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MEMORANDUM

Date: **July 2020**

Project No: **17-549**

Re: **Appendix C**
Serson Creek Technical Memo – Channel Hydraulics
Lakeview Village
City of Mississauga
Region of Peel

HYDRAULIC MODELLING OBJECTIVES

The following are the primary objectives of the hydraulic modelling completed for the detailed Serson Creek corridor design. The detailed design and hydraulic modelling has been carried out in two (2) phases – Phase 1 (interim conditions) within the lands currently held by Lakeview Village Partners and Phase 2 (ultimate conditions) which will occur in the fullness of time when the Plaster Form Inc. lands participate.

The staged approach to channel design and approval necessitates continuous updating of the hydraulic model. The hydraulic modelling results presented herein describe the channel hydraulics based on the detailed Phase 1 design only.

The following tasks were undertaken:

- Review existing CVC model
- Update existing CVC model based on available site information
- Provide comparison to CVC model
- Determine flood elevations for the existing watercourse
- Coordinate proposed channel design (slopes, section) with geomorphologist
- Determine flood elevations for the proposed watercourse under interim scenario(s) (Phases 1A/1B)

It was confirmed by CVC staff that a riparian storage analysis was not required due to proximity of the site to the lake.

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MODEL METHODOLOGY

To achieve the modelling objectives described in the preceding section, the U.S. Army Corps of Engineers' River Analysis System (HEC-RAS) was utilized. HEC-RAS is designed to perform one-dimensional steady and unsteady flow river hydraulics calculations, sediment transport-mobile bed modelling, and water temperature analysis. The HEC-RAS software supersedes the HEC-2 river hydraulics package.

The modelling system calculates water surface profiles for steady gradually varied flow. The system can handle a full network of channels, a dendritic system, or a single river reach. The steady flow component is capable of modelling subcritical, supercritical, and mixed flow regime water surface profiles.

The basic computational procedure is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is utilized in situations where the water surface profile is rapidly varied. These situations include mixed flow regime calculations (i.e., hydraulic jumps), hydraulics of bridges, and evaluating profiles at river confluences (stream junctions).

This model can consider the effects of various obstructions, such as bridges, culverts, dams, weirs, and other structures in the floodplain on water levels. The steady flow system is designed for application in floodplain management, estimation of floodplain storage, and for assessing the change in water surface profiles due to channel modifications.

The model requires the following input:

- channel geometry (low flow centerline profile and cross-sections; culvert crossing details);
- Manning's roughness for main channel and overbank areas;
- cumulative flow; and,
- downstream boundary conditions.

FLOOD MAPPING

A) EXISTING CONDITIONS

The existing CVC model for Serson Creek was provided to Urbantech in May 2019. This model included the following flows and a starting tailwater elevation of 74.80m.

Storm Event	Flow change location (m^3/s)						
	XS 12072	XS 11956	XS 11533	XS 11504	XS 11471	XS 11137	XS 10718
2-year	0.3	1	4.3	4.3	4.3	4.9	5
5-year	0.5	1.5	7.1	6.6	7.1	8.2	8.1
10-year	0.6	2.2	10.4	8.9	10.4	11.8	11.5
25-year	0.8	2.8	12.4	10.3	12.4	14.3	13.8
50-year	1.1	3.4	14.5	11.5	14.5	16.7	15.9
100-year	1.3	4	16.6	12.2	16.6	19.2	18.3
Regional	1.5	3.9	15.9	14	15.9	19.1	20.5

Based on the available topographic mapping and survey data for the Lakeview Village and G.E. Booth Wastewater Treatment Plant (WWTP), updates to the model cross-sections from Lakeshore Road East to the downstream end of the channel were made. No changes were made to the peak flows or tailwater / starting water level boundary condition. Several additional cross-sections were added as needed, or re-oriented to account for the updated topographic mapping. The existing / temporary haul road bridge crossing was added to the model.

The following table summarizes the differences between the CVC and Urbantech (updated) existing conditions model. As noted below, the updates to the model demonstrate good agreement to the CVC model, with the exception of the increased water levels associated with the inclusion of the bridge structure / haul road crossing. **Drawing FP-1** illustrates the CVC existing floodplain and the Urbantech existing floodplain.

