District Wide Water Quality Management Plan

Upper Big Blue NRD

March 2020

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Upper Big Blue

Natural Resources District

District-Wide
Water Quality Management Plan

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Acknowledgements
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Prepared for: Upper Big Blue Natural Resources District

Prepared by: JEO Consulting Group, Inc.

JEO Project Number: 161356.00

This water quality management plan was prepared to guide the Upper Big Blue Natural Resources District in developing and implementing future projects to improve water quality, hydrology, and aquatic resources within their District. The plan may also serve as a basis for seeking financial support for those projects. It has been written with guidance published in EPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters," updated March 2008, including EPA's Nine-Elements of a Successful Watershed Plan; as well as Guidance for Writing Basin Management Plans, updated November 2016. The planning process utilized a Community Based Approach.

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ACEP	Agricultural Conservation Easement Program
ACPF	Agricultural Conservation Planning Framework
ACS	U.S. Census Bureau's American Community Survey
ACT	Avoid, Control, Trap
AFO	Animal Feeding Operation
AWS	Agricultural Water Supply
BMP	Best Management Practice
BOC	Bureau of the Census (US Census Bureau)
BUL	Biologically Unique Landscapes
CDL	Cropland Data Layer
CFS	Cubic Feet per Second
CFU	Colony Forming Units
CIG	Conservation Innovation Grants
CLEAR	Community Lakes Enhancement and Restoration Program
Clearinghouse	Quality-Assessed Agrichemical Contaminant Database for Nebraska Groundwater
CP	Conservation Practices
CRP	Conservation Reserve Program
CSA	Critical Source Area
CSD	University of Nebraska Conservation and Survey Department
CSP	Conservation Stewardship Program
CWA	Cold Water A
CWB	Cold Water B
CWP	Cooperative Water Program
CY	Cubic Yard
DHHS	Nebraska Department of Health and Human Services
District	Upper Big Blue Natural Resources District
DST	Decision Support Tools
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FA	Fully-Appropriated
FEMA	Federal Emergency Management Agency
FFA	Future Farmers of America
FHWA	Federal Highway Administration
FIS	Flood Insurance Study
GIS	Geographic Information System
HCA	Hydrologically Connected Area
HFRP	Healthy Forests Reserve Program
HSG	Hydrologic Soil Group
HUC	Hydrologic Unit Code
I&E	Information and Education

IMP	Integrated Management Plan
IPM	Integrated Pest Management
IR	Integrated Report
IWS	Industrial Water Supply
JEO	JEO Consulting Group, Inc.
LID	Low Impact Development
LWCF	Livestock Waste Control Facility
MCL	Maximum Contaminant Level
Mg/L	Milligram per liter
MST	Microbial Source Tracking
NASS	National Agriculture Statistics Service
NCEI	National Centers for Environmental Information
NDA	Nebraska Department of Agriculture
NDEE	Nebraska Department of Environment and Energy
NDEQ	Nebraska Department of Environmental Quality
NDOT	Nebraska Department of Transportation
NeDNR	Nebraska Department of Natural Resources
NET	Nebraska Environmental Trust
NFS	Nebraska Forest Service
NGPC	Nebraska Game and Parks Commission
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	Natural Resources Commission
NRCS	Natural Resources Conservation Service
NRD	Natural Resources District
NRWQF	Natural Resources Water Quality Fund
NWI	National Wetland Inventory
NWQI	National Water Quality Initiative
NWS	National Weather Service
OA	Over-Appropriated
OWTS	Onsite Wastewater Treatment System
PCB	Polychlorinated Biphenyl
PCR	Primary Contact Recreation
PDW	Public Drinking Water
PIP	Project Implementation Plan
Ppm	Parts per Million
QAPP	Quality Assurance Project Plan
RCPP	Regional Conservation Partnership Program
RTP	Recreational Trail Program
RWB	Rainwater Basin
RWBJV	Rainwater Basin Joint Venture
SFR	Sport Fish Restoration Program

SHC	Strategic Habitat Conservation
SIPES	Social Indicator Planning and Evaluation System
SPA	Special Priority Area
SRF	State Revolving Fund
STEPL	Spreadsheet Tool for Estimating Pollutant Load
SWG	State Wildlife Grant Program
T&E	Threatened and Endangered
TAC	Technical Advisory Committee
TIGER	Topological Integrated Geographic Encoding and Referencing
Title 117	Nebraska Administrative Code Title 117
TMDL	Total Maximum Daily Loads
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UBBNRD	Upper Big Blue Natural Resources District
UNL	University of Nebraska-Lincoln
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VHS	Viral Hemorrhagic Septicemia
VIMP	Voluntary Integrated Management Plan
VTS	Vegetative Treatment System
WASCOB	Water and Sediment Control Basin
WBD	Watershed Boundary Dataset
WFPO	Watershed and Flood Prevention Operations Program
WHP	Wellhead Protection
WQMP	Water Quality Management Plan
WQP	Water Quality Portal
WQS	Water Quality Standards
WSF	Water Sustainability Fund
WWA	Warmwater A
WWB	Warmwater B
WWTF	Wastewater Treatment Facility

PLANNING PARTICIPANTS

TECHNICAL ADVISORY COMMITTEE

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- Marie Krausnick, Water Department Manager
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- John Miller, Projects Committee Chairman
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S&P IRRIGATION

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RAINWATER BASIN JOINT VENTURE

- Andy Bishop, Coordinator

STAKEHOLDER ADVISORY COMMITTEE

A Stakeholder Advisory Committee was formed through local solicitations and nominations. A total of eighteen stakeholders agreed to participate in this process, as listed below, representing a diverse cross-section of the community with a variety of interests in water, including agricultural, environmental, municipal, and medical.

- Bill Whitney, Prairie Plains Institute
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- Brandon Hunnicutt, Farmer
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- Dan Aspergren, Farmer
- Greg Whitmore, Farmer
- Jason Perdue, Farmer
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- John Denton, Ducks Unlimited
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- Luke Jacobsen, Farmer
- Mark Bailey, Farmer
- Marty Stange, Environmental Supervisor
- Mick Goudeken, Central Valley Ag
- Steve Driewer, GPM Enterprises Inc.
- Teresa Otte, Farmer
- Tim Richtig, City of Seward
- Tom Weber, Farmer

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EXECUTIVE SUMMARY

PLAN SUMMARY

The Upper Big Blue Natural Resources District (UBBNRD), with technical and financial assistance from the Nebraska Department of Environment and Energy (NDEE), (formerly the Nebraska Department of Environmental Quality (NDEQ)), has prepared a District-Wide Water Quality Management Plan (WQMP) to address issues and present solutions regarding nonpoint source pollution within the UBBNRD. The WQMP planning area is intended to align with the UBBNRD boundary as closely as possible, while following watershed boundaries. The plan is required to be updated every five years.

Stakeholders and the general public were engaged throughout the planning process to identify issues and solutions, which were then used to develop goals and objectives for the plan. This effort produced a voluntary plan which advises the UBBNRD by providing a framework of planning activities, identifies strategies to address and meet water quality standards, and identifies target areas where more detailed planning was completed. Target areas (which are summarized in Table ES1 and Figure ES1) were determined based on the land area that impacts the water quality of priority waterbodies which were selected based on stakeholder input and analysis of water quality data.

A STRATEGY TO INCREASE CONSERVATION

The plan relies on the following strategies:

- Utilize a voluntary approach, rooted in outreach and education
- Promote soil health, which increases productivity and profitability for producers
- Promote an improved efficiency in the use of manure, commercial fertilizers, and pesticides
- Promote the adoption of BMPs to reduce the potential for pollutant transport to surface water and groundwater
- Promote wetlands as part of a healthy, productive, landscape
- Promote healthy, undisturbed riparian areas, including adequately sized buffers to protect streambanks from runoff
- Promote the benefits of water quality improvements throughout the Target Areas

This plan emphasizes that effective outreach, education, and involvement of those responsible for land management decision is critical to facilitate behavioral changes. This includes outreach and education to producers, farm managers, property owners, land managers, water users, and the general public. This plan is non-regulatory; therefore, the success of this plan depends on the engagement and education of participants. Emphasizing the value and benefits of improved water quality will be key to the acceptance and implementation of this plan.

FUNDING FOR IMPLEMENTATION

Funding will be critical to implement this WQMP. The planning level opinion of cost for needed improvements to achieve water quality goals in identified target areas is estimated at over $73 million. Local funding (from the UBBNRD) will not be enough to address a problem of this magnitude, nor will it be solved in just five years. Therefore, prioritization of target areas or projects by the Board of Directors will be essential in focusing efforts. Additional funding form federal, state, and other local sources, along with grants, will need to be leveraged. This plan makes the UBBNRD eligible for Section 319 grant funding from the NDEE, which will be an important funding tool for implementation efforts.

Both district-wide and targeted implementation efforts to address sediment, nutrients, bacteria, and atrazine will be accomplished primarily through existing programs administered by the UBBNRD, NRCS, and other partners. Generally, these programs provide landowners and producers, both in and outside of target areas, access to technical and financial assistance. To enable targeted implementation, these programs (to the greatest extent possible) will be focused within target areas.

A ROADMAP TO CLEANER WATER

This planning document serves as a roadmap to improve the water resources and water quality within the UBBNRD. Specific projects were not identified, however the recommended type, number, and location of best management practices (BMPs) were identified. The implementation of these BMPs is intended to be accomplished through multiple projects. The focus of each of those projects should be determined by the UBBNRD Board of Directors at the time they are ready to move forward. Some examples of project types to consider are:

- A project that provides cost-share on the full list of BMPs within a specific target area.
- A project that provides higher cost-share on select BMPs or for BMPs within critical source areas.
- A project that focuses on implementing only certain types of BMPs.

SUMMARY OF TARGET AREAS

Table ES1: Summary of Target Areas

Target Area Name	Water Quality Impairment	Recommended Practices	Recommended Data Collection	Total Area (acres)	Total Estimated Cost
Recharge Lake	Nutrients	Drainage Area Practices In-Stream Practices In-Lake Practices	Bathymetric Survey Nutrient monitoring Sediment monitoring Atrazine monitoring	8,549*	$5,954,280
Beaver Creek	Atrazine	Drainage Area Practices In-Stream Practices Urban Practices	Atrazine monitoring	193,015**	$67,387,900

** Recharge Lake target area is located inside Beaver Creek target area.*
*** Although two segments of Beaver Creek have been identified as priority waterbodies, their combined drainage area is treated as a single target area.*

Drainage Area Practices:

Education and Outreach, Onsite Wastewater Treatment System Upgrades, Pet Waste Pick-Up, Working Lands Management, Irrigation Water Management, Grazing Lands Management, Cover Crops, Riparian Buffers, No-Till, Reduced-Till, Contour Buffer Strips, Non-Permitted AFO Facility BMPs, Constructed Wetlands, Wetland Restoration, Terraces, Water & Sediment Control Basins, Grassed Waterways, Land Use Change

In-Stream Practices:

Streambank/Channel Stabilization and Restoration

In-Lake Practices:

Wet Detention Pond, In-Lake Wetland, Reservoir Deepening / Sediment Removal, Shorline Stabilization

Urban Practices:

Education and Outreach, Pet Waste Pick-Up, Urban Stormwater BMPs

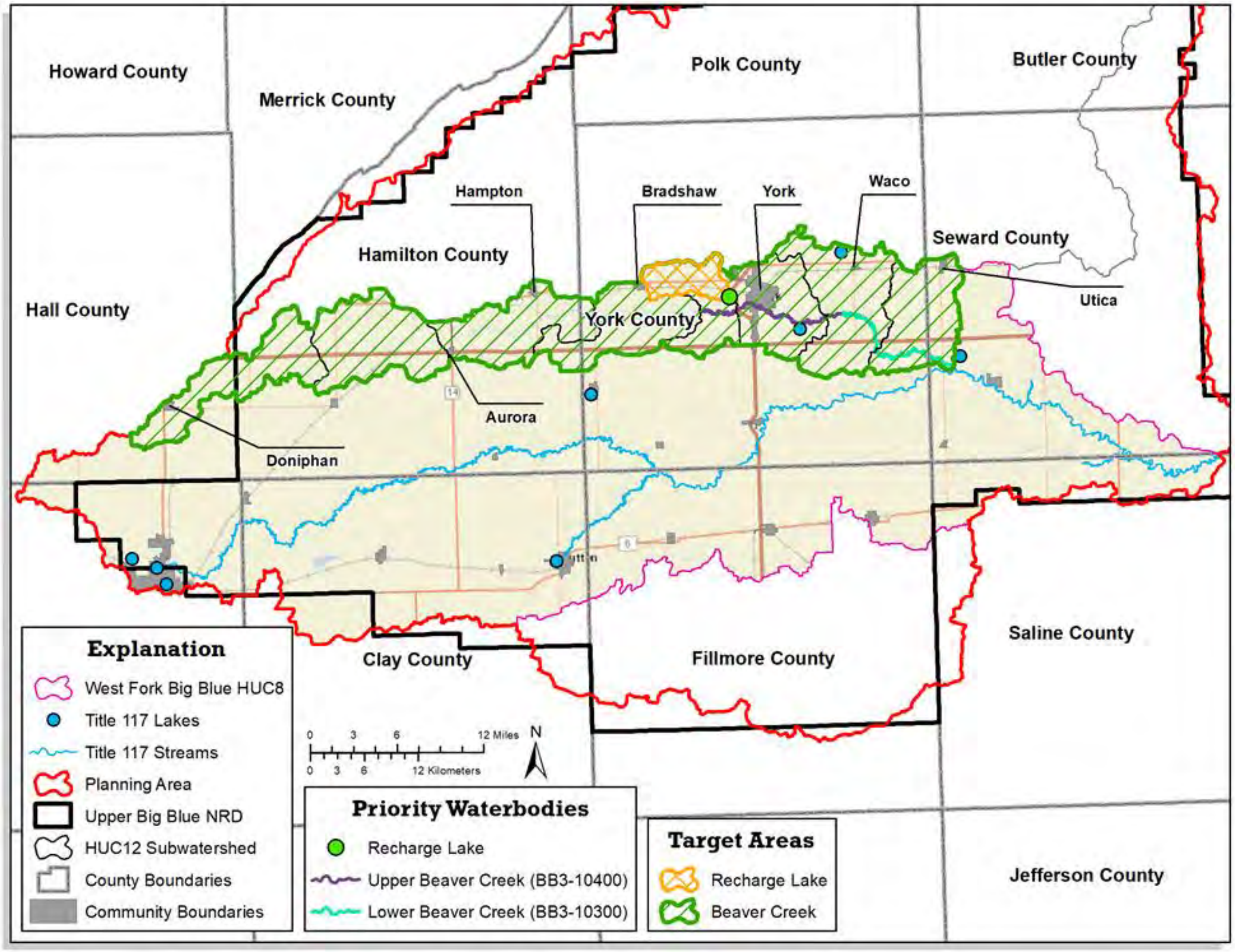

Figure ES 1: Summary of Target Areas

CHAPTER 1. INTRODUCTION AND BACKGROUND

1.01 PLAN PURPOSE

The Upper Big Blue Natural Resources District (UBBNRD) District-Wide Water Quality Management Plan (WQMP) is intended to provide a concise summary on water resource conditions in the UBBNRD, as well as offer direction for a coordinated approach to address nonpoint source pollution. The WQMP is based upon the United States Environmental Protection Agency's (EPA) Nine-Elements of Watershed Planning (USEPA, 2008), as well as basin planning guidance provided by the Nebraska Department of Environment and Energy (NDEE), (formerly the Nebraska Department of Environmental Quality (NDEQ)) (NDEQ, 2016).

The WQMP provides one overarching plan that will identify and focus on district-wide priorities. Once the plan is in place, efforts can be directed towards project development and funding acquisition. District-wide plans provide numerous benefits including: allowing access to NDEE Section 319 funding for groundwater and surface water projects; enhancing project buy-in and grant funding potential by integrating UBBNRD priorities with other natural resource agency and community priorities; providing supporting information for project and grant application development; and aiding in UBBNRD and partner agencies in budget planning. This plan also reflects the input and support given by stakeholders during the planning process.

This WQMP documents specific projects intended for implementation over the next five years. These projects and practices are aimed at improving water quality and removing targeted waterbodies from NDEE's List of Impaired Waters (Section 303(d) List).

1.02 PREVIOUS PLANNING EFFORTS

The UBBNRD and other partners have a long history of managing water quality and completing watershed-based projects. There have been numerous projects, plans, and programs developed to address these issues, some of which are listed below. While many included water quality, others focused only on water quantity. However, many of these projects lack the EPA's "Nine-Elements" of a watershed plan (discussed in more detail below). Even with these differences, these existing efforts provide a valuable framework and source of information for this plan.

Previously Developed Related Plans and Reports:

- Integrated Management Plan for the Fully Appropriated Area of the Upper Platte River Basin in the Upper Big Blue NRD, 2010
- Recharge Lake Atrazine – various studies in in the 1990s (UBBNRD, US Bureau of Reclamation, and UNL Extension)
- Project GROW (UBBNRD and City of York), started in 2017
- Special Protection Area Groundwater Quality Project: 1995 – 1999
- Wellhead Protection Area Assistance Program: 1999 - 2005

1.03 PLANNING AREA

OVERVIEW

The WQMP area is intended to match the UBBNRD boundary as closely as possible, while following watershed boundaries. Therefore, the actual plan area boundary doesn't coincide exactly with the UBBNRD boundary (Figure 1). The plan boundaries generally follow four subbasins: Middle Big Blue, Turkey, Upper Big Blue, and West Fork Big Blue.

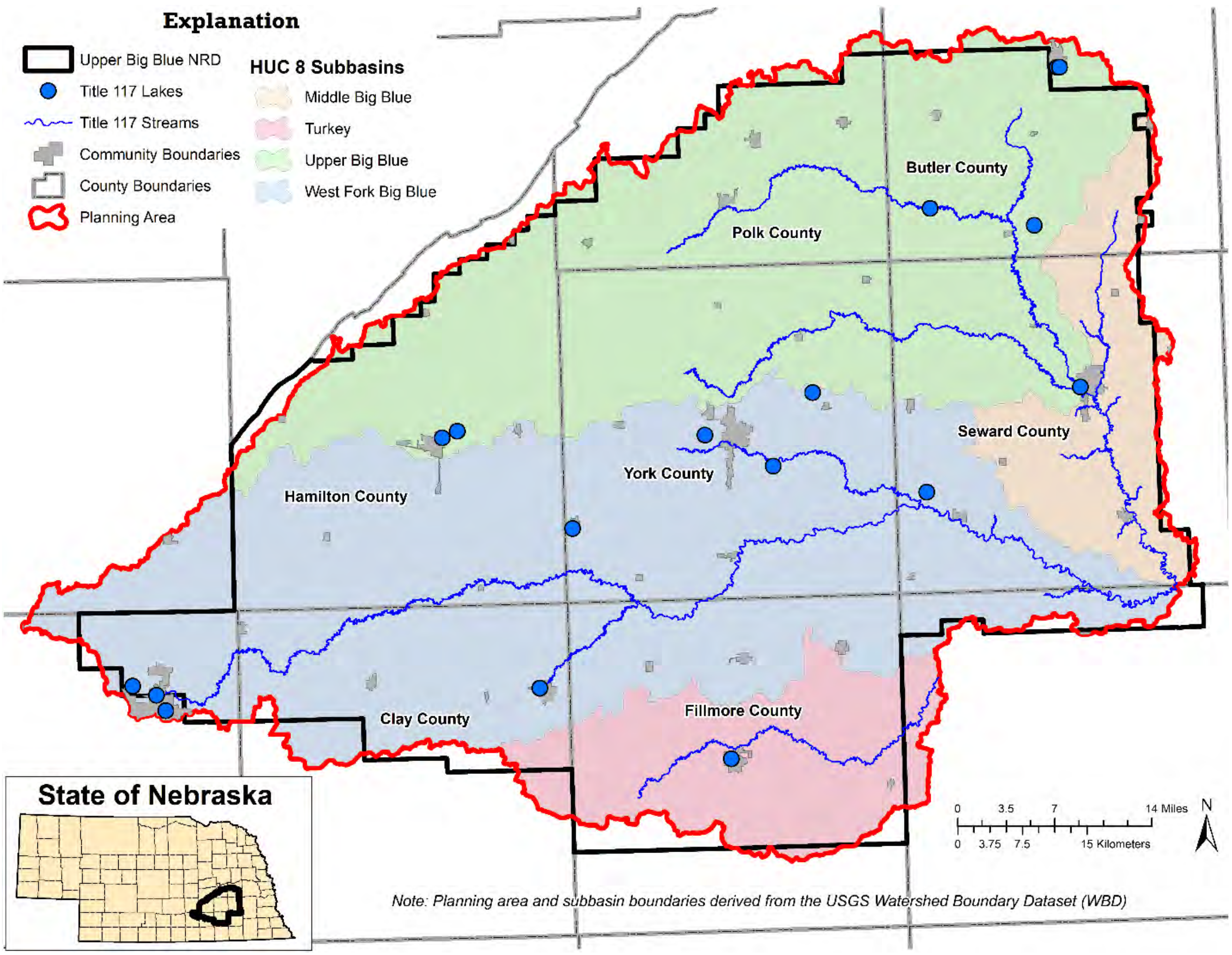

Figure 1: Plan Boundary

Watershed boundaries in the plan, unless noted otherwise, are derived from the Watershed Boundary Dataset (WBD), which is maintained by the United States Geological Survey (USGS), in cooperation with the Natural Resources Conservation Service (NRCS). The WBD is a nationally standardized database of multi-level watershed boundaries, each of which is assigned a hierarchical hydrologic unit code (HUC) number. The WBD is divided into six levels of HUCs, the boundaries of which are determined by science-based hydrologic principles without consideration for political or administrative boundaries (USGS, 2018b).

The WQMP is based upon major HUC 8 subbasins, which also serve as the basis for the planning document's organization. The boundaries for this plan were developed based on NDEE basin planning guidance (NDEQ, 2015b), which instructs plan sponsors to include a chapter for each of the HUC 8 subbasins within the planning area with targeted areas making up no more than 20% of an individual HUC 8. The most up-to-date WBD data set for Nebraska was downloaded (4/24/2018) from the NRCS Geospatial Data Gateway to accurately identify the planning area boundaries. This plan's boundaries are based upon the full or partial boundaries of four HUC 8 subbasins: portions of the Middle Big Blue (151,104 acres) and Turkey Creek (191,457 acres), and the entirety of the Upper Big Blue (708,458 acres) and West Fork Big Blue (857,200 acres). More specifically, the boundaries follow all, or portions of, the following HUC 10 or HUC 12 watersheds, which are nested within each of the HUC 8's:

- HUC 8 Subbasin: Middle Big Blue (10270202)
  - Plum Creek-Big Blue River: 1027020201 (All)
- HUC 8 Subbasin: Turkey (10270204)
  - Headwaters Turkey Creek: 1027020401 (All)
  - No Name: 102702040301 (All)
  - City of Milligan: 102702040302 (All)
  - Turkey Creek Cemetery: 102702040303 (All)
- HUC 8 Subbasin: Upper Big Blue (10270201)
  - Headwaters Big Blue River: 1027020101 (All)
  - Headwaters Lincoln Creek: 1027020102 (All)
  - Outlet Lincoln Creek: 1027020103 (All)
  - North Branch Big Blue River: 1027020104 (All)
  - Outlet Big Blue River: 1027020105 (All)
- HUC 8 Subbasin: West Fork Big Blue (10270203)
  - North Branch West Fork Big Blue River: 1027020301 (All)
  - School Creek: 1027020302 (All)
  - Upper West Fork Big Blue River: 1027020303 (All)
  - Beaver Creek: 1027020304 (All)
  - Middle West Fork Big Blue River: 1027020305 (All)
  - Lower West Fork Big Blue River: 1027020306 (All)

Efforts were made to minimize splitting any WBD boundaries. This was generally achieved by utilizing HUC 10 boundaries to define the planning area. One particular area of note is the eastern-most boundary of the Turkey Creek watershed, where several HUC 12 boundaries were used.

BASIN SUMMARY

The UBBNRD is located in southeast Nebraska and covers approximately 1,830,000 acres, including all or portions of Adams, Butler, Clay, Fillmore, Hamilton, Polk, Saline, Seward, and York counties. The planning area also includes a portion of Hall County, which is outside of the UBBNRD boundary. According to 2016 data from the US Census Bureau (BOC), the population of the planning area is approximately 71,517, which includes both rural residents and residents of 49 communities (BOC, 2016). The UBBNRD serves diverse rural and urban interests, as 92% of the land is used for agriculture, but 96% of the population is found in communities. Further details on the characteristics of the plan area are shown in Table 1.

Table 1: Plan Area Characteristics

Plan Area Component	Component Details
EPA Region	VII
8-digit Hydrologic Unit Code (HUC)	1) Upper Big Blue (10270201) 2) Middle Big Blue (10270202) 3) West Fork Big Blue (10270203) 4) Turkey Creek (10270204)
Counties	Adams, Butler, Clay, Fillmore, Hamilton, Polk, Saline, Seward, York
Tribes	None
Location of UBBNRD Office	York, NE
Latitude/longitude (UBBNRD Office)	40.887354 / -97.589259
Estimated Population (year)	71,517 (2016)
Plan Area Boundary Size	1,716,761 acres
Basin length/width	70 miles / 50 miles
Major river watershed	Big Blue River
Major streams	Big Blue River, West Fork Big Blue River, Lincoln Creek
Major economic activity	Industry, commercial, and agriculture
Major crops	Corn, soybeans
Major livestock	Cattle, swine
TMDL pollutants	*E. coli* Bacteria and Atrazine
Other Pollutants of Concern	Sediment and Nutrients (Phosphorus and Nitrogen)
Lake designated uses (number of applicable lakes)	Recreation (16) Aquatic Life (16) Public Drinking (0) Aesthetic (16) Industrial (0)
Stream designated uses (number of applicable stream segments),	Recreation (4) Aquatic Life (26) Drinking Water (0) Agriculture (26) Industrial (0) Aesthetic (26)
State Resource Waters	None
Cool Water Streams or Lakes	None

1.04 PLANNING PROCESS SUMMARY

HISTORY AND FUNCTION OF NRDS

Nebraska is unique in the United States regarding its watershed-based natural resources management system. With the establishment of the state's Natural Resources Districts (NRDs) in 1972 (which are based upon major river basins), local communities were empowered to protect, enhance, conserve, and restore their natural resources at a local level. NRDs are statutorily recognized government authorities governed by locally elected board members. Each NRD's board of directors oversees staff that perform their duties to meet the purposes of their NRD. The UBBNRD is highlighted in Figure 2, which illustrates the location of all the NRDs in relation to major river basin boundaries.

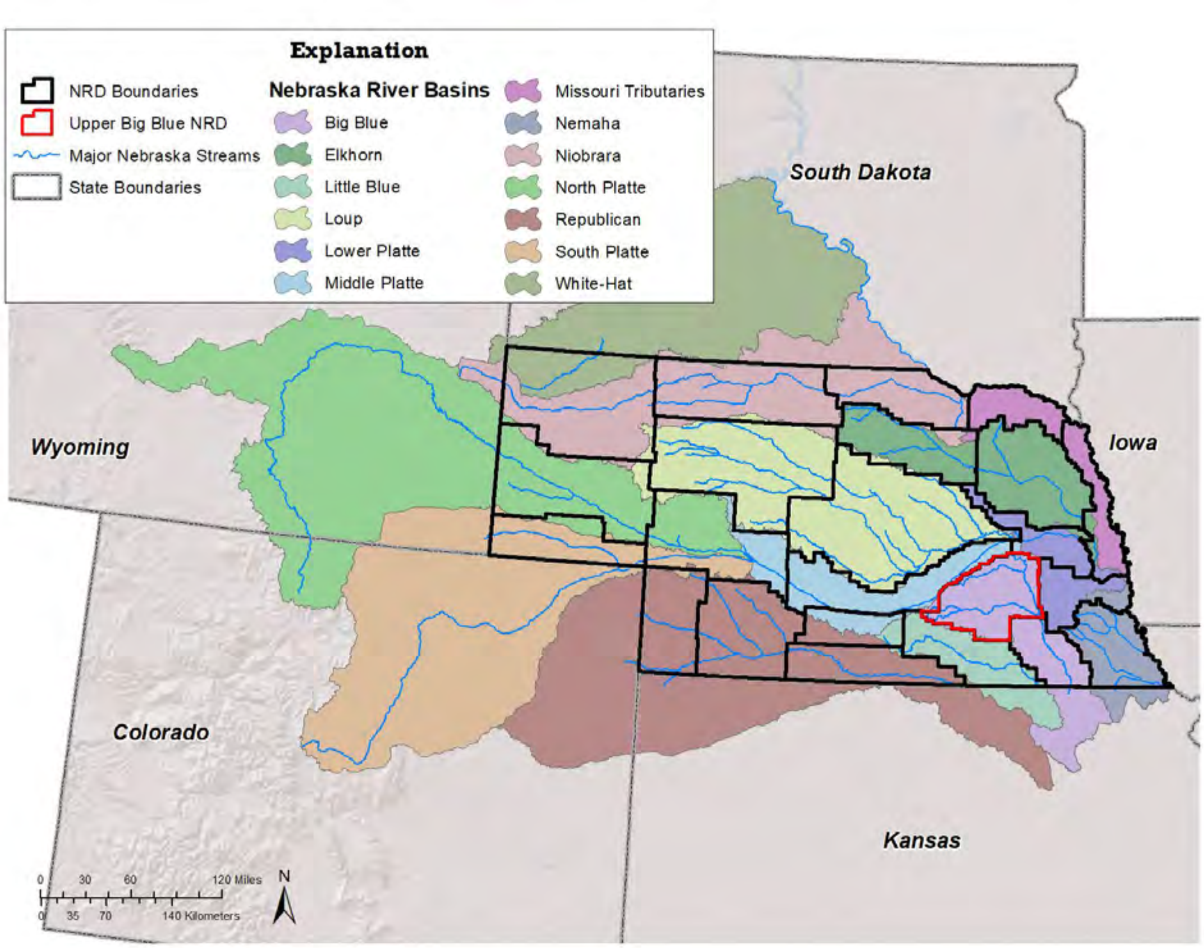

Figure 2: Nebraska's Natural Resources Districts

Watershed planning, which is a flexible framework for managing natural resources within specified drainage areas (watersheds), is a natural fit for the NRD system. NRDs develop and implement watershed-based plans at a local level, which are driven by stakeholder and community involvement and lead to long-term, proactive actions supported by science.

Using a watershed approach to restore impaired water bodies is beneficial because it addresses problems in a holistic manner. Stakeholders and citizens were actively involved in selecting management strategies for this plan, thereby ensuring they are more likely to be successfully implemented going forward.

NEBRASKA'S NONPOINT SOURCE MANAGEMENT PROGRAM

NDEE is responsible for implementing the United States Clean Water Act Section 319 Program for the State of Nebraska. This program focuses on the control of nonpoint sources of water pollution for water bodies to meet their beneficial uses. NDEE's Nonpoint Source Management Program is guided by the *State Nonpoint Source Management Plan 2015 – 2030* (NDEQ, 2015a). This WQMP has been written to not only address local concerns, but also advance the goals and objectives laid out in the State Nonpoint Source Management Plan. The NDEE was an integral partner in developing this WQMP.

NINE-ELEMENTS OF WATERSHED PLANNING

This WQMP addresses the EPA's Nine-Elements, as defined in their *Handbook for Developing Watershed Plans to Restore and Protect our Waters* (USEPA, 2008). Items that directly address one of the Nine-Elements are marked with a graphic throughout this plan, as displayed to the left. The EPA requires that the watershed projects receiving Section 319 funds be supported by either a watershed plan that addresses the Nine-Elements or an equivalent plan. Table 2 also provides the reader a shortcut to the location of each element within this plan.

Table 2: Location of Nine Elements within the Plan

Element	Page Number
Pollution/impairment source identification	108, 113, 115, 117, 153
Estimate of pollutant loading reduction needs	181, 280
Nonpoint source management practices needed	150, 150
Public information, education, and participation	7, 11, 131
Schedule for implementing management practices	181, 276
Milestones to track progress in implementing the plan	181, 277
Criteria to evaluate effectiveness of management practices	275
Monitoring to evaluate the impact of implementing management practices	81
Technical and financial resource needs	155, 278

NOTE: The implementation plans for each target area (Chapter 11) also address the nine-elements but are not included in this table.

STAKEHOLDER PARTICIPATION AND PLANNING PROCESS

Bringing together people, policies, priorities, and resources through a watershed approach blends science and regulatory responsibilities with social and economic considerations. Because watersheds typically don't follow political boundaries, gathering input from stakeholders and the general public is an important part of the planning process. Successful development and implementation of a WQMP depends primarily on the commitment and involvement of community members. Therefore, it was critical to build partnerships with key interested parties at the beginning of the planning effort.

Public involvement was a cornerstone in the development of the WQMP. Citizens, non-profit organizations, landowners, and other residents within the watershed all possess first-hand experience with the challenges faced in maintaining water quality and the success or failure of projects within the NRD. Their experience and knowledge will continue to be a vital element in identifying opportunities, creating partnerships, and completing projects for the future implementation of this plan.

The UBBNRD began the process of developing the WQMP with the establishment of a Technical Advisory Committee (TAC), which included representatives from the UBBNRD, Nebraska Department of Agriculture (NDA), UNL Extension, private irrigation companies, NRCS, Rainwater Basin Joint Venture (RWBJV), and the consultant, JEO Consulting Group, Inc. (JEO). The TAC was tasked with guiding the planning process; reviewing the plan and other technical analysis; and providing input in regard to agency priorities and capabilities. The TAC first met on May 21, 2018. JEO was contracted to guide and facilitate the planning process and to assemble the plan. Rod DeBuhr, UBBNRD Assistant General Manager, sponsored the plan's development and served as the Project Manager and primary point-of-contact. A total of six TAC meetings were held throughout the development of this plan.

Additionally, the UBBNRD established a stakeholder group which consisted of members of the public, landowners, agricultural producers, municipalities, and nonprofit organizations. The stakeholders provided public and landowner input in the planning process. The first of five stakeholder meetings was held on June 18, 2018. A final open house, for review of the final draft plan, was held on April 2, 2019. This meeting provided attendees with an overview of the purpose of the plan; an opportunity to solicit public comments and questions; and the opportunity to identify any outstanding key issues in the plan area. Further documentation of the public involvement process such as meeting minutes, sign-in sheets, and public involvement notification materials (copies and clippings) can be found in Appendix A.

PRIORITIZATION

A key part of the planning process and intent of this plan is to identify priorities and associated target areas for implementation. This is an effort to achieve economy-of-scale in the planning phase through a district-wide process, while avoiding a shotgun approach towards implementation. In order to achieve this, planning is done at the NRD scale. The *2015 State Nonpoint Source Management Plan* specifies that target areas may only make up a maximum of 20% of a HUC 8 area, also known as the 20% Rule (NDEQ, 2015a).

To achieve this while following NDEE guidance, a prioritization process was identified, which is discussed in more detail in Chapter 9. This process vetted possible priorities through technical experts and public reviews before being shared with NDEE. The final plan is then approved by the project sponsor (UBBNRD) and accepted by NDEE and EPA. For each priority water body in the four HUC 8 subbasins, the WQMP identifies pollutant sources, pollutant loads, pollutant load reductions, and an implementation strategy for the associated target area. These considerations allow the plan to become the guiding document for addressing nonpoint source pollution in the District.

1.05 DOCUMENT ORGANIZATION AND UPDATES

The WQMP document has been prepared and organized based on discussions with NDEE and UBBNRD throughout the planning process and is based upon published NDEE guidance (NDEQ, 2015b; NDEQ, 2016). The overall intent of the document's layout is to guide readers through an overview of the existing resources and conditions within the planning area, identify which resources are a priority to address with projects, and to lay out an implementation strategy to achieve the plan's goals. The HUC 8 chapters are intended to lay out a detailed nine-element based strategy of implementation for each target area.

The WQMP will require updating every five years, therefore the format takes this into consideration and is designed to be dynamic rather than fixed to allow for minimal updating effort. Future updates may include:

- Revised assessment of water quality data as compared to WQMP criteria;
- Determination of whether the current strategy is on track to meet plan goals and, if needed, new pollutant load estimates;
- Revision of goals and objectives;
- Revised priorities or target areas;
- Updated management strategies; and,
- Updates to the resource and budget needs.

CHAPTER 2. GOALS AND OBJECTIVES

2.01 INTRODUCTION

The success of a water quality management plan (WQMP) is largely dependent on the commitment and voluntary involvement of community members. As such, this plan was developed using a community-based planning process in which citizens of the district guided the development of the plan's goals and objectives. Unique to the Upper Big Blue Natural Resources District (UBBNRD)—and for the first time in Nebraska history—the community-based planning process of the WQMP was combined with that of a voluntary integrated management plan (VIMP). A WQMP addresses restoration and protection of water *quality* with assistance from NDEE, while a VIMP addresses the sustainability and *quantity* of hydrologically connected groundwater and surface water with assistance from the Nebraska Department of Natural Resources (NeDNR).

Typically, these two planning processes are conducted separately, but the UBBNRD recognizes the interconnectedness of the plans and combined the two processes. Discussions took place between the UBBNRD, NDEE, and NeDNR to ensure all concerns and planning requirements were met. This enabled district citizens to help inform the goals and objectives of both plans simultaneously. The theme for the combined processes was **One District, Two Plans, One Water**. The combined planning process results in the two plans sharing the same vision statement with each supported by a unique set of goals and objectives that complement those of the other plan.

This plan includes the stakeholder-developed goals and objectives specific to water quality, while the VIMP includes those for water quantity. The VIMP is to be developed after the completion of this plan and will be available on the UBBNRD website once it has been approved and adopted. All themes and goals identified though this planning process that overlap with the VIMP are included in Appendix A.

2.02 GOAL-SETTING PROCESS

The first step of the goal-setting process was the development of a vision, or an optimal desired future state for the district. With the overarching project theme in mind, UBBNRD, NDEE, and NeDNR collaboratively developed a vision statement. This statement, provided in Table 3 of Section 2.03, was used throughout the project to help provide context for the goals and objectives of each plan.

Figure 3: Stakeholder Meeting 2
August 14, 2018

The next step was to use stakeholder input to develop goals and objectives for the two separate plans. Stated in unmeasurable terms, *goals* establish the framework needed to make the vision a reality and are general, long-term guidelines that describe a desired achievement. O*bjectives* define specific strategies or implementation steps to achieve the identified goals and provide a way of measuring movement towards the goals.

Figure 4: Stakeholder Meeting 3
September 10, 2018

During the first three stakeholder meetings (Figure 3, Figure 4) stakeholders actively participated in open discussions on the commonalities and differences between a WQMP and VIMP, including the technical aspects of both water quality and water quantity. A content analysis of stakeholder meeting minutes revealed three recurring themes of stakeholder discussions: (1) a desire for local management; (2) the identification of education needs; and (3) a universal commitment to ensure a future water supply. The technical project team used these recurring themes, along with the *2015 State Nonpoint Source Management Plan* (NDEQ, 2015a) and statutory framework, to draft goals and objectives for both the WQMP and VIMP.

The draft goals and objectives were shared with the stakeholder group and the fourth stakeholder meeting was devoted to stakeholder review and revision of each plan's draft goals and objectives. The fifth and final stakeholder meeting provided stakeholders another opportunity to review and revise the draft goals and objectives, as well as provide input on a list of potential action items for each plan. Action items are specific activities that can be completed to achieve the plan's goals and objectives. Like the goals and objectives, the potential action items were developed through project sponsor input and reviewing stakeholder meeting minutes. Before adjourning the five-part stakeholder meeting series, stakeholders expressed concurrence with the goals and objectives of both the WQMP and VIMP. The goals and objectives provided in the next section appear as they were last revised by stakeholders in January 2018.

2.03 GOALS & OBJECTIVES

Table 3 outlines the vision, goals, and objectives that were collaboratively developed by the stakeholder group, with technical input from the Technical Advisory Committee (TAC) and staff from UBBNRD and NDEE. It is important to note that the vision, goals, and objectives reflect the needs and priorities of the district at the time of this plan's development. These needs and priorities will change over time as resources, policy, and science continues to evolve; thus, the goals and objectives should be reviewed and revised as needed, or at least every five years in accordance with the Environmental Protection Agency's (EPA) requirements (USEPA, 2001). Given the joint planning effort that developed these goals and objectives, it is also recommended that the review of the WQMP goals and objectives be coordinated with the review of the VIMP goals and objectives.

Table 3: Vision, Goals, and Objectives of the Plan

Vision

The water resources of the Upper Big Blue Natural Resources District will be locally managed by the District, in cooperation with its partners and stakeholders, through conservation, protection, and responsible development for the health and welfare of the people of the District.

Goal 1	**The quality of surface water and groundwater resources in the basin will be enhanced through a comprehensive and collaborative program that efficiently and effectively implements actions to restore and protect natural resources from degradation and impairment.**
Objective 1.1	Natural resources management actions will be based on sound data and effective directing of resources.
Objective 1.2	Enhance and continue water quality monitoring to develop a more comprehensive understanding of surface and groundwater conditions.
Objective 1.3	Strong working partnerships and collaboration among appropriate local, state, and federal agencies and organizations will be established and maintained regarding management of nonpoint source pollution.
Goal 2	**Resource managers, public officials, community leaders, and private citizens will understand the effects of human activities on water quality and support actions to restore and protect water resources from impairment by nonpoint source pollution**.
Objective 2.1	Deficiencies in knowledge needed to improve natural resource management decisions will be identified and investigated.

Objective 2.2	Develop or identify educational products and opportunities that highlight the interrelated nature of water quality and quantity.
Objective 2.3	Tools to effectively transfer knowledge and facilitate actions regarding management of natural resources will be developed, improved, and maintained.
Goal 3	**Land and water resources will be stable and productive using community-supported best management practices.**
Objective 3.1	Soil resources will be maintained or improved by keeping erosion rates below defined soil loss tolerance rates utilizing soil health practices. *(Soil loss tolerance rates are defined by the UBBNRD in accordance with the Erosion and Sediment Control Act.)*
Objective 3.2	Streams and riparian corridors will be managed to reduce or eliminate threats to property or infrastructure and improve aquatic and riparian habitats.
Objective 3.3	Reduce levels of atrazine runoff into wetlands, streams, and lakes.
Objective 3.4	Reduce levels of *E. coli* bacteria in runoff to streams.
Objective 3.5	Restore and protect historic wetland features to enhance watershed hydrology, naturally improve water quality, and increase groundwater recharge.
Goal 4	**The water quality of surface and groundwater resources will meet the conditions necessary to support domestic, industrial, agricultural, recreational, and ecological uses.**
Objective 4.1	Ensure the safety and quality of drinking water supplies.
Objective 4.2	Track progress towards meeting water quality goals or standards (as appropriate) on an annual basis, including forecasting of trends.

2.04 ACTION PLAN OVERVIEW

To help guide UBBNRD, NDEE, and citizens in the successful implementation of this plan, a detailed action plan is provided in the following section. The action plan contains specific activities that can collectively achieve the plan's goals and objectives. Activities were identified through an evaluation of watershed data, collaboration with project partners, and input from stakeholders and the general public. The action plan framework (Figure 5) is based on four types of activity: Monitoring, Education, Projects, and Policy.

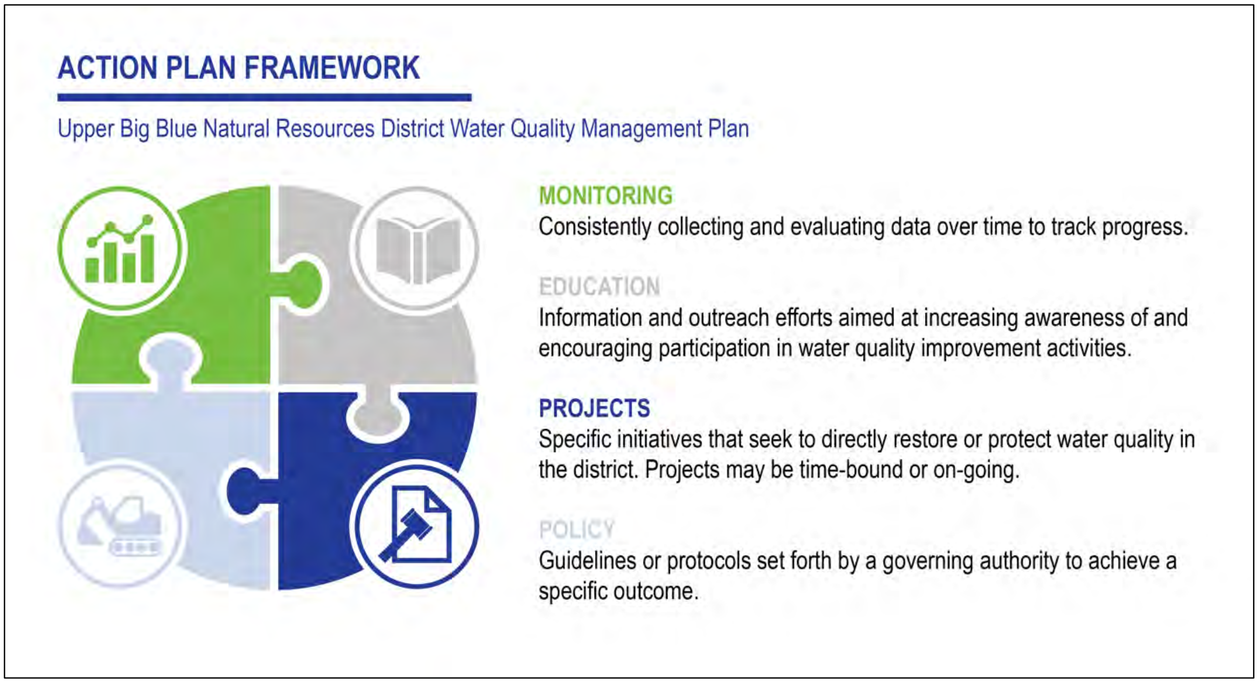

Figure 5: Action Plan Framework

2.05 ACTION PLAN

The action plan is organized by the four activity types previously discussed and provides an overview of the actives that could be completed to restore and protect water quality in the district. Each activity in the action plan lists includes the following information:

- Management Activity – a description of the activity or action to be taken.
- Goals and Objectives Addressed – which goals of this plan the activity seeks to advance.
- Timeline/Milestones – an estimate of when, or at what interval, the activity should be completed.
- Activity Lead – who is responsible for leading or facilitating the activity.
- Potential Partners – a list of the most likely agencies or organizations that may directly partner with the activity lead to complete the action.
- Potential Technical & Funding Resources – a list of the most likely entities with resources that could aid in completion of the activity.

It is anticipated that the UBBNRD will be involved at some level in most activities and is therefore not generally listed in the action plan, except for when a relevant department within the NRD can be specified. Activities related to **monitoring** appear in Table 4, **education** in Table 5, **policy** in Table 6, and **projects** in Table 7.

The collective list of activities is not intended to be exhaustive and is expected to change over time as goals are achieved, resources change, science and technology progress, and priorities evolve. The action plan should be reviewed annually and formally updated at least every five years when the goals and objectives are reviewed. It is also encouraged that, whenever possible, the action items be coordinated with those of the UBBNRD's VIMP.

Table 4: Action Plan for Monitoring Activities

MONITORING									
Action #	Management Activity	Goals Addressed				Timeline/ Milestones	Activity Lead	Potential Partners	Potential Technical & Funding Resources
		1	2	3	4				
M-1	Review current water quality sampling and monitoring activities and make recommendations for improving the monitoring network.	X	X		X	2019 via WQMP; On-going	UBBNRD Water Dept.	NDEE	UNL
M-2	Survey producers and community water suppliers on their needs and attitudes.	X	X	X	X	Pre-survey in 2019; Post-survey in 2022	UBBNRD Water Dept. with PR Dept.	UNL, NDEE	
M-3	Add at least 3 continuous water quality monitoring stations in the NRD upstream of US Hwy 81. Where possible, pair these with stream gages. *Potential sites include Lincoln Creek, Beaver Creek, and West Fork Big Blue River.*	X		X	X	2 added in 2020; 1 added in 2021	UBBNRD Water Dept.	NDEE, NeDNR	USGS, NE Environmental Trust
M-4	Review and publish an annual review of water quality data and trends for both surface and groundwater resources.	X	X			Annually	UBBNRD Water Dept. with PR Dept.	NDEE	UNL
M-5	Have communities report gallons/acre or gallons/person/day and incorporate that in public information materials.	X	X	X	X	2020	UBBNRD Water Dept.	District municipalities	DHHS

MONITORING									
Action #	Management Activity	Goals Addressed				Timeline/ Milestones	Activity Lead	Potential Partners	Potential Technical & Funding Resources
		1	2	3	4				
M-6	Establish a system of water quality milestones to incrementally track progress towards meeting water quality goals or standards.	X			X	2019; review annually	UBBNRD Water Dept.	NDEE	UNL
M-7	Compile existing vadose zone data, and sample the vadose zone in key locations within the District to estimate nitrate loading rates	X			X	Compile existing data – Fall 2020 Resampling – Fall 2023	UBBNRD Water Dept.	NDEE	UNL Water Science Lab
M-8	Collect data on rates and numbers of absentee landowners within the UBBNRD in order to better implement BMPs.	X	X	X	X	2024	UBBNRD	NRCS, UNL Extension, USDA	
M-9	Evaluate long-term trends of nitrate concentrations within communities which have experienced elevated levels.		X		X	2019; Update annually	UBBNRD	DHHS, NDEE	

Table 5: Action Plan for Education Activities

EDUCATION									
Action #	Management Activity	Goals Addressed				Timeline/ Milestones	Activity Lead	Potential Partners	Potential Technical & Funding Resources
		1	2	3	4				
E-1	Continue to engage existing stakeholders on plan activities and identify new stakeholders		X	X		On-going	UBBNRD PR Dept.		
E-2	Continue and expand education of stakeholders on the importance of environmental stewardship and safe water supply, with a focus on nitrate contamination in groundwater.	X	X	X	X	Two new education efforts implemented by end of 2020	UBBNRD PR Dept. with Water Dept.	NDEE, UNL Extension, City of York, City of Seward	Groundwater Foundation, NE Environmental Trust, NDEE
E-3	Contact, engage, solicit feedback, and educate crop consultants, agri-chemical dealers, organic producers, and other agricultural service providers about water quality issues and programs available to producers.	X	X	X		Contacts established in 2019; On-going relationship maintenance	UBBNRD Water Dept. with PR Dept.	UNL Extension. Various ag-dealers	NE Dept. of Ag.
E-4	Continue and improve education requirements of producers within Phase II and Phase III groundwater management areas.		X	X	X	Revise education requirements in 2020	UBBNRD Water Dept. and Board of Directors	UNL Extension, NRCS	

EDUCATION									
Action #	Management Activity	Goals Addressed				Timeline/ Milestones	Activity Lead	Potential Partners	Potential Technical & Funding Resources
		1	2	3	4				
E-5	Develop and distribute educational materials regarding BMPs.	X	X	X		One new educational material per year	UBBNRD PR Dept. with Water Dept.	NDEE, NeDNR, UNL Extension, NRCS	
E-6	Pursue and provide opportunities for NRD citizens and organizations to attend a rainfall simulator demonstration event that illustrates benefits of no-till, cover crops, and other in-field management decisions.	X	X	X	X	Rainfall simulator demonstration event in 2020	UBBNRD PR Dept. with Water Dept.	NDEE, UNL Extension, NRCS	NE Environmental Trust
E-7	Provide education materials to farmers discussing the benefits of soil health and the practices they can take to enhance it.	X	X	X	X	Develop in 2019; Review/revise annually	UBBNRD PR Dept.	UNL Extension, NRCS	
E-8	Provide watershed science training for new board members	X	X			As needed	UBBNRD Water Dept.	UNL Extension	
E-9	Provide education on field days which incorporate management practices to improve water quality.		X	X		Develop in 2019; Review/revise annually	UNL Extension	UBBNRD	
E-10	On Farm Research focused on nitrate management and irrigation management.	X				Develop in 2019; Review/revise annually	NRCS	UBBNRD	NRCS

Table 6: Action Plan for Policy Activities

POLICY									
Action #	Management Activity	Goals Addressed				Timeline/ Milestones	Activity Lead	Potential Partners	Potential Technical & Funding Resources
		1	2	3	4				
Pol-1	Compare goals and objectives and applicable plan elements between the WQMP and VIMP to ensure consistency where appropriate.	X	X		X	Review annually; Update in 2024	UBBNRD	NDEE, NeDNR	
Pol-2	Budget funding to support NRD-sponsored programs that support water quality improvement.	X	X	X	X	Annually during NRD budget process	UBBNRD Management with Board of Directors	NDEE, UNL	
Pol-3	Continue to promote the collaboration between NeDNR, NDEE, and UBBNRD on water quantity and quality issues.	X	X		X	On-going	UBBNRD	NDEE, NeDNR	
Pol-4	Review and formally update the action plan as goals and objectives are reviewed.	X	X	X	X	Review annually and formally update in 2024 (at a minimum)	UBBNRD	NDEE, NeDNR	

Table 7: Action Plan for Projects

PROJECTS									
Action #	**Management Activity**	**Goals Addressed**				**Timeline/ Milestones**	**Activity Lead**	**Potential Partners**	**Potential Technical & Funding Resources**
		1	**2**	**3**	**4**				
P-1	Identify critical areas along streams where sediment losses have significant impact on surface water quality with a focus on the Nebraska-Kansas border.	X		X		2019, then annually	UBBNRD Water Dept. with Projects Dept	Lower Big Blue NRD	
P-2	Continue to seek and utilize outside funding sources (federal, state, local, and others) that can supplement NRD funds for water quality programs.	X	X			On-going	UBBNRD Management	NDEE, NeDNR, UNL Extension, NRCS, RWBJV, NDA	NRCS
P-3	Identify potential partnerships where education, technical, and financial resources could be leveraged.	X	X			On-going	UBBNRD Management	NDEE, NeDNR, UNL Extension, RWBJV, NDA	NRCS

PROJECTS									
Action #	Management Activity	Goals Addressed				Timeline/ Milestones	Activity Lead	Potential Partners	Potential Technical & Funding Resources
		1	2	3	4				
P-4	Provide technical assistance to participants in selecting, installing, and maintaining BMPs.	X	X	X	X	On-going	UBBNRD Projects Dept. with Water Dept.	NRCS, UNL Extension, NE On Farm Research Network. RWBJV	NRCS
P-5	Continue to assist landowners with proper decommissioning of wells.	X	X	X	X	On-going	UBBNRD Projects Dept. with Water Dept.	NDEE, RWBJV	NDEE
P-6	Restore stream meanders through the establishment of riparian buffers, oxbow restorations, and other BMPs.	X		X		Identify annually; Restore as merited	UBBNRD Projects Dept. with Water Dept.	RWBJV	NDEE, NE Environmental Trust, NRCS, NDA
P-7	Develop programs to protect and stabilize stream channel beds from downcutting, such as grade control, weirs, and other BMPs.	X		X			UBBNRD Projects Dept. with Water Dept.	RWBJV	NDEE, NE Environmental Trust, NDA

PROJECTS									
Action #	**Management Activity**	**Goals Addressed**				**Timeline/ Milestones**	**Activity Lead**	**Potential Partners**	**Potential Technical & Funding Resources**
		1	**2**	**3**	**4**				
P-8	Develop programs for source water protection, including Wellhead Protection Plans and/or Drinking Water Protection Management Plans and projects.	X	X	X	X		District Municipalities	UBBNRD Projects Dept. with Water Dept., NDEE	NDEE
P-9	Promote pet waste clean-up activities in urban and residential areas.	X	X	X	X		District municipalities UBBNRD PR Dept. with Projects Dept.	UNL Extension, District Municipalities	
P-10	Work with owners of non-permitted animal feeding operations to voluntarily install BMPs, such as manure management, water diversions, manure storage, and vegetated treatment systems.	X	X	X	X		UBBNRD Projects Dept. with Water Dept.	UNL Extension, UNL Livestock Producer Environmental Assistance Project, RWBJV, NDEE	NRCS

PROJECTS									
Action #	**Management Activity**	**Goals Addressed**				**Timeline/ Milestones**	**Activity Lead**	**Potential Partners**	**Potential Technical & Funding Resources**
		1	**2**	**3**	**4**				
P-11	Implement BMPs and activities that: • Improve soil health • Decrease soil erosion • Reduce nitrate leaching • Restore watershed hydrology • Avoid, Control, or Trap pollutants • Protect and restore wetlands • Repair and prevent stream erosion	X	X	X	X			NRCS, NDEE, UNL Extension, RWBJV	NRCS
P-12	Complete a detailed feasibility study and renovation plan for Recharge Lake	X	X	X	X	2019 - 2020	UBBNRD	NGPC, NDEE	NGPC, NDEE

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CHAPTER 3. PLANNING AREA CHARACTERISTICS

3.01 DEMOGRAPHIC SUMMARY

POPULATION

The planning area encompasses portions of ten counties: Adams, Butler, Clay, Fillmore, Hall, Hamilton, Polk, Saline, Seward and York. There are no tribal lands located in the planning area. The planning area has 49 incorporated communities, 48 of which have a population less than 10,000 (Table 8). The largest community, Hastings, has a population of over 24,000 though portions of the City lie outside of the planning area. Because the planning area does not fall along political boundaries, only estimates are available for demographic data. To more closely resemble geographic boundaries of the planning area, demographic information was gathered from the US Census Bureau's American Community Survey (ACS) Topological Integrated Geographic Encoding and Referencing (TIGER) files at the block group level. The total population of the planning area is 71,517 (2016 ACS 5-year estimates), with a large majority (96%) residing in communities (Table 9).

Table 8: Population of Communities

City	Population	City	Population	City	Population
Aurora	4,459	Goehner	116	Rising City	312
Beaver Crossing	365	Grafton	151	Saronville	73
Bee	231	Gresham	296	Seward	7,133
Benedict	229	Hampton	467	Shelby	708
Bradshaw	326	Harvard	967	Staplehurst	254
Brainard*	323	Hastings*	24,983	Stockham	45
Cordova	104	Henderson	971	Stromsburg	1,162
David City*	2,861	Hordville*	146	Surprise	32
Doniphan*	1,010	Lushton	31	Sutton	1,679
Dorchester*	566	Marquette	214	Thayer	59
Dwight*	197	McCool Junction	448	Trumbull	267
Exeter	611	Milford	2,389	Ulysses	271
Fairmont	651	Milligan	326	Utica	824
Garland*	264	Osceola	810	Waco	318
Garrison	54	Phillips*	338	York	7,899
Geneva	2,097	Polk	336	**TOTAL**	**68,834**
Giltner	372	Prosser*	89		

**Part of the community lies outside the Planning Area.*
Source: ACS 2016 5-Year Estimates

Table 9: Urban and Rural Populations

Urban/Rural	Population	Percent
Urban (communities)	68,834	96%
Rural	2,683	4%
Total	**71,517**	**100%**

Source: ACS 2016 5-Year Estimates

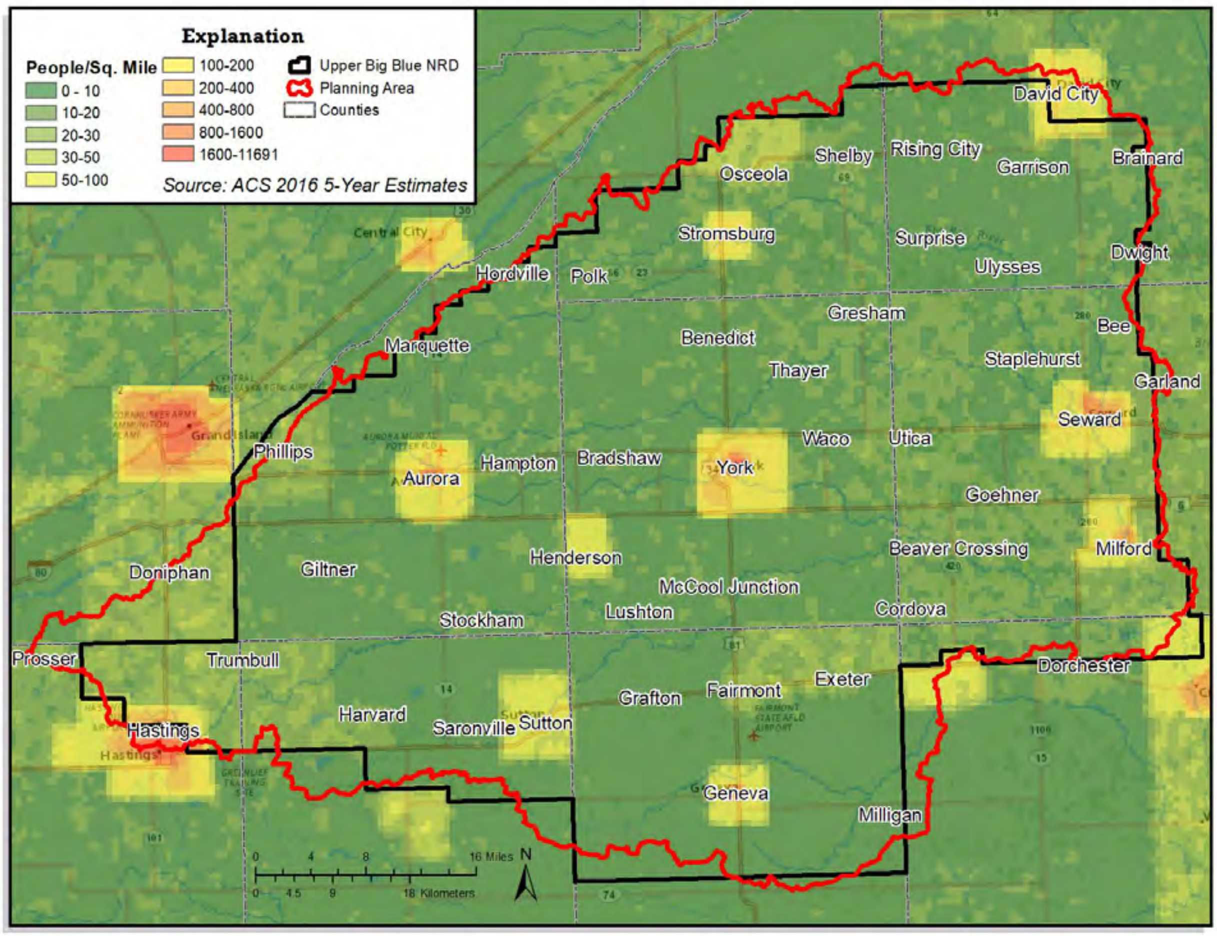


Figure 6: Population Density

AREA DEMOGRAPHICS

Demographically, residents of the planning area are predominantly white (94% Caucasian, 4% Hispanic). English is the predominant language in the planning area (~96%), with Spanish being the second-most common (~3%). Statewide, 89% of residents claim English as their primary language. The planning area is very well educated, as more than 90% of persons over 25 have obtained some form of education above their high school diploma. Twenty-three percent of the population have a bachelor's degree or greater.

The median county-wide household income ranges from a high of $61,563 in Seward County to a low of $51,166 in Butler County. By comparison, the statewide median household income is $56,927. Poverty rates across the planning area range from a high of 10.1% in Fillmore County to a low of 8.1% in Polk County, all lower than the statewide average of 11.4%.

AGRICULTURAL STATISTICS

According to the United States Department of Agriculture (USDA) Census of Agriculture, the primary crops grown in the area include corn and soybeans. The USDA Agriculture Census data is provided at a county level and summarized for each county in Table 10 and Table 11. Additionally, Table 12 demonstrates the agricultural activity changes within the planning area between 2007 and 2012. This data is notable as the types of nonpoint source pollutants generated from each agricultural activity can be considerably different in nature, concentration, and distribution.

Table 10: Selected Data from the 2012 AgCensus

County	Butler	Clay	Fillmore	Hamilton
Land in Farms (ac)	370,086	330,534	328,386	304,395
Total Crop Sales	$184,934,000	$211,743,000	$261,289,000	$272,201,000
Total Livestock Sales	$91,462,000	$143,335,000	$73,517,000	$81,036,000
Corn for Grain (ac)	151,218	159,702	181,211	181,373
Soybeans for Beans (ac)	119,130	76,829	102,201	74,979
	Polk	**Seward**	**York**	
Land in Farms (ac)	245,268	354,857	339,591	
Total Crop Sales	$167,047,000	$184,071,000	$302,771,000	
Total Livestock Sales	$159,191,000	$124,458,000	$112,642,000	
Corn for Grain (ac)	114,915	145,168	208,529	
Soybeans for Beans (ac)	77,751	114,673	92,668	

Source: 2012 USDA Census of Agriculture

Table 11: Livestock Summary from the 2012 AgCensus

	Butler	Clay	Fillmore	Hamilton	Polk	Seward	York
Cattle and calves	34,036	51,336	31,023	41,093	68,799	48,059	45,226
Hogs and pigs	41,468	167,502	33,179	8,919	49,891	49,695	29,738
Layers	620,287	974	526	692	D	1,112	D
Pullets for laying flock replacement	126	90	18	D	D	123	440
Horses and Ponies	453	736	357	514	370	895	239

Source: 2012 USDA Census of Agriculture
D – withheld to avoid disclosing data for individual operations

Table 12: Changes in Agricultural Activities from 2007 to 2012

Item	2007	2012	Percent Change
Land			
Number Farms	4,238	4,340	2%
Land in Farms (Acres)	2,350,449	2,273,117	-3%
Average Size of Farms (Acres)	4,116	3,904	-5%
Livestock (Number)			
Cattle and Calves	345,369	319,572	-7%
Beef Cows	21,909	33,833	54%
Dairy Cows	892	1,530	72%
Equine	3,261	3,564	9%
Sheep and Lambs	5,748	8,545	49%
Goats	1,827	2,380	30%
Hogs and Pigs	438,342	380,392	-13%
Broilers and other Meat Chickens	1,165	1,852	59%
Chickens - Layers	1,337,412	623,591	-53%
Crops (Acres)			
Corn for grain	1,230,581	1,142,116	-7%
Corn for silage	13,041	18,850	45%
Soybeans	564,113	658,231	17%
Forage	60,880	54,087	-11%

Source: 2007 and 2012 USDA Census of Agriculture

ABSENTEE LANDOWNERS

Absentee landowners are defined as those who own agricultural property, but do not live on, or operate on, the land. This includes a diverse cross section of people such as: retired farmers/ranchers; those who have inherited or received land through gifts, marriage, divorce, etc.; and those who purchase land for investment or recreational purposes. Often, contacting absentee landowners or successfully encouraging them to participate in conservation practices can be challenging as these landowners are often distant from the specific conservation needs of the land.

Understanding the level of absenteeism in the planning area is important to successfully develop outreach programs or target conservation programs. According to USDA Agricultural Census data (2012), a large percentage of farms within the planning area are rented or leased (Figure 7). This data indicates that greater than 60% of the operators of farms in Fillmore, Hamilton, and York counties rent or lease. In other counties more than 50% of land is rented or leased. It is recommended that future updates to this plan include additional research or data collection on absentee landowners.

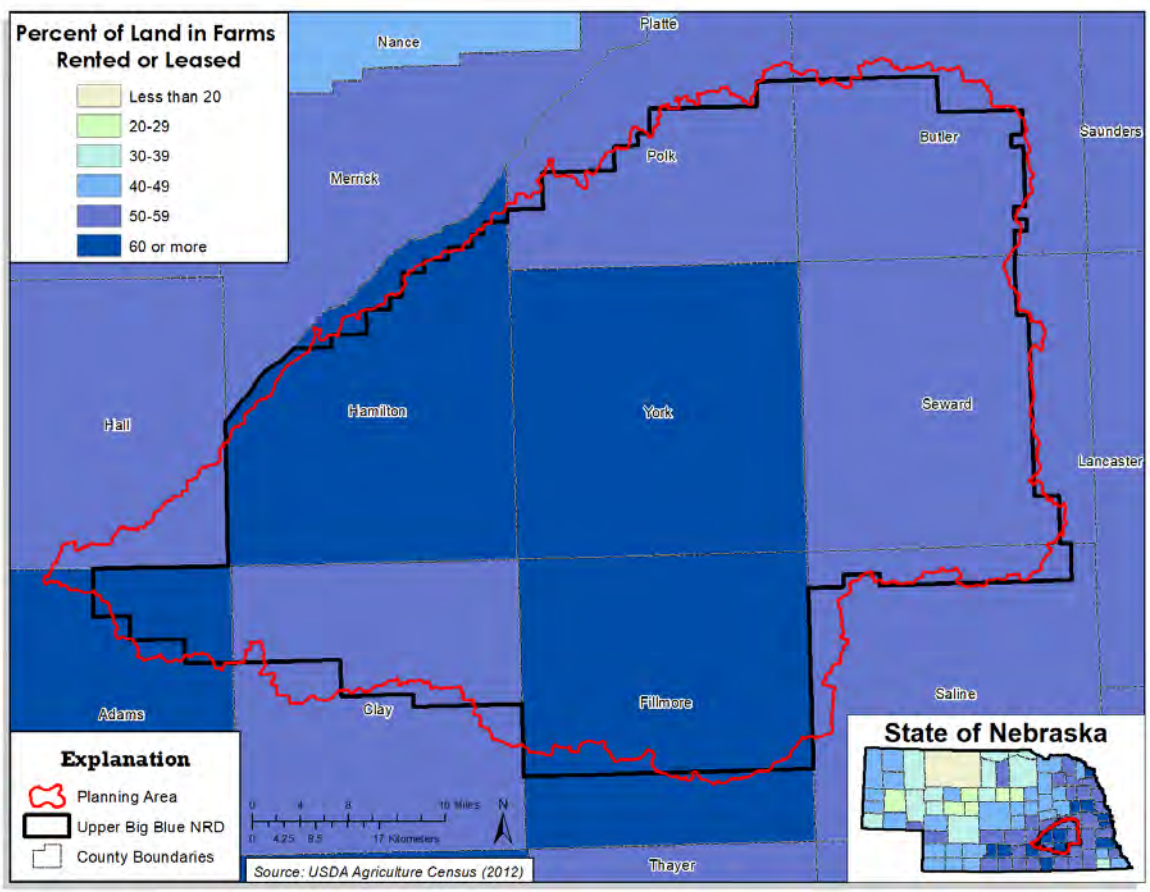


Figure 7: Proportion of Rented or Leased Farms Within the Planning Area

3.02 PHYSICAL ENVIRONMENT

ECOREGION

The Environmental Protection Agency (EPA) uses a series of ecoregions (described by Chapman, 2001), which are areas with similar ecosystems and environmental resources. The planning area lies completely within the 'Central Great Plains' EPA Level III ecoregion and consists entirely of one EPA Level IV Ecoregion: 'Rainwater Basin Plains' (Figure 8). The Central Great Plains were once a grassland dominated by mixed grass prairie with scattered low trees and shrubs. Much of this region is now in cropland. The 'Rainwater Basin Plains' ecoregion is flat to rolling loess-covered plains. Surface water drainage in this region is poorly developed, resulting in numerous closed watersheds that drain into low depressions. Most of the wetlands have been drained for cultivation and now relatively few remain. Additional discussion on wetlands can be found in Section 3.03. In addition, cropland agriculture practices and extensive irrigation have contributed to problems with ground water contamination and major changes in ground water levels.

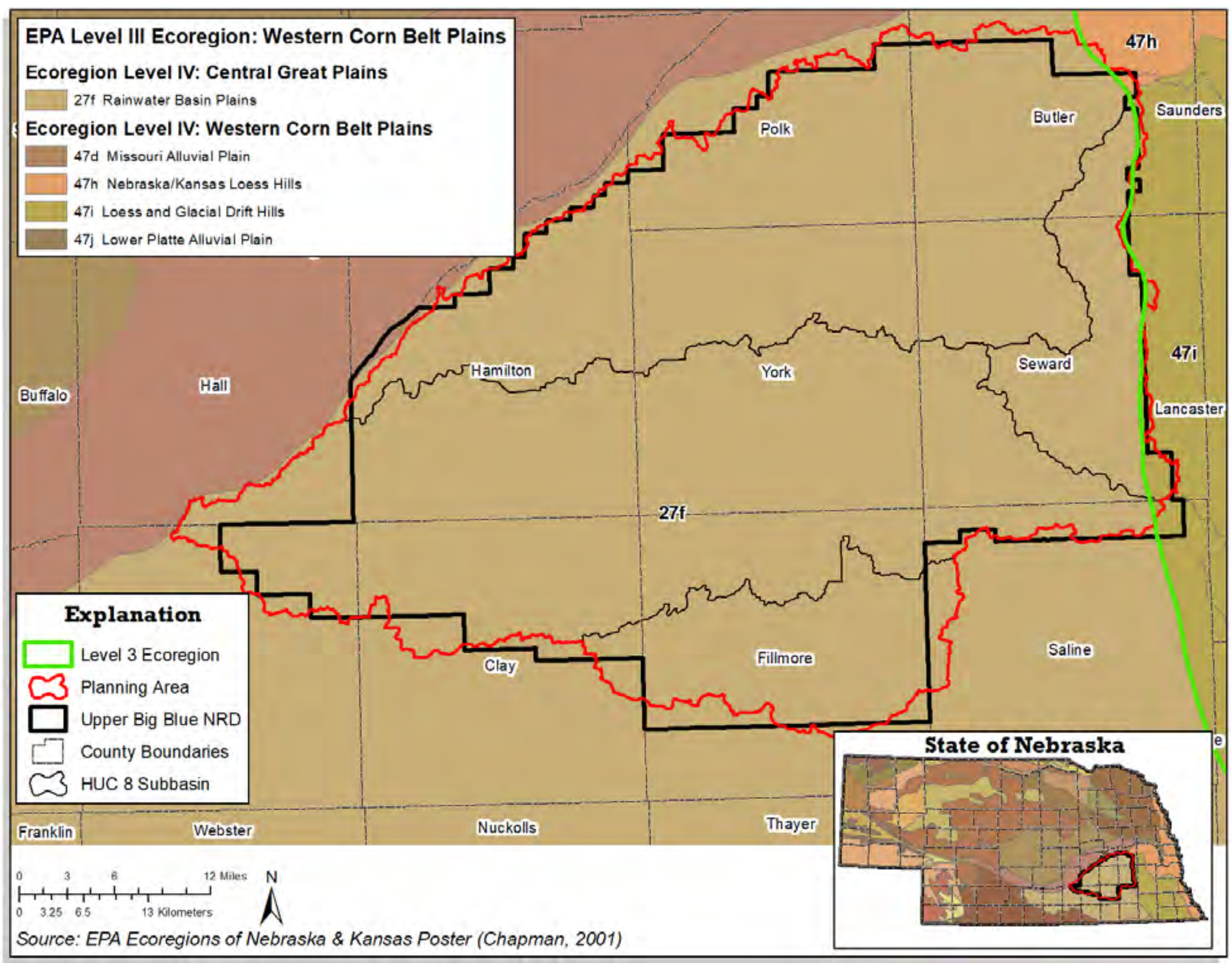


Figure 8: Ecoregion Map

CLIMATE

The climate of the planning area is considered "Humid Continental" on the Köppen-Geiger Climate Classification System (Kottek, 2006). This climate is characterized by large seasonal temperature differences with hot, humid summers and cold winters. Precipitation is distributed throughout the year. The National Centers for Environmental Information (NCEI) maintains precipitation records from numerous stations within the planning area. Average annual precipitation across the planning area is shown in Figure 9 (Szilagyi and Jozsa, 2013).

Precipitation varies only slightly across the planning area, with the majority receiving between 24 and 26 inches per year. Based upon NCEI data for York, NE (1981-2010), May has the highest average monthly precipitation (4.5 inches), while January has the lowest (0.6 inches). Average high temperatures range from 86°F during the summer months to 38°F during winter months; average low temperatures range from 61°F during the summer months to 14°F during winter months (NCEI, 2018). Average monthly temperature and precipitation variations are illustrated in Figure 10.

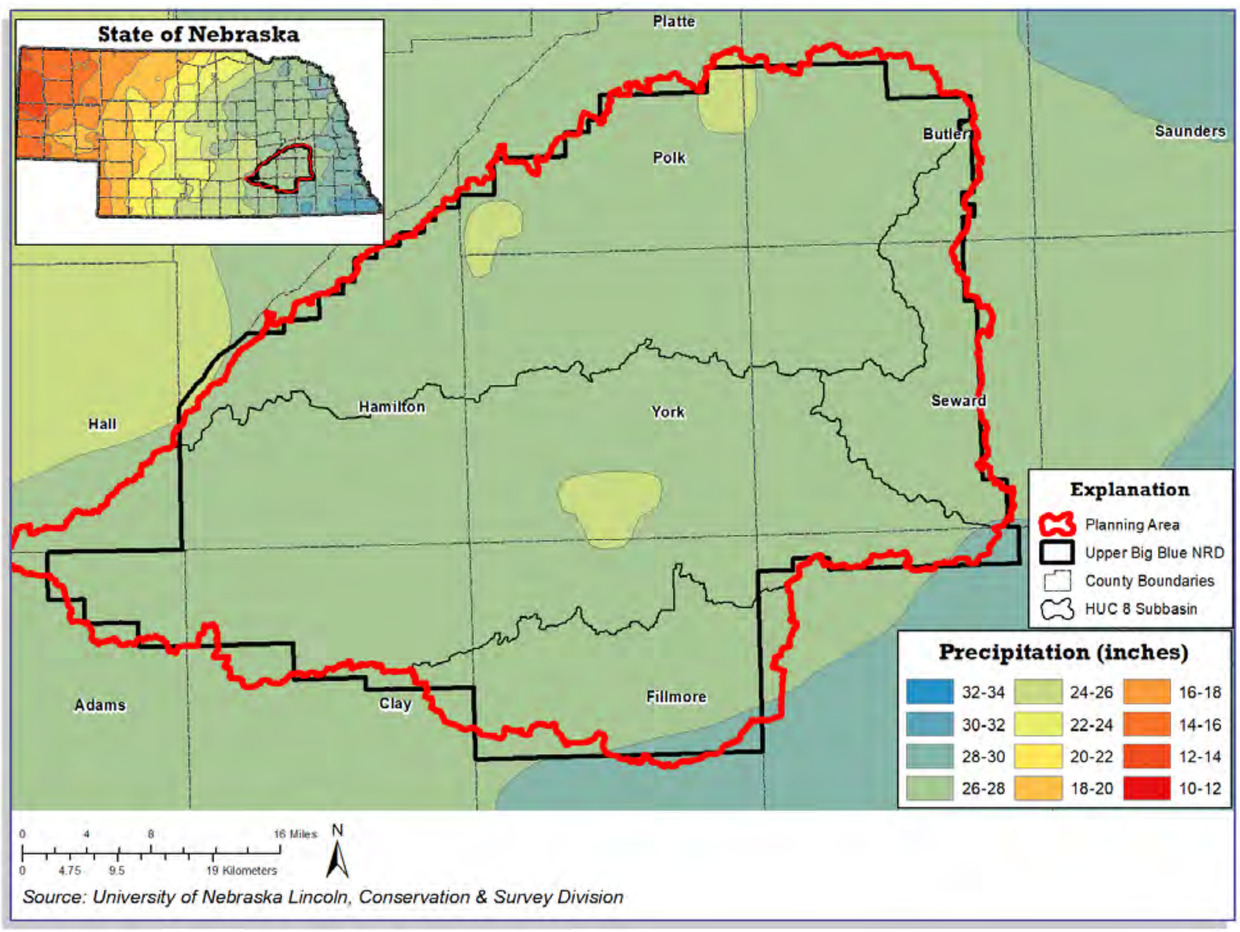


Figure 9: Annual Precipitation Map

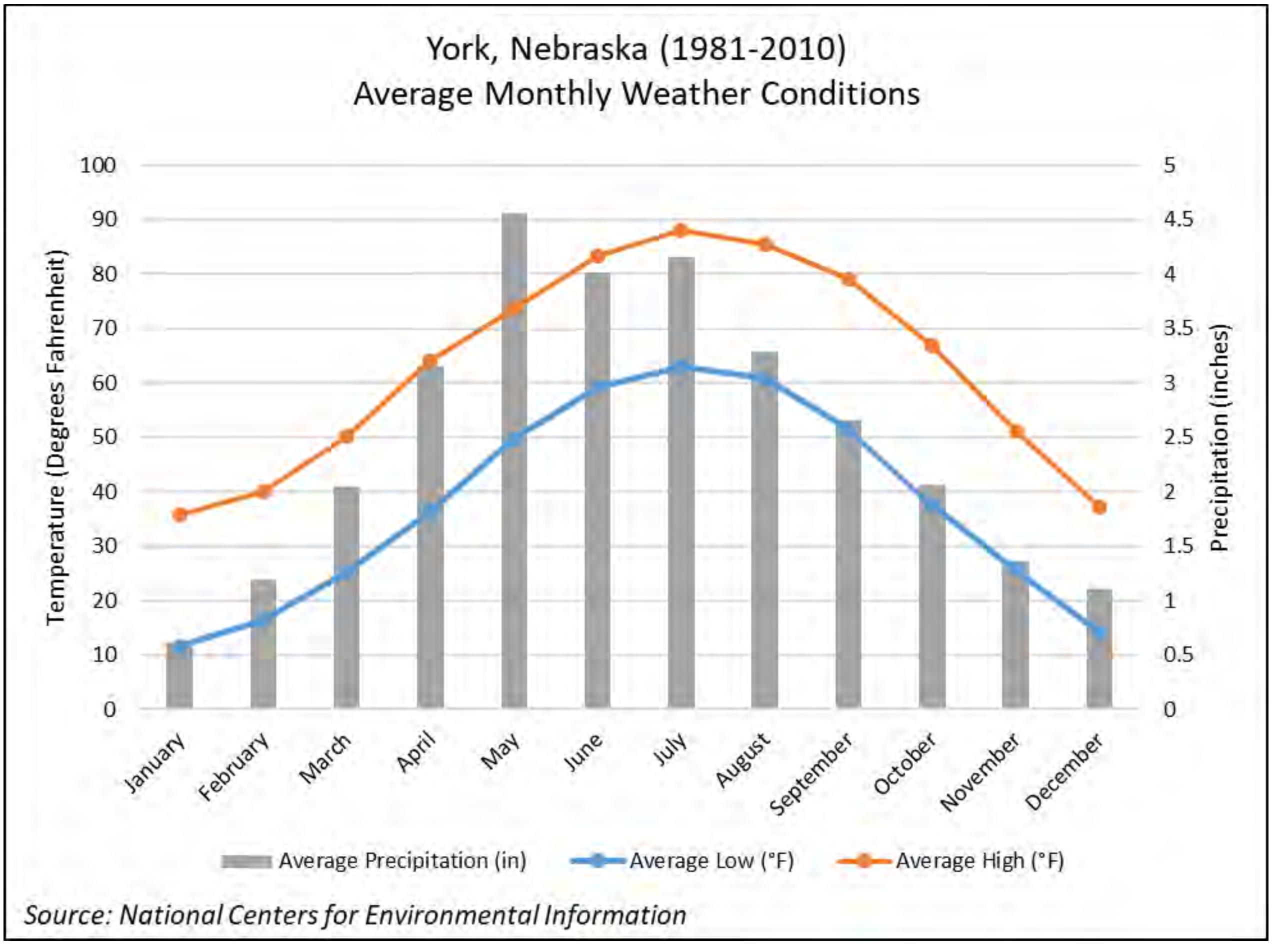


Figure 10: Average Monthly Temperature and Precipitation for York, Nebraska

TOPOGRAPHY

The Upper Big Blue subbasin drains in an east-southeasterly direction to the confluence with the Middle Big Blue subbasin at Seward, which drains southerly. A large elevation range exists across the planning area, from a high elevation of 2,055 ft (NAVD88) at the western edge to a low of 1,345 ft at the confluence with the Middle Big Blue River. The West Fork Big Blue and Turkey Creek subbasins both drain easterly towards the Big Blue River.

The planning area lies largely in the "Plains" topographic region, though areas of "Valleys" do also exist (Conservation and Survey Department [CSD], 2001). Differences in topography and elevation through the planning area influence drainage and land use patterns, as shown in Figure 11 and Figure 12. Plains are flat-lying lands with low slopes that lie above valleys and consist of sandstone, stream-deposited silt, clay, sand, and gravel overlain by wind-deposited silt. Valleys are flat-lying lands with low slopes along major streams consisting of stream-deposited silt, clay, sand, and gravel. The highest slopes tend to occur between plains and valleys.

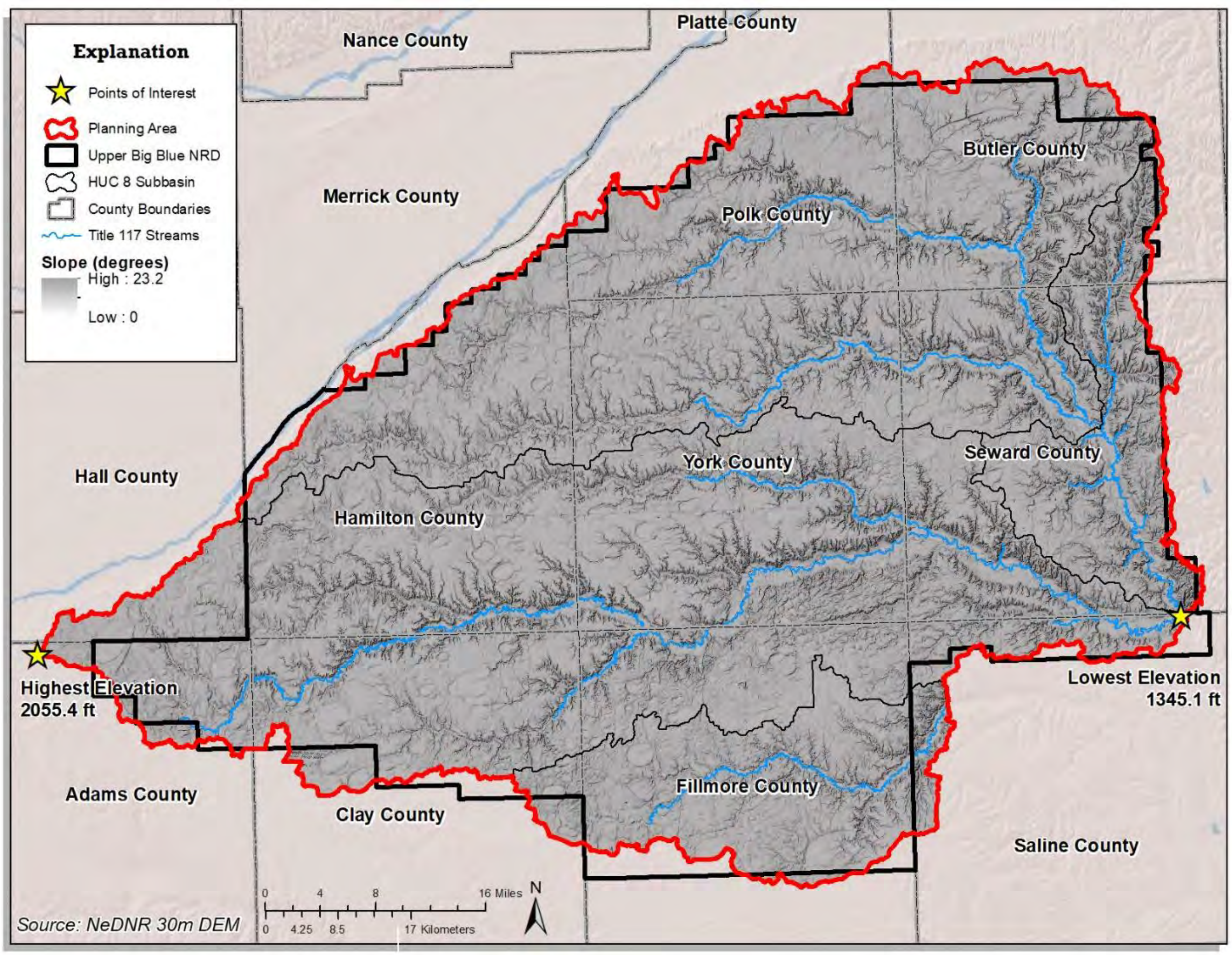


Figure 11: Elevation throughout the Planning Area

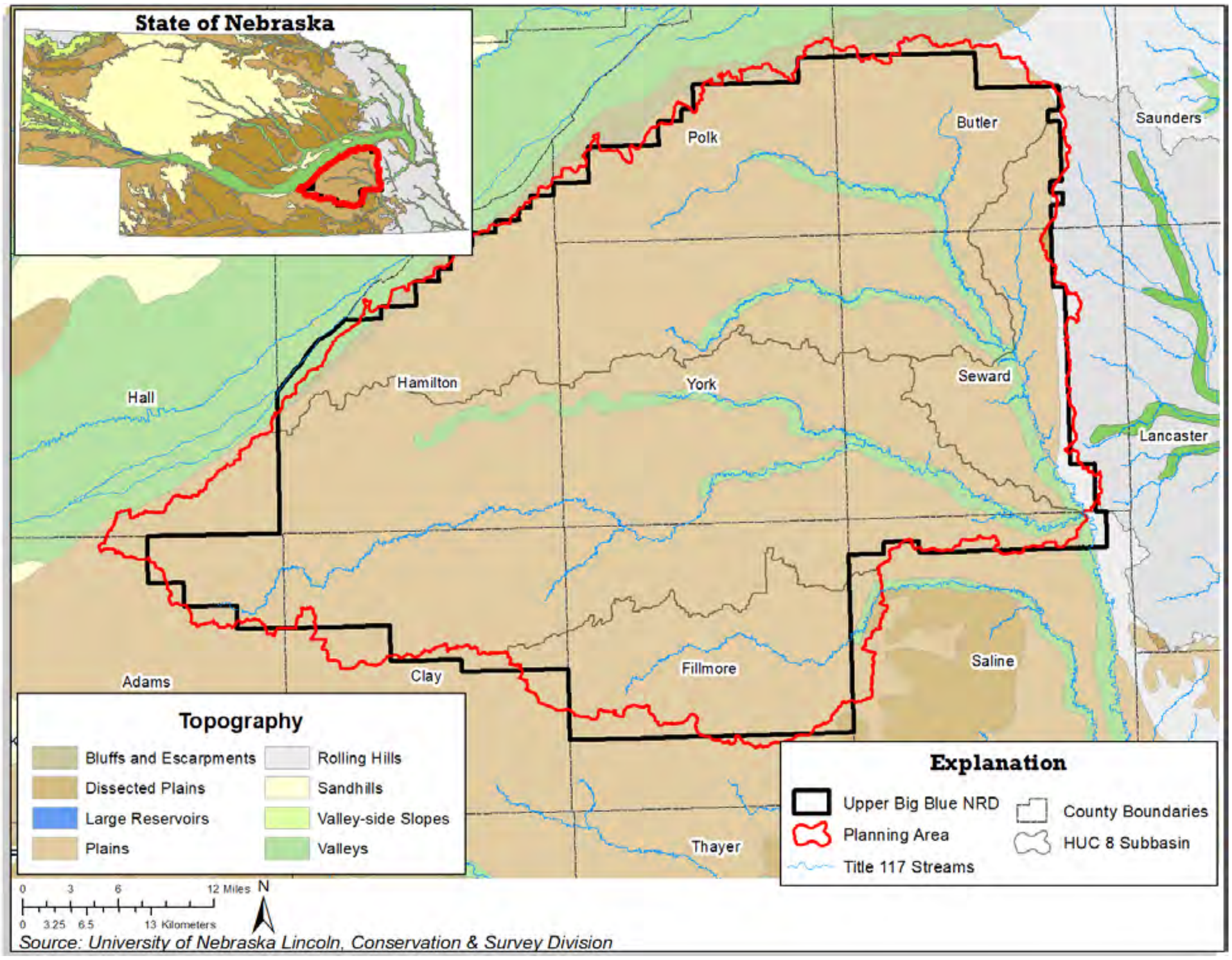


Figure 12: Topographic Regions Within and Near the Planning Area

GEOLOGIC HISTORY

The geologic history of a region is an important backdrop to explaining current conditions. The geologic history of Eastern Nebraska, where the planning area lies, is very complex, in contrast to the rest of the state. While the majority of Nebraska lies over the High Plains Aquifer, much of Eastern Nebraska's topography, geology, and water resources were modified by the most recent ice age. This has resulted in more complex local hydrogeologic conditions than the rest of the state. Localized studies at a fine scale are necessary to truly characterize water resources.

