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Proceedings of the Regional Science Peer Review Assessment of the Instream Flow Needs for Fish and Fish Habitat in the Saskatchewan River below the E.B. Campbell Hydroelectric Station

May 9–10, 2018
Winnipeg, MB

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Editors: Donald Cobb and Joclyn Paulic

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

This Proceedings report summarizes the relevant discussions and presents the key conclusions reached at the meeting. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

INTRODUCTION

The E.B. Campbell Hydroelectric Station, owned and operated by SaskPower, is a hydropeaking facility on the Saskatchewan River near Nipawin, SK. The *Fisheries Act* authorization of the E.B. Campbell Hydroelectric Station (EBC) will expire on June 30, 2018. Fisheries and Oceans Canada (DFO) Fisheries Protection Program (FPP) is seeking science advice on Instream Flow Needs (IFN) to help inform a new *Fisheries Act* authorization, including measures to avoid, mitigate, and as necessary, offset serious harm to fish and fish habitat as a result of the ongoing operations of the existing facility.

The present *Fisheries Act* authorization, ratified in 2005, includes a minimum flow release of 75 m^3 s^{-1}. To determine the effectiveness of this new minimum flow, a research study was conducted between April 2005 and March 2007 to evaluate the impacts on fish habitat. The results from this study were summarized in an unpublished DFO report in 2008. In March 2012, DFO provided national guidance on IFN (i.e., +/- 10 % of instantaneous flow; 30 % of mean annual discharge), however, cautioned that when data are available, a more detailed technical examination is required on the effectiveness of the recommended thresholds, in particular for cases of hydropeaking (DFO 2013).

Since 2008, several studies have taken place at EBC and new data is available for consideration of IFN. In order to provide IFN recommendations based on the best available data and information a regional peer-review meeting was held in Winnipeg, MB, from May 9-10, 2018. The objectives of the review are described in the Terms of Reference (Appendix 1). Meeting participants included staff from DFO Science and FPP, the University of Saskatchewan, SaskPower, the Province of Saskatchewan (Ministry of Environment), and a local fisher from Cumberland House (Appendix 2). The meeting followed the agenda outlined in Appendix 3. This proceedings report summarizes the relevant discussions from the meeting and the suggested revisions to the associated working paper (Watkinson et al. 2018).

OPENING DISCUSSION

The Chair welcomed the participants of the meeting and discussed housekeeping items. Participants were asked to introduce themselves and provide a brief description of their background and area of expertise for participating in this review. The Chair explained the Canadian Science Advisory Secretariat (CSAS) process and placed an emphasis on the role of Science in the decision-making process (i.e., management application). The Chair then reviewed and received participant approval of the wording for the Terms of Reference (ToR) and agenda. The Chair gave an overview of the presenters who would be speaking over the course of the meeting, as well as how each of these presentations related to the ToR. A draft working paper was circulated to participants in advance of the meeting. This working paper formed the basis of the peer review and provided context for the discussions forming the scientific advice. Participants were encouraged to ask questions and contribute knowledge and expertise towards developing a consensus on the conclusions, recommendations, and advice.

PRESENTATIONS

THE HISTORY OF THE E.B. CAMPBELL HYDROELECTRIC STATION AND THE APPLICATION OF THE *FISHERIES ACT* BY DFO FISHERIES PROTECTION PROGRAM

Presenter: Dave Boguski, DFO-FPP

The speaker presented his past experience with fishery studies on the Saskatchewan River near the E.B. Campbell Hydroelectric Station (EBC), the FPP program, and the main sections of the *Fisheries Act* relevant to the EBC (i.e., Section 35(1) and Section 35(2)). A brief history of the EBC was provided and an outline of the timelines and purpose of the request to DFO Science (see also ToR). SaskPower has committed to work with DFO to develop minimum flows and other mitigations to reduce serious harm to fish and has since initiated several studies at EBC. Based on this, FPP would like Science Advice on the validity of the existing instream flow recommendations that are contained within the DFO 2008 unpublished report by considering the new available data and information that exists since this report was completed. The results of this CSAS meeting would form the basis for recommended IFN for a new application by SaskPower for a *Fisheries Act* authorization.

A participant asked if there is anything contained within DFO policy on “existing” facilities. DFO is currently upgrading its policies for existing facilities, and DFO FPP does plan to initiate discussions with SaskPower on the issue of existing facilities in the future. One participant asked what the role of the provinces is in the allocation of water or is DFO the main regulator of water? It was pointed out by another participant that water management is not really the main issue for this meeting; rather it is serious harm to fish and fish habitat. Another participant added that the Water Security Agency (Province of Saskatchewan) has some influence on flows for EBC, and that water management would be part of their jurisdiction as well.

WORKING PAPER PRESENTATION – E.B. CAMPBELL HYDROELECTRIC STATION ENVIRONMENTAL IMPACTS – ABIOTIC CHANGES

Presenter: Doug Watkinson, DFO Science

Prior to the start of the presentation, the Chair identified that two reviewers (internal and external) will be presenting their review of the working paper to meeting participants following the working paper authors’ presentation. The full written comments from both reviewers have already been submitted to the working paper authors; however, the reviewers will present their overarching comments here today. She also followed up to say that these comments have not all been captured in the current version due to time restraints. All participants will have the opportunity following the meeting to review and comment on the revised version of the working paper.

The speaker provided an overview of the abiotic changes that were examined and presented in the working paper. The speaker noted that several facilities within the Saskatchewan River watershed influence the flow regime of the river. These include Brazeau, Bighorn, St. Mary, and Oldman in Alberta, Gardiner (Lake Diefenbaker), Codette, and EBC in Saskatchewan, and Grand Rapids in Manitoba.

