FINAL
Environmental Assessment
For Fish Passage in the Red River of the North Basin, Minnesota.

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Table of Contents

7. Public Comment on Draft EA/EIS and Response

8. References Cited

Appendices

Appendix A - List of fish surveys and assessments conducted in the Red River Basin.

Appendix B – Barrier Information Worksheets completed by MN DNR Fisheries personnel.

Appendix C – United States Army Corps of Engineers Preliminary Restoration Plans: Drayton Dam.

Appendix D - United States Army Corps of Engineers Environmental Assessment: Fargo South Dam

Appendix E – Reports from State Historical Preservation Office (SHPO) database search for Red River barriers.

Appendix F – Red River of the North Comprehensive Fisheries Management Plan

Appendix G – Restoration of Extirpated Lake Sturgeon (*Acipenser fulvescens*) in the Red River of the North Watershed

FINAL

Environmental Assessment

1. Purpose and Need -

This document serves as the Environmental Assessment (EA) for providing fish passage in the Red River of the North Basin, Minnesota. The purpose of an EA is to disclose, explain, and evaluate the environmental effects of proposed government actions to the decision-makers and the public. The EA describes and evaluates alternatives to the proposed course of action.

Given the current state of the surface water resources affected by fish barriers in the Red River Basin, this document considers two alternatives for providing passage at each location. The projects proposed may receive partial funding from Fish Passage Grants or Federal Sport Fish Restoration Funds that are administered by the U.S. Fish and Wildlife Service (Service) and the Department of Natural Resources (DNR). Because of the potential funding sources, the project must comply with both the National Environmental Policy Act (NEPA) and the Minnesota Environmental Policy Act (MEPA). This EA has been prepared to meet both Federal and State laws that require full public disclosure of projects that may affect the quality of the human environment.

1.1. Purpose

The primary goal of this project is to evaluate the re-establishment of fish passage at 13 existing barrier areas on the Red River and its Minnesota tributaries that will reconnect extensive reaches of the Red River and its tributary systems.

1.2. Need

The needs that should be met by the selected Alternative are:

1. Provide fish passage in the Red River and important tributary watercourses throughout the Minnesota portion of the Red River Basin.
2. Minimize the liabilities associated with owning and maintaining barriers to fish passage,
3. Ensure that private and public riparian landowners continue to have water sources for private and municipal use.
4. Ensure that there are no adverse impacts to fish and wildlife populations resulting from barrier removal.
5. Ensure continued or improved stability of the watercourse banks and bed.
6. Ensure that there are no adverse impacts to historic resources.
7. Ensure that concerns of the local community are considered.

1.3. Decisions that Need to be Made.

The Service's Regional Director will consider and select one of the alternatives analyzed in detail and will determine, based on the facts and recommendations contained herein, whether this Environmental Assessment (EA) is adequate to support a Finding of No Significant Impact (FONSI) decision, or whether an Environmental Impact Statement (EIS) will need to be prepared. The Minnesota DNR will independently consider and select one of the alternatives analyzed in detail.

1.4. Background.

The Red River of the North Basin contains an extensive system of watercourses including the Red River and eleven major tributaries in Minnesota. Prior to settlement, these

watercourses formed a network of diverse and connected aquatic habitats that supported diverse fish communities including more than 70 native species.

During the past 100 years, many barriers, including dams and culverts, have been placed on watercourses throughout the basin. These barriers effectively prevent fish passage and disconnect many reaches of habitat from each other. Over 400 dams have been constructed on watercourses in the Red River Basin (Stoner et al. 1993) and thousands of culverts have been installed at road crossings. In some locations these barriers can eliminate the potential for fish passage to many miles of quality habitat. Recent surveys have documented lower species diversity above barriers on the Wild Rice River, Tamarac River, Buffalo River, and Sand Hill River in the Red River Basin (see Appendix A - VanOffelen et al. 2002, MN DNR Survey - Wild Rice River 2003, MN DNR Survey-Tamarac River 2000).

Effectively removing barriers will re-establish fish passage in the Red River Basin and reconnect reaches of habitats for a variety of species and life stages. Re-establishing fish passage at these barriers will restore connectivity to the aquatic habitats in the Red River system.

Effective removal of barriers, particularly dams, has become a viable alternative for fish passage throughout the nation. Over 400 dams have been removed in the United States during the past few decades (Poff and Hart 2002). Many dams no longer serve their intended purpose, require costly maintenance, and pose safety risks with corresponding liability issues. These structures have become prime candidates for removal. Environmental issues to consider during dam removal include sediment, stream stability, and risks to introduce exotic species (Pizzuto 2002). In the Red River Basin fish passage has been provided at dams on Red River, Red Lake River, Buffalo River, Otter Tail River, and Middle River during the past 10 years.

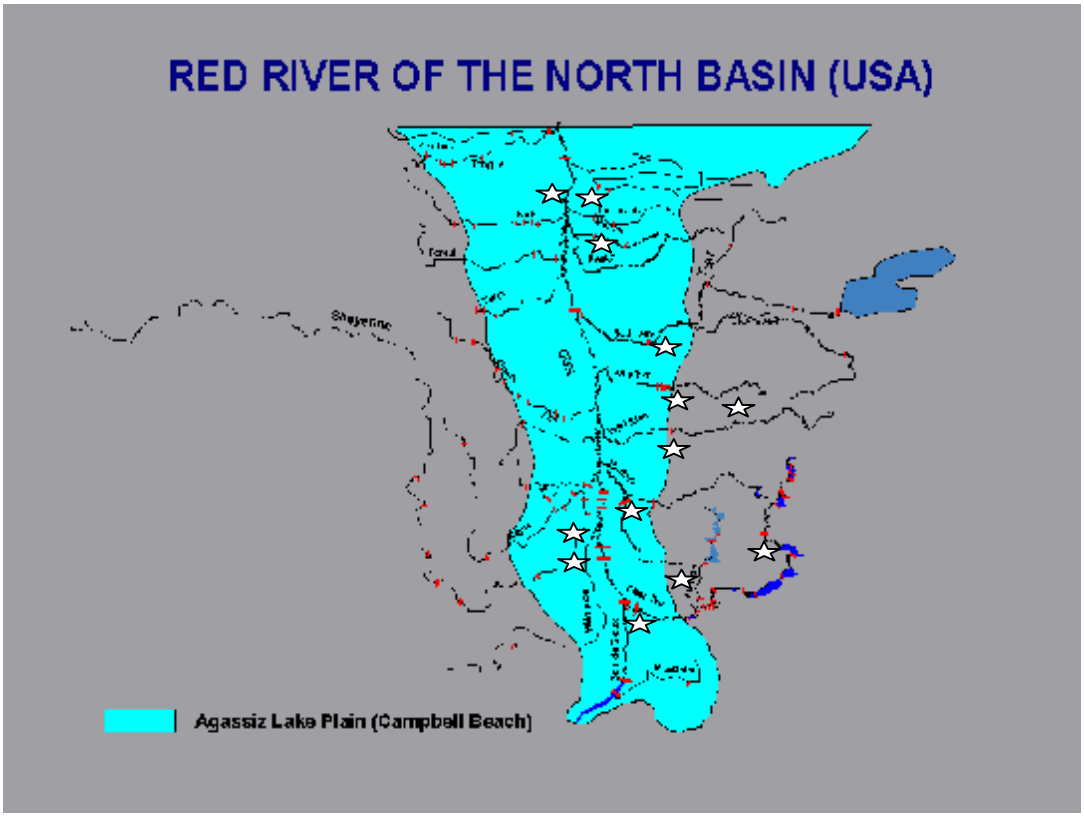


Figure 1. Location of dams in the Red River basin. The location of the 13 dams considered for fish passage in the assessment are noted by a ☆.

2. Alternatives, Including the Proposed Action
A number of alternatives were considered for each of the sites considered for fish passage in the Red River Basin.

2.1. Alternatives not Considered for Detailed Analysis – The following two alternatives were considered but were not carried forward for detailed analysis.

2.1.1. Modify existing structures with structural/engineered solutions (e.g. classic fish ladder approach). Some existing barriers could be retrofitted to obtain fish passage. These post-construction engineered solutions would require extensive design, construction, and maintenance, offer little or no recreational benefit, are not likely to improve safety, and are not likely to provide passage during the entire range of flow events. Much of the design of engineered solutions has been focused and evaluated for salmonid species. No adequate investigations have been conducted to evaluate engineered solutions for the range of fish species and life stages affected in the Red River basin.

2.1.2. Fish stocking and transport. Fish species could be captured and transported to those areas that are currently not passable. This would require an intensive effort across a wide geographic area that would be required on an annual basis and also after large storm events. This alternative is not practical and does not improve safety at current barriers.

2.2. Alternatives Carried Forward for Detailed Analysis

Two alternatives for fish passage, removal and modification, were considered at each of the thirteen barrier locations. The proposed action (Alternative A) for the Red River Basin is the combination of these individual preferred alternatives for each location.

2.2.1. Alternative A - (Proposed Action) – Table 1 lists the preferred alternatives for each of the 13 barrier sites in the Red River Basin. The combination of these individual preferred alternatives forms Alternative A. This alternative includes either modification or removal of existing barriers to provide fish passage and maintain the stability of the reach of stream channel.

In all courses of action in this alternative a sequence of events will be followed:

1) determine if removal will disturb substantial quantities of sediment,
2) sample sediment quality and quantity,
3) determine whether sediment removal will be needed prior to demolition of the structure,
4) determine wetland impacts of the project, if any, avoid as practicable and mitigate if needed,
5) determine potential impacts of project to threatened and endangered species,
6) determine whether action will have historic preservation issues,
7) clear brush and trees to gain access to the site for construction or demolition,
8) dewater the pool by cutting/removing a small portion of the dam if required by modification,
9) remove dam crest to the sill or place rock slope downstream of barrier,
10) install grade and erosion control measures to ensure stream stability post-project,
11) reinforce any abutments as needed based on engineering,
12) implement post-construction restoration of stream banks and floodplain through reshaping and native seeding of disturbed areas.

If, during the course of pre-project planning, issues become evident that warrant further investigation, a supplemental EA will be needed for that barrier.

Rock slope modifications of dams. Modification of dams will be accomplished through installation of a rock slope at the existing dam site (figures 2 – 4). Rock slopes are constructed by placing large rocks below the existing dams to create a rapids that extends from the dam crest downstream at a 20:1 slope. The top of this rock slope will be concave and contain a series of rock weirs to direct stream flow toward the center of the channel. Natural channel design principals will be used to design each rock slope. The design of each rock slope will depend on site specific conditions including hydrologic conditions and channel shape below the dam. This approach has effectively provided fish passage at several Red River Basin dams in recent years (Kidder Dam at Wahpeton, Fargo South, Fargo Midtown, Fargo North, Red Lake River at East Grand Forks, Grand Forks Riverside).

Modification of these dams with a rock slope will maintain the current crest height of most dams. At several dams, construction of a rock slope may also involve cutting a shallow notch in the dam to lower the dam's height for a portion of its width. A notch will be used at those dam sites where a low flow channel is needed to create a passable area during low flow conditions. A notch may also be used to reduce the quantity of materials needed to complete the modification.

Table 1 - List of barriers, their watercourse, their preferred alternative and the miles of stream habitat that would become accessible once the alternative action is taken.

Barrier name	Watercourse	Preferred Alternative	Upstream habitat miles
Drayton Dam	Red River of the North	Modification with rock slope and channel restoration	290
Christine Dam	Red River of the North	Removal	14
Hickson Dam	Red River of the North	Removal	50
Otter Tail Power Dam	Red Lake River	Removal	63
Heiberg Dam	Wild Rice River	Modification with rock slope	120
Lake Breckenridge Dam	Otter Tail River	Removal	32
Argyle Dam	Middle River	Removal	30
Sand Hill River barriers	Sandhill River	Modification with rock slope	79
Marsh Creek culverts	Marsh Creek	Modification with rock slope	42
Stephen Dam	Tamarac River	Modification with rock slope	26
South Branch Buffalo barriers	S. Br. Of the Buffalo River	Removal	50
Elizabeth Dam	Otter Tail River	Removal	22
Phelps Mill Dam	Otter Tail River	Modification with fish way	4

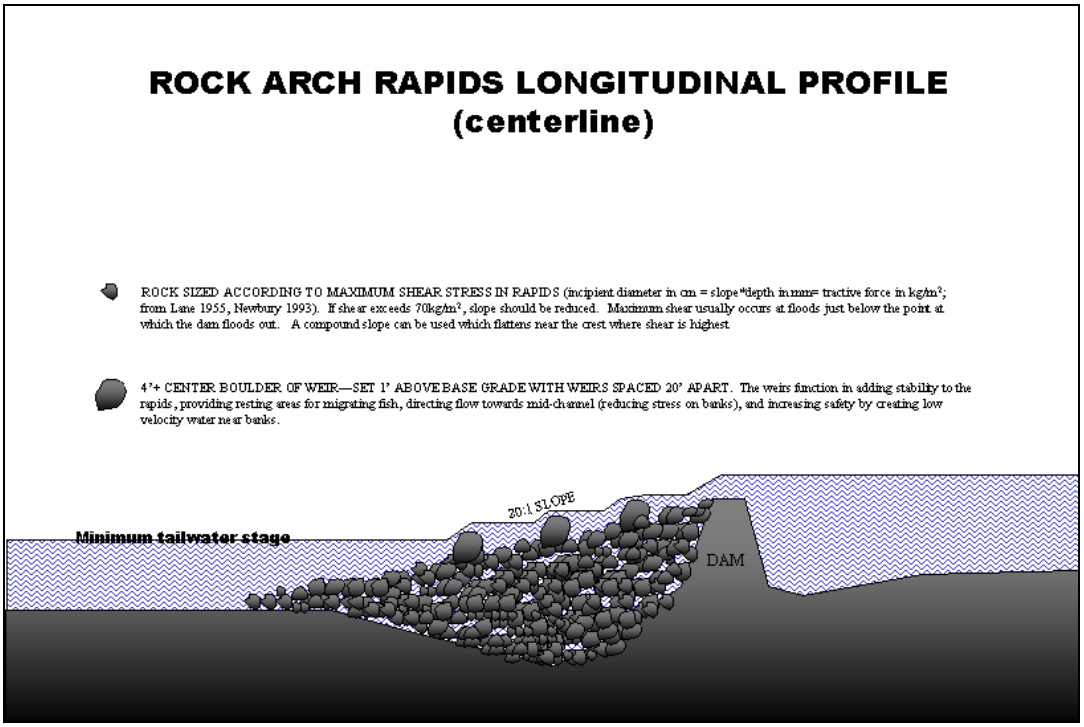


Figure 2. Longitudinal section view of a typical rock slope rapids used to modify a dam for fish passage. (provided by Luther Aadland MN DNR)

