Delaware Community Settlement Area Stormwater Master Plan

Municipality of Middlesex Centre

Stantec Consulting Ltd.
600-171 Queens Ave. London ON N6A 5J7
On behalf of:
Municipality of Middlesex Centre 10227
Ilderton Road RR#2
Ilderton, ON N0M 2A0

Notice of Completion and 30-Day Review

Delaware Community Settlement Area Stormwater Master Plan

Municipality of Middlesex Centre

NOTICE OF COMPLETION

Delaware Community Settlement Area Stormwater Master Plan

The Municipality of Middlesex Centre has completed a Municipal Class Environmental Assessment (Class EA) Master Plan to identify the necessary storm drainage system improvements to better service the existing community and to address future growth. Recommended alternatives range from ditch improvements, storm sewer installation, outlet modifications, and dry SWM ponds to address future development. This Notice hereby serves as the Notice of Completion for the Schedule B projects identified within the Master Plan.

By this Notice, the Draft Master Plan document will be placed on public record on THURSDAY, February 11th, 2016, to be reviewed by the public, and/or other interested parties at the following locations:

Interested persons should submit comments on the Master Plan document by MARCH 14th, 2016. Please forward comments to Brian Lima, P. Eng., at the address provided:

Delaware Public Library
29 Young Street
Delaware, ON
N0L 1E0
Ph: 519.652.9978
Hours: Tues 4-8pm, Thurs 6-8pm, Sat 10am-12pm.

Stantec Consulting Ltd.
600-171 Queens Ave.
London, ON N6A 5J7
Ph: 519-645-2007
Hours: Monday to Friday
8:30 a.m. – 5:00 p.m.

Middlesex Centre Public Works and Engineering
10227 Ilderton Rd,
Ilderton, ON N0M 2A0
Ph: 519-666-0190
Hours: Monday to Friday
8:30 a.m. -5:00 p.m.

Brian Lima, P.Eng.
Director – Public Works and Engineering
10227 Ilderton Road RR2
Ilderton, ON N0M 2A0
Phone: (519)-666-0190 ext.233
Fax: (519) 666-0271
Email: lima@middlesexcentre.on.ca

If concerns cannot be resolved within the review period, any interested party may request the Minister of Environment to issue an order to comply with Part II of the EA Act, elevating the status of the project. **Please note**: Part II Order requests cannot be made against the entire Master Plan document, but only against Schedule B project identified within the Master Plan. The procedure for a "Part II Order" request is as follows:

- The person with the concern shall make a written submission to the Ministry of the Environment and Climate Change, Floor 11, 77 Wellesley St. W Toronto ON M7A 2T5, Fax: 416-314-8452 and the Director, Environmental Approvals Branch, Ministry of the Environment and Climate Change 135 St. Clair Ave West, 1st Floor, Toronto ON M4V 1P5 with a copy to the Municipality of Middlesex Centre. This written request must be submitted to the Minister within the 30-calendar day review period after the proponent has filed the Master Plan document on public record and issued the Notice of Completion.

If no Part II Order requests are received, and subject to receipt of the necessary approvals, the Municipality of Middlesex Centre can proceed with design and implementation of projects identified within the Master Plan.

RECEIVED
MAR 17 2016
Municipality of Middlesex Centre

Brian Lima, P.Eng.,
Director – Public Works and Engineering,
Middlesex Centre,
10227 Ilderton Road RR2,
Ilderton, ON N0M 2A0

Re: Delaware Stormwater Master Plan

Dear Mr. Lima,

I wanted to offer feedback on the Delaware Stormwater Master Plan that you finalized in February. The feedback is primarily concerned with the "Thompson Drain" sections as they directly affect residents along Victoria Street.

I recently circulated your 'notice of completion' to concerned residents on Victoria Street, and directed them to the on-line version, or to the Library, to review the final Plan. I then solicited feedback from them, to be included in this response.

Firstly, folks were very appreciative of the work that you and your Team have done on this important foundational piece. We were also very pleased to see that you have recommended, as you stated at the October PIC, an Urban Standard for road construction along Victoria Street (Thompson Municipal Drain – Alternative 3 Proposed Storm Sewer).

We were particularly encouraged by the recommendation for "a *Tree Preservation Plan* be completed to document and assess any impact on existing trees along the right of way, and to identify appropriate mitigation measures for any trees requiring removal."

It was also good to see "minimize tree removal during construction" in the mitigation measures noted in table 8.1 (Potential Impact and Mitigation Measures).

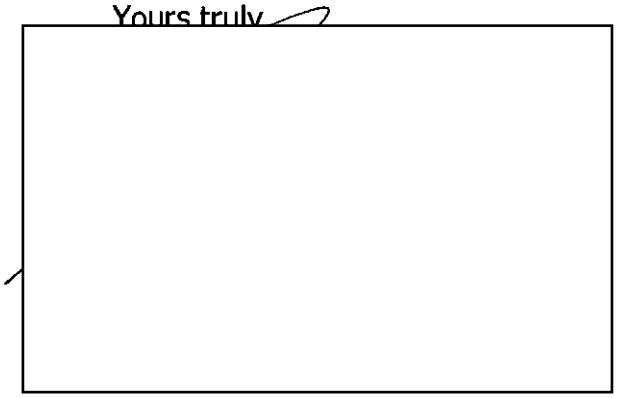
Concerns remain of course (including those who sincerely feel that road work along Victoria Street is not necessary) – what are the road design specifics (position, width, curb style, sidewalk location, boulevard width, etc.) and what trees are in peril? What will be done with Thompson Drain connections that are located on private property?

We currently are experiencing a high volume of traffic "cut throughs" on Victoria and Wellington streets, and speeding is a growing concern. Can anything be done to slow vehicles down once they are presented with a nice new, wider roadway?

Moving forward, we would like to request that residents on Victoria Street be involved in the development of the *Tree Preservation Plan,* and the design specifications for road construction as they are developed. I believe that this would help restore trust that was lost during the initial rollout of the 'Wellington Street, Victoria Street, Martin Road Reconstruction Project".

Thank you for taking the time to develop a plan that has the potential to work for all residents of Delaware, and we look forward to working with you on that plan in the future.

Yours truly



CC: Frank Berze

From: Brian Lima
To: [redacted]
Cc: Frank Berze; Oliveira, Nelson; Bergman, Stephanie
Subject: RE: Delaware Community Settlement Area Stormwater Master Plan--Resident Response
Date: Thursday, March 17, 2016 5:34:05 PM
Attachments: image005.png
image006.png
image007.png
image008.png

Good Afternoon Richard,

Thank you for your interest in this project. With regards to your inquiry, I believe your reference to the Longwoods Road Storm Sewer #1 may be incorrect as that system is located to the west near Gideon Drive and Longwoods Road. As part of the drainage area reviews, consideration was given to potentially directing flows to the Longwoods Road Culvert (which I believe you may be referring to). However, there are topography constraints associated with Wellington Street which impacts the ability to direct flows to this system. The proposed Longwoods Road Culvert area is also dependent on future development to proceed and therefore an outlet is not available, even if the topography was to work. Furthermore, flows (if possible to convey) would now be discharged to a different outlet and input from the Lower Thames Valley Conservation Authority (LTVCA) indicated concerns with directing additional flows to different outlets (even if just upstream).

Please be aware that the costs noted for the Thompson Drain does include items that are required regardless of the solution, including realignment/repairs to drains and required roadworks (works that would be necessary to address condition, etc.).

In relation to your specific issues raised in 2015, many of these can only be confirmed during the design stage. Please note that Municipal staff will continue to aim to address to the extent possible the concerns detailed in your email through a revision of the detailed design, anticipated to be finalized by year's end. Please also be advised that an informal Public Information Centre will be held this fall to table the revised detailed design with affected residents prior to the reconstruction works in early 2017.

Best Regards,

Brian Lima, P.Eng.
Director of Public Works & Engineering
Middlesex Centre | lima@middlesexcentre.on.ca
10227 Ilderton Road, RR#2 | Ilderton, Ontario, N0M 2A0
Tel: 519.666.0190 | Fax: 519.666.0271

[redacted]

To: Brian Lima <lima@middlesexcentre.on.ca>
Subject: Fw: Delaware Community Settlement Area Stormwater Master Plan--Resident Response

Brian please review following. Original message had incorrect E-Mail address for you.

Dear Brian,
As one of the concerned residents in Delaware, I have reviewed the above mentioned Stormwater Master Plan, specifically those parts that directly impact Victoria Street.

I was pleased to note that Middlesex Centre has listened to the concerns voiced by Delaware's residents and undertaken this review prior to moving forward on any other ROW proposals specifically along Victoria Street. As indicated in the report there apparently are a number of water control issues throughout Delaware, although none directly along Victoria street.

If I understand the Master Plan, it would seem to support our previously voiced concerns about the ROW proposals of 2015 along Victoria Street are not required simply to move surface water. We maintained last year that Victoria St. has not had any surface water issues for the last 20+ years.
The primary concerns voiced last year were by residents along Wellington Street to the east of Victoria and from OLOL.

That said, referencing the Stormwater Master Plan, would you explain why Wellington Street water issues cannot be resolved by tying in with the Longwoods Road Storm Sewer #1. If this was done then is there not the potential cost savings of $1,121.859 or portion thereof, by doing nothing on Victoria Street? Only Wellington Street and Martin would require upgrading??!!

Since this Master Plan is believed to set the next stage for any ROW Urban Design changes along Victoria, Wellington Streets and Martin Road, if Council approves, then I am requesting that the "Save Victoria Street" group of residents continue to be involved / notified of any specific Victoria Street reconstruction proposals as we have a vested interest in how any changes may impact our properties along with traffic flow.

Some of the issues raised in 2015 with Middlesex Centre Council were:
-identification of which trees, if any, may be removed
-Will any trees being removed be replaced? Where? What species?
-Where exactly is the centre line of the proposed new ROW Urban Design? Can this be boldly marked on the existing street for impact consideration?
-When will we see actual DRAFT ROW Urban Design proposals for Victoria Street?
-Will we be provided with actual topography overlays prior to any reconstruction proposals being approved to better understand, review and comment on the placement of said ROW Urban Design ?

From: Brian Lima [mailto:lima@middlesexcentre.on.ca]
Sent: Monday, March 14, 2016 4:12 PM
To: Oliveira, Nelson; Bergman, Stephanie
Subject: Fwd: Delaware Community Settlement Area Stormwater Master Plan--Resident Response

Hi Nelson/Stephanie,

Can you please draft the appropriate response wet the EA references?

For the other elements I'll simply respond by saying such items will be confirmed through the detailed design.

Thanks

Brian Lima, P.Eng.
Director, Public Works and Engineering
Municipality of Middlesex Centre
Phone: (519) 666-0190 Ext. 233
lima@middlesexcentre.on.ca

Sent from my iPhone

Begin forwarded message:

Brian please review following. Original message had incorrect E-Mail address for you.
Rick Richman

On Monday, March 14, 2016 3:43 PM, RICHARD RICHMAN <rric7823@rogers.com> wrote:

Dear Brian,
As one of the concerned residents in Delaware, I have reviewed the above mentioned Stormwater Master Plan, specifically those parts that directly impact Victoria Street.

I was pleased to note that Middlesex Centre has listened to the concerns voiced by Delaware's residents and undertaken this review prior to moving forward on any other ROW proposals specifically along Victoria Street. As indicated in the report there apparently are a number of water control issues throughout Delaware, although none directly along Victoria street.

If I understand the Master Plan, it would seem to support our previously voiced concerns about the ROW proposals of 2015 along Victoria Street are not required simply to move surface water. We maintained last year that Victoria St. has not had any surface water issues for the last 20+ years.
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-When will we see actual DRAFT ROW Urban Design proposals for Victoria Street?
-Will we be provided with actual topography overlays prior to any reconstruction proposals being approved to better understand, review and comment on the placement of said ROW Urban Design ?
----For instance will curbs and sidewalks be butted eliminating any boulevard between and hence making the ROW as narrow in width as possible to prevent property encroachment yet provide appropriate traffic flow?
---will curbs be what I believe are called roll over style that tend to last longer and yet provide access to properties?

I, along with others, look forward to working with Middlesex Centre to accomplish the best resolutions to meet all concerns.

From: Brian Lima
To: Doug
Cc: Frank Berze
Subject: RE: Delaware Stormwater Master Plan > Feedback from residents on Victoria Street
Date: Monday, March 14, 2016 4:46:20 PM
Attachments: image001.png
image003.png
image005.png
image007.png

Good Afternoon Doug,

Firstly, thank you for your interest in the Delaware Stormwater Master Plan and our community. Please note that Municipal staff will continue to aim to address to the extent possible the concerns detailed in your email below through a revision of the detailed design, anticipated to be finalized by year's end, and that such concerns don't appear to be associated with the Master Plan.

Please also be advised that an informal Public Information Centre will be held this fall to table the revised detailed design with affected residents prior to the reconstruction works in early 2017.

Best Regards,

Brian Lima, P.Eng.
Director of Public Works & Engineering
Middlesex Centre | lima@middlesexcentre.on.ca
10227 Ilderton Road, RR#2 | Ilderton, Ontario, N0M 2A0
Tel: 519.666.0190 | Fax: 519.666.0271

From:
Sent: Monday, March 14, 2016 4:29 PM
To: Brian Lima <lima@middlesexcentre.on.ca>
Cc: Frank Berze <fberze@rogers.com>
Subject: Re: Delaware Stormwater Master Plan > Feedback from residents on Victoria Street

Dear Brian;

I wanted to offer feedback on the Delaware Stormwater Master Plan that you finalized in February. The feedback is primarily concerned with the "Thompson Drain" sections as they directly affect residents along Victoria Street.

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Thank you for taking the time to develop a plan that has the potential to work for all residents of Delaware, and we look forward to working with you on that plan in the future.

Yours truly,

CC: Frank Berze

www.savevictoriastreet.ca

Moving forward, we would like to request that residents on Victoria Street be involved in the development of the *Tree Preservation Plan,* and the design specifications for road construction as they are developed. I believe that this would help restore trust that was lost during the initial rollout of the 'Wellington Street, Victoria Street, Martin Road Reconstruction Project".

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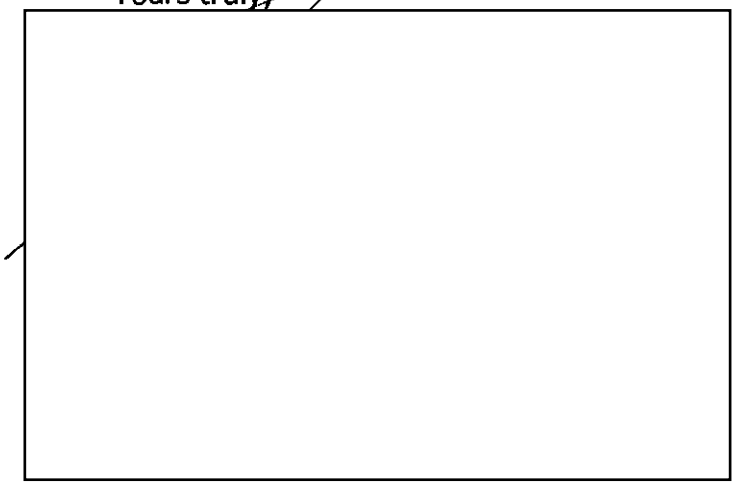

From:	Oliveira, Nelson
To:	cfnchief@live.com
Cc:	Brian Lima (lima@middlesexcentre.on.ca); Bergman, Stephanie
Subject:	Delaware Community Settlement Stormwater Master Plan
Date:	Tuesday, February 23, 2016 9:14:12 AM
Attachments:	Latest_ExecSum_Delaware_SWM.pdf

Good morning Chief Hillier:

As requested, please find attached a pdf copy of the executive summary for the above noted project. I have also printed a hard copy and will have this sent to your attention.

Best regards,

Nelson Oliveira, P.Eng
Sector Leader, Water
Stantec
Phone: 519-675-6620 (Direct Line)
Cell: 519-494-7642
Fax: 519-645-6575
nelson.oliveira@stantec.com

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Please consider the environment before printing this email.

TRACER
Team Response and Commitment to Environmental Requirements
Delaware Community Settlement Area Stormwater Master Plan
Aboriginal Consultation Tracer

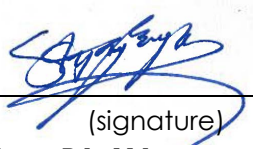
Name and Contact Information	Notice of Commencement (September 10, 2014)	Response/Follow-Up	Notice of PIC 1 (September 21, 2015)	Response/Follow-Up	Notice of Completion (February 8th, 2016)	Response/Follow-Up
Moravian of the Thames Chief Greg Peters Justin Logan 14670 School House Line, RR#3 Thamesville, ON N0P 2K0	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Follow-up email was sent to Chief Peters and Justin Logan on November 9th, 2015 with PIC presentation materials.	Delivered by Canada Post Letter Mail	No response received.
Chippewas of the Thames Chief Joe Miskokomon Ms. Fallon Burch/Mary Alikakos 320 Chippewa Rd. Muncey, ON NOL 1Y1	Delivered by Canada Post Letter mail	Jan 28, 2015 email response letter. Community would like to receive Master Plan for review and any additional environmental documentation.	Delivered by Canada Post Letter Mail	M. Alikakos attended PIC, and requested a copy of material presented, which was sent via email on October 9th. Letter response was received on October 15, stating that due to the proximity of Delaware to lands subject to the Longwoods Treaty (1820), and its location within lands subject to the Big Bear Creek Additions to Reserve land selection area, the community has expressed a high value of interest; direct consultation will be conducted at the next stages of the study. A meeting was held on January 28th, 2015. Stantec staff informed Mary A. that the Master Plan has been completed, and that she would be receiving the Notice of Completion soon. A digital copy of the document can be provided, if needed.	Delivered by Canada Post Letter Mail	No response received.
Munsee-Delaware Nation Chief Roger Thomas Glen Forrest 290 Jubilee Rd. Muncey, ON N0L 1Y1	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Follow-up call on November 9th. Message was left with Band Manager Glen Forrest, and presentation material was sent via email.	Delivered by Canada Post Letter Mail	No response received.
Oneida Nation of the Thames Chief Sheri Doxtator Cherilyn Hill 2212 Elm Ave. Southwold, ON N0L 2G0	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Follow-up phone call on November 9th 2015 to confirm that community did not require further consultation. Presentation material was forwarded via to Chief's Assistant Cherilyn Hill.	Delivered by Canada Post Letter Mail	No response received.
Bkejwanong Territory (Walpole Island) Chief Dan Miskokomon Dr. Dean Jacobs	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter mail	Follow-up email was sent to Chief Miskokomon, Jared Macbeth, and Dean Jacobs on November 9th, 2015 with PIC presentation materials.	Delivered by Canada Post Letter Mail	No response received.

TRACER
Team Response and Commitment to Environmental Requirements
Delaware Community Settlement Area Stormwater Master Plan
Aboriginal Consultation Tracer

Caldwell First Nations **Chief Louise Hillier**	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter mail	Follow-up email was sent to Chief Hillier on Novemeber 9th, 2015with PIC presentation materials.	Delivered by Canada Post Letter Mail	Chief Hillier responded via email on February 21, 2016 requesting copy of the Executive Summary, which was provided via email on February 23, 2016.
Chippewas of Kettle and Stony Point First Nation Thomas Bressette, Suzanne Bressette 6247 Indian Lane, Forest ON N0N 1J0	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Letter received November 19th, 2015: Acknowledgement of Study Commencement. The Community does not require that we engage in consultation regarding the Delaware Master Plan project; however, the Community would like to be informed of any changes in scope and/or amendments to the project that may impact their Traditional Territory. The Community welcomes any additional consultation requests. Consultant Response: No response required. We will continue to provide information and encourage input from the Community throughout the project.	Delivered by Canada Post Letter Mail	No response received.
Southern First Nations Secretariat Ms. Jolene Whiteye 22361 Austin Line Bothwell, ON N0P1C0	Delivered by Canada Post Letter mail	Correspondence received during previous projects has indicated that project information should be sent to the individual Chiefs under this council, and that this council does not review individual projects. The project team will continue to include the Southern First Nations Secretariat in future project correspondence.	Delivered by Canada Post Letter Mail		Delivered by Canada Post Letter Mail	No response received.
Ministry of the Environment Ms. Wendy Comet Ms. Ashley Johnson 135 St Clair Ave W - 3rd Floor Toronto, ON M4P 1V5	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail		Delivered by Canada Post Letter Mail	No response received.
Ministry of Aboriginal Affairs Lands & Trust Services Consultation and Accommodation Unit	Delivered by Canada Post Letter mail	May 26, 2015 - Letter response providing information on First Nations Communities (2) that may have claims impacted by project and additional communities (2) that may be interested based on proximity to project study area. All four communities have already been engaged.	Delivered by Canada Post Letter Mail		Delivered by Canada Post Letter Mail	No response received.

Sign-off Sheet

This document entitled Delaware Community Settlement Area Stormwater Master Plan was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Municipality of Middlesex Centre (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by  (signature)

Stephanie Bergman Hons. BA, MA

Reviewed by  (signature)

Nelson Oliveira, P.Eng.

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Executive Summary

Introduction

The existing storm drainage infrastructure in the Community of Delaware, located within the Municipality of Middlesex Centre (Municipality), was designed and constructed on a site-by-site basis as development occurred, without the benefit of an overall stormwater management strategy. This has resulted in a fragmented drainage system that does not efficiently service the existing community, and which has limited capacity to service future growth.

The Municipality has completed a Municipal Class Environmental Assessment (EA) following the Master Plan approach to identify necessary storm drainage system improvements to better service the existing community and to provide a drainage servicing strategy to accommodate future growth and development within Delaware.

Master Plan and Public Consultation

The intent of the Master Servicing Plan is to address public, review agency, and First Nation community's requirements and concerns and to ensure all possible alternatives and opportunities are fairly assessed and reviewed in a public forum before being finalized and carried forward for implementation.

The Master Servicing Plan is being undertaken in accordance with the Master Planning requirements of the MEA Municipal Class Environmental Assessment (October 2000, as amended in 2007 and 2011). Master Plans are not subject to requests from the public, agencies or First Nations communities for a Minster's Order (Part II Order). However, individual projects identified within a Class EA process can be subject to a Part II Order. As such, the Master Plan can be implemented following Council approval.

The first step in the Municipal Class Environmental Assessment process is to identify the problem or opportunity that has led to the undertaking of the Master Plan. The Problem and Opportunity statement for the Delaware Community Settlement Area Stormwater Master Plan is as follows:

"Historically, there has not been a comprehensive master drainage plan for the entire Delaware Community Settlement Area. Consequently, the existing storm drainage infrastructure within the community was designed and constructed on a site-by-site basis as development occurred, without the benefit of an overall storm management strategy. This has resulted in a fragmented drainage system that does not efficiently service the existing community, and which has limited capacity to service future growth.

A comprehensive stormwater master plan must be developed for the Community to identify necessary storm drainage system improvements to better service the existing community, and to

provide a drainage servicing strategy to accommodate future growth and development. The proposed servicing plan will identify the stormwater infrastructure required to mitigate the possibility of flooding and erosion, provide adequate stormwater treatment, and protect downstream aquatic habitat. The proposed stormwater management strategy will be the optimum solution that balances the following responsibilities:

- *Provides adequate drainage servicing and stormwater treatment;*
- *Protects the natural environment;*
- *Reduces negative impacts on affected landowners; and*
- *Minimizes stormwater servicing costs.*

Furthermore, a funding strategy will be developed to verify that implementation of the proposed Master Plan is feasible. Any other relevant responsibilities identified through the Class EA process will also be integrated into the proposed stormwater servicing strategy."

Consultation with members of the community involved the publication of the Notice of Commencement, an online public survey which was also published in local newspapers and hand-delivered to the entire community of Delaware, and a Public Information Centre (PIC). The Notice of PIC was published in two consecutive editions of the Banner and Londoner newspapers; additionally, all property owners who may potentially be impacted by the proposed alternatives were directly mailed invitations to the PIC. All information presented at the PIC was made available on the Municipality of Middlesex Centre website, and residents were encouraged to submit comments using the comment sheets provided. Consultation with a local landowner/developer was also undertaken to address concerns over preferred alternatives presented at the PIC, and modifications were made to allow flexibility in the location of SWM facilities servicing future developments, and to ensure that proper coordination of servicing is made during the development application process.

All project notices were mailed directly to potentially interested Aboriginal Communities, and follow-up communication was made to ensure that they had appropriate opportunities to review project information and provide comment. An Aboriginal Communications Log was completed for this project to document the communication process.

Several government agencies identified as potentially having interest in the project were added to the contact list and sent all project documentation. An Agency Communications Log was completed for this project to document the communication process. Portions of the study area are regulated by both the Upper Thames River Conservation Authority (UTRCA), and Lower Thames Valley Conservation Authority (LTVCA), and as such they were identified as important stakeholders throughout the project. All information presented at the PIC was forwarded to the representatives of the LTVCA and UTRCA. Subsequently, comments were received from both agencies that were addressed throughout the Master Plan document, and documented in the Agency Communications Log.

General Setting

The study area includes the Community Settlement of Delaware within the Municipality of Middlesex Centre, a lower tier municipality within Middlesex County. Based on the existing storm drainage infrastructure, which consists of municipal drains and municipal storm sewers, the study area was broken down into catchment areas as shown in Figure E.1.

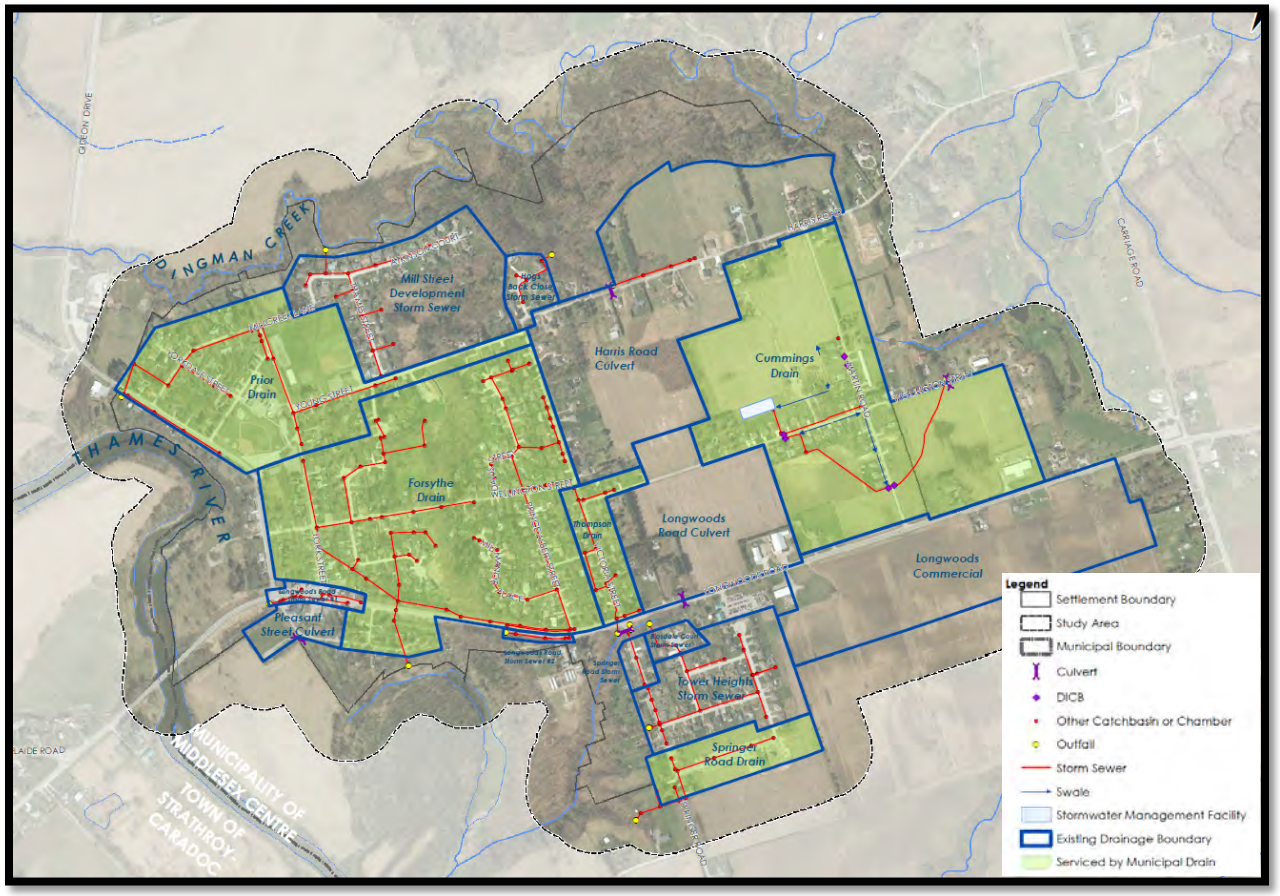


Figure E.1 Study Area

The Community of Delaware is comprised of mainly residential land use, with areas of Commercial and Employment land uses primarily along Longwoods Road. Although the majority of the study area is comprised of built-out residential development, several areas of potential future development were identified based on Municipality of Middlesex Centre Official Plan Schedule A-4 land use designations in order to address and incorporate the future need for stormwater servicing into the stormwater servicing strategy.

Review of Existing Infrastructure

A review of the existing drainage conditions was completed, and the study area was broken down into catchment areas based on the available drawings provided by the Municipality of Middlesex Centre, municipal drainage reports, topographic mapping and site visit observations. Locations of existing or potential surface ponding were identified using sewer design sheets, information provided by the Municipality, as well as collected by public response to the online survey. Please note – the exact nature and causes of the flooding reported on the online survey are unknown; though some reports were likely related to high groundwater levels resulting in increased use of residential sump pumps.

Alternative Solutions

As part of the Class EA planning process, reasonable and feasible alternative solutions to the Phase 1 problem opportunity statement are identified and described in Phase 2. The magnitude of the net positive and negative effects of each alternative solution are identified and evaluated. Study objectives were also developed to incorporate applicable design criteria in order to identify the preferred alternative to address the key issues identified for each of the existing drainage systems. The following provides a summary of the alternative solutions and preferred solution for each drainage area.

Prior Municipal Drain

The following stormwater alternatives were developed to address the problem and opportunity statement relating to Prior Municipal Drain:

> **Alternative 1**: Do Nothing
>
> **Alternative 2**: Replace Minor System, Provide Urban Road Cross Section, & Abandon Municipal Drain
>
> **Alternative 3A**: Improve Roadside Ditches, Provide 100-Year Storm Outlet & Abandon Municipal Drain
>
> **Alternative 3B**: Improve Roadside Ditches, Provide 100-Year Storm Outlet & Abandon Municipal Drain (Alternate Outlet Alignment)

Alternative 3A "Improve Roadside Ditches, Provide 100-Year Storm Outlet & Abandon Municipal Drain" was selected as the **preferred alternative**.

This alternative addresses existing capacity issues by improving roadside ditches in order to convey all flows that exceed the capacity of the minor system. The roadside ditches will also provide water quality treatment which would not be provided by minor system improvements. A storm sewer with sufficient capacity to convey the 100-year peak flows is constructed from the Millcreek Lane/Yorkdale Street intersection to the existing outlet in order to provide a major

system outlet (a portion of the outlet was recently replaced as a result of failure). Although there may be minor disruption to fronting properties during implementation of ditch improvements and the new storm sewer, this option can be implemented at a lower cost with less impact to affected roads. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

Mill Street Development Storm Sewer

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Mill Street Development Storm Sewer:

Alternative 1: Do Nothing

Alternative 2: Improve Major System

Alternative 3: Improve Minor System

Alternative 2 "Improve Major System" was selected as the **preferred alternative**.

This alternative addresses existing ponding issues at the east end of Atkinson Court by regrading the overland flow route to improve drainage. Capacity issues caused by future development are addressed by providing on-site SWM controls (quality and quantity), and a ditch-inlet catchbasin is installed to address rear-yard flooding. Minor ponding may still occur at the eastern end of Atkinson Court, but it will be below Municipal standards and unlikely to threaten safety or property. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

Hog Back Close Storm Sewer

The following stormwater alternatives were developed to address the problem opportunity statement relating to the Hog Back Close Storm Sewer:

Alternative 1: Do Nothing

Alternative 2: Replace Existing Storm Sewer

Alternative 3: Improve Major System

Alternative 1 "Do Nothing" was selected as the **preferred alternative**.

Although the existing storm sewer is over capacity to convey peak flows, the system is functioning sufficiently, and any ponding likely to occur will be below Municipal standards and unlikely to threaten safety or property. The existing conditions do not warrant the construction impacts and cost associated with the other alternatives.

Tower Heights Storm Sewer

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Tower Heights Storm Sewer:

Alternative 1: Do Nothing

Alternative 2: Replace Storm Sewer & Modify Road Profiles

Alternative 1 "Do Nothing" was selected as the **preferred alternative**.

Although the existing storm sewer is over capacity to convey peak flows, the existing conditions do not warrant the construction impacts and cost associated with replacement. Concerns have been received from residents regarding excessive reliance on sump pumps, however, these issues are primarily related to high groundwater levels, and may not be sufficiently addressed by SWM improvements. The costs and property impacts associated with replacing the over-capacity system are not warranted by existing SWM concerns.

Springer Road Municipal Drain

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Springer Road Municipal Drain:

Alternative 1: Do Nothing

Alternative 2: Abandon Municipal Drain & Negotiate Drainage Easement

Alternative 3: Abandon Municipal Drain, Replace Existing Storm Sewer & Negotiate Drainage Easement

Alternative 2 "Abandon Municipal Drain & Negotiate Drainage Easement" was selected as the **preferred alternative**.

Although the existing storm sewer is over capacity, ponding is not likely to cause risk to safety or property. Ensuring that the existing overland flow route does not become obstructed further, by means of the drainage easement, mitigates the potential for ponding during storm events. The existing conditions do not warrant the construction impacts and costs associated with replacement of the storm sewer. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

Cummings Municipal Drain

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Cummings Municipal Drain:

Alternative 1: Do Nothing

Alternative 2: Urban Right of Way within Future Development Areas & Dry SWM Pond

Alternative 3A: Semi-Urban Right of Way within Future Development Areas

Alternative 3B: Semi-Urban Right of Way within Future Development Areas (Alternate Outlet)

Alternative 2 "Urban Right of Way within Future Development Areas & Dry SWM Pond" was selected as the **preferred alternative**.

The existing drain south of Wellington Road is decommissioned, and the south roadside ditch profile is modified to convey major flows from the low point westward to the Longwoods Road Culvert. Future development areas (excluding approved Draft-Plans along Martin Road) will incorporate urban right-of-way (ROW) to convey minor and major flows. Flows from the future development areas will be conveyed by proposed storm sewers along Wellington Street and Martin Road to a regional dry SWM pond located on development lands east of Martin Road prior to discharge to the ravine. The proposed SWM pond, in conjunction with oil-grit separators (OGSs) located at each of the development lands, provides the required stormwater treatment and quantity control.

The proposed storm sewer along Wellington Street would be extended to address existing surface ponding at the Wellington Street low point.

Funding for implementation of works associated with future development will be provided through the development process, and improvements to existing stormwater system would be provided by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses key issues related to capacity and accessibility. While higher disruption and construction impacts to Wellington Street and Martin Road are anticipated over the other alternatives, this option could align with planned roadwork improvements and is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.

Longwoods Road Culvert

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Longwoods Road Culvert:

Alternative 1: Do Nothing

Alternative 2: Semi-Urban Right of Way within Future Development Areas

Alternative 3: Urban Right of Way within Future Development Area & Dry SWM Pond

Alternative 3 "Urban Right of Way within Future Development Area & Dry SWM Pond" was selected as the **preferred alternative**.

Urban ROWs within the future development area incorporates SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties. A proposed dry SWM pond and OGS provides the required stormwater treatment and quantity control.

The existing concrete box culvert beneath Longwoods Road is replaced with a new outlet which must be lowered to accommodate the proposed upstream sewers.

Improvements to the Longwoods Road north roadside ditch will mitigate flooding on commercial property. Funding for implementation of works associated with new development to be provided through development process, and improvements to existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses key issues related to post-development impacts. While this option is considered a higher cost alternative, it is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.

Longwoods Commercial Lands

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Longwoods Commercial Property:

Alternative 1: Do Nothing

Alternative 2: Control All Stormwater On-Site

Alternative 3: Dry SWM Pond

Alternative 3 "Dry SWM Pond" was selected as the **preferred alternative**.

Flows from the Longwoods Road roadside ditches are conveyed through the development lands through a drainage easement. Quality and quantity controls are provided by proposed OGSs within the future development area, and a dry SWM pond located within the development lands or potentially within the existing buffer lands (Special Policy Area #8) subject to approval/acquisition of land from the current landowner and municipal approval to address current SPA designation/development constraints. Flows are conveyed from the dry SWM pond to the Springer Road Drain outfall location by a proposed pipe located within a drainage easement south of the Tower Heights Subdivision. Funding for implementation of works associated with new development to be provided through the development process, and improvements to the existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses stormwater runoff from the future development lands, with less potential for aggravating existing high groundwater levels within the adjacent Tower Heights subdivision, as well as providing the opportunity for incorporating flows from the Springer Road Drain catchment area.

Harris Road Culvert

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Harris Road Culvert:

Alternative 1: Do Nothing

Alternative 2A: Urban Right of Way & Dry SWM Ponds within Future Development Areas

Alternative 2B: Urban Right of Way & Dry SWM Ponds within Future Development Areas (Alternate Alignment)

Alternative 3A: Semi-Urban Right of Way within Future Development Areas

Alternative 3B: Semi-Urban Right of Way within Future Development Areas (Alternate Alignment)

Alternative 2A "Urban Right of Way & Dry SWM Ponds within Future Development Areas" was selected as the **preferred alternative**.

Urban ROWs within the future development areas incorporate SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties. Proposed dry SWM ponds and OGSs provide the required stormwater treatment and quantity control. Flows will be directed to the existing ravine outlet via proposed storm sewers constructed within drainage easements. Funding for implementation of works associated with new development to be provided through development process, and improvements to the existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality.

The Harris Road culvert is lowered to accommodate the proposed upstream storm sewers. With exception of minor roadworks to accommodate storm sewer installation, no significant alterations to road cross-sections would be undertaken.

This alternative addresses capacity issues in the existing system and addresses stormwater servicing for the future development areas with less impact to existing residences (tree removal, road reconstruction), and is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.

Thompson Municipal Drain

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Thompson Municipal Drain:

Alternative 1: Do Nothing

Alternative 2: Abandon Municipal Drain & Realign Storm Sewer

Alternative 3: Proposed Storm Sewer

Alternative 4: Proposed Storm Sewer with Wellington Street Branch

Alternative 3 "Proposed Storm Sewer" was selected as the **preferred alternative**.

The proposed storm sewer provides an outlet for the existing roadside ditches along Wellington Street to limit ponding depths in front of Our Lady of Lourdes school property. The storm sewer along Victoria Street is replaced with a new storm sewer within the right of way, and a portion of sewer currently draining to the Davis Street system is connected to proposed Victoria Street sewer to alleviate impacts on the adjacent Forsythe System. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses existing capacity and ponding issues, and although fronting properties will experience temporary disruption during construction, future impacts to private property will be mitigated by aligning the sewer within the right of way, and increasing conveyance capacity.

Consultation during the Public Information Centre and subsequent comments received expressed concern over the preservation of trees along the Victoria Street streetscape. The urban right of way proposed for Victoria Street has the benefit of preserving a greater amount of trees than would a semi-urban right of way. During detailed design, however, it is recommended that a Tree Preservation Plan be completed to document and assess any impact on existing trees along the right of way, and to identify appropriate mitigation measures for any trees requiring removal.

Forsythe Municipal Drain

The following stormwater alternatives were developed to address the problem and opportunity statement relating to the Forsythe Municipal Drain:

Alternative 1: Do Nothing

Alternative 2: Improve Minor System

Alternative 3: Improve Minor System and Divert Prince Albert Street System

Alternative 2 "Improve Minor System" was selected as the **preferred alternative**.

A new storm sewer with sufficient capacity to convey the 100-year peak discharge would be constructed from the York Street low point south of Wellington Street to a new outfall to the Thames River. Segments of pipe located on private property are decommissioned, and the identified sections are replaced. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality. This alternative also includes the option to divert flows to the Thompson Drain outfall should over capacity of sewer along Longwoods Road become a concern.

Although segments of the existing storm sewer remain over capacity, the proposed sewer upgrades address areas of identified and anticipated ponding, mitigates risks to safety and property, minimizes impacts to residents during construction, and can be implemented at a lower cost.

Longwoods Road Storm Sewer #1 and #2

This storm sewer is located on a County Road and does not collect runoff from a significant external drainage area. There are no reported issues in relation to this system. If the existing minor system has insufficient capacity, the major system appears to be capable of safely conveying any surcharges to the Thames River. Moreover, any reconstruction of this system would be extremely disruptive to local businesses, residents and traffic. The extensive costs and disruption would not be warranted by the existing drainage operations; thus, no alternatives were developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

Springer Road Storm Sewer

This system was recently reconstructed with an urban road cross section and municipal storm sewers. Since the system appears to be functioning well with no reported issues, and any surcharges from the minor system can be conveyed safely to the existing ravine by the existing major system, no alternatives have been developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

Pleasant Street Culvert

Runoff from most of this catchment is conveyed as overland flow to the existing outfall. Since there appears to be little risk of local flooding caused by local storm drainage, no alternatives have been developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

Blosdale Court Storm Sewer

Since this newer system was designed in accordance with typical urban drainage practices, and local ponding depths are below Middlesex Centre design standards, no alternatives have

been developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

An overview of the **preferred alternatives** is included in Figure E.2 appended to the Executive Summary.

Capital Program Tables and Class EA Schedule Summary

This Master Plan has been completed in accordance with Approach 2 under the MEA Class EA approach for Master Plans which satisfied Phase 1 and 2 of the planning process. Accordingly, this document provides information to support any future studies or investigations in relation to each of the preferred solutions identified within the Master Plan.

Projects identified as part of the Master Plan are outlined in Table E.1, along with their respective Class EA schedule. In determining the proposed Class EA schedule for each project, recommendations are provided based on the anticipated magnitude of the preferred alternatives environmental impact, and input received by stakeholders as part of the consultation process. For drainage areas where development may occur and stormwater works are required on development lands (i.e., dry SWM pond, OGS) with no additional land acquisition or perceived impact on the environment, works are noted as Schedule A activities as the SWM facilities and related appurtenances will be addressed as part of the Planning Act.

Upon completion of the Master Plan and subject to the 30-day review period (assuming no Part II Order requests are made for individual projects identified), Schedule A, A+, and B projects are pre-approved and may proceed to design and construction subject to approval by Council. During subsequent design and construction, proposed alignments and locations of infrastructure may be refined as necessary, but within the general context of the project as defined in this Master Plan.

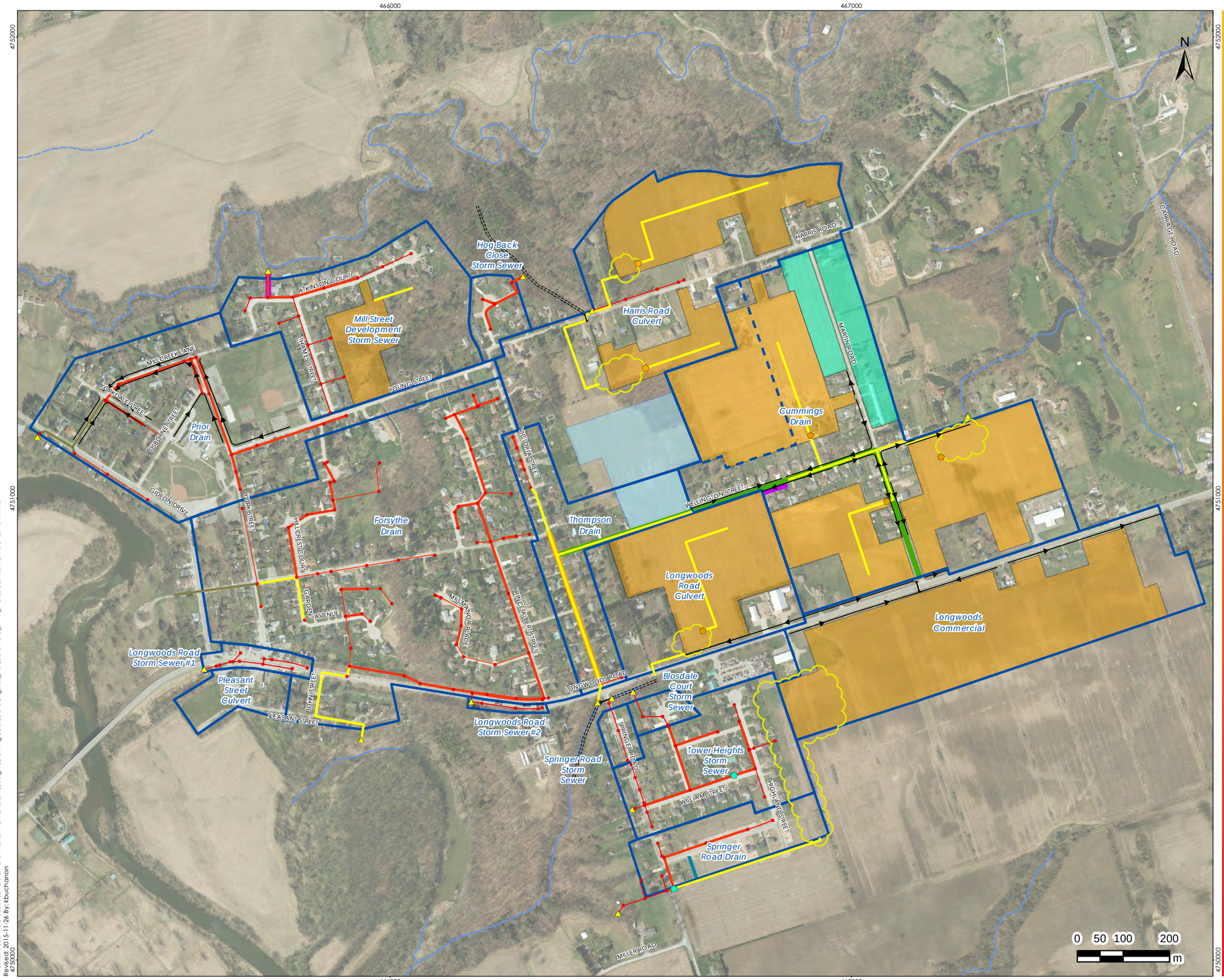
The Notice of Completion of this Master Plan is issued on the basis of the identification of the following projects and Class EA schedules.

Table E.1 Projects, Class EA Schedule, and Estimated Costs

Project/Drainage Area	Preferred Alternative	Class EA Schedule	Estimated Cost[1]
Prior Municipal Drain	Alternative 3A	Schedule A	$430,620
Mill Street Development Storm Sewer	Alternative 2	Schedule A	$134,960
Hog Back Close Storm Sewer	Alternative 1	Not applicable	Not Applicable

Project/Drainage Area	Preferred Alternative	Class EA Schedule	Estimated Cost[1]
Tower Heights Storm Sewer	Alternative 1	Not applicable	Not Applicable
Springer Road Municipal Drain	Alternative 2	Schedule B	$35,000
Cummings Municipal Drain	Alternative 2	Schedule A	$1,338,020
Longwoods Road Culvert	Alternative 3	Schedule A	$275,600
Longwoods Commercial Lands	Alternative 3A	Schedule A	$719,335
Harris Road Culvert	Alternative 2A	Schedule B	$689,362
Thompson Municipal Drain	Alternative 3	Schedule B	$1,121,859
Forsythe Municipal Drain	Alternative 2	Schedule B	$830,310
Longwoods Road Storm Sewer #1	Do Nothing	Not applicable	Not applicable
Longwoods Road Storm Sewer #2	Do Nothing	Not applicable	Not applicable
Springer Road Storm Sewer	Do Nothing	Not applicable	Not applicable
Pleasant Street Culvert	Do Nothing	Not applicable	Not applicable
Blosdale Court Storm Sewer	Do Nothing	Not applicable	Not applicable

[1] Cost estimates are considered Class 4, and consistent with ASTME 2516-06 accuracy ranges are subject to +20% to +30%, and -10% to -20%. Estimates do not include engineering, or additional costs such as dewatering, etc.



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Revised: 2015-11-26 By: kbuchanan

Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Existing Storm Sewer
- Proposed Storm Sewer (2-Year Capacity)
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (100-Year Capacity)
- Roadside Ditch
- Existing Culvert
- Existing Ravine
- Watercourse (Permanent)
- Watercourse (Intermittent)
- Proposed Dry SWM Pond (Approximate Location)
- Proposed Regrading
- Proposed Drainage Easement
- Proposed Urban R.O.W.
- Proposed Semi-Urban R.O.W.
- Proposed Drainage Boundary
- Proposed Interior Drainage Boundary
- Existing School
- Potential Future Development
- Future Development Serviced by Planned SWM Infiltration Measures

1:8,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

November 2015
165630021

Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

E.2

Title

Delaware SWM EA
Overview of Preferred Alternatives

Glossary

Stormwater	Rain, melted snow, or any other form of precipitation that has come into contact with the ground or any other surface. This water seeps into the ground, is absorbed by vegetation, evaporates, or runs off the land into storm sewers, streams, or lakes.
Stormwater Management (SWM)	The management of preciptation as it interacts with municipal infrastructure (roads and storm drains) before ultimately being absorbed into the soil or discharged to a receiving water body.
Storm Drainage System	A system for receiving, conveying and controlling discharges in response to precipitation and snowmelt. Systems consist of ditches, culverts, swales, roadways, curbs and gutters, catchbasins, manholes, pipes, detention ponds, etc.
Minor System	The storm drainage system which is designed to eliminate or minimize inconveniences or disruption of activity as a result of runoff from the more frequent, less intense storms. The minor system usually includes street gutters, storm sewers, and catchbasins. Design of a minor system is based on a storm frequency of 1 in 2 years.
Major System	The storm drainage system in which water will flow in a major storm when the capacity of the minor system is exceeded. The major system includes many features such as streets, curb and gutter systems, swales, and major drainage channels. Design of a major system is based on a storm frequency of 1 in 100 years.
Road Right of Way (ROW)/Cross Section	The configuration of the roadway. **Urban ROWs** typically include curbs and storm sewers, whereas **rural ROWs** contain roadside

	ditches. Semi-urban ROWs may contain ditches and/or storm sewers, but generally exclude curbs.
Lot Level/On-Site SWM Controls	Measures that address stormwater before it exits a site and enters the storm sewer system. These controls can include reduced lot grading, redirection of downspouts, and other site-design considerations such as porous concrete.
End-Of-Pipe SWM Controls	Multi-purpose stormwater management facilities (SWMFs) which address objectives relating to water quality, erosion control, and peak flow control. SWMFs include wet/dry ponds, wetlands, oil/grit separators, etc.
Conveyance	The movement of stormwater by means of storm sewers, ditches, swales, roads, etc.
Outlet/Outfall	The points at which stormwater discharges from a storm sewer or other conveyance system, usually into a creek, stream, or river.
Municipal Drains	Storm drainage systems which were typically constructed to service rural or agricultural lands but may be present within existing residential areas. Under Ontario's *Drainage Act*, funding for the maintenance of Municipal Drains is provided by the benefiting property owners.

1.0 INTRODUCTION

The Municipality of Middlesex Centre retained Stantec Consulting Ltd. (Stantec) to complete a Municipal Class Environmental Assessment (Class EA) following the Master Plan Approach 2 to develop a servicing strategy and conceptual design for the implementation of stormwater management measures for the Community Settlement area of Delaware.

The existing storm drainage infrastructure within the Community of Delaware was designed and constructed on a site-by-site basis as development occurred, without the benefit of an overall stormwater management strategy. This has resulted in a fragmented drainage system that does not efficiently service the existing community, and which has limited capacity to service future growth.

The Stormwater Master Plan has been developed according to the Municipal Class Environmental Assessment Process (MCEA October 2000 as amended in 2007, 2011, and 2015) to identify necessary storm drainage system improvements to better service the existing community, and to provide a drainage servicing strategy to accommodate future growth and development within Delaware.

1.1 STUDY AREA

The study area includes the Community Settlement of Delaware within the Municipality of Middlesex Centre, a lower tier municipality within Middlesex County. Based on the existing storm drainage infrastructure, which consists of municipal drains and municipal storm sewers, the study area was broken down into catchment areas as shown in Figure 1.1.

The Community of Delaware is comprised of mainly residential land use, with areas of commercial and employment land uses primarily along Longwoods Road. Though the majority of the study area is comprised of built-out residential development, several areas of potential future development were identified based on Municipality of Middlesex Centre Official Plan Schedule A-4 Land Use designations in order to address and incorporate the future need for stormwater servicing into the stormwater servicing strategy.

