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MEMORANDUM

DATE December 7, 2018 **Project No.** 1778651

TO Matt Bertram, P.Eng., Project Engineer
Skelton, Brumwell & Associates Inc.

FROM Christopher Davidson **EMAIL cdavidson@golder.com**

THE MILLER GROUP BOYINGTON PIT #3 LOW IMPACT DEVELOPMENT TREATMENT TRAIN TOOL ANALYSIS

1.0 INTRODUCTION

This memorandum details an evaluation of average annual Total Phosphorus loading at The Miller Group's ("Miller") Boyington Pit #3 under existing and proposed scenarios using the Low Impact Development Treatment Train Tool ("LID TTT"). Boyington Pit #3 is located at 4499 Concession Road 7 in Uxbridge, Ontario (the "Site").

A water balance for the Site has already been presented in the hydrogeological assessment (Golder 2018). Since the water balance approach in the LID TTT differs from that of the earlier report, and the two methods are similar but not directly comparable, the water balance results from the LID TTT are not reported here; however, the annual water balance results estimated using the LID TTT were within approximately 17% of the previously presented (Golder 2018) results based on existing condition annual average surplus volumes.

2.0 METHODOLOGY

The conceptual level models for the existing and proposed Site conditions were created using Version 1.0 of the LID TTT. A general description of the tool and its functions is available in the documentation accompanying the tool (LID TTT, 2018). The proposed fill importation boundary shown on Figure 5 of the hydrogeological assessment for Boyington Pit #3 (Golder, 2018) was used as the boundary for the existing and proposed models, giving a Site area of approximately 34 hectares.

Existing Scenario

The existing conditions scenario was created in the LID TTT as a single catchment (Figure 1 below) following the fill importation boundary from Figure 5 of the hydrogeology assessment (Golder 2018). Runoff from the catchment was sent to an outfall representing drainage to the pit floor to the north and east. Since the existing pit to the north and east is below the surrounding topography and has no natural outlet, the majority of the flow and Total Phosphorus load shown as discharging from the Site in the LID TTT model is assumed to ultimately infiltrate.

A fine sandy loam soil type was selected for the catchment based on the descriptions included in the hydrogeology report. Percentage land uses were set to values shown in Table 6 of the hydrogeological report, using the 'Other' land use in the tool for the extraction area. A Soil Conservation Service ("SCS") Curve Number

("CN") value of 65 was conservatively estimated for the extraction area (matching Open for fine sandy loam soils) and a value of 0% was selected for Imperviousness (since other hard-surface land uses are accounted for in the subcatchment). The Event Mean Concentration ("EMC") value for Total Phosphorus was set to 0.2 milligrams per litre ("mg/L"), assuming the value for Total Phosphorus matches the Open Space land use.

