Attachment B

Interbasin Water Transfer Projects In North America

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Introduction

Interbasin water transfer projects, or projects that move water from one hydrologic basin to another, such as across a continental divide, have been a controversial issue in North Dakota for nearly 50 years. Two of the main reasons for this controversy is the common misconception that the interbasin water transfer projects that North Dakota proposes to build (Northwest Area Water Supply, and Red River Valley Water Supply Project) will be the first of its kind, and that water treatment protocols will not be sufficient to prevent the spread of aquatic nuisance species. As the following document will show, instead of being the first of their kind, North Dakota's proposed water projects are not unique, and will have a greater degree of protection against biota transfer in place than existing projects. For the purposes of this white paper, nine existing, major water diversion projects will be considered in greater depth. While this paper explores the major interbasin water transfer projects, there are a number of additional projects that exist as well.

An important distinction to make in regards to water diversions, is the degree to which that water is diverted. To simplify this distinction, diversions will be broken down into two "orders." A second order diversion is the transport of water, where water from one freshwater basin is diverted to another freshwater basin. While both of these basins empty into the same body of saltwater, they are not connected by freshwater. A first order diversion is where water is transported from one basin to another basin across what is commonly referred to as a continental divide, and neither of these basins empty into the same ocean. This distinction is important, because of the concerns that have been raised about the possibility of freshwater aquatic organisms being transported via a water transfer project to a watershed where they have not been found before. In both a first a second order diversion, a freshwater organism has the potential to be introduced into a new aquatic habitat.

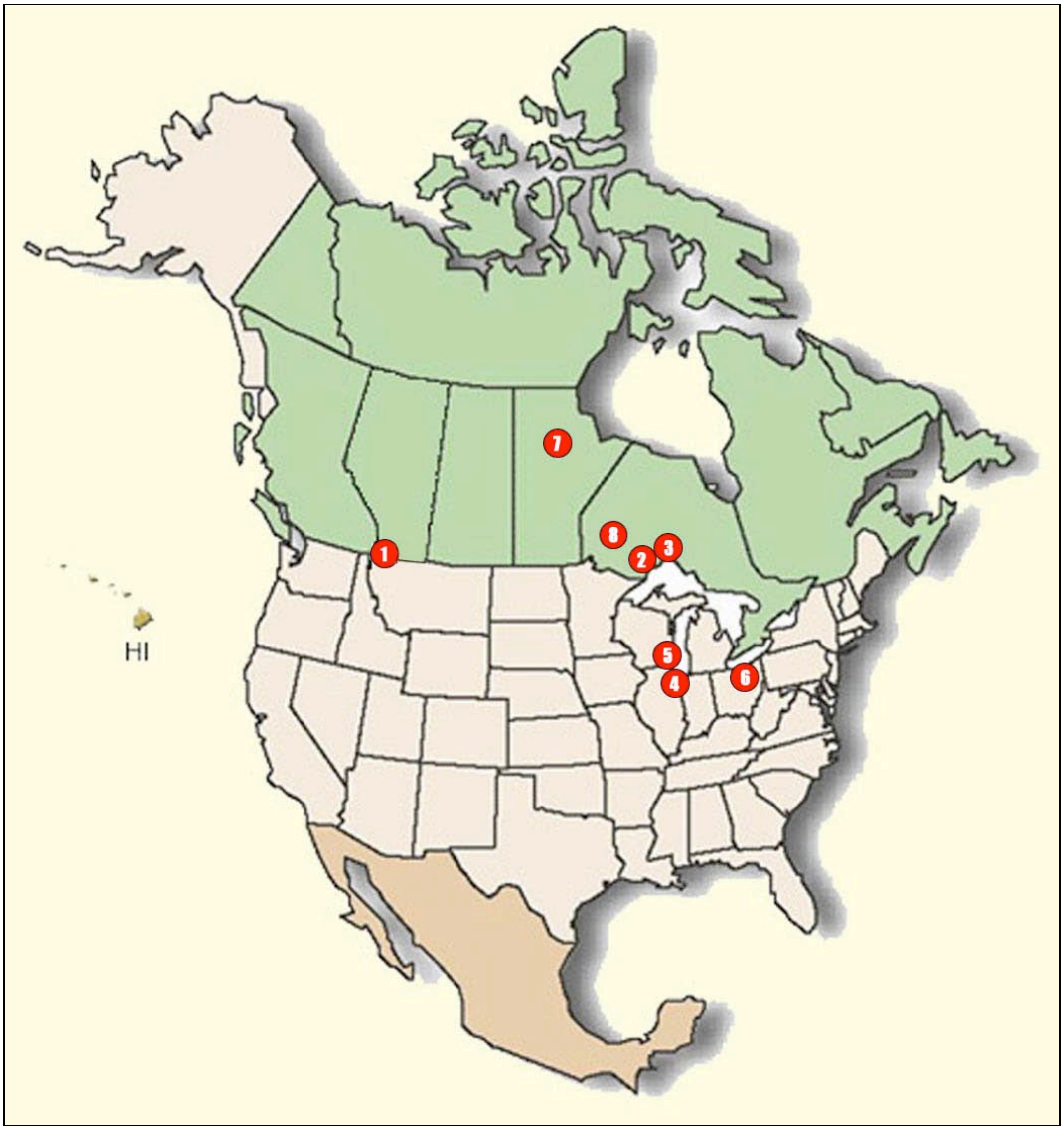

Figure 1. An overview map of the nine water diversions projects detailed in this paper.

