BMPs. This has left a lot of work to be accomplished. It should be noted that oftentimes specific stream stabilization techniques placed at strategic locations and paired with policies that encourage the establishment of riparian buffer zones can significantly reduce the costs of these efforts. Essentially, this allows nature to do most of the work, while only critical infrastructure or other points of interest are stabilized in-place. In-Stream Work includes such items as streambank/channel stabilization and restoration, grade control at bridges, and riparian buffer establishment.

Watershed Treatment is the lowest cost option of nonpoint source pollution control for all target areas. Watershed Treatment revolves around working with landowners on a voluntary basis to implement BMPs that avoid, control, and treat runoff. Additionally, this includes information and education, and targeted efforts to improve non-permitted AFOs and unregistered OWTSs. Watershed Treatment relies on landowner cooperation to construct BMPs in the most effective areas.

Table 87: Summary of Target Area Implementation Costs

Watershed Treatment	
Pawnee Lake-Middle Creek	$5,907,366
Twin Lakes	$2,331,826
Little Salt	$9,560,747
Subtotal	**$17,799,939**
In-Stream Work	
Pawnee Lake-Middle Creek	$14,043,750
Twin Lakes	$5,596,500
Little Salt	$40,788,200
Subtotal	**$60,428,450**
In-Lake Work	
Pawnee Lake-Middle Creek	$27,066,860
Twin Lakes	$2,573,750
Little Salt	N/A
Subtotal	**$29,640,610**
Norder Wetland Restoration	
Pawnee Lake-Middle Creek	N/A
Twin Lakes	N/A
Little Salt	$995,000
Subtotal	**$995,000**
Planning/Monitoring	
Pawnee Lake-Middle Creek	$50,000
Twin Lakes	$50,000
Little Salt	$50,000
Subtotal	**$150,000**
Total Cost	
Pawnee Lake-Middle Creek	$47,067,976
Twin Lakes	$10,552,076
Little Salt	$51,393,947
Subtotal	**$109,013,999**

CHAPTER 11. LOWER PLATTE RIVER HUC 8 SUBBASIN

11.01 SUBBASIN BACKROUND

The Lower Platte River Subbasin (HUC 8: 10200202) is located in northern Cass County and encompasses 115,393 acres, or approximately 11% of the planning area (entire planning area is 1,048,774 acres). Row crops (corn/soybean) are the predominant land use, with some areas of forest and grass/pasture lands which are concentrated along the northern boundary of the subbasin in the Platte River bluffs. Figure 103 illustrates the land use/land cover within the subbasin. The subbasin is nearly completely rural in nature, with Louisville (estimated population of 1,039) being the largest community in the subbasin. There are two major public recreation areas, both along the Platte River: Platte River State Park and Louisville State Recreation Area.

This chapter is intended to focus primarily on the target areas, special priority areas, and other priorities identified within the Lower Platte River HUC 8 subbasin. Little discussion is given to the rest of the subbasin here, as much of that information can be found throughout the rest of this plan. Information on an inventory of subbasin characteristics is found in the following chapters/section within this plan:

- Land Use: Chapter XX
- Existing land treatment (BMPs): Chapter XX
- Irrigation: Chapter XX
- Permitted facilities: Chapter XX
- Water resources: Chapter XX
- Existing resource conditions: Chapter XX

A general discussion of the types and sources of the pollutants that are addressed in this chapter can be found in Chapter XX. This subbasin specific chapter provides information for the contribution of pollutant by source within each target area. Additionally, this chapter provides the following information for each target area (and special priority areas, as applicable):

- Pollutant sources and loads;
- Pollutant load reductions needed to meet water quality standards (load reduction goals);
- Pollutant load reductions as a result of BMP implementation;
- Communication and outreach;
- Schedule and milestones;
- Monitoring; and
- Costs.

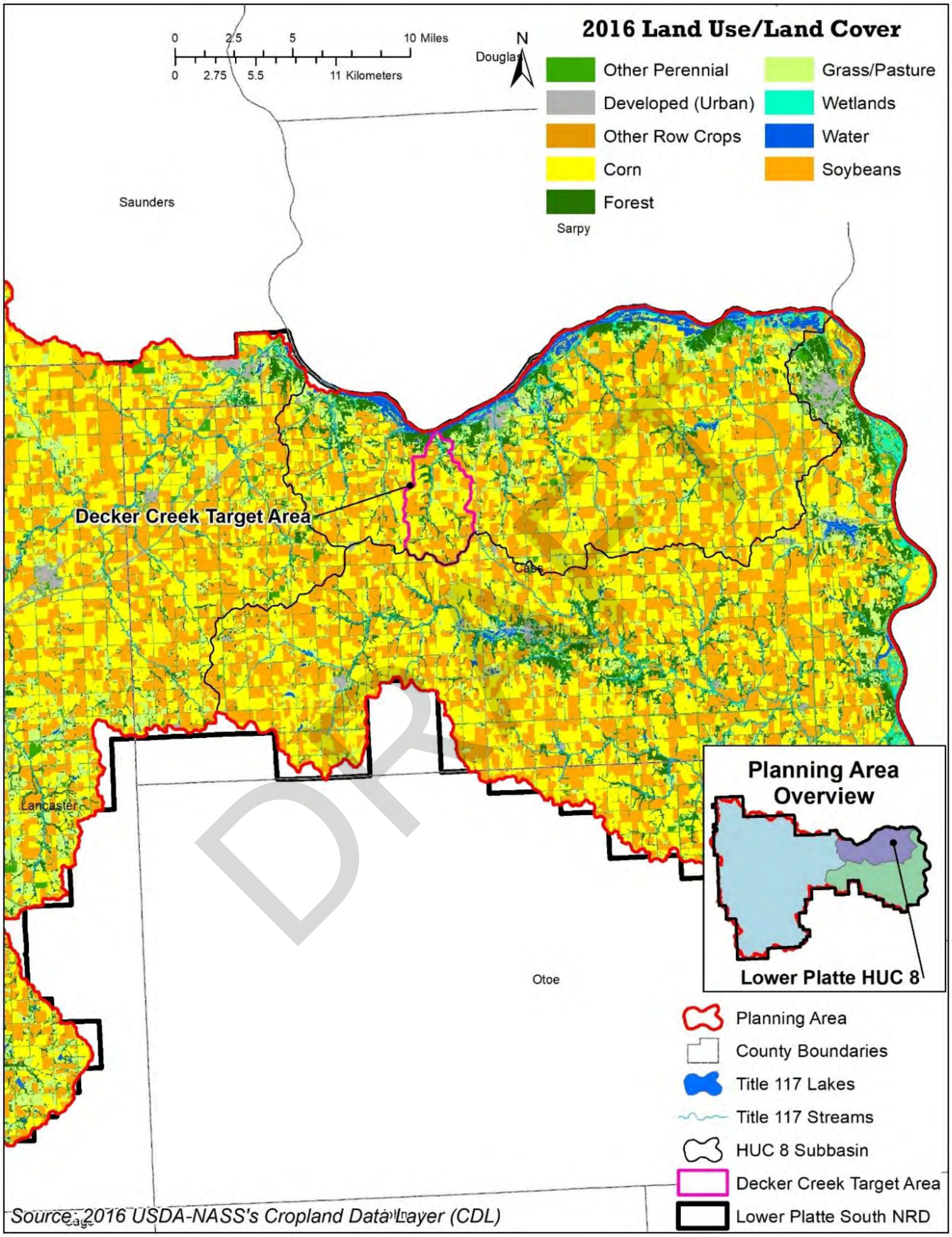


Figure 103: Land Use/Land Cover within the Lower Platte River HUC 8 Subbasin

11.02 OVERVIEW OF PRIORITIES

As discussed in Chapter XX, target areas and special priority areas were selected through a review of water quality data and stakeholder input. As shown in Figure 104 and Table 47, the following areas within this subbasin have been selected for focused implementation efforts:

Target Areas

- Decker Creek

Special Priority Areas

- On-site Wastewater Treatment Systems (OWTS)
- Non-permitted animal feeding operations (AFOs)
- Wellhead protection areas (WHP areas)

As part of the prioritization process in the development of this plan (Chapter XX), target areas were identified based on the contributing area to each priority waterbody identified. The total size of each target area was calculated through GIS analysis to ensure the sum of the targeted areas equaled less than 20% of the total HUC 8 area, satisfying the NDEQ's 20% Rule (NDEQ, 2015). Within the Lower Platte River HUC 8 Subbasin, 7,590 acres are targeted for implementation work or approximately 7% of the HUC 8 area (Table 47). The following sections of this chapter provide information on the implementation strategy for each target area, with additional details and supporting technical information located in Appendix XX.

