TECHNICAL MEMORANDUM

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TO Andreanne Simard - Director of Lands, Resources and Environment,
Stephen May - Lands Manager, Western Region
CBM Aggregates
CC George Schneider, Daniel Eusebi

FROM Paul Menkveld **EMAIL Paul.Menkveld@wsp.com**

SUPPLEMENTAL ASSESSMENT AND MITIGATION OF POST-REHABILITATION GROUNDWATER UPLIFT – PROPOSED CBM ABERFOYLE SOUTH LAKE PIT

In December 2023, CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) submitted an Aggregate Resources Act application to licence the proposed Aberfoyle South Lake Pit, located at 6947 Concession Road 2, in the Township of Puslinch, County of Wellington, Ontario. WSP Canada Inc. (WSP) prepared a Level 1/2 Water Report (Water Report) and Natural Environment Report to support this application. Stakeholder comments have been received pertaining to various aspects of the application and reports.

In response to Stakeholder comments, this technical memorandum provides a supplemental assessment and mitigation plan to address the predicted increase in post-rehabilitation groundwater levels ("groundwater uplift") immediately downgradient of the pit pond, which has the potential for occasional flooding to occur on low lying adjacent lands during periods of high groundwater levels (e.g. during the spring freshet).

BACKGROUND

As discussed in the Water Report, during aggregate extraction below the water table, a pit pond is gradually formed as extraction proceeds, which typically results in a "flattening" of the water table relative to pre-extraction conditions, with drawdown on the upgradient side, and groundwater uplift on the downgradient side. Water table flattening that is predicted to occur at the site is presented on Figure 14b in Appendix G of the Water Report, and again on Figure 1 below.

Numerical modelling simulations predict post-rehabilitation groundwater uplift at the site of approximately 0.6 m to occur immediately southwest of the proposed pit pond beyond the property limits, as shown on Figure 1. While the steady state groundwater level in this area is predicted to be below the ground surface, when seasonal variability is considered (approximately +/- 0.3 m annually at nearby MW18-01B) there is a potential for occasional flooding to occur on adjacent low lying lands during periods of high groundwater levels (e.g. during the spring freshet).

SUPPLEMENTAL ASSESSMENT AND PROPOSED MITIGATION

To address this potential impact, the installation of a tile drain is proposed in this area as a mitigation measure, to reduce the risk of occasional flooding on the neighbouring property, as shown on Figure 2. The tile drain would be installed in the setback area, between the pit pond to the east and the licence / property limit to the west.