Project	Order	Source-Receiving Basin	Built	Flow	Biota Controls	Purpose
1) Saint Mary River	First	Hudson-Missouri	1915	650 cfs	None	Irrigation
2) Long Lake	First	Hudson-Great Lakes	1948	1,377 cfs	? (see discussion)	Hydro
3) Ogoki River	First	Hudson-Great Lakes	1943	4,273 cfs	? (see discussion)	Hydro
4) Cal-Sag	First	Great Lakes-Mississippi	1900	3,213 cfs	Electrical Barrier	Sewage
5) Akron	First	Great Lakes-Mississippi	1998	7.7 cfs	? (see discussion)	Municipal
6) Pleasant Prairie	First	Great Lakes-Mississippi	1990	5 cfs	? (see discussion)	Municipal
7) Churchill River	Second	Churchill-Nelson	1976	30,013 cfs	? (see discussion)	Hydro
8) Lake Saint Joseph	Second	James-Nelson	1950s	3,072 cfs	? (see discussion)	Hydro
			Total:	**< 42,595.7 cfs**		

Saint Mary River Diversion

The first diversion that will be examined is the Saint Mary River diversion, which is a first order diversion. This project diverts water from the Saint Mary River in Montana (a tributary of Saskatchewan River, which in turn flows into the Nelson River, and then into Hudson Bay,) into the Milk River, which flows into the upper Missouri River, and eventually into the Gulf of Mexico (Figure 2.) There are no biota transfer controls in place to prevent the spread of aquatic organisms from the Hudson Bay basin to the Missouri River basin. Because of the design of the diversion, it seems unlikely that biota transfer could occur via the diversion from the Missouri River basin to the Hudson Bay basin.

"During the 1880's, settlers built small individual irrigation systems and, in 1890, constructed a community diversion dam in the vicinity of the present Fort Belknap Diversion Dam. Lack of facilities to store the early spring runoff prompted an investigation in 1891 to find a means of supplementing the low summer flow of the river.

The most feasible plan for developing a large irrigation project involved the diversion of St. Mary River into the headwaters of Milk River. Since both rivers flow through Canada, it was necessary to execute a water-right agreement with Canada before the plan could be completed. Increasing irrigation activities in the valley brought urgent requests for development. Investigation of the Milk River Project led to conditional authorization of the project in 1903.

The project was conditionally approved by the Secretary of the Interior on March 14, 1903. The St. Mary Storage Unit was authorized March 25, 1905.

Construction of the St. Mary Storage Unit began on July 27, 1906. A treaty with Great Britain relating to the distribution between Canada and the United States of the waters of the St. Mary and Milk Rivers was signed on January 11, 1909. [**This treaty is known as the Boundary Waters Treaty**] *The Dodson Diversion Dam was completed in January 1910, and the first water delivered for irrigation in 1911. In 1915, the Nelson and Swift Current Dikes, and St. Mary Diversion Dam were completed. In 1917, the Vandalia Diversion Dam was put into operation, Lake Sherburne Dam was completed in 1921, and the Fresno Dam in 1939. The Dodson Pumping Plant was completed in 1946.*

The principal crops produced on the farms in the Milk River Project are alfalfa, native hay, oats, wheat, and barley.

The St. Mary Diversion Works, located on the St. Mary River 0.75 mile downstream from Lower St. Mary Lake, consist of a 6-foot-high concrete weir and sluiceway with a length of 198 feet, and a total volume of 1,200 cubic yards. The St. Mary Canal begins at St. Mary Diversion Dam on the west side of St. Mary River and crosses the river 9.5 miles below the diversion through a two-barrel steel-plate siphon 90 inches in diameter and 3,600 feet in length. Eight miles below the St. Mary crossing a second two-barrel steelplate siphon, 78 inches in diameter and 1,405 feet long, conveys the water across Hall's Coulee. A series of five large concrete drops at the lower end of the 29-mile canal provide a total fall of 214 feet to the point where the water is discharged into North Fork Milk River. Design capacity of the canal is 850 cubic feet per second." (Bureau of Reclamation, 2004.)

In recent years, the Saint Mary River diversion has begun to show its age, as the project is beyond its original design lifespan. Peak flow has declined from 850, to now approximately 650 cubic feet per second (cfs.) The State of Montana is seeking to get federal reauthorization of the project and obtain funding to rehabilitate the project works.

