

# **Manitoba Hydro's Lake Sturgeon Stewardship & Enhancement Program**

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## Executive Summary

Lake Sturgeon were once abundant in Manitoba, but historical commercial harvesting, habitat changes due to hydroelectric development, and domestic harvesting have all contributed to the remaining depleted populations.

Lake Sturgeon occurs throughout almost all of Manitoba Hydro's system, and Manitoba Hydro recognizes that its operations affect Lake Sturgeon both directly and indirectly. Manitoba Hydro is committed to the recovery of Lake Sturgeon populations in Manitoba. Over the past 20 years, the corporation has completed numerous studies, activities, and initiatives related to Lake Sturgeon biology, ecology, behaviour, and recovery in Manitoba. In 2008, Manitoba Hydro developed the Lake Sturgeon Stewardship & Enhancement Program to coordinate and focus these efforts. The primary objective of the Program is to maintain and enhance Lake Sturgeon populations in areas affected by Manitoba Hydro's operations, now and in the future.

Manitoba Hydro has evaluated the effectiveness of a number of recovery actions, and the most effective actions to bring about recovery appear to be conservation stocking, habitat enhancement, and flow modification. However, the most appropriate recovery action at each location will vary and requires site-specific research, development and implementation. To this end, Manitoba Hydro is committed to an adaptive management approach that enables progress on recovery actions even in the presence of uncertainty.

Manitoba Hydro has developed clear, long-term objectives for Lake Sturgeon populations in Manitoba (e.g. providing successful spawning habitat for Lake Sturgeon downstream of Kettle GS within 25 years) that will assist in the recovery of Lake Sturgeon in Manitoba. Manitoba Hydro is making a commitment to undertake recovery actions but the cooperation and participation of government and First Nations communities will also be required.



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## **1.0 Background and Introduction**

### **1.1 Manitoba Hydro is Committed to Environmental Protection**

As a provincial crown corporation providing electric energy and natural gas service, Manitoba Hydro's mission is to provide for the continuance of a supply of power adequate for the needs of Manitoba and to promote economy and efficiency in the generation, distribution, supply and use of power. One of Manitoba Hydro's goals is to be proactive in protecting the environment and be recognized as a leader in environmental protection. Towards this goal, Manitoba Hydro is committed to planning, designing, constructing, operating and decommissioning its facilities in a manner that protects essential ecological processes and biological diversity.

### **1.2 Lake Sturgeon**

The Lake Sturgeon is Canada's largest freshwater fish, reaching lengths of over 2 m and weights of up to 140 kg. Its Canadian range extends from the St. Lawrence River in the east to the headwaters of the Nelson River in the west (i.e. the North Saskatchewan and South Saskatchewan rivers) and north to the Churchill River. In addition to its large size, Lake Sturgeon has a number of biological traits that distinguish the species from other freshwater fish, including longevity (greater than 100 years), old age at maturity (up to 25 years), and extended spawning periodicity (up to seven years).

#### **1.2.1 Population Decline**

Initially, Lake Sturgeon were considered a nuisance fish that destroyed gear set for "valuable species" (Scott and Crossman 1973), however, by the late 1880s the value of Lake Sturgeon began to rise as the desire for caviar (sturgeon eggs), isinglass (gelatin extracted from the swim bladder, used as a clarifying agent and glue) and smoked Lake Sturgeon meat increased. Commercial fisheries grew rapidly and by the mid 1900s most North American sturgeon populations had become depleted.

Historically in Manitoba, Lake Sturgeon were found in the Red-Assiniboine River drainage basin, the Winnipeg River, Lake Winnipeg, tributaries on the east side of Lake Winnipeg, the Saskatchewan River, the Churchill River, the Nelson River, and the Hayes/Gods river system. Lake Sturgeon populations in Manitoba suffered the same fate as elsewhere. Commercial fisheries were conducted in the early 1900s and populations were subject to a period of high exploitation. This period was subsequently followed by rapid population declines, and ultimately the collapse and closure of the fisheries. As fisheries in southern locations became depleted, more northern and remote locations were targeted. Although some commercial harvests continued until the 1990s, most fisheries were severely depleted by 1920. More recently, the ability of some populations to recover have been affected by habitat alterations from industrial developments and, to a lesser extent, domestic harvest by some First Nations. The decline of Lake Sturgeon populations has been described as a 'synergistic product of life history factors, exploitation, and environmental change' (Houston 1987).

### 1.2.2 Current Status

Once abundant in the Red and Assiniboine rivers, naturally reproducing populations of Lake Sturgeon are now considered extirpated upstream of the Lockport Lock and Dam and occur only incidentally in catches from Lake Winnipeg. Populations in the Saskatchewan River, Nelson River, Churchill River, tributaries to the east side of Lake Winnipeg, and parts of the Winnipeg River are substantially reduced from historical levels. However, strong self-sustaining Lake Sturgeon populations remain in a number of reaches in these systems including the Slave Falls Generating Station (GS) and Seven Sisters GS reservoirs, Round Lake (Pigeon River), the Churchill River near the confluence with the Little Churchill River, and the lower Nelson River below the Limestone GS.

The status of Lake Sturgeon was reviewed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in May 2005. In November 2006, COSEWIC initially assessed the “Western Populations” including the designated units of Western Hudson Bay (Churchill River) (DU1); Saskatchewan River (DU2); Nelson River (DU3); Red-Assiniboine-Lake Winnipeg (DU4); and the Winnipeg River-English River (DU5), as ‘Endangered’ (an endangered species is defined by COSEWIC as a wildlife species facing imminent extirpation or extinction). The only Manitoba population not assessed as “Endangered” was the Hayes River population, which was included with Southern Hudson Bay-James Bay (DU7) and assessed as “Special Concern”. In May 2007, COSEWIC finalized its assessment and in August 2007, forwarded it to the federal Minister of Environment with a request that the species be added to the *List of Wildlife Species at Risk* (Schedule 1) under the *Canada Species at Risk Act* (SARA). In November 2007, the federal Minister of Environment responded that Canada would initiate consultations with the governments of Manitoba and Ontario, Aboriginal peoples, stakeholders, and the public on whether or not populations of Lake Sturgeon (as above) should be so listed.

Lake Sturgeon has not been given any special status under the Manitoba *Species at Risk Act*. However, in the Strategy for the Management of Manitoba’s Fish Habitat (MDNR 1991), Lake Sturgeon has been designated as a “Heritage Species” due to its “unique life history characteristics, limited distribution, and economic, social and historical significance”.

### 1.3 Manitoba Hydro and Lake Sturgeon

Lake Sturgeon occur in almost all of the water bodies in Manitoba Hydro’s operating system. Manitoba Hydro recognizes the inherent importance of Lake Sturgeon; both in and of themselves and as part of the ecosystem, their importance to the people of Manitoba as a Heritage Species, and their cultural importance to First Nations. Manitoba Hydro also recognizes that its operations have the potential to negatively affect Lake Sturgeon directly and indirectly.

Manitoba Hydro is committed to conserving and enhancing Lake Sturgeon populations in Manitoba, and is undertaking several initiatives directed at this commitment. To ensure efficient and effective implementation of Lake Sturgeon programs, Manitoba Hydro has consolidated past efforts and is introducing new initiatives through the development of the Lake Sturgeon Stewardship and Enhancement Program (LSSEP). The vision of the LSSEP is “to maintain and enhance Lake Sturgeon populations in areas affected by Manitoba Hydro’s operations, now and in the future.”

Manitoba Hydro works collaboratively with regulators, First Nations, and other stakeholders on Lake Sturgeon stewardship activities. The recently updated Management Strategy for Lake Sturgeon in Manitoba (MWS 2011) provides the overall framework that Manitoba Hydro will use to guide Lake Sturgeon recovery actions and initiatives in Manitoba.

In some cases recovery groups have been established to cooperatively conduct recovery planning and actions. Manitoba Hydro participates in and supports the Nelson River Sturgeon Board (NRSB) that is concerned with Lake Sturgeon recovery in the upper Nelson River (Playgreen Lake downstream to Kelsey Generating Station) and the Saskatchewan River Sturgeon Management Board (SRSMB), concerned with the recovery of Lake Sturgeon in the Saskatchewan River from E.B. Campbell Dam in Saskatchewan downstream to Grand Rapids Generating Station in Manitoba<sup>1</sup>. These are both well established, successful organizations that have contributed to the recovery and protection of sturgeon populations through stocking programs, population monitoring, and increasing public awareness of sturgeon conservation.

The Management Strategy for Lake Sturgeon in Manitoba (MWS 2011) has been the framework for the development of a stewardship agreement for Lake Sturgeon in the lower Nelson River (Kelsey Generating Station downstream to Hudson Bay) initiated by Manitoba Hydro and the Keeyask Cree Nations. A stewardship agreement for Lake Sturgeon recovery in the lower Nelson River would be a legally binding commitment to recovery measures for Lake Sturgeon. Collaborative stewardship activities are an integral part of Manitoba Hydro's LSSEP.

## **2.0 Broad Objectives**

Through the Lake Sturgeon Stewardship & Enhancement Program, Manitoba Hydro is contributing to the collective long-term recovery goal of protecting and maintaining stable, self sustaining populations of Lake Sturgeon in Manitoba (DFO 2010a, MWS 2011). The DFO Recovery Potential Assessments (RPAs) for the Designatable Units in Manitoba specify that the goal will be to achieve healthy, viable populations of Lake Sturgeon within three generations (just over 100 years) (DFO 2010a). The long term objectives of Manitoba Hydro's Lake Sturgeon Stewardship & Enhancement Program are to:

- Ensure that the net effect of Manitoba Hydro's current activities does not contribute to a decrease in existing Lake Sturgeon abundance in Manitoba
- Operate and develop Manitoba Hydro's facilities in a manner that will not jeopardize the sustainability of Lake Sturgeon populations in Manitoba
- Promote recovery of Lake Sturgeon populations in Manitoba.

These objectives and the program activities supporting the objectives are designed to meet the performance measures outlined in section 4.1 of this document.

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<sup>1</sup> For further information the Ten-Year Management Plan of the SRSMB and the Ten Year Review of the NRSB can be found on their respective web pages at <http://www.saskriversturgeon.ca/> and <http://www.nelsonriversturgeon.ca/>.



