River Eutrophication

March 2021

Des Moines River Headwaters Watershed River Eutrophication Total Maximum Daily Load

Excessive Phosphorus in streams and rivers in the Des Moines River Headwaters Watershed

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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Acronyms

AFO	Animal Feeding Operation
AU	Animal units
AUID	Assessment Unit ID
AWWF	Average Wet Weather Flow
BMP	Best Management Practice
BOD_5	5-day biological oxygen demand
BWSR	Board of Water and Soil Resources
CAFO	Concentrated Animal Feeding Operation
cfs	Cubic foot per second
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
CWLA	Clean Water Legacy Act
DO_{Flux}	Diel dissolved oxygen flux
DNR	Minnesota Department of Natural Resources
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
EQuIS	Environmental Quality Information System
HSPF	Hydrologic Simulation Program-Fortran
HUC-08	8-digit Hydrologic unit code
HUC-10	10-digit Hydrologic unit code
IPHTs	Imminent public health threats
kg/day	Kilogram per day
kg/yr	Kilogram per year
LA	Load allocation
lb	Pound
lbs/ac	Pounds per acre
lbs/day	Pounds per day
LC	Loading capacity
LGU	Local Government Unit

m	Meter
MAWQCP	Minnesota Agricultural Water Quality Certification Program
mg/L	Milligrams per liter
MOS	Margin of safety
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer Systems
NLCD	National Land Cover Dataset
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
NSE	Nash-Sutcliffe Efficiency
PWP	Permanent Wetland Preserve
RC	Reserve Capacity
RES	River eutrophication standard
RIM	Reinvest in Minnesota
SDS	State Disposal System
sq mi	Square mile
SSTS	Subsurface Sewage Treatment Systems
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TP	Total phosphorus
ug/L	Microgram per liter
WLA	Wasteload allocation
WPLMN	Watershed Pollutant Load Monitoring Network
WQBELs	Water quality based effluent limits
WRAPS	Watershed Restoration and Protection Strategy
WRP	Wetland Reserve Program
WTP	Water treatment plant
WWTP	Wastewater treatment plant

Executive summary

Section 303(d) of the Clean Water Act (CWA) provides authority for completing Total Maximum Daily Load (TMDL) studies to achieve state water quality standards and/or designated uses. The TMDL establishes the maximum amount of a pollutant a waterbody can receive on a daily basis and still meet water quality standards. The TMDL is divided into wasteload allocations (WLAs) for point or permitted sources, load allocations (LAs) for nonpoint sources (NPSs) and natural background, a margin of safety (MOS), and a reserve capacity (RC).

This report addresses two river eutrophication standard (RES) impaired stream reaches listed on the Section 303(d) impaired waters list within the Des Moines River Headwaters Watershed, 8-digit hydrologic unit code (HUC-08) 07100001. River eutrophication impairments are treated as phosphorus impairments. Addressing multiple impairments in one TMDL report is consistent with Minnesota's Water Quality Framework that seeks to develop watershed-wide protection and restoration strategies rather than focus on individual reach impairments.

The Des Moines River Headwaters Watershed, located in southwestern Minnesota, drains approximately 801,772 acres of six counties (Cottonwood, Jackson, Lyon, Murray, Nobles, and Pipestone). There are 14 communities in the watershed, the largest of which are the cities of Worthington, Slayton, Windom, Lakefield, Heron Lake, and Fulda. Heron, Shetek, and Sarah lakes are in this watershed. Larger streams and rivers include Okabena Creek, Elk Creek, Jack Creek, Beaver Creek, Lime Creek, and the West Fork Des Moines River. The outlet of the Des Moines River Headwaters flows into the Lower Des Moines River (07100002) in Jackson, Minnesota.

This TMDL report used a variety of methods to evaluate current loading contributions by the various pollutant sources, as well as the allowable pollutant loading capacity (LC) of the impaired water bodies. These methods include the Hydrological Simulation Program – FORTRAN (HSPF) model and the flow duration curve approach. This TMDL report was developed in conjunction with a basin-wide TMDL report, which addresses multiple impairments throughout the watersheds of the basin, including the Des Moines River Headwaters Watershed (07100001) and the Minnesota portions of the Lower Des Moines River (07100002) Watershed and the East Fork Des Moines River (07100003).

A general strategy and cost estimate for implementation to address the impairments are included. NPS will be the focus of implementation efforts. NPS contributions are not regulated and implementation efforts will need to proceed on a voluntary basis. Permitted point sources will be addressed through the Minnesota Pollution Control Agency's (MPCA) National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit programs.

1. Project overview

1.1 Purpose

The CWA Section 303(d) requires that states publish a list of surface waters that do not meet water quality standards, and therefore do not support their designated use(s). These waters are then classified as impaired, which dictates that a TMDL must be completed to address them. The TMDL calculates the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loads across the sources of pollutants.

The passage of Minnesota's Clean Water Legacy Act (CWLA) in 2006 and the Clean Water Land and Legacy Amendment in 2008 provided a policy framework and resources to state and local governments to accelerate efforts to monitor, assess and restore impaired waters and to protect unimpaired waters. The result has been a comprehensive "watershed approach" that integrates water resource management efforts, local governments, and stakeholders to develop watershed-scale TMDL reports, restoration and protection strategies, and plans for each of Minnesota's 80 major watersheds. The information gained and strategies developed in the watershed approach are presented in major watershed-scale Watershed Restoration and Protection Strategy (WRAPS) reports, which guide restoration and protection of streams, lakes, and wetlands across the watershed, including those for which TMDL calculations are not made.

This report addresses two RES impaired stream reaches in the Des Moines River Headwaters Watershed listed on the 303(d) Impaired Waters list. The Des Moines River Headwaters Watershed boundaries presented in this TMDL report cover portions of six counties in Minnesota, including Cottonwood, Lyon, Murray, Jackson, Nobles, and Pipestone.

The goal of this TMDL is to quantify the pollutant reductions needed to meet state water quality standards for RES impairments, treated as phosphorus, for river reaches identified in **Table 1** and **Figure 1**. This TMDL report is developed and established in accordance with Section 303(d) of the CWA and provides WLAs and LAs for the watershed as appropriate. This report addresses RES impairments identified in the most recent monitoring and assessment cycle and uses the most recent methods and data available at the time of this report.

This TMDL report is developed in conjunction with a separate watershed-wide TMDL report. The watershed-wide report addresses additional impaired streams and lakes, including 1 chloride impairment, 2 turbidity/TSS impairments and 10 bacteria (*Escherichia coli [E. coli]*) impairments in 13 stream reaches, and 23 excessive lake nutrients (phosphorus) impairments in the Des Moines River Basin (MPCA 2020d). A previous TMDL report was completed in the Des Moines River Basin in 2008. The West Fork Des Moines River Watershed TMDL Final Report: Excess Nutrients (North and South Heron Lakes), Turbidity, and Fecal Coliform Bacteria Impairments (MPCA 2008) was approved by the U.S. Environmental Protection Agency (EPA) in 2008 and an implementation plan, the West Fork Des Moines River and Heron Lake TMDL Implementation Plan (Heron Lake Watershed District 2009), was approved by the MPCA in 2009. The previous report addressed a total of 33 impairments covering lake nutrients, turbidity, fecal coliform bacteria and pH in the Des Moines River Headwaters and Lower Des Moines River Watersheds. For more information, see *West Fork Des Moines River Watershed TMDL Final Report: Excess Nutrients (North and South Heron Lake), Turbidity, and Fecal Coliform Bacteria Impairments*. The watershed-wide TMDL report revises the North and South Heron Lakes TMDLs due to the availability of additional data and a watershed-wide HSPF model.

Previous effluent limit review efforts have determined facilities upstream of North Heron Lake and Talcot Lake have reasonable potential to cause or contribute to an exceedance in lake eutrophication standards. Reasonable potential analysis for facilities downstream of the lakes was completed to determine if they contribute to the RES impairments in reach 07100001-501 and 07100001-527. Based on the previous effluent review and the reasonable potential analysis, it was determined a boundary condition is needed. The boundary condition determination discussion is further described in **Section 4.1.2**.

1.2 Identification of waterbodies

This TMDL report addresses two river eutrophication impairments listed on the 2018 303(d) impaired waterbodies list for the Des Moines River Headwaters Watershed, and are listed in **Table 1**. **Figure 1** shows the location of the impaired reaches in the Des Moines River Headwaters Watershed.

Table 1. Stream reach impairments addressed in this TMDL report.

Watershed (HUC-08)	Assessment Unit ID	Waterbody	Impairment/ Parameter	Designated Class	Beneficial Use[1]	Listing Year
Des Moines River-Headwaters (07100001)	07100001-501	Des Moines River, Windom Dam to Jackson Dam	River Eutrophication	2Bg, 3C	AQR	2018
	07100001-527	Heron Lake Outlet, Heron Lk (32-0057-01) to Des Moines R	River Eutrophication	2Bg, 3C	AQR	2018

[1]AQR = Aquatic recreation.

1.3 Priority ranking

The MPCA's schedule for TMDL completions, as indicated on Minnesota's Section 303(d) impaired waters list, reflects Minnesota's priority ranking of this TMDL report. The MPCA has aligned TMDL priorities with the watershed approach and WRAPS schedule. The MPCA developed a state plan Minnesota's TMDL Priority Framework Report (2015a) to meet the needs of EPA's national measure (WQ-27) under EPA's Long-Term Vision (2013) for Assessment, Restoration and Protection under the CWA Section 303(d) Program. As part of these efforts, the MPCA identified water quality impaired segments that will be addressed by TMDLs by 2022. The Des Moines River Headwaters Watershed waters addressed by this TMDL report are part of that MPCA prioritization plan to meet EPA's national measure.

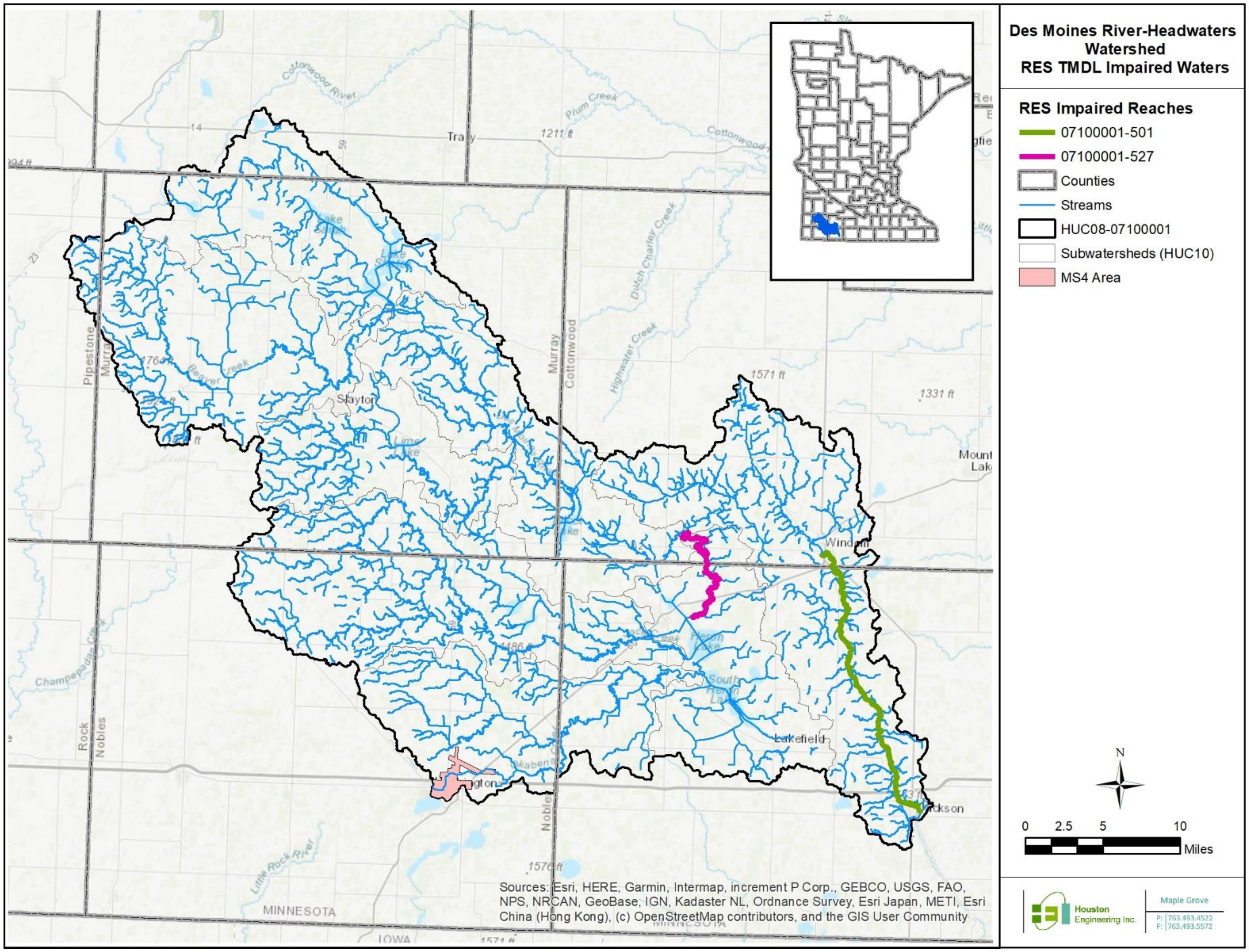


Figure 1. Impaired waters in the Des Moines River Headwaters Watershed addressed in this TMDL report.

2. Applicable water quality standards and numeric water quality targets

The criteria used to determine stream and lake impairments are outlined in the MPCA's document *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment: 305(b) Report and 303(d) List* (MPCA 2018). Minn. R. ch. 7050.0470 lists waterbody classifications and Minn. R. ch. 7050.2222 lists applicable water quality standards.

The Minnesota narrative water quality standard for all Class 2 waters (Minn. R. 7050.0150, subp. 3) states that:

> *The aquatic habitat, which includes the waters of the state and stream bed, shall not be degraded in any material manner, there shall be no material increase in undesirable slime growths or aquatic plants, including algae, nor shall there be any significant increase in harmful pesticide or other residues in the waters, sediments, and aquatic flora and fauna; the normal fishery and lower aquatic biota upon which it is dependent and the use thereof shall not be seriously impaired or endangered, the species composition shall not be altered materially, and the propagation or migration of the fish and other biota normally present shall not be prevented or hindered by the discharge of any sewage, industrial waste, or other wastes to the waters.*

The impaired waters covered in this TMDL report are classified as Class 2Bg. Relative to aquatic life and recreation, the designated beneficial uses for the most stringent classifications, 2B waters, are:

> **Class 2B waters** – *The quality of class 2B surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water aquatic biota, and their habitats according to the definitions in subpart 4c. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface water is not protected as a source of drinking water* (Minn. R. ch. 7050.0222, subp. 4).

The water quality standards shown in **Table 2** are the numeric water quality target for each parameter shown. For more detailed information refer to Minn. R. 7050.0222.

The RES consist of two parts, requiring an exceedance of the causative variable and a response variable, which indicates the presence of eutrophication. The causative variable is total phosphorus (TP). The response variables include chlorophyll-a, diel dissolved oxygen flux (DO_{Flux}), 5-day biochemical oxygen demand (BOD_5), or pH. Water quality standards for the response variables must be met, in addition to meeting phosphorus limits, for the water body to be considered meeting standards. The MPCA evaluated extensive datasets from across the state to establish clear relationships between the causal factor TP and the response variables. It is expected that by meeting the TP target, the response variables (Table 2) will also be met. The RES apply to summer month mean values, for June to September. The Des Moines River Headwaters Watershed is located in the Southern River Nutrient Region and has a TP standard of 150 microgram per liter (ug/L) or 0.15 milligrams per liter (mg/L). For more information on the development of Minnesota's RESs, please see Minnesota Nutrient Criteria Development for Rivers (MPCA 2013a).

Table 2. Surface Water quality standards for Des Moines River Headwaters Watershed stream reaches addressed in this TMDL report.

Standard	Parameter	Water Quality Standard	Units	Criteria	Period of Time Standard Applies
River Eutrophication-Southern Rivers Nutrient Region	Total phosphorus (causative[1])	Not to exceed 150	ug/L	Summer Mean	June - September
	Chlorophyll-a (response[2])	Not to exceed 35	ug/L	Summer Mean	June - September
	Diel dissolved oxygen flux (response[2])	Not to exceed 4.5	mg/L	Summer Mean	June - September
	5-day biological oxygen demand (response[2])	Not to exceed 3.0	mg/L	Summer Mean	June - September
	pH (response[2])	Not to be less than 6.5 or greater than 9.0	su[3]	Summer Mean	June - September

[1]Primary, causative indicator of impairment; must be exceeded to be assessed as impaired.

[2]Secondary, response indicator of impairment; one of the four response parameters must be exceeded to be assessed as impaired.

[3]pH is standard units.

3. Watershed and waterbody characterization

The Des Moines River Headwaters Watershed is located in southwestern Minnesota, and encompasses part of the Western Corn Belt Plains and the Northern Glaciated Plains Region. The watershed covers an area of 1,253 square miles ([sq mi] approximately 801,772 acres) and extends across six counties: Cottonwood, Jackson, Lyon, Murray, Nobles, and Pipestone. The headwaters of the Des Moines River originate in the northwestern part of the watershed in a poorly drained region from its principal source, Lake Shetek. The Des Moines River flows from the Lake Shetek outlet southeasterly for 94 miles to the Minnesota/ Iowa border, through Des Moines, Iowa, and eventually drains to the Mississippi River at Keokuk, Iowa. No part of the Des Moines River Headwaters Watershed is located within the boundary of a Native American Reservation.

The watershed lies on the Coteau des Prairies, a prominent upland in southern Minnesota with a flat iron-shaped plateau that rises to an altitude of more than 1,900 feet (579 m) within the watershed. The western boundary was formed during the late Wisconsin Glaciation and is a terminal moraine. The northern and eastern boundaries of the watershed are also morainic highs formed during recession of the Des Moines lobe during the late Wisconsin Glaciation. The Des Moines River Headwaters Watershed is comprised of glacial deposits reaching a thickness of approximately 900 feet (275 m), with numerous small glacial lakes.

