Memo

To: Liz Howson, Macaulay Shiomi Howson Ltd.

From: Aaron Farrell and Patrick MacDonald

Date: August 22, 2019 (Revised November 13, 2019)

File: TPB188126

Re: **Columbus Area Part II Plan – Preliminary Cost Estimates for Stormwater Management Facilities and Hydraulic Structures**

1.0 Introduction

As discussed (ref. personal communication Howson-Farrell, August 12, 2019), Wood Environment and Infrastructure Solutions (Wood) has calculated preliminary cost estimates for the construction of the stormwater management facilities and hydraulic structures proposed to span regulated watercourses for the Columbus Part II Plan in the City of Oshawa. As noted in the updated Work Plan, detailed cost estimates are to be determined upon receipt of the Phase 2 component of the ongoing Subwatershed Study, and based upon the preferred land use plan. At present, and in the absence of the detailed recommendations from the Subwatershed Study, the cost estimates presented herein are intended to provide high-level estimates of cumulative capital costs for each of the three (3) land use alternatives currently under evaluation, to assist in the evaluation of the alternatives based upon financial considerations. This Technical Memorandum has been prepared to summarize the results of these assessments.

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2.0 Background Information

The following information has been used for this assessment:

- Draft Columbus Subwatershed Study Phase 1 (Characterization) report (Stantec Consulting Ltd., January 2019) and the associated figures and GIS data
- GIS shape files for the three (3) land use alternatives.

In addition, and in the absence of the recommendations from the Subwatershed Study, Wood has referenced stormwater management facility unitary sizing criteria and general guidance for sizing hydraulic structures as established in Subwatershed Studies completed by Wood in other jurisdictions, to determine the sizing of end-of-pipe facilities and hydraulic structures for input to developing the cost estimates. Further information regarding the assumptions applied for this assessment are provided in the following sections.

3.0 Land Use Alternatives Imperviousness

As noted in Section 1, the three (3) land use alternatives developed for the Columbus Part II Plan have been used to develop estimated stormwater management facility sizing and associated facility footprints. The GIS data for each land use has been reviewed to determine the portion (i.e. area) of each land use within each of the respective land use alternatives. A summary of the land use composition for each alternative is presented in Table 3.1.

Table 3.1 Summary of the Land Use Area for Each Alternative

Proposed Land Use	Land Use Area (ha)		
	Alternative 1	Alternative 2	Alternative 3
Employment	116.2	116.2	116.2
High Density Res	3.8	3.0	8.7
Low Density Res	199.9	197.5	211.0
Medium Density Res I	75.2	81.9	88.3
Medium Density Res II	86.8	83.8	57.6
Mixed Use	30.5	30.0	30.6
Total Urban Area	512.4	512.4	512.4
Total Rural and Open Area	1051.3	1051.3	1051.3
Total Area	*1563.7*	*1563.7*	*1563.7*

The total impervious area corresponding to the future development for each land use alternative has been calculated using impervious coverages for each future urban land use, as applied by Wood in recent Subwatershed Studies (ref. Table 3.2).

Table 3.2 Imperviousness / Coverage Values Based on Land Use

Future Urban Land Use	Imperviousness (%)
Employment	90
Low Density Residential	65
Medium Density Residential	75
Mixed	85
High Density Residential	85

The total impervious area for each land use alternative has been calculated, by weighting the imperviousness for the respective land uses presented in Table 3.2 by the area of each land use within the respective land use alternatives, as presented in Table 3.1. The resulting impervious area for each land use alternative is summarized in Table 3.3.

Table 3.3 Summary of the Impervious Area for Each Alternative

Proposed Land Use	Impervious Area (ha)		
	Alternative 1	Alternative 2	Alternative 3
Employment	104.5	104.5	104.5
High Density Res	3.2	2.6	7.4
Low Density Res	129.9	128.4	137.2
Medium Density Res I	56.4	61.4	66.2
Medium Density Res II	65.1	62.9	43.2
Mixed Use	25.9	25.5	26.0
Total Impervious Area (ha)	*385.2*	*385.3*	*384.6*

The results in Table 3.3 indicate that the impervious coverage varies marginally among the three (3) land use alternatives being considered. Recognizing that stormwater management facility sizing is generally proportional to the change in impervious coverage between existing and future land use conditions, it is thus anticipated that the costs for implementing stormwater management would differ marginally among the three (3) alternatives.

