

Proponent (HML) response to NRCan regarding Groundwater Modelling at Howse Property Project site.

December 2016

This document present the main argument justifying the hydrogeological conceptual model and provide answers to some issues raised by NRCan.

WETLANDS

The geomorphology of the Howse deposit (page 7-136 and 7-137 of EIS, April 2016) has been interpreted by Groupe Hémisphère (GHI) as a buried kame overridden by a late glacial advance. Exploration works have shown the presence of a relatively uniform cover of till overlying an average of 28 m of buried glaciofluvial sand and gravel. The till cap is sufficiently thick and continuous that soil moisture and nutrient regime are relatively unaffected by the underlying glaciofluvial deposit. This suggests that the surface layer act as a barrier.

GHI states that, since the deglaciation of the region, organic material has accumulated in poorly to very poorly drained depression and in areas of groundwater discharge (page 7-137 of EIS, April 2016). The hydrogeological exploration has established the presence of a deep aquifer but has not allowed observing the presence of a significant shallow aquifer. This implies that the wetlands of the Howse area are mainly fed by runoff water mostly during spring snow thawing. Arrays of thermistors installed by Golder an Associates in 2013 in the Howse deposit area show that the superficial ground is frozen from November to May inclusively (graphics of figures 6.4 and 6.5 of Appendix J1 of EIS, April 2016). It can also be inferred that lakes and swamps are also frozen during this period. Under these circumstances, it can be stated that the sudden spring thawing of the snow cover will produce large amount of water that will accumulate locally in the lowland. The infiltration of water in the till will then be limited.

Based on previously mentioned observations, it appears that wetlands are related to very poorly drained topographic depression. Other observations show the lack of link between the regional aquifer with an eventual superficial aquifer or wetlands. A swampy area is identified on longitudinal geological section of figure 1 and located on plan view of figure 2. This swampy area is part of a narrow swampy structure as seen of figure 2. It can be seen on the section that groundwater table is 40 m below ground surface. This tend to prove that the wetland is insulated from the regional groundwater and has probably develop on flat lying poorly drain terrain.

Well HW-RC15-WE07R, drilled to a depth of 97 (figure 2) has a water table elevation of 59 m below ground surface. The nearby Lake X on figure 2 is part of a north-south oriented swampy structure. The deep aquifer observed into well HW-RC15-WE07R and the very organic and clayey nature of the bottom of the Lake X support the perched nature of the swampy structures. In addition, the valley shape section between the 2 ponds and the Pinette Lake is generally dry except during the thaw and for some heavy rain periods indicating that this section is not fed by surficial or regional groundwater which is anyway 41 m below ground at well HW-RC15-WE09R.

IMPACT OF DEWATERING ON TRIANGLE AND PINETTE LAKES.

Some concerns have been expressed about the potential impact on the Triangle and Pinette Lakes of the groundwater drawdown resulting of dewatering Howse deposit. The amplitude of this impact will be related to the nature and quality of the hydraulic link between groundwater and the lake. The spatial relation of the lake with groundwater table and the nature of the sediments in the bottom of the lake are the 2 main parameters to consider. GHI has conducted sampling of Triangle and Pinette Lakes and submitted sediments to grain size analysis (Cf.: Aquatic Survey - Howse Pit Study Area, Groupe Hémisphères, November 2014).

Triangle Lake

The composition of the samples taken from the bottom of the Triangle Lake was composed of 52 % silt, 40 % clay and 8 % silt. This rich clay material will reduce the conductance of lake bed sediments and will contribute to reduce the migration of water toward groundwater.

The position of the lake bottom in relation with the groundwater table can be estimated from well HW-RC15-WE08R which is at about 700 m from Triangle Lake, itself at about 1700 m from the Howse deposit. The phreatic level elevation at this well was measured at 568 m in June 2016. The maximum depth of the lake is 12 m. With a realistic groundwater hydraulic gradient of 0.01 m/m, the water table is estimated to be at the elevation of 561 m which is 7 m under the lake bottom

The nature of others lakes in the Triangle Lake area was investigated by Fracflow Consultants inc. in 2006 (Final Draft Report, Hydrogeology Field Program, Howell River, Labrador Labmag Project, July 2006). Fracflow conducted a lake and stream sediments sampling program in the Labmag area which is at a short distance from the Howse project and Triangle Lake. Samples were collected from bottom of Kivivic Lake, Lilian Lake, Rosemary Lake and Rogers Lake and a small unnamed lake (Figure 3).

The results of sampling indicated that the sediments are generally composed of organic material at the top of the sequence with a thickness varying from 0.10 m to 3 m with a mean thickness of 1.2 m. The organic material lies on a clay layer described by Fracflow as varying from brown to black stiff clay. The laboratory tests show that most of the samples have a significant percentage of silt and clay. The hydraulic conductivity for each sample varies from 1E-06 to 1E-09 as calculated by Fracflow for each sample.

The most similar lake to Triangle Lake in terms of size and general context investigated by Fracflow is the Rogers Lake. This lake is located at about 4 km southwest of Triangle Lake. The sampling indicated the presence of 3.5 m of organic material lying on a layer of at least 0.9 m of brown clay (maximum depth of sampling). This clay rich material, generally observed for other lakes contributes to reduce significantly the leakance from the lake and river bed sediments.

Pinette Lake

Pinette Lake is located 820 m from Howse deposit at an elevation of 636 m and has a maximum depth of 4.5 m. The position of the lake bottom in relation with the groundwater table can be estimated from well HW-RC15-WE09R which is at about 160 m from Pinette Lake, itself at about 820 m from the Howse deposit. The elevation of the water table was at 606 m in June 2016. The difference of hydraulic head with the well and the lake bottom is then 25 m. The recharge of the lake has then no relation with the regional groundwater.

Information on nature of the bottom of the lake is scarce. GHI (2014) noted that visual inspection reveals that the substrate is mainly composed of silt with variable amounts of cobbles, rubbles and boulders in the littoral zone. The silty nature of the bottom, if proven, can reduce the migration of lake water toward groundwater.

The lake is lying over an impervious shale formation. This geology contribute do insulate the lake from the regional aquifer.

CONCLUSION

The hydrogeological study has allowed defining the main configuration and parameters of groundwater in the Howse area. The geological and hydrogeological studies has allowed defining a deep regional aquifer but did not intersect a significant shallow aquifer. It seems that the wetlands and lakes are fed by runoff water and direct precipitation and that no obvious hydraulic connection exists between the regional aquifer and the surface water network surrounding the Howse deposit.

The proponent has put realistic efforts to obtain the best possible image of the groundwater configuration of a complex geological and structural area. He is conscious that the conceptual model obtained is incomplete although it reflect, at this stage of the project, the general nature of the local hydrogeology.

The project will be conducted in 3 main phases described in chapter 4.2 of the SNC's modelling report of December 2016. The deepening of the pit will then be increased gradually through time following this sequence. Meanwhile, some monitoring equipment will be added to follow the impacts of the aquifer dewatering. A general groundwater monitoring is suggested in page 59 and 60 of the SNC's modelling report of December 2016. The monitoring will allow to update and refine the general model actually available.