# Pomme de Terre River Watershed Report

A summary of watershed conditions and restoration and protection strategies for the Pomme de Terre River Watershed

Minnesota Pollution Control Agency

March 2013

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**Document number:** wq-ws4-01

# Contents

# What is the watershed approach?

The state of Minnesota has adopted a watershed-scale approach to address the quality of Minnesota's waters, the "Watershed Approach". This approach applies a 10-year cycle to Minnesota's 80 major watersheds to systematically gather and assess water quality data and develop restoration and protection strategies. As part of the watershed approach, waters not meeting state standards are still, as they have been in the past, listed as impaired and Total Maximum Daily Load (TMDL) studies are performed. However, the Watershed Approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health.

Analysis of the Pomme de Terre River watershed was one of the first applications of the Watershed Approach to Minnesota's watersheds (started in 2007 with the next cycle start planned for 2017). For this reason, this was a pilot investigation of the Watershed Approach, where the process and outcomes were not yet fully developed. In future iterations of the Watershed Approach, the process and outcomes will be further refined including more specific feedback loops with local working groups. This cycle of the Watershed Approach and this report outline opportunities for local working groups to refine the presented restoration and protection strategies; however, future iterations of the approach intend to involve local working groups and stakeholders more thoroughly at the beginning of the cycle.

# What is the Pomme de Terre River Watershed Report?

**Purpose**

- Support local working groups and develop scientifically supported restoration and protection strategies
- Summarize Watershed Approach work done to date including the following reports:
  - *Pomme de Terre River Watershed Monitoring and Assessment*
  - *Pomme de Terre River Watershed Biotic Stressor Identification*
  - *Pomme de Terre River Watershed Total Maximum Daily Load*
  - *Assessment Report of Selected Lakes within the Pomme de Terre River Watershed*

**Scope**

- Impacts to aquatic recreation and impacts to aquatic life in streams
- Impacts to aquatic recreation in lakes

**Audience**

- Local working groups (local governments, SWCDs, watershed management groups, etc.)
- State agencies (MPCA, DNR, BWSR, etc.)

*The Watershed Approach*
*Click to read about the Watershed Approach, including maps and schedules. (MPCA, 2012a)*
*Impaired Waters and TMDLs*
*Click to explore Minnesota's impaired waters and the TMDL process. (MPCA, 2013a)*
*MPCA Pomme de Terre River Watershed Page*
*Click to access MPCA reports and other work on the Pomme de Terre River Watershed. (MPCA, 2013b)*

# 1. Background

The Pomme de Terre River watershed, an 875 square mile, predominately rural watershed, is located in west central Minnesota within the Minnesota River Basin. The northern portion of the watershed is located in the Northern Central Forest Ecoregion while the central and southern portions are located in the Northern Glaciated Plains Ecoregion (Figure 1A). The population of the watershed is approximately 16,000 people and the watershed contains the larger cities of Morris and Appleton. Portions of six counties are within the watershed. Those counties are: Otter Tail, Douglas, Grant, Stevens, Swift, and Big Stone. The watershed contains six HUC-10 subwatersheds, 68 stream reach AUIDs, and 217 lakes (DNR-designated and greater than 10 acres) (Figure 1B).

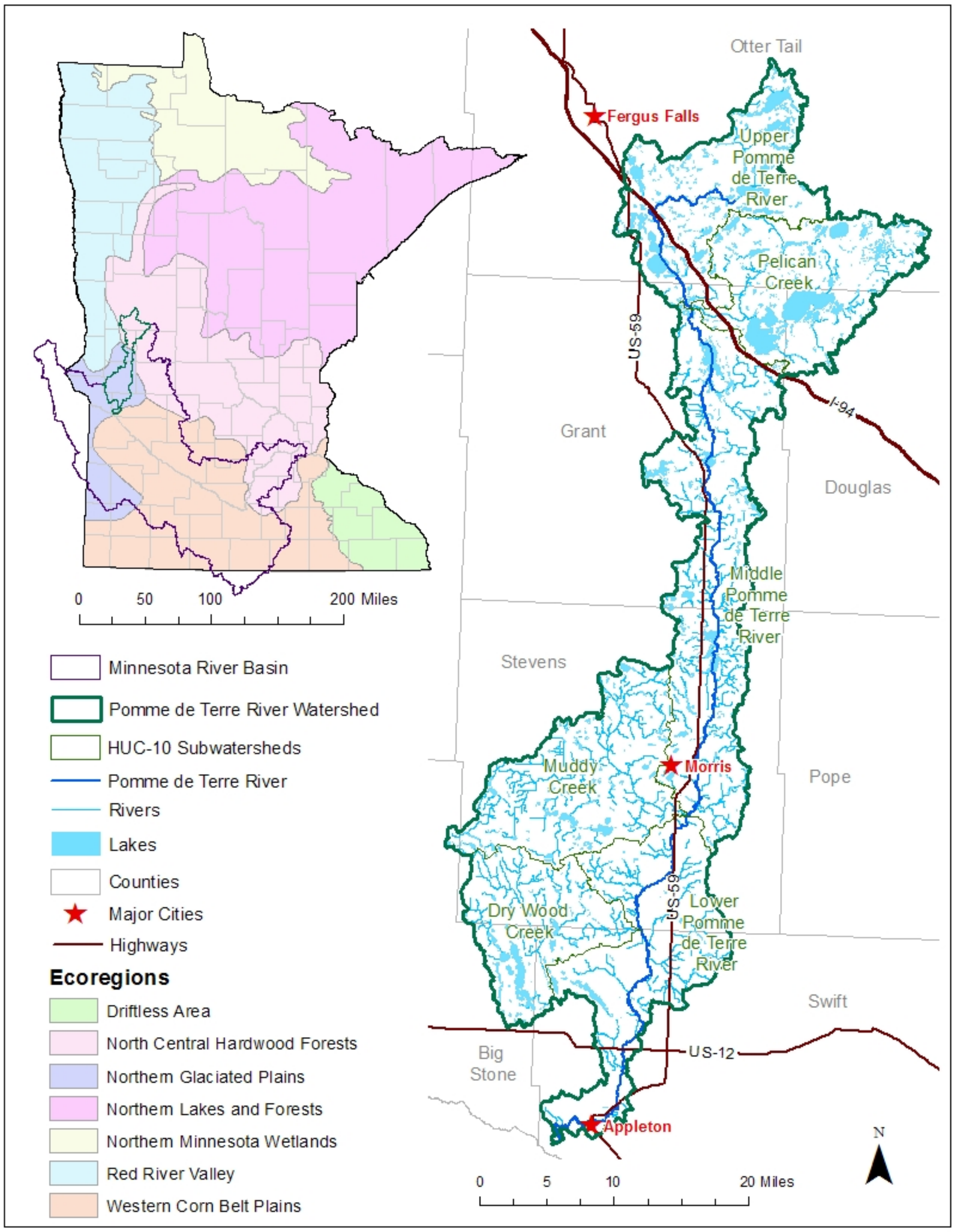


**Figure 1: (A - upper left) The location of the Pomme de Terre River watershed within the Minnesota River Basin, the state of Minnesota, and the ecoregions of Minnesota, (B - right) The HUC-10 subwatersheds, rivers, lakes and the counties, major cities, and highways in/near the Pomme de Terre River watershed**

