WETLAND WATER BALANCE RISK ASSESSMENT

BOLTON NORTH HILL
OPTION 1 & OPTION 2 LANDS

TOWN OF CALEDON
REGION OF PEEL

PREPARED FOR:

BOLTON NORTH HILL LANDOWNERS GROUP

PREPARED BY:

C.F. CROZIER & ASSOCIATES INC.
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MARCH 2025

CFCA FILE NO. 708-3446

CROZIER
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1.0 INTRODUCTION

C.F. Crozier & Associates Inc. (Crozier) was retained by the Bolton North Hill Landowners Group (BNHLG) to prepare a Wetland Water Balance Risk Evaluation. The following feature-based risk assessment pertains to the Option 1 and Option 2 Lands, herein referred to as the Subject Lands, which are part of six (6) parcels of potential development areas around the existing community of Bolton (Options 1 to 6). Please refer to Figure 1 for a site location plan and landowner boundaries.

The Bolton North Hill study area is generally located north of Columbia Way, in the vicinity of Regional Road 50 within the Town of Bolton.

In preparing this letter, the following background documents were referenced and reviewed:

- Detailed Concept Plan prepared by Bousfields Inc. (February 4, 2025)
- Wetland Water Balance Risk Evaluation Guide prepared by TRCA (November 2017)
- Town of Caledon Zoning By-Law (July 2018)
- Housing Statistics, Statistics Canada (December 2021)
- Groundwater by Freeze and Cherry (1979)
- Secondary Plan Natural Heritage Study Report prepared by Dillion Consulting Ltd. (December 2024)
- Hydrogeological Investigation prepared by C.F. Crozier & Associates Inc. (December 2024)

2.0 WETLAND RISK EVALUATION

As per TRCA standards, a Risk Evaluation is to be applied when a proposed development has the potential to impact the water balance of a wetland that has been determined to be protected. Wetland water balances are impacted by alteration to the drainage catchment of a wetland or when water taking is anticipated within the catchment of a wetland.

Per the TRCA Wetland Water Balance Risk Evaluation guide (November 2017), there are four (4) steps in evaluating wetland water balance risk, as follows:

- Step 1: Determine which retained wetland(s) may be impacted
- Step 2: Determine the magnitude of potential hydrological change
- Step 3: Determine the sensitivity of the wetland
- Step 4: Risk characterization

The following sections outline each of the steps undertaken to assess the risk associated with the proposed development on the wetland communities in the Bolton North Hill study area.

2.1 Determine which Retained Wetland(s) may be Impacted

Dillon Consulting was retained by the Bolton North Hill Landowners Group to prepare a Secondary Plan Natural Heritage Study Report (December 2024) for the Subject Lands.

Based on the findings of the Natural Heritage Report, Dillon identified a total of 11 wetlands in the vicinity of the Site which may be impacted by the proposed development. Each of these 11 wetlands was assigned a unique identifier (A, B, C, etc.) as shown on Figure 2 – Wetland Communities, enclosed with this report.

A summary of the wetlands, their respective areas, and Ecological Land Classifications communities is provided in Table 1.

Table 1: Wetland Summary

Wetland ID	**ELC Community**	**Area** (ha)
A	MAM: Meadow Marsh	0.83
B	SWD: Deciduous Swamp	0.54
C	SWD: Deciduous Swamp	0.76
D	SWD: Deciduous Swamp	0.36
E	MAM: Meadow Marsh	0.14
F	MAM: Meadow Marsh	0.09
G	MAMM1: Graminoid Mineral Meadow Marsh	1.32
H	MAMM1: Graminoid Mineral Meadow Marsh	0.88
I	MAMM1: Graminoid Mineral Meadow Marsh	0.84
J	FODM: Mineral Deciduous Forest / MAMM1: Graminoid Mineral Meadow Marsh Complex	3.03
K	MAM: Meadow Marsh	0.91

2.2 Determine the Magnitude of Potential Hydrological Change

Surface Water

Based on the existing topography, the pre-development catchments to each of the 11 wetlands were delineated by Crozier. The total development area tributary to each wetland and the total area owned by the proponent was outlined as part of the risk evaluation process. Refer to Figure 3: Pre-Development Wetland Drainage Plan for the existing catchments.

Percent imperviousness was assigned to each catchment area based on the proposed Detailed Concept Plan (Bousfields, 2025). Impervious scores were then calculated for each wetland using Equation 1 from the Wetland Water Balance Risk Evaluation guide (TRCA, November 2017).

$$S = \frac{IC(C_{dev})}{C}$$

Where:
- S = Impervious Cover Score
- IC = Proportion of Impervious Cover within the Proponent's Holdings (%)
- C_{dev} = Total Development Area of the Catchment (ha)
- C = Size of the Wetland's Catchment (ha)

Additionally, the proposed catchments to each wetland were delineated and the change in catchment size was assessed. See Figure 4: Post-Development Wetland Drainage Plan for the proposed catchments, and Figure 5: Wetland Drainage Diversion Plan for the difference in the existing and proposed catchments, provided as attachments to this report. The impervious cover scores, change in catchment sizes and the resulting sensitivity of the wetlands are summarized in Table 2; detailed calculations are provided in Appendix A.

Groundwater

To determine the potential sensitivity to water taking, construction dewatering volumes were estimated for the proposed developments within 500 m of each wetland. At the time of preparation of this assessment, the proposed development was at the conceptual stage of Site Plan Development.

Therefore, details such as finished floor elevations or excavation depths were unknown in preparing this memo and several assumptions were made in calculating the proposed water taking. The assumptions are summarized in Appendix A.

Construction dewatering rates were estimated using the DuPuy equation as described in Construction Dewatering and Groundwater Control: New Methods and Applications by Powers et al. 2007.

The Dupuit equation assumed a steady linear flow from all four sides of an excavation and is described by the following equation:

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{ln\frac{R_0}{r_w}}$$

Where:

Q_w = discharge rate in m^3/s

K = hydraulic conductivity in m/s

H = static groundwater elevation in masl

h_w = head above base of the excavation at maximum dewatering in masl

R_0 = radius of influence of point source from the centre of excavation in m

r_w = equivalent radius of the well in m

The estimated construction dewatering rates within 500 m of each wetland ranged from approximately 478,000 to 95,000 L/day considering a safety factor of 2 to account for heterogeneity of the soils and precipitation during construction. A risk level was assigned for each wetland based on total anticipated water taking volumes and anticipated duration of the water taking activity. Results are summarized in Table 2. Detailed calculations are enclosed with this letter in Appendix A.

According to Ministry of Environment, Conservation and Parks (MECP) Source Protection mapping, areas of significant groundwater recharge are located within the study area boundaries, within 500 m of Wetlands A and K as shown in Figure 6. Based on proposed land use outlined in the Detailed Concept Plan (Bousfields, 2025), the areas of significant recharge are estimated to be over 25% paved post-development and hence been assigned a high magnitude risk as shown in Appendix A.

Risk levels associated with each of the hydrologic parameters as previously mentioned were assigned based on criteria in Table 2 of the Wetland Water Balance Risk Evaluation guide.

Detailed calculations for the hydrologic changes to each wetland are provided in Appendix A and the results are summarized in Table 2.

Table 2 : Hydrologic Changes Risk Evaluation Summary

Wetland ID	Impervious Cover Score Sensitivity	Increase/Decrease in Catchment Size Sensitivity	Water Taking Discharge Sensitivity	Impact to Recharge Areas Sensitivity	Highest Level of Hydrologic Sensitivity
A	Medium	Medium	Medium	High	High
B	Low	Low	Low	Low	Low
C	Low	Low	Low	Low	Low
D	Low	Low	Low	Low	Low
E	Low	Low	Low	Low	Low
F	Low	Low	Low	Low	Low
G	High	Medium	Medium	Low	High
H	High	Medium	Medium	Low	High
I	High	Low	Medium	Low	High
J	High	Low	Medium	Low	High
K	High	Low	Medium	High	High

2.3 Determine the Sensitivity of the Wetland

Dillon Consulting conducted surveys of vegetation communities, flora species, and fauna species at the identified wetlands to evaluate the sensitivity of each wetland feature to hydrologic changes. Access to Wetlands A-D and K was not available to facilitate Flora and Fauna species surveys, therefore Dillon has recommended that conservative assumptions be made for sensitivity of these wetlands (i.e., assume 'High' risk). It is further noted that the Ecological Land Classifications (ELC) for Wetlands E and F were aerial interpreted.

Detailed survey results are enclosed with this letter and sensitivity results for each category of vegetation, fauna, and flora are summarized in Table 3.

Table 3: Wetland Sensitivity Evaluation Summary

Wetland ID	Vegetation Community Sensitivity	Fauna Sensitivity	Flora Sensitivity	Highest Level of Sensitivity
A	Low	No survey access. Assume High Sensitivity.		High
B	Low	No survey access. Assume High Sensitivity.		High
C	Low	No survey access. Assume High Sensitivity.		High
D	Low	No survey access. Assume High Sensitivity.		High
E	Low	High	Low	High
F	Low	High	Low	High
G	Low	High	Medium	High
H	Low	High	Medium	High
I	Low	High	Medium	High
J	Low	High	Medium	High
K	Low	No survey access. Assume High Sensitivity.		High

As can be seen from the summary table above, each of the 11 wetlands have been classified as a high sensitivity risk to hydrologic change.

