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Abbreviations and Acronyms

EIS	environmental impact statement
LMOC	Lake Manitoba outlet channel
LSMOC	Lake St. Martin outlet channel

QUESTION IAAC-27

EIS Guideline Reference: 7.2.2 Predicted Changes to Groundwater

EIS Reference: 1.1 Introduction (EIS Summary); 6.4.4. Assessment of Residual Environmental Effects on Groundwater

Context and Rationale

The EIS guidelines require the proponent to present information about the potential effects of the Project on groundwater, including associated effects to nearby groundwater users. The EIS guidelines require modelling to support predicted changes to groundwater elevations.

With respect to the construction phase of the project, the EIS states that groundwater drawdown associated with construction dewatering is predicted to last for a period of ten months. However, the project summary states that construction would occur over a three-year period. Drawdown following ten months of construction is provided for three km and five km from the LMOC based on modelling results shown in KGS 2017a, Deliverable D6. The method and assumptions used for this modelling are not discussed in the EIS or in KGS 2017a. The results do not appear to account for the potential for interaction between the till and the bedrock aquifer.

Details on the assumptions and methods used in the modelling are required to review the results presented. Representation of the potential for hydraulic head drawdown in the till are needed to evaluate the potential for changes to groundwater surface water interactions. The timing and duration of the dewatering of both the LMOC and LSMOC is needed to understand the potential impacts of groundwater drawdown on nearby groundwater users, during construction.

Information Requests

a) Provide the rationale for the selection of a ten-month period for the calculation of construction phase drawdown.

b) Provide a detailed description of the modeling used to evaluate the drawdown associated with the construction phase of the project.

    i. Describe the assumptions used in the model as they relate to the hydrogeological context of the project.

c) Evaluate the potential lowering of groundwater within the till based on the dewatering of the bedrock aquifer.

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a) The construction will take place over three years in stages. Draw down may occur during various periods in various geographic location along the channel depending upon the construction methods. Any section being depressurized will be drawn down and stabilized in a matter of weeks and remain at that level for the duration of construction at that stage along the channel. For analytical modelling purposes, a 10 month period is considered sufficient for the development of steady-state pumping conditions within the bedrock aquifer.

   Groundwater level drawdown in response to bedrock depressurization was evaluated through radial flow to well equations as discussed in Section 3.2 of Groundwater Study (KGS 2017 – Appendix C – Deliverable D6. Groundwater Study) by application of the Theis model (Theis 1935) while applying a variety of aquifer transmissivities and duration of approximately 10 months (see b). The actual duration of a construction stage may vary; however, the area of impact will be the same once steady state drawdown is achieved in a few months. As the construction is occurring over three years such impact could therefore take place. The draw down impacts are further discussed in response to IAAC-28a (a).

b) The Theis model is a standard analytical tool for predicting groundwater level change with respect to pumping in confined aquifers. This model is known for its reliability and application flexibility. A detailed technical discussion regarding practical application of the Theis model assumptions are described within Cooper and Jacob (1946).

   i. Relative to the hydrogeological context of the Lake Manitoba outlet channel (LMOC), the assumptions of the Theis model are generally reasonably satisfied. One of the model assumptions is that the pumped aquifer is perfectly bounded by impermeable strata, both above and below. Therefore, applying a groundwater pumping time factor of 10 months is a reasonable balance in consideration of leakage potential and lateral extent of the dewatering zone of influence. The groundwater draw down will be stable in days or weeks, so a 10 month duration adequately represents anticipated distance and magnitude of effects for the long-term (years or decades).

      Further discussion related to model assumptions, within the context of the current application, are provided in Section 3.2.1 of the Groundwater Study (KGS 2017 – Appendix C – Deliverable D6 Groundwater Study). The analytical modelling does not account for boundary conditions such as Lake Manitoba and Lake St. Martin (and the more distant Fairford River), or for complex bedrock surface topography and till infill conditions along the channel. The addition of these boundary conditions in a more complex model would reduce the distance and magnitude of the effect of the drawdown. The confined aquifer model used a range of transmissivities in a sensitivity analysis as shown on Plates D6-5 and D6-6 of the Groundwater Study (KGS 2017 – Appendix C – Deliverable D6 Groundwater Study). A worst-case assumption (i.e. those producing the largest draw down) was used in the assessment.

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c) The lowering of groundwater levels within the till soils will be a function of bedrock pressure head as shown by the analytical groundwater model for the underlying bedrock aquifer and the vertical hydraulic conductivity of the till soils.

A groundwater pumping test was done and determined the reaction of pressure in the till in the vicinity of the wetlands near the LMOC. Deliverable D6 – KGS 2017 (page 39) states “Although the bedrock pumping well produced a drawdown of 10.6 m in the bedrock observation well ED-01P, drawdown in upper and lower vibrating wires installed in the till at ED-01 P (not shown on the plot) had a negligible response, indicating that a minimal amount of leakage through the till if any would be anticipated during pumping of the bedrock aquifer.” The low permeability till will limit or preclude water level changes at surface due to any groundwater piezometric pressure drawdown. Where areas of high soil vertical hydraulic conductivity exist (if any) some groundwater level lowering within the till soils may be realized. In the worst-case scenario, groundwater level drawdown within the till cannot exceed what has been predicted on Plate D6-5 of the Groundwater Study Report (KGS 2017 Deliverable 6) for groundwater pressure draw down in the underlying bedrock. See IAAC-28 a) for further description of the drawdown in the region.

References

Cooper, H.H., Jr., and C.E. Jacob, 1946: A generalized graphical method for evaluating formation constants and summarizing well-field history, Trans. American Geophysical Union, 27(4), pp. 526-534.

KGS Group Consulting Engineers. May 2017. Investigations and Preliminary Engineering for LMB Outlet Channels Options C and D Summary Report. Appendix B – Deliverable D5. Regional Geological Setting, Appendix C – Deliverable D6 and Groundwater Study and Appendix D – Deliverable D7-Surface Water Study Theis, C.V., 1935: The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage, Trans. American Geophysical Union, 16th Annual Meeting, Part 2, pp. 519-524.