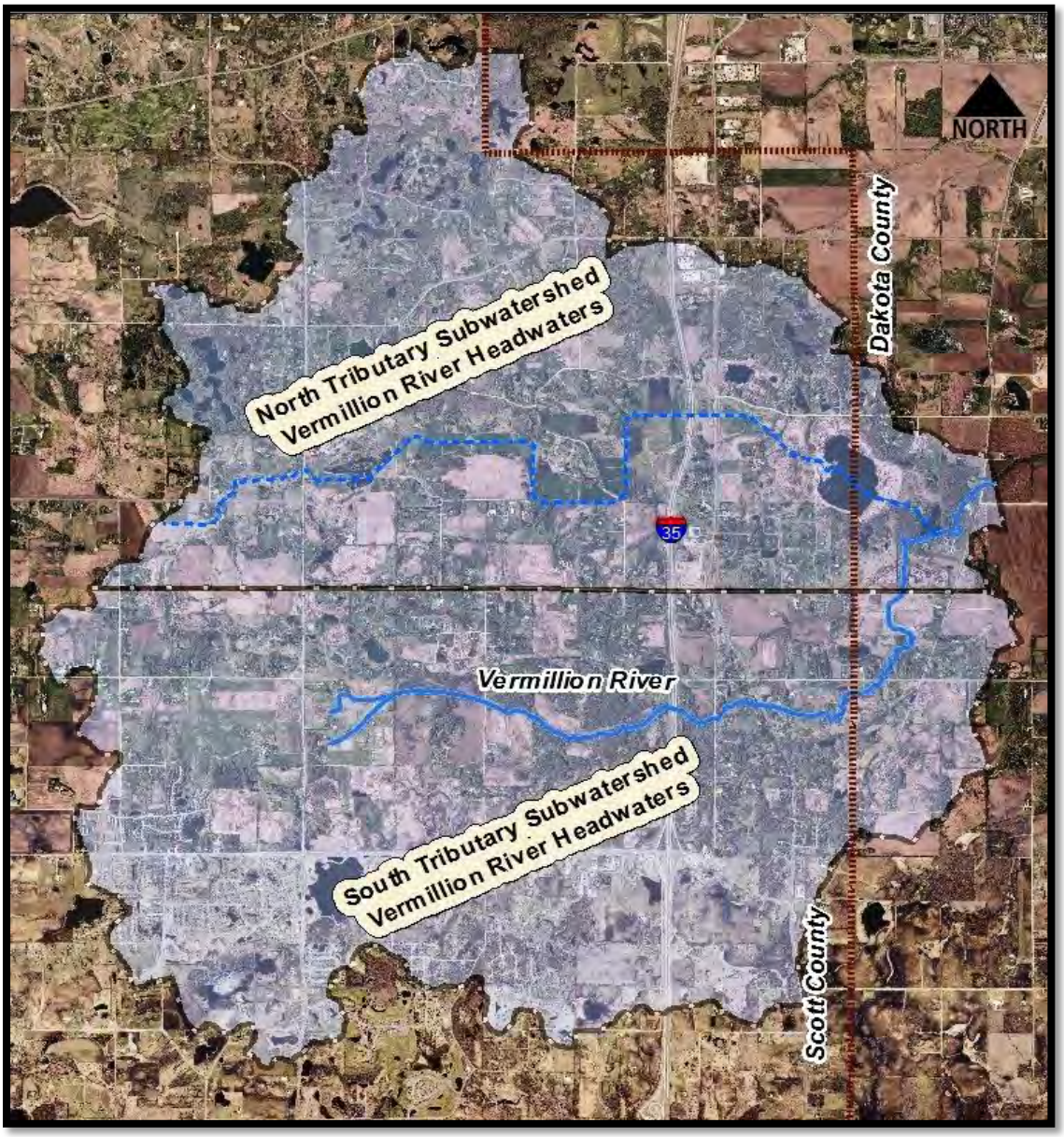
SUBWATERSHED ANALYSIS

For The

VERMILLION RIVER HEADWATERS

SCOTT COUNTY, MN



Prepared by

Scott Soil and Water Conservation District

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Executive Summary

This report is focused on identifying and assessing potential phosphorus (P) reduction BMP projects in the subwatersheds directly tributary to the headwaters of the Vermillion River located in Scott County. The various practices are identified and prioritized by cost effectiveness in Table 2. Existing land management practices were analyzed for phosphorus pollutant loading using the Revised Universal Soil Loss Equation (RUSLE2) and Minnesota Board of Soil and Water Resources (BWSR) pollution reduction calculator spreadsheets. Potential projects were identified through a series of screening steps that included both desktop analysis and field reconnaissance, taking into account pollutant delivery potential and site-specific constraints and characteristics. Potential projects were prioritized by weighing installation/construction costs, existing land use/land management practices, maintenance, and ability to serve multiple functions. A number of potential BMP's were identified as part of the overall phosphorus reduction goal of the study area during the field investigation of each site. These included:

- Water and Sediment Control Basins
- Grassed Waterways
- Filter Strips
- Wetland Restorations
- Native Grasses

This report includes maps of the proposed location and aerial extent of recommended BMP projects within each tributary subwatershed to provide a general understanding and approach to reducing the phosphorus now entering the river. If a specific project outlined in this report is selected for installation, site specific designs, landowner agreements and funding sources must be secured in order to implement the BMP. The collection of projects listed in this report should be updated on a regular basis as new projects or new technologies are identified.

Document Overview

The Vermillion River Headwaters Subwatershed Analysis is a watershed management tool developed to proactively identify and prioritize BMP projects based on performance and cost effectiveness. This process is intended, ultimately, to assist local water management and partner agencies in maximizing the value of each dollar spent.

The methods and analysis behind this document provide for the ability to rapidly assess subwatersheds for optimal locations for BMP's that are most appropriate and feasible based on actual site conditions. While accurate and sufficient for the intended purposes of this analysis, estimated final costs and pollutant removals will need to be refined once projects are selected for construction. Construction projects should be considered as only one part of an overall watershed restoration plan that includes, but not limited to, educational outreach, discharge prevention, and pollutant source control.

This document is organized into three sections including Methods, Headwaters Tributary Subwatersheds BMP's and Cost/Benefit Analysis Ranking for the proposed BMP's. Appendices provide additional information relevant to the assessment. Each section is briefly described below:

Methods

The Methods section outlines the general procedures used when assessing the watershed. It details the processes of *Project Scoping, Desktop Analysis, Field Reconnaissance Investigation, Cost/Treatment Analysis,* and *Project Ranking*. This protocol attempts to provide a sufficient level of detail to rapidly assess watersheds and catchments of variable scales and land uses. It provides the assessor defined project goals that aid in quickly narrowing down multiple potential sites to a point where the assessor can look critically at site-specific driven design options that affect BMP selection.

Vermillion River Headwaters Tributary Subwatersheds and BMP's

The watershed draining to the Headwaters of the Vermillion River within Scott County was divided into two tributary areas; "North Tributary and South Tributary Subwatersheds" for the purpose of this analysis. BMP's were proposed within each tributary subwatershed, titled by name and numbered as an identifier which is then referenced when comparing results across the watershed. Detailed information relating to each site specific BMP proposed is provided below:

Description of Existing Site Conditions

Proposed BMP existing site conditions are discussed related to soils, land cover and agricultural farming practices.

Site Selection

A rendered aerial photo highlights locations identified for suitable BMP projects. Additional field inspections will be required to verify project feasibility, but the most ideal locations for BMP project installations based on available data are identified here.

BMP Recommendations

The BMP Recommendation section describes the conceptual BMP's selected for the area. In most cases, several BMP's were reviewed with the most feasible ones recommended based on how it fits the current use of the land, efficiency of pollutant reduction and costs.

Cost/Benefit Analysis

A summary table provides for the direct comparison of the expected amount of treatment of the proposed BMP that can be expected per invested dollar.

Cost/Benefit Analysis Ranking

Projects that are 1) most able to address the project goals, 2) are compatible with current land use and 3) appear to have reasonable design, installation and maintenance costs were chosen for a cost/benefit analysis and ranked (see Table 2). The list is sorted by cost per pound of phosphorus treated by the BMP over duration (i.e. life-cycle) of 10 years, the typical minimum maintenance period for publicly-funded projects on private land, with the exception of Wetland Restoration projects which have a life-cycle of 15 years, consistent with local cost share policies. The final cost per pound of treatment value includes installation and maintenance costs.

