KLONDIKE CLEAN WATER RETENTION PROJECT

NRE Objectives

DRAFT from NRE Subcommittee 2-25-2020

The Technical Paper 14 was developed to begin incorporating and evaluating Natural Resources Enhancements (NREs) into Flood Damage Reduction (FDR) projects. There are a series of worksheets that the NRE subcommittee of the Project Team worked through to establish NREs for the Klondike project.

An NRE is an activity or activities that improves habitat conditions on the landscape so that appropriate natural resource features of sufficient quality are present to sustain plant and animal communities for the long term. An NRE needs to consider; creation, protection, conservation or restoration/enhancement.

Relevant plans and reports are reviewed against the FDR and NRE criteria outlined in TP 14 that will help establish the goals and objectives for the project.

There is an Objective Development worksheet and this is where the NRE subcommittee focused most of their effort. This worksheet helps flesh out the NRE concepts and begins to put the subcommittee's ideas on paper. Following the Objective Development worksheet, the subcommittee narrows down the focus and develops the Summary of NREs and Objectives for the project. The final summary for the Klondike NREs are found in this document. Fully detailed Objective Development Worksheets for Klondike NREs can be found subsequent to the summaries within this report.

The NRE subcommittee of the Project Team met over a period of six months from September 2019 to February 2020 to develop and discuss NREs for the KCWRP. Existing plans, resources and references were reviewed that encompassed the focus area. The team began developing goals and objectives for the streams/watercourses, water quality and wetlands/fens in the focus area. The focus areas are the South Branch and Middle Branch Two Rivers watersheds including the rich fen that is located outside and within the KCWRP proposed impoundment. Issues in the project area identified in this process related to lack of riparian habitat along watercourses, aquatic habitat needs, increased flashiness of the watercourses and impaired waters with high total suspended solids, high phosphorus and nitrogen and how to protect intact high quality fen, enhance degraded fen and improve water quality and plant diversity for the Beaches Lake Area Rich Fen.

Summary Sheets for KCWRP NRE Objectives

Low Flow Augmentation Objectives:

Habitat Category: ***Streams and watercourses related to low flow augmentation including water quality benefits***

The focus areas are the South Branch and Middle Branch Two Rivers watersheds with the main focus being the South Branch of Two Rivers. Issues in the project area identified in this process related to lack of riparian habitat along watercourses, aquatic habitat needs, increased flashiness of the watercourses and impaired waters with high total suspended solids, high phosphorus and nitrogen.

A better flow regime in the South Branch and Middle Branch of Two Rivers will lead to improved water quality (i.e. reduced impairment), decreased occurrence of high blue-green algae concentrations at Lake Bronson, and improved aquatic habitat condition for fish and macroinvertebrate populations with proper operation of a low flow augmentation pool in the KCWRP.

Objective 1: To provide a more natural flow regime to reduce flashiness of Two Rivers caused by alterations to landscape, drainage, natural hydrology, river channel morphology, climate change by:

- reducing magnitude of peak flows and increased base flows during low water periods in the summer and fall, dependent on water year conditions.
- extending the duration of seasonal high flow events
- slowing the hydrologic rate of change (i.e. increase retention time in upstream areas).

Objective 2: To address impairments on fish and macroinvertebrates through the South and Middle Branch Two Rivers and improved natural flow regime.

- improve the fish and macroinvertebrate community structure so it can be removed from MPCA's impairment listing
- reduce the relative abundance of tolerant and generalist fish species to the basin average for each station class
- increase the relative abundance of sensitive fish species to the basin average for each station.
- increase catch per unit effort excluding tolerant species at each station.
- increase the relative abundance of long lived macroinvertebrates at each station.
- decrease relative abundance of swimmer taxa (macroinvertebrates) to basin average for each station.

Objective 3: Improve levels of total suspended solids, dissolved oxygen, and total phosphorus downstream of the impoundment so that all waters meet the state standards.

- decrease TSS levels in waterbodies downstream of the impoundment to meet current state standards and reductions in TMDL loads.
- decrease Phosphorus levels in waterbodies downstream which cause blue-green algae conditions in Lake Bronson and to meet current state standards and reductions in TMDL loads.
- decrease Nitrogen levels in waterbodies downstream to meet state standards and reductions in TMDL loads.
- increase dissolved oxygen levels downstream of the impoundment through flow augmentation.

Wetland/Rich Fen Objectives:

Habitat Category: ***Wetlands/Rich Fen***

The focus areas are the Beaches Lake Area Rich Fen inside and outside of the Klondike Impoundment. Issues in the project area identified in this process related to how to protect the intact high quality fen, enhance the degraded fen, improve water quality and improve plant diversity.

Objective 1: Protect existing conditions of intact high quality fen

- maintain or improve hydrologic conditions by reducing depth, frequency and duration of inundation events.
- minimize physical disturbance and alteration within the intact fen during and after construction of impoundment to maintain hydrological function and to avoid introduction of invasive species.
- maintain or improve water quality in the fen.
- maintain plant community quality based on baseline studies completed.

Objective 2: Maintain or improve areas of the fen that are largely intact and functional but have degraded quality

- improve hydrologic conditions by reducing depth, frequency and duration of inundation events.
- minimize physical disturbance and alteration within the intact fen during and after construction of impoundment to maintain hydrological function and to avoid introduction of invasive species.
- restore the appropriate groundwater levels for a healthy fen.
- maintain or improve water quality in the fen.
- maintain or improve plant community quality.
- manage vegetation to reduce the presence and spread of invasive species and manage appropriate diversity.

Objective 3: Improve conditions of areas of the fen that had been substantially altered

- reduce the magnitude, frequency and duration of floodwater inundation by surface waters, improve water quality.
- improve groundwater conditions particularly in areas affected by surface drainage
- improve plant community quality-manage vegetation to reduce the presence, abundance and spread of invasive species, and manage appropriate diversity.
- explore the potential for acquiring marginal farmland for wetland restoration opportunities.
- meet with nearby and adjacent landowners to discuss potential conservation programs and strategies that would enhance the rich fen.

Objective 4: Increase awareness of fen functions and values and factors that affect the fen.

- develop basic fact sheets and associated materials to describe the fen functions and values. Develop outreach materials targeting natural resource professionals, local landowners, birders, hunters, and other recreational users.
- develop signage and place at most frequented locations of the Beaches Lake WMA.
- provide appropriate accessibility for the general public to view high quality fen areas
- meet with nearby and adjacent landowners to discuss potential conservation programs and strategies that would be a win-win.
- work with NRCS and SWCD to develop priorities for their conservation enhancement work, emphasizing the value of the area.

Water Quality Objectives:

Habitat Category: ***Streams and watercourses related to water quality improvements***

The focus areas are the South Branch and Middle Branch Two Rivers watersheds with the main focus being the South Branch of Two Rivers and Lake Bronson. Issues in the project area identified in this process related to lack of riparian habitat along watercourses, aquatic habitat needs, low flows/flashiness of the watercourses and impaired waters with high total suspended solids, high phosphorus and nitrogen.

Better control of storm event/spring runoff waters in the South Branch and Middle Branch watersheds will lead to improved water quality, lower algae issues at Lake Bronson, reduced impaired waters and improved aquatic habitats for fish and macroinvertebrate populations with proper operation of a low flow augmentation pool in the KCWRP.

Objective 1: Improve levels of total suspended solids downstream of the impoundment to meet state standards and TMDL reductions

a) The impoundment is primarily designed to hold water from snowmelt and storm events (water from both of which can be significant sources of overland and in-stream TSS), holding this sediment-laden water in an impoundment will allow particulates to settle out, preventing this material from continuing downstream where it would otherwise contribute to existing degraded water quality conditions.

b) The impoundment is designed to hold flood events and large precipitation events, which will prevents these large volumes of water from reaching downstream watercourses which would have otherwise caused bank scouring, sloughing, flooding, etc. all of which would increase TSS.

c) The HSPF model predicts a 62% decrease in sediment/TSS in the water held in the impoundment.

Objective 2: Improve levels of total phosphorus within and downstream of the impoundment to meet state standards and TMDL reductions and meet the MN Nutrient Reduction Strategy.

a) The impoundment will decrease phosphorus especially in water held after snowmelt, during the period of time when plant growth is at its peak, because plants need phosphorus to grow.

b) Reduced phosphorus levels will improve water quality in Lake Bronson which experiences algal blooms in summer and early fall.

c) The HSPF model predicts a 77% reduction in phosphorus in the water held in the impoundment.

Objective 3: Improve levels of nitrogen within and downstream of the impoundment to meet state standards and TMDL reductions and reductions in the Red River Basin.

a) The impoundment will decrease nitrogen especially in water held after snowmelt, during the period of time when plant growth is at its peak, because plants need nitrogen (in form of nitrates) to grow.

b) Excess nitrates in the impoundment not used by plants can undergo denitrification (to produce oxygen and gaseous nitrogen) by microbes, further reducing the nitrogen that is released downstream.

c) The HSPF model predicts a reduction in nitrogen by 81% in water held in the impoundment.

NRE Objective Development Worksheet

Project Name: Klondike Clean Water Retention Project (KCWRP)
Evaluation team: Matt Skoog, Stephanie Klamm, and Danielle Kvasager
Date: 1-21-20

Overview
Alterations to the landscape, agricultural drainage, changes to channel morphology, and climate change are some of the factors have resulted in changes to the flow regime of the Two Rivers Watershed. The result of these alterations is a watershed in which an increase in the magnitude and frequency of high flows has occurred, along with prolonged period of no flow in the channels. In short, the entire system has become flashier (Groshens 2003).

