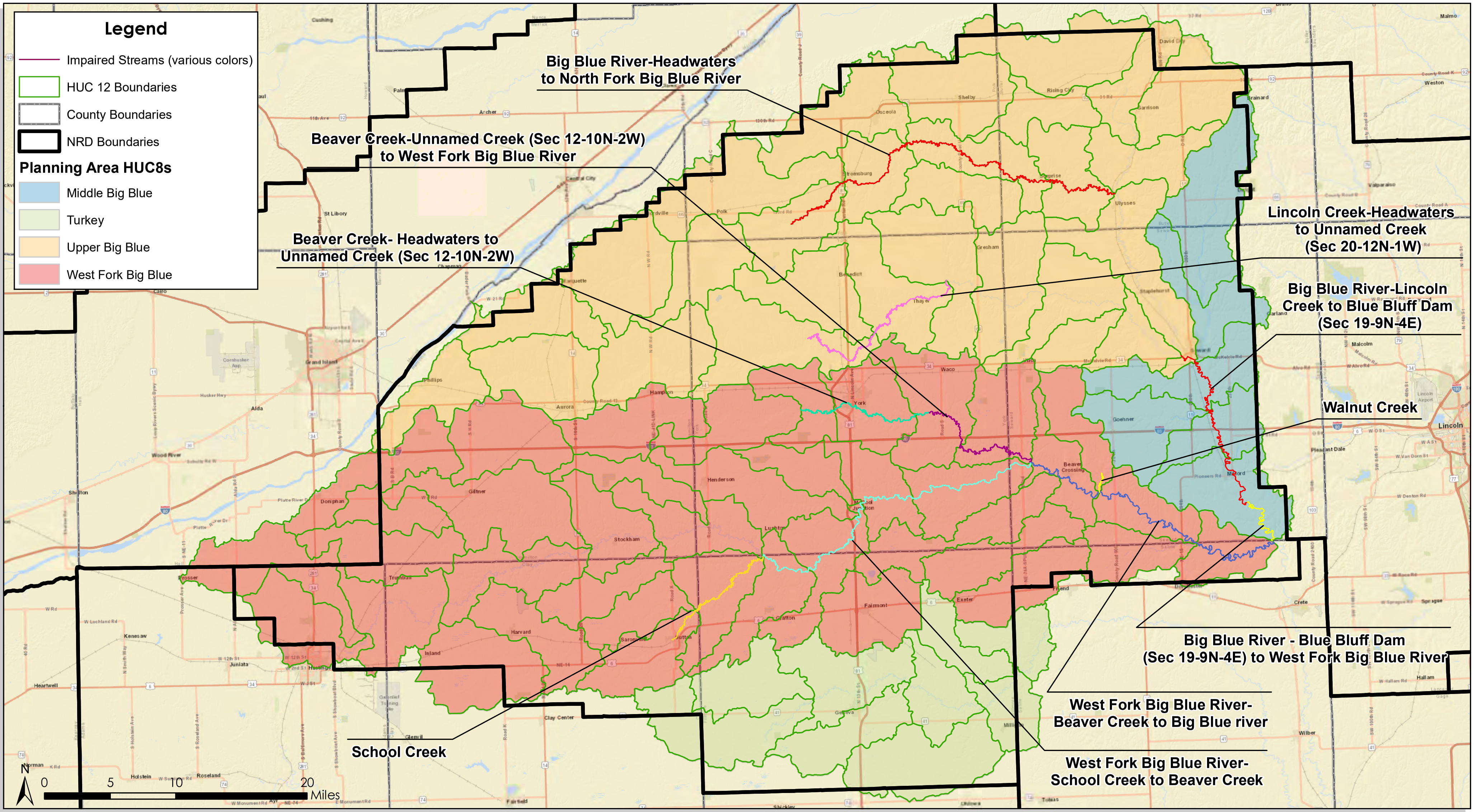


Created By: DJV
Date: 9/06/2018
Software: ArcGIS 10.4.1

Impaired Streams and Watersheds

Upper Big Blue NRD

This map was prepared using information from record drawings supplied by JEO and/or other applicable city, county, federal, or public or private entities. JEO does not guarantee the accuracy of this map or the information used to prepare this map. This is not a scaled plat.

Figure 2. Upper Big Blue Watershed - Estimated Existing Annual Bacteria Load Contribution by Land Use and Source

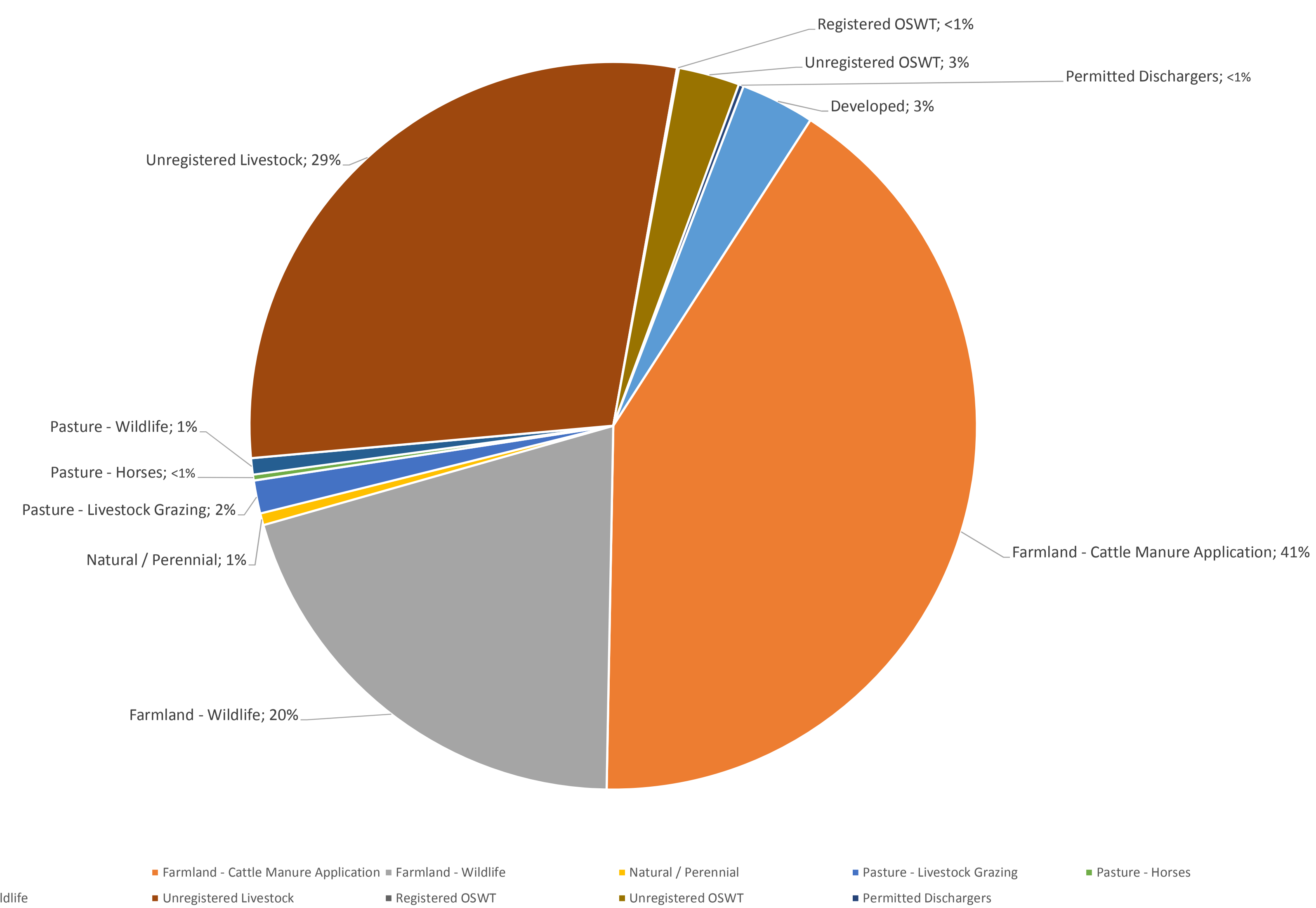


Figure 3. Estimated Existing Annual Bacteria Load by Land Use / Source for the BB3-10300 - Beaver Creek - Unnamed Creek to West Fork Big Blue River Target Area

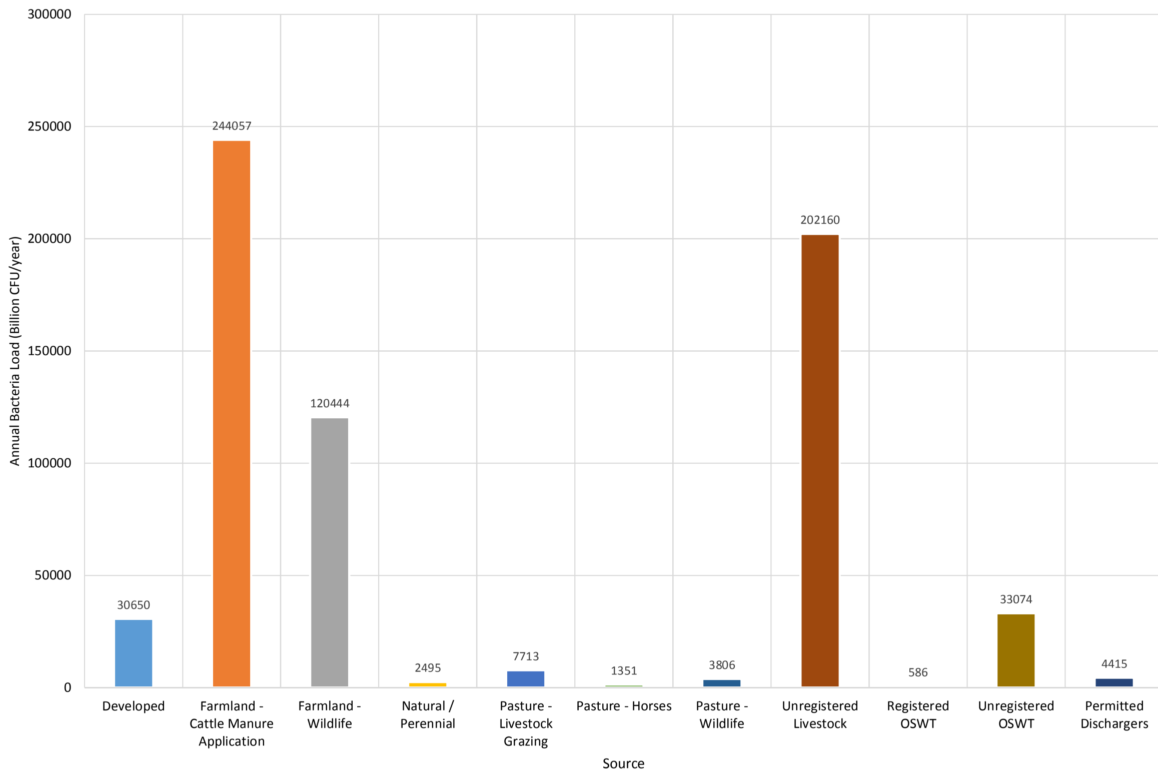


Figure 4. Estimated Existing Annual Bacteria Loads by Land Use / Source for each HUC 12 Basin Contributing to BB3-10300 - Beaver Creek - Unnamed Creek to West Fork Big Blue River

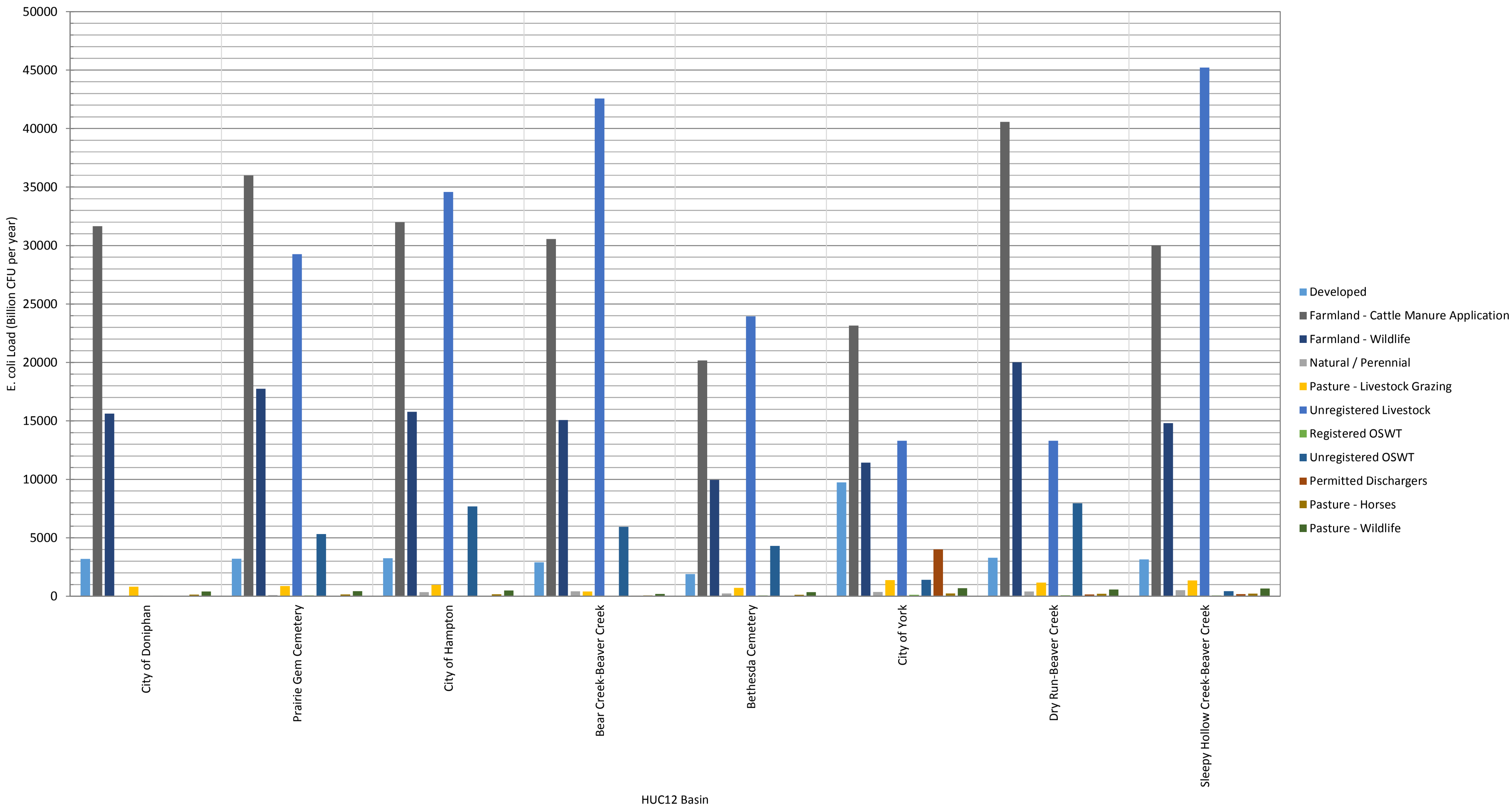
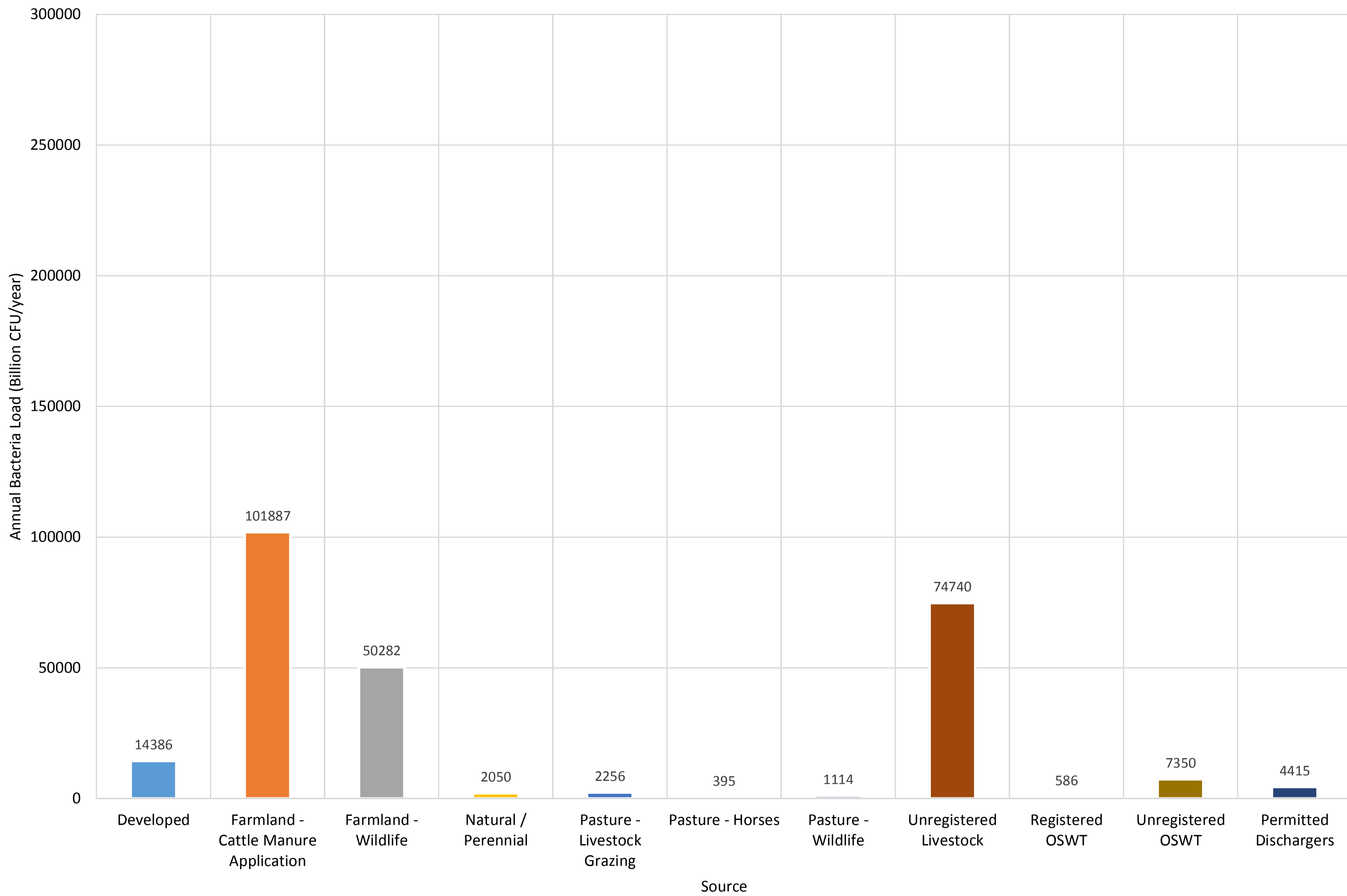


Figure 5. Estimated Annual Bacteria Load by Land Use / Source Post Best Management Practice Implementation for the BB3-10300 - Beaver Creek - Unnamed Creek to West Fork Big Blue River Target Area



Attachment 1

Technical Memo - Runoff Yield Estimation

Prepared By: Dillon Vogt
JEO Project # 161356.00

Purpose:

The purpose of this memo is to outline methods and procedures used to estimate runoff yield from the Upper Big Blue NRD. These runoff yield estimates will be used by Wright Water Engineers to estimate pollutant loadings for individual HUC 12s as part of both the Upper Big Blue NRD Water Quality Management Plan (WQMP) and Voluntary Integrated Management Plan. Runoff yield estimations were largely based on the interaction of runoff coefficients determined from soil type, land use, and slope of the contributing watershed with estimated annual runoff values provided by United States Geological Survey (USGS) gaging stations with annual water summaries.

Gaging Stations:

Due to a lack of available stations within the Upper Big Blue NRD, a runoff yield model initially developed for the Lower Platte South NRD WQMP was modified and updated with new gage information to better portray the conditions of the Upper Big Blue NRD. Stations used as part of this analysis were limited to stream flow gages with five or more years of record whose long-term trends (specifically annual runoff depths) have been provided in annual water summaries published by the USGS. In total, 13 gages within the Lower Platte South NRD were used, along with two supplementary gages located in or near the Upper Big Blue NRD.

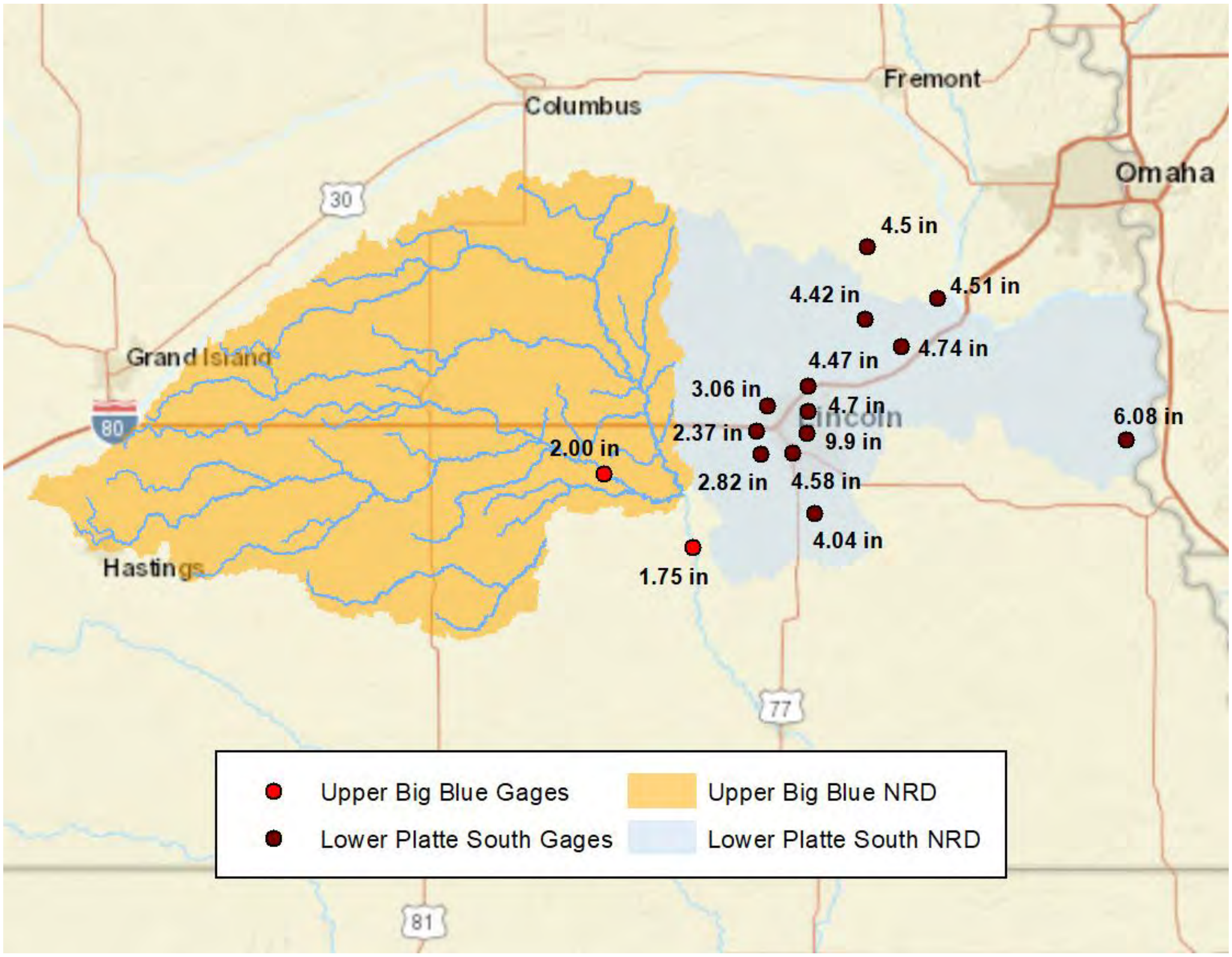
A list of gaging stations used as part of this analysis, as well as their annual estimated runoff depth are provided in Table 1.

Table 1: USGS Gages used for Analysis (Gages in study area denoted with an asterisk)

Gage ID	Gage Name	Drainage Area (Square Miles)	Period of Record[1]	Annual Runoff (Watershed Inches)
06803000	Salt Creek at Roca, NE	167.4	1952-2016	4.04
06803080	Salt Creek at Pioneers Blvd	220.6	2005-2016	4.58
06803300	Antelope Creek at 27th Street	11.0	2012-2016	9.90
06803510	Little Salt Creek Near Lincoln, NE	43.6	1969-2016	4.47
06803530	Rock Creek Near Ceresco	119.6	1971-2016	4.42
06803555	Salt Creek at Greenwood	1051.5	1952-2016	4.74
06804700	Wahoo Creek at Ashland, NE	417.3	1990-2016	4.51
06804000	Wahoo Creek at Ithaca, NE	240.7	1950-2016	4.50
06806500	Weeping Water Creek at Union, NE	271.4	1951-2016	6.08
06803093	Haines Branch at SW 56th Street	57.1	1995-2016	2.82
06803170	Middle Creek at SW 63rd	90.1	1995-2016	2.37
06803486	Oak Creek at Air Park Road	241.4	2005-2016	3.06
06803500	Salt Creek at Lincoln NE	683.8	2005-2016	4.70
06880800	West Fork Big Blue at Dorchester*	1192.0	2005-2017	2.00
06881000	Big Blue River at Crete*	2710.0	2005-2017	1.96

1 – Period of Record refers to the years analyzed as part of the average annual runoff estimation by USGS.

Figure 1 – USGS gaging location within study area. (Labeled with average annual runoff depth)



Runoff Coefficient Estimation:

Runoff coefficients used as part of this analysis were determined as outlined in the WetSpa User Manual, and were based on surface soil texture, land use, and land slope. A summary of these runoff coefficients is provided in Table 2.

Table 2 – Runoff Coefficients for different land use, soil type, and slopes.

Land use	Slope (%)	Sand	Loamy sand	Sandy loam	Loam	Silt loam	Silt	Sandy clay loam	Clay loam	Silty clay loam	Sandy clay	Silty clay	Clay
Forest	<0,5	0.03	0.07	0.10	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40
	0,5-5	0.07	0.11	0.14	0.17	0.21	0.24	0.27	0.31	0.34	0.37	0.41	0.44
	5-10	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50
	>10	0.25	0.29	0.32	0.35	0.39	0.42	0.45	0.49	0.52	0.55	0.59	0.62
Grass	<0,5	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50
	0,5-5	0.17	0.21	0.24	0.27	0.31	0.34	0.37	0.41	0.44	0.47	0.51	0.54
	5-10	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60
	>10	0.35	0.39	0.42	0.45	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72
Crop	<0,5	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60
	0,5-5	0.27	0.31	0.34	0.37	0.41	0.44	0.47	0.51	0.54	0.57	0.61	0.64
	5-10	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70
	>10	0.45	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82
Bare	<0,5	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70
soil	0,5-5	0.37	0.41	0.44	0.47	0.51	0.54	0.57	0.61	0.64	0.67	0.71	0.74
	5-10	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80
	>10	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82	0.85	0.89	0.92
IMP		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

The 2017 Cropland Data Layer (CDL) was used to define land use as part of this analysis due to relatively good spatial resolution and detailed land use categories that can easily be reclassified to fit the four types of land use considered under this methodology. It was assumed that all crop types have similar runoff coefficients. Grass was assumed to include pasture and alfalfa type land uses, and runoff coefficients for urban areas were assumed to be a mixture of grass and the average imperviousness listed in the CDL legend. Because open water areas do not have any water-soil interaction and therefore do not allow infiltration, these areas were assumed to have a runoff coefficient of 1.0. Soil texture was obtained through the USDA Web Soil Survey, and slope was calculated directly through the use of 30-meter digital elevation models (DEMs).

These data coverages were combined using the Union tool in ArcGIS resulting individual polygon elements that had exactly one soil texture, land use, and slope class. Individual elements were then assigned a runoff coefficient based on the above table and a runoff coefficient raster was created. Land Use, Soil Texture, and Slope Class and the resulting runoff coefficient estimates can be seen in Figures 2 through 4 below. The resulting raster coverage across the planning are can be seen in Figures 2 through 5 on the following pages.

Figure 2 – Land Use in the Study Area (Source: CDL 2017)

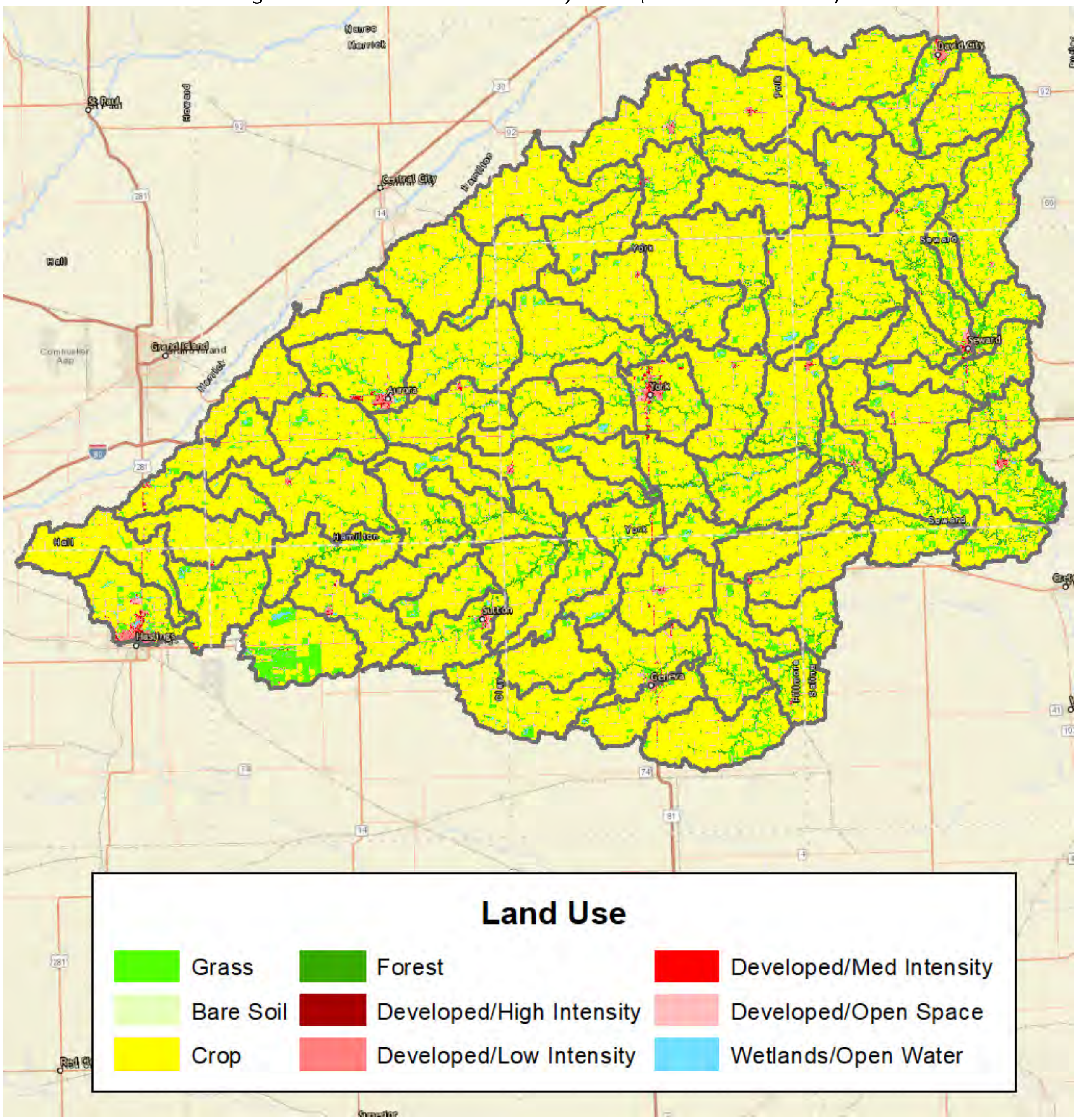


Figure 3 – Slope Classes in the Study Area (Source: Derived from 30m Digital Elevation Model)

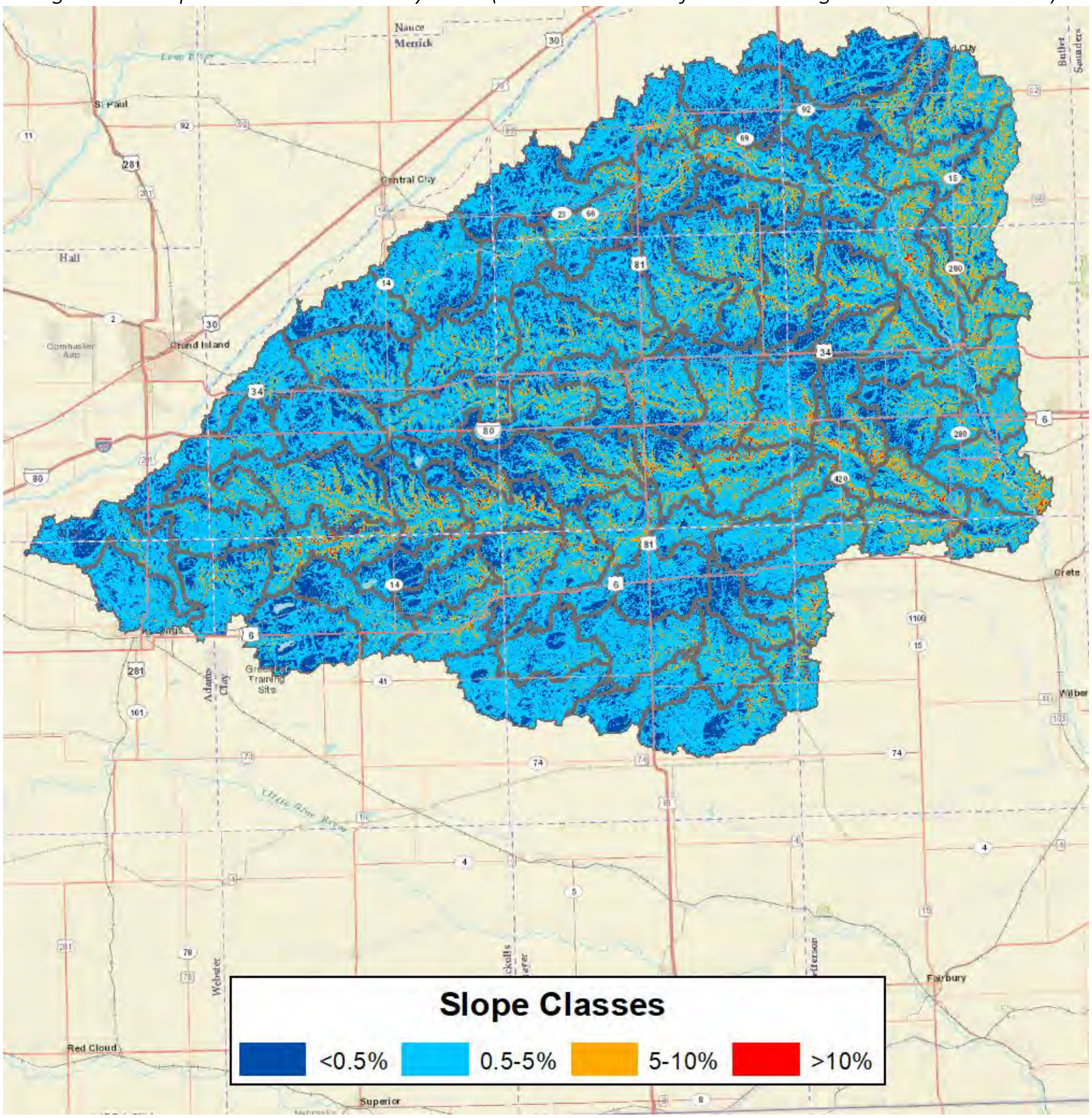


Figure 4 – Soil Surface Texture in the Study Area (Source: Web Soil Survey)