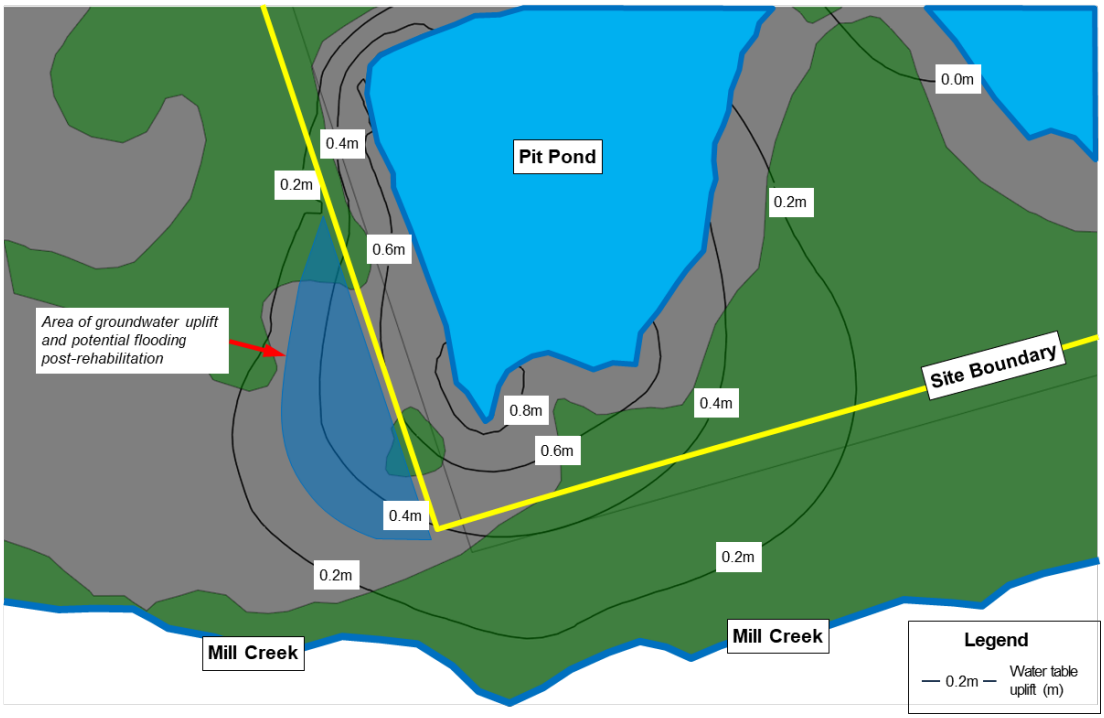

Figure 1: Numerical simulation results predicting an area of post-rehabilitation groundwater uplift, which could create minor flooding in during seasonal periods of a high water table.

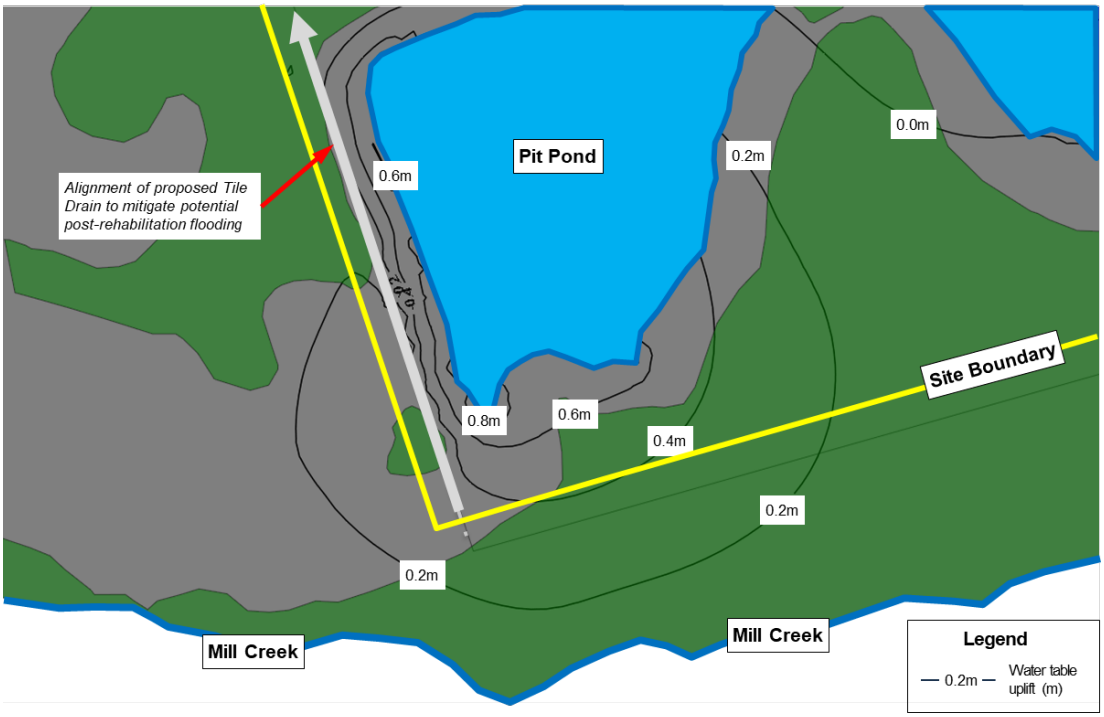

Figure 2: Numerical simulation of the installation of a tile drain to alleviate localized post-rehabilitation groundwater uplift and mitigate the potential for flooding during periods of a high water table.

This tile drain would convey excess groundwater through the subsurface during high water table periods in a northward direction, with excess groundwater reporting to Tributary 3 as additional baseflow. A detailed plan view of the proposed tile drain alignment, and a schematic cross section of the tile drain's configuration are shown on Figure 3 and would generally be constructed as follows.