The natural flow regime of a lotic system is often considered of "central importance" in determining the fish and macroinvertebrate community structure (Poff et al. 1997). Alterations to the flow regime can cause the resulting fish and macroinvertebrate communities to shift towards a state of impairment which is likely occurring in the Two Rivers Watershed (Sharp 2017). Specifically, flow instability favors species that are short-lived, tolerant, generalist species (Poff and Zimmerman 2010, Aadland et al. 2005). According to the Monitoring and Assessment Report from MPCA, Assessment Unit Identifiers (AUIDs) 502, 503, 505, and 521 are all listed as impaired for aquatic life use based on poor fish and/or macroinvertebrate communities (Dingmann et al. 2016) and are located downstream of the proposed impoundment location. Additionally, 8 AUIDs and Lake Bronson in the Two Rivers Watershed downstream of the proposed KCWRP site are expected to receive water quality benefits from low flow augmentation. Conventional water quality parameters that are expected to improve are total suspended solids (TSS), dissolved oxygen (DO), and total phosphorus (TP).

Though flow regime is of "central importance" in determining the structure of fish and macroinvertebrate communities, it does not operate in a vacuum. The species present are determined by a suite of variables and interactions (Poff 1997). Other issues in the watershed that also may be of importance in the degradation of fish and macroinvertebrate communities include loss of longitudinal (dams; Topp 2009, Groshens et al. 2003) and lateral connectivity (levees/dikes) to the floodplain, loss of high quality habitat through channelization and dredging, and/or changes to water quality (e.g., total suspended solids, total phosphorus, dissolved oxygen, etc.).

This project has the potential to address some of the flow instability and water quality issues in the South and Middle Branch Two Rivers and move the flow regime to a more natural state. Reducing the hydrologic flashiness and improving the water quality of the South and Middle Branch Two Rivers will also benefit the fish and macroinvertebrate communities with proper operation of a low flow augmentation plan. As such, it should be considered for Natural Resource Enhancement Credit, though it cannot be expected to return either stream to a fully functioning ecosystem without other NRE considerations.

Step 1) NRE planning area Description: (attach air photos, land use map, national wetland inventory map, and other data or maps that provide information on the existing conditions in the project area).

Focus areas for low flow augmentation will be all stream segments and Lake Bronson downstream of the proposed KCWRP site: AUID 501, AUID 502, AUID 503, AUID 505, AUID 509, AUID 517, AUID 518, and AUID 521.

- AUID 501 is the Two River from the outlet of the Middle Branch of Two Rivers to the confluence with North Branch Two Rivers (21 river miles),
- AUID 502 is the South Branch of Two Rivers from Lake Bronson to the confluence with the Middle Branch Two Rivers (33 river miles),
- AUID 503 is the Middle Branch Two Rivers from County Ditch 23 to the confluence with the South Branch Two Rivers (30 river miles),
- AUID 505 is the segment of the South Branch Two Rivers from its confluence with Lateral Ditch 2 of State Ditch 95 to Lake Bronson (8 miles),
- AUID 509 is the Two River from the North Branch Two Rivers to the Red River (7 river miles),
- AUID 517 is State Ditch 50 from Lateral 1 of State Ditch 95 to an unnamed creek (7 river miles),
- AUID 518 is County Ditch 15 from an unnamed creek to County Ditch 23 (4 river miles),
- AUID 521 is the segment of Lateral 1 State Ditch 95 from its confluence with an unnamed ditch to the South Branch Two Rivers (1 river mile), and
- Lake Bronson is a 320 acre lake with a maximum depth of 29 feet located on the South Branch Two Rivers between AUIDs 505 and 502.

A total of 111 river miles are to be treated with low flow augmentation.

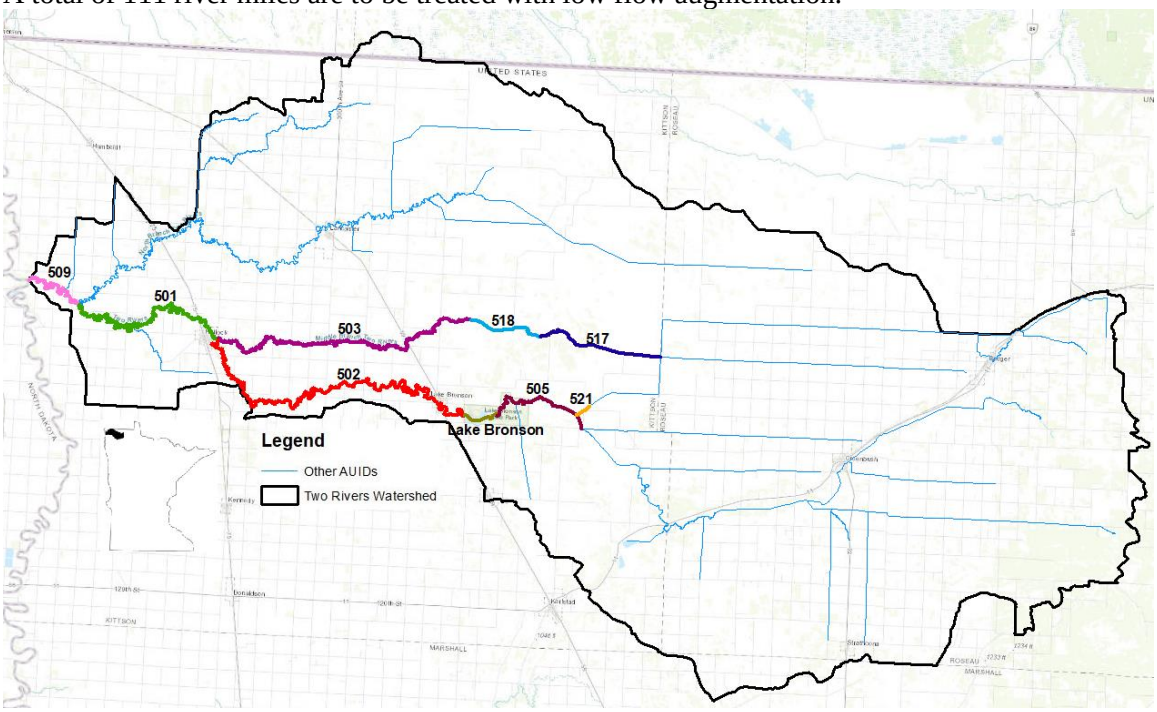

Figure 1. Map of AUIDs and Lake Bronson in the Two Rivers Watershed to be treated with low flow augmentation.

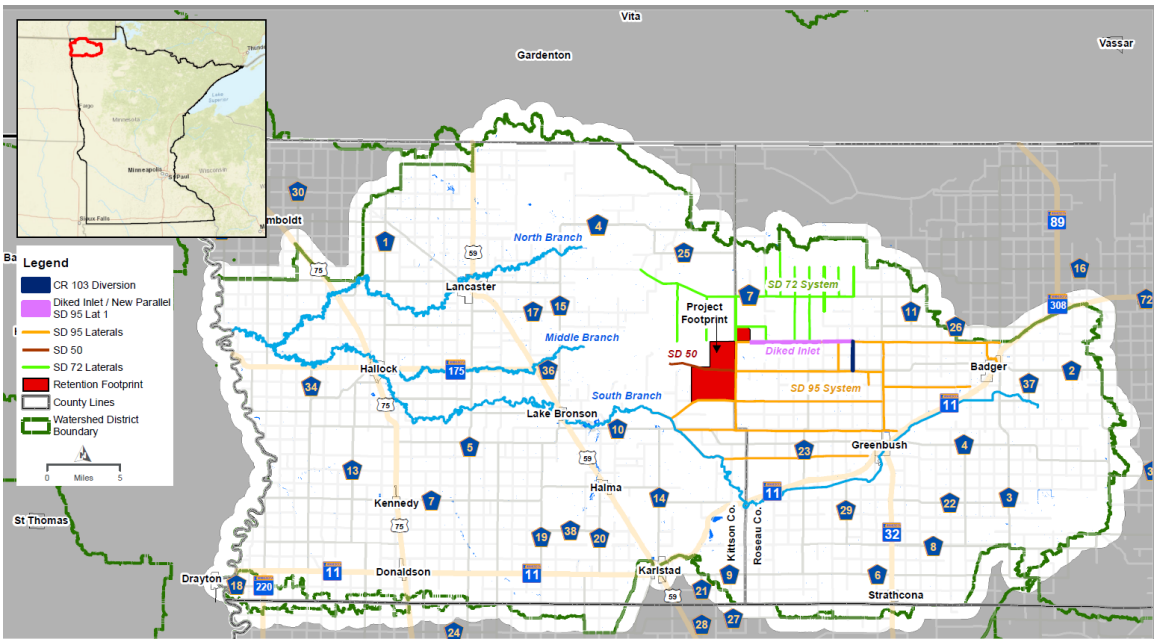

Figure 2. Overview of the Klondike footprint with associated drainage ditches and watercourses

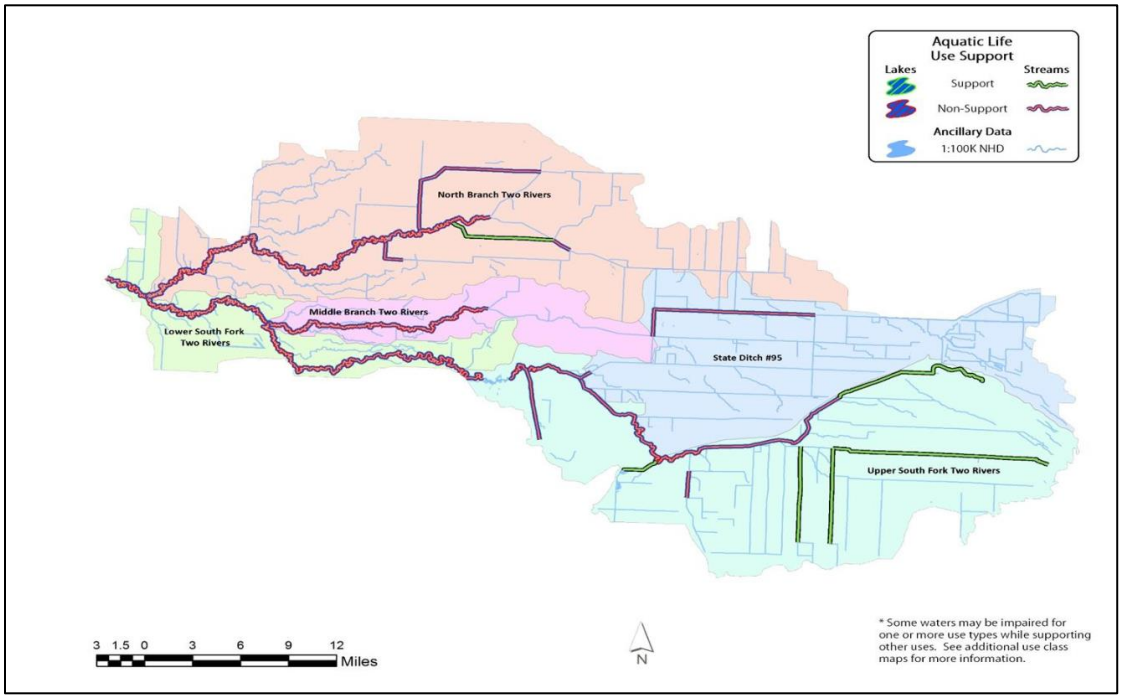

Figure 3. Map from the Two Rivers Watershed Restoration and Protection Strategies (WRAPs) report showing reaches impaired for aquatic life use.