***AUID***
*An Assessment Unit Identifier (AUID) is assigned by the state for a specified stream reach (continuous segment of stream between two specified points). Each AUID is composed of the USGS HUC-8 appended with a three digit unique identifier.*

***HUC***
*A Hydrologic Unit Code (HUC) is assigned by the USGS for each watershed (an area of land that all drains to the same outlet). HUCs are organized in a nested hierarchy by size. For example, the Minnesota River Basin is assigned a HUC-4 of 0702 and the Pomme de Terre River Watershed is assigned a HUC-8 of 07020002.*

# 2. Watershed conditions

The land use and general water quality transition through the watershed. The northern, headwater region of the watershed is rich with lakes, wetlands, forests, and grasslands. Moving south down the watershed, the land use transitions to predominately row crops in the central and southern regions of the watershed (Figure 2). The water quality is generally good in the north and degrades in the south of the watershed.

As part of the Watershed Approach, streams, lakes, and wetlands throughout the watershed were monitored for impacts to aquatic recreation, aquatic life, and aquatic consumption. (For information on impairment types, refer to the side box on Page 5.) From this monitoring data, several water bodies were assessed as impaired and several as not impaired (referred to as supporting). However, not all water bodies were monitored or assessed due to being classified as limited use resources, being predominately channelized, or time or budget constraints. Of the water bodies monitored, not all could be assessed due to insufficient data. Through continuing work and future iterations of the Watershed Approach, additional water bodies may be monitored and assessed.

This report addresses impairments to aquatic recreation and aquatic life in stream reaches and lakes but does not address impairments to aquatic consumption (human consumption of fish) or impaired wetlands. Impairments to aquatic consumption are addressed in the *Minnesota Statewide Mercury TMDL.* Impaired wetlands are not addressed due to an evolving understanding of wetland processes relative to impairment status.

Of the 68 stream reaches, 29 were monitored for impairments to aquatic recreation and/or aquatic life. Five of these were assessed as impaired for impacts to aquatic recreation and/or impacts to aquatic life, and 7 were assessed as supporting aquatic life (i.e. not impaired).

Of the 217 lakes, 30 were monitored for impairments to aquatic recreation. Four were assessed as impaired for impacts to aquatic recreation, and 7 were assessed as supporting of aquatic recreation.

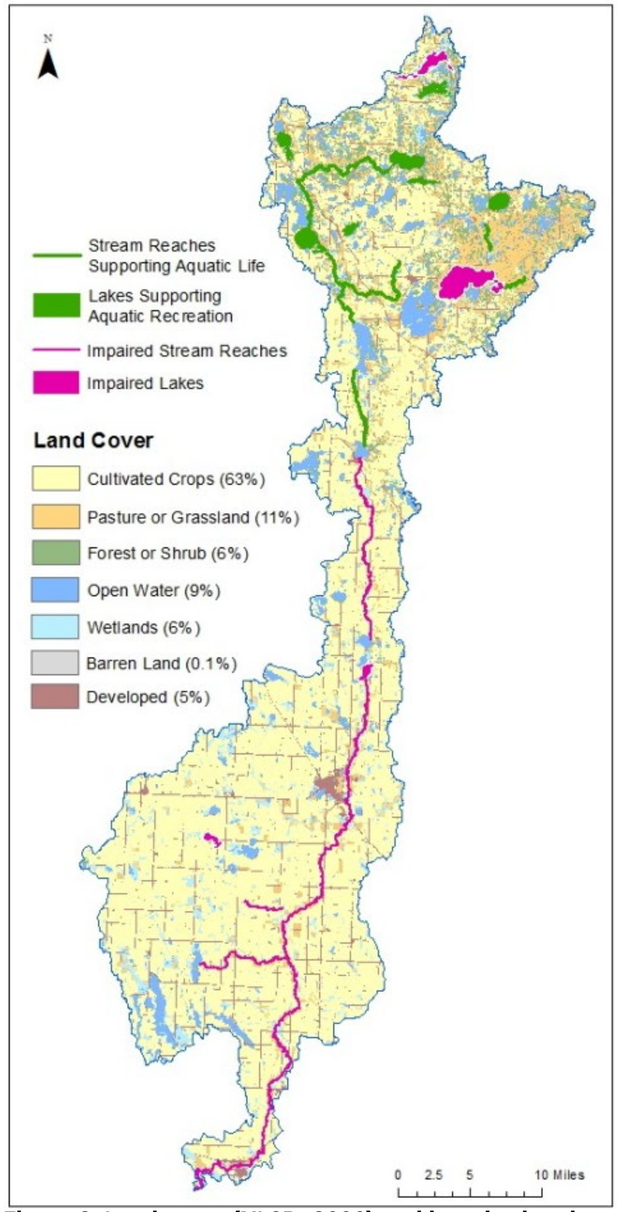


**Figure 2: Land cover (NLCD, 2006) and impaired and supporting lakes and stream reaches in the Pomme de Terre River watershed**

[Minnesota Department of Natural Resources Watershed Health Assessment Framework]

*Click to read about the DNRs watershed health assessment framework and see how the Pomme de Terre rated. (MDNR, 2011)*

[USDA Natural Resources Conservation Service Resource Profile]

*Click to access the Minnesota NRCS's report on the Pomme de Terre River Watershed. (NRCS, 2013)*

[Minnesota Statewide Mercury Total Maximum Daily Load]

*Click to find the state Mercury TMDL study and how this impairment can be addressed. (MPCA, 2007)*

## 2.1 Streams

In the monitoring and assessment phase of the Watershed Approach for the Pomme de Terre River watershed, 29 stream reaches were monitored, and of these, 16 stream reaches had some assessment to identify impacts to aquatic recreation and aquatic life (Figure 3). Five stream reaches were assessed as impaired for impacts to aquatic recreation and/or impacts to aquatic life, and 7 were assessed as supporting of aquatic life.

