

REGIONAL MUNICIPALITY OF PEEL
ALBION / VAUGHAN ROAD AND KING
STREET INTERSECTION IMPROVEMENTS,
TOWN OF CALEDON
HYDRAULIC REPORT
Schedule 'B' Class EA

B000709

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Table of Contents

1. Introduction	3
2. Existing Conditions.....	4
3. Design Criteria.....	6
3.1 WC-1 Design Criteria – Design Flows (Bridges and Culverts)	6
3.2 WC-2 Design Criteria – Freeboard and Clearance.....	7
3.3 WC-13 Design Criteria – Relief Flow (Bridges and Culverts)	7
4. Development Standards, Policies & Guidelines	7
5. Existing Conditions.....	7
5.1 Existing Hydrology	8
5.2 Updated Existing Hydrology.....	8
5.3 Updated Existing Hydraulics	11
6. Other Design Consideration.....	18
6.1 OSIM Structural Inspection.....	18
6.2 Water Survey of Canada Stream Gauge	18
6.3 Fluvial Geomorphology Assessment	18
7. Proposed Conditions	20
7.1 Bolton Residential Expansion Study (BRES) Option 6	20
7.2 Double Left Turn (Westbound)	20
7.3 Four Lane Widening.....	20
7.4 Options to Mitigate MTO Design Compliance	21
7.5 Options to Mitigate Regional Floodplain Impacts	21
7.6 Conclusion.....	21

List of Figures

Figure 1: Study Area Plan	3
Figure 2: Location Plan	5
Figure 3: Existing HEC-RAS Cross Section Locations	10
Figure 4: Updated Existing HEC-RAS Cross Section Locations for Cold Creek.....	12
Figure 5: Hydraulic Profile Humber River – Updated Existing Conditions – Structure 1	15
Figure 6: Hydraulic Profile Cold Creek – Updated Existing Conditions – Structure 2 & Structure 3 ..	16

List of Tables

Table 1 : Peak Flows for Humber River at different Flow Nodes (m ³ /s).....	8
Table 2 : Updated Peak Flows for Humber River at different Flow Nodes (m ³ /s)	9
Table 3 : Updated Boundary Conditions @ Humber Downstream	13
Table 4 : Summary of Existing HEC-RAS Modeling Results & Design Compliance	14

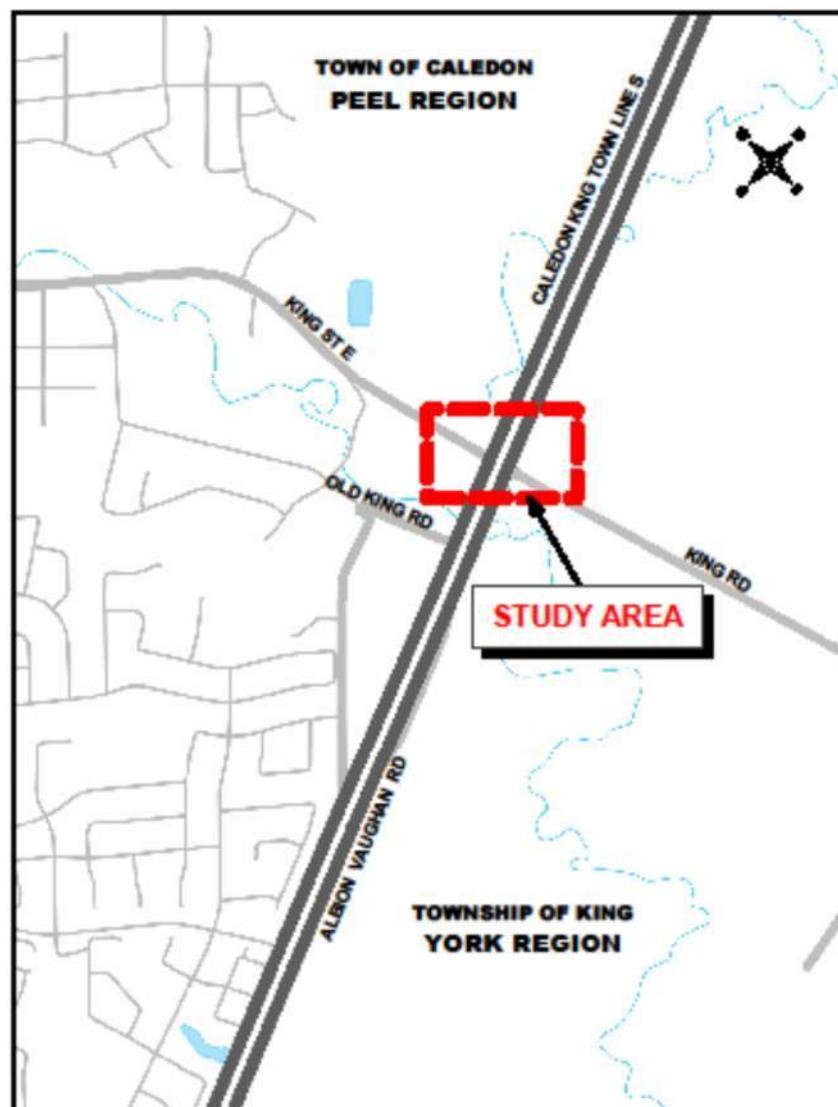
List of Appendices

Appendix A: Drainage Area Plan with Flow Nodes	
Appendix B: General Arrangement Drawings	
Appendix C: HEC-RAS Output – Existing Conditions	
Appendix D: HEC-RAS Output – Proposed Conditions	

1. Introduction

As part of the widening and intersection improvements of Albion/Vaughan Road and King Street Class EA project a hydraulic analysis of 3 Bridges at the intersection was conducted to assess the need for improvements or replacement of the existing Bridges within the study area which is shown on Figure 1 - Study Area. This report documents the design criteria, hydrologic design flows, hydraulic analysis, and floodplain analysis including detailed modelling to verify the existing and proposed conditions for the 2-year through 100-year, and Regional storm events for each Bridge. Consideration of structural conditions, erosion protection and appropriate fluvial geomorphic design input is incorporated into the sizing of Bridges which require replacement or extension.

Figure 1: Study Area Plan






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2. Existing Conditions

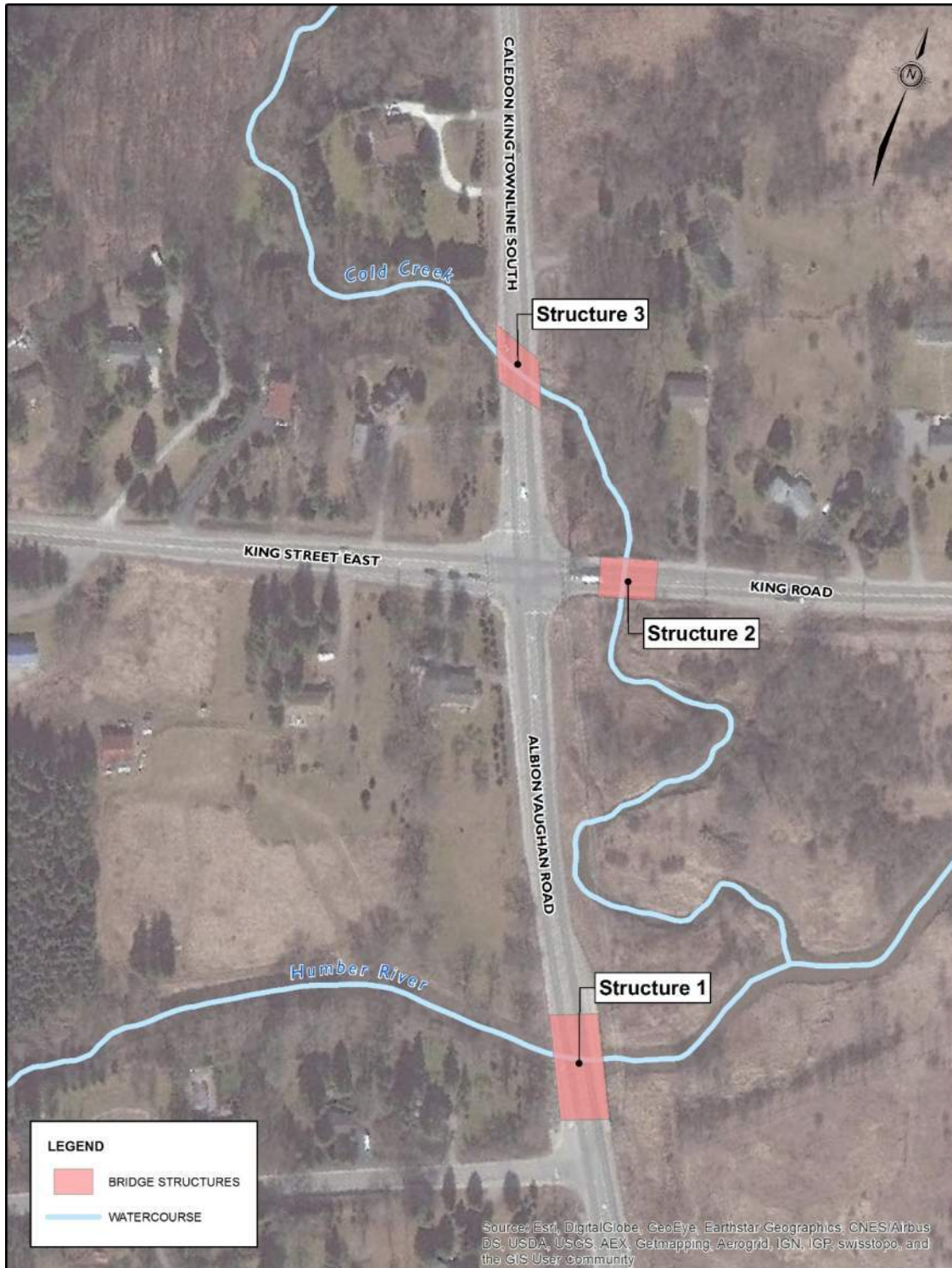
A field investigation was completed on December 8, 2016 to document the hydraulic characteristics of the existing Bridges including any drainage and erosion concerns at each Bridge. Background documents were obtained including General Arrangement drawings to confirm crossing span and height, roadway profiles, and channel dimensions. The following table provides a description of the existing bridge structures, and photograph of each watercourse crossing. The location of the structures are shown on **Figure 2 – Location Plan**.

Table 1 Summary of Existing Bridge Bridges in Study Area

Description	Picture
<p>Structure 1: Albion / Vaughan Road (Peel Regional Road 14) Bridge over Humber River is a 3 span (12.1m-20.2m-12.1m) pre-stressed concrete girder bridge, original constructed in 2004. The Bridge is located approximately 200m south of King Road.</p> <p>No erosion/scour to note. There is a pedestrian trail on the south side including staircase walkway on the west side of the Bridge.</p>	
<p>Structure 2: King Road Bridge (York Regional Road 11) over Cold Creek (Structure ID 37-78), is a 12.9m single span arch concrete bridge, constructed is unknown. The Bridge is located approximately 25m east of Caledon Townline Road.</p> <p>A water survey of Canada (WSC) monitoring gauge is located at the upstream end of King Road Bridge. The spillway/intake is on the upstream side of the bridge, and the shelter is on the south side of King on the east bank.</p>	
<p>Structure 3: Caledon King Townline Road Bridge over Cold Creek (Structure ID 37-77), is an 8.4m single span arch concrete bridge, original constructed in 1982, and rehabilitated in 2004. The Bridge is located approximately 90m north of King Road.</p> <p>There is an erosion/scour hole along the south abutment (0.3m to 0.5m deep). No damage or undercutting of the footing was observed.</p>	

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Figure 2: Location Plan



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3. Design Criteria

MTO “Highway Drainage Design Standards” (2008), Canadian Highway Bridge Design Code (CHBDC, 2000), and MTO “Drainage Management Manual” (1997) have been followed for establishing the design criteria. The design criteria and standards for assessing the watercourse crossings are described below and based on the following roadway classification for each Bridge:

- Structure 1 – Vaughan/Albion Road Bridge – Rural Arterial
- Structure 2 – King Road Bridge – Rural Collector
- Structure 3 – King/Caledon Townline Road Bridge – Rural Collector

3.1 WC-1 Design Criteria – Design Flows (Bridges and Culverts)

Standard WC-1 (excerpts below), provides design flows for bridges and culverts on various classes of roadways. It also identified requirements for accommodating the Regulatory Flow. Given the roadway classification and span of each Bridge is greater than 6.0m, the **50-year storm** is the relevant design storm based on MTO design criteria. On regulated watercourses the Regulatory Flow shall be calculated to identify potential damage to adjacent properties and to ensure that there are no increases in the Regulatory Floodline.

