MIDDLESEX CENTRE MASTER SERVICING PLAN – STORMWATER SERVICING UPDATE

April, 2024

Prepared for:
Municipality of Middlesex Centre
10227 Ilderton Road, RR#2
Ilderton, ON N0M 2A0

Prepared by:
Stantec Consulting Ltd.
600-171 Queens Avenue
London, ON N6A 5J7

Project Number:
165630236

The conclusions in the Report titled Middlesex Centre Master Servicing Plan – Stormwater Servicing Update are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from Municipality of Middlesex Centre (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

Prepared by: N. Yokich Digitally signed by Yokich, Nathan Date: 2024.04.22 14:05:10 -04'00' Adobe Acrobat version: 2024.002.20687

Signature

Nathan Yokich, P.Eng., CAN-CISEC.

Reviewed by: K. MacNaughton Macnaughton, Kate 2024.04.22 15:28:40 -04'00'

Signature

Kate Macnaughton, P.Eng.

Approved by: Paul, Jeff Digitally signed by Paul, Jeff Date: 2024.04.22 14:01:40 -04'00'

Signature

Jeff Paul, P.Eng.

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

Acronyms / Abbreviations

Stantec	Stantec Consulting Ltd.
Report	*Middlesex Centre Master Servicing Plan — Stormwater Servicing Update* (Stantec, 2024)
MSP	*Master Servicing Plan*
Municipality of Middlesex Centre	*The Municipality*
MECP	*Ministry of the Environment, Conservation and Parks*
SWM	*Stormwater Management*
Settlement Area Stormwater Master Plan	*Middlesex Centre Settlement Area Stormwater Master Plan* (Stantec, 2020)
Delaware Stormwater Master Plan	*Delaware Community Area Stormwater Master Plan* (Stantec, 2016)
Stormwater Master Plans	*Middlesex Centre Settlement Area Stormwater Master Plan* (Stantec, 2020) and *Delaware Community Area Stormwater Master Plan* (Stantec, 2016)
Official Plan	*Official Plan of the Municipality of Middlesex Centre* (May, 2023)
OMAFRA	*Ministry of Agriculture, Food and Rural Affairs*
MNRF	*Ministry of Natural Resources and Forestry*
UTRCA	*Upper Thames River Conservation Authority*
LTVCA	*Lower Thames Valley Conservation Authority*
SAR	*Species at Risk*
ESA	*Endangered Species Act*
EIS	*Environmental Impact Study*
ECA	*Environmental Compliance Approval*
CLI	*Consolidated Linear Infrastructure*
LID	*Low Impact Development*
OGS	*Oil-Grit Separator*

1 Introduction

Stantec Consulting Ltd. (Stantec) was retained by the Municipality of Middlesex Centre (the Municipality) to update its Master Servicing Plan (MSP), which was last updated in 2010. The MSP considers the Municipality's water, wastewater, stormwater and solid waste infrastructure. The MSP aims to be a roadmap to guide the Municipality's future infrastructure decisions, considering existing and future conditions over a 20-year horizon.

Planning for each component is addressed in a separate report which are then compiled and summarized in the Master Servicing Plan. This report addresses the Stormwater component of the overall MSP.

1.1 Background

Stantec previously completed the *Middlesex Centre Settlement Area Stormwater Master Plan* (*Settlement Area Stormwater Master Plan)* in July 2020 the *Community Stormwater Master Plan Update* in October 2023 and the *Delaware Community Area Stormwater Master Plan* (*Delaware Stormwater Master Plan*) in February 2016. As these reports were completed recently, this report expands upon the previously presented information as required and addresses areas of concern which were not included in previously completed studies. Specifically, the Municipality completed an Official Plan update in 2023 which brought some new lands into the settlement boundaries of the various communities and revised some land use designations. This report, therefore, focusses largely on these areas which are considered new stormwater service areas subsequent to the previous studies.

The previous reports and corresponding appendices can be downloaded through the Middlesex Centre website: https://www.middlesexcentre.on.ca/services/residents/stormwater

The following Background Documents have been uses in the preparation of this report:

- *The Soils of Middlesex County (Volume 1 and 2),* Ministry of Agriculture and Food, 1992.
- *Delaware Community Settlement Area Stormwater Master Plan,* Stantec, 2016.
- *LTVCA Regulations and Planning Policy and Procedure Manual*, Lower Thames Conservation Authority, 2016.
- Functional SWM Report, Land Development Solutions (LDS), April 2016.
- *Middlesex Centre Settlement Area Stormwater Master Plan*, Stantec, July 2020.
- *Middlesex Centre Foreign Direct Investment – Servicing Feasibility Report*, Stantec Consulting Ltd., January 31, 2022.
- *AgMaps;* Ministry of Agriculture, Food and Rural Affairs (OMAFRA), 2023.
- *Ontario GeoHub,* Land Information Ontario, 2023.

- *Ontario Watershed Information Tool; Natural Heritage Areas*, Ministry of Natural Resources and Forestry (MNRF), 2023.
- *Official Plan of the Municipality of Middlesex Centre,* Municipality of Middlesex Centre, March 2023.
- *Community Stormwater Master Plan Update,* Stantec, 2023.

2 Existing Conditions

Existing conditions of stormwater management (SWM) infrastructure was documented in both the *Settlement Area Stormwater Master Plan* and the *Delaware Stormwater Master Plan.* A summary of the existing conditions presented in each of the Stormwater Master Plans is provided in the sections below.

2.1 *Settlement Area Stormwater Master Plan Existing Conditions*

The *Settlement Area Stormwater Master Plan* focused on ten (10) settlement areas within Middlesex Centre. The settlement areas included in the study were:

- Arva
- Ballymote
- Birr
- Bryanston
- Denfield
- Ilderton
- Komoka
- Kilworth
- Lobo
- Melrose

Section 3.4 of the *Settlement Area Stormwater Master Plan* detailed existing drainage conditions within each of these settlement areas and Section 3.5 highlighted the key issues identified through the study. Table 1 summarizes the key issues identified.

Table 1: 2020 *Settlement Area Stormwater Master Plan* Summary of Key Issues

Catchment Area	Key Issue					Alternative Evaluation Required (Y/N)
	Surface Flooding Risk	Future Development Servicing	Existing Municipal Drains	Conveyance System Issues	Issues with Outlet Availability	
Arva – Built-Up Area	X		X			N
Arva – Development Area		X				Y
Ballymote		X	X	X		Y
Birr	X	X		X		N
Bryanston	X	X	X	X		N
Denfield	X	X		X		N
Ilderton Drain No. 1		X	X	X		N
Ilderton Drain No. 2		X	X			Y
Ilderton Drain No. 3		X	X	X		N
South Ilderton Development Area		X	X			Y

Table 1: 2020 *Settlement Area Stormwater Master Plan* Summary of Key Issues

Catchment Area	Key Issue					Alternative Evaluation Required (Y/N)
	Surface Flooding Risk	Future Development Servicing	Existing Municipal Drains	Conveyance System Issues	Issues with Outlet Availability	
Komoka Drain No. 1		X	X		X	Y
Komoka Drain No. 2	X		X			N
Komoka Drain No. 3		X	X			Y
Valleyview Subdivision						N
West Komoka Development Area		X				Y
Northeast Komoka Development Area		X			X	Y
Kilworth Glendon Drive Area		X			X	Y
West Kilworth Development Area		X				N
Jefferies Road Outlet		X	X			N
Kilworth Park Drive Outlet (Kilworth East)		X		X		Y
Blackburn Crescent Outlet	X		X			N
Lobo		X			X	N
Melrose	X	X	X			Y
Poplar Hill/Coldstream	X	X	X	X		N

2.1.1 2022 EXISTING CONDITIONS – SETTLEMENT AREAS

The following areas have been identified as areas where development has progressed since the completion of the *Settlement Area Stormwater Master Plan.*

2.1.1.1 Northeast Ilderton Development Area (Clear Skies Subdivision)

The SWM facility has been constructed and house construction is ongoing. Area grading has been completed for most of the subdivision with streets and servicing only completed for the initial phases in the south. No concerns relating to stormwater discharges from the SWM facility have been presented to

Stantec at the time of the writing of this report. Erosion and sediment controls during construction have been ongoing.

2.1.1.2 South Denfield Development Area (Denfield Estates)

Partial build-out of ten (10) estate lots fronting on Denfield Road at the south end of the hamlet of Denfield has occurred. Due to the nature of the lots (i.e., estate lots) and minimal hydrologic impacts of the development on Nairn Creek, no formal stormwater infrastructure has been constructed as part of this development. No concerns relating to SWM have been presented to Stantec at the time of the writing of this report.

2.1.1.3 Komoka Glendon Drive Area

A mixed residential development (town home and single family) at the west edge of the Komoka Glendon Drive area has been fully built out. SWM from this development outlets to a pond feature adjacent to Komoka Road, south of the Glendon Drive intersection. Discussions have been undertaken between several stakeholders the Municipality and Stantec regarding the construction of the stormwater facility proposed in the *Settlement Area Stormwater Master Plan* which services these lands. As a result of those discussions the *Community Stormwater Master Plan Update* was completed and issued which revised the discharge location of the facility to discharge directly to the Thames River. It is our understanding that the Municipality intends to proceed to design and construction of this facility in the immediate future.

2.1.1.4 West Kilworth Development Area

Most lands within the West Kilworth Development Area have been graded and serviced for ongoing residential development. A SWM facility at the south end of the site outlets to a tributary to the Thames River. No concerns relating to SWM have been presented to Stantec at the time of the writing of this report.

2.2 Delaware Stormwater Master Plan (Stantec, 2016)

The *Delaware Stormwater Master Plan* was completed prior to the *Settlement Area Master Plan*, and therefore was excluded from the most recent study. Section 5.3 of the *Delaware Stormwater Masterplan* detailed existing drainage conditions, and Section 5.4 highlighted the key issues identified through the study. Table 2 summarizes the key issues identified.

Table 2: 2016 Delaware Stormwater Master Plan Summary of Key Issues

Catchment Area	Key Issue					
	Surface Flooding	**Groundwater**	**Future Development Servicing**	**Municipal Drain**	**Capacity**	**Infrastructure Location**
Prior Drain	**X**			**X**		
Forsythe Drain				**X**	**X**	**X**

Table 2: 2016 Delaware Stormwater Master Plan Summary of Key Issues

Catchment Area	Key Issue					
	Surface Flooding	Groundwater	Future Development Servicing	Municipal Drain	Capacity	Infrastructure Location
Longwoods Road Storm Sewer #1						
Pleasant Street Culvert						
Mill Street Development Storm Sewer	X		X			
Hilcrest Drain (part of Forsythe Drain)				X		
Garden Avenue Drain (part of Forsythe Drain)		X		X		
Prince Albert Street Drain (part of Forsythe Drain)				X	X	
Longwoods Road Storm Sewer #2						
Thompson Drain	X	X		X	X	
Hog Back Close Storm Sewer					X	
Harris Road Culvert			X		X	
Longwoods Road Culvert			X			
Cummings Drain	X		X	X	X	
Blosdale Court Storm Sewer						
Springer Road Storm Sewer						
Tower Heights Storm Sewer	X	X				
Springer Road Drain			X	X	X	
Millmanor Place Storm Sewer (part of Forsythe Drain)						

Table 2: 2016 Delaware Stormwater Master Plan Summary of Key Issues

Catchment Area	Key Issue					
	Surface Flooding	Groundwater	Future Development Servicing	Municipal Drain	Capacity	Infrastructure Location
Davis Street Drain (part of Forsythe Drain)				X		X

2.2.1 2022 EXISTING CONDITIONS - DELAWARE

The following areas have been identified as areas where development has progressed since the completion of the *Delaware Stormwater Master Plan*.

2.2.1.1 Martin Road

New single family residential houses front the east side of Martin Road, from Longwoods Road to Wellington Street. Based on a review of the current conditions no SWM controls specific to the construction of these houses are evident. It was noted in the *Delaware Stormwater Master Plan* that the new development will be serviced through SWM infiltration measures.

2.3 New Study Areas

Subsequent to the completion of the *Stormwater Master Plans*, the Municipality embarked on an update to their Official Plan which was subsequently approved in 2023. This update brough some new lands into the settlement boundaries of the various settlement areas. In addition, drainage concerns in the Old Kilworth area were identified as requiring further study. These additional study areas as outlined in the following sections are the subject of this report. Existing condition Stormwater figures for the new study areas are provided in **Appendix B**.

2.3.1.1 Old Kilworth

The Old Kilworth development area is comprised of single-family residential lots located on the East end of Kilworth. Old Kilworth development area includes the lots adjacent to Elmhurst St. and Beechnut St. and is bounded by Parkland Pl. at the northern limits. Surface runoff from this area is conveyed by rural cross-sections, including grassed roadside ditches. Runoff is subsequently conveyed to concrete ditches that outlet to Thames River via a culvert at the end of Kilworth Park Dr.

Through the *Settlement Area Stormwater Master Plan* public consultation process, residents of the Old Kilworth Development Area provided a letter that indicated drainage issues beginning at the midpoint of Elmhurst St. and Beechnut St. In addition, the residents believe that the drainage issues may be exacerbated by the prospective development around upper Elmhurst St. if not addressed. The letter from the residents is provided in **Appendix A**. This report includes an evaluation of alternative SWM solutions

to alleviate drainage issues exacerbated by the road right-of-way runoff along Beechnut St. and Elmhurst St.

2.3.1.2 West Komoka

The West Komoka Development Area is primarily comprised of agricultural land bounded by Glendon Drive and the CN Railway on the south and north limits, respectively. Four rural properties abut the north side of Glendon Dr. from Amiens Rd. to the current Komoka Village boundary. Komoka Creek bisects the West Komoka study limits, and the flow runs from the northwest to southeast, crossing Glendon Drive. Komoka Creek is identified as a sensitive coldwater stream (Stantec, July 2020). The section of Komoka Creek within the study area is also identified as a Class D Municipal Drain (Crow Creek) per OMAFRA mapping. The Upper Thames River Conservation Authority (UTRCA) regulation area buffer extends along Komoka Creek and into the agricultural area. The Komoka/South Strathroy Creek Wetland is identified as Provincially Significant (PSW) and the boundary is irregularly offset from the Komoka Creek alignment within the study limits. An existing pond is situated along the east side of the Komoka Creek overbank at the north end of the study limits.

Runoff from the eastern portion of this catchment travels as overland flow westerly, toward Komoka Creek. Runoff from the western portion of this catchment travels southward to the existing Glendon Dr. ditching and is subsequently conveyed through the existing culvert crossings. Given the local sandy soils, flat topography, and absence of a defined overland flow route, The *Settlement Area Stormwater Master Plan* assumed that a large percentage of runoff through the catchment infiltrates into the ground. No tile drainage records exist for the agricultural lands within the study limits per the Ontario GeoHub Database.

Komoka Drain No.2, as identified in the *Settlement Area Stormwater Master Plan,* flows in a westerly direction, parallel with the northern study limits. The Komoka Drain No.2 drainage area is primarily developed with single family residential homes. Peak flow control and water quality treatment was not documented for the drainage area; therefore, it is assumed that runoff is conveyed uncontrolled to the Drain. Runoff from the Prince Street Subdivision, upstream of the West Komoka study area, is conveyed to an existing SWM pond which provides all necessary stormwater treatment. The pond has no surface water outlet and was designed for all flows up to and including the 250-year storm to be infiltrated and evaporated.

2.3.1.3 South Komoka

The South Komoka study area is identified as the southern portion of the Komoka Drain No. 1 catchment area within the *Settlement Area Stormwater Master Plan*. The Official Plan has since been amended, and three (3) additional areas have been assigned a residential land use designation within the South Komoka study area. This report will consider the stormwater servicing for the additional (3) prospective development areas. Furthermore, the preferred SWM solution for the Komoka Drain No. 1 catchment area was updated in 2023 in report titled *Community Stormwater Master Plan Update,* available on the Middlesex Centre website.

The study area is bounded by Glendon Drive (north), Queen Street (east), Komoka Road (west) and the Komoka Provincial Park boundary (south). A series of privately owned ponds currently occupy the

majority of the study area. Per the *Settlement Area Stormwater Master Plan,* the ponds located east of Komoka Road are connected by small diameter CSP culverts, and an outlet structure conveys water from the Komoka Provincial Park Pond directly to the Thames River. Ontario Parks personnel have observed the culverts to be currently blocked, and an overland flow route has formed that conveys the pond overflows southward. The outlet structure at the Komoka Provincial Park Pond was recently reconstructed with a stoplog arrangement that allows the pond depth to be controlled. Ontario Parks is planning to reduce the normal water level in its pond to provide separation from the neighboring privately owned pond.

The north potential development area is currently occupied by an outdoor driving range. The two south potential development areas are primarily comprised of agricultural lands and one rural property is located on the southwest edge of the settlement boundary, abutting Komoka Road.

Topography throughout the study area is generally flat. Runoff drains overland to the on-site privately owned ponds and the Komoka Provincial Park Pond south of the study area. A portion of the pond at the southwest corner of the study area is identified as a PSW and encroaches into the settlement boundary. The privately owned ponds and the Komoka Provincial Park is regulated by Upper Thames River Conservation Authority UTRCA.

2.3.1.4 Delaware Employment Lands

Under existing conditions, the Delaware Employment Lands study area consists primarily of agricultural lands. The study area is bounded by Springer Rd., Longwoods Rd., Carriage Rd. and Highway 402. Rural residential properties are located scattered along the study area boundaries. The study area sits on the drainage divide of the Dingman Creek Subwatershed and the Northwest Lower Thames Subwatershed.

The Tower Heights Subdivision (Site) is located on the northwest corner of the study area. An existing storm sewer system conveys flows to downstream OGS units and subsequently discharges to Thames River, west of the Site. The major overland flow route on the south end of the Site is routed through agricultural lands to the south. Tile drainage exists for the agricultural lands within the study limits south of the Tower Heights development per the Ontario GeoHub Database.

The study area exhibits a generally low gradient topography with slightly higher elevations in the northeast corner of the study area. The topography indicates runoff predominately discharges overland to two (2) watercourses that bisect the site and reach a confluence approximately 350m east of Springer Rd. The north unnamed watercourse is a headwater tributary of Thames River. A portion of the south watercourse upstream of (i.e., east of) the study area is identified as the Elviage Municipal Drain before it transitions to a natural watercourse, upstream of the confluence. Elviage Municipal Drain is not classified within the study area. Both watercourses have a permanent flow regime and flow in a westerly direction before discharging into a series of small ponds, downstream of the confluence, within the study area. The combined watercourse / pond system crosses Springer Road prior to crossing Highway 402 downstream. South of Highway 402, the watercourse continues in a southwesterly direction before discharging directly into the Thames River.

2.3.1.5 East Delaware

The Cummings Drain and Allison Drains, located within the East Delaware study area, are classified as Class F municipal drains under the Drainage Act indicating that the watercourses flow regime is intermittent. The *Delaware Stormwater Master Plan* considered potential development within the Cummings Drain catchment area; however, the official plan has since been amended, expanding the residential settlement boundary east of Martin Road to the existing Golf Course property. This report will consider the expanded settlement area, designated as Special Policy Area #29 in the *Official Plan*.

