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North Dakota

Nutrient Reduction Strategy for Surface Waters

July 2025


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OVERVIEW
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NUTRIENT REDUCTION STRATEGY DEVELOPMENT

- NDDEQ Initiated a consensus-based stakeholder process
  - 2012 Kickoff – 2021 Final Report
- Planning Team
  - 35 members
  - 5 workgroups established
    1. Prioritization
    2. Criteria
    3. Industrial and Municipal Point Source
    4. Agriculture and Nonpoint Source
    5. Education and Outreach


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STRATEGY FRAMEWORK

STRATEGY COMPONENTS

1. Criteria Development
2. Setting Reduction Targets
3. Identifying Reduction Priorities
4. Implementing Reduction Strategies

NUTRIENT CRITERIA DEVELOPMENT

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- Narrative Criteria (2017)
  - “Free from nutrients attributable to municipal, industrial, or other discharges or agricultural practices, in concentrations or loadings which will cause accelerated eutrophication resulting in the objectionable growth of aquatic vegetation or algae or other impairments to the extent that it threatens public health or welfare or impairs present or future beneficial uses.”
- Numeric Criteria (Ongoing Evaluation)
  - Nutrient Workgroup recommended NDDEQ prioritize numeric nutrient criteria development
    - Lake Sakakawea
    - Red River
    - Large Reservoirs and Deep Natural Lakes
    - Shallow Natural Lakes
    - Small Reservoirs
    - Intermittent/ephemeral streams

NARRATIVE TO NUMERIC ENDPOINTS

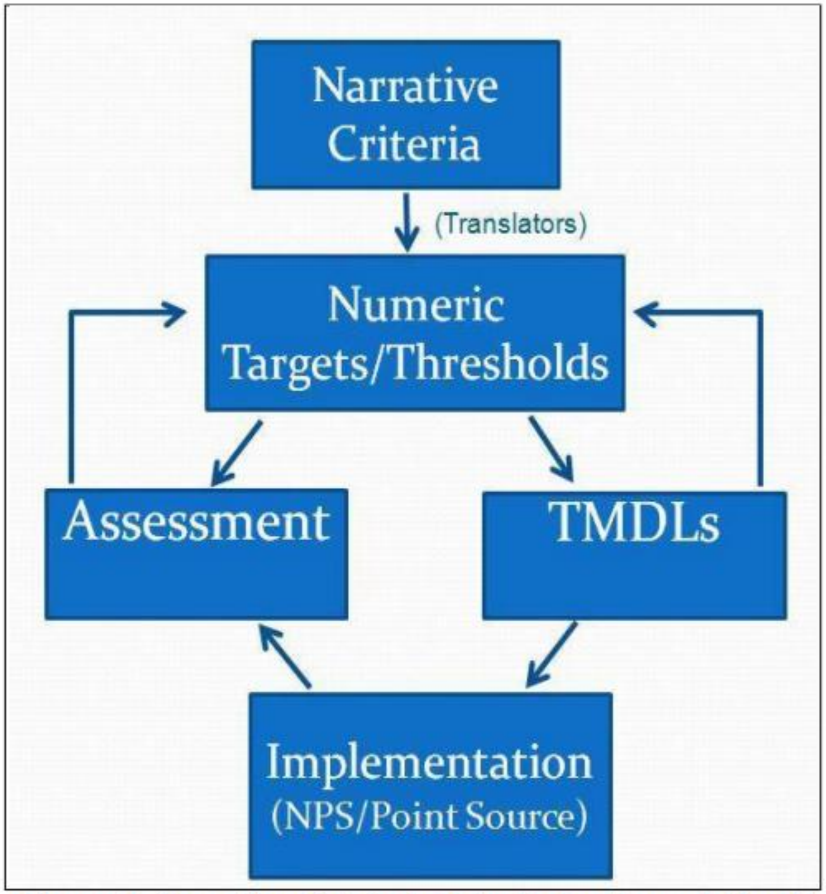

Figure 1. Narrative Nutrient Criteria Implementation Process.