During the Pleistocene epoch (from about two million to 10,000 years ago), continental glaciers invaded the northern Great Plains multiple times. Glacial ice repeatedly blocked rivers, formed lakes, filled valleys with sediment, and diverted rivers. Rivers carried melt water from glaciers that contained heavy amounts of sand and silt, which was then deposited along floodplains. Wind eroded these deposits, creating fields of dunes and depositing a layer of loess on the uplands. The maximum extents of these glaciers extended across eastern Nebraska (Figure 13), where they left behind deposits of till, which consists of a mixture of clay, silt, sand and gravel (Wayne, 2011).

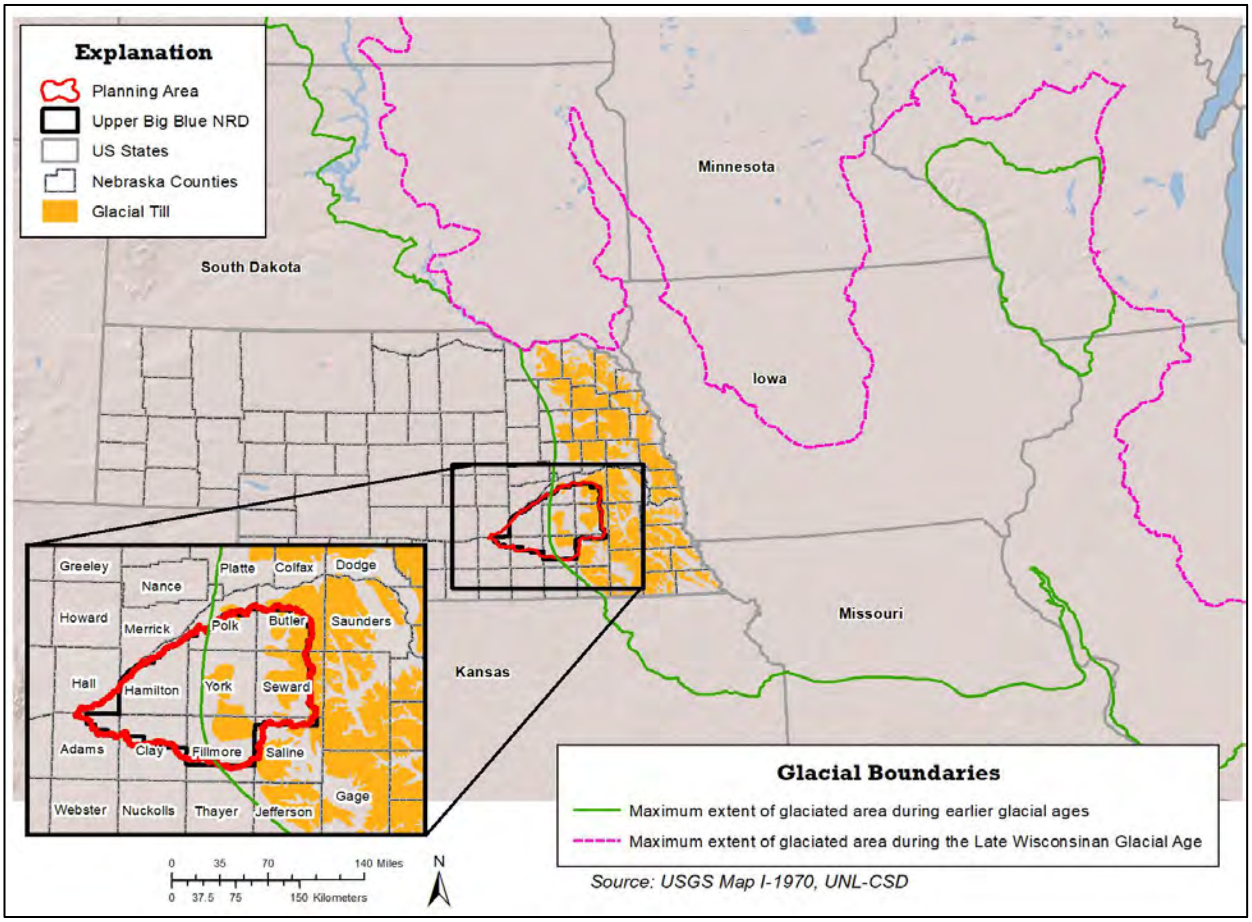


Figure 13: Regional Glacial Boundary Map and Nebraska Till Deposits

SOILS

Parent material, which is the underlying geological material in which soils form, has a major influence on soil characteristics (Figure 14). The stream valleys are composed of well-drained alluvial soils. Surface soils within the planning area basin include glacial till, Bignell loess, and alluvium. The glacial till is moderately silty and loamy with some cobbles and numerous pebbles. Bignell loess covers much of the uplands and is the principal parent material for soils in this area (USDA, 1980).

Soil characteristics such as texture, infiltration rate, and slope directly influence the amount of runoff from the landscape and the potential for erosion. Natural Resources Conservation Service (NRCS) soils data was analyzed specific to the planning area with results provided in the following sections.

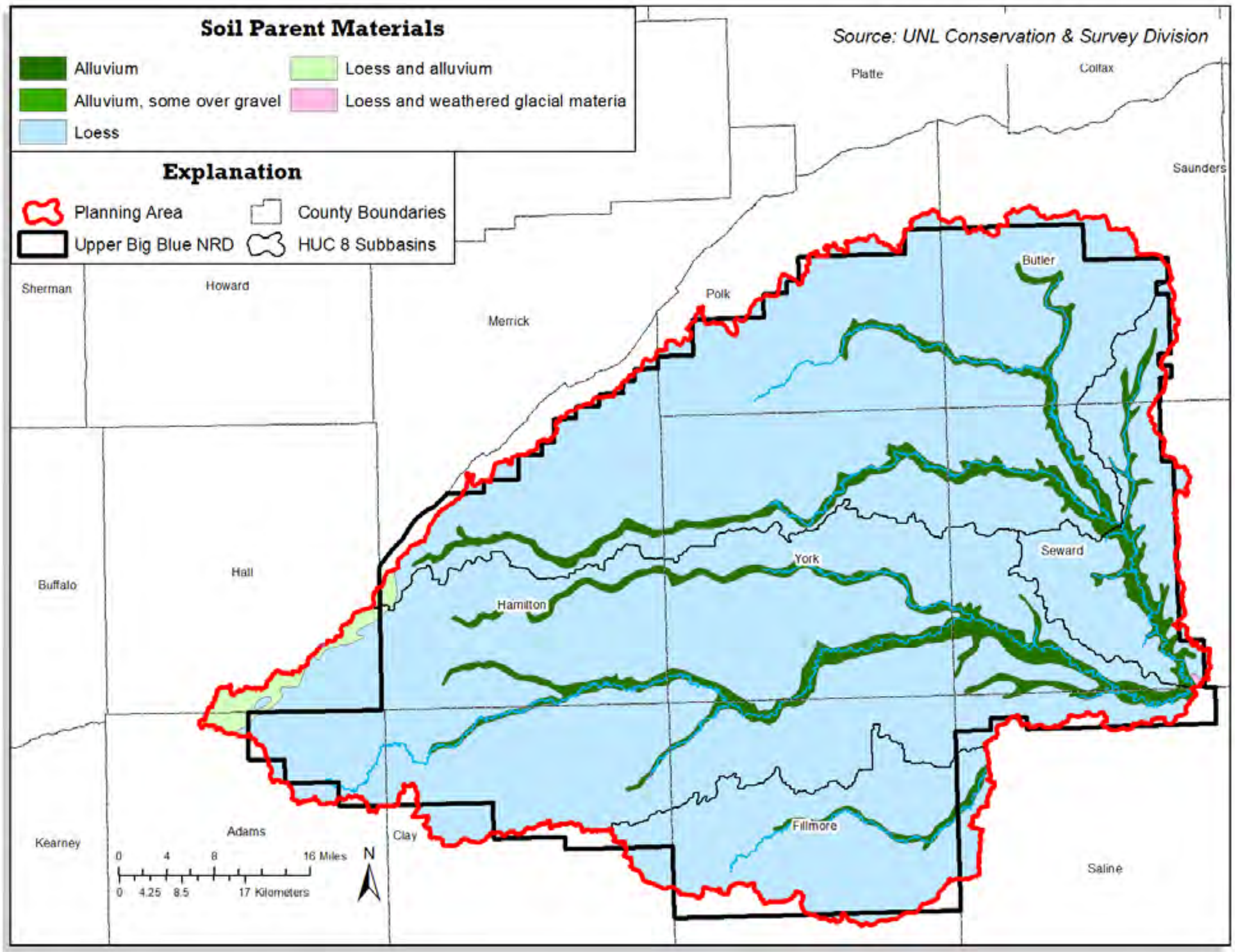


Figure 14: Soil Parent Materials

Texture

Soil texture is given in the standard terms used by the NRCS. These terms are defined according to the percentage of sand, silt, and clay in a fraction of the soil less than 2mm in diameter. If the content of particles which are coarser than sand is greater than 15%, an appropriate modifier is added.

Table 13 gives the soil texture breakdown by each Hydrologic Unit Code (HUC) 8 subbasin, while Figure 15 displays the soils based on texture. The clear majority (98%) of soils found in the planning area are comprised of silt loam and silty clay loam. The distribution of soil textures is generally consistent across subbasins, with some slight variability across the western edge of the West Fork Big Blue subbasin.

Table 13: Surface Texture of Soils Within Each HUC 8 Subbasin

	Middle Big Blue		West Fork Big Blue		Upper Big Blue		Turkey Creek	
Soil Texture	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Clay	119	0%	0	0%	0	0%	0	0%
Clay loam	1,189	1%	38	0%	0	0%	63	0%
Fine sand	0	0%	3	0%	0	0%	0	0%
Fine sandy loam	0	0%	4,823	1%	391	0%	0	0%
Loam	370	0%	3,643	0%	843	0%	0	0%
Loamy fine sand	0	0%	80	0%	0	0%	0	0%
Loamy sand	0	0%	184	0%	1	0%	0	0%
Moderately decomposed plant material	106	0%	2,118	0%	476	0%	448	0%
Silt loam	88,967	59%	697,966	81%	606,398	86%	152,267	80%
Silty clay	211	0%	0	0%	0	0%	0	0%
Silty clay loam	59,284	39%	145,103	17%	98,796	14%	38,357	20%
Variable	0	0%	0	0%	23	0%	25	0%
Other	860	1%	3,226	1%	1,530	0%	298	0%
Total	**151,105**	**100%**	**857,185**	**100%**	**708,459**	**100%**	**191,458**	**100%**

Source: USDA Web Soil Survey, 2017a

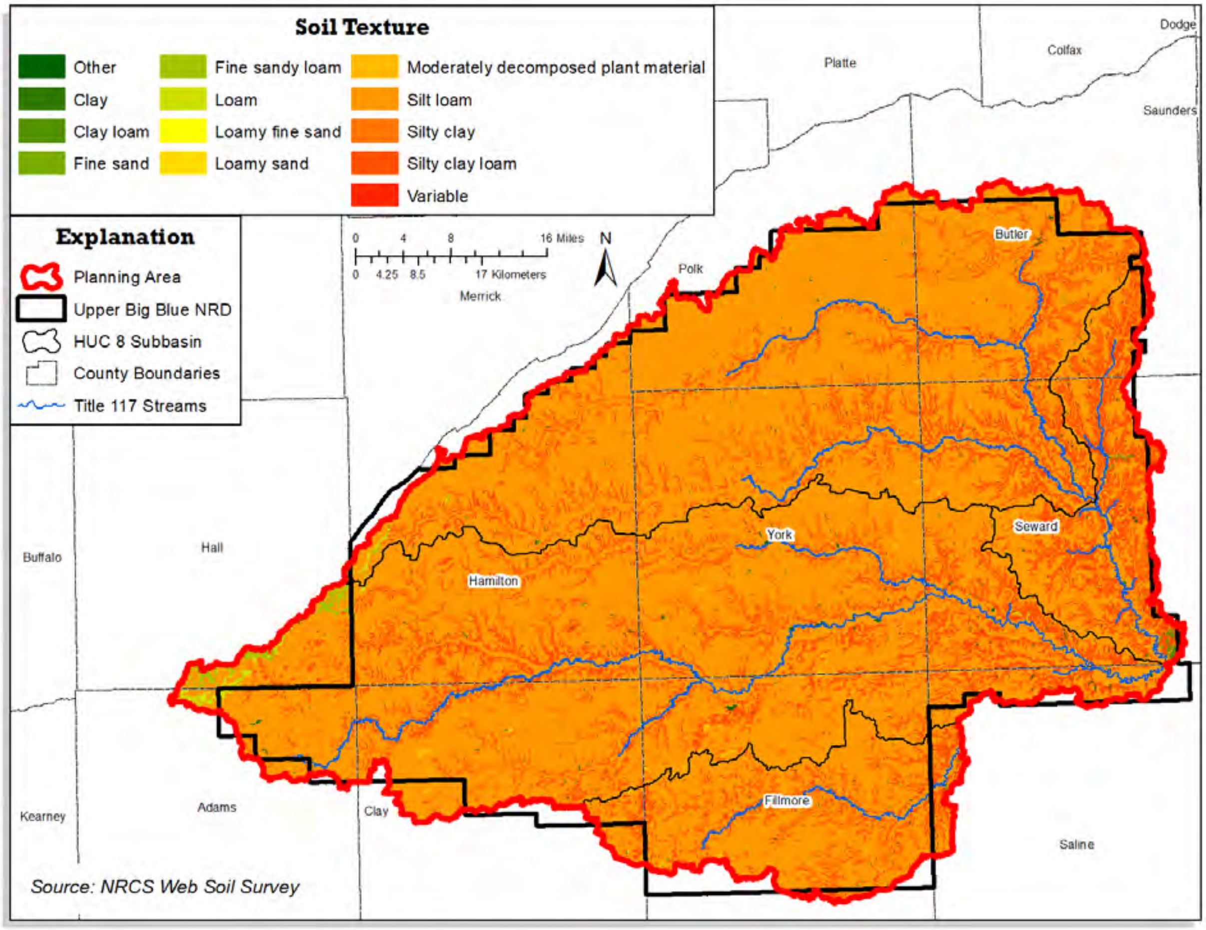


Figure 15: Soil Texture Map

Infiltration

The NRCS classification system divides soils into four major hydrologic soil groups (HSG): A, B, C, and D; and three dual classes: A/D, B/D, and C/D. Table 14 provides a description of the role soils plays in the generation of runoff. Soils within each hydrologic group have similar runoff potential under similar storm and vegetative conditions.

The soils in the planning area consist mostly of HSG C (76%), with another 12% being HSG B. Typical soils of HSG C include silt loam and silty clay loam, which is consistent with the soil textures describe above. Soils of this HSG tend to contribute to higher runoff rates than those of HSG B. Figure 16 illustrates the geographic distribution of soil types.

Table 14: Hydrologic Soil Groups and Descriptions

HSG	Description
A	HSG A soils have low runoff potential, with less than 10 % clay and more than 90% sand or gravel. Water is transmitted freely through the soil.
B	HSG B soils have moderate infiltration and transmission rate and are moderately well-to well-drained. Water movement through these soils is moderately rapid.
C	HSG C soils have moderately high runoff potential and typically have loam, silt loam, sandy clay loam, and clay loam textures. Water transmission through the soil is restricted.
D	HSG D soils have high runoff potential with clayey textures and can have high shrink-swell potential. Water movement through the soil is restricted or very restricted.
A/D B/D C/D	Soils are assigned to dual groups if the depth to a permanent water table is the sole criteria for assigning a soil to hydrologic group D. If these soils can be adequately drained, then they are assigned to dual groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table when drained. The first letter applies to the drained condition and the second to the undrained condition.

Source: USDA Web Soil Survey, 2017a

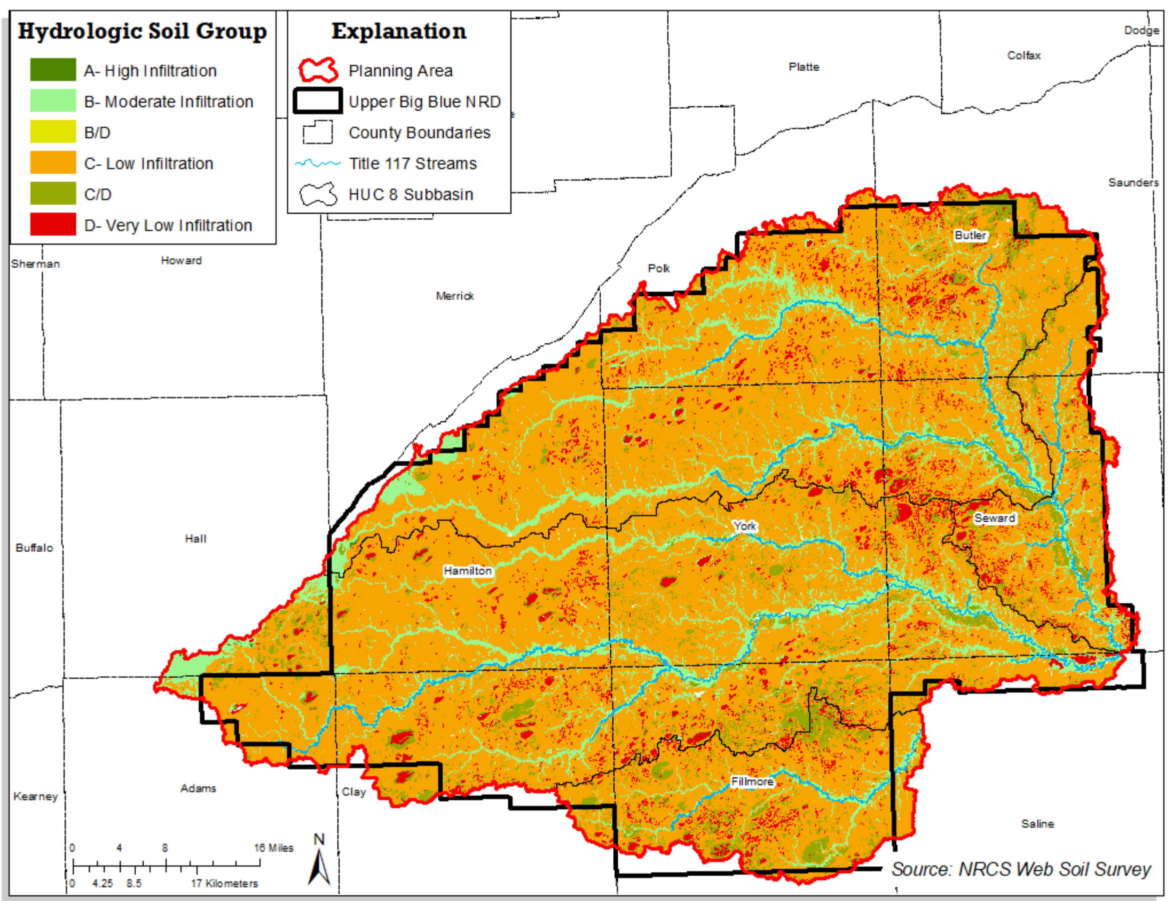


Figure 16: Hydrologic Soil Group Map

LANDUSE

Land use and land cover are two separate terms, yet they are often used interchangeably. Land use describes how people utilize the land (i.e. urban or agriculture). Land cover describes the physical material of the earth's surface (i.e., type of vegetation). For the purposes of this plan 'land use' will be used as a common term for simplicity and because the term implies intentional management. Understanding land use is at the heart of watershed planning. The activities and uses of the land within a watershed often are the primary drivers in identifying specific sources of pollutants. Understanding how land use affects watershed functions (such as hydrology) requires an understanding of both the historical and present-day land use of the watershed.

Historical Land Use

A map of the historical land use of the planning area, prior to European settlement (circa 1860), is shown in Figure 17. The map was developed primarily from field observations of native vegetation remnants and modified from the original version prepared by Kaul and Rolfsmeier (1993) and provided by the CSD. The Nebraska Natural Legacy Project's State Wildlife Action Plan lays out a clear vision of historical land use in the planning area (Schneider and others, 2011):

> *"Historically, tallgrass prairie was the predominant vegetative cover in the eastern fourth of the state. Today, approximately two percent of Nebraska's tallgrass prairie remains mostly as remnants, which are usually less than eighty acres in size. Glaciers, wind, and water have shaped the topography of the tallgrass region over the last several million years. Today, the land surface is mainly rolling hills intersected by stream valleys.*
>
> *Aside from tallgrass prairie, eastern Nebraska has a diversity of other community types ranging from deciduous woodlands to saline wetlands. Upland tallgrass prairie species can reach six feet or taller, especially when rooted in rich, moist stream valleys. Tallgrass prairies also include hundreds of species of wildflowers and other forbs. Native woodlands are found mainly in the more mesic and fire-protected stream valleys and bluffs.*
>
> *In the early 19th century, the Great Plains was generally perceived as an area unfit for agriculture and settlement. By 1900, most prime farmland in eastern Nebraska was settled by inhabitants of European descent. The land use changes in Nebraska, due to the Homestead Act, led to the development of an agriculture-based economy. Major crops grown in the tallgrass region today include corn, soybeans, wheat, oats and alfalfa. Nebraska's dairy, pork and poultry industries are located primarily in the eastern portion of the state. Beef cattle production also occurs in the region. The livestock and poultry industries found here are great consumers of the corn, soybeans and other crops, helping to add value to these raw commodities. More recently, a significant proportion of the corn harvest has*

been used in ethanol production. In recent decades, Nebraska farms have trended towards becoming fewer in number and larger in size. Since the 1950's, machinery and modern farming methods have made agriculture more efficient, thereby decreasing the number of people employed directly by agriculture."

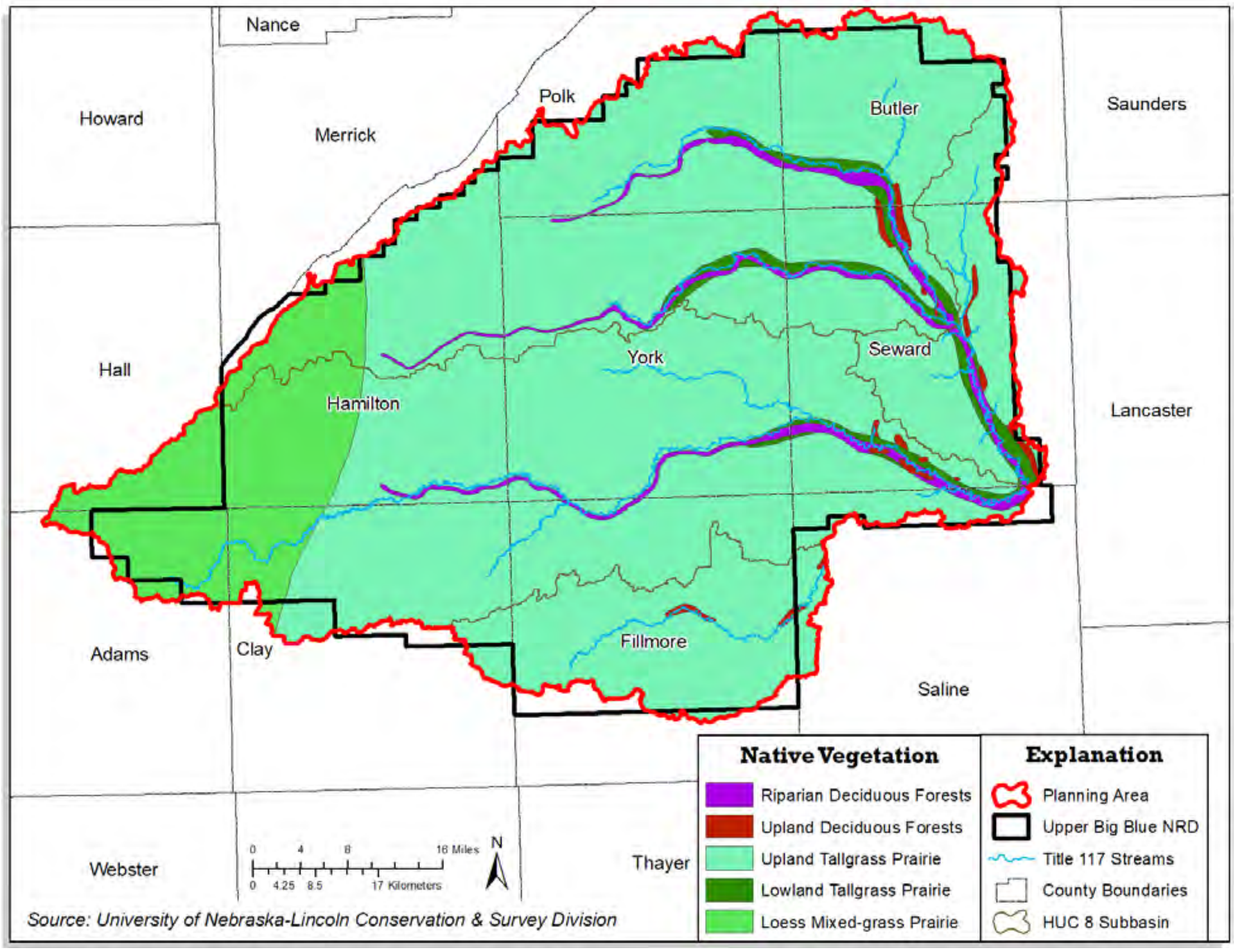


Figure 17: Native Vegetation of the Planning Area (circa 1860)

Present Day Land Use

Present day land use in the planning area was determined by Geographic Information System (GIS) analysis of the 2017 USDA-National Agriculture Statistics Service's (NASS) Cropland Data Layer (CDL) (USDA, 2017a), which is available at the USDA NRCS GeoSpatial Data Gateway. The CDL is a complete, geographically referenced classification of all satellite ortho-imagery data within a state by crop or other land use. The land use inventory allows watershed modeling to be performed, as well as assisting with identifying specific strategies to manage pollutants. As seen in Figure 18, corn and soybeans comprise a large percentage of the planning area (Table 15). However, some areas of grass and pasture remain littered across the planning area.

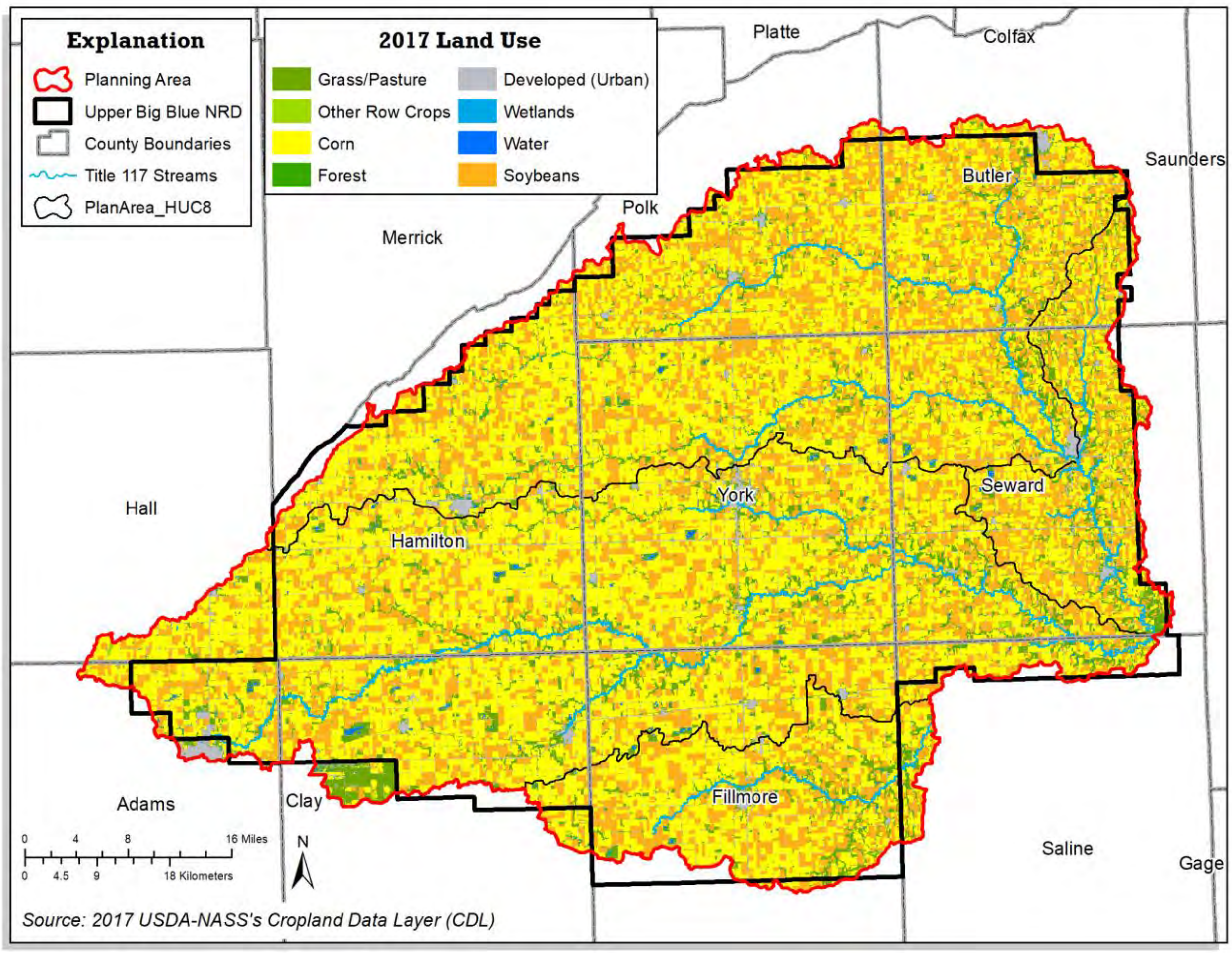


Figure 18: Present Day Land Use (2017)

Table 15: 2017 Land Use by HUC 8 Subbasin

HUC 8 Subbasin	Middle Big Blue		West Fork Big Blue		Upper Big Blue		Turkey		District Total
2017 Land Use	Acres	%	Acres	%	Acres	%	Acres	%	Acres
Corn	61,329	41%	469,692	55%	365,987	52%	95,670	50%	992,678
Soybeans	56,662	38%	240,428	28%	251,136	35%	64,643	34%	612,869
Grass/ Pasture	17,664	12%	71,096	8%	39,789	6%	16,274	9%	144,823
Urban (Developed)	8,153	5%	47,336	6%	32,921	5%	8,643	5%	97,054
Forest	5,438	4%	16,687	2%	12,401	2%	4,424	2%	38,950
Wetlands	282	0%	3,201	0%	3,622	1%	420	0%	7,525
Other Row Crops	693	0%	4,497	1%	947	0%	932	0%	7,070
Open Water	875	1%	4,075	0%	1,626	0%	359	0%	6,935
Total	**151,096**	**100%**	**857,012**	**100%**	**708,429**	**100%**	**191,366**	**100%**	**1,907,903**

Source: 2017 USDA-NASS Cropland Data Layer (USDA, 2017a)

3.03 SURFACE WATER RESOURCES

STREAMS

The four subbasins within the planning area exhibit similar dendritic (tree-like) drainage patterns and there are several perennial tributaries which contribute to surface water flows (Table 16). The Upper Big Blue subbasin includes six stream segments identified in Title 117 – Nebraska Surface Water Quality Standards, totaling 172 stream miles. The West Fork Big Blue subbasin includes eight stream segments totaling 243 stream miles. Several segments are named creeks including Beaver Creek, Johnson Creek, and School Creek. The Middle Big Blue subbasin includes ten Title 117 stream segments covering 80 stream miles. Turkey Creek consists of two stream segments in the planning area, spanning approximately 80 stream miles. Figure 19 illustrates the Title 117 streams within the planning area.

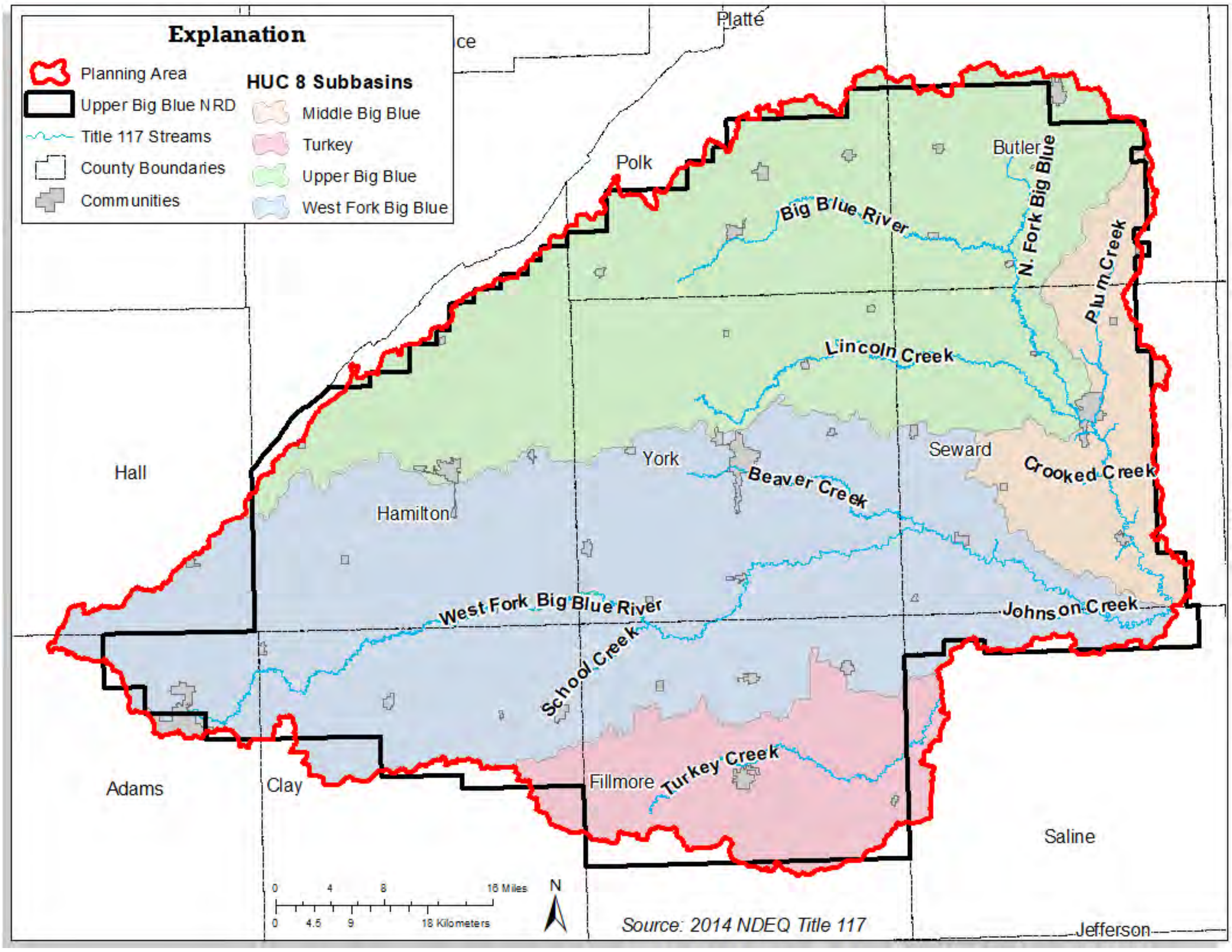


Figure 19: Designated Title 117 Streams in the Planning Area

Stream Stability

Stream channel stability generally refers to the capacity of a stream channel to transport water and sediment without changing dimensions (width, depth, cross-sectional area, and slope). However, there are several complicating factors including, but not limited to:

1. Stream bank and bed mobility is a natural phenomenon, and stable streams differ from unstable streams primarily in their rate of bank and bed mobility; and
2. Unnaturally high rates of bank and bed mobility can have multiple causes, ranging from small-scale, local causes (such as unrestricted livestock access) to large-scale, regional causes (such as watershed-wide increase in impervious pavement).

Nature rarely operates on our time scale; thus, it can be difficult to determine exactly when a change in the system reflects either an instability from short term impacts or a dynamic variation within a long-time frame.

A channel is considered stable and in equilibrium when the energy associated with flow and channel slope balances with the sediment load and bed material size. Channels in equilibrium balance these factors over time (Figure 20). Erosion is a constant and natural process in stream evolution, but it occurs at a much slower rate under stable conditions. Erosion rates can be exacerbated by human intervention such as stream straightening or cultivation through drainage ways. Therefore, the concept of “stability” is better characterized as “dynamic equilibrium”.

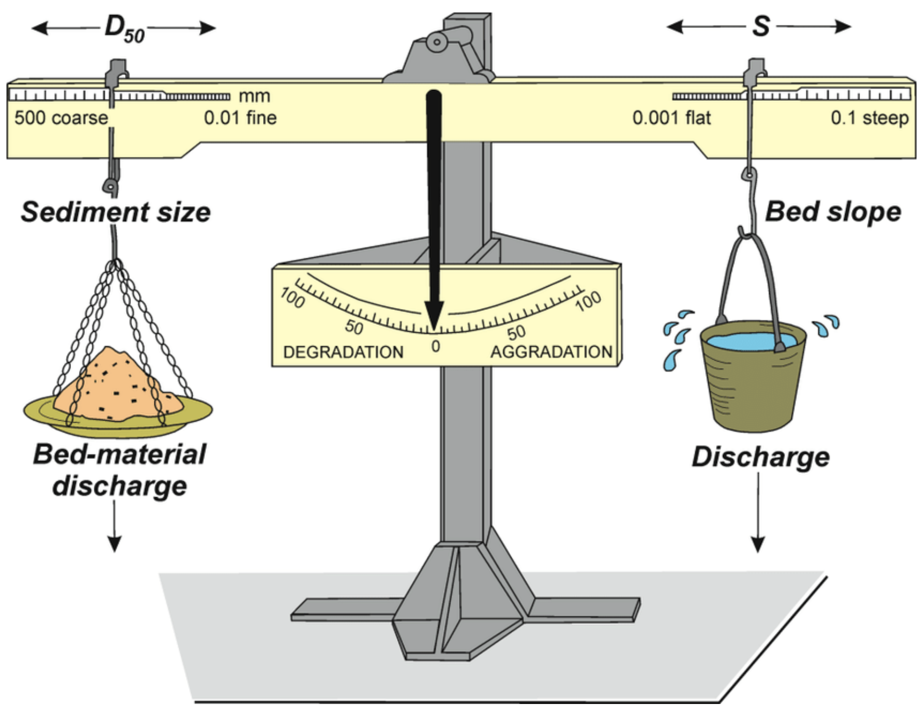


Image Source: Rinaldi, 2015

Figure 20: Lane's Balance, a representative model of stream stability

To regain dynamic equilibrium, destabilized streams generally adjust, or evolve, through a sequence of channel forms. The stream evolution model (Simon, 1989) provides a framework to understand how stream channel morphology changes throughout this evolutionary process and is broken down into six cyclical stages (Figure 21). Understanding this framework allows resource managers to evaluate present channel conditions, interpret historical conditions or activities that led to the current state, and predict future channel behavior. Stream assessments are conducted to gather this type of information.

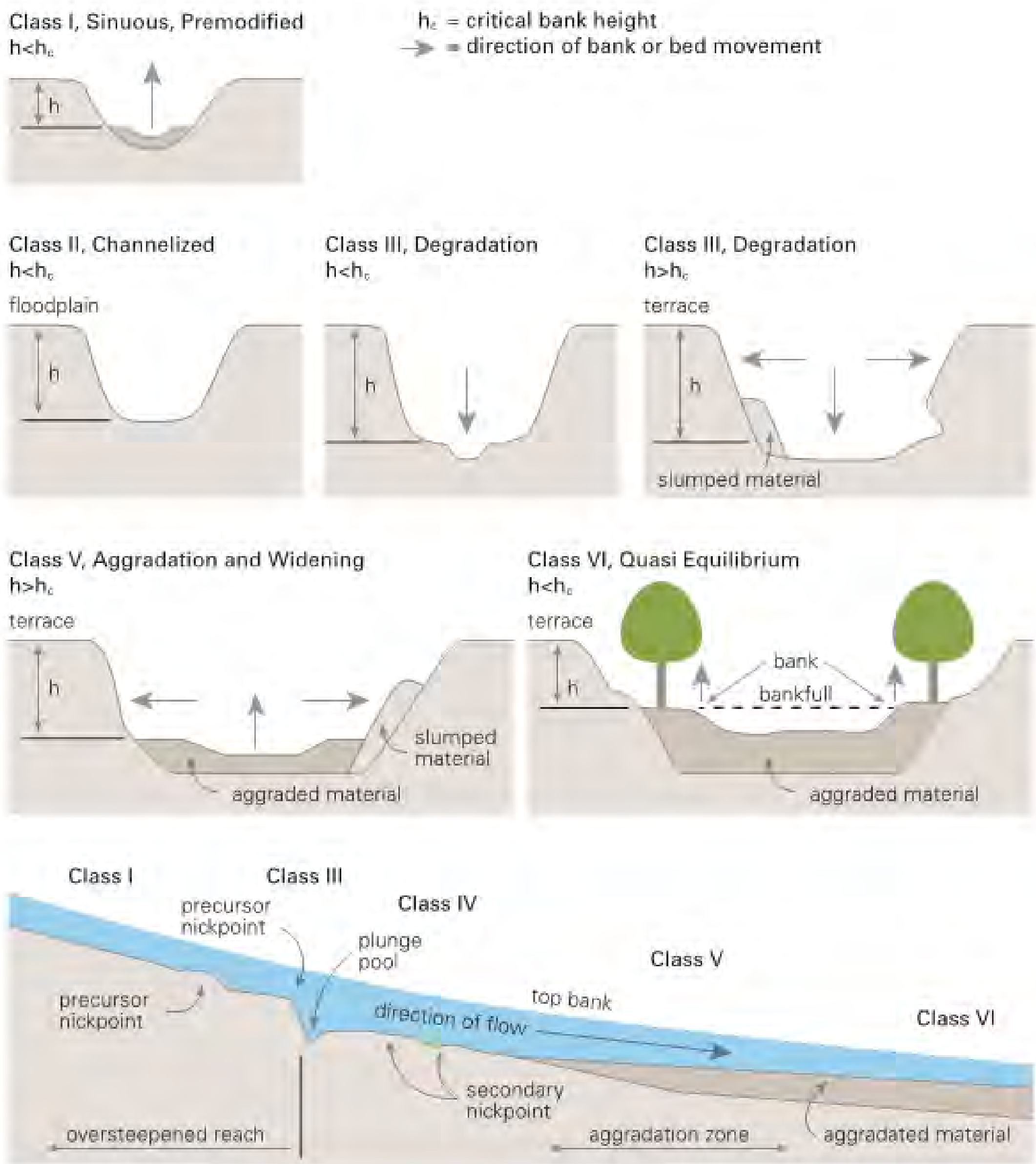


Image Source: Harmon, 2012

Figure 21: Simon Channel Evolution Model

Information on the stability of streams is typically gathered through various types of rapid stream assessments. These evaluations provide a concise, reconnaissance-level overview of stream quality conditions and may also identify potential enhancements to improve stream health. These on-the-ground assessments focus (to varying degrees) on geomorphology, riparian conditions, and in-stream habitat. It can be useful to focus on high priority areas to protect, such as areas near bridges or other infrastructure. Desktop level assessments can either enhance in-field assessments or be used as a standalone to develop an initial, rough level understanding of stream stability. Desktop tools include historic aerial photography, LiDAR, aerial oblique imagery, and stakeholder input.

A stream stability assessment has not been completed for the planning area. It is recommended that one is completed either as part of future implementation projects or prior to updating this plan. This information not only assists by providing baseline data and identifying stream stabilization/restoration opportunities, but also provides information useful to water quality modeling efforts. Currently the best estimates of overall stream stability within the planning area have been compiled from literature values and stakeholder input.

Stakeholders indicated that, in general, smaller tributary streams in the planning area are mostly stable, while larger, higher order streams are more unstable. A comprehensive USGS study (Soenksen, 2003) was used to approximate stream stability estimates for water quality modeling across the planning area. The study used in-field measurements across eastern Nebraska to look at stream stability and, while it did not cover much of the planning area, some inferences can be made. Results from the study estimated approximately 62% of stream miles in Eastern Nebraska are in some state of "stable" condition. Given stakeholder comments and the relatively flat terrain found in the study area (as opposed to Eastern Nebraska), this plan assumes that 75% of streams in the planning area are in dynamic equilibrium.

Table 16: Summary of Streams within the Planning Area

HUC 8 Subbasin	Named Streams	Individual Segments	Total Stream Miles
Upper Big Blue	4	6	172
Middle Big Blue	9	10	80
West Fork Big Blue	5	8	243
Turkey	1	2	80
Total	**19**	**26**	**575**

Source: NDEQ, 2016

LAKES AND RESERVOIRS

There are 16 Title 117 designated lakes in the planning area (Figure 22). The two largest lakes are both located in the City of Hastings: Lake Hastings at 76 surface acres and Hastings Northwest Reservoir at 46 acres (Table 17). It should be noted that Lake Hastings is partially within the UBBNRD boundary, though fully within the planning area. More than half of the 16 lakes in the planning area have a permanent pool area of five acres or less. Several of the lakes in the planning area offer recreational activities and facilities including: fishing, hiking, picnicking, and both electrical and primitive camping. The Waco Waterfowl Production Area had originally been excavated as a water concentration pit to control the spread of canary reed grass. This water pit was later filled, and now exists as a wetland (U.S. Fish and Wildlife Service [USFWS], 2014).

Several flood control reservoirs exist in the planning area to help alleviate flooding issues. In total, there are 115 dams registered with the Nebraska Department of Natural Resources (NeDNR) located within the planning area (NeDNR, 2018b). Each dam has a hazard rating based upon several criteria, including the potential for structural damage or loss of human life if they should fail. Two dams have the highest risk, or designation of 'High Hazard': Hastings Northwest Reservoir located in Hastings; and Dam 2-7-5W located in Sutton.

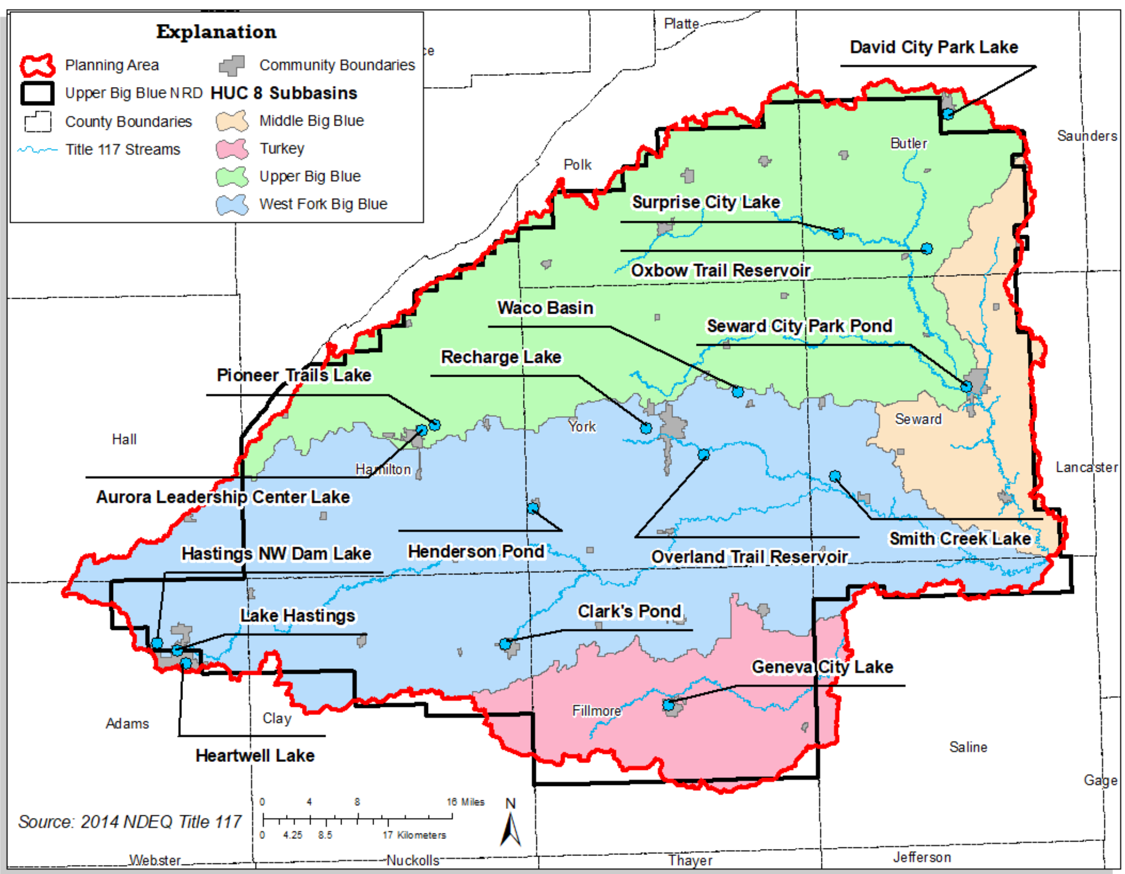


Figure 22: Designated Title 117 Lakes in the Planning Area

Table 17: Summary of Lakes within the Planning Area

Lake Name	Waterbody ID	Surface Area (acres)
Upper Big Blue HUC 8		
Seward City Park Pond	BB4-L0020	2.0
Surprise City Lake	BB4-L0030	5.0
Oxbow Trail Reservoir	BB4-L0035	34.5
Pioneer Trails Lake	BB4-L0040	6.2
Aurora Leadership Center Lake	BB4-L0045	3.0
David City Park Lake	BB4-L0010	3.6
	Subtotal	**54.3**
Middle Big Blue HUC 8		
n/a	n/a	n/a
West Fork Big Blue HUC 8		
Smith Creek Lake	BB3-L0010	19.8
Waco Basin	BB3-L0030	2.6
Overland Trail Reservoir	BB3-L0035	11.8
Clark's Pond	BB3-L0045	0.7
Hastings Northwest Dam Lake	BB3-L0060	45.6
Recharge Lake	BB3-L0080	36.3
Henderson Pond	BB3-L0040	5.0
Lake Hastings	BB3-L0050	75.7
	Subtotal	**197.5**
Turkey HUC 8		
Geneva City Lake	BB2-L0040	1.0
	Planning Area Total	**252.8**

WETLANDS

Information on Nebraska’s wetlands are primarily documented in two Nebraska Game and Parks Commission (NGPC) publications: “Guide to Nebraska’s Wetlands and their Conservation Needs” (LaGrange, 2005), and the “Wetland Program Plan for Nebraska” (LaGrange, 2015). Nebraska’s wetland resources are diverse and dynamic. Many wetlands receive their water supply from groundwater, while others are dependent on precipitation and runoff. Wetlands are known to serve many functions and provide valuable services such as water purification, wildlife habitat, flood protection, and groundwater recharge. Wetlands are defined in Title 117 as:

“Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, at prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.”

Rainwater Basin Wetlands Complex

The wetlands of Nebraska have been categorized into 14 complexes based on geography and distinct wetland forms and functions (LaGrange, 2005). It should be noted that if existing wetlands are not identified in one of these complexes, it does not indicate that they are unimportant or do not provide valuable functions. The Rainwater Basin wetland complex can be found within the planning area. The Rainwater Basin (Figure 23) is made up of playa wetlands which, which are described below (NGPC, 2005).

“Playa Wetlands are wind-formed, nearly circular depressions located in semi-arid areas. They have a clay layer in the soil under the wetland that slows runoff water from seeping into the ground. This clay layer was formed by water movement over thousands of years. Most playas are not directly connected to groundwater.

The Rainwater Basin historically contained more than 11,000 individual wetlands. Knowing the vegetation present in the wetlands can aid conservation efforts and decision making, so a vegetation map was created covering all historical wetlands based on vegetation communities present in 2012. Based upon this assessment, more than 125,000 acres of historical wetlands were identified within the planning area (Nugent and others, 2015).

Management within the Rainwater Basin is coordinated by The Rainwater Basin Joint Venture (RWBJV), which was created in 1992, under the North American Waterfowl Management Plan. The RWBJV is one of nearly two dozen Joint Ventures dedicated to habitat conservation across North America. Joint Ventures provide a framework for partnerships between various organizations, to work cooperatively on conservation projects, from research and planning through implementation, evaluation, and monitoring.

The RWBJV partnership includes conservation organizations, landowners and agriculture producers, natural resources districts, researchers, and government agencies from the federal and state levels, as well as county and local levels. Partners pool their resources and knowledge to accomplish more jointly than they could by working on their own. Specifically, the following partners are part of the RWBJV:

- US Fish and Wildlife Service
- US Forest Service
- Farm Service Agency
- Natural Resources Conservation Service
- Nebraska Game and Parks Commission
- Nebraska Association of Natural
- Resource Districts
- Upper Big Blue NRD
- Little Blue NRD
- Tri Basin NRD
- Nebraska Environmental Trust
- The Nature Conservancy
- Pheasants Forever
- Ducks Unlimited
- Many private landowners

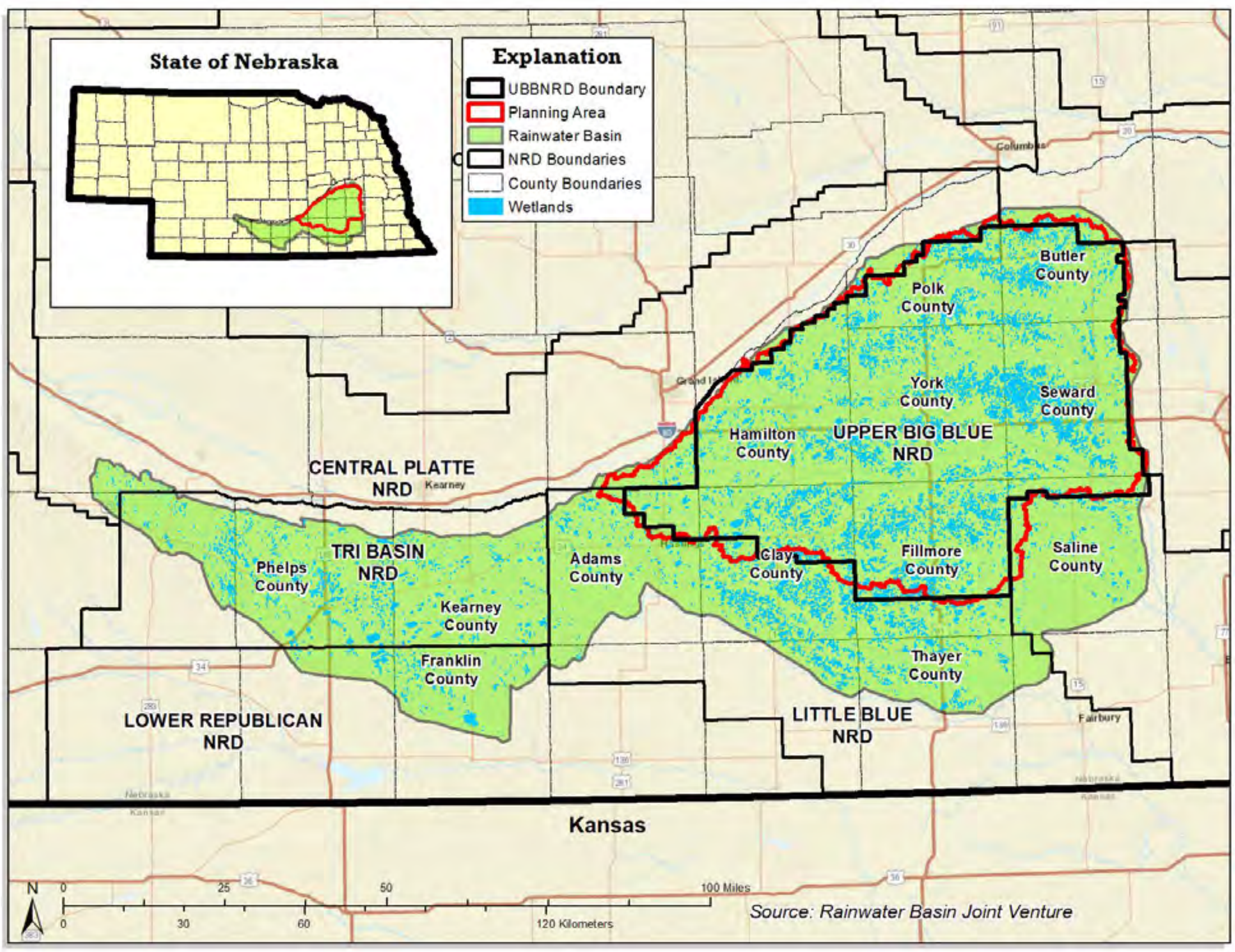


Figure 23: Rainwater Basin Wetland Complex

3.04 SURFACE WATER HYDROLOGY

HYDROLOGIC CHARACTERISTICS

Characterizing the hydrologic regime of a watershed is an important aspect to understanding its vulnerability from land and water use practices, which in turn influence water quality. It is also critical to building a water quality model. Figure 24 contains a conceptual hydrograph and cutaway which illustrates these key concepts.

Hydrologic processes are complex, involving many interactions that can be difficult to quantify. Additionally, impacts may be seen on both temporal and spatial scales. The location, extent, timing, and type of activities all play a role in alterations. Changes can be seen in the magnitude and timing of peak flows and low flows, or in year-to-year flow trends. Some activities (roads, seasonal irrigation withdrawals, etc.) cause short-lived alternations, while other activities (dams, urbanization, channelization, groundwater mining, etc.) can cause relatively permanent changes in the hydrology of a watershed (USEPA, 2003, p. 211).

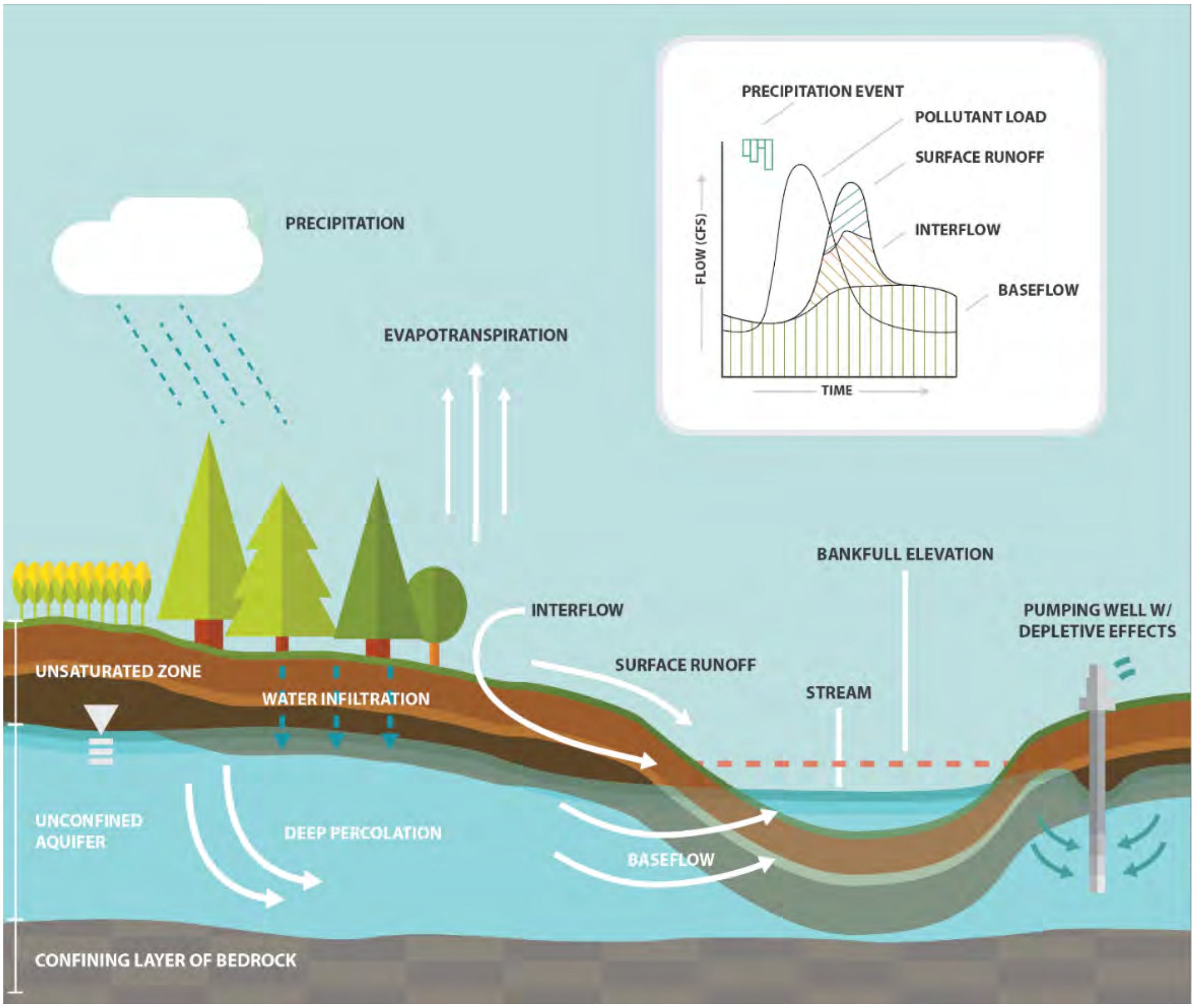


Figure 24: Conceptual Storm Hydrograph and Groundwater Flow System

STREAMFLOW

Streamflow regimes are composed of seasonally varying environmental flow components including high flows; base flows; pulses; and floods that can be characterized in terms of their magnitude, frequency, duration, timing (predictability), and rate of change (flashiness) of hydrologic conditions (Poff and others, 1997).

To understand the typical hydrologic cycle and streamflow regime of the planning area, a representative stream gage was identified to review streamflow records. However, while representative of the area and long-term trends, it should be noted that all streams have unique responses to storm events due to variability in precipitation patterns and the effects of terrain, soils, and land use. This creates both local and regional flow patterns. Additionally, several of the area streams are regulated by manmade structures such as reservoirs.

The United States Geological Survey (USGS) stream gage located on the West Fork Big Blue River near Dorchester has a long-term period of record dating and is located in the downstream portion of the planning area (USGS, 2018a). A review of the discharge data for the West Fork Big Blue River demonstrates a few trends which provide a basic understanding the dynamic hydrologic cycle of the planning area:

- Streamflow can vary considerably day-to-day, as precipitation is the most significant water supply to the planning area (Figure 25).
- A predictable seasonal pattern (Figure 25) can be seen via streamflows. Snowmelt causes an increase in runoff in late winter/early spring, leading to increased stream flows. There is also an increase in streamflows during the late spring and early summer storm season.
- A long-term trend of declining streamflows has been noted in the West Fork Big Blue River (Figure 26). Analysis has not been completed to identify the cause of this trend.
- The running 5-year average shows long-term patterns of wet and dry periods (Figure 26). The highest daily average streamflow recorded was 529 cfs in 1993, and the lowest daily average was 50 cfs in 2013. The long-term average flow is 175 cfs.
- Stream flows are seasonally predictable across the planning area, but less predictable during high flow/flood events due to natural and anthropogenic impacts which vary across subwatersheds.

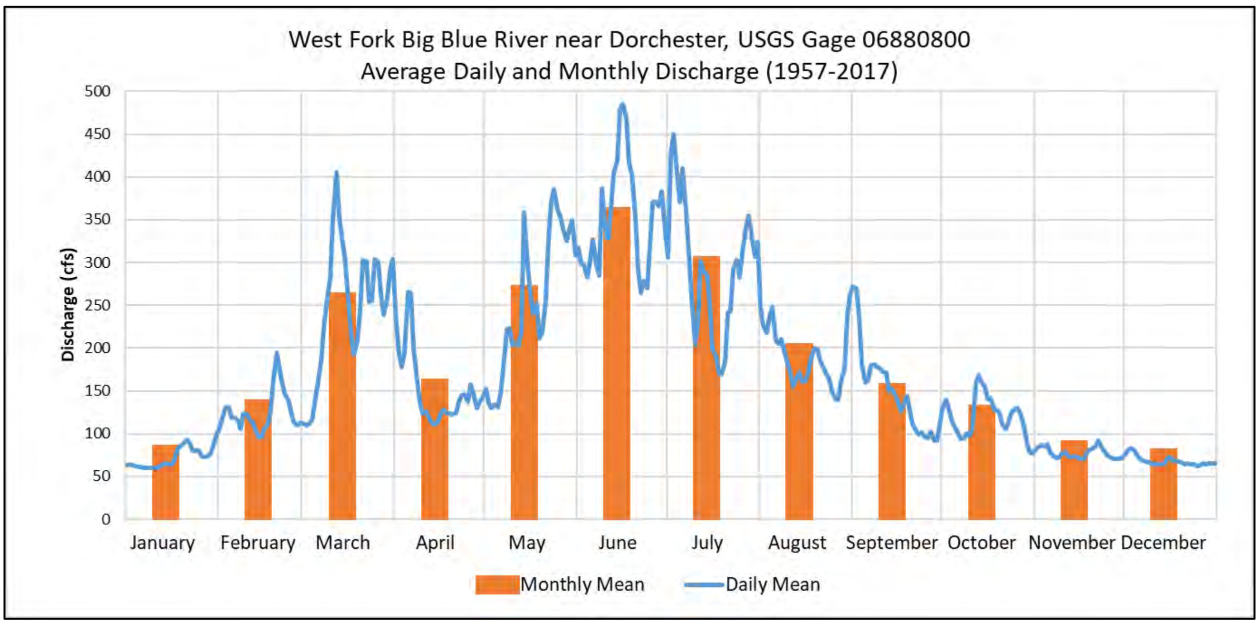


Figure 25: Streamflow Hydrograph of an Average Year for West Fork Big Blue River

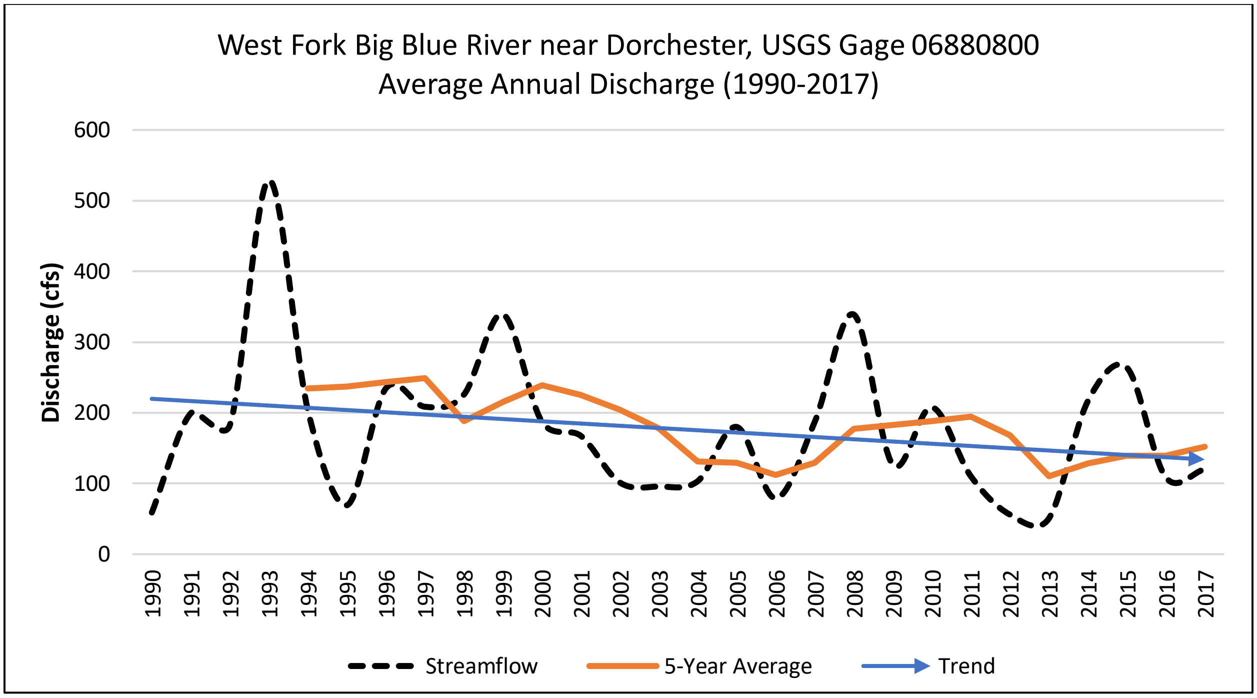


Figure 26: Long Term Streamflow Hydrograph for West Fork Big Blue River

Variations in stream flow levels, including high flow or flooding events, are an important part of the natural ecological function of streams. Many fish and aquatic organisms require habitat that cannot be maintained by minimum or even typical flows over the long term. A range of flows are necessary to scour and revitalize gravel beds, import wood and organic matter from the floodplain, and provide access to riparian wetlands. Additionally, these processes are important in the natural cycling/movement of nutrients and sediments (Poff and others, 1997).

Understanding these hydrological conditions is important to making management decisions regarding watershed planning, especially for stream restoration and management practices. However, extremely high flows may be considered flooding, which can cause damage to infrastructure, homes, businesses or other property, and endanger human life. Balance is needed in the management of streams within the planning area. It is important to note that flood risk reduction is a statutory responsibility of the UBBNRD.

The UBBNRD's Board of Directors considers flood risk reduction projects on a case-by-case basis. Currently, the UBBNRD is working with the City of Seward on such a project. Communities and individuals interested in finding out where the regulatory floodplains are within the district, can find the most up-to-date maps through the Federal Emergency Management Agency (FEMA). FEMA regularly works with the NeDNR and local entities in the production and updates of floodplain maps. Those can be found online at the FEMA Flood Map Service Center: https://msc.fema.gov/

A review of information documented in the City of Seward Flood Insurance Study (FIS) (Federal Emergency Management Agency [FEMA], 1993) helps to provide a basic understanding of flooding within the planning area. Below is an excerpt from the study describing the principal flooding problems for Seward, which are representative of many communities within the planning area:

> *"Past floods of the Big Blue River have been produced by widespread precipitation over the entire basin. Rapid snowmelt runoff can also contribute to flooding of the Big Blue River. Flooding from Plum Creek is caused by high-intensity, localized thunderstorms. Seward has a long history of damaging floods from the Big Blue River. The most recent major floods occurred in the years 1941, 1948, 1969, 1931, 1937, 1960, 1963, 1967, and 1986. Both the 1949 and 1951 flood inundated parts of western Seward, including the Hughes Brothers industrial plant, the City park, and the surrounding residential areas. As a result, a levee was constructed by the COE to protect these areas. Since completion of the levee in 1953, property damage as a result of floods has been greatly reduced. The major factors that aggravate flooding on both the Big Blue River and Plum Creek are extreme channel meandering and constrictive hydraulic structures. Floodplain development may also aggravate flooding from both the Big Blue River and Plum Creek."*

A review of data from the USGS stream gage located on the West Fork Big Blue River near Dorchester (06880800) provides an indication as to the magnitude and frequency of flooding that occurs in the planning area. Gage height data, which indicates the depth of water in the stream channel, was reviewed against the National Weather Service's (NWS) designated "flood stage", which is set at 15 feet (USGS, 2018a). Figure 27 shows that between 1999 and 2018, the gage has recorded the river reaching the NWS flood stage on a total of 19 days during over six years (1999, 2000, 2005, 2010, 2014, and 2015). The stream has been above its average level (3.5 feet), but less than flood stage, on many occasions (1,825) where it may be considered a high flow event, but not a flooding event.

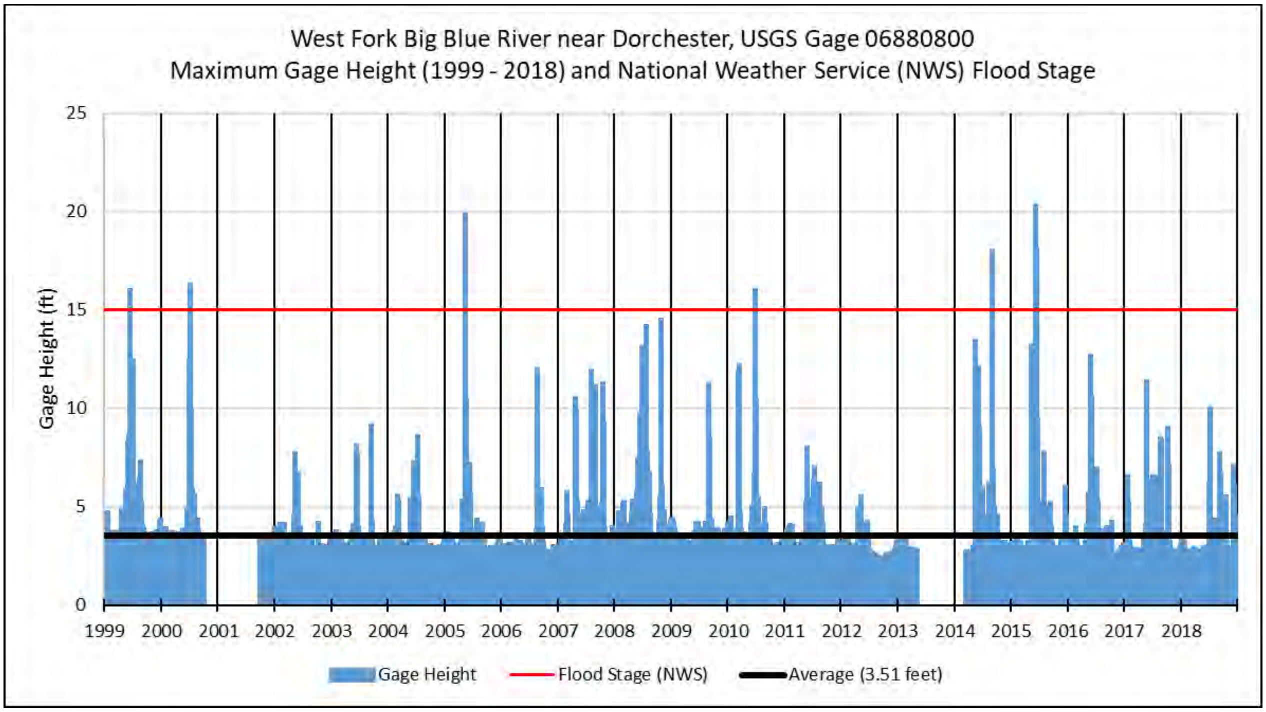


Figure 27: Maximum Daily Gage Height and Flood Stage Records for West Fork Big Blue River

RUNOFF

An analysis of runoff across the planning area was performed to estimate runoff yield from the planning area. These runoff yield estimates were then utilized to estimate pollutant loadings for individual HUC 12 subwatersheds. Runoff yield estimations were largely based on the interaction of runoff coefficients determined from soil type, land use, and slope of the contributing areas with estimated annual runoff values provided by USGS gaging stations with annual water summaries. Areas dominated by natural or perennial vegetation have the lowest amount of runoff when slope is not accounted for; however, increasing slope increases runoff. The average runoff coefficients were calibrated using historical data from USGS gages. A detailed discussion on methodology is provided in Appendix B.

Runoff varies appreciably across the planning area. The lowest runoff estimates were noted along the northern boundary of the planning area. Land use in this area consists mostly of perennial grass cover, with soils in the silt loam to clay loam range. Greater runoff values were seen in the eastern portion of the planning area due to increasing slopes and higher clay content in soils. Open water has a high yield because any precipitation that falls on streams, lakes, wetlands, etc. directly contributes to runoff. A summary of runoff volumes by land use is provided in Table 18 while the variation in runoff by HUC 12 is illustrated in Figure 28.

Table 18: Estimated Average Annual Runoff by Land Use

Land Use	Percent of Area	Percent of Basin Runoff	Total Runoff (Acre-ft.)	Total Annual Runoff Yield (in)
Grass/Pasture	7.59%	6.57%	20,747	1.72
Cultivated Crops	84.46%	84.88%	268,028	1.99
Bare Soil	0.04%	0.04%	129	2.46
Forest	2.04%	1.33%	4,207	1.30
Developed/Urban	5.09%	5.40%	17,034	2.11
Open Water/Wetlands	0.78%	1.78%	5,618	4.66
Total	**100.00%**	**100.00%**	**315,763**	**n/a**

Source: Technical Memo - Runoff Yield Estimation, JEO

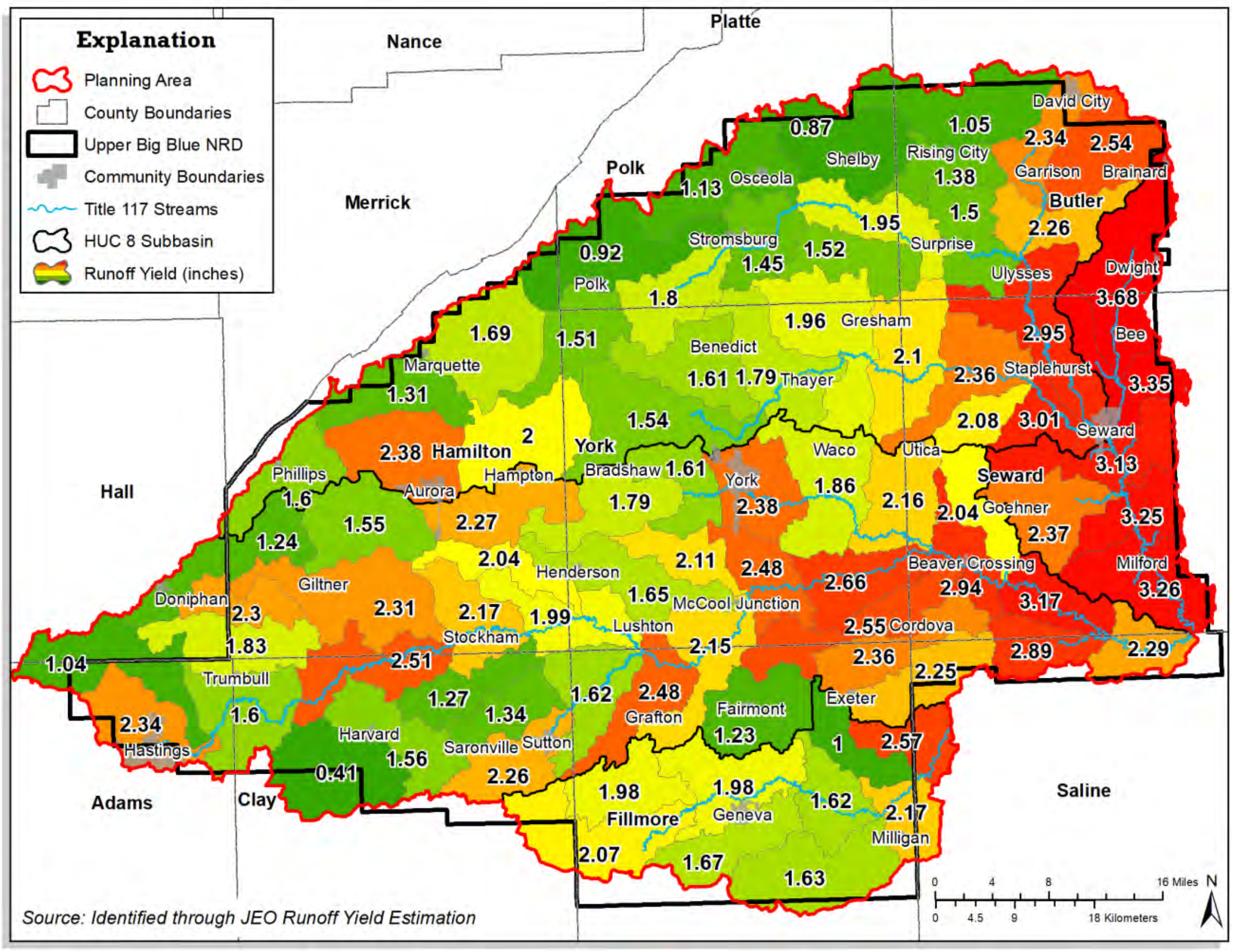


Figure 28: Estimated Average Annual Runoff by HUC 12 Subwatershed

3.05 GROUNDWATER RESOURCES

AQUIFERS

The State of Nebraska is generally supplied with an abundant supply of groundwater, making it one of Nebraska's most important natural resources. While the vast majority of the state overlays the well-known High Plains Aquifer, the groundwater resources of the planning area are quite variable from place to place. The following aquifers are found in the planning area are described below and illustrated in Figure 29 (Korus and others, 2013; Divine, 2014):

- **The High Plains aquifer**, also called the Ogallala aquifer, underlies a large portion of the planning area. This aquifer consists of Quaternary-age unconsolidated deposits. The sediments consist of sand, gravel, silt, and clay that form a layered sequence of aquifers separated by intervening aquitards (Landon and others, 2008).
- **Paleovalley aquifers** are located in the far northeastern portion of the planning area. These aquifers were developed when ancient river valleys were filled with alluvium and eventually buried by younger geologic materials.
- **Glacial aquifers** are widely separated and discontinuous local aquifers with varying properties. They were formed when glaciers repeatedly advanced and retreated across eastern Nebraska. In some areas sands and gravel were left behind in deposits known as *till.* Some of these deposits contain small, local, and discontinuous aquifers, however, typically, these aquifers only support small-scale withdraws for domestic and livestock purposes.
- **Alluvial valley aquifers** exist in the modern-day stream valleys of Nebraska, where alluvium has been deposited across wide floodplains. These typically have shallow depths to groundwater, high permeability, and are highly vulnerable to contamination.
- **The Dakota aquifer** is located along the eastern boundary of the planning area and encompass most of Seward County. This aquifer consists primarily of sandstone and produces relatively low yields of water.

"High-Risk Groundwater Areas" have been identified by the UBBNRD and are also shown on Figure 29. These areas were identified because of limitations on the availability of groundwater, due to local geologic conditions. These areas have special rules for the installation and use of groundwater wells and certified irrigated acres, as specified in the *UBBNRD Groundwater Management Rules and Regulations* - District Rule 5, Chapter 25. These rules are in place to protection existing groundwater users.

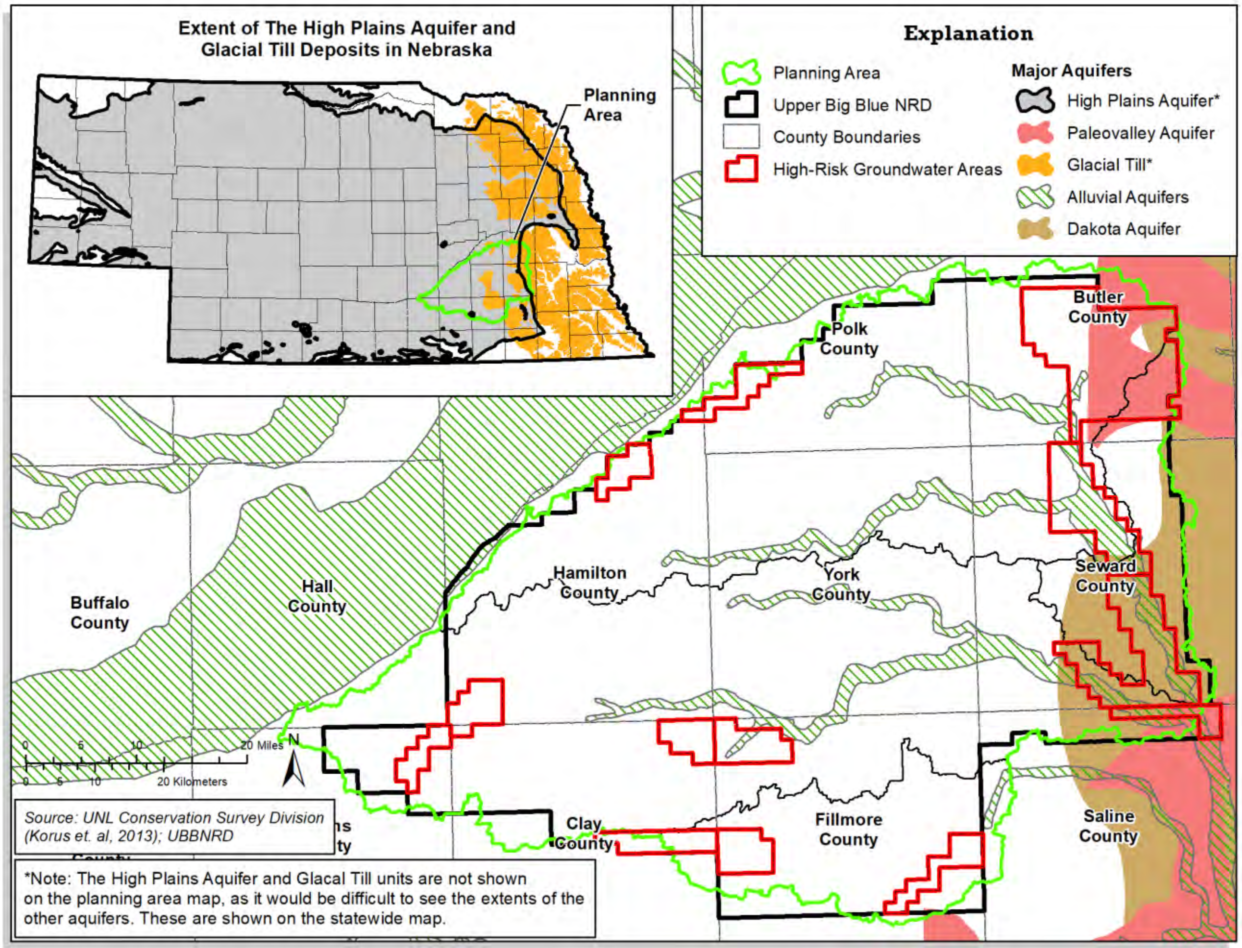


Figure 29: Major Nebraska Aquifers in the Planning Area

REGISTERED WELLS

There currently are 16,091 registered, active, wells within the planning area (NeDNR, 2018a). Refer to Figure 30 for the locations of these wells (excludes irrigation use wells). The distribution of groundwater wells across the planning area is variable, following the variability of aquifers and the population. The majority of wells (79%) within the planning area are for irrigation use (Figure 31). Locations of municipal (public drinking water supply) wells are not included in this data set due to public security reasons. Note that, prior to 1993, domestic wells were not required to be registered in Nebraska, therefore domestic wells completed prior to 1993 may not be represented herein.

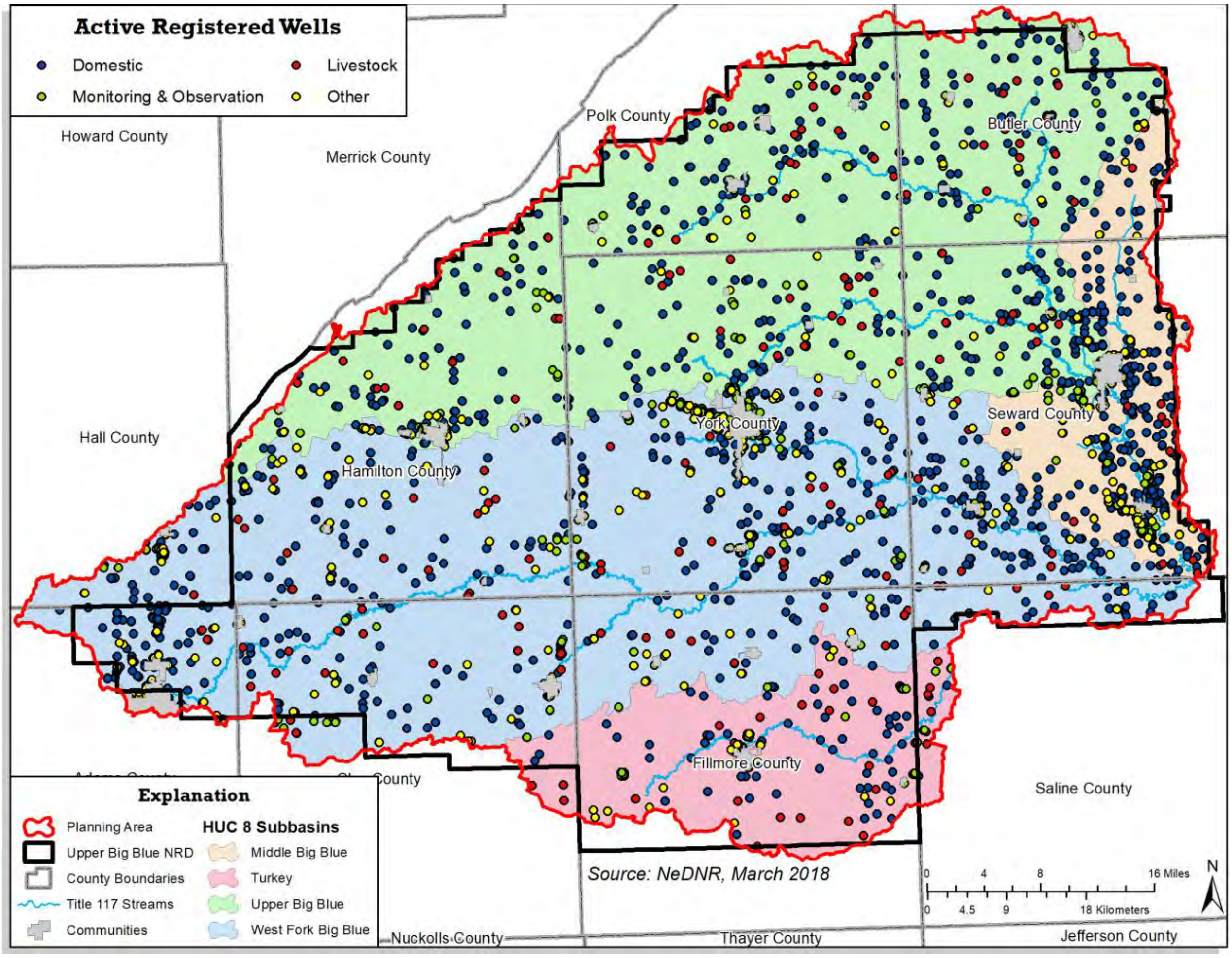


Figure 30: Active Registered Wells in the Planning Areas (excluding irrigation wells)

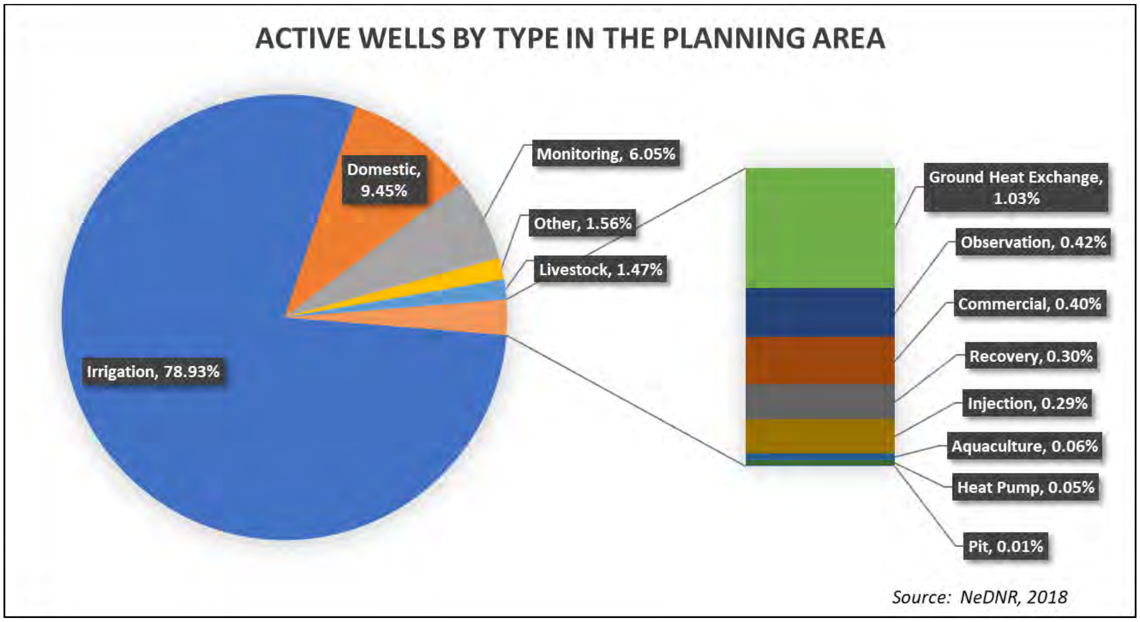


Figure 31: Distribution of Active Registered Well Uses in the Planning Area

AGRICULTURAL IRRIGATION

Irrigation is important to agriculture production in the planning area. According to the NeDNR Net Corn Crop Irrigation Requirement Map (prepared by Derrel Martin, UNL), which identifies the net amount of irrigation water that must be applied for a full yield of an irrigated corn crop. Irrigation requirements in the planning area increase from east to west, ranging from approximately 7 to 9 inches per year (Figure 32) (Martin, 2005). Irrigation demand is primarily driven by rainfall. Within the planning area there is approximately 1,258,000 acres certified by the UBBNRD for irrigation. The bulk of these are irrigated from groundwater wells. According to the NeDNR registered well database, there are 12,700 active irrigation wells in the planning area (NeDNR, 2018a). Compared to groundwater irrigation, surface water irrigation is limited as there are no major irrigation or ditch project/districts located in the planning area. According to NeDNR records, there are 1,258 active surface water irrigation diversions in the planning area. Refer to Figure 32 for locations of irrigated acres and surface water diversions.

