

## **FLOODPLAIN ASSESSMENT**

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**Addressed to: RFA Planning Consultant Inc.**

**For the  
Keene Subdivision**

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**January 30, 2025**

Prepared by:

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# 1 Objective

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Jewell Engineering Inc. (JE) has prepared this *Floodplain Assessment* to support the proposed development of the Keene Subdivision. The proposed development is a residential subdivision located at the west end of the community of Keene, ON (see Figure 2-2). The community is adjacent to the Indian River and a short distance from the north shore of Rice Lake. There is a natural tributary that traverses the east side of the subject property; the objective of the floodplain assessment is to identify its regulatory flood limits to ensure the proposed development occurs safely outside of the flood hazard boundary.

Appendix A includes the Draft Plan for the subject development. There are 16 proposed residential lots to be accessed by an extension of Edwards Drive.

The watercourse that creates the potential flood hazard at the subject site is a tributary to the Indian River. The Indian River outlets to Rice Lake 2.3km downstream of the confluence between the river and this tributary.

The results of this floodplain assessment are best summarized by the flood hazard limits shown in the Draft Plan. An image of the floodplain delineation is also provided in Section 4 of this report, and shape files are available digitally. A discussion of the hydrologic and hydraulic analysis used to identify the flood limits is provided herein.

## 2 Hydrology

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The peak flows were calculated using a hydrologic model. The HEC-HMS software program developed by the U.S. Army Corps of Engineers was the model selected since it is widely accepted across the province and based on our experience, it is also the preferred modeling program for floodplain assessments by Environment and Climate Change Canada (ECCC). It is also a publicly available software, making it widely used among practitioners.

### 2.1 Catchment Area

**The subject watercourse has a catchment area of 48.6 ha.** The catchment area was originally delineated using the Ontario Watershed Information Tool (OWIT). It was then delineated in further detail using detailed LiDAR data displayed at 1m contour intervals. A simplified figure of the catchment area is provided in Figure 2-2. For the interested reader, the same catchment boundary is shown in Appendix C at 1m contour intervals accompanied by flow arrows to indicate the direction of the overland flow path near the perimeter of the catchment boundary.

With a drainage area of 48.6 ha, the subject catchment is relatively small from a floodplain perspective. For context, a 20 km<sup>2</sup> watershed would be considered small for the purpose of a flow gauge in the *Water Survey of Canada* flow records.

For *added* context, the Rational Method is not recommended for catchments greater than 100-ha based on the *MTO Drainage Manual*. With this method being capped at 100-ha, it is typically too small for use in a floodplain assessment. However, at 48.6 ha (0.49 km<sup>2</sup>), the subject catchment is small enough for the Rational Method to be applied and it was therefore considered in this assessment, albeit for comparison purposes only.

### 2.2 Precipitation & Climate Change

The subject catchment is located within Otonabee Region Conservation Authority jurisdiction and Zone 3 of the *Flood Hazard Criteria Zones of Ontario and Conservation Authorities*. For Zone 3, the regulatory event is the Timmins or 100-yr storm, whichever is greater. Subsection 2.5 that follows will show that the Timmins event produces a larger peak flow than the 100-yr storm. Therefore, the Timmins storm is the regulatory event.

Rainfall data was obtained from the Environment Canada Intensity-Duration-Frequency (IDF) Curves for the Peterborough A Station (see Appendix B). This station was selected due to its proximity to the subject catchment in addition due its sufficient length of record.

Climate change resiliency can be accommodated by applying peak flows in the floodplain model that are higher than current IDF data. In recent federally funded floodplain mapping updates, directives indicated the preferred method to accommodate climate change impacts was to use projected increases in temperature to forecast subsequent increases in rainfall intensities. Jewell selected this approach as part of this analysis.

The Federal Climate Data Portal for Keene, ON was used to obtain the mean annual temperature change. The value for the 50<sup>th</sup> percentile of the mean annual temperature change based on the CMIP5, RCP 4.5 scenario was followed.

The year 2071 was selected since this is the furthest projected date in the Excel download from the federal climate data portal. The mean annual temperature change for the year 2071 is an increase of 3.3

degrees Celsius. The equation below was received from past correspondence with ECCC representatives, and was applied to the Timmins hyetograph for use in the climate change model. The table below shows that the impacts with this methodology are significant; the total rainfall increases by 25%.

**Estimation of Future Rainfall Intensity (Environment and Climate Change Canada):**

$$R_p = R_c \times 1.07^{\Delta T}$$

Where:

- R<sub>p</sub> = Future estimated rainfall intensity (mm/h)
- R<sub>c</sub> = Historic estimated rainfall intensity (mm/h)
- T = Temperature (°C)

**Table 2-1: Rainfall Intensities for Timmins Event in Historic & Climate Change Adjusted Scenarios**

Time	Timmins Historic Intensity	Percent of 12 hour	Future Estimated Intensity (R <sub>p</sub> )	Increase in Intensity
Hour	mm/hr	%	mm/hr	%
1	15	8	18.8	25%
2	20	10	25.0	25%
3	10	6	12.5	25%
4	3	1	3.8	25%
5	5	3	6.3	25%
6	20	10	25.0	25%
7	43	23	53.8	25%
8	20	10	25.0	25%
9	23	12	28.8	25%
10	13	6	16.3	25%
11	13	7	16.3	25%
12	8	4	10.0	25%
<b>Total</b>	<b>193</b>	<b>100</b>	<b>241</b>	<b>25%</b>

**Note:** Gold shade denotes rainfall intensities applied in climate change scenario. Blue shade denotes traditional Timmins rainfall intensities consistent with MTO Design Chart 1.04.

### 2.3 Soils and Land Cover

Based on soils mapping from the Agricultural Atlas published by the *Ontario Ministry of Agriculture, Food and Rural Affairs*, the catchment area has entirely Hydrologic Soils Group (HSG) B soils. An excerpt from Chapter 8 of the *MTO Drainage Management Manual* that describes drainage characteristics for HSGs is provided in Figure 2-1.

Land cover data was calculated using data from the *Ontario Ministry of Natural Resources and Forestry* online mapping tool combined with a review of localized development areas within the subject

catchment. The land cover breakdown is summarized in Table 2-2. The HSG and land cover information was used to calculate the weighted curve number and runoff coefficients presented in Subsection 2.4 that follows.

The hydrologic soil group is used to classify soils into groups of various runoff potential.

The Soil Conservation Service (SCS) classifies bare thoroughly wet soils into four hydrologic soil groups (A, B, C and D). SCS descriptions of the four groups, modified slightly to suit Ontario conditions, are as follows: (Design Chart 1.09)

A: High infiltration and transmission rates when thoroughly wet, eg. deep, well drained to excessively-drained sands and gravels. These soils have a low runoff potential.

B: Moderate infiltration and transmission rates when thoroughly wet, such as moderately deep to deep open textured loam.

C: Slow infiltration and transmission rates when thoroughly wet, eg. fine to moderately fine-textured soils such as silty clay loam.

D: Very slow infiltration and transmission rates when thoroughly wet, eg. clay loams with a high swelling potential. These soils have the highest runoff potential.

In Ontario, soils have been found to lie between the main groups given above, and have therefore been interpolated as AB, BC, CD as appropriate, such as Guelph loam, which is classified as BC.