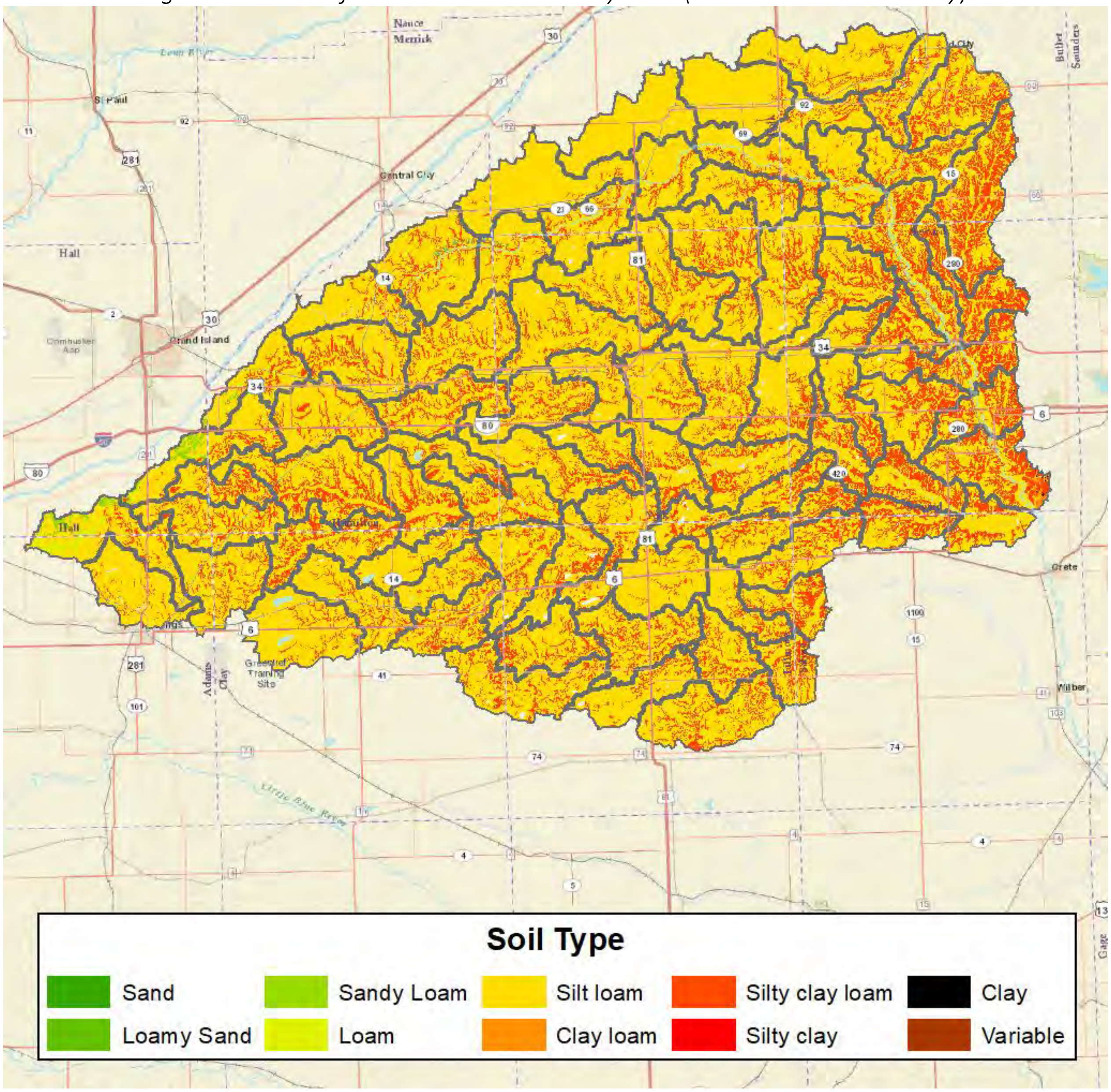
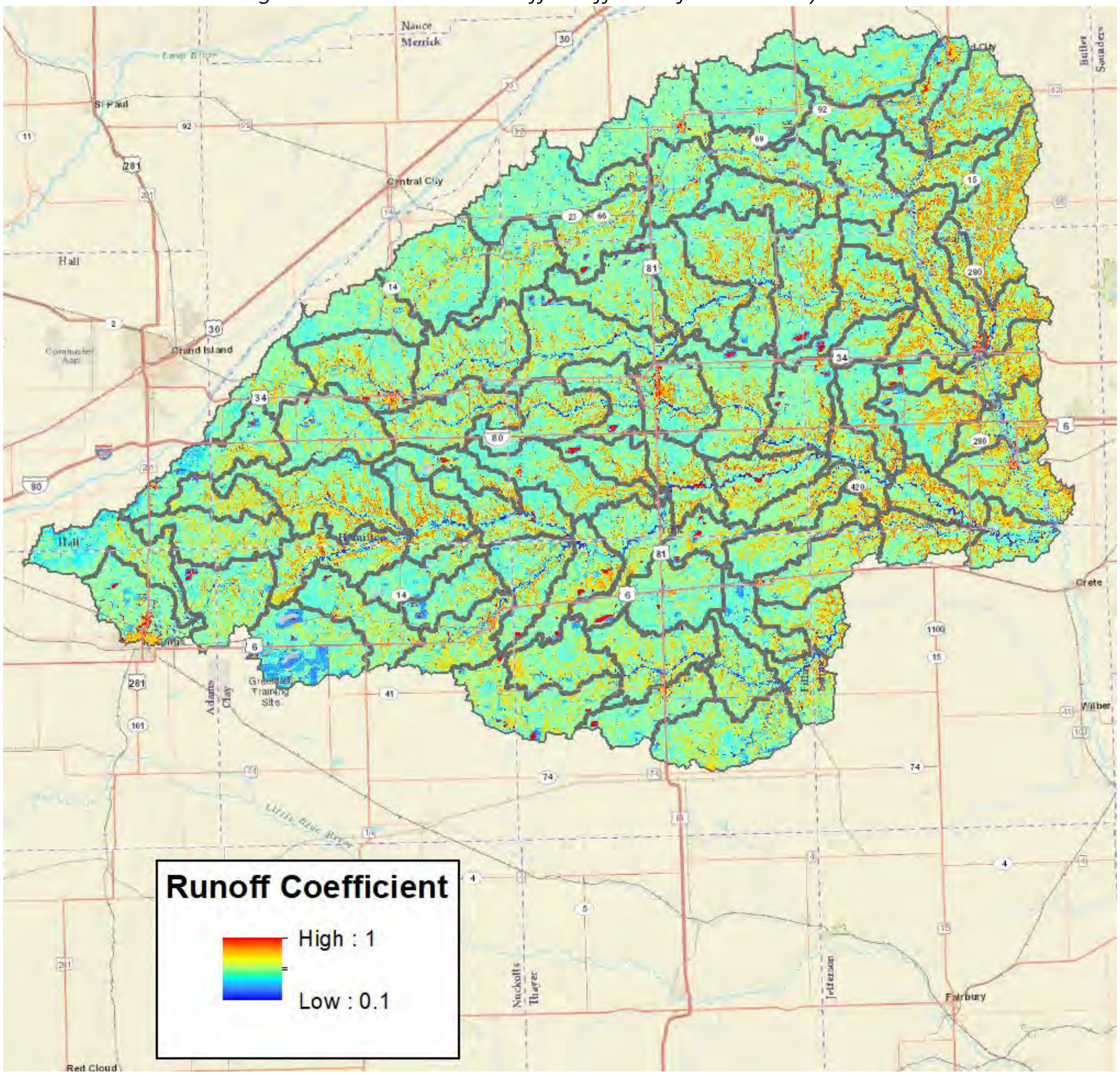


Figure 5 – Estimated Runoff Coefficient for the Study Area



Regression Analysis:

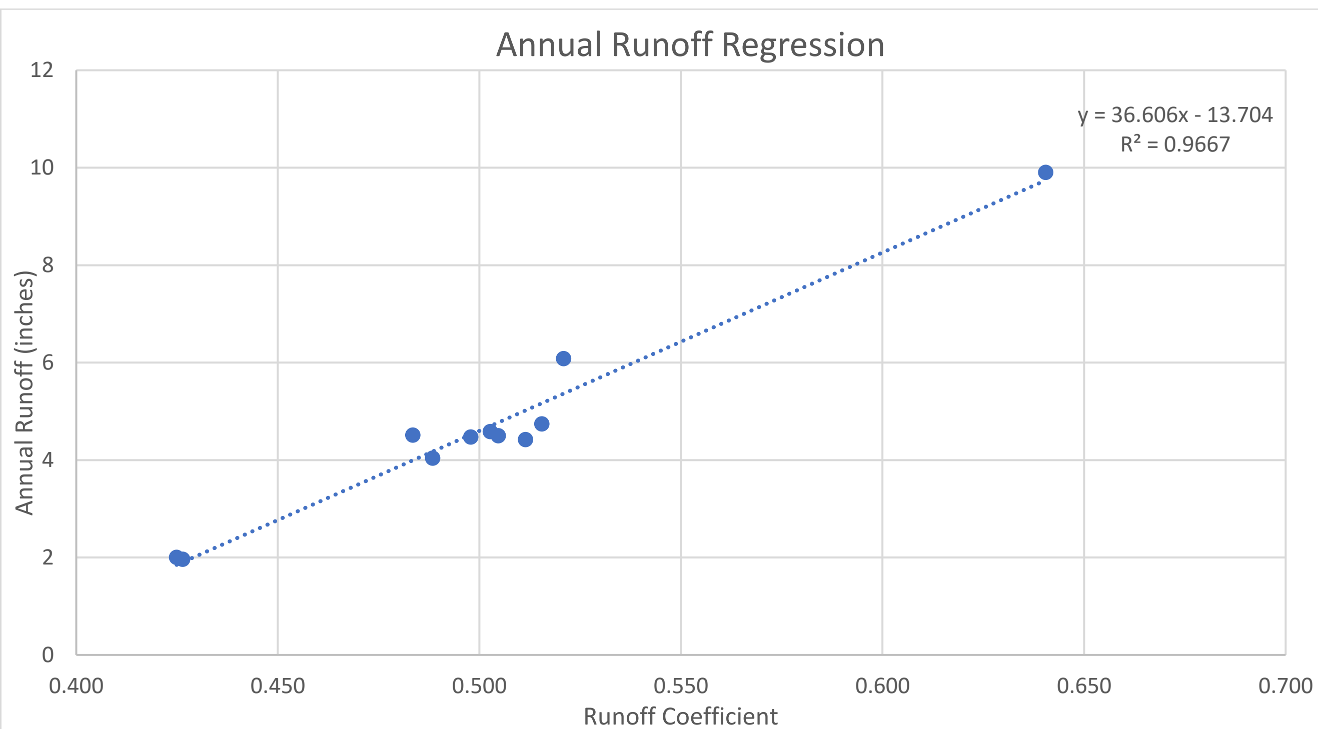
Watersheds contributing to the USGS gaging stations were delineated using ArcHydro tools, and average runoff coefficients were determined for these watersheds through GIS based analysis. These runoff coefficients were then plotted against annual average runoff estimates (from USGS) to determine if these runoff coefficients could be used as a predictor of annual runoff. Any USGS gages influenced by larg dams were omitted from this analysis as it was anticipated that significant amounts of runoff would be attenuated by these structures and therefore appear as downstream baseflow. Since the USGS removes baseflow when estimating runoff these attenuated flows would not be reflected in the average annual rainfall depth. These sites that were removed are :

- 06803093 - Haines Branch at SW56th Street (Influenced by Conestoga)
- 06803170 - Middle Creek at SW 63rd (Influenced by Pawnee)
- 06803486 - Oak Creek at Air Park Road (Influenced by Branched Oak)
- 06803500 - Salt Creek at Lincoln Nebraska (Influenced by all Three)

Note that all these gage sites were in the original Lower Platte South NRD model.

A plot of annual runoff depth and runoff coefficient from the remaining stations is provided in Figure 6 below:

Figure 6 - Runoff Regression Results



A linear regression was fit to the data and based on an R-squared value of 0.9667 it was determined that the runoff coefficient was a reasonably accurate predictor of annual runoff depth. Thus, annual runoff depths for individual HUC 12s were initially estimated based on the following equation:

$$\text{Annual Runoff} = 36.606 \times (\text{Runoff Coefficient}) - 13.704$$

Comparison of Estimates to Gage Data:

Average runoff coefficients for each HUC 12 within Upper Big Blue NRD were determined using the created runoff coefficient raster and GIS based analysis. Runoff depths for individual HUC12s were then calculated based on the regression equation presented in the previous section. To check for accuracy the predicted runoff for individual HUC12's contributing to the same gage were added together and then checked against the USGS prediction.

$$\text{Estimation at Gage} = \frac{\sum(Area)*(Runoff\ Depth)}{Total\ Contributing\ Area}$$

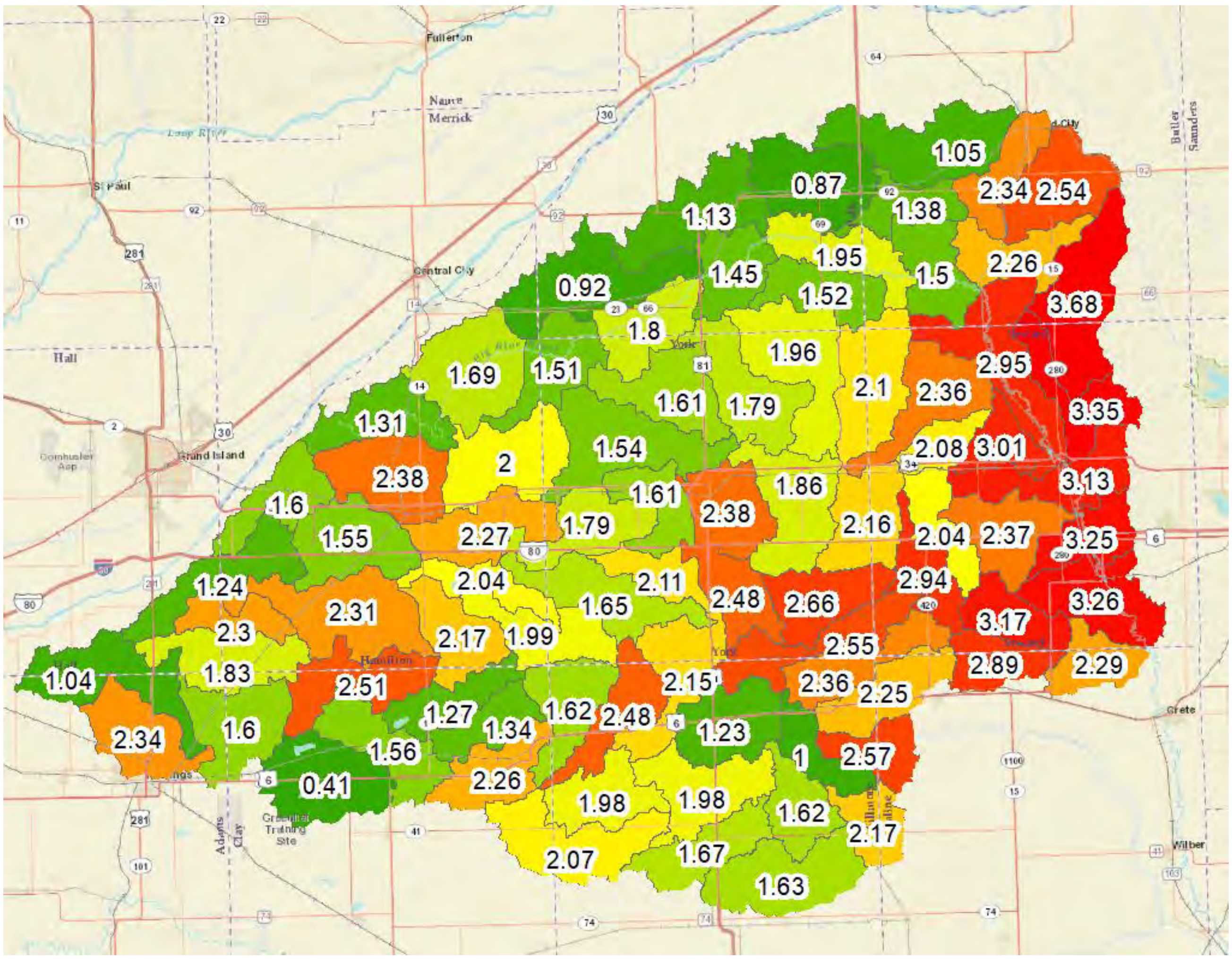
This analysis was done at every gage within the study area. Note that for the initial Lower Platte South NRD model, runoff from the area of upstream significant dams (Branched Oak, Pawnee, and Conestoga) was assumed to largely be trapped in the lake so was omitted in the analysis, however the drainage area was considered when calculating runoff depth to be consistent with USGS methodology. The table below outlines this comparison. In general, predictions for individual gages had errors ranging from approximately 2 to 12%. In areas where the estimated runoff depth differed from the USGS gage depth by more than 10%, a correction factor was applied to the contributing HUC 12s to better match the USGS gage results. A comparison of estimated runoff with USGS gage runoff is provided in Table 3, applicable correction factors are listed in the explanation of results column if applied.

Table 3 - Estimated Runoff Comparisons with Gage Data

Gage Name	Sum of Contributing Runoff Depth x Area (Sq. Mi – Inches)	Contributing Drainage Area (Sq. Mi)	Estimated Runoff Depth (in)	USGS Runoff Depth (in)	Percent Error (%)	Explanation of Results
Salt Creek @ Roca	688.0	166.8	4.12	4.04	2.08	
Salt Creek @ Pioneers	1166.5	242.7	4.81	4.58	4.95	
Salt Creek @ Lincoln	3299.2	683.4	4.83	4.70	2.71	
Little Salt Creek Near Lincoln	208.5	45.8	4.55	4.47	1.79	
Rock Creek Near Ceresco	677.2	137.2	4.93	4.42	11.64	No Dam Influence. Based on Results contributing area runoff altered by a factor of 0.90
Salt Creek at Greenwood	5079.3	1034.7	4.91	4.74	3.57	
Weeping Water Creek at Union	1329.9	250.7	5.30	6.08	12.76	No Dam Influence. Based on Results contributing area runoff altered by a factor of 1.15
Oak Creek at Air Park Road	830.6	257.9	3.22	3.06	5.23	Runoff From Areas upstream of Branched Oak Ignored
Middle Creek at SW 63rd	192.6	79.8	2.41	2.37	1.90	Runoff From Areas upstream of Pawnee Ignored when estimating Runoff Volume.
Antelope Creek at 27th	154.8	14.6	10.63	9.9	7.42	Heavily Urbanized (Downtown areas) not included at the gage. Overprediction expected
Haines Branch at SW 56th	203.0	68.0	2.98	2.82	5.84	Runoff from Areas Upstream of Conestoga not included in runoff.
West Fork Big Blue at Dorchester	2507.8	1289.7	1.94	2.00	2.8	No Dam Influence. Based on Results contributing area runoff altered by a factor of 1.08
Big Blue River at Crete	5364.5	2682.4	2.00	1.96	2.0	No Dam Influence. Based on Results contributing area runoff altered by a factor of 1.03

Based on these results, and the acceptable error of the predictions this regression method was determined to be accurate enough for planning purposes. Note that the prediction error for the two stream gages in the Upper Big Blue NRD study area is less than three percent. Initial predictions gave a percent error of 7.4% for West Fork Big Blue at Dorchester, and 2.8% for Big Blue River at Crete before the correction factors were applied. Figure 7 depicts the final estimated runoff depths (in watershed inches) for the study area. These estimates include any correction factors applied as part of this analysis.

Figure 7 – Estimated Annual Runoff Depths for Individual HUC 12s in Watershed Inches



Overview of Results

Watershed runoff varies across the watershed. Most of the lowest runoff estimates were noted along the northern edge of the study area nearest to the Platte River. Land use in this area consists mostly of row crops, primarily corn and soybeans, with soils in the loam to clay loam range. Moving southeast across the study area, land use includes more grass/pasture, slopes become steeper, and the soil type ranges from silt loam to silty clay. These combined factors increase the runoff coefficient and thus result in higher predicted runoff values. Displaying runoff units in terms of watershed inches allows for a better comparison of relative contributions from specific HUC12s throughout the watershed. Table 4 outlines some summary statistics for the study area.

Table 4 - HUC 12 Runoff Estimation Summary

Average Runoff (in):	2.01
Max Runoff (in):	3.68
Min Runoff (in):	0.41
Highest Contributors:	Headwaters Plum Creek
	Outlet Plum Creek
	Coon Creek-Big Blue River
Lowest Contributors:	Headwater School Creek
	City of Shelby
	Prairie Creek

Individual HUC 12 Breakdowns by Land Use

For pollutant modeling purposes the total runoff for individual HUC12s were partitioned into runoff volumes from specific land uses. This was done through a weighted average approach using both the total area of a specific land use multiplied by its associated runoff coefficient.

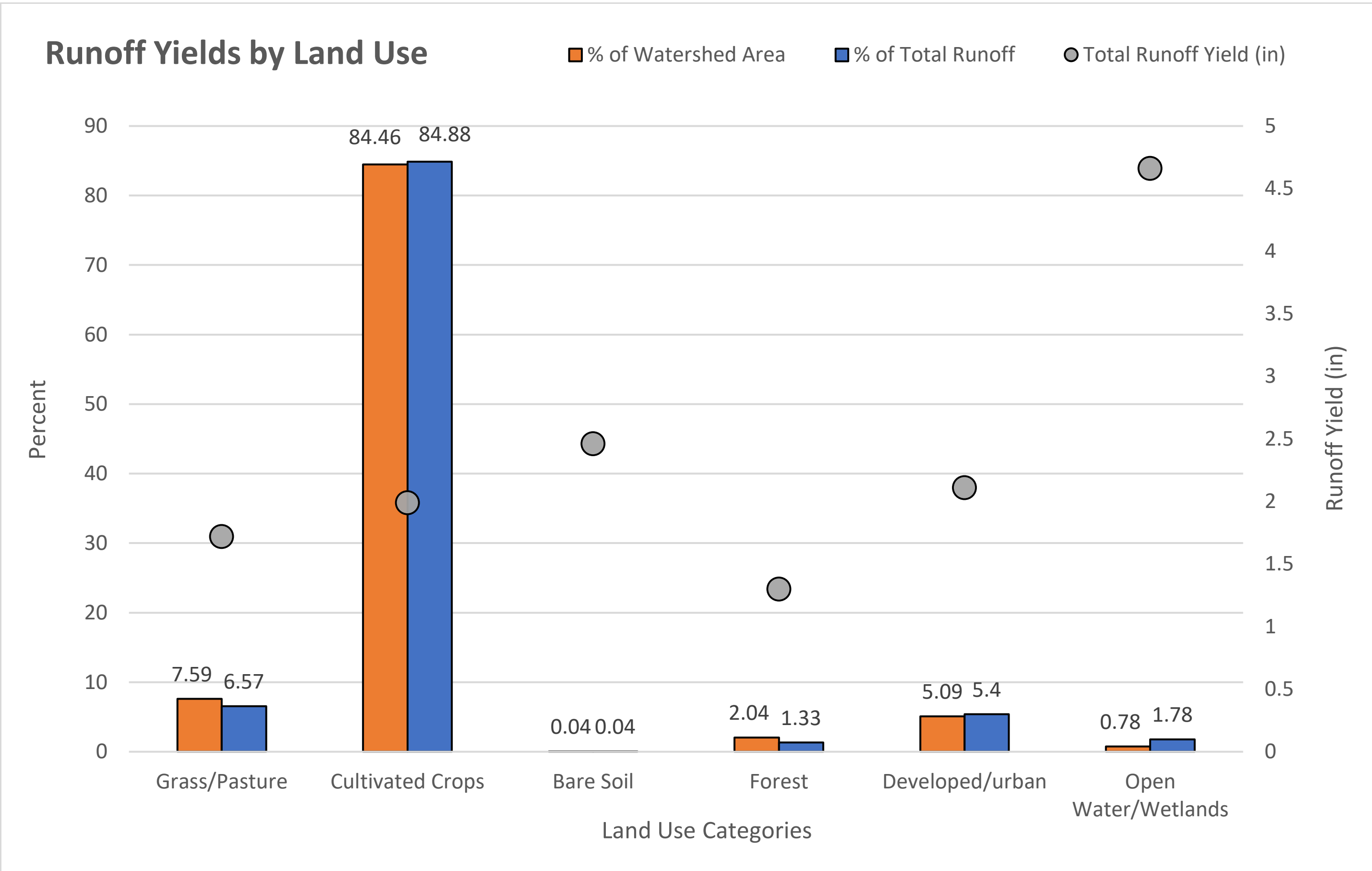
$$\% \, Runoff = \frac{Individual \ Land \ Use \ Area \times Runoff \ Coefficent}{\sum(Land \ Use \ x \ Runoff)} \times 100$$

A summary of individual land use contributions for each HUC 12 are available in the Yield Analysis spreadsheet developed from Excel. An overall breakdown for the entire study area is provided in Table 5. A graphical representation of these values is presented in Figure 8. It is shown that certain types of land use have a disproportionately high runoff yield despite their relatively small overall areas and runoff percentages.

Table 5- Breakdown of Runoff by Land Use for the Entire Study Area

Land Use	Percent of Area	Percent of Runoff	Total Runoff (Acre-ft)	Total Runoff Yield (in)
Grass/Pasture	7.59	6.57	20747	1.72
Cultivated Crops	84.46	84.88	268028	1.99
Bare Soil	0.04	0.04	129	2.46
Forest	2.04	1.33	4207	1.30
Developed/Urban	5.09	5.40	17034	2.11
Open Water/Wetlands	0.78	1.78	5618	4.66
Total	100%	100%	315763	n/a

Figure 8 – Land Use and Runoff Contribution Percentages



Attachment 2

Technical Memo – Non-permitted AFO Facilities

Prepared By: Dillon Vogt
JEO Project # 161356.00

Purpose:

The purpose of this memo is to outline methods and procedures used to estimate the number and location of cattle and animal feeding operations (AFOs) within the study area. The study area includes 4 HUC 8s (West Fork Big Blue, Upper Big Blue, Middle Big Blue, and Turkey). These livestock estimates will be used to calculate approximate *E. coli* loadings within HUC 12s as a part of the Upper Big Blue Natural Resources District (UBBNRD) Water Quality Management Plan (WQMP). Livestock estimates were based on aerial analysis, information from the United States Department of Agriculture (USDA) census of agriculture, and permitted facility data from the Nebraska Department of Environmental Quality (NDEQ).

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 NDEQ 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. 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 waste control facility from NDEQ. 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.

For the purposes of the WQMP, permitted AFOs (typically medium and large operations) are not considered to be a pollutant source due to regulatory requirements. Non-permitted (typically small AFOs) do not have regulatory requirements imposed on them and are thus treated as potential nonpoint sources of pollution for management recommendation purposes.

Aerial Analysis:

The study area was visually surveyed using aerial imagery through a combination of ArcGIS and Google Earth. The public land survey system grid was layered over the base-map to break up the study area into manageable sections for the analysis. AFOs were initially identified in ArcGIS by looking for several key features in aerial photography, confirmed in Google Earth, and then checked to ensure they were not near a permitted AFO location (discussed below). A point for each non-permitted AFO was then created in ArcGIS. A total of 1,110 Non-permitted AFOs were identified in the study area. The following key features were used to identify them:

- clearly visible cattle trails between water sources
- stream crossings
- bare or disturbed ground around water tanks or feeding areas
- barns or sheds with bare earth corrals
- evidence of highly worn areas in pastures where cattle dig and roll
- individual cattle in feedlots or pastures
- lagoons for manure storage

Figure 1 below shows an example of a typical non-permitted AFO. There are barns with bare earth corrals present, as well as possible cow trails leading to the pond on the right side of the image. This image was taken from the base-map view in ArcGIS. Figure 2 shows a more in depth look at the same location in Google Earth. The Google Earth imagery was taken at a different time of year and date than the ArcGIS imagery, and clearly shows cow trails running to the pond as well as individual cattle in the pasture.

Figure 1 – Example Non-permitted AFO as seen in ArcGIS.

Figure 2 – A zoomed in view of the same operation as in Figure 1, taken at a different date (via Google Earth).

<u>NDEQ Records:</u>
NDEQ permitted facility records were utilized to identify permitted AFOs. Livestock waste control facility records were downloaded for the study area from the NDEQ website via the online Interactive Mapping utility. NDEQ records consist of only those AFO facilities which require a permit. There are three size-based classifications used by the NDEQ to classify cattle operations:

- Small
  - Contains less than 200 dairy cattle
  - Or contains less than 300 beef cattle
- Medium
  - Contains 200 – 699 dairy cattle
  - Or contains 300 – 999 beef cattle
- Large
  - Contains 700 or more dairy cattle
  - Or contains 1,000 or more beef cattle

Table 1 below shows an example of the NDEQ record formatting. The records include a facility ID, facility name, address, description, status, and latitude and longitude coordinates. Facilities described as active cattle feeding operations or dairies were pulled from the records and used for this study. A point was mapped in ArcGIS for each permitted facility based on their latitude and longitude coordinates. Of the 1,016 permitted active cattle feeding operations identified, none were assigned size descriptions. Most small AFOs are not required to apply for a permit, therefore it was assumed that most permitted facilities are medium or large in size, despite the lack of description in NDEQ records.

Table 1 – Example of NDEQ registered facility records.

Facility_ID	Facility_Name	Street	City	County	Zip_Code	Status	Program	Program_ID	Program_Description	Program_Status	Latitude	Longitude
58076	UNL East Campus		Lincoln	Lancaster	68502	O	LWC	2-053	Cattle, sheep & horses	Active	40.83365	-96.66776
61618	Todd Farms	1618 Todd Dr	Union	Cass	68455	O	LWC	20-005	Feeder Cattle	Active	40.864444	-95.93611
49214	Mohrhauser Farms	11080 SW 119th St	Denton	Lancaster	68339	P	LWC	2-1084	Feeder Cattle	Active	40.70192	-96.88245
66671	Duane Hottovy Livestock	1675 23 Rd	Dwight	Butler	68635	O	LWC	25-1048	cattle	Active	41.07158	-96.95147
66693	John Kozisek Farm	2097 22 Rd	Dwight	Butler	68635	O	LWC	25-1011	Cattle	Active	41.06093	-96.989644
67193	Clarence Luebbe Livestock	1458 Fletcher Rd	Pleasant Dale	Seward	68423	O	LWC	16-178	Beef Cows	Active	40.87201	-96.91769
67199	Thomas Sieck Livestock	1856 Holdrege Rd	Pleasant Dale	Seward	68423	O	LWC	16-1058	beef cows	Active	40.82856	-96.9752

<u>USDA Agriculture Census:</u>

The USDA 2012 Agriculture Census (AgCensus) is the most recent freely available data source for Nebraska that provides a total count of cattle by county. It also provides counts by size of farm. Table 2 below shows an example of the AgCensus information. The census is broken up into categories of total cattle and calves by county, and total number of farms per county based on the size of their herds. The AgCensus counts all cattle in Nebraska, regardless of whether they are in permitted AFOs or non-permitted AFOs. The size categories available for farms are; 1 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 199, 200 to 499, and 500 or more. The AgCensus size classes were reclassified into 3 categories to more closely follow NDEQ size guidelines; 1 to 199 head as small, 200 to 499 as medium, and 500 or more as large.

Table 2 – Example of USDA Agriculture Census by county.

Item	Knox	Lancaster	Lincoln
INVENTORY			
Cattle and calves ....farms, 2012	700	477	625
2007	559	421	537
number, 2012	123,103	21,732	267,865
2007	115,709	23,323	248,876
Farms by inventory:			
1 to 9 .... farms, 2012	69	157	98
2007	34	109	66
number, 2012	355	671	475
2007	207	542	297
10 to 19 .... farms, 2012	57	134	48
2007	39	79	33
number, 2012	777	1,765	663
2007	525	1,106	480
20 to 49 .... farms, 2012	140	94	140
2007	82	117	95
number, 2012	4,199	2,657	4,599
2007	2,771	3,849	2,984
50 to 99 .... farms, 2012	149	54	79
2007	120	65	70
number, 2012	10,118	4,007	5,240
2007	8,123	4,369	4,644
100 to 199 .... farms, 2012	109	22	98
2007	121	31	86
number, 2012	15,096	3,038	14,061
2007	17,101	4,249	12,073
200 to 499 .... farms, 2012	134	10	84
2007	122	16	96
number, 2012	41,572	2,840	27,121
2007	38,238	5,200	31,618
500 or more .... farms, 2012	42	6	78
2007	41	4	91
number, 2012	50,986	6,754	215,706
2007	48,744	4,008	196,780

Analysis:

The study area contains parts of 10 counties. The percentage of each county's area included in the study area was calculated. To determine an approximate count of cattle within the study area, the total numbers of cattle per county from the AgCensus were multiplied by the percentage of county area included in the study. The summation of these approximations gives an estimate of the total number of cattle in the study area: 244,969.

The number of permitted cattle was found by comparing the percentage of each county included in the study area, the numbers of each size of permitted facility in each county, and the total number of cattle in each county. To estimate the size class of each permitted facility the number of operations of each size were determined from the reclassified USDA AgCensus counts and compared to the list of NDEQ permitted facilities within the study area. Each facility was assigned an assumed size class based on its location to match the estimated number of facilities of each size class per county. Once all medium and large facilities were accounted for, the remaining facilities were assumed to be small. As seen in Table 3 below, large facilities were assumed to have 1,000 cattle each, medium 500, and small 100. The count of facilities in each size class were then multiplied by the estimated number of head in each facility class, then summed. This gave the total number of permitted cattle in the study area: 222,900.

The difference between permitted and total cattle yields 22,069 non-permitted cattle in the study area. Dividing this by the number of non-permitted facilities that were identified during aerial analysis, 1,110, yields an average of 20 cattle per non-permitted facility.

Table 3 – Calculations for cattle numbers.

Permitted Large facilities	**Cattle (assume 1000)**		
97	97000		
Permitted Medium facilitie	**Cattle (assume 500)**		
85	42500		
Permitted Small facilities	**Cattle (assume 100)**		
834	83400		
Total Active Permits		**222900**	**Total Registered Cattle**
1016			
Unregistered facilities			
1110			

		Operations			Cattle							
County	**Cattle in county (2012)**	**Small**	**Medium**	**Large**	**Small**	**Medium**	**Large**	**Area of County (acres)**	**Approx study area per county (acres)**	**% of County in Study**	**Approx cattle in study area by %**	
Adams	59282	157	14	5	1700	4377	Unreported	360924.5	52413.49	0.1452	8608.938	
Butler	34036	292	28	8	11491	7378	15167	376360.87	181631.5	0.4826	16425.750	
Clay	51336	132	22	9	4740	5659	40937	366912.51	165590.83	0.4513	23168.387	
Fillmore	31023	145	8	13	6507	2358	22158	368890.41	262315.56	0.7111	22060.253	
Hall	68546	205	24	27	9257	7210	52079	353223.78	40550.69	0.1148	7869.197	
Hamilton	41093	160	14	19	6632	4108	30353	349715.15	317917.51	0.9091	37356.644	
Polk	68799	126	22	33	5793	6057	56949	282128.42	172389	0.6110	42038.270	
Saline	25879	332	16	4	13209	5477	7193	368534.16	50825.57	0.1379	3569.045	
Seward	48059	322	21	13	11871	6379	29809	368258.05	296131.99	0.8041	38646.290	
York	45226	123	6	28	3740	1783	39703	368441.54	368441.54	1.0000	45226.000	
											244969	**Total**

[Ag census] - [Permitted cattle]		
	22069	**Unregistered Cattle**
[Unregistered Cattle] / [Unregistered Facilities]		
	20	**Unregistered Cattle per Facility**

To summarize:

1. Determine which counties the study area overlaps.
2. Determine the percentage of each county's area that is included in the study area.
3. Multiply total cattle per county from the AgCensus by the percentage from step 2, yielding cattle per county in the study area.
4. Sum the cattle per county by percentage, giving total number of cattle in the study area, both permitted and non-permitted.
5. Determine the size class of each permitted facility by county.
6. Multiply the count of each facility size by assumed cattle numbers to yield total permitted cattle in the study area.
7. Subtract permitted cattle from total cattle to yield total non-permitted cattle in the study area.
8. Divide non-permitted cattle by number of non-permitted facilities to find average cattle per non-permitted AFO.

Attachment 3

Technical Memo – Existing BMP Treatment Levels

Prepared By: Dillon Vogt
JEO Project # 161356.00

Purpose:

This memorandum has been developed to document sources of information which provide data on the existing levels of land treatment or Best Management Practices (BMPs), within the planning area for the Upper Big Blue NRD Watershed Management Plan. The results of this effort will be used for the following purposes:

- Assist in developing a water quality model
- Identifying if there are still opportunities for additional BMP implementation
- Accurately estimate pollutant load reductions as a result of recommended BMPs

Methods

For the current planning purposes, only existing data sources will be used. No on-the-ground or GIS-based field assessments will be conducted. There is no comprehensive database of existing BMPs in Nebraska. Existing data is primarily limited to what is reported through various government programs, such as EQIP, however many landowners utilize BMPs on their own and those are hard to identify without conducting additional studies. The following data source was used to compile this memo:

- **Natural Resources Conservation Service (NRCS) Conservation Agronomists** are individuals hired by the United States Department of Agriculture (USDA) to manage and administer farm programs to monitor and improve soil, water, and air quality. These programs can involve education, financial or technical assistance, and collaboration with various government entities and private individuals. One Agronomist centrally located in the UBBNRD was surveyed in July 2018 to quantify the management practices present in the region.

Results

A summary of the results of the survey are shown below in Table 1.

Table 1: Summary of NRCS Survey Results

Question	Response
What are typical crop rotations?	1 yr corn – 1 yr soybeans, or 2 yrs corn – 1 yr soybeans. For seed corn usually 1 yr seed corn – 1 yr commercial corn – 1 yr soybean (lots of seed corn in this region)
What are typical livestock stocking rates?	Recommended is 4-5 acres per cow calf pair. More realistically found is about 3 acres per cow calf pair.
What are typical manure application rates?	Swine deep pit barn – 2-3,000 gal/acre Beef cattle solids – 15-20 tons/acre Beef holding pond water – 4-7 ac-in/ac annually Dairy – no estimate
What percent of treatable land is treated by the following BMPs?	
Nonstructural and avoidance practices (nutrient/manure management, planning, etc.)	Most producers have crop consultants and use soil sampling/crop scouting. Most do not follow NRCS standards.
Grazing lands management (exclusionary fencing, alternate water supplies, etc.)	Most grazing land does not follow NRCS standards, but livestock wells and cross fencing can be common.
Cover crops	Majority of seed corn acres utilize cover crops, about 25% of conventional crops use cover crops.
Riparian buffers	Not common, very few meet NRCS standards
Reduced tillage (no-till, strip till, etc.)	No-till and strip till are common, probably 50-60% district wide. Convention till is 40-50%
Contour buffer strips/filter strips	Buffer strips are not common, the few that exist do not meet NRCS standards
Non-permitted animal feeding operation BMPs (animal waste systems, diversions, manure storage, etc.)	Do not have the information to answer this question.
Wetlands/farm ponds/sediment basins	Lots of wetlands. Many are farmed, many larger ones are used as pasture. Farm ponds – yes there are many in the district but NRCS does little work with them. Sediment basins have the same issues as terraces
Terraces	Not many in the district, too flat. Seward County has the most, however many terraces are being removed to accommodate larger machinery.
Grassed waterways	Same issues as terraces.

Discussion
Non-structural management practices of some sort may not be found in a majority of fields but are still common throughout the UBBNRD. Reduced tillage practices are the most popular, and many producers utilize crop rotations and cover crop plantings. Corn and soybeans are the most common crops in this region. Some grazing management practices are common, such as cross fencing, but most practices do not meet NRCS standards. Additionally, many pastures are overstocked. Practices designed to trap or treat runoff such as terraces, grassed waterways, and sediment basins are rarely found in this region due to the flat landscape.

It is recommended that additional studies or surveys should be conducted prior to future updates of the watershed management plan to provide a more accurate estimate of existing land treatment. This would also be an opportunity to gain insight into what barriers may exist which prevent or reduce BMP adoption by producers and landowners.

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Water Quality Assessment and Implementation Strategy

For

Recharge Lake and Beaver Creek

Upper Big Blue Natural Resources District, Nebraska

Prepared by: LakeTech, Inc.

In Association with: JEO Consulting

April 2019

This document was completed as part of the process to develop a Water Quality Management Plan (WQMP) for the Upper Big Blue Natural Resources District (UBBNRD) and is not intended to serve as a "stand-alone" plan. Recharge Lake and Beaver Creek were selected as target areas in the UBBNRD WQMP. Information and data presented in this document will be utilized to summarize current conditions and required 9-elements for the WQMP.

Contents

1. Introduction

Beaver Creek is located in Seward, York, and Hamilton counties (Figure 1). The drainage encompasses 8 HUC 12 sub-watersheds totaling 193,124 acres (Table 1). Beaver Creek is comprised of two segments (BB3-10300 and BB3-10400) that extend approximately 39 miles (NDEQ, 2018). Upper Beaver Creek (BB3-10400) consists of 6 HUC 12 sub-watersheds while lower Beaver Creek (BB3-10300) is comprised of 2 HUC 12 sub-watersheds.

Beneficial uses assigned to Beaver Creek include: Aquatic Life, Aesthetics, and Agricultural Water Supplies (NDEQ, 2014). The Aquatic Life beneficial use assigned to both segments of Beaver Creek are currently impaired from different causes (NDEQ, 2018). The impairment designation for the headwaters reach (BB3-10400) stems from poor aquatic communities while the lower portion of Beaver Creek (BB3-10300) is impaired from atrazine.

In 2013, NDEQ 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.

Recharge Lake, which falls in HUC 12-102702030405, is the only public access lake in the Beaver Creek drainage (Figure 2). The 44 surface acre lake, located in York County, is extensively used by the public for both passive and active recreational activities. Beneficial uses assigned to Recharge Lake include: Primary Contact Recreation, Aquatic Life, Aesthetics, and Agricultural Water Supplies (NDEQ, 2014).

The Aquatic Life beneficial use for Recharge Lake is currently impaired due to elevated phosphorus and nitrogen in the lake water column and high concentrations of mercury in fish tissue (NDEQ, 2018). Due to the global nature of mercury sources, addressing fish tissue contamination falls outside the scope of this plan. Information on fish tissue monitoring and results can be found on NDEQ's website: deq.ne.gov/NDEQProg.nsf/OnWeb/FTMP.

