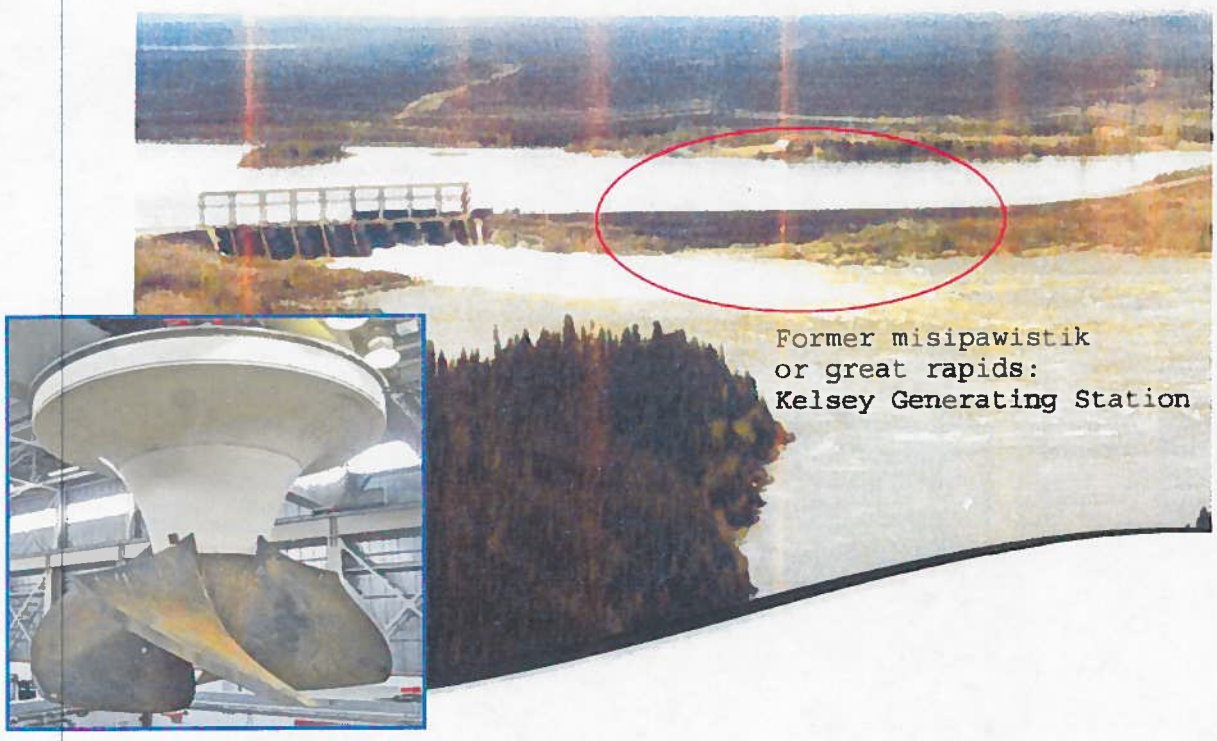
Review of reports dealing with Fish Mortality Studies and the Quantification of Fish Habitat for the Kelsey Re-runnering Project



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[Cover Image of Kelsey Generation Station adapted from *Quantification of Fish Habitat for the Kelsey Re-Runnering Project*, 2008]

Preamble

T. Dick was retained by the York Factory First Nation to review reports dealing with survival and injuries to fish passed through a turbine at Manitoba Hydro's Kelsey Generating Station on the Nelson River as well as reports dealing with fish habitat quantification and a presentation by Richard Remnant, North South Consultants, to Manitoba Department of Water Stewardship and the community of the York Factory First Nation. At the request of the York Factory First Nation, M. Anderson provided technical support to T. Dick, as well as historical references and imagery and commentary on the potential relevance and application of Aboriginal Traditional Knowledge (ATK) to the assessment of the potential effects of the re-runnering of the Kelsey Generation Station.

The study site

The Kelsey Generating Station is located on the Nelson River upstream and in relatively close proximity to where the Grassy River and the Burntwood River (including the Odei River) enter the Nelson River system below Kelsey at the western extent of Split Lake. Downstream of the confluence of the Grassy and Nelson rivers are a series of rapids which suggests prior to the Kelsey dam this must have been an exceptional area for lake sturgeon and other species of fish.