Figure 2 shows the presettlement vegetation in the Des Moines River Headwaters Watershed (DNR 1994), with the main presettlement vegetation classified as prairie. The Des Moines River Headwaters Watershed was largely settled by Europeans between the 1850s and the 1870s, and the majority of the land use changes occurred since then. Additional land use conversion has continued with approximately 81% of the watershed in row crop agriculture, approximately 6% in pasture or grassland, 3% in waterbodies or marshes, approximately 6% urban, and 1.1% forested. Lands adjacent to the Des Moines River are heavily utilized for pasture, cropland, and urban development, with a narrow riparian corridor.

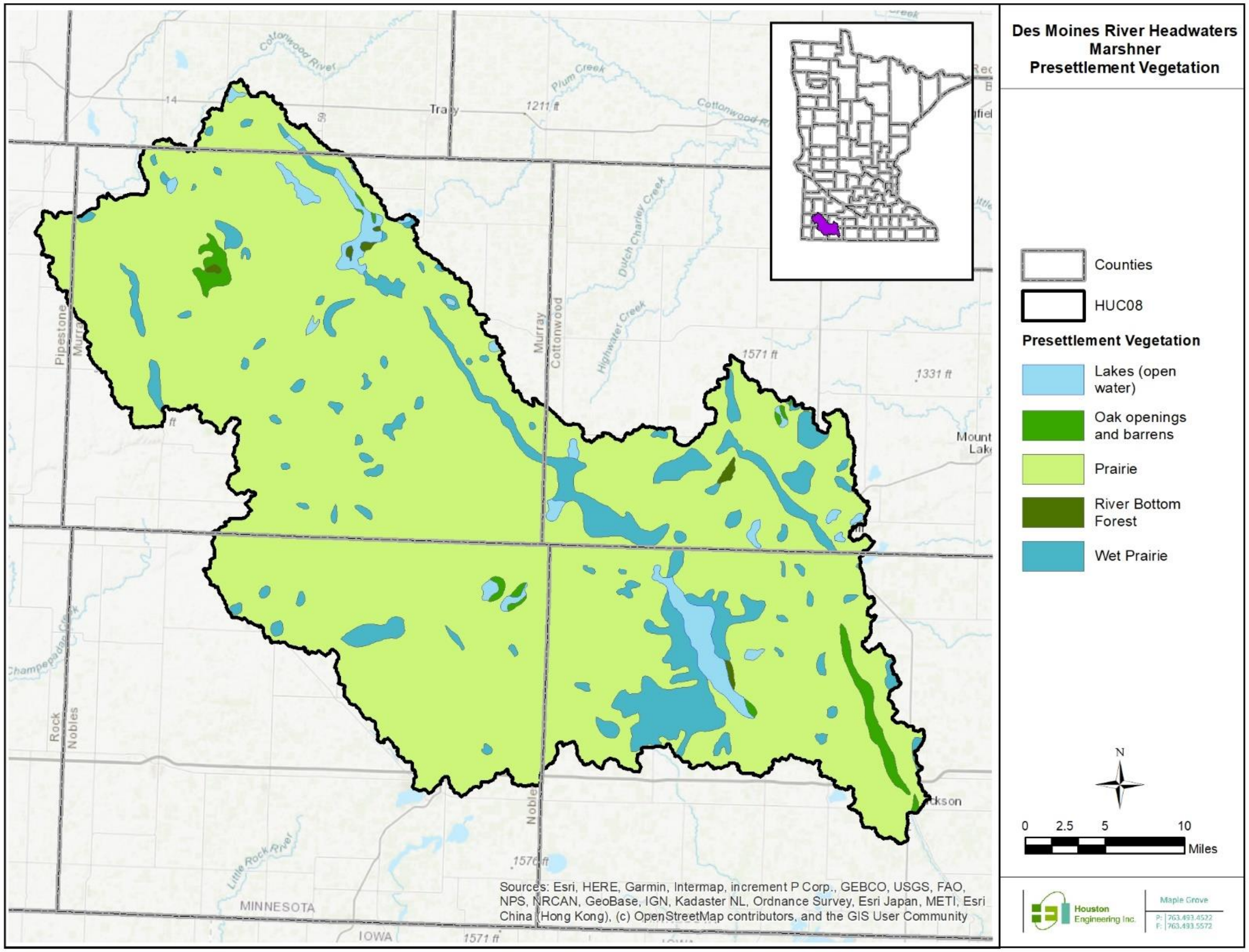


Figure 2. Pre-European settlement vegetation for the Des Moines River Headwaters Watershed.

These changes have resulted in the loss of more than 95% of the historic prairie and wetland communities within the Des Moines River Headwaters Watershed. The current land base is a highly-productive agricultural region characteristic of the loess- and glacial flour- derived soils and precipitation patterns.

3.1 Streams

This TMDL report covers two stream reaches, identified by assessment unit identification (AUID) numbers, with RES impairments. Reach information for each RES impaired stream are presented in **Table 3**.

Table 3. Approximate drainage area of impaired stream reaches.

Watershed (HUC-08)	Stream/Reach Name	AUID	Total Drainage Area [sq mi]	Reach Length [miles]
Des Moines River-Headwaters (07100001)	Des Moines River, Windom Dam to Jackson Dam	07100001-501	1,241	24.86
	Heron Lake Outlet, Heron Lk (32-0057-01) to Des Moines R	07100001-527	443.6	13.61

3.2 Subwatersheds

The headwaters of the Des Moines River flows southeast from the Shetek Lake Subwatershed (headwaters, 0710000102) through watersheds with prominent shallow, natural lakes. The Shetek Lake Subwatershed (HUC-10) is first joined by Beaver Creek Subwatershed (0710000101) and becomes the Talcot Lake-Des Moines River Subwatershed (0710000108). Several HUC-10 subwatersheds in the southern tier of counties then join the Des Moines River, including Lime Creek (0710000104), Okabena Creek (0710000107), Jack Creek (0710000107), and Heron Lake (0710000108) subwatersheds, prior to becoming the city of Windom-Des Moines River Subwatershed (0710000108). Near Jackson, Minnesota the Des Moines River then flows into the Lower Des Moines River Watershed (07100002) and flows into Iowa. **Figure 3** show the HUC-10 subwatersheds for the Des Moines River-Headwaters Watershed. **Table 4** provides a list of impairments addressed in this TMDL report located in each HUC-10 subwatershed.

Table 4. Impairments in each HUC-10 subwatershed.

HUC-08	HUC-10 Subwatershed	Waterbody	AUID/ DNR Lake ID	Impairment/ Parameter
Des Moines River-Headwaters (07100001)	Heron Lake (0710000107)	Heron Lake Outlet, Heron Lk (32-0057-01) to Des Moines R	07100001-527	River Eutrophication
	City of Windom-Des Moines River (0710000108))	Des Moines River, Windom Dam to Jackson Dam	07100001-501	River Eutrophication

The drainage areas for the two RES impaired reaches are shown in **Figure 4**. Reach 07100001-501 watershed drains 1,241 sq mi, and includes all eight of the HUC-10 subwatersheds in the Des Moines River Headwaters Watershed. Reach 07100001-527 watershed drains approximately 444 sq mi, and includes four HUC-10 subwatersheds, including Lime Creek (0710000103), Jack Creek (0710000106), Okebena Creek (0710000105), and Heron Lake (0710000107).

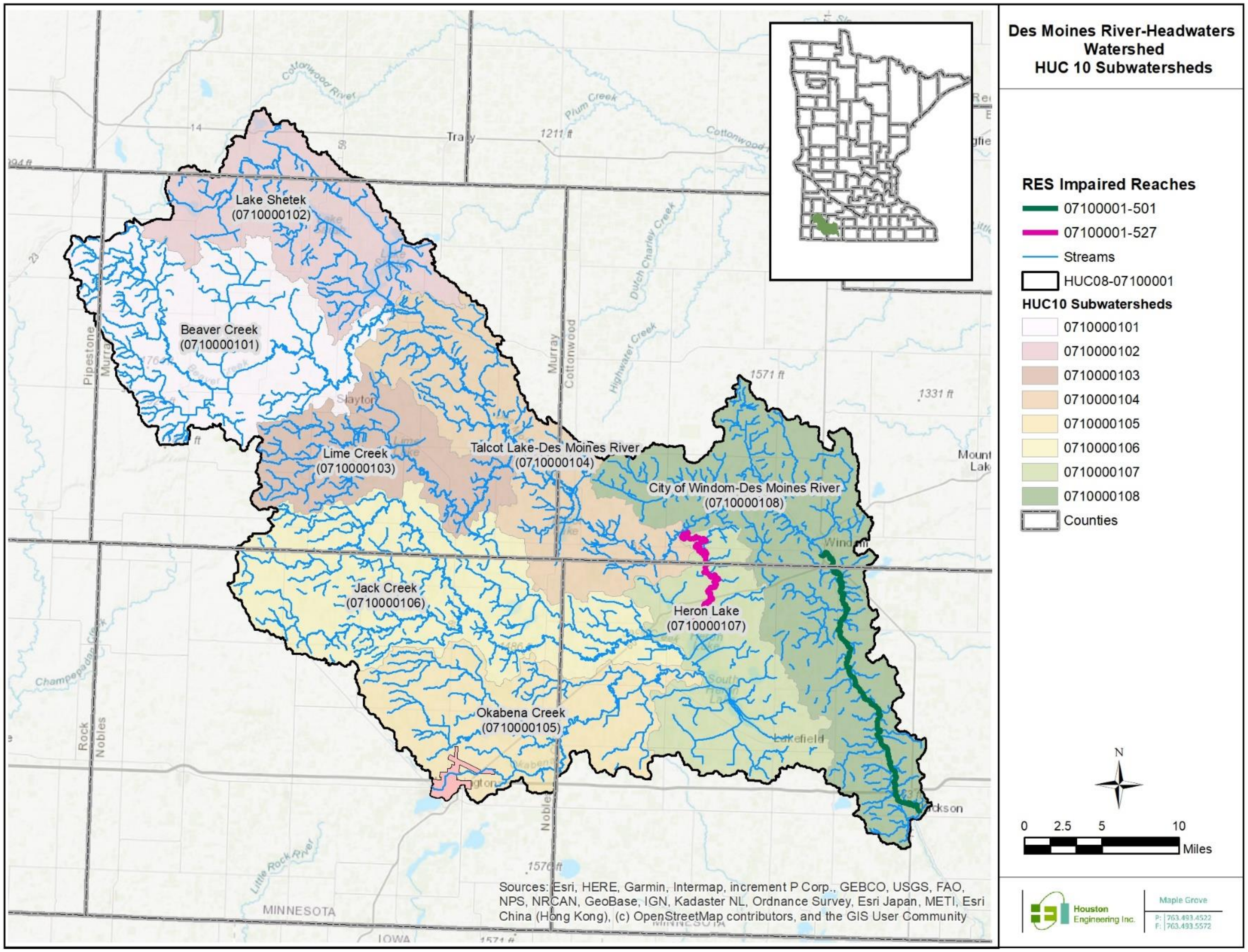


Figure 3. Des Moines River-Headwaters Watershed HUC-10 Subwatersheds.

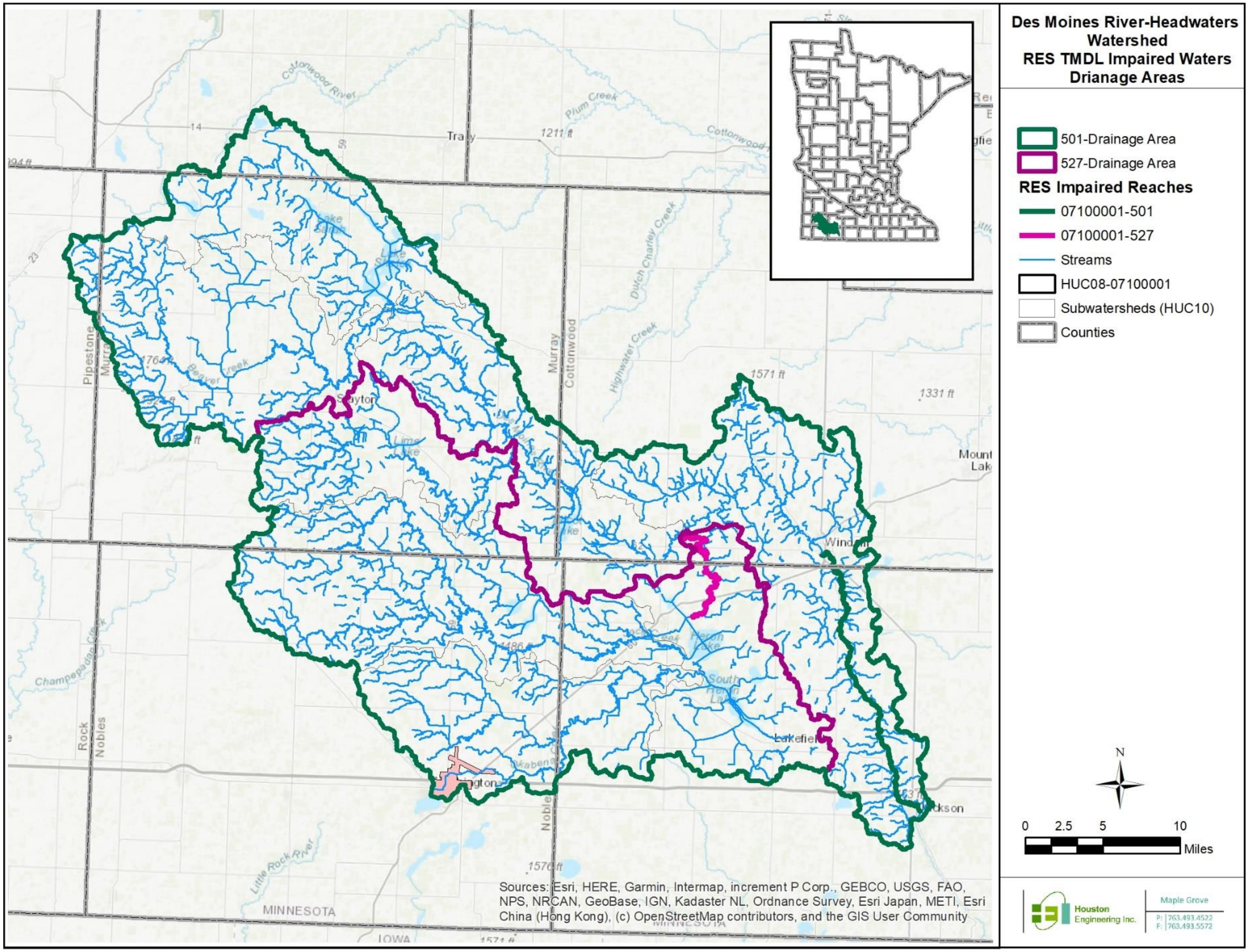


Figure 4. Drainage areas of RES impaired streams in the Des Moines River-Headwaters Watershed.

3.3 Land use

The land use for the Des Moines River-Headwaters Watershed and HUC-10 subwatersheds are summarized in **Table 5** and shown in **Figure 5**. Row crop is the largest land use in each subwatershed, and the watershed as a whole, with wetlands and lakes more common in low-relief subwatersheds. Drainage is prominent in the Beaver Creek, Okabena Creek, and Heron Lake subwatersheds where upland sloughs were historically prominent. However, drainage throughout the entirety of the Des Moines River Headwaters Watershed is common. The conversion of native vegetation to agricultural lands has resulted in increased overland flow, decreased groundwater recharge (lower groundwater infiltration), and increased the NPS transport of sediment, nutrients, chemical (agricultural and residential), and feedlot runoff.

Groundwater recharge in the region is slow and varies from 0 to 6 inches per year (MPCA 2017b). High agricultural land use contributes to high nutrient, sediment, and bacterial export as well, which can impact both surface waters and aquifers. Agricultural land use exceeds 80% in the watershed and receiving surface- and ground- water reflect these uses with elevated nutrient and bacterial loading common throughout the watershed.

Table 5. Land cover (MRLC 2011) in the Des Moines River-Headwaters Watershed

HUC-08/HUC-10 Subwatershed[3]	Cropland [%]	Rangeland [%]	Developed [%]	Wetland [%]	Open Water [%]	Forest/ Shrub [%]	Barren/ Mining [%]
Des Moines River-Headwaters (07100001)	**81.1**	**5.9**	**6.0**	**3.1**	**2.9**	**1.1**	**0.03**
Beaver Creek (0710000101)	82.2	9.8	5.1	1.8	0.6	0.4	0.02
Lake Shetek (0710000102)	72.0	8.7	5.4	3.2	10.3	0.3	0.04
Lime Creek (0710000103)	83.5	4.4	6.4	3.4	1.7	0.5	0.01
Talcot Lake-Des Moines River (0710000104)	80.0	6.3	4.7	5.5	2.9	0.4	0.07
Okabena Creek (0710000105)	88.1	1.7	8.2	1.2	0.2	0.6	0.02
Jack Creek (0710000106)	87.9	2.3	5.2	2.3	1.4	0.9	0.02
Heron Lake (0710000107)[1]	76.7	2.1	6.1	5.6	7.8	1.7	0.02
City of Windom-Des Moines River (0710000108)[2]	76.6	9.4	6.9	2.8	1.4	2.9	0.04

[1]HUC-10 includes reach 07100001-527.

[2]HUC-10 includes reach 07100001-501.

[3]Totals of percentages may not equal 100% due to rounding errors.