1.1.1 As a minimum, bridges and culverts of Provincial Highways shall be designed to the criteria shown in the following table, except as outlined in Section 1.1.2 to Section 1.1.4 of this standard:

Design Flow Return Period for Bridges and Culverts - Standard Road Classifications			
Functional Road Classification	Return Period of Design Flows (Years) ^{1,2,3}		Check Flow for Scour
	Total Span less than or equal to 6.0 m	Total Span greater than 6.0 m	
Freeway, Urban Arterial	50	100	130% of 100 year
Rural Arterial, Collector Road	25	50	115% of 100 year
Local Road	10	25	100% of 100 year
Note:			
1. The listed design flows apply to roads under the jurisdiction of the Ministry of Transportation.			
2. The Fish Passage Design Flow for culverts is defined in Standard WC-12 Fish Passage Requirements Through Culverts			
3. Sometimes referred to as Normal Design Flow			

1.1.2 On Regulated Watercourses the Regulatory Flow shall be calculated in all cases where Floodline Mapping is available, where there is a potential risk to public safety, or where there is potential damage to adjacent properties, as applied in Section 2.3 of this standard.

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3.2 WC-2 Design Criteria – Freeboard and Clearance

Standard WC-2 (partial excerpted below), identifies the soffit clearance and freeboard for bridges based on standard roadway classifications. Based on these standards, the minimum required freeboard and clearance for all Bridges is **1.0 m during the 50-year return period** design storm.

3.2 Standard Road Classifications

The following values are to be applied to Standard Road Classifications.

3.2.1 The Freeboard at bridge crossings shall be greater than or equal to 1.0m for freeways, arterials and collectors. The Freeboard at bridge crossings shall be greater than or equal to 0.3m for local roads. These freeboard requirements also apply to roadways which are parallel to the watercourse under the bridge.

3.2.2 The Clearance for freeways, arterials and collector roads shall be greater than or equal to 1.0m. The Clearance for local roads shall be greater than or equal to 0.3m.

3.3 WC-13 Design Criteria – Relief Flow (Bridges and Culverts)

Standard **WC-13** (partially excerpted below) provides the allowable depth and velocity of relief flow (weir flow) over the roadway during storm events greater than the design storm.

3.2 Depth and Velocity of Relief Flow

Where Relief Flow is provided, the following parameters shall not be exceeded at the cross section of the road for the Regulatory Flood:

3.2.1 The maximum depth of flow on the roadway shall not exceed 0.3 m; and

3.2.2 The product of the velocity and depth on the roadway shall not exceed $0.8\text{m}^2/\text{s}$.

4. Development Standards, Policies & Guidelines

The Town of Caledon Development Standards, January 2009 provides the following guidance for Design Flood Frequency based on road classification:

<u>Road Classification</u>	<u>Design Flood Frequency</u>
Arterial	1:100 year to Regional
Collector	1:50 year
Urban Local	1:25 year
Rural Local	1:25 year

This standard complies with the MTO criteria for King/Caledon Townline Road, requiring a 1:50 year design flood frequency for a collector road.

5. Existing Conditions

Existing approved hydrologic and hydraulic modeling data was obtained from the TRCA to undertake a hydraulic analysis for the watercourse crossings on Humber River and Cold Creek Tributary. Upon obtaining the models, the accuracy of the data was reviewed and updated based on the most recent data available for the subject site.

5.1 Existing Hydrology

The current HEC-RAS model is based on flows from the *Humber River Watershed Hydrology Update* completed by Aquafor Beech Ltd, in November 2002. The table below summarizes the flows at key flow nodes which are identified on the Drainage Area Plan in Appendix A.

Table 1 : Peak Flows for Humber River at different Flow Nodes (m³/s)

Flow Node	River Station	Reach	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	Regional
10	Cold Creek	Main Branch	12.69	20.85	27.1	35.6	42.24	49.04	319.93
9.6	Humber River	Reach2	22.51	36.92	47.78	62.89	75.17	88.19	436.28
9.5	Humber River	Hopeful Creek	3.55	5.85	7.55	9.83	11.75	13.71	41.39
9.2	Humber River	Bolton Reach	26.12	43.32	56.5	74.39	88.9	104.04	479.46
9.1	Humber River	Bolton Reach	27.15	44.96	58.76	77.45	92.6	107.99	463.25
11.2	Humber River	Downstream	39.58	66.42	87.28	114.97	136.72	159.21	674.4

5.2 Updated Existing Hydrology

The TRCA recently completed the *2018 Humber River Hydrology Update*, Civica, April 2018 which provides updated Regional and 2 to 100-year design storm flows for the watershed. A detailed hydrologic update was completed to reflect existing and future land use changes since the 2002 study. The update included a detailed calibration utilizing rainfall-runoff data from recent storm events. The calibration and validation process used to develop the Humber River hydrology model is well documented in the supporting report.

Given that the hydrology study was recently completed, the existing HEC-RAS hydraulic model for Humber River was not updated to reflect the latest hydrologic results. The updated flows for the 2018 study are approximately 10% lower for the Regional Flow on Cold Creek, and 25% lower for the Regional Flow on Upper Humber at Bolton. Similarly, the 2 to 100-year flows in the study area were found to be less for the 2018 study.

The table below summarizes the updated flows for future land use conditions that will be used by CIMA+ to analyze the Bridge Structures associated with the intersection improvements at Albion Vaughan Road and King Road. The location of the different "Flow Nodes" is available in Appendix A.

Table 2 : Updated Peak Flows for Humber River at different Flow Nodes (m³/s)

Flow Node	River Station	Reach	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-year	Regional*
10	Cold Creek	Main Branch	3.1	4.91	25.08	34.57	42.3	51.18	114.43	299.43
9.6	Humber River	Reach2	6.38	12.36	19.59	29.42	37.75	46.75	96.32	363.96
9.5	Humber River	Hopeful Creek	0.26	0.5	3.17	4.56	6.35	8.08	16.19	44.99
9.2	Humber River	Bolton Reach	6.68	13.02	21.18	29.59	38.28	48.28	106.13	376.6
9.1	Humber River	Bolton Reach	13.22	18.21	28.03	34.34	39.81	49.05	105.19	354.37
11.2	Humber River	Downstream	15.77	21.83	43.2	64.93	80.73	98.72	202.94	542.87

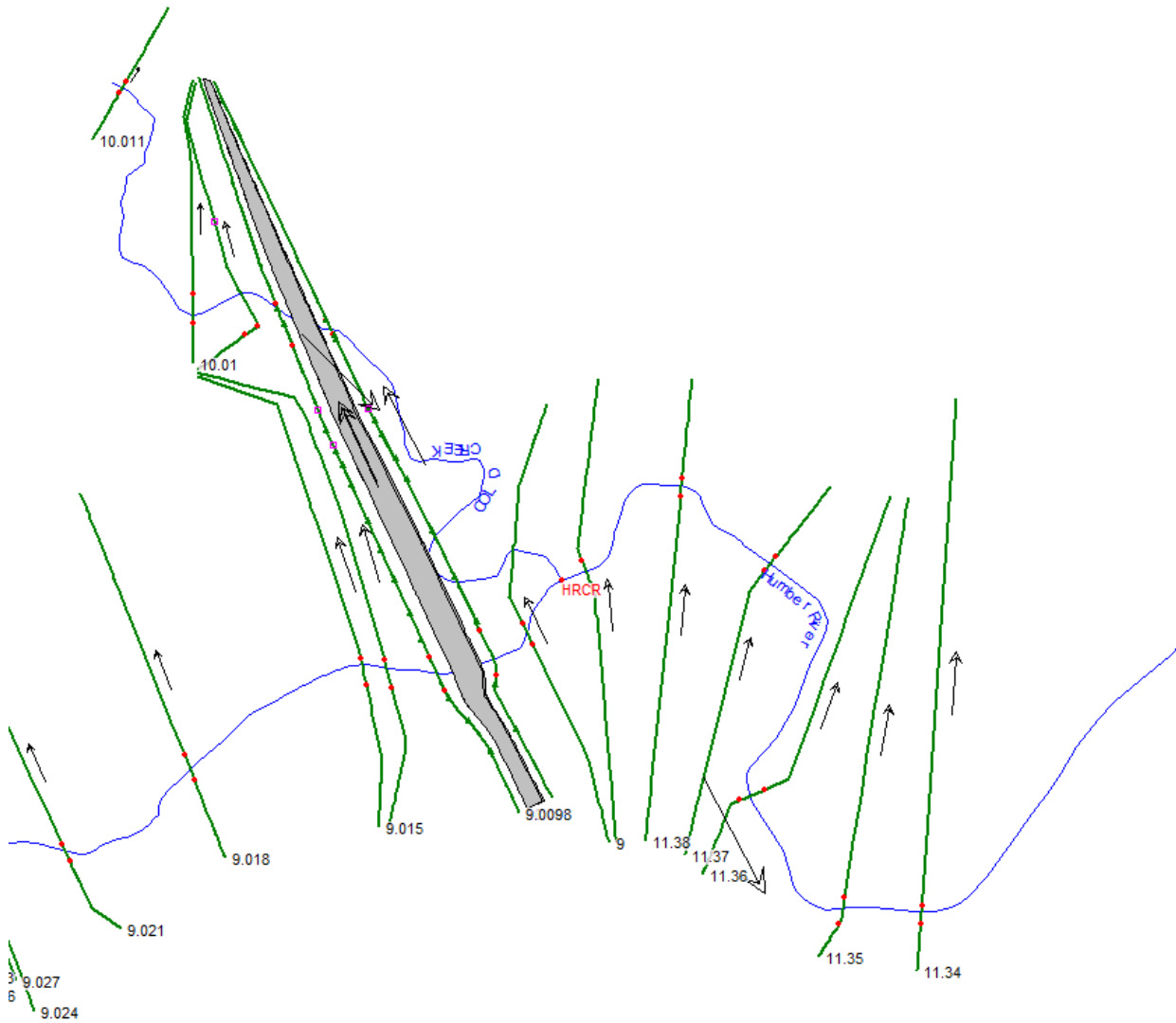
*The Regional Flow for the Humber River is based on Hurricane Hazel. Existing Hydraulics

The existing approved HEC-RAS model and Floodplain Mapping Sheet No. 78 for Humber River provided to CIMA+ by the Region of Peel who obtained it from the TRCA. An initial review of the data established that the HEC-RAS model did not include an assessment of Structure 2 - King Road Bridge at the confluence of Cold Creek and Humber River. The model was further examined and updated based on the field inventory, as-built drawings and general arrangement drawings gathered at each crossing and compiled in Appendix B.