Figure 2-1: Excerpt from 1997 MTO DMM Describing Hydrologic Soils Group Classifications

Table 2-2: Land Cover Summary

Land Cover	Area (ha)	%
Pasture & unimproved	0.0	0%
Crop & improved	19.1	39%
Woodlots and forest	4.4	9%
Lakes and wetlands	6.8	14%
Community/Infrastructure	<u>18.4</u>	<u>38%</u>
	48.6	100%

## 2.4 CN, Runoff Coefficient, and Lag Time

Curve numbers (CNs) are used in the Soil Conservation Service (now known as the *National Resources Conservation Service*) methodology for estimating the proportion of precipitation that will runoff the lands and the portion that will infiltrate. CNs are a function of soil type, land cover, slope, and land use. The higher the CN – the greater the proportion of precipitation that is expected to runoff the lands. CNs are representative of the pervious portion of the watershed.

*MTO Design Chart 1.09* was applied to the HSG and land cover data to determine a weighted curve number of 66.3 (see Table 2-3).

Table 2-3: Land Cover and HSG Inputs for Weighted CN Calculation

Land Cover	HSG	Area (ha)	CN	A x CN
<b>Woodlots and forest</b>	B	4.40	58	255
	C	0.00	76	0
	D	<u>0.00</u>	81	0
		4.40	0	255
<b>Crop and improved</b>	B	19.06	74	1,410
	C	0.00	82	0
	D	<u>0.00</u>	86	0
		19.06	0	1,410
<b>Lakes and wetlands</b>	N/A	6.76	50	338
<b>*Impervious</b>	N/A	11.01	98	1,079
Total Area & Total A x CN (w/o imp):		30.21		2,003
<b>Weighted CN</b>				<b>66.3</b>

*\*Conservatively assumed 60% impervious for existing urban areas within the subject catchment. Imperviousness is included as a separate input in the HEC-HMS model.*

The lag time was calculated using the SCS method for time of concentration calculations. The time of concentration is converted to lag time by using a factor of 0.6 (United States Department of Agriculture - Natural Resources Conservation Service, 2010). The inputs used to determine the time of concentration and lag time are summarized in Table 2-4.

Table 2-4: Inputs Applied in SCS Lag Time Calculation

Lag Time Input	Value
Longest Flow Path (m)	1,531
Retardance Factor	66.3
Average Overland Slope (%)	6.0%

Runoff coefficient (RC) is similar to CN in that it is a loss method to determine the amount of rainfall volume that is transferred to runoff vs. the amount that infiltrates into the ground. The RC is not typically applied in hydrology calculations for floodplain assessments. However, given the relatively small watershed area, the Rational Method was included in this assessment for comparison purposes only, and the RC is required as one of its inputs.

Table 2-5: Weighted Runoff Coefficient

Land Cover	Area (ha)	RC	A x RC
Crop & improved	19.06	0.35	6.67
Woodlots and forest	4.40	0.25	1.10
Lakes and wetlands	6.76	0.05	0.34
Existing Urban	<u>18.36</u>	0.60	<u>11.01</u>
	56.25		19.12
<b>Weighted RC</b>		<b>0.34</b>	

## 2.5 Peak Flow Summary

Peak flows for the 100-yr, Timmins, and Timmins plus climate change storms are provided in Table 2-6. This table shows that the Timmins peak flow is greater than the 100-yr peak flow. Therefore, the Timmins event was selected as the regulatory storm event and a peak flow of 3.50 m<sup>3</sup>/s was applied in the hydraulic model (see Section 3).

Table 2-6: Peak Flow Summary

Return Period	Q <sub>100yr</sub>	Timmins	Timmins + CC
	m <sup>3</sup> /s		
Rational Method	2.24	N/A	N/A
<b>HEC-HMS - 12Hr SCS</b>	<b>2.92</b>	<b>3.50</b>	<b>4.80</b>

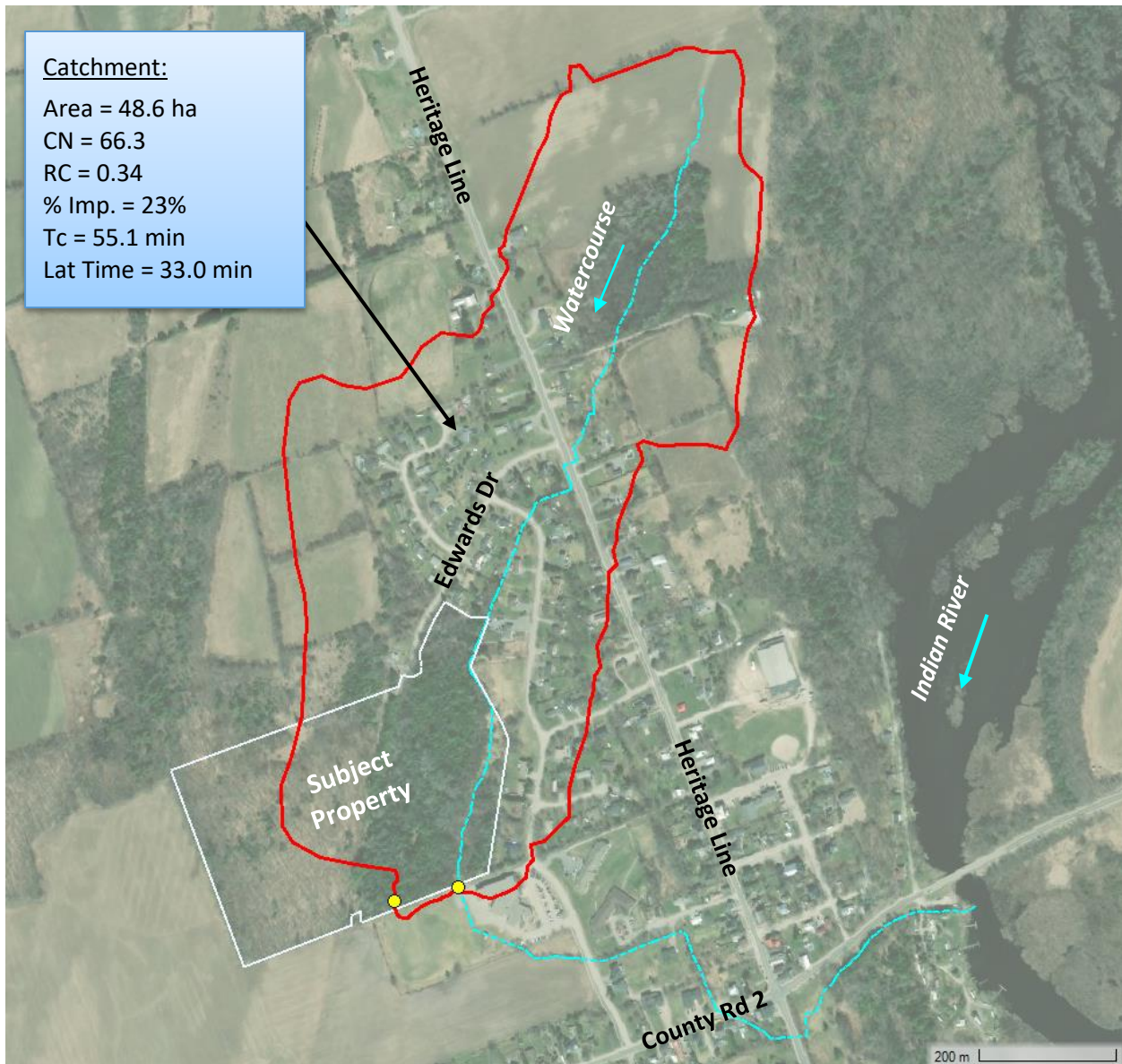


Figure 2-2: Catchment Area Boundary (Red) with Satellite Imagery

## 3 Hydraulics

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The hydraulic analysis was prepared using HEC-RAS version 6.4.1. The hydrology results from the HEC-HMS model were applied in the HEC-RAS model to delineate the flood hazard limits for the Keene Subdivision.

