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For internal use

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Subject: East Fonthill Development Stormwater Management Pond Data Review

Dear Sir:

We are pleased to provide you with a review of monitoring data collected from an outfall located near the intersection of Regional Road 20 and Rice Road in Fonthill, ON. The data was collected under two separate monitoring programs completed by WSP, Regional Road 20 Redevelopment Monitoring and East Fonthill Hydrologic Monitoring. We understand that there are concerns related to the functionality of the East Fonthill Development stormwater management pond located at the southwest corner of the Rice Road and Regional Road 20 intersection that drains from the aforementioned outfall and ultimately flows to Twelve Mile Creek.

This assessment provides background information on the work programs completed, and a presentation of the monitoring data. Detailed objectives and methodologies of the past monitoring activities are provided in Regional Road 20 Redevelopment Monitoring and East Fonthill Hydrologic Monitoring Reports which were provided under separate cover.

INTRODUCTION

REGIONAL ROAD 20 REDEVELOPMENT

Jagger Hims Limited (now WSP Canada Limited) was retained by the Niagara Region to complete surface water monitoring associated with the redevelopment of Regional Road 20 between Highway 406 and west of Station Street in the Town of Pelham, Ontario. The surface water monitoring activities included flow monitoring, water quality monitoring/sampling, and erosion monitoring. The program was approved by the Niagara Peninsula Conservation Authority (NPCA).

Phase 3 of the redevelopment program involved construction activities from west of Station Street to east of Rice Road and included the Rice Road Tributary. The southwestern corner of the Rice Road and Regional Road 20 intersection drains to Twelve Mile Creek through the Rice Road

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Tributary of Twelve Mile Creek. A square, closed-bottom concrete culvert (approximately 1.22 m wide) beneath Regional Road 20 drains away water from the area surrounding the intersection with Rice Road.

There were three surface water stations established on the Rice Road Tributary. From 2009 to 2015, SW1 was located at the culvert invert on the south side of Regional Road 20. Runoff collected from the properties northeast, southeast and southwest of the Rice Road intersection flows into the culvert. During construction of the aforementioned storm-water management pond in 2015, the invert at the south side was reconfigured making it inaccessible for monitoring and surface water flow that formerly joined into the box culvert beneath RR20 was redirected into the SWM Pond; as a consequence, SW1 was relocated to near the evert (north end) of the box culvert. The result is that roadside drainage that previous discharged directly to the Rice Road Tributary (by-passing SW1) was now directed to the SWM Pond and the resultant (attenuated) discharge was now captured by SW1 monitoring.

SW2 is located approximately 3 m north of the box culvert evert.

Between SW1 and SW2, the tributary receives surface water runoff from Regional Road 20 storm drains and from the roadside ditch located on the north side of Regional Road 20. The storm drains collect road runoff from Regional Road 20, west of the Rice Road Tributary. The roadside ditch collects water from Regional Road 20 and Hurricane Road, west of the Rice Road Tributary and east as far as Rice Road. The collected runoff then flows north into the narrowly confined, densely wooded channel of the Rice Road Tributary.

SW3 is located approximately 40 metres north of the confluence of these inputs, in the natural channel.

Pre-construction monitoring was initiated in 2007. Phase 3 construction was completed from April to October 2012. Phase 3 post-construction monitoring began in October 2012 and was completed October 2016.

EAST FONTHILL DEVELOPMENT

As part of the Village of East Fonthill Phase 1 Development activities, a storm water management pond was constructed at the northeast corner of the development area to manage storm water runoff. Pond construction occurred in 2015 and was fully constructed by October 2015.

WSP Canada Limited (WSP) was retained by Upper Canada Consultants and the Town of Pelham to complete the hydrologic monitoring of the storm water management pond, which included surface water flow monitoring and surface water quality monitoring.

The storm water management pond is located on the southwest corner of Regional Road 20 and Rice Road, in the Town of Pelham.