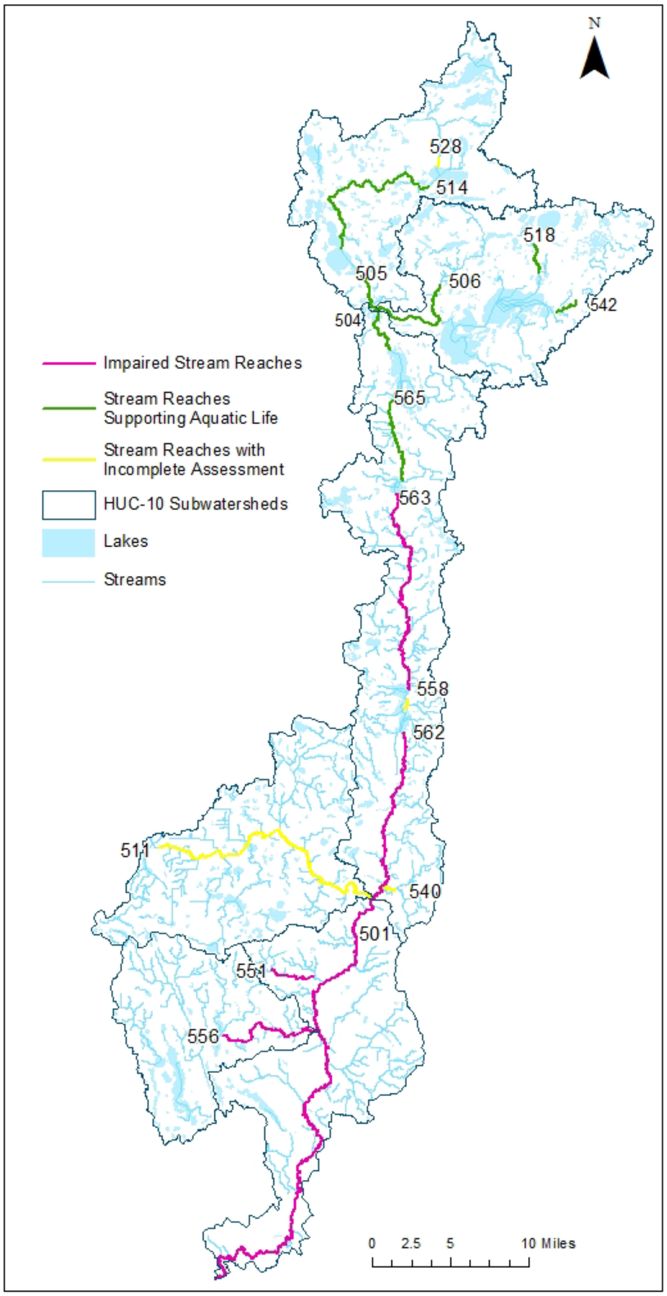


**Figure 3: The locations of impaired, supporting, and incompletely assessed stream reaches in the Pomme de Terre River watershed**

***Impaired water bodies***
*Water bodies are listed as impaired if water quality standards are not met for designated uses including: aquatic life, aquatic recreation, and aquatic consumption.*

***Impacts to aquatic life***
*The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.*

***Impacts to aquatic recreation***
*Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus, chlorophyll-A, or secchi depth standards are not met.*

*Minnesota State Water Quality Standards*
*Click to access the official state water quality standards. (MORC, 2008)*

Table 1 presents the 16 stream reaches that have been assessed. The assessed stream reaches are organized in the table by HUC-10 subwatershed and are generally presented in a north to south configuration (the top of the table corresponds to stream reaches in the northern part of the watershed). While the impact to aquatic recreation (Aq Rec) considers only bacteria concentrations, the impact to aquatic life considers: the fish IBI, the macroinvertebrate (MI) IBI, total suspended solids (TSS), dissolved oxygen (DO), and additional parameters not included in the table. If one parameter does not meet the standard, the stream reach is considered impaired for impacts to aquatic life. The Minnesota Pollution Control Agency (MPCA) *Pomme de Terre River Watershed Monitoring and Assessment* report (2011) contains a thorough discussion of stream impairments.

**Table 1: Assessed stream reaches in the Pomme de Terre River watershed, presented (mostly) from north to south**

| HUC-10 Subwatershed | AUID (Last 3 digits) | Stream | Reach Description | Aquatic Life | | | | Aq Rec |
|---|---|---|---|---|---|---|---|---|
| | | | | Fish IBI | MI IBI | DO | TSS | Bacteria |
| Upper Pomme de Terre River | 528 | Unnamed Creek | Long Lake to Stalker Lake | IF | IF | NA | NA | NA |
| | 514 | Pomme de Terre River | Stalker Lake to Tenmile Lake | Sup | Sup | NA | Sup | NA |
| | 505 | Pomme de Terre River | Tenmile Lake to Pelican Creek | Sup | Sup | NA | Sup | NA |
| Pelican Creek | 518 | Unnamed Creek | Unnamed Lake to Unnamed Creek | Sup | Sup | NA | NA | NA |
| | 542 | Unnamed Creek | Headwaters to Lake Christine | Sup | Sup | NA | NA | NA |
| | 506 | Pelican Creek | T130R41W S4, N line to PdT River | Sup | Imp | NA | Sup | IF |
| Middle Pomme de Terre River | 504 | Pomme de Terre River | Pelican Creek to PdT Lake | Sup | Sup | NA | NA | NA |
| | 565 | Pomme de Terre River | PdT Lake to Barrett Lake | Sup | Sup | NA | Sup | IF |
| | 563 | Pomme de Terre River | Barrett Lake to North PdT Lake | Imp | Sup | NA | Sup | NA |
| | 558 | Pomme de Terre River | N PdT Lake to Middle PdT Lake | IF | IF | NA | NA | NA |
| | 540 | Unnamed Creek | Unnamed Creek to PdT River | IF | IF | NA | NA | NA |
| | 562 | Pomme de Terre River | Perkins Lake to Muddy Creek | Imp | Sup | IF | Sup | IF |
| Muddy Creek | 511 | Muddy Creek | T124 R44W S3, W line to PdT River | NA | NA | NA | NA | IF |
| Dry Wood Creek | 556 | Dry Wood Creek | Dry Wood Lake to PdT River | Imp | Imp | Imp | Imp | Imp |
| Lower Pomme de Terre River | 551 | Unnamed Creek | Unnamed Creek to Unnamed Creek | Imp | NA | NA | NA | NA |
| | 501 | Pomme de Terre River | Muddy Creek to Minnesota River | Imp | Imp | Sup | Imp | Imp |

Sup = found to meet the water quality standard, Imp = does not meet the water quality standard and therefore, is impaired, IF = the data collected was insufficient to make a finding, NA = not assessed

The Pelican Creek reach macroinvertebrate impairment was identified after the IBI calculation was restructured in 2012. Because the impairment was identified after the stressor identification process and *Stressor ID* report were completed, that impairment is not discussed further in this report but will be evaluated further in the next iteration of the Watershed Approach.

*IBI as a Water Quality Measure*
*Click to read a MPCA fact sheet on IBI. (MPCA, 2008)*

## Stressors of biologically-impaired stream reaches

Five stream reaches in the Pomme de Terre River watershed were identified as impaired due to low fish or macroinvertebrate IBI scores. For these "biologically-impaired" reaches, the cause of the impairment (referred to as stressor) was identified using a stressor identification process. Results of this process are reported in the MPCA *Pomme de Terre River Watershed Biotic Stressor Identification* report (2012b) (*Stressor ID* report).