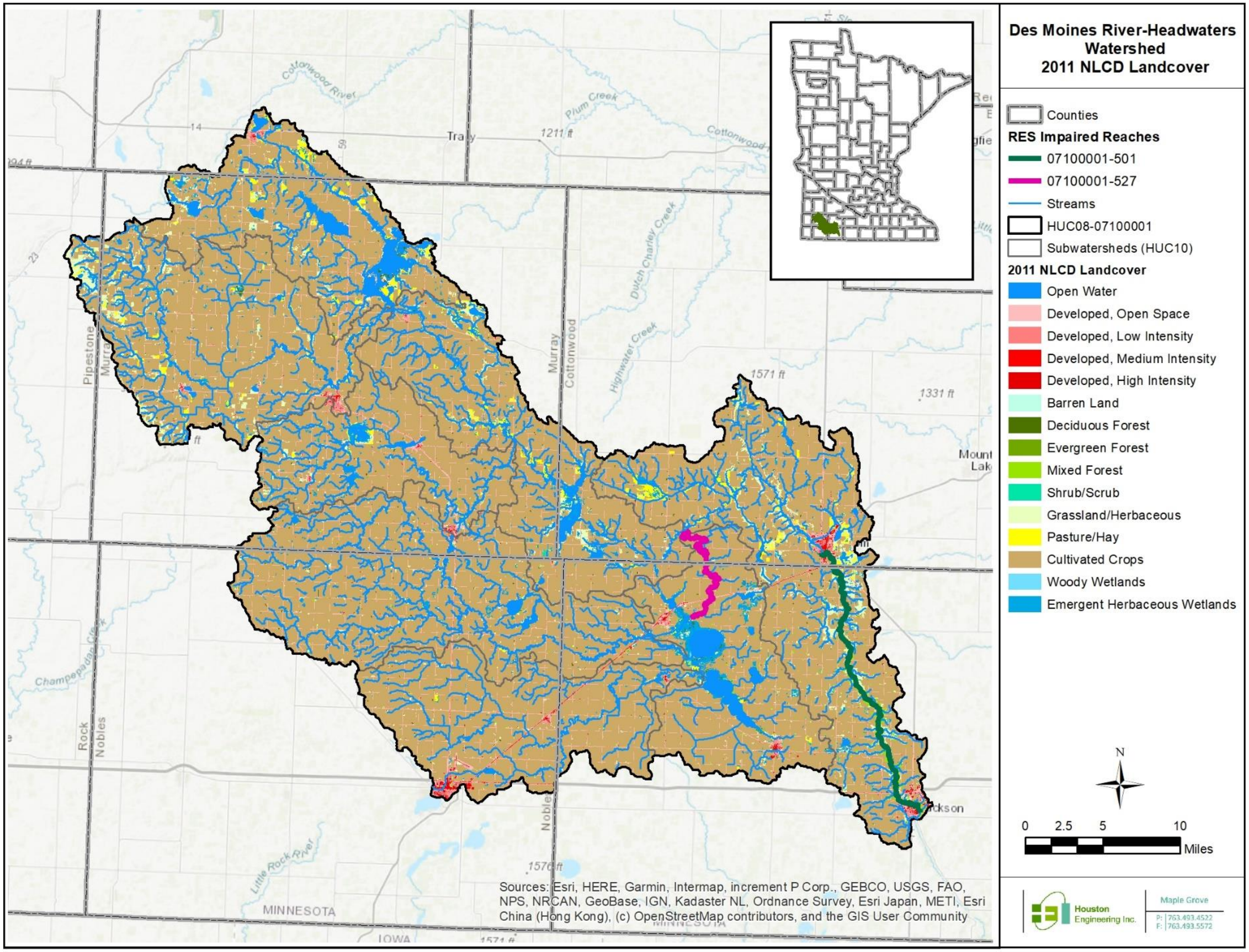


Figure 5. Land use/Land cover (MRLC 2011) in the Des Moines River-Headwaters Watershed.

3.4 Current/historical water quality

Existing water quality conditions are described using data downloaded from the MPCA's Environmental Quality Information System (EQuIS) database[1]. EQuIS stores data collected by the MPCA, partner agencies, grantees, and citizen volunteers. All water quality sampling data utilized for assessments, modeling, and data analysis, for this report and reference reports, are stored in this database and are accessible through the MPCA's Environmental Data Access website[1]. Data from the current 10-year assessment period (2006 through 2015), consistent with the time period for the application of the water quality numeric standards, were used for development of this TMDL report. Various agencies and local partners, such as the MPCA, Soil and Water Conservation Districts (SWCD), local watershed districts, and volunteer monitoring programs collected data to develop this TMDL report. **Figure 6** shows the locations of water quality sites used to develop this TMDL report.

Phosphorus and the available response variables (chlorophyll-a, pH, and/or BOD_5) data are summarized by watershed, AUID, and station in **Table 6** for each impaired stream addressed in this TMDL report. The RES impairments are based on the Southern Rivers Nutrient Region TP standard of 150 ug/L. Chlorophyll-a has a numeric standard of 35 ug/L for the Southern Rivers Nutrient Region, BOD_5 has a numeric standard of 3.0 mg/L, diel DO_{Flux} is not to exceed 4.5 mg/L, and pH must be greater than 6.5 but less than 9, all for Class 2B waters in the Southern Rivers Nutrient Region.

Table 6. Current condition in river eutrophication impairments and water quality sites in the Des Moines River Headwaters Watershed

AUID	Station	Parameter	Period	Number of samples	Summer Average (Jun-Sept)	Number of Exceedances
07100001-501	S000-027	Phosphorus (ug/L)	2014-2015	14	232	14
		Chlorophyll a (ug/L)	2015	6	40.6	2
		pH	2014-2015	21	8.5	0
	S000-481	Phosphorus (ug/L)	2014-2015	9	252	8
		pH	2014-2015	21	8.4	0
	S005-936	Phosphorus (ug/L)	2010-2015	66	218	46
		Chlorophyll a (ug/L)	2011-2013	10	122	7
		pH	2010-2015	59	8.1	0
07100001-527	S002-009	Phosphorus (ug/L)	2005-2015	137	237	96
		Five-day Biological Oxygen Demand (mg/L)	2006-2008	30	9.3	29
		pH	2006-2015	130	8.2	16
	S007-893	Phosphorus (ug/L)	2014-2015	14	216	10
		Chlorophyll a (ug/L)	2014-2015	12	23.9	3
		pH	2014-2015	20	8.3	0

[1] https://www.pca.state.mn.us/environmental-data

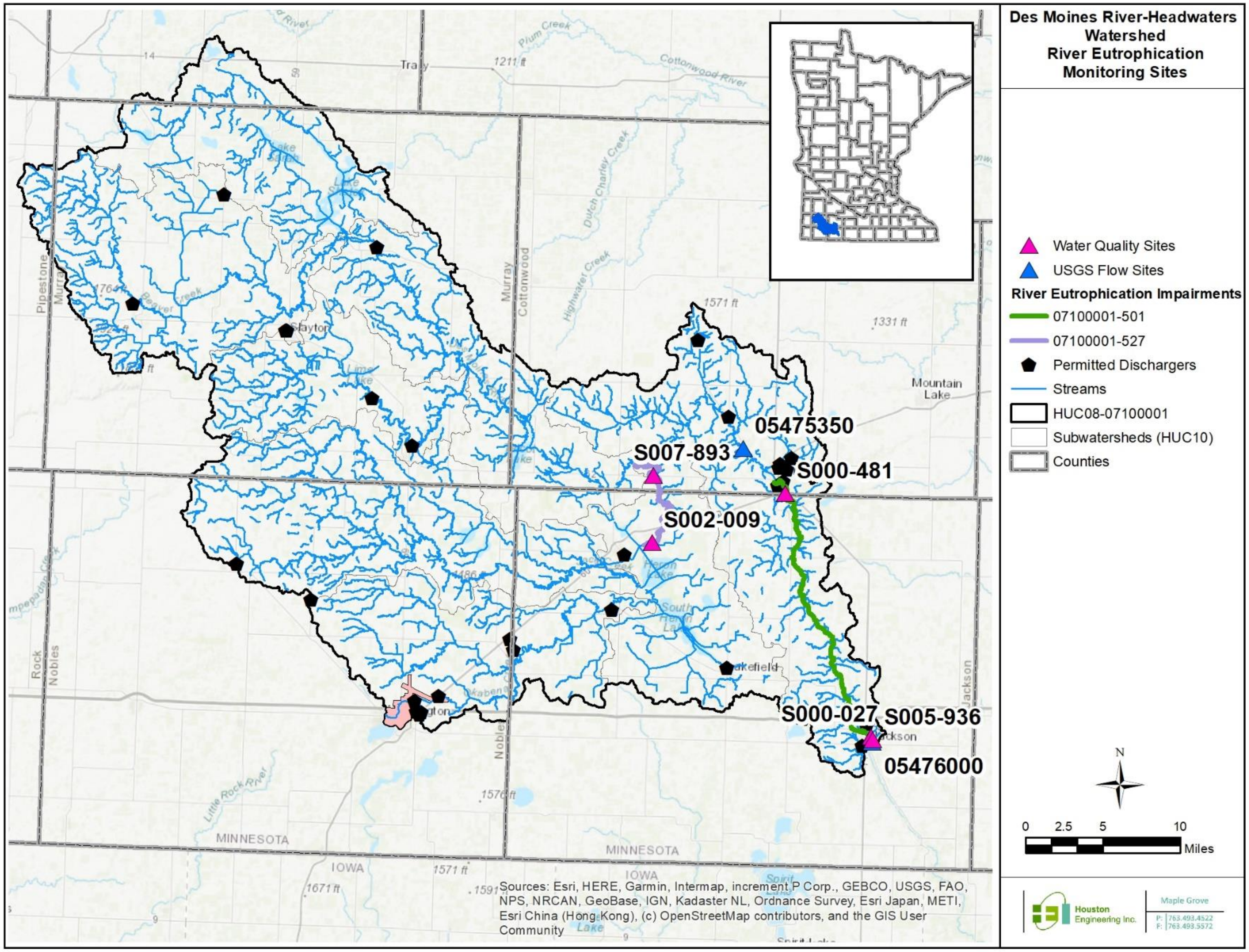


Figure 6. Monitoring locations in impaired stream reaches addressed in this TMDL report.

Two monitoring sites in the watershed are part of the MPCA's Watershed Pollutant Load Monitoring Network (WPLMN) database[2]; one watershed outlet site (Jackson) and one up-stream subwatershed site (Avoca). The WPLMN is a long-term program designed to measure and compare pollutant load information from Minnesota's streams and track water quality trends. Over the years of 2008 through 2015 at the Des Moines River at Jackson, the months of March, June, and July each accounted for 15% to 20% of the load (**Figure 7**). Over a more recent period of record (2013 through 2015), a significant portion of the load was delivered in June alone: 38% at the Jackson site and 56% at the seasonal Avoca site.

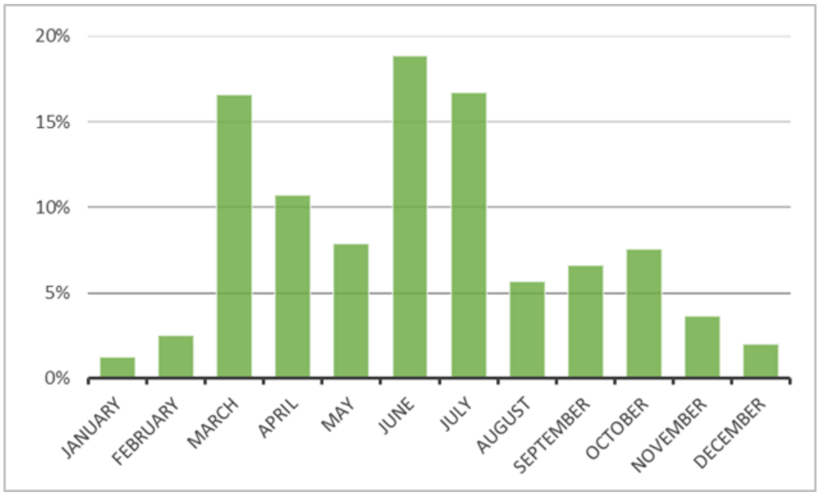


Figure 7. 2008-2015 total phosphorus WPLMN load data from the Des Moines River at Jackson (MPCA 2020c).

3.5 Pollutant source summary

3.5.1 River Eutrophication (Total Phosphorus-Streams)

Sources of phosphorus to impaired reaches addressed in this TMDL report include both point and NPS. Point sources of pollution only include those sources that are regulated through NPDES permits in the impaired watersheds and include permitted stormwater, wastewater, and NPDES-permitted concentrated animal feeding operation (CAFO). Nonpermitted or NPSs include such things as unregulated watershed runoff, septic systems, non-NPDES permitted animal feeding operations (AFOs), streambank erosion, and atmospheric deposition. Individual sources of phosphorus are discussed in detail below.

A numeric estimate of the distribution of phosphorus sources in the watershed is presented in **Figure 8**. **Figure 8** was created using multiple lines of evidence, including the Des Moines River Basin HSPF model and local knowledge (MPCA 2020c). Agricultural land uses, including both surface and tile discharge, were estimated to be the largest source of phosphorus. Much of the phosphorus leaving agricultural fields is from applied fertilizer and manure, while some is also from phosphorus native to the soil.

[2] https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring

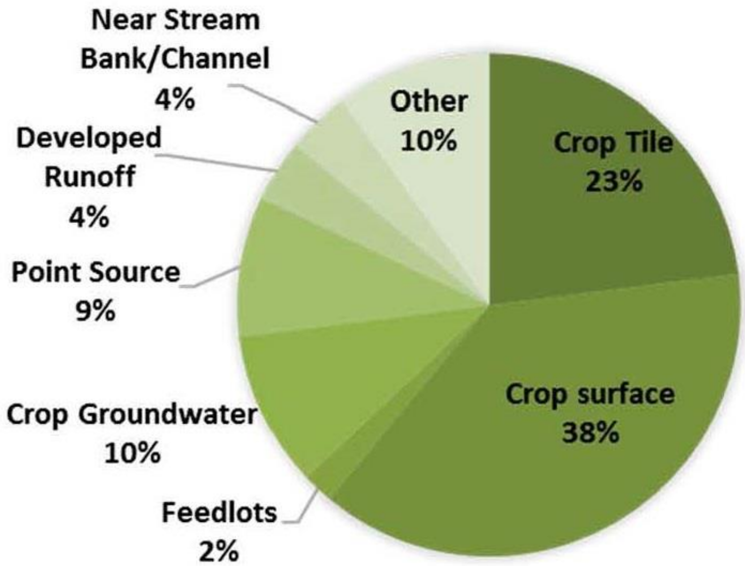


Figure 8. Sources of phosphorus in the Des Moines River watersheds based on the Des Moines River Basin WRAPS report findings (MPCA 2020c).

3.5.1.1 Permitted sources

Permitted sources account for 9% of the phosphorus load in the watershed (**Figure 8**). Permitted sources include permitted feedlots, wastewater treatment plants (WWTP), construction stormwater, industrial stormwater, and municipal stormwater. Each is discussed in detail below.

Feedlot Facilities

In Minnesota, AFOs are required to register with their respective delegated county or the state if they are 1) an animal feedlot capable of holding 50 or more animal units (AU), or have a manure storage area capable of holding the manure produced by 50 or more AUs outside of shoreland; or 2) an animal feedlot capable of holding 10 or more AUs, or have a manure storage area capable of holding the manure produced by 10 or more AUs, that is located within shoreland. Further explanation of registration requirements can be found in Minn. R. 7020.0350. **Figure 9** shows the locations and AUs for registered feedlots in the Des Moines River Headwaters Watershed.

Of the approximately 527 AFOs with 215,493 AUs, in the Des Moines River Headwaters Watershed, 49 are CAFOs. CAFOs are defined by the EPA based on the number and type of animals. See Appendix A for the complete list of CAFOs in the Des Moines River Headwaters Watershed. The MPCA currently uses the federal definition of a CAFO in its permit requirements of animal feedlots along with the definition of an AU. In Minnesota, the following types of livestock facilities are required to operate under a NPDES Permit or a state issued SDS Permit: a) all federally defined CAFOs that have had a discharge, some of which are under 1,000 AUs in size; and b) all CAFOs and non-CAFOs that have 1,000 or more AUs.

CAFOs and AFOs with 1,000 or more AUs must be designed to contain all manure and manure contaminated runoff from precipitation events of less than a 25-year - 24-hour storm event. Having and complying with an NPDES permit allows some enforcement protection if a facility discharges due to a 25-year - 24-hour precipitation event (approximately 5.2 inches in 24 hours) and the discharge does not contribute to a water quality impairment. Large CAFOs permitted with an SDS permit or those not covered by a permit must contain all runoff, regardless of the precipitation event. Therefore, many large CAFOs in Minnesota have chosen to have an NPDES permit, even if discharges have not occurred in the past at the facility. A current manure management plan, which complies with Minn. R. 7020.2225, and the respective permit, is required for all CAFOs and AFOs with 1,000 or more AUs.

CAFOs are inspected by the MPCA in accordance with the MPCA NPDES Compliance Monitoring Strategy approved by the EPA. All CAFOs (NPDES permitted, SDS permitted, and not required to be permitted) are inspected by the MPCA on a routine basis with an appropriate mix of field inspections, offsite monitoring and compliance assistance.

Wastewater Treatment Plants

WWTPs can contribute phosphorus to lakes and streams. There are 19 NPDES wastewater permits in Des Moines River Headwaters Watershed; 12 of them are municipal wastewater permits and 7 are industrial permits. Only three NPDES permits were given WLAs (see **Section 4.3.3**) due to the boundary condition (see **Section 4.1.2**). The WLAs result in a new phosphorus effluent limit for one facility and are consistent with either current or already established future phosphorus effluent limits in the other two. Effluent limits continue to be reviewed every five years as part of the permit review process, and additional or modified limits will be dependent on the receiving water body of the treated water and the broader watershed context. All facilities in the Des Moines River Headwaters Watershed have undergone an MPCA watershed phosphorus review. Watershed scale phosphorus effluent limit reviews are developed to establish the need for TP effluent limits and monitoring requirements for NPDES permitted wastewater treatment facilities. Phosphorus permit limits are based on the potential of a facility to contribute to a downstream water that exceeds lake or RESs. Procedures for implementing RESs in NPDES wastewater permits in Minnesota (MPCA 2015b) outlines the analysis and calculations used to establish necessary phosphorus limits. All facilities in the Des Moines River Headwaters Watershed that hold a permit were invited to attend a meeting in November, 2019 to learn about the TMDL WLAs and the impacts to phosphorus permit limits (see **Section 9**).

Construction Stormwater

Construction stormwater can be a source of phosphorus due to runoff of phosphorus bound to disturbed and easily erodible soils during construction activities. On average, there are approximately 400 acres (about 0.1%) in the watershed covered by a construction stormwater permit at any given time. Construction stormwater permits require erosion control measures, so phosphorus from construction is considered, but not a significant contributor of phosphorus.

