

CITY OF BRANTFORD
OFFICIAL PLAN
ENVISIONING OUR CITY: 2041

Envisioning Brantford - Municipal Comprehensive Review

Part 2: Settlement Area Boundary Expansion

DRAFT - December 2018

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EXECUTIVE SUMMARY

The City of Brantford started its Official Plan Review in 2013. To date, the City has hosted visioning sessions, prepared technical background papers and created a Draft Official Plan (Version 1, issued in July 2016). In 2016, the Official Plan Review process was put on hold while the Municipal Boundary Adjustment Agreement between the City and Brant County was finalized and pending updates to the Growth Plan for the Greater Golden Horseshoe. The lands transferred to the City are referred to, in this report, as the Boundary Adjustment Lands.

The City of Brantford's Official Plan Review process was resumed in 2017 and includes a Municipal Comprehensive Review (MCR) as input to the City's new Official Plan.

The MCR Part 1 Report identified an alternative intensification target for the delineated Built-up Area and an alternative Designated Greenfield Area (DGA) density target appropriate for the City of Brantford. That report also identified lands to convert from employment use, whether there was a need for a Settlement Area boundary expansion, and the extent of that need.

The purpose of this MCR Part 2 Report is to identify what part of the Boundary Adjustment Lands will be included in the Settlement Area boundary expansion to accommodate the identified need for additional urban lands. These additional urban lands will include both Community Areas and Employment Areas. Community Areas are lands used for a range of urban uses including residential, mixed-use, institutional, open space and commercial but do not include traditional industrial areas. Employment Areas are lands designated for clusters of businesses and economic activities including manufacturing, warehousing, offices and associated retail and ancillary uses.

Latter stages of the Official Plan Review process will determine the land uses within the Settlement Area boundary, as well as the transportation infrastructure, servicing infrastructure, environmental management and urban design guidelines necessary to implement the new urban land uses.

This report contains an extensive evaluation to determine the preferred lands for Community Area and Employment Area uses. The Boundary Adjustment Lands were delineated into 11 Expansion Blocks to accommodate the Community Area land need arising from the MCR Part 1 report and 7 Expansion Blocks to accommodate the Employment Area land need. Evaluation Principles and Criteria were developed for agricultural, archaeological, transportation, environmental, servicing, stormwater and land use components. The 11 Community Area and 7 Employment Area Expansion Blocks were evaluated based on these Principles and Criteria.

The detailed evaluation by discipline is contained in Appendix A, and the summary evaluation is contained in Tables 4.1 and 4.2. From the summary evaluation, certain Expansion Blocks were

preliminary selected as preferred on a preliminary basis. Further evaluation was conducted as summarized in Section 4 to assess the constraints identified for each Expansion Block and determine whether mitigation and phasing measures could be used to address any of the constraints.

The evaluation of the Community Area Expansion Blocks identified two potential Options for Settlement Area boundary expansion. Option 1 shown on **Figure 3** includes Expansion Blocks C2, C1, C7, C4, C5, C10, C11 and the west portion of Block C8 to meet the Community Area land needs requirement of 460 hectares. Option 2 shown on **Figure 4** includes Expansion Blocks C2, C1, C7, C4, C5, C11 and the southern portion of Block C6 to meet the land needs requirement of 460 hectares.

These two Options will be carried forward to the next stage of the study where detailed land uses, transportation networks and servicing options will be prepared and evaluated to determine the preferred Settlement Area boundary for the Community Area as well as the preferred land uses, transportation network and servicing solution.

The preferred Employment Area Expansion Blocks are shown on **Figures 3 and 4** and include Expansion Blocks E4, E7, E3, E5, E6 and the southern portions of Blocks E1 and E2 to meet the Employment Area land needs requirement of 336 hectares. The preferred land uses, transportation network and servicing solution for the Employment Area will also be determined in the next stage of the study.

1 INTRODUCTION

1.1 BACKGROUND

The City of Brantford started its Official Plan Review in 2013. Between 2013 and 2016, much work was accomplished, including the hosting of visioning sessions, the preparation of technical background papers and the creation of a new Draft Official Plan (Version 1, issued in July 2016). The Official Plan Review was put on hold while the Municipal Boundary Adjustment Agreement between the City of Brantford and County of Brant was being finalized and approved by the Province, and pending updates to the Growth Plan for the Greater Golden Horseshoe to which the new Official Plan must conform.

In 2016, the municipal boundary between the City of Brantford and the County of Brant was adjusted in order to secure additional lands in the City for future growth, effective January 1, 2017. These lands are known as the Boundary Adjustment Lands.

The boundary adjustment brought new lands into Brantford's municipal boundary. However, that does not automatically bring the lands into the City's urban area boundary, also referred to as a Settlement Area boundary. To bring additional lands into the City's Settlement Area boundary, the Province requires municipalities to conduct a Municipal Comprehensive Review (MCR) as input into their new or amended Official Plan. The MCR is to determine the extent that the Settlement Area boundary is to be expanded. Once that is done, the new or amended Official Plan can designate urban land uses within the expanded Settlement Area boundary.

The City is now embarking on a Municipal Comprehensive Review and revisions to the 2016 Draft Official Plan to include the Boundary Adjustment Lands. The City of Brantford has established an eight stage study process to complete the Municipal Comprehensive Review and finalize the new Official Plan – entitled Envisioning Brantford. To complete this work, the City has retained a consulting team led by SGL Planning & Design Inc., which includes The Planning Partnership, Cushman Wakefield, Hemson Consulting, AgPlan Limited, ASI (Archaeological Services Inc.), Ecosystem Recovery Inc., GM Blue Plan Engineering, Plan B Natural Heritage, and Dillon Consulting.

Stages 2 and 3 of the study, which are documented in the Envisioning Brantford - Municipal Comprehensive Review - Part 1 Report, identified appropriate intensification and Designated Greenfield Area (DGA) density targets, lands to convert from employment use, and whether there is a need for a Settlement Area boundary expansion and the extent of that need.

The MCR Part 1 Report identified a need for an additional 336 hectares of Employment Area lands and 460 hectares of Community Area lands beyond that currently located within the City's existing Settlement Area boundary to accommodate 2041 employment and population forecasts.

Stage 4 of the study, which is documented in this report, identifies what part of the Boundary Adjustment Lands should be included in the Settlement Area boundary to accommodate the identified need for additional urban lands.

The final stages of the study will determine the land uses within a preferred Settlement Area boundary, as well as the transportation infrastructure, servicing infrastructure, environmental management and urban design guidelines necessary to implement the new urban land uses. These matters will be addressed in subsequent reports.

1.2 REPORT PURPOSE

The purpose of this report is to document the evaluation of Settlement Area boundary Expansion Blocks to accommodate the Community Area land needs and the Employment Area land needs to 2041. The findings of Stage 2 and 3 of Envisioning Brantford, as set out in the Envisioning Brantford - Municipal Comprehensive Review - Part 1 Report, identified a need for 796 hectares of land to accommodate the 2041 population and employment forecasts. These forecasts identify both Employment Area land needs and Community Area land needs (i.e. residential, commercial, institutional and parkland).

This report addresses the Growth Plan requirements for settlement area boundary expansion as described in Section 1.3. Key outcomes and findings described in this report include:

- The Blocks to be evaluated for potential Settlement Area boundary expansion as set out in Section 2 of this report;
- The principles and Criteria used in the evaluation as listed in Section 2;
- The methodology used to evaluate the Expansion Blocks as described in Section 2;
- The evaluation conducted by each of the disciplines – agricultural, archaeology, environmental, transportation, servicing, stormwater and land use as described in Section 3; and
- The assessment of the constraints of each Block and recommendations for potential Settlement Area boundary expansion as set out in Section 4.

1.3 COMPONENTS OF THE MUNICIPAL COMPREHENSIVE REVIEW

This MCR Part 2 Report evaluates a series of options for Settlement Area boundary expansion to determine where the Settlement Area boundary expansion should occur.

The Growth Plan (2017) requires that where the need for a Settlement Area boundary expansion has been justified, the feasibility of the proposed expansion is to be determined and the most appropriate location for the proposed expansion identified based on the following:

a) There are existing or planned infrastructure and public service facilities to support the achievement of complete communities;

b) The infrastructure and public service facilities needed would be financially viable over the full life cycle of these assets, based on mechanisms such as asset management planning and revenue generation analyses;

c) The proposed expansion would align with a water and wastewater master plan or equivalent that has been completed in accordance with the policies in subsection 3.2.6 of the Growth Plan;

d) The proposed expansion would align with a stormwater master plan or equivalent that has been completed in accordance with the policies in subsection 3.2.7 of the Growth Plan;

e) Watershed planning or equivalent has demonstrated that the proposed expansion, including the associated servicing, would not negatively impact the water resource system, including the quality and quantity of water;

f) Key hydrologic areas and the Natural Heritage System should be avoided where possible;

g) For Settlement Areas that receive their water from or discharge their sewage to inland lakes, rivers, or groundwater, a completed environmental assessment for new or expanded services has identified how expanded water and wastewater treatment capacity would be addressed in a manner that is fiscally and environmentally sustainable;

h) Prime agricultural areas should be avoided where possible. An agricultural impact assessment will be used to determine the location of the expansion based on avoiding, minimizing and mitigating the impact on the Agricultural System and evaluating and prioritizing alternative locations across the upper- or single-tier municipality in accordance with the following:

   i. expansion into specialty crop areas is prohibited;

   ii. reasonable alternatives that avoid prime agricultural areas are evaluated; and

   iii. where prime agricultural areas cannot be avoided, lower priority agricultural lands are used;

i) The Settlement Area to be expanded is in compliance with the minimum distance separation formulae for development near agricultural livestock facilities;

j) Any adverse impacts on agricultural operations and on the agri-food network from expanding Settlement Areas would be avoided or, if avoidance is not possible, minimized and mitigated as determined through an agricultural impact assessment;

k) The policies of Sections 2 (Wise Use and Management of Resources) and 3 (Protecting Public Health and Safety) of the Provincial Policy Statement (PPS) are applied.

All of these matters are assessed in this report with further detail to be undertaken in Stage 6 during the Master Plan / Secondary Plan component of the study as the more detailed land uses are determined. The one exception is item g) which is assessed separately in Stage 5 of Envisioning Brantford.

2 BLOCKS, CRITERIA AND METHODOLOGY

2.1 SETTLEMENT AREA BOUNDARY EXPANSION BLOCKS

To evaluate where the Settlement Area boundary expansion should be located, the Boundary Adjustment Lands outside of the current Settlement Area boundary[1] were divided into 18 sub-areas using roads, natural features and property lines as boundaries for each sub-area as shown on **Figure 1**. For the purposes of this report, these sub-areas are referred to as Expansion Blocks. The potential Community Area Expansion Blocks total 708 hectares, and the potential Employment Area Expansion Blocks total 397 hectares exclusive of the Natural Heritage System. These areas are greater than what is required to accommodate both the 2041 population forecast (460 hectares) and 2041 employment forecast (336 hectares).

The amount of developable land within each employment and community Block is set out in **Table 1**.

Rather than delineating and evaluating one or two options for Settlement Area boundary expansion, the study team determined that it would be more appropriate to assess each Expansion Block and then determine which of the Expansion Blocks, and/or combination or grouping of Expansion Blocks, would be best able to meet the considerations for Settlement Area expansion as outlined in the Growth Plan.

The Municipal Boundary Adjustment Agreement between the City of Brantford and County of Brant identified part of the Boundary Adjustment Lands as "Trigger Lands". The residential component of the Trigger Lands is not to be redesignated for urban development until building permits have been issued for 80% of the dwellings in the non-Trigger lands section of the Boundary Adjustment Lands. As well, the employment component in the Trigger Lands are not to be redesignated until 80% of the employment lands in the non-Trigger Lands section of the Boundary Adjustment Lands are built upon. In keeping with the Municipal Boundary Adjustment Agreement, the Trigger Lands are the last priority for Settlement Area expansion. As not all of the non-Trigger Lands are required to accommodate the 2041 growth forecasts, the Trigger Lands will not be required to accommodate the 2041 forecasts and other than some minor adjustments are not included in the Block options.

The question may arise as to why all of the Boundary Adjustment Lands are not required to accommodate the 2041 forecasts when this was the position of the City during the boundary adjustment negotiations with the County of Brant. The difference lies largely with the new

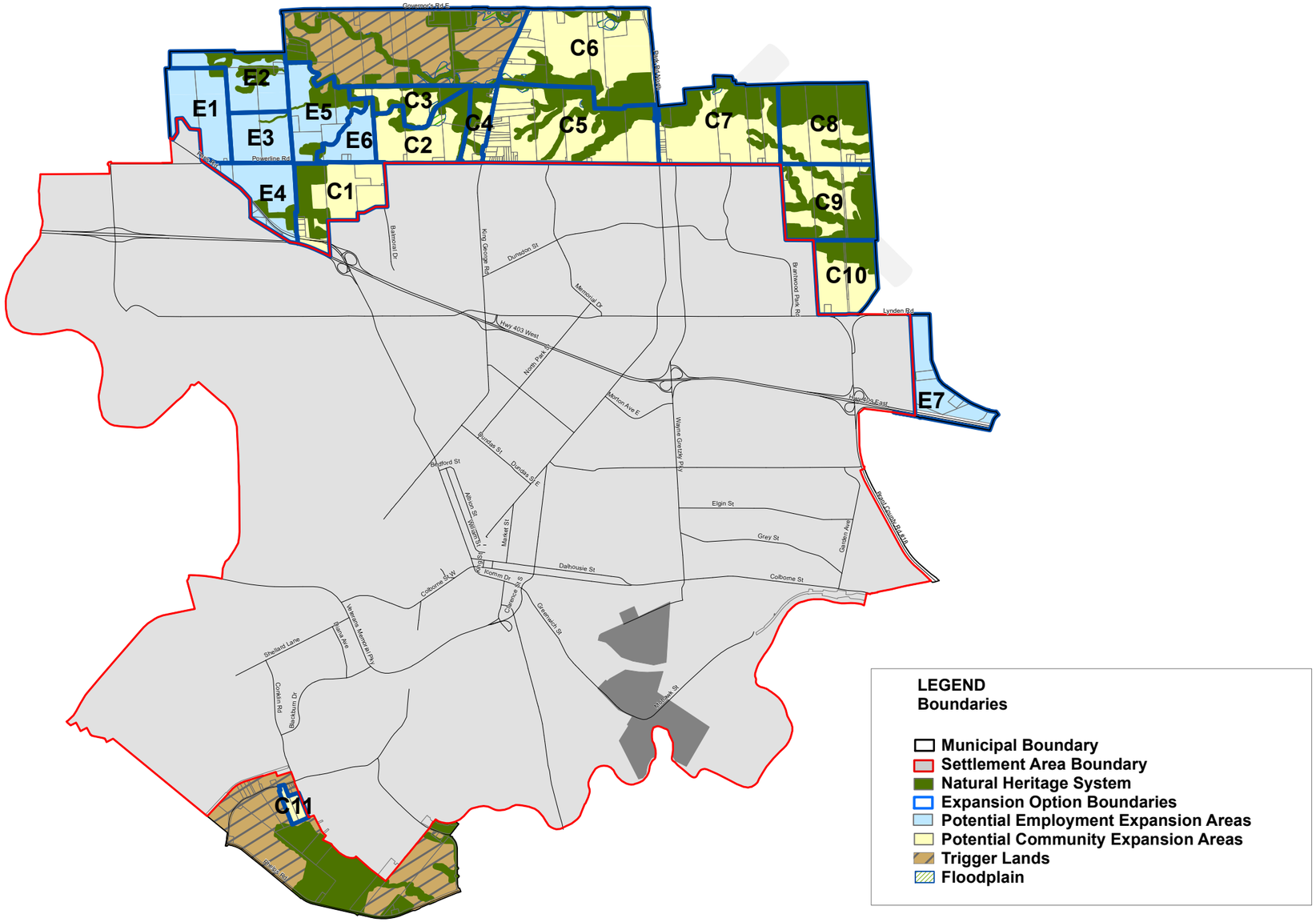
[1] *The current Settlement Area boundary includes the City's Settlement Area boundary prior to January 1st 2017 as well as the lands that were within a Settlement Area boundary in the County of Brant Official Plan on December 31st 2016 that were included in the Boundary Adjustment Lands.*

Growth Plan that came into effect on July 1 2017. The new Growth Plan requires the City to achieve a higher proportion of its development in the Built-up Area and a higher density of development on its new Designated Greenfield Areas. As a result of those new Provincial requirements, less land is needed to meet the 2041 growth targets than was anticipated during the City and County negotiations.

Table 1: Developable Land by Block Area

Block Area	Developable Land (ha)
Community Area Expansion Blocks	
C1	73.8
C2	57.6
C3	22.2
C4	15.2
C5	134.1
C6	149.9
C7	96.9
C8	51.0
C9	55.3
C10	51.6
C11	12.5
Total	**707.7**
Employment Area Expansion Blocks	
E1	80.2
E2	53.4
E3	54.1
E4	61.1
E5	57.0
E6	33.6
E7	57.4
Total	**396.8**

Figure 1: Potential Settlement Area Boundary Expansion - City of Brantford



2.2 EVALUATION PRINCIPLES AND CRITERIA

The evaluation of the Expansion Blocks was based on consistent assumptions. For the purpose of the evaluation, these assumptions included:

- All Community Area and Employment Area Expansion Blocks are considered to have the same residential and employment densities respectively[2];
- Parks and open spaces will form part of the Community Areas and will generally be distributed equally through the Expansion Blocks;
- Full municipal water, wastewater, and stormwater services will be extended to all new Expansion Blocks;
- Water and wastewater servicing will be provided by an extension of the City's existing water and wastewater system, and no new treatment plants will be constructed within the Expansion Blocks to service growth needs;
- All Expansion Blocks will be subject to meeting the minimum water, wastewater, and stormwater level of service objectives for both local infrastructure and trunk infrastructure needs; and
- Servicing of Expansion Blocks will not negatively impact existing serviced residents.

Principles and Criteria

The study team developed a series of Principles and Criteria to guide the evaluation of the 18 Expansion Blocks taking into account the matters to be assessed in the Growth Plan. The following sets out the Principles and Criteria by discipline:

Agriculture

***Principle A1**:*

- To identify the better versus the poorer agricultural areas within each Expansion Block and to retain those better areas in agriculture as long as possible.

Criteria:

- Soil potential/capability.
- Agricultural land use.
- Agricultural infrastructure.
- MDS implications.

[2] *The same density is assumed for the purposes of evaluating the Expansion Blocks, but in the Master Plan/Secondary Plan stage of the study, a range of land use designations with varying densities will be identified for the lands within Settlement Area expansion options.*

***Principle A2**:*

- To identify the better versus the poorer agricultural areas adjacent or near to the Expansion Blocks and to minimize impacts of non-agricultural uses proposed in the expansion area on the better agricultural areas identified.

Criteria:

- Soil potential/capability.
- Agricultural land use.
- Agricultural infrastructure.
- MDS implications.

***Principle A3**:*

- To avoid impacts on the agri-food network or if not possible, to minimize and mitigate impacts.

Criteria:

- Presence of agricultural services within the expansion area – i.e. distributors, veterinarians, farm supply, machinery repair, grain dryers, value added food processing etc.
- Impact on unique agricultural services.

Archaeology

***Principle B1**:*

- To protect and avoid archaeological resources and areas of potential for the presence of archaeological resources, and where avoidance is not possible, to assess and mitigate the archaeological resources.

Criteria:

- The number of known archaeological resources.
- The relative area of lands with archaeological potential to be affected.

Transportation

***Principle C1**:*

- To ensure appropriate access and connectivity to new Settlement Areas.

Criteria:

- Ease of connectivity to arterial corridors and Highway 403.
- Constraints to connectivity and access (e.g. physical features).

***Principle C2**:*

- To ensure appropriate transportation capacity is maintained.

Criteria:

- Ability of the existing/planned transportation, active transportation and transit capacity to accommodate new trips.
- Availability of opportunities to expand capacity if needed.

***Principle C3**:*

- To balance transportation needs and provide choice for the travel needs of residents.

Criteria:

- Ability to provide opportunities for potential new areas to connect with transit service and active transportation networks.

***Principle C4**:*

- To ensure transportation network continuity between existing and new areas.

Criteria:

- Degree of dependency of potential expansion areas to other adjacent urban areas (i.e. an isolated area with higher needs to service vs. areas with better synergies).

Environment

Principle D1:

- To protect, enhance and restore the Natural Heritage System (NHS) for the long-term along with existing linkage connections between the NHS and NHS features within the County of Brant and the existing Settlement Area.

Criteria:

- Ability to maintain the overall integrity and connectivity of the NHS including the minimum 30 m buffers.
- Ability to maintain connections to NHS features with the existing built up Settlement Area and adjacent rural lands (County of Brant).
- Ability to enhance the NHS through restoration of “adjacent lands” (in conjunction with compatible urban uses).
- Ability to reduce the fragmentation of the NHS and habitat loss through road and servicing crossings of valleylands, woodlands and watercourses.
- Ability to integrate major hedgerows, woodland lobes, and small, isolated woodlands/wetlands (plus 30 m buffers) that are identified as part of the NHS.

- Ability to offset the removal of NHS features and/or reduced buffers (e.g. hedgerows, woodland lobes, headwater drainage features, and small, isolated woodlands/wetlands) through restoration initiatives within or outside of the proposed urban areas.

Principle D2:

- To protect and enhance surface water quality/quantity including fish habitat.

Criteria:

- Ability to maintain wetland hydrology through groundwater recharge and surface water contributions.
- Ability to maintain and enhance coldwater fish habitat (e.g. Jones Creek) and other fish habitat features.

Principle D3:

- To protect significant wildlife habitat features and functions including the habitat of species-at-risk.

Criteria:

- Compatibility of land uses with significant wildlife habitat features and functions.
- Compatibility of land uses with the habitat of species-at-risk.

Principle D4:

- To protect stream channel and valleyland integrity, particularly in erosion prone systems.

Criteria:

- Ability to incorporate/integrate headwater drainage features as part of an overall Low Impact Development (LID) Stormwater Management (SWM) approach.
- Compatibility with erosion prone watercourses and valley systems.

Water / Wastewater

Principle E1:

- To efficiently use existing and planned infrastructure and to minimize the complexity of extending the existing water and wastewater system to the expansion areas.

Criteria:

- Need to cross existing natural heritage corridors to extend water and wastewater servicing.
- Ability to service area via existing networks vs. need to construct new pumping/other infrastructure.
- Need for localized sanitary pumping station and/or water pressure zones.

***Principle E2**:*

- To align future infrastructure with the Master Servicing Plan.

Criteria:

- Proximity and capacity of existing trunk networks.
- Scope of trunk network upgrades needed to support the growth area.
- Impacts on existing users and system level of service.
- Supports priority areas and servicing objectives identified in the Master Servicing Plan.

***Principle E3**:*

- To phase water and wastewater infrastructure logically and consecutively.

Criteria:

- Phasing impacts and dependency on adjacent Expansion Blocks to tie into existing water and wastewater systems.
- Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) Expansion Blocks.
- What are the alternative servicing options, if adjacent Expansion Blocks are not developed?
- Flexibility/impacts of post period servicing of remaining lands beyond the expanded Settlement Area.

***Principle E4**:*

- To ensure the infrastructure is financially viable over the full life-cycle and the preferred serving solution considers the best options when considering overall operational efficiency, operational resiliency to climate change and/or major component failure, operational and maintenance cost, existing renewal needs of the system, post period servicing, and greenhouse gas emissions.

Criteria:

- Local and trunk servicing capital cost within the Expansion Blocks.
- Existing trunk upgrade capital cost.
- Local and trunk life-cycle operation and maintenance costs.

<u>Stormwater</u>

***Principle F1**:*

- To avoid key hydrologic areas where possible when determining the most appropriate location for Settlement Area boundary expansion. Key hydrologic areas are defined as significant groundwater recharge areas (SGRAs), highly vulnerable aquifers (HVAs), and

significant surface water contribution areas that are necessary for the ecological and hydrologic integrity of a watershed.

Criteria:

- Presence of identified SGRAs and level of estimated recharge.
    - If SGRAs cannot be avoided, extensive infiltration practices will be required to maintain the pre-development water balance. Additional studies and long-term monitoring are more likely to be required.
- Presence of HVAs.
    - Areas designated as Highly Vulnerable Aquifers during Source Water Protection planning are likely to have activity and/or land use restrictions associated with the risk of contamination of groundwater supplies.
- Depth to groundwater table.
    - When groundwater table is at or near the ground surface, infiltration practices are constrained, and a site may need to be raised depending on development type. Storage ponds may also need to be raised to provide active storage above high groundwater level. However, groundwater table elevations exhibit large variations spatially and temporally and sufficiently detailed information is not available to use this criterion at this stage of evaluation.

Principle F2*:*

- To minimize the impact on the water resource system by minimizing the relative complexity needed to complete local stormwater servicing.

Criteria:

- Thermal regime of receiving watercourse.
    - Areas draining to receiving watercourses that are identified, or are likely to be identified, as having a coldwater thermal regime will likely require more extensive infiltrative practices and LID measures, a high degree of water quality improvement, and thermal impact mitigation design for end-of-pipe stormwater management facilities. Additional studies and long-term monitoring are more likely to be required.
- Upstream uncontrolled urban drainage area.
    - Areas which receive uncontrolled urban drainage under existing conditions may require larger facilities to control runoff from existing and new areas.
- Degree of sensitive of watercourses.
    - Watercourses that are identified as highly sensitive to hydromodification (a change in flow event frequency, duration, volume etc.) will require more comprehensive stormwater management controls than medium or low constraint watercourses.

- Degree of spatial constraint associated with watercourses within the potential Settlement Area (i.e. headwater features or other watercourses not currently identified as part of the natural heritage system).
    - A high drainage density (i.e., unit channel length per unit drainage area), may restrict developable area by requiring replication of hydrologic functions through LID measures (i.e., of low constraint watercourses).
    - An open channel corridor corresponding to the existing location of high constraint watercourses will need to be protected in the landscape. This may restrict developable area and may affect the layout of developable land.
    - An open channel corridor may need to be established to protect channel form and functions. The corridor may be relocated to accommodate development layout. The corridor provides an opportunity to manage channel processes and to mitigate effects of upstream and adjacent development. The corridor may affect developable area and development layout.

***Principle F3**:*

- To minimize the impact on the water resource system by evaluating the existing downstream system capacity.

Criteria:

- Presence and capacity of existing outlet.
    - Areas with no natural drainage outlet will require extensive LID and/or end-of-pipe infiltration practices. Areas where existing piped outlets have capacity constraints will require greater SWM controls and/or downstream upgrades to develop.
- Degree of hydromodification constraint / geomorphologic sensitivity of existing outlet.
    - Areas considered to be highly sensitive to hydromodification will require detailed study and more significant erosion control design, such as larger storage volumes for end-of-pipe facilities and/or more extensive LID measures. Long-term monitoring is more likely to be required.

***Principle F4**:*

- To phase stormwater management infrastructure logically and consecutively.

Criteria:

- Phasing impacts and dependency on adjacent Expansion Blocks to tie into existing stormwater systems.
- Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) Expansion Blocks.

- What are the alternative stormwater management options, if adjacent Expansion Block are not developed?
- Flexibility/impacts of post period servicing of remaining lands beyond the expanded Settlement Area.

Principle F5:

- To ensure that the stormwater infrastructure is financially viable by minimizing the total project life-cycle cost to service the Expansion Blocks.

Criteria:

- Local and trunk servicing capital cost within the Expansion Blocks.
- Existing trunk upgrade capital cost.
- Local and trunk life-cycle operation and maintenance costs.

Land Use

Principle G1:

- To ensure development occurs adjacent to existing built areas.

Criteria:

- Ability of the Expansion Blocks to develop consecutively to existing built areas.
- Ability of the Expansion Block to be integrated with adjacent existing neighbourhoods.

Principle G2:

- To create compact new urban areas with a mix of uses and densities.

Criteria:

- Ability to extend the intensification corridors from the built area into the Expansion Block.

Principle G3:

- To direct Employment Areas to locations in proximity to major goods movement facilities.

Criteria:

- Distance of the Expansion Block to Highway 403.
- Visibility of the Expansion Block to Highway 403.

2.3 METHODOLOGY AND DOCUMENTATION OF THE EVALUATION

For each Criterion, the Expansion Blocks were categorized as "very supportive of growth", "supportive of growth" and "constrained". Coloured circles denote the categorization with green representing "very supportive", yellow "supportive" and red "constrained". This categorization and the rationale for the categorization is provided in Appendix A. Table 1 in Appendix A contains the Community Area Block evaluation and Table 2 contains the Employment Area Block evaluation.

Simplified summary tables of the Appendix A tables, without noting the rationale for categorization, are contained in Chapter 3 in each discipline's evaluation.

For each Principle, the Expansion Blocks are ranked from Most Preferred (1) to Least Preferred (11) as shown in the last column in Appendix A and the simplified summary tables in Chapter 3.

Tables 4.1 and 4.2 summarizes the rankings for each principle and colour codes the ranks into three groups. For the Community Area Expansion Blocks, the groups are:

- Most preferred with a ranking of 1 to 3 are in green;
- Medium preferred with a ranking of 4 to 8 are orange; and
- Least preferred with a ranking of 9 to 11 are in red.

For the Employment Area Expansion Blocks, the groupings are slightly different as there were only 7 options:

- Most Preferred with a ranking of 1 to 2 are in green;
- Medium Preferred with a ranking of 3 to 5 are orange; and
- Least Preferred with a ranking of 6 to 7 are in red.

3 EVALUATION OF THE BLOCKS

3.1 AGRICULTURE

3.1.1 Introduction

The agricultural evaluation is intended to distinguish the better from the poorer agricultural lands and to rank the poorer lands as the preferred Expansion Block. Agricultural characteristics considered in the evaluation are a function of policies principally set out in the Provincial Policy Statement (PPS, 2014) as well as the Growth Plan for the Greater Golden Horseshoe (2017). This agricultural evaluation summarizes the agricultural data that will be gathered and analysed to:

i. characterize temporal and geographic trends in agriculture;

ii. provide context;

iii. evaluate impacts to agriculture; and

iv. recommend mitigation for agricultural impacts to the extent feasible.

Section 4.2.6 of the Growth Plan for the Greater Golden Horseshoe (2017) refers to the identification of an agricultural system for the Greater Golden Horseshoe. The system has been identified in the Province's map with the title "Agricultural Land Base" (February 7, 2018). The proposed Settlement Area boundary Expansion Blocks are all located within the prime agricultural area identified in the "Agricultural Land Base" map (See Appendix B, Map 1). Therefore, from the perspective of the Province's Agricultural Land Based mapping, all the proposed Settlement Area boundary Expansion Blocks are the same; that is, the provincial mapping does not differentiate amongst the Expansion Blocks. As such, this mapping did not factor into the comparative evaluation of blocks.

The report uses three phrases which are defined as follows:

- **Soil Capability Class** - This term is the one most often used in rating agricultural soils and is defined as part of the *Canada Land Inventory Soil Capability Classification for Agriculture* - Soil Capability for Common Field Crops. It is an interpretive classification of the soils maps produced within Canada where soils are identified by texture, drainage class, layers (diagnostic horizons) etc. following the Canadian System of Soil Classification (1978, third edition 1989 http://sis.agr.gc.ca/cansis/references/1998sc_a.html). The soil capability rating is a seven-class system consisting of a class number (1 (best) – 7 (poorest)) and a subclass limitation such as stoniness, slope, or erosion (represented by an alphabetic code P, T, E, etc.). The best soils with no limitations for production of common field crops are

ranked as class 1 and soils unsuitable for agriculture are rated as class 7. This information concerning capability classes and subclass limitations is provided as part of the relational database included with the soil mapping digitized by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and provided by LIO/MNR (Land Information Ontario/Ministry of Natural Resources).

- **Soil Productivity Index** - The original soil capability classification classes one through seven have been converted from an ordinal to a ratio scale on the basis of crop yields. For common field crops, such as grain corn, oats and barley, a relationship was measured to demonstrate that if class 1 land was assigned the soil productivity index value 1.00, then class 2 would be 0.80 and class 3 would be 0.64 etc. The use of the ratio scale allows for a mathematically acceptable measurement of mean value. Therefore, a given study area can have a single average value of a soil productivity index. When comparing different site alternatives, the use of the soil productivity index allows comparison of the alternatives using a single value. The use of the soil productivity index also provides a way to deal with soil complexes - where a soil complex is represented by a single polygon (in the past this was called a map unit) where there are two or more soil series/types present and mapped, and where there is some likelihood to be a combination of soil capability classes such as 60% class 1 and 40% class 2T, for example.

- **Soil Potential Index** - Like the aforementioned Soil Productivity Index, the Soil Potential Index provides an "average" (single value) soil potential for agricultural production for a given area when that area contains more than one soil potential rank or rating. The Soil Potential Index is based on ranks, which are part of an ordinal scale and provide a potential rating for the production of fruit and vegetable crops.

Additional information associated with these definitions is described in Appendix B, Part 3. Definitions associated with words or phrases related to agricultural policy in Ontario are summarized in Appendix B, Part 5.

3.1.2 Methodology for Evaluation

The findings described in the following section are based on published literature, fieldwork, and aerial photo interpretation. Much of the information relates to the use of statistics and mapping from Agriculture and Agri-Food Canada (AAFC), Statistics Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and is subject to the limitations of the surveys completed by these government groups. All the data collected is presented in maps summarized in Appendix B, Part 1. More specifically, data sources are as follows:

i. soil capability is derived from Land Information Ontario (LIO) mapping and relational databases originally prepared by OMAFRA;

ii. soil capability data was converted to soil productivity indices following Hoffman (1971, 1973);

iii. soil potential is derived from LIO mapping interpreted into soil potential classes following Acton (1989);

iv. agricultural land use is based on AAFC maps modified given findings provided by field reconnaissance and aerial photo interpretation; and

v. farm infrastructure is based on field reconnaissance and aerial photo interpretation.

The mapped data was used to provide area or number measurements for each of the Community Area and Employment Area Expansion Blocks shown on maps in Appendix B, Part 1. The numerical data was then combined to provide a preference rank for each Expansion Block.

There are several different methods available to rank agricultural areas given provincial agricultural policy. In all cases, more than one agricultural attribute is used to differentiate the better from the poorer agricultural lands so as to designate the better lands as prime.

Hence, all agricultural land evaluation related to the PPS and the Growth Plan must be multi-attribute analysis. Any multi-attribute analysis may have different results based on:

- the number and kind of variables considered;
- the scale and therefore precision at which the agricultural information is available;
- the accuracy of the information;
- the analysis method;
- the weights applied to the variables;
- whether the data was standardized; and
- whether all of the data was presented consistently to mean that a high number is intended to indicate a high importance value.

A review of the literature did not present information suggesting that a single multi-attribute analysis method is the "best" method. Even the wording employed for the quantitative methods used to combine information varies. The University of Redlands and the Spatial Decision Support Consortium (2012) have prepared a summary of the language and definitions associated with Multi-Criteria Decision Analysis (MCDA). Some of the work described by the University of Redlands is based on work by Malczewski (2006). Multi-attribute Combination Methods is a subset of MCDA having subcategories of Analytical Hierarchy Process, Concordance Methods, Fuzzy Aggregation Operation, Ideal/Reference Point Method, Value/Utility Function Method and Weighted Linear Combination. Therefore, there is a need to consider more than one agricultural metric and more than one analysis method when evaluating agricultural land.

The Ontario Ministry of Agriculture, Food and Rural Affairs suggests using a Land Evaluation and Area Review (LEAR) method to evaluate agricultural lands. A LEAR analysis fits in to the subcategory of Weighted Linear Combination which is described on the Redlands website as "the most often used technique for tackling spatial multi-attribute decision making".

The LEAR analysis is linear and other methods available to differentiate the better from the poorer agricultural lands can be used to emphasize differences by squaring those differences - thus, looking at differences based on an exponential relationship. A cluster analysis is based on a sum of squares technique and has been used to measure similarity/dissimilarity. Alternatively, Massam (1993) has used Concordance to complete spatial analyses rating different land areas. Concordance is an additive method which emphasizes the weights assigned to variables more so than the actual range of numerical difference when comparing those variables.

Regardless, there are several decisions that must be made when evaluating agricultural land given the guidance provided by the PPS and these decisions include, but are not limited to the:

- multi-attribute analysis method(s);
- agricultural indicators/variables used in the analysis;
- evaluation unit size;
- weighting/importance rating; and
- point at which differences are sufficient to place preference ranks on different Expansion Blocks.

The agricultural multi-attribute analyses done for this study include:

- weighted linear combination;
- cluster analysis using Ward's method;
- concordance; and
- opinion based on fieldwork, aerial photography and the geographic location related to soil capability, soil potential, agricultural land use, and agricultural/farm infrastructure.

Descriptive as well as numerical results, presented in Appendix B, Part 2 within this report, are combined using unit weight within the "weighted linear combination" method such as the LEAR described by OMAFRA. The Multi-Attribute Analysis or Multi-Criteria Decision Analysis used two different weightings:

i. the same weight for every criterion or "unit" weight; and
ii. weighting as summarized in Table 3.1.

Table 3.1: Agricultural Principles and Criterion			
PRINCIPLES		**CRITERIA**	**WEIGHTING**
Principle 1	Identify the better versus the poorer agricultural areas within each Block and to retain those better Block areas as long as possible	Block Area Average Soil Productivity Index	30
		Soil Potential Block Area Standardized value given 1=1.00 & 7=0	10
		Active Agriculture Proportion of Block Area	20
		Greenhouse, Fruit and Vegetable Proportion of Block Area	6
		Agricultural Infrastructure Proportionate to Block Area	5
		MDS Implications Proportionate to Block Area	10
Principle 2	Identify the better versus the poorer agricultural areas adjacent or near to the Blocks and to minimize impacts of non-agricultural uses	Average Block Area Soil Productivity Index	10
		Soil Potential Block Area Standardized value given 1=1.00 & 7=0	2
		Active Agriculture Proportion of Block Area	5
Principle 3	Avoid impacts on the agri-food network or if not possible, to minimize and mitigate impacts	1) Presence of agricultural services within the expansion area (i.e. distributors, veterinarians, farm supply, machinery repair, grain dryers, value added food processing etc.)	1
		2) Impact on unique agricultural services	1
		Total	100

No Weighting (each criterion has unit (1) weight)

All the Criteria were measured proportionately to area because the Community Area and Employment Area Expansion Blocks are of different sizes. The measurements obtained from the mapping, which is shown in Appendix B, Part 2, were converted (scaled or standardized) into 3 classes of "very supportive of growth", "supportive of growth" and "constrained" as represented graphically by:

High (red dot) means high agricultural value and is therefore "constrained", and low (green dot) means low agricultural value and is "very supportive" of non-agricultural development.

The quantitative data was scaled mathematically into three values where "3", for example, means high agricultural value and is least preferred as a development Block, by using the equation:

f(x)=((b-a)(x-Min)/Max-Min))+a, where

f(x)= the rescaled value for a given Block and criterion,

a= the lowest rescaled value (1),

b= the highest rescaled value (3),

x= the original value for a given Block and criterion,

Min= the lowest/minimum value for all Blocks within one criterion, and,

Max= the highest/maximum value for all Blocks within the same one criterion.

The rescaled values were subsequently added to provide a single total score for each Principle and for each Expansion Block. The total scores were then rescaled using the same equation outlined above to provide a rank out of 11 for each Community Area Expansion Block and out of 7 for each Employment Area Expansion Block where the most preferred Expansion Block was "1" and the least preferred from an agricultural perspective "11" or "7" (Community Area versus Employment Area, respectively).

3.1.3 Evaluation Findings

An overview of the agricultural mapping found in Appendix B, Part 1 provides the following general observations:

- the better lands, that is lands with the capability class 1, 2 and 3 for common field crop production, tend to be found in the northwest area of the Settlement Area boundary Expansion Blocks and in the areas adjacent to them;
- the better lands for soil potential for fruit and vegetable production tend to be found in the same northwest area identified by soil capability;
- the majority of lands within the Settlement Area boundary Expansion Blocks and adjacent to them are in active agricultural use;
- two relatively small areas of fruit and vegetable and/or greenhouse production are found in the north central to the northwest - with the fruit and vegetable production present within Expansion Block C7;
- farm infrastructure is present for all Expansion Blocks except for the one in the south (Expansion Block C11);
- farm infrastructure that is more likely to cause MDS conflict tend to be found to the north along Governors Road; and
- unique infrastructure such as seed suppliers, heavy animal veterinarians and/or machinery dealers are not found within the Expansion Blocks or adjacent to those Blocks.

The various Employment Area and Community Area Expansion Options were evaluated in Appendix A as follows:

- 'Very Supportive of Growth',
- 'Supportive of Growth', and
- 'Constrained'.

A numerical system was used to rank the Expansion Options. The detailed results of the evaluation for each Expansion Option based on the Agricultural Principles and Criteria are provided in Appendix A. The following Tables 3.2 and 3.3 and the text below summarize the results of the detailed evaluation in Appendix A.

Table 3.2: Agriculture - Summary Community Area Evaluation

Principle	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	10	3	6	2	9	6	11	6	3	3	1
A2	10	7	11	6	1	2	4	9	7	5	2
A3	1	1	1	1	1	1	11	1	1	1	1

Table 3.3: Agriculture - Summary Employment Area Evaluation

Principle	E1	E2	E3	E4	E5	E6	E7
A1	6	4	6	3	2	1	4
A2	7	4	5	5	1	2	2
A3	1	1	1	1	1	1	1

For the Community Area Expansion Blocks, Expansion Block C11 is most preferred and Expansion Block C7 is least preferred. For the Employment Area Expansion Blocks, E5 and E6 are most preferred with Expansion Blocks E1 and E3 being least preferred. However, all Blocks have negative agricultural impacts because they will remove prime agricultural land from production.

The use of different Multiple Criteria Decision Analysis methods tends to show that individual preference ranks for each of the Expansion Blocks change with the method and weighting used. What is constant amongst the methods is the most preferred and the least preferred Expansion Blocks. Those Community Area and Employment Area Expansion Blocks in the middle or bracketed by the most and least preferred tend to change rank. Therefore, the differences amongst the Expansion Blocks are insufficiently great to allow for a ranking into no more than 3 groups - most preferred, moderately preferred, and least preferred.

3.2 ARCHAEOLOGY

3.2.1 Introduction

A preliminary summary of archaeological studies and resources was conducted to determine whether there are known resources/sites within the Settlement Area boundary Expansion Blocks and/or if archaeological resources may be present and require further studies and excavation. The identification of known archaeological resources and studies intend to provide context for the evaluation and identification of preferred Expansion Blocks. The following section provides a description of the methodology used to evaluate the archaeological Principle and provide analysis on the findings.

3.2.2 Methodology for Evaluation

The various Employment Area and Community Area Expansion Blocks were evaluated according to the following Principle:

- Principle B1: Protect and avoid archaeological resources and areas of potential for the presence of archaeological resources, and where avoidance is not possible, assess and mitigate the archaeological resources.

The evaluation of the various Expansion Blocks proceeded on the basis of determining the number of archaeological sites within each Expansion Block that have been registered in the Ontario Archaeological Site Database maintained by the Ministry of Tourism, Culture and Sport, and then calculating the relative proportion of lands within each Expansion Block area that demonstrate archaeological potential (excluding the Natural Heritage System lands).

Registered sites were further classified according to those identified to be of cultural heritage value or interest (CHVI) and those that are not considered to have CHVI.

Archaeological potential was identified on the basis of an application of select general criteria derived from the approaches utilized previously in the development of the archaeological potential model for the City of Brantford Archaeological Management Plan.

In cases where it was determined that all, or some portion, of an Expansion Block already has been subject to archaeological assessment; the findings have been accepted by the Ministry of Tourism, Culture and Sport; and the relevant reports were accessible, these data were reviewed to identify the extent of survey coverage, the character and CHVI of any sites documented, and whether or not the sites with CHVI had been mitigated through salvage excavation. Where it has been determined that areas have been assessed and cleared of concern, they have been removed from the calculations of the relative areas of archaeological potential. Where sites with CHVI have been mitigated through salvage excavation (documentation and removal), they have also been removed from further consideration in the evaluations.

The objective of the process, as outlined above, was to evaluate each of the Expansion Blocks, and make comparisons between them on a quantitative basis. However, given the considerable differences in past survey coverage and archaeological site documentation from one Expansion Block to the next, along with gaps in data availability, not all Blocks proved to be directly comparable in this manner, necessitating a qualitative weighting of criteria in certain instances.

The evaluation rated the Blocks as "very supportive of growth", "supportive of growth" or "constrained" based on two Criteria as illustrated in Table 3.4. The colours in Table 3.4 were used in Appendix A to delineate the scoring.

Table 3.4 Archaeological Evaluation Ranking

	Very Supportive of Growth	Supportive of Growth	Constrained
Criterion 1	no registered archaeological sites in Block or sites have been removed	0-3 unmitigated archaeological sites in Block or NHS area	More than 3 unmitigated sites in Block or NHS area
Criterion 2	0-30% of the Block falls within an area of archaeological potential	31-69% of the Block falls within an area of archaeological potential	70% or more of the Block falls within an area of archaeological potential

3.2.3 Evaluation Findings

In order to evaluate the Expansion Blocks, the team identified registered archaeological sites within the Expansion Block areas. Eighteen sites were found and can be seen in Table 3.5 below.

Table 3.5 – Archaeological Findings

Expansion Block	Borden #	Site Name	Cultural Affiliation	Site Type	Development Context	Researcher / Consultant
C5	AhHb-64	Luciani 1	Pre-contact	Campsite	No Further CHVI	Timmins Martelle Heritage Consultants Inc.
C5	AhHb-65	Luciani 2	Pre-contact	Campsite	No Further CHVI	Timmins Martelle Heritage Consultants Inc.
E7	AhHb-120	Hopewell B	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
E7	AhHb-121	Hopewell C	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
E7	AhHb-122	Hopewell D	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
E7	AhHb-124	Hopewell F	Early Archaic	Lithic Scatter	Further CHVI	AMICK Consultants Limited
E7	AhHb-126	Hopewell H	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
E7	AhHb-138	----	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
C10	AhHb-144	Innes-Welton B	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
C10	AhHb-145	Innes-Welton C	Middle Archaic	Lithic Scatter	Further CHVI	AMICK Consultants Limited
C10	AhHb-146	Innes-Welton D	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
C10	AhHb-147	Innes-Welton E	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
C10	AhHb-148	Innes-Welton F	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
C10	AhHb-152	Innes-Welton J	Pre-contact	Lithic Scatter	Further CHVI	AMICK Consultants Limited
C1	AhHb-214	Virgoan Site 1	Late Archaic	Lithic Scatter	No Further CHVI	This Land Archaeology Inc.
C1	AhHb-215	Virgoan Site 2	Late Archaic	Lithic Scatter	No Further CHVI	This Land Archaeology Inc.
C1	AhHb-216	Virgoan Site 3	Late Archaic	Lithic Scatter	No Further CHVI	This Land Archaeology Inc.
C1	AhHb-217	Virgoan Site 4	Late Archaic	Lithic Scatter	No Further CHVI	This Land Archaeology Inc.

In addition to these sites, the following reports were also identified and have influenced the evaluation of the Expansion Blocks. These reports include:

AMICK Consultants Limited

C10 2007 Report on the 2006 Stage 1-2 Archaeological Assessment of the Proposed Innes and Welton Subdivision, Part of Lot 42, Concession 2, City of Brantford, Brant County. On file with the Ministry of Tourism, Culture and Sport.

E7 2017 Stage 1-3 Archaeological Investigation of the Proposed Subdivision Development Southeast of Lynden Road and Garden Avenue, Part of Lots 43 and 44, Concession 3, City of Brantford, Brant County. On file with the Ministry of Tourism, Culture and Sport.

This Land Archaeology Inc.

C1 2014 Revised Report on the 2007 to 2011 Stage 1 to 3 Archaeological Assessment of Virgoan Properties Ltd., Bieldy Knowles Farms Ltd., and John and Sandra Martin Properties, Brantford, Ontario. On file with the Ministry of Tourism, Culture and Sport.

Timmins Martelle Heritage Consultants Inc.

C5 2007 Stage 3 Archaeological Assessment, Luciani 1, AhHb-64, Northway Ford Lincoln 388 & 396 King George Road, Brantford Township, Brant County, Ontario, Municipal File# SP19/06. On file with the Ministry of Tourism, Culture and Sport.

These eighteen sites were further contextualized against the relative area of archaeological potential within the Expansion Blocks, guided by the criteria within the City of Brantford Archaeological Management Plan. Finally, previous archaeological assessments that have been conducted within the Expansion Blocks were evaluated in order to test the efficacy of the archaeological potential layer and to remove any areas that have been assessed and cleared of further concern. The final result of this evaluation can be seen in **Figure 2**.

From this analysis, several conclusions can be made:

- Other than those archaeological sites which have been identified within the Natural Heritage System, all archaeological sites within the Expansion Blocks were identified as being in an area of archaeological potential – suggesting a good fit of the model;
- It can be assumed that any portions of the Expansion Blocks that fall within this area of generalized archaeological potential, and have not been subject to previous archaeological assessment, exhibit a strong probability for containing archaeological resources; and
- Archaeological resources that are identified during the assessment of these Expansion Blocks should not pose a significant impediment to development, providing that archaeological assessment is conducted prior to any development activities, consistent with Ministry of Tourism, Culture and Sport's *Standards and Guidelines for Consultant Archaeologists.*

The various Employment Area and Community Area Expansion Options were evaluated in Appendix A as follows:

- 'Very Supportive of Growth',
- 'Supportive of Growth', and
- 'Constrained'.

A numerical system was used to rank the Expansion Options. The detailed results of the evaluation for each Expansion Option based on the Archaeological Principle and Criteria are provided in Appendix A. The following Tables 3.6 and 3.7 and the text below summarize the results of the detailed evaluation based on the single Archaeology Principle.

Table 3.6: Archaeology - Summary Community Area Evaluation

Principles	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
B1	1	2	7	8	5	2	2	6	8	10	11

Table 3.7: Archaeology - Summary Employment Area Evaluation

Principles	E1	E2	E3	E4	E5	E6	E7
B1	2	4	3	1	5	6	7

Community Area Expansion Blocks C1, C2, C6, and C7 were categorized as the most preferred of the eleven areas that were evaluated. No archaeological sites have been registered within any of these Expansion Blocks and each of the Expansion Blocks were categorized as either "very supportive of growth" or "supportive of growth". Community Area Block C3, C4, C5, and C8 ranked between 5 and 8 in the evaluation, either due to the presence of a registered archaeological site in the Expansion Blocks or being classified as "constrained" due to the relative proportion of the Expansion Blocks to fall in the area of archaeological potential. Finally, Community Area Expansion Blocks C9, C10, and C11 ranked between 9 and 11 due to the presence of archaeological sites with CHVI and having 70% or more of the Expansion Blocks within the area of archaeological potential. While Expansion Block C11 does not contain any known archaeological sites, this is likely due to the fact than an archaeological assessment has not been conducted in the Expansion Block. This portion of the City has shown, through previous assessments, to be a particularly rich area in terms of archaeological resources, with 109 of the 159 sites within the dataset within 500 m of Expansion Block C11.