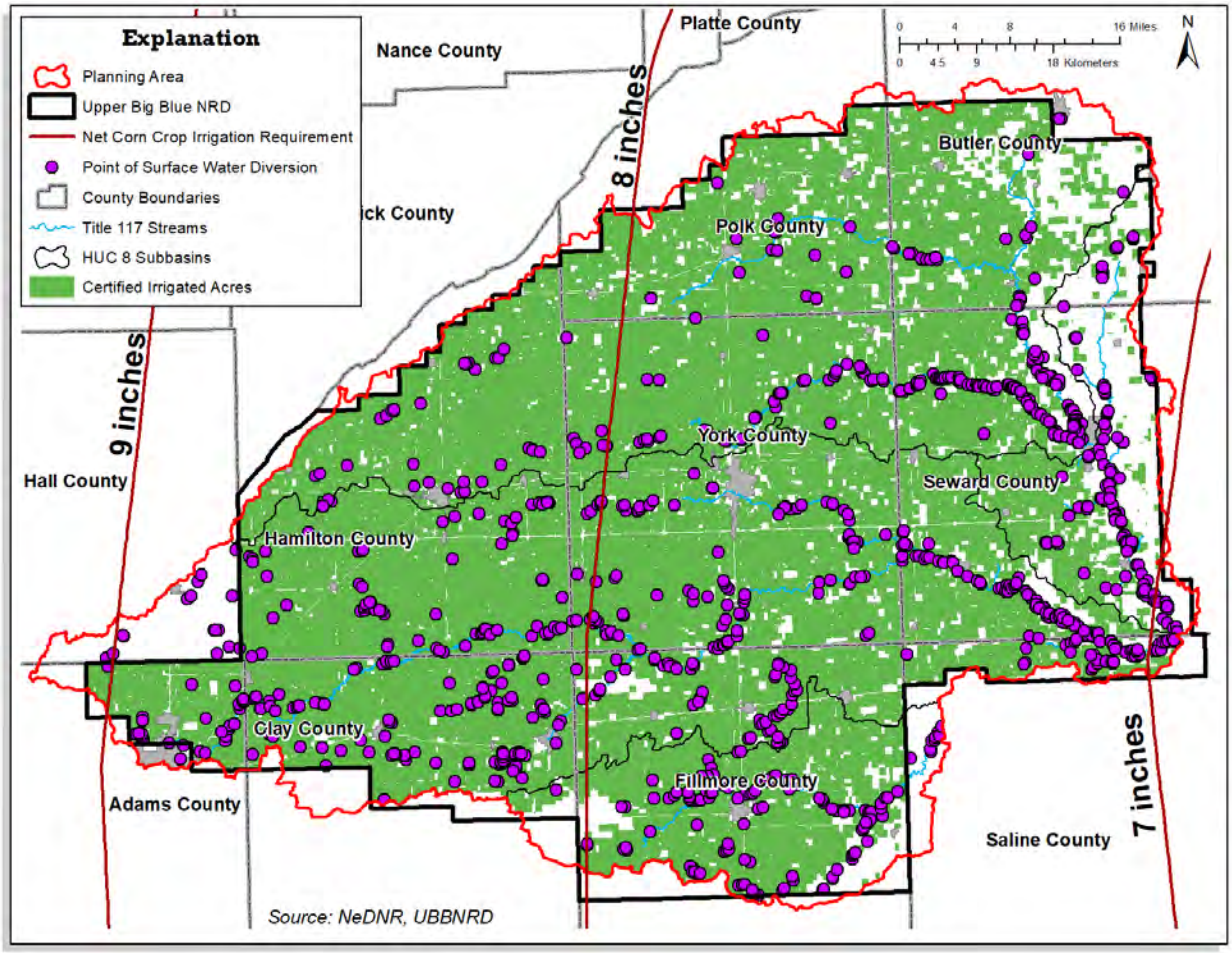


Figure 32: Agricultural Irrigation within the Planning Area

GROUNDWATER LEVELS

Groundwater level fluctuations vary to some degree across the planning area due to the complicated geology and aquifer conditions. From a long-term perspective, groundwater levels have declined over much of the planning area compared to predevelopment levels (Young and others, 2017). Predevelopment is identified as generally the early 1950s, prior to wide-spread irrigation well installation.The largest historic declines, ranging from 20 to 30 ft, are located in central Fillmore County (Figure 33). It is important to realize that this comparison is not spatially detailed and does not apply to any individual well or shorter time periods (such as year-to-year or seasonally).

For short-term fluctuations, the UBBNRD monitors groundwater levels within the planning area. Measurements are routinely taken from representative wells in both the spring and fall. For year-to-year comparisons spring measurements are used as they better represent aquifer conditions after they have had adequate time to return to static levels following summer irrigation.

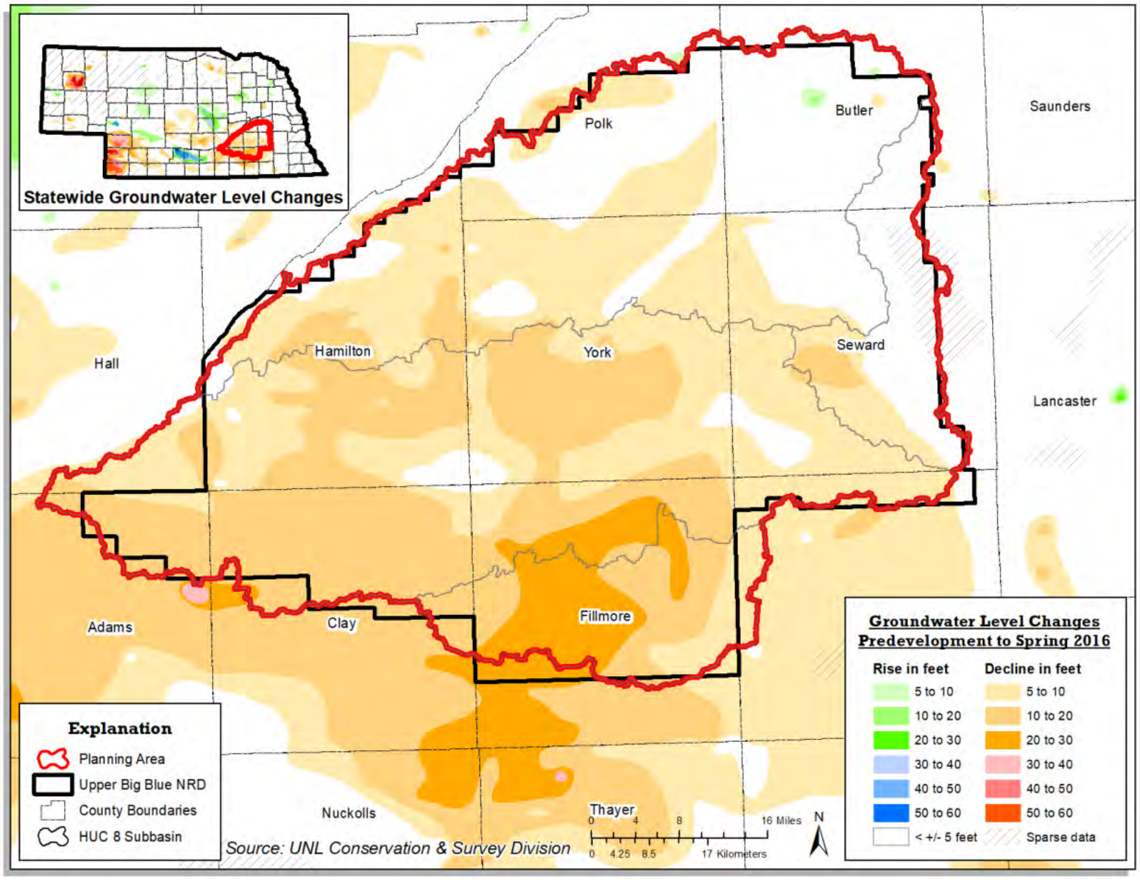


Figure 33: Groundwater Level Changes from Predevelopment to Spring 2016

GROUNDWATER NITRATE CONCENTRATIONS

Nitrates in drinking water are a concern within the UBBNRD. The Environmental Protection Agency (EPA) has developed Maximum Contaminant Levels (MCLs) for public water supplies to ensure safe drinking water. The MCL for nitrate (nitrate-nitrogen) is set at 10 mg/L. Nitrate concentration data was compiled from the NDEE Agrichemical Contaminant Database for Nebraska Groundwater (UNL, 2000). As seen in Figure 34, nitrate levels among wells varies widely across the planning area, with many exceeding the 10 mg/L MCL. Also depicted in Figure 34 are the Groundwater Quality Management Zones within the UBBNRD. These zones are split into three phases with distinct limitations, as described below.

- **Phase I** – Applies to the entire UBBNRD
  - Limits application of nitrogen fertilizers and anhydrous ammonia
- **Phase II** – Applies to areas where the UBBNRD has determined that the median groundwater nitrate level exceeds seven parts per million
  - Includes Phase I requirements
  - Requires operators to attend nitrogen certification training, irrigation scheduling equipment, soil sampling, following UNL recommended nitrogen fertilizer rate applications, and annual reporting
- **Phase III** – Applies to areas where the UBBNRD has determined that the median groundwater nitrate level exceeds ten parts per million.
  - Includes Phase I and II requirements
  - Requires additional soil sampling, irrigation water sampling, and further limits application of anhydrous ammonia with an approved nitrification inhibitor

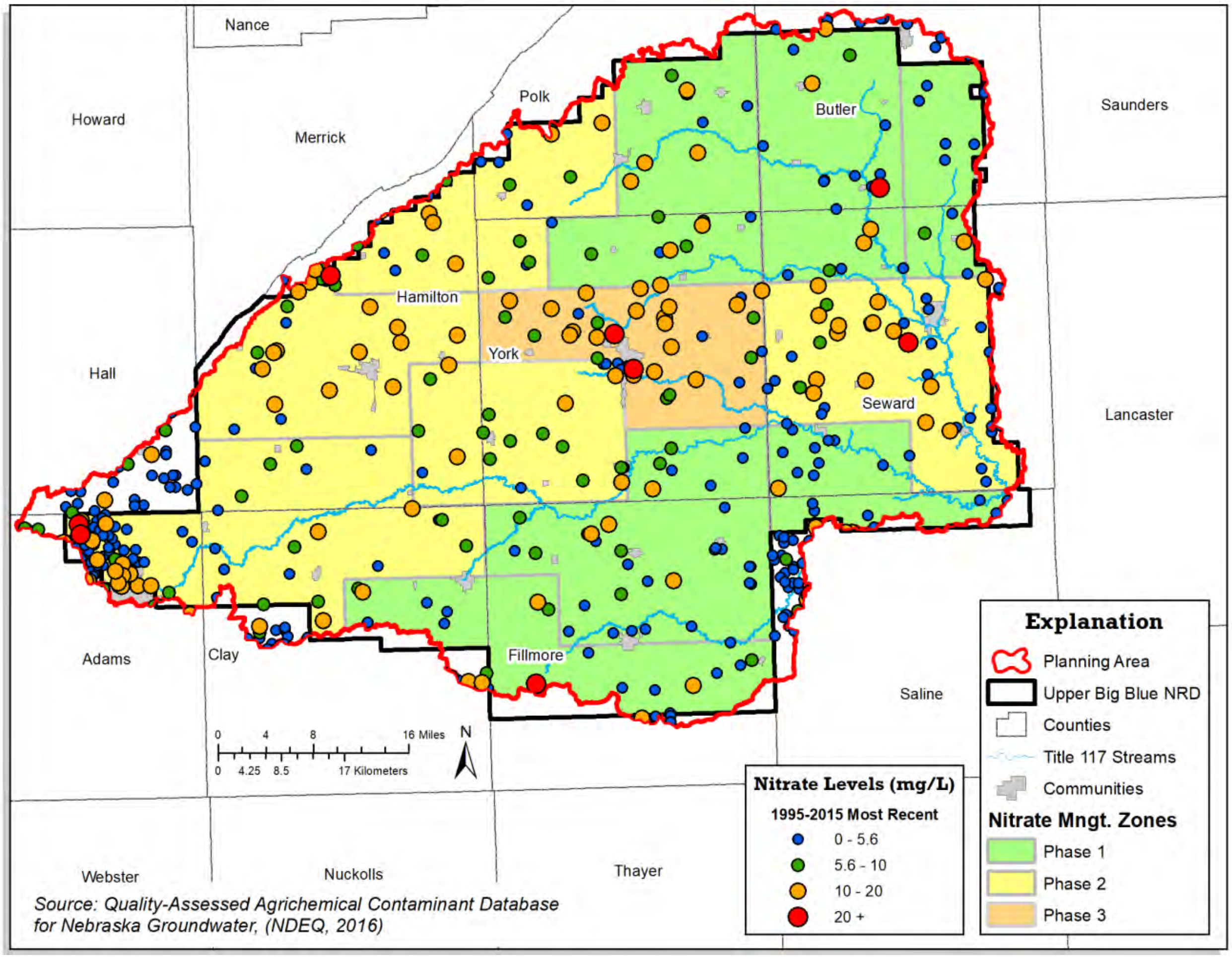


Figure 34: Most Recent Nitrate Concentrations from Wells Sampled from 1995-2015

WELLHEAD PROTECTION AREAS

The NDEE'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 Areas (WHP area). Groundwater modeling software is used to delineate the WHP area around the 20-year time-of-travel zone for the supply wells in those systems. This is the area that groundwater is expected to be extracted from during 20 years of normal water use. There are 38 designated community WHP areas within the planning area (Table 19). This plan recognizes each WHP area as a special resource area due to the influence a WHP area has on the management needs of source water aquifers and associated public drinking water systems.

The Nebraska Department of Health and Human Services (DHHS) administers a database of water sampling results from all community water systems in the state. The most recently complete year of data (2017) was reviewed to identify the highest nitrate sampling result for each community in the planning area (Table 19). While this analysis is helpful, caution in interpreting these results is advised. This is only one data point and nitrate levels may fluctuate over time.

Nitrates are known to be naturally occurring in groundwater, with a typical background concentration of 3 mg/L. Concentrations above 5 mg/L are likely a result of human activity (Gosselin, 1997). DHHS requires additional monitoring when a public drinking water system's nitrates are over 5.6 mg/L. The EPA has set a maximum contaminant level (MCL) of 10 milligrams per liter (mg/L) for nitrate-nitrogen in drinking water. In Figure 35 each WHP area is color coded by the highest nitrate value found in the DHHS database from 2017.

According to the data, eleven communities have reached nitrate levels at or above 5.6 mg/L, which triggers additional monitoring by DHHS. More concerning, five communities have measured at or over the MCL (10 mg/L):

- Aurora
- Benedict
- Hastings
- Prosser (note that Prosser is located within the Little Blue NRD, but a portion of the WHP area is within the Upper Big Blue NRD)
- Friend (note that Friend is located within the Lower Big Blue NRD, but a portion of the WHP area is within the Upper Big Blue NRD)

For the communities that have experienced elevated levels of nitrates, it is recommend that long term trends be evaluated to identify possible management recommendations.

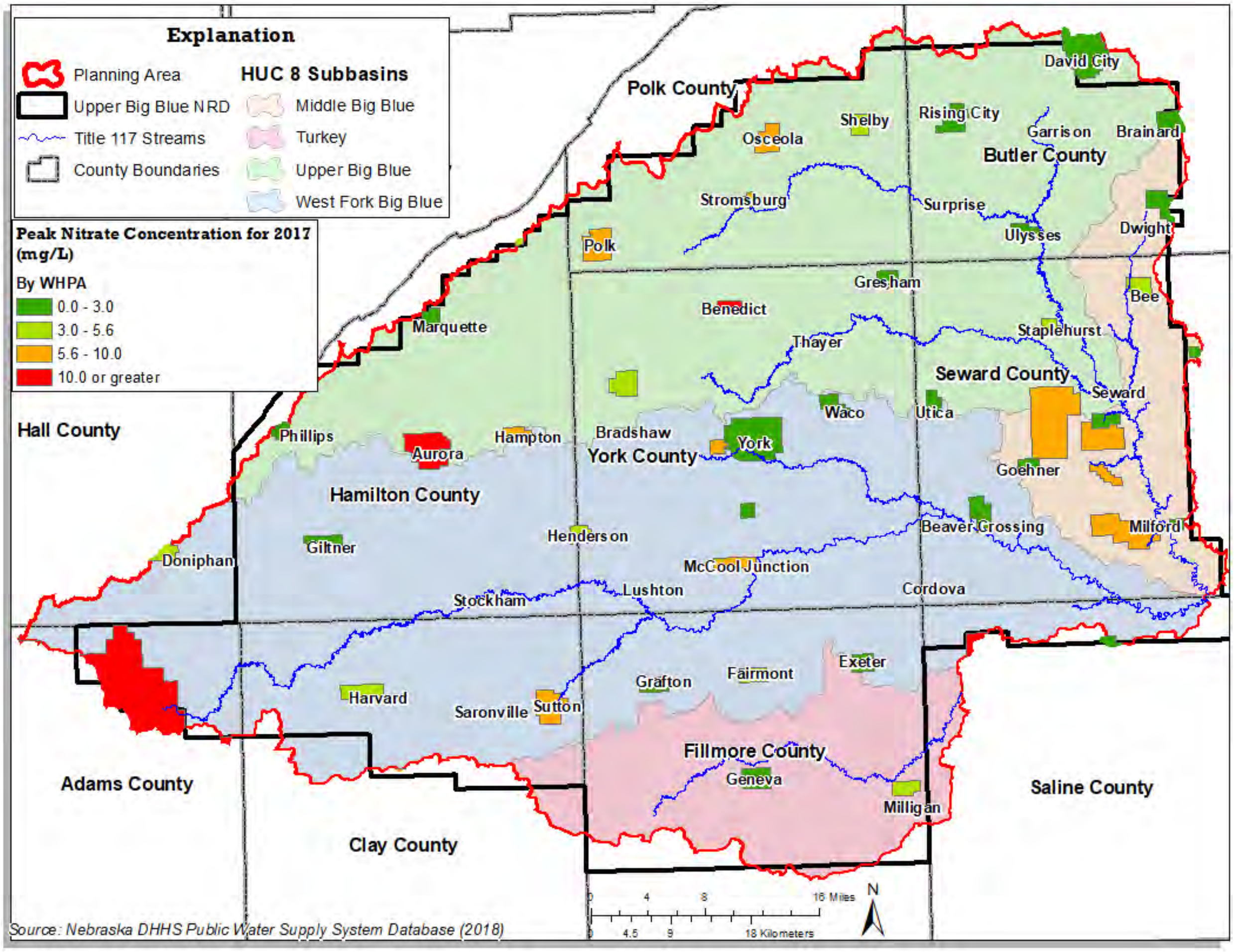


Figure 35: Wellhead Protection Areas and Maximum Nitrate Levels

MUNICIPAL WATER SYSTEM ASSISTANCE PROGRAM

This is a program offered through the UBBNRD, which provides financial assistance to communities for improvements in their water system to mitigate the impacts of non-point source groundwater contamination for the protection and public health of the community's residents. The reasons for system improvements must be related to the impacts of contamination from pollution sources which are non-point in nature. Possible projects include new well construction and/or water treatment. The NRD funds up to 25% of a project. Funding ranges from $25,000 to $100,000. To be eligible for this program, communities must have a NDEE approved wellhead protection plan.

Table 19: Summary of Wellhead Protection Areas

Community Public Water Supply Name	WHP Area Map Delineation Approved[1]	Approximate Size of WHP Area[2] (acres)	Date of WHP Plan Approved[1]	Max Nitrate-Nitrite Level[3] in 2017 (mg/L)
Aurora	2/3/2011	4,106	N/A	11.4
Beaver Crossing	4/28/2014	1,911	12/17/2004	0.0
Bee	5/6/2014	1,443	8/20/2008	5.5
Benedict	2/6/2016	844	9/26/2002	10.2
Bradshaw	12/3/2013	2,018	N/A	5.4
Brainard	2/11/2015	1,922	N/A	1.4
David City	9/10/2010	6,137	5/12/2003	0.0
Doniphan	12/30/2010	3,407	12/31/2003	4.9
Dwight	7/18/2003	2,131	5/1/2008	0.1
Exeter	9/12/2012	1,211	11/3/2003	0.0
Fairmont	12/2/2013	1,224	2/2/2004	3.5
Geneva	5/1/2007	1,819	7/1/2008	1.7
Giltner	7/27/2009	1,929	4/28/2005	0.5
Goehner	3/22/2004	969	9/11/2009	0.4
Grafton	10/30/2011	1,294	5/16/2005	2.0
Gresham	8/1/2011	1,046	12/16/2005	1.1
Hampton	11/20/2002	1,074	11/20/2002	7.9
Harvard	3/14/2011	2,122	7/21/2004	3.8
Hastings	1/1/1999	50,911	7/12/2010	10.7
Henderson	9/29/2003	1,101	3/8/2005	5.1
Marquette	1/15/2004	1,017	3/26/2007	0.1
McCool Junction	10/13/2004	1,446	11/23/2005	9.5
Milford	3/1/2002	5,037	N/A	9.2
Milligan	2/4/2004	1,216	6/23/2005	5.3
Osceola	2/18/2016	1,917	8/25/2003	7.3
Phillips	10/19/2000	762	N/A	2.3
Polk	10/15/2010	2,740	3/14/2014	9.9
Rising City	7/27/2011	1,846	N/A	0.9
Seward	1/16/2001	12,810	12/28/2009	8.3
Shelby	10/17/2012	1,219	N/A	3.2
Staplehurst	3/3/2000	681	N/A	4.5
Stromsburg	10/12/2000	631	8/25/2005	7.7
Sutton	6/8/2000	2,737	N/A	8.3
Ulysses	11/1/2011	1,083	5/3/2004	0.0
Utica	5/25/2001	1,144	1/14/2003	0.0
Waco	7/27/2009	1,452	8/25/2003	0.2
York	2/10/2016	7,720	N/A	1.2

1 – Source: NDEQ WHP Area Database, 2018
2 – Source: NDEQ WHP Area GIS Database (provided February 2017)
3 – Source: Nebraska DHHS Public Water Supply System Database, 2018. Value rounded to nearest hundredth.
N/A – No WHP plan approved, or no data available

3.06 HYDROLOGICALLY CONNECTED WATERS

Hydrologically connected waters are areas where surface and groundwater resources are connected (Figure 36), and thus impacts to one of the resources may have an impact on the other. In Nebraska, the NeDNR evaluates and identifies the location of the hydrologically connected area (HCA). This typically includes both the surface water in the watershed or catchment that runs off to the stream and the groundwater that is in hydrologic connection with the stream. NeDNR uses groundwater and watershed modeling to identify the HCA, which is defined by the NeDNR as the area where a well, located and pumped within that boundary, would result in a 10% or greater depletion in river flows over a 50-year period (i.e., the “10/50 area”).

Currently, the NeDNR uses the Blue Basins Model to estimate the extent of the HCA throughout the UBBNRD (NeDNR, 2016). A small portion of the UBBNRD has been determined to be hydrologically connected and fully-appropriated. In 2018, the NeDNR and UBBNRD jointly moved forward with developing a new groundwater flow model to better delineate the HCA. Once that modeling is complete, it is recommended that this plan be updated to reflect the newly delineated HCA.

Image Courtesy of NeDNR (Ostdiek, 2010)

Figure 36: Hydrologically Connected Areas

3.07 WATER USE AND MANAGEMENT

OVERVIEW AND MANAGEMENT

Water resources management is not under one single jurisdiction or agency in Nebraska. In general, surface water quantity is administered by the NeDNR, surface water quality is regulated by the NDEE, and groundwater quality and quantity are regulated by the local NRD. Figure 37 illustrates the complicated water management structure in Nebraska. Because management actions directed at one aspect of water may have unintended consequences for another, resource agencies must work together to ensure responsible and sustainable management of water resources.

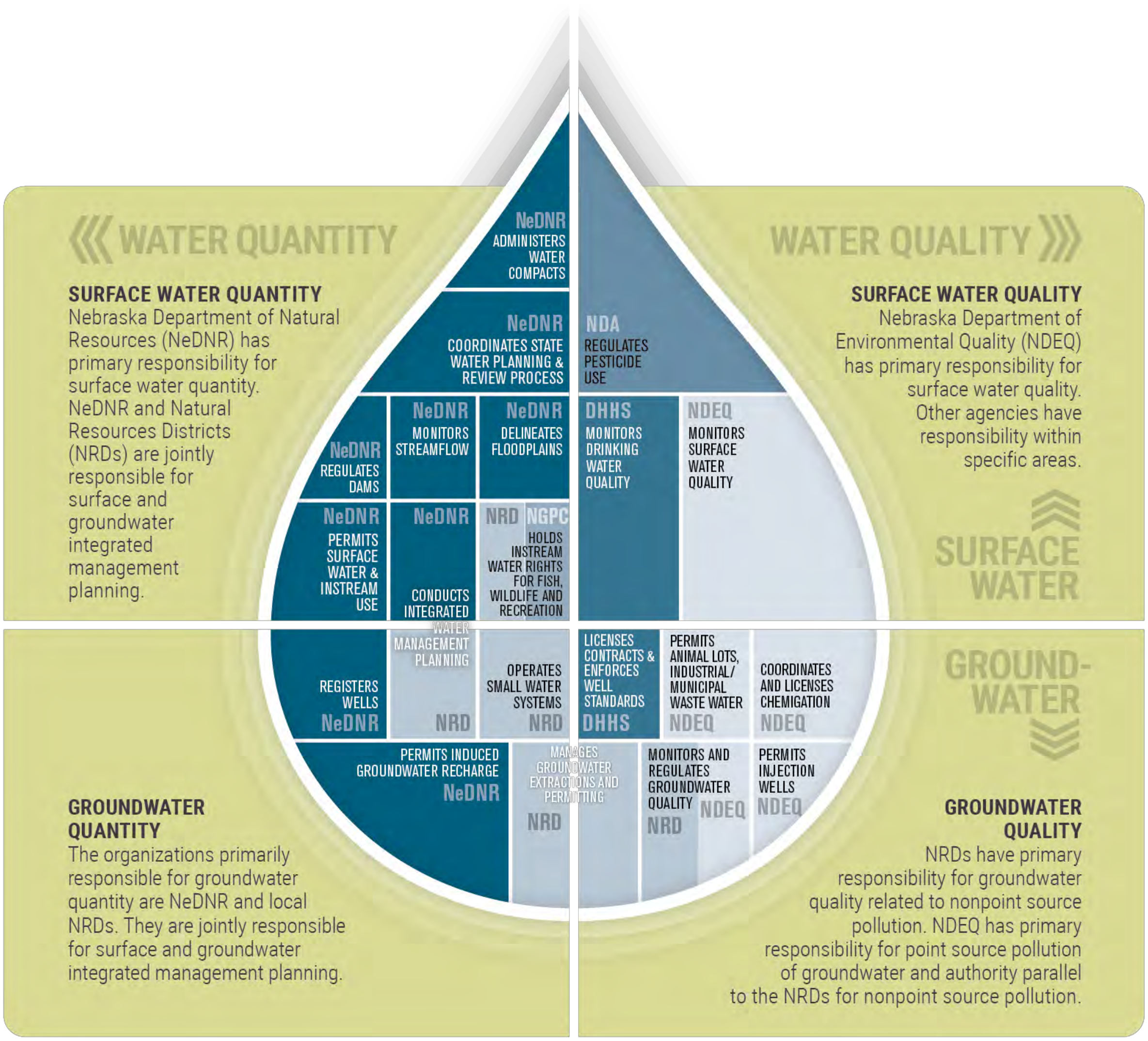


Image courtesy of NeDNR (2018c)

Figure 37: Water Management Agencies and Roles in Nebraska

SURFACE AND GROUNDWATER BALANCE

Surface Water Law

The use of surface water in Nebraska is governed by the Doctrine of Prior Appropriation (First-in-Time, First-in-Right) which allows diversion of surface water based upon the date the water right was obtained. Surface water rights entitle land owners or organizations to divert a set amount of water from a specific location, for a beneficial use. Under the prior appropriations systems, the NeDNR protects senior water rights first during periods when the overall water supply is insufficient to meet all appropriated water rights. Thus, the entity with the earliest priority date (First-in-Time) is entitled to their full appropriation (First-in-Right) before a later priority date entity receives any water.

Groundwater Law

Correlative Rights govern the use of Nebraska groundwater. Correlative Rights allow land owners to drill wells and extract groundwater from an underlying aquifer for beneficial purposes subject to that right being managed by the public (the local NRD). State law requires the registration of all irrigation wells. To execute this right, land owners must first obtain a permit to drill a well from their local NRD. If approved, the well permit allows the land owner to drill a well and extract as much groundwater as needed, provided that the use is deemed beneficial. When the well development is completed, the well is registered with the NeDNR, which places the information in a statewide database. During times of water shortages groundwater rights do not utilize a priority system. Under the correlative rights system all wells are treated equally during shortages, sometimes considered a “share and share alike” system.

Integrated Management

In 2004, the Legislature enacted LB 962 which requires the NeDNR to take a proactive approach for the management of hydrologically connected surface and groundwater. NeDNR conducts an annual assessment of the water balance in each river basin in the state and classifies each as being under-appropriate, fully-appropriated (FA), or over-appropriated (OA). To complete this, all sources and uses of water (surface and groundwater) are measured or estimated using a combination of current water development records and model estimates. In areas designated as fully-appropriated, new high-capacity wells and new surface water rights are placed under a moratorium. While new development can be allowed in these areas, the irrigation needs to be offset by removing an existing user or some other means of replacing the impact to the water balance. Those areas deemed FA or OA are required to implement an integrated management plan (IMP) to aid in balancing water demands and supplies. However, in areas that have not been declared OA or FA, NRDs may elect to complete a voluntary IMP. The voluntary IMP planning process provides an opportunity for NRDs and NeDNR to proactively work collaboratively on water management in areas where surface water and groundwater are hydrologically connected. An NRD may also elect to manage their entire NRD through their voluntary IMP. The purpose of a required IMP or voluntary IMP is to sustain a balance between water uses and supplies.

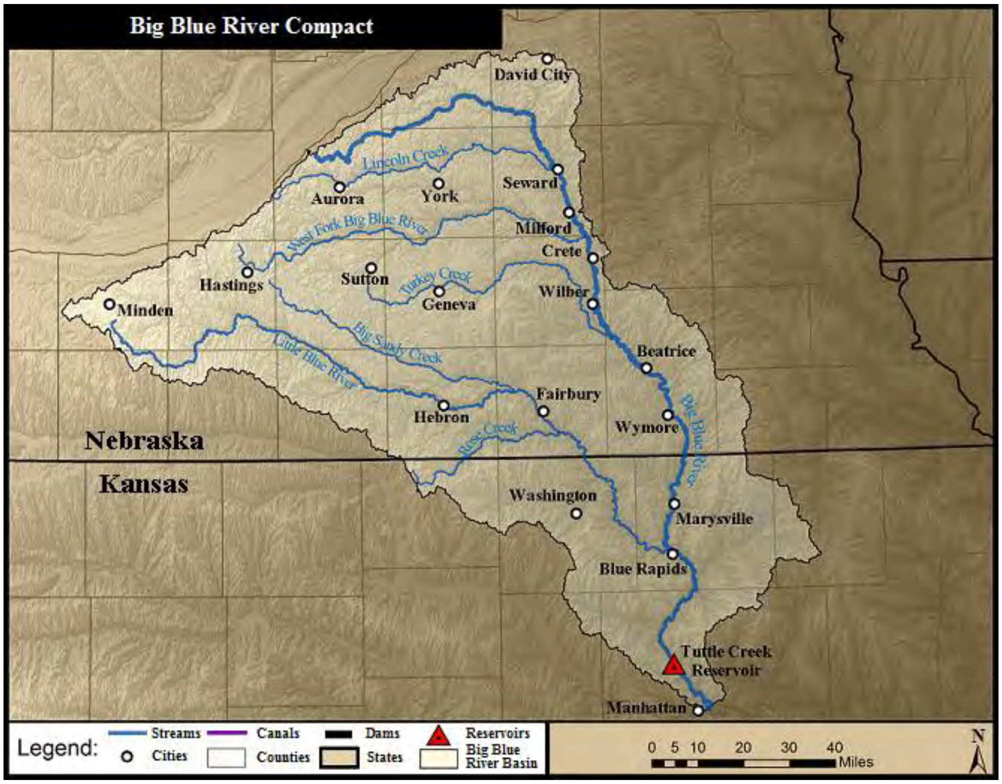
KANSAS-NEBRASKA BIG BLUE RIVER AREA

The Kansas-Nebraska Big Blue River Compact was entered into by the states and federal government in 1971. The compact regulates the use and quality of waters in the Big Blue River Basin, which flows from Nebraska into Kansas (Figure 38). A unique aspect of the compact is the inclusion of controls for water quality issues. Other Nebraska interstate compacts do not have water quality controls. The compact has the following stated purposes:

- Promotes good relations between Nebraska and Kansas on water issues,
- Promote orderly development of the Big Blue River Basin between Kansas and Nebraska and works to divide its waters fairly
- Encourage ongoing programs to stop water pollution in the two states and to reduce natural and man-made pollution of the Big Blue River Basin

The compact administration body meets annually, and is administered by both states and the federal government, with the following representatives:

- Two ex officio members who are the officials (or the officials' designees) who administers the water laws in Kansas and Nebraska (in Nebraska this is the Director of the NeDNR);
- A Big Blue River Basin resident advisory member from each state who is appointed by his or her respective governor to four-year terms
- A federal government representative who is appointed by the president and serves at his or her pleasure



Source: NeDNR, 2017

Figure 38: Big Blue River Compact Area

ONE DISTRICT, TWO PLANS, ONE WATER

The Upper Big Blue NRD is currently in the planning process to develop a voluntary IMP. A concurrent stakeholder engagement process was used for the development of this WQMP and the voluntary IMP. This is the first time in Nebraska these two planning processes have been jointly conducted. This is intended to deliver a more streamlined planning process and to help both the public and managers take a holistic look at the management of water resources (quantity and quality). While two planning documents are being produced from this process, the intent is that they will be written in harmony with mutually supporting goals and objectives. A major benefit to the general public and the stakeholders is there are fewer meetings to attend, which should equate to better engagement (Figure 39).

Figure 39: A meeting facilitator helps to guide discussions regarding both water quality and quantity

3.08 BIOLOGICAL COMMUNITIES

KEY AQUATIC SPECIES

The presence or absence of sensitive species is one metric that NDEE uses to assess water quality. According to Title 117, the following key species are located within the planning area:

- **Orangethroat Darter** (*Etheostoma spectabile*) is a small, tubular, olivaceous fish and is considered “sensitive” in its native watersheds including the. It is a bottom dweller in clear streams and springs, or pools that contain enough current to keep gravely and rock substrate free of silt.
- **Channel catfish** (*Ictalurus punctatus*) is the most numerous of catfish species and is found throughout Nebraska. It is a common gamefish and is identified as a “recreationally important” species.
- **Flathead catfish** (*Pylodictis olivaris*) prefer deep pools of streams, rivers, canals, lakes, and reservoirs where the water is turbid and currents are slow. They are found throughout Nebraska, are a common gamefish, and are identified as a “recreationally important” species.

THREATENED AND ENDANGERED SPECIES

The scope of this planning effort did not include identifying specific locations of Threatened and Endangered (T&E) species in the planning area. However, the following list identifies those T&E species that do have ranges within the planning area (NGPC, 2017).

- Western Massasauga (*Sistrurus catenatus*)
- Western Prairie Fringed Orchid (*Platanthera praeclara*)
- Piping Plover (Charadrius melodus)
- Interior Least Tern (*Sterna antillarum)*
- Whooping Crane (*Grus americana*)
- River Otter (Lontra canadensis)

No critical habitat was identified for T&E species.

AQUATIC INVASIVE SPECIES

Aquatic invasive species are non-native organisms introduced into rivers, streams, and lakes. They generally have few to no predators or any other natural controls, such as disease or competition, so their populations grow unchecked. Once established, these species may cause irreparable harm, introduce disease, out-compete native species, change the physical characteristics of waters, damage equipment, clog water delivery systems, and negatively impact local and national economies. While there is not a complete list of locations where invasive species are found, the Nebraska Invasive Species Program maintains information on potential invasive species in Nebraska (UNL, 2018). Table 20 identifies aquatic invasive species which may be present within the planning area.

Table 20: Aquatic invasive species which may be present within the planning area

Invasive Animals or Diseases	Invasive Plants
Zebra & Quagga Mussel	Brittle Naiad
Algae - Didymo	Eurasian Watermilfoil
Asian Clam	Giant Reed
Bighead Carp	Giant Salvinia
Chinese Mysterysnail	Hydrilla
Chytrid Fungus	Japanese & Giant Knotweed
Heterosporosis	Phragmites - Common Reed
Largemouth Bass Virus	Purple Loosestrife
New Zealand Mud Snail	Water Hyacinth
Red Swamp Crayfish	Japanese, Morrow's, & Hybrid Honeysuckle
Round Goby	Common Watercress
Rudd	Narrow-Leaf Cattail
Rusty Crayfish	Creeping Foxtail
Silver Carp	--
Snakehead	--
Viral Hemorrhagic Septicemia (VHS)	--
Whirling Disease	--

Source: Nebraska Invasive Species Program (UNL, 2018)

Prevention is the strongest defense against invasive species. Posting signs, distributing educational information, etc. are methods to prevent the introduction of these species into the watershed. However, if these or other invasive species are found to be in the watershed, future education efforts could be designed to target their reduction and/or elimination.

BIOLOGICALLY UNIQUE LANDSCAPES

In 2005, the NGPC published the Nebraska Natural Legacy Project as the state's first Wildlife Action Plan, which was subsequently updated in 2011. Landowners, partner organizations, public land managers, and many others have voluntarily used the Nebraska Natural Legacy Project to guide conservation work that benefits wildlife, habitat, and the residents of Nebraska. One of the goals of the Nebraska Natural Legacy Project is to identify a set of priority landscapes that, if properly managed, would conserve the majority of Nebraska's biological diversity. These landscapes, called Biologically Unique Landscapes (BUL), were selected based on known occurrences of at-risk species and natural communities.

While the planning area does technically touch the Central Platte River BUL, it is not part of the plan and discussion here will be limited to the Rainwater Basin BUL (Figure 40).

The Rainwater Basin BUL occupies parts of 17 counties in south-central Nebraska. The topography is mostly flat to gently rolling loess plains. The surface water drainage system is poorly developed, and many watersheds drain into low-lying wetlands. These wetlands are important to birds, amphibians, and small mammals. The wetlands in the area have been identified by the

North American Waterfowl Management Plan as waterfowl habitat of major concern in North America. The basin is a concentration point in the central flyway for spring migration of ducks, geese, and shorebirds. It also provides important migration habitat for whooping cranes, bald eagles, and many other bird species (Schneider and others, 2011).

Stresses Affecting Species and Habitats in the Rainwater Basin BUL

- Invasive plant species in wetlands, primarily reed canary grass, narrow-leaf cattail, smooth brome, Kentucky bluegrass, and potentially Eurasian phragmites;
- Lack of fire on the landscape and fire departments not regularly issuing burn permits;
- Drainage of or filling of wetlands and creation of water storage pits to convert to non-wetland for development;
- Sedimentation and chemical run-off into wetlands from adjacent cropland;
- Excessive plant litter accumulation in wetlands which limits available open water and mudflats;
- Limited resources influence habitat management on public lands;
- Inadequate protection and conservation of isolated, temporary wetlands;
- Localized opposition to wetland conservation easements.

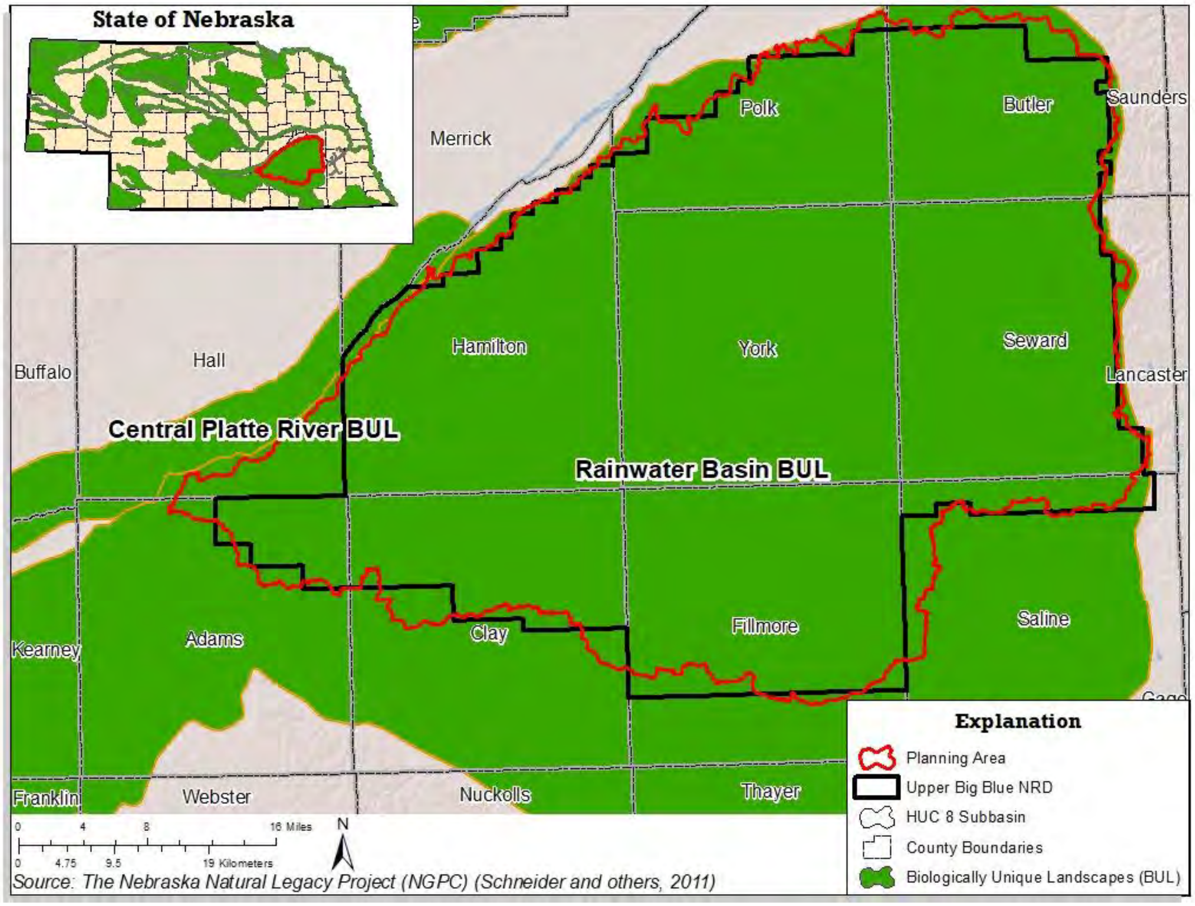


Figure 40: Biologically Unique Landscapes in the Watershed

Conservation Strategies for the Rainwater Basin BUL

- Protect and restore priority wetland acres and adjacent upland habitat;
- Provide a reliable water source when necessary for priority wetland acres to assure sufficient water quantity, quality, and distribution;
- Develop and implement best management practices to control and manage invasive plant communities;
- Offer training about prescribed fire to increase comfort levels and awareness of the needs for prescribed burn plans and permits to address both safety and liability concerns;
- Coordinate with willing landowners to protect important habitats with a variety of conservation methods, while taking into consideration conservation costs and benefits, landowner acceptance, and potential local impacts;
- Work with public and private landowners to develop an efficient system to conduct ecologically appropriate cattle grazing in the basins;
- Create grassland buffers around basins and in uplands to reduce sedimentation and chemical run-off (e.g., promotion of CRP and other similar programs)

CHAPTER 4. MONITORING

4.01 INTRODUCTION

Monitoring and assessment are vital components of water resource management. The collection and assessment of data is necessary to evaluate overall resource health and the effectiveness of practices, projects, and programs targeted at improving or protecting water quality. These activities are also needed to assist in directing management activities of resources. Monitoring goals established by the Upper Big Blue Natural Resources District (UBBNRD) are generally achieved through a mixture of coordinated monitoring practices, partnerships, and the use and analysis of available data that meets the desired quality. Steps are taken to ensure collected data is scientifically valid, which may include the development of Quality Assurance Project Plans (QAPP) for state and federal review.

The intent of this chapter is to summarize ongoing monitoring efforts in the planning area, present current data gaps, and provide recommendations for expanded monitoring. These monitoring recommendations are meant to provide data that supports an expanded understanding of baseline/existing conditions within the planning area. This data may be used to monitor conditions or to plan for future on-the-ground activities or projects. Monitoring recommendations associated with targeted implementation areas (i.e. projects) are provided in their respective chapters (Chapters 10 – 13). It should be noted that in this document all impoundment types (i.e. reservoirs, sandpits, oxbows) will be referred to as “lakes”. Monitoring recommendations in this chapter pertaining to lakes may not be applicable to all lake types and should be evaluated for applicability on a case-by-case basis.

4.02 PURPOSE OF MONITORING

To adequately design monitoring networks that facilitate water resources management, it is critical to collect and use data for its intended purposes. Data collected from physical, chemical, and biological monitoring networks in the planning area can be used for either one or a variety of purposes, as listed below:

1. Evaluate current water quality conditions.
2. Provide water quality safety information to water users.
3. Maintain long-term data sets for trend assessment.
4. Support water project or activity development.
5. Identify causes and sources of water quality problems.
6. Estimate pollutant transport and quantify loadings.
7. Evaluate water management effectiveness.
8. Support future modeling and assessment.
9. Monitor status of compliance with state and federal standards.
10. Evaluate water infrastructure for maintenance and repair.

4.03 DATA NEEDS AND USES

Several local, state, and federal agencies are currently conducting monitoring in the planning area. Current monitoring targets a broad range of data needs to support management across the planning area as well as targeted implementation on specific waterbodies. In some cases, current networks do not provide adequate information to fully evaluate resource conditions or clearly identify pollutant sources. Recommendations for expanded monitoring and assessment efforts were developed from a review of current monitoring networks and critical data needs, which are presented later in this chapter.

4.04 CURRENT MONITORING NETWORKS

An extensive amount of physical, chemical, and biological information has been collected at numerous sites across the planning area. As shown in Table 21, multiple entities have been and are currently involved in collecting various types of data. While a majority of the surface water quality data collection is coordinated by the NDEE, the UBBNRD coordinates an extensive amount of monitoring to support their groundwater quantity and quality programs. A brief description of significant monitoring programs/networks is provided below. Additional details on these programs can be found in the *2017 Nebraska Water Monitoring Programs Report* (NDEQ, 2018b). Details on the availability of water quality data specific to the planning area can be found in the technical memorandum in Appendix B.

Table 21: Current Monitoring Programs and Activities in the Planning Area

Monitoring Networks	UBBNRD	NDEE	NeDNR	NGPC	RWBJV	USGS	Municipal Facility	Private Owner
Surface water								
Stream Flow			X			X		
Ambient Stream		X				X		
Basin Rotation		X						
Beach		X						
Lake		X						
Stream Biological		X		X				
Fish Tissue			X					
Fisheries				X				
NPDES permit		X					X	
Wetlands				X	X			
Groundwater								
Ambient quality	X	X				X	X	
Levels	X					X	X	
Nitrate monitoring	X					X	X	X
Bacteria monitoring								X

UBBNRD=Upper Big Blue Natural Resources District, NDEE=NE Department of Environment and Energy, NeDNR=NE Department of Natural Resources, NGPC=NE Game and Parks Commission, USGS=United States Geological Survey, RWBJV=Rainwater Basin Joint Venture

SURFACE WATER

Stream Flow Gaging

The Nebraska Department of Natural Resources (NeDNR) and United States Geological Survey (USGS) monitor the water flowing in Nebraska's streams, rivers, and canals. There are four gaging sites located within the planning area: West Fork Big Blue River near Dorchester (USGS), Big Blue River at Seward (NeDNR), Big Blue River at Surprise (NeDNR), and Lincoln Creek near Seward (NeDNR) (Figure 41). An additional USGS gage is located outside the planning area but is relevant due to its downstream position and proximity to the planning area: Big Blue River at Crete. Additional data for each site can be found on the NeDNR website: https://nednr.nebraska.gov/RealTime/.

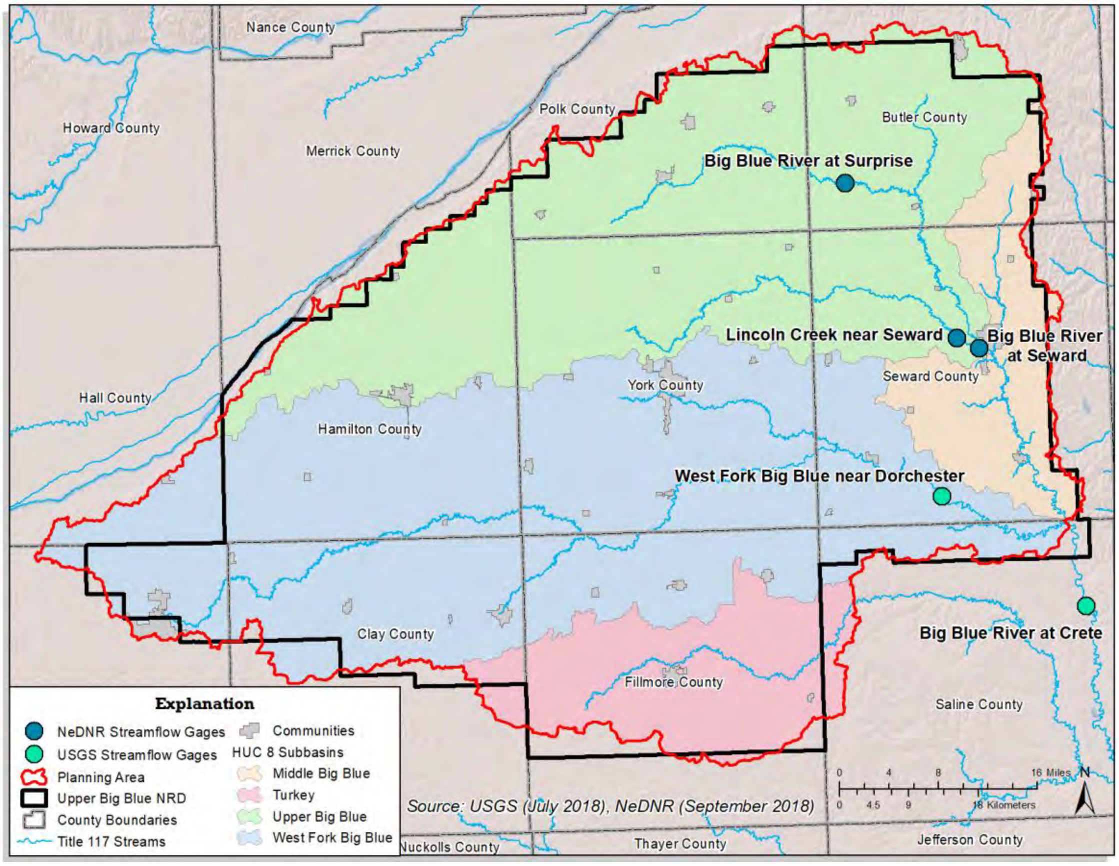


Figure 41: Stream Gaging Site Locations in the Planning Area

Ambient Monitoring

The NDEE maintains an ambient monitoring network across the state for streams and rivers. Ambient monitoring consists of fixed sites that are sampled continuously throughout the year. Note that there are no ambient lake monitoring sites in the planning area. There are three ambient stream monitoring sites in the planning area: one on the Big Blue River, one on the West Fork of the Big Blue River, and one on Lincoln Creek (Figure 42). There are no ambient sites on Turkey Creek near the planning area. In addition to being able to assess current conditions, consistent monitoring at the same location allows for the establishment of long-term data sets for trend assessments. Stream sites are monitored monthly for the following parameters: water temperature, dissolved oxygen, pH, conductivity, total suspended solids, ammonia, total nitrogen, total phosphorus, total chlorides, *E. coli* bacteria (beginning in 2018), pesticides (April through September only), and heavy metals (quarterly). Data collected is available to resource managers and the general public through the Water Quality Portal (WQP), which is accessible at: https://www.waterqualitydata.us/.

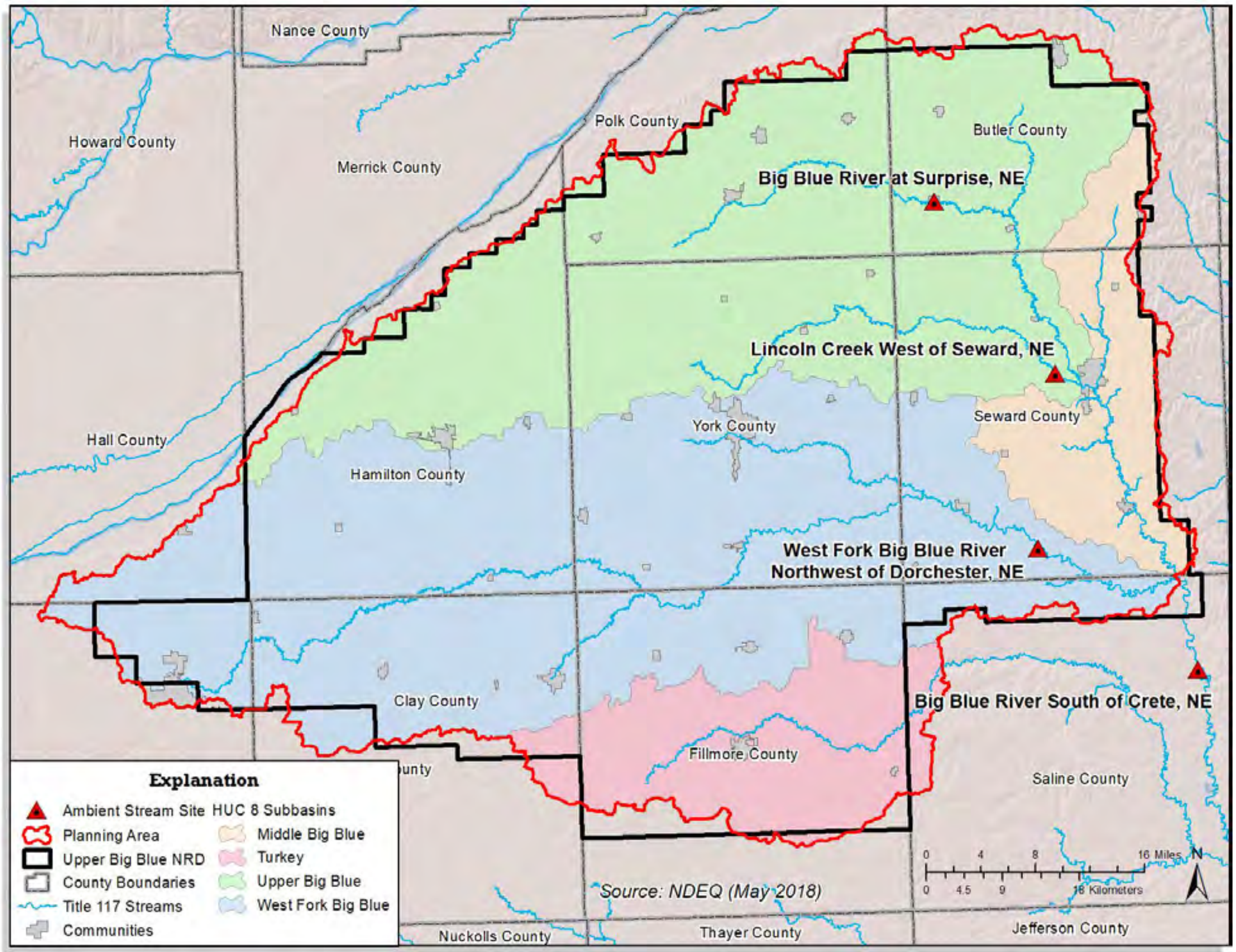


Figure 42: Ambient Stream Monitoring Site Locations in the Planning Area

Basin Rotation Monitoring

Each year the NDEE selects monitoring sites on streams and lakes focused on select basins across the state. Each basin in the state is targeted for sampling every six years in this rotation. From May through September, streams and rivers are sampled weekly while lakes are sampled monthly. Data collected is available to resource managers and the general public through the WQP. The Upper Big Blue Basin was last monitored in 2012 and is being monitored in 2018. Data collected in 2018 was not available for inclusion in this plan. A review of data found eight NDEE basin rotation stream sites within the planning area (Figure 43). Additional short term (one year) monitoring data was identified on several streams through special studies conducted by the Environmental Protection Agency (EPA). There are 12 basin rotation lake monitoring sites spread across eight lakes in the planning area (Figure 44). Note that a single lake can contain multiple monitoring sites. Lake monitoring focuses on nutrients, sediment, pesticides, heavy metals, dissolved oxygen, pH, temperature, conductivity, and water clarity.

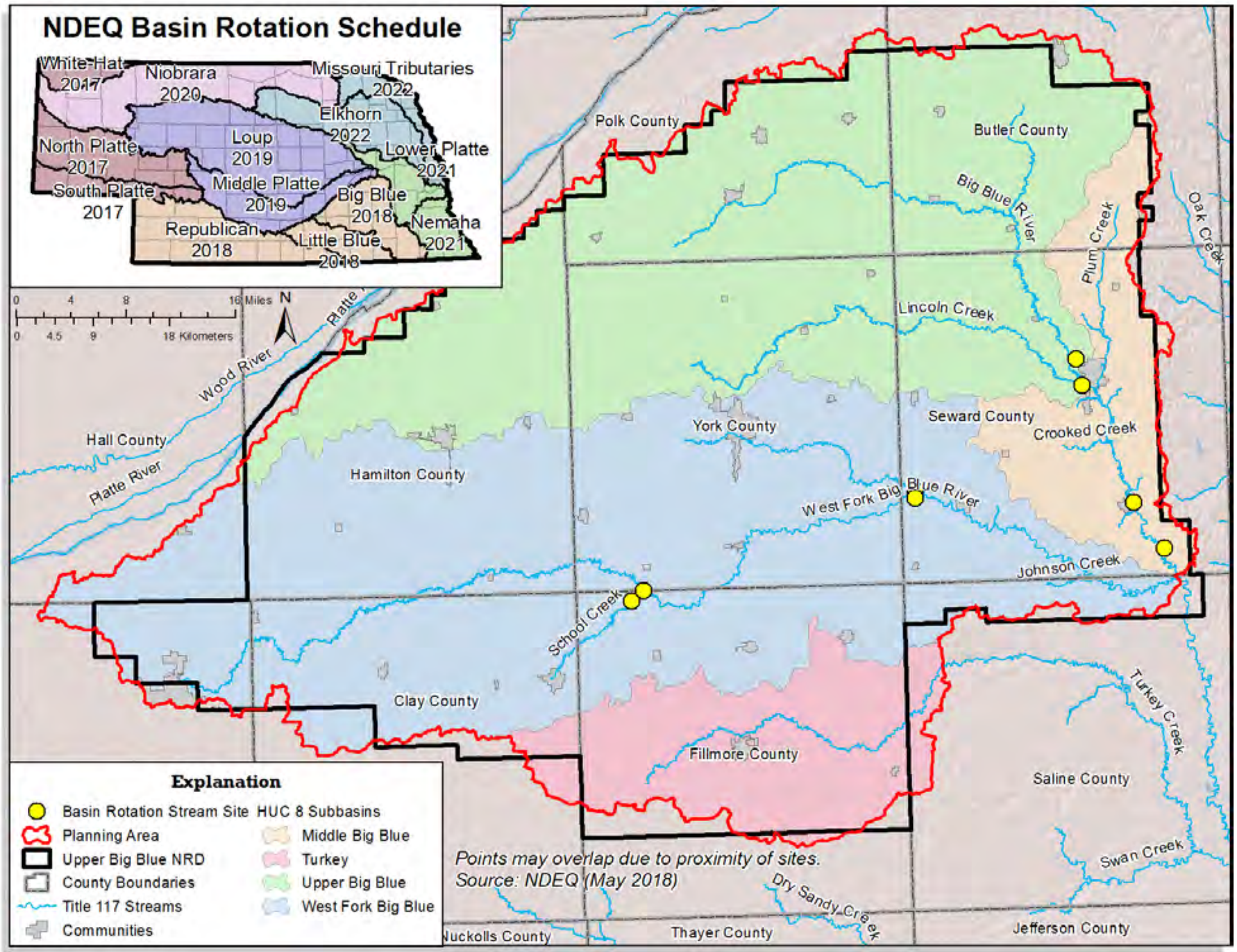


Figure 43: Basin Rotation Monitoring Sites in the Planning Area and 6-year Schedule

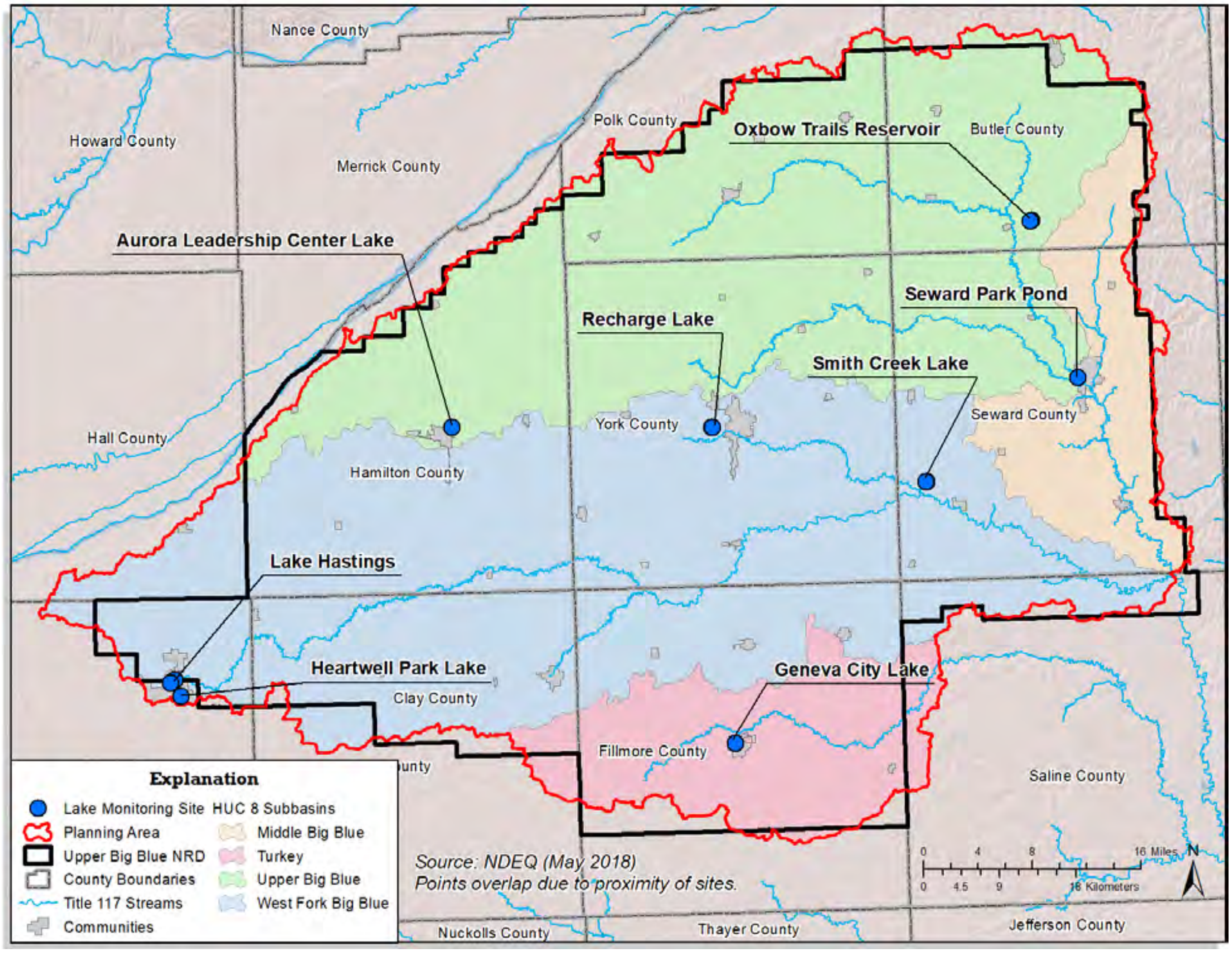


Figure 44: NDEE Basin Rotation Lake Monitoring Sites in the Planning Area

Beach Monitoring

The NDEE monitors swimming beaches across the state every year to determine the suitability for body contact recreation. Beach monitoring for *E. coli* bacteria and microcystin toxin (produced by blue green algae) is conducted during the recreation season (May 1 – September 30). Monitoring results are posted on the NDEE website on a weekly basis (www.deq.state.ne.us). There are no designated beaches within the planning area, therefor no lakes are included in the beach monitoring network.

Fish Tissue Monitoring

Since the 1970s, NDEE has monitored fish from flowing and impounded waters to determine the suitability for human consumption. Efforts are made to collect tissue samples from “sport” fish species (catfish, bass, etc.) in waterbodies that are commonly fished. When concentrations of contaminants indicate a health risk for consumers, fish consumption advisories are issued by the

Nebraska Department of Health and Human Services (DHHS) for those waterbodies. Sampling under this program is in coordination with the NDEE basin rotation monitoring approach, therefore the most recent sampling in the planning area was conducted in 2012. Table 22 summarizes the findings from the most recently published fish tissue report (NDEQ, 2017b).

Table 22: Fish Tissue Sampling Summary

Waterbody Name	Waterbody ID	Health Risk Criteria Violated
Lake Hastings	BB3-L0050	*PCBs
Recharge Lake	BB3-L0080	Mercury

**PCB – Polychlorinated Biphenyl.*
Source: NDEQ, 2017b

Stream Biological Monitoring

The planning area's streams and rivers contain a rich diversity of aquatic life including insects, fish, amphibians, and mammals. Since aquatic communities are in constant contact with the water, the health of these communities can provide insight on stressors that may not show up through traditional chemical and physical monitoring. NDEE's Stream Biological Monitoring Program uses fish and aquatic insect communities to provide statewide assessments of the biological conditions of Nebraska's streams. Each year 34 to 40 randomly selected stream sites are chosen for study in two or three river basins throughout Nebraska (Bazata, 2011). These sites are limited to those shallow enough to sample without boats (i.e. wadable streams).

The NDEE has evaluated biological communities at 16 locations on eight streams in the planning area (Table 23). Three different metrics pertaining to habitat, insect communities, and fish communities are used to determine impairment. Five of the sites evaluated were determined to be impaired. Sites that were monitored prior to 2008 were summarized in a report prepared by NDEE (Bazata, 2011), which provided more detail on the specific cause of impairment.

Table 23: Summary of Biological Community Sampling in the Planning Area

Subbasin	Segment ID	Stream Name	Habitat Metric	Insect Metric (ICI)	Fish Metric (IBI)	Overall Rating	Aquatic Life Support
Upper Big Blue	BB4-20800	Lincoln Creek	Poor	Poor	Fair	Fair	Full
Upper Big Blue	BB4-20900	Lincoln Creek	Fair	Good	Poor	Poor	Impaired
Upper Big Blue	BB4-30000	Big Blue River	Unknown	Unknown	Unknown	Unknown	Full
Upper Big Blue	BB4-40000	Big Blue River	Fair	Fair	Fair	Fair	Full
Middle Big Blue	BB4-10000	Big Blue River	Unknown	Unknown	Unknown	Unknown	Full
Middle Big Blue	BB4-20500	Unnamed Creek	Unknown	Unknown	Unknown	Unknown	Full
Middle Big Blue	BB4-20600	Plum Creek	Unknown	Unknown	Unknown	Unknown	Full
Middle Big Blue	BB4-20700	Plum Creek	Fair	Fair	Fair	Fair	Full
WF Big Blue	BB3-10000	W. F. Big Blue River	Unknown	Unknown	Unknown	Unknown	Impaired
WF Big Blue	BB3-10200	Walnut Creek	Unknown	Unknown	Unknown	Unknown	Impaired
WF Big Blue	BB3-10300	Beaver Creek	Unknown	Unknown	Unknown	Unknown	Full
WF Big Blue	BB3-10400	Beaver Creek	Good	Good	Poor	Poor	Impaired
WF Big Blue	BB3-20000	W. F. Big Blue River	Fair	Fair	Poor	Poor	Impaired
WF Big Blue	BB3-30000	W. F. Big Blue River	Excellent	Good	Good	Good	Full
Turkey	BB2-30000	Turkey Creek	Fair	Good	Fair	Fair	Full
Turkey	BB2-40000	Turkey Creek	Unknown	Unknown	Unknown	Unknown	Full

Source: Bazata, 2011

Fisheries Sampling

An unbalanced fish population can be indicative of water quality or habitat issues. The Nebraska Game and Parks Commission (NGPC) samples game fish across Nebraska in many of the most popular streams, lakes, and reservoirs. Monitoring is typically conducted to document species composition and abundance. Fish populations are sampled at most major reservoirs every year, while smaller waters are sampled less often. Sampling results are shared with the public through fish sampling reports and an annual fishing forecast. These reports allow anglers and managers to review trends in the fish populations over time. These results are one additional piece of data that can be used in conjunction with other water quality or biological monitoring data to assist in assessing the health of the whole ecosystem. A summary review of this data was outside of the scope of this planning effort, however, recent reports can be found on NGPC's website: http://outdoornebraska.gov/fishingguidesandreports/

GROUNDWATER

Groundwater typically migrates slowly (a few inches to a few feet per day), which creates a slower changing chemical environment when compared to surface water resources. Therefore, monitoring programs are typically designed to assess long term trends. The UBBNRD also coordinates a significant amount of groundwater monitoring associated with groundwater level and nitrate triggers, groundwater transfers, and well permitting. Groundwater monitoring in the planning area consists of two primary efforts: 1) groundwater levels (elevation) measurements are taken at observation wells in the spring of each year; and 2) water quality sampling (with a focus on nitrate-nitrogen) though monitoring wells. The UBBNRD utilizes a wide array of existing wells for these purposes: dedicated monitoring wells, cluster (or nested) wells, and private wells (irrigation, domestic, etc.). The UBBNRD and USGS continue to install dedicated monitoring wells. The UBBNRD utilized 805 wells for observation and/or monitoring purposes in 2017. The locations of those are shown in Figure 45.

Groundwater monitoring results are recorded in the Quality-Assessed Agrichemical Contaminant Database for Nebraska Groundwater (Clearinghouse) The Clearinghouse brings together groundwater data ranging from 1974 to the present from many different sources and provides public access to this data. The Clearinghouse can be accessed via: https://clearinghouse.nebraska.gov/Clearinghouse.aspx.

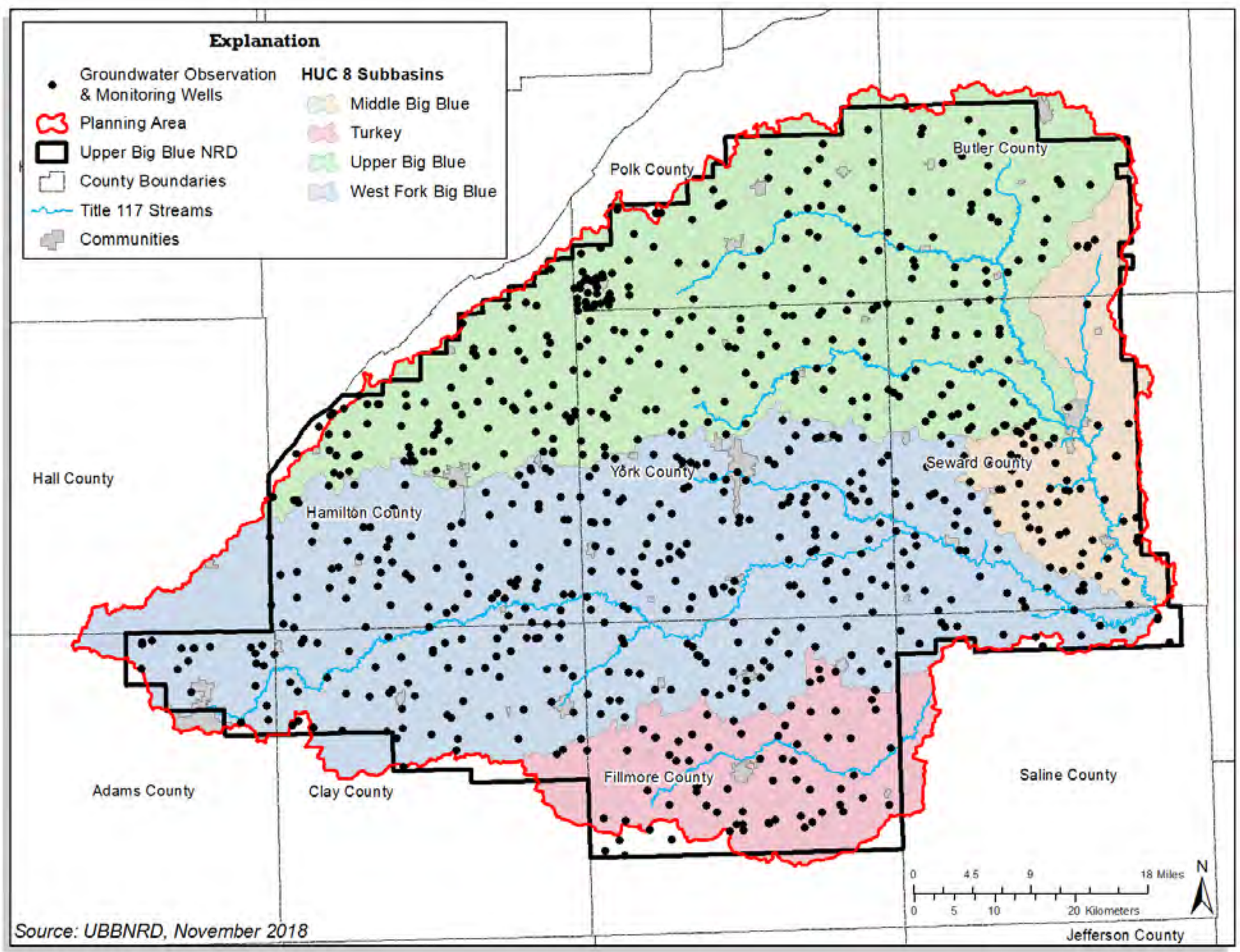


Figure 45: Groundwater Observation and Monitoring Well Locations in the UBBNRD

WETLANDS

Nebraska wetlands vary greatly in nature and appearance due to physical features such as geographic location, water source and permanence, and chemical properties. NGPC is the primary agency involved in wetland monitoring within Nebraska. NGPC has developed a Wetland Program Plan that includes monitoring and assessment activities (LaGrange, 2010), however, these monitoring activities do not have a similar programmatic approach as lakes and streams which are primarily monitored by NDEE. While monitoring conducted under this plan is coordinated by the NGPC, it is commonly completed through partnerships. Wetland monitoring activities follow the general approach developed by the United States Environmental Protection Agency (EPA). This approach entails a three-tier monitoring framework used to establish reference conditions and characterize current wetland condition and function.

Most of the wetland research, monitoring, and assessment activities within the planning area are coordinated through the Rainwater Basin Joint Venture (RWBJV). Research, inventory, and monitoring activities specific for the Rainwater Basin have been defined by the Conservation Planning Workgroup (CPW) RWBJV to help maximize the effectiveness and efficiency of conservation programs (CPW-RWBJV, 2015). Research is conducted to increase the understanding of ecological communities and processes, find solutions for issues, and improve existing conservation delivery techniques. Inventory activities are used to measure and document current resources as well as identify needs and limitations. Long-term monitoring is conducted to document changes in species or communities to determine whether conservation delivery is in fact moving the conservation state in the direction necessary to support target populations. Research, inventory, and monitoring needs surrounding 51 issues of concern are outlined in the *Rainwater Basin Joint Venture Research, Inventory, and Monitoring Plan* (CPW-RWBJV, 2015). The RWBJV collaborates with the United States Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), USGS, EPA, Landscape Conservation Cooperatives, universities, local agencies, and other partners to help facilitate projects.

While no wetlands are listed as “impaired” by NDEE in the 2018 Surface Water Quality Integrated Report (NDEQ, 2018a), the RWBJV has utilized its research, inventory, and monitoring data to prioritize wetlands for protection/restoration activities down to the county level. This can be found in the *RWBJV Implementation Plan County Step Down Goals* (RWBJV, 2010).

4.05 OTHER STUDIES AND EFFORTS

EMERGING CONTAMINANTS

The UBBNRD has become concerned that the overall groundwater chemistry is changing and naturally occurring elements in the aquifer material are being released into the groundwater. Several recent studies, including Weber, 2015 have considered the relationship of elevated groundwater nitrate levels and uranium concentrations in groundwater. Elevated uranium concentrations are found in many regions, including those without anthropogenic uranium activity (mining, nuclear testing, etc.), indicating a source of natural uranium contamination. Research indicates that natural uranium in the subsurface may be oxidized and mobilized as nitrate (in many forms) moves through the root zone and eventually to groundwater. Shallow groundwater was determined to be the most susceptible to co-contamination. Weber (2015) indicated that nitrate concentrations near the maximum contaminant levels (MCL) are correlated to elevated groundwater uranium concentrations; thus, nitrate, a primary groundwater contaminant, can be a factor leading to secondary uranium concentration.

This is significant because consumption of uranium contaminated drinking water has been linked to nephrotoxicity and osteotoxicity and, thus, poses a health risk (Weber, 2015). In fact, some public water supply systems in Nebraska treat for, not only nitrate, but also uranium. In addition to drinking water concerns, food crops irrigated with contaminated water have been demonstrated to accumulate uranium, thus leading to additional uranium exposure through food crops (Weber, 2015).

Starting in 2014, the UBBNRD began a review of uranium, arsenic, and selenium in the District's groundwater. While the NRD has begun collecting samples for those constituents, complete interpretation of the data has not occurred at the time this plan was prepared.

4.06 DATA GAPS AND EXPANDED MONITORING

INTRODUCTION

Currently, routine and ambient monitoring networks are in place to evaluate existing water quality conditions based on available resources (time, money, etc.). However, it has been identified that this current network is not spatially or temporally complete and does not provide data on several waterbodies. Expanded monitoring efforts are needed to better understand current conditions at both the subwatershed and specific resource level; to better direct management activities; and to evaluate the long-term effectiveness of practices, projects, and programs targeted at improving or protecting water quality.

This portion of the chapter describes additional monitoring needs identified to fill data gaps in water quality and resource conditions. These recommendations are meant to provide data that supports an expanded understanding of baseline/existing conditions within the planning area. This data may be used to monitor conditions or to plan for future on-the-ground activities or projects. Monitoring recommendations associated with targeted implementation areas (i.e. projects) are provided in their respective chapters (Chapters 10 – 13). Monitoring activities funded through Section 319 funds are required to be conducted under an approved QAPP.

New monitoring approaches or data collection efforts can be considered to enhance spatial data coverage, the amount of data available, and/or to address specific data gaps. Generally, this would include adding new monitoring sites, increasing data collection frequency, or using new technology and approaches. Additionally, it may be appropriate to conduct site or field scale monitoring to determine best management practice (BMP) effectiveness. When designing additional monitoring programs or sites, the following should be considered:

- Monitoring programs should be built based upon well-defined goals and objectives
- Monitoring programs should be holistic. Consideration should be given to water quality, habitat quality, biotic integrity, hydrology, and land use.
- It is critically important to prepare a monitoring plan that clearly defines how the monitoring project will be evaluated. The plan should include: 1) clearly and narrowly defined monitoring objectives; 2) a description which identifies the monitoring network design and rationale, the parameters to be monitored, and their frequency and method of collection; 3) fiscal information; 4) a schedule of tasks and products; 5) personnel responsibilities; 6) data management provisions; 7) reporting requirements; and 8) appropriate quality assurance/quality control provisions.
- Monitoring should allow for water quality assessment by hydrologic units. A "paired watershed" or "up-stream-downstream" monitoring design should be used whenever

possible. This allows monitoring both up-stream and downstream of a project or resource of interest (specific stream, etc.) to evaluate specific affects.

- Variability attributed to flow and seasonality is often ignored in monitoring water quality. These sources of variability are important in assessing water quality and must be accounted for to the greatest degree possible. In general, as stream flow decreases, influences from baseflow and/or point source discharges become more significant. Caution should also be used in evaluating improvements solely from data collected under extremely high flows or extremely low flows.

RECOMMENDATIONS

The following monitoring recommendations have been developed to enhance resource assessments and the prioritization of future project areas across the planning area. Some of these approaches may also be incorporated into monitoring recommendations for priority areas, which can be found in their respective chapters.

Tributary Monitoring

Pollutant load estimates are largely based on samples collected near the bottom of the drainages. While this information provides a sound basis for estimating overall pollutant loads, it provides minimal insight on potential contributions from individual tributaries, sources, or other areas. Strategically locating monitoring sites in upstream tributaries will allow for pollutant source bracketing, resulting in a better estimate of source contributions and a more effective implementation strategy. Additionally, sampling points located below a single source (e.g., urbanized land, cultivated fields, animal feeding areas, and/or pastures) provides information on pollutant yield source, an important factor in pollutant load modeling. In addition to the existing ambient stream sites, nine additional sites have been identified for future monitoring efforts (Figure 46). These sites have been conceptually identified for planning purposes; however, they have not been ground-truthed and will need to be finalized based on landowner access agreements, site conditions, and funding availability.

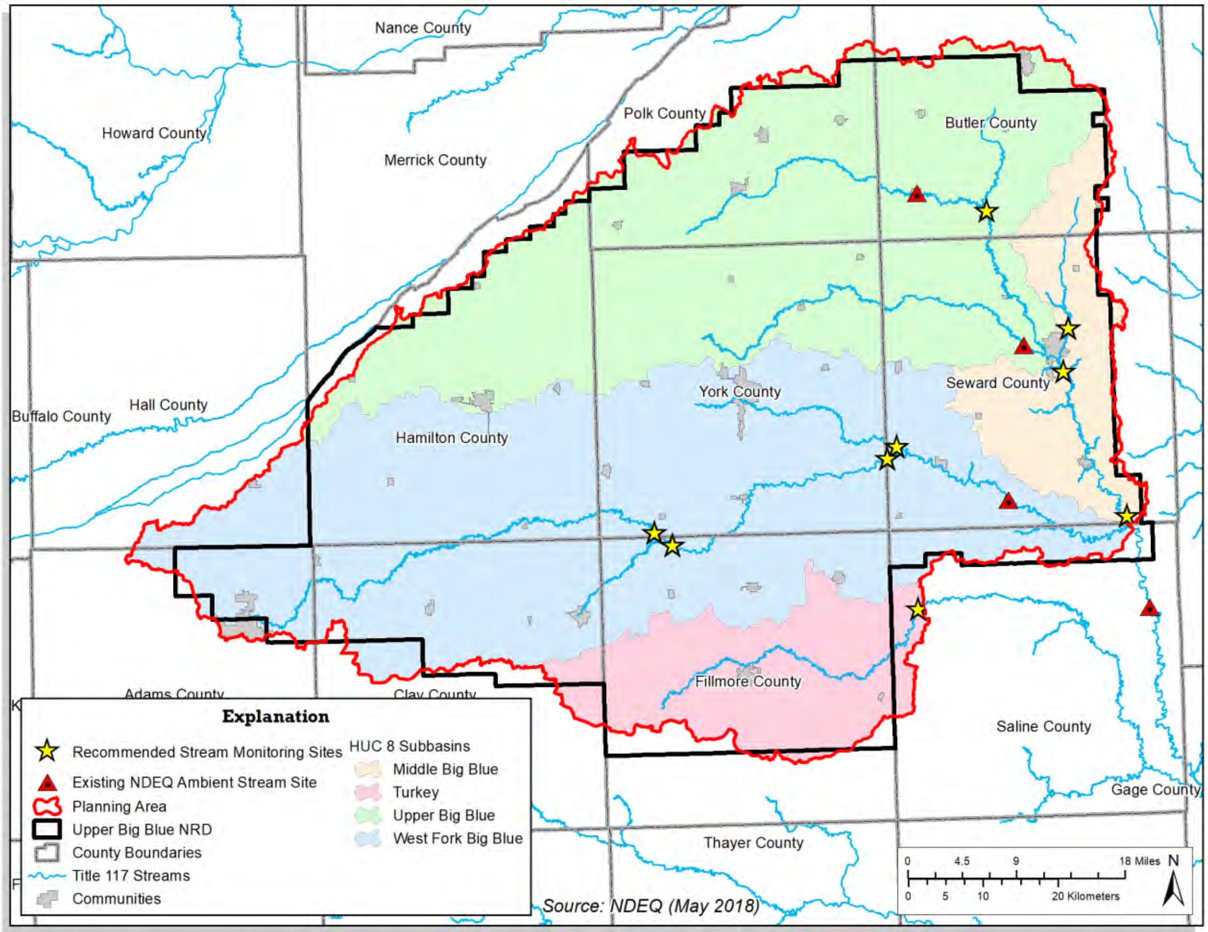


Figure 46: Recommended Water Quality Monitoring Sites for the Planning Area

Streambank Erosion

While stream bank erosion is a natural process, an acceleration in erosion can result in this source being a major contributor to overall sediment loads delivered to tributaries, streams, rivers, and reservoirs. Subwatershed priorities for quantifying streambank erosion can be based on bank erosion assessments which address bank toe and slope, bank height, soil characteristics, and general observations of erosion severity. Priorities can also be based on impacts to downstream resources, such as reservoirs, infrastructure, or loss of property. Rapid stream assessments should be used to provide a quick overview of erosion problems and prioritize streams for more detailed erosion quantification studies or stream stabilization projects.

Sediment budgets that include streambank erosion rates should be considered for larger reservoirs in the planning area believed to have sedimentation problems. There are numerous methods that can be used to quantify bank erosion with some suited to high precision, short time-scale estimates and others suited for low precision, long time-scale estimates. Typical techniques to measure bank erosion are: erosion pins (metal or electronic), bank profilers, photogrammetry, topographic survey, historic sources (maps and photos), and sedimentological and botanical evidence (Lawlor, 1993). Bank erosion modeling approaches range from empirical to process-based. Many catchment erosion models have sophisticated routines for predicting in-stream sediment transport, sediment routing, and bed degradation, but often neglect the contribution of bank erosion to sediment loads (Watson & Basher, 2006). The appropriate method of quantification should be based on specific monitoring objectives and desired confidence.

Wetland Monitoring

Wetlands can be characterized both by their condition and functions. Wetland condition is the current state as compared to reference standards for physical, chemical, and biological characteristics, while functions represent the processes that characterize wetland ecosystems. As stated in the *Wetland Program Plan for Nebraska* (LaGrange, 2010), condition and functional wetland assessments are currently lacking in many areas of Nebraska. Enhancement of wetland assessments can be accomplished in a targeted fashion by focusing on priority areas in the district. Wetlands should be prioritized for Level 1, Level 2, and Level 3 assessments, which are increasingly more intensive and costly. Data should be used to establish “reference” wetlands, which in turn establishes base conditions for physical, chemical, and biological integrity.

The RWBJV has identified and prioritized over 7,000 wetlands in the planning area. High priority wetlands that fall in an area targeted in this plan for implementation should move forward to the “Conservation Design Process” adopted by the RWBJV (CPW-RWBJV, 2015). Through this process, current landscape carrying capacity is established, limiting factors are identified, habitat objectives are defined, and “Decision Support Tools” are developed to identify locations on the landscape that have the greatest potential to benefit priority species (CPW-RWBJV, 2015).

Wetland sites that have been subjected to physical enhancements or that will benefit from upstream management practice implementation should be targeted for long-term monitoring. to document changes in species or communities. This will aid the RWBJV in determining whether actions are moving wetland habitat in the direction necessary to support target populations (CPW-RWBJV, 2015).

The RWBJV, NGPC, and their partners should be responsible for defining and coordinating wetland monitoring and assessment activities associated with this plan. This will ensure priority issues and concerns identified by management agencies are addressed.

Wetlands, especially depressional wetlands found in the Rainwater Basin, are often found at or near the bottom of drainages. For this reason, they often are responsible for disproportional amount of groundwater recharge. Monitoring should be conducted at select wetland sites to quantify the level of groundwater recharge and the quality of the water that is infiltrated. This monitoring could utilize groundwater wells, vadose zone sampling, lysimeters, and other methods.

Real-Time Bacteria Monitoring

Real-time and manual measurement data can be used to develop regression equations to predict bacteria levels in streams. Continuous in-stream water quality monitoring devices can be installed at selected stream gaging stations to provide continuous real-time measurements of specific conductance, pH, water temperature, dissolved oxygen, turbidity, and total chlorophyll. In addition, periodic water samples can be collected manually and analyzed for pollutants such as bacteria and phosphorus. Over time, these equations can allow for continuous real-time predictions of pollutant concentrations for pollutants such as bacteria and phosphorus. This information enhances the overall understanding of system function and facilitates more accurate pollutant loading estimates. Continuous, real-time data can also be used to evaluate or predict the recreational suitability of a waterbody, develop and monitor water quality goals, adjust land treatment strategies, and evaluate progress in improving water quality.

Bacteria Source Quantification

Historically, assessment techniques have not allowed for an accurate account of surface water bacteria load contributions from specific types of sources. The nature and survival of bacteria in stream and lake bottom sediment has added to this assessment uncertainty. If bacteria survive longer in sediment than in the overlying stream or lake water, then sampling the water may provide an incorrect indication of the level of contaminants that may be present in the whole environment. Additionally, uncertainty surrounding contributions from natural sources such as wildlife may lead resource managers and the public to have unrealistic expectations, establish unachievable management goals, or incorrectly prioritize efforts.

More recent technology and methods have been developed to identify and quantify waterbody specific bacteria sources using DNA. A five-year Microbial Source Tracking (MST) study conducted on Antelope Creek within the City of Lincoln indicated sizable contributions from natural sources such as geese, ducks, swallows, pigeons, and small mammals in addition to sanitary sewage (Baral and others, 2017). It is recommended that streams or lakes targeted for projects with bacteria reduction goals undergo specialized monitoring to quantify source contributions.

Bathymetric Surveys

Sediment management in lakes involves controlling erosion at the source (fields, streams, or shoreline), 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.

Bathymetric data for Recharge Lake and Smith Creek Lake was recently collected in 2016, however, data for Recharge Lake was lost and is planned to be recollected in the near future. In 2013 Pioneer Trails Lake was drained and sealed with soda ash. At that time, the NRD surveyed the lake bottom, therefore a bathymetric survey for this lake is not a priority.

Current data is lacking for the remaining larger/recreational lakes in the planning area. There are four lakes that receive runoff from agricultural land that should be considered for future surveys (Table 24). While Lake Hastings receives runoff from agricultural land, a substantial amount of urbanization has occurred directly around the lake, increasing potential sediment impacts from construction site erosion. Since no known bathymetric surveys have been completed at these sites, priorities should be based on NRD knowledge of site conditions, lake use, and local priorities.

Several lakes have a sediment basin located in the upper end to trap sediment and other pollutants. These include Pioneer Trails Lake, Recharge Lake, and Lake Hastings. 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 reclaiming lost lake storage capacity and for locating in-lake sediment control structures.

Table 24: Lakes Lacking Bathymetric Survey Data

Subbasin	Waterbody	County	NRD Jurisdiction
Upper Big Blue	Oxbow Trails Reservoir	Butler	UBBNRD
West Fork Big Blue	Recharge Lake	York	UBBNRD
	Lake Hastings	Adams	UBBNRD/LBNRD*
	Overland Trails Reservoir	York	UBBNRD

**Lake Hastings falls on the boundary between the UBBNRD and Little Blue NRD, therefore any work would likely need to be coordinated between both NRDs.*

Lake Shoreline Erosion

Shoreline erosion can be a significant contributor of sediment to a lake. Additional information is needed to verify shoreline erosion estimates, map bank migration, and establish shoreline erosion patterns. Direct measurement of the distance between the shoreline and static points on the ground and comparison of successive measurements over time can provide an exact understanding of the extent and location of erosion. When direct field measurements can be impractical and expensive, a digital analysis of high-resolution aerial photography taken over defined temporal periods can be used as a practical alternative to direct measurements in estimating actual and projected recession of the shoreline. Combining shoreline and streambank erosion estimates with bathymetric surveys will allow for internal and external contributions of sediment to be quantified.