This general area was the test site for triploid (sterilized) grass carp and silver carp that were intended to keep vegetation out of irrigation canals, both of which are exotic species of concern to the United States (Crowder, 2004; Jaffray, 2002.)

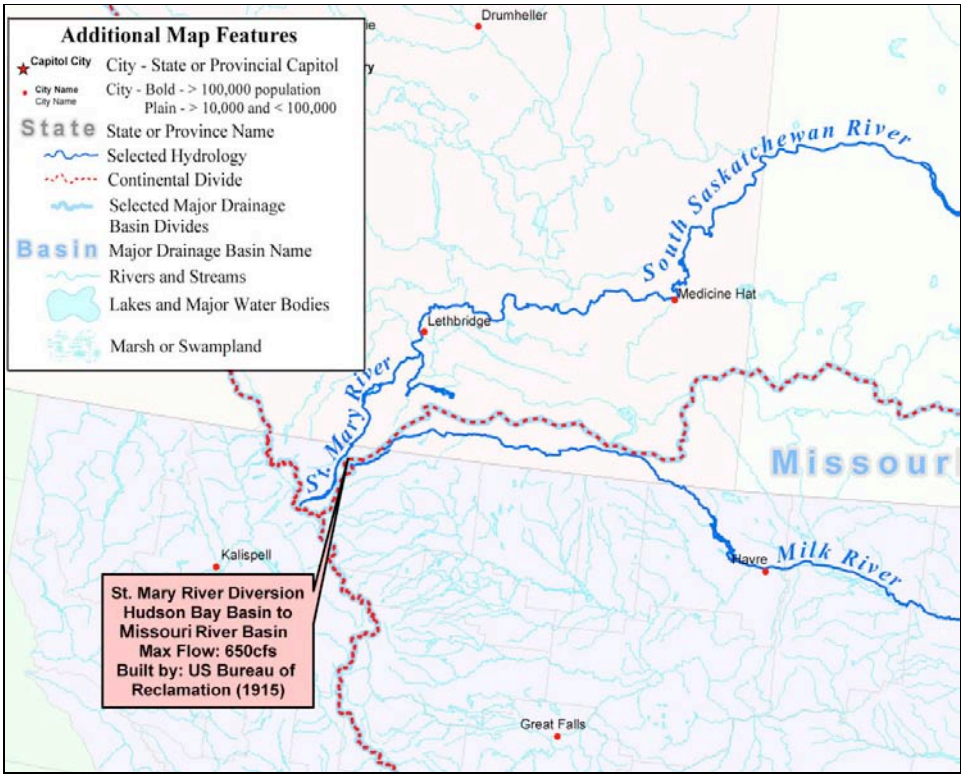

Figure 2. The Saint Mary and Milk River diversions.

Long Lake Diversion

The Long Lake diversion is a first order project that exists in southern Ontario, north of Lake Superior (Figure 3.) The project diverts water from Long Lake, which is in the Hudson Bay basin into the Aguasabon River, and eventually into Lake Superior which is in the Great Lakes basin.

The project was completed in 1948 by the Hydro-Electric Commission of Ontario for the purpose of hydroelectric power generation. In 1999, the asset was transferred to Ontario Power Generation. The diversion has an average annual flow of 1,377 cfs (Ontario Power Generation Inc., 2002.)