2.4 Risk Characterization

An overall level of risk/sensitivity has been assigned to each of the 11 wetlands based on the results of the sensitivity analysis and the hydrologic analysis. Using the decision tree shown in Figure A, each wetland was categorized into one of three possible levels of risk: Low, Medium or High.

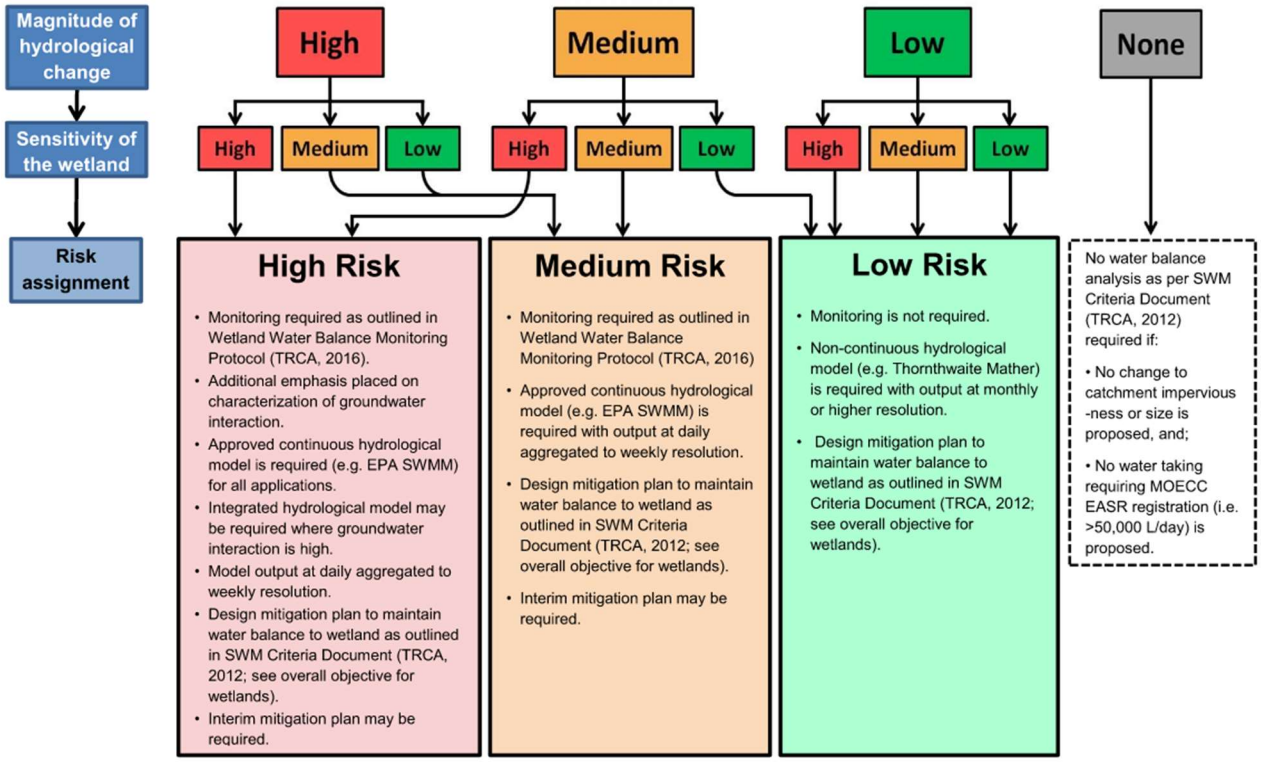

Figure A: Wetland Risk Evaluation Decision Tree

Refer to the summary of the risk characterization for each wetland, presented in Table 4.

Table 4: Wetland Risk Assignment Summary

Wetland ID	Risk Assignment	Notes
A	High	No survey access, assume High Sensitivity
B	Low	No impacts to groundwater or surface water catchments are anticipated.
C	Low	No impacts to groundwater or surface water catchments are anticipated.
D	Low	No impacts to groundwater or surface water catchments are anticipated.
E	Low	No impacts to groundwater or surface water catchments are anticipated.
F	Low	Negligible impacts to groundwater or surface water catchments are anticipated.
G	High	
H	High	
I	High	
J	High	
K	High	No survey access, assume High Sensitivity

As per Table 4, Wetlands A and G-K have been identified as high risk. Since the catchments to wetlands B-E are unchanged from pre-development to post-development, and the catchment to wetland F changes by a negligible amount (~1%), these wetlands will not be impacted by the proposed development and have been classified as low risk.

For each of the high risk wetlands (Wetlands A and G-K), pre-development monitoring of wetland hydrology is required per Wetland Water Balance Monitoring Protocol (TRCA, 2016). Crozier has completed a preliminary hydrogeological investigation for the Subject Lands (December 2024) and future updates will include wetland and stream monitoring.

To establish baseline conditions, it is proposed to monitor each wetland inlet and outlet using shallow piezometers and staff gauges within standing water locations prior to construction. Manual measurements will be taken at each monitoring location on at least a bi-monthly basis for a minimum of 1-year to establish seasonally high conditions. Automatic water level recording devices will be installed at selected locations to collect a comprehensive data set for modelling purposes. The implemented monitoring locations are shown in Figure 7.

Prior to construction, it is recommended a mitigation and contingency plan be prepared. The mitigation and contingency plan should identify each high-risk feature and measures to maintain the water balance at that location and mitigate the impacts. If the period between construction and implementation of any mitigation measures will exceed 2 -years, an interim mitigation plan may also be required.

It is recommended monitoring of the wetlands continue throughout construction and post-construction at Wetlands A and G-K to observe local conditions and detect in real-time any impact to the wetland communities. It should be noted that Wetlands A and K are not within the subject lands and access to these wetlands could be limited. From aerial imagery, Wetlands A and K appear to be hydrologically connected. Therefore, it is advisable to monitor either Wetland A or Wetland K if access is restricted, as any impacts to one are likely to affect the other. Prior to pre-construction monitoring, it should be confirmed if and how Wetland A or K can be accessed by the landowner.

A continuous hydrological model will be prepared and calibrated using monitoring data. It is possible that an integrated model may be required (to be determined through consultation with TRCA) if it is determined that groundwater constitutes a significant portion of the total inflows or outflows to the feature.

Should you have any questions or require any further information, please do not hesitate to contact the undersigned.

Sincerely,

C.F. CROZIER & ASSOCIATES INC.

Erin Dodd, P.Eng
Project Engineer

C.F. CROZIER & ASSOCIATES INC.

Jessica Lysecki, P.Eng.
Project Engineer

ED/cj

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APPENDIX A

Wetland Water Balance Risk Assessment Calculations

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Project: Bolton North Hill (Option 1 &2 Lands)
Project No.: 0708-3446
Date: March 16, 2022
Updated: February 25, 2025
Created By: E.D.
Checked By: R.S.A.

Evaluation of Hydrologic Change to Wetlands

Impervious Cover Score (S) Equation:

$$S = \frac{IC \cdot C_{dev}}{C}$$

where: IC = Percent Impervious Cover planned within the Proponent's Holdings (%)
C_{dev} = Total Development Area within Wetland Catchment (ha)
C = Total Catchment Area to Wetland (ha)

		Impervious Cover Score					Wetland Catchment Size		Water Taking / Discharge				Impact to Recharge Areas		
Wetland ID[1]	Wetland Area[1] (ha)	Pre-Development Catchment Area to Wetland (C, ha)	Total Development Area of Wetland Catchment (C_{Dev}, ha)	Area of the Wetland Catchment Owned by the Proponent (ha)	% Impervious Cover Planned within the Proponent's Holdings (IC, %)	Impervious Cover Score[2] (S) Low Magnitude (<10%) Medium Magnitude (10-25%) High Magnitude (>25%)	Post-Development Catchment Area to Wetland (C_{Post}, ha)	Percent Increase or Decrease in Catchment Size (%) Low Magnitude (<10%) Medium Magnitude (10-25%) High Magnitude (>25%)	Proposed Water Taking or Discharge (L/day)	Anticipated Duration of Water Taking or Discharge (# of months)	Notes/ Assumptions:	Hydrologic Risk Assessment Due to Water Taking or Discharge Low Magnitude (50,000-400,000L/d for <6mos) Medium Magnitude (50,000-400,000L/d for >6mos OR >400,000L/d for <6mos) High Magnitude (>400,000L/d for >6mos)	Locally Significant Recharge Area (ha)	Locally Significant Recharge Area to be Paved (ha)	Percent Impact to Recharge Areas (%) Low Magnitude (<10%) Medium Magnitude (10-25%) High Magnitude (>25%)
A	0.83	71.65	17.90	17.90	60%	15%	53.89	25%	477,678	6	See Water Taking Calculations assumption table	MEDIUM	251,210	188,408	75%
B	0.54	0.96	0.61	0.61	0%	0%	0.96	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
C	0.76	4.33	0.23	0.23	0%	0%	4.33	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
D	0.36	-	-	-	-	0%	-	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
E	0.14	-	-	-	-	0%	-	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
F	0.09	2.80	0.04	0.04	0%	0%	2.76	1%	0	0	Not anticipated to be groundwater fed	LOW			0%
G	1.32	47.10	21.93	21.93	55%	25%	52.32	11%	130,646	6	See Water Taking Calculations assumption table	MEDIUM			0%
H	0.88	68.38	35.41	35.41	56%	29%	61.45	10%	130,646	6	See Water Taking Calculations assumption table	MEDIUM			0%
I	0.84	96.36	46.02	46.02	58%	27%	96.23	0%	97,060	6	See Water Taking Calculations assumption table	MEDIUM			0%
J	3.03	100.60	46.02	46.02	58%	26%	100.47	0%	95,224	6	See Water Taking Calculations assumption table	MEDIUM			0%
K	0.91	58.55	40.00	40.00	63%	43%	62.02	6%	106,786	6	See Water Taking Calculations assumption table	MEDIUM	7,091	4,609	65%