The presenter provided an overview of the sample sites used in the 2005-2007 study. There were three reaches below the dam examined: Site 1 (higher gradient and a heavily armored river channel), Site 2 (transition zone, with some fines in the substrate and a lower gradient), and Site 3 (100% sand with cobble/boulders limited to the channel edges). A Reference Site was located upstream of Codette Dam, a run of the river facility, with some backwater influence.

The presentation described the four Biologically Significant Periods (BSP) that were determined for fish life stage and function for species downstream of EBC. These BSP were developed for the Saskatchewan River fish species using the Delphi approach at a workshop held in Prince Albert, SK in 2005. Flow data presented within the working paper was examined in relation to each of these four BSP.

It was evident that mean daily flows have changed from 50 years prior to the EBC facility construction. Two peaks in flow still exist naturally in the hydrograph from the local snowmelt in spring, followed by mountain melt, however, these two peaks have been reduced in the years since EBC operation commenced. Since September 2004, mean daily flows have increased and are closer to the historic patterns according to the modifications to the operation of the dam in the 2005 *Fisheries Act* authorization.

However, the changes to the daily hydrograph from hydropeaking exceeds the DFO (2013) flow recommendation nearly every day of the year for both (1) changes +/- 10% of the magnitude of actual (instantaneous) flow and (2) flows can be reduced to <30% mean annual discharge. A participant noted that changes to the hydrograph are not only from the operation of EBC, rather are contingent of the operation of dams, irrigation, and municipal demands upstream of EBC within Saskatchewan and Alberta. These cumulatively have an influence on the daily hydrograph. The individual went on to further highlight that it would be difficult for this group of participants to tease out the impacts that are directly from EBC operation versus those impacts that originate from other operations along the Saskatchewan River. Meeting participants acknowledged this point and agreed to an extent. The speaker continued by presenting several graphs from the working paper that clearly showed that for many days of the year the daily minimum flow was not provided downstream of the EBC. A participant asked if it was possible to use a longer hourly flow record that predates 2001. The speaker acknowledged that these are available from Environment Climate Change Canada (ECCC) but are not digitized. The digitalization would be a huge amount of effort but with limited gain in knowledge and understanding – the point is that the current daily minimum flows are still having an impact on the fishery.

The speaker went on to present the exceedance curves (flow duration curves) and indicated that water surface elevation changes at gauge 05KD003 are most significant in BSP1, 2, and 4 when seasonal flows are typically lower. Consequently, the risk of fish stranding may be higher in these BSP. It was also noted by the speaker that day of the week has an influence on the flows as well. In other words, the weekend flows are lower than the other five days of the week. In this case, water is held on the weekend in Tobin Lake (reservoir) and then released later during the weekday when more power is needed.

The speaker presented the methods for habitat mapping and modelling used at each of the study sites (e.g., water depth, substrate type, water velocity) to be used with the River2D model. Assuming a minimum water depth of 20 cm was required to be considered fish habitat in this system, Wetted Useable Area was modelled using various discharges.

The speaker spoke briefly about sediments and turbidity, water temperature, nutrients, mercury, and total dissolved gas supersaturation.

There was further discussion about the difficulties of teasing out wet and dry periods and the effect of other activities in the watershed on hourly flow rates. Further comments on this section were identified and would be provided to the working paper authors by participants following the meeting.

DFO Internal Reviewer Presentation – Mike Bradford

Overall, the reviewer suggested that the paper needs a more fulsome description of the context as this might be useful in the long-term. The scoping of the paper should include upstream and downstream of the reservoir to better understand the regulation of the Saskatchewan River as a whole. For example, winter levels are normally higher due to irrigation (water recharge). He wondered if DFO Science could assemble seasonal inflows to EBC, and compare that to downstream to better understand impacts on the Saskatchewan River Delta (i.e., regulation in headwaters). Since there is very limited storage in the reservoir, might need to regulate inflowing through management of other facilities if the volume is not available within the EBC reservoir itself.

In large rivers, a dam is the master variable that cannot always be mitigated by flow regulation, the dam itself is important. There were no comments on winter ice conditions and flow regime (open water lead below the dam). The reviewer also noted that it is important to link dam operation to water levels in the river (i.e., stage loggers in the river at key biological reaches of the river). Different flow levels and dam operation in downstream reaches might be important in discussing recommendations of flow regime. He noted that most importantly this project should be considered within the context of water management as a whole in the watershed.

University of Saskatchewan External Reviewer Presentation – Tim Jardine

The reviewer acknowledged that he has a relationship with SaskPower in that they have funded some of his research, and that he has developed a relationship over the years with the people of Cumberland House, but that he provided this review with an objective mindset.

The reviewer acknowledged that the work conducted by DFO Science in 2005-2007 informed his work and site selection. Firstly, he identified that the effects of EBC from other factors in the basin, specifically Gardiner Dam on Lake Diefenbaker influence the operation and management of the EBC (i.e., cumulative water management issues). He recommends that Gardiner Dam is such a dominant control of the river flows, that a separate *Fisheries Act* authorization should be considered at that facility, since it is clearly having an effect on fish and fish habitat downstream.

Within the working paper, the reviewer referred to Figure 2 of the document that shows a shortening of the flood period, as well as the magnitude of flows. The reviewer emphasized the importance of flood period duration. Specifically, that prolonged flood periods are what drive fish productivity in the area, and not just the event of flooding itself. A short duration flood can be more of a disturbance to the ecosystem than a promoter of productivity in this case.

The downstream effects of EBC hydropeaking are documented to reach as far as 95 km downstream of EBC based on water level gauges that were installed in the 2000s. Impacts from hydropeaking include the loss of the “Old Channel” of the Saskatchewan River being supplied with water and the loss of historic spawning habitat for Goldeye (*Hiodon alosoides*). This was verified by another participant and the situation was further described in detail that this species was once in high abundance and spawned in the channel. This is no longer the case, and it is believed that the environmental conditions are not appropriate and therefore fish will not spawn.