- Excavation of V-shaped trench with 1:1 side slopes to an elevation of 301.25 masl, with a 200 to 300 mm perforated tile drain placed near the base of the trench.

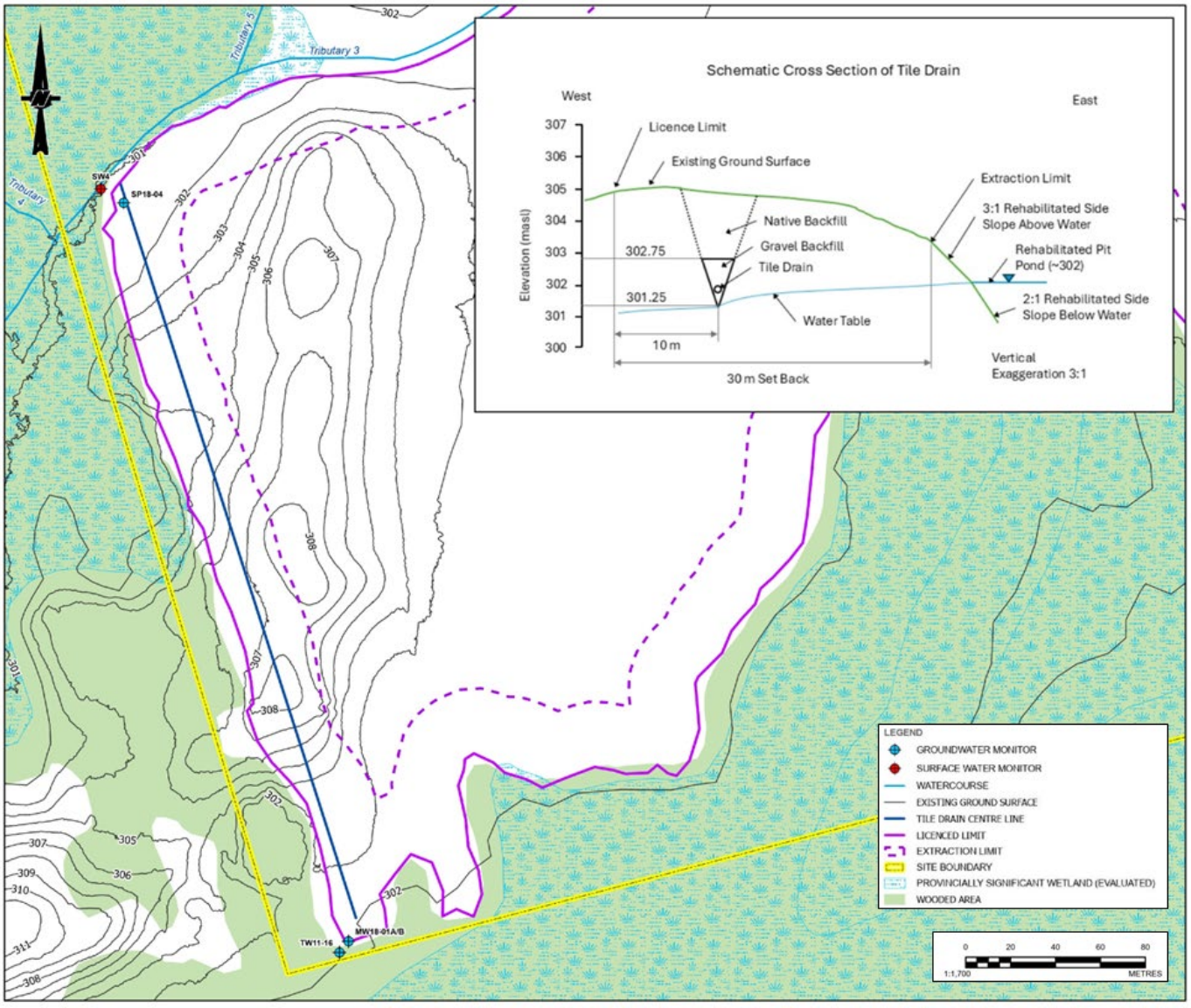

Figure 3: Proposed Tile Drain Alignment and Cross Section Detail

- The ground surface along the alignment ranges from approximately 301.25 masl at the northern end to approximately 308 masl at the crest of a hill, back down to 302 masl at the south end of the tile drain.