Notes: 1. Wetland IDs and Wetland Areas obtained from Figure 1 - Wetland Communities (Dillon Consulting, 2025-02-19)
2. Impervious cover scores calculated based on Equation 1 of the Wetland Water Balance Risk Evaluation (TRCA, November 2017)

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Impervious Cover Score (S) Equation:

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where: IC = Percent Impervious Cover planned within the Proponent's Holdings (%)
C_{dev} = Total Development Area within Wetland Catchment (ha)
C = Total Catchment Area to Wetland (ha)

		Impervious Cover Score					Wetland Catchment Size		Water Taking / Discharge				Impact to Recharge Areas		
Wetland ID[1]	Wetland Area[1] (ha)	Pre-Development Catchment Area to Wetland (C, ha)	Total Development Area of Wetland Catchment (C_{Dev}, ha)	Area of the Wetland Catchment Owned by the Proponent (ha)	% Impervious Cover Planned within the Proponent's Holdings (IC, %)	Impervious Cover Score[2] (S) Low Magnitude (<10%) Medium Magnitude (10-25%) High Magnitude (>25%)	Post-Development Catchment Area to Wetland (C_{Post}, ha)	Percent Increase or Decrease in Catchment Size (%) Low Magnitude (<10%) Medium Magnitude (10-25%) High Magnitude (>25%)	Proposed Water Taking or Discharge (L/day)	Anticipated Duration of Water Taking or Discharge (# of months)	Notes/ Assumptions:	Hydrologic Risk Assessment Due to Water Taking or Discharge Low Magnitude (50,000-400,000L/d for <6mos) Medium Magnitude (50,000-400,000L/d for >6mos OR >400,000L/d for <6mos) High Magnitude (>400,000L/d for >6mos)	Locally Significant Recharge Area (ha)	Locally Significant Recharge Area to be Paved (ha)	Percent Impact to Recharge Areas (%) Low Magnitude (<10%) Medium Magnitude (10-25%) High Magnitude (>25%)
A	0.83	71.65	17.90	17.90	60%	15%	53.89	25%	477,678	6	See Water Taking Calculations assumption table	MEDIUM	251,210	188,408	75%
B	0.54	0.96	0.61	0.61	0%	0%	0.96	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
C	0.76	4.33	0.23	0.23	0%	0%	4.33	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
D	0.36	-	-	-	-	0%	-	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
E	0.14	-	-	-	-	0%	-	0%	0	0	Not anticipated to be groundwater fed	LOW			0%
F	0.09	2.80	0.04	0.04	0%	0%	2.76	1%	0	0	Not anticipated to be groundwater fed	LOW			0%
G	1.32	47.10	21.93	21.93	55%	25%	52.32	11%	130,646	6	See Water Taking Calculations assumption table	MEDIUM			0%
H	0.88	68.38	35.41	35.41	56%	29%	61.45	10%	130,646	6	See Water Taking Calculations assumption table	MEDIUM			0%
I	0.84	96.36	46.02	46.02	58%	27%	96.23	0%	97,060	6	See Water Taking Calculations assumption table	MEDIUM			0%
J	3.03	100.60	46.02	46.02	58%	26%	100.47	0%	95,224	6	See Water Taking Calculations assumption table	MEDIUM			0%
K	0.91	58.55	40.00	40.00	63%	43%	62.02	6%	106,786	6	See Water Taking Calculations assumption table	MEDIUM	7,091	4,609	65%

Notes: 1. Wetland IDs and Wetland Areas obtained from Figure 1 - Wetland Communities (Dillon Consulting, 2025-02-19)
2. Impervious cover scores calculated based on Equation 1 of the Wetland Water Balance Risk Evaluation (TRCA, November 2017)
3. Pre-Development Catchment Areas are cumulative starting at wetland G and ending at wetland J

Post-Development Percent Impervious Calculations

Town of Caledon Standard Runoff Coefficients:

Landuse	C
Residential (Low-Density)	0.60
Residential (Medium-Density)	0.70
Residential (High-Density)	0.75
Commercial	0.90

Landuse	C
Institutional (Schools & Churches)	0.75
Parks / Open Space	0.25
Woodlot	0.25
SWM Pond	0.50

Runof coefficients, C, as per Town of Caledon Development Standards Manual 2019 - STD DWG 103.

Proposed Site Conditions

TIMP = 100* (RC - 0.25) / (0.90 - 0.25)

Weighted Runoff Coefficient C:

Wetland Catchment	Landuse	Area (ha)	C	XIMP	TIMP
A	Residential (Low-Density)	9.07	0.60	36%	54%
	Residential (Medium-Density)	4.60	0.70	46%	69%
	Institutional (School)	3.40	0.75	77%	77%
	Parks and Open Space	0.83	0.25	0%	0%
	Total/ Weighted C:	**17.90**	**0.64**	**44%**	**60%**
B	Parks and Open Space	0.23	0.25	0%	0%
	Total/ Weighted C:	**0.23**	**0.25**	**0%**	**0%**
C	Parks and Open Space	0.61	0.25	0%	0%
	Total/ Weighted C:	**0.61**	**0.66**	**0%**	**0%**
F	Parks and Open Space	0.04	0.25	0%	0%
	Total/ Weighted C:	**0.04**	**0.05**	**0%**	**0%**
G	Residential (Low-Density)	14.36	0.60	36%	54%
	Residential (Medium-Density)	1.36	0.70	46%	69%
	Institutional (School)	2.60	0.75	77%	77%
	Parks and Open Space	0.98	0.25	0%	0%
	SWM Pond	2.63	0.50	50%	50%
	Total/ Weighted C:	**21.93**	**0.60**	**41%**	**55%**
H	Residential (Low-Density)	7.11	0.60	36%	54%
	Residential (Medium-Density)	1.59	0.70	46%	69%
	Institutional (School)	0.56	0.75	77%	77%
	Parks and Open Space	1.59	0.25	0%	0%
	Commercial	2.63	0.90	100%	100%
	Total/ Weighted C:	**13.48**	**0.64**	**47%**	**59%**
I	Residential (Low-Density)	4.01	0.60	36%	54%
	Residential (Medium-Density)	5.33	0.70	46%	69%
	SWM Pond	1.27	0.50	50%	50%
	Total/ Weighted C:	**10.61**	**0.64**	**42%**	**61%**
K	Residential (Low-Density)	7.19	0.60	36%	54%
	Residential (Medium-Density)	14.34	0.70	46%	69%
	Residential (High-Density)	4.66	0.75	77%	77%
	Commercial	4.57	0.90	100%	100%
	Parks and Open Space	3.05	0.25	0%	0%
	SWM Pond	6.19	0.50	50%	50%
	Total/ Weighted C:	**40.00**	**0.65**	**51%**	**63%**

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Project:	Bolton North Hill (Option 1 &2 Lands)
Project No.:	0708-3446
Date:	February 25, 2025
Created By:	E.D.
Checked By:	R.S.A