Conservation Tillage and Residue Management are practices that were identified as BMP's for several sites during the field reconnaissance stage of this SWA. These practices were not modeled for this report due to the lack of an accurate treatment analysis model for pollutant reduction. These practices shall remain a goal of the Scott County SWCD to incorporate into conservation throughout the Vermillion Headwaters Subwatersheds.

The project watershed contains approximately 284 acres of cropland designated as "Highly Erodible Lands" (HEL) with 12% and greater slopes. Several BMP'S were identified and included in this report related to these erodible lands; however, these suggested BMP's address only specific erosion sites as identified during the field reconnaissance of these areas. Native Grass plantings over the HEL areas would substantially reduce the sediment and phosphorus transport from sheet and rill erosion now occurring on these lands. Due to agricultural commodity and land prices, Native Grasses were not proposed as a specific BMP on each of these sites except for a single location as detailed as one of the proposed BMP's in this report. The Scott SWCD with funding from a CWF grant will be targeting specific sites on HEL fields within the watershed suited for Native Grass BMP's.

Methods

Step #1: Project Scoping

Designating an impaired water body and its subsequent subwatershed to analyze is the first step in the assessment process. Water quality monitoring data, non-degradation report modeling, and TMDL studies are just a few of the resources available to help determine which water bodies or water courses are a priority. Assessments supported by a Local Government Unit with sufficient capacity (staff, funding, available GIS data, etc.) to greater facilitate the assessment also rank highly.

The headwaters of the Vermillion River are located in southeastern Scott County, with the majority of the watershed located within in Dakota County. Portions of the Vermillion River, its tributaries, and some lakes in the watershed are listed as 'impaired' by the Minnesota Pollution Control Agency (MPCA) and the U.S. Environmental Protection Agency (EPA). The impairments range from biological impairments (Fish and Macroinvertebrates), Turbidity, Low Dissolved Oxygen, E. Coli and Fecal Coliform, and excess nutrients. For this study, the Scott SWCD identified sediment loads to the Vermillion River as the priority study area with phosphorus as the target pollutant for this assessment.

Small agricultural fields interspersed throughout the watershed containing approximately 2,100 acres were the focus areas for sediment reduction. Total area of the headwaters watershed located within Scott County encompasses approximately 11,446 acres. The majority of land use within the watershed is comprised of the City of Elko New Market, rural residential neighborhoods, commercial development along Interstate 35W and mixed pasture/range/open/non-ag, woodlands. Wetlands identified through the Scott County Wetland Inventory Map represent approximately 2,277 acres and as mentioned above, small agricultural fields containing an estimated 2,100 acres.

Step 2: Desktop Analysis

The purpose of the desktop analysis was to narrow the amount of field reconnaissance and other time-consuming tasks that would be needed to complete the SWA by identifying and prioritizing those areas within the watershed that likely yield the greatest pollutant (phosphorus) load. ArcGIS with Spatial Analyst were the tools used to complete the desktop analysis. Various spatial layers, including those listed below, were used to create 30' x 30' gridded raster files which stored the attributes necessary to calculate soil erosion rates based on the revised universal soil loss equation, or RUSLE2. It was assumed that areas having the highest soil erosion rates were also the areas that generated the greatest phosphorus load.

Soil loss rates were then multiplied by "delivery ratio" that was assigned to each of the DNR catchment areas. Catchments that are internally drained were assigned a delivery ratio of 0;

catchments having landscape features (e.g. a wetland complex) that provide natural filtering and treatment of runoff prior to discharging to the Vermillion River were assigned a delivery ratio of 0.5; and catchments that discharge directly to the river or its tributaries without filtering or treatment were assigned a delivery ratio of 1.0. The Zonal Statistics tool in Spatial Analyst was used to generate the mean of the product of the soil loss rate times the delivery ratio for each catchment. The results of this analysis determined that the catchments assigned a delivery ration of 1.0 would be the single largest source of pollutants, and therefore was identified as the priority area for further analysis.

The DNR catchment assigned a delivery ratio of 1.0 was then divided into the agricultural portions of the watershed comprising approximately 2,100 acres for detailed analysis. Field reconnaissance maps of these areas were produced based on the results of this analysis.

The ArcGIS model utilized the following GIS layers:

Data Layer Name	Source	RUSLE* Factor Derived
Aerial Photography	Scott County (2013)	
Soils	Soils (SSURGO)	K
Topography	2 Foot contours (2011 LiDAR)	
Digital Elevation Model	2011 LiDAR	LS
Land Cover	Minnesota Land Cover Classification System (2007)	C
Watershed Catchments	MNDNR AutoCatchments	
Subcatchments	2 Foot contours (Scott County 2013)	
Precipitation Data	Scott County Water Monitoring Program (2002 – 2012)	R

*RUSLE = R x K x LS x C x P, where R=rainfall, K=soil erodibility, LS=slope length/steepness, C=land cover, and P=conservation practice.

Step 3: Field Reconnaissance

After identifying priority agricultural locations through the desktop analysis, these areas were then set as priorities for guiding field reconnaissance work. Field maps were prepared with base data layers including aerial photos, elevation contours, parcel lines, public right-of-way, wetlands and soils. During the field reconnaissance, SWCD staff verified existing site conditions as well as site constraints to determine potential BMP options as well as to eliminate non-feasible options from consideration.

SWCD staff identified potential locations that would benefit from BMP treatment based on observed or predicted level of erosion and pollutant transport. BMP types included terraces, water and sediment control basins, filter strips, grassed waterways, wetland restoration sites and native grasses. Sites identified during the field reconnaissance were determined the best locations for BMP installations for pollutant treatment based on professional knowledge and experience.

In Table 1, below, BMPs were considered for each site:

Table 1 - Site Pollutant Feature and Potential BMP Types		
Pollutant Source/Feature	**Potential BMP Practice**	
Ephemeral Erosion	Grassed Waterway Critical Area Planting	Filter Strip Water and Sediment Control Basin
Sheet & Rill Erosion	Native Grasses Filter Strip	
Farmed Wetland	Wetland Restoration	

Step 4: Cost/Benefit Ranking

After feasible BMP projects were identified, potential phosphorus reductions were calculated and preliminary cost estimates compiled. The projects were then ranked based on the cost per pound of phosphorus removal per year, over a 10 or 15 year life-cycle, depending on the BMP. The final value for the cost per pound of treatment includes construction and installation.

Treatment analysis

Modeling of the phosphorus loading for each BMP proposed, before and after project installation, was completed using RUSLE2 and BWSR spreadsheet software, whenever possible. The phosphorus reduction estimates associated with the installation of each project should be considered as pollutant reduction to the Headwaters of the Vermillion River. It is important to note that reported treatment levels are dependent upon optimal site selection and sizing. Not all locations and sizes will yield the same results.

Cost Estimates

Each project was assigned estimated costs for construction and installation based on a recent analysis of values for similar projects installed in Scott County from 2006 to 2011. The values used in the calculations can be found in the Appendix. An annual cost per pound of phosphorus removal was then calculated for the 10 or 15-year life-cycle. In the final evaluation and ranking, the estimated costs to remove phosphorus are listed.

Cost/Benefit Ranking

Table 2, below, summarizes the identified potential projects within the study area. Potential projects are listed from most cost effective to least, based on cost per pound of phosphorus removed over the life-cycle timeframe. Cost estimates represent material and labor for each project installed on that particular site. Depending on complexity, additional project costs ranging from 25% to 50% of the construction cost must be added to account for project outreach and promotion, survey, design, construction oversight and operation and maintenance.

Proposed project cost estimates with Native Grasses and Wetland Restorations include Scott WMO incentive funds of $225/ac and $2000/ac, respectively. The reported treatment levels are dependent upon optimal siting and sizing which would be achieved during the actual design stage of the proposed project, as well as landowner cooperation. More detail regarding each specific project can be found in the profile pages of this report.