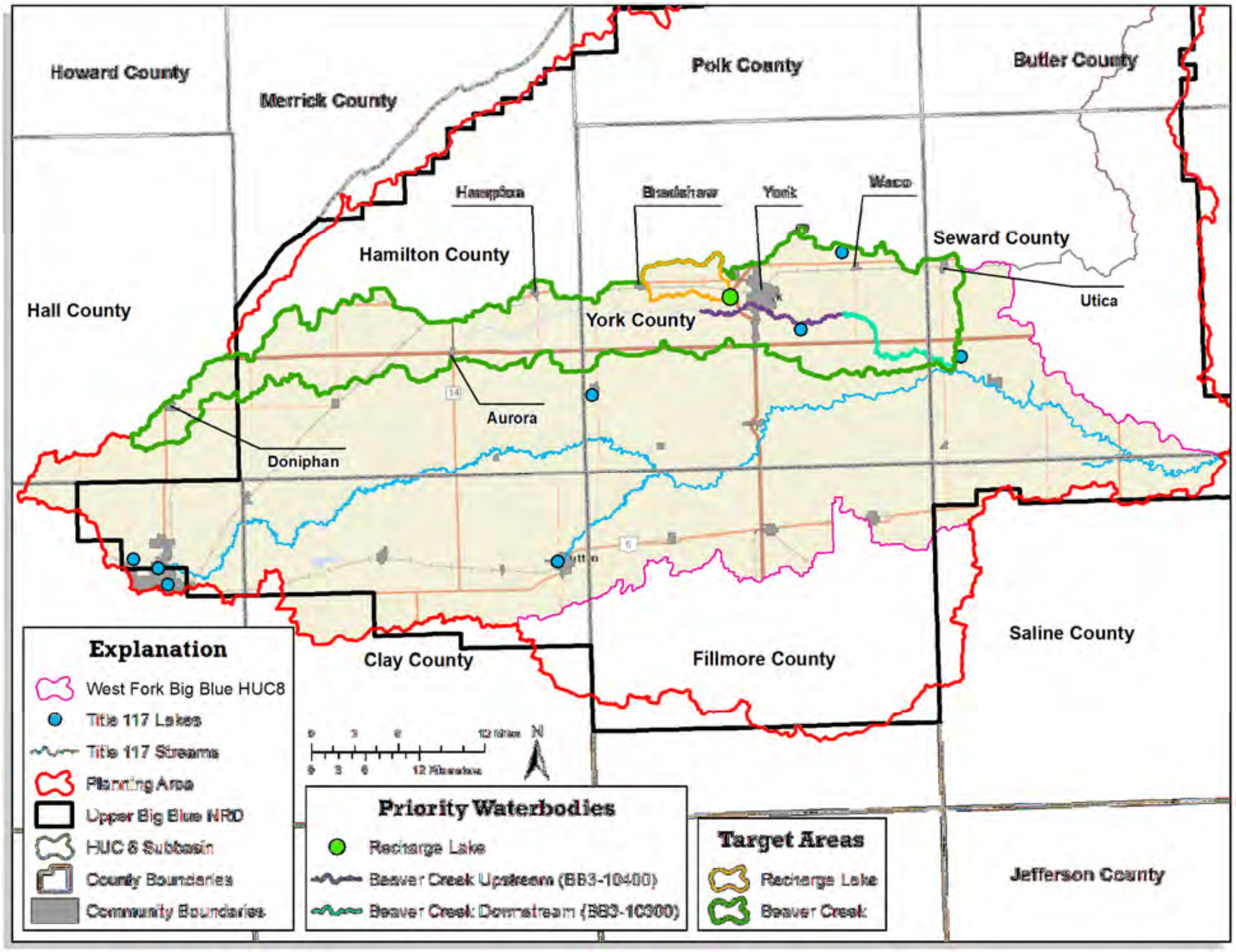

Figure 1. Beaver Creek Drainage Area

Table 1: HUC 12 Sub-watersheds in the Beaver Creek Drainage

HUC12	Area (acres)	% of Total Drainage
Upper Beaver Creek		
102702030408	23,866	12.36%
102702030407	30,747	15.92%
102702030406	22,282	11.54%
102702030405	16,367	8.47%
102702030404	22,784	11.80%
102702030403	24,287	12.58%
Lower Beaver Creek		
102702030402	27,626	14.30%
102702030401	25,165	13.03%
Total	**193,124**	**100%**

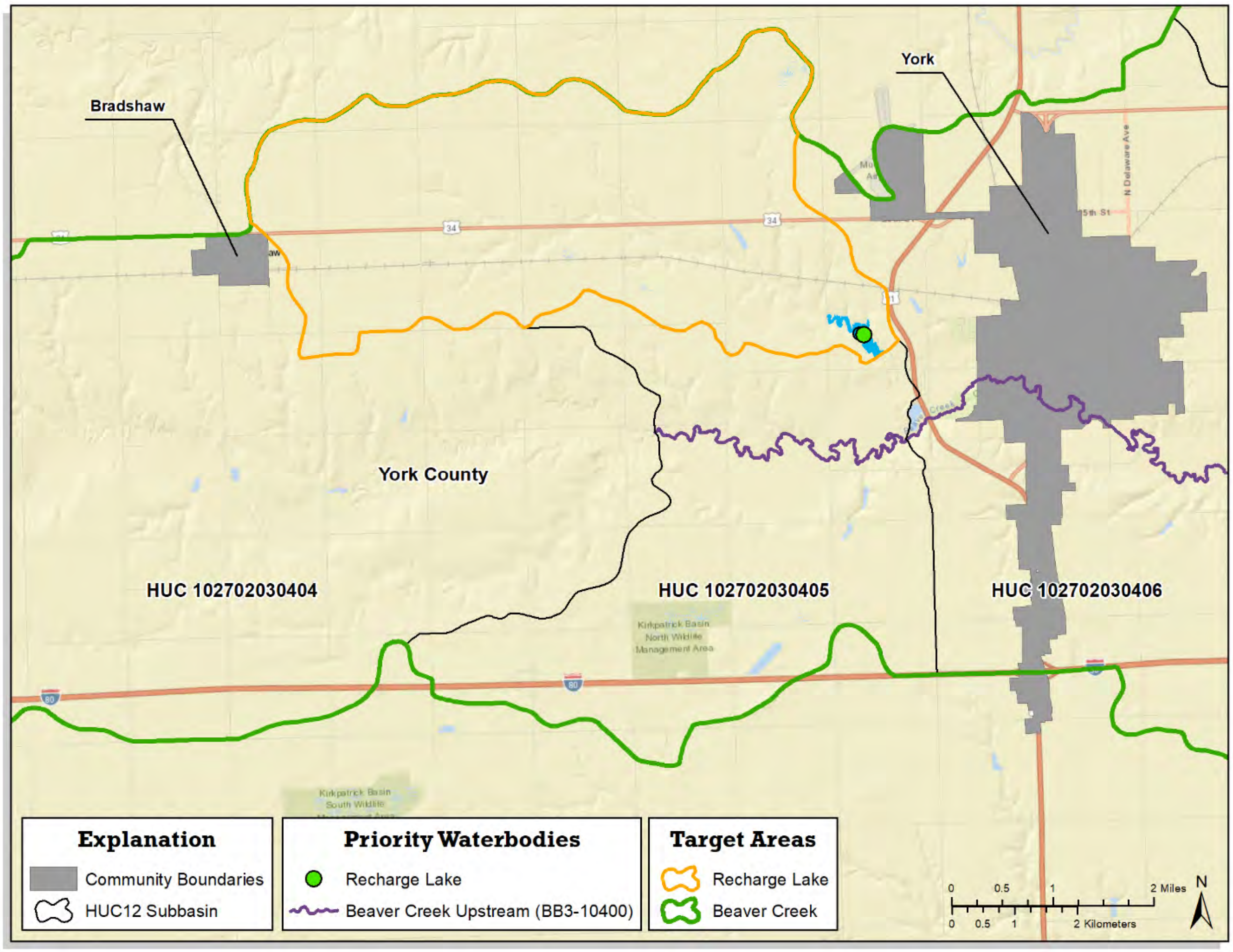

Figure 2: Location of Recharge Lake, York County

Atrazine carried by stormwater runoff has been a documented concern in the Beaver Creek drainage 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 µg/L and monthly average concentrations as high as 61.10 µg/L (Figure 3).

Recharge Lake was placed on the Section 303(d) List of Impaired Waters in 1994. This listing led the Upper Big Blue Natural Resources District (UBBNRD) to initiate a Section 319 project in the Recharge Lake drainage to address atrazine concerns. The atrazine project was completed in 1997. 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). The general approach that made this project a success has not changed and can be applied to the larger Beaver Creek drainage. As demonstrated in the Recharge Lake project, a sound, defensible monitoring network, substantial producer involvement, and a coordinated governmental partnership that provides the necessary expertise and funding are essential to address atrazine issues.

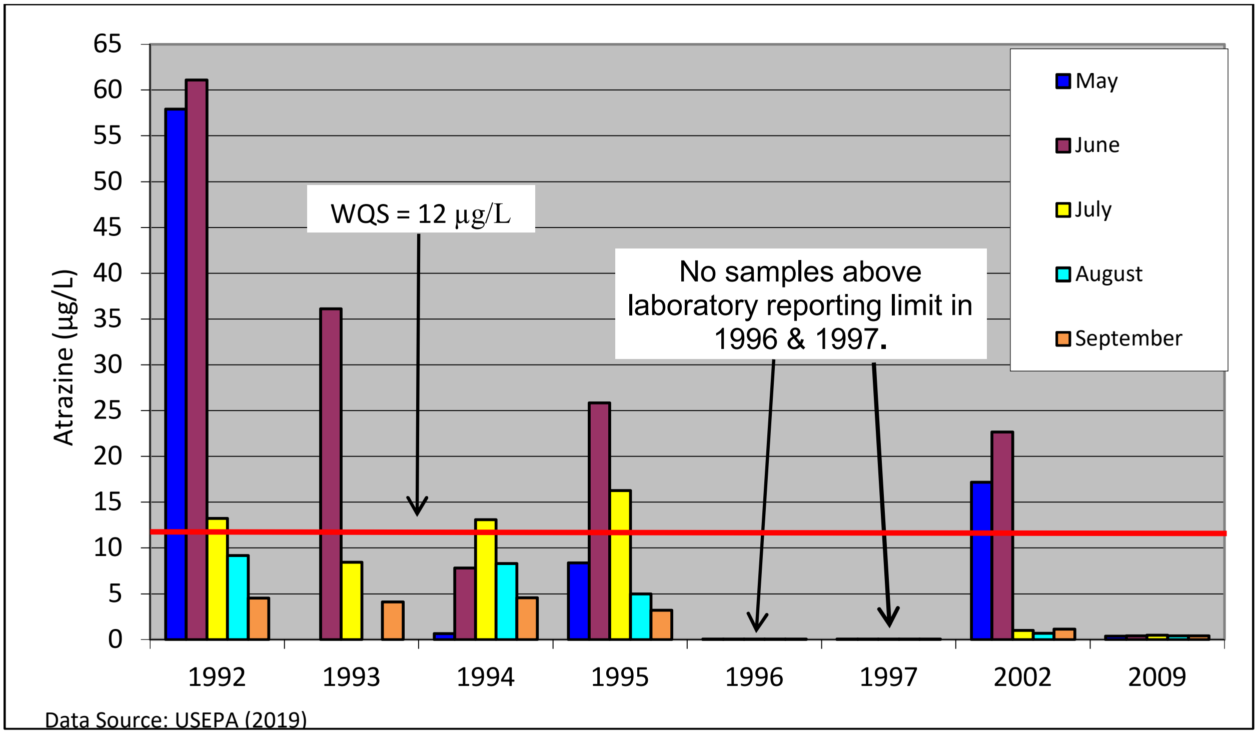

Figure 3: Average Monthly Atrazine Concentrations in Recharge Lake, York County

2. Water Quality Data and Impairment Summary

Upper Beaver Creek (BB3-10400)

NDEQ has completed Aquatic Community assessments on both segments of Beaver Creek. Based on the results of these assessments, the headwaters (BB3-10400) was assigned an impairment designation due to poor aquatic communities (NDEQ, 2018). 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, 2011).

Lower Beaver Creek (BB3-10300)

Atrazine data for Beaver Creek was collected near Beaver Crossing from 2001-2003 (Site: JSBBRA 18) (NDEQ, 2013). A total of 95 samples were collected, representing all 12 months (Table 2). Seventy-seven samples (81%) were collected from April through September. A total of 9 samples exceeded the chronic atrazine standard of 12 µg/L, all of which were collected in May and June. Because of these results, the TMDL was developed for seasonal (May-June) atrazine impairments (Figure 4).

Table 2: Summary of Atrazine Samples Collected from Beaver Creek

Segment BB3-10300	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Avg. 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)

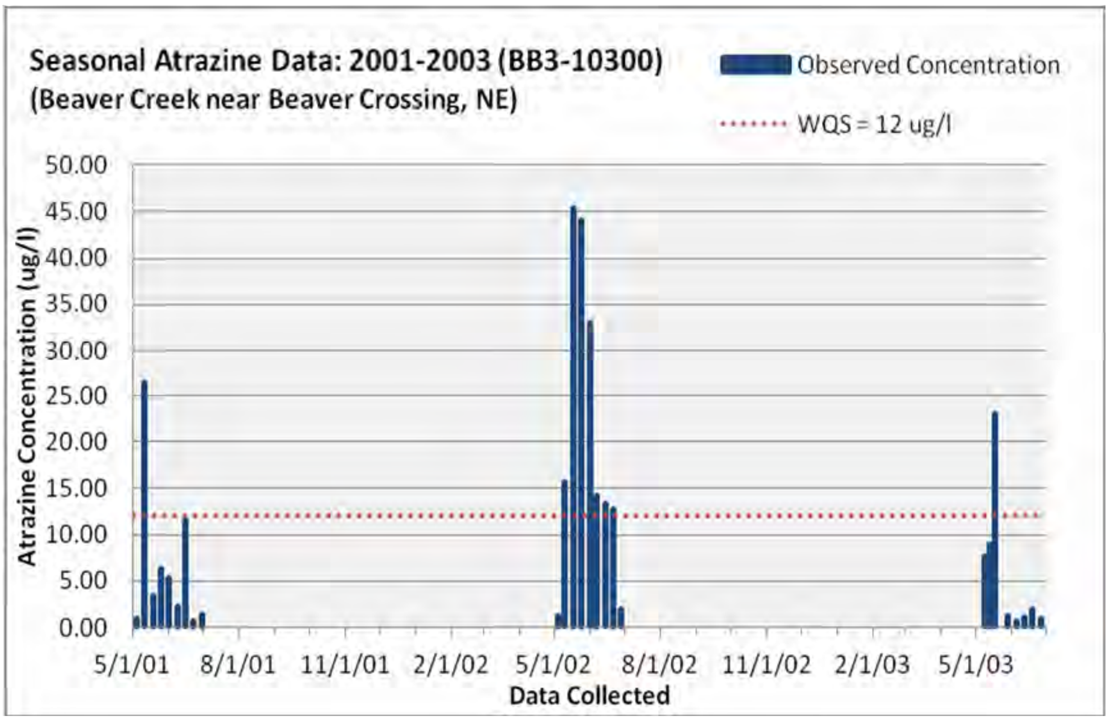

Figure 4: Seasonal Atrazine Data for Beaver Creek (Source: NDEQ, 2013)

Recharge Lake (BB3-L0080)

NDEQ conducted water quality sampling at Recharge Lake in 2002, 2009, and 2010. All 15 of the total phosphorus samples collected exceed the Nebraska water quality standard of 50 µg/L (Table 3). Total nitrogen was estimated from nitrate/nitrite and kjeldahl nitrogen concentrations. Total nitrogen exceeded the Nebraska water quality standard of 1000 µg/L in all 14 samples.

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 6 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. 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, a minimal amount of conservation pool volume data exists. Follow-up volume surveys should be conducted to provide accurate sediment deposition estimates.

Table 3: Summary of Nutrient Sampling Conducted at Recharge Lake.

Sampling Period: 2002-2010	**Total Nitrogen**	**Total Phosphorus**
Number of Samples	14	15
Mean (μg/L)	2180	495
Water Quality Standard (μg/L)	1000	50

Data Source: USEAPA (2019)

3. Land Cover and Pollutant Sources

Land cover in the Beaver Creek drainage was determined by GIS analysis of the 2017 USDA-NASS Cropland Data Layer (CDL), which is available at the USDA NRCS GeoSpatial Data Gateway (USDA, 2017). The CDL is a complete, geographically referenced classification of all satellite ortho-imagery data, by crop or land cover, within a particular state. By using imagery from multiple times of the year, the CDL classifies pastures, trees, and other permanent vegetation separately from annual crops. An inventory of land cover is necessary for water quality modeling and assists with identifying specific management strategies to reduce potential pollutants. Not all land cover types identified directly correspond to the land cover types available in the watershed modeling software used (i.e., EPA's Spreadsheet Tool for the Estimation of Pollutant Load [STEPL] Model). Therefore, land cover from the CDL was reclassified and aggregated into the appropriate land use areas for use in the STEPL model.

Beaver Creek

The drainage area of Beaver Creek is comprised of eight HUC 12 sub-watersheds that total 192,994 acres (Table 4). The drainage includes the communities of Doniphan, Aurora, Hampton, Bradshaw, York, Waco, and Utica. Land used for corn and soybean production accounts for approximately 83% of the drainage and is the dominant land cover type. Grass, which includes pasture, comprises approximately 6% of the area.

The USDA Crop Data Layer does not identify open lots used for animal feeding and holding, or on-site wastewater treatment systems. These sources were identified through aerial images and treated as a separate pollutant source (JEO, 2018). A total of 98 open lots were identified that encompass approximately 145 acres (Table 5). A total of 1,718 on-site wastewater systems (OWT Systems) were identified in the drainage area, with an estimated 120 of these being registered with the State of Nebraska. There are no permitted discharges in the drainage.

Table 4: Land Cover in the Beaver Creek Drainage (2017)

Model Category and Associated Land Cover	Acres	% of Area
Grass		**5.82%**
Grass/Pasture	10927.32	5.66%
Other hay/non-alfalfa	312.42	0.16%
Cultivated Crops		**82.94%**
Soybeans	49030.73	25.41%
Corn	111047.27	57.54%
Forest		**1.70%**
Deciduous	3276.21	1.70%
Mixed	0.00	0%
Evergreen	0.00	0%
Other Crops		**1.26%**
Alfalfa	1628.74	0.84%
Winter wheat	317.80	0.16%
Oats	34.92	0.02%
Fallow/Idle cropland	8.01	0.00%
Barren	94.06	0.05%
Sorghum	332.95	0.17%
Rye	24.02	0.01%
Urban		**7.34%**
Developed Open Space	9121.75	4.73%
Developed/Low intensity	3685.73	1.91%
Developed/Medium intensity	976.74	0.51%
Developed/High intensity	382.30	0.20%
Not Modeled		**0.93%**
Open water	861.08	0.45%
Woody wetlands	664.91	0.34%
Herbaceous wetlands	267.23	0.14%
TOTALS	**192,994**	**100%**
Perennial Stream Miles	**140.95**	NA

Source: USDA (2017)

Table 5: Estimates of Livestock and On-site Wastewater Systems in the Beaver Creek drainage.

	Count
Open Lots-Animal Feeding	
Approximate Total animals	1,960
Approximate Animals per lot	20
Total acres	145.3
Onsite Wastewater Systems	
Registered	120
Unregistered	1,598
NPDES Permits	0

Source: JEO (2018)

Recharge Lake

The drainage area of Recharge Lake is comprised of 8,549 acres (Table 6). There are no communities in the drainage. Land used for corn and soybean production accounts for approximately 87% of the drainage and is the dominant land cover type. Grass, which includes pasture, comprises approximately 5% of the area.

A total of 3 open lots for livestock were identified in the drainage that total approximately 4.4 acres (Table 7). A total of 62 on-site wastewater systems (OWT Systems) were identified in the drainage area, with an estimated 13 of these being registered with the State of Nebraska. There are no permitted discharges in the drainage.

Table 6: Land Cover in the Recharge Lake Drainage (2017)

Model Category and Associated Land Cover	Acres	% of Area
Grass		**4.93%**
Grass/Pasture	407.39	4.77%
Other hay/non-alfalfa	13.57	0.16%
Cultivated Crops		**86.75%**
Soybeans	3072.34	35.98%
Corn	4335.26	50.77%
Forest		**0.91%**
Deciduous	77.96	0.91%
Mixed	0.00	0.00%
Evergreen	0.00	0.00%
Other Crops		**0.75%**
Alfalfa	56.82	0.67%
Winter wheat	0.22	0.00%
Oats	1.11	0.01%
Fallow/Idle cropland	0.00	0.00%
Barren	5.56	0.07%
Sorghum	0.00	0.00%
Rye	0.00	0.00%
Urban		**5.94%**
Developed Open Space	374.57	4.39%
Developed/Low intensity	110.34	1.29%
Developed/Medium intensity	15.81	0.19%
Developed/High intensity	6.63	0.08%
Not Modeled		**0.72%**
Open water	40.73	0.48%
Woody wetlands	17.78	0.21%
Herbaceous wetlands	2.89	0.03%
TOTALS	**8,538.99**	**100%**
Perennial Stream Miles	**7.90**	NA

Source: USDA (2017)

Table 7: Estimates of Livestock and On-site Wastewater Systems in the Recharge Lake Drainage

	Count
Open Lots-Animal Feeding	
Approximate Total animals	60
Approximate Animals per lot	20
Total acres	4.4
Onsite Wastewater Systems	
Registered	49
Unregistered	13
NPDES Permits	0

Source: JEO (2018)

Atrazine Sources

Atrazine is a triazine herbicide currently registered for use on broadleaf and grassy weeds. Although atrazine can be used for a variety of purposes, its greatest use is on corn and sorghum (USEPA, 2019). Producer responses to 1992 and 1996 surveys regarding noxious weeds in the Recharge Lake drainage showed that shattercane, velvetleaf, grasses/foxtail, sunflowers, and pigweed were the five weeds accounting for 87% of the responses on corn and grain sorghum acres (Zoubek, 1996).

4. Pollutant Loads

Beaver Creek – Sediment and Nutrients

Current sediment and nutrient loading to Beaver Creek stemming from surface runoff were estimated using the STEPL model (TetraTech, 2018). The average annual phosphorus load to Beaver Creek is estimated to be 344,006 lbs/yr. (Table 8). The largest contributor of phosphorus to Beaver Creek is from land used for corn and soybean production, which constitutes 85.6% of the total load (**Error! Reference source not found.**5). Assessments of sub-watershed loads indicate HUC12 – 102702030407 contributes the greatest load of phosphorus to Beaver Creek.

Table 8: HUC 12 Sub-watershed Phosphorus Loads to Beaver Creek

HUC12	Phosphorus Load (lbs/yr.)	% Contribution
102702030401	29,658.2	8.62%
102702030402	39,481.4	11.48%
102702030403	46,378.0	13.48%
102702030404	45,409.8	13.20%
102702030405	31,267.1	9.09%
102702030406	39,050.1	11.35%
102702030407	58,691.3	17.06%
102702030408	54,070.4	15.72%
Total	**344,006.1**	**100%**

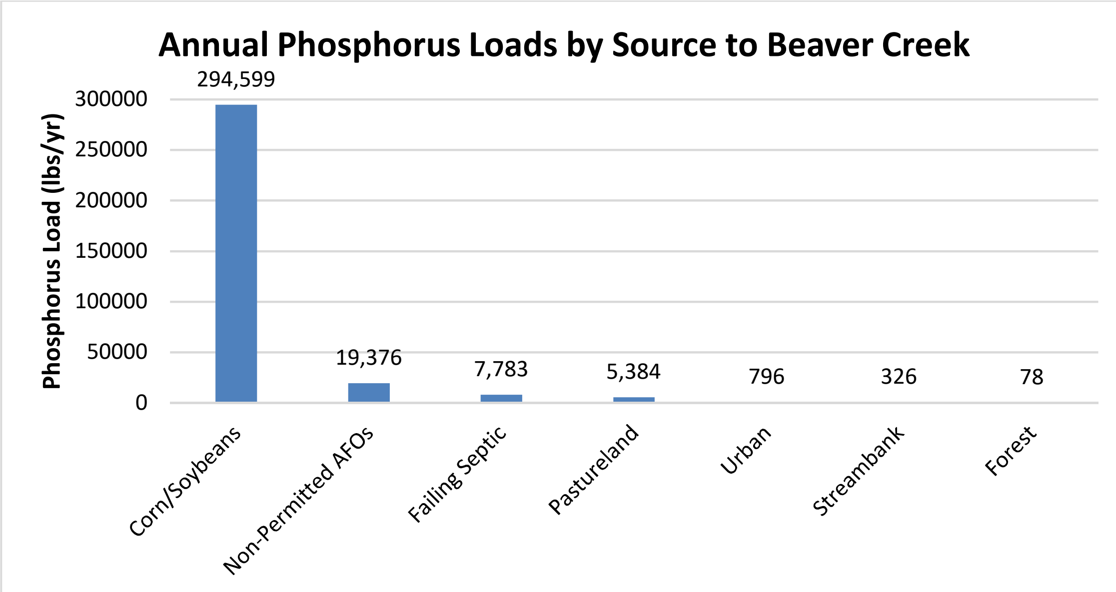

Figure 5: Phosphorus Sources and Annual Average Loads to Beaver Creek

The average annual nitrogen load to Beaver Creek stemming from surface runoff is estimated to be 1,228,735 lbs/yr. (Table 9). The largest contributor of nitrogen to Beaver Creek is from land used for corn and soybean production, which constitutes 70.1% of the total load (**Error! Reference source not found.**6). Assessments of sub-watershed loads indicate HUC12 – 102702030407 contributes the greatest load of nitrogen to Beaver Creek.

Table 9: HUC 12 Sub-watershed Nitrogen Loads to Beaver Creek

HUC12	**Nitrogen Load (lbs/yr.)**	**% Contribution**
102702030401	121,831.8	9.92%
102702030402	151,680.4	12.34%
102702030403	158,988.0	12.94%
102702030404	154,320.2	12.56%
102702030405	110,016.9	8.95%
102702030406	143,516.7	11.68%
102702030407	206,803.3	16.83%
102702030408	181,577.8	14.78%
Total	1,228,735.2	**100%**

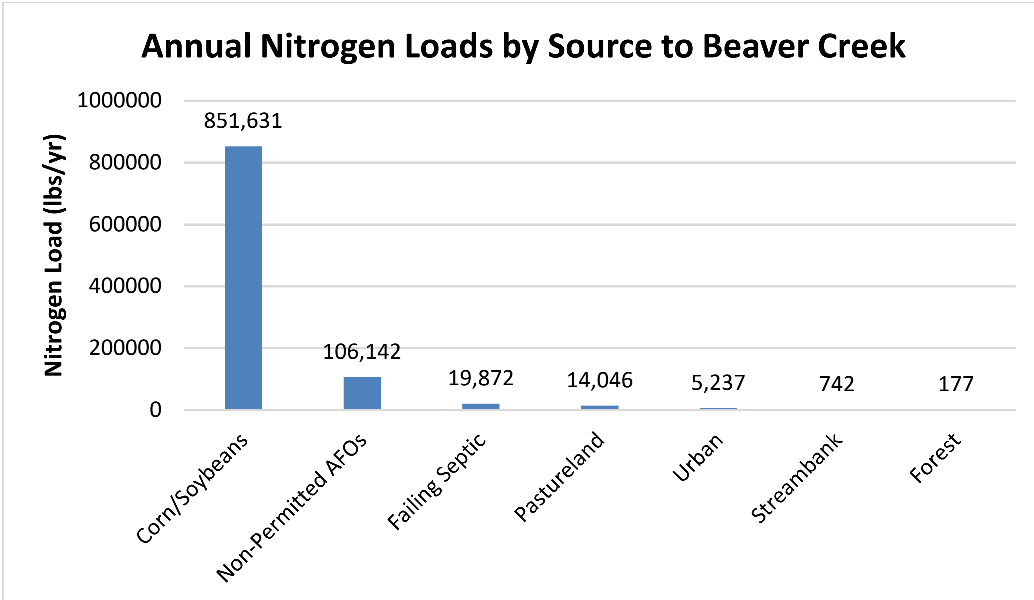

Figure 6: Nitrogen Sources and Annual Average Loads to Beaver Creek

The average annual sediment load to Beaver Creek is estimated to be 93,632 tons/yr. (Table 10). The largest contributor of sediment to Beaver Creek is from land used for corn and soybean production, which constitutes 97.3% of the total load (**Error! Reference source not found.**7). Assessments of sub-watershed loads indicate HUC12 – 102702030407 contributes the greatest load of sediment to Beaver Creek (Table 9).

Table 10: HUC 12 Sub-watershed Sediment Loads to Beaver Creek

HUC12	Sediment Load (tons/yr.)	% Contribution
102702030401	6,654.2	7.11%
102702030402	9,713.9	10.37%
102702030403	13,625.9	14.55%
102702030404	13,343.8	14.25%
102702030405	8,610.5	9.20%
102702030406	9,627.3	10.28%
102702030407	16,253.9	17.36%
102702030408	15,802.6	16.88%
Total	93,632.0	**100%**

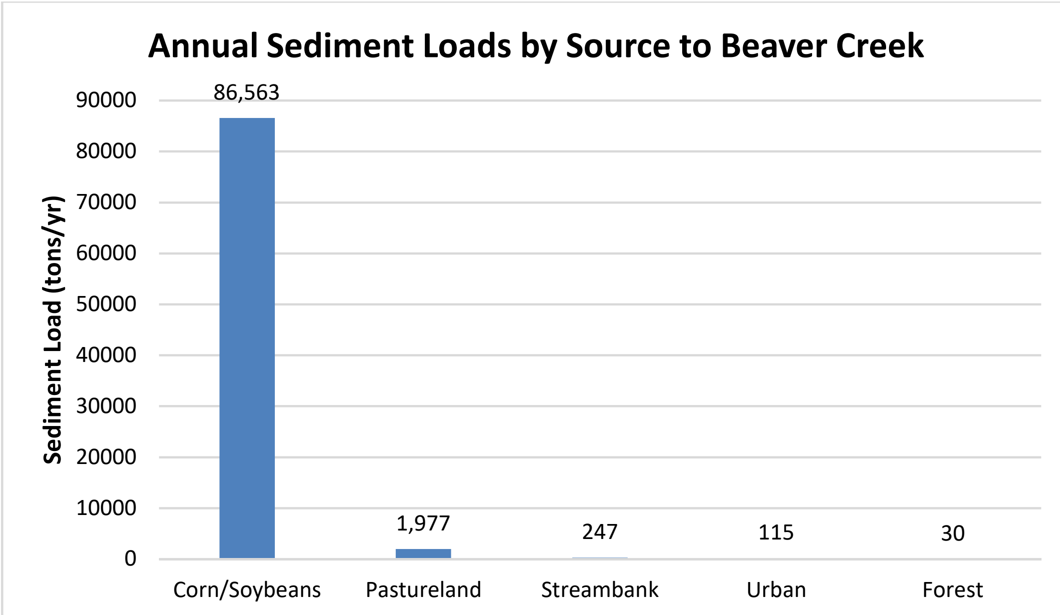

Figure 7: Sediment Sources and Annual Average Loads to Beaver Creek

Beaver Creek - Atrazine

Since sorghum was only grown on 333 acres (or, less than 1%) of the Beaver Creek drainage in 2017, land used for corn production is presumably where the majority of atrazine is applied. A total of 111,047 acres in the Beaver Creek drainage were used for corn production in 2017 (USDA, 2017). Atrazine loads and target reductions for Beaver Creek were determined as part of the 2013 TMDL (NDEQ, 2013). Atrazine loads were calculated by NDEQ from sample concentrations and estimates of stream discharge (Figure 8).

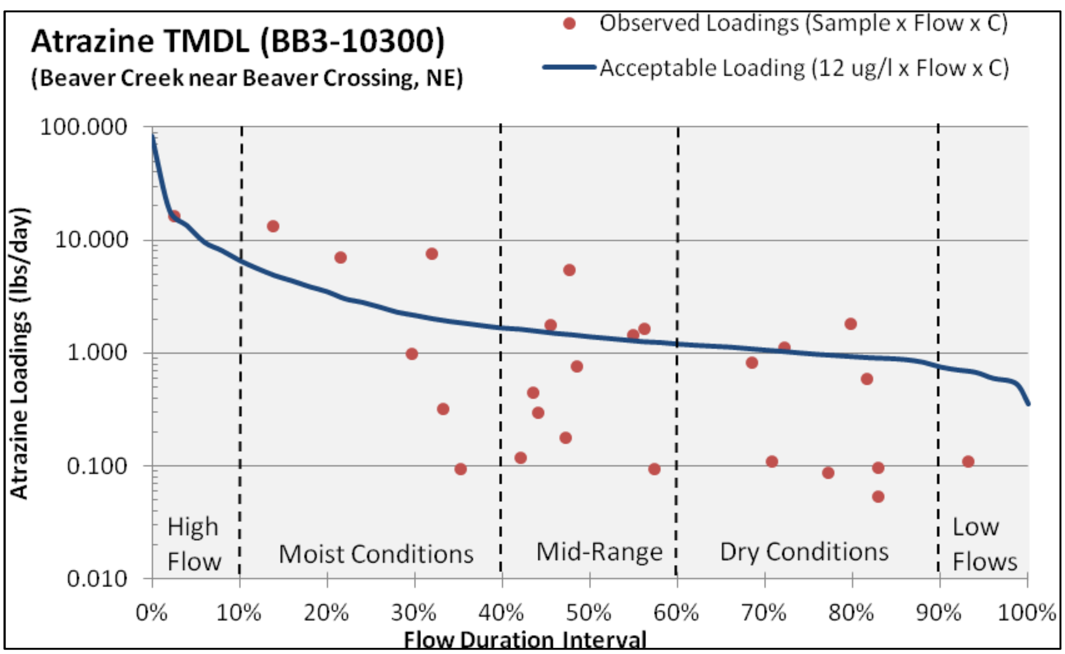

Figure 8: Atrazine Loads to Beaver Creek (Source: NDEQ. 2013)

The contribution of atrazine to the lower reach of Beaver Creek from individual HUC 12 sub-watersheds was estimated from the amount of corn in each HUC 12 drainage and highest measured atrazine concentration of 45.46 µg/L. Sub-watershed contributions of atrazine ranged from 8.1% to 16.1% (Table 11). Based on these contributions, applying BMPs to HUC 102702030402 would have the biggest impact in reducing atrazine concentrations in lower Beaver Creek.

Table 11: Contribution of Atrazine to Lower Beaver Creek from HUC 12 Sub-watersheds

HUC12	Atrazine Contribution (µg/L)	Atrazine Contribution (%)
102702030401	6.58	14.5%
102702030402	7.30	16.1%
102702030403	6.26	13.8%
102702030404	5.94	13.1%
102702030405	3.68	8.1%
102702030406	3.92	8.6%
102702030407	6.60	14.5%
102702030408	5.14	11.3%
Total	**45.46(a)**	**100.0%**

(a) Value represents the maximum measured atrazine concentration.

Recharge Lake – Sediment and Nutrients

Average annual pollutant loads to Recharge Lake were estimated for phosphorus, nitrogen, and sediment. Pollutant loads and the contribution from primary sources were estimated from; the Statistical Tool for Estimating Pollutant Load (STEPL) model (Tetra-Tech, 2018), Sediment Phosphorus Release Regression Equation (A. Dzialowski & L. Carter, 2012) and data calculations. A summary of data, data sources, and assessment methods can be found in the Appendix X.

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

The average annual phosphorus and nitrogen loads to Recharge Lake are approximately 32,235 lbs/yr. and 53,682 lbs/yr., respectively (Table 12 and Table 13). The average annual sediment to Recharge Lake is estimated to be 6,050 tons/yr. (Table 14). The largest contributor of all three constituents is from land used for corn and soybean production. Phosphorus loads from waterfowl waste and lake sediment re-suspension accounts for 39% of the total load.

Please note that due to rounding throughout the pollutant load calculation process the numbers presented under each source may not precisely sum to the total load presented.

Table 12: Phosphorus Sources and Average Annual Loads to Recharge Lake

Source	Acres	Annual Phosphorus Load (lbs/yr.)	% Contribution
External Loads			
Corn-Soybeans	7490	17,078	53%
Urban	507	15	<1%
Grass-Pasture	408	164	<1%
Other crops	82	192	<1%
Forest	78	2	<1%
Open lots-animal feeding/holding[1]	4	900	3%
Unregistered on-site wastewater system (#)	49	239	<1%
Registered on-site wastewater system (#)	6	30	<1%
Streambank (miles)	10.14	6	<1%
Atmospheric Deposition	44	7	<1%
Internal Loads			
Bottom Sediment P Release	44	900	3%
Waterfowl and Resuspension	44	12,700	39%
Total Load	**-**	**32,235**	**100%**

Note. [1]Pertains to non-permitted animal feeding operations.

Table 13: Nitrogen Sources and Average Annual Loads to Recharge Lake

Source	Acres	Annual Nitrogen Load (lbs/yr.)	% Contribution
External Loads			
Corn-Soybeans	7490	46,747	87%
Urban	507	103	<1%
Grass-Pasture	408	422	<1%
Other crops	82	525	1%
Forest	78	5	<1%
Open lots-animal feeding/holding[1]	4	4931	9%
Unregistered on-site wastewater system (#)	49	609	1%
Registered on-site wastewater system (#)	6	76	<1%
Streambank (miles)	10.14	14	<1%
Atmospheric Deposition	44	250	<1%
Total Load	**-**	**53,682**	**100%**

Note. [1]Pertains to non-permitted animal feeding operations.

Table 14: Sediment Sources and Average Annual Loads to Recharge Lake

Source	Acres	Annual Sediment Load (Tons/yr.)	% Contribution
External Loads			
Corn-Soybeans	7490	5,379	89%
Urban	507	2	<1%
Grass-Pasture	408	603	10%
Other crops	82	60	1%
Forest	78	1	<1%
Open lots-animal feeding/holding[1]	4	0	0%
Unregistered on-site wastewater system (#)	49	0	0%
Registered on-site wastewater system (#)	6	0	0%
Streambank (miles)	10.14	5	<1%
Total Load	**-**	**6,050**	**100%**

Note. [1]Pertains to non-permitted animal feeding operations.

5. Required Pollutant Load Reductions

Beaver Creek – Sediment and Nutrients

There are no water quality standards for phosphorus, total nitrogen, or sediment in streams or rivers, therefore, no reduction targets have been established. While no standards are in place for these pollutants, load reductions that could be achieved from BMP implementation were estimated.

Beaver Creek - Atrazine

As part of the TMDL, NDEQ determined atrazine reductions necessary for Beaver Creek to meet the chronic water quality standard of 12 µg/L (NDEQ, 2013). The average required reduction determined for each flow condition ranges from 0 for low flows to 74% for moist conditions (Table 15). The maximum allowable atrazine load ranges from less than 1 lb/day under the lowest flow condition to over 82 lbs/day for the highest flows (Table 16). 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 µg/L requires a 73.6% reduction to meet the chronic standard of 12.00 µg/L.

Table 15: Atrazine Loading Reduction Targets for Beaver Creek.

BB3-10300
Atrazine Target = 12 µg/L

Flow Condition	Flow Exceedance Range	Maximum Observed Atrazine Concentration (µg/L)	Loading Reduction Required (%)
High Flows	0%-10%	11.62	--
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	--

Source: NDEQ (2013)

Table 16: Percentile Flows and Maximum Daily Atrazine Loading for Beaver Creek.