The SWM pond has three inlet structures that collect runoff from roadside ditches along the east and west sides of Rice Road (south of Regional Road 20), and from manholes along the south side of Regional Road 20 (west of Rice Road). The bottom draining SWM pond discharges north through an existing 1.22-m diameter concrete culvert beneath Regional Road 20 into the Rice Road Tributary. On the north side of Regional Road 20, the Rice Road Tributary receives surface water runoff from Regional Road 20 storm drains and from the roadside ditch located on the north

side of Regional Road 20. The collected runoff then flows north into the narrowly confined, densely wooded channel of the Rice Road Tributary. The Rice Road Tributary flows north to Twelve Mile Creek, ultimately to Lake Ontario.

Five surface water monitoring stations were established for the monitoring program. As noted above, the storm water management pond was fully constructed by October 2015. The locations of the stations are described below.

- SW1 – Inlet to pond, northwest corner of pond
- SW2 – Inlet to pond, northeast corner of pond
- SW3 – Inlet to pond, east side of pond
- SW4 – Outlet from pond to box culvert beneath Regional Road 20 to the Rice Road Tributary
- SW5 – Downstream in the Rice Road Tributary, approximately 40 metres north of Regional Road 20

Stations SW1, SW2 and SW3 (not shown on the attached Figure 1) were monitored for surface water quality and surface water temperature while stations SW4 and SW5 were monitored for surface water flow, surface water quality and surface water temperature.

Pre-construction monitoring was conducted from March to May 2015. Construction of the stormwater management pond occurred from June 2015 until late September 2015. Post-construction monitoring began in October 2016 and was conducted until December 2018.

MONITORING LOCATIONS

The following table summarizes the monitoring locations and associated data that were collated for this assessment. The monitoring locations are shown on Figure 1.

Station ID (this assessment)	Regional Road 20 Redevelopment Station ID	East Fonthill Development Station ID	Location Description
SW1 (Effluent)	SW1	SW4	Outlet/effluent from south of Regional Road 20 / stormwater management pond
SW2	SW2		3 metres north of the box culvert
SW3	SW3	SW5	40 metres north (downstream) of the box culvert in the natural channel

The SW1 location was relocated from the south end of the box culvert to the north end of the box culvert in September 2015 to accommodate the pond construction activities.

Manual and electronic flow temperature measurements were collected as part of the both monitoring programs. Submerged electronic monitoring equipment at station SW1 measured and recorded water level, velocity, and temperature at 10-minute intervals on a seasonal basis (i.e., during non-freezing conditions). The water level and temperature at the SW3 monitoring station were recorded at hourly intervals by a Levellogger located in a stilling well in the watercourse. Manual flow measurements were made during each site inspection of the monitoring stations. Flows were measured manually generally following the USGS area-velocity method.



During the manual flow measurement event, surface water samples were obtained from the stations noted above and submitted to an accredited lab for water quality analyses.

MONITORING PROGRAM RESULTS

The following section provides a summary of the results of the surface water monitoring programs. The significant dates of construction and development phases that occurred in the vicinity of the Rice Road and Regional Road 20 intersection are as follows.

- Regional Road 20 Phase 3 Construction Activities; April 2012 to October 2012
- East Fonthill Development Stormwater Management Pond Construction; June 2015 to September 2015

For the purpose of this assessment, the monitoring results are assembled according to the aforementioned significant dates of construction and development. The data sets are organized as follows.

Monitoring Phase	Date Range
Pre-development monitoring	Prior to April 2012
Development / construction monitoring	April 2012 to September 2015
Post pond-construction monitoring	October 2015 to December 2018

SURFACE WATER QUALITY

Concentrations of total suspended solids (TSS) were assessed in the pond effluent (SW1) to determine if the stormwater management pond was effectively removing sediment prior to discharging. TSS concentrations from the monitoring locations are presented on Figure 2 and summarized in the table, below.