Lake Sediment Re-suspension and Phosphorus Release

Lake bottom sediment plays an important role in the overall nutrient dynamics of shallow lakes (Sondergaard and others, 2003). Lakes in the planning area are generally shallow, wind-mixed lakes that can experience turn-over multiple times per year. Phosphorus bound in lake bottom sediments may eventually be released to the lake water. The amount of phosphorus released from sediment can increase when the lower portions of the lake's water column become anoxic, or void of dissolved oxygen.

The resuspension of lake bottom sediment can also introduce phosphorus into the water column. Sediment resuspension increases lake water turbidity and nutrient availability, resulting in impacts to: primary producers, benthic and zooplankton communities, aquatic vegetation, fish predation, and recreation use of the lake. Studies have shown that elevated sediment resuspension simultaneously decreases the Nitrogen:Phosphorus ratio in the water column and light penetration into the water, which favors blue green algae (Horppila and Nurmenen, 2001; Niemisto, 2008). These studies also revealed that sediment resuspension can be the primary cause of late summer algae blooms.

An understanding of the quantity and quality of sediment deposited in a lake is necessary for effective water quality management. It is recommended that lakes targeted for projects that have nutrient reduction goals undergo specialized monitoring to evaluate sediment quality and quantify phosphorus loading stemming from internal processes. A variety of approaches can be used to evaluate sediment quality and sediment phosphorus release rates, as well as quantify impacts from resuspension. The development of an approach should be specific for the lake being studied and should be done as a collaborative effort between resource managers and researchers.

Urban Waterfowl Impacts

Waterfowl populations located in urban areas have grown substantially over the past few decades (Smith and others, 1999). Central Nebraska is situated in the chokepoint of the central flyway migration route (Figure 47). Urban lakes provide open water and grassy park areas, which attract migrating waterfowl species looking to rest and feed. These favorable conditions and park visitors feeding the waterfowl can contribute to excessive waterfowl numbers and allow a larger resident geese population to become established. Resident geese not only contribute to water quality problems year-round, but also act as an attractant to migratory geese.

Source: O'Brian, 2016

Figure 47: Nebraska's Location Within the Central Flyway

There are nine public access lakes in the planning area located within an urban area (Table 25). Abundant droppings from resident and migrating waterfowl can impact these small urban lakes by increasing bacteria and nutrient loads. Studies have shown that the amount of feces produced by different species of waterfowl varies. Geese generally defecate between 28 to 92 times per day, with the total wet weight of the fecal material averaging from one to three pounds per day. Canada geese excrete 521g to 1,410g (1.15 - 3.11 lbs.) of Kjeldahl nitrogen per goose each year and 163g to 638g (0.36 - 1.41 lbs.) of phosphorus per goose each year (Manny and others, 1994).

Nitrogen and phosphorus act as fertilizers, which can cause eutrophication in bodies of water. Monitoring resident and migratory waterfowl use of urban lakes can allow for the quantification of nutrient loads and provide baseline data and justification for waterfowl reduction programs.

Table 25: Urban Lakes Located in the Planning Area

Subbasin	Waterbody	County	NRD Jurisdiction
Upper Big Blue	David City Park Lake	Butler	LPNNRD*
	Surprise City Lake	Butler	UBBNRD
	Aurora Leadership Center	Hamilton	UBBNRD
	Seward City Park Pond	Seward	UBBNRD
West Fork Big Blue	Heartwell Lake (Hastings)	Adams	UBBNRD/LBNRD*
	Lake Hastings	Adams	UBBNRD/LBNRD**
	Clark's Pond (Sutton)	Clay	UBBNRD
	Henderson Pond	York	UBBNRD
Turkey	Geneva City Lake	Fillmore	UBBNRD

**These lakes are located within the HUC 8 basin, but outside of the UBBNRD.*
***Lake Hastings falls on the boundary between the UBBNRD and Little Blue NRD, therefore any work would likely need to be coordinated between both NRDs.*

Wellhead Protection Areas

Both urban and agricultural areas can provide significant loads of nitrogen, as ammonium or nitrate, into groundwater. There are numerous sources of nitrogen pollution, including diffuse sources (parks, gardens, agricultural fields, livestock), intense point sources (industrial discharges and chemical spills), and multi-point sources (leaking sewers and septic systems). Data on the loadings associated with the various sources can provide a link between current land cover, BMPs currently used or in place, and concentrations of nitrates in the vadose zone and/or groundwater. Estimating source loads will provide valuable baseline data that can be used to ensure all major sources are addressed, enhance BMP selection, improve spatial targeting of BMPs, and provide quantifiable metrics to evaluate the success of future groundwater protection projects and programs. Since nitrate migration through the soil is slow, short term benefits associated with BMP implementation must be shown through source load reductions. Source loads and their reductions can be tied to future vadose assessments to fully evaluate nitrate load reductions to groundwater. Most wellhead protection (WHP) areas encompass smaller land masses which are more manageable and are suitable to showing success. Source load quantification is recommended for all wellhead protection areas targeted for BMP implementation.

The WHP area for the City of York provides an opportunity for a source loading pilot project. In 2008, the City of York purchased 400 acres of farm ground east of the city. The property was developed into what is now the City of York Wellfield. Soil health of the wellfield had diminished due to conventional tillage practices and limited crop rotations. In the summer of 2017, the Upper Big Blue Natural Resources District approached the City of York with a solution called "Project GROW". This project targets the implementation of specific BMPs in the wellfield. Project GROW will focus on 160 acres of the total 400-acre wellfield. The project includes a community garden, a berry orchard, and an expanded pollinator habitat. Using no-till practices, diverse cover crops, and proven crop rotations, the demonstration will improve soil health, decrease soil erosion, and improve water holding capacity, all while maintaining profitability. The community garden and berry orchard will help supplement individual needs for locally-grown food.

Vadose Zone Monitoring

Implementation of a vadose zone monitoring program could be focused on WHP areas, areas with elevated nitrate concentrations, and groundwater management areas. The program could include a combination of deep vadose sampling (i.e., ground surface to aquifer) and shallow vadose sampling (i.e., ground surface to a depth of 15 feet), using similar methods and procedures.

The deep vadose sampling would be done at the same locations each time, with a sampling frequency of every 5 - 10 years. This sampling interval is more practical as nitrates move slowly through the soil profile, which lessens the value of annual sampling at the same site. The deep sampling would be used to track long-term trends of nitrate leaching from the surface to the saturated zone. Two to three shallow sampling events could occur between the deep vadose sampling events. Analyses would be completed to establish trends between the shallow and deep nitrate loads to determine effectiveness of management practices. Detailed land management information from each sampling site is necessary to make accurate comparisons between nitrate management practices. Efforts would require detailed reporting forms, completed by the producers and/or land managers, to track nitrate application, inhibitor application, crop type, use of a crop consultant, and other relevant factors. Collection of this information would greatly increase the value of a vadose zone monitoring program. A non-financial incentive to encourage participation in the program also could be used to waive training requirements for fields that sample below certain limits.

Point Source Contribution Monitoring

This plan assumes that all permitted facilities are meeting their National Pollutant Discharge Elimination System (NPDES) permit parameters and are in compliance; however, due to the potential of point source contributions influencing nutrient and bacteria concentrations at low flow conditions, periodic compliance monitoring may be necessary. Periodic compliance monitoring should be conducted at NPDES permitted facilities (or waste application sites) to verify that they adhere to permit conditions. Facilities are selected randomly or in response to inspection or reported information. NPDES permits require self-monitoring of the effluent by the permittee with frequency of the monitoring being based on the discharge characteristics. The data are then reported to the NDEE quarterly, semiannually, or annually, and entered into the EPA's Permitting Compliance System.

4.07 QUALITY ASSURANCE, DATA MANAGEMENT, ANALYSIS, AND ASSESSMENT

A variety of tools and procedures exist for compiling, managing, and analyzing data, with costs ranging from inexpensive to very expensive. No single method is applicable to all situations. As a result, managers need to use a blend of methodologies specific for the situation, intended use of the data, and available funds. In most cases, data collection procedures, data management protocols, and quality assurance procedures are in place at the local or state level. Future monitoring activities may be incorporated into established frameworks or addressed in a separate QAPP to ensure scientific validity.

Any UBBNRD effort resulting in the collection of data and/or information will follow proper data management protocol. The UBBNRD maintains several databases pertaining to water monitoring activities and uses methods to ensure data quality. UBBNRD databases are considered public information and can be obtained upon request at any point. However, data collected by other agencies, such as the NeDNR, NDEE, NGPC, or others, will not be managed by the UBBNRD unless specific arrangements for doing so have been made in advance. In most cases, water quality data is entered into publicly accessible databases such as the WQP and Clearinghouse.

4.08 REPORTING AND INFORMATION DISSEMINATION

The UBBNRD will utilize all pertinent data and information to make informed resource management decisions. Ultimately, the NRD Board of Directors makes the final decisions. The UBBNRD staff utilizes the following established processes to disseminate data and information to the board: monthly board meetings, subcommittee updates, special meetings, and presentations by the public and professionals.

The UBBNRD is continually disseminating data and information to the general public. Dissemination processes for the public include: NRD newsletters, NRD website, local newspapers, social media, public meetings, and special events. Communication and outreach efforts are further described in Chapter 6.

Raw data, reports, and other information gathered by entities outside the NRD may not be made directly available to the UBBNRD. Data collected by NDEE can be found in many different reports. The Federal Clean Water Act requires the State to provide certain reports and lists, including the Section 305(b) Water Quality Inventory Report and Section 303(d) List of Impaired Waters. In some cases, data and information will be reported in other documents such as standards revisions, water quality based permits, total maximum daily loads (TMDLs), and various nonpoint source management plans. Data from the groundwater level monitoring network is currently available to anyone through the Conservation and Survey Division (CSD) and the NeDNR.

4.09 GENERAL SUPPORT FOR MONITORING ACTIVITIES

The UBBNRD will continue to be active in gathering data to support management decisions. They annually evaluate current and future monitoring resources needed to support and facilitate nonpoint source management, especially related to groundwater management. This includes staff and training, travel, equipment, supplies, laboratory resources, and funding resources.

4.10 MONITORING PROGRAM REVIEW

The UBBNRD will conduct periodic reviews of each aspect of its monitoring program to determine how well the program serves its management needs for the district. This should involve evaluating and determining how needed changes and additions are incorporated into future monitoring cycles. This evaluation will take into consideration the effects of funding changes on its monitoring program strategy. Since water quality monitoring programs are effective only when they meet the needs of water quality resource managers, the UBBNRD will have a feedback mechanism for reporting useful information to water managers and incorporating their input on future data needs. Information needs may include: site-specific criteria modification studies; support for enforcement actions; and validation of the success of control measures, water quality modeling, monitoring unassessed waters, and/or other activities. Decision-makers at the national, regional, state, and local levels should be considered in this process.

CHAPTER 5. WATER QUALITY ASSESSMENT

5.01 INTRODUCTION

The intent of this chapter is to provide an overview of protected beneficial uses, impaired or high-quality surface waters, pollutants of concern, and general water quality assessment approaches used to develop this plan. This information was used in the prioritization process. The 2018 Integrated Report (IR) prepared by NDEE provided the current impairment status of streams and lakes (NDEQ, 2018a). More detailed analysis was conducted on priority waterbodies. This was done to estimate pollutant loads, pollutant loading capacities, and the load reduction needed for a waterbody to meet water quality standards. This additional analysis is discussed in Chapter 11.

The IR is organized by major river basins; therefore, it is important to clarify that only a portion of the Big Blue River Basin falls within the jurisdiction of the Upper Big Blue NRD (Figure 48). As such, several stream segments and lakes in the Big Blue River Basin will not be addressed in this plan. Figure 49 provides a map of the stream segments located in the planning area.

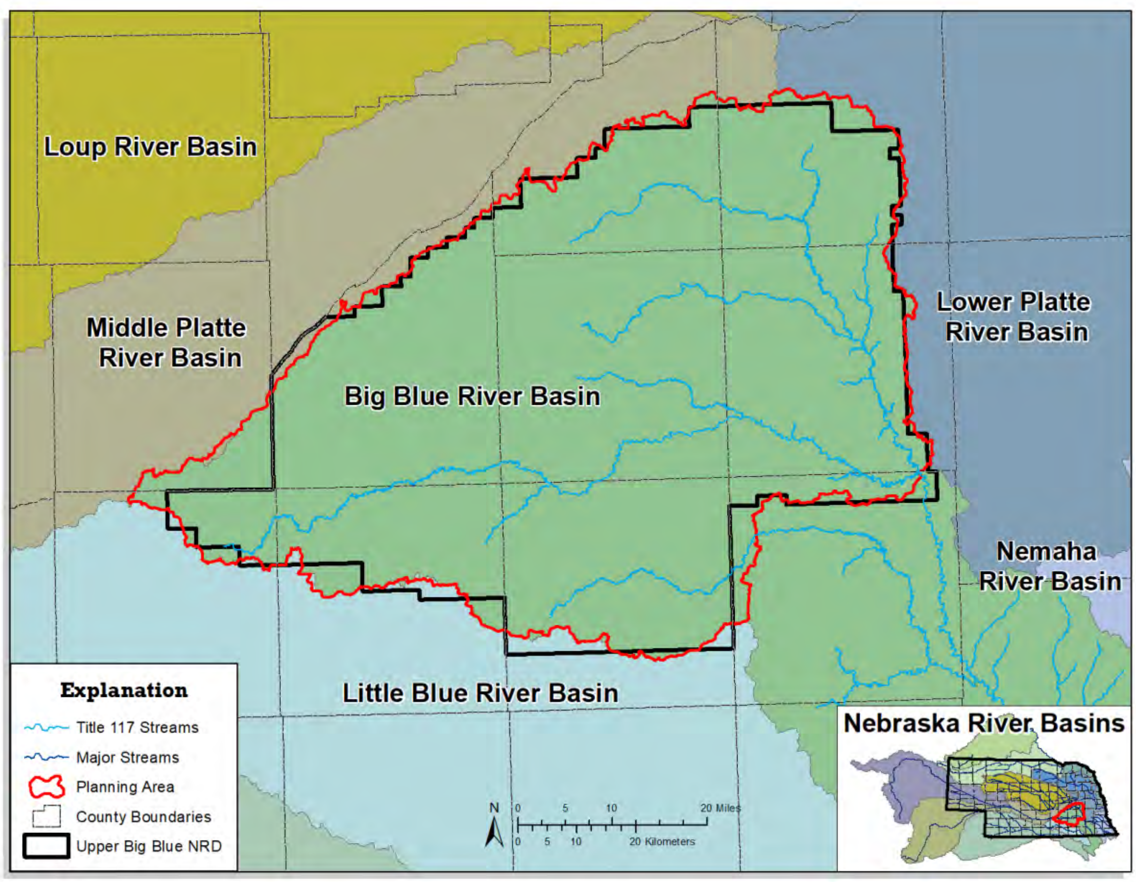


Figure 48: Big Blue River Basin and Planning Area

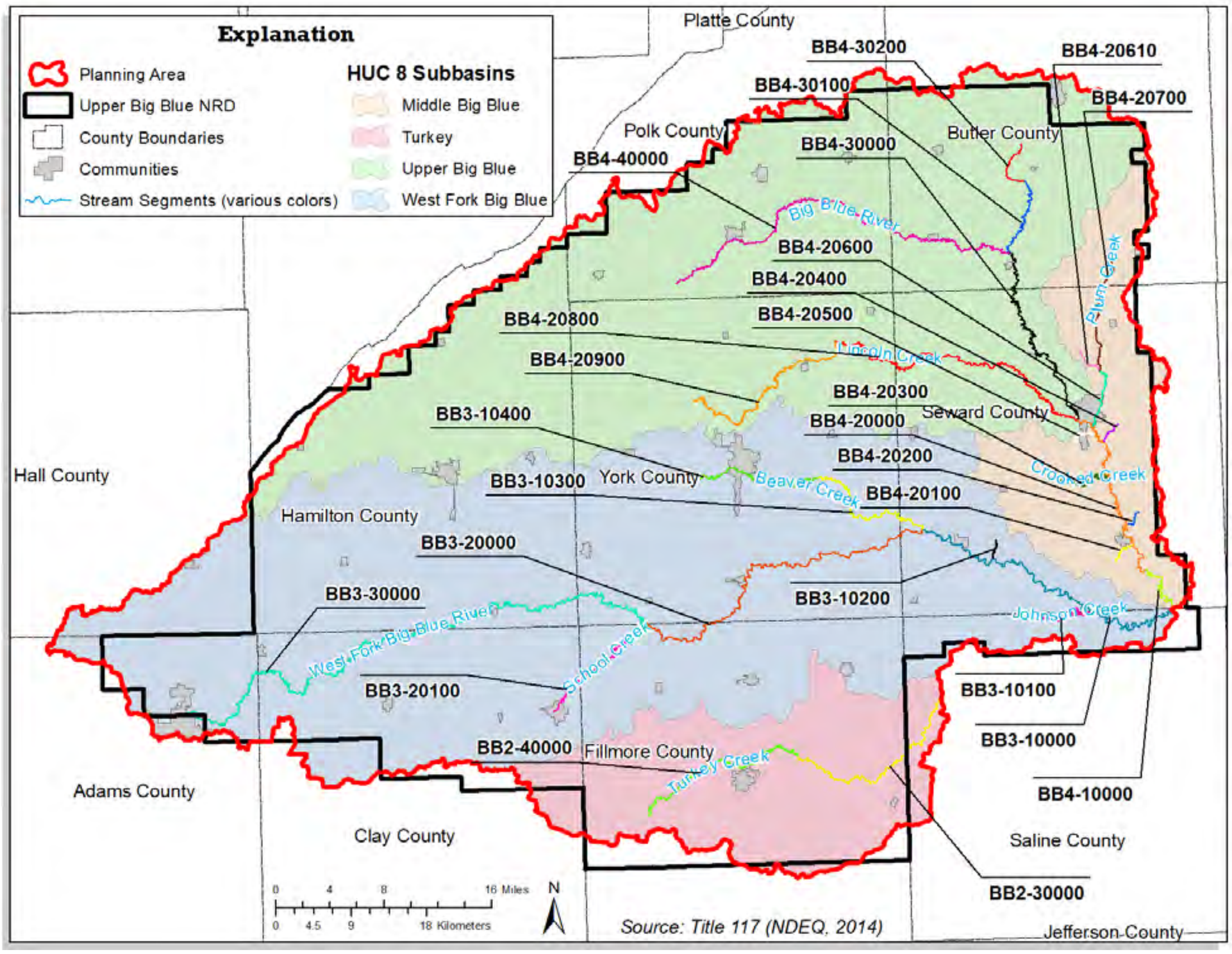


Figure 49: Stream Segments Located within the Planning Area

5.02 PERTINENT WATER QUALITY STANDARDS

TITLE 117 AND APPLICABLE WATER QUALITY STANDARDS

Nebraska Administrative Code Title 117 (Title 117) provides water quality standards for all surface waters within Nebraska (NDEQ, 2014). This includes numerical standards for many potential pollutants to water quality based on the waterbody's assigned beneficial use. Some uses require higher quality water than others. When multiple uses are assigned to the same waters, all assigned uses will be protected. This plan has been written to address nonpoint source pollutant loadings from bacteria (*E. coli*), nutrients (phosphorus and nitrogen), sediment, and aquatic life. A list of Nebraska Surface Water Quality Standards (WQS) utilized for the development of this plan is below in Table 26.

Nebraska's WQS are in place to protect the quality of surface water for human consumption, wildlife, industry, recreation, and other productive, beneficial uses (NDEQ, 2014). Beneficial uses are also protected by permits issued in accordance with the requirements of these standards and through NDEE requirements for the applicable level of treatment or control for point and nonpoint sources of pollution. It should be noted that these standards apply to all surface waters of the State, except as noted in Title 117, even if they are not specifically assigned a beneficial use in Title 117.

Table 26: Applicable Water Quality Standards

Parameter	Beneficial Use	Chronic Standard
E. coli Bacteria	Primary Contact Recreation	Geometric Mean-126 col./100mls
Atrazine	Aquatic Life	12.00 µg/L
pH	Aquatic Life	Acceptable Range = 6.5 – 9.0
Lakes Only (Eastern)		
Total Phosphorus	Aquatic Life	50 µg/L
Total Nitrogen	Aquatic Life	1000 µg/L
Chlorophyll-a	Aquatic Life	10 mg/m^3
Sedimentation	Aesthetics	Total Conservation Pool Volume Loss > 25% Conservation Pool Volume Loss < 0.75%/year

SAFE DRINKING WATER ACT

In 1974, the Safe Drinking Water Act directed the EPA to establish national drinking water standards – these are known as Maximum Contaminant Levels (MCLs). These standards set limits on the amounts of various substances allowed in public drinking water. The Nebraska Department of Health and Human Services (DHHS) is the primary agency responsible for enforcing the federal drinking water regulations in Nebraska. Because the majority of drinking water in Nebraska originates as groundwater, the NDEE and numerous natural resources districts are also involved in helping communities protect groundwater through the Wellhead Protection Program.

Groundwater pollution throughout Nebraska is variable by the type of pollutant and scale of the contamination. The most pervasive groundwater pollutant is nitrate-nitrogen (nitrate). Nitrates are known to cause a disease called methemoglobinemia (or "blue baby syndrome") primarily with infants, but it may also impact pregnant women and health-compromised adults. High nitrate levels in groundwater are typically caused by nonpoint source pollution and, thus, are of interest in this planning effort. The MCL for nitrate-nitrogen is 10 milligrams per liter (mg/L) or parts per million (ppm) in drinking water.

TOTAL MAXIMUM DAILY LOADS

A Total Maximum Daily Load (TMDL) is developed by NDEE when a waterbody has been identified as "impaired" for one or more designated beneficial uses and has been identified as a Category 5 waterbody. TMDLs establish the maximum allowable load of a pollutant which a specific waterbody can receive and still meet WQS. NDEE has developed a TMDL document for waterbodies in the planning area, as shown in Table 27. Copies of all TMDL documents can be found on the NDEE website at: http://deq.ne.gov/NDEQProg.nsf/OnWeb/TMDL.

Table 27: Completed TMDL for the Planning Area

TMDL Date	Stream Segment ID	Waterbody Name	Pollutant
2013	BB3-10000	West Fork Big Blue River, near Dorchester	Atrazine, *E. coli*
	BB3-10300	Beaver Creek – Unnamed Creek to West Fork Big Blue River	Atrazine
	BB3-20000	West Fork Big Blue River, near Cordova	Atrazine, *E. coli*
	BB4-10000	Big Blue River at Milford	Atrazine, *E. coli*
	BB4-40000	Big Blue River – Headwaters to North Fork Big Blue River	Atrazine
	BB4-20800*	Lincoln Creek – Unnamed Creek to Big Blue River*	Atrazine

**In the 2018 IR Lincoln Creek has been delisted for atrazine, but it is listed in the 2013 TMDL.*

5.03 OVERVIEW OF EXISTING WATER QUALITY DATA

The general condition of water resources in the planning area is based on completed beneficial use support assessments, water quality assessments, planning documents completed by resource agencies, and resource assessments conducted as part of the development of this plan. Additional input and information was provided through stakeholder input. Waterbody impairments are based on the most current beneficial use support assessment in the 2018 IR.

The 2018 IR was reviewed to identify the current status of water quality conditions for each lake and stream segment within the study area. While there are multiple streams and lakes identified as impaired (indicating they are not meeting one or more water quality standards), there are many others that are not able to be assessed due to a lack of monitoring data. This highlights the challenges of the limited data available in the planning area.

Water quality data was compiled for 36 monitoring locations from the NDEE and the EPA. These locations include 12 lake sites and 24 stream sites. Note that a single lake can contain multiple monitoring locations. For the purpose of this plan, the 12 lake monitoring sites are located in 8 separate lakes across the planning area. Records were compiled from 1999-2018 in an effort to capture the most relevant and recent monitoring data. Surface water quality records are available for a longer period of record; however, historical water quality data is likely not relevant to current conditions. The longest period of record for water quality data compiled is 19 years, which was assumed to be sufficient to accurately portray existing conditions for the purposes of this project. Additional details on the availability of water quality data in the planning area can be found in the technical memorandum in Appendix B.

5.04 BENEFICIAL USES

DESIGNATIONS

Nebraska's surface water quality standards protect streams and lakes for the following beneficial uses: Water Supplies, Aquatic Life, Primary Contact Recreation, and Aesthetics (NDEQ, 2014). Water supplies are divided into three discrete categories based on the specific use; public drinking water (PDW), agricultural water supply (AWS), and industrial water supply (IWS). While all streams and lakes are assigned the AWS use, the PDW and IWS uses only pertain to specific waters. All streams and lakes are assigned the aesthetics and aquatic life uses. In order to provide varying levels of protection, the aquatic life use is divided into four discrete classes based on stream characteristics and the type of biota they support: Cold Water A (CWA), Cold Water B (CWB), Warmwater A (WWA), and Warmwater B (WWB). While all lakes are assigned the primary contact recreation (PCR) use, only streams that meet certain physical characteristics have this designation. In some cases, site specific criteria for a pollutant are also assigned to a waterbody.

Beneficial uses are assigned to 26 stream segments and 16 lakes in the planning area, as shown in Table 28. There are no streams or lakes assigned the IWS use or the PDW supply; however, all 16 lakes and four of the 26 stream segments addressed in this plan are designated for PCR use. While all 16 lakes in the planning area have a WWA designation, the stream segments are split between the WWA (4) and WWB (22) classes (Table 29). There are no CWA or CWB designated streams.

Two segments of the Big Blue River are assigned site specific criteria, both of which relate to ammonia: Big Blue River (BB4-10000) and Big Blue River (BB4-20000). No lakes are designated as State Resource Waters in the planning area.

Beneficial use support summaries for streams and lakes were compiled from the 2018 IR. Individual beneficial use support assessment results for all waterbodies in the planning area can be found in Appendix B.

Table 28: Beneficial Use Designations for Streams and Lakes in the Planning Area

Subbasin	# in Title 117	PDW	PCR	AL	AWS	Aesthetics	Site Specific Criteria
Upper Big Blue							
Stream Segments	6	0	0	6	6	6	0
Lakes	6	0	6	6	6	6	0
Middle Big Blue							
Stream Segments	10	0	2	10	10	10	2
Lakes	0	0	0	0	0	0	0
West Fork Big Blue							
Stream Segments	8	0	2	8	8	8	0
Lakes	9	0	9	9	9	9	0
Turkey Creek							
Stream Segments	2	0	0	2	2	2	0
Lakes	1	0	1	1	1	1	0

**PDW – Public Drinking Water Supply, PCR – Primary Contact Recreation, AL – Aquatic Life, AWS – Agricultural Water Supply.*
Source: NDEQ, 2018a

Table 29: Distribution of Aquatic Life Classes in the Planning Area

Subbasin	# in Water Quality Standards	Cold Water A	Cold Water B	Warm Water A	Warm Water B
Upper Big Blue					
Stream Segments	6	0	0	0	6
Lakes	6	0	0	6	0
Middle Big Blue					
Stream Segments	10	0	0	2	8
Lakes	0	0	0	0	0
West Fork Big Blue					
Stream Segments	8	0	0	2	6
Lakes	9	0	0	9	0
Turkey Creek					
Stream Segments	2	0	0	0	2
Lakes	1	0	0	1	0

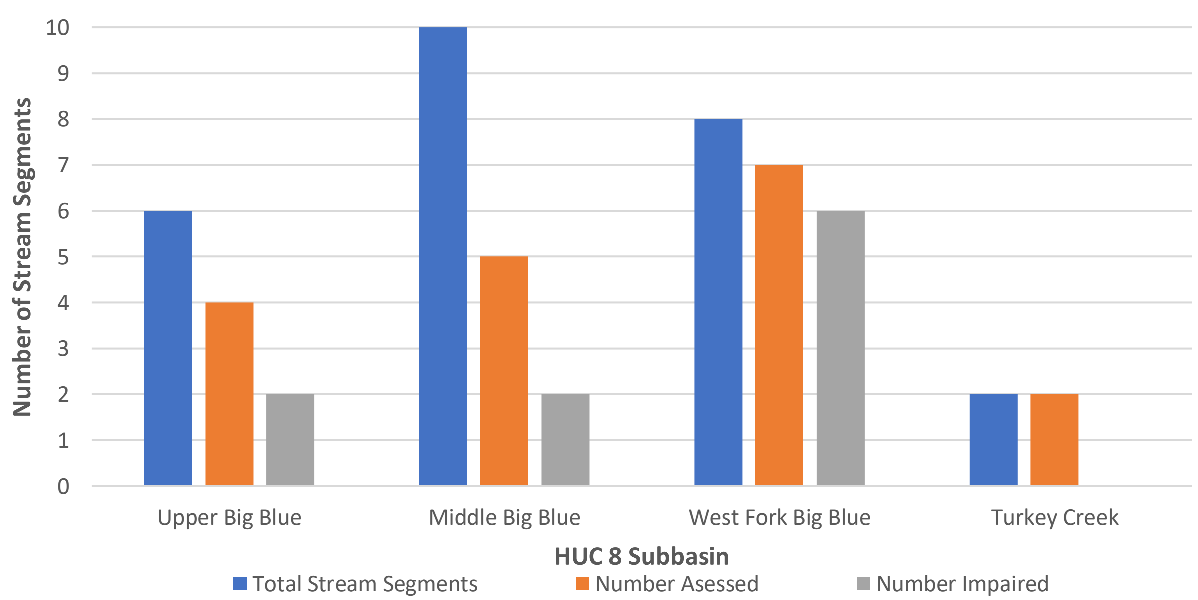
Source: NDEQ, 2018a

SUPPORT ASSESSMENTS

NDEE has conducted beneficial use support assessments on 18 of the 26 stream segments in the planning area, as shown in Table 30 and visualized in Figure 50. Of the 18 stream segments assessed, ten are identified as impaired. The highest level of stream impairments occurs in the West Fork Big Blue Subbasin where 75% of the total stream segments and 85% of the assessed segments are impaired.

Table 30: Beneficial Use Support Summary for Stream Segments in the Planning Area

	Upper Big Blue	Middle Big Blue	West Fork Big Blue	Turkey Creek
Total Number of Stream Segments	6	10	8	2
Number Assessed	4	5	7	2
Number Impaired	2	2	6	0
% of Total Segments Impaired	33%	20%	75%	0%
% of Assessed Segments Impaired	50%	40%	85%	0%
Total Stream Segment Miles	172 miles	80 miles	244 miles	80 miles
Miles Assessed	155 miles	60 miles	236 miles	80 miles
Miles Impaired	84 miles	33 miles	144 miles	0 miles
% of Total Miles Impaired	49%	41%	59%	0%
% of Assessed Miles Impaired	54%	55%	61%	0%



Source: NDEQ (2018a)

Figure 50: Beneficial Use Support Summary for Stream Segments in the Planning Area

NDEE has conducted beneficial use support assessments on 12 of the 16 lakes in the planning area, as shown in Table 31 and visualized in Figure 51. Of the 12 lakes assessed, eight are identified as being impaired. The highest level of lake impairments occurs in the West Fork Big Blue Subbasin where 67% of the total lakes and 75% of the assessed lakes are impaired.

Table 31: Beneficial Use Support Summary for Lakes in the Planning Area

	Upper Big Blue	Middle Big Blue	West Fork Big Blue	Turkey Creek
Total Number of Lakes	6	0	9	1
Number Assessed	4	0	8	0
Number Impaired	2	0	6	0
% of Total Lakes Impaired	33%	0%	67%	0%
% of Assessed Lakes Impaired	50%	0%	75%	0%
Total Number of Acres	54 acres	0 acres	200 acres	1 acre
Acres Assessed	43 acres	0 acres	189 acres	0 acres
Acres Impaired	38 acres	0 acres	168 acres	0 acres
% of Total Acres Impaired	70%	0%	84%	0%
% of Assessed Acres Impaired	88%	0%	89%	0%

Source: NDEQ, 2018a

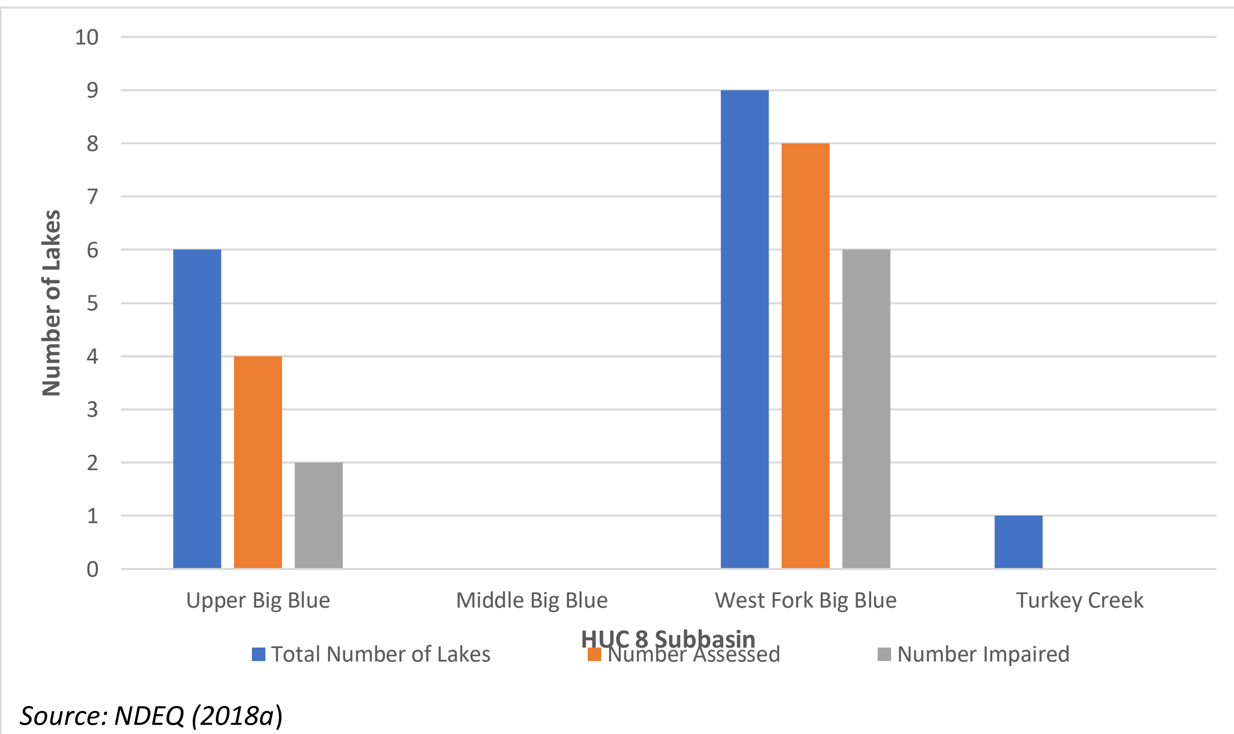


Figure 51: Beneficial Use Support Summary for Lakes in the Planning Area

5.05 HIGH-QUALITY AND IMPAIRED WATERS

HIGH-QUALITY WATERS

The 2015 Nebraska Nonpoint Source Management Plan (NDEQ, 2015a) does not identify any high-quality streams or lakes in the planning area.

IMPAIRED WATERS

Streams

Ten stream segments have been assessed as impaired in the planning area. Five of these stream segments have impaired aquatic communities. The impairment is based on three individual metrics relating to aquatic habitat, aquatic insects, and fish (NDEQ, 2011a). While impaired aquatic communities can generally be tied to nonpoint source pollution there are no specific pollutants or loads associated with this cause of impairment.

Based on completed beneficial use support assessments the primary pollutants causing water quality degradation in streams are bacteria and atrazine, which relate to the Primary Contact Recreation and Aquatic Life uses. Atrazine is a partial cause of impairment on three stream segments and the sole cause of impairment on three additional stream segments. Bacteria is a partial cause of impairment on three stream segments and the sole cause of impairment on one more stream segment. Stream segment impairments can be seen below in Table 32 and are visualized in Figure 52.

Table 32: Impaired Stream Segments in the Planning Area

Subbasin	Stream Name	Segment	Beneficial Use (Pollutant Causing Impairment)
Upper Big Blue	Lincoln Creek	BB4-20900	Aquatic Life (Impaired Aquatic Community)
	Big Blue River	BB4-40000	Aquatic Life (Atrazine)
Middle Big Blue	Big Blue River	BB4-10000	Recreation (Bacteria), Aquatic Life (Atrazine)
	Big Blue River	BB4-20000	Recreation (Bacteria)
West Fork Big Blue	West Fork Big Blue River	BB3-10000	Recreation (Bacteria), Aquatic Life (Impaired Aquatic Community, Atrazine)
	Walnut Creek	BB3-10200	Aquatic Life (Impaired Aquatic Community)
	Beaver Creek	BB3-10300	Aquatic Life (Atrazine)
	Beaver Creek	BB3-10400	Aquatic Life (Impaired Aquatic Community)
	West Fork Big Blue River	BB3-20000	Recreation (Bacteria), Aquatic Life (Impaired Aquatic Community, Atrazine)
	School Creek	BB3-20100	Aquatic Life (Atrazine)
Turkey Creek	N/A	N/A	N/A

Source: NDEQ, 2018a

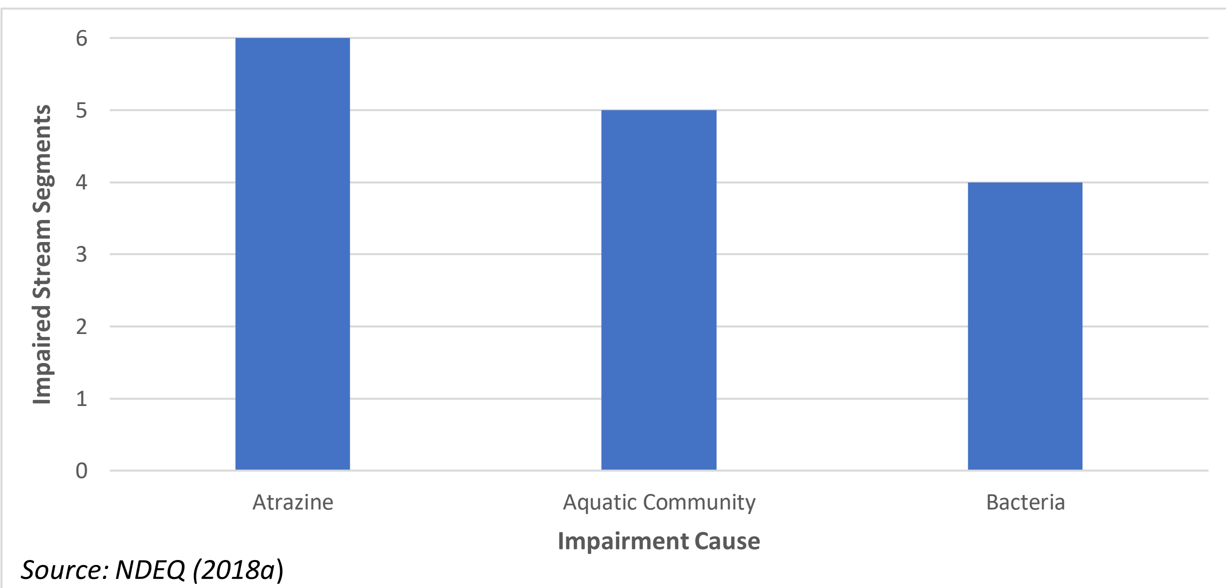


Figure 52: Causes of Stream Impairment in the Planning Area

Lakes

Based on completed beneficial use support assessments, the primary pollutants causing water quality degradation in lakes include: chlorophyll a, nutrients, pH, bacteria, and sediment (Figure 53). All impairments relate to the recreation, aquatic life, and aesthetic uses and are directly or indirectly associated with nutrient and sediment loading. Lake impairments are detailed below in Table 33. It should be noted that Waco Basin is no longer a lake; although the NDEE has not updated Title 117 or the Integrated Report to reflect this. Waco Basin was a former open water irrigation reuse pit but was filled in 2001 through the cooperative efforts of the Rainwater Basin Joint Venture (RWBJV) to restore its function as a wetland (USFWS, 2014). Due to this change, pursuing restoration projects is no longer valid or a priority for the UBBNRD or other partners.

Table 33: Impaired Lakes in the Planning Area

Subbasin	Lake Name	Lake ID	Beneficial Use (Pollutant Causing Impairment)
Upper Big Blue	David City Park Lake	BB4-L0010	Aquatic Life (Chlorophyll a, Nutrients)
	Pioneer Trails Lake	BB4-L0040	Unknown
Middle Big Blue	N/A	N/A	N/A
West Fork Big Blue	Waco Basin*	BB3-L0030	Recreation (Bacteria), Aquatic Life (Nutrients)
	Lake Hastings	BB3-L0050	Aquatic Life (Fish Consumption Advisory, Hazard Index Compounds, Cancer Risk Compounds, Chlorophyll a, Nutrients), Aesthetics (Sediment)
	Hastings Northwest Dam Lake	BB3-L0060	Aquatic Life (Chlorophyll a, pH, Nutrients)
	Heartwell Lake	BB3-L0070	Aesthetics (Algae Blooms)
	Recharge Lake	BB3-L0080	Aquatic Life (Fish Consumption Advisory, Mercury, Chlorophyll a, Nutrients)
	Henderson Pond	BB3-L0040	Aquatic Life (Chlorophyll a, Nutrients)
Turkey Creek	N/A	N/A	N/A

**Waco Basin is no longer a lake and currently functions as a wetland.*
Source: NDEQ, 2018a

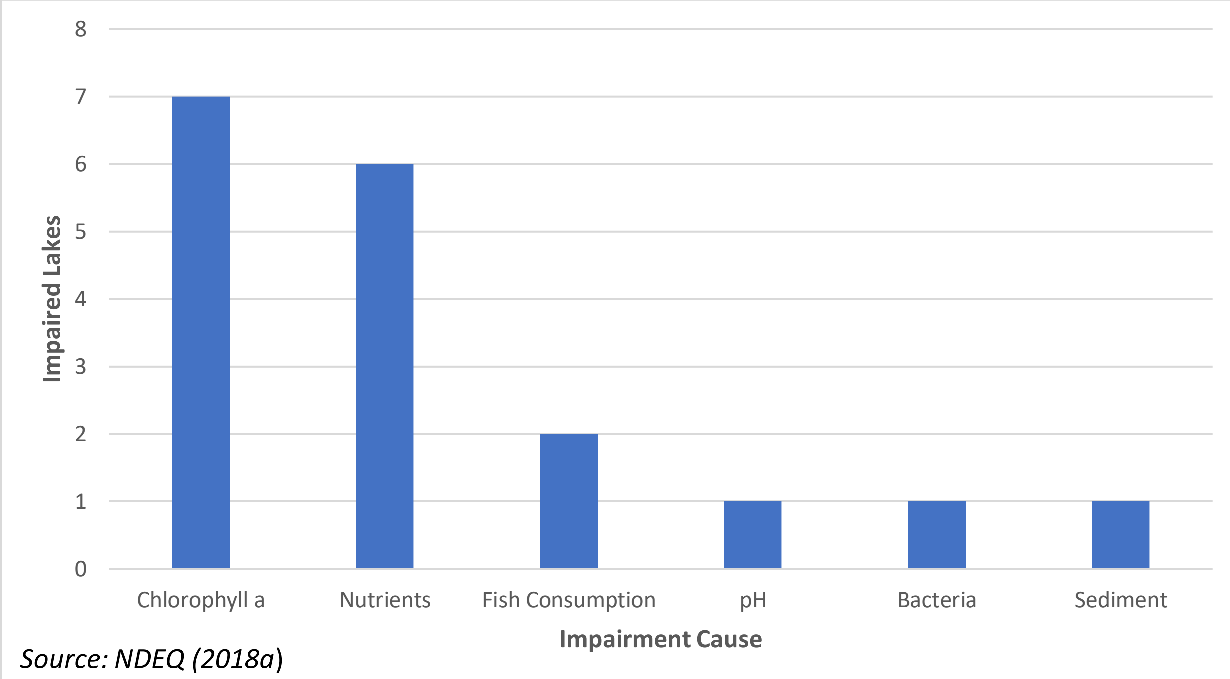


Figure 53: Causes of Lake Impairments in the Planning Area

5.06 POLLUTANTS OF CONCERN

INTRODUCTION

Sources of pollution can be separated in two primary categories: point sources and nonpoint sources. A point source is any discernible, confined, discrete conveyance from which pollutants can be discharged. Point source pollution can be easily tracked along the pollutant's travel path and identified at the source. Examples would include any pipe, ditch, tunnel, conduit, or well that might discharge pollutants. The discharge from some point sources is regulated by the National Pollutant Discharge Elimination System (NPDES) permit program. Many agricultural, industrial, and municipal facilities are required to obtain NPDES permit coverage. However, individual homes connected to a municipal or septic system typically do not need coverage under a NPDES permit.

Identifying permitted facilities is important in developing a water quality management plan. While these facilities are assumed to be meeting all their permit requirements, their pollutant load contributions do need to be accounted for. This allows for the identification of nonpoint pollution loads to be clearly identified and separated. Nonpoint sources of pollution come from facilities, activities, or land uses that do not meet regulatory requirements to be considered point sources. Because these facilities are not regulated, are typically smaller, or are otherwise not well defined, they are thus treated as nonpoint sources for management purposes. This is conceptually illustrated below in Figure 54.

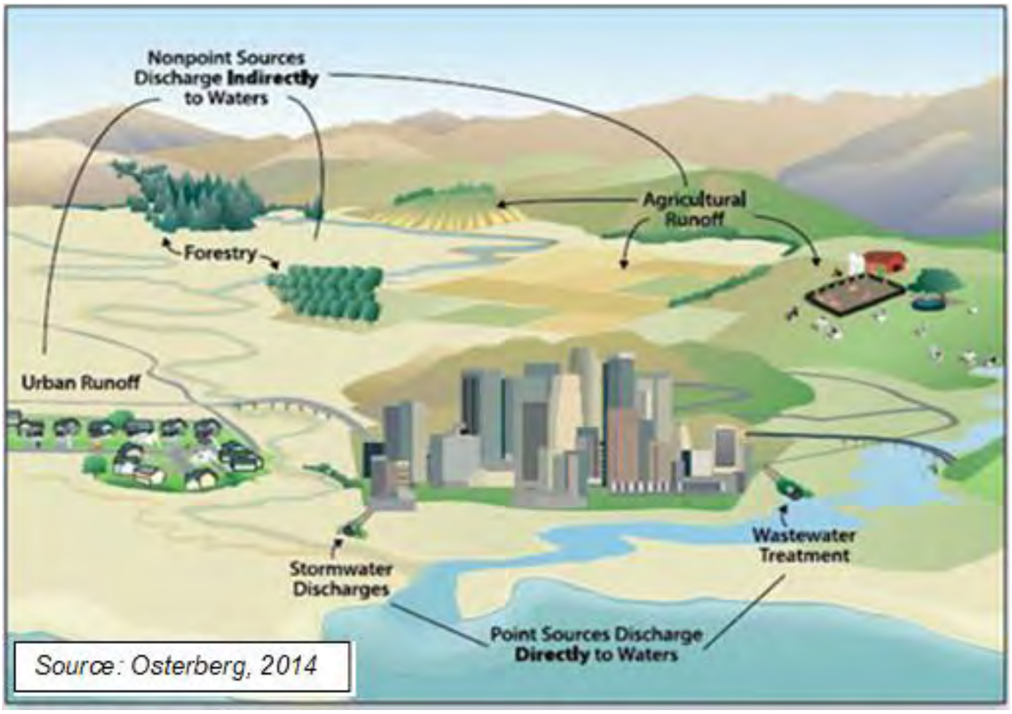


Figure 54: Examples of Point and Nonpoint Sources of Water Pollution

POLLUTANTS ADDRESSED IN THIS PLAN

9

Nonpoint source pollution is typically transported from broader areas during precipitation events; however, the origin is often difficult, if not impossible, to identify due to the diffuse and widespread nature of the pollution. Within the planning area, nonpoint source pollution is considered the major contributor to water quality impairments. While it can be difficult to identify specific nonpoint sources, this plan addresses the following pollutants of concern for priority waterbodies and target areas: bacteria, nutrients, sediments, and atrazine. Pollutants, sources, and their impacts are summarized in Table 34. The following sections discuss each source in greater detail.

Table 34: Summary of Pollutants and Sources

Pollutant & Sources		Possible Impacts on Waterbody Uses
Point Sources (permitted)*	Nonpoint Sources	
Pathogens/Bacteria (*E. coli*)		
• WWTFs • Permitted AFOs	• Wildlife and Pets • Unpermitted AFOs & grazing livestock • Underperforming septic systems • Land application of manure • Land application of wastewater/ sludge	• Human health risks • Recreation impairments
Nutrients (Phosphorus and Nitrogen)		
• WWTFs • Permitted AFOs	• Fertilizer application • Wildlife and Pets • Unpermitted AFOs & grazing livestock • Underperforming septic systems • Land application of manure or wastewater • Gully, Rill, and Stream Erosion	• Aquatic life impairments • Human health risks • Drinking water supply impacts • Recreational impacts
Sediment		
• WWTFs • Stormwater systems • Construction Sites	• Agriculture (cropland and pastureland erosion) • Silviculture and timber harvesting (erosion) • Urban Sources, Construction, and, Roads • Underperforming septic systems • Gully, Rill, and Stream Erosion	• Aquatic Habitat • Fills reservoirs • Recreational impacts • Human health risks – fish consumption
Atrazine		
• None	• Agriculture (applied primarily to corn)	• Aquatic life • Drinking water supply impacts

**AFO – Animal Feeding Operations; WWTF – Wastewater Treatment Facility*
**Point sources were initially identified in order to distinguish the level of pollutant loads associated with all sources; however, they were not considered for management recommendations.*

E. coli Bacteria

Many types of bacteria may be present in waterbodies, making it difficult to identify and measure specific pathogenic organisms. Therefore, indicator organisms are used to determine the level of impairment of surface waters. Studies conducted by the EPA to determine the correlation between different bacteria and the occurrence of gastrointestinal illness suggest that *E. coli* is the best indicator of health risk from contact with recreational waters. *E. coli* is a species of fecal coliform bacteria that is commonly found in the fecal matter of warm-blooded animals. Most strains of *E. coli* are harmless; however, certain strains (0157:H7) can cause mild to severe gastrointestinal illness.

In 2005, *E. coli* became the sole parameter for assessing the Primary Contact Recreation use in Nebraska. Sources of *E. coli* include the waste from wildlife, pets, livestock, and humans. Additionally, the spreading of manure and livestock waste or wastewater for agricultural purposes can also be a source. Contamination from manure is most pronounced where animals congregate and/or have direct access to water bodies, or where manure is applied improperly.

Current concentrations of *E. coli* in several of the streams in the planning area exceed water quality standards, indicating an exposure risk to users and a possibility for the exposure to other pathogenic bacteria originating from fecal contamination which may cause gastrointestinal illness, such as giardia (popularly referred to as beaver fever).

Nutrients

Nutrients such as phosphorus and nitrogen occur naturally in the environment. However, an overabundance of these nutrients pose ecological and human health risks and may lead to impaired water quality. Nutrient enrichment in Nebraska water bodies can stem from both external and internal sources. External sources consist of soil erosion (from the landscape, stream banks, and lake shores); animal, pet, and livestock waste; human waste; and fertilizer runoff. Internal sources are nutrients which originate from an external source and become trapped in waterbodies (particularly in lakes and reservoirs) and are recycled naturally.

Excess nutrients in water bodies leads to excess algae production, which in turn may lead to decreased oxygen levels that disrupt aquatic life. Blue-green algae (cyanobacteria) thrive in nutrient enriched waters and will, when conditions are right, produce large “blooms”. Blue-green algae produce cyanotoxins which can make humans and animals sick.

While both phosphorus and nitrogen exist in both dissolved and sediment-bound forms, they each have different preferences in how they are transported. Phosphorus has a greater tendency to adhere to soil particles, leading to a greater threat to surface water bodies via soil erosion and surface runoff. Nitrogen is more readily soluble and poses an increased risk to groundwater contamination through leaching. Nitrogen contamination of groundwater is a particular concern for communities that rely on groundwater for their source of drinking water. Elevated levels of nitrates in drinking water are known to cause a disease called methemoglobinemia (or “blue baby syndrome”) with infants. The introduction of anthropogenic fertilizers (primarily nitrogen based) for row crops causes an increased risk of contamination from those land uses.

Sediment

Sedimentation and excessive soil erosion also contribute to impaired water quality Alone, sediment can degrade water clarity (measured as turbidity), which is harmful to aquatic habitat and is aesthetically undesirable. Excessive sedimentation diminishes the suitability of instream and streamside habitat for fish and wildlife. Sediment buries river and lake gravel substrate that supports spawning and foraging habitat for benthic and other aquatic organisms. Sedimentation reduces the capacity of lakes, reducing the productivity and ability to attenuate other pollutants.

Sediment can also act as a transport mechanism to waterbodies when other pollutants adhere to it. Sediment associated contaminants, such as mineral or organic compounds, can be passed on to fish, birds, and mammals (from bottom-dwelling fish and organisms) in lakes and streams. The EPA has identified sediment pollution as a potential source of contamination of consumable fish and may pose several health risks to humans. The *Wadeable Streams Assessment* done in 2004-2005 by the EPA reported that increases in nutrients (e.g., nitrogen and phosphorus) and streambed sediments have the highest negative impact on biological conditions (Paulsen and others, 2006).

The two primary sources of sedimentation are landscape erosion (sheet, rill, and gully) from upland areas, and streambed/bank erosion. The erosion of stream banks is a natural process that can have beneficial impacts on the creation and maintenance of riparian habitat; however, excessive erosion can smother submerged aquatic vegetation, fill in riffle pools, and contribute to increased levels of turbidity and nutrients. Excessive erosion from within streams is largely due to hydromodification. Hydromodification is the alteration of the natural flow of water through a landscape. In the planning area, this has primarily been due to changes in watershed hydrology (runoff) and the channelization of streams. This issue can be exacerbated by some agricultural practices such as channel straightening or cultivating through drainage ways. An additional source of soil erosion, which essentially only impacts lakes, is shoreline erosion. Shoreline erosion rates are determined by soil types, bank height, lake orientation, lake fetch, lake depth, and recreational activities such as power boating (Asplund, 1996).

Erosion and sediment loading occur as a result of two separate processes: precipitation events and baseflows. During precipitation events, runoff water from upland areas causes erosion and transports sediment downhill. Precipitation also increases stream flows, causing increased streambank and bed erosion. When there is no precipitation, stream bed and bank erosion still takes place due to the baseflow of the stream.

Atrazine

Atrazine is one of the most heavily used pesticides in North America (USEPA, 2003). Atrazine is a potent endocrine disrupter and exposure is linked to a number of serious health affects in animals and humans at extremely low doses. Fish and amphibians are most vulnerable, and it is known to compromise fish and amphibian growth, behavior, immune function, and gonadal development.

Atrazine is a triazine herbicide currently registered for use on broadleaf plants and some grassy weeds. Although atrazine can be used for a variety of purposes, its most common use is on corn and sorghum (USEPA, 2018). Sorghum is a minor crop within the planning area, therefore land used for corn production is presumably where the majority of atrazine is applied and is thus considered the source of atrazine in the planning area.

POLLUTANTS DISMISSED

For the purposes of this plan, point sources of pollution such as Wastewater Treatment Facilities (WWTFs) were considered to be meeting permitting conditions and not contributing beyond the pollutant limits set by permits. Permitted Animal Feeding Operation (AFO) facilities are designed to contain any runoff that is generated by storm events weaker in intensity than the 25-year storm event. Therefore, management recommendations and associated load reductions were eliminated from further consideration for these point sources. However, initial analysis was necessary to distinguish pollutant loads between point and nonpoint sources.

Pollutants that originate from naturally occurring sources (independent of human activity) will not be addressed in this plan. None were identified in the 2018 IR.

Other water quality parameters listed as causes of impairments in the 2018 IR are not directly addressed in this plan. These include chlorophyll a and pH. For the purposes of this plan, which addresses the management of nonpoint source pollution, these parameters are not considered to be pollutants. These water quality parameters serve as symptoms of impairments, rather than the cause of an impairment. Thus, they are expected to show improvements by addressing sediment and nutrient pollutants during the implementation of this plan. Additional discussion is provided within Chapter 11 for target areas with these impairments.

Fish tissue contamination was not addressed in this plan due to the global nature of the sources. Mercury is a naturally occurring substance but can enter the environment from human activities, including atmospheric deposition from air emissions and improper disposal of products containing mercury. When mercury from human activities enters rivers and lakes, it can transform into methyl-mercury and can accumulate in fish tissue. Consumption of fish containing mercury is considered a primary path for human exposure. Because the majority of mercury contamination is caused by air emissions, which are not contained by watershed boundaries, mercury is not a pollutant that can be addressed through typical nonpoint source pollution management strategies and will be given no further consideration in this plan.

5.07 POLLUTANT SOURCES

LANDUSE

Pollutant loading assessments conducted on target areas were centered on runoff generated from specific nonpoint sources of pollution. In some cases, similar land cover types were grouped to define one source. The extent or area of each source was either determined through the 2017 U.S. Department of Agriculture (USDA) Cropland Data Layer for landuse/landcover data or estimated from aerial photography. A description of each source is provided below.

Urban (developed)

Urban land refers to any areas that have been developed specifically for human habitation. The smallest villages and the largest cities are considered urban under this land cover definition. These lands are also interchangeably described as developed, which means only that they have been altered for humans through the construction of roads, buildings, power lines, sewer systems, buildings, or any number of other amenities. Developed, in this case, does not indicate that the land is being used for irrigated crop production. Most urban land is considered “impervious”, that is nearly all precipitation that falls on these surfaces (parking lots, streets, etc.) runs off and does not infiltrate into soil.

Developed land contributes to nutrient pollution through soil erosion and fertilizer application to lawns. Soil erosion is typically low due to increased impervious surfaces, unless construction or land clearing is occurring. Urban wildlife and improper disposal of pet waste are both sources of bacterial and nutrient contamination. While urban areas make up a small portion of total land use, the relative contribution may be much higher due to the lack of natural vegetation and increased runoff when compared to other land use types.

Corn and Soybeans

These are areas used to produce corn and soybeans. Most of the cultivation that occurs in the planning area is generally associated with these two crops. Farmland contributes to nutrient pollution through soil erosion, which is accelerated caused by the limited amount of perennial vegetation or groundcover most of the year. This leads to the formation of rills and gullies and increased sediment loss. Bacterial pollution from farmland is primarily associated with wildlife and manure applied as fertilizer. Nutrient pollution is associated with both sediment that is eroded away, as well as the application of commercial fertilizers and animal waste. Nitrogen leaching loss from applied fertilizer and the spreading of manure is increased by excessive applications of irrigation water. With improper management of nitrogen sources, non-irrigated crop production can also contribute to the problem. (Kranz, 2015). Most atrazine originates from land used for corn production.

Other Cropland

Areas used to produce annual and perennial crops other than corn or soybeans. This category can include oat, rye, sorghum, winter wheat, barren, and idle cropland. This land use has similar pollutants as corn and soybeans, with the exception of atrazine.

Forest

This land cover category is comprised of both deciduous and evergreen forests, as well as areas of thick brush. Forested land found in the planning area is primarily limited to riparian and natural areas. Forests contribute to nutrient and sediment pollution through soil erosion, however, it is often minimal due to the high amount of perennial vegetation and groundcover present. Bacterial pollution from forests is primarily associated with wildlife.

Permanent Grass or Pasture

This land cover category includes areas with permanent grasses: lands enrolled in CRP, pastures, prairies, and developed open space. Developed open space, typically parkland, is a small part of this land use. Most of this land use can be used for livestock grazing or the production of hay crops, typically on a perennial cycle. Grass/Pasture land uses contribute to nutrient and sediment pollution through soil erosion; however, it is often minimal due to the high amount of perennial vegetation and groundcover present. Bacterial pollution from this land use is primarily associated with wildlife or where livestock are present at some point during the year.

ANIMAL FEEDING OPERATIONS

Animal feeding operations (AFOs) are facilities that confine livestock in a limited feeding space for an extended period of time. The Nebraska Livestock Waste Management Act authorizes the NDEE to regulate discharge of livestock waste from these operations. Nebraska’s Livestock Waste Control Regulations (Title 130) classifies AFOs as small, medium, or large operations based on the number and type of livestock confined in the facility (NDEQ, 2011b). Title 130 also requires inspection of medium and large operations to assess the potential for waste discharge. Depending on the size of the operation and potential to discharge pollutants, the operation may be required to obtain a construction and operating permit for a livestock waste control facility (LWCF) from NDEE. AFOs confining less than the equivalent of 300 beef cattle are considered administratively exempt from inspection and permitting unless they have a history or potential to discharge pollutants to Waters of the State.

Voluntary management recommendations are not identified in this plan for permitted AFOs (typically medium and large operations) as they are assumed to be meeting their regulatory requirements. However, non-permitted (typically small AFOs) do not have regulatory requirements imposed on them and are thus considered for management recommendations.

Permitted Animal Feeding Operations

Active AFOs are considered potential sources of *E. coli* bacteria. Figure 55 shows the AFOs within the planning area that have been entered into the NDEE *Regulated Facilities database* (NDEQ, 2018c). There are 1,016 permitted AFOs within the planning area. Table 35 provides the number per HUC 8 Subbasin. Each AFO may have more than one LWCF. An operation that has discharged livestock waste to Waters of the State or has been determined by NDEE that such a discharge is more likely than not to occur is required to obtain a permit issued by the State of Nebraska for construction and operation of a LWCF. These facilities are designed to contain any runoff that is generated by storm events that are less than or equal to a 25-year, 24-hour rainfall event.

Land application of liquid or dry manure from a LWCF is a recognized way of controlling the discharge from these facilities, as well as recycling nutrients from the AFO. Certain controls are required to be in place and must be documented in a nutrient management plan, which NDEE maintains a copy of. Records and controls for non-permitted AFOs are not required to be kept.

Table 35: Permitted AFOs per Subbasin

HUC 8 Subbasin	Number of Permitted AFOs
Upper Big Blue	436
Middle Big Blue	108
West Fork Big Blue	389
Turkey Creek	83
Total	**1,016**

Source: NDEQ, 2018c

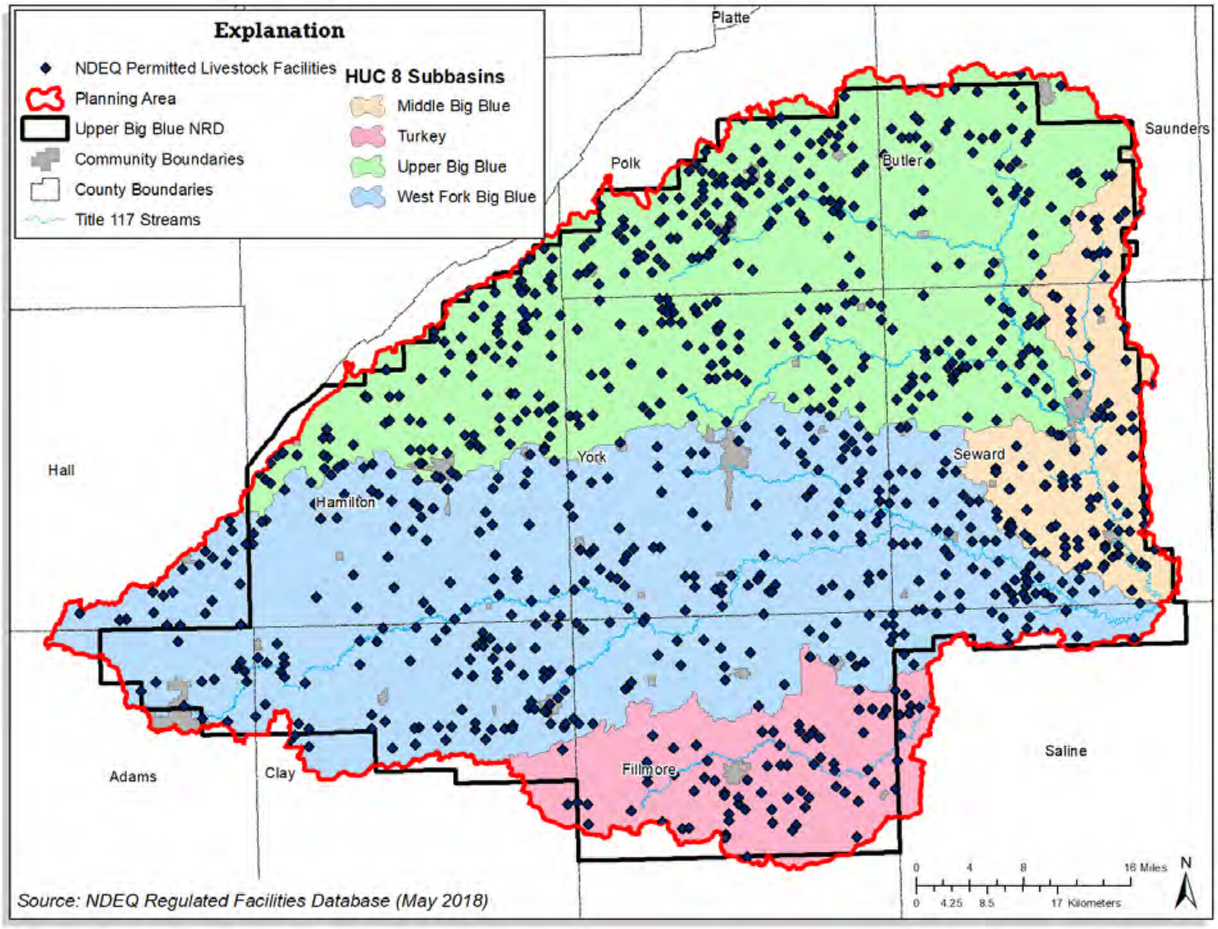


Figure 55: Permitted Livestock Facilities in the Planning Area

Non-Permitted Animal Feeding Operations

According to the 2012 Agricultural Census (USDA, 2014), there are 244,969 total cattle in the planning area. It is estimated that approximately 222,900 cattle are in livestock facilities permitted by NDEE. Therefore, the remaining cattle (over 22,000) are associated with non-permitted AFOs. Cattle manure associated with non-permitted AFOs can be assumed to be found in varying locations depending on the time of year and how a producer might manage their cattle. Cattle and their manure may be found in heavy use areas (such as barnyards, stables, wintering areas, and open lots) or they may also be found grazing in pastures or other fields. Because of the amount of grassland in the watershed, it is anticipated a high number of non-permitted cattle do spend some time on pasture. The exact number and location of non-permitted AFOs in the watershed is not known as their location or other information is not recorded in NDEE's database of permitted livestock facilities. Non-permitted facilities may include both pasture/grazing-based operations and confinement/feedlot-based operations; however, due to the lack of data, a distinction cannot be made between them in this plan.

NDEE does not require controls for non-permitted AFOs (including cattle found in pastures); therefore, these operations are considered to be at high risk for contributing nonpoint source pollution and have been identified for management actions in this plan. To estimate the distribution of non-permitted livestock, a visual analysis of aerial imagery was completed to identify potential non-permitted AFO facilities. Additional discussion on this analysis can be found in Appendix B. These operations are common throughout the planning area, as can be seen in Table 36 and Figure 56 below. Non-permitted AFOs may contribute to bacteria, nutrient, and sediment pollution due to animal waste, removal of vegetation from heavy use areas, and streambank/riparian area degradation due to cattle access.

Table 36: Estimated Non-Permitted Livestock per Subbasin

HUC 8 Subbasin	Estimated # of Non-Permitted Cattle
Upper Big Blue	7,280
Middle Big Blue	2,700
West Fork Big Blue	9,960
Turkey Creek	2,260
Total	**22,200**

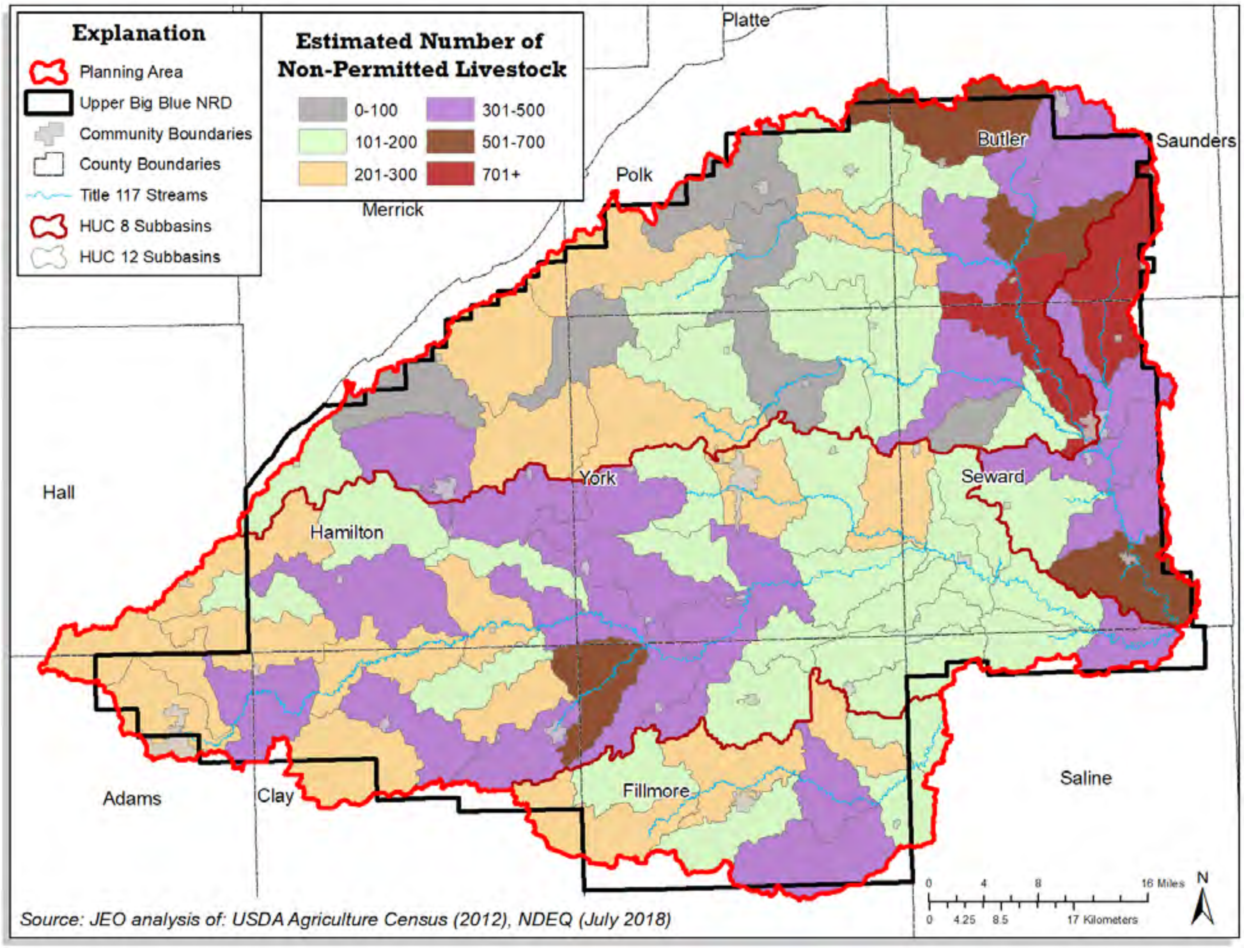


Figure 56: Estimated Number of Non-Permitted Livestock per Subwatershed

ON-SITE WASTEWATER

Illicit connections, discharges, combined sewer overflows, sanitary sewer overflows, straight pipes from septic tanks, underperforming septic systems, or other onsite wastewater systems can also be sources for *E. coli* bacteria. Under Title 124, Chapter 3, NDEE requires anyone doing work associated with onsite wastewater systems to be certified by the State of Nebraska, and requires systems constructed, reconstructed, altered, or modified to be registered (NDEQ, 2012). As of June 2018, a total of 1,007 onsite wastewater systems have been registered within the planning area, as shown in Table 37. Systems installed prior to 2001 were not required to be registered; therefore, the exact number of septic systems or underperforming septic systems is not possible to determine. According to the National Environmental Services Center, it is estimated that 40% of all septic systems are presently underperforming and about 6% of systems are either repaired or replaced annually (NESC, 2013).

The number of unregistered onsite wastewater treatment systems (OWTS) was estimated using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) data server (Tetra Tech, 2013). Septic system data for each HUC 12 subwatershed is based on septic system surveys performed by the National Small Flow Clearing House in 1991 and 1998. There are an estimated 7,388 unregistered OWTS in the planning area, as shown in Table 37. Registered OWTS facilities were downloaded and mapped into their respective HUC 12 subwatersheds from the *NDEE Regulated Facilities Database* (NDEQ, 2018c). Pollutant loads from both registered and non-registered systems was estimated for modeling purposes; however, only unregistered systems were included in the implementation strategy.

Table 37: Registered and Unregistered Onsite Wastewater Facilities by Subbasin

HUC 8 Subbasin	Registered OWTS	Unregistered OWTS
Upper Big Blue	423	2,649
Middle Big Blue	160	794
West Fork Big Blue	393	3,524
Turkey Creek	31	421
Total	**1,007**	**7,388**

Source: NDEQ, 2018c and STEPL data server (June 2018)

IN-LAKE POLLUTANT SOURCES

Lake Bottom Sediment – The sediment at the bottom of a lake or reservoir plays an important role in the overall nutrient dynamics of shallow lakes, such as those found in the planning area. Internal phosphorus loading originates from a phosphorus pool accumulated in the sediment. Sediments can release phosphorus into overlying water under certain environmental conditions, which may have a significant impact on water quality.

Bottom Sediment Resuspension – Phosphorus contained in the bottom sediment can be introduced into the water column through sediment resuspension. Resuspension is caused by wind and wave action or by some species of fish which stir up bottom sediments during feeding. Some recreational activities, such as power boating, can also increase sediment and nutrient resuspension.

Shoreline Erosion – As reservoirs age, they lose depth due to sediment deposition from the watershed. Shoreline and bank erosion processes can add additional sediment and pollutants to the reservoir while affecting the depth and habitat diversity of shorelines. Physical factors such as bank height, prevailing winds, fetch, and the amount of vegetation on the banks and in the water can dictate the extent of shoreline erosion.

Waterfowl – While lakes provide necessary habitat for aquatic birds, water quality impacts can occur from large numbers of resident and migratory waterfowl. Bird feces can be a significant contributor of nutrients and bacteria to lakes resulting in increased eutrophication and health risks to recreational users.

5.08 WATER QUALITY MODELING PROCESS

The resources and information identified in this and other chapters in the plan, along with literature reviews, were used to develop estimates of pollutant source loads within identified target areas using various water quality models. A water quality model allows quantitative predictions about existing pollutant loads, as well as quantifying the effects of implementing various BMPs. Water quality modeling allows natural resource managers to evaluate management strategies and show incremental progress towards meeting water quality standards or other goals. Detailed documentation on the approach, inputs, and results of each water quality model can be found in Appendix C.

A simplified modeling approach was developed to meet planning requirements and resource management goals. Figure 57 illustrates the general modeling process. This approach was necessary due to the limited amount of water quality monitoring data available over a large geographic area. Various hydrologic and water quality variables for all pollutant sources were utilized to reasonably match existing water quality data. The watershed yield analysis provided an estimate of annual surface runoff volumes for each HUC 12 by land use and all models were populated with the most current information and data.

Multiple modeling methodologies were used:

- To model *E. coli* bacteria, a model specific to each HUC 8 subbasin was built in a tabular format to identify existing pollutant loads. Modeling results were then provided on a HUC 12 subwatershed basis. Pollutant load reductions, due to BMP implementation, were only modeled in applicable target areas. *E. coli* loads from various land use areas were calculated using the Simple Method (Schueler, 1987), which estimates the annual load as a product of the annual runoff volume and associated concentration of *E. coli* in the runoff.
- To model nutrient and sediment, three models were used together: STEPL (TetraTech, 2007), Canfield-Bachmann Loading Regression Equation (Canfield & Bachmann, 1981), and Sediment Phosphorus Release Regression Equation (Dzialowski & Carter, 2012). These were only used in target areas.

Future plan updates will allow additional water quality data and implementation strategies to be evaluated. Model estimates, in conjunction with future plan reviews and monitoring, will be used to show incremental progress towards meeting plan goals.

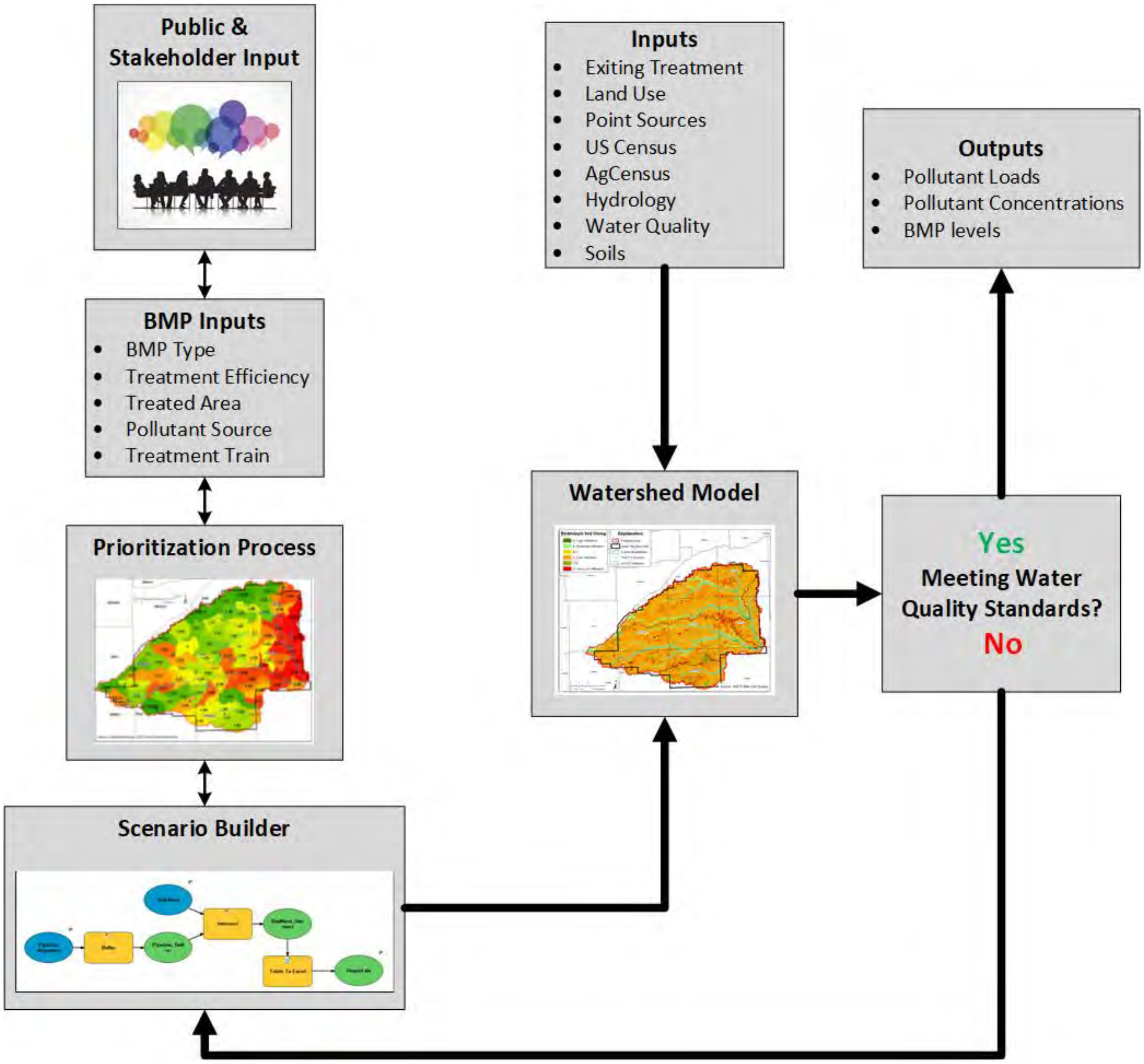


Figure 57: Illustration of Water Quality Modeling Process

CHAPTER 6. EDUCATION AND OUTREACH

6.01 INTRODUCTION

Watershed planning education and outreach refers to the on-going process of informing and involving the watershed's population in the development and implementation of a watershed plan. This process is essential to this water quality management plan, because the success of any planning effort is dependent on the voluntary efforts of the landowners and residents within the watershed. An informed and involved public is needed both for the implementation of the plan, as well as the long-term acceptance, adoption, and maintenance of BMPs within the planning area.

The purpose of this chapter is to provide a framework of an effective education and outreach strategy that can be used to support the implementation of the plan in pursuit of the goals described in Chapter 2. The framework outlined in this chapter is based on stakeholder input; communication and marketing best practices; public participation best practices; and principles outlined in *The Social Indicator Planning & Evaluation System (SIPES) for Nonpoint Source Management: A Handbook for Watershed Projects* (Genskow and Prokopy, 2011). Recommended for use by NDEE's 2015 *State Nonpoint Source Management Plan*, the SIPES handbook is an excellent resource regarding the identification and monitoring of social indicators, or measures that describe the awareness, values, and behaviors of people and communities, related to water quality improvement.

6.02 TARGET AUDIENCES

While all members of the general public should be targeted for education and outreach programs, these programs should be developed for specific targeted audiences. A targeted audience is a population subset that is the ideal recipient of a message based on shared characteristics or interests. Developing education and outreach for target audiences maximizes effectiveness of the effort because it helps ensure the right message is provided to the individuals who can readily use or act on that information.

Several target audiences have been identified by the stakeholders and TAC for this plan, including but not limited to:

- Recreational water users throughout district and within each target area;
- Land managers, property owners, and residents throughout district and within each target area;
- Producers who utilize cover crops, no-till/reduced-till, grassed waterways, and those with the potential to implement similar practices;
- Upper Big Blue Natural Resources District (UBBNRD) Board of Directors and staff;
- County government staff and elected officials;
- Municipal government staff and elected officials;

- Rural homeowners with private wells and septic systems;
- Urban landowners and residents;
- Absentee landowners, both local and distant;
- Crop consultants, agri-chemical dealers, and other agricultural service providers
- Civic leaders, such as service organizations and non-profits;
- Youth (Future Farmers of America [FFA], agricultural students, science classes, etc.);
- Young or beginning producers; and
- Funding institutions
- State government staff and elected officials

Knowing which audience(s) to target is only half of the equation. Effective education and outreach also requires both an understanding of how to reach people and lead them to action. By developing this understanding, the UBBNRD will be better positioned to influence people's awareness, values, and behaviors related to water quality improvements. The type of information that would be helpful to have for each target audience includes:

- Preferred delivery method: what format and frequency of communication (mailer, email, website, video, etc.) does the audience prefer?
- Motivators and incentives: what drives this audience's decision-making process?
- Existing perceptions: what do they currently think about water quality?
- Barriers and obstacles: what would prevent this audience from engaging?

This type of information can be collected a variety of ways, such as through surveys, in-person interactions, and advisory boards. The initial research of target audiences can also serve as baseline information for on-going monitoring of the awareness, values, and behaviors related to water quality improvements. As described by the previously mentioned SIPES handbook, monitoring social indicators alongside environmental indicators will offer meaningful insight regarding progress made in achieving the goals and objectives described in this plan. Refer to the SIPES handbook for additional details on how to use social indicators to help plan, implement, and evaluate water quality improvement projects.

6.03 STRATEGIES AND DESIRED OUTCOMES

Education and outreach strategies are grouped based on the desired type of outcome: information gain or behavior change. An information-based strategy seeks to fulfill information needs and gain knowledge, while a behavior-based strategy seeks to motivate change. Typically, an information-based strategy should precede a behavior-based strategy, but that is not always the case. For example, information needs can be sufficiently met for common and readily-understood topics, like household water conservation, using a behavior-based approach. To determine which strategy to use throughout the implementation of this plan, revisit the goals and objectives provided in Chapter 2 to identify whether the desired outcome is information- or behavior-based.

INFORMATION-BASED STRATEGY

The purpose of an information-based strategy is to increase awareness or understanding of water quality topics. When the desired outcome is increased *awareness*, the goal of the strategy is to make target audiences aware that water quality issues are present, what actions have been or are being taken to improve water quality, what specific issues can be fixed by BMPs, as well as what technical resources and funding opportunities are available. When the desired outcome is increased *understanding*, the goal of the strategy is to broaden or deepen the target audience's understanding of water quality topics and projects. Table 38provides an outline of efforts that would support an information-based education and outreach strategy. These information-based outcomes are to be considered a component of the overall education and outreach strategy for this plan. They are to be implemented and evaluated when appropriate but supplementary to, or in support of, the action items outlined in Chapter 2.

Table 38: Potential Education and Outreach Efforts for Information-Based Outcomes

Communication or Outreach Effort	Outcome
Create logos, taglines, and key messages for each priority and special priority area in the watershed to create a sense of place and value.	Awareness
Promote the final plan through newsletters, flyers, press releases, websites, and events.	Awareness
Acknowledge, recognize, record, and share previous and existing conservation efforts completed by landowners.	Awareness
Provide updates on plan progress and monitoring through newsletters, flyers, press releases, websites, and events.	Awareness
Identify and partner with other groups within the watershed that are already conducting environmental or conservation efforts.	Understanding
Develop a reporting system to identify successes and failures of projects.	Understanding
Provide educational opportunities (fact sheets, public meetings, field days, classroom activities, etc.) that focus on specific issues, solutions, and funding opportunities.	Understanding
Showcase the relevancy and benefits of this plan's implementation to help audiences understand local impact.	Understanding
Develop and organize demonstration site, tours, and field days.	Understanding

BEHAVIOR-BASED STRATEGY

The purpose of a behavior-based strategy is to provide information that leads to changes in values and behaviors. This plan seeks to address change at two levels. At the first level, education and outreach will seek to influence or *change existing values and behaviors* to gain acceptance and adoption of best management practices (BMPs). At the second level, education and outreach will seek to influence *generational change*, or help shape the attitudes, values, and behaviors of future land managers, producers, residents, and decisions makers. Generational change will ultimately help enhance the sustainability of implementing BMPs throughout the district. Table 39 provides an outline of efforts that would support a behavior-based education and outreach strategy. These behavior-based outcomes are to be considered a component of the overall education and outreach strategy of this plan. They are to be implemented and evaluated when appropriate but supplementary to, or in support of, the action items outlined in Chapter 2.

Table 39: Potential Education and Outreach Efforts for Behavior-Based Outcomes

Communication or Outreach Efforts	Outcome
Provide information directly to target audiences about the benefits of BMPs, as well as technical and financial programs available to assist in the implementation of BMPs.	Change in existing values and behaviors
Provide information directly to farm consultants, agricultural retailers, and other audiences that have a high degree of influence on landowner and producer decisions.	Change in existing values and behaviors
Hold targeted coffee shop meetings, tailgate sessions, and other informal information exchanges to build relationships and to learn more about the barriers and obstacles audiences perceive regarding implementing BMPs.	Change in existing values and behaviors
Identify and work with local schools to develop a water quality monitoring program, with information developed for both students and parents.	Change in existing values and behaviors; Generation change
Include school-aged youth in project plans, such as field tours of project sites.	Generational change
Provide information about water quality and benefits of BMPs to youth-based programs (FFA, agricultural students, science classes, etc.)	Generational change
Provide information targeted for younger generations at regularly used recreation areas (beaches, picnic shelters, etc.) about the importance of watershed management and its relation to water quality of the water body where information is posted.	Generational change

6.04 METHODS OF EDUCATION AND OUTREACH

Education and outreach methods should be tailored to the target audience. This will make the education and outreach more effective and more likely to achieve the desired outcome. A diverse outreach campaign utilizing multiple methods should be used to reach multiple target audiences or the general public regarding district-wide initiatives. Table 40 describes a variety of potential education and outreach methods:

Table 40: Education and Outreach Delivery Methods

Method	Description	Recommended Use
One-on-One Contact	On-site meetings to discuss location of projects or to answer questions about programs and projects.	For siting projects within targeted areas.
Direct Mailing	Targeting informational mailer sent to all properties within specified area.	For increasing attendance of public meeting or participation in area event or program.
Mass Media	Newspaper, radio, television news, agriculture-based magazines, outdoor magazines, etc.	For increasing general awareness of activities and progress.
Electronic and Social Media	Websites, social media platforms (Listserv emails, Facebook, Twitter, etc.)	For supplementing other outreach methods.
Signage	Billboards, cooperator recognition signs, traveling displays, demonstration signs, etc.	For high-traffic areas, such as major intersections, public beaches, entrances to recreation areas, boat ramps, or area events.
Events	Events related to water resources, such as training opportunities, demonstration field days, and/or recognition picnics.	For use in conjunction with other area events, such as county fairs and nitrogen certification training events.
Field Clinics or Workshops	Outdoor recreation (kayaking, fishing, etc.), equipment calibration, water quality testing, BMP maintenance inspection, etc.	For use in supporting the education or adoption of a specific management activity.
On-site Project Demonstration	Water quality monitoring and BMP installation or maintenance.	For use in supporting the education or adoption of a specific management activity.
Curriculum	Lesson plans and materials for formal and informal education.	For youth-based outreach.
Educators	Assist with the development and delivery of materials.	For youth-based outreach.

Consideration should also be given to the time at which education and outreach materials and efforts are employed. Timing of education and outreach can be based on target audience research, such as avoiding information distribution to producers during the peak of harvest, or timed to occur alongside relevant events, such as state or county fairs. Regardless of the basis, timing should be deliberate to help ensure target audiences will be receptive to education and outreach efforts.

6.05 EVALUATION

Education and outreach should continually be evaluated and conducted for each strategy for several reasons. First, evaluation supports mid-course adjustments and follow-up outreach to ensure the strategy is achieving its desired outcome. Second, evaluation provides an alternative means (i.e. social indicators) to measure the progress of this plan's goals and objectives. And third, evaluation will help the UBBNRD refine its education and outreach strategies for future projects and initiatives.

Evaluation methods should be identified during the initial development of each education and outreach strategy, so they can be employed throughout a project or initiative. This early emphasis also prevents evaluation from being overlooked. Evaluation methods that may be used include, but are not limited to:

- Tracking if or how the target audience engaged in the education and outreach;
- Conducting pre-, mid-, and post-surveys;
- Providing and encouraging completion of evaluation forms;
- Offering and assessing the interest in participation incentives;
- Hosting formal or informal focus groups to discuss specific practices; and
- Tracking media coverage.

Evaluation data should be summarized for each project to allow for side-by-side comparison of efforts and outcomes. Evaluation data can also be gathered to measure the collective progress in achieving this plan's goals and objectives.

6.06 ENHANCING EXISTING PROGRAMS

INFORMATION AND EDUCATION COORDINATOR

The UBBNRD has a dedicated information and education (I&E) coordinator whose primary responsibility is informing and educating the public about the mission and impact of the NRD, including water quality. Having and maintaining this position places the UBBNRD in a better position to develop and implement a multi-faceted, yet cohesive, education and outreach strategy to support this plan.

STRENGTHENING PARTNERSHIPS

A recurring theme of stakeholder and sponsor conversations was the desire to partner more with other organizations to amplify the reach and impact of existing programs and associated education and outreach efforts. As part of its broader education and outreach approach, the UBBNRD should continue identifying, pursuing, and strengthening mutually-beneficial relationships with credible organizations that have shared interests and goals (water quality, water and soil conservation, etc.). These partnerships may include, but are not limited to:

- NDEE
- Natural Resources Conservation Service (NRCS)
- Nebraska Department of Natural Resources (NeDNR)
- University of Nebraska
- District municipalities
- Sanitary Improvement Districts
- Rainwater Basin Joint Venture
- Neighboring NRDs and/or NARD
- Groundwater Foundation
- Nebraska Forest Service
- Nebraska Department of Agriculture
- Nebraska Natural Resources Commission
- Nebraska Game and Parks Commission
- United States Geological Survey (USGS)
- US Army Corps of Engineers
- Nebraska Corn Growers Association
- Nebraska Soybean Growers Association
- Prairie Plains Institute
- Pheasants Forever
- Nebraska Rural Water Association

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CHAPTER 7. MANAGEMENT PRACTICES

7.01 INTRODUCTION

An important step in finding solutions to address nonpoint source pollution is to create a toolbox of practical management alternatives that can be utilized by landowners, producers, resource managers, and others. A variety of proven and modern management measures for upland, stream, lake, wetland, and groundwater resources are currently available to achieve improved and protected water quality. This chapter describes structural and non-structural measures which have been identified for their capability to address the primary pollutants degrading water quality in the basin: total nitrogen, total phosphorus, sediment, bacteria, and atrazine.