Table 88: Priority Waterbodies and Associated Target Areas within the Lower Platte River HUC 8 Subbasin

Priority Water Body Addressed (Water Body ID)	HUC 12 Subwatershed	Target Area Size (acres)	% of Total HUC 8 Size	Pollutants/Impairments Addressed
Decker Creek (LP1-11200)	102002020203	7,590	7%	*E. coli* bacteria
Total	**n/a**	**7,590**	**7%**	**n/a**

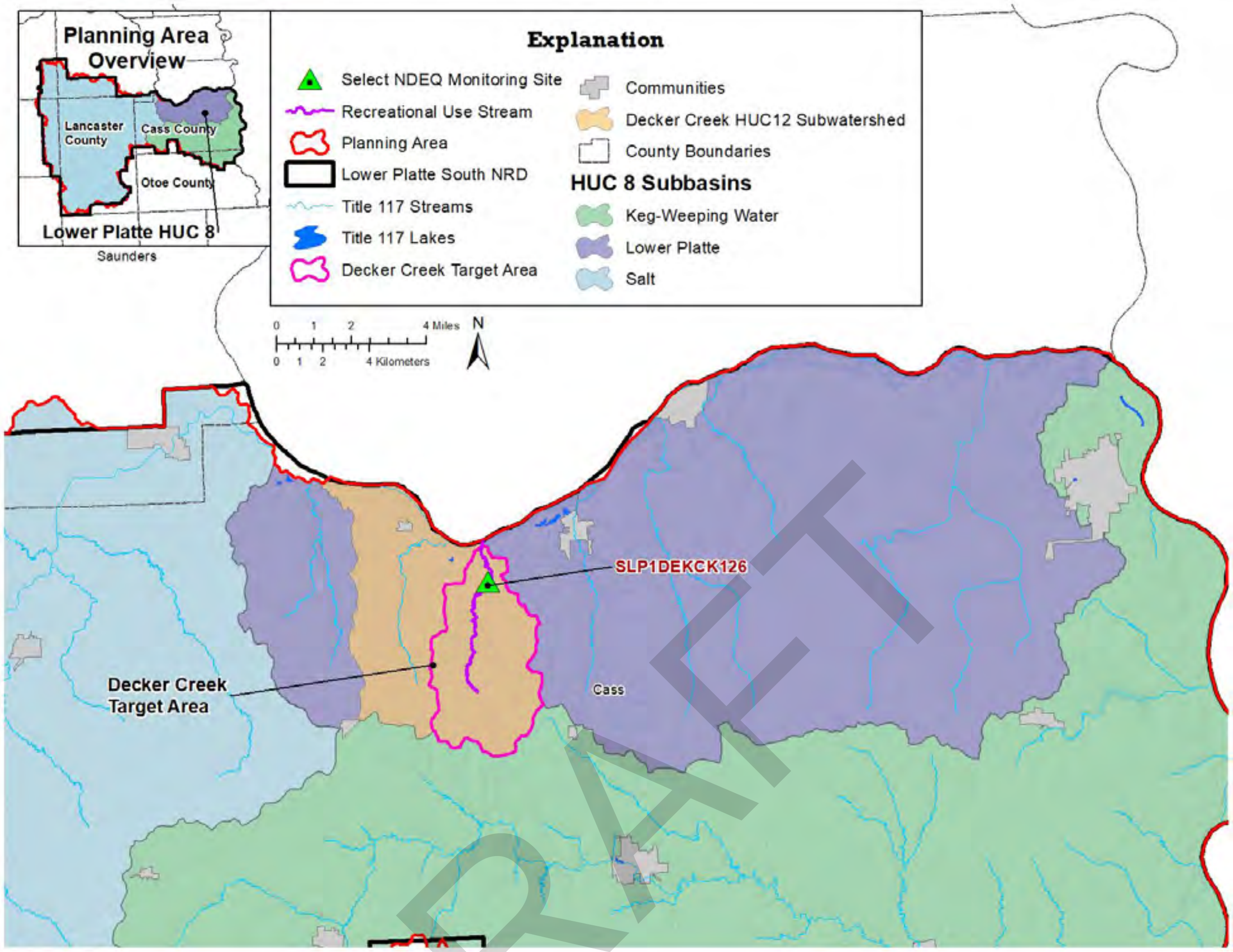


Figure 104: Target Areas within the Lower Platte River HUC 8 Subbasin

11.03 DECKER CREEK TARGET AREA

INTRODUCTION

NOTE TO READERS

Information in this section is summarized from the pollutant modeling files and from the *Bacteria Load Estimate Report* (WWE, 2018), a copy of which is also provided in Appendix XX. Unless otherwise noted, additional details and background information can be found in that comprehensive document.

The Decker Creek target area encompasses approximately 7,590 acres of the Decker Creek-Platte River subwatershed (HUC 12: 102002020203). It should be noted that the Decker Creek Target Area is located wholly within this HUC 12 but does not include all of it. The Decker Creek Drainage Area was delineated separately, as the HUC 12 includes the drainage areas for multiple, unrelated, tributaries to the Platte River (Figure 104). Decker Creek (LP1-11200) consists of one stream segment and is a tributary to the Platte River. The headwaters start in rolling agriculture lands and the stream flows north, approximately 6.5 miles, through the river bluffs before it meets up with the Platte River.

IMPAIRMENTS

Decker Creek's assigned beneficial uses Primary Contact Recreation, Aquatic Life; Aesthetics; and Agricultural Water Supplies (NDEQ, 2014). The creek is fully supporting all assigned beneficial uses except for Primary Contact Recreation, which is impaired due to *E. coli* bacteria (NDEQ, 2016). NDEQ provided *E. coli* loading goals in the 5-alt assessment (NDEQ, 2017b). There are no point source discharges to the Decker Creek drainage area.

POLLUTANT SOURCES AND LOADS

The average annual *E. coli* load carried by Decker Creek is estimated to be 76,100 billion colony forming units (cfu). The largest contributors of bacteria to Decker Creek are from non-permitted animal feeding operations (AFOs) (32%) and developed land use (30%). Readers should note that "developed" land uses in the target area consist of numerous acreages, farmsteads, streets, roads, and other impervious surfaces. Sources of bacteria from these urban land uses include both wildlife and pet waste. There are no point source discharges to the Decker Creek drainage area (NDEQ, 2017a).