Percent of Flow Exceed		100	90	80	70	60	50	40	30	20	10	0
Flow Percentile		0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
BB3-10300	Flow (cfs)	5	12	14	16	18	21	26	33	54	101	1275
WQS = 12 µg/l	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)

Recharge Lake – Sediment and Nutrients

The total phosphorus loading capacity for Recharge Lake was determined from 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, the literature value of 61% for Midwest reservoirs provided by Fernandes Cunha, do Carmo Calijuri, and Dodds (2014) was used to convert the net loading capacity to a gross loading capacity.

The current in-lake phosphorus concentration of 495 µg/L will need to be reduced by 90% to meet the water quality standard of 50 µg/L (Table 17). The phosphorus load capacity associated with an in-lake concentration of 50 µg/L is approximately 590 lbs/yr. In order to meet the water quality standard, the current annual phosphorus load of 32,235 lbs/yr. will need to be reduced by approximately 98%.

The load reduction target for total nitrogen was based on the required in-lake concentration reduction of 54.1% (Table 18). Applying this percent reduction to the current total nitrogen load of 53,682 lbs/yr. would result in an annual loading reduction target of 29,057 lbs/yr.

Recharge Lake is not currently impaired from sediment so no reduction target was established. However, sediment load reductions that could be achieved from BMP implementation were estimated.

Table 17: Phosphorus Reduction Targets for Recharge Lake

Phosphorus Levels and Targets	#
Current in-lake phosphorus (µg/L)	495
Target in-lake phosphorus (µg/L)	50
Target reduction (µg/L)	445
Target reduction (%)	89.9%
Current Drainage Area Loads and Reductions	
Current load (lbs/yr.)	32,235
Load capacity (lbs/yr.)	590
Target reduction (lbs/yr.)	31,645
Target Reduction (%)	98.2%

Table 18: Nitrogen Reduction Targets for Recharge Lake

Nitrogen Levels and Targets	#
Current in-lake nitrogen (µg/L)	2,180
Target in-lake nitrogen (µg/L)	1,000
Target reduction (µg/L)	1,180
Target reduction (%)	54.1%
Current Drainage Area Loads and Reductions	
Current load (lbs/yr.)	53,682
Target reduction (lbs/yr.)	29,057
Target Reduction (%)	54.1%

6. BMP Targeting

Beaver Creek & Recharge Lake- Sediment and Nutrients

Best management practices for the Beaver Creek drainage and smaller Recharge Lake drainage are targeted at reducing runoff loads of sediment, nutrients, and atrazine. The recommended BMPs include multiple practices that target pollutant sources through the ACT approach (avoid, control, trap), also known as a “treatment train”. The identification of management practices, suites of practices, and best suited locations were determined from the ACPF Toolbox software, which provides field level recommendations of conservation opportunities (possible sites for BMPs) to inform local watershed planning efforts. Additional opportunities were found through analysis of aerial photography to identify non-permitted AFOs and rural residences that may have unregistered OSWTs. It is assumed that these facilities are meeting all legal requirements; however, they are possible sources of pollutant loads. In all cases only willing landowners will be included in this voluntary implementation strategy.

The implementation strategy presented in this plan should be used as a guide for practice implementation and may be subject to revision as new information becomes available, and as willing landowners are identified. Although avoidance practices are not part of the ACPF, they are an important part of the pollutant reduction strategy for Beaver Creek and Recharge Lake. A multitude of avoidance practices can be used to achieve desired goals. For a detailed description of these and other practices provided below, refer to Chapter 7 of the WQMP.

To provide an accurate load reduction estimate from practice implementation, recommended practices were used to develop a “treatment train” (following ACT methodology) that follows the flow of pollutants from the source to the receiving waterbody (**Error! Reference source not found.**9). The drainage area treatment train comprises six levels of treatment, which begin with education/outreach and end with near stream improvements (i.e. riparian buffers). Due to the large number of acres recommended for cover crops, reduced/no-till, contour buffers, and terraces, some fields will require multiple BMPs. Recommended BMPs and level of treatment targeted are provided in Table 19 and Table 20. In order to meet the phosphorus standard in Recharge Lake, additional in-lake management measures were assessed and included in the implementation strategy. Those include water quality basin enhancement, wetland development, shoreline stabilization, and lake deepening.

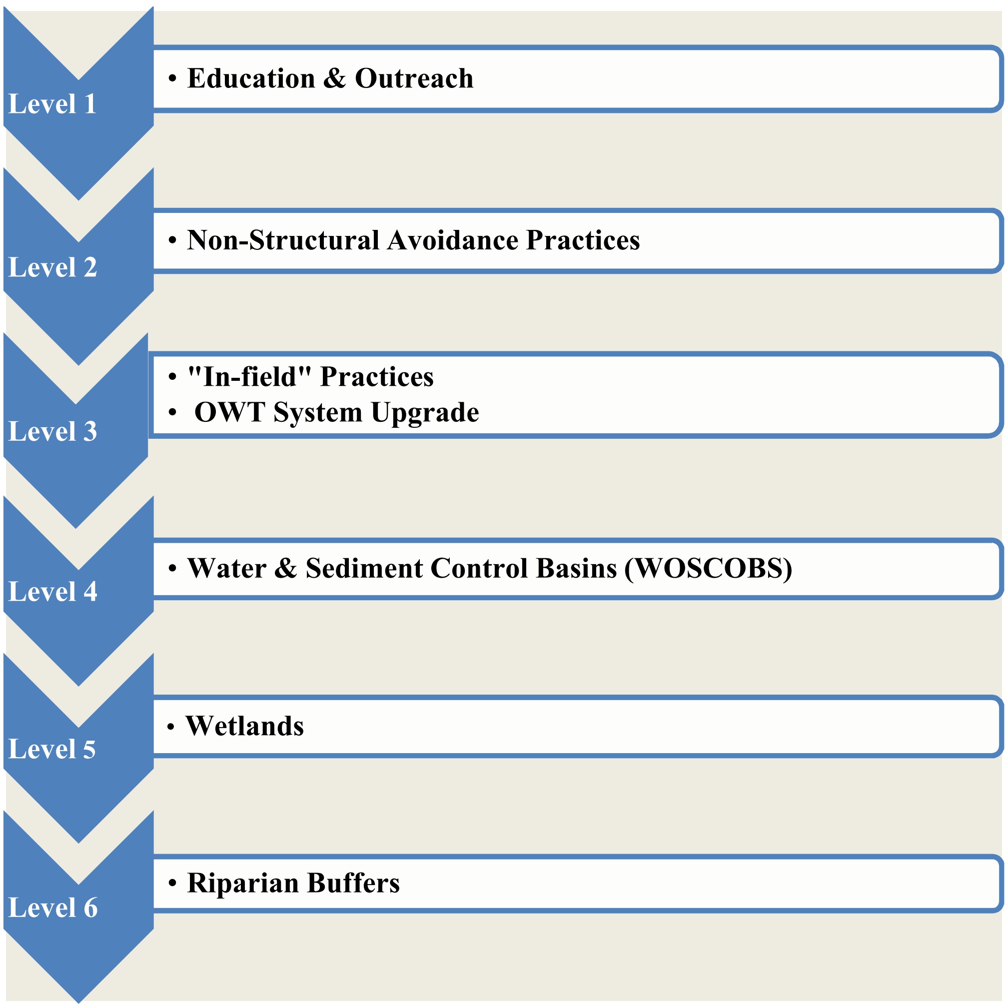

Figure 9: Implementation of Priority BMPs through a “Treatment Train” Approach

Table 19: BMPs and Targeted Treatment for HUC 12 Sub-watersheds in the Beaver Creek Drainage

Land Cover Type / Pollutant Source	BMP	HUC 12 Acres Targeted (HUC 102702030…)								Totals
		401	402	403	404	405	406	407	408	
All	Education & Outreach	All	All	All	All	All	All	All	All	All
Corn-Bean	Avoidance	5402.0	5975.0	5088.0	4966.0	1512.0	3829.0	6578.0	4797.0	38147
	Irrigation Water Management Practice Suite	8643.0	9560.0	8140.0	7945.0	2420.0	6126.0	10525.0	7675.0	61034
	Terraces-Reduced/No-Till-Cover Crops	193.0	212.0	186.0	174.0	14.0	85.0	363.0	220.0	1447
	Contour Buffers-Cover Crops-Reduced/No-Till	650.0	714.0	627.0	589.0	136.0	455.0	1035.0	668.0	4874
	Reduced/No-Till-Cover Crops	8880.0	9829.0	8345.0	8176.0	2574.0	6353.0	10443.0	7746.0	62346
	Cover Crops	1080.0	1195.0	1018.0	993.0	302.0	766.0	1316.0	959.0	7629
	WASCOBs	946.8	1044.2	912.7	892.5	164.0	728.7	1463.5	798.9	6951
	Grassed Waterway	7271.2	7866.6	6724.1	6329.9	1723.2	6575.0	10164.6	5339.7	51994
	Wetlands	4260.4	4681.6	4022.9	3898.1	764.6	3412.8	5062.3	3223.0	29326
	Farm Ponds	135.1	148.2	127.5	123.5	13.0	167.8	156.9	130.2	1002
	Riparian Buffers	5606.4	5490.7	5159.7	4976.9	1514.7	4061.7	7238.5	4492.1	38541
Open Lots	Non-Permitted AFO Practice Suite	14.6	9.3	17.6	16.6	6.2	12.5	8.3	13.5	99
Pasture	Grazing Management	581.0	716.0	598.0	321.0	289.0	980.0	835.0	944.0	5264
	WASCOBs	50.9	62.5	53.6	28.8	17.0	93.3	92.9	78.6	478
	Wetlands	229.0	280.4	236.4	125.9	103.2	436.8	321.2	317.2	2050
	Farm Ponds	7.3	8.9	7.5	3.9	1.1	21.5	9.9	12.8	73
	Riparian Buffers	301.4	328.9	303.1	160.8	137.9	519.8	459.3	442.1	2653
Other Crops	WASCOBs	22.9	13.9	18.8	2.6	5.5	19.5	19.7	13.2	116

	Grassed Waterway	175.7	105.3	138.4	18.5	44.4	175.6	137.1	88.5	884
	Wetlands	102.9	62.7	82.8	11.4	36.5	91.1	68.3	53.4	509
	Farm Ponds	3.3	1.9	2.6	0.4	0.2	4.5	2.1	2.2	17
	Riparian Buffers	135.4	73.5	106.2	14.5	41.9	108.5	97.7	74.5	653
Forest	Wetlands	5.5	22.9	95.3	127.2	50.7	104.7	99.8	117.9	624
	Farm Ponds	0.2	0.7	3.0	4.0	0.3	5.1	3.1	4.8	21
Urban	Urban Stormwater Practice Suite	694.4	723.2	705.2	654.3	201.6	1756.4	744.3	667.4	6147
Streambank	Restoration / Stabilization (miles)	0.0	0.0	6.9	4.9	1.4	3.3	2.5	3.5	23
Septic Systems	Unregistered System Upgrade (#)	144	130	139	118	43	532	106	144	1356

Table 20: BMPs and Targeted Treatment for the Recharge Lake Drainage

Land Cover Type / Pollutant Source	BMP	Acres Targeted
All	Education & Outreach	All
Corn-Bean	Avoidance	1,873
	Irrigation Water Management Practice Suite	2,996
	Terraces-Reduced/No-Till-Cover Crops	32
	Contour Buffers-Cover Crops-Reduced/No-Till	116
	Reduced/No-Till-Cover Crops	3,222
	Cover Crops	375
	WASCOBs	270.4
	Grassed Waterway	1,325.50
	Wetlands	2,582.00
	Farm Ponds	4.3
	Riparian Buffers	1,496.50
Open Lots	Non-Permitted AFO Practice Suite	3.1
Pasture	Grazing Management	204
	WASCOBs	14.7
	Wetlands	140.6
	Farm Ponds	0.2
	Riparian Buffers	81.5
Other Crops	WASCOBs	2.9
	Grassed Waterway	14.5
	Wetlands	28.3
	Farm Ponds	0.1
	Riparian Buffers	16.4
Forest	Wetlands	26.9
	Farm Ponds	0.1
Urban	Urban Stormwater Practice Suite	228.2
Streambank	Restoration / Stabilization (miles)	1.5
Septic Systems	Unregistered System Upgrade (#)	43

Beaver Creek - Atrazine

While the focus of this plan is on atrazine, a holistic approach to pest management is necessary to fully protect water resources. The term “Integrated Pest Management” and its acronym “IPM” are widely used and can refer to anything from an individual pest management technique to a very complex year-round pest management system (USDA, 2011). Technical assistance for managing pests on cropland is not an identified role for conservation planners, but they must still work closely with Extension, producers and their crop consultants to appropriately integrate all planned pest management activities into the conservation planning process. Comprehensive IPM systems utilize a site-specific combination of pest Prevention, Avoidance, Monitoring, and Suppression strategies, or IPM ‘PAMS’ strategies. For more information please see:

- http://www.ipmcenters.org/ipmelements/ index.cfm

- http://www.ipm.ucdavis.edu/PMG/cropsagriculture.html
- http://www.ipmcenters.org/ipmsymposiu mv/posters/142.pdf

The NRCS Pest Management Policy defines a specific role for conservation planners to assist producers in pest management:

(1) Evaluate environmental risks associated with a client's probable pest suppression strategies.
(2) Provide technical assistance to clients to mitigate identified environmental risks.
(3) Assist clients to adopt IPM techniques that protect natural resources.
(4) Assist clients to:
(i) Inventory, assess, and suppress noxious and invasive weeds on non-cropland.
(ii) Suppress weeds to ensure successful implementation and/or maintenance of permanent vegetative conservation practices (e.g., buffer type practices).

Several BMPs targeted for reducing sediment and nutrient loss from corn ground will also reduce atrazine loads carried to receiving streams in runoff. Those practices, along with NRCS Integrated Pest Management (IPM) conservation practice code 595 and other NRCS conservation practices provided the foundation for a treatment train approach to addressing atrazine in Beaver Creek (Figure 10).

Education and avoidance practices such as reducing application rates, application timing, increasing residue, and using alternative products will result in the largest atrazine load reduction to Beaver Creek (Table 21). These practices were also the most favorable in the Recharge Lake project. Over 60% of the producers in the Recharge Lake drainage that were involved in a post project survey in 1996 indicated that they that they're using more post emergence products, more premixes that contain less atrazine, and new products that target weed problems (Zoubek, 1996).

In-field practices to control runoff encompass managerial practices such as the location and method of application (e.g., spot treatment, banding) and structural/vegetative treatments (e.g., terraces, filter strips). These practices were also favorable in the Recharge Lake project. Over 60% of the producers involved in the post project survey in 1996 indicated that they collected more soil samples, utilized ridge till planting, incorporated more herbicides, avoided using chemicals around wells and rivers, reduced atrazine rates, and applied more post emergence herbicides (Zoubek, 1996).

Near field trapping and filtration of runoff can be achieved through wetlands, runoff detention cells, and filter strips. These practices should be used in conjunction with avoidance and in-field practices that control runoff.

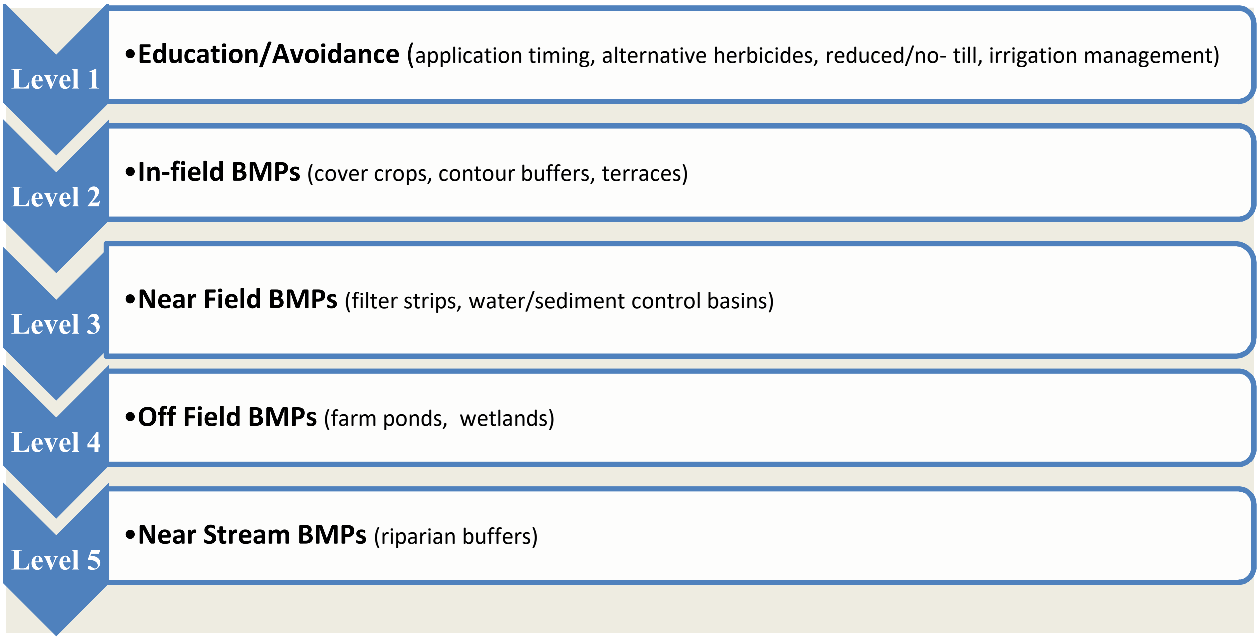

Figure 10: Atrazine Treatment Train for Beaver Creek

Table 21: BMPs and Targeted Treatment to Reduce Atrazine Loads from Corn in the Beaver Creek Drainage

BMP	HUC 12 Corn Acres Targeted (HUC 102702030…)								Totals
	401	402	403	404	405	406	407	408	
Education & Avoidance	4,019	4,459	3,828	3,631	2,249	2,397	4,034	3,143	27,760
Irrigation Water Management	6,431	7,135	6,124	5,810	3,599	3,835	6,454	5,029	44,417
No-till / Reduced-Till	7,235	8,027	6,890	6,536	4,049	4,315	7,261	5,658	49,971
Cover Crops	8,038	8,919	7,656	7,262	4,499	4,794	8,068	6,286	55,522
Contour Buffers	484	533	472	431	167	285	635	437	3,444
Terraces	143	158	140	127	30	53	222	144	1,017
Streambank Stabilization / Restoration (miles)	0.0	0.0	6.9	4.9	1.4	3.3	2.5	3.5	22.5
Grassed Waterways	5,410	5,871	5,059	4,629	2,026	4,116	6,233	3,499	36,843
WASCOBs	704	779	687	653	289	456	897	524	4,989
Wetlands/Farm Ponds	3,271	3,605	3,123	2,941	2	2,242	3,201	2,197	20,582
Riparian Buffers	4,172	4,098	3,882	3,639	2,001	2,543	4,439	2,944	27,718

7. Pollutant Load Reductions

Beaver Creek – Sediment and Nutrients

Average annual load reductions that could be achieved from BMP implementation in the Beaver Creek drainage were estimated for phosphorus, nitrogen, and sediment. Implementing the proposed BMP strategy could result in a 59.99% reduction in average annual phosphorus loads and 47.43% decrease in nitrogen loads to Beaver Creek (Table 22 and Table 23). Sediment loading to Beaver Creek could be reduced by approximately 56.57% (Table 24). No loading reduction targets were established for nutrients or sediment loads to Beaver Creek.

Beaver Creek - Atrazine

Atrazine load reductions associated with using the treatment train approach will reduce seasonal (May-June) in-stream concentrations by approximately 68.7%, which does not meet the reduction target of 73.6% (Table 25). However, if a 68.7% reduction were applied to measured concentrations, all but two of the 26 samples would meet the chronic water quality standard of 12 μg/L (Figure .11). Assessment procedures utilized by NDEQ do allow for a certain number of water quality standard violations based on sample size (NDEQ, 2018). Based on a sample size of 26, five exceedances would be allowed to maintain a full support status. The proposed BMP strategy would reduce measured exceedances of the chronic standard from 9 to 2, resulting in a full support status (Table 26).

Table 22: Phosphorus Load Reductions to Beaver Creek that can be Achieved from BMP Implementation

Land Cover Type / Pollutant Source	BMP	HUC 12 Phosphorus Load Reductions (lbs/yr) (HUC 102702030…)								Totals
		401	402	403	404	405	406	407	408	
All	Education & Outreach	2,966	3,948	4,638	4,541	3,127	3,905	5,869	5,407	34,401
Corn-Bean	Avoidance	3,292	4,395	5,074	5,045	3,146	3,617	6,452	5,804	36,825
	Irrigation Water Management Practice Suite	933	1,231	1,421	1,413	881	1,013	1,807	1,625	10,324
	Terraces-Reduced/No-Till-Cover Crops	167	155	185	176	29	80	355	266	1,413
	Contour Buffers-Cover Crops-Reduced/No-Till	395	524	624	597	234	428	1,013	806	4,621
	Reduced/No-Till-Cover Crops	3,883	5,187	5,972	5,959	3,865	4,306	7,350	6,725	43,247
	Cover Crops	81	108	124	124	77	89	158	142	903
	WASCOBs	239	319	378	377	168	286	595	401	2,763
	Grassed Waterway	1,460	1,912	2,215	2,125	944	2,052	3,273	2,133	16,114
	Wetlands	1,540	2,048	2,386	2,355	1,865	1,917	2,934	2,318	17,363
	Farm Ponds	40	54	63	62	8	75	74	80	456
	Riparian Buffers	1,672	1,987	2,528	2,495	1,396	1,799	3,418	2,753	18,048
Open Lots	Non-Permitted AFO Practice Suite	504	946	845	839	1,048	2,054	1,826	1,841	9,903
Pasture	Grazing Management	26	42	52	29	300	78	70	103	700
	WASCOBs	2	4	5	3	20	8	8	9	59
	Wetlands	15	24	31	17	221	52	40	51	451
	Farm Ponds	0	1	1	0	1	2	1	2	8
	Riparian Buffers	18	26	36	19	177	55	52	66	449
Other Crops	WASCOBs	9	6	12	2	5	11	12	10	67
	Grassed Waterway	53	38	68	9	27	82	66	53	396
	Wetlands	55	41	73	10	54	76	59	57	425

Land Cover Type / Pollutant Source	BMP	HUC 12 Phosphorus Load Reductions (lbs/yr) (HUC 102702030…)								Totals
		401	402	403	404	405	406	407	408	
	Farm Ponds	1	1	2	0	0	3	1	2	10
	Riparian Buffers	60	40	77	11	40	71	69	68	436
Forest	Wetlands	0	0	1	1	1	1	1	2	7
	Farm Ponds	0	0	0	0	0	0	0	0	0
Urban	Urban Stormwater Practice Suite	16	9	11	8	6	84	9	12	155
Streambank	Restoration / Stabilization (miles)	0	0	10	8	2	6	4	7	37
Septic Systems	Unregistered System Upgrade (#)	699	631	678	575	418	2,591	516	703	6,811

Table 23: Nitrogen Load Reductions to Beaver Creek that can be Achieved from BMP Implementation

Land Cover Type / Pollutant Source	BMP	HUC 12 Nitrogen Load Reductions (lbs/yr) (HUC 102702030…)								Totals
		401	402	403	404	405	406	407	408	
All	Education & Outreach	12183	15168	15899	15432	11002	14352	20680	18158	122874
Corn-Bean	Avoidance	4231	5350	5775	5701	3632	4168	7358	6367	42582
	Irrigation Water Management Practice Suite	11254	14231	15361	15164	9662	11086	19572	16937	113267
	Terraces-Reduced/No-Till-Cover Crops	290	378	420	399	79	184	809	583	3142
	Contour Buffers-Cover Crops-Reduced/No-Till	1040	1306	1386	1316	552	964	2365	1810	10739
	Reduced/No-Till-Cover Crops	10242	12960	13948	14266	9453	10511	17755	15628	104763
	Cover Crops	804	1017	1097	1083	690	792	1398	1210	8091
	WASCOBs	621	784	869	855	390	662	1361	883	6425
	Grassed Waterway	1886	2336	2532	2397	1085	2361	3729	2336	18662
	Wetlands	3094	3893	4242	4134	3335	3431	5200	3948	31277
	Farm Ponds	89	112	123	120	16	151	146	148	905
	Riparian Buffers	5423	6088	7250	7045	3989	5333	9865	7439	52432
Open Lots	Non-Permitted AFO Practice Suite	2053	3873	3458	3527	4406	8641	7683	7966	41607
Pasture	Grazing Management	139	208	238	130	1163	363	324	454	3019
	WASCOBs	6	8	10	5	34	16	16	17	112
	Wetlands	28	41	48	26	292	82	63	77	657
	Farm Ponds	1	1	1	1	1	4	2	3	14
	Riparian Buffers	50	67	84	46	357	133	124	150	1011
Other Crops	WASCOBs	22	16	27	4	11	26	28	22	156
	Grassed Waterway	68	47	77	10	31	94	75	58	460

Land Cover Type / Pollutant Source	BMP	HUC 12 Nitrogen Load Reductions (lbs/yr) (HUC 102702030…)								Totals
		401	402	403	404	405	406	407	408	
	Wetlands	111	78	130	18	96	137	105	98	773
	Farm Ponds	3	2	4	1	0	6	3	4	23
	Riparian Buffers	195	122	222	30	115	213	199	185	1281
Forest	Wetlands	0	0	1	2	1	1	1	2	8
	Farm Ponds	0	0	0	0	0	0	0	0	0
Urban	Urban Stormwater Practice Suite	96	58	66	52	36	506	56	73	943
Streambank	Restoration / Stabilization (miles)	0	0	22	17	5	14	10	15	83
Septic Systems	Unregistered System Upgrade (#)	1785	1610	1730	1469	1066	6616	1317	1795	17388

Table 24: Sediment Load Reductions to Beaver Creek that can be Achieved from BMP Implementation

Land Cover Type / Pollutant Source	BMP	HUC 12 Sediment Load Reductions (tons/yr) (HUC 102702030…)								Totals
		401	402	403	404	405	406	407	408	
All	Education & Outreach	665	971	1363	1334	861	963	1760	1580	9498
Corn-Bean	Avoidance	0	0	0	0	0	0	0	0	0
	Irrigation Water Management Practice Suite	0	0	0	0	0	0	0	0	0
	Terraces-Reduced/No-Till-Cover Crops	52	53	69	66	11	29	132	104	516
	Contour Buffers-Cover Crops-Reduced/No-Till	123	178	233	225	86	157	377	315	1692
	Reduced/No-Till-Cover Crops	1270	1854	2348	2365	1491	165	2882	2768	15143
	Cover Crops	33	48	61	61	37	43	77	73	433
	WASCOBs	89	130	170	171	74	127	267	189	1217
	Grassed Waterway	421	603	768	744	322	700	1132	775	5464
	Wetlands	681	991	1269	1264	974	1003	1555	1291	9028
	Farm Ponds	17	25	31	31	4	36	37	42	224
	Riparian Buffers	565	735	1027	1024	549	710	1385	1184	7179
Open Lots	Non-Permitted AFO Practice Suite	0	0	0	0	0	0	0	0	0
Pasture	Grazing Management	5	9	11	6	65	16	15	22	148
	WASCOBs	1	2	2	1	10	4	4	4	29
	Wetlands	9	14	18	10	135	30	24	30	270
	Farm Ponds	0	0	0	0	1	1	1	1	5
	Riparian Buffers	8	11	16	9	82	24	24	30	204
Other Crops	WASCOBs	3	2	4	1	2	4	5	4	25
	Grassed Waterway	13	10	20	3	8	24	20	17	115
	Wetlands	21	17	34	5	24	34	27	28	189
	Farm Ponds	1	0	1	0	0	1	1	1	5
	Riparian Buffers	18	13	27	4	14	24	24	25	148
Forest	Wetlands	0	0	1	1	0	1	1	1	4
	Farm Ponds	0	0	0	0	0	0	0	0	0
Urban	Urban Stormwater Practice Suite	4	3	3	2	2	21	2	3	40
Streambank	Restoration / Stabilization (miles)	0	0	7	6	2	5	3	5	28
Septic Systems	Unregistered System Upgrade (#)	0	0	0	0	0	0	0	0	0

Table 25: Expected Atrazine Reductions in Beaver Creek Resulting from BMP Implementation

Beginning Atrazine Conditions	Practice Efficiency (%)	Acres Applied	Concentration Reduction (µg/L)
Beginning Atrazine Concentration			45.46
Reduction from BMPs			
Education & Avoidance	40	27760	4.54
Irrigation Water Management	50	44417	9.10
No/Reduced Till	50	49971	10.23
Cover Crops	25	55522	2.69
Contour Buffers	30	3444	0.22
Terraces	15	1017	0.03
Streambank Stabilization/Restoration (miles)	25	22.7	0.49
Grassed Waterways/Filter Strips	30	36843	1.86
Water & Sediment Control Basins	15	4989	0.13
Wetlands/Farm Ponds	25	22815	0.83
Riparian Buffers	30	27718	2.67
Expected Conditions			
Total reduction (µg/L)			31.24
Expected concentration (µg/L)			14.21
Chronic standard (µg/L)			12.00
Total reduction (%)			68.7
Target reduction (%)			73.6

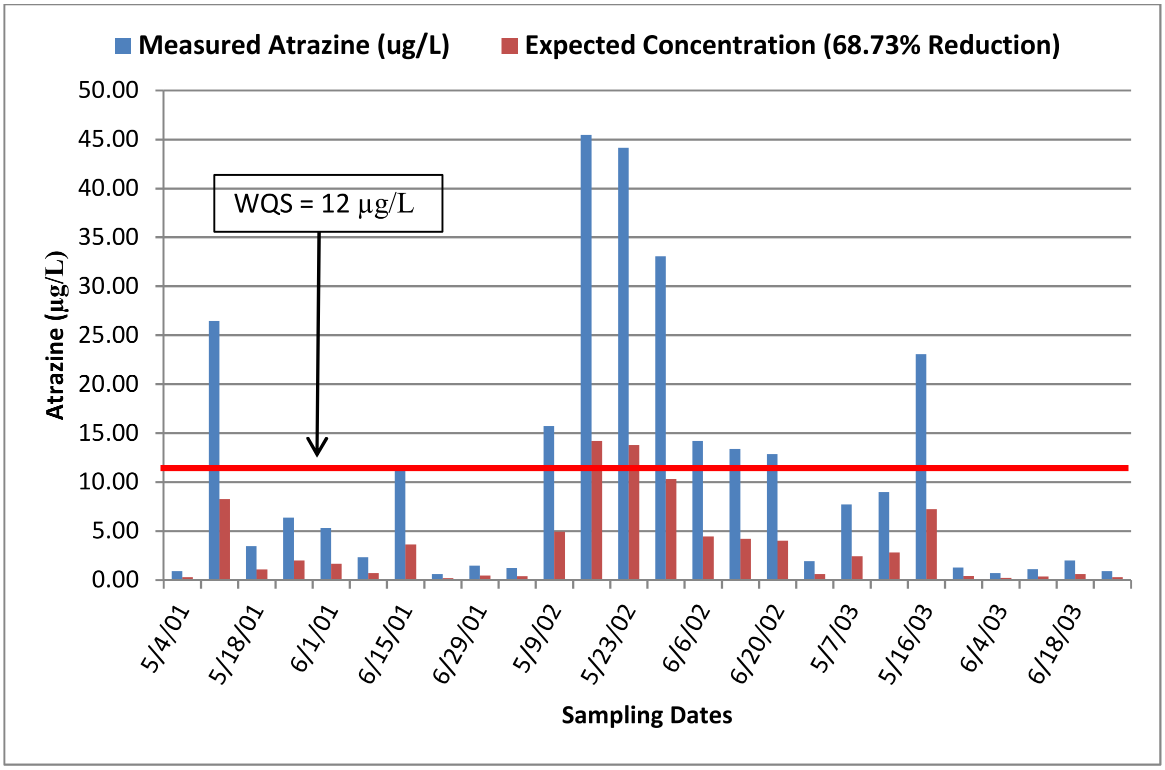

Figure 11. Measured Atrazine and Expected Reductions from BMPs in the Beaver Creek Watershed

Table 26: Current and expected beneficial use support for atrazine if a 68.7% reduction is achieved.

	Measured Condition (2001-2003)	**Expected Conditions (with a 68.7% reduction)**
Number of Samples	26	26
# Violations	9	2
# Violations Allowed by NDEQ	5	5
Impairment Designation	Impaired	Not Impaired

Recharge Lake – Sediment and Nutrients

Although nutrient reduction benefits from implementing BMPs in the lake and drainage area have been estimated and provide a path to meeting water quality standards, cumulative benefits of implementing a comprehensive plan are difficult to accurately project. Thus, a sound monitoring and data collection network will be critical to adaptively manage Recharge Lake.

Drainage Area BMPs

Applying the proposed BMPs in the Recharge Lake drainage will result in significant pollutant load reductions (Table 27). Although drainage area BMPs will reduce the external phosphorus load by an estimated 61%, large contribution from internal sources limit the total load reduction to 36%. This reduction falls below the reduction target of 98%.

The total nitrogen load reduction of 57% that would result from drainage area BMPs, will achieve the reduction target of 54% (Table 27). While no sediment load reduction target was established for sediment, the annual load reduction that would result from drainage area BMPs is estimated to be 55%.

Table 27: Nutrient and Sediment Load Reductions to Recharge Lake that can be achieved from Drainage Area BMPs

Land Cover Type / Pollutant Source	BMP	Phosphorus Load Reduction (lbs/yr)	Nitrogen Load Reduction (lbs/yr)	Sediment Load Reduction (tons/yr)
All	Education & Outreach	1874	6233	553.6
Corn-Bean	Avoidance	2135	2337	0.0
	Irrigation Water Management Practice Suite	598	6217	0.0
	Terraces-Reduced/No-Till-Cover Crops	36	77	14.1
	Contour Buffers-Cover Crops-Reduced/No-Till	132	297	52.7
	Reduced/No-Till-Cover Crops	2636	6114	1087.6
	Cover Crops	52	444	26.9
	WASCOBs	129	282	60.6
	Grassed Waterway	503	548	183.0
	Wetlands	1762	2990	984.0
	Farm Ponds	2	4	1.2
	Riparian Buffers	818	2247	332.2
Open Lots	Non-Permitted AFO Practice Suite	460	1933	0.0
Pasture	Grazing Management	21	91	4.5
	WASCOBs	2	3	0.8
	Wetlands	22	32	13.1
	Farm Ponds	0	0	0.0
	Riparian Buffers	11	24	4.7
Other Crops	WASCOBs	2	5	0.9
	Grassed Waterway	8	9	2.6
	Wetlands	19	50	14.2
	Farm Ponds	0	0	0.0
	Riparian Buffers	14	38	4.8
Forest	Wetlands	0	1	0.2
	Farm Ponds	0	0	0.0
Urban	Urban Stormwater Practice Suite	3	19	0.8
Streambank	Restoration / Stabilization	1	2	0.5
Septic Systems	Unregistered System Upgrade	209	533	0.0
Total Reduction	NA	11449	30530	3343.0

Land Cover Type / Pollutant Source	BMP	Phosphorus Load Reduction (lbs/yr)	Nitrogen Load Reduction (lbs/yr)	Sediment Load Reduction (tons/yr)
Beginning Load	NA	32235	53682	6050
Expected Load	NA	20786	23152	2707.0
Total Reduction (%)	NA	36%	57%	55%
Reduction Target (%)	NA	98.20%	54%	NA

In-lake BMPs

The proposed implementation strategy for the Recharge Lake drainage area will achieve the nitrogen load reduction target of 54%. In contrast, it does not achieve the phosphorus loading reduction target of 98% because of the large contribution (i.e., 42%) 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, it is recommended that all in-lake management measures be further evaluated to facilitate development of conceptual designs and accurate cost estimates.

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 12). 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. 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 (Table 28). Reductions were based on expected loads after BMP implementation in the drainage area. Phosphorus load reductions associated with wet detention is estimated to be 14,342 lbs/yr. while a 12,734 lbs/yr. decrease in nitrogen loads would be realized. The sediment load reduction is estimated to be 2,328 tons/yr.

Table 28: *Estimated Pollutant Load Reductions to Recharge Lake Resulting from Wet Ponds*

Near Lake Wet Pond Effects	Phosphorus (lbs/yr.)	Nitrogen (lbs/yr.)	Sediment (ton/yr.)
Wet detention pond removal efficiency (%)	69	55	86
Post drainage BMP implementation load	20,786	23,152	2,707
Pollutant load reduction	14,342	12,734	2,328

(a) Source: TetraTech (2018)

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 12).

Pollutant load reductions associated with in-lake wetlands were estimated for sediment, phosphorus, and nitrogen (Table 29). Reductions were based on expected loads after BMP implementation in the drainage area and wet pond development. Phosphorus load reductions associated with wetland development is estimated to be 2,835 lbs/yr. while a 2,084 lbs/yr. decrease in nitrogen loads would be realized. The sediment load reduction is estimated to be 296 tons/yr.

Table 29: *Estimated Pollutant Load Reductions to Recharge Lake Resulting from In-lake Wetlands*

Near Lake Wet Pond Effects	Phosphorus (lbs/yr.)	Nitrogen (lbs/yr.)	Sediment (ton/yr.)
Wetland removal efficiency (%)[a]	44	20	78
Post BMP implementation load	6,444	10,418	379
Pollutant load reduction	2,835	2,084	296

(a) Source: TetraTech (2018)

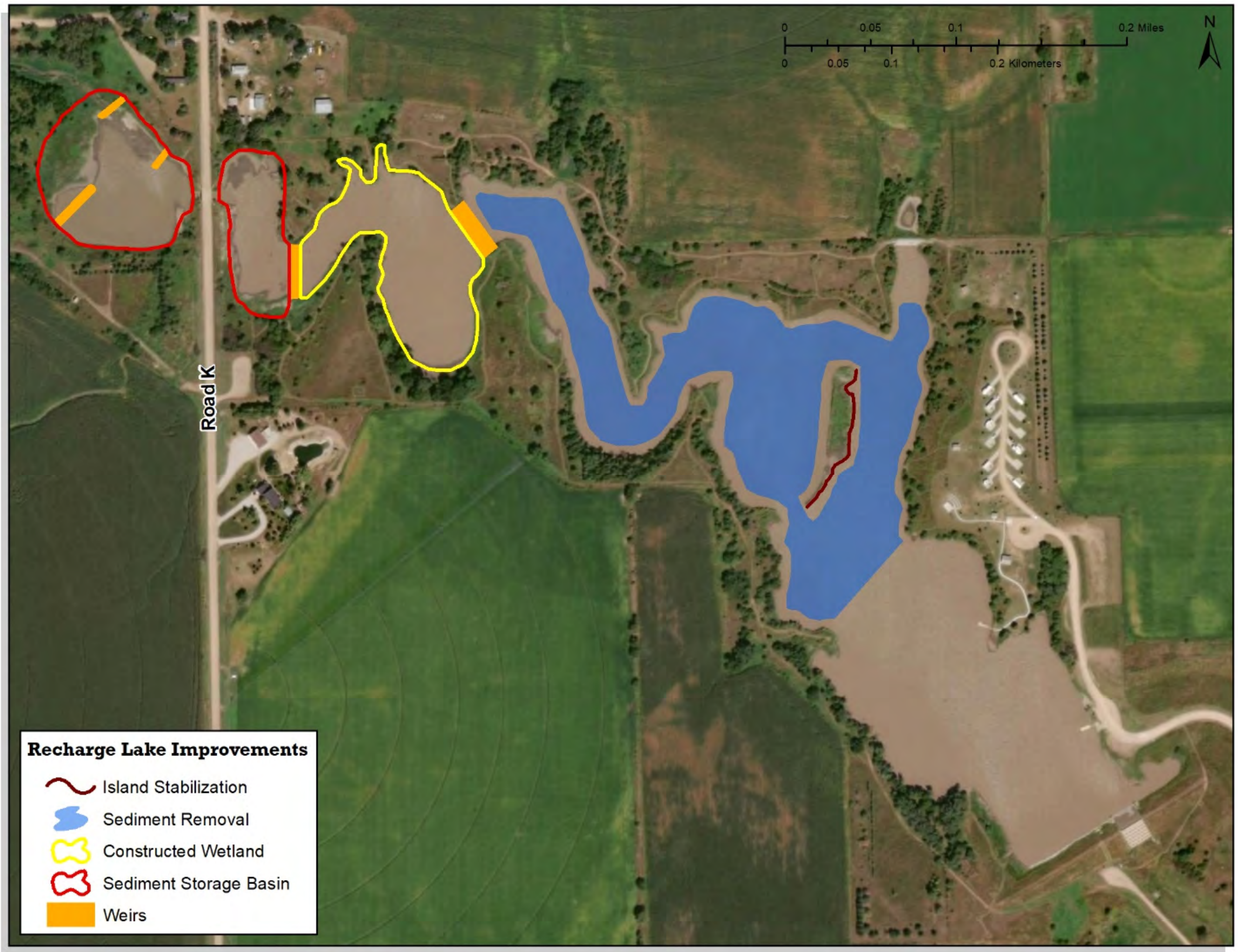

Figure 12. Conceptual In-Lake BMPs

Reservoir Deepening

Sediment removal from the Recharge Lake will reduce bottom sediment re-suspension and increase the reservoirs ability to attenuate nutrients. Nitrogen reduction benefits were not determined for lake deepening due to the lack of data and literature.