The study area is bounded by the ongoing development adjacent to Martin Road to the west, Harris Road to the north, and Longwoods Road at the south. Under existing conditions, the study area is comprised of agricultural, woodlots, ponds and low-density residential properties. The Cummings Drain and Allison Drain headwaters extend into the study area boundary. As a result, a large portion of the study area is within the UTRCA regulated area. Aquatic Species at Risk (SAR) have been identified in Cummings and Allison Drain.

The existing site runoff generally slopes south towards Cummins Drain with a portion of the north area draining north to the Allison Drain Extension. Localized low-points exist within the study area and there are several ponding areas along the Cummings Drain alignment.

3 Alternative Solution Determination

3.1 Applicable Standards and Design Guidelines Documents

The following standards and design guidelines were referenced in the preparation of this analysis:

- *Stormwater Management Planning and Design Manual (SWMPDM)*, Ministry of Environment Conservation and Parks (formerly Ministry of Environment), March 2003.
- *Low Impact Development Stormwater Management Planning and Design Guide (LID Manual)*, Credit Valley Conservation and Toronto and Region Conservation Authority, 2010.
- *Stormwater Management Policy Manual Municipality of Middlesex Centre*, Stantec Consulting Ltd., June 2011.
- *Middlesex Centre Infrastructure Design Standards*, Municipality of Middlesex Centre, January 2018.
- *Erosion and Sediment Control Guide for Urban Construction*, Toronto and Region Conservation Authority, 2019.
- *Dingman Creek Subwatershed: Stormwater Servicing Study*, Aquafor Beech Limited, September 2020.
- *LID SWM Planning and Design Guide (LID Manual)*, Sustainable Technologies Evaluation Program, June 2023.

3.2 Stormwater Design Criteria and Key Objectives

The following study objectives were developed to provide a framework of the stormwater design criteria for each of the key issues previously noted, specific to the existing drainage systems. The objectives were used in the development of alternative solutions and will become part of the evaluation criteria discussed in Section 6.

- **Surface Flooding** – The Master Plan will provide solutions to mitigate potential for surface flooding that threatens property or public safety. The Middlesex Centre design standards state that maximum design ponding depths are 300 mm on roadways and 450 mm at rear yard catchbasins. These depths are to be used as targets in the Master Plan.
- **Groundwater** – Homes where sump pumps run frequently were likely designed without adequate consideration for the local groundwater elevations. Urban stormwater systems are typically designed to collect and convey surface runoff from rainfall events to mitigate the possibility of surface flooding. Collecting subsurface water to lower local groundwater elevations and reduce the use of residential sump pumps is not usually considered a responsibility of the municipality. Further detailed design phases may consider localized opportunities to mitigate high groundwater impacts where feasible;

however, consideration for overall water balance and impact to receiving watercourses are recommended to be reviewed in conjunction with this assessment.

- **Future Development Servicing** – Areas of future development require adequate downstream storm drainage servicing to convey post-development runoff and to mitigate downstream flooding. The Master Plan identifies measures to control peak flows to pre-development magnitudes for all storms up to and including the 100-year event, consistent with the Municipality's design standards. Furthermore, opportunities to mitigate surface water problems in existing developed areas by providing additional capacity in the future storm infrastructure will be identified. Additionally, future stormwater servicing infrastructure is to provide Ministry of the Environment, Conservation and Parks (MECP) 'Enhanced' water quality control to the runoff from all new development.

- **Municipal Drains** – Drainage servicing in many areas is provided by municipal drains, established and maintained through the provisions of the *Drainage Act*. Municipal drains are typically constructed to address drainage concerns in rural or agricultural areas, and thus typically have insufficient capacity to convey peak discharges within developed areas. Additional complications include access for maintenance and procuring funding for maintenance. The Master Plan provides recommendations for instituting a consolidated and sustainable approach to the funding and maintenance of stormwater drainage within the Settlement Area.

- **Conveyance/Capacity** – In accordance with the Middlesex Centre design standards, all proposed minor storm drainage systems presented in the Master Plan are to be designed to convey the peak runoff from the 2-year design storm event and all proposed major storm drainage systems are to be designed to convey the peak runoff from the 100-year design storm event.

- **Outlet Availability** – Within a number of catchment areas throughout the Municipality, existing storm drainage outlets are not conveyed through municipally controlled lands. This presents a challenge, particularly within areas of future development. Establishing new outlets must have regard for downstream capacity, sensitive habitats, and erosion and sedimentation.

3.3 Baseline Conditions

A desktop review of the existing drainage performance was conducted to determine the baseline parameters and target levels of service for the five (5) new study areas.

3.3.1 OLD KILWORTH

A SWM strategy is required to improve the existing drainage conditions along Elmhurst St. and Beechnut St. The Old Kilworth drainage area was included in the Kilworth East catchment area presented in the *Settlement Area Stormwater Master Plan;* however, the solutions presented have been reviewed and updated in this report to alleviate the drainage issues noted from residents.

The SWM measures proposed within this catchment area are required to mitigate drainage issues from initial conditions to a reasonable extent as there are no existing SWM controls present. No original development plans nor as-built information is available for the Old Kilworth development.

Key Issues and Considerations

- Residents indicate the existing drainage system is inadequate. Review of available imagery indicates this may be a result of:
    - Shallow slope of roadside ditching and lack of a formal outlet;
    - Blockage of culverts at driveways;
    - Low gradient system including insufficient lot grading;
    - Potential high groundwater table during saturated conditions; and
    - Landscaping adjustments blocking and/or filling roadside ditches and culverts
- The Middlesex Soils Survey suggests that the local soils are primarily comprised of Caledon fine sandy loam. The high permeability potential of this soil may provide opportunities to treat stormwater using infiltration methods provided that local groundwater levels are sufficiently low.
- Landowner education should be considered to advise the landowners that filling ditches and blocking culverts in their lot frontage will exacerbate the drainage issues.

3.3.2 WEST KOMOKA

Runoff from this future development area will generally travel as overland flow to Komoka Creek, which was classified as a sensitive coldwater fishery. A SWM strategy is required to treat the runoff from future development in accordance with the following SWM criteria:

- Provide Enhanced water quality control to remove 80% of TSS from stormwater runoff;
- Attenuate the peak discharges from all design events up to and including the 100-year storm to predevelopment conditions; and
- Incorporate temperature mitigation measures to reduce future potential for impacts to the Komoka Creek coldwater fishery.

The SWM criteria are subject to change following pre-consultation with UTRCA, municipality of Middlesex Centre, MECP and other stakeholders.

There is an opportunity to provide stormwater treatment to the runoff from both the future Glendon Drive improvements and existing development conveyed by Komoka Drain No. 2, which currently discharges untreated runoff to Komoka Creek.

The existing outlet for the western portion of the catchment is the existing Glendon Drive culvert, and the upstream topography is relatively flat. Using the Drainage Act to construct a new outlet to convey stormwater from the downstream side of the Glendon Drive culvert to Komoka Creek was considered.

However, the UTRCA noted that this outlet strategy could exacerbate existing erosion concerns on the downstream properties (Stantec, July 2020).

Key Issues and Considerations

- A SWM strategy is required to convey and treat the runoff from the proposed development area and proposed Glendon Drive Improvements.
- Future development has the potential to provide opportunities to treat runoff from Komoka Drain No. 2.
- The sensitivity of the cold-water species in Komoka Creek must be considered in SWM strategy.
- The municipal drains within the settlement area are recommended to be abandoned in accordance with the provisions of Section 84 of the Drainage Act. It is assumed that the drains within the settlement area will be abandoned during future development activities.
- The Middlesex Soils Survey suggests that the local soils are primarily comprised of Caledon and Plainfield fine sandy loams. Since the permeability of these soils tends to be high, SWM treatment using infiltration methods may be feasible in this area, provided that local groundwater levels are sufficiently low.
- This area is designated as Settlement Employment area in the Official Plan.

3.3.3 SOUTH KOMOKA

Under existing conditions, runoff from the future development areas drain to the on-site private ponds and south to the Komoka Provincial Park Pond. It is understood that the previous land use of the study area was an aggregate pit / quarry. A SWM strategy is required to treat runoff from future development in accordance with the following SWM criteria:

- Provide Enhanced water quality control to remove 80% of TSS from stormwater; and
- Attenuate the peak discharges from all design events up to and including the 100-year storm to predevelopment rates

The SWM criteria are subject to change following pre-consultation with UTRCA, the municipality of Middlesex Centre, MECP and other stakeholders. Due to the presence of the PSW, it is anticipated that an Environmental Impact Study (EIS) will be required for the study area prior to development. For areas discharging to Komoka Park Provincial Park, a Provincial Parks and Conservation Reserves Class Environmental Assessment may be required.

Key Issues and Considerations

- A SWM strategy is required to convey and treat the runoff from the proposed development area and proposed.

- The south portion of the study area is designated as residential area in the Official Plan.
- The Middlesex Soils Survey suggests that the local soils are identified as not mapped, thus the soils are assumed to be similar to adjacent developments. The adjacent Edgewater Development suggests that the subsurface soils consist of sandy silt which correspond to hydrologic soil groups A to B (LDS, 2016). Since the permeability of these soils tends to be high, SWM treatment using infiltration methods may be feasible in this area, provided that local groundwater levels are sufficiently low.

3.3.4 DELAWARE EMPLOYMENT LANDS

Under existing conditions, runoff from the future development area generally travels as overland flow to the existing unnamed watercourse discussed in Section 2.3.1.4. A SWM strategy is required to treat runoff from future development in accordance with the following SWM criteria:

- Provide Enhanced water quality control to remove 80% of TSS from stormwater; and
- Attenuate the peak discharges from all design events up to and including the 100-year storm to predevelopment rates.

The proposed development is located on the divide of the UTRCA and LTCVA regulation boundary. As a result, the SWM criteria are subject to change following pre-consultation. It is anticipated that an EIS will be required for the study area prior to development. A legal outlet from the development to the existing Elviage municipal drain may be required under the provisions of the drainage act.

Key Issues and Considerations

- A SWM strategy is required to convey and treat runoff from the proposed residential and employment development areas.
- The aquatic and terrestrial habitat associated with the receiving watercourse must be considered in SWM strategy.
- Tile Drains are mapped within the study area indicating a history of high groundwater levels.
- The municipal drains within the employment lands are recommended to be abandoned in accordance with the provisions of Section 84 of the Drainage Act. It is assumed that the drains within the settlement area will be abandoned during future development activities.
- The Middlesex Soils Survey suggests that the local soils are generally comprised of Caledon and Bookton sandy loams north of the watercourse and Muriel Silty Clay loam south of the watercourse. Since the of these soils are moderately well drained, SWM treatment using infiltration methods may be feasible in this area, provided that local groundwater levels are sufficiently low.
- The area is designated as SPA #29 with a combination of Residential and Settlement Employment area in the Official Plan.

3.3.5 EAST DELAWARE

Under existing conditions, runoff from the future development area generally travels as overland flow to the existing Cummings Drain watercourse. The Cummings Drain and Allison Drain confluence is located in the adjacent golf course property and ultimately discharges to Dingman Creek. As a result, any future development will be in accordance with the Dingman Creek Subwatershed Study. A SWM strategy is required to treat the runoff from future development in accordance with the following SWM criteria:

- Control the runoff from the 25mm event or provide end-of-pipe treatment to achieve Enhanced water quality control to remove 80% of TSS from stormwater; and
- Attenuate the peak discharges from all design events up to and including the 100-year storm to predevelopment rates.

The proposed development is located within the UTRCA regulation boundary. As a result, the SWM criteria are subject to change following pre-consultation. It is anticipated that an EIS will be required for the study area prior to development to determine the potential impacts and outline environmental objectives. A legal outlet from the development to the existing Cummings Municipal Drain may be required under the provisions of the drainage act.

Key Issues and Considerations

- A SWM strategy is required to convey and treat the runoff from the proposed development area.
- Aquatic Species at Risk (SAR) have been identified in Cummings and Allison Drain and as such the sensitive nature of the receiving watercourses must be considered in SWM strategy.
- The municipal drains within the settlement area are recommended to be abandoned in accordance with the provisions of Section 84 of the Drainage Act. It is assumed that the municipal drains within the settlement area will be abandoned during future development activities.
- The Middlesex Soils Survey suggests that the local soils are primarily comprised of Colwood loam and Fox and Caledon sandy loams. The permeability of the soils is rated to be high to poor. Therefore, SWM treatment using infiltration methods may be feasible in this area, provided that local groundwater levels are sufficiently low.

4 Development of Alternative Solutions

Phase 2 of the previous *Stormwater Master Plans* provided alternative SWM solutions for the key issues identified throughout the settlement areas within Middlesex Centre. As a part of this report, conceptual alternative solutions were established for the additional study areas, including Old Kilworth, West Komoka, South Komoka, Delaware Employment Lands and East Delaware. It should be noted that the footprint of the SWM Facilities displayed on the alternative solutions figures are estimated based on the contributing land area and are not representative of the actual required footprint.

4.1.1 OLD KILWORTH

Alternative 1 – Do Nothing

Residents of Beechnut St. and Elmhurst St. will continue to experience drainage issues along the road right-of-way. Drainage issues may worsen from future development plans located upstream of Beechnut St. and Elmhurst St.

Alternative 2 - Enhanced ditching

With this alternative, the existing ditching within the Beechnut St., Elmhurst St. and Blackburn Cr. right-of-ways would be enhanced to convey runoff from minor and major flow events to the existing downstream outlet at Kilworth Park Dr. Additional Entrance and Centerline culverts would be added where required.

The existing roadside ditches along Blackburn Cr. would be replaced with widened grassed bottom ditches to accommodate the additional concentrated runoff, provide water quality treatment and attenuate the proposed peak discharges to pre-development magnitudes. Concrete lined ditches are removed and the ditches will be regraded and seeded. The proposed ditches are significantly wider than the existing concrete lined ditches to provide sufficient capacity to convey the peak flows and a stable cross-section that mitigates erosion. The proposed ditches may encroach beyond property lines and result in tree removals. Regular ditch maintenance will be required to monitor sediment accumulation and excessive vegetation.

Alternative 3 - Bioswales

Under this alternative, bioswales would be implemented where feasible within the road right-of-ways. The bioswales would be designed to collect runoff from minor storm events within the adjacent lots and road right-of-ways to be infiltrated. Overflows would be implemented to bypass the filter bed media and be conveyed downstream during a large storm event. Ultimately the bioswales would provide water quality treatment and quantity control for frequent storm events.

Alternative 4 – Urbanized Road Cross-section with a Formal Outlet

This alternative would convey all minor storm runoff through an urbanized road cross-section within the Beechnut St., Beechnut Pl., Parkland Pl, Elmhurst St., Blackburn Cr., and a portion of Kilworth Park Dr. rights-of-way. The urbanized cross-section would include a curb and gutter and storm sewer network to

provide minor storm conveyance. Existing roadside ditching would also be enhanced to provide major storm flow conveyance. The urbanized cross-section may necessitate an alteration of the road profile and encroachment on adjacent properties to accommodate the requisite storm sewer cover and adjacent lot grading. It is anticipated that the existing outlet at Kilworth Park Dr., through the Kilworth Flats, would be retrofitted to accommodate the storm sewer outlet.

4.1.2 WEST KOMOKA

Alternative 1 – Do Nothing

In this alternative, runoff from future development in the West Komoka Development Area will be conveyed directly to Komoka Creek without treatment. This alternative does not meet the SWM control targets for this area and will not meet development application requirements.

Alternative 2 –SWM Wet Facilities – Control Runoff from Komoka Drain No. 2

Under this alternative, the developments would be constructed with an urban / semi-urban cross-section for minor and major overland flow routes to be directed through the road right-of-way and via storm sewers to two (2) SWM wet facilities. The proposed SWM facilities, SWM Facility 1 and SWM Facility 2, would provide all necessary water quantity and water quality control for the proposed development areas. Both SWM facilities would be designed to provide the requisite permanent pool and extended detention volumes and include sediment forebay(s). Measures such as reverse sloped outlet pipes and connection of outlets to cooling trenches are recommended to be considered at the design stage to limit temperature impacts Komoka Creek.

The east SWM Facility (1), for the proposed development located east of Komoka Creek will provide sufficient capacity to accommodate the runoff from Komoka Drain No. 2 and the Glendon Dr. improvements. The east SWM Facility (1) will intercept runoff from Komoka Drain 2 and outlet back into the drain downstream of the SWM pond.

The west SWM Facility (2) will outlet to a proposed storm sewer located on Glendon Dr. and subsequently to Komoka Creek.

Should infiltration be required for the development, there is opportunity for infiltration facilities to be implemented at/downstream of the outlet of each SWM pond.

Salt management plans are required to reduce the possibility of road salt entering the proposed infiltration facilities to prevent groundwater contamination. The proposed dry SWM facilities ultimately outlet to Komoka Creek.

Alternative 3 –SWM Wet Facilities – Komoka Drain No. 2 Remains Untreated

Similar to alternative 2, the developments would be constructed with an urban / semi-urban cross-section and two end of pipe Wet SWM facilities. Under this alternative the east SWM Facility (1) will be located adjacent to, and outlet directly to, the Komoka Creek valley via an outfall. Runoff from Komoka Drain

No. 2 will continue to drain directly to Komoka Creek. The west SWM Facility (2) will be in the same location as alternative 2.

Salt management plans are required to reduce the possibility of road salt entering the proposed infiltration facilities to prevent groundwater contamination. The proposed dry SWM facilities ultimately outlet to Komoka Creek.

Alternative 4 – LID Controls and Dry End-of-Pipe Facilities

Alternative 3 would include a combination of Low Impact Development (LID) measures and two dry ponds. This alternative would require semi-urban cross-sections to allow for LID controls within the road right-of-way. A treatment train approach using distributed, or lot-level controls would be applied upstream of the dry SWM facilities to reduce suspended sediment loading and achieve water quality criteria. Lot level controls include most LID measures such as bio-retention areas (bio-swales), tree pits, vegetated conveyance systems such as grassed swales, vegetated buffer strips, and filter strips. These controls provide passive water quality treatment, primarily filtering sediments and heavy metals prior to out-letting. Additional treatment can also be provided with the use of enhanced grass swales with permanent rock check dams to reduce flow velocities and allow finer sediment to settle. Distributed infiltration measures and engineered infiltration systems such as infiltration trenches, porous pavements, and sand filters provide water quality and water quantity benefits while also contributing to groundwater recharge.

Salt management plans are required to reduce the possibility of road salt entering the proposed infiltration facilities to prevent groundwater contamination. The proposed dry SWM facilities ultimately outlet to Komoka Creek.

4.1.3 SOUTH KOMOKA

Alternative 1 – Do Nothing

In this alternative, runoff from future developments in the South Komoka development area is conveyed directly to the private ponds or southward to the Komoka Provincial Park Pond without treatment. This alternative does not meet the SWM control targets for this area and will not meet development application requirements.