The layout of the existing cross-sections did not account for the backwater affects of Structure 2. To assess the hydraulic performance of the 2 structures on Cold Creek it was determined that an updated model was required to assess Cold Creek independently from Humber River. The following section describes the revisions to the model including updated flows, boundary conditions and geometric files. The following Figure 3 shows the location of the existing HEC-RAS cross sections in the approved TRCA model.

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Figure 3: Existing HEC-RAS Cross Section Locations



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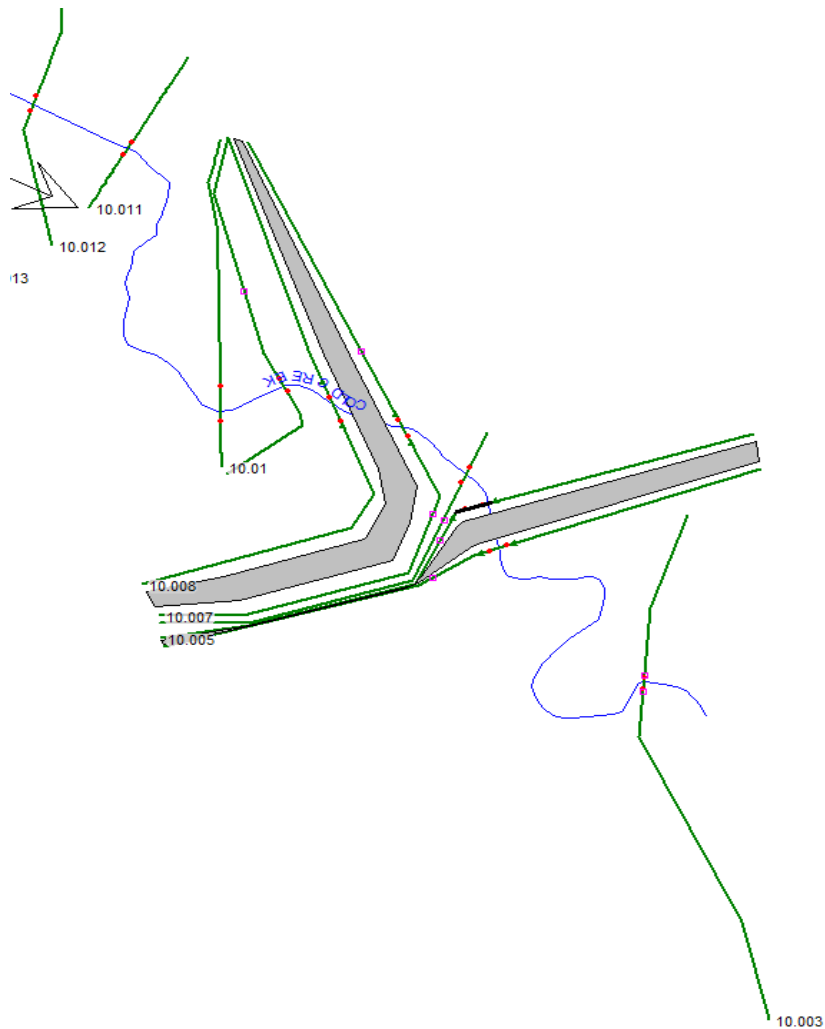
5.3 Updated Existing Hydraulics

The existing HEC-RAS cross-section locations for Humber River was reviewed and no changes were made to the cross-section geometry for the Humber Reach. The model was re-run based on the flows from the *2018 Humber River Hydrology Update* and revised boundary conditions further described below.

To assess the backwater of Cold Creek and the associated structures, the geometry for the tributary was updated to include four additional cross-sections including sections 10.003, 10.004, 10.005, and 10.006. In addition, cross-section 10.007 and 10.008, upstream and downstream of Caledon-King Townline Road (Structure 3 over Cold Creek) was re-aligned to allow for the high and low cord of King Street East to be accommodated.

The updated existing HEC-RAS cross section locations are shown in Figure 4 below for Cold Creek Tributary. The addition of the cross-sections and the incorporation of Structure 2 over Cold Creek allows for a separate hydraulic assessment of backwater on Cold Creek.

Figure 4: Updated Existing HEC-RAS Cross Section Locations for Cold Creek



No general arrangement drawings were available for King Road, so the low cord of the bridge was based on field measurements, while the high cord was derived from as-built drawings. The new and updated cross-sections were cut based on the contours within the floodplain mapping sheet for consistency with the existing model. Modeling parameters including bank location, manning's coefficient ($n=0.035$ in the channel, and $n=0.08$ in the overbank), and downstream cross-section lengths were updated to reflect the new distances between cross-sections. Upon, updating the geometric data, the updated hydrologic flows and revised boundary conditions were incorporated into the model. The boundary conditions for the model are based on a rating curve; the curve was updated and compared to critical flow conditions. The updated boundary conditions are summarized in the following Table 3, as can be seen the water surface elevation is governed by the downstream water surface elevation in comparison to critical flow conditions. The updated water surface (WS) elevation was estimated utilizing the following relationship:

$$Y = 1.0678\ln(x) + 203.81 \quad (R^2 = 0.9991)$$

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Table 3 : Updated Boundary Conditions @ Humber Downstream

Existing Boundary Conditions			Updated Boundary Conditions		
Flow (m3/s)	WS Elevation (m)	WS Elevation (m) @ Critical Flow	Flow (m3/s)	WS Elevation (m)	WS Elevation (m) @ Critical Flow
39.58	207.76	206.94	15.77	206.76	206.51
66.42	208.27	207.34	21.83	207.10	206.63
87.28	208.57	207.59	43.2	207.83	207.00
114.97	208.91	207.91	64.93	208.27	207.32
136.72	209.04	207.99	80.73	208.50	207.51
159.21	209.18	208.49	98.72	208.71	207.72
674.4	210.78	210.33	542.87	210.53	210.12

After updating the model input data, a backwater analysis was completed with HEC-RAS 4.1.0 using open channel, steady flow analysis with Energy (Standard Step) for low flows, Pressure / Weir for high flows. **Table 4** provides a summary of hydraulic results at each bridge.

As the table shows, Structure 1 conveys the 100-yr flow, Structure 2 conveys the 25-year flow, and Structure 3 conveys the 5-year flow for existing conditions. The hydraulic profiles for Humber River and Cold Creek are shown in Figure 5 and Figure 6, including the 2-yr through 500-yr and Regional storm events.

Table 4 : Summary of Existing HEC-RAS Modeling Results & Design Compliance

Bridge / Structure Number:	Criteria	Structure 1	Structure 2	Structure 3
Water Level (upstream of bridge) (m)				
2-year (~bankfull)		208.03	208.75	208.81
10-year		208.74	209.63	210.02
50-year		209.13	210.39	210.45
100-year		209.30	210.47	210.52
Regulatory (Hurricane Hazel)		211.42	211.71	211.90
Bridge Characteristics				
Soffit (m)		210.37	209.50	209.42
Edge of Travelled Way (m)		209.48	210.11	209.90
Design Compliance:				
Existing Performance (Return Period)	50-yr	100-yr	25-yr	5-yr
Clearance (using 50-year water level) (m)	> 1.0	1.24	-0.89	-1.03
Freeboard (using 50-year water level) (m)	> 1.0	0.35	-0.28	-0.55
Relief Flow Depth (Regulatory water level) (m)	< 0.3	1.92	1.60	2.00
Channel Velocity (m/s)				
2-year		0.62	1.27	0.42
100-year (for erosion protection)		0.69	1.49	0.79
Regulatory (Hurricane Hazel)		0.65	1.80	0.75
Product of Velocity * Relief Flow Depth (m²/s)				
Regulatory (Hurricane Hazel)	< 0.8	1.2	2.9	1.5

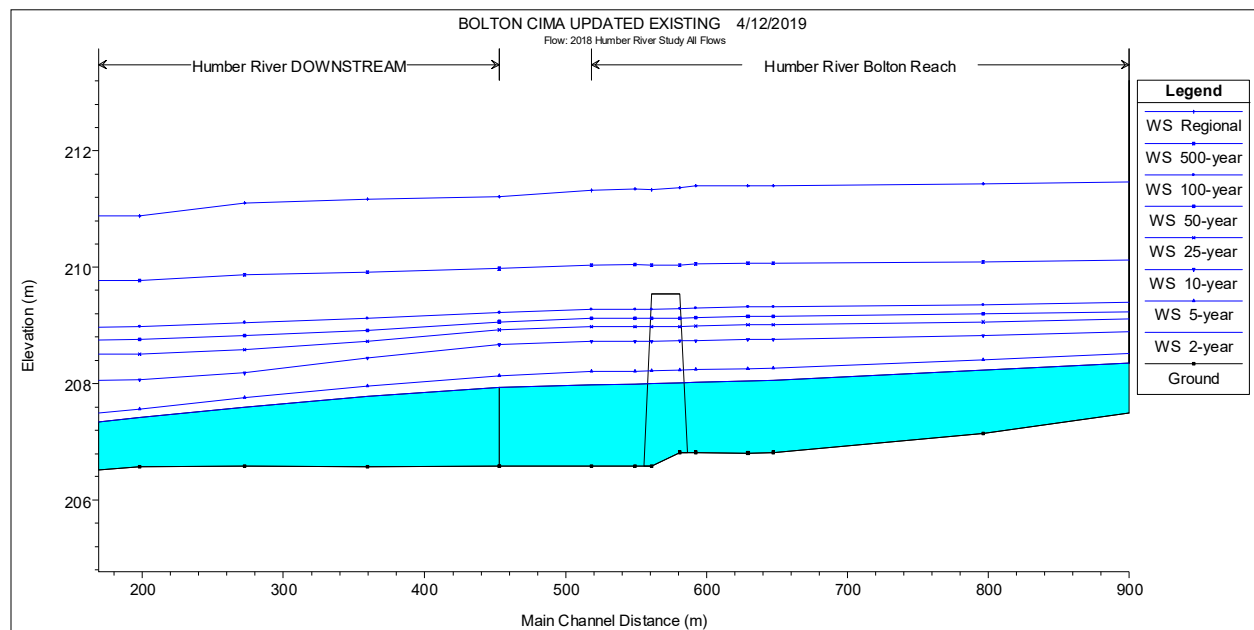
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Structure 1 successfully meets MTO criteria for clearance, which states that at a 50-year water level clearance must measure greater than or equal to 1.0 vertical metre. The clearance measured for this Bridge was 1.24m. However, in regards to freeboard (measured using 50-year water levels) and relief flow depth (measured using regulatory water levels), Structure 1 failed to meet either criteria. Freeboard was measured at 0.35m, below the acceptable criteria of greater than or equal to 1.0m. Relief flow depth was measured at a depth of 1.92m, exceeding the criteria of less than or equal to 0.3m.

For Structure 2, none of the MTO criteria for freeboard, clearance and relief flow depth were met. Freeboard for this bridge was measured at -0.28m, clearance at -0.89m, and relief flow depth at 1.60m. Both freeboard and clearance were measured at 50-year water levels and relief flow depth was measure using regulatory water levels.