The suitability and performance of management techniques can vary significantly based on site conditions (e.g. soils, slope). While the focus of the plan is within target areas, this list is intended to be general in nature for applications throughout the entire planning area. Site specific Best Management Practice (BMP) recommendations for each target area, along with pollutant reduction estimates, are described later within HUC 8 subbasin chapters.

NOTE TO READERS

The BMP examples and references included in this plan are not intended to be comprehensive - the list does not preclude the UBBNRD or its partners from using other technically sound practices.

Due to the large number of practices available to improve water quality, detailed reviews for each practice were not possible within this plan. The United States Department of Agriculture (USDA) currently lists more than 1,100 practices that are eligible under the Environmental Quality Incentives Program (EQIP) program. Details on the magnitude, cost, water quality benefits, and maintenance of specific practices can be provided by appropriate experts or found in technical documents such as the *Natural Resources Conservation Service (NRCS) Field Office Technical Guide* and the *Agricultural BMP Handbook for Minnesota* (MDA, 2012). A detailed description of wetland management practices, benefits, and costs can be found in the *Best Management Practices for Rainwater Basin Wetlands Handbook (RWBJV, 2016).*

Selection of various management practices or actions should consider not only the watershed or field level characteristics, but also management goals and any technical and financial resources available. Finally, because this is a voluntary plan, social and political realities which may affect landowner participation and plan implementation are considered. Projects can be implemented much more effectively and successfully when public buy-in is garnered through active involvement during the planning process.

A small list of priority practices has been identified based on stakeholder feedback garnered throughout the development of this plan and available modeling or BMP siting tools. These were identified to focus the planning efforts on the actions most likely to be implemented. Information on treatment efficiency and how the priority practices were utilized in the water quality model is also presented. Water quality modeling was used to assist in developing an implementation plan, which identifies where and at what level management practices and monitoring will be implemented within target areas. Implementation strategies have been developed for target areas and outlined in Chapters 10 - 13.

7.02 PRACTICE CLASSIFICATION

Water quality management practices have many names. For example, NDEE refers to management practices as *conservation practices* (CP) in the State Nonpoint Source Management Plan (NDEQ, 2015a). However, they are more commonly identified as *best management practices* (BMPs); therefore, BMP will be used throughout this plan. Water quality BMPs typically consist of either physical structures or management activities. When properly implemented, these BMPs prevent or reduce the movement of pollutants from their source to receiving waterbodies. While BMPs can be targeted for a single pollutant, many actions reduce loads from multiple pollutants. Classification of BMPs is based on the primary construction/implementation requirements. Practices are generally divided into two types: structural and non-structural, as described below.

STRUCTURAL BMPS

Structural practices typically consist of using “brick and mortar” techniques. They often involve construction of physical barriers that intercept, trap, treat, or remove pollutants from runoff, or prevent pollutants from entering runoff. Structural techniques tend to be more durable, although they do require periodic maintenance. These techniques are more effective when used in tandem with non-structural practices. In most cases, structural practices require a greater level of cooperation from the landowners, as the structures may be intrusive to their day-to-day operation. This can lead to structural practices being more expensive to implement and maintain than non-structural practices; however, they also typically provide longer term benefits.

NON-STRUCTURAL BMPS

Non-structural practices rely on management actions to control and treat pollution. The goal of these practices is to avoid or lessen the severity of degradation at the source. Examples of non-structural practices include: no-till/reduced-till farming, irrigation management, chemigation, and other nutrient management practices. Implementation of these practices typically only requires a landowner or operator to adjust their existing operational practices. One of the main challenges in implementing non-structural management practices is to ensure they are continued in the long run. It can also be challenging for agencies to verify the continuation of non-structural practices when they are widely dispersed throughout a watershed. If cost-share or other financial incentives are used, agencies are typically required to withhold full payment for a set period of time during implementation to ensure the practice is fully incorporated into the operator’s methodology.

7.03 SYSTEMS APPROACH TO MANAGEMENT

Management of nonpoint source pollution is most effective when a multi-practice systematic approach is taken to eliminating pollutants at the source, rather than mitigating them at their point of delivery. This process is also known as a "treatment train". BMPs that work cohesively deliver more effective pollutant control than a single practice can provide. The NRCS has identified this system through the acronym "ACT" (Avoid, Control, Trap) and NDEE describes these actions as follows (NDEQ, 2015b):

Avoid (A). It is sometimes feasible to eliminate contamination at the source by discontinuing a potentially harmful activity or use of a particular product. Discontinuing the use of a pesticide, for example, would completely eliminate that product from the runoff stream. When discontinuing an activity or product is not feasible, altering the activity or application of a product may significantly reduce, but not eliminate, contamination from that source. For example, limiting livestock access to a stream or changing the rate and timing of chemical application can reduce contaminant runoff. Where complete avoidance is not feasible or acceptable, it is important to employ additional complementary BMPs to further reduce contaminant runoff.

Control (C). Practices that control the direction and rate of runoff can provide additional reduction of contaminants during precipitation events. These practices allow precipitation, infiltration, absorption or attenuation of contaminants before they reach a receiving water. Filter strips and porous pavement, for example, facilitate infiltration of runoff water into the soil where natural processes degrade and absorb contaminants.

Trap (T). When avoidance or control of pollutant runoff is impractical or inadequate, trapping contaminants before they can discharge into receiving waters may be a necessary last line of defense. The distinction between practices that control contaminants and those that trap contaminants, however, is somewhat ambiguous, as the practices function in much the same way by utilizing precipitation, infiltration, absorption, or attenuation of contaminants. Many BMPs provide both functions. Sediment basins or constructed wetlands designed to intercept flow and remove contaminants before discharging to a receiving water are the clearest examples of practices employed to trap contaminants.

7.04 COMMON BMPS

Many BMPs have been proven effective in reducing nonpoint source pollution and are commonly employed in Nebraska. These actions have been identified in the *2015 Nebraska State Nonpoint Source Management Plan* (NDEQ, 2015a) and are displayed in Table 41. BMPs are loosely grouped together based on the type of landscape or by the pollutant they are used to address. However, many can be used in a variety of settings as well as in tandem with other practices. Practices effective in restoring or protecting groundwater resources from the impacts of nonpoint source pollution are also noted in the table. For simplicity, practices that are effective at treating

Atrazine are provided separately in Table 42. Descriptions of more commonly used practices are located in Appendix D.

The table below is intended to provide examples of the most commonly accepted practices in Nebraska. However, it is not meant to preclude other innovative practices that may be appropriate to specific projects or site conditions. While this list provides a look inside the "tool box" that managers have, a smaller list of priority practices (located later in this chapter) was selected to be the focus in this plan.

Table 41: Common Conservation Practices

Practice	Practice Mode of Action			Pollutants Addressed		
	Avoid	Control	Trap	E. coli	Sediment	Nutrients
Cropland						
Filter/buffer strip/Grassed waterway		X	X	X	X	X
Contour farming		X	X		X	X
Integrated pest management	X	X				
Underground outlet/grass waterway		X	X		X	X
Crop to grass/habitat/CRP conversion	X				X	X
Irrigation management	X	X			X	X
No-till		X	X		X	X
Reduced-Till		X	X		X	X
Soil sampling*	X					X
Terraces/diversions		X	X		X	X
Retention basin		X	X	X	X	X
Detention basin*		X	X	X	X	X
Sediment control basin		X	X	X	X	X
Non-Permitted Livestock						
Alternate water supply	X			X	X	X
Manure management at AFO Facilities	X	X		X		X
Reduced nutrients in feed*	X					X
Pasture management/Prescribed grazing	X	X		X	X	X
Exclusion fencing	X			X	X	X
Urban						
Pet waste ordinances/management	X			X		X
Porous pavement		X	X	X		X
Bioswale		X	X	X	X	X
Soil amendments	X	X	X		X	X
Rain garden		X	X	X	X	X

Practice	Practice Mode of Action			Pollutants Addressed		
	Avoid	Control	Trap	E. coli	Sediment	Nutrients
Rain water harvesting	X	X		X	X	X
Low-impact landscaping	X				X	X
Low or No-phosphorus Fertilizer*	X					X
Low impact development (LID)						
In-Stream or Riparian Corridor						
Re-meandering	X		X	X	X	X
Oxbow reconnection	X	X	X	X	X	X
Floodplain construction/reconnection		X	X	X	X	X
Streambank stabilization		X		X	X	X
Grade stabilization structure		X			X	
In-stream/constructed wetland		X	X	X	X	X
Riparian zone renovation	X	X	X	X	X	X
In-Lake						
Sediment removal		X			X	X
In-Lake forebays*	X		X	X	X	X
Alum application		X	X			X
Lake aeration*		X				X
Shoreline stabilization		X			X	X
Fish renovation*	X					X
Aquatic habitat development	X	X		X	X	X
Phosphorus precipitation and inactivation						
Wetlands						
Constructed wetland		X	X	X	X	X
Wetland renovation*		X	X	X	X	X
Groundwater						
Well sealing	X			X		X
On-site Wastewater Treatment System (OWTS) education*						
Irrigation management*	X	X			X	X
Nutrient management	X	X				X
Cover crop	X	X			X	X
Conservation Practice Facilitation						
Conservation consultant	N/A	N/A	N/A	N/A	N/A	N/A
Watershed coordinator	N/A	N/A	N/A	N/A	N/A	N/A
Crop production deferment	N/A	N/A	N/A	N/A	N/A	N/A

Source: 2015 Nebraska State Nonpoint Source Management Plan.
** denotes practices that have been added based on previous experience and knowledge*

Table 42: Common BMPs Which Treat Atrazine

Practice	Practice Mode of Action			Rank*
	Avoid	Control	Trap	
General Pesticide Management BMPs (for reducing pesticide availability in the field)				
Follow integrated pest management (IPM) principles	X	X		2
Follow label requirements for application rates, mixing, loading, and proper disposal of rinsate and containers	X			2
Pesticide rotation/alternative pesticides	X			3
Avoid application if rainstorms are pending within 48 hours	X			2
Delay application on saturated or wet soil	X			3
Follow mandatory and precautionary label statements for protecting water resources	X			2
Change in application timing or banding	X	X		2-3
General Cropland Management BMPs (for reducing water and sediment runoff)				
Crop rotation	X			2
Crop rotation with 50% legumes, small grains, or grasses	X	X	X	3
Filter strips (along wetlands, streams, rivers, and impoundments)		X	X	1
Grassed waterways (functional)		X	X	1
Terraces (functional) and other earthen structures		X	X	1
Irrigation water management (timing and amount)		X		1

Note: Adopted from the Nebraska Department of Agriculture (NDA, 2016)
**Practices ranked by how effective atrazine runoff is reduced: 3 = highly, 2 = moderately, 1 = slightly*

7.05 GROUNDWATER MANAGEMENT PRACTICES

Groundwater nitrate contamination was identified as a very important concern to stakeholders. Additionally, the UBBNRD, NDEE, and other state agencies have prioritized this issue due to the human health risks caused by nitrates in drinking water. Therefore, this planning effort has also placed emphasis on identifying BMPs to address nitrate contamination of groundwater.

There is a clear association between nonpoint source groundwater pollution and irrigated agriculture. Nitrogen leaching loss from applied fertilizer and the spreading of manure is increased by excessive applications of irrigation water. With improper management of nitrogen sources, non-irrigated crop production can also contribute to the problem. Additionally, urban sources of contamination, including nitrate leaching from areas such as lawns and golf courses, contribute to nitrate contamination (Kranz, 2015). Identifying and utilizing BMPs that improve irrigation management and/or reduce the levels of applied nitrogen fertilizer will result in decreased nitrogen loading to both surface and groundwater resources.

The following practices will be implemented using a mixture of educational, technical, and financial assistance. BMPs are targeted at cropland (both irrigated and dryland) and urban areas to address nitrogen. Specific BMPs will only be determined once a project sponsor meets with a landowner or producer. Many of these are common BMPs, as identified in Table 41, however, the following list also provides additional options under each general type of BMP.

- Nitrogen management planning
  - Soil sampling
  - Crop tissue analysis
  - Practicing the 4Rs of Nutrient Stewardship
    - Right source, right rate, right time, right place
  - Irrigation water sampling
  - Retiming of fertilizer application (from fall to spring)
  - Split application of fertilizer and/or fertigation
  - Nitrogen inhibitors
- Irrigation water management
  - Soil moisture sensors
  - Efficiency upgrades to existing irrigation system
  - Variable rate irrigation systems
  - Irrigation Scheduling
  - Flow meters
  - Irrigation systems conversions to center pivot or subsurface drip
- Cover Crops
- No-till / Reduced-till

7.06 WETLAND RESTORATION BMPS

Wetlands, both naturally occurring and constructed, serve a unique function in a landscape. They are found in low lying areas of the landscape, and thus trap and treat many pollutants. Other benefits include groundwater recharge, flood water storage, and providing fish and wildlife habitat. Due to the importance of wetlands within the UBBNRD and Rainwater Basin area, this plan has also identified practices used to create, restore, or enhance wetland functions. Wetlands have been identified as special priority areas and should be targeted for management actions as part of an overall watershed restoration approach.

The management of wetland resources within the UBBNRD will be driven by the comprehensive plans and implementation strategies developed by the Rainwater Basin Joint Venture (RWBJV). As such, wetland management and restoration practices provided below align with those provided in the *Best Management Practices for Rainwater Basin Wetlands Handbook* (RWBJV, 2016). These practices can be used to achieve both short and long-term management objectives. The following practices have been identified for the planning area:

- Prescribed grazing
- Prescribed burning
- Herbicide
- Haying, shredding, and/or mowing
- Disking and rototilling
- Water level manipulation
- Sediment removal
- Hydrologic restoration
- Upland buffers

These wetland management practices may be used in a variety of settings as well as in tandem with other BMP practices. Descriptions of each practice is provided in Appendix D. This list is not meant to preclude other innovative practices that may be effective. Implementation of these practices will serve to improve water quality locally and for downstream resources.

7.07 PRACTICE SUITES

In the context of watershed planning, there are instances where numerous BMPs all have the potential to address a certain pollutant source. However, as this plan relies on voluntary actions, it will be necessary to contact landowners and producers in order to determine which BMPs will meet their specific needs. Most of this coordination will take place after this plan has been finalized; therefore, for the purpose of this planning effort, some BMP practices have been grouped together into “suites”. These suites allow for clearer stakeholder communication and a simplified modeling approach for estimating load reductions, costs, etc. Each practice suite is discussed below.

NON-STRUCTURAL AND AVOIDANCE BMPS

This practice suite will typically be implemented through education and technical assistance and be targeted towards cropland and manure application sites. Nutrients, *E. coli* bacteria, and atrazine are all addressed by these BMPs. This suite consists of non-structural and management-based BMPs targeted at nutrient, manure, and pesticide management. Specific BMPs will only be determined once a project sponsor meets with a landowner or producer. However, potential BMP actions may include, but are not limited to, the following:

- Conservation planning
- Modified timing, rates, or placement of application of nutrients and herbicides
- Education for manure application
- Nitrogen inhibitors
- Changing nutrient sources
- Soil and plant tissue sampling
- Practicing the 4Rs of Nutrient Stewardship
    - Right source, right rate, right time, right place

- Integrated pest management

GRAZING LANDS MANAGEMENT BMPS

This practice suite will typically be implemented through education and technical assistance; however, conservation payments may assist in some cases. These BMPs are targeted at pasture land and address nutrients, sediment, and *E. coli* bacteria. This suite consists of both structural and non-structural BMPs. Specific BMPs will only be determined once a project sponsor meets with a landowner or producer. However, potential BMP actions may include, but are not limited to, the following:

- Exclusion or cross fencing
- Alternative water sources
- Grazing management plans
- Stream crossings

NON-PERMITTED AFO FACILITY BMPS

This practice suite will primarily be implemented with financial assistance; however, education and technical assistance will also be important to enhance producer adoption. BMPs are targeted at all non-permitted animal feeding operations (AFOs) and will address nutrients, sediments, and *E. coli* bacteria. This suite consists of both structural and non-structural BMPs. Specific BMPs will only be determined once a project sponsor meets with a landowner or producer. However, potential BMP actions may include, but are not limited to, the following:

- 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
- Education for manure application

7.08 ADDITIONAL CONSERVATION STRATEGIES

In addition to the BMPs previously discussed, additional management actions were also identified. These include actions that may not correlate directly into “quantifiable” loading reductions but are vital to implementation of the plan. These management strategies may also allow stakeholders to achieve additional goals identified in the plan. The additional management strategies are described below:

- **Information and Education.** Information and education programs will be ongoing throughout the life of this plan, which may also include conservation practice demonstration sites. Outreach programs build awareness and promote behavioral changes that will improve the success rate of projects and enhance load reductions. Additional discussion can be found in Chapter 6.
- **Recognize Past and Current Conservation Efforts**. Recognizing successful practices and the landowners who have implemented them is useful for outreach efforts and in highlighting success stories. Cataloging this information also helps future estimates of existing treatment levels. Additionally, rehabilitating structures or expanding existing BMP programs may be a way to both reward past conservation efforts by landowners, as well as increase awareness and the effectiveness of existing treatment options economically. The NRCS's Conservation Stewardship Program (CSP) is a good example of this type of program.
- **Wellhead Protection (WHP) Area Planning**. Each WHP Area has been identified as a special priority area due to the influence it has on source water aquifers and associated public drinking water systems. Developing and implementing either a wellhead protection plan or a drinking water protection and management plan for each WHP area in the planning area is highly encouraged. Many of the BMPs for WHP areas will also reduce pollutant loads entering surface waters.
- **Water Quality Monitoring**. There are existing limitations in the available water quality data within the planning area. To combat these limitations and benefit future water quality improvement projects, more frequent water quality monitoring at expanded sampling locations, particularly pre- and post-project status, should be used. Additional discussion regarding water quality monitoring is located in Chapter 4.
- **District-wide Initiatives**. Priority should be given to practices which are more successful when offered throughout the district. These practices may include actions that: don't inherently fit into target areas; promote specific conservation practices; enhance landowner involvement; provide information and education; or are opportunities for demonstration sites. Ultimately these programs build awareness and promote behavioral changes to improve the success rate of projects and enhance load reductions.

7.09 ACPF TOOL

In order to identify potential locations and the quantity of BMPs recommended in this plan, the planning team utilized a tool developed by the USDA. The Agricultural Conservation Planning Framework (ACPF) tool is used extensively across the Midwest to assist in watershed planning activities. The ACPF tool utilizes modern, high-resolution geo-spatial datasets within the ArcGIS environment and LiDAR data to analyze soils and land use. This analysis assists in identifying a broad range of opportunities to install BMPs at the field level. The results can be used by natural resource manager to approach and encourage landowners and producers to engage in watershed management activities.

Conceptually, the ACPF tool is based on the “Conservation Pyramid” (Figure 58), which emphasizes soil conservation as the foundation to agricultural watershed management. Well-managed soils lose less water to runoff and leaching, which improves production and enables additional BMPs to effectively treat any losses that still may occur. These additional BMPs control water flows and trap/treat nutrient losses in fields, at field edges, and in riparian zones. The ACPF tool identifies locations where specific landscape attributes are favorable for installation of each type of BMP and prioritizes these locations according to susceptibility to runoff and erosion losses. The ACPF tool provides an inventory of BMP alternatives which can be considered at the field level. Prescriptions and recommendations are left as local decisions. The planning team utilized this tool in targeted agricultural areas. Technical information including ArcGIS shapefiles of the data created by the ACPF tool is available in the attached GIS Deliverable. Additional details on how this data was incorporated into each of the target area implementation plans can be found in Chapters 10 - 13.

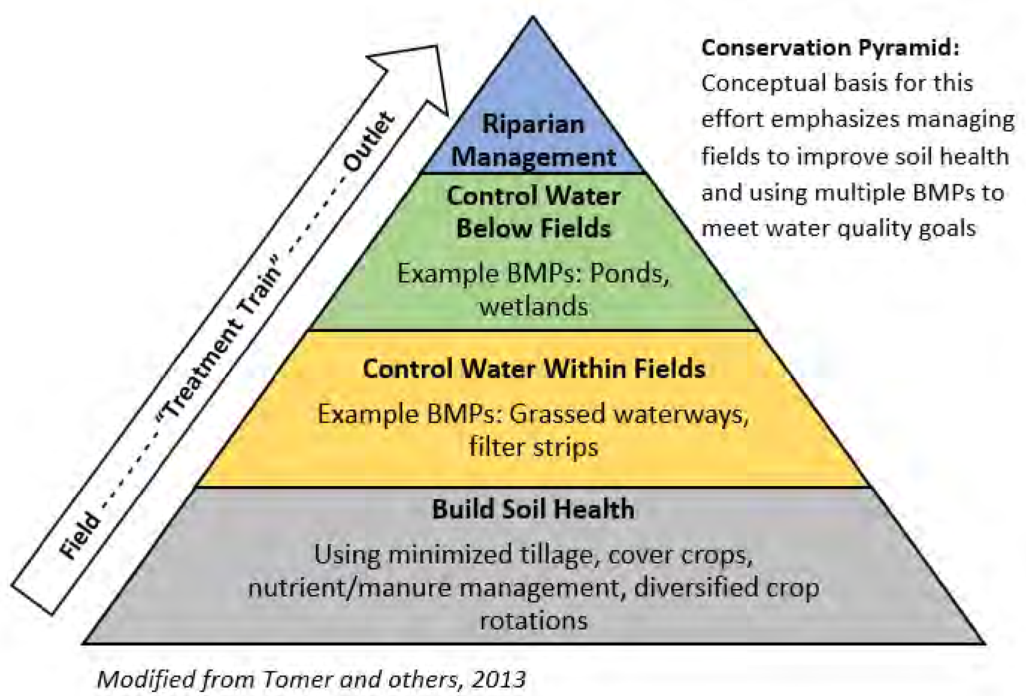


Figure 58: Conservation Pyramid

7.10 PRIORITY PRACTICES

SELECTION

This chapter has identified various types of management practices that could be considered for implementation in the planning area. While these should all be considered viable options, it is not practical to evaluate every BMP or implementation scenario. To develop this chapter's list, the following tools/techniques were utilized:

- Agricultural Conservation Planning Framework (ACPF) tool
- Technical Advisory Committee (TAC) input
- Stakeholder committee input
- Public review

BMPs and treatment scenarios were reviewed and evaluated through the community-based watershed planning process. BMPs believed to have the biggest impact on water quality and that were acceptable by landowners were identified as "priority practices." The ACPF tool identified opportunities for structural BMPs; and the TAC and stakeholder groups provided input on non-structural BMPs. Priority BMPs were also evaluated on their efficiency in addressing pollutants of concern. Additional consideration was given to those practices which addressed multiple goals besides pollutant load reductions. Table 43 summarizes the priority practices and their treatment efficiencies.

POLLUTANT TREATMENT EFFICIENCIES

The treatment efficiencies shown in Table 43 are used for planning purposes; however, actual performance may be different than documented in the literature. When feasible, it is recommended that pollutant load reductions be calculated from BMPs within the region with statistically based influent and effluent monitoring results. This data may be available in the future if pre-and post-BMP monitoring is implemented. As previously discussed, treatment efficiencies for practice suites are estimated based on the efficiency of each type of BMP in that suite.

Guidance from the literature was used to estimate treatment efficiencies and to assist in identifying where BMPs could be implemented. Detailed descriptions of each practice, efficiencies, modeled implementation levels, and other key assumptions can be found in the water quality modeling reports located in Appendix C. Additional details on locations, total amounts, and load reductions are provided in the implementation plans for each subbasin (Chapters 10 -13).

Table 43: Summary of Priority Practices and Estimated Treatment Efficiencies Summary

Management Practice	Estimated Treatment Efficiency				
	E. coli	TN	TP	TSS (Sediment)	Atrazine
Education and Information	10%	10%	10%	10%	0%
OWTS Education	Changes to failure rate in model.				
Pet Waste Ordinances	20%	0%	0%	0%	0%
Non-structural & Avoidance BMPs	10%	20%	50%	0%	40%
Irrigation Water Management	10%	35%	10%	0%	50%
Grazing Lands Management BMPs	40%	43%	26%	15%	0%
Cover Crops	40%	14%	11%	15%	25%
Riparian Buffers	70%	41%	45%	56%	30%
No-Till Farming	0%	25%	69%	77%	50%
Strip-Till (Reduced-Till) Farming	0%	15%	30%	40%	50%
Contour Buffer (filter) Strips	70%	40%	45%	73%	30%
Non-permitted AFO Facility BMPs	75%	56%	73%	70%	0%
Wetlands/Farm Ponds/Sediment Basins	78%	28%	45%	69%	25%
Wetland Restoration	Changes to land use numbers in model.				
Stream Restoration	35%	75%	75%	75%	25%
Terraces	70%	25%	31%	40%	15%
Water and Sediment Control Basins (WASCOBS)	70%	25%	31%	40%	15%
Grassed Waterways	70%	10%	25%	65%	30%
Land Use Change	Changes to land use numbers in model.				
Urban Stormwater BMPs	37%	40%	43%	78%	0%

Note: TN – Total Nitrogen; TP – Total Phosphorous; TSS – Total Suspended Solids

7.11 EXISTING TREATMENT

Estimating currently treated areas is an important step in the planning process. This knowledge helps prioritize BMP implementation and is necessary for water quality modeling calibration. These estimates are also used to determine potential pollutant load reductions that additional treatment could have in the watershed. Unfortunately, no central listing or full inventory exists for this information. The NRCS works with many producers through EQIP and other programs; however, that information is subject to privacy laws. Additionally, many landowners implement BMPs on their own without government assistance.

To estimate the existing level of treatment in the watershed, multiple resources were reviewed and documented in a technical memorandum, located in Appendix B. Table 44 displays estimates for existing treatment levels. The planning team assumed that these levels represented the average across the entire planning area. It is likely that these levels may vary amongst locations in the planning area, and it is recommended that detailed estimates be conducted for inclusion in future updates to this plan.

Table 44: Existing Treatment Levels of Priority BMPs Across the Planning Area

Management Practice	Estimated Existing Treatment Level
Education and Information	n/a
OWTS System Upgrades	n/a
Pet Waste Pick-Up	8%
Non-structural & avoidance BMPs	50%
Irrigation Water Management	35%
Grazing Lands Management BMPs	25%
Cover Crops	25%
Riparian Buffers	5%
No-Till Farming	25%
Strip-Till (Reduced Till) Farming	30%
Contour Buffer Strips (Filter Strips)	5%
Non-permitted AFO Facility BMPs	5%
Wetlands/Farm Ponds/Sediment Basins	40%
Wetland Restoration	n/a
Stream Restoration	75%
Terraces	10%
WASCOBS	5%
Grassed Waterways	10%
Land Use Change	8%
Urban Stormwater BMPs	5%

N/A – Estimate was not available or was unable to be calculated at planning area scale

7.12 CONSIDERATIONS FOR BMP IMPLEMENTATION

EFFECTIVENESS

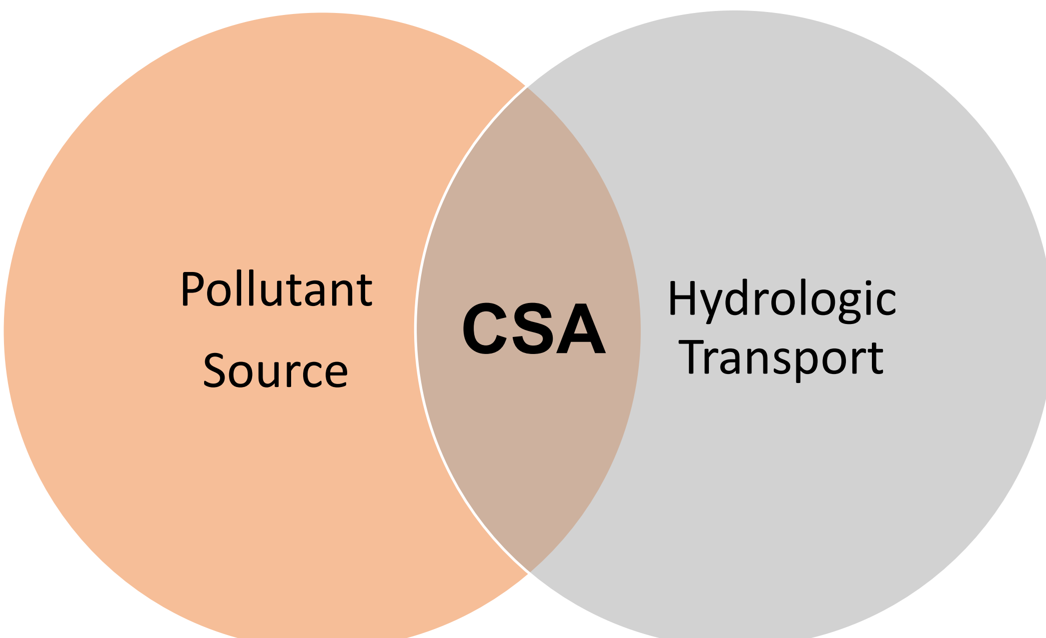
There is great variation in management practices which can be utilized to improve soil health, water quality, and habitat. When implementing this plan, flexibility in practice selection must be considered as there are differences for planning purposes versus real life application. Each target area is unique, and implementation will need to be flexible in order to be tailored to the field level and landowner preferences. Efforts were made to identify effective BMPs which can be voluntarily adopted by landowners. This plan does not assume non-priority practices have little to no benefit, rather there is a limit of how many BMPs can be reasonably modeled within the scope of this planning effort. Project sponsors will encourage the use of a multi-faceted systems approach when implementing this plan.

The effectiveness of individual management practices in reducing nonpoint source pollutant loads can be highly variable based on several site-specific factors including soil type, land slope, and maintenance. Additionally, the installation or use of one practice is rarely sufficient to completely control the pollutant of concern. Using a combination of practices that control the same pollutant is generally more effective. To most effectively control nonpoint source pollution, management systems should be designed based on the following factors:

1. Pollutant type, source, and cause;
2. Agricultural, climatic, and environmental conditions;
3. Farm operator's economic situation;
4. System designer's experience; and
5. Producer/landowner acceptance.

CRITICAL SOURCE AREA TARGETING

Even properly designed management systems constitute only one part of an effective land treatment strategy. For a truly effective land treatment strategy, properly designed systems must be placed in the correct locations in the watershed (i.e., critical source areas), and the extent of land treatment must be sufficient to achieve water quality improvements. A critical source area (CSA) occurs where a pollutant source in the landscape coincides with active hydrologic transport mechanisms (Meals and others, 2012), as shown conceptually in Figure 59.



Source: Meals and others, 2012

Figure 59: The concept of critical source areas (CSA)

Due to the importance of CSAs, it is essential that these landscapes be identified and BMPs are specifically targeted to these areas. This will allow an overall implementation strategy to be more cost-effective. Generally, 75% of the CSAs must be treated with the appropriate BMP systems. In comparison, if the problem derives from livestock, 100% of the CSAs within the watershed must be treated with BMP systems (Meals, 1993). The implementation strategies found in Chapters 10 – 13 of this plan include identification of CSAs and riparian critical zones utilizing the ACPF tool. Riparian critical zones occur in areas where high runoff and shallow water tables intersect within a stream corridor. These critical zones have the greatest chance of anywhere along the length of a stream to deliver pollutants directly into the water system, and should also be considered CSAs. All producers should be encouraged to develop operation specific conservation plans. These plans incorporate specific tools that can be used to achieve operation and resource goals.

CHAPTER 8. TECHNICAL AND FINANCIAL RESOURCES

8.01 OVERVIEW

As the primary sponsor of this plan, the UBBNRD will also be its champion. The intent of this chapter is to summarize the technical and financial resources available to support the UBBNRD in plan implementation, including a list of the primary agencies and most widely available funding sources. Specific cost estimates needed to implement the plan are described later in subbasin specific Chapters 10 - 13. The UBBNRD should consider at least five primary categories when establishing detailed cost estimates for future projects as described below:

- **Project Development** – efforts related to project development including assessment of data, preparation of project implementation plans, monitoring plans, and development of funding strategies and applications.
- **Land Conservation Measures (BMPs)** – the UBBNRD has multiple programs that provide funding or enhance existing conservation funding from other agencies to incentivize implementation of BMPs. Additional programs or program enhancements may be necessary to achieve plan goals within target and special priority areas. Specific program examples include:
    a. The UBBNRD Land Treatment Program provides technical and financial assistance for the construction or installation of conservation practices to prevent or reduce soil erosion, sedimentation, and water contamination, and to assist with management of both surface water and groundwater. Various conservation practices are eligible for cost-share assistance of up to 75%. The Natural Resources Commission determines the list of eligible practices, establishes operating procedures, and annually allocates the funds among the 23 NRDs. The NRCS provides technical assistance needed in planning and installing the conservation measures. NRDs are responsible for the administration of the program at the local level. The Soil and Water Conservation Fund was created in 1977 to provide financial assistance to private landowners for installation of soil and water conservation practices. The UBBNRD also budgets local tax dollars to fund this program.
    b. The Nebraska Buffer Strip Program encourages landowners to establish vegetative buffer strips along shorelines of streams, wetlands, and lakes which reduce the levels of sediment and other pollutants reaching the surface water. The Nebraska Department of Agriculture (NDA) determines the cost share rates and funding is provided from fees assessed on all pesticides used in Nebraska.
- **Cost of Targeted Projects and Actions** – the UBBNRD annually plans and budgets for site specific projects. Target projects include water quality, flood control, streambank improvements, wetland enhancements, and many others. Specific costs often includes surveys, engineering design, permitting, construction, and operation and maintenance.

- **Monitoring Cost** – the UBBNRD monitoring efforts vary and are more focused on groundwater quality and quantity. Monitoring projects implemented in relation to this plan are important and these costs should be incorporated into project implementation plans.
- **Staffing** – the UBBNRD currently has staff that are responsible for overseeing planning and implementation of conservation projects. The UBBNRD regularly evaluates staffing needs, workloads, and often addresses the varying workload with seasonal help. Additional staff should be considered for plan implementation, coordination with partner agencies, monitoring and assessment, project tracking and reporting, and public education and outreach efforts.

While the UBBNRD is a taxing authority, it, like other NRDs, rely on a variety of local, state, and Federal funding to leverage the available funding resources. All available monetary and technical resources will need to be explored and leveraged to achieve the plan goals. Agencies and other groups which have resources that may be useful in addressing nonpoint source pollution in the watershed have been identified. Many of these primary organizations are identified in the Nebraska Nonpoint Source Management Plan (NDEQ, 2015a). During the implementation process, other resources may be identified and should be considered. Participation will depend on the agency/organization's program capabilities and priorities. A summary of organizations and programs from the Nebraska Nonpoint Source Management Plan as well as others highlighted specifically for the planning area which are available to assist with plan implementation are summarized in Table 45.

Table 45: Summary of Financial and Technical Resources

Organization/Program	Acronym	Type of Assistance	
		Technical	Funding
Nebraska Environmental Trust (NET) www.environmentaltrust.org/			
Nebraska Environmental Trust Fund	NET		X
United States Bureau of Reclamation (USBR) https://www.usbr.gov/			
WaterSMART Grant			X
Drought Response Program			X
United States Geological Survey (USGS) – Nebraska Water Science Center http://ne.water.usgs.gov/			
Monitoring Data and Project/Study Partnership Opportunities		X	X
Cooperative Water Program	CWP	X	X
Federal Highway Administration (FHWA) and Nebraska Department of Transportation (NDOT) https://dot.nebraska.gov/			
Various Programs and Technical Support		X	X

Organization/Program	Acronym	Type of Assistance	
		Technical	Funding
County Bridge Match Program			X
US Army Corps of Engineers (USACE) www.usace.army.mil/			
Section 14 Emergency Streambank and Shoreline Protection		X	X
Section 206 Aquatic Ecosystem Restoration		X	X
US Department of Health and Human Services (DHSS) www.hhs.gov/			
Various Safe Water and Wastewater Treatment Programs		X	X
National Park Service (NPS) www.nps.gov/			
Various Recreational Facilities Programs		X	X
US Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS) http://www.nrcs.usda.gov/			
Environmental Quality Incentives Program	EQIP	X	X
Conservation Stewardship Program	CSP	X	X
Conservation Reserve Program	CRP	X	X
National Water Quality Initiative	NWQI	X	X
Agricultural Conservation Easement Program	ACEP	X	
Conservation Innovation Grants	CIG	X	X
Healthy Forests Reserve Program	HFRP	X	X
Regional Conservation Partnership Program	RCPP	X	X
Watershed and Flood Prevention Operations Program	WFPO	X	X
US Forest Service (USFS) or Nebraska Forest Service (NFS) http://nfs.unl.edu/			
Various Forestry Programs		X	X
Nebraska Department of Natural Resources (NeDNR) http://www.dnr.nebraska.gov/			
Small Watersheds Flood Control Fund			X
Natural Resources Water Quality Fund	NRWQF		X
Water Well Decommissioning Fund			X
Soil and Water Conservation Fund			X
Water Sustainability Fund	WSF		X
Stream Gaging Program	X	X	
Nebraska Department of Environment and Energy (NDEE) http://www.deq.state.ne.us/			
Nonpoint Source Pollution Management Program	319	X	X

Organization/Program	Acronym	Type of Assistance	
		Technical	Funding
Wetlands Program Development Grants			X
Linked Deposit Program through the Clean Water State Revolving Fund			X
Community Lakes Enhancement and Restoration Program	CLEAR	X	X
Underground Storage Tank Program		X	X
State Revolving Fund	SRF		X
Nebraska Game and Parks Commission (NGPC) outdoornebraska.ne.gov/			
State Wildlife Grant Program	SWG		X
Land and Water Conservation Fund			X
Recreational Trail Program	RTP		X
Nebraska Wildlife Conservation Fund			X
Aquatic Habitat Improvement Program		X	X
Sport Fish Restoration Program	SFR	X	X
Open Fields and Waters Access Program		X	X
WILD Nebraska Program		X	X
Nebraska Natural Heritage Program		X	X
Nebraska Department of Agriculture www.nda.nebraska.gov/			
Nebraska State Buffer Strip Program	-		X
Rainwater Basin Joint Venture http://rwbjv.org/	RWBJV	X	X
Property owner outreach, fundraising, project implementation			
Groundwater Foundation www.groundwater.org/			
Education and Community-based action programs		X	
University of Nebraska Extension extension.unl.edu			
Information and Various Outreach Programs		X	
Pheasants Forever www.pheasantsforever.org/			
Corners for Wildlife Program			X
Local PF Chapters - Various conservation programs		X	X
Ducks Unlimited www.ducks.org/			
Various Conservation Programs		X	X
Nebraska Weed Management Area Coalition			

Organization/Program	Acronym	Type of Assistance	
		Technical	Funding
www.nebraskawma.org			
Technical Assistance		X	

8.02 PLANNING AREA SPECIFIC RESOURCES

Above and beyond internal BMP funding programs, there are several key funding sources provided by various agencies that are commonly utilized by project sponsors, including NRDs, for water quality-based improvement projects within Nebraska. It is common for the UBBNRD to partner with other agencies for both technical and financial resources. It is likely the UBBNRD will need follow this same strategy for implementation of this plan.

CLEAN WATER ACT SECTION 319 PROGRAM

The EPA awards funds through the Section 319 Program to states, territories, and tribes to reduce and mitigate nonpoint source pollution and improve water quality. Nonpoint source programs may include technical and financial assistance for education, training, demonstration projects, and BMP implementation. Funds are awarded annually to states in accordance with a state-by-state allocation formula developed by the EPA. In Nebraska, NDEE administers these funds through a competitive application process, where applications are due the Tuesday following Labor Day. Section 319 funding, which may assist in the implementation of this plan, will be pursued. It is anticipated that additional funding sources will be utilized to assist in implementing activities that Section 319 funding does not target.

WATER SUSTAINABILITY FUND (WSF)

The WSF is administered through the NeDNR by the Natural Resources Commission (NRC). Applications are due annually by July 31 and after which the NRC reviews, scores, and approves successful applications. The WSF is intended to provide cost-share opportunities to projects that control flooding, ensure long-term water availability, reduce aquifer depletion, increase stream flows, address water quality concerns, and keep Nebraska in compliance with interstate water compacts. The WSF receives $11 million each year and has two project categories, smaller projects with a cost below $250,000 and large projects with costs above $250,000.

NEBRASKA ENVIRONMENTAL TRUST

The Nebraska Environmental Trust (NET) was established in 1992 to conserve, enhance, and restore the natural environment of Nebraska. The NET especially seeks projects that bring public and private partners together to implement high-quality, cost-effective projects. Applicants for NET grants must meet specific eligibility criteria that assure public benefit and substantial environmental gains. Annual applications are due the Tuesday following Labor Day. Although NET grants have no match requirement, a local match is recommended. More information can be found at: https://www.environmentaltrust.org/.

NGPC AQUATIC HABITAT PROGRAM

The Nebraska Game and Parks Commission (NGPC) regularly leads many aquatic habitat renovation projects across the state through the Aquatic Habitat Program. Funding is generated through the annual purchase of an Aquatic Habitat Stamp available when obtaining a Nebraska fishing license.

RAINWATER BASIN JOINT VENTURE

The Rainwater Basin Joint Venture (RWBJV) was created in 1992 under the North American Waterfowl Management Plan. While the RWBJV works across Nebraska, a lot of its work is focused within the Rainwater Basin which covers much of the UBBNRD. The RWBJV primarily works on restoring, maintaining, or enhancing wetland habitats. The RWBJV includes a wide variety of private, local, state, and Federal partners who work to implement conservation actions. Entities who may work jointly in this endeavor include landowners, conservation agencies, researchers, agriculture businesses and associations, and others. The RWBJV can provide valuable technical and financial assistance in partnership with the UBBNRD towards the implementation of this plan.

PROPERTY OWNERS

Landowners/operators will contribute both time and resources for implementing conservation measures. The cost of conservation measure implementation to landowners/operators will vary by practice type, and by the extent of funding received from other sources. Financial assistance through incentives will be necessary for many conservation measures, particularly for smaller producers that may not be able to afford to install more costly measures.

8.03 ALTERNATIVE FUNDING OPTIONS

Successfully implementing this plan will require creative approaches to project funding. A broad range of funding opportunities will create opportunities for additional implementation options. Alternative funding sources can sometimes be found at the regional or local level through partnerships with private sector businesses, private foundations, and other non-governmental organizations.

The following general types of alternative funding sources and techniques have been employed in other communities. This approach is not as clear-cut as applying for grants. It involves engaging a broad spectrum of stakeholders and employing combinations of funding sources in solving what are formidable issues. However, the reality is that significant increases in government funding to address nonpoint source pollution efforts are not on the immediate horizon and the UBBNRD will need to be creative, cooperative, and proactive to realize implementation on a meaningful level.

I. Local Options
   a. Capital Improvement Funds
   b. Permits and Fees
   c. In-Kind Services
   d. Developers/Property Owners

II. Private Foundations or non-profits
   a. Farm Bureau
   b. Nebraska Cattlemen Association
   c. Corn Growers Association
   d. Soybean Association

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CHAPTER 9. PRIORITIZATION PROCESS

9.01 INTRODUCTION

The purpose of this chapter is to list the priorities identified during the planning process, and describe the process used to select them. These identified priorities are to be implemented during the initial five-year increment of this plan. Consistency in terminology amongst stakeholders was required to identify priorities and key terms are defined in this chapter. In order to identify priorities, target areas for implementation had to be selected. Priorities were identified for priority waterbodies, target areas, and special priority areas, as well as for both monitoring and information and education efforts.

9.02 TERMINOLOGY

20% Rule – To concentrate resources and focus on obtainable management goals, the NDEE developed the "20% Rule". This rule states that areas targeted for implementation efforts will make up no more than 20% of a total basin's area (NDEQ, 2015b). The Upper Big Blue Natural Resources District (UBBNRD) covers multiple HUC 8 subbasins. For the purposes of this definition, each HUC 8 is considered an individual basin. Therefore, the combined contributing drainage area of all the priority waterbodies in each HUC 8 subbasin cannot exceed 20% of that HUC 8 subbasin's total area. Geographic information system (GIS) mapping was used to ensure that the 20% Rule was met within this plan.

Priority Waterbodies – The actual resource that is to be protected or restored. These are specific lakes, streams, wetlands, or other unique water resources identified through stakeholder input and listed in *Nebraska's Surface Water Quality Standards* (Title 117) (NDEQ, 2014). These may include areas most susceptible or sensitive to nonpoint source pollution. Due to limits on the scope and funding for planning efforts, priority waterbodies were divided into two groups: Tier 1 and Tier 2.

> **Tier 1 Priority Waterbodies** – Tier 1 waterbodies have a detailed implementation strategy developed for them within this plan and will be eligible for Section 319 project funding.
>
> **Tier 2 Priority Waterbodies** – Tier 2 waterbodies do not have detailed implementation strategies developed. Implementation work related to Tier 2 waterbodies will not be eligible to receive Section 319 funding; however, nonfederal funds utilized for water quality projects on Tier 2 waterbodies may count towards matching dollars for Section 319 projects on Tier 1 waterbodies.

Target Areas – The defined areas within a watershed where implementation of best management practices (BMPs) will be focused to improve or protect the water quality of Tier 1 priority waterbodies. The boundaries of target areas are based on designated drainage areas or stream corridors. While they typically follow HUC 12 boundaries, that is not a requirement. Target areas may only make up a maximum of 20% of a HUC 8 subbasin area. Target areas are often delineated to specific drainage areas using GIS analysis of land use, topography, soils, water quality modeling, or other tools. Selection of these areas may also be based on varying factors such as pollutant load, pollutant source, achievable results, landowner interest, etc.

Special Priority Areas (SPA) – Areas determined to have specific, limited, and timely needs that may lie outside of a target area. These areas are identified through stakeholder input and existing plans or other reports. SPAs do not count towards the 20% Rule but are eligible for Section 319 funding, even though they may lie outside of the target areas. Section 319 funding must be administratively tied to a Section 319 project (i.e. part of the same project) that is focused on a target area. BMPs in SPAs are restricted to those necessary to address the specific needs of the SPA. SPAs may receive enhanced Section 319 funding when they lie within a Tier 1 priority waterbody target area, however detailed implementation plans are not required for SPAs.

Priority Practices – BMPs identified by the project partners that are key to achieving goals in both the target areas and SPAs. These are typically selected from a wide variety of practices based on estimated pollutant treatment efficiencies, agency and public input, and anticipated landowner acceptance. These are the BMPs that are included in the water quality modeling efforts.

Critical Source Areas (CSA) – These are relatively small areas within a watershed that generate a disproportionate amount of pollutant load (Meals, 2012). Identifying these areas allows for better targeting of BMPs to use financial and technical resources most effectively. CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism; therefore, identifying the pollutant of concern, its source, and understanding hydrology are key steps in CSA identification. CSAs are identified within target areas which often require detailed assessments, modeling, GIS analysis, or in-field work to identify and define. Additional details on CSAs can be found in Chapter 7 and the individual subbasin chapters.

Monitoring Priorities – Monitoring priorities consist of stand-alone data collection efforts outside of those tied to a project. 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 adoption levels and effectiveness.

Information & Education (I&E) Priorities – I&E priorities consist of stand-alone I&E efforts outside of those tied to a project. Each target area has an I&E component; however, there can also be standalone I&E priorities, especially as it relates to specific issues identified by stakeholders. For each priority it will be important to identify: target audiences, desired outcomes, barriers to communication, specific strategies or techniques to use, and evaluation methods.

9.03 METHODOLOGY

This plan covers a large geographic area, including multiple HUC 8 subbasins, with many competing priorities. Priority waterbodies were identified in order to narrow the focus of this plan to priorities that can be reasonably addressed in the near future by plan partners. This process had to recognize the inherent differences in the sources of pollutants for each waterbody, the scale of contributing areas, and the resources and effort required to address them. The first five years of implementation efforts will focus on the final waterbodies selected.

The initial list of waterbodies was limited to those that have been identified as impaired (NDEQ, 2018a), or are designated as a high quality or unique resource (NDEQ, 2015a). Waterbodies lacking data or complete assessments (NDEE categories 2 or 3) were excluded. Waterbodies where naturally occurring materials have led to water quality impairments or where impairment is not caused by nonpoint source pollution (e.g. mercury) were not considered within the prioritization process.

To facilitate the selection of priority water bodies, a screening process unique to the UBBNRD was utilized. The screening process utilizes a point-based system to represent various interests of resource management agencies and the public. Each screening factor was weighted equally. The diagram shown in Figure 60 outlines the process. Additional details on the screening and selection process are provided in Appendix B. Once a draft list of priority waterbodies was assembled, a review of water quality data, identification of contributing drainage area (to comply with the 20% rule), and input from stakeholders was considered to make the final selection.

Once the final priority waterbodies were identified, implementation strategies were developed for each resource, which are included in Chapters 10 - 13. These implementation strategies include target areas for treatment, BMPs, quantified pollutant load reductions, schedules, milestones, and costs. Detailed implementation strategies were only developed for the Tier 1 priority waterbodies, as other areas are not anticipated to receive Section 319 funding for projects in the first five-year increment of the plan.

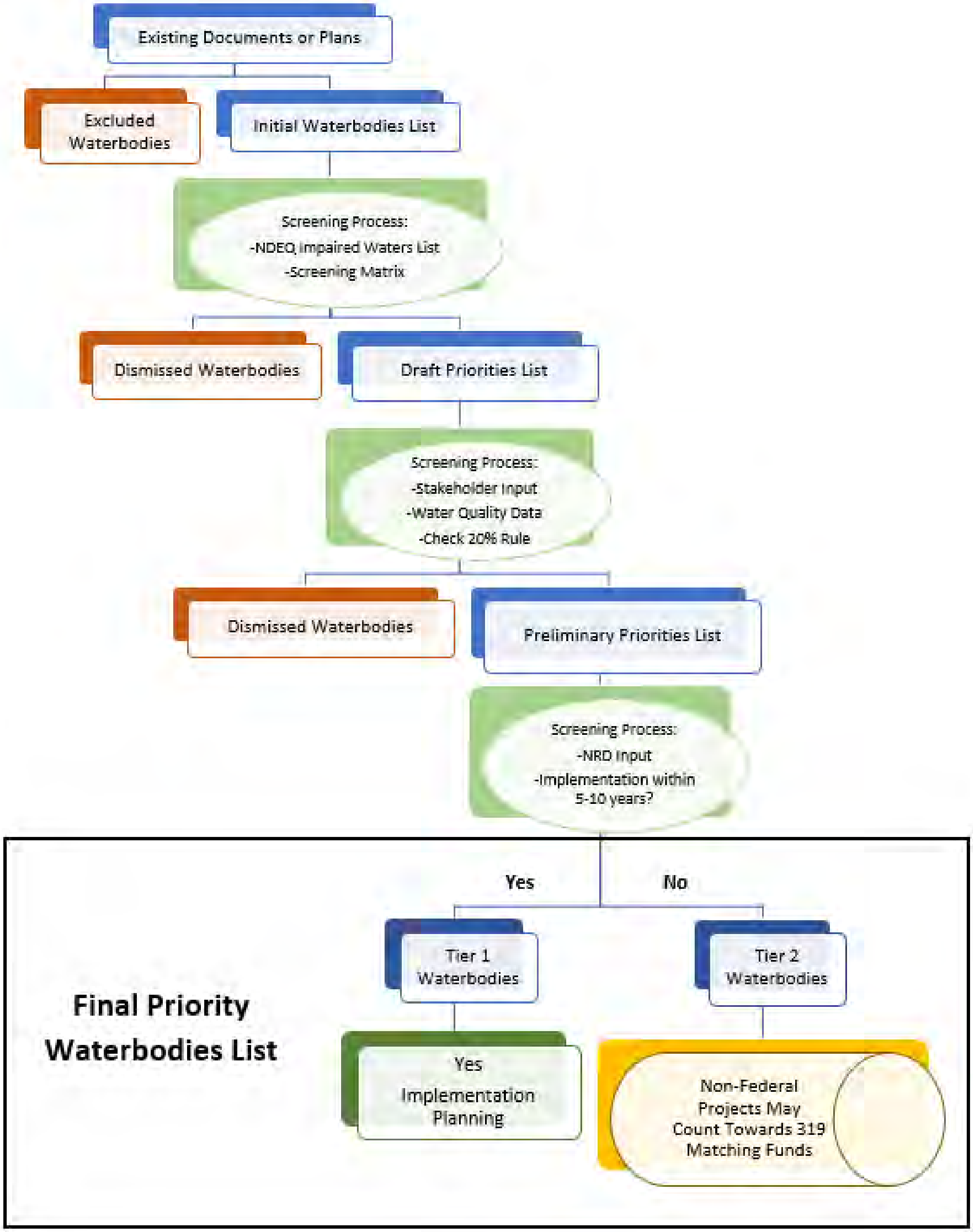


Figure 60: Flowchart of Waterbody Prioritization Process

9.04 PRIORITY WATERBODIES AND TARGET AREAS

Three Tier 1 priority areas were identified through the screening process: two segments of Beaver Creek and one segment of Recharge Lake. An additional five Tier 2 priority areas were identified: School Creek, Lake Hastings, Oxbow Trail Reservoir, and two segments of Lincoln Creek. Priority waterbodies are shown in Figure 61 and detailed in Table 46. The identified Tier 1 priority waterbodies comply with the 20% Rule.

TIER 1 WATERBODIES

Beaver Creek

Two impaired segments of Beaver Creek, the headwaters segment and the downstream segment, were selected as Tier 1 priority waterbodies. The headwaters segment (BB3-10400) is a Category 5 waterbody with the Aquatic Life use impaired. The downstream segment (BB3-10300) is a Category 4a waterbody impaired due to atrazine. Both segments are in the West Fork Big Blue subbasin and cover an area from approximately the City of York to several miles west of Beaver Crossing.

Recharge Lake

Recharge Lake (BB3-L0080) is a Category 5 waterbody impaired due to nutrients. The lake is located near the City of York in the West Fork Big Blue subbasin.

Detailed implementation plans have been prepared to address the atrazine impairment on Beaver Creek, and the nutrient impairment on Recharge Lake. The Aquatic Life impairment on the headwaters of Beaver Creek will be addressed indirectly through the recommended stream assessments and habitat restoration projects. These implementation plans are included in Chapter 11 and include information necessary to meet the Environmental Protection Agency's (EPA) Nine Elements.

TIER 2 WATERBODIES

School Creek

School Creek is a Category 5 waterbody located in the West Fork Big Blue subbasin and is impaired due to atrazine. The stream runs approximately from Sutton to its confluence with the West Fork Big Blue River south of Lushton, near the York-Fillmore County line.

Lake Hastings

Lake Hastings is a Category 5 waterbody with the Aquatic Life use impaired. The lake is located in the City of Hastings in the West Fork Big Blue subbasin.

Oxbow Trails Reservoir

Oxbow Trails Reservoir is a Category 5 waterbody with the Aquatic Life use impaired due to nutrients. The lake is located in the Upper Big Blue subbasin, east of Ulysses.

Lincoln Creek

Two impaired segments of Lincoln Creek were selected as Tier 2 priority waterbodies: the headwaters segment and the downstream segment. The headwaters segment is a Category 5 waterbody with an aquatic community impairment. The downstream segment is a Category 1 waterbody with no impairment. Both segments are located in the Upper Big Blue subbasin and run approximately from northwest of the City of York to Seward.

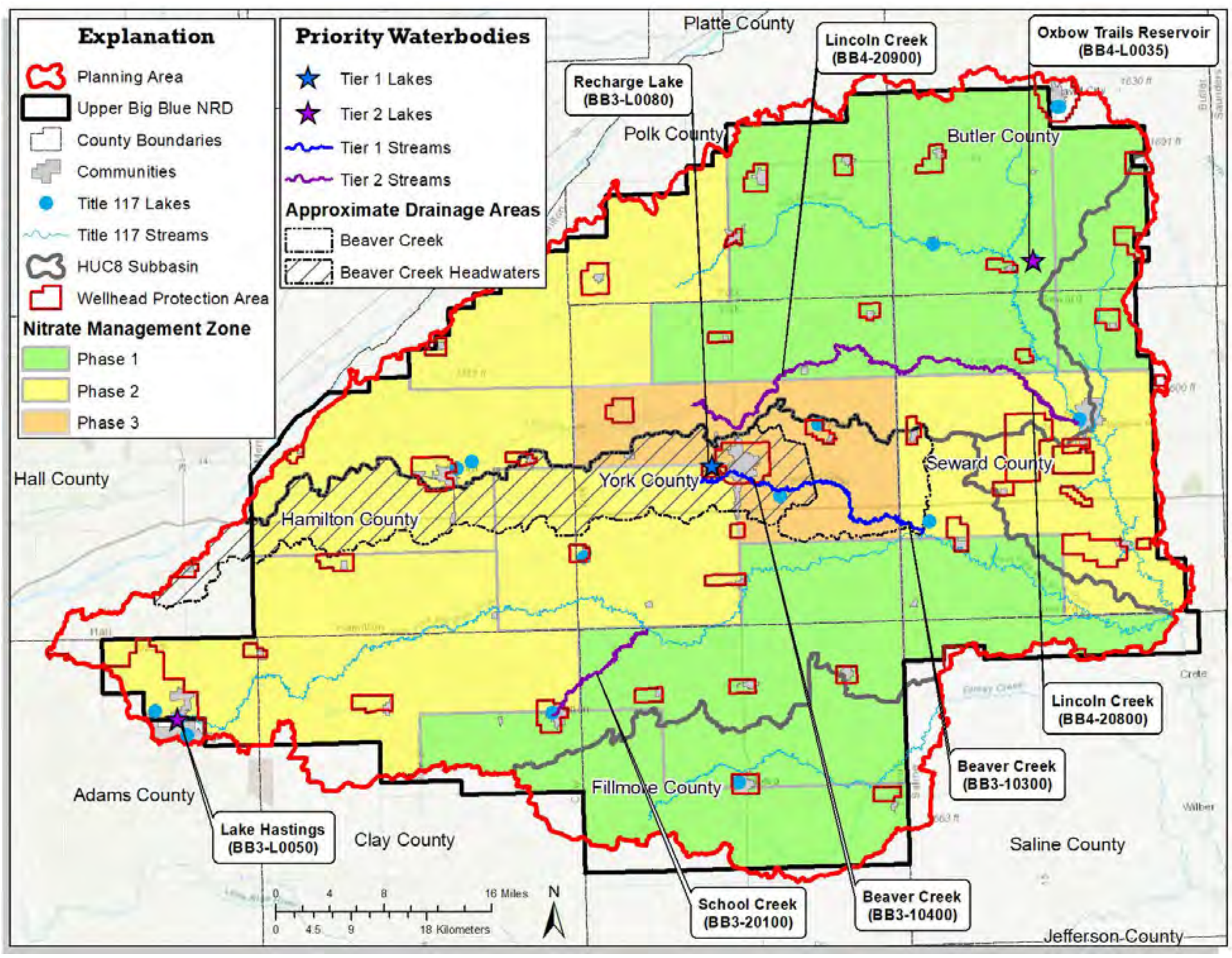


Figure 61: Locations of Priority Waterbodies

Table 46: List of Priority Waterbodies

Subbasin	Tier	Waterbody ID	Name	Impaired Use*	Cause of Impairment*
West Fork Big Blue	1	BB3-10400	Beaver Creek – Headwaters to Unnamed Creek	Aquatic Life	Unknown
West Fork Big Blue	1	BB3-10300	Beaver Creek – Unnamed Creek to West Fork Big Blue River	Aquatic Life	Atrazine
West Fork Big Blue	1	BB3-L0080	Recharge Lake	Aquatic Life	Nutrients
West Fork Big Blue	2	BB3-20100	School Creek	Aquatic Life	Atrazine
West Fork Big Blue	2	BB3-L0050	Lake Hastings	Aquatic Life & Aesthetics	Nutrients & Sediment
Upper Big Blue	2	BB4-20900	Lincoln Creek – Headwaters to Unnamed Creek	Aquatic Life	Unknown
Upper Big Blue	2	BB4-20800	Lincoln Creek – Unnamed Creek to Big Blue River	None	None
Upper Big Blue	2	BB4-L0035	Oxbow Trails Reservoir	Aquatic Life	Nutrients

Source: NDEQ, 2018a

9.05 SPECIAL PRIORITY AREAS

SPAs provide flexibility to address identified small-scale areas with specific, limited, and timely needs that lie outside of the target areas. They address issues that occur widely across the planning area and may affect not only water quality, but also the health and safety of humans. Additionally, some priority BMPs do not have specifically targeted land uses or an easily defined subwatershed associated with their implementation; thus, SPAs do not count towards the 20% Rule. Some BMPs, when implemented in broad areas, have greater appeal to the public and spur greater involvement. SPAs allow for the opportunity to implement practices outside of target areas and are eligible for Section 319 funding. Projects in these areas are excellent candidates for partnering opportunities. The following SPAs have been identified:

ON-SITE WASTEWATER TREATMENT SYSTEMS

New regulations and design standards for on-site wastewater systems in 2004 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 inspections on-site wastewater systems and to replace systems installed before 2004.

WELLHEAD PROTECTION AREAS

NDEE'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 Wellhead Protection (WHP) areas. This plan recognizes WHP areas as SPAs due to the influence WHP areas have on the management needs of source water aquifers and associated public drinking water systems. WHP areas within the planning area are identified in Chapter 3. Completing WHP plans for each WHP area and implementing BMPs which target groundwater quality are priorities. These BMPs would include, but are not limited to: fertilizer at agronomic rates, irrigation water management, and cover crops.

Stakeholders identified two WHP areas as a high priority for planning and management: City of York and Seward WHP areas. Developing a Drinking Water Protection Management Plan (DWPMP) for each area is considered a priority. Without a DWPMP those areas (and other WHP areas) may not be eligible for Section 319 funding for any on-the-ground projects. Developing a DWPMP creates eligibility for Section 319 project funding.

NON-PERMITTED LIVESTOCK OPERATIONS

Almost all livestock operations have the potential to adversely impact water quality; however, those that are not are exempt by NDEE from regulatory requirements are at special risk. This includes non-permitted animal feeding operation (AFO) facilities, livestock grazing pastures, or other operations deemed exempt by NDEE. Non-permitted AFOs and pastures are identified as SPAs to provide a proactive approach to livestock waste management while demonstrating appropriate treatment technologies and BMPs. Only operations that are exempted by regulations or are deemed exempt by NDEE are included. BMPs for these SPAs include all of those identified in Chapter 7 under the following practice suites: "Non-permitted AFO Facility BMPs" and "Grazing Lands Management BMPs".

RAINWATER BASIN WETLANDS

Wetlands are a crucial landscape feature throughout the UBBNRD, and the Rainwater Basin Joint Venture (RWBJV) has identified hundreds of wetlands in need of conservation and restoration efforts. BMPs improve water quality before reaching a wetland by trapping sediment or allowing the removal of nutrients, which also improves the health of nearby wetlands. Additionally, the restoration of existing wetlands increases the ability of a wetland to trap pollutants and improves water quality downstream. The following BMPs have been identified as applicable to this SPA: rest, prescribed grazing, prescribed burning, herbicide, haying/shredding, disking, water level manipulation, sediment removal, hydrologic restoration, and upland buffers.

STREAM CORRIDORS

Stream corridors and riparian buffers serve an important role in maintaining the ecological health of a watershed. They are often the last line of defense to trap and control pollutants in runoff. They also can provide natural buffers against flooding and contribute to groundwater recharge. While recommended widths of riparian buffers can vary, this plan uses a 50-foot buffer width (on each side of a stream) as the delineation of the SPA in order to cover a variety of designs and goals that are commonly integrated into riparian buffer designs. The following BMPs have been identified as applicable to this SPA: riparian buffers, stream restoration, and stream stabilization.

9.06 MONITORING PRIORITIES

The following non-project specific monitoring priorities were identified.

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

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

Bathymetric Surveys – Most of the reservoirs in the planning area either lack bathymetric survey data or the data is extremely old. For future planning efforts, data should be collected to update sedimentation rate estimates. The UBBNRD should develop a comprehensive data collection schedule/plan to begin updating bathymetric surveys for area reservoirs.

Water Quality Data – Current water quality data for many waterbodies throughout the UBBNRD is lacking. The UBBNRD should consider beginning a data collection effort for at least one year or season focused on waterbodies without current information.

Stream Erosion – Stream erosion is an ever-growing problem in the UBBNRD. Conventional farming practices can lead to high rates of surface water runoff, which leads to additional stream erosion. The UBBNRD should consider implementing a monitoring program to track the instream erosion rates and processes across the district.

9.07 INFORMATION AND EDUCATION PRIORITIES

The following non-project specific public information and education priorities were identified.

Stream Erosion – Offering educational sessions to landowners and operators experiencing issues with stream erosion may help improve water quality throughout the UBBNRD. This may include more conservation focused farming practices or the installation of BMPs.

Crop and Land Use Diversity – Diversifying land use can reduce overall runoff, erosion, and nutrient loss. Varying crop rotations and grazing programs allows soil and native vegetation to recover. The UBBNRD should consider hosting educational sessions for landowners and operators.

Overall Water Quality and Supply Status – Groundwater is a vital resource throughout the UBBNRD and the State of Nebraska. Educating the public about the quality and availability of their water supply is a step towards future conservation.

BMP Demonstrations – The UBBNRD should consider hosting field days for operators and officials to see the impacts of BMP installation firsthand. People will be more likely to install BMPs if they are shown the positive effects.

Cost Versus Benefits of Conservation – Creating a standardized cost-benefit analysis of BMP installations and other conservation efforts can help landowners, operators, and other targeted groups understand the importance of water quality management and how it might fit into their operations.

Target Audiences – Targeted audiences should include a broad range of stakeholders, including landowners, operators, and local officials. Agriculture based youth groups such as 4-H and Future Farmers of America (FFA) should be considered a priority audience for future conservation efforts. See Chapter 6 for additional discussion on this item.

Additional Staff and Budget – The UBBNRD may consider enlarging their staff and budget for the purposes of implementing this plan, particularly as it relates to outreach efforts. Having dedicated staff members for education and outreach roles may improve conservation efforts throughout the UBBNRD. See Chapter 6 for additional discussion on this item.

CHAPTER 10. UPPER BIG BLUE HUC 8 SUBBASIN

10.01 SUBBASIN BACKGROUND

The Upper Big Blue Subbasin (HUC 8: 10270201) is the second largest of the four subbasins addressed in this plan. The subbasin covers 708,458 acres (total planning area is 1,908,206 acres) and includes portions of Butler, Hall, Hamilton, Polk, Seward, and York Counties (Figure 62). Land use in this subbasin is dominated by agriculture, with 87% of the subbasin area dedicated to row crops (corn/soybean). There are several urban areas throughout the subbasin, which make up a total of 5% of the subbasin area. Remaining land use is divided amongst grass/pasture (6%), forest (2%), 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 (SPAs) identified within the Upper Big Blue 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. Other subbasin characteristics and information is found in the following chapters/sections within this plan:

- Land use: Chapter 3
- Existing land treatment (BMPs): Chapter 7
- Irrigation: Chapter 3
- Permitted facilities: Chapter 5
- Existing resource conditions: Chapter 5

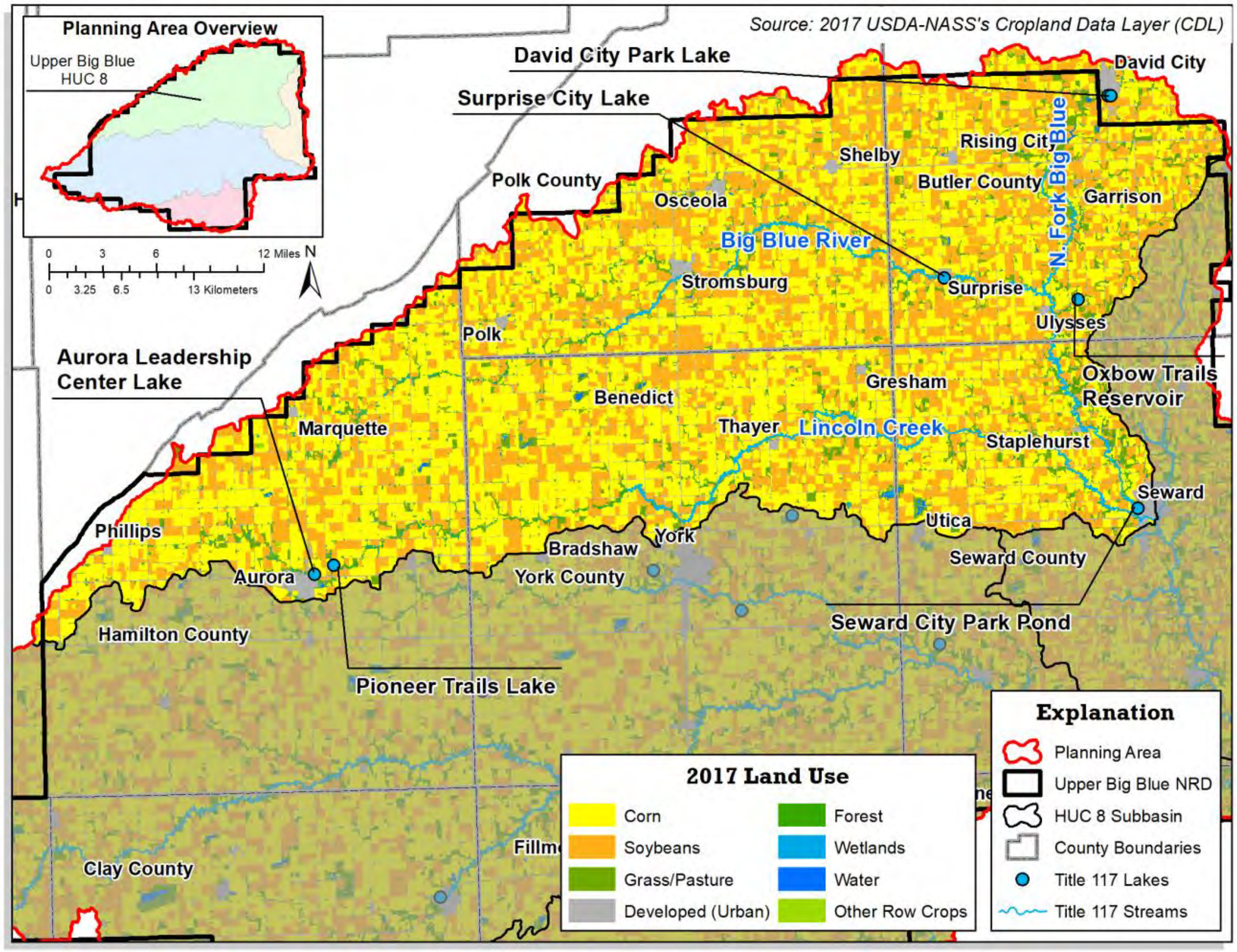


Figure 62: Land Use Within the Upper Big Blue HUC 8 Subbasin

10.02 OVERVIEW OF PRIORITIES

As discussed in Chapter 9, priority waterbodies and associated target areas were selected through a review of water quality data and stakeholder input. No target areas were identified in the Upper Big Blue Subbasin.

10.03 SPECIAL PRIORITY AREAS

Special priority areas (SPAs) provide flexibility to address small-scale areas that lie outside of the target area with specific, limited, and timely identified needs. SPAs help address broad issues which occur widely across the subbasin and may affect not only water quality, but also the health and safety of humans. Since some best management practices (BMPs) for SPAs do not have specifically targeted land uses or an easily defined subwatershed associated with their implementation, the SPAs do not count towards the 20% Rule.

Practices are restricted to those necessary to address the specific needs of the SPA. BMPs are designed to address these specific needs and may cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities.

SPECIAL PRIORITY AREAS WITHIN THE SUBBASIN:

The following list identifies the SPAs identified within the subbasin. Unless otherwise described below, descriptions of each SPA are available in Chapter 9. Table 47 provides a count of SPAs identified in this subbasin, as well as a list of BMPs to address each SPA.

- Wellhead Protection Areas (WHP areas) (Figure 63)
    - A portion of the Seward WHP area is located inside the Upper Big Blue HUC 8. The Seward WHP area has been identified as a high priority for planning and management.
- Non-permitted Livestock Operations (Figure 64)
- Rainwater Basin Wetlands (Figure 65)
- Onsite Wastewater Treatment Systems (OWTS)*
- Stream Corridors*

**Note that OWTS and Stream Corridors are only mapped for Target Areas and are not shown in the figures below.*

Table 47: SPAs Identified in the Upper Big Blue HUC 8 Subbasin

SPA Type	Number Identified	Potential BMPs
Onsite Wastewater Systems (OWTS) New regulations and design standards offer an opportunity to address potential sources of bacteria and nutrient contamination.	423	• Education • System maintenance • System upgrade or replacement
Wellhead Protection Areas (WHP Areas) Protection of these areas is extremely important to protect source water aquifers and drinking water safety.	19	• Nutrient management • Irrigation management • Cover crops • WHP Plan development
Non-permitted Livestock Operation These operations are not required to be regulated but are considered a possible source of pollutants in runoff.	364	• Manure storage systems • Clean water diversion systems • Vegetative treatment systems • Terraces • Containment • Evaporation ponds • Open lot runoff management • Heavy use area protection • Feed management practices • Education for manure application
Rainwater Basin Wetlands Wetland conservation and restoration improves water quality and overall landscape health.	2,636	• Prescribed grazing • Prescribed burning • Herbicide • Haying, shredding, or mowing • Disking / rototilling • Water level manipulation • Sediment removal • Hydrologic restoration • Upland buffers
Stream Corridors Stream corridors and riparian buffers are the last line of defense before pollutants enter streams.	Approximately 172 miles of perennial streams	• Re-meandering • Oxbow restoration / reconnection • Floodplain construction / reconnection • Streambank stabilization • Grade stabilization • In-stream / constructed wetlands • Riparian zone renovation

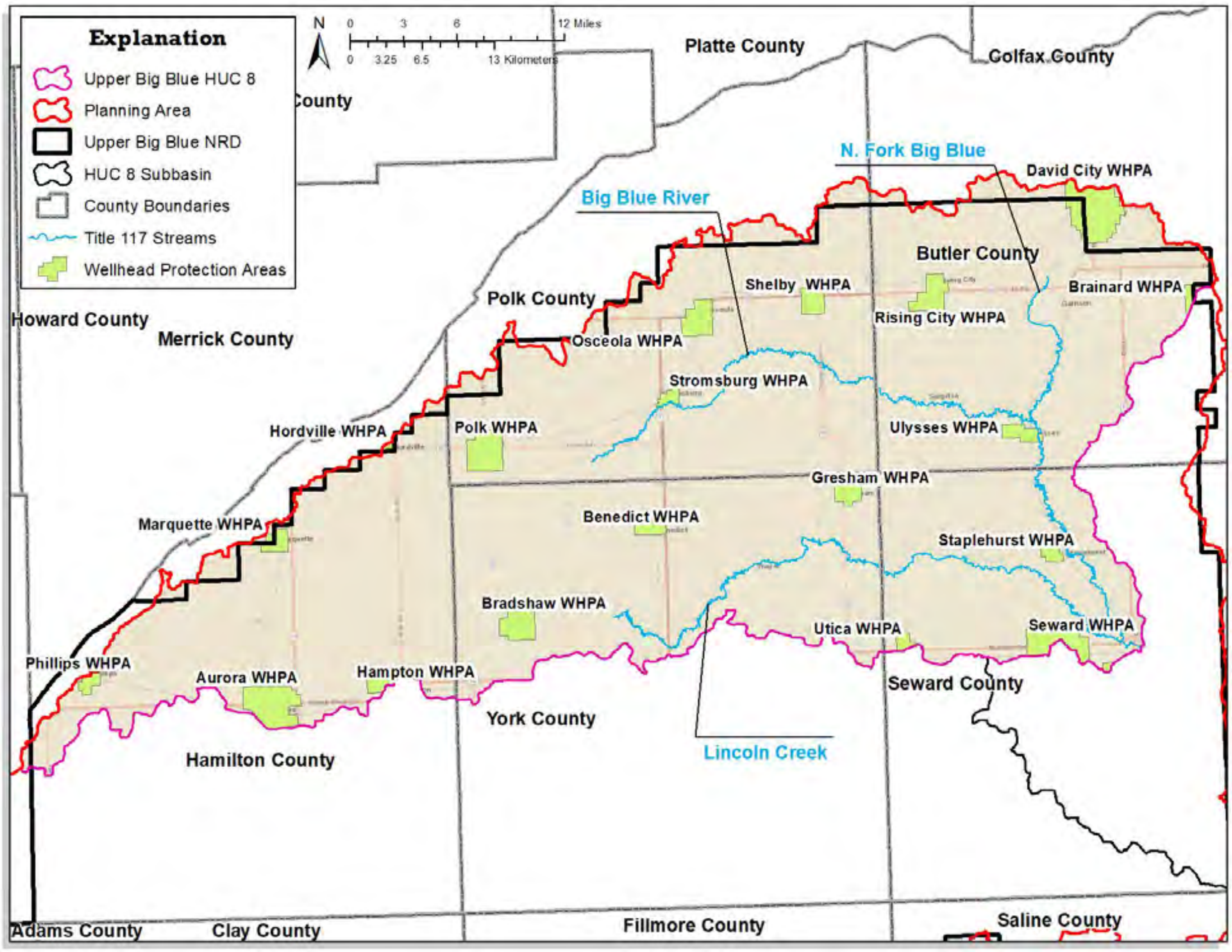


Figure 63: Wellhead Protection Areas Within the Upper Big Blue HUC 8 Subbasin

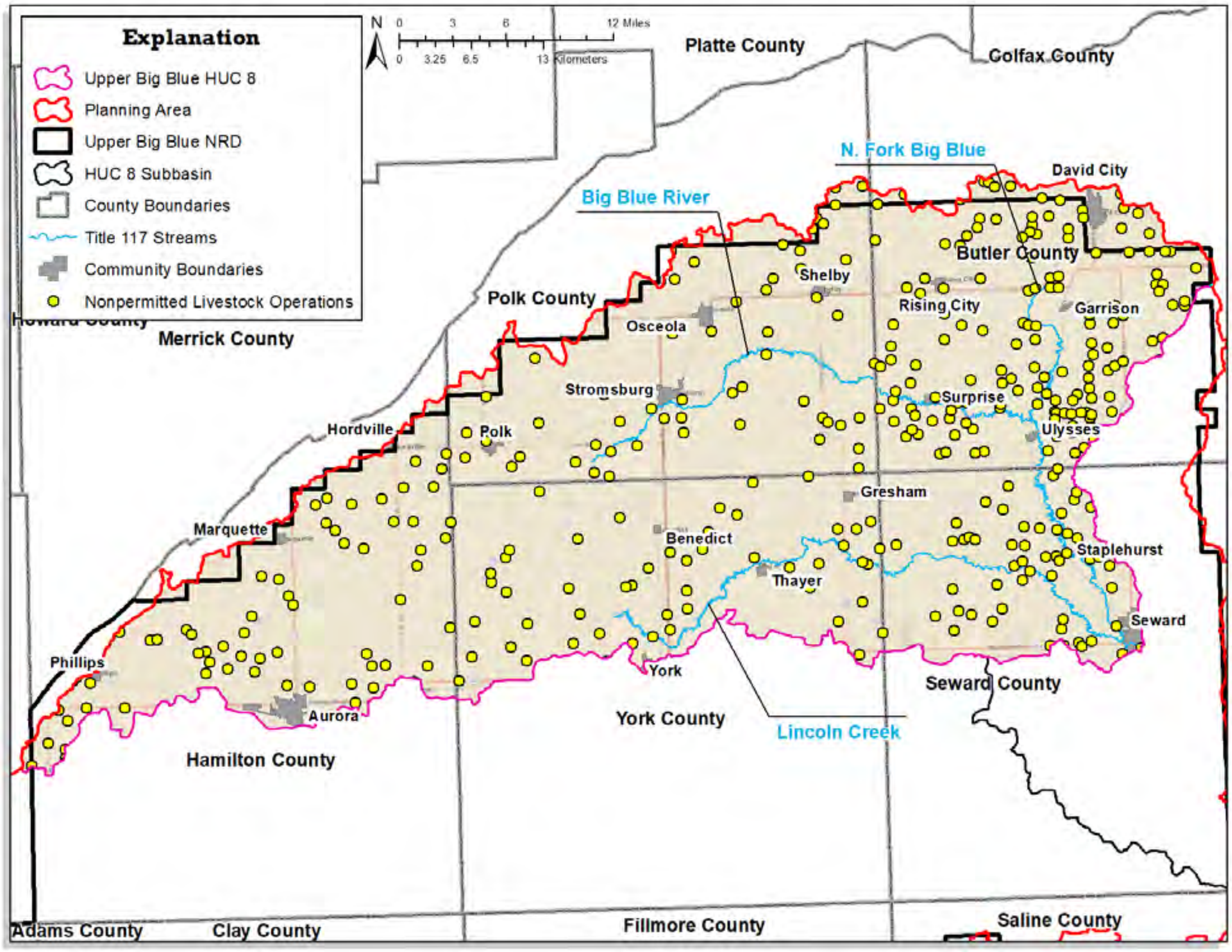


Figure 64: Nonpermitted Livestock Operations Within the Upper Big Blue HUC 8 Subbasin

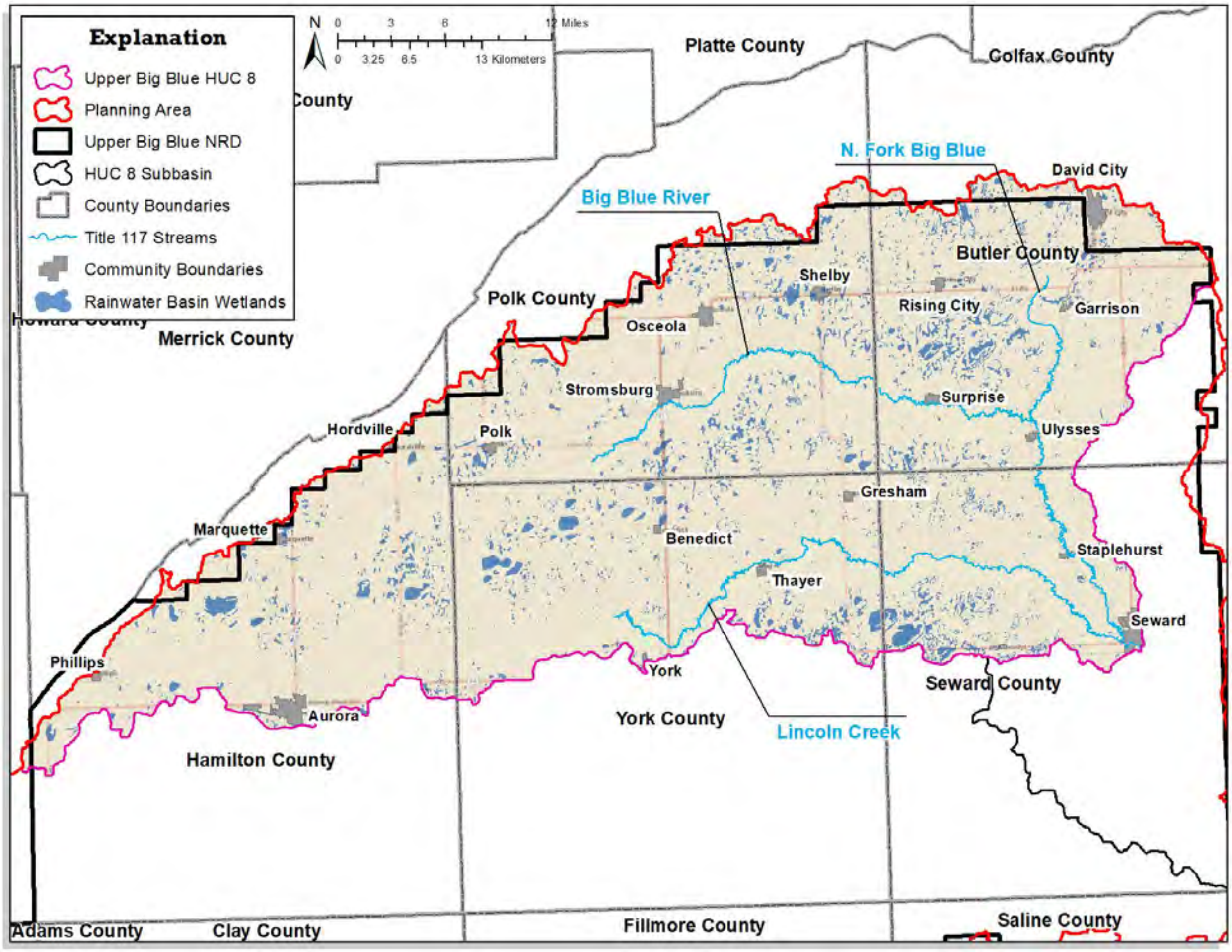


Figure 65: Rainwater Basin Wetlands Within the Upper Big Blue HUC 8 Subbasin

10.04 MONITORING PRIORITIES

Long-term monitoring data is lacking throughout the Upper Big Blue Subbasin. Monitoring data is necessary to establish baselines, fill in data gaps, and to track plan progress. Collecting bathymetric survey data at Oxbow Trail Reservoir is the only monitoring priority specific to the Upper Big Blue HUC 8 Subbasin. No other monitoring priorities were identified specific to this subbasin. Chapter 9 provides information on district-wide monitoring priorities identified by stakeholders and project partners.

OXBOW TRAILS RESERVOIR BATHYMETRIC SURVEY

Sediment management for 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. A loss in 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: tracking reservoir sedimentation rates over time; determining sediment trapping efficiencies of wetland/ sediment basins; estimating reservoir and sediment basin maintenance requirements and financial needs; and planning for in-lake management measures.

Current bathymetric information is lacking for Oxbow Trails Reservoir. Sediment basins should be surveyed every three to five years, in comparison 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 as this information is valuable in developing strategies for re-claiming lost lake storage capacity and for locating in-lake sediment control structures.

10.05 INFORMATION AND EDUCATION PRIORITIES

No standalone Information and Education (I&E) priorities were identified for the Upper Big Blue HUC 8 Subbasin. Chapter 9 provides information on district-wide I&E priorities identified by stakeholders and project partners.

10.06 MASTER COST SUMMARY

Cost estimates are only developed for implementation within target areas. Therefore, no cost estimate is provided for the Upper Big Blue Subbasin.

CHAPTER 11. WEST FORK BIG BLUE HUC 8 SUBBASIN

11.01 SUBBASIN BACKGROUND

The West Fork Big Blue Subbasin (HUC 8: 10270203) is the largest of the four subbasins that make up the Upper Big Blue Natural Resources District (UBBNRD). The subbasin covers 857,185 acres (total planning area is 1,908,206 acres) and includes portions of Adams, Clay, Fillmore, Hall, Hamilton, Saline, Seward, and York Counties (Figure 66). Land use in this subbasin is dominated by agriculture, with 83% of the subbasin area dedicated to row crops (corn/soybean). Grass and pasture make up 8% of the area, and an additional 6% is made up of urban areas. Remaining land use is divided amongst forest (2%), and small amounts of open water, wetlands, or other perennial vegetation.

This chapter is intended to focus primarily on the target areas and special priority areas (SPAs) identified within the West Fork Big Blue 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. Other subbasin characteristics and information is found in the following chapters/sections within this plan.

- Land use: Chapter 3
- Existing land treatment/best management practices (BMPs): Chapter 7
- Irrigation: Chapter 3
- Permitted facilities: Chapter 5
- Water resources: Chapter 3
- Existing resource conditions: Chapter 5

A general discussion of the types and sources of pollutants addressed in this chapter can be found in Chapter 5. This subbasin specific chapter provides information for the contribution of pollutants by source within each target area. Additionally, this chapter provides the following information for each target area (and SPAs, 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 plans;
- Schedule and milestones;
- Monitoring; and
- Cost estimates.

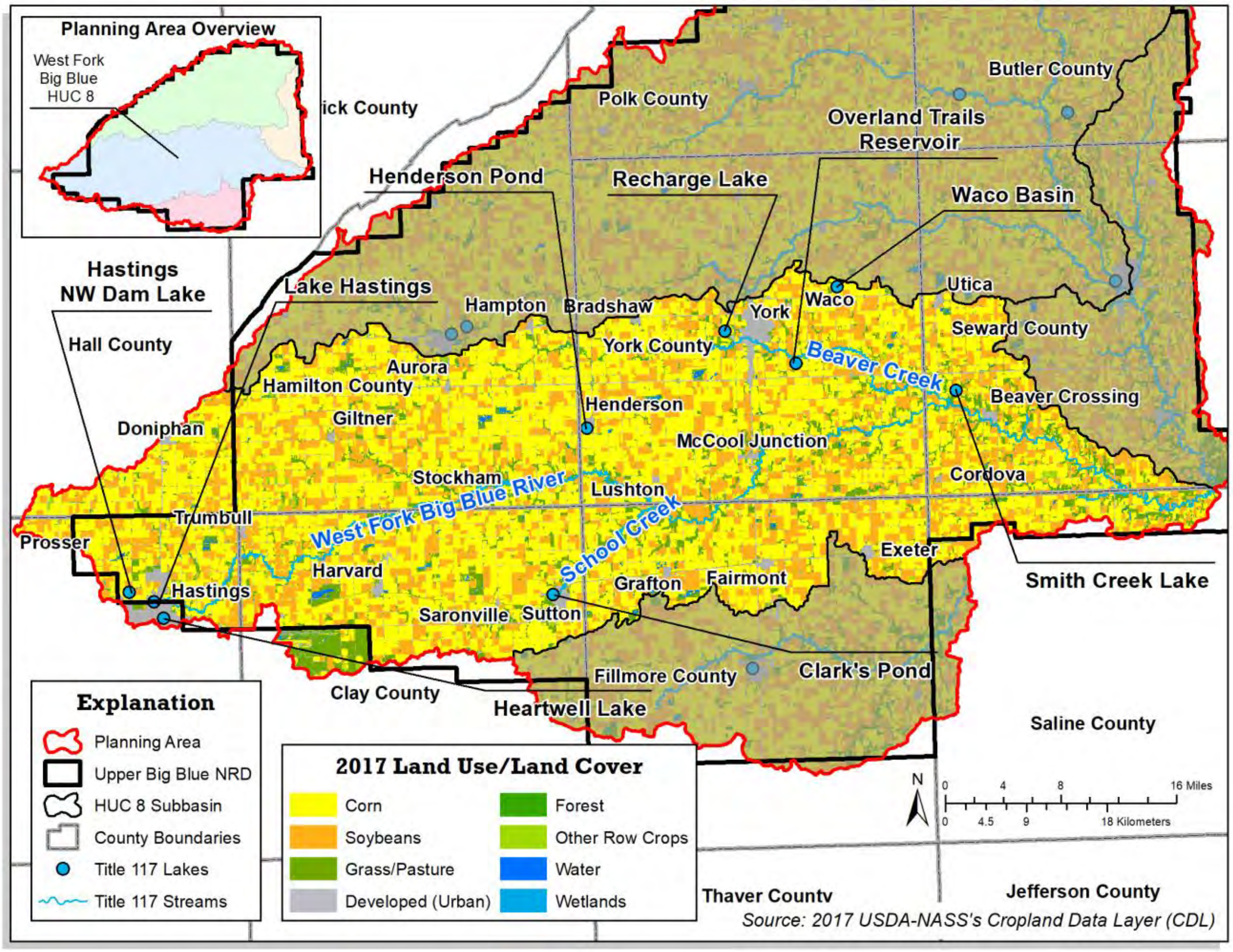


Figure 66: Land Use Within the West Fork Big Blue HUC 8 Subbasin

11.02 OVERVIEW OF PRIORITIES

SPAs address small-scale areas that lie outside of the target area with specific, limited, and timely identified needs. SPAs help address broad issues which occur widely across the subbasin and may affect not only water quality, but also the health and safety of humans. Since some BMPs for SPAs do not have specifically targeted land uses or an easily defined subwatershed associated with their implementation, the SPAs do not count towards the 20% Rule.