Alternative 2 – On-site LID Controls

Under this alternative, the future development lands will be serviced primarily with on-site LID controls. The LID controls would provide all the necessary SWM control to achieve water quantity, water quantity, and potential water balance requirements. Should the development's require additional water quality control, upstream engineered controls such as oil-grit-separators or catchbasin can be integrated into the treatment train.

As water quantity will primarily be controlled via infiltration measures, a provisional outlet is recommended to be provided in the event of LID control fail and to accommodate runoff generated during infrequent storm events. Per the *Community Stormwater Master Plan Update*, there is potential to integrate the

future development provisional outlets to the proposed storm sewers as part of the Glendon Drive improvements and the proposed storm sewer outlet to the Thames River.

Alternative 3 – Wet SWM Facilities

Under this alternative, the future development lands would be serviced through two (2) SWM Wet facilities. The development would assume an urban cross-section and the profile would accommodate minor and major overland flow routes through the road right-of-way. The SWM facilities would be designed to provide the requisite permanent pool and, extended detention control volumes and include sediment forebay(s) following the inlet structures.

An existing private pond bisects the settlement area to north and south segments. The SWM facility for the north segment, currently occupied by an existing driving range, would discharge to the north end of the existing private pond. This option will require agreements with the current landowner. Overflow from the private pond ultimately discharges to the Komoka Provincial Park Pond. The south SWM facility would abut Komoka Road and collect runoff from the two south settlement areas. Conveyance would be required across the existing on-site pond outlet channel. Discharge from the south SWM facility would be directed to the proposed storm sewer network along Komoka Road which outlets to the Thames River per the *Community Stormwater Master Plan Update*.

4.1.4 DELAWARE EMPLOYMENT LANDS

Alternative 1 – Do Nothing

No SWM works would be completed under this alternative. Runoff from future development would be conveyed uncontrolled to the on-site watercourses. This alternative does not meet the SWM control targets for this area and will not meet development application requirements.

Alternative 2 –LID Controls and Dry End-of-Pipe Facilities

This alternative includes a treatment train approach using distributed or lot-level controls that would be applied upstream of four (4) dry SWM facilities to achieve water quality criteria. Similar to West Komoka Alternative 4, the treatment train may consist of bio-retention areas (bio-swales), vegetated conveyance systems such as grassed swales, vegetated buffer strips and enhanced grass swales. Infiltration measures such as infiltration trenches or porous pavements provide additional water quality and water quantity benefits while also contributing to groundwater recharge.

Following pre-treatment from the LIDs, future developed runoff would be conveyed to end-of-pipe dry SWM facilities. Based on the existing topography of the future development area, existing natural watercourse pathways, and the overall drainage area, four (4) individual dry SWM facilities will be required. The dry SWM facilities would be designed to provide the necessary stormwater quantity control for the future employment lands prior to discharging to the on-site watercourses.

Alternative 3 – Service Proposed Development with Single Online Wet SWM Facility

Alternative 3 proposes conveyance of all minor and major flows from the employment lands to a single online wet SWM facility. The online SWM facility would be located downstream of the watercourse confluence to maximize the development catchment area treated. The SWM facility would be sized to provide sufficient permanent pool and extended detention volumes.

It should be noted that within the *LTVCA Regulations and Planning Policy and Procedure Manual* that online SWM ponds providing water quality is generally not accepted.

Alternative 4 – Service Proposed Development with Phased Wet SWM Facilities

Under this alternative, the future development SWM would be provided by several SWM Wet facilities. The facilities would be constructed with a phased approach, depending on the development application schedule. It is anticipated that four (4) SWM wet facilities would be required to service the employment lands development area. The development would assume an urban / semi-urban cross-section and the profile would accommodate minor and major overland flow routes through the road right-of-way and storm sewers. The SWM facilities would be designed to provide the requisite permanent pool and extended detention volumes and include sediment forebay(s). The existing on-site watercourses will remain in the same alignment and SWM facility outfalls will discharge to the watercourse's banks. Upstream pre-treatment controls such as oil and grit separators (OGS) may be implemented to enhance water quality treatment.

4.1.5 EAST DELAWARE

Alternative 1 – Do Nothing

Under this alternative, no SWM works would be implemented to service the potential development. Runoff from the future development would be conveyed uncontrolled to the on-site watercourses. This alternative does not meet the SWM control targets for this area and will not meet development application requirements.

Alternative 2 – Service Proposed Development with a single SWM Wet Facility

Under this alternative, the future development SWM would be provided through a single SWM Wet facility. The development would assume an urban cross-section and the profile would accommodate minor and major overland flow routes through the road right-of-way and storm sewers. The SWM facility would be designed to provide the requisite permanent pool and extended detention volumes and include sediment forebay(s). The existing on-site watercourses will remain in the same alignment and the SWM facilities will outlet to Cumming Municipal Drain. A portion of Cummings Municipal Drain would be abandoned under the provisions of the Drainage Act.

Alternative 3 – LID Controls and a single Dry End-of-Pipe Facility

This alternative would include a treatment train approach using LID controls and a single dry SWM facility. LID controls would be applied upstream of the dry facility to reduce suspended sediment loading

and achieve water quality criteria by retaining the 25mm storm event. A semi-urban road cross-section would be implemented and allow LID controls within the road right-of-way.

The dry SWM facility would be designed to provide the necessary quantity control for the future employment lands prior to discharging to the on-site watercourse adjacent to the development. The proposed dry SWM facility will outlet to Cummings Municipal Drain through an outfall. A portion of Cummings Municipal Drain would be abandoned under the provisions of the Drainage Act.

5 Opinions of Probable Cost

The opinion of probable cost for the stormwater alternatives is being completed at a preliminary level of detail defined as ASTM 2516-06 Class 4 within the *Stormwater Master Plans*. A class 4 estimate is defined as the following.

- *"Class 4 (other definitions: Class IV, Level 2, Class C): This is generally referred to as a preliminary, feasibility, schematic design, predesign, authorization or basic system cost opinion. It is used for detailed planning, evaluation of alternatives, confirm economic viability, preliminary budget approval and cash flow projections. At this stage the project concept and scope have been established and enough work completed to define capacities and processes resulting in block schematics, plot plans, process flow diagrams, general arrangement drawings and infrastructure requirements. The cost opinion is based on elemental units using historical costs, standard estimating references, supplier quotes and historical data from similar projects."*

Based on the evaluation of alternative solutions provided in **Appendix C**, cost estimates were developed for the two most feasible alternatives for each of the five new study areas. The cost estimates for the two alternatives were then considered for the selection of the preferred alternative.

Construction costs for the SWM works are obtained from a culmination of municipal or private development unit cost data collected from previous Stantec projects. An inflationary factor of 10% was applied to each unit cost. In addition, contingency and engineering costs were applied to the capital cost of each project at 30% and 20%, respectively. A lump sum of fix costs was also applied which includes mobilization/demobilization, traffic control, insurance/bonding, and assumed miscellaneous temporary fixed costs. The design characteristics of stormwater infrastructure for new developments is largely based of the configuration of the site plan. As development plans have not been confirmed yet for the new study areas, several assumptions and exclusions are made as follows:

- Footprint and volume of SWM Facilities are estimated based on approximate contributing land area;
- The upstream storm sewers within future development lands are excluded;
- Permitting fees are excluded;
- The number of LID features required for a development is estimated; and
- An average unit cost is developed for the upstream pre-treatment measures and LID features.

Table 3 includes a summary of the cost options for the evaluated alternatives. Detailed cost opinions are provided in **Appendix D.**

Table 3: Stormwater Alternatives - Opinions of Probable Cost

Location	Alternative	Subtotal - SWM Features	Fixed Costs / Contingency / Engineering	Total Project Cost (CAD)
West Komoka	2	$1,780,000	$1,004,000	$2,784,000
West Komoka	3	$1,470,000	$849,000	$2,319,000
South Komoka	2	$1,187,000	$707,500	$1,894,500
South Komoka	3	$1,081,000	$654,500	$1,735,500
Delaware Employment	2	$1,832,000	$1,030,000	$2,862,000
Delaware Employment	4	$1,933,000	$1,080,500	$3,013,500
East Delaware	2	$455,000	$341,500	$796,500
East Delaware	3	$330,000	$279,000	$609,000
Old Kilworth	2	$211,000	$255,500	$466,500
Old Kilworth	3	$200,000	$250,000	$450,000

6 Evaluation of Alternative Solutions

An evaluation of the alternative solutions was completed for each of the additional study areas discussed above. The following categories were evaluated for each alternative.

- Socio-Economic;
- Natural Environment;
- Technical Considerations; and
- Financial.

Evaluation tables for each alternative are provided in **Appendix C**.

7 Recommended Solutions

Based on the evaluation of alternative solutions presented in **Appendix C**, the following sections present the preferred alternative for each of the five new study areas that were not covered by the original *Stormwater Master Plans*. Preferred alternative figures are provided in **Appendix E**.

7.1 Overview of Stormwater Master Plan Recommendations

Refer to the *Stormwater Master Plans* provided on the Middlesex Centre website for stormwater servicing recommendations for catchment areas not evaluated in this study.

7.2 Old Kilworth

Alternative 3 – Bioswales

As mentioned above, through the *Settlement Area Stormwater Master Plan* public consultation process, residents of the Old Kilworth Development Area have indicated drainage issues beginning at the midpoint of Elmhurst St. and Beechnut St. Through a review of the local topography and the properties abutting the roads, it was determined that the subdivision was built with insufficient minor and major overland flow routes and is lacking a formal outlet. To mitigate the insufficient drainage within the Old Kilworth development area, a number of bioswales within the existing roadside ditches is proposed to capture and treat runoff during frequent storm events.

The bioswales will be designed in accordance with the *LID Manual*. Infiltration testing is recommended to be completed on the native soil to determine the design infiltration rate of the bioswales. In addition, an investigation into the groundwater levels within the study is required to determine the spatial suitability of the bioswales. Regrading of the roadside ditching may be required to provide positive drainage to the bioswales. Overflow from the bioswales will be conveyed to the existing road right-of way. As drainage issues were noted in a relatively small subject area, this alternative is preferred as there is minimum impact to private property while providing local ponding relief during frequent storm events. The bioswales ultimately provide water quality treatment, storage volume and reduced detention times from existing conditions.

Environmental and Permitting Considerations

- An Environmental Compliance Approval (ECA) or incorporation into the Consolidated Linear Infrastructure (CLI) stormwater program will be required from the MECP for the bioswales.
- The usage of salt is recommended to be minimized to prevent potential groundwater and surface water contamination. Potential for alternative methods of de-icing is recommended to be evaluated.

7.3 West Komoka

Alternative 3 – SWM Wet Facilities – Komoka Drain No. 2 Remains Untreated

The future land use identified in the *Official Plan* in this catchment area is Settlement Employment. The preferred solution includes servicing the stormwater runoff from the proposed development and contributing lands with two SWM Wet Ponds. SWM Facility (1) would be located on the east side of Komoka Creek and SWM Facility (2) on the west. Both SWM facilities will be designed in accordance with *SWMPDM* Wet Pond guidelines to meet the permanent pool and extended detention volume requirements and include sediment forebay(s) at each inlet. SWM Facility 2 will collect runoff from the proposed development west of Komoka Creek and discharge to a proposed storm sewer within the Glendon Drive right-of-way and outlet to Komoka Creek. An emergency overflow weir will be implemented where overflow will discharge to the Glendon Drive ditching and subsequently to the Glendon Dr. culvert. The downstream capacity of the Glendon Drive ditching is recommended to be assessed.

SWM Facility (1) will collect runoff from the proposed development east of Komoka Creek. SWM Facility (1) will outlet to Komoka Creek through an outfall. Runoff from infrequent storm events will be attenuated in the facility and discharged to Komoka Creek via an overflow weir. Tailwater conditions in Komoka Creek is recommended to be considered in the outlet design.

The available soils information and the lack of a defined channel downstream of the Glendon Dr. culvert, west of Komoka Creek, suggest that the site soils are permeable. Therefore, on-site infiltration measures and / or infiltration facilities following the SWM facilities are recommended to be implemented to satisfy water balance requirements. Industrial land uses discharging to infiltration facilities is recommended to be avoided, as current MECP guidance states that runoff from industrial sites should not be treated using infiltration measures due to the associated risk of groundwater contamination.

As Komoka Creek is identified as a coldwater fishery, it is recommended that reverse slope pipes and cooling trenches be implemented at the outlet of each SWM facility to mitigate potential temperature impacts. A hydrogeological assessment will be required to be completed prior to detailed design to measure soil permeability, identify the maximum local groundwater elevations, and establish the infiltration rates.

Environmental and Permitting Considerations

- A scoped Environmental Impact Study or other project review by a qualified environmental professional is recommended to be undertaken during the planning and design of future development within the area to confirm the presence or absence of significant environmental features. The Study can confirm the requirements for permits or registrations under the ESA and SARA.
- A Stage 1 archaeological assessment will confirm the presence of absence of archaeological potential. This may be completed as part of future Planning Act approvals.
- ECA or incorporation into the incorporation to CLI stormwater program will be required from the MECP for the proposed SWM facilities.

- A Section 28 permit will be required from the UTRCA for the proposed facility and associated SWM works.
- Municipal drain abandonment to be completed in accordance with the requirements of section 84 of the Drainage Act.

7.4 South Komoka

Alternative 2 – On-site LID Controls

The preferred alternative for the South Komoka development area is on-site LID controls. The land use designation for this area is Residential.

It is noted within the *Settlement Stormwater Master Plan* that adjacent developments contain underlying soils that are conducive to infiltration LID features and there are several spatial and potential permitting constraints associated with SWM Facilities. Therefore, the preferred alternative incorporates a treatment train approach using distributed and / or lot-level LID controls to provide stormwater treatment that is integrated within the developable lands. LID features such as bio-swales, grassed swales, vegetated buffer strips and enhanced grass swales can be incorporated within the road right-of-way. Infiltration measures such as infiltration chamber systems, lot-level infiltration galleries, and porous pavements could provide additional water quality and water quantity benefits while also contributing to groundwater recharge. Engineered pre-treatment measures such as oil-grit-separators or catchbasin inserts provide pre-treatment for the LID features and are recommended for the development.

A provisional outlet is recommended to be provided for water quantity controls in the event of LID control failure and to accommodate runoff generated during infrequent storm events. Per the *Community Stormwater Master Plan Update*, there is potential to integrate the future development provisional outlets to the proposed storm sewers as part of the Glendon Drive improvements and the proposed storm sewer outlet to the Thames River.

Environmental and Permitting Considerations

- A scoped Environmental Impact Study or other project review by a qualified environmental professional is recommended to be undertaken during the planning and design of future development within the area to confirm the presence or absence of significant environmental features. The Study can confirm the requirements for permits or registrations under the ESA and SARA.
- A Stage 1 archaeological assessment will confirm the presence of absence of archaeological potential. This may be completed as part of future Planning Act approvals.
- ECA or incorporation into the incorporation to CLI stormwater program will be required from the MECP for the proposed SWM facilities.
- A Section 28 permit will be required from the UTRCA for the proposed facility and associated SWM works.

- It is not anticipated that that a Provincial Parks and Conservation Reserves Class Environmental Assessment will be required for the developable lands.

7.5 Delaware Employment Lands

Alternative 2 - LID Controls and Dry End-of-pipe Facilities

The future land use identified in the *Official Plan* for this catchment area is Residential and Settlement Employment. Both land use designations within the employment lands are contained within Special Policy Area #29 in the *Official Plan* (March, 2023).

The preferred alternative under proposed development conditions incorporates a treatment train approach using distributed or lot-level SWM controls to provide pre-treatment within the developable lands. Water quality objectives may be achieved through a combination of bio-retention areas (bio-swales), vegetated conveyance systems such as grassed swales, vegetated buffer strips and enhanced grass swales. Infiltration measures such as infiltration chamber systems or porous pavements provide additional water quality and water quantity benefits while also contributing to groundwater recharge. Engineered pre-treatment measures such as oil-grit-separators or catchbasin inserts may be included in the upstream treatment train for each catchment. Depending on ownership of the prospective employment lands, each site plan within the development will require on-site SWM controls prior to discharging to a shared water quantity SWM facility. The development would assume an urban / semi-urban cross-section and allow for LID controls within the road right-of-way. Middlesex soil mapping suggests that the northern portion of the service area is comprised of permeable soils while the southern portion of the site is comprised of moderately permeable soils which are less suited to accommodate infiltration features. Available information indicates the potential for high groundwater levels within the area, which may impact the effectiveness of LID technologies.

Runoff from the proposed development will collectively be conveyed to four end-of-pipe dry SWM facilities adjacent to the watercourses that bisects the site. The locations of the SWM facilities were established based on the following objectives:

- Maintain the existing hydrologic function of the upstream watercourses;
- Maintain existing flow paths to the watercourses; and
- Minimizing impact to terrestrial and aquatic environments.

The SWM facilities will be located on private land such that the landowner will be responsible for the ongoing operation and maintenance and the municipality will not assume the facilities. The dry SWM facilities will provide sufficient extended detention and release rates to attenuate the peak flows to pre-development conditions. Dry facilities may be able to incorporate infiltration depending on the effectiveness of the upstream treatment measures and local permeability of underlying soils determined during geotechnical investigations. It may be determined that target drawdown time and peak outflows of the facilities be governed by the flow regime and sensitivity of the downstream watercourses. It is recommended that detailed hydraulic, fluvial and natural heritage analyses is recommended to be

undertaken on this watercourse prior to development to determine allowable release rates to the watercourses.

Environmental and Permitting Considerations

- No aquatic SAR were identified on the available DFO mapping for the on-site watercourses in this location; however, a review is recommended to be conducted prior to construction of the proposed outlet to identify potential impacts on habitats within the drain and potential authorization under the Fisheries Act.
- The proposed SWM facility locations shown are approximate. A scoped Environmental Impact Study or other project review by a qualified environmental professional is recommended to be undertaken during the planning and design of future development within the area to confirm the presence or absence of significant environmental features. The Study can confirm the requirements for permits or registrations under the ESA and SARA.
- A Stage 1 archaeological assessment will confirm the presence of absence of archaeological potential. This may be completed as part of future Planning Act approvals.
- An ECA or incorporation into the incorporation to CLI stormwater program will be required from the MECP for the proposed SWM facilities.
- A Section 28 permit will be required from the LTVCA for the proposed facility and associated SWM works.
- Municipal drain abandonment to be completed in accordance with the requirements of section 84 of the Drainage Act.

7.6 East Delaware

Alternative 3 - LID Controls and a single Dry End-of-Pipe Facility

The preferred alternative for the East Delaware development area, encompassing Allison / Cummings Municipal Drain's, is LID controls with a dry SWM facility downstream. The land use designation for this area is Residential and is contained within Special Policy Area #29 in the *Official Plan* (march, 2023).

It is noted within the *Delaware Stormwater Master Plan* that the approved draft plans for the lands just east and west of Martin Road are serviced by stormwater infiltration measures. In addition, Middlesex soil mapping suggests that portion of the service area is comprised of permeable soils thus, conducive to infiltration LID features. The preferred alternative incorporates a treatment train approach using distributed or lot-level LID controls to provide pre-treatment within the developable lands. The governing Dingman Creek Subwatershed Study water quality criteria will be achieved through retaining the 25mm storm event through storage in the LID features.