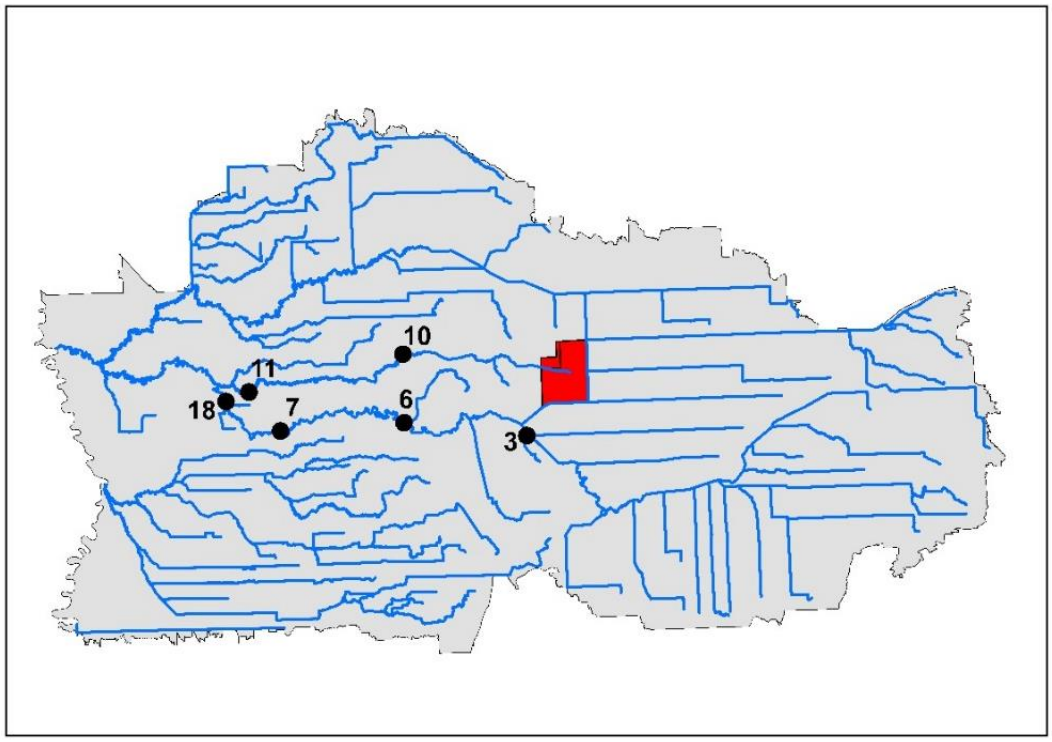

Figure 4. Map of sampling stations from Red River Basin Stream Survey Report Two Rivers Watershed 2001 within the reaches referred to in this document.

Step 2) Determine appropriate goals for the NRE planning area based on existing natural resource and conservation plans and planning tools. Where applicable provide relevant NRE related maps from these plans and resources. See Appendix A for list of useful reference plans and resources.

Goal: Use of KCWRP for low flow augmentation to improve the following in the South and Middle Branch Two Rivers and Lake Bronson:

a. the flow regime
b. fish and macro-invertebrate communities
c. water quality (total suspended solids, dissolved oxygen, and total phosphorus

The appropriate habitat categories for the NRE planning area are:

Streams and watercourses

Step 3) Establish NRE Planning Area Objectives

1. To provide a more natural flow regime to reduce flow instability of Middle and South Branch Two Rivers downstream of KCWRP caused by alterations to landscape, drainage, natural hydrology, river channel morphology, and climate change through:
    a. Reduced magnitude of peak flows and increased base-flows during low water periods in the summer and fall, dependent on water year conditions.
    b. Extend duration of seasonal high flow events
    c. Slowing the hydrologic rate of change (i.e. increased retention time in upstream areas).

A Hydrological Simulation Program – FORTRAN (HSPF) model was developed with the KCWRP project included and estimates that low flow augmentation from the impoundment can provide a 59% increase in the 50% lowest flows.

2. To improve fish community structure to the modified and general use thresholds so that the MPCA impairment can be removed.
3. To improve macroinvertebrate community to the modified and general use threshold structure so that the MPCA impairment can be removed.
4. Reduce the relative abundance of tolerant fish species at MPCA biological stations (10EM192, 13RD085, 93RD401, 93RD405, 05RD093, 13RD042, 13RD043) and MNDNR fisheries station 10 to the basin average for each station class.
5. Reduce the relative abundance of generalist fish species at MPCA biological stations (10EM192, 13RD085, 93RD401, 13RD085, 05RD093, 13RD042, 13RD043) to the basin average for each station class.
6. Increase the relative abundance of sensitive fish species at MPCA biological stations (10EM192, 93RD401, 93RD405, 05RD093, 13RD042, 13RD043) to the basin average for each station class.
7. Increase catch per unit effort excluding tolerant species at MPCA biological stations (13RD085, 93RD401, 10EM192, 13RD082, 05RD093, 93RD405, 13RD042, 13RD043) to the basin average for each station class.
8. Increase the relative abundance of long lived macroinvertebrates at MPCA biological stations (13RD082, 93RD401, 05RD093, 93RD405, 13RD042, 13RD043) to basin average for each station class.
9. Decrease relative abundance of swimmer taxa (refers to a macroinvertebrate taxon that moves and finds food in their environment by swimming) at MPCA biological stations (05RD093, 93RD405, 13RD042, 13RD043) to basin average for each station class.
10. TSS levels in waterbodies downstream of the impoundment site can be restored to conditions better than what currently exists (with the goal of meeting state standards [65 mg/L] and TMDL reductions). Stagnant conditions cause algal growth and harmful blooms of blue-green algae, which increases TSS in watercourses, but using the impoundment for low flow augmentation will reduce the frequency and duration of stagnant conditions, thereby lowering algal growth and TSS. Decreasing TSS levels also reduces the chances that it will be a stressor to biological communities.
11. Dissolved oxygen levels downstream of the impoundment site can be restored to conditions better than what currently exists (with the goal of meeting state standards [5 mg/L]). A major cause of low dissolved oxygen in the NRE planning area is lack of flow in watercourses, which can be alleviated by low flow augmentation. To mitigate the possibility that water leaving the impoundment may have low dissolved oxygen due to sitting idle, structures will be placed immediately downstream of the outlets so that as the water is coming out of the impoundment, it's impact with the structures will churn it and increase surface area of the water exposed to air, thereby aerating it (i.e., increasing dissolved oxygen) before traveling further downstream. Increasing DO levels also reduces the chances that it will be a stressor to biological communities.
12. Total phosphorus levels within and downstream of the impoundment site can be restored to conditions better than what currently exists (with the goal of meeting state standards [150 µg/L]). Keeping water in the impoundment for low flow augmentation pool allows more time for plants to take up phosphorus from the water. Decreasing TP levels also reduces the chances that it will be a stressor to biological communities.

Table 1. Current conditions and thresholds (i.e., goals to aim for) of biological communities downstream of the proposed KCWRP site and the threshold.

		Fish			Macroinvertebrate	
AUID	Station	Class	Current Score	General Use Threshold	Class	Current Score	General Use Threshold
502	10EM192	4	51	38	2	70	31
	13RD082	4	60	38	2	59	31
	13RD085	1	50	49	*	*	*
	93RD401	1	37	49	2	31	31
503	05RD093	2	79, 13, 0	50	7	50, 33	41
	93RD405	6	42	42	7	54	41
505	13RD042	5	36	47	5	29	37
521	13RD043	5	0, 56	47	7	44	41

Note: Basin averages should be based on the MPCA stressor reports and/or MN DNR fisheries surveys. Green = Site exceeds Modified or General Use Threshold, Orange = At site, at least one score meets, Red = Site does not meet Modified or General Use Threshold

Table 2. Current water quality conditions and state standards (i.e., goals to aim for) of AUIDs downstream of the proposed KCWRP site.

	Total Suspended Solids		Dissolved Oxygen		Total Phosphorus	
AUID	Current Conditions	State Standards	Current Conditions	State Standards	Current Conditions	State Standards
501		65 mg/100mL	*	5 mg/100mL		150 µg/L
502			*			
503			*			
505						
509			*			
517	n/a		n/a		n/a	
518	n/a		n/a		n/a	
521						
Lake Bronson	n/a		n/a			65 µg/L

Red = does not meet standards, green = does meet standards, orange = insufficient data for assessment, and n/a = not assessed (very little data available).
*While the DO results that are available indicate that standards are met, there is a lack of early morning DO measurements (when DO is generally lower).
Note that not meeting standards does not always mean that there is an impairment.

Other Considerations:

- Maintenance of peak flows in the South Branch Two Rivers sufficient to decrease embeddedness of sediment and fine particles for high quality fish spawning habitat in riffles for lithophilic spawners. Fines and sediment plug spaces in riffle substrate which limits water flow and reduces

the ability for specialized spawners to successfully spawn (sediment and fine materials smother out eggs).