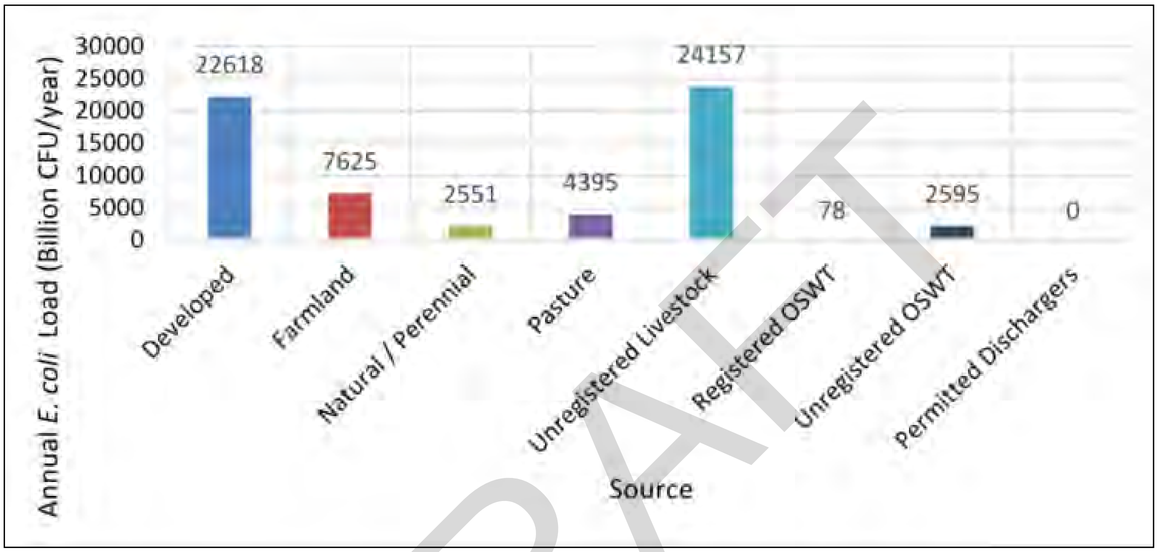


Figure 105: Existing *E. coli* Bacteria Loads and Sources to Decker Creek

REQUIRED POLLUTANT LOAD REDUCTIONS

For simplicity, the *E. coli* pollutant load estimates were assumed to be consistent with the concentrations identified in the 5-alt assessment. Therefore, reductions in load estimates were assumed to result in changes to in-stream concentrations by the same relative amount. Required *E. coli* load reductions were based on 5-alt assessment data (NDEQ, 2017) which identified a 98% reduction from 4,076 cfu/100mL to 82 cfu/100mL. This goal is set below the water quality standard of 116 cfu/100mL to account for a margin of safety (Table 79).

Table 89: *E. coli* Pollutant Load Reduction Goals for Decker Creek

Seasonal Geometric Mean (#/100mL)	*E.coli* Above Water Quality Standard (#/100mL)	Reductions needed to meet Water Quality Standards	Expected Geometric Mean with the Margin of Safety (#/100mL)
4,076	3,950	98%	82

Source: Adapted from NDEQ 5-alt data files (NDEQ, 2017)

IMPLEMENTATION STRATEGY

The implementation strategy for the Decker Creek Target Area includes multiple practices which target pollutant sources through the ACT approach, also known as a "treatment train". All nonpoint source pollutant sources are addressed. It is assumed that AFOs and OWTSs are meeting all legal requirements; however, they are also possible sources of pollutant loads. In all cases, only willing landowners will be included in this voluntary implementation strategy. Multiple sources were used to identify BMPs:

- **ACPF tool** – The ACPF tool was used to identify the best suited locations for various BMPs throughout the target area.
- **Aerial analysis** –Additional opportunities for BMPs were found through analysis of aerial photography. This analysis identified nonpermitted AFOs and rural residences that may have unregistered OWTSs.

The implementation strategy presented in this plan should be used as a guide for BMP implementation and may be subject to revision as new information becomes available and willing landowners are identified. Although avoidance practices are not part of the ACPF, they are an important part of this strategy. For additional details about the BMPs identified, please refer to Chapter XX, Appendix XX, or the referenced planning documents previously discussed.

A VOLUNTARY PLAN

The implementation of this plan is based entirely on the voluntary actions of landowners and citizens. Individuals must decide if it is an advantage to participate, and it is the responsibility of the LPSNRD and other stakeholders to find ways to make participation advantageous.

To provide an accurate load reduction estimate from implementation efforts, recommended practices were used to develop a "treatment train" that follows the movement of pollutants from the source to the receiving waterbody (Table 90). The drainage area's treatment train begins with education/outreach and avoidance practices and ends with near stream improvements (i.e. riparian buffers).

Table 90. Implementation of Priority BMPs through a "Treatment Train" Approach

Order	Land Use / Source Targeted	Priority BMP
1	Watershed	Watershed Education
2	All OWTSs	OWTS Upgrade
3	Developed Areas	Pet Waste Ordinance
4	Watershed	Non-structural & avoidance BMPs (Working Lands Management)
5	Pastureland and Unregulated Cattle	Grazing Lands Management BMPs
6	Farmland	Cover Crops
7	Farmland and Pastureland	Riparian Buffers
8	Farmland	Contour Buffer (filter) Strips
9	Unregulated Cattle	Non-Permitted AFO Facility BMPs
10	Watershed	Wetlands/Farm Ponds/Sed. Basins
11	Watershed	Stream Restoration
12	Farmland	Terraces
13	Watershed	WASCOBS

BMP TARGETING

A suite of structural and non-structural management practices was selected based on stakeholder input and the results of technical analysis. In addition to structural practices, education/outreach and avoidance practices were added to the suite of recommendations for the Decker Creek Target Area (Table 53). All land cover types and pollutant sources were targeted for education and outreach activities except for water and wetlands, which were not classified as pollutant sources. Figure 73 provides an overview of conceptual locations where BMPs could be placed. Please note that, due to technical issues, the ACPF Tool was not utilized to identify locations for streambank stabilization or riparian buffers. All of Decker Creek was targeted for these practices due to observed incision and erosion issues throughout the target area. This map does not show "planned" locations, but instead provides a starting point for discussion with willing landowners and provides managers methods to develop this WQMP. Detailed map books can be found in Appendix XX.

Table 91: Priority BMPs and Targeted Pollutant Sources for the Decker Creek Target Area

BMP Type	Land Use/Pollutant Source Targeted or Treated	Priority BMP
Non-Structural	Watershed Wide	Education & Outreach
	Unregistered OWTS	OWTS Education & Upgrade
	Developed	Pet Waste Education
	Cropland	Non-structural & Avoidance BMPs
	Pasture and Non-permitted AFOs	Grazing Lands Management BMPs
	Cropland	Cover Crops
Structural	Cropland and Pastureland	Riparian Buffers
	Cropland	Contour Buffer (filter) Strips
	Non-permitted AFOs	Non-permitted AFO Facility BMPs
	Watershed Wide	Wetlands/Farm Ponds/Sediment Basins
	Watershed Wide	Stream Restoration
	Cropland	Terraces
	Cropland	WASCOBS