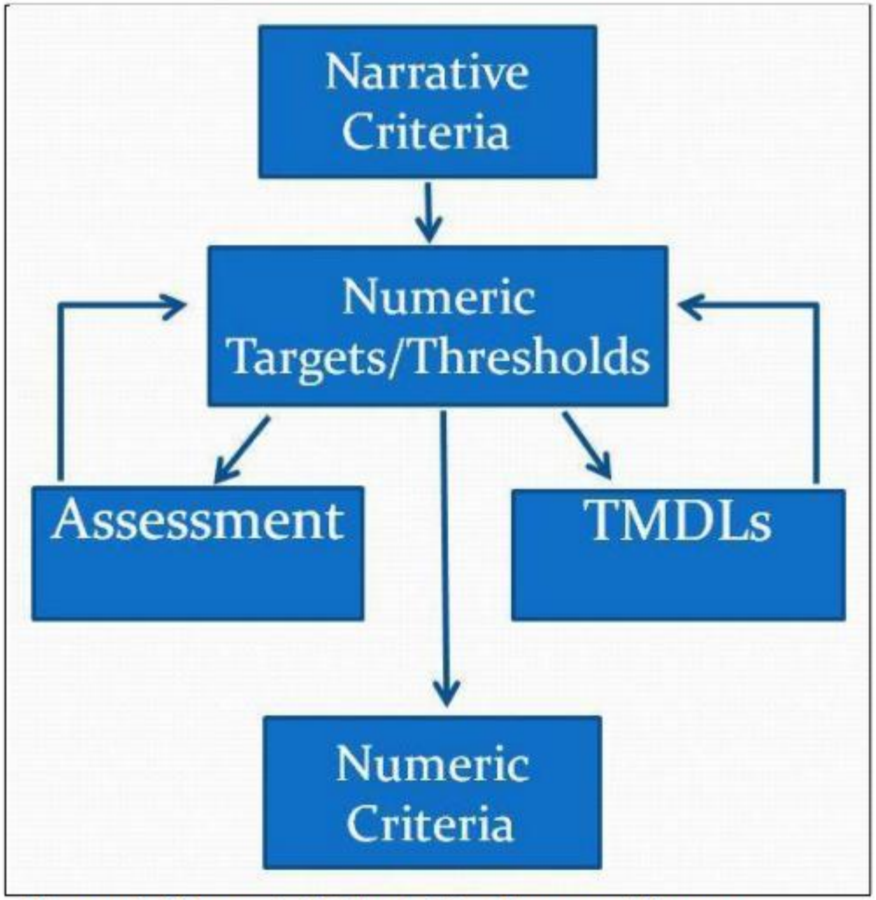

Figure 2. Numeric Criteria Development Process.

IMPLEMENTATION STRATEGIES

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- North Dakota's NPDES Program
  - Municipal and Industrial Point Source
  - Storm Water Point Sources
  - Animal Feeding Operations (AFO) / Confined Animal Feeding Operations (CAFOs)
- Private Sewage Disposal Systems
  - Inventory and assess watersheds for septic system contributions
- Agriculture Nonpoint Sources
  - Implement BMPs to:
    - Prevent pollutants from leaving a specific area,
    - Reduce/eliminate the introduction of pollutant,
    - Protect sensitive areas, or
    - Prevent the interaction between precipitation and pollutants.