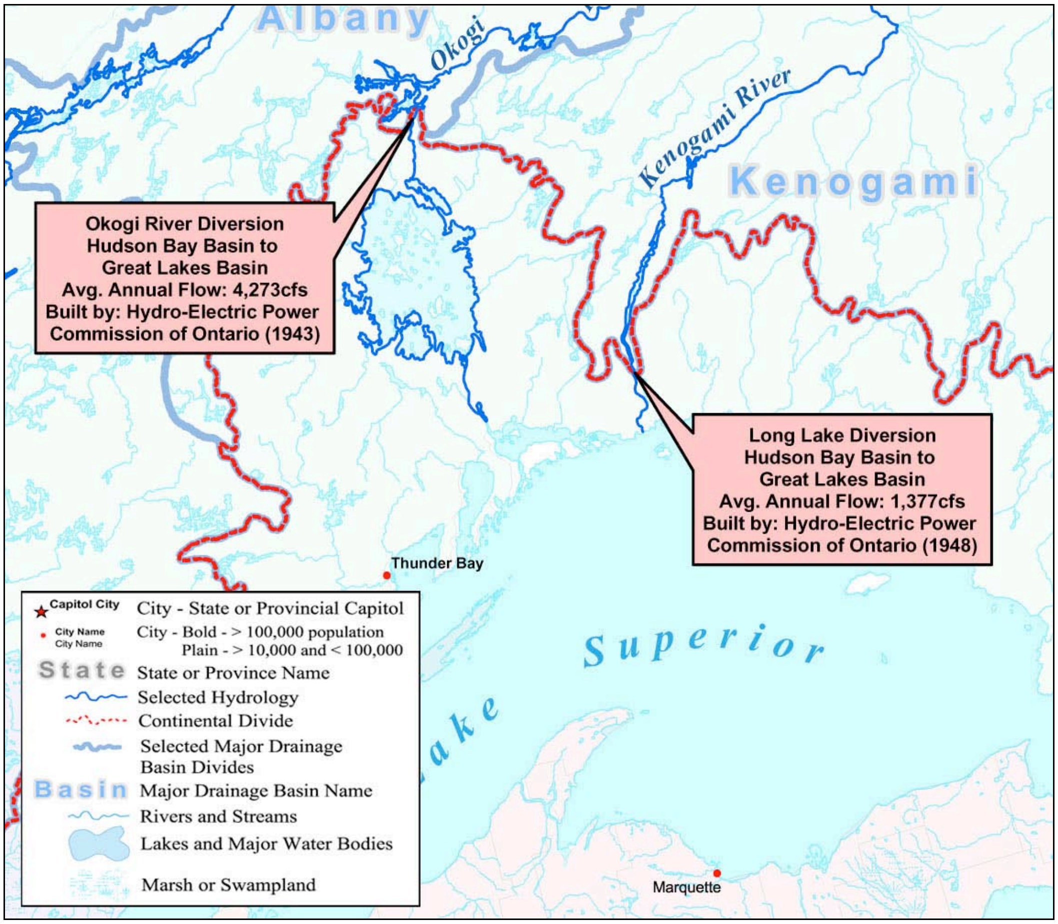

Figure 3. The Long Lake and Ogoki River diversions.

Ogoki River Diversion

The Ogoki River diversion diverts water from the Hudson Bay basin, into the Great Lakes basin, and is the another first order diversion (Figure 3.) The project, which was completed in 1943 by the Hydro-Electric Commission of Ontario for the purpose of hydroelectric power generation, and was transferred to Ontario Power Generation in 1999, takes water from the Ogoki River (Albany River watershed), and transfers that water to Lake Nipigon, and then into Lake Superior.

The project has an average annual flow of 4,273 cfs (Ontario Power Generation Inc., 2002.)

Chicago Sanitary and Ship Canal (Cal-Sag) Diversion

A first order water diversion, that transfers water from the Great Lakes basin to the Mississippi River basin, exists adjacent to the City of Chicago, Illinois (Figure 4.) The diversion has an average annual flow of 3,213 cfs. The text below, provides a summary on the origins of the project.

"*Impetus for constructing the canal was brought about in the mid 1800's by a series of major typhoid outbreaks caused by sewage buildup along Chicago's Lake Michigan waterfront from where the city also drew its drinking water (Changnon and Changnon 1996). The canal, in excess of 23 ft. deep and ranging from 115 to 245 ft. wide, was designed to divert water from Lake Michigan in large enough quantities to essentially "flush" Chicago's sewage and industrial wastes away from the city and the lake, downstream into the Illinois River.*

This single engineering action greatly facilitated the potential for exchange of species between the two ecosystems. It also caused the Illinois River to become the recipient of massive quantities of domestic and industrial wastes, creating significant environmental problems for what was once an extremely productive aquatic ecosystem. Over time, as volumes of wastes generated by the growing metropolis increased, so did the amount of diversion water needed to flush them downstream. These increasing diversions not only supported waste stabilization for Chicago, but also a growing commercial navigation industry on the Illinois River. To accommodate navigation demands, the Calumet River was joined to the Chicago Sanitary and Ship Canal via the Cal-Sag Channel; and the Chicago River Locks and Controlling Works, the T.J. O'Brien Lock and Dam, and the Indiana Harbor Canal were constructed. Thus the Chicago Sanitary and Ship Canal became known as the Cal-Sag and Chicago Sanitary and Ship Canal.

Ever increasing diversions of lake water needed to meet domestic and industrial demands eventually culminated in interstate and international controversies over water rights and usage, some of which ended up in and were settled by the courts (Changnon and Changnon 1996). Others continue to this day -- one of which is the significant and far reaching effect that the canal system is beginning to play on the stability of both the Great Lakes and the Mississippi River Basin ecosystems." (Rasmussen, 2002.)

The Cal-Sag project existed for nearly a century without any form of biota transfer controls. However, in the 1990s, increasing concern over the transfer of exotic species between the Great Lakes and the Mississippi River, led to work on designing some sort of control to reduce biota transfer. A barrier was built in 2002 which passed an electrical current through the water at one location along the canal. This control is limited in function because the voltage cannot be set too high due to human safety concerns, which in turn limits the barrier's effectiveness against various sizes and types of organisms. The project has a high O&M cost of approximately $330,000, and as of today, the barrier is still running into significant funding problems, and its future is uncertain (Springfield State Journal Register, 2006.)