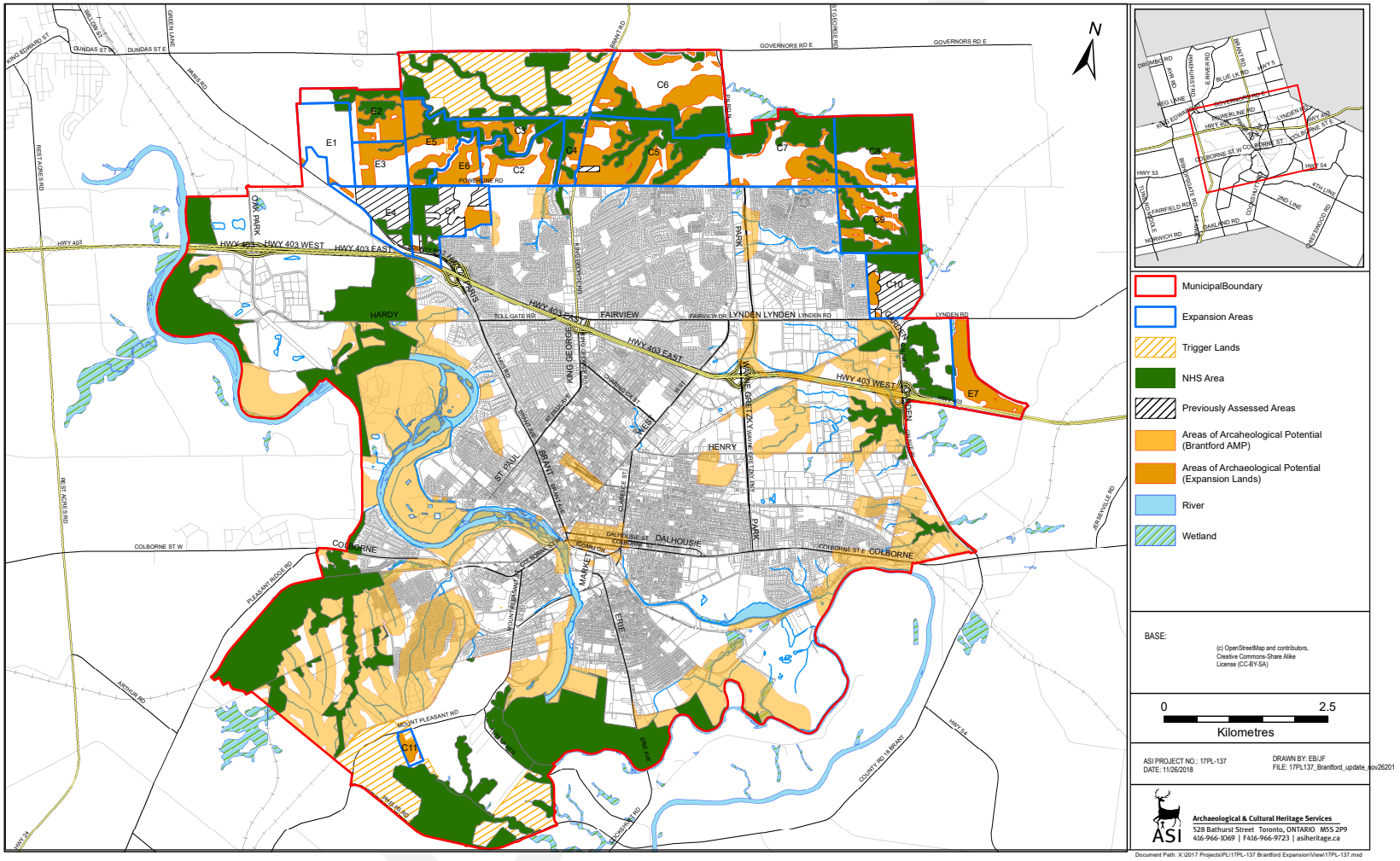
For the Employment Area Expansion Blocks, Blocks E1 and E4 scored the highest of the seven Blocks that were evaluated. Each of these Expansion Blocks were evaluated as "very supportive of growth" in both Criteria with no archaeological resources identified on the property and less than 30% of the Expansion Blocks lands within an area of archaeological potential. For Expansion Block E4, 96% of the Block's area has been subject to previous archaeological assessment. Expansion Blocks E2 and E3 received a rank of 4 and 3, respectively, due to the higher proportion of the lands within an area of archaeological potential. Expansion Blocks E5 and E6 were given the rank of 5 and 6, respectively, due to the fact that more than 70% of the areas were identified as having archaeological potential.

Finally, Expansion Block E7 was given the lowest ranking due to the fact that 97% of the Block was identified as having archaeological potential as well as the presence of six registered

archaeological sites. However, while these sites were registered as part of an archaeological assessment of the adjacent lands, the fact that sites are registered on the E7 Expansion Block suggests that the western portion of the area has been subject to an archaeological assessment. This report was not accessible and all attempts to retrieve it were unsuccessful. Therefore, while this report may change the relative proportion of the land, which falls in an area of archaeological potential, the high number of unmitigated archaeological sites within the Block suggests that development may be constrained until further analysis of these sites can be conducted.

Ultimately, the determination of the archaeological potential of a property only assesses the likelihood of recovering archaeological resources within a given area but does not indicate the degree of mitigation that may be required prior to development. In this sense, only in those areas which have been subject to previous archaeological assessment and cleared of further concern can the potential costs to developers be determined. This includes Expansion Blocks C1, C5 and C10, as well as Block E4. Following this grouping, the best indication of the degree of potential mitigation required within a given Expansion Block is the relative area of lands with archaeological potential.

Figure 2: Archaeology Evaluation – Areas of Archaeological Potential



3.3 TRANSPORTATION

3.3.1 Introduction

This section provides a summary of the ability of Brantford's existing and future planned transportation capacity to support growth within the identified Boundary Adjustment Lands. It is a high level review, intended only to support the further evaluation and identification of Settlement Area boundary expansion area potential.

This summary is intended to provide high-level evaluation of the road capacity, land access, transit service, active mode connections, and basic ability to accommodate increased travel demands within each of the Expansion Blocks. This review is not intended to capture specific or general capital upgrades and/or operational improvement requirements of the transportation system.

The following sections present a description of the methodology used to evaluate the Settlement Area boundary Expansion Blocks, the Criteria used to evaluate the Settlement Area boundary Expansion Blocks, and a brief overview of the evaluation results.

3.3.2 Methodology for Evaluation

Each Expansion Block was evaluated based on the following Principles:

Principle C1: To ensure appropriate access and connectivity to new urban areas.
Land access was evaluated to ensure there is appropriate access and connectivity to new urban areas. This evaluation looked at the ease of connectivity to arterial corridors and Highway 403. The evaluation also identified the number of accesses that would be required and that could be facilitated, as well as the ability to provide good access and frontage on arterials. The evaluation also considered constraints to connectivity and access (e.g. physical features, parcel shapes) and the impact that physical constraints place on the collector road framework.

Principle C2: To ensure appropriate transportation capacity is maintained.
Roadway capacity was assessed to ensure appropriate transportation capacity is maintained. The evaluation analyzed the ability of the existing/planned transportation and transit capacity to accommodate new trips and whether there were existing constraints to capacity or planned expansion for the corridors. The Expansion Blocks were also evaluated in regards to the availability of opportunities to expand capacity if needed.

Principle C3: To balance transportation needs and provide choice for the travel needs of residents.
Travel needs were evaluated to ensure that transportation needs were balanced and that residents were provided choice for their travel needs. The evaluation identified whether there

were opportunities for the Expansion Blocks to connect with transit service and whether transit service extension to the Expansion Block was logical. The Expansion Blocks were also evaluated in regards to active transportation, and whether the Expansion Block was able to connect to existing networks. The evaluation considered whether the Expansion Block would utilize active transportation for recreational or utilitarian purposes.

Principle C4: To ensure transportation network continuity between existing and new areas. Network continuity was evaluated to ensure transportation network continuity was provided between existing and new areas. The evaluation also analyzed the Expansion Block's degree of dependency on other adjacent urban areas (i.e. whether it was an isolated area with higher needs to service vs. areas with better synergies). The Expansion Blocks were assessed on their ability to connect infrastructure across parcel boundaries and whether the Expansion Block could support and/or benefit from adjacent properties.

For each Principle and Criteria, areas were scored based on the relative supportiveness of the transportation system using the relative scoring system identified in Table 3.8 below. The colours in Table 3.8 were used in Appendix A to delineate the scoring.

Table 3.8: Transportation Evaluation Ranking

Transportation Score		
Very Supportive of Growth	**Supportive of Growth**	**Constrained**
• Existing and planned infrastructure has available capacity and access to support growth • Alternative mode services and networks can easily and logically be extended and connected • Upgrades **may be required** to support ultimate build-out scenarios	• Existing and planned infrastructure has some available capacity and access to support growth • Alternative mode services and networks can potentially be extended and connected • Upgrades **will be required** to support ultimate build-out scenarios	• Existing and planned infrastructure has limited/no capacity to support growth • Access to Block is limited • Alternative mode services and networks poorly connected • Upgrades to support growth **not feasible** or if feasible, **results in significant impacts.**

Areas were then rank ordered within each criteria group based on their transportation score.

3.3.3 Evaluation Findings

A numerical system was used to rank the Expansion Options. The detailed results of the evaluation for each Expansion Option based on the Transportation Principles and Criteria are provided in Appendix A. The following Tables 3.9 and 3.10 and the text below provide an overall summary of the evaluation for Community Area and Employment Area Expansion Blocks.

Table 3.9: Transportation - Summary Community Area Evaluation

Principle	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
C1	3	1	10	3	3	3	3	3	10	1	9
C2	1	1	10	10	1	7	1	1	9	1	7
C3	1	1	10	8	1	9	1	1	10	1	1
C4	1	1	10	1	1	9	1	1	10	1	1

Table 3.10: Transportation - Summary Employment Area Evaluation

Principle	E1	E2	E3	E4	E5	E6	E7
C1	4	6	1	1	4	6	1
C2	7	1	1	1	1	1	6
C3	7	1	1	1	1	1	1
C4	6	7	1	1	1	1	1

Community Area Expansion Blocks C1, C2, C5, C7, C8 and C10 scored the highest of the eleven Blocks that were evaluated. Each of these Expansion Blocks received a "very supportive of growth" ranking in at least six of the seven criteria. None of the aforementioned Expansion Blocks received a "constrained" ranking in any of the seven criteria. From a transportation point of view, Expansion Blocks C1, C2, C5, C7, C8 and C10 would require minimal change to infrastructure and service to accommodate residential development.

The lowest scoring residential Expansion Blocks were C3 and C9. Both of these Blocks received a "constrained" ranking in five of the seven criteria. From a transportation point of view, these Blocks would be problematic and would require significant changes or investment to infrastructure and service to mitigate constraints. Both Expansion Blocks C3 and C9 are very "constrained" by natural heritage features, including one or more meandering watercourses. These natural features will restrict access and limit connectivity, and network continuity for all modes of transportation and will require costly infrastructure in order to access the small and irregular shaped lands of C3 and C9.

Expansion Blocks C4, C6, and C11 scored in the middle, receiving a variety of "very supportive of growth", "supportive of growth", and "constrained" rankings. From a transportation point of view, these Blocks are acceptable choices for residential development but each would have at least one constraint to address. It should be noted that access to Expansion Block C4 will have

to conform to all access provisions, design and spacing criteria as outlined by the Ontario Ministry of Transportation (MTO) as MTO will continue to have jurisdiction over the section of King George Road / Highway 24 north of Powerline Road for the foreseeable future. While this may limit opportunities for full access private driveways, public roadway access may be allowed if Ministry criteria are met. Although Expansion Blocks C5 and C6 also have frontage along this section of King George Road / Highway 24, the limited property depth between King George Road / Highway 24 and the watercourse within Block C4 make access more problematic as there is limited space for an internal road network.

For the Employment Area Expansion Blocks, E3, E4, and E5 scored the highest of the seven Blocks that were evaluated. Each of these Expansion Blocks received a "very supportive of growth" ranking in at least five of the seven criteria. None of the aforementioned Blocks received a "constrained" ranking in any of the seven criteria. From a transportation point of view, Expansion Blocks E3, E4, and E5 would require minimal change to infrastructure and service to accommodate employment development.

The lowest scoring Employment Area Expansion Blocks were E1 and E2. Both of these Blocks received a "constrained" ranking in at least one of the seven criteria. From a transportation point of view, these Blocks would require typical changes or investment to infrastructure and service to mitigate constraints. E1 is "constrained" in its ability to connect with active transportation but is "supportive of growth" in all other criteria. E1 has limited access to both Paris and Powerline Roads and the future capacity of Paris Road is "constrained". E2 is "constrained" by its various natural heritage features. These features will limit connectivity and network continuity for all modes of transportation. Overall, the constraints exhibited by E1 and E2 are manageable and can be overcome.

Expansion Blocks E6 and E7 scored in the middle, receiving a variety of "very supportive of growth", and "supportive of growth" rankings. Although these Blocks did not receive the highest score, from a transportation point of view, they are all good choices for employment related development, scoring only slightly lower that the highest scoring Expansion Blocks of E3, E4, and E5.

3.4 ENVIRONMENT

3.4.1 Introduction

The following section provides an overview description of the natural heritage characteristics of the Boundary Adjustment Lands. The various natural heritage features and areas that comprise the Boundary Adjustment Lands are shown in Figure 1 on page 7.

Section 4.2.2 of the Growth Plan for the Greater Golden Horseshoe (2017) refers to the identification of Natural Heritage System for the Greater Golden Horseshoe. The system has been identified in the Province's map with the title "Regional Natural Heritage System for the

Growth Plan for the Greater Golden Horseshoe" (February 9, 2018). This Provincial Natural Heritage System has been overlaid on the Natural Heritage System in Figure 1 of this report to show the differences between the Province's Regional Natural Heritage System and the draft Natural Heritage System being considered for the City's Official Plan (See Appendix C, Maps 1, 2 and 3). For the most part the two systems are the same except for three areas contained in C8, C10 and E7. The Growth Plan requires the Regional Natural Heritage to be incorporated into the City's Official Plan as an overlay but permits the municipality to refine the provincial mapping with greater precision through its Municipal Comprehensive Review. In the future stages of the Municipal Comprehensive Review / Official Plan Review, these three areas of difference will be reviewed and assessed to finalize the Natural Heritage System boundary.

Jones Creek

The northwest portion of the Boundary Adjustment Lands is mainly comprised of gently rolling agricultural land interspersed with remnant woodlands, wetlands, headwater drainage features, hedgerows, and cultural meadows/thickets. The natural heritage features within this portion of the study area consist of the following:

- Jones Creek – coldwater stream supporting brook trout;
- Cold Spring Creek Provincially Significant Wetland (PSW) – associated with Jones Creek and tributaries;
- Unevaluated wetlands (isolated and riparian);
- Headwater drainage features;
- Woodlands – primarily associated with riparian corridors and upland areas; and
- Field border hedgerows, plantations and shelter belt plantings that meet the MNRF definition of woodland and provide linkage functions between natural areas.

The above noted features are primarily located in the centre of the concession block, in association with Jones Creek and its tributaries. The majority of the remnant natural heritage features were initially identified as key components of the County of Brant Natural Heritage System. Forest cover in the County of Brant is less than 13%, which is well below the minimum 30% woodland cover target recommended by Environment Canada (2013)[3].

Fairchild Creek

The northeast portion of the study area is also agricultural in character with gently rolling topography. Environmental features in this area consist of Jones Creek, tributaries to Fairchild Creek, unevaluated wetlands (mainly riparian), field border hedgerows and remnant woodlands. The natural heritage features in the northeast section of the study area include:

- Jones Creek (coldwater brook trout stream);

[3] *How Much Habitat is Enough 3rd Edition*

- Fairchild Creek tributaries (warm water fish habitat);
- Remnant woodlands of varying size;
- Unevaluated wetlands – in association with Fairchild Creek tributaries; and
- Hedgerow connections.

Tutela Heights

Tutela Heights is characterized by rolling, hummocky moraine topography associated with tablelands on the south side of the Grand River valley. Headwater tributaries and unevaluated wetland features are associated with low-lying areas. Remnant woodlands and field border hedgerows occur in upland areas. Rolling farm fields and cultural old field meadow occupy the balance of this portion of the Boundary Adjustment Lands around Tutela Heights.

Environmental Principles

The following environmental principles were developed to assist in the identification of environmentally sustainable Community Areas and Employment Areas within the Boundary Adjustment Lands:

- To protect, enhance and restore the NHS for the long-term along with existing linkage connections between the NHS and NHS features within the County of Brant and the existing urban area;
- To protect and enhance surface water quality/quantity including fish habitat;
- To protect significant wildlife habitat features and functions including the habitat of species-at-risk; and
- To protect stream channel and valleyland integrity, particularly in erosion prone systems.

3.4.2 Methodology for Evaluation

To assist in the evaluation of various Community Area and Employment Area Settlement Area boundary Expansion Blocks, the following evaluation criteria were established:

- Ability to maintain the overall integrity and connectivity of the NHS including the minimum 30 m buffers;
- Ability to maintain connections to NHS features with the existing built up Settlement Areas and adjacent rural lands (County of Brant);
- Ability to maintain wetland hydrology through groundwater recharge and surface water contributions;
- Ability to maintain groundwater and surface water quality and quantity;
- Ability to maintain and enhance coldwater fish habitat (Jones Creek) and other fish habitat features;

- Compatibility of land uses with significant wildlife habitat features and functions;
- Compatibility of land uses with the habitat of species-at-risk;
- Ability to enhance the NHS through restoration of "adjacent lands" (in conjunction with compatible urban uses);
- Ability to incorporate/integrate headwater drainage features as part of an overall LID SWM approach;
- Compatibility with erosion prone watercourses and valley systems;
- Ability to reduce the fragmentation of the NHS and habitat loss through road and servicing crossings of valleylands, woodlands and watercourses;
- Ability to integrate major hedgerows, woodland lobes, and small, isolated woodlands/wetlands (plus 30 m buffers) that are identified as part of the NHS; and
- Ability to offset the removal of NHS features and/or reduced buffers (e.g. hedgerows, woodland lobes, headwater drainage features, and small, isolated woodlands/wetlands) through restoration initiatives within or outside of the proposed urban areas.

3.4.3 Evaluation Findings

The various Community Area and Employment Area Expansion Blocks were evaluated in Appendix A as follows:

- "very supportive of growth",
- "supportive of growth", and
- "constrained".

A numerical system was used to rank the Expansion Blocks. The detailed results of the evaluation for each Expansion Block based on the Environmental Principles and Criteria are provided in Appendix A and a summary evaluation is provided in the Tables 3.11 and 3.12 and the text below.

Community Area Blocks

Table 3.11: Environment - Summary Community Area Evaluation

Principle	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
D1	1	4	7	4	4	4	7	7	7	1	1
D2	1	3	6	3	6	6	6	6	6	3	1
D3	6	3	6	6	3	6	6	6	6	3	1
D4	1	6	2	6	2	2	6	6	6	2	6

Principle D1) To protect, enhance and restore the NHS for the long-term along with existing linkage connections between the NHS and NHS features within the County of Brant and the existing Settlement Area.

Based on the evaluation criteria, Expansion Blocks C1, C10 and C11 are preferred. The subject areas are mainly comprised of agricultural land with scattered, isolated natural features and/or natural features that can be integrated within the urban fabric while still maintaining connections to other natural areas, and minimizing further fragmentation of the natural heritage system. Expansion Blocks C3, C7, C8 and C9 are the least preferred due to the relationship with natural heritage system features and functions and the potential for negative impacts. The balance of the land use Blocks pose varying degrees of opportunity and constraint to future development.

Principle D2) To protect and enhance surface water quality/quantity including fish habitat.

Expansion Blocks C1 and C11 are preferred as the subject areas have little or no wetlands or headwater drainage features present. Blocks that include wetlands, headwater drainage features, Jones Creek or tributaries to Fairchild Creek pose certain challenges to maintain and enhance the groundwater and surface water regime. These Expansion Blocks include C3, C5, C6, C7, C8 and C9.

Principle D3) To protect significant wildlife habitat features and functions including the habitat of species-at-risk.

Expansion Blocks C10 and C11 are preferred from a significant wildlife habitat perspective due to lack of natural cover or the ability to provide adequate setbacks and avoid habitat fragmentation. Blocks that will require fragmentation of the natural heritage system for infrastructure crossings are least preferred due to the potential for negative impacts to wildlife habitat, including habitat for species-at-risk. These Expansion Blocks include C1, C3, C4, C6, C7 and C8.

Principle D4) To protect stream channel and valleyland integrity, particularly in erosion prone systems.

Expansion Block C1 is preferred as significant headwater drainage features are protected within the NHS and the area is well upstream of Jones Creek. While the majority of the Expansion Blocks can accommodate the existing headwater tributaries, areas adjacent to Jones Creek or the Fairchild Creek tributaries pose compatibility issues due to a combination of erosion prone steep slopes and stream channel constraints. Expansion Blocks C2, C4, C7, C8, C9 and C11 will pose certain challenges to protect stream channel and valleyland integrity.

Employment Area Blocks

Table 3.12: Environment - Summary Employment Area Evaluation							
Principle	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**
D1	1	7	1	3	5	5	3
D2	1	7	1	1	5	5	4
D3	1	7	1	5	5	1	1
D4	1	6	3	1	6	5	3

Principle D1) To protect, enhance and restore the NHS for the long-term along with existing linkage connections between the NHS and NHS features within the County of Brant and the existing Settlement Area.

Based on the above evaluation criteria, Expansion Blocks E1 and E3 are the preferred Blocks from an environmental protection perspective. The subject Employment Areas are mainly agricultural in character with scattered woodland/hedgerow features. Expansion Block E2 is the least preferred due to the proximity of provincially significant wetlands, Jones Creek and headwater drainage features. Expansion Blocks E5 and E6 are partially constrained by headwater drainage features and hedgerows that provide a linkage function between natural features. Environmental connections and integration can also be accommodated with Expansion Blocks E4 and E7, however, the location and type of features (wetlands, watercourses) will pose some challenges.

Principle D2) To protect and enhance surface water quality/quantity including fish habitat.

Based on evaluation criteria related to the maintenance of wetland hydrology, groundwater recharge and fish habitat enhancement, Expansion Blocks E1, E3 and E4 are the preferred Expansion Blocks. The subject Employment Areas are mainly comprised of cultivated agricultural land. The presence of wetlands and drainage features pose certain constraints with respect to the other Expansion Blocks, in particular E2 and E5.

Principle D3) To protect significant wildlife habitat features and functions including the habitat of species-at-risk.

Expansion Blocks E1, E3, E6 and E7 are preferred from the standpoint of significant wildlife habitat features/functions, including habitat for species-at-risk. The four preferred areas are mainly comprised of cultivated agricultural land. Expansion Blocks E2, E4 and E5 are constrained by the presence of wetlands, drainage features and hedgerow connections.

Principle D4) To protect stream channel and valleyland integrity, particularly in erosion prone systems.

Expansion Blocks E1 and E4 are preferred as there are no watercourses present (i.e. E1) or the land is mainly cultivated (i.e. E4). Expansion Blocks E2, E5 and E6 are constrained either due to the relationship with Jones Creek, the presence of headwater drainage features, or sensitive valley slopes and channels.

3.5 WATER / WASTEWATER

3.5.1 Introduction

The following section outlines the proposed high level servicing Principles and Criteria that will be utilized to evaluate the Settlement Area boundary Expansion Blocks. These servicing Principles and Criteria will be utilized to complete a comparative evaluation of each Expansion Block relative to each other.

Water System Servicing Context

The Brantford water system is supplied by a single water treatment plant (Holmedale WTP), located off Grand River Avenue, on the western edge of the City. Water is distributed from the WTP via a network of trunk watermains, pump stations, and water storage reservoirs. Water servicing for the Settlement Area boundary Expansion Blocks will be supplied by the existing WTP and will be conveyed through the existing trunk network.

Water System Servicing Context – North West Expansion Blocks (E1, E2, E3, E4, E5, E6, C1)

The northwest Expansion Blocks, generally consisting of the Employment Area Expansion Blocks north of Highway 403 and the Community Area Expansion Blocks west of Balmoral Drive, could be serviced via an extension of the City's Pressure District 4 (PD4), which is supplied by the existing Northwest Booster Pump Station and Reservoir. The existing PD4 currently has surplus capacity to accommodate growth. The primary servicing constraint will be the need to extend trunk water servicing north of Highway 403.

Water System Servicing Context – North & East Expansion Blocks (E7, C2, C3, C4, C5, C6, &, C8, C9, C10)

The North & East areas consist of the Community Area Expansion Blocks north of Powerline Road and along the eastern limit of the City, as well as the Hopewell Employment Area lands along the eastern edge of the City (Expansion Block E7). These lands could be serviced via an extension of the City's existing PD3 zone, which is supplied by Tollgate Booster Pump Station and Reservoir, the Gretzky Booster Pump Station and Reservoir, the Albion Booster Pump station, and the King George Elevated Tank.

The combined PD3 facilities currently have some surplus capacity to support growth; however, capacity upgrades are likely needed to support build out. The potential upgrade needs, combined with asset renewal needs and potential operational improvements, will likely trigger the need for a new elevated storage facility and reconfigured trunk supply strategy.

The extension of water servicing to the northern most Expansion Block (C6) could be provided by the City's existing trunk water main network, which generally follows the King George Road and Park Road alignments. These trunk water mains have some capacity to support growth, however, upgrading the trunk water main capacity will likely be needed to support the Expansion Blocks. A new east/west trunk main between King George Road and Park Road is also

likely needed. These upgrades will also support growth within the City's intensification corridors.

The easterly Expansion Blocks will likely need a new trunk water main extension to extend water servicing.

Water System Servicing Context - Tutela Heights Expansion Block (C11)
For the Tutela Heights Expansion Block (C11), water servicing would be provided by integration into the existing Tutela Heights water system. Currently the water servicing is provided by the County of Brant, and the City needs to complete trunk water infrastructure upgrades, likely including construction of a new booster pumping station, storage reservoir, and trunk water main to support servicing of the Tutela Heights area from the City's water system.

The required upgrades to integrate the Tutela Heights water system into the City's existing system will support service extension to the Tutela Heights Settlement Area boundary Expansion Block.

Wastewater System Servicing Context
All wastewater flows within the City of Brantford are collected and conveyed to the City's Pollution Prevention and Control Plant (PPCP), located off Morrison Road in the southeast part of the City. Wastewater is collected and conveyed to the PPCP via a network of trunk sewer mains and pump stations. Wastewater servicing for the potential Settlement Area boundary Expansion Blocks will also be provided by the existing PPCP with flows needing to be received by and conveyed through the existing trunk network.

Wastewater System Servicing Context - North West Employment Expansion Blocks (E1, E2, E3, E4)
The northwest Expansion Blocks generally consisting of the Employment Area Expansion Blocks north of Highway 403 and west of Golf Road (E1, E2, E3 and E4) could be serviced via an extension from the existing Northwest and Oakhill Drive trunk sewer, which currently services the City's Northwest business park. This trunk sewer currently has surplus capacity to accommodate growth. The primary servicing constraint will be the need to extend the trunk sewer north of Highway 403. The trunk sewer also has capacity to support the Employment Area and Community Area Expansion Blocks to the east (E5, E6, C2, C3), if needed to support more flexible staging options.

Wastewater System Servicing Context - North West Community Area Expansion Block (C1)
The northwest Community Area Expansion Block C1 generally consists of the areas south of Powerline Road. This area will would likely connect to the existing local collection immediately to the south. The existing system has some capacity to support growth, and some upgrades may be required. Further, some local pump stations may be required, but there will be opportunities to integrate with C2.

Wastewater System Servicing Context - North & East Community Area & Employment Area Expansion Blocks (E5, E6, C2, C3, C4, C5, C6, C7, C8, C9, C10)

The north and east Community Area and Employment Area Expansion Blocks consist of the majority of the potential Settlement Area boundary Expansion Blocks. The logical servicing strategy is to direct all flows to the existing eastern trunk sewer that starts at Coulbeck Road and Powerline Road, which flows south, ultimately to the PPCP via the Empey SPS. This trunk main has substantial capacity to support growth, however, some upgrades may be required. Further, the existing Empey SPS is near capacity, and upgrades would be required to support growth.

This strategy supports servicing from east to west, via an extension of the trunk sewer. This solution presents potential phasing issues. There are opportunities to support interim phasing of the other Blocks (C2, C4, C5) through the existing sewer network system south of Powerline Road; however, these systems have limited capacity to support significant growth areas.

Further, local SPS within Expansion Blocks C3, C2, C6 and C8 would need to cross environmental features and/or overcome topography issues to connect to the trunk network.

This east-west servicing strategy would also require some additional sewer line extension from Expansion Blocks C9 and C10 through the City to connect to the trunk sewer.

Wastewater System Servicing Context – Hopewell (E7)

A servicing extension to the new Hopewell Employment Area adjacent to Expansion Block E7 will require a new pump station and force main, as well as sewer upgrades within the City. The required upgrades to extend sanitary services to the new Hopewell Employment Area will support service extension to the E7 Expansion Block.

Wastewater System Servicing Context - Tutela Heights (C11)

Wastewater servicing to Tutela Heights Expansion Block C11 would be provided by integration into the future Tutela Heights wastewater system. Currently, there is no municipal wastewater servicing and the City requires both local and trunk infrastructure upgrades, likely including construction of a booster pumping station, force main, and potential trunk sewer to support wastewater servicing of the Tutela Heights area. The required upgrades to extend sanitary services to Tutela Heights would support service extension to the C11 Expansion Block.

3.5.2 Methodology for Evaluation

For the purposes of this evaluation, the following overarching servicing philosophies have been assumed:

- That all Community Area and Employment Area Blocks will be subject to the same community and employment densities respectfully;

- That full municipal water and wastewater services will be extended to all Expansion Blocks;
- That water and wastewater servicing will be provided by an extension of the City's existing water and wastewater system, and that no new treatment plants will be constructed within the growth areas to service growth needs;
- That all Expansion Blocks will be subject to meeting the minimum water and wastewater level of service objectives for both local infrastructure and trunk infrastructure needs as outlined by:
    - The City's current municipal design and construction standards,
    - Applicable provincial and federal regulatory requirements,
    - Performance objectives as outlined in the City's Master Servicing Plan Criteria;
- That servicing of Expansion Blocks will not negatively impact existing serviced residents, and appropriate capacity upgrades to the existing water and wastewater systems needed to maintain appropriate levels of service, while also extending services to new growth, must be properly accounted for; and
- That servicing needs will consider the best life-cycle options, and will consider overall operational efficiency, operational resiliency to climate change and/or major component failure, operational and maintenance cost, existing renewal needs of the system, post period servicing, and greenhouse gas emissions.

The overall evaluation will be completed by evaluating the identified water and wastewater Principles for each Expansion Block relative to each other, with the end objective of providing each Expansion Block with a relative ranking for each of water and wastewater servicing. Table 3.13 provides an overview of the classification utilized to evaluate each individual Block's ability to support growth, as it relates to both local servicing considerations as well as capacity/ability of the existing infrastructure systems to support individual areas. The colours in Table 3.13 were used in Appendix A to delineate the scoring.

Table 3.13 – Servicing Score			
	Very Supportive of Growth	**Supportive of Growth**	**Constrained**
Growth Block Servicing	• Typical/standard site servicing approach • No/limited phasing restrictions	• May require localized pump station and/or not standard servicing approach • Potential phasing restriction	• Requires complex and/or difficult local servicing strategy • Dependent on adjacent Blocks for trunk servicing
	AND	AND/OR	AND/OR
Existing System Capacity	• Existing Infrastructure has Available Capacity to Support Growth • Upgrades **May Be Required** to Support Ultimate Buildout Scenarios	• Existing Infrastructure has Some Available Capacity to Support Growth • Upgrades **Will Be Required** to Support Ultimate Buildout Scenarios	• Existing Infrastructure Has Limited/No Capacity to Support Growth • Upgrades to Support Growth **Not Feasible or** If Feasible, **Are Required in The Short Term**

The following outlines the overall Water and Wastewater Servicing Principles and Criteria that will be utilized in the evaluation:

W/WW Principle #1 – Local Servicing Complexity/Constraints and Ease of Integration with Existing Network

Evaluate the relative complexity needed to complete local water and wastewater system servicing of the Expansion Block and to extend the existing water and wastewater system to the Expansion Block. Associated criteria:

1. Need to cross existing natural heritage corridors to extend water and wastewater servicing;
2. Ability to service area via existing networks vs. need to construct new pumping/other infrastructure; and
3. Need for localized sanitary pumping station and/or water pressure zones.

W/WW Principle #2 – Existing Trunk Network Capacity

Evaluates the existing water and wastewater system capacity to extend servicing to individual Expansion Blocks. Associated criteria:

1. Proximity and capacity of existing trunk networks;
2. Scope of trunk network upgrades needed to support growth area;
3. Impacts on existing users and system level of service; and
4. Supports priority areas and servicing objectives identified in the Master Servicing Plan.

W/WW Principle #3 – Phasing Restriction/Limitation

Evaluates how the phasing and/or development of adjacent Expansion Blocks impacts the relative severability of the individual Expansion Block. Associated criteria:

1. Phasing impacts and dependency on adjacent Expansion Blocks to tie into existing water and wastewater systems;
2. Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) Expansion Blocks;
3. What are the alternative servicing scenarios, if adjacent Expansion Blocks are not developed; and
4. Flexibility/impacts of post period servicing of lands remaining beyond the expanded Settlement Area boundary.

W/WW Principle #4 –Relative Life Cycle Cost

Evaluates the total project life-cycle cost to service the individual Expansion Blocks. Associated criteria:

1. Local and trunk servicing capital cost within the Expansion Blocks;
2. Existing trunk upgrade capital cost; and
3. Local and trunk life-cycle operation and maintenance costs.

Cost comparison will be on a relative basis and will not include detailed analysis. For major water and wastewater infrastructure that would be needed to service multiple Expansion Blocks, such as new elevated storage reservoirs or major sewage pumping stations, the costs will be identified but not allocated to individual Expansion Blocks. However, consideration for its benefit and phasing implications will be evaluated in Principles 1, 2, and 3. Any major infrastructure that is needed to service a limited area will be considered in the individual Expansion Block's total life-cycle costs.

3.5.3 Water Servicing Evaluation Findings

The water evaluation leveraged the following information and analysis to inform the water servicing evaluation:

- Utilization of existing topographic and natural environment features information to review how the proposed Expansion Block would integrate with the existing water infrastructure;
- Utilization of existing water system performance information, including the City's existing hydraulic water model and facility capacity and allocation tables. This information was utilized to assess the capacity of existing water infrastructure to support the identified Expansion Block; and
- Identify existing planned upgrades and/or known system issues.

Utilizing the above information, preliminary servicing concepts needed to service the Expansion Blocks were completed in order to:

- Identify likely trunk water servicing infrastructure configuration within the Expansion Block areas;
- Identify likely water infrastructure upgrades to the existing water system needed to service the Expansion Blocks;
- Identify any area specific servicing constraints/issues and/or operational concerns;
- Identify potential upgrade synergies between existing planned upgrades and/or known system issues with upgrades to the existing water system needed to service the Expansion Blocks; and
- Identify any phasing constraints and/or alternative servicing scenarios.

Utilizing the results of the servicing analysis summarized above, the individual Expansion Blocks were evaluated utilizing the general criteria summarized in Section 3.5.2.

Water - Overall Servicing Evaluation

A numerical system was used to rank the Expansion Options. The detailed results of the evaluation for each Expansion Option based on the Water Servicing Principles and Criteria are provided in Appendix A. Tables 3.14 and 3.15 summarize the results of the overall water infrastructure servicing evaluation, including finalized rankings.

Table 3.14: Water Servicing - Summary Community Area Evaluation

Principles	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
E1 W	1	1	9	1	1	7	1	6	11	9	7
E2 W	8	3	11	1	3	8	1	3	8	3	3
E3 W	3	3	11	7	3	9	1	7	9	3	1
E4 W	1	1	10	6	6	6	1	6	11	1	1

Table 3.15: Water Servicing - Summary Employment Area Evaluation

Principles	E1	E2	E3	E4	E5	E6	E7
E1 W	2	5	5	5	2	2	1
E2 W	1	1	1	1	5	5	5
E3 W	2	4	3	4	7	4	1
E4 W	4	4	4	4	1	1	1

The key factors impacting the overall Expansion Block rankings consists of:

- Connectivity and integration into the existing/future water infrastructure;
- Capacity of the existing water system; and
- Growth phasing and implementation.

Water - Key Servicing Evaluation Considerations- Community Area Lands
Expansion Blocks C7 and C2 represent the highest ranked Blocks due to their easy integration to the existing system, the connection points, available capacity, and the limited local constraints.

Expansion Block C11 is the next highest ranked Block. C11 presents some phasing delays related to the overall extension of water servicing to the Tutela Heights area.

The next grouping of Community Area Expansion Blocks C1, C4, C5, and C10 also received generally high ranking due to their relatively easy integration to the existing system. However, growth in these areas would likely trigger some upgrades to the existing system to support growth.

Expansion Blocks C6 and C8 are generally ranked lower due to phasing constraints and the need to extend servicing through other growth Block and natural heritage corridors.

Finally, Expansion Blocks C9 and C3 have the lowest ranking due to phasing constraints and the fragmented nature of the Blocks and likely more difficult local servicing needs.

Water - Key Servicing Evaluation Considerations- Employment Area Lands
Expansion Block E7 is the most favorable Block due to its proximity and integration with the adjacent servicing needs with the adjacent Hopewell lands.

The remaining Employment Area Expansion Blocks have a similar servicing strategy and the overall rankings are primarily governed by phasing constraints and localized servicing constraints. The next highest ranked Expansion Block is E1, as trunk servicing from the remaining Employment Area Expansion Blocks would need to pass through Block E1. The remaining Employment Area Expansion Blocks all have similar overall rankings, with a balance of either phasing constraints vs. local servicing constraints.

3.5.4 Wastewater Servicing Evaluation Findings

The water evaluation leveraged the following information and analysis to inform the wastewater servicing evaluation:

- Utilization of existing topographic and natural environment features information to review the how the proposed Expansion Block would integrate with the existing wastewater infrastructure;
- Utilization of existing wastewater system performance information, including the City's existing hydraulic wastewater model and facility capacity and allocation tables. This information was utilized to assess the capacity of existing wastewater infrastructure to support the identified Expansion Block; and
- Identify existing planned upgrades and/or known system issues.

Utilizing the above information, preliminary servicing concepts needed to service the Expansion Blocks was completed in order to:

- Identify likely trunk waste servicing infrastructure configuration within the Expansion Blocks;
- Identify likely wastewater infrastructure upgrades to the existing wastewater system needed to service the Expansion Blocks;
- Identify any area specific servicing constraints/issues and/or operational concerns, including capacity to servicing via gravity sewer vs. need for local pump station;
- Identify potential upgrade synergies between existing planned upgrades and/or known system issues with upgrades to the existing wastewater system needed to service the Blocks; and
- Identify any phasing constraints and/or alternative servicing scenarios.

Utilizing the results of the servicing analysis summarized above, the individual Expansion Blocks were evaluated utilizing the general criteria summarized in this section.

Wastewater - Overall Servicing Evaluation

Tables 3.16 and 3.17 summarize the results of the overall wastewater infrastructure servicing evaluation, including finalized rankings. The detailed wastewater infrastructure evaluation tables by criteria are attached in Appendix A.

Table 3.16: Wastewater Servicing - Summary Community Area Evaluation

Principles	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
E1 WW	2	4	10	4	4	9	1	4	10	2	4
E2 WW	1	4	4	4	4	10	2	4	4	2	11
E3 WW	6	7	11	9	7	10	1	1	1	1	1
E4 WW	1	5	11	5	5	8	2	2	8	2	10

Table 3.17: Water Servicing - Summary Employment Area Evaluation

Principles	E1	E2	E3	E4	E5	E6	E7
E1 WW	1	1	1	1	6	6	1
E2 WW	1	1	1	1	1	1	1
E3 WW	2	4	4	2	4	4	1
E4 WW	1	1	1	1	6	6	1

The key factors impacting the overall Expansion Block rankings consists of:

- Growth phasing and implementation;

- Local servicing limitations and topographic constraints;
- Connectivity and integration into the existing/future wastewater infrastructure; and
- Capacity of the existing wastewater system.

Wastewater - Key Servicing Evaluation Considerations- Community Areas

Expansion Blocks C7, C10, and C1 represent the highest ranked Blocks due to their easy integration to the existing system, the connection point's available capacity, and the limited local constraints.

The next grouping of Community Area Blocks comprising C8, C2, C4, and C5 also received generally high rankings due to their relatively easy integration to overall trunk servicing strategy for the Community Area Blocks; however, they are dependent on trunk servicing through Block C7.

Expansion Block C11 is the next ranked Block. C11 presents some phasing delays related to the overall extension of water servicing to the Tutela Heights area.

Finally, Expansion Blocks C6 and C3 have the lowest ranking due to phasing constraints and the generally fragmented nature of the Blocks, a more likely difficult local servicing need, and a resulting need for a localized pumping station.

Wastewater - Key Servicing Evaluation Considerations- Employment Areas

Block E7 is the most favorable Expansion Block, due to its proximity and integration with the adjacent servicing needs with the adjacent Hopewell lands.

The remaining Employment Area Expansion Blocks have a similar servicing strategy and the overall rankings are primarily governed by phasing constraints and localized servicing constraints. The next highest Expansion Blocks are E1 and E4, as trunk servicing from the remaining Employment Area Expansion Blocks would need to pass through Block E1. E2 and E3 overall ranks are close to those of E1 and E4, and are lower due to the need to extend servicing through E1 and E4 to service Expansion Blocks E2 and E3.

Expansion Blocks E5 and E6 are the lowest ranked, as they would be the last to be serviced depending on either servicing through E3 and E1, or to the east via several Community Area Blocks.

3.6 STORMWATER

3.6.1 Introduction

Unlike the water and wastewater servicing systems, the stormwater management system is highly decentralized. Storm drainage systems are typically designed to mimic pre-development drainage patterns and outlet locations, and in the City of Brantford the natural topography results in multiple drainage directions with multiple receiving watercourses. Some of these receiving watercourses are located within the existing Settlement Area, and some of these are located outside of the existing Settlement Area. All receiving watercourses ultimately discharge to the Grand River.

The existing stormwater management system includes the following major catchment areas, which are named according to their receiving watercourses:

- Fairchild Creek, including named tributaries (Jones Creek, Garden Avenue Municipal Drain) and unnamed tributaries;
- D'Aubigny Creek and its unnamed tributaries;
- Mohawk Lake; and
- The Grand River and its unnamed tributaries.

In this section, catchments were named according to the following convention:

- UJ: Upper Jones Creek (Jones Creek upstream of Highway 24 including major tributaries that join upstream of Highway 24);
- LJ: Lower Jones Creek (Jones Creek downstream of Highway 24 including minor tributaries);
- JT: Tributaries to Jones Creek which join downstream of Park Rd. North (Road 32)
- F: Fairchild Creek and its unnamed tributaries;
- GD: Garden Avenue Municipal Drain and its unnamed tributaries;
- P: Phelps Creek, project name given to the unnamed tributary to the Grand River which crosses Phelps Road, including its tributary which joins upstream of Cockshutt Road; and
- NO: No outlet, local depression between Governor's Road East and Paris Road.

Stormwater servicing for the Settlement Area boundary Expansion Blocks will also mimic existing drainage patterns. Preliminary drainage analysis has been completed using 1 metre contours provided by the City of Brantford.

New storm sewers and overland flow drainage paths will direct runoff to the existing watercourses, while control structures such as Low Impact Development (LID) practices,

detention ponds designed for quantity, quality and/or erosion control, and temperature control structures will be utilized in combination to mitigate the site-specific impacts of urban drainage on the receiving watercourse and the overall water cycle.

In some cases, Settlement Area boundary Expansion Blocks currently receive storm drainage from the existing Settlement Areas, whether controlled or uncontrolled. These drainage routes will need to be maintained, and uncontrolled runoff will likely need to be controlled with any proposed new infrastructure.

Only very small areas within the Expansion Blocks currently drain to the existing storm sewer network.

Stormwater System Servicing Context – North West Employment Areas (E1, E2, E3, E4, E5, E6)
Stormwater servicing for the northwest Employment Area Expansion Blocks would likely consist of a combination of on-site controls (likely including LID practices and/or on-site detention), conveyance through storm sewers, and end-of-pipe controls (e.g. detention ponds) prior to discharge to an existing watercourse (tributaries to Upper Jones Creek named UJ-1 through UJ-3 for the purposes of this analysis). However, there are some exceptions and special considerations for individual Expansion Blocks.

Portions of Expansion Blocks E1 and E2 do not drain to Upper Jones Creek, but instead drain to a depression to the west of the Boundary Adjustment Lands where runoff likely infiltrates. Parcels in this catchment (named NO-1) will likely need a very high degree of infiltration practices, whether on privately or publicly owned lands, or both.

The majority of area in E1 drains onto E2 and E3 by sheet flow with no existing channel. Therefore, E1 would need to outlet to trunk infrastructure in E2 and E3. If E2 and E3 are not brought within the Settlement Area boundary, other servicing alternatives include extending a trunk sewer on Powerline Road or requiring a very high degree of infiltration practices, whether on privately or publicly owned lands, or both. A high level of infiltration will be required in E1 regardless of outlet due to designation as a Significant Groundwater Recharge Area under source water protection planning. Some portions of Expansion Blocks E2 and E3 may outlet to trunk infrastructure in E5.

A large area within Expansion Block E2 drains to isolated provincially significant wetlands. Therefore, stormwater servicing in this Block may require more end-of-pipe facilities, additional LID practices, greater level of study, and an increase in monitoring.

Expansion Block E4 can be serviced conventionally with two end-of-pipe facilities, but would require a high level of infiltration and constraints to land use due to designation as a Significant Groundwater Recharge Area and Highly Vulnerable Aquifer under source water protection planning.

Expansion Block E5 can be serviced conventionally, but due to the multiple drainage directions, multiple end-of-pipe facilities would be required.

Due to the shape of Expansion Block E6 and its drainage split, stormwater servicing would likely consist of on-site controls directly discharging to the creeks, with a small facility and easement to control road drainage.

Stormwater System Servicing Context – Upper Jones Creek and Tributaries, Northwest Community Areas (C1, C2, C3, C4)

Stormwater servicing for the northwest Community Area Expansion Blocks C1, C2, C3 and C4) would likely consist of a combination of on-site controls (LID practices and/or on-site detention, more likely for commercial or higher density residential land uses), conveyance through storm sewers, and end-of-pipe controls (e.g. detention ponds) prior to discharge to an existing watercourse (reaches of and tributaries to Upper Jones Creek named UJ-3 through UJ-5.) However, there are special considerations for the individual Expansion Blocks.

Expansion Block C1 has split drainage, and multiple end-of-pipe facilities will be required, including a small facility, which would outlet to the existing storm sewer system and two or more facilities, which would outlet to UJ-2 and/or UJ-3. Controlled drainage from two existing City facilities would need to be conveyed through the Expansion Block to UJ-3. A high degree of infiltration would be required due to designation as a Significant Groundwater Recharge Area.

Expansion Block C2 would be serviced conventionally, with two or more large end-of-pipe facilities distributed over a large area (likely to be developed in phases). Drainage from the existing golf course would need to be conveyed through the Block to UJ-5.

Expansion Block C3 would require multiple end-of-pipe facilities over a relatively small area due to the catchment shape and drainage splits.

Expansion Block C4 due to its shape and location may be developed as commercial land use. In this case, servicing would likely consist of on-site controls directly discharging to the adjacent creeks. If developed as residential land, multiple small end-of-pipe facilities would be required.

Stormwater System Servicing Context – Lower Jones Creek, Fairchild Creek and Tributaries, Northeast Community Areas (C5, C6, C7, C8, C9, C10)

Stormwater servicing for the northeast Community Area Expansion Blocks C5, C6, C7, C8, C9 and C10 would likely consist of a combination of on-site controls (LID practices and/or on-site detention, more likely for commercial or higher density residential land uses), conveyance through storm sewers, and end-of-pipe controls (e.g. detention ponds) prior to discharge to an existing watercourse (reaches of and tributaries to Lower Jones Creek and Fairchild Creek named LJ-1 through LJ-3, JT-3, JT-4, F-1 through F-4, GD-1.) However, there are special considerations for the individual Expansion Blocks.

Expansion Blocks C5 and C6 would be serviced conventionally, with multiple facilities required due to the catchment shape and drainage splits. Over-control of runoff in C5 would likely be required due to the existing uncontrolled urban drainage into the Expansion Block and downstream erosion sensitivity.

Expansion Blocks C7 and C8 would likely require more complex servicing including a higher degree of study and monitoring, additional LID practices, and a greater number of end-of-pipe facilities due to the presence of isolated provincially significant wetlands and multiple drainage directions under existing conditions.

Expansion Block C9 would require complex servicing including a higher degree of study and monitoring, additional LID practices, and a greater number of end-of-pipe facilities due to the presence of isolated provincially significant wetlands and multiple drainage directions (F-1, F-2, F-3 and F-4) under existing conditions. In addition, over-control of runoff would likely be required due to the existing uncontrolled urban drainage to F3.

Expansion Block C10 would be serviced conventionally with one main end-of-pipe facility which outlets to a tributary of the Garden Avenue Drain to the south (GD-1). Small areas currently draining to F-4 and F-5 may be regraded to drain to GD-1. Small areas identified as wetlands within C10 appear to be in upland areas, such that complex control of surface runoff is likely not required. Changes to the watershed and subwatershed boundaries required for servicing may require a new assessment under the Ontario Drainage Act and/or over-control of runoff.

Stormwater System Servicing Context – Hopewell (E7)
Expansion Block E7 would be serviced conventionally with some degree of on-site controls possible, conveyance through storm sewers (assuming that the headwater feature GD-4A can be removed), and one main end-of-pipe facility which outlets to a tributary of the Garden Avenue Drain to the south. Minor changes to the watershed and subwatershed boundaries required for servicing may require a new assessment under the Ontario Drainage Act.

Stormwater System Servicing Context – Tutela Heights (C11)
Expansion Block C11 would be serviced conventionally with a single end-of-pipe facility that outlets to Phelps Creek, assuming that the headwater feature P1-E can be removed and its function replicated through LID practices.