The Old Channel was the supply line for the Cumberland Delta marshes (e.g., muskrat habitat, Cut Beaver Lake fishery). Euteneier (2002) showed that a flow of 500 $m^3 s^{-1}$ is the effective flow needed for water to enter the Old Channel. However, since the minimum flows were implemented in 2004, more water reaches the Old Channel than previously observed.

Sediment starvation is a key impact of EBC that should be highlighted in the working paper. It is a well-known fact that dams trap sediment, and it has been documented that EBC discharges clearer water (lower total suspended sediments) downstream (e.g., Ashmore and Day 1988). By

deepening and widening the main channel downstream of EBC, the river no longer connects to wetlands, and sediment and nutrients are not being provided to those areas. This affects the ecology of wetlands.

For the section on water temperature, Mihalicz (2018) showed that there is not a significant temperature effect from EBC; since there are no hypolimnetic discharges. Although, there may be less variability, this would not occur at all times of the year.

North/South Consultants reported that total Phosphorus (P) was higher downstream of EBC. Interestingly, P associates with sediment, which is lower downstream of the dam. Mihalicz (2018) showed different results than the North/South Consultants report, with slightly lower P downstream. Food web structure has been known to be altered below dams, leading, for example, to dense mats of filamentous algae below the dam (due to loss of light-blocking sediment). Invertebrate communities were expected to switch to grazing taxa at EBC, however, this was not observed because the algae are likely unpalatable. Comparable densities of invertebrates were found in Mihalicz (2018) but often they are higher below hydro facilities due to a dominance of tolerant taxa. The reviewer will provide the Mihalicz (2018) reference and other references from his review to the working paper authors.

DISCUSSION

One participant asked if this new information will be put into the revised working paper (i.e., Research Document), and it was agreed that it would be good to include this and the recent invertebrate, temperature, and nutrient data.

A discussion ensued about scoping EBC in the context of a broader examination of flow management. EBC cannot fix the larger water management issues for the Saskatchewan River, but this issue should at least be identified and future work to rectify this situation should be suggested. The issue was raised again that in order to identify the fisheries impacts of EBC, the problem is broader in scope. So do you revisit it in the future, ignore it or issue a new *Fisheries Act* authorization for Gardiner Dam?

A participant provided some context to the water temperature impacts that Cumberland Lake is experiencing based on his observations. He noted that in July local people see lots of fish belly-up in the water; he inferred that the water is too warm. Cumberland Lake was once 20 ft. deep, and now it is only 2 ft. deep. We need to recognize that these impacts are from the large dam. If SaskPower were to restore the 16.5% reduction in water, this might help a bit with temperature impacts downstream.

A participant made some suggestions for the drafting of summary bullets for the Science Advisory Report (SAR). The first bullet should be the context of EBC within the larger watershed, second, that the hydrograph has changed and there is no doubt it is a highly regulated river. The next bullet should be the issue of sediment starving, we need more information on this. Finally, daily flow fluctuations from EBC need to be examined. These are the important issues for a *Fisheries Act* authorization. However, the future really needs to look at the entire system more holistically.

A general discussion took place about what is at hand. A participant reiterated that in June 2018 the existing authorization expires but a discussion between SaskPower and DFO Ecosystems Management will take place to negotiate a new authorization. For this meeting, what we are trying to achieve is answering the questions of how can we try to naturalize the flow regime and reduce impacts? It was pointed out that the application for authorization did look at impacts upstream of EBC where flow is regulated by the Provinces of Alberta and Saskatchewan. Also, it was noted that EBC runs as a run of the river on a weekly flow basis, but not hourly. A

discussion ensued about building in flexibility into the flow operation, this would help diversity overall, and take into account Alberta needs, which is not yet fully utilizing its water allocation. A participant clarified that SaskPower operates the facility, but Water Security operates Lake Diefenbaker's seasonal flows, there are many competing demands for water from Lake Diefenbaker and a draft operational plan is not yet finalized. Releases from Lake Diefenbaker eventually will be released from EBC, so should the rule curve for Tobin Lake have a wide band in it to reflect Lake Diefenbaker? It was pointed out that the Tobin Lake spring level is maintained for spawning within the lake, but the same considerations are not given to downstream fish.

One participant raised the issue of future changes in the system, including climate change and how this might affect the entire management of the system (e.g., less water for everyone). For example, Manitoba Hydro is looking into flows to Hudson Bay to monitor for large scale changes in the system.

A discussion took place about how to deal with fixing fish and fish habitat downstream of EBC (i.e., restoration, repair, mitigation). DFO FPP stated that discussions will take place with SaskPower about what is the most reasonable mitigation, and this will be discussed with Cumberland House. Additionally, the Province of Saskatchewan's Fisheries Management Objectives will also be considered. As we know, it is a complicated system and trade-offs will be needed. One participant noted that in British Columbia there is long-term fisheries management/ water management planning process that appears to have been successful.

Further discussion about ice dynamics and the issue of water quantity and water quality continued. The completeness of the site descriptions should include ice dynamics, for example, for 10 km downstream of EBC the river is ice free in the winter months. This can be added to the working paper.

A discussion about water control by Ducks Unlimited in the Old Channel was brought forward by a participant. It was pointed out that the Old Channel entrance is high and dry, and that providing more water is not the solution, rather you need sediment to feed the main channel, otherwise it just accelerates the process. The structure of the river channel needs the sediment as do the birds and other animals in the delta that depend on that sediment. There was a discussion about how it would be possible to release trapped sediment. It is a challenging engineering question, but examples do exist. Although no decision was made as to how sediment can be supplied back into the river, it was noted that it is important to the health of the delta.