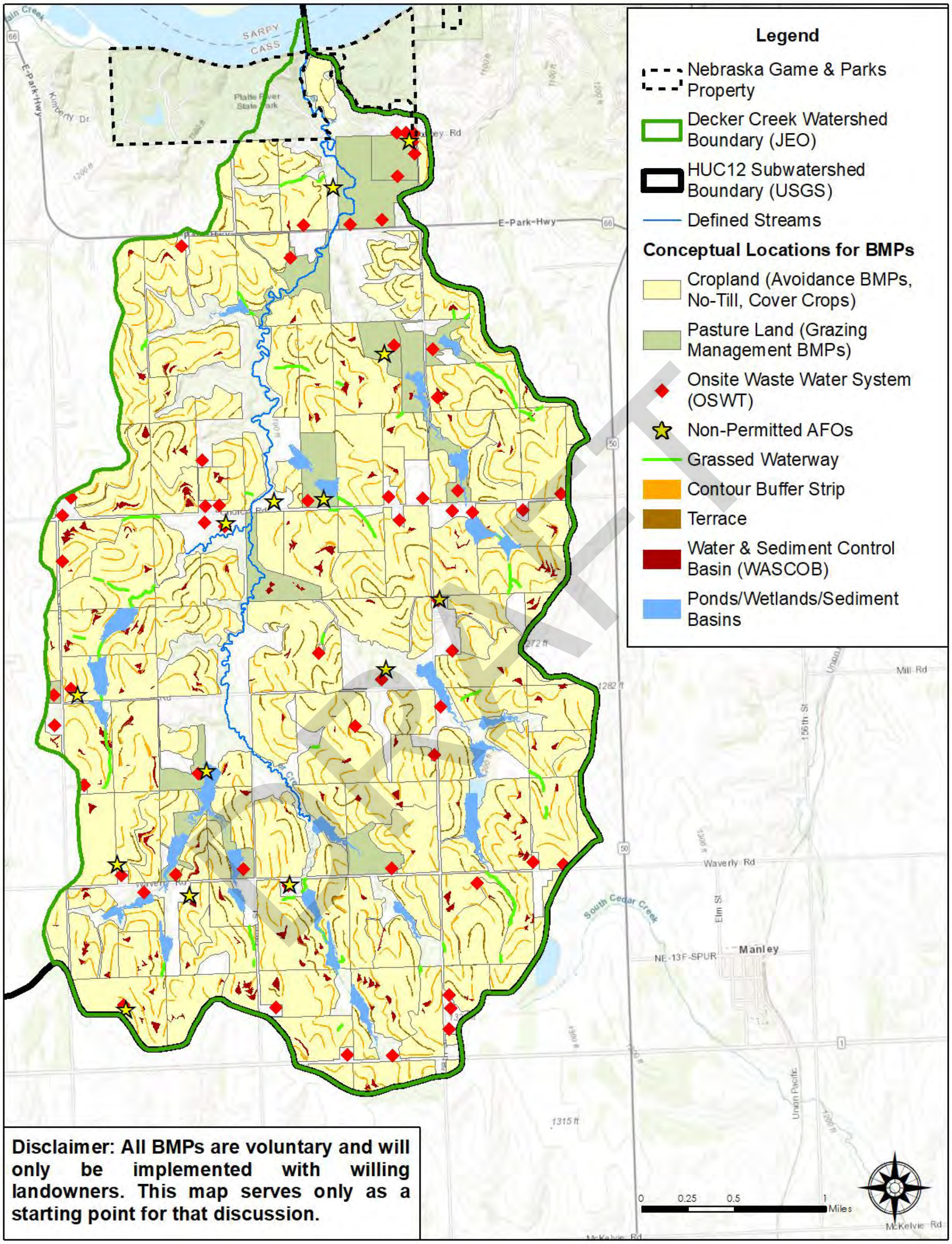


Figure 106: Conceptual locations of in-field and edge-of-field BMPs

CRITICAL SOURCE AREAS

Critical Source Areas (CSA) are a relatively small fraction of a watershed that generate a disproportionate amount of the pollutant load (Meals, 2012). As discussed in Chapter XX, CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism. Identifying CSAs allows for the prioritization of fields where BMPs are likely most needed and allows for financial and technical resources to be used most efficiently.

CSAs in the Decker Creek Target Area were identified using the field runoff risk assessment in the Agricultural Conservation Planning Framework (ACPF) Toolbox. This assessment provides a relative risk rating (not an absolute risk rating) and is based on a cross-reference of two factors:

- Slope steepness – Steeper fields have a higher risk of generating runoff
- Distance to stream – The closer a field is to a waterbody, the higher the risk a pollutant will be delivered to waterbody

Once the assessment is complete, each field receives a relative classification ranging from A (highest risk – most critical), to B (very high), C (high), and other ('present'). One limitation of this tool is that only agriculture landuses (cropland or pasture land) are included. These other land uses (typically rural residences or other natural areas) are identified as "unknown" in the assessment. "Unknown" areas may still have an elevated runoff risk (especially for pollutants such as manure application or failing OWTSs). A "present" or "unknown" classification does not mean that a BMP would not provide benefits to a given field, but rather indicates that other fields have a greater potential to deliver pollutants to a waterbody via surface runoff. In future updates to this plan, an assessment of all fields for runoff risk is recommended.

For the purposes of this plan, areas identified as A or B through the runoff risk assessment have been identified as CSAs. In the Decker Creek Target Area (Figure 107), there are 973 acres of CSAs (approximately 13% of the target area), which are broken down as follows:

- Highest Risk CSA: 135 acres
- Very High Risk CSA: 838 acres

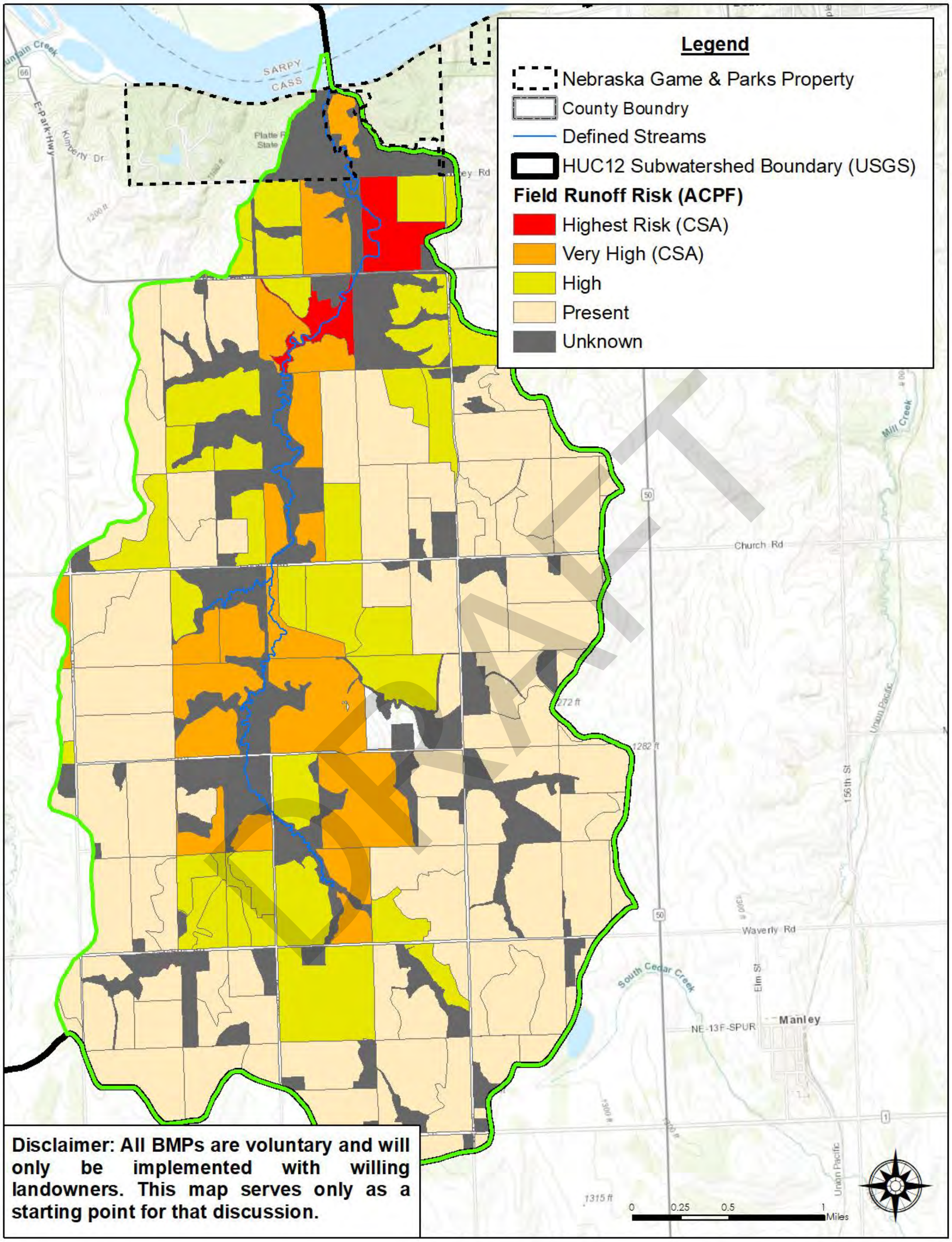


Figure 107: Critical Source Areas in the Decker Creek Target Area Identified with the ACPF Tool

MEETING WATER QUALITY STANDARDS

Average annual load reductions associated with a comprehensive BMP implementation strategy were estimated for *E. coli* bacteria. An estimated 75% reduction in *E. coli* loads was determined to be attainable. Unfortunately, this does not meet the goal of 98% reduction established by the 5-alt assessment (Table 82). Additional details can be found in the summary report located in Appendix XX.