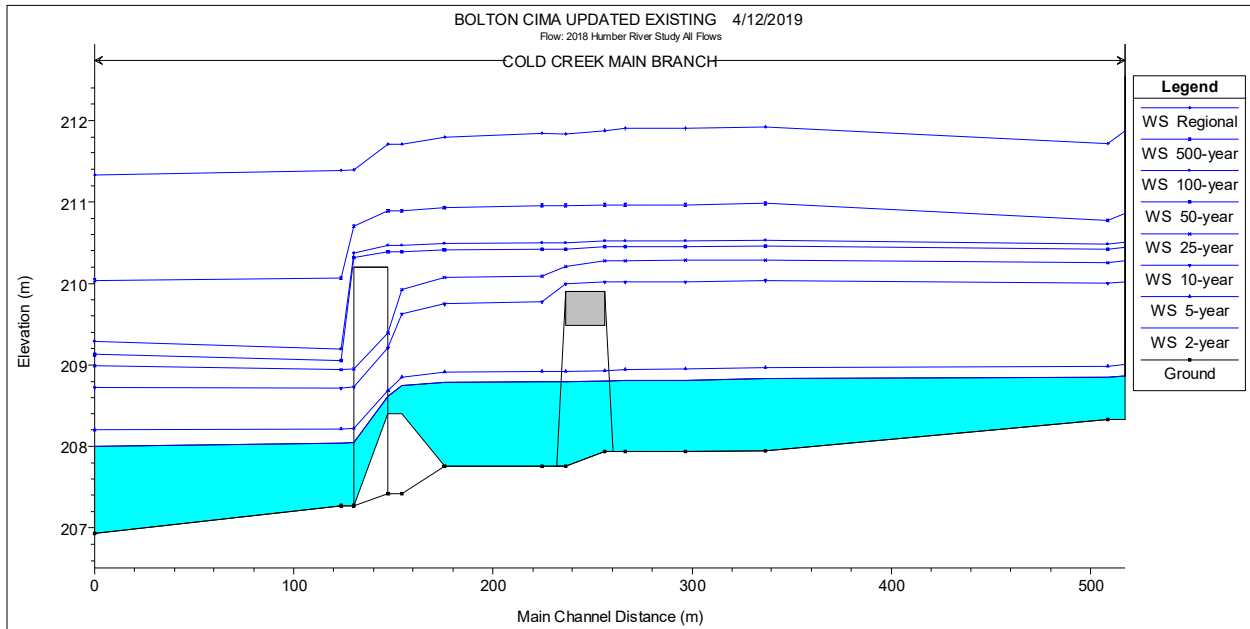
Structure 3 also failed to meet the MTO criteria for freeboard, clearance and relief flow depth. Using 50-year water levels, freeboard and clearance both landed outside the criteria at -0.55m, and -1.03m, respectively. Using regulatory water levels relief flow depth was measured to be above criteria at 2.00m.

Figure 5: Hydraulic Profile Humber River – Updated Existing Conditions – Structure 1



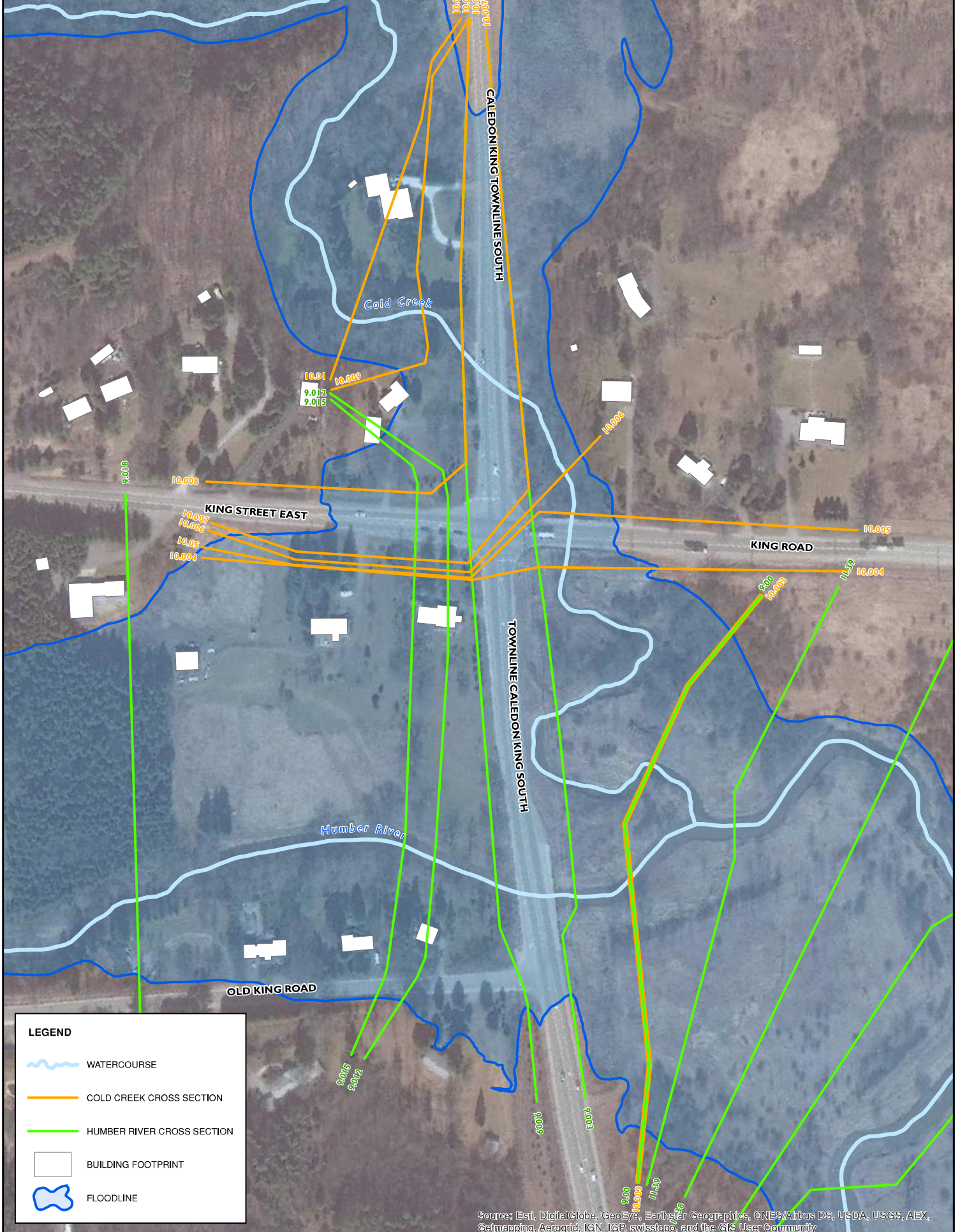
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Figure 6: Hydraulic Profile Cold Creek – Updated Existing Conditions – Structure 2 & Structure 3



The existing flood lines for the study area under the Regional storm event are depicted within the flood map presented in Figure 7. The flood map also displays built structures within the study area, nine of which are located with the boundaries of the flood lines and would thus be affected by flooding under existing conditions.

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PROJECT NAME: PEEL - KING VAUGHAN ENVIRONMENTAL ASSESSMENT	PROJECT No: 8000709	CLIENT FILE No: --
DRAFTER: S. ELLIOTT	DESIGNER: ---	DRAWING No: ---
APPROVER: B. GRESSMANN	APPROVER: ---	SHEET No: 1 of 1
SHEET TITLE: FIGURE 7: FLOODLINE MAPPING		
DATE: 10/24/2017		

6. Other Design Consideration

6.1 OSIM Structural Inspection

Burgess Engineering Inc. completed OSIM Biennial Inspection Reports for each bridge as part of the Albion Vaughan Road and Kings Street Class EA. The condition of the existing Bridges was inspected on February 18th, 2017 using sounding hammer, measuring equipment, and GPS. The following is a brief summary of the results for each bridge:

Albion Vaughan Bridge – Structure 1

The bridge is in good to excellent condition showing no signs of structural distress. Minor asphalt repairs were recommended for maintenance.

King Road Bridge – Structure 2

The Bridge is in good to excellent condition showing no signs of structural distress. Minor asphalt and barrier handrail repairs were recommended for maintenance. It was also noted that there was a minor debris blockage upstream which should be reviewed for historical design before removal.

Caledon King Townline South Bridge – Structure 3

The Bridge is in good to excellent condition showing no signs of structural distress. Minor asphalt, drainage repair and stream debris removal is recommended for maintenance.

6.2 Water Survey of Canada Stream Gauge

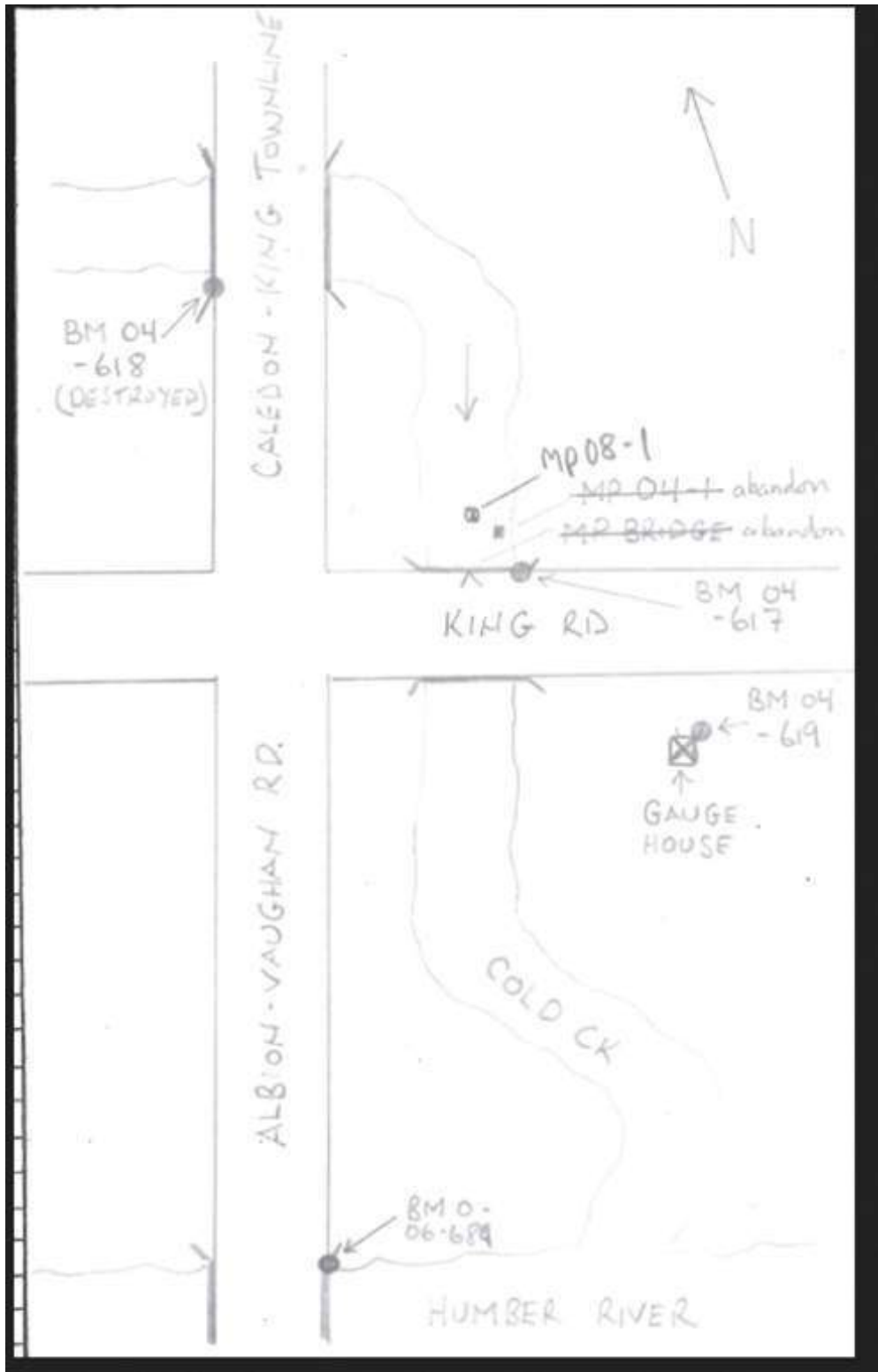
Upon completing the field investigation, CIMA contacted the National Hydrological Service to verify the location of the Water Survey of Canada (WSC) stream gauge 02HC023 Cold Creek near Bolton. The upstream blockage at the upstream face of King Road Bridge was determined to be an active stream gauge re-located in 2004. The station collects water levels using a pressure sensor consisting of black tubing (Orifice line) connecting the equipment inside the gauge house down into the river. The orifice line runs west to the stream and north along the left bank to the upstream side of the King Road bridge. More specifically, it runs through a conduit secured to the left bank bridge abutment and out into the stream approx. 1 m upstream of the upstream side of the bridge, and ending in an orifice static tube secured to the streambed at a t-bar and a 1" square iron pin. There is also a bolt located on the upstream side of the King Road bridge which is used as a measuring point. A site sketch is shown in Figure 8. A blockage at the upstream face of King Road Bridge has been incorporated into the model to account for the gauge.