1.2 PROJECT SCOPE AND OBJECTIVES

The intent of this Master Plan is to identify and address public, review agency, and Aboriginal Community comments and concerns, and to ensure that all possible alternatives and opportunities are fairly assessed and reviewed in a public forum before being finalized and carried forward for implementation. The scope of work being completed as part of this Master Plan includes:

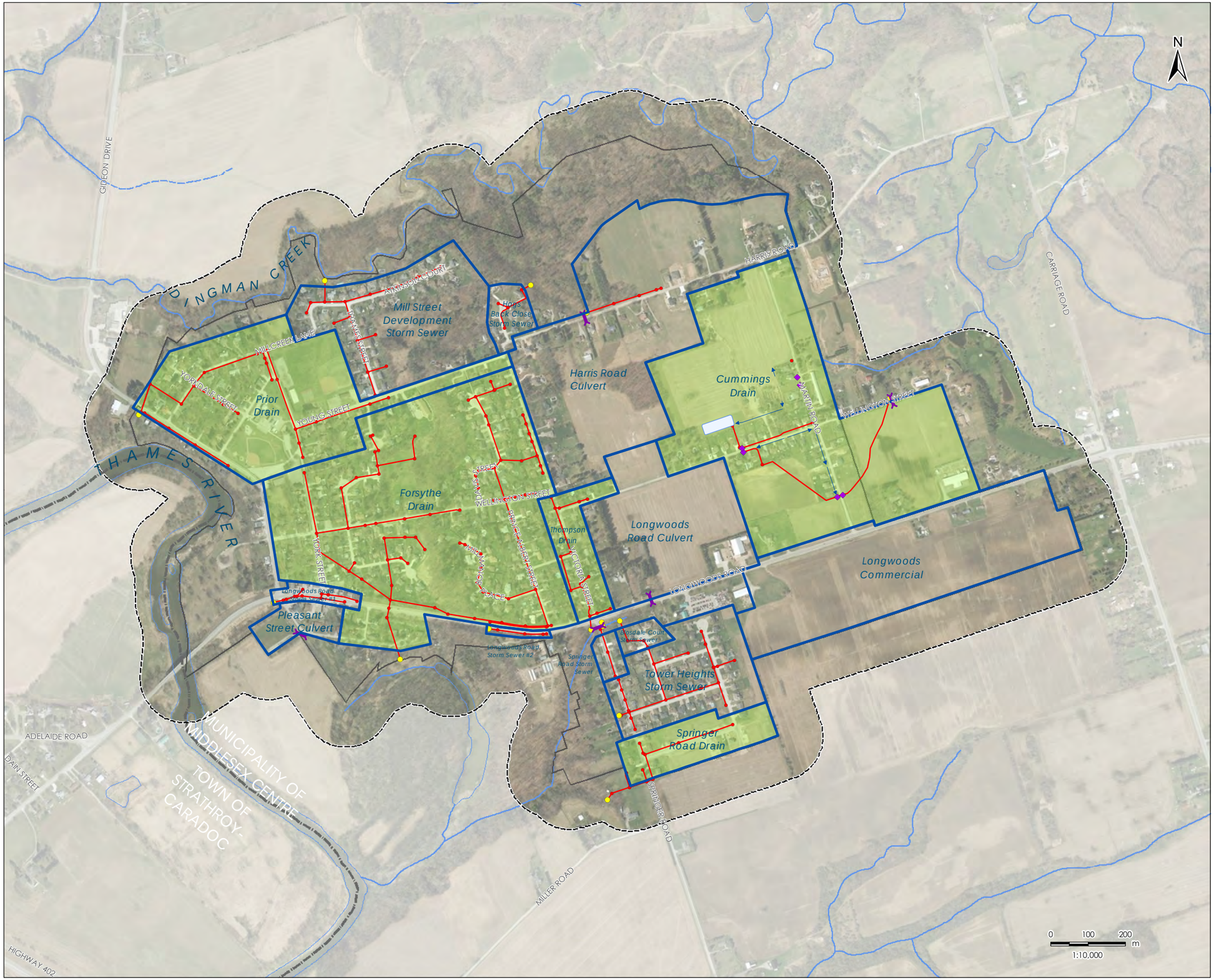
- Background review and identification of key issues;

- Natural Environment Review;
- Technical review of existing drainage conditions and catchment areas;
- Identification and evaluation of alternatives based on a set of criteria that address key issues, as well as the social, natural, technical, and economic environmental factors;
- Development of a Stormwater Management Master Plan to outline a drainage servicing strategy based on the preferred alternatives;
- Public, Aboriginal Community, agency, and stakeholder consultation; and
- Preparation and Filing of a Master Plan document.

The objective of the Master Plan (MP) is to identify necessary stormwater drainage system improvements to better service the existing community, and to provide a stormwater servicing strategy to accommodate future growth and development. The MP will identify the stormwater infrastructure required to mitigate the possibility of flooding and erosion, provide adequate stormwater treatment, and protect against impacts to the downstream receiving water systems. The MP will contain the stormwater servicing strategy that best balances the following responsibilities:

- Provides adequate drainage servicing and stormwater treatment for existing and future development areas;
- Protects the natural environment;
- Reduces negative impacts on affected properties; and
- Minimizes stormwater servicing costs.

Furthermore, a funding strategy has been recommended to verify that implementation of the proposed MP is feasible. Any other relevant responsibilities identified through the Class EA process will also be integrated into the MP.



Stantec

Legend

- Settlement Boundary
- Study Area
- Municipal Boundary
- Culvert
- DICB
- Other Catchbasin or Chamber
- Outfall
- Storm Sewer
- Swale
- Stormwater Management Facility
- Existing Drainage Boundary
- Serviced by Municipal Drain

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2015.
3. 2010 imagery used under license with Middlesex Centre.

November 2015
165630021

Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

1.1

Title

Study Area

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Revised: 2015-11-24 By: kbuchanan

1.3 REPORT FORMAT

This MP document provides the context in which the Class EA process was carried out and documents the rationale leading to the preferred stormwater MP, and includes the following:

- An overview of the Class EA and Master Plan process;
- The public consultation plan followed throughout the project, documenting all points of contact with the public, agencies, Aboriginal Communities, and other stakeholders;
- Identification and description of the problem and opportunities;
- Overview of applicable planning and policy documents;
- An overview of the existing drainage infrastructure;
- An overview of the existing natural and social environment conditions;
- Identification, development, and evaluation of alternative solutions;
- A description of the preferred solutions, making up the preferred stormwater MP;
- Recommendations for implementation;
- Recommended mitigation and compensation measures based on the general scope of the proposed works.

2.0 MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PROCESS

All municipalities in Ontario, including the Municipality of Middlesex Centre, are subject to the provisions of the Environmental Assessment Act (EA Act) and its requirements to prepare an Environmental Assessment (EA) for applicable public works projects. The Ontario Municipal Engineers Association (MEA) "Municipal Class Environmental Assessment" document (October 2000 as amended in 2007, 2011, and 2015) provides municipalities with a five-phase planning procedure approved under the EA Act to plan and undertake all municipal infrastructure projects in a manner that protects the environment as defined in the Act.

Key components of the EA planning process include:

- Consultation with potentially interested parties early and throughout the process;
- Consideration for a reasonable range of alternative solutions;
- Systematic evaluation of alternatives;
- Clear and transparent documentation; and
- Traceable decision-making

2.1 TYPES OF PROJECTS

The MEA Class EA document provides a framework by which projects are classified as Schedule "A", A+", "B", or "C". Classification of a project is based on a variety of factors including the general complexity of the project and level of investigation required, and the potential impacts on the natural and social environment that may occur. It is the responsibility of the proponent to identify the appropriate schedule for a given project, and to review the applicability of the chosen schedule at various stages throughout the project. Each of the schedules requires a different level of documentation and review to satisfy the requirements of the Class EA, and thus comply with the EA Act as noted below.

Schedule "A" projects are limited in scale, have minimal adverse impacts on the natural and social environments, and include the majority of municipal sewage, stormwater management, water operations, and maintenance activities. These projects are pre-approved and may be implemented without following the procedures outlined in the Class EA planning process. Examples of Schedule "A" projects include watermain and sewer extensions where all such facilities are located within the Municipal road allowance or an existing utility corridor. As such, these projects are pre-approved and subsequently do not require any further planning and public consultation.

Schedule "A+" projects are similarly pre-approved under the Municipal Class EA, but require that potentially affected parties be notified prior to implementation. The public has a right to comment to municipal officials or their council on the project; however, considering that the

projects are pre-approved, there is no appeal process to the Minister of the Environment and Climate Change on these projects (Part II Order Requests as discussed in Section 2.4).

Schedule "B" projects have the potential for some adverse environmental and social effects. The proponent is required to undertake a screening process involving mandatory contact with potentially affected members of the public, Aboriginal Communities, and relevant review agencies to ensure that they are aware of the project and that their concerns are addressed.

Schedule "B" projects require that Phases 1 and 2 of the Municipal Class EA planning process be followed and a Project File report be prepared and submitted for a mandatory 30-day review by the public, agencies, and Aboriginal Communities. If all comments or concerns received within this 30-day review period can be addressed, the proponent may proceed to project implementation (Phase 5). If concerns are raised that cannot be resolved, then the Part II Order procedure may be invoked.

Schedule "C" projects have the potential for significant environmental impacts and must follow the full planning and documentation procedures specified in the Class EA document (Phase 1 to 4). An Environmental Study Report (ESR) must be prepared and filed for review by the public, review agencies and Aboriginal communities. If concerns are raised that cannot be resolved, then the Part II Order procedure may be invoked. Projects generally include the construction of new facilities and major expansions to existing facilities.

2.2 5-PHASE PLANNING PROCESS

Figure 2.1 illustrates the process followed in the planning and design of projects covered by a Municipal Class EA. The figure incorporates steps considered essential for compliance with the requirements of the EA Act discussed below.

Phase 1 Identify the problem (deficiency) or opportunity, which may include public consultation to confirm/review the problem or opportunity.

Phase 2 Identify a reasonable range of alternative solutions to address the problem or opportunity. This Phase also includes an inventory of the natural environment in order to identify potential mitigation measures, and to assist in the evaluation of alternatives in terms of the identified evaluation criteria. A preferred solution is chosen based on the results of the evaluation and taking into account input from the public, review agencies, and Aboriginal Communities. It is at this point that the appropriate Schedule (B or C) is chosen for the undertaking. If Schedule B is chosen, the process and decisions are then documented in a Project File. Schedule C projects proceed through the following additional phases.

Phase 3 (For Schedule "C" projects only) Examine the alternative methods for implementing the preferred solution, which typically involve design alternatives. More detailed inventory of the natural, social, economic, and technical

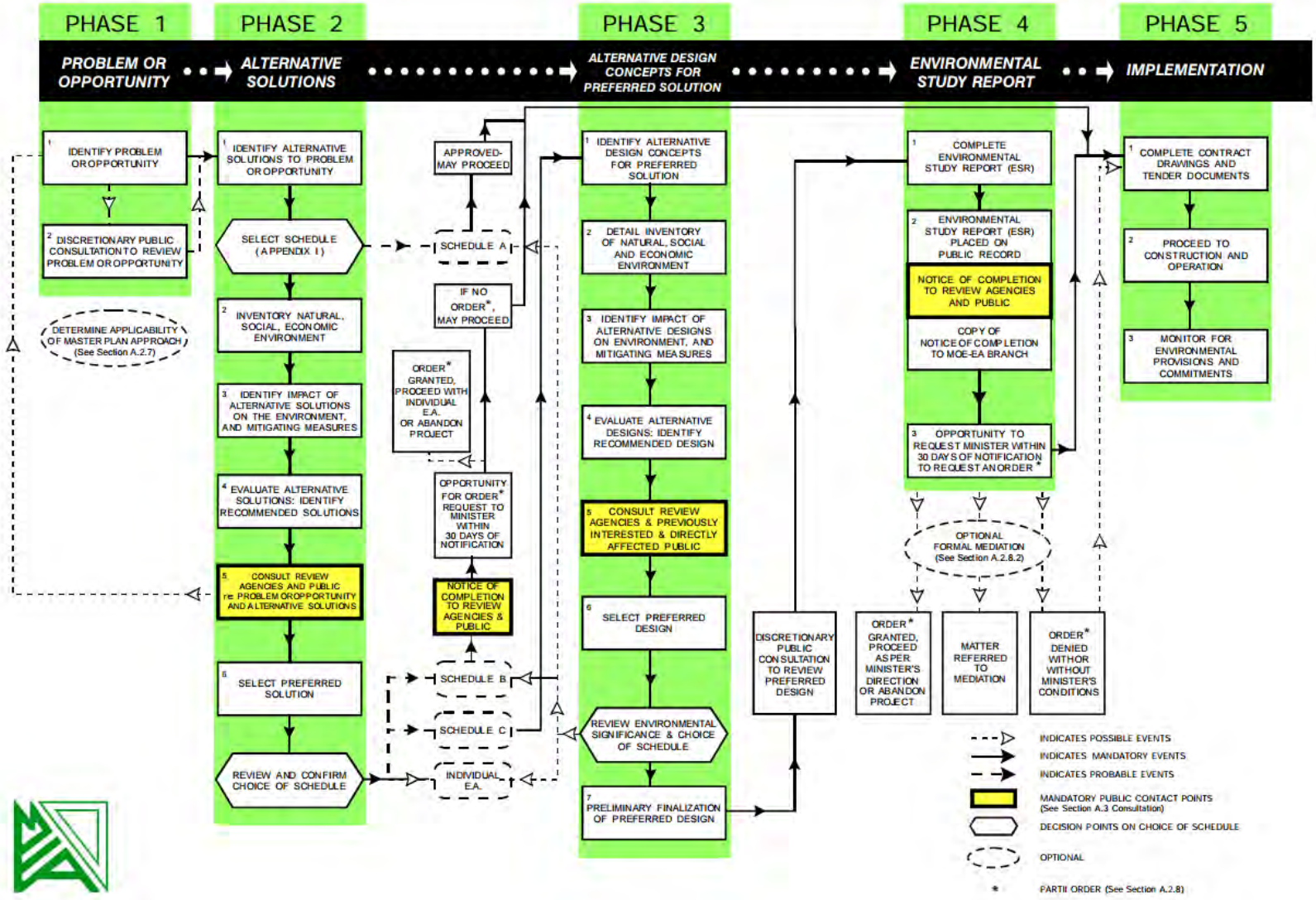
environment is undertaken in order to assess the impacts of the alternative designs, in an attempt to minimize negative effects and maximize positive effects.

Phase 4 (For Schedule "C" projects only) Document the Class EA Process followed in an Environmental Study Report (ESR), which includes a summary of the rationale and the planning, design, and consultation process followed for the project and make the documentation available for consideration by the public, review agencies, Aboriginal Communities, and the public through a mandatory 30-day review period.

Phase 5 Complete contract drawings and documents, and proceed to construction and operation with monitoring to ensure adherence to environmental provisions and commitments.

The Municipal Class EA process and associated documentation serves as a public statement of the decision making process followed by municipalities for the planning and implementation of necessary infrastructure.

Figure 2.1 – Municipal Class Environmental Assessment Planning Process



2.3 MASTER PLAN APPROACH

The stormwater servicing strategy is being undertaken in accordance with the Master Plan requirements found within the MEA Municipal Class Environmental Assessment document. This approach was developed to recognize the benefits of considering a group of related projects, or an overall system – in this case stormwater management – prior to addressing individual projects or areas.

Master Plans are long-range plans undertaken to create a framework for future projects that form part of an integrated system. The projects identified within Master Plans are typically distributed geographically throughout the study area, and are intended to be implemented over an extended period of time based on project triggers including required maintenance, available funding, etc.

The scope and complexity of Master Plans varies significantly. The MEA document emphasizes the need to customize the planning process to fit the needs of the undertaking, and offers four general approaches that address Master Plans of varying complexity. This Master Plan is following Approach 2, which involves the completion of a Master Plan document at the conclusion of Phases 1 and 2, fulfilling the requirements for Schedule B projects. Any project identified within the Master Plan as a Schedule 'C' undertaking would be subject to the completion of Phases 3 and 4, including the preparation and filing of an ESR for public review prior to implementation.

2.4 CHANGING THE PROJECT STATUS – "PART II ORDER"

The planning process as outlined above encourages the identification and resolution of concerns throughout the project, and it is the obligation of the proponent to adequately address concerns raised by the public, Aboriginal Communities, and/or agencies. If an interested party feels as though their concerns have not been adequately addressed, and that the proposed undertaking needs to be subject to a more in-depth planning process, a request for a Part II Order may be submitted. Under the provisions of Section 16 of the *Environmental Assessment Act* (EAA) the Minister or delegate may require a proponent to comply with Part II of the EAA by completing an Individual EA before proceeding to implementation; the Minister may also deny the request, and/or impose conditions on the proposed undertaking.

According to Section A.2.8, a Part II Order request:

- Must be made in writing to the Minister of the Environment and Climate Change or delegate, with a copy to the proponent;
- Must be made upon the completion of the planning process (after a Notice of Completion is issued, outlining the public review period) so that all potential environmental impacts and impact management measures are understood;

- Must not be made for the sole purpose of delaying, stopping, or frustrating the planning and implementation of a project subject to the Class Environmental Assessment process;
- Must focus on potential environmental effects of the project, the class environmental assessment process, and not on decisions made outside the class environmental assessment process (for example, land use planning decisions made under the Planning Act or issues related to municipal funding of projects);
- Must not raise issues that are not related to the project; and
- Should be withdrawn promptly by the requester if the proponent has satisfied the concerns of the requester.

It is the proponent's responsibility to provide several opportunities for public, Aboriginal Community, and agency review and input, as well as that of the public, Aboriginal Community, and agency to bring their concerns to the attention of the proponent early in the planning process. Every reasonable effort must be made by the proponent to address the concerns brought forward. If concerns have not been addressed upon the issuance of a Notice of Completion, any member of the public, Aboriginal Community or agency can submit a request with the following information to the Minister of the Environment and Climate Change or delegate within the 30-day public review period as outlined in the Notice (requests submitted after this time may not be considered):

- The project name and proponent;
- Environmental impacts of the project and their significance;
- The adequacy of the planning process;
- The availability of other alternatives to the project (where appropriate as some projects may not have any alternative);
- The adequacy of the public consultation program and the opportunities for public participation;
- The involvement of the requester in the planning of the project;
- The nature of the specific concerns which remain unresolved;
- Details of any discussions held between the requester and the proponent;
- The benefits of requiring the proponent to undertake a higher level of assessment (e.g. an individual environmental assessment); and
- Any other important matters considered relevant.

More information on submitting a Part II Order request can be found in Section A.2.8 of the MEA Municipal Class EA document.

3.0 PUBLIC CONSULTATION PLAN

Consultation with potentially affected persons is a vital part of the EA process, both in the collection of background information used to identify key issues, and in the development of the

preferred solutions to best address all stakeholders' concerns while satisfying the Problem/Opportunity statement for the particular project. At the outset of the project, a stakeholder list was developed which included government agencies, conservation authorities, and Aboriginal Communities, to which all project notification was sent. The contact list has been included in Appendix A1.

In addition to the standard points of contact including the Notice of Commencement (Appendix A2), and the Notice of Public Information Centre (Appendix A4), an additional public survey was developed using the online service Survey Monkey® to obtain specific information on residents' existing stormwater drainage issues and concerns. The results were reviewed and addressed where feasible in the development of alternative solutions. A copy of the survey and a report detailing the 134 responses are included in Appendix A3.

The following chart documents the various points of contact throughout the project, the means of dissemination, and the stakeholder groups to which each notification was sent.

Table 3.1 Stakeholder Consultation

Point of Contact	Date and method of dissemination
Notice of Commencement (Appendix A2)	Published in the Middlesex Banner Newspaper, Wednesday, January 14th, 2015 Published in the Londoner Newspaper on Thursday January 15th, 2015, and posted on their website from January 9th-17th, 2015, Published on the Municipality of Middlesex Centre website starting January 9th, 2015 Mailed via Canada Post to all stakeholders identified on the project contact list on January 15th, 2015.
Notice of Study Update, and online public survey (Appendix A3)	Published in the Middlesex Banner Newspaper on July 29th, 2015. Published in the Londoner Newspaper on July 30th, 2015. Published on the Middlesex Centre website starting July 30th, 2015. Notice of Study Update, and hard copies of the online survey was hand delivered to all

	residents within the Delaware Community Settlement area, and copies were left at the Delaware Community Library, and Delaware Community Centre.
Notice of PIC #1 (Appendix A4)	Published in the Middlesex Banner Newspaper on September 23rd and 30th, 2015 Published in the Londoner Newspaper on September 24th, and October 1st, 2015 Mailed via Canada Post on September 29th, 2015 to all stakeholders identified on the project contact list, and all who requested to be added to the project mailing list. Emailed on Sept. 17th, 2015 to all residents who provided contact information on the online survey Mailed on Sept. 30th, 2015 to residents whose properties could potentially be impacted by the proposed alternatives.
Public Information Centre, Delaware Community Centre (Appendix A4)	October 8th, 2015, 4:30-6:30pm (open house format)
Notice of Completion (Appendix A8)	

3.1 ABORIGINAL CONSULTATION

At the outset of the project, a search was conducted using the Aboriginal Treaty Information System administered by Aboriginal Affairs and Northern Development to identify any active or closed land claims in and around the study area (included in Appendix A6). Based on this information, proximity to the study area, known interests, and communication from the Ministry of Aboriginal Affairs, a list of seven (7) potentially interested Aboriginal Communities was compiled and included:

- Chippewas of the Thames;
- Oneida Nation of the Thames;
- Munsee-Delaware Nation;

- Delaware Nation (Moravian of the Thames);
- Bkejwanong Territory (Walpole Island);
- Caldwell First Nation; and
- Chippewas of Kettle and Stony Point.

All project notices were mailed directly to these communities, and follow-up communication was made to ensure that they had appropriate opportunities to review project information and provide comment. A table documenting all communication is included in Appendix A6.

3.2 AGENCY CONSULTATION

At the outset of the project, several government agencies identified as potentially having interest in the project were added to the contact list found in Appendix A1, and sent all project documentation. All communication with agencies are included in a table found in Appendix A7.

Portions of the study area are also regulated by both the Upper Thames River Conservation Authority (UTRCA), and Lower Thames Valley Conservation Authority (LTVCA), and as such they were identified as important stakeholders throughout the project. In response to the Notice of Commencement, UTRCA provided information relating to regulation limits, terrestrial and aquatic Species at Risk (SAR), and Source Protection areas, which were incorporated into the Natural Environment Review (NER) found in Section 5.2 of this document and used in the evaluation of alternative solutions. UTRCA also provided Section 3.5.2 – Policies for Stormwater management and Erosion and Sediment Control measures within the UTRCA's Environmental Planning Policy Manual and their Stormwater Management Policy Guidelines which were consulted throughout the development and evaluation of alternative solutions.

All information presented at the Public Information Centre was forwarded to the representatives of the LTVCA and UTRCA. Subsequently, comments were received from both agencies that were addressed throughout the Master Plan document. All agency comments and responses have been documented in a table found in Appendix A7.

3.3 PUBLIC INFORMATION CENTRE, AND CONSULTATION WITH RESIDENTS, LANDOWNERS, AND DEVELOPERS

As outlined in Table 3.1 above, consultation with members of the community involved the publication of the Notice of Commencement (Appendix A2), an online public survey which was also published in local newspapers and hand-delivered to the entire community of Delaware (A3), and a Public Information Centre (PIC) held at the Delaware Community Centre on October 8th, 2015 (Appendix A4). The Notice of PIC was published in two consecutive editions of the Banner and Londoner newspapers; additionally, all property owners who may potentially be impacted by the proposed alternatives were directly mailed invitations to the PIC (Appendix A1).

Information presented at the PIC included:

- An overview of the Master Plan Municipal Class EA process;
- Definitions of key terms;
- The Problem Statement and Key Issues by drainage area;
- An overview of the Existing Conditions (Natural Environment, Land Use, and Drainage);
- The alternatives considered for each drainage area;
- Evaluation criteria and summary of the evaluation process; and
- An overview of the funding implications.

All information presented at the PIC was made available on the Municipality of Middlesex Centre website, and residents were encouraged to submit comments using the comment sheets provided. All comments received subsequent to the PIC, along with how they were addressed in the Master Plan are documented in a table found in Appendix A5.

4.0 PHASE 1 – PROBLEM OR OPPORTUNITY

4.1 PROBLEM STATEMENT

The first step in the Class EA process is to identify the problem or opportunity that has led to the undertaking of the Master Plan. The Problem and Opportunity statement for the Delaware Community Settlement Area Stormwater Master Plan is as follows:

Historically, there has not been a comprehensive master drainage plan for the entire Delaware Community Settlement Area. Consequently, the existing storm drainage infrastructure within the community was designed and constructed on a site-by-site basis as development occurred, without the benefit of an overall storm management strategy. This has resulted in a fragmented drainage system that does not efficiently service the existing community, and which has limited capacity to service future growth.

A comprehensive stormwater Master Plan must be developed for the Community to identify necessary storm drainage system improvements to better service the existing community, and to provide a drainage servicing strategy to accommodate future growth and development. The proposed servicing plan will identify the stormwater infrastructure required to mitigate the possibility of flooding and erosion, provide adequate stormwater treatment, and protect downstream aquatic habitat. The proposed stormwater MP will contain the optimum solutions that balance the following responsibilities:

- *Provides adequate drainage servicing and stormwater treatment;*
- *Protects the natural environment;*
- *Reduces negative impacts on affected properties; and*
- *Minimizes stormwater servicing costs.*

Furthermore, a funding strategy will be developed to verify that implementation of the proposed Master Plan is feasible. Any other relevant responsibilities identified through the Class EA process will also be integrated into the proposed stormwater MP.

5.0 PHASE 2 – EXISTING CONDITIONS

5.1 POLICY AND PLANNING REVIEW

A review was completed of relevant policy and planning documents and a summary is provided below.

5.1.1 Provincial Policy Statement (PPS) 2014

The Provincial Policy Statement (PPS) is the complimentary policy document to the *Planning Act* (2005), issued under Section 3 pf the *Act*, and sets a policy foundation for regulating the development and use of land. It provides direction on matters of provincial interest and supports the enhancement of the quality of life for all citizens of Ontario. Consistency with the Provincial Policy Statement shall be considered during the development and evaluation of alternative solutions.

Five general principles are established in the PPS that are further elaborated on in a detailed set of policies that generally address the following matters:

- Building Strong Healthy Communities (PPS Section 1);
- Wise Use and Management of Resources (PPS Section 2);
- Protecting Public Health and Safety (PPS Section 3).

The preferred alternatives and supporting recommendations will meet the objectives of the PPS by providing for infrastructure that is appropriate to address projected needs, protects the natural environment, and protects public health and safety.

5.1.2 County of Middlesex Official Plan

The Municipality of Middlesex Centre is a lower-tier municipality within Middlesex County. The Middlesex County Official Plan provides a broad policy framework, and deals with issues of Provincial and County wide interest, with which local municipal Official Plans must conform.

The County of Middlesex is currently undertaking a five-year review of their Official Plan. The current Official Plan outlines policies for Growth Management which recognizes the need to provide some growth in each local municipality. A hierarchy has been established to provide environmentally responsible growth to avoid conflict with natural features and hazards and the agricultural community. The majority of growth shall be directed to the designated settlement areas. Community Areas (such as Delaware) shall demonstrate the potential to accommodate future growth through population projections, must currently serve a community function and must demonstrate the potential to provide a level of service necessary to support future growth through a master servicing component of a Settlement Capability Report and/or completion of an Environmental Assessment. The goal of the Official Plan is that future development within

settlement areas proceed on the basis of full municipal services. Partial services may be permitted on an interim basis where proper justification is provided.

The Middlesex County Official Plan states that local official plans shall encourage stormwater management practices that minimize stormwater volumes and contaminant loads.

5.1.3 Municipality of Middlesex Centre Official Plan

5.1.3.1 Schedule A-4 - Land Use

As shown on Schedule A-4 (**Figure 5.1** below)of the Middlesex Centre Official Plan, the Delaware Community Settlement Area is primarily designated as residential. A settlement commercial area is located along the north of Longwoods Road, with a small area along the south of Longwoods Road, and a small area along Gideon Drive north of Wellington Street. Settlement employment areas surround the commercial area on the north and south sides of Longwoods Road, a village centre is present to the west of the settlement boundary in the area of Longwoods Road at York Street and Gideon Drive, with parks and recreation designations at the western end of Longwoods Road, north of Young Street between York Street and Thames Street.

In addition, there are four Special Policy Areas within the study area (SPA# 3, 5, 8, and 10) and one adjacent to the settlement boundary (SPA #4). These SPAs are subject to the specific guidelines for future development as set out in OP Section 11.

SPA #3 restricts developments utilizing private on-site septic systems to those lands located on the existing right of ways (Harris Road, Martin Road, and Wellington Street), and development of interior lands will only be permitted once municipal sewage servicing has been established. Development must also ensure that the lands are graded to control stormwater run-off quality and quantity, confirming that the creation of lots will not prejudice future stormwater management efforts of the area.

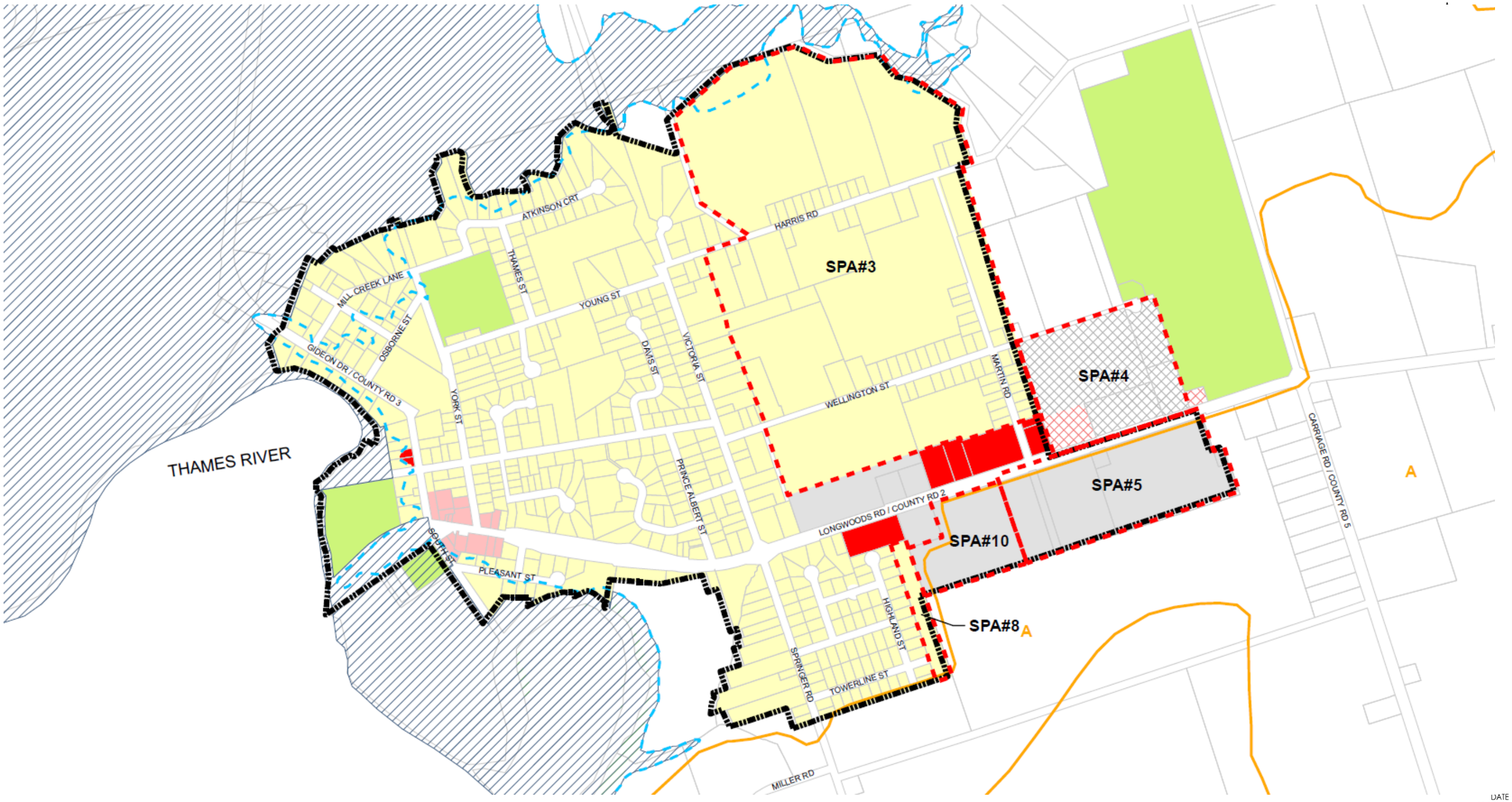
SPA #4 located adjacent to the settlement boundary, includes provision for development on municipal water services.

SPA #5 includes provisions for the development of lands subject to a noise impact assessment.

SPA#8 reserves these lands within 38.1 metres from the Settlement Boundary as a buffer between residential uses and the adjacent agricultural uses. Development on these lands is not currently permitted. Information suggests that the previous agricultural uses (orchard) have ceased and that the current landowner may seek relief from the provisions on this land to permit potential future development.

SPA#10 was the subject of Official Plan Amendment (OPA) No. 32, which was adopted by Council February 18th, 2015. The OPA permits use of this land for Settlement Commercial purposes, and prevents the following uses on the southwest portion previously identified as buffer

lands: gas bars, car washes, public garages, motor vehicle sales establishments, motor vehicle service establishments, or drive-thru facilities.



DATE
PROJECT

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Legend

SPA | SettlementBoundary | Aggregate Overlay | Flood plain | Flood Line

Official Plan Designation

Agriculture | Parks and Recreation | Residential | Settlement Commercial | Settlement Employment | Village Centre

Figure No.
5.1

Title
Municipality of Middlesex Centre
Official Plan Schedule A-4

5.1.3.2 Section 9.3 Municipal Infrastructure and Services Policies

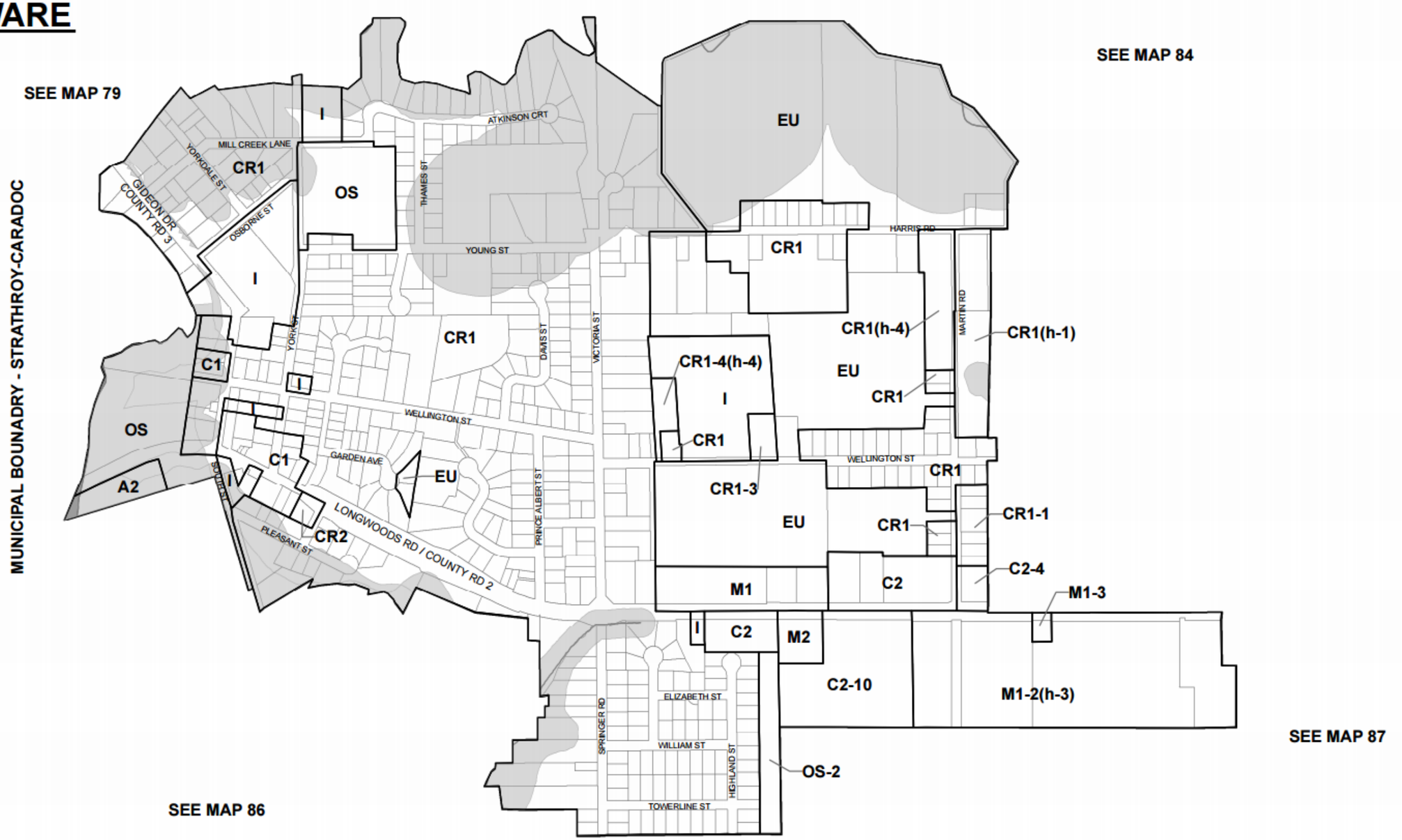
Section 9.3.1 outlines Municipal Infrastructure and Services Policies for Settlement Areas and states that:

- Primary municipal services in the Municipality are water supply, sewage disposal and stormwater management;
- Currently, three settlement areas (Arva, Ilderton and Komoka/Kilworth) are generally serviced by municipal sanitary sewer systems;
- Six of the eleven settlement areas (including Delaware) are on full municipal water services;
- Future development within settlement areas are to proceed on the basis of full municipal services, with partial services potentially being permitted on an interim basis;
- The Municipality will undertake the preparation of Community Storm Water Management Studies in the settlement areas where appropriate and necessary.

5.1.4 Municipality of Middlesex Centre Zoning By-Law

The settlement area is made up of, but not limited to, Community Residential (CR1/CR2), Highway Commercial (C2), Light Industrial (M1), Open Space (OS) and Existing Use (EU) zones shown on Map U-5 of Zoning By-Law 2005-005 (Figure 5.2).

DELAWARE



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Notes

Figure No.
5.2

Title
Municipality of Middlesex Centre
Zoning Bylaw 2005-005
Map U-5

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There are two holding provisions on lands in Delaware. Holding provision h-1 states that the removal of a holding symbol is conditional upon a subdivision agreement being entered into with the Corporation for the affected lands, including but not limited to the requirements for the development to be connected to a public water supply system and public sanitary sewer system. The holding provision h-3 requires the completion of a noise impact analysis for the subject lands in conjunction with the site plan process.

Regulation 4.17 states that no permanent buildings or structures shall be erected or used:

- 7.5 m from top-of-bank of a municipal drain having a width of less than 4.5m from top-of-bank to top-of-bank;
- Closer than 18.5 m (61 ft) from the top-of-bank of a municipal drain having the width of between 4.5 m (15 ft) and 7.5 m (25 ft) from top-of-bank to top- of-bank;
- Closer than 30.5 m (100 ft) from the top-of-bank of a municipal drain which is 7.5 m (25 ft) or more from top-of-bank to top-of-bank;
- Closer than 7.5 m (25 ft) from the centreline of a municipal tile drain.

5.1.5 Middlesex Centre Urban Design Guidelines

The urban design guidelines outline that Delaware has a population of approximately 1,590 people and is located in close proximity to Highway 402. The majority of development has occurred in the western portion of the village with a large amount of undeveloped land to the east of Victoria Street. Delaware has two elementary schools, a community centre and library, and a fire station. The commercial areas are car oriented due to the lack of sidewalks. Housing is made up of predominately one and two storey single-detached homes.

The Design Guidelines provide direction for new development in the Municipality and are to be considered when infill, subdivision, employment, institutional and commercial development is proposed. For the purpose of this study, Section 4.8 provides direction for Landscape Treatment Stormwater Management Ponds associated with new residential neighbhourhoods and non-residential development in settlement areas which are intended to support a naturalized appearance that will blend them into the landscape. Wet ponds are preferred. The following are basic principles for the landscape design treatment of stormwater management facilities:

- SWM areas will be designed as open, aesthetic amenities, allowing for accessibility and for enhancing the visual quality of the natural landscape;
- Trees, shrubs and grasses will be native and thrive in wetland, marsh and flood fringe areas;
- Walkways or boardwalks will be constructed to allow users to observe the marsh area;
- Where erosion control measures are required, the soft technique of bioengineering will be employed; and

- SWM areas will be integrated with natural heritage features, where possible.

5.1.6 Municipality of Middlesex Centre Site Plan Manual

The Municipality has prepared a Site Plan Manual to ensure that development proposals are in keeping with municipal policies, by-laws, guidelines and standards. Site Plan approval allows the Municipality and other agencies to review the overall site design, impacts to surrounding lands, widening of roads, grading and site drainage and more.

A series of drawings/plans are required to make a 'complete' site plan submission. Site Servicing Requirements for Site Plan Submission include:

- Existing and proposed grade elevations;
- Existing services location, size and depth of cover over watermain and sewer inverts for storm and sanitary services;
- Statement if existing services are to be used; and
- MOECC requirements.

Specifically related to Storm Drainage Systems, drawings must show catch basin locations, direction of surface drainage flow, drainage piping locations, private drain connection, drainage swales, flows from adjacent properties, weeping tiles, drywell system and retention systems, sediment and erosion control measures, and stormwater management measure for water quality and quantity controls.

5.1.7 Municipality of Middlesex Centre Infrastructure Design Standards

Section 4 of the Municipality's Infrastructure Design Standards contains specific engineering and construction guidelines related to the stormwater drainage system, as well as information on infrastructure easements (Section 4.17). Design Standards shall be followed during detailed design and implementation of improvements identified within this Master Plan, including maximum ponding depths of 300mm, and 450mm for landscaped areas.

5.2 EXISTING CONDITIONS – NATURAL ENVIRONMENT REVIEW

As part of the Municipal Class EA process, A Natural Environment Review (NER) was prepared to characterize the significance and sensitivity of the natural features in the study area, identify potential environmental effects and recommend appropriate measures in order to avoid or minimize potential negative impacts on the surrounding environment.

For the purposes of this Master Plan, the NER was prepared through a desktop review of available federal and provincial databases, and is intended to provide a general framework for future projects. Prior to construction, field investigation may be required to confirm the presence

of Species at Risk (SAR) or Significant Wildlife Habitat, and if proposed works may endanger SAR habitat or Significant Wildlife Habitat, a permit will be required under the Species at Risk Act/Endangered Species Act.

5.2.1 Methodology for Data Collection

The following were used as primary data sources for this report:

- Natural Heritage Information Centre (NHIC) Biodiversity Explorer database (Ontario Ministry of Natural Resources, 2010);
- Upper Thames River Conservation Authority Watershed Report Cards;
- Lower Thames Valley Conservation Authority Watershed Report Cards;
- Upper Thames River Source Protection Area Approved Updated Assessment Report;
- Lower Thames Valley Source Protection Area Approved Updated Assessment Report;
- Land Information Ontario; and
- Geology Ontario.

5.2.2 Field Studies and Investigations

Fieldwork was not incorporated into the natural environment characterization. Species information may be sufficiently updated at the time of project implementation. Fieldwork should be planned and completed at the project onset through discussions with agency staff, subject to the extent of work proposed.

5.2.3 Environmental Planning and Policy Documents

5.2.3.1 Provincial Policy Statement (2014)

The wise use and management of the natural environment is recognized as a crucial component of ensuring Ontario's long-term prosperity, environmental health and social well-being. Accordingly, the Provincial Policy Statement (PPS) provides direction for the long-term protection, restoration and improvement of the diversity and connectivity of natural features, the ecological function and biodiversity of natural systems, and the quality and quantity of water at a watershed scale.

Policy 2.1 of the PPS (2014) provides direction for the protection of the natural heritage features, while guidance in this regard is provided through the Natural Heritage Reference Manual (Ministry of Natural Resources, 2010). The natural heritage features to be considered in accordance with the PPS include:

- Significant wetlands (PSW) and significant coastal wetlands;
- Significant habitat of endangered and threatened species;
- Significant woodlands;
- Significant valleylands;
- Significant wildlife habitat;

- Significant areas of natural and scientific interest (ANSIs); and
- Fish habitat.

In southern Ontario, development and site alteration is not permitted in significant habitat of endangered and threatened species or fish habitat except in accordance with provincial and federal requirements. Development and site alteration may be permitted on lands adjacent to significant wetlands, coastal wetlands and the habitat of endangered and threatened species if it is demonstrated that there will be no negative impacts on the natural features or the ecological functions for which the area was identified.

Development is not permitted within, or on lands adjacent to, the other significant natural heritage features unless the ecological function of these lands has been evaluated and it has been demonstrated that no negative impacts on the natural heritage features or their ecological function will occur.

The assessment, selection and implementation of any preferred alternatives should be consistent with the context and direction provided by the policies in the PPS.

5.2.3.2 COUNTY OF MIDDLESEX OFFICIAL PLAN – NATURAL ENVIRONMENT POLICIES (2.2.1 AND 3.4.1)

Middlesex County is an upper tier municipality. The County's Official Plan (OP) outlines broad policies for the Natural System which includes Natural Hazards, Natural Environment Areas, Natural Heritage Features, and Groundwater Features. While the policies do not preclude development in these areas, they are intended to protect them from adverse impacts of development. Schedule 'C' of the OP maps significant woodlands, which have been identified as such through the Middlesex Natural Heritage Study (MNHS - discussed below), as well as Areas of Natural and Scientific Interest (ANSI), identified for protection by the Ontario Ministry of Natural Resources and Forestry. Schedule 'C' however, is not intended as a land-use schedule, and the use of land within and contiguous to natural features shall proceed in accordance with the underlying land use designations shown on Schedule 'A' (2.2.1.3 – Natural Systems Policies, pg. 2-7), as well as those of the local Municipal OPs.

5.2.3.3 MUNICIPALITY OF MIDDLESEX CENTRE OFFICIAL PLAN – NATURAL ENVIRONMENT POLICIES (SECTION 3)

The Municipality of Middlesex Centre is a lower-tier municipality within Middlesex County. Land use, environmental, social and economic matters are guided by the Municipality's Official Plan (OP).

The OP promotes the identification, conservation, and protection of significant natural features and functions to prevent incompatible development and minimize potential impacts. The natural features include Natural Environment Areas, which prohibit development and are identified on Schedule A and A 2, as well as Greenland Features where development and site

alteration may be permitted, subject to a Development Assessment Report (DAR) (as described in Section 3.8 of the OP). According to the OP, 'development' includes the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act, but does not include activities that create or maintain infrastructure authorized under the Environmental Assessment process, works subject to the Drainage Act, or conservation projects.

Natural Environment Areas include wetlands, significant habitat of Threatened and Endangered species and floodplains. Greenland Features include significant woodlands as identified through the MNHS. Any development or site alteration within or adjacent to a Greenland Feature, or adjacent to a Natural Environment Area, may be permitted subject to the findings of a DAR. The extent of 'adjacent lands' varies based on the type of feature, and is outlined in Figure1 of the Middlesex Centre OP.

Natural Hazard Areas include floodplains, steep slopes, and other hazard lands identified by the Conservation Authority Regulation, and are identified on Schedule C. New development is generally prohibited in such areas to ensure there is no increased risk to life or property, either as a result of or to the new development.

5.2.3.4 Species at Risk Act

The Species at Risk Act (SARA) identifies wildlife species considered to be at risk in Canada and designates them as threatened, endangered, extirpated or of special concern. Species at risk are identified and assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which is an independent committee of wildlife experts and scientists that makes recommendations to the federal government regarding the status of wildlife species in Canada.

The purpose of SARA is to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened.

The protection and conservation measures afforded by SARA apply to those species identified on Schedule 1 of the Act. Other species identified by COSEWIC as species at risk that required further assessment in accordance with current assessment criteria are identified on Schedule 2 (Endangered and Threatened) and Schedule 3 (Special Concern) of the Act. All listed (Schedule 1) aquatic species and migratory birds in Canada are protected by SARA. Remaining listed species (plants, mammals, reptiles, amphibians) are only protected where they occur on federal lands (I.e. National Parks, First Nations Reserves).

Any activity affecting a listed species or its critical habitat requires the prior issuance of a permit from the applicable agency, either Environment Canada or Department of Fisheries and Oceans Canada (DFO). Permits may only be issued for scientific research relating to the conservation of the species, where activities are required to benefit a species or to enhance its

chances of survival or for incidental impacts. Efforts to avoid, reduce, or minimize impacts must first be employed and activities will not be permitted if they would jeopardize the survival or recovery of the species.

5.2.3.5 Endangered Species Act

Similar to SARA, the Endangered Species Act identifies wildlife species considered to be at risk in Ontario and designates them as threatened, endangered, extirpated or of special concern. Provincial species at risk are identified and assessed by the Committee on the Status of Species at Risk in Ontario (COSSARO) which is a committee of wildlife experts and scientists, as well as those who provide Aboriginal traditional knowledge, that classify species according to their degree of risk based on the best available scientific information, community knowledge and aboriginal traditional knowledge. When COSSARO classifies a species at risk, that classification applies throughout Ontario, unless otherwise noted.

The Endangered Species Act (2007) replaces the original (1971) to provide broader protection for species at risk and their habitats, a stronger commitment to recovery of species, greater flexibility, increased fines and more effective enforcement, as well as greater accountability through government reporting requirements.

The Endangered Species Act protects species at risk and their habitats by prohibiting anyone from killing, harming, harassing or possessing protected species, as well as prohibiting any damage or destruction to the habitat of species identified on the Species At Risk in Ontario (SARO) list. All species on the SARO list are provided with general habitat protections under the Endangered Species Act, which protect areas that species depend on to carry out their life processes, such as reproduction, rearing, hibernation, migration, or feeding.

A species added to the SARO list is required to have a regulation approved by the Ministry of Natural Resources and Forestry (MNRF) within a set period of time to define species specific habitat requirements, which identifies specific boundaries, areas, or features of an area where the species lives, used to live or is believed to be capable of living. This 'regulated habitat' replaces the general habitat description once approved.

Any activity that may impact a protected species or its habitat requires the prior issuance of a permit from the MNRF. Such permits may only be issued under certain circumstances, which are limited to activities required to protect human health and safety, activities that will assist in the protection or recovery of the species, activities that will result in an overall benefit to the species or activities that may provide significant social or economic benefit without jeopardizing the survival or recovery of the species in Ontario.

Recent changes to the Endangered Species Act allow for specific infrastructure projects to proceed without the prior issuance of a permit. For these activities the work must be registered and certain rules and guidelines adhered to. Consultation with the ministry is recommended prior to the works starting in order to ensure compliance with the Endangered Species Act.

5.2.3.6 Conservation Authority Approval

Upper Thames River Conservation Authority and Lower Thames Valley Conservation Authority are responsible for approval of development or site alteration within hazardous areas adjacent to shorelines, watercourses and wetlands within their respective geographical jurisdictions. These areas, known as the "Regulation Limit", are detailed in Ontario Regulation 157/06 and Ontario Regulation 152/06: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, and its accompanying mapping. The purposes of these regulations are to protect life and property from flooding, erosion and unstable slopes.

Regulated areas are further discussed in Section 5.20 and 5.28.

5.2.3.7 Summary of Policy Implications

This Master Plan process recognizes the objectives of the policies noted above and the requirements of the individual agencies. The corresponding opportunities and constraints established by these policies and supporting guidelines should be recognized and addressed throughout the planning process, as well as through implementation, including the identification of appropriate mitigation, restoration, and enhancement measures to offset potential negative impacts. The intent of this review is to demonstrate how the proposed project complies with the applicable policies noted above. As such, this approach is to recognize the objectives of the policies noted above and the requirements of the individual agencies charged with their implementation. This information will be considered during the establishment of the preferred alternative and identification of appropriate mitigation, restoration and, where feasible, enhancement opportunities.

5.2.4 Existing Natural Features and Functions

5.2.4.1 Climate

Environment Canada's St. Thomas weather monitoring station is the closest station to the Delaware Community Settlement Area with sufficient temperature, precipitation and other weather data, (Environment Canada Station Climate ID 6137362). This climate station meets the World Meteorological Organization (WMO) standards for temperature and precipitation. Climate averages for the period 1971-2000 are outlined in Table 5.1 below (Environment Canada, 2013).

Table 5.1 St. Thomas Climate Averages (1971-2000)

Climate Station ID 6137362		Value	Month
Daily Average Temperature	**Highest Month**	21.2 °C	July
	Lowest Month	-4.70 °C	January

Climate Station ID 6137362		Value	Month
Average Monthly Precipitation	**Highest Month**	94.8 mm	September
	Lowest Month	37.3 mm	February
Total Annual Precipitation		993.0 mm	---

5.2.4.2 Physiography

The Delaware study area is situated in two physiographic regions. The majority of the study area is in the Caradoc Sand Plains and the London Annex. The western third of the study area is considered spillway (Chapman & Putnam, 1984).

Figure 5.3 illustrates the physiographic regions for the study area.

5.2.4.3 Geology

The bedrock geology across the study area consists primarily of limestone, dolostone and shale (the Hamilton Group), with a drift thickness typically greater than 20 metres. The surficial geology is characterized by modern alluvial deposits (sand), generally in the lowland area and deltaic deposits (gravel), in the upland area. The easternmost portion of the study area along Longwoods Road consists of coarse-textured glaciolacustrine deposits. A small portion at the southern limit of the study area consists of fine-textured glaciolacustrine deposits (Ontario Geological Survey, 2011).

Figure 5.4 illustrates the geology for the study area.