Runoff above the 25mm storm event will be conveyed to a dry SWM facility positioned adjacent to the existing Cummings Municipal Drain alignment. The SWM facility will be located on private land such that

the landowner(s) will be responsible for the ongoing operation and maintenance and the municipality will not assume the facilities. The dry SWM facilities will provide sufficient extended detention and release rates to attenuate the peak flows to pre-development conditions up to and including the 100-year storm event.

Environmental and Permitting Considerations

- The proposed SWM facility locations shown are approximate. A scoped Environmental Impact Study or other project review by a qualified environmental professional is recommended to be undertaken during the planning and design of future development within the area to confirm the presence or absence of significant environmental features. The Study can confirm the requirements for permits or registrations under the ESA and SARA.
- A Stage 1 archaeological assessment will confirm the presence of absence of archaeological potential. This may be completed as part of future Planning Act approvals.
- An ECA or incorporation into the incorporation to CLI stormwater program will be required from the MECP for the proposed SWM facilities.
- A Section 28 permit will be required from the UTRCA for the proposed facility and associated SWM works.
- Municipal drain abandonment to be completed in accordance with the requirements of section 84 of the Drainage Act.

8 Summary and Next Steps

This report for the stormwater infrastructure fulfills the planning and documentation requirements of the Master Servicing Plan for the Municipality of Middlesex Centre and includes the following discussions.

- Introduction, including background review (Section 1).
- Existing Conditions and review of the Stormwater Master Plans (Section 2).
- Alternative Solution Determination and Baseline Conditions (Section 3).
- Development of Alternative Solutions (Section 4).
- Opinions of Probable Coast (Section 5).
- Evaluation of Alternative Solutions (Section 6).
- Recommended Solutions (Section 7).

The findings of this report will be used to inform the overall MSP report to guide the Municipality's long-term infrastructure planning to meet its Official Plan goals.

APPENDIX A:
Background Documents

November 1, 2022

Dan Anderson, C. Tech

Drainage Superintendent

Municipality of Middlesex

10227 Ilderton Road, Ilderton, ON N0M 2A0

519-666-0190 Ext. 5229

anderson@middlesexcentre.ca

Dear Dan,

A sincere thank you for meeting with our group on October 27, 2022 and offering the opportunity to bring to the forefront the lack of a municipally-developed drainage and stormwater management solution in this neighbourhood.

During our meeting, we provided concrete evidence of the ongoing stormwater management issues primarily caused by run-off from the roadway and the lack of drainage to manage it. We also shared historical information on the temporary solutions enacted by residents, at their cost, to mitigate the issues. I have checked whether records of this infrastructure exist, and I cannot find any records. We highlighted that, despite paying a monthly stormwater management fee, there is no evidence of improvement to date. The problem has become critical for residents midway down Beechnut and Elmhurst Streets, which has been exacerbated by the onset of climate change. To the best of our knowledge, no residents of the subject streets were ever consulted when the Municipality formulated the Stormwater Masterplan a few years ago. The consultation for Master Plans is done through Public Information Centres (PICs). Two were held with notices being sent out with resident's water bills, posted in public spaces such as arenas, community centres, the Municipal Office as well as on the Municipal website and also published in the Banner and I also believe the Londoner. Good news is that the Municipality is currently undertaking a Master Servicing Plan which looks at all services other than road. This could be a good opportunity to bring the issues forward to the Engineering Consultants hired to review this plan and get a long-term solution in the works. This consultation will also happen through PICs, which currently do not have a date, but I will be sure to let you know when the first is scheduled to ensure you guys are aware and can attend.

Part of our discussion revolved around the development plans presented in the "*6-10*-14 Elmhurst Proposal. We have done an extensive investigation of the geotechnical report submitted within that proposal and were appalled by the erroneous information contained therein and the oversight surrounding the anticipated impacts on groundwater and drainage. We also provided evidence that the core soil samples used in the report are not representative of the aggregate composition of all homes in the neighbourhood. Given these concerns, it is our opinion that, without proper planning, developments like this one will exacerbate our ongoing situation.

We want to elaborate on our position. We believe that specific aspects of stormwater control are critical, especially for residents with shallow wells, and that something must be done in the short-term to solve the drainage issues that seem to begin mid-way down Beechnut and Elmhurst Streets. I will look into what short term solutions could be implemented for road run off, however the issue of groundwater and general lot grading cannot be dealt with through short-term band aids. It will require an entire area plan. Moreover, we believe that the stormwater and drainage issues affecting our neighbourhood will require a two-pronged solution incorporating a short-term, more timely remedy to the critical issues experienced by residents and the development of a major plan for a permanent resolution that might require relevant approvals and budgetary consideration. We are requesting that the short-term fixes be implemented while a long-term assessment is completed on the broader scope of the issues.

Thank you for allotting time to take a physical tour of some properties on Beechnut Street to observe the current situation and see the individual solutions enacted by residents to control groundwater surge and provide ad hoc drainage. It was left that you will consult with staff at the Municipality and check the records for any plans surrounding stormwater management and drainage in Old Kilworth. It would also be beneficial to hear what the Municipality knows about our current geological mix, what system(s) they presently have knowledge of and what is being planned or proposed for future consideration. The Stormwater Master Plan does not detail and improvement of infrastructure in your area, however this may be able to be amended through the Master Servicing Plan.
As I have mentioned, I have checked for records of the tile running down the west side of Beechnut St (and any other records for the area) and I cannot find any. In talking to our Transportation Manager, its also his understanding that any maintenance to the system has been undertaken through resident requests and without access to any detailed information on the system as a whole.
As for the record of geological mix, to my knowledge we do not keep a database of ground conditions throughout the Municipality. Any information we have on this would be provided through Geotechnical Reports for specific projects and would likely be confined to just the project area. Since there has not been any development or capital projects in your area, I doubt we have any real detailed information. I will check into this though.

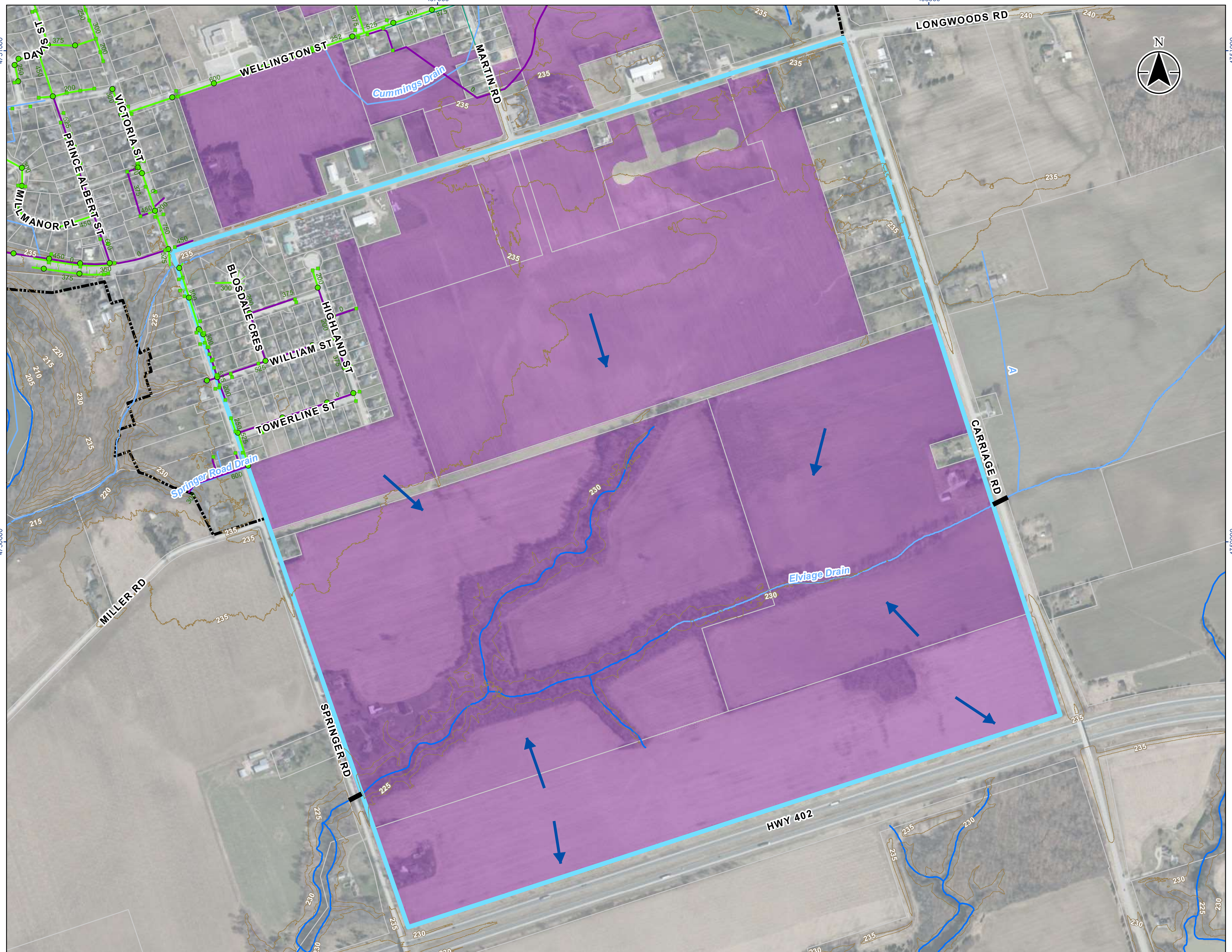
Finally, you mentioned that older sections of Delaware have been experiencing similar challenges with stormwater and drainage issues and a lack of accurate records. Assuming that remedial action was taken by the Municipality, could the same solutions apply to us? We would appreciate any insight that you might have to offer in this context.
When I mentioned Delaware I meant the former township, not the town itself. The lack of record there has typically presented itself through roadside catchbasins (CBs) and or tiles that cross the road that are now in need of repair but there is no documentation of were the CBs outlet to or any legal means for the Municipality to undertake repairs of a lot of the infrastructure as they are undocumented and head through private property. The remedy for this is the Petition and creation of a new Municipal Drain through the Ontario Drainage Act. The Drainage Act allows for the creation of a legal outlet through private property along with a defined maintenance requirement and responsibility. This is legislation that is intended for agricultural purposes however so this remedy is not a solution that allies to you. Solutions in Municipal Settlement Areas should be done through Municipal Servicing.

We cannot emphasize enough that this matter is of critical concern to our neighbourhood and requires the immediate attention of the Municipality. We will continue to advocate for a solution in order to prevent any adverse effects to our community, including securing assurances from the Municipality that drainage from upper Elmhurst Street will not harm residents downstream. In this vein, we look forward to continuing to work with you and your department on an efficient and effective solution. We will also be meeting with the municipal councillors for this area and the designate for Delaware.
It is good to bring forth community issues to your Councillors. Budget, plans and reports are recommended by Municipal staff but ultimately requires the approval of Municipal Council. In general if you feel that there is a concern in your community bringing it to the attention of your Councillor is a good step.

Once again, we very much appreciate the time that you took to meet with us. We will await your direction and advice on the issues tabled at our meeting.

Sincerely,

APPENDIX B:
Existing Conditions Figures



Stantec

Legend

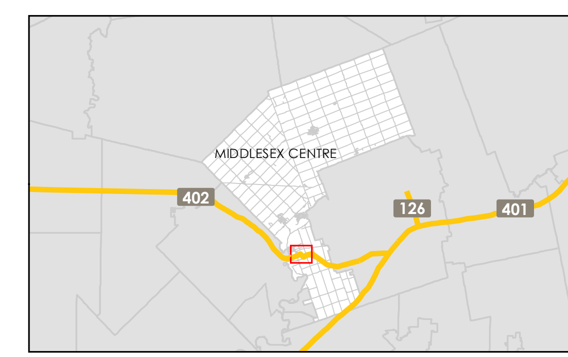
- Constructed Drain
- Culvert
- Elevation Contour
- Flow Direction
- Storm Sewer
- Municipal Drain
- Perforated Subdrain
- Watercourse
- Development Area
- Storm Catchment Area
- Settlement Boundary
- Waterbody

0 275 550 m

1:8,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Orthoimagery © First Base Solutions, 2018. Imagery Date, 20XX.



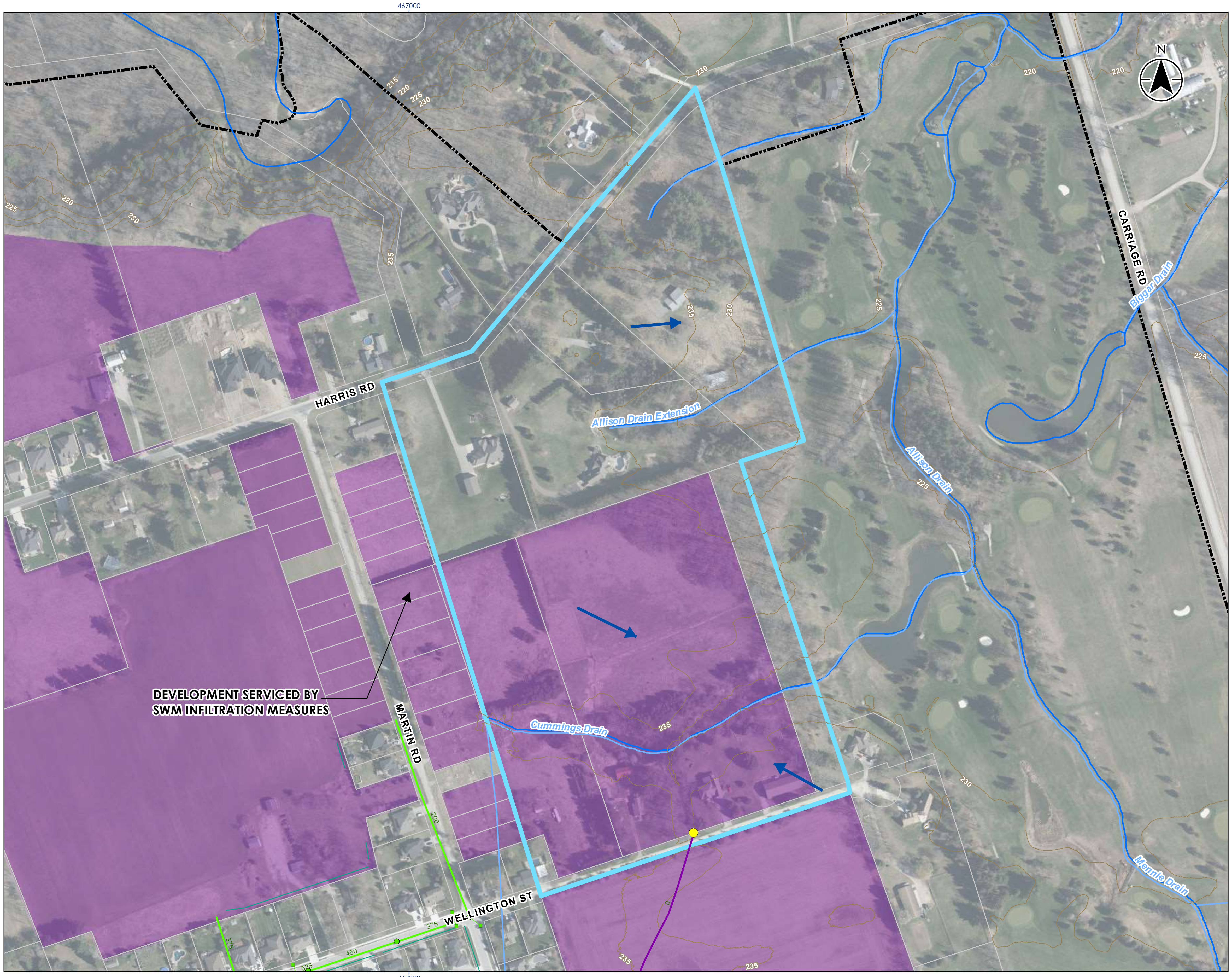
Project Location
Municipality of Middlesex Centre, ON

165630236 REVA
Prepared by KDB on 2024-04-22

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
1.1

Title
Existing Drainage Overview
Delaware Employment Lands



Stantec

Legend

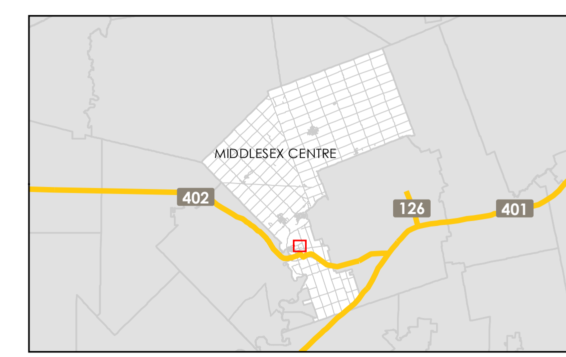
- Outfall
- Constructed Drain
- Elevation Contour
- Flow Direction
- Storm Sewer
- Municipal Drain
- Perforated Subdrain
- Watercourse
- Development Area
- Storm Catchment Area
- Settlement Boundary
- Waterbody

0 120 240 m

1:3,500 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Orthoimagery © First Base Solutions, 2018. Imagery Date, 20XX.