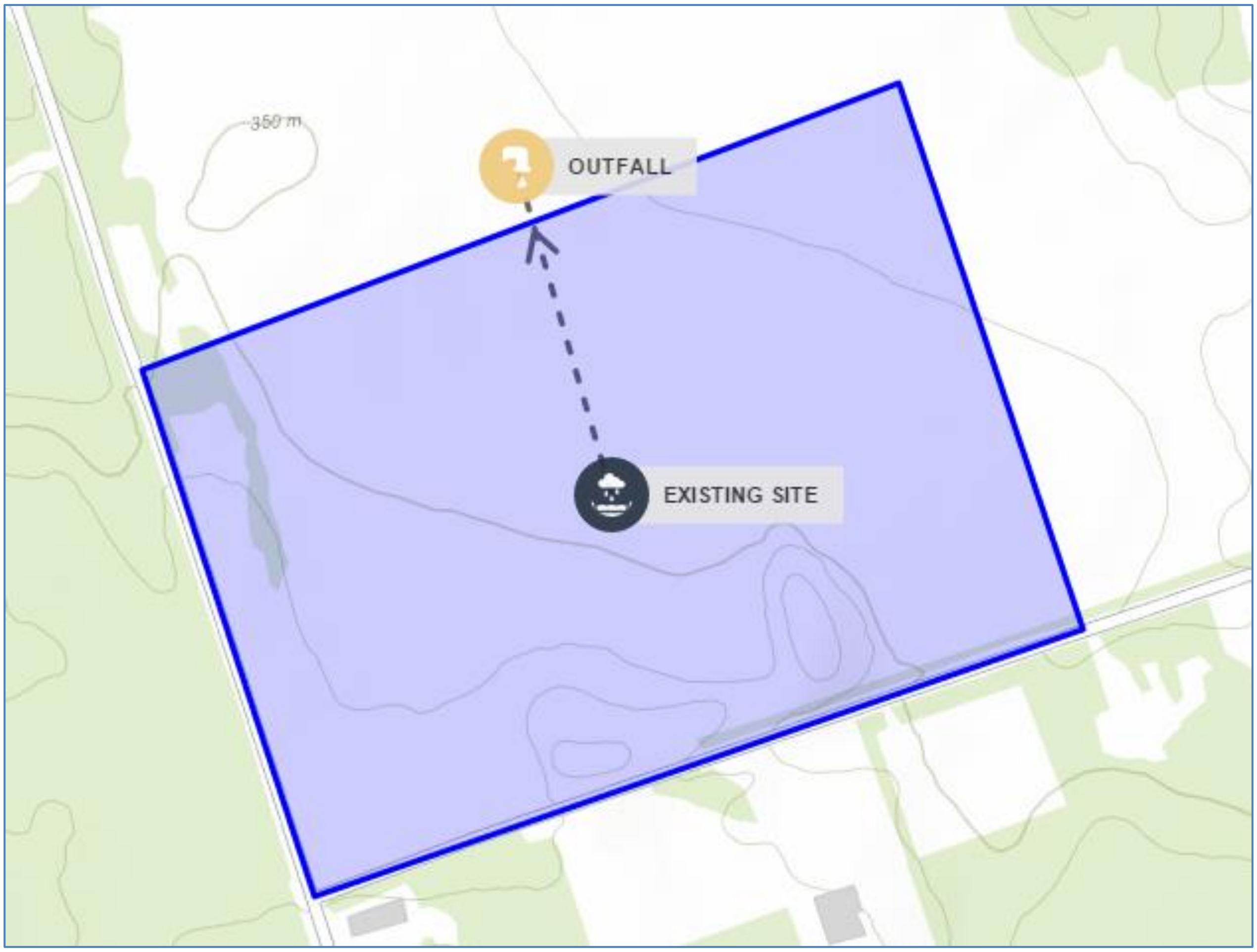

Figure 1: Existing Scenario Model Schematic

Proposed Scenario

The proposed conditions scenario was created in the LID TTT as a single catchment following the rough catchment shown in Figure 6 of the hydrogeology assessment (Golder 2018). The Site was divided into two drainage directions (North and East), and the North and East catchments then further divided into subcatchments based on the following categories shown in Table 1 below. The schematic for the proposed scenario model is shown on Figure 2 (attached).

Table 1: Proposed Scenario Subcatchment Areas

Subcatchment	Area (hectares)	
	Draining North	Draining East
Draining to Filter Strip	16.2	4.9
Filter Strip	0.7	0.4
Slope Below Filter Strip	2.9	1.0
External	5.2	3.1
Total	25.0	9.4
	34.4	

Runoff from the North and East internal catchments in the model was directed to the respective North and East vegetated filter strips. The North and East filter strips and the fill slope below the filter strips will drain to a parallel set of infiltration basins in the proposed scenario, which are modeled as a single unlined dry ponds of equivalent area. The pond spillways and external areas were directed to outfalls representing overland drainage to the existing pit floor area. As with the existing scenario, there is no surface outlet from the pit floor, and the majority of the flow and Total Phosphorus load shown as discharging from the Site is therefore assumed to ultimately infiltrate.