6.3 Fluvial Geomorphology Assessment

Golder Associates Ltd. completed a fluvial geomorphological assessment for each bridge as part of the Class EA study.

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Figure 8: WSC Site Sketch



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7. Proposed Conditions

The Transportation and Traffic Study Report completed by CIMA as part of the EA study identified a number of alternatives to reduce traffic impacts for the 2031 traffic scenario. The following provides an overview of the intersection improvement alternatives developed for the EA and an assessment of the proposed impacts associated with each option.

7.1 Bolton Residential Expansion Study (BRES) Option 6

The BRES Option 6 intersection improvements include the addition of a right turn lane for eastbound traffic. The proposed improvements will not require any bridge lengthening. A retaining wall will be constructed to mitigate any impacts to the encroachment of fill adjacent to Cold Creek. A hydraulic assessment for this alternative is not required.

7.2 Double Left Turn (Westbound)

The double left turn intersection improvements include the addition of a right turn lane for eastbound traffic plus the addition of a left turn lane for westbound traffic. This will require two westbound and southbound receiving lanes, construction of a retaining wall, and lengthening of King Road Bridge (Structure 2).

A hydraulic assessment of the dual left-turn westbound alternative was completed to evaluate the impact of lengthening the King Road Bridge to a total length of 20.5m (3.5m lengthening on the south side). It was determined that the hydraulic impact for the Double Left-Turn Westbound alternative will have negligible impacts on water levels and velocities when compared to existing conditions. Also, the lengthening on the south side only would minimize the impacts to the Water Survey of Canada (WSC) stream gauge. Detailed hydraulic modeling is attached in Appendix D.

7.3 Four Lane Widening

The Four Lane Widening intersection improvements include the addition of a NBL through-right lane, conversion of SBL right turn lane to southbound through right lane, addition of a westbound through-right lane, and converting existing EBL right turn lane to eastbound through right lane. Each direction will have 1 left turn lane, 1 through lane, 1 through – right lane, and 2 receiving lanes. This alternative will require construction of a retaining wall, lengthening of King Road Bridge (Structure 2) and lengthening of Caledon King Townline Road Bridge (Structure 3).

A hydraulic assessment of the four lane widening alternative was completed to evaluate the impact of lengthening the King Road Bridge to a total length of 24.0m (3.5m lengthening on the south side and 3.5m lengthening on the north side), and lengthening the Caledon King Townline Road Bridge to a total length of 24.8m (2.0m on the west side and 2.8m lengthening on the east side). It was determined that the hydraulic impact for the Four Lane Widening alternative will have negligible impacts on water levels and velocities when compared to existing conditions. The lengthening on the north side will have impacts on the Water Survey of Canada (WSC) stream gauge and will require consultation with the National Hydrological Service. Detailed hydraulic modeling is attached in Appendix D.

7.4 Options to Mitigate MTO Design Compliance

Further options have been reviewed to determine the feasibility of improving the freeboard and clearance at Structure 2 and Structure 3, to comply with MTO design criteria. Specifically, achieving conveyance of the 50yr design event with a minimum of 1.0m of freeboard and clearance measured relative to the 50yr design flow. Two options were investigated:

Option 1: Removal/relocation of the WSC Gauge that causes a blockage of flow upstream of Structure 2. This would reduce 2yr through 100yr water levels in the range of 0.5m to 1.0m between King Road (Structure 2) and King / Caledon Townline (Structure 3). This option would allow for conveyance of the 100yr flow under King Road Bridge with approx. 0.8m freeboard and 0.1m of clearance for the 50yr HWL. Re-locating or removing the WSC gauge would require consultation with the National Hydrological Service.

Option 2: Further to option 1, removal/relocation of the WSC Gauge and replacement of King/Caledon Bridge including raising the profile +/- 0.5m and increasing the bridge span to +/- 12m. This option would allow for conveyance of 100yr flow at Structure 3 but would still only provide less than 0.5m freeboard for the 50yr. The resulting road grade changes will significantly impact the intersection and King Road Bridge. To achieve MTO design compliance this option is not a cost-effective solution for improving the performance of the Structure 3 and reducing upstream flooding impacts. The option could lead to complete reconstruction of the intersection and replacement of both Structure 2 and Structure 3.

7.5 Options to Mitigate Regional Floodplain Impacts

No further options were investigated to reduce the Regional Floodplain; the above noted options 1 & 2 found no significant reductions in floodplain impacts. It is noted that updated floodplain mapping based on the 2018 hydrologic study should be completed but is outside the scope of the study.

7.6 Conclusion

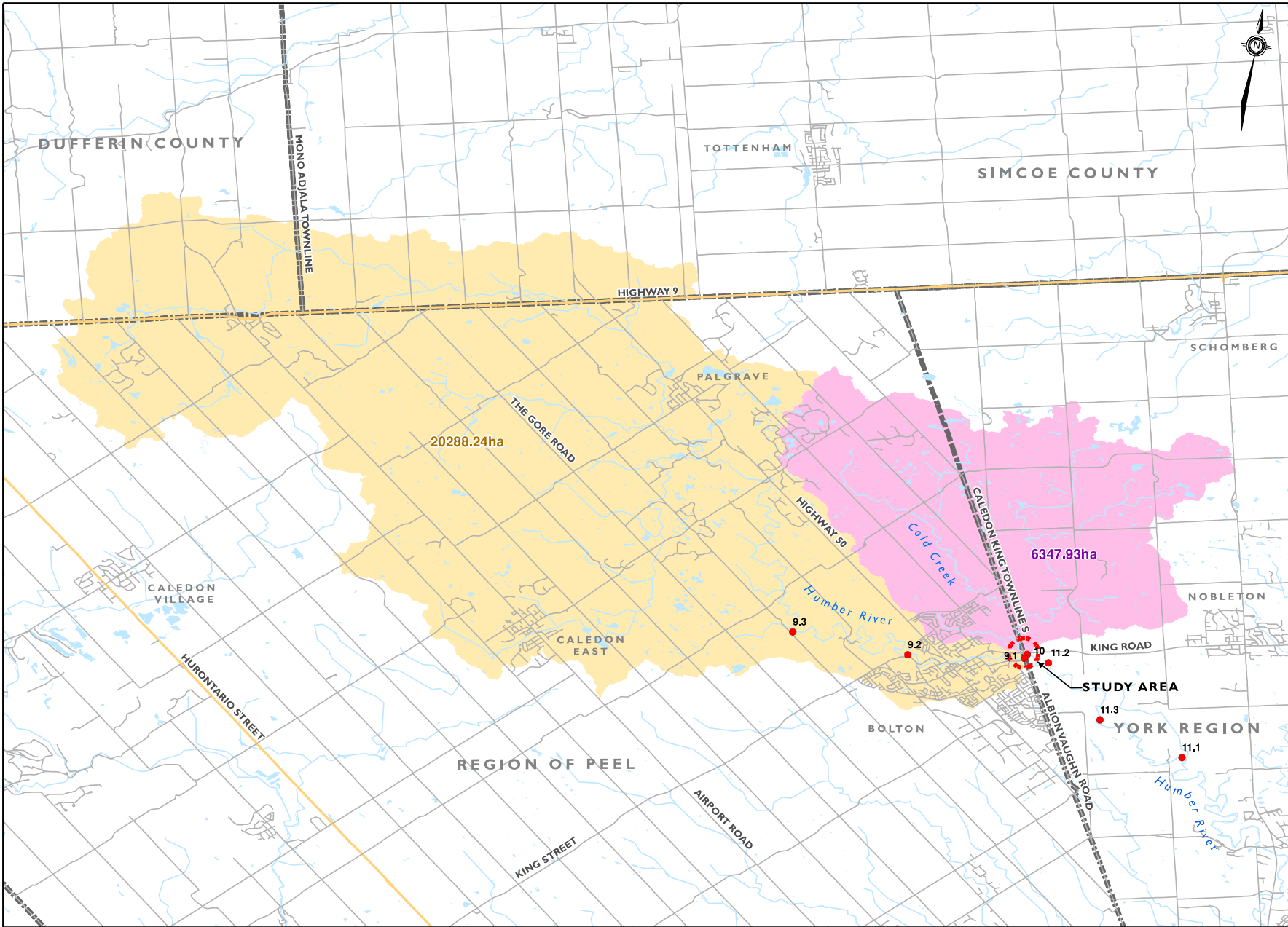
The preferred option is the four-lane widening. It was determined that the hydraulic impact for the Four Lane Widening will have negligible impacts. The maximum increase in water level is 0.01m and the maximum increase in velocity is 0.22 m/s compared to existing conditions. This is considered to be within the accuracy of the hydraulic model. The widening on the north side will have impacts on the Water Survey of Canada (WSC) stream gauge and will require consultation with the National Hydrological Service. Detailed hydraulic modeling is attached in Appendix D. At detailed design the hydraulic modelling should be updated utilizing the most current hydraulic modelling.