- Maintenance of channel forming flows in the South and Middle Branch Two Rivers sufficient to allow lateral connectivity to important floodplain habitat for floodplain spawning fishes.
- Operation and construction of project should not limit connectivity to critical fish and macroinvertebrate habitat
- Operation of the project should limit the risk of entrainment of fishes inside of the impoundment.
- Water releases from impoundment needs to be of high enough quality to sustain aquatic life.
- Objectives for fish and macroinvertebrate communities are primarily related to the abundance of tolerant, pioneering, generalist species which could also be related to other disturbances such as lack of quality habitat. Thus, only addressing the flow instability problem may not be able to fix the problem.

Future Actions

- Low flow pool capacity and operational plan needs have not been addressed specifically at this point. An adaptive, binding operational plan that is designed in a way that the natural flow regime needs are met using the best available science is needed to further evaluate this NRE. The operational plan must address multiple factors including, but not limited to seasonality and water year type using various triggers.

NRE Objective Development Worksheet

Project Name: Klondike Area Rich Fen
Evaluation team: Becky Marty, Randy Prachar, Keylor Andrews
Date: February 24, 2020

Overview

The Beaches Lake Area Rich Fen covers approximately 18,000 acres, primarily in Kittson County, with a portion extending east into Roseau County. Much of the fen lies within the State's Beaches Lake Wildlife Management Area (WMA), while other portions lie on private and watershed district lands. The proposed footprint of the Klondike Impoundment lies immediately south and east of most of the WMA, and a portion of the impoundment footprint (approximately 300 acres?) includes intact fen. Figure 3 displays the Klondike project features overlaid on the Beaches Lake Area Fen.

A Fen Management Plan (FMP) was prepared in 2017 "to provide management, protection and enhancement guidance to the Department of Natural Resources, the Two Rivers Watershed District and the Klondike Project planning team." The FMP covers the fen as a whole, and thus encompasses far more land than the Klondike impoundment. Goals from the FMP are used in this NRE worksheet to organize the discussion of objectives and potential actions. In addition the FMP lists 14 strategies considered to possibly protect or enhance the fen. Some of these are specific to the proposed Klondike impoundment and others are more general to the fen as a whole. The NRE Subcommittee of the Klondike Project Team discussed all of these strategies. Some of them could readily be implemented with the project while others could be reasonable "add-ons" to improve natural resource functions but are not directly necessary for project implementation. This NRE worksheet was developed with that understanding.

By capturing and storing flood water, the Klondike project has the potential to reduce overland flooding of the fen, including portions of the WMA. The NRE Subcommittee of the Klondike Project Team reviewed the FMP and considered how the listed goals, objectives, and strategies could be considered in the context of defining appropriate NREs for the Klondike project.

The Klondike impoundment project will alter the hydrologic and vegetative conditions of approximately 300 acres (?) of fen lying within the impoundment footprint, by inundating that land during periodic flood storage operations. This alteration represents an impact that presumably will be identified for required mitigation. At the time this NRE worksheet was prepared, impacts to the fen and other wetlands had not been characterized in detail, and a mitigation plan had not yet been prepared. Actions used as mitigation for impacts to wetlands (including the fen), as well as other impacts of the project, cannot be counted as NREs. Thus, the discussion of fen NREs will be incomplete until these impacts are fully defined and a mitigation plan has been prepared.

This worksheet includes some actions (as noted in the FMP) related to modifying existing ditches within the intact fen on state land. The DNR resource professionals who authored this worksheet consider these to be among the most valuable actions for fen enhancement. Representatives of TRWD have indicated concern that the complexity of gaining acceptance of ditch modifications from local ditch authorities and the public may compromise the overall implementation pathway for the Klondike project. Other participants on the NRE Subcommittee have noted that these actions may be identified later as part of the mitigation program. The authors recognize that these points remain unresolved at the time this worksheet was prepared.

Step 1) NRE Planning Area. See the three figures below.

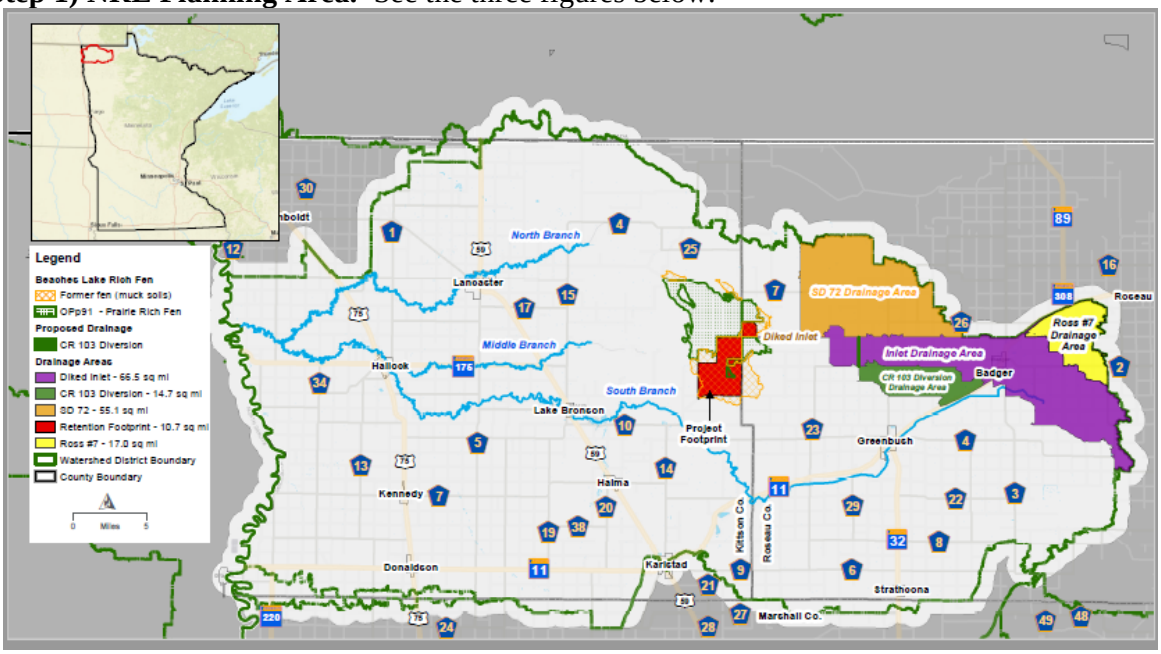

Figure 1: Map of the Two Rivers Watershed and relevant large-scale features for context. Note the upstream drainage areas of the project (in gold, purple, green and yellow) and the proposed Klondike project (in red). The Beaches Lake Rich Fen is outlined in gold. The green hash-marked parts are Beaches Lake WMA.

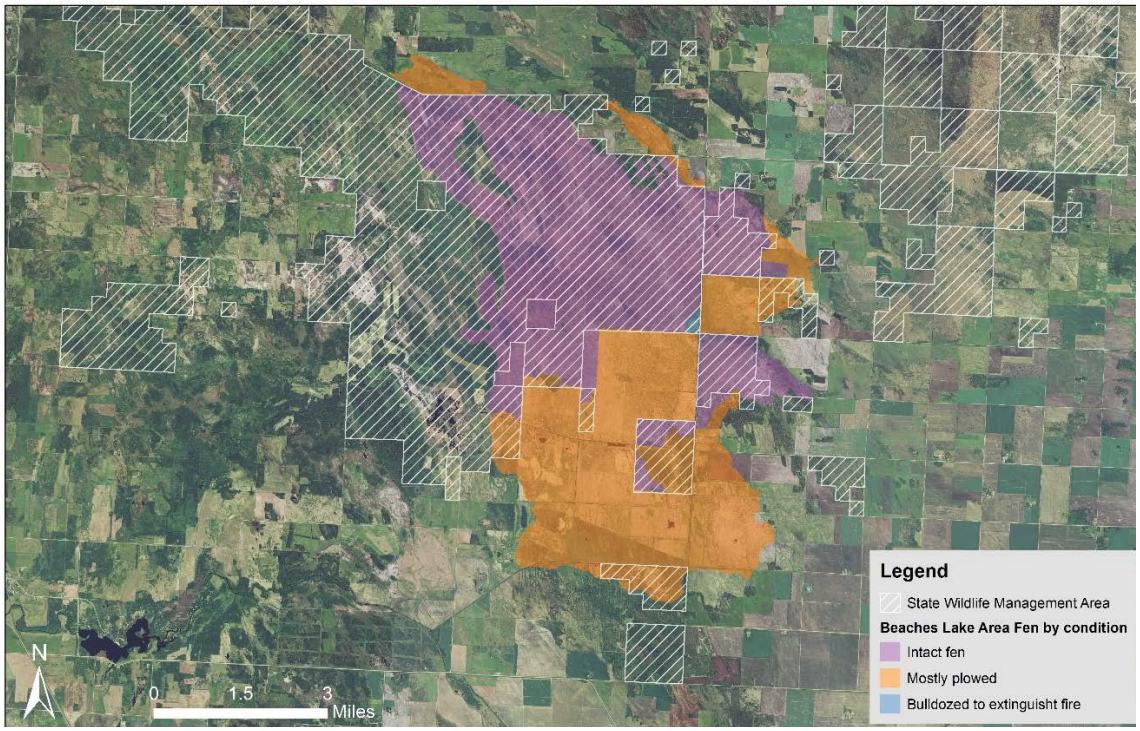

Figure 2: Beaches Lake Rich Fen (purple, gold, and blue colors). The purple areas are intact, mainly high quality fen. The golden areas are disturbed fen; most of which was plowed in the past. The blue area was bulldozed. Currently most of the gold and blue areas are generally degraded poor quality wetlands. White stripes are the Beaches Lake Wildlife Management Area.