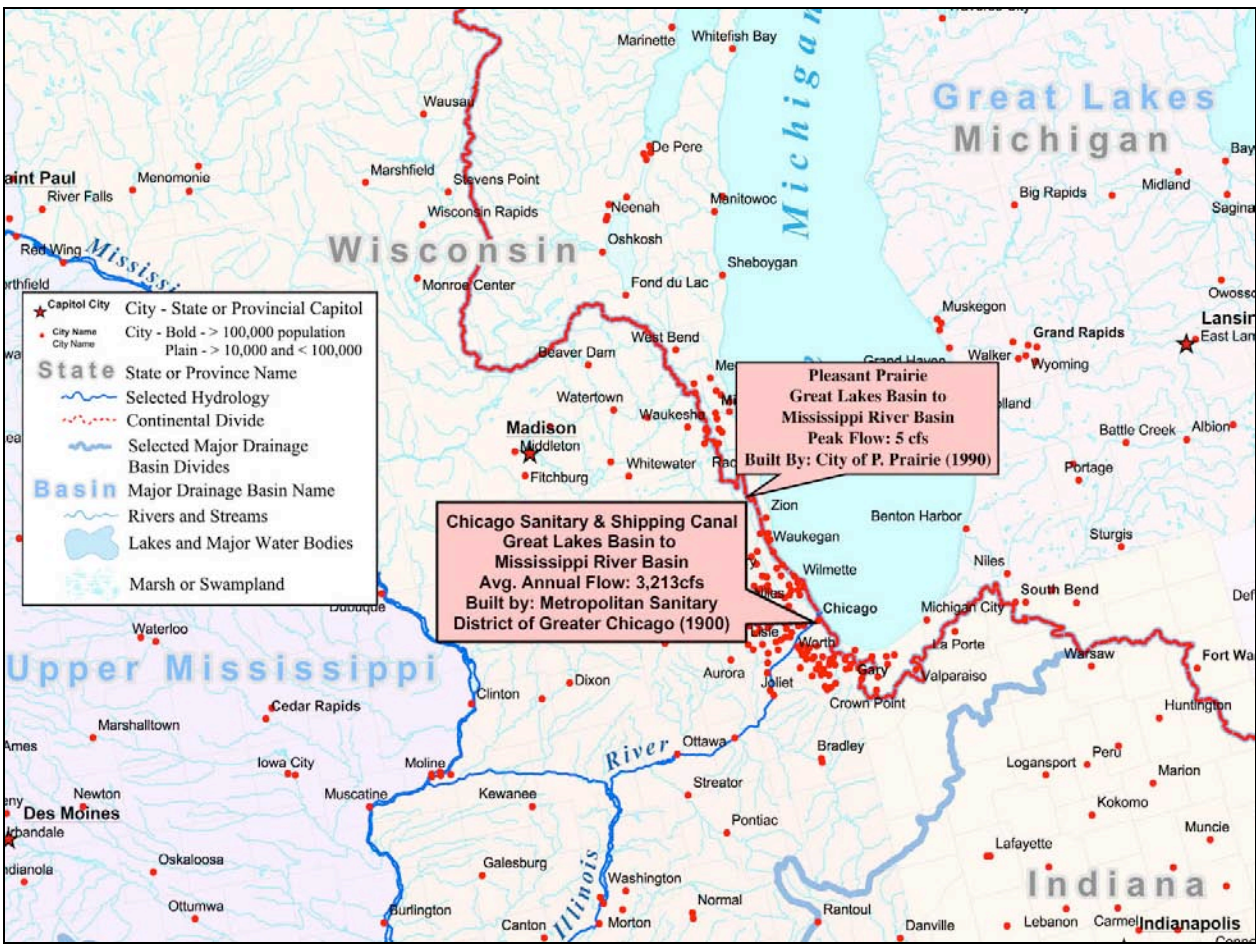

Figure 4. The Cal-Sag and Pleasant Prairie diversions.

Akron And Pleasant Prairie

There are two additional first order diversions that currently take water from the Great Lakes basin, and transfer it outside the basin. These diversions are for municipal water supply. In each of these projects, the concerns over the project were related to water being diverted from the Great Lakes, not biota transfer.

Akron, OH, diverts about 7.7 cfs from the Great Lakes diversion. The project was approved in 1997 (Figure 4) (Marsh, 1998.)

A description of the Pleasant Prairie, WI diversion is below.

"*The village of Pleasant Prairie, Wisconsin, straddles the Great Lakes and Mississippi* [**River**] *Basins* **[Figure 5]**. *Before 1990, Pleasant Prairie relied on groundwater for its water supply. In 1982, when two of the village's wells were found to be contaminated with radium at levels four times higher than federal standards, the state notified the village that it would have to correct the radium problem.24*

Although there were a number of options available to the village, including a cleanup of the radium contamination, the village decided to bring Lake Michigan water to one of the wells through a diversion that would discharge into the Mississippi River basin. According to the village's officials, "this was by far the least expensive, the fastest, and the most practical [option]."25

In December 1989, the state gave approval for the diversion of 12 mld (3.2 mgd) [**5 cfs**] *of water to a well in Pleasant Prairie serving four thousand users in three subdivisions, a mobile home park and a factory.*

*Because of concerns raised by the province of Ontario, several of the Great Lakes states and citizens' groups led by Great Lakes United, the state of Wisconsin termed the diversion a "temporary" one. The agreement between the village and the state requires Pleasant Prairie to build a pipeline to return effluent from that section of the village to Lake Michigan by 2010.**

Since the diversion began in 1990, development in the area served by the well has increased substantially. Village planners have approved several new developments, including 500- and 156-lot subdivisions." (Diversions, 1997.)