Evaluation of Wetland Sensitivity

Wetland ID[1]	Notes/ Assumptions	Vegetation[2]			Fauna[3]								Flora[3]		
		Vegetation Community Type	ELC Code	Sensitivity	Herpetofauna Species	Sensitivity	Bird Species	Sensitivity	Mammal Species	Sensitivity	Fish Species	Sensitivity	Flora Species (Scientific Name)	Flora Species (Common Name)	Sensitivity
A	No Survey access to this wetland; Aerial only.	Meadow Marsh	MAM	Low											
B	No Survey access to this wetland; Aerial only.	Deciduous Swamp	SWD	Low											
C	No Survey access to this wetland; Aerial only.	Deciduous Swamp	SWD	Low											
D	No Survey access to this wetland; Aerial only.	Deciduous Swamp	SWD	Low											
E	ELC Aerial Interpreted	Meadow Marsh	MAM	Low	northern spring peeper	High									
					gray treefrog	High									
F	ELC Aerial Interpreted	Meadow Marsh	MAM	Low	northern spring peeper	High									
					gray treefrog	High									
G		Gramminoid Mineral Meadow Marsh	MAMM1	Low	northern spring peeper	High	Canada goose	Low					Symphyotrichum puniceum var. puniceum	swamp aster	Medium
					American toad	Medium	mallard	Low					Typha latifolia	broad-leaved cattail	Low
					green frog	Medium	great blue heron	Low							
					gray treefrog	High									
H		Gramminoid Mineral Meadow Marsh	MAMM1	Low	northern spring peeper	High	Canada goose	Low					Symphyotrichum puniceum var. puniceum	swamp aster	Medium
							mallard	Low					Typha latifolia	broad-leaved cattail	Low
I		Gramminoid Mineral Meadow Marsh	MAMM1	Low	northern spring peeper	High	Canada goose	Low					typha latifolia	broad-leaved cattail	Low
					American toad	Medium	mallard	Low					symphyotrichum puniceum var. puniceum	swamp aster	Medium
													impatiens capensis	orange touch-me-not	Medium
J		Mineral Deciduous Forest / Graminoid Mineral Meady Marsh Complex	FODM / MAMM1	Low	northern spring peeper	High	Canada goose	Low					typha latifolia	broad-leaved cattail	Low
					American toad	Medium	mallard	Low					symphyotrichum puniceum var. puniceum	swamp aster	Medium
													impatiens capensis	orange touch-me-not	Medium
K	No Survey access to this wetland; Aerial only.	Meadow Marsh	MAM	Low											

Notes:

1. Wetland IDs obtained from Figure 1 - Wetland Communities (Dillon Consulting, 2025-02-19)
2. Vegetation Community Types, ELC Codes, and sensitivity classified by Dillon Consulting based on Appendix 2 of the TRCA Wetland Water Balance Risk Evaluation Guide (Nov. 2017)
3. Flora and fauna Types and sensitivity classified by Dillon Consulting based on Appendix 3 of the TRCA Wetland Water Balance Risk Evaluation Guide (Nov. 2017)

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Project:	Bolton North Hill
Project No.:	0708-3446
Date:	February 26, 2025
Created By:	C.M.
Checked By:	C.G.

WATER TAKING CALCULATIONS

Table 1: Evaluation of Groundwater Fed Wetlands

Wetland ID[1]	Wetland Area[1] (ha)	Avg. Ground Elevation[2] (masl)	Estimated Seasonal High Groundwater Elevation[3] (masl)	Nearest Monitoring Well[3]	Groundwater Flora Indicators[4]	Anticipated to be Groundwater Fed (Y/N)	Reasoning
A - Meadow Marsh	0.83	256	260.7	MW19		Y	mineral rich soils; evidence of potentiometric surface above ground level
B - Deciduous Swamp	0.54	271	264.2	MW17		N	
C - Deciduous Swamp	0.76	270	264.8	MW15		N	
D - Deciduous Swamp	0.36	272	267	MW14		N	
E - Meadow Marsh	0.14	267	266	MW14		N	
F - Meadow Marsh	0.09	267	265.5	MW14		N	
G - Mineral Meadow Marsh	1.32	262	262.2	MW12	Orange Touch-Me-Not	Y	flora indicator; mineral rich soils
H - Mineral Meadow Marsh	0.88	259	259.2	MW7		Y	mineral rich soils; connected to wetland G
I - Mineral Meadow Marsh	0.84	257	258.5	MW4		Y	mineral rich soils standing water; connected to wetland I
J - Mineral Deciduous Forest/Mineral Meadow Marsh Complex	3.03	257	258.4	MW4		Y	standing water; mineral rich soils; evidence of high potentiometric surface
K - Meadow Marsh	0.91	250	~251	MW8		Y	no wells located in this area; assumed to be groundwater fed as worst case scenerio

Notes:

1. Wetland IDs and Wetland Areas obtained from Figure 1 - Wetland Communities (Dillon Consulting, 2025-02-19)
2. Estimated average ground elevation of wetland area from Reigon of Peel DEM (February 2025)
3. Estimated groundwater elevation from Hydrogeological Investigation (Crozier, 2025-02-26)
4. Flora and fauna classified by Dillon Consulting based on Appendix 3 of the TRCA Wetland Water Balance Risk Evaluation Guide (Nov. 2017)

Table 2: Summary Table

ESTIMATED DEWATERING VOLUMES

Wetland ID	Total Estimated Short Term Dewatering Volumes (L/day)		Estimated Duration of Open Excavation or Dewatering Activity
		with SF of 2	
A	238,839	477,678	12 months
B			
C			
D			
E			
F			
G	65,323	130,646	12 months
H	65,323	130,646	12 months
I	48,530	97,060	12 months
J	47,612	95,224	12 months
K	53393	106,786	12 months

Assumptions:

—Low density residential single family dwellings are estimated to be 10 m by 25 m based on an average home size of 250 m^2. (Detailed Concept Plan, Bousfields Inc., January 27, 2025) (Zoning By-Law, Town of Caledon, July 2018) (Housing Statistics, Statistics Canada, December 2021)

—Townhouses are estimated to be 6 m by 20 m based on an average home size of 120 m^2 (Concept Plan, Bousfields Inc., December 20, 2021) (Zoning By-Law, Town of Caledon, July 2018) (Housing Statistics, Statistics Canada, December 2021)

—Average basement ceiling height is estimated to be 7 ft or 2.25 m (Ontario Building Code)

—Average hydraulic conductivity value for silty clay to clayey silt till is approximately 7.5 x 10^{-8} cm/s to 2.5 x 10^{-6} cm/s based on literature values and regional testing (Freeze and Cherry, 1979) (Soil Engineers Ltd., January 2020)

—Calculation of short-term dewatering was chosen to represent greatest water taking as short-term volumes are greater than long-term values.

Table 3: Assumed Excavation Areas for Type of Development within 500 m of Wetland

	Area within 500 m of Wetland					Estimated Number of Homes within 500 m of	
Wetland ID	LD (m^2)	MD (m^2)	HD (m^2)	School (m^2)	Mixed Use (m^2)	LD	MD
A	151,000	109,000	0	34,000	500	500	800
B							
C							
D							
E							
F							
G	115,000	70,000	0	0	0	450	550
H	115,000	70,000	0	0	0	450	550
I	33,000	24,000	0	0	0	100	75
J	33,000	24,000	0	0	0	100	75
K	33,000	24,000	1,500	0	0	100	75

CALCULATION TABLES

TABLE 4a - LOW DENSITY DWELLING

ESTIMATE CONSTRUCTION DEWATERING VOLUME CALCULATIONS

Based on Dupuit Equation for Radial Flow to a Well or Point Source Excavation in an Unconfined Aquifer

Component	Variable	Units	Value	Note
Hydraulic Conductivity of Soil	K	m/s	2.50E-07	estimated based on regional studies and literature values, ranges from 7.5 x 10^{-8} m/s to 2.5 x 10^{-7} m/s.
Base of Aquifer		masl	247.00	elevation of extent of excavation - 1.0 m (estimated based on borehole logs).
Groundwater Elevation		masl	251.00	estimated groundwater level (Feb, 2025)
Elevation Requiring Dewatering		masl	248.00	assumed to be 2.0 m below the extent of excavation.
Extent of Excavation		masl	250.00	estimated to be approximately 7 ft or 2.25 mbgs based on Ontario Building Code minimum of 6.5 ft.
Equivalent Radius of the Well	r_w	m	102.52	squareroot of excavation area divided by pi.
Excavation Area		m^2	33000	estimated from the Concept Plan prepared by Bousfields Inc. Feb 2025

Calculations

Hydraulic Head of Water Table	H	m	4.00	
Hydraulic Head at Max. Dewatering	h	m	1.00	
Radius of Influence	R_0	m	107.02	
Pumping Rate	Q	m^3/s	2.74E-04	
Dewatering Volume per Day	Q	L/day	23681.88	

TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME **Q = 23682 L/day**

TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME W/ SAFETY FACTOR OF 2.0 **Q = 47364 L/day**

TABLE 4b - MEDIUM DENSITY DWELLING

ESTIMATE CONSTRUCTION DEWATERING VOLUME CALCULATIONS

Based on Dupuit Equation for Radial Flow to a Well or Point Source Excavation in an Unconfined Aquifer

Component	Variable	Units	Value	Note
Hydraulic Conductivity of Soil	K	m/s	2.50E-07	estimated based on regional studies and literature values, ranges from 7.5 x 10^{-8} m/s to 2.5 x 10^{-7} m/s.
Base of Aquifer		masl	247.00	elevation of extent of excavation - 1.0 m (estimated based on borehole logs).
Groundwater Elevation		masl	251.00	estimated groundwater level (Feb, 2025)
Elevation Requiring Dewatering		masl	248.00	assumed to be 2.0 m below the extent of excavation.
Extent of Excavation		masl	250.00	estimated to be approximately 7 ft or 2.25 mbgs based on Ontario Building Code minimum of 6.5 ft.
Equivalent Radius of the Well	r_w	m	87.43	squareroot of excavation area divided by pi.
Excavation Area		m^2	24000	estimated from the Concept Plan prepared by Bousfields Inc. Feb 2025

Calculations

Hydraulic Head of Water Table	H	m	4.00	
Hydraulic Head at Max. Dewatering	h	m	1.00	
Radius of Influence	R_0	m	91.93	
Pumping Rate	Q	m^3/s	2.35E-04	
Dewatering Volume per Day	Q	L/day	20269.70	

TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME **Q = 20270 L/day**

TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME W/ SAFETY FACTOR OF 2.0 **Q = 40539 L/day**

TABLE 4c - HIGH DENSITY DWELLING

ESTIMATE CONSTRUCTION DEWATERING VOLUME CALCULATIONS

Based on Dupuit Equation for Radial Flow to a Well or Point Source Excavation in an Unconfined Aquifer

Component	Variable	Units	Value	Note
Hydraulic Conductivity of Soil	K	m/s	2.50E-07	estimated based on regional studies and literature values, ranges from 7.5 x 10^{-8} m/s to 2.5 x 10^{-7} m/s.
Base of Aquifer		masl	244.00	elevation of extent of excavation - 1.0 m (estimated based on borehole logs).
Groundwater Elevation		masl	251.00	estimated groundwater level
Elevation Requiring Dewatering		masl	245.00	assumed to be 2.0 m below the extent of excavation.
Extent of Excavation		masl	247.00	estimated to be approximately 1 level of underground parking, or 3 m parking lot height.
Equivalent Radius of the Well	r_w	m	21.86	squareroot of excavation area divided by pi.
Excavation Area		m^2	1500	estimated from the Concept Plan
Calculations				
Hydraulic Head of Water Table	H	m	7.00	
Hydraulic Head at Max. Dewatering	h	m	1.00	
Radius of Influence	R_0	m	30.86	
Pumping Rate	Q	m^3/s	1.09E-04	
Dewatering Volume per Day	Q	L/day	9440.52	
TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME				**Q = 9441 L/day**
TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME W/ SAFETY FACTOR OF 2.0				**Q = 18881 L/day**

TABLE 4d - SCHOOLS

ESTIMATE CONSTRUCTION DEWATERING VOLUME CALCULATIONS

Based on Dupuit Equation for Radial Flow to a Well or Point Source Excavation in an Unconfined Aquifer

Component	Variable	Units	Value	Note
Hydraulic Conductivity of Soil	K	m/s	2.50E-07	estimated based on regional studies and literature values, ranges from 7.5 x 10^{-8} m/s to 2.5 x 10^{-7} m/s.
Base of Aquifer		masl	252.00	elevation of extent of excavation - 1.0 m (estimated based on borehole logs).
Groundwater Elevation		masl	260.70	estimated groundwater level (Feb, 2025)
Elevation Requiring Dewatering		masl	253.00	assumed to be 2.0 m below the extent of excavation.
Extent of Excavation		masl	255.00	estimated to be approximately 7 ft or 2.25 mbgs based on Ontario Building Code minimum of 6.5 ft.
Equivalent Radius of the Well	r_w	m	104.06	squareroot of excavation area divided by pi.
Excavation Area		m^2	34000	estimated from the Concept Plan prepared by Bousfields Inc. Feb 2025
Calculations				
Hydraulic Head of Water Table	H	m	8.70	
Hydraulic Head at Max. Dewatering	h	m	1.00	
Radius of Influence	R_0	m	115.61	
Pumping Rate	Q	m^3/s	5.57E-04	
Dewatering Volume per Day	Q	L/day	48127.71	
TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME				**Q = 48128 L/day**
TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME W/ SAFETY FACTOR OF 2.0				**Q = 96255 L/day**

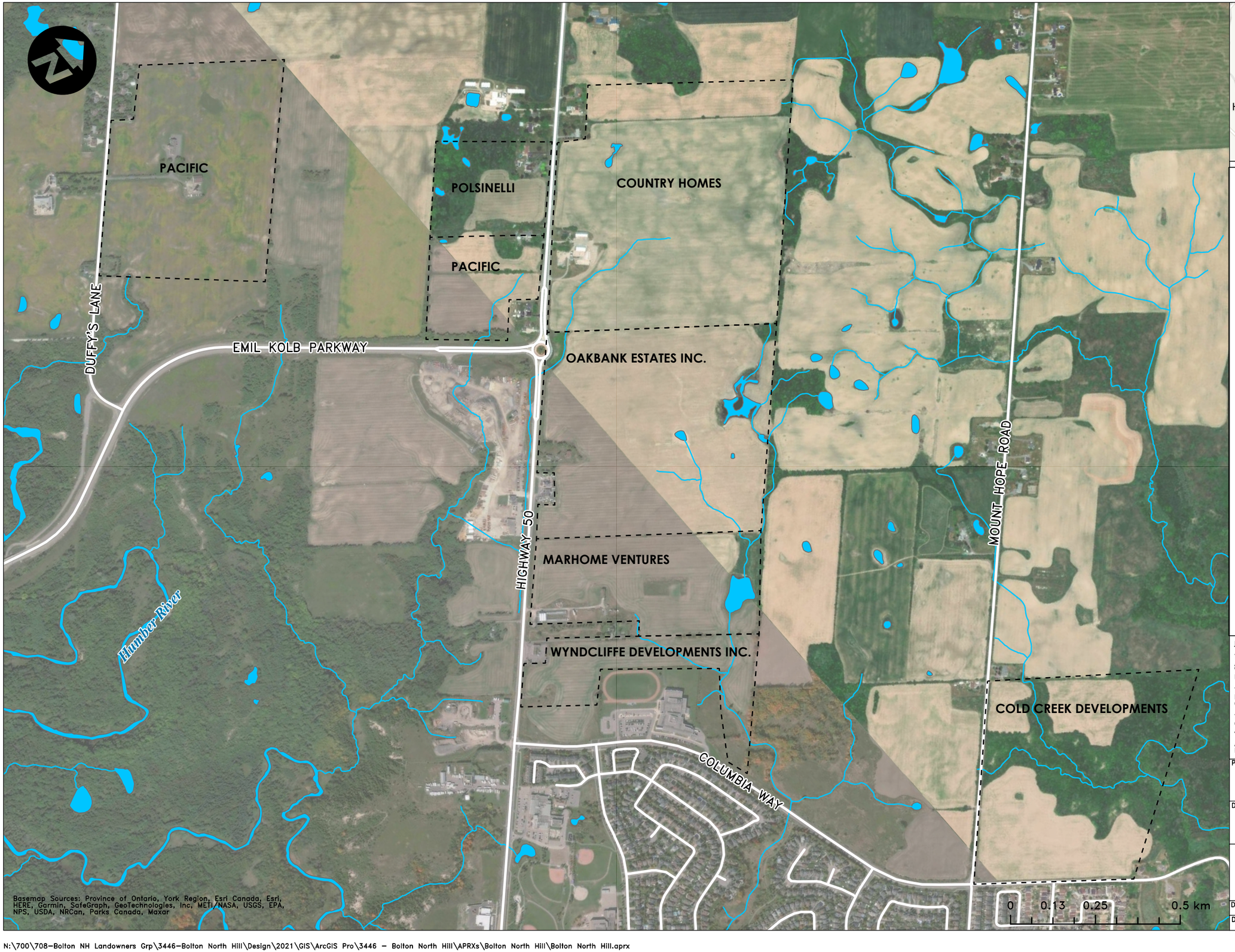
TABLE 4e - Mixed Use

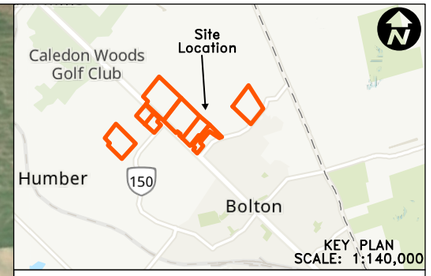
ESTIMATE CONSTRUCTION DEWATERING VOLUME CALCULATIONS

Based on Dupuit Equation for Radial Flow to a Well or Point Source Excavation in an Unconfined Aquifer

Component	Variable	Units	Value	Note
Hydraulic Conductivity of Soil	K	m/s	2.50E-07	estimated based on regional studies and literature values, ranges from 7.5 x 10^{-8} m/s to 2.5 x 10^{-7} m/s.
Base of Aquifer		masl	252.00	elevation of extent of excavation - 1.0 m (estimated based on borehole logs).
Groundwater Elevation		masl	260.70	estimated groundwater level (Feb, 2025)
Elevation Requiring Dewatering		masl	253.00	assumed to be 2.0 m below the extent of excavation.
Extent of Excavation		masl	255.00	assuming no basement
Equivalent Radius of the Well	r_w	m	12.62	squareroot of excavation area divided by pi.
Excavation Area		m^2	500	estimated from the Concept Plan prepared by Bousfields Inc. Feb 2025
Calculations				
Hydraulic Head of Water Table	H	m	8.70	
Hydraulic Head at Max. Dewatering	h	m	1.00	
Radius of Influence	R_0	m	24.17	
Pumping Rate	Q	m^3/s	9.02E-05	
Dewatering Volume per Day	Q	L/day	7795.03	
TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME				**Q = 7795 L/day**
TOTAL ESTIMATED CONSTRUCTION DEWATERING VOLUME W/ SAFETY FACTOR OF 2.0				**Q = 15590 L/day**