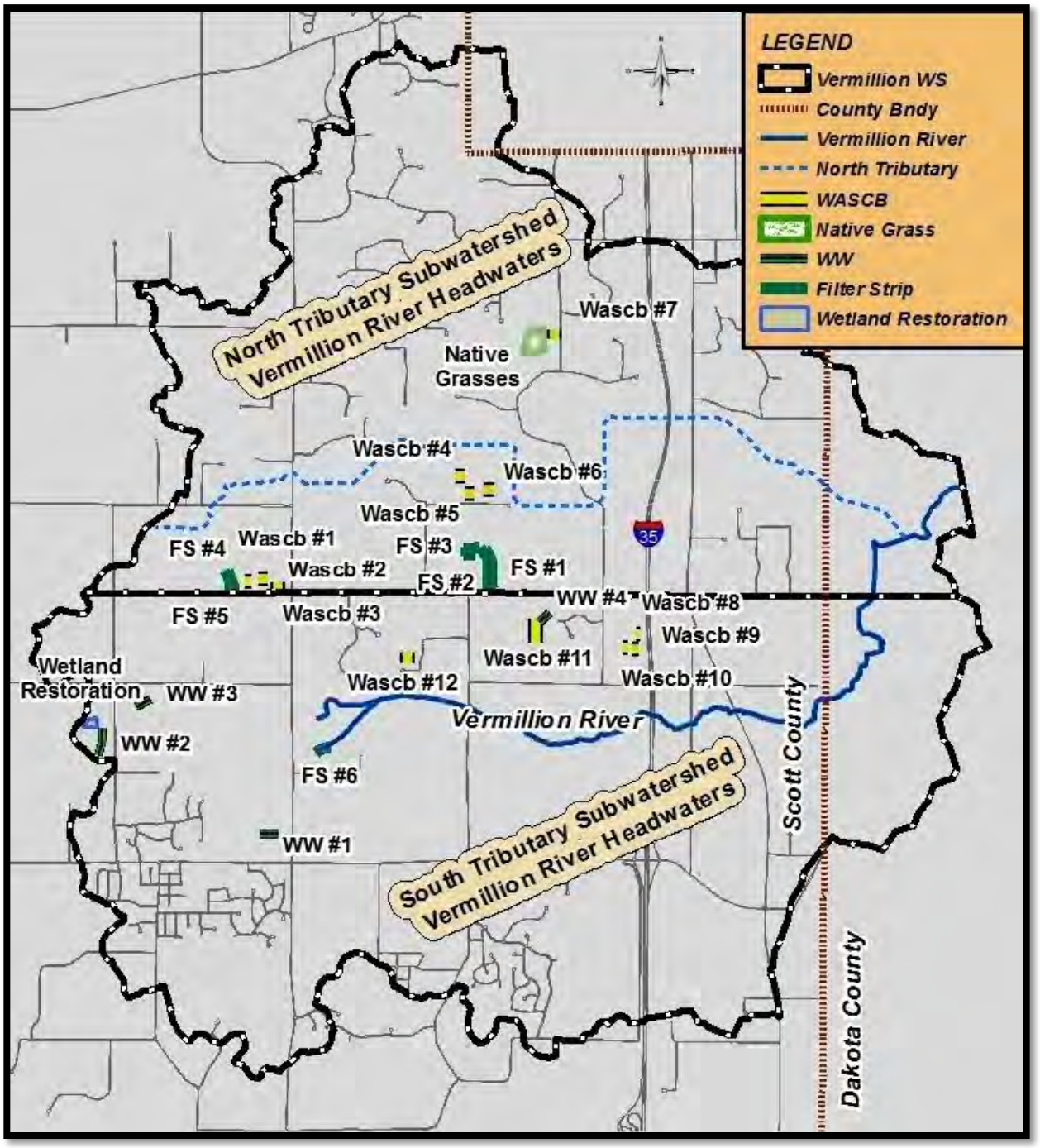
In addition to ranking, Table 2 includes a column titled “Feasibility Code”. The purpose of this code is to provide a basic indication of the feasibility or “reasonable likelihood” the listed project would be installed by the landowner on a voluntary basis. The selected code is based on relative success SWCD staff has had in promoting the selected BMP project through promotional and landowner engagement initiatives conducted in recent history. The following criteria apply to each of the three codes used:

Feasibility Code	Feasibility Code Description
A	Low likelihood of landowner acceptance due to inconsistency of the practice with current cultural or operational practices, and or perceived low cost/benefit ratio.
B	Low likelihood of landowner acceptance due to loss of agricultural production, land value or other land-use concerns
C	Good to high likelihood of landowner acceptance, particularly with substantial cost share availability

Table 2: Summary of Potential BMP Projects with Cost Benefit and Ranking								
Rank	**Feasibility Code**	**BMP/Project Name**	**Tributary Watershed**	**Qty.**	**Units**	**P Reduction (lbs./yr.)**	**Estimated Project Cost**	**Cost/lb/Yr**
1	C	Filter Strip #5	North	0.80	Acres	19.8	$ 1,920	$ 10
2	C	Filter Strip #1	North	1.5	Acres	32.3	$ 3,600	$ 11
3	C	WASCOB #4	North	1	Each	37	$ 5,300	$ 14
4	C	WASCOB #1	North	1	Each	33.8	$ 5,300	$ 16
5	C	WASCOB #6	North	1	Each	30.6	$ 5,300	$ 17
6	C	Filter Strip #4	North	0.8	Acres	10.5	$ 1,920	$ 18
7	C	Grassed Waterway #4	South	400	Ln Ft	8.6	$ 2,000	$ 23
8	C	WASCOB #3	North	1	Each	22.3	$ 5,300	$ 24
9	C	Grassed Waterway #3	South	250	Ln Ft	4.1	$ 1,250	$ 30
10	C	Grassed Waterway #1	South	150	Ln Ft	2.4	$ 750	$ 31
11	C	WASCOB #7	North	1	Each	23.4	$ 7,500	$ 32
12	B	Filter Strip #6	South	0.6	Acres	4.3	$ 1,440	$ 33
13	C	WASCOB #2	North	1	Each	28.7	$ 10,600	$ 37
14	C	Grassed Waterway #2	South	400	Ln Ft	4.5	$ 2,000	$ 44
15	C	Filter Strip #2	North	2.3	Acres	11.7	$ 5,520	$ 47
16	B	WASCOB #11	South	1	Each	25.5	$ 12,500	$ 49
17	A	Native Grasses	North	7.5	Acres	29.2	$ 14,300	$ 49
18	A	Wetland Restoration	South	3.2	Acres	27	$ 24,000	$ 59
19	C	WASCOB #12	South	1	Each	6.9	$ 5,300	$ 77
20	C	WASCOB #9	South	1	Each	6.4	$ 5,300	$ 83
21	C	WASCOB #10	South	1	Each	6.4	$ 5,300	$ 83
22	B	Filter Strip #3	North	0.3	Acres	0.7	$ 720	$ 103
23	A	WASCOB #5	North	1	Each	5.1	$ 5,300	$ 104
24	A	WASCOB #8	South	1	Each	1.4	$ 5,300	$ 378