The hydraulic model extends from slightly north of the upstream property limit to 90m downstream of Pinecrest Ave. Pinecrest Avenue is located 240m downstream of the pipe outlet from the subject site. The extents were selected so that the flood hazard limits are identified across the entire subject property while providing sufficient distances upstream and downstream to allow the model to establish its boundary conditions.

### 3.1 Topography & Land Cover

The topography of the site was completed by Cambium Inc. and supplemented by LiDAR data obtained from *Land Information Ontario*. The majority of the floodplain on the subject site is coincident with the water level that would be observed in the existing wetland. The water levels for the wetland and floodplain across the site are influenced by an outlet near the south property boundary that divides the subject site from the North Shore Public School Property. Further survey was completed by Jewell using high-precision GPS and a total station to identify the location, size, invert, and downstream flow path of the wetland outlet pipe.

The hydraulic model requires inputs for Manning's  $n$  values. The *HEC-RAS User's Manual* and *MTO Drainage Manual* provide ranges of roughness coefficient values for varying surface cover such as crop overbank areas, treed areas, and channel bottoms. Given the vegetation associated with the wetland, and drainage channels that may become overgrown or accumulate sediment over time, a Manning's roughness value of 0.06 was conservatively applied throughout the surface contact area of the model.

### 3.2 Model Selection

Given the straight flow path of the channel across the site, a one-dimensional model would typically be appropriate. However, the presence of the wetland and apparent secondary spill location (see Figures 3-2 to 3-4) warranted consideration of an unsteady, two-dimensional flow model. Wetlands are typically associated with significant storage potential and a possibility to attenuate flows. With the storage from the wetland, and the outlet pipe that drains across the school property, the wetland functions as a small reservoir. A two-dimensional model accounts for the storage within the wetland and the subsequent raise in water levels during the regulatory flood event. Therefore, it was selected as the preferred modeling approach for this floodplain assessment.

Jewell developed a computational mesh that ultimately controls the movement of water across the site. The mesh developed for this floodplain assessment is comprised of more than 16,000 grid cells (not all of which are utilized), with smaller cells aligned along the channel and spill locations to ensure a proper and realistic movement of simulated flood waters across the site.

### 3.3 Internal and External Boundary Conditions

There are two (2) boundary conditions (BCs) supplied to the hydraulic model (see Figure 3-1). The first is an inflow BC and the second is an outflow BC.

The 2D unsteady flow model received its flow data from an inflow hydrograph where the incoming flows change with time. The inflow hydrograph was obtained by the tabular output in the HEC-HMS model. The inflow hydrograph corresponds to the peak flow that was presented in Section 2 of this report.

The outflow boundary condition is established by normal depth as the channel continues downstream beyond Pinecrest Avenue. The outflow BC was selected downstream of Pinecrest Avenue to ensure the model extended a far enough downstream to account for downstream flow characteristics.



Figure 3-1: Inflow and Outflow Boundary Condition Locations to Demonstrate Model Extents

### 3.4 Wetland Outlet & Storage Impacts

The flood limits on the subject site are mostly governed by the existing wetland. The storage within the wetland, combined with the outlet pipe and spillway towards the school property to the south, create a natural storage basin. The water level in the wetland influences the flood limits shown in the Draft Plan, since the wetland spans majority of the proposed development when looking in a northeast to southwest direction.

The storage within the wetland is accounted for since the 2D HEC-RAS model uses an elevation-volume relationship that is calculated for each wetted cell in the model run.

The outlet from the subject property includes a pipe outlet and two natural spillways. The low flow outlet for the wetland is the 1.03m span x 0.74m rise CSP arch pipe that traverses the school property to the south. This pipe run has a long length, expected to be greater than 100m.

The pipe dimensions were identified in the field survey and confirmed with field measurements using a measuring tape. On the downstream side of the pipe, there is notable blockage as the water level on the downstream end is slightly below the pipe obvert. This was observed during a period where no flow was observed at the upstream end of the pipe, meaning the downstream sediment build-up and associated tailwater is likely a frequently occurring condition.

Since the downstream pipe may not have free flowing conditions, the hydraulic model was run with the conservative assumption that the blockage at the downstream end of the pipe would result in an equivalent depth of blockage at the upstream end of the pipe (this assumption neglects the head differential between the upstream and downstream ends, and also assumes that the blockage at the downstream end of the pipe is entirely due to sediment build-up rather than standing water – both of these are conservative assumptions).

With this blockage, the conveyance of the pipe is dramatically limited, and high flows would be conveyed by two natural spillways that occur as low points in the original ground of the terrain layer. Their locations are identified in Figures 3-2 to 3-4.

The wetland provides some flow attenuation. The flow attenuation would be greater in return period events (2- through 100-yr) and lesser in the Timmins or Timmins plus climate change events. This is expected since higher flows utilize the spill locations that can convey greater flows with smaller increases in water levels.

**Spillway #1** represents the natural low point in the ground near wetland outlet pipe. It conveys majority of the flows in a major storm event. The invert of Spillway #1 is lower than Spillway #2 by 9cm and therefore is the first point of spill beyond the capacity of the wetland pipe outlet.

**Spillway #2** represents the natural low point in the ground west of the wetland outlet pipe. It helps convey flows along with Spillway #1 during severe rainfall events such as the Timmins or Timmins plus climate change storms.

A wetland storage and outlet summary for the 100-yr, Timmins, and Timmins plus climate change events is provided in Table 3-1.