BMPS

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IMPLEMENTATION STRATEGIES

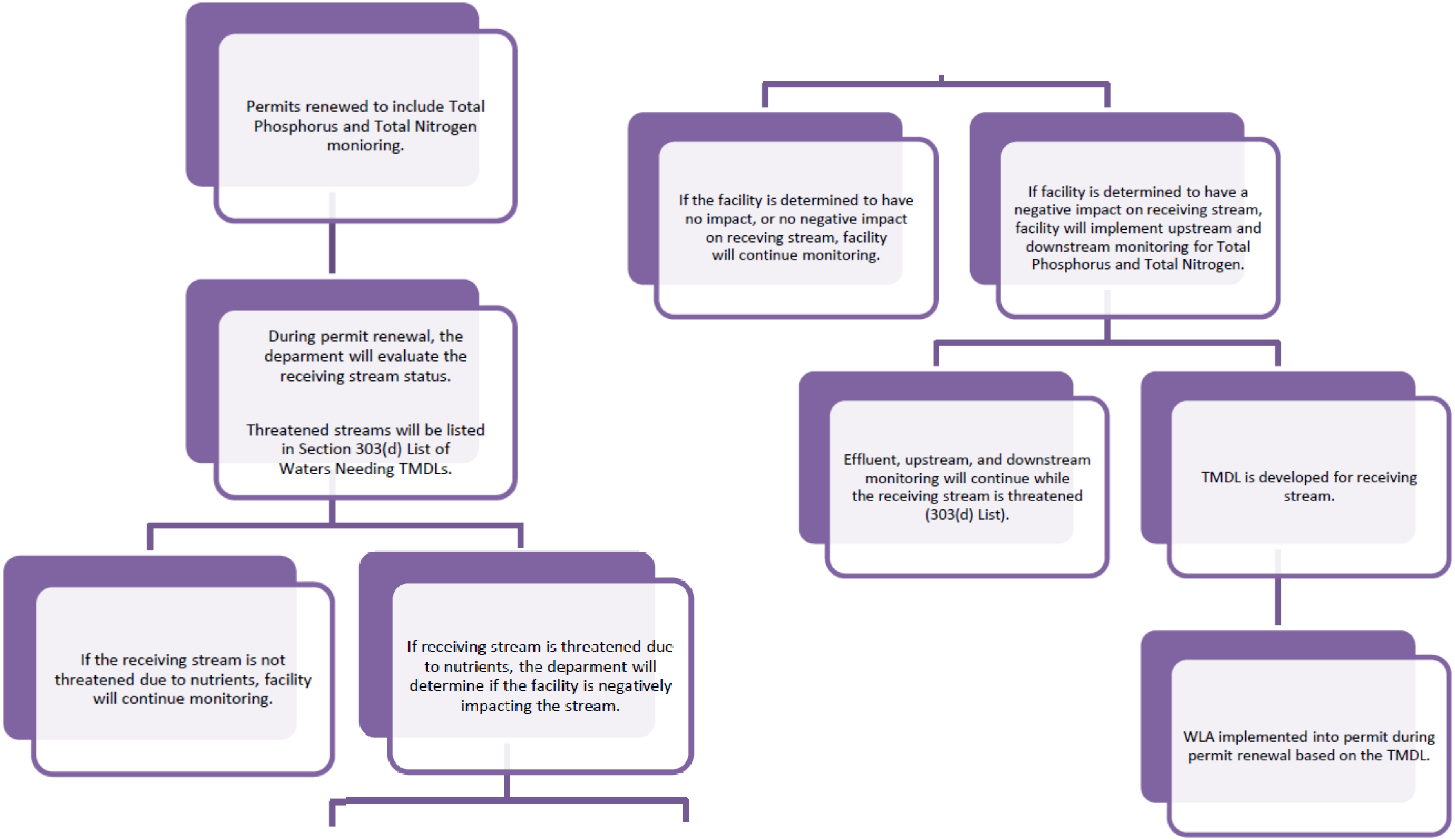

Figure 5. Nutrient Reduction Strategy Implementation Flow Chart for Category I

STRATEGY IMPLEMENTATION

BASIN WQ MANAGEMENT TEMPLATE

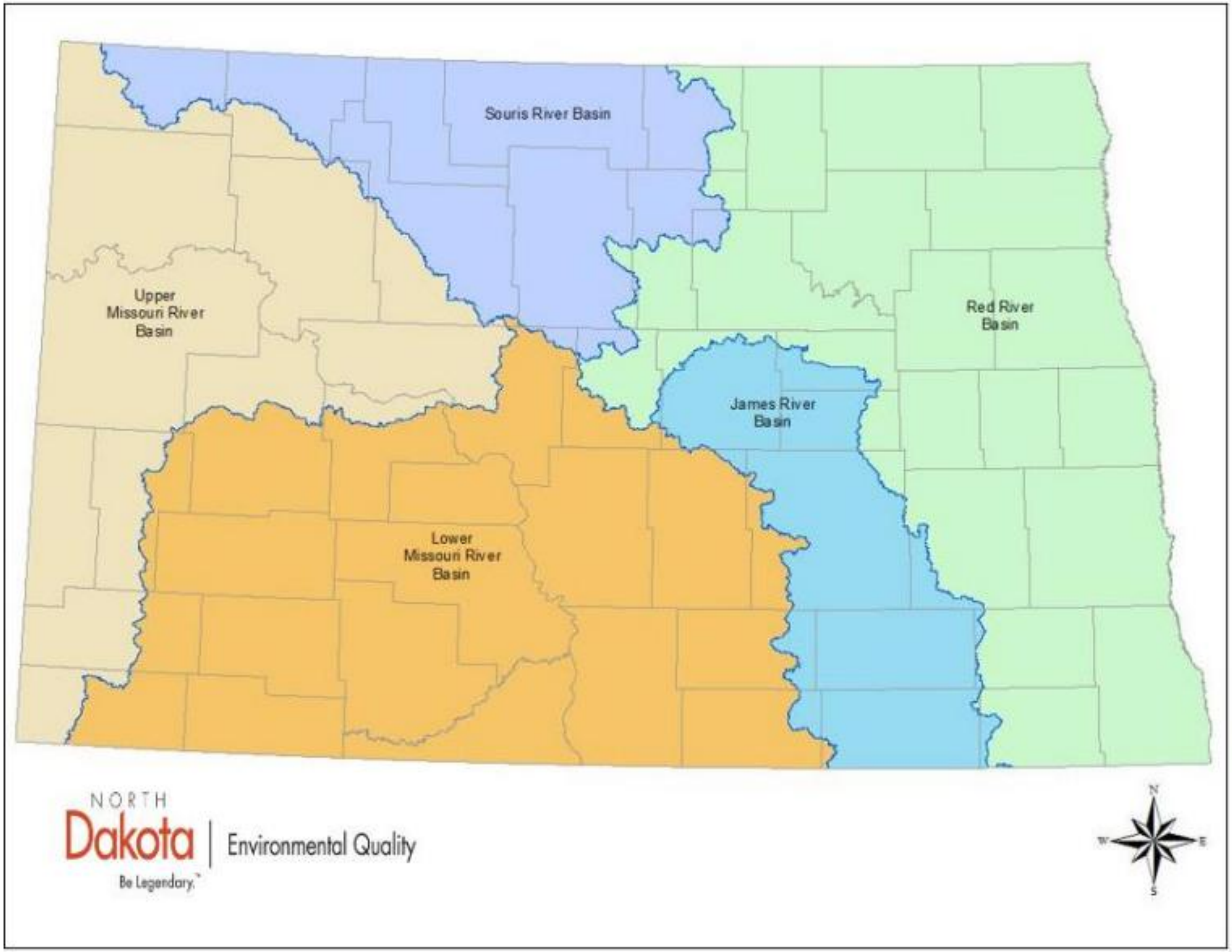

Figure 7. Major River Basins in North Dakota.

WQ AND WATERSHED MANAGEMENT SUPPORT PROGRAMS

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- Water Quality Standards Programs
- Monitoring and Assessment Programs
- Total Maximum Daily Load Program
- Point Source Control Program
- Nonpoint Source Pollution Control Program

REPORTING AND ACCOUNTABILITY

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- Report at the state, basin, and watershed scale

- Reporting
  - Websites
  - Presentations
  - Meetings
    - ND Water Quality Monitoring Conference
  - Traditional Reports
    - Integrated Section 305(b) Water Quality Assessment
    - Section 303(d) List of Impaired Waters
    - Section 319 Nonpoint Source Program

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Contact: Watershed Management Program

Phone: 701-328-5210

December 2019

Harmon Lake

(46.939395 N, -100.963482 W)