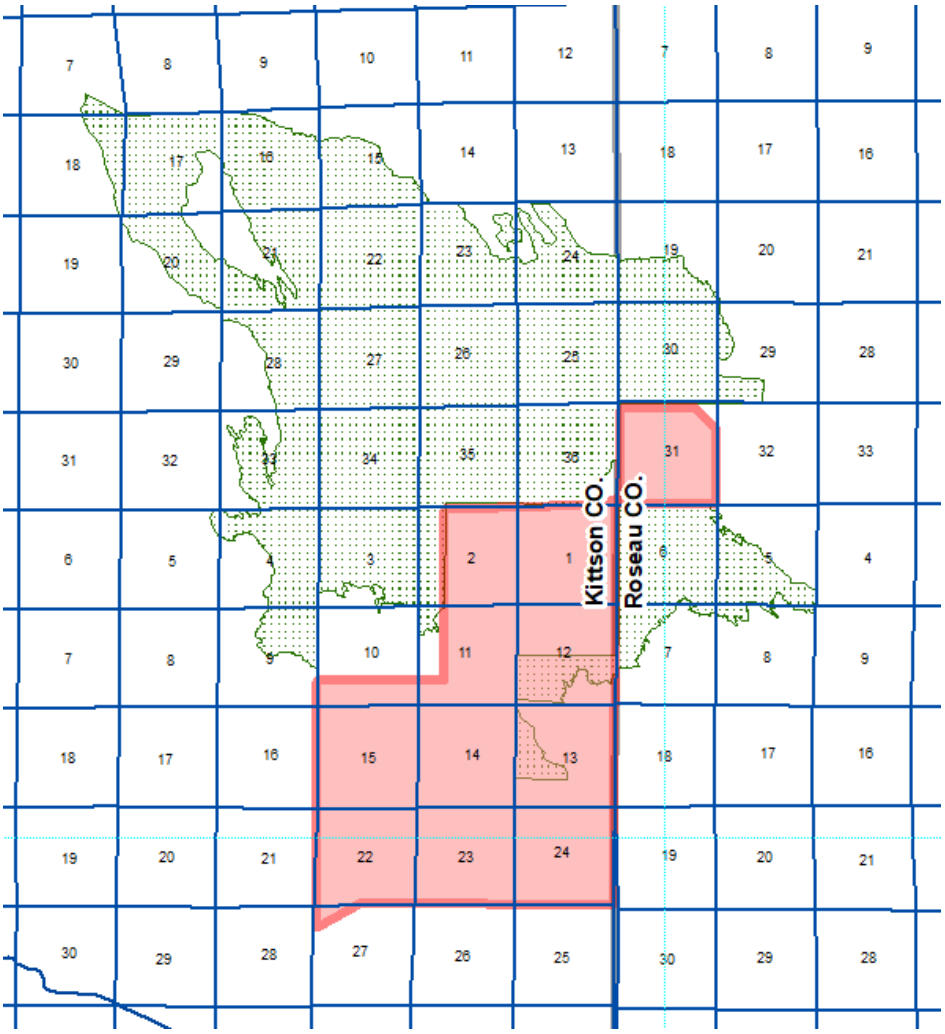

Figure 3: A close-up look at the proposed Klondike impoundment relative to the rich fen. The pink area is the proposed impoundment, and the green stippled area is the rich fen. Section numbers are shown for reference.

Step 2) Goals appropriate for the Klondike Area Rich fen NRE.

The 2017 FMP identified four top-level goals for the Beaches Lake Area Fen (these included areas inside and outside of the WMA and proposed impoundment).

Goal 1. Protect existing conditions of intact high quality fen.

Goal 2. Maintain or improve areas of the fen that are largely intact and functional but have degraded quality.

Goal 3. Improve the conditions of areas of the fen that have been substantially altered.

Goal 4. Increase awareness of fen functions and values, and factors that affect the fen.

The map below identifies high-, medium- and low-quality areas that align with the categories listed in Goals 1 - 3. See Appendix A for a list of useful reference sources.

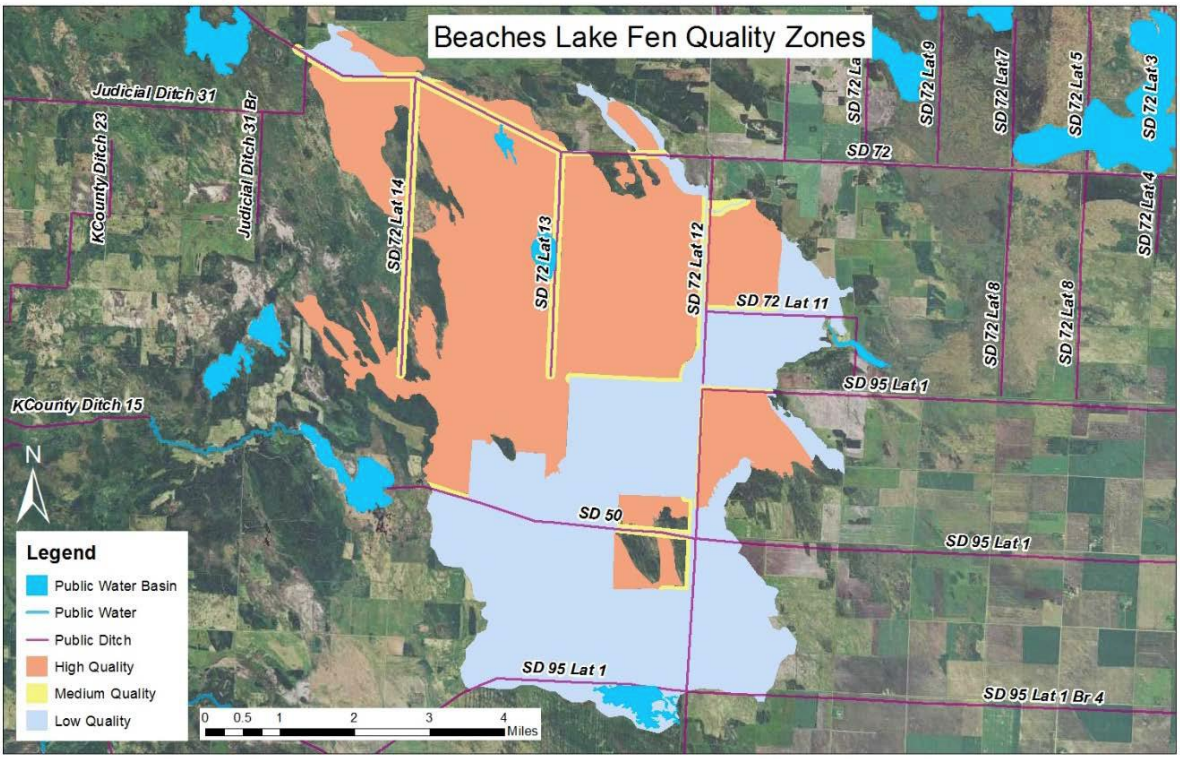

Figure 4: High, Medium and Low Quality areas, aligning with goal statements from Fen Management Plan.

Step 3) Establish NRE Planning Area Objectives

List appropriate habitat categories for the NRE planning area

The appropriate habitat category for the Klondike Area Rich Fen NRE planning area is: Wetlands (and shallow lakes)

Objectives:
Based on extensive field work and photo interpretation, the fen area was mapped in three quality areas (see Beaches Fen Quality Zones map). Each area has specific management objectives.

(Note: Under each Goal below, the items lettered [a] through [f] are objectives. Beneath each objective, the items numbered [i] through [v] are actions to achieve the objectives.)

Goal 1. Protect existing conditions of **intact high quality fen. T**he following objectives were developed to achieve this goal (Note – the portions of the high quality fen within the proposed Klondike impoundment will have to be mitigated.):

a) Maintain or improve hydrologic conditions by reducing depth, frequency, and duration of inundation events. Sustain appropriate groundwater depths (approximately 0 to .5ft below land surface).
   i. Prevent overland runoff from entering the high quality areas of the fen. Explore diverse options to reduce this flowage prior to it getting to the fen; explore funding options for this work to be done on private and public lands. Evaluate modeled

redirection of the waters to make this possible and address impacts this causes elsewhere.

ii. Focus efforts on ditch abandonment of Laterals 13 and 14 of State Ditch 72. Develop and implement a restoration of hydrological function along these ditches to augment existing fen habitat. Use experts in restoration of surface and subsurface hydrology in this habitat type to guide restoration efforts, recognizing to maximize fen and watershed benefits the ditches need to be filled, not just plugged. Model the changes in hydrologic flow out of the fen into the State Ditch 72.

iii. Work closely with the counties involved (Kittson and Roseau) to emphasize the benefits of ditch abandonment and restoration in this area (current citizens pay taxes on these ditches but the ditches do not provide benefits to the local, adjacent farmers. The ditches channel water out of the fens and do this faster than natural flow which contributes to downstream flood events. The ditches move more water out of the fens than would naturally occur, contributing to excess water downstream.)

b) Minimize physical disturbance and alteration within the intact fen during and after construction to maintain hydrological function and avoid introduction of invasive species.
   i. Use the highest level BMPs (exceeding standards) when doing the work.
   ii. When abandoning the ditches and restoring the natural flowage, follow expert guidance to minimize disturbance to and into the fen, and potential introduction or spread of invasive or aggressive native species.

c) Maintain or improve water quality
   i. Prevent the introduction of nutrients (especially N and P) from entering the fen from overland floodwaters.
   ii. Create sinuous channels for water flow through public and private ditches outside the fen (typically private ditches on individual farms) to allow for deposition of nutrients, reduction of water velocity, and increased water absorption prior to water reaching the high quality fen areas. Where feasible and with owner approval, add buffer zones planted with native vegetation to reduce erosion and silt delivery to watercourses.
   iii. Plant vegetation that will absorb more nutrients and water to help with this. Use a diversity of species to connect with all root zones and increase absorption.

d) Maintain plant community quality based on baseline studies completed
   i. Prioritize using the more conservative rich fen species (i.e., the species that have low tolerance to environmental condition changes) found in the medium and high quality fen areas to monitor and assess effectiveness of maintaining and enhancing the fen. Develop restoration strategies to reduce any potential threats by non-native and aggressive native species.
   ii. Follow guidance in the native plant community classification for species diversity and community structure.