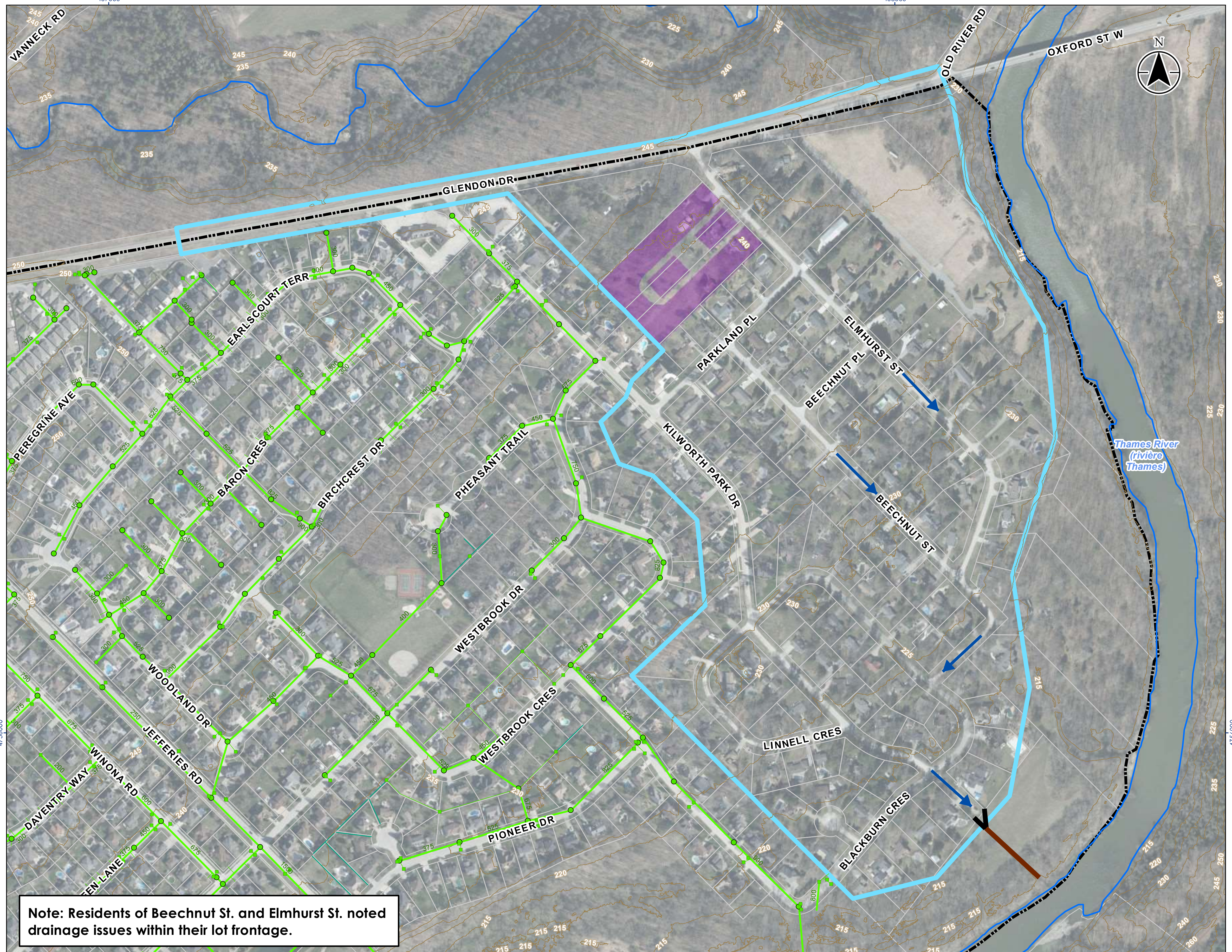
Project Location
Municipality of Middlesex Centre, ON

165630236 REVA
Prepared by KDB on 2024-04-22

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
1.2

Title
Existing Drainage Overview
East Delaware



Stantec

Legend

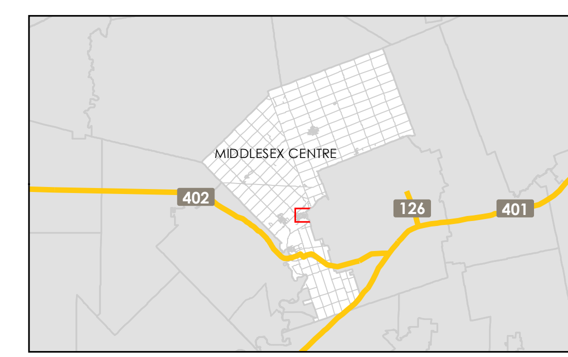
- Culvert
- Elevation Contour
- Flow Direction
- Open Ditch
- Storm Sewer
- Municipal Drain
- Perforated Subdrain
- Watercourse
- Development Area
- Storm Catchment Area
- Settlement Boundary
- Waterbody

0 170 340 m

1:5,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Orthoimagery © First Base Solutions, 2018. Imagery Date, 20XX.



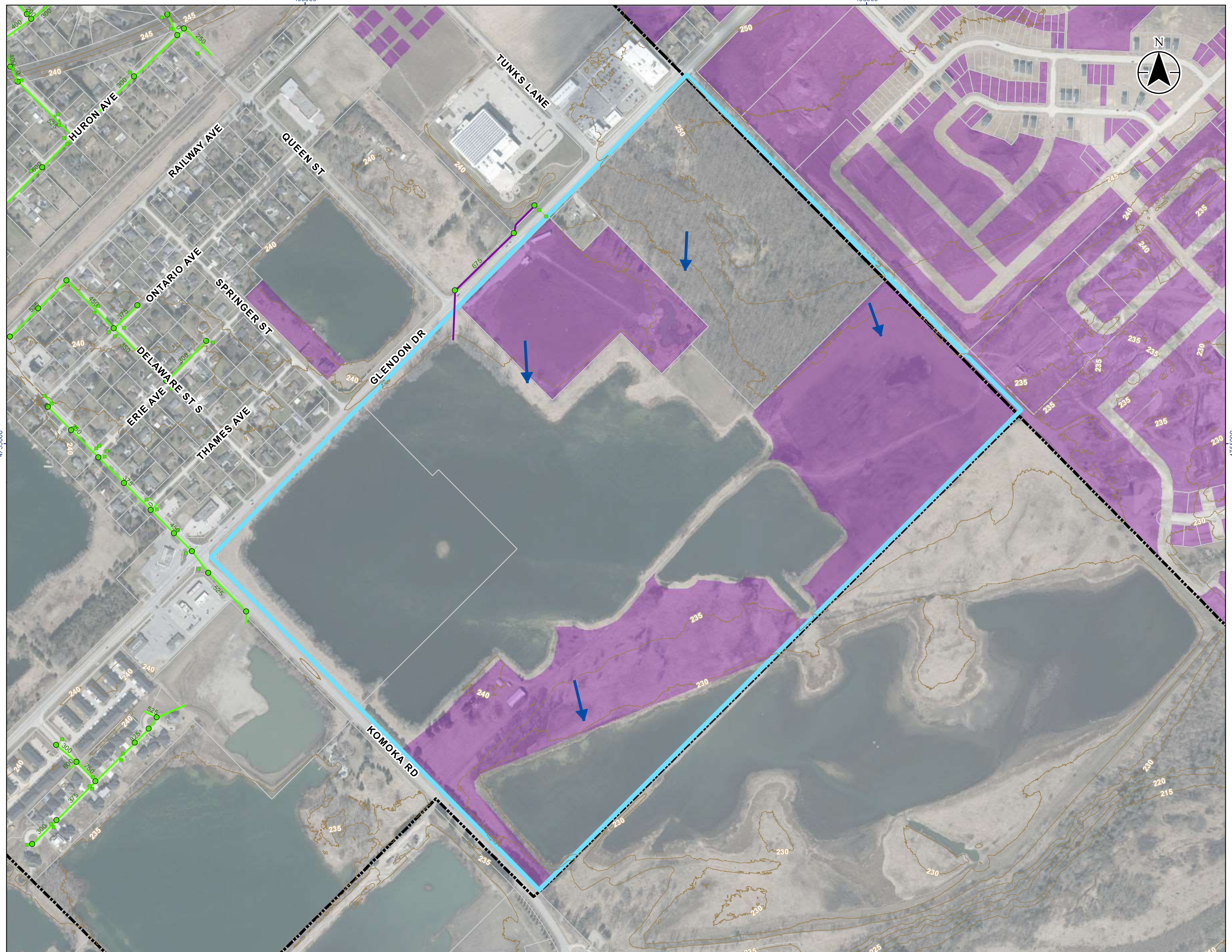
Project Location
Municipality of Middlesex Centre, ON

165630236 REVA
Prepared by KDB on 2024-04-22

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
1.3

Title
Existing Drainage Overview
Old Kilworth



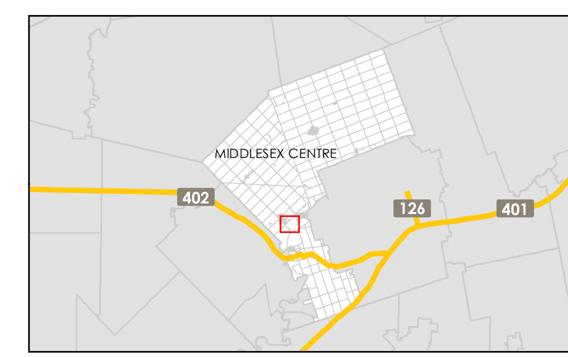
Stantec

Legend
- Elevation Contour
- Flow Direction
- Storm Sewer
- Municipal Drain
- Perforated Subdrain
- Development Area
- Storm Catchment Area
- Settlement Boundary

0 240 480 m

1:7,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Orthoimagery © First Base Solutions, 2018. Imagery Date, 20XX.



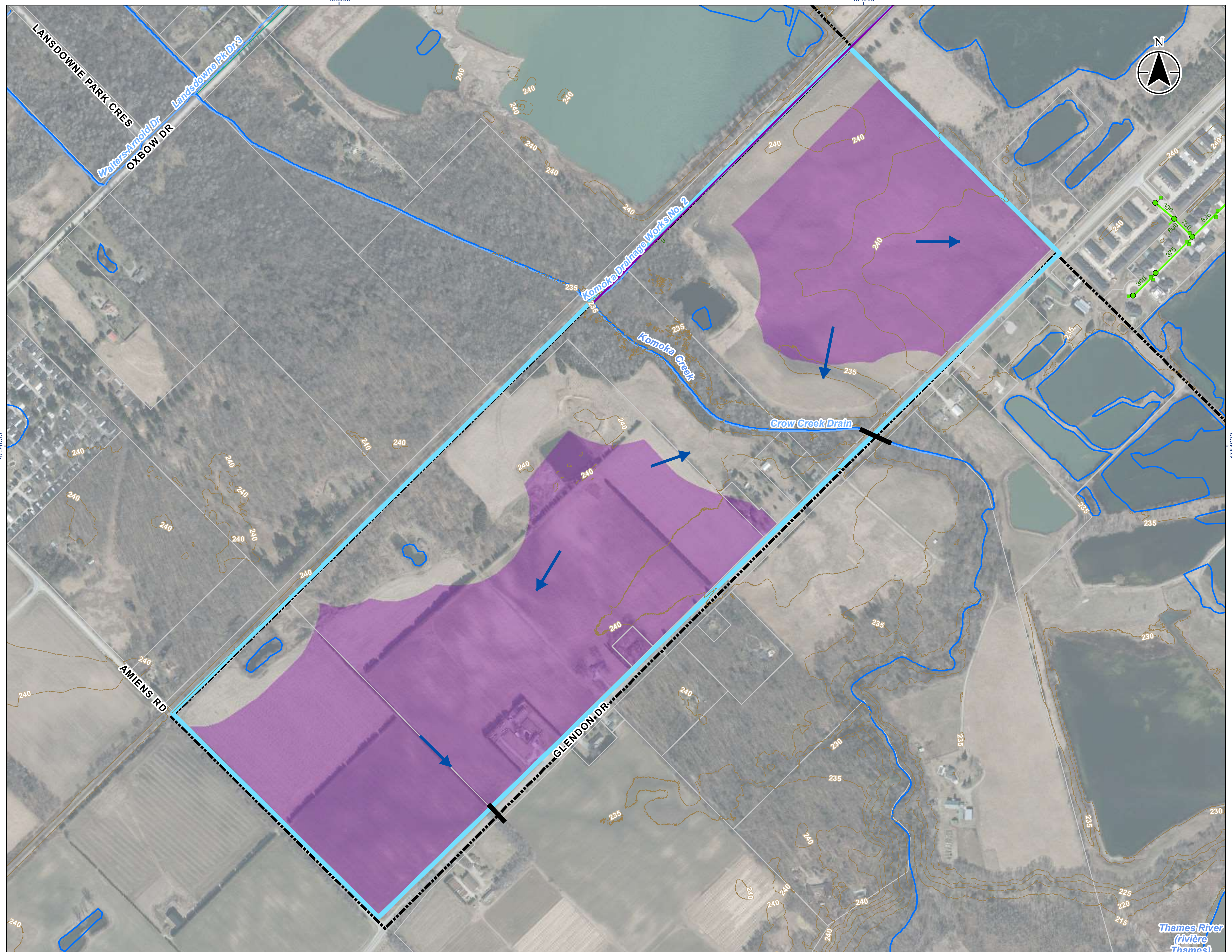
Project Location
Municipality of Middlesex Centre, ON

165630236 REVA
Prepared by KDB on 2024-04-22

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
1.4

Title
Existing Drainage Overview
South Komoka



Stantec

Legend

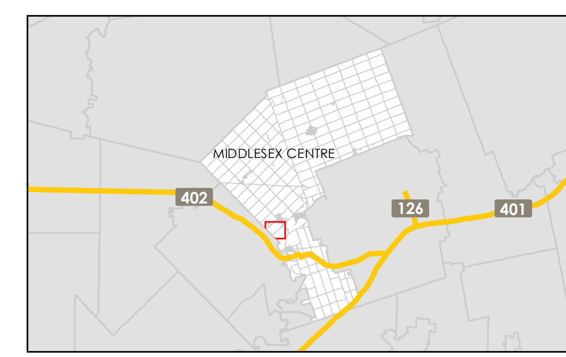
- Constructed Drain
- Culvert
- Elevation Contour
- Flow Direction
- Storm Sewer
- Municipal Drain
- Perforated Subdrain
- Watercourse
- Development Area
- Storm Catchment Area
- Settlement Boundary
- Waterbody

0 260 520 m

1:7,500 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Orthoimagery © First Base Solutions, 2018. Imagery Date, 20XX.



Project Location
Municipality of Middlesex Centre, ON

165630236 REVA
Prepared by KDB on 2024-04-22

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
1.5

Title
Existing Drainage Overview West Komoka

APPENDIX C:
Evaluation of Alternative Solutions

Ranking		Alternative			
		Old Kilworth			
		1	2	3	4
Category	Evaluation Criteria	Do Nothing	Enhanced ditching	Bioswales	Urbanized Road Cross-section with a Formal Outlet
Socio-Economic	Potential to impact existing residences, businesses and community features	Ponding on adjacent properties will remain prevalent within the road right-of-way. Issues may be exacerbated by potential upstream development. No impact to cultural heritage or archaeological resources is anticipated. Local community will continue to voice their concerns of drainage issues on their property.	Impacts to the adjacent properties landscaped areas and entrance ways within the road right-of-way are anticipated. Perceived loss of private property due to ditch widening. No impact to cultural heritage or archaeological resources is anticipated as site is built up. Proposed ditching will require additional maintenance from homeowners to operate efficiently. Moderate disturbance to landowners access during construction. Operational efficiency may be impacted by prospective development upstream.	Potential encroachment in adjacent private land to accommodate bioswales. Operational efficiency may be impacted by prospective development upstream. No impact to cultural heritage or archaeological resources is anticipated as site is built up. Minor impacts to landowners access during construction. Proposed bioswales will require additional maintenance from homeowners to operate efficiently. Provides an aesthetic that is typically desired by the community.	Loss of private property is anticipated to accommodate the revised road profile and storm sewer cover. Widening of the road is anticipated. No impact to cultural heritage or archaeological resources is anticipated as site is built up. Significant distribution to landowners property and access during construction. Landowners will lose a portion of the property frontage from the road improvements.
	Potential to impact significant natural heritage features				
	Potential effects on known or potential significant archaeological resources, built heritage resources and cultural landscape features				
	Potential to accommodate planned significant population and job growth in strategic growth areas				
Natural Environment	Potential to impact fish and aquatic habitat	Downstream road runoff will continue to be conveyed uncontrolled to Thames River. Thames River contains critical habitat for aquatic Species at Risk (SAR). No terrestrial impacts anticipated. No significant hydrogeological impacts anticipated. Catchment area is within a Significant Groundwater Recharge Area (SGRA). Catchment area is within a Highly Vulnerable Aquifer Zone(HVA). No impacts to drinking water or source protection policies are anticipated.	The proposed enhanced ditching mitigates the effects the road runoff on aquatic life and habitat downstream through reducing peak flows and providing opportunity for sediment settling within the ditching. Ultimate receiver is part of the Komoka Provincial Park ANSI; no impacts are anticipated. Ditch improvements may have significant impacts to trees within the right-of-way and breeding bird window should be considered. High water table may result in baseflow in ditching and reduce conveyance capacity. No impacts to drinking water or source protection policies are anticipated. Provides water quality treatment benefits for the downstream critical aquatic habitat.	The proposed bioswales improves water quality and mitigates the erosion impacts from road runoff on aquatic life and habitat downstream. Ultimate receiver is part of the Komoka Provincial Park ANSI. No impacts are anticipated. Groundwater level may impact the design depth of the bioswale. Bioswales supplement groundwater recharge. Domestic wells are present on adjacent properties. Domestic wells are present on adjacent properties. Potential for contamination of groundwater from road salt applications. Partially mitigates erosion impacts to Thames River.	Untreated urban section runoff will increase peak flows to downstream receiver and exacerbate the erosion following the downstream outfall. Potential for impacts to Komoka Provincial Park ANSI through outlet retrofit. Site assessments should be conducted to delineate the extent of significant environmental features and provide specific mitigation measures. No significant hydrogeological impacts anticipated. No impacts to drinking water or source protection policies are anticipated.
	Potential to impact water resources including surface water (i.e. rivers, creeks, etc.), groundwater recharge areas and wellhead protection areas				
	Potential to impact significant natural heritage features				
	Potential to impact significant wildlife habitat and species at risk				
Technical Considerations	Potential land requirements including land purchase and temporary/permanent easements	Periodic maintenance required by adjacent landowners to alleviate ponding. No construction occurring. Currently does not meet municipality stormwater design standards or OWRA requirements. Runoff is untreated and existing ponding within the right-of-way will continue.	Regular ditch maintenance will be required to monitor sediment accumulation and excessive vegetation. Potential relocation of existing hydro poles, underground utilities and landowner property required to widen Kilworth Subdivision Roadside ditches. Encroachment onto homeowner property requires landowner agreements. Enhanced ditching will provide additional water quality treatment and peak flow attenuation to the drainage area runoff.	Annual inspection should be completed on distribution piping and landscaping. Regular maintenance and cleanouts are anticipated. Potential Relocation of existing hydro poles, underground utilities and landowner property. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. Encroachment onto homeowner property requires landowner agreements. Infiltration performance is dependent on the underlying soil infiltration rates. High groundwater levels must be offset from the base of the storage layer (typically 1m below) for the underlying soil to be permeable.	The storm sewer system would be included as a municipal asset. Maintenance could include pumping sumps in CBMHs or repairing deteriorated rigid infrastructure; however time intervals between maintenance would likely be prolonged. Required relocation of existing hydro poles, underground utilities and landowner property required. Significant undertaking for the municipality. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. Encroachment onto homeowner property requires landowner agreements. UTRCA approval required under O.Reg. 157/06 for outlet reconfiguration. Provides an improved flow path for runoff from the road right-of-way.
	Constructability				
	Effect on existing utilities and infrastructure				
	Ability to coordinate with existing and planned infrastructure improvements				
	System resiliency and system suitability				
Financial	Lifecycle operations and maintenance costs	No SWM features are constructed. No additional costs related to operation and maintenance are anticipated. Ongoing maintenance to manage local drainage issues at landowners expense.	Moderate capital costs anticipated. Debris removal, periodic regrading, and lawn maintenance are anticipated to result in moderate to high operation and maintenance costs. Moderate costs associated with construction ditching and maintenance.	Moderate capital costs anticipated. Cleanouts and vegetation maintenance will result in moderate to high operation and maintenance costs. Moderate costs associated with construction ditching and maintenance.	Significant capital cost associated with utility relocation, road repaving and removal of concrete ditches. Low operation and maintenance costs are anticipated on a short-term basis. Necessary repairs or cleanouts will be expensive and will need to be budgeted as a capital expenditure. High capital costs associated with construction.
	Estimated capital cost				
Summary Ranking	Green is the most well aligned with the criterions, Yellow is somewhat aligned with the criterions, and red is the least well aligned with the criterions.	Not Preferred	Less Preferred Alternative	Preferred Alternative	Less Preferred Alternative