## 3.0 Implementing Recovery Measures

### Adaptive Management Approach

Manitoba Hydro is following an adaptive management approach to the implementation of recovery measures, which will allow the corporation to proceed concurrently with recovery actions and ongoing research and evaluation (Figure 1). This approach allows for the continual improvement of protection and stewardship measures by systemically reducing uncertainties associated with Lake Sturgeon populations and improving knowledge about the effectiveness of potential recovery measures. This adaptive management approach (Figure 1) integrates six components:

- Evaluation of current status of populations and increase understanding of Lake Sturgeon ecology
- Evaluation of potential recovery actions
- Research and development of potential recovery actions
- Implementation of recovery actions
- Monitoring
- Reporting

A significant amount of site specific and general information from the first three components is required for the efficient and effective implementation of recovery actions. For example, the information gained from studies completed by Manitoba Hydro in the past is now supporting the implementation of recovery actions at various locations throughout Manitoba. There are still ongoing efforts to increase the understanding of the status and biology of current populations of Lake Sturgeon in Manitoba (Section 3.1, Appendix A-1), as well as research and development into potential recovery actions (Section 3.2, Appendix A-2). Manitoba Hydro's adaptive management approach incorporates the results from each step in the process and applies them to the other components to enhance existing information, identify information gaps, and improve current and future recovery actions. Manitoba Hydro expects that recovery actions, once implemented, will need to be monitored, evaluated, and modified to achieve maximum benefit for Lake Sturgeon populations. An example of Manitoba Hydro's adaptive management approach to the implementation of recovery actions is the Pointe du Bois Spawning Habitat Enhancement Trial (Section 3.3), which integrates research and recovery actions.

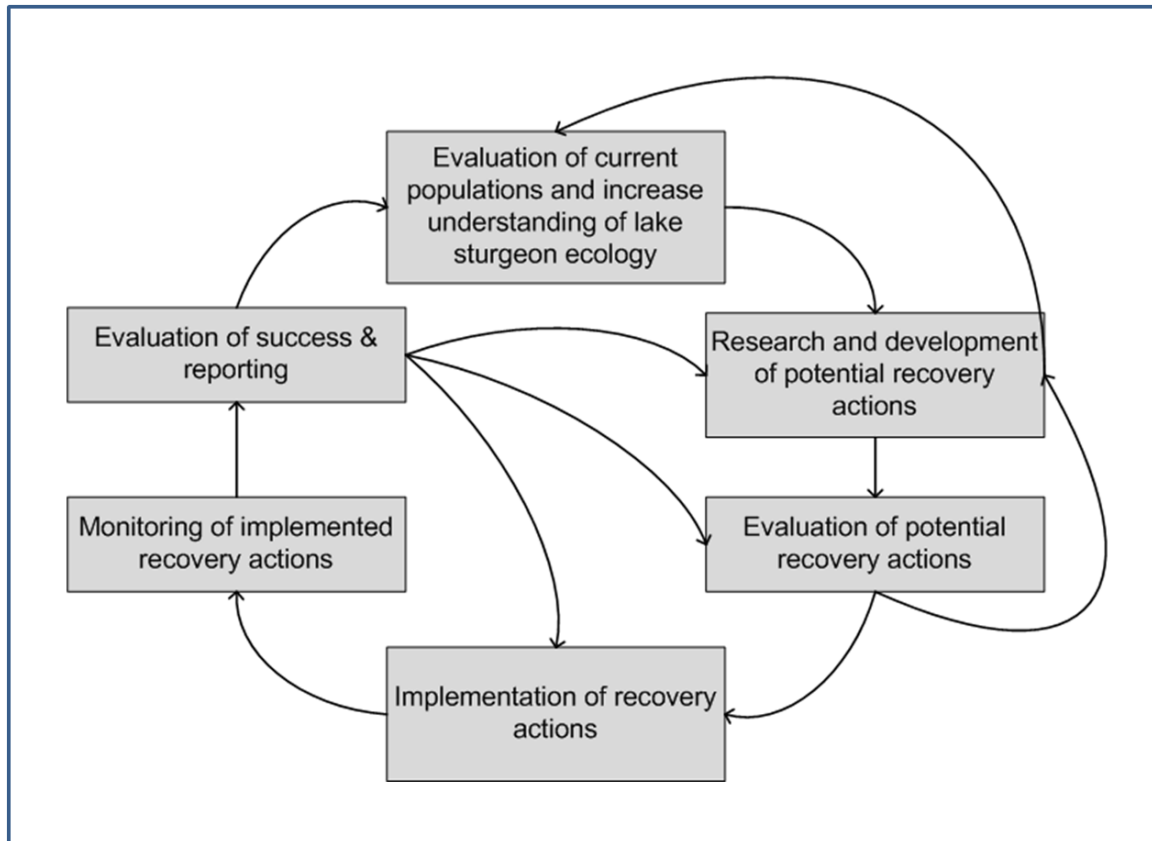


Figure 1: Manitoba Hydro's adaptive management approach to the implementation of recovery actions to contribute to the recovery of Lake Sturgeon populations in Manitoba.

### 3.1 Evaluation of Current Status of Populations and Increase Understanding of Lake Sturgeon Ecology

Evaluation of current Lake Sturgeon populations provides a foundation of information from which potential recovery actions can be identified and prioritized, evaluated, developed and implemented. This assessment involves an evaluation of populations, available habitat, and spawning adults in each reach of river being considered, as well as developing a greater understanding of Lake Sturgeon ecology.

#### 3.1.1 Population Inventories

Population studies examine abundance, age structure, health and condition of Lake Sturgeon, which can be used to identify potential limiting factors for the population. For example, the presence of juveniles is an indicator that successful spawning has occurred in the recent past. Manitoba Hydro has completed numerous studies on populations in reaches of the Winnipeg River, Nelson River, Churchill River, Saskatchewan River and the Assiniboine River (Appendix A-1). These studies have made a significant contribution towards understanding the current status of Lake Sturgeon populations throughout the province.

### **3.1.2 Habitat Assessment**

Habitat assessments evaluate the availability of habitats that are required by Lake Sturgeon at different life stages, and can be used to identify specific habitat types that may be absent or lacking and therefore limiting the population in a particular reach of river. This information can then be used to identify specific opportunities for recovery actions. Manitoba Hydro has completed habitat assessments in reaches of the Winnipeg River, Nelson River, Churchill River, and the Saskatchewan River, and has also funded Lake Sturgeon ecology research. These studies have considerably improved our appreciation of Lake Sturgeon habitat requirements in various parts of the province (Appendix A-2).

### **3.1.3 Spawning and Juvenile Studies**

The availability of spawning habitat and spawning adult Lake Sturgeon are essential for a sustainable population. Manitoba Hydro has gained considerable information on spawning locations of Lake Sturgeon, and is developing an understanding of the spawning habitat requirements for Lake Sturgeon in Manitoba through the development of a Habitat Suitability Index (HSI) model and assessments of spawning habitat.

The HSI model was developed from scientific literature and data on Lake Sturgeon egg deposition collected at the Pointe du Bois Generating Station from 2007 to 2010. The model uses Lake Sturgeon egg deposition data with physical (substrate, distance from a barrier) and hydraulic information (velocity, water depth, flow direction) to refine suitability criteria and develop suitability indices to create an overall HSI. The development of this model, and the data collection associated with its development, has advanced the understanding of Lake Sturgeon spawning habitat requirements in Manitoba.

Manitoba Hydro has also completed assessments of spawning habitat and the presence of spawning Lake Sturgeon in reaches of the Winnipeg, Nelson, Churchill, and Saskatchewan rivers (Appendix A-1), and has funded research to further the understanding of Lake Sturgeon spawning habitat requirements (Appendix A-2, Hrenchuk 2011).

Research funded by Manitoba Hydro has also enhanced the understanding of juvenile Lake Sturgeon ecology and habitat in large rivers (Appendix A-2, Barth et al 2009, Barth 2011). The presence of juvenile Lake Sturgeon in a river provides evidence that successful spawning (or stocking) has recently occurred, and that suitable juvenile habitat is available. Studies on juvenile abundance and habitat have been completed on the Nelson River, Hayes River, Winnipeg River, and Assiniboine River (Appendix A-1).

### **3.1.4 Movement, Harvest, and other Studies**

Manitoba Hydro has examined the movement of Lake Sturgeon in large rivers, including studies in the Nelson, Saskatchewan and Winnipeg rivers, and has also funded research to examine movements of Lake Sturgeon at small and large scales (Appendix A-1, A-2). Domestic harvest of Lake Sturgeon increases the mortality of sturgeon, a threat to the recovery of Lake Sturgeon in Manitoba that has been identified in DFO's Recovery Potential Assessments (DFO 2010a, DFO 2010b). Manitoba Hydro has worked with the Nelson River Sturgeon Management Board and the Saskatchewan River Sturgeon

Management Board to estimate the domestic harvest in some reaches of the Nelson and Saskatchewan rivers.

Manitoba Hydro has also supported traditional knowledge studies in the upper and lower Nelson River areas, which have provided information on, among other things, historical spawning locations (Appendix A-1). The corporation has also funded ecological research to improve the overall understanding of Lake Sturgeon ecology in Manitoba, including juvenile habitat and ecology, movement and habitat use of adult Lake Sturgeon, and the behaviour and ecology of sub-adult Lake Sturgeon.

### **3.1.5 *Importance of Information***

Over the past 20 years, Manitoba Hydro has gathered a considerable amount of information that has made a significant contribution to the current understanding of populations, habitat, spawning behaviour, juvenile ecology, movement and general Lake Sturgeon ecology in Manitoba. Although earlier studies were largely completed to support Manitoba Hydro projects, many of the studies completed since 2008 have been focused to address particular issues, and/or particular locations within Manitoba Hydro's operating system. The collection of information from rivers throughout the province provides a solid foundation on which Manitoba Hydro, Manitoba Conservation and Water Stewardship and Fisheries and Oceans Canada can identify, prioritize, develop, and implement potential recovery actions.

## **3.2 *Potential Recovery Actions***

Potential recovery actions must be evaluated and prioritized based on efficacy, technical feasibility and economic feasibility. Potential recovery actions that Manitoba Hydro could undertake, that may provide the greatest contribution to Lake Sturgeon recovery in Manitoba include conservation stocking, creation of spawning habitat, and flow modification. Each of these is outlined in the sections below.