WORKING PAPER PRESENTATION – E.B. CAMPBELL HYDROELECTRIC STATION ENVIRONMENTAL IMPACTS – BIOTIC CHANGES

Presenter: Doug Watkinson, DFO Science

The working paper author provided an overview of the fish catch data for Sites 1-3 (downstream of EBC) and the Reference Site. There were differences in age and size structure of the fish communities. Growth rates were not different, but in general, smaller, younger fish were not well represented downstream of EBC. The working paper authors speculated as to why this might be the case. Shorthead Redhorse (*Moxostoma macrolepidotum*) and White Sucker (*Catastomus commersonii*) dominated the fish community downstream of EBC.

Hourly discharge during a stranding event at Site 2 was presented (Figure 21 of the working paper). Flows changed from over 800–400 m^2 s^{-1} very rapidly, and this led to stranding of small-bodied fish in the side channels.

The working paper author presented the section on Lake Sturgeon (*Acipenser fulvescens*). There was a strong relationship between discharge in BSP3 and recruitment for Lake Sturgeon. A participant noted that local fishers no longer see the large (e.g., 50 lbs) sturgeon anymore, even though they have not been commercially fished for over 40 years.

University of Saskatchewan External Reviewer Presentation – Tim Jardine

The use of BSP was well received and matches the fish biology to seasonal timing and adaptation of species to flow events. The reviewer asked if BSP3 was long enough though and a suggestion to extend BSP3 to July 24th, to include spawning and juvenile rearing habitat was requested. Participants agreed with this suggestion and it will be included in the SAR and revised in the working paper.

The Lake Sturgeon recruitment and flow relationship is the most compelling evidence for higher minimum flows in the Saskatchewan River below EBC. It should be noted that BSP are for instantaneous flows and not mean daily flows. The reviewer suggested that continual flow through the spillway could be used as a mitigation/offsetting measure. If the flows are sufficient for fish to overwinter in the spillway channel (i.e., so as not to freeze to the bottom) and it is used by fishes this would be useful. Future research (some of which is being addressed with his group) include sediment starving, stranding in the old channel and downstream reaches in the study area, and stranding during the winter. These considerations will be addressed in the working paper.

DFO Internal Reviewer Presentation – Mike Bradford

Fish community downstream of the dam suggests that the dam has impacted the small-bodied fish community. The Site C dam in British Columbia showed the importance of tributaries for fish productivity. The presence of a dam and reservoir can interfere with that process. It was noted that there are very few tributaries along this part of the Saskatchewan River (other than the Torch River); mostly mainstream spawning. It would be useful to include Habitat Suitability Indices (HSI) curves in the appendices of the working paper. The reviewer suggested that there might be a missing part of the story with the low flows at night, but there are no HSI data for night time.

The reviewer commented that issues around stranding are more complex than just ramping rate, especially with respect to side channels. It can be the change in flow from high to low and the antecedent flow, time of year, and species presence. The reviewer questioned the relationship of high flows and Lake Sturgeon spawning, and suggested it may be flow or a turbidity effect? It is difficult to tease those apart since flow and total suspended solids are tightly linked. An example from a Quebec study was shared with the meeting participants, which showed higher wetted area equaled higher recruitment of Lake Sturgeon.

There was a discussion about the spillway channel flows and whether to maintain minimum flow to keep it wetted, or actually add generation and add more water down the stream channel?

Another discussion about whether there are lake spawners for Lake Sturgeon was brought up as the local fishers see them spawning in Cumberland Lake. Local fishers see males and females in spawning condition, but they are not sure what the impact is on spawning success of the lake spawners when the water level drops.

THE SASKATCHEWAN RIVER DELTA PRESENTATION – GARY CARRIERE

The local Cumberland House participant provided an overview of the Saskatchewan River Delta and the importance of the delta to the local people. The Saskatchewan River Delta is the third

largest delta in the world. It is an important area for a wide variety of wildlife (both freshwater and land) and furbearers. Now the river structures on the Saskatchewan River have significantly affected the delta, and the delta users are stuck with the problems. The presenter stated that it was a welcome opportunity to sit at the table with people who can make decisions.

Since the EBC was built, five lakes have been lost. Infilling and vegetation have taken over, and a single channel is left; the natural system is disturbed. Sediment and nutrient starvation has affected the delta and he noted a change from Walleye (*Sander vitreus*) to sucker habitat. In the olden days, they used to fill their boat with six nets, now even with twenty nets they barely get two tubs of Walleye. He estimated to have lost 30–40% of Cumberland Lake already due to infilling and the lost fish habitat associated with it.

The presenter provided a picture presentation for context and to demonstrate the changes, they have observed in the delta. He explained that there is not enough water in the lake to dampen the effects of big wind driven events and other environmental factors. He stressed the need to work together to protect nature in the Cumberland Lake and the Saskatchewan River Delta. He urged the need to overcome government silos and cautioned that the local community recognizes that the demand for water will only increase and they expect droughts in the future (i.e., climate change). SaskPower needs to think outside the box and provide for more than just the generation of power and the subsequent monetary value, but also the values of the land.

DISCUSSION

A general discussion ensued after the Saskatchewan River Delta presentation with respect to the changes observed by the local fishers. Further detail about the change in fishing effort was discussed. The number of Walleye fishers is down; there used to be 30 boats on the water and now there are only 4 or 5. Similarly, the Lake Sturgeon fishery is mainly on the river now with only about 11 fishers. The participant also noted that the Tearing River was once a sturgeon spawning location.

There was a discussion about HSI, and the importance of confidence in these curves prior to the issuance of an authorization. The curves are a good starting place, but wetted/weighted useable areas are a good accounting tool to use for offsetting. Specific HSI may not be what is needed, especially if they focus on only one life history stage (e.g., spawning). One participant noted that a lot of time can be spent on HSI, and there are lots of caveats that are associated with each of them. They emphasized that it was more important to use a Delphi approach and think about species and what is good for that species at a given location based on the best available information.