APPENDIX A

Drainage Area Plan with Flow Nodes

B000709





LEGEND

- CATCHMENT AREAS**
 - HUMBER RIVER BOLTON REACH
 - COLD CREEK
- ROAD NETWORK**
 - MTO OWNED ROAD
 - MUNICIPALLY OWNED ROAD
- OTHER FEATURES**
 - FLOW NODES
 - WATERCOURSE
 - WATERBODY
 - MUNICIPAL BOUNDARY



PROJECT NAME:
PEEL - KING VAUGHN ENVIRONMENTAL ASSESSMENT

SHEET TITLE:
DRAINAGE AREAS



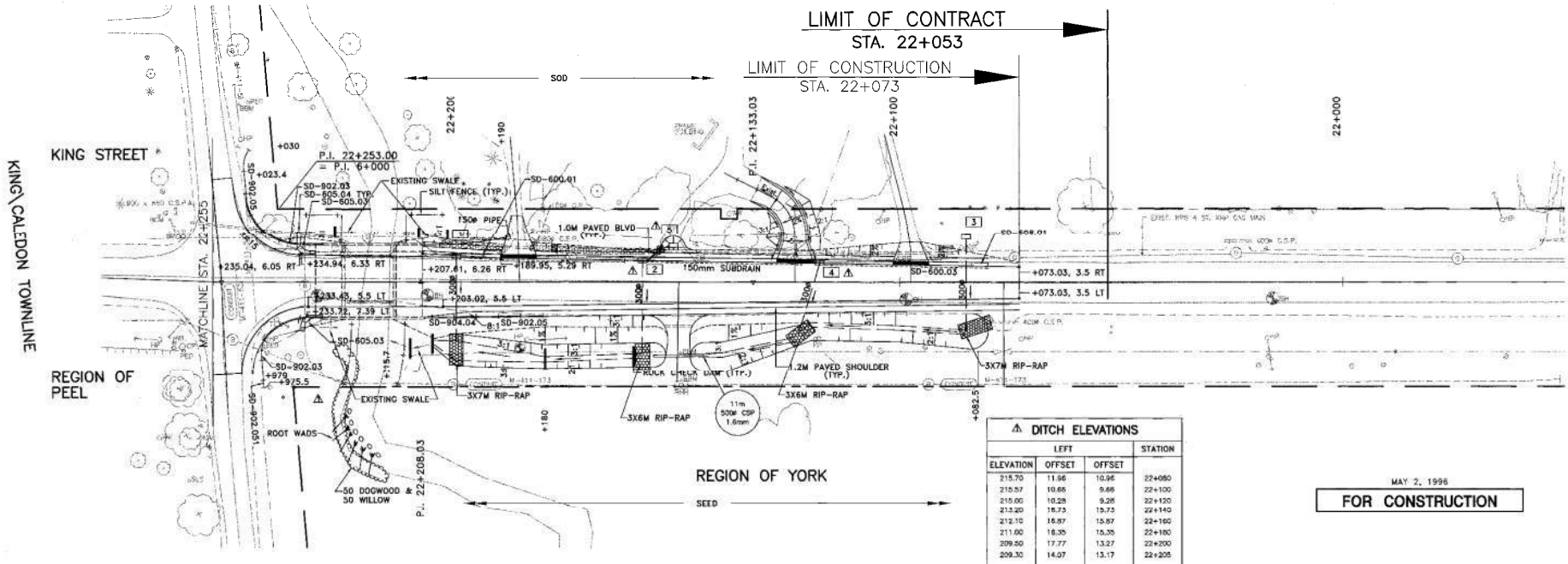
PROJECT No: 8000709	CLIENT FILE No: --
DRAFTER: S. ELLIOTT	DESIGNER: --
APPROVER: R. CRESSMAN	APPROVER: --
DATE: 1/9/2017	SHEET No: 1 of 1

APPENDIX B

General Arrangement Drawings

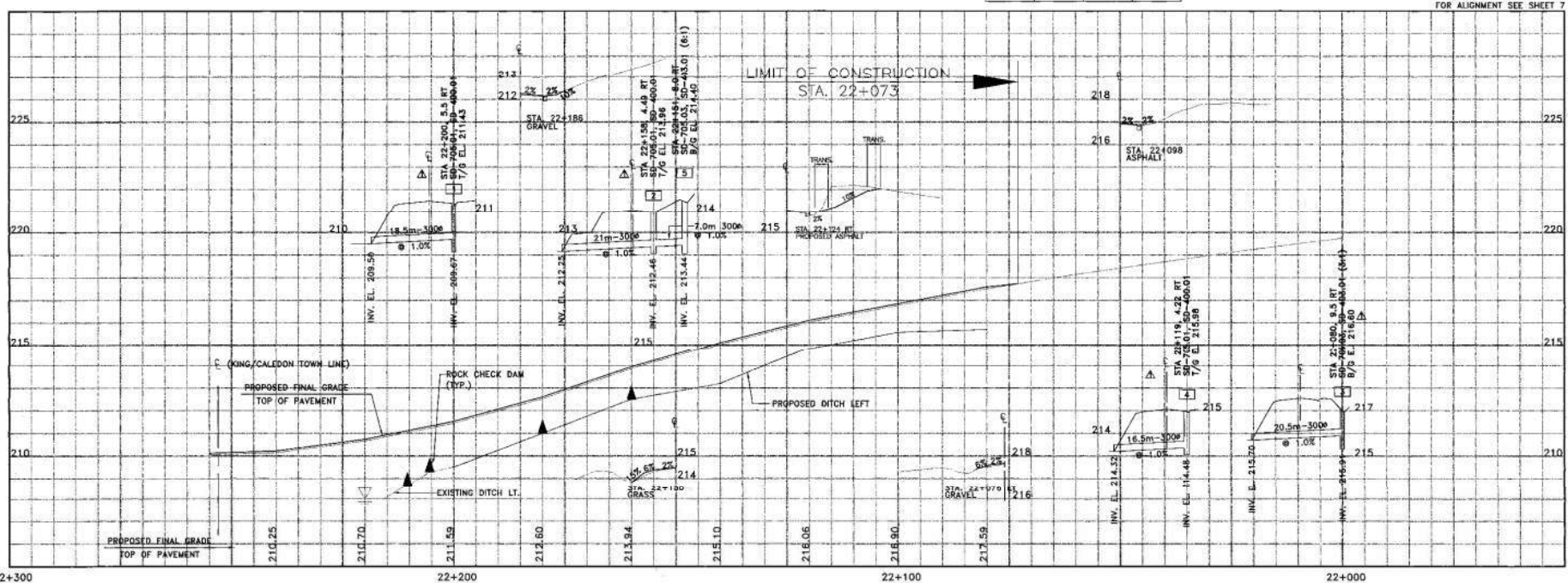
B000709





DITCH ELEVATIONS			
LEFT			STATION
ELEVATION	OFFSET	OFFSET	
215.70	11.66	10.96	22+080
215.57	10.66	9.46	22+100
215.00	10.28	9.28	22+120
213.20	15.73	15.73	22+140
212.10	18.87	18.87	22+160
211.00	18.30	18.30	22+180
208.50	17.77	13.37	22+200
209.30	14.07	13.17	22+205

MAY 2, 1998
FOR CONSTRUCTION

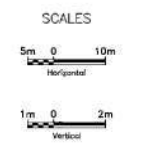


QUANTITIES

CUT	899 m ³
FILL	238 m ³
STRIPPING	201 m ³
DITCHING	- m ³
AVAIL. CUT	899 m ³

DRIVEWAYS

CUT	88 m ³
FILL	- m ³
STRIPPING	19 m ³
DITCHING	- m ³
AVAIL. CUT	88 m ³



NOTE: THE LOCATION OF UTILITIES IS APPROXIMATE ONLY, AND THE EXACT LOCATION SHOULD BE DETERMINED BY CONSULTING THE MUNICIPAL AUTHORITIES AND UTILITY COMPANIES CONCERNED. THE CONTRACTOR SHALL PROVE THE LOCATION OF UTILITIES AND SHALL BE RESPONSIBLE FOR ADEQUATE PROTECTION FROM DAMAGE DURING CONSTRUCTION.

STORM SEWERS:
 1. INVERT ELEVATIONS SHOWN ARE AT CENTRE-LINE OF CATCHBASIN OR MANHOLE.
 2. PIPE LENGTHS SHOWN ARE CENTRE-LINE TO CENTRE-LINE OF CATCHBASIN OR MANHOLE.
 3. OFFSETS SHOWN ARE TO CENTRE OF CATCHBASIN OR MANHOLE COVER.

No.	DATE	REVISIONS	BY
1	06/24/24	ADDED CS 445, ADJUST DITCHES, MOVED CS2, ADDD SPECIAL CONTRACTOR DRAW	D.S.



DESIGN D.S.	KING ROAD (Y.R. 11) AT KING/CALEDON TOWNLINE NEW CONSTRUCTION STA. 22+073 TO STA. 22+255	DWG. NO. P-1011-62
DRAWN I.R.		CONT. NO. 96-110
CHECKED L.K.N.		SHEET NO. 3

APPENDIX C

HEC-RAS Output – Existing Conditions

B000709



Q Total (m ³ /s)			
Profile	Existing	Updated Existing	Difference
2-year	12.69	3.1	-9.59
5-year	20.85	4.91	-15.94
10-year	27.1	25.08	-2.02
25-year	35.6	34.57	-1.03
50-year	42.24	42.3	0.06
100-year	49.04	51.18	2.14
Regional	319.93	299.43	-20.5

River	Reach	Minimum Channel Elevation (m)			Water Surface Elevation (m)			Channel Velocity (m/s)		
River Sta	Profile	Existing	Updated Existing	Difference	Existing	Updated Existing	Difference	Existing	Updated Existing	Difference
COLD CREEK	MAIN BRANCH									
10.015	2-year	209.16	209.16	0	210.22	209.69	-0.53	1.08	0.63	-0.45
10.015	5-year	209.16	209.16	0	210.47	209.82	-0.65	1.28	0.77	-0.51
10.015	10-year	209.16	209.16	0	210.61	210.49	-0.12	1.4	1.5	0.1
10.015	25-year	209.16	209.16	0	210.77	210.67	-0.1	1.56	1.66	0.1
10.015	50-year	209.16	209.16	0	210.85	210.78	-0.07	1.69	1.81	0.12
10.015	100-year	209.16	209.16	0	210.9	210.87	-0.03	1.88	2	0.12
10.015	Regional	209.16	209.16	0	212.98	212.85	-0.13	2.41	2.44	0.03
10.014	2-year	209.17	209.17	0	209.85	209.44	-0.41	2.07	1.56	-0.51
10.014	5-year	209.17	209.17	0	210.17	209.52	-0.65	1.89	1.76	-0.13
10.014	10-year	209.17	209.17	0	210.36	210.3	-0.06	1.81	1.59	-0.22
10.014	25-year	209.17	209.17	0	210.58	210.52	-0.06	1.72	1.53	-0.19
10.014	50-year	209.17	209.17	0	210.72	210.68	-0.04	1.62	1.45	-0.17
10.014	100-year	209.17	209.17	0	210.67	210.79	0.12	2.02	1.5	-0.52
10.014	Regional	209.17	209.17	0	213.04	212.9	-0.14	1.48	1.47	-0.01
10.013	2-year	208.49	208.49	0	209.63	209.05	-0.58	1.42	0.88	-0.54
10.013	5-year	208.49	208.49	0	209.93	209.21	-0.72	1.68	1	-0.68
10.013	10-year	208.49	208.49	0	210.11	210.2	0.09	1.83	1.25	-0.58
10.013	25-year	208.49	208.49	0	210.27	210.43	0.16	2.1	1.33	-0.77
10.013	50-year	208.49	208.49	0	210.36	210.59	0.23	2.31	1.46	-0.85
10.013	100-year	208.49	208.49	0	210.56	210.7	0.14	1.75	1.5	-0.25
10.013	Regional	208.49	208.49	0	213.01	212.88	-0.13	1.62	1.6	-0.02
10.012	2-year	208.33	208.33	0	209.53	208.98	-0.55	1.26	0.7	-0.56
10.012	5-year	208.33	208.33	0	209.84	209.13	-0.71	1.47	0.85	-0.62
10.012	10-year	208.33	208.33	0	210.02	210.13	0.11	1.65	1.32	-0.33
10.012	25-year	208.33	208.33	0	210.25	210.39	0.14	1.57	1.28	-0.29
10.012	50-year	208.33	208.33	0	210.39	210.56	0.17	1.57	1.28	-0.29
10.012	100-year	208.33	208.33	0	210.52	210.67	0.15	1.56	1.37	-0.19
10.012	Regional	208.33	208.33	0	212.95	212.82	-0.13	2.07	2.05	-0.02
10.011	2-year	208.33	208.33	0	209.14	208.85	-0.29	2.02	0.86	-1.16
10.011	5-year	208.33	208.33	0	209.29	208.98	-0.31	2.72	1.03	-1.69
10.011	10-year	208.33	208.33	0	209.47	210.01	0.54	2.85	1.54	-1.31
10.011	25-year	208.33	208.33	0	209.67	210.26	0.59	3.05	1.65	-1.4
10.011	50-year	208.33	208.33	0	209.88	210.42	0.54	2.93	1.76	-1.17
10.011	100-year	208.33	208.33	0	209.99	210.48	0.49	3.08	2.02	-1.06
10.011	Regional	208.33	208.33	0	211.81	211.72	-0.09	5.78	5.65	-0.13
10.010	2-year	207.94	207.94	0	208.93	208.83	-0.1	0.71	0.21	-0.5
10.010	5-year	207.94	207.94	0	209.29	208.96	-0.33	0.71	0.26	-0.45
10.010	10-year	207.94	207.94	0	209.51	210.04	0.53	0.76	0.4	-0.36
10.010	25-year	207.94	207.94	0	209.81	210.29	0.48	0.71	0.45	-0.26
10.010	50-year	207.94	207.94	0	210.02	210.46	0.44	0.69	0.49	-0.2
10.010	100-year	207.94	207.94	0	210	210.53	0.53	0.82	0.56	-0.26
10.010	Regional	207.94	207.94	0	211.69	211.91	0.22	1.73	1.46	-0.27
10.009	2-year	206.82	207.93	1.11	208.94	208.82	-0.12	0.22	0.38	0.16
10.009	5-year	206.82	207.93	1.11	209.3	208.95	-0.35	0.25	0.48	0.23
10.009	10-year	206.82	207.93	1.11	209.53	210.03	0.5	0.24	0.64	0.4
10.009	25-year	206.82	207.93	1.11	209.82	210.29	0.47	0.24	0.64	0.4
10.009	50-year	206.82	207.93	1.11	210.03	210.45	0.42	0.24	0.66	0.42
10.009	100-year	206.82	207.93	1.11	210.01	210.53	0.52	0.29	0.74	0.45
10.009	Regional	206.82	207.93	1.11	211.73	211.9	0.17	0.68	1.78	1.1
10.008	2-year	207.94	207.93	-0.01	208.85	208.81	-0.04	1.17	0.24	-0.93