5.2.4.4 Soils

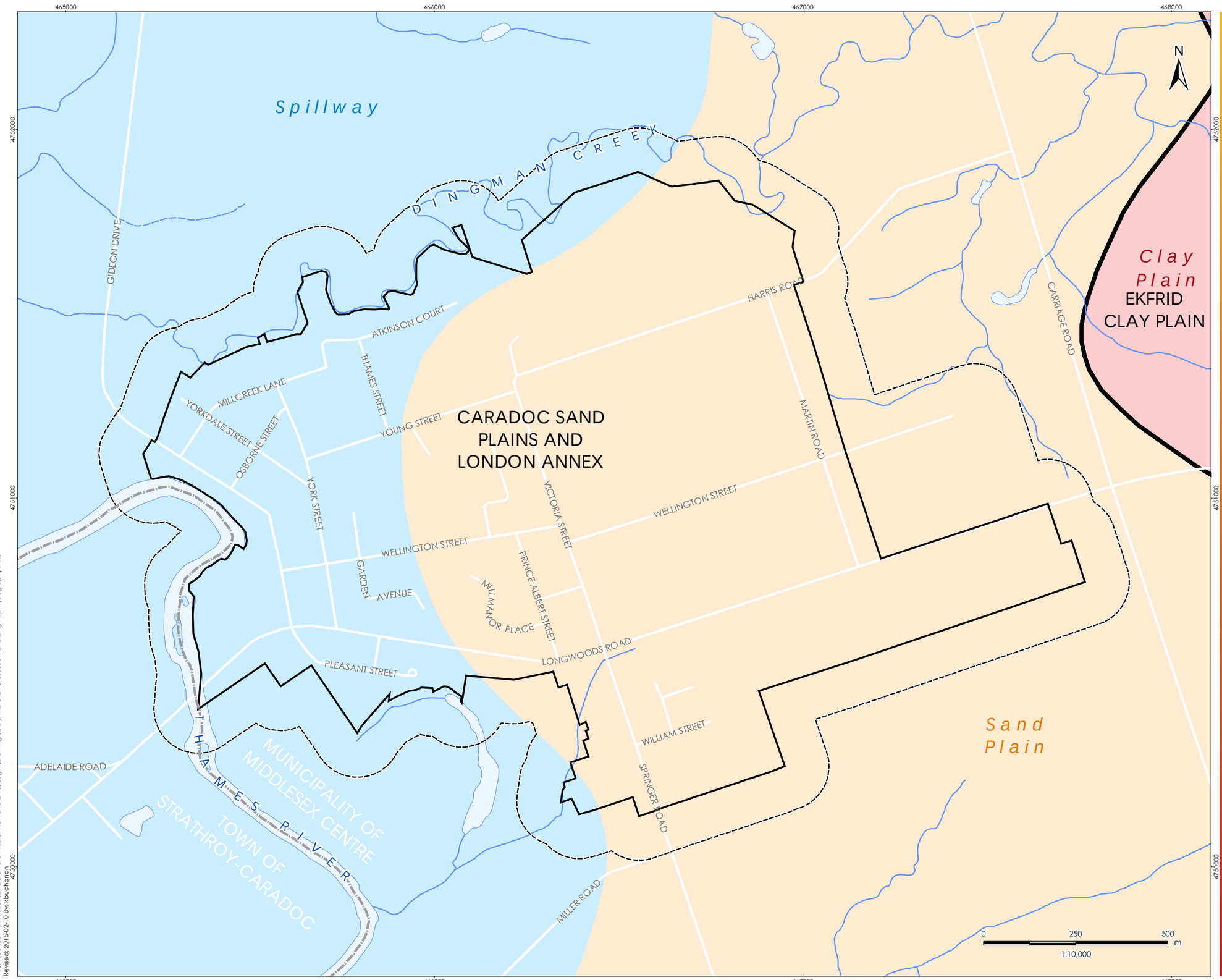
Brant, Fox and Caledon are the primary mixes of soil types found within the study area. The Plains are a mix of loams with sandy loam being the dominant soil type. Fine sandy loam is also predominant in this area. The Spillway region consists primarily of loam with a small area of silty clay loam and another small area of loamy sand. These soil types range in drainage from well to imperfect and rapid to imperfect. Historically the gravelly terraces along the Thames from Delaware to London were characterized by orchards and market gardens (Chapman & Putnam, 1984).

Figure 5.5 illustrates the soil types for the study area.

5.2.4.5 Topography

The topography in the watershed is primarily level at approximately 230 – 240 metres above sea level. A drop in elevation upwards of 30 metres occurs along the Thames River valley and north east of Dingman Creek.

Figure 5.6 illustrates the topography for the study area.



Stantec

Legend

- Study Area

Background Information

- Settlement Boundary
- Municipal Boundary
- Conservation Authority Boundary

Physiography

- Physiographic Region

Physiography Type

- Clay Plain
- Sand Plain
- Spillway

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Physiography from Physiography of Southern Ontario (MRD228, Ontario Ministry of Northern Development and Mines). Intended for use at 1:250,000; boundaries are approximate (± 500 metres).

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Figure No.

5.3

Title

Physiography

V:\01655\active\165630021 Delaware Master Plan and EA\design\drawing\GIS\MXD\NER\165630017_NER_Fig4-1_Physiography.mxd
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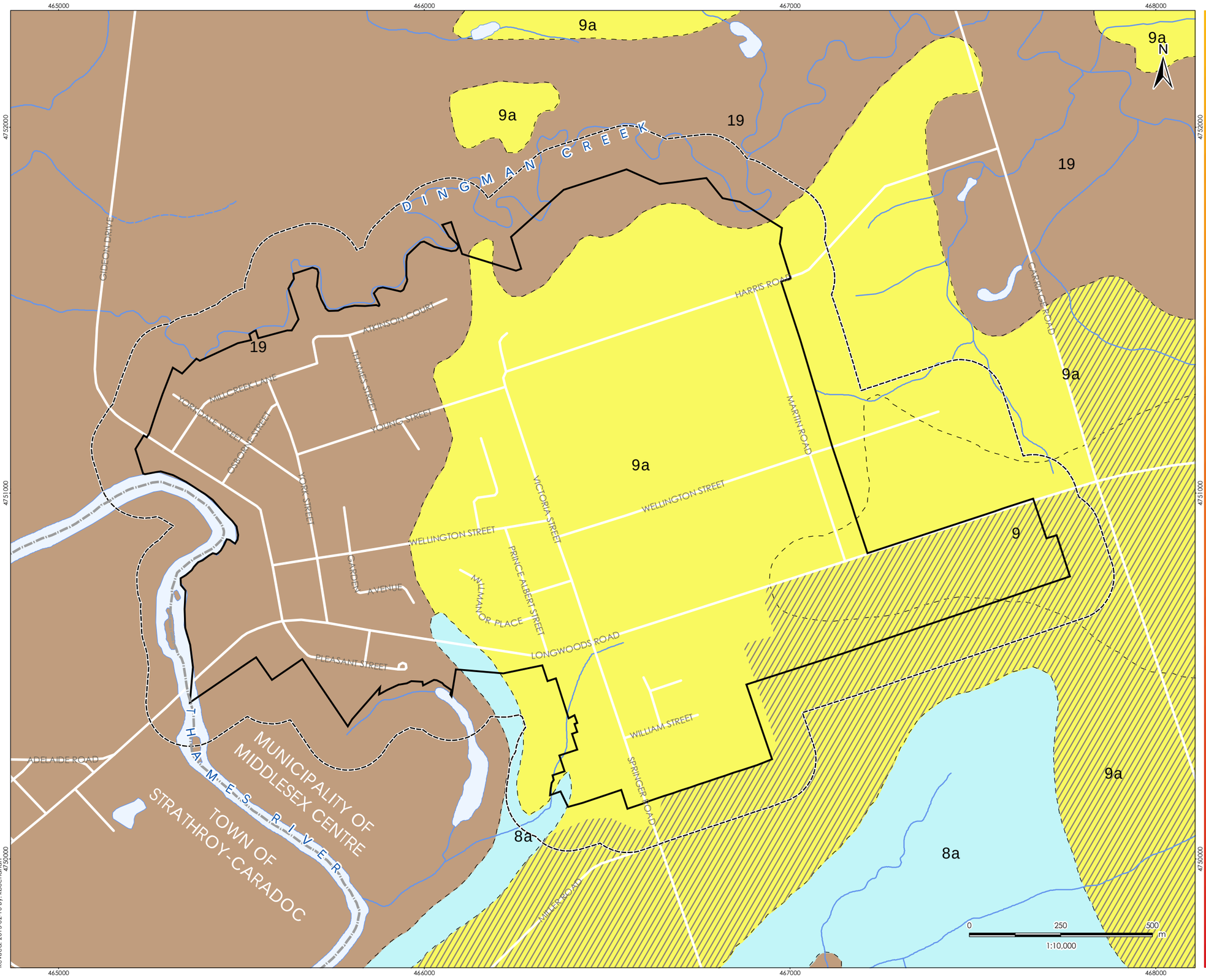

Stantec

Legend

- Study Area

Background Information

- Settlement Boundary
- Municipal Boundary

Surficial Geology Unit

- 8: Fine-textured glaciolacustrine deposits
- 8a: Massive-well laminated
- 9: Coarse-textured glaciolacustrine deposits
- 9a: Deltaic deposits
- 19: Modern alluvial deposits
- Approximate Aggregate Area

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Geology from Surficial Geology of Southern Ontario (MRD128-REV, Ontario Ministry of Northern Development and Mines). Intended for use at 1:50,000; boundaries are approximate (± 250 metres).
4. Approximate aggregate area from Middlesex Cetre Official Plan, consolodated June 2014.

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Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

5.4

Title

Surficial Geology

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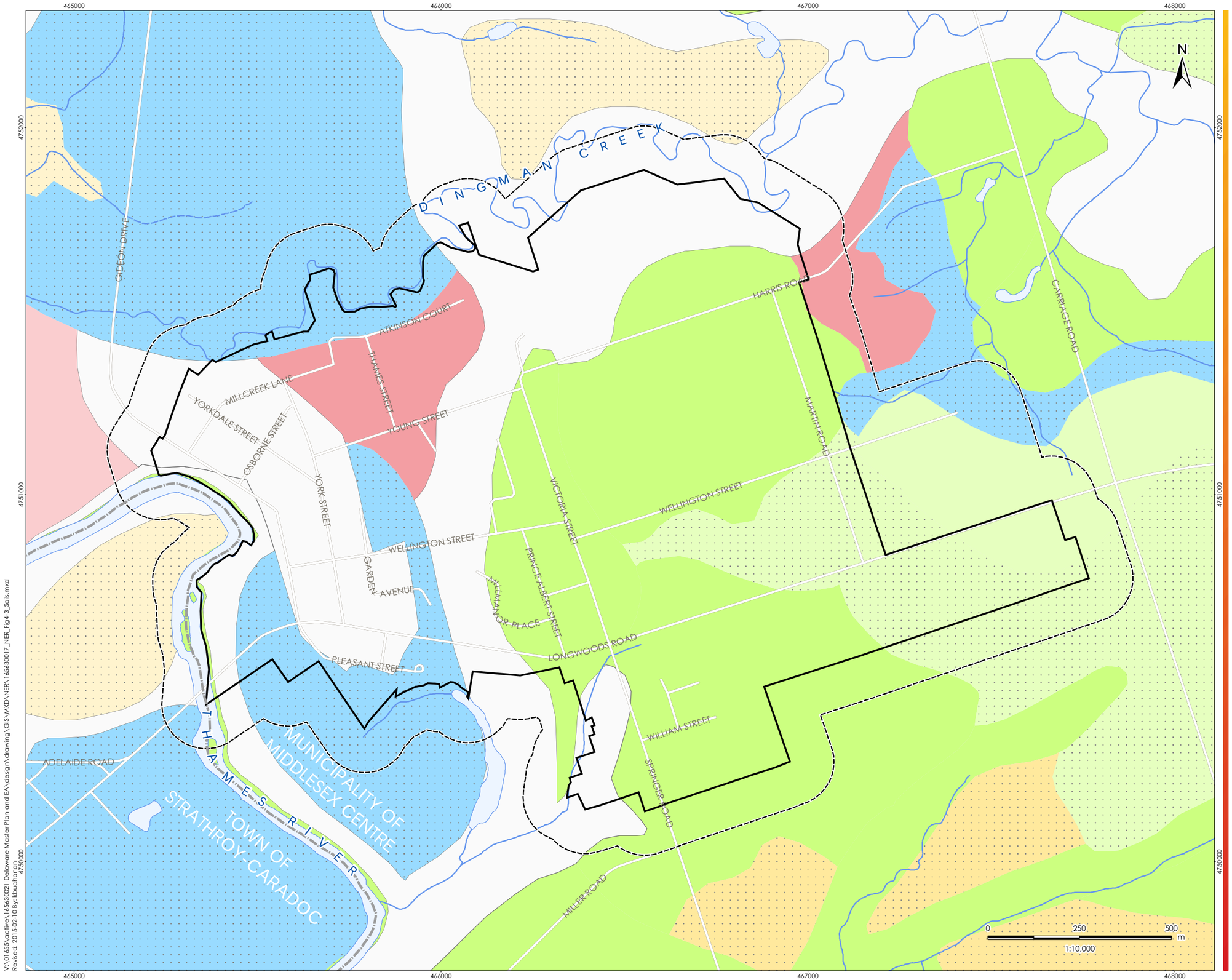
Revised: 2015-02-10 By: kbuchanan



Stantec

Legend

- Study Area

Background Information

- Settlement Boundary
- Municipal Boundary

Dominant Soil Texture

- Loam
- Sandy Loam
- Fine Sandy Loam
- Clay Loam
- Silty Clay Loam
- Loamy Sand
- Loamy Fine Sand
- No Data
- Poor Infiltration
- Very Poor Infiltration

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Soils based on Soils of Middlesex County, 1992 (ON56, Ontario Ministry of Agriculture and Food). Intended for use at 1:50,000; boundaries are approximate (± 200 metres).

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

5.5

Title

Soils

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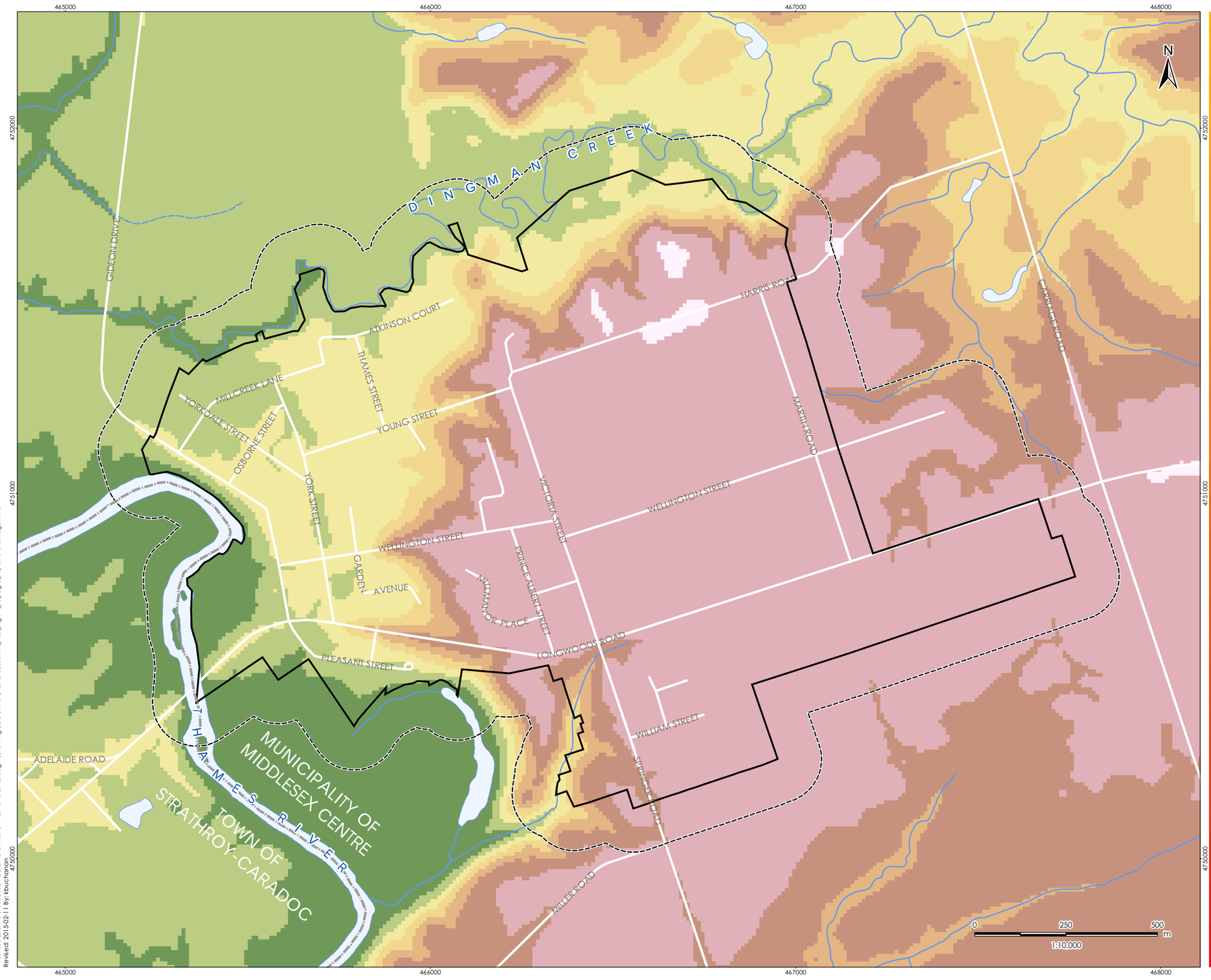
Revised: 2015-02-10 By: kbuchanan



Stantec

Legend

- Study Area

Background Information

- Settlement Boundary
- Municipal Boundary

Elevation (m)

- > 240
- 235 - 240
- 230 - 235
- 225 - 230
- 220 - 225
- 215 - 220
- 210 - 215
- < 210

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Elevation from Provincial Digital Elevation Model v2.0 (Ontario Ministry of Natural Resources and Forestry).

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Municipality of Middlesex Centre
Delaware Community Settlement Area
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Figure No.

5.6

Title

Topography

V:\01655\active\165630021 Delaware Master Plan and EA\design\drawing\GIS\MXD\NER\165630017_NER_Fig4-4_Topography and Drainage.mxd
Revised: 2015-02-11 By: kbuchanan

5.2.4.6 Watersheds

Conservation Authority jurisdiction divides the study area approximately in half. The UTRCA portion of the study area falls into the Dingman Creek subwatershed as described in the Authority's Watershed Report Card. This northern half of the study area drains north towards Dingman Creek and then southeast to the Thames River.

The southern portion of the study area is in the LTVCA. The Northwest Lower Thames subwatershed drains southwest to a municipal drain and then on to the Thames River.

Desk top information is not readily available for the LTVCA subwatershed area. If any identified projects are located within this jurisdiction additional natural resource information may be required prior to detailed design.

Figure 5.7 illustrates the UTRCA and LTVCA watersheds.

5.2.4.7 Aquatic Species

There have been a total of 43 fish species and 13 freshwater mussel species identified in the Dingman Creek watershed. Gamefish include Smallmouth and Largemouth Bass, Black Crappie, Northern Pike, and Brown Trout. The 2012 UTRCA Report Card records list one fish species at risk being present at the time of publication (Upper Thames River Conservation Authority, 2012).

Lower Thames Valley Watershed 2013 Report Card does not list species at risk for the watersheds.

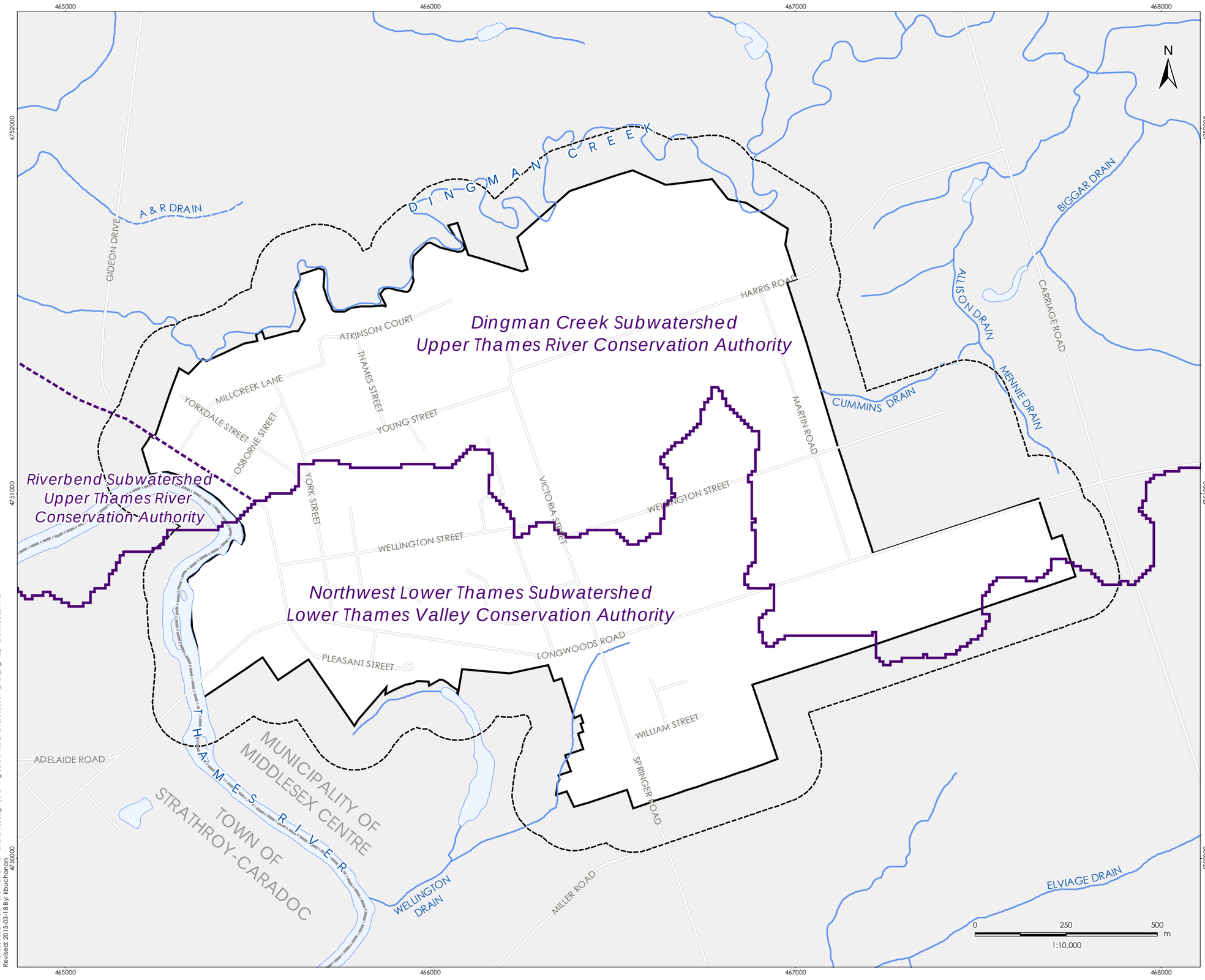
A review of DFO Distribution of Fish Species at Risk mapping illustrates numerous species at risk within the study area (Fisheries and Oceans Canada, 2013). Table 5.2 lists the species at risk identified by the conservation authorities and DFO mapping.

Table 5.2 Aquatic Species at Risk

	Endangered Species Act (Provincial)		**Species at Risk Act** (Federal)		
	Threatened	**Endangered**	**Threatened**	**Endangered**	**Under consideration for listing**
FISH					
Silver Shiner	☑				☑
Eastern Sand Darter		☑			☑
Pugnose Minnow	☑				☑
Channel Darter	☑		☑		

	Endangered Species Act (Provincial)		**Species at Risk Act** (Federal)		
	Threatened	**Endangered**	**Threatened**	**Endangered**	**Under consideration for listing**
FISH					
Lake Chubsucker	☑			☑	
Northern Madtom		☑		☑	
Pugnose Shiner	☑			☑	
Spotted Gar	☑		☑		
Mussels					
Eastern Pondmussel		☑		☑	
Kidneyshell		☑		☑	
Mapleleaf	☑		☑		
Northern Riffleshell		☑		☑	
Rainbow Mussel	☑			☑	
Rayed Bean		☑		☑	
Round Hickorynut		☑		☑	
Round Pigtoe		☑		☑	
Snuffbox		☑		☑	
Salamander Mussel		☑			☑

Recommended alternatives may require additional review of updated information and may require field investigations to determine the presence or absence of at risk species.



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Revised: 2015-03-18 By: kbuchanan

Stantec

Legend

- Study Area
- Approximate Watershed Boundary
- Conservation Authority Boundary

Background Information

- Settlement Boundary
- Municipal Boundary

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Drain names from constructed drainage dataset (Ontario Ministry of Agriculture, Food and Rural Affairs).
4. Conservation authority boundary from Middlesex Centre Official Plan.
5. Subwatershed boundaries from Conservation Authority Watershed Report Cards.

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Municipality of Middlesex Centre
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Figure No.

5.7

Title

Watersheds and Drainage

5.2.4.8 Water Quality

The UTRCA 2012 Watershed Report Card grades surface water quality according to the document *Watershed Reporting: Improving Public Access to Information* (Conservation Ontario, 2003).

Three indicators are used to assess the surface water quality for each watershed:

- Bacteria (*E. coli*);
- Total phosphorus; and
- Benthic invertebrates.

The results pertaining to the northern portion of the study area regulated by the UTRCA are outlined in Table 5.3. The grades assigned are based on province-wide standards developed by the Conservation Authorities, A being excellent, B good, C fair, D poor, and F very poor. The overall target for the UTRCA is a grade of B.

Table 5.3 UTRCA Dingman Creek Subwatershed Surface Water Quality

Indicators	Dingman Creek			Upper Thames 2006-2010	Provincial Guideline
	1996-2000	2001-2005	2006-2010		
Total Phosphorous (mg/l)	0.152 D	0.104 D	**0.106 D Steady**	**0.091 D**	**0.030 B (Aquatic Life)**
Bacteria (*E.coli*/100ml)	744 D	480 D	**300 C Improved**	**249 C**	**100 B (Recreation)**
Benthic Score (FBI)	6.76 D	6.07 D	**5.81 D Improved**	**6.04 D**	**<5.00 B (Target Only)**

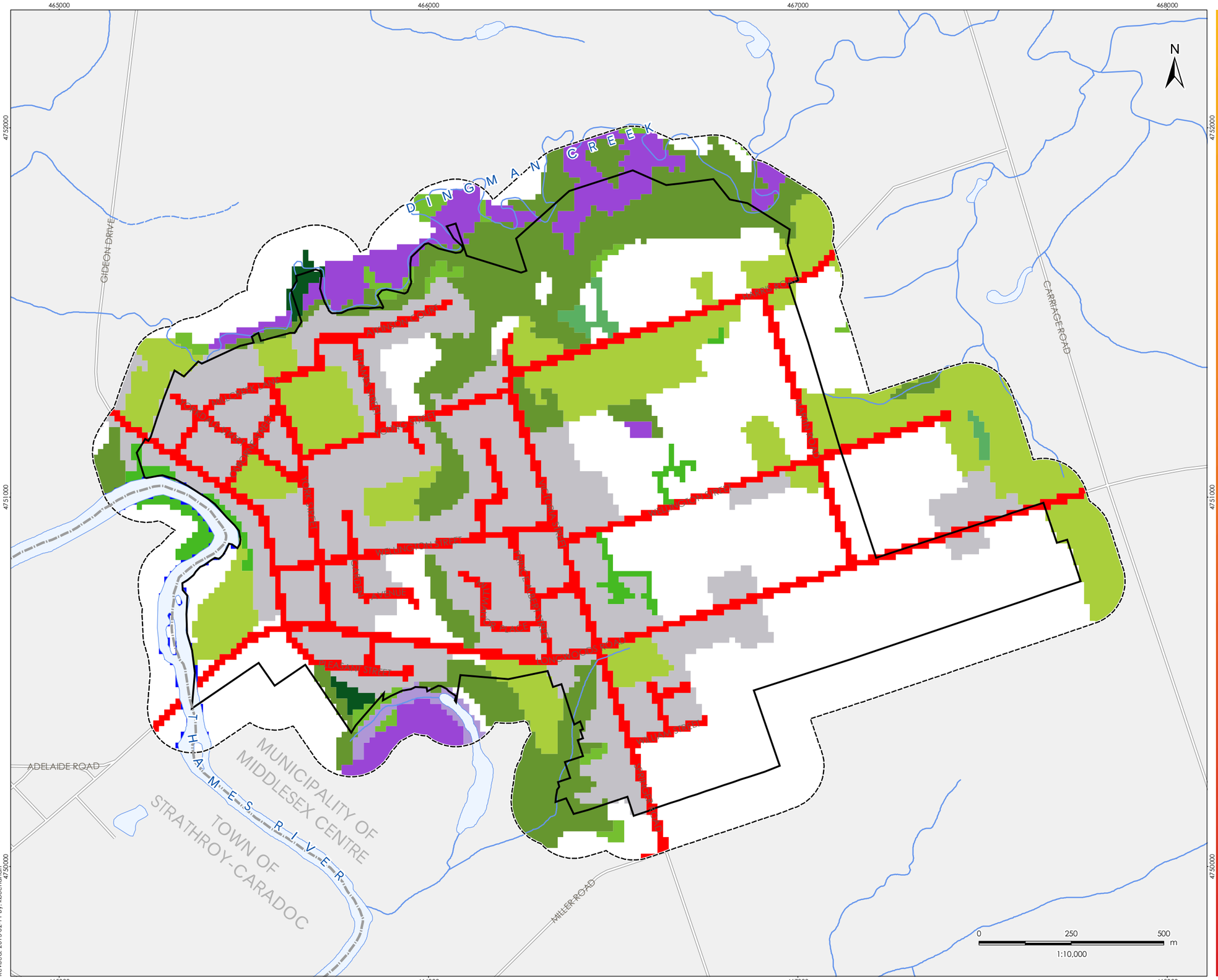
5.2.4.9 Vegetation Communities

Field investigations of vegetation communities have not been conducted for this NER, however the Ministry of Natural Resources and Forestry's Southern Ontario Land Resources Information

System (SOLRIS) dataset provides a high-level overview of the types of vegetation communities that exist on the landscape.

Significant land cover classes described by SOLRIS in the study area include "undifferentiated land" (almost exclusively agriculture) and developed areas at approximately 37 %, and 42 % respectively.

Forested areas cover approximately 15 % of the landscape. Forests throughout the study area are predominantly deciduous. Wetlands account for less than 5% and open water is less than 2%. Figure 5.8 illustrates the SOLARIS data set within the study area.



Stantec

Legend

- Study Area

Background Information

- Settlement Boundary
- Municipal Boundary

SOLRIS Classification (MNR, 2000)

- 27. Forest
- 28. Coniferous Forest
- 30. Deciduous Forest
- 36. Plantations - Tree Cultivated
- 37. Hedge Rows
- 42. Transportation
- 44. Built-up Area Pervious
- 45. Built-up Area Impervious
- 50. Swamp
- 63. Marsh
- 66. Open Water

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Land use from Southern Ontario Land Information Resource System (Ontario Ministry of Natural Resources, 2000).

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Municipality of Middlesex Centre
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Municipal Class Environmental Assessment

Figure No.

5.8

Title

Southern Ontario Land Resources Information System Classification

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Revised: 2015-02-11 By: kbuchanan

5.2.4.10 Plant Species

The Natural Heritage Information Centre (NHIC) maintains a publicly available database of critical flora and fauna previously observed within the study area. Since 1990, there have been four observations (four species) of tracked plant species in the study area (Ontario Ministry of Natural Resources, 2010), one which is currently listed as at-risk.

The UTRCA 2012 Watershed Report Card lists a total of four species at risk in the Dingman Creek subwatershed. Table 5.4 lists the recorded species from the NHIC and the report card according to their classification on the Species at Risk in Ontario List at the time of reporting.

Table 5.4 Plant Species at Risk

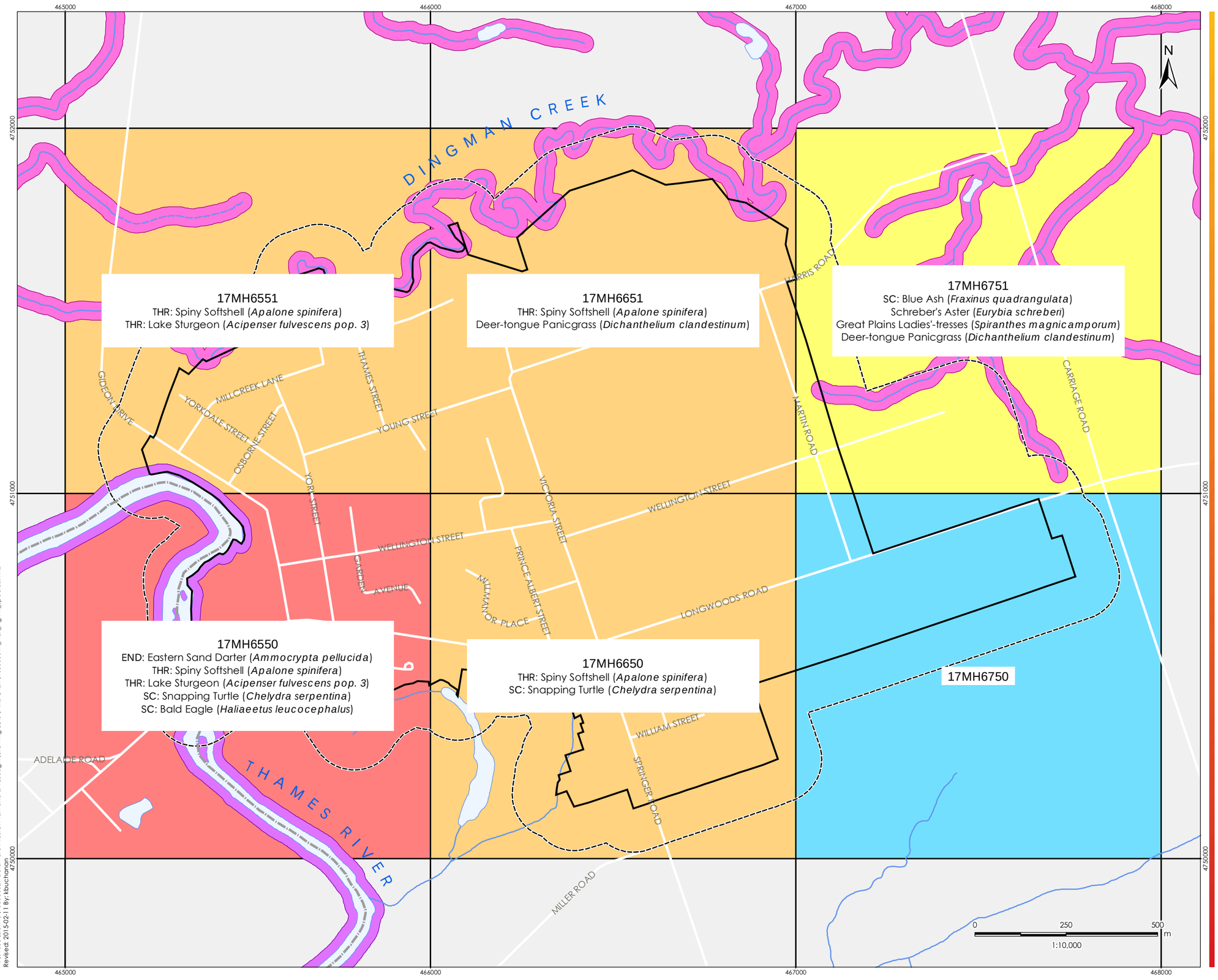
Endangered	Special Concern
American Chestnut (*Castanea dentate)* Eastern Flowering Dogwood (*Cornus florida)* False Hop Sedge (*Carex lupuliformis)*	Blue Ash (*Fraxinus Quadrangulata*)

5.2.4.11 Wildlife

The NHIC publicly lists a total of one at–risk bird species observed in or near the study area since 1990 (Ontario Ministry of Natural Resources, 2010). The 2012 UTRCA Watershed Report Card lists a total of one at-risk bird species, one mammal and four reptiles within the Dingman Creek sub-watershed. These species are listed in Table 5.5 below. The LTVCA report card does not record species at risk in the watershed. Figure 5.9 illustrates the NHIC data set (in 1km squares) for the study area.

Table 5.5 Wildlife Species at Risk

Sub-watershed	Birds	Mammals	Reptiles
Dingman Creek	Least Bittern (Thr) Bald Eagle (SC)	American Badger (End)	Spiny Softshell Turtle (Thr) Spotted Turtle (End) Northern Map Turtle (SC) Eastern Hog-nosed Snake (Thr)



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Revised: 2015-02-11 By: kbuchanan

Stantec

Legend

- Study Area

Background Information

- Settlement Boundary
- Municipal Boundary
- NHIC 1 km Grid Square

Highest Provincial Species Ranking

- Endangered or Restricted Records
- Threatened
- Special Concern
- Tracked by NHIC
- No Species Identified

DFO Species at Risk Mapping

- Protected Mussel / Protected Fish Species
- Protected Mussel / Under Review Fish Species

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Natural Heritage Information Centre data current to July 2013.
4. Aquatic Species at Risk mapping current to May 2014.

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Figure No.

5.9

Title

NHIC Recorded Species Observed Since 1990 and Aquatic Species at Risk

5.2.4.12 Natural Hazard Features

Natural processes that have the potential to cause damage to property, personal injury or loss of life are regulated in Ontario under the Conservation Authorities Act. These hazards can include flooding, erosion, dynamic beaches and unstable slopes.

Ontario Regulation (O. Reg.) 157/06 outlines regulated areas within the jurisdiction of UTRCA, and O. Reg. 152/06 outlines regulated areas within the jurisdiction of LTVCA. Both consider:

- 1937 Flood Event – 250 Year Flood Event Standard (UTRCA);
- The Hurricane Hazel and the 100 Year Flood Event Standard (LTVCA);
- Long term stable slopes;
- Dynamic beaches;
- Riverine meander belts;
- Wetlands;
- Other hazardous lands; and
- Additional setbacks from these features.

Approximately 26 percent of the study area is regulated by the UTRCA under O. Reg. 157/06 and 12 percent of the study area is regulated by the LTVCA under O.Reg 152/06. Both areas are illustrated in Figure 5.10.

Any development or site alteration proposed within the regulated areas will require prior written approval from the appropriate Conservation Authority.

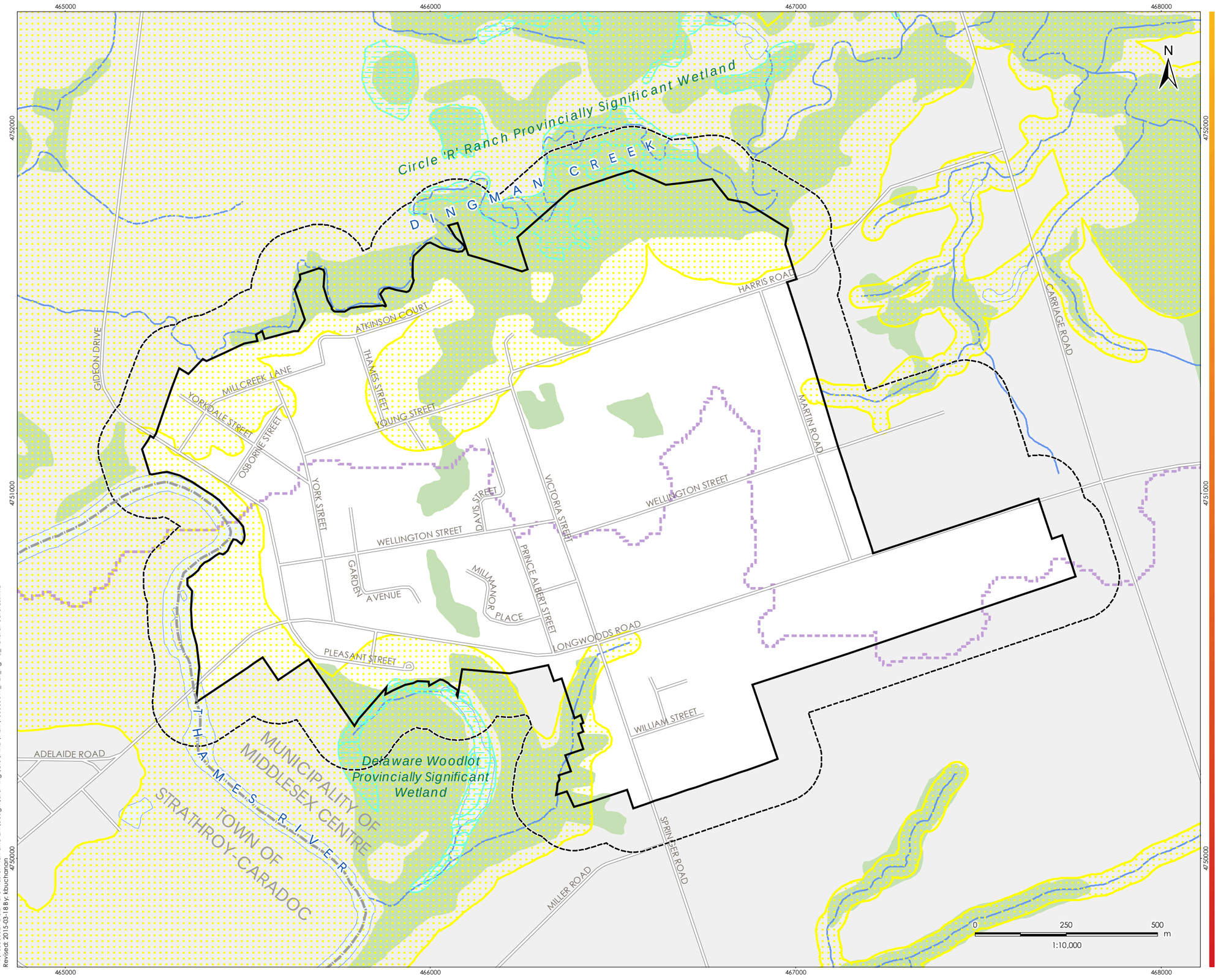
5.2.4.13 Significant Wetlands

There are two wetlands within the study area and both are identified as Provincially Significant. The Circle 'R' Ranch is located in the northern limit of the study area in the Dingman Creek valley. The Delaware Woodlot is located in the southern limit of the study area within an oxbow of the Thames River. The Municipality of Middlesex Centre Official Plan states that development or site alteration within 120m of significant wetlands is subject to the completion of a Development Assessment Report (DAR). Significant Wetlands are illustrated in Figure 5.10.

5.2.4.14 Significant Woodlands

The Municipality of Middlesex Centre Official Plan identifies Significant Woodlands on Schedule B of their Official Plan. They are of County significance and are identified through the Middlesex Natural Heritage Study. Development or site alteration may be permitted in significant woodlands if it has been demonstrated that there will be no negative impacts on the natural features or the ecological functions for which the area is identified, based on the findings of a Development Assessment Report. According to the Municipality's OP, development or site alteration within 50 metres of significant woodland may require the completion of a

Development Assessment Report (DAR). Figure 5.10 Natural Features and Conservation Authority Regulated Lands illustrates forested areas that may qualify as Significant Woodlands.



Stantec

Legend

- Study Area
- Settlement Boundary
- Municipal Boundary
- Conservation Authority Boundary
- Wetland (MNR)
- Regulated Area (UTRCA, LTVCA)
- Significant Woodlot (MNHS)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. UTRCA Regulated Area currently under review and subject to change.
4. Significant Woodlots from Middlesex Natural Heritage Study.

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Stormwater Drainage Master Plan

Figure No.

5.10

Title

Natural Features and Regulated Area

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Revised: 2015-03-18 By: kbuchanan

5.2.4.15 Invasive Species

Invasive species have far-reaching impacts on the natural environment and are one of the greatest threats to biodiversity. The Ontario Ministry of Natural Resources and Forestry define invasive species as: "harmful alien species whose introduction or spread threatens the environment, the economy, or society, including human health" (Ministry of Natural Resources and Forestry, 2012).

Consultation with First Nations communities during similar projects has identified concerns over the potential for common reed (Phragmites australis subsp. australis) to become established in the area of the project site once construction has been completed.

Common reed is an invasive perennial grass that creates monoculture stands that in most cases leads to a decrease in biodiversity and destruction of habitat for other species (Ontario Ministry of Natural Resources, 2011). It thrives in disturbed habitat and is often among the first species to colonize a new area. It is for this reason that it has been identified as a concern.

It is important to note that the invasive subspecies is similar to a native species (subspecies americanaus) and is imperative to correctly identify before implementing a management or removal plan.

5.2.4.16 Drinking Water Source Protection

Drinking Water Source Protection represents the first barrier in the protection of drinking water. Protecting surface and ground water from becoming contaminated or overused will ensure a sufficient supply of clean, safe drinking water. The Clean Water Act 2006 (CWA) is intended to protect existing and future sources of drinking water as part of the government's overall commitment to protecting human health and the environment. The CWA sets out a framework for source protection planning on a watershed basis with Source Protection Areas established based on the watershed boundaries of Ontario's 36 Conservation Authorities.

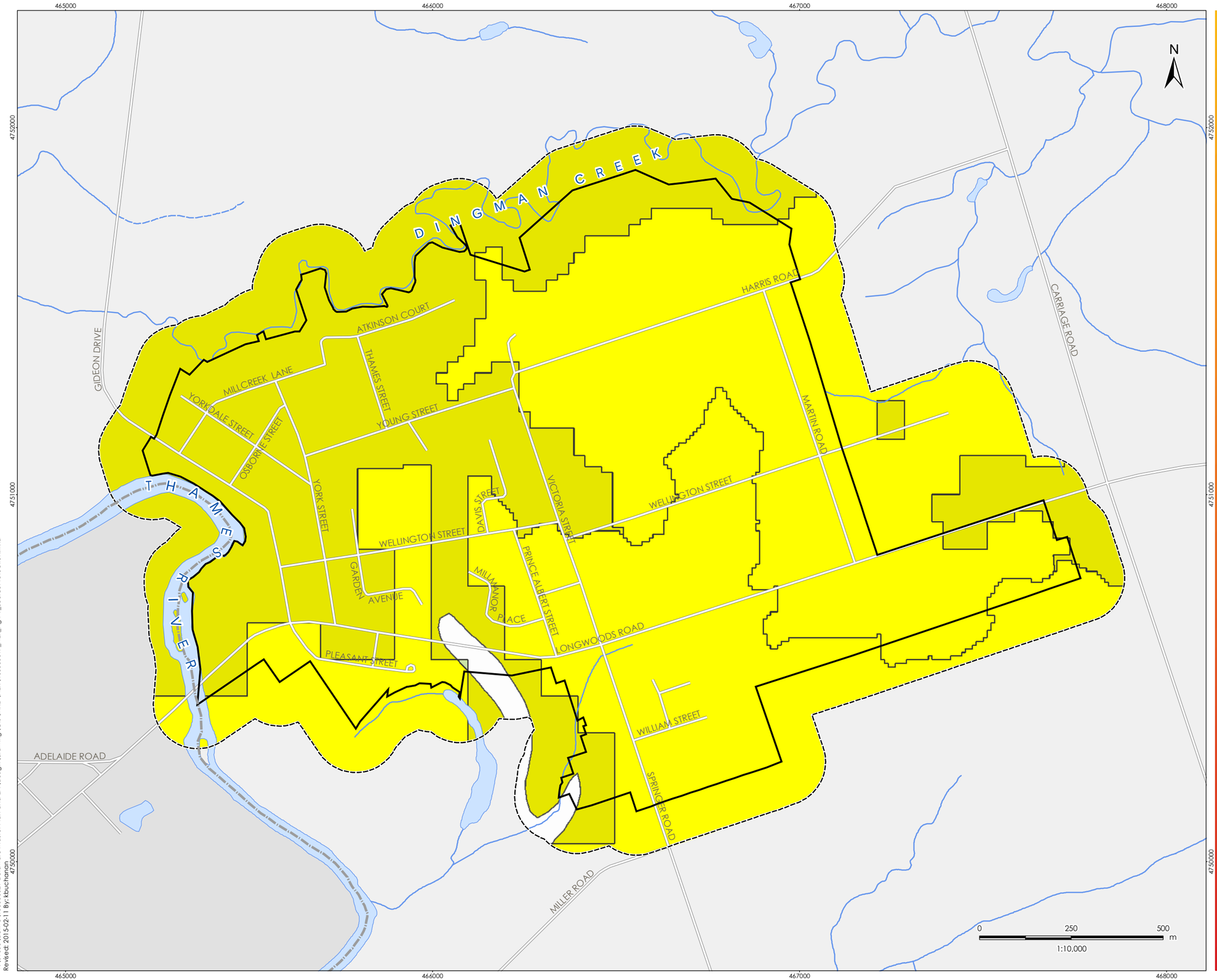
For the purposes of drinking water source protection, the Upper Thames River Source Protection Area is partnered with the Lower Thames Valley Source Protection Area and the St. Clair Region Source Protection Area to create the Thames, Sydenham & Region Source Protection Region (TSRSPR). This Source Protection Region is one of 19 established across the province.

The Upper Thames Valley Source Protection Area Assessment Report prepared by the Thames-Sydenham and Region Source Protection Committee (TSRSPC) delineates Significant Groundwater Recharge Areas (SGRAs) and Highly Vulnerable Aquifers as the types of vulnerable areas present within the northern study area (Thames-Sydenham and Region Source Protection Committee, 2011).

The Lower Thames Valley Source Protection Area Report prepared by TSRSPC delineates Highly Vulnerable Aquifers as being present within the southern study area (Thames-Sydenham and Region Source Protection Committee, 2011).

Figure 5.11 illustrates the approximate boundaries of the source water protection areas.

Placement of certain types of infrastructure within a Significant Groundwater Recharge area or a Highly Vulnerable Aquifer may be affected by the Source Protection Plan for this area. Through a review of the TSRSP Plan, Volume II – Policies affecting the TSR (revision March 5, 2015), the proposed work is located in areas delineated as Highly Vulnerable Aquifer and Significant Groundwater Recharge Area with vulnerability score of 6. The applicable Policy number is 3.03, ID #4613, New Prescribed Instruments Related to Moderate and Low Threats – Management. The proposed activity is the implementation of Dry Stormwater Management Ponds. This activity is included under the high level activity 'Sewage", and in this case the prescribed instrument would be subjected to Provincially issued documents in order to approve and construct such as permits, licenses, and MOECC approvals.



Stantec

Legend

- Study Area
- Settlement Boundary
- Municipal Boundary

Drinking Water Source Protection Vulnerable Areas

- Highly Vulnerable Aquifer and Significant Groundwater Recharge Area
- Highly Vulnerable Aquifer

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Drinking Water Source Protection Vulnerable Areas and symbology from Thames, Sydenham and Region Source Protection Region web mapping service, accessed February 11, 2015.

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Figure No.

5.11

Title

Drinking Water Source Protection Areas

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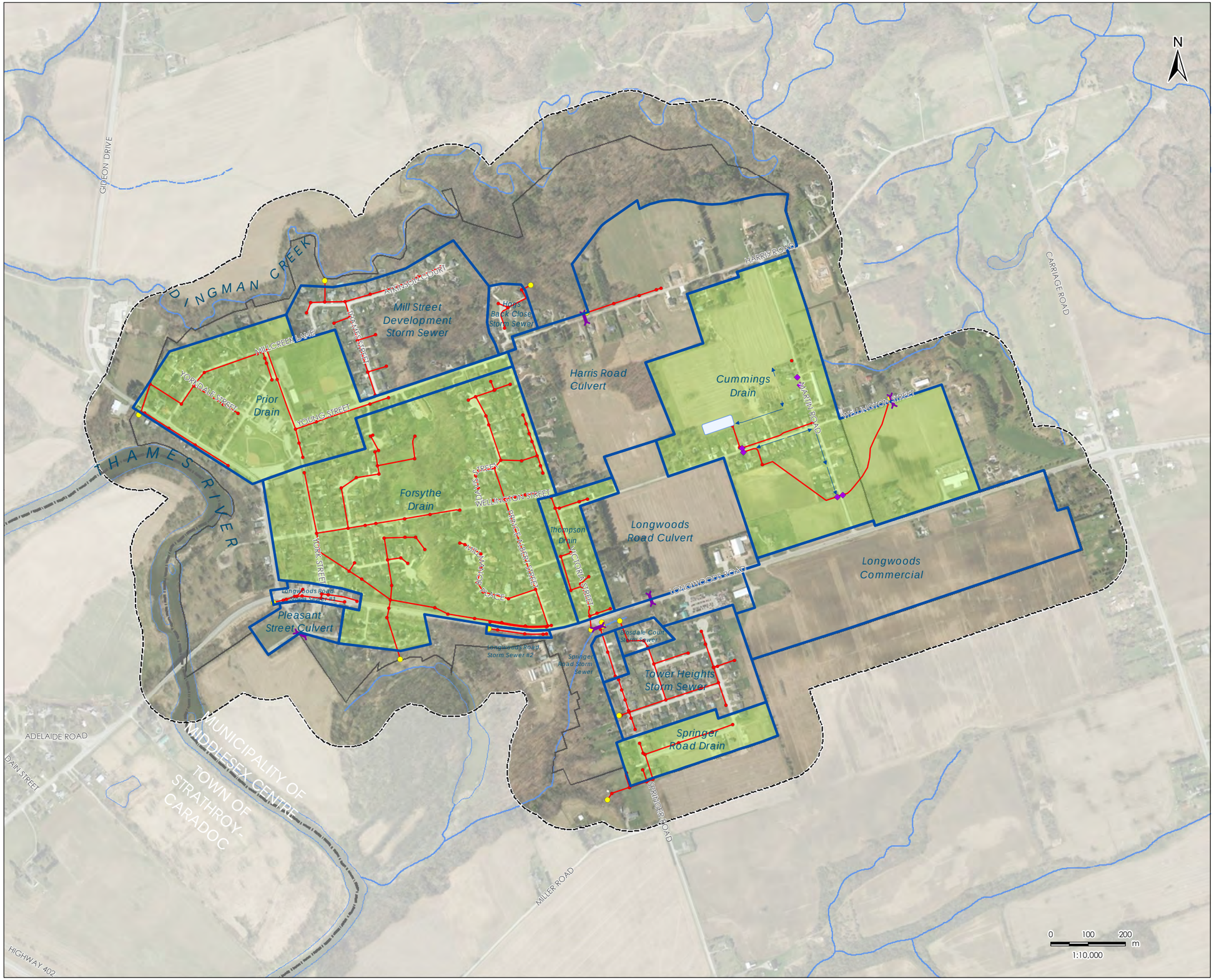
Revised: 2015-02-11 By: kbuchanan

5.3 EXISTING DRAINAGE

A review of the existing drainage conditions was completed, and the study area was broken down into catchment areas based on the available drawings provided by the Municipality of Middlesex Centre, municipal drainage reports, topographic mapping and site visit observations. Figure 5.12 shows the study area and catchment areas; figures included Section 6.2 show existing drainage infrastructure within each catchment area; Figure 5.13 shows the location of drainage concerns expressed through the online survey distributed to all Delaware residents. Please note – the exact nature and causes of the flooding reported on the online survey are unknown; though some reports were likely related to high groundwater levels resulting in increased use of residential sump pumps. These reports were taken into consideration during the development of alternative solutions.