A participant suggested it may be better to look at other effects of regulation and things that can be done to offset/mitigate. For example, the lack of small-bodied fish downstream of EBC is likely related to the lack of connectivity with side channels and sediment in the river. Clearly there have been modifications to the hydrograph, and winter flow patterns are 3-4 times higher to generate power but by reducing hydropeaking operations during selected BSP one should expect that this would help to ensure successful egg incubation and larval drift. As stated previously, flows less than 500 $m^3 s^{-1}$ mean that connections to the side channels are not maintained.

A participant questioned what offsetting means for EBC? Is offsetting for the death of fish through turbine mortality, fish productivity, and/or stranding and is it the same as offsetting for a new facility; as this could be precedent setting. What is mitigation/avoidance as opposed to serious harm on an existing facility and the ongoing serious harm, how do we address that? What can you do to mitigate and how do you offset? The participant emphasized the need for direction for offsetting in the context of existing facilities (i.e., what stage are we offsetting to?

Pre-dam or some other stage of development). The Chair intervened and reiterated the ToR for this science peer review. For this question, a broader discussion will have to take place with hydro producers and management on existing facilities. Another participant pointed out that there are really two categories being discussed; things related to the Saskatchewan River watershed, and things specific to EBC. It was suggested that for the SAR it may be better to remove the word “offsetting” and just discuss as “measures” or “actions” that could be used to increase fishery productivity around the EBC. Participants agreed that this was the appropriate approach for both the SAR and the working paper (see pages 50-51).

A participant raised the concern that some of the suggested flows to sustain BSP downstream are not even achievable from an engineering perspective. They identified that there is a need to balance operation of the dam against the broader flow operational matters in the watershed. Another participant cautioned that this science advisory process does not take into account operations and suggested the group discuss what is best to maintain fish and fish habitat rather than discuss SaskPower ideas around operation. There was general agreement with respect to the purpose of this meeting; however, another participant cautioned that it would important to not make a series of recommendations that are not feasible for EBC. It was then noted that the 75 $m^3 s^{-1}$ minimum flows are actually in reality closer to 90 $m^3 s^{-1}$ due to the operational constraints of the turbine.

One participant made the observation that the fish data used in the working paper were from the first year after the 2004 minimum flow modifications, this raises the question as to whether the data is more representative of fish distribution and species composition prior to the modifications? This should be noted in the working paper and it should be identified in the SAR and noted that it will be very important to continue to study the fish populations to see what the community is like now after the modifications have been implemented for some time.

The issue of ramping and the operation of Tobin Lake was discussed in the original 2005 *Fisheries Act* authorization. SaskPower has provided updated ramping rates that are up for discussion as DFO FPP proceeds with the new authorization. It was also pointed out that the turbines in EBC are being re-purposed.

This concluded the Day 1 presentations and discussions. The Chair provided a brief summary of the day and encouraged everyone to think about the main conclusions and the advice for discussion in Day 2 of the meeting.

ADDITIONAL DATA ON THE OPERATION OF EBC

Presenter: Jackie Lukey, SaskPower

Following Day 1 discussions, SaskPower prepared some data for the participants to provide further context to the operation of the dam. Although the material was not circulated for review prior to the CSAS meeting, it was information that was included in the application for authorization. The presenter circulated and discussed pie charts that SaskPower had prepared from the Prairie Provinces Water Board data on natural flows to help tease out the various water uses on the Saskatchewan River. Of the total annual water withdrawals that occur upstream of EBC, diversions account for 72% of the change in overall volume. Most of water withdrawals occur from May to September, and additions to flow occur from October to April (e.g., recharge from irrigation). Alberta storage/diversion is the dominant factor. The total loss of annual natural flow in the Saskatchewan River (13.3%), Alberta accounted for 72%, Lake Diefenbaker 21%,Tobin Lake 6%, and 1% from evaporation.

When high flows are expected, SaskPower will draw down the reservoir down to refill it to near capacity. During the spring spawning period, SaskPower will let the peak go to full service limit,

then draw down 15 cm and hold it steady for the spawning period of fish in Tobin Lake. A participant suggested that rule curves for Tobin Lake and Diefenbaker Lake should be included in the description; this will allow a better picture of flexibility in the system.

Ice damming is unavoidable and does occur downstream of EBC. It was pointed out by one participant that the sudden release of water attracts fish to spawn where they normally would not, and when flows are suddenly cut off, fish stranding occurs (e.g., Northern Pike). This situation has been happening for 60 years, and has been affecting commercial fishing.

The regulation for the operation of the Tobin reservoir is part of the 1985 water license, but also based on the 2004 DFO authorization. No issues have been raised, therefore it is unlikely to change.

The presenter showed the five-day moving average of the inflows to EBC for each of the BSP (2005-2017). Winter flows are higher because of the water releases from upstream reservoirs. Stored water is released for hydropower production during the winter months. The water releases are regulated by Saskatchewan Water Security Agency, but the facility is run by SaskPower, who have to release water as directed by the Water Security Agency. Lake Diefenbaker holds back water in summer and is drawn down in winter, unless they have to spill water. In spring, they have to maintain water levels in Lake Diefenbaker for Piping Plover nesting under regulations for a Species at Risk.

During winter, open water persists up to about 10 km downstream of EBC (i.e., Site 2).

The issue of complexities of water management (current and future) were again discussed, and the difficulty of pinpointing one issue to EBC. For example, one participant said there was a proposed upgrade related to increased Potash production, with diversion of water from Diefenbaker to the Qu'Appelle River. Also, Alberta is looking at additional water use, which would again limit the volume of water that flows in the Saskatchewan River. However, it was pointed out by another participant that it is the seasonal pattern of flow alteration and hydropeaking that is the issue at EBC, and it would not be worth focussing on small withdrawals from the total annual flow. Again from a scientific perspective, the discussion here needs to focus on EBC; what can be done for fish and fish habitat?