Table 92: Estimated *E. coli* Reductions and Goals After BMP Implementation

E. Coli **Pollutant Loads/Concentrations**	**cfu/100mL**	**%**
Existing	4,076	n/a
Cumulative Reductions Due to BMP Implementation	-3,069	75%
Estimated Load After BMP Implementation	1007	n/a
Water Quality Goal	82	98%

There are several factors involved in identifying either a path to meet water quality goals or determining limitations to the goal. BMPs identified were estimated to achieve the maximum feasible reductions based upon existing monitoring data, BMP treatment efficiencies, and sources of bacteria loads. Based on currently available data, it is infeasible to expand conceptual BMP implementation beyond this level. However, through the development of this plan, existing monitoring data indicated that Decker Creek exhibited, by far, the highest levels of *E. coli* bacteria within monitored streams in the planning area (Figure 108).

It is recommended that a detailed monitoring plan be implemented either in conjunction with or prior to BMP implementation efforts. Given that BMP effectiveness in treating *E. coli* can vary significantly between sites, on-site monitoring and sampling will provide a much more accurate assessment of load reductions. This additional and updated data will provide better estimates of pollutant sources and improve targeting of those sources. It is intended that feasibility of achieving required load reductions will be periodically re-evaluated based upon new monitoring and sampling data. Additional discussion is provided in the following Monitoring and Evaluation section.

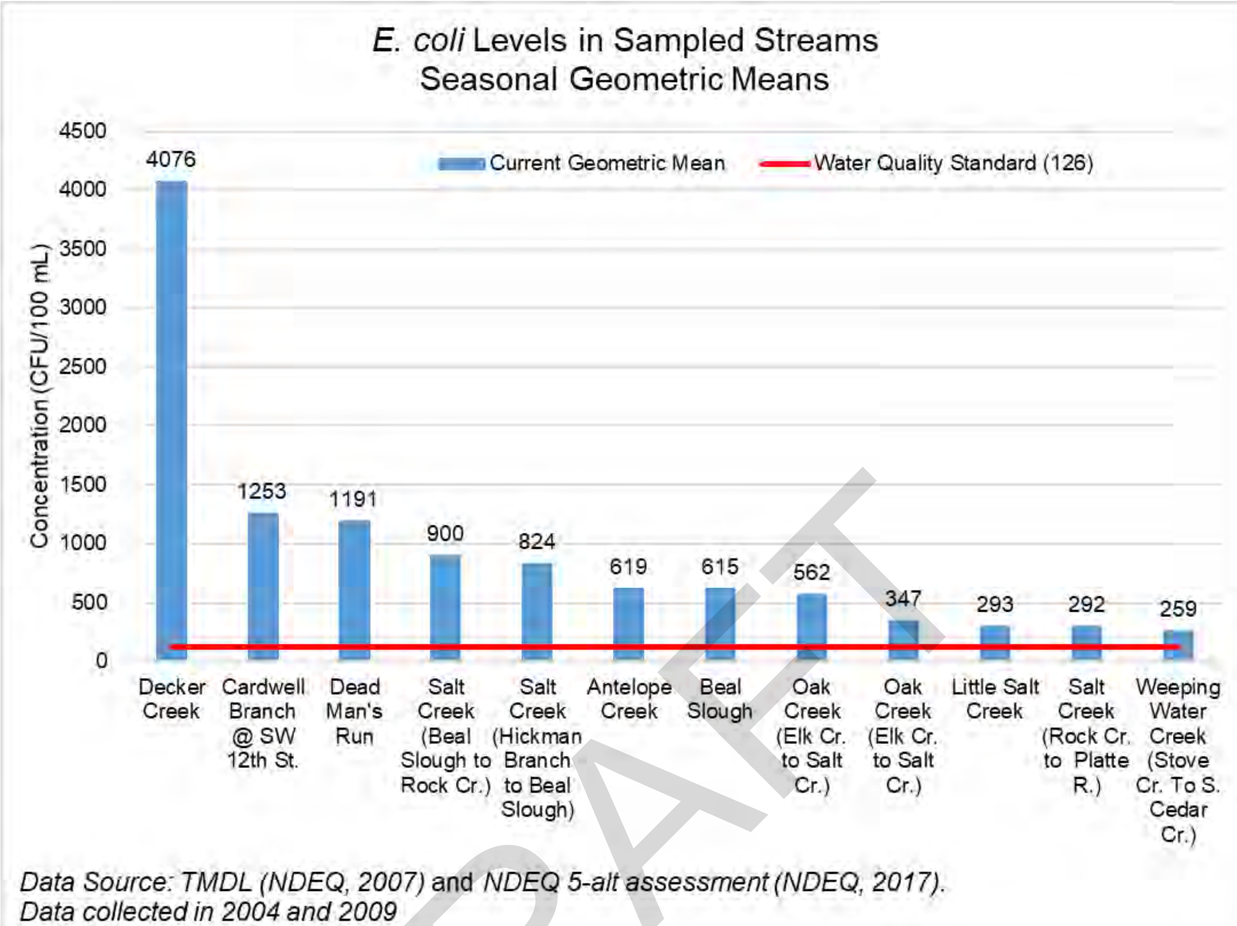


Figure 108: *E. coli* Concentration Levels in Area Streams

MONITORING AND EVALUATION

The LPSNRD will follow the established protocol and procedures to: develop sound, defensible monitoring strategies and networks; properly manage data; and disseminate information to decision makers and other stakeholders. Monitoring goals can only be achieved through partnerships with other resource agencies such as NDEQ. Steps will be taken to ensure collection of scientifically valid data, which may include the development of Quality Assurance Project Plans (QAPP) for state and federal review. Additional guidance and references are located in Chapter XX.

To adequately design monitoring networks that facilitate water resource management, it is critical to use data for its intended purposes. Thus, it is necessary to establish specific monitoring goals and objectives. A set of monitoring goals and objectives has been developed for Decker Creek. Targeted parameters, monitoring sites, and monitoring frequency have been defined to meet each objective. Monitoring goals and objectives provided below in *italics* may require expanded or new monitoring efforts, whereas objectives and parameters in plain text are currently being addressed.

Monitoring Goal 1: Evaluate the water quality condition of Decker Creek.

- Evaluate beneficial use support and water quality trends for Decker Creek.
- Monitoring Parameters: heavy metals, pesticides, nutrients, *E. coli,* and field measurements
- Monitoring Frequency: (Annual) Monthly January-December
- Monitoring Site: Decker Creek southwest of Louisville NE (SLP1DEKCK126)

Monitoring Goal 2: Establish a spatially robust monitoring network to further characterize *E. coli* sources

- *Collect grab samples at up to 6 distributed locations across the drainage area*
- *At each monitoring site, conduct stream flow discharge monitoring during collection of grab samples*
- *At SLPDEKCK126, install a long term, continuous stream flow discharge monitoring station*
- *Conduct 1-3 years of annual sampling on a biweekly basis, during the primary recreation season (May 1 – September 30)*
- *Utilize microbial source tracking to better characterize E. coli sources*

COMMUNICATION AND OUTREACH

Chapter 6 of this plan provides a broad programmatic approach that the LPSNRD and its partners will take to address nonpoint source pollution through communication and outreach activities. Specifically, within a target area there are certain pieces of information necessary for successful communication and outreach efforts, which will in turn support the implementation of BMPs. Those items specific to the Decker Creek Target Area were identified via stakeholder and public input, and are as follows:

- Identified Target Audiences
    - Recreational water users of the Platte River
    - Visitors to Platte River State Park
    - Land managers, residents, and property owners within the Decker Creek Target Area
    - Producers with existing BMPs who may be interested in implementing more
    - Rural homeowners on private wells and septic systems
    - YMCA Camp Kitaki staff and management
- Methods
    - Utilize parcel ownership information, along with the detailed BMP location maps created with the ACPF Tool, to contact specific landowners about BMPs applicable to their properties
        - A postcard mass mailing followed up by phone calls will help start initial implementation efforts and/or increase attendance at public meetings
    - Utilize the public lands at Platte River State Park, or the nearby YMCA Camp Kitaki (nonprofit) for BMP demonstration sites or education outreach opportunities
    - Develop signage to be used at project demonstration sites, key watershed entrances or landmarks, and other highly visible areas
    - Utilize the Platte River State Park, or communities of South Bend, Louisville, and Middle Island Lake Association for the following:
        - Post flyers, distribute press releases, and advertise at local events
        - Hold targeted coffee shop meetings, tailgate sessions, and other informal/casual informational exchanges to build relationships and to learn more about the constraints and hurdles to BMP adoption
    - Hold training and demonstration field days
    - Hold an outdoor recreation clinic (hiking, birdwatching, kayaking etc.) at Platte River State Park or Camp Kitaki
    - Work with Camp Kitaki staff to develop an outdoor education program focused on collecting water quality samples throughout the summer months

Plan and project sponsors will utilize these target audiences and outreach methods when building project level communication and outreach plans, typically as part of a Project

Implementation Plan (PIP). The PIP will identify the specific and tailored actions for each target audience, as discussed in Chapter 6.