- The tile drain will be approximately 350 m long and positioned in the setback area approximately 10 m east of the western licence limit.
- The trench walls will be lined with a non-woven geotextile liner and backfilled with a clean coarse grained granular material (e.g. 19 mm clear stone) up to a height of 1.5 m from the bottom of the trench.
- Non-woven geotextile liner will also be placed on top of the backfill to prevent fines from above entering the tile drain.
- The trench will be backfilled above the non-woven geotextile with native materials removed from the setback, such that no extraction is taking place in the set backs.
- The toe of the tile drain will terminate proximal to Tributary 3 on a rip-rap outfall apron, allowing excess water discharge to the stream as baseflow. No adverse impact to surface water quality in Tributary 3 is anticipated as the tile drain will receive clean cool groundwater from the subsurface and transmit it along.
- It is proposed that the drain will be constructed prior to the commencement of operations, to permit the naturalization of the setbacks during the operational period, without the need to disturb the setback in this area during rehabilitation. As groundwater uplift is not predicted during operations, the tile drain is not predicted to consistently convey water during the operational period and would begin to passively operate once aggregate extraction ceases and groundwater levels increase toward their post-rehabilitation levels.

Additional numerical modelling simulations were run for post-rehabilitation conditions with the tile drain in place, and the simulations show that the tile drain will limit groundwater levels to 301.25 masl along the alignment and thereby limit potential off-site groundwater uplift to approximately 0.25 m. Groundwater inflow to the tile drain is predicted to be approximately 212 m^3/day in a steady state.

The implications of the installation of a tile drain to baseflow along reaches of Tributary 3 and Mill Creek were also evaluated as part of the numerical modelling simulations under post-rehabilitation conditions.

- With reference to Figure 4 and Table 1, the numerical simulations suggest that of the groundwater that reports to the tile drain (212 m^3/day), most of that groundwater would have otherwise discharged to the low-lying area of groundwater uplift and 6 m^3/day would have reported to Mill Creek as groundwater discharge.
- The implementation of the tile drain mitigation effectively transfers a small portion of groundwater from Mill Creek to Tributary 3 along the reach between the toe of the drain (near SW4), and the confluence of Tributary 3 and Mill Creek (approximately 750 m downstream at SW-M1 to SW-M3).
- When compared to the original post-rehabilitation scenario (i.e. with no tile drain), there is an increase in baseflow of 14% predicted to Tributary 3 (at SW-M1) and negligible decrease in Mill Creek upstream of the confluence (at SW-M2). The downstream of the confluence (at SW-M3) the tile drain scenario results in a slight net increase in baseflow (1.4%) to the overall system.