In the stressor identification process, several candidate stressors were considered and from those, primary stressors were identified. A full review of candidate and primary stressors and the effect stressors have on aquatic life is presented in the *Stressor ID* report. The primary stressors for each biologically-impaired stream reach were identified thorough an intensive analysis of data, including application of the U.S. Environmental Protection Agency's (EPA's) Causal Analysis/Diagnosis Decision Information System (EPA, 2012), as well as professional judgment, and stakeholder and local insight. The most common stressors identified were: altered hydrology, high nitrate concentrations, and low dissolved oxygen concentrations. Other identified stressors were high phosphorous, lack of habitat availability, high turbidity, and lack of connectivity for fish passage due to impoundments (dams) (Table 2).

**Table 2: Primary stressors to aquatic life in biologically-impaired reaches in the Pomme de Terre River watershed**

| HUC-10 Subwater-shed | AUID (Last 3 digits) | Stream | Reach Description | Biological Impairment | Primary Stressor | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Dissolved Oxygen | Nitrate | Phosphorus | Turbidity | Fish Passage (dams) | Altered Hydrology | Habitat |
| Middle Pomme de Terre River | 563 | Pomme de Terre River | Barrett Lake to North PdT Lake | Fish | ● | | | | ● | ● | ● |
| | 562 | Pomme de Terre River | Perkins Lake to Muddy Creek | Fish | | | | | | ● | ● |
| Dry Wood Creek | 556 | Dry Wood Creek | Dry Wood Lake to PdT River | Fish & MI | ● | ● | ● | ● | | ● | ● |
| Lower Pomme de Terre River | 551 | Unnamed Creek | Unnamed Creek to Unnamed Creek | Fish | | ● | | | | ● | |
| | 501 | Pomme de Terre River | Muddy Creek to Minnesota River | Fish & MI | | ● | | | | ● | ● |

*EPA Causal Analysis/Diagnosis Decision Information System*
*Click to explore the EPA CADDIS approach to identifying stressors. (EPA, 2012)*
*MPCA Stressor Identification Process*
*Click to read about the MPCA's stressor ID process. (MPCA, 2013c)*

## 2.2 Lakes

In the monitoring and assessment phase of the Watershed Approach in the Pomme de Terre River watershed, 30 lakes were monitored to identify impacts to aquatic recreation. Four lakes were assessed as impaired for impacts to aquatic recreation, 7 lakes were assessed as supporting of aquatic recreation, and 19 lakes had insufficient data to make an assessment (Figure 4). At this time, unlike streams, lakes are not monitored and assessed for impacts to aquatic life.

Table 3 presents the 30 lakes that have been monitored and the assessment status of each of the lakes. The lakes are organized by HUC-10 and are mostly presented from north to south. Lakes are impaired for impacts to aquatic recreation if one or more water quality standards are exceeded. The water quality standard parameters for lakes are: total phosphorus, chlorophyll-a, and Secchi depth. The water quality standard parameter concentrations are specified for lakes depending on the lake's maximum depth, eco-region location, and other factors. The MPCA *Assessment Report of Selected Lakes within the Pomme de Terre River Watershed* (2010) (*Lakes Assessment Report)* contains a thorough discussion of lake assessments.

**Table 3: The impaired and supporting lakes of the Pomme de Terre River watershed, presented (mostly) from north to south**

| HUC-10 Subwatershed | Lake ID | Lake | Aquatic Recreation |
|---|---|---|---|
| Upper Pomme de Terre River | 56-0379 | North Turtle | Imp |
| | 56-0377 | South Turtle | Sup |
| | 56-0639 | Indian | IF |
| | 56-0651 | Larson | IF |
| | 56-0781 | Swan | Sup |
| | 56-0437 | Stalker | Sup |
| | 56-0390 | Long | Sup |
| | 56-0589 | Mineral | IF |
| | 56-0604 | North Ten Mile | IF |
| | 56-0559 | Clear | Sup |
| | 56-0613 | Ten Mile | Sup |
| Pelican Creek | 56-0393 | Johnson | IF |
| | 56-0251 | Torgerson | IF |
| | 56-0252 | Middle | IF |
| | 56-0253 | Eagle | Sup |
| | 56-0160 | Spitzer | IF |
| | 56-0408 | Sewell | IF |
| | 21-0375 | Christina | Imp |
| | 21-0353 | Anka | IF |
| | 26-0002 | Pelican | IF |
| Middle Pomme de Terre River | 26-0097 | Pomme de Terre | IF |
| | 26-0095 | Barrett | IF |
| | 75-0061 | North PdT | IF |
| | 75-0074 | Middle PdT | IF |
| | 75-0075 | Perkins | Imp |
| | 75-0097 | Crystal | IF |
| Muddy Creek | 75-0200 | Hattie | Imp |
| Dry Wood Creek | 76-0169 | North Drywood | IF |
| | 60-0020 | Artichoke | IF |
| Lower PdT R. | 76-0146 | Oliver (east portion) | IF |

Imp = impaired for impacts to aquatic recreation, Sup = fully supporting aquatic recreation, IF = insufficient data to make an assessment

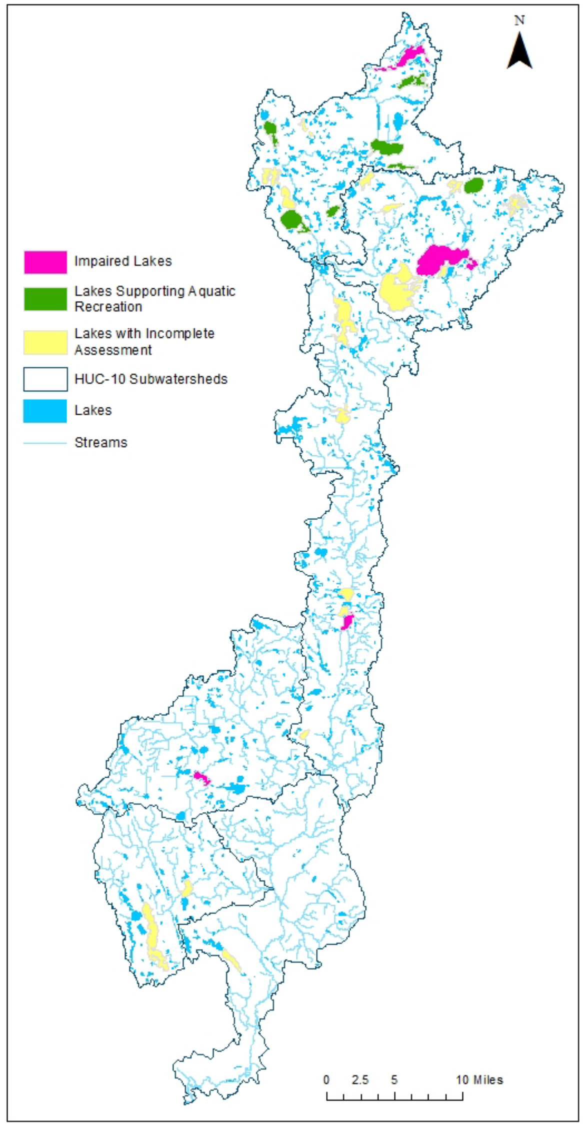


**Figure 4: The locations of impaired, supporting, and incompletely assessed lakes in the Pomme de Terre River watershed**

## 2.3 Trends

Year-to-year weather variations affect water quality observation data; for this reason, interpreting long term data trends minimizes year-to-year variation and provides insight into changes occurring in a water body over time. Statistical methods are frequently applied to noisy data (which is the norm in environmental data) to determine the statistical significance of trends. A statistical analysis using the Seasonal Kendall trend test (with 90% statistical confidence) was conducted on data from one observation location in the Pomme de Terre River watershed, the station at Appleton near the mouth of the river (Table 4).

