Reviewer Comments and Proponent Responses

Project: Jackfish
Board: Mackenzie Valley Land and Water Board
Organization: Northwest Territories Power Corporation (NTPC)

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
GNWT-ENR - EAM (Environmental Assessment and Monitoring) - Environmental Regulatory Analyst					
1	Cover Letter	see attached	N/A	NTPC thanks ENR-EAM for their time reviewing the Jackfish Hydro Thermal Plume Delineation Study	Noted
2	Habitat Classification	Figure 2.3-2 of the Thermal Plume Delineation Report (the Report) shows the transects followed for sonar imagery evaluation of habitat classification. The Government of the Northwest Territories (GNWT) Department of Environment and Climate Change (ECC) notes that the area nearest the discharges does not appear to have been surveyed and it is unclear why it was not included.	ECC recommends that Northwest Territories Power Corporation (NTPC) discuss the transects used for sonar imagery, specifically including rationale for the omission of the area nearest to the discharges.	Figure 2.3-2 was provided to illustrate the approach taken for assessing fish distribution and habitat classification, to aid interpretation. Only the coarse (100-m grid) transect was depicted. Two other transects were surveyed and analyzed with the same methods and are shown in Figure 2.3-1: a perimeter survey (at approx. 4 m depth) and a fine scale transect (10 m grid) in the area most likely to be impacted by a thermal plume, near the discharges	Board requires NTPC to update the Report to include the explanation.
3	Typo	Section 4.0 of the Report states that “For the late fall, late winter, and spring freshet period these increases were less than 1°C for less than 1% of the lake surface.” ECC notes that this is likely a typo. It may be intended to say “…more than 1°C…” rather than “…less that 1°C…”.	ECC recommends that NTPC review the above-noted statement and revise as needed to ensure that it is accurate.	Correct, edit should read: that “For the late fall, late winter, and spring freshet period these increases were limited to less than 1°C for approximately 99% of the lake.”	Board requires NTPC to update the Report to include the edit.
4	Temperature Monitoring	Section 4.0 of the Report includes a recommendation that continuous temperature monitoring be conducted throughout the open water period. ECC notes that the recommendation	ECC recommends that NTPC provide information on the locations where it is recommended that continuous temperature monitoring be	NTPC will provide information on proposed locations for monitoring, if appropriate, in the AEMP Design Plan.	Noted

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		does not include any detail on the locations at which this monitoring should take place.	conducted during the open water period.		
Environment and Climate Change Canada (ECCC) - Eva Walker					
1	Intake design - Section 1.0 Introduction, pg. 13/930; Section 2.3.2.1 Field Methods: Thermistors, pg. 24/930	Some background information regarding the plant design, specifically the intake and discharge designs, is provided in the introduction. Further information on the depth of intakes (i.e., distance above lakebed), distances between intakes and discharges, intake rates, discharge rates, discharge schedule over the monitoring period, etc. would aid in facilitating the review, validating model scenarios, and determining the level of risk to the aquatic environment.	Environment and Climate Change Canada (ECCC) recommends that the proponent provide further information on the intake and discharge designs, the frequency at which discharges occurred over the monitoring period, and the lengths of time that discharges occurred for.	Intakes for each plant are located near the lakebed and thus their positions are estimated based on design and as-built drawings of the plants as they could not be accessed in the field. These locations are shown in Figure 2.2-1. Water depths at the assumed location of the intakes at the time of the bathymetric survey were 4.3 m at K, 6.2 m at EMD, and 4.4 m at CAT. In addition to the details regarding discharge rates and schedule over the monitoring period, a table and plots of flows and delta-Ts through each plant over the monitoring period have been provided in Attachment 1 of this document.	Proponent's response is satisfactory.
2	ECCC Cover Letter	ECCC Cover Letter	NA	NTPC Thanks ECCC for their time reviewing the Jackfish Thermal Plume Delineation Study	Noted
3	Intake discharges - Section 2.5.2.1 Thermistors, pgs. 37-38/390; Section 2.2 Sampling Stations, pgs. 20-21/930	Section 2.5.2.1 discusses the results of the thermistor monitoring of temperatures at the intakes and discharges for each plant over the course of the entire monitoring period. In Section 2.5.2.1 Figure 2.5-2, it is noted that K-plant has greater differences in temperatures between the intakes and discharge, and that thermal stratification was only observed at this plant. The provided	ECCC recommends that the proponent provide further information and discussion on the depths of the intakes for each plant. This discussion should include the potential for interference by nearby discharges on the intake temperatures at each plant as well as how temperatures may vary between seasons and with	Stratification effects at K plant: The higher discharge temperatures at K plant recorded by thermistors shown in Figure 2.5-2 are likely due to the configuration of K plant, where water is withdrawn from the lake and held in a pumphouse before it is pumped through the cooling loop and discharged back to the lake. During summer, this may increase the temperature of the water prior to its	Board requires NTPC to update the Report to include the explanation