Ranking		Alternative			
		West Komoka			
		1	2	3	4
Category	**Evaluation Criteria**	**Do Nothing**	**SWM Wet Facilities – Control Runoff from Komoka Drain No. 2**	**SWM Wet Facilities – Komoka Drain No. 2 Remains Untreated**	**LID Controls and Dry End-of-Pipe Facilities**
Socio-Economic	Potential to impact existing residences, businesses and community features	Untreated runoff from future development travels overland to Komoka Creek. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. Occasional flooding of proposed development is anticipated. Flood risk for Glendon Drive.	SWM facilities reduce available development area and will be incorporated into the proposed development concept for the site. Provides the opportunity to integrate Komoka Drain No. 2 into the SWM design. Construction of SWM facilities is not anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to construction of SWM facilities. SWM facilities must be designed in order to mitigate the risk of drowning and other hazards to public safety. Short-term impacts during construction should be anticipated. SWM facilities can be incorporated into a community walking trail for dual land use opportunity.	SWM facilities reduce available development area and will be incorporated into the proposed development concept for the site. Construction of SWM facilities is not anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to construction of SWM facilities. SWM facilities must be designed in order to mitigate the risk of drowning and other hazards to public safety. Short-term impacts during construction should be anticipated. SWM facilities can be incorporated into a community walking trail for dual land use opportunity.	Less land required for SWM facilities than Alternative 2. LID measures can be incorporated in employment lands design. Construction of SWM features is not anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to construction of SWM facilities. Landowners will be required to operate and maintain LID features on their property. Short-term impacts during construction should be anticipated. Temporary infrequent deep standing water in proposed dry SWM pond presents a low risk to public safety.
	Potential to impact water resources including surface water (i.e. rivers, creeks, etc.), groundwater recharge areas and wellhead protection areas				
	Potential effects on known or potential significant archaeological resources, built heritage resources and cultural landscape features				
	Potential to accommodate planned significant population and job growth in strategic growth areas				
Natural Environment	Potential to impact fish and aquatic habitat	Komoka Drain 2 discharges untreated stormwater to Komoka Creek. However, approximately 1300 m of existing vegetated open channel on the south side of the railroad likely reduces the temperature and water quality effects of urban runoff on aquatic life and habitat. Untreated stormwater from the eastern portion of the development area discharges directly to Komoka Creek. Overland flows of untreated stormwater may impact terrestrial resources north of the study area or within the Komoka Creek Valley. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Significant infiltration likely occurs on site under existing conditions. Catchment area is within a Significant Groundwater Recharge Area (SGRA). Catchment area is within a Highly Vulnerable Aquifer Zone (HVA). No impacts to drinking water or source protection policies are anticipated.	Proposed SWM facilities mitigate water quality and temperature impacts on aquatic life and habitat from proposed development. Outlets to watercourse have high erosion potential during large storm events. Improves peak flow control and water quality treatment for Komoka Drain No. 2. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Cooling trenches provides opportunity for groundwater recharge. Impacts of future development may increase potential for contamination. No impacts to drinking water or source protection policies are anticipated.	Proposed SWM facilities mitigate water quality and temperature impacts on aquatic life and habitat from proposed development. Outlets to watercourse have high erosion potential during large storm events. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Impacts of future development may increase potential for contamination. Cooling trenches provides opportunity for groundwater recharge. No impacts to drinking water or source protection policies are anticipated.	Proposed SWM infrastructure mitigates water quality and temperature impacts on aquatic life and habitat from proposed development. Outlets to watercourse has high erosion potential during large storm events. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. LID controls mitigate impact of proposed development on local annual infiltration volume. Select impervious runoff into infiltration facilities poses a potential risk for groundwater contamination. No impacts to drinking water or source protection policies are anticipated.
	Potential to impact significant natural heritage features				
	Potential to impact significant wildlife habitat and species at risk				
Technical Considerations	Potential land requirements including land purchase and temporary/permanent easements	No significant impacts to operation and maintenance schedules are anticipated. Development construction requires sediment and erosion control measures. Does not meet municipality stormwater design standards or OWRA requirements. Flooding is anticipated within the proposed development area.	SWM facilities will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECAs. The constructability of SWM facilities is dependent on the local groundwater elevations and soil conditions. Phasing sequencing will need to be followed to transfer the flow from Komoka Drain No. 2 into the proposed east SWM facility. It is anticipated that Wet Ponds will be deeper than the Dry facilities in Alternative 4 due to the addition of a permanent pool. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. Municipal drain abandonment to be completed in accordance with the requirements of the Drainage Act. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. MECP may require water balance mitigation measures in the proposed subdivision/site design if no infiltration facilities are proposed. UTRCA approval is required under O.Reg. 157/06 for the SWM facilities. SWM facilities provide Enhanced water quality treatment, peak flow control and temperature mitigation to runoff from the proposed development and Komoka Drain No.2 drainage area. Impacts to floodplain and erosion thresholds should be assessed prior to detailed design.	SWM facilities will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECAs. The constructability of SWM facilities is dependent on the local groundwater elevations and soil conditions. It is anticipated that Wet Ponds will be deeper than the Dry facilities in Alternative 4 due to the addition of a permanent pool. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. MECP may require water balance mitigation measures in the proposed subdivision/site design if no infiltration facilities are proposed. UTRCA approval is required under O.Reg. 157/06 for the SWM facilities. SWM facilities provide Enhanced water quality treatment, peak flow control and temperature mitigation to runoff from the proposed development. Impacts to floodplain and erosion thresholds should be assessed prior to detailed design.	Operation and maintenance of - privately owned LID measures will be the responsibility of the owner. A bylaw may be required to compel owners to operate and maintain their LID measures. SWM facilities will require ongoing monitoring and maintenance by the private landowners with the conditions of the corresponding ECAs. The municipality will be responsible for operating and maintaining SWM measures located on public lands. The constructability of SWM facilities is dependent on the local groundwater elevations and soil conditions. Constraints to LID feature constructability will be depended on the development site plan, grading and servicing. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. UTRCA approval is required under O.Reg. 157/06 for the LID controls and SWM facilities. LID controls provide Enhanced water quality treatment, peak flow control and temperature mitigation to runoff from the proposed development. Groundwater recharge and water balance objectives are achieved through onsite LID features. High groundwater elevations may interfere with LID design and operation. No anticipated Impacts to floodplain or erosion hazards.
	Constructability				
	Effect on existing utilities and infrastructure				
	Ability to coordinate with existing and planned infrastructure improvements				
	System resiliency and system suitability				
Financial	Lifecycle operations and maintenance costs	No significant anticipated operations or maintenance costs. No associated capital costs. Costs to rehabilitate development impacts to downstream watercourses can outweigh initial capital costs.	This alternative has the highest estimated capital costs. The ponds will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECA. Intermittent cleanouts of the pond forebay(s) and main cells will be required; estimated on a 10-year basis. Sediment cleanouts of the pond will need to be budgeted as a capital expenditure. Highest anticipated capital costs and ongoing operation and maintenance costs to the municipality.	This alternative has the second highest estimated capital costs. The ponds will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECA. Intermittent cleanouts of the pond forebay(s) and main cells will be required; estimated on a 10-year basis. Sediment cleanouts of the pond will need to be budgeted as a capital expenditure. Second highest anticipated capital costs and ongoing operation and maintenance costs to the municipality.	Estimated capital cost for proposed regional SWM ponds is anticipated to be lower than Alternative 2 and 3. Costs associated with maintenance of pretreatment measures and inspections are anticipated to be moderately high. Maintenance and cleanouts of the Dry facilities on private lands will be the responsibility of the property owners. Cleanouts of pretreatment measures on public property to be included in operations budget. Capital costs and maintenance costs of private LID features and Dry facilities to be borne by the developer and property owners, respectively. Overall cost to municipality is moderate compared to Alternative 2 and 3.
	Estimated capital cost				
Summary Ranking	**Green is the most well aligned with the criterions, Yellow is somewhat aligned with the criterions, and red is the least well aligned with the criterions.**	**Not Preferred**	**Less Preferred Alternative**	**Preferred Alternative**	**Less Preferred Alternative**

Ranking		Alternative		
		South Komoka		
		1	2	3
Category	Evaluation Criteria	Do Nothing	On-site LID Controls	Wet SWM Facilities
Socio-Economic	Potential to impact existing residences, businesses and community features	Untreated runoff from future development area will impact private pond water levels and downstream Komoka Provincial Park Pond. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. Occasional flooding of proposed development is anticipated. Flood risk for adjacent properties and roads.	LID measures can be incorporated road right-of way and lot design to reduce urbanization. No anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. Property owners will be required to operate and maintain LID features on their property. Short-term impacts during construction should be anticipated. Less impact to private lands with SWM features incorporated into site plan. Allows development in accordance with Official Plan land use designation.	SWM facilities reduce available development area and will be incorporated into the proposed development concept for the site. No anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. SWM facilities must be designed in order to mitigate the risk of drowning and other hazards to public safety. SWM facilities can be incorporated into a community walking trail for dual land use opportunity.
	Potential effect on approved/planned land uses			
	Potential effects on known or potential significant archaeological resources, built heritage resources and cultural landscape features			
	Potential to accommodate planned significant population and job growth in strategic growth areas			
Natural Environment	Potential to impact fish and aquatic habitat	Untreated stormwater from the development areas discharge directly to on-site ponds and PSW. Overland flows of untreated stormwater may impact terrestrial resources within the woodlots adjacent to the site. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Catchment area is within a Highly Vulnerable Aquifer Zone (HVA). No impacts to drinking water or source protection policies are anticipated. Development encroaches on-site PSW (Komoka / South Strathroy Creek Wetland.	Proposed LID controls and potential engineered pretreament measures mitigates water quality impacts from proposed development. On-site controls will also provide peak flow attenuation. No significant aquatic impacts anticipated. No significant terrestrial impacts are anticipated. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Low impact development (LID) provides treatment to mitigate impacts to groundwater from new development. However, there is a risk of infiltration of potential contaminants and subsequent groundwater impacts. No impacts to drinking water or source protection policies are anticipated.	Proposed wet SWM facilities attenuates flows and treats runoff from proposed development. Outlets to downstream watercourse has high erosion potential during large storm events. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Impacts of future development may increase potential for contamination. No impacts to drinking water or source protection policies are anticipated.
	Potential to impact water resources including surface water (i.e. rivers, creeks, etc.), groundwater recharge areas and wellhead protection areas			
	Potential to impact significant natural heritage features			
	Potential to impact significant wildlife habitat and species at risk			
Technical Considerations	Potential land requirements including land purchase and temporary/permanent easements	No change to operational/maintenance requirements. No construction impacts as no work is associated with this alternative. Does not meet municipality stormwater design standards or OWRA requirements. Flooding is anticipated within the proposed development area.	Operation and maintenance of - privately, and municpal owned LID measures will be the responsibility of the owner and muncicpality, respectively. A bylaw may be required to compel owners to operate and maintain their LID measures. On-site controls will require ongoing monitoring and maintenance with the conditions of the corresponding ECAs. The constructability of on-site controls is dependent on the local groundwater elevations and soil conditions. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. Constraints to LID feature constructability will be depended on the development site plan, grading and servicing.UTRCA approval is required under O.Reg. 157/06 for the SWM controls. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. LID controls provide Enhanced water quality treatment, peak flow control and temperature mitigation to runoff from the proposed development. High groundwater elevations may interfere with LID design and operation. Impacts to Komoka Provincial Park Pond should be assessed prior to detailed design.	Wet SWM facilities will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECAs. The constructability of SWM facility is dependent on the local groundwater elevations and soil conditions. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. An MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. The MECP may require water balance mitigation measures in the proposed subdivision/site design if no infiltration facilities are proposed. UTRCA approval is required under O.Reg. 157/06 for the SWM facilities. SWM facilities provide Enhanced water quality treatment and peak flow control for runoff from the proposed development.
	Constructability			
	Effect on existing utilities and infrastructure			
	Ability to coordinate with existing and planned infrastructure improvements			
	System resiliency and system suitability			
Financial	Lifecycle operations and maintenance costs	No associated costs for SWM. No significant anticipated operations or maintenance costs.	This alternative has the highest estimated capital costs. Costs associated with maintenance of pretreatment measures and inspections are anticipated to be moderately high. Maintenance and cleanouts of the privite LID controls will be the responsibility of the property owners. Cleanouts of pretreatment measures on public property to be included in operations budget. Capital costs and maintenance costs of private LID features will be borne by the developer and property owners. Long-term costs to municipality are low-moderate compared to Alternative 3.	The regional ponds will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECA. Intermittent cleanouts of the pond forebay(s) and main cells will be required; estimated on a 10-year basis. Sediment cleanouts of the pond will need to be budgeted as a capital expenditure.
	Estimated capital cost			
Summary Ranking	**Green is the most well aligned with the criterions, Yellow is somewhat aligned with the criterions, and red is the least well aligned with the criterions.**	**Not Preferred**	**Preferred Alternative**	**Less Preferred Alternative**

Ranking		Alternative Delaware Employment			
		1	2	3	4
Category	**Evaluation Criteria**	**Do Nothing**	**LID Controls and Dry End-of-Pipe Facilities**	**Service Proposed Development with One Online SWM Wet Pond**	**Service Proposed Development with Phased SWM Wet Facilities**
Socio-Economic	Potential to impact existing residences, businesses and community features	Proposed new developments will increase flow to adjacent lands without SWM controls in place increasing risk. No anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. No risk to archaeological resources. Occasional flooding of proposed development and adjacent land is anticipated. Flood risk for Highway 402. Does not meet provincial and official plan policy to provide stormwater treatment for future development land.	Land for on-site dry facilities to be provided in future site plans. LID measures can be incorporated employment lands design to reduce urbanization. No anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. Property owners will be required to operate and maintain LID features on their property. Short-term impacts during construction should be anticipated. Temporary standing water in proposed dry SWM pond presents a low risk to public safety. Less impact to private lands with SWM features incorporated into site plan. Allows development in accordance with Official Plan land use designation.	One online SWM facility will maximize developable land. Development site plan will have to consider the location of the single SWM facility. No anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. SWM facility must be designed in order to mitigate the risk of drowning and other hazards to public safety. Allows development in accordance with Official Plan land use designation. Maximizes developable land.	SWM facilities reduce available development area and will be incorporated into the proposed development concept for the site. No anticipated to impact built cultural heritage resources. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. SWM facilities must be designed in order to mitigate the risk of drowning and other hazards to public safety. SWM facilities can be incorporated into a community walking trail for dual land use opportunity.
	Potential effect on approved/planned land uses				
	Potential effects on known or potential significant archaeological resources, built heritage resources and cultural landscape features				
	Potential to accommodate planned significant population and job growth in strategic growth areas				
Natural Environment	Potential to impact fish and aquatic habitat	Untreated stormwater from the development area discharges overland to the onsite watercourses. No aquatic SAR have been identified within the onsite watercourses. Overland flows of untreated stormwater may impact terrestrial resources north of the study area or along the watercourses alignments. Significant infiltration likely occurs on site under existing conditions. Portion of the Catchment area is within a Significant Groundwater Recharge Area (SGRA). Portion of Catchment area is within a Highly Vulnerable Aquifer Zone (HVA). No impacts to drinking water or source protection policies are anticipated.	Proposed upstream SWM controls mitigates water quality impacts from proposed development. Outlet from Dry facilities has high erosion potential during large storm events. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Low impact development (LID) provides treatment to mitigate impacts to groundwater from new development. However, there is a risk of infiltration of potential contaminants and subsequent groundwater impacts. No impacts to drinking water or source protection policies are anticipated.	Proposed SWM facility mitigates water quality impacts from proposed development. Online SWM facility would create a barrier for fish passage to/from the upstream watercourses. Substantial impact to watercourse terrestrial habitat during construction. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Impacts of future development may increase potential for contamination. No impacts to drinking water or source protection policies are anticipated.	Proposed SWM facilities mitigates water quality impacts from proposed development. Outlets to watercourse have high erosion potential during large storm events. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Impacts of future development may increase potential for contamination. No impacts to drinking water or source protection policies are anticipated.
	Potential to impact water resources including surface water (i.e. rivers, creeks, etc.), groundwater recharge areas and wellhead protection areas				
	Potential to impact significant natural heritage features				
	Potential to impact significant wildlife habitat and species at risk				
Technical Considerations	Potential land requirements including land purchase and temporary/permanent easements	No change to operational/maintenance requirements. No construction impacts as no work is associated with this alternative. Does not meet municipality stormwater design standards or OWRA requirements. Flooding is anticipated within the proposed development area.	Operation and maintenance of - privately owned LID measures will be the responsibility of the owner. A bylaw may be required to compel owners to operate and maintain their LID measures. SWM facilities will require ongoing monitoring and maintenance by the private landowners with the conditions of the corresponding ECAs. The municipality will be responsible for operating and maintaining SWM measures located on public lands. The constructability of SWM facilities is dependent on the local groundwater elevations and soil conditions. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. Constraints to LID feature constructability will be depended on the development site plan, grading and servicing. LTVCA approval may be required under O.Reg. 152/06 for the SWM facilities. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. LID controls provide Enhanced water quality treatment, peak flow control and temperature mitigation to runoff from the proposed development. Soils in northern portion of future development area are likely amenable to LID measures but the soils in the southern portion are less permeable. High groundwater elevations may interfere with LID design and operation. Impacts to floodplain and erosion thresholds should be assessed prior to detailed design.	SWM facility will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECAs. Stringent operational and maintenance program required to ensure sediment or deleterious substances are not released downstream. Significant construction related challenges related to dewatering, in-water timing windows and potential for groundwater seepage due to depth of facility. May require permits from DFO depending on outcome of environmental studies. Construction works may be subject to MECP Permit To Take Water (PTTW). MECP may require water balance mitigation measures in the proposed subdivision/site design if no infiltration facilities are proposed. LTVCA approval may be required under O.Reg. 152/06 for the SWM facilities. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. Impacts to floodplain and erosion thresholds should be assessed prior to detailed design. SWM facility provides Enhanced water quality treatment, peak flow control to runoff from the proposed development.	SWM facilities will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECAs. The constructability of SWM facilities is dependent on the local groundwater elevations and soil conditions. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. LTVCA approval may be required under O.Reg. 152/06 for the SWM facilities. MECP may require water balance mitigation measures in the proposed subdivision/site design if no infiltration facilities are proposed. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. Impacts to floodplain and erosion thresholds should be assessed prior to detailed design. SWM facility provides Enhanced water quality treatment, peak flow control to runoff from the proposed development.
	Constructability				
	Effect on existing utilities and infrastructure				
	Ability to coordinate with existing and planned infrastructure improvements				
	System resiliency and system suitability				
Financial	Lifecycle operations and maintenance costs	No associated costs for SWM. No significant anticipated operations or maintenance costs.	Moderate capital cost as majority of works relate to work on development lands, therefore limited cost anticipated for the Municipality. Operation and maintenance costs are the responsibility of the site owner. Cleanouts of pretreatment measures on public property to be included in operations budget.	High capital cost due to construction of online SWM Facility. The regional pond will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECA. Intermittent cleanouts of the pond forebay(s) and main cells will be required; estimated on a 10-year basis. Sediment cleanouts of the pond will need to be budgeted as a capital expenditure.	High capital cost due to construction of SWM Wet Facilities. The regional ponds will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECA. Intermittent cleanouts of the pond forebay(s) and main cells will be required; estimated on a 10-year basis. Sediment cleanouts of the pond will need to be budgeted as a capital expenditure.
	Estimated capital cost				
Summary Ranking	**Green is the most well aligned with the criterions, Yellow is somewhat aligned with the criterions, and red is the least well aligned with the criterions.**	**Not Preferred**	**Preferred Alternative**	**Less Preferred Alternative**	**Less Preferred Alternative**