SCHEDULE

A timeframe for implementing general actions is provided in Table 93. Actions are subject to approval by the LPSNRD Board of Directors and may change as the plan is implemented. Phase I activities will include the initiation of drainage area BMPs and enhanced monitoring. Phase II will begin upon the five-year revision of this plan and will include any implementation that was not completed in Phase I. A summary of progress achieved during Phase I will be included in the plan revision.

Table 93: Schedule for Implementation within the Decker Creek Target Area

Activity	Phase I						Phase II
	2018	2019	2020	2021	2022	2023	2024-2028
EPA approval of the plan							
Monitoring (ongoing)							
Organize stakeholder groups							
Drainage area BMP Implementation							
Project evaluation							
Final reporting							
Update HUC8 subbasin plan							
Continue implementation as needed							

MILESTONES

Major milestones that pertain to monitoring, planning, and management practice implementation are provided in Table 84. These milestones will be used to gauge progress in meeting the desired project schedule. As the implementation of this plan is initiated milestones will be adjusted accordingly for changes to the schedule.

Table 94: Milestones for Implementation within the Little Salt Creek Subwatershed

Activity		Phase I						Phase II
		2018	2019	2020	2021	2022	2023	2024-2028
Monitoring	Coordinate with NDEQ	■	■	■	■	■		
	Finalize strategies and QAPPs		■					
	Assess data (annually)	■	■	■	■	■		
Planning	Drainage area BMP PIP		■		■			
	Funding Assistance		■		■			
	Apply for funding assistance grants				■			■
	Evaluate progress in meeting goals						■	
	Identify additional BMP needs						■	
	Prepare final report(s)						■	
	Revise WQMP plan as needed							■
Information /Education	Develop stakeholder group		■					
	Work one-on-one with producers		■	■	■	■	■	
Implementation	Initiate BMP implementation		■	■	■	■	■	
	Complete Phase I BMP implementation							

COST

The preliminary opinion of total cost of implementing the nonpoint source pollution control strategy for the Decker Creek Target Area is estimated to be $9,438,765 (Table 85). This does not include costs for final designs of engineering projects as these costs would be contingent on project scoping. When possible, costs were determined from the 2018 USDA-NRCS EQIP practice payment schedule (USDA, 2018). These costs are subject to change based on final designs, inflation, bidding climate at the time of construction, and project size and complexity.

Table 95: Implementation costs for the Decker Creek Target Area

Practice	Units	Units Targeted	Unit Cost	Total Cost
Education/Information*	years	5	$ 10,000	$ 50,000
Pet Waste Ordinances/Eduction*	years	5	$ 5,000	$ 25,000
Avoidance practices*	acres	5,060	$ 108	$ 546,480
Contour (filter) buffers	acres	320	$ 500	$ 160,000
Terraces	feet	147,840	$ 4	$ 591,360
Cover crops	acres	4,500	$ 133	$ 598,500
No-till	acres	850	$ 20	$ 17,000
Water and Sediment Control Basins (WASCOB)	feet	55,900	$ 4	$ 223,600
Wetlands	#	27	$ 35,000	$ 945,000
Riparian buffers	acres	30	$ 1,650	$ 49,500
Grazing management	acres	600	$ 42	$ 25,200
OWTS Inspection & Retrofits	#	59	$ 5,500	$ 324,500
Non-Permitted AFO Facility BMP	units	7	$ 20,000	$ 140,000
Grassed Waterways	acre	15	$ 6,575	$ 98,625
SubTotal (Drainage Area Treatment)				**$ 3,794,765**
Streambank/channel stabilization & Restoration	feet	36,960	$ 150	$ 5,544,000
SubTotal (In-Stream Work)				**$ 5,544,000**
Updates to WQMP	each	0	$ -	$ -
Additional monitoring*	years	5	$ 20,000	$ 100,000
SubTotal (Planning/Monitoring)				**$ 100,000**
Total				**$9,438,765**

**Based on estimated costs during first 5-year increment only*

11.04 SPECIAL PRIORITY AREAS

Special priority areas provide flexibility in addressing identified small-scale areas with specific, limited, and timely needs. They address issues that occur widely in the subbasin that may affect not only water quality, but also the health and safety of humans. Additionally, some BMPs do not have specific targeted land uses or an easily defined subwatershed associated with their implementation; thus, these areas do not count towards the 20% Rule.

Some BMPs have a broader appeal and impact on public involvement when implemented on an area-wide basis. Practices are restricted to those necessary to address the specific needs of the special priority area. BMPs address specific issues within areas, many of which cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities. The following special priority areas are relevant to the Lower Platte River Subbasin.

DISTRICT-WIDE SPECIAL PRIORITY AREAS

The following special priority areas were identified as special priority areas for the entire district, therefore, they are discussed in more detail in Chapter 13. No additional discussion is provided in this chapter.

- On-site Wastewater Treatment Systems (OWTS)
- Non-permitted Animal Feeding Operations (AFOs)
- Wellhead Protection Areas (WHP areas)

No other Special Priority Areas were identified within the Lower Platte River Subbasin.

11.05 MONITORING PRIORITIES

Stakeholders identified monitoring priorities. While many of these activities may provide general support towards target area implementation, they would take place separately of any target area implementation or pre/post project monitoring activities. Below are lists of these priorities along with a brief description of each.

DISTRICT-WIDE MONITORING PRIORITIES

The following monitoring priorities are applicable to the entire district; therefore, they are discussed in more detail in Chapter 13. Additionally, other supporting information may be found in Chapter 4. No additional discussion is provided in this chapter.

- Existing BMP Treatment Levels
- Pre-project Monitoring

JENNY NEWMAN LAKE

Based on a review of a recent NGPC water quality report (Blank and others, 2017), additional studies are needed to evaluate possible on-site wastewater system influence in runoff to the lake.

DECKER CREEK

Development of a monitoring plan is needed to better identify bacteria sources in the Decker Creek watershed, which are the highest in the district. This additional monitoring data may help to better identify pollutant sources and target implementation efforts. This would be beyond the scope of traditional pre/post project monitoring. Additional details are found in the Decker Creek Target Area section of this chapter.

11.06 COMMUNICATION AND OUTREACH PRIORITIES

Stakeholders identified communication and outreach priorities. While many of these activities may provide general support towards target area implementation, they would take place separately of any target area communication and outreach activities. Below are lists of these priorities along with a brief description of each.

DISTRICT-WIDE COMMUNICATION AND OUTREACH PRIORITIES

The following communication and outreach priorities are applicable to the entire district; therefore, they are discussed in more detail in Chapter 13. Additionally, other supporting information may be found in Chapter 6. No additional discussion is provided in this chapter.

- LPSNRD Board of Directors
- Rural Water Districts
- County Commissioners
- Village/city governments with WHP areas

No other Communication and Outreach Priorities were identified within the Lower Platte River Subbasin.