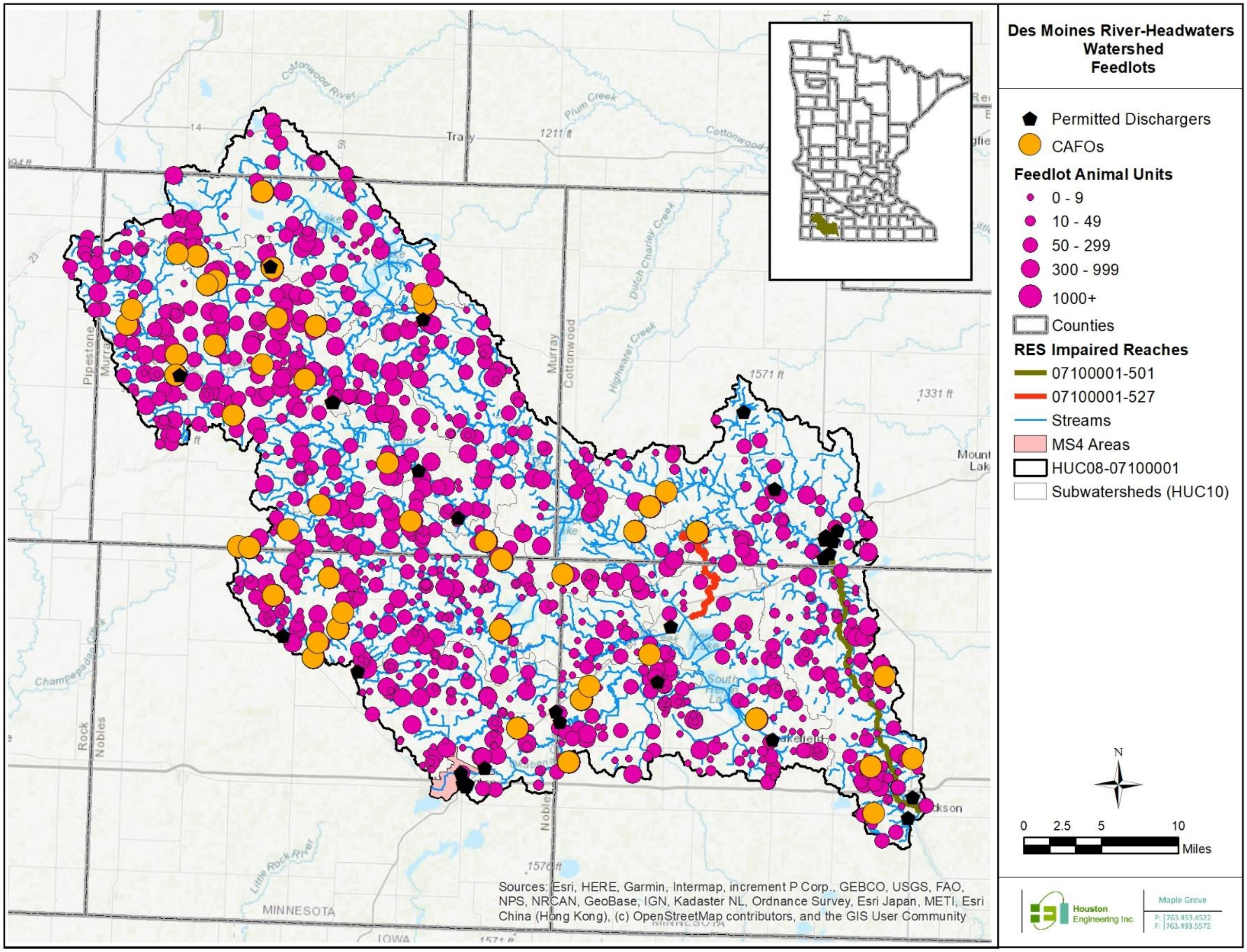


Figure 9. Permitted sources and feedlots in the Des Moines River Headwaters Watershed.

Industrial Stormwater

Industrial stormwater can be a source of phosphorus. A phosphorus-containing material handled, used, processed, or generated, when exposed to stormwater, may leak, leach, or decompose and be carried offsite. There are seven NPDES permitted industrial stormwater permittees, but only one (Heron Lake Bio Energy; NPDES Permit #MN0067385) received a WLA which is consistent with their current permit (see **Section 4.3.3**) in the drainage area of the impaired rivers covered in this TMDL report, due to the boundary condition (see **Section 4.1.2**). It is assumed that loads from permitted industrial stormwater sites that operate in compliance with the permit are meeting the WLA.

Municipal Stormwater

Phosphorus from sediment, grass clippings, leaves, fertilizers, and other phosphorus-containing materials can be a source of phosphorus and can be conveyed through stormwater pipe networks to surface waters. Developed areas attribute approximately 4% of TP load in the Des Moines River Basin watersheds (see **Figure 8**). The city of Worthington (MS4 Permit #MS400257) is the only Municipal Separate Storm Sewer System (MS4) permitted area in the watershed and covers 4.15 sq mi in the drainage area of both impaired reaches. Worthington did not receive a WLA (see **Section 4.3.3**) for either impaired reach, due to the boundary condition (see **Section 4.1.2**).

3.5.1.2 Nonpermitted sources

NPSs (nonpermitted sources) include overland erosion and runoff, streambank erosion, non-NPDES permitted AFOs, land applied manure, subsurface sewage treatment systems (SSTS), and atmospheric deposition. NPSs account for 89% of the phosphorus load in the watershed (see **Figure 8**). Individual NPSs of phosphorus are discussed in detail below.

Upland Erosion and Runoff

Soil erosion can source of nutrients because phosphorus often binds to sediment particles and can be transported downstream along with the sediment. Upland erosion includes overland erosion and tile lines with open tile intakes. In addition to sediment, organic materials often contain phosphorus and, much like sediment, organic materials can be transported across the landscape with runoff. Overland erosion can occur by sheet, rill, or gully modes of sediment transport that can convey phosphorus tightly bound to sediment to surface waters. Upon the formation of a gully, these areas are sensitive and highly susceptible to continued disturbance. In addition, dissolved phosphorus can be transported through tile lines in agriculture areas. Protecting sensitive areas with deep-rooted vegetation that stabilizes soils can help mitigate phosphorus loss. Minimizing uncovered fields can also reduce the erosive power of heavy rain events.

Phosphorus loading from upland sources is estimated to be 0.3-0.6 lbs/acre annually for the Des Moines River Headwaters Watershed. Overland runoff coupled with the high percentage of straightened stream channels, agricultural land use, loss of wetlands and tiling – jointly indicating an altered hydrology – increase the conveyance of phosphorus loss from the landscape to water bodies once mobilized from soils.

Stream Bank Erosion

Like overland erosion, phosphorus can be bound to sediment in streambanks and transported downstream when erosion occurs, and thus be a source of phosphorus. During large precipitation events or during spring snow melt, streams can convey water at high velocity and volumes with significant stream energy. High stream power values commonly observed in the watershed exceed the stress stream banks can withstand. This leads to bank failure and stream bank erosion, with sediment and bound phosphorus transported downstream. The removal of natural vegetation can exacerbate streambank erosion along a channel.

In addition, alterations to the stream reaches, e.g. channel widening and channel straightening, further increase stream energy and likelihood of streambank erosion. Intense agricultural land use throughout the watershed, specifically row crop production, has led to an altered hydrology for the region through the drainage of wetlands and straightening of streams to facilitate farm needs. These landscape-scale hydrological impacts have increased stream slope through straightening streams and the volume of water drained annually. Increased stream slope and water conveyance increases the stream power and the likelihood of streambank failure that can contribute to elevated in-channel phosphorus loads. Near streambank and channel erosion accounts for 4% of TP loading in the watershed.

Non-NPDES Permitted Feedlots and Manure Application

AFOs under 1,000 AUs and those that are not federally defined as CAFOS do no operate with permits. These facilities must operate their facilities in accordance with Minn. R. 7020.2000 through 7020.2150 to minimize their impact on water quality. AFOs may pose an environmental concern if the facilities are located near water and manure is inadequately managed, especially in open lot feedlots. There are 337 facilities in the Des Moines River Headwater Watershed that have open lots. Of those with open lots, 39 are located within 1,000 feet of a lake or 300 feet of a stream.

Approximately 58% of the AUs in the watershed are swine and the majority of the manure is held in liquid manure storage areas. Another 40% of the AUs are cattle and the manure is held in either liquid manure storage areas or in stockpiles. When stored and applied properly, manure provides a natural source for crop fertilizer.

However, manure can have a high content of phosphorus per unit of manure. Since manure can have different ratios of nitrogen to phosphorus content, deliberate manure management measures must be employed to ensure excessive phosphorus application do not occur if manure is applied based on nitrogen rates. There is potentially a significant amount of winter application of manure onto snow covered or frozen soils based on MPCA feedlot staff observation. High intensity precipitation events during the spring can cause erosion of both the soil as well as the manure that is applied onto the soil, leading to high phosphorus loads making their way to streams and lakes. Land applied manure from all AFOs must comply with Minn. R. 7020.2225.

SSTS

Nutrients from SSTSs can be a source of phosphorus. Failing SSTS with an insufficient dry zone between the leach field and bedrock or saturated zone, or improperly designed SSTS, can result in the transfer of phosphorus to groundwater and surface waters. SSTSs that discharge untreated sewage to the land surface are considered imminent public health threats (IPHTs). The approach to identifying IPHTs varies by county, and IPHTs typically include straight pipes, effluent ponding at ground surface, effluent backing up into homes, unsafe tank lids, electrical hazards, or any other unsafe condition deemed by a certified SSTS inspector. Therefore, not all of the IPHTs discharge pollutants directly to surface waters.

Counties are required to submit annual reports to the MPCA regarding SSTS within their respective county. Data reported is aggregate information by each county so the location of SSTSs are not known to the state. SSTS data from the county environmental services offices in each county is shown in **Figure 10**. Data is reported on the county scale and not specific to the Des Moines River Headwaters Watershed. These counties continue to invest in the education of landowners on the maintenance and impact failing systems can have on humans and wildlife.

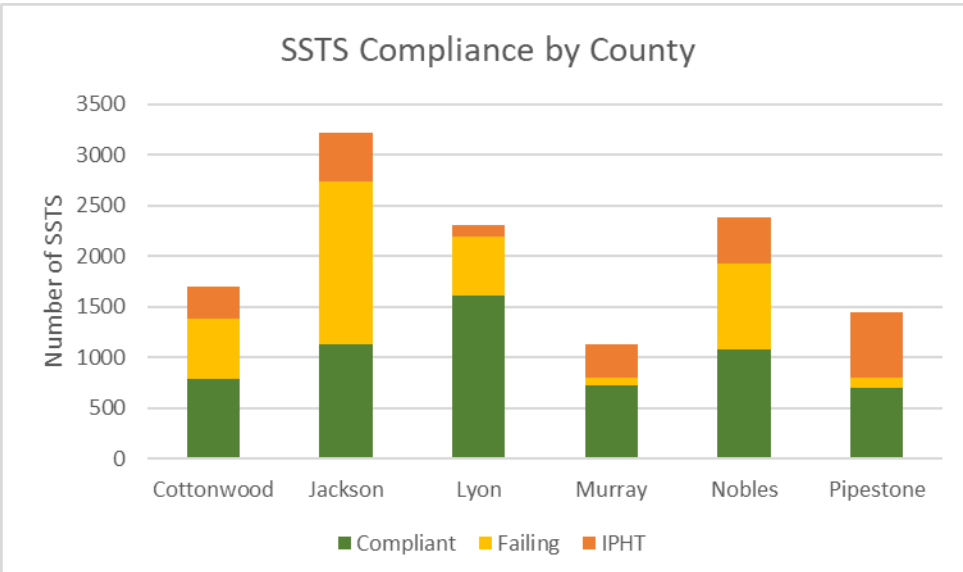


Figure 10. Individual subsurface sewage treatment systems by county in the Des Moines River Headwaters Watershed.

Atmospheric Deposition

Atmospheric deposition to the surface of streams can be a source of phosphorus, include from pollen, soil (aeolian particulates), oil, coal particulate matter, and fertilizers. Regional phosphorus loading for the region is modeled to be 0.99 lb/acre/year (Barr 2007).

4. TMDL development

A TMDL represents the maximum mass of a pollutant that can be assimilated by a receiving waterbody without causing an impairment in that receiving waterbody. TMDLs are developed based on the following equation:

$$TMDL = LC = \sum WLA + \sum LA + MOS + RC$$

Where:

LC = loading capacity, or the greatest amount of a pollutant a waterbody can receive and still meet water quality standards (see **Section 4.3.1**);

WLA = Wasteload allocation, or the portion of the LC allocated to existing or future permitted point sources (see **Section 4.3.3**);

LA = load allocation, or the portion of the LC allocated for existing or future NPSs (see **Section 4.3.2**);

MOS = margin of safety, or accounting for any uncertainty associated with attaining the water quality standard. The MOS may be explicitly stated as an added, separate quantity in the TMDL calculation or maybe implicit, as in a conservative assumption (EPA 2007) (see **Section 4.3.4**);

RC = reserve capacity, or the portion of the TMDL that accommodates for future loads. (see **Section 4.3.5**).

Per Code of Federal Regulations (40 CFR 130.2(1)), TMDLs can be expressed in terms of mass per time, toxicity or other appropriate measures. For this TMDL report, the TMDLs, allocations and margins of safety are expressed in mass/day. Discussion of each TMDL component is discussed in greater detail below.

4.1 Loading allocation methodology/Natural background

4.1.1 Natural background consideration

"Natural background" is defined in both Minnesota rule and statute: Minn. R. 7050.0150, subp. 4 "Natural causes" means the multiplicity of factors that determine the physical, chemical or biological conditions that would exist in the absence of measurable impacts from human activity or influence." The CWLA (Minn. Stat. § 114D.10, subd. 10) defines natural background as "characteristics of the water body resulting from the multiplicity of factors in nature, including climate and ecosystem dynamics that affect the physical, chemical or biological conditions in a water body, but does not include measurable and distinguishable pollution that is attributable to human activity or influence."

In general, natural background conditions refer to inputs that would be expected under natural, undisturbed conditions. Natural background sources can include inputs from natural geologic processes such as soil loss from upland erosion and stream development, atmospheric deposition, and loading from forested land, wildlife, etc. For each impairment, natural background levels are implicitly incorporated in the water quality standards used by the MPCA to determine/assess impairment, and therefore natural background is accounted for and addressed through the MPCA's waterbody assessment process. Natural background conditions were also evaluated, where possible, within the modeling and source assessment portion of this report. These source assessment exercises indicate natural background inputs are generally low compared to livestock, cropland, streambank, WWTPs, failing SSTSs, and other anthropogenic sources.

Based on the MPCA's waterbody assessment process and the TMDL source assessment exercises, there is no evidence at this time to suggest that natural background sources are a major driver of any of the impairments and/or affect the waterbodies' ability to meet state water quality standards. For all impairments addressed in this TMDL report, natural background sources are implicitly included in the LA portion of the TMDL allocation tables, and TMDL reductions should focus on the major anthropogenic sources identified in the source assessment. Federal law instructs an agency to distinguish between natural and nonpoint source loads “[w]herever possible.” 40 C.F.R. § 130.2(g). However, Minnesota law[3] does not compel the MPCA to develop a separate LA for natural background sources, distinct from NPS.

4.1.2 Upstream Waterbodies/Upstream Boundary

Multiple lakes upstream of the RES impaired stream reaches are impaired by excessive nutrients and are included in the Des Moines River Basin Watersheds TMDL Report (MPCA 2020d) that is being completed in conjunction with this TMDL report. Previous effluent limit review efforts have determined facilities upstream of Heron Lake and Talcot Lake have reasonable potential to cause or contribute to an exceedance in lake eutrophication standards. A reasonable potential analysis for facilities downstream of the lakes was completed to determine if they contribute to the RES impairments in reaches 07100001-501 and 07100001-527. Using HSPF, 3 scenarios were simulated to help determine WLAs for WWTPs in the impaired streams’ watersheds. One scenario set the outflow of the lakes to the lake eutrophication standard (90 ug/L of phosphorus) and downstream point source effluent to a limit of 1,000 ug/L of phosphorus. The resulting modeled water quality in the RES reaches met the RES criteria.

Therefore, it was determined that Lake Talcot and North Heron Lake would be the upper boundary of the river eutrophication TMDL impacted area. **Figure 11** shows the boundary conditions for the RES impaired stream reaches. Only point sources within the boundary condition will be given WLAs. Section 3.5.1.1 described the relationship between the WLAs and existing permit limits. Upstream areas will be covered under the TMDLs for Lake Talcot and North Heron Lake (MPCA 2020d).

[3] The MPCA is not required to designate a separate LA for natural background (Matter of Decision to Deny Petitions for a Contested Case Hearing, 924 N.W.2d 638 (Minn. Ct. App. 2019), review denied (Apr. 24, 2019)).