River	Reach	Minimum Channel Elevation (m)			Water Surface Elevation (m)			Channel Velocity (m/s)		
COLD CREEK	MAIN BRANCH									
River Sta	Profile	Existing	Updated Existing	Difference	Existing	Updated Existing	Difference	Existing	Updated Existing	Difference
10.008	5-year	207.94	207.93	-0.01	209.17	208.95	-0.22	1.38	0.32	-1.06
10.008	10-year	207.94	207.93	-0.01	209.37	210.02	0.65	1.54	0.47	-1.07
10.008	25-year	207.94	207.93	-0.01	209.63	210.28	0.65	1.69	0.53	-1.16
10.008	50-year	207.94	207.93	-0.01	210.03	210.45	0.42	0.19	0.47	0.28
10.008	100-year	207.94	207.93	-0.01	210.01	210.52	0.51	0.23	0.53	0.3
10.008	Regional	207.94	207.93	-0.01	211.73	211.9	0.17	0.59	1.26	0.67
10.0075		Structure 3								
10.007	2-year	207.75	207.75	0	208.64	208.8	0.16	1.52	0.3	-1.22
10.007	5-year	207.75	207.75	0	208.96	208.92	-0.04	1.69	0.41	-1.28
10.007	10-year	207.75	207.75	0	209.13	209.77	0.64	1.89	0.66	-1.23
10.007	25-year	207.75	207.75	0	209.36	210.09	0.73	2.06	0.44	-1.62
10.007	50-year	207.75	207.75	0	209.5	210.42	0.92	2.22	0.37	-1.85
10.007	100-year	207.75	207.75	0	209.64	210.5	0.86	2.36	0.42	-1.94
10.007	Regional	207.75	207.75	0	211.7	211.84	0.14	0.62	1	0.38
10.006	2-year	-	207.75		-	208.79		-	0.3	
10.006	5-year	-	207.75		-	208.91		-	0.42	
10.006	10-year	-	207.75		-	209.75		-	0.77	
10.006	25-year	-	207.75		-	210.07		-	0.69	
10.006	50-year	-	207.75		-	210.41		-	0.59	
10.006	100-year	-	207.75		-	210.49		-	0.66	
10.006	Regional	-	207.75		-	211.79		-	1.67	
10.005	2-year	-	208.4		-	208.75		-	0.84	
10.005	5-year	-	208.4		-	208.85		-	1.02	
10.005	10-year	-	208.4		-	209.63		-	1.62	
10.005	25-year	-	208.4		-	209.93		-	1.73	
10.005	50-year	-	208.4		-	210.39		-	0.91	
10.005	100-year	-	208.4		-	210.47		-	1.02	
10.005	Regional	-	208.4		-	211.71		-	2.43	
10.0045		Structure 2								
10.004	2-year	-	207.27		-	208.04		-	0.57	
10.004	5-year	-	207.27		-	208.21		-	0.68	
10.004	10-year	-	207.27		-	208.72		-	1.92	
10.004	25-year	-	207.27		-	208.94		-	2.17	
10.004	50-year	-	207.27		-	209.05		-	2.42	
10.004	100-year	-	207.27		-	209.19		-	2.65	
10.004	Regional	-	207.27		-	211.41		-	1.85	
10.003	2-year	-	206.94		-	208		-	0.41	
10.003	5-year	-	206.94		-	208.2		-	0.18	
10.003	10-year	-	206.94		-	208.73		-	0.46	
10.003	25-year	-	206.94		-	208.99		-	0.46	
10.003	50-year	-	206.94		-	209.12		-	0.49	
10.003	100-year	-	206.94		-	209.29		-	0.51	
10.003	Regional	-	206.94		-	211.35		-	0.96	

Profile	Q Total (m ³ /s)		
	Existing	Updated Existing	Difference
2-year	27.15	13.22	-13.93
5-year	44.96	18.21	-26.75
10-year	58.76	28.03	-30.73
25-year	77.45	34.34	-43.11
50-year	92.6	39.81	-52.79
100-year	107.99	49.05	-58.94
Regional	463.25	354.37	-108.88

River	Reach	Minimum Channel Elevation (m)			Water Surface Elevation (m)			Channel Velocity (m/s)		
River Sta	Profile	Existing	Updated Existing	Difference	Existing	Updated Existing	Difference	Existing	Updated Existing	Difference
9.015	2-year	206.82	206.82	0	208.69	208.06	-0.63	0.78	0.81	0.03
9.015	5-year	206.82	206.82	0	209.05	208.26	-0.79	0.85	0.88	0.03
9.015	10-year	206.82	206.82	0	209.25	208.76	-0.49	0.88	0.74	-0.14
9.015	25-year	206.82	206.82	0	209.52	209.02	-0.5	0.87	0.68	-0.19
9.015	50-year	206.82	206.82	0	209.67	209.16	-0.51	0.92	0.66	-0.26
9.015	100-year	206.82	206.82	0	209.82	209.33	-0.49	0.94	0.67	-0.27
9.015	Regional	206.82	206.82	0	211.74	211.4	-0.34	1.45	1.28	-0.17
9.012	2-year	206.81	206.81	0	208.69	208.05	-0.64	0.65	0.75	0.1
9.012	5-year	206.81	206.81	0	209.05	208.25	-0.8	0.72	0.8	0.08
9.012	10-year	206.81	206.81	0	209.25	208.76	-0.49	0.8	0.62	-0.18
9.012	25-year	206.81	206.81	0	209.52	209.02	-0.5	0.85	0.57	-0.28
9.012	50-year	206.81	206.81	0	209.66	209.15	-0.51	0.9	0.58	-0.32
9.012	100-year	206.81	206.81	0	209.81	209.32	-0.49	0.97	0.63	-0.34
9.012	Regional	206.81	206.81	0	211.73	211.39	-0.34	1.37	1.21	-0.16
9.009	2-year	206.82	206.82	0	208.68	208.03	-0.65	0.64	0.58	-0.06
9.009	5-year	206.82	206.82	0	209.02	208.24	-0.78	0.83	0.63	-0.2
9.009	10-year	206.82	206.82	0	209.2	208.74	-0.46	0.97	0.63	-0.34
9.009	25-year	206.82	206.82	0	209.46	209	-0.46	1.12	0.64	-0.48
9.009	50-year	206.82	206.82	0	209.65	209.13	-0.52	0.88	0.69	-0.19
9.009	100-year	206.82	206.82	0	209.8	209.3	-0.5	0.9	0.77	-0.13
9.009	Regional	206.82	206.82	0	211.74	211.4	-0.34	0.99	0.88	-0.11
9.006	Structure 1									
9.003	2-year	206.58	206.58	0	208.66	208	-0.66	0.55	0.55	0
9.003	5-year	206.58	206.58	0	209	208.21	-0.79	0.71	0.57	-0.14
9.003	10-year	206.58	206.58	0	209.17	208.73	-0.44	0.83	0.53	-0.3
9.003	25-year	206.58	206.58	0	209.43	208.98	-0.45	0.81	0.54	-0.27
9.003	50-year	206.58	206.58	0	209.59	209.12	-0.47	0.87	0.58	-0.29
9.003	100-year	206.58	206.58	0	209.75	209.28	-0.47	0.81	0.65	-0.16
9.003	Regional	206.58	206.58	0	211.69	211.34	-0.35	0.88	0.77	-0.11
9.000	2-year	206.58	206.58	0	208.65	207.99	-0.66	0.52	0.5	-0.02
9.000	5-year	206.58	206.58	0	208.99	208.2	-0.79	0.57	0.55	-0.02
9.000	10-year	206.58	206.58	0	209.17	208.72	-0.45	0.63	0.49	-0.14
9.000	25-year	206.58	206.58	0	209.43	208.98	-0.45	0.66	0.44	-0.22
9.000	50-year	206.58	206.58	0	209.59	209.12	-0.47	0.7	0.45	-0.25
9.000	100-year	206.58	206.58	0	209.75	209.28	-0.47	0.73	0.48	-0.25
9.000	Regional	206.58	206.58	0	211.66	211.32	-0.34	1.3	1.12	-0.18

APPENDIX D

HEC-RAS Output – Proposed Conditions

B000709



Profile	Q Total (m ³ /s)
2-year	3.10
5-year	4.91
10-year	25.08
25-year	34.57
50-year	42.30
100-year	51.18
500-year	114.43
Regional	299.43