3.6.2 Methodology for Evaluation

For the purposes of this evaluation, the following overarching servicing philosophies have been assumed:

- That all Community Area and Employment Area Expansion Blocks will be subject to the same community and employment density respectfully;
- That full municipal stormwater services will be extended to all new Expansion Blocks;

- That all Expansion Blocks will be subject to meeting the minimum stormwater level of service objectives for both local infrastructure and trunk infrastructure needs as outlined by:
    - The City's current municipal design and construction standards,
    - Applicable provincial and federal regulatory requirements,
    - Performance objectives as outlined in the City's Master Servicing Plan Criteria;
- That servicing of Expansion Blocks will not negatively impact existing serviced residents, and appropriate capacity upgrades to the existing stormwater systems needed to maintain appropriate levels of service, while also extending services to new growth, must be properly accounted for;
- That area specific stormwater management targets may be applied on a sub-catchment level subject to any mitigation needs to address area localized hydrologic/hydrogeological conditions; and
- That servicing needs will consider the best life-cycle options, and will consider overall operational efficiency, operational resiliency to climate change and/or major component failure, operational and maintenance cost, existing renewal needs of the system, post period servicing, and greenhouse gas emissions.

The overall evaluation will be completed by evaluating the identified stormwater Principles for each Expansion Block relative to each other, with the end objective of providing each Expansion Block with a relative ranking for each stormwater service.

Table 3.18 provides an overview of the classification utilized to evaluate each individual Expansion Block's ability to support growth, as it relates to both local servicing considerations as well as capacity/ability of the existing infrastructure systems to support individual areas. The colours in Table 3.18 were used in Appendix A to delineate the scoring.

GIS overlay analysis was used to determine the presence and relative influence of constraints such as SGRAs, HVAs, groundwater depth, wetlands, etc. for each Expansion Block.

Table 3.18 - Servicing Score			
	Very Supportive of Growth	**Supportive of Growth**	**Constrained**
Growth Block Servicing	• Typical/standard site servicing approach • No/limited phasing restrictions	• May require localized pump station and/or not standard servicing approach • Potential phasing restriction	• Requires complex and/or difficult local servicing strategy • Dependent on adjacent Blocks for trunk servicing
	AND	AND/OR	AND/OR
Existing System Capacity	• Existing Infrastructure has Available Capacity to Support Growth • Upgrades **May Be Required** to Support Ultimate Buildout Scenarios	• Existing Infrastructure has Some Available Capacity to Support Growth • Upgrades **Will Be Required** to Support Ultimate Buildout Scenarios	• Existing Infrastructure Has Limited/No Capacity to Support Growth • Upgrades to Support Growth **Not Feasible or** If Feasible, **Are Required in The Short Term**

Drainage patterns were determined using the 1 m contour layer provided by the City of Brantford in combination with the City's storm sewer, detention pond, and sewershed GIS layers, and the GRCA watercourses layer. The major watercourses (Jones Creek, Fairchild Creek, Phelps Creek and their tributaries) were divided into sections and the catchments associated with the farthest downstream point in each section were delineated. Where land within the Expansion Blocks did not appear to drain to a watercourse but instead to a significant local depression, the catchment of the local depression was also delineated.

This process was completed for the on-going City of Brantford Boundary Adjustment Lands scoped Subwatershed Study, taking place concurrently with the planning process. We note that some catchment areas delineated for the purposes of that study do not coincide with the areas to be evaluated; therefore, the numbering of the catchments considered in this evaluation is not necessarily sequential.

The catchments layer created from this analysis were then overlain on the Expansion Blocks. Characteristics related to the receiving watercourse segments (see below) were assigned proportionally to the Expansion Blocks in determining the relative impacts and ranking for each criterion. In addition, the drainage splits within catchments, upstream uncontrolled drainage areas, lack of outlet, etc. were considered in determining the likely stormwater servicing strategy, phasing impacts, and costing.

Some additional analyses were required to screen watercourse segments for the following characteristics: spatial constraint, watercourse sensitivity and hydromodification constraint, and thermal regime. High level assessment of spatial and hydromodification constraints was completed by Ecosystem Recovery Incorporated. Methodology and results are presented in Appendix D.

Several data sources were used to screen watercourses for identified or likely thermal regime:

1. Land Information Ontario/ Ministry of Natural Resources Aquatic Resource Area GIS Layer ON_ARA_WATER_LINE_SEGMENT (shows provincially identified thermal regimes where present);
2. Grand River Conservation Authority (GRCA) stream temperature monitoring data for Jones Creek at Governor's Road and Jones Creek at Highway 24, analyzed per Chu et al. (2009);
3. Ontario Geological Survey (OGS) Surficial geology GIS Layer;
    - Streams located in coarse textured, sandy soils are more likely to receive cold groundwater discharge than streams located in clay soils.
4. GRCA Layer GW_Discharge_Areas; and
    - Streams located in areas where the water table is expected at or above the ground surface are more likely to receive cold groundwater discharge.
5. Consideration of existing upstream drainage areas.
    - Stream segments receiving urban drainage under existing conditions are likely warmer than segments located immediately upstream.

3.6.3 Evaluation Findings

A numerical system was used to rank the Expansion Options. The detailed results of the evaluation for each Expansion Option based on the Stormwater Principles and Criteria are provided in Appendix A. Table 3.19 and Table 3.20 summarize the results of the overall stormwater infrastructure servicing evaluation, including finalized rankings.

Table 3.19: Stormwater - Summary Community Area Evaluation

Principles	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
F1	11	6	6	1	5	1	6	6	1	1	6
F2	3	3	10	7	11	7	3	3	7	2	1
F3	3	2	6	6	11	6	3	6	6	3	1
F4	1	1	10	1	1	10	1	1	7	7	7
F5	5	4	6	3	11	7	10	8	9	1	2

Table 3.20: Stormwater - Summary Employment Area Evaluation

Principles	E1	E2	E3	E4	E5	E6	E7
F1	4	6	2	7	3	4	1
F2	1	6	1	1	7	1	5
F3	7	4	4	2	2	1	4
F4	7	5	6	4	2	1	3
F5	7	5	3	6	2	4	1

Community Area Key Considerations

Expansion Blocks C10, C2, and C11 are the most favourable Community Area Expansion Blocks from a stormwater servicing perspective. Key considerations are as follows:

- Avoid key hydrologic areas;
- Relatively straightforward servicing strategies leading to low to moderate relative costs; and
- Moderate or low constraints related to watercourse sensitivity and spatial constraints such as headwater drainage features.

We note that both C2 and C11 have the risk of a high groundwater table in some locations. In addition, the receiving watercourse for C2 is likely a coldwater or coolwater stream, while the receiving watercourse for C11 is potentially a coldwater or coolwater stream. These factors will need to be investigated and mitigated as necessary during future stages of planning and development.

Expansion Block C4 is the next most favourable Block, as it also avoids key hydrologic areas, but discharges to moderate and high sensitivity channels and would have a moderate complexity and cost due to its shape and proximity to the receiving watercourse.

Expansion Block C1 is ranked below C4 due to the presence of key hydrologic areas (SGRA and HVA), which would increase the risk associated with development and servicing cost to mitigate the risks.

Expansion Blocks C7 and C8 are ranked below C1. Both are considered to have high servicing complexity due to their topography and the presence of isolated wetlands. Both discharge into highly sensitive channels.

Expansion Blocks C9 and C6 are the next lowest ranked. Both are considered to have high servicing complexity due to their topography and shape. C6 discharges into a highly sensitive channel and some receiving streams are potentially coldwater or coolwater streams. C9 contains both moderately and highly sensitive watercourses, receives uncontrolled urban drainage under existing conditions, and has a moderate drainage density of headwater drainage features.

The least preferred Community Area Expansion Blocks from a stormwater servicing perspective are C3 and C5. Key considerations are as follows:

- C3 discharges to streams that are potentially or likely coldwater streams, some of which are sensitive to erosion, and there is a risk of high groundwater table in some locations;
- C3 has a moderate to high relative cost due to shape and topography (multiple drainage directions), and the City must consider handling of runoff from the adjacent Trigger Lands;
- C5 receives uncontrolled drainage from approximately 88 ha of built-up area and discharges to moderate and high constraint channels. Controlling this drainage to protect the channels would increase the relative complexity and cost; and
- C5 has a relatively high drainage density of watercourses and additional potential headwater drainage features.

Employment Lands Key Considerations

Expansion Blocks E6 and E7 are the most favorable Employment Area Expansion Blocks from a stormwater servicing perspective. Key considerations are as follows:

- Both E6 and E7 avoid key hydrologic areas;
- Both E6 and E7 discharge directly to watercourses and can be developed independently of any other Block;
- E6 has no downstream constraints and multiple surface drainage features that are available to receive flow. Although one feature is identified as sensitive, this can be mitigated. There are likely no headwater drainage features present;
- E7 discharges to a watercourse that is unlikely to be a coldwater stream and has low sensitivity;
- E6 can be serviced using on-site controls; and
- E7 can be serviced conventionally with one SWM facility.

We note that both E6 and E7 have the risk of a high groundwater table in some locations. This risk will need to be considered and investigated during future stages of planning and development.

The next highest ranked Expansion Blocks are E3 and E5, which have some constraints but overall can likely be serviced with relatively low to moderate cost and risk. Both Expansion Blocks have some SGRA component, but these areas are relatively small. Expansion Block E3 is dependent on the development of Expansion Block E5 and discharges to a medium sensitivity stream that is potentially a coldwater stream. Expansion Block E5 discharges to medium sensitivity streams that are potentially coldwater streams and has a relatively high drainage

density of headwater drainage features, which may increase the servicing complexity, but can be developed independently of any other Expansion Block.

Expansion Block E4 is ranked below these Blocks, primarily due to the presence of key hydrologic areas (SGRA, HVA, potential high groundwater table) which will likely result in land use restrictions and higher cost of servicing and monitoring.

Expansion Blocks E1 and E2 are the lowest ranked. E1 has no defined channel and is dependent on the development of Expansion Blocks E2, E3 and E5 to reach an outlet. Part of the area drains to a local depression rather than a watercourse, and the Block coincides with a SGRA. These factors will lead to a higher cost of servicing and monitoring.

Expansion Block E2 also has a SGRA component and development partly depends on Expansion Block E5. In addition, the presence of isolated PSWs increases the complexity and cost of servicing and monitoring, in order to mitigate any potential impacts.

3.7 LAND USE

3.7.1 Land Use Characteristics of the Blocks

From a land use perspective, the Settlement Area boundary Expansion Blocks are currently primarily agricultural in use. Community Area Expansion Blocks are mainly located on the north and northeastern portion of the Boundary Adjustment Lands, with one small site located in Tutela Heights in the southwest Boundary Adjustment Lands. The Expansion Blocks vary in developable area, ranging from roughly 12 hectares to as large as 150 hectares. The lands in the north and northeastern portion of the Boundary Adjustment Lands have limited built form, predominately farmhouses, barns or agricultural facilities. Community Area Expansion Blocks C1, C4, C5, C7, C9, C10 and C11 sit adjacent to the City's current Settlement Area boundary and all have some adjacent or nearby community land uses. Expansion Blocks C3 and C6 are separated from the remainder of the Expansion Blocks by a Natural Heritage System. Expansion Blocks C8, C9 and C10 are not well connected to existing built form and C9 has an extensive Natural Heritage System within its boundaries.

The Employment Area Expansion Blocks are largely clustered in the northwest corner of the Boundary Adjustment Lands with an additional Expansion Block located adjacent to the Hopewell Lands on the eastern side of the City. The Expansion Blocks range in developable land from 34 hectares to as large as 80 hectares. The Employment Area Expansion Blocks are predominately of agricultural use with limited built form other than sparsely located farmhouses, barns and agricultural facilities. There are however eleven single detached dwellings on the north side of Paris Road within Block E4. Block E1 is adjacent to an existing developed urban area, with minor retail development at the intersection of Paris Road and Powerline Road.

3.7.2 Methodology for Evaluation

In order to determine the most preferred Settlement Area boundary Expansion Blocks, in relation to land use, the Expansion Blocks were evaluated on the following Principles and Criteria.

***Principle G1**:*

- To ensure development occurs adjacent to existing built areas.

Criteria:

- Ability of the expansion area to develop consecutively to existing built areas.
- Ability of the expansion area to be integrated with adjacent existing neighbourhoods.

***Principle G2**:*

- To create compact new urban areas with a mix of uses and densities.

Criteria:

- Ability to extend the intensification corridors from the built area into the urban expansion areas.

Principle G3*:*

- To direct employment areas to locations in proximity to major goods movement facilities.

Criteria:

- Distance of the expansion area to Highway 403.
- Visibility of the expansion area to Highway 403.

Criteria for each Principle were evaluated for the Community Area and Employment Area Expansion Blocks and assigned a score of "very supportive", "supportive" or "constrained". Each Expansion Block was then further analyzed through a ranking system. Blocks were ranked most preferred (1-3), medium preferred (4-8) and least preferred (9-11) for Community Area Expansion Blocks. The Employment Area Expansion Blocks were ranked most preferred (1-2), medium preferred (3-5) and least preferred (6-7). A Block was ranked most preferred if it gained "very supportive" results for all criteria for the Principle. If Expansion Blocks were viewed to have the same results, then they were ranked the same and the next Block would be ranked as per the number of Blocks already ranked. For example, if C1 and C2 shared a ranking of 1, then the next Block, C3, would jump to a rank of 3, and so on.

The methodology used to evaluate the Expansion Blocks for Principle 1 identified whether or not the Expansion Blocks are adjacent to an existing urban area. The Expansion Block was identified as "very supportive" if it was adjacent to an urban area; "supportive" if it depended on an adjacent Expansion Block to first develop in order for it to have adjacent built form; and "constrained" if it was not adjacent to an urban area.

The second criteria for Principle 1 was evaluated by determining whether the Expansion Block was able to integrate with adjacent existing neighbourhoods. The Expansion Block was considered "very supportive" if it was adjacent to existing built neighbourhoods and had high potential for extending existing street networks. An Expansion Block was considered "supportive" if there was potential for integration, and included evaluating the Expansion Block's increased likelihood for integration if an adjacent Expansion Block had a high potential for development. Expansion Blocks were evaluated as "constrained" if they were not adjacent and/or could not integrate with any urban areas. Expansion Blocks were also considered to be "constrained" if there was a significant Natural Heritage System that limited an Expansion Block's ability to integrate with adjacent urban areas. An overall rank was provided for each Expansion Block once both criterions were evaluated. Expansion Blocks for Principle 1 were then evaluated as a whole and ranked. Expansion Block that were "very supportive" and adjacent to existing built areas were assigned a ranking of 1, most preferred, a medium preferred ranking was assigned to Expansion Blocks that were "supportive" and a least

preferred rank was given to Expansion Blocks that were not adjacent to existing built areas and identified as "constrained".

The second land use Principle for the Community Area Expansion Blocks was to create compact new urban areas with a mix of uses and densities. The methodology used to evaluate this Principle was to determine whether an intensification corridor could be extended from the built area into the future Settlement Area boundary expansion Blocks. The methodology used to evaluate the Expansion Blocks was straightforward. Expansion Blocks that were adjacent to an intensification corridor and could accommodate the corridor extension were identified as "very supportive". If the Expansion Block depended on another Expansion Block to develop in order to extend the corridor, it was considered "supportive". If the Expansion Block was not on a corridor, it was identified as "constrained". The overall ranking for this Principle grouped the Expansion Blocks into these three categories; therefore, any Expansion Block that could extend the intensification corridor received a ranking of 1, most preferred. Expansion Blocks that relied on adjacent Expansion Blocks in order to extend the corridor were assigned a medium preferred rank of 4 and Expansion Blocks that were not adjacent to the intensification corridor were ranked least preferred, which in this case resulted to be a rank of 6.

The methodology for the Employment Area Expansion Blocks was similar to that of the Community Area Expansion Block evaluation, however the analysis looked at both adjacent employment uses and adjacent existing built areas. Principle 1 evaluated each Expansion Block in relation to its ability to develop consecutively to existing employment areas. Expansion Blocks were evaluated as "very supportive" if they were adjacent to an existing built area and/or existing employment areas and could integrate well with existing employment uses. Expansion Blocks were evaluated as "supportive" if they required another Expansion Block to first develop in order to integrate. Expansion Blocks were considered "constrained" if they were not adjacent to existing built areas and employment uses. The overall ranking for Principle 1 grouped the seven Employment Area Blocks. Those that were adjacent to existing built/employment areas were assigned a ranking of 1, most preferred. Expansion Blocks that were dependent on adjacent Expansion Blocks for integration and adjacent employment uses were identified as medium preferred and given a rank of 4. Expansion Blocks there were identified as "constrained" were ranked least preferred with a ranking of 6.

The final Principle for the Employment Area Expansion Blocks was to direct employment to locations in proximity to major goods movement facilities. The methodology used to evaluate this Principle was to identify whether the Expansion Block was near and visible from Highway 403. The evaluation identified whether there were existing street networks that connected the Expansion Block to Highway 403, and if the route was straightforward or complex. Expansion Blocks that were well connected to Highway 403 were identified as "very supportive". Expansion Blocks that were connected through indirect routes to Highway 403 were evaluated as "supportive". The Expansion Blocks that had poor connectivity to Highway 403 were identified as "constrained". The second criteria evaluated whether the Expansion Block was visible from Highway 403. The methodology for this evaluation was simple; the Expansion

Block either had good visibility, poor visibility or no visibility. The Expansion Blocks that had good visibility were considered "very supportive", those that had poor visibility were considered "supportive", and the Expansion Blocks that had no visibility were identified as "constrained". The Expansion Blocks were then evaluated as a whole and provided a rank. The Expansion Blocks that had good access and visibility to Highway 403 were ranked most preferred, the Expansion Blocks that had some level of connectivity and visibility to Highway 403 were assigned a medium preferred ranking, and Expansion Blocks that were not connected or visible were ranked least preferred.

3.7.3 Evaluation Findings

A numerical system was used to rank the Expansion Options. The detailed results of the evaluation for each Expansion Option based on the Land Use Principles and Criteria are provided in Appendix A. Tables 3.21 and 3.22 and the text below summarize the results of the evaluation for the Community Area and Employment Area Blocks.

Table 3.21: Land Use - Overall Community Area Evaluation

Principles	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
G1	1	6	11	1	1	10	1	8	8	6	1
G2	6	4	6	1	1	4	1	6	6	6	6

Table 3.22: Land Use - Overall Employment Area Evaluation

Principles	E1	E2	E3	E4	E5	E6	E7
G1	1	6	4	1	4	6	1
G3	3	6	4	1	4	6	1

The evaluation identified that Expansion Blocks C4 and C5 were most preferred for Community Area expansion as they both received a rank of one for each Principle as shown in Appendix A. Expansion Blocks C1 and C11 had equivalent results and were not identified as most preferred only because they are not on an intensification corridor. Expansion Blocks C2, C8, C9 and C10 had a range of scores between four and eight making them next preferred. These Expansion Blocks still have potential for development but rely heavily on the development of their adjacent Blocks to increase their viability. C9 also has additional constraints due to a significant NHS system spread throughout the entire Expansion Block area. Finally, C3 and C6, the Blocks located at the northern edge of the Expansion Blocks, were identified as least preferred as they are the most difficult lands to integrate with the existing built area due to the separation by the NHS systems.

The land use evaluation for the Employment Area Expansion Blocks provided fairly conclusive analysis. Expansion Blocks E4 and E7 were clearly identified as most preferred, both receiving a rank of one for both Principles. Expansion Block E1 could also be considered most preferred as

it received a rank of one for its ability to develop consecutively to existing built areas, however it lacks visibility to Highway 403. Expansion Blocks E3 and E5 also received equivalent rankings of four making them the next preferred Blocks. E3 is more favourable if E1 and E4 are developed, as it would have two adjacent built areas. The development of E3 would also make E5 more favourable. The least preferred Employment Area Expansion Blocks were E2 and E6, both not adjacent to existing employment areas and a relatively far distance to and visibility from Highway 403.

4 PREFERRED BLOCKS

The results of the evaluation described in Section 3 and Appendix A are summarized in Tables 4.1 and 4.2. The Envisioning Brantford MCR Part 1 Report identified a need for 460 hectares of Community Area lands and 336 hectares of Employment Area lands.

This Stage 4 analysis identified the following Community Area Expansion Blocks as the most preferred to achieve Community Area land needs:

- Community Area Blocks: C2, C1, C7, C4, C5, C11, C10, and C8.

To achieve the Employment Area land needs, this Stage 4 analysis identified the following Employment Area Expansion Blocks as the most preferred:

- Employment Area Expansion Blocks: E4, E7, E3, E5, E6 and E1.

Although these Community Areas and Employment Areas are the most preferred Expansion Blocks, the evaluation in Section 3 and the matrices in Appendix A indicate that these Expansion Blocks are not necessarily the most favourable for all criteria. For instance, on a number of criteria, Community Area Expansion Block C6 was more preferred than Expansion Blocks C8 or C10. Therefore, further review has been conducted to assess the trade-offs and the degree of potential constraints for the preferred Expansion Blocks, so that it can be determined which compilation or grouping of Expansion Blocks should form a preferred Settlement Area boundary expansion. Potential for mitigation, management or phasing measures are assessed for each Expansion Block with identified constraints.

Employment Area Expansion Blocks Evaluation Matrix - Each sub-region was ranked from Most Preferred (1) to Least Preferred (7). In order to analyze the overall evaluation, ranks have been categorized into three groups and coloured accordingly. Ranks are considered: most preferred (1-2), medium preferred (3-5) and least preferred (6-7).

Table 4.1: Community Area Expansion Blocks Evaluation Matrix

Each sub-region was ranked from Most Preferred (1) to Least Preferred (11). In order to analyze the overall evaluation, ranks have been categorized into three groups. Ranks are considered: most preferred (1-3), medium preferred (4-8) and least preferred (9-11).

Principles	Community Area Expansion Blocks										
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Agriculture											
A1	10	3	6	2	9	6	11	6	3	3	1
A2	10	7	11	6	1	2	4	9	7	5	2
A3	1	1	1	1	1	1	11	1	1	1	1
Archaeology											
B1	1	2	7	8	5	2	2	6	8	10	11
Transportation											
C1	3	1	10	3	3	3	3	3	10	1	9
C2	1	1	10	10	1	7	1	1	9	1	7
C3	1	1	10	6	1	9	1	6	10	6	1
C4	1	1	10	1	1	8	1	1	10	8	1
Environment											
D1	1	4	7	4	4	4	7	7	7	1	1
D2	1	3	6	3	6	6	6	6	6	3	1
D3	6	3	6	6	3	6	6	6	6	3	1
D4	1	6	2	6	2	2	6	6	6	2	6

Water & Wastewater											
E1 W	1	1	9	1	1	7	1	6	11	9	7
E1 WW	2	4	10	4	4	9	1	4	10	2	4
E2 W	6	3	11	1	3	6	1	6	6	6	3
E2 WW	1	4	4	4	4	10	2	4	4	2	11
E3 W	3	3	11	7	3	9	1	7	9	3	1
E3 WW	6	7	11	9	7	10	1	1	1	1	1
E4 W	1	1	10	6	6	6	1	6	11	1	1
E4 WW	1	5	11	5	5	8	2	2	8	2	10
Stormwater											
F1	11	6	6	1	5	1	6	6	1	1	6
F2	3	3	10	7	11	7	3	3	7	2	1
F3	3	2	6	6	11	6	3	6	6	3	1
F4	1	1	10	1	1	10	1	1	7	7	7
F5	5	4	6	3	11	7	10	8	9	1	2
Land Use											
G1	1	6	11	1	1	9	1	7	9	7	1
G2	6	4	6	1	1	4	1	6	6	6	6

Table 4.2: Employment Area Expansion Blocks Evaluation Matrix

Each sub-region was ranked from Most Preferred (1) to Least Preferred (7). In order to analyze the overall evaluation, ranks have been categorized into three groups. Ranks are considered: most preferred (1-2), medium preferred (3-5) and least preferred (6-7).

Principles	Employment Area Expansion Blocks						
	E1	E2	E3	E4	E5	E6	E7
Agriculture							
A1	6	4	6	3	2	1	4
A2	7	4	5	5	1	2	2
A3	1	1	1	1	1	1	1
Archaeology							
B1	2	4	3	1	5	6	7
Transportation							
C1	4	6	1	1	4	6	1
C2	7	1	1	1	1	1	6
C3	7	1	1	1	1	1	1
C4	6	7	1	1	1	1	1
Environment							
D1	1	7	1	3	5	5	3
D2	1	7	1	1	5	5	4
D3	1	7	1	5	5	1	1
D4	1	6	3	1	6	5	3

Water & Wastewater							
E1 W	2	5	5	5	2	2	1
E1 WW	1	1	1	1	6	6	1
E2 W	1	1	1	1	5	5	5
E2 WW	1	1	1	1	1	1	1
E3 W	2	4	3	4	7	4	1
E3 WW	2	4	4	2	4	4	1
E4 W	4	4	4	4	1	1	1
E4 WW	1	1	1	1	6	6	1
Stormwater							
F1	4	6	2	7	3	4	1
F2	1	6	1	1	7	1	5
F3	7	4	4	2	2	1	4
F4	7	5	6	4	2	1	3
F5	7	5	3	6	2	4	1
Land Use							
G1	1	6	4	1	4	6	1
G3	3	6	4	1	4	6	1

4.1 ASSESSMENT OF PREFERRED COMMUNITY AREA BLOCKS

Community Area Expansion Block C2

Expansion Block C2 is the most preferred Community Area Expansion Block, receiving favourable rankings from all disciplines, ranging from one (most preferred) to seven (medium preferred), as seen in Table 4.1. Expansion Block C2 received relatively few medium preferred rankings and is considered to have low to medium constraints for agriculture, environment, water and wastewater and stormwater. In regards to agriculture, the land has high soil capability for common field crops (Class 2) and high soil potential for fruits and vegetables, however all Expansion Blocks have class 1 to 3 soils, so this is not a comparative disadvantage.

Expansion Block C2 also has some environmental constraints as it is adjacent to Jones Creek, however this constraint can be mitigated by controlling the drainage to protect the channels. Expansion Block C2's integration with adjacent Expansion Blocks and existing urban area has been identified as moderate because it largely abuts an existing golf course to the south, but it can be integrated with development in Expansion Blocks C1 and C4.

Expansion Block C2 has primarily low constraints for transportation, water and wastewater and stormwater. However, Expansion Block C2 has a risk of high groundwater table in some locations, with potential coldwater or coolwater receiving watercourses. These factors will need to be investigated and mitigated as necessary during future stages of planning and development.

Community Area Expansion Block C1

Expansion Block C1 was found to be 'most preferred', however because it has high soil capability for common field crops (class 2) and soil potential for fruits and vegetables, it is considered constrained under Principles A1 and A2. However, all of the Expansion Blocks contain class 1 to 3 soils. Expansion Block C1 also has a higher number of farm building clusters (agricultural infrastructure) on and adjacent to the Block. Further analysis will be required at the Master Plan/Secondary Plan stage to identify minimum distance separation (MDS) requirements and means of mitigating or phasing development to minimize MDS impacts.

The constraints identified in Expansion Block C1, in relation to water and wastewater are in regards to its proximity to existing trunk water and wastewater infrastructure, which limits development phasing and density; however, there is likely sufficient available capacity in the local water and wastewater system to allow for independent servicing of this Block without new trunk infrastructure. Stormwater constraints are due to the presence of key hydrologic areas (SGRA and HVA) and a vulnerable aquifer; however, the risks associated with development of C1 can likely be mitigated although potentially at a higher servicing cost.

Community Area Expansion Block C7

Expansion Block C7 is constrained by high soil capability for common field crops (class 2) and soil potential for fruits and vegetables; however, all Expansion Blocks have class 1 to 3 soils. Block C7 is unique because it has existing fruit and vegetable production along with direct sales of farm products to the public. Impact on this agricultural related use can be minimized through phasing of development implemented through policies of the Official Plan which can be considered in the next stage of the study.

The environmental evaluation identified Block C7 to be 'medium preferred' for all four Principles. This ranking is due to headwater drainage features that connect between wetlands as well as a tributary to Fairchild Creek that has been incorporated into the Natural Heritage System. These constraints can be mitigated by minimizing creek crossings for essential infrastructure.

Another constraint identified is with the NHS feature at the north of Block C7, which has a high potential to support species at risk. This constraint can be mitigated through buffers adjacent to the main Natural Heritage System or to flank the area with a linear park system or a single-loaded road.

Another constraint identified in Block C7 is the highly sensitive main branch of Lower Jones Creek (sediment generating reaches) and increasing downstream sensitivity of Fairchild Creek tributary that extends into Expansion Block C8. This constraint can be addressed through appropriate stormwater management controls as well as mitigating against cumulative impact from adjacent and downstream Blocks on erosion and sedimentation conditions. Valley slope instability concerns also exist along Lower Jones Creek, which can be mitigated by establishing appropriate buffers to protect valleylands.

Expansion Block C7 is considered to have high stormwater servicing complexity due to its topography and the presence of isolated wetlands and the fact that it discharges into highly sensitive channels. Expansion Block C7 also has a relatively high drainage density, including potential headwater drainage features outside of the Natural Heritage System. These constraints can be mitigated by employing stormwater management facilities near the wetlands and managing potential discharge into the existing channels. Mitigation may also require establishment of a defined channel corridor for the Fairchild Creek Tributary (F-2A). Both water and wastewater trunk servicing strategy for the northern Expansion Blocks are dependent on trunk servicing through C7.

Community Area Expansion Block C4

Expansion Block C4 had a low ranking for Transportation Principle 2 (to ensure appropriate transportation capacity is maintained) and Principle 3 (to balance transportation needs and provide choice for the travel needs of residents). Transportation Principle 2 ranked Expansion

Block C4 "supportive of growth" for its ability to accommodate additional auto and transit and "constrained" for its potential to expand capacity in the future. The current 4-lane cross section on Highway 24 (King George Road) is adequate for capacity under existing conditions but becomes congested with future growth. An additional auto lane (moving the cross section to a basic 6-lane design) would provide capacity and resolve the issue, but it is not in the current long term plan. Although transit service could be extended into the area, it would operate in congested conditions without lane expansion. If Block 4 is selected as part of the Settlement Area boundary expansion, the Transportation Master Plan could plan for additional roadway capacity to support the development of Block C4.

Expansion Block C4 ranked "very supportive" on Transportation Principle 3 for its ability to provide opportunities for potential new areas to connect with transit service but only "supportive" for its ability to provide opportunities for potential new areas to connect with active transportation networks. The area is constrained physically by natural features and its narrow depth along Highway 24 (King George Road). Providing connectivity across/through the Natural Heritage System to connect Block 4 to Block 2 would improve transit and transportation connectivity. Opportunities for connection can be explored in the Master Plan/Secondary Plan stage.

Expansion Block C4 is ranked generally high in regards to water and wastewater servicing, however the main constraint identified for this Block is Principle E3 for wastewater which reflects the requirement for trunk extension, which can be mitigated through a phasing strategy and service extension through Expansion Block C7.

Community Area Expansion Block C5

In regards to Agriculture Principle 1, Expansion Block C5 is constrained due to having the highest average soil capability for common field crops and relatively high soil potential for fruit and vegetables. However, all Expansion Blocks contain class 1 to 3 soils, and this consideration must be weighed alongside the evaluation of other Blocks and their related overall constraints. Expansion Block C5 requires minimal change to transportation infrastructure and service to accommodate residential development, it is also adjacent to existing built areas and has an opportunity to extend the intensification corridor along King George Road on the west and Wayne Gretzky Parkway on the east.

Expansion Block C5 also requires a water and wastewater phasing strategy and requires trunk servicing extension through Expansion Block C7. Additionally, Expansion Block C5 has a relatively high drainage density of watercourses including being located adjacent to Jones Creek, with headwater drainage features and existing uncontrolled drainage from the adjacent urban area. These constraints can be mitigated through controlling the drainage to protect the channels. This would increase the complexity and cost of development as well as require some land allocated for mitigation of existing stormwater management issues.

Community Area Expansion Block C10

The archaeological assessment of Expansion Block C10 assigned a ranking of 8 'medium preferred' due to the presence of three archaeological sites containing Cultural Heritage Value or Interest (CHVI) within the Block and an additional three sites with CHVI within the NHS area. A Stage 3 archaeological assessment has been recommended for each of these sites prior to any development activities (Amick 2007)[4]. For the remainder of Expansion Block C10, only 20% (8.97 ha) of the area retains potential for the recovery of archaeological resources, largely related to areas not previously assessed or areas recommended for further protection and avoidance. However, the eastern part of the Expansion Block (approx. 18 ha) has been cleared of further archaeological concern and does not present any significant archaeological constraints.

From an Environmental perspective, Expansion Block C10 is most preferred on a number of criteria. In terms of transportation, it is also most preferred although access onto Lynden Road may be difficult due to the bridge and grades crossing the railway track. From a water and wastewater servicing perspective, Expansion Block C10 is constrained due to servicing capacity restrictions similar to other options. From a land use perspective, the Expansion Block is adjacent to the existing urban area, but the opportunities for integration are limited due to the lack of connecting roads to the west and the rail corridor to the south and east.

Community Area Expansion Block C11

The archaeological evaluation for Expansion Block C11 assigned a ranking of 11 'least preferred' due to the fact that 91% of the Block's area (8.89 ha) was identified as retaining potential for the recovery of archaeological resources as well as the fact that 109 of the 159 sites in the archaeological sites layer used for this analysis are within 500 metres of this Block. While none of Expansion Block C11 has been subject to previous archaeological assessment, it is assumed that any archaeological assessment will recover archaeological resources related to past use of this area over the last 12,000 years. Providing that archaeological assessment is conducted prior to any development activities, consistent with Ministry of Tourism, Culture and Sport's *Standards and Guidelines for Consultant Archaeologists*, this land has no other significant constraints from an archaeological perspective.

Expansion Block C11 was found to be "constrained" under evaluation of Transportation Principle 1 (To ensure appropriate access and connectivity to new urban areas) and Principle 2 (To ensure appropriate transportation capacity is maintained). Transportation Principle 1 was ranked "supportive of growth" for its ability to provide access and connectivity to arterial road corridors but was found to have "constrained" opportunities for access. Direct access to Mount

[4] AMICK Consultants Limited (2007) Report on the 2006 Stage 1-2 Archaeological Assessment of the Proposed Innes and Welton Subdivision, Part of Lot 42, Concession 2, City of Brantford, Brant County. On file with the Ministry of Tourism, Culture and Sport.

Pleasant Road is an advantage as is the parcel's proximity to downtown. However, access to the Highway 403 and the commercial opportunities in north Brantford are further away. However, significant commercial activities are located in downtown Brantford and therefore this constraint is considered minor.

Transportation Principle 2 ranked Block C11 "very supportive of growth" for its ability to accommodate additional auto and transit but only "supportive of growth" for its potential for opportunity to expand capacity in the future. The alternative received only a "supportive" ranking, because while existing capacity is available via 2-lane Mount Pleasant Road, Mount Pleasant Road will become congested with anticipated growth in the area. The opportunity for widening is limited to a 4-lane cross section as it is constrained by the geography and the effectiveness of a widening is dependent on the capacity of the Grand River crossing. Effectiveness of transit extension into the area would depend on the density of future development south of the Grand River. Transit would require higher density but the available road network would suggest that only lower density development could be supported.

A constraint identified for Block C11 is in regards to the phasing delays related to the overall extension of wastewater servicing to the Tutela Heights area and the need for adjoining sanitary sewer networks to be built first. In regards to stormwater, Block C11 is also identified to have a risk of high groundwater table, with potential coldwater or coolwater receiving watercourses. These constraints can be mitigated through a phasing strategy and by applying appropriate stormwater management facilities.

Community Area Expansion Block C8

As per the evaluation for Agriculture Principle 2, Expansion Block C8 is more constrained than other Community Area Expansion Blocks because of the characteristics of adjacent lands resulting in medium impact levels for soil capability, soil potential, farm infrastructure and possible MDS conflicts. However, these constraints are on adjacent lands outside of the Boundary Adjustment Lands. Further evaluation of potential MDS issues will need to be undertaken in the Master Plan/Secondary Plan stage, which can be addressed through phasing to minimize impact on adjacent agricultural operations.

The environmental and stormwater constraints for Expansion Block C8 are similar to Expansion Block C7. The proposed mitigating measures addressed above for Expansion Block C7 would equally apply to Expansion Block C8.

In terms of land use and servicing, Expansion Block C8 should not proceed before Block 7 to allow for proper servicing and progression of development.

Community Area Expansion Block C6

From an agricultural perspective, Expansion Block C6 is "supportive" of development in terms of soil capability and is "supportive" to "very supportive" for soil capability of adjacent lands with a rank of 2 on Principle A2. It is also "very supportive" in terms of presence of archaeological resources with a ranking of 2.

From a transportation perspective, Expansion Block C6 ranks most preferred on Principle C1 – access and connectivity but medium preferred on capacity due to capacity limitations on Hwy 24 / King George Road. It ranks least preferred on Principle C3 due to difficulties with transit connectivity. This constraint could be improved through transit service along King George Road and Park Road looping through the Block. It is also least preferred on Principle C4 again due to limitations of potential connections to the south. This limitation could be mitigated with a mid-block north-south connection.

From an environmental perspective, Expansion Block C6 is as medium preferred or most preferred on the four Environmental Principles with lower rankings largely due to its relationship abutting the Jones Creek corridor. This relationship can be mitigated through buffers and limited creek crossings.

In terms of servicing, Expansion Block C6 is "constrained" due to requiring services to extend through Block C5 prior to extension to Block C6, and from a wastewater perspective, it is "constrained" due the need for localized sewage pumping stations, limited trunk sewer capacity and the requirement for servicing to cross the NHS. Expansion Block C8 and C10 may also require localized sewage pumping stations. In terms of life-cycle costs, it is similar to other Expansion Blocks including Block C8 on water infrastructure but has potentially high capital costs for wastewater due to more extensive infrastructure.

In terms of stormwater, Expansion Block C6 is moderately preferred except for Principle F3 where it is least preferred due to having to address stormwater from the Trigger Lands. This aspect is a minor constraint, since it is separated from the Trigger Lands by Hwy 24.

From a land use perspective, Expansion Block C6 is least preferred due to the difficulty of integration with other Community Areas due to the intervening NHS. However, this Expansion Block is quite large and can accommodate a range of land uses, which mitigate the need for integration. As well, the extension of Intensification Corridors along Hwy 24 /King George Road and / or along Park Road and the creation of a mid-block north-south collector road could increase the potential integration.

Summary of Preferred Community Area Expansion Blocks

Community Area Expansion Blocks C2, C1, C7, C4, C5 and C11 remain preferred, and most constraints can be mitigated or addressed through phasing and buffering.

Expansion Block C10, although preferred on a number of criteria, will be isolated to a degree due to the lack of direct connections to the adjacent residential neighbourhoods to the west.

Expansion Block C8, although an extension of Expansion Block C7, will be isolated as well due to the lack of adjacent urban areas to the north, east and south. It may also require more extensive wastewater servicing infrastructure. The cost of this servicing infrastructure is not yet known.

Expansion Block C6 is isolated due to the intervening NHS north of Expansion Block N5. However, it is a large Expansion Block which can mitigate the lack of integration. As well, Hwy 24/King George Road, Park Road and a potential mid-block north-south collector road offer opportunities for integration with the rest of the community. The remaining potential constraints are due to required upgrades in servicing infrastructure; the cost of which is not known at this stage.

In order address the potential isolation of Expansion Blocks C6, C8 and C10, and also explore in greater detail servicing solutions and costs for these Expansion Blocks, it is recommended that two Options or grouping of Expansion Blocks be carried forward to the next stage of the Study for potential Settlement Area boundary expansion.

These two Community Area Options include:

- Option 1: C2, C1, C7, C4, C5, C11, C10, and the west portion of C8.
- Option 2: C2, C1, C7, C4, C5, C11 and the south portion of C6.

In terms of total land area, Option 1 comprises 493 hectares, which exceeds the land needs by 33 hectares. Block C8 was the least preferred of the Blocks in Option 1 and is surrounded on three sides by rural and Natural Heritage System lands. In addition, the eastern portion of Block C8 slopes to the east, and a more complicated servicing solution including potential pumping stations would be required to bring these lands into urban use. In view of these constraints, Block C8 was reduced to include only its western portion in order to meet the 460 hectare Community Area land needs requirement. The resulting boundary of Option 1 is shown on Figure 3.

Option 2 comprises 540 hectares, which exceeds the land needs by 80 hectares. In this Option, Block C6 was the least preferred Block. Block C6 is constrained by an adjacent livestock operation east of Park Road and a high point mid-way along the block that results in more complicated servicing solutions closer to Governors Road. Maintaining the southern half of Block C6 within Option 2 allows for 3 collector road access points and a simpler servicing solution with fewer potential pumping stations. The resulting boundary of Option 2 is shown on Figure 4.

In the next stage of the Study, the two Groupings will be assessed to determine which is the preferred option for Community Area Settlement Area boundary expansion

Figure 3: Potential Employment Area and Community Area Option 1
Settlement Area Boundary Expansion -
City of Brantford

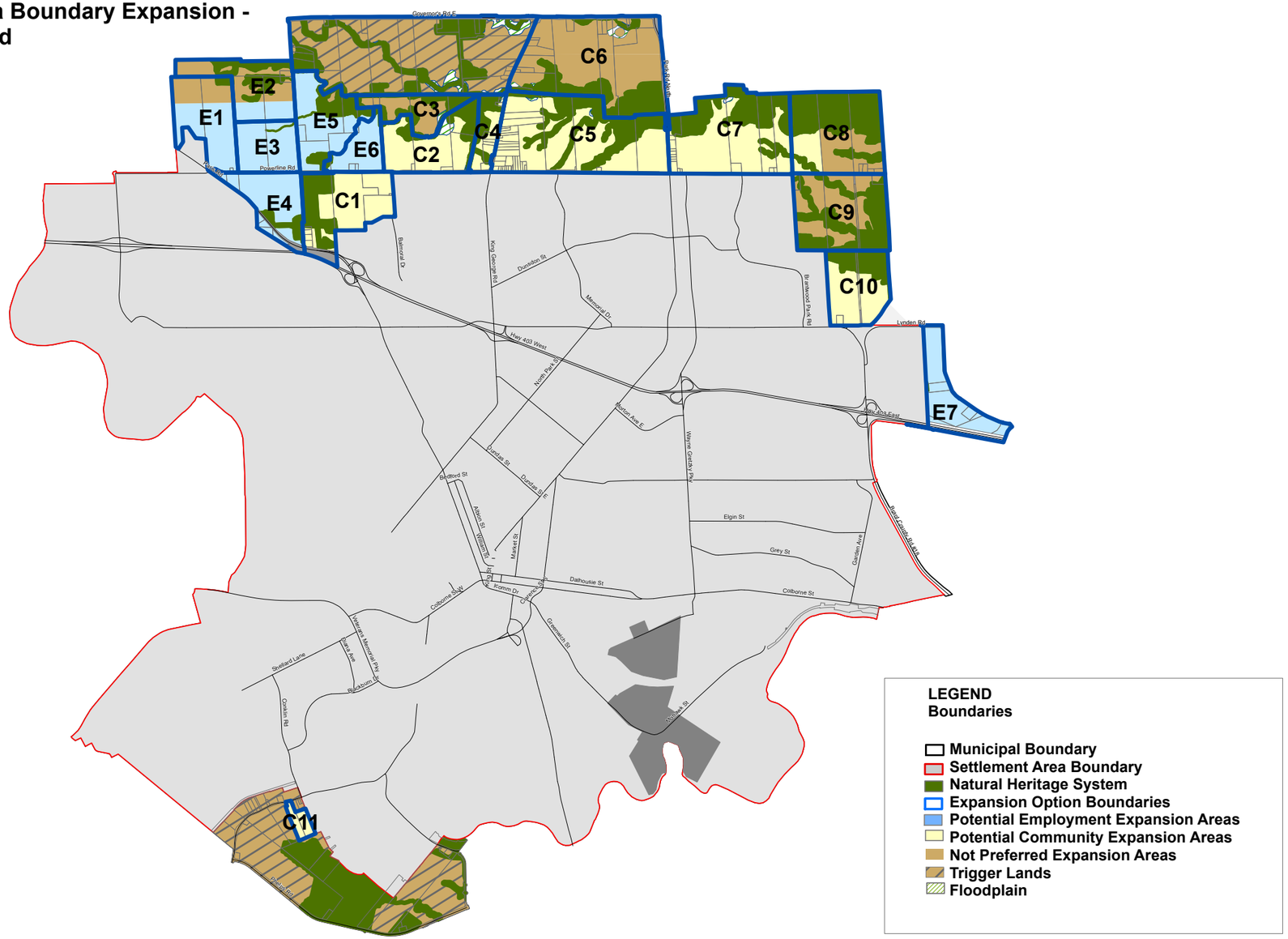
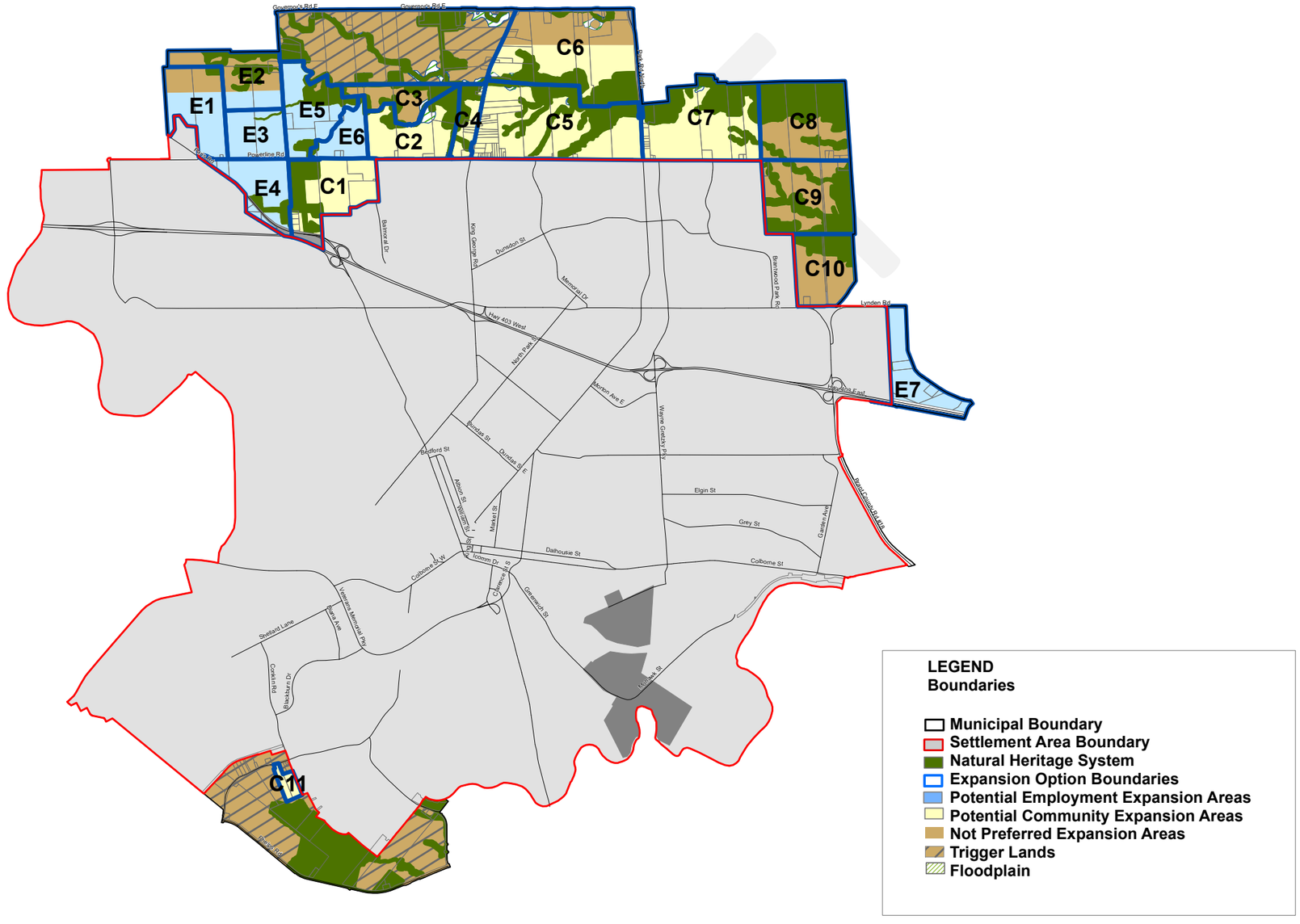


Figure 4: Potential Employment Area and Community Area Option 2 Settlement Area Boundary Expansion - City of Brantford



4.2 ASSESSMENT OF PREFERRED EMPLOYMENT AREA BLOCKS

Employment Area Expansion Block E4

Expansion Block E4 is identified as the most preferred Employment Area Expansion Block, although some minor constraints have been identified. In regards to the agricultural evaluation, Expansion Block E4 has a Class 3 soil capability and high soil potential with 70% of the Block area currently in active agricultural use. 23% of lands adjacent to Expansion Block E4 are in active agricultural use and have class 2 and 3 soil capability and high soil potential. However, all Expansion Blocks have class 1 through 3 soils and have some active agricultural use on or adjacent to the Block.

From an archaeological standpoint, Expansion Block E4 is 'most preferred' as 96% of the Block area has been subject to previous archaeological assessment and cleared of further concern. Expansion Option E4 also ranks highly in regards to transportation, requiring minimal change to infrastructure and service to accommodate employment development.

Expansion Option E4 also ranks relatively high in regards to environmental criteria, due to the fact that it is mainly comprised of cultivated agricultural land, however Expansion Block E4 does have some presence of an important woodlot/wetland connection at the south end, which could be mitigated by providing a sufficient buffer between it and future development. In regards to water and wastewater, Expansion Block E4 is ranked 'most preferred' as trunk servicing for the Employment Area Expansion Blocks will need to be passed through Expansion Blocks E4 and E1.

Expansion Block E4 is "constrained" on Principle F1 due to the presence of key hydrological areas (SGRA, HVA) and a potential high groundwater table, which will make servicing the Block difficult and result in land use restrictions. These constraints can be mitigated but will require higher cost of servicing and monitoring.

In regards to land use evaluation, Expansion Block E4 is 'most preferred' due to its proximity to adjacent employment uses and connection to Highway 403.