4.0 Stormwater Management Facility Cost Estimates

As noted previously, specific details regarding the siting and unitary sizing of end-of-pipe facilities are currently being developed as part of the Subwatershed Study, and are anticipated to be provided in the Subwatershed Study Phase 2 report (. In the absence of these details, cumulative cost estimates for the construction of end-of-pipe facilities have been estimated based upon the following assumptions:

- Unitary storage of 800 m^3/impervious hectare required for erosion control and 100 year flood control within end-of-pipe facilities.
- Additional unitary storage volume of 800 m^3/impervious hectare, above the 100 year operating condition, required for Regional (Hurricane Hazel) storm control (assumed to be required within the end-of-pipe facility).
- Stormwater management facility footprints (in hectares) would be equal to 12% of the impervious area resulting from the future development (approximately 9% of the total future urban area).
- Unitary construction cost of \$60/m^3, including maintenance access and landscaping costs.
- Land value of \$2,000,000/ha assumed for total cost estimates.

The preceding unitary rates for SWM facility sizing have been used in conjunction with the impervious areas presented in Table 3.3 to develop preliminary estimates of the total storage volume requirements (including Regional Storm controls) for end-of-pipe stormwater management facilities for each of the respective land use alternatives. The resulting total storage volumes have then been used, in conjunction with the unitary construction costs provided above, to determine the preliminary estimated total construction costs of end-of-pipe facilities for each land use. In addition, land costs have been estimated for each of the three scenarios, based upon the additional impervious area resulting from the future development, and the estimated facility footprints and the unitary land value of $2M. The results of this assessment are presented in Table 4.1.

Table 4.1 SWM Facility Footprint Area, Volume, and Costing Summary

Parameter	Alternative 1	Alternative 2	Alternative 3
Total Developed Area (ha)	512.4	512.4	512.4
Total Impervious Area (ha)	385.2	385.3	384.6
SWM Footprint Area (ha)	46.22	46.23	46.15
Regional Storage Volume (m^3)	616,272	616,448	615,296
Total SWM Facility Capital Cost ($)	36,978,000	36,989,000	36,919,000
Total SWM Land Value ($)	92,448,000	92,472,000	92,304,000
Total Cost ($)	*129,426,000*	*129,461,000*	*129,223,000*

As anticipated, the results in Table 4.2 indicate a marginal variation in stormwater management facility costs among the three (3) land use alternatives, with Alternative 2 anticipated to yield the highest cost for end-of-pipe facilities (i.e. $129,461,000) and Alternative 3 yielding the lowest cost for end-of-pipe facilities (i.e. $129,223,000).

5.0 Hydraulic Structures Cost Estimates

Cost estimates have been prepared for the future hydraulic structures (bridges and culverts) for each land use alternative. These estimates have been prepared, considering only the hydraulic structures spanning the regulated watercourses, as presented on each land use alternative (ref. attached). In the absence of the detailed information from the Subwatershed Study, the required size of opening has been estimated, premised upon conveying the Regional Storm event peak flow rate through the opening, and calculated using the orifice equation (as opposed to detailed numerical modelling).

For this assessment, it has been assumed that the crossings would be open footing structures, with minimum spans to consider anticipated fluvial criteria based upon bankfull dimension and meander belt width; the structure rise has been sized to convey the Regional Storm event peak flow, as presented in Phase 1 of the Subwatershed Study, below the obvert/soffit of the structure. The estimated size of opening for the hydraulic structures under each alternative, as well as the associated conveyance capacity, are summarized in Table 5.1.

Table 5.1	**Preliminary Sizing of Hydraulic Structures for Cost Estimates**			
Crossing ID	**Replacement/New Structure**	**Height (m)**	**Span (m)**	**Design Regional Peak Flow Rate (m^3/s) (ref. Stantec, January 2019)**
Land Use Alternative 1				
1	Replacement	3.05	14.64	79.68
2	New	1.83	7.32	47.76
3	New	1.52	4.88	11.96
4	New	1.52	4.88	11.96
5	New	1.52	7.32	19.4
Land Use Alternative 2				
1	New	3.05	14.64	86.62
2	Replacement	3.05	14.64	79.68
3	New	1.83	7.32	47.76
5	New	1.52	4.88	11.96
4	New	1.52	4.88	11.96
6	New	1.52	7.32	19.4
Land Use Alternative 3				
1	New	3.05	14.64	86.62
2	Replacement	3.05	14.64	79.68
3	New	1.83	7.32	47.76
4	New	1.52	4.88	11.96
5	New	1.52	4.88	11.96
6	New	1.52	4.88	11.96
7	New	1.52	7.32	19.4
8	New	1.52	7.32	19.4
9	New	1.52	7.32	19.4

The estimated cost for the hydraulic structures has been calculated based upon the following assumptions:

- Conspan™ structures assumed to establish supply cost.
- Construction cost = 2 x supply cost
- Engineering and contingency = 25% of construction cost

The cost estimates for the hydraulic structures under each alternative is presented in Table 5.2.