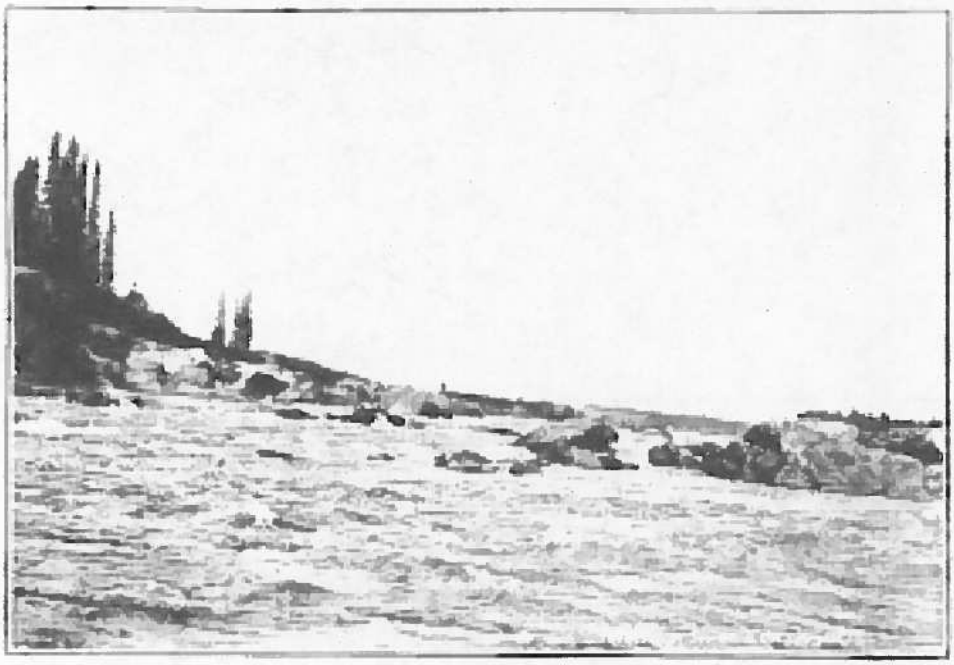

Figure 1. *Misipawistik*, Grand Rapid (more recently described as Kelsey Rapids) taken from the head of the rapids looking downstream (from Denis and Challies, 1916)

Today's Kelsey Rapids is traditionally referred to as *Misipawistik*, meaning "great rapid", in the language of the local Cree First Nation communities who continue to use, occupy and inhabit the area. Reflecting the name given by the Cree peoples, the rapids are referred to as the "Grand Rapid" by Denis and Challies (1916) in a publication providing a detailed, reach-by-reach description of the major rivers in Manitoba, Saskatchewan and Alberta. In this early report, the Grand Rapid of the Nelson River (Kelsey Rapids) (Fig. 1) was described as descending 20.1 feet and had two sharp pitches or chutes 600 feet apart (Fig. 2). Below the second pitch there were rapids which extended across the river (Fig.2). The river was about 400 feet high and the banks were comprised of granite 20 feet high. The total distance of the rapids was 1300 feet. The flow characteristics in and below the rapids must have provided ideal habitat for lake sturgeon.

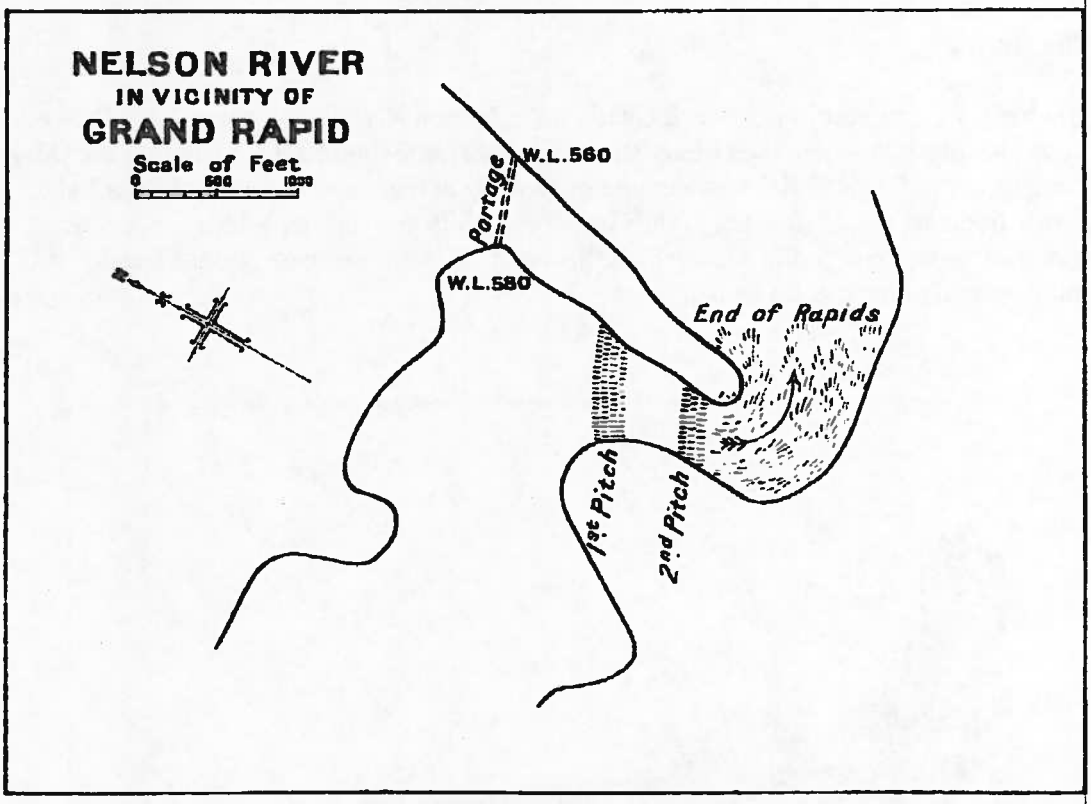

Fig. 2. Diagram of Kelsey Rapids illustrating the two pitches and extent of rapids. Note downstream end of rapids (from Denis and Challies, 1916)

The section of the Nelson River at Grand Rapid (Kelsey Rapids) was severely altered by the building of the Kelsey GS, the flows of the river were redirected and significant losses occurred to high-value fish habitat. The powerhouse (Fig.3) was built into excavated rock over which the original portage trail meandered (Fig. 2) and much of the rapids were destroyed by a dyke constructed across the main rapids (Fig.3). The location of the powerhouse redirected flows through the turbines directly across the river and perpendicular to natural flows.