### **3.2.1 *Conservation Stocking***

Commercial fishing severely depleted Lake Sturgeon populations throughout Manitoba prior to habitat changes that resulted from hydroelectric development. Because they are slow to mature, and have a low spawning periodicity, Lake Sturgeon populations are particularly vulnerable to overfishing and the natural recovery of a severely depleted population may be slow or even impossible. In some areas of Manitoba, low populations of Lake Sturgeon may not spawn successfully even with suitable habitat, because of the reduced likelihood of locating other spawning Lake Sturgeon. Conservation stocking has been successful in supplementing existing populations and reintroducing/establishing self sustaining populations of Lake Sturgeon in other regions, most notably Wisconsin and Michigan (Smith 2009). In some locations, conservation stocking may be the only effective option for recovering Lake Sturgeon populations (DFO 2010b).

This measure is technically feasible to implement, as Manitoba Hydro has already partnered with Manitoba Conservation and Water Stewardship, the Nelson River Sturgeon Co-management Board, and the Saskatchewan River Sturgeon Management Board to collect spawn, incubate eggs, hatch, and rear Lake Sturgeon and then stock fingerlings and yearlings into the Nelson, Saskatchewan, and Assiniboine rivers. The

rearing and research required for these stocking efforts is made possible because of Manitoba Hydro's ownership and maintenance of the Grand Rapids Hatchery. In addition, research initiatives supported by Manitoba Hydro have investigated the success of stocking Lake Sturgeon in the Winnipeg River. Since the success of conservation stocking in the recovery of Lake Sturgeon has been observed elsewhere, the potential contribution of stocking towards the protection and maintenance of healthy, viable Lake Sturgeon populations in Manitoba is high. The economic feasibility of conservation stocking is high relative to other mitigation measures.

### **3.2.2 Creation of Spawning Habitat**

Hydroelectric facilities are commonly developed at rapids or falls on a river due to the change in river bed elevation. These are also the types of habitats in which Lake Sturgeon are known to spawn. The development of hydroelectric facilities has changed and/or reduced available spawning habitat at a number of locations in Manitoba. However, there is potential to improve the conditions downstream of generating stations to provide suitable habitat for Lake Sturgeon spawning. Through the completion of numerous spawning studies and habitat assessments (Appendix A-1), Manitoba Hydro has gained a greater understanding of the habitat requirements of spawning Lake Sturgeon, particularly habitat use in the Nelson and Winnipeg rivers. This knowledge can now be used to identify areas downstream of generating stations that have suitable depth and velocity but may lack suitable substrate or flow diversity. These areas provide an opportunity for habitat improvement by altering substrate composition or through the addition of large boulders that result in more turbulent flow. It is hypothesized that Lake Sturgeon may cue into fast water that is immediately next to slow water, that allows them to rest and recover. These factors, along with information being collected from the Spawning Enhancement Trial at the Pointe du Bois Generating Station (Appendix A-2), are being incorporated into the development of a methodology for creating spawning habitat downstream of generating stations.

An additional difficulty with the creation of spawning habitat is that in many locations the number of adult spawning Lake Sturgeon may be insufficient to result in successful recruitment. In reaches with severely depleted Lake Sturgeon populations, the first priority would be to stock Lake Sturgeon, and then to provide the spawning habitat before the stocked Lake Sturgeon reach maturity. Adaptive management would be used to ensure that created spawning habitat is suitable and is being used successfully by spawning Lake Sturgeon. This involves a long term commitment to monitoring and completing improvements to the habitat if necessary, based on the results of the monitoring. The economic feasibility of constructing spawning shoals is moderate but any work conducted in remote locations will be expensive.

### **3.2.3 Augmentation and/or Manipulation of Flow**

Augmentation of flow is the provision of additional flow at specific times of the year, and manipulation of flow refers to the operation of specific generating units or spill gates to provide more favorable conditions for Lake Sturgeon at specific times of the year. Augmentation and/or manipulation of flow could mitigate some of the changes in habitat (such as decreased benthic production) that may result from fluctuations in water levels and flows downstream of hydroelectric peaking facilities. However, manipulating or

augmenting flow at one facility may require alterations in flow at other facilities and is limited by water power licenses.

In many reaches, Lake Sturgeon recovery is limited by the low number of spawning adults and habitat may not be a limiting factor. Augmenting or manipulating flow in these reaches would have little effect in bringing about the recovery of Lake Sturgeon. In reaches of river within Manitoba Hydro's operating system where habitat may be one of the factors limiting the recovery of the Lake Sturgeon population, augmentation or manipulation of flow could contribute to Lake Sturgeon recovery. In some locations, augmentation and/or manipulation of flow would be of particular benefit if it is combined with the creation of spawning habitat. Although this measure has the potential to incur high operational costs to Manitoba Hydro, augmentation and/or manipulation of flows will be considered at facilities where it would provide measurable benefit to Lake Sturgeon populations and is operationally feasible.

### ***3.2.4 Upstream Passage, Downstream Passage, and Fish Exclusion***

The development of hydroelectric generating stations in Manitoba has created impassable barriers that, depending on the location, may or may not have been passable to Lake Sturgeon prior to development. The need for upstream and/or downstream passage should be separately evaluated at each hydroelectric facility, since site specific conditions determine whether passage has the potential to be biologically beneficial (or detrimental) to upstream and downstream populations of Lake Sturgeon. There are studies that suggest Lake Sturgeon require a long reach of unrestricted river (Auer 1996); however, there is also evidence to show that if the habitat required to support all life stages is available in an impounded reach, a healthy self sustaining population of Lake Sturgeon can persist. This is clearly demonstrated by the healthy population of Lake Sturgeon that thrives in a small (8 km) impounded reach of the Winnipeg River, between the Pointe du Bois and Slave Falls generating stations (DFO 2010a).

Providing passage is important in reaches where it may not be possible to provide the habitat required by all life stages of Lake Sturgeon and where the upstream reach could provide the lacking habitat type. There may also be some support for providing passage for genetic purposes, so that Lake Sturgeon from a downstream reach may occasionally move and spawn with an upstream population. If the need for genetic variation is the primary purpose for providing passage at a particular site, Manitoba Hydro is open to considering the implementation of an active fish transport program to enable some fish to move upstream to spawn.

Many uncertainties and risks persist with the provision of passive passage mechanisms. There has been a general lack of success in passing Lake Sturgeon over high head obstructions, and there are uncertainties about how to attract Lake Sturgeon to the entrance of a passage structure. Providing passage also creates the potential for an ecological trap by moving Lake Sturgeon from suitable habitat, past an obstruction, into an environment that may be less suitable than the habitat from which they originated. If Lake Sturgeon then move back downstream, they may risk injury or mortality if they are unable to find the passage structure and instead pass over the spillway or through the powerhouse.

Fish passage is an expensive mitigation measure that has considerable uncertainty, and in many locations would have questionable benefit to Lake Sturgeon populations. In locations where providing passage may be deemed to have significant benefit to Lake Sturgeon populations upstream and/or downstream of a hydroelectric facility, Manitoba Hydro is willing to consider the development and implementation of passive and/or active passage mechanisms.

### **3.2.5 *Prioritization of Recovery Actions***

To efficiently contribute to the protection and maintenance of healthy, viable populations of Lake Sturgeon in Manitoba, it is necessary for Manitoba Hydro to prioritize potential recovery action options and then focus efforts accordingly. Manitoba Hydro has identified conservation stocking and the creation of spawning habitat as the most effective methods for the corporation to implement that would contribute to the protection and maintenance of sturgeon populations in Manitoba. Manitoba Hydro may also consider augmenting and/or manipulating flow, and other recovery actions such as upstream and downstream passage that, with additional information, are deemed to have significant benefits to Lake Sturgeon populations. The evaluation of potential recovery options will be revised as new information becomes available from population and habitat assessments and the identification of factors that may be limiting recovery.

## **3.3 *Research and Development of Potential Recovery Actions***

There are relatively few examples of mitigation and/or compensation measures that have been implemented specifically for Lake Sturgeon. Even where recovery actions have been successful elsewhere, they need to be adapted for each specific location in Manitoba. This is why the site specific information on populations and habitats outlined in Section 3.1 is so important to the implementation of these actions (Section 3.1). Some of the potential recovery actions currently being assessed for use by Manitoba Hydro are outlined below.

### **3.3.1 *Conservation Stocking***

Conservation stocking has been successfully conducted in other regions, including Wisconsin and Michigan (Smith 2009), and in the Management Strategy for Lake Sturgeon in Manitoba (MWS 2011) has been identified as an effective recovery tool for depleted populations. Conservation stocking requires the collection of sperm and eggs from wild broodstock, after which the eggs will be fertilized, incubated, and reared in a hatchery, then released at a fall fingerling or yearling stage. Rearing Lake Sturgeon in a hatchery increases the survival of young Lake Sturgeon through critical life stages in which Lake Sturgeon normally experience high mortality rates. Manitoba Hydro recognizes conservation stocking as one of the most effective methods of bringing about Lake Sturgeon recovery, particularly at locations where populations are significantly depleted. To effectively implement this measure, Manitoba Hydro has addressed, and continues to address issues and uncertainties related to conservation stocking including genetics, disease risk, egg/sperm collection techniques, culture techniques, and survival of stocked Lake Sturgeon (Appendix A-2). Recent examples include:

- Development of Lake Sturgeon rearing experience and expertise at Manitoba Hydro's Grand Rapids Hatchery, in a partnership with Manitoba Conservation and Water Stewardship.
- Funding experimental research on Lake Sturgeon rearing methods (Klassen and Peake 2007, Klassen and Peake 2008).
- Funding a two year study (2011-2012) at the University of Manitoba on the long term and short term effects of using hormone injection (Ovaprim™) on adult spawning sturgeon to improve the efficiency of egg collection. The effects of Ovaprim™ on Lake Sturgeon and the potential effects of human consumption of Lake Sturgeon after they are injected are not well understood and will be addressed through this research.
- Funding a four year research study (2011-2014) at DFO's Freshwater Institute to address disease risks for Manitoba Lake Sturgeon and through identification and development of tests for unclassified pathogens observed in Lake Sturgeon at the Grand Rapids Hatchery. The study will also examine the occurrence of disease in wild populations and develop a management strategy for disease in hatchery reared fish.