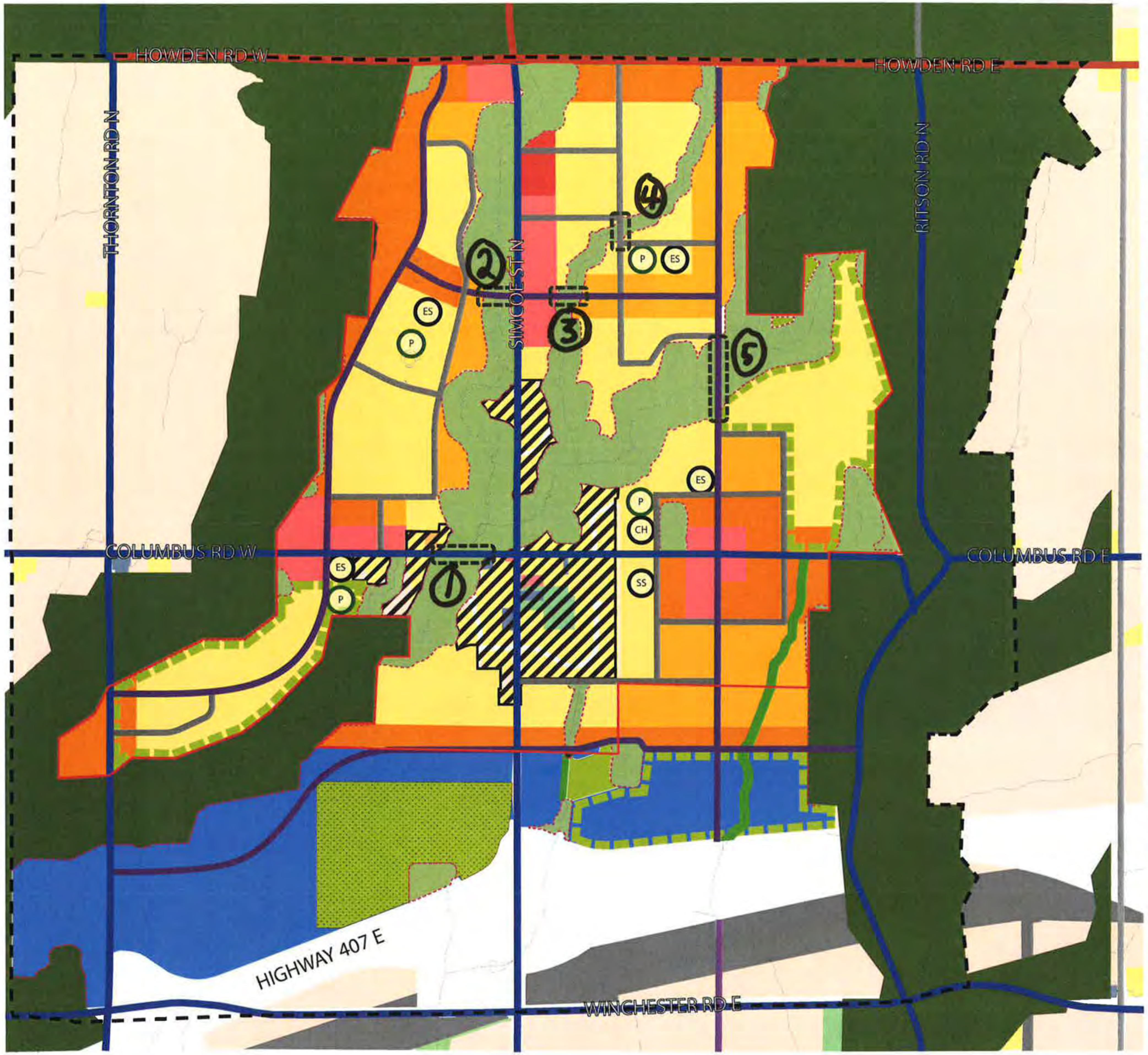
Table 5.2 Preliminary Cost Estimates of Hydraulic Structures for Each Land Use Alternative