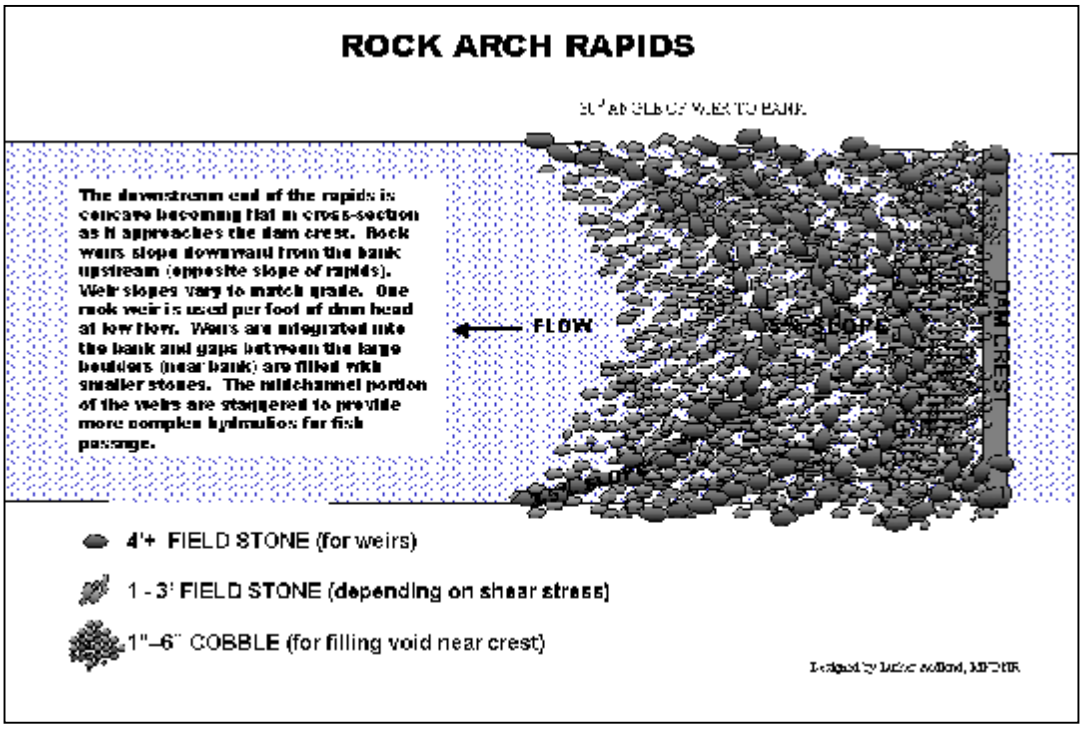


Figure 3. Plan view of a typical rock slope rapids used to modify a dam for fish passage. (provided by Luther Aadland MN DNR)

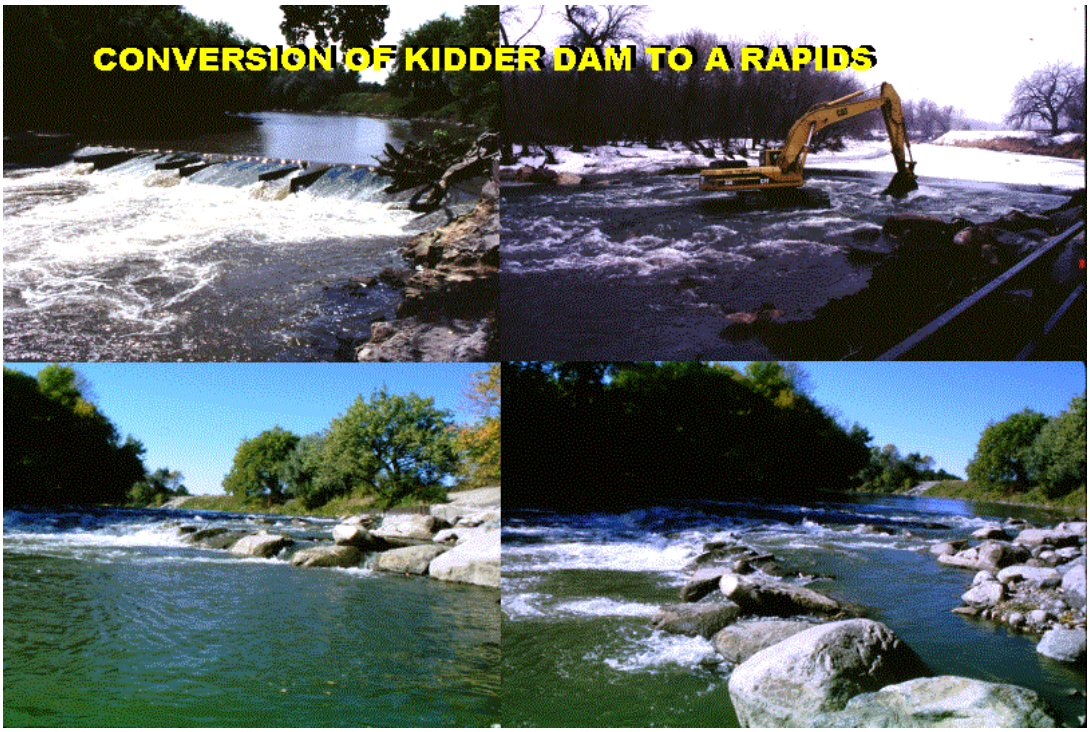


Figure 4. Photos of the modification of the Kidder dam to a rock slope rapids. Upper left - dam prior to modification. Upper right – dam during construction of rock slope. Lower photos – post project completion.

Modification of culverts – Culverts that are barriers to fish passage will be modified through use of a rock slope to raise the height of the tailwater downstream of the culverts and reduce velocities within them (figure 5). If raising the tailwater will not create conditions for fish passage culvert modification may also include placement of large rocks within the culverts to add roughness and create areas along the length of a culvert with reduced velocity.

Removal of dams - Removal of the barriers will be accomplished through the demolition of the majority of the current structure, removal of the debris, and placement of one or more rock slopes or weirs to ensure continued stability of the stream bed and banks (figure 6). The sill or base of each dam is likely to remain in place as a base for rocks and additional grade control. Dam abutments may or may not be removed depending on an assessment of their expected structural integrity after the dam removal.

Prior to removal, sediment quantity and quality in the impounded area upstream of the dam will be assessed. Sediment issues at all but one dam proposed for removal are expected to be minor and similar to those encountered at previous dam removals in the Red River basin (Buffalo River State Park and Old Mill State Park). Sediment issues will minimized by placement of the rock slopes at the site. Removal at the Elizabeth Dam will dewater a large impoundment. The sediment and bank stability issues at this site will need additional investigation and a supplemental EA may be needed prior to removal to evaluate the need to stabilize or remove the existing sediment.

Figure 5. Photos of culvert modification on the Otter Tail River at U.S. Highway 10, Frazee,MN. Left photo shows the riffle used to raise the tailwater and right photo shows placement of boulders within the culvert to reduce velocities.

Rock Slope Fishway – A rock slope fishway may need to be constructed to provide fish passage at Phelp's Mill. To create a rock slope fishway a diversion channel will be constructed parallel to the current embankment to bypass the current barrier (figure 7). The culvert through the embankment will be set, sized, and sloped to allow fish passage during a variety of flows and maintain the pool behind the embankment. The bypass channel will be constructed using natural channel design principles to create a stable channel for the expected hydrologic conditions at the site. The outlet of the bypass channel will be armored with large rocks to prevent excessive erosion at the outlet of the existing dam.

Figure 6. Photo after the removal of the dam on the Otter Tail River near Frazee, MN. The hydropower dam was located at the culverts.

Figure 7. Photo of the rock slope fishway constructed on the Otter Tail River at the Lake Breckenridge dam. The culvert through the embankment is in the foreground. The existing dam is a located at the end of the constructed step-pool channel.

2.2.2. Alternative B - No Action. The no action alternative would leave the existing barriers in place in their current condition with their current impacts. This alternative would assume that future maintenance of these structures would be required to maintain the structural integrity and safety of some barriers. Some barriers may still be removed or modified under this alternative in the future due to safety risks and lack of funding or interest in maintenance. Owners of these structures would be responsible for their maintenance.

2.2.3. Alternative C – Remove barriers at all locations. All of the barriers could be removed through demolition and debris removal.

Under this course of action a sequence of events will be followed:

1) determine if removal will disturb substantial quantities of sediment,
2) sample sediment quality and quantity,
3) determine whether sediment removal will be needed prior to demolition of the structure
4) determine wetland impacts of the project, if any, avoid as practicable and mitigate if needed,
5) determine potential impacts of project to threatened and endangered species,
6) determine whether action will have historic preservation issues,
7) clear brush and trees to gain access to the site for construction or demolition,
8) remove dam crest to the sill or place rock slope downstream of barrier,
9) install grade and erosion control measures to ensure stream stability post-project,
10) reinforce any abutments as needed based on engineering,
11) implement post-construction restoration of stream banks and floodplain through reshaping and native seeding of disturbed areas.

If, during the course of this review, issues become evident that warrant further investigation, a supplemental EA will be needed for that barrier.

Removal of dams - Removal of the barriers will be accomplished through the demolition of the majority of the current structure, removal of the debris, and placement of one or more rock slopes or weirs to ensure continued stability of the stream bed and banks (figure 6). The sill or base of each dam is likely to remain in place as a base for rocks and additional grade control. Dam abutments may or may not be removed depending on an assessment of their expected structural integrity after the dam removal.

Prior to removal, sediment quantity and quality in the impounded area upstream of the dam will be assessed. Sediment issues at all but one dam proposed for removal are expected to be minor and similar to those encountered at previous dam removals in the Red River basin (Buffalo River State Park and Old Mill State Park). Sediment issues will minimized by placement of the rock slopes at the site. Removal at the Elizabeth Dam may dewater a large impoundment. The sediment and bank stability issues at this site will need additional investigation and a supplemental EA may be needed prior to removal to evaluate the need to stabilize or remove the existing sediment.

3. Affected Environment –
This section first presents a discussion of the overall physical characteristics and aquatic habitat conditions found within the system of watercourses in the Red River Basin. Discussions of the physical characteristics and biological environment at each barrier location follow this overview in Sections 3.1 and 3.2.

The Red River of the North Basin contains an extensive system of watercourses (Figure 8). The Red River is the primary waterway or main stem of this system with a contributing drainage area of 35,530 square miles in the United States (Stoner 1991). The Red River is a low gradient highly sinuous river that is formed at the confluence of the Bois de Sioux and Otter Tail River near Breckenridge, MN. In the United States, this river flows northward for 394 miles through the remnant bed of glacial Lake Agassiz and drops a total of 200 feet (<0.5 feet per mile). These lands are part of the Red River Valley ecoregion. Land use throughout the basin for the past century has been dominated by row crop agriculture that includes an extensive artificial surface water drainage system (Goldstein 1995). The Red River Basin was once covered by glacial Lake Agassiz that receded as glaciers retreated and left the current natural drainage patterns on the landscape about 8,500 year ago.

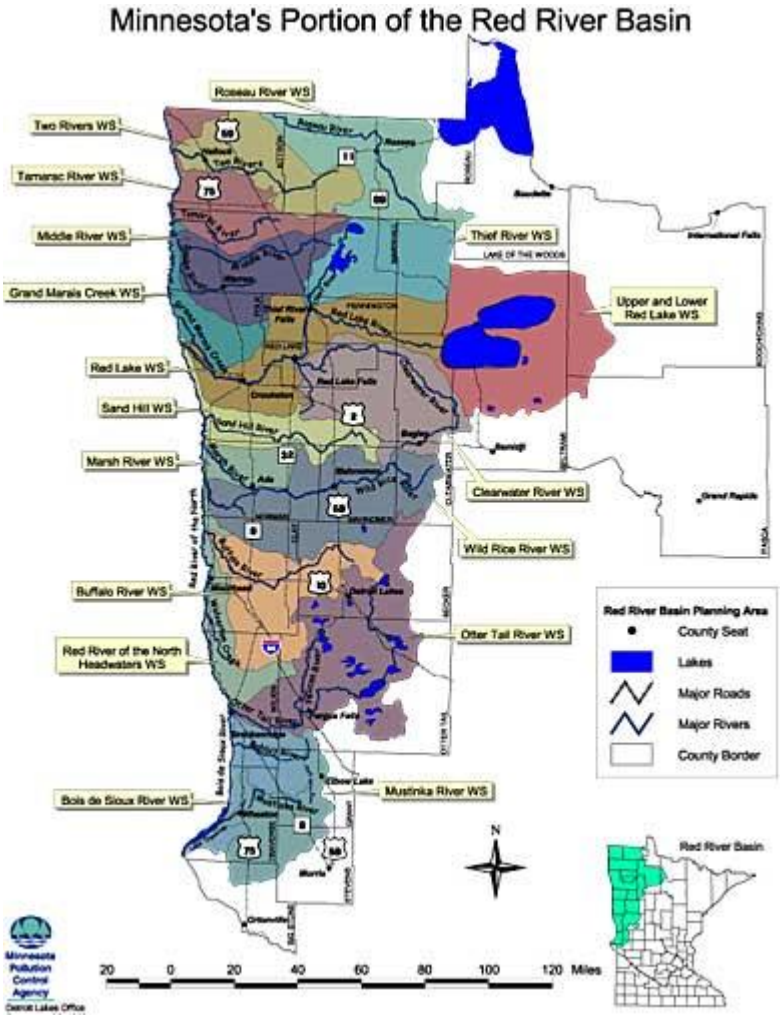


Figure 8. The streams and watersheds of the Red River Basin (From www.pca.state.mn.us/water/basins/redriver).