Morton County

- Harmon Lake is a small reservoir in south-central North Dakota (Figure 1). See map at (https://gf.nd.gov/gnf/maps/fishing/lakecontours/harmon2009.pdf).
- There is one boat ramp on Harmon Lake on the north side of the lake.
- The Harmon Lake watershed is about 24,000 acres of mostly grassland/pasture and agriculture. The most common crops grown are spring wheat, other hay/non-alfalfa and soybeans (Table 1).
- Harmon Lake is a Class III fishery, which are "capable of supporting natural reproduction and growth of warm water fishes (e.g., largemouth bass and bluegill) and associated aquatic biota."
- The North Dakota Game and Fish stocks Harmon Lake annually with catchable trout. Bluegill, white sucker, black crappie, black bullhead, common shiner, largemouth bass, golden shiner, northern pike and walleye were captured in the last sample by the NDGF.
- Harmon Lake has been assessed since it was first created with the first sample collected in 2009.

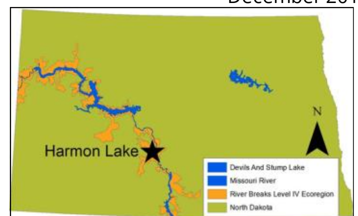


Figure 1. Location of Harmon Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2017). Value listed of crop type represents percentage of total production

Land Cover Type	% in Watershed	% within 500 meters
Grassland/Pasture	56.4%	69.6%
Agriculture	34.4%	2.7%
Spring Wheat	*39.7%*	*32.6%*
Other Hay/Non-Alfalfa	*19.5%*	*7.1%*
Soybeans	*14.0%*	*3.1%*
Wetlands	3.4%	21.5%
Developed	3.1%	1.0%
Forest	1.8%	3.5%
Open Water	0.9%	1.7%
Barren	< 0.1%	< 0.1%

Temperature and Dissolved Oxygen

- Harmon Lake commonly stratifies in the summer, with warm, well-oxygenated water at the top of the water column, and cold, low-oxygen water near the bottom.
- There was thermal stratification recorded at most visits in 2018. Temperature change in the water column was 16.9 degrees Celsius (ºC), 14.9ºC, 10.5ºC and 0.6ºC from May, July, August and October, respectively.
- Dissolved oxygen was relatively high near the surface, but decreased quickly under thermal stratification.

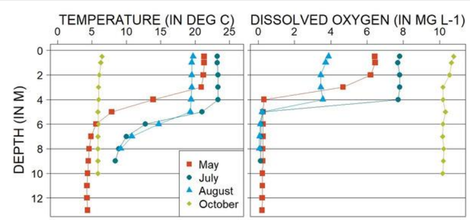


Figure 2. 2018 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L-1)

Trophic State Indices

- Trophic state is a measure used by scientists to assess the condition (where lower scores indicate better water quality) of a lake using three common measures: total phosphorus (TP), Secchi disk transparency and chlorophyll-a concentration.
- Harmon Lake is a eutrophic reservoir (Figure 3) that has moderate nutrient concentrations and moderate algal growth.
- Trophic state in 2018 is similar to historical indices, which makes sense considering how recent historical data have been collected.
- The lake has had *harmful* algal (cyanobacteria) blooms, most notably in summer 2019.

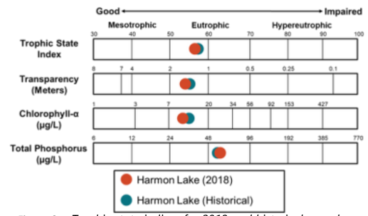


Figure 3. Trophic state indices for 2018 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2018 was greater than the historical median for the lake and greater than the median for reservoirs in the River Breaks Level IV Ecoregion (hereafter, Ecoregion) where Harmon Lake is located (Figure 4).
- Median total phosphorus (TP) concentration in 2018 was less than the median for the lake and less than the median for the Ecoregion (Figure 4).
- Dissolved nutrients samples were not collected in 2018.
- Ammonia was detected at relatively high concentrations in two samples at Harmon Lake in 2018, while nitrate-plus-nitrite was only detected once.

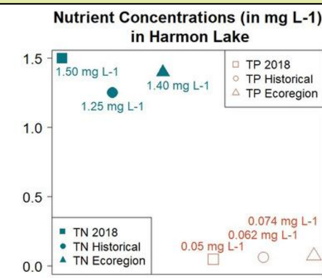


Figure 4. Median concentrations of TN and TP in mg L-1 compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2018 and historical samples and from all Ecoregion reservoirs.