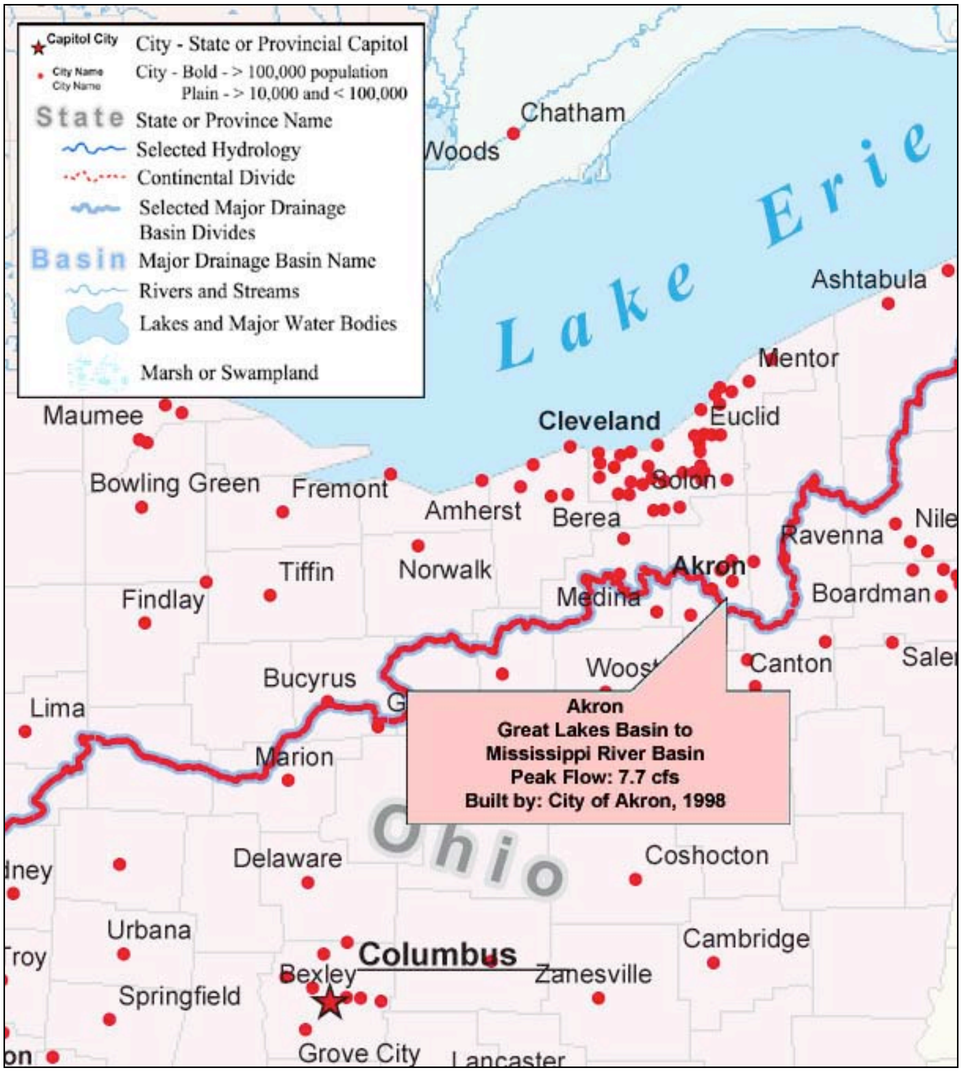

Figure 5. The Akron diversion.

Churchill River Diversion

The Churchill River project in northern Manitoba, is a second order diversion that moves water from one freshwater to another freshwater basin, and then discharges empty into the same body of saltwater. These basins were not previously connected by freshwater (Figure 6.)

The following text describes the project, which diverts water from the Churchill River basin into the Nelson River basin for hydroelectric power generation.

"*Following joint federal-provincial studies, Manitoba Hydro in February 1966 announced its intention to divert the Churchill River as part of an overall plan of northern hydro development. In December 1972, a licence to proceed with the diversion was issued to Manitoba Hydro by the Water Resources Branch of the Manitoba Department of Mines, Resources and Environmental Management. Construction contracts were awarded in 1973, and the diversion was in operation in 1977.*

The diversion plan

The diversion plan centres around Southern Indian Lake, a widening in the Churchill River. There are three main components:

1. A control dam at Missi Falls, the natural outlet of Southern Indian Lake, controls the outflow and also raises the lake level three metres.