Employment Area Expansion Block E7

Expansion Block E7 is among the most preferred Expansion Blocks, however the following constraints have been identified. In regards to agricultural evaluation, Expansion Block E7 has high soil capability for common field crops and soil potential for limited fruits and vegetables. In addition, 95% of the Expansion Block area was identified as currently in active agricultural use, while 86% of the adjacent bounding area was found to have active agricultural use. In regards to the archaeological assessment, Expansion Block E7 was assigned a ranking of 7 due to the presence of four archaeological sites containing Cultural Heritage Value or Interest (CHVI) within the Block area and an additional two sites with CHVI within the NHS area. A Stage 3 archaeological assessment has been recommended for each of these sites prior to any

development activities (Amick 2017)[5]. However, at the time of this analysis, a final report of the assessments conducted within and adjacent to this property was not available. Therefore, while the general archaeological potential model created for this evaluation identified 97% of the Expansion Block area (42.98 ha) as retaining potential for the recovery of archaeological resources, it is unknown whether any of these areas have been subject to archaeological assessment and cleared of further archaeological concern. For any portions of Expansion Block E7, which have not been subject to previous archaeological assessment, archaeological assessments should be conducted prior to any development activities, consistent with Ministry of Tourism, Culture and Sport's *Standards and Guidelines for Consultant Archaeologists*.

The transportation evaluation of Principle 2 for Expansion Block E7 ranked "very supportive" of growth for its ability to accommodate additional auto and transit but only "supportive" of growth for its potential for opportunity to expand capacity in the future. The alternative received only "supportive" ranking because the geography/layout of the parcel limits its connections to the road network and transit service to Lynden Road via Adams Road. Adams road is a 2-lane collector road, which would require upgrading to support development. Lynden Road is an arterial road, which provides access to Highway 403 via Garden Avenue. The Lynden Road geometry approaching Garden Avenue is not appropriate for high volumes of traffic or for the truck traffic that could be expected with the development of an employment / industrial area. Improvements would be required to the roadway surface, cross section and geometry to facilitate increased employment development and potential for transit service extension. These upgrades would be complicated by the physical geography of the area (associated grades, location and orientation of the rail corridor), requiring significant engineering and construction costs. However, these improvements are required for the adjacent Hopewell lands, which are already within the existing Settlement Area boundary.

Expansion Block E7 is 'most preferred', due to its proximity and integration with the adjacent servicing needs on the Hopewell lands. A servicing extension to the new Hopewell employment area adjacent to Expansion Block E7 will require a new pump station and force main, as well as sewer upgrades within the City. The required upgrades to extend sanitary services to the new Hopewell employment area will support service extension to Expansion Block E7. In regards to stormwater evaluation, Expansion Block E7 has limited constraints and will be serviced conventionally. Minor changes will be required to the watershed and subwatershed boundaries as per the new assessment under the Ontario Drainage Act.

In regards to the land use evaluation Expansion Block E7 is identified as 'most preferred' as it is adjacent to existing Employment uses, has good visibility and is well connected to Highway 403.

[5] AMICK Consultants Limited (2017) Stage 1-3 Archaeological Investigation of the Proposed Subdivision Development Southeast of Lynden Road and Garden Avenue, Part of Lots 43 and 44, Concession 3, City of Brantford, Brant County. On file with the Ministry of Tourism, Culture and Sport.

Employment Area Expansion Block E3

Agricultural evaluation of Expansion Block E3 on Principle A1 is found to be 'least preferred' because the Expansion Block has high on-site values for soil capability (class 2), soil potential, active agricultural use (93%) and number of farm building clusters. However, all Expansion Blocks have class 1 through 3 soils and are in active agricultural use. Further evaluation of potential MDS issues for the farm building clusters will need to be undertaken in the Master Plan/Secondary Plan stage which can be addressed through phasing to minimize impact on agricultural operations.

The constraints identified for E3 are in regards to a small significant groundwater recharge area (SGRA) in the Block, which discharges to a medium sensitivity stream that is potentially a coldwater stream. Water and wastewater servicing is also dependent of the servicing of adjacent Expansion Blocks. These constraints can be mitigated with relatively low to moderate cost and risk and is also dependent on development of adjacent Expansion Blocks.

Employment Area Expansion Blocks E5

Expansion E5 is identified as 'most preferred' on agriculture as it does not have prime agricultural land or the presence of agricultural services for production. The environmental evaluation ranks the Expansion Option as 'medium preferred' due to the potential for infrastructure crossing a riparian corridor between Blocks E5 and E6 that links a large woodland in Expansion Block C1 to Jones Creek. This constraint could be mitigated by providing a sufficient buffer along the watercourse and avoid and/or minimize creek crossings for essential infrastructure. Principle D2 evaluated Expansion Block E5 in regards to protecting and enhancing surface water quality and quantity. It ranked 'medium preferred' because it is located near the headwaters of Jones Creek and in close proximity to a groundwater recharge zone. This constraint can be mitigated by maintaining and/or enhancing pre-development groundwater recharge through Low Impact Development measures. In regards to Expansion Block E5's ranking for Principle D3, the constraint exists due to a riparian corridor that provides an important connection between a large woodlot in Expansion Block C1 and Jones Creek. In order to mitigate this constraint, the connection should be maintained/enhanced through provision of an appropriate creek block width and avoid/minimize crossings for essential infrastructure.

Water and wastewater servicing of Expansion Block E5 is also dependent on extending servicing through either Expansion Block E3 or E1. These constraints can be mitigated but may increase the servicing complexity and cost, and it will also require a phasing strategy.

Expansion Block E5 also ranked 'medium preferred' in regards to stormwater conditions. Expansion Block E5 is considered "constrained" due to it discharging into medium sensitivity streams that are potentially coldwater streams, and it has a relatively high drainage density of

headwater drainage features. Drainage networks in the Expansion Block also include watercourses from outside the defined Natural Heritage System and include additional potential headwater drainage features. In order to manage this constraint, the headwater drainage feature functions should be replicated through low impact development and stormwater management measures. The City/developers should also consider cumulative impact from upstream development for all watercourses within the Expansion Block and identify mitigation measures. Opportunities may also exist to enhance the existing channel form and function through channel realignment and restoration.

Employment Area Expansion Block E6

In relation to agricultural evaluation, Expansion Block E6 is identified as 'most preferred' as it does not have prime agricultural land or the presence of agricultural services for production. Expansion Block E6 ranked 'least preferred' for archaeology due to the fact that more than 70% of the Block area was identified as having archaeological potential. Further archaeological assessments will be required prior to development, but is not a constraint to development.

Expansion Block E6 ranked relatively well in regards to the transportation evaluation, however the shape of the lot and the natural heritage system features constrain network connection opportunities, although this is manageable.

From an environmental perspective, Expansion Block E6 is identified as "constrained" due to its relationship with Jones Creek and the presence of headwater features and hedgerows that provide a linkage function between natural features. This constraint could be mitigated by providing a sufficient buffer along the watercourse and by avoiding and/or minimizing creek crossings for essential infrastructure. Expansion Block E6 is identified as preferred from the standpoint of significant wildlife features and functions as the lands are mainly cultivated agricultural land.

In regards to water and wastewater evaluation, Expansion Block E6 is dependent on extending servicing through either Block E3 and E5, or to the south and east through the Community Area Blocks. This constraint can be mitigated through a phasing strategy; however, it may also increase the servicing complexity and cost.

The stormwater evaluation for Expansion Block E6 concludes that there are no downstream constraints, however due to the shape of Expansion Block E6 and the drainage split, stormwater servicing will likely consist of on-site controls directly discharging to the creeks. There is also a risk of a high groundwater table in some locations. These constraints will need to be considered and investigated during future stages of planning and development.
In regards to the land use evaluation, Expansion Block E6 is identified as 'least preferred' due to the fact that it is not adjacent to existing employment areas, however this constraint will be

mitigated through the build out of Block E5. The Expansion Block also has poor visibility to Highway 403 and is relatively far from the highway and should be phased accordingly.

Employment Area Expansion Block E1

The agricultural evaluation, for Principle 1 and 2, classified Expansion Block E1 as least preferred. Block E1 is "constrained" because the Expansion Block has the highest value for soil capability (class 2), soil potential, and active agricultural use (95%). The lands adjacent to Block E1 have high soil capability and soil potential and active agricultural use. However, all Expansion Blocks have class 1 through 3 soils and are in active agricultural use.

The transportation evaluation of Expansion Block E1 for Principle 2 (to ensure appropriate transportation capacity is maintained) ranked "supportive of growth" for its ability to accommodate additional auto and transit and for its potential for opportunity to expand capacity in the future. The alternative received only "supportive of growth" ranking because although it is in close proximity to the arterial network, it has limited frontage to Powerline Road and lack of frontage on Paris Road. The capacity of 2-lane Paris Road is expected to be constrained in the future. A widening of Paris Road and Powerline Road would be required to accommodate future development. Widening is easier for Paris Road than Powerline Road, which would be difficult due to the geometry and grades at the Paris Road / Powerline Road intersection. If future lands to the east developed earlier, opportunities to connect to new arterial and/or collector roads would be realized.

Expansion Block E1 ranked "supportive of growth" on Transportation Principle 3 for its ability to provide opportunities for potential new areas to connect with transit service but "constrained" for its ability to provide opportunities for potential new areas to connect with active transportation networks. With Block E1's location in the northeast quadrant of Brantford, it is well removed from most activity centers and urban corridors. The nature of its remote location makes connecting the area to an active mode system difficult. Transit would be easier to connect via Powerline Road. Again, if Block E1 were to come on line as a later phase, infrastructure and service from adjacent parcels could be extended to connect the system more easily and efficiently.

Finally, Expansion Block E1 ranked "supportive of growth" on Transportation Principle 4 for its ability to connect infrastructure across parcel boundaries to adjacent properties. The area access is limited effectively to frontage along Powerline Road. The success of this area would be dependent on its ability to connect to other areas. The only areas that provide effective opportunities to connect with are Expansion Blocks E2 and E3. However, E2 has natural areas, which constrain it, leaving E3 as a more viable opportunity. The Southern portion of Block E1 is less constrained from a connectivity perspective than the northern portion.

Expansion Block E1 requires complex stormwater management as the Expansion Block has no

defined channel, with part of the Block draining to a local depression rather than a watercourse. The Expansion Block also coincides with a significant groundwater recharge area (SGRA). Drainage outlet for the Expansion Block is dependent on the development of adjacent Blocks, as is water and wastewater trunk servicing extension. The Southern portion of Expansion Block E1 would be more preferred than the northern portion as infrastructure would extend in from the South. The constraints could also be mitigated by identifying a phasing and stormwater management strategy; however, these mitigation measures will lead to a higher cost of servicing and monitoring.

Employment Area Expansion Block E2

The agricultural evaluation identifies that 67% of Expansion Block E2 is in active agricultural use, however there are no greenhouses for fruit or vegetables. Expansion Block E2 also has high soil capability for common field crops (class 1). The lands adjacent to Expansion Block E2 have moderate soil capability and soil potential with 74% of lands bounding Expansion Block E2 found to have active agricultural uses. However, as previously mentioned, all Expansion Options have class 1 through 3 soils and have some active agricultural use on or adjacent to the Expansion Option.

From an archaeological perspective, Expansion Block E2 is ranked 'medium preferred' due to the higher proportion of the lands within an area of archaeological potential. Further archaeological assessments will be required in order to mitigate this constraint.

In regards to the transportation evaluation, Expansion Block E2 is identified as 'least preferred' due to the various natural heritage features within the Block area. These features will limit connectivity and network continuity for all modes of transportation, however these constraints are manageable and can be overcome.

From an environmental standpoint, Expansion Block E2 is considered least preferred for Principle 1 due to its proximity to provincially significant wetlands and headwater drainage features. Expansion Block E2 is also constrained due to its proximity to the headwaters of Jones Creek, a groundwater recharge zone and significant wildlife habitat features.

Water and wastewater evaluation for Expansion Block E2 identify moderate constraints that are mainly due to the Block's dependence on adjacent Expansion Blocks for servicing. These constraints can be mitigated through phasing with relatively low to moderate cost and risk.

In regards to stormwater, Expansion Block E2 is ranked low due to the fact that it drains to isolated provincially significant wetlands. Therefore, stormwater servicing in this Block may require more end-of-pipe facilities, additional LID practices, greater level of study, and an increase in monitoring. Expansion Block E2 also has a SGRA component and development partly depends on Expansion Block E5, therefore a phasing strategy will be required.

In regards to the land use evaluation, Expansion Block E2 is identified as 'least preferred' due to the fact that it is not adjacent to existing employment areas, however this constraint will be mitigated through the build out of adjacent Expansion Blocks E1, E3 and E5. The Block also has poor visibility to Highway 403 and is relatively far from the highway and should be phased accordingly.

Summary of Preferred Employment Area Expansion Blocks

Employment Area Expansion Blocks E4, E7, E3, E5, E6 and E1 remain preferred, and most constraints can be mitigated or addressed through phasing and buffering.

These preferred Expansion Blocks total slightly more than 336 hectares. In order to closely meet the 336 hectare land need requirement, only the southern portions of Expansion Blocks E1 and E2 are included in the preferred Employment Settlement Area boundary expansion as shown on **Figures 3 and 4**.

5 CONCLUSION AND NEXT STEPS

The Envisioning Brantford Municipal Comprehensive Review Part 2 Report has identified a number of preferred Blocks for Settlement Area boundary expansion to accommodate the land needs for 460 hectares of Community Area lands and 336 hectares of Employment Area lands.

The evaluation of the Community Area Expansion Blocks identified two potential Options or grouping of Blocks. Option 1 shown on **Figure 3** includes Expansion Blocks C2, C1, C7, C4, C5, C10, C11 and the western portion of Block C8. Option 2 shown on **Figure 4** includes Expansion Blocks C2, C1, C7, C4, C5, C11 and the Southern portion of Block C6.

Two Options were selected due to the need for more detailed analysis on servicing solutions and costs and means to integrate the Expansion Blocks and mitigate potential isolation. These two Options will be carried forward to the next stage of the study where detailed land uses, transportation networks and servicing options will be prepared and evaluated to determine the preferred Settlement Area boundary expansion, as well as the preferred land uses, transportation network and servicing solution.

The preferred Employment Area Expansion Blocks are shown on **Figures 3 and 4** and include Expansion Blocks E4, E7, E3, E5, E6, and the southern portions of Blocks E1 and E2.

Stage 6 of Envisioning Brantford involves the preparation of a Master Plan/Secondary Plan for the Settlement Area boundary expansion lands. In this Stage, further evaluation of the two Community Area Expansion Options will be undertaken and will include identifying, in more detail, the constraints and developable potential within each Option. As a result, further refinement and determination of the preferred Settlement Area boundary expansion (i.e., Option 1 versus Option 2) will be undertaken in Stage 6.

Appendix A

Detailed Evaluation Matrix – Community Area and Employment Area Expansion Blocks

Ranking Scheme: Most Preferred (1) to Least Preferred (11) **Very Supportive** **Supportive** **Constrained**

A) Agriculture

Principle A1) Identify the better versus the poorer agricultural areas within each Block and to retain those better areas in agriculture as long as possible.

Blocks	Criterion				Rank
	1) Block average soil capability	**2) Block average soil potential**	**3) Block agricultural land use**	**4) Block agricultural infrastructure**	
C1	Soil capability for common field crops (corn, wheat, oats etc.) Class 2	Soil potential for limited fruits and vegetables higher	52% of block area in active agricultural use (cultivated crops, hay, pasture)- no greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately high relative to the block area (size)	**10**
C2	Soil capability for common field crops below Class 3	Soil potential for limited fruits and vegetables higher	56% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately low relative to the block area (size)	**3**
C3	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables higher	40% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately low relative to the block area (size)	**6**
C4	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	28% of block area in active agricultural use (cultivated crops, hay, pasture) - small area of greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately low relative to the block area (size)	**2**
C5	Soil capability for common field crops Class 2	Soil potential for limited fruits and vegetables higher	63% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately moderate relative to the block area (size)	**9**
C6	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	62% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of farm building clusters including barns including barns is proportionately moderate relative to the block area (size)	**6**
C7	Soil capability for common field crops Class 2	Soil potential for limited fruits and vegetables medium	55% of block area in active agricultural use (cultivated crops, hay, pasture) - high amount of greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately high relative to the block area (size)	**11**
C8	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	35% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately high relative to the block area (size)	**6**
C9	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	52% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately moderate relative to the block area (size)	**3**
C10	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	61% of area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	No barn facilities	**3**
C11	Soil capability for common field crops below Class 3	Soil potential for limited fruits and vegetables low	84% of area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	No barn facilities	**1**

Principle A2) Identify the better versus the poorer agricultural areas adjacent or near to the boundary expansion blocks and to minimize impacts of non-agricultural uses proposed in the Annex lands on the better agricultural areas identified

Blocks	Criterion				Rank
	1) Average block boundary soil capability	**2) Average block boundary soil potential**	**3) Block boundary agricultural land use**	**4) MDS implications**	
C1	Soil capability for common field crops Class 2	Soil potential for limited fruits and vegetables higher	20% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**10**
C2	Soil capability for common field crops Class 2	Soil potential for limited fruits and vegetables higher	1% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**7**
C3	Soil capability for common field crops Class 2	Soil potential for limited fruits and vegetables higher	Less than 1% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately high relative to the block boundary (length)	**11**
C4	Soil capability for common field crops Class 2/3	Soil potential for limited fruits and vegetables medium	Less than 1% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**6**
C5	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables lower	8% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**1**
C6	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables lower	24% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**2**
C7	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables lower	16% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately medium relative to the block boundary (length)	**4**
C8	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	35% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately medium relative to the block boundary (length)	**9**
C9	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	32% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**7**
C10	Soil capability for common field crops Class 3	Soil potential for limited fruits and vegetables medium	33% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately medium relative to the block boundary (length)	**5**
C11	Soil capability for common field crops below Class 3	Soil potential for limited fruits and vegetables low	69% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**2**

Principle A3) Avoid impacts on the agri-food network or if not possible to minimize and mitigate impacts.

Blocks	Criterion		Rank
	1) Presence of agricultural services within the expansion area (i.e. distributors, veterinarians, farm supply, machinery repair, grain dryers, value added food processing etc.)	**2) Impact on unique agricultural services as defined in criterion 1 beyond the boundaries associated with each block.**	
C1	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C2	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C3	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C4	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C5	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C6	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C7	None of the agricultural services are present within the block area	Relatively high effect due to an on-farm retail sales building in conjunction with the effect on agricultural system economics due to a reduction in agricultural land and infrastructure	**11**
C8	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C9	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C10	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**
C11	None of the agricultural services are present within the block area	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure	**1**

Ranking Scheme: Most Preferred (1) to Least Preferred (11) **Very Supportive** **Supportive** **Constrained**

B) Archaeology

KEY: GREEN – 0-35%; YELLOW – 35-70%; RED – 35-100% GREEN – no registered sites in Blocks Area/ sites have been removed; YELLOW – 0-3 unmitigated sites in blocks or NHS area; RED – 4+ unmitigated sites in blocks or NHS area

Principle B1) To protect and avoid archaeological resources and areas of potential for the presence of archaeological resources, and where avoidance is not possible to assess and mitigate the archaeological resources.

Blocks	Criterion		Rank
	1) The number of known archaeological resources	**2) The relative area of lands outside of NHS with archaeological potential to be affected**	
C1	**5** [AhHb-214-AhHb-218] **all sites have been mitigated.** 75 percent (41.25 ha) of the Blocks area has been subject to previous archaeological assessment and cleared of further concern.	**11.24 ha** (20.4% of 54.99 ha)	**1**
C2	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**20.36 ha** (46% of 44.10 ha)	**2**
C3	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**17.12 ha** (80% of 21.39 ha)	**7**
C4	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**10.81 ha** (99% of 10.86 ha)	**8**
C5	**2 in area of potential** [AhHb-64; AhHb-65] all sites mitigated. Two percent of the Blocks (2.48 ha) area has been subject to previous archaeological assessment and cleared of further concern.	**98.42 ha** (70% of 140.57 ha)	**5**
C6	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**62.891 ha** (49% of 129.22 ha)	**2**
C7	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**41.89 ha** (45% of 92.26 ha)	**2**
C8	1 in NHS area [AhHb-150 **– contains CHVI**].	**29.67 ha** (63% of 46.5 ha)	**6**
C9	1 in NHS area [AhHb-149 **– contains CHVI**].	**30.06 ha** (89% of 33.75 ha)	**10**
C10	3 in area of potential [AhHb-144; AgHb145; AhHb-146; – **contains CHVI];** 3 in NHS area and blocks area [AhHb-147; AhHb-148; AhHb-152 – no CHVI].	**8.97 ha** (20% of 45.6 ha) ** ****the three archaeological sites within the blocks areas require further assessment – with a 70m buffer around each site, this equates to the 9ha area of potential/monitoring area.***	**9**
C11	0 sites. None of the Blocks area has been subject to previous archaeological assessment. However, this area is 500 m from centre of Riverbend cluster (109 of the 159 sites in dataset. Many archaeological assessments have taken place within the vicinity of this Blocks area – almost all identify archaeological resources.	**8.01 ha** (91% of 8.89 ha)	**11**

C) Transportation

Ranking Scheme: Most Preferred (1) to Least Preferred (11) 🟢 **Very Supportive** 🟡 **Supportive** 🔴 **Constrained**

Principle C1) To ensure appropriate access and connectivity to new urban areas.

Blocks	Criterion		Rank
	1) Ease of connectivity to arterial corridors and Highway 403 – number of accesses needed versus that can be facilitated, ability to provide good access, frontage on arterials	**2) Constraints to connectivity and access (e.g. physical features)** – physical constraint / parcel shape impact on collector road framework	
C1	- Good access to Powerline Road - Good proximity to Hwy 403 🟢	- Block shape constrained by natural features - Frontage along Powerline Road limited - Connections to existing development good 🟡	**3**
C2	- Good access to Powerline Road - Good proximity to Hwy 403 🟢	- Shape of block can accommodate network - Good frontage along Powerline Road 🟢	**1**
C3	- Access to arterial limited by natural features 🔴	- natural area limits network development potential 🔴	**10**
C4	- Good access to Powerline Road - Good access to Hwy 24 - Good proximity to Hwy 403 🟢	- Shape of block can accommodate network access - Good frontage along Hwy 24 🟡	**3**
C5	- Good access to Powerline Road - Good access to Hwy 24 - Good proximity to Hwy 403 🟢	- Shape of block can accommodate network - Good frontage along Powerline Road - Physical features limit flexibility 🟡	**3**
C6	- Good access to Hwy 24 - Good access to Park Road N. - Good proximity to Hwy 403 🟢	- Shape of block can accommodate network access - Good frontage along Hwy 24 - Good frontage along Park Road N - Physical features limit flexibility 🟡	**3**
C7	- Good access to Powerline Road - Good access to Park Road N - Good proximity to Hwy 403 🟢	- Shape of block can accommodate network access - Good frontage along Powerline Road - Good frontage along Park Road N - Physical features limit flexibility 🟡	**3**
C8	- Good access to Powerline Road - Good proximity to Hwy 403 🟢	- Shape of block can accommodate network access - Good frontage along Powerline Road - Physical features limit flexibility 🟡	**3**
C9	- Access to arterials limited 🔴	- Shape of block limits network potential - Physical features constrain flexibility 🔴	**10**
C10	- Good access to Lynden Road - Good access to Garden Ave - Good proximity to Hwy 403 🟢	- Shape of block can accommodate network access - Good frontage along Lynden Road 🟢	**1**
C11	- Good access to Mt Pleasant Road - Proximity to Hwy 403 not good 🟡	- Shape and size of block limits flexibility 🟡	**9**

Principle C2) To ensure appropriate transportation capacity is maintained.

Blocks	Criterion		Rank
	1) Ability of the existing/planned transportation and transit capacity to accommodate new trips – existing constraints to capacity, planned expansion in corridors	**2) Availability of opportunities to expand capacity if needed** – additional capacity expansion	
C1	- Good capacity along Powerline Road	- Powerline Road expansion potential	**1**
C2	- Good capacity along Powerline Road	- Powerline Road expansion potential	**1**
C3	- Proximity to Powerline Road with good capacity	- Remote area - Connections to arterial system limited	**10**
C4	- Capacity along Hwy 24 / King George Road limited	- Hwy 24 / King George Road potential limited	**10**
C5	- Good capacity along Powerline Road	- Powerline Road expansion potential	**1**
C6	- Capacity along Hwy 24 / King George Road limited	- Connections to appropriate road infrastructure - Proximity and connections to natural features good	**7**
C7	- Good capacity along Powerline Road	- Powerline Road expansion potential	**1**
C8	- Good capacity along Powerline Road	- Powerline Road expansion potential	**1**
C9	- Good capacity along Powerline Road	- Remote area - Connections to system limited	**9**
C10	- Good capacity along Lyndon Road - Good capacity along Garden Avenue	- Lyndon Road expansion potential - Garden Avenue extension / expansion potentiel	**1**
C11	- Good Capacity along Mt Pleasant Road	- Mt Pleasant expansion potential limited	**7**

Principle C3) To balance transportation needs and provide choice for the travel needs of residents.

Blocks	Criterion		Rank
	1) Ability to provide opportunities for potential new areas to connect with transit service – transit service extension logical	**1) Ability to provide opportunities for potential new areas to connect with active transportation networks** – active modes recreation versus utilitarian different from transit, utilitarian connection to appropriate roadway functions, recreational connection to multi-use trail opportunities	
C1	- Expansion of transit service and coverage can be accommodated easily 	- Connections to appropriate road infrastructure - Proximity and connections to natural features good 	**1**
C2	- Expansion of transit service and coverage can be accommodated easily 	- Connections to appropriate road infrastructure - Proximity and connections to natural features good 	**1**
C3	- Expansion of transit coverage difficult – connections, access 	- Remote area - Connections to system limited 	**10**
C4	- Expansion of transit service and coverage can be accommodated easily 	- Proximity and connections to natural features good 	**6**
C5	- Expansion of transit service and coverage can be accommodated easily 	- Connections to appropriate road infrastructure - Proximity and connections to natural features good 	**1**
C6	- Expansion of transit coverage difficult – connections, access 	- Proximity and connections to natural features good 	**9**
C7	- Expansion of transit service and coverage can be accommodated easily 	- Connections to appropriate road infrastructure - Proximity and connections to natural features good 	**1**
C8	- Expansion of transit service less efficient due to distance from other transit routes and limitation on route blocks 	- Connections to appropriate road infrastructure - Proximity and connections to natural features good 	**6**
C9	- Shape of block not conducive to service expansion - Significant physical constraints 	- Proximity and connections to natural features good 	**10**
C10	- Expansion of transit service less efficient due to distance from other transit routes and limitation on route blocks 	- Connections to appropriate road infrastructure - Proximity and connections to natural features good 	**6**
C11	- Expansion of transit service and coverage can be accommodated easily 	- Connections to appropriate road infrastructure - Proximity and connections to natural features good 	**1**

Principle C4) To ensure transportation network continuity between existing and new areas.

Blocks	Criterion	Rank
	1) Degree of dependency of potential expansion areas to other adjacent urban areas (i.e. an isolated area with higher needs to service vs. areas with better synergies) – ability to connect infrastructure across parcel boundary, support / benefit from adjacent properties	
C1	- Good potential for connections to adjacent areas 	**1**
C2	- Good potential for connections to adjacent areas 	**1**
C3	- Connections to adjacent areas problematic because of prevailing physical features 	**10**
C4	- Good potential for connections to adjacent areas 	**1**
C5	- Good potential for connections to adjacent areas 	**1**
C6	- Efficiency of connections to adjacent areas limited 	**8**
C7	- Good potential for connections to adjacent areas 	**1**
C8	- Good potential for connections to adjacent areas 	**1**
C9	- Connections to adjacent areas problematic because of prevailing physical features 	**10**
C10	- Efficiency of connections to adjacent areas limited 	**8**
C11	- Good potential for connections to adjacent areas 	**1**

D) Environment

Ranking Scheme: Most Preferred (1) to Least Preferred (11) 🟢 **Very Supportive** 🟡 **Supportive** 🔴 **Constrained**

Principle D1) To protect, enhance and restore the NHS for the long-term along with existing linkage connections between the NHS and NHS features within Brant County and the existing urban area.

Blocks	Criterion						Rank
	1) Ability to maintain the overall integrity and connectivity of the NHS including the minimum 30 m buffers	**2) Ability to maintain connections to NHS features with the existing built up urban areas and adjacent rural lands (Brant County)**	**3) Ability to enhance the NHS through restoration of "adjacent lands" (in conjunction with compatible urban uses)**	**4) Ability to reduce the fragmentation of the NHS and habitat loss through road and servicing crossings of valleylands, woodlands and watercourses**	**5) Ability to integrate major hedgerows, woodland lobes, and small, isolated woodlands/wetlands (plus 30 m buffers) that are identified as part of the NHS**	**6) Ability to offset the removal of NHS features and/or reduced buffers (e.g. hedgerows, woodland lobes, headwater drainage features, and small, isolated woodlands/ wetlands) through restoration initiatives within or outside of the proposed urban areas.**	
C1	hedgerows may pose a challenge 🟢	in conjunction with E4, E5 and E6 🟢	floodplain restoration opportunity 🟢	watercourse crossings 🟡	hedgerows may pose a challenge 🟢	floodplain restoration opportunity 🟢	**1**
C2	Jones Creek forms North edge 🟡	requires watercourse restoration 🟢	watercourse/floodplain restoration opportunity 🟢	connected to C3 🔴	mainly cultivated 🟢	mainly cultivated 🟢	**4**
C3	surrounded by NHS features 🔴	surrounded by NHS features 🔴	habitat and linkage restoration opportunity. Open space uses preferred 🟢	crossing of Jones Creek required 🔴	some hedgerow removal required 🟡	this area could accommodate habitat off-setting for majority of annexed lands 🟢	**7**
C4	mosaic of cultural habitat with wetlands to the west and north 🟡	linkages associated with drainage features 🟡	opportunities for watercourse/linkage restoration 🟡	none required 🟡	features protected 🟡	PSW and watercourse setbacks 🟡	**4**
C5	hedgerow and drainage features pose challenges 🔴	some headwater drainage feature connections not ID as part of the NHS 🔴	for headwater drainage features to be retained and valley/woodland edge 🟢	crossing of Jones Creek to access C6? 🔴	hedgerow configuration poses challenges 🔴	through watercourse restoration and buffer naturalization 🟢	**4**
C6	headwater drainage feature traverses the area 🟡	east-west linkage maintained 🟢	headwater drainage feature, woodland/valleyland edges 🟢	crossing of Jones Creek to access C5? 🔴	some features will pose challenges 🟡	possible with watercourse and woodland/valleyland edge restoration 🟢	**4**
C7	High - Jones Creek forms North edge, drainage feature with wetlands in center of block 🟡	Jones Creek forms North edge 🟢	in conjunction with drainage features 🟢	Jones Creek forms North edge, central watercourse poses challenges 🟡	some features pose challenges 🟡	in conjunction with watercourse and edge restoration 🟢	**7**
C8	High - Jones Creek forms North edge, drainage feature with wetlands at S end of block 🟡	east-west linkage associated with drainage features 🟢	in conjunction with drainage features 🟡	drainage feature at South end poses challenges 🟡	some features will pose challenges 🟡	in conjunction with watercourse and edge restoration 🟡	**7**
C9	tributaries to Fairchild Creek with riparian wetlands plus buffers pose challenges 🟡	in association with drainage features 🟢	in conjunction with drainage features 🟡	watercourses (3) will pose a challenge. Potential connection to C10 🔴	NHS feature mainly associated with watercourses 🟡	in conjunction with watercourse and edge restoration 🟡	**7**
C10	woodland/wetlands associated with Fairchild Creek tributary 🟢	in conjunction with tributary 🟢	in conjunction with watercourse and isolated wetlands 🟡	potential connection to C9 🔴	hedgerows and isolated wetlands will pose a challenge 🟡	in conjunction with NHS buffers 🟡	**1**
C11	mainly cultivated with cultural meadow 🟢	no strong connections present 🟢	mainly cultural in character. Key features beyond area 🟢	no features or corridors present 🟢	no features present 🟢	no features present 🟢	**1**

Principle D2) To protect and enhance surface water quality/quantity including fish habitat.

Blocks	Criterion		Rank
	1) Ability to maintain wetland hydrology through groundwater recharge and surface water contributions.	**2) Ability to maintain and enhance coldwater fish habitat (Jones Creek) and other fish habitat features**	
C1	limited wetland cover	headwater drainage feature present	**1**
C2	mainly cultivated, headwater drainage features support wetlands	headwater drainage feature supports Jones Creek	**3**
C3	wetlands associated with Jones Creek	Jones Creek forms South boundary	**6**
C4	wetlands associated with tributaries and Jones Creek	Jones creek forms West boundary	**3**
C5	wetlands associated with Jones Creek	Jones Creek forms North edge	**6**
C6	large wetland area associated with Jones Creek	Jones Creek forms South edge	**6**
C7	Jones Creek wetlands to the North	Jones Creek to the North	**6**
C8	Jones Creek and Fairchild Creek tributary wetlands	Jones Creek and Fairchild Creek tributaries	**6**
C9	wetlands associated with Fairchild Creek tributaries	tributaries to Fairchild Creek	**6**
C10	wetlands associated with Fairchild Creek	Fairchild Creek tributary	**3**
C11	no wetlands present	no watercourses present	**1**

Principle D3) To protect significant wildlife habitat features and functions including the habitat of species-at-risk.

Blocks	Criterion		Rank
	1) Compatibility of land uses with significant wildlife habitat features and functions	**2) Compatibility of land uses with the habitat of species at risk**	
C1	large forest block with interior habitat	woodlot may support area sensitive species (birds)	**6**
C2	Jones Creek corridor	Jones Creek corridor	**3**
C3	part of Jones Creek corridor	part of Jones Creek corridor	**6**
C4	cultural meadow habitat, linkages	cultural meadow habitat (birds)	**6**
C5	Jones Creek corridor	Jones Creek corridor	**3**
C6	Jones Creek corridor	Jones Creek corridor	**6**
C7	Jones Creek corridor	Jones Creek corridor	**6**
C8	Jones Creek corridor	Jones Creek corridor	**6**
C9	Fairchild Creek tributaries	Fairchild Creek tributaries	**3**
C10	riparian woodland/wetlands (Fairchild Creek tributary)	riparian woodland/wetlands (Fairchild Creek tributary)	**1**
C11	Moderate – cultural meadow	Moderate – cultural meadow	**1**

Principle D4) To protect stream channel and valleyland integrity, particularly in erosion prone systems.

Blocks	Criterion		Rank
	1) Ability to incorporate/integrate headwater drainage features as part of an overall LID SWM approach	**2) Compatibility with erosion prone watercourses and valley systems**	
C1	features accommodated	well upstream of Jones Creek	**1**
C2	central drainage feature	Low - adjacent to Jones Creek	**6**
C3	no drainage features present	Moderate - adjacent to Jones Creek	**2**
C4	features accommodated	Low - adjacent to Jones Creek - Moderate to high constrained channels	**6**
C5	several headwater drainage features present	adjacent to Jones Creek - J-2D degraded, high erosion, most of main channels sensitive, steep slopes along valley wall of lower Jones tributary	**2**
C6	features accommodated	adjacent to Jones Creek - moderate erosion prone creeks along Jones tributary	**2**
C7	headwater drainage features present	adjacent to Jones Creek - low sediment generating areas, steep slopes and erosion along lower Jones Creek	**6**
C8	features accommodated	adjacent to Jones Creek - low sediment generating areas, steep slopes and erosion along lower Jones Creek	**6**
C9	Fairchild Creek tributaries	Fairchild Creek system - low sediment generating areas, steep slopes and erosion along lower Jones Creek	**6**
C10	Fairchild Creek tributary	Fairchild Creek system - moderate sediment generating areas, steep slopes and erosion along lower Jones Creek	**2**
C11	Header water drainage features present	upper headwater drainage features associated with wetlands	**6**

E) Water / Wastewater

Ranking Scheme: Most Preferred (1) to Least Preferred (11) 🟢 **Very Supportive** 🟡 **Supportive** 🔴 **Constrained**

Principle E1) To efficiently use existing and planned infrastructure and to minimize the complexity of extending the existing water and wastewater system to the Urban Expansion areas.

Water				
Blocks	**Criterion**			**Rank**
	1) Need to cross existing natural heritage corridors to extend water and wastewater servicing	**2) Ability to service area via existing networks vs. need to construct new pumping/other infrastructure**	**3) Need for localized sanitary pumping station and/or water pressure zones**	
C1	• Majority of lands can be serviced without crossing natural heritage corridors 🟢	• Can be serviced with direct connection to PD4 🟢	• Extension of existing pressure district 🟢	**1**
C2	• All lands can be serviced without crossing natural heritage corridors if serviced from Powerline Rd 🟢	• Can be serviced with direct connection to PD2/3 🟢	• Extension of existing pressure district 🟢	**1**
C3	• Must cross natural heritage corridor to provide servicing 🔴	• Can be serviced with connection to PD2/3 via C2 🟡	• Extension of existing pressure district 🟢	**9**
C4	• All lands can be serviced without crossing natural heritage corridors 🟢	• Can be serviced with direct connection to PD2/3 🟢	• Extension of existing pressure district 🟢	**1**
C5	• Majority of lands can be serviced without crossing natural heritage corridors 🟢	• Can be serviced with direct connection to PD2/3 🟢	• Extension of existing pressure district 🟢	**1**
C6	• Must cross natural heritage corridor to provide servicing from C5 • May be serviced from Hwy 24 to avoid crossing natural heritage corridors 🟡	• Can be serviced with connection to PD2/3 via C5 🟡	• Extension of existing pressure district 🟢	**7**
C7	• All lands can be serviced without crossing natural heritage corridors 🟢	• Can be serviced with direct connection to PD2/3 🟢	• Extension of existing pressure district 🟢	**1**
C8	• Majority of lands can be serviced without crossing natural heritage corridors 🟢	• Can be serviced with connection to PD2/3 via C7 🟡	• Extension of existing pressure district 🟢	**6**
C9	• Few lands can be serviced without crossing natural heritage corridors 🔴	• Can be serviced with connection to PD2/3 • May be some areas of localized high pressure 🟡	• May require local adjustment of pressure district by PRV installation 🟡	**11**
C10	• All lands can be serviced without crossing natural heritage corridors if serviced from Lynden Rd • Looping from C9 will require the crossing of a natural heritage corridor 🟡	• Can be serviced with connection to PD2/3 • May be some areas of localized high pressure 🟡	• May require local adjustment of pressure district by PRV installation 🟡	**9**
C11	• All lands can be serviced without crossing natural heritage corridors 🟢	• Can be serviced by local Tutela Heights • Pumping station is required for service off of existing system which is required for integration of Tutela Heights 🟡	• Will require a localized pressure district to service Tutela Heights, works need to service existing Tutela Heights water system 🟡	**7**

Wastewater				
Blocks	Criterion			Rank
	1) Need to cross existing natural heritage corridors to extend water and wastewater servicing	2) Ability to service area via existing networks vs. need to construct new pumping/other infrastructure	3) Need for localized sanitary pumping station and/or water pressure zones	
C1	• Majority of lands can be serviced without crossing natural heritage corridors	• Natural drainage towards existing urban boundary to the south • Can be serviced by Woodlawn SPS or conveyed east to a new SPS on Powerline	• May require additional SPS and requirement is dependent on servicing preference	2
C2	• All lands can be serviced without crossing natural heritage corridors if serviced from Powerline Rd	• Likely require SPS to service wastewater to existing system • Limited capacity within existing along northern boundary, flows to be conveyed east on Powerline to the City's Eastern Trunk	• Will likely require centralized SPS to convey flows east • Dependent on phasing and overall servicing strategy • Likely to consolidate SPS needs for joint servicing of C5, C4, and potential employment lands	4
C3	• Must cross natural heritage corridor to provide servicing	• Will require local SPS to service wastewater to new trunk for North lands • Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk through C4	• Will require additional SPS local to convey flows to the new trunk for North lands;	10
C4	• All lands can be serviced without crossing natural heritage corridors	• Likely require SPS to service wastewater to existing system • Limited capacity within existing along northern boundary, flows to be conveyed east on Powerline to the City's Eastern Trunk	• Will likely require centralized SPS to convey flows east • Dependent on phasing and overall servicing strategy • Likely to consolidate SPS needs for joint servicing of C5, C2, and potential employment lands	4
C5	• Majority of lands can be serviced without crossing natural heritage corridors	• Likely require SPS to service wastewater to existing system • Limited capacity within existing along northern boundary, flows to be conveyed east on Powerline to the City's Eastern Trunk	• Will likely require centralized SPS to convey flows east • Dependent on phasing and overall servicing strategy • Likely to consolidate SPS needs for joint servicing of C2, C4, and potential employment lands	4

Wastewater				
Blocks	**Criterion**			**Rank**
	1) Need to cross existing natural heritage corridors to extend water and wastewater servicing	**2) Ability to service area via existing networks vs. need to construct new pumping/other infrastructure**	**3) Need for localized sanitary pumping station and/or water pressure zones**	
C6	• Must cross natural heritage corridor to provide servicing from C5 • May be serviced from Hwy 24 or Park Rd to avoid crossing natural heritage corridors	• Will require local SPS to service wastewater to new trunk for North lands • Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk	• Will require additional SPS local to convey flows to the new trunk for North lands	**9**
C7	• All lands can be serviced without crossing natural heritage corridors	• Conveyance to existing system possible without need for additional SPS • Flows to be conveyed south by either Park Rd or Eastern Trunk	• Will not require additional SPS due to similar elevations as the existing system	**1**
C8	• Majority of lands can be serviced without crossing natural heritage corridors	• May require local SPS to service wastewater to existing system to Eastern Trunk	• May require local SPS as elevations decrease moving away from the existing system	**4**
C9	• Few lands can be serviced without crossing natural heritage corridors	• Will require SPS to service wastewater to existing system to Eastern Trunk	• May require multiple local SPS as elevations decrease moving away from the existing system	**10**
C10	• All lands can be serviced without crossing natural heritage corridors if serviced from Lynden Rd • Looping from C9 will require the crossing of a natural heritage corridor	• Unlikely to required local SPS to connect to existing system • Flows to be conveyed south by Eastern Trunk	• Unlikely to required SPS due to similar elevations as the existing system	**2**
C11	• All lands can be serviced without crossing natural heritage corridors	• Will require local SPS to service wastewater to existing system • Current Tutela Heights is not serviced for sanitary and further integration with the existing system would require a new SPS	• Will require a new SPS to convey existing and future Tutela Heights flows to the Existing System • Potential to integrate C11 system into new Tutela Heights system	**4**

Principle E2) To align future infrastructure with the Master Servicing Plan.

Water					
Blocks	**Criterion**				**Rank**
	1) Proximity and capacity of existing trunk networks	**2) Scope of trunk network upgrades needed to support growth area**	**3) Impacts on existing users and system level of service**	**4) Supports priority areas and servicing objectives identified in the Master Servicing Plan**	
C1	Ease to connect to existing 300 mm Current trunk has capacity to support growth area	Further upgrades required to connect 300 mm on Balmoral Dr. ¶May require upsizing of trunk watermain	Not expected to impact existing users and level of service Ensure trunk is sufficiently sized	Upgrades required would unlikely to benefit priority growth areas Supports MSP objectives	**6**
C2	Ease to connect to existing 400 mm Current trunk has capacity to support growth area but my be undersized to support intensification as well	Extension of 400 mm trunk along Powerline Rd. May require upsizing of trunk watermain	Upsizing of primary PD2/3 trunk along King George corridor may be required to support growth Upsizing like also needed to support King George Intensification corridor	Upsizing trunk would support priority areas within King George corridor Supports MSP objectives	**3**
C3	Difficult to connect to trunk network Current trunk has capacity to support growth area but my be undersized to support intensification as well	Extension of trunk network through C2 May require upsizing of trunk watermain	Not expected to impact existing users and level of service Ensure trunk is sufficiently sized	Upsizing trunk would support priority areas within King George corridor Long extension of trunk would not support priority areas Supports MSP objectives	**11**
C4	Ease to connect to existing 400 mm Current trunk has capacity to support growth area but my be undersized to support intensification as well	No trunk extension required May require upsizing of trunk watermain	Upsizing of primary PD2/3 trunk along King George corridor may be required to support growth Upsizing like also needed to support King George Intensification corridor	Upsizing trunk would support priority areas within King George corridor Supports MSP objectives	**1**
C5	Ease to connect to existing 400 mm Current trunk has capacity to support growth area but my be undersized to support intensification as well	Extension of 400 mm trunk along Powerline Rd May require upsizing of trunk watermain	Not expected to impact existing users and level of service Transmission looping through C5 has potential to strengthen existing PD2/3 transmission network	Transmission looping through C5 has potential to strengthen existing PD2/3 transmission network and support priority growth areas Supports MSP objectives	**3**
C6	Ease to connect to existing 400 mm Current trunk has capacity to support growth area but my be undersized to support intensification as well	Extension of 400 mm trunk along Hwy 24 or Park Rd May require upsizing of trunk watermain	Not expected to impact existing users and level of service Ensure trunk is sufficiently sized	Upsizing trunk would support priority areas within King George corridor Long extension of trunk would not support priority areas Supports MSP objectives	**6**

Water					
Blocks	**Criterion**				**Rank**
	1) Proximity and capacity of existing trunk networks	**2) Scope of trunk network upgrades needed to support growth area**	**3) Impacts on existing users and system level of service**	**4) Supports priority areas and servicing objectives identified in the Master Servicing Plan**	
C7	Ease to connect to existing 400 mm Current trunk has capacity to support growth area but my be undersized to support intensification as well	No trunk extension required May require upsizing of trunk watermain	Not expected to impact existing users and level of service Ensure trunk is sufficiently sized	Upsizing trunk would support priority areas within Wayne Gretsky corridor Supports MSP objectives	**1**
C8	Ease to connect to existing 400 mm Current trunk has capacity to support growth area but my be undersized to support intensification as well	Extension of 400 mm trunk along Powerline Rd May require upsizing of trunk watermain	Not expected to impact existing users and level of service Ensure trunk is sufficiently sized	Upsizing trunk would support priority areas within Wayne Gretzky corridor Long extension of trunk would not support priority areas Supports MSP objectives	**6**
C9	Moderately difficult to connect to trunk network Current trunk has capacity to support growth area but my be undersized to support intensification as well	Extension of 400 mm trunk along Powerline Rd May require upsizing of trunk watermain	Not expected to impact existing users and level of service Ensure trunk is sufficiently sized	Upsizing trunk would support priority areas Long extension of trunk would not support priority areas Supports MSP objectives	**6**
C10	Ease to connect to existing 300 mm Current trunk has capacity to support growth area but my be undersized to support intensification as well	Extension of 300 mm trunk along Lynden Rd may be required	May impact low fire flows located on Lynden Rd Ensure trunk is sufficiently sized to support growth area and intensification	Upsizing trunk would support priority areas within Lynden Rd corridor Supports MSP objectives	**6**
C11	Ease to connect to existing 200 mm Current trunk may be under capacity to support growth area	May require upsizing of trunk from Gillespie Dr	Not expected to impact existing users and level of service Ensure trunk is sufficiently sized	Upgrades required would likely not benefit priority areas Supports MSP objectives	**3**

Wastewater					
Blocks	**Criterion**				**Rank**
	1) Proximity and capacity of existing trunk networks	**2) Scope of trunk network upgrades needed to support growth area**	**3) Impacts on existing users and system level of service**	**4) Supports priority areas and servicing objectives identified in the Master Servicing Plan**	
C1	• Connections to existing system to the south • Likely sufficient capacity in existing system	• Individual block unlikely to trigger upgrades • Upgrades likely if extending servicing to additional growth blocks	• Limited impacts expected	• Individual block unlikely to trigger upgrades • Upgrades likely if extending servicing to additional growth blocks • Upgrades unlikely to support priority growth areas • Supports MSP objectives	**1**
C2	• Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**4**
C3	• Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**4**
C4	• Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**4**
C5	• Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**4**
C6	• Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk through C5	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**10**

Wastewater					
Blocks	**Criterion**				**Rank**
	1) Proximity and capacity of existing trunk networks	**2) Scope of trunk network upgrades needed to support growth area**	**3) Impacts on existing users and system level of service**	**4) Supports priority areas and servicing objectives identified in the Master Servicing Plan**	
C7	• Can connect directly to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**2**
C8	• Extension of trunk network is required to tie-into the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**4**
C9	• Can connect directly to the City's Eastern Trunk • Dependent on local SPS serving	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**4**
C10	• Can connect directly to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• Limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**2**
C11	• Extension to trunk network is required from West Conklin as there is currently no sanitary servicing within Tutela Heights • Servicing of block will be integrated into broader Tutela Heights strategy	• Extension of trunk network from West Conklin is required • Should full sanitary servicing of Tutela Heights be undertaken, trunk extension may be aligned • Upgrades of trunk network within West Conklin may be required	• Not expected to impact existing users and level of service as conveyance is directly to the WWTP	• Does not impact priority areas • Supports MSP objectives	**11**

Principle E3) To phase water and wastewater infrastructure logically and consecutively.