Measure	2018 Median	Historical Median	Ecoregion Median
Alkalinity	340.5 mg L-1	338 mg L-1	376 mg L-1
Bicarbonate (HCO-3)	372 mg L-1	374.5 mg L-1	412 mg L-1
Calcium (Ca2+)	47.0 mg L-1	64.6 mg L-1	47.3 mg L-1
Carbonate (CO2-3)	21.1 mg L-1	11 mg L-1	19 mg L-1
Conductivity	2,405 µS cm-	2,055 µS cm-	1,680 µS cm-
Dissolved Solids	1 1,710 mg L-	1 1,515 mg L-	1 1,150 mg L-
Magnesium (Mg2+)	1 93 mg L-1	1 77.4 mg L-1	1 64.7 mg L-1
Sodium (Na+)	405.5 mg L-1	313 mg L-1	262.5 mg L-1
Sulfate (SO2-4)	928 mg L-1	800.5 mg L-1	483 mg L-1

- Sulfate is the dominant anion in Harmon Lake, while sodium is the dominant cation (Figure 5).
- Median concentrations of most cations and anions are greater than the historical median for the lake and greater than the median for the Ecoregion.

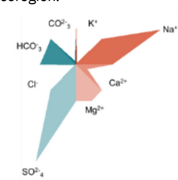
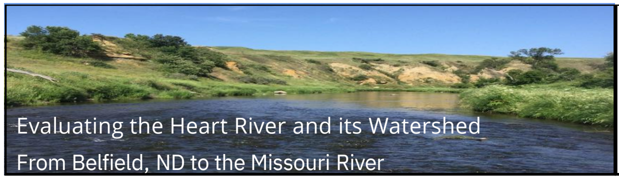


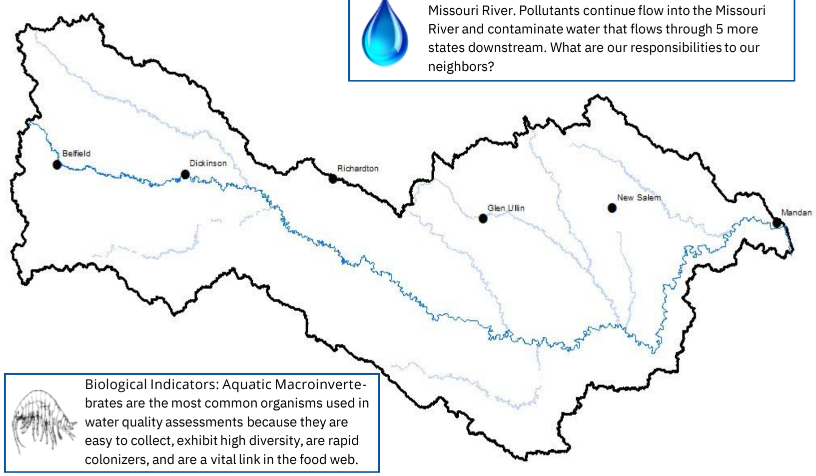
Figure 5. Maucha diagram showing ionic balance based on 2018 data



Evaluating the Heart River and its Watershed
From Belfield, ND to the Missouri River

Fish Species: The three most abundant fish species are non-game species, 1) sand shiner, 2) fathead minnow, and 3) white sucker. There is one game species, small mouth bass, that is the 5th most abundant species.

Downstream Damage:The Heart River is a tributary of the Missouri River. Pollutants continue flow into the Missouri River and contaminate water that flows through 5 more states downstream. What are our responsibilities to our neighbors?



Biological Indicators: Aquatic Macroinverte-brates are the most common organisms used in water quality assessments because they are easy to collect, exhibit high diversity, are rapid colonizers, and are a vital link in the food web.

Swimmers and Boaters Beware: Harmful Algal Blooms (HABs) are becoming more prevalent in recreational waterbodies. HABs cause toxins that can be harmful to humans, pets, and livestock.