Ranking		Alternative		
		East Delaware		
		1	2	3
Category	**Evaluation Criteria**	**Do Nothing**	**Single Wet SWM Facility**	**LID Controls and Dry End-of-Pipe Facility**
Socio-Economic	Potential to impact existing residences, businesses and community features	Untreated runoff from future development area will impact adjacent single-family properties and increase flows to municipal drains. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to development. Occasional flooding of proposed development is anticipated. Flood risk for adjacent properties.	SWM facility reduces available development area and will be incorporated into the proposed development concept for the site. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to construction of SWM facility. SWM wet facility must be designed in order to mitigate the risk of drowning and other hazards to public safety. Short-term impacts during construction should be anticipated. SWM facility can be incorporated into a community walking trail for dual land use opportunity.	Less land requirements for SWM facility than Alternative 2. LID measures can be integrated into urban design. It is anticipated that appropriate cultural heritage assessments will be undertaken in accordance with the appropriate Planning Act applications for future developments. An archaeological assessment will be required prior to construction of dry SWM facility. Landowners will be required to operate and maintain LID features on their property. Short-term impacts during construction should be anticipated. Temporary infrequent deep standing water in proposed dry SWM pond presents a low risk to public safety.
	Potential effect on approved/planned land uses			
	Potential effects on known or potential significant archaeological resources, built heritage resources and cultural landscape features			
	Potential to accommodate planned significant population and job growth in strategic growth areas			
Natural Environment	Potential to impact fish and aquatic habitat	Untreated stormwater from the development area discharges directly to Cummings and Allison Drains. Both drains contain threatened species under the SARA and ESA. Overland flows of untreated stormwater may impact terrestrial resources within the on-site woodlots. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Significant infiltration likely occurs on site under existing conditions. Catchment area is within a Significant Groundwater Recharge Area (SGRA). Catchment area is within a Highly Vulnerable Aquifer Zone (HVA). No impacts to drinking water or source protection policies are anticipated.	Proposed wet SWM facility attenuates flows and treats runoff from proposed development. Outlet to watercourse has high erosion potential during large storm events. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. Proposed development reduces local groundwater recharge volume which can impact local aquifer levels. Impacts of future development may increase potential for contamination. No impacts to drinking water or source protection policies are anticipated.	Proposed SWM infrastructure mitigates water quality and temperature impacts on aquatic life and habitat from proposed development. Outlet to watercourse has high erosion potential during large storm events. No significant terrestrial impacts are anticipated as SWM facilities should be located with a buffer outside of significant features. Site-specific environmental impact assessments (EIS) should be conducted prior to detailed design and construction to confirm the presence/absence of significant habitats and resources, including SAR. LID controls mitigate impact of proposed development on local annual infiltration volume which can negatively impact local aquifer levels. Select impervious runoff into infiltration facilities poses a potential risk for groundwater contamination. No impacts to drinking water or source protection policies are anticipated.
	Potential to impact water resources including surface water (i.e. rivers, creeks, etc.), groundwater recharge areas and wellhead protection areas			
	Potential to impact significant natural heritage features			
	Potential to impact significant wildlife habitat and species at risk			
Technical Considerations	Potential land requirements including land purchase and temporary/permanent easements	No significant impacts to operation and maintenance schedules are anticipated. Development construction requires sediment and erosion control measures. Does not meet municipality stormwater design standards or OWRA requirements. Flooding is anticipated within the proposed development area.	Wet SWM facility will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECAs. The constructability of SWM facility is dependent on the local groundwater elevations and soil conditions. It is anticipated that Wet Ponds will be deeper than the Dry facilities in Alternative 3 due to the addition of a permanent pool. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. Municipal drain abandonment to be completed in accordance with the requirements of the Drainage Act. An MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. MECP may require water balance mitigation measures in the proposed subdivision/site design if no infiltration facilities are proposed. UTRCA approval is required under O.Reg. 157/06 for the SWM facilities. SWM facilities provide Enhanced water quality treatment and peak flow control for runoff from the proposed development.	Operation and maintenance of privately owned LID measures will be the responsibility of the owner. A bylaw may be required to compel owners to operate and maintain their LID measures. SWM facilities will require ongoing monitoring and maintenance by the private landowners with the conditions of the corresponding ECAs. The municipality will be responsible for operating and maintaining SWM measures located on public lands. The constructability of SWM facilities is dependent on the local groundwater elevations and soil conditions. A portion of the on-site soil conditions are conducive to infiltration features. Constraints to LID feature constructability will be depended on the development site plan, grading and servicing. Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. MECP ECA or incorporation to Consolidated Linear Infrastructure (CLI) is required. UTRCA approval is required under O.Reg. 157/06 for the SWM facilities. LID controls provide Enhanced water quality treatment / retention of the 25mm storm event, peak flow control and temperature mitigation to runoff from the proposed development. Groundwater recharge and water balance objectives are achieved through onsite LID features. High groundwater elevations may interfere with LID design and operation. Impacts to floodplain should be assessed prior to detailed design.
	Constructability			
	Effect on existing utilities and infrastructure			
	Ability to coordinate with existing and planned infrastructure improvements			
	System resiliency and system suitability			
Financial	Lifecycle operations and maintenance costs	No associated costs for SWM. No significant anticipated operations or maintenance costs.	This alternative has the highest estimated capital costs. The regional pond will require ongoing monitoring and maintenance by the municipality in accordance with the conditions of the corresponding ECA. Intermittent cleanouts of the pond forebay(s) and main cells will be required; estimated on a 10-year basis. Sediment cleanouts of the pond will need to be budgeted as a capital expenditure.	Estimated capital cost for proposed regional SWM pond is anticipated to be lower than Alternative 2. Costs associated with maintenance of pretreatment measures and inspections are anticipated to be moderately high. Maintenance and cleanouts of the Dry facilities will be the responsibility of the property owners. Cleanouts of pretreatment measures on public property to be included in operations budget. Capital costs and maintenance costs of private LID features and Dry facilities to be borne by the developer and property owners, respectively. Long-term costs to municipality are low-moderate compared to Alternative 2.
	Estimated capital cost			
Summary Ranking	**Green is the most well aligned with the criterions, Yellow is somewhat aligned with the criterions, and red is the least well aligned with the criterions.**	**Not Preferred**	**Less Preferred Alternative**	**Preferred Alternative**

APPENDIX D:
Opinion of Probable Costs

Middlesex Masterplan Preliminary Costing Summary - Stormwater

Location	Alternative	Subtotal - SWM Features (Rounded)	Fixed Costs	Sub-Total Cost	Contingency	Engineering	Summation	Total Project Cost
West Komoka	2	$1,780,000	$76,000	$1,856,000	$556,800	$371,200	$1,004,000	$2,784,000
West Komoka	3	$1,470,000	$76,000	$1,546,000	$463,800	$309,200	$849,000	$2,319,000
South Komoka	2	$1,187,000	$76,000	$1,263,000	$378,900	$252,600	$707,500	$1,894,500
South Komoka	3	$1,081,000	$76,000	$1,157,000	$347,100	$231,400	$654,500	$1,735,500
Delaware Employment	2	$1,832,000	$76,000	$1,908,000	$572,400	$381,600	$1,030,000	$2,862,000
Delaware Employment	4	$1,933,000	$76,000	$2,009,000	$602,700	$401,800	$1,080,500	$3,013,500
East Delaware	2	$455,000	$76,000	$531,000	$159,300	$106,200	$341,500	$796,500
East Delaware	3	$330,000	$76,000	$406,000	$121,800	$81,200	$279,000	$609,000
Old Kilworth	2	$211,000	$100,000	$311,000	$93,300	$62,200	$255,500	$466,500
Old Kilworth	3	$200,000	$100,000	$300,000	$90,000	$60,000	$250,000	$450,000

	West Komoka	Unit	Quantity	Cost ($)
Alt 2				
Wet Facility 1	Headwall w/ Grate and Chainlink	Each	3	$42,786.09
	Outlet Structure	LS	2	$42,470.35
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	100	$8,250.00
	Fencing	m	500	$61,094.00
	Planting / Restoration	LS	2	$88,000.00
	Excavation	m3	20000	$348,480.00
	Dewatering During Construction	LS	5	$18,150.00
	Clay Liner	m3	500	$8,250.00
	Total			$650,682
Wet Facility 2	Headwall w/ Grate and Chainlink	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	15000	$261,360.00
	Dewatering During Construction	LS	1	$3,630.00
	Clay Liner	m3	300	$4,950.00
	Storm sewer outlet	m	1000	$607,674.10
	Total			$1,060,050
	Cooling Trench	Each	1	$68,626.50
	Total			$1,779,359

	West Komoka	Unit	Quantity	Cost ($)
Alt 3				
Wet Facility 1	Headwall w/ Grate and Chainlink	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	300	$18,931.12
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	300	$36,656.40
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	10000	$174,240.00
	Dewatering During Construction	LS	1	$3,630.00
	Clay Liner	m3	300	$4,950.00
	Total			$340,417
Wet Facility 2	Headwall w/ Grate and Chainlink	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	15000	$261,360.00
	Dewatering During Construction	LS	1	$3,630.00
	Clay Liner	m3	300	$4,950.00
	Storm sewer outlet	m	1000	$607,674.10
	Total			$1,060,050
	Cooling Trench	Each	1	$68,626.50
	Total			$1,469,094

	South Komoka	Unit	Quantity	Cost ($)
Alt 2	Excavation and disposa	m3	1500	$74,250.00
Bioswale x 5	Beehive catch basin	each	15	$23,100.00
	200 mm diameter perf	m	750	$49,500.00
	Amended soil	cu. yard	500	$23,375.00
	Rock chip layer	tn	100	$5,500.00
	Rock Trench c/w clears	tn	2000	$81,400.00
	Seed	m2	500	$1,100.00
	Perimeter plantings	each	500	$19,250.00
	Total			$277,475.00
Upstream LID	Stormceptor	Each	2	$134,889.25
	Infiltration Galleries	Each	30	$774,602.43
Total				$1,186,967

	South Komoka	Unit	Quantity	Cost ($)
Alt 3				
Wet Facility 1	Headwall w/ Grate and	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	100	$8,250.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	18000	$313,632.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	500	$8,250.00
	Total			$509,598
Wet Facility 2	Headwall w/ Grate and	Each	4	$57,048.12
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	20000	$348,480.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	500	$8,250.00
	Total			$571,320
Total				$1,080,919

Delaware Employment		Unit	Quantity	Cost ($)
Alt 2				
Dry Facility 1	Headwall w/ Grate and	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	450	$28,396.69
	Signage	Each pond	1	$1,650.00
	Access	m2	100	$8,250.00
	Fencing	m	0	$0.00
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	5000	$87,120.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	0	$0.00
	Total			$222,806
Dry Facility 2	Headwall w/ Grate and	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	200	$12,620.75
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	0	$0.00
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	4000	$69,696.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	0	$0.00
	Total			$187,956
Dry Facility 3	Headwall w/ Grate and	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	200	$12,620.75
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	0	$0.00
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	4000	$69,696.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	0	$0.00
	Total			$187,956
Dry Facility 4	Headwall w/ Grate and	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	200	$12,620.75
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	0	$0.00
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	4000	$69,696.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	0	$0.00
	Total			$187,956
Upstream LID	Stormceptor	Each	4	$269,778.50
	Infiltration Galleries	Each	30	$774,602.43
Total				$1,831,055

Delaware Employment		Unit	Quantity	Cost ($)
Alt 4				
Wet Facility 1	Headwall w/ Grate anc	Each	3	$42,786.09
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	750	$47,327.81
	Signage	Each pond	1	$1,650.00
	Access	m2	150	$12,375.00
	Fencing	m	300	$36,656.40
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	20000	$348,480.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	750	$12,375.00
	Total			$570,515
Wet Facility 2	Headwall w/ Grate anc	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	15000	$261,360.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	400	$6,600.00
	Total			$454,026
Wet Facility 3	Headwall w/ Grate anc	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	15000	$261,360.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	400	$6,600.00
	Total			$454,026
Wet Facility 4	Headwall w/ Grate anc	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	80	$6,600.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	15000	$261,360.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	400	$6,600.00
	Total			$454,026
Total				$1,932,594

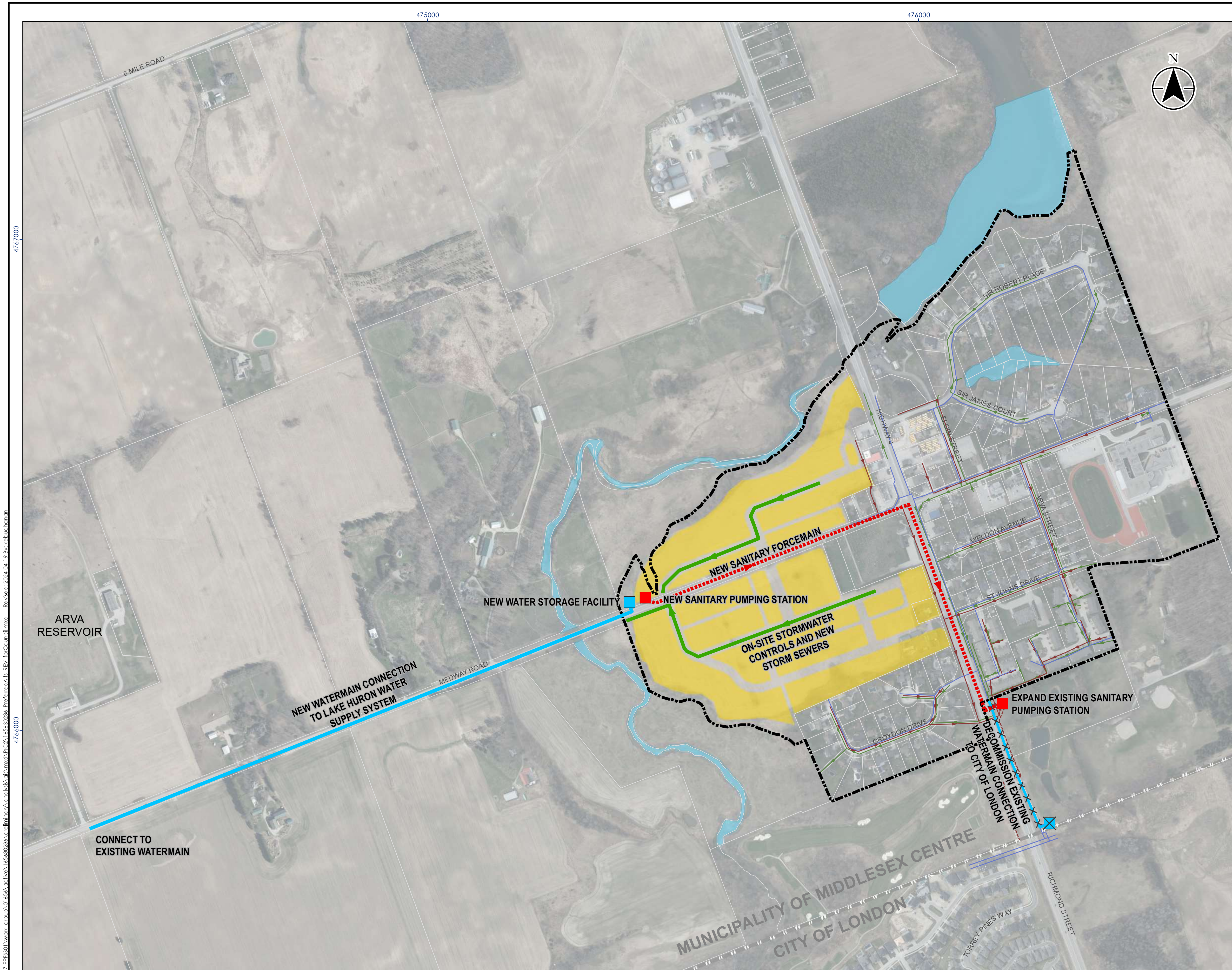
	East Delaware	Unit	Quantity	Cost ($)
Alt 2				
Wet Facility 1	Headwall w/ Grate and	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	500	$31,551.87
	Signage	Each pond	1	$1,650.00
	Access	m2	100	$8,250.00
	Fencing	m	400	$48,875.20
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	15000	$261,360.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	350	$5,775.00
	Total			$454,851
Total				$454,851

	East Delaware	Unit	Quantity	Cost ($)
Alt 3				
Dry Facility 1	Headwall w/ Grate and	Each	2	$28,524.06
	Outlet Structure	LS	1	$21,235.18
	Rip-rap	m2	250	$15,775.94
	Signage	Each pond	1	$1,650.00
	Access	m2	100	$8,250.00
	Fencing	m	0	$0.00
	Planting / Restoration	LS	1	$44,000.00
	Excavation	m3	5000	$87,120.00
	Dewatering During Cor	LS	1	$3,630.00
	Clay Liner	m3	0	$0.00
	Total			$210,185
Upstream LID	Stormceptor	Each	1	$67,444.63
	Infiltration Galleries	Each	2	$51,640.16
Total				$329,270

	Old Kilworth	Unit	Quantity	Cost ($)
Alt 2	Excavation and disposal	m3	4000	$198,000.00
	Culvert	m	12	$2,468.40
	Restoration	Ls	1	$10,000.00
	Total			$210,468

	Old Kilworth	Unit	Quantity	Cost ($)
Alt 3	Excavation and disposal off site	m3	1000	$49,500.00
Bioswale x 5	Beehive catch basin	each	10	$15,400.00
	200 mm diameter perforated HD	m	500	$33,000.00
	Amended soil	cu. yard	150	$7,012.50
	Rock chip layer	tn	50	$2,750.00
	Rock Trench c/w clearstone and	tn	2000	$81,400.00
	Seed	m2	400	$880.00
	Perimeter plantings	each	250	$9,625.00
	Total			$199,568

APPENDIX E:
Preferred Alternative Figures



Stantec

Legend

- Settlement Boundary
- Parcel
- Future Growth Area

Proposed Project

- Sanitary
- Water
- Storm

Existing Servicing

- Sanitary Facility
- Sanitary Sewer
- Sanitary Forcemain
- Water Facility
- Watermain
- Storm Sewer

0 250 500 m

1:8,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Produced using information licensed under Open Government License - Ontario. Produced using information © County of Middlesex 2023. Parcels © Teranet Enterprises Inc. and its suppliers. All rights reserved. Not a plan of survey.
3. Spring 2020 orthoimagery © 2023 King's Printer for Ontario. All Rights Reserved.