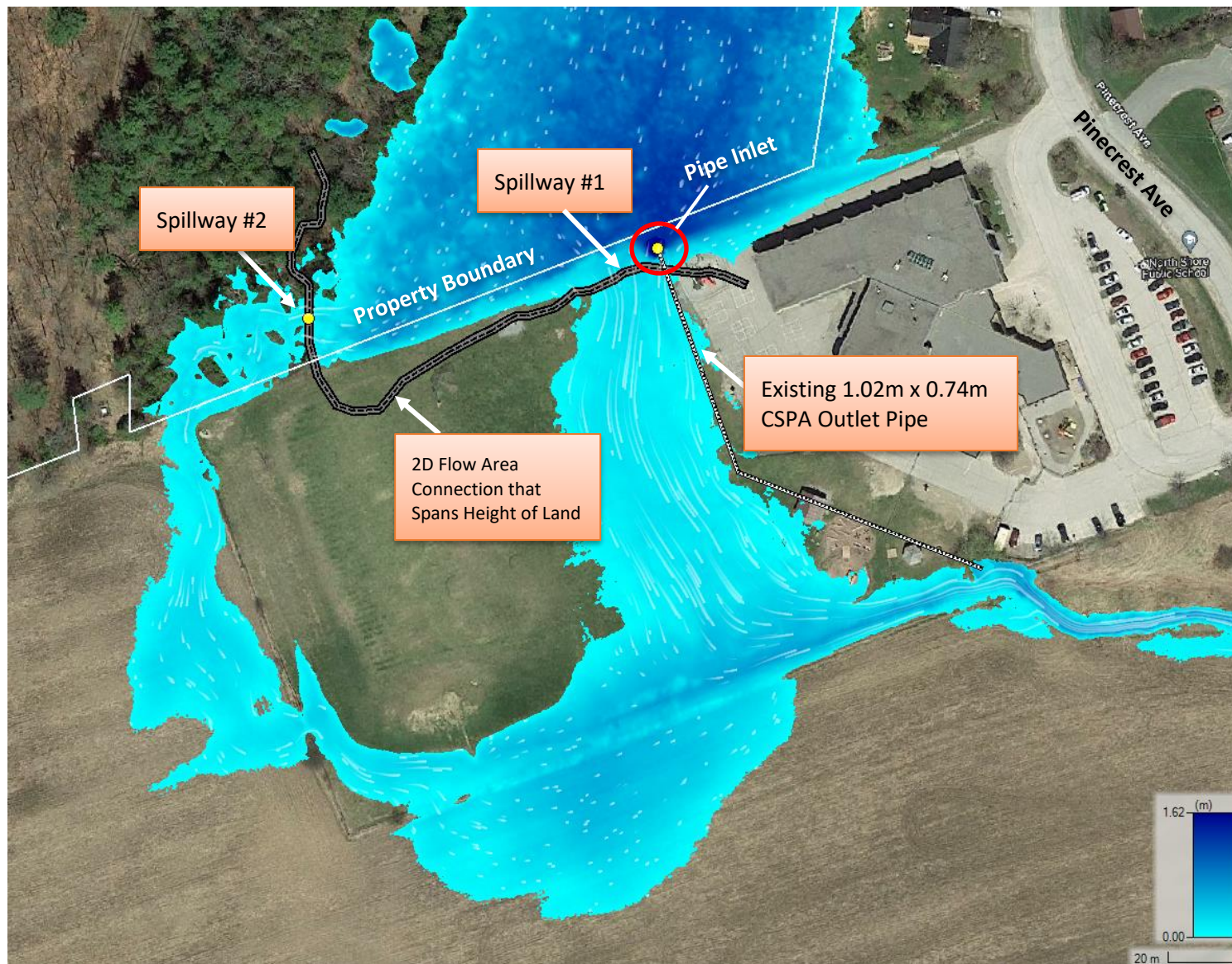


Figure 3-2: Outlet and High Ground Location in Hydraulic Model; Depth Layer + Satellite Overlay

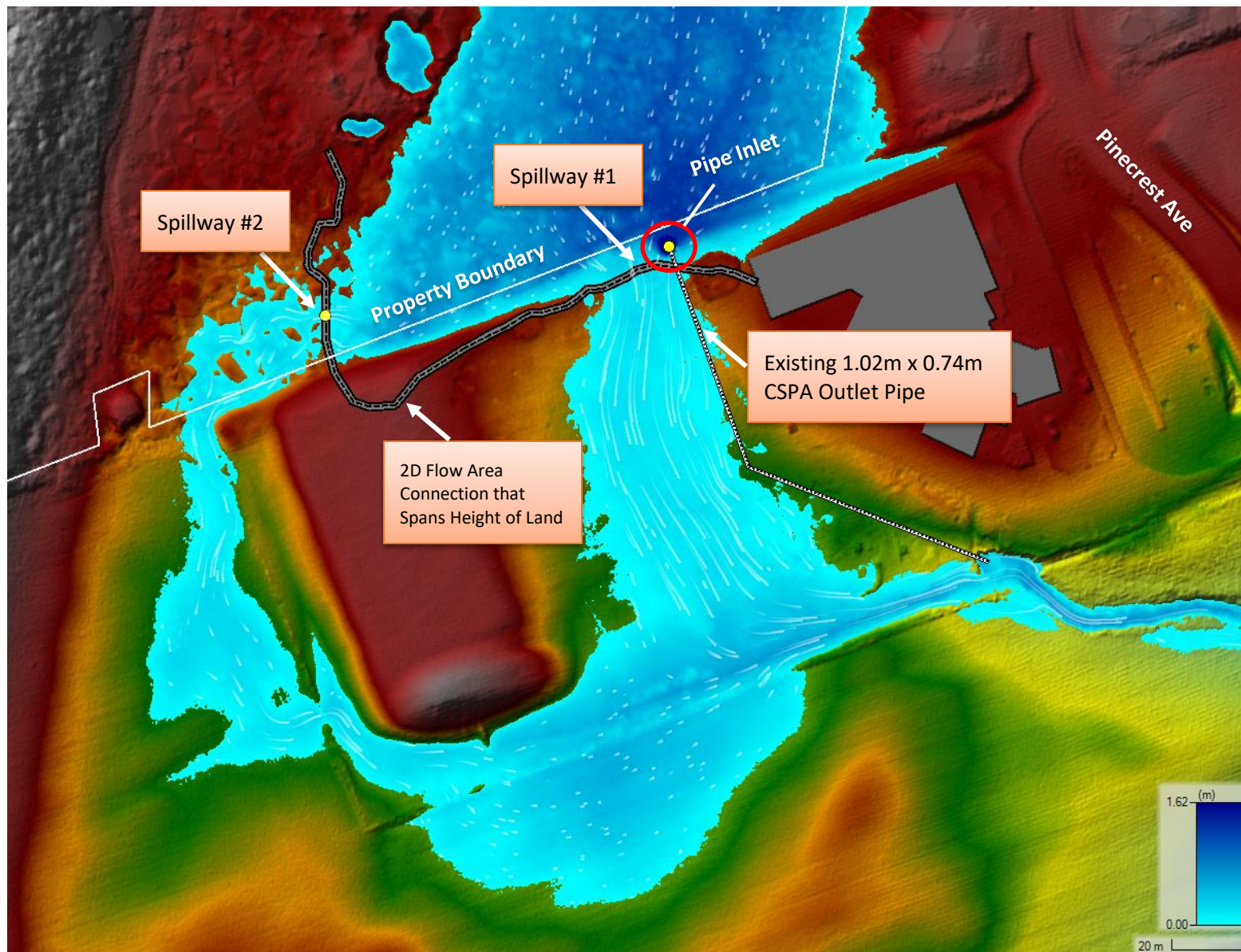


Figure 3-3: Outlet and High Ground Location in Hydraulic Model; Depth Layer + Terrain Overlay