In addition to the main stem of the Red River there are eleven major tributaries in this system. Unlike the Red River, these tributaries and the network of watercourses within each of their watersheds flow through diverse landscapes including areas in four ecoregions: the Red River Valley, North Central Hardwood Forests, Northern Minnesota Wetlands, and Northern Lakes and Forests (Figure 9). In addition to these ecoregions the Red Basin in Minnesota is characterized by three physiographic regions: the lake plain, till plain including remnant beach ridge areas, and moraine. In general, reaches of the tributaries in the flat lake plain portion of the Red River Valley ecoregion have similar characteristics to the Red River main stem (low gradient, very sinuous, clay/silt dominated beds); reaches of tributaries in the beach ridge portions of the Red River Valley and North Central Hardwood Forests are similar to each other (high gradients, moderate sinuosity, sand/gravel dominated beds), and reaches of streams located above the beach ridge areas in North Central Hardwood Forests, Northern Minnesota Wetlands, and Northern Lakes and Forests ecoregions have a variety of characteristics (moderate to low gradients, moderate to high sinuosity, and silt, sand, and gravel dominated beds).

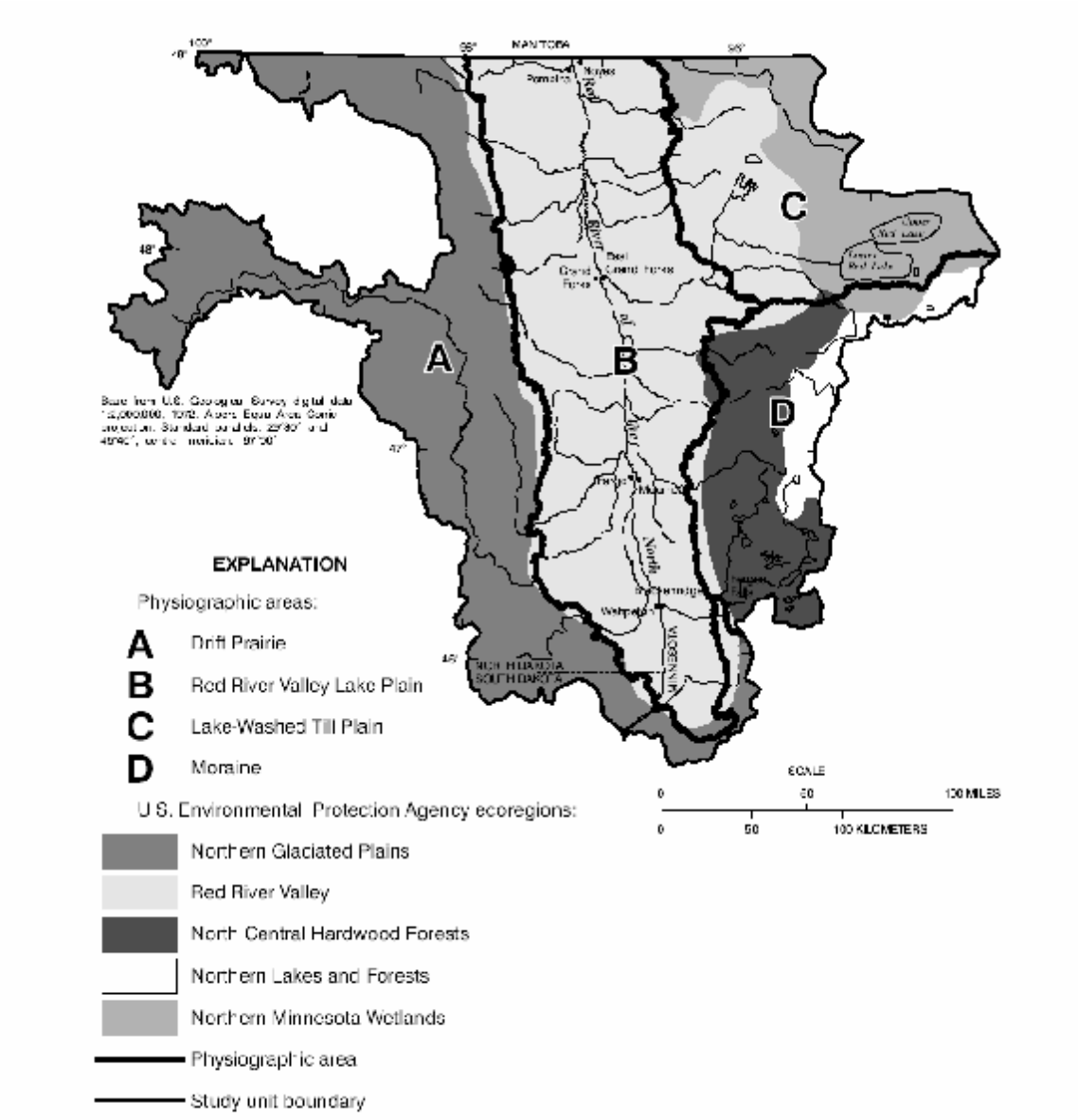


Figure 9. Ecoregions and physiographic areas of the Red River Basin. From U.S.G.S. report – Goldstein et. al 1996)

The watercourses in the Red River Basin form a network of diverse and connected habitats. The Red River is a classic low gradient prairie stream that provides deep pool habitat in meander bends and transitional run habitats between meander bends. Substrates in most of the reaches of Red River are composed of rather homogeneous clay and/or silt. Fallen and submerged trees and root wads provide additional habitat features for fish and invertebrates. The Red River provides overwintering habitat for fish from throughout the system and is also the primary refuge for fish in the system during extended drought periods. Spawning habitat for many species is limited in the Red River. The tributaries contain diverse habitats needed for spawning and rearing of various life stages of many species. In particular, reaches of streams in the remnant beach ridge areas provide diverse habitats comprised of riffle and pools with heterogeneous substrates ranging from sands to boulders. Fallen trees and root wads are a relatively minor habitat

feature in these beach ridge reaches. Reaches of streams upstream from the beach ridge areas also provide diverse habitats for a variety of species. In these areas, streams range from those that contain riffle and pool habitats similar to those in the beach ridge area as well as many miles of low gradient streams that meander through and between lakes, wetlands, and wetland complexes. In the absence of man made barriers, these habitats are accessible throughout the system.

Diverse fish communities are supported by the habitats and conditions provided in the Red River Basin. Seventy-seven native and seven introduced species have historically been found in the basin (Peterka and Koel 1996, Table 2). Many of these species are found throughout the system at different life stages and different times of year. Adult and juvenile channel catfish *Ictalurus punctatus*, northern pike *Essox lucius*, walleye *Stizotstedion vitreum*, sauger *Stizostedion canadense*, redhorse species *Moxostoma sp.*, are commonly found throughout the main stem of the Red River and the lower reaches of its tributaries (see Peterka and Koel 1996 and various MN DNR survey reports listed in Appendix 1). Channel catfish, walleye, sauger, mooneye, goldeye, redhorse species, numerous minnow species and others are found upstream of the lake plain. The high gradient stream reaches in the beach ridges are particularly important because they contain quality spawning habitats for numerous species. These habitats include by diverse features including riffle, run, and pools with diverse substrates that include sands, gravels, cobbles, and larger subrstrates. These types of habitats are almost only found in the beach ridge reaches of the system and are used by many species. The thousands of miles of diverse habitats within the tributary watersheds also provide habitat and conditions for rearing many species and maintaining healthy populations. These watercourses and their fish communities provide recreational opportunities throughout the Red River basin including the Red River itself which is considered a world class catfish fishery (see Appendix A - Topp 1996).

These habitats are particularly critical for the successful re-establishment of self sustaining lake sturgeon *Acipenser fulvescens* populations (MN DNR 2002). Historically, lake sturgeon were abundant in the Red River Basin until the late 1800's. By the mid-1900's lake sturgeon were effectively extirpated from the system. The population decline can be attributed to over exploitation, water quality degradation, habitat degradation, and construction of barriers that prevent movements to traditional spawning habitats. Current management efforts include reintroduction of juvenile sturgeon into the system (starting in the late 1990's), active management of angling for sturgeon (currently no harvest is permitted), active habitat management and improvement, and removal of barriers. Lake sturgeon are a long lived species that reach maturity after 15+ years. They prefer to spawn in fast flowing high gradient stream habitats with larger substrates. Access to quality habitats in the beach ridges will help ensure reestablishment of this species to the basin.

The seven non-native fish species that have previously been found in the basin, excluding common carp, *Cyprinus carpio,* are relatively rare in the watercourses and lakes. Common carp have been sampled consistently in the Red River, lower reaches of some tributaries, and in some lakes within the basin. They have not been commonly caught in watercourses upstream of the lake plain areas.

Table 2. Fish species reported in surveys of streams and lakes of the Red River basin during 1892-1994 with 3-letter codes and native (N) or introduced (I) status. (From http://www.npwrc.usgs.gov/resource/fish/fishred/table02.htm)

	Taxon	Common Name	Code	Native
Petromyzontidae				
1	*Ichthyomyzon castaneus*	chestnut lamprey	CHL	N
2	*Ichythyomyzon unicuspis*	silver lamprey	SIL	N
Acipenseridae				
3	*Acipenser fulvescens*[1]	lake sturgeon	LKS	N
Lepisosteidae				
4	*Lepistoseus osseus*[1]	longnose gar	LNG	N
Amiidae				
5	*Amia calva*	bowfin	BOF	N
Hiodontidae				
6	*Hiodon alosoides*	goldeye	GOE	N
7	*Hiodon tergisus*	mooneye	MOE	N
Salmonidae				
8	*Coregonus artedii*	ciscoe	TLC	N
9	*Coregonus clupeaformis*	whitefish	WTF	N
10	*Oncorhynchus mykiss*	rainbow trout	RBT	I
11	*Salmo trutta*	brown trout	BNT	I
12	*Salvelinus fontinalis*	brook trout	BKT	I
Catostomidae				
13	*Carpiodes cyprinus*	quillback carpsucker	QBS	N
14	*Catostomus commersoni*	white sucker	WTS	N
15	*Hypentelium nigricans*	northern hogsucker	NHS	N
16	*Ictiobus cyprinellus*	bigmouth buffalo	BIB	N
17	*Moxostoma anisurum*	silver redhorse	SLR	N
18	*Moxostoma erythrurum*	golden redhorse	GLR	N
19	*Moxostoma macrolepidotum*	shorthead redhorse	SHR	N
20	*Moxostoma valenciennesi*	greater redhorse	GRR	N
Cyprinidae				
21	*Campostoma anomalum*	central stoneroller	CSR	N
22	*Campostoma oligolepis*	largescale stoneroller	LSR	N
23	*Cyprinella spiloptera*	spotfin shiner	SFS	N
24	*Cyprinus carpio*	common carp	COP	I
25	*Hybognathus hankinsoni*	brassy minnow	BRM	N
26	*Luxilus comutus*	common shiner	CSH	N

27	*Macrhybopsis storeriana*	silver chub	SLC	N
28	*Margariscus margarita*	pearl dace	PRD	N
29	*Nocomis biguttatus*	hornyhead chub	HHC	N
30	*Notemigonus chrysoleucas*	golden shiner	GOS	N
31	*Notropis anogenus*	pugnose shiner	PGS	N
32	*Notropis atherinoides*	emerald shiner	EMS	N
33	*Notropis blennius*	river shiner	RVS	N
34	*Notropis dorsalis*	bigmouth shiner	BMS	N
35	*Notropis heterodon*	blackchin shiner	BCS	N
36	*Notropis heterolepis*	blacknose shiner	BNS	N
37	*Notropis hudsonius*	spottail shiner	SPO	N
38	*Notropis rubellus*	rosyface shiner	RFS	N
39	*Notropis stramineus*	sand shiner	SDS	N
40	*Notropis texanus*	weed shiner	WDS	N
41	*Notropis volucellus*	mimic shiner	MMS	N
42	*Phoxinus eos*	northern redbelly dace	NRD	N
43	*Phoxinus neogaeus*	finescale dace	FND	N
44	*Pimephales notatus*	bluntnose minnow	BNM	N
45	*Pimephales promelas*	fathead minnow	FHM	N
46	*Platygobio gracilis*	flathead chub	FHC	I
47	*Rhinichthys atratulus*	blacknose dace	BND	N
48	*Rhinichthys cataractae*	longnose dace	LND	N
49	*Semotilus atromaculatus*	creek chub	CRC	N
Ictaluridae				
50	*Ameiurus melas*	black bullhead	BLB	N
51	*Ameiurus natalis*	yellow bullhead	YEB	N
52	*Ameiurus nebulosus*	brown bullhead	BRB	N
53	*Ictalurus punctatus*	channel catfish	CCF	N
54	*Noturus flavus*	stonecat	STC	N
55	*Noturus gyrinus*	tadpole madtom	TPM	N
Umbridae				
56	*Umbra limi*	central mudminnow	CNM	N
Esocidae				
57	*Esox lucius*	northern pike	NOP	N
58	*Esox masquinongy*	muskellunge	MUE	I
Cyprinodontidae				
59	*Fundulus diaphanus*	banded killifish	BKF	N

Gadidae				
60	*Lota lota*	burbot	BUB	N
Percopsidae				
61	*Percopsis omiscomaycus*	trout-perch	TRP	N
Percichthyidae				
62	*Morone chrysops*	white bass	WHB	I
Centrarchidae				
63	*Ambloplites rupestris*	rock bass	RKB	N
64	*Lepomis cyanellus*	green sunfish	GSF	N
65	*Lepomis gibbosus*	pumpkinseed	PMK	N
66	*Lepomis humilis*	orangespotted sunfish	OSS	N
67	*Lepomis macrochirus*	bluegill	BLG	N
68	*Micropterus dolomieui*	smallmouth bass	SMB	N
69	*Micropterus salmoides*	largemouth bass	LMB	N
70	*Pomoxis annularis*	white crappie	WHC	N
71	*Pomoxis nigromaculatus*	black crappie	BLC	N
Percidae				
72	*Etheostoma caeruleum*	rainbow darter	RBD	N
73	*Etheostoma exile*	Iowa darter	IOD	N
74	*Etheostoma microperca*	least darter	LED	N
75	*Etheostoma nigrum*	johnny darter	JND	N
76	*Perca flavescens*	yellow perch	YEP	N
77	*Percina caprodes*	logperch	LGP	N
78	*Percina maculata*	blackside darter	BSD	N
79	*Percina shumardi*	river darter	RVD	N
80	*Stizostedion canadense*	sauger	SAR	N
81	*Stizostedion vitreum*	walleye	WAE	N
Scianidae				
82	*Aplodinotus grunniens*	freshwater drum	FRD	N
Cottidae				
83	*Cottus bairdi*	mottled sculpin	MTS	N
Gasterosteidae				
84	*Culaea inconstans*	brook stickleback	BST	N

Many of the habitats in the Red River Basin have been disconnected from each other by man made barriers. These barriers include thousands of road culverts and dams. Roads cross many watercourses many times in the basin. Culverts have been placed at many of these road crossings. Culverts can effectively create a barrier to fish passage during a range of flows when they create high velocity conditions over a distance greater than the burst speed of fish. When fish cannot sustain an adequate speed for a long enough period of time to get through a culvert, the culvert becomes an effective barrier. In addition to culverts, over 400 dams have been constructed on watercourses in the Red River Basin (Stoner et al. 1993). Dams have been constructed for a variety of reasons including water supply, flood control, erosion control, lake level stabilization, and power generation. Almost all of these dams are “run of the river” dams less than 15 feet high and are considered low head dams; however, they effectively reduce fish passage opportunities. The general effects of dams on aquatic systems have been well documented (Chisholm and Aadland 1994, Baxter 1977). A barrier in a key location can potentially eliminate the potential for fish passage to many miles of quality habitat. Recent surveys have documented lower species diversity above barriers on the Wild Rice River, Tamarac River, Buffalo River, and Sand Hill River in the Red River Basin (see Appendix A - VanOffelen et al. 2002, MN DNR Survey - Wild Rice River 2003, MN DNR Survey-Tamarac River 2000).