Practices are restricted to those necessary to address the specific needs of the SPA. BMPs are designed to address these specific needs and may cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities. As discussed in Chapter 9, SPAs were selected through a review of water quality data and stakeholder input. The following SPAs within this subbasin have been selected for focused implementation efforts:

- Onsite Wastewater Treatment Systems (OWTS)
- Wellhead Protection Areas (WHP areas)
- Non-permitted Animal Feeding Operations (AFOs)
- Rainwater Basin Wetlands
- Stream Corridors

As part of the prioritization process in the development of this plan (Chapter 9), target areas were identified based on the contributing area to each priority waterbody identified. Three target areas were selected (Figure 67):

- Recharge Lake (BB3-L0080)
- Beaver Creek – Headwaters to Unnamed Creek (BB3-10400)
    - “Upper Beaver Creek”
- Beaver Creek – Unnamed Creek to West Fork Big Blue River (BB3-10300)
    - “Lower Beaver Creek”

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 NDEE 20% Rule (NDEQ, 2015b). Within the West Fork Big Blue Subbasin, 193,015 acres are targeted for implementation work, approximately 22.5% of the total HUC 8 area (Table 48). NDEE has indicated that is it permissible to slightly exceed the 20% Rule when there is clear justification to do so. In this case, all priority waterbodies are in a single hydrologic drainage area, which must be targeted to comprehensively address the impairments to the waterbodies.

Although two segments of Beaver Creek have been identified as priority waterbodies, their combined drainage area will be treated as a single target area in this plan. 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 C.

Table 48: Priority Waterbodies and Associated Target Areas Within the West Fork Big Blue HUC 8 subbasin

<table>
<tr><th>Priority Waterbody (Waterbody ID)</th><th>HUC 12 Subwatershed(s) Containing Waterbody</th><th>Target Area Size (acres)</th><th>% of Total HUC 8 Size</th><th>Pollutants and Impairments Addressed</th></tr>
<tr><td>Recharge Lake (BB3-L0080)</td><td>102702030405</td><td>8,549*</td><td>N/A*</td><td>Aquatic Life impaired, due to Mercury, Chlorophyll a, Total Nitrogen, and Total Phosphorus</td></tr>
<tr><td>Upper Beaver Creek (BB3-10400)</td><td rowspan="2">102702030401
102702030402
102702030403
102702030404
102702030405
102702030406
102702030407
102702030408</td><td rowspan="2">193,015**</td><td rowspan="2">22.5%**</td><td>Aquatic Life - Unknown cause</td></tr>
<tr><td>Lower Beaver Creek (BB3-10300)</td><td>Aquatic Life impaired, due to Atrazine</td></tr>
<tr><td>Total</td><td>N/A</td><td>193,015</td><td>22.5%</td><td>N/A</td></tr>
</table>

** Recharge Lake target area is located inside Beaver Creek target area and is therefore not counted in the percentage or total area.*

*** Although two segments of Beaver Creek have been identified as priority waterbodies, their combined drainage area is treated as a single target area.*

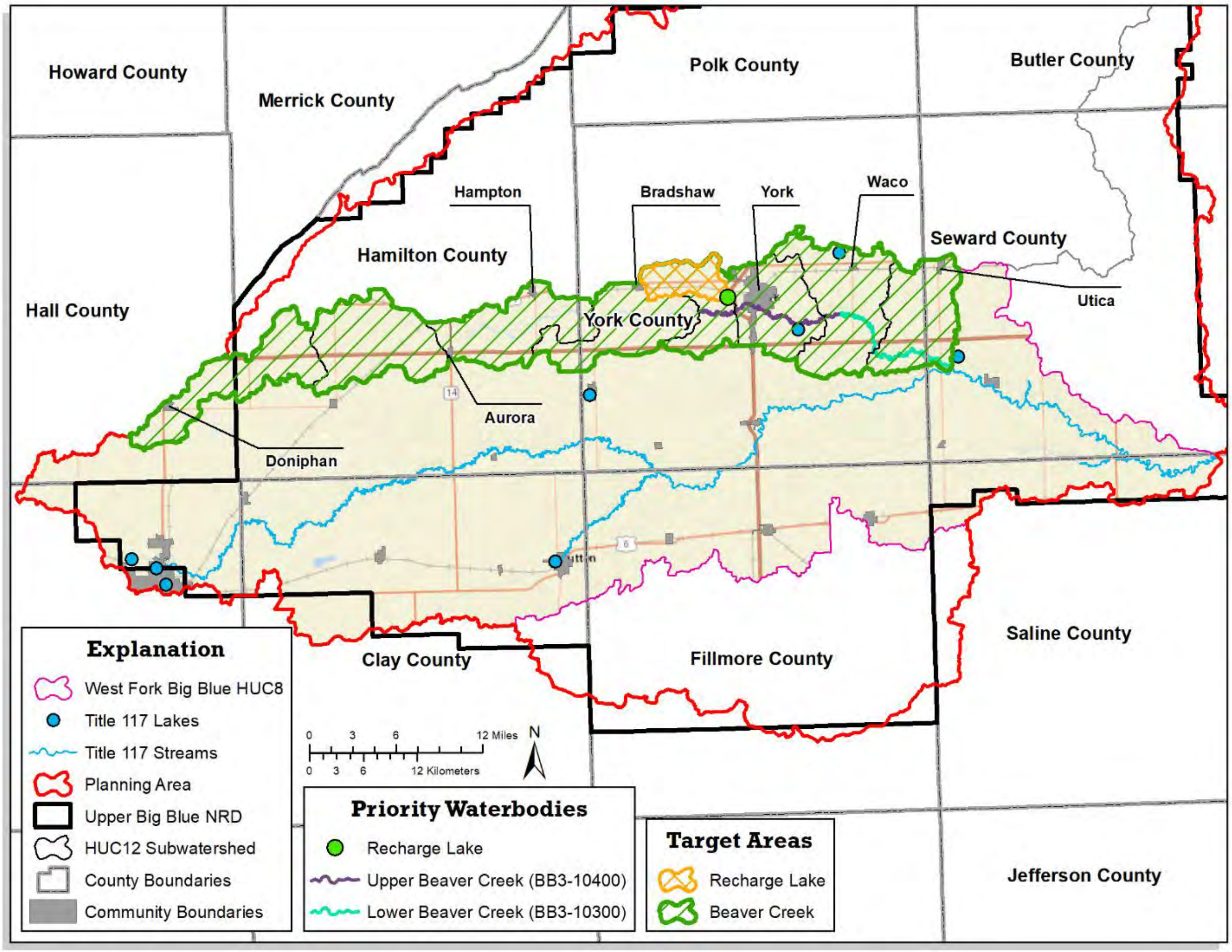


Figure 67: Target Areas Within the West Fork Big Blue HUC 8 Subbasin

11.03 RECHARGE LAKE TARGET AREA

INTRODUCTION

Recharge Lake is located in HUC 102702030405 near the City of York (Figure 68). The Recharge Lake target area includes 8,549 acres draining to the lake, or approximately the northern half of HUC 102702030405. The lake was constructed in 1990 for a five-year groundwater recharge study (UBBNRD, 2018). With a surface area of 44 acres, the lake is now used extensively by the public for passive and active recreational activities. Beneficial uses assigned to Recharge Lake include: Primary Contact Recreation, Aquatic Life, Aesthetics, and Agricultural Water Supplies (NDEQ, 2014).

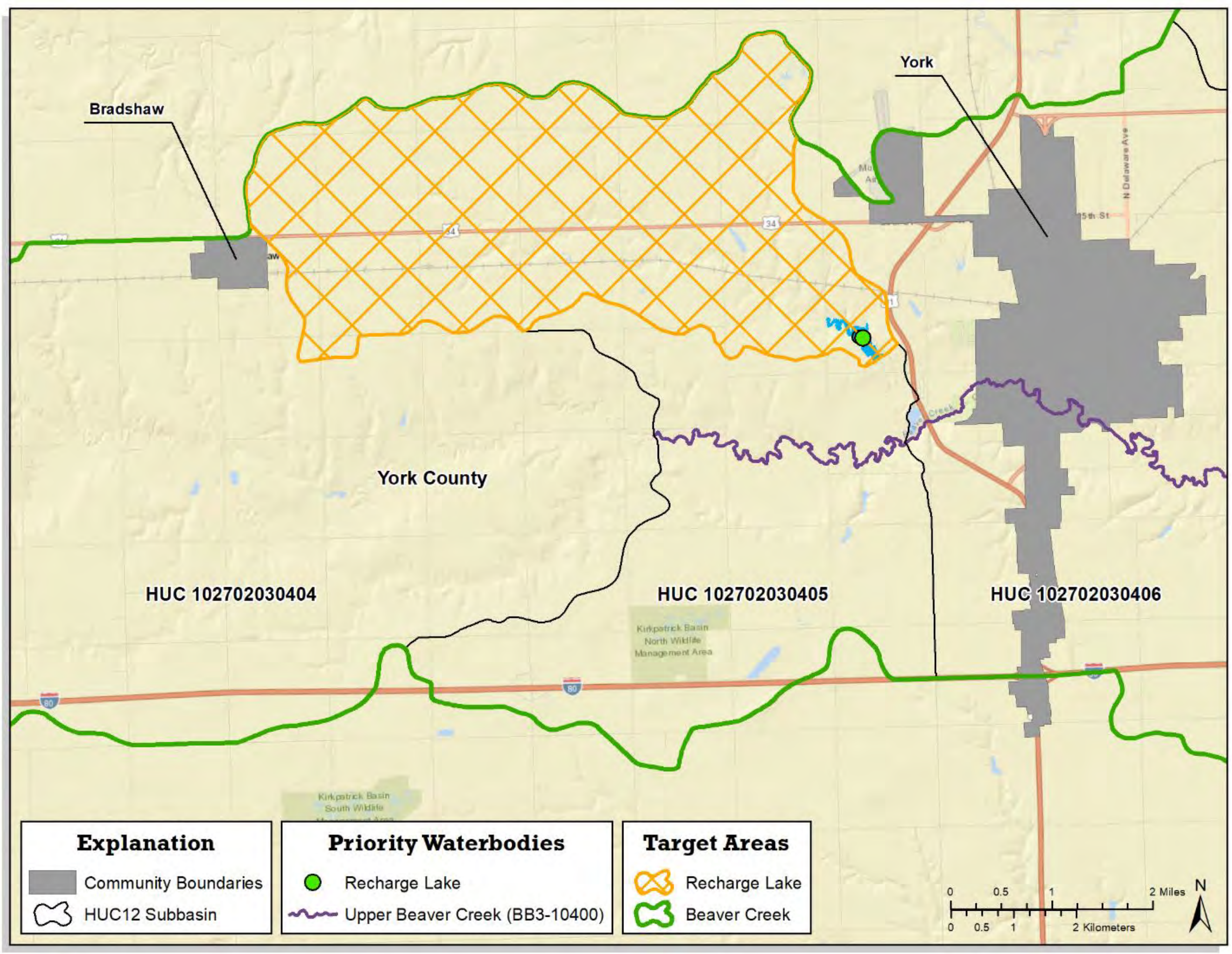


Figure 68: Location of the Recharge Lake Target Area

IMPAIRMENTS

The Aquatic Life beneficial use for Recharge Lake is currently impaired due to elevated phosphorus and nitrogen in the lake water column (Table 49) and high concentrations of mercury in fish tissue (NDEQ, 2018a). NDEE conducted water quality sampling at Recharge Lake in 2002, 2009, and 2010. All 15 of the total phosphorus samples collected exceeded the Nebraska water quality standard of 50 ug/L. Total nitrogen was estimated from nitrate/nitrite and kjeldahl nitrogen concentrations. Total nitrogen exceeded the Nebraska water quality standard of 1,000 ug/L in all 14 samples. As discussed in Chapter 5, mercury contamination is primarily caused by air emissions, and is not addressed in this plan.

Table 49: Recharge Lake Nutrient Concentrations

Parameter	Data Period	Number of Samples	Mean Value (ug/L)	Water Quality Standard (ug/L)
Total Phosphorus	2002 – 2010	15	495	50
Total Nitrogen	2002 – 2010	14	2,180	1,000

Source: USEPA, 2019

Atrazine carried by stormwater runoff has been a documented concern in Recharge Lake since the early 1990s. In the spring of 1992, high concentrations of atrazine were measured in the primary inflow to Recharge Lake (USEPA, 2010). Follow-up monitoring conducted in the lake during 1992 documented atrazine concentrations as high as 93.3 ug/L and monthly average concentrations as high as 61.1 ug/L

Recharge Lake was placed on the Section 303(d) List of Impaired Waters in 1994. This listing led the UBBNRD to initiate a Section 319 project to address atrazine concerns. This project was completed in 1997 and post project monitoring conducted in 1997, 2002, and 2009 documented significant reductions in atrazine concentrations in Recharge Lake. As a result of these reductions, atrazine was taken off the Section 303(d) list of impairments to Recharge Lake in 2010 (USEPA, 2010). This success has helped to demonstrate that atrazine impairments can be addressed through voluntary nonpoint source pollution management actions.

POLLUTANT SOURCES AND LOADS

Pollutant loads and source contributions were estimated using a combination of mathematical calculations and water quality modeling. Additional details including a summary of data, data sources, and methods can be found in the modeling documentation in Appendix C. Please note that due to rounding throughout the pollutant load calculation process the numbers presented under each source in the following tables may not precisely sum to the total load presented.

Nutrients and Sediment

Runoff loads of sediment, phosphorus, and nitrogen were estimated for the Recharge Lake drainage, as well as internal loads generated by waterfowl, resuspension, and phosphorus released by sediment. The average annual phosphorus and nitrogen loads to Recharge Lake are approximately 32,235 lbs/yr (Table 50), and 53,682 lbs/yr (Table 51). The average annual sediment load to Recharge Lake is estimated to be 6,050 tons/yr (Table 52). The largest contributor of all three constituents is land used for the production of corn and soybeans. Note that the acres listed in these tables may not add up precisely to the total area of the Target Area due to small rounding errors throughout the modeling process.

While phosphorus and nitrogen concentrations in Recharge Lake are excessive, algal production is generally minimal. Algae density, as measured by chlorophyll *a*, was below the water quality standard of 10 mg/m^3 in SIX of the 14 samples collected from 2002-2010. The average water clarity measurement for the period of record is approximately 14 inches, with several measurements less than 10 inches. It is believed that high lake turbidity caused by suspended sediment is currently limiting light penetration resulting in lower algae production. While Recharge Lake is not impaired for sediment, there is a minimal amount of data available to support that assessment. Lake volume bathymetric surveys should be conducted to provide accurate sediment deposition estimates.

Table 50: Phosphorus Sources and Average Annual Loads to Recharge Lake

Source	Acres	Annual Phosphorus Load (lbs/yr.)	% Contribution
External Loads			
Corn-Soybeans	7,490	17,078	53%
Non-permitted AFOs	4	900	3%
Unregistered OWTS (#)	49	239	<1%
Other crops	82	192	<1%
Grass-Pasture	408	164	<1%
Registered OWTS (#)	6	30	<1%
Urban	507	15	<1%
Atmospheric Deposition	44	7	<1%
Streambank (miles)	10.14	6	<1%
Forest	78	2	<1%
Internal Loads			
Waterfowl and Resuspension	44	12,700	39%
Bottom Sediment P Release	44	900	3 %
Total Load		**32,235**	**100%**

Source: Water Quality Modeling

Table 51: Nitrogen Sources and Average Annual Loads to Recharge Lake

Source	Acres	Annual Nitrogen Load (lbs/yr.)	% Contribution
External Loads			
Corn-Soybeans	7,490	46,747	87%
Non-permitted AFOs	4	4,931	9%
Unregistered OWTS (#)	49	609	1%
Other crops	82	525	1%
Grass-Pasture	408	422	<1%
Atmospheric Deposition	44	250	<1%
Urban	507	103	<1%
Registered OWTS (#)	6	76	<1%
Streambank (miles)	10.14	14	<1%
Forest	78	5	<1%
Total Load		**53,682**	**100%**

Source: Water Quality Modeling

Table 52: Sediment Sources and Average Annual Loads to Recharge Lake

Source	Acres	Annual Sediment Load (tons/yr.)	% Contribution
External Loads			
Corn-Soybeans	7,490	5,379	89%
Grass-Pasture	408	603	10%
Other crops	82	60	1%
Streambank (miles)	10.14	5	<1%
Urban	507	2	<1%
Forest	78	1	<1%
Non-permitted AFOs	4	0	0%
Unregistered OWTS (#)	49	0	0%
Registered OWTS (#)	6	0	0%
Total Load		**6,050**	**100%**

Source: Water Quality Modeling

REQUIRED POLLUTANT LOAD REDUCTIONS

The total phosphorus loading capacity for Recharge Lake was determined using the Canfield-Bachmann lake loading regression equation (Canfield & Bachmann, 1981). The phosphorus loading capacity as determined through this equation is based on net loads to the lake. In order to estimate net phosphorus loads, pollutant export through the outlet structure needed to be quantified. Due to the lack of data to estimate pollutant retention, a value of 61% was used to convert the net loading capacity to a gross loading capacity (Cunha et al. 2014).

The current in-lake phosphorus concentration of 495 ug/L will need to be reduced by 89.9% to meet the water quality standard of 50 ug/L (Table 53). The phosphorus load capacity associated with an in-lake concentration of 50 ug/L is approximately 590 lbs/yr according to the model. In order to meet the water quality standard, the current annual phosphorus load of 32,235 lbs/yr will need to be reduced by 31,645 lbs/yr or 98.2%.

The load reduction goal for total nitrogen was calculated based on the average of all available in-lake total nitrogen concentrations. With an average concentration of 2,180 ug/L, a 54.1% reduction is required to meet the water quality standard of 1,000 ug/L. Applying a 54.1% reduction to the current load of 53,682 lbs/yr would result in an annual load reduction goal of 29,057 lbs/yr (Table 54). Recharge Lake is not currently impaired due to sediment, so no reduction goal was established. However, sediment load reductions that could be achieved through BMP implementation were estimated.

Table 53: Phosphorus Reduction Goals for Recharge Lake

Total Phosphorus	Current Level	Water Quality Goal	Reduction Needed	
In-Lake Concentration	495 ug/L	50 ug/L	445 ug/L	89.90%
Pollutant Load	32,235 lbs/yr	590 lbs/yr	31,645 lb/yr	98.20%

Source: Water Quality Modeling

Table 54: Nitrogen Reduction Goals for Recharge Lake

Total Nitrogen	Current Level	Water Quality Goal	Reduction Needed	
In-Lake Concentration	2,180 ug/L	1,000 ug/L	1,180 ug/L	54.13%
Pollutant Load	53,682 lbs/yr	N/A	29,057	54.13%

Source: Water Quality Modeling

IMPLEMENTATION APPROACH

The implementation strategy for the Recharge Lake target area includes implementing multiple practices that target pollutant sources through the “treatment train” approach. In a treatment train approach, multiple complementary BMPs are installed in series to treat various pollutants with increased efficiency. All nonpoint pollutant sources are addressed using this approach. The identification of management practices and best suited locations were identified through stakeholder input, analysis of aerial imagery, and the Agricultural Conservation Planning Framework (ACPF) Tool. For a detailed description of BMPs, refer to Chapter 7.

To provide an accurate load reduction estimate from practice implementation, water quality modeling followed a treatment train approach. Figure 69 provides a general illustration of the target area’s treatment train, which is comprised of six levels of treatment. Pollutant load reductions begin with the implementation of education and outreach, and runoff is progressively treated (pollutants removed) until it reaches a receiving waterbody. This figure is meant for illustrative purposes only, as the exact approach to treatment varies based on pollutant sources, type, and location.

The implementation strategy presented in this plan should be used as a guide and may be subject to revision as new information becomes available. In all cases, only willing landowners will be included in this voluntary implementation strategy.

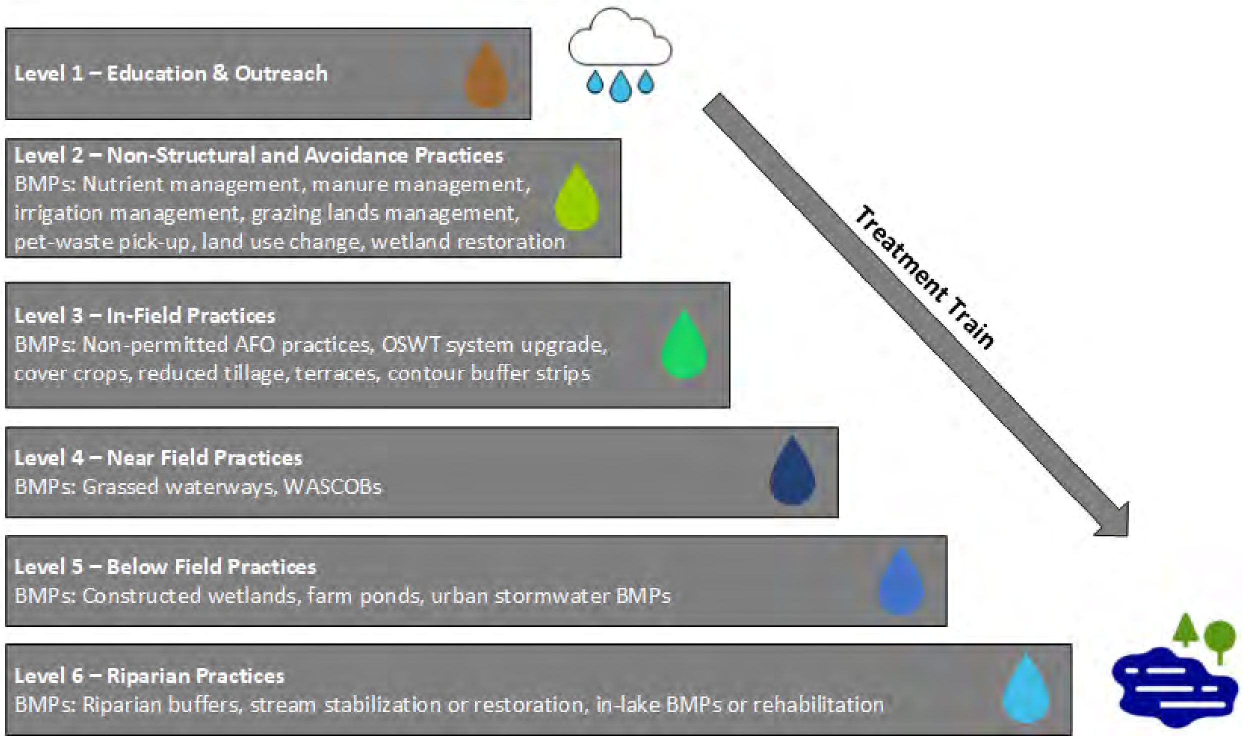


Figure 69: Implementation of Priority BMPs through a "Treatment Train" Approach

BMP TARGETING

Drainage Area Treatment

BMPs for the Recharge Lake target area are focused on reducing sediment and nutrient loads. By implementing these practices throughout the target area, effectiveness of downstream projects and BMPs will increase. Land used for corn and soybean production is targeted for the most practices (Table 55), but all pollutant sources are targeted by at least one BMP practice. Figure 70, Figure 71, and Figure 72 provide an overview of locations where BMPs could potentially be placed. While the locations identified in these maps are not final, they provide a starting point for discussion with willing landowners and also assisted in the development of the water quality models used in this plan. Note that some fields may have multiple BMPs. Riparian BMPs shown in Figure 72 are representative of the ideal locations for various buffers to be installed, but not of the physical extents of each buffer.

Table 55: Priority BMPs and Targeted Pollutant Sources for Recharge Lake

BMP	Pollutant Sources and Area Treated*								
	Entire Watershed	Corn and Soybean	Non permitted AFOs (#)	Pasture	Other Crops	Forest	Urban	Streambank (mi)	Septic Systems
Education & Outreach	8,549								
Avoidance		1,873							
Irrigation Water Management Practice Suite		2,996							
Reduced-Till		1,500							
No-Till		1,873							
Cover Crops		3,745							
Terraces		32							
Contour Buffer Strips		116							
WASCOBs		270		15	3				
Grassed Waterway		1,326			15				
Constructed Wetlands		2,582		141	28	27			
Farm Ponds/Sediment Basins		4		0.2	0.1	0.1			
Riparian Buffers		1,497		82	16				
Non-Permitted AFO Practice Suite (#)			2						
Grazing Management				204					
Urban Stormwater Practice Suite							228		
Stream Restoration / Stabilization (miles)	**							1.5	
Unregistered OWTS System Upgrade (#)									43
Pet Waste Pick-up (# of communities)							***		
Wetland Restoration		40****							
Land Use Change		897****							

Source: Water Quality Modeling
Area treated is in acres unless otherwise noted
**Stream restoration and stabilization also provide treatment to all upstream sources*
***Pet waste pick-up is generally applied on a community-scale. However, pet waste pick-up should be applied to the communal areas surrounding Recharge Lake to reduce E. coli entering the lake, and as a good public education and outreach activity.*
****Wetland restoration and land use change are both modeled by changing assigned land use acres from cropland (primarily corn and soybean) to wetlands and perennial vegetation, respectively, and therefore do not have a traditional treatment area.*

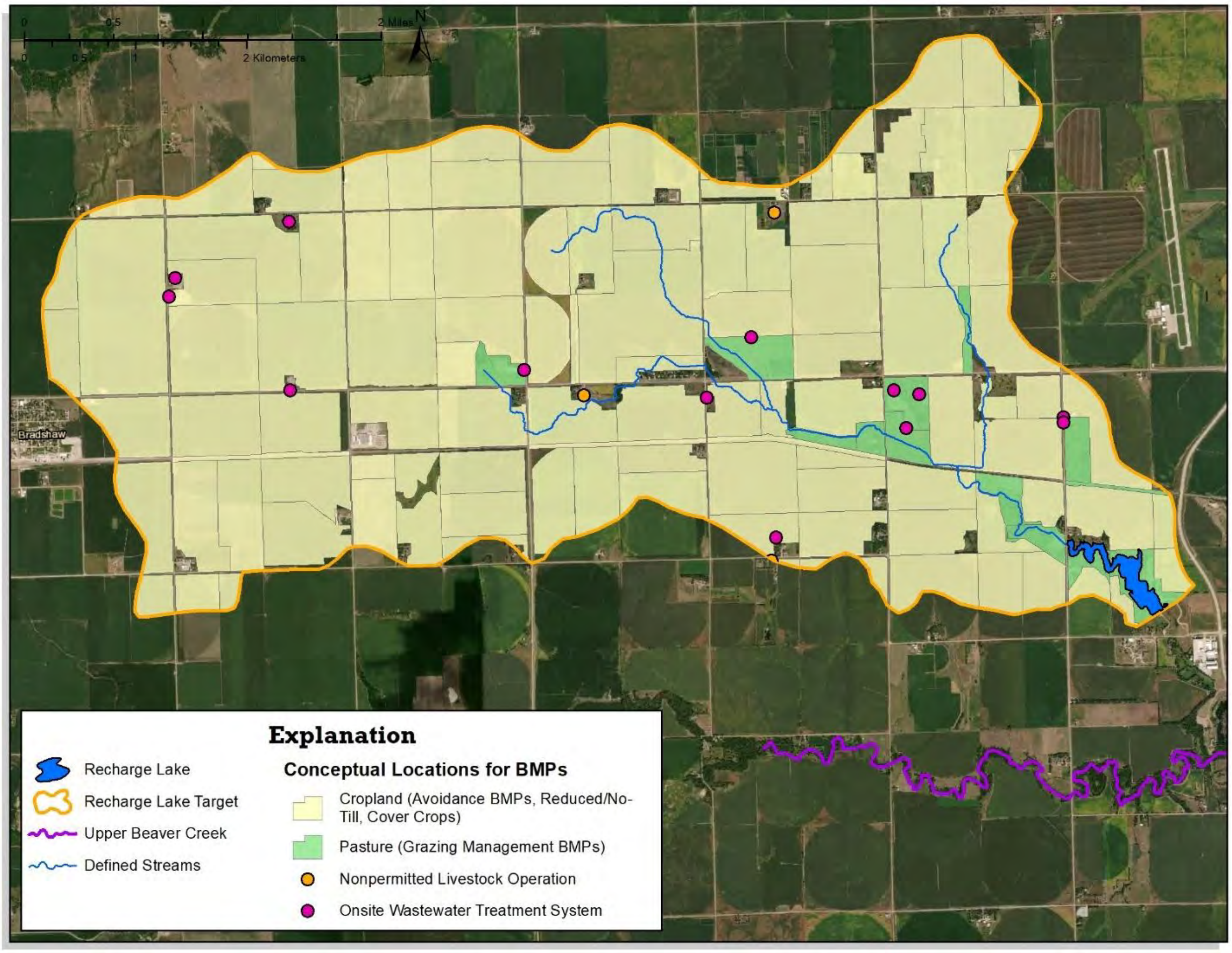


Figure 70: Conceptual Locations of Soil Health and Grazing Management BMPs

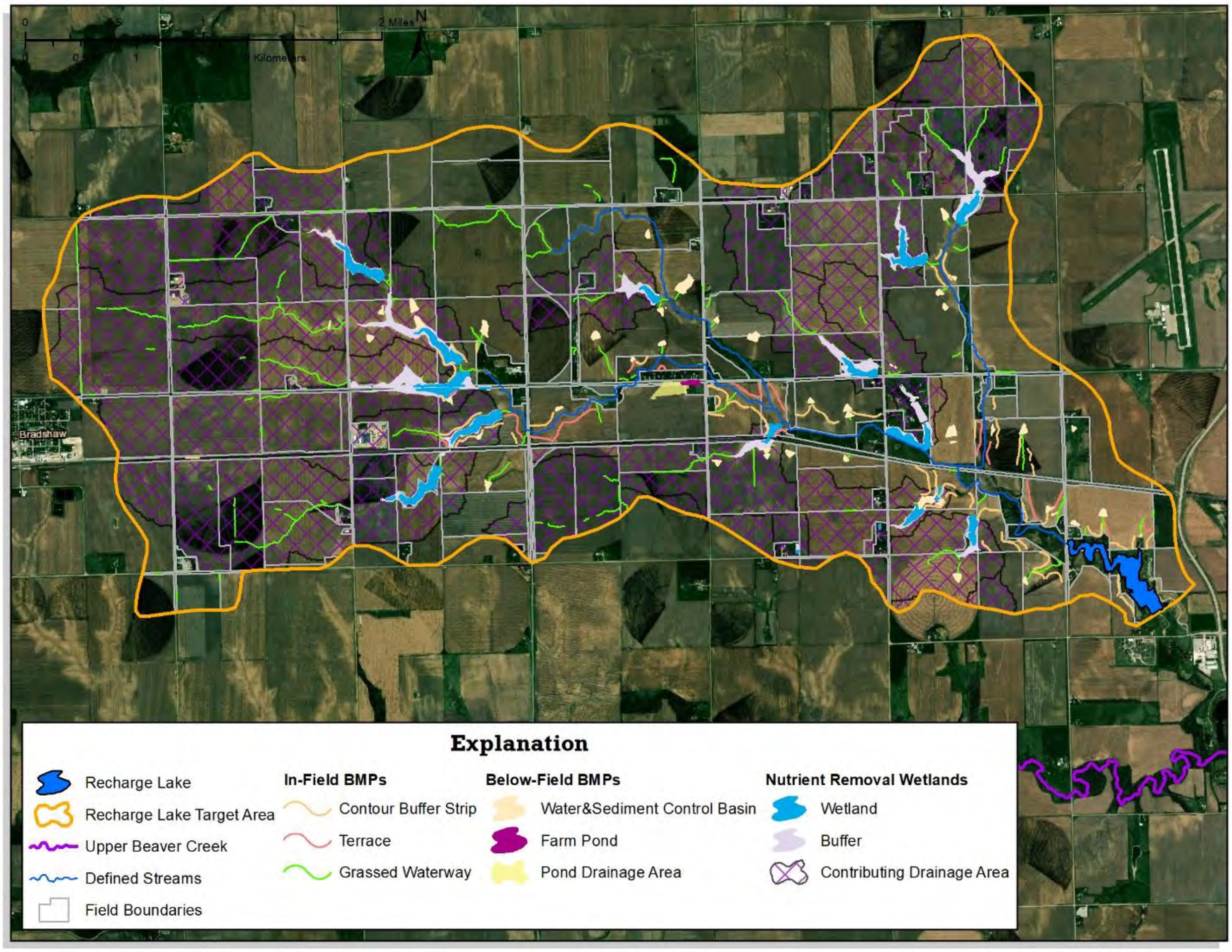


Figure 71: Conceptual Locations of In-Field and Below-Field BMPs

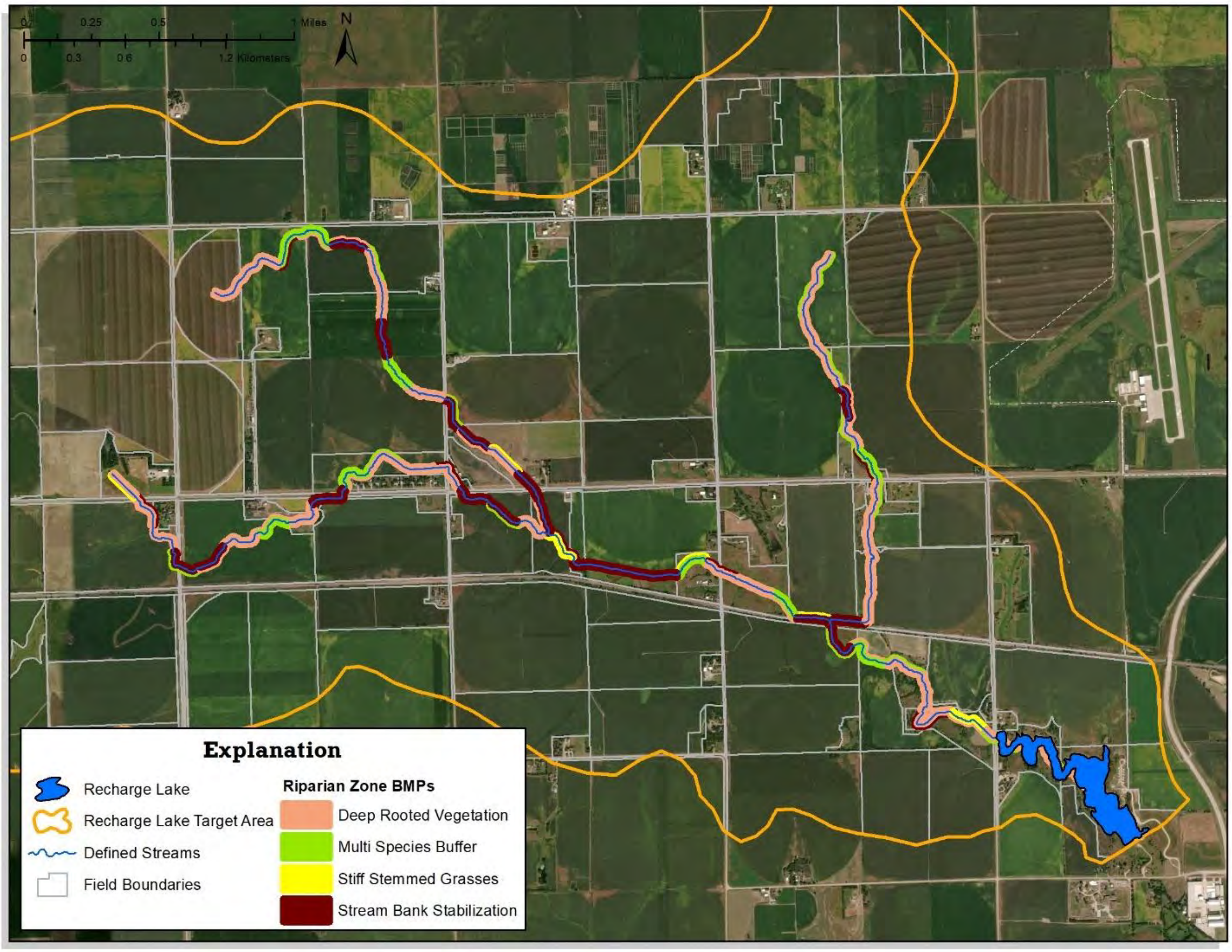


Figure 72: Conceptual Locations of Riparian Zone BMPs

In-Lake Treatment

The proposed implementation strategy for the Recharge Lake target area will achieve the nitrogen load reduction target of 54%. In contrast, it does not achieve the phosphorus loading reduction target of 98% due to the large contribution from in-lake sources. Therefore, in-lake management practices will be required to achieve phosphorus load reduction goals.

Although the conceptual locations for each practice have been identified (Figure 73), it is recommended that all in-lake management practices be further evaluated to facilitate the development of conceptual designs and accurate cost estimates. A complete and detailed feasibility study and renovation plan will need to be developed before any in-lake measures can be designed, permitted, and constructed. The following recommendations are based on all currently available data concerning Recharge Lake but may require alterations as more data becomes available.

Near-Lake Wet Detention Pond

A wet pond is a constructed basin that has a permanent pool of water throughout the year (or at least throughout the wet season) (TetraTech, 2018). Wet ponds remove sediment and nutrients through particle settling. Nutrient uptake also occurs through biological activity in the pond. Wet ponds are among the most cost-effective and widely used storm water treatment practices.

Road K that transects the upper end of Recharge Lake currently provides a constriction for stormwater runoff entering the lake (Figure 73). Additionally, the physical features of a wet pond currently exist on the west side of Road K. While the footprint of a wet pond exists, it appears to be providing minimal water quality benefits as stormwater flows short-circuit the larger pool area, minimizing particle settling opportunities. Enhancements could be made to this area to develop a functioning wet pond. Approximately 6 acres could be dedicated as a primary sediment storage basin which also acts as a near-lake wet detention pond. Enhancements would include increasing depth to accommodate additional sediment storage and installing structures to deflect stormwater flows which will increase water retention time in the basin.

Pollutant load reductions associated with the installation of a wet pond were estimated for sediment, phosphorus, and nitrogen. Reductions were based on expected loads after BMP implementation throughout the target area. Pollutant treatment efficiencies for this wet detention pond were modeled as the following (TetraTech, 2018):

- Phosphorus: 69%
- Nitrogen: 55%
- Sediment: 86%

In-Lake Wetlands

While the area directly west and east of Road K can be used as a primary area for sediment deposition, in-lake structures can be used to develop a 4.5 acre wetland area that will enhance small particle settling and help reduce turbidity in the main body of the reservoir (Figure 73).

Pollutant load reductions associated with in-lake wetlands were estimated for sediment, phosphorus, and nitrogen. Reductions were based on expected loads after BMP implementation throughout the target area and wet detention pond development. Pollutant treatment efficiencies for this in-lake wetland were modeled as the following (TetraTech, 2018):

- Phosphorus: 44%
- Nitrogen: 20%
- Sediment: 78%

Reservoir Deepening

Sediment removal from Recharge Lake will reduce bottom sediment re-suspension, increase the reservoir's ability to attenuate nutrients, and reduce in-lake phosphorus bound to sediment. Nitrogen reduction benefits were not determined for lake deepening due to the lack of available data and literature on the topic.

A goal of increasing the conservation pool storage volume reported in 2018 by 20% (62 acre-feet) was established (UBBNRD, 2018). If the 20% storage volume increase was achieved, current in-lake phosphorus concentrations would decrease by an estimated 40.7 ug/L. This equates to an annual phosphorus load reduction of 10%.

Areas of Recharge Lake that are less than ten feet deep should be considered a higher priority for sediment removal. While current depths have not been documented, a majority of the sediment removal would occur in the upper portion of the reservoir (Figure 73). A number of different methods can be used to remove deposited sediment including: sluicing, hydraulic dredging, and dry excavation. Although all options should be evaluated, dry excavation is generally the most cost-effective and has been the most commonly used on lakes in this area.

Island Stabilization

While lake shoreline erosion is occurring in isolated spots, a larger concern is the loss of the large island located in the center of Recharge Lake. Reconnaissance level estimates indicate the island has lost approximately 60% of its surface area due to erosion. One side of the elongated island is exposed to prevailing southeast winds in the summer and fall seasons. Impacts of wind and wave action on the island contribute to lake turbidity and the loss of reservoir volume. Approximately 506 feet of the south facing island shoreline would need to be stabilized (Figure 73). A common alternative is adding a ribbon of rock riprap to "armor" the shoreline. Dredged materials from reservoir deepening may also be added to the island to help increase the surface area towards previous levels.

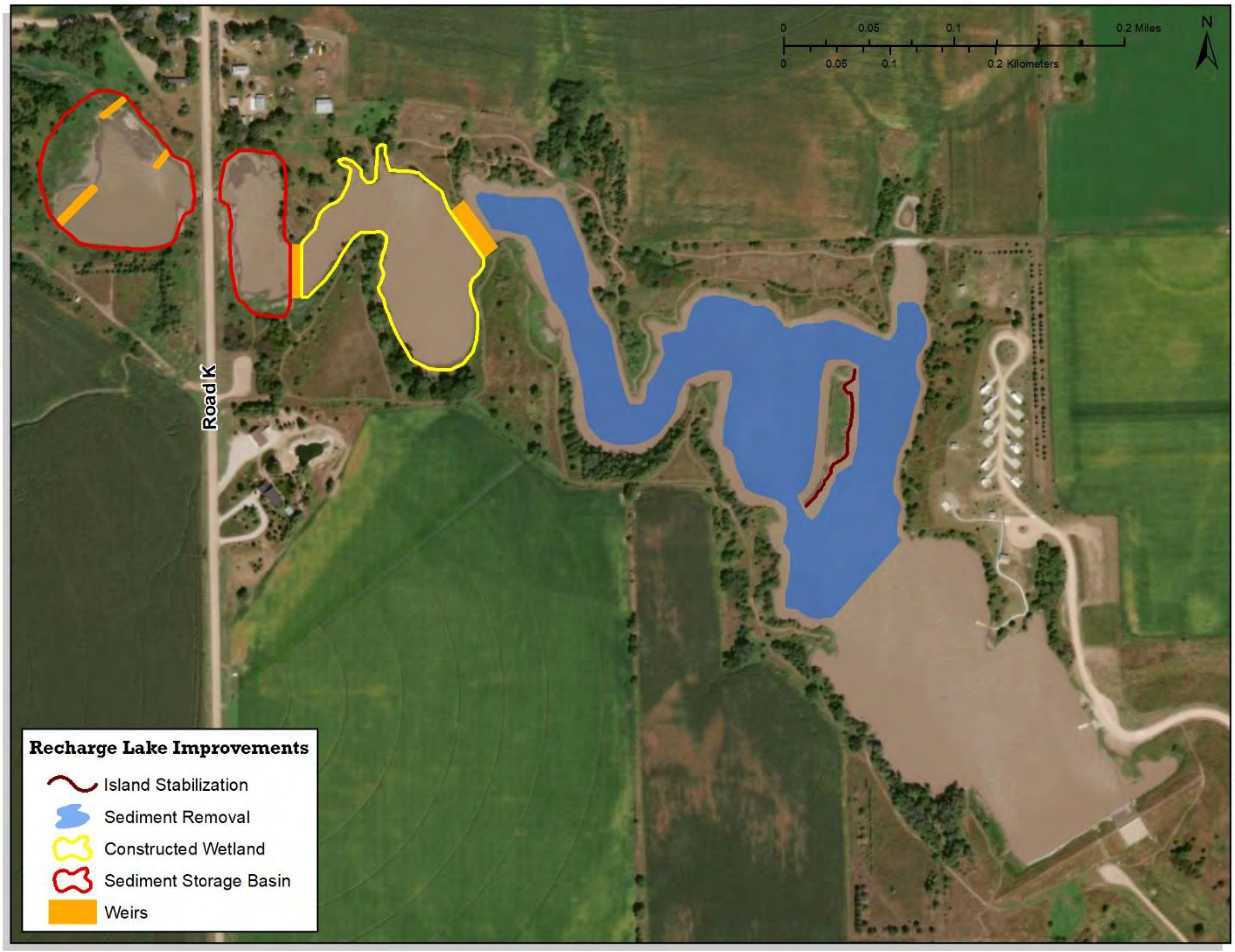


Figure 73: Conceptual Locations for In-Lake BMPs for Recharge Lake

CRITICAL SOURCE AREAS

Critical Source Areas (CSAs) are relatively small fractions of a watershed that generates a disproportionate amount of the pollutant load (Meals, 2012). As discussed in Chapter 7, 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 most likely needed and allows for financial and technical resources to be used most efficiently.

CSAs in the Recharge Lake 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 that waterbody

Once the assessment is complete, each field received a relative risk classification, ranging from A (very high risk – most critical), to B (high), C (moderate), D (low), and other (‘unknown’). One limitation of this tool is that only agricultural land uses (cropland or pasture) are included, while 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). An “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. The Recharge Lake target area contains 2,137.6 acres of CSAs (Figure 74), which are broken down as follows:

- Very High Risk CSA: 658.1 acres
- High Risk CSA: 1,479.5 acres

Also displayed in Figure 74 are riparian critical zones identified using the ACPF Tool. Critical zones occur in areas where high runoff and shallow water tables intersect within the stream corridor. Critical zones have the greatest chance of anywhere along the length of a stream to deliver pollutants directly into the water system. These are important locations for the installation and management of riparian buffers or other BMPs. Two critical zones were identified in the Recharge Lake target area.

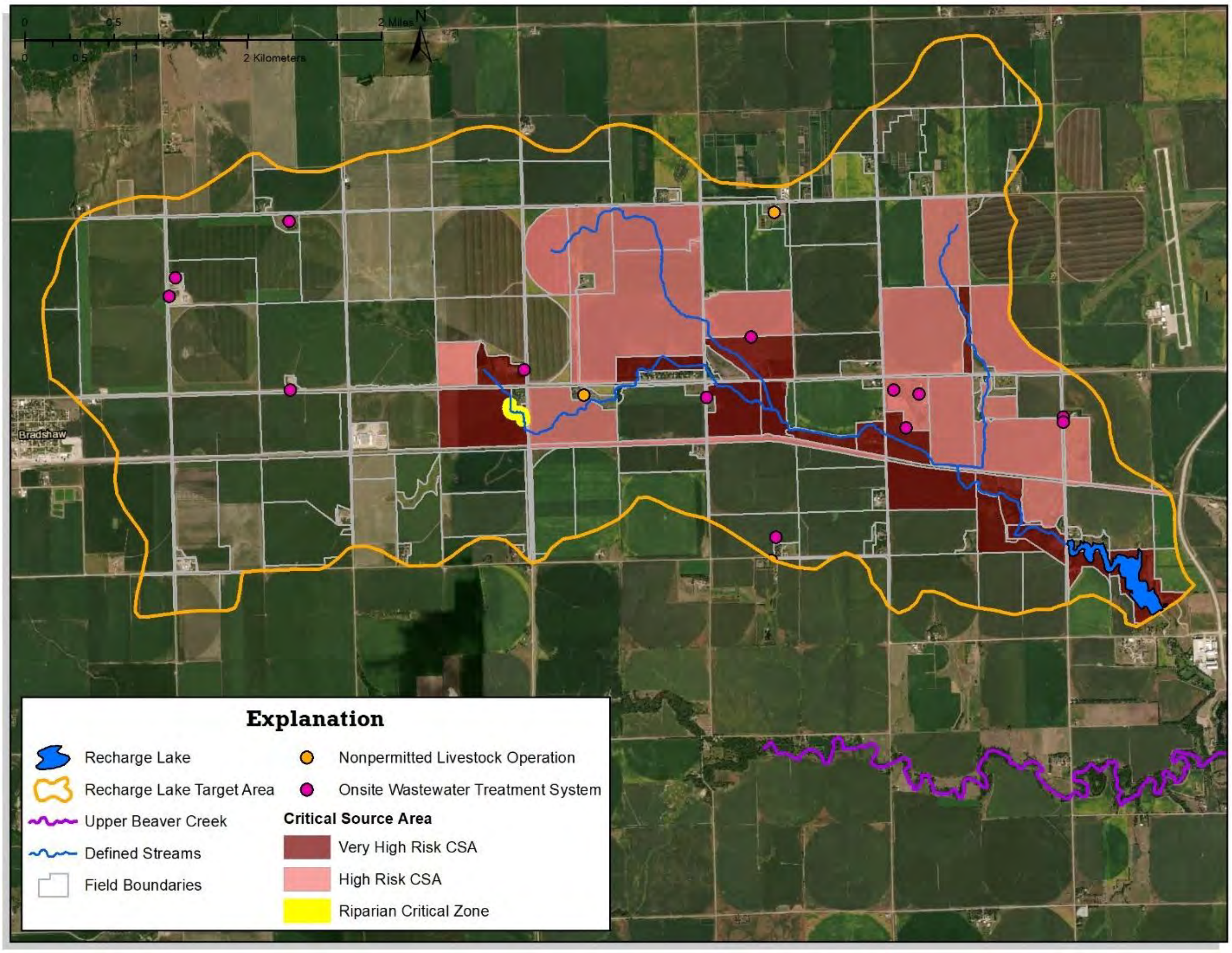


Figure 74: Critical Source Areas in the Recharge Lake Target Area

MEETING WATER QUALITY STANDARDS

Implementing a comprehensive strategy for Recharge Lake that includes management practices both throughout the watershed and within the lake will result in the lake meeting water quality standards for nitrogen and phosphorus. While the lake is not impaired from algae density, as water clarity increases high nutrient concentrations will result in more algae growth. It is assumed that if lake nutrient concentrations meet the water quality standards, algae biomass will also meet the standard.

On their own, drainage area BMPs will reduce the phosphorus load by 36%. In-lake measures will play a large role in achieving water quality goals. In-lake BMPs will reduce the phosphorus load by an additional 63%, yielding a cumulative phosphorus reduction of 99%. If the phosphorus load reduction goal is achieved, the in-lake phosphorus concentration is expected to be 44 ug/L, which falls below the standard of 50 ug/L (Table 56).

Drainage area BMPs will result in a 57% reduction in total nitrogen loads. In-lake measures will reduce the nitrogen load by an additional 28%, resulting in a cumulative nitrogen load reduction of 85%. If the load reduction goal is achieved, the in-lake nitrogen concentration is expected to be 345 ug/L, which is well below the water quality standard of 1,000 ug/L (Table 56).

While no reduction goal was established for sediment, load reductions associated with management measures were estimated. Drainage area BMPs account for a 55% reduction to sediment loads to Recharge Lake while in-lake measures account for an additional 44% reduction, yielding a cumulative sediment load reduction of 99% (Table 56).

Although nutrient reduction benefits of implementing external and internal management practices have been estimated and provide a path to meeting water quality standards (Table 57), 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 Recharge Lake.

Table 56: Estimated Pollutant Load Reductions for Recharge Lake

Pollutant Load Reductions	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	Sediment (tons/yr)	Sediment (acre ft/yr)
Beginning Load	32,235	53,682	6,050	2.78
Load reduction from drainage area BMPs	11,449	30,530	3,343	1.53
Load reduction from in-lake BMPs	20,425	14,818	2,624	1.20
Final pollutant load	361	8,334	83	0.04
Total Reduction	99%	85%	99%	99%

Source: Water Quality Modeling

Table 57: Pollutant Load Reduction Goals for Recharge Lake

Pollutant	Load Reductions		In-Lake Concentration (ug/L)			Will Waterbody Meet Water Quality Standards or Goals?
	Goal	Modeled	Current	WQS or Goal	Modeled	
Total Phosphorus	98%	99%	495	50	44	Yes
Total Nitrogen	54%	84%	2,180	1,000	345	Yes

Source: Water Quality Modeling

MONITORING AND EVALUATION

Monitoring

The UBBNRD will follow standard operating 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 NDEE, the Nebraska Game and Parks Commission (NGPC), Natural Resources Conservation Service (NRCS), and the Nebraska Department of Natural Resources (NeDNR). Steps will be taken to ensure collection of scientifically valid data, which may include the development of Quality Assurance Project Plans (QAPPs) for state and federal review. Additional guidance and references are located in Chapter 4.

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 Recharge Lake target area. Targeted parameters, monitoring sites, and monitoring frequency have been defined to meet each objective. Resource agencies should prioritize these goals and objectives and plan monitoring strategies accordingly. 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 and funding.

Monitoring Goal 1: Evaluate the water quality condition of Recharge Lake

Monitoring Objective 1 Evaluate beneficial use support and water quality trends for Recharge Lake

- Monitoring parameters: Total phosphorus, total kjeldahl nitrogen, nitrate-nitrite nitrogen, total suspended solids, chlorophyll *a*, atrazine
- Monitoring site: Deepwater Site (LBB3RECHRG01) (Figure 75)
- Monitoring frequency: (Annual) Monthly from May – September

Monitoring Objective 2 Document current atrazine concentrations in the primary inflow to Recharge Lake

- Monitoring parameter: Atrazine
- Monitoring site: Upstream of County Road K, sufficiently upstream enough to avoid backwater effects from lake
- Monitoring frequency: (Annual) Runoff events from May - June

Monitoring Objective 3 Estimate the current lake conservation pool storage volume

- Conduct bathymetric survey
- Conduct spatial assessment of soft sediment using ground penetrating radar or manual sediment depth measurements

Monitoring Goal 2: Estimate pollutant loads and source contributions to Recharge lake

Monitoring Objective 4 Quantify sediment, nutrient, and atrazine runoff loads for the Recharge Lake target area

- Monitoring parameters: Total phosphorus, total kjeldahl nitrogen, nitrate-nitrite nitrogen, total suspended solids, atrazine, stream discharge
- Monitoring site: Upstream of County Road K, sufficiently upstream enough to avoid backwater effects from lake
- Monitoring frequency: (Annual) Runoff events from May - September

Monitoring Objective 5 Verify sediment and nutrient loads stemming from streambank erosion

- Streambank migration: Specialized study

Monitoring Objective 6 Quantify internal phosphorus, nitrogen, and sediment loads to Recharge Lake from specific sources

- Lake shoreline migration: Specialized study
- Bottom sediment phosphorus release: Specialized study
- Bottom sediment resuspension: Specialized study
- Waterfowl waste nutrient loads: Specialized Study

Monitoring Objective 7 Estimate the current lake conservation pool storage volume

- Conduct bathymetric survey

Monitoring Objective 8 Quantify annual lake retention of phosphorus, nitrogen, and sediment

- Monitoring parameters: Total phosphorus, total kjeldahl nitrogen, nitrate-nitrite nitrogen, total suspended solids
- Monitoring site: Lake outflow (to supplement established sites)
- Monitoring frequency: (Annual) When discharge occurs from January – December

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

Monitoring Objective 9 Evaluate spatial sediment deposition in Recharge Lake

- Conduct spatial assessment of soft sediment using ground penetrating radar or manual sediment depth measurements

Figure 75: Monitoring Site Location

Evaluation

The ultimate purpose of establishing sound evaluation criteria is to learn from past successes and failures and improve nonpoint source pollution management approaches. As such, evaluation criteria have been established to assess all aspects of implementing this plan. Criteria include implementation strategies, education programs, monitoring networks, and overall project management. The review process should answer the following key questions:

- Which techniques and approaches worked?
- Which techniques and approached did not work?
- What were the major obstacles?
- Did the project solve the problem that it was designed to address?
- What lessons were learned that can be applied to future projects?
- Which on-the-ground techniques (or BMPs) were most accepted by landowners?

Post project reviews will consider both quantitative and qualitative metrics. Quantitative metrics will require the collection and assessment of environmental data. Review criteria should be summarized and included in final project reports.

Qualitative Metrics: Project Implementation and Administration

- Project completed on time
- Project completed on budget
- Success in meeting project goals
- Success of meeting project milestones and schedules
- Positive and negative feedback received from stakeholders and the public
- Positive and negative feedback received from UBBNRD board members, NGPC, NDEE, and other project partners
- Positive and negative feedback received from landowners implementing BMPs
- Required information delivered to agencies and funding partners
- Problematic areas of the project and needed changes for future efforts
- Adequate technical and financial support of the project

Quantitative Metrics: Environmental Outcomes

- Status of meeting measurable project objectives
- Performance of management practices and pollutant load reductions
- Changes in stream water quality, habitat, or biological communities
- Changes in lake water quality, habitat, or biological communities
- Progress in meeting water quality standards
- Removal from the Section 303(d) list
- Changes in public use of the resource

Many nonpoint sources projects do not result in immediate and measurable changes in water quality. The evaluation of the quantitative metrics may require long-term monitoring commitments.

COMMUNICATION AND OUTREACH

Chapter 6 of this plan provides a broad programmatic approach that the UBBNRD 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 Recharge Lake target area were identified via stakeholder and public input, and are as follows:

- Identified Target Audiences
  - Recreational users of Recharge Lake
  - Pheasants Forever – Corn Country and Lincoln Creek Chapters
  - Land managers, residents, and property owners within the Recharge Lake target 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 information 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 Recharge Lake 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 local events
    - Hold targeted coffee shop meeting, 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.
  - Hold an outdoor recreation clinic (kayaking, birdwatching, etc.) utilizing the Recharge Lake recreation area.

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.

SCHEDULE

A timeframe for implementing general actions is provided in Table 58. Actions are subject to approval by the UBBNRD Board of Directors, or other project sponsors, and may change as the plan is implemented. Phase I activities will include the initiation of drainage area BMPs and in-lake BMPs. Phase II will begin upon the five-year revision of this plan and will include any implementation that was not completed during Phase I. A summary of progress achieved during Phase I will be included in the plan revision.

Table 58: Schedule for Implementation within the Recharge Lake Target Area

Activity	Phase I						Phase II
	2019	2020	2021	2022	2023	2024	2025-2029
UBBNRD approval of the plan	■						
Monitoring (ongoing)	■	■	■	■	■		
Organize stakeholder groups		■	■	■			
Drainage area BMP implementation			■	■	■	■	
In-Lake 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 59. These milestones will be used to gauge progress towards meeting the desired project schedule. As the implementation of this plan is initiated, milestones will be adjusted accordingly for changes to the schedule.

Table 59: Milestones for Implementation Inside the Recharge Lake Target Area

Activity		Phase I						Phase II
		2019	2020	2021	2022	2023	2024	2025-2029
Monitoring	Coordinate with NDEE	■	■	■	■	■		
	Finalize strategies and QAPPs		■					
	Assess data (annually)	■	■	■	■	■		
Planning	Drainage area BMP PIP		■		■			
	In-Lake BMPs Final Engineering			■	■			
	In-Lake BMPs 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		■	■	■	■	■	
	In-Lake BMPs					■	■	

COST

The preliminary opinion of total cost of implementing the nonpoint source pollution control strategy for the Recharge Lake Target Area is estimated to be $5,954,280 (Table 60). These costs are approximate numbers only and were identified based on the requirements to meet water quality standards. This does not include costs for bathymetric surveys or final designs of engineering projects as these costs would be contingent on project scoping. When possible, costs were determined from the 2019 United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Environmental Quality Incentives Program (EQIP) practice payment schedule (USDA, 2019). 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 designs, inflation, bidding climate at the time of construction, and project size and complexity.

Table 60: Implementation Costs for the Recharge Lake Target Area

Practice	Units	Units Applied	Unit Cost	Total Cost
Education/Outreach	Year	5	$2,000	$10,000
Non-Structural/Avoidance	Acre	1,870	$55	$102,850
OWTS Upgrade	Each	43	$5,500	$236,500
Pet Waste Pickup	Each	1	$5,000	$5,000
Irrigation Water Management Suite	Acre	3,000	$34	$102,000
Grazing Lands Management Suite	Acre	200	$21	$4,200
Cover Crops	Acre	3,700	$66	$244,200
Riparian Buffers	Acre	30	$1,634	$49,020
No-Till	Acre	1,870	$22	$41,140
Reduced-Till	Acre	1,500	$42	$63,000
Contour Buffer Strip	Acre	10	$288	$2,880
Non-Permitted AFO Suite	Each	2	$20,000	$40,000
Farm Ponds/Sediment Basins/Wetland Construction	Each	9	$46,200	$415,800
Wetland Restoration	Acre	40	$3,277	$131,080
Terraces	Foot	9,200	$3	$27,600
WASCOBs	Foot	11,100	$3	$33,300
Grassed Waterway	Acre	30	$6,357	$190,710
Land Use Change	Year	5	$1,000	$5,000
Urban Stormwater Practice Suite	Year	0	$10,000	$0
Subtotal (Drainage Area Treatment)				**$1,704,280**
Stream Restoration/Stabilization	Foot	8,000	$167	$1,336,000
Subtotal (In-Stream Work)				**$1,336,000**
Island Stabilization	Foot	500	$350	$175,000
Sediment Removal	CY	57,600	$16	$921,600
Treatment Wetland	Acre	5	$25,000	$125,000
Sediment Basins	CY	28,900	$16	$462,400
Rock Weirs	Ton	2,900	$100	$290,000
Engineering	Each	1	$865,000	$865,000
Subtotal (In-Lake Work)				**$2,839,000**
Updates to Watershed Plan	Each	1	$25,000	$25,000
Additional Monitoring	Year	5	$10,000	$50,000
Subtotal (Planning/Monitoring)				**$75,000**
Total				**$5,954,280**

11.04 BEAVER CREEK TARGET AREA

INTRODUCTION

The Beaver Creek Target Area is made up of eight HUC 12 subwatersheds totaling 193,124 acres (Table 61 and Figure 76). Note that the HUC 12 subwatersheds are labeled by their last three digits in Figure 76. Beaver Creek is comprised of two segments, (BB3-10300 and BB3-10400) that extend approximately 39 miles (NDEQ, 2018a). Lower Beaver Creek consists of two HUC 12 subwatersheds, while Upper Beaver Creek consists of six HUC 12 subwatersheds. Beneficial uses assigned to Beaver Creek include: Aquatic Life, Aesthetics, and Agricultural Water Supplies (NDEQ, 2014).

The Aquatic Life beneficial use is assigned to both segments of Beaver Creek, and both segments are currently impaired for this use from different causes (NDEQ, 2018a). The impairment designation for the upstream reach stems from poor aquatic communities, while the lower reach is impaired due to atrazine.

Table 61: HUC 12 Subwatersheds in the Beaver Creek Target Area

HUC 12	Area (acres)	% of Total Drainage Area
Lower Beaver Creek		
102702030401	25,165	13.03%
102702030402	27,626	14.30%
Upper Beaver Creek		
102702030403	24,287	12.58%
102702030404	22,784	11.80%
102702030405	16,367	8.47%
102702030406	22,282	11.54%
102702030407	30,747	15.92%
102702030408	23,866	12.36%
Total	**193,124**	**100%**

Source: Water Quality Modeling

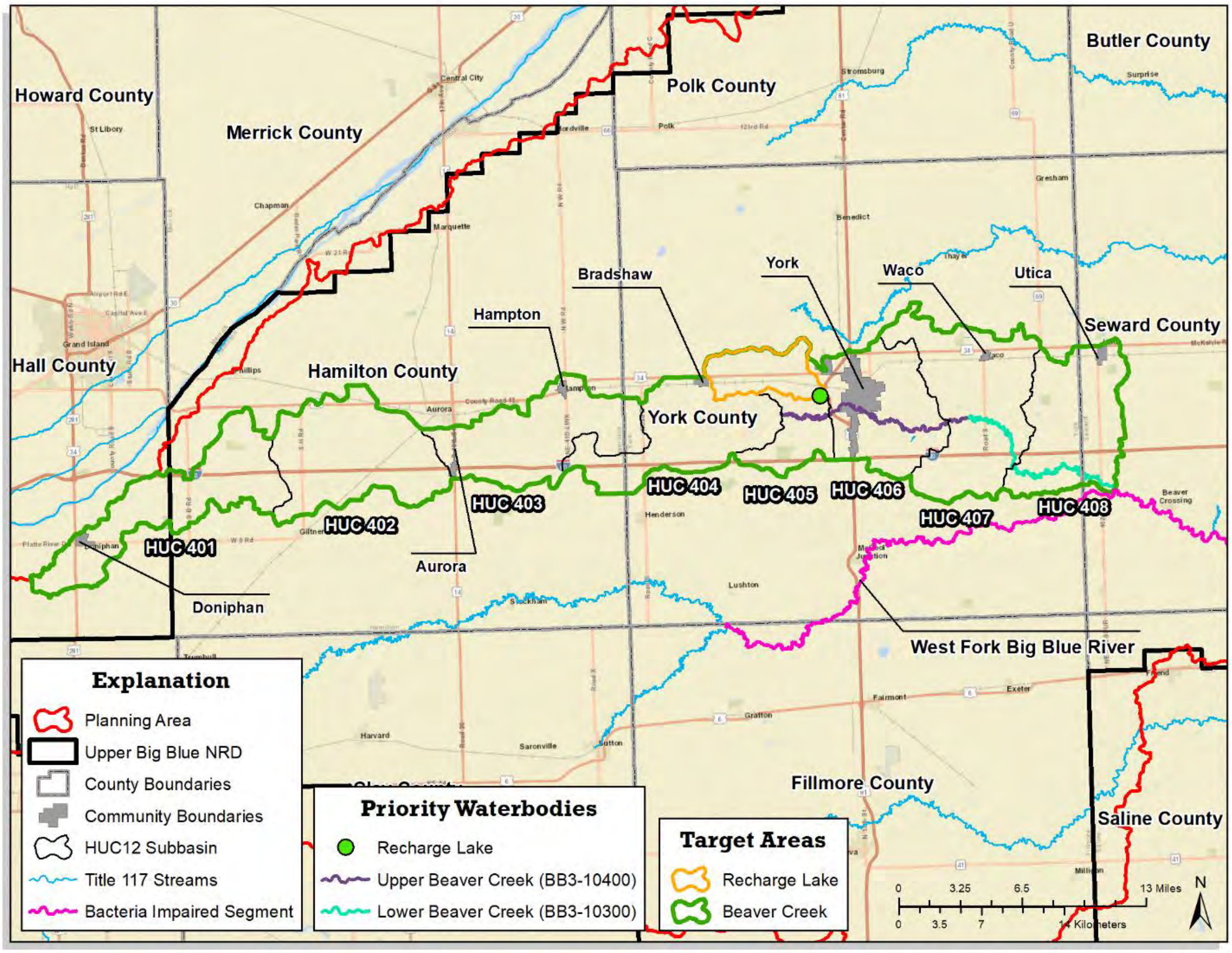


Figure 76: Location of the Beaver Creek Target Area

IMPAIRMENTS

NDEE has completed Aquatic Community assessments on both segments of Beaver Creek. Based on the results of these assessments, Upper Beaver Creek was assigned an impairment designation due to poor aquatic communities (NDEQ, 2018a). Aquatic community health is based on three factors: aquatic insect community health, fish community health, and habitat quality. While aquatic habitat and the fish community were assigned a “good” rating, the aquatic insect community was assigned a “poor” rating resulting in the impairment listing (NDEQ, 2011a).

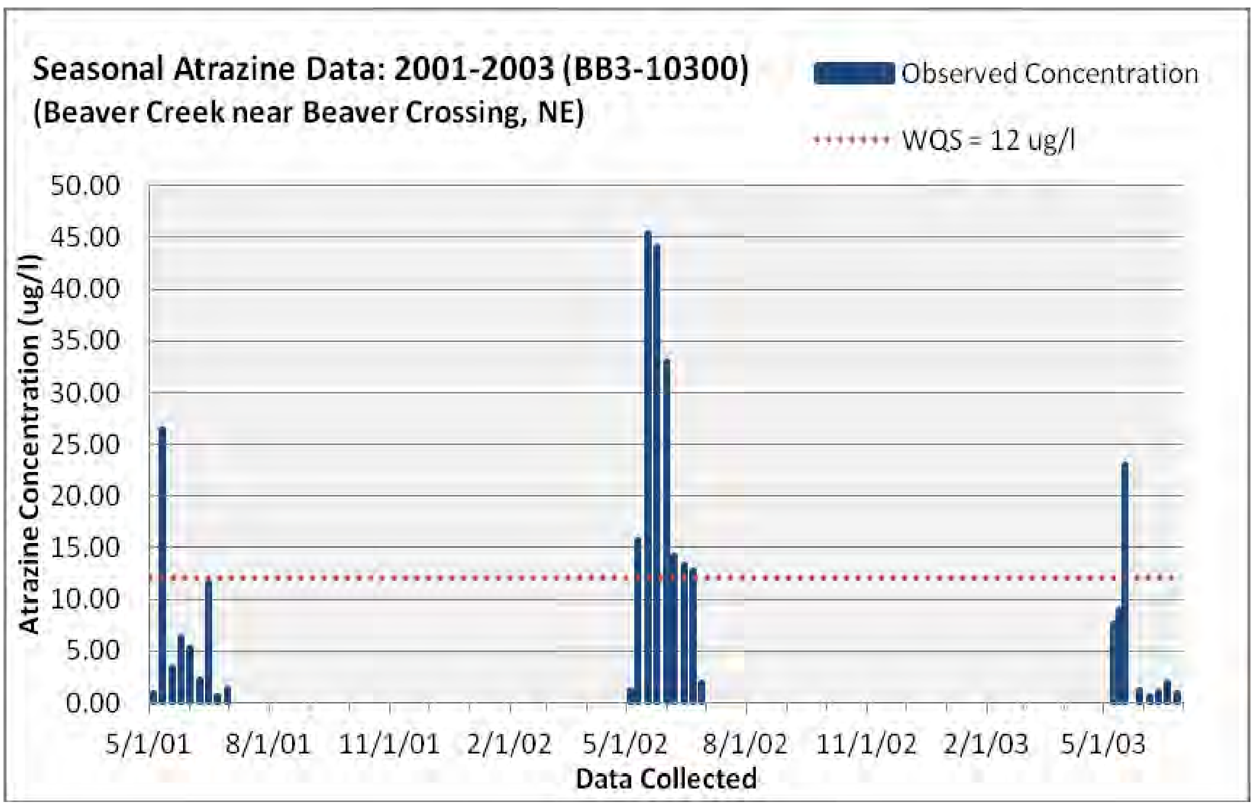
In 2013, NDEE completed a Total Maximum Daily Load (TMDL) for multiple segments in the Big Blue River Basin that are impaired from atrazine, including Lower Beaver Creek (NDEQ, 2013). Data and information provided in the TMDL were used as a basis for developing BMP strategies to reduce atrazine concentrations in Beaver Creek.

Atrazine data for Beaver Creek was collected west of Beaver Crossing from 2001-2003 (NDEQ, 2013). A total of 95 samples were collected representing all 12 months (Table 62). 77 samples (81%) were collected from April through September. A total of nine samples exceeded the chronic atrazine standard of 12 ug/L, all of which were collected in May and June. The highest sample collected was on May 17, 2002 with a concentration of 45.46 ug/L. Because of these results, the TMDL was developed for seasonal May-June atrazine impairments (Figure 77).

Table 62: Summary of Atrazine Samples Collected from Lower Beaver Creek

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Avg. Atrazine Con. (µg/l)	0.3	0.3	0.3	0.7	16.7	5.2	2.2	0.8	0.3	0.3	0.3	0.3
# Above WQS	0	0	0	0	6	3	0	0	0	0	0	0
# of Samples	2	4	4	12	12	13	12	15	12	2	4	2

Source: NDEQ, 2013



Source: NDEQ, 2013

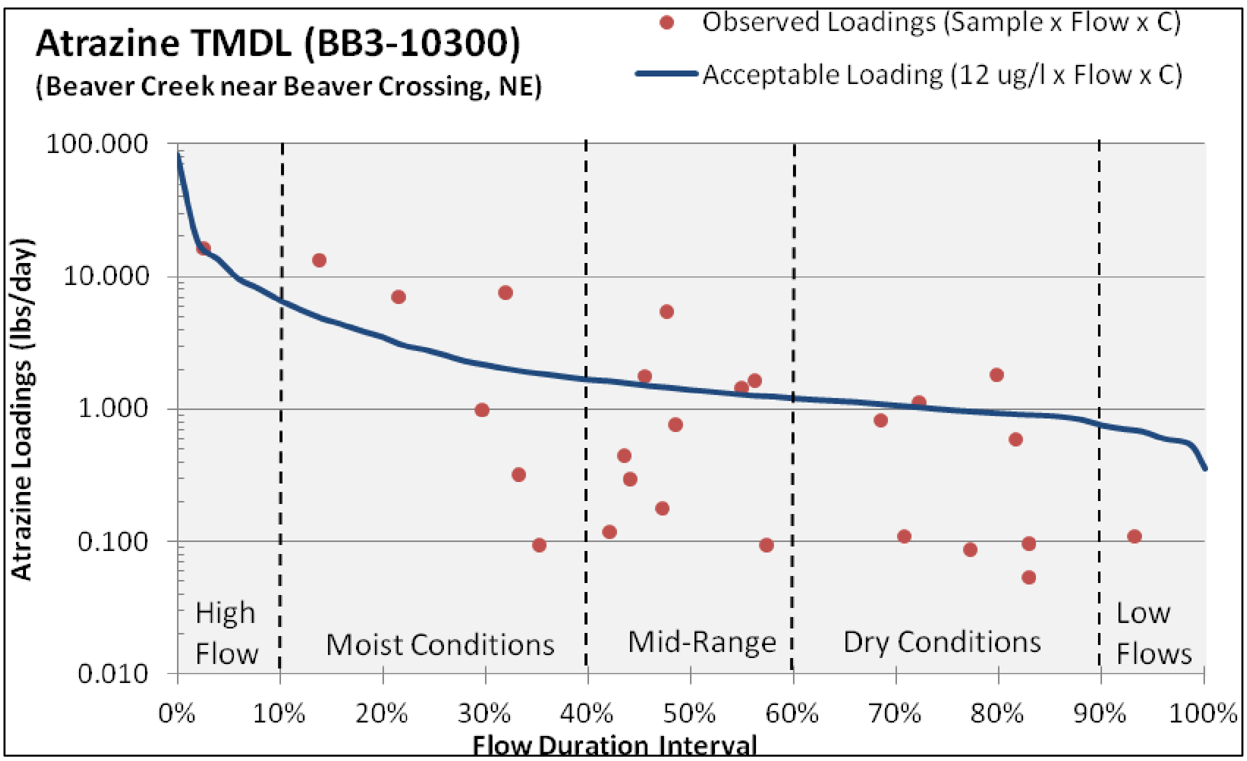
Figure 77: Seasonal Atrazine Data for Beaver Creek

POLLUTANT SOURCES AND LOADS

Pollutant load contributions were estimated using a combination of mathematical calculations and water quality modeling. Additional details including a summary of data, data sources, and methods can be found in the modeling documentation in Appendix C. Please note that due to rounding throughout the pollutant load calculation process the numbers presented under each source in the following tables may not precisely sum to the total load presented.

Atrazine

Atrazine is a triazine herbicide currently registered in Nebraska 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 (UESPA, 2018). As sorghum was only grown on 333 acres (<1%) of the Beaver Creek drainage in 2017, 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 Beaver Creek has been allocated to land used for corn production (111,047 acres in 2017). Atrazine loads and reduction goals for Beaver Creek were determined as part of the 2013 TMDL (NDEQ, 2013). Atrazine loads were calculated by NDEE from sample concentrations and estimates of stream discharge (Figure 78).



Source: NDEQ, 2013

Figure 78: Atrazine Loads to Beaver Creek

The contribution of atrazine to the lower reach of Beaver Creek from individual HUC 12 subwatersheds (Figure 76) was estimated based on the amount of corn in each HUC 12 drainage and the highest measured atrazine concentration of 45.46 ug/L (collected on 05/17/2002). Subwatershed contributions of atrazine ranged from 8.1% to 16.1% (Table 63).

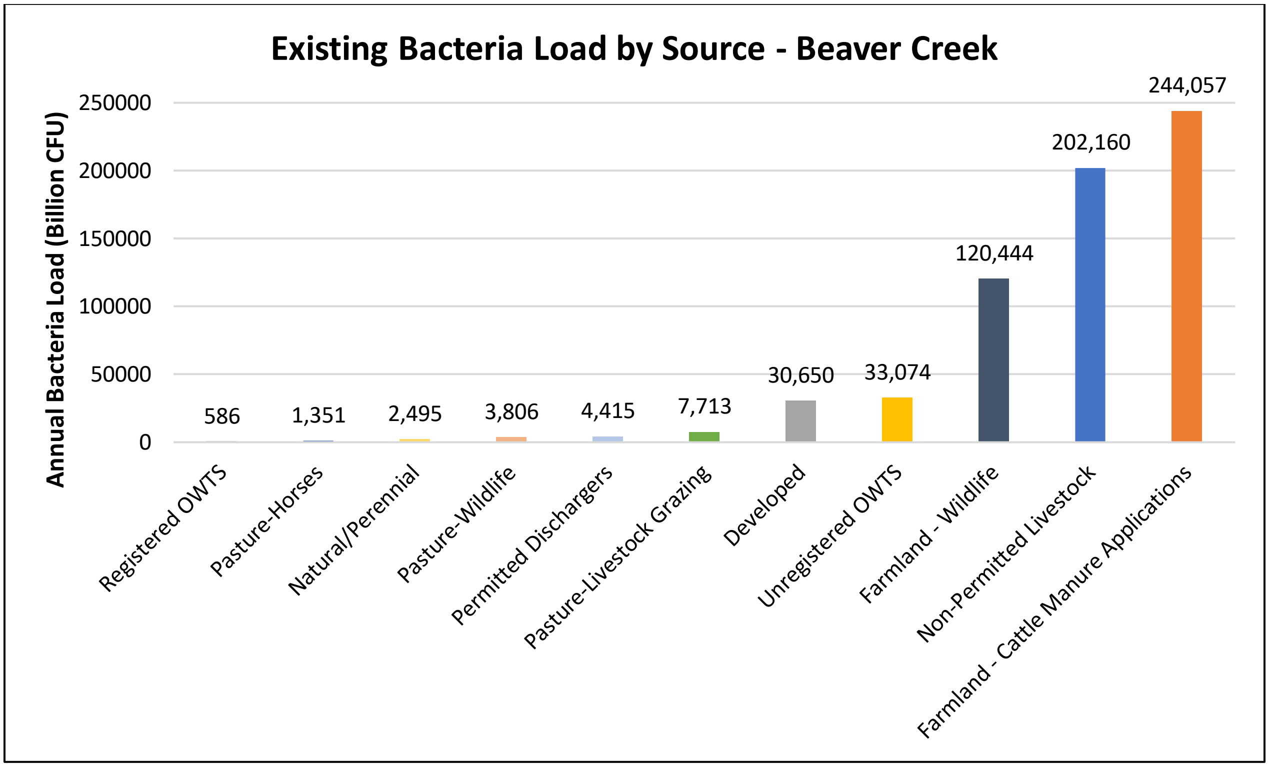
Table 63: Contribution of Atrazine to Beaver Creek per HUC12

HUC12	Atrazine Contribution (µg/L)	Atrazine Contribution (%)	Corn Acres
102702030401	6.58	14.50%	16,077
102702030402	7.3	16.10%	17,838
102702030403	6.26	13.80%	15,311
102702030404	5.94	13.10%	14,525
102702030405	3.68	8.10%	8,997
102702030406	3.92	8.60%	9,588
102702030407	6.6	14.50%	16,136
102702030408	5.14	11.30%	12,573
Total	**45.46**	**100.0%**	**111,045**

Source: Water Quality Modeling

E. coli Bacteria

The average annual *E. coli* load carried by Beaver Creek is estimated to be 650,751 billion colony forming units (CFU) (WWE, 2019). The largest contributors of bacteria to Beaver Creek are cattle manure applied to farmland (40%), and non-permitted AFOs (29%) (Figure 79). While Beaver Creek itself is not impaired for *E. coli*, the downstream West Fork Big Blue River (BB3-10000) is.



Source: WWE, 2019

Figure 79: Existing *E. coli* Bacteria Loads and Sources to Beaver Creek

REQUIRED POLLUTANT LOAD REDUCTIONS

Since no water quality standards for phosphorus, nitrogen, or sediment apply to Beaver Creek, no reduction goals have been established. However, load reductions that could be achieved from BMP implementation were estimated.

Atrazine

As part of the TMDL, NDEE determined atrazine reductions necessary for Beaver Creek to meet the chronic water quality standard of 12 ug/L (NDEQ, 2013). The average required reduction determined for each flow condition ranges from zero for low flows, to 74% for moist conditions (Table 64). The maximum allowable atrazine load ranges from less than one lb/day under the lowest flow condition to over 82 lbs/day during the highest flows (Table 65). In order to provide the maximum protection to the stream, the TMDL targeted the highest measured atrazine concentration as the basis for determining reductions. The maximum measured atrazine concentration of 45.46 ug/L requires a 73.6% reduction to meet the chronic standard of 12 ug/L.

Table 64: Atrazine Loading Reduction Goals for Beaver Creek

Flow Condition	Flow Exceedance Range	Maximum Observed Atrazine Concentration (ug/L)	Loading Reduction Required (%)
High Flows	0-10%	11.62	N/A
Moist Conditions	10-40%	45.46	74%
Mid-Range Flows	40-60%	44.15	73%
Dry Conditions	60-90%	23.04	48%
Low Flows	90-100%	1.92	N/A

Source: NDEQ, 2013

Table 65: Percentile Flows and Maximum Daily Atrazine Loading for Beaver Creek

% Flow Exceedance	100	90	80	70	60	50	40	30	20	10	0
Flow Percentile	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Flow (cfs)	5	12	14	16	18	21	26	33	54	101	1,275
TMDL (lb/day)	0.35	0.75	0.92	1.05	1.19	1.38	1.65	2.14	3.46	6.54	82.35

Source: NDEQ, 2013

E. coli Bacteria

As Beaver Creek is not impaired due to bacteria, there is no reduction goal to be met. However, Beaver Creek is a tributary to the West Fork Big Blue River (BB3-10000), which is impaired for bacteria. Therefore, reducing bacteria carried by Beaver Creek will also help to address the bacteria impairment of the West Fork Big Blue River.

IMPLEMENTATION APPROACH

The implementation strategy for the Beaver Creek target area includes multiple practices that target pollutant sources through the "treatment train" approach. In a treatment train approach, multiple complementary BMPs are installed in series to treat various pollutants with increased efficiency. All nonpoint pollutant sources are addressed using this approach. The identification of management practices and best suited locations were identified through stakeholder input, analysis of aerial imagery, and the ACPF Tool. For a detailed description of BMPs, refer to Chapter 7.

To provide an accurate load reduction estimate from practice implementation, water quality modeling followed a treatment train approach. Figure 80 provides a general illustration of the target area's treatment train, which is comprised of six levels of treatment. Pollutant load reductions begin with the implementation of education and outreach, and runoff is progressively treated (pollutants removed) until it reaches a receiving waterbody. This figure is meant for illustrative purposes only, as the exact approach to treatment varies based on pollutant sources, type, and location.

The implementation strategy presented in this plan should be used as a guide and may be subject to revision as new information becomes available. In all cases, only willing landowners will be included in this voluntary implementation strategy.

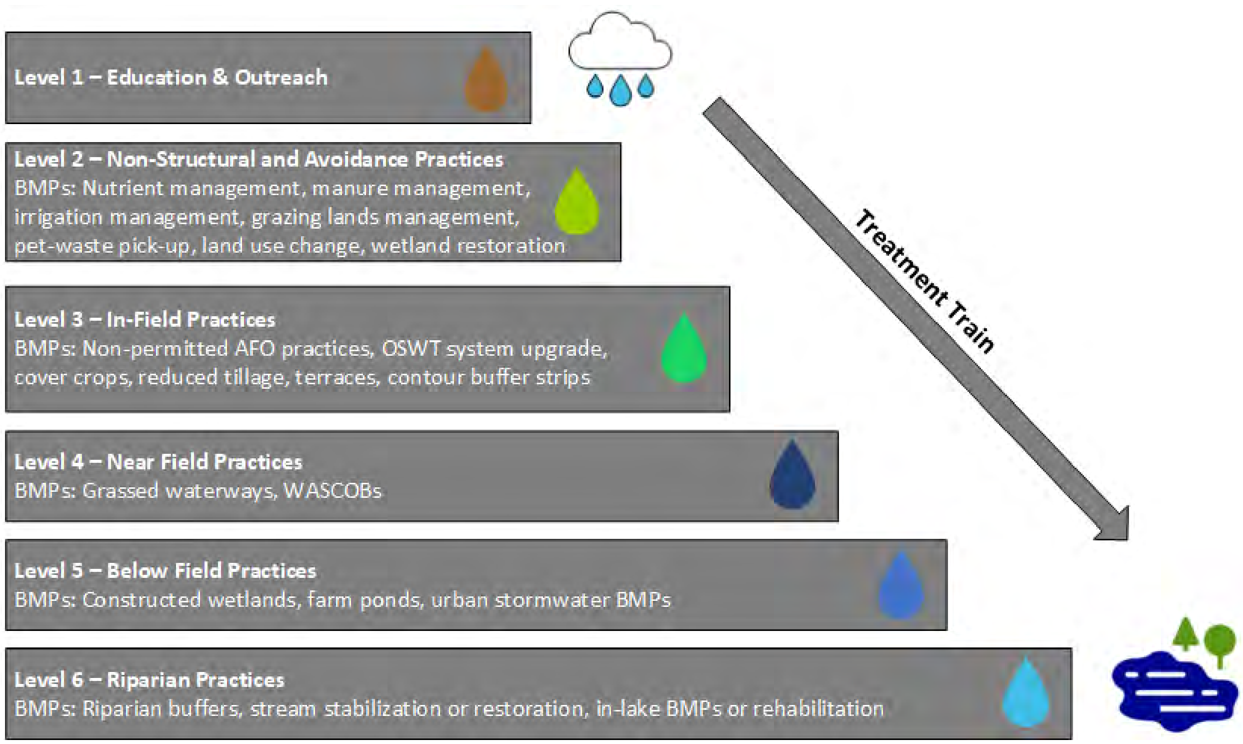


Figure 80: Implementation of Priority BMPs through a "Treatment Train" Approach

BMP TARGETING

BMPs for the Beaver Creek target area are focused on reducing atrazine and *E. coli* loads. By implementing these practices throughout the target area, effectiveness of downstream projects and BMPs will increase. Land used for corn and soybean production is targeted for the most practices (Table 66), but all pollutant sources are targeted by at least one BMP practice. Note that some fields may have multiple BMPs.

BMPs were applied to the entire Beaver Creek target area for pollutant reduction modeling purposes. However, the ACPF Tool, which identifies potential BMP locations, was only utilized in the four lower HUC 12 subwatersheds in the target area (HUCs 102702030405, 102702030406, 102702030407, and 102702030408). These four HUC 12 subwatersheds were assumed to have the most immediate impact on water quality in Beaver Creek due to their location immediately surrounding the impaired stream segments. It is anticipated that these four HUC 12 subwatersheds will be targeted for implementation first and it is recommended that when the UBBNRD is ready to shift focus to the upstream HUC 12s, the ACPF Tool should be utilized to identify potential BMP locations.

To save space in this plan, maps of potential BMP locations within the Beaver Creek Target Area, are only included for the eastern-most HUC 12 subwatershed (HUC 102702030408) (Figure 81, Figure 82, and Figure 83). These maps serve as representative examples of where and how BMPs should be targeted throughout the Beave Creek Target Area. ACPF data for the remaining three HUC 12 subwatersheds is provided in GIS format on the CD accompanying this plan. While the locations identified in these maps are not final, they provide a starting point for discussion with willing landowners and assisted in the development of the water quality models used in this plan. Riparian BMPs shown in Figure 83 are representative of the ideal locations for various buffers to be installed, but not of the physical extents of each buffer.