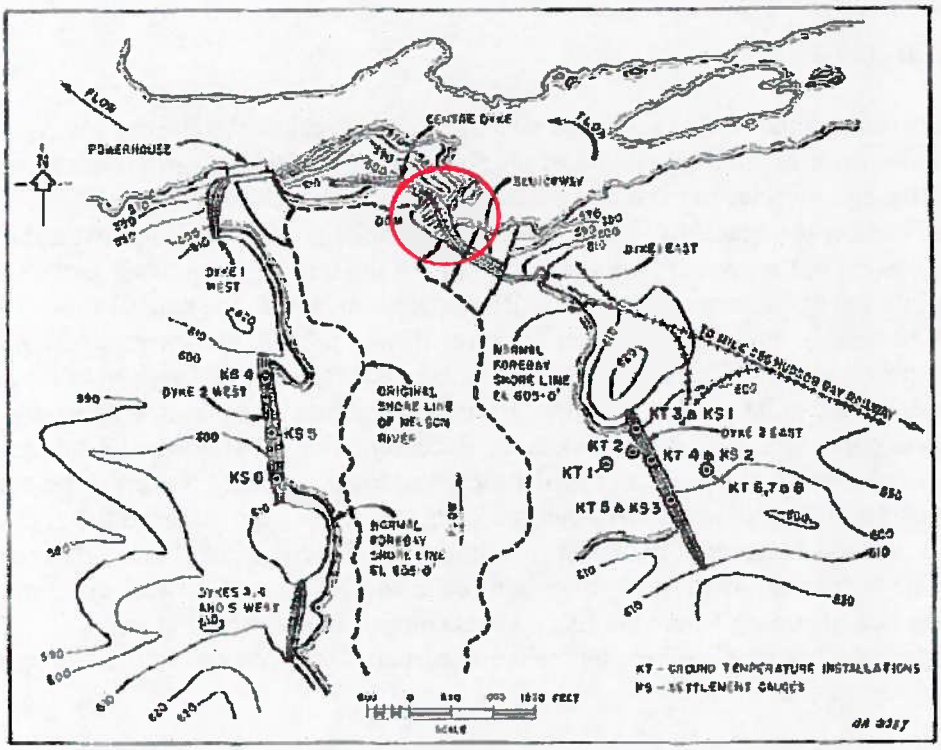

Figure 3. Site plan showing location of ground temperature and settlement gauge installations. Circle shows location of the Kelsey rapids, the dyke and sluiceway (from Johnson, from Dykes on permafrost in Manitoba)

Figure 4. Composite of aerial photographs taken in 1950 of the Grand Rapid (Kelsey Rapids) site showing the confluence of the Grassy River and Nelson River downstream of the Grand Rapid (from Manitoba Air Photo Library)

General comments

A major fault of the studies reviewed was the failure to relate the current environment to conditions prior to the construction of the Kelsey Generating Station. To relate increased flows through turbines to in stream habitat only is a relatively small component of the overall historical impacts of Kelsey on the local river environment. Moreover, the configuration of the dam in terms of water exiting the turbines is unusual as the water flows into the main stem of the Nelson River perpendicular to the natural flow. This raises interesting questions as to how the river flowed prior to the construction of Kelsey. What spawning sites were there along the Nelson River below Kelsey and the spillway, historically and today, and in the Grass River where some dewatering will occur. To our knowledge there has not been a systematic documentation of Aboriginal Traditional Knowledge (ATK) to document the historical and local record i.e. describe the natural flows of the Nelson River at *misipawistik*, or "great rapid", and describe fish movements prior to the construction of the Kelsey. Without ATK there appears to be little readily available historical record of the river before the construction of the Kelsey Generating Station, i.e., regarding where the fish species congregated, the location of spawning/nursery/feeding areas and whether certain fish species able to move upstream through the rapids.

The most serious omission from all the reports was the failure to reference Aboriginal Traditional Knowledge pre- Kelsey since this is the **true** baseline reference data by which to assess impacts of hydro developments.

The scope of the fish mortality studies was too narrow as it did not include mortality due to spillway flows plus the mortality due to the turbines. ATK from other areas has reported significant mortality of fish, especially small fish, passing over the spillways. Furthermore there were some discrepancies with the methods for assessing injuries, documentation of the types of injuries encountered and also problems with the numbers of fish used in the study. It is important to note that First Nations communities along the lower Nelson River want to understand the overall impacts on fish populations, from all the dams.

The methods used to assess fish movements following passage through the turbines were problematic as it was difficult to understand total fish survival as it was presented.

The methods used in the fish habitat studies were also a problem and better pictures at water level illustrating key habitat types would have been helpful.

It is problematic to reach an understanding of the recycling or ramping of water through the turbines without reviewing the 2005 report (Appendix A, Water regime assessment for additional sites, 2005). The interpretation of the ramping effects on the wet/dry cycle concerning impacts on fish habitat and productivity requires a more thorough discussion on loss of productivity, the impacts of increased frequency of cycling over a longer period of time (twice the pre-rerunnering time) on the wet/dry cycle and other uses of habitat such as fish spawning and nursery areas.

The power point presentation would be very difficult to follow without one having had the opportunity to carry out a thorough review of the reports prior to the presentation.

Part I: Fish mortality studies

1a) **Objectives**

Fish mortality studies:

(i) Estimate the short term 48 hr survival and malady (injury) free rate for pike walleye and whitefish fish passed through the turbines.

b) Objectives should have included mortality due to spillway operations.

2. **Methodologies**

a) Methods were adequate for the turbine passage study. The lack of clarity in the numbers of fish detected post fish passage and the inability to detect the tag signal suggests that more effort should have gone into untreated fish movement prior to the fish passage study. There is too much speculation in the conclusions on what happened to the tagged fish that were not detected.

3. **Analysis**

a) Statistical analysis as written was adequate but interpretation is dependent on the quality of the data (see below).

b) Results

(i) There are numerous flaws in these reports and they are difficult follow due to lack of illustrations of the types of injuries encountered by fish passing through the turbines and lack of consistency in the descriptions of injuries between major and minor injuries.