A geotechnical review of available documentation was completed by EXP Services Inc. to provide an overall summary of soil and groundwater characteristics (Appendix B). The findings of this review were incorporated into the summary of existing drainage conditions per catchment area, and were consulted during the development of alternative solutions.

The following sections include descriptions of the existing drainage infrastructure for each catchment area, including known flooding concerns, current funding structure, and road classification.



Stantec

Legend

- Settlement Boundary
- Study Area
- Municipal Boundary
- Culvert
- DICB
- Other Catchbasin or Chamber
- Outfall
- Storm Sewer
- Swale
- Stormwater Management Facility
- Existing Drainage Boundary
- Serviced by Municipal Drain

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
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3. 2010 imagery used under license with Middlesex Centre.

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165630021

Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

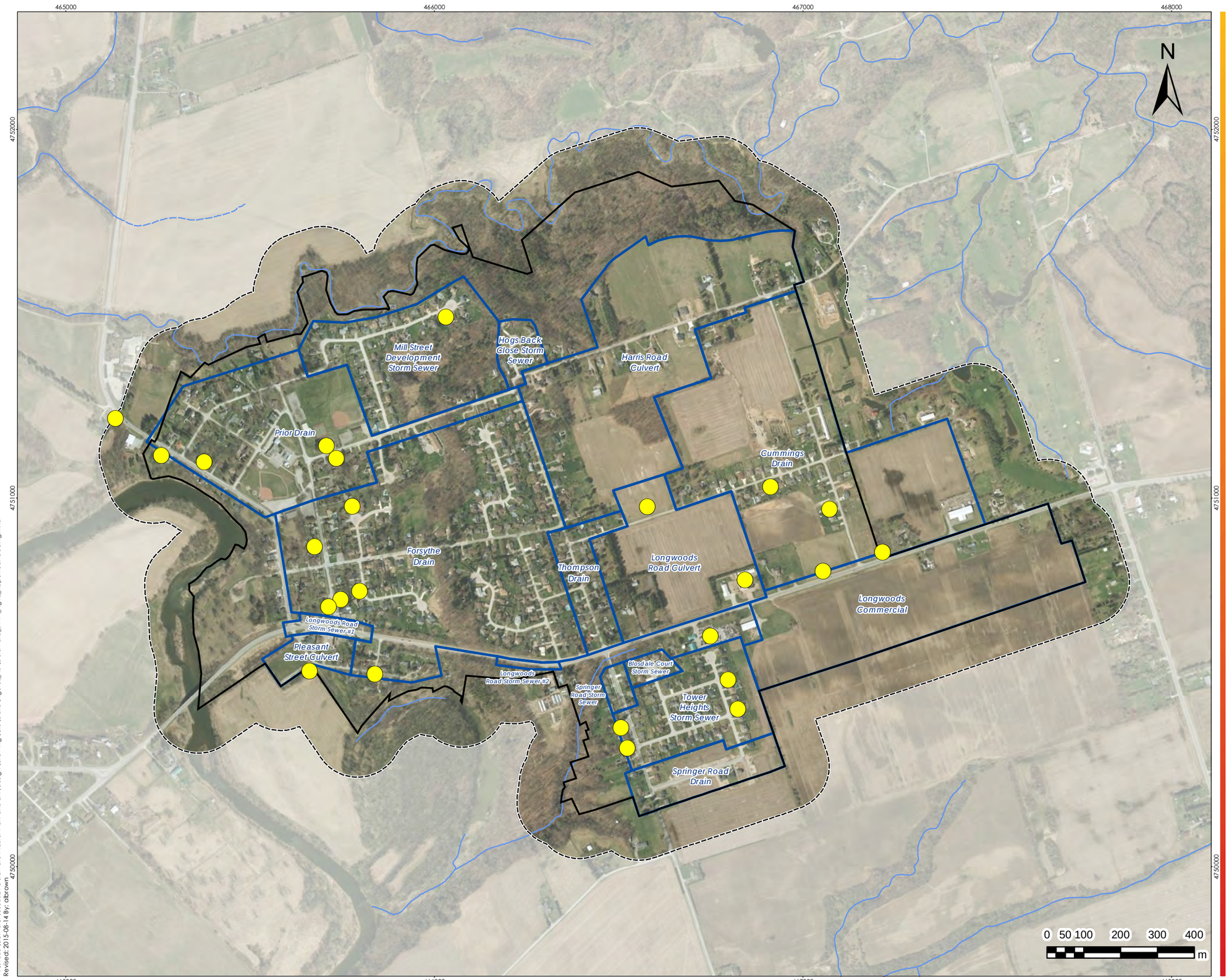
Figure No.

5.12

Title

Existing Conditions
Drainage Servicing

V:\01655\active\165630021 Delaware Master Plan and EA\design\drawing\GIS\MXD\Storm\165630021_Storm_Fig1-1_ExistingConditions.mxd
Revised: 2015-11-24 By: kbuchanan



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Revised: 2015-08-14 By: albrown

Stantec

Legend

- Location of Reported Street Flooding
- Study Area
- Settlement Boundary
- Existing Drainage Boundary

Please Note: the nature, cause, and severity of reported flooding is not known; in many cases, reported flooding is likely due to high groundwater levels characateristic of many areas in Delaware.

1:10,000

Notes

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Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

5.13

Title

Delaware SWM EA
Reported Surface Street Flooding from Online Survey

5.3.1 Prior Municipal Drain

The Prior Drain is classified as a municipal drain under the Drainage Act. The majority of the current system has insufficient capacity to accommodate minor flows. There is no defined route for major flows and therefore all flows are ultimately directed to the undersized minor system. As a result, ponding along Millcreek Lane and Young Street is likely. A localized low point off Gideon Drive has also resulted in reports of ponding during significant storm events.

The existing municipal drain is constructed of recycled concrete pipe without gaskets. Consequently, root penetration has likely occurred where trees or other vegetation have been planted close to existing pipes, which further reduces the pipe capacity.

A significant portion of the existing pipe upstream of the outfall is outside of the municipal right-of-way. As a result, future maintenance may be complicated by built and vegetated features. Site review has confirmed the presence of trees along a portion of this segment, potentially causing damage or reduced capacity on this downstream segment. At present, the Municipality has paid for minor maintenance of the drain, rather than assess costs to the benefitting landowners in accordance with the Drainage Act.

Roads within the catchment area are generally classified as rural to semi-urban with no curbs in place. Although not clearly defined in all areas, the roadside ditches provide some water quality treatment prior to discharge to the outlet structure. There are no stormwater quantity control measures in place.

A small portion of the existing storm sewer from Gideon Road to the outlet east of Gideon Road was replaced in July/August 2015 due to pipe failure.

5.3.2 Mill Street Development Storm Sewer

In general, the Mill Street Development drainage infrastructure consists of municipal storm sewers along each roadway with no defined ditch works. Roads are generally classified as meeting the urban residential cross section with roll over curbs, and the system is considered a municipal stormwater system. The catchment area consists of existing residential and proposed future development lands. There is currently no stormwater quantity or quality controls in place.

The current infrastructure appears to provide adequate drainage servicing to the existing development area. However, the capacity of downstream portions of the existing storm sewer is expected to be exceeded under design peak flows. In addition, ponding depths greater than the Municipality of Middlesex Centre (MOMC) design standards (300mm) is anticipated to occur at the low point in the vicinity of Atkinson Court and Thames Street under the maximum 100-year design event. This low point is approximately 300mm lower than the maximum elevation of the downstream overland flow route that conveys major flows from Atkinson Court to Dingman Creek, based on available drawing information.

Surface ponding at the eastern limit of Atkinson Court, near ST34, is likely only a temporary nuisance during severe storm events and is unlikely to cause property damage or safety concerns. However, significant rear yard flooding has been reported at 80 and 86 Atkinson Court. This ponding is generally attributed to a localized low spot receiving overland flow from adjacent lands.

5.3.3 Hog Back Close Storm Sewer

The Hog Back Close storm sewer is classified as a municipal storm sewer with the roadway meeting the urban cross-section standard with roll-over curbs.

The current infrastructure does not have capacity to address minor flows and the major system outlet is insufficient resulting in ponding depths greater than the MOMC standard of 300mm, as the elevation of the overland flow route appears to be higher than the Hog Back Close low point.

A portion of the existing storm sewer including the overflow route is located on private lands.

There are no water quality controls in place. Peak flows to the ravine are currently limited by the capacity of the storm sewer.

5.3.4 Tower Heights Storm Sewer

The Tower Heights Subdivision is a relatively new single family residential subdivision with urban residential cross section with roll over curbs. The local storm sewers are classified as a municipal stormwater system. These sewers are relatively shallow and do not have sufficient capacity to convey the calculated design peak discharges, resulting in more frequent overland flow conditions. Furthermore, the existing road profiles include two low points (William Street near Springer Road, and Elizabeth Street) where the maximum ponding depths are greater than 300 mm (above MOMC design standards). The existing storm sewer discharges to a ravine on the west side of Springer Road. There have been reported issues relating to erosion downstream of the existing outfall.

An existing oil-grit separator (OGS) is in place near 99 William Street, providing limited water quality treatment for the portion of storm sewer located only upstream of the unit. No other water quality controls or quantity control measures are in place.

5.3.5 Springer Road Municipal Drain

The Springer Road Drain is classified as a municipal drain that provides a minor system outlet to the southern portion of the Tower Heights Subdivision. The closed drain is relatively shallow and the majority of the system does not have adequate capacity to accommodate minor flows.

The existing Towerline Street profile slopes westward, and the maximum ponding depth at the low point located just east of the Springer Road intersection is greater than the MOMC

maximum allowable depth of 300 mm. Based on the available lot grading information, the existing major overland flow outlet from the low point is along the rear property lines of 3630 and 3638 Springer Road.

Roads within the catchment area are generally classified as urban with roll-over curbs.

An existing OGS provides water quality control for the drain system located within the right-of-ways. There are no water quantity control measures in place.

5.3.6 Cummings Municipal Drain

Cummings Drain is classified as a municipal drain under the Drainage Act that provides an outlet for existing residential areas and agricultural lands that are zoned for future development. Portions of the current drain have insufficient capacity to accommodate minor flows. As a result, ponding at the low point along Wellington Street occurs, with additional ponding noted along Martin Road.

A significant portion of the existing system is outside the right-of-way, i.e. on privately owned land. As a result, future maintenance may be complicated by existing and future development activities. At present, the municipality has paid for minor maintenance of the drain, rather than assess costs to the benefitting landowners in accordance with the Drainage Act.

Roads within the catchment area are generally classified as semi-urban with no curbs in place.

Existing roadside ditches provide some water quality treatment prior to discharge to the ravine. There are no stormwater quantity control measures in place with exception of an existing dry SWM pond located north of Wellington Street that discharges to the drain via a shallow corrugated steel pipe (CSP) located between 133 and 137 Wellington Street, which generally services the northwest portion of the area. The drain is the sole stormwater outlet at the Wellington Road low point located approximately 150 m west of Martin Road. Flow from the catchment area is conveyed to an existing ravine located off Wellington Street approximately 150m east of Martin Road.

5.3.7 Longwoods Road Culvert

This drainage area is mostly comprised of agricultural land that drains to the existing Longwoods Road concrete box culvert as shallow overland flow. The lands are designated as Residential and Settlement Employment in Schedule A-4 of the Middlesex Centre Official Plan, and a stormwater management strategy is required to convey and treat the runoff from future development.

Ponding currently exists in proximity to Our Lady of Lourdes Catholic School and north of Longwoods Road within the frontage of a commercial property and home.

There are no water quality or quantity controls in place.

5.3.8 Longwoods Commercial Lands

The catchment area consists of a portion of the Longwoods Road right-of-way and proposed future commercial development lands.

There is currently no existing downstream drainage infrastructure to convey the runoff from the proposed commercial development to a downstream outlet. Runoff from the existing agricultural land and the Longwoods Road right-of-way travels southward as shallow surface flow to the neighboring property. A SWM strategy to treat the future site runoff and convey it to an appropriate outlet is necessary.

There is currently no stormwater quantity or quality controls in place, with exception of some ditching along Longwoods Road that would only provide water quality treatment for the right-of-way.

5.3.9 Harris Road Culvert

The catchment area consists of existing residential and proposed future residential development lands. The existing Harris Road drainage infrastructure which consists of a small segment of municipal storm sewers within the right-of-way and overland flow route to the CSP culvert does not have sufficient capacity to accommodate the runoff from future development. Furthermore, existing residential development on Harris Road separates the future development areas from the Harris Road right-of-way. This makes conveying stormwater from the future development to the existing outlet difficult.

Harris Road is generally classified as a rural road cross-section with no curbs or defined ditches. Minor ditching is available in proximity to the storm sewer to direct flows to catchbasins. No quantity control measures are in place. There are currently no known issues associated with ponding due to storm events.

5.3.10 Thompson Municipal Drain

The Thompson Drain is classified as a municipal drain under the Drainage Act. The current system has insufficient capacity to accommodate the minor flows and roadside ditches, where present, are shallow and poorly defined. There are no reported ponding issues within the catchment area.

A portion of the drain is located outside of the municipal right-of-way, along rear and side lot lines. As a result, future maintenance may be complicated by built and vegetated features (fences, landscaping, trees, etc.). At present, the municipality has paid for minor maintenance of the drain, rather than assess costs to the benefitting landowners in accordance with the Drainage Act.

Roads within the catchment area are generally classified as semi-urban. Although not clearly defined in all areas, the roadside ditches provide some water quality treatment prior to discharge to the outlet structure. There are no stormwater quantity control measures in place.

5.3.11 Forsythe Municipal Drain

The Forsythe Municipal Drain as defined under this Master Plan includes the following sub-drainage systems:

- Hillcrest Drain;
- Garden Avenue Drain;
- Prince Albert Drain;
- Millmanor Place Storm Sewer; and
- Davis Street Drain.

The Forsythe Drain is generally classified as a municipal drain under the Drainage Act which collects and conveys stormwater from a substantial portion of the Delaware Settlement Area, with exception of the small segment of municipal storm sewer within the Millmanor Place Storm Sewer system. Many of the existing pipes located within the system have insufficient capacity to accommodate minor flows. There is no defined route for major flows and therefore all flows are ultimately directed to the undersized minor system. As a result, ponding along York Street and Garden Avenue is likely.

A significant portion of the existing system is located outside of the municipal right-of-way, therefore future maintenance may be complicated by built and vegetated features. Review of available aerial photography has indicated the presence of obstructions such as sheds, fences, and trees along the municipal drain limits. At present, the municipality has paid for minor maintenance of the drain, rather than assess costs to the benefitting landowners in accordance with the Drainage Act.

Roads within the catchment area are generally classified as semi-urban to urban cross sections with presence of sidewalks along Wellington Street and York Street. There are no defined ditches within the catchment area, nor any water quantity controls in place.

5.3.12 Longwoods Road Storm Sewer #1

The Longwoods Road Storm Sewer #1 conveys minor flows from a small area along the Longwoods Road right-of-way to an existing roadside ditch that discharges directly to the Thames River. The storm sewer is classified as a municipal stormwater system. There are no known issues with this system.

5.3.13 Longwoods Road Storm Sewer #2

Similar to Longwoods Road Storm Sewer #1, Storm Sewer #2 conveys minor flows from a small area along the Longwoods Road right-of-way to an existing ravine that discharges to an oxbow of the Thames River. The storm sewer is classified as a municipal stormwater system. There are no known issues with this system.

5.3.14 Springer Road Storm Sewer

The Springer Road storm sewer has been recently reconstructed, and consists of storm sewers within an urban road cross section. The system discharges to the existing outlet located on the South side of Longwoods Road. The storm sewer conveys minor flows from the design service area and the urban road cross section conveys major flows. There are no known issues with this system.

5.3.15 Pleasant Street Culvert

Runoff from this drainage area travels as shallow surface flow to an existing culvert located in the southeast corner of Pleasant Park. Some runoff is also conveyed to the culvert by an existing drainage tile located on the north side of Pleasant Street. However, based on site investigation, the capacity of this pipe is likely relatively small and may result in infrequent ponding under larger storm events. The culvert discharges to an existing pond located within an undeveloped municipal right-of-way. Overflows from the pond travel as shallow overland flow over privately owned lands to an existing downstream oxbow of the Thames River.

5.3.16 Blosdale Court Storm Sewer

The Blosdale Court storm sewer is a newer system that was designed in accordance with typical urban drainage practices. The minor system discharges to the existing ravine via a dedicated storm easement. Ponding depths within the catchment area are less than the maximum Municipal design standards (300mm), and major flows are conveyed by the downstream Tower Heights storm sewer. There are no known issues with this system.

5.4 KEY ISSUES

In order to develop alternative solutions, an understanding of the key servicing issues is critical. Based on a review of the existing stormwater drainage system as noted in Section 5.2, the following provides a summary of the key issues noted:

- Surface Flooding – Locations where there is no effective overland flow outlet to convey the runoff from major storm events. This can be a threat to both property and public safety;

- Groundwater – Areas where there are high groundwater elevations or surface seepage;

- Future Development Servicing – Areas of potential future development require adequate downstream storm drainage servicing to convey post-development runoff and to mitigate downstream flooding;

- Municipal Drains – Municipal drains present operation and maintenance, funding, and access challenges. Furthermore, they are typically designed based on agricultural, rather than urban drainage requirements;

- Capacity – Systems that have insufficient capacity to collect and convey the existing peak discharges from existing development; and

- Infrastructure Location – Areas where the drainage infrastructure is located outside of the municipal right-of-ways and designated drainage easements.

Key Issues noted for each drainage area are summarized in Table 5.1 below.

Table 5.6 Key Issues by Drainage Area

Drainage Area	Issues					
	Surface Flooding	Groundwater	Future Development Servicing	Municipal Drain	Capacity	Infrastructure Location
Prior Drain	X			X		
Forsythe Drain				X	X	X
Longwoods Road Storm Sewer #1						
Pleasant Street Culvert						
Mill Street Development Storm Sewer	X		X			
Hillcrest Drain (part of Forsythe Drain)				X		
Garden Avenue Drain (part of Forsythe Drain)		X	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	

Drainage Area	Issues					
	Surface Flooding	Groundwater	Future Development Servicing	Municipal Drain	Capacity	Infrastructure Location
Blosdale Court Storm Sewer						
Springer Road Storm Sewer						
Tower Heights Storm Sewer	X	X				
Spinger Road Drain			X	X	X	
Millmanor Place Storm Sewer (part of Forsythe Drain)						
Davis Street Drain (part of Forsythe Drain)				X		X

5.4.1 Municipal Drains and Existing Funding Mechanism

Construction and maintenance of municipal drains is subject to the provisions of the *Drainage Act*. Municipal Drains within the study area generally consist of Petition Drains, which are typically created by landowners needing to address a drainage problem. A prescribed petition under the Drainage Act is submitted to the Municipality requesting the establishment of a municipal drain. Should the prescribed conditions be met, the Municipality engages an engineer to prepare a report identifying the proposed solution to the problem and assessment of how costs are to be shared between all benefiting property owners. Assuming no appeals are issued, council for the Municipality passes a by-law adopting the engineer's report. The Municipality then has the authority and responsibility to construct the project and assess costs to landowners in accordance with the accepted report. Once the municipal drain is constructed, it becomes part of the Municipality's infrastructure.

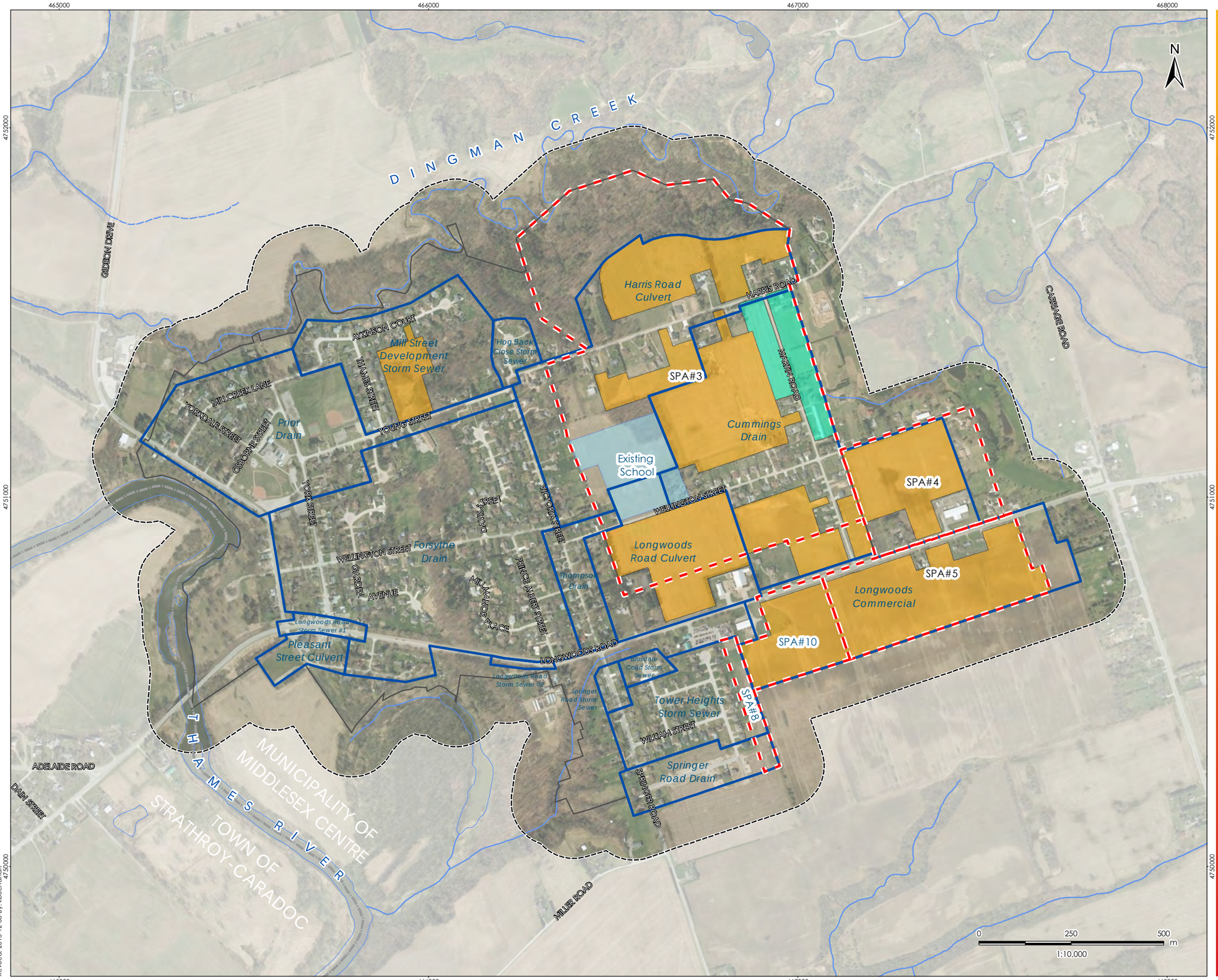
In certain circumstances, the Municipality can be held liable for damages for not maintaining the infrastructure. Landowners who obstruct or destroy a portion of the drainage works can also be liable for damages.

Repairs and maintenance of these municipal drains is undertaken by the Municipality. Under the Act, costs for repairs and maintenance are to be assessed to each of the benefitting landowners, and repair costs can accrue to $5,000 before being assessed to property owners. However, the Municipality has not typically assessed costs to landowners. Rather, repairs and maintenance of drains have been paid for through municipal operating budgets.

Similarly, there is no funding mechanism in place to fund the maintenance or repairs of Municipal Storm Sewers. Repairs to this infrastructure are currently being funded through Municipal Sanitary Reserves, to which residents of Delaware do not currently contribute as municipal sanitary servicing is not provided. The recommended approach to the funding of both Municipal Drains and Municipal Storm Sewers is discussed in Section 8 of the Master Plan.

5.4.2 Servicing for Future Development

Identifying servicing options for future development is necessary to ensure that development proceeds in a coordinated, holistic manner that does not negatively impact either upstream or downstream services. The limits and the form of future development within the study area are generally not yet known. The lands identified on Figure 5.14 as Potential Development Areas are estimated based on land-use designations in the Municipality of Middlesex Centre and Middlesex County Official Plans discussed previously, property boundary information provided by Middlesex County mapping, and the general limits of natural features. Please note that these limits are estimates only, and their identification on Figure 5.14 does not condone or permit development on these lands; any potential development will be subject to relevant approval requirements, including Conservation Authority approval requirements for lands located within the Conservation Authority Regulation Limit.



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Revised: 2015-12-08 By: kbuchanan

Stantec

Legend

- Study Area
- Settlement Boundary
- Municipal Boundary
- Existing Drainage Boundary
- Special Policy Area
- Potential Future Development
- Future Development Serviced by SWM Infiltration Measures
- Existing School

Please Note: Limits of Potential Future Development Areas are estimated based on Official Plan land use designations, and general topographic mapping. Future development applications will be subject to all relevant approvals including Conservation Authority requirements.

1:10,000

Notes

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Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

5.14

Title

Potential Development Areas

6.0 PHASE 2 – EVALUATION OF ALTERNATIVE SOLUTIONS

As part of the Class EA planning process, reasonable and feasible alternative solutions to the Phase 1 problem opportunity statement are identified and described in Phase 2. The magnitude of the net positive and negative effects of each alternative solution are identified and evaluated. Based on this evaluation, a preliminary preferred option is selected and confirmed based on public, agency and First Nation community consultation. The following sections describe the design criteria and alternative options developed for each drainage area to address the key issues.

6.1 STORMWATER DESIGN CRITERIA AND KEY OBJECTIVES

The following study objectives were developed to incorporate applicable design criteria (Municipality of Middlesex Centre Design Standards, Ministry of the Environment and Climate Change Stormwater Management Planning and Design Manual 2003) in order to identify the ideal outcome 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 6.2, against which each alternative solution will be evaluated.

- Surface Flooding – The Master Plan should mitigate 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, respectively. These depths should 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 to overall water balance and impact to receiving watercourses should 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 should identify measures to control peak flows to pre-development magnitudes for all storms up to and including the 100-year event. Furthermore, opportunities to mitigate surface water problems in existing developed areas by providing additional capacity in the future storm infrastructure will be identified. Furthermore, the future stormwater servicing infrastructure is to provide MOECC 'Normal' level protection water quality control to the runoff from all new development.

- Municipal Drains – Drainage servicing in much of Delaware is provided by Municipal Drains. There are several problems associated with these systems; they 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 should provide recommendations for instituting a consolidated and sustainable approach to the funding and maintenance of stormwater drainage within the Settlement Area of Delaware.

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

- Infrastructure Location – All proposed drainage infrastructure should be located in the municipal right-of-ways. In locations where this is not feasible, the Master Plan should identify proposed drainage easement locations.

6.2 ALTERNATIVE SOLUTIONS BY CATCHMENT AREA

6.2.1 Prior Municipal Drain

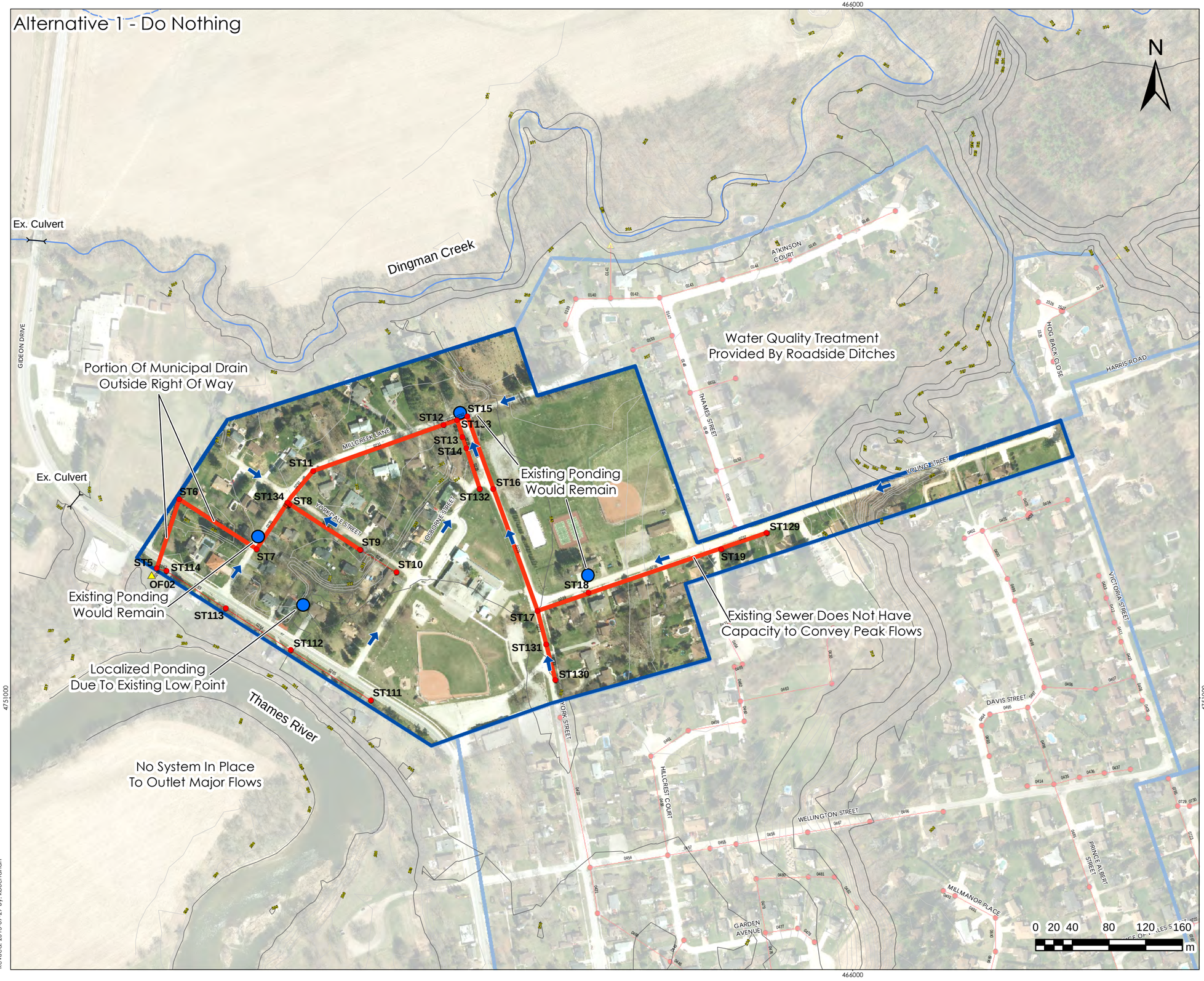
6.2.1.1 Alternative 1 – Do nothing

Under this alternative, no works would be completed (see Figure 6.1). Accordingly, overland flows continue to occur more frequently than if the storm sewer were designed in accordance with the current MOMC design standards. Concerns related to ponding would continue.

The costs of future drain maintenance should be assessed to the benefiting landowners, in accordance with the Drainage Act. Root penetration, particularly along the segment of sewer off the right-of-way, may further reduce the existing pipe capacity if no maintenance work is completed.

No additional water quality or quantity controls would be implemented with this alternative. Accordingly, no land acquisition would be required.

Alternative 1 - Do Nothing



Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Drainage Boundary

1:4,000

Notes

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Figure No.

6.1

Title

Delaware SWM EA Prior Drain Alternative 1 **Do Nothing**

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Revised: 2015-09-29 By: kbuchanan

6.2.1.2 Alternative 2 – Replace Minor System, Provide Urban Road Cross Section, & Abandon Municipal Drain

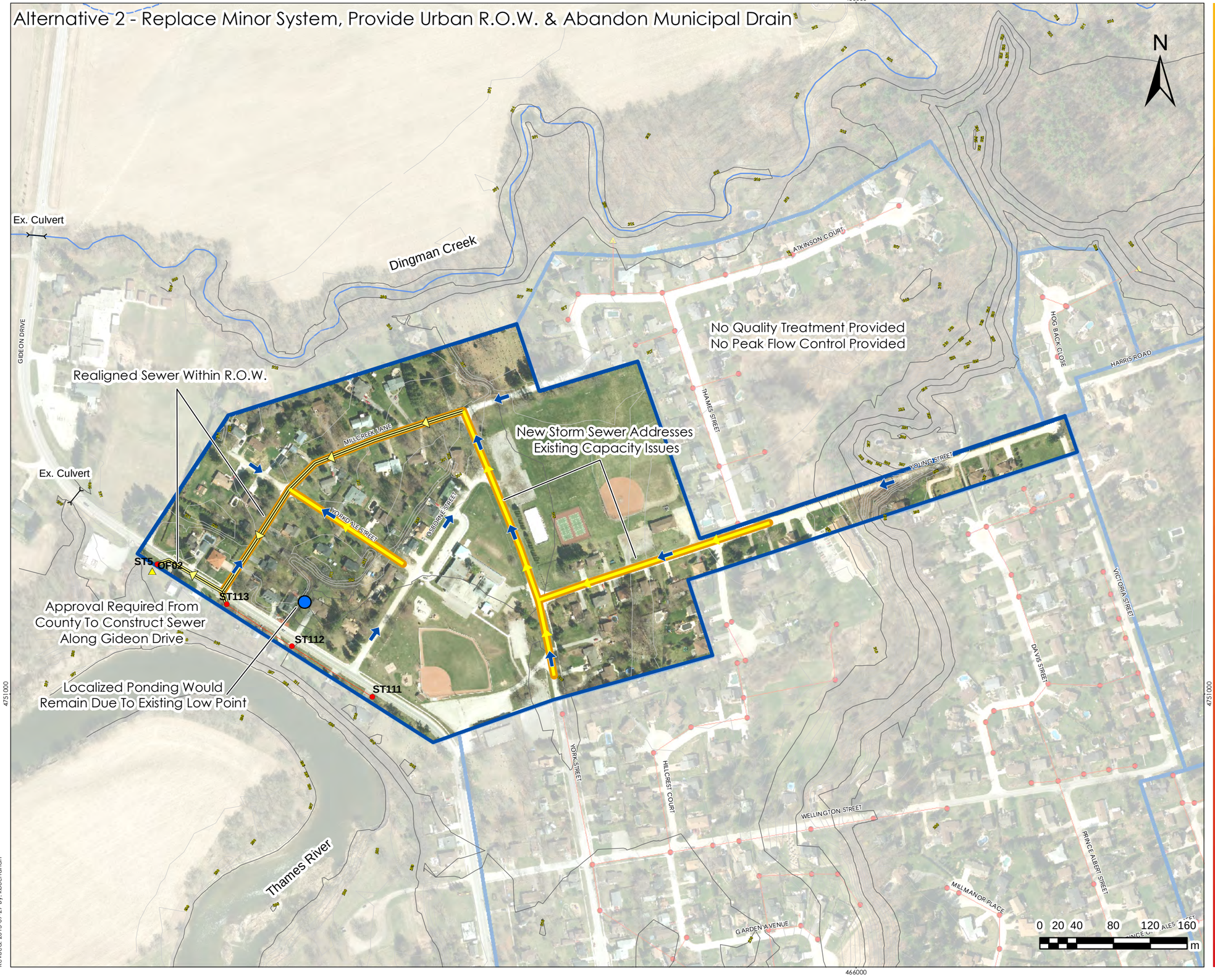
The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement (see Figure 6.2).

A proposed storm sewer with sufficient capacity to convey the 100-year peak discharge is proposed from the existing outfall to the Millcreek Lane/York Street intersection to mitigate flooding. The new sewer is constructed within the right-of-way to eliminate issues related access and disruption to property. Rear lot catchbasins, if and where present, are connected to the realigned sewer or otherwise regrading is undertaken to remove risk of ponding.

The upstream portions of the proposed storm sewer are designed to convey the 2-year peak discharge. All roads where sewer replacement is proposed are restored in accordance with the MOMC standard urban cross section. Some modifications to the road profiles will be necessary to allow fronting properties to drain to the right-of-ways. Coordination/approval with the County of Middlesex is required due to work along Gideon Drive. UTRCA permitting/approval will be required for work within the floodplain.

The proposed sewer works addresses ponding along Millcreek Lane and Young Street. Localized ponding remains off Gideon Drive due to low grades in this area, which cannot be drained by gravity to the new storm sewer system without impacted depth of the outfall and overall functionality of the sewer system. Site specific measures such as sump pump, etc. would need to be implemented at this location by the landowner should the potential for damage be considered significant.

Water quality treatment is impacted due to elimination of ditches with construction of urban cross sections. No water quantity control is provided with this alternative.



Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Storm Sewer (100-Year Capacity)
- Proposed Urban R.O.W.
- Drainage Boundary

1:4,000

Notes

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Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.2

Title

Delaware SWM EA
Prior Drain Alternative 2

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Revised: 2015-09-29 By: kbuchanan

6.2.1.3 Alternative 3A – Improve Roadside Ditches, Provide 100-year Storm Outlet & Abandon Municipal Drain

The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement (see Figure 6.3).

The roadside ditches are deepened and widened to increase their conveyance capacities and to convey all flows that exceed the capacity of the minor system to the Millcreek Lane/Yorkdale Street intersection, addressing capacity issues associated with storm sewers that remain. A proposed storm sewer with sufficient capacity to convey the 100-year peak discharge is constructed from this intersection to the outlet to convey the major flows to the existing outfall. Catchbasins are installed at the intersection of Millcreek Lane and Yorkdale Street to convey the major flows into the new storm sewer. Driveway culverts and some tree removal will be required to accommodate the proposed ditch improvements. The new sewer is constructed within the right-of-way to eliminate issues related to access and disruption to property. Rear lot catchbasins, if and where present, are connected to the realigned sewer or otherwise regrading is undertaken to remove risk of ponding.

All roads where sewer replacement is proposed are restored in accordance with the MOMC standard semi-urban cross section. Coordination/approval with the County of Middlesex is required due to work along Gideon Drive. UTRCA permitting/approval will be required for work within the floodplain.

The proposed sewer works addresses ponding along Millcreek Lane and Young Street. Localized ponding remains off Gideon Drive due to low grades in this area, which cannot be drained by gravity to the new storm sewer system without impacted depth of the outfall and overall functionality of the sewer system. Site specific measures such as sump pump, etc. would need to be implemented at this location by the landowner should the potential for damage be considered significant.

Water quality treatment is improved with upgraded ditches. Deepened ditches provide further storage, however no peak flow control is provided with this alternative.

Alternative 3A - Improve Roadside Ditches, Provide 100-Year Storm Outlet, & Abandon Municipal Drain

466000

N

Ex. Culvert

Dingman Creek

Improved Ditches Help
To Convey Major Flows

Water Quality Treatment Provided
By Roadside Ditches

No Peak Flow Control Provided

Ex. Culvert

Approval Required From
County To Construct Sewer
Along Gideon Drive

Localized Ponding Would
Remain Due To Existing Low Point

Existing Sewer Does Not Have Capacity
To Convey Minor Flows, However Improved
Ditches Mitigate Chance Of Ponding

Thames River

ST133 ST15 ST12 ST11 ST16 ST9 ST10 ST5 OF02 ST113 ST112 ST111 ST129 ST19 ST18 ST17 ST131 ST130

GIDEON DRIVE
MILL CREEK LANE
TORYDALE STREET
OSBORNE STREET
ATKINSON COURT
THAMES STREET
HOG BACK CLOSE
HARRIS ROAD
YOUNG STREET
VICTORIA STREET
DAVIS STREET
WELLINGTON STREET
PRINCE ALBERT STREET
MILLMANOR PLACE
GARDEN AVENUE
ILLCREST COURT

4751000

466000

0 20 40 80 120 160 m

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Roadside Ditch
- Proposed Storm Sewer (100-Year Capacity)
- Drainage Boundary

1:4,000

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.3

Title

Delaware SWM EA
Prior Drain Alternative 3A

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Revised: 2015-09-29 By: kbuchanan

6.2.1.4 Alternative 3B – Improve Roadside Ditches, Provide 100-year Storm Outlet, & Abandon Municipal Drain (Alternate Outlet Alignment)

This alternative is similar to Alternative 3A, however the proposed 100-year storm sewer is located in the Yorkdale Street right-of-way to reduce the amount of roadway restoration and to avoid disturbance to Gideon Drive, which is an arterial road (see Figure 6.4). The proposed 100-year storm sewer discharges northward, and a proposed open channel located within a proposed drainage easement conveys both the major and minor flows to the existing Gideon Drive culvert. The proposed drainage easement would need to be negotiated with the landowner.

Alternative 3B - Improve Roadside Ditches, Provide 100-Year Storm Outlet, & Abandon Municipal Drain (Alternate Alignment)

466000

N

Ex. Culvert

Dingman Creek

Drainage Easement Required

Improved Ditches Help To convey Major Flows

Water Quality Treatment Provided By Roadside Ditches

No Peak Flow Control Provided

Ex. Culvert

OF02

ST5

ST114

ST113

ST112

ST111

ST11

ST8

ST114

ST9

ST10

ST133

ST12

ST13

ST14

ST15

ST132

ST16

ST17

ST131

ST130

ST18

ST19

ST129

Localized Ponding Would Remain Due To Existing Low Point

Existing Sewer Does Not Have Capacity To Convey Minor Flows, However Improved Ditches Mitigate Chance Of Ponding

Thames River

GIDEON DRIVE

MILLGREEN LANE

TORYMEL STREET

OSBORNE STREET

ATKINSON COURT

THAMES STREET

HOG BACK CLOSE

HARRIS ROAD

YOUNG STREET

VICTORIA STREET

DAVIS STREET

LLCREST COURT

WELLINGTON STREET

PRINCE ALBERT STREET

MILLMANOR PLACE

GARDEN AVENUE

4751000

466000

0 20 40 80 120 160 m

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Revised: 2015-09-15 By: albrown

Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Roadside Ditch
- Proposed Open Channel
- Proposed Storm Sewer (100 Year Capacity)
- Drainage Boundary

1:4,000

Notes

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Client/Project

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Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.4

Title

Delaware SWM EA
Prior Drain Alternative 3B

6.2.2 Mill Street Development Storm Sewer

6.2.2.1 Alternative 1 – Do Nothing

Under this scenario, no works would be completed and development would occur without implementation of stormwater management controls (see Figure 6.5).

Flows generated from development lands, along with existing flows, exceed the capacity of the existing storm sewer along a significant portion of Atkinson Court. Ponding depths greater than MOMC design standards may continue to occur during severe storm events at the low point near Atkinson Court and Thames Street. While this temporary ponding is unlikely to pose a significant safety risk or cause property damage during the 100-year event, a more severe storm event could result in flood limits that encroach on neighboring residences.

Surface ponding at the eastern limit of Atkinson Court, near ST34, and significant rear yard flooding near 80 and 86 Atkinson Court would continue as no new works would be implemented under this alternative.

Water quality to the outfall would be impaired further as development would be proceeding without implementation of controls.

6.2.2.2 Alternative 2 – Improve Major System

To reduce the risk of flooding during storm events more severe than the 100-year storm, the existing overland flow route, located in the drainage easement between 55 and 57 Atkinson Court, is regraded to reduce the maximum ponding depths at the Atkinson Court/Thames Street intersection (see Figure 6.5).

The existing high point elevation is reduced by approximately 0.93 m, which significantly increases the swale side slopes between the two residences. In order to improve the major system, work within the floodplain is required.

On-site SWM controls are provided within the future development lands to reduce the post-development peak flows generated by this area and to provide water quality treatment. The post-development peak discharges are attenuated to existing conditions (pre-development) to mitigate the possibility of the downstream storm sewers surcharging during the 2-year design event.

A proposed ditch inlet catchbasin (DICB) connection to the proposed storm sewer located in the future development area mitigates rear yard flooding at 80 and 86 Atkinson Court. In order to construct the DICB and storm connection, an easement will be required. It should be noted that response from the UTRCA suggests that a portion of this site may be listed as erosion hazard and/or protected wetland. Should the extent of ponding be located within the wetland area, the proposed DICB cannot be constructed as this is a protected feature. Further refinement of

developable land will be required as part of the development process and will be subject to approval by the UTRCA.

The existing surface ponding at the eastern limit of Atkinson Court, near ST34, is not addressed under this alternative.

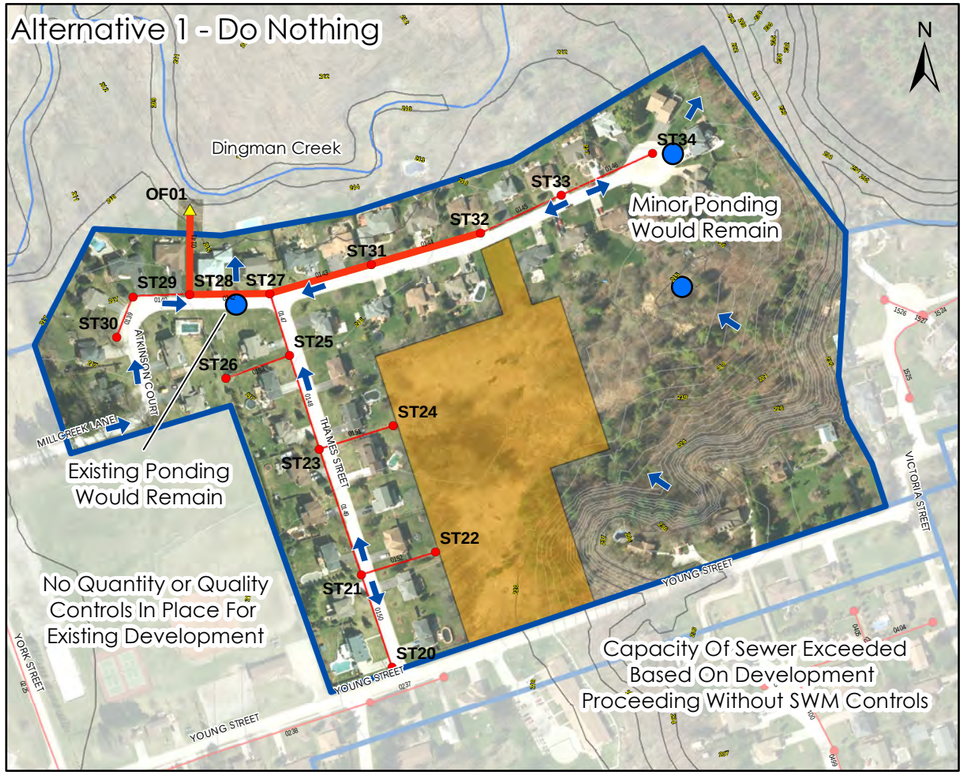
6.2.2.3 Alternative 3 - Improve Minor System

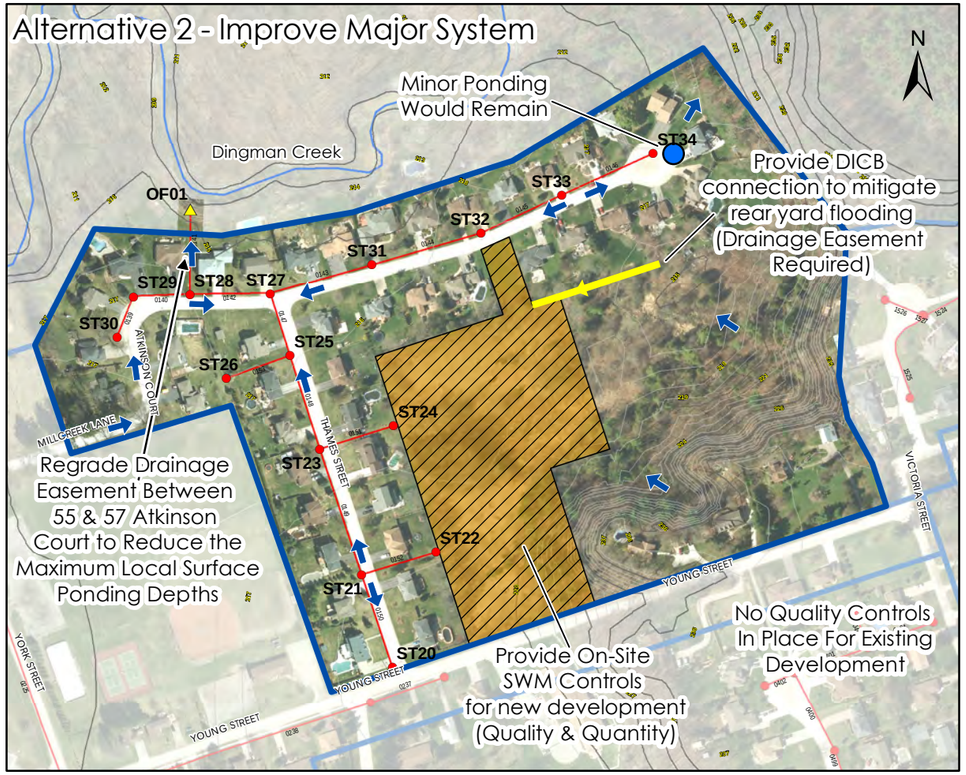
To reduce the 100-year ponding depths at the Atkinson Road low point, the existing storm sewer is replaced with a pipe designed to convey the 100-year design event peak discharge (see Figure 6.5). The proposed storm sewer follows the existing pipe alignment from the Atkinson Court low point to the existing outfall. Additional catchbasins located at the low point help convey flows to the new storm sewer, reducing the duration of surface ponding. In order to improve the minor system, work within the floodplain is required.

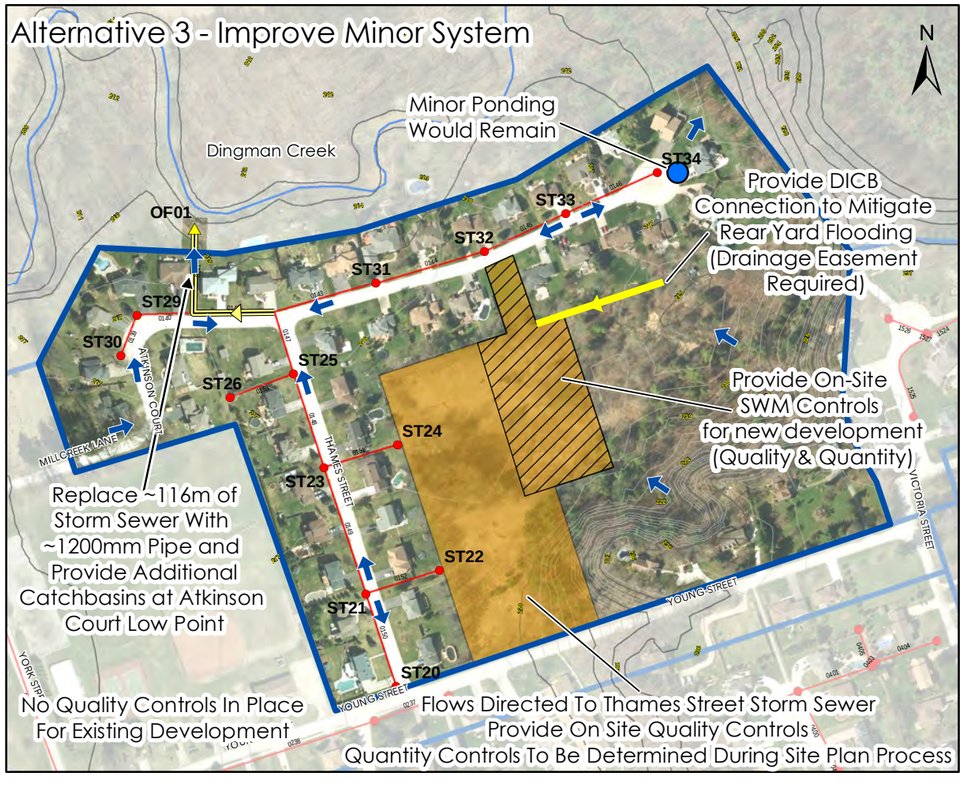
On-site SWM controls are provided within a portion of the future development lands directing flows to the Atkinson Court storm sewer system to reduce the post-development peak flows generated by this area and to provide water quality treatment. The post-development peak discharges are attenuated to existing conditions (pre-development) to mitigate the possibility of the downstream storm sewers surcharging during the 2-year design event. For the remaining development lands to be directed to the Thames Street storm sewer, on-site quality controls are to be implemented with quantity controls to be confirmed during the site plan process to ensure that the downstream system is not negatively impacted during the 2-year design event.

A proposed ditch inlet catchbasin (DICB) connection to the proposed storm sewer located in the future development area mitigates rear yard flooding at 80 and 86 Atkinson Court. In order to construct the DICB and storm connection, an easement will be required. It should be noted that response from the UTRCA suggests that a portion of this site may be listed as erosion hazard and/or protected wetland. Should the extent of ponding be located within the wetland area, the proposed DICB cannot be constructed as this is a protected feature. Further refinement of developable land will be required as part of the development process and will be subject to approval by the UTRCA.

The existing surface ponding at the eastern limit of Atkinson Court, near ST34, is not addressed under this alternative.







Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Storm Sewer (100-Year Capacity)
- Potential Future Development
- Drainage Boundary
- DICB Ditch Inlet Catchbasin

0 20 40 80 120 160 m

1:4,000

Notes

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Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.5

Title

Delaware SWM EA
Mill St. Development Alternatives

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Revised: 2015-09-16 By: albrown

6.2.3 Hog Back Close Storm Sewer

6.2.3.1 Alternative 1 – Do Nothing

Under this alternative, no works would be completed (see Figure 6.6). Accordingly, ponding in excess of the MOMC maximum allowable depth of 300mm may continue in the vicinity of the Hog Back Close low point.

No additional water quality or quantity controls would be implemented with this alternative. Overland flows would continue as a result of the insufficient capacity of the storm sewers and grading issues associated with the overland flow routes. No land acquisition would be required.