### **3.3.2 Creation of Spawning Habitat**

The development of hydroelectric facilities has resulted in changes to Lake Sturgeon habitat at a number of locations in Manitoba. Rehabilitation of habitat, including the enhancement of spawning habitat has been identified by DFO as an important measure for population recovery (DFO 2010a, DFO 2010b). Lake Sturgeon spawning habitat has been successfully created in other areas such as the Detroit River and Rivière-des-Prairie (QC), but in river conditions that are very different from the Winnipeg and Nelson rivers (Boase et al 2010, Hydro Quebec 2011). To ensure effective implementation of this recovery action, Manitoba Hydro has funded and directed a number of studies to examine the specific spawning requirements of Lake Sturgeon and to develop methods for creating spawning habitat downstream of hydroelectric facilities in Manitoba (Appendix A-2). Recent examples include:

- Completion of the Pointe du Bois spawning habitat enhancement trial. As part of this trial, a single spawning shoal was initially constructed downstream of the generating station in 2009 to take advantage of the suitable velocity and depth in the tailrace of the Pointe du Bois Generating Station. Further monitoring during the 2009 spawning season revealed that Lake Sturgeon were spawning very close to the generating station. So, when three more shoals were constructed in 2010, they were placed as close as possible to the generating station. This study is providing important information about Lake Sturgeon spawning and the creation of suitable habitat, which will be relevant for improving habitat at new and existing hydroelectric facilities. Although this is an experimental trial, the study demonstrates the adaptive management approach that Manitoba Hydro is taking to implement recovery actions.
- Development of a Habitat Suitability Index model for Lake Sturgeon spawning habitat from primary scientific literature and field data collected from the Winnipeg River. The model will be improved as more data on spawning habitat are collected, and can be applied to new locations to evaluate the suitability of habitat for Lake Sturgeon spawning. The model could also help to identify areas with appropriate depth and velocity, in which the substrate could be altered to improve habitat.



### **3.3.3 Augmentation/Manipulation of Flow**

Augmentation and/or manipulation of flow could contribute to the recovery of Lake Sturgeon populations in some locations in Manitoba, particularly when completed in conjunction with the creation of spawning habitat. Manitoba Hydro has directed internal studies and external research to investigate opportunities and examine the feasibility of improving habitat through augmentation or manipulation of flow (Appendix A-2), including:

- Internal investigations into the economic feasibility of augmenting or manipulating flow at some existing facilities.
- Funding a research project downstream of Seven Sisters Generating Station on the Winnipeg River to investigate the influences of water velocity and hydropower operations on spawning site choice and recruitment success of Lake Sturgeon (Hrenchuk 2011). The results of this study have identified that there may be opportunities for improving habitat downstream of Seven Sisters Generating Station on the Winnipeg River.

### **3.3.4 Upstream Passage, Downstream Passage, and Fish Exclusion**

Hydroelectric development results in the fragmentation of riverine habitat. Unfortunately, there are limited examples of successful Lake Sturgeon passage, and no existing examples of successful Lake Sturgeon passage over high head obstructions. Significant uncertainties exist with respect to the provision of passage, including designing successful passage for Lake Sturgeon, the potential benefits and risks to upstream and downstream populations of Lake Sturgeon, and even uncertainty whether historical passage was possible at locations where hydroelectric development has occurred.

The need for upstream and/or downstream passage must be evaluated at each hydroelectric facility, since site specific conditions determine whether passage has the potential to be biologically beneficial (or detrimental) to upstream and downstream populations of Lake Sturgeon. Manitoba Hydro has funded research, and completed review studies on the provision of passage for Lake Sturgeon, and has also funded research on fish exclusion at hydroelectric facilities (Appendix A-2). Recent examples include:

- Funding a three year research project (2009-2011) on the protection of Lake Sturgeon immediately upstream of hydropower facilities in Manitoba. The objectives of the study are to investigate the occurrence of sturgeon moving downstream past a hydroelectric facility, the likelihood of sturgeon encountering the upstream side of a dam, and of the potential for using underwater light as a behavioural deterrent.
- Completion of a small number of Lake Sturgeon transfer and tracking studies to evaluate the effectiveness of a 'trap and transport' method of moving fish past a barrier to address the need to provide genetic transfer between river reaches.
- Completion of a review of fish protection measures at intakes, and an evaluation of the feasibility, conceptual design, and the likelihood of success associated with engineered and natural structures for upstream and downstream passage of Lake Sturgeon at new hydroelectric facilities in Manitoba.

## **3.4 Implementation of Recovery Actions**

The effective implementation of recovery actions requires significant preliminary research including an understanding of the populations and habitat required (and available) and the development of techniques and methods for implementing the proposed recovery actions. The sections below provide an overview of recovery actions currently being implemented at Manitoba Hydro's existing facilities and those that are proposed for future generating stations.

### **3.4.1 Implementation of Recovery Actions at Existing Facilities**

#### **Pointe du Bois Spillway Replacement Project**

The general arrangement for the Pointe du Bois Spillway Replacement project was selected based on a number of criteria, including Lake Sturgeon habitat. The selected location of the primary spillway discharge channel will provide a dispersed and turbulent flow pattern over existing Lake Sturgeon spawning habitat, such that the changes in the suitability of the Lake Sturgeon spawning habitat will be minimized. A Lake Sturgeon spawning monitoring and adaptive management program will be implemented during construction and operation. Spillway flow velocities and Lake Sturgeon spawning success will be monitored for any effects of the project on Lake Sturgeon spawning success. Any reduction in Lake Sturgeon spawning success during spill events as a result of changed flow pattern below the spillway rapids will be mitigated through an adaptive habitat enhancement approach.

#### **Nelson River from Kettle GS to Long Spruce GS**

The review of existing facilities has identified a number of locations where the creation of spawning habitat, conservation stocking, and flow modifications may assist in the recovery of Lake Sturgeon populations. The reach of the Nelson River from Kettle GS to Long Spruce GS has a depleted population of Lake Sturgeon. Spawning habitat may be limited in this reach, but the recovery of the population is also likely limited by the very low numbers of Lake Sturgeon. Manitoba Hydro has decided to focus on this reach because it has greater habitat diversity than other reaches with low populations of Lake Sturgeon. Manitoba Hydro plans to evaluate the spawning adult population, examine the juvenile population, and complete a detailed habitat assessment immediately downstream of Kettle GS. If an evaluation of the spawning population and juvenile population indicates it is an appropriate measure, and would be beneficial, Manitoba Hydro will initiate a stocking program in this reach to supplement the population. The results of the habitat assessment will be used to develop plans/designs to improve and/or create spawning habitat immediately downstream of Kettle GS. A long-term monitoring program will be conducted to evaluate success of the constructed spawning habitat and stocking efforts.

#### **Winnipeg River at Seven Sisters GS**

Research funded by Manitoba Hydro has determined that Lake Sturgeon spawn downstream of the Seven Sisters Generating Station powerhouse and spillway (Hrenchuk 2011). Although more monitoring is required, the results suggest that in low flow years, Lake Sturgeon are attracted into the area of higher flow in the powerhouse tailrace. In contrast, in years of higher flow, Lake Sturgeon appear to spawn downstream of both the powerhouse and spillway. Lake Sturgeon are spawning successfully downstream of the powerhouse, but seem to have lower hatch success. In higher flow

years, when the station is spilling, Lake Sturgeon spawn in the spillway, and seem to have higher hatch success. The hatch success could be related to water velocity and/or substrate. A number of methods are being evaluated to determine whether the spawning habitat can be improved downstream of the powerhouse and/or spillway.

### **Jenpeg GS Fish Salvage Program**

Fish salvage procedures were developed and implemented at Jenpeg GS to minimize the impact of dewatering on fish during re-running. During dewatering procedures, depending on the design of the unit, there is a possibility that fish could become stranded. The procedures outline planning considerations as well as actions that should be taken to meet Manitoba Conservation and Water Stewardship's Fisheries Management Objectives and to ensure compliance with the *Fisheries Act*. The Lake Sturgeon population is severely depleted near Jenpeg GS, and no Lake Sturgeon have been observed during re-running. Manitoba Hydro has asked MWS to review the procedures, and will also report information on the fish salvage to MWS and DFO. Manitoba Hydro is adopting a similar approach to unit dewatering at other facilities, and is incorporating special considerations for priority species such as Lake Sturgeon.

### **3.4.2 Implementation of Mitigation and/or Compensation at Future Facilities**

The Keeyask GS planned for the lower Nelson River includes specific mitigation and compensation measures for Lake Sturgeon. The mitigation measures are targeting the provision of habitat suitable to meet all life history functions both upstream and downstream of the generating station. The proposed measures include:

- Construction of 3 hectares of Lake Sturgeon spawning habitat in the tailrace of the generating station to compensate for the loss of spawning habitat in Gull Rapids, the site of the generating station. The structures would be located in flows that are expected to attract spawning Lake Sturgeon and would be designed to have suitable depth, velocity, substrate and turbulent flow patterns. It is based on successful structures built in similar river environments in Quebec.
- An adaptive management plan for the modification of existing spawning habitat at Birthday Rapids, which will be mostly submerged in the new reservoir. Post-impoundment, the absence of turbulent flow may result in Lake Sturgeon no longer using this area to spawn, and proposed measures would create localized turbulent flow in areas of suitable depth, velocity and substrate.
- Provision for the creation of young-of-the-year habitat within the reservoir. Current research indicates that sandy substrates in deep, low velocity areas of the river channel provide optimal young-of-the-year habitat. Areas currently used will no longer be suitable following reservoir creation, so sand may be placed in an area of river channel if monitoring indicates that young-of-the-year Lake Sturgeon are not surviving on the substrate present after impoundment.

In addition to the mitigation measures described above, a stocking program is being developed to supplement the Lake Sturgeon population within the Keeyask reservoir, in Stephens Lake and at off-site locations on the Nelson River and the Burntwood River (immediately upstream of Split Lake). The program in the Keeyask reservoir is intended to supplement the Lake Sturgeon population within the reservoir, to increase the existing population, and maintain numbers in the event that natural recruitment is reduced in the initial post-impoundment period; the program at Stephens Lake is intended to re-

establish a viable population in that lake; and the program at off-site locations on the Nelson River and the Burntwood River is intended to restore populations that have been historically depleted, such that available habitat in these areas can support a larger population than currently exists. Such conservation stocking programs to rehabilitate depleted populations are consistent with the management actions and priorities identified in the Management Strategy for Lake Sturgeon in Manitoba (MWS 2011).

The implementation of these mitigation measures is expected to increase the regional population of Lake Sturgeon.