11.07 COST SUMMARY FOR TARGET AREAS

As there is only one target area identified within this subbasin, a cost summary is not available. Additional details are found in the Decker Creek Target Area section of this chapter.

CHAPTER 12. KEG-WEEPING WATER CREEK HUC 8 SUBBASIN

12.01 SUBBASIN BACKGROUND

The Keg-Weeping Water Subbasin (HUC 8: 10240001) is the second largest of the three subbasins addressed in this plan. The area is 206,944 acres (planning area is 1,048,774 acres) and consists primarily of Cass County (Figure 109). Land use/land cover in this subbasin is dominated by agriculture, with 73% of the subbasin area dedicated to row crops (corn/soybean). There are several small urban areas throughout the subbasin which make up a total of 2% of the subbasin area. Remaining land use is divided amongst forest (10%); grass/pasture (7%); and small amounts of open water, wetlands, or other perennial vegetation.

No target areas were identified within this subbasin, therefore this chapter is intended to focus primarily on the special priority areas identified within the Keg-Weeping Water HUC 8 subbasin. Little discussion is given to the rest of the subbasin here, as much of that information can be found throughout the rest of this plan. Information on an inventory of subbasin characteristics is found in the following chapters/sections within this plan:

- Land Use: Chapter XX
- Existing land treatment (BMPs): Chapter XX
- Irrigation: Chapter XX
- Permitted facilities: Chapter XX
- Existing resource conditions: Chapter XX

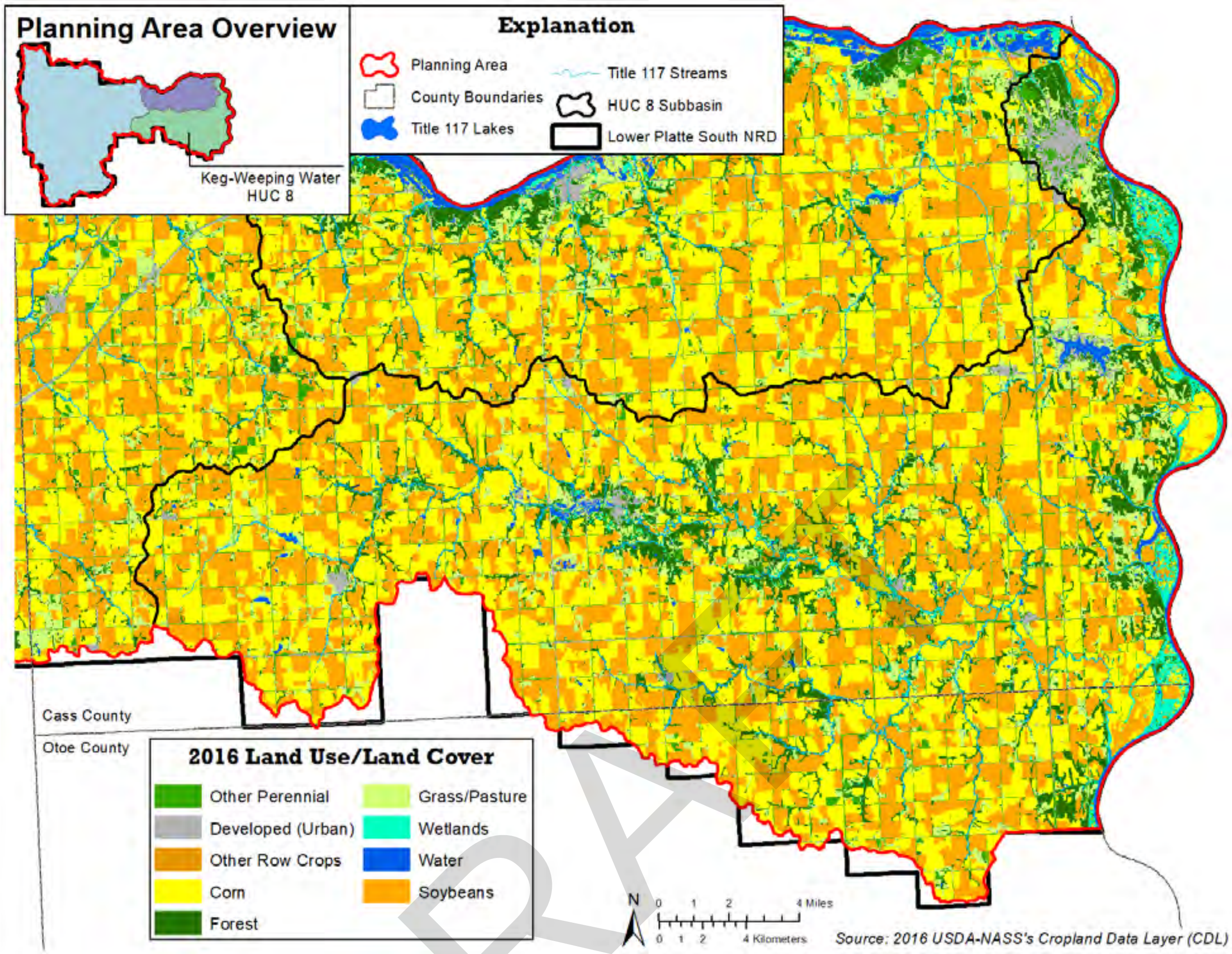


Figure 109: Land Use/Land Cover Within the Keg-Weeping Water HUC 8 Subbasin

12.02 OVERVIEW OF PRIORITIES

As discussed in Chapter XX, target areas and special priority areas were selected through a review of water quality data and stakeholder input. As shown in Figure 110, the following areas within this subbasin have been selected for focused implementation efforts:

Target Areas

- No target areas were identified in the Keg-Weeping Water Subbasin.

Special Priority Areas

- Wellhead Protection Areas (WHP areas)
- On-site Wastewater Treatment Systems (OWTS)
- Non-permitted Animal Feeding Operations (AFOs)