6.2.3.2 Alternative 2 – Replace Existing Storm Sewer

To provide a minor system that complies with the existing MOMC design standards, the existing storm sewer is replaced with a new storm sewer to the outfall designed to convey the 2-year design event peak discharge (see Figure 6.6). The proposed storm sewer follows the existing pipe alignment and discharges to the ravine located east of Hog Back Close. Erosion protection is provided at the pipe outlet to mitigate the possibility of downstream erosion in the existing ravine due to higher flows being conveyed through the upgraded system.

The proposed minor system improvements will reduce the maximum ponding depths during all design events up to and including the 100-year event to magnitudes less than the maximum MOMC design standard of 300 mm.

A drainage easement may need to be negotiated with the affected landowner(s) to provide access for both construction and future maintenance.

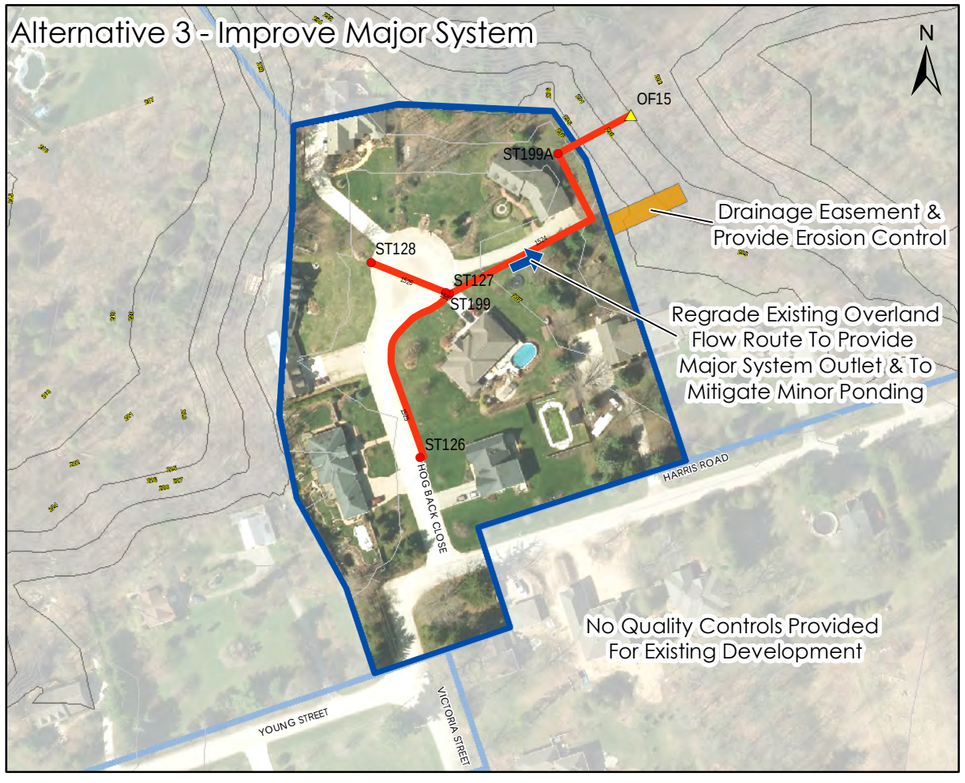
No additional water quality controls are provided with this alternative.

6.2.3.3 Alternative 3 – Improve Major System

The existing overland flow route, located between 56 and 58 Hog Back Close is regraded to reduce the maximum ponding depths on Hog Back Close to depths below MOMC maximum of 300mm (see Figure 6.6). Erosion protection is provided on the downstream ravine slope to mitigate the possibility of downstream erosion caused by the proposed overland flows.

The existing storm sewer would remain and would still have insufficient capacity to address minor flows, however the proposed improvements to overland flow routes will help convey excess flow to the ravine.

A drainage easement may need to be negotiated with the affected landowner(s) to provide access for both construction and future maintenance, and to prevent future obstruction of the overland flow route. No additional water quality controls are provided with this alternative.



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Revised: 2015-09-29 By: kbuchanan

Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Drainage Boundary

0 10 20 40 60 80 m

1:2,000

Notes

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Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.6

Title

Delaware SWM EA
Hog Back Close Storm Sewer Alternatives

6.2.4 Tower Heights Storm Sewer

6.2.4.1 Alternative 1 – Do Nothing

Under this alternative, no works would be completed (see Figure 6.7). Accordingly, overland flows continue to occur more frequently within the subdivision than if the storm sewer were designed in accordance with the current MOMC design standards. In addition, reported issues relating to erosion downstream of the existing outfall would continue.

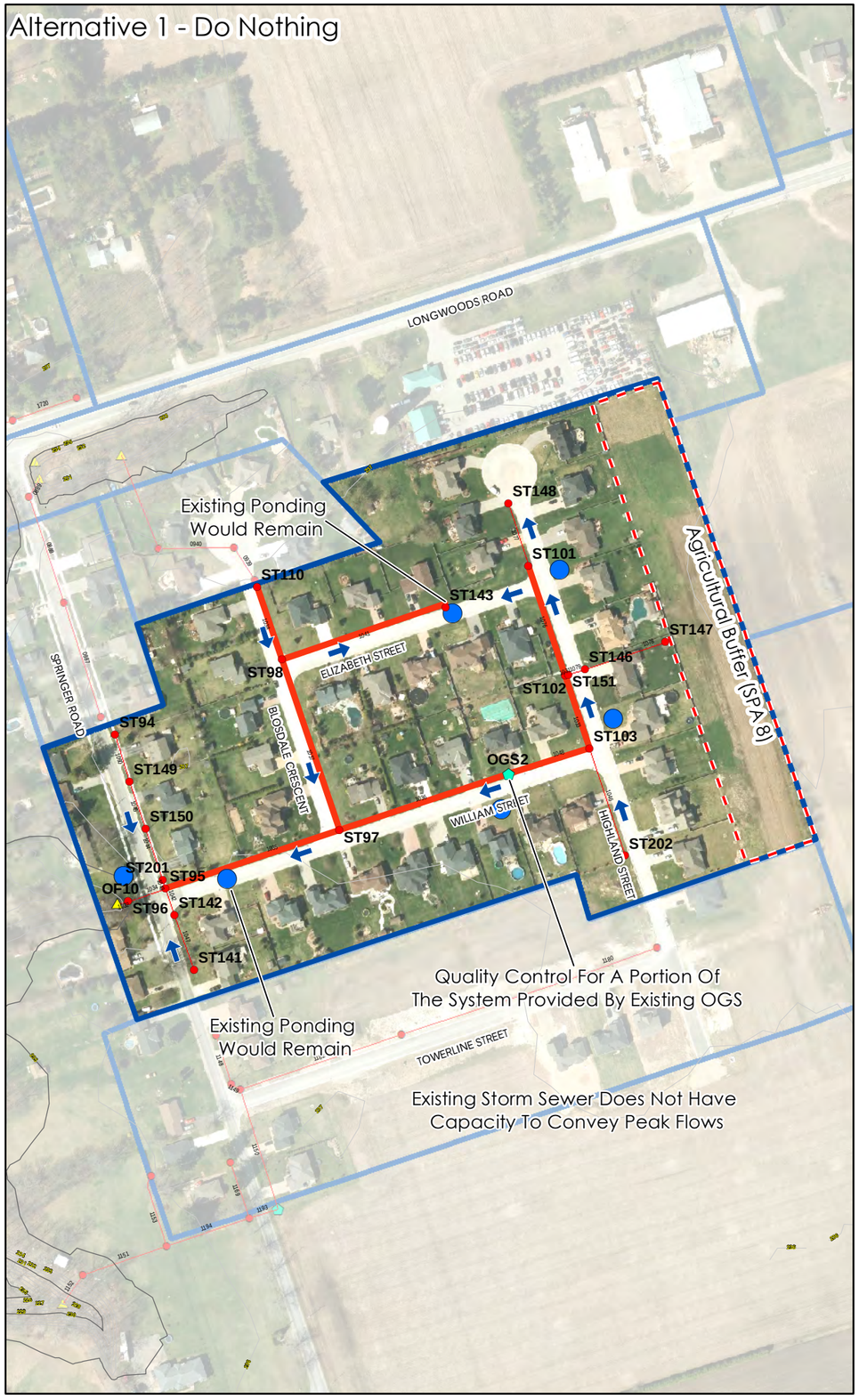
The temporary surface ponding that occurs at the Elizabeth Street low point and the William Street low point during severe storm events remains, but is unlikely to cause property damage or to present a significant safety concern.

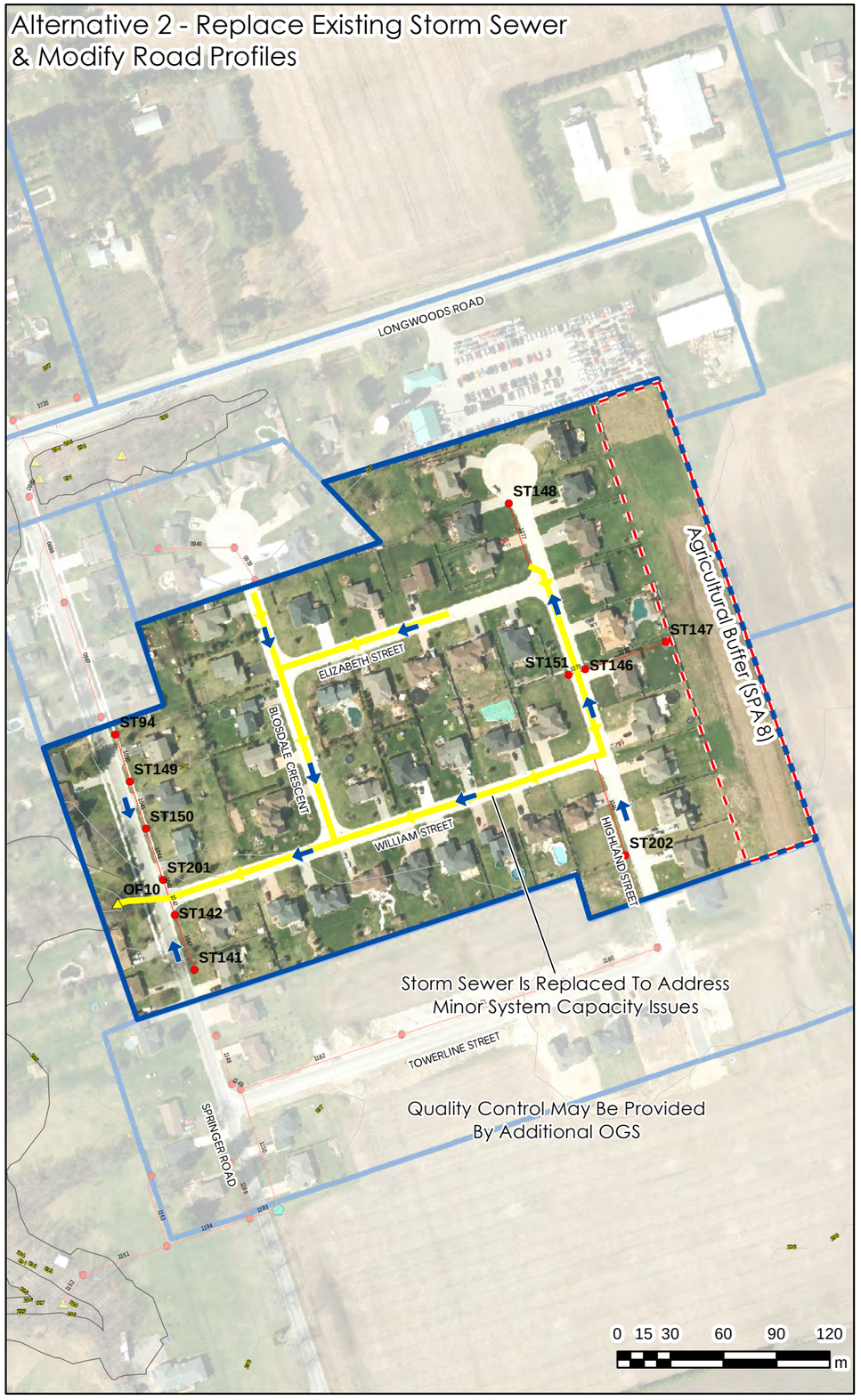
The existing oil-grit separator would continue to provide limited water quality treatment for the portion of the upstream drainage area. No other water quality controls or quantity control measures would be in place.

6.2.4.2 Alternative 2 – Replace Storm Sewer & Modify Road Profiles

Under this alternative, the existing storm sewer is replaced with a system that has sufficient capacity to convey the 2-year peak design discharge (see Figure 6.7). In addition, road profiles would be modified to reduce the maximum ponding depths at Elizabeth Street and William Street at or less than 300 mm (MOMC design standard maximum allowable depth).

This alternative would allow for the installation of a new oil-grit separator to treat the runoff from most of the drainage area, improving overall water quality to the outfall. However, the construction of a new storm sewer may result in the direction of higher flows to the outfall, which typically were mitigated due to bottlenecks within the previous system. To address these concerns, additional erosion protection would be provided at the reconstructed outfall. To accommodate the outfall improvements, tree removal may be required.





Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed StormSewer (2-Year Capacity)
- Drainage Boundary
- Special Policy Area

1:3,000

Notes

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Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.7

Title

Delaware SWM EA
Tower Heights Storm Sewer
Alternatives

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Revised: 2015-09-29 By: kbuchanan

6.2.5 Springer Road Municipal Drain

6.2.5.1 Alternative 1 – Do Nothing

Under this alternative, no works would be completed (see Figure 6.8). Accordingly, overland flows continue to occur more frequently within the subdivision than if the minor system were designed in accordance with the current MOMC design standards. The temporary surface ponding that occurs at the Towerline Street low point during severe storm events is unlikely to cause property damage or to present a significant safety concern. However, any future modifications to the lot grading within the existing overland flow route could raise the maximum ponding depths further above the MOMC allowable depth of 300mm.

6.2.5.2 Alternative 2 – Abandon Municipal Drain & Negotiate Drainage Easement

Under this alternative, no significant works would be undertaken (see Figure 6.8). The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement.

Overland flows occur within the subdivision more frequently than if the storm sewer were designed in accordance with the current MOMC design standards. The temporary surface ponding that occurs at the Towerline Road low point during severe storm events is unlikely to cause property damage or to present a significant safety concern, although ponding depths above the MOMC standard would be anticipated.

A drainage easement would need to be negotiated with the existing landowner to reduce the possibility of the existing major flow outlet being obstructed, which would raise the local ponding depths.

No other measures would be implemented.

6.2.5.3 Alternative 3 – Abandon Municipal Drain, Replace Existing Storm Sewer, & Negotiate Drainage Easement

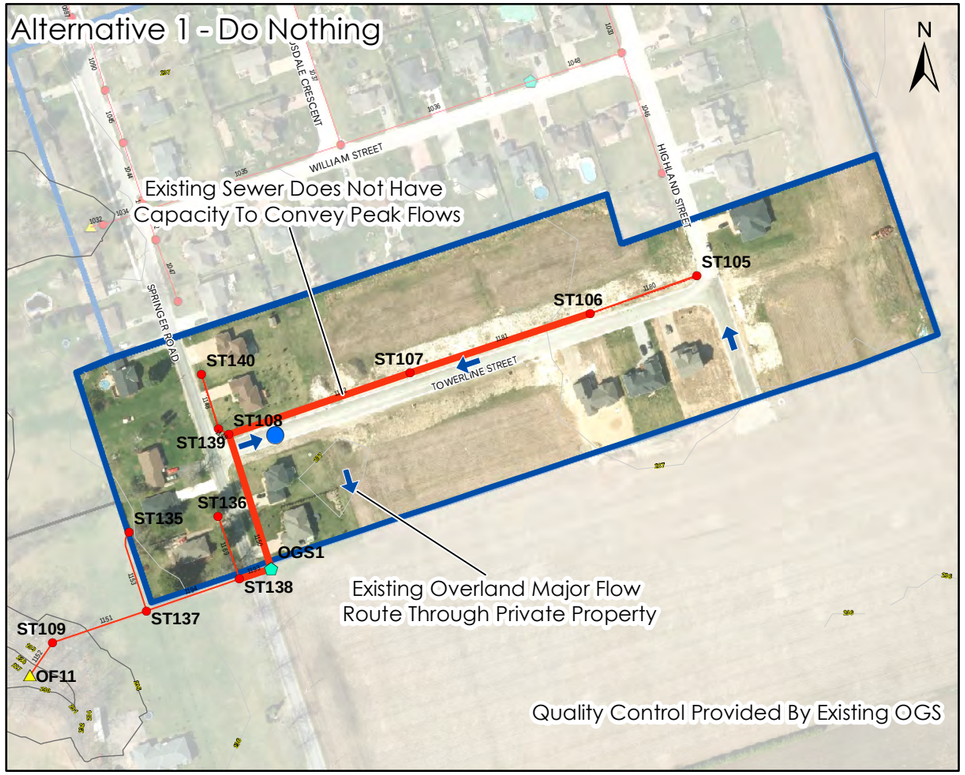
Under this alternative, the existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement (see Figure 6.8).

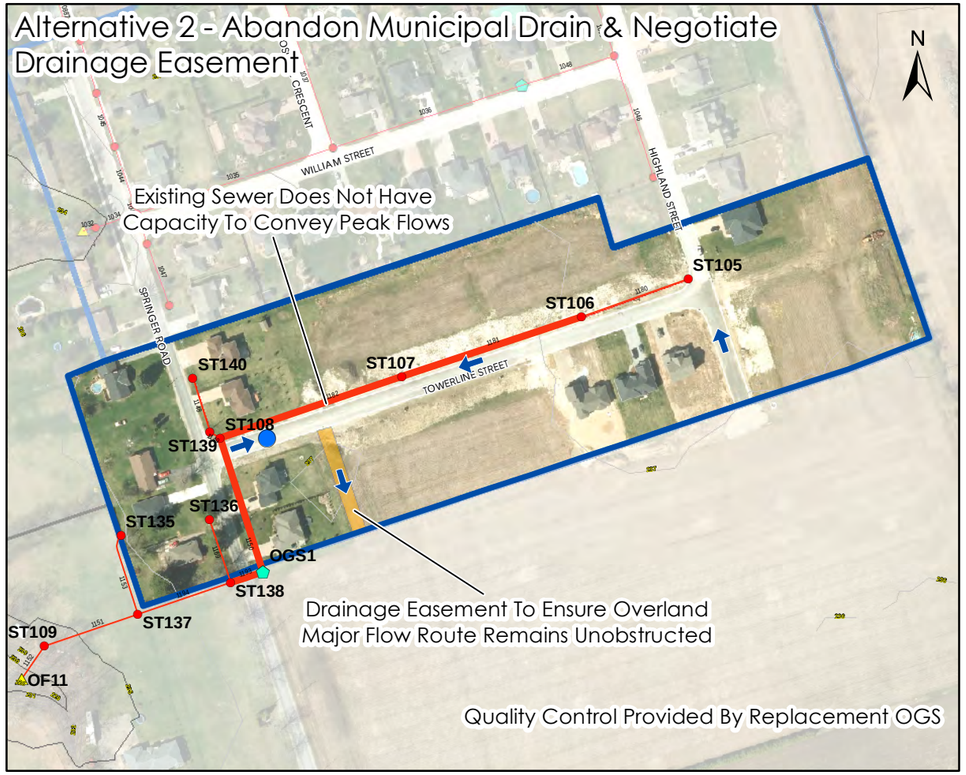
The majority of the existing storm sewer is replaced with a system that has sufficient capacity to convey the 2-year peak design discharge. The proposed storm sewer could be further upgraded to provide a stormwater outlet to the Longwoods Road Commercial Lands located east of the Tower Heights Subdivision, subject to selection of the preferred alternative for that catchment area.

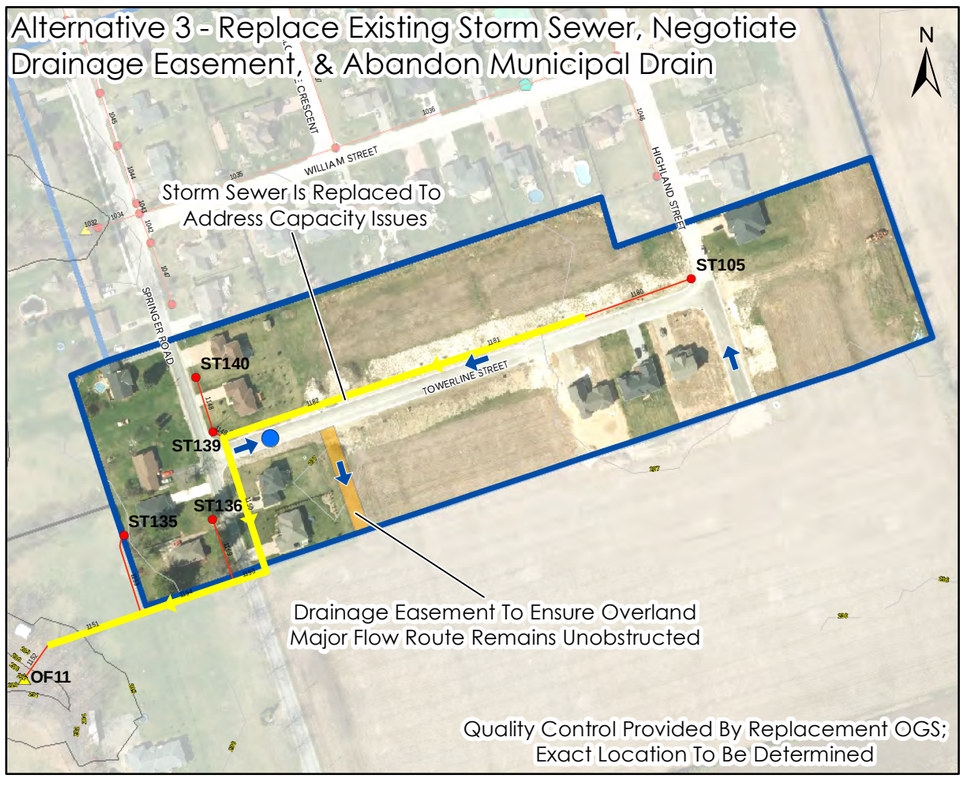
A drainage easement would need to be negotiated with the existing landowner to reduce the possibility of the existing major flow outlet being obstructed, which would raise the local ponding depths.

A new oil-grit separator would be in place to provide improved water quality control. No water quantity control measures would be implemented; however, the acquisition of the easement to accommodate the overland major flow route would mitigate the potential for obstruction in the future.

Roads disturbed would be restored to existing conditions. There is limited opportunity to improve grades to eliminate existing ponding at the low point along Towerline Street under severe storm events. Although it is unlikely to cause property damage or to present a significant safety concern, ponding depths above the MOMC standard would be anticipated.







Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Drainage Boundary

0 15 30 60 90 120 m

1:3,000

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.8

Title

Delaware SWM EA
Springer Road Drain
Alternatives

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Revised: 2015-09-30 By: kbuchanan

6.2.6 Cummings Municipal Drain

6.2.6.1 Alternative 1 – Do Nothing

The existing approved draft plans on the east and west side of Martin Road will be serviced by stormwater infiltration measures (see Figure 6.9). Any additional future development, however, will occur with insufficient stormwater management controls, causing greater risks to public safety and property damage, and impacts to the receiving ravine. Existing capacity issues will be enhanced with additional development. Persistent ponding will continue to occur at the Wellington Road low point and along Martin Road and the existing dry SWM pond will continue to discharge to the drain via the shallow CSP located outside of the municipal right-of-way.

6.2.6.2 Alternative 2 – Urban Right of Way within Future Development Areas, & Dry SWM Pond

The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement (see Figure 6.9).

This alternative would involve implementation of urban road cross-sections within the proposed development areas with a regional dry SWM pond located on development lands east of Martin Road prior to discharge to the ravine. The proposed dry SWM pond, in conjunction with oil/grit separators located at each of the development lands, provides all necessary stormwater treatment and quantity control to the runoff from the design service area.

Minor flows within the development areas would be collected and conveyed by proposed storm sewers, with major flows collected and conveyed by the proposed right-of-ways.

A proposed storm sewer is constructed from the Wellington Street low point to the proposed dry SWM pond located east of Martin Road. As future development occurs, the proposed Wellington Street storm sewer will provide a minor system outlet. The south Wellington Street roadside ditch profile is modified to convey major flows from the low point westward to the future residential development that drains to the Longwoods Road culvert.

Due to grading constraints, major flows from a portion of the future development located north of Wellington Street are conveyed to the future Harris Road culvert drainage system.

The proposed works would address existing ponding issues noted at the Wellington Street low point and along Martin Road. This alternative would also involve decommissioning of the drain system currently on private property. However, the Municipality would need to acquire land for the proposed dry SWM pond. Temporary infrequent deep ponding should be expected within the dry SWM facility as a result of storm events.

Wellington Street and Martin Road, south of Wellington Street would be reconstructed to a semi-urban cross-section to accommodate the proposed works.

6.2.6.3 Alternative 3A – Semi-Urban Right of Way within Future Development Areas

The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement (see Figure 6.9).

To reduce surface ponding at the Wellington Street low point, the proposed storm sewer is constructed from the Wellington Street low point to the future Victoria Street replacement storm sewer (refer to Thompson Drain Alternative 4). The proposed storm sewer has sufficient capacity to accommodate the runoff from the future development located northwest of the Wellington Street/Martin Road intersection. Stormwater from this future development area is conveyed to the proposed storm sewer by the existing CSP located between 133 and 137 Wellington Street, requiring a drainage easement.

The south Wellington Road roadside ditch profile is modified to convey major flows from the low point westward to the future residential development that drains to the Longwoods Road culvert.

The road cross-sections for all future residential development located in the Cummings Drain service area are semi-urban. The proposed roadside ditches provide all necessary stormwater treatment to the runoff from the proposed residential areas. The semi-urban right of way is not consistent with MOMC guidelines for new development.

Stormwater from the future residential development located south of the Wellington Street/Martin Road intersection is conveyed to the existing outlet location by a proposed open channel located in a drainage easement southeast of Martin Road and Wellington Street along the west limit of the proposed development lands. The proposed open channel will require an easement to be secured. This open channel will help convey the runoff from all events up to and including the 100-year design storm. Upgraded ditching along Wellington Street east of Martin helps provide additional peak flow storage prior to discharge to the ravine. Improved overland flow route along the west side of Martin Road will help address existing ponding noted in this area.

Redirection of segments of the catchment area to other catchments also reduces flows to the ravine.

Wellington Street and Martin Road, south of Wellington Street would be reconstructed to a semi-urban cross-section to accommodate the proposed works.

6.2.6.4 Alternative 3B – Semi-Urban Right of Way within Future Development Areas (Alternate Outlet)

Similar to Alternative 3A, the existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement (see Figure 6.9).

However, under this alternative, flow is not diverted from the catchment area to the Victoria Street storm sewer system (Thompson Drain). Rather, to reduce surface ponding at the Wellington Street low point, a proposed storm sewer is constructed from the Wellington Street low point to the existing ravine outlet located east of Martin Road. The proposed storm sewer has sufficient capacity to accommodate the runoff from the future development located northwest of the Wellington Street/Martin Road intersection.

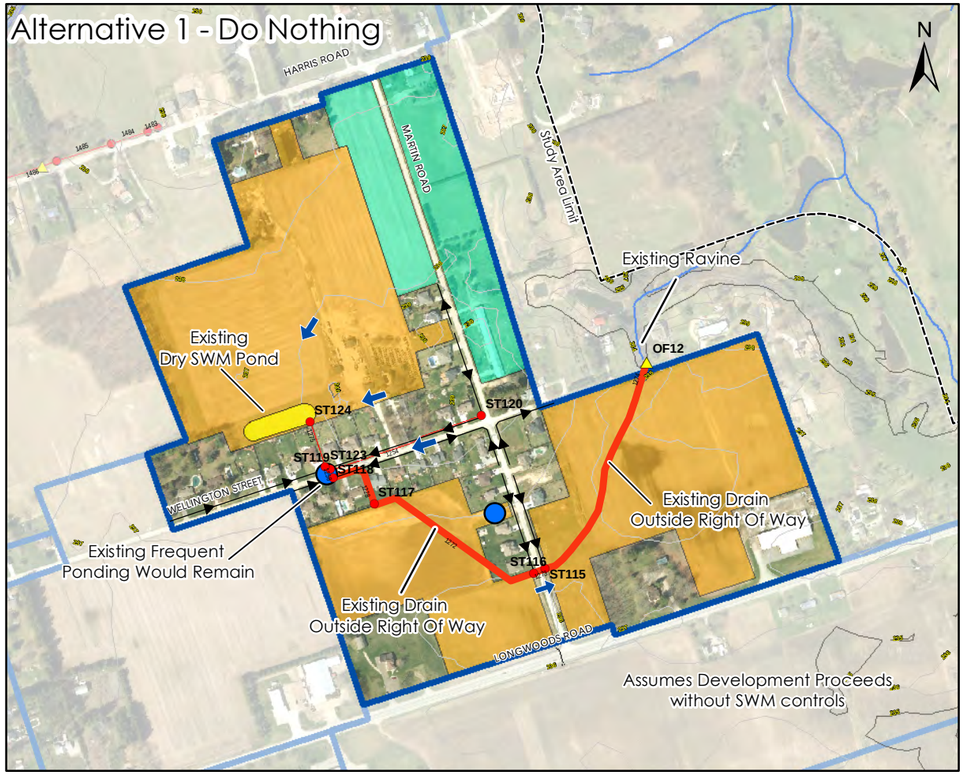
The south Wellington Road roadside ditch profile is modified to convey major flows from the low point westward to the future residential development that drains to the Longwoods Road culvert.

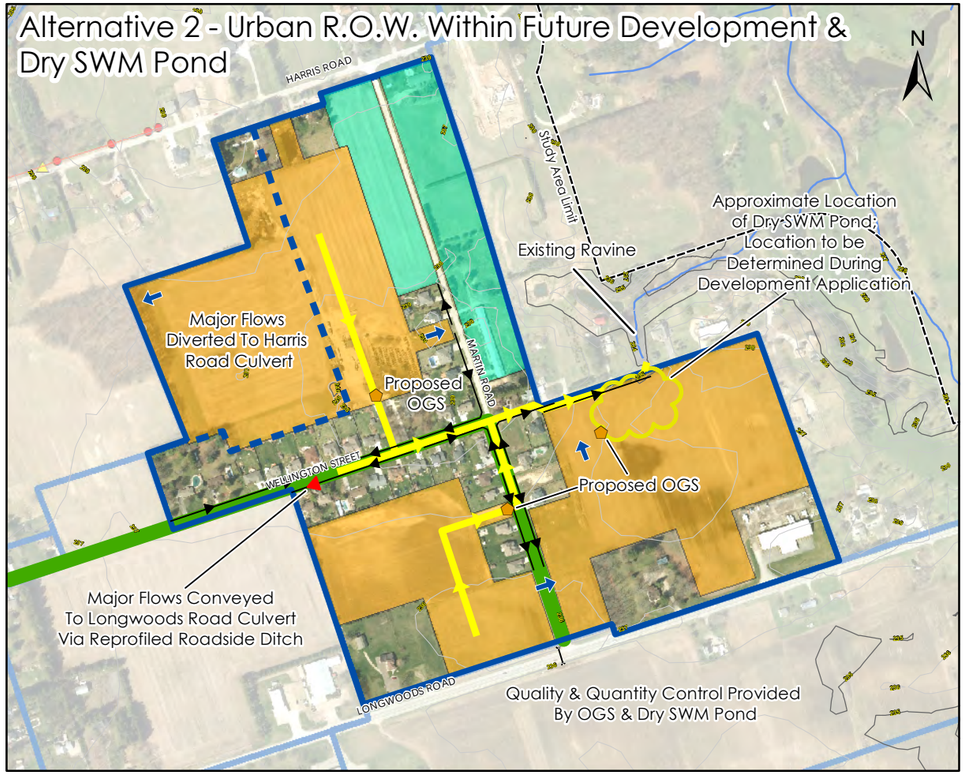
The road cross-sections for all future residential development located in the Cummings Drain service area are semi-urban. The proposed roadside ditches provide all necessary stormwater treatment to the runoff from the proposed residential areas. The semi-urban right of way is not consistent with MOMC guidelines for new development.

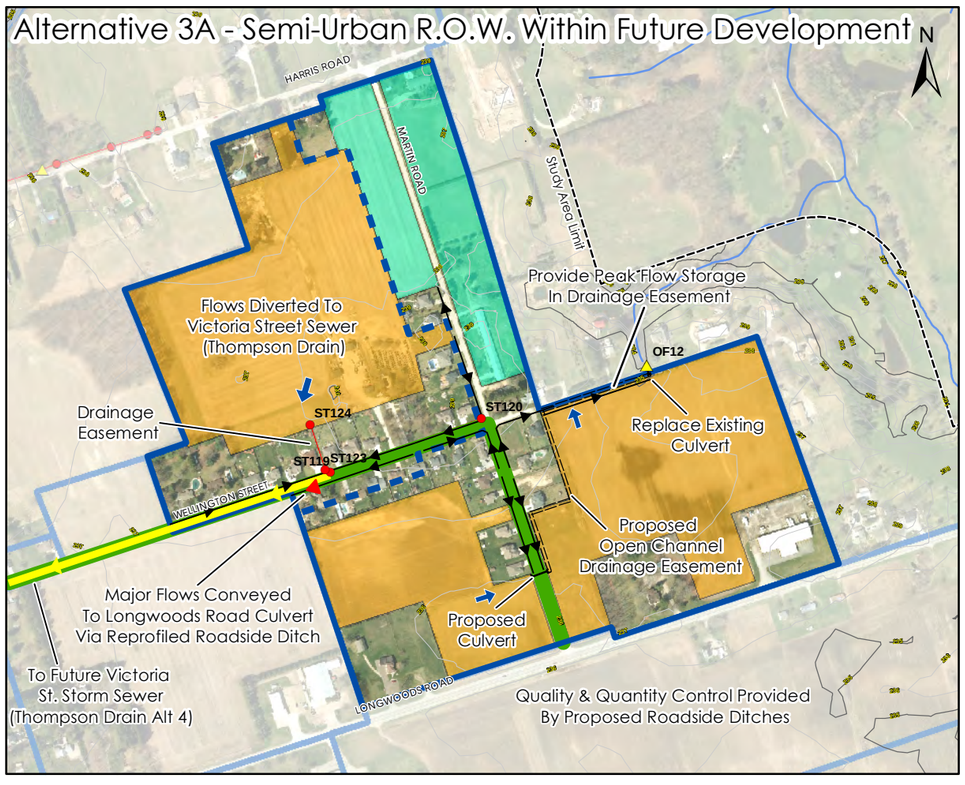
Stormwater from the future residential development located south of the Wellington Street/Martin Road intersection is conveyed to the existing outlet location by a proposed open channel located in a drainage easement southeast of Martin Road and Wellington Street along the west limit of the proposed development lands. The proposed open channel will require an easement to be secured. This open channel will help convey the runoff from all events up to and including the 100-year design storm. Upgraded ditching along Wellington Street east of Martin helps provide additional peak flow storage prior to discharge to the ravine. Improved overland flow route along the west side of Martin Road will help address existing ponding noted in this area.

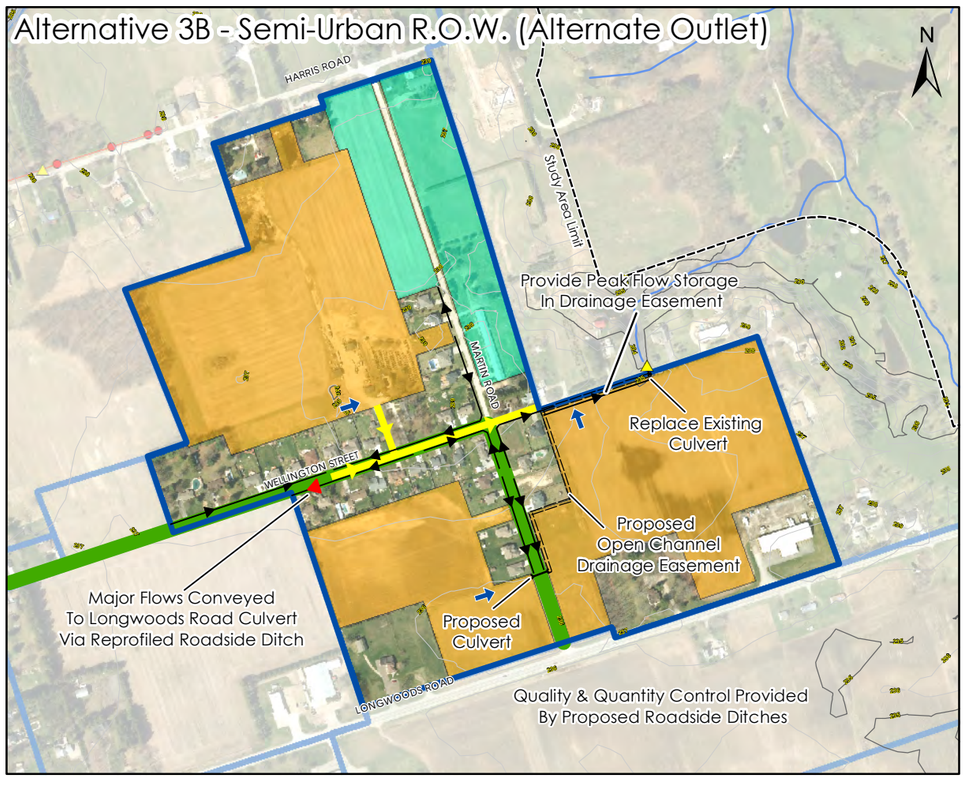
Redirection of segments of the catchment area to other catchments also reduces flows to the ravine.

Wellington Street and Martin Road, south of Wellington Street would be reconstructed to a semi-urban cross-section to accommodate the proposed works.









Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Roadside Ditch
- Proposed Storm Sewer (2-Year Capacity)
- Drainage Boundary (Interior)
- Drainage Boundary
- Proposed Dry SWM Pond
- Proposed Semi-Urban R.O.W.
- Potential Future Development
- Future Development Serviced by SWM Infiltration Measures

1:7,500

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.9

Title

Delaware SWM EA
Cummings Drain Alternatives

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Revised: 2015-11-26 By: kbuchanan

6.2.7 Longwoods Road Culvert

6.2.7.1 Alternative 1 – Do Nothing

Under this scenario, no works would be completed and development would occur without implementation of stormwater management controls (see Figure 6.10). Ponding would continue, with potential for additional areas to be impacted with increased post-development flows.

Water quality to the box culvert would be impaired further as development would be proceeding without implementation of controls.

6.2.7.2 Alternative 2 – Semi-Urban Right of Way within Future Development Areas

Under this alternative, the future development is constructed with semi-urban road cross sections to convey and treat the site runoff (see Figure 6.10). The proposed roadside ditches will provide the necessary stormwater treatment within the development lands by filtering suspended sediment, providing temporary surface storage, and infiltration opportunities. The semi-urban right of way is not consistent with MOMC guidelines for new development.

Improvements to the Longwoods Road north roadside ditch will likely be required to accommodate the future subdivision grading and to convey the post-development peak discharges. All runoff is conveyed by the existing downstream box culvert to the existing ravine. The upgraded ditches will provide improved water quality treatment.

The existing ponding north of Longwoods Road would be addressed with improvements to the roadside ditch. Observed ponding in front of the school cannot be addressed within the catchment area, but can be addressed as part of the Thompson Drain alternatives, if required.

Major flows from the Wellington Street ditch could be conveyed through the development lands to the existing outlet. Refer to Alternatives 2, 3A, and 3B of Cummings Drain for additional information. If redirected, increased flows could result in risk of erosion in ravine, therefore erosion control measures may be required.

6.2.7.3 Alternative 3 – Urban Right of Way within Future Development Area & Dry SWM Pond

This alternative would involve implementation of urban road cross-sections within the proposed development areas with SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties (see **Figure 6.10**).

Minor flows within the development areas would be collected and conveyed by proposed storm sewers, with major flows collected and conveyed by the proposed right-of-ways. The

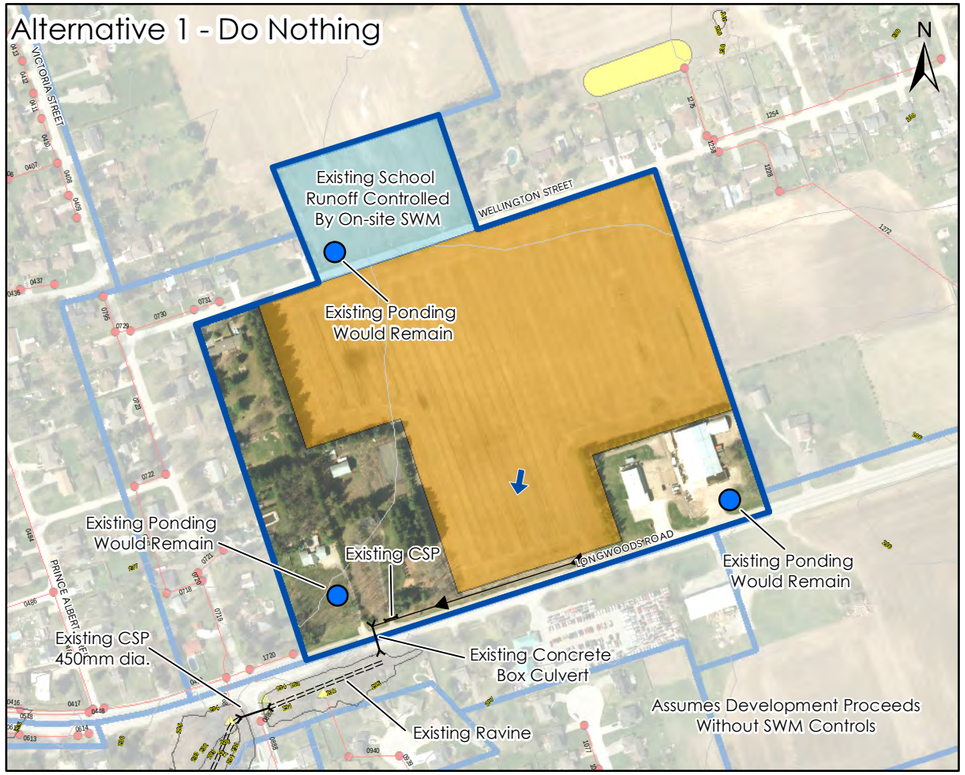
major system can be designed to accommodate the major flows from the Wellington Street low point to mitigate surface flooding per Alternatives 2, 3A, and 3B of Cummings Drain.

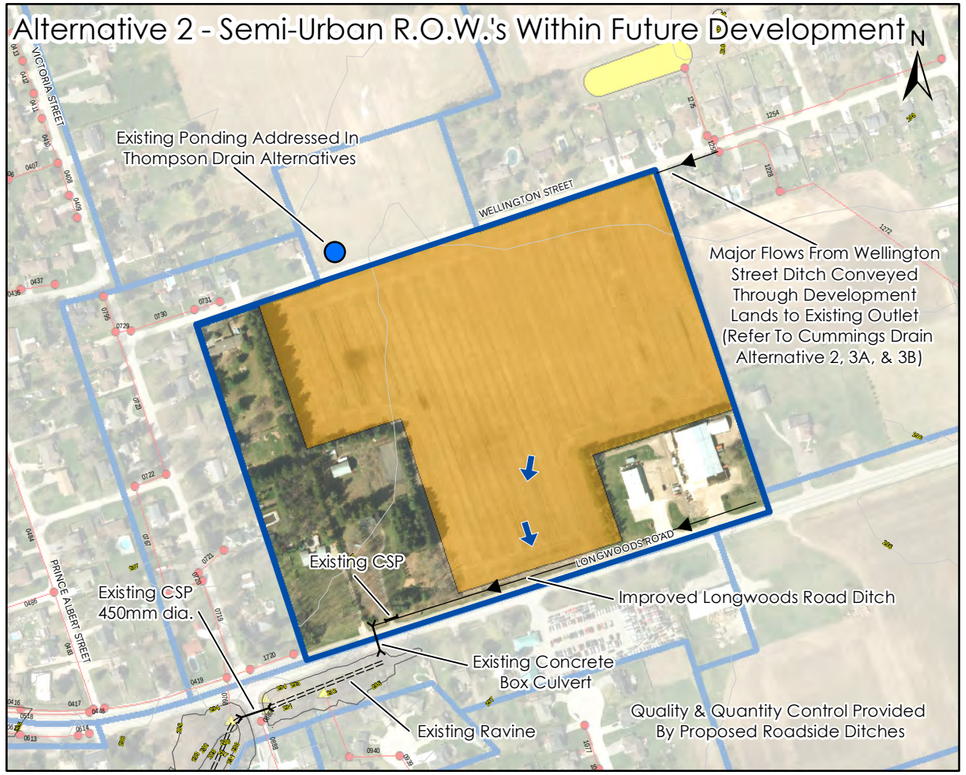
All necessary stormwater treatment is provided by a proposed dry SWM pond and OGS. The proposed dry SWM pond discharges to a proposed outlet pipe that discharges to the downstream ravine at the existing outfall location.

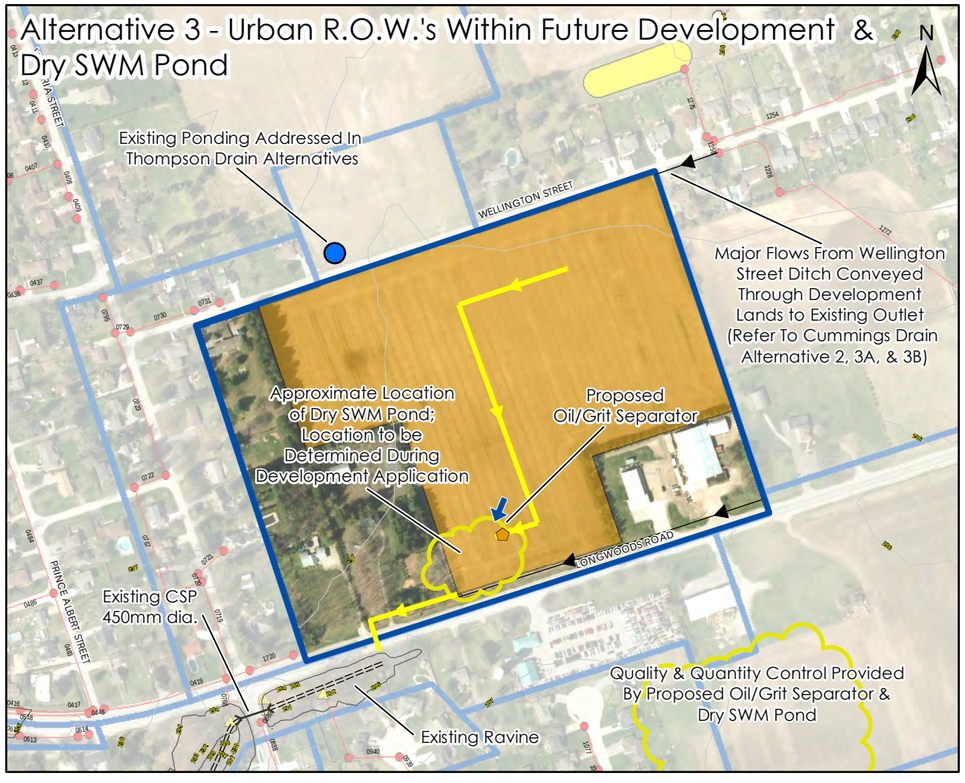
The existing concrete box culvert beneath Longwoods Road is replaced with a new outlet which must be lowered to accommodate the proposed upstream sewers. Accordingly, approval from the County will be required.

Improvements to the Longwoods Road north roadside ditch will likely be required to accommodate the new storm sewer outlet. The existing ponding north of Longwoods Road would be addressed with improvements to the roadside ditch. Observed ponding in front of the school cannot be addressed within the catchment area, but can be addressed as part of the Thompson Drain alternatives, if required.

The proposed OGS and dry SWM facility would provide water quality and quantity control for the development areas. Should major flows from the Wellington Street ditch be conveyed through the development lands (per Alternatives 2, 3A, and 3B of Cummings Drain), flow control via the dry pond could help mitigate impacts to the ravine, although separate erosion control measures at the outfall should be undertaken.







Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Roadside Ditch
- Proposed Storm Sewer
- Proposed Dry SWM Pond
- Existing School
- Potential Future Development
- Drainage Boundary

0 25 50 100 150 200 m

1:5,000

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.10

Title

Delaware SWM EA
Longwoods Road Culvert
Alternatives

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Revised: 2015-11-26 By: kbuchanan

6.2.8 Longwoods Commercial Lands

6.2.8.1 Alternative 1 – Do Nothing

Under this scenario, no works would be completed and development would occur without implementation of stormwater management controls (see Figure 6.11). Increased post-development flows will be directed to the adjacent property.

The existing roadside ditches along Longwoods Road would continue to provide water quality treatment, but not for the proposed development lands. No water quantity controls would be in place.

6.2.8.2 Alternative 2 – Control All Stormwater On-Site

This alternative involves the implementation of on-site low impact development (LID) technologies to address runoff from the proposed commercial development (see Figure 6.11). This option requires consideration of on-site soil characteristics and presence/level to groundwater. The available Middlesex County soils mapping suggests that the western portion of the service area is comprised of permeable soils which likely make infiltration measures feasible. In contrast, the mapping suggests that the eastern portion of the service area is comprised of less permeable soils which are less suited to accommodate the proposed development. Available information also indicates the potential for high groundwater levels within the area, which may impact the effectiveness of LID technologies.

Water quality and quantity control would be provided by the on-site works, subject to determining the characteristics of the soils and groundwater levels. LID measures may result in local groundwater mounding. The extent of water quality treatment will be dependent on the type of commercial development that may be established, as some developments will require more extensive on-site controls (i.e., gas station, dry cleaner, etc.).

The existing right-of-way would continue to direct flow onto the commercial lands, and therefore a swale would be required to maintain shallow surface flow to the south through the commercial block.

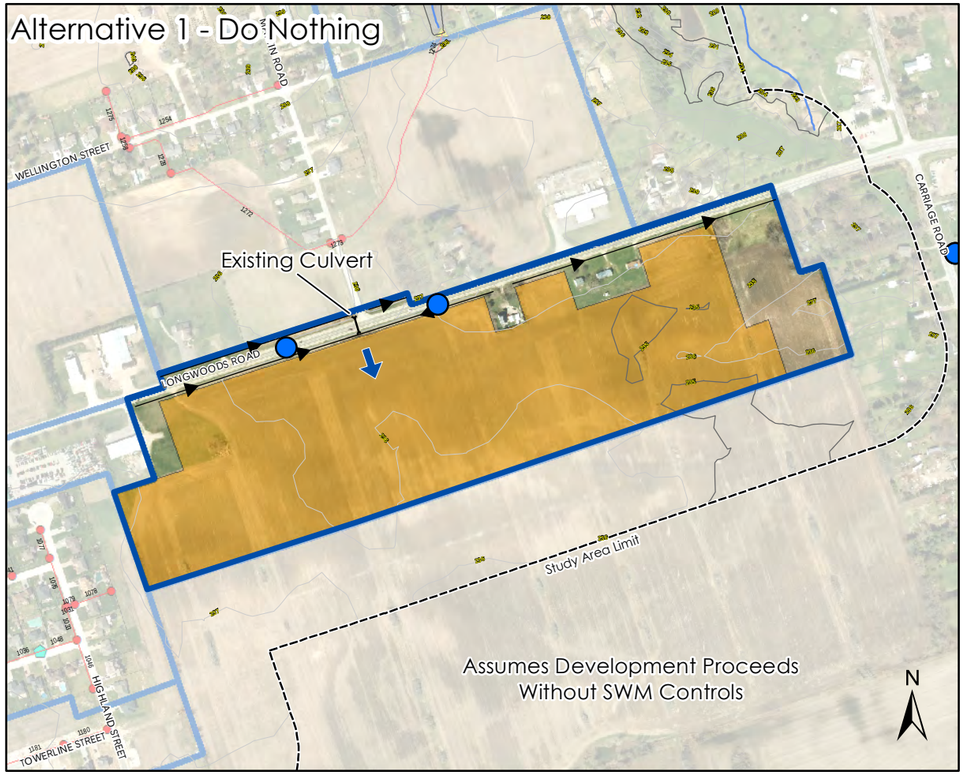
6.2.8.3 Alternative 3 – Dry SWM Pond

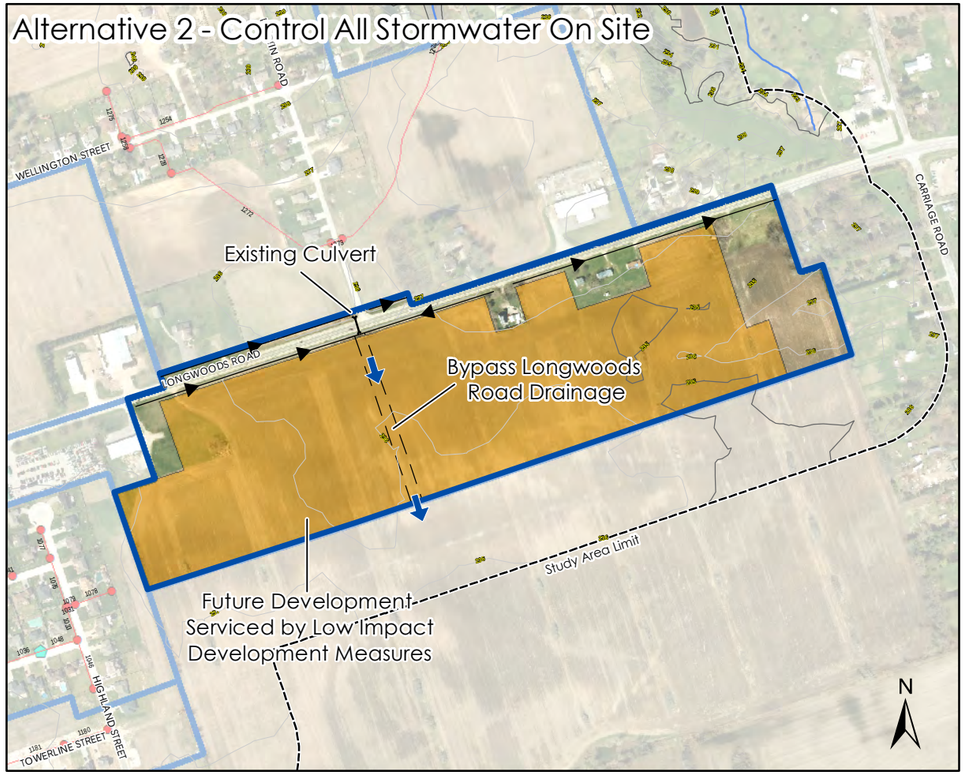
Stormwater treatment is provided to the runoff from the proposed commercial development by OGSs and a proposed dry SWM pond located within the existing buffer lands east of the Tower Heights Subdivision (see Figure 6.11). Stormwater is conveyed from the dry SWM pond to the Springer Road Drain outfall location by a proposed pipe located within a drainage easement south of the Tower Heights Subdivision, which will require negotiation with the landowner. As an option for the Municipality, the storm sewer pipe from the dry SWM pond could be increased in size to accommodate runoff from Towerline Street.