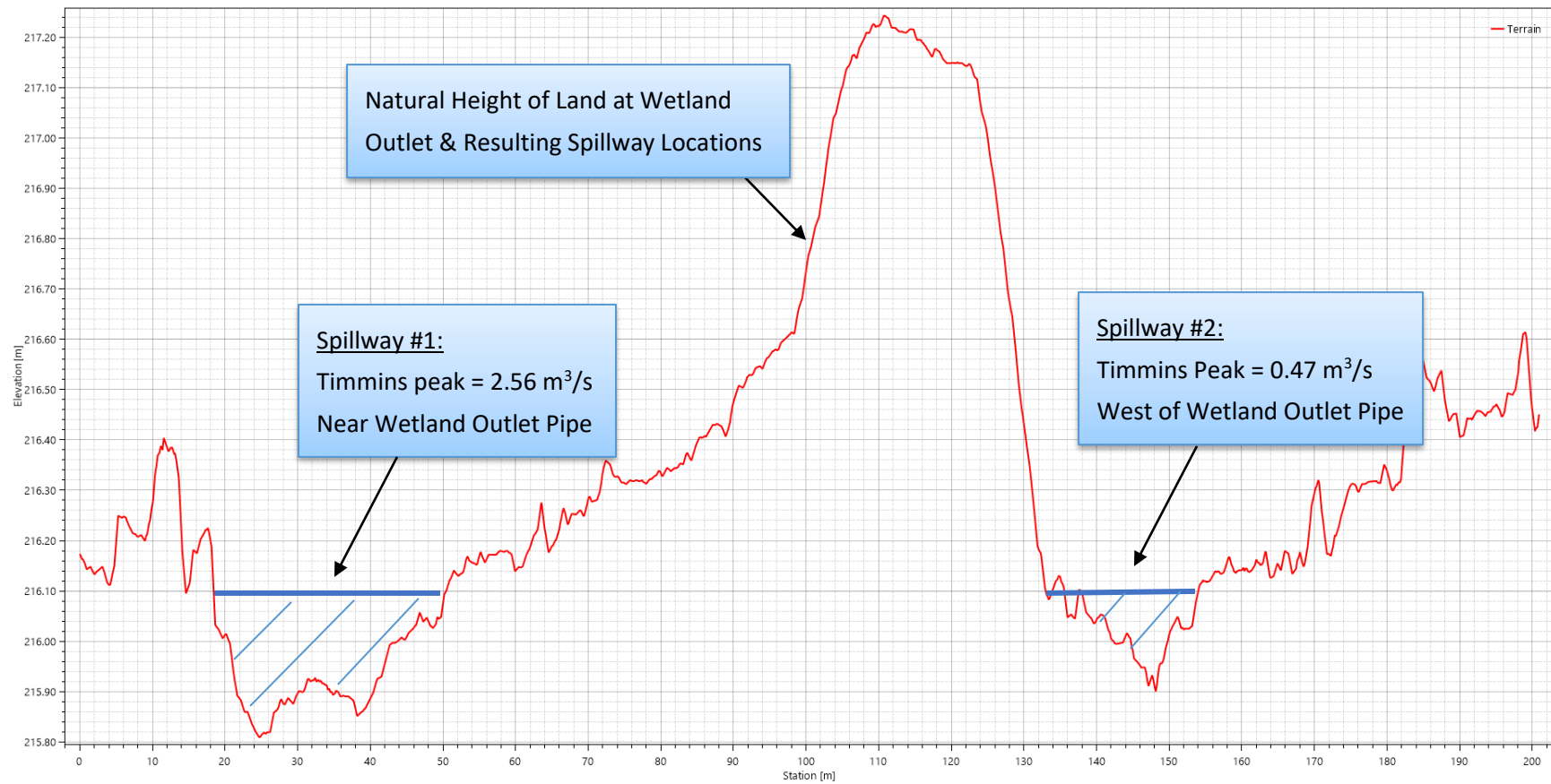


Figure 3-4: Profile of Spill Locations in Timmins Regulatory Storm Event (datum CGVD 2013)

Table 3-1: Wetland Storage and Outlet Summary

Parameter	Unit	100-Yr	Timmins	Timmins + Climate Change
*Max. Water Level	m	216.28	216.41	216.46
Max. Storage	ha-m	1.23	1.53	1.65
Q <sub>peak</sub> Inflow	m <sup>3</sup> /s	2.92	3.50	4.80
Q <sub>peak</sub> Outflow		0.80	3.00	4.41
Q <sub>peak</sub> Reduction	%	73%	14%	8%
Q <sub>peak</sub> Spillway #1	m <sup>3</sup> /s	0.73	2.56	3.55
Q <sub>peak</sub> Spillway #2		0.03	0.47	0.88
**Q <sub>peak</sub> Spillways Total		0.77	2.97	4.38
Q <sub>peak</sub> Culvert		0.03	0.03	0.03
Max. Depth Spillway #1	m	0.16	0.29	0.34
Max. Depth Spillway #2		0.07	0.20	0.25

\* Water levels shown in datum CGVD 28.

\*\* "Q<sub>peak</sub> Spillways Total" is a sum of the two spillway hydrographs. It is therefore slightly lower than the sum of the individual peaks of Spillways #1 and #2.

## 4 Flood Hazard Limit Delineation

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The flood hazard limits presented in the Draft Plan were obtained from the output of the hydraulic model. The magenta line in Figure 4-1 illustrates the regulatory (Timmins) flood hazard limits across the subject property.

While climate change forecasts yield a significant increase in peak runoff rate, the impact on the lateral extents of the flood hazard limit were muted due to the two natural overflow spillways at the wetland outlet, combined with the relatively sharp change in overbank slope near the perimeter of the wetland.

When plotted, the Timmins flood limit and Timmins plus climate change limit were indistinguishable due to the thickness of the lines, highlighting their minor lateral differences. Therefore, standard setbacks from this regulated feature would be sufficient to accommodate potential impacts due to climate change.

Table 4-1 summarizes the Timmins water surface elevations (WSELs) at each of the cross sections shown in Figure 4-1. Note that these elevations are presented in datum CGVD 28 to allow ease of comparison to the preliminary road grades in the Draft Plan submission package.

**Table 4-1: Timmins WSELs Across the Subject Site (Datum CGVD 28)**

<b>Station</b>	<b>Timmins WSEL (m)</b>
*0 + 396	218.18
0 + 310	216.86
0 + 233	216.41
0 + 126	216.40
0 + 009	216.40
0 + 000	216.40

*\*WSEL varies slightly across this section. Value shown is highest value.*

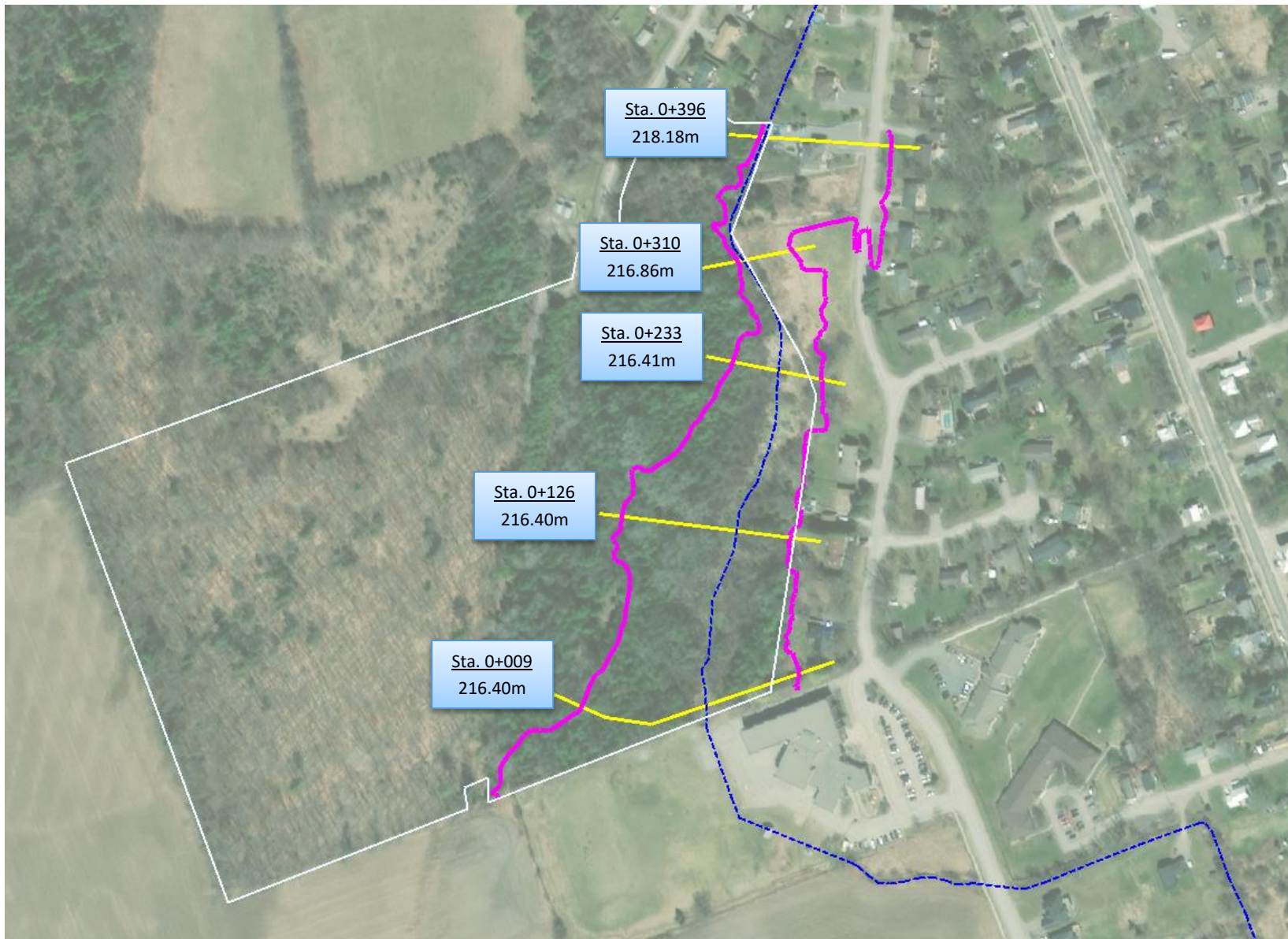


Figure 4-1: Timmins Flood Hazard Limit and WSELs at Five (5) Cross Sections Across Subject Property – Water Levels Shown in Datum CGVD 28

## 5 Conclusions & Recommendations

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Jewell has prepared this *Floodplain Assessment* to support the Keene Subdivision. The proposed development is a residential subdivision located at the west end of the community of Keene, ON. The development will be comprised of 16 residential lots to be accessed by an extension of Edwards Drive.