(ii) There is no information in these reports on total annual mortality. However, conclusions (executive summary, p. i and ii Survival and movement of fish experimentally .... 2009) state "it does not appear that such movements have a substantial effect on the populations of the two predators and probably other large–bodied species in the Nelson River near Kelsey GS." It is assumed that "other large bodied fish" refers to lake sturgeon but lake sturgeon were not used in the study even though the York Factory First Nation and other First Nations are very concerned about lake sturgeon passage through turbines and have observed lake sturgeon mortalities.(Please see section 4 for additional discussion on this point.)

(iii) p. xii. (Survival and movement of fish.... 2009). What will be done with the information? Quote "Manitoba Hydro will use the information collected in this study together with information collected in other related studies that looked at numbers of fish naturally moving through Manitoba Hydro facilities to help try to answer what effect does the movement of adult fish downstream through a typical Manitoba Hydro GS have on those fish species upstream and downstream." It is not clear why the movement of fish through turbines and over spillways will be the same for all dams.

(iv) The size range and species of fish are limited. Larger pike and lake sturgeon should have been tested. Maria (burbot) spawns during the winter but this species is not considered in this study. What is the ATK on this species in this region of the Nelson River?

(v) Numbers of whitefish used in the study were much less than originally proposed. The numbers are too small to assess the impacts of passage through the turbines. This is an unresolved issue with respect to the original objectives.

(vi) It would be helpful to include a figure that showed where the control fish were put into the system. The release locations for treated fish are illustrated in Fig. 2-2 (p.41, Estimating direct survival and injury.... 2009).

(vii) The researchers were unable to calculate 48 hr survival for the control sub-adult pike because too many fish (40%) died of fungus and predation (p. xi, Survival and movement ..., 2009)), Estimating direct survival and injury..., 2009). Handling is problem but there is no discussion on why? This raises concerns about the overall study and the manner in which all fish were handled.

(viii) The types of injuries are important to record, as pictures, and be available to community members so they can actually see the types of damage to the fish. Table D-2 (Appendices, p. 99-105, Estimating direct survival and injury.... 2009) is helpful but a corresponding picture for each type of injury would certainly go along way to understanding the range of "minor injuries" reported. Especially since the authors deal with malady–free rates (fish free of injuries and/or scale loss, or loss of equilibrium attributed to turbine passage).

(ix) Problems with data; appendix Table D-2 (p. 99-105, Estimating direct survival and injury.... 2009) and Table 2-1. From Table 2-1 (p. 25, Estimating direct survival and injury.... 2009) there is total of 116 pike (released) but apparently 3 were lost going through the turbine so I assume they died making a total of 113. From Table D-

2 according to the malady column there are major dead = 28; minor dead = 5; major alive = 10; minor alive = 28. A total of 69 dead and injured. I assume the remainder of the treated fish were not injured. A total of 61.06 % of pike were injured. From the presentation: There were 95 pike tested; 76% survived and 38% were injured. What do terms like major dead, minor dead, major alive and minor alive really mean?

(x) Table D-2 Walleye Mid, Test fish, 6/12/08, lot 4. 700, (p. 103, Estimating direct survival and injury.... 2009). Maladies column; torn isthmus; laceration, split upper jaw. This is considered a minor injury? Fish 495 same designation as fish 700 but fish 814 (laceration and split upper jaw) is designated a major injury. Why?

(xi) Figure 3-5. (p. 55, Estimating direct survival and injury.... 2009). The number and shape of turbine blades are supposed to decrease mortality. Statements like the following are confusing. The one hour survival rate for sub-adults (88.9%) was higher than the one hour survival rate for adults (83.0%). It is likely, that the presence of one less blade (five versus six) for the new runner may account for most of the higher fish survival in the 2008 study. But smaller fish are known to have higher survival rates. Also the conventional view is that the shape of the blade affects fish mortality and injuries. The five blade turbine with the new runner blade has a narrow profile compared to a broader, rounder edge of the old design. It is concluded that lower proportion of malady-free (so-called clean fish) was lower for large pike because of the blade design (fewer blades but a narrow profile?). It is also concluded that injuries are less severe due to blade design? So what determines major injuries in fish passed through the turbines? Size (presumably length) of fish, number of blades or shape of blades? I have seen presentations where rounder shaped blades on turbines are being considered because they are more "fish friendly", presumably this means that this design kills and damages less fish. How well understood and documented is this relationship between fish mortality and turbine design?

(xii) Acoustic tagged fish were immediately released after inspection. It is assumed these were not part of the study but I am not sure. Table D-2 (Estimating direct survival and injury.... 2009) lists under maladies column acoustic tagged. It is not clear what this means unless the researchers are assuming an acoustic tag is a malady or is it the surgery that is a malady? Did all treated fish have surgery to implant an acoustic tag or were there control fish with surgery but no tag? Both treatment and control fish?

(xiii) The report is confusing to read. Suggestions (a) A table in the methods listing species and number of fish in each treatment and controls by year and which fish were fitted with acoustic tags

would make reading a lot easier. (b) Table 2-2, (p. 22, Estimating direct survival and injury.... 2009) in the text is a problem when information is cross reference to D-2 (appendix, (Estimating direct survival and injury.... 2009)) I cannot find split upper or lower jaws as injuries in Table 2-2. It is assumed all fish identified with major damage die but see reference to fish 576 (Table D-2, p. 100), acoustic tagged (is that malady?), scrape (large) at anal fin and designated as major. What about the minor category? Minor injury categories should have been broken down into several categories with pictures etc. to support the designation and set up a table with a scale of 1-5 with 1 having the least damage and 5 the most. What about amount scale loss? Twenty percent scale loss is quite high for fish like whitefish which has large scales. It is very difficult for anyone to be confident about the interpretations in this section.