All waters within the Pomme de Terre River watershed flow through the Pomme de Terre River and discharge into the Minnesota River, just southwest of Appleton. Because this location is the aggregate of all waters in the watershed, the river at this location may be regarded as an indicator of the overall health of the watershed.

**Table 4: Water quality trends of the Pomme de Terre River at Appleton (just upstream from the mouth of the river), green values indicate an improving trend in water quality for that parameter while red values indicate a degrading trend in water quality for that**

| Parameter | Historical Trend (1971-2009) | Recent Trend (1995-2009) |
|---|---|---|
| Total Suspended Solids | no trend | -38% |
| Biochemical Oxygen Demand | -56% | no trend |
| Total Phosphorus | -42% | no trend |
| Nitrite/ Nitrate | +280% | no trend |
| Chloride | +89% | no trend |

Both the historical (years 1971 to 2009) and recent (year 1995 to 2009) trends are presented for comparison. More trends are apparent in the historical data set. This may be due to one or more factors: trend analysis over shorter time periods is statistically more difficult, fewer samples were taken per year starting in 1994 - which resulted in fewer data points to apply trend analysis, or those parameters may have stabilized in more recent years.

Trend data on the Pomme de Terre River at Appleton indicates that there are mixed trends in water quality at this location. The nuances differentiating why certain trends show improvement and others show decline is outside the scope of this brief analysis; however, these trends do reflect the effect (changes in water quality) that are caused by changes within the watershed over the same period of time.

Similar to trend data at the mouth of the Pomme de Terre River, data for lakes within the Pomme de Terre River watershed show mixed trends. Of the 217 lakes, 183 have trend data. The water quality trends of those lakes include: 31 declining, 16 improving, and 136 with no statistically significant trend. Refer to the MPCA *Lakes Assessment Report* for more information on lake trend data.

Trend information should be considered in relation to other more recent monitoring and assessment data. However, trend data can be particularly useful for understanding the condition of the watershed in relation to changes in the landscape made over the same period of record.

## 2.4 Pollutant and stressor sources

The primary pollutant sources and stressor sources, as identified in the Watershed Approach work including the *Stressor ID* report and the *Lakes Assessment* report, are summarized in Table 5**.** These sources represent the likely primary sources as identified in the Watershed Approach work and do not necessarily represent a comprehensive list of pollutant and stressor sources.

**Table 5: The identified likely primary sources of pollutants and stressors of impaired water bodies in the Pomme de Terre River watershed, presented (mostly) from north to south**

| Waterbody, Location, and Upstream Influences | | | Primary Sources of Pollutants/Stressors | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HUC-10 Subwatershed | Water Body | **Location** and Upstream Counties | Fertilizer & manure run-off | Livestock overgrazing in riparian | Failing septic systems | Wildlife | Poor riparian vegetation cover | Upland soil erosion | Bank erosion/excessive peak flows | Low base flow | Channelization | Dams | Upstream influences | Internal sources |
| Upper PdT River | North Turtle Lake | **Ottertail** | • | | | | | | | | | | | |
| Pelican Creek | Christina Lake | **Douglas, Grant**, Ottertail | • | | | • | | | | | | | | • |
| Middle Pomme de Terre River | PdT River, 563 | **Grant, Stevens,** Ottertail, Douglas | • | | | | • | | • | • | • | • | | |
| | Perkins Lake | **Stevens**, Grant, Ottertail, Douglas | • | | | | | • | | | | | • | |
| | PdT River, 562 | **Stevens,** Grant, Ottertail, Douglas | | | | | • | | • | • | • | • | | |
| Muddy Creek | Hattie Lake | **Stevens** | • | | | | | • | | | | | | • |
| Dry Wood Creek | Dry Wood Creek, 556 | **Stevens, Swift**, Big Stone | • | • | • | | • | • | • | • | • | • | • | |
| Lower Pomme de Terre River | Unnamed Creek, 551 | **Stevens** | • | | | | | • | | • | • | | • | |
| | PdT River, 501 | **Stevens, Swift**, Ottertail, Douglas, Grant, Big Stone | • | | • | | • | • | • | | • | • | • | |

Impaired for impacts to aquatic life    Impaired for impacts to aquatic recreation    Impaired for impacts to aquatic life & recreation

# 3. Prioritizing and implementing restoration and protection

One of the most important objectives in the Watershed Approach is to identify scientifically and locally supported restoration and protection strategies. Ideally, these strategies would be developed from a collaborative process between state agencies, local working groups, landowners, and other stakeholders. Although collaboration efforts were made during this project with some success, in future iterations of the Watershed Approach, the MPCA hopes to provide more comprehensive guidance for local collaborative processes that relate to the development of restoration and protection strategies.

The restoration and protection strategies that are presented in this report (Table 6) were developed as broad strategies and are intended to be further refined and applied by local working groups to target conservation practices. The strategies can be further refined (i.e. spatially targeted) using any number of tools available, some of which are discussed in this section. Eventually, the refined restoration and protection strategies may be reflected in local water plans, comprehensive watershed plans, and applications for federal and state clean water funds. An example of how this process could be applied is illustrated in Figure 5.