Percentage land uses were set to values shown in Table 7 of the hydrogeological assessment (Golder 2018), using the ‘Other’ land use in the tool for the extraction area (using the same values as before) and ‘Open Space/Parkland’ for the vegetated filter strips. The vegetated filter strips themselves were coded as Vegetated filter strips assuming soil parameters for fine sandy loam soils below and 100 millimetres (“mm”) surface storage.

3.0 RESULTS AND DISCUSSION

The LID TTT results for the existing and proposed scenarios are shown on Figure 3 and Figure 4 below, with the final Total Phosphorus loading summarized in Table 2. In general, the results show that there is a slight increase in Total Phosphorus generated at the Site between the existing and unmitigated proposed scenarios (from 5.3 kg/yr to 6.0 kg/yr); this appears to be the result of the increased runoff in the proposed scenario (29,900 m^3/yr in the proposed scenario compared to 25,600 m^3/yr in the existing scenario) being proportionally larger than the associated decrease in average generated Total Phosphorus concentration (0.201 mg/L in the proposed scenario compared to 0.208 mg/L in the existing scenario). However, the infiltration and Total Phosphorus removal provided by the vegetated filter strips and infiltration basins reduce the total (mitigated) outgoing phosphorus loading in the proposed scenario to 0.2 km/yr (a 5.8 kg/yr or 97% reduction compared to the existing scenario). As discussed, with no natural surface connections from the pit floor, the majority of the Total Phosphorus load shown as discharging for the Site in both existing and proposed scenarios is assumed to ultimately infiltrate across the remainder of the pit floor.

Loading Summary TP | Pre Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated	Outgoing
			Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.242 m^3/s	25,630.000 m^3 0.208 mg/l 5.321 kg	25,628.000 m^3 0.208 mg/l 5.321 kg
Total	**0.000 %**	**0.242 m^3/s**	**25,630.000 m^3** **0.208 mg/l** **5.321 kg**	**25,628.000 m^3** **0.208 mg/l** **5.321 kg**

Figure 3: Existing Scenario Annual Average Total Phosphorus Summary

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3)	Generated Average Concentration (mg/l)	Generated Total Load (kg)	Outgoing Total Flow (m^3)	Outgoing Average Concentration (mg/l)	Outgoing Total Load (kg)
Catchment 1	97.013 %	0.012 m^3/s	26,478.920 m^3	0.202 mg/l	5.338 kg	755.000 m^3	0.211 mg/l	0.159 kg
Catchment 2	96.677 %	0.032 m^3/s	3,469.168 m^3	0.200 mg/l	0.695 kg	111.000 m^3	0.208 mg/l	0.023 kg
Total	**96.974 %**	**0.044 m^3/s**	**29,948.088 m^3**	**0.201 mg/l**	**6.033 kg**	**866.000 m^3**	**0.211 mg/l**	**0.183 kg**

Figure 4: Proposed Scenario Annual Average Total Phosphorus Summary

Table 2: Total Phosphorus Loading Summary

	Existing Scenario	Proposed Scenario
Generated Phosphorus Load (kg/yr)	5.3	5.3
Outgoing Phosphorus Load (kg/yr)	6.0	0.2

4.0 ASSUMPTIONS AND LIMITATIONS

This model reflects the conceptual level of design for the Site. This model is not meant to take the place of detailed stormwater modelling for the Site. The Golder team that developed the LID TTT was involved in generation of this report; however this has not affected the application of the model for this Site.

This report was prepared for the exclusive use of The Miller's Group. Any use which a third party makes of this report, or any reliance on, or decisions to be made based of it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

5.0 REFERENCES

Golder Associates Ltd., "Hydrogeological Assessment, Boyington Pit#3, 4499 to 4589 Concession Road 7, Uxbridge, Ontario", September 2018.