FIGURES





LEGEND

- Subject Lands
- Road
- Watercourse
- Waterbody
- Road Label
- Landowner

DRAWING NOTES:

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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

BOLTON NORTH HILL
TOWN OF CALEDON

Drawing

SITE LOCATION PLAN

CROZIER
CONSULTING ENGINEERS
2800 High Point Drive
Suite 100
Milton, ON L9T 6P4
905-875-0026 T
905-875-4915 F
www.cfcrozier.ca

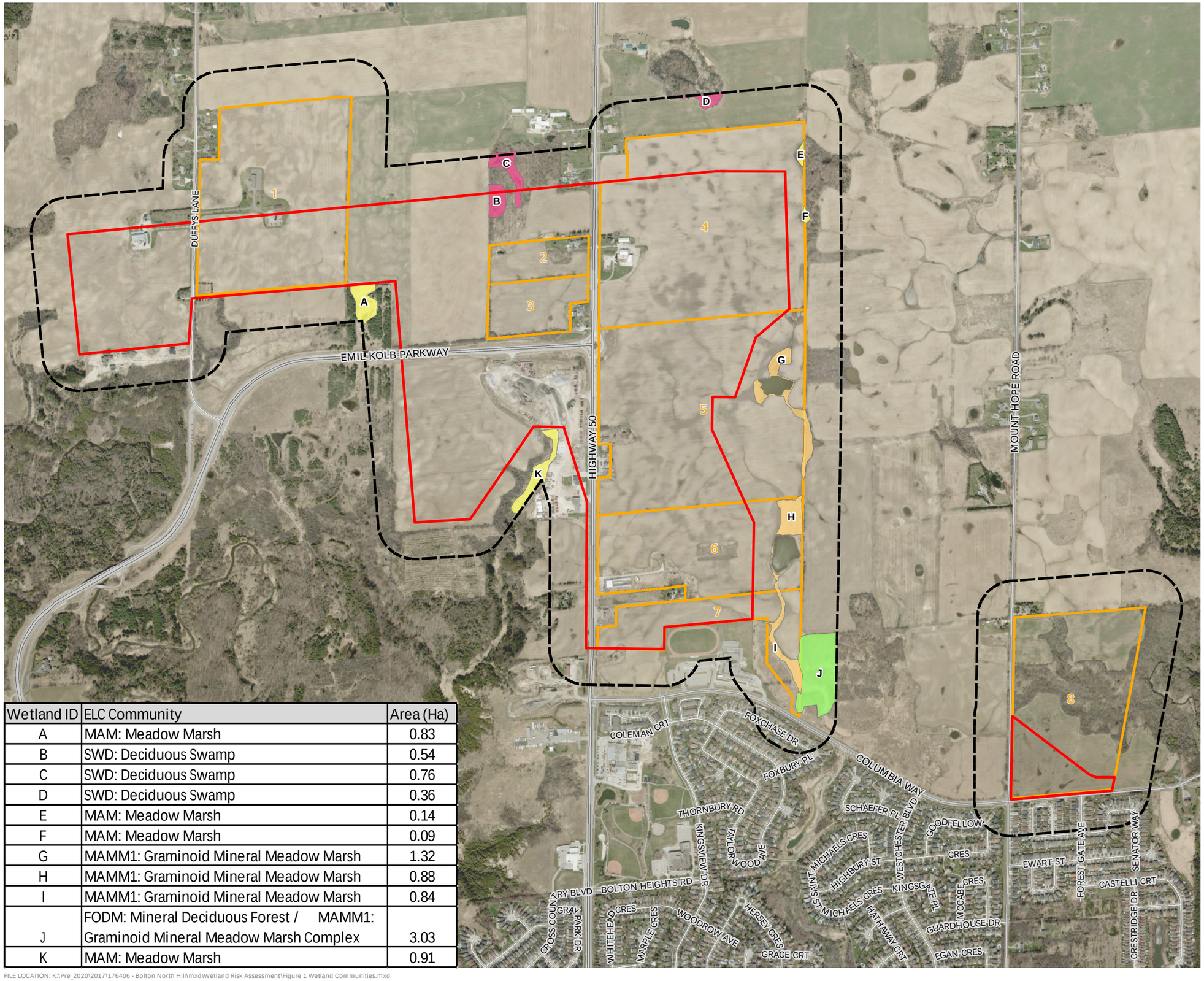
Drawn	Design	Project No.
C.M.	R.A.	0708-3446
Date	Projection	Scale
22.04.12	EPSG:26917	1:10,500

Dwg. FIG. 1

N:\700\708-Bolton NH Landowners Grp\3446-Bolton North Hill\Design\2021\GIS\ArcGIS Pro\3446 - Bolton North Hill\APRXs\Bolton North Hill\Bolton North Hill.aprx

BOLTON NORTH HILL SECONDARY PLAN NATURAL HERITAGE STUDY

FIGURE 2
WETLAND COMMUNITIES



- Secondary Plan Area
- Study Area (120 m Setback)
- Participating Landowner Property

Wetland

- FODM: Mineral Deciduous Forest / MAMM1: Graminoid Mineral Meadow Marsh Complex
- MAM: Meadow Marsh
- MAMM1: Graminoid Mineral Meadow Marsh
- SWD: Deciduous Swamp

Wetland ID	ELC Community	Area (Ha)
A	MAM: Meadow Marsh	0.83
B	SWD: Deciduous Swamp	0.54
C	SWD: Deciduous Swamp	0.76
D	SWD: Deciduous Swamp	0.36
E	MAM: Meadow Marsh	0.14
F	MAM: Meadow Marsh	0.09
G	MAMM1: Graminoid Mineral Meadow Marsh	1.32
H	MAMM1: Graminoid Mineral Meadow Marsh	0.88
I	MAMM1: Graminoid Mineral Meadow Marsh	0.84
J	FODM: Mineral Deciduous Forest / MAMM1: Graminoid Mineral Meadow Marsh Complex	3.03
K	MAM: Meadow Marsh	0.91

1:12,000

0 100 200 m

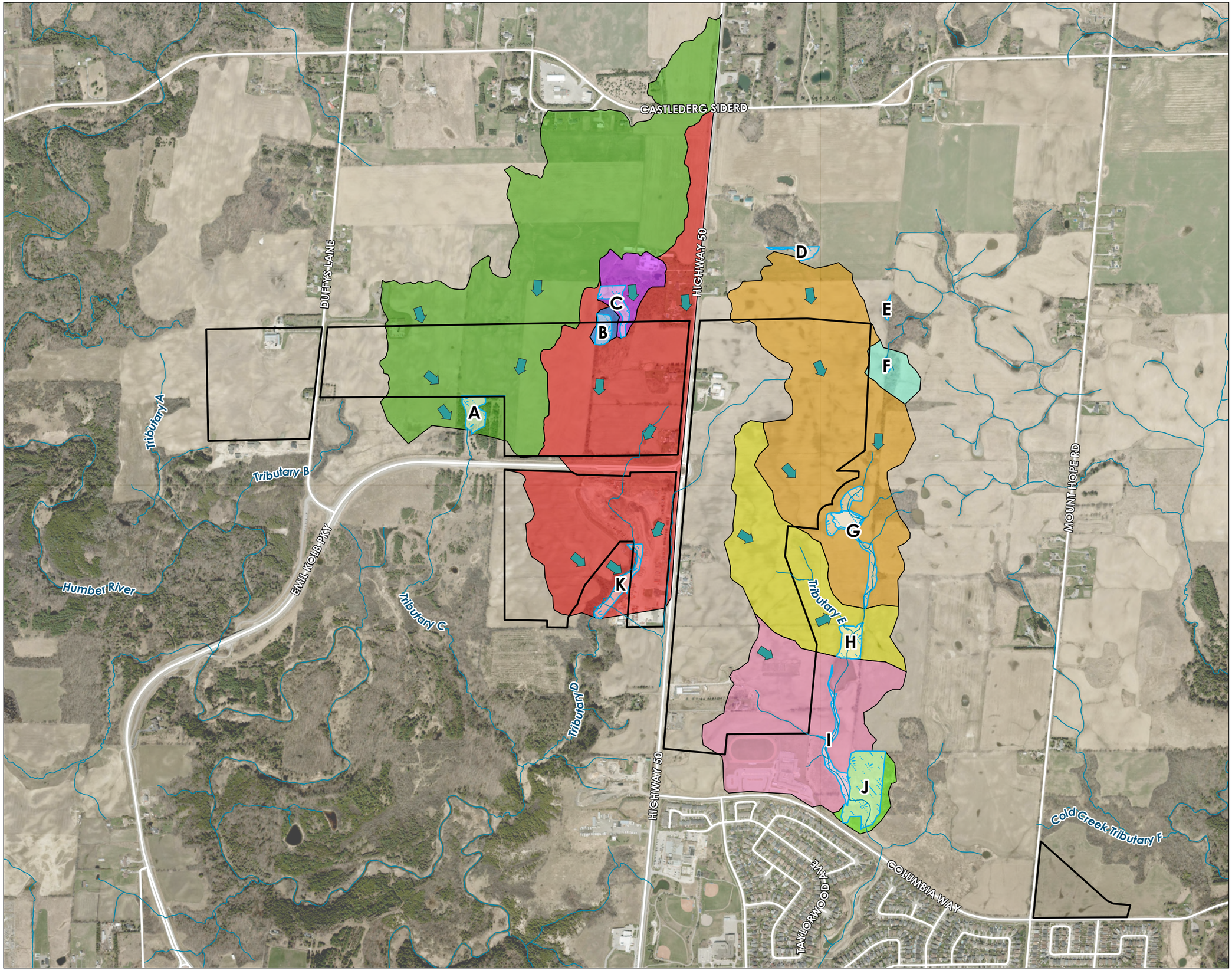
MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, REGION OF PEEL, TRCA