Effluent (SW1)	Average	Maximum
Pre-development monitoring	61.1 mg/L	281 mg/L
Development / construction monitoring	36.3 mg/L	228 mg/L
Post pond-construction monitoring	23.2 mg/L	103 mg/L

As indicated in the table above, both the average and the maximum concentrations of TSS observed in the pond effluent after pond construction were less than the respective pre-development concentrations suggesting that the pond was effectively attenuating TSS to pre-development concentrations or better.

A TSS concentration of 506 mg/L was observed at SW2 in June 2016. On that date, the TSS concentration in the SWM pond effluent (SW1) was <10 mg/L suggesting that the TSS concentrations observed at SW2 were the results of surface water inputs between SW1 and SW2.

SURFACE WATER TEMPERATURE

Electronic and manual temperature measurements from the monitoring locations are presented on Figure 3. The electronic temperature measurements from the pond effluent and downstream monitoring locations are summarized on the following tables. It is noted that electronic data is not

available from SW1 during 2012 due to the culvert reconstruction and from SW4 during 2016 due to equipment failures.

Electronic Measurements

Effluent (SW1)	Average	Maximum
Pre-development monitoring	15.4 °C	30.9 °C
Development / construction monitoring	14.2 °C	29.0 °C
Post pond-construction monitoring	14.1 °C	24.0 °C

Electronic Measurements

Downstream (SW3)	Average	Maximum
Pre-development monitoring	13.9 °C	29.2 °C
Development / construction monitoring	12.4 °C	19.0 °C
Post pond-construction monitoring	13.2 °C	19.3 °C

In general, the measured temperatures reflect seasonal variations as depicted on Figure 3. Due to the intermittent nature of the discharge, the electronic temperatures at SW1 often reflect ambient temperatures in the culvert. Surface water temperatures at SW3 are moderated, as the logger is located within the sump of the stilling well, below the creek bed; thus, recorded temperatures at SW3 reflect seasonal surface water temperatures moderated by the temperature in the shallow sub-surface.

As indicated in the tables above, the average and maximum electronic temperatures measured in the pond effluent and at the downstream location after the pond was constructed were lower than the pre-development monitoring temperatures suggesting that the pond is attenuating surface water temperatures to pre-development levels or better.

Additionally, the daily maximum ambient air temperatures recorded at the Environment Canada Welland-Pelham Climatological Station are presented on Figure 3. As indicated on the figure, water temperatures in the effluent relative to the daily maximum ambient air temperature are reduced post pond-construction.

The manual temperature measurements from the pond effluent and downstream monitoring locations are presented on the following tables. It is noted that manual temperature measurements were not obtained from East Fonthill station SW5.

Manual Measurements

Effluent (SW1)	Average	Maximum
Pre-development monitoring	12.7 °C	27.6 °C
Development / construction monitoring	11.2 °C	23.7 °C
Post pond-construction monitoring	12.4 °C	23.8 °C

Consistent with the electronic measurements, the average and maximum manual temperatures measured in the pond effluent after the pond was constructed were lower than the pre-development monitoring temperatures.

Manual Measurements

Downstream (SW3)	Average	Maximum
Pre-development monitoring	12.4 °C	22.9 °C
Development / construction monitoring	11.5 °C	22.4 °C
Post pond-construction monitoring	14.0 °C	23.0 °C

While the average manual temperatures at the downstream location were greater in the post pond-construction monitoring than the pre-development monitoring, the maximum manual temperatures were similar. It is noted, however, that the database is limited for manual measurements at SW3 during the development/construction and post pond-construction monitoring periods

SURFACE WATER DISCHARGE RATE

Flow monitoring was conducted to determine pre- and post development flow rates and to ensure that the stormwater management pond is attenuating post-development peak flows to pre-development levels. Pond effluent and downstream flow rates are provided on Figure 4 and summarized in the table below. As previously mentioned, electronic data is not available from SW1 during 2012 due to the culvert reconstruction and from SW4 during 2016 due to equipment failures.