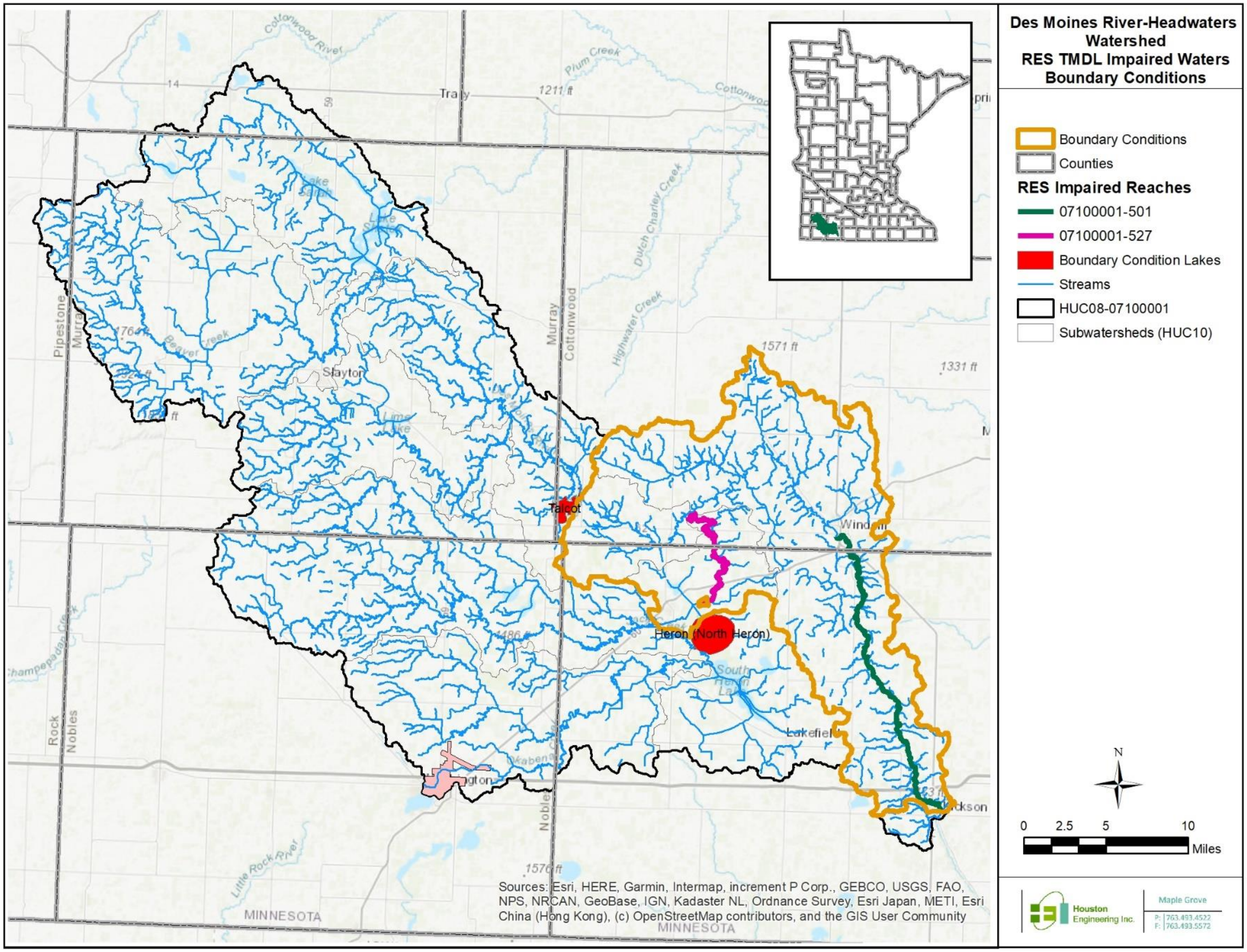


Figure 11. Boundary conditions for impaired reaches addressed in this TMDL report.

4.2 Data Sources

4.2.1 Hydrologic Simulation Program-Fortran

The HSPF model is a comprehensive package for simulation of watershed hydrology sediment transportation, and water quality for conventional and toxic organic pollutants, including P. HSPF incorporates a watershed-scale Agricultural Runoff Model and NPS models into a basin-scale analysis framework that includes fate and transport in one dimensional stream channels. It is a comprehensive model of watershed hydrology and water quality that allows the integrated simulation of point sources, land, and soil contaminant runoff processes with in-stream hydraulic and sediment-chemical interactions. The result of this simulation is a time history of the runoff flow rate, sediment load, and nutrient and pesticide concentrations, along with a time history of water quantity and quality at the outlet of any subwatershed.

An HSPF model was developed in 2016 for Minnesota's portion of the Des Moines River Basin. HSPF models predict the range of flows that have historically occurred in the modeled area and the load contributions from a variety of point and NPSs in a watershed. Multiple memos are available which discuss modeling methodologies, data used, and calibration results for the three major watershed in the basin (Tetra Tech 2016). The HSPF model simulates hydrology and water quality for the period 1993 to 2014. To develop the river eutrophication TMDLs, summer (June-Sept) daily flows and average phosphorus concentrations were extracted from the HSPF model for the period 2005 through 2014.

4.3 Phosphorus

Phosphorus TMDLs were completed for two streams with river eutrophication impairments in the Des Moines River Headwaters Watershed.

4.3.1 Loading capacity

The river eutrophication water quality standard of 150 ug/L is for the summer average concentration in a reach. In order to align with this standard, the LC is based on the seasonal (June through September) average phosphorus load. The LC was calculated as the average seasonal flow multiplied by the South River Nutrient Region TP standard of 150 ug/L. The summer average flow was estimated by taking the midpoint flows of five equally spaced flow zones: 0% to 20%, 20% to 40%, 40% to 60%, 60% to 80%, and 80% to 100% exceeds flows. In other words, the average seasonal flow for each impairment is the average of the 10%, 30%, 50%, 70%, and 90% exceedance flows (**Figures 12 and 13**). This type of averaging was used instead of a simple average of all flows in order to limit the bias of very high flows on phosphorus loading, recognizing that the effects of phosphorus (i.e., algal growth) are most problematic at lower flows. Note that these five flow zones are divided up differently than those typically used in TSS and *E. coli* TMDLs (5%, 25%, 50%, 75%, and 95%). The phosphorus approach is based on using an average of the five flow zones, and having five "equally-sized" zones avoids weighting some zones more than others when calculating the average condition.

The existing concentration of each impaired reach was calculated as the average of the seasonal (June through September) average phosphorus concentrations of the years of available data. The summer average concentrations were taken from the Des Moines River Basin HSPF model (Tetra Tech 2016). The overall estimated concentration-based percent reduction needed to meet each TMDL was calculated as the existing concentration minus the TP standard (150 µg/L) divided by the existing concentration.

Figure 12 and **Table 7** provide the flow duration curve and median flows for AUID 07100001-501, respectively. **Figure 13** and **Table 8** provide the flow duration curve and median flows for AUID 07100001-527, respectively.

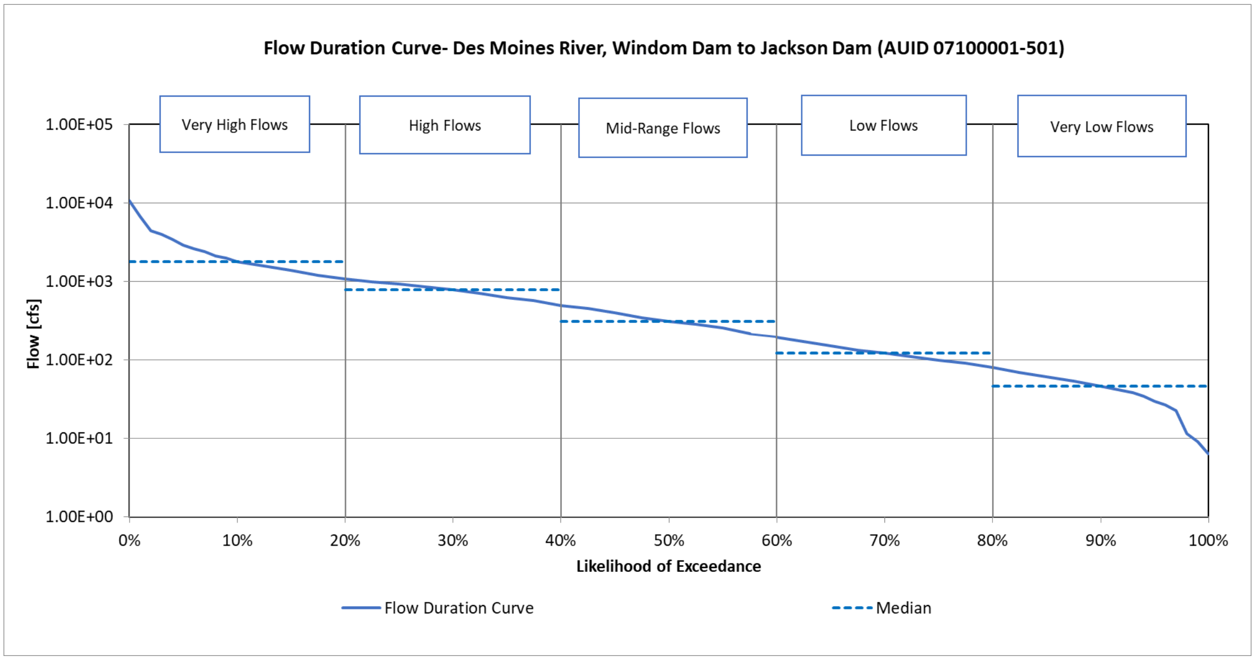


Figure 12. Flow duration curve for Des Moines River, Windom Dam to Jackson Dam (AUID 07100001-501) (2005-2014).

Table 7. Summer average flow and phosphorus loading in Des Moines River, Windom Dam to Jackson Dam (AUID 07100001-501)

Flow		Phosphorus	
Exceedance	Flow (cfs)		
10%	1,792	**Average HSPF TP concentration (ug/L)**	336
30%	786	**Water Quality Standard (ug/L)**	150
50%	309	**Existing Load (lbs/day)**	1,106
70%	121	**Load Capacity (lbs/day)**	494
90%	47	**Load Reduction (lbs/day)**	612
Weighted Average Flow	611	**Percent Reduction (%)**	55.3%

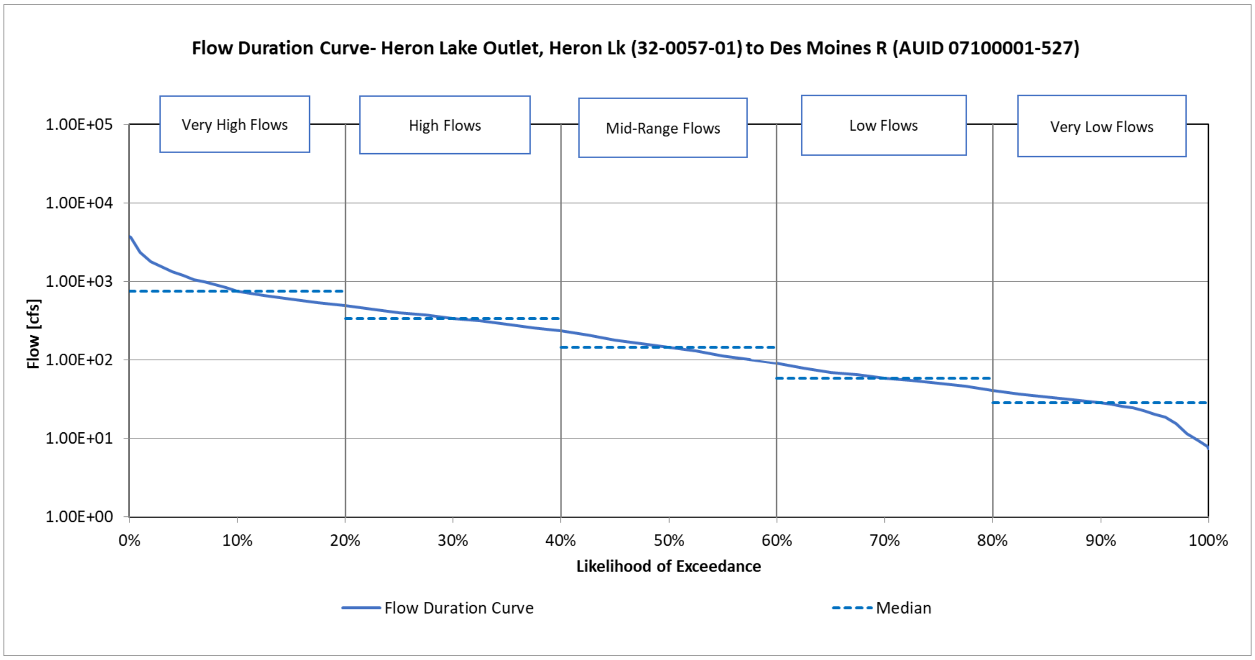


Figure 13. Flow duration curve for Heron Lake Outlet, Heron Lk (32-0057-01) to Des Moines R (AUID 07100001-527) (2005-2014).

Table 8. Summer average flow and phosphorus loading in Heron Lake Outlet, Heron Lk (32-0057-01) to Des Moines R (AUID 07100001-527).

Flow		Phosphorus	
Exceedance	Flow (cfs)		
10%	751	**Average HSPF TP concentration (ug/L)**	302
30%	338	**Water Quality Standard (ug/L)**	150
50%	147	**Existing Load (lbs/day)**	431
70%	59	**Load Capacity (lbs/day)**	214
90%	28	**Load Reduction (lbs/day)**	217
Weighted Average Flow	265	**Percent Reduction (%)**	50.3%

4.3.2 Load allocation methodology

LA represent the portion of the LC designated for NPSs of phosphorus. The LA is the remaining load once the WLA, RC, and MOS are determined and subtracted from the LC. The LA includes all sources of phosphorus that do not require NPDES permit coverage, including unregulated watershed runoff, in/near-channel sources, groundwater, and atmospheric deposition and a consideration for "natural background" conditions. Information on NPSs of phosphorus were previously discussed in **Section 3.5.1**.

4.3.3 Wasteload allocation methodology

Wastewater Treatment Facilities

Based on the boundary condition described in **Section 4.1.2**, only WWTPs downstream of Lake Talcot and Heron Lake need WLAs. All other WWTPs in the drainage areas of the RES impaired reaches are addressed in TMDLs for Lake Talcot or North Heron Lake (MPCA 2020d). There are three permitted wastewater dischargers (**Table 10**) within the boundary condition that need a WLA for the RES impaired reaches. Using HSPF, three scenarios were simulated to help determine WLAs for WWTPs in the impaired streams (MPCA 2017a). For these scenarios, it was shown that if Lake Talcot and Heron Lake were to meet their water quality standards for nutrients, and the WWTPs downstream of the impaired lakes were given a limit on phosphorus of 1,000 ug/L, then the impaired stream reaches would meet the phosphorus numeric standard.

One facility, Heron Lake, already has a 1,000 ug/L limit. The remaining two permits (Red Rock Rural Water Treatment Plant (WTP) and Windom WWTP) have a recommended limit of 1,000 ug/L for June through September (MPCA 2017a). Future permit conditions will be consistent with the assumptions of the TMDL report. The TMDL and implications of the WLAs to permitted facilities were discussed at a meeting with representatives of the point sources in November of 2019 (see Section 9).

WLAs for permitted wastewater dischargers are based on the reported maximum allowable discharge and a set discharge limit of TP. **Table 9** shows the calculation steps to derive the WLA from a maximum flow rate and concentration limit. The permittees, permit numbers, permitted flows, and WLAs are provide in **Table 10,** as well as the AUIDs impacted.

Table 9. Converting flow and permit limit concentrations into phosphorus loads.

Waste Load (lbs/day) = TP Limit (1 mg/L) * Flow (mgd) * Factor			
Multiply by 3.785 to convert	million gallons per day	→	million liters per day
Multiply flow by limit to get	million liters/day* mg/L	→	kg/day
Multiply by **2.204** to convert	kg/day	→	lbs/day

Table 10. WLA for NPDES permitted wastewater dischargers in impaired reaches in Des Moines River Basin.

Watershed (HUC-08)	Facility	Permit Number	AUIDs	Flow (mgd)	Discharge Limits[1] (ug/L)	TP (lbs/day)
Des Moines River-Headwaters (07100001)	Heron Lake WWTP	MNG580189	07100001-501, 07100001-527	0.766[2]	1,000	0.79[3]
	Red Rock Rural Water WTP	MNG640077	07100001-501	0.016	1,000	0.13
	Windom WWTP	MN0022217	07100001-501	1.930[4]	1,000	16.1

[1]Heron Lake has a phosphorus limit; Windom has a future phosphorus limit that has not gone into effect; Red Rock Rural Water has a recommended limit

[2]Assumes 6” discharge a day of 4.6-acre secondary pond = 0.766 mgd

[3]0.766 mgd x 1 mg/L = 6.39 lb/day x 15 summer discharge days = 95.85 lb/season ÷ 122 summer days = 0.785 lb/day.

[4] Windom proposed Average Wet Weather Flow (AWWF) = 1.93 mgd; current AWWF = 1.83 mgd.

Straight Pipe Septic Systems

Straight pipe septic systems are illegal and unpermitted, and as such, receive no WLA.

Industrial and Construction Stormwater Permits

WLAs for construction and industrial stormwater discharges, which are covered by the state’s general permits were combined and addressed through a categorical allocation. Stormwater runoff from construction sites that disturb: (a) one acre of soil or more, (b) less than one acre of soil and are part of a “larger common plan of development or sale” that is greater than one acre, or (c) less than one acre, but determined to pose a risk to water quality are regulated under the state’s NPDES/SDS General

Stormwater Permits for Construction Activity (MNR1000001). This permit requires and identifies best management practices (BMPs) to be implemented to protect water resources from mobilized sediment and other pollutants of concern. If the owner/operator of impacted construction sites, obtain and abide by the NPDES/SDS General Construction Stormwater Permit, the stormwater discharges associated with those sites are expected to meet the WLAs set in this TMDL report.

Similar to construction activities, industrial sites are regulated under general permits, in this case either the NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) or the NPDES/SDS General Permit for Construction Sand & Gravel, Rock Quarrying, and Hot Mix Asphalt Production facilities (MNG490000). Like the NPDES/SDS General Construction Stormwater Permit, these permits identify BMPs to be implemented to protect water resources from pollutant discharges at the site. If the owner/operator of industrial sites abide by the necessary NPDES/SDS General Stormwater Permits, the discharges associated with those sites are expected to meet the WLAs set in this TMDL report. There is one industrial stormwater NPDES permit within the boundary condition, Heron Lake Bio Energy (NPDES Permit #MN0067385) and is in the drainage area of both RES impaired streams. Heron Lake Bio Energy only discharges stormwater, therefore will be covered under the categorical WLA for construction and industrial stormwater WLAs.

It is assumed that 0.1% of the drainage area is under construction and industrial activities at any given time. Therefore, to calculate the WLA for construction and industrial stormwater, this TMDL report assumes that 0.1% of the load capacity for the reach is assigned to construction/industrial stormwater WLA.

Municipal Separation Storm Sewer System (MS4)

The only MS4 area in the watershed is city of Worthington (MS4 Permit #MS400257) but is outside the boundary condition (**Section 4.1.2**). Therefore, no WLA was assigned in this TMDL to the City of Worthington MS4 for either RES impaired reaches.

Livestock Facilities

NPDEs permitted feedlot facilities are assigned a zero WLA. This is consistent with the conditions of the permits, which allow no pollutant discharge from the livestock housing facilities and associated sites. A list of CAFOs within the boundary condition is located in Appendix A.