Re-establishing fish passage in the Red River Basin will reconnect reaches of habitats for a variety of species and life stages. Several dams in the basin have been recently removed or modified to provide fish passage on the Red River and its tributaries. To continue this process, Minnesota DNR has identified and prioritized 13 locations where fish passage is still needed to reconnect vast reaches of important aquatic habitats. Re-establishing fish passage at these barriers will restore connectivity to the Red River system.

All barriers are operated as run of the river structures and are located in relatively stable reaches of watercourses. Discrete plunge pools and varying levels of bank erosion are present at all locations. Hydraulic residence time in impounded areas upstream of the dams is low at all structures excluding the Lake Breckenridge and Elizabeth dams. Sediment retention, water quality, and thermal regime are unlikely to have been affected at any barrier excluding these two structures.

Table 3. Physical characteristics of barriers in the Red River basin. Information was gathered from MN DNR fisheries personnel and from existing studies on these structures. Dimensions are estimated from field surveys and air photo interpretation. Sediment concerns were judged based on discussions with DNR personnel and review of studies and experiences in the Red River Basin with previous fish passage projects.

Barrier name	Watercourse	Location	Ownership	Approx. Width (ft)	Approx.Height (ft)	Approx. Pool length (ft)	Approx. Pool area	Sediment Concerns	Year Built	Purpose	Current Function	Safety Hazzard
Drayton Dam	Red River of the North	T159N, R50W, sec 18	City Of Drayton, ND	255	12	Unknown		Low	1964	Water supply	Yes	Boating
Christine Dam	Red River of the North	T136N, R48W, sec 18	City Of Fargo, ND	205	10	Unknown		Low	1937	Water supply	No	Boating
Hickson Dam	Red River of the North	T137N, R48W, sec 19	City Of Fargo, ND	200	17	Unknown		Low	1937	Water supply	No	Boating
Otter Tail Power Dam	Red Lake River	T150N, R46W, sec 35	Otter Tail Power Co.		2	Unknown		Low	1916	Hydropower	No	Boating
Heiberg Dam	Wild Rice River	T144N, R41W, sec 26,35	Wild Rice Watershed District	155	7	2900	~5.9	Low	1975	Ice Control	*	*
Lake Breckenridge Dam	Otter Tail River	T132N, R47W, sec 11	City Of Breckenridge	59	17	~6,320	173	Unknown	1935	Water supply	No	Boating
Argyle Dam	Middle River	T156N, R48W, sec 15	Unknown	50	5	1400	1.5	Low	~1934	Unknown		Boating, structural
Sandhill River barriers	Sandhill River	T147N, R45 sect. 19,27; T147N R46W, sec 24	Sandhill Watershed District, road authority	dams 20-25	6-8	< 2000	<1	Low	1950's	Erosion control	Yes	Boating
Marsh Creek culverts	Marsh Creek	T144N, R43W, sec 21	Mahnomen County	NA	NA	NA	NA	Low	2002			None
Stephen Dam	Tamarac River	T157N, R48W, sec 8	City Of Stephen	58	9	7500	16	Low	1987	Water supply, recreation	No, Yes	Boating
South Branch Buffalo barriers	S. Br. Of the Buffalo River	T139N, R47W, sec 5,9	Unknown	~50	~2	< 500	< 2	Low	Unknown	Unknown	No	None
Elizabeth Dam	Otter Tail River	T143N, R43W, sec 32	Private	366	15	3800	34	Unknown	1922	Milling	No	Structural
Phelps Mill Dam	Otter Tail River	T134N, R41W, sec 35	Otter Tail County	120 ft.	15 ft.	9200	90	Low	1873	Milling	No	None

* The Wild Rice River washed around the Heiberg dam in June, 2002. Watercourse restoration is in process.

3.1. Physical Characteristics

Many specific physical characteristics of the barriers are summarized in Table 3. Additional detailed information on barriers solicited from Minnesota Department of Natural Resources Fisheries personnel is found in Appendix B.

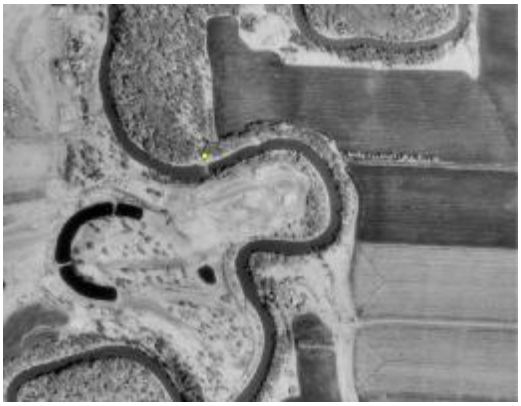
3.1.1. Drayton Dam, Red River of the North, Drayton, ND.

The Drayton Dam is located on the Red River near the City of Drayton, North Dakota at river mile 207. The dam was built inside the apex of an existing meander which was then filled in and water was diverted over the new dam and channel. The dam crest is narrower than the typical river width in this area. Erosion has been a continual problem downstream of this dam with considerable maintenance costs in recent years. The dam is barrier to fish passage during typical flows found in most months. This river channel and floodplain upstream and downstream of the structure have physical characteristics typical for the main stem of the Red River (low gradient, sinuous, clay substrates). The impounded pool is contained within the river channel and does not extend to the floodplain. The water supply inlet for the City of Drayton is within this impoundment. The City of Drayton has requested a U.S. Army Corps of Engineers (U.S.A.C.E.) Section 206 project for this structure. The U.S.A.C.E. has recently completed a preliminary restoration plan for this barrier (Appendix C). The next barrier on the main stem of the Red River is located approximately 290 river miles upstream (assuming the Fargo South dam fish passage project is completed). Between this dam and the next upstream barrier there are four major tributaries in Minnesota (Red Lake River, Sand Hill River, Wild Rice River, Buffalo River) that drain almost 10,000 square miles in Minnesota through a network of watercourses in their watersheds

3.1.2. Christine Dam, Red River of the North, Christine, ND.

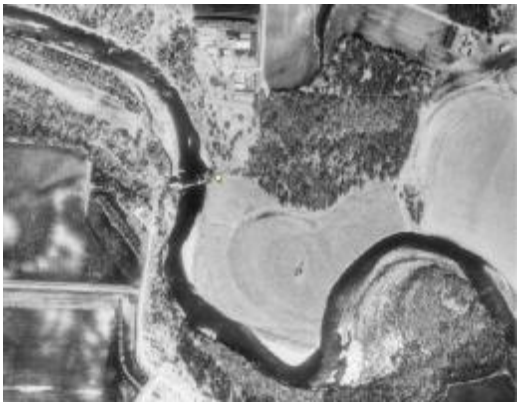
The Christine dam is located on the Red River south of Moorhead, Minnesota at river mile 497. The dam was constructed in the early 1930's for water supply for Fargo-Moorhead. The dam has never been operated for this purpose. The dam is a barrier to fish passage during most flow events. Fish passage is presumed possible during relatively infrequent high flow events. This river channel and floodplain upstream and downstream of the structure has physical characteristics typical for the main stem of the Red River. The impounded pool is contained within the river channel and does not extend to the floodplain. The river channel has an eroded plunge pool downstream of the dam. The next barrier on the main stem of the Red River is located approximately 14 river miles upstream.

3.1.3. *Hickson Dam, Red River of the North, near Hickson, ND.*



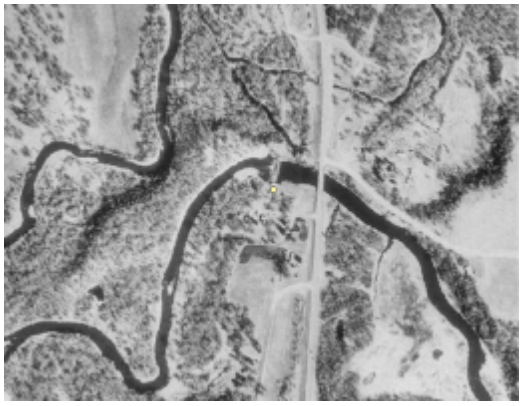
The Hickson dam is located on the Red River south of Moorhead, Minnesota near Wolverton, Minnesota. The dam was constructed in the early 1930's for water supply for Fargo-Moorhead. The dam has never been operated for this purpose. The dam is a barrier to fish passage during most flow events. Fish passage is presumed possible during relatively infrequent high flow events. This river channel and floodplain upstream and downstream of the structure has physical characteristics typical for the main stem of the Red River. The river channel is eroded and unstable immediately adjacent to the dam. The impounded pool is contained within the river channel and does not extend to the floodplain. No barriers exist on the main stem of the Red River upstream of this dam. Two major tributaries (Bois de Sioux and Otter Tail Rivers) draining over 3,000 square miles are found upstream of this barrier.

3.1.4. Otter Tail Power Dam, Red Lake River, Crookston, MN.



The Otter Tail Power Dam is located on the Red Lake River upstream of Crookston, Minnesota. The dam was constructed in 1914-1916 for hydropower production. The dam was used for hydropower until it was damaged during a flood in 1950. In 1951, the structure was partially demolished and has been left in a state of disrepair. The dam is a barrier to fish passage during low flow events. The dam is located in a higher gradient reach of the Red Lake River with quality habitats including riffles, pools, and runs and diverse substrates. Sinuosity in this reach is approximately 2.0. The impounded pool is contained within the river channel and does not extend to the floodplain. The river channel is eroded downstream of this dam. The next barrier on the Red Lake River is located approximately 63 river miles upstream at Thief River Falls. Tributaries between this barrier and the next upstream barrier include the Black River and Clearwater River (~150 miles total length).

3.1.5. *Heiberg Dam, Wild Rice River, Twin Valley, MN.*



Heiberg dam is located on the Wild Rice River in the central portion of the Red River Basin in Minnesota. A dam was originally constructed at this site in the late 1800's . A new dam was constructed at the site in 1975 to control ice. In June, 2002, floodwaters eroded an embankment immediately upstream of the structure and the river was directed into a new channel which had been a tributary to the river.

The dam was a barrier to fish passage during most flows and fish passage was unlikely even during high flows. The Wild Rice Watershed District is currently pursuing repair of this structure with assistance from the Federal Emergency Management Agency (FEMA). A draft environmental assessment was recently completed for FEMA. The dam is located in a high gradient reach of the Wild Rice River with quality habitats including riffles, pools, and runs and diverse substrates. Sinuosity of this reach is approximately 2.1. The previously impounded pool extended slightly into the river floodplain. No other barriers are located on the Wild Rice River. Approximately 120 miles of river with quality habitats for spawning, rearing, and seasonal use are found upstream of this barrier. Several tributary streams are also found above this barrier including Spring Creek, Marsh Creek, and the White Earth River.

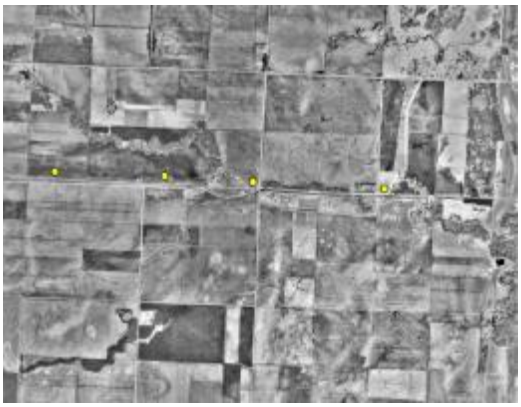
3.1.6. Argyle Dam, Middle River, Argyle, MN.

The Argyle dam is located on the Middle River in the northern portion of the Red River Basin. The concrete dam was originally constructed in about 1934. A city park is located at the site. The dam has not been regularly maintained. The dam is a barrier to fish passage during most flow event and is likely only passable during relatively infrequent high flow events. Stream reaches with high quality riffle habitats are located upstream of this site. Sinuosity in this reach is approximately 2.3. The impounded pool extends slightly into the river floodplain but is primarily contained within the existing channel. No other barriers are present upstream of this site. A previous barrier located at Old Mill State Park was removed in 2000.