Water				
Blocks	**Criterion**			**Rank**
	1) Phasing impacts and dependency on adjacent blocks to tie-into existing water and wastewater systems	**2) Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) blocks**	**3) What are the alternative servicing blocks, if adjacent growth blocks are not developed**	**4) Flexibility/impacts of post period servicing of remaining boundary lands**	
C1	• Not impacted by phasing	• Easy to integrate with E6; Difficult to integrate with E4 as it requires crossing natural heritage corridors	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**3**
C2	• Not impacted by phasing	• Difficult to integrate with C3, C4, and E6 as it requires crossing natural heritage corridors • Connections not need to service C2	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**3**
C3	• Impacted by phasing from either C2, C4, or E6	• Difficult to integrate with C2, C4, and E6 as it requires crossing natural heritage corridors	• Extension of trunk across natural heritage corridors	• May require local upsizing within C3 to connect and service remaining boundary lands	**11**
C4	• Not impacted by phasing	• Easy to integrate with C5 • Difficult to integrate with C2 as it requires crossing natural heritage corridors	• Internal looping to trunk	• May require upsizing of Hwy 24 trunk to service remaining boundary lands	**7**
C5	• Not impacted by phasing	• Easy to integrate with C4 and C7 • Difficult to integrate with C6 as it requires crossing natural heritage corridors • Connections not need to service C5	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**3**
C6	• Does not require phasing with trunk extension • Phasing from C5 will provide better system looping and planning	• Difficult to integrate with C5 as it requires crossing natural heritage corridors	• Looping from Hwy 24 to Park Rd	• May require local upsizing within C6 to connect and service remaining boundary lands	**9**
C7	• Not impacted by phasing	• Easy to integrate with C5 and C8	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**1**
C8	• Does not require phasing with trunk extension • Phasing from C7 may provide better system looping and planning	• Easy to integrate with C7 • Difficult to integrate with C9 as it requires crossing natural heritage corridors • Connections not need to service C8	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**7**
C9	• Impacted by phasing of C7 and C8	• Difficult to integrate with C8 and C10 as it requires crossing natural heritage corridors	• Internal looping to trunk crossing natural heritage corridors	• Not affected by servicing of remaining boundary lands	**9**
C10	• Not impacted by phasing	• Difficult to integrate with C9 as it requires crossing natural heritage corridors • Connections not need to service C10	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**3**
C11	• Not impacted by phasing	• Not applicable	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**1**

Wastewater				
Blocks	**Criterion**			**Rank**
	1) Phasing impacts and dependency on adjacent blocks to tie-into existing water and wastewater systems	**2) Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) blocks**	**3) What are the alternative servicing blocks, if adjacent growth blocks are not developed**	**4) Flexibility/impacts of post period servicing of remaining boundary lands**	
C1	• Not impacted by phasing if servicing to the south • Impacted by phasing of C2, C4, C5, and C7 if trunk servicing is provided on Powerline Rd to City's Eastern Trunk;	• Easy to integrate with E6 and C2 due to favourable elevations • May be difficult to integrate with E4 due to natural heritage corridor but elevations are favourable	• Servicing through south to Woodlawn SPS	• Not affected by servicing of remaining boundary lands	**6**
C2	• Impacted by phasing of C4 and C5 as trunk servicing is provided on Powerline Rd to City's Eastern Trunk;	• May be difficult to integrate with E6, C3, and C4 due to natural heritage corridor but elevations are favourable	• Extension of the trunk from King George and installation of trunk on Powerline	• Not affected by servicing of remaining boundary lands	**7**
C3	• Impacted by phasing of C2, C4, and C5 as trunk servicing is provided on Powerline to City's Eastern Trunk;	• May be difficult to integrate with E6, C2, and C4 due to natural heritage corridor and elevations are somewhat unfavourable	• Not adjacent to the existing system and servicing not advised without adjacent blocks	• May require local upsizing within C3 to connect and service remaining boundary lands	**11**
C4	• Impacted by phasing of C5 as trunk servicing is provided on Powerline Rd to City's Eastern Trunk;	• May be difficult to integrate with C5 due to somewhat unfavourable elevations;	• Extension of the trunk from King George and installation of trunk on Powerline	• May require upsizing of Hwy 24 trunk to service remaining boundary lands	**9**
C5	• Not impacted by phasing if servicing is provided on Powerline to Park Rd • Impacted by phasing of C7 if conveyance is provided by Eastern Trunk	• Easy to integrate with C7 as elevations are favourable;	• Is not impacted by phasing	• Not affected by servicing of remaining boundary lands	**7**
C6	• Impacted by phasing of C5 as trunk servicing is provided on Powerline Rd to Park Rd • Impacted by phasing of C7 if conveyance is provided by Eastern Trunk	• May be difficult to integrate with C5 due to natural heritage corridor and elevations are somewhat unfavourable	• Not adjacent to the existing system and servicing not advised without adjacent blocks	• May require local upsizing within C6 to connect and service remaining boundary lands	**10**
C7	• Not impacted by phasing	• Easy to integrate C5 and C8 due to favourable elevations	• Is not impacted by phasing	• Not affected by servicing of remaining boundary lands	**1**
C8	• Not impacted by phasing	• Easy to integrate C7 due to favourable elevations;	• Is not impacted by phasing	• Not affected by servicing of remaining boundary lands	**1**
C9	• Not impacted by phasing	• Not expected to integrate with adjacent growth blocks	• Is not impacted by phasing	• Not affected by servicing of remaining boundary lands	**1**
C10	• Not impacted by phasing	• Not expected to integrate with adjacent growth blocks	• Is not impacted by phasing	• Not affected by servicing of remaining boundary lands	**1**
C11	• Not impacted by phasing	• Not expected to integrate with adjacent growth blocks	• Is not impacted by phasing	• Not affected by servicing of remaining boundary lands	**1**

Principle E4) To ensure the infrastructure is financially viable over the full life cycle and the preferred serving solution considers the best life-cycle blocks when considering overall operational efficiency, operational resiliency to climate change and/or major component failure, operational and maintenance cost, existing renewal needs of the system, post period servicing, and greenhouse gas emissions.

Water				
Blocks	**Criterion**			**Rank**
	1) Local and trunk servicing capital cost within the development blocks	**2) Existing trunk upgrade capital cost**	**3) Local and trunk life cycle operation and maintenance costs**	
C1	• Moderate capital costs to avoid natural heritage corridors	• Low capital costs if existing upsizing is required on Balmoral Dr	• Typical life cycle costs	**1**
C2	• Typical capital costs	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**1**
C3	• Moderate capital costs associated with extension of existing trunk on Powerline and through C2	• Moderate capital costs associated if upsizing King George corridor is required	• High life cycle costs as servicing must cross natural heritage corridors	**10**
C4	• Moderate capital costs to avoid natural heritage corridors	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**6**
C5	• Moderate capital costs to avoid natural heritage corridors	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**6**
C6	• Moderate capital costs to avoid natural heritage corridors and extension of existing trunk on Hwy 24 and/or Park Rd	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**6**
C7	• Typical servicing capital costs	• Moderate capital costs associated if upsizing Wayne Gretzky corridor is required	• Typical life cycle costs	**1**
C8	• Moderate capital costs to avoid natural heritage corridors and extension of existing trunk on Powerline Rd	• Moderate capital costs associated if upsizing Wayne Gretzky corridor is required	• Typical life cycle costs	**6**
C9	• High capital costs to avoid natural heritage corridors and extension of existing trunk on Powerline Rd	• Moderate capital costs associated if upsizing Wayne Gretzky corridor is required	• High life cycle costs as servicing must cross natural heritage corridors	**11**
C10	• Typical servicing capital costs	• Moderate capital costs associated if upsizing Lynden Rd corridor is required	• Typical life cycle costs	**1**
C11	• Typical servicing capital costs	• Moderate capital costs associated with upsizing West Conklin trunk • Upsizing is also required to service the existing Tutela Heights through the Brantford water system	• Typical life cycle costs	**1**

Wastewater				
Blocks	**Criterion**			**Rank**
	1) Local and trunk servicing capital cost within the development blocks	**2) Existing trunk upgrade capital cost**	**3) Local and trunk life cycle operation and maintenance costs**	
C1	• Typical servicing costs expected 🟢	• Limited upgrades expected 🟢	• Typical life cycle costs 🟢	**1**
C2	• Moderate capital costs associated with installation of trunk along Powerline and new SPS 🟡	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• Typical life cycle costs 🟢	**5**
C3	• High capital costs associated with avoidance of natural heritage corridors, installation of trunk along Powerline and new SPS 🔴	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• High life cycle costs as servicing must cross natural heritage corridors 🔴	**11**
C4	• Moderate capital costs associated with installation of trunk along Powerline and new SPS 🟡	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• Typical life cycle costs 🟢	**5**
C5	• Moderate capital costs associated with installation of trunk along Powerline and new SPS 🟡	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• Typical life cycle costs 🟢	**5**
C6	• High capital costs associated with avoidance of natural heritage corridors, installation of trunk along Powerline and new SPS 🔴	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• Typical life cycle costs 🟢	**8**
C7	• Typical capital costs associated with installation of trunk along Powerline 🟢	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• Typical life cycle costs 🟢	**2**
C8	• Typical capital costs associated with avoidance of natural heritage corridors 🟢	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• Typical life cycle costs 🟢	**2**
C9	• Typical capital costs associated with avoidance of natural heritage corridors 🟢	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• High life cycle costs as servicing must cross natural heritage corridors 🔴	**8**
C10	• Typical capital costs associated with installation of trunk along Lynden 🟢	• Moderate capital costs associated with upgrading existing trunk to Empey 🟡	• Typical life cycle costs 🟢	**2**
C11	• High capital costs associated with installation of sanitary servicing to/in Tutela Heights and installation of a new SPS 🔴	• High capital costs associated with installation of sanitary servicing to/in Tutela Heights and installation of a new SPS 🔴	• Typical life cycle costs 🟢	**10**

F) Stormwater

Ranking Scheme: Most Preferred (1) to Least Preferred (11) 🟢 **Very Supportive** 🟡 **Supportive** 🔴 **Constrained**

Principle F1) To avoid impacts to local/regional hydrologic and hydrogeological function. Key hydrologic areas are to be avoided where possible when determining the most appropriate location for settlement area boundary expansion. Key hydrologic areas are defined as significant groundwater recharge areas (SGRAs), highly vulnerable aquifers (HVAs), and significant surface water contribution areas that are necessary for the ecological and hydrologic integrity of a watershed. Areas with shallow groundwater table/potential for groundwater discharge, and areas with isolated wetlands, may also have important hydrologic and hydrogeological functions.

Blocks	Criterion				Rank
	1) Presence of identified SGRAs and level of estimated recharge	2) Presence of HVAs	3) Depth to groundwater table	4) Presence of isolated wetlands	
C1	• Approx. 80% of net area is identified as SGRA in GRCA mapping 🔴	• Approx. 25% of net area is identified as HVA in GRCA mapping 🟡	• Groundwater table predicted above ground surface in some locations 🔴	• None 🟢	**11**
C2	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted above ground surface in some locations 🔴	• None 🟢	**6**
C3	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted above ground surface in some locations 🔴	• None 🟢	**6**
C4	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted well below ground surface 🟢	• None 🟢	**1**
C5	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted above ground surface in isolated locations but largely predicted well below ground surface 🟡	• None 🟢	**5**
C6	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted well below ground surface 🟢	• None 🟢	**1**
C7	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted well below ground surface 🟢	• Two isolated wetlands present (unevaluated) 🔴	**6**
C8	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted well below ground surface 🟢	• Isolated wetland present (unevaluated) 🔴	**6**
C9	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted well below ground surface 🟢	• None 🟢	**1**
C10	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted well below ground surface 🟢	• None 🟢	**1**
C11	• Not identified as SGRA 🟢	• Not identified as HVA 🟢	• Groundwater table predicted above ground surface in some locations 🔴	• None 🟢	**6**

Principle F2) To minimize the impact on the water resource system by minimizing the relative complexity needed to complete local stormwater servicing.

Blocks	Criterion					Rank
	1) Thermal regime of receiving watercourse	**2) Upstream uncontrolled urban drainage area**	**3) Degree of sensitive of watercourses**	**4) Degree of spatial constraint associated with watercourses within potential boundary area (i.e. headwater features or other watercourses not currently identified as part of the natural heritage system)**	**5) Topographical complexity and number of outlets**	
C1	• Major receiver UJ-3 potentially a coldwater stream in at least some reaches	• None • Upstream urban drainage is controlled through two SWM facilities	• Discharges into a low constraint watercourse (UJ-5B); C1 will also flow into E5 and E6 channels	• Moderate drainage density of low constraint channels and headwater drainage features	• High complexity – at least three outlets over small area	**3**
C2	• Major receiver UJ-5 likely a coldwater or coolwater stream, particularly downstream of confluence with UJ-4 (identified coldwater stream)	• Receives uncontrolled drainage from approximately 30 ha of built-up urban area, 36 ha of golf course • Receives controlled drainage from SWM facility	• Need to consider preferred outlet (e., UJ-5B vs more sensitive UJ-5F channel). Future development south of this block would also discharge into C2	• Low drainage density of low sensitivity watercourses	• Low complexity – two or more outlets over large area	**3**
C3	• Major receivers are UJ-3 and UJ-5, potentially and likely coldwater streams, respectively (see above)	• None	• Need to consider preferred outlet (e., UJ-5B vs more sensitive channels)	• Low drainage density of headwater drainage features; several potential headwater channels identified	• High complexity due to shape, slopes, drainage splits, proximity to watercourse	**10**
C4	• Discharges to UJ-5G, likely a coolwater stream per 2016-2017 temperature monitoring	• Receives uncontrolled drainage from approximately 40 ha built-up area	• Moderate and high sensitivity channels in area. Discharge from area flows into LJ-1D, which is a high constraint channel.	• Likely no additional headwater channels	• Moderate complexity due to shape, NHS, and proximity to watercourse	**7**
C5	• Discharges to LJ-1 and LJ-2, potentially a coolwater stream. Also discharges to F-3, unlikely to be a coldwater or coolwater stream	• Receives uncontrolled drainage from approximately 88 ha built-up area	• Discharges into LJ-1 and LJ-2, which are high constraint channels. LJ-2D sensitive to uncontrolled drainage upstream	• Relatively high drainage density of watercourses and additional potential headwater drainage features; low and medium constraint watercourses.	• High complexity – four or more outlets	**11**
C6	• Discharges to LJ-1, LJ-2, JT-3 and JT-4, some of which are potentially coldwater or coolwater streams. JT-4 does not appear to receive any groundwater discharge.	• None	• High sensitivity channels would receive flow and could affect channel in C5, C7	• Moderate drainage density of low constraint channels and potential headwater drainage features; may need additional drainage features to support SWM outflow	• High complexity – four or more outlets	**7**

Blocks	Criterion					Rank
	1) Thermal regime of receiving watercourse	**2) Upstream uncontrolled urban drainage area**	**3) Degree of sensitive of watercourses**	**4) Degree of spatial constraint associated with watercourses within potential boundary area (i.e. headwater features or other watercourses not currently identified as part of the natural heritage system)**	**5) Topographical complexity and number of outlets**	
C7	• Discharges to F-2 and F-3, both unlikely to be coldwater or coolwater streams	• None	• LJ-2 and LJ-3 are high sensitivity channels, F-2A is low constraint, F-2B and 2C are moderately constrained; all flow to C8 and C9	• Relatively high drainage density of low constraint and medium constraint watercourses, and headwater drainage features	• High complexity due to drainage splits	**3**
C8	• Discharges to F-1G and F-2, both unlikely to be coldwater or coolwater streams	• None	• Watercourses are medium or high constrained; F-2C drains to C9.	• Moderate drainage density of potential headwater drainage features	• High complexity due to drainage splits	**3**
C9	• Discharges to F-2 and F-3, both unlikely to be coldwater or coolwater streams	• Receives uncontrolled drainage from approximately 35 ha of built-up area	• All watercourses considered to be high or moderately sensitive; if wetland, then less sensitive to altered flows. Watercourses may be impacted from upstream development	• Moderate drainage density of headwater drainage features	• High complexity due to shape, proximity to watercourses	**7**
C10	• Discharges to tributaries to Fairchild Creek which are unlikely to be coldwater or coolwater streams.	• None	• Headwater drainage features discharge into highly sensitive F4-H or into adjacent channels	• Moderate drainage density of potential headwater drainage features	• Low complexity – one to two outlets possible	**2**
C11	• Discharges to Phelps Creek, potentially a coldwater or coolwater stream in at least some reaches	• None	• Low sensitivity watercourse P1-E	• Low drainage density of low constraint watercourses	• Low complexity – single outlet	**1**

Principle F3) To minimize the impact on the water resource system by evaluating the existing downstream system capacity.

Blocks	Criterion		Rank
	1) Presence and capacity of existing outlet	**2) Degree of hydromodification constraint/ geomorphologic sensitivity of existing outlet**	
C1	• Approximately 8.6 ha discharges to existing SWM system, capacity constraints possible. Remaining area has natural outlets UJ-2A and UJ-3E, although culvert capacities should be confirmed.	• low constraint and few potential headwater features; discharges into E6 and E5	**3**
C2	• No constraints	• low constraint in C2, but outlet likely to go into medium or high constraint channel	**2**
C3	• No constraints	• moderate sensitivity of UJ-2B; high sensitivity UJ-5C, low sensitivity of UJ-5B	**6**
C4	• No constraints	• moderate and high sensitivity channels	**6**
C5	• Approximately 15 ha discharges to existing SWM system via road culvert and open ditches, capacity constraints possible. Remainder has no constraints	• moderate and high constraint receiving watercourses • high drainage density can be opportunity to have multiple outlet areas	**11**
C6	• No constraints	• high sensitive receiving watercourses	**6**
C7	• Approximately 18 ha discharges to existing SWM system via road culvert and open ditches, capacity constraints possible. Remainder has no constraints	• high sensitive main channel, low constraint for most of smaller tributary F-2A; all flow into C8 and C9; prefer discharge to F-2A	**3**
C8	• No constraints	• high sensitive main channel, moderate constraint for most of smaller tributary F-2A, drains into C9	**6**
C9	• No constraints	• all watercourses are medium or high constrained channel	**6**
C10	• Approximately 28 ha discharges to existing road culverts and watercourse, unlikely to have constraints. Remainder has no constraints	• potential headwater features identified	**3**
C11	• No constraints	• low constraint channel	**1**

Principle F4) To phase stormwater infrastructure logically and consecutively.

Blocks	Criterion				Rank
	1) Phasing impacts and dependency on adjacent blocks to tie-into existing stormwater systems/outlets	**2) Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) blocks**	**3) What are the alternative servicing blocks, if adjacent growth blocks are not developed**	**4) Flexibility/impacts of post period servicing of remaining boundary lands**	
C1	• No dependency • Direct outlet to watercourse available	• Opportunity to integrate with parts of E6, C2 for discharge to UJ-3 through planning	• Not applicable	• Not applicable	**1**
C2	• No dependency • Direct outlet to watercourse available	• Opportunity to integrate with parts of E6, C1 for discharge to UJ-3	• Not applicable	• Not applicable	**1**
C3	• No dependency • Direct outlet to watercourse available	• None	• Not applicable	• Component of trigger lands draining to UJ-3 should be accounted for	**10**
C4	• No dependency • Direct outlet to watercourse available	• Opportunity to partially integrate with parts of C5.	• Not applicable	• Not applicable	**1**
C5	• No dependency • Direct outlet to watercourses/ existing storm sewer available	• Opportunity to partially integrate with parts of C4 for discharge to UJ-5. Opportunity to partially integrate with parts of C7 for discharge to F-3/ existing storm sewer and for LJ-2.	• Not applicable	• Not applicable	**1**
C6	• No dependency • Direct outlet to watercourses available	• None	• Not applicable	• Component of trigger lands draining to LJ-1 should be accounted for	**10**
C7	• No dependency • direct outlet to watercourses/ existing storm sewer available	• Opportunity to partially integrate with parts of C8 for discharge to F-2. Opportunity to partially integrate with parts of C5 for discharge to F-3/ existing storm sewer and for LJ-2.	• Not applicable	• Not applicable	**1**
C8	• No dependency • Direct outlet to watercourse available	• Opportunity to partially integrate with parts of C7 for discharge to F-2.	• Not applicable	• Not applicable	**1**
C9	• No dependency • Direct outlet to watercourse available	• None	• Not applicable	• Not applicable	**7**
C10	• No dependency • Direct outlet to existing watercourse through undeveloped land within settlement boundary.	• None	• Not applicable	• Not applicable	**7**
C11	• No dependency • Direct outlet to watercourse available	• None	• Not applicable	• Not applicable	**7**

Principle F5) To ensure that the stormwater infrastructure is financially viability by minimizing the total project life cycle cost to service the urban boundary expansion areas.

Blocks	Criterion			Rank
	1) Local and trunk servicing capital cost within the development blocks	**2) Existing trunk upgrade capital cost**	**3) Local and trunk life cycle operation and maintenance costs**	
C1	• Moderate relative cost. Need to handle upstream catchment areas, potential coldwater stream, partial SGRA and HVA	• Potential upgrades required within UJ-3 catchment	• Low to moderate relative cost due to multiple end-of-pipe facilities	**5**
C2	• Moderate relative cost • Some consideration for erosion sensitivity of outlet, potential coldwater stream	• None	• Low to moderate relative cost due to multiple end-of-pipe facilities	**4**
C3	• Moderate to high relative cost due to shape and multiple drainage directions	• None	• Moderate relative cost due to multiple end-of-pipe facilities	**6**
C4	• Moderate relative cost • Potential for on-site controls discharging to creek	• None	• Low relative cost	**3**
C5	• High relative cost • Overcontrol of drainage likely required due to upstream uncontrolled urban drainage • Multiple facilities needed • Erosion sensitivity of outlet	• Potential upgrades required within F-3 catchment	• High relative cost	**11**
C6	• Moderate to high relative cost due to shape and multiple drainage directions, erosion sensitivity	• None	• Moderate relative cost due to multiple end-of-pipe facilities	**7**
C7	• High relative cost • Multiple drainage directions, complexity due to wetland	• Potential upgrades required within F-3 catchment	• High relative cost	**10**
C8	• High relative cost • Multiple drainage directions, complexity due to wetland	• None	• High relative cost	**8**
C9	• High relative cost • Upstream urban drainage, multiple drainage directions, shape	• None	• High relative cost	**9**
C10	• Low relative cost • Conventional servicing	• None	• Low relative cost	**1**
C11	• Low relative cost • Conventional servicing	• None	• Low relative cost	**2**

G) Land Use

Ranking Scheme: Most Preferred (1) to Least Preferred (11) **Very Supportive** **Supportive** **Constrained**

Principle G1) To ensure development occurs adjacent to existing built areas.

Blocks	Criterion		Rank
	1) Ability of the expansion area to develop consecutively to existing built areas.	**2) Ability of the expansion area to be integrated with adjacent existing neighbourhoods.**	
C1	- adjacent to urban area	- adjacent built form with some street networks to integrate but golf course to east	**1**
C2	- adjacent to urban area	- no neighbourhood to integrate with - adjacent to existing golf course to the south	**6**
C3	- not adjacent to existing urban area - even if C2 develops it is separated by NHS	- NHS buffer between C2 and C3 and does not allow integration	**11**
C4	- adjacent to existing urban area - residential neighbourhood to the south across Powerline Rd	- ability to integrate with commercial/mixed use development on King George	**1**
C5	- adjacent to urban area - large existing residential development to the south, across Powerline Rd	- roughly 5 existing streets that can be extended and integrated with new development - potential NHS land limitations to the North	**1**
C6	- not adjacent to existing urban area - better potential if C5 is developed	- no existing neighbourhoods to integrate with, unless C5 is developed - west across HW 24 are trigger lands so very little potential of future development - large NHS buffer between C5 and C6 which limits integration	**9**
C7	- adjacent to urban area - existing built area to the south, across Powerline Rd	- roughly 4 road networks that can be integrated across highway 23 with adjacent existing neighbourhood - Park Rd N to the West with potential of extending Wayne Gretsky Pkw	**1**
C8	- kiddie corner to existing urban area	- potential integration if C7 or C9 are developed but with rural on 3 sides	**7**
C9	- adjacent to existing urban area to the west - better potential if C8 and C7 are developed	- low potential to integrate with adjacent neighbourhood - no existing road that can be extended into the area - potential NHS limitations cutting through the site and east/south of the site	**9**
C10	- adjacent to existing urban area - existing neighbourhoods to the west	- potential for integration through Lynden Road but integration limited	**7**
C11	- adjacent to existing urban area - Mt Pleasant Rd to the north of the site	- future residential development to North East and could integrate with it	**1**

Principle G2) To create compact new urban areas with a mix of uses and densities.

Blocks	Criterion	Rank
	1) Ability to extend the intensification corridors from the built area into the urban expansion areas	
C1	- not on a corridor	**6**
C2	- close to King George corridor but separated by NHS	**4**
C3	- not on a corridor	**6**
C4	- on King George corridor	**1**
C5	- on King George corridor on the west and Wayne Gretzky Pkwy corridor on the east	**1**
C6	- potential extension of King George corridor and Wayne Gretzky Pkwy corridor if C5 is developed	**4**
C7	- potential to extend the intensification corridor along Wayne Gretzky Pkwy	**1**
C8	- not on a corridor	**6**
C9	- not on a corridor	**6**
C10	- not on a corridor	**6**
C11	- not on a corridor	**6**

A) Agriculture

Ranking Scheme: Most Preferred (1) to Least Preferred (7) 🟢 **Very Supportive** 🟡 **Supportive** 🔴 **Constrained**

Principle A1) Identify the better versus the poorer agricultural areas within each block and to retain those better areas as long as possible.

Blocks	Criterion				Rank
	1) Block average soil capability	**2) Block average soil potential**	**3) Block agricultural land use**	**4) Block agricultural infrastructure**	
E1	Soil capability for common field crops (corn, wheat, oats etc.) Class 2 🔴	Soil potential for limited fruits and vegetables higher 🔴	95% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables 🔴	Number of farm building clusters including barns is proportionately medium relative to the block area (size) 🟡	**6**
E2	Soil capability for common field crops Class 1 🔴	Soil potential for limited fruits and vegetables medium 🟡	67% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables 🟡	Number of farm building clusters including barns is proportionately medium relative to the block area (size) 🟡	**4**
E3	Soil capability for common field crops Class 2 🔴	Soil potential for limited fruits and vegetables higher 🔴	93% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables 🔴	Number of farm building clusters including barns is proportionately higher relative to the block area (size) 🔴	**6**
E4	Soil capability for common field crops Class 3 🟡	Soil potential for limited fruits and vegetables higher 🔴	70% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables 🟡	Number of farm building clusters including barns is proportionately low relative to the block area (size) 🟢	**3**
E5	Soil capability for common field crops Class 3 🟡	Soil potential for limited fruits and vegetables medium 🟡	60% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables 🟢	Number of farm building clusters including barns is proportionately low relative to the block area (size) 🟢	**2**
E6	Lowest soil capability for common field crops Class 3 🟢	Soil potential for limited fruits and vegetables lower 🟢	56% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables 🟢	Number of farm building clusters including barns is proportionately low relative to the block area (size) 🟢	**1**
E7	Soil capability for common field crops Class 3 🟡	Soil potential for limited fruits and vegetables lower 🟢	81% of block area in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables 🟡	Number of farm building clusters including barns is proportionately medium relative to the block area (size) 🟡	**4**

Principle A2) Identify the better versus the poorer agricultural areas adjacent or near to the boundary expansion blocks and to minimize impacts of non-agricultural uses proposed in the Annex lands on the better agricultural areas identified.

Blocks	Criterion				Rank
	1) Average block boundary soil capability	**2) Average block boundary soil potential**	**3) Block boundary agricultural land use**	**4) MDS implications**	
E1	Soil capability for common field crops Class 2	Soil potential for limited fruits and vegetables higher	86% of block boundary in active agricultural use - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately medium relative to the block boundary (length)	**7**
E2	Soil capability for common field crops Class 2 & 3	Soil potential for limited fruits and vegetables medium	74% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately medium relative to the block boundary (length)	**4**
E3	Soil capability for common field crops Class 2	Soil potential for limited fruits and vegetables higher	65% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately medium relative to the block boundary (length)	**5**
E4	Soil capability for common field crops Class 2 & 3	Soil potential for limited fruits and vegetables higher	23% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately high relative to the block boundary (length)	**5**
E5	Soil capability for common field crops Class 2 & 3	Soil potential for limited fruits and vegetables lower	11% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of farm building clusters including barns is proportionately low relative to the block boundary (length)	**1**
E6	Soil capability for common field crops Class 2 & 3	Soil potential for limited fruits and vegetables lower	2% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately low relative to the block boundary (length)	**2**
E7	Soil capability for common field crops Class 2 & 3	Soil potential for limited fruits and vegetables lower	36% of block boundary in active agricultural use (cultivated crops, hay, pasture) - no greenhouses fruits or vegetables	Number of adjacent/near farm building clusters including barns is proportionately medium relative to the block boundary (length)	**2**

Principle A3) Avoid impacts on the agri-food network or if not possible to minimize and mitigate impacts.

Blocks	Criterion		Rank
	1) Presence of agricultural services within the expansion area (i.e. distributors, veterinarians, farm supply, machinery repair, grain dryers, value added food processing etc.)	**2) Impact on unique agricultural services as defined in criterion 1 beyond the boundaries associated with each block.**	
E1	None of the agricultural services are present within the block area 🟢	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure 🟡	**1**
E2	None of the agricultural services are present within the block area 🟢	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure 🟡	**1**
E3	None of the agricultural services are present within the block area 🟢	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure 🟡	**1**
E4	None of the agricultural services are present within the block area 🟢	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure 🟡	**1**
E5	None of the agricultural services are present within the block area 🟢	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure 🟡	**1**
E6	None of the agricultural services are present within the block area 🟢	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure 🟡	**1**
E7	None of the agricultural services are present within the block area 🟢	Some moderate effect on the agricultural system economics due to a reduction in agricultural land and infrastructure 🟡	**1**

B) Archaeology

Ranking Scheme: Most Preferred (1) to Least Preferred (7) **Very Supportive** **Supportive** **Constrained**

GREEN – 0-35%; YELLOW – 35-70%; RED – 35-100%
GREEN – no registered sites in Blocks Area/ sites have been removed; YELLOW – 0-3 unmitigated sites in blocks or NHS area; RED – 4+ unmitigated sites in blocks or NHS area

Principle B1) To protect and avoid archaeological resources and areas of potential for the presence of archaeological resources, and where avoidance is not possible to assess and mitigate the archaeological resources.

Blocks	Criterion		Rank
	1) The number of known archaeological resources	**2) The relative area of lands outside NHS with archaeological potential to be affected**	
E1	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**1.34 ha** (1.7% of 79.47 ha)	**2**
E2	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**34.19 ha** (63% of 54.61 ha)	**4**
E3	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**24.84 ha** (48% of 51.68 ha)	**3**
E4	0 sites. 96 percent of the Blocks area (38.84 ha) has been subject to previous archaeological assessment and cleared of further concern.	**1.01 ha** (2.5% of 39.93 ha)	**1**
E5	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**35.74 ha** (75% of 47.96 ha)	**5**
E6	0 sites. None of the Blocks area has been subject to previous archaeological assessment.	**24.73 ha** (93% of 26.43 ha)	**6**
E7	**4 in area of potential** [AhHb-120; AhHb-122; AhHb-124; AhHb-126 – **all contain CHVI**]; 2 in NHS [AhHb-121; AhHb-138 – **all contain CHVI**]. ***An unknown portion of the Blocks area has been subject to archaeological assessment, as the reporting is not available at this time.**	**42.98 ha** (97% of 44.18 ha)	**7***

C) Transportation

Ranking Scheme: Most Preferred (1) to Least Preferred (7) **Very Supportive** **Supportive** **Constrained**

Principle C1) To ensure appropriate access and connectivity to new urban areas.

Blocks	Criterion		Rank
	1) Ease of connectivity to arterial corridors and Highway 403 - ability to provide good access, number of accesses needed versus that can be facilitated, frontage on arterials	**2) Constraints to connectivity and access (e.g. physical features)** – physical constraint / parcel shape impact on collector road framework	
E1	- Access to Powerline Road limited - Access to Paris Road limited - Good proximity to Hwy 403	- Area of lot good - Shape of lot constrains network connection opportunities	**4**
E2	- Good access to Golf Road - Good proximity to Hwy 403	- natural area limits network development potential	**6**
E3	- Good access to Golf Road - Good access to Powerline Road - Good proximity to Hwy 403	- Shape of lot allows for good road network flexibility - Physical constraints minimal	**1**
E4	- Good access to Golf Road - Good access to Powerline Road - Good proximity to Hwy 403	- Shape of lot allows for good road network flexibility - Physical constraints minimal	**1**
E5	- Good access to Golf Road, long frontage - Good proximity to Hwy 403	- Physical constraints confined to east side of block	**4**
E6	- Access to Powerline Road limited - Good proximity to Hwy 403	- Shape of lot constrains network connection opportunities	**6**
E7	- Good access to Highway 403 at - Garden Ave via Adams Road	- Physical constraints limited - Long frontage along Adams Road	**1**

Principle C2) To ensure appropriate transportation capacity is maintained.

Blocks	Criterion		Rank
	1) Ability of the existing/planned transportation and transit capacity to accommodate new trips – existing constraints to capacity, planned expansion in corridors	**2) Availability of opportunities to expand capacity if needed** – additional capacity expansion	
E1	- Future capacity of Paris Road constrained - Good capacity along Powerline Road 	- Powerline Road expansion potential 	**7**
E2	- Good capacity along Powerline Road 	- Powerline Road expansion potential - Golf Road expansion potential 	**1**
E3	- Good capacity along Powerline Road 	- Powerline Road expansion potential - Golf Road expansion potential 	**1**
E4	- Good capacity along Powerline Road 	- Powerline Road expansion potential - Golf Road expansion potential 	**1**
E5	- Good capacity along Powerline Road 	- Powerline Road expansion potential - Golf Road expansion potential 	**1**
E6	- Good capacity along Powerline Road 	- Powerline Road expansion potential - Golf Road expansion potential 	**1**
E7	- Good capacity long Lynden Road - Good capacity along Garden Ave 	- Adam Road expansion potential limited given role and function - Lynden Road connection to Garden Ave constrained 	**6**

Principle C3) To balance transportation needs and provide choice for the travel needs of residents.

Blocks	Criterion		Rank
	1) Ability to provide opportunities for potential new areas to connect with transit service. – transit service extension logical	**2) Ability to provide opportunities for potential new areas to connect with active transportation networks** – active modes recreation versus utilitarian different from transit, utilitarian connection to appropriate roadway functions, recreational connection to multi-use trail opportunities	
E1	- Expansion of transit coverage difficult – connections, access 	- Remote connection - Natural areas of trails discontinuous 	**7**
E2	- Expansion of transit coverage can be accommodated easily 	- Remote connection - Golf Road function appropriate for on street paths - Natural area continuity for trail connectivity 	**1**
E3	- Expansion of transit coverage can be accommodated easily 	- Remote connection - Golf Road function appropriate for on street paths - Natural area continuity for trail connectivity 	**1**
E4	- Expansion of transit coverage can be accommodated easily 	- Remote connection - Golf Road function appropriate for on street paths - Natural area continuity for trail connectivity 	**1**
E5	- Expansion of transit coverage can be accommodated easily 	- Remote connection - Natural area continuity for trail connectivity 	**1**
E6	- Expansion of transit coverage can be accommodated easily 	- Remote connection - Natural area continuity for trail connectivity 	**1**
E7	- Expansion of transit coverage can be accommodated easily 	- Remote connection - Natural area continuity for trail connectivity 	**1**

Principle C4) To ensure transportation network continuity between existing and new areas.

Blocks	Criterion	Rank
	1) Degree of dependency of potential expansion areas to other adjacent urban areas (i.e. an isolated area with higher needs to service vs. areas with better synergies) – ability to connect infrastructure across parcel boundary, support / benefit from adjacent properties	
E1	- Efficiency of connections to adjacent areas limited 	**6**
E2	- Connections to adjacent areas problematic because of prevailing physical features 	**7**
E3	- Good potential for connections to adjacent areas 	**1**
E4	- Good potential for connections to adjacent areas 	**1**
E5	- Good potential for connections to adjacent areas 	**1**
E6	- Good potential for connections to adjacent areas 	**1**
E7	- Good potential for connections to adjacent areas 	**1**

Ranking Scheme: Most Preferred (1) to Least Preferred (7) **Very Supportive** **Supportive** **Constrained**

D) Environment

Principle D1) To protect, enhance and restore the NHS for the long-term along with existing linkage connections between the NHS and NHS features within Brant County and the existing urban area.

Blocks	Criterion						Rank
	1) Ability to maintain the overall integrity and connectivity of the NHS including the minimum 30 m buffers	**2) Ability to maintain connections to NHS features with the existing built up urban areas and adjacent rural lands (Brant County)**	**3) Ability to enhance the NHS through restoration of "adjacent lands" (in conjunction with compatible urban uses)**	**4) Ability to reduce the fragmentation of the NHS and habitat loss through road and servicing crossings of valleylands, woodlands and watercourses**	**5) Ability to integrate major hedgerows, woodland lobes, and small, isolated woodlands/wetlands (plus 30 m buffers) that are identified as part of the NHS**	**6) Ability to offset the removal of NHS features and/or reduced buffers (e.g. hedgerows, woodland lobes, headwater drainage features, and small, isolated woodlands/ wetlands) through restoration initiatives within or outside of the proposed urban areas.**	
E1	isolated hedgerows	isolated hedgerows	isolated hedgerows	isolated hedgerows	Isolated hedgerows. Buffer reduction feasible	isolated hedgerow features	**1**
E2	PSW's and headwater drainage features (coldwater)	PSW's and headwater drainage features (coldwater)	If developable area is reduced	drainage feature, wetland and linkage constraints	features plus buffer constrain developable area.	PSW's associated with headwater drainage features (coldwater)	**7**
E3	isolated hedgerow	isolated hedgerow	isolated hedgerow	High – isolated hedgerow	High – Isolated hedgerow	High – isolated hedgerow feature	**1**
E4	Moderate to High – important woodlot/wetland connection at south end	Moderate – in conjunction with connected NHS	30 m buffers provide adequate enhancement	Low to Moderate – woodlot/wetland connection at South end should be maintained	Low to Moderate – important woodlot/wetland connection at South end	Low to Moderate – hedgerows provide important link between NHS features	**3**
E5	Moderate – presence of headwater drainage features and hedgerows linked to PSW's	High – NHS features associated with drainage	Moderate to High – buffer areas	Low – connection to E6 requires watercourse crossing	Low to Moderate – hedgerows provide important connection between NHS features	Moderate to High – in conjunction with watercourse restoration	**5**
E6	NHS features associated with main branch of Jones Creek	Jones Creek forms North edge	Moderate to High – in conjunction with C3	Low – due to relationship with C3	mainly cultivated land	mainly cultivated land	**5**
E7	tributary to Fairchild Ck. Traverses center of block	if watercourse is retained	mainly cultivated	mainly cultivated	mainly cultivated	watercourse traverses the block.	**3**

Principle D2) To protect and enhance surface water quality/quantity including fish habitat.

Blocks	Criterion		Rank
	1) Ability to maintain wetland hydrology through groundwater recharge and surface water contributions.	**2) Ability to maintain and enhance coldwater fish habitat (Jones Creek) and other fish habitat features**	
E1	High – mainly cultivated land	Moderate – mainly cultivated land, no watercourses present	**1**
E2	Low to Moderate – presence of headwater drainage features and wetlands (PSW)	Low to Moderate – headwater drainage features with source wetlands (PSW)	**7**
E3	Moderate to High – mainly cultivated land, headwater drainage feature at North end.	Moderate to High – mainly cultivated land, headwater drainage feature at North end	**1**
E4	High – mainly cultivated	Moderate to High – mainly cultivated	**1**
E5	Low to Moderate – presence of headwater drainage features and wetlands (PSW)	Low to Moderate – presence of headwater drainage features and wetlands (PSW)	**5**
E6	Moderate to High – mainly cultivated, flanked by headwater drainage features	Moderate to High – mainly cultivated, flanked by headwater drainage features	**5**
E7	Moderate to High – mainly cultivated, wetlands to the west. Drainage feature traverses block	Moderate to High – mainly cultivated, wetlands to the west. Drainage feature traverses block	**4**

Principle D3) To protect significant wildlife habitat features and functions including the habitat of species-at-risk.

Blocks	Criterion		Rank
	1) Compatibility of land uses with significant wildlife habitat features and functions	**2) Compatibility of land uses with the habitat of species at risk**	
E1	High – mainly cultivated land	High – mainly cultivated land	**1**
E2	Low to Moderate – headwater drainage features and wetlands	Low to Moderate – headwater drainage features and wetlands	**7**
E3	High – mainly cultivated	High – mainly cultivated	**1**
E4	Moderate to High – presence of woodlands/wetlands with hedgerow connections	Moderate to High – presence of woodlands/wetlands with hedgerow connections	**5**
E5	Low to Moderate – headwater drainage features, wetlands, connecting hedgerows	Low to Moderate – headwater drainage features, wetlands, connecting hedgerows	**5**
E6	Moderate to High – mainly cultivated	Moderate to High – mainly cultivated	**1**
E7	Moderate to High – mainly cultivated	Moderate to High – mainly cultivated	**1**

Principle D4) To protect stream channel and valleyland integrity, particularly in erosion prone systems.

Blocks	Criterion		Rank
	1) Ability to incorporate/integrate headwater drainage features as part of an overall LID SWM approach	**2) Compatibility with erosion prone watercourses and valley systems**	
E1	High – no features present	High – no features present	**1**
E2	Moderate to High – features present	Low to Moderate – Jones Creek abuts the area	**6**
E3	High – mainly cultivated, drainage feature at N end	High – mainly cultivated, drainage feature at N end	**3**
E4	High – mainly cultivated	High – mainly cultivated	**1**
E5	Low to Moderate – headwater drainage features traverse the area	Low to Moderate – Jones Creek flanks the area	**6**
E6	Moderate to High – mainly cultivated, flanked by drainage features	Low to Moderate – Jones Creek flanks the area	**5**
E7	Low to Moderate – drainage feature traverses center of block	Low to Moderate – tributary to Fairchild Creek	**3**

E) Water / Wastewater

Ranking Scheme: Most Preferred (1) to Least Preferred (7) 🟢 **Very Supportive** 🟡 **Supportive** 🔴 **Constrained**

Principle E1) To efficiently use existing and planned infrastructure and to minimize the complexity of extending the existing water and wastewater system to the Urban Expansion areas.

Water				
Blocks	**Criterion**			**Rank**
	1) Need to cross existing natural heritage corridors to extend water and wastewater servicing	**2) Ability to service area via existing networks vs. need to construct new pumping/other infrastructure**	**3) Need for localized sanitary pumping station and/or water pressure zones**	
E1	• All lands can be serviced without crossing natural heritage corridors 🟢	• Can be serviced with connection to PD4 but requires crossing of Hwy 403 for extension of the trunk network • Hwy 403 crossing and trunk extension required to service remain NW employment lands 🟡	• Serving strategy dependent of phasing • PD4 connection requires crossing of Hwy 403 extension of the trunk network • Hwy 403 crossing and trunk extension required to service remain NW employment lands 🟡	**2**
E2	• Servicing dependent of growth phasing • May required crossing natural heritage corridors 🟡	• Can be serviced with connection to PD2/3 via E5/E6 or PD4 via E1 🟡	• Serving strategy dependent of phasing • May require extension of trunk watermain from PD4 and/or local Pump Station 🟡	**5**
E3	• Servicing dependent of growth phasing • May required crossing natural heritage corridors 🟡	• Can be serviced with connection to PD2/3 via E5/E6 or PD4 via E1 🟡	• Serving strategy dependent of phasing • May require extension of trunk watermain from PD4 and/or local Pump Station 🟡	**5**
E4	• Servicing dependent of growth phasing • May required crossing natural heritage corridors 🟡	• Can be serviced with connection to PD2/3 via E5/E6 or PD4 via E1 🟡	• Serving strategy dependent of phasing • May require extension of trunk watermain from PD4 and/or local Pump Station 🟡	**5**
E5	• Majority of lands can be serviced without crossing natural heritage corridors if serviced from Powerline Rd • Looping from E6 will require the crossing of a natural heritage corridor 🟡	• Can be serviced with connection to PD2/3 via E6 and C2 🟡	• Extension of existing pressure district 🟢	**2**
E6	• Majority of lands can be serviced without crossing natural heritage corridors if serviced from Powerline Rd • Looping from E5 and/or C2 will require the crossing of a natural heritage corridor 🟡	• Can be serviced with connection to PD2/3 via C2 🟡	• Extension of existing pressure district 🟢	**2**
E7	• All lands can be serviced without crossing natural heritage corridors if serviced from Lynden Rd 🟢	• Serviced via extension of PD2/3 through new employment lands 🟢	• May require local adjustment of pressure district by PRV installation 🟡	**1**

Wastewater			
Blocks	**Criterion**		**Rank**
	1) Need to cross existing natural heritage corridors to extend water and wastewater servicing	**2) Ability to service area via existing networks vs. need to construct new pumping/other infrastructure**	**3) Need for localized sanitary pumping station and/or water pressure zones**	
E1	• All lands can be serviced without crossing natural heritage corridors 	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along Powerline • Both require long trunk extensions and potential SPS 	• Servicing needs dependent on broader servicing strategy and phasing • Unlikely to need localized SPS to service individual blocks 	**1**
E2	• Majority of lands can be serviced without crossing natural heritage corridors 	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along Powerline • Both require long trunk extensions and potential SPS 	• Servicing needs dependent on broader servicing strategy and phasing • Unlikely to need localized SPS to service individual blocks 	**1**
E3	• All lands can be serviced without crossing natural heritage corridors 	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along Powerline • Both require long trunk extensions and potential SPS 	• Servicing needs dependent on broader servicing strategy and phasing • Unlikely to need localized SPS to service individual blocks 	**1**
E4	• Majority of lands can be serviced without crossing natural heritage corridors 	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along Powerline • Both require long trunk extensions and potential SPS 	• Servicing needs dependent on broader servicing strategy and phasing • Unlikely to need localized SPS to service individual blocks 	**1**
E5	• Servicing likely to cross natural heritage corridors 	• Servicing strategy for employment lands dependent of phasing • Likely require a centralized SPS to support E5, E6, and/or C3 to service wastewater to new trunk for North lands • Limited capacity within existing along northern boundary, flows to be conveyed east on Powerline to the City's Eastern Trunk 	• Servicing needs dependent on broader servicing strategy and phasing • May to need localized SPS to service individual blocks 	**6**

Wastewater				
Blocks	**Criterion**			**Rank**
	1) Need to cross existing natural heritage corridors to extend water and wastewater servicing	**2) Ability to service area via existing networks vs. need to construct new pumping/other infrastructure**	**3) Need for localized sanitary pumping station and/or water pressure zones**	
E6	• Servicing likely to cross natural heritage corridors 	• Servicing strategy for employment lands dependent of phasing • Likely require a centralized SPS to support E5, E6, and/or C3 to service wastewater to new trunk for North lands • Limited capacity within existing along northern boundary, flows to be conveyed east on Powerline to the City's Eastern Trunk 	• Servicing needs dependent on broader servicing strategy and phasing • May to need localized SPS to service individual blocks 	**6**
E7	• Lands likely can be serviced without crossing natural heritage corridors, dependent on local servicing strategy 	• Will require local SPS to service wastewater to existing system • SPS likely to be integrated as part of a single SPS with existing employment lands to the west 	• Servicing needs dependent on broader servicing strategy and phasing • Unlikely to need localized SPS to service individual blocks 	**1**

Principle E2) To align future infrastructure with the Master Servicing Plan.

Water					
Blocks	**Criterion**				**Rank**
	1) Proximity and capacity of existing trunk networks	**2) Scope of trunk network upgrades needed to support growth area**	**3) Impacts on existing users and system level of service**	**4) Supports priority areas and servicing objectives identified in the Master Servicing Plan**	
E1	• Ease to connect to existing 400 mm • Current trunk has capacity to support growth area but my be undersized to support intensification as well	• Long extension of 400 mm trunk along Powerline Rd or extension from PD4 • Extension needed to support growth of remain NW employment lands	• Not expected to impact existing users and level of service • Ensure trunk is sufficiently sized	• Watermain extension support servicing of NW employment lands • Supports MSP objectives	**1**
E2	• Ease to connect to existing 400 mm • Current trunk has capacity to support growth area but my be undersized to support intensification as well	• Long extension of 400 mm trunk along Powerline Rd or extension from PD4 • Extension needed to support growth of remain NW employment lands	• Not expected to impact existing users and level of service • Ensure trunk is sufficiently sized	• Watermain extension support servicing of NW employment lands • Supports MSP objectives	**1**
E3	• Ease to connect to existing 400 mm • Current trunk has capacity to support growth area but my be undersized to support intensification as well	• Long extension of 400 mm trunk along Powerline Rd or extension from PD4 • Extension needed to support growth of remain NW employment lands	• Not expected to impact existing users and level of service • Ensure trunk is sufficiently sized	• Watermain extension support servicing of NW employment lands • Supports MSP objectives	**1**
E4	• Ease to connect to existing 400 mm • Current trunk has capacity to support growth area but my be undersized to support intensification as well	• Long extension of 400 mm trunk along Powerline Rd or extension from PD4 • Extension needed to support growth of remain NW employment lands	• Not expected to impact existing users and level of service • Ensure trunk is sufficiently sized	• Watermain extension support servicing of NW employment lands • Supports MSP objectives	**1**
E5	• Ease to connect to existing 400 mm • Current trunk has capacity to support growth area but my be undersized to support intensification as well	• Extension of 400 mm trunk along Powerline Rd • May require upsizing of trunk watermain	• Not expected to impact existing users and level of service • Ensure trunk is sufficiently sized	• Upsizing trunk would support priority areas within King George corridor • Long extension of trunk would not support priority areas • Supports MSP objectives	**5**
E6	• Ease to connect to existing 400 mm • Current trunk has capacity to support growth area but my be undersized to support intensification as well	• Extension of 400 mm trunk along Powerline Rd • May require upsizing of trunk watermain	• Not expected to impact existing users and level of service • Ensure trunk is sufficiently sized	• Upsizing trunk would support priority areas within King George corridor • Long extension of trunk would not support priority areas • Supports MSP objectives	**5**
E7	• Ease to connect to existing 300 mm • Current trunk has capacity to support growth area but my be undersized to support intensification as well	• Extension of 300 mm trunk along Lynden Rd • May require upsizing of trunk watermain	• May impact low fire flows located on Lynden Rd • Ensure trunk is sufficiently sized to support growth area and intensification	• Upsizing trunk would support priority areas within Lynden Rd corridor • Supports MSP objectives	**5**

Wastewater					
Blocks	**Criterion**				**Rank**
	1) Proximity and capacity of existing trunk networks	**2) Scope of trunk network upgrades needed to support growth area**	**3) Impacts on existing users and system level of service**	**4) Supports priority areas and servicing objectives identified in the Master Servicing Plan**	
E1	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along powerline road • Both require long trunk extensions and potential SPS	• Upgrades dependent on boarder servicing strategy and phasing • South servicing not anticipated to trigger any upgrades • East servicing likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• South servicing not expected to impact existing users • East servicing limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**1**
E2	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along powerline road • Both require long trunk extensions and potential SPS	• Upgrades dependent on boarder servicing strategy and phasing • South servicing not anticipated to trigger any upgrades • East servicing likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• South servicing not expected to impact existing users • East servicing limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**1**
E3	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along powerline road • Both require long trunk extensions and potential SPS	• Upgrades dependent on boarder servicing strategy and phasing • South servicing not anticipated to trigger any upgrades • East servicing likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• South servicing not expected to impact existing users • East servicing limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**1**

Blocks	Wastewater				Rank
	Criterion				
	1) Proximity and capacity of existing trunk networks	2) Scope of trunk network upgrades needed to support growth area	3) Impacts on existing users and system level of service	4) Supports priority areas and servicing objectives identified in the Master Servicing Plan	
E4	• Servicing strategy for employment lands dependent of phasing • Block to extend to the south via long trunk extension, or to the east to the Eastern Trunk along powerline road • Both require long trunk extensions and potential SPS	• Upgrades dependent on boarder servicing strategy and phasing • South servicing not anticipated to trigger any upgrades • East servicing likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• South servicing not expected to impact existing users • East servicing limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**1**
E5	• Servicing strategy for employment lands dependent of phasing • Likely requires a centralized SPS to support E5, E6, and/or C3 and a new trunk for north lands • Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• South servicing, not expected to impact existing users • East servicing limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**1**
E6	• Servicing strategy for employment lands dependent of phasing • Likely requires a centralized SPS to support E5, E6, and/or C3 and a new trunk for north lands • Limited capacity within existing along northern boundary • Flows to be conveyed east on Powerline to the City's Eastern Trunk	• Likely upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• South servicing, not expected to impact existing users • East servicing limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**1**
E7	• Will require local SPS to service wastewater to existing system • SPS likely to be integrated as part of a single SPS with existing employment lands to the west	• Likely Upgrades to existing trunk network and Empey SPS required • Upgrades benefit servicing of full north lands and priority growth areas	• South servicing, not expected to impact existing users • East servicing limited capacity for conveyance to Empey SPS • Will require upgrades to SPS to limit impact on existing users	• Required upgrades to Empey SPS will support priority area intensification • Supports MSP objectives	**1**

Principle E3) To phase water and wastewater infrastructure logically and consecutively.