Goal 2. Maintain or improve areas of the fen that are **largely intact and functional but have degraded quality. T**he following objectives were developed to achieve this goal. (Note – the portions of the medium quality fen within the proposed Klondike impoundment will have to be mitigated. ***Bold text*** *shows distinctions from similar objectives that were listed under Goal 1.*):

a) **Improve** hydrologic conditions by reducing the depth, frequency, and duration of inundation events.
   i. **Reduce** overland runoff from entering the **medium** quality areas of the fen. *(Same as Goal 1.a.i – detail not repeated here)*
   ii. Focus efforts on ditch abandonment of Laterals 13 and 14 of State Ditch 72. (*Same as Goal 1.a.ii – detail not repeated here*).

iii. Work closely with the counties involved (Kittson and Roseau) to emphasize the benefits of ditch abandonment and restoration in this area. (*Same as Goal 1.a.iii – detail not repeated here*)

b) Minimize physical disturbance and alteration within the intact fen during and after construction to maintain hydrological function and avoid introduction of invasive species. (*Same as Goal 1.b.i and 1.b.ii – sub-points not repeated here*)

c) Restore the appropriate groundwater levels for a healthy fen.
   i. Improve the area hydrology to maintain groundwater depths at approximately ground level to .5ft below ground surface.

d) Maintain and improve water quality.
   i. Prevent, **or at least reduce** the introduction of nutrients (especially N and P) from entering the fen from overland floodwaters.
   ii. Create sinuous channels for water flow through public and private ditches outside the fen to allow for deposition of nutrients, reduction of water velocity, and increased water absorption prior to water reaching the **medium** quality fen areas. (Similar to Goal 1.c.ii – detail not repeated here) (typically private ditches on individual farms)
   iii. Plant vegetation that will absorb more nutrients and water to help with this. Use a diversity of species to connect with all root zones and increase absorption. (*same as Goal 1.c.iii*)

e) Maintain **and improve** plant community quality.
   i. Prioritize using the rich fen species that **can tolerate variable inundation levels** to monitor and assess effectiveness of maintaining and enhancing the **medium quality fen areas**. Develop restoration strategies to reduce any potential threats by non-native and aggressive native species.
   ii. Follow guidance in the native plant community classification for species diversity and community structure (*same as Goal 1.d.ii*).

f) Manage vegetation to reduce the presence and spread of invasive species, and manage appropriate diversity.
   i. Actively manage the invasive species along the ditches and ditch berms. Use best management practices to reduce these native and non-native invasive species so they will not spread into the high quality areas of the fen or share their seeds downstream, impacting farms and other areas.

Goal 3. Improve conditions of areas of the fen that have been **substantially altered**. The following objectives were developed to achieve this goal. ((Note – the portions of the low quality fen within the proposed Klondike impoundment might need to be mitigated. ***Bold text*** *shows distinctions from similar objectives that were listed under Goals 1 and 2*):

a) Reduce the magnitude, frequency, and duration of floodwater inundation by surface waters. Improve water quality.
   i. Evaluate converting the existing, NRCS 30-year protection of the Quick property to a permanent status (Figure 5). See NRCS WRP/RIM Restoration Implementation Plan, approved 6/1/2018 and associated agreement. Site work included ditch plugs, ditch fill, removing trees/brush, and seeding native prairie plants on 58 acres of disturbed land within the 1,300 acre property.

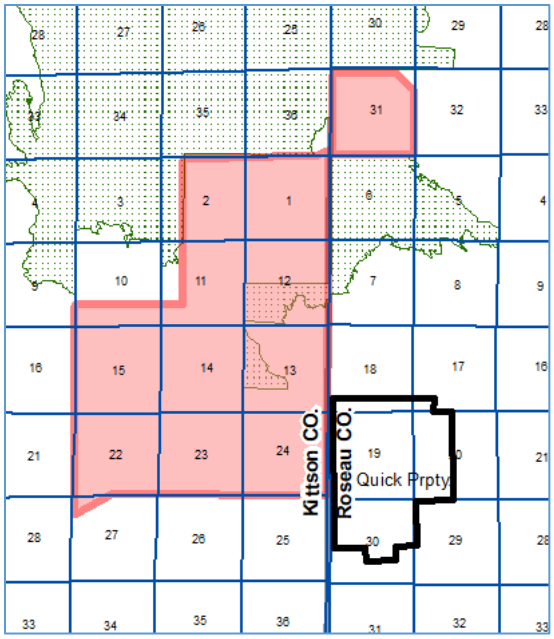

Figure 5: Approximate boundary of Quick Property (in black) owned by TRWD and currently enrolled in WRP/RIM.

ii. Explore installing ditch plugs in old (no-longer maintained) field ditches. Reseed these areas with natives.

iii. Create sinuous channels for water flow to allow for deposition of nutrients, reduction of water velocity, and increased water absorption prior to water reaching the medium and high quality fen areas. (*Similar to Goal 2.d.ii*) (typically private ditches on individual farms)

iv. **Work with adjacent land owners to** support their use of native species that will absorb more nutrients and water.

v. Work closely with the counties involved (Kittson and Roseau) to emphasize the benefits of ditch abandonment and restoration in this area. (*Same as Goal 1.a.iii – detail not repeated here*)

b) Improve groundwater conditions particularly in areas affected by surface drainage.

i. Explore installing ditch plugs in old (no-longer maintained) field ditches. Reseed these sites with natives.

c) Improve plant community quality - Manage vegetation to reduce the presence, abundance, and spread of invasive species, and manage appropriate diversity.

i. **Plan for management of these areas using prescribed fire**.

ii. Provide for establishment and maintenance of native vegetation; seek out opportunities to introduce pollinator habitat where site conditions allow.

iii. Alter moisture regimes (e.g., plug shallow field ditches) and allow for vegetation management techniques (e.g., haying, grazing) to enhance fen vegetation distribution, diversity, and species composition.

iv. Create the impoundment berm so it can be used as a travel corridor for fire protection and ease of access for invasive species control. (And berm/dike repair and maintenance.)

v. In low quality areas near and especially upstream from medium and high quality areas, manage against aggressive and invasive species by farming annuals and planting native species.

d) Explore the potential for acquiring marginal farmland for wetland restoration opportunities. This would enhance all the objectives of this goal.

e) Meet with nearby and adjacent landowners to discuss potential conservation programs and strategies that would enhance the rich fen.

i. Work with NRCS and SWCD to develop priorities for their conservation enhancement work, emphasizing the value of this area.

Goal 4. Increase awareness of fen functions and values, and factors that affect the fen. The following objectives were developed to achieve this goal: (*Note this goal and the objectives below are fully distinct from those listed for Goals 1 – 3*).

a) Develop basic fact sheets and associated materials to describe the fen functions and values. Develop outreach materials targeting natural resource professionals, local landowners, birders, hunters, and other recreational users.
   i. Provide these to area hotels, visitor bureaus, science classes, continuing education classes, community education opportunity events, etc.

b) Develop signage and place at most frequented locations of the Beaches Lake WMA.

c) Provide appropriate accessibility for the general public to view high quality fen areas.
   i. Create bird viewing platforms, hunting blinds and other wildlife viewing and hunting opportunities associated with the fen.

d) Meet with nearby and adjacent landowners to discuss potential conservation programs and strategies that would be a win-win.

e) Work with NRCS and SWCD to develop priorities for their conservation enhancement work, emphasizing the value of this area.

NRE Objective Development Worksheet

Project Name: Klondike Clean Water Retention Project (KCWRP)
Evaluation team: Danielle Kvasager
Date: 1-24-20

Overview
Excessive levels of sediment, phosphorus (as it relates to its role in dissolved oxygen levels), and nitrogen have a detrimental effect on the use of the waterbodies by aquatic life (fish and aquatic macroinvertebrates). Excessive levels of phosphorus have an additional negative effect on the use of the waterbodies for aquatic recreation (any activity where there is direct contact with water by humans, pets, etc.). Too much phosphorus increases the risk of harmful algal blooms, exposure to which can cause illness. There are many other measures of water quality (e.g., chloride, bacteria, pH, etc.), but the aforementioned three are the main ones that are known to be improved by impoundments.

The KCWRP will improve water quality. This impoundment project will be designed to reduce sediment, phosphorous, and nitrogen loading to the South and Middle Branches of the Two Rivers downstream of the propose location. Of particular focus is the improved water quality in Lake Bronson, located on the South Branch Two Rivers.

A Hydrological Simulation Program – Fortran (HSPF) model of the Two Rivers Watershed with the KCWRP built into it provides reduction estimates of three water quality parameters. It estimates that sediment, phosphorus, and nitrogen of water in the impoundment can be decreased by 62%, 77%, and 81% before being released at the impoundment outlets.

Step 1) NRE planning area Description: (attach air photos, land use map, national wetland inventory map, and other data or maps that provide information on the existing conditions in the project area.)

Focus areas for improved water quality (decrease in sediment, phosphorus, and nitrogen) will be all stream segments (AUIDs 501, 502, 503, 505, 509, 517, 518, and 521) and Lake Bronson downstream of the proposed KCWRP site up to the point where the Two River outlets to the Red River of the North:

- AUID 501 is the Two River from the outlet of the Middle Branch Two Rivers to the confluence with North Branch Two Rivers (21 river miles),
- AUID 502 is the South Branch Two Rivers from Lake Bronson to the confluence with the Middle Branch Two Rivers (33 river miles),
- AUID 503 is the Middle Branch Two Rivers from County Ditch 23 to the confluence with the South Branch Two Rivers (30 river miles),
- AUID 505 is the segment of the South Branch Two Rivers from its confluence with Lateral Ditch 2 of State Ditch 95 to Lake Bronson (8 miles),
- AUID 509 is the Two River from the North Branch Two Rivers to the Red River (7 river miles),
- AUID 517 is State Ditch 50 from Lateral 1 of State Ditch 95 to an unnamed creek (7 river miles),
- AUID 518 is County Ditch 15 from an unnamed creek to County Ditch 23 (4 river miles),
- AUID 521 is the segment of Lateral 1 State Ditch 95 from its confluence with an unnamed ditch to the South Branch Two Rivers (1 river mile), and
- Lake Bronson is a 320 acre lake with a maximum depth of 29 feet located on the South Branch Two Rivers between AUIDs 505 and 502.

A total of 111 river miles are to benefit from improved water quality.