3.1.7. Lake Breckenridge Dam, Otter Tail River, Breckenridge, MN.

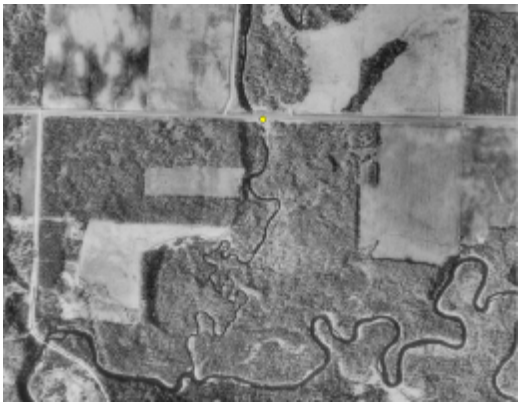
The Lake Breckenridge Dam is located on the Otter Tail River in the southern portion of the Red River Basin. The concrete dam was originally constructed in 1935 for water supply and is no longer used for this purpose. Fish passage was incorporated into this dam via a fishway and culvert through the embankment in 1998, but the dam continues to limit fish passage during high flows. The 1.0 mile long reservoir formerly contained at least 1.7 miles of high quality river habitats with riffle and pools and runs and diverse substrates Approximately 32 miles of riverwith diverse habitats are found between this barrier and the next upstream barrier. Upper reaches and margins of the pool are characterized by wetlands.

3.1.8. Sand Hill Dams and Culverts, Sand Hill River, Fertile/Beltrami, MN.



A series of barriers are present on the lower reaches of the Sandhill River in the central portion of the Red River Basin. Four of these barriers are concrete grade/erosion control "check dams" that were constructed in the late 1950's on a reach of the Sandhill River that was channelized. One other barrier is a "texas" or "low water" crossing which is part of a township road. This crossing has several small culverts. The other barrier is a set of concrete culverts under a township road. All these structures are barriers to fish passage during almost all flow events. The dams are barriers during all but the highest flow events. The culverts are barriers during all but the lowest flow events. The Sand Hill watershed district has requested a U.S.A.C.E. Section 206 project for the dams. The U.S.A.C.E. has recently completed a preliminary restoration plan for these barriers (Appendix C). . Approximately, 59 miles of river with diverse quality fish habitats for spawning, rearing, and seasonal use are found upstream of the upstream culvert barrier.

3.1.9. County Road Culverts, Marsh Creek, Mahnomen, MN.

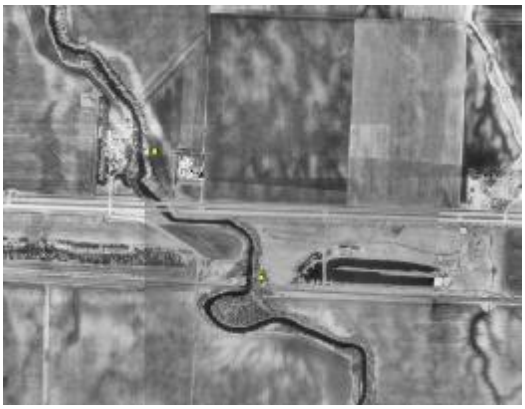


A set of culverts under a county road is located in the lower reach of Marsh Creek in Mahnomen County. These concrete culverts were installed during a road repair in 2002. The length and slope of the culverts create barriers to fish passage in all but the lowest flow events. These structures are located approximately one mile from the confluence of the creek with the Wild Rice River. The channel and floodplain of the stream is wooded and relatively stable upstream and downstream of the culverts. Approximately 42 miles of creek are found between this barrier and the next upstream barrier which is at the outlet of a lake.

3.1.10. Stephen Dam, Tamarac River, Stephen, MN.

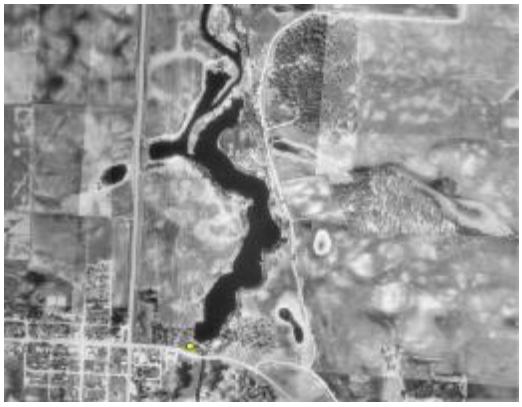
The Stephen dam is located on the Tamarac River in Stephen, Minnesota. The dam was built in 1987 for water supply for the City of Stephen and the local golf course and for recreation. The City no longer uses the reservoir for water supply. The dam is a barrier to fish passage during most flow events and is likely only passable during relatively infrequent high flow events. Stream reaches with high quality habitats are located upstream of this site. The impounded pool is approximately 1.75 miles long and is primarily contained within the existing channel. Approximately 26 miles of river with similar habitats are found between this barrier and the next upstream barrier which is at the outlet of reservoir on a state wildlife management area.

3.1.11. South Branch Buffalo River Dams, S. Branch of the Buffalo River, near U.S. Highway 10.



Two small dams are located on the South Branch of the Buffalo River upstream and downstream from the State Highway 10 bridge. The downstream structure is a concrete crossing built by the adjoining landowner. The upstream sheetpile structure is likely to have been a water supply dam for the railroad in the late 1800's and early 1900's. These structures are likely to prohibit fish passage during low flow periods. The small impounded pools are limited to the river channel. The channel and floodplain of the stream is wooded and relatively stable upstream and downstream. Channel sinuosity is 1.5 in stream reaches near these barriers. This sinuosity is lower than expected due to past channel manipulations. Approximately 50 miles of river are found upstream of this site. Tributaries include Stony Creek, Whisky Creek, and Deerhorn Creek. These tributaries provide many additional miles of habitat that extend into beach ridge areas.

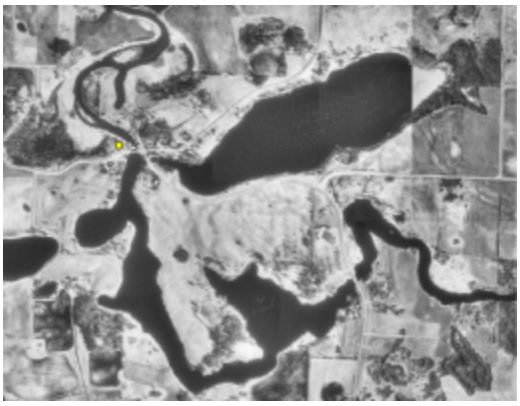
3.1.12. Elizabeth Dam, Pelican River, Elizabeth, MN.



The Elizabeth Dam is located on the Pelican River near Elizabeth, MN. The concrete structure was constructed for milling in 1922. The structure is no longer operational. The dam is a fish barrier during all flow events. The dam creates a 34 acre pool approximately 3,800 feet long where high quality river habitats once occurred. The pool contains an unknown quantity of sediment. Downstream and upstream reaches of river contain quality habitats with riffles, runs, and pools. Sinuosity in this area is 1.7. Approximately 22 miles of river are found between this barrier

and the next upstream barrier at Pelican Rapids. Diverse quality fish habitats for spawning, rearing, and seasonal use are found upstream.

3.1.13. Phelps Mill Dam, Otter Tail River, Phelps, MN.



The Phelps Mill Dam is located on the Otter Tail River near Phelps, MN. The concrete structure was constructed for milling in 1922. The structure is no longer operational. The dam is a fish barrier during all flow events. The dam creates a 90 acre pool that is approximately 2 miles long where high quality river habitats once occurred. The pool contains an unknown quantity of sediment. Downstream and upstream reaches of river are quality habitats with riffles, runs, and pools. Sinuosity in this area is approximately 1.8.

3.2. Biological Environment

3.2.1. Habitat/vegetation

The habitat/vegetation characteristics present at each barrier site are discussed below. The discussions of habitat focus on aquatic habitat associated with the watercourses channel and adjacent floodplain.

3.2.1.1. Drayton Dam, Red River of the North, Drayton, ND.

The reach of Red River near the Drayton Dam is typical for the main stem of the Red River. Channel sinuosity is greater than 2.0 with habitat including deep water pools in meanders and intermediate run habitat found between meanders. Bottom substrates are dominated by clay. Fallen and submerged trees and root wads provide a common habitat feature. These habitat features support a variety of large river species including adult and juvenile channel catfish, northern pike, walleye, sauger, redhorse species, and mooneye and goldeye. Some spawning habitat is provided for channel catfish. This reach of river is known for a fall aggregation of sauger at the dam. Riparian and upland habitats at this site are limited to a narrow band of woodlands

3.2.1.2. *Christine Dam, Red River of the North, Christine, ND.*

The reach of Red River near the Christine Dam is typical for the main stem of the Red River. Habitats include deep water pools in meanders and intermediate run habitat between meanders. Bottom substrates are dominated by clay. Fallen and submerged trees and root wads are a common habitat feature. These

habitat features support a variety of large river species including adult and juvenile channel catfish, northern pike, walleye, sauger, redhorse species, and mooneye and goldeye. Some spawning habitat is provided for channel catfish. The river in this reach has a narrow wooded riparian corridor.

3.2.1.3. Hickson Dam, Red River of the North, near Hickson, ND

The reach of Red River near the Drayton Dam is typical for the main stem of the Red River. Habitats include deep water pools in meanders and intermediate run habitats found between meanders. Bottom substrates are dominated by clay. Fallen and submerged trees and root wads are a common habitat feature. These habitat features support a variety of large river species including adult and juvenile channel catfish, northern pike, walleye, sauger, redhorse species, and mooneye and goldeye. Some spawning habitat is provided for channel catfish. The river in this reach has a narrow wooded riparian corridor. The only reach of the Red River with a classic riffle is located several miles upstream of this barrier. These areas provide spawning habitats typically only found in the Red River tributaries (e.g., walleye, sauger, numerous minnow species, etc.).

3.2.1.4. Otter Tail Power Dam, Red Lake River, Crookston, MN.

The reach of Red Lake River near the Otter Tail Power dam is typical for those located in the upper beach ridge portion of the Red River Basin. Diverse habitats in this reach include pools, riffles, and runs. Bottom substrates are dominated by sand, gravel, and larger substrates. These habitat features support a variety of river species including adult and juvenile channel catfish, smallmouth bass, northern pike, walleye, sauger, redhorse species, and mooneye and goldeye . Furthermore, these habitats provide spawning habitats to these species and others that prefer riffle habitats (many minnow species, darters, etc). The river in this reach has corridor of mixed land use with woodlands, some pasture, and row crop agriculture.

3.2.1.5. Heiberg Dam, Wild Rice River, Twin Valley, MN.

The reach of the Wild Rice River near the Heiberg Dam is typical of streams found in the beach ridge portion of the Red River Basin with diverse habitats including pools, riffles, and runs. Bottom substrates are diverse with sand, gravel, and larger substrates. The river downstream of this reach is the transitional reach between the relatively steep beach ridge area and the flat Red River valley lake plain. The river upstream of this site is relatively steep and flows through a relatively deep valley. These habitat

features support a variety of river species including adult and juvenile channel catfish, smallmouth bass, northern pike, walleye, sauger, redhorse species, and mooneye and goldeye . Furthermore, these habitats provide rearing and spawning habitats to these species and others that prefer riffle habitats (many minnow species, darters, etc). The corridor at this reach is a mix of hardwoods (white oak, red oak, basswood, sugar maple, etc). A small streamside park is located at the site.

3.2.1.6. *Argyle Dam, Middle River, Argyle, MN.*

The reach of the Middle River near the Argyle Dam is typical of streams found in the in the valley floor portion of the Red River basin. The low gradient channel is sinuous with pools in meander bends and transitional run habitat between meanders. Substrates are rather homogeneous clay. These habitat features and hydrologic conditions seasonally support a variety of river species including adult and juvenile channel catfish, northern pike, walleye, sauger, redhorse species, and mooneye and goldeye . The river upstream of this site becomes higher gradient with riffles, runs and pools. Downstream of the site the watercourse has been ditched. A small city park is located at this site.

3.2.1.7. Lake Breckenridge Dam, Otter Tail River, Breckenridge, MN.

The reach of the Otter Tail River near the Lake Breckenridge dam is typical of streams found at the base of the beach ridge with diverse habitats including pools, riffles, and runs. Bottom substrates are diverse with sand, gravel, and larger substrates. The river reach here is the transitional area between the relatively steep beach ridge area upstream and the flat valley floor downstream. These habitat features and hydrologic conditions seasonally support a variety of species including adult and juvenile channel catfish, northern pike, walleye, smallmouth bass, sauger, redhorse species, and mooneye and goldeye and a variety of minnow species. The impoundment upstream of this site is shallow with extensive sedimentation. Wetland habits have formed in the upper reaches and along the margins of the pool. These wetlands range in quality. Water level fluctuations are likely to have reduced the quality and function of these wetlands.

3.2.1.8. Sand Hill Dams and Culverts, Sand Hill River, Fertile/Beltrami, MN.

The reach of the Sand Hill River near the texas crossing and check dams is a large straight ditch in the valley floor. In these areas the channel provides rather homogeneous habitats for some larger river species. Between the most upstream check dam and the barrier culvert the stream becomes a more typical sinuous and steep reach of a beach ridge stream with diverse, high quality habitats of riffles, pools, and runs and diverse substrates. These areas would provide habitat for variety of species including adult and juvenile channel catfish, northern pike, walleye, smallmouth bass, sauger, redhorse species, and mooneye and goldeye and a variety of minnow species if they were accessible from downstream.

3.2.1.9. County Road Culverts, Marsh Creek, near Mahnomen, MN.

The Marsh Creek is a typical tributary stream found upstream of the beach ridge portion of Red River Basin stream with diverse habitats including pools, riffles, and runs. Bottom substrates are diverse with sand, gravel, and larger substrates. Approximately 42 miles of creek are found between this barrier and the next upstream barrier which is at the outlet of a lake. Diverse quality fish habitats for spawning, rearing, and seasonal use are found in the downstream third of this reach. The remaining upstream channel has been ditched and provides limited spawning and rearing habitats.

3.2.1.10. Stephen Dam, Tamarac River, Stephen, MN.

The Tamarac River a typical tributary stream is typical of streams found in the in the valley floor portion of the Red River basin. The low gradient channel is sinuous with pools in meander bends and transitional run habitat between meanders. Substrates are rather homogeneous clay. . Diverse quality fish habitats for spawning, rearing, and seasonal use are found in the reach between these barriers. The pool is

known to have relatively poor water quality (low dissolved oxygen) during low flow and winter conditions.