More Water: Increased rain events combined with a change in land usage from rangeland to crop land are bringing more pollutants to the river from the landscape, such as sediment, bacteria, and nutrients.

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The Big Picture

An important tributary. The Heart River is approximately 180 miles long, running from about Belfield, ND to the Missouri River near Mandan, and drains an area of 3,370 square miles.

An impacted river. Land use in the Heart River Basin (ND) is dominated by agriculture (48% crop cover and 33% of grassland/ pasture).

Sediment. 85,166 US tons of sediment moves through the Heart River in North Dakota annually. That is 2,129 semi-loads!

Pesticides. In 2021 the Heart River had 1 pesticide detection. The detection did not exceed the Aquatic Life Benchmark. *For more information on pesticides visit nd.gov/ ndda

Nutrients. Nutrient loads have increased almost 50% over the last 20 years. This is likely due to a large transition from mostly rangeland to crops fields.

Moving nutrients.

On average the Heart River moves 40.5 US tons of phosphorus and 293 US tons of nitrogen through ND yearly.

Phosphorus: 1 semi-load

Nitrogen: 7 semi-loads

Harmful Algal Blooms (HABS)

Excess nutrients cause HABs to appear more frequently and with more severity. Lake Tschida, Sweet Briar Dam, and Patterson Lake have recurrent blooms that result in advisories and/or warnings.

Tributaries in trouble

Many tributaries to the Heart River are negatively affected by agriculture. Run off from crops and cattle are a large contributor to the high amounts of nutrients, sediment, and E. *coli*.

Major pollutants in the Heart River

Phosphorus and Nitrogen. It fuels harmful algal blooms and excessive plant growth.

Bacteria. Mainly from cow manure.

Sediment. Eroding banks and fields as a result of human impact.

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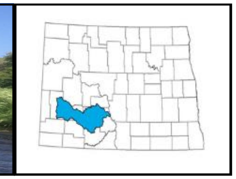
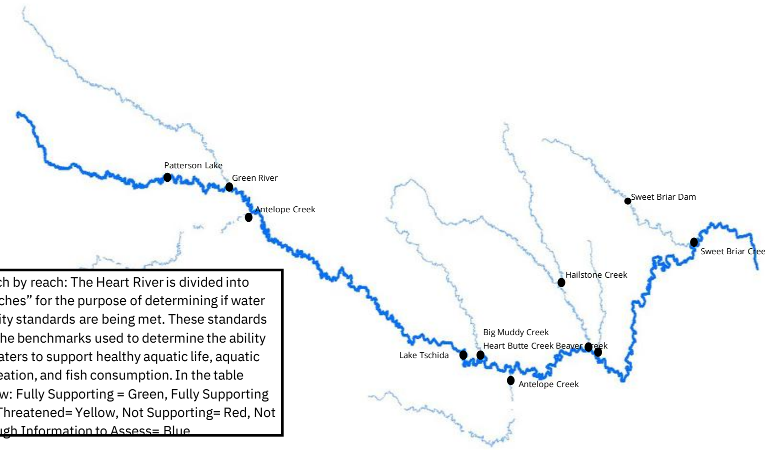
The Heart River: Evaluating its Health



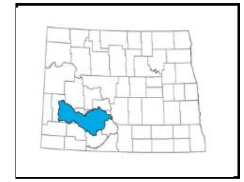


Reach by reach: The Heart River is divided into "reaches" for the purpose of determining if water quality standards are being met. These standards are the benchmarks used to determine the ability of waters to support healthy aquatic life, aquatic recreation, and fish consumption. In the table below: Fully Supporting = Green, Fully Supporting but Threatened= Yellow, Not Supporting= Red, Not Enough Information to Assess= Blue