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		reasoning for this difference in temperatures and stratification was that the discharge thermistor could have been situated in warmer surface waters than the intake. While this could be true, this would have been the same case for all of the plant discharges and is difficult to verify without further information on the intake depths. Additionally, it is noted from Figure 2.2-1 pg. 21 Section 2.2 that discharges and intakes for all three plants are located relatively close together, with K-plant located at the most north-west location. The possibility of plume discharges from one plant causing elevated temperatures at the next closest intake should be considered. Due to the close proximity of the plant intakes and discharges, depending on the time of year and direction of currents, the discharge thermal plume extents overlapping with intake locations may be causing elevated intake temperatures. This would then interfere with the calculation of differences between intake and discharge temperatures, as the intake temperatures would be elevated above ambient conditions. A comparison of intake temperatures to in-lake reference temperatures at similar depths would aid in determining if temperatures at intakes are elevated due to plume	changes in current directions, and a comparison of intake temperatures to in-lake reference temperatures at similar depths, if data is available. ECCC also recommends that the proponent provide further information regarding the intermittent temperature increases at the CAT plant discharge, including information on maximum temperatures, temperature differences between intake and discharge, duration, and potential causes.	passage through the cooling loop. Because thermistors are installed at the intakes in the lake, and on the end of the discharge pipe in the lake, additional heat that may be added from holding is not directly measured by thermistors which results in an appearance that is consistent with stratification. The SNP intake temperature data from K plant measures intake temperature of water after it has been pumped from holding and before the generator, which has a very similar temperature profile to the temperatures measured by the K plant discharge thermistor. Intake Locations Refer to ECCC-1 Calculation on differences between intake and discharge temperatures Intake and discharge temperatures are measured inside the cooling water loop of each plant, with intake temperatures recording inflow temperatures prior to the application of thermal loads from operations and outflow temperatures being recorded after the application of thermal loads. As such, the delta-T calculated using these data reflects the heat load applied by each plant, irrespective of whether the intake temperature is elevated through thermal discharges from other plants or not. Consequently, there is no interference	

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		interference. Finally, it is noted in Figure 2.2-1 pg. 21 Section 2.2 that there are many temperature spikes occurring at the CAT plant discharge that are not seen at the other plant discharges. No explanation has been provided for these variations.		in the calculation of delta-Ts (temperature differences) through each plant used to define the thermal loading from each plant to the lake. Temperature Spikes at CAT Plant We assume this question is referring to Figure 2.5-2 rather than Figure 2.2-1 and have responded accordingly. The data presented on Figure 2.5-2 are of lake thermistor data, positioned at the discharge locations for each plant. These temperature spikes occur when the plants generate power. As shown on Figures 1 through 3 in Attachment A attached to this comment response document, temperature spikes (measured inside the plants and used for modelling) occurred at EMD plant more frequently than at CAT plant. This could suggest that the EMD discharge thermistor is no longer affixed to the discharge which could only be verified by commercial divers, and the temperature data recorded from inside the plants should be taken as more reliable.	
4	Assessment of effects to fish - Section 3.1.3 Assessment of Effects to Fish and Fish Habitat, pgs. 55-56/930	It is unclear why the assessment of effects to fish and fish habitat is so limited. Based upon the provided fisheries information, Lake Whitefish is likely the most thermally sensitive cold water fish species present in the study area, and it is accurate to use as the representative species for the assessment. However, very little information about Lake Whitefish has	ECCC recommends that the proponent review the provided ECCC guidance document and update the results and conclusions of the assessment based on the following: - The assessment of effects to fish and fish habitat should be updated to provide an assessment of risk to the most	The approach taken for assessing impacts on the fish community and fish habitat is aligned with the provided ECCC guidance document, provides the most appropriate thermal benchmarks, and is consistent with the study design for the program. Appropriate thermal benchmarks For Lake Whitefish young of the year	Proponent’s response is adequate. Consideration and alignment with ECCC’s recommended guidance has been completed by NTPC. Board notes that ongoing monitoring will occur through the AEMP and refinements to that monitoring can be considered through the AEMP Annual Report and AEMP Design Plan.