Existing Conditions Model - CVC vs. Urbantech

Section	Existing Conditions			Note
	CVC	Urbantech	Difference	
	Water Surface Elevation (m)			
11137	83.7	83.71	0.01	No appreciable change
11116	Lakeshore Road East			No appreciable change; no change to culvert structure elevations or dimensions
11096	83.32	83.33	0.01	No appreciable change
11051	83.15	83.25	0.10	Urbantech cross-sections based on detailed / recent survey of Serson Creek. Water level increase due to inclusion of TRCA haul road bridge crossing structure at 10589.43
10998	83.04	83.14	0.10	
10917	82.65	82.62	-0.03	
10861	82.5	82.51	0.01	
10797	82.21	82.40	0.19	
10718	81.93	82.36	0.43	
10591	-	82.34	-	Added section
10590	-	82.34	-	Added section
10589.4	Existing Temporary Bridge			Existing TRCA haul road bridge structure; not included in CVC model.
10589	-	81.74	-	Added section
10588.7	-	81.78	-	Added section
10588	81.62	81.57	-0.05	Urbantech cross-sections based on detailed / recent survey of Serson Creek.
10465	-	81.43	-	Added Section
10464	81.14	81.22	0.08	Urbantech cross-sections based on detailed / recent survey of Serson Creek.
10350	-	80.55	-	Added Section
10349	79.91	79.75	-0.16	Urbantech cross-sections based on detailed / recent survey of Serson Creek.
10211	78.2	78.15	-0.05	
10117	76.97	76.97	0.0	
10037	75.74	75.79	0.05	

B) PROPOSED CHANNEL

For the proposed channel, the design is divided into interim and ultimate construction stages.

Phase 1A, (i.e., the current proposal under request for permit), is the interim condition in which the ultimate channel between the Plaster Form Inc. and the connection to the Jim Tovey Lakeview Conservation Area is constructed, with an interim channel connection to the existing ditch along the former rail corridor. The existing channel between this location upstream to Lakeshore Road East will be maintained in this phase. These works eliminate the low-flow bypass towards the G.E. Booth WWTP. It is assumed that the existing TRCA haul road / bridge crossing is in place in this scenario.

Phase 1B (i.e., the current proposal under request for permit) is identical to Phase 1A, with the exception that the temporary haul road and bridge crossing are removed. This improves / reduces the floodplain upstream. The bridge crossing is expected to be removed in 2024, subject to TRCA's schedule.

Phase 2 represents the ultimate conditions in which the remaining portion of Serson Creek is realigned from Lakeshore Road East to the Phase 1A/1B channel limit.

Notes regarding Phase 2:

It is understood that CVC will not review this portion of the channel works at this time. The future channel alignment upstream of Phase 1 will have no hydraulic impacts on the Phase 1A/Phase 1B water levels.

The ultimate channel block has been sized and conceptually shown in the preferred alignment on the plans, but this memo has been scoped to focus on the Phase 1A/1B portion of the channel.

It is understood that the alignment of the Phase 2 channel is subject to CVC / City review; however, the Phase 1A/1B channel design is "fixed" based on the downstream tie-in to the TRCA channel / Jim Tovey Lakeview Conservation Area and the upstream elevation of the existing channel at the property Lakeview Village property line.

PROPOSED GEOMETRY - INTERIM

The channel geometry in the post-development interim hydraulic model is based on the corridor alignment and grading provided on attached grading plans and channel profiles for the Phase 1A/1B corridor. The main channel elevations and sections were based on collaboration between the fluvial geomorphologic design by Beacon and design by Urbantech to optimize the capacity of the channel within the constraints associated with the existing and future development. Refer to **Drawings CH-1 to CH-3** for the channel plan and profile drawings and **Drawings SEC-1 to SEC-3** for the channel sections.

PROPOSED BOUNDARY AND FLOW CONDITIONS

The existing flow rates and boundary conditions in the May 2019 CVC model were used to simulate the Phase 1A/1B channel. It is assumed that the channel flows will not increase beyond existing conditions; i.e. any future development drainage from the adjacent Lakeview Village or Plaster Form Inc. lands directed to the channel will not exceed the existing flow rates from those lands. If increased flows are proposed, the HEC-RAS analysis should be revisited to confirm channel capacity. As shown on **Figures STM-1** and **STM-2**, the proposed drainage area is slightly smaller than the existing drainage area. The proposed Serson Innovation Corridor blocks are proposed to drain to the subdivision sewers rather than to Serson Creek; this is consistent with the assumption that the flows will not increase beyond existing rates.