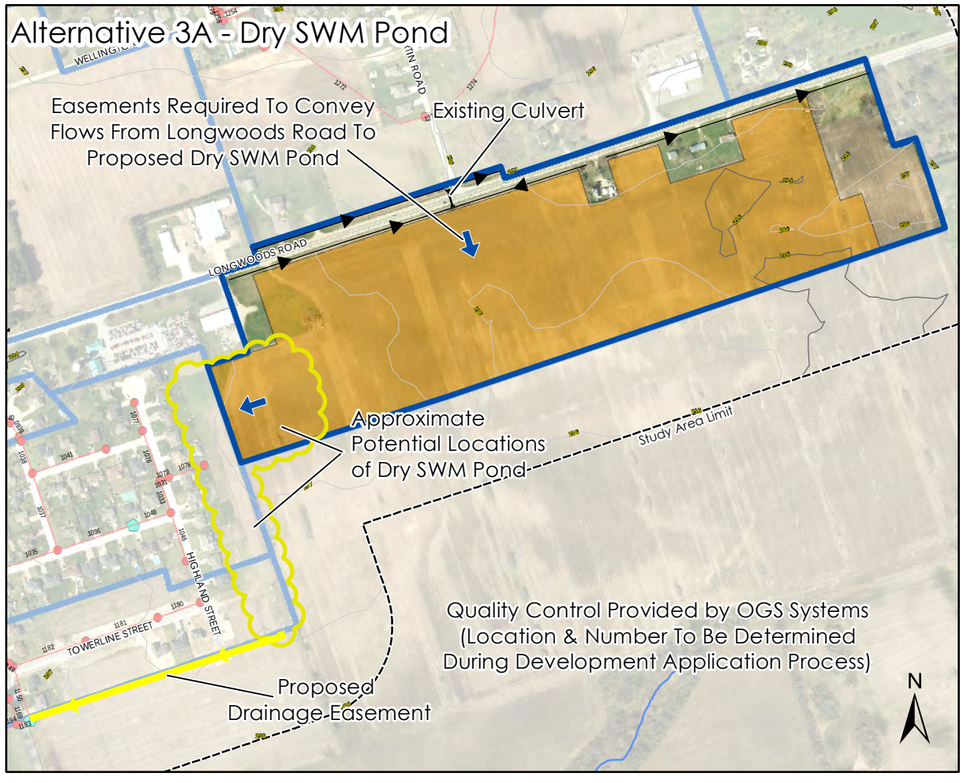
In order to accommodate flows from the Longwoods Road right-of-way, easements will be required within the commercial block. In addition, coordination with potential multiple developments within the block will be required to ensure that flows can ultimately be directed to the dry SWM pond.

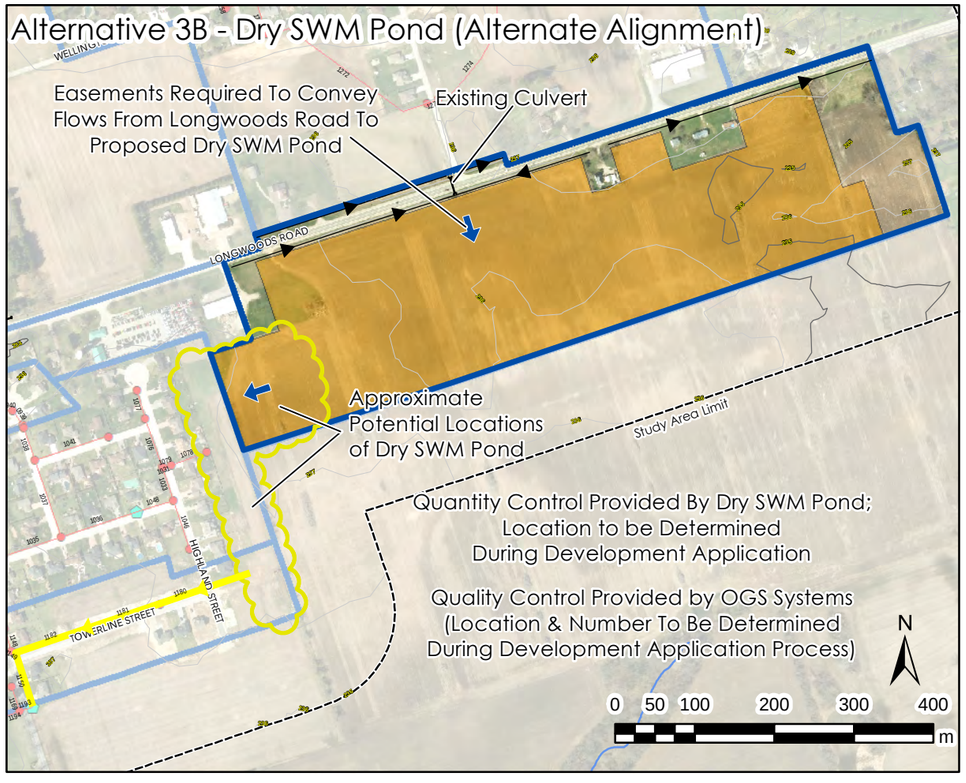
Temporary infrequent deep ponding should be expected within the dry SWM facility as a result of storm events.

The Springer Road Drain is lowered from the outfall to OGS1 to accommodate the proposed pond outlet. Approval from the LTVCA will be required for this work.









Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Roadside Ditch
- Proposed Storm Sewer (2-Year Capacity)
- Potential Future Development
- Drainage Boundary

1:7,500

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.11

Title

Delaware SWM EA
Longwoods Commercial Lands
Alternatives

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Revised: 2015-11-26 By: kbuchanan

6.2.9 Harris Road Culvert

6.2.9.1 Alternative 1 – Do Nothing

Under this scenario, no works would be completed and development would occur without implementation of stormwater management controls (see Figure 6.12).

Flows generated from development lands, along with existing flows, exceed the capacity of the existing conveyance system. Potential for ponding would increase due to increased flows and hydraulic constraints.

Water quality to the ravine would be impaired further as development would be proceeding without implementation of controls.

6.2.9.2 Alternative 2A – Urban Right of Way & Dry SWM Ponds within Future Development Areas

This alternative would involve implementation of urban road cross-sections within the proposed residential development areas with SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties (see Figure 6.12).

Minor flows within the development areas would be collected and conveyed by proposed storm sewers, with major flows collected and conveyed by the proposed right-of-ways.

All necessary stormwater treatment is provided by proposed dry SWM ponds and oil/grit separators. The proposed dry SWM pond located south of Harris Road discharges to an outlet pipe located in a proposed drainage easement which would require negotiation with the existing landowner. The outlet pipe conveys the stormwater to the existing outfall location. Similarly, the proposed dry SWM pond located north of Harris Road discharges to an outlet pipe located in a proposed drainage easement at 101 Harris Road, which would require negotiation with the landowner.

The Harris Road culvert must be lowered to accommodate the proposed upstream storm sewers. With exception of minor roadworks required to construct the storm sewers from development areas to the culvert, no significant alternations to the road cross-sections would be undertaken.

Provision of an alternative outlet to Dingman Creek from the future development located north of Harris Road was not considered in detail due to the steep valley slopes and natural heritage concerns.

The proposed OGS and dry SWM facilities would provide water quality and quantity control for the development areas. The proposed south development could also accommodate major flows from a portion of Cummings Drain. No additional treatment of quantity control would be provided for flow generated from existing residential areas or for the Harris Road right-of-way.

Temporary infrequent deep ponding should be expected within the dry SWM facilities as a result of storm events.

6.2.9.3 Alternative 2B – Urban Right of Way & Dry SWM Ponds within Future Development Areas (Alternate Alignment)

This option is similar to Alternative 2A, with a proposed alternate discharge point from the future residential area north of Harris Road to eliminate the need for an additional drainage easement (see Figure 6.12). However, to accommodate this alternative, a new storm sewer is required within the Harris Road right-of-way.

Similar to Alternative 2A but the proposed dry SWM pond located north of Harris Road discharges to a proposed storm sewer located in the Harris Road right-of-way. Harris Road is reconstructed to a semi-urban cross-section, with minor flows conveyed by the proposed storm sewer and major flows conveyed by ditches.

The proposed OGS and dry SWM facilities would provide water quality and quantity control for the development areas. The proposed south development could also accommodate major flows from a portion of Cummings Drain. Ditching along Harris Road would improve water quality treatment for runoff from existing development and the right-of-way. Temporary infrequent deep ponding should be expected within the dry SWM facilities as a result of storm events.

A drainage easement would still be required to accommodate flows from development areas south of Harris Road. The option to direct major flows from a portion of Cummings Drain would also exist for this alternative.

6.2.9.4 Alternative 3A – Semi-Urban Right of Way within Future Development Areas

Under this alternative, the future residential development is constructed with semi-urban road cross sections to convey and treat the site runoff (see Figure 6.12). The proposed roadside ditches will provide the necessary stormwater treatment within the development lands by filtering suspended sediment, providing temporary surface storage, and infiltration opportunities. The semi-urban right of way is not consistent with MOMC guidelines for new development.

Drainage easements are required north and south of Harris Road to convey stormwater from the proposed roadside ditches to the existing Harris Road culvert. The option to direct major flows from a portion of Cummings Drain would also exist for this alternative.

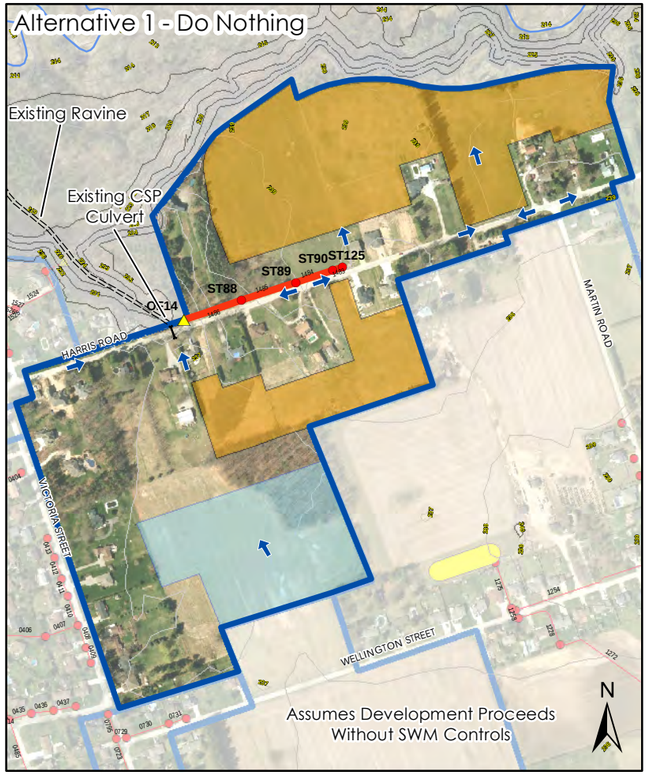
No additional treatment or quantity control would be provided for flow generated from existing residential areas or for the Harris Road right-of-way.

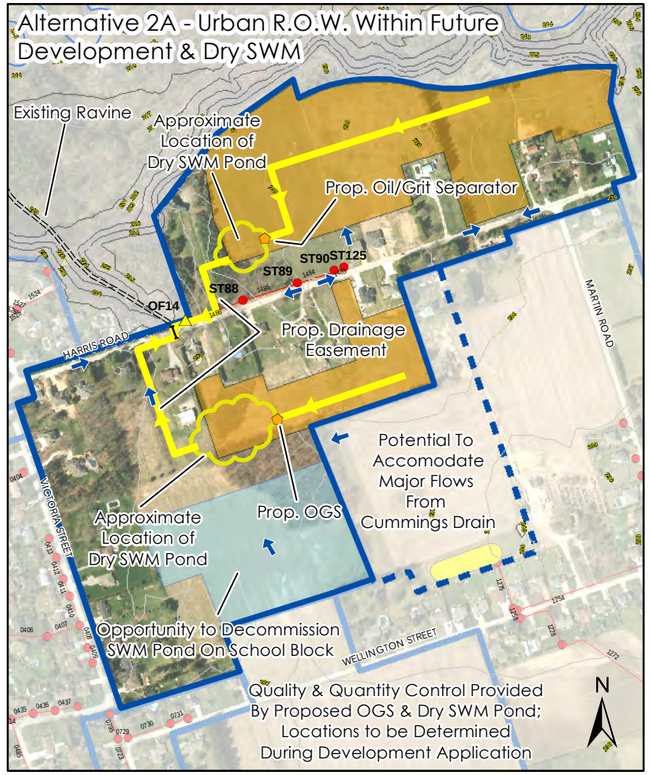
6.2.9.5 Alternative 3B – Semi-Urban Right of Way within Future Development Areas (Alternate Alignment)

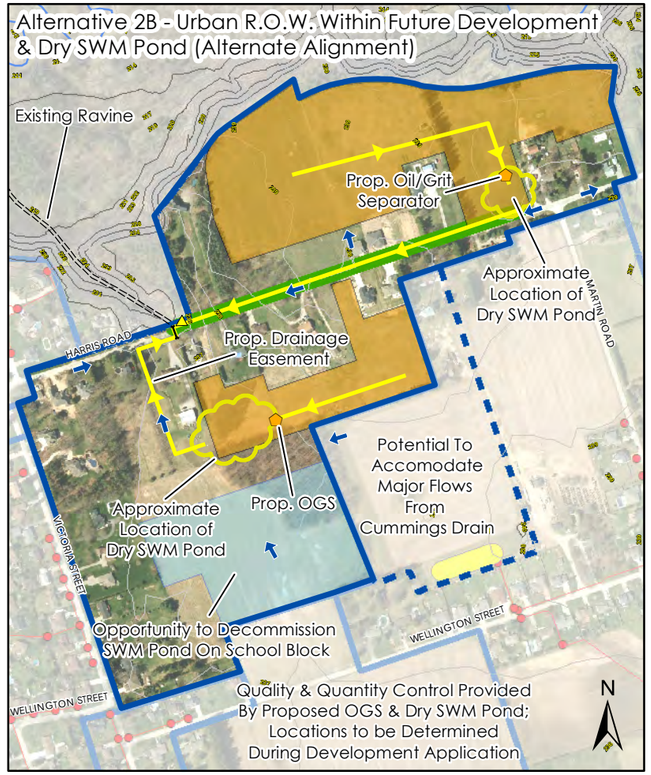
Similar to Alternative 3A but the proposed roadside ditches located north of Harris Road discharge to an improved roadside ditch located on the south side of the Harris Road right-of-way (see Figure 6.12). The proposed Harris Road ditch is designed with sufficient capacity to convey the 100-year design peak discharge to the downstream ravine.

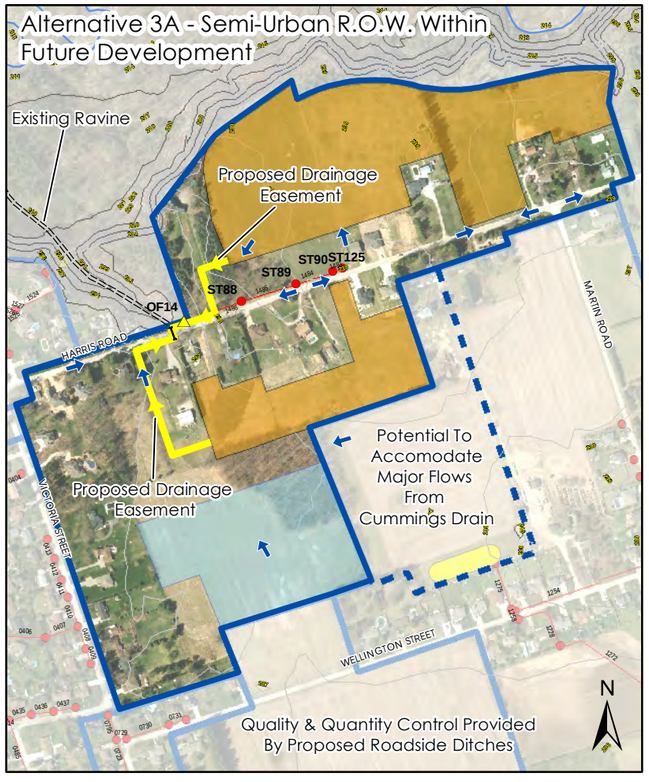
The upgraded roadside ditches along Harris Road improve treatment of runoff from existing and new development. Semi-urban cross-sections within new development areas provide the necessary stormwater treatment and temporary surface storage. The semi-urban right of way is not consistent with MOMC guidelines for new development.

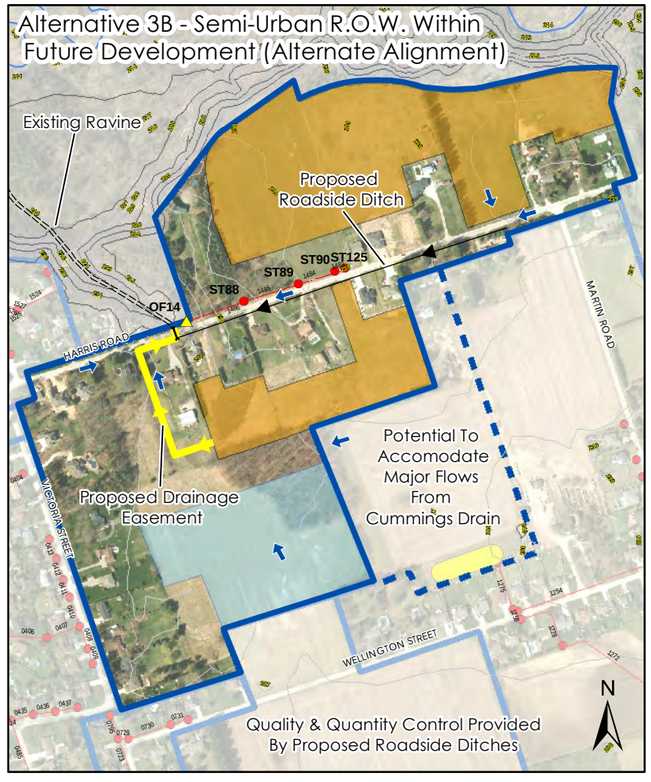
A drainage easement would still be required to accommodate flows from development areas south of Harris Road. The option to direct major flows from a portion of Cummings Drain would also exist for this alternative.











0 50 100 200 300 400 m

Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Roadside Ditch
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Dry SWM Pond
- Proposed Semi-Urban R.O.W.
- Drainage Boundary (Interior)
- Drainage Boundary
- Potential Future Development
- Existing School

1:7,500

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.12

Title

Delaware SWM EA
Harris Road Culvert Alternatives

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Revised: 2015-11-26 By: kbuchanan

6.2.10 Thompson Municipal Drain

6.2.10.1 Alternative 1 – Do Nothing

Under this alternative, no works would be completed (see Figure 6.13). Accordingly, overland flows continue to occur more frequently along Victoria Street than if the storm sewer were designed in accordance with the current MOMC design standards.

The costs of future drain maintenance should be assessed to the benefiting landowners, in accordance with the Drainage Act. Root penetration, particularly from ST161 to ST160, may further reduce the existing pipe capacity if no maintenance work is completed.

No additional water quality or quantity controls would be implemented with this alternative. Accordingly, no land acquisition would be required.

6.2.10.2 Alternative 2 – Abandon Municipal Drain & Realign Storm Sewer

The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement. The existing pipes from ST68 to ST160 are decommissioned and replaced with a new pipe from ST68 to ST158 located in the Victoria Street right-of-way (see Figure 6.13). ST161 is connected to the realigned storm sewer along Victoria Street. Rear lot catchbasins, if and where present, are connected to the realigned sewer or otherwise regrading is undertaken to remove risk of ponding.

With exception of the new segment of sewer which would be designed to convey minor flows, overland flows continue to occur more frequently along Victoria Street than if the remaining storm sewers were designed in accordance with the current MOMC design standards.

No additional water quality or quantity controls would be implemented with this alternative.

6.2.10.3 Alternative 3 – Proposed Storm Sewer

The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The Municipality implements budgeting to pay for capital and maintenance works. A proposed storm sewer designed in accordance with current MOMC standards conveys the minor flows from the current Thompson Drain design service area (see Figure 6.13). The portion of the Victoria Street storm sewer that drains to the Davis Street system (currently directing flow to the Forsythe Drain) is connected to the proposed new storm sewer. Sewer upgrades along this existing segment are not proposed as ponding, if present, is not considered to be significant. However, upgrades of this segment could be undertaken as part of future roadwork upgrades.

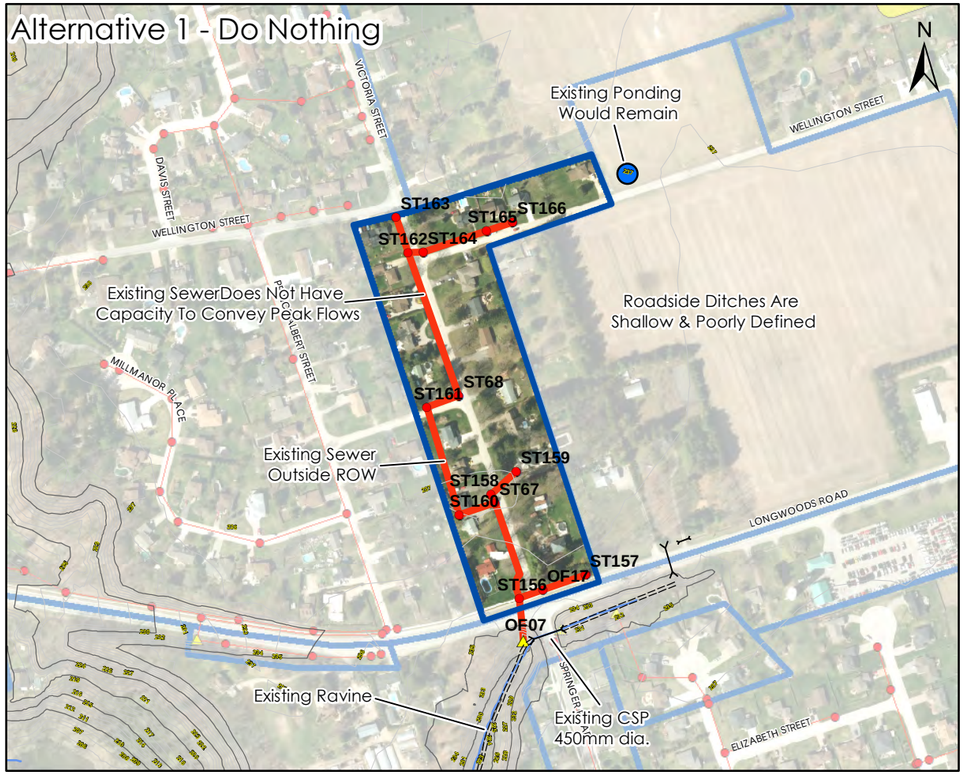
A new storm sewer along Wellington Street is connected to the new Victoria Street storm sewer to provide an outlet for the existing roadside ditch along Wellington Street. This would alleviate issues related to ponding of water in front of Our Lady of Lourdes Catholic School.

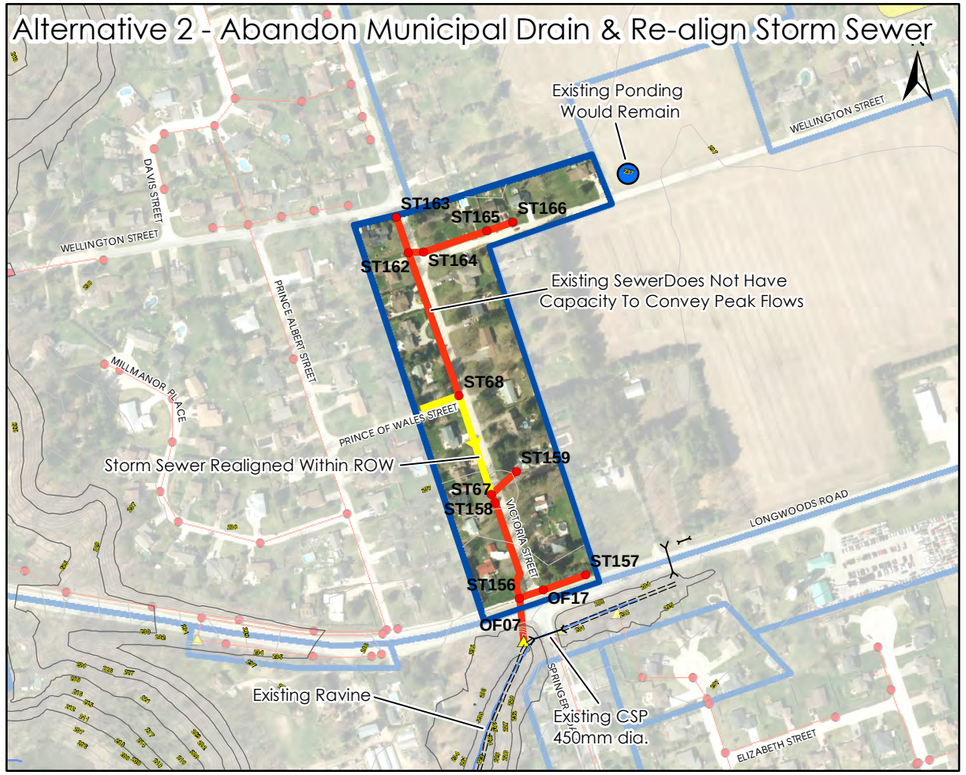
Victoria Street from Wellington Street to Longwoods Road is reconstructed to an urban cross section, which helps to improve conveyance of major flows to the ravine. Wellington Street is reconstructed to a semi-urban cross section due to grading issues requiring use of ditches to convey flows. Coordination/approval with the County of Middlesex is required due to crossing of Longwoods Road. LTVCA permitting/approval will be required for work within the floodplain.

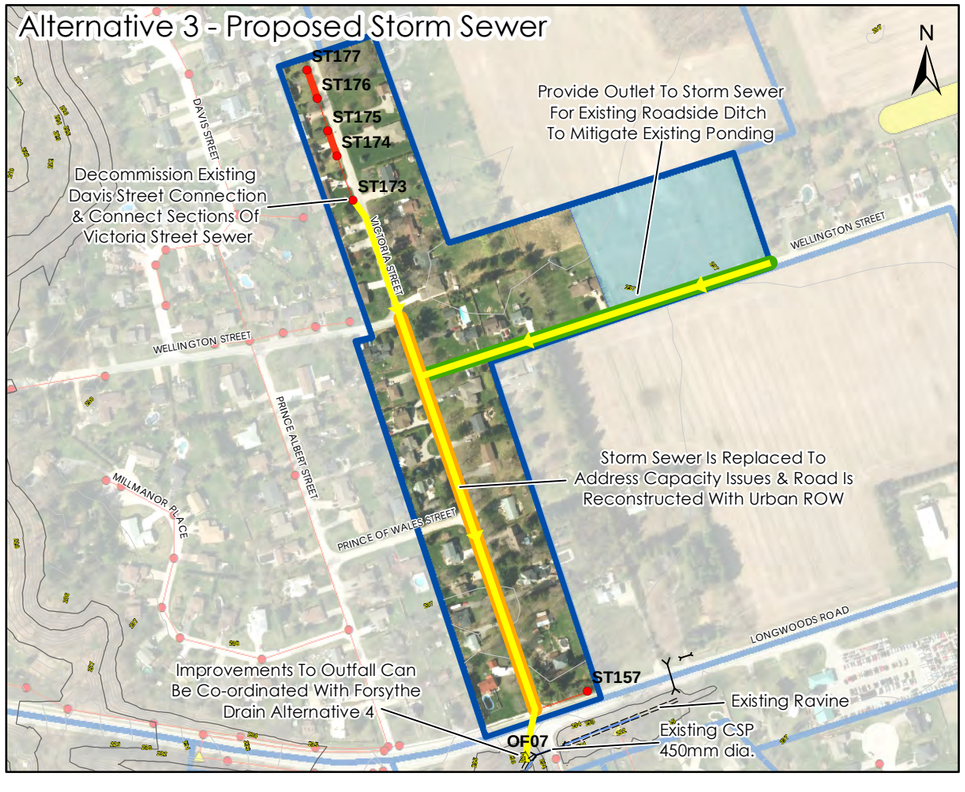
Water quality treatment is impacted due to elimination of ditches along Victoria Street from Wellington Street to Longwoods Road, although this is considered to be minor as the existing ditches are not well defined. Higher flows to the ravine are anticipated due to additional flows via connection of a portion of the former Davis Street system and segment of Wellington Street, although upgrades at the outfall could help mitigate erosion and other related issues.

6.2.10.4 Alternative 4 – Proposed Storm Sewer with Wellington Street Branch

This alternative is similar to Alternative 3, however the proposed sewer along Wellington Street is extended further to address servicing issues within Cummings Drain (see Figure 6.14). Wellington Street would be reconstructed to a semi-urban standard. Higher peak flows to the ravine are anticipated with additional drainage areas from Cummings Drain, although upgrades at the outfall could be implemented to mitigate erosion and other related issues.







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Revised: 2015-09-30 By: kbuchanan

0 25 50 100 150 200 m

Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Urban R.O.W.
- Proposed Semi-Urban R.O.W.
- Drainage Boundary
- Existing School

1:5,000

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

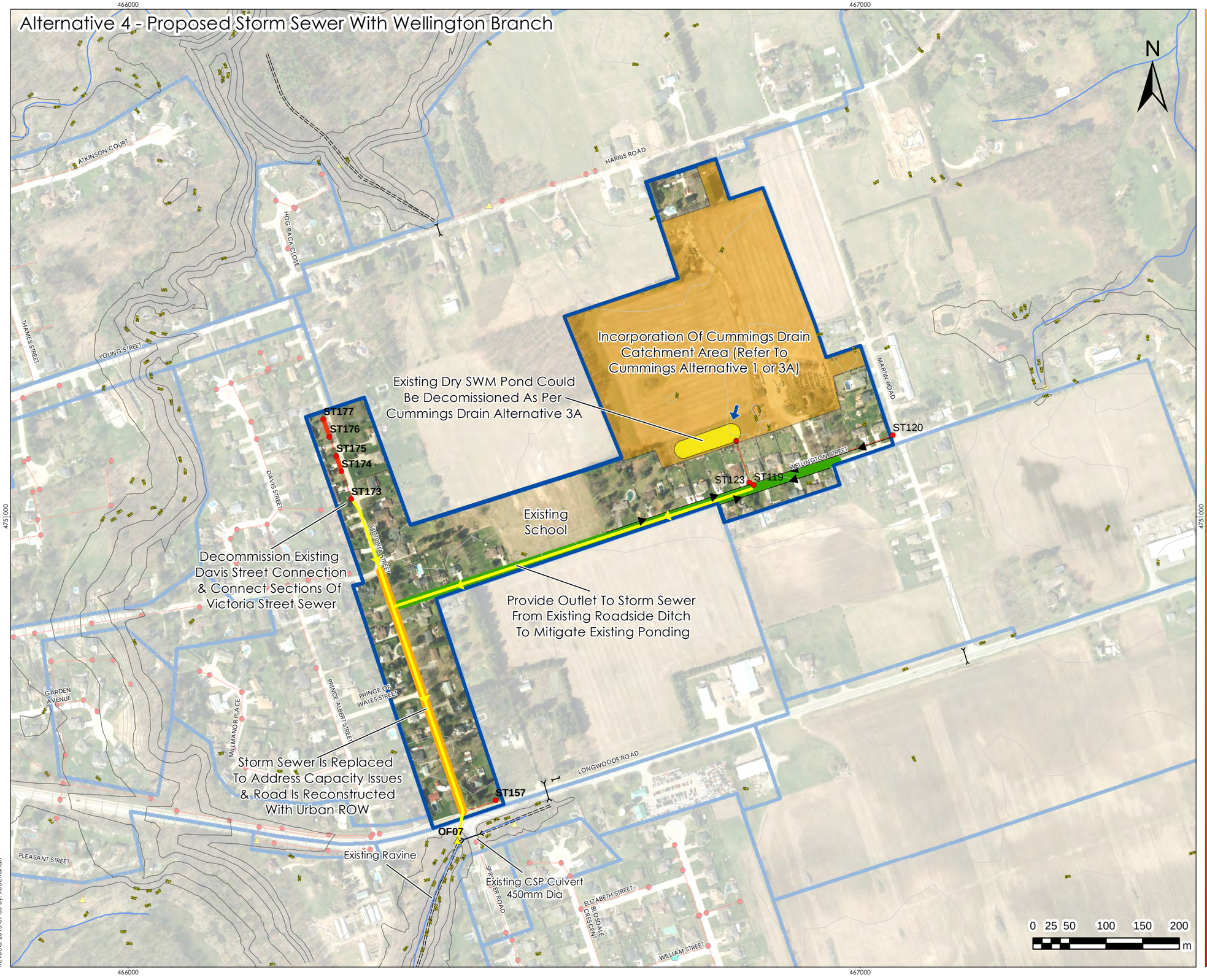
Figure No.

6.13

Title

Delaware SWM EA
Thompson Drain Alternatives
Part 1

Alternative 4 - Proposed Storm Sewer With Wellington Branch



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Revised: 2015-09-30 By: kbuchanan

Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Overland Flow Direction
- Exisiting Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Roadside Ditch
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Semi-Urban Road Section
- Proposed Urban Road Section
- Drainage Boundary
- Potential Future Development

1:5,000

Notes

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Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.14

Title

Delaware SWM EA
Thompson Drain Alternatives
Part 2

6.2.11 Forsythe Municipal Drain

6.2.11.1 Alternative 1 – Do Nothing

Under this alternative, no works would be completed (see Figure 6.15). Accordingly, overland flows continue to occur more frequently than if the storm sewer were designed in accordance with the current MOMC design standards. Concerns related to ponding would continue.

The costs of future drain maintenance should be assessed to the benefiting landowners, in accordance with the Drainage Act. Root penetration, particularly along the segments of sewer off the right-of-way, may further reduce the existing pipe capacity if no maintenance work is completed.

No additional water quality or quantity controls would be implemented with this alternative. Accordingly, no land acquisition would be required.

6.2.11.2 Alternative 2 – Improve Minor System

The existing municipal drain is abandoned in accordance with the provisions of the Drainage Act. The existing pipes are retained and the Municipality implements budgeting to pay for their maintenance/replacement.

The existing municipal drain from ST47 to ST49 would be decommissioned (see Figure 6.15). A new storm sewer to convey minor flows would be constructed on Garden Avenue from ST184 to Wellington Street, and along Wellington Street heading west from the intersection with Garden Avenue, to York Street (ST40 to ST46).

The existing municipal drain from ST58 to the outfall would be replaced with a new storm sewer to convey minor flows to the outlet. The new storm sewer would be located within easements which would require negotiation with impacted landowners. Segments of storm sewers currently outside the right-of-way that are to remain will require negotiation of easements.

Rear lot catchbasins, if and where present along existing drains to be decommissioned to accommodate realignments within right-of-ways would require connection to the realigned sewer or otherwise regrading is undertaken to remove risk of ponding.

A new storm outfall to the Thames River within the Delaware Conservation Area west of Gideon Drive would be required. A new storm sewer with sufficient capacity to convey the 100-year peak discharge would be constructed from the York Street low point south of Wellington Street to the new outfall.

The proposed works would reduce risk of ponding at the identified locations. Segments of existing sewers that have insufficient capacity are not replaced, as major flows can still be directed to outlets. However, upgrades of these segments could be undertaken as part of future roadwork upgrades.

All roads where sewer replacement is proposed are restored in accordance with the MOMC standard to match pre-construction conditions (i.e., semi-urban to urban cross-sections where indicated). Coordination/approval with the County of Middlesex is required due to crossing of Longwoods Road. LTVCA permitting/approval will be required for construction of the new outfall and upgrades to the existing outfall.

No water quality or water quantity controls would be implemented with this alternative.

6.2.11.3 Alternative 3 – Improve Minor System and Divert Prince Albert Street System

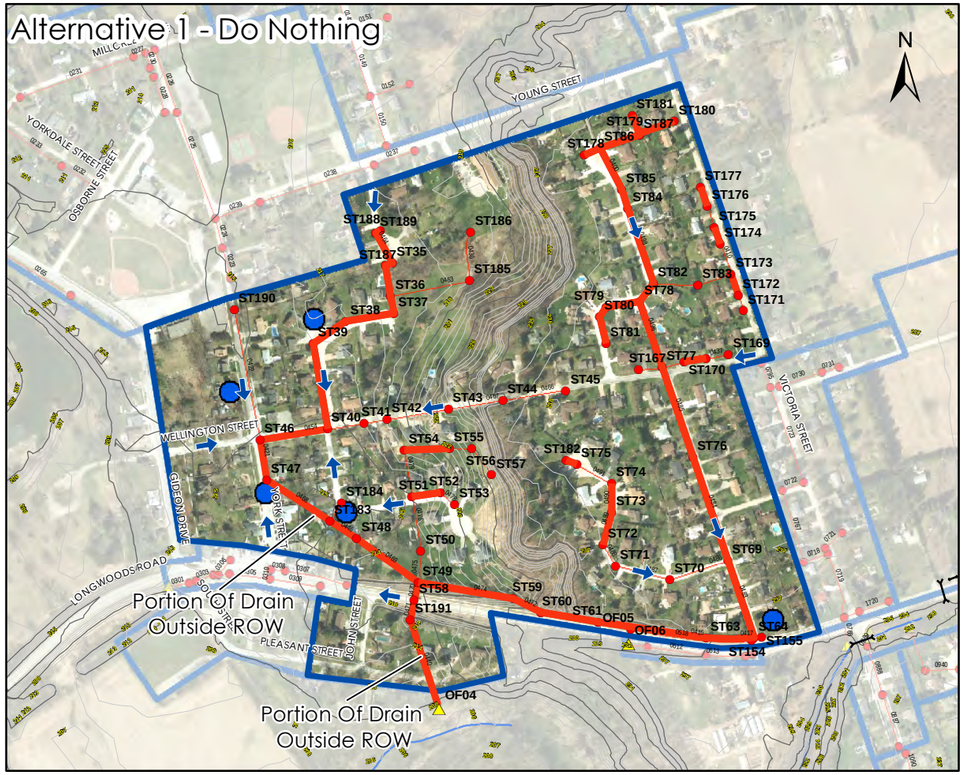
This alternative is similar to Alternative 3, however further decommissioning of the Garden Avenue system from ST51 to ST49 would be undertaken to remove issues associated with easement acquisition and maintenance of works out of the right-of-way (see Figure 6.15). The proposed new Garden Avenue sewer would be extended further upstream to redirect these flows to the new Wellington Street sewer and outfall.

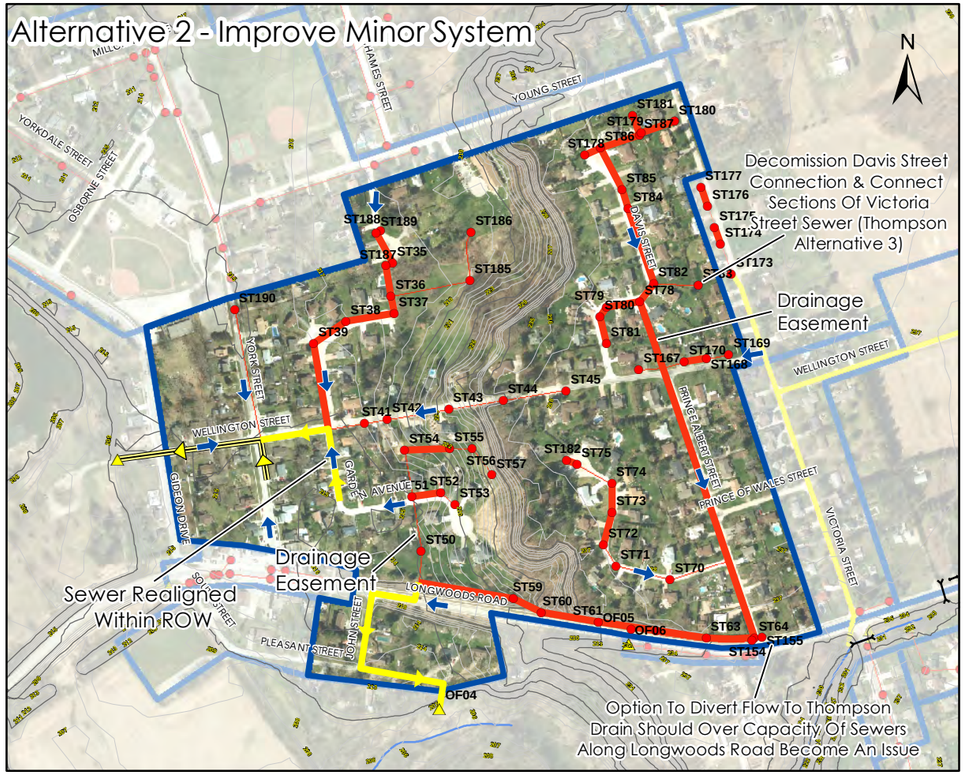
A portion of the Prince Albert Street storm sewer would be replaced from Wellington Street to Longwoods Road with a new system to convey minor flows in accordance with MOMC standards. The new sewer would be extended further along Longwoods Road to the Thompson Drain outfall in order to alleviate capacity issues along the existing Longwoods Road storm sewers.

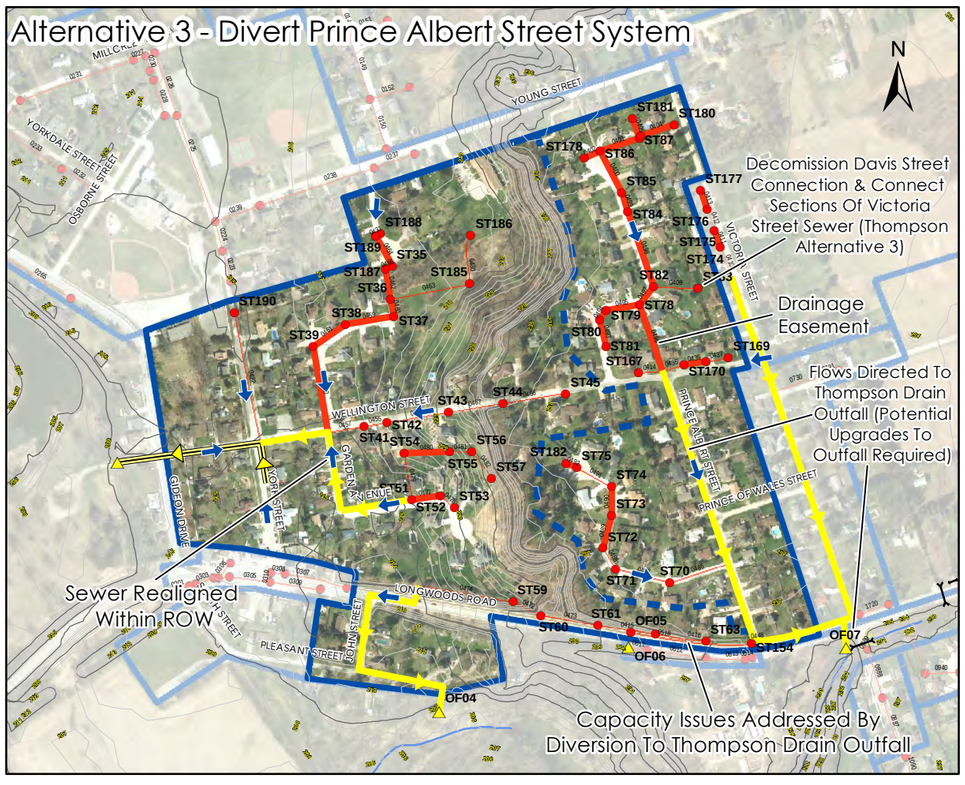
A portion of the Davis Street storm sewer located on Victoria Street would be disconnected from the catchment area and redirected to the Victoria Street system (Thompson Drain). The redirection would be undertaken only with upgrades to the Thompson Drain system per the alternatives noted for that catchment area in order to minimize impacts to that system. The potential redirection would reduce flows within the Davis Street system.

This option would require further works along Longwoods Road and coordination/approval with the County. All roads where sewer replacement is proposed are restored to match pre-construction conditions. Minor upgrades to Prince Albert Street could be undertaken to improve overland flow routes.

No water quality or water quantity controls would be implemented with this alternative.







0 50 100 200 300 400 m

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Legend

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Storm Sewer (100-Year Capacity)
- Drainage Boundary (Interior)
- Drainage Boundary

1:7,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

November 2015
165630021

Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

6.15

Title

Delaware SWM EA
Forsythe Drain Alternatives

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Revised: 2015-11-26 By: kbuchanan

6.2.12 Longwoods Road Storm Sewer #1 and #2

This storm sewer is located on a County Road and does not collect runoff from a significant external drainage area. There are no reported issues in relation to this system. If the existing minor system has insufficient capacity, the major system appears to be capable of safely conveying any surcharges to the Thames River. Moreover, any reconstruction of this system would be extremely disruptive to local businesses, residents and traffic. The extensive costs and disruption would not be warranted by the existing drainage operations; thus, no alternatives were developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

6.2.13 Springer Road Storm Sewer

This system was recently reconstructed with an urban road cross section and municipal storm sewers. Since the system appears to be functioning well with no reported issues, and any surcharges from the minor system can be conveyed safely to the existing ravine by the existing major system, no alternatives have been developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

6.2.14 Pleasant Street Culvert

Runoff from most of this catchment is conveyed as overland flow to the existing outfall. Since there appears to be little risk of local flooding caused by local storm drainage, no alternatives have been developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

6.2.15 Blosdale Court Storm Sewer

Since this newer system was designed in accordance with typical urban drainage practices, and local ponding depths are below Middlesex Centre design standards, no alternatives have been developed for this catchment area, and the existing infrastructure will be maintained according to regular maintenance procedures.

6.3 EVALUATION METHODOLOGY

As part of Phase 2 of the Municipal Class EA process, the framework and criteria for evaluating the alternative solutions should be defined. The following sections describe the environmental components and evaluation criteria that were employed during the selection of preferred alternatives.

The environmental components outlined below represent a broad definition of the environment as described in the EA Act.

Table 6.1 Environmental Components

Environmental Component	Description
Social/Cultural	Component that evaluates potential effects on residents, neighbourhoods, businesses, community character, social cohesion, community features, and historical/archaeological and heritage components.
Natural Environment	Component having regard for protecting significant natural and physical elements of the environment (i.e. air, land, water, and biota), including natural heritage and environmental features and functions.
Technical	Component that considers technical suitability and other engineering aspects of the servicing options.
Economic/Financial	Component that addresses the potential effect on servicing costs.

A qualitative evaluation was used to consider the relative suitability of each servicing option and to identify significant advantages and disadvantages with respect to a specific set of evaluation criteria identified for each environmental component.

The following criteria were identified for this study:

Table 6.2 Evaluation Criteria

Environmental Component	Evaluation criteria	Description
Social/ Cultural	Public Health and Safety	• Impacts to health and safety for each option and during construction
	Cultural Heritage Resources	• Disruption of site having significant archaeological, historical, or architectural value
	Aesthetics	• Visual appearance with or without mitigation • Materials used in construction
	Property Impacts/Acquisitions	• Potential acquisition of additional land for construction • Potential negotiation of drainage easements • Disruption to property both during and after construction
	Municipal Policy/Guidelines	• Conforms to provincial, county and municipal land use policies, and general guidelines
	Aboriginal Impacts	• Land Claims/Treaty Rights

Natural Environment	Floodplain Impact/Policy	• Impacts to surrounding floodplain areas
	Erosion and Sedimentation Impacts	• Impacts and mitigation measures for erosion and sedimentation downstream
	Aquatic Habitats	• Reduction or deterioration of habitat • Effects of contamination on aquatic life • Effects of timing of construction on spawning periods • Changes in vegetation composition
	Terrestrial Habitats	• Reduction or deterioration of wildlife habitat • Effects on wildlife habitat related to food and shelter • Effects of contamination on wildlife • Effects of timing of construction on breeding periods • Removal or disturbance of significant trees and/or ground flora • Changes in vegetation composition
	Migratory/Other Birds	• Reduction or deterioration of habitat • Effects of contamination on birds • Effects of timing of construction on nesting periods • Changes in vegetation composition
	Groundwater/Water Quality	• Changes or impacts to groundwater quality
Technical	Compliance with Stormwater Design Targets	• Ministry of the Environment and Climate Change, municipal, and other design standards
	Effects on Local Ponding Depths	• Impacts to design ponding depths
	Effect on Groundwater Levels	• Potential impacts on groundwater levels, and opportunities for mitigating high groundwater levels
	Capacity (for Existing and Future Development)	• Capacity to accommodate runoff from existing and future development areas.
	Compliance with Applicable Floodplain Policies	• Potential impact of alternative on floodplain based on location of proposed works, potential for erosion, etc
	Site Design Challenges	• Identifying any site design challenges and solutions
	Geotechnical Considerations	• Potential soil and/or groundwater impacts, based on findings from desktop study and other information sources
	Consequences of System Failure	• Overall impacts/consequences if system fails
	Construction	• Implementation, noise/vibration/dust during construction, construction access
	Operation and Maintenance	• Adjacent property requirements • Vegetation establishment

		• Accessibility
	Approval and Regulatory Requirements	• Provincial & Municipal Requirements • Conservation Authority Requirements
Economic/ Financial	Initial Capital Costs	• Total Project Costs (design/construction)
	Property Acquisition Costs	• Costs associated with any required property acquisitions
	Operation and Maintenance Costs	• Costs associated with operation and maintenance

6.4 EVALUATION OF ALTERNATIVE SOLUTIONS

The alternatives for each catchment area (see Section 6.2) were compared using the evaluation criteria listed in Table 6.2 above. A decision matrix was developed to document the potential impacts associated with each option, and assist in selecting the preferred solution in coordination with Municipality of Middlesex Centre staff. The matrices are provided below in Tables 6.3 to 6.13.