Crossing ID	Deck Area (m^2)	Supply Cost ($)	Construction Cost ($)	Engineering and Contingency Cost ($)	Total Cost for Each Crossing ($)	Total Cost ($)
Land Use Alternative 1						
1	388.1	1,552,000	3,105,000	776,000	3,881,000	*10,975,000*
2	210.1	840,000	1,681,000	420,000	2,101,000	
3	144.6	578,000	1,157,000	289,000	1,446,000	
4	144.6	578,000	1,157,000	289,000	1,446,000	
5	210.1	840,000	1,681,000	420,000	2,101,000	
Land Use Alternative 2						
1	388.1	1,552,000	3,105,000	776,000	3,881,000	*14,856,000*
2	210.1	1,552,000	3,105,000	776,000	3,881,000	
3	144.6	840,000	1,681,000	420,000	2,101,000	
4	144.6	578,000	1,157,000	289,000	1,446,000	
5	210.1	578,000	1,157,000	289,000	1,446,000	
6	210.1	840,000	1,681,000	420,000	2,101,000	
Land Use Alternative 3						
1	388.1	1,552,000	3,105,000	776,000	3,881,000	*20,504,000*
2	388.1	1,552,000	3,105,000	776,000	3,881,000	
3	210.1	840,000	1,681,000	420,000	2,101,000	
4	144.6	578,000	1,157,000	289,000	1,446,000	
5	144.6	578,000	1,157,000	289,000	1,446,000	
6	144.6	578,000	1,157,000	289,000	1,446,000	
7	210.1	840,000	1,681,000	420,000	2,101,000	
8	210.1	840,000	1,681,000	420,000	2,101,000	
9	210.1	840,000	1,681,000	420,000	2,101,000	

As noted previously, the estimates provided in the foregoing are to be revised, pending the completion of the Impact Assessment and Management Strategy for the Columbus Subwatershed Study being completed by others.

We trust that the foregoing satisfies your current requirements. Feel free to contact us should you have any questions or require any clarification to the above.

PM/AF/pm/af
Attach.



City of Oshawa

Integrated Columbus Part II Planning Act & Municipal Class EA Study

Alternative 1

- Columbus Study Area Boundary
- Columbus Part II Plan Area
- Water Bodies
- Watercourse/Drainage Feature (C.S.W.S.)

Land Use

- Columbus Special Policy Area
- Low Density Residential
- Medium Density Residential I
- Medium Density Residential II
- High Density Residential I
- Mixed Use
- Prime Agricultural
- Employment
- Community Park Location Option
- ES Elementary School
- SS Secondary School
- P Park
- CH Community Hub

Road Network

- Existing Type A Arterial Road
- Existing Type B Arterial Road
- Existing Type C Arterial Road
- Proposed Type C Arterial Road
- Proposed Collector Road
- NHS Crossing