A target of increasing the conservation pool storage volume measured in 2016 by 20% or 62 acre-feet. If the 20% storage volume increase was achieved, current in-lake phosphorus concentration would decrease by an estimated 40.7 µg/L. This equates to an annual load reduction of 3,248 lbs/yr. or a 10% reduction to the current total phosphorus load.

Areas of Recharge Lake that are less than 10 feet deep should be considered to be a higher priority for deepening. While current water depths have not been documented, a majority of the sediment removal would occur in the upper portion of the reservoir (Figure 12). 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 the most cost-effective and has been the most commonly used on lakes in the area.

Island Stabilization

While lake shoreline erosion is occurring in isolated spots, a larger concern may be the loss of the island. 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 lake volume. Approximately 506 feet of the south facing island shoreline would need to be stabilized. Due to the large number of potential approaches available to stabilize this island and large associated cost, specific recommendations are not included in this plan. If a lake renovation plan were developed, the island should be specifically addressed in a feasibility study.

Achieving Water Quality Standards

Implementing a comprehensive strategy for Recharge Lake that includes both external and internal management practices will result in the lake meeting water quality standards for in-lake 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 standard, algae biomass will also meet the standard.

Drainage area BMPs account for 36% of the expected 99% phosphorus load reduction indicating the large role in-lake measures will play in achieving the water quality goals. If the phosphorus load reductions are achieved, the in-lake phosphorus concentration is expected to be 44 μg/L, which falls below the water quality standard of 50 μg/L (Table 30).

Drainage area BMPs will result in a 57% reduction in total nitrogen loads while in-lake measures will result in a 28% reduction. If the load reduction target is achieved, the in-lake nitrogen concentration is expected to be 345 μg/L, which is well below the water quality standard of 1,000 μg/L (Table 31).

While no reduction target 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 a 43% reduction (Table 32).

Table 30: Estimated Phosphorus Reductions and Water Quality Targets for Recharge Lake

Phosphorus Load Load (lbs/yr.)	
Beginning total phosphorus load	32,235
Drainage area BMP reductions	11,449
Extended wet detention reduction	14,342
In-lake wetlands reduction	2,835
Lake deepening reduction	3,248
Total reduction	31,868
Expected load	367
Phosphorus loading capacity	590
Phosphorus Concentration (µg/L)	
Current Concentration	495
Expected Concentration	44
In-Lake Water Quality Standard	50

Table 31: Estimated Nitrogen Reductions and Water Quality Targets for Recharge Lake

Nitrogen Load (lbs/yr.)	
Beginning total nitrogen load	53,682
Drainage area BMP reductions	30,530
Extended wet detention reduction	12,734
In-lake wetlands reduction	2,084
Lake deepening reduction	Not Estimated
Total reduction	45,347
Expected load	8,335
Nitrogen loading target	24,625
Nitrogen Concentration (µg/L)	
Current Concentration	2,180
Expected Concentration	345
In-Lake Water Quality Standard	1000

Table 32: Estimated Sediment Load Reductions for Recharge Lake

Sediment Load (tons/yr.)	
Beginning total sediment load	6,050
Drainage area BMP reductions	3,343
Extended wet detention reduction	2,328
In-lake wetlands reduction	296
Lake deepening reduction	Not Estimated
Total reduction	5,967
Expected load	83
Sediment loading target	NA

8. Monitoring

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

To adequately design monitoring networks that facilitate water resource management, it is critical to use data for its intended purposes. Thus, it is critical to establish specific monitoring goals and objectives. A broad set of monitoring goals and objectives have been developed for Beaver Creek. 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.

Beaver Creek

Monitoring Goal 1: Evaluate atrazine in Beaver Creek.

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

a. Monitoring parameter: Atrazine.
b. Monitoring site: Beaver Creek (Historic Site: JSBBRA 18).
c. Monitoring frequency: (Annual) Runoff events during May and June.

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

a. Monitoring parameters: Stream discharge.
b. Monitoring site: Beaver Creek runoff monitoring site (JSBBRA 18).
c. Monitoring frequency: (Annual) Runoff events from May-September.

Recharge Lake

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.

a. Monitoring parameters: Total phosphorus, kjeldahl nitrogen, nitrate-nitrite nitrogen, total suspended solids, chlorophyll *a*, atrazine.
b. Lake monitoring sites: Deepwater Site (LBB3RECHRG01).
c. Monitoring frequency: (Annual) Monthly from May-September.

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

a. Monitoring parameter: Atrazine.
b. Monitoring site: TBD.
c. Monitoring frequency: (Annual) Runoff events from May-June.

Monitoring Objective 3. Estimate the current lake conservation pool storage volume.

a. Conduct bathymetric survey.
b. Conduct spatial assessment of soft sediment using Ground Penetrating Radar (GPR) or manual sediment depth measurements.

<u>Monitoring Goal 2: Estimate pollutant loads and source contribution to Recharge Lake.</u>

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

a. Monitoring parameters: Total phosphorus, kjeldahl nitrogen, nitrate-nitrite nitrogen, total suspended solids, atrazine, stream discharge.
b. Monitoring site: TBD.
c. Monitoring frequency: (Annual) Runoff events from May-September.

Monitoring Objective5. Verify sediment and nutrient loads stemming from streambank erosion.

a. Streambank migration: Specialized study.

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

a. Lake shoreline migration: Specialized study.
b. Bottom sediment phosphorus release: Specialized study.
c. Bottom sediment resuspension: Specialized study.
d. Waterfowl waste nutrient loads: Specialized study.

Monitoring Objective 7. Estimate the current lake conservation pool storage volume.

a. Conduct bathymetric survey.

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

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

<u>Monitoring Goal 3. Gather data needed to complete pre-implementation planning.</u>

Monitoring Objective 9. Evaluate spatial sediment deposition in Recharge Lake.

a. Conduct spatial assessment of soft sediment using Ground Penetrating Radar (GPR) or manual sediment depth measurements.

9. Evaluation

The ultimate purpose of establishing sound evaluation criteria is to improve approaches to manage nonpoint source pollution by learning from both successes and failures. In doing so, evaluation criteria have been established to assess all aspects of implementing this plan. Criteria include implementation strategies, educational programs, monitoring networks, and overall project management. The review process should answer the following key questions:

- What techniques and approaches worked?
- What techniques and approaches 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?

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

Qualitative Metrics: Project Implementation and Administration

1. Project completed on time.
2. Project completed on budget.
3. Success in meeting project goals.
4. Success of meeting project milestones.
5. Positive and negative feedback received from stakeholders.
6. Positive and negative feedback received from LPSNRD board, NGPC and USACE staff, and other project partners.
7. Required information delivered to agencies and funding partners.
8. Problematic areas of the project and needed changes for future efforts.
9. Adequate technical and financial support for the project.

Quantitative Metrics: Environmental Outcomes

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

Many nonpoint source projects do not result in immediate and measurable changes in water quality. The evaluation of metrics 10 through 15 may require long-term monitoring commitments.

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APPENDICIES

Table I – IPM Techniques for Reducing Pesticide Environmental Risk

	Mitigation Index Value4 (by Pesticide Loss Pathway)				
IPM Techniques	**Leaching**	**Solution Runoff**	**Adsorbed Runoff**	**Drift**	**Function and Performance Criteria**
Application Timing - Ambient Temperature				10-15%	Reduces exposure - spraying during cooler temperatures (e.g. early morning, evening or at night) can help reduce drift losses. Avoid spraying in temperatures above 90º F.
Application Timing - Rain	25%	25%	25%		Reduces exposure - delaying application when significant rainfall events are forecast that could produce substantial leaching or runoff can reduce pesticide transport to ground and surface water.
Application Timing - Relative Humidity				10-15%	Reduces exposure - spraying when there is higher relative humidity reduces evaporation of water from spray droplets thus reducing drift losses.
Application Timing - Wind				25%	Reduces exposure - delaying application when wind speed is not optimal can reduce pesticide drift. Optimal spray conditions for reducing drift occur when the air is slightly unstable with a very mild steady wind between 2 and 9mph.
Formulations and Adjuvants[2,3]	10-15%	10-15%	10-15%	10-15%	Reduces exposure – specific pesticide formulations and/or adjuvants can increase efficacy and allow lower application rates, drift retardant adjuvants can reduce pesticide spray drift.
Monitoring + Economic Pest Thresholds.	50%	50%	50%	50%	Reduces exposure - reduces the amount of pesticide applied with preventative treatments because applications are based on monitoring that determines when a pest population exceeds a previously determined economic threshold.
Partial Treatment	50%	50%	50%	25%	Reduces exposure - spot treatment, banding and directed spraying reduces amount of pesticide applied. Assumes less than 50% of the area is treated.
Precision Application Using "Smart Sprayers"	25%	25%	25%	25%	Reduces exposure - using "Smart Sprayer" technology (i.e. green sensors, sonar-based sensors, GPS-based variable rate application, computer controlled spray nozzles, etc.) can substantially reduce the amount of pesticide applied.
Set-backs	10-15%	10-15%	10-15%	25%	Reduces exposure – reduces overall amount of pesticide applied, reduces offsite pesticide drift. Assumes that the set-backs with no application are at least 30 feet wide.
Soil Incorporation[2,3]			50%	50%	Reduces exposure – reduces solution and adsorbed runoff losses, but potentially increases leaching losses, especially for low KOC pesticides. Applicable to shallow mechanical or irrigation incorporation. Not applicable if pesticide leaching to groundwater is an identified natural resource concern. Not applicable if soil erosion is not adequately managed.
Spray Nozzle Selection, Maintenance and Operation.				25%	Reduces exposure – selecting appropriate nozzle and pressure for the application, with an emphasis on higher volume spray nozzles run at lower pressures, will produce larger droplets and a narrower droplet size distribution, which reduces spray drift. Proper nozzle

					spacing, boom height, and boom suspension, along with frequent calibration and replacement of worn nozzles and leaking tubing, can increase efficacy and reduce drift potential.
Substitution – Cultural, Mechanical or Biological Controls	50%	50%	50%	50%	Reduces risk – partial substitution of alternative cultural, mechanical and/or prescribed burning, or biological pest suppression techniques reduces the application of a pesticide that poses a hazard to an identified natural resource concern. Not applicable if hazards from alternative suppression techniques are not adequately managed.
Substitution – Lower Risk Pesticides[2,3]	50%	50%	50%	50%	Reduces risk – partial substitution of an alternative lower risk pesticide reduces the application of a pesticide that poses a hazard to an identified natural resource concern. Not applicable if the alternative pesticide is not explicitly recommended by Extension or an appropriately certified crop consultant because NRCS cannot make pesticide recommendations.
Substitution - Semiochemicals	50%	50%	50%	50%	Reduces risk – using semiochemicals (e.g., mating disruption pheromones) to decrease reproductive success or control population density/location reduces the application of a pesticide that poses a hazard to an identified natural resource concern.

1 Additional information on pest management mitigation techniques can be obtained from Extension pest management publications including IPM Guidelines and Crop Profiles, pest management consultants, and pesticide labels.

2 The pesticide label is the law - all pesticide label specifications must be carefully followed, including required mitigation. Additional mitigation may be needed to meet NRCS pest management requirements for identified resource concerns.

3 NRCS does not make pesticide recommendations. All pesticide application techniques must be recommended by Extension or an appropriately certified crop consultant and selected by the producer.

4 Numbers in these columns represent index values that indicate relative effectiveness of IPM mitigation techniques to reduce hazardous pesticide losses through the identified pathways.

Table 2. Conservation Practices for Reducing Pesticide Environmental Risk

	Mitigation Index Value4 (by Pesticide Loss Pathway)				
IPM Techniques	**Leaching**	**Solution Runoff**	**Adsorbed Runoff**	**Drift**	**Function and Performance Criteria**
Alley Cropping (311)	10-15%	10-15%	25%	25%	Increases infiltration and uptake of subsurface water, reduces soil erosion, can provide habitat for beneficial insects which can reduce the need for pesticides, also can reduce pesticide drift to surface water.
Anionic Polyacrylamide (PAM) Erosion Control (450)		10-15%	50%		Increases infiltration and deep percolation, reduces soil erosion.
Bedding (310)	10-15%	10-15%	10-15%		Increases surface infiltration and aerobic pesticide degradation in the rootzone.
Conservation Cover (327)	25%	25%	25%		Increases infiltration, reduces soil erosion, and builds soil organic matter In perennial cropping systems such as orchards, vineyards, berries and nursery stock.
Conservation Crop Rotation (328)	25%	25%	25%		Reduces the need for pesticides by breaking pest lifecycles. The rotation shall consist of at least 2 crops in the rotation and no crop grown more than once before growing a different crop.
Constructed Wetland (656)	10-15%	10-15%	25%		Captures pesticide residues and facilitates their degradation.
Contour Buffer Strips (332)		25%	25%		Increases infiltration, reduces soil erosion.
Contour Farming (330)		10-15%	10-15%		Increases infiltration and deep percolation, reduces soil erosion.
Contour Orchard and Other Fruit Area (331)		10-15%	10-15%		Increases infiltration and deep percolation, reduces soil erosion.
Cover Crop (340) that is incorporated into the soil.	10-15%	10-15%	10-15%		Increases infiltration, reduces soil erosion, builds soil organic matter. Assumes at least 4000 lbs/ac of live biomass at the time of tillage.
Cover Crop (340) for weed suppression that is mulch tilled or no- tilled into for the next crop.	25%	25%	25%	25%	Increases infiltration, reduces soil erosion, builds soil organic matter. Requires at least 4000 lbs/ac of live biomass at the time of tillage and at least 30% ground cover at the time of the pesticide application.
Cross Wind Ridges (588)			10-15%3		Reduces wind erosion and adsorbed pesticide deposition in surface water. Assumes the pesticide is applied while the field is in the ridged state.
Cross Wind Trap Strips (589C)			25%3		Reduces wind erosion and adsorbed pesticide deposition in surface water, traps adsorbed pesticides.
Deep Tillage (324)		10-15%	10-15%		Increases infiltration and deep percolation. Not applicable if pesticide leaching to groundwater is an identified natural resource concern.
Dike (356)		25%	25%		Reduces exposure potential - excludes outside water or captures pesticide residues and facilitates their degradation. Not applicable if pesticide leaching to groundwater is an identified natural resource concern.

Drainage Water Management (554)		25%	25%		Drainage during the growing season increases infiltration and aerobic pesticide degradation in the rootzone and reduces storm water runoff. Managed drainage mode when the field is not being cropped reduces discharge of pesticide residues from the previous growing season. Seasonal saturation may reduce the need for pesticides. Not applicable if pesticide leaching to groundwater is an identified natural resource concern.
Field Border (386)	10-15%	25%	10-15%		Increases infiltration and traps adsorbed pesticides, often reduces application area resulting in less pesticide applied, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, also can reduce inadvertent pesticide application and drift to surface water. Assumes 20 foot minimum width.
Filter Strip (393)		25%	50%	25%	Increases infiltration and traps adsorbed pesticides, often reduces application area resulting in less pesticide applied, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, also can reduce inadvertent pesticide application and drift to surface water. Assumes 30 foot minimum width.
Forage Harvest Management (511)	25%	25%	25%	25%	Reduces exposure potential - timely harvesting reduces the need for pesticides.
Grade Stabilization Structure (410)		25%	25%		Decrease head cutting and sediment transport in natural and artificial channels and capture sediment from runoff and provide residence time for sediment to settle out of runoff water.
Hedgerow Planting (442)			25%[3]	25%	Reduces adsorbed pesticide deposition in surface water, also can reduce inadvertent pesticide application and drift to surface water
Herbaceous Wind Barriers (603)			10-15%3	10-15%	Reduces wind erosion, traps adsorbed pesticides, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, and can reduce pesticide drift to surface water.
Irrigation System, Microirrigation (441)	25%	50%	50%		Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water.
Irrigation System, Sprinkler (442)	25%	25%	25%		Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water.
Irrigation System, Surface and Subsurface (443)	10-15%	10-15%	10-15%		Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water.
Irrigation System, Tail Water Recovery (447)		50%	50%		Captures pesticide residues and facilitates their degradation.
Irrigation Water Management (449)	50%	50%	50%		Reduces exposure potential - water is applied at rates that minimize pesticide transport to ground and surface water, promotes healthy plants which can better tolerate pests.
Mulching (484) with natural materials	25%	25%	25%		Increases infiltration, reduces soil erosion, reduces the need for pesticides.
Mulching (484) with plastic	25%	10-15%	10-15%		Reduces the need for pesticides. Not applicable if erosion and pesticide runoff from non-mulched areas is not adequately managed.

Residue and Tillage Management, No-till/Strip-Till/Direct Seed (329)	10-15%	25%	50%		Increases infiltration, reduces soil erosion, builds soil organic matter. Assumes at least 60% ground cover at the time of application.
Residue and Tillage Management, Mulch-Till (345)	10-15%	10-15%	25%		Increases infiltration, reduces soil erosion, builds soil organic matter. Assumes at least 30% ground cover at the time of application.
Residue and Tillage Management, Ridge Till (346)	10-15%	10-15%	25%		Increases infiltration, reduces soil erosion, builds soil organic matter.
Riparian Forest Buffer (391)	0	10-15%	25%	10-15%	Increases infiltration and uptake of subsurface water, traps sediment, builds soil organic matter, and reduces pesticide drift. This assumes 30 foot minimum width.
Riparian Herbaceous Cover (390)	10-15%	25%	25%	10-15%	Increases infiltration, traps sediment, builds soil organic matter, and reduces pesticide drift. This assumes 30 foot minimum width.
Sediment Basin (350)			25%		Captures pesticide residues and facilitates their degradation. Not applicable if less than 50% of the treatment area drains into the sediment basin.
Stripcropping (585)		50%	50%	10-15%	Increases infiltration, reduces soil erosion and generally will only be treating half the area of concern.
Subsurface Drainage (606)	10-15%	25%	25%		Increases infiltration and aerobic pesticide degradation in the root zone.
Surface Roughening (609)			10-15%3		Reduces wind erosion and adsorbed pesticide deposition in surface water.
Terrace (600) with outlet to a vegetated waterway		25%	50%		Increases infiltration and deep percolation, reduces soil erosion. Not applicable if pesticide leaching to groundwater is an identified natural resource concern.
Terrace (600) with outlet to a defined channel or surface water		10-15%	10-15%		Increases infiltration and deep percolation, reduces soil erosion. Not applicable if pesticide leaching to groundwater is an identified natural resource concern.
Vegetative Barriers (601)			25%		Reduces soil erosion, traps sediment, increases infiltration.
Water and Sediment Control Basin (638)		25%	50%		Captures pesticide residues and facilitates their degradation, increases infiltration and deep percolation. Not applicable if pesticide leaching to groundwater is an identified natural resource concern.
Windbreak/Shelterbelt Establishment (380)			25%[3]	25%	Reduces wind erosion, reduces adsorbed pesticide deposition in surface water, traps adsorbed pesticides, and reduces pesticide drift.

[1] Additional information on pest management mitigation techniques can be obtained from Extension pest management publications including IPM Guidelines and Crop Profiles, pest management consultants, and pesticide labels.

[2] The pesticide label is the law - all pesticide label specifications must be carefully followed, including required mitigation. Additional mitigation may be needed to meet NRCS pest management requirements for identified resource concerns.

[3] Mitigation applies to adsorbed pesticide losses being carried to surface water by wind.

[4] Numbers in these columns represent index values that indicate relative effectiveness of pesticide mitigation techniques to reduce hazardous pesticide losses through the identified pathways.

Technical Memo – STEPL Model Guidance

Prepared By: Dillon Vogt
JEO Project # 161356.00

Purpose:

The purpose of this memo is to provide a brief outline of the methods and procedures used to estimate existing pollutant loads contributing to the impairments of two priority waterbodies identified in the Upper Big Blue Natural Resources District (UBBNRD); Beaver Creek and Recharge lake.

The Spreadsheet Tool for Estimating Pollutant Loads (STEPL) is a Microsoft Excel based program developed by the United States Environmental Protection Agency (EPA) to allow users to calculate watershed pollutant loads for sediment, nitrogen, and phosphorus based on a variety of inputs including land cover areas and components of the Universal Soil Loss Equation (USLE). Inputs are widely available from various sources including government agencies and private industry.

Beaver Creek Model Setup:

The Beaver Creek target area is made up of eight HUC 12 subbasins. The lower six of these eight subbasins contain portions of Beaver Creek, therefore 12 streambanks were modeled (one for each side of Beaver Creek in the lower six HUC12s). The lengths of these streambanks were based on a shapefile provided by the Upper Big Blue NRD portraying portions of Beaver Creek which receive baseflow and can be considered perennial. No major gully formations were observed in the Beaver Creek target area; therefore, gullies were not modeled within STEPL. The eight subbasins were each treated as a watershed in a single STEPL model, and are designated as follows:

- HUC 102702030401 = W1
- HUC 102702030402 = W2
- HUC 102702030403 = W3
- HUC 102702030404 = W4
- HUC 102702030405 = W5
- HUC 102702030406 = W6
- HUC 102702030407 = W7
- HUC 102702030408 = W8

The eight subwatersheds are located throughout Hall, Hamilton, York, and Seward County. York County was used for annual precipitation statistics, as Recharge Lake and the impaired segments of Beaver Creek are primarily located in York County. Land use breakdowns were calculated in GIS using the 2017 United States Department of Agriculture (USDA) Cropland Data Layer (CDL). Nonpermitted livestock operations were identified by JEO via aerial analysis, and an average area of each nonpermitted livestock operation was calculated based on areas observed during the aerial analysis.

Livestock numbers were calculated based on county-level statistics from the 2012 USDA Census of Agriculture (Ag Census), and the 2011 USDA CDL. As the 2012 Ag Census reports statistics collected in 2011, land cover information from the 2011 CDL was utilized to find an average number of livestock based on the ratio of grass and pasture to other land covers in York County. This number was then compared to the areas of grass and pasture in the target area, and an approximate number of livestock in the target area was calculated. This process is summarized in the equation below.

$$\frac{[Priority\ Area\ Grass\&Pasture\ acres\ (2011)]}{[York\ County\ Grass\&Pasture\ acres\ (2011)]} * York\ County\ Ag\ Census\ Livestock\ Counts\ (2012)$$

The number of unregistered septic systems in the target area was calculated based on information downloaded from TetraTech, and the number of months in which manure is applied to fields (2 months) was based on prior modeling experience. A septic system failure rate of 40% was applied based on guidance from published EPA documentation.

USLE parameters were calculated in GIS for each land use category in each HUC12 utilizing information from the USDA Web Soil Survey and the 2017 CDL. The dominant soil hydrologic group was determined to be group C for all eight subbasins based on the USDA Web Soil Survey.

Soil nitrogen and phosphorus concentrations were based on STEPL supporting documentation. Average values were taken from the soil maps displayed in version 3.2 of the Region 7 Desktop Manual for Running STEPL Model. Soil nitrogen was determined have a range between 0.1 – 0.19, so a value of 0.15 was used in the model. Soil phosphorus was determined to have a range between 0.1 - 0.19, so a value of 0.15 was selected. The phosphorus value of 0.15 was multiplied 0.44, as per manual guidance, and a final value of 0.066 was used in the model.

Percentages of urban land use distribution were based on prior modeling experience. The 2017 CDL reports three different categories of urban development – high, medium and low intensity. 25% of high density was applied to industry, and the remaining 75% was applied to commercial.

All medium-density development was applied to multi-family. All low-density development was applied to single-family. In this region no land was applied as institutional, transportation, urban-cultivated, or vacant.

A shapefile of certified irrigated acres was supplied by the UBBNRD. For current condition modeling purposes, it was assumed that all cropland in the target area was irrigated. From personal correspondence with the UBBNRD, irrigation frequency was set at 8 applications per year and a water depth of 1 inch both before and after BMPs. BMPs applied in crop fields in this region do not typically impact the amount of irrigation water that is applied, but rather how much of that water leaves the field as runoff.

To determine the Land & Rain abstraction factor, all irrigated acres were set to zero in the Inputs tab. Then, in the Land & Rain tab, the abstraction factor was adjusted until the total runoff for each watershed equaled the runoff yield calculated by JEO in the 2018 Upper Big Blue NRD Runoff Yield Estimation. An abstraction factor of 0.1932 placed the total runoff calculated by STEPL within 6 acre-feet of the runoff volume calculated in the JEO Runoff Yield Estimation. Once the abstraction factor was set it was not adjusted after irrigated acres were re-applied to the Inputs tab.

Each watershed containing a perennial segment of Beaver Creek (the downstream 6 HUC12s, W3 – W8) was assigned two streambanks. Length was calculated in GIS using the previously mentioned NRD shapefile. Lateral recession rate was based on predominant soil type and vegetative cover in each HUC12. All were assigned a rate of Slight (0.03 ft/yr). Dominant soil textural class for all HUC12s based on the USDA Web Soil Survey was Silt Loam, and the area was determined to be well vegetated via aerial analysis. Bank height was determined through GIS analysis of aerial and LIDAR (Light Detection and Ranging) elevation data. Five cross sections were taken throughout each HUC12 to determine an average streambank height.

Recharge Lake Model Setup:

The Recharge Lake target area is made up of approximately half of a HUC 12 subbasin. One watershed was used in the modeling process. No perennial streams as identified by the UBBNRD are located above Recharge Lake, therefore streambank lengths were calculated in GIS by aerial analysis of the “main branch” of the stream which feeds into Recharge Lake. No major gully formations were observed in the Recharge Lake target area; therefore, gullies were not modeled within STEPL.

All inputs for Recharge Lake were acquired from the same sources as Beaver Creek. Other than physical differences (acres of land uses, livestock numbers, etc), many of the inputs were the same (soil nitrogen and phosphorus concentrations, etc.).

An abstraction factor of 0.2 (the maximum value allowed by the program) places the total runoff calculated by STEPL within 70 acre-feet of the runoff volume calculated in the JEO Runoff Yield Estimation.

Streambank length was calculated in GIS utilizing the United State Geological Survey (USGS) National Hydrologic Dataset shapefile. Lateral recession rate was assigned a rate of Slight (0.03 ft/yr). The dominant soil textural class was Silt Loam (USDA Web Soil Survey), and the area was determined to be well vegetated via aerial analysis. Bank height was determined through GIS analysis of aerial and LIDAR elevation data. Five cross sections were taken throughout the target area to determine an average streambank height.

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered 8 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4.

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2;
(c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table 6;
(c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheets.

Export input/output data: Export Data

☐ **Treat all the subwatersheds as parts of a single watershed**

☑ **Groundwater load calculation**

State	County	Weather Station
Nebraska	York	_NE-York_Mean

Calculate Manure Application Months: Manure Application

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

									Rain correction factors		
									0.884	0.489	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	1543	22128	1161	28	0	20.	0-24%	24880.8	27	77	0.642
W2	1607	24219	1432	117	0	13.	0-24%	27388.3	27	77	0.642
W3	1567	20768	1196	482	0	25.	0-24%	24038.2	27	77	0.642
W4	1454	19921	642	648	0	23.	0-24%	22688.7	27	77	0.642
W5	955	13802	986	314	0	13.	0-24%	16070.3	27	77	0.642
W6	3903	15724	1960	470	0	17.	0-24%	22074.8	27	77	0.642
W7	1654	26668	1669	519	0	11.9	0-24%	30521.9	27	77	0.642
W8	1483	19504	1888	702	0	19.3	0-24%	23596.3	27	77	0.642

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1	207	0	213	20	18	49	0	0	2	2
W2	357	0	531	23	30	23	0	0	2	2
W3	318	0	474	20	27	84	0	0	2	2
W4	157	0	1089	18	8	41	1	0	2	2
W5	196	0	1361	22	10	51	1	0	2	2
W6	385	0	2663	43	21	101	2	0	2	2
W7	342	0	2368	38	19	89	2	0	2	2
W8	378	39	2115	30	30	155	1	0	2	2
Total	2340	39	10814	214	163	593	7	0		

3. Input septic system and illegal direct wastewater discharge dat

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	164	2.43	40	0	0
W2	148	2.43	40	0	0
W3	159	2.43	40	0	0
W4	135	2.43	40	0	0
W5	98	2.43	40	0	0
W6	608	2.43	40	0	0
W7	121	2.43	40	0	0
W8	165	2.43	40	0	0

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

Watershed	Cropland					Pastureland					Forest					User Defined				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1	150.000	0.353	0.220	0.200	0.998	150.000	0.354	0.220	0.040	1.000	150.000	0.369	0.220	0.003	1.000	150.000	0.336	0.220	0.162	1.000
W2	150.000	0.377	0.282	0.200	0.998	150.000	0.377	0.282	0.040	1.000	150.000	0.377	0.282	0.003	1.000	150.000	0.379	0.282	0.162	1.000
W3	150.000	0.380	0.400	0.200	0.998	150.000	0.391	0.400	0.040	1.000	150.000	0.370	0.400	0.003	1.000	150.000	0.377	0.400	0.162	1.000
W4	150.000	0.380	0.412	0.200	0.998	150.000	0.383	0.412	0.040	1.000	150.000	0.374	0.412	0.003	1.000	150.000	0.377	0.412	0.162	1.000
W5	150.000	0.375	0.334	0.200	0.998	150.000	0.324	0.379	0.334	1.000	150.000	0.375	0.334	0.003	1.000	150.000	0.381	0.334	0.162	1.000
W6	150.000	0.377	0.365	0.200	0.998	150.000	0.382	0.365	0.040	1.000	150.000	0.374	0.365	0.003	1.000	150.000	0.378	0.365	0.162	1.000
W7	150.000	0.377	0.425	0.200	0.998	150.000	0.381	0.425	0.040	1.000	150.000	0.375	0.425	0.003	1.000	150.000	0.384	0.425	0.162	1.000
W8	150.000	0.373	0.517	0.200	0.998	150.000	0.381	0.517	0.040	1.000	150.000	0.372	0.517	0.003	1.000	150.000	0.377	0.517	0.162	1.000

Optional Data Input

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

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%	Soil E. coli conc. (#/100mg)
W1	○	○	●	○	C	0.150	0.066	0.300	0.000
W2	○	○	●	○	C	0.150	0.066	0.300	0.000
W3	○	○	●	○	C	0.150	0.066	0.300	0.000
W4	○	○	●	○	C	0.150	0.066	0.300	0.000
W5	○	○	●	○	C	0.150	0.066	0.300	0.000
W6	○	○	●	○	C	0.150	0.066	0.300	0.000
W7	○	○	●	○	C	0.150	0.066	0.300	0.000
W8	○	○	●	○	C	0.150	0.066	0.300	0.000

6. Reference runoff curve number (may be modified

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

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

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

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

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

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

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

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated %	Vacant (developed)	Open Space %	Total % Area
W1	1543	1.5	0.5	0	0	7.1	24.7	0	0	66.2	100
W2	1607	0.8	0.3	0	0	2.3	18.9	0	0	77.7	100
W3	1567	0.9	0.3	0	0	3.4	22.5	0	0	72.9	100
W4	1454	0.6	0.2	0	0	2.5	21.2	0	0	75.5	100
W5	955	0.9	0.3	0	0	2.5	20.2	0	0	76.1	100
W6	3903	5	1.6	0	0	15.6	38.7	0	0	39.1	100
W7	1654	0.6	0.2	0	0	2.5	16.4	0	0	80.3	100
W8	1483	1.2	0.4	0	0	4.5	24.6	0	0	69.3	100

9. Input irrigation area (ac) and irrigation amount (in)

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	22128	22128	1	1	8
W2	24219	24219	1	1	8
W3	20768	20768	1	1	8
W4	19921	19921	1	1	8
W5	13802	13802	1	1	8
W6	15724	15724	1	1	8
W7	26668	26668	1	1	8
W8	19504	19504	1	1	8

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

Land use	N	P	BOD	E. coli
1. L-Pasturela	**4**	**0.3**	**13**	0
1a. w/ manure	4	0.3	13	0
2. M-Pasturel	**4**	**0.3**	**13**	0
2a. w/ manure	4	0.3	13	0
3. H-Pasturel	**4**	**0.3**	**13**	0
3a. w/ manure	4	0.3	13	0

Input Ends Here.