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		been provided despite it being a well-studied species for thermal sensitivity. It is stated that: "An optimal thermal niche of 15.5°C to 19.5°C for juvenile Lake Whitefish growth (Edsall 1999) was used as a generalised reference range for evaluating operational effects on fish community long-term growth. Alternate guidelines are available for specific Lake Whitefish life history stages (e.g., egg incubation, rearing, and spawning; BCMOE 1981); however, this information was not available to assess the dynamics of these life stages and a generalised approach was required to assess impacts on the fish community in Jackfish Lake as a whole. The assessment was also bound to the early and late summer model periods when the impacts of thermal discharge from the plant were likely to be most apparent." Environment and Climate Change Canada (ECCC) has published a guidance document on Environmental Effects Assessment of Freshwater Thermal Discharge (https://publications.gc.ca/collections/collection_2019/eccc/En14-102-2019-eng.pdf) which provides information on conducting thermal risk assessments, including: selecting representative species from warm-, cool-, and cold-water guilds, conducting reviews based on the most sensitive life-stages present, and information on available thermal	thermally sensitive lifestages (ex. Egg development stage) of selected coldwater and warmwater representative species, to determine the level of risk to fish community long-term growth. This should include an evaluation of the most appropriate thermal benchmarks to utilize based upon data availability, comparison of measured temperatures to selected thermal benchmarks, and an evaluation of spatial extent of potentially impacted habitat. - The risk assessment should not be limited to just the spring and summer seasons but should instead consider the presence of sensitive life stages of selected fish species.	ECCC document recommends a range of critical upper thermal limits from 20.62 °C to 26.65 °C, depending on acclimation temperatures. At a moderate acclimation temperature of 15 °C the upper thermal threshold is 25.78 °C. The thermal niche used for this assessment (max 19.5 °C) is below these thresholds and conservative compared to the ECCC guidelines. The 19.5 °C threshold value also coincides with the upper avoidance limit defined for migrating Lake Whitefish (19 °C; Coutant 1973) cited in Oliver and Fidler 2001, which were used to establish BC water quality guidelines. Most thermally sensitive life stages Juvenile Lake Whitefish life stages (including young of the year) were used as the representative life stage and species for the following reasons: - They inhabit the lake in areas expected to be impacted by a thermal plume. - Lake Whitefish spawning habitat (cobble and gravel benthic substrates at 2 to 4 m depth) was not identified as being unique or - concentrated in the area of the outflows, rather, spawning habitat was distributed throughout the lake such that risk of exposure would be low. See report Figure 2.5-5. - The thermal plume was predicted to be of limited spatial extent and duration for the hypothetical scenario, with relatively small aerial extent,	

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		benchmarks for a variety of species and life stages, including Lake Whitefish. It is recommended that proponents conduct their own additional research into determining available thermal benchmarks for selected representative species due to geographical and environmental differences in the study areas, however, the guidance document can provide supplemental data if needed.		higher temperatures aggregated at the surface, and temporally bound to the Facility operation period. - For the hypothetical scenario, temperatures expected to exceed juvenile Whitefish thermal thresholds in the plume (max 19.5 °C) were limited to the surface, limited to periods when the facility is operating, and not present at the benthic substrate. Substrate habitat quality (including temperatures) is of critical importance to egg development and spawning and was not identified as a concern for this assessment. - Thermal plumes predicted for the egg development period (September to January) did not approach thermal optima for incubation defined in the ECCC document (4-6°C). See Figure 39 and 40 of Appendix A. Warm water representative species A warm water species (e.g., likely Northern Pike) was not considered because effects on Lake Whitefish were considered representative of the most severe impacts on the fish community in the lake Oliver, G.G. and L.E. Fidler. 2001. Towards a Water Quality Guideline for Temperature in the Province of British Columbia. Aspen Applied Sciences Ltd. Report to the BC Ministry of Environment, Lands and Parks.	