3.2.1.11. S. Br. Buffalo River Dams, South Branch of the Buffalo River, near U.S. Highway 10.

The South Branch of the Buffalo River is one of the few larger watercourses located entirely within the lake plain portion (valley floor) of the Red River Basin. The reach of river near the barrier is very sinuous with a low gradient. Habitats provided are similar to those found in the lower reach of the major tributaries and the main stem of the Red River (pools separated by run habitats with homogeneous clay substrates). Some quality fish habitats for spawning, rearing, and seasonal use are found upstream.

3.2.1.12. Elizabeth Dam, Pelican River, Elizabeth, MN.

The Pelican River is a tributary to the Otter Tail River above the beach ridge area of the Red River Basin. Diverse habitats in this reach include pools, riffles, and runs. Bottom substrates are diverse with sand, gravel, and larger substrates. The impoundment at this site is shallow with extensive sedimentation.

3.2.1.13. Phelps Mill Dam, Otter Tail River, Phelps, MN

The reach of the Otter Tail River at Phelps Mill is typical of rivers upstream of the beach ridge portion of the Red River Basin. Diverse habitats found in this reach include pools, riffles, and runs. Bottom substrates are diverse with sand, gravel, and larger substrates. Furthermore, the Otter Tail river flows through numerous lakes in this region. Approximately 3.5 miles of river are found between this barrier and the next upstream barrier at Otter Tail Lake. Approximately 2 miles of river are found between this barrier and the next lake downstream. Diverse quality fish habitats for spawning, rearing, and seasonal use are found upstream. The impoundment at this site is shallow with extensive sedimentation.

3.3. Listed, Proposed, and Candidate Species

No federal listed, proposed, or candidate species in the Natural Heritage Inventory reside or have permanent, nesting, or rearing habitats near the barrier locations described in this EA. The Red River Valley does provide a primary migratory route and habitat for many bird species and several animal species listed as threatened may pass near the barrier locations. These include bald eagle *Haliaeetus leucocephalus*, and Gray Wolf, *Canis lupus*. Among plant species listed as threatened only the western-prairie fringed orchid, *Platanthera praeclarai,* has been found in the Red River basin but it is not located within several miles of any of the barriers. No Threatened and Endangered species critical habitats (http://criticalhabitat.fws.gov/) have been identified near any of the barrier location

No state listed species of special concern are listed near most of the barrier sites. One rare but not listed upland plant species *Astragalus neglectus* was observed near the Heiberg dam but this species would not be affected by work in the river channel. Black sandshell mussels *Ligumia recta,* a species of special concern, were found in the Otter Tail River downstream of the Lake Breckenridge Dam. A species of special concern is "…not endangered or threatened, it is extremely uncommon in Minnesota, or has unique or highly specific habitat requirements and deserves careful monitoring of its status." (General state information on endangered, threatened, and special concern species is available at www.dnr.state.mn.us/ets/index.htm; detailed heritage database search and information provided by Janet Boe, MN DNR Ecological Services, Bemidji, MN). MN DNR has also conducted a Natural Heritage review and recommendations for eight of the dams (Table 4)

Lake sturgeon *Acipenser fulvescens* are listed as a species of special concern in Minnesota. The MN DNR has developed and is implementing a restoration plan for this species in collaboration with the White Earth Band of Ojibwe to reintroduce lake sturgeon within the Wild Rice River and Otter Tail River watersheds. This plan states "Barriers to fish passage areas are thought to be the most significant obstacle to restoration of lake sturgeon populations". The plan discusses the need to remove as many barriers as possible in the basin with specific reference to the Drayton Dam, Christine Dam, Hickson Dam, and Heiberg Dam.

Table 4. MN DNR comments and suggestions related to natural heritage issues present at eight Red River Basin barriers (from Mike Halverson, DNR fisheries, St. Paul).

Lake/County	Natural Heritage
Red Lake River (Otter Tail Dam) Polk County Dam Removal	Several rare mussel species have been documented within 3 miles of the project site. While the project should improve water quality and conditions for mussels in the long run, we ask that special attention be paid to sediment control during the duration of the project.
Red River –Drayton Kittson County Dam Modification	Several rare mussel species have been documented within 3 miles of the project site. While the project should improve water quality and conditions for mussels in the long run, we ask that special attention be paid to sediment control during the duration of the project. If any mussels are encountered during construction of the rock rapids, we ask that they be moved out of harms way.
Sand Hill River Polk County Dam Modification	This project triggered NHP review as Prairie Chickens have been documented within 1.5 miles of the project site. However, based on the nature and location of the proposed project I do not believe it will affect any known occurrences of rare features.
Wild Rice River Heiberg Dam Norman County Modification	Based on the nature and location of the proposed project we do not believe it will affect any known occurrences of rare features.
Middle River at Argyle Marshall County Dam Removal	No comment needed
Red River Christine Dam Wilkin County Dam Removal	Lake sturgeon occurs near the project - Fisheries will address
Red River Hickson Dam Wilkin County Dam Modification	No comment needed
Tamarack River Stephen Dam Marshall County	No comment needed

3.4. Other Wildlife Species

As described in previous sections, diverse fish communities are found in watercourses of the Red River Basin. The composition of these communities is affected by numerous factors including physical stream characteristics (habitat type and quality), time of year, hydrologic conditions (see Goldstein et al. 1996; Peterka and Koel 1996). Barriers have also played a role in shaping fish communities in many reaches of Red River watercourses.

A review of the fish sampling history at Heiberg dam provides a good example of the effects that a barrier can have on fish communities in Red River streams. In 1973, MN DNR investigators found 31 species in the area of State Highway 32 near Twin Valley (Huber 1973). Their results included the catch of northern pike and several large river species. The presence of these species just east of Highway 32 was expected in 1973 because the barrier, Heiberg Dam, was compromised in 1965 and not rebuilt until 1977. Anecdotal evidence from discussions with local anglers suggests that there was good fishing for walleye and northern pike in the Mahnomen area during the 1970's and that catfish were caught more than 30 miles upstream. In 2000, twenty-two species were found in waters above Heiberg Dam and 24 species were found below it. No game fish species or traditional large river species (i.e. walleye, northern pike, goldeye, channel catfish, golden redhorse, sauger) were found upstream of the dam. Ten species found downstream were not found upstream and eight species found upstream were not captured downstream. In the 1994 survey (Huberty 1994), 15 species caught downstream of the dam were not sampled upstream and three species caught upstream were not sampled downstream. In the 1999 survey (VanOffelen et al. 1999), 10 species sampled below the dam were not captured upstream and nine species caught upstream were not sampled downstream. In June, 2002, a summer flood eroded a channel around the Heiberg dam and effectively eliminated the dam as a barrier. In 2003, all species, excluding sauger, that had not been found upstream of Heiberg dam since in 1973 were captured upstream.

Fish species diversity has consistently been lower upstream of barriers than downstream of barriers in all sampled streams where barriers prevent fish passage during the typical range of flows (Table 5). As described for each barrier (3.2.1.1-3.2.1.13), diverse aquatic habitats are found upstream of each barrier. These habitats provided spawning and rearing habitat found in limited quantity elsewhere in the Red River system.

Table 5. Species captured downstream ("Ds.") and upstream ("Us.") of barriers on Red River Basin Rivers. Note: the upstream Wild Rice River sampling in '03 occurred after the dam failed.

	Wild Rice River			Buffalo River		Roseau River		Tamarac River	
Fish Species - Common Name	Ds. '00	Us. '00	Us. '03	Ds. '01	Us. '01	Ds. '00	Us. '00	Ds. '00	Us. '00
Bigmouth Shiner						X			
Black Bullhead			X		X			X	X
Black Crappie				X		X		X	X
Blacknose Dace			X	X		X	X		
Blacknose Shiner									
Blackside Darter	X		X	X	X				
Bluegill	X		X	X		X	X	X	
Brassy Minnow		X				X	X		
Brown Bullhead			X	X				X	X
Brook Stickleback						X	X		
Burbot				X		X	X		
Central Mudminnow						X	X		
Channel Catfish	X		X	X		X		X	
Chestnut Lamprey	X	X	X			X	X		
Common Carp	X			X		X			X
Common Shiner	X	X	X	X	X	X	X		
Creek Chub	X	X	X		X	X	X		
Emerald Shiner			X						
Fathead Minnow	X	X	X			X			
Finescale Dace						X			
Freshwater Drum			X			X		X	
Golden Redhorse	X	X	X	X	X	X	X		
Goldeye	X		X	X				X	
Hornyhead Chub	X	X	X	X	X				
Iowa Darter					X				
Johnny Darter	X	X		X	X	X	X		
Largemouth Bass				X	X		X	X	
Longnose Dace		X	X	X	X				
Mooneye				X					
Northern Pike	X	X	X	X	X	X	X	X	X
Northern Redbelly Dace						X	X		
Pearl Dace									
Pumpkinseed		X	X						X
Quillback	X		X	X					
Rock Bass	X	X	X	X		X	X	X	
Sand Shiner	X	X		X	X	X			
Sauger	X			X		X		X	
Shorthead Redhorse	X	X	X	X	X	X	X	X	
Silver Lamprey							X		
Smallmouth Bass	X		X	X					
Spotfin Shiner	X			X					
Stonecat	X	X	X	X	X	X	X		X
Tadpole Madtom						X	X		
Trout Perch		X	X	X	X	X	X		
Walleye	X		X	X	X	X	X	X	
White Sucker	X	X	X	X	X	X	X	X	X
Yellow Bullhead			X						
Yellow Perch	X	X		X	X				

Many wildlife species typically use the corridor habitats (riparian/wetland and upland) associated with rivers and streams. In the Red River basin, near the barriers, the wildlife habitat in the stream corridor is limited to a narrow strip of land that buffers the watercourse from agricultural land. Even this typically narrow corridor can provide habitat and connectivity between other habitats for many upland species, including whitetailed deer, beaver, raccoon, skunk, gray squirrels, belted kingfisher, and a variety of avian species.

The impounded area at all sites, except Lake Breckenridge and the Elizabeth dam, do not provide a substantial pool area that is used by wildlife. At Lake Breckenridge and the Elizabeth dam, large pool areas provide migratory habitat for numerous waterfowl species and may provide nesting habitat for some species including mallard and Canada geese.

3.5. Land Use

The barriers are on reaches of stream that are near or within the Red River Valley ecoregion. Historically, this ecoregion was dominated by large expanses of tallgrass prairie and wetlands intersected by stream channels and flowages with narrow wooded corridors. The majority of this landscape is now agricultural. Land use near most sites is predominantly row crop agricultural with a little pasture and hayland (see air photos associated with individual barrier descriptions). A narrow wooded corridor is adjacent to the river channel at most sites but does not typically extend beyond the meander belt of the channel. No sites are actively pastured. A couple of barriers are located in or near a small town (Heiberg, Argyle, Stephen, Elizabeth, Phelps Mill). Land use associated with some of these includes a small park area (Heiberg, Argyle, Stephen).

3.6. Cultural/Paleontological Resources

The MN State Historical Preservation Office (SHPO) searched their database for archaeological and historical/architectural features in townships near the barrier sites (Appendix D). A few archaeological sites were identified near the barriers; however, none of these are immediately adjacent to the river channel and will not be affected by any alternatives. Several historical/architectural sites were also identified near a few of the barriers. Except for Phelps Mill, none of these are immediately adjacent to the river channel and will not be affected by any alternatives.

The MN DNR has also reviewed the historic and preservation issues for removal or modification of eight of the dams (Table 6). Five have been reviewed and been cleared (Heiberg dam, Sand Hill River dams, Otter Tail dam, Drayton dam, Stephen dam). The Argyle and Christine dams need further review and a review of the Hickson dam has not yet been completed.

Several buildings and the historic bridge site at Phelps Mills iareon the Natural Register of Historic Places. Further, formal review by MN DNR and SHPO will be required before any alternatives would be selected for this site. The final design of the project at Phelp's Mill will likely need to avoid changes to this structure to garner approval by SHPO.

The FEMA based Environmental Assessment for Heiberg Dam also found no archaeological or historic resources that would be affected by any proposed alternative. The proposed action at Heiberg will partially restore the function of the dam.

Table 6. MN DNR comments and suggestions related to SHPO issues present at eight Red River Basin barriers (from Mike Halverson, DNR fisheries, St. Paul)

Lake/County	SHPO
Red Lake River (Otter Tail Dam) Polk County Dam Removal	No further Review Pat Emerson – April 2004
Red River –Drayton Kittson County Dam Modification	No further Review Pat Emerson – April 2004
Sand Hill River Polk County Dam Modification	No comments needed Pat Emerson - 6/5/03
Wild Rice River Heiberg Dam Norman County Modification	We conclude that no historic properties eligible for or listed on the National Register of Historic Places will be affected by this project.
Middle River at Argyle Marshall County Dam Removal	**Needs** further review Pat Emerson 6/5/03
Red River Christine Dam Wilkin County Dam Removal	The dam needs to be evaluated for National Register eligibility. Postponed – SHPO # 2000-2369
Red River Hickson Dam Wilkin County Dam Modification	No comments received yet 6/01/05
Tamarack River Stephen Dam Marshall County	No comments needed Pat Emerson - 6/5/03

3.7. Local Socio-economic Conditions

All dam sites are located in rural northwestern Minnesota. Agriculture is a primary part of the economic base. Most of the barriers have become a part of the identity of local communities. MN DNR fisheries managers have discussed removal and modification options with local stakeholders at each barrier and have provided a written appraisal of local support for removal or modification (Appendix B). Local support for providing fish passage is consistent at all locations. Several communities prefer to modify the existing barriers rather than remove them in order to maintain a small pool upstream and alleviate future maintenance responsibilities. Other communities are interested in complete removal

for fish passage and to eliminate a safety hazard. Two dams, Drayton and Stephen, are currently used for water supply. At these dams, water supply needs will need to accommodated in the project design. Water supply has been successfully been incorporated at both dam removals and modifications (e.g., Buffalo River State Park dam removal, Red Lakes River dam modification in East Grand Forks).

4. Environmental Consequences

4.1. Alternative A (Proposed Action)

One of two actions, removal or modification, are proposed for each barrier location in alternative A (list below, table 1). This chapter will review environmental consequences based on whether removal or modification are the proposed action.