Vermillion River Headwaters Tributary Subwatersheds and BMP's

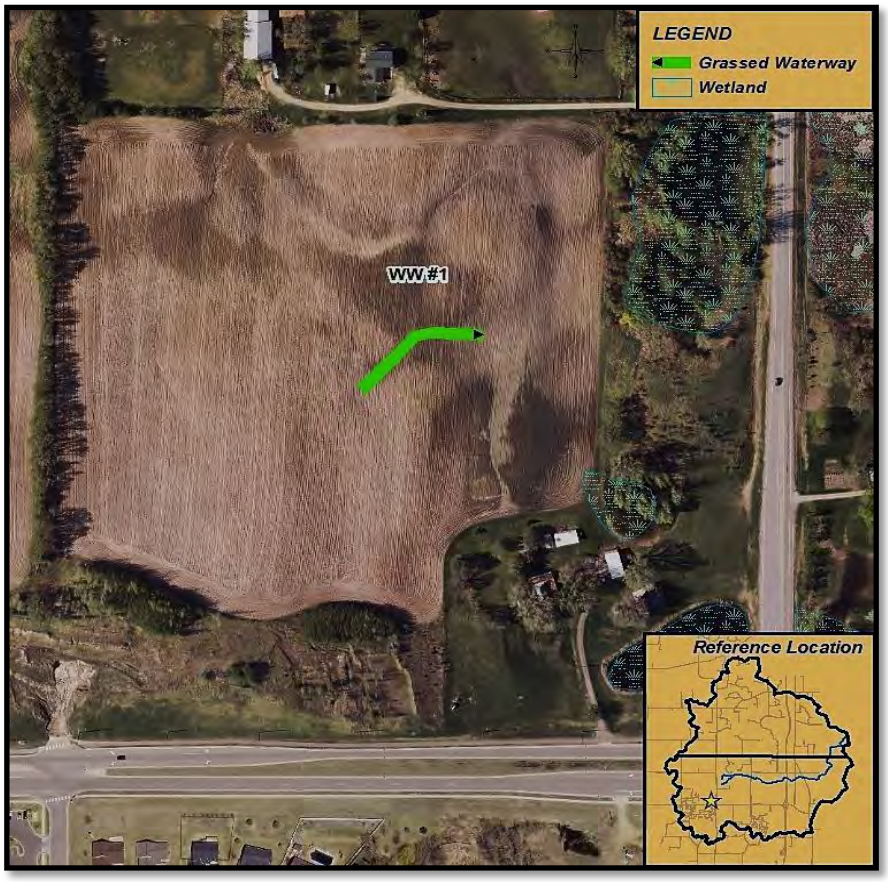
The following pages provide definition and detailed assessments for each of the projects identified through the field reconnaissance and subsequent evaluation thereof. For organizational and report presentation purposes, the selected projects were grouped into two focus areas, the "North and South Tributary Subwatersheds of the Vermillion River Headwaters". Each individual proposed BMP is shown on Figure 1 below and detailed on the following pages. The break between the North and South Tributary areas is derived from the drainage area contributing runoff to the main channel of the Vermillion River; South Tributary Watershed, and the drainage area contributing runoff to a tributary channel in the northern drainage area; North Tributary Watershed.



Waterway #1 – South Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

This site is located adjacent to the City of Elko New Market and consists of an agricultural field with conventional tillage practices of corn/soybean rotations. Hayden loams with slopes of 6% - 18% are the predominant soils of this field with an existing wetland located to the east which is the receiving waters for runoff. Ephemeral erosion is occurring in the concentrated flow areas depositing sediment just west of the wetland.



BMP RECOMMENDATIONS

The suggested BMP in this area is a *Grassed Waterway (#1)* to reduce sediment transport and subsequent Phosphorus loading.

BMP COST BENEFIT ANALYSIS

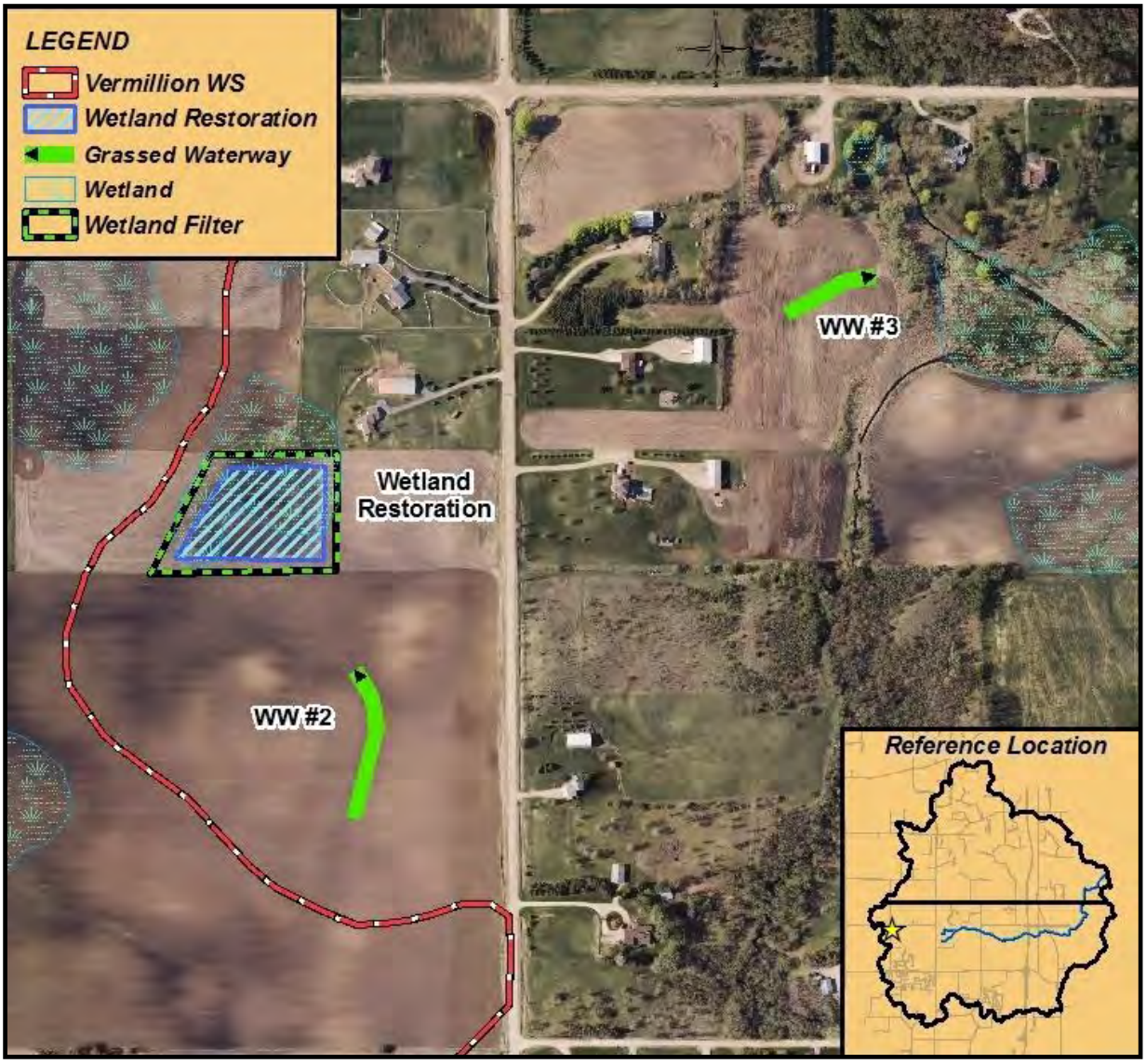
The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
Grassed Waterway #1	150	Lin Ft	10	2.4	0	2.4	$ 750	$ 31

Waterways #2 & 3/Wetland Restoration – South Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

Proposed Waterways #2 & #3 and the Wetland Restoration are located at the westerly boundary of the South Tributary Watershed. Soils at the waterway locations are Lester & Hayden loams with slopes of 6% - 18%. The site of the proposed Wetland Restoration consists of Pete & Muck soils and existing wetlands identified through the Scott County Wetland Inventory Map. Conventional tillage practices of corn/soybean rotations are utilized in this area with ephemeral erosion occurring in the concentrated flow areas due to the steep slopes.



BMP RECOMMENDATIONS

Due to the seasonal crop losses sustained and the identification of an existing wetland through the Scott County Wetland Inventory, A *Wetland Restoration* project consisting of 3.2 acres is one of the proposed

BMP's in this area as shown on the map above. A perimeter Upland Native Buffer around the *Wetland Restoration* is included as part of the *BMP* as required providing additional wildlife habitat in the area.

The concentrated ephemeral erosion sites observed are proposed to be corrected with *Grassed Waterway's (2)* as suggested BMP's in this area.

