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Abbreviations and Acronyms

CDA	Canadian Dam Association
cfs	cubic feet per second
EIS	environmental impact statement
mm	millimetre

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EIS Guideline Reference: 7.6.2 Effects of the environment on the project

EIS Reference: 15.3 Effect of Extreme Weather and Climate Conditions on the Project; 15.4 Effect of Extreme Hydrological Conditions on the Project; 15.5 Effect of Long-term Climate Change on the Project

Context and Rationale

The EIS Guidelines state that effects of the environment on the project be considered in different probability patterns (e.g., 5-year flood vs. 100-year flood), under a range of future climate states; consideration of the potential impact of climate change on these probability patterns over the lifetime of the project and the discussion will include a description of climate data and projections used; and that details be provided of planning, design and construction strategies (or measures) intended to minimize the potential environmental effects of the environment on the project.

The EIS states that: the outlet channels and other structures will be designed to resist both normal and extreme physical environmental conditions, based on historical records and future climate; the design flood is anticipated to be between the 1 in 10-year and the 1 in 300-year flood event; and climate change is likely to increase the frequency, duration, and magnitude of extreme weather events, including extreme precipitation and flooding.

The EIS does not describe how flooding under future climate scenarios compares to the design flood of the project and does not provide details on how future climate scenarios were considered in the design of the project.

If the frequency and magnitude of future flood events or likelihood of channel breaches or infrastructure failure are underestimated, direct and cumulative effects to valued components, including federal lands, from the loss of flood protection integrity may be greater than predicted.

Information Requests

a) Provide an assessment of how the project will perform over its lifetime in the context of climate change, climate uncertainty, and increasing frequency, duration, and magnitude of extreme weather events. Specifically:

   i. Confirm the design flood of the project.

   ii. Provide estimates of the frequency and magnitude of floods, and methodologies used to develop estimates, under a range of future climate states.

   iii. Describe how these estimates compare to the design flood and were considered in the design of the outlet channels and other infrastructure.

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iv. Describe the frequency at which flood events under different climate scenarios are estimated to exceed the design capacity of the outlet channels and infrastructure.

v. Provide details of the planning, design and construction strategies (or measures) intended to minimize the potential environmental effects of the environment on the project.

vi. Update the effects analysis and conclusions as necessary.

Response IAAC-58a

a) The purpose of the Lake Manitoba and Lake St. Martin Outlet Channel Project is to develop permanent flood mitigation for Lake Manitoba and Lake St. Martin to alleviate flooding in the Lake St. Martin region. As such, the effect of extreme weather events (i.e., increased precipitation and flooding) is the reason for the Project. Thus, the effect of the environment on the Project is the purpose the Project was specifically designed to respond to.

The large storage capacities of the lakes within the watershed buffer against the worst effects of increased runoff volumes due to climate change resulting in minor to negligible increases for major flood events. The effects of increased run-off volumes due to climate change may also be offset by increases in lake evaporation. Recent research from Yale University suggests that a high-emissions climate change scenario could result in global annual lake evaporation increases of 16% by the end of the century (Wang et al. 2018), potentially resulting in the increase in evaporation due to climate change outpacing the increase in precipitation.

The Project is designed to reduce peak water levels from those of the 2011 flood (a 1:300-year frequency). The channels and control structures are designed for this flood frequency and will meet the Canadian Dam Safety Guidelines (Canadian Dam Association 2013).

i. The Lake Manitoba outlet channel is being designed to convey 7,500 cfs at 814 ft water elevation and the Lake St. Martin outlet channel is being designed to convey 11,500 cfs at 801 ft. water elevation. Both channels will be designed to convey the 1 in 300-year event (equivalent to the 2011 event) with reduced freeboard to a degree of tolerable risk as determined using the risk based approach described in the Canadian Dam Association (CDA) Dam Safety Guidelines.

ii. A sensitivity analysis was conducted to determine the possible effects of climate change on the hydrologic regime of the lakes system. The analysis was based on the climate change simulations developed by Manitoba Hydro in a report entitled “Lake Winnipeg Watershed Hydroclimatic Study” (July 2014). The report quantified the historic climate that played a role in shaping Lake Winnipeg’s current water regime and projected future climate and runoff scenarios. The study used a delta analysis to develop adjustment factors for climate parameters such as temperature, precipitation, and run-off based on comparisons of the averages of the climate parameters generated by Global Climate Models for a future time horizon to a baseline period. The baseline period selected for the study was 1981-2010. Thirty-

year averages of temperature, precipitation, and runoff were generated based on 147 simulations of future climate periods. These averages were used to create adjustment factors to be applied to the baseline period for analysis with the 2011 event included in the baseline period.

The range of increased annual runoff for the Lake Manitoba watershed, based on the climate change projections, was 7 mm to 15.5 mm representing an 11-25% increase in average annual run-off relative to the 30-year base period. The seasonal timing of the run-off volume increases due to climate change was varied to determine the sensitivity of these variations on the model results. The simulation results for the 1981-2011 period yielded minor changes to the hydrologic regime compared to the no climate change scenario with only a 1% increase in the amount of days that both lakes would be above their desired operating ranges. It was also found that the potential increased runoff due to climate change only raised the peak for a 2011 equivalent event by 30-90 mm for Lake Manitoba and 30-60 mm for Lake St. Martin. These potential increases were considered to be well within the safety factor ranges for the Project design.

iii. See the response to part ii above.

iv. The outlet channels and infrastructure have been designed to accommodate a 1:300 year flood, the largest flood on record. If climate change results in floods greater than this, the design capacity of the outlet channel and infrastructure will be exceeded and water in excess of the design capacity will flow overland.

v. The Project has been planned to alleviate the effects of flooding in the Lake St. Martin region. It has been planned to at least mitigate a future event equivalent to the historically unprecedented 2011 flood and, as such, is adequate for its intended purpose. The structures will be designed using limits states design. This approach requires the designer to consider a broad range of natural forces including extreme weather events that may act at once or in combination upon a structure so it can safely withstand those forces. Both sides of the equation (load/force and resistance/strength) are factored (loads increased and resistances decreased) using industry codes and standards such as the National Building Code of Canada, American Association of State Highway and Transportation Officials, Load Resistance Factored Design, and Canadian Standards Association S16.1. Project Environmental Requirements (Volume 1, Section 3, Appendix 3F) include measures to protect the Project from effects of the environment, including stopping work during extreme weather conditions and implementing sediment and erosion control measures that will protect Project infrastructure from slope failure.

vi. Given the above, with the effects analysis and conclusions in the environmental impact statement (EIS) based on protection from a 2011 flood equivalent, Manitoba Infrastructure views the information provided in the EIS as adequate. As such, an update of the EIS is not required.

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References

Canadian Dam Association 2013. Dam Safety Guidelines 2007 (2013 Edition). Canadian Dam Association. ISBN 978-0- 9936319-0-0. www.cda.ca

Manitoba Hydro. 2014. Lake Winnipeg Watershed Hydroclimatic Study. https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/lake_wpg_regulation/Appendix_7_Lake_Winnipeg_Watershed_Hydroclimatic_Study.pdf

Wang, Wei & Lee, Xuhui & Xiao, Wei & Liu, Shoudong & Schultz, Natalie & Wang, Yongwei & Zhang, Mi & Zhao, Lei. (2018). Global lake evaporation accelerated by changes in surface energy allocation in a warmer climate. Nature Geoscience. 11. 10.1038/s41561-018-0114-8.