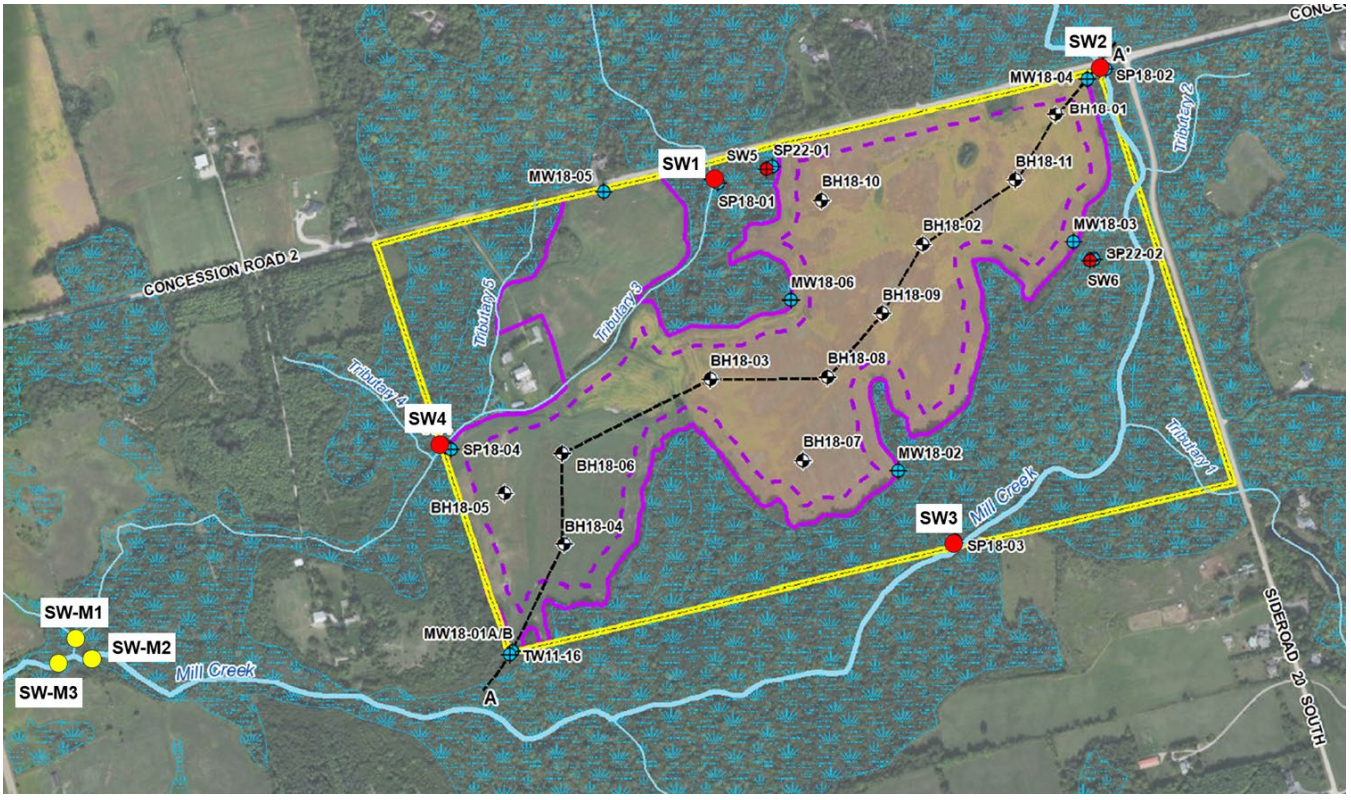

Figure 4: Surface Water Stations on Mill Creek and Tributary 3 (SW1 to SW4), and modelled surface water stations (SW-M1 to SW-M3) at the confluence of Tributary 3 and Mill Creek.

Table 1: Simulated Baseflow at Mill Creek and Tributary 3 Surface Water Stations - Current Conditions and Post-Rehabilitation with Tile Drain Mitigation.

	Station ID	Description	Pre-Pit Baseflow Contribution (m^3/day)	Rehabilitated			Rehabilitated with Tile Drain Mitigation		
				Baseflow (m^3/day)	Change in Baseflow (m^3/day)		Baseflow (m^3/day)	Change in Baseflow (m^3/day)	
Tributary 3	SW1	Upper Tributary 3	611	561	-50	-8%	561	-50	-8%
	SW4	Site Boundary Tributary 3	1,072	1,033	-39	-4%	1,223	151	14%
	SW-M1	Downstream Tributary 3	1,303	1,393	90	7%	1,583	280	21%
Mill Creek	SW2	Upper Mill Creek	9,741	9,686	-55	-1%	9,686	-55	-1%
	SW3	Site Boundary Mill Creek	9,870	8,725	-1145	-12%	8,725	-1145	-12%
	SW-M2	Mill Creek Downstream of Site Boundary (upstream of Tributary 3)	10,284	10,209	-75	-1%	10,203	-81	-1%
Mill Creek and Tributary 3	SW-M3	Mill Creek Downstream of Tributary 3 Confluence	13,677	13,689	12	0.1%	13,873	196	1.4%