Proposed Action - Modification of existing barriers for fish passage at:

- *Drayton Dam, Red River of the North, Drayton, ND.*
- *Heiberg Dam, Wild Rice River, Twin Valley, MN.*
- *Check dams and culverts, Sand Hill River, between Fertile/Beltrami , MN.*
- *Stephen Dam, Tamarac River, Stephen, MN*
- *County Road Culverts, Marsh Creek, west of Mahnomen, MN.*
- *Phelps Mill Dam, Otter Tail River, Phelps, MN.*

Proposed Action - Removal of existing barrier(s) for fish passage at:

- *Christine Dam, Red River of the North, near Christine, ND.*
- *Hickson Dam, Red River of the North, near Hickson, ND.*
- *Otter Tail Power Dam, Red Lake River, Crookston, MN.*
- *Argyle Dam, Middle River, Argyle, MN.*
- *Lake Breckenridge Dam, Otter Tail River, Breckenridge, MN.*
- *S. Br. Buffalo River Dams, S. Branch of the Buffalo River, near U.S. Highway 10.*
- *Elizabeth Dam, Pelican River, Elizabeth, MN.*

4.1.1. Habitat Impacts

Implementing alternative A, regardless of whether modification or removal is the preferred method at any location, would directly restore fish passage to more than 800 miles of streams (Table 7) and hundreds more miles of additional tributary waterways to these streams. Removal or modification of the three remaining dams on the main stem of the Red River would build upon past fish passage projects and provide 545 miles of connected large river habitats from Winnipeg, MN to the Red River's headwaters at the confluence of the Bois de Sioux and Otter Tail rivers. Removal or modification at the 10 others barrier locations on the tributaries to the Red River would effectively connect more than 400 additional miles of habitat and countless miles of watercourses within the watersheds of these tributaries. Connecting these watercourses will provide access to quality spawning and rearing habitats that are currently not accessible for many fish species. These approaches to restoring fish passage have been successful at several barriers within the Red River Basin (Kidder Dam at Wahpeton, Fargo South Dam, Fargo Midtown Dam, Fargo North Dam, Red

Lake River Dam at East Grand Forks, Grand Forks Riverside Dam, Otter Tail River Dam Frazee, Otter Tail River culverts, Frazee, MN).

Modification based alternatives
Habitat impacts of modification at the barriers will be similar among all locations. Modification will create conditions so that fish may freely move upstream and downstream of the current barrier during a wide range of flows. The habitats upstream and downstream of each barrier will become connected similar to how they were connected prior to the existence of the barrier(s) at each location. The rock riffle slopes designed for each barrier will also create a short segment of riffle habitat. This riffle habitat will be similar to habitats commonly found in the reaches of stream that flow through the beach ridge portions of streams in the basin. This riffle habitat will likely provide preferred habitat for several fish species including iowa darter, johnny darter, longnose dace, and blacknose dace. These riffle habitats will also provide spawning habitats for walleye, sauger, and smallmouth bass and may provide habitat for a variety of aquatic invertebrates. The riffle habitats may also temporary displace a relatively deep plunge pool present at some sites; however, a similar deep water habitat is likely to form downstream of the riffle. The pool habitat upstream of the existing barriers will remain relatively unchanged (e.g. upstream pool size/depth, hydraulic residence time, sediment dynamics) unless a notch is needed in the existing structure to accommodate low-flow conditions.

At barriers where a notch is needed, the pool area and depth will be reduced during periods of low flow. This will result in a conversion of this pool habitat to more lotic habitat conditions and will reduce the likelihood that the existing pool will contribute to increased downstream water temperatures. Some short-term bank sloughing and erosion will be expected during the first few storm events at these notched and modified barriers. Once this initial sloughing and erosion occurs the vegetation and soils on the bank should adjust to the new water level and flow regime and become as stable as they were prior to modification.

Removal based alternatives
Barrier removal in all cases would involve near complete removal of the existing structure and placement of one or more rock weirs at, upstream, and/or downstream of the site to ensure continued stability of the stream bed. Based on past experiences in the Red River Basin (dam removals at the Buffalo River State Park and Old Mill State Park) sediment will be released from the old impoundment during construction. The quantity of sediment released will be dependent upon the conditions at each barrier. The one time release of sediment is unlikely to affect downstream habitats for more than several days based on past experiences and the limited quantity of sediment expected at most barriers. A sediment wedge will be conveyed and continually distributed downstream of barriers that are dams.

Sediment related habitat issues at Lake Breckenridge and Elizabeth dam require further consideration. Although Lake Breckenridge has a large impoundment that holds a large quantity of sediment the sediment found in this impoundment is not likely to affect downstream habitat. The dam removal at Lake Breckenridge will incorporate a series of rock riffles to maintain a pool level near the existing pool level. Since the majority of the pool will be maintained only a small fraction of the total amount of sediment found in this impoundment will have a chance of being released. The potential effects of sediment on habitat from the removal of the Elizabeth dam are

relatively unknown because quantity and quality of sediment and the design details for the removal are relatively unknown. If the barrier removal is similar to the one proposed for Lake Breckenridge with a series of rock riffles to maintain the current pool level then the effects of sediment on downstream habitat are not likely to be substantial. If the barrier is removed and the pool level is reduced more than several feet the sediment related issues at this site will need additional investigation and a supplemental EA may be needed prior to removal to evaluate the affects of this removal on sediment and habitat.

Removal of these barriers for fish passage will change habitats in the impounded pool area to differing degrees. Where water levels are lowered, the pool habitats will return to more riverine like conditions. During the transitional period back to riverine conditions, erosion will occur in the pool. Downstream habitat and conditions may change in the short term due to a temporary increase in sediment load; however, experiences at the Middle River and Buffalo River suggest that sediment issues in downstream reaches are not detectable within months of dam removal. Habitats upstream of the barriers will not be affected as long as measures are taken to stabilize the stream channel at the impoundment.

Table 7. Miles of stream habitat that will become accessible with barrier removal or modification.

Barrier name	Watercourse	Miles of stream habitat connected
Drayton Dam	Red River of the North	290
Christine Dam	Red River of the North	14
Hickson Dam	Red River of the North	50
Otter Tail Power Dam	Red Lake River	63
Heiberg Dam	Wild Rice River	120
Lake Breckenridge Dam	Otter Tail River	32
Argyle Dam	Middle River	30
Sand Hill River barriers	Sand Hill River	79
Marsh Creek culverts	Marsh Creek	42
Stephen Dam	Tamarac River	26
South Branch Buffalo barriers	S. Br. Of the Buffalo River	50
Elizabeth Dam	Otter Tail River	22
Phelps Mill Dam	Otter Tail River	4
	Total	822

4.1.2. Biological Impacts

Implementing alternative A, regardless of whether modification or removal is the preferred method at any location, would directly restore fish passage to more than 800 miles of streams (Table 7) and hundreds more miles of additional tributary waterways to these streams. Removal or modification of the three remaining dams on the main stem of the Red River would build upon past fish passage projects and provide 545 miles of connected large river habitats from Winnipeg, MN to the Red River's headwaters at the confluence of the Bois de Sioux and Otter Tail rivers. Removal or modification at the 10 others barrier locations on the tributaries to the Red River would effectively connect more than 400 additional miles of habitat and countless miles of watercourses within the watersheds of these tributaries. Connecting these watercourses will provide access to quality spawning and rearing habitats that are currently not accessible for many fish species. These approaches to restoring fish passage have been successful at several barriers within the Red River Basin (Kidder Dam at Wahpeton, Fargo South Dam, Fargo Midtown Dam, Fargo North Dam, Red Lake River Dam at East Grand Forks, Grand Forks Riverside Dam, Otter Tail River Dam Frazee, Otter Tail River culverts, Frazee, MN).

The potential for expanding the distribution of non-native fish species and other aquatic biota by providing fish passage at these barriers is low. The system currently has few non-native species. Three trout species occur in the Red River basin but their range is isolated to the few reaches of streams that provide coldwater habitat. The flathead chub, *Platygobio gracilis,* has been reported only once in the Red River basin when a single specimen was collected from the Red River south of Grand Forks in 1984. Muskellunge, *Esox masquinongy*, have not been sampled within the Red River or its tributaries; however, they are present in several lakes upstream of barriers on the Otter Tail and Pelican Rivers. Common carp are found throughout the Red River system in lakes and streams. They have been most often found in the lower reaches of the tributaries and may expand their range with removal of barriers; however, common carp have been most frequently sampled in the Red River main stem and lower reaches of tributaries. Removal of barriers is not expected shift the preferred habitat of common carp from these lower reaches or the Red River. Providing fish passage at the 13 barrier locations will restore the natural connections within the system of watercourses. Since many miles of the Red River and its tributaries are already connected with no known substantial negative effects of these species on aquatic communities, removal of barriers should follow this established pattern found elsewhere in the basin and no substantial negative effects are expected on aquatic communities. No non-native pathogens are known to occur in the Red River basin within Minnesota (Joe Marcino, MN DNR pathologist, personal communication). If additional non-native fish species or other aquatic biota are introduced into the system in the future, implementation of this alternative may increase the risk of expanding the distribution of these organisms. If new organisms are introduced upstream of any of the barrier locations, implementing this alternative is likely to have no effect. If new organisms are introduced downstream of the barriers their removal/modification may permit the spread of the organisms upstream.

Modification based alternatives

Habitat impacts of modification at the barriers will be similar among all locations. Modification will create conditions so that fish may freely move upstream and downstream of the current barrier during a wide range of flows.

Removal based alternatives
Barrier removal in all cases would involve near complete removal of the existing structure and placement of one or more rock weirs at, upstream, and/or downstream of the site to ensure continued stability of the stream bed. Habitat impacts would be restoration of lotic habitats to the pool area above the dam. At Lake Breckenridge, a series of rock riffles will be used to maintain the pool near current levels to minimize impacts to existing wetland habitats in the pool area. At the Elizabeth dam, approximately 3,800 feet of the Pelican River will be restored.

4.1.3. Listed, Proposed, and Candidate Species
Implementing this alternative is not likely to affect any federal listed, proposed, or candidate species in the Natural Heritage Inventory (Table 4). No species reside near any of the barriers.

Black sand shell mussels found downstream of the Lake Breckenridge dam may be affected by removal of the Lake Breckenridge dam. The magnitude and duration of the impacts depend upon the specific plans for dam removal and sediment control in the reservoir after the removal. Removal of the Breckenridge dam is also likely to create more than 1.5 miles of habitat for this mussel species.

4.1.4. Cultural Resources
No impacts to cultural resources are expected under this alternative. Formal review of SHPO related issues has been conducted for eight dams (Table 6). Further review has been recommended for two dams and the Phelps Mill dam has been added to the list for review. No action will be taken at any site until complete review and clearance of the location and project design by SHPO. The Service's Region 6 HPO will be consulted prior to any actions on barriers that are partially located in North Dakota.

4.1.5. Social Values
Removal and modification of dams as proposed in this alternative are generally socially acceptable with the local communities.

4.1.6. Environmental Justice
None of the projects in this alternative will have a negative impact on the human environment. None of the projects in this alternatives will have a negative impact on a minority population or ethnic group. None of the projects in this alternatives will negatively impact the economically disadvantaged. Efforts by the White Earth Band Of Ojibwe to restore lake sturgeon to the Red River Basin will benefit from the proposed action.

4.1.7. Cumulative Impacts
The proposed alternative provides substantial cumulative benefits. Cumulative impacts of implementing the preferred alternative will be to restore fish passage directly to more than 800 miles of streams (Table 7) and indirectly to many hundreds more miles of tributaries in the Red River basin. The result of this action on the main stem of the Red River would be to provide connected habitats from Winnipeg, MB all

the way to its headwaters at the confluence of the Bois de Sioux and Otter Tail rivers (454 miles). In addition to the main stem of the Red River, more than 400 miles of tributaries to the Red River would be effectively connected to the main stem and countless miles of watercourses within tributary watersheds would also be connected. Connecting these watercourses provides access to quality spawning and rearing habitats that are currently not accessible. The proposed alternative will increase the likelihood that self sustaining lake sturgeon populations will be re-established in the Red River Basin. Furthermore, safety risks posed at barriers will be substantially reduced.

Dams that are barriers to fish passage are being removed and modified throughout the upper Midwest. In additional to fish passage issues, many barriers are greater than 50 years old, no longer serve their intended functions, pose safety risks, and have long term maintenance costs for their owners. Often dam or barrier removal projects are targeted toward one specific barrier or dam. The approach outlined in this alternative is a watershed wide approach to fish passage in the system of watercourses within the Red River Basin. It considers both removal and modification to accomplish fish passage and to accommodate site specific issues ranging from sediment control and wildlife habitat to the social, cultural, and historic needs of local communities.

4.2. Alternative B (No Action)

4.2.1. Habitat Impacts

No action at each of the barrier locations will perpetuate the current conditions at each site and continue to contribute to the fragmentation of habitats in the main stem of the Red River and its tributaries. Impounded areas of those barriers with substantial impoundments will continue to provide predominantly lentic habitats in areas known previously to contain quality lotic habitats.

4.2.2. Biological Impacts

No action at each of the barrier locations will perpetuate the current conditions at each site and continue to contribute to the fragmentation of habitats in the main stem of the Red River and its tributaries. Fish species diversity will continue to be lower upstream of barriers than downstream of barriers. Spawning and rearing of numerous species that require diverse habitat conditions (e.g., walleye, sauger, channel catfish, lake sturgeon) will continue to be limited throughout the system.

4.2.3. Listed, Proposed, and Candidate Species

No listed, proposed, or candidate species would be affected by no action. The potential for restoration of lake sturgeon the Red River Basin would be reduced if no action were taken.

4.2.4. Cultural Resources

No cultural resources are likely to be affected by no action. The historic bridge at Phelps Mill will continue to exist in a degraded condition.

4.2.5. Social Values

No action will not likely affect social values. Continued repair and maintenance will be required to maintain its structural integrity. Repair and maintenance will also be required at all other barriers. Barriers owners will be responsible for this maintenance.

4.2.6. Environmental Justice

This alternative will not have a negative impact on the human environment. This alternative will not have a negative impact on a minority population or ethnic group. The alternative will not negatively impact the economically disadvantaged. Efforts by the White Earth Band Of Ojibwe to restore lake sturgeon to the Red River Basin will be hindered by the no action.