For Keeyask, proposed mitigation measures are targeting the provision of habitat suitable to meet all life history functions both upstream and downstream of the generating station. After extensive study in this area there does not appear to be any concerted migrations of Lake Sturgeon over Gull Rapids in the existing environment and, as such, the provision of fish passage at the generating station is likely not required to maintain fish populations. However, the merits and drawbacks of the provision of upstream and downstream passage past the generating station are currently being considered.

In addition to the above, there are several measures included in the design of the station to reduce the injury and mortality of Lake Sturgeon and other fish species that pass downstream via the turbines or the spillway. The spacing between the trashracks at the water intakes to the station will exclude large adult Lake Sturgeon, and water velocity past the trashracks is not sufficient to trap adult Lake Sturgeon on the trashracks themselves. The turbines have been designed to include several features to decrease the incidence of injury and mortality to fish. Stranding of fish following spillway operation will be mitigated through the construction of channels linking pools left after spillway operation ceases to the downstream river channel. As well, the design of the spillway does not include a plunge pool or baffle blocks, which can cause fish injury and mortality.

The mitigation and compensation measures that will be implemented with the potential development of Conawapa Generating Station are still under development, but will focus on providing habitat for all life stages of Lake Sturgeon upstream and downstream of the generating station.

### **3.5 Monitoring**

All recovery actions implemented by Manitoba Hydro will have a monitoring and reporting program that is designed to evaluate the success of a specific action on the recovery of Lake Sturgeon. The monitoring program will be used to evaluate and potentially improve the implemented recovery action (Figure 1).

### **3.6 Reporting**

Manitoba Hydro will prepare annual reports on the Lake Sturgeon Stewardship & Enhancement Program. The reports will include a summary of activities, study results, evaluation of implemented actions and possible improvements, opportunities for future recovery actions and/or studies. The reports will be available to MWS, DFO, and the general public. Manitoba Hydro would welcome MWS and DFO to comment on and discuss the activities of the LSSEP on an annual basis.

Manitoba Hydro will conduct a review of the program every five years to evaluate the progress being made on meeting the objectives of the program (Section 4.0). These five year evaluations will be shared with MWS, DFO, and will be available to the general public, to provide an additional opportunity for input into the program.

### **3.7 Public Education**

To effectively implement recovery of Lake Sturgeon, it is important to inform the general public and stakeholders of the current status of populations and the measures that are being taken to recover the populations. Manitoba Hydro has worked with the Nelson River Sturgeon Management Board (NRSB) and the Saskatchewan River Sturgeon Management Board (SRSMB) on several initiatives to increase public awareness of the depleted Lake Sturgeon populations and the recovery actions that are underway (Appendix A-3). The NRSB has an ongoing program to support school classrooms to keep Lake Sturgeon in aquariums, to educate school-age children about Lake Sturgeon and Lake Sturgeon conservation. Manitoba Hydro has assisted both Lake Sturgeon management boards in the development of promotional materials such as brochures and displays, as well as the development of websites to inform the public of the boards' activities and progress (Appendix A-3).

Manitoba Hydro is also working with the Keeyask Cree Nations to develop a Lower Nelson River Sturgeon Stewardship Agreement that would see the creation of a Lower Nelson River Sturgeon Stewardship Committee. One of the primary functions of this Committee would be the development and implementation of a public awareness campaign around the protection and enhancement of Lake Sturgeon in the Lower Nelson River. It is anticipated that the agreement will be signed and the Committee functioning by the spring of 2012.

## **4.0 Manitoba Hydro's Lake Sturgeon Recovery Plan**

### **4.1 Performance Measures**

Manitoba Hydro has developed five performance measures towards which future recovery actions will be focused. These performance measures support the management goals outlined in the Manitoba Conservation and Water Stewardship Management Strategy for Lake Sturgeon in Manitoba (MWS 2011). Although Manitoba Hydro will implement actions towards achieving these performance measures, there are other factors beyond the authority and control of Manitoba Hydro, so the successful completion of these goals will also depend on cooperation and actions by other agencies including Manitoba Conservation and Water Stewardship, Fisheries & Oceans Canada, and First Nations.

These performance measures have been developed as a means to evaluate the long term success of recovery actions implemented by Manitoba Hydro (Appendix B). Manitoba Hydro's progress on these recovery actions will be evaluated in the five year reviews of the Lake Sturgeon Stewardship & Enhancement Program. These performance measures include:

1. Within five years, have baseline information on Lake Sturgeon populations and habitat throughout waterways that are within Manitoba Hydro's system.
  - Over the next five years, Manitoba Hydro will strive to complete studies in the reaches of rivers within the Manitoba Hydro operating system where Lake Sturgeon populations and habitat have not yet been evaluated.
2. Within 15 years, through cooperative efforts with regulators and First Nations, ensure long term sustainability of the Lake Sturgeon population in the Churchill River.
  - Where possible, Manitoba Hydro will work with First Nations and with sturgeon management boards to provide education and promote sustainable harvesting. Manitoba Hydro is currently working with Tataskweyak Cree Nation and eventually, other interested parties to develop a Churchill River Lake Sturgeon stewardship agreement.
  - Manitoba Hydro will strive to improve habitat on the Churchill River through habitat modification if it is deemed to be feasible.
3. Within 20 years, increase the Lake Sturgeon population in the upper Nelson River through conservation stocking and harvest reduction.
  - Lake Sturgeon conservation stocking and harvest reduction has been occurring and will continue through the efforts of the Nelson River Sturgeon Management Board. Recent adoption of new techniques may allow for a more efficient stocking program.
4. Within 25 years, spawning habitat will be improved/created at suitable locations in the Nelson and Winnipeg rivers.
  - At the present time, Manitoba Hydro does not have sufficient information to know where it may be appropriate to improve or create habitat that would be suitable for Lake Sturgeon spawning. Manitoba Hydro will collect information that will permit this evaluation and is committed to improving spawning habitat downstream of existing facilities.
5. Within 25 years of the initiation of a stocking program, Lake Sturgeon will be spawning successfully downstream of Kettle GS.
  - The population of Lake Sturgeon in this reach is depleted, so Manitoba Hydro may first implement a conservation stocking program to support the establishment of a sustainable population. After a stocking program is established, suitable spawning habitat will be designed/constructed immediately downstream of Kettle GS. Manitoba Hydro will use an adaptive management approach to monitor and improve the habitat so that it is suitable for Lake Sturgeon spawning.
6. Within 30 years, Lake Sturgeon population trends in the lower Nelson River will be increasing, primarily through conservation stocking efforts, habitat enhancement and harvest reduction.
  - Although there are many factors to be considered, including the feasibility of using wild broodstock, Manitoba Hydro plans to expand conservation stocking into reaches of the lower Nelson River where stocks are severely depleted. There are also factors such as domestic harvest that remain beyond the control of Manitoba Hydro and would require support from government agencies and First Nations communities. To ensure long-term cooperative recovery efforts Manitoba Hydro is working towards a legally binding Stewardship Agreement with regulators and First Nations to detail commitments to recovery actions, timelines and funding for the lower Nelson River.

The actions that Manitoba Hydro undertakes over the next 25 years to bring about Lake Sturgeon recovery in Manitoba will contribute to the collective achievement of these five performance measures (Appendix B).

## 4.2 Immediate Future (1-3 years)

Manitoba Hydro has identified specific objectives for the next three years that will contribute to the achievement of the performance measures and the goal of protecting and maintaining stable, self sustaining populations of Lake Sturgeon in Manitoba (DFO 2010a, MWS 2011).. The specific objectives listed below focus on creating spawning habitat and conservation stocking, since these are initiatives that Manitoba Hydro could undertake that would make the greatest contribution to protecting and maintaining healthy Lake Sturgeon populations in Manitoba.

### Spawning Habitat

- Refine the understanding of spawning site choice and environmental variables that affect the suitability of habitat for spawning and obtain a more thorough understanding of movement and habitat use in adults, by funding academic research on Lake Sturgeon spawning and behaviour.
- Improve the ability to create spawning habitat downstream of hydroelectric generating stations, by monitoring the shoals that were constructed immediately downstream of the Pointe du Bois Generating Station in a habitat enhancement trial. Monitoring the shoals for spawning Lake Sturgeon under varying flow conditions will provide an evaluation of the success of the constructed spawning habitat and may identify improvements for future designs.
- Improve the understanding of Lake Sturgeon spawning habitat by completing studies on the Winnipeg River that will determine whether Lake Sturgeon are spawning at suspected and/or historical spawning locations.
- Collect detailed habitat information immediately downstream of Kettle GS that will be necessary to develop a design for spawning habitat enhancement.

### Conservation Stocking

- Improve the ability to collect spawn from Lake Sturgeon for the purposes of conservation stocking, by funding academic research on the long and short term effects of hormone injection (Ovaprim™) in Lake Sturgeon. The use of hormones to improve spawn collection may be necessary for an effective conservation stocking program, and this research will improve the understanding of the risks and benefits of using hormones (Ovaprim™) to induce spawning.
- Address the disease risks for Manitoba Lake Sturgeon by funding academic research to develop and use diagnostic tests to identify the agent(s) causing infectious disease in Lake Sturgeon, define the disease interrelationships within and amongst populations, and evaluate the impact of infectious disease(s) on Lake Sturgeon conservation aquaculture.
- Continue stocking initiatives and develop Lake Sturgeon culture expertise by investing in the maintenance and improvement of infrastructure (Manitoba Hydro's Grand Rapids Hatchery) necessary to support Lake Sturgeon culture programs.

- Evaluate the success of past stocking efforts and provide information on the survival of stocked Lake Sturgeon, by examining populations in the Assiniboine River and the Nelson River (Sea Falls to Pipestone Lake) where stocking efforts have been focused in the past.

#### Other Studies

- Examine issues related to downstream passage of Lake Sturgeon by funding academic research to determine whether downstream passage by Lake Sturgeon is common or rare, determine the survivability of passage, evaluate the likelihood of Lake Sturgeon encountering the upstream side of a dam, and evaluate the effectiveness of using underwater lighting to deter Lake Sturgeon from areas of higher risk.
- Examine the potential technical feasibility, economic feasibility, and the potential contribution to the recovery of Lake Sturgeon of augmentation and/or manipulation of flow at two facilities (Seven Sisters GS and Kettle GS) in the Manitoba Hydro system.
- Assess the implications of flow on Lake Sturgeon access into the Little Churchill River and associated habitat characteristics, in a study that will be completed with Tataskweyak Cree Nation.