Natural Heritage System

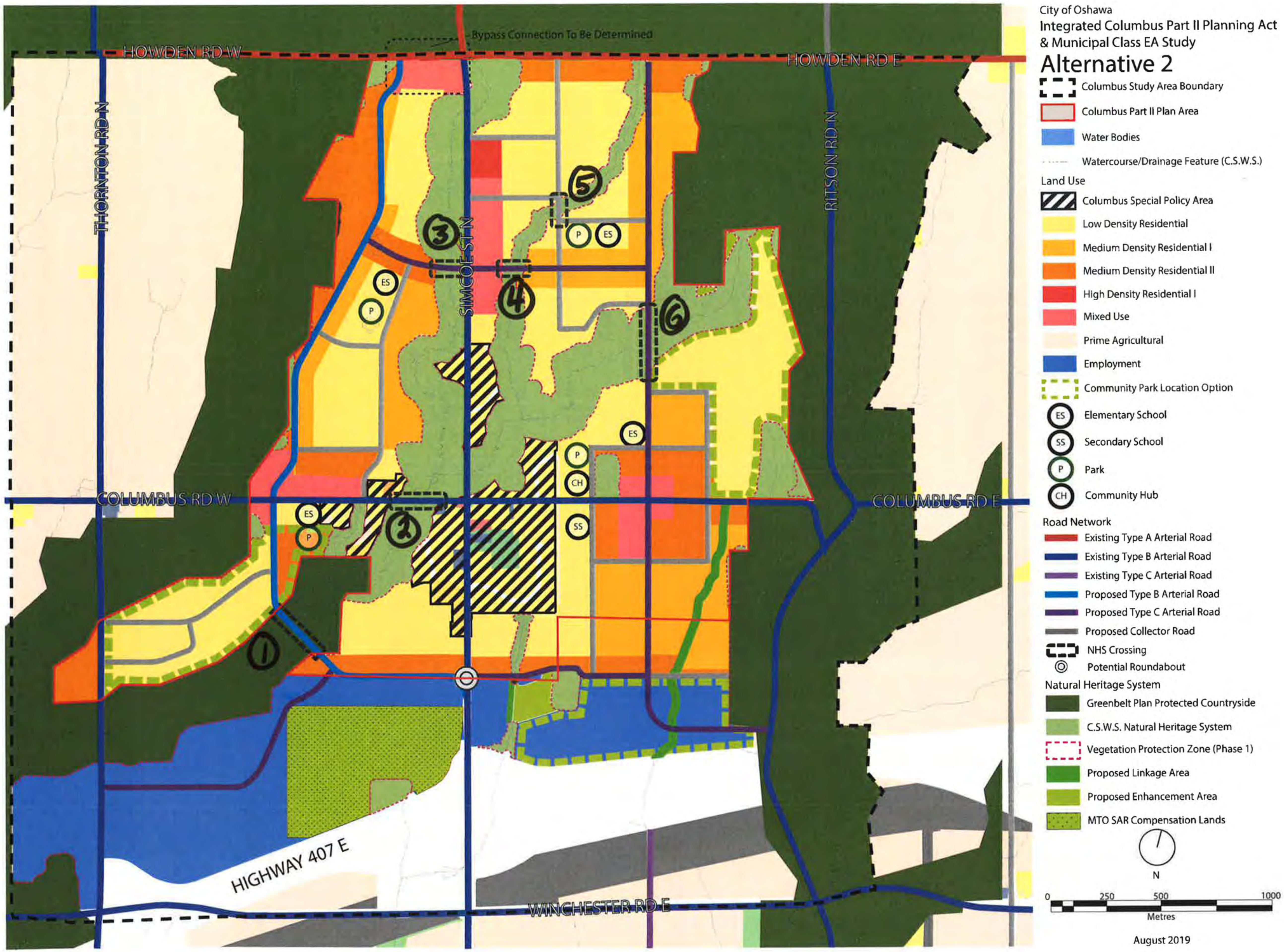
- Greenbelt Plan Protected Countryside
- C.S.W.S. Natural Heritage System
- Vegetation Protection Zone (Phase 1)
- Proposed Linkage Area
- Proposed Enhancement Area
- MTO SAR Compensation Lands