Lake Simcoe and Region Conservation Authority, Toronto and Region Conservation Authority, Credit Valley Conservation Authority, "Low Impact Development Treatment Train Tool User Guide", 2018

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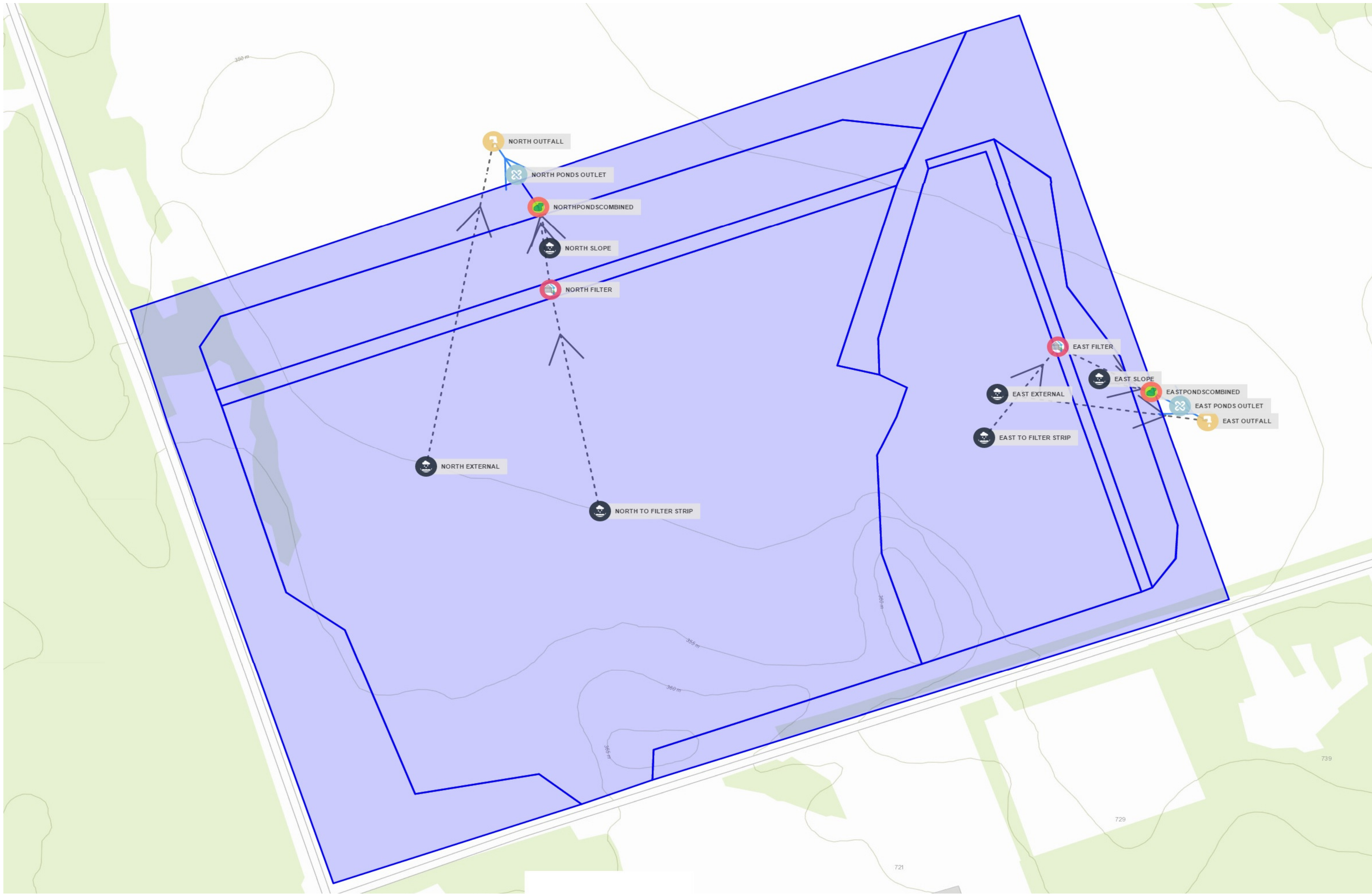
ATTCHMENTS

Figure 2: Proposed Scenario Model Schematic

Proposed Scenario Modelling Schematic	Figure 2



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