The subject catchment is within *Zone 3 of Flood Hazard Criteria Zones for Ontario Conservation Authorities*. Therefore, the regulatory event is the 100-yr or Timmins event; whichever produces the greater peak flow. The hydrology analysis in Section 2 concluded that the Timmins storm produces the higher peak flow; the Timmins event was selected as the regulatory storm.

A climate change scenario was included in the hydrologic and hydraulic models. While climate change forecasts yield a significant increase in peak runoff rate, the impact on the lateral extents of the flood hazard limit were muted due to the two natural overflow spillways at the wetland outlet, combined with the relatively sharp change in overbank slope near the perimeter of the wetland basin.

Based on the detailed assessment of the subject catchment, its site-specific hydrologic model, and the detailed 2D unsteady flow hydraulic model, it is recommended that the flood hazard limit presented in Figure 4-1 be applied as Timmins flood hazard limit for use in the engineering design of the Keene Subdivision. This flood hazard limit is available as a georeferenced shape file and is also shown in the Draft Plan in Appendix A.

It is recommended that the proposed development occur outside of the flood hazard limit, in addition to relevant setbacks that may be applied at the discretion of Otonabee Region Conservation Authority. The inclusion of the flood hazard limit and relevant setbacks will ensure the flood risk is appropriately mitigated for future residents and property owners within the Keene Subdivision.

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## 6 References

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<https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=27002.wba>

**Appendix A:**  
**Draft Plan with Flood Hazard Limits**

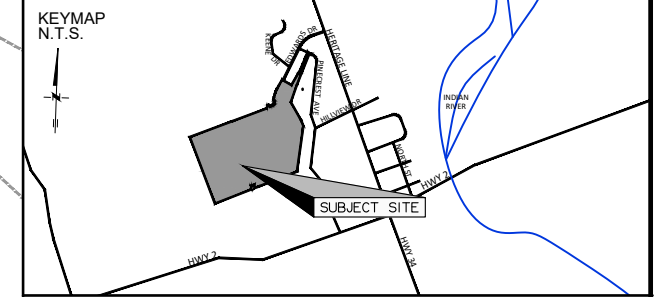
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**DRAFT PLAN OF SUBDIVISION**

**PART OF LOT 13 & 14, CONCESSION 7**  
 (GEOGRAPHIC TOWNSHIP OF OTONABEE)  
 PART 4, PLAN 45R-6864 & PARTS 1, 2, 3, 4 & 5 PLAN 45R-14319  
 SAVE AND EXCEPT PART 2 45R-16688 & PART 1 PLAN 45R-16795  
 SUBJECT TO AN EASEMENT AS IN LT21491, TOGETHER WITH AN  
 EASEMENT OVER PARTS 1 & 2 PLAN 45R-6864  
 TOWNSHIP OF OTONABEE-SOUTH MONAGHAN  
 COUNTY OF PETERBOROUGH

SCALE = 1:2,000 METRIC

DRAWN BY: F.M.	CHECKED BY: S.L.	DATE: JANUARY 23, 2025	SCALE: 1:2,000
DATE:	APPR'D:		



**LAND USE SCHEDULE**

LAND USE	AREA(m <sup>2</sup> )	AREA%	UNITS
LOTS 1-16 - SINGLE DETACHED DWELLINGS - 30M. MIN FRONTAGE (1,709.0m <sup>2</sup> )	37,822.7m <sup>2</sup>	26.8	16
BLOCKS 17-18 - WETLAND, WILDLIFE CORRIDOR & PASSIVE PARKLAND	90,875.9m <sup>2</sup>	64.4	
-LAND WITHIN WETLAND & 30m SETBACK (62,287.9m <sup>2</sup> ) (68.5%) -LAND OUTSIDE WETLAND AND 30m SETBACK (28,588m <sup>2</sup> ) (31.4%)			
18.0m MUNICIPAL ROAD ALLOWANCE = 554.4m - EDWARDS DRIVE EXTENSION	12,361.1m <sup>2</sup>	8.8	
<b>TOTAL</b>	<b>141,059.7m<sup>2</sup></b>	<b>100</b>	<b>16</b>

- ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT.**
- (a) SEE SURVEYORS CERTIFICATE.
  - (b) AS SHOWN ON DRAFT PLAN.
  - (c) AS SHOWN ON DRAFT PLAN.
  - (d) SEE LAND USE SUMMARY
  - (e) SEE DRAFT PLAN
  - (f) AS SHOWN ON DRAFT PLAN.
  - (g) AS SHOWN ON DRAFT PLAN.
  - (h) MUNICIPAL WATER AND INDIVIDUAL ON-SITE SEWAGE.
  - (i) SILTY SAND
  - (j) AS SHOWN ON DRAFT PLAN.
  - (k) GARBAGE COLLECTION, FIRE PROTECTION, ROAD MAINTENANCE
  - (l) AS SHOWN ON DRAFT PLAN.

**METRIC NOTE:**  
 DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO BY DIVIDING BY 0.3048.

**TOPOGRAPHY NOTE:**  
 EXISTING ELEVATIONS PREPARED BY JEWEL ENGINEERING.  
 CONTOURS DRAWN AT INTERVALS OF 1.0m.

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**SURVEYOR'S CERTIFICATE**

I CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ARE CORRECTLY SHOWN.