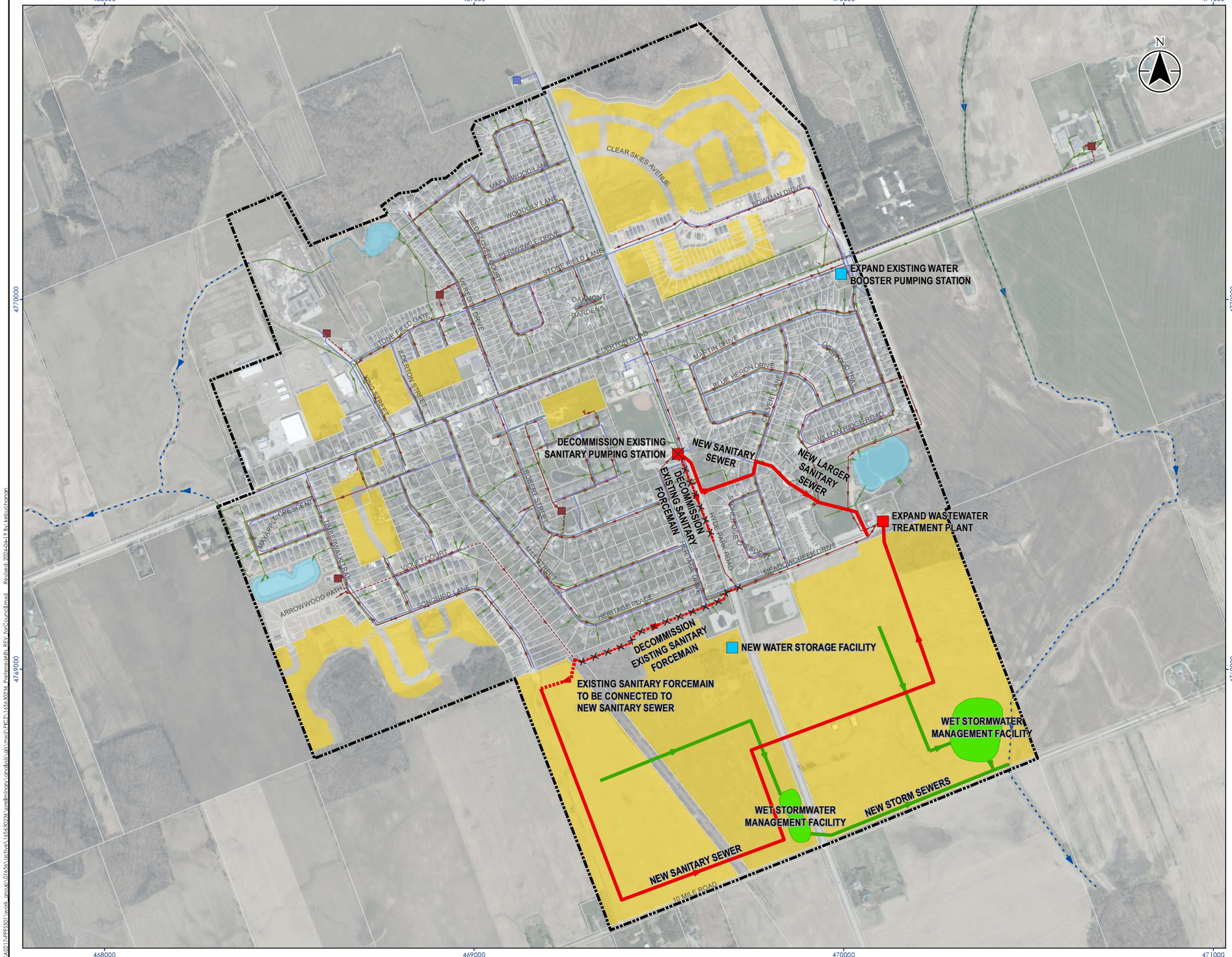
Project Location
Municipality of Middlesex Centre

165630236 REVA
Prepared by KDB on 2024-04-19

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
6-1

Title
Proposed Projects
Arva



Stantec

Legend

- Settlement Boundary
- Parcel
- Future Growth Area

Proposed Project

- Sanitary
- Water
- Storm

Existing Servicing

- Sanitary Facility
- Sanitary Sewer
- Sanitary Forcemain
- Water Facility
- Watermain
- Storm Sewer

0 250 500 m

1:10,500 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Produced using information licensed under Open Government License - Ontario. Produced using information © County of Middlesex 2023. Parcels © Teranet Enterprises Inc. and its suppliers. All rights reserved. Not a plan of survey.
3. Spring 2020 orthoimagery © 2023 King's Printer for Ontario. All Rights Reserved.

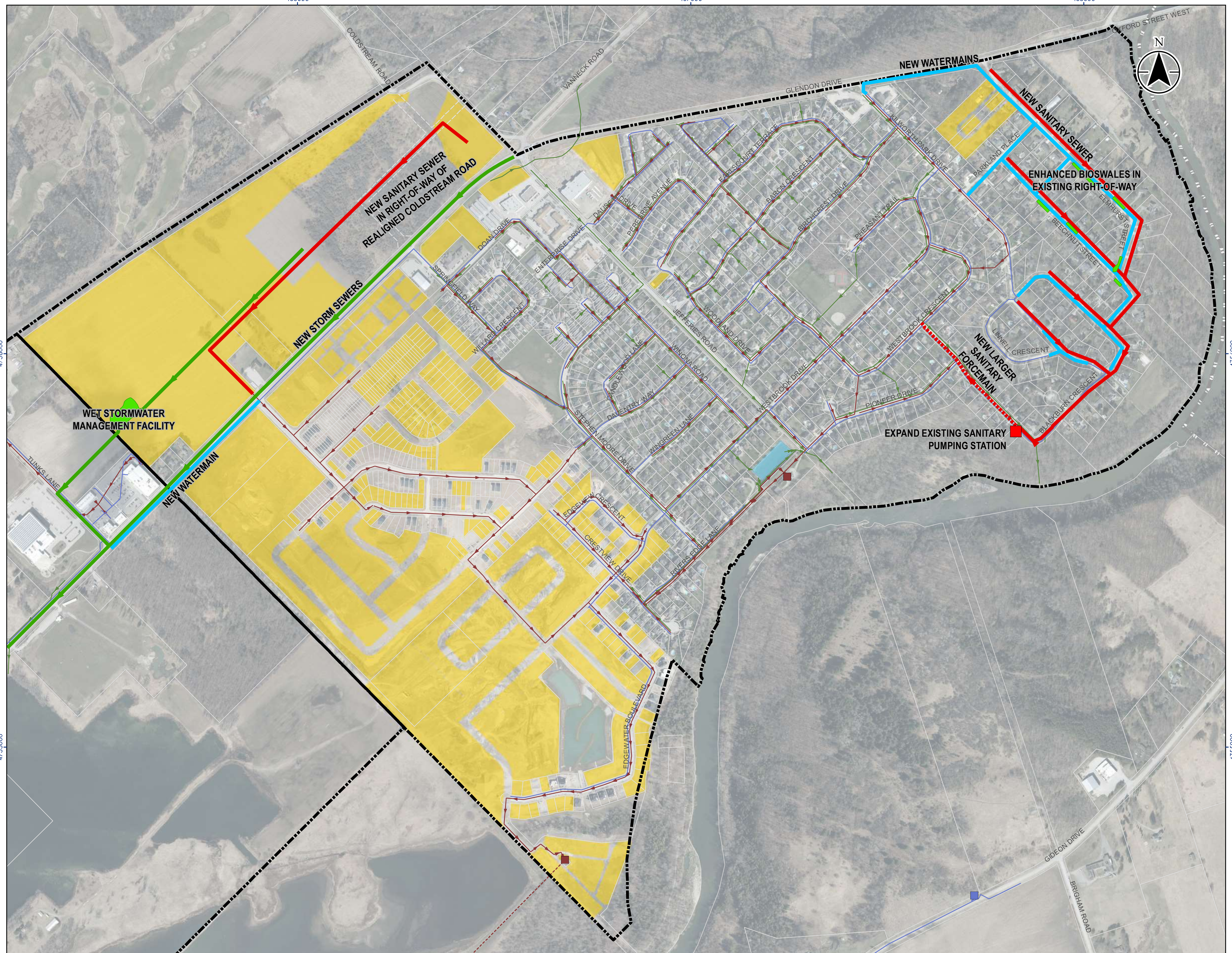
Project Location
Municipality of Middlesex Centre

165630236 REVA
Prepared by KDB on 2024-04-19

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
6-2

Title
Proposed Projects
Ilderton



Legend

- Settlement Boundary
- Parcel
- Future Growth Area

Proposed Project

- Sanitary
- Water
- Storm

Existing Servicing

- Sanitary Facility
- Sanitary Sewer
- Sanitary Forcemain
- Water Facility
- Watermain
- Storm Sewer

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Produced using information licensed under Open Government License - Ontario. Produced using information © County of Middlesex 2023. Parcels © Teranet Enterprises Inc. and its suppliers. All rights reserved. Not a plan of survey.
3. Spring 2020 orthoimagery © 2023 King's Printer for Ontario. All Rights Reserved.

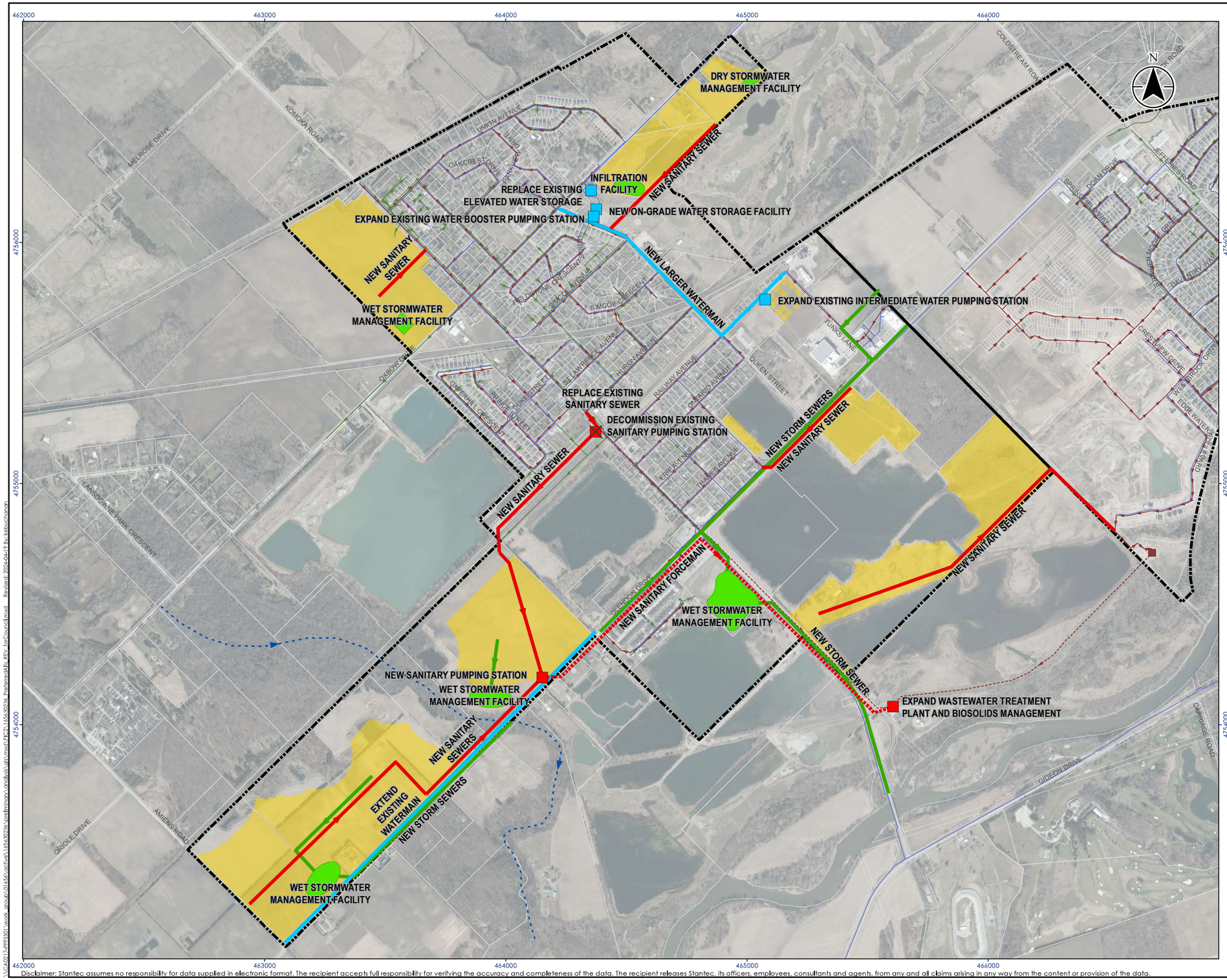
Project Location
Municipality of Middlesex Centre

165630236 REVA
Prepared by KDB on 2024-04-19

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
6-3

Title
Proposed Projects Kilworth



Stantec

Legend

- Settlement Boundary
- Parcel
- Future Growth Area

Proposed Project

- Sanitary
- Water
- Storm

Existing Servicing

- Sanitary Facility
- Sanitary Sewer
- Sanitary Forcemain
- Water Facility
- Watermain
- Storm Sewer

0 250 500 m

1:16,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Produced using information licensed under Open Government License - Ontario. Produced using information © County of Middlesex 2023. Parcels © Teranet Enterprises Inc. and its suppliers. All rights reserved. Not a plan of survey.
3. Spring 2020 orthoimagery © 2023 King's Printer for Ontario. All Rights Reserved.

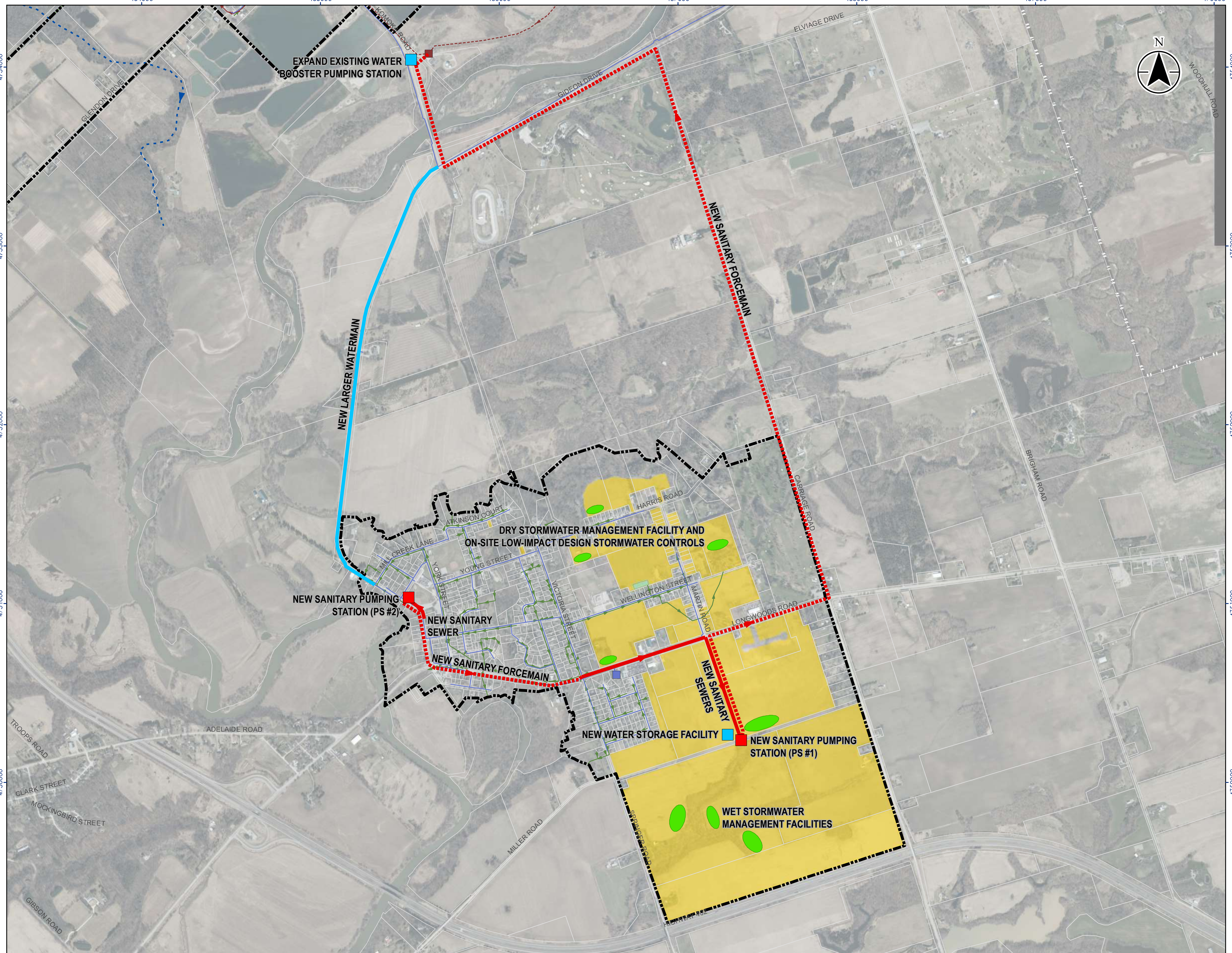
Project Location
Municipality of Middlesex Centre

165630236 REVA
Prepared by KDB on 2024-04-19

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
6-4

Title
Proposed Projects
Komoka



Stantec

Legend

Settlement Boundary
Parcel
Future Growth Area

Proposed Project
- Sanitary
- Water
- Storm

Existing Servicing
- Sanitary Facility
- Sanitary Sewer
- Sanitary Forcemain
- Water Facility
- Watermain
- Storm Sewer

0 250 500 m
1:22,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Produced using information licensed under Open Government License - Ontario. Produced using information © County of Middlesex 2023. Parcels © Teranet Enterprises Inc. and its suppliers. All rights reserved. Not a plan of survey.
3. Spring 2020 orthoimagery © 2023 King's Printer for Ontario. All Rights Reserved.

Project Location
Municipality of Middlesex Centre

165630236 REVA
Prepared by KDB on 2024-04-19

Client/Project
MUNICIPALITY OF MIDDLESEX CENTRE
MASTER SERVICING PLAN

Figure No.
6-5

Title
Proposed Projects Delaware