2. An excavated channel from South Bay of Southern Indian Lake to Issett Lake creates a new outlet to allow Churchill water to flow into the Rat River-Burntwood River-Nelson River system.

3. A control dam at Notigi on the Rat River regulates the flow into the Burntwood-Nelson system.

As originally conceived, the diversion plan was to raise the level of Southern Indian Lake by 10.6 m. This "high level diversion", however, would have required that many residents of the region (including the entire community of South Indian Lake) would have to move to higher ground. Because of this, and because of environmental concerns, the plan was modified to limit the lake level rise to three metres.

Under the terms of the licence, Manitoba Hydro is permitted to divert up to 850 cubic metres per second (m3/s) [**30,013 cfs**] *from the Churchill into the Nelson. The licence also stipulates that the outflow from the control dam at Missi Falls must be at least 14 m3/s during the open water season, and 43 m3/s during the ice cover period*." (Manitoba Hydro, 2002.)

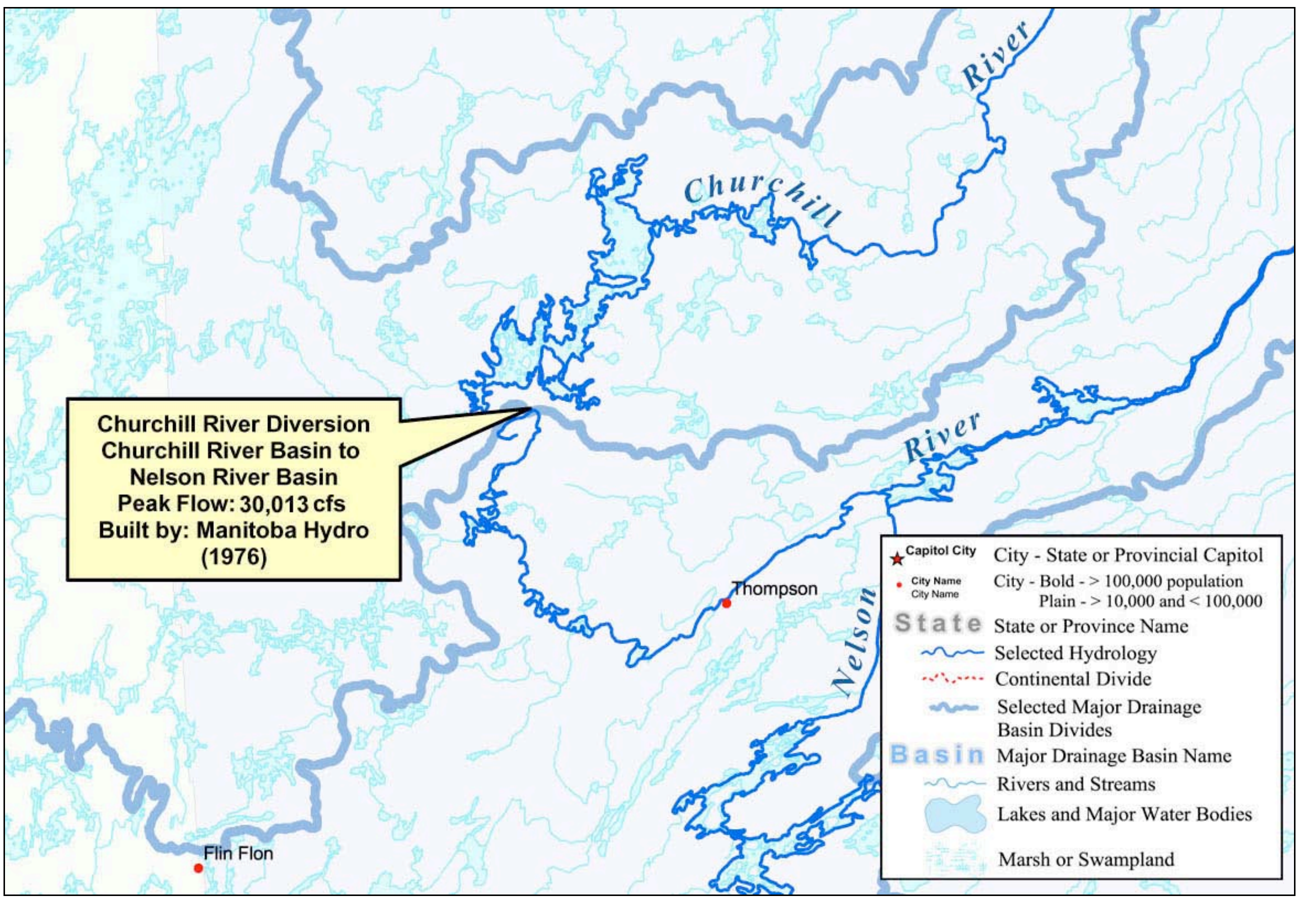

Figure 6. The Churchill River diversion.