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

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

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

Watershed	Cropland						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0
W5	0	0	0	0	0	0 No BMP	0
W6	0	0	0	0	0	0 No BMP	0
W7	0	0	0	0	0	0 No BMP	0
W8	0	0	0	0	0	0 No BMP	0

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

Watershed	Pastureland						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0
W5	0	0	0	0	0	0 No BMP	0
W6	0	0	0	0	0	0 No BMP	0
W7	0	0	0	0	0	0 No BMP	0
W8	0	0	0	0	0	0 No BMP	0

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

Watershed	Forest						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0
W5	0	0	0	0	0	0 No BMP	0
W6	0	0	0	0	0	0 No BMP	0
W7	0	0	0	0	0	0 No BMP	0
W8	0	0	0	0	0	0 No BMP	0

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

Watershed	User Defined						
	N	P	BOD	Sediment	E. coli	0 No BMP	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0
W5	0	0	0	0	0	0 No BMP	0
W6	0	0	0	0	0	0 No BMP	0
W7	0	0	0	0	0	0 No BMP	0
W8	0	0	0	0	0	0 No BMP	0

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

Watershed	Feedlots						
	N	P	BOD	Sediment	E. coli	0 No BMP	%Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0
W2	0	0	0	0	0	0 No BMP	0
W3	0	0	0	0	0	0 No BMP	0
W4	0	0	0	0	0	0 No BMP	0
W5	0	0	0	0	0	0 No BMP	0
W6	0	0	0	0	0	0 No BMP	0
W7	0	0	0	0	0	0 No BMP	0
W8	0	0	0	0	0	0 No BMP	0

6. BMPs and efficiencies for different pollutants on URBAN

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

7. Combined watershed BMP efficiencies from the BMP calculator

Watershed	**Watershed Combined BMP Efficiencies**					
	N	P	BOD	Sediment	E. coli	BMPs
W1-Crop	0	0	0	0	0	Combined BMPs
W2-Crop	0	0	0	0	0	Combined BMPs
W3-Crop	0	0	0	0	0	Combined BMPs
W4-Crop	0	0	0	0	0	Combined BMPs
W5-Crop	0	0	0	0	0	Combined BMPs
W6-Crop	0	0	0	0	0	Combined BMPs
W7-Crop	0	0	0	0	0	Combined BMPs
W8-Crop	0	0	0	0	0	Combined BMPs
W1-Pasture	0	0	0	0	0	Combined BMPs
W2-Pasture	0	0	0	0	0	Combined BMPs
W3-Pasture	0	0	0	0	0	Combined BMPs
W4-Pasture	0	0	0	0	0	Combined BMPs
W5-Pasture	0	0	0	0	0	Combined BMPs
W6-Pasture	0	0	0	0	0	Combined BMPs
W7-Pasture	0	0	0	0	0	Combined BMPs
W8-Pasture	0	0	0	0	0	Combined BMPs
W1-Forest	0	0	0	0	0	Combined BMPs
W2-Forest	0	0	0	0	0	Combined BMPs
W3-Forest	0	0	0	0	0	Combined BMPs
W4-Forest	0	0	0	0	0	Combined BMPs
W5-Forest	0	0	0	0	0	Combined BMPs
W6-Forest	0	0	0	0	0	Combined BMPs
W7-Forest	0	0	0	0	0	Combined BMPs
W8-Forest	0	0	0	0	0	Combined BMPs
W1-User	0	0	0	0	0	Combined BMPs
W2-User	0	0	0	0	0	Combined BMPs
W3-User	0	0	0	0	0	Combined BMPs
W4-User	0	0	0	0	0	Combined BMPs
W5-User	0	0	0	0	0	Combined BMPs
W6-User	0	0	0	0	0	Combined BMPs
W7-User	0	0	0	0	0	Combined BMPs
W8-User	0	0	0	0	0	Combined BMPs

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

a. Nutrient load from runoff (lb/year) and E. coli (MPN/year) without BMPs

Watershed	Cropland				Pastureland				Forest				User Defined				Total			
	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli
W1	45178.6	8984.4	82913.1	0.0	231.7	17.4	753.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45410.4	9001.8	83666.2	0.0
W2	49447.8	9833.4	90748.0	0.0	285.8	21.4	928.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49733.6	9854.8	91676.9	0.0
W3	42401.9	8432.2	77817.2	0.0	238.7	17.9	775.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42640.6	8450.1	78593.0	0.0
W4	40672.6	8088.3	74643.5	0.0	128.1	9.6	416.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40800.8	8097.9	75059.9	0.0
W5	28179.5	5603.9	51715.8	0.0	196.8	14.8	639.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28376.3	5618.6	52355.3	0.0
W6	32103.6	6384.2	58917.4	0.0	391.2	29.3	1271.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32494.8	6413.6	60188.8	0.0
W7	54447.9	10827.7	99924.3	0.0	333.1	25.0	1082.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54781.1	10852.7	101007.0	0.0
W8	39821.2	7919.0	73081.0	0.0	376.8	28.3	1224.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40198.1	7947.3	74305.7	0.0
Total	332253.3	66073.1	609760.3	0.0	2182.3	163.7	7092.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	334435.6	66236.8	616852.8	0.0

b. Nutrient load reduction in runoff with BMPs (lb/year) and E. coli (MPN/year)

Watershed	Cropland				Pastureland				Forest				User Defined				Total			
	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli
W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	E. coli Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	E. coli Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	E. coli Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction	%E. coli Reduction
	lb/year	lb/year	lb/year	t/year	Billion MPN/ye	lb/year	lb/year	lb/year	t/year	Billion MPN/ye	lb/year	lb/year	lb/year	t/year	Billion MPN/ye	%	%	%	%	%
W1	121831.8	29658.2	181424.1	6654.2	0.0	0.0	0.0	0.0	0.0	0.0	121831.8	29658.2	181424.1	6654.2	0.0	0.0	0.0	0.0	0.0	0.0
W2	151680.4	39481.4	231264.2	9713.9	0.0	0.0	0.0	0.0	0.0	0.0	151680.4	39481.4	231264.2	9713.9	0.0	0.0	0.0	0.0	0.0	0.0
W3	158988.0	46377.7	256638.2	13625.9	0.0	3666.3	1613.2	7332.6	1222.1	0.0	155321.7	44764.5	249305.6	12403.8	0.0	2.3	3.5	2.9	9.0	0.0
W4	154320.2	45409.8	251085.3	13343.8	0.0	2931.5	1289.9	5863.0	977.2	0.0	151388.7	44119.9	245222.3	12366.6	0.0	1.9	2.8	2.3	7.3	0.0
W5	110016.9	31267.1	177144.9	8610.5	0.0	922.1	405.7	1844.2	307.4	0.0	109094.8	30861.4	175300.7	8303.1	0.0	0.8	1.3	1.0	3.6	0.0
W6	143516.7	39050.1	248172.3	9627.3	0.0	2291.7	1008.4	4583.5	763.9	0.0	141225.0	38041.7	243588.8	8863.4	0.0	1.6	2.6	1.8	7.9	0.0
W7	206803.3	58691.3	328320.2	16253.9	0.0	1695.9	746.2	3391.8	565.3	0.0	205107.4	57945.1	324928.4	15688.6	0.0	0.8	1.3	1.0	3.5	0.0
W8	181577.8	54070.4	299373.6	15802.6	0.0	2591.0	1140.0	5182.0	863.7	0.0	178986.8	52930.3	294191.5	14938.9	0.0	1.4	2.1	1.7	5.5	0.0
Total	1228735.2	344006.1	1973422.7	93632.0	0.0	14098.6	6203.4	28197.2	4699.5	0.0	1214636.6	337802.7	1945225.5	88932.5	0.0	1.1	1.8	1.4	5.0	0.0

c. Nutrient and sediment load by land uses with BMP (lb/year) and E. coli (MPN/year)

Watershed	Urban					Cropland					Pastureland					Forest				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	533.0	82.7	2266.6	23650.6	0.0	84616.5	26337.0	161788.8	13145946.4	0.0	647.6	200.4	1584.8	138614.9	0.0	0.8	0.3	1.6	261.3	0.0
W2	319.8	46.0	1269.8	14284.3	0.0	107001.9	35157.2	205856.1	19184683.9	0.0	968.0	321.6	2293.3	227397.2	0.0	4.2	1.8	8.4	1393.4	0.0
W3	365.3	54.6	1492.4	16302.3	0.0	115496.7	40593.9	224006.8	24364938.3	0.0	1107.0	399.9	2512.4	289426.7	0.0	24.8	10.9	49.7	8278.3	0.0
W4	286.3	42.3	1142.5	12863.8	0.0	114012.3	40357.8	221322.9	24446560.3	0.0	605.7	219.7	1371.6	159184.4	0.0	35.3	15.5	70.6	11767.2	0.0
W5	200.2	29.0	803.0	8916.4	0.0	72646.9	25169.5	140650.5	14822463.3	0.0	5408.9	2308.1	11063.8	1737364.9	0.0	15.2	6.7	30.4	5070.1	0.0
W6	2813.2	435.1	12476.5	122366.1	0.0	83355.2	28934.9	161420.5	17083844.6	0.0	1688.9	600.3	3866.7	432558.0	0.0	22.8	10.1	45.7	7616.5	0.0
W7	310.9	45.0	1221.2	13966.8	0.0	147156.6	51619.5	285341.6	30902880.5	0.0	1508.6	542.2	3433.6	391825.0	0.0	27.0	11.9	54.0	8994.4	0.0
W8	408.0	61.8	1700.4	18124.1	0.0	127345.4	46429.6	248129.4	29174733.8	0.0	2111.7	791.6	4694.4	578289.1	0.0	47.2	20.8	94.5	15745.6	0.0
Total	5236.7	796.4	22372.4	230474.3	0.0	851631.4	294599.5	1648516.6	173126051.0	0.0	14046.3	5383.8	30820.5	3954660.2	0.0	177.4	78.0	354.8	59126.9	0.0

Watershed	Feedlot					User Defined					Septic					Gully					Streambank				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	5237.6	985.4	7454.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2039.4	798.8	8327.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W2	9880.9	1852.2	14321.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1840.4	720.8	7515.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W3	8821.8	1653.4	12784.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1977.2	774.4	8073.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	193.0	84.9	385.9	128642.2	0.0
W4	8997.7	1641.0	14151.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1678.8	657.5	6855.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	154.3	67.9	308.6	102860.3	0.0
W5	11240.0	2050.0	17679.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1218.7	477.3	4976.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.5	21.4	97.1	32354.6	0.0
W6	22042.5	4018.7	34665.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7560.7	2961.3	30872.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120.6	53.1	241.2	80411.7	0.0
W7	19599.0	3572.7	28555.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1504.7	589.3	6144.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.3	39.3	178.5	59505.9	0.0
W8	20322.5	3602.7	30921.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2051.8	803.6	8378.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	136.4	60.0	272.7	90913.1	0.0
Total	106141.9	19376.1	160534.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19871.6	7783.0	81142.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	742.0	326.5	1484.1	494687.7	0.0

d. Load from groundwater by land uses with BMP (lb/year) and E. coli (MPN/year)

Watershed	Urban					Cropland					Pastureland					Forest				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	1285.4	54.0	0.0		0.0	26031.8	1138.9	0.0		0.0	1365.8	59.8	0.0		0.0	2.5	0.2	0.0		0.0
W2	1432.7	60.2	0.0		0.0	28491.7	1246.5	0.0		0.0	1684.6	73.7	0.0		0.0	10.5	0.9	0.0		0.0
W3	1367.2	57.4	0.0		0.0	24431.9	1068.9	0.0		0.0	1407.0	61.6	0.0		0.0	43.3	3.5	0.0		0.0
W4	1288.0	54.1	0.0		0.0	23435.5	1025.3	0.0		0.0	755.3	33.0	0.0		0.0	58.2	4.8	0.0		0.0
W5	845.7	35.5	0.0		0.0	16237.0	710.4	0.0		0.0	1160.0	50.7	0.0		0.0	28.2	2.3	0.0		0.0
W6	2714.0	114.0	0.0		0.0	18498.0	809.3	0.0		0.0	2305.8	100.9	0.0		0.0	42.2	3.5	0.0		0.0
W7	1487.8	62.5	0.0		0.0	31372.8	1372.6	0.0		0.0	1963.4	85.9	0.0		0.0	46.6	3.8	0.0		0.0
W8	1268.5	53.3	0.0		0.0	22944.9	1003.8	0.0		0.0	2221.1	97.2	0.0		0.0	63.1	5.2	0.0		0.0
Total	11689.2	490.9	0.0	0.0	0.0	191443.7	8375.7	0.0	0.0	0.0	12863.0	562.8	0.0	0.0	0.0	294.8	24.1	0.0	0.0	0.0

Watershed	Feedlot					User Defined					Total				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	71.4	0.8	0.0		0.0	0.0	0.0	0.0	0.0	0.0	28757.0	1253.7	0.0	0.0	0.0
W2	45.6	0.5	0.0		0.0	0.0	0.0	0.0	0.0	0.0	31665.2	1381.8	0.0	0.0	0.0
W3	86.5	1.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	27335.9	1192.4	0.0	0.0	0.0
W4	81.3	0.9	0.0		0.0	0.0	0.0	0.0	0.0	0.0	25618.3	1118.2	0.0	0.0	0.0
W5	45.6	0.5	0.0		0.0	0.0	0.0	0.0	0.0	0.0	18316.5	799.5	0.0	0.0	0.0
W6	61.1	0.7	0.0		0.0	0.0	0.0	0.0	0.0	0.0	23621.1	1028.3	0.0	0.0	0.0
W7	40.8	0.5	0.0		0.0	0.0	0.0	0.0	0.0	0.0	34911.5	1525.2	0.0	0.0	0.0
W8	66.2	0.8	0.0		0.0	0.0	0.0	0.0	0.0	0.0	26563.8	1160.2	0.0	0.0	0.0
Total	498.6	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	216789.2	9459.3	0.0	0.0	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	E. coli Load (Billion MPN/yr)
Urban	5236.69	796.43	22372.38	115.24	0.00
Cropland	851631.44	294599.48	1648516.61	86563.03	0.00
Pastureland	14046.29	5383.82	30820.48	1977.33	0.00
Forest	177.38	78.05	354.76	29.56	0.00
Feedlots	106141.92	19376.09	160534.93	0.00	0.00
User Defined	0.00	0.00	0.00	0.00	0.00
Septic	19871.59	7783.04	81142.32	0.00	0.00
Gully	0.00	0.00	0.00	0.00	0.00
Streambank	742.03	326.49	1484.06	247.34	0.00
Groundwater	216789.22	9459.30	0.00	0.00	0.00
Total	1214636.56	337802.71	1945225.54	88932.50	0.00

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom You entered 1 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Tabl

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table

(c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tabl

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table

(c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheet

Export input/output data: Export Data ☐ **Treat all the subwatersheds as parts of a single watershed** ☑ **Groundwater load calculation**

State: Nebraska **County**: York **Weather Station**: _NE-York_Mean **Calculate Manure Application Months:** Manure Application

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

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
Rain correction factors									0.884	0.489	
W1	507	7490	408	78	0	4.4	0-24%	8487.4	27	77	0.642

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1	88	0	615	9	4	23	0	0	2	2
Total	88	0	615	9	4	23	0	0		

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	49	2.43	40	0	0

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

Watershed	Cropland R	Cropland K	Cropland LS	Cropland C	Cropland P	Pastureland R	Pastureland K	Pastureland LS	Pastureland C	Pastureland P
W1	150.000	0.370	0.387	0.200	0.998	150.000	0.380	0.387	0.040	1.000

Watershed	Forest R	Forest K	Forest LS	Forest C	Forest P	User Defined R	User Defined K	User Defined LS	User Defined C	User Defined P
W1	150.000	0.380	0.387	0.003	1.000	150.000	0.450	0.387	0.162	1.000

Optional Data Input:

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

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%	Soil E. coli conc. (#/100mg)
W1	○	○	●	○	C	0.150	0.066	0.300	0.000

6. Reference runoff curve number (may be modified)

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

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

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

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

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

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

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

8. Input or modify urban land use distributior

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated %	Vacant (developed)	Open Space %	Total % Area
W1	507	0.98	0.32	0	0	3.1	21.8	0	0	73.8	100

9. Input irrigation area (ac) and irrigation amount (in

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	7490	7490	1	1	8

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

Land use	N	P	BOD	E. coli
1. L-Pasturel	**4**	**0.3**	**13**	0
1a. w/ manure	4	0.3	13	0
2. M-Pasturel	**4**	**0.3**	**13**	0
2a. w/ manure	4	0.3	13	0
3. H-Pasturel	**4**	**0.3**	**13**	0
3a. w/ manure	4	0.3	13	0

Input Ends Here.

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

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

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

Watershed	Cropland						
	N	P	BOD	Sediment	E. coli	BMPs	% Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0

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

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

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

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

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

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

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

Watershed	Feedlots						
	N	P	BOD	Sediment	E. coli	BMPs	%Area BMP Applied
W1	0	0	0	0	0	0 No BMP	0

6. BMPs and efficiencies for different pollutants on URBAN

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

7. Combined watershed BMP efficiencies from the BMP calculator

Watershed	Watershed Combined BMP Efficiencies					
	N	P	BOD	Sediment	E. coli	BMPs
W1-Crop	0	0	0	0	0	Combined BMPs
W1-Pasture	0	0	0	0	0	Combined BMPs
W1-Forest	0	0	0	0	0	Combined BMPs
W1-User	0	0	0	0	0	Combined BMPs

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

a. Nutrient load from runoff (lb/year) and E. coli (MPN/year) without BMPs

Watershed	Cropland				Pastureland				Forest				User Defined				Total			
	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli
W1	14474.6	2878.5	26564.1	0.0	60.4	4.5	196.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14535.0	2883.0	26760.6	0.0
Total	14474.6	2878.5	26564.1	0.0	60.4	4.5	196.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14535.0	2883.0	26760.6	0.0

b. Nutrient load reduction in runoff with BMPs (lb/year) and E. coli (MPN/year)

Watershed	Cropland				Pastureland				Forest				User Defined				Total			
	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli	N	P	BOD	E. coli
W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	E. coli Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	E. coli Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	E. coli Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction	%E. coli Reduction
	lb/year	lb/year	lb/year	t/year	Billion MPN/ye	lb/year	lb/year	lb/year	t/year	Billion MPN/ye	lb/year	lb/year	lb/year	t/year	Billion MPN/ye	%	%	%	%	%
W1	62858.6	18948.8	103280.3	5536.4	0.0	268.5	118.1	536.9	89.5	0.0	62590.1	18830.6	102743.3	5446.9	0.0	0.4	0.6	0.5	1.6	0.0
Total	62858.6	18948.8	103280.3	5536.4	0.0	268.5	118.1	536.9	89.5	0.0	62590.1	18830.6	102743.3	5446.9	0.0	0.4	0.6	0.5	1.6	0.0

c. Nutrient and sediment load by land uses with BMP (lb/year) and E. coli (MPN/year)

Watershed	Urban					Cropland					Pastureland				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	103.0	15.3	426.5	4563.5	0.0	46747.1	17078.4	91109.1	10757500.0	0.0	422.4	163.8	920.3	120646.6	0.0
Total	103.0	15.3	426.5	4563.5	0.0	46747.1	17078.4	91109.1	10757500.0	0.0	422.4	163.8	920.3	120646.6	0.0

Watershed	Forest					Feedlot					User Defined				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	5.2	2.3	10.4	1729.9	0.0	4931.5	900.1	7760.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	5.2	2.3	10.4	1729.9	0.0	4931.5	900.1	7760.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Watershed	Septic					Gully					Streambank				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	609.3	238.7	2488.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.1	6.2	28.3	9419.9	0.0
Total	609.3	238.7	2488.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.1	6.2	28.3	9419.9	0.0

d. Load from groundwater by land uses with BMP (lb/year) and E. coli (MPN/year)

Watershed	Urban					Cropland					Pastureland				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	444.1	18.7	0.0		0.0	8811.4	385.5	0.0		0.0	480.0	21.0	0.0		0.0
Total	444.1	18.7	0.0	0.0	0.0	8811.4	385.5	0.0	0.0	0.0	480.0	21.0	0.0	0.0	0.0

Watershed	Forest					Feedlot					User Defined				
	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli	N	P	BOD	Sediment	E. coli
W1	7.0	0.6	0.0		0.0	15.1	0.2	0.0		0.0	0.0	0.0	0.0		0.0
Total	7.0	0.6	0.0	0.0	0.0	15.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Watershed	Total				
	N	P	BOD	Sediment	E. coli
W1	9757.5	425.9	0.0	0.0	0.0
Total	9757.5	425.9	0.0	0.0	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	E. coli Load (Billion MPN/yr)
Urban	102.96	15.33	426.50	2.28	0.00
Cropland	46747.08	17078.37	91109.15	5378.75	0.00
Pastureland	422.38	163.79	920.32	60.32	0.00
Forest	5.19	2.28	10.38	0.86	0.00
Feedlots	4931.48	900.10	7760.62	0.00	0.00
User Defined	0.00	0.00	0.00	0.00	0.00
Septic	609.33	238.65	2488.09	0.00	0.00
Gully	0.00	0.00	0.00	0.00	0.00
Streambank	14.13	6.22	28.26	4.71	0.00
Groundwater	9757.53	425.90	0.00	0.00	0.00
Total	62590.09	18830.64	102743.32	5446.93	0.00
Registered OV	20.207341	7.914541893	82.5133091	0	0
New Total	62610.30	18838.55	102825.84	5446.93	0.00

Treatment Train Reductions 24882

	Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Beginning Watershed Sediment Load
	121831.7738	29658.22201	13308473.26

Land Cover Type	Current Acres	BMP	% Acres-BMPs Already in Place	# BMPs (units)	Acres To Be Treated	% Acres to Be Treated	Model/Calc. Reduction %s (N,P,Sed)	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction
Level 1 Education/Outreach	**All**						10%,10%10%	12183	2966	1330847
Corn-Bean				Beginning Corn-Bean Load				84616.47912	26337.03784	13145946.36
Level 2	21607	Non-Structural & Avoidance	50%		5402	25.0%	20%,50%,0%	4231	3292	0
				New Load				80386	23045	13145946
	21607	Irrigation Water Management Practice Suite	35%		8643	40.0%	35%,10%,0%	11254	922	0
				New Load				69132	22123	13145946
Level 3	21607	Terraces-Reduced Till-NoTill-Cover Crops	NA		193	0.9%	53%,81%,88%	380	167	103243
Level 3	21607	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		650	3.0%	43%,57%,62%	1040	395	245150
Level 3	21607	Reduced Till-NoTill-Cover Crops	NA		8880	41.1%	31%,41%,47%	10242	3883	2539387
Level 3	21607	Cover Crops	NA		1080	5.0%	20%,7%,10%	804	81	65730
				New Load				56666	17597	10192436
Level 4	21607	WASCOBS	5%		946.7611672	4.38%	25%,31%,40%	621	239	178642
				New Load				56045	17358	10013794
	21607	Grassed Waterway	10%		7271.16653	33.65%	10%,25%,65%	1886	1460	842458
				New Load				54159	15898	9171336
Level 5	21607	Wetlands	40%		4260.373183	19.72%	28%,45%,69%	3094	1540	1362388
				New Load				51065	14358	7808948
	21607	Farm Ponds	40%		135.1298269	0.63%	28%,45%,69%	89	40	33698
				New Load				50976	14317	7775250
Level 6	21607	Riparian Buffers	NA		5606.447176	25.9%	41%,45%,56%	5423	1672	1129785
				Final Corn-Bean Load				45553	12646	6645466
Open Lots				Beginning Open Lot Load				5237.600833	985.3796279	0
	21	Non-Permitted AFO Facility Practice Suite	5%		14.6	70.0%	56%,73%,70%	2053	504	0
				Final Open Lot Load				3184	482	0
Pasture				Beginning Pasture Load				647.5682109	200.3509341	138614.9025
Level 3	1161	Grazing Management	25%		581	50.00%	43%,26%,15%	139	26	10396
				New Load				508	174	128219
Level 4	1161	WASCOBS	25%		50.89199511	4.38%	25%,31%,40%	6	2	2248
				New Load				503	172	125971
Level 5	1161	Wetlands	NA		229.0111791	19.73%	28%,45%,69%	28	15	17145
				New Load				475	157	108825
	1161	Farm Ponds	NA		7.263739504	0.63%	28%,45%,69%	1	0	470
				New Load				474	156	108356
Level 6	1161	Riparian Buffers	NA		301.3677495	26.0%	41%,45%,56%	50	18	15751
				Final Pasture Load				424	138	92605
Other Crops				Beginning Other Crop Load				2034.8	633.3	316132.0
Level 4	522	WASCOBS	5%		22.8731535	4.38%	25%,31%,40%	22	9	5541
				New Load				2013	625	310591
	522	Grassed Waterway	10%		175.6668037	33.65%	10%,25%,65%	68	53	26131
				New Load				1945	572	284460
Level 5	522	Wetlands	NA		102.9279328	20%	28%,45%,69%	111	55	42257
				New Load				1834	517	242203
	522	Farm Ponds	NA		3.264651509	0.63%	28%,45%,69%	3	1	1045
				New Load				1831	515	241158
Level 6	522	Riparian Buffers	NA		135.4482326	25.9%	41%,45%,56%	195	60	35042
				Final Other Crop Load				1636	455	206116
Forest				Beginning Forest Load				0.784045665	0.344980092	261.3485549
Level 5	28	Wetlands	NA		5.52103854	19.72%	28%,45%,69%	0	0	36
				New Load				1	0	226
	28	Farm Ponds	NA		0.175115407	0.63%	28%,45%,69%	0	0	1
				Final Forest Load				1	0	225
Developed				Beginning Developed Load				532.9541918	82.67345623	23650.64401
Level 5	1543	Urban Stormwater Practice Suite	5%		694.35	45.00%	40%,43%,78%	96	16	8301.4
				Final Developed Load				437	67	15349.3
Streambank Stabilization	(sum of length of strea			Beginning Streambank Load				0	0	0
Level 3	0	Restoration/Stabilization	NA	0.00	0	0.00%	75%,75%,75%	0	0	0
				Final Streambank Load				0	0	0
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				2039	799	0
Level 3	164 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	144 Systems	88% of systems		1784.5	698.9	0
				Final Septic Load				255	100	0

	Nitrogen	**Phosphorus**	**Sediment**
Total Reduction	55804	18116	7995692
Begininning Watershed Load	121831.7738	29658.22201	13308473.26
End Gross Load	66028	11542	5312781
% Reduction	46%	61%	60%

Total Corn Acres in HUC 8:		111045.17
Total Corn Acres in HUC 12:	**16076.98**	
% Corn in HUC 12:	0.144778746	

Level 1		
Non-Structural & Avoidance		
BMP Effectiveness (%)	40%	
Acres Targeted	4019.25	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.66
New Load/Concentration		5.92

Level 1		
Irrigation Water Management		
BMP Effectiveness (%)	50%	
Acres Targeted	6431	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		1.32
New Load/Concentration		4.61

Level 1		
No-Till/Reduced-Till		
BMP Effectiveness (%)	50%	
Acres Targeted	7235	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		1.48
New Load/Concentration		3.13

Level 2		
Cover Crops		
BMP Effectiveness (%)	25%	
Acres Targeted	8038	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.39
New Load/Concentration		2.74

Level 2		
Contour Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	484	
Acres Targeted (%)	3%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.90%	
Concentration Reduction (ppb)		0.03
New Load/Concentration		2.71

Level 2		
Terraces		
BMP Effectiveness (%)	15%	
Acres Targeted	143	
Acres Targeted (%)	1%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.13%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		2.70

Level 3		
Streambank Stabilization/Restoration		
BMP Effectiveness (%)	25%	
Feet Targeted	0	
Feet Targeted (%)	0%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	0.00%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		2.70

Level 3		
Grassed Waterways/Filter Strips		
BMP Effectiveness (%)	30%	
Acres Targeted	5410	
Acres Targeted (%)	34%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.10%	
Concentration Reduction (ppb)		0.27
New Load/Concentration		2.43

Level 3		
WASCOBS		
BMP Effectiveness (%)	15%	
Acres Targeted	704	
Acres Targeted (%)	4%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.66%	
Concentration Reduction (ppb)		0.02
New Load/Concentration		2.41

Level 4		
Wetlands / Farm Ponds		
BMP Effectiveness (%)	25%	
Acres Targeted	3271	
Acres Targeted (%)	20%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	5.09%	
Concentration Reduction (ppb)		0.12
New Load/Concentration		2.29

Level 5		
Near Stream Riparian Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	4172	
Acres Targeted (%)	26%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	7.78%	
Concentration Reduction (ppb)		0.18
Final Load/Concentration		2.11

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	**Expected Concentration (µg/L)**
Level 1	3.4554	3.13
Level 2	0.4232	2.70
Level 3	0.2907	2.41
Level 4	0.1227	2.29
Level 5	0.1782	2.11
Total Reduction	4.4701	
Percent HUC 12 Reduction (%)	68%	
Percent HUC 8 Reduction (%)	9.83%	

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Land Cover Type	Current Acres	BMP	% Acres-BMPs Already in Place	# BMPs (units)	Acres To Be Treated	% Acres to Be Treated	Model/Calc. Reduction %s (N,P,Sed)	Beginning Watershed Nitrogen Load 151680.4278 Nitrogen Reduction	Beginning Watershed Phosphorus Load 39481.44344 Phosphorus Reduction	Begininng Watershed Sediment Load 19427758.77 Sediment Reduction
Level 1 Education/Outreach	**All**						10%,10%10%	15168	3948	1942776
Corn-Bean				Beginning Corn-Bean Load				107001.8771	35157.15709	19184683.86
Level 2	23900	Non-Structural & Avoidance	50%		5975	25.0%	20%,50%,0%	5350	4395	0
				New Load				101652	30763	19184684
	23900	Irrigation Water Management Practice Suite	35%		9560	40.0%	35%,10%,0%	14231	1231	0
				New Load				87421	29532	19184684
Level 3	23900	Terraces-Reduced Till-NoTill-Cover Crops	NA		212	0.9%	42%,57%,62%	378	155	105314
Level 3	23900	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		714	3.0%	43%,57%,62%	1306	524	355342
Level 3	23900	Reduced Till-NoTill-Cover Crops	NA		9829	41.1%	31%,41%,47%	12960	5187	3708353
Level 3	23900	Cover Crops	NA		1195	5.0%	20%,7%,10%	1017	108	95923
				New Load				71760	23558	14919751
Level 4	23900	WASCOBS	5%		1044.206463	4.37%	25%,31%,40%	784	319	260741
				New Load				70976	23239	14659009
	23900	Grassed Waterway	10%		7866.561214	32.91%	10%,25%,65%	2336	1912	1206234
				New Load				68640	21327	13452775
Level 5	23900	Wetlands	40%		4681.551866	19.59%	28%,45%,69%	3893	2048	1981279
				New Load				64747	19278	11471496
	23900	Farm Ponds	40%		148.2428304	0.62%	28%,45%,69%	112	54	49096
				New Load				64635	19224	11422400
Level 6	23900	Riparian Buffers	NA		5490.69003	23.0%	41%,45%,56%	6088	1987	1469516
				Final Corn-Bean Load				58547	17237	9952884
Open Lots				Beginning Open Lot Load				9880.935972	1852.194071	0
	13	Non-Permitted AFO Facility Practice Suite	5%		9.3	70.0%	56%,73%,70%	3873	946	0
				Final Open Lot Load				6008	906	0
Pasture				Beginning Pasture Load				968.0038856	321.6002275	227397.2019
Level 3	1432	Grazing Management	25%		716	50.00%	43%,26%,15%	208	42	17055
				New Load				760	280	210342
Level 4	1432	WASCOBS	25%		62.54919498	4.37%	25%,31%,40%	8	4	3675
				New Load				752	276	206667
Level 5	1432	Wetlands	NA		280.4304616	19.58%	28%,45%,69%	41	24	27926
				New Load				710	252	178742
	1432	Farm Ponds	NA		8.879919851	0.62%	28%,45%,69%	1	1	765
				New Load				709	251	177977
Level 6	1432	Riparian Buffers	NA		328.898789	23.0%	41%,45%,56%	67	26	22891
				Final Pasture Load				642	225	155086
Other Crops				Beginning Other Crop Load				1433.9	471.1	257084.9
Level 4	320	WASCOBS	5%		13.98118383	4.37%	25%,31%,40%	16	6	4493
				New Load				1418	465	252592
	320	Grassed Waterway	10%		105.3276745	32.91%	10%,25%,65%	47	38	20785
				New Load				1372	427	231807
Level 5	320	Wetlands	NA		62.6826586	20%	28%,45%,69%	78	41	34140
				New Load				1294	386	197667
	320	Farm Ponds	NA		1.984866342	0.62%	28%,45%,69%	2	1	846
				New Load				1292	384	196821
Level 6	320	Riparian Buffers	NA		73.51644464	23.0%	41%,45%,56%	122	40	25322
				Final Other Crop Load				1170	345	171499
Forest				Beginning Forest Load				4.180329149	1.839344825	1393.44305
Level 5	117	Wetlands	NA		22.91834705	19.59%	28%,45%,69%	0	0	188
				New Load				4	2	1205
	117	Farm Ponds	NA		0.725716756	0.62%	28%,45%,69%	0	0	5
				Final Forest Load				4	2	1200
Developed				Beginning Developed Load				319.82502	46.0398455	14284.26211
Level 5	1607	Urban Stormwater Practice Suite	5%		723.15	45.00%	40%,43%,78%	58	9	5013.8
				Final Developed Load				262	37	9270.5
Streambank Stabilization	(sum of length of strea			Beginning Streambank Load				0	0	0
Level 3	0	Restoration/Stabilization	NA	0.00	0	0.00%	75%,75%,75%	0	0	0
				Final Streambank Load				0	0	0
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				1840	721	0
Level 3	148 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	130 Systems	88% of systems		1610.4	630.7	0
				Final Septic Load				230	90	0

	Nitrogen	Phosphorus	Sediment
Total Reduction	69754	23678	11337681
Begininning Watershed Load	151680.4278	39481.44344	19427758.77
End Gross Load	81926	15804	8090078
% Reduction	46%	60%	58%

Total Corn Acres in HUC 8:	111045.17
Total Corn Acres in HUC 12:	**17837.753**
% Corn in HUC 12:	0.160635114

Level 1		
Non-Structural & Avoidance		
BMP Effectiveness (%)	40%	
Acres Targeted	4459.44	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.73
New Load/Concentration		6.57

Level 1		
Irrigation Water Management		
BMP Effectiveness (%)	50%	
Acres Targeted	7135	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		1.46
New Load/Concentration		5.11

Level 1		
No-Till/Reduced-Till		
BMP Effectiveness (%)	50%	
Acres Targeted	8027	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		1.64
New Load/Concentration		3.47

Level 2		
Cover Crops		
BMP Effectiveness (%)	25%	
Acres Targeted	8919	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.43
New Load/Concentration		3.04

Level 2		
Contour Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	533	
Acres Targeted (%)	3%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.90%	
Concentration Reduction (ppb)		0.03
New Load/Concentration		3.00

Level 2		
Terraces		
BMP Effectiveness (%)	15%	
Acres Targeted	158	
Acres Targeted (%)	1%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.13%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		3.00

Level 3		
Streambank Stabilization/Restoration		
BMP Effectiveness (%)	25%	
Feet Targeted	0	
Feet Targeted (%)	0%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	0.00%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		3.00

Level 3		
Grassed Waterways/Filter Strips		
BMP Effectiveness (%)	30%	
Acres Targeted	5871	
Acres Targeted (%)	33%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	9.87%	
Concentration Reduction (ppb)		0.30
New Load/Concentration		2.70

Level 3		
WASCOBS		
BMP Effectiveness (%)	15%	
Acres Targeted	779	
Acres Targeted (%)	4%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.66%	
Concentration Reduction (ppb)		0.02
New Load/Concentration		2.68

Level 4		
Wetlands / Farm Ponds		
BMP Effectiveness (%)	25%	
Acres Targeted	3605	
Acres Targeted (%)	20%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	5.05%	
Concentration Reduction (ppb)		0.14
New Load/Concentration		2.55

Level 5		
Near Stream Riparian Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	4098	
Acres Targeted (%)	23%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	6.89%	
Concentration Reduction (ppb)		0.18
Final Load/Concentration		2.37

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	**Expected Concentration (µg/L)**
Level 1	3.8338	3.47
Level 2	0.4693	3.00
Level 3	0.3158	2.68
Level 4	0.1356	2.55
Level 5	0.1756	2.37
Total Reduction	4.9301	
Percent HUC 12 Reduction (%)	68%	
Percent HUC 8 Reduction (%)	10.84%	

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								Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Begininng Watershed Sediment Load
								158988.0251	46377.70599	27251788.71
Land Cover Type	**Current Acres**	**BMP**	**% Acres-BMPs Already in Place**	**# BMPs (units)**	**Acres To Be Treated**	**% Acres to Be Treated**	**Model/Calc. Reduction %s (N,P,Sed)**	**Nitrogen Reduction**	**Phosphorus Reduction**	**Sediment Reduction**
Level 1 Education/Outreach	**All**						10%,10%10%	15899	4638	2725179
Corn-Bean				Beginning Corn-Bean Load				115496.7489	40593.92134	24364938.29
Level 2	20350	Non-Structural & Avoidance	50%		5088	25.0%	20%,50%,0%	5775	5074	0
				New Load				109722	35520	24364938
	20350	Irrigation Water Management Practice Suite	35%		8140	40.0%	35%,10%,0%	15361	1421	0
				New Load				94361	34099	24364938
Level 3	20350	Terraces-Reduced Till-NoTill-Cover Crops	NA		186	0.9%	42%,57%,62%	420	185	137783
Level 3	20350	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		627	3.1%	41%,57%,62%	1386	624	465475
Level 3	20350	Reduced Till-NoTill-Cover Crops	NA		8345	41.0%	31%,41%,47%	13948	5972	4695876
Level 3	20350	Cover Crops	NA		1018	5.0%	20%,7%,10%	1097	124	121825
				New Load				77509	27194	18943980
Level 4	20350	WASCOBS	5%		912.7384017	4.49%	25%,31%,40%	869	378	339870
				New Load				76640	26816	18604109
	20350	Grassed Waterway	10%		6724.10646	33.04%	10%,25%,65%	2532	2215	1536806
				New Load				74108	24601	17067303
Level 5	20350	Wetlands	40%		4022.937715	19.77%	28%,45%,69%	4242	2386	2537680
				New Load				69866	22215	14529623
	20350	Farm Ponds	40%		127.4520822	0.63%	28%,45%,69%	123	63	62789
				New Load				69743	22153	14466834
Level 6	20350	Riparian Buffers	NA		5159.717304	25.4%	41%,45%,56%	7250	2528	2054107
				Final Corn-Bean Load				62493	19625	12412727
Open Lots				Beginning Open Lot Load				8821.804048	1653.433613	0
	25	Non-Permitted AFO Facility Practice Suite	5%		17.6	70.0%	56%,73%,70%	3458	845	0
				Final Open Lot Load				5364	809	0
Pasture				Beginning Pasture Load				1106.989333	399.9464707	289426.7313
Level 3	1196	Grazing Management	25%		598	50.00%	43%,26%,15%	238	52	21707
				New Load				869	348	267720
Level 4	1196	WASCOBS	25%		53.62624415	4.48%	25%,31%,40%	10	5	4802
				New Load				859	343	262918
Level 5	1196	Wetlands	NA		236.3602098	19.76%	28%,45%,69%	48	31	35852
				New Load				812	313	227066
	1196	Farm Ponds	NA		7.488209618	0.63%	28%,45%,69%	1	1	981
				New Load				810	312	226085
Level 6	1196	Riparian Buffers	NA		303.1495765	25.3%	41%,45%,56%	84	36	32091
				Final Pasture Load				726	276	193994
Other Crops				Beginning Other Crop Load				2371.3	833.4	500235.9
Level 4	419	WASCOBS	5%		18.79324889	4.49%	25%,31%,40%	27	12	8975
				New Load				2345	822	491261
	419	Grassed Waterway	10%		138.4490956	33.04%	10%,25%,65%	77	68	40582
				New Load				2267	754	450680
Level 5	419	Wetlands	NA		82.83213415	20%	28%,45%,69%	130	73	67011
				New Load				2137	681	383669
	419	Farm Ponds	NA		2.624233512	0.63%	28%,45%,69%	4	2	1658
				New Load				2134	679	382011
Level 6	419	Riparian Buffers	NA		106.2383825	25.4%	41%,45%,56%	222	77	54241
				Final Other Crop Load				1912	601	327769
Forest				Beginning Forest Load				24.83487527	10.92734512	8278.291757
Level 5	482	Wetlands	NA		95.28660778	19.77%	28%,45%,69%	1	1	1129
				New Load				23	10	7149
	482	Farm Ponds	NA		3.018808002	0.63%	28%,45%,69%	0	0	31
				Final Forest Load				23	10	7118
Developed				Beginning Developed Load				365.3149387	54.56728664	16302.31169
Level 5	1567	Urban Stormwater Practice Suite	5%		705.15	45.00%	40%,43%,78%	66	11	5722.1
				Final Developed Load				300	44	10580.2
Streambank Stabilization	(sum of length of strea			Beginning Streambank Load				192.9632313	84.90382179	128642.1542
Level 3	244893	Restoration/Stabilization	NA	3.48	36733.95	15.00%	75%,75%,75%	22	10	14472
				Final Streambank Load				171	75	114170
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				1977	774	0
Level 3	159 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	139 Systems	88% of systems		1730.1	677.6	0
				Final Septic Load				247	97	0

	Nitrogen	Phosphorus	Sediment
Total Reduction	75020	27506	14966644
Begininning Watershed Load	158988.0251	46377.70599	27251788.71
End Gross Load	83968	18872	12285145
% Reduction	47%	59%	55%

Total Corn Acres in HUC 8:	111045.17	
Total Corn Acres in HUC 12:	**15311.212**	
% Corn in HUC 12:	0.137882741	

Level 1		
Non-Structural & Avoidance		
BMP Effectiveness (%)	40%	
Acres Targeted	3827.80	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.63
New Load/Concentration		5.64

Level 1		
Irrigation Water Management		
BMP Effectiveness (%)	50%	
Acres Targeted	6124	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		1.25
New Load/Concentration		4.39

Level 1		
No-Till/Reduced-Till		
BMP Effectiveness (%)	50%	
Acres Targeted	6890	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		1.41
New Load/Concentration		2.98

Level 2		
Cover Crops		
BMP Effectiveness (%)	25%	
Acres Targeted	7656	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.37
New Load/Concentration		2.61

Level 2		
Contour Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	472	
Acres Targeted (%)	3%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.92%	
Concentration Reduction (ppb)		0.03
New Load/Concentration		2.58

Level 2		
Terraces		
BMP Effectiveness (%)	15%	
Acres Targeted	140	
Acres Targeted (%)	1%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.14%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		2.57

Level 3		
Streambank Stabilization/Restoration		
BMP Effectiveness (%)	25%	
Feet Targeted	36734	
Feet Targeted (%)	15%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	3.75%	
Concentration Reduction (ppb)		0.10
New Load/Concentration		2.48

Level 3		
Grassed Waterways/Filter Strips		
BMP Effectiveness (%)	30%	
Acres Targeted	5059	
Acres Targeted (%)	33%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	9.91%	
Concentration Reduction (ppb)		0.26
New Load/Concentration		2.22

Level 3		
WASCOBS		
BMP Effectiveness (%)	15%	
Acres Targeted	687	
Acres Targeted (%)	4%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.67%	
Concentration Reduction (ppb)		0.02
New Load/Concentration		2.20

Level 4		
Wetlands / Farm Ponds		
BMP Effectiveness (%)	25%	
Acres Targeted	3123	
Acres Targeted (%)	20%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	5.10%	
Concentration Reduction (ppb)		0.11
New Load/Concentration		2.09

Level 5		
Near Stream Riparian Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	3882	
Acres Targeted (%)	25%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	7.61%	
Concentration Reduction (ppb)		0.16
Final Load/Concentration		1.93

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	**Expected Concentration (µg/L)**
Level 1	3.2908	2.98
Level 2	0.4038	2.57
Level 3	0.3689	2.20
Level 4	0.1124	2.09
Level 5	0.1591	1.93
Total Reduction	4.3350	
Percent HUC 12 Reduction (%)	69%	
Percent HUC 8 Reduction (%)	9.54%	