4.2.7. Cumulative Impacts

The cumulative impacts of the no action alternative will be the continued fragmentation of quality lotic habitats and aquatic communities throughout the Red River main stem and its tributaries. Continued fragmentation of these resources will reduce the likelihood that self sustaining lake sturgeon populations will be re-established in the Red River Basin. Furthermore, safety risks at barriers will be perpetuated and owners will be required to maintain the structures.

4.3. Alternative C. Alternative C is removal at all locations. For those dams where the preferred alternative is removal, impacts will be the same as listed for alternative A in 4.1. The impacts described below apply to those barriers where modification was discussed previously in 4.1 as the preferred alternative:

- *Drayton Dam, Red River of the North, Drayton, ND.*
- *Heiberg Dam, Wild Rice River, Twin Valley, MN.*
- *Check dams and culverts, Sand Hill River, between Fertile/Beltrami , MN.*
- *Stephen Dam, Tamarac River, Stephen, MN*
- *County Road Culverts, Marsh Creek, west of Mahnomen, MN.*
- *Phelps Mill Dam, Otter Tail River, Phelps, MN.*

Removal of these barriers rather than modification will generally have impacts similar to modification.

4.3.1. Habitat Impacts

Habitat impacts will for this alternative will be similar to those described in Alternative A (see 4.1.1). Fish passage will be restored to more than 800 miles of streams (Table 4) and hundreds more miles of additional tributary waterways to these streams. This alternative does potentially have some sediment related and habitat related issues that differ from Alternative A.

Barrier removal in all cases would involve near complete removal of the existing structure and placement of one or more rock weirs at, upstream, and/or downstream of the site to ensure continued stability of the stream bed. Based on past experiences in the Red River Basin (dam removals at the Buffalo River State Park and Old Mill State Park) sediment will be released for the old impoundment during construction. The quantity of sediment released will be dependent upon the conditions at each barrier. The one time release of sediment is unlikely to significantly affect downstream habitats based on past experiences and the limited quantity of sediment expected at most barriers. A sediment wedge will be conveyed and continually distributed downstream of barriers that are dams.

Sediment related habitat issues at Lake Breckenridge and Elizabeth dam require further consideration. Although Lake Breckenridge has a large impoundment that holds a large quantity of sediment the sediment found in this impoundment is not likely

to affect downstream habitat. The dam removal at Lake Breckenridge will need to incorporate a series of rock riffles to maintain a pool level near the existing pool level to minimize loss of wetland habitats. Since the majority of the pool will be maintained only a small fraction of the total amount of sediment found in this impoundment will have a chance of being released. The potential effects of sediment on habitat from the removal of the Elizabeth dam are relatively unknown because quantity and quality of sediment and the design details for the removal are relatively unknown. If the barrier removal is similar to the one proposed for Lake Breckenridge with a series of rock riffles to maintain the current pool level then the effects of sediment on downstream habitat are not likely to be substantial. If the barrier is removed and the pool level is reduced more than several feet the sediment related issues at this site will need additional investigation and a supplemental EA may be needed prior to removal to evaluate the affects of this removal on sediment and habitat.

Removal of these barriers for fish passage will change habitats in the impounded pool area to differing degrees. Where water levels are lowered, the pool habitats will return to more riverine like conditions. During the transitional period back to riverine conditions, erosion will occur in the pool. Downstream habitat and conditions may change in the short term due to a temporary increase in sediment load; however, experiences at the Middle River and Buffalo River suggest that sediment issues in downstream reaches are not detectable within months of dam removal. Habitats upstream of the barriers will not be affected as long as measures are taken to stabilize the stream channel at the impoundment.

4.3.2. Biological Impacts

Implementing alternative C, would directly restore fish passage to more than 800 miles of streams (Table 4) and hundreds more miles of additional tributary waterways to these streams. Removal of the three remaining dams on the main stem of the Red River would build upon past fish passage projects and provide 545 miles of connected large river habitats from Winnipeg, MN to the Red River's headwaters at the confluence of the Bois de Sioux and Otter Tail rivers. Removal at the 10 others barrier locations on the tributaries to the Red River would effectively connect more than 400 additional miles of habitat and countless miles of watercourses within the watersheds of these tributaries. Connecting these watercourses will provide access to quality spawning and rearing habitats that are currently not accessible for many fish species. Restoring fish passage has been successful at several barriers within the Red River Basin (Kidder Dam at Wahpeton, Fargo South Dam, Fargo Midtown Dam, Fargo North Dam, Red Lake River Dam at East Grand Forks, Grand Forks Riverside Dam, Otter Tail River Dam Frazee, Otter Tail River culverts, Frazee, MN).

The potential for expanding the distribution of non-native fish species and other aquatic biota by providing fish passage at these barriers is low. The system currently has few non-native species. Three trout species occur in the Red River basin but their range is isolated to the few reaches of streams that provide coldwater habitat. The flathead chub, *Platygobio gracilis,* has been reported only once in the Red River basin when a single specimen was collected from the Red River south of Grand Forks in 1984. Muskellunge, *Esox masquinongy*, have not been sampled within the Red River or its tributaries; however, they are present in several lakes upstream of barriers on the Otter Tail and Pelican Rivers. Common carp are found throughout the Red River system in lakes and streams. They have been most often found in the lower reaches of the tributaries and may expand their range with removal of barriers; however,

common carp have been most frequently sampled in the Red River main stem and lower reaches of tributaries. Removal of barriers is not expected shift the preferred habitat of common carp from these lower reaches or the Red River. Providing fish passage at the 13 barrier locations will restore the natural connections within the system of watercourses. Since many miles of the Red River and its tributaries are already connected with no known substantial negative effects of these species on aquatic communities, removal of barriers should follow this established pattern found elsewhere in the basin and no substantial negative effects are expected on aquatic communities. No non-native pathogens are known to occur in the Red River basin within Minnesota (Joe Marcino, MN DNR pathologist, personal communication). If additional non-native fish species or other aquatic biota are introduced into the system in the future, implementation of this alternative may increase the risk of expanding the distribution of these organisms. If new organisms are introduced upstream of any of the barrier locations, implementing this alternative is likely to have no effect. If new organisms are introduced downstream of the barriers their removal/modification may permit the spread of the organisms upstream.

Barrier removal in all cases would involve near complete removal of the existing structure and placement of one or more rock weirs at, upstream, and/or downstream of the site to ensure continued stability of the stream bed. Unlike a modification, habitat impacts would be the restoration of lotic habitats to the pool area above the dam. At Lake Breckenridge, a series of rock riffles will be used to maintain the pool near current levels to minimize impacts to existing wetland habitats in the pool area. At the Elizabeth dam, approximately 3,800 feet of the Pelican River will be restored.

4.3.3. Listed, Proposed, and Candidate Species

No federal listed, proposed, or candidate species in the Natural Heritage Inventory are present near the areas described in this EA.

Black sand shell mussels, a MN species of concern, were found downstream of the Lake Breckenridge dam may be affected by removal of the Lake Breckenridge dam. The magnitude and duration of the impacts depend upon the specific plans for dam removal and sediment control in the reservoir after the removal. Removal of the Breckenridge dam is also likely to create more than 1.5 miles of habitat for this mussel species.

4.3.4. Cultural Resources

Impacts to cultural resources are not expected under this alternative. Formal review of SHPO related issues has been conducted for eight dams (Table 6). Further review has been recommended for two dams and the Phelps Mill dam has been added to the list for review. No action will be taken at any site until complete review and clearance of the location and project design by SHPO.

4.3.5. Social Values

Removal of dams at some locations may not be socially acceptable with the local communities. Removal will result in the loss of the structure and a subsequent loss of the impoundment area.

4.3.6. Environmental Justice

None of the projects in this alternative will have a negative impact on the human environment. None of the projects in this alternatives will have a negative impact on a minority population or ethnic group. None of the projects in this alternatives will negatively impact the economically disadvantaged. Efforts by the White Earth Band Of Ojibwe to restore lake sturgeon to the Red River Basin will benefit from the proposed action.

4.3.7. Cumulative Impacts

The cumulative impacts of implementing the alternative C are similar to those described for alternative A (4.1.7). Fish passage will be restored to more than 800 miles of streams (Table 7) and indirectly to many hundreds more miles of tributaries in the Red River basin. The proposed alternative provides substantial cumulative benefits.

Dams that are barriers to fish passage are being removed and modified throughout the upper Midwest. In additional to fish passage issues, many barriers are greater than 50 years old, no longer serve their intended functions, pose safety risks, and have long term maintenance costs for their owners. Often dam or barrier removal projects are targeted toward one specific barrier or dam. The approach outlined in this alternative is a watershed wide approach to fish passage in the system of watercourses within the Red River Basin. It uses removal to accomplish fish passage and does not accommodate site specific social needs of local communities.

4.4. Summary of Environmental Consequences by Alternative

Issue	**A. Proposed Alternative (Modification and Removal)**	**B. No Action**	**C. Alternative (Removal)**
Habitat Impacts			
Stream stability	Will have no long term effects on stream stability. Individual barrier alternatives will be designed and implemented to ensure stream stability.	Will continue current conditions. Erosion and instability will continue to occur at those barriers with existing downstream erosion.	Will have no long term effects on stream stability. Individual barrier alternatives will be designed and implemented to ensure stream stability.
Sedimentation	Will have no long term effects on sedimentation. Individual barrier alternatives will be designed and implemented to reduce short term sediment loads at project implementation.	Will continue current conditions. Barriers will continue to alter sediment regimes.	Will have no long term effects on sedimentation. Individual barrier alternatives will be designed and implemented to reduce short term sediment loads at project implementation.
Connectivity	Will restore fish passage to more than 800 miles of lotic habitats and substantially help defragment the aquatic ecosystem of the Red River Basin.	Continued fragmentation of the aquatic ecosystem in the Red River Basin . Continued loss of access to high gradient reaches of spawning habitat for many fish species.	Will restore fish passage to more than 800 miles of lotic habitats and substantially help defragment the aquatic ecosystem of the Red River Basin.

Biological Impacts			
Fish	Will reconnect more than 800 miles of watercourses within the Red River Basin that provied diverse habitats for many species. Reproduction and rearing of many fish species will be enhanced throughout the basin	Will continued fragmentation of the aquatic ecosystem in the Red River Basin and continue the loss of spawning and rearing habitats to many fish species.	Will reconnect more than 800 miles of watercourses within the Red River Basin that provied diverse habitats for many species. Reproduction and rearing of many fish species will be enhanced throughout the basin
Mussels	Will restore passage and connectivity for some fish species that may host mussel glochidia. Project implementation my temporarily inundate some downstream mussel habitats. Additional mussel habitat will be created upstream of some locations.	Will continued fragmentation of the aquatic ecosystem in the Red River Basin.	Will restore passage and connectivity for some fish species that may host mussel glochidia. Project implementation my temporarily inundate some downstream mussel habitats. Additional mussel habitat will be created upstream at most locations.
Endangered/ Threatened species		Will maintain the current condition of existing structures. Some may need costly maintenance to maintain their intergrity into the future.	
Other Wildlife	Willl have little effect on terrestrial wildlife species	Will maintain the status quo.	Willl have little effect on terrestrial wildlife species
Cumulative	Will restored fish passage and biological connectivity to more than 800 miles of lotic habitats and defragment the aquatic ecosystem of the Red River Basin. Minimal to no impacts to terrestrial habitats near barriers.	Continued fragmentation of the aquatic ecosystem in the Red River Basin . Cnintued loss of access to high gradient reaches of beach ridge habitats.	Will restored fish passage and biological connectivity to more than 800 miles of lotic habitats and defragment the aquatic ecosystem of the Red River Basin. Minimal to no impacts to terrestrial habitats near barriers.
Water Quality Impacts	Will temporarily increase in sediment loading during implementation. Will reduced the likelihood for elevated water temperatures and will reduce the potential for low dissolved oxygen levels downstream of each barrier.	Will maintain current conditions including some elevated water temperatures and reduced dissolved oxygen levels downstream of impoundments.	Will temporarily increase in sediment loading during implementation. Will reduced the likelihood for elevated water temperatures and will reduce the potential for low dissolved oxygen levels downstream of each barrier.

Social Impacts	Will change the character of the barrier but is unlikely to have any substantial social impacts. Removal was selected at those sites where local support was expected. Modification was selected at those sites where there is local interest in maintaining the character of the site yet still provide fish passage. Also, where water supply was a function of the barrier, modification was preferred.	Will maintain the status quo regarding the social values of the barriers. Some barriers may require the local community to pay for long term maintenance.	Will change the character of the barrier and may have some social impacts. Removal was selected at all even where local support may not be expected.
Safety Impacts	Will reduce safety hazzards associated with the barriers.	Will maintain the status quo regarding safety at the barriers. Some may become less safe as they age and become further deteriorated.	Will reduce safety hazzards associated with the barriers.

5. List of Preparers
Lead author - Henry VanOffelen, U.S. Fish and Wildlife Service

6. Consultation and Coordination With the Public and Others
This document was completed in consultation with Jeff Gosse, Service Regional Environmental Coordinator. Numerous biologists with the Minnesota Department of Natural Resources including: Luther Aadland, David Friedl, Tom Groshens, Gary Huberty, Mike Larson, Arlin Schalekamp, and Dennis Topp and Tom Raster, U.S. Army Corps of Engineers, provided background information and documents. MN DNR staff has met with local leaders at the barrier location and have discussed the removal and/or modification of their barriers.

7. Public Comments on Draft EA/EIS and Responses
The public comment period for this draft environmental assessment was from June 17, 2005 through July 19, 2005. Copies of the document were available for public review at four US Fish and Wildlife Service offices, three MN DNR offices, White Earth DNR office, two libraries, five city offices, and two watershed district offices. In addition, the draft EA was available on the Service's Regional Internet site at: http://www.fws.gov/midwest/NEPA. No comments were received from the public.

8. References Cited

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Appendices

Appendix A - List of fish surveys and assessments conducted in the Red River Basin.

Appendix B – Barrier Information Worksheets completed by MN DNR Fisheries personnel.

Appendix C – United States Army Corps of Engineers Preliminary Restoration Plans: Drayton Dam and Sand Hill River barriers.

Appendix D - United States Army Corps of Engineers Environmental Assessment: Fargo South Dam

Appendix E – Reports from State Historical Preservation Office (SHPO) database search for Red River barriers.

Appendix F – MN DNR's Red River Fish Mgt. plan

Appendix G – MN DNR's Sturgeon Restoration plan