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
				Coutant, C.C., 1973. Effect of thermal shock on vulnerability of juvenile salmonids to predation. Journal of the Fisheries Board of Canada, 30(7), pp.965-973.	
5	Measurement point for fisheries assessment - Section 3.1.3 Assessment of Effects to Fish and Fish Habitat, pgs. 55-56/930	It is unclear why an intermediate point 100 m from the discharges has been selected as the measurement point for the fisheries assessment. The entirety of the thermal plume should be assessed to determine the potential for acute and chronic effects to fish and fish habitat, as well as the spatial and temporal extent of potential effects.	ECCC recommends that the proponent review Comment 3 and the provided ECCC guidance document. ECCC recommends the proponent provide either a rationale for selecting the 100 m measurement point OR update the assessment of effects to fish and fish habitat to include the entirety of the plume.	The 100-m interval was selected to provide an intermediate reference point between the discharge locations and the nearest temperature monitoring locations farther out in the lake. The 100m points are more likely to be directly impacted by a thermal plume than the temperature monitoring station farther out in the lake. Selection of the location was based on the shapes of the predicted thermal plumes (the centroid at 100m) under the hypothetical scenario during the period of interest (early and late summer periods). This provided a reasonable assessment of the impacts experienced by the reference species, Lake Whitefish, during the monitoring period of 2021/2022. This approach was considered the most robust approach for assessing the impacts of modelled thermal plumes on the fish community using the predictions at the 100 m interval as a conservative characterization of the entirety of the plume.	Board requires NTPC to update the Report to include the explanation
6	Temperature - Section 3.2.1.2 Effect of Measured	ECCC noted that in Table 3.2-2 that at the lake bottom 99% of the extracted area of the 95th percentile extents (51 ha of the 95th percentile extents) is	ECCC recommends that the proponent provide more information on the maximum temperature effect and extent.	Temperature Section It should be noted that Figure 3.2-4, which depicts median plume extents at lake surface does not correspond to	Board requires NTPC to update the Report to include the corrected information as explained in the Proponent's response.

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
	Operational Discharges on Jackfish Lake, pgs. 60-63/930	greater than 0.3°C. This is vague as no maximum temperature is provided, yet the majority of the temperature effect occurs at greater than 0.3°C. Additionally, Figure 3.2-4 which corresponds to Table 3.2-2 does not seem to accurately represent this temperature effect.	Figure 3.2-4 should be updated to accurately represent the temperature effect.	the 99% value alluded to in Table 3.2-2, which presents 95th percentile lake bottom temperatures. Instead, Figure 3.2-6 should be used. Nevertheless, a versioning error in the results used to develop some tables was detected upon review of ECCC comments which has resulted in updates to Tables 3.2-2, 3.2-7 and Figure 3.2-5. Though these changes are not material to the results or conclusions, they did require corrections and should now facilitate easier comparisons between Figures and Tables.	
7	Temperature simulation periods - Section 3.2.1.3 Seasonal Water Temperatures in Jackfish Lake Resulting from Hypothetical Maximum Operational Discharges pgs. 65-79/930	In this section hypothetical simulation results for five different periods are discussed. A late fall simulation between October 21st and 25th 2021 is examined, and then the next consecutive simulation period examined is April 10th to 14th 2022. This is a significant time gap over winter considering the next simulation period is May 25th to 29th, only a month later. Often thermal plumes present some of the greatest temperature risks during the winter months due to there being greater differences between discharge temperatures and ambient temperatures, as well as increased operational demands during the winter months.	ECCC recommends that further analysis and thermal plume delineation is provided with an early winter hypothetical simulation occurring sometime in November to December, with consideration of presence of sensitive life stages for representative fish species	Regulatory feedback on the thermal modelling plan (MVLWB 2019) specifically requested operational conditions on Jackfish Lake to be examined under the following conditions: late fall, late winter immediately before ice break up, spring freshet, and late summer. Hence, a hypothetical worst case mid-winter condition was not modelled. It should also be noted that the thermal regime of Jackfish Lake is slightly different than that of typical of lakes situated much further to the south. Being located in a discontinuous permafrost zone, the accumulation of thermal loads under periods of ice cover, which can indeed show higher differences between operational and non-operational temperatures in warmer climes, is significantly reduced. As such, the influence of cooler	Proponent response is satisfactory.