### 4.3 Near Future (4-5 years)

The studies and research that will be completed over the next three years will be used to support future implementation of recovery actions. The timing and priorities of recovery action implementation may change based on the results of the preceeding studies. Manitoba Hydro is currently planning on completing these studies and actions within the next four to five years:

#### Spawning Habitat

- Develop designs for enhancing spawning habitat downstream of Kettle GS.
- Implement seasonal flow modifications at a generating station on the Winnipeg River on a trial basis to improve habitat, and examine any effects on reproductive success.
- Evaluate and prioritize other sites where habitat enhancement would be likely to contribute to recovery, and collect information that would be necessary to develop a design for habitat enhancement.

#### Conservation Stocking

- Stock Lake Sturgeon between Kettle GS and Long Spruce GS.
- Evaluate whether it would be beneficial to genetic diversity of populations to move 1-2 adult sturgeon from below generating stations to above in order to facilitate upstream gene flow; implement if determined to be desirable.

#### Ecology

- Develop a greater understanding of larval and juvenile Lake Sturgeon ecology (e.g. larval drift, vulnerability to predation, survival after stocking, habitat requirements, creation of juvenile habitat).



#### 4.4 Long term (>5 years)

The activities that Manitoba Hydro is planning for more than five years from now will largely depend on the results of the studies and initiatives listed above, and will be revised and further developed as we learn more about potential recovery actions and the status of current populations. The activities and initiatives below will build on the information and evaluations completed within the next five years, and will therefore be subject to change and revision:

##### Spawning Habitat

- Construct habitat enhancement downstream of Kettle GS, within 15 years of the initiation of stocking in this reach of the Nelson River, to ensure that stocked Lake Sturgeon have suitable habitat to spawn successfully.

##### Conservation Stocking

- Continue stocking in the Nelson River from Kettle GS to Long Spruce GS.
- Explore other locations within the Nelson River where conservation stocking would contribute to the recovery of Lake Sturgeon and begin stocking if sufficient broodstock is available.

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Appendix A-1: Summary of population and habitat studies and activities completed by Manitoba Hydro to support the recovery of Lake Sturgeon in Manitoba.

Activity	Waterbodies	Year(s)	Partici- pants	Objectives	Relevance for Sturgeon Recovery
<b>Nelson River - below Kelsey GS</b>					
Population and Habitat Studies	Split Lake (including Burntwood and Grass rivers), Clarke Lake, Gull Lake, Stephens Lake, Long Spruce Forebay, Limestone Forebay, Lower Nelson River, Angling Lake	1986-2010	FLCN, CNP, YFFN, MFB, consultants	Collect information on relative abundance, size and condition, population estimates, movements, and identify important habitats (spawning, nursery)	These studies have made a significant contribution to our current understanding of populations and habitat in the Nelson River, and have also made significant contributions in understanding Lake Sturgeon ecology in Manitoba. These studies provide a foundation of information that will be used to identify, develop, and implement mitigation and compensation measures.
Spawning Studies	Limestone GS, Lower Limestone Rapids, Angling River, Weir River, Split Lake, Gull Lake	1988-2010	YFFN, CNP, FLCN, consultants	Characterize the spawning populations and habitats	These studies have evaluated the abundance of spawning sturgeon and identified known and suspected spawning locations. These results will help to identify, develop and implement mitigation and/or compensation measures. The characterization of the known spawning habitat has contributed to the understanding of spawning habitat requirements for sturgeon.
Juvenile Studies	Split Lake (including the Burntwood and Grass rivers and Clark Lake), Gull Lake, Stephens Lake (including the base of Gull Rapids), Long Spruce Forebay, Limestone Forebay, Lower Nelson River below Limestone GS	2006-2010	consultants, YFFN, CNP, FLCN	Collect information on juvenile relative abundance, habitat preferences, size and condition data	Evaluating the presence/abundance of juveniles provides an indication that adults are spawning successfully, and appropriate juvenile habitat is available. Previous to this work (and research funded by MH), juvenile habitat was not well understood in large rivers. This work has made significant contributions to our understanding of juvenile sturgeon habitat requirements. This information will be critical to recovery planning and the development/ implementation of future habitat enhancements.

Activity	Waterbodies	Year(s)	Partici- pants	Objectives	Relevance for Sturgeon Recovery
Movement Studies	Clark Lake to Stephens Lake Radio and Acoustic Telemetry, Limestone Forebay and Lower Nelson River Acoustic and Radio telemetry	1986-2009, 2011	MFB, consultants, FLCN, CNP, YFFN	Collect information on spawning habitats, movement patterns (including movements over Birthday and Gull Rapids), and increase our understanding of adult and juvenile habitat preferences	Studying the movement of sturgeon in this reach has determined that most sturgeon reside in a fairly small home range. Although several Lake Sturgeon moved through Gull Rapids, these observations were not during the spawning season, and may have been incidental or due to foraging. These studies have not produced evidence to suggest that Lake Sturgeon in Stephens Lake migrate past Gull Rapids to spawn. These studies suggest that provision of passage may not be necessary or beneficial for the sustainability of the downstream or upstream populations of Lake Sturgeon.
TK Studies	Lower Nelson River	2007	FLCN	Record traditional knowledge and cultural importance of sturgeon to FLCN	These traditional knowledge studies have provided information on Lake Sturgeon populations and habitat that will be useful in planning mitigation and compensation measures, and will contribute to a general understanding of the species and populations in the Nelson River.
<b>Nelson River - above Kelsey GS</b>					
Population and Habitat Studies	Cross Lake to Kelsey GS	1993-2011	NRSB	Determine relative abundance, size and condition, habitat preferences and generate a population estimate	The NRSB has completed many studies on populations and habitat on the Nelson River upstream of the Kelsey GS, which have made substantial contributions to the understanding of Lake Sturgeon in this reach. These studies have helped to evaluate the recovery potential and provide a foundation for identification, development and implementation of recovery actions.
Population and Habitat Studies	Nelson River from Sea Falls to Pipestone Lake	2011	consultants	Determine the relative abundance and population structure of Lake Sturgeon to examine the success of 10 years of sturgeon stocking by NRSB (postponed to 2012 due to high flow conditions)	This study will provide information on Lake Sturgeon population and habitat in an area where little is known about the sturgeon population. The abundance of sturgeon will give some indication of the success of the conservation stocking efforts of the NRSB, which will be relevant to future stocking programs.

<b>Activity</b>	<b>Waterbodies</b>	<b>Year(s)</b>	<b>Partici- pants</b>	<b>Objectives</b>	<b>Relevance for Sturgeon Recovery</b>
Spawning Studies	Landing River	1993-1997	NRSB	Characterize the spawning population, size and condition, and evaluate habitat	These spawning studies identified the presence and abundance of spawning sturgeon in the Landing River area. This information helped to plan conservation stocking efforts undertaken by the NRSB.
Spawning Studies	Playgreen Lake	1995	consultant	Document historical and potential Lake Sturgeon spawning habitat	Knowledge of historical spawning habitats will help to understand habitat required for spawning, and to identify areas that could be used (or enhanced to be made suitable) for spawning in the future.
Movement Studies	Sipiwesk Lake to Kelsey GS Radio Telemetry		NRSB	Delineate populations and determine habitat preferences	Determining the extent to which Lake Sturgeon move within a river will help to determine the normal home range of a Lake Sturgeon, and to assess the habitat types used by Lake Sturgeon.
Harvest Studies	Landing River, Bear Island, Cross Lake	1993-1997	NRSB, UM/NRI	Generate a domestic harvest estimate, for consideration in stock management	Domestic harvest, on a depleted sturgeon population is a threat to the recovery of Lake Sturgeon. Determining the level of harvest (and the level of the threat) is critical for effective recovery planning for sturgeon, and may be used in the future in the management of domestic harvest.
TK Studies	Sipiwesk Lake to Split Lake – Wabowden/Thicket Portage/Pikwitonei	1997	NRSB/UM/NRI	Assemble historical documents and record traditional knowledge, collect information on the commercial fishery, and increase public awareness	Quantification of the commercial harvest will be useful in describing the populations prior to/during commercial harvest, and therefore provide a greater understanding of the impact of commercial harvest on Lake Sturgeon populations.
TK Studies	Cross Lake	1998-2002	UM/NRI	Record traditional knowledge, increase public awareness	These traditional knowledge studies have provided information on Lake Sturgeon populations and habitat that will be useful in planning mitigation and compensation measures, and will contribute to a general understanding of the species and populations in the Nelson River.
<b>Churchill River</b>					

<b>Activity</b>	<b>Waterbodies</b>	<b>Year(s)</b>	<b>Partici- pants</b>	<b>Objectives</b>	<b>Relevance for Sturgeon Recovery</b>
Population and Habitat Studies	Churchill River near mouth of L. Churchill	2003, 2010	CNP, consultants	Determine relative abundance, size and condition, habitat preferences and generate a population estimate	These studies have provided information on populations and habitat in the Churchill River near the mouth of the Little Churchill, an area that has not been well studied. Information gained from these studies may be used to identify, develop, and implement recovery actions.
Population and Habitat Studies	Churchill River from Missi Falls CS to the confluence with the Little Churchill River	2010	consultants	Determine relative abundance, size and condition	This population inventory will contribute to the evaluation of recovery potential and provide a foundation for identification, development and implementation of recovery actions.
Spawning Studies	Churchill River near the Little Churchill River	2011	TCN	Determine where Lake Sturgeon are spawning in the Churchill/Little Churchill River area, and to describe habitat in the general area of the confluence	This study has identified that successful sturgeon spawning is occurring in the Little Churchill River. This information as well as the habitat information from this study will guide future recovery actions in the region.
<b>Hayes River</b>					
Population and Habitat Studies	Lower Hayes River, Fox River (Rainbow Falls)	2004-2007	YFFN, CNP, FLCN, consultants	Determine relative abundance, habitat preferences, movements, population characteristics, identify important habitats, and generate a population estimate.	These studies have provided information on Lake Sturgeon populations and habitat in the Hayes River, an area where Lake Sturgeon have not been well studied. Information from the Hayes River may provide a valuable comparison for other populations in Manitoba, as it is an unregulated, undeveloped river.
Juvenile Studies	Hayes River mouth	2005, 2006, 2008	consultants, YFFN, CNP, FLCN	Determine the relative number of juveniles, collect size and condition data, and characterize juvenile habitat	Evaluating the presence/abundance of juveniles provides an indication that adults are spawning successfully, and appropriate juvenile habitat is available. Completing this study on the unregulated/undeveloped Hayes River provides a comparison for studies completed on the Nelson River.
<b>Lake Winnipeg-East side tributaries</b>					
Population and Habitat Studies	Round Lake/Pigeon River Inventory	1997-1998	UM	Determine relative abundance, size and condition, habitat preferences and generate a population estimate	The population inventory and habitat assessment was completed in an area that had not previously been studied. This study contributed to the evaluation of recovery potential and provide a foundation for identification, development and implementation of recovery actions.