Treatment Train Reductions				22689				Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Beginning Watershed Sediment Load
								154320.1967	45409.80813	26687582.48
Land Cover Type	**Current Acres**	**BMP**	**% Acres-BMPs Already in Place**	**# BMPs (units)**	**Acres To Be Treated**	**% Acres to Be Treated**	**Model/Calc. Reduction %s (N,P,Sed)**	**Nitrogen Reduction**	**Phosphorus Reduction**	**Sediment Reduction**
Level 1 Education/Outreach	**All**						10%,10%10%	15432	4541	2668758
Corn-Bean				Beginning Corn-Bean Load				114012.2988	40357.76428	24446560.3
Level 2	19863	Non-Structural & Avoidance	50%		4966	25.0%	20%,50%,0%	5701	5045	0
				New Load				108312	35313	24446560
	19863	Irrigation Water Management Practice Suite	35%		7945	40.0%	35%,10%,0%	15164	1413	0
				New Load				93148	33901	24446560
Level 3	19863	Terraces-Reduced Till-NoTill-Cover Crops	NA		174	0.9%	42%,57%,62%	399	176	132817
Level 3	19863	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		589	3.0%	41%,57%,62%	1316	597	449248
Level 3	19863	Reduced Till-NoTill-Cover Crops	NA		8176	41.2%	32%,41%,47%	14266	5959	4729205
Level 3	19863	Cover Crops	NA		993	5.0%	20%,7%,10%	1083	124	122233
				New Load				76084	27045	19013058
Level 4	19863	WASCOBS	5%		892.5482869	4.49%	25%,31%,40%	855	377	341742
				New Load				75229	26668	18671316
	19863	Grassed Waterway	10%		6329.85046	31.87%	10%,25%,65%	2397	2125	1487522
				New Load				72832	24543	17183793
Level 5	19863	Wetlands	40%		3898.135142	19.63%	28%,45%,69%	4134	2355	2528343
				New Load				68698	22188	14655450
	19863	Farm Ponds	40%		123.4555132	0.62%	28%,45%,69%	120	62	62851
				New Load				68579	22126	14592598
Level 6	19863	Riparian Buffers	NA		4976.887073	25.1%	41%,45%,56%	7045	2495	2047546
				Final Corn-Bean Load				61534	19631	12545053
Open Lots				Beginning Open Lot Load				8997.672139	1641.015584	0
	24	Non-Permitted AFO Facility Practice Suite	5%		16.6	70.0%	56%,73%,70%	3527	839	0
				Final Open Lot Load				5471	802	0
Pasture				Beginning Pasture Load				605.6896945	219.7336391	159184.3945
Level 3	642	Grazing Management	25%		321	50.00%	43%,26%,15%	130	29	11939
				New Load				475	191	147246
Level 4	642	WASCOBS	25%		28.84551301	4.49%	25%,31%,40%	5	3	2646
				New Load				470	189	144599
Level 5	642	Wetlands	NA		125.9805319	19.62%	28%,45%,69%	26	17	19579
				New Load				444	172	125021
	642	Farm Ponds	NA		3.98985429	0.62%	28%,45%,69%	1	0	536
				New Load				444	171	124484
Level 6	642	Riparian Buffers	NA		160.843803	25.1%	41%,45%,56%	46	19	17465
				Final Pasture Load				398	152	107019
Other Crops				Beginning Other Crop Load				325.2	115.1	69735.7
Level 4	58	WASCOBS	5%		2.606200139	4.49%	25%,31%,40%	4	2	1253
				New Load				322	114	68482
	58	Grassed Waterway	10%		18.48287358	31.87%	10%,25%,65%	10	9	5456
				New Load				311	104	63027
Level 5	58	Wetlands	NA		11.38237617	20%	28%,45%,69%	18	10	9273
				New Load				294	94	53753
	58	Farm Ponds	NA		0.360484447	0.62%	28%,45%,69%	1	0	231
				New Load				293	94	53523
Level 6	58	Riparian Buffers	NA		14.53228242	25.1%	41%,45%,56%	30	11	7510
				Final Other Crop Load				263	84	46013
Forest				Beginning Forest Load				35.30171578	15.53275494	11767.23859
Level 5	648	Wetlands	NA		127.1686165	19.62%	28%,45%,69%	2	1	1593
				New Load				33	14	10174
	648	Farm Ponds	NA		4.027481408	0.62%	28%,45%,69%	0	0	44
				Final Forest Load				33	14	10130
Developed				Beginning Developed Load				286.3442849	42.33449648	12863.75964
Level 5	1454	Urban Stormwater Practice Suite	5%		654.3	45.00%	40%,43%,78%	52	8	4515.2
				Final Developed Load				235	34	8348.6
Streambank Stabilization	(sum of length of strea			Beginning Streambank Load				154.2905093	67.88782411	102860.3396
Level 3	171648	Restoration/Stabilization	NA	2.44	25747.2	15.00%	75%,75%,75%	17	8	11572
				Final Streambank Load				137	60	91289
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				1679	658	0
Level 3	135 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	118 Systems	88% of systems		1468.9	575.3	0
				Final Septic Load				210	82	0

	Nitrogen	Phosphorus	Sediment
Total Reduction	73248	26798	14663878
Begininning Watershed Load	154320.1967	45409.80813	26687582.48
End Gross Load	81073	18612	12023705
% Reduction	47%	59%	55%

Total Corn Acres in HUC 8:	111045.17	
Total Corn Acres in HUC 12:	**14524.9651**	
% Corn in HUC 12:	0.130802317	

Level 1		
Non-Structural & Avoidance		
BMP Effectiveness (%)	40%	
Acres Targeted	3631.24	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.59
New Load/Concentration		5.35

Level 1		
Irrigation Water Management		
BMP Effectiveness (%)	50%	
Acres Targeted	5810	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		1.19
New Load/Concentration		4.16

Level 1		
No-Till/Reduced-Till		
BMP Effectiveness (%)	50%	
Acres Targeted	6536	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		1.34
New Load/Concentration		2.82

Level 2		
Cover Crops		
BMP Effectiveness (%)	25%	
Acres Targeted	7262	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.35
New Load/Concentration		2.47

Level 2		
Contour Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	431	
Acres Targeted (%)	3%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.89%	
Concentration Reduction (ppb)		0.03
New Load/Concentration		2.45

Level 2		
Terraces		
BMP Effectiveness (%)	15%	
Acres Targeted	127	
Acres Targeted (%)	1%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.13%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		2.44

Level 3		
Streambank Stabilization/Restoration		
BMP Effectiveness (%)	25%	
Feet Targeted	25747	
Feet Targeted (%)	15%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	3.75%	
Concentration Reduction (ppb)		0.09
New Load/Concentration		2.35

Level 3		
Grassed Waterways/Filter Strips		
BMP Effectiveness (%)	30%	
Acres Targeted	4629	
Acres Targeted (%)	32%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	9.56%	
Concentration Reduction (ppb)		0.23
New Load/Concentration		2.12

Level 3		
WASCOBS		
BMP Effectiveness (%)	15%	
Acres Targeted	653	
Acres Targeted (%)	4%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.67%	
Concentration Reduction (ppb)		0.02
New Load/Concentration		2.10

Level 4		
Wetlands / Farm Ponds		
BMP Effectiveness (%)	25%	
Acres Targeted	2941	
Acres Targeted (%)	20%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	5.06%	
Concentration Reduction (ppb)		0.11
New Load/Concentration		1.99

Level 5		
Near Stream Riparian Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	3639	
Acres Targeted (%)	25%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	7.52%	
Concentration Reduction (ppb)		0.15
Final Load/Concentration		1.84

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	**Expected Concentration (µg/L)**
Level 1	3.1218	2.82
Level 2	0.3819	2.44
Level 3	0.3416	2.10
Level 4	0.1063	1.99
Level 5	0.1499	1.84
Total Reduction	4.1015	
Percent HUC 12 Reduction (%)	69%	
Percent HUC 8 Reduction (%)	9.02%	

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								Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Beginning Watershed Sediment Load
								110016.8603	**31267.12783**	**17220907.05**
Land Cover Type	**Current Acres**	**BMP**	**% Acres-BMPs Already in Place**	**# BMPs (units)**	**Acres To Be Treated**	**% Acres to Be Treated**	**Model/Calc. Reduction %s (N,P,Sed)**	**Nitrogen Reduction**	**Phosphorus Reduction**	**Sediment Reduction**
Level 1 Education/Outreach	**All**						10%,10%10%	11002	3127	1722091
Corn-Bean				Beginning Corn-Bean Load				72646.87258	25169.52598	14822463.34
Level 2	13541	Non-Structural & Avoidance	50%		3385	25.0%	20%,50%,0%	3632	3146	0
				New Load				69015	22023	14822463
	13541	Irrigation Water Management Practice Suite	35%		5416	40.0%	35%,10%,0%	9662	881	0
				New Load				59352	21142	14822463
Level 3	13541	Terraces-Reduced Till-NoTill-Cover Crops	NA		46	0.3%	34%,39%,46%	79	29	22911
Level 3	13541	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		252	1.9%	43%,57%,62%	552	234	171026
Level 3	13541	Reduced Till-NoTill-Cover Crops	NA		5796	42.8%	32%,41%,47%	9453	3865	2981894
Level 3	13541	Cover Crops	NA		677	5.0%	20%,7%,10%	690	77	74112
				New Load				48578	16938	11572521
Level 4	13541	WASCOBS	5%		434.4694269	3.21%	25%,31%,40%	390	168	148524
				New Load				48189	16769	11423997
	13541	Grassed Waterway	10%		3048.731906	22.51%	10%,25%,65%	1085	944	643023
				New Load				47104	15826	10780974
Level 5	13541	Wetlands	40%		3346.597273	24.71%	28%,45%,69%	3335	1865	1948139
				New Load				43769	13961	8832835
	13541	Farm Ponds	40%		17.25858884	0.13%	28%,45%,69%	16	8	7768
				New Load				43753	13953	8825067
Level 6	13541	Riparian Buffers	NA		3011.168043	22.2%	41%,45%,56%	3989	1396	1098981
				Final Corn-Bean Load				39764	12556	7726086
Open Lots				Beginning Open Lot Load				11239.9723	2049.982684	0
	13	Non-Permitted AFO Facility Practice Suite	5%		9.3	70.0%	56%,73%,70%	4406	1048	0
				Final Open Lot Load				6834	1002	0
Pasture				Beginning Pasture Load				5408.890137	2308.081366	1737364.937
Level 3	986	Grazing Management	25%		493	50.00%	43%,26%,15%	1163	300	130302
				New Load				4246	2008	1607063
Level 4	986	WASCOBS	25%		31.65028268	3.21%	25%,31%,40%	34	20	20634
				New Load				4212	1988	1586428
Level 5	986	Wetlands	NA		243.7933331	24.73%	28%,45%,69%	292	221	270654
				New Load				3920	1767	1315774
	986	Farm Ponds	NA		1.25725582	0.13%	28%,45%,69%	1	1	1158
				New Load				3919	1766	1314616
Level 6	986	Riparian Buffers	NA		219.357943	22.2%	41%,45%,56%	357	177	163781
				Final Pasture Load				3561	1589	1150835
Other Crops				Beginning Other Crop Load				1404.3	486.6	286534.8
Level 4	262	WASCOBS	5%		8.406606247	3.21%	25%,31%,40%	11	5	3678
				New Load				1393	482	282857
	262	Grassed Waterway	10%		58.99031578	22.52%	10%,25%,65%	31	27	15922
				New Load				1362	455	266936
Level 5	262	Wetlands	NA		64.75375205	25%	28%,45%,69%	96	54	48237
				New Load				1265	401	218699
	262	Farm Ponds	NA		0.333938712	0.13%	28%,45%,69%	0	0	192
				New Load				1265	401	218506
Level 6	262	Riparian Buffers	NA		58.26348764	22.2%	41%,45%,56%	115	40	27211
				Final Other Crop Load				1150	361	191295
Forest				Beginning Forest Load				15.21017416	6.692476629	5070.058053
Level 5	314	Wetlands	NA		77.60564177	24.72%	28%,45%,69%	1	1	865
				New Load				14	6	4205
	314	Farm Ponds	NA		0.400216624	0.13%	28%,45%,69%	0	0	4
				Final Forest Load				14	6	4202
Developed				Beginning Developed Load				200.1600932	28.98144971	8916.350361
Level 5	955	Urban Stormwater Practice Suite	5%		429.75	45.00%	40%,43%,78%	36	6	3129.6
				Final Developed Load				164	23	5786.7
Streambank Stabilization	(sum of length of strea			Beginning Streambank Load				48.53192711	21.35404793	32354.61808
Level 3	50752	Restoration/Stabilization	NA	0.72	7612.8	15.00%	75%,75%,75%	5	2	3640
				Final Streambank Load				43	19	28715
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				1219	477	0
Level 3	98 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	86 Systems	88% of systems		1066.3	417.6	0
				Final Septic Load				152	60	0

	Nitrogen	**Phosphorus**	**Sediment**
Total Reduction	51501	18059	9507875
Begininning Watershed Load	110016.8603	31267.12783	17220907.05
End Gross Load	58515	13208	7713032
% Reduction	47%	58%	55%

Total Corn Acres in HUC 8:	111045.17	
Total Corn Acres in HUC 12:	**8997.00197**	
% Corn in HUC 12:	0.081021104	

Level 1		
Non-Structural & Avoidance		
BMP Effectiveness (%)	40%	
Acres Targeted	2249.25	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.37
New Load/Concentration		3.31

Level 1		
Irrigation Water Management		
BMP Effectiveness (%)	50%	
Acres Targeted	3599	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		0.74
New Load/Concentration		2.58

Level 1		
No-Till/Reduced-Till		
BMP Effectiveness (%)	50%	
Acres Targeted	4049	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		0.83
New Load/Concentration		1.75

Level 2		
Cover Crops		
BMP Effectiveness (%)	25%	
Acres Targeted	4499	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.22
New Load/Concentration		1.53

Level 2		
Contour Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	167	
Acres Targeted (%)	2%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.56%	
Concentration Reduction (ppb)		0.01
New Load/Concentration		1.52

Level 2		
Terraces		
BMP Effectiveness (%)	15%	
Acres Targeted	30	
Acres Targeted (%)	0%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.05%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		1.52

Level 3		
Streambank Stabilization/Restoration		
BMP Effectiveness (%)	25%	
Feet Targeted	7613	
Feet Targeted (%)	15%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	3.75%	
Concentration Reduction (ppb)		0.06
New Load/Concentration		1.46

Level 3		
Grassed Waterways/Filter Strips		
BMP Effectiveness (%)	30%	
Acres Targeted	2026	
Acres Targeted (%)	23%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	6.75%	
Concentration Reduction (ppb)		0.10
New Load/Concentration		1.36

Level 3		
WASCOBS		
BMP Effectiveness (%)	15%	
Acres Targeted	289	
Acres Targeted (%)	3%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.48%	
Concentration Reduction (ppb)		0.01
New Load/Concentration		1.35

Level 4		
Wetlands / Farm Ponds		
BMP Effectiveness (%)	25%	
Acres Targeted	2235	
Acres Targeted (%)	25%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	6.21%	
Concentration Reduction (ppb)		0.08
New Load/Concentration		1.27

Level 5		
Near Stream Riparian Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	2001	
Acres Targeted (%)	22%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	6.67%	
Concentration Reduction (ppb)		0.08
Final Load/Concentration		1.18

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	Expected Concentration (µg/L)
Level 1	1.9337	1.75
Level 2	0.2293	1.52
Level 3	0.1670	1.35
Level 4	0.0840	1.27
Level 5	0.0847	1.18
Total Reduction	2.4987	
Percent HUC 12 Reduction (%)	68%	
Percent HUC 8 Reduction (%)	5.50%	

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								Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Beginining Watershed Sediment Load
								143516.7019	**39050.09812**	**19254619.27**
Land Cover Type	**Current Acres**	**BMP**	**% Acres-BMPs Already in Place**	**# BMPs (units)**	**Acres To Be Treated**	**% Acres to Be Treated**	**Model/Calc. Reduction %s (N,P,Sed)**	**Nitrogen Reduction**	**Phosphorus Reduction**	**Sediment Reduction**
Level 1 Education/Outreach	**All**						10%,10%10%	14352	3905	1925462
Corn-Bean				Beginning Corn-Bean Load				83355.15541	28934.91784	17083844.64
Level 2	15315	Non-Structural & Avoidance	50%		3829	25.0%	20%,50%,0%	4168	3617	0
				New Load				79187	25318	17083845
	15315	Irrigation Water Management Practice Suite	35%		6126	40.0%	35%,10%,0%	11086	1013	0
				New Load				68101	24305	17083845
Level 3	15315	Terraces-Reduced Till-NoTill-Cover Crops	NA		85	0.6%	42%,57%,62%	184	80	58441
Level 3	15315	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		455	3.0%	41%,57%,62%	964	428	314427
Level 3	15315	Reduced Till-NoTill-Cover Crops	NA		6353	41.5%	32%,41%,47%	10511	4306	3330575
Level 3	15315	Cover Crops	NA		766	5.0%	20%,7%,10%	792	89	85419
				New Load				55651	19403	13294982
Level 4	15315	WASCOBS	5%		728.7443751	4.76%	25%,31%,40%	662	286	253050
				New Load				54989	19117	13041933
	15315	Grassed Waterway	10%		6575.023029	42.93%	10%,25%,65%	2361	2052	1399788
				New Load				52628	17065	11642145
Level 5	15315	Wetlands	40%		3412.764967	22.28%	28%,45%,69%	3431	1917	2005305
				New Load				49197	15148	9636840
	15315	Farm Ponds	40%		167.8086307	1.10%	28%,45%,69%	151	75	72859
				New Load				49046	15073	9563981
Level 6	15315	Riparian Buffers	NA		4061.651396	26.5%	41%,45%,56%	5333	1799	1420406
				Final Corn-Bean Load				43713	13274	8143575
Open Lots				Beginning Open Lot Load				22042.50603	4018.690265	0
	18	Non-Permitted AFO Facility Practice Suite	5%		12.5	70.0%	56%,73%,70%	8641	2054	0
				Final Open Lot Load				13402	1965	0
Pasture				Beginning Pasture Load				1688.869496	600.3161922	432557.9726
Level 3	1960	Grazing Management	25%		980	50.00%	43%,26%,15%	363	78	32442
				New Load				1326	522	400116
Level 4	1960	WASCOBS	25%		93.26795872	4.76%	25%,31%,40%	16	8	7616
				New Load				1310	515	392500
Level 5	1960	Wetlands	NA		436.7808973	22.28%	28%,45%,69%	82	52	60353
				New Load				1228	463	332148
	1960	Farm Ponds	NA		21.47689776	1.10%	28%,45%,69%	4	2	2511
				New Load				1224	461	329636
Level 6	1960	Riparian Buffers	NA		519.8282796	26.5%	41%,45%,56%	133	55	48958
				Final Pasture Load				1091	406	280678
Other Crops				Beginning Other Crop Load				2221.0	771.0	455208.3
Level 4	409	WASCOBS	5%		19.46135037	4.76%	25%,31%,40%	26	11	8664
				New Load				2195	760	446544
	409	Grassed Waterway	10%		175.5880816	42.93%	10%,25%,65%	94	82	47927
				New Load				2100	678	398618
Level 5	409	Wetlands	NA		91.13897411	22%	28%,45%,69%	137	76	68659
				New Load				1963	602	329959
	409	Farm Ponds	NA		4.481382865	1.10%	28%,45%,69%	6	3	2495
				New Load				1957	599	327465
Level 6	409	Riparian Buffers	NA		108.4676926	26.5%	41%,45%,56%	213	71	48633
				Final Other Crop Load				1745	527	278832
Forest				Beginning Forest Load				22.84950862	10.05378379	7616.502874
Level 5	470	Wetlands	NA		104.7318284	22.28%	28%,45%,69%	1	1	1171
				New Load				21	9	6445
	470	Farm Ponds	NA		5.149755371	1.10%	28%,45%,69%	0	0	49
				Final Forest Load				21	9	6397
Developed				Beginning Developed Load				2813.211865	435.1070335	122366.0721
Level 5	3903	Urban Stormwater Practice Suite	5%		1756.35	45.00%	40%,43%,78%	506	84	42950.5
				Final Developed Load				2307	351	79415.6
Streambank Stabilization	(sum of length of streai			Beginning Streambank Load				120.6175556	53.07172445	80411.7037
Level 3	117227	Restoration/Stabilization	NA	1.67	17584.05	15.00%	75%,75%,75%	14	6	9046
				Final Streambank Load				107	47	71365
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				7561	2961	0
Level 3	608 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	532 Systems	88% of systems		6615.6	2591.1	0
				Final Septic Load				945	370	0

	Nitrogen	Phosphorus	Sediment
Total Reduction	70845	24740	11247204
Begininning Watershed Load	143516.7019	39050.09812	19254619.27
End Gross Load	72671	14311	8007415
% Reduction	49%	63%	58%

Total Corn Acres in HUC 8:	111045.17	
Total Corn Acres in HUC 12:	**9588.22155**	
% Corn in HUC 12:	0.08634524	

Level 1		
Non-Structural & Avoidance		
BMP Effectiveness (%)	40%	
Acres Targeted	2397.06	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.39
New Load/Concentration		3.53

Level 1		
Irrigation Water Management		
BMP Effectiveness (%)	50%	
Acres Targeted	3835	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		0.79
New Load/Concentration		2.75

Level 1		
No-Till/Reduced-Till		
BMP Effectiveness (%)	50%	
Acres Targeted	4315	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		0.88
New Load/Concentration		1.86

Level 2		
Cover Crops		
BMP Effectiveness (%)	25%	
Acres Targeted	4794	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.23
New Load/Concentration		1.63

Level 2		
Contour Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	285	
Acres Targeted (%)	3%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.89%	
Concentration Reduction (ppb)		0.02
New Load/Concentration		1.61

Level 2		
Terraces		
BMP Effectiveness (%)	15%	
Acres Targeted	53	
Acres Targeted (%)	1%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.08%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		1.61

Level 3		
Streambank Stabilization/Restoration		
BMP Effectiveness (%)	25%	
Feet Targeted	17584	
Feet Targeted (%)	15%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	3.75%	
Concentration Reduction (ppb)		0.06
New Load/Concentration		1.55

Level 3		
Grassed Waterways/Filter Strips		
BMP Effectiveness (%)	30%	
Acres Targeted	4116	
Acres Targeted (%)	43%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.88%	
Concentration Reduction (ppb)		0.21
New Load/Concentration		1.35

Level 3		
WASCOBS		
BMP Effectiveness (%)	15%	
Acres Targeted	456	
Acres Targeted (%)	5%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.71%	
Concentration Reduction (ppb)		0.01
New Load/Concentration		1.33

Level 4		
Wetlands / Farm Ponds		
BMP Effectiveness (%)	25%	
Acres Targeted	2242	
Acres Targeted (%)	23%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	5.84%	
Concentration Reduction (ppb)		0.08
New Load/Concentration		1.26

Level 6		
Near Stream Riparian Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	2543	
Acres Targeted (%)	27%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	7.96%	
Concentration Reduction (ppb)		0.10
Final Load/Concentration		1.16

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	Expected Concentration (µg/L)
Level 1	2.0608	1.86
Level 2	0.2512	1.61
Level 3	0.2798	1.33
Level 4	0.0779	1.26
Level 5	0.0999	1.16
Total Reduction	2.7696	
Percent HUC 12 Reduction (%)	71%	
Percent HUC 8 Reduction (%)	6.09%	

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	Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Beginning Watershed Sediment Load
	206803.3437	**58691.2895**	**32507783.89**

Land Cover Type	Current Acres	BMP	% Acres-BMPs Already in Place	# BMPs (units)	Acres To Be Treated	% Acres to Be Treated	Model/Calc. Reduction %s (N,P,Sed)	Nitrogen Reduction	Phosphorus Reduction	Sediment Reduction
Level 1 Education/Outreach	**All**						10%,10%10%	20680	5869	3250778
Corn-Bean				Beginning Corn-Bean Load				147156.5794	51619.51714	30902880.45
Level 2	26313	Non-Structural & Avoidance	50%		6578	25.0%	20%,50%,0%	7358	6452	0
				New Load				139799	45167	30902880
	26313	Irrigation Water Management Practice Suite	35%		10525	40.0%	35%,10%,0%	19572	1807	0
				New Load				120227	43360	30902880
Level 3	26313	Terraces-Reduced Till-NoTill-Cover Crops	NA		363	1.4%	42%,57%,62%	809	355	263994
Level 3	26313	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		1035	3.9%	43%,57%,62%	2365	1013	753826
Level 3	26313	Reduced Till-NoTill-Cover Crops	NA		10443	39.7%	32%,41%,47%	17755	7350	5764386
Level 3	26313	Cover Crops	NA		1316	5.0%	20%,7%,10%	1398	158	154514
				New Load				97900	34485	23966160
Level 4	26313	WASCOBS	5%		1463.506643	5.56%	25%,31%,40%	1361	595	533191
				New Load				96539	33890	23432969
	26313	Grassed Waterway	10%		10164.6445	38.63%	10%,25%,65%	3729	3273	2263024
				New Load				92810	30618	21169945
Level 5	26313	Wetlands	40%		5062.258762	19.24%	28%,45%,69%	5200	2934	3110645
				New Load				87609	27684	18059301
	26313	Farm Ponds	40%		156.9156598	0.60%	28%,45%,69%	146	74	74310
				New Load				87463	27609	17984991
Level 6	26313	Riparian Buffers	NA		7238.50796	27.5%	41%,45%,56%	9865	3418	2770620
				Final Corn-Bean Load				77598	24191	15214371
Open Lots				Beginning Open Lot Load				19598.9618	3572.685043	0
	12	Non-Permitted AFO Facility Practice Suite	5%		8.3	70.0%	56%,73%,70%	7683	1826	0
				Final Open Lot Load				11916	1747	0
Pasture				Beginning Pasture Load				1508.589994	542.1926185	391824.9945
Level 3	1669	Grazing Management	25%		835	50.00%	43%,26%,15%	324	70	29387
				New Load				1184	472	362438
Level 4	1669	WASCOBS	25%		92.85415567	5.56%	25%,31%,40%	16	8	8066
				New Load				1168	464	354372
Level 5	1669	Wetlands	NA		321.1818446	19.24%	28%,45%,69%	63	40	47055
				New Load				1105	423	307318
	1669	Farm Ponds	NA		9.95572598	0.60%	28%,45%,69%	2	1	1265
				New Load				1103	422	306053
Level 6	1669	Riparian Buffers	NA		459.2569144	27.5%	41%,45%,56%	124	52	47161
				Final Pasture Load				979	370	258892
Other Crops				Beginning Other Crop Load				1979.4	694.3	415669.5
Level 4	355	WASCOBS	5%		19.7444647	5.56%	25%,31%,40%	28	12	9248
				New Load				1952	682	406422
	355	Grassed Waterway	10%		137.1332788	38.63%	10%,25%,65%	75	66	39249
				New Load				1876	616	367173
Level 5	355	Wetlands	NA		68.29595882	19%	28%,45%,69%	105	59	53950
				New Load				1771	557	313223
	355	Farm Ponds	NA		2.116980966	0.60%	28%,45%,69%	3	1	1289
				New Load				1768	556	311934
Level 6	355	Riparian Buffers	NA		97.65617777	27.5%	41%,45%,56%	199	69	48053
				Final Other Crop Load				1569	487	263881
Forest				Beginning Forest Load				26.98310774	11.87256741	8994.369248
Level 5	519	Wetlands	NA		99.84676796	19.24%	28%,45%,69%	1	1	1194
				New Load				26	11	7800
	519	Farm Ponds	NA		3.094966539	0.60%	28%,45%,69%	0	0	32
				Final Forest Load				25	11	7768
Developed				Beginning Developed Load				310.9116839	44.97692343	13966.77074
Level 5	1654	Urban Stormwater Practice Suite	5%		744.3	45.00%	40%,43%,78%	56	9	4902.3
				Final Developed Load				255	36	9064.4
Streambank Stabilization	(sum of length of strea			Beginning Streambank Load				89.2587976	39.27387094	59505.86506
Level 3	88560	Restoration/Stabilization	NA	1.26	13284	15.00%	75%,75%,75%	10	4	6694
				Final Streambank Load				79	35	52811
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				1505	589	0
Level 3	121 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	106 Systems	88% of systems		1316.6	515.7	0
				Final Septic Load				188	74	0

	Nitrogen	Phosphorus	Sediment
Total Reduction	100246	36032	19236833
Begininning Watershed Load	206803.3437	58691.2895	32507783.89
End Gross Load	106557	22659	13270951
% Reduction	48%	61%	59%

Total Corn Acres in HUC 8:	111045.17	
Total Corn Acres in HUC 12:	**16136.1436**	
% Corn in HUC 12:	0.145311535	

Level 1 **Non-Structural & Avoidance**		
BMP Effectiveness (%)	40%	
Acres Targeted	4034.04	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.66
New Load/Concentration		5.95

Level 1 **Irrigation Water Management**		
BMP Effectiveness (%)	50%	
Acres Targeted	6454	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		1.32
New Load/Concentration		4.62

Level 1 **No-Till/Reduced-Till**		
BMP Effectiveness (%)	50%	
Acres Targeted	7261	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		1.49
New Load/Concentration		3.14

Level 2 **Cover Crops**		
BMP Effectiveness (%)	25%	
Acres Targeted	8068	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.39
New Load/Concentration		2.75

Level 2 **Contour Buffers**		
BMP Effectiveness (%)	30%	
Acres Targeted	635	
Acres Targeted (%)	4%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	1.18%	
Concentration Reduction (ppb)		0.04
New Load/Concentration		2.71

Level 2 **Terraces**		
BMP Effectiveness (%)	15%	
Acres Targeted	222	
Acres Targeted (%)	1%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.21%	
Concentration Reduction (ppb)		0.01
New Load/Concentration		2.70

Level 3 **Streambank Stabilization/Restoration**		
BMP Effectiveness (%)	25%	
Feet Targeted	13284	
Feet Targeted (%)	15%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	3.75%	
Concentration Reduction (ppb)		0.10
New Load/Concentration		2.60

Level 3 **Grassed Waterways/Filter Strips**		
BMP Effectiveness (%)	30%	
Acres Targeted	6233	
Acres Targeted (%)	39%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	11.59%	
Concentration Reduction (ppb)		0.31
New Load/Concentration		2.29

Level 3 **WASCOBS**		
BMP Effectiveness (%)	15%	
Acres Targeted	897	
Acres Targeted (%)	6%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.83%	
Concentration Reduction (ppb)		0.02
New Load/Concentration		2.27

Level 4 **Wetlands / Farm Ponds**		
BMP Effectiveness (%)	25%	
Acres Targeted	3201	
Acres Targeted (%)	20%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	4.96%	
Concentration Reduction (ppb)		0.11
New Load/Concentration		2.15

Level 5 **Near Stream Riparian Buffers**		
BMP Effectiveness (%)	30%	
Acres Targeted	4439	
Acres Targeted (%)	28%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	8.25%	
Concentration Reduction (ppb)		0.18
Final Load/Concentration		1.98

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	**Expected Concentration (µg/L)**
Level 1	3.4681	3.14
Level 2	0.4357	2.70
Level 3	0.4370	2.27
Level 4	0.1123	2.15
Level 5	0.1777	1.98
Total Reduction	4.6308	
Percent HUC 12 Reduction (%)	70%	
Percent HUC 8 Reduction (%)	10.19%	

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								Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Beginining Watershed Sediment Load
								181577.8	**54070.4**	**31605200**
Land Cover Type	**Current Acres**	**BMP**	**% Acres-BMPs Already in Place**	**# BMPs (units)**	**Acres To Be Treated**	**% Acres to Be Treated**	**Model/Calc. Reduction %s (N,P,Sed)**	**Nitrogen Reduction**	**Phosphorus Reduction**	**Sediment Reduction**
Level 1 Education/Outreach	**All**						10%,10%10%	18158	5407	3160520
Corn-Bean				Beginning Corn-Bean Load				127345.4	46429.6	29174733.8
Level 2	19187	Non-Structural & Avoidance	50%		4797	25.0%	20%,50%,0%	6367	5804	0
				New Load				120978	40626	29174734
	19187	Irrigation Water Management Practice Suite	35%		7675	40.0%	35%,10%,0%	16937	1625	0
				New Load				104041	39001	29174734
Level 3	19187	Terraces-Reduced Till-NoTill-Cover Crops	NA		220	1.1%	42%,57%,62%	583	266	207685
Level 3	19187	Contour Buffer-Cover Crop-Reduced Till-Notill	NA		668	3.5%	43%,57%,62%	1810	806	629373
Level 3	19187	Reduced Till-NoTill-Cover Crops	NA		7746	40.4%	32%,41%,47%	15629	6725	5535880
Level 3	19187	Cover Crops	NA		959	5.0%	20%,7%,10%	1210	142	145873
				New Load				84809	31062	22655923
Level 4	19187	WASCOBS	5%		798.9621528	4.16%	25%,31%,40%	883	401	377364
				New Load				83926	30661	22278559
	19187	Grassed Waterway	10%		5339.722681	27.83%	10%,25%,65%	2336	2133	1550025
				New Load				81590	28528	20728534
Level 5	19187	Wetlands	40%		3223.16187	16.80%	28%,45%,69%	3948	2318	2582327
				New Load				77643	26210	18146207
	19187	Farm Ponds	40%		130.1827126	0.68%	28%,45%,69%	148	80	84953
				New Load				77495	26130	18061253
Level 6	19187	Riparian Buffers	NA		4492.14417	23.4%	41%,45%,56%	7439	2753	2368004
				Final Corn-Bean Load				70056	23377	15693249
Open Lots				Beginning Open Lot Load				20322.5	3602.7	0
	19	Non-Permitted AFO Facility Practice Suite	5%		13.5	70.0%	56%,73%,70%	7966	1841	0
				Final Open Lot Load				12356	1762	0
Pasture				Beginning Pasture Load				2111.7	791.6	578289.1
Level 3	1888	Grazing Management	25%		944	50.00%	43%,26%,15%	454	103	43372
				New Load				1658	689	534917
Level 4	1888	WASCOBS	25%		78.63810677	4.17%	25%,31%,40%	17	9	8912
				New Load				1640	680	526005
Level 5	1888	Wetlands	NA		317.2407433	16.80%	28%,45%,69%	77	51	60985
				New Load				1563	628	465020
	1888	Farm Ponds	NA		12.81327535	0.68%	28%,45%,69%	3	2	2178
				New Load				1560	626	462842
Level 6	1888	Riparian Buffers	NA		442.1407343	23.4%	41%,45%,56%	150	66	60699
				Final Pasture Load				1410	560	402144
Other Crops				Beginning Other Crop Load				2112.8	770.3	484034.5
Level 4	318	WASCOBS	5%		13.24184575	4.16%	25%,31%,40%	22	10	8062
				New Load				2091	760	475972
	318	Grassed Waterway	10%		88.49954134	27.83%	10%,25%,65%	58	53	33116
				New Load				2033	707	442856
Level 5	318	Wetlands	NA		53.42006771	17%	28%,45%,69%	98	57	55171
				New Load				1934	650	387686
	318	Farm Ponds	NA		2.157623354	0.68%	28%,45%,69%	4	2	1815
				New Load				1931	648	385871
Level 6	318	Riparian Buffers	NA		74.45193739	23.4%	41%,45%,56%	185	68	50592
				Final Other Crop Load				1745	580	335279
Forest				Beginning Forest Load				47.2	20.8	15745.6
Level 5	702	Wetlands	NA		117.9273193	16.80%	28%,45%,69%	2	2	1825
				New Load				45	19	13921
	702	Farm Ponds	NA		4.763055328	0.68%	28%,45%,69%	0	0	65
				Final Forest Load				45	19	13855
Developed				Beginning Developed Load				408	61.8	18124.1
Level 5	1483	Urban Stormwater Practice Suite	5%		667.35	45.00%	40%,43%,78%	73	12	6361.6
				Final Developed Load				335	50	11762.5
Streambank Stabilization	(sum of length of streai			Beginning Streambank Load				136.4	60	90913.1
Level 3	124224	Restoration/Stabilization	NA	1.76	18633.6	15.00%	75%,75%,75%	15	7	10228
				Final Streambank Load				121	53	80685
Septic Systems	(# of systems)			Beginning Septic Load (Reg. & Un. Reg. Systems)				2052	804	0
Level 3	165 Systems	Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	144 Systems	88% of systems		1795.3	703.2	0
				Final Septic Load				256	100	0

	Nitrogen	Phosphorus	Sediment
Total Reduction	86368	31445	16985386
Beginninng Watershed Load	181577.8	54070.4	31605200
End Gross Load	95209	22625	14619814
% Reduction	48%	58%	54%

Total Corn Acres in HUC 8:	111045.17
Total Corn Acres in HUC 12:	**12572.88958**
% Corn in HUC 12:	0.113223204

Level 1		
Non-Structural & Avoidance		
BMP Effectiveness (%)	40%	
Acres Targeted	3143.22	
Acres Targeted (%)	25%	Cheat Sheet (75-50)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	10.0%	
Concentration Reduction (ppb)		0.51
New Load/Concentration		4.63

Level 1		
Irrigation Water Management		
BMP Effectiveness (%)	50%	
Acres Targeted	5029	
Acres Targeted (%)	40%	Cheat Sheet (75-35)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	20.00%	
Concentration Reduction (ppb)		1.03
New Load/Concentration		3.60

Level 1		
No-Till/Reduced-Till		
BMP Effectiveness (%)	50%	
Acres Targeted	5658	
Acres Targeted (%)	45%	Cheat Sheet (100-55)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	22.50%	
Concentration Reduction (ppb)		1.16
New Load/Concentration		2.44

Level 2		
Cover Crops		
BMP Effectiveness (%)	25%	
Acres Targeted	6286	
Acres Targeted (%)	50%	Cheat Sheet (75-25)
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	12.50%	
Concentration Reduction (ppb)		0.31
New Load/Concentration		2.14

Level 2		
Contour Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	437	
Acres Targeted (%)	3%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	1.04%	
Concentration Reduction (ppb)		0.03
New Load/Concentration		2.11

Level 2		
Terraces		
BMP Effectiveness (%)	15%	
Acres Targeted	144	
Acres Targeted (%)	1%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.17%	
Concentration Reduction (ppb)		0.00
New Load/Concentration		2.11

Level 3		
Streambank Stabilization/Restoration		
BMP Effectiveness (%)	25%	
Feet Targeted	18634	
Feet Targeted (%)	15%	Cheat Sheet (90-75)
Reduction Effectiveness (% feet targeted X BMP Effectiveness (%)	3.75%	
Concentration Reduction (ppb)		0.08
New Load/Concentration		2.03

Level 3		
Grassed Waterways/Filter Strips		
BMP Effectiveness (%)	30%	
Acres Targeted	3499	
Acres Targeted (%)	28%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	8.35%	
Concentration Reduction (ppb)		0.18
New Load/Concentration		1.85

Level 3		
WASCOBS		
BMP Effectiveness (%)	15%	
Acres Targeted	524	
Acres Targeted (%)	4%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	0.62%	
Concentration Reduction (ppb)		0.01
New Load/Concentration		1.84

Level 4		
Wetlands / Farm Ponds		
BMP Effectiveness (%)	25%	
Acres Targeted	2197	
Acres Targeted (%)	17%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	4.37%	
Concentration Reduction (ppb)		0.08
New Load/Concentration		1.76

Level 5		
Near Stream Riparian Buffers		
BMP Effectiveness (%)	30%	
Acres Targeted	2944	
Acres Targeted (%)	23%	
Reduction Effectiveness (% acres targeted X BMP Effectiveness (%)	7.02%	
Concentration Reduction (ppb)		0.12
Final Load/Concentration		1.64