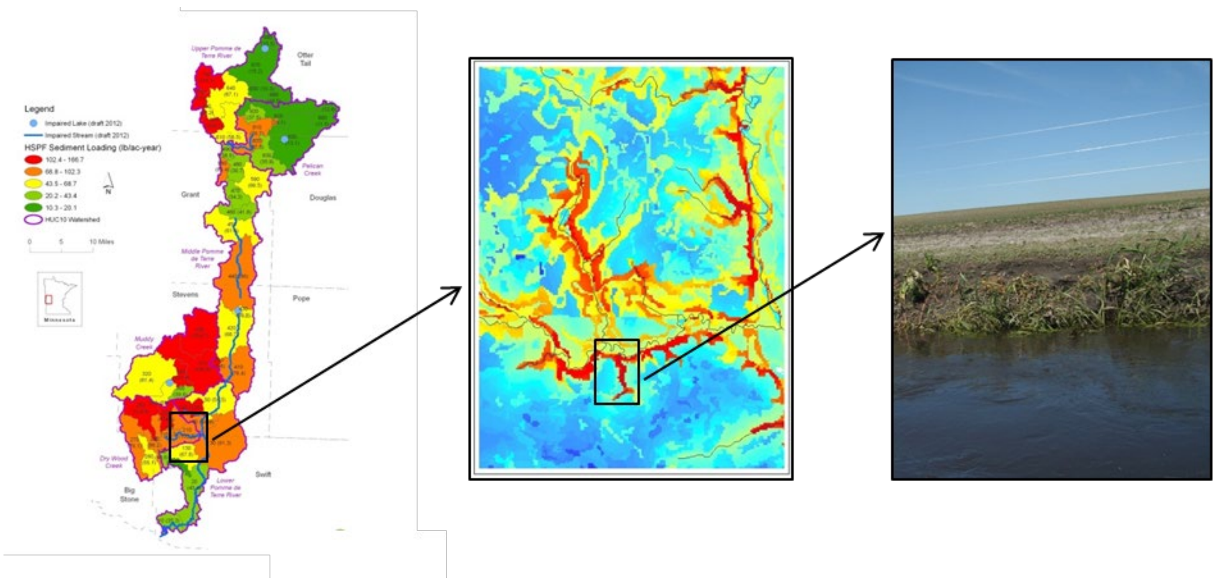


**Figure 5: Hypothetical example of how broad restoration and protection strategies can be refined: Hydrologic Simulation Program-FORTRAN (HSPF) modeling (left) identifies that sediment loading is high in the Dry Wood Creek subwatershed and therefore, erosion and sediment control is identified as a broad restoration and protection strategy. The local working group staff uses a GIS tool to find target areas (in red, center) and verifies computer targeting by making a field visit. The local working group staff have working relationships with a couple landowners in the identified areas (due to civic engagement events, etc.) and these landowners are interested in implementing soil erosion BMPs on their land (right).**

## 3.1 Broad restoration and protection strategies

A team of water quality professionals familiar with the Pomme de Terre River Watershed was assembled to develop broad strategies to restore and protect water quality in the watershed. Members of this team included staff of the MPCA, Minnesota Department of Natural Resources (MDNR), Minnesota Department of Agriculture, and the Coordinator of the Pomme de Terre River Association. Broad restoration and restoration strategies developed by the team were presented to the Pomme de Terre River Association Technical Advisory Committee. The broad restoration and protection strategies are presented in Table 6. These strategies represent first priorities. Because a strategy is not identified as priority in a location, does not necessarily mean that the strategy is not appropriate for that location.

The development of the broad restoration and protection strategies in Table 6 drew on several resources including: monitoring and assessment and stressor identification (previously discussed in this report), an analysis of the pollutant reduction necessary to meet water quality standards (*Pomme de Terre River Watershed Total Maximum Daily Load* report), HSPF modeling analysis and mapping (Figure 7A), human disturbance score calculation and mapping (Figure 7B), and geomorphology analysis conducted primarily by MDNR staff.

Some of the outputs of the above-mentioned tools are presented in this report (Figure 7) but were not available on the MPCA website as of the date of this report. However, local working groups can obtain the GIS or modeling output from the MPCA watershed project manager for reference.

## 3.2 Tools available for local working groups

Several tools are available to target land for restoration and protection. Ultimately, these tools, along with local working group and stakeholder feedback, field reconnaissance, knowledge of best management practices (BMP) suitability, and landowner support, are intended to identify projects that can be implemented to restore and protect Minnesota's waters. In addition to the GIS tools presented in Table 7, local working staff may find and apply tools that are more geared towards their expertise and local priorities. Additional tools include but are not limited to: other GIS mapping applications, simple or elaborate computer models, or empirical calculation models.

Once a specific location is targeted for restoration or protection, a BMP or conservation practice can be selected for the location. Local working group staff generally has an extensive working knowledge of available BMPs and the suitability of specific BMPs in their region. Some available BMP resources (with links) are listed below:

- *Agricultural BMP Handbook for Minnesota* (MDA, 2012)
- *Minnesota Natural Resources Conservation Service Field Office Technical Guide (FOTG)* (USDA, 2013)
- *Stormwater BMP Manual* (MPCA, 2000)
- *Industrial Stormwater BMP Guidebook* (MPCA, 2012d)
- *Shoreland BMP Factsheets* (UM, 2002)
- *Forestry Best Management Practice for Wetlands* (USDA, 1997)

*Hydrologic Simulation Program – FORTRAN (HSPF)*
*Click to read about the USGS watershed modeling tool. (USGS, 2013)*

*MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters*
*Click to read about the Human Disturbance Score and other criteria for assessing water quality. (MPCA, 2102c)*

## 3.3 Civic engagement

Watershed restoration and protection depend largely on a commitment at the community level to protect healthy water and address problems in lakes and streams. The 2006 Clean Water Legacy Act required the development of strategies for educating and encouraging the participation of citizens and stakeholders in the restoration and protection of Minnesota's waters. Because of this, the MPCA and other state agencies responsible for implementing the Clean Water Legacy Act have increased their efforts at public participation and specifically have worked to integrate civic engagement into the Watershed Approach.

Public participation, generally, is any interaction with the public, but civic engagement refers to a specific process within the universe of public participation. The tenets of civic engagement encourage: learning about watershed residents, fostering communication between watershed residents, and decision making that is informed by watershed residents. Although the term civic engagement can be interpreted in different ways, a useful definition has been provided by the University of Minnesota Extension office. They define civic engagement as: "Making resourceFULL™ decisions and taking collective action on public issues through processes of public discussion, reflection and collaboration" (UM, 2012).

### Previous efforts

The public participation strategy in the *Pomme de Terre River Turbidity TMDL Implementation Plan* (PdTRA, 2011a) included: widening the volunteer base, having board and stakeholder meetings, hosting outreach and education events, and creating promotional items.

The public participation strategy in the *Pomme de Terre River Fecal Coliform TMDL Implementation Plan (PdTRA, 2008)* resulted in input from stakeholders. Involved stakeholders prioritized strategies to prevent the delivery of bacteria to the river. Preferred restoration strategies were identified and potential BMPs were developed. These strategies, in order of preference were: 1) riparian buffers, 2) wastewater treatment systems, 3) manure management, 4) pasture management, and 5) urban stormwater management.