4.3.4 Margin of safety

The purpose of the MOS is to account for uncertainty with the allocations resulting in attaining water quality standards. Uncertainty can be associated with data collection, lab analysis, data analysis, modeling error, and implementation activities. An explicit 10% of the LC MOS was applied to the TDMLs in this report. The explicit 10% MOS accounts for:

- Uncertainty in the observed daily flow record;
- Uncertainty in the simulated flow and concentration data from the HSPF model;
- Uncertainty in the observed water quality data;

The majority of the MOS is apportioned to uncertainty related to the HSPF model than with the other causes for uncertainty. The hydrologic validation statistics for the HSPF model at the Des Moines River at Jackson, Minnesota (USGS station ID 05476000) were:

- -9.33% error in total flow volume;
- 3.68% error in bottom 50% low flows;
- -8.93% error in the top 10% high flows;
- A Nash-Sutcliffe coefficient of model fit efficiency (NSE) of 0.72 for daily flows;
- And, an NSE of 0.79 for monthly flows;
- -8.34% relative error on phosphorus concentrations.

Overall, the HSPF model accuracy was determined to be "Good". The load capacities were developed using the HSPF modeled daily flow and phosphorus concentrations data from June to September. There is no reason to believe a 10% MOS is inappropriate, as it is consistent with HSPF modeling level of accuracy and the HSPF model is a valid representation of hydrological and chemical conditions in the watershed. More information on the calibration of the HSPF model can be found in Tetra Tech (2016).

4.3.5 Reserve Capacity

The RC represents a set-aside for potential future loading sources. In this TMDL report, the RC is reserved for currently "unsewered" communities that may become "sewered" and discharge to a WWTP in the future.

The potential need for RC for these situations has been estimated based on the assumption that 10% of the unsewered population within the project watershed may discharge to WWTPs in the future. The potential TP load from future WWTPs serving these populations has been calculated based on an assumption of 0.8 kg/capita/year of TP load to the WWTP and a reduction efficiency of 80% at the WWTP, resulting in a load to the receiving water of 0.16 kg/capita/year (MPCA 2012b).

A RC was allocated for both impaired reaches addressed in this TMDL report. These reaches are likely to have "unsewered" communities become "sewered" in the future. A summary of the RC calculations for future "sewered" communities is presented in **Table 11.**

Table 11. Reserve capacity for future "sewered" communities.

Lake (AUID)	Estimated population not currently connected to NPDES permitted WWTP	Estimated required future permit population[1]	Estimated untreated annual TP load[2]	Reserve Capacity [80% removal] (kg/yr)	Reserve Capacity [80% removal] (kg/day)	Reserve Capacity [80% removal] (lbs/day)
07100001-501	1,464	146	117	23	0.06	0.14
07100001-527	179	18	14	3	0.01	0.02

[1]. Not currently connected to NPDES permitted WWTP that may require a TP WLA in the future (10%)

[2]. For population not currently connected to NPDES permitted WWTP that may require a TP WLA in the future (0.8 kg/capita/yr)

4.3.6 Seasonal variation

Critical conditions for the stream eutrophication impairments are during the summer months (June 1 – September 30), which is when phosphorus and chlorophyll-a concentrations peak. Stream assessments for eutrophication focus on summer average TP concentration, chlorophyll-a concentration, BOD_5, diel DO_{Flux} and pH. The TMDL models are focused on the growing season (June 1 through September 30) as the critical condition, which inherently accounts for the seasonal variation. The load reductions are designed so that the stream will meet the water quality standards over the course of the growing season as a long-term average. The nutrient standards set by the MPCA, which are a growing season concentration average rather than an individual sample (i.e., daily) concentration value, were set with this concept in mind. Additionally, by setting the TMDL to meet targets established for the applicable summer period, the TMDL will inherently be protective of water quality during all other seasons.

4.3.7 TMDL summary

The allowable TP load (TMDL) for each reach was divided among the WLA, LA, MOS, and RC as described in the above sections. The following tables summarize the existing and allowable TP loads, the TMDL allocations (wasteload and load in tables), MOS, and RC, plus the estimated load reduction needed to meet RES numeric standard.

The following rounding conventions were used in the TMDL tables:

- Values ≥10 reported in lbs/yr have been rounded to the nearest lb.
- Values <10 and ≥1 reported in lbs/yr have been rounded to the nearest tenth of a lb.
- Values ≥0.01 reported in lbs/day have been rounded to the nearest hundredth of a lb.
- Values <0.01 reported in lbs/day have been rounded to enough significant digits so that the value is greater than zero and a number is displayed in the table.
- While some of the numbers in the tables show multiple digits, they are not intended to imply great precision.
- Some small arithmetic errors may exist; this is due to rounding errors.

Table 12 provides the TMDL for reach 07100001-501 and **Table 13** provide the TMDL for reach 07100001-527.

Table 12. Allocations for Des Moines River, Windom Dam to Jackson Dam (AUID 07100001-501) for River Eutrophication TMDL.

Phosphorus as P		Flow Condition-Summer Average [lbs /day]
Wasteload Allocation	**Total WLA**	**18**
	Heron Lake WWTP	0.79
	Red Rock Rural Water WTP	0.13
	Windom WWTP	16.1
	Construction/Industrial Stormwater	0.49
Load Allocation	**Total LA**	**427**
Margin of Safety		**49**
Reserve Capacity		**0.14**
Loading Capacity (TMDL)		**494**
Existing Load		**1,106**
Estimated Load Reduction		**55%**

Table 13. Allocations for Heron Lake Outlet, Heron Lk (32-0057-01) to Des Moines R (AUID 07100001-527) for River Eutrophication TMDL.

Phosphorus as P		Flow Condition-Summer Average [lbs /day]
Wasteload Allocation	**Total WLA**	**1.2**
	Heron Lake WWTP	0.79
	Construction/Industrial Stormwater	0.43
Load Allocation	**Total LA**	**191**
Margin of Safety		**21**
Reserve Capacity		**0.02**
Loading Capacity (TMDL)		**214**
Existing Load		**431**
Estimated Load Reduction		**50%**

5. Future growth considerations

According to the Minnesota State Demographic Center (MDA 2015), over the next 20 years (2015 to 2035), the populations in the Des Moines River Basin are projected to decrease in all counties (Cottonwood -15%, Lyon -3.1%; Murray -10.7%; Nobles -0.4%; and Pipestone -13.8%), except Jackson (1.5%). Like most of Minnesota's rural areas, this loss of population will likely occur in the rural areas and small towns and will result in a negligible amount of change in land use. The overall population projection for all six counties is -4%. The MPCA does not anticipate significant population growth within the Des Moines River Headwaters Watershed.

5.1 New or expanding permitted MS4 WLA transfer process

Future transfer of watershed runoff loads in this TMDL report may be necessary if any of the following scenarios occur within the project watershed boundaries.

1. New development occurs within a regulated MS4. Newly developed areas that are not already included in the WLA must be transferred from the LA to the WLA to account for the growth.
2. One regulated MS4 acquires land from another regulated MS4. Examples include annexation or highway expansions. In these cases, the transfer is WLA to WLA.
3. One or more nonregulated MS4s become regulated. If this has not been accounted for in the WLA, then a transfer must occur from the LA.
4. Expansion of a U.S. Census Bureau Urban Area encompasses new regulated areas for existing permittees. An example is existing state highways that were outside an urban area at the time the TMDL report was completed but are now inside a newly expanded urban area. This will require either a WLA to WLA transfer or a LA to WLA transfer.
5. A new MS4 or other stormwater-related point source is identified and is covered under a NPDES Permit. In this situation, a transfer must occur from the LA.

Load transfers will be based on methods consistent with those used in setting the allocations in this TMDL report. In cases where WLA is transferred from or to a regulated MS4, the permittees will be notified of the transfer and have an opportunity to comment.

5.2 New or expanding wastewater

A small RC was set aside for each TMDL for future treatment of "unsewered" communities. Because phosphorus loading must be reduced substantially to these reaches, there is little capacity for new sources that will result in more phosphorus being added during the months of June through September. For this reason, only a small RC is available to establish WLAs for the conversion of existing phosphorus loads; it is not intended to provide WLAs for new and expanding industrial or municipal discharges. The RC will support projects that address failing or nonconforming septic systems and "unsewered" communities, and will be made available only to new WWTPs or existing WWTPs that provide service to existing populations with failing or nonconforming systems.

6. Reasonable assurance

A TMDL report needs to provide reasonable assurance that water quality targets will be achieved through the specified combination of point and NPS reductions reflected in the LAs and WLAs. According to EPA guidance (EPA 2002), "When a TMDL is developed for waters impaired by both point and NPSs, and the WLA is based on an assumption that nonpoint-source load reductions will occur... the TMDL report should provide reasonable assurances that nonpoint-source control measures will achieve expected load reductions in order for the TMDL report to be approvable. This information is necessary for the EPA to determine that the TMDL, including the LA and WLAs, has been established at a level necessary to achieve water quality standards". In the Des Moines River Basin considerable reductions in NPSs are required.

The MPCA will:

- Evaluate existing programmatic, funding, and technical capacity to implement basin and watershed strategies.
- Identify gaps in current programs, funding, and local capacity to achieve the needed controls.
- Build program capacity for short-term and long-term goals. Demonstrate increased implementation and/or pollutant reductions.
- Commit to track/monitor/assess and report progress at set regular times.

6.1 Regulatory

6.1.1 Construction Stormwater

State implementation of the TMDL will be through action on NPDES Permits for regulated construction stormwater. To meet the WLA for construction stormwater, construction stormwater activities are required to meet the conditions of the Construction General Permit under the NPDES program and properly select, install, and maintain all BMPs required under the permit, including any applicable additional BMPs of the Construction General Permit for discharges to impaired waters. Local construction stormwater requirements must be met if they are more restrictive than requirements of the State General Permit.

6.1.2 Industrial Stormwater

To meet the WLA for industrial stormwater, industrial stormwater activities are required to meet the conditions of the industrial stormwater general permit or Nonmetallic Mining & Associated Activities general permit (MNG49) under the NPDES program, and properly select, install and maintain all BMPs required under the permit. The BMPs and other stormwater control measures that should be implemented at the industrial sites are defined in the state's NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) or facility specific Individual Wastewater Permit or NPDES/SDS General Permit for Construction Sand & Gravel, Rock Quarrying and Hot Mix Asphalt Production facilities (MNG490000). If an industrial facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS Permit and properly selects, installs and maintains all BMPs required under the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL report.

6.1.3 Wastewater NPDES & SDS Permits

Permits issued under the NPDES program are required to have effluent limits consistent with the assumptions and requirements of the WLAs in this TMDL report. Attaining the WLAs, as developed and presented in this TMDL report, is assumed to ensure meeting the water quality standards for all of the river eutrophication 303(d) listings. During the permit issuance or reissuance process, wastewater discharges will be evaluated for the potential to cause or contribute to violations of phosphorus water quality standards. Water Quality Based Effluent Limits (WQBELs) will be developed for facilities whose discharges are found to have a reasonable potential to cause or contribute to phosphorus above the water quality standards. The WQBELs will be calculated based on summer average conditions, may vary slightly from the TMDL WLAs, and will include concentration based effluent limitations, as found in the Phosphorus Effluent Limit Review memorandum (MPCA 2017a).

6.1.4 Subsurface Sewage Treatment Systems Program

SSTS, commonly known as septic systems, are regulated by Minn. Stat. §§ 115.55 and 115.56. Counties and other local units of government (LGUs) that regulate SSTS must meet the requirements for local SSTS programs in Minn. R. ch. 7082. Counties and other LGUs must adopt and implement SSTS ordinances in compliance with Minn. R. chs. 7080, through Minn. R. ch. 7083.

These regulations detail:

- Minimum technical standards for individual and mid-size SSTS;
- A framework for LGU to administer SSTS programs and;
- Statewide licensing and certification of SSTS professionals, SSTS product review and registration, and establishment of the SSTS Advisory Committee.

Compliance inspections by Counties and other LGUs are required by Minnesota Rule for all new construction, and for existing systems if the LGU issues a permit for the addition of a bedroom. In order to increase the number of compliance inspections, the MPCA has developed and administers several grants to LGUs for various ordinances. Additional grant dollars are awarded to counties that have additional provisions in their ordinance above the minimum program requirements. The MPCA has worked with counties through the SSTS Implementation and Enforcement Task Force to identify the most beneficial way to use these funds to accelerate SSTS compliance statewide. Figure 14 shows the number of SSTS replaced in the counties that are included in the Des Moines Headwaters Watershed since 2002.

The MPCA staff keeps a statewide database of potentially unsewered or undersewered areas that could include IPHT systems. Some of those systems potentially could be straight-pipe systems. The counties and other LGUs are working on assessing these areas and determining if any individual straight pipes exits. Upon confirmation of a straight-pipe system, the county sends out a notice of noncompliance, which starts a 10-month deadline to bring the system into compliance.

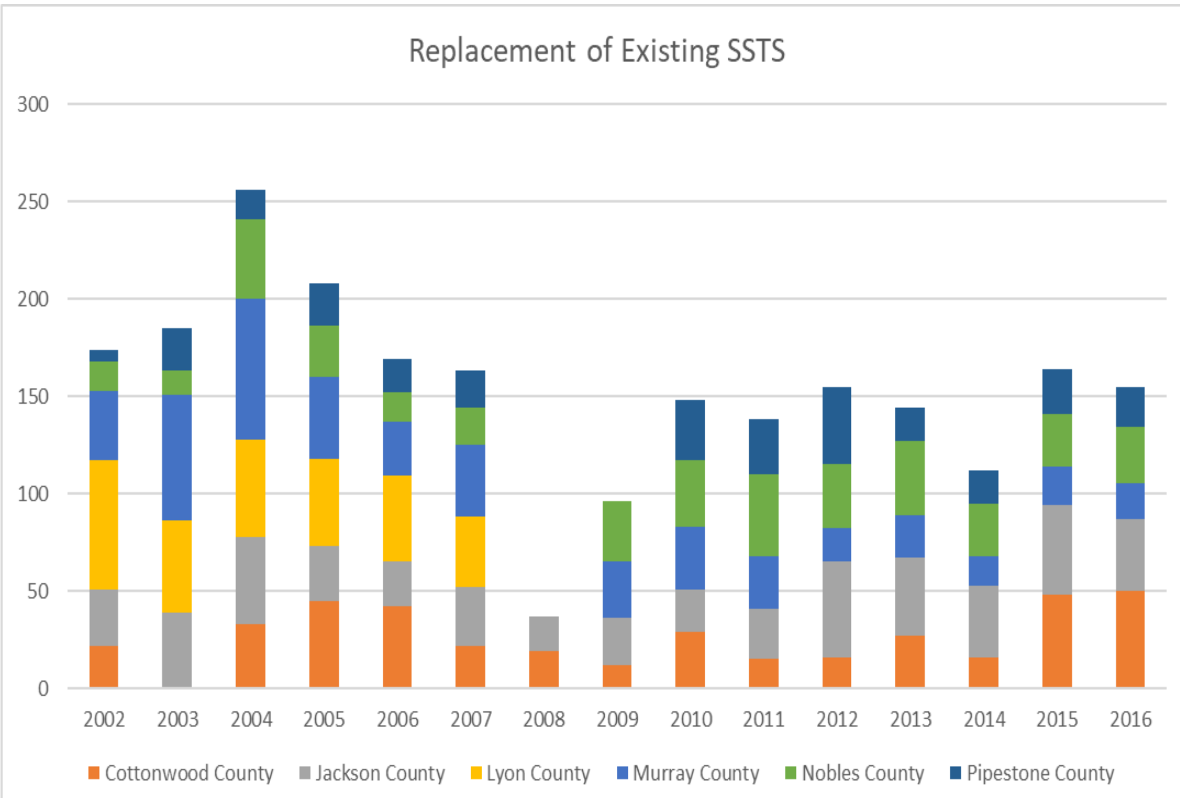


Figure 14. SSTS replacements in the Des Moines Headwaters Watershed counties since 2002.

6.1.5 Feedlots

All feedlots in Minnesota are regulated by Minn. R. ch. 7020. The MPCA has regulatory authority for feedlots, but counties may choose to participate in a delegation of the feedlot regulatory authority to the local unit of government. Delegated counties are then able to enforce Minn. R. ch. 7020 (along with any other local rules and regulations) within their respective counties for facilities that are under the CAFO threshold. In the Des Moines River Basin, all of its counties of Murray, Cottonwood, Jackson, Nobles, Pipestone, Lyon, and Martin are delegated the feedlot regulatory authority. The counties will continue to implement the feedlot program and work with producers on manure management plans.

The MPCA regulates the collection, transportation, storage, processing and disposal of animal manure and other livestock operation waste. The MPCA Feedlot Program implements rules governing these activities and provides assistance to counties and the livestock industry. The feedlot rules apply to most aspects of livestock waste management including the location, design, construction, operation and management of feedlots and manure handling facilities.

Since 2011, 469 facilities have been inspected in the Des Moines River Headwaters Watershed. Thirty-four inspections showed minor noncompliance and two showed major noncompliance. An additional 20 inspections were conducted in regards to land application. Three minor noncompliance inspections were noted.

6.1.6 Nonpoint Sources

Existing regulations on NPSs of pollution are limited. The following are the current, existing NPS statutes/rules in Minnesota:

- 50-foot buffer required for the shore impact zone of streams classified as protected waters (Minn. Stat. § 103F.201) for agricultural land uses and 16.5-foot minimum width buffer required on public drainage ditches (Minn. Stat. § 103E.021). As of January 2020, the counties of the Des Moines River Watershed have ranged from 80% to 100% compliance (Cottonwood 95% to 100%; Lyon 80% to 89%; Murray 95% to 100%; Jackson 95% to 100%; Nobles 95% to 100%; Pipestone 95% to 100%) (BWSR 2020).
- Protecting highly erodible land within the 300-foot shoreland district (Minn. Stat. § 103F.201).
- Excessive soil loss statute (Minn. Stat. § 103F.415)
- Nuisance NPS pollution (Minn. R. 7050.0210, subp. 2)

6.2 Nonregulatory

6.2.1 Pollutant Load Reduction

Water Quality Trends for Minnesota Rivers and Streams at Milestone Sites (MPCA 2014) notes that sites across Minnesota, including the Des Moines River Headwaters Watershed, show reductions over the period of record for TSS, phosphorus, ammonia, and BOD_5. The Minnesota NRS documented a 33% reduction of the phosphorus load leaving the state via the Mississippi River from the pre-2000 baseline to current (MPCA 2015c). These reports generally agree that while further reductions are needed, municipal and industrial phosphorus loads as well as loads of runoff-driven pollutants (i.e. TSS and TP) are decreasing; a conclusion that lends assurance that the Des Moines River Basin WRAPS and TMDL phosphorus goals and strategies are reasonable, and that long-term, enduring efforts to decrease erosion and nutrient loading to surface waters have the potential to reduce pollutant loads.