Table 6.3 Prior Municipal Drain Evaluation Matrix

Prior Drain					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 Improve Minor System**	**Alternative 3A Improve Major System**	**Alternative 3B – Improve Major System (Alternate Alignment)**
Social/Cultural					
	Public Health and Safety	• Ponding noted at several areas within the catchment, including along Millcreek Lane and Young Street. More severe storm event may cause flooding of adjacent lands and increase public risk.	• Reduced risk to public safety due to better major and minor system drainage. Ponding along Millcreek Lane and Young Street addressed through improvements. • Localized ponding off Gideon Drive remains, but at low point below storm sewer system.	• Reduced risk to public safety due to better major system drainage. Ponding along Millcreek Lane and Young Street addressed through improvements. • Localized ponding off Gideon Drive remains, but at low point below storm sewer system.	• Reduced risk to public safety due to better major system drainage. Ponding along Millcreek Lane and Young Street addressed through improvements. • Localized ponding off Gideon Drive remains, but at low point below storm sewer system.
	Cultural Heritage Resources	• No built heritage properties registered within this catchment area, therefore no impacts. • No risk to potential archaeological resources as there is no work involved with this option.	• No built heritage properties registered within this catchment area, therefore no impacts. • Potential impact to archaeological resources as a result of work in proximity to the existing outlet and watercourse.	• No built heritage properties registered within this catchment area, therefore no impacts. • Potential impact to archaeological resources as a result of work in proximity to the existing outlet and watercourse.	• No built heritage properties registered within this catchment area, therefore no impacts. • Potential impact to archaeological resources is mitigated due to realignment of outlet and discharge into existing Gideon Drive culvert.
	Aesthetics	• No anticipated additional impact as no work is planned with this alternative. • Aesthetic impacts related to standing/ponding water.	• Short-term impacts during construction should be anticipated. • Streetscape modified with redevelopment of a portion of Millcreek Lane, York Street, and Young Street to an urban design standard. • Aesthetic impacts associated with tree removals along roads.	• Short-term impacts during construction should be anticipated. • Construction may impact roadside vegetation including trees.	• Short-term impacts during construction should be anticipated. • Construction may impact roadside vegetation including trees.
	Property Impacts/Acquisitions	• Potential risk to private property during major flooding events. • No property acquisition would be required since additional SWM measures will not be implemented.	• Lower risk to private property during flooding events. • Significant disruption to adjacent properties during construction given extent of work in relation to providing urban cross section. • Additional property acquisition may be required along right-of-ways. • Operational disruptions to Gideon Drive (Arterial Road) during construction.	• Lower risk to private property during flooding events. • Potential impacts to properties fronting right-of-way, including installation of driveway culverts and tree removals. • Operational disruptions to Gideon Drive (Arterial Road) during construction.	• Lower risk to private property during flooding events. • Potential impacts to properties fronting right-of-way, including installation of driveway culverts and tree removal • Drainage easement required at end of Yorkdale Street and through adjacent field. • Less properties affected by road reconstruction in comparison to Alternatives 2 and 3A. • Avoids disruption to Gideon Drive.
	Policy/Guidelines	• Catchment area within an existing development, not subject to specific OP Policies.	• Catchment area within existing settlement, not subject to specific OP policies	• Catchment area within existing settlement, not subject to specific OP policies	• Catchment area within existing settlement, not subject to specific OP policies
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall				

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.3 Prior Municipal Drain Evaluation Matrix

Prior Drain					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 Improve Minor System**	**Alternative 3A Improve Major System**	**Alternative 3B – Improve Major System (Alternate Alignment)**
Natural Environment					
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• Subject area located within regulation limits and any disruption/alteration is subject to UTRCA regulation.	• Subject area located within regulation limits and any disruption/alteration is subject to UTRCA regulation.	• Subject area located within regulation limits and any disruption/alteration is subject to UTRCA regulation.
	Erosion and Sedimentation Impacts	• Low erosion risk since existing storm sewer restricts peak flows entering Thames River.	• Increased risk of erosion due to higher peak flows to Thames River due to storm sewer upgrades. (erosion control measures to be implemented during detailed design)	• Increased risk of erosion due to higher peak flows to Thames River due to storm sewer upgrades (erosion control measures to be implemented during detailed design).	• Increased risk of erosion due to higher peak flows to Thames River due to storm sewer upgrades (erosion control measures to be implemented during detailed design).
	Aquatic Habitats	• No additional impact.	• Higher peak flows to Thames River as a result of storm sewer upgrades that may affect downstream aquatic habitat under major flow events.	• Higher peak flows to Thames River as a result of storm sewer upgrades that may affect downstream aquatic habitat under major flow events.	• Higher peak flows to Thames River as a result of storm sewer upgrades that may affect downstream aquatic habitat under major flow events.
	Terrestrial Habitats	• No additional impact.	• May include some loss of vegetation/trees (mitigation measures to be implemented). • Potential impacts to SAR habitats along Thames River/Dingman Creek Corridors with increased flows.	• Tree removal likely required for ditch improvements. • Potential impacts to SAR habitats along Thames River/Dingman Creek Corridors with increased flows.	• Tree removal likely required for ditch improvements. • Less potential impacts to SAR habitats since water is not directly discharged into Thames River.
	Migratory/Other Birds	• No impact.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• Tree removal likely required for ditch improvements. Consideration of breeding periods for construction timing.	• Tree removal likely required for ditch improvements. Consideration of breeding periods for construction timing.
	Groundwater/Water Quality	• Southeastern portion of catchment likely within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present.	• Southeastern portion of catchment likely within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Removal of ditches along a portion of Millcreek Lane, York Street, and Young Street could reduce infiltration of groundwater at a marginal level and reduce water quality treatment. • No proposed water quality treatment. • No anticipated groundwater impacts.	• Southeastern portion of catchment likely within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Proposed roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present.	• Southeastern portion of catchment likely within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Proposed roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present.
	Overall				
Technical					
	Compliance with Stormwater Design Targets	• Water quality treatment provided by existing roadside ditches. • Currently no major system outlet for the catchment area.	• Elimination of ditches may reduce water quality treatment with this alternative. • No peak flow control provided with this alternative.	• Water quality treatment provided by roadside ditches. • No peak flow control with this alternative.	• Water quality treatment provided by roadside ditches. • No peak flow control with this alternative.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.3 Prior Municipal Drain Evaluation Matrix

Prior Drain					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 Improve Minor System**	**Alternative 3A Improve Major System**	**Alternative 3B – Improve Major System (Alternate Alignment)**
	Effect on Local Ponding Depths	• Ponding will continue along Millcreek Lane and Young Street/York Street intersection.	• Ponding depths reduced by improved major/minor system.	• Ponding depths mitigated by improved roadside ditches and increased capacity of outfall.	• Ponding depths mitigated by improved roadside ditches and proposed outlet to existing culvert.
	Effect on Groundwater levels	• No anticipated impacts, although condition of pipe may promote groundwater intrusion and control.	• Groundwater levels may be impacted during construction due to temporary dewatering requirements. • Potential impact to long-term groundwater level as existing drain is constructed of recycled concrete without gaskets. Replacement with sealed pipe system may result in increase to groundwater level.	• Groundwater levels may be impacted during construction due to temporary dewatering requirements. • As most of the existing system remains intact, less potential impact to existing groundwater levels.	• Groundwater levels may be impacted during construction due to temporary dewatering requirements. • As most of the existing system remains intact, less potential impact to existing groundwater levels.
	Capacity (for existing and future development)	• Existing storm sewer does not have sufficient capacity to convey design peak discharges.	• Provides sufficient capacity to convey the minor and major system design peak discharge.	• Provides sufficient capacity to convey the major system design peak discharge.	• Provides sufficient capacity to convey the major system design peak discharge.
	Compliance with Applicable Floodplain Policies	• No anticipated impacts.	• Portion of subject area located within floodplain, UTRCA permit required to undertake work.	• Portion of subject area located within floodplain, UTRCA permit required to undertake work.	• Portion of subject area located within floodplain, UTRCA permit required to undertake work.
	Site Design Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Modifications to road profiles needed to allow fronting properties to drain to the right-of-ways with change to urban cross section. • Potential conflicts with existing utilities and municipal services. • Minimizing disturbance to existing properties due to road improvements. • Need to prevent backwater from Thames River from flooding subject area. • Traffic control required due to work on Gideon Drive.	• Minimizing disturbance to existing properties due to ditch improvements. • Need to prevent backwater from Thames River from flooding subject area. • Providing additional cover over existing pipes where ditch improvements are proposed. • Traffic control due to work on Gideon Drive.	• Minimizing disturbance to existing properties due to ditch improvements. • Need to prevent backwater from Thames River from flooding subject area. • Providing additional cover over existing pipes where ditch improvements are proposed. • Challenges associated with securing and maintaining drainage easement through private property.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts. • Discussion with the County required to confirm geotechnical requirements for potential repairs to Gideon Drive as a result of construction.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts. • Discussion with the County required to confirm geotechnical requirements for potential repairs to Gideon Drive as a result of construction.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts.
	Consequences of System Failure	• Existing flood conditions on roadway and within private properties. Severe storm	• Lowest likelihood of system failure as a large component of the system is replaced to new municipal standards.	• Low likelihood of system failure although portion of system could still be impacted by root penetration from nearby	• Low likelihood of system failure although portion of system could still be impacted by root penetration from nearby vegetation.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.3 Prior Municipal Drain Evaluation Matrix

Prior Drain					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 Improve Minor System**	**Alternative 3A Improve Major System**	**Alternative 3B – Improve Major System (Alternate Alignment)**
		event would pose risk to public safety and property. • Root entry into existing system is highly likely where trees are planted close to sewer, therefore potential of failure for current system is high in those areas.	• Failure could cause flooding on private properties, however improvements to road profile should address major flows.	vegetation. • Failure would cause flooding on private properties.	• Failure would cause flooding on private properties.
	Construction	• No construction impacts as no work is associated with this alternative.	• Significant disruption to Gideon Drive during construction. • Significant disruption to construct proposed urban right-of-ways. • Tree removal likely required to construct proposed urban right-of-ways. • Significant dewatering may be required for proposed storm sewer construction.	• Significant disruption to Gideon Drive during construction. • Tree removal likely required to construct proposed ditch improvements. • Significant dewatering may be required for proposed storm sewer construction.	• Significant disruption to neighboring property to construct proposed outlet channel. • Tree removal likely required to construct proposed ditch improvements. • Significant dewatering may be required for proposed storm sewer construction.
	Operation and Maintenance	• Portion of drain located outside of right of way, resulting in difficult access for maintenance. • Trees planted close to pipes, likely causing root penetration.	• All storm sewers replaced within right-of-way, inaccessible portions of drain decommissioned. • No operation and maintenance challenges anticipated.	• Capacity of existing pipes likely impaired by root penetration. • Property owners to maintain condition of proposed roadside ditches.	• Capacity of existing pipes likely impaired by root penetration. • Property owners to maintain condition of proposed roadside ditches.
	Approval and Regulatory Requirements	• None required.	• Storm sewer works will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Subject area located within UTRCA Regulated Limit and will require permit. • County approval required for work on County roads.	• Storm sewer works will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Subject area located within UTRCA Regulated Limit and will require permit. • County approval required for work on County roads.	• Storm sewer works will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Subject area may be within UTRCA Regulated Limit and may therefore require permit. • County approval may not be required, depending on extent/proximity to County roads.
	Overall	🔴	🔴	🟢	🟡
Economic/Financial					
	Initial Capital Costs	• No initial capital costs.	• High initial capital costs including removal and replacement of existing pipe system including decommissioning of existing Municipal Drain on private property. • Potential total costs for upgrades may be shared with allocated budget for roadway/transportation improvements as a significant component relates to surface feature restoration and establishment (i.e., curb/gutter, sidewalk if required, etc.).	• Moderate capital cost, including need to decommission portion of existing Municipal Drain on private property. • Existing sewers have insufficient capacity in comparison to design peak flows, however the proposed upgrades should address major flow conveyance to the outlet reducing possibility of ponding. The Municipality could replace these sewers in the future, potentially in conjunction with other municipal initiatives (i.e., roadworks).	• Moderate cost, but subject to securing an easement in the adjacent land. Additional cost associated to decommission portion of existing Municipal Drain on private property. • Existing sewers have insufficient capacity in comparison to design peak flows, however the proposed upgrades should address major flow conveyance to the outlet reducing possibility of ponding. The Municipality could replace these sewers in the future, potentially in conjunction with other municipal initiatives (i.e., roadworks).

Most Preferred	Neutral	Least Preferred
🟢	🟡	🔴

Table 6.3 Prior Municipal Drain Evaluation Matrix

Prior Drain					
Evaluation Criteria		Alternative 1 – Do Nothing	Alternative 2 Improve Minor System	Alternative 3A Improve Major System	Alternative 3B – Improve Major System (Alternate Alignment)
			• Costs associated with abandoning municipal drain on private property.	• Costs associated with abandoning municipal drain on private property.	• Costs associated with abandoning municipal drain on private property.
	Property Acquisition Costs	• No property required.	• No property acquisition anticipated, however subject to review of lot lines and final required profile of roadways to allow fronting properties to drain to the right-of-ways with change to urban cross section.	• No property acquisition anticipated.	• Potential costs associated with obtaining drainage easement for new open channel outlet to existing Gideon Drive culvert.
	Operation and Maintenance Costs	• Over time further obstruction to the sewers should be anticipated due to higher potential for root intrusion and therefore maintenance costs may increase. • Costs assessed to landowners in accordance with the Drainage Act.	• No significant anticipated change in existing maintenance costs • Costs paid by municipal budget as Municipality would now own the infrastructure.	• Portion of existing system may require more maintenance over time to address potential for root intrusion. • Costs paid by municipal budget as Municipality would now own the infrastructure.	• Portion of existing system may require more maintenance over time to address potential for root intrusion. • Costs paid by municipal budget as Municipality would now own the infrastructure.
	Overall				
TOTAL					

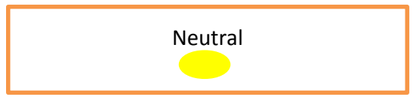

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Table 6.4 – Mill Street Development Storm Sewer Evaluation Matrix

Mill Street Development Storm Sewer				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Improve Major System** **Lower overland flow route grades to reduce maximum ponding depth**	**Alternative 3 - Improve Minor System** **Reconstruct storm sewer from low point to outfall to provide additional capacity**
Social/Cultural				
	Public Health and Safety	• Ponding anticipated at Atkinson Court/Thames St – low risk to public safety during 100 year storm event, however ponding depth is above Municipality design depth standards. More severe storm event may cause flooding of adjacent lands and increase public risk. • Additional ponding noted at rear yard near 80/86 Atkinson Court (low point) likely due to overland flow from adjacent high lands. Ponding also observed at east end of Atkinson Court, but not considered significant. • Negative water quality impacts to receiving water course since SWM measures will not be implemented to service future development.	• Mitigates risk to public safety during major flood events. • Addresses ponding issue at Atkinson Court/Thames St and rear yard at 80/86 Atkinson Court. • Does not address minor ponding concerns at east end of Atkinson Court at cul-de-sac. • Low risk to residents adjacent to drainage easement with increased side slope of swales which is required to convey major flows.	• Mitigates risk to public safety during major flood events. • Addresses ponding issue at Atkinson Court/Thames St and rear yard at 80/86 Atkinson Court. • Does not address minor ponding concerns at east end of Atkinson Court at cul-de-sac.
	Cultural Heritage Resources	• No built heritage properties registered within the catchment area, therefore no impacts. • No disruption of archaeological resources as there is no work involved with this option	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material due to close proximity to watercourse (if construction extends beyond already disturbed land).	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for disruption of archaeological material due to close proximity to watercourse (if construction extends beyond already disturbed land).
	Aesthetics	• No anticipated additional impact as no work is planned with this alternative. • Aesthetic impacts related to standing/ponding water.	• Short-term impacts during construction should be anticipated and potential aesthetic impacts in the vicinity of the regraded swale depending on final depth and restoration requirements. • Aesthetic impacts associated with ponding water addressed at two of the three locations.	• Short-term impacts during construction should be anticipated. • Aesthetic impacts associated with ponding water addressed at two of the three locations.
	Property Impacts/Acquisitions	• Potential risk to private property during major flooding events. • No property acquisition would be required since additional SWM measures will not be implemented.	• Disruption to properties adjacent to drainage easement (55 and 57 Atkinson Crt). • Need to negotiate drainage easement for proposed rear yard catchbasin.	• Disruption to properties adjacent to drainage easement (55 and 57 Atkinson Crt) • Temporary disruption to neighbouring properties to construct new storm sewer along portion of Atkinson Crt. • Need to negotiate drainage easement for proposed rear yard catchbasin.
	Policy/Guidelines	• Not in compliance with the objectives of the OP, as new development would not incorporate on-site SWM controls.	• In compliance with OP. • Development intensity is limited by footprint of on-site SWM controls and floodplain/conservation authority mapping.	• In compliance with OP. • Development intensity is limited by footprint of on-site SWM controls and floodplain/conservation authority mapping.
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation	• No concerns from aboriginal communities expressed, will continue consultation throughout	• No concerns from aboriginal communities expressed, will continue

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.4 – Mill Street Development Storm Sewer Evaluation Matrix

Mill Street Development Storm Sewer				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Improve Major System** **Lower overland flow route grades to reduce maximum ponding depth**	**Alternative 3 - Improve Minor System** **Reconstruct storm sewer from low point to outfall to provide additional capacity**
		throughout study.	study.	consultation throughout study.
	Overall			
Natural Environment				
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• Subject area located within floodplain and any disruption/alteration is subject to UTRCA regulation.	• Subject area located within floodplain and any disruption/alteration is subject to UTRCA regulation.
	Erosion and Sedimentation Impacts	• Low erosion risk – peak flows restricted by capacity of existing pipe.	• Increased risk of erosion during storm events that result in major flows as overland flow route discharges to Dingman Creek.	• Increased risk of erosion with increased peak flows as storm sewer can now convey the 100-year peak flows to Dingman Creek.
	Aquatic Habitats	• Potential impacts to SAR habitats due to impairment of water quality if SWM controls are not implemented for future development.	• Potential impacts to SAR habitats within Dingman Creek with higher peak flows.	• Potential impacts to SAR habitats within Dingman Creek with higher peak flows
	Terrestrial Habitats	• Potential impacts to SAR habitats due to impairment of water quality if SWM controls are not implemented for future development.	• Potential impacts to SAR habitats along Dingman Creek corridor with higher peak flows.	• Potential impacts to SAR habitats along Dingman Creek corridor with higher peak flows
	Migratory/Other Birds	• No impact.	• No anticipated impacts.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.
	Groundwater/ Water Quality	• Eastern portion of catchment is considered within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• Eastern portion of catchment is considered within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • On-site SWM controls for future development area will provide water quality treatment.	• Eastern portion of catchment is considered within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • On-site SWM controls for future development area will provide water quality treatment.
	Overall			
Technical				
	Compliance with Stormwater Design Targets	• No stormwater control measures are currently provided. • Will not comply with SWM design targets for new development.	• Quality and quantity control measures provided for future development only (via OGS, infiltration area, etc as SWM pond not feasible due to site size). No additional quality control for existing areas.	• Quality control measures provided for future development area only, with quantity control measures provided for a portion of future development directing flow to Atkinson Court to maintain post-development flow below current pipe capacity. Control measures generally limited to OGS, infiltration areas, etc. as SWM pond is not feasible due to size of site. Quantity control requirements for remaining development area to be confirmed through site plan approval.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.4 – Mill Street Development Storm Sewer Evaluation Matrix

Mill Street Development Storm Sewer				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Improve Major System**	**Alternative 3 - Improve Minor System**
			Lower overland flow route grades to reduce maximum ponding depth	**Reconstruct storm sewer from low point to outfall to provide additional capacity**
	Effect on Local Ponding Depths	• Ponding at west Atkinson Court low point, greater than Municipality's design depth. • Ponding at east Atkinson Court low point, but less than Municipality's design depth. • Nuisance flooding in rear yards of 80 and 86 Atkinson Court.	• Reduces ponding depth at west low point to Municipality's maximum design standard. • Nuisance rear yard flooding mitigated with installation of rear yard catchbasin. • Ponding at east Atkinson Court low point, but less than Municipality's design depth.	• Reduces ponding depth to Municipality's maximum design standard • Nuisance rear yard flooding mitigated with installation of rear yard catchbasin. • Ponding at east Atkinson Court low point, but less than Municipality's design depth.
	Effect on Groundwater Levels	• No anticipated impacts.	• No anticipated impacts as proposed storm sewer works would generally be built at approximate similar depths of existing sewers. • Groundwater levels may be impacted during construction due to temporary dewatering requirements.	• No anticipated impacts as proposed storm sewer works would generally be built at approximate similar depths of existing sewers. • Groundwater levels may be impacted during construction due to temporary dewatering requirements.
	Capacity (for existing and future development)	• Existing sewer does not have sufficient capacity to convey design peak discharges along majority of Atkinson Court assuming development proceeds without on-site SWM controls.	• Major system conveys the 100-year peak discharge. • Future SWM controls limit total design flows to existing storm sewer capacity.	• System conveys all flows up to and including the 100-year peak discharge. • Future SWM controls limit total design flows to storm sewer capacity.
	Compliance with Applicable Floodplain Policies	• No anticipated impacts.	• Work within floodplain required to construct regraded ditch will require UTRCA approval.	• Work within floodplain required to construct new sewer will require UTRCA approval.
	Site Design Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Limited space within existing drainage easement to lower overland flow route elevations near 55 and 57 Atkinson Crt. • Considerations needed for impacts of steep side slopes on adjacent properties. • Need to negotiate drainage easement for proposed rear yard catchbasin.	• Limited space within existing drainage easement to construct large diameter pipe near 55 and 57 Atkinson Crt. • Potential utility conflicts • Need to negotiate drainage easement for proposed rear yard catchbasin. • Proposed upgrades can be integrated into existing urban cross section. • Must provide sufficient capacity in new catchbasins located at low point near Atkinson Crt. And Thames St. to convey flows to new sewer.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts.
	Consequences of System Failure	• Low potential for property damage only during storm event worse than 100 year event.	• No significant consequences.	• No significant consequences.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.4 – Mill Street Development Storm Sewer Evaluation Matrix

Mill Street Development Storm Sewer				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Improve Major System** **Lower overland flow route grades to reduce maximum ponding depth**	**Alternative 3 - Improve Minor System** **Reconstruct storm sewer from low point to outfall to provide additional capacity**
	Construction	• No construction impacts as no work is associated with this alternative.	• Significant disruption to neighbouring residents.	• Significant disruption to neighbouring residents. • Temporary closure of Atkinson Court right-of-way. • Significant dewatering may be required for proposed storm sewer construction.
	Operation and Maintenance	• No change to current operational/maintenance requirements.	• On-site SWM controls to be operated and maintained by site owners. • Periodic maintenance of proposed rear yard catchbasin should be expected.	• On-site SWM controls to be operated and maintained by site owners. • Periodic maintenance of proposed rear yard catchbasin should be expected.
	Approval Requirements & Regulatory Requirements	• Development applications subject to comment/permit from UTRCA.	• Outfall located within UTRCA regulated area, any alteration requires permit. • Construction works may be subject to MOECC PTTW. • Development applications may be subject to comment/permit from UTRCA.	• Outfall located within UTRCA regulated area, any alteration requires permit. Additional storm sewer interconnection will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Development applications may be subject to comment/permit from UTRCA.
	Overall	🔴	🟢	🟢
Economic/Financial				
	Initial Capital Costs	• No initial capital costs	• Lower capital cost	• Highest capital cost
	Property Acquisition Costs	• No property required	• Potential costs associated with obtaining drainage easement for rear yard catchbasin.	• Potential costs associated with obtaining drainage easement for rear yard catchbasin.
	Operation and Maintenance Costs	• No anticipated change in existing maintenance costs.	• Negligible cost for periodic maintenance of proposed rear yard catchbasin • Operation and maintenance costs of proposed on-site SWM controls (i.e., OGS, infiltration bed, etc.) the responsibility of the site owner.	• Negligible cost for periodic maintenance of proposed rear yard catchbasin • Operation and maintenance costs of proposed on-site SWM controls (i.e., OGS, infiltration bed, etc.) the responsibility of the site owner.
	Overall	🟢🔴	🟡🟢	🔴🟡
Overall		Does not address key issues	Addresses key issues at lower cost. Requires UTRCA permitting and mitigation measures.	Addresses key issues, however existing conditions do not warrant extensive reconstructio of storm sewer.

Most Preferred	Neutral	Least Preferred
🟢	🟡	🔴

Table 6.5 – Hog Back Close Storm Sewer Evaluation Matrix

Hog Back Close Storm Sewer				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Replace Existing Storm Sewer**	**Alternative 3 – Improve Major System** **Regrade overland flow route**
Social/Cultural				
	Public Health and Safety	• Minor safety concerns associated with temporary ponding depths (estimated greater than 300 mm during major storm events).	• Mitigates risk to public safety during major storm events by addressing temporary ponding via new storm sewer.	• Mitigates risk to public safety during major storm events by addressing temporary ponding via regraded overland flow route.
	Cultural Heritage Resources	• No built heritage properties registered within this catchment area, therefore no impacts. • No risk to potential archaeological resources as there is no work involved with this option.	• No built heritage properties registered within this catchment area, therefore no impacts. • Potential impact to archaeological resources as a result of work in proximity to the existing outlet.	• No built heritage properties registered within this catchment area, therefore no impacts. • Potential impact to archaeological resources as a result of work in relation to upgrading overland flow route.
	Aesthetics	• No anticipated additional impact as no work is planned with this alternative. • Aesthetic impacts related to standing/ponding water.	• Short-term impact during construction should be anticipated. • Aesthetic impacts associated with tree removals to accommodate upgraded sewer and outlet works.	• Short-term impact during construction should be anticipated. • Aesthetic impacts associated with tree removals to accommodate upgraded overland flow route.
	Property Impacts/Acquisitions	• No anticipated property impacts.	• Significant disruption to properties adjacent to proposed new sewer. Need to negotiate easement for propose storm sewer between 56 and 58 Hog Back Close. • Tree removal may be required to accommodate upgrade.	• Disruption to properties at 56 and 58 Hog Back Close to accommodate upgrades to overland flow route, however extent of impacts less than Alternative 2. • Tree removal may be required to accommodate upgrade.
	Policy/Guidelines	• Catchment area within existing development, not subject to specific OP SWM policies.	• Catchment area within existing development, not subject to specific OP SWM policies.	• Catchment area within existing development, not subject to specific OP SWM policies.
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall			
Natural Environment				
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• No anticipated floodplain impacts.	• No anticipated floodplain impacts.
	Erosion and Sedimentation Impacts	• Erosion risk is low since the existing storm sewer severely restricts the peak flows that enter the ravine.	• Higher peak flows to ravine as a result of upgraded storm sewer may affect downstream channel erosion rates.	• Higher peak flows to ravine as a result of upgraded overland flow route may affect downstream channel erosion rates.
	Aquatic Habitats	• No impacts anticipated	• Higher peak flows to ravine as a result of upgraded storm sewer may affect aquatic habitats.	• Higher peak flows to ravine as a result of upgraded overland flow route may affect aquatic habitats.
	Terrestrial Habitats	• No terrestrial habitat impacts anticipated.	• May include some loss of vegetation/trees (mitigation measures to be implemented).	• May include some loss of vegetation/trees (mitigation measures to be implemented).
	Migratory/Other Birds	• No anticipated impacts	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.

Most Preferred

Neutral

Least Preferred

Table 6.5 – Hog Back Close Storm Sewer Evaluation Matrix

Hog Back Close Storm Sewer				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Replace Existing Storm Sewer**	**Alternative 3 – Improve Major System Regrade overland flow route**
			• Low potential impact to SAR within Thames River Corridor (Bald Eagle).	• Low potential impact to SAR within Thames River Corridor (Bald Eagle).
	Groundwater/Water Quality	• No anticipated impacts. • Majority of catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• No anticipated impacts. • Majority of catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• No anticipated impacts. • Majority of catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).
	Overall			
Technical				
	Compliance with Stormwater Design Targets	• No water quality control provided. • Peak flows to the ravine are limited by the capacity of the existing storm sewer. • Insufficient major system outlet currently in place.	• No water quality control provided. • Peak flows to the ravine are significantly higher than under existing conditions for all design events.	• No water quality control provided. • Peak flows to the ravine are significantly higher than under existing conditions for all design events that exceed the capacity of the existing storm sewer.
	Effects on Local Ponding Depths	• No anticipated change, as no work is anticipated. Maximum surface ponding depth on Hog Back Close >300 mm.	• Ponding depth under 100-year event on Hog Back Close <300 mm.	• Maximum ponding depth on Hog Back Close <300 mm.
	Effect on Groundwater Levels	• No anticipated impacts.	• No anticipated impacts. • Groundwater levels are not anticipated to be impacted during construction due to dewatering efforts, based on background information.	• No effects on local groundwater elevations anticipated.
	Capacity (for existing and future development)	• Existing storm sewer does not have sufficient capacity to convey the design peak discharges.	• Proposed storm sewer has sufficient capacity to convey the minor system design peak discharges.	• Existing storm sewer does not have sufficient capacity to convey the minor system design peak discharges. • Proposed overland flow route has sufficient capacity to convey the major flows.
	Compliance with Applicable Floodplain Policies	• No anticipated impacts.	• No anticipated impacts.	• No anticipated impacts.
	Site Design Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Proposed storm sewer alignment is very close to 58 Hog Back Close residence and driveway, and traverses its backyard. • Existing trees located along storm sewer alignment will likely require removal.	• Proposed overland flow route alignment is very close to 58 Hog Back Close driveway. • Existing trees located along overland flow route alignment will likely require removal.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Upgraded works need to consider slope stability requirements. Based on background information, groundwater is slightly deeper at this location and therefore direct groundwater impacts are not anticipated. Native soils not expected to cause impacts.	• Upgraded works need to consider slope stability requirements. Based on background information, groundwater is slightly deeper at this location and therefore direct groundwater impacts are not anticipated. Native soils not expected to cause impacts.
	Consequences of System Failure	• No significant consequences of failure anticipated as homes appear to be	• No significant consequences of failure anticipated as homes appear to be	• Homes appear to be higher than the maximum local ponding depths,

Most Preferred

Neutral

Least Preferred

Table 6.5 – Hog Back Close Storm Sewer Evaluation Matrix

Hog Back Close Storm Sewer				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Replace Existing Storm Sewer**	**Alternative 3 – Improve Major System Regrade overland flow route**
		higher than the maximum local ponding depths.	higher than the maximum local ponding depths.	however failure could result in erosion of ravine slope.
	Construction	• No construction impacts.	• Impacts on local residents will include noise/vibration/dust during construction. Storm sewer construction access hampered by existing trees, proximity of storm sewer to existing home and driveway, and outfall location at bottom of ravine.	• Impacts on local residents will include noise/vibration/dust during construction. Overland flow route construction access hampered by existing trees, proximity of overland flow route to existing driveway, and steep ravine slopes.
	Operation and Maintenance	• Storm sewer maintenance access hampered by existing trees, proximity of storm sewer to existing home, and outfall location at bottom of ravine.	• Storm sewer maintenance access hampered by proximity of storm sewer to existing home, and outfall location at bottom of ravine. • Tree removal along proposed storm sewer alignment should improve access for future maintenance.	• Storm sewer maintenance access hampered by proximity of storm sewer to existing home, and outfall location at bottom of ravine. • Tree removal along overland flow route alignment should improve access for future maintenance.
	Approval and Regulatory Requirements	• None required	• Construction works may be subject to MOECC PTTW, although anticipated groundwater levels appear to be deeper in this area. • Storm sewer and outfall works will be subject to MOECC ECA. • Work on outfalls may require UTRCA permit if within the Regulation Limit.	• Work on overland flow route improvements and erosion protection may require UTRCA permit if within the Regulation Limit.
	Overall	🟡	🔴	🔴
Economic/Financial				
	Initial Capital Costs	• No initial capital costs.	• Highest capital cost due to extent of storm sewer and outfall work and potential impact to neighbouring properties.	• Lower capital cost in comparison to Alternative 2.
	Property Acquisition Costs	• No property acquisition proposed.	• Potential costs associated with obtaining a proposed drainage easement with affected landowners.	• Potential costs associated with obtaining a proposed drainage easement with affected landowners.
	Operation and Maintenance Costs	• No anticipated change in existing maintenance costs.	• No anticipated change in existing maintenance costs.	• No anticipated change in existing maintenance costs.
	Overall	🟢	🔴	🟡
TOTAL		Only minor inconveniences likely to be experienced by severe storm events.	Extensive construction and costs not warranted by the existing conditions	Extensive construction and costs not warranted by the existing conditions

Most Preferred	Neutral	Least Preferred
🟢	🟡	🔴

Table 6.6 Tower Heights Storm Sewer – Evaluation Matrix

Tower Heights Storm Sewer			
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Replace Existing Storm Sewer & Modify Road Profiles**
Social/Cultural			
	Public Health and Safety	• Ponding anticipated near William Street and Springer Road and on Elizabeth Street. Moderate risk to public safety during severe storm events, with ponding depth above Municipality design depth standards.	• Mitigates risk to public safety during severe storm events with improved drainage system.
	Cultural Heritage Resources	• No built heritage properties registered within the catchment area, therefore no impacts. • No disruption of archaeological resources as there is no work involved with this option	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material due to close proximity to watercourse (if construction extends beyond already disturbed land).
	Aesthetics	• No anticipated additional impact as no work is planned with this alternative. • Aesthetic impacts related to standing/ponding water.	• Short-term impacts during construction should be anticipated. • Mitigates aesthetic impacts by reducing the duration and frequency of surface ponding.
	Property Impacts/Acquisitions	• Low risk of damage to private property during severe storm events.	• Reduces potential risk of damage to private property during severe storm events.
	Policy/Guidelines	• Catchment area within an existing development, not subject to specific OP Policies	• Catchment area within an existing development, not subject to specific OP Policies
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall		
Natural Environment			
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• Proposed improvements to outfall subject to LTVCA permitting.
	Erosion and Sedimentation Impacts	• Erosion downstream of the existing outfall has been reported and will likely continue.	• Increased risk of erosion due to higher peak flows to ravine due to storm sewer upgrades. • Erosion mitigated by additional erosion protection incorporated in proposed outfall design.
	Aquatic Habitats	• No anticipated impacts. Existing OGS treats runoff from a portion of the catchment area	• Higher peak flows to ravine as a result of storm sewer upgrades that may affect downstream aquatic habitat. Proposed OGS treats runoff from most of the catchment area.
	Terrestrial Habitats	• No anticipated impacts.	• Potential impacts to streambank vegetation with higher peak flows.
	Migratory/Other Birds	• No anticipated impacts.	• May require tree clearing to permit construction of upgrades to outfall, therefore consideration of breeding periods for construction timing.
	Groundwater/Water Quality	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Potential for contamination from road contaminants, runoff from western portion of service area not treated prior to discharge.	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Potential for contamination from road contaminants could be mitigated by replacing existing OGS with a unit that treats runoff from more of the drainage area.
	Overall		
Technical			
	Compliance with Stormwater Design	• Limited stormwater treatment provided to runoff from a portion	• Opportunity to provide water quality treatment to the runoff

Most Preferred

Neutral

Least Preferred

Table 6.6 Tower Heights Storm Sewer – Evaluation Matrix

Tower Heights Storm Sewer			
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Replace Existing Storm Sewer & Modify Road Profiles**
	Targets	of the drainage area by an existing OGS.	from most of the drainage area with installation of a new OGS. • Limited opportunity to mitigate higher peak discharges to ravine with upgrades to outfall.
	Effect on Local Ponding Depths	• Maximum ponding depths are greater than Municipality design standards.	• Maximum ponding depths reduced to within acceptable MOMC design standards.
	Effect on Groundwater Levels	• Local high groundwater levels will remain.	• Local high groundwater levels will remain. • Temporary lowering of local groundwater levels during construction due to dewatering.
	Capacity (for existing and future development)	• Existing sewer does not have sufficient capacity to convey design peak discharges.	• Proposed storm sewer capacity conveys the calculated minor flows. • Modifications to road profiles improve capacity to convey major flows.
	Compliance with Applicable Floodplain Policies	• No anticipated impacts.	• Proposed outfall replacement is located outside of floodplain.
	Site Design Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Potential conflicts with existing utilities and municipal services. • Difficulties in constructing outlet on steep ravine slopes.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts.
	Consequences of System Failure	• System failure results in local flooding and may cause property damage.	• Unobstructed overland flow route conveys major flows to existing outlet.
	Construction	• No construction impacts as no work is associated with this alternative.	• Significant disruption to local residents caused by proposed storm sewer construction and road re-profiling. • Significant dewatering may be required for proposed storm sewer construction. • Difficulties constructing proposed upgrades to outfall on steep slopes.
	Operation and Maintenance	• Monitoring of erosion at pipe outfall required given previous issues with erosion. • Annual maintenance and inspection of existing OGS required.	• Annual maintenance and inspection of proposed OGSs required.
	Approval and Regulatory Requirements	• None required.	• Storm sewer works including OGS will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • LTVCA permit likely required for outfall modifications
	Overall		
Economic/Financial			
	Initial Capital Costs	• No initial capital costs.	• High capital cost due to extent of sewer and road works required.
	Property Acquisition Costs	• No property required.	• No property required.
	Operation and Maintenance Costs	• No anticipated change.	• Additional operation and maintenance costs for proposed larger OGS.

Most Preferred

Neutral

Least Preferred

Table 6.6 Tower Heights Storm Sewer – Evaluation Matrix

Tower Heights Storm Sewer			
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Replace Existing Storm Sewer & Modify Road Profiles**
	Overall		
TOTAL		Minimal risk to property/safety during major storm events, newer system does not warrant replacement.	Extent and cost of reconstruction not warranted by existing conditions

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.7 Springer Road Municipal Drain – Evaluation Matrix

Springer Road Drain				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Negotiate Drainage Easement**	**Alternative 3 – Replace Existing Storm Sewer, Negotiate Drainage Easement & Abandon Municipal Drain**
Social/Cultural				
	Public Health and Safety	• Low risk to public safety during severe storm events, with ponding depth above Municipality design depth standards at Towerline Street low point.	• Low risk to public safety during severe storm events, with ponding depth above Municipality design depth standards at Towerline Street low point. • Mitigates risk associated with potential obstruction of existing overland flow route by providing an additional route.	• Low risk to public safety during severe storm events, with ponding depth above Municipality design depth standards at Towerline Street low point.
	Cultural Heritage Resources	• No built heritage registered • No risk to potential archaeological resources	• No built heritage registered • No risk to potential archaeological resources	• No built heritage registered • Low potential for disruption of archaeological resources
	Aesthetics	• No anticipated additional impact as no work is planned with this alternative. • Aesthetic impacts related to standing/ponding water.	• No anticipated additional impact as no work is planned with this alternative with exception of securing an additional drainage easement. • Aesthetic impacts related to standing/ponding water.	• Short-term impacts during construction should be anticipated. • Aesthetic impacts associated with frequency and duration of ponding water addressed.
	Property Impacts/Acquisitions	• Potential property damage due to temporary ponding and Towerline Street low point.	• Mitigates risk of property damage due to flooding. • Need to negotiate drainage easement for overland flows. • Need to negotiate easement for existing catchbasins located west of Springer Road.	• Mitigates risk of property damage due to flooding • Significant disruption to adjacent properties during storm sewer replacement. • Need to negotiate drainage easement for overland flows. • Need to negotiate easement for existing catchbasins located west of Springer Road.
	Policy/Guidelines	• In compliance with OP.	• In compliance with OP.	• In compliance with OP.
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall			
Natural Environment				
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• No additional floodplain impacts anticipated.	• Proposed works will increase peak flows to receiving ravine. Additional flows may also be directed pending preferred solution for Longwoods Commercial Lands (refer to Alternatives 3A and 3B).
	Erosion and Sedimentation Impacts	• No anticipated impacts. Low erosion risk, as current flows to ravine restricted by existing pipe capacity.	• No anticipated impacts. Low erosion risk, as current flows to ravine restricted by existing pipe capacity.	• Risk of erosion along ravine as a result of increase in sewer capacity. Risk is further increased if additional flows from Longwoods Commercial Lands (Alternative 3A or 3B) are accommodated, however SWM controls under that option are intended to restrict flows to accommodate drain capacity.
	Aquatic Habitats	• Existing OGS treats runoff to	• Existing OGS treats runoff to	• Higher peak flows to the ravine as a result of storm sewer upgrades that

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.7 Springer Road Municipal Drain – Evaluation Matrix

Springer Road Drain				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Negotiate Drainage Easement**	**Alternative 3 – Replace Existing Storm Sewer, Negotiate Drainage Easement & Abandon Municipal Drain**
		mitigate potential impacts to downstream habitat	mitigate potential impacts to downstream habitat.	may affect downstream aquatic habitat under major flow events. • Replacement OGS treats runoff to mitigate potential impacts to downstream habitat.
	Terrestrial Habitats	• Existing OGS treats runoff to mitigate potential impacts to vegetation along receiving watercourse.	• Existing OGS treats runoff to mitigate potential impacts to vegetation along receiving watercourse.	• Potential impacts to streambank vegetation with higher peak flows. • Replacement OGS treats runoff to mitigate potential impacts to vegetation along receiving watercourse.
	Migratory/Other Birds	• No anticipated impacts.	• No anticipated impacts.	• May require tree clearing to permit construction of upgrades to outfall, therefore consideration of breeding periods for construction timing.
	Groundwater/ Water Quality	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • No anticipated impacts on groundwater or surface water quality.	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • No anticipated impacts on groundwater or surface water quality.	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • No anticipated impacts on groundwater or surface water quality.
	Overall	🟢	🟢	🔴
Technical				
	Compliance with Stormwater Design Targets	• Water quality control is provided by existing OGS.	• Water quality control is provided by existing OGS.	• Water quality control is provided by replacement OGS. • No quantity control provided for higher peak discharges, however dedicated drainage easement provides additional security against obstruction (currently overflow occurs on private lands).
	Effect on Local Ponding Depth	• Maximum ponding depth at Towerline Street low point greater than Municipality's design standards.	• Maximum ponding at Towerline Street low point greater than Municipality's design depth.	• Maximum ponding at Towerline Street low point less than Municipality's design standard, and the frequency of overland flows resulting in ponding is reduced.
	Effect on Groundwater Levels	• Local high groundwater levels will remain.	• Local high groundwater levels will remain.	• Local high groundwater levels will remain. • Temporary lowering of local groundwater levels during construction due to dewatering.
	Capacity (for existing and future development)	• Existing sewer does not have sufficient capacity to convey design peak discharges.	• Existing sewer does not have sufficient capacity to convey design peak discharges.	• Proposed storm sewer provides sufficient capacity to accommodate the calculated peak design flows. • Can provide capacity to accommodate runoff from Longwoods Commercial Lands future development (refer to Alternative 3A or 3B).
	Compliance with Applicable Floodplain Policies	• No anticipated impacts.	• No anticipated impacts.	• This option may involve direction of flows from Longwoods Commercial Lands (Alternative 3A or 3B) depending on the selection of the preferred solution for that catchment area.
	Site Design Challenges	• Future obstructions within the existing overland flow route could raise local ponding depths.	• Likelihood of obstructions within the existing overland flow route are mitigated by proposed drainage easement.	• Disruption to local residents along Towerline Street and Springer Road to construct new sewer and to residents adjacent to outlet sewer. • Potential conflicts with existing utilities and municipal services. • Challenges associated with constructing deep outlet pipe on steep

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.7 Springer Road Municipal Drain – Evaluation Matrix

Springer Road Drain				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Negotiate Drainage Easement**	**Alternative 3 – Replace Existing Storm Sewer, Negotiate Drainage Easement & Abandon Municipal Drain**
				• slope. • Likelihood of obstructions within the existing overland flow route are mitigated by proposed drainage easement.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• No additional issues as there is limited work involved with this option.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts. • Potential slope stability issues for outlet reconstruction.
	Consequences of System Failure	• Major flows conveyed by overland flow route to neighboring farmland. • Potential property damage if building openings located next to overland flow route are below grade.	• Proposed drainage easement lowers risk of future obstruction of the existing overland flow route. • Potential property damage if building openings located next to overland flow route are below grade.	• Proposed drainage easement lowers risk of future obstruction of the existing overland flow route. • Potential property damage if building openings located next to overland flow route are below grade are mitigated by increased capacity in the storm sewer and reduction of frequency.
	Construction	• No construction impacts as no work is associated with this alternative.	• No construction impacts as no work is associated with this alternative.	• Significant disruption to local residents during sewer and road reconstruction. • Consideration should be given to completing construction prior to full subdivision build-out to minimize disruption to residents. • Work could be coordinated with upstream works to service Longwoods Commercial Lands.
	Approval Requirements & Regulatory Requirements	• None required	• None required	• Storm sewer will be subject to MOECC ECA. • LTVCA permit likely required to replace the existing outfall
	Overall			
Economic/Financial				
	Initial Capital Costs	• No initial capital costs.	• No anticipated capital cost.	• High capital cost due to construction of new sewers and reconstruction of Towerline Street, including upgrades to outfall structure. • Potential total costs for upgrades may be shared with works related to upgrades to the Longwoods Commercial Lands (Alternative 3B).
	Property Acquisition Costs	• No property required.	• Drainage easement must be negotiated.	• Drainage easement must be negotiated.
	Operation and Maintenance Costs	• Costs should be assessed to landowners in accordance with the Drainage Act.	• Costs associated with operation and maintenance of existing OGS. • Costs paid by municipal budget	• Costs associated with operation and maintenance of replacement OGS. • Costs paid by municipal budget
	Overall			
TOTAL		Does not address key issues.	Addresses key issues with minimal construction and costs	Significant costs and construction not warranted by existing conditions.

Most Preferred 

Neutral 

Least Preferred 

Stantec

Table 6.8 Communings Municipal Drain – Evaluation Matrix

Cummings Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Urban R.O.W.s and Dry SWM Pond**	**Alternative 3A – Semi-Urban R.O.W.s**	**Alternative 3B – Semi-Urban R.O.W.s (Alternate Outlet)**
Social/Cultural					
	Public Health and Safety	• Moderate risk to public safety due to frequent prolonged ponding at Wellington Road low point. • Additional ponding noted off Martin Road. • Proposed new developments will increase flow to system, increasing risk of ponding and impacts to public health and safety.	• Mitigates risk to public safety during major flood events. • Reduced ponding at low point along Wellington Road, reducing risk to public safety. • Ponding along Martin Road addressed through new development works. • Temporary infrequent deep standing water in proposed dry SWM pond presents a low risk to public safety.	• Mitigates risk to public safety during major flood events. • Reduced ponding at low point along Wellington Road, reducing risk to public safety. • Ponding along Martin Road addressed via overland flow route to proposed ditch improvements along Martin Road.	• Mitigates risk to public safety during major flood events. • Reduced ponding at low point along Wellington Road, reducing risk to public safety. • Ponding along Martin Road addressed via overland flow route to proposed ditch improvements along Martin Road.
	Cultural Heritage Resources	• No built heritage properties registered within the catchment area, therefore no impacts. • No risk to archaeological resources.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material although proposed works generally limited to within existing right-of-way.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material although proposed works generally limited to within existing right-of-way.
	Aesthetics	• No anticipated additional impact as no work is planned with this alternative. • Aesthetic impacts related to standing/ponding water.	• Short-term impacts during construction should be anticipated. • Aesthetic impacts associated with frequency and duration of ponding water addressed at both locations identified. • New development to include urban cross sections. • Wellington Street and Martin Road to semi-urban design standard. • Aesthetic impacts associated with tree removals along roads and construction of dry pond.	• Short-term impacts during construction should be anticipated. • Aesthetic impacts associated with frequency and duration of ponding water addressed at both locations identified. • New development and existing streets to semi-urban design standard. • Aesthetic impacts associated with tree removals along roads.	• Short-term impacts during construction should be anticipated. • Aesthetic impacts associated with frequency and duration of ponding water addressed at both locations identified. • New development and existing streets to semi-urban design standard. • Aesthetic impacts associated with tree removals along roads.
	Property Impacts/Acquisitions	• Potential risk to private property during flood events. • No property acquisition would be required since additional SWM measures will not be implemented.	• Lowers risk to private property during flooding events. • Municipality will need to acquire land for proposed dry SWM pond to service existing ROW and development lands. • Tree removal may be required	• Lowers risk to private property. • Drainage easement required for existing pipe from ST124 to ST119. • Proposed open channel drainage easement required along west side of new development at southeast corner of Wellington Street and	• Lowers risk to private property. • Drainage easement required east of Martin Road. • Proposed open channel drainage easement

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.8 Communings Municipal Drain – Evaluation Matrix

Cummings Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Urban R.O.W.s and Dry SWM Pond**	**Alternative 3A – Semi-Urban R.O.W.s**	**Alternative 3B – Semi-Urban R.O.W.s (Alternate Outlet)**
			along right of way.	Martin Road. • Tree removal may be required along drainage easement required east of Martin Road • Tree removal may be required along right of way.	required along west side of new development at southeast corner of Wellington Street and Martin Road. • Tree removal may be required along right of way.
	Policy/Guidelines	• Catchment area identified for future residential, commercial, and employment in OP, current SWM operations will not support future development as lack of SWM controls will increase flooding potential.	• Provides SWM measures to service future residential, commercial and employment area development as per OP policy. • Meets Municipality's design standards for urban right of ways within new development.	• Provides SWM measures to service future residential, commercial and employment area development as per OP policy. • Does not meet Municipality's design standards for urban right of ways in future developments	• Provides SWM measures to service future residential, commercial and employment area development as per OP policy. • Does not meet Municipality's design standards for urban right of ways in future developments
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall				
Natural Environment					
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• Major flows from a portion of the future development are diverted to the Harris Road culvert. • Major flows from the low point along Wellington Street (south side) are conveyed to the Longwoods Road culvert (refer to Alternative 2 or 3 of Longwoods Road Culvert).	• Minor flows from a significant portion of the service area are diverted to the future Victoria Street storm sewer outlet. • Major flows from the low point along Wellington Street (south side) are conveyed to the Longwoods Road culvert (refer to Alternative 2 or 3 of Longwoods Road Culvert).	• No additional floodplain impacts anticipated as flows continue to be conveyed to existing outlet. • Major flows from the low point along Wellington Street (south side) are conveyed to the Longwoods Road culvert (refer to Alternative 2 or 3 of Longwoods Road Culvert).
	Erosion and Sedimentation Impacts	• No anticipated impacts.	• Risk of erosion along ravine as a result of increase in sewer capacity and implementation of urban design standard within new development areas mitigated by new dry pond and OGS. In addition, a portion of future	• Likely less risk of erosion along ravine as a portion of existing and proposed development will be redirected to Victoria Street (Thompson Drain) or to the Longwoods Road Culvert.	• Increased risk of erosion along ravine as a result of increase in sewer capacity mitigated by peak flow control in drainage easement.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.8 Communings Municipal Drain – Evaluation Matrix

Cummings Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Urban R.O.W.s and Dry SWM Pond**	**Alternative 3A – Semi-Urban R.O.W.s**	**Alternative 3B – Semi-Urban R.O.W.s (Alternate Outlet)**
			development is to be redirected to the Harris Road culvert.		
	Aquatic Habitats	• Potential impacts to SAR habitats due to impairment of water quality if SWM controls are not implemented for future development.	• Higher peak flows to ravine as a result of development and proposed upgrades to existing storm sewer system, however dry pond and OGS could mitigate downstream impacts to aquatic habitats.	• Redirection to adjacent catchments should mitigate overall impacts to aquatic habitats near the existing outlet.	• Peak flow control in drainage easement limits potential impacts to aquatic habitats.
	Terrestrial Habitats	• No anticipated impacts.	• Potential impacts to streambank vegetation with higher peak flows, however dry pond and OGS will mitigate impacts.	• No anticipated impacts as significant portion of the system would be redirected to Longwoods Road Culvert and Thompson Drain.	• Potential impacts to streambank vegetation mitigated by peak flow control in drainage easement.
	Migratory/Other Birds	• No anticipated impacts.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.
	Groundwater / Water Quality	• Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. Additional development may increase potential for contaminants. • Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. Impacts of existing and future development may increase potential for contaminants, although some impacts to outlet mitigated through OGS. • Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. New development to implement semi-urban standard, including ditches to improve treatment. • Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. New development to implement semi-urban standard, including ditches to improve treatment. • Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).
	Overall				
Technical					
	Compliance with Stormwater Design Targets	• Existing roadside ditches provide water quality benefits. • Will not comply with SWM design targets.	• Proposed OGS and dry SWM pond provide all necessary stormwater treatment and control to the minor flows from the entire service area.	• Proposed roadside ditches provide all necessary stormwater treatment to the runoff from future development.	• Proposed roadside ditches provide all necessary stormwater treatment to the runoff from future development.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.8 Communings Municipal Drain – Evaluation Matrix

Cummings Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Urban R.O.W.s and Dry SWM Pond**	**Alternative 3A – Semi-Urban R.O.W.s**	**Alternative 3B – Semi-Urban R.O.W.s (Alternate Outlet)**
	Effects on local ponding depth	• Frequent persistent ponding occurs at Wellington Street low point and off Martin Road.	• Mitigates ponding at Wellington Street low point and along Martin Road.	• Mitigates ponding at Wellington Street low point and along Martin Road.	• Mitigates ponding at Wellington Street low point and along Martin Road.
	Effect on Groundwater Levels	• No anticipated impacts.	• New storm sewer may impact groundwater levels during construction and via pipe bedding once installed depending on depth. • Local high groundwater levels may be reduced by future residential sump pumps. • Local high groundwater levels may be reduced by seepage into proposed dry SWM pond. • Temporary lowering of local groundwater levels during construction due to dewatering.	• Local high groundwater levels may be reduced by future residential sump pumps. • Temporary lowering of local groundwater levels during construction due to dewatering.	• New storm sewer may impact groundwater levels during construction and via pipe bedding once installed depending on depth. • Local high groundwater levels may be reduced by future residential sump pumps. • Temporary lowering of local groundwater levels during construction due to dewatering.
	Capacity (for existing and future development)	• Existing drainage system does not provide capacity for future development. • Frequent persistent ponding occurs at Wellington Street low point and off Martin Road.	• Proposed drainage system provides capacity to accommodate the runoff from future development and address existing ponding issues.	• Proposed drainage system provides capacity to accommodate the runoff from future development and address existing ponding issues.	• Proposed drainage system provides capacity to accommodate the runoff from future development and address existing ponding issues.
	Compliance with Applicable Floodplain Policies	• No anticipated floodplain impacts.	• No anticipated floodplain impacts within this catchment.	• No anticipated floodplain impacts within this catchment.	• No anticipated floodplain impacts within this catchment.
	Site Design Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Grading challenges associated with directing major flow from future development located northwest of Martin/Wellington to an appropriate outlet. • Groundwater levels are highly variable in this area and may impact construction of storm sewers and dry pond.	• Coordination with future downstream Victoria Street storm sewer required • Limited access to outlet pipe from ST124 to ST119 • Grading challenges associated with proposed roadside ditches. • Groundwater levels may effect construction of Wellington Street storm sewer.	• Grading challenges associated with proposed roadside ditches. • Groundwater levels may effect construction of Wellington Street storm sewer.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Groundwater impacts during construction should be anticipated given extent of sewer works and highly variable conditions in this area. Native soils not expected to cause impacts.	• Groundwater impacts during construction should be anticipated given extent of sewer works and highly variable conditions in this area. Native soils not expected to cause impacts.	• Groundwater impacts during construction should be anticipated given extent of sewer works and highly variable conditions in this area. Native soils not expected to cause impacts.