Summary of Concentration Reductions by Level

	Concentration Reduction (µg/L)	Expected Concentration (µg/L)
Level 1	2.7022	2.44
Level 2	0.3353	2.11
Level 3	0.2684	1.84
Level 4	0.0804	1.76
Level 5	0.1237	1.64
Total Reduction	3.5101	
Percent HUC 12 Reduction (%)	68%	
Percent HUC 8 Reduction (%)	7.72%	

		8569				Beginning Watershed Nitrogen Load	Beginning Watershed Phosphorus Load	Begininng Watershed Sediment Load
						62325.39226	**18739.94089**	**11072838.04**
BMP	**% Acres-BMPs Already in Place**	**# BMPs (units)**	**Acres To Be Treated**	**% Acres to Be Treated**	**Model/Calc. Reduction %s (N,P,Sed)**	**Nitrogen Reduction**	**Phosphorus Reduction**	**Sediment Reduction**
					10%,10%10%	6233	1874	1107284
		Beginning Corn-Bean Load				46747.08298	17078.3682	10757499.99
Non-Structural & Avoidance	50%		1873	25.0%	20%,50%,0%	2337	2135	0
		New Load				44410	14944	10757500
Irrigation Water Management Practice Suite	35%		2996	40.0%	35%,10%,0%	6217	598	0
		New Load				38192	14346	10757500
Terraces-Reduced Till-NoTill-Cover Crops	NA		32	0.4%	41%,57%,62%	77	36	28297
Contour Buffer-Cover Crop-Reduced Till-Notill	NA		116	1.6%	43%,57%,63%	297	132	105342
Reduced Till-NoTill-Cover Crops	NA		3222	43.0%	32%,41%,47%	6114	2636	2175172
Cover Crops	NA		375	5.0%	20%,7%,10%	444	52	53787
		New Load				31260	11489	8394902
WASCOBS	5%		270.4145891	3.61%	25%,31%,40%	282	129	121234
		New Load				30978	11361	8273668
Grassed Waterway	10%		1325.542497	17.70%	10%,25%,65%	548	503	366058
		New Load				30430	10858	7907610
Wetlands	40%		2582.026764	34.47%	28%,45%,69%	2990	1762	1968005
		New Load				27440	9096	5939605
Farm Ponds	40%		4.33771821	0.06%	28%,45%,69%	4	2	2373
		New Load				27435	9093	5937232
Riparian Buffers	NA		1496.518006	20.0%	41%,45%,56%	2247	818	664312
		Final Corn-Bean Load				25188	8276	5272920
		Beginning Open Lot Load				4931.476859	900.096643	0
Non-Permitted AFO Facility Practice Suite	5%		3.1	70.0%	56%,73%,70%	1933	460	0
		Final Open Lot Load				2998	440	0
		Beginning Pasture Load				422.3841063	163.7868786	120646.6399
Grazing Management	25%		204	50.00%	43%,26%,15%	91	21	9048
		New Load				332	142	111598
WASCOBS	25%		14.73019391	3.61%	25%,31%,40%	3	2	1612
		New Load				329	141	109987
Wetlands	NA		140.649789	34.47%	28%,45%,69%	32	22	26162
		New Load				297	119	83825
Farm Ponds	NA		0.23628692	0.06%	28%,45%,69%	0	0	33
		New Load				297	119	83791
Riparian Buffers	NA		81.51927186	20.0%	41%,45%,56%	24	11	9375
		Final Pasture Load				273	108	74416
		Beginning Other Crop Load				524.6	191.7	120718.5
WASCOBS	5%		2.960480148	3.61%	25%,31%,40%	5	2	1743
		New Load				520	190	118975
Grassed Waterway	10%		14.51194723	17.70%	10%,25%,65%	9	8	5264
		New Load				511	181	113711
Wetlands	NA		28.26784976	34%	28%,45%,69%	50	29	28300
		New Load				460	152	85411
Farm Ponds	NA		0.047489038	0.06%	28%,45%,69%	0	0	34
		New Load				460	152	85377
Riparian Buffers	NA		16.38377523	20.0%	41%,45%,56%	38	14	9553
		Final Other Crop Load				423	138	75824
		Beginning Forest Load				5.18957973	2.283415081	1729.85991
Wetlands	NA		26.88893026	34.47%	28%,45%,69%	1	0	411
		New Load				5	2	1318
Farm Ponds	NA		0.045172499	0.06%	28%,45%,69%	0	0	1
		Final Forest Load				5	2	1318
		Beginning Developed Load				102.9620795	15.33385024	4563.513523
Urban Stormwater Practice Suite	5%		228.15	45.00%	40%,43%,78%	19	3	1601.8
		Final Developed Load				84	12	2961.7
		Beginning Streambank Load				14.12985302	6.217135327	9419.902011
Restoration/Stabilization	NA	0.76	8030.607	15.00%	75%,75%,75%	2	1	1060
		Final Streambank Load				13	6	8360
		Beginning Septic Load (Reg. & Un. Reg. Systems)				609	239	0
Unregistered System Upgrade	NA	100% Reduction on X Systems to Achieve 5% Failure	43 Systems	88% of systems		533.2	208.8	0
		Final Septic Load				76	30	0

	Nitrogen	Phosphorus	Sediment
Total Reduction	30530	11459	6686062
Begininning Watershed Load	62325.39226	18739.94089	11072838.04
End Gross Load	31795	7281	4386776
% Reduction	49%	61%	60%

Land Cover Type / Pollutant Source	BMP	Phosphorus Load Reduction (lbs/yr)	Nitrogen Load Reduction (lbs/yr)	Sediment Load Reduction (tons/yr)
All	Education & Outreach	1874	6233	553.6
Corn-Bean	Avoidance	2135	2337	0.0
	Irrigation Water Management Practice Suite	598	6217	0.0
	Terraces-Reduced/No-Till-Cover Crops	36	77	14.1
	Contour Buffers-Cover Crops-Reduced/No-Till	132	297	52.7
	Reduced/No-Till-Cover Crops	2636	6114	1087.6
	Cover Crops	52	444	26.9
	WASCOBs	129	282	60.6
	Grassed Waterway	503	548	183.0
	Wetlands	1762	2990	984.0
	Farm Ponds	2	4	1.2
	Riparian Buffers	818	2247	332.2
Open Lots	Non-Permitted AFO Practice Suite	460	1933	0.0
Pasture	Grazing Management	21	91	4.5
	WASCOBs	2	3	0.8
	Wetlands	22	32	13.1
	Farm Ponds	0	0	0.0
	Riparian Buffers	11	24	4.7
Other Crops	WASCOBs	2	5	0.9
	Grassed Waterway	8	9	2.6
	Wetlands	19	50	14.2
	Farm Ponds	0	0	0.0
	Riparian Buffers	14	38	4.8
Forest	Wetlands	0	1	0.2
	Farm Ponds	0	0	0.0
Urban	Urban Stormwater Practice Suite	3	19	0.8
Streambank	Restoration / Stabilization	1	2	0.5
Septic Systems	Unregistered System Upgrade	209	533	0.0
Total Reduction	NA	11449	30530	3343.0
Beginning Load	NA	32235	53682	6050
Expected Load	NA	20786	23152	2707.0
Total Reduction (%)	NA	35.52%	56.87%	55.26%
Reduction Target (%)	NA	98.20%	54.10%	NA

	Phosphorus	Nitrogen	Sediment
Wet Detention			
Effectiveness	69.00%	55.00%	86.00%
Beginning Loads	20786	23152	2707
Reductions	14342	12734	2328
Expected Load	6444	10418	379
Wetland Development			
Effectiveness	44.00%	20.00%	78.00%
Beginning Loads	6444	10418	379
Reductions	2835	2084	296
Expected Load	3608	8335	83
Lake Deepening			
Effectiveness	10.05%	NA	NA
Beginning Loads	3608	NA	NA
Reductions	3241	NA	NA
Expected Load	367	NA	NA
Island Stabilization			
Effectiveness	Not Estimated	Not Estimated	Not Estimated
Beginning Loads			
Reductions			
Expected Load			
FINAL LOADS	367	8335	83
LOAD CAPACITY/TARGET	590	24625	NA
Total Reduction	31868	45347	5967
% Reduction	98.86%	84.47%	98.62%
% Reduction Target	98.17%	54.13%	NA

APPENDIX D: BEST MANAGEMENT PRACTICES

1.01 INTRODUCTION

This appendix is meant to add further clarification and definition of what each BMP practice mentioned in the watershed plan is. It is intended to be general in nature to provide that context, but does not include information on pollutant removal or treatment efficiencies or rates, as those values can vary widely based on many factors. Information on those values is included in the water quality modeling report for BMPs that were used in the water quality modeling effort.

1.02 CROPLAND PRACTICES

CONTOUR BUFFER (FILTER) STRIPS

Grass filter strips, or vegetated buffers, are planted between surface waters and fields to protect water quality. The use of vegetated buffers along streams, and vegetated filter strips in uplands can provide significant reductions of nutrients, sediment and pathogens to waterbodies. Pollutant removal rates largely depend on buffer width, vegetative make up and pollutant type. Various standards exist for buffer width recommendations for both water quality maintenance and basic habitat as this number may be modified based on other factors such as slope, soil type, adjacent land use, the presence of certain wildlife communities, stream size, and stream order.

CONTOUR FARMING

Contour farming is growing crops perpendicular to a field slope, rather than up and down, with each row generally following the same elevation across the field. This practice reduces soil erosion and facilitates equipment and other farming or conservation practices.

INTEGRATED PEST MANAGEMENT

This is a site-specific combination of pest prevention, pest avoidance, pest monitoring, and pest suppression strategies. Typically, a comprehensive plan is developed to meet the following purposes:

1. Prevent or mitigate off-site pesticide risks to water quality from leaching, solution runoff and adsorbed runoff losses.
2. Prevent or mitigate off-site pesticide risks to soil, water, air, plants, animals and humans from drift and volatilization losses.
3. Prevent or mitigate on-site pesticide risks to pollinators and other beneficial species through direct contact.
4. Prevent or mitigate cultural, mechanical and biological pest suppression risks to soil, water, air, plants, animals and humans

UNDERGROUND OUTLET/ GRASS WATERWAY

Underground outlets consist of using tiling or other conduit, or system of conduits, installed beneath the surface of the ground to convey surface water to a suitable outlet. This carry water to a suitable outlet from terraces, water and sediment control basins, diversions, waterways, surface drains, other similar practices or flow concentrations without causing damage by erosion or flooding. Conversely a grass waterway function similarly to avoid erosion; however, a grass waterway uses a shaped or graded channel that is established with suitable vegetation to carry surface water at a nonerosive velocity to a stable outlet.

CROP TO GRASS/ HABITAT/ CRP CONVERSION

This is also known as cropland conversion or land retirement, and consists of converting cropland to perennial grassland cover. This is often through existing government retirement programs such as CRP. Significant environmental gains can be achieved by permanently converting row crop back into grass. Crop ground to grass conversions are considered by producers for multiple reasons including economic gains, wildlife enhancement, and pastureland establishment.

IRRIGATION MANAGEMENT

This practice consists of determining and controlling the volume, frequency, and application rate of irrigation water. This allows improved water use efficiency (both groundwater and surface water), minimizes soil erosion, and reduces the amount of pollutants that are leached into groundwater or carried to surface waters. A variety of techniques and technologies are utilized, including variable rate irrigation, soil moisture monitoring, weather monitoring, irrigation system improvements, changes in crop type, and other methods.

NO-TILL / REDUCED-TILL

This BMP involves managing the amount of crop and plant residue on the soil surface year-round, primarily through limiting tillage or plowing activities which disturb and expose the soil. Leaving plant residue on the soil surface protects from erosion and improves soil organic matter over time.

SOIL SAMPLING

Soil testing can be considered the basis for all nutrient management plans and should be practiced regularly by all producers. As commodity prices drop, managing input costs becomes an increasing concern to producers, making nutrient management even more important. Soil sampling is a practice that may save a producer a considerable amount of money by reducing fertilizer inputs, yet maintaining a strong yield, without economic incentives to encourage implementation.

TERRACES/DIVERSIONS

Terraces consist of an earthen embankment, channel, or a combined ridge and channel built across the slope of the field. They may reduce the sediment load and content of associated pollutants in surface water runoff. Terraces intercept and store surface runoff, trapping sediments and pollutants. In some types of terraces, underground drainage outlets are used to collect soluble nutrient and pesticide leachates, reducing the risk of movement of pollutants into the groundwater, and improving field drainage. However, the waterbody receiving runoff directly via tile drains can be impacted by high pesticide and dissolved nutrient concentrations, as well as a change in the hydrology of the stream network.

A diversion is very similar to a terrace, but its purpose is to direct or divert surface water runoff away from an area, or to collect and direct water to a pond. Filter strips should be installed above the diversion channel to trap sediment and protect the diversion. Similarly, vegetative cover should be maintained in the diversion ridge. Any associated outlets should be kept clear of debris.

RETENTION BASIN

Retention basins are also referred to as wet ponds or farm ponds, and they hold back water. The retention pond has a permanent pool of water that fluctuates in response to precipitation and runoff from the contributing areas. Maintaining a pool discourages re-suspension of sediments and keeps deposited sediments at the bottom of the holding area. Natural attenuation of pollutants, especially nutrients and bacteria, is a key benefit to retention facilities. Renovation of existing structures is also a practice and can be a more cost-effective practice than constructing a new pond.

DETENTION BASIN

Detention ponds are similar to retention basins, but do not permanently hold water, and can serve as infiltration or bioretention features. They are designed to remain dry except during or after rain or snow melt, which allows for agricultural use to continue on a regular basis above the structure. Their purpose is to slow down water flow and hold it for a short period of time to allow natural treatment of pollutants.

SEDIMENT CONTROL BASIN

Sediment control basins can be used to collect, trap, and store sediment produced by agricultural or urban activities, or serve as flow detention facility. Sediment traps are much smaller than a retention or detention basin. A sediment control basin is constructed by excavation or by placing an earthen embankment across a low area or drainage swale. They may include a riser and pipe outlet with a small spillway.

CROP ROTATION

Changing which crops are planted each season in a planned sequence serves to improve soil health and provide long-term yield benefits. Properly designed crop rotations can reduce fertilizer needs, reduce soil erosion, increase soil organic matter, add diversity, and reduce excess nutrient loss. Rotations need to be properly suited to soils, climate, and farming style of individual operators.

APPLICATION TIMING AND BANDING

Optimal timing and placement of nutrients should be done with the consideration of a number of factors including: nutrient source, cropping system limitations, soil properties and biology, weather conditions, and drainage systems. Fall application may increase the risk of nutrient losses and reduced efficiency compared to spring application. Nitrogen application should be planned to correspond with crop uptake. Phosphorus should not be surface applied if there is a high potential for runoff. Ammonia should only be applied when soil moisture conditions are conducive to proper injection and sealing to avoid losses. Banding nitrogen and phosphorus can improve the nutrient availability and minimize losses to surface and groundwater.

1.03 NON-PERMITTED LIVESTOCK PRACTICES

ALTERNATE WATER SUPPLY

This BMP ensures that livestock have adequate access to clean drinking water away from streams, ponds, springs or wells. Used mainly with grazing systems, well-designed watering systems protect soil and water quality while improving livestock health and productivity. They reduce sediment and nutrient loading in streams and lakes by preventing bank and shore erosion and limiting the amount of livestock urine and feces deposited directly in the water. Watering system "hardware" typically includes permanent or portable watertight tanks or troughs with pipelines and pumps to move water from the water source to the tanks.

MANURE MANAGEMENT

Land application of animal manure helps to recycle nutrients in the soil and adds organic matter to improve soil structure, tilth, and water holding capacity. One major concern about this practice is that unintended runoff to surface water and buildup of phosphorus in soils results in nutrient delivery to downstream water resources, therefore soil sampling as part of a nutrient management is recommended to be completed with this practice. Manure management includes methods such as applying manure at agronomic rates, using methods that limit runoff (such as knifing) and applying manure outside of priority area subwatersheds.

Additionally, this practice also includes activities to limit the exposure of manure to precipitation, particularly at non-permitted AFO facilities. This is usually in manure storage areas or heavy use areas such as barnyards, stables, wintering areas, and open lots. Usually these practices include clean water embankment diversions, runoff capture and detainment, vegetated treatment of runoff, installation of concrete and curbs to facilitate clean out, and installing a structure with a roof and gutter to collect precipitation and divert it from the site.

REDUCED NUTRIENTS IN FEED

Geographic areas with intense livestock production often import more nutrients in the form of feed than is exported in livestock or crop products. When manure is applied intensely to these areas over long periods of time, phosphorus tends to increase in the soils unless the manure is exported. Phosphorus inputs not only include the natural content of feed, but mineral supplements. Careful balancing of livestock rations may allow reductions in added phosphorus, thereby reducing the phosphorus content of manure. Providing education to producers to promote feed ration optimization as a means to improve profits is a key component to this practice.

PASTURE MANAGEMENT/PRESCRIBED GRAZING

Allowing cattle to overgraze pastures and especially along streams can also lead to stress on pasture and excessive erosion initiated by hoof damage to stream banks. Grazing management consists of developing a plan to maintain vegetative cover usually based on stocking rates, fencing livestock into smaller paddocks to allow for rotational grazing, fencing livestock from sensitive areas such as streambanks, and providing alternative water sources to help distribute impacts from cattle.

EXCLUSION FENCING

Livestock find their own favorite areas to graze, drink, congregate, and rest within a riparian area. Without management, some areas will be overused, and the resulting impacts will impair or destroy the riparian system. This practice includes installing fencing to restrict or eliminate livestock access to streams or other water bodies. This also requires a producer to provide an alternative water source to livestock. Key practice components include providing: off-stream watering, livestock comfort, streamside fencing, stream crossings, and buffer strips.

VEGETATIVE TREATMENT SYSTEM

Installation and evaluation of vegetative treatment systems was supported in the early stages of development by the Nebraska Nonpoint Source Pollution Management Program. The systems were specifically designed for small livestock operations to capture feedlot runoff in a small settling basin. Periodically, the effluent is applied to a permanent grass area through a gravity flow system, or through a sprinkler system, to grassed areas or cropland.

Vegetative treatment systems prevent the runoff and leaching of nutrients, and effectively attenuate bacteria. Vegetative treatment systems might be an adaptable alternative to lagoons for large animal feeding operations. Design and management standards developed in Nebraska were incorporated into the Nebraska NRCS Field Office Technical Guide for management of runoff from small and medium livestock operations.

1.04 URBAN PRACTICES

PET WASTE ORDINANCES/ MANAGEMENT

Pet waste can contribute nutrients and bacteria to water bodies during precipitation events, particularly in urban areas with a high concentration of pets and limited natural areas to manage runoff. Encouraging communities to adopt ordinances requirement pet owners to clean up after their pets is an important first step in this practice. Education of pet owners, however, is critical to compliance with this practice.

POROUS PAVEMENT

Pervious pavement consists of a permeable surface course underlain by a uniformly-graded stone bed. This practice provides temporary storage of precipitation and helps to reduce peak flows during runoff events, promotes infiltration, and reduces runoff of nonpoint source pollution. The surface may consist of porous asphalt, porous concrete, or various porous structural pavers laid on uncompacted soil.

BIOSWALES

Bioswales are vegetated drainage courses designed to trap sediment and other pollutants from storm runoff. They are often installed as an alternative to underground storm sewers. The bioswale is engineered so runoff from frequent, small rains infiltrate into the soil below. When larger storms occur, bioswales slow the flow of runoff while using above ground vegetation to filter and clean the runoff before it ends up in a lake or stream. Bioswales can be good cost-effective replacement for low-flow concrete liners in need of expensive repairs.

SOIL AMENDMENTS

Healthy soil is important to preventing runoff. Typically, as development occurs, top soil is removed, and the remaining subsoil is compacted by grading and construction activity. The owner is left with heavily compacted subsoil, usually with high clay content and little organic matter. Soil quality restoration is simple - start by preserving top soil, reducing soil compaction, and increase organic matter content with the addition of compost. Soil quality restoration can be completed on any existing yard, making this one of the easiest and least expensive water quality conservation practices to implement.

RAIN GARDENS

Small-scale bioretention features, often referred to as ‘rain gardens’, are a structural conservation practice commonly used for stormwater quality improvement and reduction of stormwater runoff in urban areas. When properly designed and maintained, they can offer highly efficient reduction of phosphorus, as well as other pollutants, and are highly aesthetic.

RAIN WATER HARVESTING

Rain barrels are a very simple method for collecting roof runoff for beneficial uses such as irrigation of landscaping and gardens. Residential rain barrels typically hold 55 gallons and are connected to a downspout with a faucet and overflow pipe. Rain water is naturally soft, oxygenated, and free of chemicals that are used to treat most sources of publicly supplied water. This practice reduces runoff from residential areas.

LOW IMPACT LANDSCAPING

Native vegetation enhances a landscape's ability to manage stormwater and requires less water to survive. A diversified habitat with native vegetation encourages use by birds, butterflies, and other wildlife. In most cases, native vegetation doesn't require fertilizer or pesticides for survival. Native landscaping and turf can replace bluegrass and other non-native drought intolerant species commonly used in communities.

LOW OR NO-PHOSPHORUS FERTILIZERS

Nutrients are essential for plant growth, especially nitrogen, phosphorus, and potassium. Fertilizers, pesticides, and animal waste commonly include phosphorus. Excessive phosphorus loading is a leading contributor to algae growth, which lowers water quality and causes several issues in community lakes. No-phosphorus fertilizers (i.e. 30-0-3) are recommended to be used on established lawns, as most soils in Nebraska contain enough natural phosphorus to support a healthy lawn.

LOW IMPACT DEVELOPMENT

Numerous projects in Nebraska, including many in the City of Lincoln, have focused on introducing urban stormwater management practices to citizens, community leaders, and practitioners in the construction and land maintenance industries. Larger communities have relaxed mandatory curb and gutter standards to allow alternative street designs. Curb cuts draining runoff to rain gardens or bioswales and low-maintenance landscapes are now being encouraged in streetscape designs. Architects and engineers are gaining more experience with roof gardens, low-input landscaping and green space as design options for public and private buildings. Permeable pavement is accepted as a common design option for low traffic areas such as parking spaces, trails and walkways. Low/no-phosphate fertilizer is now available through most garden centers and lawn maintenance companies. Landscape designers now promote rain barrels, rain gardens and native plants requiring less water and nutrients. Installation and evaluation of demonstration sites and extensive communication and training for private citizens, community leaders and industry professionals was instrumental in gaining acceptance and creating a market for low impact development practices in Nebraska.

1.05 IN-STREAM OR RIPARIAN CORRIDOR PRACTICES

RE-MEANDERING

Many streams in Nebraska have been straightened for various land use purposes; however, removing meanders and shortening the length of a waterway interferes with the natural functions of a stream and riparian system. A stream naturally tries to maintain a balance between sediment and water conveyance through flow rates and the natural length of the stream. When a stream is shortened is flows faster and becomes more erosive as it tries to regain that balance. Re-meandering consists of mechanically restoring or building meanders back into the stream system to increase length and complexity of the stream channel. This decreases erosion and improves habitat and pollutant treatment capabilities.

OXBOW RECONNECTION

Reconnecting oxbows to a stream can be done on a permanent basis, similar to re-meandering, or providing a connection to an existing oxbow during high flow events. This practice helps to reconnect the stream to the floodplain, increases the channel length, and provides additional habitat and water storage benefits. These features all help a stream to provide additional pollutant treatment capabilities.

FLOODPLAIN CONSTRUCTION/ RECONNECTION

Reconnecting a stream to its historic floodplain or bringing the floodplain back into contact with the stream is typically completed with earth moving equipment and is paired with streambank or grade stabilization practices or riparian area management and may also include reconnecting a stream with old oxbow channels. This practice helps to restore the natural hydrology of a stream system, improves aquatic habitat, and provides more opportunity for pollutant treatment during storm events.

STREAMBANK STABILIZATION

Streambank protection consists of restoring and protecting banks of streams and excavated channels against scour and erosion by using vegetative plantings, soil bioengineering, and structures. Eroding stream banks can be a major contributor of sediment and other pollutants to rivers, lakes, and streams. Due to straightening of streams, increased stream slope has occurred which increases the energy of the flow. This has caused the channel bed to incise resulting in bank failure and channel widening. Erosion occurs in many natural streams that have vegetated banks, however, land use changes or natural disturbances can cause the frequency and magnitude of water forces to increase. Loss of streamside vegetation leads to reduced resistance, making stream banks more susceptible to erosion.

GRADE CONTROL STRUCTURES

Grade control riffles spaced at regular intervals may help curb areas of minor incision in sections of streams by changing their profile from an erosive, steep incline to a stable stair-step pattern with hardened beds at each step. They allow stream elevation to drop in a controlled setting, while preventing further degradation.

IN-STREAM/CONSTRUCTED WETLANDS

In-stream wetlands can be created on small streams by impounding or adding a control structure to the stream, usually in smaller, lower order streams. Construction or restoration of created in-stream wetlands provides an opportunity to control nonpoint source pollution, regulate water storage, and provide habitat for both aquatic and non-aquatic species. A constructed wetland is an artificial wetland created for the purpose of treating runoff from an anthropogenic source, such as a livestock facility, urban runoff, or agricultural runoff. Designers use the natural processes involving wetland vegetation, soils, and hydrology to improve water quality. Constructed wetlands can enhance existing wetland systems or create a new system.

RIPARIAN ZONE RENOVATION

Riparian zone renovation includes improving the interface between land and a waterway through establishment of native vegetation. Riparian zones have been removed from many waterways affecting natural stream flow, accelerating stream bank erosion, and reducing pollutant filtration and infiltration. Structural alternatives may require stream bank reshaping, establishing native vegetation using live pole harvesting and planting, livestock exclusion fencing, and buffering.

1.06 IN-LAKE PRACTICES

SEDIMENT REMOVAL

Lake sediment removal is usually undertaken to deepen a lake and increase its volume to enhance fish production, to remove nutrient rich sediment, to remove toxic or hazardous material, or to reduce the abundance of rooted aquatic plants. The technique is recommended for deepening and for long range reduction of phosphorus release from sediment.

IN-LAKE FOREBAYS

Utilizing a portion of an existing reservoir, adding additional reservoir area above the existing reservoir, or a combination of both as a sediment/water quality basin is another means of minimizing the potential for materials to enter the main basin of a lake. Forebays, which serve as a trap for sediment and other pollutants, are commonly created at the headwaters of the reservoir to complement upstream conservation work. Forebays are multi-beneficial and can be comprised of soil or rock which can serve additional purposes (e.g., fishing jetty). In-lake sediment forebays can reduce sedimentation to the reservoir, capture nutrients, and promote establishment of wetlands as a natural filter. The layout of forebays allows for easier access of equipment to remove sediment when excavation efforts are necessary.

ALUM APPLICATION

An alum application consists of applying a prescribed amount of a chemical complex, typically salts of aluminum, calcium or iron compounds, within a lake to bind with soluble phosphorus and make it unavailable for biological uptake by algae. Aluminum sulfate (alum) is frequently used because it retains its phosphorus-sorbing ability over a relatively wide range of environmental conditions. This allows for the control of algal blooms by reducing the availability of phosphorus that fuels the growth of algae.

LAKE AERATION

Lake aeration can be accomplished by pumping oxygen (or air) into the deep, often nutrient-enriched, oxygen-depleted layer that forms in deeper lakes called the hypolimnion. The goal of hypolimnetic aeration is to maintain oxygen in this layer to limit phosphorus release from sediments without causing the water layers to mix (de-stratify).

SHORELINE STABILIZATION

As reservoirs age, they lose depth due to sediment deposition from the watershed. Shoreline/bank erosion processes can add additional sediment and pollutants to the reservoir while negatively 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. Bank stabilization practices should be recommended based on a reconnaissance survey of each waterbody. A combination of rip rap (hard armor) and tall grass management or tall grass buffers are common for stabilization of shoreline. Stable vegetated shorelines have increased capacity to attenuate pollutants. Operation and maintenance changes can also support a more stable shoreline by limiting mowing and allowing a healthy stand of vegetation to support the banks along shorelines.

FISH RENOVATION

Fisheries renovation and the restoration and enhancement of in-lake fish habitat can help decrease sediment and nutrient re-suspension and restore healthy ecosystem functions, including riparian and littoral vegetation. A focus of fishery renovation oftentimes involves removing rough fish, such as common carp which stir up and suspend bottom sediments in the water column. Potential in-lake restoration components might include shoreline stabilization, shoals, scallops, spawning beds, etc. Because each lake is unique, the most appropriate combinations of habitat improvement techniques should be employed.

AQUATIC HABITAT DEVELOPMENT

Aquatic habitat restoration includes improving the conditions or enhancing stream ecology to support desired fish and other aquatic species. Actions vary depending upon the goals, but may include increasing overhanging vegetation, decreasing sedimentation, reducing algae growth, providing structural habitat, and removing trash and other man-made products. Aquatic habitat improvement is often a component or result of other interventions, such as streambank stabilization, buffering, and riparian zone renovation. Common structural alternatives include restoring natural flow cycles such as reconnection to an oxbow or floodplain, riverine wetland restoration, native vegetation, and wetland enhancement.

PHOSPHORUS PRECIPITATION AND INACTIVATION

Similar to an in-lake alum application phosphorus precipitation and inactivation are techniques used to control algal blooms by reducing the availability of phosphorus that fuels the growth of algae. Phosphorus precipitation uses a relatively low dose of alum to provide temporary control of algal abundance in the water column until the phosphorus supply is replenished.

Phosphorus precipitation can also be used on streams entering a lake by injecting liquid alum on a flow-weighted basis during rain events. Alum-drip systems have resulted in immediate and substantial improvements in water quality to many lakes across the U.S. The use of an alum-drip system is a potential alternative to be used in conjunction with watershed conservation practices, structural practices such as in-lake forebays, and detention structures.

1.07 WETLAND PRACTICES

CONSTRUCTED WETLAND

A constructed wetland is an artificial wetland created for the purpose of treating runoff from an anthropogenic source, such as a livestock facility, urban runoff, or agricultural runoff. Designers use the natural processes involving wetland vegetation, soils, and hydrology to improve water quality. Constructed wetlands can enhance existing wetland systems or create a new system.

WETLAND RENOVATION/RESTORATION

Wetland enhancements such as enlargement, vegetation or hydrology management, or restoration of a filled in wetland can offer many water quality benefits. Wetlands treat and filter water and remove pollutants such as nutrients, sediments, and bacteria through attenuation, absorption, filtration, exposure to UV light and microbial predators. Secondary benefits of wetland enhancements include aesthetics, wildlife habitat creation, groundwater recharge, and restoration of the ecosystem's natural functionality.

PRESCRIBED GRAZING

Grazing is a tool that allows for flexibility with regard to timing, frequency, and intensity of plant defoliation and trampling. There are many ways to use grazing as a management tool in wetlands. One is to use cattle infrequently and for a limited period of time to address a particular management objective. Another scenario is to use cattle as part of a permanent grazing system, such as rotational grazing. Grazing can also be used annually as a tool to maintain the vegetation community.

PRESCRIBED BURNING

Implementing prescribed fire is relatively inexpensive for public land managers who typically already have equipment and trained staff. There are also local burn associations that allow private landowners to work together to implement prescribed fire on their lands. When these resources are not available, private contractors can be hired. Costs vary widely, depending on the site and complexity of the burn plan. In 2013, bids from private contractors ranged from $25.00/acre to $75.00/acre. Most prescribed fires are conducted during late winter through green up (USFWS 2011). Spring represents the best opportunity to acquire burn permits since temperatures are low and humidity is high, making prescribed fires easier to control on days with light wind (USFWS 2007). However, burning can be justified for any season of the year as long as management objectives are met.

HERBICIDE

Depending on the chemical, herbicide applications can significantly impact both desired and undesired vegetation communities. Pederson et al. (1989) recognized the effectiveness of chemical applications but noted their potential negative effects as well. For example, most research indicates that the glyphosate-based herbicides do not cause direct mortality in invertebrates but may induce changes in vegetation structure that have a negative impact (Henry et al. 1994, Solberg and Higgins 1993). Due to the challenges of moving heavy equipment to and within ponded wetlands, herbicide treatments have become a necessary alternative to methods such as haying, shredding, mowing, and disking, particularly when managing some of the more aggressive species such as river bulrush, Phragmites, cattails, and reed canarygrass.

HAYING, SHREDDING, MOWING

Haying, shredding, or mowing temporarily opens wetlands and can result in increased waterfowl and shorebird use. Although Davis and Bidwell (2008) found an increase in vertebrate biomass in shredded wetlands, these treatments generally do not cause long-term changes to plant communities (Pederson et al. 1989, USFWS 2007). Like burning, these methods are nonselective management practices. Haying, shredding, or mowing affect both actively growing desirable and undesirable plants species equally from a vegetative standpoint. If properly timed, however, these methods can place more stress on the undesirable species being targeted (LaGrange and Stutheit 2011).

DISKING AND ROTOTILLING

Disking and rototilling are among the most aggressive mechanical management treatments within wetlands. These actions are non-selective, significantly impacting all species in the treated area. A heavy construction disk or rototiller is designed to mechanically turn over the first eight to twelve inches of soil and cut the root masses of plants into pieces. This equipment can be effective in reducing the population of unwanted vegetation on a site. Experience has shown that for disking alone to be effective, especially on species such as reed canarygrass, a minimum of 3 passes with a heavy disk must be made. Rototilling is more effective in a single pass because the tiller blades cut the roots, rhizomes, and tubers and bring them to the soil surface where they die more quickly by drying in the heat of summer or by freezing during the winter (LaGrange and Stutheit 2011). However, most rototillers are narrow and require the tractor operator to go very slowly which greatly limits the number of acres that can be treated in a day.

WATER LEVEL MANIPULATION

Active management of water levels via supplementation or drawdown, also referred to as moist-soil management, has been documented to significantly increase seed production (Anderson and Smith 1999, Bolen et al. 1989, Haukos and Smith 1993) and invertebrate density (Anderson and Smith 1999, Davis and Smith 1998). Playa wetlands that were managed using moist-soil management techniques had significantly more waterfowl (Anderson and Smith 1999, Haukos and Smith 1993) and shorebird (Anderson and Smith 1999, Davis and Smith 1998) use compared to unmanaged sites. Although water-level manipulation infrastructure exists in some form at most public wetlands, water has not been extensively used as a management tool in the Rainwater Basin (RWB).

SEDIMENT REMOVAL

Sediment removal often requires heavy equipment (e.g., paddle scrapers, pan scrapers, excavators, bull dozers) to excavate culturally accelerated sediment or fill material from the wetland footprint (LaGrange et al. 2011). Sediment removal is not considered a management practice, but rather a wetland enhancement or restoration action (LaGrange et al. 2011, LaGrange and Stutheit 2011). Although this activity can have a profound impact on wetland vegetation, the primary goal of sediment removal is to restore wetland hydrology by removing built-up organic materials and sediment that has been deposited in the wetland from adjacent croplands (LaGrange et al. 2011).

HYDROLOGIC RESTORATION

Restoring the natural hydrologic characteristics of a wetland to the greatest feasible degree enhances both water quality and quantity. This in turn leads to healthier plant and animal communities in the wetland habitat. This can be done in a variety of ways such as reclaiming water from irrigation reuse pits and implementing upstream conservation practices. Large restorations may require additional supplemental water delivery from high volume wells, which would require the development of a long-term funding mechanism.

1.08 GROUNDWATER PRACTICES

WELL SEALING

Well sealing, or well decommissioning of a well includes the of filling, sealing, and plugging a water well. This reduces the risk of pollutants and other contaminants from entering a well which is a direct conduit to groundwater.

OWTS UPGRADE PRACTICES

Adoption of new regulations and new design standards for onsite wastewater systems in 2004, offered an opportunity to address this potential source of bacterial and nutrient contamination of streams. The On-site Wastewater System Upgrade practice for Section 319 projects was created to support pumping and inspection of on-site wastewater systems and to replace systems installed before 2004. Education of homeowners is an important component of this practice to ensure the proper maintenance and functioning of systems.

IRRIGATION MANAGEMENT

See above under Cropland practices.

NUTRIENT MANAGEMENT

Nutrient loss can be reduced by implementing general nutrient application guidelines that have been developed for voluntary or regulatory use. A compilation of guidelines recommended in Nebraska and surrounding states can be used to direct voluntary efforts. Developing a plan to manage nutrients in a farm is an important aspect of properly implementing this practice. General fertilizer application guidelines can include:

- Always apply nutrients at agronomic rates
- Maintain soil phosphorus concentrations at peak production levels
- Do not apply nutrients directly to surface water
- Do not apply nutrients to saturated ground
- Do not apply nutrients to ground that is frequently flooded or when flooding is expected
- Do not apply nutrients to frozen or snow-covered soils

COVER CROPS

Cover crops are an important tool for promoting healthy soils. They are designed to absorb excess nutrients after crop harvest and to prevent erosion when the field would otherwise be bare soil. A cover crop is not typically harvested, but is grown to benefit the topsoil and or other crops; however, certain cover crop varieties to have additional benefits as forage crops. If the length of the growing season permits, however, it can be harvested prior to planting a summer crop. Crops such as cereal rye, oats, sweet clover, winter barley, and winter wheat are planted to temporarily protect the soil from wind and water erosion during times when cropland is not adequately protected.

1.09 CONSERVATION PRACTICE FACILITATION

CONSERVATION CONSULTANT

Structural conservation practices generally are easily understood and permanently maintained by land managers. Adoption of management practices, on the other hand, may require learning and applying new skills and developing confidence over several years that management practices will yield the desired benefits. The conservation consultant practice was created as a complement to other management practices to assist land managers in successfully implementing new management practices such as no-till or nutrient and irrigation management. Successful implementation and understanding of conservation management practices by land managers is critical to long-term continuance of those practices.

WATERSHED COORDINATOR

A watershed coordinator can be vital instrument to ensure the success and implementation of a watershed management plan. The coordinator is a person with the day-to-day responsibilities of implementing the plan. Their duties often consist of coordinate with partner organizations the implementation, tracking, and progress reporting of implementation and BMP efforts. Additionally, they provide personal contact with landowners and perform outreach and education activities. They ultimately provide a face and accountability to a watershed project.

CROP PRODUCTION DEFERMENT

Access to agricultural land for installation of structural conservation practices is severely limited by crop production during the growing season (May – October) and by harsh winter conditions (January – February). The Crop Production Deferment practice was created to remove this obstacle to timely implementation of watershed management projects. Producers are paid the average county rental rate to defer crop production on the area delineated for construction (not whole fields) to allow access for summer construction. The area must have sufficient ground cover prior to construction and must be planted to a cover crop immediately after construction to prevent erosion. Acceptable cover may include early maturing crops (e.g., small grains), forage and grass that the producer may harvest prior to construction. The land must be available no later than August 1 for construction to begin. Construction must be completed within the year of deferment. The producer is compensated after construction is completed and the cover crop is planted.

APPENDIX E: BMP CALCULATOR TOOL

This tool was developed utilizing the water quality models developed as a part of this project. The BMP calculator tool estimates load reductions for singular BMPs, instead of through a treatment train (i.e. if 12 acres of no-till faming was practiced and the associated load reduction is calculated, or if 12 OWTS upgrades were implemented, the associated load reduction is calculated). The file is password protected so the built-in formulas are not inadvertently changed. Users only need to fill in the blue highlighted column in Table 2 with their treatment units to calculate estimated load reductions for all pollutants.

An interactive electronic version (Microsoft Excel File) is included as a digital appendix.

- The password is: UBBNRD

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