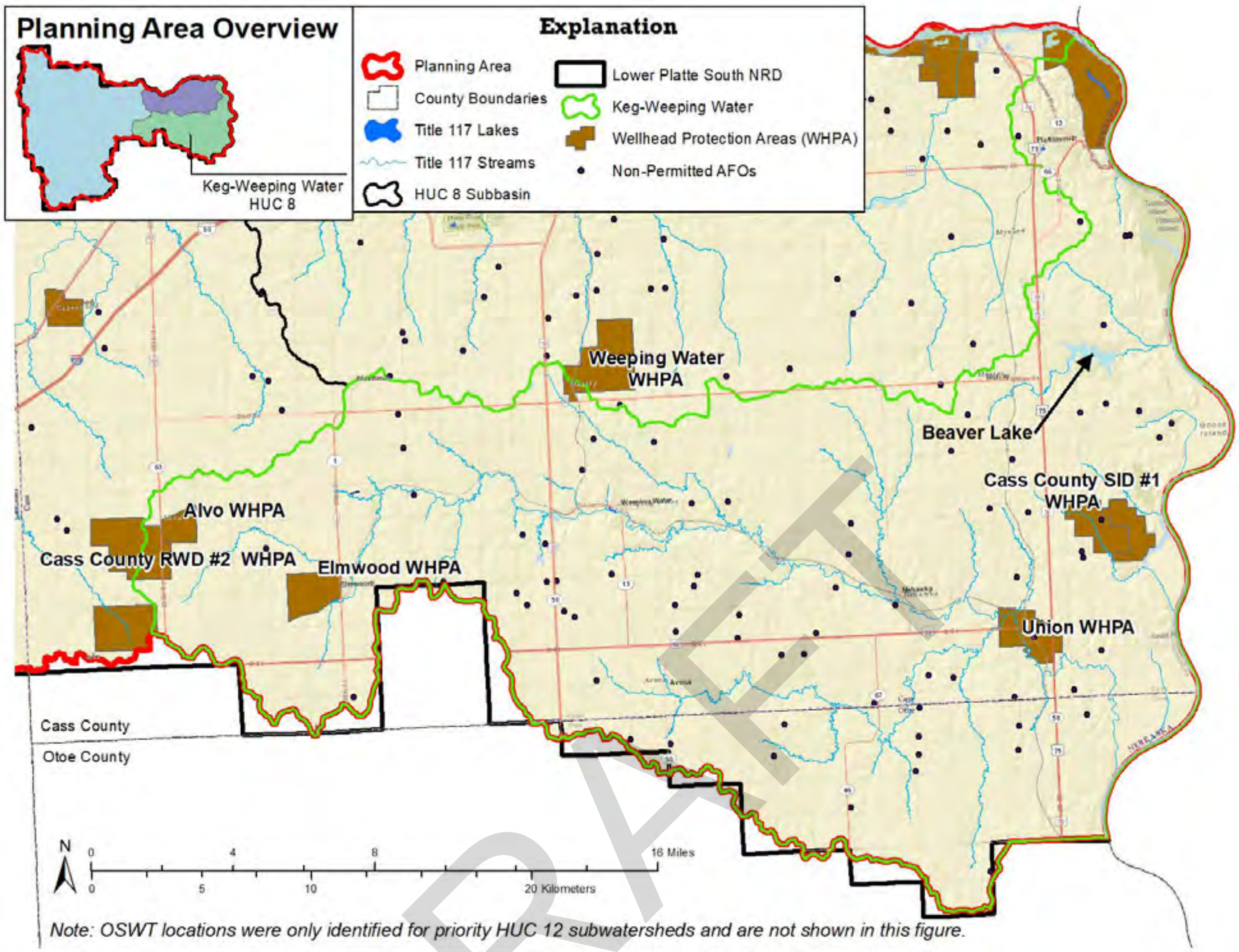


Figure 110: Special Priority Areas Within the Keg-Weeping Water HUC 8 Subbasin

12.03 SPECIAL PRIORITY AREAS

Special priority areas provide flexibility in addressing identified small-scale areas with specific, limited, and timely needs. They address issues that occur widely in the subbasin that may affect not only water quality, but also the health and safety of humans. Additionally, some BMPs do not have specific targeted land uses or an easily defined subwatershed associated with their implementation; thus, these areas do not count towards the 20% Rule.

Some BMPs have a broader appeal and impact on public involvement when implemented on an area-wide basis. Practices are restricted to those necessary to address the specific needs of the special priority area. BMPs address specific issues within areas, many of which cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities. The following special priority areas are relevant to the Keg-Weeping Water Subbasin.

WELLHEAD PROTECTION AREAS

NDEQ's Wellhead Protection Program is a voluntary program that help community water systems protect groundwater through a series of steps that include delineation and mapping of the Wellhead Protection (WHP) areas. This plan recognizes WHP areas as special priority areas due to the influence a WHP area has on the management needs of source water aquifers and associated public drinking water systems. WHP areas within the planning area are identified in Chapter XX.

Pollutant management in WHP areas typically focuses on nitrate-nitrate (nitrate) contamination of groundwater. Nitrates are known to cause a disease called methaemoglobinaemia (or "blue baby syndrome") with infants. Carcinogenic compounds have also been known to become more prevalent when there are high levels of nitrates in drinking water. While low levels of nitrates in groundwater can occur naturally, the major source of nitrates in agriculturally dominated areas, such as this subbasin, are nitrogen fertilizers. Completion of WHP plans for each area is a priority, as well as any BMPs which target groundwater quality. These would include but are not limited to: Fertilizer at Agronomic Rates, Irrigation Water Management, and Cover Crops.

ON-SITE WASTEWATER TREATMENT SYSTEMS

Illicit connections, discharges, sanitary sewer overflows, straight pipes from septic tanks, failing septic systems, or other failing on-site wastewater treatment systems (OWTS) can be sources of *E. coli* bacteria and nutrients contamination. Under Title 124 Chapter 3, NDEQ requires individuals doing work associated with OWTSs to be certified by the State of Nebraska, and requires that all systems constructed, reconstructed, altered, or modified to be registered (NDEQ, 2012). Registration requirements did not exist for systems installed prior to 2001; therefore, the precise number of septic systems, including failing systems, is not possible to determine. The OWTS education and retrofit BMP is targeted at this special resource area and includes pumping, inspection, and replacement of OWTS systems installed before 2004.

NON-PERMITTED LIVESTOCK FACILITIES

AFOs confining less than the equivalent of 300 beef cattle are considered administratively exempt from inspection and permitting unless they have a history of discharging or the potential to discharge pollutants to Waters of the State. For the purposes of this plan, permitted AFOs (typically medium and large operations) are not considered to be a pollutant source due to regulatory requirements. Non-permitted (typically small) AFOs do not have regulatory requirements imposed on them and are thus treated as potential nonpoint sources of pollution for management recommendation purposes. Non-permitted AFOs may contribute to bacteria, nutrient, and sediment pollution due to runoff from areas with a high density of livestock and minimal perennial vegetation or groundcover.

Almost all livestock operations have the potential to adversely affect water quality; however, non-permitted livestock facilities are not required to maintain BMPs. Non-permitted livestock facilities are identified as a special priority area in order to provide a proactive approach to livestock waste treatment, while also demonstrating appropriate treatment technologies and BMPs. Only operations that are exempted by regulations or are deemed exempt by NDEQ are included. BMPs include all of those identified under the “Non-permitted AFO Facility BMPs” practice suite:

- Animal waste/manure storage systems
- Clean water diversion systems
- Vegetative treatment systems (VTS)
- Terraces
- Containment
- Evaporation ponds
- Open lot runoff management
- Heavy use area protection
- Feed management practices

12.04 MONITORING PRIORITIES

Existing BMP Treatment Levels – Gathering more site-specific information is needed on the level of implementation of BMPs across the planning area. This would ideally include an inventory of existing structural BMPs, identified via aerial imagery and/or LiDAR data; and non-structural BMPs, likely identified through surveys.

12.05 COMMUNICATION AND OUTREACH PRIORITIES

Beaver Lake – Beaver Lake is a private lake community that uses surface water for its drinking water supply. The reservoir was formed by building a dam across Rock Creek, just east of the Village of Murray. Utilizing surface water for drinking water poses a unique threat due to the possibly of blue-green algae blooms and associated elevated levels of microcystin toxins, which pose human health hazards. The project team prioritized Information and Education (I&E) activities for both in-lake management and watershed management to mitigate the possibilities of eutrophication which often leads to these dangerous algae blooms.

Village/City Governments with WHP Areas - These decision makers are responsible for approving funds and projects within their specific jurisdiction. The planning team will work with them through targeted I&E efforts related to nonpoint source pollution and source water management.

LPSNRD Board of Directors – The Board was identified as a target for education on the various water quality issues and priorities as identified in this plan. The Board must fully understand what is in this plan if it is expected to take action on the implementation activities within it.

Rural Water Districts – These organizations are responsible for providing safe drinking water to many rural citizens, outside the purview of municipal or county government structures. The planning team will work with them through targeted I&E efforts related to nonpoint source pollution and source water management.

County Commissioners – These decision makers are responsible for approving funds and projects within their specific county. These entities must fully understand what is in this plan if they are expected to take action on the implementation activities within it.

12.06 MASTER COST SUMMARY

Cost estimates are only completed for target area activities. Therefore, no cost estimates are provided for the Keg-Weeping Water Subbasin. Cost estimates for the installation of BMPs at special priority areas will be identified in WHP plans and/or made on a project level basis.

CHAPTER 13. BASIN-WIDE IMPLEMENTATION STRATEGY

THIS CHAPTER IS A SUMMARY OF ALL RECOMMENDATIONS AND ACTIONS IDENTIFIED IN THE PLAN. IT WILL BE COMPLETED ONCE THE FULL PLAN HAS BEEN REVIEWED.

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APPENDIX XX: BMP CALCULATOR TOOL

APPENDICES WILL BE COMPILED AND FINALIZED AFTER DRAFT REVIEW. MATERIALS ARE AVAILABLE UPON REQUEST.

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