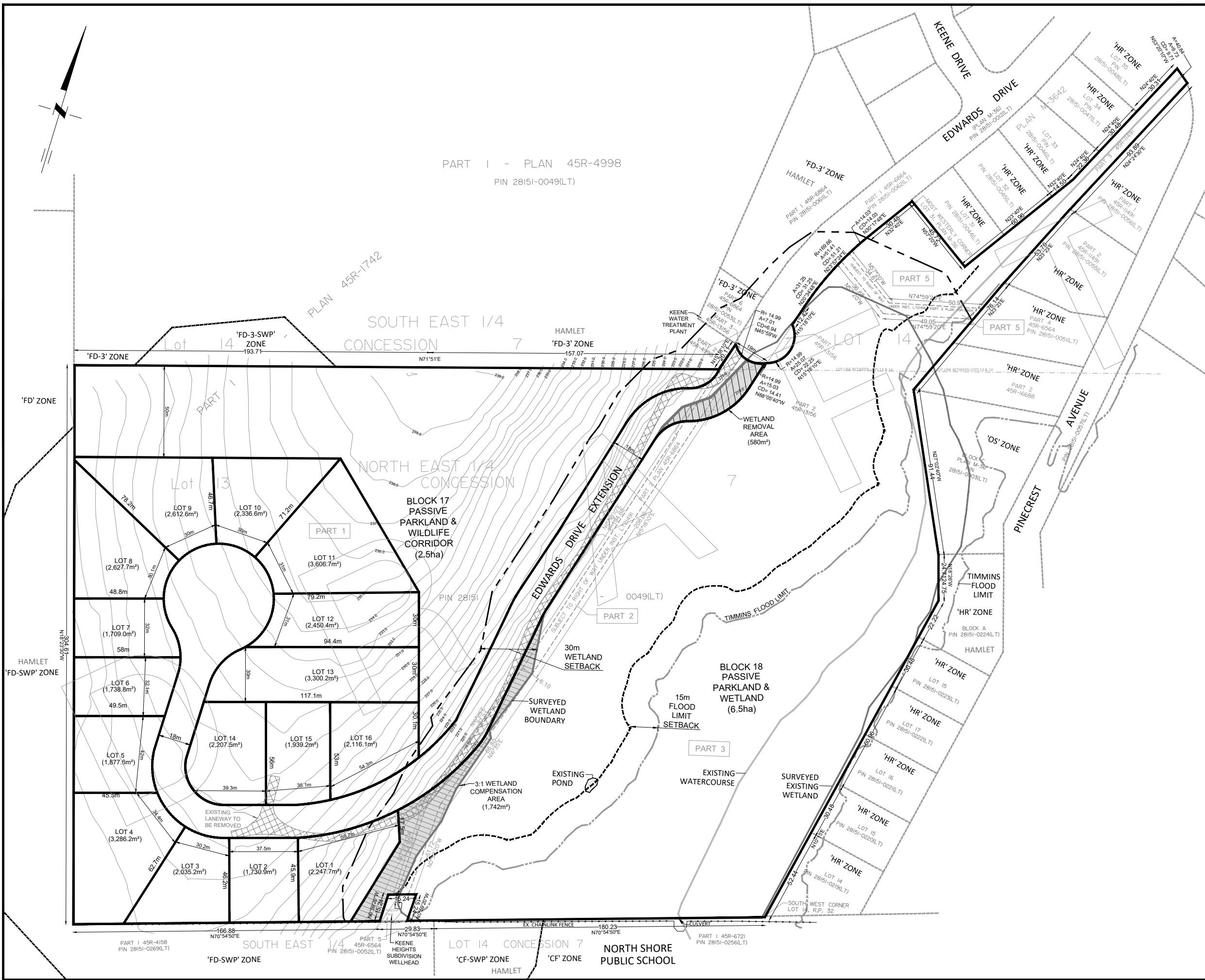
JOHN S. DUNCAN  
 ONTARIO LAND SURVEYOR. DATE \_\_\_\_\_

BENINGER SURVEYING LTD.  
 ONTARIO LAND SURVEYORS  
 414 WATER STREET, PETERBOROUGH, ONTARIO  
 (705) 743-8634

JAN 23, 2025

211 Dundas Street East, Suite 202, Belleville, Ontario, K8N 1E2

JOB No. 888



PART 1 - PLAN 45R-4998  
 PIN 28151-0049(LT)

SOUTH EAST 1/4  
 CONCESSION 7

NORTH EAST 1/4  
 CONCESSION 7

BLOCK 17  
 PASSIVE  
 PARKLAND &  
 WILDLIFE  
 CORRIDOR  
 (2.5ha)

BLOCK 18  
 PASSIVE  
 PARKLAND &  
 WETLAND  
 (6.5ha)

NORTH SHORE  
 PUBLIC SCHOOL

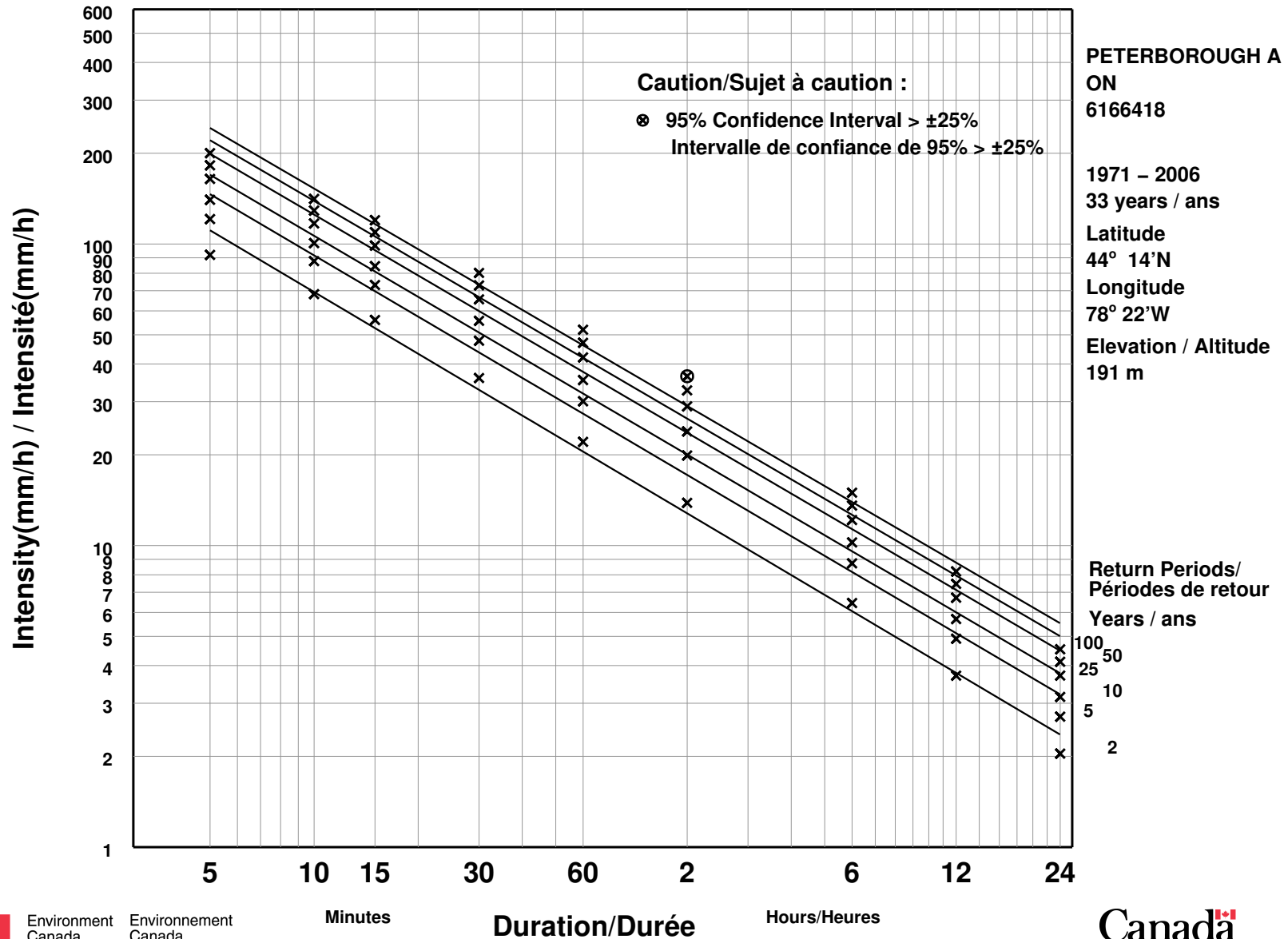
**Appendix B:**  
**Peterborough A Station IDF Curves**

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# Short Duration Rainfall Intensity–Duration–Frequency Data

