APPENDIX G

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

TECHNICAL MEMORANDUM

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TO Robert Hunton, P.Eng.
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PRELIMINARY HYDROGEOLOGICAL ASSESSMENT
PROPOSED EXCAVATION - WEST TRANSITWAY EXTENSION AT MOODIE DRIVE
OTTAWA, ONTARIO

Golder Associates has undertaken a preliminary hydrogeological assessment related to the proposed excavation for the West Transitway at Moodie Drive. The purpose of the assessment was to determine the flow rate of groundwater into the proposed excavation and to estimate the extent of the drawdown of the water table.

Work within the excavation and the final design of the road would require control of groundwater levels (drainage would be below the elevation of the estimated spring groundwater level). An un-calibrated simplified three dimensional numerical model (MODFLOW) was constructed to simulate steady state dewatering and drawdown at the site. The model was developed using information from three existing borehole logs completed at the site.

The numerical model covers an area of approximately 2,000 metres by 2,000 metres divided into five metre by 10 metre grid blocks in the area of the excavation and increasing in size towards the edge of the model domain. There are 20 layers in the model with a uniform thickness of one metre for the first ten layers below ground surface and 5.6 metres for the next ten layers. The ground surface was assumed to be a constant 66 metres above sea level (masl) across the entire model domain based on surveyed ground surface elevations.

Boundary conditions were established in the model using constant heads. To establish a five metre gradient across the model domain, a uniform constant head boundary condition equivalent to 67.5 masl was placed on the southern edge (all layers) of the model and a uniform constant head boundary of 62.5 masl was placed on the northern edge (Layers 4 to 20). All other boundaries in the model were no flow boundaries and no recharge was applied to the model domain.

Based on the information in the well logs, a simplified hydrostratigraphic model was developed for the surficial geology and bedrock in the area. It was assumed that the surficial sediments were a uniform isotropic medium with a hydraulic conductivity (K) value of $1x10^{-7}$ metres per second (m/s) and the bedrock was a uniform isotropic medium with a K value of $5x10^{-5}$ m/s.

The excavation was simulated in the numerical model by the use of drain boundary conditions and high K fill. A 15 metre by 400 metre east-west trench was introduced into the numerical model by changing the K value within the trench to a value of $1x10^{-4}$ m/s. For this assessment, the bottom of the trench (pavement sub-drain level) was simulated at elevation 64.2 metres. A drain boundary condition was applied to all cells surrounding the trench in order to simulate dewatering in the trench. The drain boundary condition of the cells below the trench was set at 64.2 masl (bottom of the excavation) and those on the side of the trench were set to the bottom of the cell plus 10% of the thickness of the cell. The adjacent creek was not included in the model.

For this assessment, the hydraulic head at the excavation under initial conditions (pre-excavation) was set at 65.1 masl (measured in the monitoring well in March 2010) to simulate spring groundwater conditions and 64.1 masl (measured in the monitoring well in May 2010) to simulate summer conditions.

The drawdown associated with the dewatering was calculated as the difference between the steady state solution of the initial modelled heads (without the trench) and the steady state solution of final modelled heads (with the trench).

Relative to spring groundwater levels, the numerical model predicts approximately 0.5 metres of drawdown at about 15 to 30 metres from the excavation (in all directions). The predicted steady-state flow rate into the excavation is about 190 cubic metres per day.

Relative to the estimated summer groundwater levels, there would be no groundwater drawdown since the pavement subdrains would be above the expected summer groundwater levels.

Information provided by MRC indicates that the water level in Stillwater Creek between Corkstown Road and the NCC pedestrian pathway is at about elevation 64.3. Downstream of the pathway (approximately 150 metres) the creek water level is indicated to decrease from about elevation 64.1 metres to about elevation 63.1 metres.

Based on the preliminary groundwater modeling, and information provided by MRC regarding creek water level, the long-term groundwater level lowering associated with the Transitway cut at Moodie Drive is not expected to result in an impact to Stillwater Creek.

This hydrogeologic assessment is considered sufficient only for evaluation of the preliminary/functional design. Further investigation of the hydrogeologic conditions in the vicinity of the creek would be required in order to verify the modeling predictions. Information concerning the creek (i.e., flow data, creek bottom elevation, top of water elevation, etc.) would also need to be confirmed.

If the predicted water levels and limits of groundwater drawdown are considered to be unacceptable, several alternatives could be considered to eliminate or minimize the groundwater drawdown. Some alternatives could include:

- Raise the Transitway Profile – This alternative could include either raising the current underpass profile so that the drainage systems would be above the seasonal high groundwater level, or changing the profile so that the Transitway crosses over Moodie Drive (i.e., eliminate the underpass profile).
- Water-Tight Construction – This alternative would require the entire underpass (bridge structures, pavement surface, and retaining walls) to be constructed as a water-tight undrained "system". For this alternative, the bridge structures, pavement surface, and retaining walls would have to be designed to be integral with each other (i.e., entire cut designed like a "boat").
- Groundwater Recharge System – This alternative would involve collecting the groundwater obtained from the drainage systems and pumping that groundwater (via a series of wells) back into the bedrock, thereby recharging the drained aquifer. This option may only be marginally feasible.
- Perimeter Grout Curtain – This alternative would involve pressure-injecting grout directly into the bedrock at overlapping intervals around the perimeter of the excavation, forming a continuous barrier. If constructed properly, groundwater drawdown would be limited to the interior of the barrier. A hydraulic barrier in the soil, such as a diaphragm wall, could also be required for this option.

A detailed evaluation of the feasibility of the above alternatives would require further investigation.

We trust that this memo is sufficient for your present requirements. Please don't hesitate to contact the undersigned if you have any questions.

Yours truly,

GOLDER ASSOCIATES LTD.

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