From SaskPower perspective, the fisheries issues were previously reviewed by an Advisory Committee involving SaskPower, DFO, and the Province of Saskatchewan, and decisions like the situation for EBC are looked at outside of the *Fisheries Act* authorization. This committee also decided, it was not necessary to go forward with authorizations for other existing facilities. These are management decisions and discussions that are not relevant to the Science Advice being discussed at this meeting.

The Chair pointed out that the information from SaskPower presented today was useful. However, it was not presented to participants before the meeting. Therefore, it was difficult for participants to determine how to incorporate it into the existing working paper or as another working paper to be used in the provision advice but it substantiates the need for a broader, integrated water management plan for the Saskatchewan River.

The use of Wetted Useable Area rather than the Weighted Useable Area was discussed. The authors of the working paper further explained the differences between the two calculations and referred to the Research Document. A decision was made by the participants to include the HSI in an Appendix of Research Document.

Several participants identified their concern that the minimum instream flows calculated in the working document are not often met because the river system simply cannot meet these flows during dry periods. One participant suggested that if high minimum flows are recommended for

use by EBC and these discharges are not attainable every year, it would be useful to build that point into the "variation" discussion (i.e., natural variation of rivers also have periods of low flows and fish are adapted to the fact that not all years provide for ideal Wetted Usable Area). The suggestion to use proportions based on the mean moving average daily inflows to EBC could be explored as an option when flows are low at EBC.

Within the working paper, the authors prepared some recommendations for the participants to consider as a starting point for the SAR bullet points. These recommendations would be removed from the working paper once the document is finalized as the Research Document and the SAR is final.

REVIEW OF SUMMARY BULLETS AND UNCERTAINTIES

Based on the information provided, there are changes to the hydrograph pre- and post-dam construction, and there is a clear winter flow pattern to generate electricity. Despite the recognition by participants of the impact from upstream facilities on the river, changes in flows overall are less severe than from the current hydropeaking regime. A discussion followed about the major shifts in water use in the 1960s from irrigation to agriculture and that some of the water diversions are over 100 years old. It was agreed to rework the bullets of the SAR to reflect the complicated water management system that is upstream of EBC. However, it was agreed that it should not include the 13% value that was presented in the morning as this was new information, and is based on an annual average of 30 years of data, so the net loss in summer must be larger than 13%. It was pointed out by one participant that those numbers are from the application for the *Fisheries Act* authorization that has been submitted to DFO FPP. In spite of this, it was again recommended by a participant that we recognize that the system is highly managed, but we don't have the information in our hands to review numbers specifically, and it is more important to focus on what EBC is currently doing and the things that can be done to minimize impacts to fish and fish habitat despite the issues upstream.

Weighted Useable Area was discussed in the morning of Day 2 but was again brought up here for the summary bullets. A suggestion was made to drop the word "optimal" from the summary bullets. The working paper authors were asked how those numbers were developed. A rule was set up to pick inflection points based on a simple math equation in an Excel spreadsheet. The flows were modelled on 50 $m^3 s^{-1}$ increments and if it was greater than 1% Weighted Useable Area per increment, than the associated flow increment was chosen.

There was a recommendation in the working paper that minimum flows in each BSP be not lower than some minimum value; however, SaskPower does not believe this is sustainable during dryer years within the greater watershed (i.e., the facility does not have capacity to deliver it alone). One participant acknowledged that while the flows are interesting and important, it may be that the pattern of flows for each BSP that are more important. If this is not obtainable operationally, then SaskPower and the Province of Saskatchewan need to discuss. A participant suggested that another way to calculate values is to use a percentage of flow. For BSP2 and 3, you could increase flow percentages so that they are relatively higher than the other BSP. Another participant supported this concept, but only if other water users could be convinced to release flow in various years. In the context of hydropeaking, the risk to fish is minimized if SaskPower can minimize flows below 500 $m^3 s^{-1}$. There is less concern above 500 $m^3 s^{-1}$.

It was noted by one participant that since the construction of the EBC, there are no longer any 10–20 year cycles of higher flows, he also reiterated the need to focus on water quality in addition to quantity. The participant also noted that minimum flows need to be higher in winter than they currently are and suggested using the knowledge of local fishers who observe the

environment regularly. The change in minimum flow implemented in 2004 definitely helped in regards to flows, but still need to focus on ways of restoring sediment dynamics of the river and the delta.

A conceptual table demonstrating an approach for percentage of flows calculation for each BSP was presented by the working paper author. He noted that the hard numbers need to be examined further but that this was an example to show how the "pattern" of flow could be established, and at the end of the day, DFO FPP and SaskPower would have to negotiate the reality of operation. Participants agreed that this example should be presented in the SAR conclusions.

One participant asked where 10–15 cm/h down ramping rate came from in the working paper? When you are down ramping flows from 300 to 91 $m^3 s^{-1}$, it represents a drop of a meter at the tail race river elevation. This level of down ramping is typically conducted over the period of an hour. If the 10–15 cm/h was implemented at EBC, starting at flow of 500 $m^3 s^{-1}$ and down ramping at 10–15 cm/h would require about 12–13 h. Other dams (e.g., in British Columbia and the U.S.) are way more restrictive but the river systems are also smaller. A participant suggested that you could look at the North/South Consultants report on stranding and down ramping rates because they also added some sites further downstream. One participant noted it is a tricky issue and needs to be further evaluated rather than be proposed as a hypothesis here in the SAR as season, type of flow, and time all play a role in down ramping. The participant further suggested finding some biologically important areas downstream to examine how down ramping affects natural channel processes rather than just the tailrace. Elimination of daily flow rate changes would be ideal for the ecosystem, however, is not practicable. One participant hesitated to recommend 10–15 cm/h without studies to confirm its application to the Saskatchewan River. A study should be conducted to look at stranding in flows below 500 $m^3 s^{-1}$, and until such a study is conducted, this would be a source of uncertainty in the SAR. It was noted that in British Columbia, there are small hydro projects developing a protocol on data collection and management. They use monitoring to develop a site specific ramping protocol, and currently use 100 cm/h. It is safe to say that down ramping is not biologically ideal, and that is why it is authorized. A participant suggested not put a number in the bullet points of the SAR, this remains an obvious gap; perhaps more examination of the data can assist or future research.