Table 66: Priority BMPs and Targeted Pollutant Sources for Beaver Creek

BMP	Pollutant Sources and Area Treated*								
	Entire Watershed	Corn and Soybean	Non permitted AFOs (#)	Pasture	Other Crops	Forest	Urban	Streambank (mi)	Septic Systems (#)
Education & Outreach	193,124								
Avoidance		38,147							
Irrigation Water Management Practice Suite		61,034							
Reduced-Till		30,515							
No-Till		38,150							
Cover Crops		76,340							
Terraces		1,447							
Contour Buffer Strips		4,874							
WASCOBs		6,951		478	116				
Grassed Waterway		51,994			884				
Constructed Wetlands		29,326		2,050	509	624			
Farm Ponds/Sediment Basins		1,002		73	17	21			
Riparian Buffers		38,541		2,653	652				
Non-Permitted AFO Practice Suite (#)			66						
Grazing Management				5,264					
Urban Stormwater Practice Suite							6,147		
Stream Restoration / Stabilization (miles)	**							21	
Unregistered OWTS System Upgrade (#)									1,356
Pet Waste Pick-up (# of communities)									
Wetland Restoration		2,440***							
Land Use Change		18,606***							

Source: Water Quality Modeling
**Area treated is in acres, unless otherwise noted*
***Stream restoration and stabilization also provide treatment to all upstream sources*
****Wetland restoration and land use change are both modeled by changing assigned land use acres from cropland (primarily corn and soybean) to wetlands and perennial vegetation, respectively, and therefore do not have a traditional treatment area.*

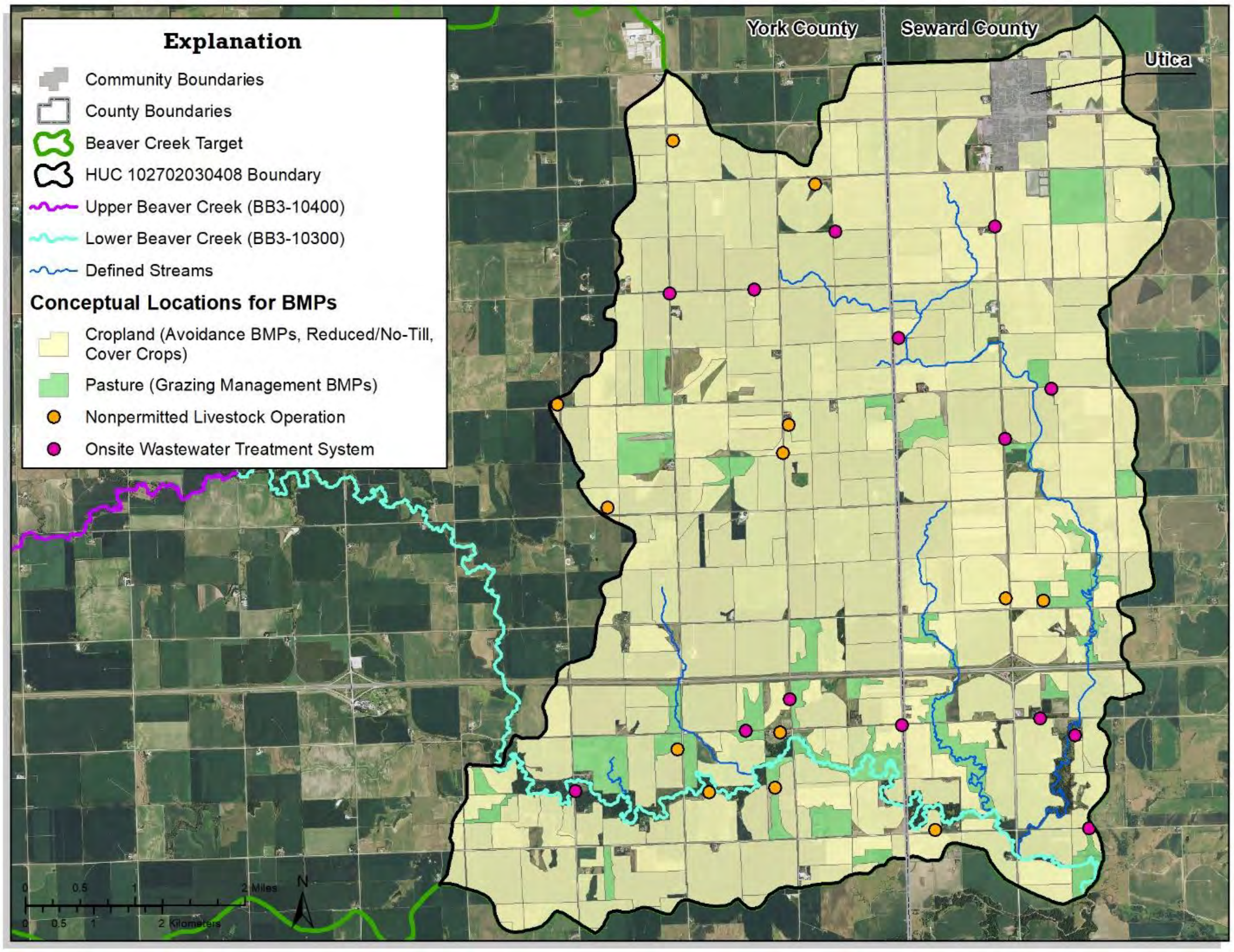


Figure 81: Conceptual Locations of Soil Health and Grazing Management BMPs

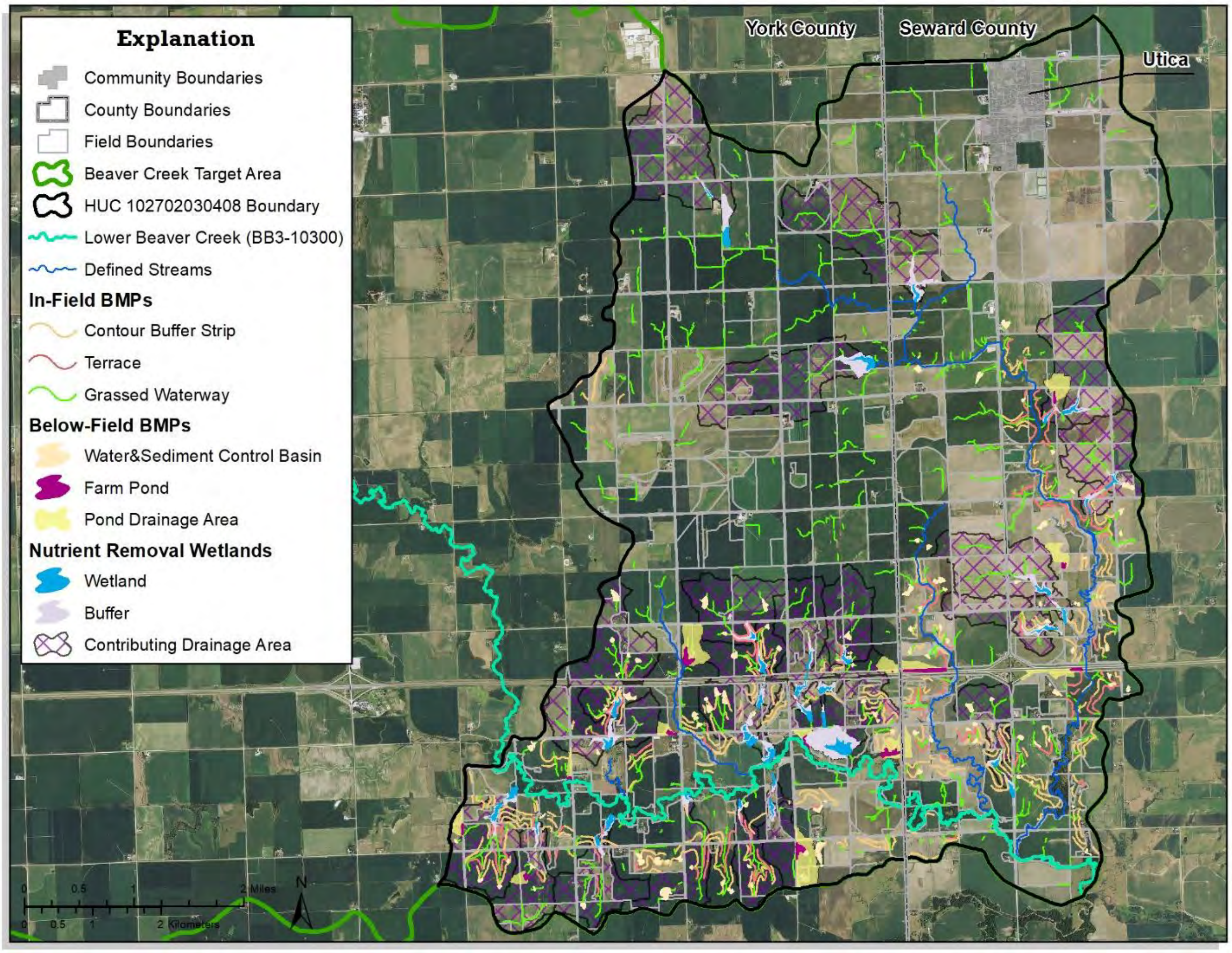


Figure 82: Conceptual Locations of In-Field and Below-Field BMPs

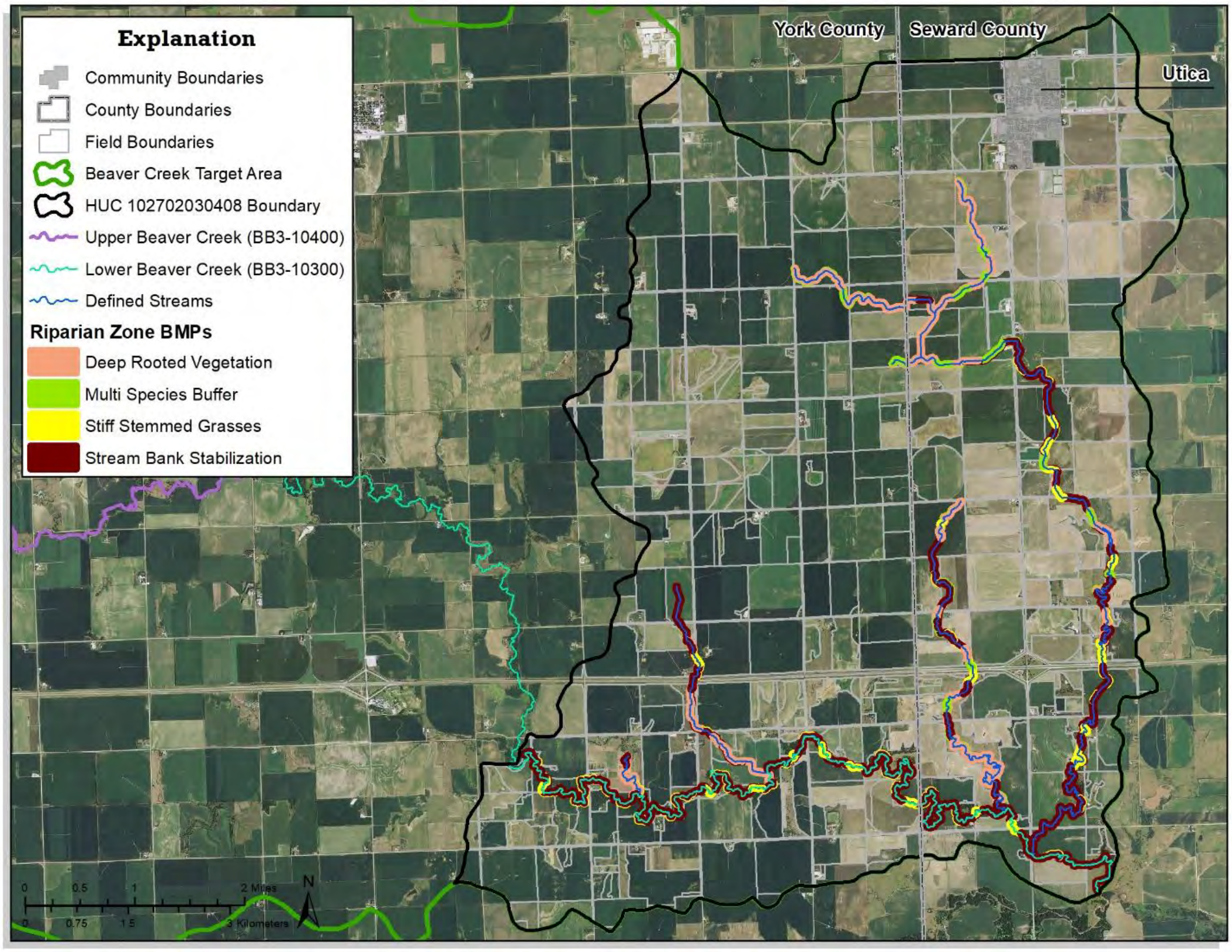


Figure 83: Conceptual Locations of Riparian Zone BMPs

CRITICAL SOURCE AREAS

Critical Source Areas (CSAs) are relatively small fractions of a watershed that generate a disproportionate amount of pollutant load (Meals, 2012). As discussed in Chapter 7, 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 most likely needed and allows for financial and technical resources to be used most efficiently.

For the same reasons discussed above in the BMP Targeting section, CSAs in the Beaver Creek target area were only identified in the lower four HUC 12 subwatersheds (HUCs 102702030405, 102702030406, 102702030407, and 102702030408). CSAs in the Beaver 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 that waterbody

Once the assessment is complete, each field received a relative risk classification, ranging from A (very high risk – most critical), to B (high), C (moderate), D (low), and other ('unknown'). One limitation of this tool is that only agricultural land uses (cropland or pasture) are included, while 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). An "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. A representative map displaying CSAs identified in the easternmost HUC 12 subwatershed of the Beaver Creek target area (HUC 102702030408) can be seen in Figure 84. In total, the lower four Beaver Creek target area contain 19,806.7 acres of CSAs, which are broken down as follows:

- Very High Risk CSA: 7,189.8 acres
  - HUC 102702030405: 1,105.5 acres
  - HUC 102702030406: 1,303.0 acres
  - HUC 102702030407: 3,186.9 acres
  - HUC 102702030408: 1,594.4 acres
- High Risk CSA: 12,616.9 acres
  - HUC 102702030405: 2,012.7 acres
  - HUC 102702030406: 2,869.4 acres
  - HUC 102702030407: 3,653.3 acres
  - HUC 102702030408: 4,081.5 acres

Also displayed in Figure 84 are riparian critical zones identified using the ACPF Tool. Critical zones occur in areas where high runoff and shallow water tables intersect within the stream corridor. Critical zones have the greatest chance of delivering pollutants directly into the water system anywhere along the length of a stream. These are important locations for the installation and management of runoff control practices. Ten critical zones were identified in the lower four HUC 12 subwatersheds of the Beaver Creek target area.

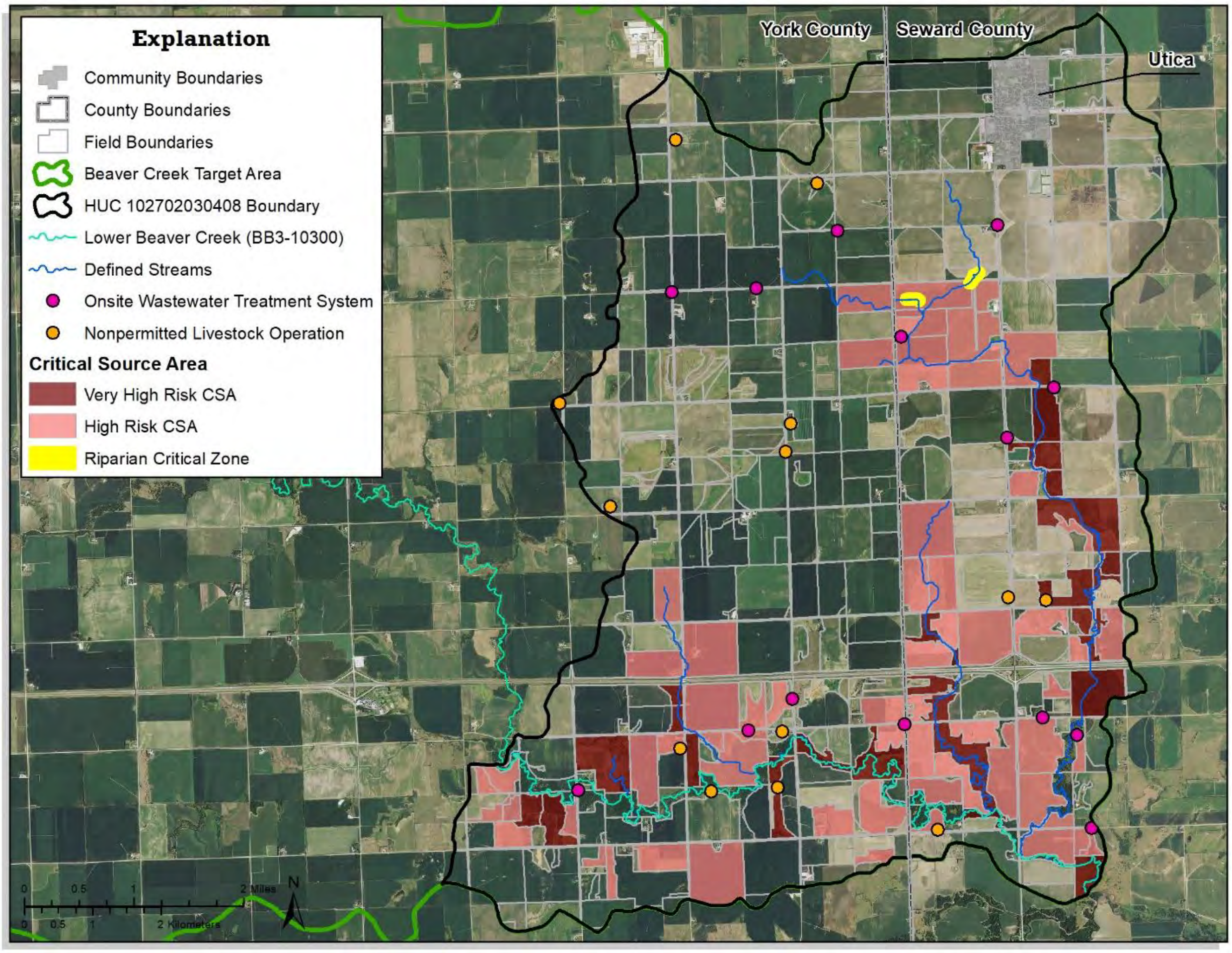


Figure 84: Example Critical Source Areas in the Beaver Creek Target Area

MEETING WATER QUALITY STANDARDS

Average annual load reductions associated with subwatershed area BMP implementation were estimated for atrazine, *E. coli* bacteria, total nitrogen, total phosphorus, and sediment (Table 67). Atrazine, the primary pollutant of concern, would be reduced by approximately 68.70%. Total nitrogen load would be reduced by 47.43%, phosphorus by 59.99%, and sediment by 56.57%. A 60.14% reduction to the *E. coli* bacteria load in Beaver Creek will benefit the West Fork Big Blue River (BB3-10000) downstream with a reduction of 15% (Table 68).

The calculated atrazine reduction does not meet the reduction goal of 73.6% required to reduce the highest recorded measurement (45.46 ug/L) in the 2013 TMDL to the water quality standard (12 ug/L). However, applying the calculated reduction of 68.7% to all measured concentrations from the 2013 TMDL results in only two values violating the water quality standard (Figure 85). Assessment procedures utilized by NDEE allow for a certain number of water quality standard violations based on sample size. The allowed number of violations is statistically calculated on a case-by-case basis using the binomial method to estimate exceedance probability (NDEQ, 2017a). Based on the sample size of 26 used in the 2013 TMDL, five exceedances would be allowed to maintain a full support status. The proposed BMP strategy would reduce measured exceedances of the water quality standard from nine to two, resulting in the waterbody meeting standards (Table 69).

Table 67: Estimated Pollutant Load Reductions for Beaver Creek

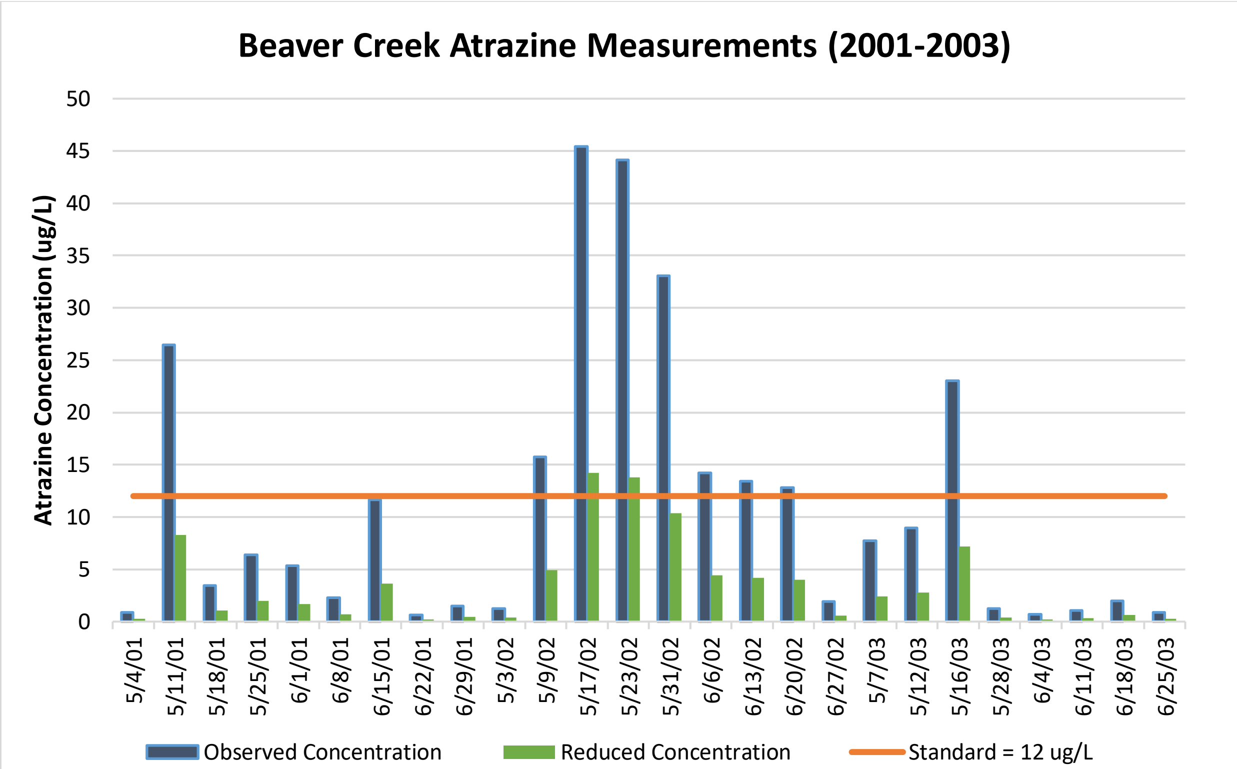
	Atrazine (ug/L)	*E. coli* (billion CFU)	Sediment (t/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)
Beginning load	45.46	650,800	93,632	344,006	1,228,735
BMP Load Reductions	31.23	391,400	52,967	206,369	582,789
Expected conditions	14.23	259,400	40,665	137,637	645,946
BMP Load Reductions (%)	68.70%	60.14%	56.57%	59.99%	47.43%

Source: Water Quality Modeling

Table 68: Estimated In-Stream *E. coli* Reductions

Segment ID	Waterbody Name	Pre-BMP Implementation		Post-BMP Implementation		
		Existing Load (billion CFU)	Existing Seasonal Geometric Mean (CFU/100 ml)	Estimated Load (billion CFU)	Estimated Percent Reduction	Estimated Seasonal Geometric Mean (CFU/100 ml)
BB3-10300	Beaver Creek	650,800	N/A	259,400	60%	N/A
BB3-10000	West Fork Big Blue River	2,841,900	1,699	2,407,800	15%	1,444

Source: WWE, 2019



Source: Water Quality Modeling

Figure 85: Measured Atrazine Concentrations and Expected Reductions in Beaver Creek

Table 69: Atrazine Load Reduction Goals for Beaver Creek

	TMDL Measured Conditions (2001 – 2003)	Expected Conditions (Post-BMP Implementation)
Number of Samples	26	26
Number of Violations	9	2
Number of Violations Allowed by NDEE	5	5
Will Waterbody Meet Water Quality Standards?	No	Yes

Source: Water Quality Modeling

MONITORING AND EVALUATION

Monitoring

The UBBNRD will follow standard operating 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 NDEE, NRCS, NeDNR, and NGPC. Steps will be taken to ensure collection of scientifically valid data, which may include the development of QAPPs for state and federal review. Additional guidance and references are located in Chapter 4.

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 Beaver Creek target area. Targeted parameters, monitoring sites, and monitoring frequency have been defined to meet each objective. Resource agencies should prioritize these goals and objectives and plan monitoring strategies accordingly. 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 and funding.

Monitoring Goal: Evaluate atrazine in Beaver Creek

Monitoring Objective 1 Document current atrazine concentration in Beaver Creek during the months of May and June.

- Monitoring parameter: Atrazine
- Monitoring site: Beaver Creek near Beaver Crossing) (Figure 86) (This is also the same location as Historic Site: JSBBRA 18
- Monitoring frequency: (Annual) Runoff events during May and June

Monitoring Objective 2 Quantify atrazine runoff loads for the Beaver Creek target area.

- Monitoring parameter: Stream discharge
- Monitoring site: Beaver Creek near Beaver Crossing (Historic Site: JSBBRA 18)
- Monitoring frequency: (Annual) Runoff events from May - September

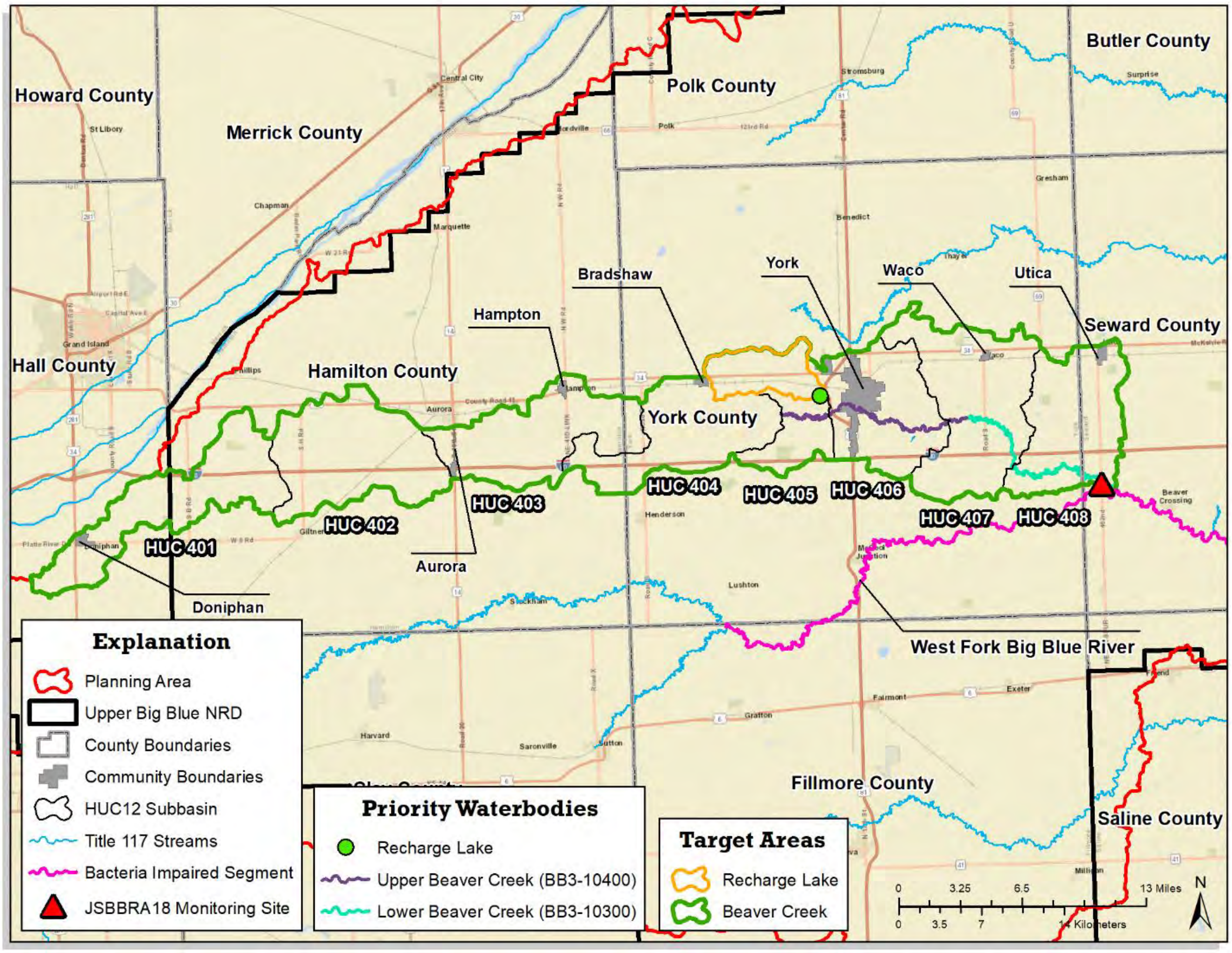


Figure 86: Monitoring Site Location

Evaluation

The ultimate purpose of establishing sound evaluation criteria is to learn from past successes and failures and improve nonpoint source pollution management approaches. As such, evaluation criteria have been established to assess all aspects of implementing this plan. Criteria include implementation strategies, education programs, monitoring networks, and overall project management. The review process should answer the following key questions:

- Which techniques and approaches worked?
- Which techniques and approached did not work?
- What were the major obstacles?
- Did the project solve the problem that it was designed to address?
- What lessons were learned that can be applied to future projects?
- Which on-the-ground techniques (or BMPs) were most accepted by landowners?

Post project reviews will consider both quantitative and qualitative metrics. Quantitative metrics will require the collection and assessment of environmental data. Review criteria should be summarized and included in final project reports.

Qualitative Metrics: Project Implementation and Administration

- Project completed on time
- Project completed on budget
- Success in meeting project goals
- Success of meeting project milestones and schedule
- Positive and negative feedback received from stakeholders and the public
- Positive and negative feedback received from UBBNRD board members, NGPC, NDEE, and other project partners
- Positive and negative feedback received from landowners implementing BMPs
- Required information delivered to agencies and funding partners
- Problematic areas of the project and needed changes for future efforts
- Adequate technical and financial support of the project

Quantitative Metrics: Environmental Outcomes

- Status of meeting measurable project objectives
- Performance of management practices and pollutant load reductions
- Changes in stream water quality, habitat, or biological communities
- Changes in lake water quality, habitat, or biological communities
- Progress in meeting water quality standards
- Removal from the Section 303(d) list
- Changes in public use of the resource

Many nonpoint sources projects do not result in immediate and measurable changes in water quality. The evaluation of the quantitative metrics may require long-term monitoring commitments.

COMMUNICATION AND OUTREACH

Chapter 6 of this plan provides a broad programmatic approach that the UBBNRD 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 Beaver Creek target area were identified via stakeholder and public input, and are as follows:

- Identified Target Audiences
    - Recreational water users of public lands along Beaver Creek
    - Pheasants Forever – Corn Country and Lincoln Creek Chapters
    - Land managers, residents, and property owners within the Beaver Creek target 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 information 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 Beaver Creek 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 local events
        - Hold targeted coffee shop meeting, 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.
    - Hold an outdoor recreation clinic (kayaking, birdwatching, etc.) on public lands in the Beaver Creek target area.

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 PIP. The PIP will identify the specific and tailored actions for each target audience.

SCHEDULE

A timeframe for implementing general actions is provided in Table 70. Actions are subject to approval by the UBBNRD Board of Directors, or other project sponsors, and may change as the plan is implemented. Phase I activities will include the initiation of drainage area BMPs. Phase II will begin upon the five-year revision of this plan and will include any implementation that was not completed during Phase I. A summary of progress achieved during Phase I will be included in the plan revision.

Table 70: Schedule for Implementation within the Beaver Creek Target Area

Activity	Phase I						Phase II
	2019	2020	2021	2022	2023	2024	2025-2029
UBBNRD 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 71. These milestones will be used to gauge progress towards meeting the desired project schedule. As the implementation of this plan is initiated, milestones will be adjusted accordingly for changes to the schedule.

Table 71: Milestones for Implementation Inside the Beaver Creek Target Area

Activity		Phase I						Phase II
		2019	2020	2021	2022	2023	2024	2025-2029
Monitoring	Coordinate with NDEE	■	■	■	■	■		
	Finalize strategies and QAPPs		■					
	Assess data (annually)	■	■	■	■	■		
Planning	Drainage area BMP 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		■	■	■	■	■	

COST

The preliminary opinion of total cost of implementing the nonpoint source pollution control strategy for the Beaver Creek Target Area is estimated to be $67,387,900 (Table 72). These costs are approximate numbers only and were identified based on the requirements to meet water quality standards. 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 2019 USDA-NRCS EQIP practice payment schedule (USDA, 2019). These costs are subject to change based on final designs, inflation, bidding climate the time of construction, and project size and complexity.

Table 72: Implementation Costs for the Beaver Creek Target Area

Practice	Units	Units Applied	Unit Cost	Total Cost
Education/Outreach	Year	5	$10,000	$50,000
Non-Structural/Avoidance	Acre	38,000	$55	$2,090,000
OWTS Upgrade	Each	1,356	$5,500	$7,458,000
Pet Waste Pickup	Each	4	$5,000	$20,000
Irrigation Water Management Suite	Acre	61,000	$34	$2,074,000
Grazing Lands Management Suite	Acre	5,200	$21	$109,200
Cover Crops	Acre	76,300	$66	$5,035,800
Riparian Buffers	Acre	750	$1,634	$1,225,500
No-Till	Acre	38,100	$22	$838,200
Reduced-Till	Acre	30,500	$42	$1,281,000
Contour Buffer Strip	Acre	500	$288	$144,000
Non-Permitted AFO Suite	Each	67	$20,000	$1,340,000
Farm Ponds/Sediment Basins/Wetland Construction	Each	202	$46,200	$9,332,400
Wetland Restoration	Acre	2,400	$3,277	$7,864,800
Terraces	Foot	420,000	$3	$1,260,000
WASCOBs	Foot	226,000	$3	$678,000
Grassed Waterway	Acre	1,000	$6,357	$6,357,000
Land Use Change	Year	5	$5,000	$25,000
Urban Stormwater Practice Suite	Year	4	$10,000	$40,000
Subtotal (Drainage Area Treatment)				**$47,222,900**
Stream Restoration/Stabilization	Foot	120,000	$167	$20,040,000
Subtotal (In-Stream Work)				**$20,040,000**
Updates to Watershed Plan	Each	1	$75,000	$75,000
Additional Monitoring	Year	5	$10,000	$50,000
Subtotal (Planning/Monitoring)				**$125,000**
Total				**$67,387,900**

11.05 SPECIAL PRIORITY AREAS

SPAs provide flexibility to address small-scale areas that lie outside of the target area with specific, limited, and timely identified needs. SPAs help address broad issues which occur widely across the subbasin and may affect not only water quality, but also the health and safety of humans. Since some BMPs for SPAs do not have specifically targeted land uses or an easily defined subwatershed associated with their implementation, the SPAs do not count towards the 20% Rule.

Practices are restricted to those necessary to address the specific needs of the SPA. BMPs are designed to address these specific needs and may cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities.

The following list identifies the SPAs within the West Fork Big Blue Subbasin. Unless otherwise described below, descriptions of each SPA are available in Chapter 9. Table 47 provides a count of SPAs identified in this subbasin, as well as a list of BMPs to address each SPA.

- WHP areas (Figure 87)
    - The York WHP area is located inside the West Fork Big Blue HUC 8. The York WHP area has been identified as a high priority for planning and management.
- Non-permitted AFOs (Figure 88)
- Rainwater Basin Wetlands (Figure 89)
- OWTSs (Figure 90)
- Stream Corridors

Table 73: SPAs Identified in the West Fork Big Blue HUC 8 Subbasin

SPA Type	Number Identified	Potential BMPs
OWTSs New regulations and design standards offer an opportunity to address potential sources of bacteria and nutrient contamination.	393	• Education • System maintenance • System upgrade or replacement
WHP Areas Protection of these areas is extremely important to protect source water aquifers and drinking water safety.	19	• Fertilizer application rate management • Irrigation water management • Cover crops • WHP Plan development
Non-permitted AFOs These operations are not required to be regulated but are considered a possible source of pollutants in runoff.	498	• Manure storage systems • Clean water diversion systems • Vegetative treatment systems • Terraces • Containment • Evaporation ponds • Open lot runoff management • Heavy use area protection • Feed management practices • Education for manure application
Rainwater Basin Wetlands Wetland conservation and restoration improves water quality and overall landscape health.	3,138	• Prescribed grazing • Prescribed burning • Herbicide • Haying, shredding, or mowing • Disking / rototilling • Water level manipulation • Sediment removal • Hydrologic restoration • Upland buffers
Stream Corridors Stream corridors and riparian buffers are the last line of defense before pollutants enter streams.	Approximately 244 miles of perennial streams	• Re-meandering • Oxbow restoration / reconnection • Floodplain construction / reconnection • Streambank stabilization • Grade stabilization structures • In-stream / constructed wetlands • Riparian zone renovation

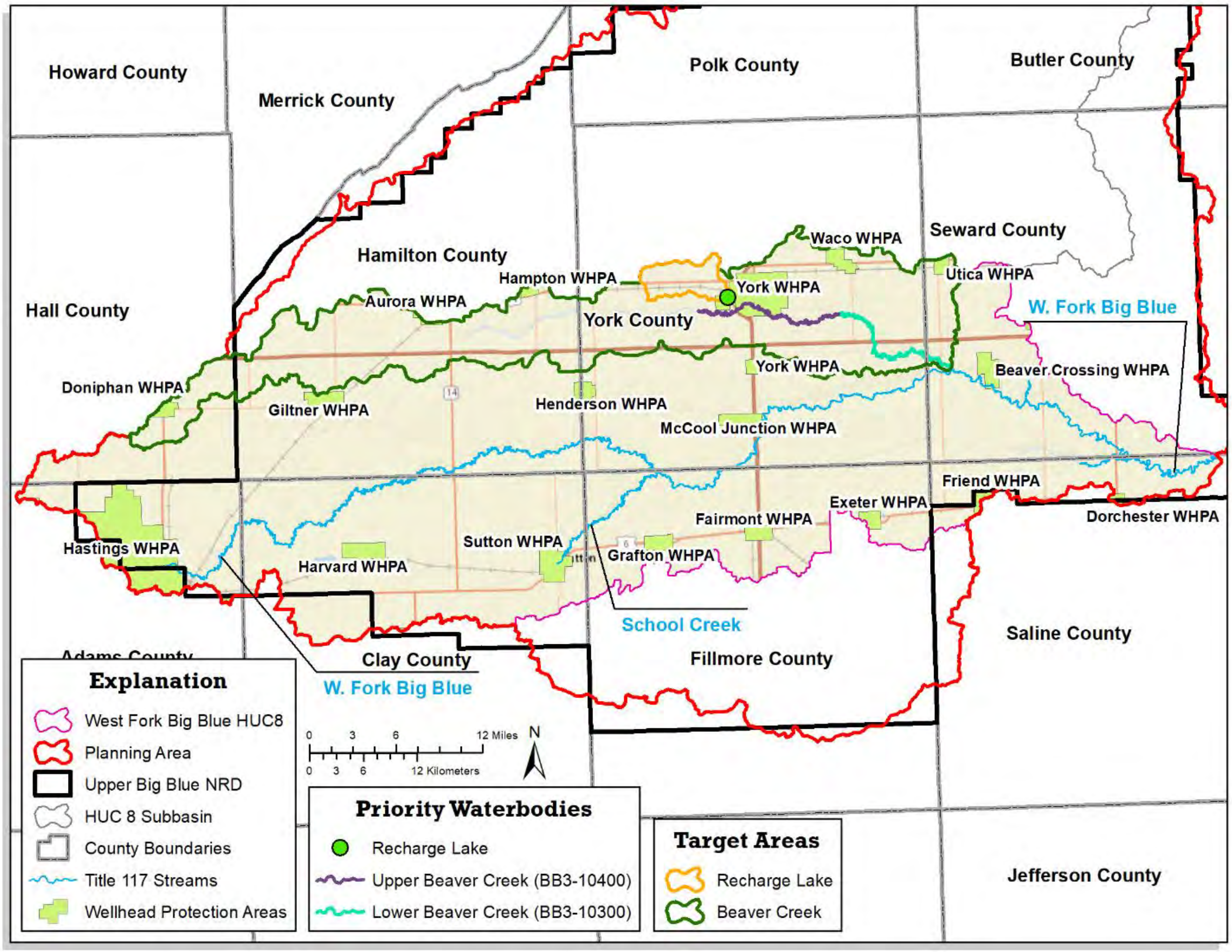


Figure 87: Wellhead Protection Areas Within the West Fork Big Blue HUC 8 Subbasin

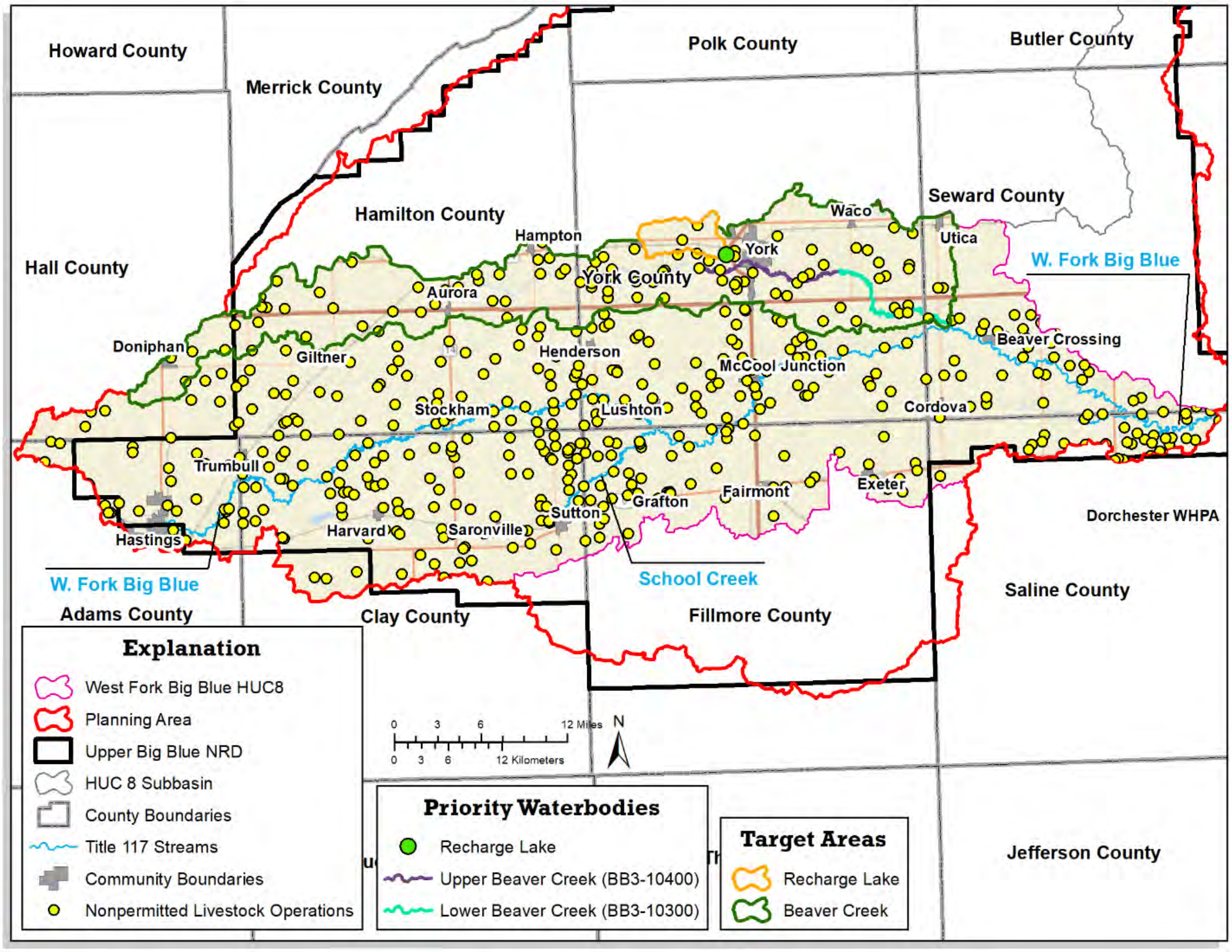


Figure 88: Nonpermitted Livestock Operations Within the West Fork Big Blue HUC 8 Subbasin

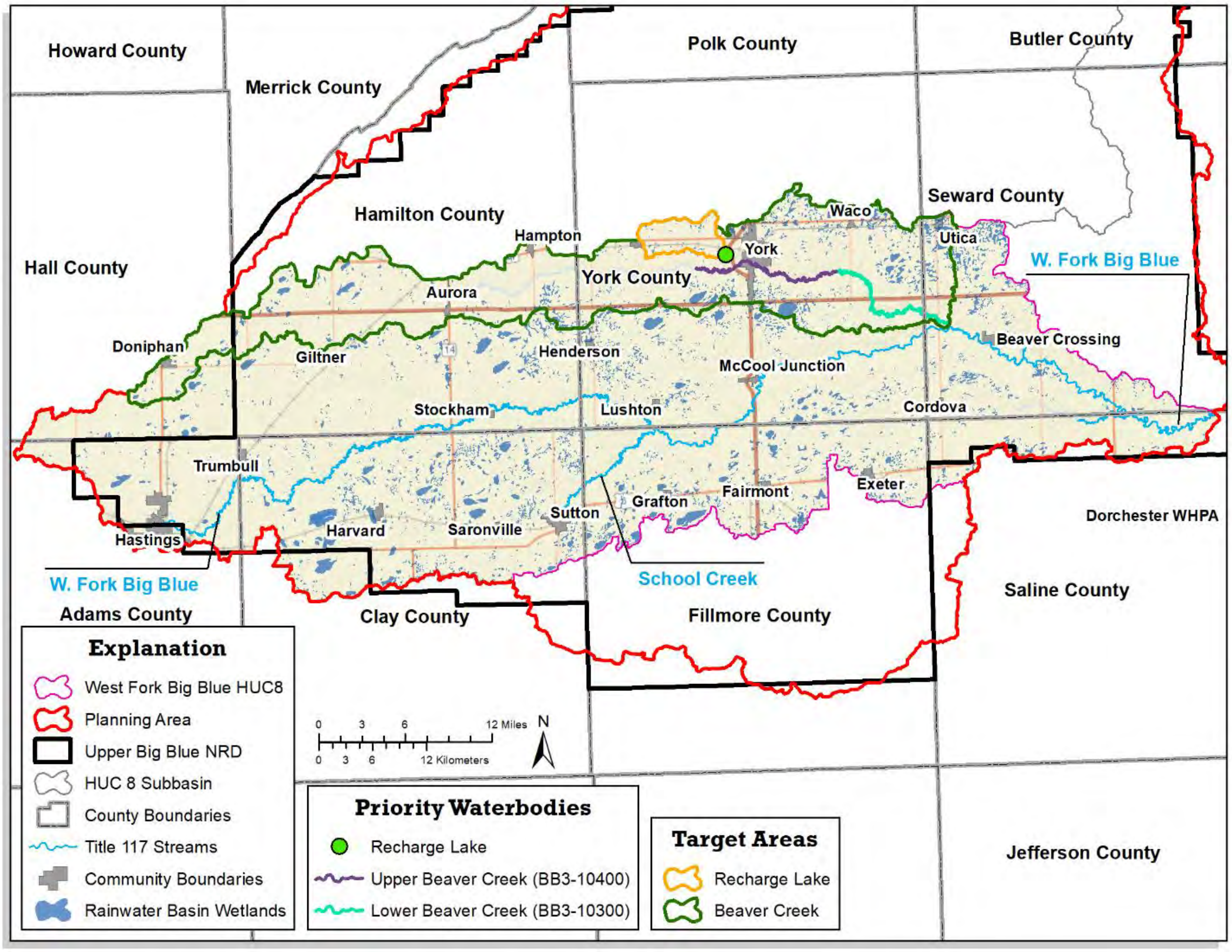


Figure 89: Rainwater Basin Wetlands Within the West Fork Big Blue HUC 8 Subbasin

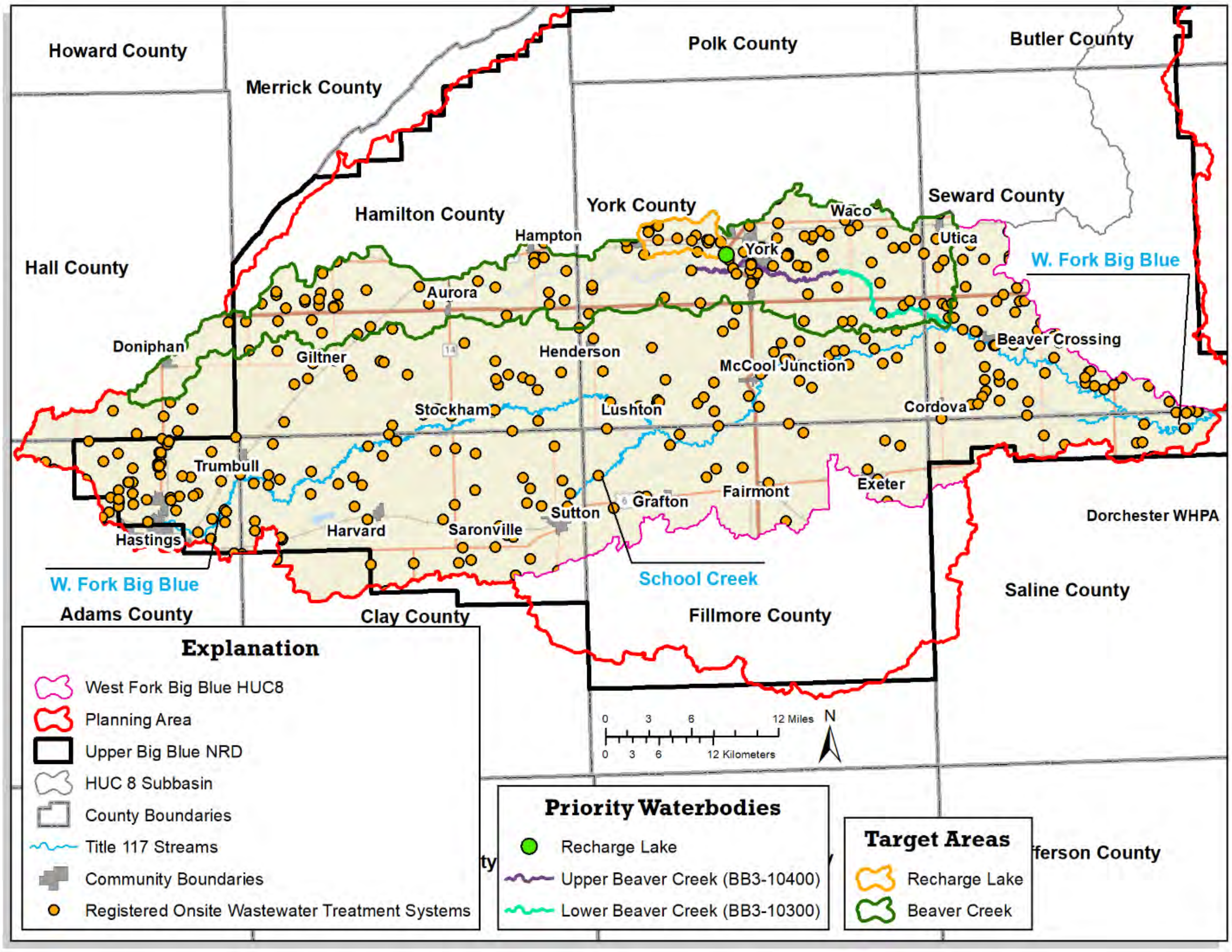


Figure 90: OWTS Within the West Fork Big Blue HUC 8 Subbasin

11.06 MONITORING PRIORITIES

Monitoring priorities were identified by the project team and technical advisory committee after reviewing existing data and a discussion on possible future data needs. 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 PRIORITIES

The following monitoring priorities are applicable to the entire district; therefore, they are discussed in more detail in Chapter 9. Additionally, other supporting information may be found in Chapter 4. No additional discussion is provided in this chapter.

- Tributary Monitoring
- Wetland Monitoring
- Real-Time Bacteria Monitoring
- Bacteria-Source Quantification
- Lake Shoreline Erosion
- Lake Sediment Re-suspension and Phosphorus Release
- WHP Areas
- Vadose Zone Monitoring
- Point Source Contribution Monitoring

BATHYMETRIC SURVEYS

Sediment management in lakes involves controlling erosion at the source (fields, streams, or shoreline), 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 data is lacking for the remaining larger/recreational lakes in the planning area. There are three lakes in the West Fork Big Blue HUC 8 that receive runoff from agricultural land that should be considered for future surveys (Table 74). While Lake Hastings receives runoff from agricultural land, a substantial amount of urbanization has occurred directly around the lake, increasing potential sediment impacts from construction site erosion. Since no known bathymetric surveys have been completed at these sites, priorities should be based on UBBNRD knowledge of site conditions, lake use, and local priorities.

Several lakes have a sediment basin located in the upper end to trap sediment and other pollutants, including Recharge Lake and Lake Hastings. 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 reclaiming lost lake storage capacity and for locating in-lake sediment control structures.

Table 74: Priority Sites for Bathymetric Surveys in the West Fork Big Blue Subbasin

Waterbody	County	NRD Jurisdiction
Recharge Lake	York	UBBNRD
Lake Hastings	Adams	UBBNRD/LBNRD*
Overland Trails Reservoir	York	UBBNRD

**Lake Hastings falls on the boundary between the UBBNRD and Little Blue NRD, therefore any work would likely need to be coordinated between both NRDs.*

URBAN WATERFOWL IMPACTS

Waterfowl populations located in urban areas have grown substantially over the past few decades (Smith and others, 1999). Central Nebraska is situated in the chokepoint of the central flyway migration route (Figure 91). Urban lakes provide open water and grassy park areas, which attract migrating waterfowl species looking to rest and feed. These favorable conditions and park visitors feeding the waterfowl can contribute to excessive waterfowl numbers and allow a larger resident geese population to become established. Resident geese not only contribute to water quality problems year-round, but also act as an attractant to migratory geese.

Source: O'Brian, 2016

Figure 91: Nebraska's Location Within the Central Flyway

There are three public access lakes in the West Fork Big Blue HUC 8 within an urban area (Table 75). Abundant droppings from resident and migrating waterfowl can impact these small urban lakes by increasing bacteria and nutrient loads. Nitrogen and phosphorus act as fertilizers, which can cause eutrophication in waterbodies. Monitoring resident and migratory waterfowl use of urban lakes can allow for the quantification of nutrient loads and provide baseline data and justification for waterfowl reduction programs.

Table 75: Urban Lakes Located in the West Fork Big Blue Subbasin

Waterbody	County	NRD Jurisdiction
Lake Hastings	Adams	UBBNRD/LBNRD*
Clark's Pond (Sutton)	Clay	UBBNRD
Henderson Pond	York	UBBNRD

**Lake Hastings falls on the boundary between the UBBNRD and Little Blue NRD, therefore any work would likely need to be coordinated between both NRDs.*

11.07 INFORMATION AND EDUCATION PRIORITIES

The following information and education priorities are applicable to the entire district; therefore, they are discussed in more detail in Chapter 6. Additionally, other supporting information may be found in Chapter 9. No additional discussion is provided in this chapter.

- Stream Erosion
- Crop and Land Use Diversity
- Overall Water Quality and Supply Status
- BMP Demonstrations
- Cost Versus Benefits of Conservation
- Target Audiences
- Additional Staff and Budget

11.08 SUBBASIN SUMMARY

SCHEDULE

A timeframe for implementing general actions is provided in Table 76. Actions are subject to approval by the UBBNRD Board of Directors, or other project sponsors, and may change as the plan is implemented. Phase I activities will include the initiation of drainage area BMPs throughout both target areas, and in-lake BMPs within Recharge Lake. Phase II will begin upon the five-year revision of this plan and will include any implementation that was not completed during Phase I. A summary of progress achieved during Phase I will be included in the plan revision.

Table 76: Schedule for Implementation

Activity	Phase I						Phase II
	2019	2020	2021	2022	2023	2024	2025-2029
UBBNRD approval of the plan	■						
Monitoring (ongoing)	■	■	■	■	■		
Organize stakeholder groups		■	■	■			
Drainage area BMP implementation			■	■	■	■	
In-Lake BMP implementation					■	■	
Project evaluation						■	
Final reporting						■	
Update HUC8 subbasin plan							■
Continue implementation as needed							■

POLLUTANT LOAD REDUCTIONS

Cumulative average annual pollutant load reductions that could be achieved from BMP implementation throughout the Recharge Lake and Beaver Creek target areas were estimated for phosphorus, nitrogen, sediment, atrazine, and *E. coli* bacteria. These reductions are outlined below in Table 77. Water quality standards can be achieved for both Recharge Lake and Beaver Creek for their respective impairments by following the BMP targeting and implementation strategy outlined in this plan

Table 77: Summary of Target Area Pollutant Load Reductions

Pollutant	Beginning Load	Expected Post-BMP Load	Reduction (%)
Recharge Lake			
Phosphorus (lbs/yr)	32,235	367	98.86%
Nitrogen (lbs/yr)	53,682	8,335	84.47%
Sediment (tons/yr)	6,050	83	98.63%
Beaver Creek			
Phosphorus (lbs/yr)	344,006	137,637	59.99%
Nitrogen (lbs/yr)	1,228,735	645,946	47.43%
Sediment (tons/yr)	93,632	40,665	56.57%
Atrazine (ug/L)	45.46	14.23	68.72%
E. coli Bacteria (billion CFU)	650,800	259,400	60.14%

Source: Water Quality Modeling

COSTS

The preliminary opinion of total cost for implementing the nonpoint source pollution control strategy for the two target areas is estimated to be $73,342,180 (Table 78). This does not include costs for bathymetric surveys of final designs of engineering projects. When possible, costs were determined form the 2019 USDA-NRCS EQIP practice payment schedule (USDA, 2019). 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.

Major costs vary between the target areas. The greatest cost for Recharge Lake is in-lake work, which includes such items as sediment removal, island stabilization, wetland construction, in-lake sediment basins, and construction of weirs. The greatest cost for Beaver Creek is watershed treatment, which includes implementing a wide variety of BMPs across thousands of acres.

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 much work to be accomplished. It should be noted that oftentimes specific streambank restoration or 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 restoration and stabilization, and riparian buffer establishment.

Watershed treatment is the lowest cost for greatest benefit option of nonpoint source pollution control. 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 78: Summary of Target Area Implementation Costs

Drainage Area Treatment	
Recharge Lake	$1,704,280
Beaver Creek	$47,222,900
Subtotal	**$48,927,180**
In-Stream Work	
Recharge Lake	$1,336,000
Beaver Creek	$20,040,000
Subtotal	**$21,376,000**
In-Lake Work	
Recharge Lake	$2,839,000
Beaver Creek	N/A
Subtotal	**$2,839,000**
Planning & Monitoring	
Recharge Lake	$75,000
Beaver Creek	$125,000
Subtotal	**$200,000**
Total Cost	
Recharge Lake	$5,954,280
Beaver Creek	$67,387,900
Total	**$73,342,180**

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CHAPTER 12. MIDDLE BIG BLUE HUC 8 SUBBASIN

12.01 SUBBASIN BACKGROUND

The Middle Big Blue Subbasin (HUC 8: 10270202) is the smallest of the four subbasins addressed in this plan. The subbasin covers 151,105 acres (total planning area is 1,908,206 acres) and includes portions of Butler and Seward Counties (Figure 92). Land use in this subbasin is dominated by agriculture, with 78% of the subbasin area dedicated to row crops (corn/soybean). There are several urban areas throughout the subbasin, which make up a total of 5% of the subbasin area. Remaining land use is divided amongst grass/pasture (12%), forest (4%), 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 (SPAs) identified within the Middle Big Blue 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. Other subbasin characteristics and information is found in the following chapters/sections within this plan:

- Land use: Chapter 3
- Existing land treatment (BMPs): Chapter 7
- Irrigation: Chapter 3
- Permitted facilities: Chapter 5
- Existing resource conditions: Chapter 5

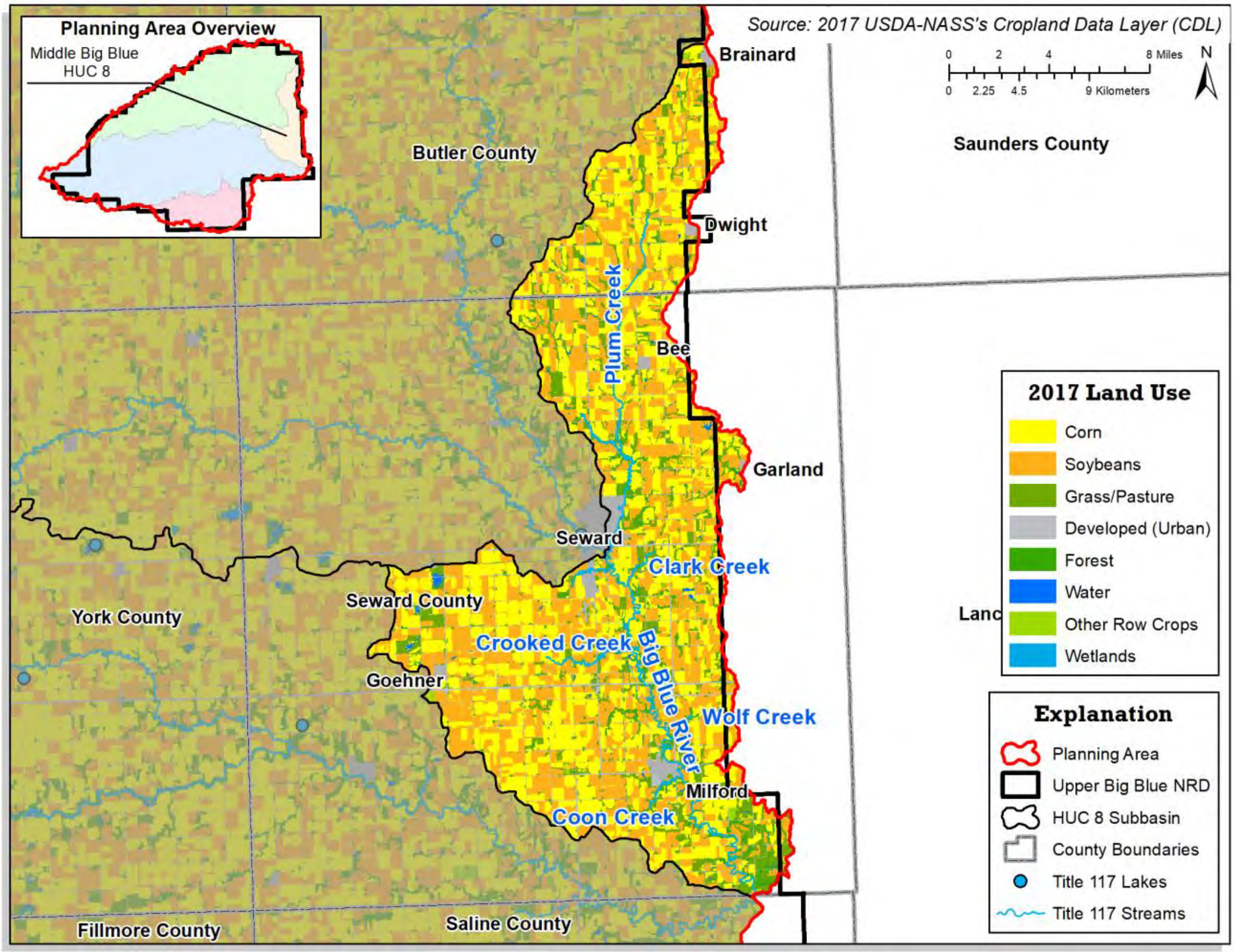

Figure 92: Land Use Within the Middle Big Blue HUC 8 Subbasin

12.02 OVERVIEW OF PRIORITIES

As discussed in Chapter 9, priority waterbodies and associated target areas were selected through a review of water quality data and stakeholder input. No target areas were identified in the Middle Big Blue Subbasin.

12.03 SPECIAL PRIORITY AREAS

Special priority areas (SPAs) address small-scale areas that lie outside of the target area with specific, limited, and timely identified needs. SPAs help address broad issues which occur widely across the subbasin and may affect not only water quality, but also the health and safety of humans. Since some best management practices (BMPs) for SPAs do not have specifically targeted land uses or an easily defined subwatershed associated with their implementation, the SPAs do not count towards the 20% Rule.

Practices are restricted to those necessary to address the specific needs of the SPA. BMPs are designed to address these specific needs and may cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities.

SPECIAL PRIORITY AREAS WITHIN THE SUBBASIN:

The following list identifies the SPAs identified within the subbasin. Unless otherwise described below, descriptions of each SPA are available in Chapter 9. Table 79provides a count of SPAs identified in this subbasin, as well as a list of BMPs to address each SPA.

- Onsite Wastewater Treatment Systems (OWTS)
- Wellhead Protection Areas (WHP areas) (Figure 93)
    - A portion of the Seward WHP area is located inside the Middle Big Blue HUC 8. Seward WHP area has been identified as a high priority for planning and management.
- Non-permitted Livestock Operations (Figure 94)
- Rainwater Basin Wetlands (Figure 95)
- Onsite Wastewater Treatment Systems (OWTS)*
- Stream Corridors*

**Note that OWTS and Stream Corridors are only mapped for Target Areas and are not shown in the figures below.*

Table 79: SPAs Identified in the Middle Big Blue HUC 8 Subbasin

SPA Type	Number Identified	Potential BMPs
Onsite Wastewater Systems (OWTS) New regulations and design standards offer an opportunity to address potential sources of bacteria and nutrient contamination.	160	• Education • System maintenance • System upgrade or replacement
Wellhead Protection Areas (WHP Areas) Protection of these areas is extremely important to protect source water aquifers and drinking water safety.	9	• Nutrient management • Irrigation management • Cover crops • WHP Plan development
Non-permitted Livestock Operation These operations are not required to be regulated but are considered a possible source of pollutants in runoff.	135	• Manure storage systems • Clean water diversion systems • Vegetative treatment systems • Terraces • Containment • Evaporation ponds • Open lot runoff management • Heavy use area protection • Feed management practices • Education for manure application
Rainwater Basin Wetlands Wetland conservation and restoration improves water quality and overall landscape health.	533	• Prescribed grazing • Prescribed burning • Herbicide • Haying, shredding, or mowing • Disking / rototilling • Water level manipulation • Sediment removal • Hydrologic restoration • Upland buffers
Stream Corridors Stream corridors and riparian buffers are the last line of defense before pollutants enter streams.	Approximately 81 miles of perennial streams	• Re-meandering • Oxbow restoration / reconnection • Floodplain construction / reconnection • Streambank stabilization • Grade stabilization • In-stream / constructed wetlands • Riparian zone renovation

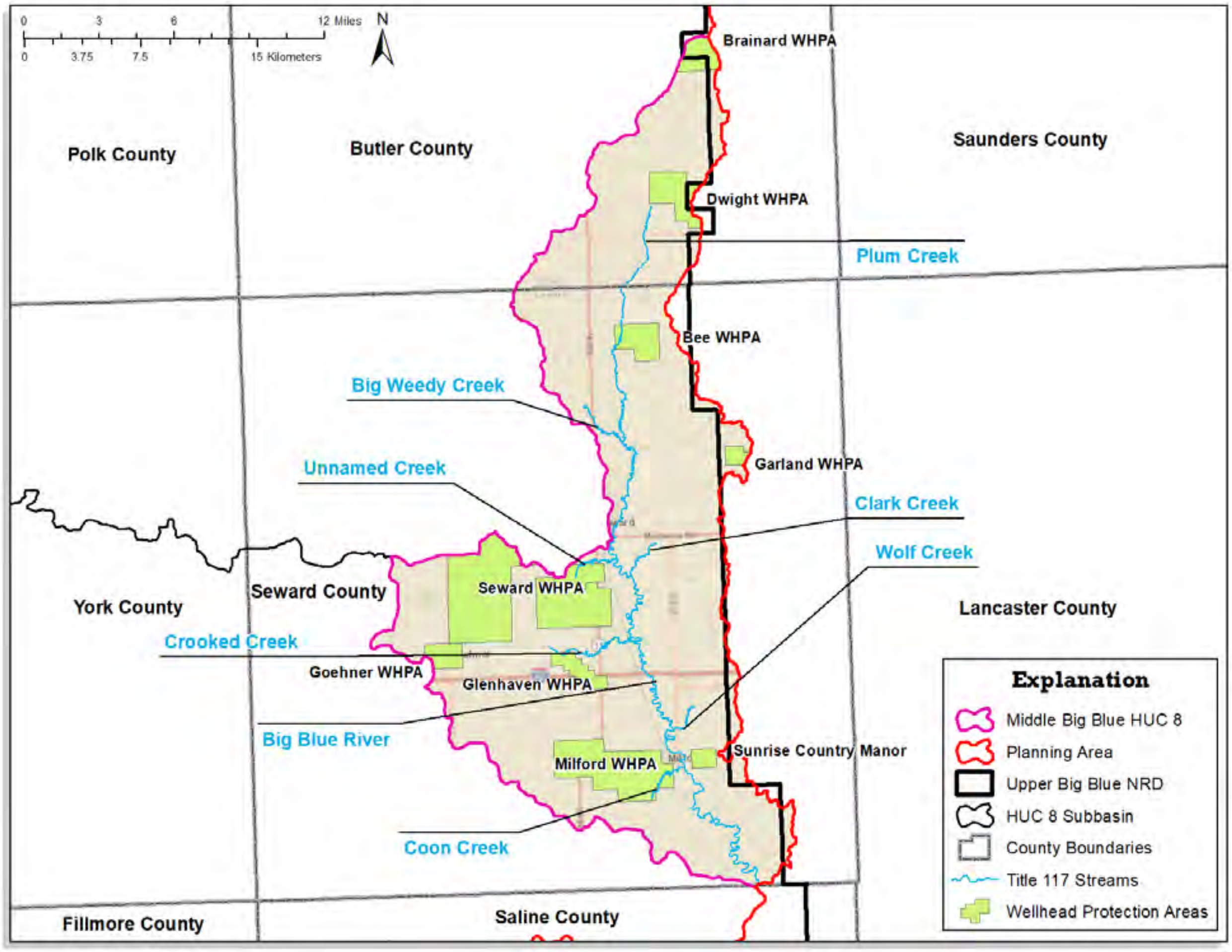

Figure 93: Wellhead Protection Areas Within the Middle Big Blue HUC 8 Subbasin

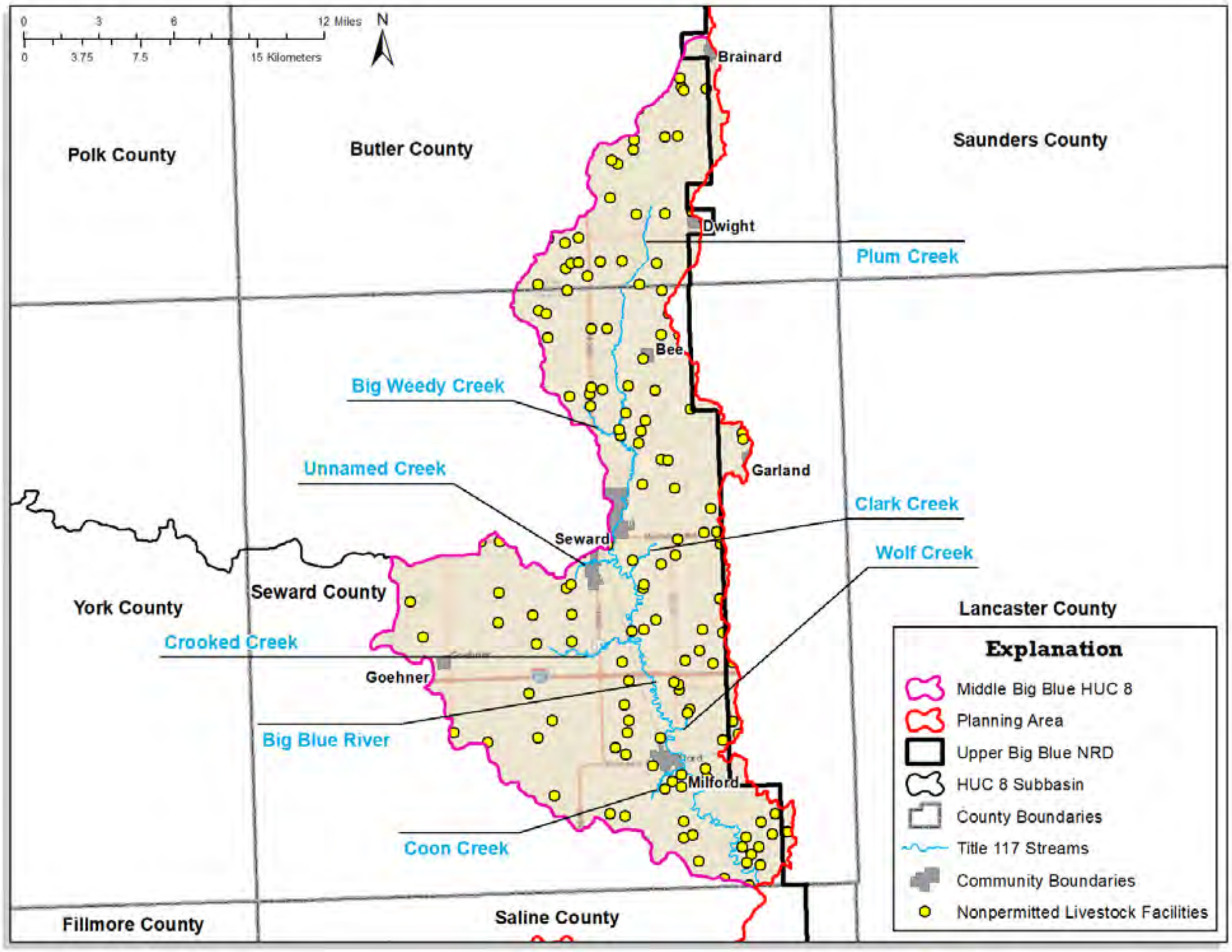

Figure 94: Non-permitted Livestock Operations Within the Middle Big Blue HUC 8 Subbasin

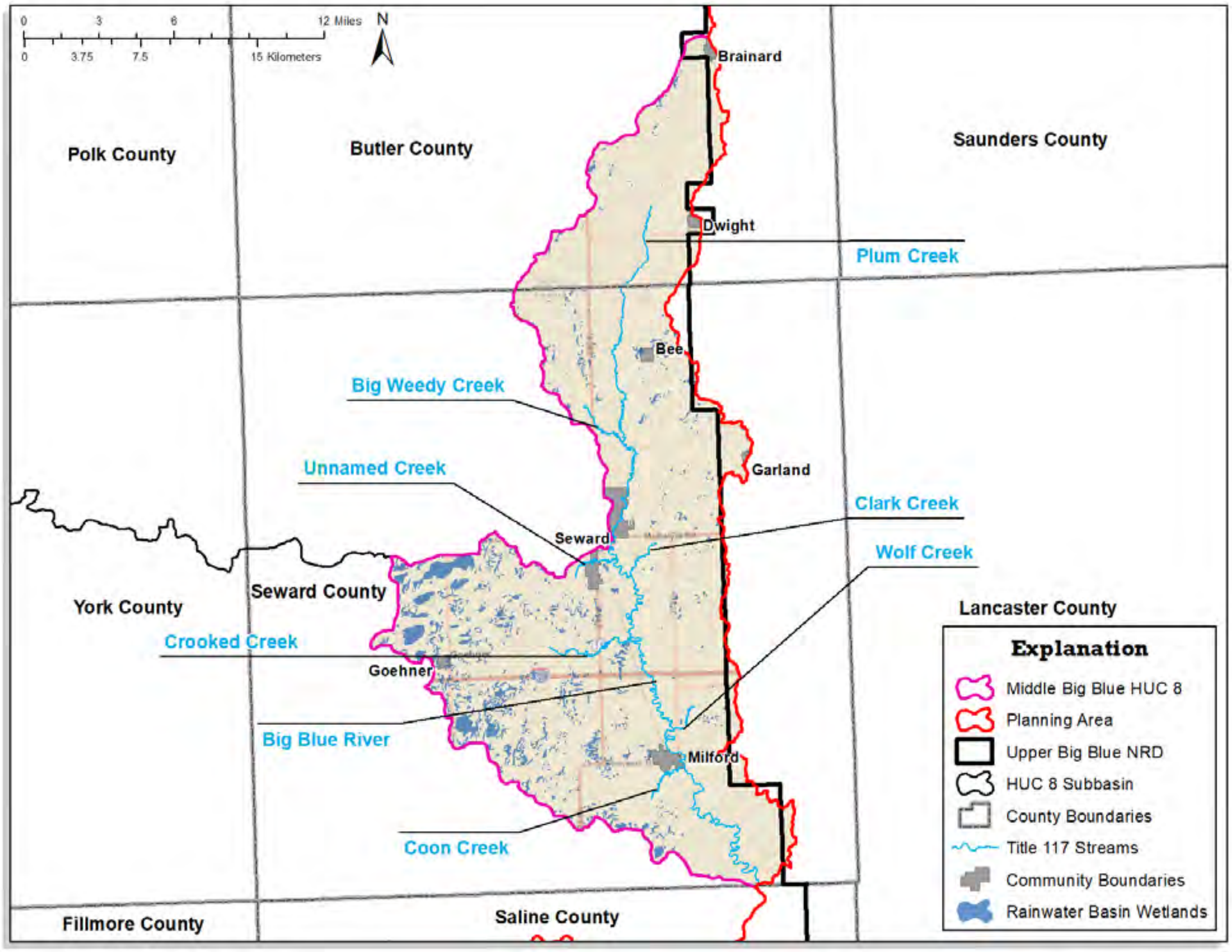

Figure 95: Rainwater Basin Wetlands Within the Middle Big Blue HUC 8 Subbasin

12.04 MONITORING PRIORITIES

Long-term monitoring data is lacking throughout the Middle Big Blue Subbasin. Monitoring data is necessary to establish baselines, fill in data gaps, and to track plan progress. No monitoring priorities were identified specific to this subbasin. Chapter 9 provides information on district-wide monitoring priorities identified by stakeholders and project partners.

12.05 INFORMATION AND EDUCATION PRIORITIES

No standalone Information and Education (I&E) priorities were identified for the Middle Big Blue HUC 8 Subbasin. Chapter 9 provides information on district-wide I&E priorities identified by stakeholders and project partners.

12.06 MASTER COST SUMMARY

Cost estimates are only developed for implementation within target areas. Therefore, no cost estimate is provided for the Upper Big Blue Subbasin.

CHAPTER 13. TURKEY CREEK HUC 8 SUBBASIN

13.01 SUBBASIN BACKGROUND

The Turkey Creek Subbasin (HUC 8: 10270204) is the third largest of the four subbasins addressed in this plan. The subbasin covers 191,458 acres (total planning area is 1,908,206 acres) and includes portions of Clay, Fillmore, and Saline Counties (Figure 96). Land use in this subbasin is dominated by agriculture, with 84% of the subbasin area dedicated row crops (corn/soybean). There are several urban areas throughout the subbasin, which make up a total of 5% of the subbasin area. Remaining land use is divided amongst grass/pasture (9%), forest (2%), 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 (SPAs) identified within the Turkey 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. Other subbasin characteristics and information is found in the following chapters/sections within this plan:

- Land use: Chapter 3
- Existing land treatment (BMPs): Chapter 7
- Irrigation: Chapter 3
- Permitted facilities: Chapter 5
- Existing resource conditions: Chapter 5

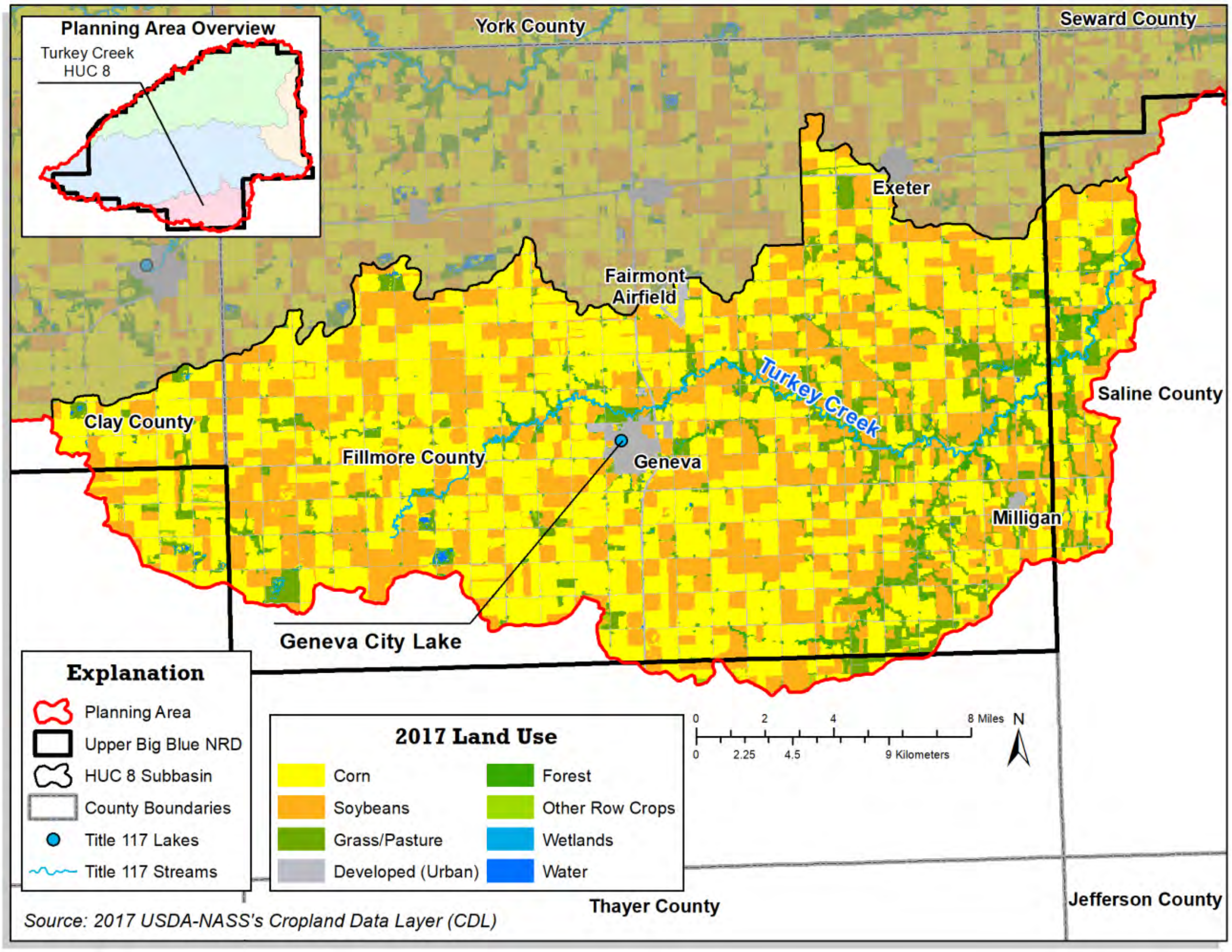

Figure 96: Land Use/Land Cover Within the Turkey Creek HUC 8 Subbasin

13.02 OVERVIEW OF PRIORITIES

As discussed in Chapter 9, priority waterbodies and associated target areas were selected through a review of water quality data and stakeholder input. No target areas were identified in the Turkey Creek Subbasin.

13.03 SPECIAL PRIORITY AREAS

Special priority areas (SPAs) address small-scale areas that lie outside of the target area with specific, limited, and timely identified needs. SPAs help address broad issues which occur widely across the subbasin and may affect not only water quality, but also the health and safety of humans. Since some best management practices (BMPs) for SPAs do not have specifically targeted land uses or an easily defined subwatershed associated with their implementation, the SPAs do not count towards the 20% Rule.

Practices are restricted to those necessary to address the specific needs of the SPA. BMPs are designed to address these specific needs and may cross subwatershed and target area boundaries. Projects in these areas are excellent candidates for partnering opportunities.

SPECIAL PRIORITY AREAS WITHIN THE SUBBASIN:

The following list identifies the SPAs identified within the subbasin. Unless otherwise described below, descriptions of each SPA are available in Chapter 9. Table 80provides a count of SPAs identified in this subbasin, as well as a list of BMPs to address each SPA.

- Wellhead Protection Areas (WHP Areas) (Figure 97)
- Non-permitted Livestock Operations (Figure 98)
- Rainwater Basin Wetlands (Figure 99)
- Onsite Wastewater Treatment systems (OWTS)*
- Stream Corridors*

**Note that OWTS and Stream corridors are only mapped for Target Areas and are not shown in the figures below.*

Table 80: SPAs Identified in the Turkey Creek HUC 8 Subbasin

SPA Type	Number Identified	Potential BMPs
Onsite Wastewater Systems (OWTS) New regulations and design standards offer an opportunity to address potential sources of bacteria and nutrient contamination.	423	• Education • System maintenance • System upgrade or replacement
Wellhead Protection Areas (WHP Areas) Protection of these areas is extremely important to protect source water aquifers and drinking water safety.	19	• Nutrient management • Irrigation management • Cover crops • WHP Plan development
Non-permitted Livestock Operation These operations are not required to be regulated but are considered a possible source of pollutants in runoff.	364	• Manure storage systems • Clean water diversion systems • Vegetative treatment systems • Terraces • Containment • Evaporation ponds • Open lot runoff management • Heavy use area protection • Feed management practices • Education for manure application
Rainwater Basin Wetlands Wetland conservation and restoration improves water quality and overall landscape health.	2,636	• Prescribed grazing • Prescribed burning • Herbicide • Haying, shredding, or mowing • Disking / rototilling • Water level manipulation • Sediment removal • Hydrologic restoration • Upland buffers
Stream Corridors Stream corridors and riparian buffers are the last line of defense before pollutants enter streams.	Approximately 79 miles of perennial streams	• Re-meandering • Oxbow restoration / reconnection • Floodplain construction / reconnection • Streambank stabilization • Grade stabilization • In-stream / constructed wetlands • Riparian zone renovation

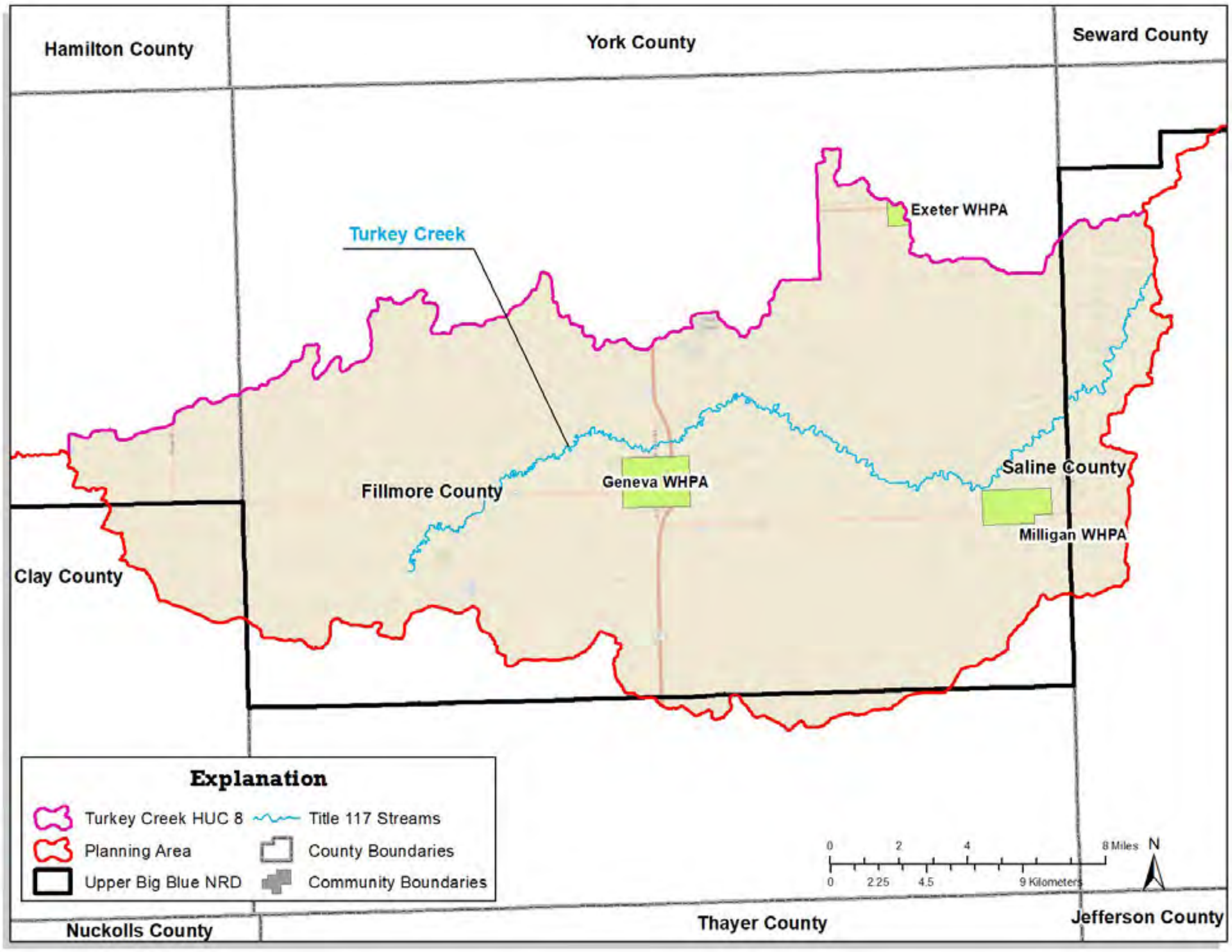

Figure 97: Wellhead Protection Areas Within the Turkey Creek HUC 8 Subbasin

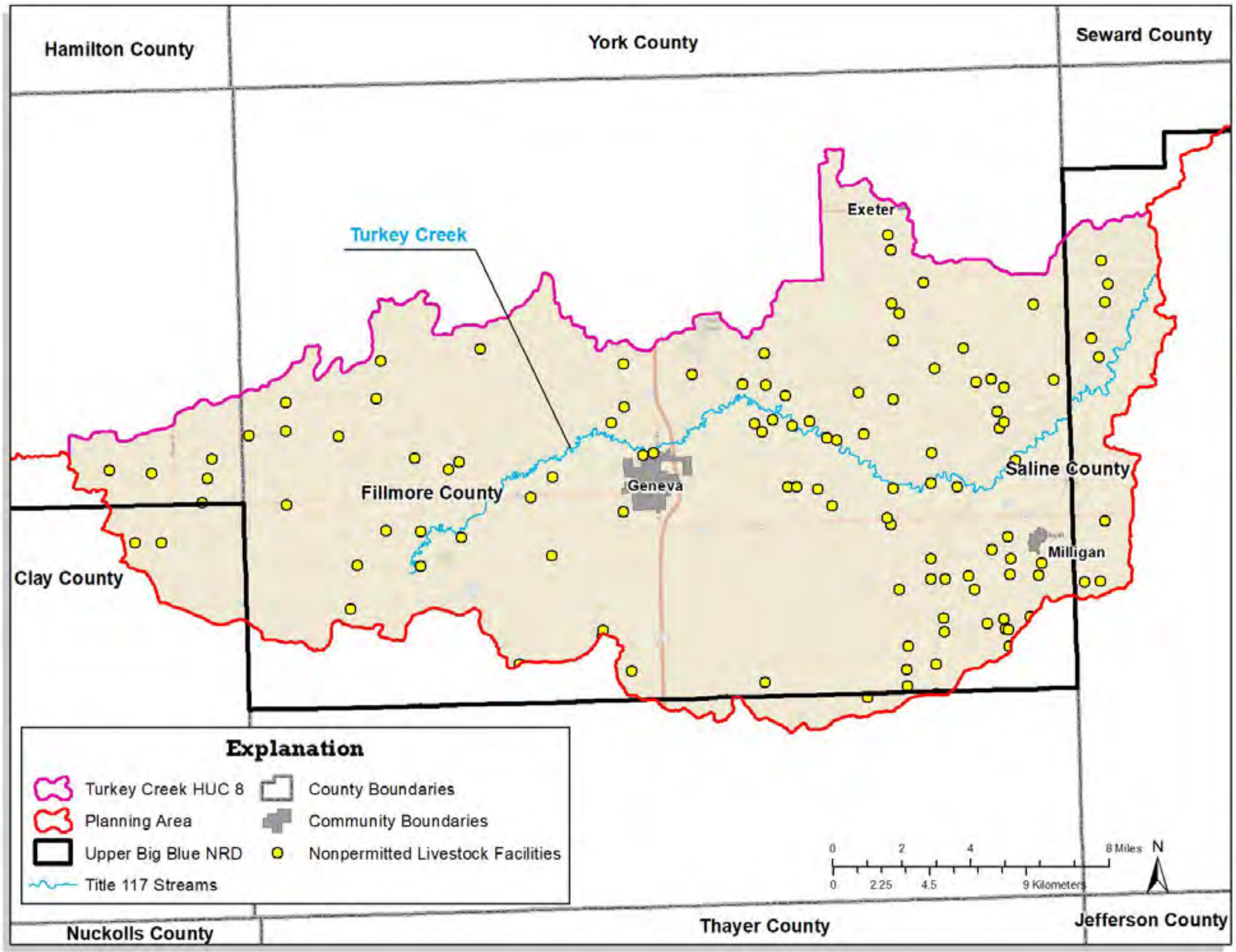

Figure 98: Nonpermitted Livestock Operations Within the Turkey Creek HUC 8 Subbasin

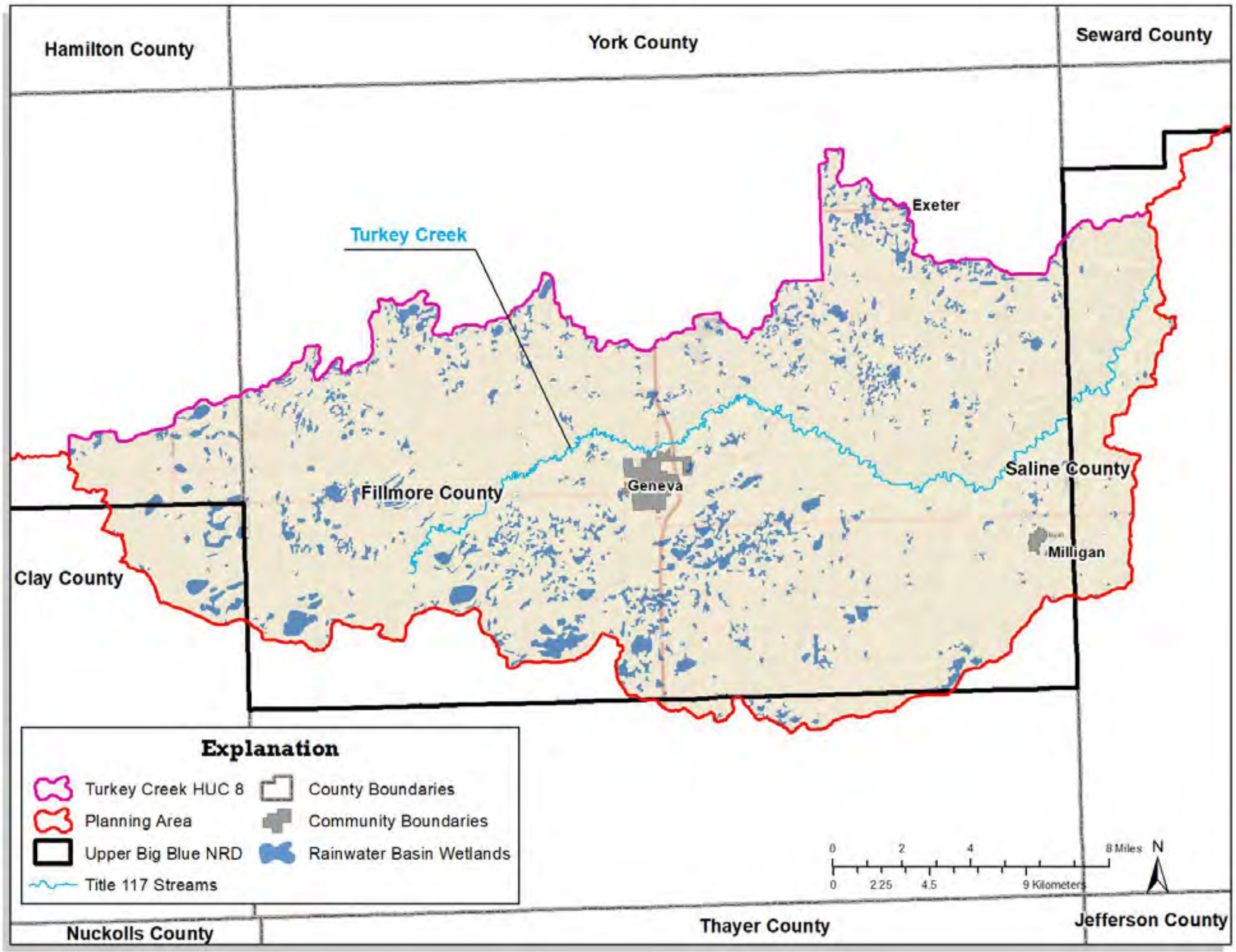

Figure 99: Rainwater Basin Wetlands Within the Turkey Creek HUC 8 Subbasin

13.04 MONITORING PRIORITIES

Long-term monitoring data is lacking throughout the Turkey Creek Subbasin. Monitoring data is necessary to establish baselines, fill in data gaps, and to track plan progress. No monitoring priorities were identified specific to this subbasin. Chapter 9 provides information on district-wide monitoring priorities identified by stakeholders and project partners.