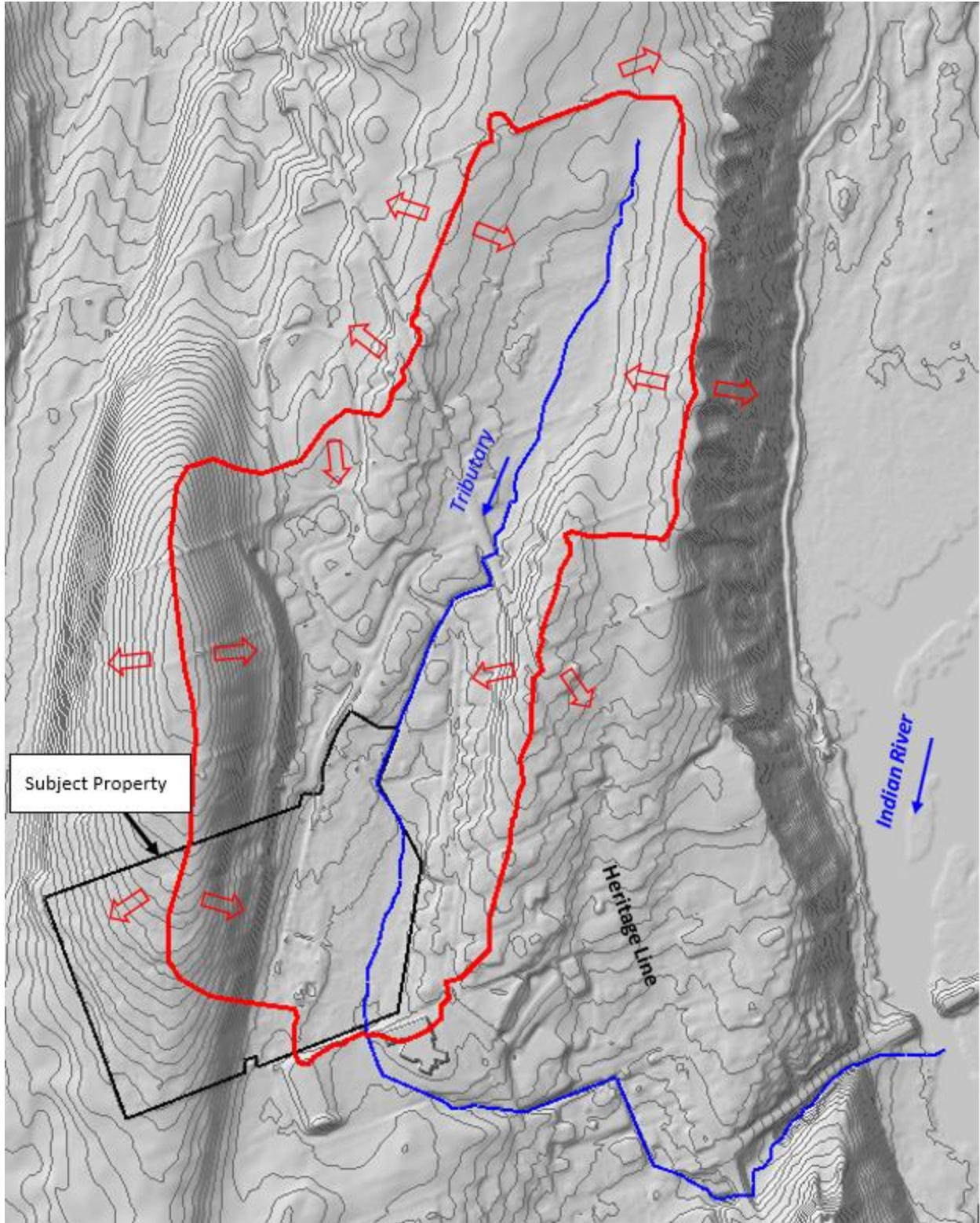
2022/10/31

## Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée



Appendix C:  
Catchment IMG with 1m Contour Display

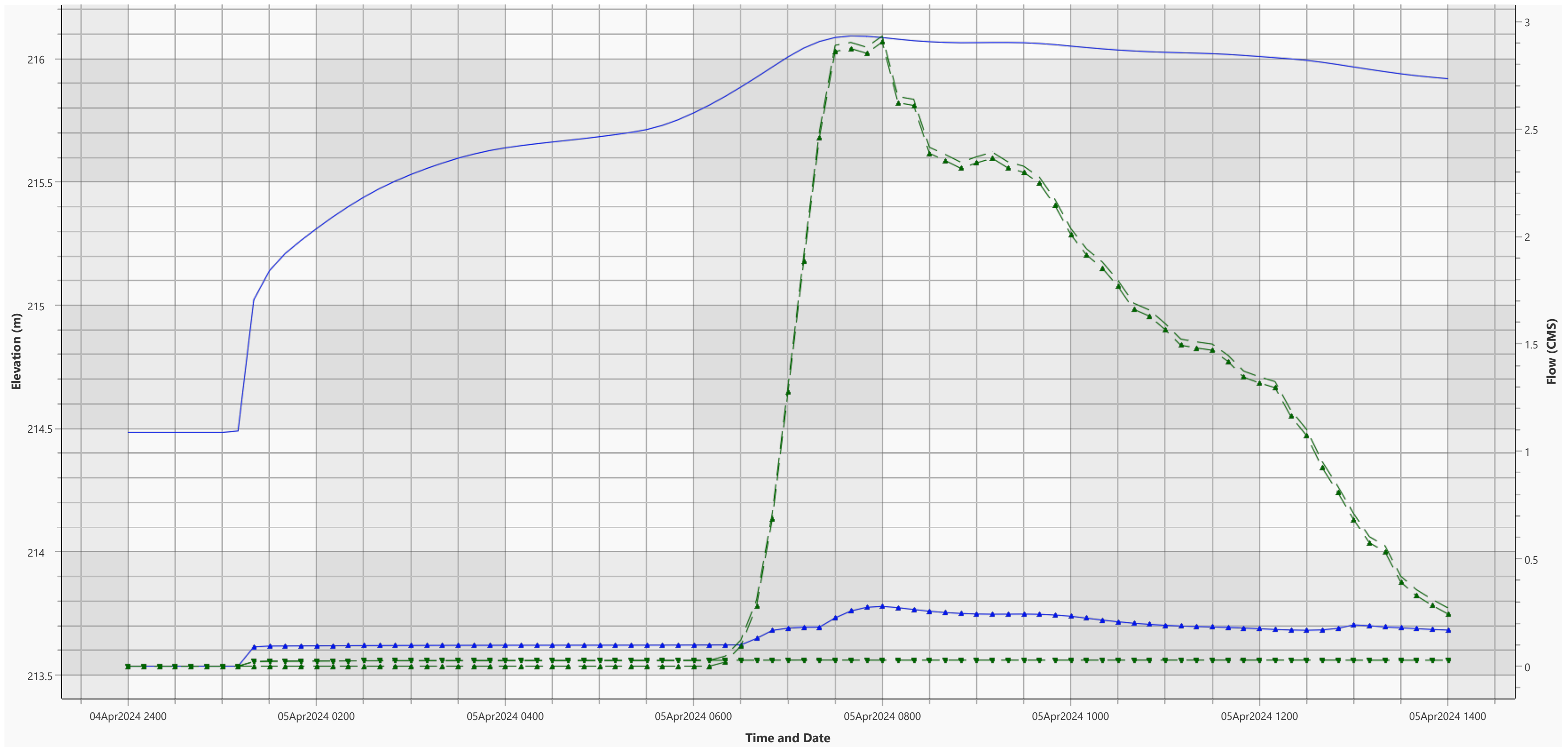
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**Appendix D:**  
HEC-HMS Model (see Digital Attachment)

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**Appendix E:**  
Stage (CGVD 2013) & Flow Hydrographs - Wetland Outlet (Pipe + Natural Ground Spillways)



**Legend**

- Stage HW
- Stage TW
- Total Flow
- Weir Flow
- Total Culvert Flow