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
				substrate temperatures in Jackfish Lake relative to many others in the south of Canada, means that the largest temperature differences between operational and non-operational conditions occurs in the summer. Reference: MVLWB (Mackenzie Valley Land and Water Board). 2019. Type A Water Licence MV2019L1-0001. 18 October 2019	
8	Hypothetical simulations - Section 3.2.1.3 Seasonal Water Temperatures... pgs. 65-79/930; Appendix A Section 2.4.8.3 Application of Operational Data to Thermal Modelling Assessment pgs. 112-115/930	In this section the hypothetical simulations have a hypothetical maximum operational heat load applied to them based upon a real maximum heat load discharge event from December 23rd 12:30 to December 25th 19:00 2021. While the real heat load discharge event occurred over a 2.5-day period, these scenarios were played out over a 4-day period. It is unclear how the heat load event has been applied in each scenario. It is unclear if there is run time before and after the heat load event, why this may be included, and how it may influence the results of the event.	ECCC recommends that the proponent provide further information on how hypothetical scenarios have the heat load event applied, and how the duration of the scenario (4 days) versus the duration of the event (2.5 days) may influence the results of the analysis.	The hypothetical discharge scenario observed between December 23, 2021 12:30 through December 25, 2021 19:00 was applied across a one-year model simulation on five occasions, commencing with the outset of each four day period used to develop results. The four-day sequence used to represent each hypothetical seasonal discharges event therefore includes the 2.5-day discharge period, followed by 1.5 days to allow the thermal plume to vertically mix and influence bottom temperatures if conditions are favourable. Because hypothetical discharges are applied to a year-long simulation influenced by atmospheric and hydrologic influences, these four-day sequences also included adequate run time before each discharge event.	Board requires NTPC to update the Report to include the explanation
9	Figures - Section 3.2.1.3.1	Figure 3.2-7 does not seem to accurately correspond to Table 3.2-3 in this Section. Figure 3.2-7 seems to	ECCC recommends that further justification on the temperature ranges selected, and that tables	The table has now been updated to include 0 values rather than a hyphen (-) characters, but results remain	Board requires NTPC to update the Report to include the edit.

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
	Late Fall pgs. 65-67/390	depict delta T temperatures within the 1.5-1.75°C range, however Table 3.2-3 demonstrates that temperatures do not exceed the 1.25-1.75°C delta T range.	or figures are updated as needed.	identical. The reason that Figure 3.2-7 shows contours above the 1.5°C threshold and the table does not is because the 1.5 to 1.75°C contour amounts to 0.03 ha, which is applied as a '0' value after rounding to one decimal place.	
10	Late summer simulations - Section 3.2.1.3.5 pgs. 77-79/390; Section 3.2.1.1 Water Temperatures in Jackfish Lake under Measured Operational Conditions pg. 57/930; Appendix A Section 2.4.8.2 Review and Adjustment of Operational Data, pgs. 111-112/930	The late summer hypothetical simulation occurs from August 1st to 5th 2022. It is noted that in Section 3.2.1.1 and Appendix A Section 2.4.8.2 that operational conditions were simulated from July 22nd onwards, as no operational data could be used (unreliable measured temperatures). It is unclear how this may have affected the results of this particular analysis, as no discussion of these limitations is discussed in this section.	ECCC recommends that they proponent discuss the uncertainties and limitations of the model, with reference to how the late summer hypothetical simulation may have been impacted by the lack of operational data available either in this section or an independent section.	Please see response to ECCC Comment 5 for some context. A single simulation including five discrete 2.5-day discharge events was run over a full year with boundary conditions including measured meteorological, hydrological and substrate temperature conditions so that the effects of this largest observed discharge event could be properly evaluated under different seasonal conditions. This was deemed necessary for two reasons. Firstly, as noted in the ECCC comment, no operational data were available after July 2022. Secondly, operational heat loads were so infrequent and low throughout most of the monitoring period that a meaningful understanding of discharge effects under varying seasonal conditions required the application of the maximum observed thermal loading event, measured between December 23 and 25, 2021.	Board requires NTPC to update the Report to include the explanation
11	Lake surface temperatures - Section 3.2.1.3.5 Late Summer	It is noted in Table 3.2-7 that at the lake surface 0.2 ha of the 95th percentile extents are greater than 4°C. This is vague as no maximum temperature is provided, and Figure	ECCC recommends that the proponent provide more information on the maximum temperature effect and extent.	Acknowledged. This table has now been updated to include areal extents for the full range of modelling results, which was erroneously omitted due to a versioning error in the original	Board requires NTPC to update the Report to include the edit.