Note: No change in
 Minimum Channel Elevation

River	Reach	Water Surface Elevation (m)					Channel Velocity (m/s)						
		Existing		Double LT Turn		4 Lane Widening		Existing		Double LT Turn		4 Lane Widening	
COLD CREEK	MAIN BRANCH												
River Sta	Profile			Difference From Existing		Difference From Existing			Difference From Existing		Difference From Existing		
10.015	2-year	209.69	209.69	0.00	209.69	0.00	0.63	0.63	0.00	0.63	0.00		
10.015	5-year	209.82	209.82	0.00	209.82	0.00	0.77	0.77	0.00	0.77	0.00		
10.015	10-year	210.49	210.49	0.00	210.49	0.00	1.50	1.50	0.00	1.50	0.00		
10.015	25-year	210.67	210.67	0.00	210.67	0.00	1.66	1.66	0.00	1.67	0.01		
10.015	50-year	210.78	210.78	0.00	210.78	0.00	1.81	1.81	0.00	1.80	-0.01		
10.015	100-year	210.87	210.87	0.00	210.87	0.00	2.00	2.00	0.00	2.00	0.00		
10.015	500-year	211.29	211.29	0.00	211.29	0.00	3.05	3.05	0.00	3.05	0.00		
10.015	Regional	212.85	212.85	0.00	212.85	0.00	2.44	2.44	0.00	2.44	0.00		
10.014	2-year	209.44	209.44	0.00	209.44	0.00	1.56	1.56	0.00	1.56	0.00		
10.014	5-year	209.52	209.52	0.00	209.52	0.00	1.76	1.76	0.00	1.76	0.00		
10.014	10-year	210.30	210.30	0.00	210.30	0.00	1.59	1.59	0.00	1.60	0.01		
10.014	25-year	210.52	210.52	0.00	210.52	0.00	1.53	1.53	0.00	1.54	0.01		
10.014	50-year	210.68	210.68	0.00	210.69	0.01	1.45	1.45	0.00	1.45	0.00		
10.014	100-year	210.79	210.79	0.00	210.79	0.00	1.50	1.50	0.00	1.50	0.00		
10.014	500-year	211.44	211.44	0.00	211.44	0.00	1.54	1.54	0.00	1.54	0.00		
10.014	Regional	212.90	212.90	0.00	212.90	0.00	1.47	1.47	0.00	1.47	0.00		
10.013	2-year	209.05	209.05	0.00	209.05	0.00	0.88	0.88	0.00	0.88	0.00		
10.013	5-year	209.21	209.21	0.00	209.21	0.00	1.00	1.00	0.00	1.01	0.01		
10.013	10-year	210.20	210.20	0.00	210.20	0.00	1.25	1.25	0.00	1.26	0.01		
10.013	25-year	210.43	210.43	0.00	210.43	0.00	1.33	1.33	0.00	1.34	0.01		
10.013	50-year	210.59	210.59	0.00	210.59	0.00	1.46	1.46	0.00	1.45	-0.01		
10.013	100-year	210.70	210.70	0.00	210.70	0.00	1.50	1.50	0.00	1.51	0.01		
10.013	500-year	211.40	211.40	0.00	211.40	0.00	1.53	1.53	0.00	1.53	0.00		
10.013	Regional	212.88	212.88	0.00	212.88	0.00	1.60	1.60	0.00	1.60	0.00		
10.012	2-year	208.98	208.98	0.00	208.97	-0.01	0.70	0.70	0.00	0.71	0.01		
10.012	5-year	209.13	209.13	0.00	209.13	0.00	0.85	0.85	0.00	0.85	0.00		
10.012	10-year	210.13	210.13	0.00	210.12	-0.01	1.32	1.32	0.00	1.33	0.01		
10.012	25-year	210.39	210.39	0.00	210.38	-0.01	1.28	1.28	0.00	1.29	0.01		
10.012	50-year	210.56	210.56	0.00	210.56	0.00	1.28	1.28	0.00	1.28	0.00		
10.012	100-year	210.67	210.67	0.00	210.67	0.00	1.37	1.37	0.00	1.38	0.01		
10.012	500-year	211.33	211.33	0.00	211.33	0.00	1.74	1.74	0.00	1.74	0.00		
10.012	Regional	212.82	212.82	0.00	212.82	0.00	2.05	2.05	0.00	2.05	0.00		
10.011	2-year	208.85	208.85	0.00	208.83	-0.02	0.86	0.86	0.00	0.90	0.04		
10.011	5-year	208.98	208.98	0.00	208.96	-0.02	1.03	1.03	0.00	1.06	0.03		
10.011	10-year	210.01	210.01	0.00	210.00	-0.01	1.54	1.54	0.00	1.56	0.02		
10.011	25-year	210.26	210.26	0.00	210.25	-0.01	1.65	1.65	0.00	1.67	0.02		
10.011	50-year	210.42	210.42	0.00	210.42	0.00	1.76	1.76	0.00	1.76	0.00		
10.011	100-year	210.48	210.48	0.00	210.48	0.00	2.02	2.02	0.00	2.03	0.01		
10.011	500-year	210.78	210.78	0.00	210.77	-0.01	3.64	3.64	0.00	3.65	0.01		
10.011	Regional	211.72	211.72	0.00	211.72	0.00	5.65	5.65	0.00	5.65	0.00		

River	Reach	Water Surface Elevation (m)					Channel Velocity (m/s)						
COLD CREEK	MAIN BRANCH	Existing		Double LT Turn		4 Lane Widening		Existing		Double LT Turn		4 Lane Widening	
River Sta	Profile			Difference From Existing		Difference From Existing			Difference From Existing		Difference From Existing		Difference From Existing
10.004	2-year	208.04	208.04	0.00	208.04	0.00	0.57	0.57	0.00	0.57	0.00	0.57	0.00
10.004	5-year	208.21	208.21	0.00	208.21	0.00	0.68	0.68	0.00	0.68	0.00	0.68	0.00
10.004	10-year	208.71	208.71	0.00	208.71	0.00	1.92	1.92	0.00	1.94	0.00	1.94	0.02
10.004	25-year	208.94	208.94	0.00	208.94	0.00	2.17	2.17	0.00	2.19	0.00	2.19	0.02
10.004	50-year	209.05	209.05	0.00	209.05	0.00	2.42	2.42	0.00	2.46	0.00	2.46	0.04
10.004	100-year	209.19	209.19	0.00	209.18	-0.01	2.65	2.65	0.00	2.71	0.00	2.71	0.06
10.004	500-year	210.06	210.06	0.00	210.06	0.00	2.08	2.08	0.00	2.11	0.00	2.11	0.03
10.004	Regional	211.39	211.39	0.00	211.39	0.00	1.85	1.85	0.00	1.85	0.00	1.85	0.00
10.003	2-year	208.00	208.00	0.00	208.00	0.00	0.41	0.41	0.00	0.41	0.00	0.41	0.00
10.003	5-year	208.20	208.20	0.00	208.20	0.00	0.18	0.18	0.00	0.18	0.00	0.18	0.00
10.003	10-year	208.73	208.73	0.00	208.73	0.00	0.46	0.46	0.00	0.46	0.00	0.46	0.00
10.003	25-year	208.99	208.99	0.00	208.99	0.00	0.46	0.46	0.00	0.46	0.00	0.46	0.00
10.003	50-year	209.12	209.12	0.00	209.12	0.00	0.49	0.49	0.00	0.49	0.00	0.49	0.00
10.003	100-year	209.29	209.29	0.00	209.29	0.00	0.51	0.51	0.00	0.51	0.00	0.51	0.00
10.003	500-year	210.04	210.04	0.00	210.04	0.00	0.66	0.66	0.00	0.66	0.00	0.66	0.00
10.003	Regional	211.33	211.33	0.00	211.33	0.00	0.96	0.96	0.00	0.96	0.00	0.96	0.00

Profile	Q Total (m ³ /s)
2-year	13.22
5-year	18.21
10-year	28.03
25-year	34.34
50-year	39.81
100-year	49.05
500-year	105.19
Regional	354.37

Note: No change in
 Minimum Channel Elevation

River	Reach	Water Surface Elevation (m)					Channel Velocity (m/s)				
HUMBER RIVER	BOLTON REACH										
River Sta	Profile	Existing	Double LT Turn	4 Lane Widening	Existing	Double LT Turn	4 Lane Widening	Existing	Double LT Turn	4 Lane Widening	
			Difference From Existing	Difference From Existing		Difference From Existing	Difference From Existing		Difference From Existing	Difference From Existing	
9.015	2-year	208.06	208.06	0.00	208.06	0.00	0.81	0.81	0.00	0.81	0.00
9.015	5-year	208.26	208.26	0.00	208.26	0.00	0.88	0.88	0.00	0.88	0.00
9.015	10-year	208.76	208.76	0.00	208.76	0.00	0.74	0.74	0.00	0.74	0.00
9.015	25-year	209.02	209.02	0.00	209.02	0.00	0.68	0.68	0.00	0.68	0.00
9.015	50-year	209.16	209.16	0.00	209.16	0.00	0.66	0.66	0.00	0.66	0.00
9.015	100-year	209.33	209.33	0.00	209.33	0.00	0.67	0.67	0.00	0.67	0.00
9.015	500-year	210.07	210.07	0.00	210.07	0.00	0.77	0.77	0.00	0.77	0.00
9.015	Regional	211.40	211.40	0.00	211.40	0.00	1.28	1.28	0.00	1.28	0.00
9.012	2-year	208.05	208.05	0.00	208.05	0.00	0.75	0.75	0.00	0.75	0.00
9.012	5-year	208.25	208.25	0.00	208.25	0.00	0.80	0.80	0.00	0.80	0.00
9.012	10-year	208.76	208.76	0.00	208.76	0.00	0.62	0.62	0.00	0.62	0.00
9.012	25-year	209.02	209.02	0.00	209.02	0.00	0.57	0.57	0.00	0.57	0.00
9.012	50-year	209.15	209.15	0.00	209.15	0.00	0.58	0.58	0.00	0.58	0.00
9.012	100-year	209.32	209.32	0.00	209.32	0.00	0.63	0.63	0.00	0.63	0.00
9.012	500-year	210.06	210.06	0.00	210.06	0.00	0.77	0.77	0.00	0.77	0.00
9.012	Regional	211.39	211.39	0.00	211.39	0.00	1.21	1.21	0.00	1.21	0.00
9.009	2-year	208.03	208.03	0.00	208.03	0.00	0.58	0.58	0.00	0.58	0.00
9.009	5-year	208.24	208.24	0.00	208.24	0.00	0.63	0.63	0.00	0.63	0.00
9.009	10-year	208.74	208.74	0.00	208.74	0.00	0.63	0.63	0.00	0.63	0.00
9.009	25-year	209.00	209.00	0.00	209.00	0.00	0.64	0.64	0.00	0.64	0.00
9.009	50-year	209.13	209.13	0.00	209.13	0.00	0.69	0.69	0.00	0.69	0.00
9.009	100-year	209.30	209.30	0.00	209.30	0.00	0.77	0.77	0.00	0.77	0.00
9.009	500-year	210.06	210.06	0.00	210.06	0.00	0.68	0.68	0.00	0.68	0.00
9.009	Regional	211.40	211.40	0.00	211.40	0.00	0.88	0.88	0.00	0.88	0.00
9.006		Structure 1									
9.003	2-year	208.00	208.00	0.00	208.00	0.00	0.55	0.55	0.00	0.55	0.00
9.003	5-year	208.21	208.21	0.00	208.21	0.00	0.57	0.57	0.00	0.57	0.00
9.003	10-year	208.73	208.73	0.00	208.73	0.00	0.53	0.53	0.00	0.53	0.00
9.003	25-year	208.98	208.98	0.00	208.98	0.00	0.54	0.54	0.00	0.54	0.00
9.003	50-year	209.12	209.12	0.00	209.12	0.00	0.58	0.58	0.00	0.58	0.00
9.003	100-year	209.28	209.28	0.00	209.28	0.00	0.65	0.65	0.00	0.65	0.00
9.003	500-year	210.04	210.04	0.00	210.04	0.00	0.53	0.53	0.00	0.53	0.00
9.003	Regional	211.34	211.34	0.00	211.34	0.00	0.77	0.77	0.00	0.77	0.00
9.000	2-year	207.99	207.99	0.00	207.99	0.00	0.50	0.50	0.00	0.50	0.00
9.000	5-year	208.20	208.20	0.00	208.20	0.00	0.55	0.55	0.00	0.55	0.00
9.000	10-year	208.72	208.72	0.00	208.72	0.00	0.49	0.49	0.00	0.49	0.00
9.000	25-year	208.98	208.98	0.00	208.98	0.00	0.44	0.44	0.00	0.44	0.00
9.000	50-year	209.12	209.12	0.00	209.12	0.00	0.45	0.45	0.00	0.45	0.00
9.000	100-year	209.28	209.28	0.00	209.28	0.00	0.48	0.48	0.00	0.48	0.00
9.000	500-year	210.03	210.03	0.00	210.03	0.00	0.60	0.60	0.00	0.60	0.00
9.000	Regional	211.32	211.32	0.00	211.32	0.00	1.12	1.12	0.00	1.12	0.00