BMP COST BENEFIT ANALYSIS

The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

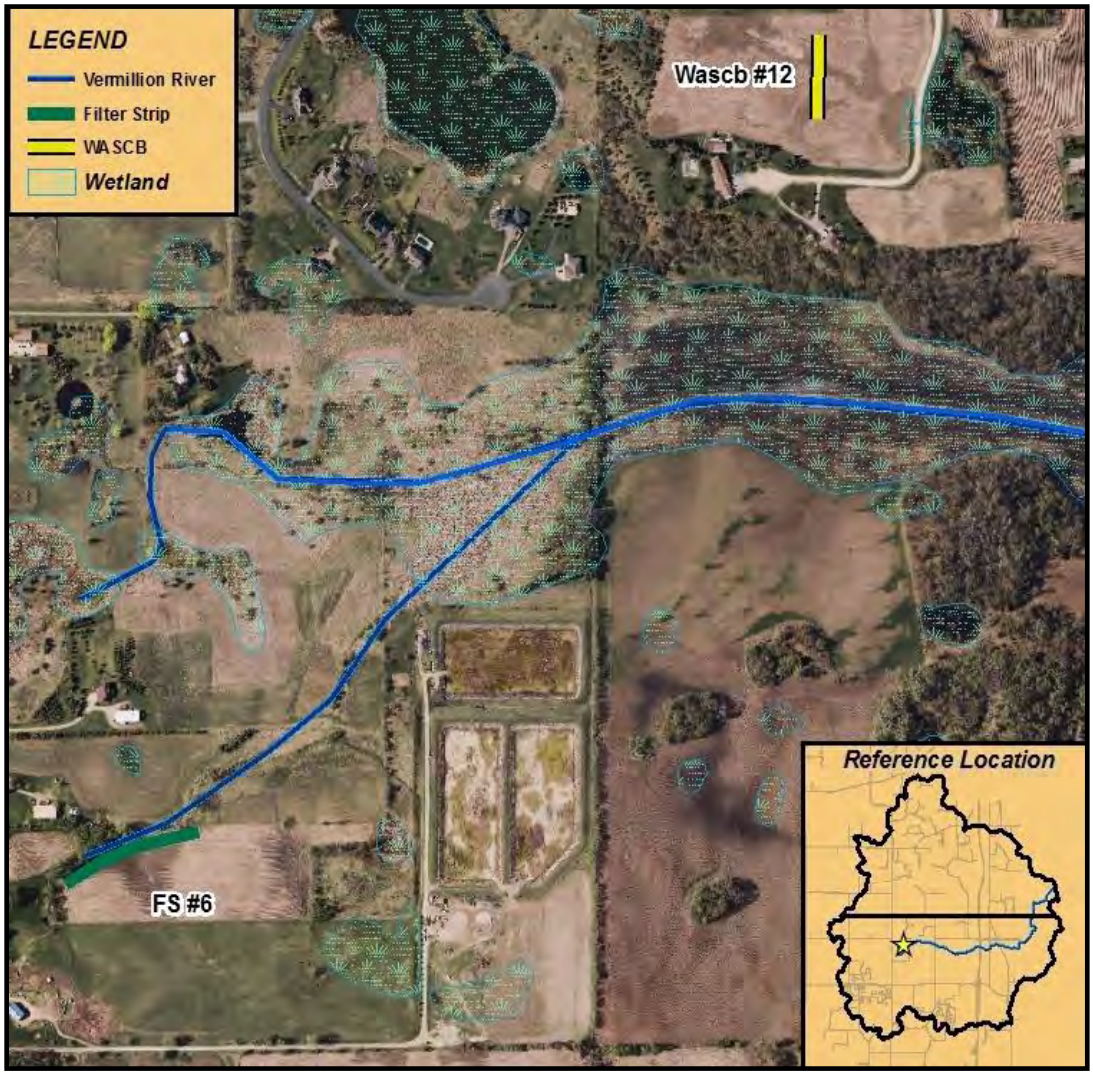
Practice	Qty.	Units	Term (years)	P Load (lbs../yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
Wetland Restoration	3.2	Acres	15	47	20	27	$ 24,000[1]	$ 59
Grassed Waterway #2	400	Lin Ft	10	4.5	0.0	4.5	$ 2,000	$ 44
Grassed Waterway #3	250	Lin Ft	10	4.1	0.0	4.1	$ 1,250	$ 30

[1] Estimated overall cost of the Wet Detention Basin includes the WMO cost share of $2000/Ac. for Wetland Restoration.

WASCB #12/Filter Strip #6 – South Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

This area of the South Tributary Watershed consists of residential development, wetlands identified through the Scott County Wetland Inventory Map and interspersed small, agricultural fields where conventional tillage practices are utilized. The Headwaters of the Vermillion River is located in this area as identified by the DNR Protected Waters Map. Hayden loams are the predominant soil in the upland areas with Webster soils in the lower elevations and Peat and Muck in the wetland areas.



BMP RECOMMENDATIONS

A *Water & Sediment Control Basin (WASCOB #12)* would be installed to eliminate ephemeral erosion identified during the field reconnaissance to reduce sediment transport and subsequent phosphorus loading. Constructing a *Filter Strip (#6)* located along the Headwaters of the Vermillion River will reduce sediment and phosphorus levels from overland flows.

BMP COST BENEFIT ANALYSIS

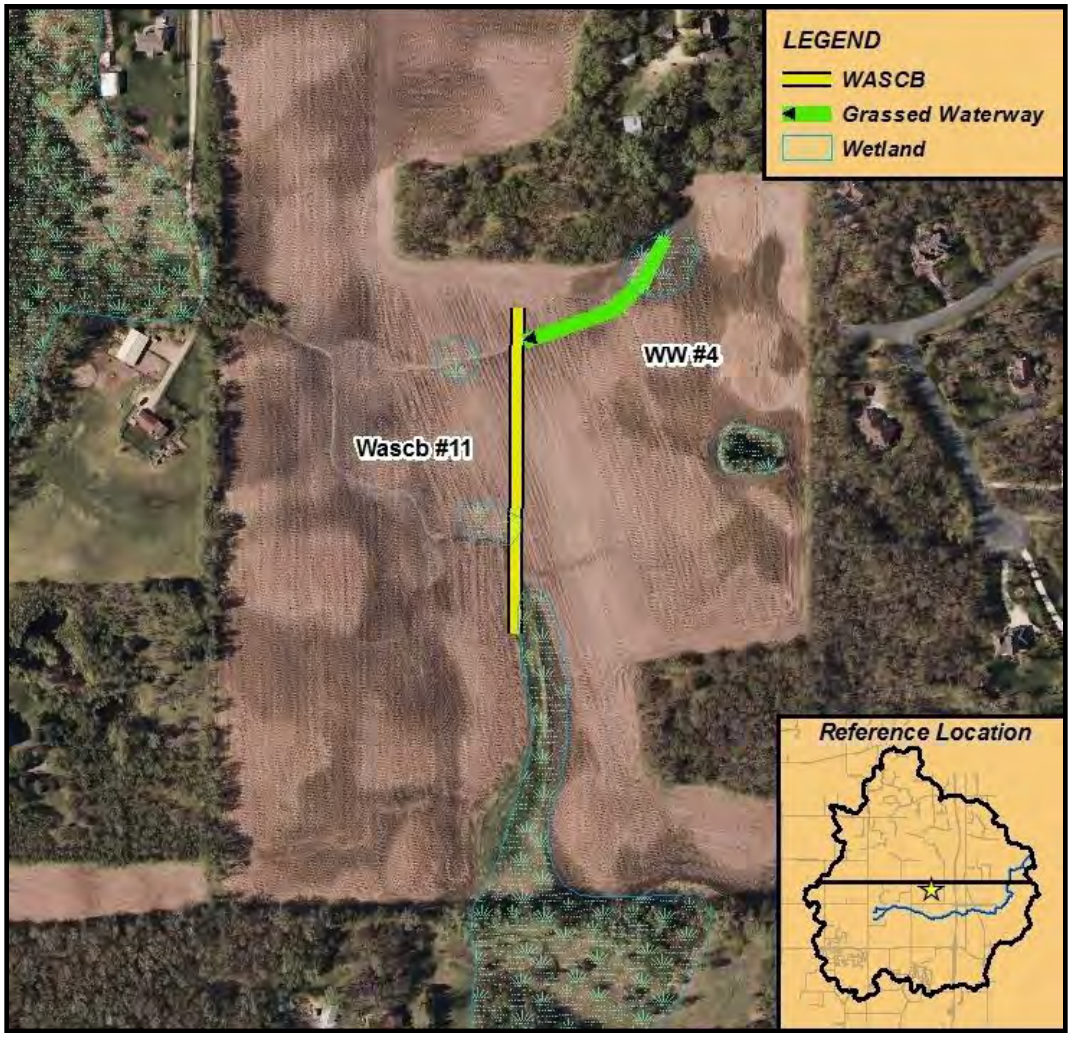
The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
Filter Strip #6	0.6	Acres	10	7.6	3.3	4.3	$ 1,440	$ 33
WASCB #12	1	Each	10	7.4	0.5	6.9	$ 5,300	$ 77

WASCB #11/Waterway #4 – South Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

Field reconnaissance of this area revealed significant ephemeral erosion occurring within this agricultural area. The erosion is due to the significant slopes of the Hayden loam soils of 2% to 18% within the concentrated flow areas as well as these flow areas draining identified wetlands during storm events. Sediment and subsequent phosphorus from this field is outletted directly into a defined channel which eventually reaches the Vermillion River



BMP RECOMMENDATIONS

Suggested BMP's in this area include a *Grassed Waterway* (#4) and the installation of a *Water & Sediment Control Basins (WASCOB #11)* to reduce sediment transport and subsequent Phosphorus loading to the open water channel.