Activity	Waterbodies	Year(s)	Partici- pants	Objectives	Relevance for Sturgeon Recovery
<b>Winnipeg River</b>					
Population and Habitat Studies	Pointe Du Bois Forebay/Eaglenest Lake Inventory, Pointe du Bois /Slave Falls Reservoir Inventory, Below Slave Falls	2006-2010	consultants	Determine relative abundance, population characteristics, habitat preferences and generate a population estimate.	The extensive amount of work completed on Lake Sturgeon populations, habitat, movement, and general ecology on the Winnipeg River has provided valuable information with which we can identify, develop, and implement recovery actions in these and other regions.
Population and Habitat Studies	Winnipeg River from McArthur GS to Pine Falls GS	2010	consultants	Determine relative abundance, population characteristics, habitat preferences, assess the habitat available	This study provides information on Lake Sturgeon and habitat in the Winnipeg River in two reaches which have not previously been studied.
Spawning Studies	Lamprey Rapids, Pointe du Bois GS, Slave Falls GS	2005-2010	consultants	Characterize the spawning populations and habitats	These spawning studies evaluated the presence and abundance of spawning sturgeon, which can help to focus efforts to improve spawning habitat. Characterizing the spawning habitat in this reach of the Winnipeg River will help to define the habitat requirements for spawning sturgeon.
Spawning Studies	Winnipeg River from McArthur to Pine Falls	2011	consultants	Evaluate spawning between McArthur GS and Pine Falls GS to determine whether successful spawning is occurring	This reach of the Winnipeg River has not been well studied. This study has increased our knowledge of sturgeon populations in these reaches, and has contributed to our understanding of habitat requirements for spawning sturgeon..
Spawning Studies	Pointe du Bois	2006-2010	consultants	Develop a habitat suitability index (HSI) model for Lake Sturgeon, using site specific measurements of known spawning habitat to supplement measurements from the literature.	The development and application of this model has resulted in significant advancement in understanding habitat characteristics that are suitable and optimal for Lake Sturgeon spawning in Manitoba.
Juvenile Studies	Pointe du Bois to Slave Falls, Slave Falls to Seven Sisters, Numao Lake, McArthur to Great Falls	1998, 2005-2009, 2011	consultants	Determine relative abundance (juveniles), size and condition characterize juvenile habitat, and understand habitat preferences	These studies on the Winnipeg River have contributed to our overall understanding of juvenile sturgeon and their habitat requirements.

<b>Activity</b>	<b>Waterbodies</b>	<b>Year(s)</b>	<b>Partici- pants</b>	<b>Objectives</b>	<b>Relevance for Sturgeon Recovery</b>
Movement Studies	Pointe du Bois to Slave Falls, Slave Falls to Seven Sisters, Numao Lake, Seven Sisters	1998, 2006-2009	consultants	Determine movement patterns/home ranges and habitat preferences	Determining the extent to which Lake Sturgeon move within a river has helped to determine the normal home range of a Lake Sturgeon, and to assess the habitat types used by Lake Sturgeon.
<b>Assiniboine River</b>					
Population and Habitat Studies	Assiniboine River near Brandon	2011	consultants	Determine relative abundance and population structure 15 years after stocking by the province (study delayed to 2012 due to high flow conditions)	This study will provide information on Lake Sturgeon population and habitat in an area that has not recently been studied. The abundance of Lake Sturgeon will provide an indication of the survival of Lake Sturgeon stocked by the province of Manitoba in 1995, and will be relevant to future stocking programs.
Juvenile Studies	Assiniboine River	2005-2006	UM	To determine habitat preferences of juvenile sturgeon	This study was initiated to evaluate the presence of juveniles and to describe juvenile habitat, which would have provided an indication as to the success of sturgeon stocked in 1995. This study was not completed due to field sampling difficulties and personal concerns of the student undertaking the project.
<b>Saskatchewan River</b>					
Population and Habitat Studies	Saskatchewan River - MB Border to The Pas	1996-2010	SRSMB	Determine relative abundance, size and condition, habitat preferences and generate a population estimate	The ongoing population inventories allow us to observe trends in the population. These studies contribute to the evaluation of recovery potential and provide a foundation for identification, development and implementation of recovery actions.
Spawning Studies	Big Stone Rapids to Summerberry River	2000	SRSMB, consultants	Locate spawning habitat and determine relative number of spawning sturgeon	This study described spawning habitat and examined the abundance of spawning sturgeon, which will help to identify, develop and implement recovery actions.
Movement Studies	Saskatchewan River – EB Campbell Dam to Grand Rapids Dam - Radio Telemetry	1994-1997	SRSMB	Develop greater understanding of habitat preferences and movements	This study provided greater understanding of habitat preferences, and the degree to which sturgeon move in the Saskatchewan River.



Activity	Waterbodies	Year(s)	Partici- pants	Objectives	Relevance for Sturgeon Recovery
Harvest Studies	Saskatchewan River – MB Border to The Pas	2001, 2002	SRSMB	Generate an estimate of domestic harvest	Evaluating (and monitoring) the level of harvest (and therefore level of a potential threat to recovery) is critical for effective recovery planning for sturgeon, and may be used in the future in the management of domestic harvest.

FLCN: Fox Lake Cree Nation, CNP: Cree Nation Partners, YFFN: York Factory First Nation, MFB: Manitoba Fisheries Board, NRSB: Nelson River Sturgeon Management Board, UM/NRI: University of Manitoba/Natural Resources Institute, SRSMB: Saskatchewan River Sturgeon Management Board

Appendix A-2: Summary of research and development activities and studies completed by Manitoba Hydro to support the recovery of Lake Sturgeon in Manitoba.

Activity	Waterbodies	Year(s)	Participants	Objectives	Relevance for Sturgeon Recovery
<b>Nelson River - below Kelsey GS</b>					
Sturgeon Stocking and Culture	Transfer and Tracking of Adult Sturgeon in the Long Spruce Forebay	1987	consultants, FLCN, CNP, YFFN	Investigate the habitat use and movement of Lake Sturgeon following a transfer between reaches of the Nelson River	This study further developed the understanding of behaviour/movement of a sturgeon after transplant into new reach of river. This study is relevant for a potential future recovery action of relocating sturgeon from an area of abundance to an area of low abundance to supplement a lower population.
Genetic Studies	Split Lake to Kettle GS, Kettle GS to Weir R	2006, 2009	consultants, YFFN, FLCN, CNP, Laval University	Genetically delineate populations of Lake Sturgeon	Information on the genetic relatedness of Lake Sturgeon from different rivers/regions will assist in selecting appropriate broodstock for stocking. Genetic results can also help to identify the extent of historical movement of Lake Sturgeon.
Investigation of Fish Passage Options	Future development	ongoing	consultants	Investigate methods of providing fish passage	Various fish passage technologies and examples are being evaluated for potential use at future developments
Investigations of Mitigation Options	Future development	ongoing	consultants	Investigate and develop designs for mitigation and compensation measures	Mitigation and compensation measures will ensure that sufficient quantity and quality of habitat for all life stages of Lake Sturgeon exist upstream and downstream of new facilities. These ongoing studies are developing methods to ensure that these habitats will be provided.
<b>Nelson River - above Kelsey GS</b>					
Sturgeon Stocking and Culture	Sturgeon Culture at the Silas Ross Memorial Sturgeon Rearing Facility		NRSB	Produce sturgeon for stocking, increase expertise in rearing Lake Sturgeon, develop methods for efficient culture ('grow-out') of sturgeon and increase public awareness of Lake Sturgeon	This program has established procedures for initiating and operating a satellite grow-out facility for Lake Sturgeon that are incubated and hatched at Grand Rapids Hatchery. This expertise and method development will be applicable for future stocking programs that will be an important component of Lake Sturgeon recovery.

<b>Activity</b>	<b>Waterbodies</b>	<b>Year(s)</b>	<b>Participants</b>	<b>Objectives</b>	<b>Relevance for Sturgeon Recovery</b>
Sturgeon Stocking and Culture	Sturgeon Stocking in the upper Nelson River	1998-2010	NRSB, MFB	Stock Lake Sturgeon fry, fingerlings, and juveniles into the upper Nelson River	Developed expertise in collecting eggs and sperm from Lake Sturgeon, rearing Lake Sturgeon (GRH), and have stocked sturgeon into the upper Nelson River over the past 15 years . The survival of the stocked sturgeon are unknown but the relative abundance of sturgeon will be assessed in 2012.
Genetic Studies	Landing River area			Genetically delineate populations of Lake Sturgeon	Information on the genetic relatedness of Lake Sturgeon from different rivers/regions will assist in selecting appropriate broodstock for stocking. Genetic results can also help to identify the extent of historical movement of Lake Sturgeon.
<b>Churchill River</b>					
Genetic Studies	Churchill River	2009	consultants, Laval University	Genetically delineate populations of Lake Sturgeon	Information on the genetic relatedness of Lake Sturgeon from different rivers/regions will assist in selecting appropriate broodstock for stocking. Genetic results can also help to identify the extent of historical movement of Lake Sturgeon.
<b>Hayes River</b>					
Genetic Studies	Lower Hayes River	2006	consultants, YFFN, FLCN, CNP, Laval University	Genetically delineate populations of Lake Sturgeon	Information on the genetic relatedness of Lake Sturgeon from different rivers/regions will assist in selecting appropriate broodstock for stocking. Genetic results can also help to identify the extent of historical movement of Lake Sturgeon.
<b>Lake Winnipeg-East side tributaries</b>					
Population and Habitat Studies	Round Lake/Pigeon River Inventory	1997-1998	UM	Determine relative abundance, size and condition, habitat preferences and generate a population estimate	This population inventory and habitat assessment was completed in an area that had not previously been studied, adding to the breadth of information available on Lake Sturgeon populations in Manitoba.
<b>Winnipeg River</b>					