(xiv) Re-runnering 2005-06 report: (a) 48 hr survival was 60% for Northern Pike (NP) and 80% for Walleye (Wa) ; (b) malady rates (mortality and visible injuries) 52.9% for NP and 30.5% for Wa; (c) clean fish (free of maladies) was 47.1% for NP and 67.4 for Wa). If values for (b) and (c) added together for NP = 100 if added for Wa = 97.9.

(xv) Estimating direct survival and injury.... 2009): p. 20, pike # 86576 and pike # 86811 and walleye # 86805 are listed in Table D-2 (p. 100). These fish were assessed as major injuries: 576 scrape (large) at anal fin; 811 fins displaced and caudal fin missing; 805 lacerations and tear in upper jaw. Not clear why these fish are considered to have major injuries. Again this is an example of problems with classification of injuries.

(xvi) Appendix 3 (Survival and movement of fish experimentally passed through a re-runnered turbine at the Kelsey generating Station, 2008, p. 49). Acoustic tagged fish in 2006 and tracked in 2008: 6 pike listed, of these 2 died, 3 are unknown (deal or alive) and one is alive. There does not appear to be a comparable table for the 2008 data set. Table 7 (p. 40, Long term survival and movement of acoustic-tagged fish .... 2009) clearly shows the control fish are more frequently detected than the fish passed through the turbine (treated). Fish detection of the treated fish varied markedly over time. There is speculation on what may have of happened but not much proof. There are problems with experimental design and the data collected since walleye control fish are not located in 1-8 days and after 72-119 days.

4. Conclusions

a) The conclusions of the results from the mortality studies supports to some extent the data but we need to be clear about the quality of data used in the calculations

(see 3(b) section) as there are discrepancies among data sets. Also control fish should not die. Results appear to support the conclusions but when one digs deeper the inconsistencies in classification of fish injuries and difference in numbers of fish in various categories is problematic and raises questions about the accuracy of the results and the value of the interpretations. Moreover, the conclusions from the fish movement studies after fish passage through the turbines are difficult to winnow from the text and data in the tables are not easy to evaluate. These observations raise doubts about the experimental design of the fish movement studies post-passage through the turbines and the overall conclusions.

b) The power point presentation to YFFN consisted of nine slides, two of which dealt with fish movements at Limestone and two of which dealt with fish habitat below Kelsey. The presentation is a superficial overview of several complex questions based on reports that were both confusing and in some areas of the reports unclear statements were made (see references in the specific comments section). Consequently it is not surprising that there were inaccuracies in the numbers in the data presented. Perhaps even more important the presentation did not clearly describe the key methodologies nor were the results sufficiently developed to understand the relationship among fish species, fish size and turbine blade design. There was no explanation why lakes sturgeons were not included in the mortality studies. For example, there was no effort to connect what the community members already know concerning injuries and damage to the fish. In other words there were no pictures to support the classification of injuries following passage through the turbines. The section on fish movements through Limestone was difficult to follow without a more complete explanation. I assume DS in the table refers to zones in the previous figure but the species of fish were not listed. It was also unclear if the fish movement study through Limestone had any relevance to the fish mortality study at Kelsey. The section on habitat was unhelpful as there was no interpretation of the ramping effects (changing water flows and levels) on fish habitat. In fact it is unclear how anyone could get anything out of this section of the presentation if the reports had not been read thoroughly prior to the presentation.

Part II: Quantification of fish habitat for the Kelsey re-runnering project

1a) **Objectives**

(i) Determine existing environment and post-project water depths and elevation to differentiate areas that will undergo habitat modifications,

(ii) Describe shoreline habitat and produce a classification of near shore habitat in order to quantify areas of habitat modification and

(iii) Understand the composition of near shore areas in each of the habitat types to describe potential effects to aquatic biota (includes substrate classification, presence of macrophytes (aquatic plants) and in selected areas benthic invertebrates).

b) The objectives were clearly defined and appropriate for the study. However, as stated above, the lack of ATK limits the value of the study and provides no information on the environment pre-Kelsey construction.

c) The objectives were appropriate for the study

2. Methodologies

The methods were adequate for the general tagging part of the study. Lack of the availability and consideration of ATK information is a major concern. The amount of sampling for benthic organisms was minimal and likely accounts for large variation in the results. Better illustrations of the habitat types and correlating sample sites with data and use of better maps would have been helpful. The fact that sampling was done in a very high flow year makes meaningful interpretation of the data difficult.

3. Analysis

a) Statistical analysis as written was adequate but interpretation is dependent on the quality of the data (see below) and the presentation of background information. Problems with sampling methods and cross referencing data to the sample sites, the failure to adequately describe the overall impacts of ramping and the implications of an increase in the total number of days ramping occurs raises serious concerns about the overall conclusions.

b) Results and summary sections

(i) Without detailed background information it was very difficult to interpret this document. The 2005 document (Assessment of the potential of the Kelsey re-runnering: on the water regime in the Sipiwesk Lake to Split Lake reach of the Nelson River and Appendix A, Water regime assessment for additional Sites. December 2005) are critical to understand the ramping process.