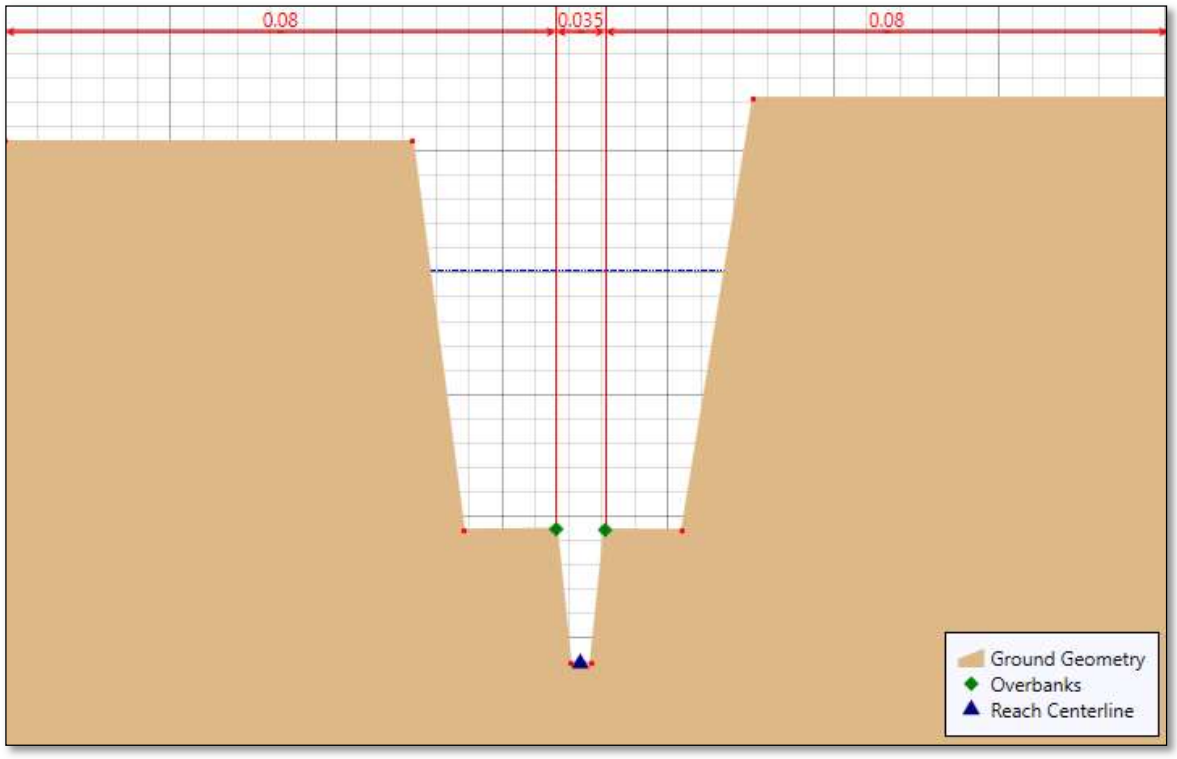
The drainage areas / flows are not expected to change for the ultimate (Phase 2) channel.

PROPOSED MODEL PARAMETERS – INTERIM

Manning's roughness for the proposed channel (main channel and overbank areas) was deemed to be uniform throughout the length of the channel. A value of 0.035 for the main channel and 0.080 for wooded overbank areas was utilized.

Manning's roughness for the existing culvert at Lakeshore Road was based on the USACE HEC-RAS Hydraulic Reference Manual. The same culvert parameters from the existing model were adapted where the concrete box culvert has a Manning's roughness of 0.013 for the top and 0.035 for the bottom.

Contraction and expansion coefficients were set to 0.1 and 0.3, respectively, for smooth transitions between cross-sections. At abrupt transitions (upstream and downstream of culverts, bends in channel direction, and wetlands), the contraction and expansion coefficients were increased to 0.3 and 0.5, respectively.



Typical Assignment of Manning's Roughness

C) PROPOSED FLOODPLAIN MAPPING

The interim (Phase 1A/1B) floodplain extents were determined by simulating the interim channel geometries (with culverts and with bridge in the case of Phase 1A) with the existing flow rates as per the May 2019 CVC model. The steady-state model engine was used for this simulation. The resulting water surface elevations were used to plot the proposed interim flood elevations on the proposed ground surface.

The proposed interim Phase 1A and Phase 1B flood elevations are shown in **Drawing FP-2**. Along the length of the restored channel, the interim Regional floodplain is contained within the corridor.