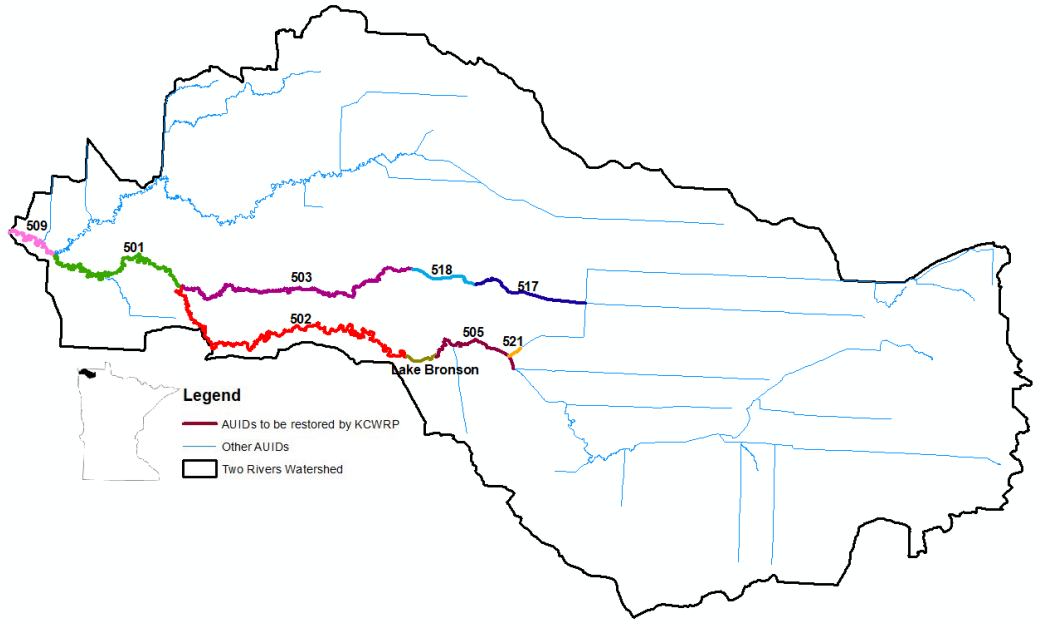

Figure 1. AUIDs (i.e., stream segments) and lake downstream of the proposed location for the impoundment that can have improved water quality as a result of the impoundment.

Table 1 below shows current conditions, good and bad, of relevant water quality in watercourses downstream of the project based on MPCA's 2015 assessments. Relevant water quality includes parameters that the project can improve, whether directly or indirectly.

Table 3. Current conditions of relevant water quality parameters in watercourses downstream of the project based on MPCA's most current assessment in 2015.

AUID	Fish	Aquatic Macroinvertebrate	Dissolved Oxygen[a]	Total Suspended Solids (i.e., sediment)	NH_3 (nitrogen related)	Nutrients (phosphorus related)
501						
502						
503						
505						
509						
517						
518						
521						

[a] DO is listed because high phosphorus can cause low DO.

Green indicates that state water quality standard was met, red indicates that state water quality standard was not met (indicates impairment) and indicates an impairment listed on the 305(b) Impaired Waters List, orange indicates that assessments were attempted but it was determined that data was insufficient for assessment, and no color indicates that assessment was not attempted due to no data or expired data (i.e., older than 10 years).

The red boxes in Table 1 shows the relevant water quality issues. All of these issues have also been officially listed as impaired on the 305(b) Impaired Waters List. While only sediment and biological related impairments are listed as issues, there were not enough data to determine conditions of AUID 517,

AUID 518, and Lake Bronson or for dissolved oxygen and phosphorus. Thus, other poor water quality likely exists, but more data is needed to make an official determination. For example, phosphorus levels in Lake Bronson (and several of the AUIDs) are exceedingly high, but there are not enough data to officially assess conditions. Although nitrogen does meet standards in waterbodies where it was assessed, the MN Nutrient Reduction Strategy has a goal of 13% reduction in nitrogen; the impoundment project will provide a decrease in nitrogen. There are other water quality issues and impairments caused by pollutants such as *Escherichia coli* and mercury that are not relevant to the project, and thus are not listed in Table 1.

The biologically-caused impairments are considered relevant to the project, because the causes for the fish and aquatic macroinvertebrate communities being poor can be related to the water quality parameters or pollutants that the project is expected to improve. Table 2 below lists those causes of poor biological communities. Causes in Table 2 relevant to the project include high suspended sediment and low dissolved oxygen (DO). As mentioned previously, the project can reduce sediment, thereby improving conditions for the biological communities. The cause of low dissolved oxygen can be high phosphorus, which the project will also reduce.

Table 4: Stressors to the biological communities (fish and/or benthic macroinvertebrates) listed as impaired

MPCA's AUID	Relevant Impairment(s)	Stressors*				
		Loss of Longitudinal Connectivity	Flow Regime Instability	Insufficient Physical Habitat	High Suspended Sediment	Low Dissolved Oxygen
09020312-521	Fish bioassessments	++	++	++		++
	Benthic macroinvertebrates bioassessments		++	+		+
09020312-505	Fish bioassessments	++	++	+		+
	Benthic macroinvertebrates bioassessments		+	+	+	+
09020312-502	Fish bioassessments	+++	++	++		
	Benthic macroinvertebrates bioassessments		+	+		
09020312-503	Fish bioassessments	+	+	+		+
	Benthic macroinvertebrates bioassessments		+	+	+	+

*a gauge of how well the evidence supports that the stressor is having a negative effect on the biological community: +++ = convincingly supports, ++ = strongly supports, + = somewhat supports, and a blank space indicates no support.

Step 2) Determine appropriate goals for the NRE planning area based on existing natural resource and conservation plans and planning tools. Where applicable provide relevant NRE related maps from these plans and resources. See Appendix A for list of useful reference sources.

Goal: Use of KCWRP to improve (i.e., decrease) the following water quality parameters in the South and Middle Branch Two Rivers and Lake Bronson to conditions that meet state standards, TMDL reductions, and/or MN Nutrient Reduction goals:

d. sediment
e. phosphorus
f. nitrogen

The appropriate habitat categories for the Klondike impoundment and downstream reaches NRE planning area are: Streams and other watercourses

Step 3) Establish NRE Planning Area Objectives

TSS/sediment levels in waterbodies downstream of the impoundment can be improved to conditions better than existing conditions (with the goal of meeting state standards and TMDL reductions; see below) in the following ways:

- As the impoundment is primarily designed to hold water from snowmelt and storm events (water from both of which can be significant sources of overland and in-stream TSS), holding this sediment-laden water in an impoundment will allow particulates to settle out, preventing this material from continuing downstream where it would otherwise contribute to existing degraded water quality conditions. To mitigate the possibility that water leaving the impoundment at a high velocity will cause further suspension of solids, structures large and heavy enough to not be displaced by the velocity of water (perhaps a rock riffle) will be placed immediately downstream of the outlets that will 1) prevent the finer particle solids underneath the structures from being suspended and 2) slow down the velocity of the water being released from the impoundment to prevent excessive suspension of solids downstream.
- Since the impoundment is designed to hold flood events and large precipitation events (i.e., it reduces peak flows downstream), it prevents these large volumes of water from reaching downstream watercourses which would have otherwise caused bank scouring, sloughing, flooding, etc. all of which would increase TSS. As can be seen in the TMDL tables below (Tables 5 and 6) it is these high flows where the greatest reduction of sediment is needed.
- The HSPF model predicts that the KCWRP can decrease sediment by 62% in water held in the impoundment (note that this estimate does not include the sediment reduction that is achieved by reducing peak flows downstream).

Phosphorus levels within and downstream of the impoundment will be improved to conditions better than existing conditions (with the goal of meeting state standards and the MN nutrient reduction strategy; see below) in the following ways:

- The impoundment will decrease phosphorus especially in water held after snowmelt, during the period of time when plant growth is at its peak, because plants need phosphorus to grow. Removing phosphorus from the water at the impoundment will improve degraded water quality downstream.
- The HSPF model predicts that the KCWRP can decrease phosphorus by 77% in water held in the impoundment.

Nitrogen levels within and downstream of the impoundment will be improved to better than existing conditions (with the goal of continuing to meet state standards and the MN nutrient reduction strategy; see below) in the following ways:

- The impoundment will decrease nitrogen especially in water held after snowmelt, during the period of time when plant growth is at its peak, because plants need nitrogen (in form of nitrates) to grow. Removing nitrogen from the water at the impoundment will ensure that standards continue to be met downstream and help in meeting nitrogen reduction goals for the Red River Basin.
- Excess nitrates in the impoundment not used by plants can undergo denitrification (to produce oxygen and gaseous nitrogen) by microbes, further reducing the nitrogen that is released downstream.
- The HSPF model predicts that the KCWRP can decrease nitrogen by 81% in water held in the impoundment.

Table 5: State water quality standards of Class 2 waterbodies downstream of the proposed project area in the Two Rivers Watershed.

Pollutant	Water Quality Standard	Units	Applicable AUIDs/Lake
TSS	30	mg/L	505, 521
	65		501, 502, 503, 509, 517, 518
NH_3	40	µg/L	All AUIDs and Lake Bronson
TP	65	µg/L	Lake Bronson
	150		All AUIDs

Table 6: Minnesota Nutrient Reduction Strategy goals.

Major Basin	Phosphorus reduction goal	Nitrogen reduction goal
Lake Winnipeg[a]	10% reduction from 2003 conditions	13% reduction from 2003 conditions

[a] The Two Rivers Watershed is a component of this major basin.

Table 7. Total suspended solids TMDL and reductions for AUID 501 to address the turbidity-caused impairment.