BMP COST BENEFIT ANALYSIS

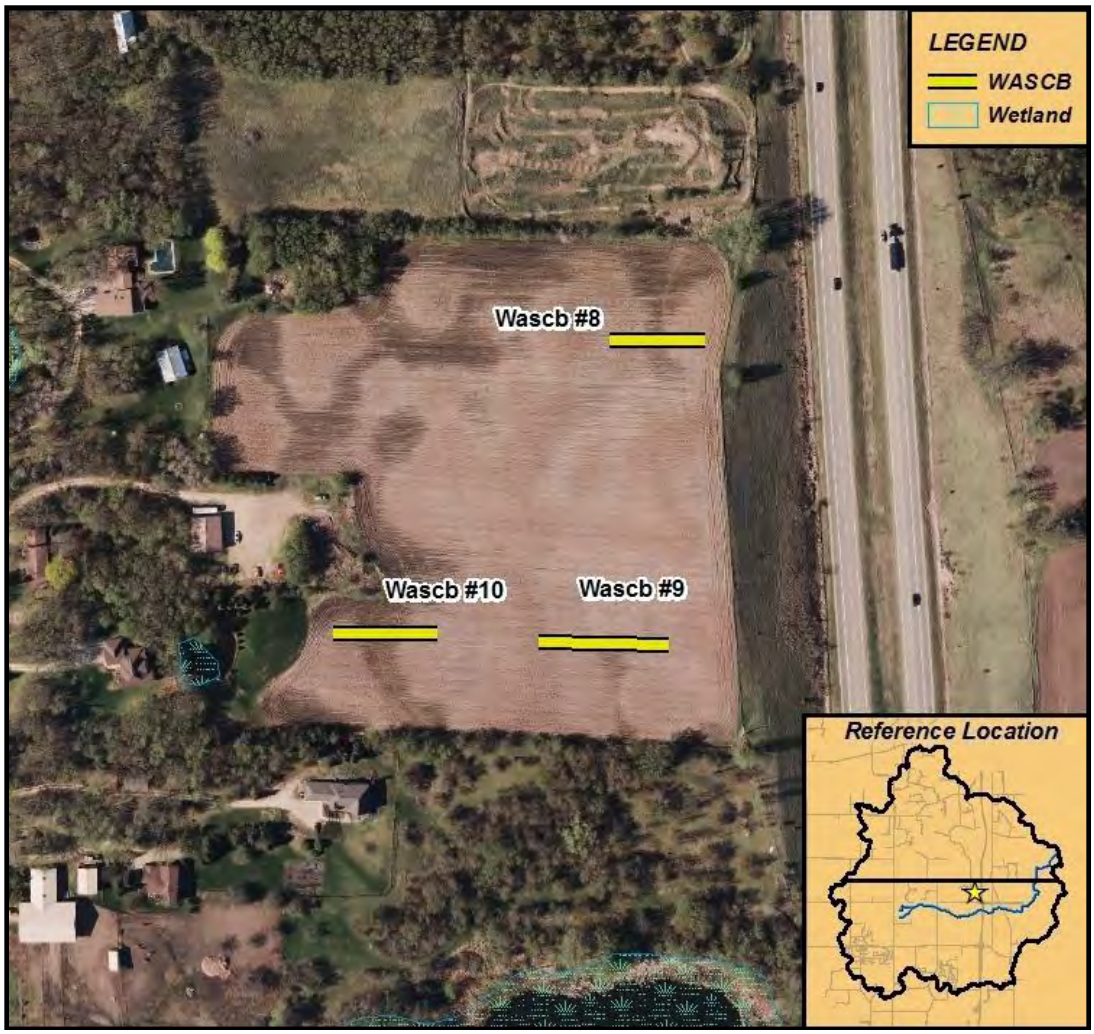
The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
Grassed Waterway #4	400	Lin Ft	10	8.6	0	8.6	$ 2,000	$ 23
WASCB #11	1	Each	10	27.9	2.4	25.5	$ 12,500	$ 49

WASCB's #8, #9 & #10 – South Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

This site is located adjacent to Interstate 35W and is currently farmed in a conventional corn/soybean crop rotation. The south portion of the agricultural field drains to an open water wetland complex identified through the Scott County Wetland Inventory Maps with the north portion draining to an open grassland area. Past aerial photos indicate Grassed Waterways were present in the areas of ephemeral erosion. Soil types vary from Hayden Loams with slopes of 6% - 12% in the higher elevations to Webster/Glencoe Loams in the lower elevations.



BMP RECOMMENDATIONS

Ephemeral erosion is occurring along the concentrated flow paths transporting sediment from the steeper slopes ranging from 6% to 12%. Suggested BMP's in these areas include the installation of *WASCB's* (#8, #9 & #10) to reduce sediment transport.

BMP COST BENEFIT ANALYSIS

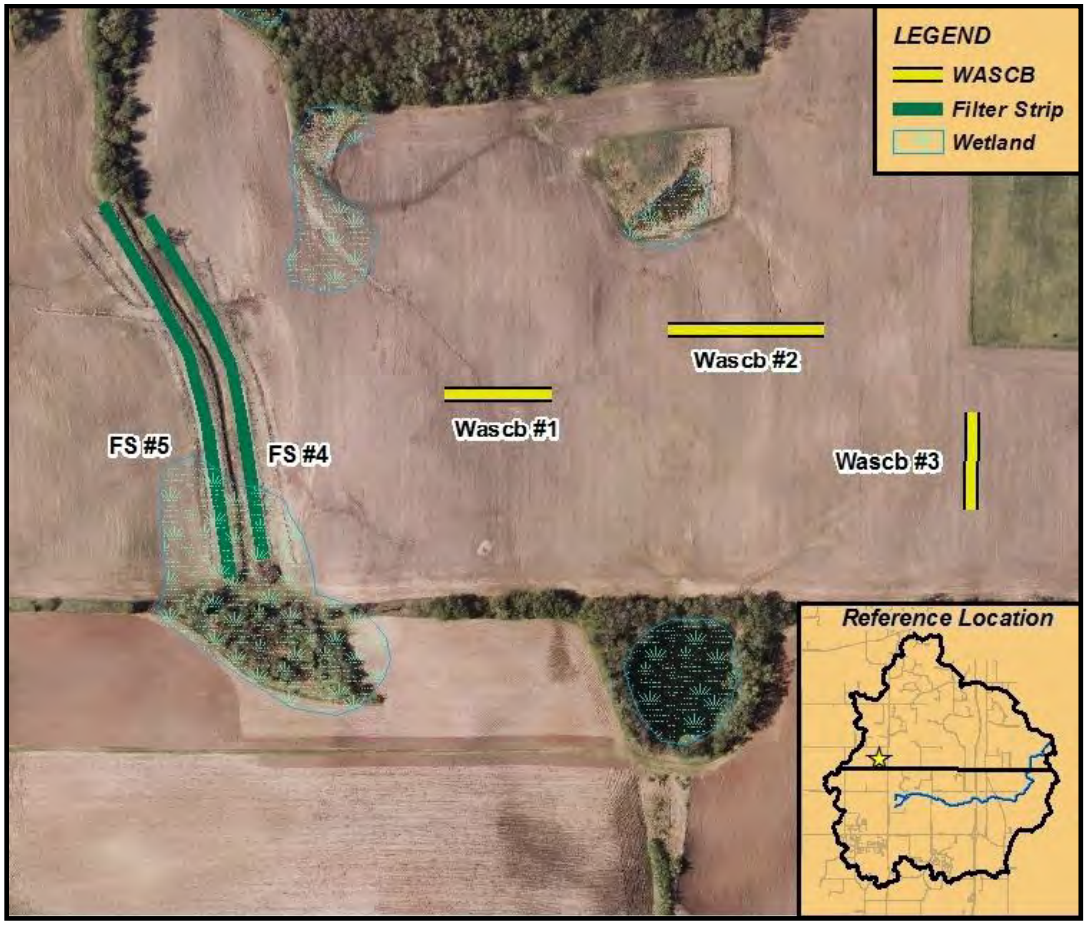
The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
WASCB #8	1	Each	10	1.4	0.0	1.4	$ 5,300	$ 378
WASCB #9	1	Each	10	6.4	0.0	6.4	$ 5,300	$ 83
WASCB #10	1	Each	10	6.4	0.0	6.4	$ 5,300	$ 83