(ii) This section is difficult to follow and the total days of ramping is difficult to determine. I assumed daily ramping when water is below 2212 m^3/sec. The daily up and down level of water is between 1.2 and 1.6 m, essentially a section of the river goes from drought conditions (dry) to full bank (wetted). The view presented in the report is that ramping from 1700 m^3/sec to 2212 m^3/sec does not have much of an impact but the actually ramping is from 628 m^3/sec to 2212 m^3/sec. The ramping from 1700- 2212 m^3/sec is the impact if time zero is the time of installation of the new turbines and if adequate compensation had been provided for past impacts. There is no reference to past compensation in this report. The interpretation is that the difference in impact on habitat by the new turbines is the net loss of habitat between 1700-2212 m^3/sec. and not the loss between 628-2212 m^3/sec. But cycling is actually from 628-2212 m^3/sec on a daily basis and this ramping creates the total habitat lost and

furthermore is over a longer time frame (see pages iii and iv, Quantification of fish habitat for the Kelsey re-runnering project, 2010). The impacts of ramping during critical spring spawning periods (May and June) is also not considered. The reader is referred to the 2005 report Figures 6 and 41 (Appendix A, see pt (i) for reference). It appears that some ramping may occur during the winter but there is no discussion on impacts of ice formation and possible ice scouring and damage to fish habitat.

(iii) The report states that increasing the capacity of the station will increase the potential frequency for water level changes within a day from 27% to 56% of the time. It is important to note that this change means ~ 100 days /year at 27% and 200+ days/year at 57%. Most of the cycling changes occur during open water when productivity is highest (April to early October). The dry areas are most pronounced during this period and generally less cycling occurs during the winter. Consequently unwetted areas are lowest during the most productive period (spring, summer and fall) and wetted areas are highest in the winter as cycling is less but this period has low productivity due to low water temperatures and a short day length. Consequently the greatest impact is during the highest productivity period during spring, summer and fall.

(iv) Most of the shoreline mapping below Kelsey was done at high flow rates which makes it difficult to see shoreline substrates. A search of satellite maps on the internet reveals many more rocky shoals than are seen or described in this report. The cycling will certainly affect these sites at spawning and as potential incubation and nursery areas for larval fish. ATK studies need to be conducted in order to document these sites and relate to high and low flows by season.

(v) This report is very difficult to read and requires far more effort than necessary due to the failure to cross reference information in tables and figures. The pictures provided in the report that illustrate major habitat types require the reader to use his/her imagination to see cover types and shoreline height. There is no effort to relate pictures to a map of the overall study area. It is difficult to asses this section as cross referencing substrates and depths where samples were collected in the tables and on maps was not obvious.

(vi) The report quite rightly states that the total flows in the river will not change and maximum and minimum water levels will stay about the same? More water is simply being passed through the turbines. But the problem is that the perpendicular flows from the turbines will be increased and less flow will pass over the spillway. Where in the report is this impact assessed with respect to fish movements, spawning, etc.? ATK would be very useful here.

(vii) 1.0. p. 1, paragraph 2, Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010). "Increasing capacity of

individual turbines will increase minimum elevation that can be potentially affected by cycling i.e. the entire elevation range that can be affected by cycling will be shifted upwards such that some habitat that is typically wetted will no longer be potentially dewatered by cycling." What is the "new minimum elevation"? How is this factored into the doubling of exposure time of the dry/wet cycle along the river and the actual ramping from 628 m^3/sec to 2200 m^3/sec?

(viii) Designation of river reaches: The rationale is not clear. For example, Kelsey GS East arm (see Fig. 4) is a complicated reach of the Nelson River as it has a backwater area to the east, an intermittent flow over the spillway and a large perpendicular flow from the turbines making this area diverse fish habitat, certainly in terms of flow and flow affects on substrate type. Also it is unclear how this area was and is used by spawning fish pre- and post-Kelsey.

(ix) Habitat classification: Better pictures illustrating habitat classification types are needed. This section would be much easier to follow if a reference map had been provided to show where the pictures were taken and a better perspective if pictures had been taken from the water and these pictures enlarged in the document. Fig. 5 Class A habitat (p.35 Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010): Is picture 5.1 referring to stream mouth? Left side of picture, is that exposed rock? Fig 6. Classification B (p.36, Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010)). Where are bedrock outcrops? Difficult to see at the magnification presented. Fig.7. Class C (p.27, Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010). Steeper topography is ok for picture 7.1 but 7.33 seems to have a low shore line and it looks like there has been some flooding in this area in the past. Note low vegetation suggesting new growth.

(x) Appendix 3: Table A3.1 (p. 59, Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010) and Table A3.2 (p. 60, Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010: It looks like two sample sites are very close together for both the east and west arms. Why was this done? Which samples are these in the Tables? What was the purpose? Were the samples from the same substrate and depth? Tables A3.1 and A3.2 provide depth and I think samples 1 and 2 were taken closer together and closer to shore but I am not certain? Why were samples taken so far east in the east arm as it is not representative of the flow regimes in the east arm even today (see Fig. 18, p. 48, Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010) and Table A3.2 (p. 60, Quantification of fish habitat for the Kelsey re-runnering project, 2008 (February 2010)? It would be much easy to review if the data was better cross referenced and if substrate types were added to the table.