Reliable means of reducing NPS pollutant loads are fully addressed in the WRAPS report (MPCA 2020c), a document written to be a companion to this TMDL report. In order for the impaired waters to meet water quality standards, the majority of pollutant reductions in the Des Moines River Basin will need to come from NPSs. Agricultural drainage and surface runoff are major contributors of nutrients, bacteria, sediment, and increased flows throughout the watershed. As described in the Des Moines River Basin WRAPS report, the BMPs included there have all been demonstrated to be effective in reducing transport of pollutants to surface water. The combinations of BMPs discussed throughout the WRAPS process were derived from Minnesota's Nutrient Reduction Strategy (NRS) (MPCA 2015c) and related tools. As such, they were vetted by a statewide engagement process prior to being applied in the Des Moines River Basin.

Selection of sites for BMPs will be led by LGUs, including SWCDs, watershed districts, and county planning and zoning, with support from state and federal agencies. These BMPs are supported by programs administered by the SWCDs and the Natural Resource Conservation Service (NRCS). Local resource managers are well-trained in promoting, placing, and installing these BMPs. Some counties within the basin have shown significant levels of adoption of these practices. State and local agencies will need to work with landowners to identify priority areas for BMPs and practices that will help reduce nutrient runoff, as well as streambank and overland erosion. Agencies, organizations, LGUs, and citizens alike recognize that resigning waters to an impaired condition is not acceptable. Throughout the course of the WRAPS and TMDL meetings, local stakeholders endorsed the BMPs selected in the WRAPS report. These BMPs reduce pollutant loads from runoff (i.e. phosphorus, sediment and pathogens) and loads delivered through drainage tiles or groundwater flow (e.g. nitrates).

From 2004 to 2019, over 3,800 BMPs were installed in the Des Moines River Headwaters Watershed by local partners (MPCA 2020a) using a variety of state, federal, and private funds. **Figure 15** depicts the number of BMPs per subwatershed in the Des Moines Headwaters Watershed. Additional information about the BMPs may be found on the MPCA's Healthier Watersheds website.

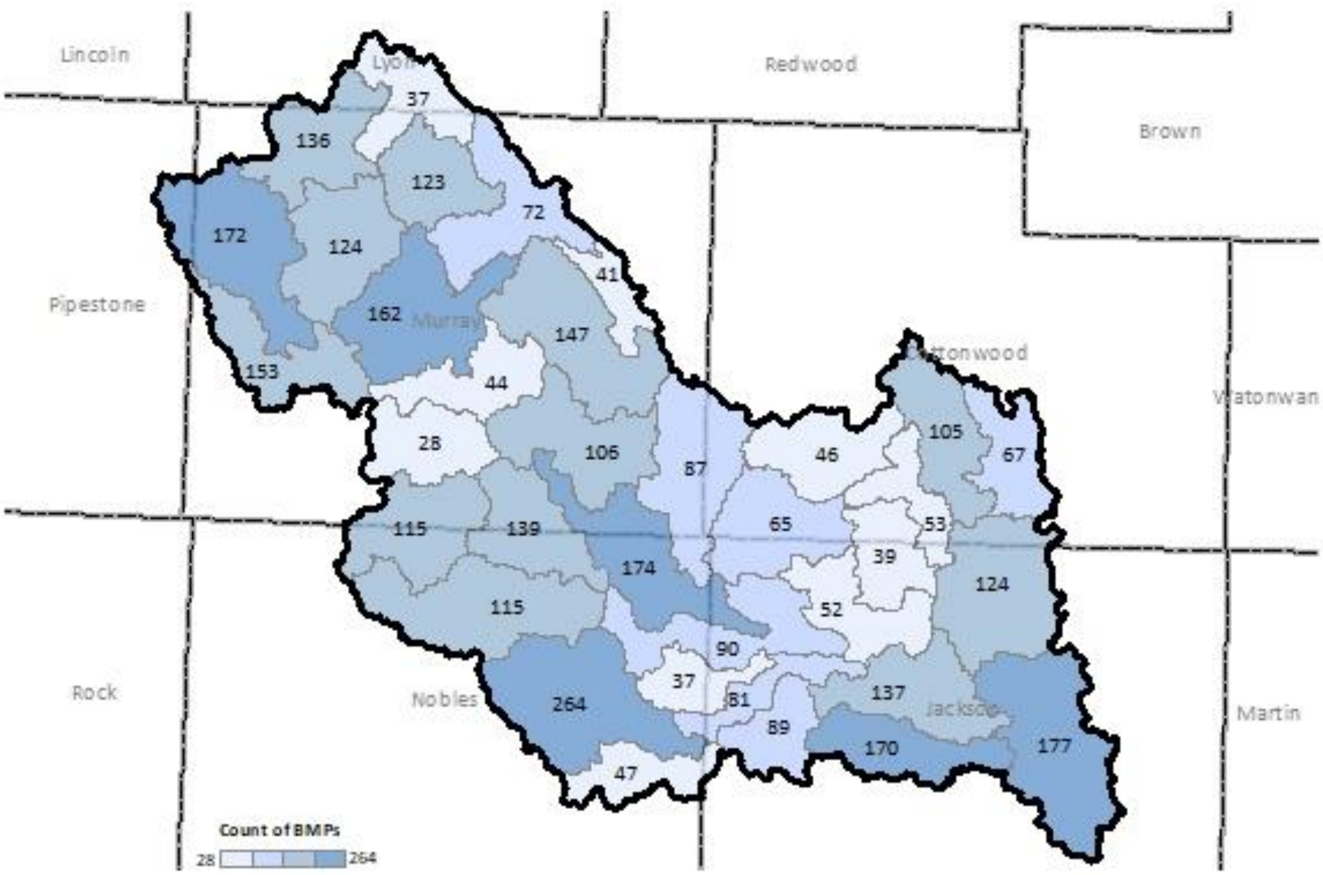


Figure 15. The number of reported BMPs installed by subwatershed in the Des Moines River Headwaters Watershed.

To help achieve NPS reductions, a large emphasis has been placed on public participation, where the citizens and communities that hold the power to improve water quality conditions are involved in discussions and decision-making. The watershed's citizens and communities will need to voluntarily adopt the practices at the necessary scale and rates to achieve the 10-year targets presented in the Des Moines River Basin WRAPS Report. The WRAPS report also presents the pollutant reduction goals and targets for the primary sources, and the estimated years to meet the goals developed by the WRAPS Local Work Group. The strategies identified and relative adoption rates developed by the WRAPS Local Work Group were used to calculate the adoption rates needed to meet the pollutant/stressor 10-year targets. In addition to public participation, several government programs are in place to support a political and social infrastructure that aims to increase the adoption of strategies that will improve watershed conditions and reduce loading from NPSs. Section 6.2.3 provides funding spent in the watershed through these government programs as well as local and landowner contributions.

Minnesota Nutrient Reduction Strategy

The *Minnesota Nutrient Reduction Strategy* (MPCA 2014) guides activities that support nitrogen and P reductions in Minnesota waterbodies and those downstream of the state (e.g., Lake Winnipeg, Lake Superior, and the Gulf of Mexico). The NRS was developed by an interagency coordination team with help from public input. Fundamental elements of the NRS include:

- Defining progress with clear goals.
- Building on current strategies and success.
- Prioritizing problems and solutions.
- Supporting local planning and implementation.

Included within the strategy discussion are alternatives and tools for consideration by drainage authorities, information on available tools and approaches for identifying areas of P and nitrogen loading and tracking efforts within a watershed, and additional research priorities. The NRS is focused on incremental progress and provides meaningful and achievable nutrient load reduction milestones that allow for better understanding of incremental and adaptive progress toward final goals. It has set a reduction of 45% for both P and nitrogen in the Mississippi River, downstream of the Des Moines River Basin.

Successful implementation of the NRS will require broad support, coordination, and collaboration among agencies, academia, local government, and private industry. The MPCA is implementing a framework to integrate its water quality management programs on a major watershed scale, a process that includes:

- Intensive watershed monitoring.
- Assessment of watershed health.
- Development of WRAPS reports.
- Management of NPDES and other regulatory and assistance programs.

This framework will result in nutrient reduction for the basin as a whole and the major watersheds within the basin.

Agricultural Water Quality Certification Program

The Minnesota Agricultural Water Quality Certification Program is a voluntary opportunity for farmers and agricultural landowners to take the lead in implementing conservation practices that protect waters. Those who implement and maintain approved farm management practices are certified and in turn obtain regulatory certainty for a period of 10 years.

Through this program, certified producers receive:

- **Regulatory certainty**: Certified producers are deemed to be in compliance with any new water quality rules or laws during the period of certification.
- **Recognition**: Certified producers may use their status to promote their business as protective of water quality.
- **Priority for assistance**: Producers seeking certification can obtain specially designated technical and financial assistance to implement practices that promote water quality.

Through this program, the public receives assurance that certified producers are using conservation practices to protect Minnesota's lakes, rivers, and streams. Since the start of the program in 2014, the Ag Water Quality Certification Program as of June 2020 has state-wide:

- Enrolled over 620,000 acres;
- Included 900 producers;
- Added more than 1,800 new conservation practices;
- Kept over 84 million pounds of sediment out of Minnesota rivers;
- Saved 230 million pounds of soil and 46,00 pounds of P on farms; and

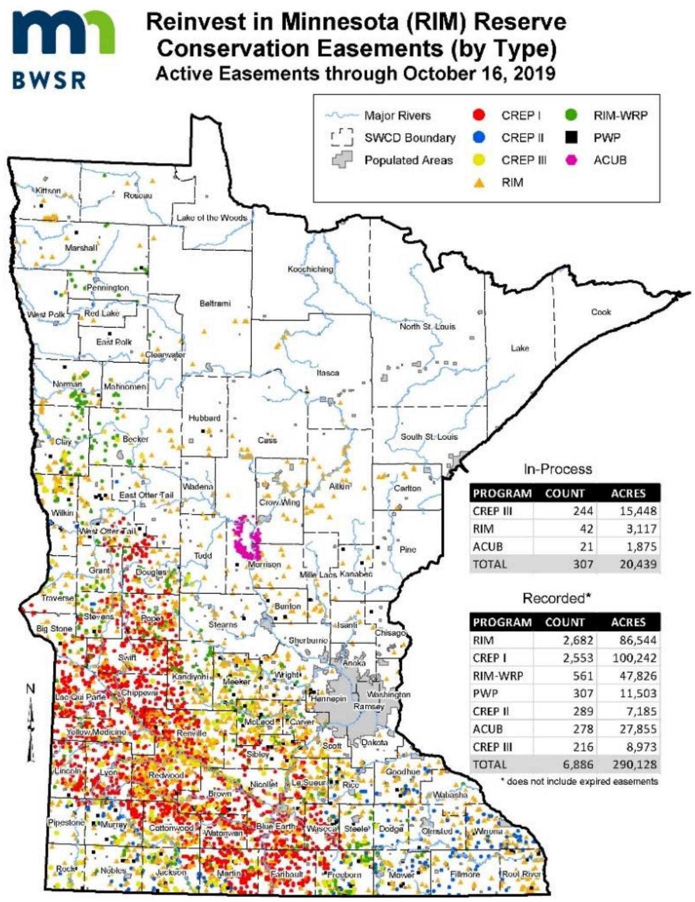
As of November 2020, there were 23,341 acres certified in the Des Moines River Headwaters Watershed.

Federal Section 319 Grants

Federal Section 319 grants and state Clean Water Partnership grants and loans have been utilized within the Des Moines River Headwaters Watershed. Section 319 grants are utilized by local units of government to work with citizens and landowners to implement NPS conservation practices. These funds also help with education and public participation to help promote the voluntary practices and educate on water quality. Clean Water Partnership grants were also awarded to local units of government to implement conservation practices and fund education and public participation activities. Clean Water Partnership loans are loaned out to local units of governments and have primarily been utilized to upgrade septic systems within the watershed. Section 319 grants are continuing in the South Heron Lake subwatershed and loans are continuing for septic system upgrades throughout the watershed.

Minnesota Conservation Easements

Conservation easements, both permanent and temporary, are a critical component of the state's efforts to improve water quality by reducing soil erosion, phosphorus and nitrogen loading, and improving wildlife habitat and flood attenuation on private lands. Easements protect the state's water and soil resources by permanently restoring wetlands, adjacent native grassland wildlife habitat complexes and permanent riparian buffers. In cooperation with county SWCDs and the USDA NRCS, Board of Water and Soil Resources (BWSR) programs compensate landowners for granting conservation easements and establishing native vegetation habitat on economically marginal, flood-prone, environmentally sensitive or highly erodible lands. These easements vary in length of time from 10 years to permanent/perpetual easements. Types of conservation easements in Minnesota include: Conservation Reserve Program (CRP); Conservation Reserve Enhancement Program (CREP); Reinvest in Minnesota (RIM); and the Wetland Reserve Program (WRP) or Permanent Wetland Preserve (PWP), and are implemented throughout Minnesota (**Figure 16**). As of October 2019, in the counties of Cottonwood, Jackson, Lyon, Murray, Nobles, and Pipestone, there were 69,520 acres of short-term conservation easements such as CRP and 28,140 acres of long term or permanent easements (CREP, RIM, WRP; BWSR 2019).



In-Process

PROGRAM	COUNT	ACRES
CREP III	244	15,448
RIM	42	3,117
ACUB	21	1,875
TOTAL	307	20,439

Recorded*

PROGRAM	COUNT	ACRES
RIM	2,682	86,544
CREP I	2,553	100,242
RIM-WRP	561	47,826
PWP	307	11,503
CREP II	289	7,185
ACUB	278	27,855
CREP III	216	8,973
TOTAL	6,886	290,128

* does not include expired easements

Figure 16. Reinvest in Minnesota Reserve Conservation Easements by county in Minnesota broken out by type.

6.2.2 Prioritization

The Des Moines River Basin WRAPS details a number of tools that provide means for identifying priority pollutant sources and implementation work in the watershed. Further, LGUs in the Des Moines River Basin often employ their own additional local analysis for determining priorities for work.

Light Detection and Ranging data is available for all of the Des Moines River Basin within Minnesota. It is being increasingly used by LGUs to examine landscapes, understand watershed hydrology, and prioritize BMP targeting.

A Prioritize, Target, and Measure Application (PTMApp) was developed for the Des Moines River Headwaters Watersheds which produced a data set that includes the most cost-effective BMP implementation for identified priority resources, including impaired waters. The PTMApp is being used by LGUs in watershed planning efforts.

6.2.3 Funding

On November 4, 2008, Minnesota voters approved the Clean Water, Land and Legacy Amendment to the constitution to:

- protect drinking water sources;
- protect, enhance, and restore wetlands, prairies, forests, and fish, game, and wildlife habitat;
- preserve arts and cultural heritage;
- support parks and trails; and
- protect, enhance, and restore lakes, rivers, streams, and groundwater

This is a secure funding mechanism for 25 years with the explicit purpose of supporting water quality improvement projects.

Additionally, there are many other funding sources for nonpoint pollutant reduction work; they include but are not limited to CWA Section 319 grant programs, the state Clean Water Partnership 0% interest loan program, BWSR state Clean Water Fund implementation funding, and NRCS incentive programs. Programs and activities are also occurring at the local government level, where county staff, commissioners, and residents work together to address water quality issues.

Since 2004, over $128 million dollars have been spent addressing water quality issues in the Des Moines River Headwaters Watershed (**Figure 17**). CRP payments made up 34% of the amount equally over $43 million dollars. Additional information about funding may be found on the MPCA's Healthier Watersheds website.