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
	pgs. 77-79/930	3.2-15 which corresponds to Table 3.2-2 seems to depict that in certain areas, of potentially greater than 0.2 ha, there may be delta T temperature differences of 4-7°C.		submission. It is noted that the results do not materially change the conclusions drawn in the original submission.	
12	Intake design and modeling inputs - Appendix A Section 2.2.7.2 Cooling Water Flow and Delta Temperature (Delta-T) Operational Inputs, pgs. 101-102/930; Appendix A Section 2.4.8.1 Intake and Discharge Configurations, pg. 110/930	As discussed in Comment 2, it is unclear how the close proximity of the intakes and discharges may have impacted the delta T calculations due to interference by the thermal discharges on intake temperatures. This may have also impacted the modelling inputs; however, no further information is provided in this section.	ECCC recommends that the proponent provide further information on whether there is any plume interference on intake temperatures and whether this has impacted modelling inputs.	Please refer to response under the third header in ECCC Comment 2.	Board noted that reference to ECCC-2 is not correct as that comment refers to the cover letter. Board assumed ECCC and NTPC meant reference to ECCC-3; see Board Decision for that comment.
13	Calibration station selection - Appendix A Section 2.3.1 Temperature Timeseries pg. 102/930	In this section it is stated that Southwest Bay, Mid-Lake, CAT discharge and K-plant discharge temperature data were dedicated to model calibration while Northwest Bay and EMD discharge temperature data were used for model validation. No further information or justification was	ECCC recommends that the proponent provide further justification for how stations were selected for either calibration or validation exercises, including any information on characteristics of stations that may make	It is agreed that the conventional approach for calibration and validation is to perform these tasks over two separate time periods. That said, the limited temporal availability of operational data, as well as the need to consider varying seasonal conditions in the calibration process, meant that	Board requires NTPC to update the Report to include the explanation

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		provided as to how it was determined which stations would be used for calibration versus validation, and there was no discussion regarding the possibility or options for different approaches.	selection of that station more optimal for one use versus the other.	an alternative, however not incorrect, approach was adopted. The locations selected for the calibration process were necessarily geared to maximizing spatial separation between loggers, as well as including the deepest water location available, at the Mid-Lake monitoring station. The far-field calibration location could have included Southwest Bay or Northwest Bay; however, it was decided that including the location most remote from the discharge locations made the most sense as it would be least influenced by thermal discharges and thus provide the best available examination of environmental influences on lake temperature conditions. Lastly, a subset of two of three in-lake discharge monitoring locations was selected, noting that K plant delivered almost no thermal loading throughout the monitoring period (see Figure 2 of Attachment A). As such, two monitoring locations remained, the first coinciding with the EMD discharge which delivered the highest thermal loading over the monitoring period and Northwest Bay, which was suitably remote from the discharge. Ultimately, the division of calibration and validation locations is reasonable	

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
				and fit for purpose, as borne out by the calibration and validation results presented in Appendix A of the report.	
14	Calibration and validation of models - Appendix A Section 3.2.1.1 Thermal Calibration Results pgs. 123-129/930; Appendix A Sections 3.2.2 Model Validation Results pgs. 130-134/930	In these sections the performance metrics for the calibration and validation of the model are presented. Based upon Figures 14 through 25 and Figures 27 through 32, the model appears to have a pattern of under predicting winter (November through April) temperatures, and over predicting spring (May to June) and late summer (August through September) temperatures. Additionally, based upon Figures 24, 25, 29, 31 and 32 the model has more difficulty predicting temperatures at greater depths as well as capturing the variability at greater depths, with a tendency to under predict temperatures. There is no discussion of how these trends may impact the results of the modelling.	ECCC requests that the proponent provide further information on how trends of over prediction, under prediction, and difficulty capturing variability of temperatures may impact modelling results and the effects assessment to fish and fish habitat.	Model calibration and validation metrics show that model performance is well within industry standards for three-dimensional models and particularly good for shallow lake environments. Like all sophisticated modelling platforms, perfect 3D-model performance is not expected and has not ever been achieved based on our knowledge of the industry. Secondly, model error is expected to remain similar for operational and non-operational conditions, seeing as the thermal dynamics of this lake are primarily driven by meteorological rather than operational effects. Given that the extent of operational effects is determined by subtracting the non-operational scenario results at each node, and for each time step, from operational scenario results, error in presented modelling results is expected to be relatively consistent between simulation scenarios, and well within the performance metrics presented. It should be noted that RMSE does not represent a simple arithmetic average of model error (which would be much lower than that presented) but is developed using a root mean squared error approach which provides a more conservative representation of model performance.	Board require NTPC to update the Report to include the explanation