Water					
Blocks	**Criterion**				**Rank**
	1) Phasing impacts and dependency on adjacent blocks to tie-into existing water and wastewater systems	**2) Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) blocks**	**3) What are the alternative servicing blocks, if adjacent growth blocks are not developed**	**4) Flexibility/impacts of post period servicing of remaining boundary lands**	
E1	• Does not require phasing with trunk extension • Phasing of E3, E5, E6, and C2 may provide better system looping and planning	• Easy to integrate with E2, E3, and E4	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**2**
E2	• Impacted by phasing from either E1, E3, or E5	• Easy to integrate with E1, E3, and E5	• Extension of trunk up Golf Rd	• Not affected by servicing of remaining boundary lands	**4**
E3	• Impacted by phasing from either E1, E4, or E5	• Easy to integrate with E1, E2, E4, and E5	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**3**
E4	• Does not require phasing with trunk extension • Phasing of E5, E6, and C2 may provide better system looping and planning	• Easy to integrate with E3 • Difficult to integrate with C1 as it requires crossing natural heritage corridors	• Internal looping to trunk	• Not affected by servicing of remaining boundary lands	**4**
E5	• Does not require phasing with trunk extension • Phasing of E6 and C2 may provide better system looping and planning	• Easy to integrate with E2 and E3 • Difficult to integrate with E6 as it requires crossing natural heritage corridors	• Extension of trunk up Golf Rd	• May require local upsizing within E5 to connect and service remaining boundary lands	**7**
E6	• Does not require phasing with trunk extension • Phasing of C2 may provide better system looping and planning	• Easy to integrate with C1 • Difficult to integrate with E5 and C2 as it requires crossing natural heritage corridors	• Internal looping to trunk	• May require local upsizing within E6 to connect and service remaining boundary lands	**4**
E7	• Not impacted by phasing	• Not applicable	• Internal looping	• Not affected by servicing of remaining boundary lands	**1**

Wastewater					
Blocks	**Criterion**				**Rank**
	1) Phasing impacts and dependency on adjacent blocks to tie-into existing water and wastewater systems	**2) Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) blocks**	**3) What are the alternative servicing blocks, if adjacent growth blocks are not developed**	**4) Flexibility/impacts of post period servicing of remaining boundary lands**	
E1	• Impacted by phasing of E3, E5, E6, C2, C4, C5, and C7 as trunk servicing is provided on Powerline to City's Eastern Trunk • Not impacted by phasing if serviced to the south	• Easy to integrate E2 and E3 due to favourable elevations	• Extension of trunk up Oak Park (must cross 403)	• Not affected by servicing of remaining boundary lands	**2**
E2	• Impacted by phasing of E3, E5, E6, C2, C4, C5, and C7 as trunk servicing is provided on Powerline to City's Eastern Trunk • Impacted by phasing of E1, E3, and E4 if serviced to the south	• Easy to integrate E1, E3, and E4 due to favourable elevations	• Not adjacent to the existing system and servicing not advised without adjacent blocks	• Not affected by servicing of remaining boundary lands	**4**
E3	• Impacted by phasing of E5, E6, C2, C4, C5, and C7 as trunk servicing is provided on Powerline to City's Eastern Trunk • Impacted by phasing of E1 and/or E4 if serviced to the south	• Easy to integrate E1, E2, and E4 due to favourable elevations	• Not adjacent to the existing system and servicing not advised without adjacent blocks	• Not affected by servicing of remaining boundary lands	**4**
E4	• Impacted by phasing of E3, E5, E6, C2, C4, C5, and C7 as trunk servicing is provided on Powerline to City's Eastern Trunk • Not impacted by phasing if serviced to the south	• Easy to integrate E2 and E3 due to favourable elevations	• Extension of trunk up Oak Park (must cross 403)	• Not affected by servicing of remaining boundary lands	**2**
E5	• Impacted by phasing of E6, C2, C4, and C5 as trunk servicing is provided on Powerline to City's Eastern Trunk	• May be difficult to integrate with E6 due to natural heritage corridor but elevations are favourable	• Extension of the trunk from King George and installation of trunk on Powerline	• May require local upsizing within E5 to connect and service remaining boundary lands	**4**
E6	• Impacted by phasing of C2, C4, and C5 as trunk servicing is provided on Powerline to City's Eastern Trunk	• May be difficult to integrate with C2 due to natural heritage corridor but elevations are favourable	• Extension of the trunk from King George and installation of trunk on Powerline	• May require local upsizing within E6 to connect and service remaining boundary lands	**4**
E7	• Not impacted by phasing	• Not applicable	• Is not impacted by phasing	• Not affected by servicing of remaining boundary lands	**1**

Principle E4) To ensure the infrastructure is financially viable over the full life cycle and the preferred serving solution considers the best life-cycle blocks when considering overall operational efficiency, operational resiliency to climate change and/or major component failure, operational and maintenance cost, existing renewal needs of the system, post period servicing, and greenhouse gas emissions.

Water				
Blocks	**Criterion**			**Rank**
	1) Local and trunk servicing capital cost within the development blocks	**2) Existing trunk upgrade capital cost**	**3) Local and trunk life cycle operation and maintenance costs**	
E1	• High capital costs associated with extension of trunk on Powerline Rd or from PD4	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**4**
E2	• High capital costs associated with extension of trunk on Powerline Rd and Golf Rd or from PD4 • Moderate capital costs to avoid natural heritage corridors	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**4**
E3	• High capital costs associated with extension of trunk on Powerline Rd or from PD4	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**4**
E4	• High capital costs associated with extension of trunk on Powerline Rd or from PD4	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**4**
E5	• Moderate capital costs associated with extension of trunk on Powerline Rd	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**1**
E6	• Moderate capital costs associated with extension of trunk on Powerline Rd	• Moderate capital costs associated if upsizing King George corridor is required	• Typical life cycle costs	**1**
E7	• Moderate capital costs associated with extension of trunk on Lynden Rd	• Moderate capital costs associated if upsizing Lynden Rd corridor is required	• Typical life cycle costs	**1**

Wastewater			
Blocks	**Criterion**		**Rank**
	1) Local and trunk servicing capital cost within the development blocks	**2) Existing trunk upgrade capital cost**	**3) Local and trunk life cycle operation and maintenance costs**	
E1	• Moderate capital costs associated with installation of trunk servicing	• Moderate capital costs associated with upgrading existing trunk to Empey	• Typical life cycle costs	**1**
E2	• Moderate capital costs associated with installation of trunk servicing	• Moderate capital costs associated with upgrading existing trunk to Empey	• Typical life cycle costs	**1**
E3	• Moderate capital costs associated with installation of trunk servicing	• Moderate capital costs associated with upgrading existing trunk to Empey	• Typical life cycle costs	**1**
E4	• Moderate capital costs associated with installation of trunk servicing	• Moderate capital costs associated with upgrading existing trunk to Empey	• Typical life cycle costs	**1**
E5	• High capital costs associated with avoidance of natural heritage corridors, installation of trunk along Powerline and new SPS	• Moderate capital costs associated with upgrading existing trunk to Empey	• Typical life cycle costs	**6**
E6	• High capital costs associated with avoidance of natural heritage corridors, installation of trunk along Powerline and new SPS	• Moderate capital costs associated with upgrading existing trunk to Empey	• Typical life cycle costs	**6**
E7	• Moderate capital costs associated with installation of trunk servicing • Trunk servicing costs needed to service employment lands to the west	• Moderate capital costs associated with upgrading existing trunk to Empey	• Typical life cycle costs	**1**

F) Stormwater

Ranking Scheme: Most Preferred (1) to Least Preferred (7) 🟢 **Very Supportive** 🟡 **Supportive** 🔴 **Constrained**

Principle F1) To avoid impacts to local/regional hydrologic and hydrogeological function. Key hydrologic areas are to be avoided where possible when determining the most appropriate location for settlement area boundary expansion. Key hydrologic areas are defined as significant groundwater recharge areas (SGRAs), highly vulnerable aquifers (HVAs), and significant surface water contribution areas that are necessary for the ecological and hydrologic integrity of a watershed. Areas with shallow groundwater table/potential for groundwater discharge, and areas with isolated wetlands, may also have important hydrologic and hydrogeological functions.

Blocks	Criterion								Rank
	1) Presence of identified SGRAs and level of estimated recharge		2) Presence of HVAs		3) Depth to groundwater table		4) Presence of isolated wetlands		
E1	88% of net area identified as SGRA by GRCA	🔴	Not identified as HVA	🟢	Groundwater table predicted well below ground surface	🟢	None	🟢	4
E2	20% of net area identified as SGRA by GRCA	🟡	Not identified as HVA	🟢	Groundwater table predicted well below ground surface	🟢	Two isolated PSWs within catchment area	🔴	6
E3	17% of net area identified as SGRA by GRCA	🟡	Not identified as HVA	🟢	Groundwater table predicted well below ground surface	🟢	None	🟢	2
E4	78% of net area identified as SGRA by GRCA	🔴	Approximately 50% of net area is identified as HVA by GRCA	🟡	High groundwater table predicted in relatively small area	🟡	None - downstream PSWs are well integrated in stream corridor/ NHS	🟢	7
E5	2% of net area identified as SGRA by GRCA	🟡	Not identified as HVA	🟢	High groundwater table predicted in relatively small area	🟡	None	🟢	3
E6	Not identified as SGRA	🟢	Not identified as HVA	🟢	High groundwater table predicted in relatively large area	🔴	None	🟢	4
E7	Not identified as SGRA	🟢	Not identified as HVA	🟢	High groundwater table predicted in relatively small area	🟡	None	🟢	1

Principle F2) To minimize the impact on the water resource system by minimizing the relative complexity needed to complete local stormwater servicing.

Blocks	Criterion					Rank
	1) Thermal regime of receiving watercourse	**2) Upstream uncontrolled urban drainage area**	**3) Degree of sensitive watercourses**	**4) Degree of spatial constraint associated with watercourses within potential boundary area (i.e. headwater features or other watercourses not currently identified as part of the natural heritage system)**	**5) Topographical complexity and number of outlets**	
E1	Within catchment of UJ-1, potentially a coldwater stream in at least some reaches (groundwater table predicted to be above ground surface in some locations along stream length, but soils along stream length are of low permeability.)	None	No existing watercourses present in E1; runoff would be conveyed into E2 and/or E3 watercourses and may require additional SWM control to reduce impacts downstream.	Likely no headwater drainage features or watercourses present; since there is currently no outlet for several natural depressions, a new channel may need to be constructed to convey water to the drainage network, if the capacity of the depressions is insufficient to store additional water	Moderate complexity – 3 likely outlets	**1**
E2	Within catchment of UJ-1, potentially a coldwater stream in at least some reaches	None	Headwater drainage features drain into moderately sensitive reach UJ-1E; they may receive flow from E1	Moderate drainage density of low-sensitivity channels; if E1 is developed, then surface water runoff will need to be conveyed through E2 watercourses	Moderate complexity due to isolated wetlands	**6**
E3	Within catchment of UJ-1, potentially a coldwater stream in at least some reaches	None	UJ-1F may receive flow from E1; the tributary discharges into medium-sensitivity channel UJ-1H in E5	Low drainage density of low sensitivity channels. Likely no additional headwater drainage features present. If E1 is developed, then surface water runoff may need to be conveyed through E3 watercourses	Low complexity – 2 likely outlets	**1**
E4	Immediate receiver UJ-2A and downstream receiver UJ-3A are potentially coldwater streams (groundwater table predicted to be above ground surface in some locations along stream length, but soils along stream length are of low permeability.)	None	Potential headwater drainage features discharge into UJ-2A, which has low-sensitivity; water flows into E5	Low drainage density of headwater drainage features.	Low complexity – 2 likely outlets	**1**
E5	Major receiver UJ-1 is potentially a coldwater stream in at least some reaches	None	Channels and potential headwater drainage features discharge into medium sensitivity channels UJ-1, UJ-2, and UJ-3. The watercourses would receive urban runoff from E2 and E3	Relatively high drainage density of headwater drainage features; two tributaries already mapped within the drainage network	Moderate complexity – 3 likely outlets	**7**
E6	Receiver UJ-3A is potentially a coldwater stream	None	No sensitive watercourses. Channels in proximity (UJ-2a, UJ-3E) are of low sensitivity; these watercourses will also receive flow from C1	Likely no headwater drainage features or watercourses present	Moderate complexity due block shape and location of drainage split	**1**
E7	Receivers GD-4 and F-6 are unlikely to be coldwater streams (clay soils and low groundwater table)	None	GD-4A low sensitivity watercourse and only drainage feature within area	Moderate drainage density of low sensitivity channels and headwater drainage features not within natural heritage system	Moderate complexity depending on whether watercourse can be removed, watershed altered	**5**

Principle F3) To minimize the impact on the water resource system by evaluating the existing downstream system capacity.

Blocks	Criterion		Rank
	1) Presence and capacity of existing outlet	**2) Degree of hydromodification constraint/ geomorphologic sensitivity of existing outlet**	
E1	Approximately 21 ha drain to a natural depression with no outlet. Approximately 56 ha naturally drain overland to E2 and E3 blocks with no apparent defined channel.	There is currently no defined channel within E1; an outlet may be required to convey water to the defined drainage network in E2 and/or E3; runoff must not alter sensitivity of downstream drainage network and therefore require additional control	**7**
E2	Approximately 5 ha drain to a natural depression with no outlet. Remainder has no constraints beyond potential road culvert capacity constraints	Multiple surface drainage features are available for drainage outlets; none identified as sensitive; potential for channel modifications if necessary; tributaries discharge into moderately sensitive downstream channel	**4**
E3	Approximately 17 ha naturally drain overland toward E5 crossing Golf Road with no apparent culvert or defined channel. Remainder has no constraints beyond potential road culvert capacity constraints	Only one watercourse (low sensitivity) identified in the block; this may not be able to accommodate all future flows from block E3 (and potential E1), additional drainage channel may need to be developed, existing feature modified to accommodate flow, or more LID measures implemented.	**4**
E4	Culvert capacity should be checked, no other potential constraints	Several surface features present, but may not be able to accommodate all future flows, additional drainage channel may need to be developed, existing feature modified to accommodate flow, more LID measures implemented.	**2**
E5	No constraints	Multiple surface drainage features (low and medium constraint) are available for drainage outlets; potential for channel modifications if necessary. Strategic placement of any SWM ponds/outfalls to reduce/avoid cumulative impact from E1, E2 and E3 runoff.	**2**
E6	No constraints	Multiple surface drainage features are available to receive flow; one identified as sensitive; potential for channel modifications if necessary and typical SWM controls likely	**1**
E7	Approximately 12 ha naturally drain overland toward Brant County crossing Adams Road with no apparent culvert or defined channel. Remainder has no constraints beyond potential road culvert capacity constraints.	Several surface features present, but may not be able to accommodate future flows, additional drainage channel may need to be developed, existing feature modified to accommodate flow, more LID measures implemented.	**4**

Principle F4) To phase stormwater infrastructure logically and consecutively.

Blocks	Criterion				Rank
	1) Phasing impacts and dependency on adjacent blocks to tie-into existing stormwater systems	**2) Flexibility/impacts of integrating servicing with adjacent (upstream/downstream) blocks**	**3) What are the alternative serving blocks, if adjacent growth blocks are not developed**	**4) Flexibility/impacts of post period servicing of remaining boundary lands**	
E1	• Majority of land area dependent on development of E2 or E3 in order to reach outlet; E2 and E3 are themselves dependent on E5	• SWM facilities for the UJ-1 subcatchment of E1 could be integrated with facilities in E2, E3, and/or E5, or stand alone	• 100% infiltration system, or extend trunk infrastructure on Powerline Road	• Not applicable	**7**
E2	• Majority of land area dependent on development of E5	• Opportunity to integrate servicing with E1 and/or E5	• Outlets to the main UJ-1 watercourse through E5 can be created/protected	• Not applicable	**5**
E3	• Dependent on development of E5	• Opportunity to integrate servicing with E1 and/or E5	• Outlets to the main UJ-1 watercourse through E5 can be created/protected	• Not applicable	**6**
E4	• Direct outlet to watercourse, independent of any other block	• None	• Not applicable	• Not applicable	**4**
E5	• Direct outlet to watercourses, independent of any other block	• Opportunity to integrate servicing with E1, E2, and/or E3	• Not applicable	• Not applicable	**2**
E6	• Direct outlet to watercourse, independent of any other block	• Opportunity to integrate with part E5 for UJ-2A, part C2 for UJ-3E through planning	• Not applicable	• Not applicable	**1**
E7	• Direct outlet to watercourses, independent of any other block	• None	• Not applicable	• Not applicable	**3**

Principle F5) To ensure that the stormwater infrastructure is financially viability by minimizing the total project life cycle cost to service the urban boundary expansion areas.

Blocks	Criterion			Rank
	1) Local and trunk servicing capital cost within the development blocks	**2) Existing trunk upgrade capital cost**	**3) Local and trunk life cycle operation and maintenance costs**	
E1	• High relative cost due to SGRA and catchment with no legal outlet, potential for coldwater stream	• None	• High relative cost due to infiltration facilities	**7**
E2	• Moderate relative cost due to presence of wetland and small SGRA component, potential for coldwater stream	• None	• Moderate relative cost	**5**
E3	• Low to moderate relative cost, conventional servicing with small SGRA component, potential for coldwater stream	• None	• Low to moderate relative cost	**3**
E4	• Moderate relative cost, SGRA with otherwise conventional servicing, potential for coldwater stream	• None	• High for SGRA, HVA	**6**
E5	• Low relative cost, conventional servicing, potential for coldwater stream	• None	• Low relative cost	**2**
E6	• Moderate relative cost. Likely on-site controls discharging to creek, potential for coldwater stream	• None	• Low relative cost	**4**
E7	• Low relative cost, conventional servicing	• None	• Low relative cost	**1**

G) Land Use

Ranking Scheme: Most Preferred (1) to Least Preferred (7) **Very Supportive** **Supportive** **Constrained**

Principle G1) To ensure development occurs adjacent to existing built areas.

Blocks	Criterion		Rank
	1) Ability of the expansion area to develop consecutively to existing built areas.	**2) Ability of the expansion area to be integrated with adjacent existing neighbourhoods.**	
E1	- Adjacent to existing urban area and north of Northwest Industrial Area (NIA)	- could integrate with NIA - existing Paris Rd to the south of site	**1**
E2	- Not adjacent to existing urban area - requires E1 and E3 to develop in order to be in urban boundary	- only if E1 or E3 are developed	**6**
E3	- not adjacent to existing urban area - requires E4 to develop in order to be in urban boundary	- only if E1 or E4 are developed	**4**
E4	- adjacent to existing urban area - close to commercial/industrial uses off of Alexander Graham Bell Pkwy	- access to Paris Road, to the south, which allows integration - existing commercial/industrial development SW	**1**
E5	- not adjacent to existing urban area - requires E4 or E3 to develop in order to be in urban boundary	- no existing neighbourhoods to integrate into	**4**
E6	- not adjacent to existing urban area - requires E5 to develop in order to be adjacent	- no existing neighbourhoods to integrate into - even if E5 is developed for employment, it is separated by NHS	**6**
E7	- Adjacent to existing urban area - NHS buffer between existing built form and E7	- can integrate well with future development of Hopewell Lands	**1**

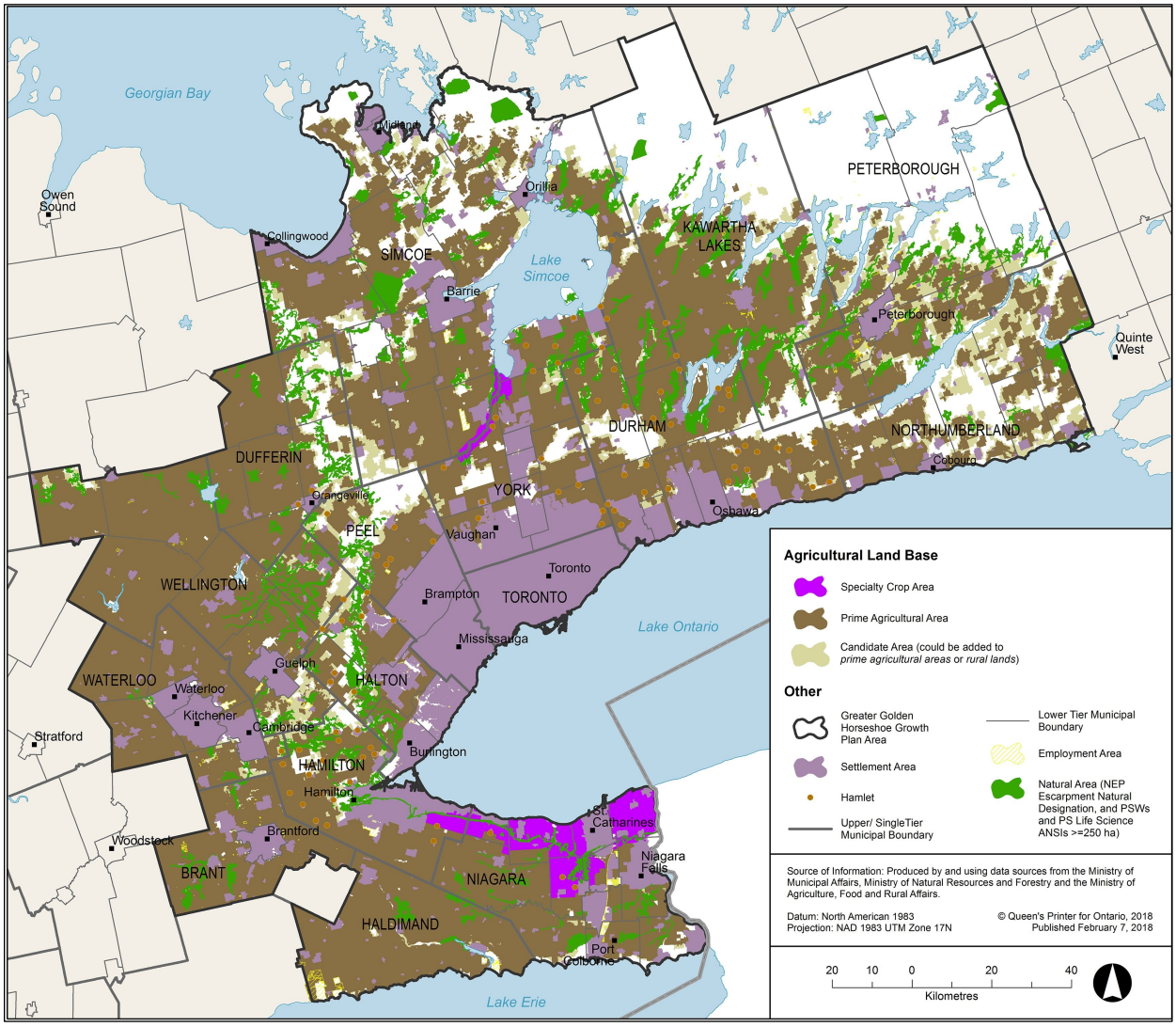
Principle G3) To direct employment areas to locations in proximity to major goods movement facilities.

Blocks	Criterion		Rank
	1) Distance of the expansion area to Highway 403	**2) Visibility of the expansion area to Highway 403**	
E1	- Easy connection through Paris Rd	- not good visibility	**3**
E2	- 2.5 km from SE corner of E2 to HW 403, connecting through Golf Rd and Paris Rd - Farthest distance of all blocks	- no visibility	**6**
E3	- Could connect through Golf Rd/ Powerline Rd then connecting to Paris Rd	- no visibility	**4**
E4	- North of 403, across Paris Rd	- 403 visible	**1**
E5	- 1.8 km from South-West corner of E5 HW 403 - Could connect through Golf Rd/ Powerline Rd then connecting to Paris Rd	- no visibility	**4**
E6	- 2.3 km from South-West corner of E6 to HW 403 - Could connect through Powerline Rd then connect to Paris Road	- no visibility	**6**
E7	- 403 at the south of site with off ramp right at the SW	- visible from south side of the site	**1**

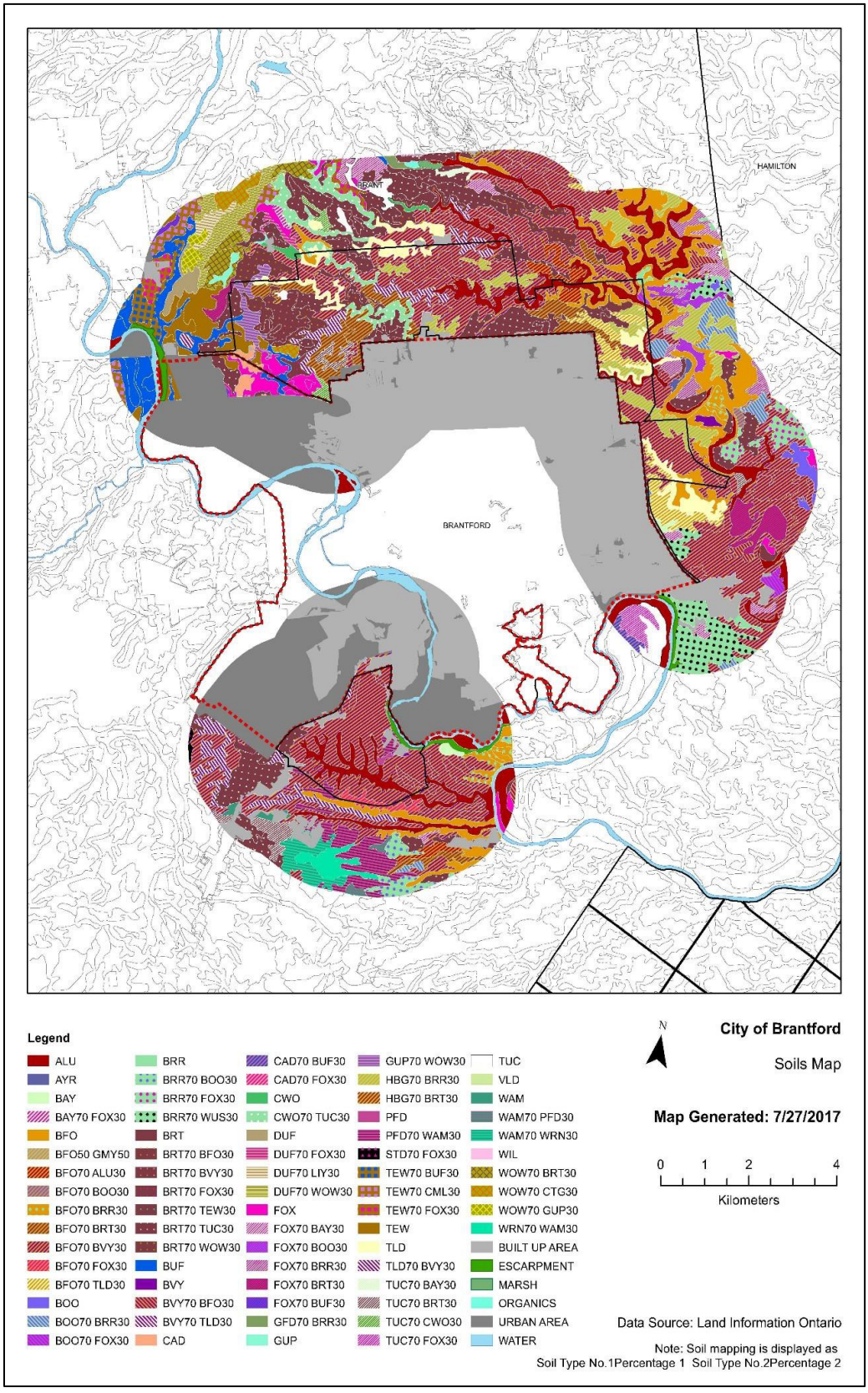
Appendix B
Agricultural References, Maps and Tables

Appendix B

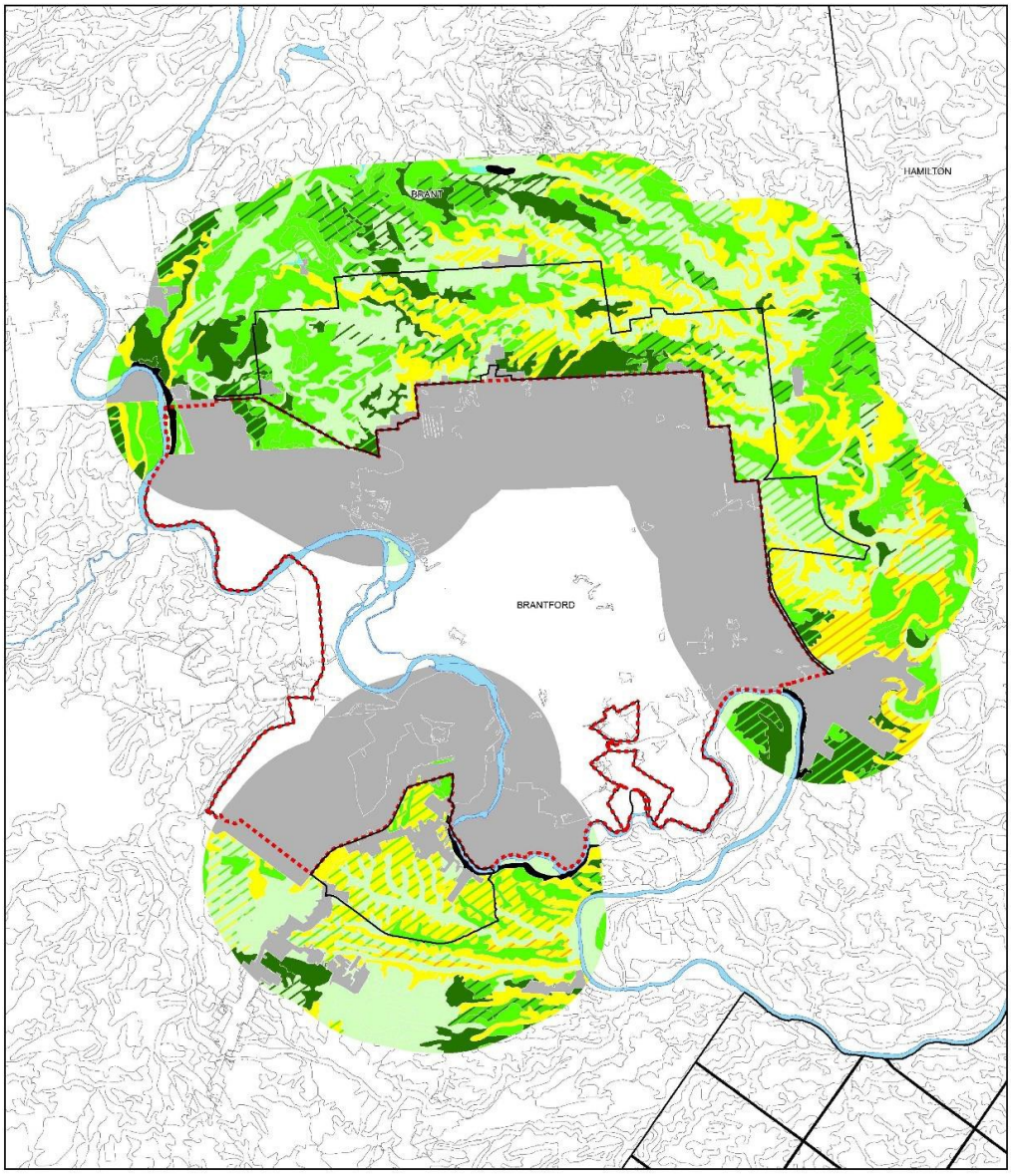
Part 1– Agricultural References, Maps and Tables
Map 1



Map 2


HAMILTON
BRANT
BRANTFORD
Legend
ALU
AYR
BAY
BAY70 FOX30
BFO
BFO50 GMY50
BFO70 ALU30
BFO70 BOO30
BFO70 BRR30
BFO70 BRT30
BFO70 BVY30
BFO70 FOX30
BFO70 TLD30
BOO
BOO70 BRR30
BOO70 FOX30
BRR
BRR70 BOO30
BRR70 FOX30
BRR70 WUS30
BRT
BRT70 BFO30
BRT70 BVY30
BRT70 FOX30
BRT70 TEW30
BRT70 TUC30
BRT70 WOW30
BUF
BVY
BVY70 BFO30
BVY70 TLD30
CAD
CAD70 BUF30
CAD70 FOX30
CWO
CWO70 TUC30
DUF
DUF70 FOX30
DUF70 LIY30
DUF70 WOW30
FOX
FOX70 BAY30
FOX70 BOO30
FOX70 BRR30
FOX70 BRT30
FOX70 BUF30
GFD70 BRR30
GUP
GUP70 WOW30
HBG70 BRR30
HBG70 BRT30
PFD
PFD70 WAM30
STD70 FOX30
TEW70 BUF30
TEW70 CML30
TEW70 FOX30
TEW
TLD
TLD70 BVY30
TUC70 BAY30
TUC70 BRT30
TUC70 CWO30
TUC70 FOX30
TUC
VLD
WAM
WAM70 PFD30
WAM70 WRN30
WIL
WOW70 BRT30
WOW70 CTG30
WOW70 GUP30
WRN70 WAM30
BUILT UP AREA
ESCARPMENT
MARSH
ORGANICS
URBAN AREA
WATER
N
City of Brantford
Soils Map
Map Generated: 7/27/2017
0 1 2 4
Kilometers
Data Source: Land Information Ontario
Note: Soil mapping is displayed as
Soil Type No.1Percentage 1 Soil Type No.2Percentage 2

MAP 3



Legend

- WATER
- ORGANICS
- 0
- 1
- 1_70 2_30
- 2
- 2_70 1_30
- 2_70 3_30
- 3
- 3_70 1_30
- 3_70 2_30
- 3_70 4_30
- 4
- 4_70 2_30
- 4_70 3_30
- 4_70 5_30
- 7

N

City of Brantford
Soils Capability Map

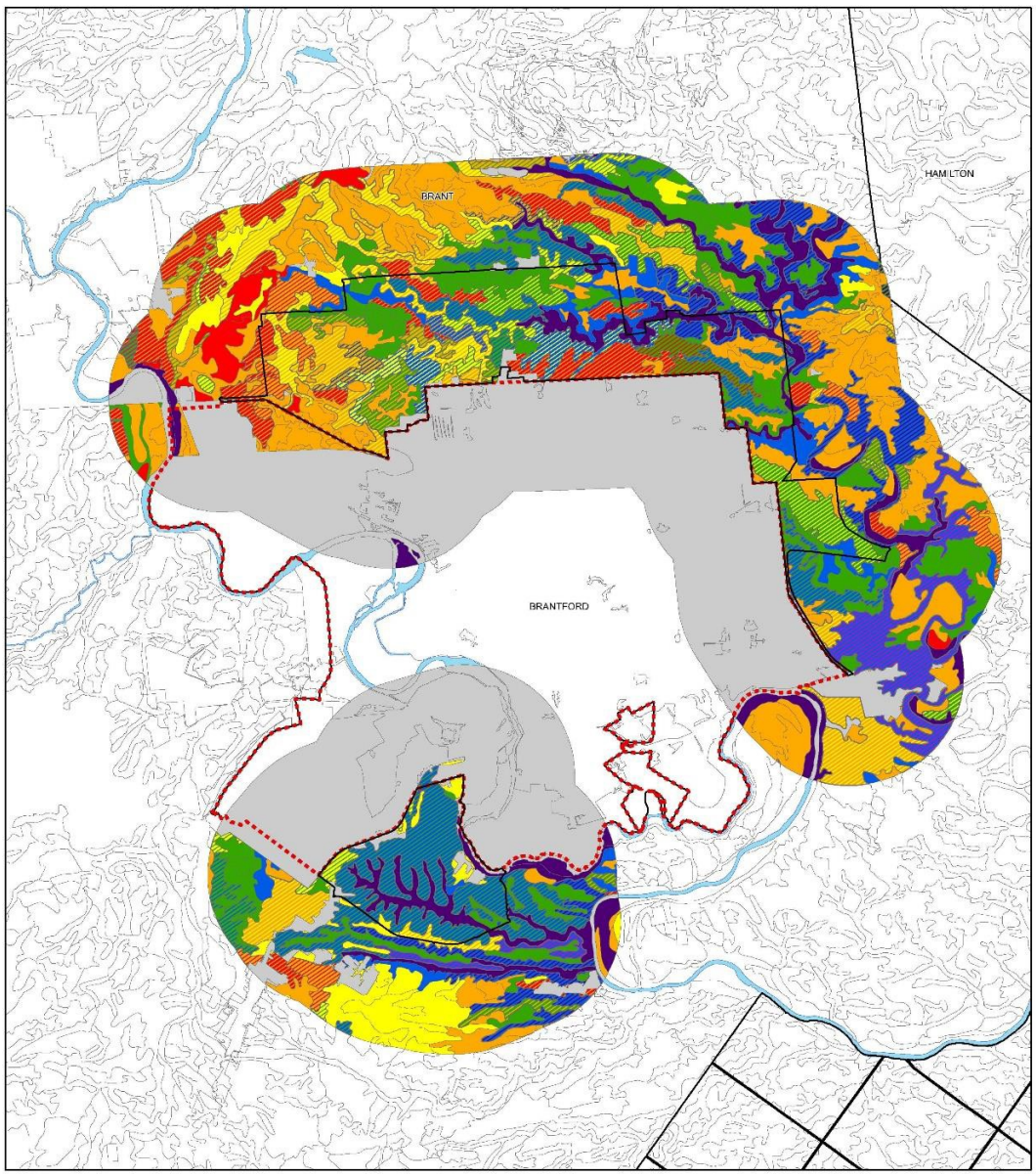
Map Generated: 7/27/2017

0 1 2 4
Kilometers

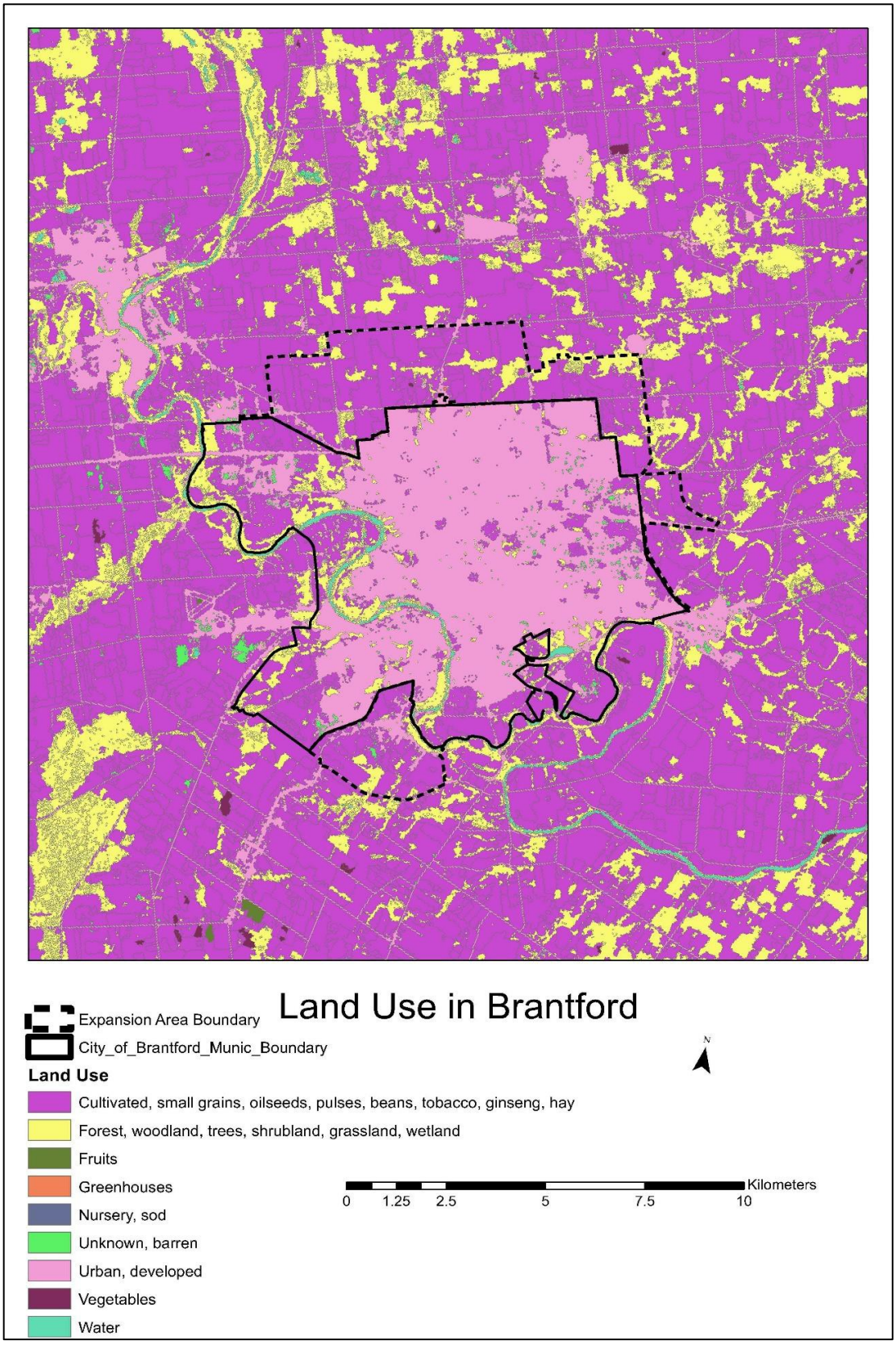
Data Source: Land Information Ontario

Note: Soil mapping is displayed as
Capability No.1_Percentage 1 Capability No.2_Percentage 2

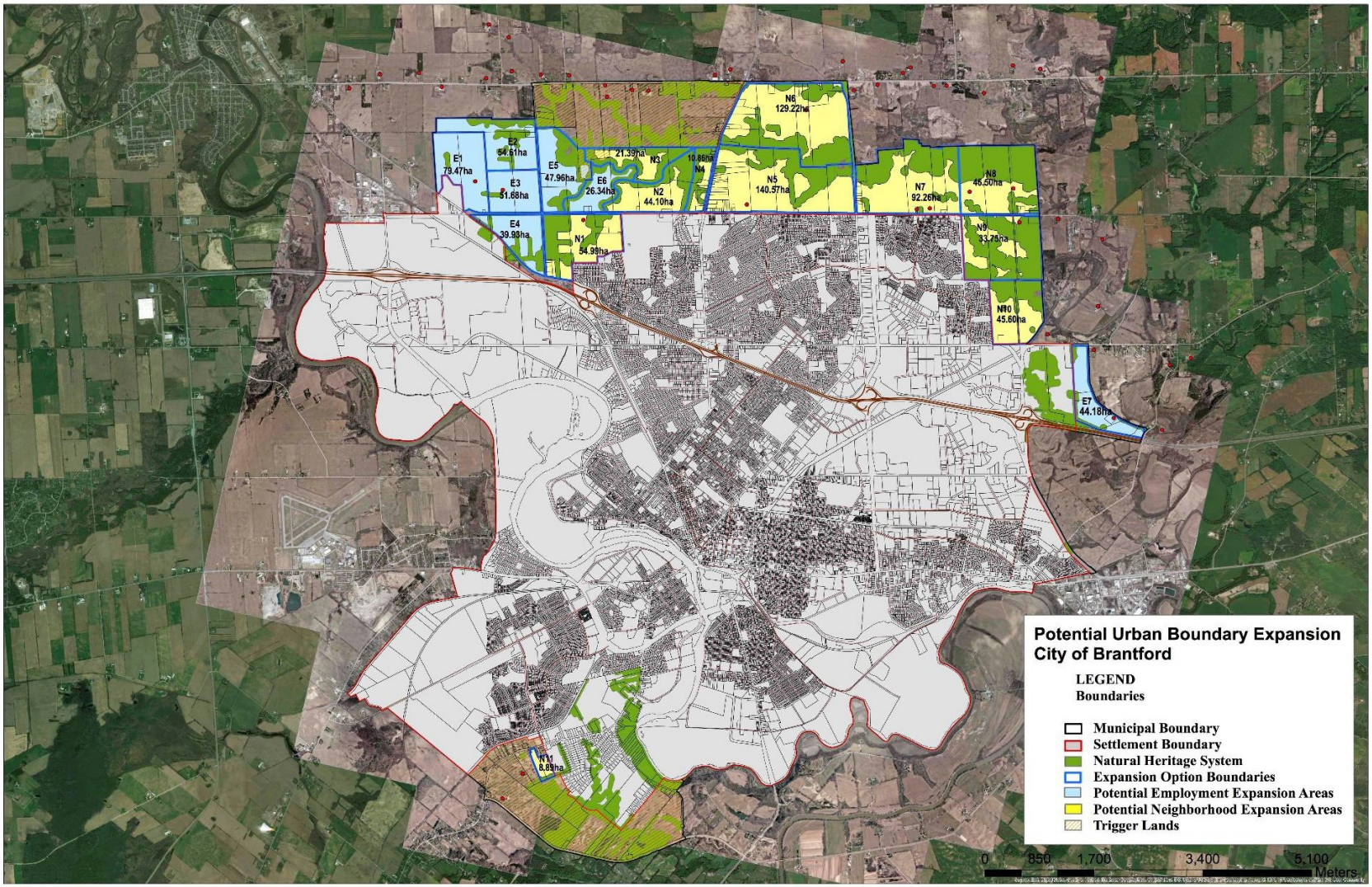
MAP 4


BRANT
HAMILTON
BRANTFORD
Expansion Area Boundary
1
1,2
1,3
2
2,1
2,3
2,4
2,5
3
3,1
3,2
3,4
3,5
4
4,1
4,2
4,3
4,5
4,6
5
5,2
5,3
5,4
5,6
5,7
7,0
7,4_50
X
N
City of Brantford
Average Soil Potential Rating
Map Generated: 1/3/2018
0 1 2 4
Kilometers
Data Source: Land Information Ontario

MAP 5


Land Use in Brantford
Expansion Area Boundary
City_of_Brantford_Munic_Boundary
Land Use
Cultivated, small grains, oilseeds, pulses, beans, tobacco, ginseng, hay
Forest, woodland, trees, shrubland, grassland, wetland
Fruits
Greenhouses
Nursery, sod
Unknown, barren
Urban, developed
Vegetables
Water
N
0 1.25 2.5 5 7.5 10
Kilometers

Map 6


N6
129.22ha
E2
54.61ha
E1
79.47ha
E5
47.96ha
21.39ha
N3
10.86ha
N4
E6
26.34ha
N2
44.10ha
N5
140.57ha
N7
92.26ha
N8
45.50ha
E3
51.68ha
E4
39.93ha
N1
54.99ha
N9
33.75ha
MR10
45.60ha
E7
44.18ha
MR11
8.89ha
Potential Urban Boundary Expansion
City of Brantford
LEGEND
Boundaries
Municipal Boundary
Settlement Boundary
Natural Heritage System
Expansion Option Boundaries
Potential Employment Expansion Areas
Potential Neighborhood Expansion Areas
Trigger Lands
0
850
1,700
3,400
5,100
Meters

Block	Block Area Average Soil Productivity Index	Block Area Average Soil Productivity Index Rescaled	Soil Potential Block Area Standardized value given rank 1=1.00 & 7=0	Soil Potential Block Area Standardized value given rank 1=1.00 & 7=0 Rescaled	Active Agriculture Proportion of Block Area	Active Agriculture Proportion of Block Area Rescaled	Greenhouse, Fruit and Vegetable Proportion of Block Area	Greenhouse, Fruit and Vegetable Proportion of Block Area Rescaled	Agricultural Infrastructure Proportion to Block Area	Agricultural Infrastructure Proportion to Block Area Rescaled	MDS Implications Proportion to Block Area	MDS Implications Proportion to Block Area Rescaled	Average Block Boundary Soil Productivity Index	Average Block Boundary Soil Productivity Index Rescaled	Soil Potential Block Boundary Standardized value given 1=1.00 & 7=0	Soil Potential Block Boundary Standardized value given 1=1.00 & 7=0 Rescaled
N1	0.739173	3	0.664441	3	0.520353	2	0	1	0.11777	3	0	1	0.734945	3	0.694751	3
N2	0.623012	1	0.627232	3	0.555889	2	0	1	0	1	0	1	0.732964	3	0.621565	3
N3	0.699739	2	0.668065	3	0.398506	1	0	1	0	1	0.745033	3	0.735677	3	0.649888	3
N4	0.682679	2	0.567134	2	0.283929	1	0	1	0	1	0	1	0.719169	3	0.589106	2
N5	0.77329	3	0.607401	3	0.632812	2	0.005652	1	0.055494	2	0.055494	1	0.683247	2	0.316361	1
N6	0.666407	2	0.454597	2	0.624536	2	0	1	0.048875	2	0.146625	1	0.641411	2	0.352778	1
N7	0.751972	3	0.530795	2	0.546564	2	0.401914	3	0.131388	3	0.32847	2	0.68528	2	0.288095	1
N8	0.65156	2	0.460732	2	0.354246	1	0	1	0.154362	3	0.385905	2	0.680114	2	0.467403	2
N9	0.663891	2	0.500972	2	0.284317	1	0	1	0.081106	2	0.162212	1	0.695364	2	0.481819	2
N10	0.663899	2	0.528627	2	0.605383	2	0	1	0	1	0.257294	2	0.630925	2	0.460826	2
N11	0.595997	1	0.295929	1	0.843633	3	0	1	0	1	0	1	0.5933	1	0.314064	1

Neighbourhood Block	Total Principle 1	Total Principle 2	Total Principle 3	Total	Neighbourhood Block	Rescaled Principle 1	Rescaled Principle 2	Rescaled Principle 3	Total	Total Rescaled (1-11)
N1	10.97	8.55	2.00	22	**N1**	8	8	1	17	7
N2	8.06	7.62	2.00	18	**N2**	3	6	1	9	4
N3	8.58	9.77	2.00	20	**N3**	4	11	1	16	7
N4	7.44	7.25	2.00	17	**N4**	2	5	1	7	3
N5	10.67	5.78	2.00	18	**N5**	7	1	1	9	4
N6	8.50	6.08	2.00	17	**N6**	4	2	1	6	2
N7	12.66	6.63	4.00	23	**N7**	11	3	11	25	11
N8	8.76	8.14	2.00	19	**N8**	4	7	1	12	5
N9	7.92	7.75	2.00	18	**N9**	3	6	1	10	4
N10	8.17	7.03	2.00	17	**N10**	3	4	1	8	3
N11	7.00	6.13	2.00	15	**N11**	1	2	1	4	1

Block	Block Area Average Soil Productivity Index	Block Area Average Soil Productivity Index Rescaled	Soil Potential Block Area Standardized value given 1=1.00 & 7=0	Soil Potential Block Area Standardized value given 1=1.00 & 7=0 Rescaled	Active Agriculture Proportion of Block Area	Active Agriculture Proportion of Block Area Rescaled	Greenhouse, Fruit and Vegetable Proportion of Block Area	Greenhouse, Fruit and Vegetable Proportion of Block Area Rescaled	Agricultural Infrastructure Proportionate to Block Area	Agricultural Infrastructure Proportionate to Block Area Rescaled	MDS Implications Proportionate to Block Area	MDS Implications Proportionate to Block Area Rescaled	Average Block Boundary Soil Productivity Index	Average Block Boundary Soil Productivity Index Rescaled	Soil Potential Block Boundary Standardized value given 1=1.00 & 7=0	Soil Potential Block Boundary Standardized value given 1=1.00 & 7=0 Rescaled
E1	0.76606	3	0.811043	3	0.953133	3	0	0	0.121622	2	0.121622	2	0.780975	3	0.810723	3
E2	0.739377	3	0.720725	2	0.673841	2	0	0	0.122847	2	0.245695	2	0.711812	1	0.696875	2
E3	0.750501	3	0.762085	3	0.934204	3	0	0	0.186591	3	0.186591	2	0.762385	3	0.810242	3
E4	0.694769	2	0.809053	3	0.697261	2	0	0	0	1	0.355222	3	0.731032	2	0.814761	3
E5	0.71237	2	0.652181	2	0.59893	1	0	0	0	1	0	1	0.700557	1	0.636417	1
E6	0.638994	1	0.555388	1	0.559308	1	0	0	0	1	0.224207	2	0.708112	1	0.604552	1
E7	0.692799	2	0.574696	1	0.814372	2	0	0	0.191456	3	0.191456	2	0.701364	1	0.589328	1

Employment block	Total Principle 1	Total Principle 2	Total Principle 3	Total	Employment block	Rescaled Principle 1	Rescaled Principle 2	Rescaled Principle 3	Total	Total Rescaled (1-7)
E1	11.27	10.65	2.00	24	**E1**	7	7	1	15	7
E2	8.74	8.32	2.00	19	**E2**	5	5	1	11	5
E3	11.23	10.04	2.00	23	**E3**	7	6	1	14	7
E4	7.56	9.25	2.00	19	**E4**	4	6	1	11	5
E5	6.11	4.64	2.00	13	**E5**	3	1	1	5	1
E6	4.00	5.59	2.00	12	**E6**	1	2	1	4	1
E7	8.29	5.90	2.00	16	**E7**	5	2	1	8	3

Part 3 – Soil Classification, Capability, Productivity and Potential

SOIL CLASSIFICATION AND SOIL SURVEY

Ontario's published soil surveys follow a hierarchical system of soil classification to represent a three-dimensional area called a pedon (see http://www.pedosphere.ca/resources/CSSC3rd/chapter02.cfm). This three- dimensional area is intended to be represented as a two-dimensional map polygon usually shown as the soil series on soil maps in Ontario. Soil characteristics such as texture and particle size are a part of a continuum and the soil map also must present a landscape continuum as part of a discrete map polygon. In short, soils are represented as discrete units on a map even though the soils themselves are not discrete. As a result, there can be and there has been different ways of representing changes in soils that have been mapped within Ontario and within parts of the rest of the world. Not surprisingly, the opportunity to represent soils in different ways has resulted in significant changes in the approach to mapping soils over the time within which soil surveys have been published in Ontario. The older soil surveys tend to lump large areas into soil map polygons, whereas newer soil surveys have smaller more detailed polygons. Newer soil surveys also tend to have complexes (which are soil map polygons containing 2 or more soil series and/or two a more soil capability classes and subclass limitations). Examples of more recent soil surveys include Niagara, Haldimand-Norfolk, Brant, Kent, Middlesex, Ottawa urban fringe, Ottawa-Carlton and the soils component within the report titled *State of the Resources for the Duffin-Rouge Agricultural Preserve*. A review of older as well as newer Ontario soil reports indicates the following:

- soil series with the same name may not have the same characteristics between Counties and/or Regions,
- some soil series identified in detailed field studies are not always represented in the County/Regional published soil survey within which the detailed work is being completed; and,
- not all the soil capabilities assigned to a soil series are consistent from one soil report to another soil report.