Lake Saint Joseph

The Lake Saint Joseph project in southwestern Ontario is a second order diversion, built for the purpose of hydroelectric power generation (Figure 7.) The project, which has an annual average flow of 3,072 cfs, was completed in the 1950s by Hydro-Electric Commission of Ontario for the purpose of hydroelectric power generation, and was transferred to Ontario Power Generation in 1999. The diversion takes water from the James Bay basin, and transfers it into the Nelson River basin (Ontario Power Generation Inc., 2002.)

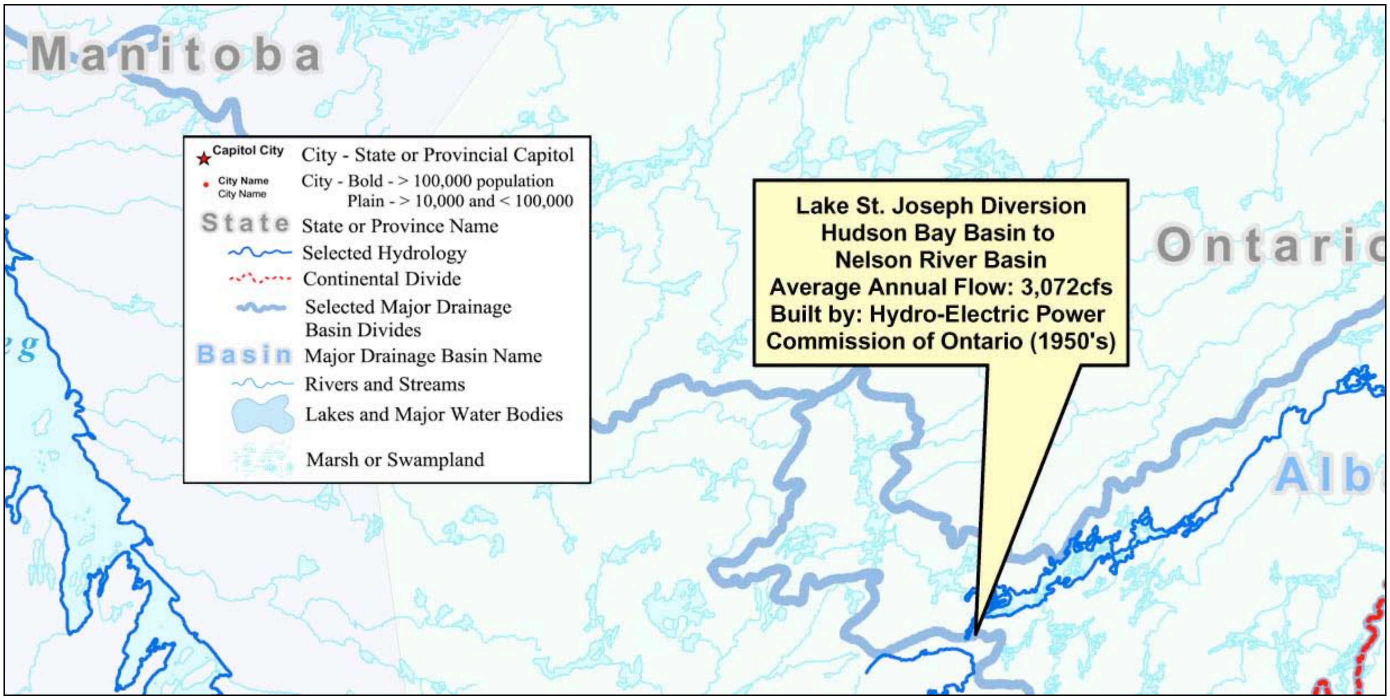

Figure 7. The Lake Saint Joseph diversion.

Discussion

In this paper we have examined several existing, first and second order water diversions in the central portion of the northern half of North America.

As the text has shown, there are a large number of water transfer projects throughout the north-central portion of North America.

In general, these projects have been in existence for a number of decades. While information on some of these projects is limited, with the exception of the Cal-Sag, biota transfer does not appear to have been a concern raised during their construction. In the case of the hydroelectric diversions, the design of such a structure seems to preclude a design that would filter out biota. In the case of diversions for water supply, water treatment may deactivate or remove any foreign organisms at water treatment sites.

Major water diversion projects, both across continental divides, and those that divert water between sub-basins of the same oceanic drainage basin, such as those projects either proposed or already built in North Dakota, are not unique. What is most striking about these projects, given the controversy over North Dakota's water projects, is how common they are throughout North America. The minimal amount of concern over biota transfer, and the fact that the construction of such projects have not ceased, as is the case for both the Akron, and Pleasant Prairie Projects, contradicts the claims of many North Dakota water diversion project opponents. Currently, another municipal water transfer project, in Waukesha County, Wisconsin, has gained approval. Clearly such projects will continue to be built in the future.

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