N

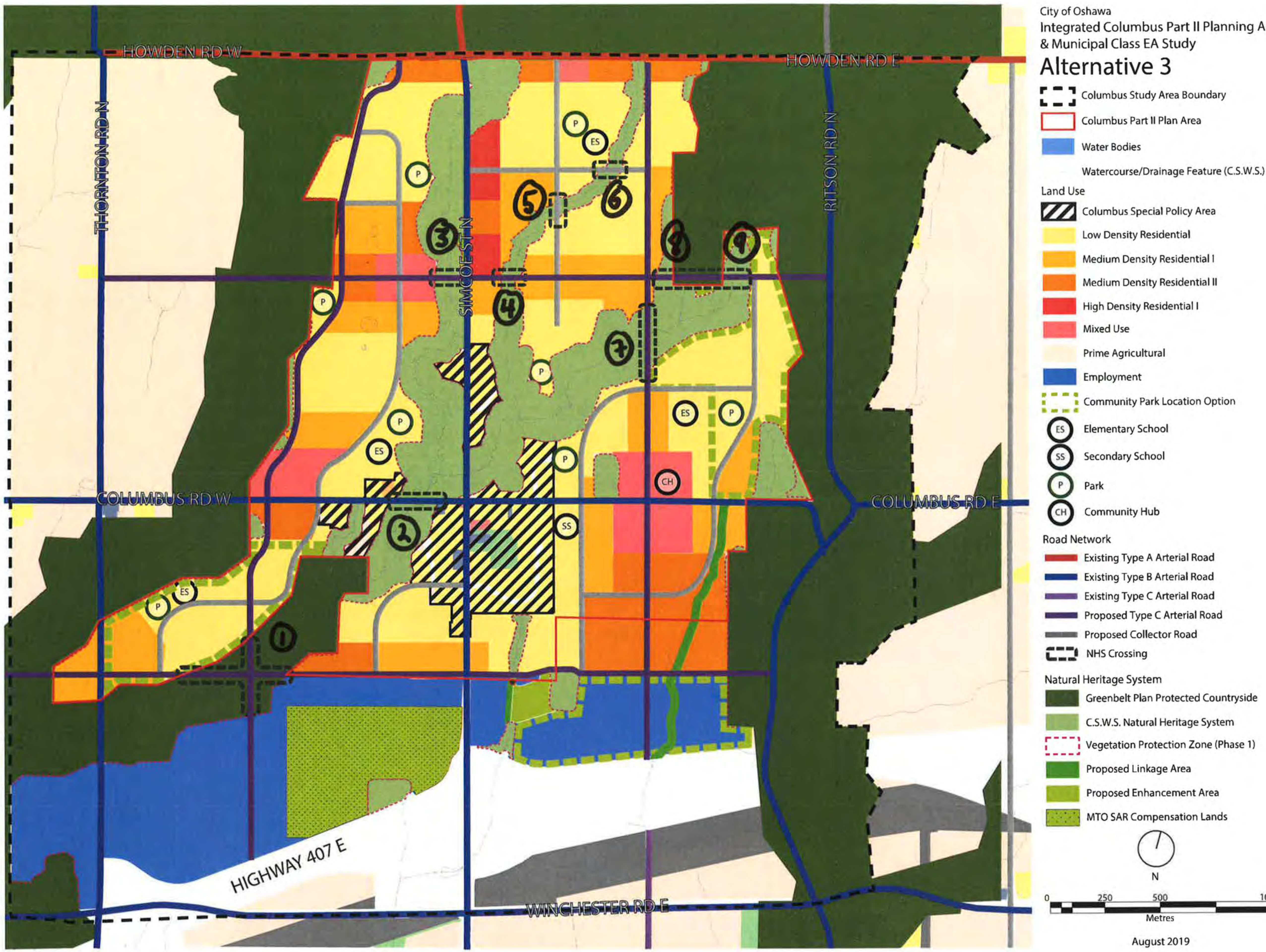
0 250 500 1000

Metres

August 2019



City of Oshawa
Integrated Columbus Part II Planning Act & Municipal Class EA Study
Alternative 2
Columbus Study Area Boundary
Columbus Part II Plan Area
Water Bodies
Watercourse/Drainage Feature (C.S.W.S.)
Land Use
Columbus Special Policy Area
Low Density Residential
Medium Density Residential I
Medium Density Residential II
High Density Residential I
Mixed Use
Prime Agricultural
Employment
Community Park Location Option
Elementary School
Secondary School
Park
Community Hub
Road Network
Existing Type A Arterial Road
Existing Type B Arterial Road
Existing Type C Arterial Road
Proposed Type B Arterial Road
Proposed Type C Arterial Road
Proposed Collector Road
NHS Crossing
Potential Roundabout
Natural Heritage System
Greenbelt Plan Protected Countryside
C.S.W.S. Natural Heritage System
Vegetation Protection Zone (Phase 1)
Proposed Linkage Area
Proposed Enhancement Area
MTO SAR Compensation Lands
N
0 250 500 1000
Metres
August 2019
Bypass Connection To Be Determined
HOWDEN RD W
HOWDEN RD E
THORNTON RD N
SIMCOE ST N
RITSON RD N
COLUMBUS RD W
COLUMBUS RD E
HIGHWAY 407 E
WINCHESTER RD E
ES
P
SS
CH
1
2
3
4
5
6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Vegetation Protection Zone (Phase 1)
Proposed Linkage Area
Proposed Enhancement Area
MTO SAR Compensation Lands
N
0
250
500
1000
Metres
August 2019
HOWDEN RD W
HOWDEN RD E
THORNTON RD N
SIMCOE ST N
RITSON RD N
COLUMBUS RD W
COLUMBUS RD E
HIGHWAY 407 E
WINCHESTER RD E