Antelope Creek	Aquatic Life	Recreation	
from confluence with East Branch Antelope Creek to	Green	Red	• Not supporting Recreation due to elevated Fecal Coliform.
Antelope Creek main stem downstream to confluence with East Branch Antelope Creek.	Green	Red	• Not supporting Recreation due to elevated Fecal Coliform.
Lake Tschida	Yellow	Yellow	• Fully supporting, but threatened Recreation due to nutrient loads/ eutrophication. • Fully supporting, but threatened Aquatic Life due to excess nutrient loads/ eutrophication and Sedimentation/ Siltation
Heart River from confluence of Plum Creek to confluence of Govt'	Blue	Yellow	• Fully supporting, but threatened Recreation due to elevated *E. coli*.
Heart River from Patterson Lake to confluence of Green River.	Red	Green	• Not supporting Fish and Aquatic Biota due to benthic macroinvertebrate
Danzig Dam	Yellow	Green	• Fully supporting, but threatened Fish and Aquatic Biota due to Sedimentation/ Siltation.
Heart River from confluence with Fish Creek to confluence with Dead Heart Slough.	Blue	Yellow	• Fully supporting, but threatened Recreation due to elevated *E. coli.*
Danzig Dam Watershed, Hailstone Creek upstream from Danzig Dam.	Green	Yellow	• Fully supporting, but threatened Recreation due to elevated *E. coli.*

Improving water quality in the Heart River Basin

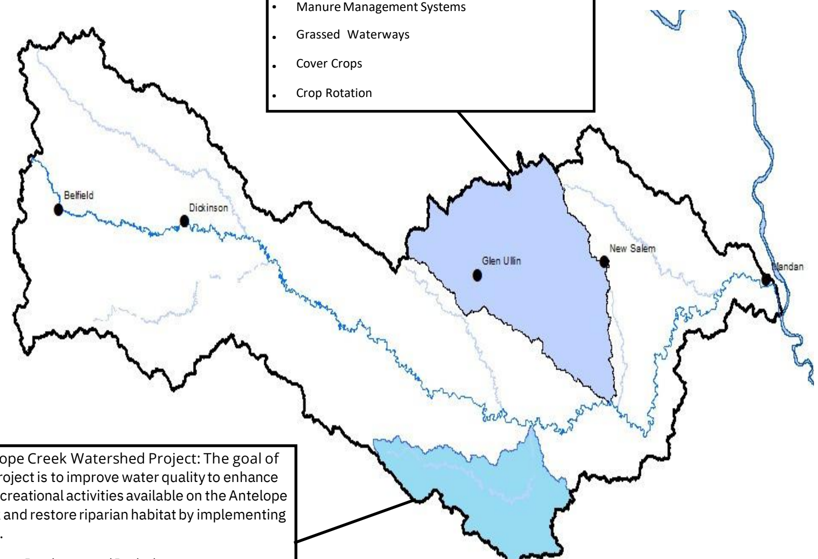
Section 319 dollars are spent to reduce nutrients and sediment entering small streams and eventually the Heart River. Local Soil Conservation Districts (SCDs) work with land-owners to decide what best management practice (BMP) is best for their land and for the river. This is a subset of projects. For information on other 319 projects contact NDDEQ Watershed Management.



Big Muddy/ Hailstone/ Simms/ Danzig Watershed Project: The primary goal of this project is to improve the water quality and restore the riparian habitat and beneficial uses of these watersheds by implementing Best Management Practices.

Practices Implemented Include:

- Manure Management Systems
- Grassed Waterways
- Cover Crops
- Crop Rotation



Antelope Creek Watershed Project: The goal of this project is to improve water quality to enhance the recreational activities available on the Antelope Creek and restore riparian habitat by implementing BMPs.

Practices Implemented Include:

- Cover Crops
- Grazing Management
- Manure Management Systems
- Livestock Water Sources

ACTIONS

- NDPDES Permits – per strategy
  - Total N and Total P effluent monitoring Category 1 Facilities
- Additional Reduction Strategies
  - Treatment system upgrades
  - Regionalization
  - Beneficial Reuse

EXAMPLES:

EXAMPLES:

EXAMPLES:

TAKE AWAYS AND RESOURCES

- Federal Funding
- Biggest resource is PEOPLE
- Education and Outreach

- https://deq.nd.gov/WQ/3_Watershed_Mgmt/4_Nutrient_Reduction/NutRed.aspx

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Questions?

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