### Ongoing efforts

Civic engagement has been one focus in the *Major Watershed Restoration and Protection Plan* (PdTRA, 2011b) adopted by the Pomme de Terre River Association Joint Powers Board (the Association) in April of 2011. The Association has been learning about watershed stakeholders and their opinions toward water quality. The Association's observations and follow-up include:

- Members of the agricultural community tend to be the most frequent attendees at Association events. The Association intends to maintain contacts made in meetings and use their input to inform restoration and protection strategies.
- Lakeshore residents, at times, have limited attendance. The Association learned that many lakeshore property owners in the watershed are absentee landowners - many live in the metropolitan areas of Minnesota and visit the watershed primarily in the summer. The Association is working to determine the best ways to coordinate the gathering of input from this group to inform restoration and protection strategies.
- Outdoor sport and recreation club members have limited attendance. The Association learned that these groups tend to be unaware that the Association exists. The Association intends to contact these groups and share information on the state of water quality in the watershed and gather input from this group to inform restoration and protection strategies.

Efforts to educate the community are addressed through various programs. One such program was the Pomme de Terre River Watershed Academy, an eight-week course to educate and involve citizens in the watershed. Other opportunities for community education include: bus tours of healthy and non-healthy parts of the watershed, BMP use and selection education, upstream/downstream friendship tours, and listening sessions.

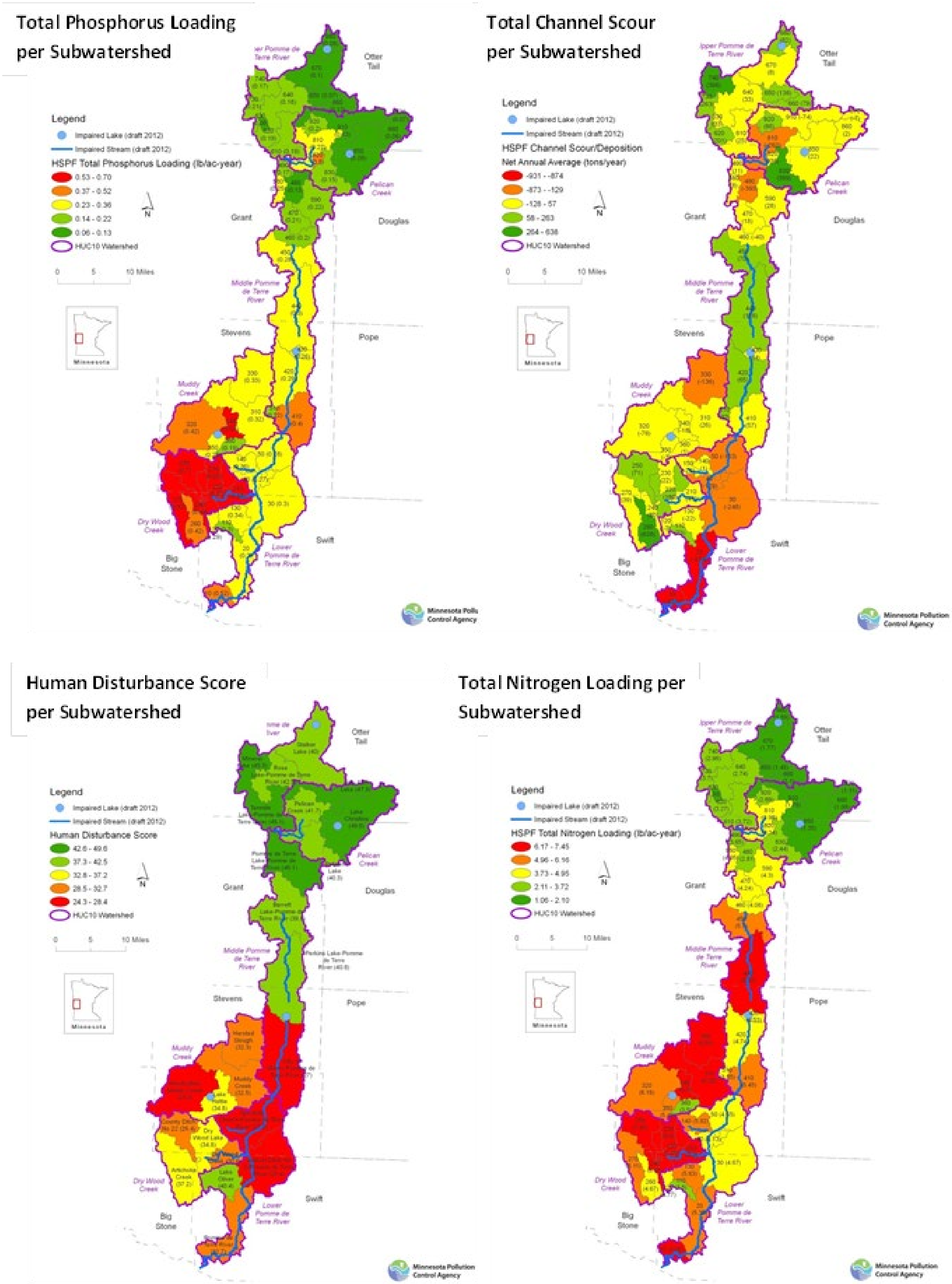


**Figure 6: (A - upper and right) output of MPCA HSPF modeling and (B -lower left) human disturbance score calculation**

**Table 6: Broad restoration and protection strategies for impaired and supporting water bodies by subwatershed in the Pomme de Terre River watershed, to be refined by local working groups, presented (mostly) from north to south**

| Waterbody, Location, and Upstream Influences | | | Priority Restoration & Protection Strategies | | | | | | | | | | | | | Primary Responsibility | | | | | | | | | | Goals *see footnote | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HUC-10 Subwater-shed | Water Body | **Location** and Upstream Influence Counties | (I)ncrease or (M)aintain Perennial Vegetation | Soil Erosion and Sediment Controls | Nutrient Management | Stream Bank Stabilization | Wetland Restoration | In-lake management of internal loading sources | Stream Channel to Floodplain Reconnection | Water & Sediment Control Basins/Rain Gardens | Controlled drainage | Surface tile intake and side-inlet controls | Dam removal/fish passage | Shoreland and Floodplain Management | Adequate Wastewater Treatment/Septic Systems | Landowners | PdT River Association | SWCD | Counties | Cities | BWSR | NRCS | MDNR | MPCA | USFWS | Pollutant Reductions | Milestones |
| Upper Pomme de Terre River | North Turtle Lake | **Ottertail** | M | | • | | | | | | | | | • | • | • | • | • | • | | | | | | | Reduce TP 21% | |
| | South Turtle Lake | **Ottertail** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |
| | Swan Lake | **Ottertail** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |
| | Stalker Lake | **Ottertail** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |
| | Pdt River, 514 | **Ottertail** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |
| | Long Lake | **Ottertail** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |
| | Clear Lake | **Ottertail** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |

| HUC-10 Subwater-shed | Water Body | Location and Upstream Influence Counties | (I)ncrease or (M)aintain Perennial Vegetation | Soil Erosion and Sediment Controls | Nutrient Management | Stream Bank Stabilization | Wetland Restoration | In-lake management of internal loading sources | Stream Channel to Floodplain Reconnection | Water & Sediment Control Basins/Rain Gardens | Controlled drainage | Surface tile intake and side-inlet controls | Dam removal/fish passage | Shoreland and Floodplain Management | Adequate Wastewater Treatment/Septic Systems | Landowners | PdT River Association | SWCD | Counties | Cities | BWSR | NRCS | MDNR | MPCA | USFWS | Pollutant Reductions | Milestones |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Ten Mile Lake | **Ottertail** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |
| | PdT River, 505 | **Ottertail, Grant** | M | | | | | | | | | | | • | | • | • | • | • | | | | | | | | |
| Pelican Creek | Eagle Lake | **Ottertail** | M | | | | | | | | | | | • | | • | • | | • | | | | | | | | |
| | Unnamed Creek, 518 | **Ottertail** | M | | | | | | | | | | | • | | • | • | | • | | | | | | | | |
| | Unnamed Creek, 542 | **Douglas,** Ottertail | M | | | | | | | | | | | • | | • | • | | • | | | | | | | | |
| | Christina Lake | **Douglas, Grant**, Ottertail | M | | • | | | • | | | | | | • | • | • | • | • | • | | | | • | | • | Reduce TP 31% | |
| | Pelican Creek, 506 | **Grant**, Ottertail | M | | | | | | | | | | | • | | • | • | | • | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Middle Pomme de Terre River | PdT River, 504 | **Grant**, Ottertail, Douglas | M | | | | | | | | | | | • | | • | • | | • | | | | | | | | |
| | PdT River, 565 | **Grant,** Ottertail, Douglas | M | | | | | | | | | | | • | | • | • | | • | | | | | | | | |
| | PdT River, 563 | **Grant, Stevens,** Ottertail, Douglas | I | | • | • | • | | • | • | • | • | • | • | | • | • | • | • | | • | • | • | | | Reduce TP 15% | |
| | Perkins Lake | **Stevens**, Grant, Ottertail, Douglas | I | • | • | | | | | | | | | • | • | • | • | • | • | | • | • | | | | Reduce TP 29% | |
| | PdT River, 562 | **Stevens,** Grant, Ottertail, Douglas | I | • | | • | • | | • | • | • | • | • | • | • | • | • | • | • | • | • | • | | • | | | |
| Muddy Creek | Hattie Lake | **Stevens** | I | • | • | | | • | | | | | | • | • | • | • | • | • | | | | | | | Reduce TP 66% | |
| Dry Wood Creek | Dry Wood Creek, 556 | **Stevens, Swift**, Big Stone | I | • | • | • | • | | • | • | • | • | • | • | • | • | • | • | • | | • | • | | | | Reduce TSS up to 72%, TP by 70%, and *E. Coli* by up to 90% | |
| Lower Pomme de Terre | Unnamed Creek, 551 | **Stevens** | I | • | • | | • | | • | • | • | • | | • | | • | • | • | • | | • | • | | | | | |
| | PdT River, 501 | **Stevens, Swift**, Ottertail, Douglas, Grant, Big Stone | I | • | • | • | • | | • | • | • | • | • | • | • | • | • | • | • | • | • | • | | • | | Reduce TSS 53%, Reduce fecal coliform 39% | |

*Footnote: In order to provide an example for other major watersheds, and because the Pomme de Terre project began in 2007, MPCA staff decided that this report needed to be completed, despite some gaps. An adequate process for defining meaningful goals and milestones for multiple pollutants, stressors, and management activities was one such gap. The MPCA will support goal and milestone development as part of efforts to integrate restoration and protection strategies into local plans.

Impaired for impacts to aquatic life

Impaired for impacts to aquatic recreation

Impaired for impacts to aquatic life & recreation

Supports aquatic life

Supports aquatic recreation

**Table 7: GIS tools available to local working group staff to refine the broad restoration and protection strategies**

| Tool | What is the tool? | How can the tool be used? | Access and ease of use? | Information source and data available |
|---|---|---|---|---|
| **Ecological Ranking Tool (Environmental Benefit Index - EBI)** | Three GIS layers containing: soil erosion risk, water quality risk, and habitat quality. Locations on each layer are assigned a score from 0-100. The sum of all three layer scores (max of 300) is the EBI score. This higher the score, the higher the value in applying restoration or protection. | Any one of the three layers can be used separately or the sum of the layers (EBI) can be used to identify areas that are in line with local priorities. Raster calculator allows a user to make their own sum of the layers to better reflect local values. | GIS layers are available on the BWSR website. Beginning to intermediate GIS skills required. | MBWSR, 2011 |
| **Zonation** | A framework and software for large-scale spatial conservation prioritization; it is a decision support tool for conservation planning. This values-based model can be used to identify areas important for protection and restoration. | Zonation produces a hierarchical prioritization of the landscape based on the occurrence levels of features in sites (grid cells). It iteratively removes the least valuable remaining cell, accounting for connectivity and generalized complementarity in the process. The output of Zonation can be imported into GIS software for further analysis. Zonation can be run on very large data sets (with up to ~50 million grid cells). | Specialized skills or experience needed to run application but beginning to intermediate GIS skills required to use GIS output. Assistance through state agency staff may be available. | FCEMB,2012 |
| **Restorable Depressional Wetland Inventory** | A GIS layer representing drained, potentially restorable wetlands in agricultural landscapes. Created primarily through photo-interpretation of 1:40,000 scale color infrared photographs acquired in April and May, 1991 and 1992. | Identify restorable wetland areas with an emphasis on: wildlife habitat, surface and ground water quality, reducing flood damage risk. To see a comprehensive map of restorable wetlands, must display this dataset in conjunction with the USGS National Wetlands Inventory (NWI) polygons that have a 'd' modifier in their NWI classification code | The GIS layer is available on the DNR Data Deli website. Beginning to intermediate GIS skills required. | MDNR, 2013 |
| **National Hydrography Dataset (NHD) & Watershed Boundary Dataset (WBD)** | The NHD is a vector GIS layer that contains features such as lakes, ponds, streams, rivers, canals, dams and stream gages, including flow paths. The WBD is a companion vector GIS layer that contains watershed delineations. | General mapping and analysis of surface-water systems. These data has been used for: fisheries management, hydrologic modeling, environmental protection, and resource management. A specific application of the data set is to identify buffers around riparian areas. | The layers are available on the USGS website. Beginning to advanced GIS skills, depending on the exact application. | USGS, 2013 |
| **Light Detection and Ranging (LiDar)** | Elevation data in a digital elevation model (DEM) GIS layer. Created from remote sensing technology that uses laser light to detect and measure surface features on the earth. | General mapping and analysis of elevation/terrain. These data have been used for: erosion analysis, water storage and flow analysis, siting and design of BMPs, wetland mapping, and flood control mapping. A specific application of the data set is to delineate small catchments. | The layers are available on the MN Geospatial Information website. Beginning to advanced GIS skills, depending on the exact application. | MGIO, 2013 |

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