Activity	Waterbodies	Year(s)	Participants	Objectives	Relevance for Sturgeon Recovery
Sturgeon Stocking and Culture	Winnipeg River	1996-2005	MFB, UM, UNB	Supplement the existing populations in the Winnipeg River and develop expertise in sturgeon culture.	The existing population of Lake Sturgeon in the Winnipeg River was supplemented through stocking of hatchery reared Lake Sturgeon. These studies have made a significant contribution to the knowledge and experience of culturing and stocking sturgeon that will be relevant to future conservation stocking programs.
Genetic Studies				Genetically delineate populations of Lake Sturgeon	Information on the genetic relatedness of Lake Sturgeon from different rivers/regions will assist in selecting appropriate broodstock for stocking. Genetic results can also help to identify the extent of historical movement of Lake Sturgeon.
Investigations of Mitigation Options	Winnipeg River at Pointe du Bois (Habitat Enhancement Trial)	2009-2011 (ongoing)	consultants	Develop methods for creating suitable Lake Sturgeon spawning habitat downstream of the powerhouse of a hydroelectric generating station	The results of this study will be applied to the development of spawning habitat creation/improvement immediately downstream of future and/or existing facilities. As the shoals are monitored under different flow conditions in the future, the ongoing studies will develop a greater understanding of the habitat variables important for sturgeon during spawning.
Research	Winnipeg River-long and short term effects of injecting sturgeon with Ovaprim	2011-2012	UM	Evaluate the long term and short term effects of injecting sturgeon with hormones to improve spawn collection.	This research will greatly reduce some of the uncertainties with respect to the safety of using Ovaprim on sturgeon that may be consumed by people. Ovaprim increases the probability of successful spawn collection from sturgeon and is considered necessary for a successful stocking program on the Nelson River due to the low numbers of broodstock.
Research	An evaluation of current strategies to mitigate the impact of hydroelectric activity on Lake Sturgeon	2005-2009	UNB	Develop further understanding of Lake Sturgeon ecology in large rivers that are impacted by hydroelectric development	This research has provided significant advances in our understanding of sturgeon ecology in large rivers, including habitat preferences, behaviour, and general ecology of juvenile, subadult, and adult Lake Sturgeon. This research has formed a strong foundation of information on which to develop recovery actions. This research has also contributed to the development of culture and stocking methods.

<b>Activity</b>	<b>Waterbodies</b>	<b>Year(s)</b>	<b>Parti- pants</b>	<b>Objectives</b>	<b>Relevance for Sturgeon Recovery</b>
Research	Sturgeon spawning habitat	2007-2013	UNB	Evaluate spawning habitat requirements and variables that spawning sturgeon may select for, as well as factors that may affect hatching success.	These studies have identified potential recovery actions, and have also contributed to our understanding of the habitat required for successful hatch, and the selection of spawning sites by Lake Sturgeon.
Research	Protection of Lake Sturgeon immediately upstream of hydropower facilities in Manitoba	2009-2012	UNB	Investigate downstream movement of sturgeon past a generating station and examine underwater lighting as a potential behavioural deterrent.	This research has provided valuable information on general sturgeon movement as well as specific information on sturgeon movement past a generating station. This information will be relevant for future discussions on the need for sturgeon passage at existing facilities.
<b>Assiniboine River</b>					
Sturgeon Stocking and Culture	Assiniboine River at Brandon	1996-2006	MFB	Re-establish sturgeon populations in the Assiniboine River by stocking fry, fingerlings, and juveniles.	This stocking effort has successfully reintroduced Lake Sturgeon to an area where they had previously been extirpated. Juvenile sturgeon are now being caught by anglers in the Assiniboine and Red rivers and commercial fishermen in Lake Manitoba and Lake Winnipeg. Relative abundance, as well as size and condition data will be collected in 2012.
<b>Saskatchewan River</b>					
Sturgeon Stocking and Culture	Saskatchewan River at The Pas	2003	SRSMB, MFB	Supplement the existing Lake Sturgeon population in the Saskatchewan River by stocking sturgeon	This program developed expertise in Lake Sturgeon spawn collection, rearing Lake Sturgeon, and stocking. Survival rate of the stocked sturgeon is unknown at this time.
Sturgeon Stocking and Culture	Grand Rapids Hatchery	1996-2002	MFB	Develop methods for the efficient culture of Lake Sturgeon, including the production of larvae and juveniles	The culture program at Grand Rapids Hatchery has been developing methods for culturing sturgeon on an ongoing basis, which will be crucial to any future stocking programs implemented for Lake Sturgeon recovery in Manitoba.
Genetic Studies	EB Campbell to Grand Rapids reach			Genetically delineate populations of Lake Sturgeon	Information on the genetic relatedness of Lake Sturgeon from different rivers/regions will assist in selecting appropriate broodstock for stocking. Genetic results can also help to identify the extent of historical movement of Lake Sturgeon.

Activity	Waterbodies	Year(s)	Partici- pants	Objectives	Relevance for Sturgeon Recovery
<b>Manitoba</b>					
Research	Addressing disease risk in Lake Sturgeon	2011-2014	DFO, UM	Develop and use diagnostic tests to identify the aetiological agent(s) causing infectious disease in Manitoba Lake Sturgeon; define the disease interrelationships within and amongst Manitoba Lake Sturgeon populations; and evaluate the impact of identified infectious diseases(s) on Manitoba Lake Sturgeon conservation aquaculture	Conservation stocking is a very useful compensation tool for Lake Sturgeon. However, recent problems with disease at the Grand Rapids Hatchery have caused high mortality, and considerable uncertainty with releasing potentially diseased sturgeon into a population in which the disease prevalence is unknown. These issues must be addressed to efficiently culture sturgeon, and also to understand and evaluate potential risk to wild populations.
Sturgeon Stocking and Culture	Grand Rapids Hatchery	2009-2013	(no partners)	Maintain and repair infrastructure at the Grand Rapids Hatchery	Maintaining the Grand Rapids Hatchery infrastructure is necessary for the continued use of the facility for the purposes of Lake Sturgeon stocking

FLCN: Fox Lake Cree Nation, CNP: Cree Nation Partners, YFFN: York Factory, NRSB: Nelson River Sturgeon Management Board, MFB: Manitoba Fisheries Board, UM: University of Manitoba, UNB: University of New Brunswick, SRSMB: Saskatchewan River Sturgeon Management Board,

Appendix A-3: Public awareness programs and activities completed by Manitoba Hydro to support the recovery of Lake Sturgeon in Manitoba.

<b>Public Awareness Activity</b>	<b>Year(s)</b>	<b>Objectives/Outcome</b>
Lake Sturgeon aquarium displays in Manitoba Hydro offices in Winnipeg and Thompson	2005-2011	Increase public awareness and interest in Lake Sturgeon and Lake Sturgeon conservation.
Feature entitled "Safeguarding the Sturgeon" on the Manitoba Hydro website	2007	Increase public awareness of Lake Sturgeon issues and Manitoba Hydro activities related to Lake Sturgeon recovery in Manitoba.
Sturgeon recovery display materials used at venues such as the Mid-Canada Boat Show	2008, 2010	Increase public awareness of Lake Sturgeon conservation and Manitoba Hydro activities relating to Lake Sturgeon recovery in Manitoba.
Television commercial aired locally (Manitoba)	2007	Increase public awareness and interest of Lake Sturgeon conservation in Manitoba, and of Manitoba Hydro's efforts towards the recovery of Lake Sturgeon in Manitoba.
Production of posters and brochures describing sturgeon life history and promoting sturgeon management board activities	2002, 2010	Increase public awareness of sturgeon conservation issues and the activities of the Nelson River and Saskatchewan River sturgeon boards.
The sturgeon boards' "Sturgeon in the Schools" programs in Manitoba and Saskatchewan		Increase the knowledge and awareness of Lake Sturgeon conservation in youth, particularly Aboriginal youth living in northern communities, who will become the future guardians of the Lake Sturgeon.
Development of sturgeon board websites	2006	The sturgeon board web sites are a source of information for the general public, on Lake Sturgeon conservation issues and activities of the boards that are contributing to Lake Sturgeon recovery.
Community meetings to raise awareness of sturgeon issues and management board activities	2002-present	Increase the public awareness of Lake Sturgeon conservation issues and management board activities.
Development of promotional materials for SRSMB	2010	To promote the Lake Sturgeon recovery activities of the SRSMB and inform/educate the public of Lake Sturgeon and Lake Sturgeon recovery efforts.
Development of brochure describing Manitoba Hydro's Lake Sturgeon Stewardship & Enhancement Program	2011	To promote public awareness of sturgeon conservation, and provide information on the actions that Manitoba Hydro is taking towards sturgeon recovery.

## Appendix B: Relevance of components of Manitoba Hydro's recovery action plan to performance measures of the recovery of Lake Sturgeon in Manitoba

Performance Measures  Recovery Actions in Manitoba Hydro's Lake Sturgeon Recovery Plan	1) 5 y: population information	2) 15 y: stabilize population in Churchill R.	3) 20 y: increasing population trend	4) 25 y: improve spawning habitat in Nelson R. and Winnipeg R.	5) 25 y: successful spawning downstream of Kettle GS	6) 30 y: increasing population trend in lower Nelson R.
<b>Immediate Future (1-3 y)</b>						
Improve understanding of spawning habitat				x	x	
Improve ability to create spawning habitat				x	x	
Identify spawning locations on the Wpg R	x			x	x	
Collect detailed habitat info downstream of Kettle GS				x	x	
Improve ability to collect spawn			x		x	x
Address disease risks			x		x	x
Continue stocking, development of expertise in sturgeon culture			x		x	x
Evaluate success of past stocking efforts			x		x	x
Examine downstream passage issues				x	x	
Examine feasibility of flow modification at two facilities				x	x	
Assess Lake Sturgeon access into Little Churchill R.		x				
Acquire baseline information on populations throughout MB	x					
<b>Near Future (4-5 y)</b>						
Develop spawning habitat enhancement design for Kettle GS				x	x	
Implement seasonal flow modifications on a trial basis				x		
Evaluate locations for future habitat enhancement projects				x		
Stock Lake Sturgeon between Kettle GS and Long Spruce GS					x	
Develop greater understanding of larval and juvenile ecology	x					
<b>Long Term (&gt;5 y)</b>						
construct habitat enhancement downstream of Kettle GS				x	x	
Continue stocking in Nelson River from Kettle GS to Long Spruce GS					x	
Explore/stock in locations where stocking would contribute to recovery			x			x