IMPACTS ON BUFFER ZONE

The current buffer area is an active crop production area that is subject to annual ploughing, cultivating, and planting. The area occurs on a higher elevation of land relative to the surrounding lands. The proposed tile drain alignment would be installed in a trench at depth as shown as Figure 3 prior to the on-set of operation and prior to the need for the buffer. The area would be excavated to the noted depth, the tile drain installed, and the material replaced its original elevation and topography. Generally, there are no concern with this pre-operations work in this agricultural setting, and the installation would be generally consistent with activities that are actively undertake year to year under current agricultural practice with the implementation of several mitigation measures as follows:

- Strip topsoil and temporarily store separately from subsoils
- Spoils pile should be stored on the east side of the trench away for the woodland and wetland edge
- Erosion control setting silt fencing should be installed as required to ensure no erosion or sediment transport for the temporary spoils piles enter the wetland areas.
- Work to be completed in the shortest period possible, limiting the period of open trench and spoil piles.
- Work to be scheduled during period of forecasted low, or preferably no, precipitation periods.
- Backfilling the original grade to be completed immediately after drain installation and subsoil replaced and topsoil used to cap the trench area.
- The rehabilitation of the trench area and temporary work area be restored and managed as outline in the following section of this technical memorandum.

REHABILITATION AND ENHANCEMENT PLAN

The area of the trench and temporary work area within the future buffer area will be created similar to other buffer areas on the Site, to offer an enhancement to the area and surrounding landscape. Principle initiatives to create a stable and improved near wetland environment are as follows:

- In areas where subsoil with low organic content are exposed to the surface, ensure topsoil is replaced over the excavation to allow for a good growing media and reduce the propagation of invasive species that can out compete other plants;
- Install temporary silt fencing as necessary until the proposed plantings become established and self-sustaining within the vicinity of the trench;
- Plant exposed soils with an oat cover crop for temporary stabilization;
- Plant entire buffer with a native seed herbaceous cover mix for upland areas and addition of milk weed to enhance area for Monarch Butterfly habitat;
- Plant a low-density native shrub and tree compliment within the buffer zone to supplement the native herbaceous plantings;
- Transfer the currently proposed wetland enhancement in the southwest buffer area to a new proposed location coincident with and adjacent to with wetland feature to the east of the trench and in the open agricultural field, as shown on the revised Site Plans;
- Monitor the site for signs of rill and other erosion until the area has stabilized and vegetation within the buffer has become established and self-sustaining;
- Monitor wetland edge for signs of erosion and sedimentation. Correct any potential issue and restabilize and plant areas; and
- Monitor the newly planting buffers for invasive species and if needed initiate an invasive species control program.

SUMMARY

A tile drain is proposed as a mitigation to address post-rehabilitation groundwater uplift downgradient and west of the site and thereby limit the potential for flooding to occur in low-lying areas on the adjacent property during high groundwater table periods. The tile drain will also have the net benefit of increasing baseflow to Tributary 3 and will also result in a slight net increase in baseflow to Mill Creek, as simulated downgradient of the site at the confluence of Tributary 3 and Mill Creek.

The tile drain system will be installed as pre- operation activity within the currently active farm field. During construction, standard mitigation measures related to sediment and erosion control will be implemented to protect the adjacent feature and work will be completed in expediate manner to reinstate general topography and reduce the period of construction. The trench area will be restored and rehabilitated, as part of the buffer creation process, will involve the planting of native flora, enhancement planting such a milkweed and a monitoring program to assess the success of the plantings, monitor for erosion and sediment transport, and invasive species control. Agricultural activities will no longer occur with the buffer area, and this area will be permanently part of the natural heritage wetland/woodland area. A wetland pocket will be created along the wetland/woodland edge directly to the east of the lower trench area, coincident with the natural heritage feature edge on the east side on the agricultural field.

CLOSURE

We trust that this technical memorandum meets your current needs. If you have any questions or require clarification, please contact the undersigned at your earliest convenience.

WSP Canada Inc.

Paul Menkveld, M.Sc., P.Eng.
Hydrogeological Engineer

George Schneider, M.Sc., P.Geo.
Senior Geoscientist

Daniel Eusebi, B.E.S. R.P.P., M.C.I.P.
Senior Principal Ecologist

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