The significance of the difference between old mapping styles and newer ones can be illustrated by using an old soil report and comparing the old soil map to a newer map. Both maps were produced by government staff. Within Durham Region as well as a part of York Region an area identified as an Agricultural Preserve was remapped (Schut *et al*) at a scale of 1:20,000 in 1994 relative to two maps produced in 1956 (Olding et al.) and 1955 (Hoffman and Richards) both at a scale of 1:63,360. A review of these older and newer maps shows that:

- there are differences in the number and size of soil polygons and the differences in the soil polygons represent differences in soil series and soil phases, and
- soil capability values assigned to each of the soil polygons are different from older map to newer map.

When the soil capability information is calculated as a productivity index, the old map assigned an average productivity index of 0.91 (equivalent to capability class 1 soils) to that part of the Agricultural Preserve located within Durham Region whereas the new map

has an average productivity index of 0.66 that is relatively equivalent to capability class 3 (0.64). This information demonstrates that the soil productivity within the Preserve is significantly lower than the original mapping by Olding *et al.* (1956) would indicate. Given that some of the soils mapped in the Preserve by Schut et al. (1994, OMAF) require tile drainage, this tile drainage would need to be in place to reach the average productivity index value of 0.66.

RATING FOR COMMON FIELD CROPS

The original soil capability classification is part of the Canada Land Inventory (CLI) and used an ordinal scale having the numbers 1 through 7. (A discussion of the definition of different scales is available in many mathematics texts. Siegel (1956) outlines a good summary matrix of the definitions for different scales that can be related to statistical tests). Alternatively, Velleman and Wilkinson (1993) describe mathematical scales as part of a continuum and argue that the use of specific statistical tests for specific scales is inappropriate. Irrespective of scale, the CLI capability interpretation was derived based on "*research data, recorded observations, and experience*" and was not intended for use as an indicator of the "*most profitable use of land*".

The class, the broadest category in the capability classification, is a grouping of subclasses that have the same relative degree of limitation or hazard. The limitation or hazard becomes progressively greater from class 1 to class 7. The class indicates the general suitability of the soils for agricultural use.

Class 1 - Soils in this class have no significant limitations in use for crops.
Class 2 - Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.
Class 3 - Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices or both.
Class 4 - Soils in this class have severe limitations that restrict the range of crops or require special conservation practices or both.
Class 5 - Soils in this class have very severe limitations that restrict their capability of producing perennial forage crops, and improvement practices are feasible.
Class 6 - Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible.
Class 7 - Soils in this class have no capability for arable agriculture or permanent pasture.

Agricultural soils information is currently available in old-style printed format as well as in digital format. The original information was presented as soil survey reports with accompanying soil maps. Some more recent soil survey publications include a separate interpretive map for soil capability following the rules outlined in the *Canada Land Inventory Soil Capability Classification for Agriculture*. However, most reports contain a section that has a matrix summarizing soil capability classes for different soil series and phases relative to slope class. The very early soil reports prior to the 1960s tend to have a descriptive summary of the relative merits of different soil series for common field crop production - a precursor to the CLI soil capability classification. When the CLI soil

capability classification work was started, a list of all the soil series was compiled and a soil capability class assigned to each soil series having a given set of limitation such as slope class and stoniness class. This information served as a base and blueprint maps, produced by projecting soil polygon/map unit boundaries on to topographic maps at a scale of 1 to 50,000, summarized capability on a County basis. When the County work was being done, additional detailed soil surveys were completed in several smaller sample areas to assist in assigning soil capability classes to the soils/soil polygons found within the County. The blueprint maps served (without edit) as the base to produce generalized 1: 250,000 scale soil capability maps by the Federal Government in Ottawa. The same blueprint maps were also used as a data source when the soil surveys for Ontario were digitized by OMAFRA. The digitizing included matching soil polygon series and soil capability information at the boundaries between Counties/Regions. Additionally, several more detailed soil surveys have been completed and the soil capabilities outlined in these published reports do not always match the soil capability values assigned on the blueprint maps. As a result, soil capability values can come from different sources as follows:

- the unpublished summary of capability classes assigned to all the soil series present as a result of mapping up to the 1960s;
- the blueprint map soil capability classes;
- the separate County summary data prepared as the base for the blueprint maps;
- the soil capability classes assigned within published soil reports after the 1960s some of which result because of published scientific information about the effects of soil characteristics such as density on soil capability.

Other soil capabilities have been derived because of the identification of new soil series, new soil phases and differing opinions about the capability of different soils

Subsequently, research by Hoffman (1973) indicated that soil capability class was an indicator of common field crop yields and productivity (yield) indices could be derived based on those yields. The indices, described more specifically in Appendix 1, are used as an “average” for three crops: oats, barley, and corn.

The soil capability class ordinal scale could then be converted into an interval scale using Hoffman’s (1973) data. The data used to create the interval scale are based on older soil surveys and the soil capability class summaries associated with the older surveys are summarized by Hoffman and Noble (1975). New surveys have been completed for Regions such as Middlesex, Elgin, and Niagara. In these new surveys, because of work by McBride (1983), the soil capability classes for some soils have been changed to a lower class, particularly for soils with a high clay content. While McBride’s work has been related to average yield data, on a County or Regional basis, no site-specific yield data has been used to confirm that the newer changes to soil capability class is supported by specific yields as was completed in Hoffman’s (1973) research. Therefore, the capability classes used in the newer soil surveys, such as the one for Niagara, might better be described as part of an ordinal scale.

Regardless of the difference of opinion concerning arithmetic scale, yield data, and productivity indices, both data sources and methods have been investigated as part of the work described in the following paragraphs.

The original soil capability rating report (Environment Canada, 1972) has several assumptions which have been applied to the interpretation of soil survey information. Two of these assumptions (Environment Canada, 1972) are germane to a discussion on the capability of the subject lands and are as follows:

- *Good soil management practices that are feasible and practical under a largely mechanized system of agriculture are assumed.*
- *Soils considered feasible for improvement by draining, by irrigating, by removing stones, by altering soil structure, or by protecting from overflow, are classified according to their continuing limitations or hazards in use after the improvements have been made. The term "feasible" implies that it is within present day economic possibility for the farmer to make such improvements and it does not require a major reclamation project to do so. Where such major projects have been installed, the soils are grouped according to the soil and climatic limitations that continue to exist. A general guide as to what is considered a major reclamation project is that such projects require co- operative action among farmers or between farmers and governments. (Minor dams, small dykes, or field conservation measures are not included).*

Therefore, these assumptions have been considered in the evaluation of soils in the study area. Soil capability mapping used in this study has been based on the original soil map which is now available in digital format from the Ontario Ministry of Agriculture, Food and rural affairs (OMAFRA). The 1:50,000 scale blueprint soil capability maps available from OMAFRA were not used directly because these maps were originally prepared without edit (and therefore may be inaccurate) to be generalised for soil capability maps produced at the scale of 1:250,000 by the Federal Government.

As discussed previously, the Canada Land Inventory (CLI) originally assumed that soil management that could be applied by a farmer would occur. Therefore, improvements such as irrigation and adequate drainage (both surface and subsurface) were already assumed to be applied in the rating of soils into capability classes

Tile Drainage

As noted previously, soil capability and therefore productivity makes assumptions about tile drainage (that is, that tile drainage is applied where it is needed and that capability class ratings reflect the fact that the drainage is already assumed to be in place). There are some differences of opinion about which soil drainage classes would benefit from tile drainage. However, it is likely that imperfectly and poorly drained soils would show improved yields when tiles had been installed. There is no doubt that poorly drained soils have better yields when tile drained. As well, it is likely that the imperfectly drained soils would benefit from tile drainage. Unfortunately, the newer soil surveys do not indicate how soil capability class levels would change if imperfectly drained soils are not tiled.

Some information is available to assist in estimating how productivity is diminished in areas requiring tile drainage. For example, yield data collected over 20 years and that were summarized and evaluated by Irwin (1999) indicate that, because of tile drainage, average yields have improved within a range where the least improvement was a 10

percent increase for coloured beans in contrast to a high increase of 38 percent for wheat. The summary by Irwin (1999) did not differentiate by soil series, soil drainage class, or by location in the Province. Based on a general interpretation of the data from Irwin (1999), it can be estimated that imperfectly drained soils in an undrained state could be poorer by a single capability class. However, the installation of tile drainage on the imperfectly drained soils is less likely than installation on poorly and very poorly drained soils.

SOIL PRODUCTIVITY INDEX CALCULATION

Soil Productivity Index

The soil productivity index is an arithmetic mean that expresses the relative occurrence of soil capability classes 1 to 7 on selected properties or within specified boundaries. The index is based on soil productivity ratings (Hoffman, 1973). Areas with the highest soil capability index will have mainly class 1 land. Areas with a low index will consist of lower soil capabilities. The productivity index method has been used because it provides a single number derived from a listing, by proportion, of the soil capability classes 1 through 7 which allows for direct comparison among different areas or sites.

Impacts on soil capability will generally be greatest on an area with a high soil capability index; that is, impacts will be highest when good (higher capability land) is lost to development.

Method

Soil Productivity Index = *(proportion of area of class 1 soils x 1.0) + (proportion of area of class 2 soils x 0.8) + (proportion of area of class 3 soils x 0.64) + (proportion of area of class 4 soils x 0.49) + (proportion of area of class 5 soils x 0.33) + (proportion of area of class 6 soils x 0.17) + (proportion of area of class 7 soils x 0.02)*

The area of each soil map unit was measured, and areas of similar soil capability were summed for CLI classes 1 to 7 lands. The area was calculated for each CLI class and subsequently multiplied by a productivity index corresponding to each soil class. The productivity index is specific to each capability class. The proportion of each area occupied by each soil capability class was multiplied by the corresponding soil productivity value (following Hoffman, 1973) and products were subsequently summed to obtain a soil productivity index for lands affected by or potentially affected by development.

SOIL POTENTIAL FOR SPECIALTY CROPS

The discussion on specialty crops is guided by the definition within the PPS and uses existing databases, aerial photo interpretation and roadside reconnaissance to evaluate:

- which fruit and vegetable crops are being grown where,
- what soils have the best potential for growing fruits and vegetables,
- which areas have better climate for specialty crop production,
- what areas have farmers experienced in growing specialty crops, and

- what areas have infrastructure associated with growing specialty crops.

While the five questions, which match the five characteristics in the definition within the PPS, seem relatively straightforward there are three principal limitations associated with the delineation of *specialty crop areas*. The 2005 *PPS* has added additional wording to the definition of *specialty crop area* that includes the phrase *areas designated using evaluation procedures established by the Province, as amended from time to time.* Currently the Province and OMAFRA do not have an evaluation procedure that is being used consistently to designate *specialty crop areas.* Neither has the Province prepared a summary of evaluation methods available and documented the relative strengths and weaknesses of those methods. In addition, the Province and OMAFRA must deal with the same kinds of data limitations associated with soil rating systems and climate described as part of this report.

Nonetheless, the Province has designated two specialty crop areas within the *Greenbelt Plan* - these being the Holland Marsh as well as tender fruit and grape lands within Niagara Region. Unfortunately, a review of these areas indicates that some lands designated within *specialty crop areas* meet all five tests described previously whereas other lands may meet only one of the tests. This second limitation makes it difficult to ascertain exactly how many characteristics should be used to differentiate *specialty crop areas*. This conclusion is based on land use observations (including farm infrastructure) and soil potential for specialty crops in Hamilton, Grimsby, and Lincoln where soils series such as Haldimand and Lincoln, which are unsuitable for tender fruit production and have relatively low capabilities for other fruits and vegetables, have been included as part of *tender fruit and grape lands*. The physical evidence, including agricultural crops and infrastructure, supports the view that only a single factor, that is, climate, was used to place these high clay content low permeability soil areas within the *tender fruit and grape lands* category. If a single factor approach to the delineation of *specialty crop areas* is accepted, then much of southern Ontario could be classified as part of a *specialty crop area* and different agricultural areas could no longer be rated as relatively better or poorer.

The third limitation results because of the kinds of data limitations associated with soil rating systems and climate described in the following paragraphs. All the databases evaluated have limitations associated with scale, data availability or alternatively, data suppression. For example, a soil rating system for specialty crops was developed by Hoffman and Cressman in 1984 for Ontario Hydro (Ecologistics and Smith, Hoffman, 1984). This is a three-class system – good, fair, or poor which uses crop groupings but has not been applied on a broad scale to the Province. The Ontario Institute of Pedology and subsequently the Ontario Center for Soil Resource Evaluation has compiled specialty crop capability systems for some areas within Ontario. However, no data on soil potential for specialty crops is available much of southern Ontario. Therefore, the potential of soils for specialty crops within the study area must be ascertained by reviewing information from several sources because the Province has not a single specialty crop soil potential rating for all of Ontario. Given this lack of comprehensive soil potential information for specialty crops, it is not possible to reasonably differentiate which soils are most unique for specialty crop production within the Province.

However, some soil potential ratings for fruit and vegetables have been produced for Haldimand-Norfolk, Niagara, Elgin, Middlesex, and Brant. Unfortunately, the fruit and vegetable crop groupings used in different soil surveys are dissimilar in number as well as in the kinds of fruits or vegetables included in each group. For example, Niagara has 20 crop groupings (9 for fruits and 11 for vegetables) whereas Haldimand-Norfolk has 15 groups that do not always separate fruit and vegetables into separate categories. More details about the soil potential ratings for specialty crops are outlined in a summary in the following Table. In addition, both five as well as seven class soil potential rating systems have been used in published soil survey reports in Ontario.

As a second example of information limitations, climate data is limited due to scale and a lack of integration. Several single factor maps produced on a broad scale are available for crop heat units, plant hardiness zones, temperature minima and maxima as well as precipitation. More specific maps such as the map for *Site Selection for Grapes in the Niagara Peninsula* (Fisher and Slingerland, 2002) are not available for the rest of southern Ontario. Additionally, specific studies on irrigation such as that done for Niagara Region (Stantec, 2007) are not available for most Regions and Counties.

ONTARIO SPECIALTY CROP SOIL CLASSIFICATIONS SUMMARY

Crop Grouping Description 1	Niagara Crop Grouping	Crop Grouping Description 2	Haldimand-Norfolk Crop Grouping	Crop Grouping Description 3	Middlesex and Elgin Crop Grouping	Crop Grouping Description 4	Brant Crop Grouping
	Seven Class System		Seven Class System		Five Class System		Seven Class System
Tree Fruits, Grapes and Small Fruits:	**Tree Fruits, Grapes and Small Fruits:**	**Tree Fruits, Grapes and Small Fruits:**	**Tree Fruits, Grapes and Small Fruits:**	**Tree Fruits, Grapes and Small Fruits:**	**Tree Fruits, Grapes and Small Fruits:**	**Tree Fruits, Grapes and Small Fruits:**	**Tree Fruits, Grapes and Small Fruits:**
Peaches, Apricots, Nectarines	A	Apricots, Sour Cherries, Sweet Cherries, Peaches	D1				
Sweet Cherries	B						
Sour Cherries	C						
Labrusca Grapes	D	Hybrid and Vinifera Grapes, Labrusca Grapes	D3				
Vinifera Grapes	E						
Apples	F	Apples	D4	Apples	2	Apples	D1
Pears, Plums	G	Pears, Plums	D2	Pears, Plums	3		
Strawberries, Raspberries	H	Peppers, Raspberries, Rhubarb, Strawberries	B3	Raspberries, Strawberries	1	Strawberries	B3
Currants, Gooseberries	I						
				Rutabagas	3		
		Peanuts	A2	Peanuts	2		
				Heart Nuts, Filbert Nuts	3		
				Walnuts	2		

Vegetable Crops:	**Vegetable Crops:**	**Vegetable Crops:**	**Vegetable Crops:**	**Vegetable Crops:**	**Vegetable Crops:**	**Vegetable Crops:**	**Vegetable Crops:**
Crop Grouping Description 1	Niagara Crop Grouping	Crop Grouping Description 2	Haldimand-Norfolk Crop Grouping	Crop Grouping Description 3	Middlesex and Elgin Crop Grouping	Crop Grouping Description 4	Brant Crop Grouping
Broccoli, Brussels Sprouts, Cauliflower	J	Cabbage, Cauliflower, Canola, Sweet Corn, Tomatoes, Turnips	C3	Brussels Sprouts, Cauliflower, Cabbage	8	Cabbage, Cauliflower	C2
Bulb Onions, Garlic	K	Onions, Beets, Carrots	B1				
Green (Bunching) Onions	L						
Eggplant, Peppers	M	Peppers, Raspberries, Rhubarb, Strawberries	B3	Peppers	6	Peppers	B2
Cucumbers	N			Cucumbers	4		
Muskmelon	O	Ginseng, Muskmelon, Watermelon	B2			Ginseng	B1
Potatoes	P	Potatoes	A3	Irish Potatoes	3	Potatoes	A1
Tomatoes	Q					Tomatoes	C2
Sweet Corn	R			Sweet corn	7	Sweet Corn	C2
Celery, Lettuce	S	Cucumber, Lettuce, Radish	C4				
Pumpkins, Squash	T	Green Beans, Peas, Pumpkins, Squash	C2				
		Asparagus	A1	Asparagus	1		
		Fava Beans, Soybeans, White Beans	C1	Soybeans	4	Beans	C1
				Sweet Potatoes	2		
				White beans	5		

Part 4 – Map Scale

The ability to show a map polygon of a particular size varies with the scale of the map relative to the technology used to draw the map. This occurs irrespective of the character of the information displayed within the polygon. There are limitations to how small a polygon can be and be visible as a polygon on any given map. The following two Tables summarizes information on minimum mappable area similar to that presented within the Food Land Guidelines (1978) with the addition of information for the scale of 1:63,360 because that is the scale of any of the soil maps in southern Ontario. The 2nd following Table provides additional information about how a square map unit in cm^2 would relate to the land area at different map scales.

At a scale of 1:63,360 minimum mappable area is 16.2 ha or 40 acres. On that basis many changes that can be observed in the field will not be identified on many of the County soil maps produced in southern Ontario.

Minimum Mappable Area

Map Scale	Field Distance Represented by Map Lines		Minimum Area Identifiable on Map (40 mm^2)	
	Metres	Feet	Hectares	Acres
1:1,000,000	1000	3250	4000	9900
1:500,000	500	1625	1000	2500
1:250,000	250	812	250	620
1:125,000	125	400	62.5	150
1:63,360	63	207	16.2	40
1:50,000	50	160	10	25
1:25,000	25	80	2.5	6
1:10,000	10	32	0.4	1
1:5000	5	16	0.1	0.25

The Relationship between Map Scale, Map Unit Area ($CM^{2)}$ *

Map Unit Area cm2	Map Scale				
	1:5,000	1:20,000	1:50,000	1:100,000	1:250,000
	(ha)	(ha)	(ha)	(ha)	(ha)
0.25	0.06	1	6.25	25	156
0.5	0.13	2	12.5	50	312
1	0.25	4	25	100	625
5	1.25	20	125	500	3125
10	2.5	40	250	1000	6250
100	25	400	2500	10000	62500

* From Mapping Systems Working Group, 1981. Province of British Columbia. 1997. Soil inventory methods for British Columbia.
http://www.ilmb.gov.bc.ca/risc/pubs/teecolo/soil/soil-2.htm

Part 5 – Policy Definitions Related to Agriculture

Several definitions are available in policy which assist in understanding the information requirements and analysis that is needed to characterize the possible, probable, and unknown effects of the proposed development use. These definitions are listed as follows and are provided within the *Growth Plan for the Greater Golden Horseshoe* (2018).

Agri-food Network
Within the *Agricultural System*, a network that includes elements important to the viability of the agri-food sector such as regional *infrastructure* and transportation networks; on- farm buildings and infrastructure; agricultural services, farm markets, distributors, and primary processing; and vibrant, agriculture-supportive communities. (Greenbelt Plan)

Agricultural Impact Assessment
A study that evaluates the potential impacts of non-agricultural development on agricultural operations and the *Agricultural System* and recommends ways to avoid or, if avoidance is not possible, minimize and mitigate adverse impacts. (Greenbelt Plan)

Agricultural System
The system mapped and issued by the Province in accordance with this Plan, comprised of a group of inter-connected elements that collectively create a viable, thriving agricultural sector. It has two components: 1. An agricultural land base comprised of *prime agricultural areas*, including *specialty crop areas,* and *rural lands* that together create a continuous productive land base for agriculture; 2. An *agri-food network* which includes *infrastructure*, services, and assets important to the viability of the agri-food sector. (Greenbelt Plan)

Agricultural Uses
The growing of crops, including nursery, biomass, and horticultural crops; raising of livestock; raising of other animals for food, fur or fibre, including poultry and fish; aquaculture; apiaries; agro-forestry; maple syrup production; and associated on-farm buildings and structures, including, but not limited to livestock facilities, manure storages, value-retaining facilities, and accommodation for full-time farm labour when the size and nature of the operation requires additional employment. (PPS, 2014)

Agriculture-related Uses
Farm-related commercial and farm-related industrial uses that are directly related to farm operations in the area, support agriculture, benefit from being in close proximity to farm operations, and provide direct products and/or services to farm operations as a primary activity. (PPS, 2014)

Minimum Distance Separation Formulae
Formulae and guidelines developed by the Province, as amended from time to time, to separate uses so as to reduce incompatibility concerns about odour from livestock facilities. (PPS, 2014)

Normal Farm Practices
A practice, as defined in the Farming and Food Production Protection Act, 1998, that is conducted in a manner consistent with proper and acceptable customs and standards as established and followed by similar agricultural operations under similar circumstances; or makes use of innovative technology in a manner consistent with proper advanced farm management practices. Normal farm practices shall be consistent with the Nutrient Management Act, 2002 and regulations made under that Act. (PPS, 2014)

On-farm Diversified Uses
Uses that are secondary to the principal *agricultural use* of the property, and are limited in area. *On-farm diversified uses* include, but are not limited to, home occupations, home industries, agri-tourism uses, and uses that produce value-added agricultural products. (PPS, 2014)

Prime Agricultural Area
An area where *prime agricultural lands* predominate. This includes areas of *prime agricultural lands* and associated Canada Land Inventory Class 4 through 7 lands and additional areas where there is a local concentration of farms which exhibit characteristics of ongoing agriculture. *Prime agricultural areas* are to be identified by the Ontario Ministry of Agriculture, Food and Rural Affairs using guidelines developed by the Province as amended from time to time. (Based on PPS, 2014 and modified for this Plan)

Prime Agricultural Lands
Specialty crop areas and/or Canada Land Inventory Class 1, 2, and 3 lands, as amended from time to time, in this order of priority for protection (PPS, 2014)

Rural Lands
Lands which are located outside *settlement areas* and which are outside *prime agricultural areas*. (PPS, 2014)

Specialty Crop Area
Areas designated using guidelines developed by the Province, as amended from time to time. In these areas, specialty crops are predominantly grown such as tender fruits (peaches, cherries, plums), grapes, other fruit crops, vegetable crops, greenhouse crops, and crops from agriculturally developed organic soil usually resulting from:

a) soils that have suitability to produce specialty crops, or lands that are subject to special climatic conditions, or a combination of both;

b) farmers skilled in the production of specialty crops; and

c) a long-term investment of capital in areas such as crops, drainage, *infrastructure* and related facilities and services to produce, store, or process specialty crops. (PPS, 2014) and the Growth Plan (2017)

Part 6 – Multi-Attribute Analysis and Agricultural Performance

MULTI-ATTRIBUTE ANALYSIS

Any multi-attribute analysis, including a LEAR analysis, may have different results based on:

- the number and kind of variables considered,
- the analysis method,
- the weights applied to the variables,
- whether the data was standardized, and
- whether all the data was presented consistently to mean that a high number is intended to indicate a high importance value.

A review of the literature did not present information suggesting that a particular single multi-attribute analysis method is the best method. Even the wording employed for the quantitative methods used to combine information varies. The University of Redlands and the Spatial Decision Support Consortium (2012) have prepared a summary of the language and definitions associated with Multi-Criteria Decision Analysis (MCDA). Some of the work described by the University of Redlands is based on work by Malczewski (2006). Multi-attribute Combination Methods is a subset of MCDA having subcategories of Analytical Hierarchy Process, Concordance Methods, Fuzzy Aggregation Operation, Ideal/Reference Point Method, Value/Utility Function Method and Weighted Linear Combination. A LEAR analysis fits in to the subcategory of Weighted Linear Combination which is described on the Redlands website as "the most often used technique for tackling spatial multi-attribute decision making".

AgPlan Limited and Michael Hoffman have carried out various Multi-Criteria Decision Analyses at different scales throughout the Province of Ontario. The following paragraphs briefly describe the methods used to evaluate agricultural performance within different Regions or Counties in central to southwestern Ontario. Most of the variables used in the regional scale analyses are outlined in the Agricultural Census for Ontario. Additional variables for soil productivity and crop yields are available through OMAF(RA) for the years used in the analyses. The early census years had relatively few variables (in the order of 30) while later census years used many variables (in the range of hundreds). Some environmental variables used in the later analyses first appeared in 1996.

In the work carried out in Ontario, the study design started with a 4-variable database derived from published as well as field work sources. There is the potential for an infinite number of ways to modify the data using the three ways described. Therefore, individual databases were designed to include some relatively different measures of agricultural performance/achievement.

Regional Comparison

At the regional scale for example, environmental, economic, and production viewpoints were separated for some databases. In other instances, a modified characterization within a single category such as production was completed. For example, production was characterized as using total production values (volumetric or gravimetric) for some data sets and as production per unit area (yield) in other data sets. Multiple characterisations were used to represent different perspectives as well as different values associated with the agricultural indicators/metrics. Therefore, for example, total production values were

included because they give a relative indication of a County's contribution to the total food production that occurred within a given year within southern to central Ontario. However, this production indicator tends to be correlated with the area of the County. Therefore, yield data was included and/or emphasized to minimize any effect associated with a County's size on that County's achievement rating. As well, each of the data sets was modified using different weighting schemes to represent disparate views about which indicators are better predictors of agricultural performance.

Different variables were grouped into databases to emphasize different parts of each year's agricultural indicators. In general terms, one database was prepared with a cross section of production, economic, and socio-cultural components. The production component concentrated on field crops. A second database was prepared specifically for fruits and vegetables. These two databases were combined to form a relatively long list of agricultural indicators. This large database was subsequently reduced in size for a limited number of analyses so that the importance of a set of agricultural indicators (such as yield, for example) was emphasized. Not all census years between 1925 and 2016 were analysed for all the different data sets. This was not possible because some years, particularly the 1930-1950 ones, did not have sufficient data to allow for the creation of different agricultural variable subsets, for example. Regardless, all census years (at 10-year intervals between 1931 and 2011) had a minimum of twelve different score outcomes 6 different data sets multiplied by 2 different analysis methods (SAW and CCD). The analysis of the 2016 agricultural census data is in process.

Methods and Standardization

The combination of different variables to produce a single value has traditionally presented problems and colloquially is known as the "combining apples and oranges" problem. The problem of combination has been reduced by choosing methods that compare indicators using a standardized quantitative scale. As described previously, each data set could be analysed using three different methods as follows:

1. Simple additive weighting (SAW);
2. Concordance (CCD); and
3. Cluster Analysis (Ward's Method) (CLUSTER).

For the simple additive weighting and concordance methods, the data were standardized based on the maximum and minimum indicator values for each variable. Standardization used the following formula:

$$\textit{Standardized Score} = \frac{100 \times (\text{Raw Data Value}) - (\text{Minimum Raw Data Value})}{(\text{Maximum Raw Data Value}) - (\text{Minimum Raw Data Value})}$$

Therefore, all scores range between the values 0 and 100.

In the case of the CLUSTER analyses, data were not standardized. The results of the CLUSTER analysis did not yield scores that could be used in the overall evaluation; instead, the classification was used to see if it supported the scores assigned using the other methods.

In addition to different data sets, different years and different agglomeration analysis methods, different weights were considered. Three general examples included:

- Method 1 - which gave 50% of the total weight to soil capability and soil productivity (half of the 50% was allotted to soil capability);
- Method 2 - all variables given equal weight; and
- Method 3 - all variables given equal weight, but some variables were inverted.

As described for general method 3, agricultural databases were also set up to allow for the calculation of the inverse of any variable. The need to allow for the calculation of an inverse value was based on the fact that it is difficult to state categorically that an agricultural variable is clearly positive or negative. As an example, the increasing use of chemical fertilizers can be viewed as negative because more fertilizer use increases the probability of water pollution if fertilizer applications are excessive. Alternatively, increases in amounts of fertilizer used can be interpreted as a positive indication of increased economic activity. Because multi-attribute analysis combines variables by multiplication and/or by addition, for example, variables needed to be set up so that they all have the same general meaning as follows:

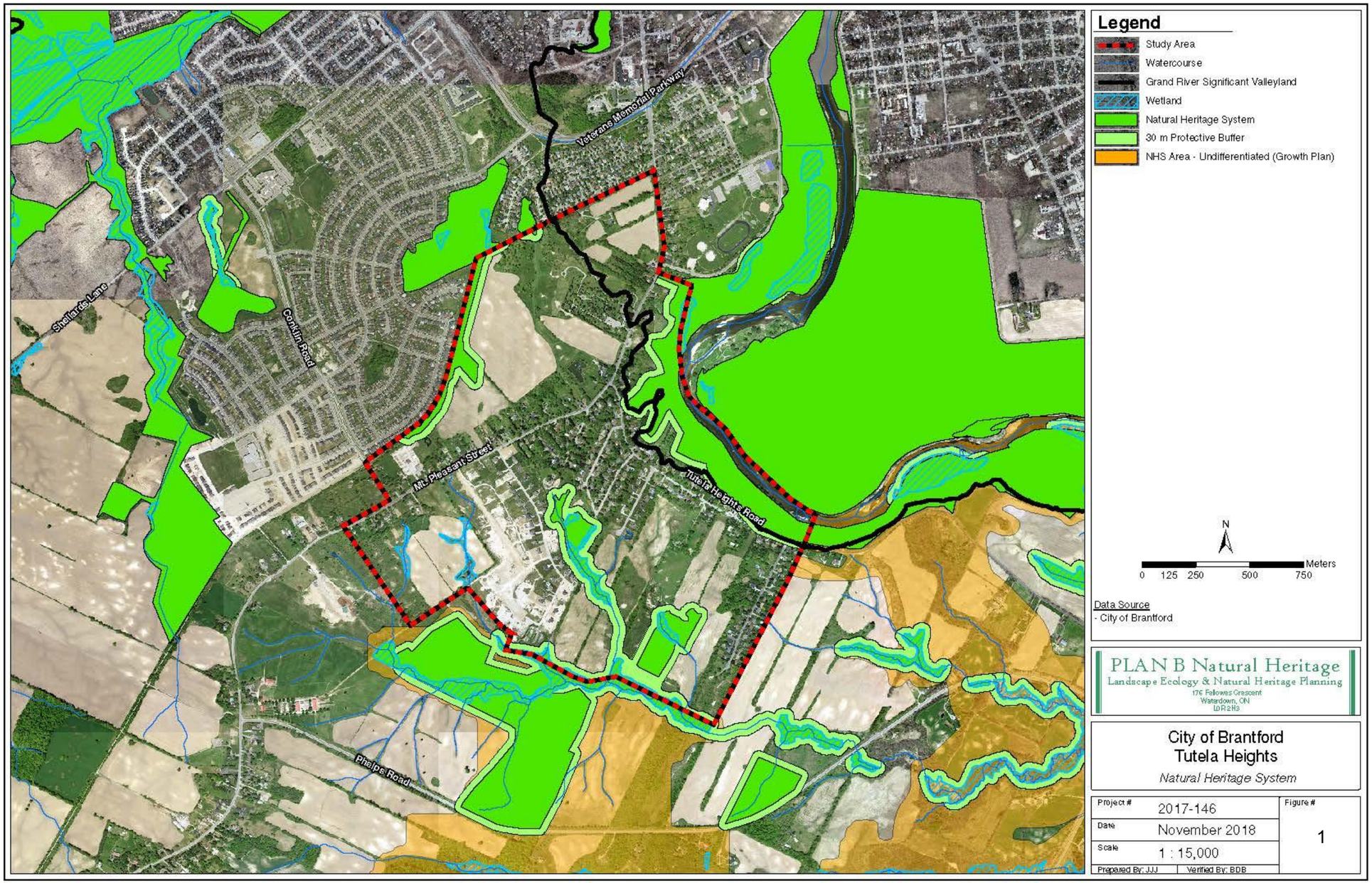
- high variable numerical value equals high agricultural value which is interpreted as having a good or positive characteristic.

For fertilizer use, the data would be used as presented with a high value indicating a positive contribution to economic activity. In the second analysis that data would be inverted to reflect a positive characteristic that little fertilizer use is better for the environment.

Appendix C

Overlay Maps of the Regional Natural Heritage System for the Growth Plan and the City's Draft Natural Heritage Systems

Appendix C - Overlay Maps of the Regional Natural Heritage System for the Growth Plan and the City's Draft Natural Heritage System
Map 1



Legend

- Study Area
- Watercourse
- Grand River Significant Valleyland
- Wetland
- Natural Heritage System
- 30 m Protective Buffer
- NHS Area - Undifferentiated (Growth Plan)

N

0 125 250 500 750 Meters

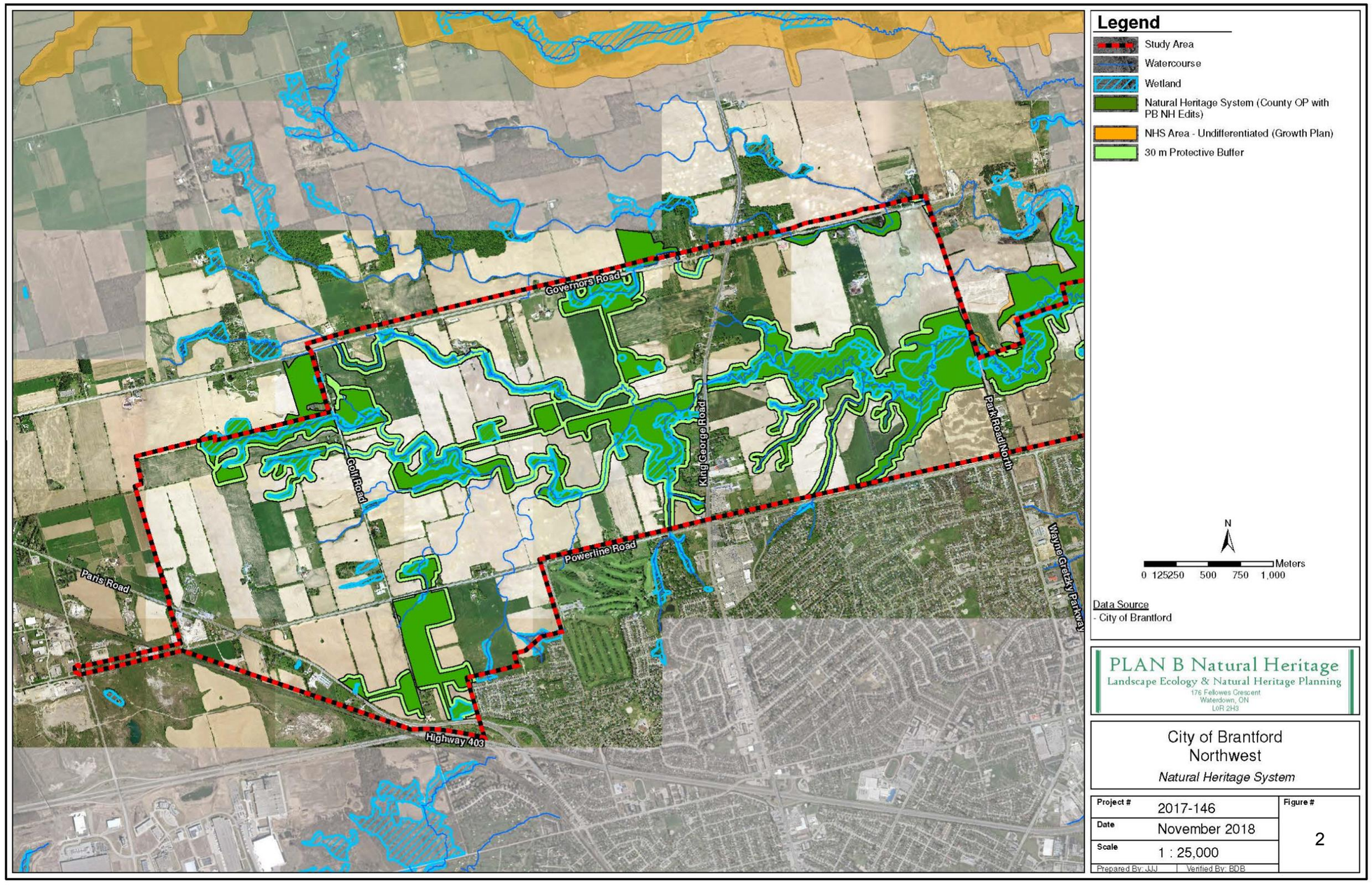
Data Source
- City of Brantford

PLAN B Natural Heritage
Landscape Ecology & Natural Heritage Planning
176 Fellowes Crescent
Waterdown, ON
L0R 2H3

City of Brantford
Tutela Heights
Natural Heritage System

Project #	2017-146	Figure # 1
Date	November 2018	
Scale	1 : 15,000	
Prepared By: JJJ	Verified By: BDB	

Map 2



Legend

- Study Area
- Watercourse
- Wetland
- Natural Heritage System (County OP with PB NH Edits)
- NHS Area - Undifferentiated (Growth Plan)
- 30 m Protective Buffer

N

0 125250 500 750 1,000 Meters

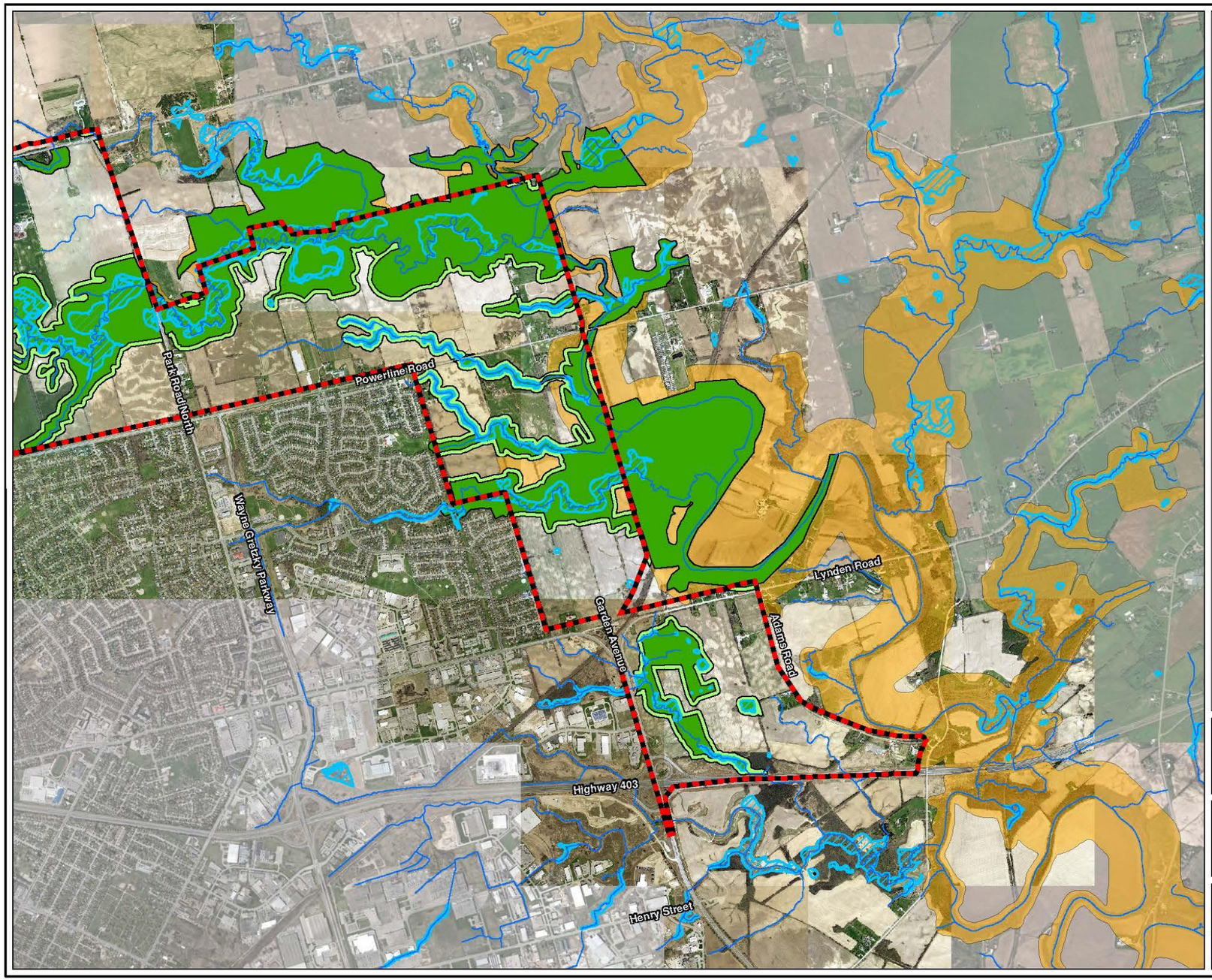
Data Source
- City of Brantford

PLAN B Natural Heritage
Landscape Ecology & Natural Heritage Planning
176 Fellowes Crescent
Waterdown, ON
L0R 2H3

City of Brantford
Northwest
Natural Heritage System

Project #	2017-146		Figure #
Date	November 2018		2
Scale	1 : 25,000		
Prepared By: JJJ		Verified By: BDB	

Map 3



Legend

- Study Area
- Watercourse
- Wetland
- Natural Heritage System (County OP with PB NH Edits)
- NHS Area - Undifferentiated (Growth Plan)
- 30 m Protective Buffer

N

0 125250 500 750 1,000 Meters

Data Source
- City of Brantford

PLAN B Natural Heritage
Landscape Ecology & Natural Heritage Planning
176 Fellowes Crescent
Waterdown, ON
L0R 2H3

City of Brantford
Northeast
Natural Heritage System

Project #	2017-146	Figure # 3
Date	November 2018	
Scale	1 : 25,000	
Prepared By: JJJ	Verified By: BDB	

Appendix D

Surface Water Drainage Network – Fluvial Geomorphology

Appendix D – Surface Water Drainage Network – Fluvial Geomorphology

1 Introduction

Characteristics of the drainage network and the condition of the constituent watercourses need to be considered when assessing an area for future development potential. The intent of the geomorphic assessment was to examine, at a high level, the potential constraints associated with the surface drainage network within the Brantford Expansion Area (BEA). The assessment focused specifically on the spatial footprint (i.e., defined channel corridor) that may be required to contain existing and future anticipated channel form and functions, and on the sensitivity of the watercourses to urban hydromodification. Sensitivity to hydromodification determines the relative complexity of storm water management controls that may be needed to mitigate these effects. In addition to the available GIS mapping, airphotos, and background reports, desktop analyses were completed to enhance the suite of parameters that were considered to be beneficial for identifying potential constraints to future urban development. A technical memorandum is provided in the appendix of this chapter to provide additional detail of the technical analyses completed.

This chapter provides an overview of the work completed to characterize the watercourses situated within the BEA in general, and specifically within each of the 18 sub-areas defined by SGL Group (**Section 2**). This is followed by an overview of the evaluation principles and criteria that guided evaluation of each of the 18 sub-areas in the BEA (**Section 3**), including a description of the evaluation methodology. A brief overview of evaluation results is provided in **Section 4**. Results of the geomorphic assessment are integrated into the overall Stormwater Servicing Evaluation Chapter

2 Characteristics of the Study Area

The characteristics and conditions of the drainage network and each of its constituent watercourses is a result of the interaction between landscape properties and surface water runoff. This section provides an overview of the key controls on drainage network characteristics and on channel form, function, and sensitivity. Results of the study area characterization and the morphological metrics of the individual watercourses provides the basis for evaluating the spatial constraints and watercourse sensitivity in the context of Stormwater Servicing development support level in each of the defined 18 sub-areas within the BEA. A summary of the characterization completed, by sub – area, is provided in

2.1 Surficial Geology and Physiography

The boundary materials (bed and banks) of a watercourse are determined by the local surficial geology and upstream sediment contributions. The physiography of a region is intrinsically linked to the topography of the landscape and the geomorphic influences acting upon it. Together, the surficial geology and physiography of a region will exert a dominant influence on channel form, function and processes.

2.1.1 Surficial Geology

Characteristics of the boundary materials (size, cohesion) along a watercourse affects the configuration of the watercourse, the available sediment supply for downstream channel sections, and the rate and mode of channel erosion. Non-cohesive and unconsolidated sediment are more prone to erosion from hydraulic stresses than cohesive and consolidated sediment. The predominant mode of channel adjustment (i.e., channel response to change tends to occur along those boundary materials that are weaker which can lead to predominant widening, migration or deepening tendencies); this accounts for valley form formation

The permeability of the surficial geology determines the drainage density; the topography (often influenced by geological processes) influences drainage pattern.