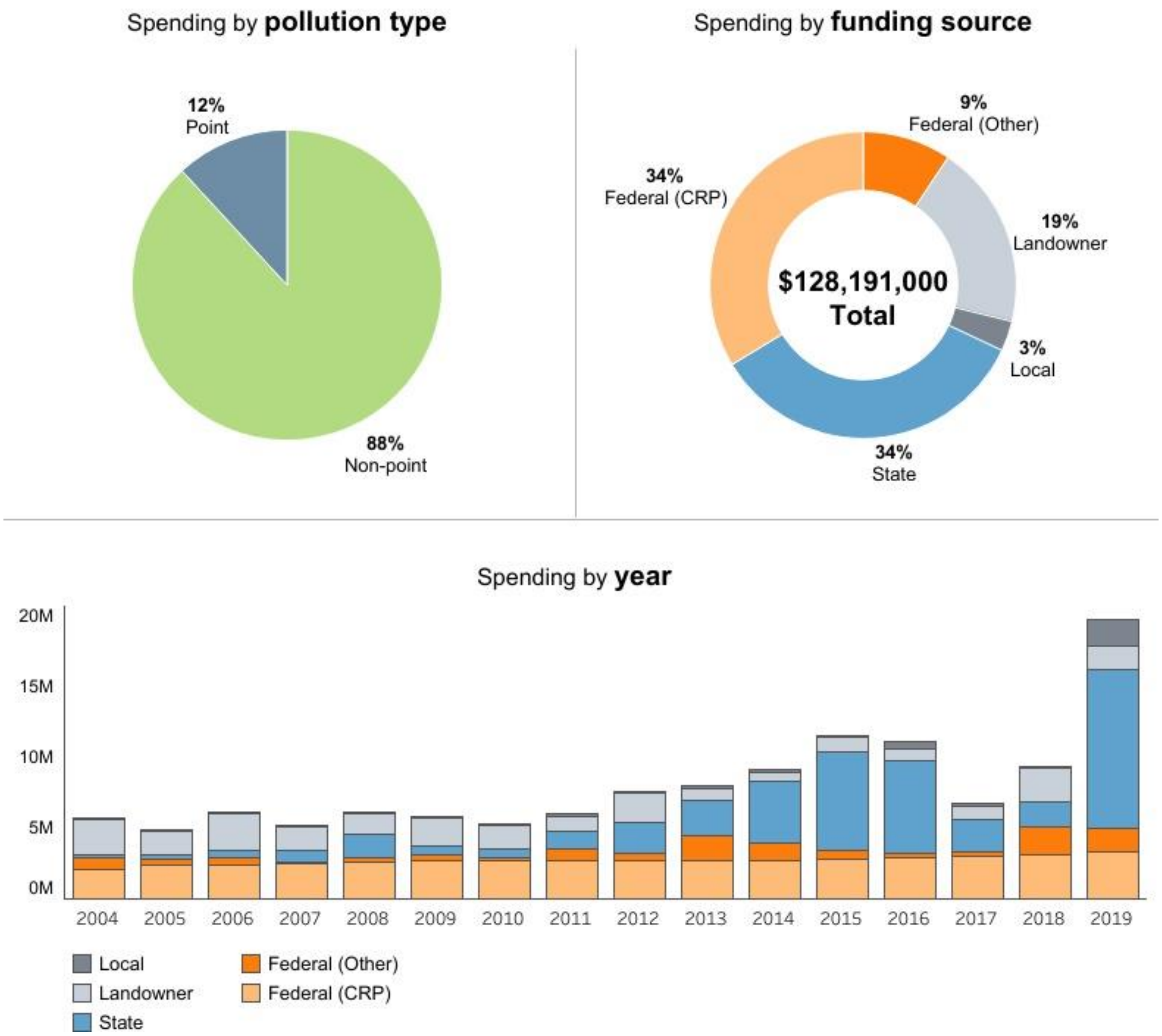


Figure 17. Funds spent in the Des Moines River Headwaters Watershed for conservation practices, shown by pollution type, funding sources and year, according to the MPCA Healthier Watersheds website (MPCA 2020b).

6.2.4 Planning and Implementation

The WRAPS report, TMDLs, and all the supporting documents provide a foundation for planning and implementation. Subsequent planning, including potential development of a "One Watershed, One Plan" for the Des Moines River Basin, will draw on the goals, technical information, and tools to describe in detail strategies and actions for implementation. For the purposes of reasonable assurance, the WRAPS document is sufficient in that it provides strategies for achieving pollutant reduction goals. However, many of the goals outlined in this TMDL report are also very similar to objectives outlined in the County Water Plans. These county plans have the same goal of removing streams from the 303(d) Impaired Waters List. These plans provide watershed specific strategies for addressing water quality issues. In addition, the commitment and support from the local governmental units will ensure that this TMDL report is carried successfully through implementation.

6.3 Reasonable Assurance Summary

In summary, significant time and resources have been devoted to identifying the best BMPs, providing means of focusing them in the Des Moines River Basin, and supporting their implementation via state initiatives and dedicated funding. The Des Moines River Basin WRAPS and TMDLs process engaged partners to arrive at reasonable examples of BMP combinations that attain pollutant reduction goals. Minnesota is a leader in watershed planning as well as monitoring and tracking progress toward water quality goals and pollutant load reductions. Finally, examples cited herein confirm that BMPs and restoration projects have proven to be effective over time and as stated by the State of Minnesota Court of Appeals in A15-1622 MCEA vs. MPCA and MCES.

We conclude that substantial evidence exists that voluntary reductions from NPSs have occurred in the past and can be reasonably expected to occur in the future. The NRS (MPCA 2015c) provides substantial information on existing state programs designed to achieve reductions in NPS pollution as evidence that reductions in nonpoint pollution have been achieved and can reasonably be expected to continue to occur.

7. Monitoring plan

Data from water quality monitoring programs enables water quality condition assessment, and creates a long-term data set to track progress towards water quality goals. These programs will continue to collect and analyze data in the Des Moines River Basin as part of *Minnesota's Water Quality Monitoring Strategy* (MPCA 2011). Data needs are considered by each program, and additional monitoring is implemented when deemed necessary and feasible. These monitoring programs are summarized below:

Intensive Watershed Monitoring (MPCA 2012a) data provides a periodic but intensive "snapshot" of water quality throughout the watershed. This program collects water quality and biological data at stream and lake monitoring stations across the basin in 1 to 2 years, every 10 years. To measure pollutants across the basin, the MPCA will re-visit and re-assess the basin, as well as have some capacity to visit new sites in areas with BMP implementation activity. This work is scheduled to start its second iteration in the Des Moines River Basin in 2024.

WPLMN (MPCA 2013b) data provide a continuous and long-term record of water quality conditions at the major watershed and subwatershed scale. This program collects pollutant samples and flow data to calculate continuous daily flow, sediment, and nutrient loads. In the Des Moines River Basin, there is a basin site for the West Fork Des Moines River at Jackson, at River Street, and one subwatershed site on the West Fork Des Moines River near Avoca, at CSAH6.

Citizen Stream and Lake Monitoring Program (MPCA 2013c) data provide a continuous record of waterbody transparency throughout much of the watershed. This program relies on a network of private citizen volunteers who make monthly lake and river measurements annually.

Local water quality monitoring programs are also utilized to track progress towards water quality goals. The Heron Lake Watershed District's monitoring plan provides long-term data on three streams and six lakes. Water quality sampling, stream elevation gages and discharge measurements are collected yearly to calculate nutrient loads at each stream site. Water quality samples are collected on the lakes once every three years to maintain long-term records. One monitoring site is located on Heron Lake Outlet while the remaining sites are upstream of this reach.

BMPs implemented by local units of government will be tracked through BWSR's e-Link system.

8. Implementation strategy summary

The strategies described in this section are potential actions to reduce nutrient loading (TP) to two stream segments in the Des Moines River Headwaters Watershed. A more detailed discussion on implementation strategies can be found in the *Des Moines River Basin WRAPS Report* (MPCA 2020c).

8.1 Permitted sources

8.1.1 Construction Stormwater

The WLA for stormwater discharges from sites where there is construction activity reflects the number of construction sites greater than one acre expected to be active in the watershed at any one time, and the BMPs and other stormwater control measures that should be implemented at the sites to limit the discharge of pollutants of concern. The BMPs and other stormwater control measures that should be implemented at construction sites are defined in Minnesota's NPDES/SDS General Stormwater Permit for Construction Activity (MNR100001). If a construction site owner/operator obtains coverage under the NPDES/SDS General Stormwater Permit and properly selects, installs, and maintains all BMPs required under the permit, including those related to impaired waters discharges and any applicable additional requirements of the Construction General Permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL report. Construction activity must also meet all local government construction stormwater requirements.

8.1.2 Industrial Stormwater

The WLA for stormwater discharges from sites where there is industrial activity reflects the number of sites in the watershed for which NPDES Industrial Stormwater Permit coverage is required, and the BMPs and other stormwater control measures that should be implemented at the sites to limit the discharge of pollutants of concern. If a facility owner/operator obtains stormwater coverage under the appropriate NPDES/SDS Permit and properly selects, installs, and maintains all BMPs required under the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL report. Industrial activity must also meet all local government construction stormwater requirements.

8.1.3 MS4

There are no permitted MS4 areas within the boundary conditions of the impaired waters addressed in this TMDL report.

8.1.4 Wastewater

The MPCA issues permits for WWTP that discharge into waters of the state. Where necessary, wastewater permits include site specific limits that are based on water quality standards. Permits regulate discharges, with the goals of protecting public health and aquatic life and assuring that every facility treats wastewater, and not cause or contribute to downstream impairments. In addition, SDS Permits set limits and establish controls for land application of sewage.

The Heron Lake and Windom WWTP permits already contain 1.0 mg/L limits consistent with these TMDL WLAs. A 1.0 mg/L limit has been recommended for inclusion in the Red Rock Rural Water WTP permit upon reissuance since they discharge to surface water.

8.2 Nonpermitted sources

8.2.1 River Nutrients (TP)

A summary of potential BMPs and reduction strategies to reduce NPSs is provided in **Table 14**. Considering the majority of the source of TP is from agricultural land use within the watershed, a summary of the agricultural BMPs is provided in **Table 15**. This table also includes benefits to reduce other pollutants. Potential BMPs and implementation strategies are explored more thoroughly in the *Des Moines River Basin WRAPS Report* (MPCA 2020c).

Table 14. Potential river nutrient reduction implementation strategies

Potential BMP/Reduction Strategy
Agricultural BMP Implementation – *Encourage property owners to implement agricultural BMPs for nutrient load reduction. The Agricultural BMP Handbook for Minnesota (MDA 2012) provides an inventory of agricultural BMPs that address water quality in Minnesota. Several examples include conservation cover, buffer strips, grade stabilization, controlled drainage, rotational grazing, and irrigation management, among many other practices.*
Education Programs – *Provide education and outreach on low-impact lawn care practices, proper yard waste removal, and other topics to increase awareness of sources of pollutants.*
Shoreline Restoration – *Encourage property owners to restore their shoreline with native plants and install/enhance shoreline buffers.*
Raingarden/Bio-filtration Basins – *Encourage the use of rain gardens and similar features as a means of increasing infiltration and evapotranspiration. Opportunities may range from a single property owner to parks and open spaces.*
Stormwater Pond Retrofits/Installation - *As opportunities arise, retrofit stormwater treatment through a variety of BMPs. Pond expansion and pre-treatment of water before it reaches the ponds may be beneficial dependent on drainage area. Also, identify target areas for new stormwater pond installation.*
Street Sweeping *Identify target areas for increased frequency of street sweeping and consider upgrades to traditional street sweeping equipment.*

Table 15. Summary of agricultural BMPs and their primary and secondary targeted pollutants.

BMP (NRCS standard)	Targeted pollutant	Secondary pollutant		
	Phosphorus	*E. coli*	Sediment	Nitrate
Filter strips (636)	X	X	X	
Riparian buffers (390)	X	X	X	
Clean water diversion (362)	X	X		
Access control/fencing (472 and 382)	X	X	X	
Water storage facilities (313) and nutrient management (590)	X	X		X
Grassed waterways (412)	X		X	
Water and sediment control basins (638)	X		X	
Conservation cover (327)	X		X	X
Conservation/reduced tillage (329 and 345)	X		X	
Cover crops (340)	X		X	X

8.3 Cost

The CWLA requires that a TMDL report include an overall approximation of the cost to implement a TMDL [Minn. Stat. 2007 § 114D.25]. The costs to implement the activities outlined in the *Des Moines River Basin WRAPS* (MPCA 2020c) for the Des Moines River Headwaters Watershed are approximately $20 to $36 million over the next 20 years. This range reflects the level of uncertainty in the source assessment and addresses the high priority sources identified in **Section 3.5** and in the *Des Moines River Basin Watersheds* TMDL (MPCA 2020d). The cost includes increasing local capacity to oversee implementation in the watershed, and the voluntary actions needed to achieve reductions. Required buffer installation and replacement of ITPHS systems are not included.

8.4 Adaptive management

Adaptive management is an iterative implementation process that makes progress toward achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities. The State of Minnesota has a unique opportunity to adaptively manage water resource plans and implementation activities every 10 years after IWM. This opportunity resulted from a voter-approved tax increase to improve state waters. The resulting interagency coordination effort is referred to as the Minnesota Water Quality Framework, which works to monitor and assess Minnesota's major watersheds every 10 years. This Framework supports ongoing implementation and adaptive management of conservation activities and watershed-based local planning efforts utilizing regulatory and nonregulatory means to achieve water quality standards.

Implementation of TMDL related activities can take many years, and water quality benefits associated with these activities can also take many years to be realized. As the pollutant source dynamics within the watershed are better understood, implementation strategies and activities will be adjusted and refined to efficiently meet the TMDL, and lay the groundwork for de-listing the impaired reaches and lakes. The follow up water monitoring program outlined in **Section 7** will be integral to the adaptive management approach, providing assurance that implementation measures are succeeding in achieving water quality standards. Adaptive management does not include changes to water quality standards or LC. Any changes to water quality standards or LC must be preceded by appropriate administrative processes, including public notice and an opportunity for public review and comment.

A list of implementation strategies in the WRAPS report prepared in conjunction with this TMDL report will focus on adaptive management (**Figure 18**). Continued monitoring and "course corrections" responding to monitoring results are the most appropriate strategy for achieving the water quality goals established in this TMDL report. Management activities will be changed or refined to efficiently meet the TMDLs and lay the groundwork for de-listing the impaired water bodies.

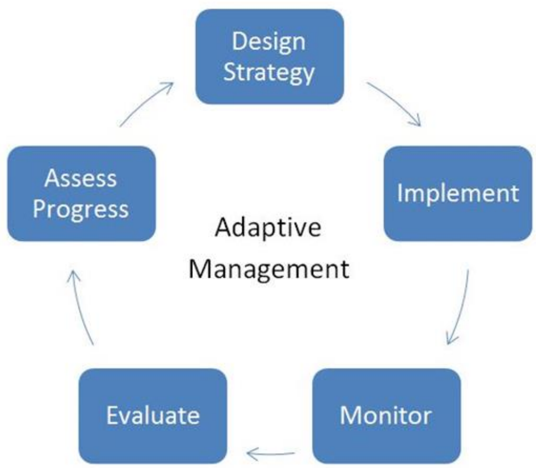


Figure 18. Adaptive management concept.

9. Public participation

The MPCA worked with county and SWCD staff, the Heron Lake Watershed District, citizens, and other state agency staff in the six counties to help with education on water quality on impaired reaches and survey citizens regarding water quality issues. Local work group involvement related to the TMDL included report development and editing and setting pollution reduction goals. The following are brief summaries of public participation activities completed in the Des Moines River Headwaters Watershed.

West Fork Des Moines River Major Watershed Project

During this project it was determined that civic engagement activities needed to focus on two areas: gathering information from and sharing information with the public and public education in regards to water quality and impaired waters. This was accomplished through citizen surveys, and sharing information through social media and education at six events held throughout the watershed. Information gathered through this project informed the development of the TMDL and WRAPS reports.

Update for municipal wastewater discharge permit holders

A meeting was held in November 2019 with Des Moines Watershed NPDES/SDS permit holders. The purpose of the meeting was to explain existing and new standards and how TMDLs will impact their facilities. Phosphorus limits where discussed along with how the RES TMDL will impact NPDES permits. This meeting allowed an opportunity for permit holders to ask questions about TMDL Reports and their specific permits.

Public notice

An opportunity for public comment on this draft TMDL report was provided via a public notice in the State Register from December 7, 2020 through January 6, 2021. There were two comment letters received and responded to as a result of the public comment period.

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Appendix A: CAFOs

Facility Name	Animal Units	County	Permit Number	RES Impaired Reach
		NPDES Permitted CAFOs		
Triple X Swine LLP	1800	Cottonwood	MNG440010	501
Brian Majerus Farm - Farmland Site	1152	Jackson	MNG440047	501
Lake Shore Pork	1560	Jackson	MNG440055	*
Christensen Farms Site C013	1435.2	Cottonwood	MNG440063	501, 527
Faccendiere - Tutt Site	1560	Murray	MNG440139	*
Schultz Hog Farms Inc	1248	Murray	MNG440140	*
VanderPoel Hog Properties	1140	Murray	MNG440141	*
Buldhaupt Farms	2400	Murray	MNG440142	*
Multi-Site - Double K Inc	1800	Nobles	MNG440273	*
Multi-Site - Double K Inc	290.2	Nobles	MNG440273	*
Paradise Pork	1248	Nobles	MNG440278	*
Gervais Brothers II	1996	Murray	MNG440321	*
Brewster Finisher	1350	Jackson	MNG440337	*
Southwest Prairie Pork - Wilmont 13	1200	Nobles	MNG440370	*
Kramer Swine Finishing	1440	Murray	MNG440396	*
Schwartz Farms Inc - Brewster	1123.2	Jackson	MNG440529	*
MW Gervais Farms LLC	990	Murray	MNG440549	*
G & K Kramer Inc	900	Murray	MNG440551	*
Brian & Mark Soleta Farm	990	Jackson	MNG440647	*
Brian & Mark Soleta Farm - Sec 16	990	Jackson	MNG440648	*
Keith Doeden Farm	1350	Murray	MNG440663	*
Chad Swenson Swine Facility	990	Murray	MNG440695	*
GED Farms	890	Jackson	MNG440714	501
Mike Haupert Farm	936	Murray	MNG440716	*
Larry & Wayne Christopher Farm	810	Jackson	MNG440730	*
Birch Lawn Farms Inc	900	Murray	MNG440869	*
Phil Gervais Farm	1611.2	Murray	MNG440879	*
G & K Kramer Inc - Sec 21	900	Murray	MNG440886	*
Hurd Hog Farm Inc	1200	Murray	MNG440924	*
Russ Penning Farm - Sec 4	2325	Nobles	MNG440964	*
Christensen Farms Site - F132	981	Cottonwood	MNG441035	501
Salentiny Brothers Farm	1520	Jackson	MNG441041	501
Todd Miller Farm	1200	Murray	MNG441042	*
Randy Hein Farm	1490	Nobles	MNG441082	*
Aaron Miller Farm	1095	Murray	MNG441223	*
Grant Prins - Sec 35	1500	Murray	MNG441248	*
Faccendiere-Gilbertson	990	Murray	MNG441259	*
Wilmont Finishers	990	Nobles	MNG441298	*
Robert Ford Farm - Dennis Site	1440	Murray	MNG441798	*
Adam Miller Farm	1440	Murray	MNG441923	*

Andy Henning Farm - Sec 9	1440	Nobles	MNG441951	*
Nick Henning Farm - Sundberg Site	1440	Nobles	MNG441952	*
Darin Henning Feedlot	1440	Murray	MNG441965	*
Josh Bonnstetter Feedlot	1440	Murray	MNG442058	*
SDS Permitted CAFOs				
Christensen Farms Site F077	1200	Cottonwood	MNG450066	501
CAFOs not requiring a Permit				
Farm 277 - Burnham	990	Jackson		*
Doug & Jerry Brake	900	Murray		*
507 Feeders LLC	900	Murray		*
Chris Kremer	1120	Nobles		*

* Not located within direct drainage of RES impaired reach