13.05 INFORMATION AND EDUCATION PRIORITIES

No standalone Information and Education (I&E) priorities were identified for the Turkey Creek HUC 8 Subbasin. Chapter 9 provides information on district-wide I&E priorities identified by stakeholders and project partners.

13.06 MASTER COST SUMMARY

Cost estimates will only be developed for implementation within target areas. Therefore, no cost estimate is provided for the Turkey Creek Subbasin.

CHAPTER 14. DISTRICT-WIDE IMPLEMENTATION STRATEGY

14.01 INTRODUCTION

This chapter provides an overall summary of activities outlined in this plan, as well as a general framework for implementing them. To facilitate understanding and coordination of activities, a general framework and list of responsibilities for primary partners is provided. Additionally, an overview of implementation by subbasin is provided, including schedules, milestones, budgets, and pollutant load reductions. Implementation efforts are anticipated to take place both within target areas and on a basin-wide scale. Details on target area implementation are provided in Chapters 10 - 13.

This plan lays out a voluntary approach that will demonstrate an incremental, but measurable, approach to reducing pollutant loads and meeting water quality standards. Milestones and monitoring criteria have been identified which will assist the UBBNRD in evaluating progress and making course corrections along the way. Based on funding availability and planning guidance, the plan will be implemented through a targeted approach and will be updated at five-year intervals to assess progress and adjust priorities and strategies as needed.

It is important to note that the strategies discussed in this plan are just a few of the many scenarios that could lead to meeting water quality standards. An overarching intention of this plan was not to identify all scenarios (which is not feasible here) but to lay out a reasonable strategy for implementation which allows for adjustment in the future. Ongoing and expanded water monitoring will both assist with implementation and resource prioritization, as well as be utilized in evaluating BMPs and the effectiveness of this strategy. At the five-year update, monitoring results and lessons learned will be identified, along with future and ongoing needs of the district.

14.02 IMPLEMENTATION FRAMEWORK

The overall framework for water quality protection across the basin necessitates a multi-faceted approach that includes both regulatory and non-regulatory efforts. This plan assumes that regulatory actions are currently enforced and are being implemented by appropriate agencies, and thus the focus is on non-regulatory and voluntary management efforts. The framework for implementation of this plan (Figure 100) relies on both existing programs and new initiatives that are identified to take place district-wide, within target areas, and within special priority areas. Implementation actions will take place at various scales and include installation/adoption of BMPs, monitoring, and information/education efforts. It will be necessary to leverage existing UBBNRD programs (such as landowner cost-share) against outside financial and technical resources (such as the Section 319 program) to address all management priorities identified in this plan.

It is necessary for the UBBNRD to balance improvement for all areas, including: larger receiving waterbodies (Big Blue River, West Fork Big Blue River, etc.), which may take longer to be realized than improvements within smaller waterbodies; and target areas or special priority areas that may exhibit localized impacts. Some projects may provide immediately measurable benefits; whereas other will require long-term implementation before improvements can be measured. Consequently, it is vital that the UBBNRD collaborate with other partners, such as NRCS, RWBJV, UNL Extension, and others. Nitrate related projects, if located within wellhead protection areas, will be done in collaboration with each respective community. In most cases, such projects are at the discretion of the community to initiate.

It is imperative that all resource managers, decision makers, and the general public understand natural resources, associated issues, various management tools, expected outcomes, and costs. Understanding can only be achieved through continuous monitoring, analysis, outreach, and communication.

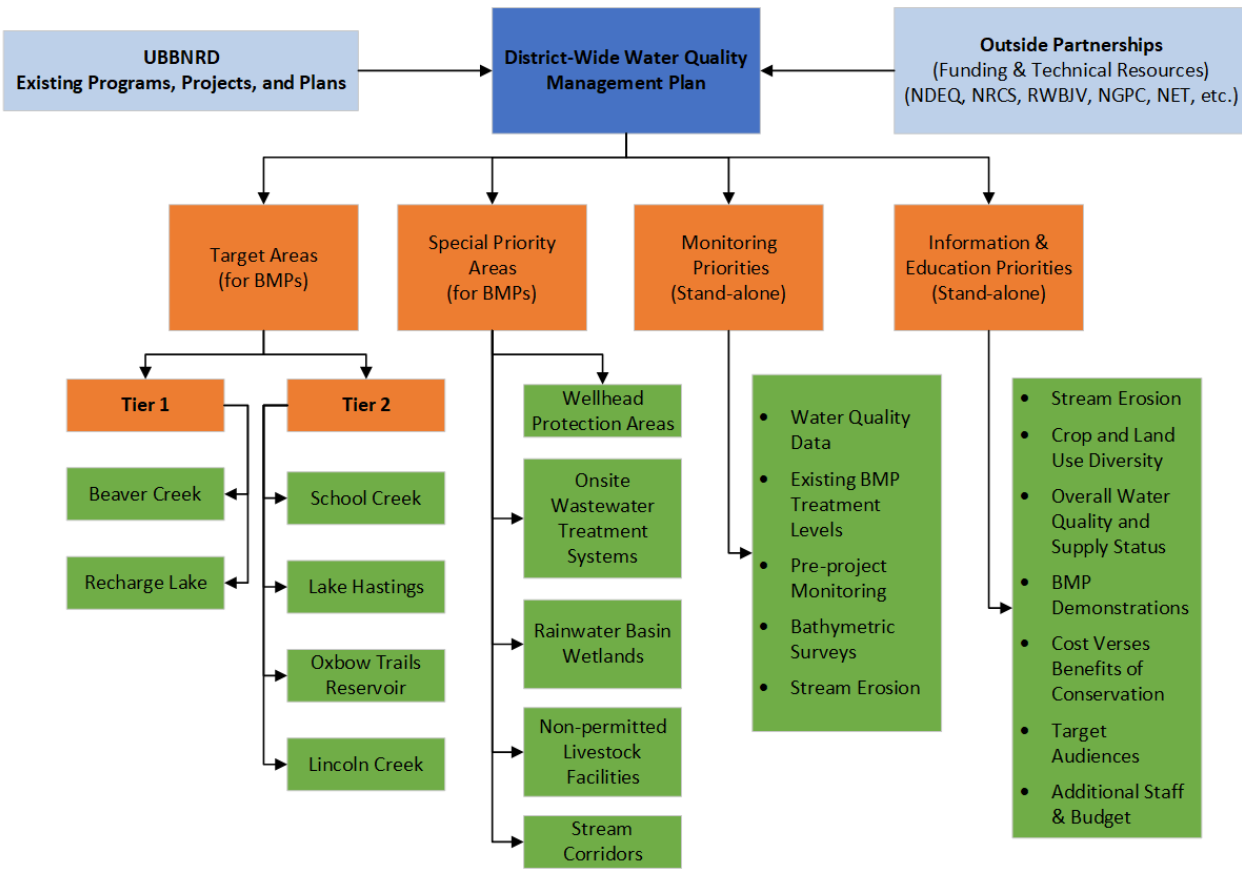

Figure 100: Implementation Framework for the UBBNRD District-Wide WQMP

14.03 IMPLEMENTATION STRATEGIES

Both basin-wide and targeted implementation efforts to address sediment, nutrients, bacteria, and atrazine will be accomplished primarily through existing programs administered by the UBBNRD, NRCS, and other partners. Generally, these programs provide landowners and producers, both in and outside of target areas, access to technical and financial assistance. To enable targeted implementation, these programs (to the greatest extent possible) will be focused on the priorities and impaired waters addressed in this plan. Based on the water quality issues identified in the basin, the plan will rely on the following strategies:

- Utilize a voluntary approach, rooted in outreach and education
- Promote soil health, which increases productivity and profitability for producers
- Promote an improved efficiency in the use of manure, commercial fertilizers, and pesticides
- Promote the adoption of BMPs to reduce the potential for pollutant transport to surface water and groundwater
- Promote wetlands as part of a healthy, productive, landscape
- Promote healthy, undisturbed riparian areas, including adequately sized buffers to protect streambanks from runoff
- Promote the benefits of water quality improvements throughout the Target Areas

While these general strategies translate across the planning area, specific practices and actions will need to be tailored to the specific project setting or landowner. A key to getting any individual conservation practice adopted or implemented by private landowners or producers is to identify barriers to adoption. These barriers may be related to: a lack in understanding or knowledge of a practice, logistics, available technical staff, funding, and/or producer costs. To make progress in addressing these and other barriers it is necessary for producers and resource agencies to jointly develop creative strategies that involve all available funding sources. These barriers will vary on a case by case basis and will need to be identified and addressed as they arise.

14.04 STAKEHOLDER COORDINATION

The UBBNRD is the sponsor of this plan; however, it has been developed through a stakeholder-driven process which included input from other government agencies that may play a role in implementation. Collaboration between agencies and stakeholders is important, especially as each agency has its own capabilities and priorities. Therefore, the following list summarizes the expected responsibilities, roles, and expectations which are critical to the successful implementation of this plan.

UBBNRD – The UBBNRD will be the local champion of this plan and will lead and coordinate implementation efforts amongst other agencies. It will provide funding, education, and/or support at various levels, and work with other partners where beneficial.

NDEE/EPA Section 319 Program – The NDEE/EPA Section 319 program will provide technical expertise and funding through educational and grant programs to assist with implementation of BMPs. This will typically be focused on practices which are innovative, have a high impact on water quality, or that include education or public involvement.

NRCS – The NRCS will lead the effort on implementing traditional BMPs through technical support and targeted EQIP funding. Additional support may be provided through the National Water Quality Initiative, Conservation Stewardship Program, and Conservation Reserve Program.

NGPC – The NGPC assists in the management of fisheries at some lakes within the planning area. They may lead the effort on lake management or renovation efforts, including in-lake BMPs. Additionally, the NGPC manages or owns numerous public access areas (wildlife management areas, etc.) that may benefit from water quality improvements. Projects in these areas will be great partnership opportunities. The NGPC may also provide funding and technical support on various projects.

RWBJV – The RWBJV is dedicated to cooperative, mutually beneficial conservation projects to protect wild bird habitat throughout central Nebraska. The RWBJV provides a wealth of technical knowledge, specifically related to wetland conservation and restoration. Additionally, the RWBJV specializes in accessing unique funding sources and partnerships which may be beneficial in the implementation of this plan.

UNL Extension – UNL Extension delivers research-based knowledge Nebraskans can immediately use, especially in the areas of agriculture, water, and environmental management. Extension employees are located in nearly every county in Nebraska and can bring local knowledge and relationships into education and outreach efforts. Additionally, Extension staff could augment UBBNRD staff for on-the-ground outreach and watershed coordination activities.

14.05 FUNDING STRATEGY

OVERVIEW

While the UBBNRD and other stakeholders in the planning area do have taxing authorities that they use to support a variety of public needs, additional support from local, state, and federal funding is essential to accomplish the priorities identified in this plan. Many of these funding sources (such as Nebraska Environmental Trust, NRCS EQIP program, etc.) were identified within Chapter 8; however, because Section 319 funding was used in the development of this plan, special attention is given to this program. This section has been developed in response to requests by NDEE and EPA to clarify and summarize which BMPs are eligible for funding and implementation through the Section 319 program. It should be noted that this is for planning purposes only and project specific circumstances, policy changes, or additional project data may change the results of this initial assessment.

SECTION 319 PROJECT FUNDING ELIGIBILITY

Implementing BMPs identified for each target area or special priority area is critical to reducing pollutant loads and allowing waterbodies to meet water quality standards. However, it is not anticipated that the Section 319 program will participate in all identified activities. The NDEE/EPA Section 319 program will only provide funding through grant programs to assist with implementation of certain priority BMPs. BMPs are eligible for Section 319 funding by meeting three criteria (Figure 101). They must: (1) address an impaired waterbody; (2) be considered cost effective; and (3) be located within a target area or SPA. This can be summed up by saying the Section 319 program is interested in getting the most “bang for their buck.” Additionally, Section 319 funding for BMPs is encouraged to be commensurate with the targeted pollutant load reductions anticipated from each BMP.

When SPAs are found outside of target areas, they may still be eligible for Section 319 funding; however, BMPs are restricted to those necessary to address the specific needs of the SPA. For the purposes of utilizing Section 319 funding, the implementation of BMPs within the SPA must be administratively tied to a Section 319 project (i.e. part of the same project) where the majority of BMPs are focused within a target area.

Figure 101: Graphical Representation of how Section 319 Eligible BMPs are Identified

This plan has been written to only address pollutants that contribute to waterbody impairment. Water quality modeling was utilized to identify the efficiency that each BMP potentially has on each targeted pollutant. Much of this information is presented in Chapter 7; however, Table 81 is particularly relevant to identifying Section 319 eligibility for various BMPs. Detailed descriptions of each practice, efficiencies, modeled implementation levels, and other key assumptions can be found in the water quality modeling reports located in Appendix C. BMPs will only be eligible for Section 319 funding when they have a greater than 0% treatment efficiency for a specific pollutant that impair a targeted waterbody. Based on current Section 319 program requirements, it is assumed that project monitoring, I&E, or BMPs that are education based (pet waste management, etc.) will be eligible for Section 319 funding. These activities have been identified as a priority of the Section 319 program, despite the difficulty in applying load reductions directly to these actions.

Additionally, Section 319 funding eligibility relies on cost effectiveness, or BMPs that are a "high impact practice." In other words, identifying which BMPs provide a high pollutant load reduction per unit of cost, relative to one another. That information is beyond the scope of this plan due to the basin-wide scale and multiple target areas identified. BMP cost effectiveness will need to be determined through the development of a Project Implementation Plan (PIP) for each project that is requesting Section 319 funding.

For certain target areas, there may be some BMPs identified as "low priority" for Section 319 funding. This may happen even if many of them help to meet other management goals of the UBBNRD or participating landowners. These BMPs are still considered an important piece of this plan, and other funding mechanisms should be targeted to fill the funding gap for these BMPs. Also, it should be noted that as better monitoring data is collected, understanding BMP effectiveness and cost efficiencies may change. Therefore, this analysis should be updated in plan updates.

Table 81: Summary of Priority BMPs and Estimated Treatment Efficiencies

Management Practice	Estimated Treatment Efficiency				
	E. coli	TN	TP	TSS (Sediment)	Atrazine
Education and Information	10%	10%	10%	10%	0%
OWTS Education	Changes to failure rate in model.				
Pet Waste Ordinances	20%	0%	0%	0%	0%
Non-structural & Avoidance BMPs	10%	20%	50%	0%	40%
Irrigation Water Management	10%	35%	10%	0%	50%
Grazing Lands Management BMPs	40%	43%	26%	15%	0%
Cover Crops	40%	14%	11%	15%	25%
Riparian Buffers	70%	41%	45%	56%	30%
No-Till Farming	0%	25%	69%	77%	50%
Strip-Till (Reduced-Till) Farming	0%	15%	30%	40%	50%
Contour Buffer (filter) Strips	70%	40%	45%	73%	30%
Non-permitted AFO Facility BMPs	75%	56%	73%	70%	0%
Wetlands/Farm Ponds/Sediment Basins	78%	28%	45%	69%	25%
Wetland Restoration	Changes to land use numbers in model.				
Stream Restoration	35%	75%	75%	75%	25%
Terraces	70%	25%	31%	40%	15%
Water and Sediment Control Basins (WASCOBS)	70%	25%	31%	40%	15%
Grassed Waterways	70%	10%	25%	65%	30%
Land Use Change	Changes to land use numbers in model.				
Urban Stormwater BMPs	37%	40%	43%	78%	0%

14.06 PLAN EVALUATION

ADAPTIVE MANAGEMENT

Adaptive management is a process used when there is uncertainty in precisely how selected actions will affect the outcome, but decisions regarding management actions must be made. It is a systematic process of "learning by doing," as illustrated in Figure 102. This process involves evaluating alternative hypotheses by applying an experimental management program. Knowledge gained from previous management actions is then used to improve future management decisions. Monitoring is designed to reduce uncertainty, move decisions forward, and is a process of using the best available science to test hypotheses, implement management actions, learn from the results, and revise actions as required.

The UBBNRD will utilize an adaptive management scheme to assess, design, implement, monitor, evaluate, and adjust actions taken. The premise of adaptive management will drive the plan monitoring and evaluation process. Assessing through monitoring is an ongoing activity, with evaluation and adjustments taking place both as necessary and formally every 5 years. All available data will be utilized.

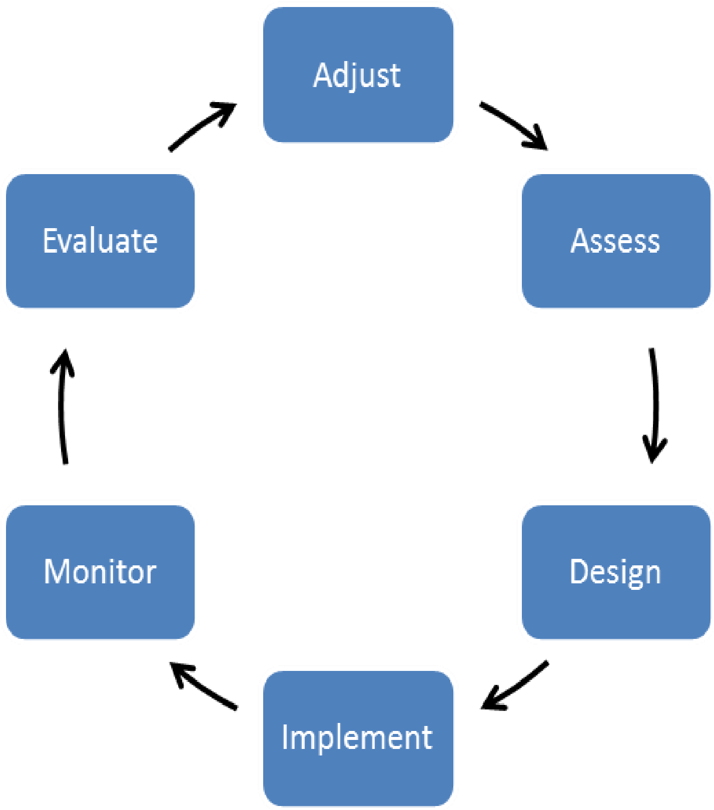

Figure 102: Basic Procedural Steps of Adaptive Management

MEASURING AND EVALUATING PROGRESS

Progress of plan implementation will be monitored by the UBBNRD, who will coordinate with other partners to identify the extent and level of BMPs implemented. As progress is tracked, the UBBNRD will evaluate these records against the milestones identified in the plan. The BMP Calculator Tool (discussed below) will be useful in this regard.

Progress will be tracked annually as the UBBNRD works to compile BMP implementation results and monitors water quality. Should it be realized that implementation is falling short of milestones, the UBBNRD will consider assembling stakeholders to review or update strategies.

Implementation records will be compiled into a summary report for review during the 5-year update process. If necessary, these can also be incorporated back into the appropriate water quality model and load reductions can be calculated. At this time the plan will be formally updated to incorporate these records, new water quality data, and lessons learned to improve the implementation approach. Stakeholders will have an opportunity to review the plan and their input on priorities will be considered in preparation of starting the next increment of plan implementation.

BMP CALCULATOR TOOL

Included as part of this plan is a “BMP Calculator Tool.” This calculator is a Microsoft Excel based tool that was built using average results from the water quality models and provides estimates of loading reductions achieved via individual BMPs. A static version of this can be found in Appendix E, while a copy of the Excel file is provided digitally on the CD accompanying this plan. The BMP Calculator Tool will allow the UBBNRD to quantify estimated pollutant load reductions achieved through BMP implementation prior to their effects showing up in water quality sampling (which often takes a long time to be realized). These results can be evaluated against plan milestones. Additionally, the BMP Calculator Tool will prove useful when estimating the benefits of planned water quality projects, a required item when developing a PIP for a Section 319 funded project. Over time, it is recommended that the water quality models and the BMP Calculator Tool be updated as future water quality data becomes available, and to ensure they represent the conditions of each target area.

14.07 SUMMARY OF TARGETED IMPLEMENTATION

The following is a district-wide summary of the activities and accomplishments expected to be achieved through implementation projects during the first 5-year phase of this plan. These summaries are provided by subbasin for each target area, and include schedules, milestones, budgets, and load reductions. Details for each target area can be found in Chapters 10 – 13.

MASTER SCHEDULE

The master schedule (Table 82) presents a compilation of the major events and activities planned in the individual target areas, during the first 5-year phase of this plan. Please note that the completion of this plan will take more than five years. Based on potential funding sources, a timeline of 50 years or more is anticipated. As the plan will be updated every five years, a long term schedule is not provided here. Detailed schedules can be found in the appropriate subbasin chapter.

Table 82: Master Schedule for the UBBNRD District-Wide WQMP

Subbasin / Target Area **Major Activity**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Upper Big Blue Subbasin						
No Target Areas						
West Fork Big Blue Subbasin						
Recharge Lake Target Area						
Secure project funding	X					
Project Monitoring	X	X	X	X	X	
Organize stakeholders		X				
Implement BMPs and I&E			X	X	X	X
In-Lake BMP feasibility study					X	X
Project Evaluation						X
Final project reporting						X
Beaver Creek Target Area						
Secure project funding	X					
Project Monitoring	X	X	X	X		
Organize stakeholders		X	X	X		
Implement BMPs and I&E			X	X	X	X
Project Evaluation						X
Final project reporting						X
Middle Big Blue Subbasin						
No Target Areas						
Turkey Creek Subbasin						
No Target Areas						

MASTER MILESTONES

The master milestones (Table 83) presents a compilation of the major completion dates for the major events and activities planned in the individual target areas, during the first 5-year phase of this plan. This will be updated every five years. Additional details can be found in the appropriate subbasin chapter.

Table 83: Master Milestones for the UBBNRD District-Wide WQMP

Subbasin / Target Area **Major Activity**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Upper Big Blue Subbasin						
No Target Areas						
West Fork Big Blue Subbasin						
Recharge Lake Target Area						
Develop PIP for BMP Implementation		X		X		
Apply for funding assistance grants	X	X		X		
Prepare final report(s)						X
RFP for in-lake BMP feasibility study					X	
Complete in-lake feasibility study						X
Initiate BMP implementation		X				
Complete Phase 1 BMP Implementation						X
Beaver Creek Target Area						
Develop PIP for BMP Implementation		X		X		
Apply for funding assistance grants	X	X		X		
Prepare final reports(s)						X
Initiate BMP implementation		X				
Complete Phase 1 BMP Implementation						X
Middle Big Blue Subbasin						
No Target Areas						
Turkey Creek Subbasin						
No Target Areas						

MASTER BUDGET

The master budget table (Table 84) presents a compilation of the major cost categories for major events and activities planned in the individual target areas during the first 5-year phase of this plan. This will be updated every five years. Additional details can be found in the appropriate subbasin chapter.

Cost opinions were calculated based on literature reviews, project team experience, and information provided by stakeholders. Cost opinions include staff time, design costs, material costs, and implementation costs, as appropriate. Every effort has been made to prepare realistic cost opinions; however, due to the broad scope and long-term implementation time frame of this plan and affiliated actions, actual costs may vary widely. This may be due but not limited, to the following factors: inflation, site specific conditions for structural BMPs, varying methodologies for BMP implementation, changes to the plan based on monitoring results, or other unforeseen changes to operational costs. Detailed cost opinions will be prepared for each water quality improvement project. Additionally, these estimates were developed for the priority BMPs, but other practices may also be considered. This also includes costs for plan maintenance and updates or other evaluations necessary to implement projects.

This cost opinion should be used for general planning purposes only, as cost opinions and budgeting techniques can vary widely based on the type of project being planned. In addition, the reader should keep in mind that cost opinions are representative of the total cost of implementation, which may ultimately be shared amongst various stakeholders and land owners through landowner financial assistance and other funding strategies.

The budget below is presented with the understanding that a reasonable funding goal when considering all potential funding sources (state and federal agencies, grants, private ventures, etc.) is approximately $1 million per year. The cost estimate includes the total implementation of all BMPs and potential projects identified in this plan. With these facts in mind, the final and total completion of this plan may take 50 years or more. The milestones presented above look forward five years into the future and will be updated every five years. Therefore, long term schedule and milestones are not presented in this plan.

Table 84: Master Budget for the UBBNRD District-Wide WQMP

Category	Cost
Upper Big Blue Subbasin	
No Target Areas	
West Fork Big Blue Subbasin	
Recharge Lake Target Area	
Drainage Area Treatment	$ 1,704,280
In-Stream Work	$ 1,336,000
In-Lake Work	$ 2,839,000
Planning	$ 25,000
Monitoring	$ 50,000
Target Area Total	**$ 5,954,280**
Beaver Creek Target Area	
Drainage Area Treatment	$ 47,222,900
In-Stream Work	$ 20,040,000
Planning	$ 75,000
Monitoring	$ 50,000
Target Area Total	**$ 67,387,900**
Subbasin Total	**$ 73,342,180**
Middle Big Blue Subbasin	
No Target Areas	
Turkey Creek Subbasin	
No Target Areas	
District-Wide Activities	
5-year Plan Update*	$ 150,000
Grand Total	**$ 73,492,180**

Based on estimated costs for first 5-year increment only
**Does not include target area plan updates.*

LOAD REDUCTION SUMMARY

The load reduction summary (Table 85) presents a summary of beginning load, projected load reduction and final load for each pollutant in the individual target areas. Additional details can be found in the appropriate subbasin chapter.

Table 85: Load Reduction Summary for the UBBNRD District-Wide WQMP

Subbasin / Targeted Waterbody	Pollutant	Pollutant Load		
		Current	Reduction	Final
Upper Big Blue Subbasin				
No target waterbodies				
West Fork Big Blue Subbasin				
Recharge Lake (BB3-L0080)	*E. coli* (billion CFU)	N/A	N/A	N/A
	Sediment (t/yr)	6,050	5,967	83
	Phosphorus (lbs/yr)	32,235	31,868	367
	Nitrogen (lbs/yr)	53,682	45,347	8,335
	Atrazine (µg/L)	N/A	N/A	N/A
Beaver Creek (BB3-10300)	*E. coli* (billion CFU)	650,800	391,400	259,400
	Sediment (t/yr)	93,632	52,967	40,665
	Phosphorus (lbs/yr)	344,006	206,369	137,637
	Nitrogen (lbs/yr)	1,228,735	582,789	645,946
	Atrazine (µg/L)	45.46	31.23	14.23
Middle Big Blue Subbasin				
No target waterbodies				
Turkey Creek Subbasin				
No target waterbodies				

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APPENDIX A: STAKEHOLDER & PUBLIC PARTICIATION MATERIALS

PRESS RELEASES, MAILINGS, AND OTHER CLIPPED ARTICLES

- Nebraska TV (abc) Online Screenshot – June 14, 2018
- UBBNRD Press Release – June 18, 2018
- York News Times Online Screenshot – March 19, 2019
- Aurora News-Register scan – March 27, 2019
- Hastings Tribune Online Screenshot – March 30, 2019
- Hastings Tribune Online Screenshot – April 3, 2019
- Aurora News-Register scan – April 9, 2019

FLYERS

- UBBNRD Open House Meeting Flyer – April 2, 2019

MEETING ITEMS

- Public Open House
    - Open House Sign-in Sheet – April 2, 2019
    - Open House Comment Cards (identifying information removed)
- Technical Advisory Committee Meetings (TAC)
    - TAC Meeting #1 Sign-in Sheet – May 21, 2018
    - TAC Meeting #1 Notes
    - TAC Meeting #2 Sign-in Sheet – August 20, 2018
    - TAC Meeting #2 Notes
    - TAC Meeting #3 Sign-in Sheet – October 1, 2018
    - TAC Meeting #3 Notes
    - TAC Meeting #4 Sign-in Sheet – December 3, 2018
    - TAC Meeting #4 Notes
    - TAC Meeting #5 Sign-in Sheet – February 4, 2019
    - TAC Meeting #6 Sign-in Sheet – April 1, 2019
- Stakeholder Meetings
    - Stakeholder Meeting #1 Sign-in Sheet – June 18, 2018
    - Stakeholder Meeting #1 Notes
    - Stakeholder Meeting #2 Sign-in Sheet – August 14, 2018
    - Stakeholder Meeting #2 Notes
    - Stakeholder Meeting #3 Sign-in Sheet – September 10, 2018
    - Stakeholder Meeting #3 Notes
    - Stakeholder Meeting #4 Sign-in Sheet – November 27, 2018
    - Stakeholder Meeting #4 Notes
    - Stakeholder Meeting #5 Sign-in Sheet – January 14, 2018
    - Stakeholder Meeting #5 Notes

- Stakeholder Ratified Goals and Objectives
- Stakeholder Summary Report

PROJECT HANDOUTS

- Water Quality Management Plan Informational Handout

Upper Big Blue NRD teams up for water management plans

by KHGI
Thursday, June 14th 2018

Water (MGN)

AA

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YORK, Neb. — The Upper Big Blue Natural Resources District is embarking on the first-ever combined water quality management and voluntary integrated management planning processes in partnership with both the Nebraska Department of Environmental Quality and the Nebraska Department of Natural Resources.

Water quality management plans address restoration and protection of water quality and are developed with assistance from NDEQ. Voluntary integrated management plans address the sustainability and quantity of hydrologically connected groundwater and surface water and are developed with assistance from NeDNR. Typically, these two planning processes are entirely separate due to the difference in focus and involved state agency.

The Upper Big Blue NRD viewed the separate planning processes as a way to combine two inseparable priorities for water quantity and quality into a consolidated planning process that fully engages citizens within the district to help inform the goals and objectives for both plans. The theme for this project is: “One District, Two Plans, One Water.”

The joint planning process will involve a consortium of multi-agency resource experts from federal, state and local agencies being referred to as a Technical Advisory Committee, and also a stakeholder committee comprised of citizens from throughout the entire NRD who represent different types of water users.

Both plans will help to inform future water management decisions to ensure sustainable water quality and quantity in the District for generations to come. This combined planning approach provides the Upper Big Blue NRD and the citizens of its District with a comprehensive view of its water resources in a more time-efficient and cost-effective manner.

The first stakeholder committee meeting will be held at the Upper Big Blue NRD's headquarters building located at 319 E. 25th Street in York from 7-9 p.m. June 18. The public is invited.

The public is also encouraged to follow the joint planning process by periodically checking for project updates at www.upperbigblue.org (http://www.upperbigblue.org).

MORE TO EXPLORE

Upper Big Blue NRD Makes State History with Precedent-Setting Initiative

Monday, June 18, 2018

Upper Big Blue NRD Makes State History with Precedent-Setting Initiative

YORK, Neb. – The Upper Big Blue Natural Resources District (NRD) is embarking on the first-ever combined water quality management and voluntary integrated management planning processes in partnership with both the Nebraska Department of Environmental Quality (NDEQ) and the Nebraska Department of Natural Resources (NeDNR).

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WEATHER

River Flood Warning until 7PM CDT SUN

https://www.yorknewstimes.com/news/public-input-sought-for-nrd-s-water-quality-management-plan/article_3b7a0ffe-49f8-11e9-a48a-bb642f6e3d59.html

Public input sought for NRD's water quality management plan

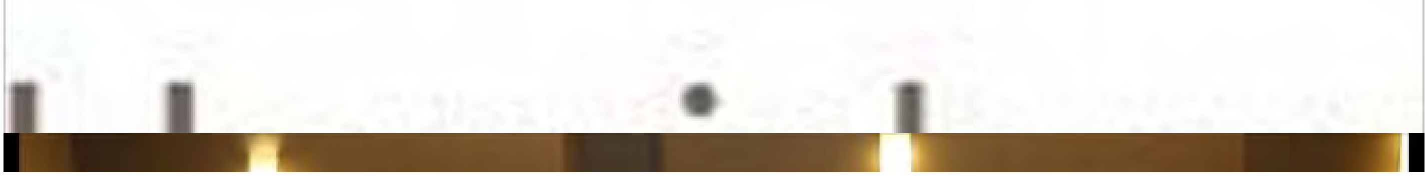
12 hrs ago

YORK – Landowners and residents of the Upper Big Blue Natural Resources District (NRD) are invited to attend an open house to learn more about the Upper Big Blue NRD's recent water resource planning efforts that address both water quality and quantity.

This joint planning process, the first of its kind in Nebraska history, began in fall 2018 and will be complete in summer 2018. Partial funding for this project is provided by the NDEQ through a nonpoint source pollution grant.

The open house meeting will be held on Tuesday, April 2, from 7 to 8:30 p.m. at the Upper Big Blue NRD Office (319 E. 25th Street, York, NE 68467). No formal presentations are planned.

The open house will feature informational displays and handouts detailing the community-guided planning efforts resulting in a draft Water Quality Management Plan and a set of goals and objectives for a to-be-developed Voluntary Integrated Management Plan.



These efforts were in collaboration with the Nebraska Department of Environmental Quality (NDEQ) and the Nebraska Department of Natural Resources (NeDNR), the respective state partner for each plan. Upper Big Blue NRD staff, representatives from NDEQ and NeDNR, and the consultant team will be available for discussion and questions during the open house. The meeting will also include information and resources about how communities and area residents can help manage the district's shared resource.

The Water Quality Management Plan is guided by goals and objectives developed by district-wide citizens who are stakeholders for all types of water uses including agriculture and urban users. The plan addresses restoration and water quality protection by identifying several priority areas for initial focus, including two segments of Beaver Creek, Recharge Lake, School Creek, Lake Hastings, two segments of Lincoln Creek, and Oxbow Trail Reservoir. Pollutants of concern include nutrients (phosphorus and nitrogen), E. coli bacteria, sediment, herbicides (atrazine), and pesticides. The draft plan will be made available on the NRD website, and the public is encouraged to provide feedback on it by May 15.

The Voluntary Integrated Management Plan will address the sustainability and quantity of hydrologically connected groundwater and surface water. This plan will be developed after completion of the Water Quality Management Plan is complete. The Voluntary Integrated Water Management Plan's goals and objectives were also developed by the same district-wide water use stakeholders who volunteered a great amount of their personal time for this joint planning process.

NRD seeks input on problems, possible solutions to water worries

■ Public hearing set for Tuesday in York

Editor's note: This article was written and shared by Steve Moseley of the York News-Times.

Fresh water is ... or certainly should be ... of deep importance to everyone in this region of the state; both in terms of quantity and quality.

Because those two aspects of this most vital and precious resource are intertwined, both will be taken up from 7-8:30 p.m. Tuesday, April 2 during an event for the public at Upper Big Blue Natural Resources District headquarters in York.

The building is located one block east of Lincoln Avenue (old Hwy 81) across the street from the county fairgrounds. Directions are included here with water users in other portions of the Upper Big Blue in mind. The NRD staff and JEO Consulting did not put this unique and informative evening together exclusively for folks in the York area. There is no part of the Upper Big Blue -- from Hastings to Aurora to Seward and beyond -- that does not have one or more concerns at some level about water quantity, quality or both. The NRD wants badly for people in those areas to participate as well.

Six individual stations will be scattered about the large conference room, each of which will take up a particular topic. All six will be staffed with people standing ready to answer questions and, perhaps of equal importance, hear public comment, ideas and suggestions about how the ongoing issue of managing surface and ground water to best serve very diverse public interests ought to proceed.

The Upper Big Blue, explained assistant general manager Rod DeBuhr and water department manager Marie Krausnick on Friday, is the first NRD in the state to fold the general categories of water quality and quantity together into a single integrated study and mitigation initiative.

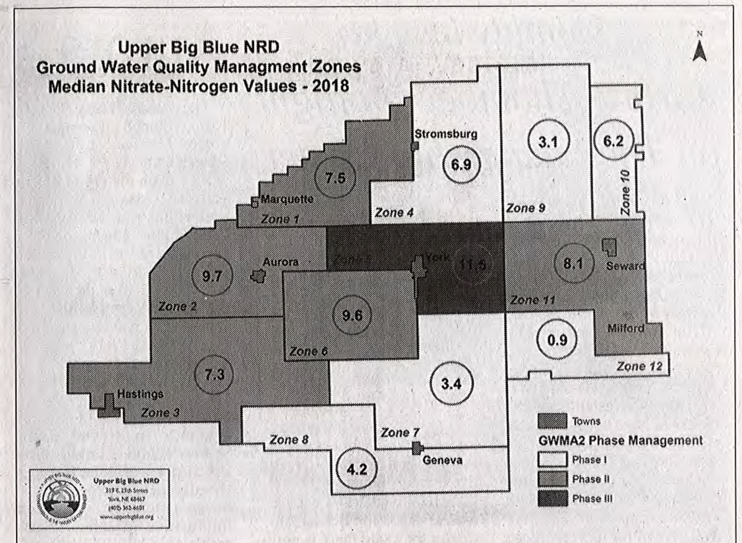
More typically in the past, DeBuhr said, was for NRDs, including his, to take up those topics separate and apart from each other. More recently, he explained, the Nebraska Department of Environmental Quality and the Nebraska Department of Natural Resources have worked to get themselves on the same page. They now encourage NRDs to do the same.

That, said DeBuhr, is because water quality and quantity, though separate in many ways, do indeed hold ramifications for the other.

Though standing at the beginning of what will certainly be a long and serpentine path to achieve solutions, the Upper Big Blue is nonetheless the first NRD to embark upon the journey. DeBuhr said while the basic concept was hatched at the state level, "We (Upper Big Blue) sat down" with DEQ and DNR "and helped develop it" into what the local NRD has flagged 'One District, Two Plans, One water.'

A key phase is already complete. DeBuhr said the NRD sought stakeholders from across a wide swath of water users -- agricultural, municipal, commercial and others -- then carefully polled them about what each sees as most important in terms of water in their individual areas of usage. An 18-member committee of stakeholders was formed and subsequently met in a series of NRD-sponsored sessions.

"We asked for their vision" about the issue and what the NRD's goals should be," he said.



Worries for the future include the stubborn resistance of nitrate levels in groundwater within the district to subside, especially in Zone 5 which includes York (see accompanying illustration). District testing confirms a median nitrate level of up to 11.5 parts per million from a dedicated network of monitoring wells. That is an obvious and legitimate worry because seven or fewer ppm is the goal. Zone 5 not only exceeds that goal but also the 10 ppm safe drinking water standard set by the EPA.

"The board has been wrestling with this issue in areas of our district for 20 years," said Krausnick of the NRD directors.

DeBuhr said "rapid use of nitrates" in production agriculture dates to the late 40s and early 50s and has has had a cumulative impact over the decades.

"Irrigation is a big contributor, too," added Krausnick. Studies have found that nitrate leaching into the unsaturated zone is higher under irrigated fields. That hits this area especially hard given the fact York County has been reported to have more irrigated acres of production cropland than any other county in the state.

"The board recognizes the need for fertilizer," said DeBuhr. "Economics demand we fertilize."

The question then becomes how to mitigate a problem everyone knows exists.

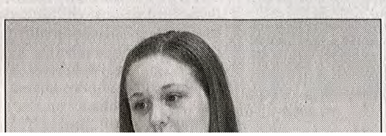
Nitrification inhibitors, applied with the pre-plant fertilizer applications decrease the potential for nitrate leaching by delaying nitrogen's conversion to nitrate in the soil, said DeBuhr.

Inhibitors, said DeBuhr, are required now for fall applications of anhydrous ammonia in Zone 5. Extending that mandate to spring treatments, too, is on the Upper Big Blue's rules and regulations table.

Outright prohibition of fall application of nitrogen, long before a crop will need it in the next year's growing season, are in place among other NRDs. The Upper Big Blue strongly discourages fall application of anhydrous ammonia, but does not yet prohibit it. Given the known fact Zone 5, an area of 216 square miles, is above the safe drinking water standard, and that other zones are at the cusp of exceeding 10 ppm, clearly there may come a day when the NRD has no other choice than to take that action.

DeBuhr and Krausnick urge anyone with an interest in fresh water and plenty of it -- which of course is every single person in the region -- to attend April 2 to see, hear and speak in their own voice about this critical public issue.

"The board wants feedback," said Krausnick, "not just from York but all the counties and communities in the NRD," whether they be farmers, livestock producers, commercial users or family consumers.



March Bloodmobile sees 123 pints donated

The American Red Cross bloodmobile visit to Aurora Methodist Church on March

Obermeier, Sharon Hansen, Ann

Marinell Kopecky. Ophttp://www.hastingstribune.com/news/ubbnrd-takes-new-dive-into-water-quality-quantity-challenges/article_bc63ecfc-5105-11e9-abaf-6741933746b6.html

UBBNRD takes new dive into water quality, quantity challenges

Andy Raun Mar 30, 2019

Plagued by continual worries over elevated groundwater nitrate concentrations and other matters, the Upper Big Blue Natural Resources District has adopted a new, cross-referenced approach to managing water resources across its jurisdiction.

Now, district staff and board members are inviting patrons to an open house Tuesday in York to learn more about a draft Water Quality Management Plan, plus a set of goals and objectives to be incorporated into a voluntary integrated water management plan yet to be developed.

Between the water quality plan and the voluntary IMP, the district is seeking to chart a better way forward in terms of both groundwater quality and quantity. Nebraska's NRDs are charged by state law with regulating groundwater management.

The Nebraska Department of Natural Resourc
resources, which are commonly understood to
Department of Environmental Quality gets inv

The open house is set for 7-8:30 p.m. Tuesday at the UBBNRD office, now located across the street from the York County Fairgrounds at 319 E. 25th St. That location is on the north side of town and just one block east of Lincoln Avenue, which is the main drag through the city of York running north and south.

The Upper Big Blue district encompasses all of York County, virtually all of Hamilton County, the northeastern corner of Adams County, and portions of Clay, Fillmore, Saline, Seward, Butler and Polk counties. The district includes around 1.23 million irrigated acres.

Tuesday’s open house will feature informational displays and handouts and explain the work that has gone into developing the draft Water Quality Management Plan and the goals and objectives for the future IMP. No formal presentations are planned.

The efforts have been made in collaboration with NDEQ and the state natural resources agency. They also involved a technical advisory committee and were influenced by a group of 18 agricultural, municipal, commercial and other water-using stakeholders from across the NRD who met in a series of NRD-sponsored sessions.

“We asked for their vision about the issue and what the NRD’s goals should be,” said Rod DeBuhr, UBBNRD assistant general manager, in an interview with Steve Moseley, former managing editor of the York News-Times, who covers NRD news for that newspaper and also is helping the district disseminate information about Tuesday’s meeting to all corners of its jurisdiction.

In Nebraska, surface water management is the province of the state Department of Natural Resources — the agency that works jointly with NRDs across the state in developing integrated management plans either on a voluntary or mandatory basis. IMPs address the sustainability of interconnected groundwater and surface water supplies needed to support local communities, agriculture and other users.

Six stations will be set up for patrons to visit T
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and suggestions.

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manager, said the Upper Big Blue is the first N
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DeBuhr said whereas water quality and quantity have been addressed separately in the past, the relevant state agencies — NDEQ and NDNR — have worked recently to get on the same page with quality and quantity issues and are encouraging natural resources districts to do the same.

Water quality worries for the future include the stubborn resistance of groundwater nitrate levels to subside, despite increased awareness of the associated human health ramifications and improved management by many farmers who apply nitrogen for their crops. In 2018, the UBBNRD's Zone 5, which encompasses the York area, hit a median nitrate level of 11.5 parts per million. The Environmental Protection Agency has set 10 ppm as the federal safe drinking water action level for nitrates in groundwater.

Other median nitrate levels within the UBBNRD include 9.6 ppm in Zone 6 (Henderson area), 9.7 ppm in Zone 2 (Giltner and Aurora), 7.3 ppm in Zone 3 (Hastings area and northeast) and 8.1 ppm in Zone 11 (Seward and Milford area).

The increasing groundwater nitrate levels correlate to increasingly intense farming practices since the 1940s and to increased irrigation, which promotes nitrate leaching.

DeBuhr said the NRD board of directors under
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"The board recognizes the need for fertilizer,"
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Nitrification inhibitors, which are applied with pre-plant fertilizer applications, decrease the potential for nitrate leaching by delaying nitrogen fertilizer's conversion to nitrate in the soil, DeBuhr told Moseley. When the conversion occurs before the new crop is ready to take up the fertilizer, leaching can ensue.

Inhibitors already are required for fall applications of anhydrous ammonia in Zone 5 around York. The UBBNRD is considering extending that mandate to spring applications, also.

Some NRDs already ban fall nitrogen applications for spring-planted crops outright. The UBBNRD strongly discourages fall anhydrous ammonia applications but does not yet prohibit them.

Upper Big Blue officials want residents and water users from all parts of the district to attend Tuesday's meeting and be part of the conversation. For more information visit www.upperbigblue.org.

Andy Raun

UBBNRD takes new dive into water quality, quantity challenges

Notebook:	Newspaper clippings
Created:	4/3/2019 10:45 AM
URL:	http://www.hastingstribune.com/news/ubbnrd-takes-new-dive-into-water-quality-quantity-chall...

UBBNRD takes new dive into water quality, quantity challenges

Plagued by continual worries over elevated groundwater nitrate concentrations and other matters, the Upper Big Blue Natural Resources District has adopted a new, cross-referenced approach to managing water resources across its jurisdiction.

Now, district staff and board members are inviting patrons to an open house Tuesday in York to learn more about a draft Water Quality Management Plan, plus a set of goals and objectives to be incorporated into a voluntary integrated water management plan yet to be developed.

Between the water quality plan and the voluntary IMP, the district is seeking to chart a better way forward in terms of both groundwater quality and quantity. Nebraska’s NRDs are charged by state law with regulating groundwater management.

The Nebraska Department of Natural Resources regulates the management of surface water resources, which are commonly understood to be interconnected with groundwater. The Nebraska Department of Environmental Quality gets involved with all kinds of water contamination issues.

The open house is set for 7-8:30 p.m. Tuesday at the UBBNRD office, now located across the street from the York County Fairgrounds at 319 E. 25th St. That location is on the north side of town and just one block east of Lincoln Avenue, which is the main drag through the city of York running north and south.

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The efforts have been made in collaboration with NDEQ and the state natural resources agency. They also involved a technical advisory committee and were influenced by a group of 18 agricultural, municipal, commercial and other water-using stakeholders from across the NRD who met in a series of NRD-sponsored sessions.

"We asked for their vision about the issue and what the NRD's goals should be," said Rod DeBuhr, UBBNRD assistant general manager, in an interview with Steve Moseley, former managing editor of the York News-Times, who covers NRD news for that newspaper and also is helping the district disseminate information about Tuesday's meeting to all corners of its jurisdiction.

In Nebraska, surface water management is the province of the state Department of Natural Resources — the agency that works jointly with NRDs across the state in developing integrated management plans either on a voluntary or mandatory basis. IMPs address the sustainability of interconnected groundwater and surface water supplies needed to support local communities, agriculture and other users.

Six stations will be set up for patrons to visit Tuesday, with representatives of the NRD, state agencies and the consulting firm JEO standing by to answer questions and field comments, ideas and suggestions.

In a recent interview with Moseley, DeBuhr and Marie Krausnick, UBBNRD water department manager, said the Upper Big Blue is the first NRD in the state to fold the general categories of water quality and quantity together in a single, integrated study and mitigation initiative. The overall effort has been given the theme of “One District, Two Plans, One Water.”

DeBuhr said whereas water quality and quantity have been addressed separately in the past, the relevant state agencies — NDEQ and NDNR — have worked recently to get on the same page with quality and quantity issues and are encouraging natural resources districts to do the same.

Water quality worries for the future include the stubborn resistance of groundwater nitrate levels to subside, despite increased awareness of the associated human health ramifications and improved management by many farmers who apply nitrogen for their crops. In 2018, the UBBNRD’s Zone 5, which encompasses the York area, hit a median nitrate level of 11.5 parts per million. The Environmental Protection Agency has set 10 ppm as the federal safe drinking water action level for nitrates in groundwater.

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The increasing groundwater nitrate levels correlate to increasingly intense farming practices since the 1940s and to increased irrigation, which promotes nitrate leaching.

DeBuhr said the NRD board of directors understands farmers’ need to fertilize, groundwater quality issues notwithstanding, but wants more effective strategies for mitigating the problem everyone already knows to exist.

“The board recognizes the need for fertilizer,” DeBuhr told Moseley. “Economics demand we fertilize.”

Nitrification inhibitors, which are applied with pre-plant fertilizer applications, decrease the potential for nitrate leaching by delaying nitrogen fertilizer’s conversion to nitrate in the soil, DeBuhr told Moseley. When the conversion occurs before the new crop is ready to take up the fertilizer, leaching can ensue.

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Upper Big Blue officials want residents and water users from all parts of the district to attend Tuesday's meeting and be part of the conversation. For more information visit www.upperbigblue.org.

NRD open house sheds light on proposed new water plans

Nitrate levels draw concern from group of stakeholders

by Cheyenne Rowe

Interested or concerned residents, farmers and water system professionals gathered in a brightly lit conference room last week in York to discuss something of importance -- water. More specifically, those in attendance gathered to learn about ways they can help both quality and quantity of the water in the Upper Big Blue Natural Resource District (UBBNRD).

Recent water quality testing done across the NRD, which includes Hamilton County, revealed dangerously high nitrate levels in drinking water in the York County area. Hamilton County currently remains at a moderate level. This means that the nitrate levels in local drinking water have not surpassed the 10 parts per million that the USDA deems safe to drink. The nitrates in York County tested at 11.5 ppm from the area's monitoring wells.

'Drinking water nitrates are a concern for not just our district but also for large portions of Nebraska. Nitrates not only pose a health concern for infants and elderly, it has proven to be a costly contaminant to remediate for communities in our district.'

Marie Krausnick

"Drinking water nitrates are a concern for not just our district but also for large portions of Nebraska," said UBBNRD Water Department Manager Maire Krausnick. "Nitrates not only pose a health concern for infants and elderly, it has proven to be a costly contaminant to remediate for communities in our district. The costs of drilling a new municipal well for small communities like McCool Junction or installing water treatment plants for communities the size of Seward place large financial burden on these communities."

Further, according to Krausnick, the district began implementing water quality rules in 1994. Those specific rules have since been modified to address nitrate concerns and the UBBNRD Board of Directors is currently reviewing them again to re-evaluate how they are impacting those issues.

"The open house provided one opportunity for the public to share their concerns about the nitrate issue and offer possible solutions," she said. "The two new plans are separate from our existing nitrate rules."

These two new plans include a Water Quality Management Plan and a Voluntary Integrated Management Plan. The water quality plan addresses the restoration and protection of water quality with help from the Nebraska Department of Environmental Quality (NDEQ). The voluntary integrated management plans (IMPs) were created with help from the Nebraska Department of Natural Resources (NeDNR) to address sustainability and quantity of ground and surface water. The plans were addressed with input from local stakeholders gathered by the UBBNRD.

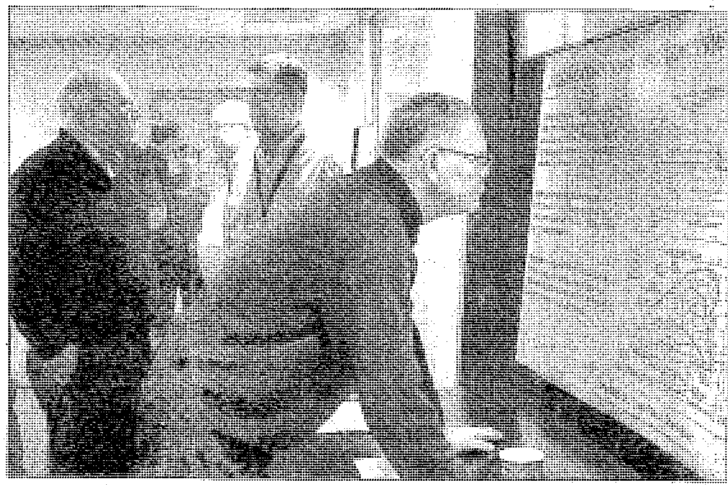
"These two separate water management planning initiatives are in reality completely connected and inseparable in terms of the water users involved and the area these plans cover," said Adam Rupe, Natural Resources specialist with JEO Consulting Group. "It was ideal to work with the same diverse group of stakeholders at the same time for both plans. The entire process was driven by input from the stakeholders. It is imperative that they were involved because they are the ones that are impacted by water quality and quantity issues. Their experience in the issues and possible solutions also means they are able to provide real-world feedback."

Rupe and JEO Consulting were responsible for facilitating the stakeholder meetings and organizing the process, said Rupe, as well as writing the WQMP which is still in draft format.

"Writing the water quality management plan also includes extensive data organization and analysis, water quality modeling, literature reviews and extensive agency coordination," Rupe explained. "Writing the voluntary integrated management plan has not commenced yet. The stakeholders developed goals and objectives, which the plans are being structured around."

According to literature provided at the open house, the two voluntary plans are set to provide the UBBNRD with many benefits "including access to grant funding, community involvement opportunities, and supporting information for future project development." Additionally, these plans will collect important data regarding the quality and quantity of water in the area.

(See OPEN HOUSE, C7)



News-Register/Cheyenne Rowe

City Administrator Rick Melcher, left, and Mayor Marlin Seeman, right, hear from one of the many professionals on hand to explain the two new voluntary plans being proposed by the UBBNRD, NDEQ and NeDNR.

UBBNRD

(Continued from C6)

"The WQMP will provide a concise summary of the condition of water resources in the district and will provide direction and a coordinated approach for addressing non-point source pollution," Krausnick explained. "This plan primarily deals with surface water impairments. Once the plan is in place, efforts can be directed to project development and funding acquisition."

In initial meetings, stakeholders identified groundwater nitrate contamination as one of their primary concerns, which the UBBNRD and NDEQ have also put extreme care into due to the potential health risks this could pose due to contaminated (at too-high levels) drinking water.

The other half of the voluntary plans being formulated by the district and state is the Voluntary Integrated Management Plan (IMP). This is something that every NRD in the state is working with the NeDNR to implement or develop. Required IMPs are only mandatory when the area's water has been deemed fully appropriated, or used up, hence the voluntary nature of the one being developed in the UBBNRD. This helps proactively to maintain a healthy balance between use and supplies of groundwater.

"The Voluntary Integrated Management Plan addresses the interaction of groundwater pumping on surface water flows in the basins, rivers and streams," Krausnick reported. "If we begin to see steep groundwater level declines paired with surface water appropriations being shut off we could see our Voluntary Integrated Management Plan become and involuntary plan. But if our producers continue to be good stewards of our groundwater resource and Mother Nature provides growing season rainfall we will likely not be designated fully appropriated by the State of Nebraska Department of Natural Resources."

'If we begin to see steep groundwater level declines paired with surface water appropriations being shut off we could see our Voluntary Integrated Management Plan become and involuntary plan.'

Marie Krausnick

Members of the community are vital in this process, both as stakeholders sharing their concerns and opinions and as community members participating in the voluntary plans. The UBBNRD's stakeholder group contained 18 people "representing a diverse cross-section of the community. The UBBNRD and NDEQ also assembled a Technical Advisory Committee (TAC) comprised of 17 representatives from multiple organizations focused on natural resources."

Addressing the issue

There are reportedly many things being done by many people in relation to lowering the nitrate level in the groundwater and maintaining good water sustainability practices. Landowners, producers and even the NRD continue to educate each other on the best ways to address the issue at hand. The Water Quality Management Plan in specific identifies a series of action items community members can complete in order to help do their part. A question arose of how farmers were to approach fertilizing their fields, as this is literally putting nitrates on the soil.

'Fertilizer is a necessary part of agricultural production, but timing and release of fertilizer applications will be key as we move forward in regulating drinking water quality.'

Marie Krausnick

"Fertilizer is a necessary part of agricultural production, but timing and release of fertilizer applications will be key as we move forward in regulating drinking water quality," Krausnick stated. "Agriculture in our district has seen significant changes in research and technology since the early 1950's increasing agricultural efficiency. The UBBNRD wants to see farmers be successful and environmentally aware. Research has shown that commercial fertilizer and animal manure are the sources of nitrate contamination in the district. Using what we know today will help us remediate our drinking water quality into the future."

According to literature provided by the district, there are many best management practices and other ways anyone and everyone can get involved in protecting water quality. These practices were developed by the stakeholders themselves on top of suggestions that the NRD provide as much education about the issue as possible.

Some of the best management practices include following a water storage and flood control program, utilizing cover crops, terracing, grassed waterways, sediment control basins, planned grazing systems, buffer strips and well and water testing.

"The Water Quality Management Plan needs to be approved by the Environmental Protection Agency and UBBNRD Board of Directors before the district can apply for grant funding to begin implementing projects from the plan," Krausnick said when asked about the plan moving forward. "It will likely be mid to late summer before we have those approvals. The Voluntary Integrated Management Plan is still in the planning phase. We have collected all the information from our stakeholders and will begin writing this plan after we have approval for the Water Quality Management Plan."

According to Aurora native John Miller, an NRDthe turnout pleased presenters and was about double what they were originally expecting.

"I believe we opened some eyes that before did not realize we put as much attention to water quality as we do quantity," he said. "As in any open meeting there are those who think we do too much and others who think we don't do enough. In general I think the majority were there to gather insight into what we are doing. I was pleased to see so many were leaving written comments. I have not seen these comments yet, but looking forward to do so."

Upper Big Blue Natural Resources District

OPEN HOUSE PUBLIC MEETING

The Upper Big Blue NRD is working with the Nebraska Department of Environmental Quality (NDEQ) and Nebraska Department of Natural Resources (NeDNR) to develop a Water Quality Management Plan and Voluntary Integrated Management Plan. These plans are based on input from a local stakeholder group, and will help guide water resource management for the next decade.

We are hosting an open house public meeting to share information from the planning process and draft Water Quality Management Plan, answer questions the public may have, and discuss what you can do to help protect our shared resource.

Tuesday, April 2, 2019
7:00 - 8:30 p.m.

Upper Big Blue NRD Office
319 E. 25th Street
York, NE 68467

No formal presentations are planned, so please stop by as you have time!

We hope to see you there!

If you are unable to attend or if you would like more information, please contact Rod DeBuhr at 402-362-6601.

One District, Two Plans, One Water

NEBRASKA
DEPT. OF ENVIRONMENTAL QUALITY

NEBRASKA
Good Life. Great Water.
DEPT. OF NATURAL RESOURCES

Upper Big Blue NRD
Water Quality Management & Voluntary Integrated Management Plans
Open House Meeting
UBBNRD Office – Tuesday, April 2, 2019; 7:00 p.m.

NAME	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL	WOULD YOU LIKE TO BE NOTIFIIED WHEN THE DRAFT WQMP AND VIMP ARE AVAILABLE?
Todd Schoch	920 Road 19 York NE 68467	402-366-1439	twschoch@gmail.com	☐ YES ☐ NO
Wade Walters	507 N Plum St. Shickley, NE 68436	402-759-1831	walterswade@outlook.com	☒ YES ☐ NO
David Robotham	203 N Blackburn York	710-1877	david.Robotham1877 (Gmail)	☒ YES ☐ NO
Gary Hellerich	2854 CR A Valparaiso	402-560-8508	ghellerich@inebraska.com	☑ YES ☐ NO
Mark + Chrystal Houston	942 E 5th st, York 68467	402-314-7551	markhouston1@gmail.com	☒ YES ☐ NO
Joe Frei	York	402 910-1842	Jfrei@cityofyork.net	☒ YES ☐ NO
Lisa Brink	1615 Road York	512.750.3531	brinklm13@gmail.com	☑ YES ☐ NO
Jerry Stahr	1701 Road 14 York	402-366-0602	jerrysuestahr@gmail.com	☒ YES ☐ NO
Luke Jacobsen	2204 N 'R' Rd Marquette, Ne	402 854-3104		☑ YES ☐ NO

Please Sign In!

Upper Big Blue NRD
Water Quality Management & Voluntary Integrated Management Plans
Open House Meeting
UBBNRD Office – Tuesday, April 2, 2019; 7:00 p.m.

NAME	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL	WOULD YOU LIKE TO BE NOTIFIIED WHEN THE DRAFT WQMP AND VIMP ARE AVAILABLE?
RILEY COOK	8609 Osborne Dr. W. HASTINGS, NE 68901	402-984-1787	rileycook73@gmail.com	☒ YES ☐ NO
Kevin Medow	4338 Bluff Rd. Utica, NE 68456	402-641-1644	medowfarms@gmail.com	☒ YES ☐ NO
ERIC MELCHER	905 13th ST, AURORA NE 68818	402-694-6992	ctyadm@cityofaurora.org	☒ YES ☐ NO
Marlin Seeman	1719 L St Aurora, NE 68818	402 694 6883	MayorSeeman@cityofAurora.org	☐ YES ☒ NO
John S. Goertzen	1307 Rd B Bradshaw NE 68319	402-366-7061	jsgoertzen@gmail.com	☒ YES ☐ NO
Josh Bowers				☐ YES ☐ NO
Joyce Forst	2108 Yankee Hill Rd Milford, Ne 68405	402-641-4486	NA	☐ YES ☐ NO
Dale L. Anderson	706 No. 1st #5 Seward, Ne 68434	40284 · 8777	N.A.	☐ YES ☐ NO
Greg W Whitmore	12959 W Rd Shelby NE 68662	402-527-5648		☒ YES ☐ NO

Please Sign In!

Upper Big Blue NRD
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UBBNRD Office – Tuesday, April 2, 2019; 7:00 p.m.

NAME	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL	WOULD YOU LIKE TO BE NOTIFIED WHEN THE DRAFT WQMP AND VIMP ARE AVAILABLE?
Todd Baudor	Po Box 43 Waco 68460	402 366 4888	tbaudor@outlook.com	☑ YES ☐ NO
Chris Farley	208 S. Strickler Waco NE 68460	402-366-6038	chris.farley@windstream.net	☑ YES ☐ NO
Randy Obermier	1101 N Academy	402-362-5063	ybnr99@gmail.com	☑ YES ☐ NO
Larry Tonniges	4210 Branched Oak Rd	402-641-1048	larsuston@hotmail.com	☑ YES ☐ NO
Mark Jost	2402 E 10 Rd Henderson 68371	402-694-9242	mark@jostfarms.com	☑ YES ☐ NO
Clarence Hoffman	1503 N. Michigan York, NE 68467	402-362-5577	cih@pennerstire.com	☑ YES ☐ NO
Ronald Uffelman	1214 Rd V Waco NE 68460	402-366-6673	ronald.uffelman@outlook.com	☑ YES ☐ NO
Jim Green	P.O Box 355 McCool Jct. NE 68401	402-724-2525	mccoolutilities@galaxycable.net	☑ YES ☐ NO
Kelly Brocke	Po Box 116, Benedict NE 68316	402-732-6801	volo@windstream.net	☑ YES ☐ NO

Please Sign In!

Upper Big Blue NRD

Water Quality Management & Voluntary Integrated Management Plans

Open House Meeting

UBBNRD Office – Tuesday, April 2, 2019; 7:00 p.m.

NAME	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL	WOULD YOU LIKE TO BE NOTIFIIED WHEN THE DRAFT WQMP AND VIMP ARE AVAILABLE?
Ron Mogul Jr	#7 Country Club Terrace York NE 68467	402-362-7949	rmogul.jr@gmail.com	☒ YES ☐ NO
Tim Beckman	211 East 8th Stromsburg NE	402 366 0286	wl-o@windstream.net	☐ YES ☐ NO
Gary Eberle				☐ YES ☐ NO
John Miller				☐ YES ☐ NO
Bill Stahly				☐ YES ☐ NO
Marty Stange	1228 North Denver Ave. Hastings, NE 68901	402-831-1399	mstange@hastingsutilities.com	☒ YES ☐ NO
Allen Stuhr	101 Blaine St P.O. Box 6 Waco	402-366-2202		☒ YES ☐ NO
Jonathan Reypel	415 RD F Henderson, NE 68371	402 366 5237		☒ YES ☐ NO
Marlin Vollbrecht	814 R Road Shickley 68436	402-759-4684		☒ YES ☐ NO

Please Sign In!

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Water Quality Management & Voluntary Integrated Management Plans
Open House Meeting
UBBNRD Office – Tuesday, April 2, 2019; 7:00 p.m.

NAME	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL	WOULD YOU LIKE TO BE NOTIFIIED WHEN THE DRAFT WQMP AND VIMP ARE AVAILABLE?
Evelyn M Waldman	814 Rd Q Shickley NE	402-759-4684		☐ YES ☐ NO
[illegible]	2255 128 Rd Shelby			☐ YES ☐ NO
Lynn Yates	NRD director			☐ YES ☐ NO
Jenny Rees	2345 Nebraska Ave. York	362-5508	jrees2@unl.edu	☒ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO

Please Sign In!

UPPER BIG BLUE NRD

WATER QUALITY MANAGEMENT PLAN AND VOLUNTARY INTEGRATED MANAGEMENT PLAN

One District, Two Plans, One Water

Public Meeting Comment Form

After reviewing the displays and speaking with project representatives, please take a few moments to fill out this form and place in the available drop boxes. Comments may also be submitted to Rod DeBuhr at rdebuhr@upperbigblue.org.

1. What was the most helpful thing you learned tonight?

2. Was there anything you would have like to have learned at this meeting that we did not cover?

3. What technical or cost-share programs would you like to see?

If there is an elimination of fall AA application, I would like to see a cost share program to purchase liquid tanks, applicator, etc. I want the flexibility of all sources of N application. (over)

4. What information or resources would be most helpful to you to get involved?

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): ______

U.S. Mail Address: ______

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

- ☐ District resident – urban area
- ☒ District resident – rural area
- ☒ District producer or farmer
- ☐ Other: ______

☐ Check here you want to be notified when the draft plans are available for public comment (don't forget to provide your email address!)

☐ Check here if would be interested in serving as a stakeholder on a future NRD project

In Partnership With
Nebraska Department of Environmental Quality
Nebraska Department of Natural Resources

If producers are restricted with rates of nitrogen, lawn applications should follow suit. No fall applications of lawns. ~~The same should go for water applications~~

I also talked to Marie about improving social media of the NRD. Twitter, apps, etc. Need improvement in this area.

UPPER BIG BLUE NRD

WATER QUALITY MANAGEMENT PLAN AND VOLUNTARY INTEGRATED MANAGEMENT PLAN

One District, Two Plans, One Water

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1. What was the most helpful thing you learned tonight?

That there are programs in the works to start mitigating groundwater contamination. I was encouraged that cover crops are being reccommended as well as bufferstrips.

2. Was there anything you would have like to have learned at this meeting that we did not cover?

What has worked to address these problems in other areas. What alternatives and options could be used to decrease farmers' need for fertilizer and still remain economically viable.

3. What technical or cost-share programs would you like to see?

Programs to help farmers plant bufferstrips, cover crops, and alternative fertilizer options.

4. What information or resources would be most helpful to you to get involved?

Information about future events like this and volunteer opportunities. I'm also an educator at UNL and often have my students write about local issues like this so educational materials or partnerships would be useful. I'm a writing teacher, not ag, but I try to get my students interested in local issues.

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): ______

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

- ☒ District resident – urban area
- ☐ District resident – rural area
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In Partnership With
Nebraska Department of Environmental Quality
Nebraska Department of Natural Resources

UPPER BIG BLUE NRD

WATER QUALITY MANAGEMENT PLAN AND VOLUNTARY INTEGRATED MANAGEMENT PLAN

One District, Two Plans, One Water

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1. What was the most helpful thing you learned tonight?

all the different BMPs to improve water. It's empowering to know what we can do immediately.

2. Was there anything you would have like to have learned at this meeting that we did not cover?

Is there something more that our city government could be doing around this issue?

3. What technical or cost-share programs would you like to see?

n/a

4. What information or resources would be most helpful to you to get involved?

I'm not a farmer, but there are waterways like Beaver Creek and Recharge that I'd like to know as a volunteer how I can work for their improvement.

Please provide additional comments or questions on the backside of this form.

Nam[redacted]

Representing (if applicable): ____________________

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

- ☒ District resident – urban area
- ☐ District resident – rural area
- ☐ District producer or farmer
- ☐ Other: ____________________

☒ Check here you want to be notified when the draft plans are available for public comment (don't forget to provide your email address!)

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In Partnership With
Nebraska Department of Environmental Quality
Nebraska Department of Natural Resources

Thank you!

UPPER BIG BLUE NRD

WATER QUALITY MANAGEMENT PLAN AND VOLUNTARY INTEGRATED MANAGEMENT PLAN

One District, Two Plans, One Water

Public Meeting Comment Form

After reviewing the displays and speaking with project representatives, please take a few moments to fill out this form and place in the available drop boxes. Comments may also be submitted to Rod DeBuhr at rdebuhr@upperbigblue.org.

1. What was the most helpful thing you learned tonight?

Fall Fertilizer is needed in our area, work load is a big problem not all people (NH3) including board members are aware of how safe NH3 is in the soil all winter, its not going anywhere (with N-Serve) otherwise our yeilds would suffer

2. Was there anything you would have like to have learned at this meeting that we did not cover?

3. What technical or cost-share programs would you like to see?

cost share equipment to split apply, or varible rate fertilizer (NH3) or other forms, works for me and have cut fertilizer use

4. What information or resources would be most helpful to you to get involved?

Listen to the university of Nebraska when they say Fall fertilizer, is not the problem

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable):

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

- ☐ District resident – urban area
- ☐ District resident – rural area
- ☑ District producer or farmer
- ☐ Other:

☑ Check here you want to be notified when the draft plans are available for public comment (don't forget to provide your email address!)

☐ Check here if would be interested in serving as a stakeholder on a future NRD project

In Partnership With
Nebraska Department of Environmental Quality
Nebraska Department of Natural Resources

UPPER BIG BLUE NRD

WATER QUALITY MANAGEMENT PLAN AND VOLUNTARY INTEGRATED MANAGEMENT PLAN

One District, Two Plans, One Water

Public Meeting Comment Form

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1. **What was the most helpful thing you learned tonight?**

How Can I help to reduce nitrates

2. **Was there anything you would have like to have learned at this meeting that we did not cover?**

3. **What technical or cost-share programs would you like to see?**

Cost share

4. **What information or resources would be most helpful to you to get involved?**

Nitrogen quality needed for various yields.

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): [redacted]

U.S. Mail Address: [redacted]

E-Mail Address: ____________________

Phone Number: ____________________

Describe Yourself (check all that apply):

- ☐ District resident – urban area
- ☐ District resident – rural area
- ☑ District producer or farmer
- ☐ Other: ____________________

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1. **What was the most helpful thing you learned tonight?** That we need to work together or we are going to be told what to do. We as a community have problems with nitrates. It appears we end up spending LOTS OF MONEY for ~~new~~ new well and at times our farm neighbors don't care what happens. We MUST work together

2. **Was there anything you would have like to have learned at this meeting that we did not cover?**
NO

3. **What technical or cost-share programs would you like to see?**
more buffer strips. funding for better science. The most powerful country in world and we fail to use good science

4. **What information or resources would be most helpful to you to get involved?**
Not sure, but need to get more involved

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): ____________

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

- ☒ District resident – urban area
- ☐ District resident – rural area
- ☐ District producer or farmer
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1. What was the most helpful thing you learned tonight? That we are looking into possible restriction of fertilizer application in the fall.

2. Was there anything you would have like to have learned at this meeting that we did not cover?
Hope to have more meetings like this as programs progress.

3. What technical or cost-share programs would you like to see? More investigation as to how accurate UNL guidelines for nitrogen carry over and application rates are. Their rates are not sustainable from a producer point of view. They call for under application for crop production.

4. What information or resources would be most helpful to you to get involved?

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable):

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

- ☐ District resident – urban area
- ☐ District resident – rural area
- ☒ District producer or farmer
- ☐ Other:

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Public Meeting Comment Form

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1. **What was the most helpful thing you learned tonight?**

That the district is working on water quality & quantity plans.
That plans are voluntary not required

2. **Was there anything you would have like to have learned at this meeting that we did not cover?**

More specifics about potential regulations, cost share opportunities, & how soon it will impact my farm

3. **What technical or cost-share programs would you like to see?**

cover crops, VRI, soil moisture probes
Ability to restore wetlands & continue to pump off surface water for irrigation, graze the wetland and qualify for govt cost share to do so.

4. **What information or resources would be most helpful to you to get involved?**

The draft management plans to read through

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): [redacted]

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

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- ☐ District resident – rural area
- ☒ District producer or farmer
- ☐ Other: ____________

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UPPER BIG BLUE NRD

WATER QUALITY MANAGEMENT PLAN AND VOLUNTARY INTEGRATED MANAGEMENT PLAN

One District. Two Plans. One Water

Public Meeting Comment Form

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1. What was the most helpful thing you learned tonight?

That there are No New Solutions, but Applying what we know can mitigate the problem Going forward.

2. Was there anything you would have like to have learned at this meeting that we did not cover?

That the Nitrate problem was Created 20-30 years ago and won't be Solved Quickly.

3. What technical or cost-share programs would you like to see?

Education

4. What information or resources would be most helpful to you to get involved?

Please provide additional comments or questions on the backside of this form.

Name [redacted]

Representing (if applicable):

U.S. Mail Address: [redacted]

E-Mail Address:

Phone Number:

Describe Yourself (check all that apply):

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- ☐ District resident – rural area
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1. What was the most helpful thing you learned tonight?

THAT WE "ARE" TRYING

2. Was there anything you would have like to have learned at this meeting that we did not cover?

HOW MUCH OF A TAX BITE YOU TAKE ?

3. What technical or cost-share programs would you like to see? →

4. What information or resources would be most helpful to you to get involved?

MORE TAXES --- NEEDS TO BE SPRED OVER EVERYONE --- REMEMBER THAT'S "YOU" AS WELL ; THINGS WILL "TAKE MORE TIME" THAN MONEY

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): [redacted]

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

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1. What was the most helpful thing you learned tonight?

WE HAVE ON-GOING PROGRAMS AIMED AT TAKING CARE OF OUR MOST PRECIOUS RESOURCE - WATER

2. Was there anything you would have like to have learned at this meeting that we did not cover?

WHAT CAN I DO TO HELP?

3. What technical or cost-share programs would you like to see?

ANY

4. What information or resources would be most helpful to you to get involved?

TELL THE PUBLIC WHAT THEY CAN DO TO HELP. FOLKS KNOW BUT NEED CONSTANT REMINDERS

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): [redacted]

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

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1. What was the most helpful thing you learned tonight?

2. Was there anything you would have like to have learned at this meeting that we did not cover?

see back

3. What technical or cost-share programs would you like to see?

Data Loggers for municiple well(s) level. Long term analysis of data.

4. What information or resources would be most helpful to you to get involved?

Continued Public Awareness

Please provide additional comments or questions on the backside of this form.

Name: [redacted]

Representing (if applicable): [redacted]

U.S. Mail Address: [redacted]

E-Mail Address: [redacted]

Phone Number: [redacted]

Describe Yourself (check all that apply):

- ☑ District resident – urban area
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- ☐ District producer or farmer
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① Information for residents (to hand out) locally on overuse of lawn treatments and how it effects the ground water. ② Also information showing that the average lawn (yard) does require daily watering and effects on chemicals and fertilizers applied.

Upper Big Blue NRD – Water Quality Management Plan
"Technical Advisory Committee #1"
UBBNRD Office – Monday, May 21, 2018, 3:00 PM

Please place a check next to your name, if present. | If any information is incorrect, or needs updated, please cross out and provide

Present	NAME	TITLE	ORGANIZATION / INTEREST Represented	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL
✓	Carla McCullough	319 Nonpoint Source Coordinator	NDEQ	1200 N St., The Atrium, Suite 400, Lincoln, NE 68509	402.471.3382	Carla.mccullough@nebraska.gov
X	Craig Romary	Environmental Programs Specialist	NE Dept. of Ag	PO Box 94947, Lincoln, NE	402.471.6883	Craig.romary@nebraska.gov
X	Ted LaGrange	Wetland Program Manager	NGPC	2200 N. 33rd St., Lincoln, NE 68503	402.471.5436	Ted.lagrange@nebraska.gov
X	Amy Zoller	Integrated Water Management Coordinator	NeDNR	P.O. Box 94676, Lincoln, NE 68509-4676	402.471.0625	amy.zoller@nebraska.gov
	Josh Bauers	District Conservationist	NRCS	419 W 6th St, #2, York, NE 68467	402.908.3157	joshua.bowers@ne.usda.gov
	Andy Bishop	Coordinator	Rainwater Basin Joint Venture	2550 N Diers Ave, Grand Island, NE 68803	308.382.8112	andy_bishop@fws.gov
X	Matt Poesnecker	General Manager/Co-Owner	S & P Irrigation	110 S 16th St., Aurora, NE 68818	402.694.4011	matt@spirrigation.com
X	Lynn Yates	UBB Board Chairman	UBB NRD	915 Road 12, Geneva, NE 68361	402.759.4732	vyates53@gmail.com
	Doug Dickinson	UBB Board Projects Committee Chairman	UBB NRD	3354 McKelve Road, Seward NE 68434-7510	402.643.5456	farm_life@hotmail.com
X	John Miller	UBB Board Projects Committee Chairman	UBB NRD	165 Driftwood Drive, Aurora, NE 68818-1413	402.694.3570	pandj@hamilton.net
X	Rod DeBuhr	UBB Staff	UBB NRD	310 E 25th St., York NE 68467	402.362.6601	rdebuhr@upperbigblue.org
X	Jack Wergin	UBB Staff	UBB NRD	310 E 25th St., York NE 68467	402.362.6601	jwergin@upperbigblue.org
X	Marie Krausnick	UBB Staff	UBB NRD	310 E 25th St., York NE 68467	402.362.6601	mebel@upperbigblue.org
X	Katie Pekarek	Associate Extension Educator- School of Natural Resources	UNL Extension	912 Hardin Hall, Lincoln, NE 68583-0989	402.817.5097	kpekarek2@unl.edu
X	Steve Melvin	Extension Educator-Southeast Research and Extension Center	UNL Extension	1510 18th Street, PO Box 27, Central City, NE 68826-0027	308.946.3843	steve.melvin@unl.edu
X	Jenny Rees	Extension Educator-Southeast Research and Extension Center	UNL Extension	2345 Nebraska Avenue, York, NE 68467-1104	402.363.5508	jrees2@unl.edu
	Mike Zwingman	Technical Development Manager	Verdesian Life Sciences		402.366.3442	mike.zwingman@vlsci.com
X	Rick Wilson	Project Manager	JEO Consulting Group	2700 Fletcher Ave, Lincoln, NE 68504	402.435.3080	rwilson@jeo.com
X	Adam Rupe	Natural Resources Specialist	JEO Consulting Group	2700 Fletcher Ave, Lincoln, NE 68504	402.435.3080	arupe@jeo.com

David Eigenberg UBB NRD

Please Sign In!

Upper Big Blue NRD – Water Quality Management Plan
"Technical Advisory Committee #1"
UBBNRD Office – Monday, May 21, 2018, 3:00 PM

Please place a check next to your name, if present. | If any information is incorrect, or needs updated, please cross out and provide

Present	NAME	TITLE	ORGANIZATION / INTEREST Represented	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL
X	Steve Wolf	Community Engagement Director	JEO Consulting Group	111717 Burt Street, Suite 210, Omaha, NE 68154	402.392.9907	swolf@jeo.com
X	Heather Duncan	Nebraska liaison, 319 program	EPA Region 7	11201 Renner Blvd, Lenexa, KS 66219	913.551.7640	duncan.heather@epa.gov

Please Sign In!

ENGINEERING ■ ARCHITECTURE ■ SURVEYING ■ PLANNING

Upper Big Blue Natural Resources District Water Quality Management Plan and Voluntary Integrated Management Plan Facilitation

Technical Advisory Committee
Meeting Minutes

DATE AND TIME | May 21, 2018 3:00 PM
JEO PROJECT NO. | P161356.00
LOCATION | UBBNRD Office
ATTENDEES |

See attached sign-in sheet

AGENDA |

See attached agenda

- **Status**

  The purpose of the meeting was to inform the Technical Advisory Committee (TAC) about the Upper Big Blue Natural Resources District Water Quality Management Plan (WQMP) and Voluntary Integrated Management Plan (VIMP) Facilitation. Additionally, the TAC provided insight and guidance regarding the project.

- **Discussion**
  - Rick Wilson presented an overview of the project. Meeting dates and the schedule were discussed.
    - The first stakeholder meeting will be June 18th, 7:00-9:00 pm at the UBBNRD
    - The group decided unanimously that it would "officially" be called the "Technical Advisory Committee" (TAC)
  - Steve Wolf presented the approach and discussed the community-based planning process.
  - Adam Rupe presented a summary of existing surface water quality conditions and problems, based on the newly released (2018) NDEQ Integrated Report (IR), and 2013 Total Maximum Daily Load (TMDL)
    - The 2018 IR can be downloaded from the following link: http://deq.ne.gov/publica.nsf/PubsForm.xsp?documentId=89721A3F201CE5348625827A006BF7D4&action=openDocument
    - The TMDL can be downloaded from the following link: http://deq.ne.gov/NDEQProg.nsf/OnWeb/TMDLlist
    - Adam provided a handout summarizing the IR and TMDL, as it applies to the UBBNRD planning area
    - The primary pollutants of concern are: Nutrients (nitrogen and phosphorus), Sediments, *E. coli* bacteria, and Atrazine
    - Discussion about several waterbodies took place. If there are any issues with those identified or missing, please provide those comments to JEO
    - Lincoln Creek, which used to be listed due to high levels of atrazine, has recently be delisted due to improvements shown in recent water quality data – this is a success story that should be shared
    - JEO is still requiring additional water quality sampling/monitoring data
  - Rod DeBuhr summarized existing groundwater water quality in the watershed, and provided a handout

- Adam presented an overview of the prioritization process, and the group discussed the various inputs such as rainwater basin data and how V-IMP/ water quantity components should be discussed
    - Draft process chart is attached to these notes
- During the round table discussion, the following comments were made:
    - Clarification was provided regarding how water bodies are assigned to Water Quality Standards Regulations, Title 117.
    - Clarification was provided regarding NDEQs the ambient versus basin rotational stream monitoring program. Ambient monitoring is done at 97 fixed locations across the state on-a-monthly basis. The basin rotation program goes a 6-year rotation with the Blue River Basin being sampled this year (2018). Last time the basin was sampled was 2012.
    - Waco Basin was discussed. It is a basin that that was filled in and is now a wetland.
    - Heartwell Lake near Hastings is in the Basin.
    - NGPC has wetlands monitoring data from 2011 to 2016.
    - NDEQ protects groundwater quality through the Wellhead Protection Program and education/outreach is important.
        - This is primarily the avenue that the water quality management plan, and Section 319 funding, is allowed to address groundwater
    - From the EPA perspective the interconnectivity of surface water and groundwater was discussed. Nebraska is leading the way in the country.
    - Over 300 wells are monitored yearly for nitrate in the UBBNRD. Over 41% exceed the MCL.
    - Groundwater Management Areas (GWMA) cover the District and over 60% are in Phase 2 or 3.
    - 1/3 of the Hastings WPHA is in the UBBNRD.
    - Question: do we have to address the worse-case (groundwater pollution) areas first, Answer: not necessarily
    - It will be interesting to see how the goals and objectives of the VIMP and WQMP match up.
    - Andy Bishop from the Rainwater Basin has important data for this study.
    - A reminder was made that plan updates occur every 5 years.
    - Question: Will priority areas be identified by the TAC or stakeholders? Answer: An initial list will be developed by the TAC and sponsors, for input from the stakeholders. Stakeholders will be important in helping to understand general issues and priorities within the district
    - UBBNRD is assembling the list of stakeholders and the recruitment process is going well and it is a diverse group. The list of Stakeholders will be provided to the TAC.
    - Current size of the stakeholder group is 15.
    - Question: can the public attend the stakeholder meetings? Answer: yes, they can.
    - Transparency of the process is important for the public. The stakeholder meetings will be conducted according to the “fishbowl technique”.
    - Hopefully the stakeholders will engage in the meetings and at the coffee shop with their neighbors.
    - A discussion was held if the NRD was responsible for just groundwater and not surface water. The response is that the NRD is responsible for both in many ways, as stated in their statutory responsibilities

  - Greater communication of the role that wetlands play in groundwater recharge is needed. They are also important for flood control and in improving water quality. They are really a nexus where each plan overlap
  - While the information used in preparing NDEQs Surface Water Quality Integrated Report (IR) can be dated, it is still an important reference item.
  - The timing of the TAC and stakeholder meetings will need to be determined by the sponsors and communicated to all parties.
  - During this project it will be important to keep the difference between the WQMP and the VIMP clear.
  - It is important to keep things moving forward in the meetings, as we have limited time. Keep the stakeholders focused on the prize.
  - Meeting the 20% rule might be difficult.
  - The notion that surface water is on the way out of the District presents a "why do we care attitude". This should be addressed.
  - Excellent progress has been made in management of atrazine in runoff. But even the small amounts that escape capture can still be measured. It is a real challenge to explain technical information like parts per billion to the public and some stakeholders.
  - well head protection areas could be included as special priority areas and these special priority areas would not have to be included in the 20% priority areas for the WQMP
  - The TAC will meet prior to each stakeholder meeting

- **Action Items (Responsible Party)**
  - Finalize and then distribute the stakeholder list (NRD)
  - Determine when the TAC will meet next (JEO and NRD)
  - Provide Recharge Lake Atrazine Project information to JEO (NRD)
  - Get the data from Andy Bishop (JEO)
  - Get the NGPC wetlands monitoring data from 2011-2015 (JEO)
  - Provide other relevant datasets to JEO (NRD)

Upper Big Blue NRD – Water Quality Management Plan
"Technical Advisory Committee (TAC) Meeting #2"
UBBNRD Office – Monday, August, 20 2018, 1:00 PM

Please place a check next to your name, if present. | If any information is incorrect, or needs updated, please cross out and provide

Present	NAME	TITLE	ORGANIZATION / INTEREST Represented	ADDRESS Street #, Street Name, City, Zip	PHONE	EMAIL
X	Carla McCullough	319 Nonpoint Source Coordinator	NDEQ	1200 N St., The Atrium, Suite 400, Lincoln, NE 68509	402.471.3382	Carla.mccullough@nebraska.gov
X	Craig Romary	Environmental Programs Specialist	NE Dept. of Ag	PO Box 94947, Lincoln, NE	402.471.6883	Craig.romary@nebraska.gov
X	Ted LaGrange	Wetland Program Manager	NGPC	2200 N. 33rd St., Lincoln, NE 68503	402.471.5436	Ted.lagrange@nebraska.gov
X	Amy Zoller	Integrated Water Management Coordinator	NeDNR	P.O. Box 94676, Lincoln, NE 68509-4676	402.471.0625	amy.zoller@nebraska.gov
X	Josh ~~Bauers~~ Bowers	District Conservationist	NRCS	419 W 6th St, #2, York, NE 68467	402.908.3157	joshua.bowers@ne.usda.gov
	Andy Bishop	Coordinator	Rainwater Basin Joint Venture	2550 N Diers Ave, Grand Island, NE 68803	308.382.8112	andy_bishop@fws.gov
	Matt Poesnecker	General Manager/Co-Owner	S & P Irrigation	110 S 16th St., Aurora, NE 68818	402.694.4011	matt@spirrigation.com
	Lynn Yates	UBB Board Chairman	UBB NRD	915 Road 12, Geneva, NE 68361	402.759.4732	vyates53@gmail.com
	Doug Dickinson	UBB Board Projects Committee Chairman	UBB NRD	3354 McKelve Road, Seward NE 68434-7510	402.643.5456	farm_life@hotmail.com
	John Miller	UBB Board Projects Committee Chairman	UBB NRD	165 Driftwood Drive, Aurora, NE 68818-1413	402.694.3570	pandj@hamilton.net
X	Rod DeBuhr	UBB Staff	UBB NRD	310 E 25th St., York NE 68467	402.362.6601	rdebuhr@upperbigblue.org
X	Jack Wergin	UBB Staff	UBB NRD	310 E 25th St., York NE 68467	402.362.6601	jwergin@upperbigblue.org
X	Marie Krausnick	UBB Staff	UBB NRD	310 E 25th St., York NE 68467	402.362.6601	mebel@upperbigblue.org
X	Katie Pekarek	Associate Extension Educator- School of Natural Resources	UNL Extension	912 Hardin Hall, Lincoln, NE 68583-0989	402.817.5097	kpekarek2@unl.edu
	Steve Melvin	Extension Educator-Southeast Research and Extension Center	UNL Extension	1510 18th Street, PO Box 27, Central City, NE 68826-0027	308.946.3843	steve.melvin@unl.edu
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X	Adam Rupe	Natural Resources Specialist	JEO Consulting Group	2700 Fletcher Ave, Lincoln, NE 68504	402.435.3080	arupe@jeo.com

Please Sign In!

UBBNRD Water Quality Management Plan and Voluntary Integrated Management Plan Facilitation

Technical Advisory Committee (TAC) Meeting #2 Minutes

DATE AND TIME | August 20, 2018; 1:00 p.m.
JEO PROJECT NO. | 161356.00
LOCATION | York, NE - UBBNRD Office
ATTENDEES | See sign in sheet
UBBNRD - Rod DeBuhr, Marie Krausnick, Jack Wergin
NDNR - Amy Zoller
NDEQ – Carla McCullough, Katie Pekarek
JEO – Rick Wilson, Adam Rupe

1. Meeting Overview and Purpose

- This was the 2nd of 6 planned Technical Advisory Committee (TAC) Meetings
- Educate TAC on existing water quality data
- Gather TAC input on the prioritization process
- Review the initial list of priorities

2. Discussion Items

- Rick provided an update on project activities
- Adam made a presentation regarding surface water quality and wetlands
- Marie made a presentation regarding groundwater quality
- Jack discussed land treatment conservation programs
- Adam made a presentation about the prioritization process
- Scientific studies show that as nitrate levels increase in the groundwater they may trigger the release of arsenic, uranium, and selenium
- Ted LaGrange asked if atrazine is being applied at a lower rate. Craig Romary responded that 50-80% of corn is treated with atrazine. It was suggested that herbicide use by county can be found in USGS publications.
- Rod stated that the basin rotation program tests for multiple pesticides, not just atrazine
- Rod asked if we restore/rehabilitate wetlands how do we quantify improvement? Carla offered that the LBNRD water quality plan included wetlands, and this might be an example to follow.
- Ted stated that wetland restoration is typically habitat focused as opposed to water quality
- Ted discussed the hydrogeomorphic model developed by USFWS, Corps, NDEQ, NGPC for the Rainwater Basin. JEO will look into getting that for use in the prioritization process
- Carla suggested addressing groundwater quality through wellhead protection areas or NRD management zones/phases.
    - These zones may be too large for planning purposes
- For target areas based on streams, it was suggested to focus on smaller streams/drainage areas

- Rod commented that the basin characteristics and problems across the district are not “unique”, they are the same across the NRD. This makes it difficult to prioritize or identify targeted areas?
    - Amy mentioned that land slope might help refine/focus on targeted areas.
- Hartwell Lake and Hastings area are both in the LBNRD plan, which should be reviewed to see what was included
- Ted recommended the Rainwater Basin model may help in the prioritization process.
- Ted commented that NGPC fisheries data is available for some lakes/ponds or streams.
- Rod listed four NRD owned lakes which have sedimentation issues:
    - Smith Creek has dispersive clays
    - Recharge Lake
    - Oxbow Lake – has good quality otherwise
    - Pioneer Trails – has good quality otherwise
- Rod stated that reducing the irrigation application rate will provide a positive benefit on groundwater contamination.
- Other screening factors mentioned
    - Waterfowl or wildlife use
    - Surface water and groundwater will probably need difference criteria
    - Explore what LBNRD and Hastings have done
    - WHPA and wetlands
    - Take out Hastings NW Dam Lake, as it is private
    - Screen out large watersheds early in the process
    - Large watersheds could be addressed through a rotational program
    - The plan could recommend additional monitoring to be done for large areas
    - Ensuring “fairness” across the NRD – how do you handle some areas being prioritized, but not others?
    - Make stream corridors the target areas, and only address issues close to streams
    - Identify BMPs that are mutually beneficial to the VIMP and WQMP
        - Irrigation Efficiency
    - Are other factors (hazard mitigation, drought, flooding, etc.) included into the process?
    - Possibly have more than one prioritization process based on the resource focus (lakes, streams, wetlands, groundwater, etc.)
- Images from the flipcharts are attached for supplemental information

3. Meeting Adjourn

- Next Meeting: Oct 1, 2018, 10:00 at the NRD

4. Action Items

- JEO to ensure they have RWBJ model
- JEO to update prioritization process and present results at next meeting
- JEO to look at LBNRD plan to review it for multiple items discussed

WQ Data

- What other pesticides are sampled or need to in future?
  - Emerging contaminants? Neonicanoids
  - Application Rates changing?
    Estimates by County available
- Hartwell & Hastings – in CB plan
- Seward Lake was renovated in 2015?
- Henderson Pond – no data?
- EPA study