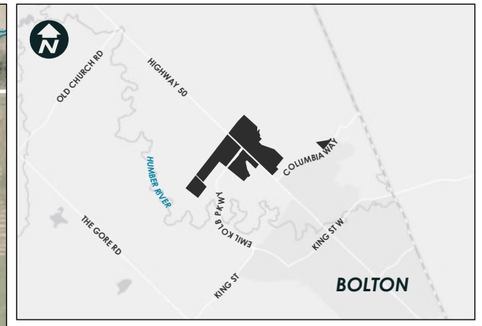
MAP CREATED BY: GM/ZB
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 176406
STATUS: DRAFT
DATE: 2025-02-19

FILE LOCATION: K:\Pre_2020\2017\176406 - Bolton North Hill\mxd\Wetland Risk Assessment\Figure 1 Wetland Communities.mxd





LEGEND

- STUDY AREA
- WATERCOURSE
- EXISTING OVERLAND FLOW DIRECTION
- WETLANDS

PRE-DEVELOPMENT DRAINAGE AREA BOUNDARY

- WETLAND A
- WETLAND B
- WETLAND C
- WETLAND F
- WETLAND G
- WETLAND H
- WETLAND I
- WETLAND J
- WETLAND K

0 175 350 700 Metres

Source: Peel Region, Maxar, Esri, HERE, Garmin, USGS, EPA, NPS, NRCan

BOLTON NORTH HILL SUBWATERSHED STUDY

PRE-DEVELOPMENT WETLAND DRAINAGE PLAN

CROZIER

CELEBRATING 20 YEARS SINCE 2004

DRAWN:	DESIGN:	PROJECT NO.	
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DATE:	PROJECTION:	SCALE:	FIG.3
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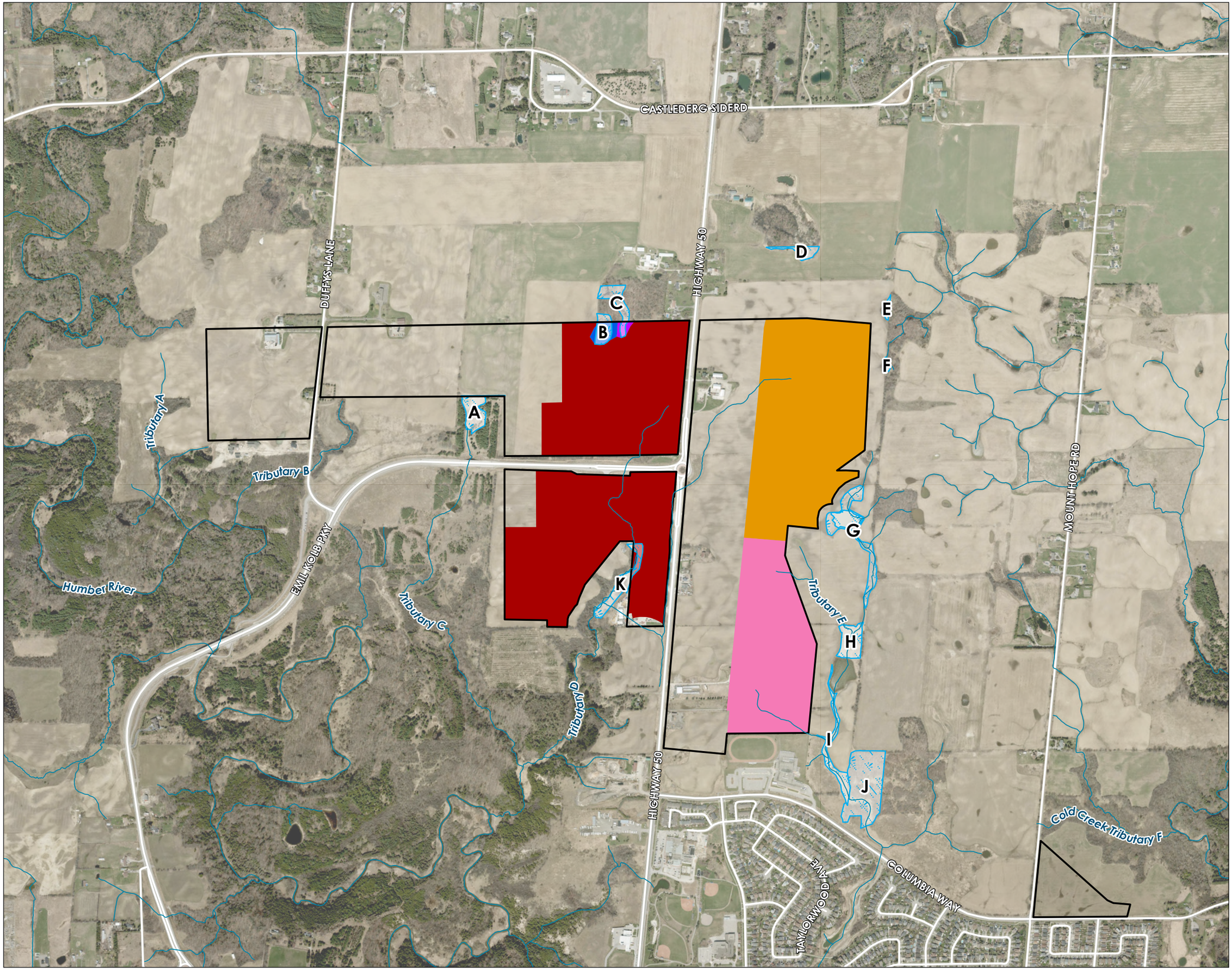