WASCB's #1, #2 & #3/Filter Strips #4 & #5 – North Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

This area of the North Tributary Watershed consists of a well-defined drainage channel which flows to a natural channel carrying sediment and subsequent phosphorus to the Vermillion River complex and several wetlands. Ephemeral erosion was identified through the field reconnaissance of this area due to the significant slopes of the Hayden loam soils which have slopes of 6% to 18% within the concentrated flow areas. Sediment carried from the site travels into either an identified wetland or the drainage channel located in lower elevation areas consisting of Palms Muck and Peat soils.



BMP RECOMMENDATIONS

The significant areas of ephemeral erosion transporting sediment to the existing wetlands and drainage channel would be improved with *Water & Sediment Control Basins (WASCOB's #1, #2 & #3).* The installation of *Filter Strips #4 & #5* on both sides of the drainage channel will provide phosphorus reduction and improve water quality.

BMP COST BENEFIT ANALYSIS

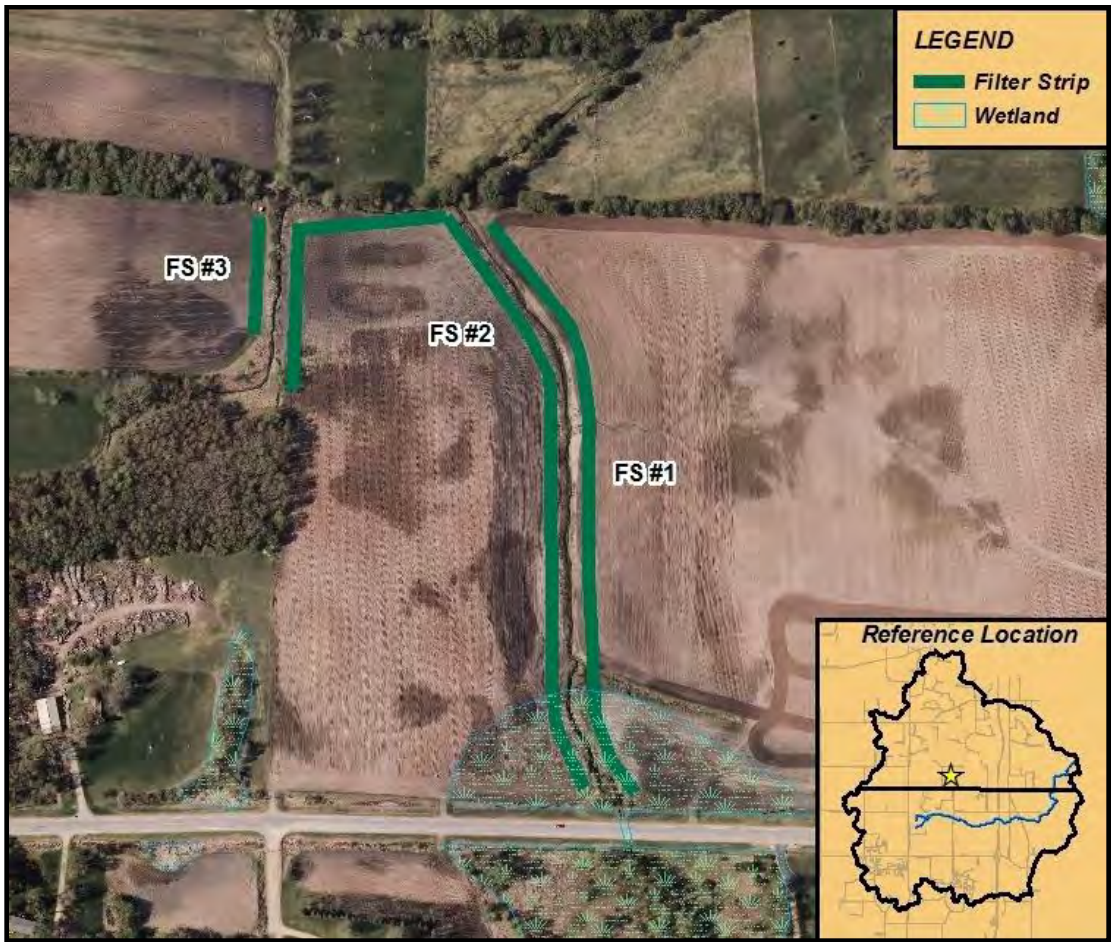
The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
WASCB #1	1	Each	10	33.8	0.0	33.8	$ 5,300	$ 16
WASCB #2	1	Each	10	28.7	0.0	28.7	$ 10,600	$ 37
WASCB #3	1	Each	10	22.3	0.0	22.3	$ 5,300	$ 24
Filter Strip #4	0.8	Acres	10	18.5	8.0	10.5	$ 1,920	$ 18
Filter Strip #5	0.8	Acres	10	34.9	15.1	19.8	$ 1,920	$ 10

Filter Strips #1, #2 & #3 – North Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

A focus of this site was the open water channel bisecting fields consisting of Hayden loam soils with slopes of 6% to 18%. The Field Reconnaissance identified sheet & rill erosion as well as isolated areas of ephemeral erosion all moving sediment to the open water channel. Conventional tillage practices of corn/soybean rotations are utilized on these fields. The open water channel flows through areas of identified wetlands shown on the Scott County Wetland Inventory Maps.



BMP RECOMMENDATIONS

Filter Strips #1, #2 & #3 installed along the open water channel will provide a buffer to reduce phosphorus levels from overland flows from the crop fields.

BMP COST BENEFIT ANALYSIS

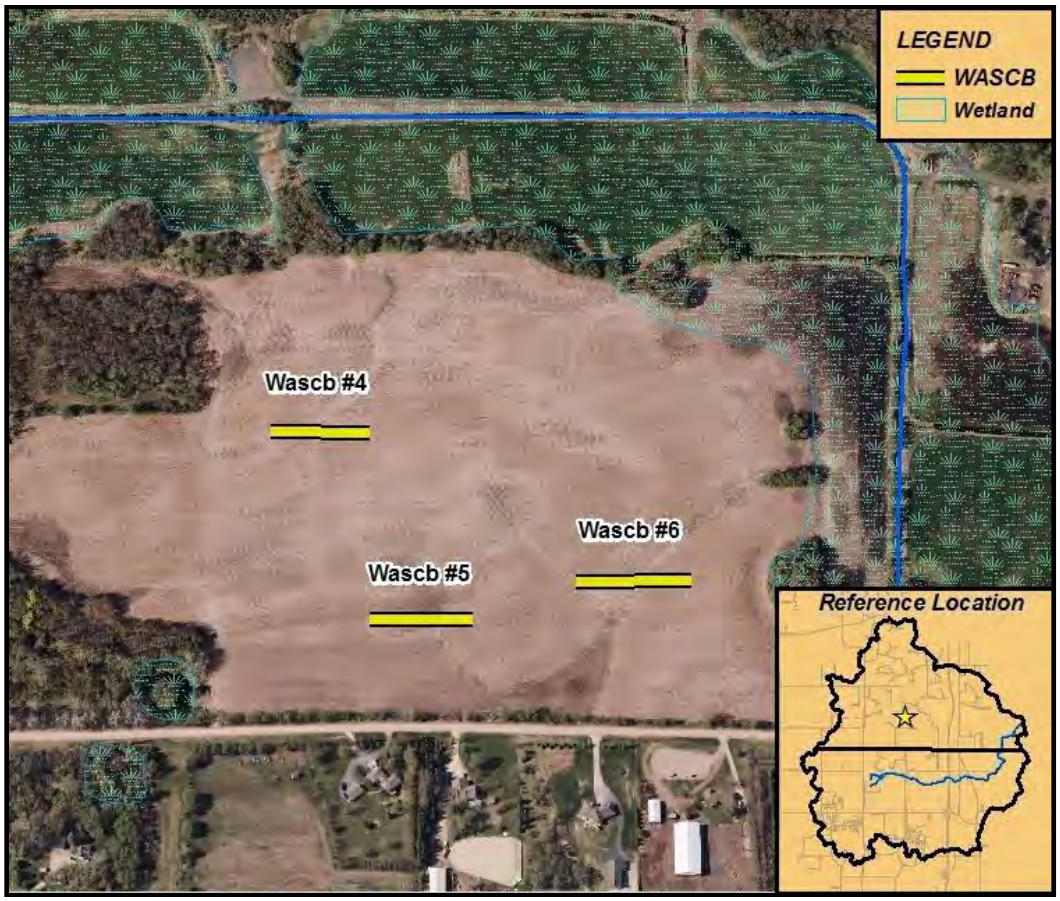
The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
Filter Strip #1	1.5	Acres	10	56.9	24.6	32.3	$ 3,600	$ 11
Filter Strip #2	2.3	Acres	10	20.6	8.9	11.7	$ 5,520	$ 47
Filter Strip #3	0.3	Acres	10	1.3	0.6	0.7	$ 720	$ 103