A participant acknowledged that Lake Sturgeon no longer use the old river channel as habitat, but they are using the channel immediately below the facility. It appears the population is doing quite well, so wonders if there is anything that needs fixing. Another participant noted that the 16% of water that was promised to be restored was never done, which lead to the shrinking of Cumberland Lake area. The geomorphological study has shown the impact; a mile and a half of willows have grown from the shore, therefore a loss of fish productivity is assumed. We are not sure if the Lake Sturgeon are limited by spawning habitat. Another participant noted that the evidence is based on changes in cohort size with flow rates. It is not unusual to expect good and bad years of recruitment to the population. It has been identified that higher daily discharge has an impact on periods when fish are spawning, consequently, upstream flow rates may need to be adjusted accordingly to meet Lake Sturgeon spawning requirements.

The two-week period of BSP3 that was identified for Lake Sturgeon appears to be between the spring local runoff and the summer mountain runoff. Over a ten-year average, that flow is not present consistently during the BSP3 for Lake Sturgeon, it is present two weeks later, so maybe the BSP need to be modified. A participant added that these runoff flows have been occurring later in the year from the historic flows. Considering the life history of Lake Sturgeon, those flows do not need to occur every single year; there is some evidence that only years with high flows is the only factor for successful Lake Sturgeon spawning and that maybe the timing in

when the peak occurs is too late in some years because of the temperature requirements for successful spawning are also need to be met. One participant noted that Lake Sturgeon start their spawning when the leaves start to come out on trees. Another participant suggested an adaptive management approach, if we know that major floods are important for the riverine system, and spawning connectivity then we should be regulating them by passing them on during important BSP. Unless you can design a water management plan more holistically, we will have little control over what is good for the fish. Timing of early flows needs to be passed on as early as possible, and this is not currently happening. One participant noted that EBC passes what they get and cannot change the timing by storing water. When they draw down the reservoir (starting in February), they do it slowly while there is still ice on the river. Some discussion about the Codette reservoir and its capacity to store water, even though it is 90 m deep, it is very narrow, so fills and empties rapidly during hydropower generation.

A number of mitigation options was discussed in addition to the overall flow management (e.g., Old Channel, spillway). All mitigations were discussed in the context of how they can be most beneficial to fish and fish habitat.

- Reconnection of the Old Channel downstream: This could include dredging the blockage at the entrance, or providing flows higher than 500 $m^3 s^{-1}$ and holding those for a time to allow fish to spawn and hatch and leave the channel.
- Adding continuous flow in the spillway will increase the available wetted habitat and reduce stranding in the spillway. Re-sculpturing the riverbed in the spillway channel to reconnect isolated pools and reduce the bed elevation could also be additional measures.
- A participant again recommended adaptive management in a given year based on water availability (i.e., a holistic water and sediment management plan in the Saskatchewan River).

A general broad ranging discussion on the working document and SAR followed. The working paper was accepted as the Research Document to support the SAR.

- For the Research Document, it was requested that the participants in the expert meeting on BSP be added, or if a reference was available that should be included.
- Participants wanted to be sure that both in the SAR and the Research Document the BSP for Lake Sturgeon is recognized as 700 $m^3 s^{-1}$ daily instantaneous flow (i.e., distinct from the general BSP3).
- For the SAR, the table on percentage of flow should be explicitly presented as an example of how a flow regime could look but is not prescriptive.
- Since there is a structure on the river system, it was recognized by participants that the goal of zero stranding is unrealistic; however, reduction to the lowest possible stranding rates should be the goal. DFO FPP will decide what offset is required. The current down ramping schedule for EBC has reduced stranding to date, so any further change to down ramping would need to be discussed and an acceptable number of stranding determined. One participant suggested that stranding in the side channels will always happen downstream until sediment is allowed to accompany flows. The river keeps cutting down. Stranding happens daily but also seasonally with perching of side channels.
- We know what water level changes are in the spillway channel with changing flows, but not the Weighted Useable Area, this may be something to consider in the future.
- For Lake Sturgeon, a discussion about combining the two strategies (absolute and percent of minimum Instream Flow Needs) was recommended by one participant meaning that we

need 700 $m^3 s^{-1}$ during the for Lake Sturgeon BSP3 spawning period when those flows are available, it is not necessary every year based on Lake Sturgeon life history. This should be reflected in the SAR summary bullet.

- The important channel forming flows (i.e., connectivity) would minimize the peaking of flows as well. A summary bullet that identifies that a flow of >1000 $m^3 s^{-1}$ has the potential to increase productivity and therefore storing high flows upstream should be avoided.
- Adaptive management will be important to the success of mitigating harm to fish and fish habitat. This can be accomplished through monitoring and future modifications based on additional knowledge.

Participants agreed that one summary bullet in the SAR should explicitly indicate the general uncertainties. A list of uncertainties that should be captured within that section of the SAR are:

- Participants agreed that this system is heavily managed, and yet there are many data and knowledge gaps and degrees of uncertainty throughout. For example, in the case of EBC, we do not really know the impact of the last flow modification that was made in 2004 on the fish populations (e.g., abundance, distribution). Pre- and post-monitoring are necessary to identify change and/or impact from a change/modification.
- Much of the basic understanding of the biotic/abiotic environment is lacking. For these areas, it will be important to include traditional knowledge to help reduce uncertainties and/or focus research and monitoring questions.
- The concern around the presence of gas bubbles is an unknown; however, at this time, too little is known and it not a manageable feature, so it did not make the list of priorities at this time.
- A participant asked if ice dynamics downstream of EBC are an issue? Since there was not data collected for winter, this was identified as a data gap.
- With respect to the sediment section, participants agreed that there is a need to further understand Phosphorus in the system; where is it being deposited and made available.
- Spillway channel habitat suitability could be considered (similar to Sites 1, 2 and 3) in the future for habitat modelling. Some Lidar information is available that shows that at 50 and 100 $m^3 s^{-1}$ flows the Wetted Useable Area does not look different. However, a participant identified that it would be impracticable to maintain 500 $m^3 s^{-1}$. It is hard to block fish from moving up during high flows and structures would likely be washed out.
- There is no information on fishing effort, therefore this Science Advice cannot comment on the status of the fish populations. We assume sustainability based on the applications from the commercial fishing. Catch per Unit Effort (CPUE) data from the fisheries is currently a gap.
- Participants also identified that there is not a lot of data on the water levels downstream of EBC and how that changes with flow.