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
MVLWB - Katherine Harris					
1	Section 2.3.2.1 Field Methods - Temperature Loggers	There appears to be an inconsistency in the temperature monitoring information. Section 2.1 (p. 7) states that the late fall sampling occurred September/October 2021, but text under Section 2.3.2.1 Field Methods - Temperature Loggers (p. 12) states that temperature monitoring was initiated on 5 October 2022. This date implies temperature monitoring occurred after the late summer program was completed in August 2022. Clarification is required.	Can NTPC confirm if there is an error in the identified text and clarify the date that temperature monitoring was initiated?	The date of the initiation of temperature monitoring included the incorrect year. The correct date of temperature monitoring under Section 2.3.2.1 is 5 October 2021.	Board requires NTPC to update the Report to include the edit.
2	Section 2.5.3.2 Spatial and Seasonal Patterns - Vertical Patterns in Jackfish Lake	Concentrations of total and dissolved manganese in the bottom samples collected on August 25, 2022 from station Mid-1 were reported as 594 m/L and 547 mg/L, respectively. Remobilization of manganese from the sediments under the observed low oxygen concentrations is provided as a possible explanation for higher manganese concentrations at depth and other metals (e.g., iron) show a similar pattern of increasing at depth at this station; however, the reported manganese concentrations are extremely elevated relative to other reported concentrations at station Mid-1 as well as other stations within the lake. Based on the information provided in Appendix B QA/QC Procedures and Results, these two data points for manganese do not appear to have been flagged and	Can NTPC clarify whether the results for total and dissolved manganese reported for the bottom sample collected at station Mid-1 on August 25, 2022 were verified by the laboratory and additional information to support why these data points should not have a caveat applied?	The total and dissolved manganese results from bottom samples collected at station Mid-1 on 25 August 2022 (i.e., 0.594 and 0.547 mg/L, respectively) were not verified with the laboratory because no quality issues were identified for these data based on a review of total versus dissolved concentrations (i.e., dissolved not greater than total by more than 30%), blank samples collected in August (i.e., no concentrations above 5X the detection limit) and consistency with historical ranges and patterns. In 2018, concentrations of total manganese at the bottom of the Mid Lake station were as high as 0.804 mg/L in July (i.e., higher than 0.594 mg/L observed in August 2023) and similarly much higher than other results reported in 2018 at the bottom of Mid Lake (i.e.,	Response adequate

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		verified during the QA/QC review. It is unclear why these data points were not reviewed further.		0.0275 to 0.1040 mg/L) or other stations in Jackfish Lake (Golder 2019). Mid Lake-1 is the deepest sampled location in Jackfish Lake and dissolved oxygen (DO) concentrations were less than 0.5 mg/L at the bottom when elevated manganese concentrations were identified; low bottom concentrations of DO are known to cause reducing conditions that can lead to release of manganese from sediments (CCME 2019). Of note, there were two instances of laboratory results for the 2022 data where manganese concentrations were verified by the laboratory because the concentration in the duplicate sample had a relative percent difference greater than 20% compared to the original sample. Dissolved manganese concentrations in the bottom sample collected at Northwest Bay -N (parent sample and duplicate) on 25 August 2022 and in bottom samples collected at Near Outflow – In Lake (parent sample and duplicate) on 6 July 2022 were verified by the laboratory by repeat re-analyses. References: CCME (Canadian Council of Ministers of the Environment). 2019. Scientific criteria document for the development of the Canadian water quality guidelines for the protection of aquatic	

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
				life: manganese. CCME, Winnipeg, MB. Golder (Golder Associates Ltd.). 2019. 2018 Environmental Monitoring Report – Jackfish Lake. Prepared for Northwest Territories Power Corporation, Hay River, NWT, Canada.	
3	Section 2.5.4 Fish and Fish Habitat - Figures 2.5-5 and 2.5-6	Figure 2.5-5 includes a single point labelled as a "diffuser". This does not accurately reflect the setup of the Jackfish facility as there is no diffuser, but rather multiple separate intake and discharge pipes that cover a span of the shore rather than a single point. No intake/discharge locations are identified on Figure 2.5-6. Clarification is required.	Can NTPC provide clarification on the intake/discharge pipe information provided on Figure 2.5-5 and omitted on Figure 2.5-6?	Refer to ECCC-1 reply.	Board requires NTPC to correct information related to intake/discharge pipes on these two figures.
4	Appendix B QA/QC	In Appendix B, Section 4.3.1 In Situ Field Measurements (p. 12), reference is made to a sample collected at the Mid-lake 1 station on 1 October 2022. This appears to be an error as the monitoring program was completed on 27 September 2022. Clarification is required.	Can NTPC confirm there is an error in the identified text and clarify the collection date for the referenced sample?	NTPC confirms there is an error; the collection date should read October 1, 2021 (i.e., not 2022).	the Board requires NTPC to update the Report to include the edit.
5	Appendix B QA/QC - Table 4-1	A summary of detection limits is provided in Appendix B, Table 4-1, with bolded text used to indicate where a reported detection level was above the quoted detection limit. The reported detection limits for xylenes, m,p-chloride, fluoride, xylenes, and o-xylene are bolded, but the reported detection limits appear to be lower than the quoted detection limits. It appears that an explanation regarding	Can NTPC confirm there is an inconsistency in Appendix B between the text provided on p. 13 and the footnote for Table 4-1 regarding the application of bolded values for chloride, fluoride, xylenes, m,p-xylenes, and o-xylene?	NTPC confirms there is an inconsistency in Appendix B between the text provided on p. 13 and the footnote for Table 4-1 regarding the application of bolded values for chloride, fluoride, xylenes, m,p-xylenes, and o-xylene. In Table 4-1, either the bolding for detection limits not above ALS detection limits should be removed or the footnote updated to say: Boldedvalues are above or	Board requires NTPC to update the Report to include the edit.