4. Physical Setting and ATK Indications

a) The result of the ATK studies previously conducted and presently being conducted by the York Factory First Nation (and other First Nations) indicate that the multiple confluences of these rivers in the vicinity of the former rapids at the Kelsey site, known as *misipawistik*, or great rapids, by the local Cree, and present-day Kelsey Generating Station represents highly significant and productive fisheries habitat extensively used by First Nations peoples, particularly in respect of lake sturgeon, northern pike, walleye and whitefish (Figs. 1, 4, 5). Notwithstanding any lack of baseline information documented at the time of the construction of the Kelsey Generating Station and the need to further document ATK, it is well supported in the scientific literature that these multiple and closely adjacent river confluences are expected to represent important habitat, including spawning habitat, for these fish species.

b) A review of engineering drawings and current photographs in the available literature reveals that the former river channel and rapids at the Kelsey site have been covered by the "Centre Dyke" of the Kelsey Project and that the present spillway, although in very close proximity to the east of the former rapids, is an excavation (Fig.3).

c) The present York Factory ATK Community Researcher has reported that two First Nation individuals who are each former Manitoba Hydro employees at the Kelsey Generating Station shared first-person recollections of discovering the heads of "large" lake sturgeon when cleaning around the turbine area. The York Factory Community Researcher, who is himself an experienced boatman, fisher and hunter in the Kelsey area, also reports that both of these former Manitoba Hydro employees are each experienced boatmen, fishers and hunters, who have regularly harvested lake sturgeon and are knowledgeable of the behaviour of lake sturgeon. These reports from York Factory's ATK researcher confirm that large lake sturgeon continued to attempt to pass downstream through the Kelsey powerhouse and that mortalities of lake sturgeon occur when passing through the turbines. Further investigation and documentation of these reports are important, including in respect of whether the discoveries of the remains of lake sturgeon inside the powerhouse were reported to Manitoba Hydro or to Manitoba Fisheries Branch or to Fisheries and Oceans Canada and whether follow-up studies or investigations were conducted by Manitoba Hydro or these agencies in response to these reports. It is also noted that there are no references to these previous experiences with turbine mortality in the reports examined.

d) The York Factory ATK Community Researcher also reports that lake sturgeon visibly gather in mid-summer in the bay below and across from the spillway when the spillway is operating at limited discharge or is closed.

e) M. Anderson recently (June, 2011) interviewed two individuals living in Grand Rapids, Manitoba, each of whom was employed at the Kelsey site prior to or during project construction. One individual recalled being employed as a boatman during the Kelsey project investigations in the 1950's. This individual,

who was a youth at the time, reported delighting in startling the site investigation personnel by operating his boat very close to the upper edge of the former rapids at the Kelsey site. From this direct vantage point just upstream of the head of the former rapids, this individual reported observing large sturgeon moving upstream through the rapids during the first part of June (Fig. 5). Both individuals reported observing large numbers of lake sturgeon of all sizes gathered in the waters at the bottom of the former rapids. Both individuals recalled lake sturgeon being specifically harvested by First Nations fishers downstream of the Kelsey site using fishing equipment specialized for harvesting sturgeon, primarily at the low-lying banks at the outlet of the Grassy River (Fig. 4). Both individuals described the lake sturgeon being harvested as "18 inches in diameter" and "6 or 7 feet long". This preliminary ATK information reinforces the findings and conclusions in this report in respect of the importance of documenting and considering the ATK of the York Factory First Nation and other First Nations with knowledge of the area, particularly in light of the lack of pre-project baseline information on fish populations, fisheries habitat and fish movement through the former *misipawistik*, or "great rapids".

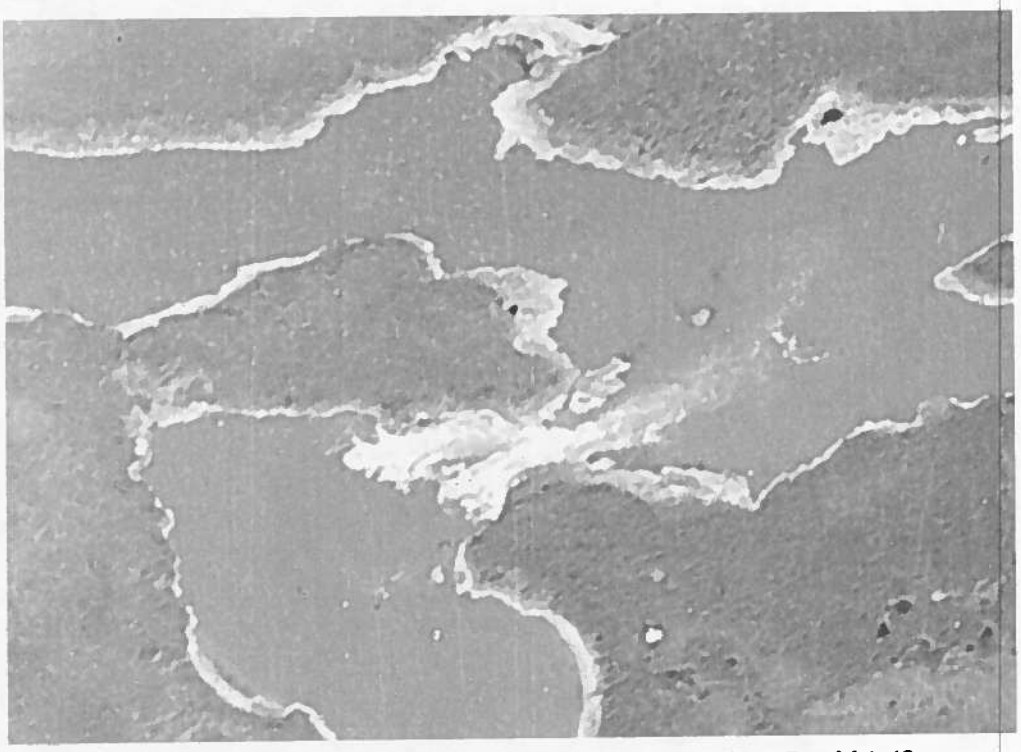

Figure 5. Aerial photograph taken in 1950 of the Grand Rapid (Kelsey Rapids) (from Manitoba Air Photo Library, A12567-19).