In Phase 1A, the existing TRCA haul road / bridge crossing causes backwater that continues to result in flooding upstream, within the woodland area north of the haul road. A berm is proposed in the channel upstream of the tie-in point to eliminate flooding and to ensure the frequent flows are directed into the realigned corridor rather than the "remnant" channel through the woodlot. However, this berm has been disregarded as it relates to Regional flood mapping in accordance with CVC flood mapping protocol. The interim / Phase 1A flood elevations upstream of the tie-in point are lower than existing water levels as a result of the rehabilitated corridor widening and lowering.

For Phase 1B, the removal of the temporary haul road bridge further reduces the Regional floodplain by more than 80cm such that the backwater near the tie in point does not spill into the woodland even if the berm is not considered.

The proposed interim channel design contains the maximum design flows with sufficient freeboard to private property or structures (minimum 0.30m). Note that the proposed berm on the G.E. Booth WWTP property is not required to contain the floodplain and is situated above the Regional floodplain. This berm is provided for screening / landscaping purposes and has been agreed to by the Region of Peel staff.

The following table illustrates the interim flood elevations compared to the existing (Urbantech / updated) flood elevations. There is a considerable decrease in water level at most section as a result from increasing the width and overall capacity of the reach between the WWTP bypass and the lake.

Sections	Phase 1A (Interim with Temporary Bridge) vs. Existing Conditions Results			
	Existing	Phase 1A	Difference	Note
	Water Surface Elevation (m)			
11137	83.71	83.71	0.00	Existing Channel
11116	Lakeshore Road			Existing Culvert
11096	83.33	83.33	0.00	Existing Channel
11051	83.25	83.24	-0.01	
10998	83.14	83.14	0.00	
10917	82.62	82.54	-0.08	
10861	82.51	82.35	-0.16	
10797	82.40	82.13	-0.27	
10718	82.36	81.94	-0.42	
10591	82.34	81.86	-0.48	
10590	82.34	81.88	-0.46	
10589.52	Existing Temporary Bridge (TRCA Haul Road)			Phase 1A only
10589	81.74	81.16	-0.58	Phase 1A/1B Interim Channel
10588.7	81.78	80.88	-0.90	
10588.4	-	80.76	-	
10588	81.57	80.66	-0.91	
10466	-	80.57	-	
10465	81.43	80.39	-1.04	
10464.6	-	80.31	-	
10464	81.22	80.16	-1.06	
10351	-	80.06	-	
10350	80.55	79.89	-0.66	
10349.5	-	79.65	-	
10349	79.75	79.47	-0.28	
10212	-	79.23	-	
10211.9	-	79.12	-	
10211.6	-	78.87	-	
10211.4	-	78.66	-	
10211	78.15	78.49	0.34	
10118	-	78.42	-	
10117.4	-	77.81	-	
10117	76.97	76.78	-0.19	Existing Channel
10037	75.79	75.81	0.02	

The water elevation comparison between the existing conditions and the Phase 1B condition is included in the following table.

Sections	Phase 1B (Interim; no bridge) vs. Existing Conditions Results			
	Existing	Phase 1B	Difference	Note
	Water Surface Elevation (m)			
11137	83.71	83.71	0.00	Existing Channel
11116	Lakeshore Road			Existing Culvert
11096	83.33	83.33	0.00	Existing Channel
11051	83.25	83.24	-0.01	
10998	83.14	83.14	0.00	
10917	82.62	82.54	-0.08	
10861	82.51	82.35	-0.16	
10797	82.40	82.13	-0.27	
10718	82.36	81.43	-0.93	
10590	82.34	81.04	-1.30	
10589.6	-	81.10	-	Phase 1B Interim Channel
10589.3	-	81.03	-	
10589	81.74	80.99	-0.75	
10588.7	81.78	80.88	-0.90	
10588.4	-	80.76	-	
10588	81.57	80.66	-0.91	
10466	-	80.57	-	
10465	81.43	80.39	-1.04	
10464.6	-	80.31	-	
10464	81.22	80.16	-1.06	
10351	-	80.06	-	
10350	80.55	79.89	-0.66	
10349.5	-	79.65	-	
10349	79.75	79.47	-0.28	
10212	-	79.23	-	
10211.9	-	79.12	-	
10211.6	-	78.87	-	
10211.4	-	78.66	-	
10211	78.15	78.49	0.34	
10118	-	78.42	-	
10117.4	-	77.82	-	
10117	76.97	76.78	-0.19	Existing Channel
10037	75.79	75.81	0.02	

All referenced figures and drawings are included in the main body of the Serson Creek channel design brief.

A copy of the HEC-RAS models referenced herein is included in the digital submission.

Regards,

Urbantech® Consulting

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