Effluent (SW1)	Maximum	
	Electronic	Manual
Pre-development monitoring	553.8 L/s	72.8 L/s
Development / construction monitoring	627.8 L/s	43.9 L/s
Post pond-construction monitoring	319.5 L/s	43.9 L/s

As indicated in the table above, the maximum electronic flow rates measured in the pond discharge location (SW1) after the pond was constructed were lower than the pre-development monitoring flow rates suggesting that the pond is effectively attenuating post-development peak flows to pre-development levels. Similar results were measured at the downstream location (SW3), presented in the table below.

Downstream (SW3)	Maximum	
	Electronic	Manual
Pre-development monitoring	683.3 L/s	83.0 L/s
Development / construction monitoring	2804.2 L/s	28.6 L/s
Post pond-construction monitoring	257.2 L/s	23.4 L/s

EROSION MONITORING

Licensed Ontario Land Surveyors (William A. Mascoe Surveying Limited) surveyed the creek reach annually in April from 2007 to 2016 following the snow melt/spring freshet, using Total Station survey equipment. The creek profile was surveyed at approximately one-metre intervals, including breaks in grade, lowest point, edge of creek, and top of bank. Field benchmarks were

established, and the work was completed relative to the Regional Niagara UTM system for future monitoring purposes.

Figures 5.1 through 5.9, from past Regional Road 20 Redevelopment Annual Monitoring Reports, presents the year-to-year erosion/accretion from 2008 until 2016. Figure 6, from the Regional Road 20 Redevelopment 2016 Annual Monitoring Report, presents the erosion/accretion difference between 2016 and 2007 surveys, identifying areas of either erosion or accretion relative to the original 2007 survey. The differences were interpolated using the ESRI's ArcGIS using the "Topo to Raster" tool which is a technique used to create a hydrologically correct surface. The algorithm used is based on that of ANUDEM (developed by Hutchinson et al at the Australian National University). Between April 2007 and April 2016, the year-to-year erosion/accretion in the surveyed reach is generally less than 0.5 m, with small areas of greater erosion/accretion which shifted each year; year-to-year erosion/accretion as shown in Figure 5.1 to Figure 5.8. Overall erosion/accretion is shown in Figure 6, and there did not appear to be a significant change in erosion/accretion rates over the monitoring period.

CONCLUSIONS

Based on the data presented in this assessment, the following conclusions are provided:

- For the purpose of this assessment, the monitoring results were assembled according to significant dates of construction and development in the vicinity of the Twelve Mile Creek tributary / East Fonhill Development stormwater management pond located near the intersection of Regional Road 20 and Rice Road in the Town of Pelham. The data sets are organized as follows:
 - Pre-development monitoring – Prior to April 2012
 - Development / construction monitoring – April 2012 to September 2015
 - Post pond-construction monitoring – October 2015 to December 2018
- Average and maximum total suspended solids concentrations in the effluent are lower in the post pond-construction monitoring than the pre-development monitoring.
- Average and maximum electronically and manually measured temperatures in the effluent and downstream locations are lower in the post pond-construction monitoring than the pre-development monitoring, with the exception of the average manual temperatures at the downstream location which are greater in the post pond-construction period. It was noted that the database is limited for manual measurements at the downstream location during the development/construction and post pond-construction monitoring periods
- Peak flow rates in the effluent and downstream location are lower in the post pond-construction monitoring than the pre-development monitoring.
- Erosion monitoring has indicated the erosion/accretion in the surveyed reach is generally less than 0.5 m between April 2007 and April 2016.
- The stormwater management pond located at the northeast corner of the East Fonhill Development is effectively attenuating peak TSS concentrations, temperatures, and flow rates to pre-development levels or better.

We trust that this information is sufficient for your needs. Please contact us if there are any questions or comments.

Yours sincerely,



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Encl. Figures 1 through 6

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