5. Conclusions

a) There are major concerns with the reports reviewed during the preparation of these comments. There are problems with sampling methods and in the cross referencing of data to the sample sites. Failure to adequately describe the overall impacts of ramping and the increase in the total number of days ramping occurs – particularly during periods of peak biological productivity - raises serious concerns about the overall conclusions on the total loss of fish habitat. Further, the presentation of ramping and the wet/dry cycle is misleading as it accounts mostly for impacts after the new turbines are installed and not on the overall impacts of the cycling of the turbines. The fact that the study was done during a very high water period raises doubts about how accurate small reaches of shoreline (fish habitat) were described. ATK on these shoreline reaches would have significantly improved the knowledge about these areas. There is no information on, nor an interpretation of, spawning fish habitat at the rapids downstream of Kelsey but before Split Lake. It is unclear if the increased flows through the new turbines will further impact the general movements of fish in the area below the turbines and around the spillway.

b) There was no effort to relate information on spawning fish pre-and post- Kelsey and no ATK on fish movement pre-and post- Kelsey, especially pre-Kelsey movement of lake sturgeon through the rapids. The available preliminary ATK information suggests that lake sturgeon moved upstream through the former rapids and continue to attempt to move downstream through the Kelsey powerhouse. This information underscores the significance and relevance of conducting ATK studies in relation to pre-project and post-project fish habitat, spawning areas and fish movement as part of any assessment of the impacts or adverse effects of the Kelsey re-runnering project.

Recommendations

1. <u>An Aboriginal Traditional Knowledge study must be completed and integrated into the fish habitat studies pre and post-Kelsey.</u>

2. There needs to be a much more comprehensive study on overall mortalities due to the operation of hydro generation stations and spillways. As stated in the Introduction to the "Fish Survival and Movements after Turbine Passage" document "...information on the fate of potamadromous species (Lucas and Baras, 2001), or so called "resident" fish populations when passing hydroelectric generating stations is largely absent". The Limestone study report on fish movements in the vicinity of a generating station is an initial attempt to look at fish movements around and through a generating station and over a spillway but does not address issues of entrainment and avoidance by fish moving downstream. From discussions with experts on fish passage it is apparent that these experts are unable to estimate the proportion of a fish population that moves downstream through the turbines and over the spillway. This is an obvious data gap. Clearly, there needs to be more comprehensive fish mortality studies dealing with entrainment, avoidance and the proportion of fish that move through turbines and over spillways. These findings must be compared to the movement of fish in

an unperturbed environment in the vicinity of low and high natural flows versus unpredictable flows (from the perspective of a fish) during the operation of the generating station. In addition a spillway mortality study is required to complete mortality studies.

3. The studies on the turbine mortality of fish should be re-examined and an accurate injury classification system developed. This classification system should be relevant to what First Nation community members are observing, i.e. the presence of dead fish, fish with severed heads (including lake sturgeon), etc. York Factory must be involved in the design of the fish mortality studies and in ensuring that the sample sizes recommended for the study are achieved. Since lake sturgeon are such an important species along the Nelson River, York Factory should decide if that species should be tested in a turbine mortality study.

4. Data on natural (untreated fish) movements of tagged fish below the Kelsey Generating Station must be adequate so that the interpretation of the loss (disappearance) of treated fish in an experimental study such as the fish movements following passage through a turbine is credible.

5. Turbine design needs to be revisited in light of some of contradictory results reported.

6. The current documents could be simplified and presented with greater clarity. Results need to be lucid and presented in a consistent format. The information on turbine cycling needs to be much better explained in the context of fish habitat loss. However, even with an improvement in the presentation of these reports there are enough serious flaws in the design and data, and concerns about the interpretation, that the studies should be repeated.

7. The conclusions presented in future reports should be expressed simply to reduce the time required to read the documents and to reduce the chance of error in the presentation and interpretation of the data.

The following reports and presentations were reviewed:

Part I: Fish mortality studies

1. Survival and movement of fish experimentally passed through a re-runnered turbine at the Kelsey generation station, 2008.

2. Fish movements and turbine passage at selected Manitoba hydro generating stations (2005-2006 interim report).

3. Long term survival and movement of acoustic-tagged fish following passage through a re-runnered turbine at the Kelsey generating station. Study done in 2008, published 2009.

4. Power point Presentation: Studies conducted by Manitoba Hydro related to the Kelsey GS project, July 2010.

Part II: Quantification of fish habitat for the Kelsey re-runnering project

1. Kelsey generating station quantification of fish habitat for the Kelsey re-runnering project 2008.

2. Assessment of the potential effects of Kelsey re-runnering on the water regime in the Sipiwesk Lake to Split Lake reach of the Nelson River. 2005

3. Water regime assessment for additional Sites. Appendix A, December 2005. Assessment of the potential of the Kelsey re-runnering: on the water regime in the Sipiwesk Lake to Split Lake reach of the Nelson River.

4. Long term survival and movement of acoustic-tagged fish following passage through a re-runnered turbine at the Kelsey generating station. Study done in 2008, published 2009.

5. Quantification of fish habitat for the Kelsey re-runnering project, 2008.

6. Power point Presentation: Studies conducted by Manitoba Hydro related to the Kelsey GS project, July 2010.

Other reports considered for background information were:

1. Dykes on Permafrost: Kelsey Generating Station Manitoba, 1969.

2. Denis, L.G and J.B. Chalies. 1916. Water powers of Manitoba, Saskatchewan and Alberta. Commission of Conservation Canada. p 464.

3. Appendix A. 2005. Assessment of the potential effects of Kelsey re-runnering. Water regime assessment for additional sites.