No.	Topic	Reviewer Comment	Reviewer Recommendation	Proponent Response	Board Decision
		the detection limits for these parameters as being lower than quoted is provided in the text on p. 13 of Appendix B, but this text is inconsistent with the table footnote. Clarification is required.		below ALS method detection limits.	
6	Appendix E	The main report document includes and Appendix E, which states on the cover page that "Appendices E1, E2, E3, E7 are provided electronically and E4, E5, E6 are provided in this Appendix E". Board staff note that Appendices E4, E5, and E6 are included in the main report document as stated, but they are also provided in the separate Appendix E (i.e., the separate electronic document includes all components not just a subset as stated) In addition, a separate file for Appendix E7 was provided, but this information appears to be included in the separate Appendix E document. In future, consideration of providing the information in only one location may be appropriate to avoid potential confusion. Clarification as to whether the information presented differs between the three files is required.	Can NTPC verify whether there are differences in the Appendix E-related information that appears to be included in more than one location and, if so, clarify what those differences include?	The identified sections/information in the report were provided in duplicate and in the future, NTPC will provide the sections/information in only one location.	Board requires NTPC to update the Report to include the edit.

Government of Northwest Territories Gouvernement des Territoires du Nord-Ouest

April 14 2023

Tyree Mullaney
Regulatory Specialist
Mackenzie Valley Land and Water Board
P.O. Box 2130 4922 - 48th Street
YELLOWKNIFE, NT X1A 2P6

Dear Tyree Mullaney,

RE: JackfishThermal Plume Delineation Study Report (MV2019L1-0001)

The Department of Environment and Climate Change (ECC), Government of the Northwest Territories has reviewed the application at reference based under its mandated responsibilities under the *Waters Act*. ECC has provided comments and recommendations on the Online Review System for the consideration of the Mackenzie Valley Land and Water Board at this time.

Please contact Celena Hoeve, Intern-Pollution Control Specialist with the Water Resources Group at Celena_Hoeve@gov.nt.ca if you have any technical questions.

Please contact GNWT_EA@gov.nt.ca with any general questions or concerns.

Sincerely,

Sjensen

Shakita Jensen
Regulatory Analyst
Environment and Climate Change

Environmental Protection Operations Directorate
Prairie & Northern Region
5019 52nd Street, 4th Floor
P.O. Box 2310
Yellowknife, NT X1A 2P7

ECCC File: 5420 000 001/015
MVLWB File: MV2019L1-0001

April 14, 2023

via online review system

Tyree Mullaney
Regulatory Specialist
Mackenzie Valley Land and Water Board
7th Floor, 4922 48th Street
P.O. Box 2130
Yellowknife, NT X1A 2P6

Dear Tyree Mullaney:

RE: MV2019-0001 – Northwest Territories Power Corporation – Jackfish Power Plant – Thermal Plume Delineation Study Report

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Mackenzie Valley Land and Water Board (MVLWB) regarding the above mentioned report.

Environment and Climate Change Canada (ECCC) provides expert information and knowledge to project assessments on subjects within the department's mandate, including climate change, air quality, water quality, biodiversity, environmental preparedness and emergencies. This work includes reviewing proponent characterization of environmental effects and mitigation measures, and providing advice to decision makers on activities needed to mitigate these environmental effects. Any comments received from ECCC in this context does not relieve the proponent of its obligations to respect all applicable federal legislation.

If you need more information, please contact Eva Walker at (867) 444-0394 or eva.walker@ec.gc.ca.

Sincerely,

Eva Walker
Senior Environmental Assessment Officer

cc: Melissa Pinto, Acting Head, Environmental Assessment North (NT and NU)