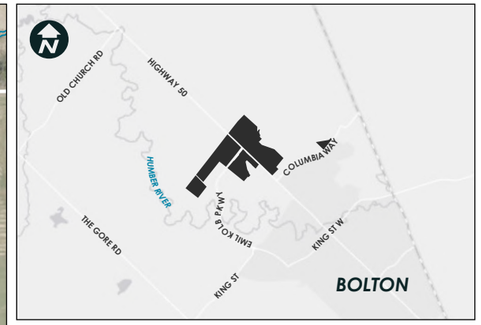

LEGEND

- STUDY AREA
- WATERCOURSE
- WETLANDS

POST-DEVELOPMENT INTERNAL DRAINAGE AREA

- WETLAND B
- WETLAND C
- WETLAND G
- WETLAND I
- WETLAND K

0 175 350 700 Metres

Source: Peel Region, Maxar, Esri, HERE, Garmin, USGS, EPA, NPS, NRCan

BOLTON NORTH HILL SUBWATERSHED STUDY

POST-DEVELOPMENT WETLAND DRAINAGE PLAN

CROZIER

DRAWN:	DESIGN:	PROJECT NO.	
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DATE:	PROJECTION:	SCALE:	FIG.4
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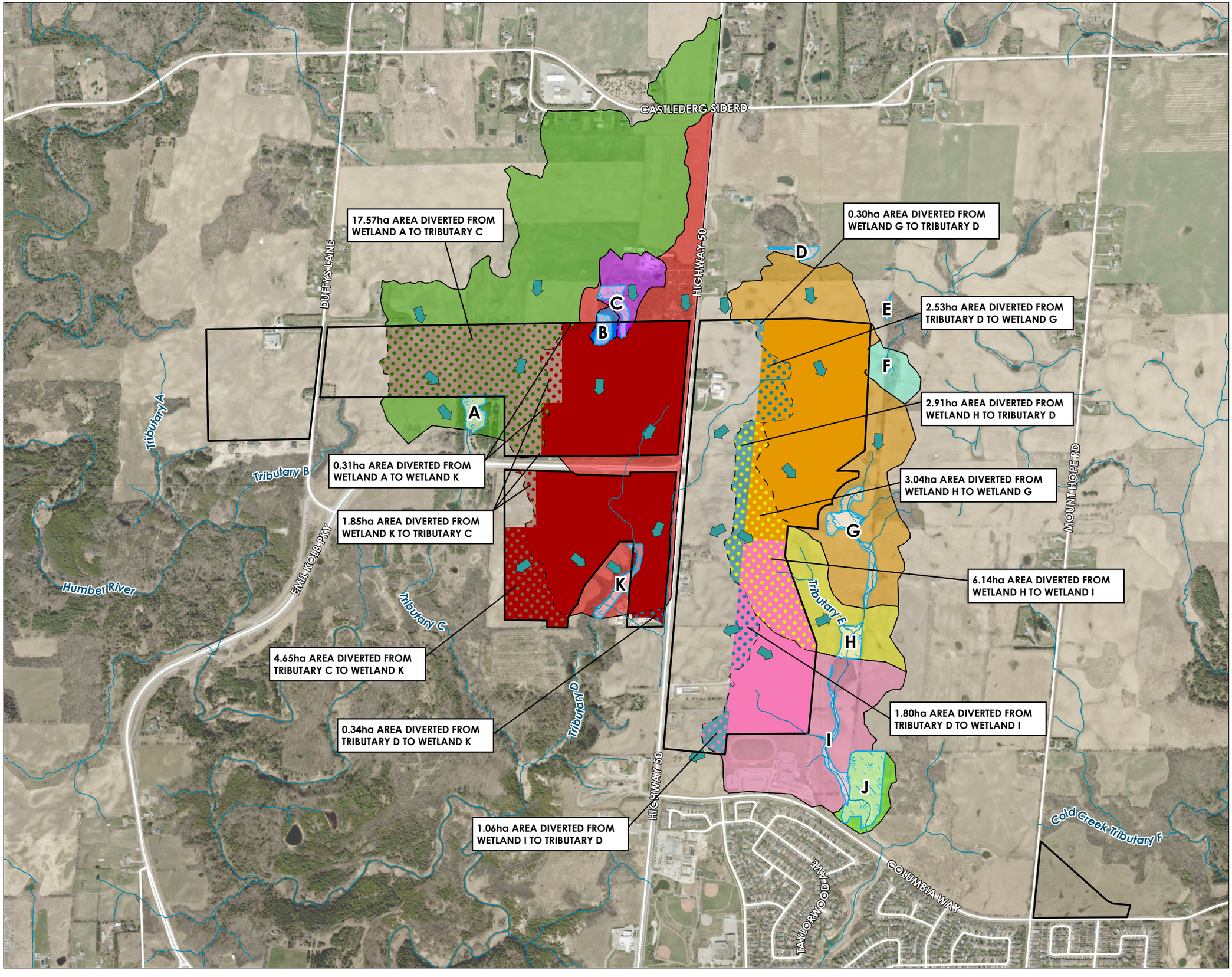

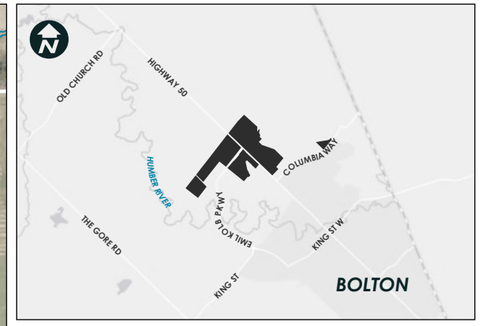

LEGEND

- STUDY AREA
- WATERCOURSE
- EXISTING OVERLAND FLOW DIRECTION
- WETLANDS
- PRE-DEVELOPMENT DRAINAGE AREA BOUNDARY

POST-DEVELOPMENT INTERNAL DRAINAGE AREA

- WETLAND B
- WETLAND C
- WETLAND G
- WETLAND I
- WETLAND K

DRAINAGE AREA DIVERSION

- WETLAND A TO TRIBUTARY C
- WETLAND G TO TRIBUTARY D
- WETLAND H TO TRIBUTARY D
- WETLAND I TO TRIBUTARY D
- WETLAND K TO TRIBUTARY C
- WETLAND H TO WETLAND G
- WETLAND H TO WETLAND I
- WETLAND A TO WETLAND K
- TRIBUTARY C TO WETLAND K
- TRIBUTARY D TO WETLAND G
- TRIBUTARY D TO WETLAND I
- TRIBUTARY D TO WETLAND K

0 175 350 700 Metres

Source: Peel Region, Maxar, Esri, HERE, Garmin, USGS, EPA, NPS, NRCan

BOLTON NORTH HILL SUBWATERSHED STUDY

WETLAND DRAINAGE DIVERSION PLAN

CROZIER

CELEBRATING 20 YEARS SINCE 2004

DRAWN:	DESIGN:	PROJECT NO.	
J.M / D.M	A.W	708 - 3446	
DATE:	PROJECTION:	SCALE:	
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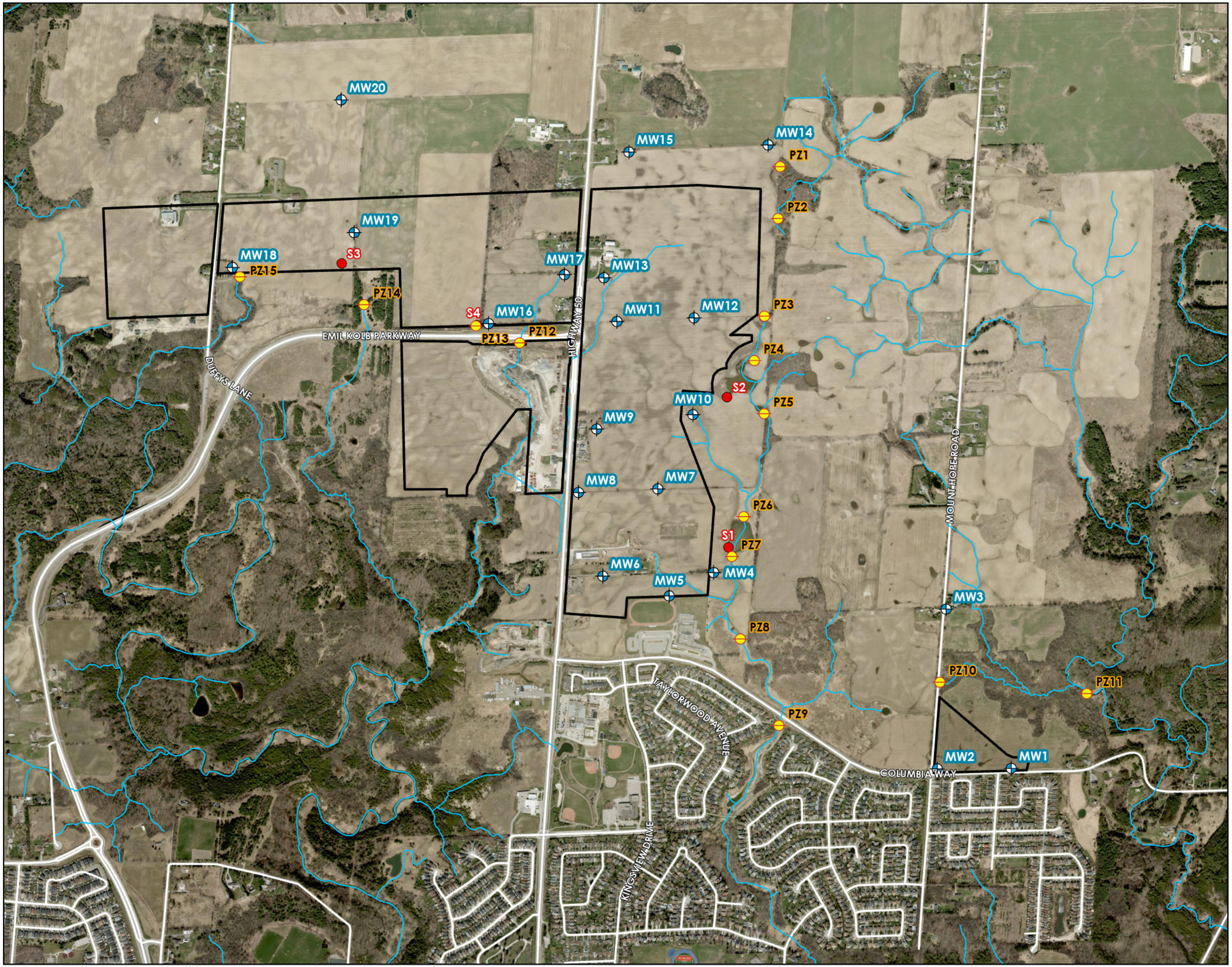

LEGEND

- STUDY AREA
- WATERCOURSE
- MONITORING WELL
- PIEZOMETER
- STAFF GAUGE

0 175 350 700 Metres

Source: Peel Region, Maxar, Esri, HERE, Garmin, USGS, EPA, NPS, NRCan

BOLTON NORTH HILL SUBWATERSHED STUDY

MONITORING NETWORK

CROZIER

DRAWN:	DESIGN:	PROJECT NO.	
C.M	A.W	708 - 3446	
DATE:	PROJECTION:	SCALE:	FIG. 6
2025-02-28	EPSG:26917	1:150,000	

LEGEND

- STUDY AREA
- WATERCOURSE
- HIGHLY VULNERABLE AQUIFER
- SIGNIFICANT GROUNDWATER RECHARGE AREA

0 175 350 700 Metres

Source: Peel Region, Maxar, Esri, HERE, Garmin, USGS, EPA, NPS, NRCan

BOLTON NORTH HILL SUBWATERSHED STUDY

HIGHLY VULNERABLE AQUIFER & SIGNIFICANT GROUNDWATER RECHARGE AREAS

CROZIER

DRAWN:	DESIGN:	PROJECT NO.	
C.M	A.W	708 - 3446	
DATE:	PROJECTION:	SCALE:	FIG. 7
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