Key surficial geology units situated within the study area, as defined by the Ontario Geological Survey (OGS, 2010) include:

> **Modern Alluvium -** clay, silt, sand, gravel, may contain organic remains. This material can generally be reworked by flows that are conveyed through the channel. Excess flow above the threshold of sediment mobility could result in a response to channel form and function. This corresponded to the Sand attribute in the GIS Geology Material layer. Due to erosion, excess sediment loading into the watercourse could lead to excess deposition in downstream channel locations which may affect aquatic habitat and channel stability.
>
> Within the BEA area, modern alluvium occurs along the main branch of Jones Creek, Fairchild Creek and several of its tributaries along the east side of the BEA. The creek corridor is situated within the massive well laminated clay.
>
> **Massive well laminated clay –** also referred to as fine textured glacio-lacustrine deposits that consist of silt and clay, minor sand and gravel and may be massive to well laminated. Erosion of clay materials is influenced less by hydraulic stress than by chemical weathering processes and are prone to long term channel bed lowering when this material is exposed on the channel bed. This corresponded to the Clay attribute in the GIS Geology Material layer.
>
> The watercourses situated outside of the Natural Heritage Area flow through the Massive well-laminated clay and modern alluvium deposits.
>
> **Coarse textured lacustrine deposits –** consisting of sand, gravel, minor silt and clay. Excess flow above the threshold of sediment mobility could result in a response to channel form and function.
>
> The physiography is referred to as Norfolk Sand Plain which is characterized by coarse sands and silts associated with deltaic sediment. The sediment allows for greater infiltration and groundwater movement (MacVeigh et al., 2016). This corresponded to the Sand attribute in the GIS Geology Material layer.

A summary of the dominant surficial geology characterization within the northern and southern BEA is provided in **Table 2-2**.

2.1.2 Physiography

The physiography of a landscape refers to its physical description including dominant slopes and topographic patterns. Within the northern BEA, the landscape is generally graded from west to east; this is reflected in the predominant west to east orientation of the drainage network. The main channel of Jones Creek incises into a valley that gradually deepens in the east direction; the valley slopes are classified as steep and over-steep slopes (based on GRCA mapping) and have both a north and south facing aspect. In some cases, the steep slopes have east and west facing aspects and are associated with tributaries that are incising into the Jones Creek valley wall.

In the southern BEA, Phelps Creek and its tributaries similarly flow in a west to east orientation and the tributaries flow towards the main channel from the north and south. Phelps Creek is not situated within a well-defined valley; no steep or over-steep slopes were classified in GRCA mapping.

Watercourses with steep and over-steep slopes are located within relatively narrow valley settings. Smaller watercourses tend to exhibit valley widths ranging from 15 – 30 m, with larger watercourses such as Jones Creek and Fairchild Creek exhibiting widths from 15 – 100 m. Along the main tributary of Lower

Jones Creek, throughout sub-areas C6 – C8, there are areas of valley wall contact where the channel has bisected steep valley slopes.

The majority of the tributaries which exhibit steep slopes and narrow valley settings coincide with the modern alluvial surficial geology units. The remainder of the northern BEA, and sub-area C11 within the southern BEA tend to demonstrate unconfined channel settings. Such areas are located in areas dominated by clay surficial geology.

2.2 Drainage Network and Flow Regime

The Brantford Expansion Area (BEA) is situated within the Grand River watershed. The northern BEA lands are drained predominantly by the Jones Creek drainage network which flows into Fairchild Creek; along the east side of the BEA, these lands, the main channel of Fairchild Creek and several of its smaller unnamed tributaries drain the area. The southern BEA lands are drained by the Phelps Creek drainage network.

The Fairchild Creek Subwatershed Study Characterization Report (MacVeigh et al., 2016). describes the many tributaries within the northern BEA are highly meandering, narrow and incised, with sand and silt substrates. Riparian wetlands were identified as an important control on channel flows; when present, riparian wetlands induce high flows which are sharp but prolonged, and baseflows that are low but more stable. Conversely, in the absence of riparian wetlands, channels exhibit highly variable flows with, "rapid, short, and intense high flows and extremely low baseflows," (MacVeigh et al., 2016).

In addition to the mapped surface water features, review of aerial photography clearly revealed the presence of smaller headwater drainage features. While no field reconnaissance has yet been completed, it is likely that most of the headwater channels are ephemeral or intermittent; several of the headwater features appeared to be well defined and may support perennial flow. The potential headwater drainage features observed on the study area airphotos were digitized and used to augment the surface water drainage feature mapping received from GRCA for the purpose of this high-level evaluation.

GIS analyses were completed to characterize various properties of the augmented drainage network within the BEA and within each of the 18 sub-areas. To facilitate characterization, the drainage network was delineated into links or channel sections of the drainage network (i.e., generally between tributary confluences. Naming of the links followed the general subcatchment area numbering scheme used by other disciplines in this study; mapping showing the watercourse links is provided in the appendix to this chapter. Specific analyses completed are summarized below; additional detail is provided in the technical memorandum provided in the appendix to this chapter.

Drainage Density – this refers to the length of watercourse per unit area and provides an indication of how well an area is drained by the surface water drainage network. The density of channels within a landscape is a result of two primary factors: the volume of water received at the surface (i.e., precipitation), and the distribution of water on the land surface (e.g., geology soils, vegetation, topography) (Knighton, 1998). The drainage density is considered to be extremely high in comparison to other areas of the Grand River watershed, indicative of high runoff rates and low groundwater recharge which is attributed to the relative impermeability of the clay plains" (McVeigh et al., 2016)

Stream Order - external links of the drainage network are defined as the first surface drainage features that collect water and enable a connected pathway towards the main channel. These features may include shallow topographic depressions that become connected as a continuous channel only during high runoff events, ephemeral and/or continuous channels. Low stream order channels (zero or first order) are often considered to be a low constraint to development and, within

the Headwater Drainage Features Assessment (CVC/TRCA 2014) generally do not need to maintain their exact position within the landscape as long as their function is replicated within proposed development (e.g., drainage swales). Higher order streams are often associated with well-defined and stable or quasi-stable forms that should be maintained in their position; delineation of a channel corridor is required, if not already situated within a natural heritage system.

Flow Regime – the opportunity to replicate channel functions through Low Impact Development measures is greatest with ephemeral and intermittent watercourses. When a watercourse is intermittent or perennially flowing, then erosion control targets may be required to minimize impact of post-development runoff on the receiving watercourse. While the flow regime of each watercourse within the study area was not known, it could be estimated through review of aerial photography (e.g., well defined channel or dry swale).

Slope – the gradient of a watercourse provides an indication of the overall setting in which the channel is situated. Steep watercourses are often indicative of incision into the landscape and may represent ravine forms that are sensitive to a change in hydrology. Low gradient watercourses are often indicative of flatter terrain in which a broader spatial footprint may be occupied by a watercourse.

Stream Power – stream power is a measure of flow energy within a watercourse that is based on channel slope and flow. High stream power values are indicative of high erosion and sediment transport potential. Various classification schemes exist that correlate stream type with stream power; stream type can be, indicative of the processes occurring within the channel and the sediment load and supply characteristics necessary to sustain the stream type. When the stream power of flows is in proximity to a threshold number associated with a change in stream type, then adjustment in channel form from one type to another may occur. If the boundary materials and sediment supply are insufficient to sustain the new channel type, then instability will result.

The stream power of watercourses within the study area was estimated for each link of the drainage network, as outlined in the Attached Technical Memorandum.

Sinuosity – the sinuosity of a watercourse refers to the ratio of channel length to valley length in a down-valley direction. The ratio provides indication of the existing lateral footprint of a watercourse in the landscape. Watercourses that have been previously altered and/or are ephemeral, typically have sinuosity values typically around 1.0; well-developed/established watercourses have higher ratios. Opportunity for watercourse enhancement and/or relocation is typically associated with a previously straightened channel; the footprint of the channel corridor in a development scenario would be wider than under existing conditions. Many low sinuosity watercourses are not typically situated within a natural heritage system and may have a low stream order.

An overview of the drainage network characteristics within the BEA sub-areas is provided in **Table 2.2.**

2.3 Landuse and Landcover

The landuse and landcover of an area influence the hydrologic pathways of precipitation and sediment sources on the land surface. The existing landuse within the BEA consists primarily of agricultural lands (row crops, corn, grains, and hay) (MacVeigh et al., 2016). It is possible that tile drains have been placed within the fields, which convey water to an open water feature in the downslope direction. In future development scenarios, daylighting of any piped watercourses would be required by regulatory agencies, to re-establish surface water pathways.

The BEA lands are situated downstream of existing urban areas; urban runoff is directed into the tributaries of several sub-areas (**Table 2-1**) (note: no runoff is directed to the employment land sub-areas). Stormwater management with no, or minimal, erosion control changes the hydrologic

characteristics of a watercourse (peak flow, volume, frequency of events, increase in small flows (i.e., water that previously infiltrated now runs off) which may result in an erosion or adjustment channel response. The cumulative effect of multiple stormwater management facilities should be considered in any development scenario, especially in sensitive watercourses.

Table 2-1. Overview of Sub-Areas receiving controlled or uncontrolled runoff

Expansion Area	Sub-Areas with Uncontrolled Discharge	Sub-Areas with Controlled Discharge
Northern BEA	C2, C4, C5, C9	C6, C7, C8, C10
Southern BEA		C11

The structural strength of channel banks is enhanced by the rooting network of riparian vegetation. Thus, the natural heritage classification of the study area provides some insight into the ability of watercourse to absorb a change in hydrology due to upstream urbanization. Areas identified as wetland provide a water storage and flow attenuation function that is beneficial to enabling some change in hydrology to be absorbed and provides for temporary storage of water.

2.4 Watercourse Conditions

The condition of a watercourse determines its resilience to changes in hydrology and sediment loading. This condition, is often referred to the quasi equilibrium form in which any subtle changes in flow or sediment are balanced by adjustments in one of several degrees of freedom (e.g., widening). The sensitivity of a channel to a future change in hydrology or sediment loading is determined by several factors as outlined below.

Pre-Existing Condition: a review of the Fairchild Creek Subwatershed Study Characterization Report (MacVeigh et al., 2016) was completed. Observations of existing channel sensitivity or erosion concerns were noted for each watercourse. Evidence of systematic erosion and excess sediment loading may be indicative of channel changes/adjustments in response to previous changes in landuse and/or controls in channel defining parameters (note: channel planform adjustments/changes may require decades to centuries to complete). A review of aerial photography was also completed to view imagery of channel form and conditions and to identify typical indicators of instability/sensitivity (e.g., unstable banks, excess deposition).

Results from a suspended sediment transport study on Fairchild Creek identified areas of high suspended sediment loading and extensive erosion; these areas included that Lower Fairchild Creek tributaries where little to no riparian buffers are present (see Error! Reference source not found.). Such areas contribute significantly to erosion of sediment, and the overall sediment and nutrient loading within the watershed. These areas were considered to be indicative of sensitive watercourses due to the erosion already occurring within the systems.

Stormwater Influence - Watercourses situated downstream of uncontrolled discharge outlets are likely to have been impacted by the change in flows that occur within them. This effect is limited to the zone of influence downstream of the outfall and generally dissipates in the downstream direction as the flow rate within the watercourse increases as a function of drainage area. **Table 2-1** provides a summary of the sub-areas that are influenced by controlled and uncontrolled stormwater discharge.

Channel Alteration - In conjunction with agricultural activity, straightening of watercourses may have occurred; re-establishment of a sinuous form within a defined corridor may be required in conjunction with future land development. Channel alteration is common among the watercourses within the urban growth boundary. Smaller order channels tend to be located in agricultural

lands, which commonly exhibit straightening. Systems which are not considered to be altered are the main branches of Jones Creek and Fairchild Creek.

Watercourses that have been previously altered/straightened are less likely to have well developed channel bed morphology and provide an opportunity for enhancement. Where changes in the watershed have previously occurred, then it is likely that the channel has already become 'stressed' and may, or may not, be able to absorb additional change in the flow regime due to land use change (i.e., urbanization).

A summary of key watercourse conditions observed within the sub-areas is provided in **Table 2-2**.

Table 2-2. Summary of drainage network and watercourse characteristics in BEA sub-areas.

Expansion Sub- Area	Total Stream Length Outside NHS (m)	Potential Headwater Drainage Feature Length (m)	Drainage Density Range Outside NHS (m/km^2)	Dominant Stream Order	Dominant Surficial Geology Unit	Steep Slopes along Valley Wall	Confined or Incised Valley Setting	Natural Heritage System	Erosion Prone
E1	-	-	0-10	-	LD				
E2	139	883	10-20	1	MLC	Yes			
E3	458	-	20-100	1	MLC				
E4	-	931	0-10	-	MA	Yes			
E5	1100	1431	0-10	2	MLC				
E6	1775	-	0-10	2	MLC			Yes	
E7	862	367	>100	1	MLC				
C1	785	641	20-100	1	MA				
C2	495	-	20-100	1	MLC				
C3	-	651	0-10	3	MLC			Yes	
C4	1231	-	10-20	2	MLC				
C5	1703	1919	10-20	3	MLC		Yes		Yes
C6	1283	1423	20-100	3	MLC		Yes		
C7	1052	906	20-100	3	MLC	Yes	Yes		Yes
C8	86	1258	0-10	4	MLC	Yes	Yes	Yes	Yes
C9	226	1426	10-20	2	MLC	Yes	Yes		Yes
C10	-	2338	0-10	2	MLC	Yes		Yes	Yes
C11	353	-	>100	1	MLC				

3 Evaluation Methodology

The surface water feature evaluation is a component of the stormwater servicing evaluation and results of the evaluation described in this chapter are integrated into the results of the stormwater servicing evaluation. All evaluation results will be combined with results from the other core disciplines in order to determine the preferred urban boundary growth areas.

3.1 Overall Philosophy

For the purposes of this evaluation, the following philosophy has been assumed as it relates to surface water management:

- Stormwater discharge into a receiving watercourse should not contribute to an increase in erosion potential, a change in channel stability, or cause a change in channel functions or processes.
- Uncontrolled runoff due to existing development may have contributed to an impacted downstream channel which may require mitigation in a future development scenario.
- Drainage from a stormwater pond will generally need to be conveyed into a surface water feature; where no surface water feature occurs within a sub- area or in the downstream sub-area, then an open water feature may need to be created.
- Where watercourses are considered to be sensitive to hydromodification, then more complex stormwater management strategies may be required to mitigate effects.
- The cumulative downstream effect of stormwater discharge on surface water channel stability should be considered.
- Headwater drainage features are considered to be important components of the drainage network and will require replication of function through Low Impact Development (LID) measures.
- Well defined watercourses that are not situated within the Natural Heritage System could be enhanced through restoration work and could be relocated within the landscape, if these have been previously straightened and are degraded.
- Watercourses situated within the limits of the natural heritage system provide an adequate channel corridor to support watercourse function and process and will minimize interaction with the built environment.

3.2 Evaluation Principles and Criteria

A set of principles and criteria were developed to guide the evaluation of each of the 18 BEA sub -areas. The principles specific to the stormwater servicing evaluation, into which the geomorphic assessment of surface water features contributes, are outlined below:

Stormwater Servicing Principle F2: **To minimize the impact on the water resource system by minimizing the relative complexity needed to complete local stormwater servicing.**

Evaluation Criteria include the following:

- Degree of sensitive watercourses
    - Watercourses that are identified as highly sensitive to hydromodification (a change in flow event frequency, duration, volume, etc.) will require more comprehensive stormwater management controls than medium or low constraint watercourses.
    - Sensitive watercourses include those that are s includes sensitivity due to existing characteristics based on natural factors that determine channel condition, and to watercourses that have been impacted due to the release of uncontrolled water from urban development areas near the boundary of the BEA.

- Degree of spatial constraint associated with watercourses within potential boundary area (headwater features or other watercourses not currently identified as part of the natural heritage system).
    - A high drainage density (i.e. unit channel length per unit drainage area) may restrict developable area, by requiring replication of hydrologic functions through LID measures (i.e. low constraint watercourses) and/or establishing/maintaining an open channel corridor for medium or high constraint watercourses.
    - An open channel corridor corresponding to the existing location of high constraint/sensitive watercourses will need to be protected in the landscape. This may restrict developable land and may affect the layout of developable land
    - An open channel corridor may need to be established to protect channel form and functions. The corridor may be relocated to accommodate development layout; the corridor provides an opportunity to manage channel processes and to mitigate effects of upstream and adjacent development. The corridor may affect developable area and development layout.
    - A surface water drainage feature will need to be established where no features currently exist either in the sub-area, or in the downstream sub-area. This feature will convey stormwater to an existing defined watercourse.

Stormwater Servicing Principle F3: **To minimize the impact on the water resource system by evaluating the downstream system capacity.**

Evaluation Criteria included:

- Degree of hydromodification constraint/geomorphologic sensitivity to existing outlet
    - Areas considered to be highly sensitive to hydromodification will require detailed study and more significant erosion control design, such as larger storage volumes for end-of-pipe facilities and/or more extensive LID measures. Long-term monitoring is more likely to be required.

Since surface water features are also an integral part of the natural heritage system (NHS), input from a geomorphologic perspective was also to the following:

Environment Protection Principle D5*:* **To protect, enhance, and restore the NHS for the long-term along with existing linkage connections between the NHS and NHS features within Brant Country and the existing urban area.**

Evaluation Criteria, from a geomorphic perspective, included:

- Compatibility with erosion prone watercourses and valley systems
    - Areas considered to be erosion prone were considered to be less supportive of urban growth due to the potential to degrade surface water features (i.e., from a geomorphic and aquatic habitat perspective).

3.3 Evaluation Method

The evaluation was completed by examining the drainage network and channel conditions within each of the 18 sub-areas that would be directly impacted by development. The evaluation also considered downstream channel conditions as these could also be impacted by stormwater discharge, especially if the discharge occurred near the sub-area boundaries (i.e., watercourses within the downstream sub-areas could be within the zone of influence of an outfall).

The evaluation process used to assess the ability of the watercourses within each of the 18 sub-areas to support growth according to each of the principles identified in **Section 3.2** is provided in the following subsections.

3.3.1 Degree of Sensitive Watercourses

The ability of a watercourse to accommodate changes in hydrology depends on its pre-existing condition, the factors that influence channel shape (geologic materials, vegetation), and their relative erodibility. A review of background reports, GIS mapping, and aerial photography was completed to gain insight into the sensitivity of the watercourses to urban hydromodification. This included consideration of downstream channel linkage sensitivity. The factors considered in the evaluation included the following:

- Pre-existing condition
- Surficial geology
- Slope
- Stream power
- Natural Heritage/Vegetation Cover

The relevance of each of these factors was presented in the preceding chapter. Analyses and characterization of the entire drainage network was completed through GIS analyses and the sensitivity of all watercourse links was estimated; additional detail is provided in the technical memorandum appended to this chapter. The sub-area evaluation considered the individual watercourse link sensitivities and applied the evaluation scheme outlined in **Table 3-1.**

Table 3-1. Sensitive Watercourses Evaluation in Support of Stormwater Servicing Principle F2.

Sensitive Watercourse Evaluation			
	1	2	3
	Very Supportive of Growth	**Supportive of Growth**	**Constrained**
Principle F2: Relative Complexity of local stormwater servicing	• the effects of a change in surface water runoff can likely be mitigated through the implementation of Low Impact Development measures (LID) (e.g., swales). Through the LID measures, the function of watercourses (i.e., typically ephemeral or intermittent channels) is also replicated (e.g., flow attenuation, water storage).	• the existing channel is considered to be relatively stable and able to accommodate some changes to the post development hydrograph, when typical stormwater management controls are implemented.	• when a watercourse is near the threshold of a stable channel form, or when the boundary materials are highly erodible, then it may be sensitive to a change in the hydrograph due to landuse change. If sufficient mitigation measures are not implemented, then acceleration of existing processes that could induce risk to the environment, to property, or to aquatic habitat could result. In sensitive watercourses, more stringent stormwater management controls may be necessary than average standard practice.

3.3.2 Degree of Spatial Constraint

Watercourses that are maintained as open features in the landscape require a defined channel corridor to contain channel processes and to protect adjacent landuse from erosion and potential land loss. In those cases where the watercourses are situated within defined natural heritage features, a channel corridor is implicitly defined and protected and no alteration to the corridor or watercourse to accommodate development is anticipated.

Determining whether a channel corridor may be required for the watercourses not already situated within a natural heritage feature, was estimated through high level desktop analysis; this included an evaluation of the potential headwater drainage features identified through the airphoto review. For the Brantford Urban Boundary Expansion Area, a review of GIS mapping and aerial photography was completed to identify channel position within the drainage network (stream order), existing lateral expression of the planform (sinuosity), previous modifications to the planform and context of existing landuse. The factors considered in the evaluation included the following:

- Stream order
- Drainage Density
- Sinuosity
- Flow regime
- Previous alteration or channel change

The relevance of each of these factors was presented in the preceding chapter. Analyses and characterization of the entire drainage network, outside of the Natural Heritage Area, was completed through GIS analyses. Results of the analyses were integrated to estimate the likely constraint level for each watercourse link within the sub-area. Evaluation of the spatial constraint potential within each sub-area considered the drainage network classification for each of its constituent watercourses and applied the evaluation scheme outlined in **Table 3-2.**

Table 3-2. Spatial Constraint for Surface Watercourse Evaluation in Support of Stormwater Servicing Principle F2.

Spatial Constraint Evaluation			
	1	2	3
	Very Supportive of Growth	**Supportive of Growth**	**Constrained**
Principle F2: Relative Complexity of local stormwater servicing	• the function of a watercourse can be replicated through Low Impact Development measures (LID) (e.g., swales) and thus a defined channel corridor may not be required.	• the form and function of a watercourse can be enhanced or replicated through channel restoration design; the channel could be relocated within the landscape and placed within a defined channel corridor.	• the form and function of a watercourse are well developed, and/or the watercourse is highly sensitive. The existing and future anticipated footprint of the watercourse should be protected in its current location. • The sub-area has a high drainage density including medium constraint channels

3.3.3 Degree of Hydromodification Constraint/Geomorphic Sensitivity

The ability of a watercourse to accommodate future changes in hydrology depends on its pre-existing condition and the sensitivity of the watercourse to a change. Like the sensitivity characterization (**Section 3.3.1**) of the BEA watercourses, hydromodification constraints and geomorphic sensitivity was evaluated. This was based on a review of background reports, GIS mapping, and aerial photography. An overview of the relevance of each component included in the assessment is provided below.

- Pre-existing condition

- Stream order
- Surficial geology
- Slope
- Stream power
- Natural Heritage/Vegetation Cover

The relevance of each of these factors was presented in the preceding chapter. Analyses and characterization of the entire drainage network was completed through GIS analyses and the sensitivity of all watercourse links was estimated; additional detail is provided in the technical memorandum appended to this chapter. The sub-area evaluation considered the individual watercourse link sensitivities and applied the evaluation scheme outlined in Table 3-3. Further consideration of the drainage network and need for establishing additional surface water linkages differentiates the analyses described in this section in comparison to those outlined in **Section 3.3.1**.

Table 3-3. Hydromodification and Geomorphic Sensitivity of Surface Water Feature Evaluation in Support of Stormwater Servicing Principle F3.

Hydromodification and Geomorphic Sensitivity Evaluation			
	1	2	3
	Very Supportive of Growth	**Supportive of Growth**	**Constrained**
Principle F3: Existing Downstream Capacity	• the effects of a change in surface water runoff can likely be mitigated through the implementation of Low Impact Development measures (LID) (e.g., swales). Through the LID measures, the function of watercourses (i.e., typically ephemeral or intermittent channels) is also replicated (e.g., flow attenuation, water storage).	• the existing channel is considered to be relatively stable and able to accommodate some changes to the post development hydrograph, when typical stormwater management controls are implemented. • Multiple sub-areas occur downstream of the evaluated sub-area, with watercourses of moderate to high constraint sensitivity. Cumulative impacts need to be considered, which will define stormwater management control.	• when a watercourse is near the threshold of a stable channel form, or when the boundary materials are highly erodible, then it may be sensitive to a change in the hydrograph. If sufficient mitigation measures are not implemented, then acceleration of existing processes that could induce risk to the environment, to property, or to aquatic habitat could result. In sensitive watercourses, more stringent stormwater management controls may be necessary than average standard practice. • Sensitive channels are situated downstream of the sub-areas and will require more complex stormwater management controls.

4 Summary of Evaluation Results

The sub-area evaluation was completed for all surface water features within the 18 sub-areas, from a geomorphic perspective, based on desktop analyses.

From a sensitive watercourse perspective, those sub-areas considered to be very supportive of growth included watercourse that were considered to have low sensitivity, low stream power, and exhibited stable channel form. Sub-areas considered to be supportive of growth included watercourses that were considered to be moderately sensitive. Constraints for growth were identified for those sub-areas in which stormwater outflow would likely be discharged directly into a sensitive watercourse, or upstream of a sensitive watercourse; likewise, if the tributary was anticipated to receive discharge from multiple stormwater outfalls (i.e., cumulative impacts), then the sub-area was considered to be constrained for growth. A summary of the evaluation results is provided in **Table 4-1.**

Table 4-1. Overview of Evaluation Results.

	Sensitivity	**Spatial Constraint**	**Hydromodification/ Geomorphic Sensitivity**
Very Supportive of Growth	C11	C6, C8, C11 E1, E3,E4, E6	C11 E6
Supportive of Growth	C1, C2, C7, C9, C10 E1, E2, E3, E4, E6	C1, C2, C3, C4, C7, C9, C10 E2, E7	C1, C2, C7, C10 E1, E2, E3, E4, E5, E7
Constrained	C3, C4, C5, C6, C8 E5	C5 E5	C3, C4, C5, C6, C8, C9

From a spatial constraint evaluation, the sub-areas considered to be most supportive of growth were those in which there was a low drainage density, and low order watercourses. Sub-areas considered to be supportive of growth had a low to moderate drainage density generally low stream orders, and moderate number of previously unmapped potential headwater drainage features. Sub-areas considered to be constrained included high drainage density including a high number of previously unmapped potential headwater drainage features. A summary of the evaluation results is provided in **Table 4-1.**

The sub-area evaluation from the perspective of hydromodification and geomorphic sensitivity was similar to the evaluation of sensitive watercourses outlined above **(Table 4-1)**. In this evaluation, further consideration was given to the drainage network characteristics (e.g., low order watercourses).

The high-level constraint assessment completed for this study is intended to provide input into the selection of potential urban growth areas. Subsequent steps to further define watercourse constraints include field-truthing of selected areas to verify assumptions pertaining to each of the components included in the assessment. Detailed analyses and comprehensive field assessments will be required to inform specific recommendations and considerations for post-development conditions.

5 References

CVC/TRCA. 014. Evaluation, Classification and Management of Headwater Drainage Features Guidelines.

Knighton, D., 1998. Fluvial forms and processes. London, Arnold.

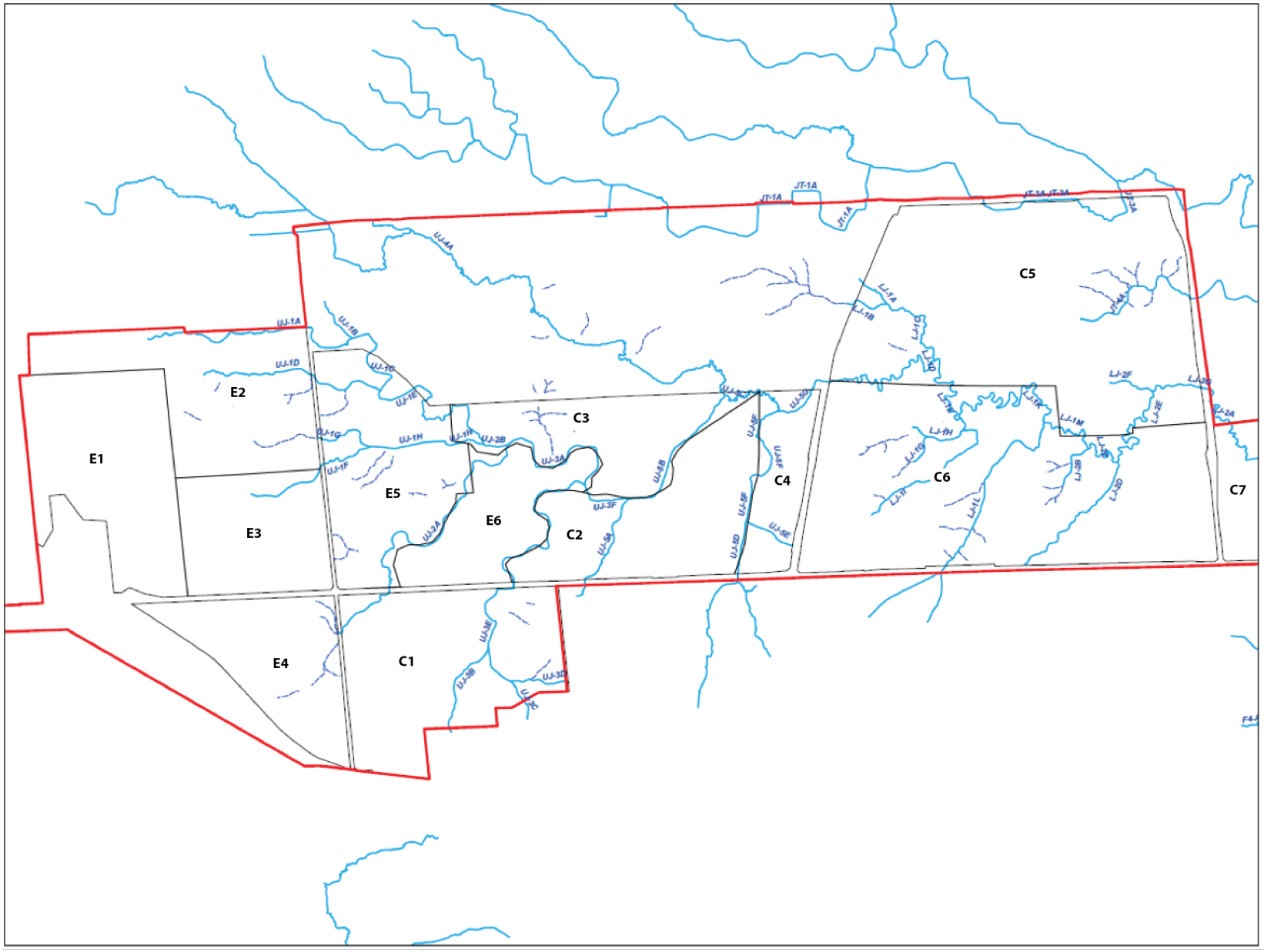
MacVeigh, B., T. Zammit and J. Ivey. 2016. Fairchild Creek Subwatershed Characterization Study. Version 1.0. Cambridge, ON: Grand River Conservation Authority.

Ontario Geological Survey, 2010. Surficial Geology. Data file.

Appendix

Watercourse Labels

Technical Memorandum



Brantford Urban Boundary

Reach Identification
Jones Creek

Legend

- Urban Growth Boundary
- Expansion Area
- Watercourse
- Headwater Drainage Features

ecosystem recovery inc.
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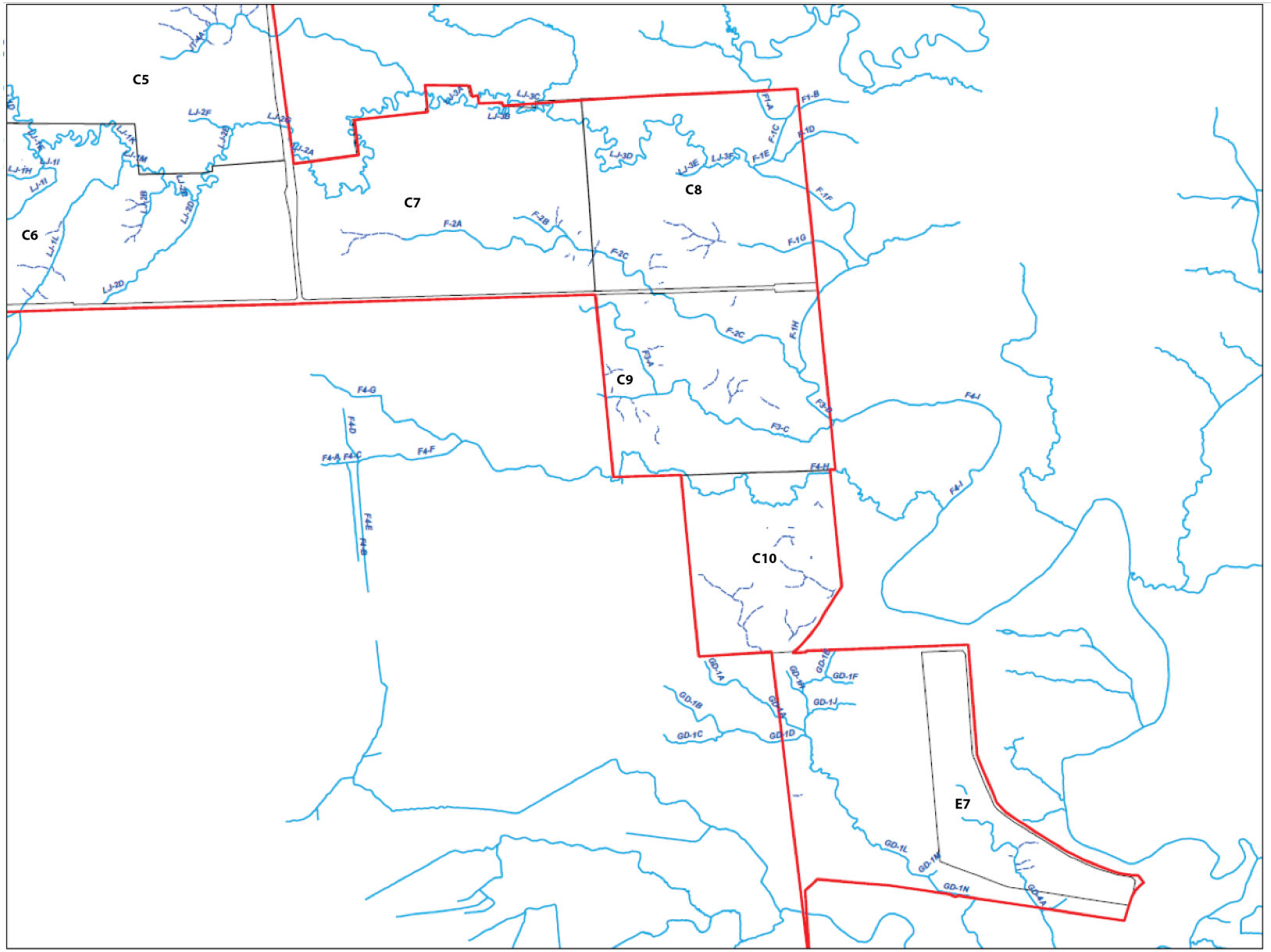
NAD 1983 UTM 17	1:20,000
Project: 1706 Date: February 2018	

Data Sources: Ecosystem Recovery Inc., 2017: Watercourse, Headwater drainage features; GMBP, 2017: Urban growth boundary; Expansion areas;



Brantford Urban Boundary

Reach Identification
Fairchild Creek & Garden Tributary

Legend

- Urban Growth Boundary
- Expansion Area
- Watercourse
- Headwater Drainage Features

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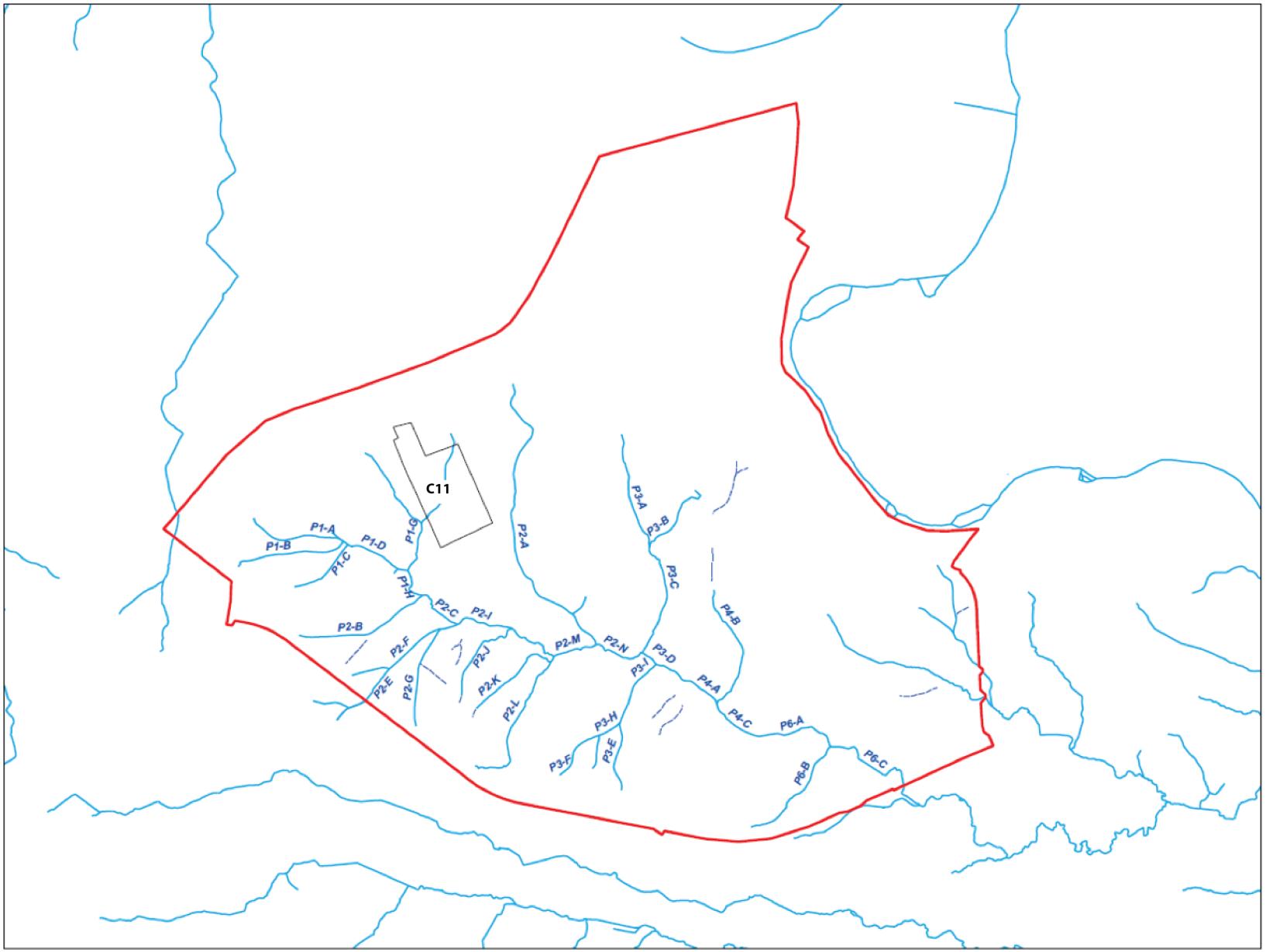
NAD 1983 UTM 17	1:20,000
Project: 1706 Date: February 2018	

Data Sources: Ecosystem Recovery Inc., 2017: Watercourse, Headwater drainage features; GMBP, 2017: Urban growth boundary; Expansion areas;



Brantford Urban Boundary

Reach Identification
Phelps Creek

Legend

- Urban Growth Boundary
- Expansion Area
- Watercourse
- Headwater Drainage Features

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NAD 1983 UTM 17	1:15,000
Project: 1706 Date: February 2018	

Data Sources: Ecosystem Recovery Inc., 2017: Watercourse, Headwater drainage features; GMBP, 2017: Urban growth boundary; Expansion areas;

ecosystem recovery inc.
PROFESSIONAL ENGINEERS

Technical Memorandum

80 Courtland Avenue East, Unit 2, Kitchener, ON, N2G 2T8

Tel 519.621.1500 ■ Fax 226.240.1080

To:	Mariëtte Pushkar, M.Sc., P.Geo	**Date:**	October 16, 2017
From:	Julia Howett, M.Sc.	**ERI Project No.:**	1706
Re:	Brantford Urban Boundary Expansion – Geomorphic Analyses in Support of High Level Screening Assessment		

In addition to the available GIS mapping, airphotos, and background reports, desktop analyses were completed to enhance the suite of parameters that were considered to be beneficial for identifying potential constraints to future urban development. This Technical Memorandum provides an overview of the supplementary analyses that were completed to support the high level constraint assessment for the watercourses situated within the Brantford Urban Boundary Expansion Area (i.e., the study area).

GIS mapping layers and attribute data were received from the GRCA. Where necessary, additional attributes were quantified/determined based on supplementary analyses (see attached Technical Memorandum for an overview of additional analyses completed). Aerial photography of the study area was received from the City of Brantford; this was used to review site conditions, as a base of supplementary analyses, and to verify GIS attribute data (e.g., stream order, sinuosity)

Stream Power:

Stream power may be defined as the rate at which a stream can perform geomorphic work; this includes both erosion and sediment transport. Stream power can be expressed as total stream power per unit length or as specific stream power per unit width. In the scientific literature, unit stream power has been correlated to stream type, and thus provides some indication of the typical channel form and processes associated with the energy.

The calculation of both forms of stream power are as follows:

Total Stream Power (Ω): $\Omega = yQs$ where y is the specific weight of water (9810 N m^3), Q is stream discharge (m^3/s), and s is the energy slope (%).

Specific Stream Power (ω): $\omega = \Omega/w$ where w is channel width (m).

The input parameters needed to quantify the stream power for each channel link are outlined below.

Discharge:

Discharge is a key variable necessary to enable the quantification of stream power. The two-year flow rate was estimated for selected reaches within the study area using an online application developed by the Ministry of Natural Resources, titled *Ontario Flow Assessment Tool* (OFAT). The OFAT application provides the user with an estimate of the flow series at user-selected locations along a drainage

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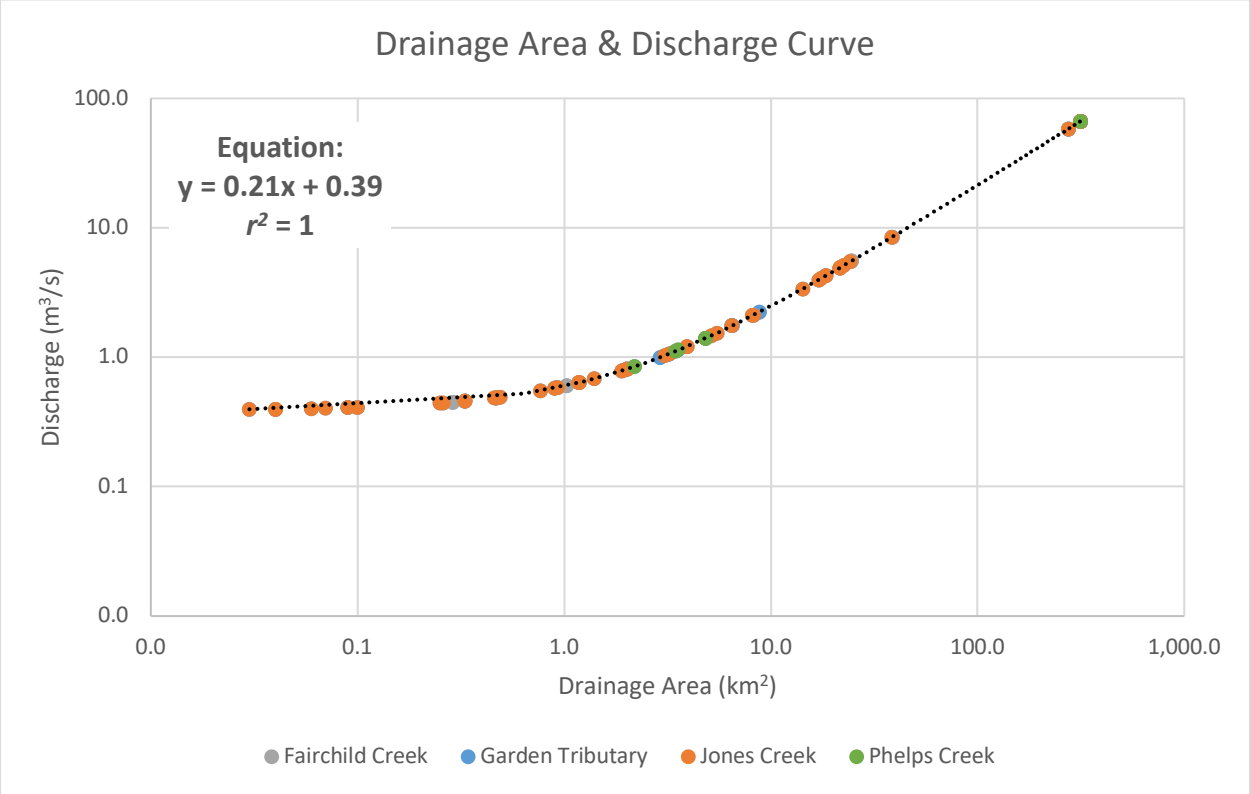
network. Since discharge is a function of drainage area, the two-year flow events were plotted against drainage area (also obtained from OFAT). A 'line of best fit' was derived from the plotted data that could be used to estimate the two-year flow event for each link in the drainage network within the study area.



Slope & Sinuosity:

Both channel slope and sinuosity were derived using the *Stream Gradient and Sinuosity Toolbox* for ArcGIS. Using the channel centreline and a Digital Elevation Model (DEM), slopes were calculated by extracting elevation values along each link of the drainage network. Sinuosity values are calculated by assessing the length of a channel centreline and the straight-line distance between the beginning and end points of a channel link.

Channel Width:

The width of a watercourse is influenced by boundary materials, the rooting network of bankside vegetation, and the magnitude of flow that is conveyed through the watercourse. Empirical relations often estimate channel width based on drainage area when flow rate is not known. An empirical relation was developed to estimate channel width for each channel section within the study area.

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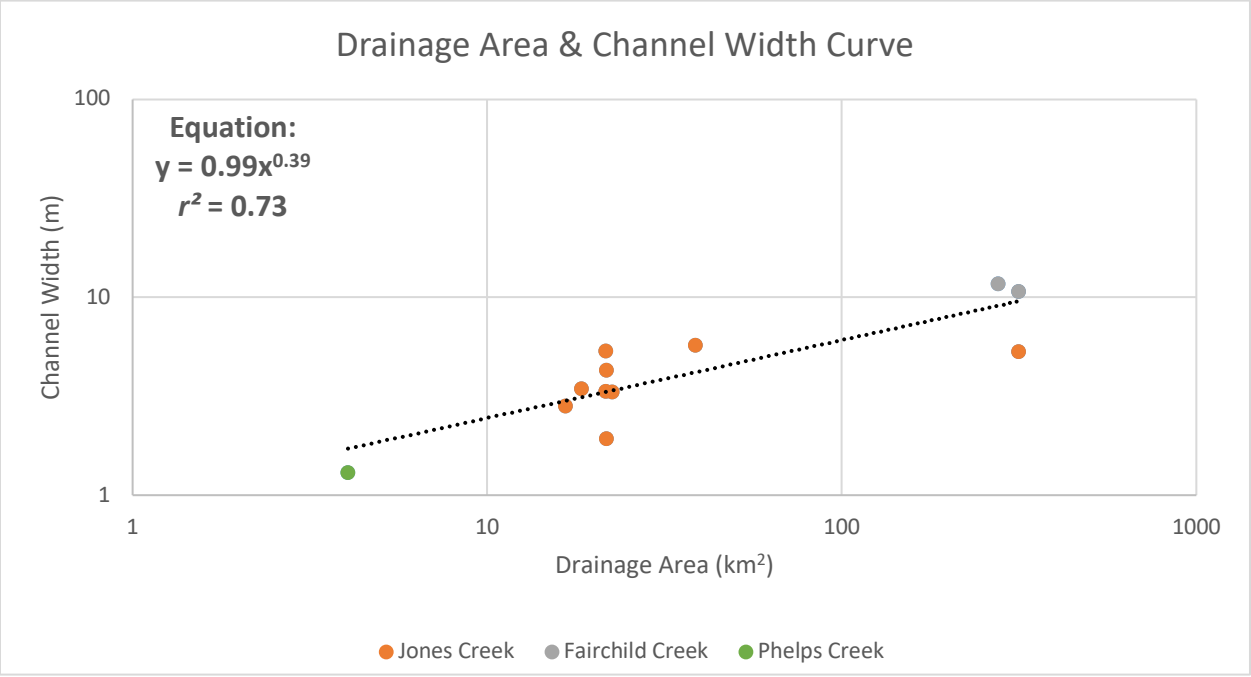
Using the aerial image provided by the City of Brantford, channel width was measured on visible watercourses within the study area. For each channel link, several channel width measurements (approximately 8-10 measurements) were made and averaged. As the limits of each reach were partially controlled by the confluence of a tributary, the widths which were measured remain reflective of the drainage area for that particular reach. A total of twelve channel links were sampled: Jones Creek (8), Fairchild Creek (2), Phelps Creek (2).

The relationship between channel width and drainage area (derived from GIS mapping) was determined by plotting the data onto a graph and fitting a power curve through the data. While this equation is considered sufficiently reliable for the purpose of a high-level overview of channel conditions, further refinement of the methodology (e.g., consider boundary material, surrounding vegetation etc.) is recommended for any other purpose.



Appendix E
Glossary

Appendix E - Glossary

Built-up Area – All lands within the delineated built boundary.

Community Area – Areas designated and used for a range of urban uses including residential, mixed-use, institutional, open space and commercial.

Delineated Built Boundary – The limits of the developed urban area as defined by the Minister of Municipal Affairs and Housing in consultation with affected municipalities for the purpose of measuring the minimum intensification target in this Plan.

Designated Greenfield Area (DGA) – Lands within settlement areas but outside of delineated built-up areas that have been designated in an official plan for development.

Employment Area – Areas designated in an official plan for clusters of business and economic activities including, but not limited to, manufacturing, warehousing, offices, and associated retail and ancillary facilities.

Employment Lands Employment – Refers to industrial-type jobs including, but not limited to manufacturing, research and development, warehousing and distribution and wholesale trade.

Home-Based Employment – People who work from their home.

Major Office Employment – Refers to freestanding office buildings that are approximately 4,000 square meters of floor space of greater.

Minimum Distance Separation Formulae – Formulae and guidelines to determine setback distance between livestock barns, manure storage or anaerobic digesters and surrounding lands with the objective of separating uses to reduce incompatibility concerns related to odour.

Natural Heritage System – Refers to the connected systems of natural features and areas and the lands and waters that link them together.

No Fixed Place of Employment (NFPE) – Refers to workers who are not located at a fixed workplace each day of the year such as construction employees.

Population-Related Employment – Refers to employment that exists in response to or serves a resident population and is not primarily located in Employment Areas. Such employment is typically accommodated within neighbourhoods, downtowns and commercial areas.

Rural Employment – Refers to employment that exists in the City of Brantford outside of the City's current Settlement Area boundary.

Settlement Area – Urban areas and rural *settlement areas* within municipalities that are built up areas where development is concentrated, have a mix of land uses and have been designated in an official plan for development.

Urban Growth Centre – Refers to existing or emerging downtown areas as defined by the Minister of Municipal Affairs and Housing.

Usual Place of Work (UPOW) employment – Refers to workers who are employed at a specific address.