The Chair thanked everyone who participated in person and by phone. The Science Advisory Report (SAR) and Proceedings will be drafted over the next few weeks and then sent to the participants for their review. The Research Document will be revised and provided to participants for their final review in the next few months.

The meeting was adjourned.

REFERENCES

Ashmore, P.E., and Day, T.J. 1988. Spatial and temporal patterns of suspended-sediment yield in the Saskatchewan River basin. Can. J. Earth Sci. 25: 1450-1463.

Euteneier, D. 2002. Water fluctuations in the Saskatchewan River Delta complex, Cumberland Lake area. Saskatchewan Water and Infrastructure Management Division, Prince Albert.

Mihalicz, J.E. 2018. Effects of hydropeaking dam on river health and benthic macroinvertebrate secondary production in a Northern Great Plains river. MSc Thesis. University of Saskatchewan. 82 pp.

APPENDIX 1: TERMS OF REFERENCE

Assessment of the Instream Flow Needs for fish and fish habitat in the Saskatchewan River below the E.B. Campbell Hydroelectric Station

Regional Peer Review – Central and Arctic Region

May 9-10, 2018
Winnipeg, MB

Chairperson: Eva Enders

Context

The E.B. Campbell Hydroelectric Station, owned and operated by SaskPower, is a hydropeaking facility on the Saskatchewan River near Nipawin, SK. The *Fisheries Act* authorization of the E.B. Campbell Hydroelectric Station will expire on June 30, 2018. Fisheries and Oceans Canada (DFO) Fisheries Protection Program (FPP) is seeking science advice on Instream Flow Needs (IFN) to help inform a new *Fisheries Act* authorization, including measures to avoid, mitigate, and as necessary, offset serious harm to fish and fish habitat as a result of the ongoing operations of the existing facility.

The present *Fisheries Act* authorization includes a minimum flow release of 75 $m^3 s^{-1}$ and was followed by a research study (conducted April 2005 to March 2007) to evaluate impacts on fish habitat. The results from this study, as well as additional reports, data, and publications were summarized in an unpublished 2008 DFO report. In March 2012, DFO provided national guidance on IFN (i.e., +/- 10 % of instantaneous flow; 30 % of mean annual discharge), however, cautioned that when data are available, a more detailed technical examination is required on the effectiveness of the recommended thresholds, in particular for cases of hydropeaking (DFO 2013). FPP has requested DFO Science to update the unpublished 2008 DFO report with a description of E.B. Campbell Hydroelectric Station's flow regulation impacts on fish and fish habitat, and provide IFN recommendations.

Objectives

The objectives of the peer review are:

1. to evaluate the assessment of the IFN for fish and fish habitat in the Saskatchewan River below the E.B. Campbell Hydroelectric Station based on available science data; and,
2. to identify potential avoidance, mitigation, monitoring, and offsetting measures and to inform contingency planning.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Expected Participation

- Fisheries and Oceans Canada (DFO) (Science, and Ecosystems and Fisheries Management sectors)
- Province of Saskatchewan (Water Security Agency, Environment)
- Corporate and private industry
- First Nations

- Academia
- Other invited experts

References

DFO. 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/017.

APPENDIX 2: LIST OF MEETING PARTICIPANTS

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APPENDIX 3: MEETING AGENDA

Fisheries and Oceans Canada

Canadian Science Advisory Secretariat (CSAS)
Regional Science Advisory Workshop

Impacts of the operations of the E.B. Campbell Hydroelectric Station on fish and fish habitat in the Saskatchewan River below E.B. Campbell

May 9-10, 2018
Large Seminar Room
Freshwater Institute
Winnipeg, MB

Chair: Eva Enders

Day 1 – Wednesday, May 9, 2018

9:00 a.m. Welcome and Introductions (Chair)

- Participant Introductions - Please be prepared with a few sentences about the expertise you bring to the table
- Terms of Reference and Meeting Objectives
- Review Agenda
- Overview of CSAS peer review process

9:15 a.m. Opening Remarks (D. Boguski)

9:30 p.m. Working Paper – Hydrograph section (D. Watkinson)

10:00 p.m. BREAK

10:15 p.m. Discussion

12:00 p.m. Lunch

1:00 p.m. Working Paper – Fish Habitat section (D. Watkinson)

1:30 p.m. Discussion

2:30 p.m. BREAK

2:45 p.m. Working Paper – Flow recommendation section (D. Watkinson)

3:00 p.m. Discussion

4:00 p.m. Day 1 Wrap-up

Day 2 – Thursday, May 10, 2018

9:00 a.m.	Review Day 1 (Chair)
9:15 a.m.	Review of summary bullets
10:00 a.m.	BREAK
10:15 a.m.	Discuss uncertainties
11:00 a.m.	View documentary on the impacts on the Saskatchewan River Delta
12:00 p.m.	Lunch
1:00 p.m.	Discuss future monitoring plans and research needs
2:00 p.m.	Review Draft Science Advisory Report
3:45 p.m.	Concluding remarks (Chair)
4:00 p.m.	Meeting Complete – THANK YOU!