Total Suspended Solids		Flow Regime				
		Very High	High	Mid	Low	Very Low
		[tons/day]				
Loading Capacity		347.9	87.8	28.81	9.20	1.64
Wasteload Allocation	Total WLA	1.22	0.96	0.90	0.88	0.87
	Badger WWTF	0.07	0.07	0.07	0.07	0.07
	Greenbush WWTF	0.43	0.43	0.43	0.43	0.43
	Hallock WWTF	0.29	0.29	0.29	0.29	0.29
	Lake Bronson WWTF	0.08	0.08	0.08	0.08	0.08
	Construction/Industrial Stormwater	0.35	0.09	0.03	0.009	0.002
Load Allocation	Total LA	311.9	78.0	25.0	7.40	0.60
Margin of Safety (MOS)		34.8	8.8	2.9	0.92	0.16
Existing Load		820.9	131.5	28.4	6.13	0.89
Unallocated Load		0.0	0.0	0.4	3.07	0.75
Estimated Load Reduction		58%	33%	0%	0%	0%

LC, WLA, LA, and MOS are part of the TMDL equation (Equation 1). The existing load is based on available water quality data; the unallocated load is the load, if any, that remains if the existing load is below the load capacity; and the estimated load reduction is the reduction, as a percentage, of the existing load to meet the numeric water quality standard.

Table 8. Total suspended solids TMDL and reductions for AUID 509 to address the turbidity-caused impairment.

Total Suspended Solids		Flow Regime				
		Very High	High	Mid	Low	Very Low
		[tons/day]				
Loading Capacity		520.7	130.3	45.0	14.4	2.79
Wasteload Allocation	Total WLA	1.47	1.08	0.99	0.96	0.95
	Badger WWTF	0.07	0.07	0.07	0.07	0.07
	Greenbush WWTF	0.43	0.43	0.43	0.43	0.43
	Hallock WWTF	0.29	0.29	0.29	0.29	0.29
	Lake Bronson WWTF	0.08	0.08	0.08	0.08	0.08
	Lancaster WWTF	0.08	0.08	0.08	0.08	0.08
	Construction/Industrial Stormwater	0.52	0.13	0.04	0.014	0.003
Load Allocation	Total LA	467.2	116.2	39.5	12.0	1.56
Margin of Safety (MOS)		52.1	13.0	4.5	1.44	0.28
Existing Load		1,509.3	579.5	154.0	26.6	2.2
Unallocated Load		0.0	0.0	0.0	0.0	0.59
Estimated Load Reduction		65%	78%	71%	46%	0%

LC, WLA, LA, and MOS are part of the TMDL equation (**Equation 1**). The existing load is based on available water quality data; the unallocated load is the load, if any, that remains if the existing load is below the load capacity; and the estimated load reduction is the reduction, as a percentage, of the existing load to meet the numeric water quality standard.

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Sharp, M. 2017. Two Rivers Watershed Stressor Identification Report. Minnesota Pollution Control Agency, St. Paul, Minnesota.

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Relevant Plans and Reference Documents for Establishing NRE Goals and Objectives

- **Red River Basin Mediation Agreement** discusses the Natural Resource Management Goals of Managing streams for natural characteristics as well as improving water quality and enhancement and protection of wetlands. (Reference: http://www.rrwmb.org/Governing_Documents/Gov%20Docs%20New/Mediation%20Agreement.pdf, 1998).

- **Red River Basin Stream Survey Report-Two Rivers Watershed 2001** lists recommendations on habitat protection and enhancement for Two Rivers which include update operating plan of the Lake Bronson dam to augment base flows to the South Branch Two Rivers, define areas critical for sustaining base flows, restore wetlands in critical areas to augment base flows, support incentives to implement strategies that will stabilize streams and re-establish natural functioning stream channels wherever possible; particularly channelized reaches (pg 44). It also gives condition of fish communities in the form of IBI scores (pg 34) and lists the fish species were observed historically at particular sites. (Reference: Hard copy, 2003).

- **Two Rivers Watershed District Overall Plan** lists in plan for sections on existing conditions that systems such as State Ditch 95, Lat. 1, Lake Bronson and Middle Branch that the systems have been altered and has flashy flows, susceptibility to enhance low flow or no flow periods, and lack of riparian habitat limiting the function of aquatic resources. Solution for such issues include flood water retention (semi-permanent storage of flood water for other beneficial uses such as water supply, wetland or recreation). Overall Watershed goals include addressing natural systems to reduce the "flashiness" of the hydrograph related to ditches and natural water resources. Other strategies for natural resources include restore more natural hydrographs to waters in the watershed-reduce the "flashiness" and to create a healthier and more diverse fish population throughout the TRWD. (Reference: http://www.tworiverswd.com/overall_plan.html, 2004).

- **Nature Conservancy's The Northern Tallgrass Prairie Ecoregion Plan** lists in the plan strategies for threats to the tallgrass prairie streams, rivers and wetlands, with major threats being habitat alteration and degraded water quality. The plan provides some goals for the tallgrass prairie ecoregion that are relevant to wetlands, streams and water quality. (Reference:http://support.natureconservancy.ca/pdf/blueprints/Northern_Tallgrass_Prairie.pdf, 2004).

- **Beaches Lake WMA Management Guidance Document** lists habitat management goals for the WMA, with practices being prescribed burning, sheering or Hydro-axing of brush and other wetland vegetation. (Reference: Electronic copy, 2006).

- **Roseau County Water Plan** lists reduce the "flashiness" of the hydrograph related to ditches and natural watercourses as a priority issue in the County. (Reference: https://2b849565-bf8c-4458-bf63 -01f58312fd47.filesusr.com/ugd/d82f3b_5ecfba83a59d402eafe7585466d34d27.pdf, 2010).

- **Kittson County Water Plan** lists priority water quality, NREs and reduce erosion as concerns in the County Water Plan.
  (Reference: http://www.kittsonswcd.org/uploads/3/4/8/3/34837176/2010_-_2019_kittson_county_local_water_plan_clwp.pdf, 2010).

- **Aspen Parkland Subsection Forest Management Plan** lists in plan for (Reference: https://files.dnr.state.mn.us/forestry/planning/aspen-parklands/aspen-parklands-final-plan.pdf, 2011).

- **Beaches Lake High Conservation Value Forest** discusses management objectives for the HCVF. (Reference: http://eco-app.dnr.state.mn.us/hcvf/hcvf_link.php?hcvf_num=350350, 2013).

- **MPCA's Development of a Fish-Based Index of Biological Integrity for Minnesota's Rivers and Streams** describes the development and classification of biological indices used as objectives in this document.
  (Reference: https://www.pca.state.mn.us/sites/default/files/wq-bsm2-03.pdf, 2014).

- **MPCA's Minnesota Nutrient Reduction Strategy** provides goals, milestones, evaluations, etc. related to nutrients (phosphorus and nitrogen) in Minnesota. A goal is a 10% reduction in phosphorus and 13% reduction in nitrogen compared to 2003 conditions in waters that eventually drain into Lake Winnipeg (includes waters from Two Rivers Watershed). (Reference: https://www.pca.state.mn.us/sites/default/files/wq-s1-80.pdf, 2014).

- **State Wildlife Action Plan** addresses primary causes for species population declines and focuses on prioritization of areas within the Wildlife Network (Reference: https://www.dnr.state.mn.us/mnwap/index.html, 2015).

- **MPCA's Two Rivers Watershed Monitoring and Assessment Report** documents biological and non-biological impairments related to aquatic life use. It also indicates which AUIDs are meeting state standards.
  (Reference: https://www.pca.state.mn.us/sites/default/files/wq-ws3-09020312b.pdf, 2016).

- **MPCA's Two Rivers Stressor Identification Report** lists both the South Branch and Middle Branch Two Rivers as well as State Ditch 95, Lat. 1 as having stressors to the biological communities related to flow regime instability as stressors in this watershed. MPCA Stressor Identification Report also lists three conventional water quality pollutants, high sediment, low dissolved oxygen, and total phosphorus (as it relates to eutrophication) as stressors to biological communities in the South Branch and Middle Branch Two Rivers as well as State Ditch 95, Lat. 1.
  (Reference: https://www.pca.state.mn.us/sites/default/files/wq-ws5-09020312a.pdf, 2017).

- **MPCA's Macroinvertebrate Data Collection Protocols for Lotic Waters in Minnesota** describes classification of various macroinvertebrate taxa.
  (Reference: https://www.pca.state.mn.us/sites/default/files/wq-bsm4-01.pdf, 2017).

- **Beaches Lake Area Fen Management Plan** addresses stressors on the rich fen along with strategies/actions and goals to protect and improve fen conditions. (Reference: Electronic copy, 2017).

- **Minnesota Prairie Conservation Plan** focuses on strategies to protect grasslands and wetlands in Minnesota. Three strategies are noted (protection, restoration and enhancement). This plan fits into the Fen Enhancement Plan
(Reference: https://files.dnr.state.mn.us/eco/mcbs/mn_prairie_conservation_plan.pdf, 2018).

- **MPCA's Two River Watershed Restoration and Protection Strategies (WRAPS)** provides strategies that can be implemented to improve water quality that is causing impairments and improve stressors that are negatively affecting biological communities. One such strategy is to increase base flows during low flows, which the KCWRP can provide. (Reference: https://www.pca.state.mn.us/sites/default/files/wq-ws4-57a.pdf, 2019).

- **Hydrological Simulation Program – Fortran (HSPF) Model**
An HSPF model of the Two Rivers Watershed has been developed that has the KCWRP built into it to investigate the water quality benefits of the impoundment. The model estimates that sediment, phosphorus, and nitrogen of water in the impoundment can be decreased by 62, 77, and 81% before being released at the impoundment outlets. (Tetra Tech, 2019).

- **MPCA Impaired Waters Listing and TMDL Plans** The 305(b) Impaired Waters List provides a list of waterbodies in the state that have enough data to be assessed and the assessments have determined that the waterbodies do not meet state standards for one or more parameter/pollutant. There are impairments on AUIDs and lake downstream of the proposed project site. TMDLs exist for the 2 sediment-related impairments on AUIDs 501 and 509 and they provide sediment reductions that must be met in order for sediment to meet state water quality standards. (Reference: https://www.pca.state.mn.us/sites/default/files/wq-iw 1-65.xlsx, 2020).

- **Kittson-Roseau Aspen Parkland IBA** (Reference: https://www.audubon.org/important-bird-areas/kittson-roseau-aspen-parkland-iba).