WASCB's #4, #5 & #6 – North Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

Three specific locations of ephemeral erosion within this field were identified as contributing a significant amount of sediment and subsequent phosphorus to the receiving waters. Wetlands as noted on the Scott County Wetland Inventory maps as well as the North Tributary Channel to the Vermillion River represent the immediate receiving waters. Conventional corn/soybean crop rotations are utilized in this location on Hayden soils with slopes ranging from 2% to 25%. The wetlands and tributary channel are located adjacent to the north and east of this location



BMP RECOMMENDATIONS

Water & Sediment Control Basins (WASCOB's #4, $5 & #6) would be installed in the areas of ephemeral erosion to reduce sediment transport and subsequent phosphorus loading to the wetlands and tributary channel.

BMP COST BENEFIT ANALYSIS

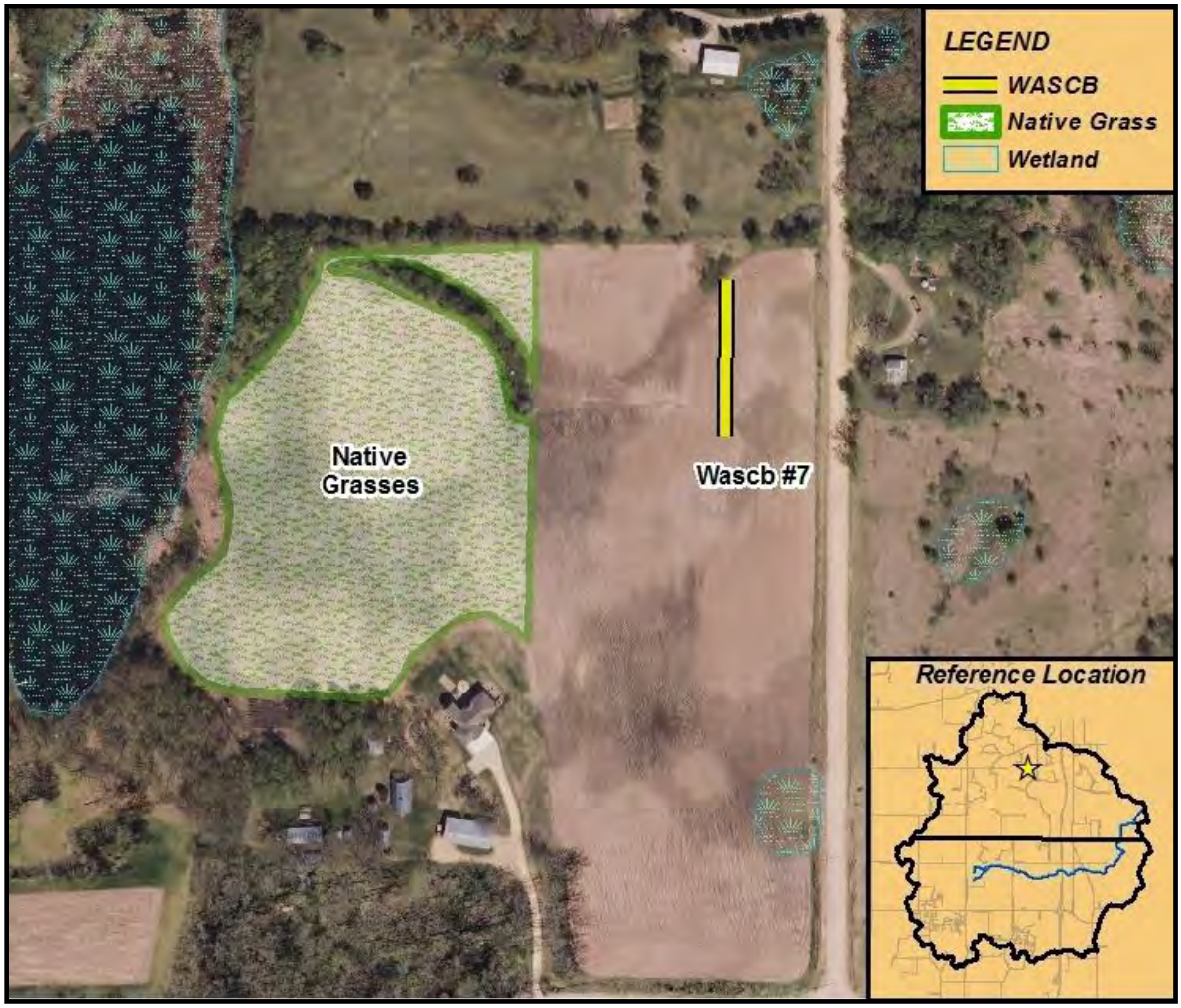
The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
WASCB #4	1	Each	10	37.0	0.0	37.0	$ 5,300	$ 14
WASCB #5	1	Each	10	5.1	0.0	5.1	$ 5,300	$ 104
WASCB #6	1	Each	10	30.6	0.0	30.6	$ 5,300	$ 17

WASCB #7/Native Grasses – North Tributary Subwatershed

DESCRIPTION of EXISTING SITE CONDITIONS

The land use of this site consists of an agricultural field with rotational corn/soybean farming practices draining east to west to an open water wetland as identified through the Scott County Wetland Inventory Map. Hayden loams ranging in slope from 6% to 25% are contributing sediment and subsequent phosphorus via both sheet & rill and ephemeral erosion to the wetland.



BMP RECOMMENDATIONS

Due to several factors associated with the westerly portion of this field; irregular shaped field, potentially highly erodible soils with up to 25% slopes and proximity to open water, a BMP of *Native Grasses* is proposed. Converting 7.5 acres of this agricultural field to Native Grasses will remove the majority of sediment and phosphorus currently traveling to the open water wetland. Additionally, a *Water & Sediment Control Basins (WASCOB #7)* would be installed to eliminate the ephemeral erosion in the remaining portion of the field located to the east.

BMP COST BENEFIT ANALYSIS

The following table shows anticipated phosphorus reductions based on BMP practices and their associated costs with term years for each practice identified.

Practice	Qty.	Units	Term (years)	P Load (lbs./yr.)		Total P Reduction	Estimate Cost (Materials & Labor)	Term Cost ($/lbs. P/yr.)
				Before	After			
WASCB #7	1	Each	10	23.4	0	23.4	$ 7,500	$ 32
Native Grasses	7.5	Acres	10	29.4	0.2	29.2	$ 14,300[1]	$ 49

[1] Estimated overall cost of the Native Grass planting includes the WMO cost share onetime payment of $225/Acre.

Appendix

The following table provides the average cost of materials and construction of each individual BMP. The cost listed is the average from projects installed in Scott County from 2006 to 2012.

Practice	Units	BMP Average Cost/Unit
Filter Strip (Non-harvested)	Ac	$2,400
Grassed Waterway	Lin Ft	$5
Native Grasses	Ac	$1,680
WASCB	Each	$5,300
Wetland Restoration	Ac	$5,500