Most Preferred

Neutral

Least Preferred

Table 6.8 Communings Municipal Drain – Evaluation Matrix

Cummings Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Urban R.O.W.s and Dry SWM Pond**	**Alternative 3A – Semi-Urban R.O.W.s**	**Alternative 3B – Semi-Urban R.O.W.s (Alternate Outlet)**
	Consequences of System Failure	• Potential property damage near Wellington Street low point.	• Overflow from dry SWM pond directed to ravine outlet to mitigate property damage. • Major flows from Wellington Street low point conveyed by future drainage system to Longwoods Road culvert.	• Major flows from Wellington Street low point conveyed by future drainage system to Longwoods Road culvert.	• Major flows from Wellington Street low point conveyed by future drainage system to Longwoods Road culvert.
	Construction	• No construction impacts as no work is associated with this alternative.	• Significant dewatering for proposed storm sewers and dry SWM pond may be required. • Significant disruption along Wellington Street and Martin Road to construct new sewers and improve ditches and upgrade to semi-urban standard.	• Significant disruption along Wellington Street and Martin Road to construct new sewers and improve ditches and upgrade to semi-urban standard.	• Significant disruption along Wellington Street and Martin Road to construct new sewers and improve ditches and upgrade to semi-urban standard.
	Operation and Maintenance	• Limited access to outlet pipe from existing dry SWM pond • Ponding at Wellington Road low point with limited access to downstream drain.	• Occasional inspection and maintenance of proposed dry SWM pond would be required. • Annual inspection and maintenance of proposed OGS would be required. • Property owners to maintain condition of proposed roadside ditches.	• Property owners to maintain condition of proposed roadside ditches.	• Property owners to maintain condition of proposed roadside ditches.
	Approval and Regulatory Requirements	• Development applications subject to comment/permit from UTRCA.	• Storm sewer works including dry pond and OGS will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Subject area located within UTRCA Regulated Limit and will require permit. • Development applications subject to comment/permit from UTRCA.	• Storm sewer works for new connection to Thompson Drain will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Subject area located within UTRCA Regulated Limit and will require permit. • Development applications subject to comment/permit from UTRCA.	• Storm sewer works will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Subject area located within UTRCA Regulated Limit and will require permit. • Development applications subject to comment/permit from UTRCA.
	Overall	🔴	🟢	🟡	🟡
Economic/Financial					
	Initial Capital Costs	• No initial capital costs.	• High capital cost due to extent of work required. • Works related to diversion of flow to Harris Road culvert (Alternatives 2, 2A, 3A, or 3B of Harris Road Culvert) and Longwoods Road culvert(refer to Alternative 2 or 3 of Longwoods	• High capital cost due to construction of a significant run of sewer to connect to the Thompson Drain. • Work related to diversion of flow to Victoria Street storm sewer (Alternative 4 of Thompson Drain)	• Moderate capital cost when compared to Alternatives 2 and 3A. • Work related to diversion of flow to Longwoods Road culvert (Alternative 2 or 3 of Longwoods Road

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.8 Communings Municipal Drain – Evaluation Matrix

Cummings Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Urban R.O.W.s and Dry SWM Pond**	**Alternative 3A – Semi-Urban R.O.W.s**	**Alternative 3B – Semi-Urban R.O.W.s (Alternate Outlet)**
			Road Culvert) would impact cost associated with those systems and therefore need to be considered.	and Longwoods Road culvert (Alternative 2 or 3 of Longwoods Road Culvert) would impact cost associated with those systems and therefore need to be considered.	Culvert) would impact cost associated with those systems and therefore need to be considered.
	Property Acquisition Costs	• No property required.	• Land required for proposed dry SWM pond on development lands.	• Potential costs associated with obtaining drainage easements on north side of Wellington Street and east of Martin Road.	• Potential costs associated with obtaining drainage easement east of Martin Road.
	Operation and Maintenance Costs	• Downstream outlet is prone to clogging and regular maintenance requirements to mitigate ponding. • Costs assessed to landowners in accordance with the Drainage Act.	• Costs associated with operation and maintenance of proposed OGS and dry SWM pond. • Costs paid by municipal budget as Municipality would now own the infrastructure. • Roadside ditch minor maintenance typically performed by property owners.	• Costs paid by municipal budget as Municipality would now own the infrastructure. • Roadside ditch minor maintenance typically performed by property owners.	• Costs paid by municipal budget as Municipality would now own the infrastructure. • Roadside ditch minor maintenance typically performed by property owners.
	Overall				
	TOTAL	Does not address key objectives	Addresses key objectives and complies with municipal policy guideline.	Addresses key objectives but does not comply with municipal policy/guidelines	Addresses key objectives but does not comply with municipal policy/guidelines

Most Preferred

Neutral

Least Preferred

Stantec

Figure 6.9 Longwoods Road Culvert – Evaluation Matrix

Longwoods Road Culvert				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Semi-Urban R.O.W.s**	**Alternative 3 – Urban R.O.W.s and Dry SWM Pond**
Social/Cultural				
	Public Health and Safety	• Ponding observed north of Longwoods Road within frontage of commercial property.	• Mitigates ponding observed through ditch upgrades. • Ponding observed in front of school would either remain or could be addressed as part of Thompson Drain upgrades (Alternatives 3 or 4).	• Mitigates ponding observed through ditch upgrades. • Temporary infrequent deep standing water in proposed dry SWM pond presents a low risk to public safety.
	Cultural Heritage Resources	• No built heritage properties registered within the catchment area, therefore no impacts. • No disruption of archaeological resources as there is no work involved with this option	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material.
	Aesthetics	• Aesthetic impacts related to standing/ponding water.	• Short-term impacts during construction should be anticipated. • Minimal long-term aesthetic impacts with exception of work to occur with regards to development lands.	• Short-term impacts during construction should be anticipated. • Minimal long-term aesthetic impacts with exception of work to occur with regards to development lands including construction of dry pond.
	Property Impacts/Acquisitions	• Frequent flooding of Longwoods Road commercial property will likely continue.	• Flooding of Longwoods Road commercial property mitigated by proposed ditch improvements and local drainage servicing. • Temporary disruption to neighboring properties on Longwoods Road. • Reduces ponding at Wellington Street low point (refer to Cummings Drain for additional information).	• Flooding of Longwoods Road commercial property mitigated by proposed ditch improvements and local drainage servicing. • Land for proposed dry SWM pond to be obtained through development application process • Temporary disruption to neighboring properties on Longwoods Road • Reduces ponding at Wellington Street low point (refer to Cummings Drain for additional information).
	Policy/Guidelines	• Would not comply with guidelines for SPA #3 in OP Section 11 which outline that new development is to proceed under full municipal services.	• Would provide municipal SWM services to service future development in accordance with OP Section 11 (SPA #3 guidelines). • Does not meet municipal design standards for urban right of ways within new development.	• Would provide municipal SWM services to service future development in accordance with OP Section 11 (SPA #3 guidelines). • Meets municipal design standards for urban right of ways within new development.
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall	🔴	🟡	🟢
Natural Environment				
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• Major flows from the low point along Wellington Street (south side) are conveyed to the Longwoods Road culvert (refer to Alternative 2, 3A and 3B of Cummings Drain).	• Major flows from the low point along Wellington Street (south side) are conveyed to the Longwoods Road culvert (refer to Alternative 2, 3A and 3B of Cummings Drain).

Most Preferred	Neutral	Least Preferred
🟢	🟡	🔴

Figure 6.9 Longwoods Road Culvert – Evaluation Matrix

Longwoods Road Culvert				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Semi-Urban R.O.W.s**	**Alternative 3 – Urban R.O.W.s and Dry SWM Pond**
	Erosion and Sedimentation Impacts	• No anticipated impacts.	• Increased risk of erosion along ravine with redirection of flows from Cummings Drain (to address Wellington Street low point). • Opportunity to implement erosion control measures within new development areas to mitigate downstream erosion risk.	• Opportunity to implement erosion control measures within new development areas to mitigate downstream erosion risk. • Increased risk of erosion along ravine with redirection of flows from Cummings Drain (to address Wellington Street low point).
	Aquatic Habitats	• No anticipated impact.	• Higher peak flows to ravine as a result of development and proposed redirection of flows from Cummings Drain. • SWM treatment within development lands should mitigate impacts to downstream aquatic habitat.	• Higher peak flows to ravine as a result of development and proposed redirection of flows from Cummings Drain. • SWM treatment within development lands should mitigate impacts to downstream aquatic habitat.
	Terrestrial Habitats	• No anticipated impact.	• Potential disruption to roadside terrestrial resources (tree removal).	• Potential disruption to roadside terrestrial resources (tree removal).
	Migratory/Other Birds	• No anticipated impact.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.
	Groundwater/ Water Quality	• Entire catchment is considered within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. Additional development may increase potential for contaminants.	• Entire catchment is considered within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing and proposed roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present.	• Entire catchment is considered within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Proposed dry SWM pond and OGS to provide necessary water quality treatment.
	Overall			
Technical				
	Compliance with Stormwater Design Targets	• No existing SWM controls, runoff travels directly to ravine.	• Proposed roadside ditches provide all necessary stormwater treatment.	• Quality and quantity control measures provided via OGS and dry pond.
	Effect on Local Ponding Depths	• No additional change. Surface ponding continues to occur at Wellington Road low point and Longwoods Road commercial property.	• Flooding of Longwoods Road commercial property mitigated by proposed ditch improvements and local drainage servicing. • Reduces ponding at Wellington Street low point (refer to Alternatives 2, 3A, and 3B of Cummings Drain for additional information).	• Flooding of Longwoods Road commercial property mitigated by proposed ditch improvements and local drainage servicing. • Reduces ponding at Wellington Street low point (refer to Alternatives 2, 3A, and 3B of Cummings Drain for additional information).
	Effect on Groundwater Levels	• No anticipated impacts.	• Local high groundwater levels may be reduced by future residential sump pumps.	• New storm sewer may impact groundwater levels during construction and via pipe bedding once installed

Most Preferred

Neutral

Least Preferred

Figure 6.9 Longwoods Road Culvert – Evaluation Matrix

Longwoods Road Culvert				
Evaluation Criteria		Alternative 1 - Do Nothing	Alternative 2 – Semi-Urban R.O.W.s	Alternative 3 – Urban R.O.W.s and Dry SWM Pond
				depending on depth. • Local high groundwater levels may be reduced by future residential sump pumps. • Local high groundwater levels may be reduced by seepage into proposed dry SWM pond.
	Capacity (for existing and future development)	• Existing drainage system does not provide capacity for future development, increasing risk of flooding.	• Provides capacity for future development. • Provides capacity to convey major flows from Wellington Street low point(refer to Alternatives 2, 3A, and 3B of Cummings Drain for additional information). • Provides capacity to mitigate ponding on Longwoods Road commercial property.	• Provides capacity for future development. • Provides capacity to convey major flows from Wellington Street low point(refer to Alternatives 2, 3A, and 3B of Cummings Drain for additional information). • Provides capacity to mitigate ponding on Longwoods Road commercial property.
	Compliance with Applicable Floodplain Policies	• No anticipated floodplain impacts.	• No anticipated floodplain impacts, although additional flow is anticipated based on reprofiling of Wellington Street and redirection of segment of Cummings Drain.	• No anticipated floodplain impacts, although additional flow is anticipated based on reprofiling of Wellington Street and redirection of segment of Cummings Drain.
	Site Design and Operational Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Grading of proposed road profiles and roadside ditches likely challenging due to relatively flat local topography.	• Groundwater levels are highly variable in this area and may impact construction of storm sewers and dry pond. Significant dewatering may be required.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• No significant groundwater impacts anticipated. Native soils not expected to cause impacts.	• Groundwater impacts during construction should be anticipated given extent of sewer works and highly variable conditions in this area. Native soils not expected to cause impacts. • Additional geotechnical investigation needed during detailed design of dry SWM pond.
	Consequences of System Failure	• Flows in excess of the Longwoods Road culvert capacity are conveyed westward by the Longwoods Road R.O.W.	• Major flows conveyed by proposed semi-urban R.O.W.s to Longwoods Road R.O.W. • Flows in excess of the Longwoods Road culvert capacity are conveyed westward by the Longwoods Road R.O.W.	• Overflows from the proposed dry SWM pond conveyed westward by the Longwoods Road R.O.W. • Flows in excess of the Longwoods Road culvert capacity are conveyed westward by the Longwoods Road R.O.W.
	Construction	• No construction impacts as no work is associated with this alternative.	• No significant construction challenges anticipated.	• Significant dewatering for proposed storm sewers and dry SWM pond may be required. • Significant disruption of Longwoods Road traffic likely required to construct proposed outlet storm sewer.
	Operation and Maintenance	• Periodic inspection and debris removal at existing Longwoods Road culvert required.	• Proposed driveway culverts to be maintained by residents. • Property owners to maintain condition of proposed roadside ditches. • Periodic inspection and debris removal at existing Longwoods Road culvert.	• Periodic inspection and maintenance of proposed dry SWM pond. • Annual inspection and maintenance of proposed OGS. • Periodic inspection and debris removal at existing Longwoods Road culvert.
	Approvals and Regulatory Requirements	• Development applications subject to comment/permit from UTRCA.	• Development applications may be subject to comment/permit from LTVCA.	• Storm sewer works including dry pond and OGS will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Development applications may be subject to comment/permit from LTVCA. • Proposed outfall subject to LTVCA permit.
	Overall	🔴	🟢	🟡
Economic/Financial				

Most Preferred	Neutral	Least Preferred
🟢	🟡	🔴

Figure 6.9 Longwoods Road Culvert – Evaluation Matrix

Longwoods Road Culvert				
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 – Semi-Urban R.O.W.s**	**Alternative 3 – Urban R.O.W.s and Dry SWM Pond**
	Initial Capital Costs	• No initial capital costs.	• Low capital cost as majority of flows are addressed through ditch works. • Works related to diversion of flow from Cummings Drain (Alternatives 2, 3A, and 3B) would impact cost associated with that system and therefore need to be considered.	• Highest capital cost due to extent of work required. • Works related to diversion of flow from Cummings Drain (Alternatives 2, 3A, and 3B) would impact cost associated with that system and therefore need to be considered.
	Property Acquisition Costs	• No property required.	• No property acquisition anticipated.	• Land required for proposed dry SWM pond on development lands (to be obtained through development application process).
	Operation and Maintenance Costs	• No change anticipated, although maintenance costs associated with cleaning of Longwoods Road culvert should be expected.	• Roadside ditch minor maintenance typically performed by property owners. • Costs associated with cleaning of Longwoods Road culvert should be expected.	• Costs associated with operation and maintenance of proposed OGS and dry SWM pond. • Longwoods Road roadside ditch minor maintenance typically performed by property owners.
	Overall			
TOTAL		Does not meet key objectives	Meets key objectives, however does not meet municipal design standards.	Higher cost option, however meets key objectives and municipal design standards.

Most Preferred

Neutral

Least Preferred

Table 6.10 Longwoods Commercial Development – Evaluation Matrix

Longwoods Commercial Development					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Control All Stormwater On-Site**	**Alternative 3A – Dry SWM Pond**	**Alternative 3B – Dry SWM Pond (Alternate Alignment)**
Social/Cultural					
	Public Health and Safety	• Proposed new developments will increase flow to adjacent lands without SWM controls in place increasing risk.	• Concerns expressed from residents in adjacent development regarding existing high groundwater levels, and the potential impact from LID measures.	• Temporary infrequent deep standing water in proposed dry SWM pond presents a low risk to public safety.	• Temporary infrequent deep standing water in proposed dry SWM pond presents a low risk to public safety.
	Cultural Heritage Resources	• No built heritage properties registered within the catchment area, therefore no impacts. • No risk to archaeological resources.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material as a result of site development activities.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material as a result of site development activities.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material as a result of site development activities.
	Aesthetics	• No anticipated impact as no work is planned with this alternative.	• Short-term impacts during construction should be anticipated.	• Short-term impacts during construction should be anticipated. • Aesthetic impacts related to conversion of current parcel adjacent to existing residential area to dry pond. • Aesthetic impacts associated with constructing proposed dry pond outlet pipe.	• Short-term impacts during construction should be anticipated, including impacts related to work along Towerline Street. • Aesthetic impacts related to conversion of current parcel adjacent to existing residential area to dry pond. • Aesthetic impacts associated with lowering of portion of Springer Road Drain (refer to Alternative 3 of Springer Road Drain).
	Property Impacts/Acquisitions	• No property acquisition would be required since additional SWM measures will not be implemented.	• Land for on-site SWMF to be provided in future site plans. • Bypass swale required to be maintained within the development lands to convey flows from Longwoods Road R.O.W. • Concerns expressed from residents regarding threat to private property in adjacent development should LID measures aggravate existing high groundwater levels.	• Land for proposed dry SWM pond to be acquired. • Short-term impacts during construction should be anticipated. • Drainage easement required along rear lots south of Towerline Street to accommodate future development. • Required easement currently outside Settlement Area boundary. • Drainage easement required to convey flows from Longwoods Road R.O.W. to proposed dry SWM pond.	• Land for proposed dry SWM pond to be acquired. • Short-term impacts during construction should be anticipated. • Drainage easement required to convey flows from Longwoods Road R.O.W. to proposed dry SWM pond.
	Policy/Guidelines	• Does not meet official plan land use designation.	• Allows development in accordance with Official Plan	• Allows development in accordance with Official Plan	• Allows development in accordance with Official Plan

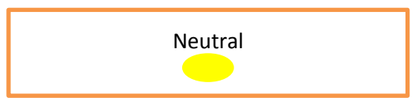
Most Preferred

Neutral

Least Preferred

Table 6.10 Longwoods Commercial Development – Evaluation Matrix

Longwoods Commercial Development					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Control All Stormwater On-Site**	**Alternative 3A – Dry SWM Pond**	**Alternative 3B – Dry SWM Pond (Alternate Alignment)**
			land use designation. • Development intensity is limited by footprint of on-site SWM controls.	land use designation. • Location of proposed SWM pond in development buffer is consistent with intent of OP. • Required easement currently outside Settlement Area boundary.	land use designation. • Location of proposed SWM pond in development buffer is consistent with intent of OP.
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall				
Natural Environment					
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• No additional floodplain impacts anticipated.	• Surface water is diverted from the existing outlet to an alternate tributary of the Thames River.	• Surface water is diverted from the existing outlet to an alternate tributary of the Thames River.
	Erosion and Sedimentation Impacts	• No anticipated impacts.	• No anticipated impacts.	• Risk of erosion and sedimentation along tributary as a result of increased flows mitigated by new dry pond and OGS.	• Risk of erosion and sedimentation along tributary as a result of increased flows mitigated by new dry pond and OGS.
	Aquatic Habitats	• No anticipated impacts.	• No anticipated impacts.	• Higher peak flows to tributary as a result of development mitigated by dry pond and OGS.	• Higher peak flows to tributary as a result of development mitigated by dry pond and OGS.
	Terrestrial Habitats	• No anticipated impacts.	• No anticipated impacts.	• Potential impacts to streambank vegetation due to higher peak flows mitigated by dry pond and OGS.	• Potential impacts to streambank vegetation due to higher peak flows mitigated by dry pond and OGS.
	Migratory/Other Birds	• No anticipated impacts.	• No anticipated impacts.	• No anticipated impacts, however this alternative does rely on lowering of Springer Road Drain which may require tree removals (refer to Alternative 3 of Springer Road Drain).	• No anticipated impacts, however this alternative does rely on lowering of Springer Road Drain which may require tree removals (refer to Alternative 3 of Springer Road Drain).
	Groundwater/ Water Quality	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Significant infiltration likely occurs on site. Infiltration of potential contaminants may impact groundwater quality if present. Additional development may increase potential for contaminants.	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing roadside ditches provide marginal water quality benefits at outlet but only for runoff from Longwoods Road. • Low impact development (LID) provides treatment to mitigate impacts to groundwater from new development. However,	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing roadside ditches provide marginal water quality benefits at outlet but only for runoff from Longwoods Road. However infiltration of potential contaminants may impact groundwater quality if present. Impacts of future development	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing roadside ditches provide marginal water quality benefits at outlet but only for runoff from Longwoods Road. However infiltration of potential contaminants may impact groundwater quality if present. Impacts of future development



Stantec

Table 6.10 Longwoods Commercial Development – Evaluation Matrix

Longwoods Commercial Development					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Control All Stormwater On-Site**	**Alternative 3A – Dry SWM Pond**	**Alternative 3B – Dry SWM Pond (Alternate Alignment)**
			there is a risk of infiltration of potential contaminants and subsequent groundwater impacts.	may increase potential for contaminants, although some impacts to outlet mitigated through OGS.	may increase potential for contaminants, although some impacts to outlet mitigated through OGS.
	Overall				
Technical					
	Compliance with Stormwater Design Targets	• Existing roadside ditches provide water quality benefits. • Will not comply with SWM design targets.	• Proposed LID provides quantity and quality controls for new development.	• Proposed OGS and dry SWM pond provide all necessary stormwater treatment and control from the development area.	• Proposed OGS and dry SWM pond provide all necessary stormwater treatment and control from the development area.
	Effect on Local Ponding Depths	• No anticipated impacts.	• No anticipated impacts.	• No anticipated impacts.	• No anticipated impacts, however proposed storm sewer reduces ponding depths on Towerline Road (refer to Alternative 3 of Springer Road Drain).
	Effect on Groundwater Levels	• No anticipated impacts on local groundwater levels.	• Groundwater levels may be variable within the catchment. Implementation of LID technologies may impact levels and may cause local groundwater mounding. • Additional infiltration may impact adjacent Tower Heights development.	• Local high groundwater levels may be reduced by seepage into proposed dry SWM pond. • Temporary lowering of local groundwater levels during construction due to dewatering.	• Local high groundwater levels may be reduced by seepage into proposed dry SWM pond. • Temporary lowering of local groundwater levels during construction due to dewatering.
	Capacity (for existing and future development)	• No available conveyance route or outlet currently present to accommodate future development.	• Proposed on-site SWM control provides capacity to accommodate the runoff from future development.	• Proposed new conveyance route and outlet provides capacity to accommodate the runoff from future development. • Proposed pipe could be designed with additional capacity to accommodate runoff from Towerline Street.	• Proposed new conveyance route and outlet provides capacity to accommodate the runoff from future development. • Mitigates existing storm sewer capacity issues on Towerline Road.
	Compliance with Applicable Floodplain Policies	• No anticipated floodplain impacts.	• No anticipated floodplain impacts.	• A portion of surface water is redirected to another tributary of the Thames River.	• A portion of surface water is redirected to another tributary of the Thames River.
	Site Design and Operational Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Soils in western portion of future development area are likely amenable to LID measures but the soils in the eastern portion are much less permeable. • High groundwater elevations may interfere with LID design and operation. • LID may not be compatible with	• Conveying surface water from the eastern portion of the future development area to the proposed dry SWM pond will likely require swales with very shallow bottom slopes. • Site may require imported fill to drain surface water westward. • Challenges associated with	• Conveying surface water from the eastern portion of the future development area to the proposed dry SWM pond will likely require swales with very shallow bottom slopes. • Disruption to local residents along Towerline Street to construct new sewer and to residents adjacent

Most Preferred

Neutral

Least Preferred

Table 6.10 Longwoods Commercial Development – Evaluation Matrix

Longwoods Commercial Development					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Control All Stormwater On-Site**	**Alternative 3A – Dry SWM Pond**	**Alternative 3B – Dry SWM Pond (Alternate Alignment)**
			• some commercial land uses. • Feasibility of LID measures subject to determination of groundwater levels in proposed development area.	constructing new outlet west of Springer Road. • Challenges associated with potential future development of land in phases/via multiple developers. Need to ensure site design is undertaken to accommodate full development.	to proposed dry SWM pond. • Site may require imported fill to drain surface water westward • Challenges associated with constructing new outlet west of Springer Road. • Challenges associated with potential future development of land in phases/via multiple developers. Need to ensure site design is undertaken to accommodate full development.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Soils and groundwater may impact feasibility of implementing LID for new development.	• Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. • Groundwater impacts during construction should be anticipated given proposed sewer works. Native soils not expected to cause impacts.	• Potential need to import fill to accommodate required grading plan to achieve stormwater servicing. • Groundwater impacts during construction should be anticipated given proposed sewer works and upgrading within Springer Road Drain. Native soils not expected to cause impacts.
	Consequences of System Failure	• There is currently no drainage system in place with exception of ditches along Longwoods Road. • With proposed development, increased flows would continue to discharge to adjacent lands and may result in ponding, erosion, and impact to land use.	• Overflows from on-site SWM controls travel to neighboring agricultural property, similar to existing conditions. • Potential interference with groundwater levels in the area due to LID implementation.	• Dry SWM pond to be designed with an overflow weir to mitigate the possibility of property damage if the pond is overtopped.	• Dry SWM pond to be designed with an overflow weir to mitigate the possibility of property damage if the pond is overtopped.
	Construction	• No construction impacts as no work is associated with this alternative.	• Moderate disruption to neighboring residents, but generally attributed to development activities.	• Moderate disruption to neighbouring residents during dry pond construction. • Significant disruption to agricultural land during outlet pipe construction. • Significant disruption to neighbouring residents during outfall construction.	• Significant disruption to neighbouring residents during dry pond construction. • Significant disruption to Towerline Road residents during outlet pipe construction. • Significant disruption to neighbouring residents during outfall construction. Refer to Alternative 3 of Springer Road Drain.
	Operation and Maintenance	• No change to current operational/maintenance requirements.	• Construction and maintenance are the responsibility of the site owner.	• Access to dry pond outlet pipe likely limited during the cropped portion of the year. • Occasional inspection and maintenance of proposed dry SWM pond would be required.	• Occasional inspection and maintenance of proposed dry SWM pond would be required. • Limited access to outfall.

Most Preferred

Neutral

Least Preferred

Table 6.10 Longwoods Commercial Development – Evaluation Matrix

Longwoods Commercial Development					
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Control All Stormwater On-Site**	**Alternative 3A – Dry SWM Pond**	**Alternative 3B – Dry SWM Pond (Alternate Alignment)**
				• Limited access to outfall.	
	Approval Requirements & Regulatory Requirements	• None required.	• MOECC ECA may be required by the land developer.	• Storm sewer works including dry pond and OGS will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • LTVCA permit likely required for outfall modifications.	• Storm sewer works including dry pond and OGS will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • LTVCA permit likely required for outfall modifications.
	Overall	🔴	🔴	🟡	🟡
Economic/Financial					
	Initial Capital Costs	• No initial capital costs.	• Low capital cost as majority of works relate to work on development lands, therefore limited cost anticipated for the Municipality.	• High capital cost due to construction of dry SWM pond and storm sewer outlet, including lowering of Springer Road Drain outfall. • Potential total costs for upgrades may be shared with works related to upgrades to the Springer Road Drain (Alternative 3 of Springer Road Drain).	• High capital cost due to construction of dry SWM pond and storm sewer outlet, including lowering of Springer Road Drain and reconstruction of the sewer along Towerline Street (refer to Alternative 3 of Springer Road Drain). • Potential total costs for upgrades may be shared with works related to upgrades to the Springer Road Drain (Alternative 3 of Springer Road Drain).
	Property Acquisition Costs	• No property required.	• No property required.	• Block required for dry SWM pond. • Drainage easement must be negotiated south of Towerline Street. Second easement must be negotiated for Springer Road Drain work (refer to Alternative 3 of Springer Road Drain).	• Block required for dry SWM pond. • Drainage easement must be negotiated for Springer Road Drain work (refer to Alternative 3 of Springer Road Drain).
	Operation and Maintenance Costs	• No anticipated change.	• Operation and maintenance costs are the responsibility of the site owner.	• Costs associated with operation and maintenance of proposed OGS and dry SWM ponds.	• Costs associated with operation and maintenance of proposed OGS and dry SWM ponds.
	Overall	🟢🔴	🟢🔴	🟡🟢	🟡🟡
TOTAL		Does not address key issues.	Does not address key issues, greater potential for impacts to neighbouring development with infiltration measures.	Addresses key issues, with less reconstruction/impacts on neighbouring development and lower cost.	Addresses key issues, at greater cost and greater reconstruction/impacts to neighbouring development.

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.11 Harris Road Culvert – Evaluation Matrix

Harris Road Culvert						
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2A – Urban Road Cross Section & Dry SWM Ponds**	**Alternative 2B - Urban Road Cross Section & Dry SWM Ponds (Alternate Alignment)**	**Alternative 3A – Semi-Urban Cross Section**	**Section 3B – Semi-Urban Cross Section (Alternate Alignment)**
Social/Cultural						
	Public Health and Safety	• No significant risk to public health and safety. • Negative water quality impacts to receiving water course since SWM measures will not be implemented to service future development.	• Temporary infrequent deep standing water in proposed dry SWM ponds present a low risk to public safety.	• Temporary infrequent deep standing water in proposed dry SWM ponds present a low risk to public safety.	• No significant public health and safety issues anticipated.	• No significant public health and safety issues anticipated.
	Cultural Heritage Resources	• No built heritage properties registered within the catchment area, therefore no impacts. • No risk to archaeological resources	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential for the disruption of archaeological material.
	Aesthetics	• No anticipated impact as no work is planned with this alternative.	• Short-term impacts during construction should be anticipated. • New development to include urban cross sections. • Aesthetic impacts associated with tree removals along proposed north drainage easement.	• Short-term impacts during construction should be anticipated. • New development to include urban cross sections. • Harris Road to be upgraded to urban cross section.	• Short-term impacts during construction should be anticipated. • New development to include semi-urban cross sections. • Aesthetic impacts associated with tree removals along proposed north drainage easement.	• Short-term impacts during construction should be anticipated. • New development to include semi-urban cross sections.
	Property Impacts/Acquisitions	• No property acquisition would be required since additional SWM measures will not be implemented.	• Drainage easements required both north and south of Harris Road to accommodate future development. • Opportunity to decommission existing SWM pond on school block. • Tree removal may be required along north drainage easement.	• Drainage easement required south of Harris Road to accommodate future development. • Proposed Harris Road improvements will affect fronting properties. • Opportunity to decommission existing SWM pond on school block. • Tree removal may be required along north drainage easement and to accommodate Harris Road improvements.	• Drainage easements required both north and south of Harris Road. • Tree removal may be required along north drainage easement.	• Drainage easement required south of Harris Road. • Proposed Harris Road improvements will affect fronting properties. • Tree removal may be required along north drainage easement and to accommodate Harris Road roadside ditch improvements.
	Policy/Guidelines	• Catchment area identified for future residential in OP, current SWM operations will not support future development as lack of	• Would provide municipal infrastructure for future development per OP Section 11. • Meets municipal standard for urban right of ways within	• Would provide municipal infrastructure for future development per OP Section 11. • Meets municipal standard for urban right of ways within	• Would provide municipal infrastructure for future development per OP Section 11. • Does not meet municipal standard for urban right of ways within future development	• Would provide municipal infrastructure for future development per OP Section 11. • Does not meet municipal standard for urban right of ways within future development

Most Preferred

Neutral

Least Preferred

Table 6.11 Harris Road Culvert – Evaluation Matrix

Harris Road Culvert						
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2A – Urban Road Cross Section & Dry SWM Ponds**	**Alternative 2B - Urban Road Cross Section & Dry SWM Ponds (Alternate Alignment)**	**Alternative 3A – Semi-Urban Cross Section**	**Section 3B – Semi-Urban Cross Section (Alternate Alignment)**
		SWM controls will increase flooding potential.	future developments.	future development.		
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall	🔴	🟡	🔴	🟡	🟡
Natural Environment						
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• Proposed SWM controls will limit peak flows to receiving ravine.	• Proposed SWM controls will limit peak flows to receiving ravine.	• Proposed SWM controls will limit peak flows to receiving ravine.	• Proposed SWM controls will limit peak flows to receiving ravine.
	Erosion and Sedimentation Impacts	• No opportunity to address erosion/sedimentation issues	• Risk of erosion along ravine as a result of new sewer works and implementation of urban design standard within new development areas mitigated by new dry ponds and OGS.	• Risk of erosion along ravine as a result of new sewer works and implementation of urban design standard within new development areas mitigated by new dry ponds and OGS.	• Risk of erosion along ravine as a result of new development mitigated by proposed roadside ditches.	• Risk of erosion along ravine as a result of new development mitigated by proposed roadside ditches.
	Aquatic Habitats	• Potential impacts to SAR habitats due to impairment of water quality if SWM controls are not implemented for future development.	• Dry ponds and OGS designed to mitigate downstream impacts to aquatic habitats within ravine.	• Dry ponds and OGS designed to mitigate downstream impacts to aquatic habitats within ravine.	• Higher peak flows as a result of development mitigated by proposed SWM controls (ditches).	• Higher peak flows as a result of development mitigated by proposed SWM controls (ditches).
	Terrestrial Habitats	• Potential impacts to stream banks due to uncontrolled/untreated runoff due to new development.	• Potential impacts to streambank vegetation due to higher peak flows mitigated by dry ponds and OGS.	• Potential impacts to streambank vegetation due to higher peak flows mitigated by dry ponds and OGS.	• Potential impacts to streambank vegetation due to higher peak flows mitigated by dry ponds and OGS.	• Potential impacts to streambank vegetation due to higher peak flows mitigated by dry ponds and OGS.
	Migratory/Other Birds	• No anticipated impact,	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.
	Groundwater Quality	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing roadside ditches are present along a portion of Harris Road and provide water quality	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • OGS provides water quality treatment prior to discharge to proposed dry SWM ponds.	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • OGS provides water quality treatment prior to discharge to proposed dry SWM ponds.	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing and proposed roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Existing and proposed roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.11 Harris Road Culvert – Evaluation Matrix

Harris Road Culvert						
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2A – Urban Road Cross Section & Dry SWM Ponds**	**Alternative 2B - Urban Road Cross Section & Dry SWM Ponds (Alternate Alignment)**	**Alternative 3A – Semi-Urban Cross Section**	**Section 3B – Semi-Urban Cross Section (Alternate Alignment)**
		benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. Additional development may increase potential for contaminants.			groundwater quality if present.	groundwater quality if present.
	Overall	🟡	🟢	🟢	🟡	🟡
Technical						
	Compliance with Stormwater Design Targets	• No stormwater control measures are currently provided with exception of some minor ditches. • Will not comply with SWM design targets for new development.	• Proposed OGS and dry SWM ponds provide all necessary stormwater treatment to the runoff from new development areas. • No additional treatment provided along Harris Road.	• Proposed OGS and dry SWM ponds provide all necessary stormwater treatment to the runoff from new development areas. • No additional treatment provided along Harris Road.	• Proposed roadside ditches provide all necessary stormwater treatment to the runoff from future development.	• Proposed roadside ditches provide all necessary stormwater treatment to the runoff from future development. • Improved ditches along Harris Road help improve treatment of runoff along roadway.
	Effects on Local Ponding Depths	• Currently no reported ponding issues, however further development without SWM controls may result in future ponding issues.	• No anticipated impacts. Upgrades should convey minor and major flows from existing and new development.	• No anticipated impacts. Upgrades should convey minor and major flows from existing and new development.	• No anticipated impacts. Upgrades should convey minor and major flows from existing and new development.	• No anticipated impacts. Upgrades should convey minor and major flows from existing and new development.
	Effect on Groundwater Levels	• No anticipated impacts.	• New storm sewer may impact groundwater levels during construction and via pipe bedding once installed depending on depth. • Local high groundwater levels may be reduced by future residential sump pumps. • Local high groundwater levels may be reduced by seepage into proposed dry SWM pond. • Temporary lowering of local groundwater levels during construction due to dewatering.	• New storm sewer may impact groundwater levels during construction and via pipe bedding once installed depending on depth. • Local high groundwater levels may be reduced by future residential sump pumps. • Local high groundwater levels may be reduced by seepage into proposed dry SWM pond. • Temporary lowering of local groundwater levels during construction due to dewatering.	• Local high groundwater levels may be reduced by future residential sump pumps.	• Local high groundwater levels may be reduced by future residential sump pumps.
	Capacity (for existing and future development)	• Existing drainage system does not provide capacity for future development.	• Proposed drainage system provides capacity to accommodate the runoff from future development. • Proposed drainage system provides opportunity to	• Proposed drainage system provides capacity to accommodate the runoff from future development. • Proposed drainage system provides opportunity to	• Proposed drainage system provides capacity to accommodate the runoff from future development. • Proposed drainage system provides opportunity to	• Proposed drainage system provides capacity to accommodate the runoff from future development. • Proposed drainage system provides opportunity to

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.11 Harris Road Culvert – Evaluation Matrix

Harris Road Culvert						
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2A – Urban Road Cross Section & Dry SWM Ponds**	**Alternative 2B - Urban Road Cross Section & Dry SWM Ponds (Alternate Alignment)**	**Alternative 3A – Semi-Urban Cross Section**	**Section 3B – Semi-Urban Cross Section (Alternate Alignment)**
			accommodate major flows from a portion of Cummings Drain.	accommodate major flows from a portion of Cummings Drain.	accommodate major flows from a portion of Cummings Drain.	accommodate major flows from a portion of Cummings Drain.
	Compliance with Applicable Floodplain Policies	• No anticipated floodplain impacts.	• No anticipated floodplain impacts.	• No anticipated floodplain impacts.	• No anticipated floodplain impacts	• No anticipated floodplain impacts
	Site Design Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Minimizing disturbance to existing residences adjacent to proposed drainage easements.	• Challenges modifying existing Harris Road R.O.W. while minimizing disturbance to existing residences and utilities. • Minimizing disturbance to existing residences adjacent to proposed south drainage easement.	• Minimizing disturbance to existing residences adjacent to proposed drainage easements. • Proposed roadside ditch grading design due to relatively flat local topography.	• Challenges modifying existing Harris Road roadside ditch while minimizing disturbance to existing residences and utilities. • Minimizing disturbance to existing residences adjacent to proposed south drainage easement. • Proposed roadside ditch grading design due to relatively flat local topography.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Groundwater impacts during construction should be anticipated given extent of sewer works and requirement to lower culvert adjacent to ravine. Native soils not expected to cause impacts.	• Groundwater impacts during construction should be anticipated given extent of sewer works and requirement to lower culvert adjacent to ravine. Native soils not expected to cause impacts.	• Groundwater impacts during construction should be anticipated given extent of sewer works and requirement to lower culvert adjacent to ravine. Native soils not expected to cause impacts.	• Groundwater impacts during construction should be anticipated given extent of sewer works and requirement to lower culvert adjacent to ravine. Native soils not expected to cause impacts.
	Consequences of System Failure	• Existing overland flow route south of Harris Road is partially obstructed by a hedgerow, which may cause local flooding during severe storm events.	• Overflows from the proposed dry SWM ponds are conveyed to the ravine by the proposed downstream major system.	• Overflows from the proposed dry SWM ponds are conveyed to the ravine by the proposed downstream major system.	• The proposed major system will convey all flows in excess of the proposed ditch capacities to the downstream ravine.	• The proposed major system will convey all flows in excess of the proposed ditch capacities to the downstream ravine.
	Construction	• No construction impacts as no work is associated with this alternative.	• Significant dewatering may be required to construct proposed storm sewers and dry SWM ponds. • Disruption to local residents to construct proposed works. More significant disruption to residents adjacent to proposed new drainage easements.	• Significant dewatering may be required to construct proposed storm sewers and dry SWM ponds. • Significant temporary construction impacts to local residents given work along Harris Road and to resident adjacent to proposed south drainage easement.	• Disruption to local residents to construct proposed works. More significant disruption to residents adjacent to proposed new drainage easements. • In general, disruption to residents anticipated to be less than Alternatives 2A, 2B, and 3B.	• Disruption to local residents to construct proposed works. More significant disruption to residents adjacent to proposed south drainage easement. • In general, disruption to residents anticipated to be less than Alternatives 2A, 2B, and 3A.
	Operation and Maintenance	• No change to current operational/maintenance requirements.	• Occasional inspection and maintenance of proposed dry SWM pond would be required.	• Occasional inspection and maintenance of proposed dry SWM pond would be required.	• Property owners to maintain condition of proposed roadside ditches.	• Property owners to maintain condition of proposed roadside ditches.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.11 Harris Road Culvert – Evaluation Matrix

Harris Road Culvert						
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2A – Urban Road Cross Section & Dry SWM Ponds**	**Alternative 2B - Urban Road Cross Section & Dry SWM Ponds (Alternate Alignment)**	**Alternative 3A – Semi-Urban Cross Section**	**Section 3B – Semi-Urban Cross Section (Alternate Alignment)**
			• Annual inspection and maintenance of proposed OGS would be required.	• Annual inspection and maintenance of proposed OGS would be required.		
	Approval and Regulatory Requirements	• None required	• Storm sewer works including dry pond and OGS will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • UTRCA permit likely required for outfall modifications. • Development applications subject to comment/permit from UTRCA.	• Storm sewer works including dry pond and OGS will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • UTRCA permit likely required for outfall modifications. • Development applications subject to comment/permit from UTRCA.	• UTRCA permit likely required for outfall modifications. • Development applications subject to comment/permit from UTRCA.	• UTRCA permit likely required for outfall modifications. • Development applications subject to comment/permit from UTRCA.
	Overall	🔴	🟡	🔴	🟡	🟡
Economic/Financial						
	Initial Capital Costs	• No initial capital costs.	• High capital cost, but majority of works relate to work on development lands, therefore limited cost anticipated for the Municipality.	• Highest capital cost due to additional work required along Harris Road to convey flows.	• Lowest capital cost in comparison to Alternatives 2A, 2B, and 3B as portion of costs paid for by development.	• Moderate capital cost, with additional work required along Harris Road.
	Property Acquisition Costs	• No property required.	• Costs associated with obtaining two drainage easements to suit development. • Costs of 2 SWM blocks	• Costs associated with obtaining one drainage easement • Costs of 2 SWM blocks	• Costs associated with obtaining two drainage easements.	• Costs associated with obtaining one drainage easement.
	Operation and Maintenance Costs	• No anticipated change	• Costs associated with operation and maintenance of proposed OGS and dry SWM ponds.	• Costs associated with operation and maintenance of proposed OGS and dry SWM ponds.	• Roadside ditch minor maintenance typically performed by property owners.	• Roadside ditch minor maintenance typically performed by property owners.
	Overall	🟢🔴	🔴🟢	🔴🟡	🟡🟡	🟡🟡
Total		Does not address key issues	Higher cost option, but addresses key issues and meets municipal design standards	Meets key issues, but at a higher cost and additional construction required.	Addresses key issues, but does not meet municipal design standards	Addresses key issues, but does not meet municipal design standards.

Most Preferred	Neutral	Least Preferred
🟢	🟡	🔴

Table 6.12 Thompson Municipal Drain – Evaluation Matrix

Thompson Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Realign Storm Sewer**	**Alternative 3 – Proposed Storm Sewer**	**Alternative 4 – Improve Minor System and Incorporate with Wellington St**
Social/Cultural					
	Public Health and Safety	• No reported areas of ponding however design flows exceed the capacity of the existing pipes. • No significant risks to public health and safety within subject area.	• No reported areas of ponding however design flows exceed the capacity of the existing pipes. • No significant risks to public health and safety within subject area.	• Proposed storm sewer should eliminate surface ponding during minor events. • Design flows are anticipated to exceed the capacity of the existing pipes for portion of Forsythe Drain to be connected (on Victoria St.). • No significant risks to public health and safety within subject area. • Provides an outlet to limit ponding depths in ditches along Our Lady of Lourdes school frontage.	• Proposed storm sewer should eliminate surface ponding during minor events. • Design flows are anticipated to exceed the capacity of the existing pipes for portion of Forsythe Drain to be connected (on Victoria St.). • No significant risks to public health and safety within subject area. • Reduces risk to public health and safety by reducing flooding at Wellington Street low point (within current Cummings Drain catchment). • Provides an outlet to limit ponding depths in ditches along Our Lady of Lourdes school frontage.
	Cultural Heritage Resources	• No built heritage properties registered within the catchment area, therefore no impacts. • No impact to potential archaeological resources as there is no work involved with this option.	• No built heritage properties registered within the catchment area, therefore no impacts. • Potential risk to archaeological resources, however extent of work is anticipated within existing right of way which is likely disturbed.	• No built heritage properties registered within the catchment area, therefore no impacts. • Higher potential risk to archaeological resources given extent of work and proximity to outfall/water (if construction extends beyond already disturbed land).	• No built heritage properties registered within the catchment area, therefore no impacts. • Higher potential risk to archaeological resources given extent of work and proximity to outfall/water (if construction extends beyond already disturbed land).
	Aesthetics	• No anticipated impact as no work is planned with this alternative.	• Short-term impacts during construction should be anticipated. • Aesthetic impacts associated with tree removals along roads.	• Short-term impacts during construction should be anticipated. • Modified streetscape modified with redevelopment of a portion of Victoria Street to an urban design standard. • Aesthetic impacts associated with tree removals along roads, but urban road cross section has smaller footprint compared to rural or semi-urban cross section.	• Short-term impacts during construction should be anticipated. • Modified streetscape with redevelopment of a portion of Victoria Street to an urban design standard. Segment of Wellington Street to be reconstructed to semi-urban design standard to address need to maintain/enhance roadside ditches for drainage.
	Property Impacts/Acquisitions	• Portion of drain currently located within private property, therefore potential disruption due to required maintenance activities over time.	• Mitigates damage to private property for maintenance activities associated with ST161 to ST160 as proposed storm sewer segment would be constructed	• Tree removal may be required to accommodate upgrades within right of way. • Abandonment of Davis Street connection and redirection of	• Tree removal may be required to accommodate upgrades. • Abandonment of Davis Street connection and redirection of segment of Victoria Street sewer to Thompson

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.12 Thompson Municipal Drain – Evaluation Matrix

Thompson Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Realign Storm Sewer**	**Alternative 3 – Proposed Storm Sewer**	**Alternative 4 – Improve Minor System and Incorporate with Wellington St**
		• No property acquisition would be required since additional SWM measures will not be implemented and the existing system would be retained as a municipal drain.	within right of way. • Tree removal may be required to accommodate upgrades within right of way. • No property acquisition would be required as works are limited to within the right of way.	segment of Victoria Street sewer to Thompson Drain eliminates a portion of drain currently beneath private property. • Mitigates damage to private property for maintenance activities associated with ST161 to ST160 as proposed storm sewer segment would be constructed within right of way.	Drain eliminates a portion of drain currently beneath private property. • Mitigates damage to private property for maintenance activities associated with ST161 to ST160 as proposed storm sewer segment would be constructed within right of way. • Reduces risk to property by reducing flooding at Wellington Street low point.
	Policy/Guidelines	• Catchment area within existing development, not subject to specific OP SWM policies.	• Catchment area within existing development, not subject to specific OP SWM policies.	• Catchment area within existing development, not subject to specific OP SWM policies.	• Catchment area within existing development, not subject to specific OP SWM policies.
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall				
Natural Environment					
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• No floodplain impacts anticipated over existing conditions.	• Work within floodplain required for modifications to existing outlet. Subject to LTVCA regulations. • Additional flows would be conveyed to the outlet with redirection of a portion of the Victoria Street system (from Prince Albert Street drain).	• Work within floodplain required for modifications to existing outlet. Subject to LTVCA regulations. • Additional flows would be conveyed to the outlet with direction of minor flows from Cummings Drain (refer to Alternative 3A of Cummings Drain), which is not identified as a preferred solution for that catchment area.
	Erosion and Sedimentation Impacts	• No additional impact on downstream erosion and sedimentation.	• No anticipated impact on downstream erosion and sedimentation.	• Increased risk of erosion along ravine as a result of increased peak flows caused by larger drainage area and more efficient minor system. • Erosion risk mitigated by erosion protection to be incorporated in proposed outfall design.	• Increased risk of erosion along ravine as a result of increased peak flows caused by larger drainage area and more efficient minor system. • Erosion risk mitigated by erosion protection to be incorporated in proposed outfall design.
	Aquatic Habitats	• No additional impact.	• No additional impact.	• Higher peak flows to ravine as a result may affect downstream aquatic habitats.	• Higher peak flows to ravine as a result of connection of a portion of the Victoria Street storm sewer and portion of Wellington Street system that may affect downstream aquatic habitats under major flow events.

Most Preferred

Neutral

Least Preferred

Table 6.12 Thompson Municipal Drain – Evaluation Matrix

Thompson Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Realign Storm Sewer**	**Alternative 3 – Proposed Storm Sewer**	**Alternative 4 – Improve Minor System and Incorporate with Wellington St**
					• Higher peak flows to ravine if Prince Albert system is diverted to Thompson Drain outfall. Refer to Alternative 4 of Forsythe Drain.
	Terrestrial Habitats	• No additional impact.	• May include some loss of vegetation/trees.	• May include some loss of vegetation/trees.	• May include some loss of vegetation/trees.
	Migratory/Other Birds	• No impact.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing.
	Groundwater/ Water Quality	• Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. • Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• Existing roadside ditches provide water quality benefits at outlet, however infiltration of potential contaminants may impact groundwater quality if present. • Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Removal of ditches along a portion of Victoria St. could reduce infiltration of groundwater at a marginal level and reduce water quality treatment.	• Entire catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA). • Removal of ditches along a portion of Victoria St. could reduce infiltration of groundwater at a marginal level and reduce water quality treatment.
	Overall				
Technical					
	Compliance with Stormwater Design Targets	• Existing roadside ditches provide water quality benefits.	• Existing roadside ditches provide water quality benefits.	• Quality treatment likely impacted with elimination of roadside ditches. • Higher peak discharges to downstream ravine anticipated.	• Quality treatment along Victoria Street likely impacted with elimination of roadside ditches. • Higher peak discharges to downstream ravine anticipated.
	Effects on Local Ponding Depths	• No known issues with ponding.	• No anticipated impact.	• Proposed minor/major system will reduce possibility of local ponding. • Proposed Wellington Street storm sewer reduces ponding at Our Lady of Lourdes roadside ditch.	• Proposed minor/major system will reduce possibility of local ponding. • Proposed storm sewer reduces local ponding at Wellington Road low point. • Proposed Wellington Street storm sewer reduces ponding at Our Lady of Lourdes roadside ditch.
	Effect on Groundwater Levels	• No anticipated impacts.	• No anticipated impacts as proposed storm sewer works would generally be built at approximate similar depths of existing sewers. • Groundwater levels may be impacted during construction due	• Potential for impacts to local groundwater levels as more flow would be conveyed through the new storm sewer, reducing infiltration rates/quantity. • Groundwater levels may be impacted during construction due	• Potential for impacts to local groundwater levels as more flow would be conveyed through the new storm sewer, reducing infiltration rates/quantity. • Groundwater levels may be impacted during construction due to temporary

Most Preferred

Neutral

Least Preferred

Table 6.12 Thompson Municipal Drain – Evaluation Matrix

Thompson Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Realign Storm Sewer**	**Alternative 3 – Proposed Storm Sewer**	**Alternative 4 – Improve Minor System and Incorporate with Wellington St**
			to temporary dewatering requirements.	to temporary dewatering requirements.	dewatering requirements.
	Conveyance Capacity (for existing and future development)	• Existing sewer has insufficient capacity to accommodate the calculated design peak flows along entire municipal drain system.	• Existing sewer has insufficient capacity to accommodate the calculated design peak flows along most of the system with exception of realigned segment of storm sewer. • Major flows will still be directed to the existing outlet.	• Proposed storm sewer provides sufficient capacity to convey the design peak discharge with exception of small segment of redirected sewer from former Davis Street connection. • Major flows will still be directed to the existing outlet.	• Proposed storm sewer provides sufficient capacity to convey the design peak discharge with exception of small segment of redirected sewer from former Davis Street connection. • Major flows will still be directed to the existing outlet.
	Compliance with Applicable Floodplain Policies	• Area within existing development, not subject to specific floodplain policies. No anticipated impacts.	• Area within existing development, not subject to specific floodplain policies. No anticipated impacts.	• LTVCA approval required for potential modifications to existing outlet.	• LTVCA approval required for potential modifications to existing outlet
	Site Design Challenges	• Not applicable as no work would be undertaken as part of this alternative.	• Potential conflicts with existing utilities.	• Potential conflicts with existing utilities and municipal services. • Grading challenges associated with matching proposed right-of-ways to existing properties. • Additional site challenges associated with potential upgrade to urban design. • Requires crossing of Longwoods Road (County approval required).	• Potential conflicts with existing utilities and municipal services. • Grading challenges associated with matching proposed right-of-ways to existing properties. • Additional site challenges associated with potential upgrade to urban design. • Requires crossing of Longwoods Road (County approval required).
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts.	• Groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts. • Discussion with the County required to confirm geotechnical requirements for potential repairs to Longwoods Road as a result of construction.	• Groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts. • Discussion with the County required to confirm geotechnical requirements for potential repairs to Longwoods Road as a result of construction.
	Consequences of System Failure	• Temporary ponding occurs in front yards	• Temporary ponding occurs in front yards	• Proposed major system conveys all overflows to downstream ravine.	• Proposed major system conveys all overflows to downstream ravine.
	Construction	• No construction impacts as no work is associated with this alternative.	• Significant dewatering may be required for proposed storm sewer construction. • Significant disruption to neighbouring residents.	• Significant dewatering may be required for proposed storm sewer construction. • Significant disruption to neighbouring residents, including requirements to integrate urban right-of-ways. • Requires crossing of Longwoods	• Significant dewatering may be required for proposed storm sewer construction. • Significant disruption to neighbouring residents. • Requires crossing of Longwoods Road.

Most Preferred

Neutral

Least Preferred

Table 6.12 Thompson Municipal Drain – Evaluation Matrix

Thompson Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Realign Storm Sewer**	**Alternative 3 – Proposed Storm Sewer**	**Alternative 4 – Improve Minor System and Incorporate with Wellington St**
				Road.	
	Operation and Maintenance	• Portion of drain located outside of right of way, resulting in difficult access for maintenance. • Maintenance currently undertaken by Municipality.	• No operation and maintenance challenges anticipated. • With abandonment of municipal drains, Municipality would continue undertaking maintenance activities.	• No operation and maintenance challenges anticipated. • With abandonment of municipal drains, Municipality would continue undertaking maintenance activities.	• No operation and maintenance challenges anticipated. • With abandonment of municipal drains, Municipality would continue undertaking maintenance activities.
	Approval and Regulatory Requirements	• None required.	• Storm sewer works will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Proximity of work near outfall may require LTVCA permit.	• Storm sewer works will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Proximity of work near outfall may require LTVCA permit. • County approval required for work on County roads.	• Storm sewer works will be subject to MOECC ECA. • Construction works may be subject to MOECC PTTW. • Proximity of work near outfall may require LTVCA permit. • County approval required for work on County roads.
	Overall	🔴	🟡	🟢	🟢
Economic/Financial					
	Initial Capital Costs	• No initial capital costs.	• Moderate capital costs associated with construction of realigned storm sewer within R.O.W.	• Higher capital costs. • Works related to upgrades to the outfall structure and to connection of a segment of Prince Albert Drain (from ST 173 to 177) would coincide with Alternative 4 of Forsythe Drain and therefore costs may be lower with coordination of projects. • Potential total costs for upgrades may be shared with allocated budget for roadway/transportation improvements as a significant component relates to surface feature restoration and establishment (i.e., curb/gutter, sidewalk if required, etc.).	• Highest capital costs. • Works related to upgrades to the outfall structure and direction of flows from Cummings Drain would coincide with Alternative 4 of Forsythe Drain and Alternative 3A of Cummings Drain and therefore costs may be lower with coordination of projects. • Potential total costs for upgrades may be shared with allocated budget for roadway/transportation improvements as a significant component relates to surface feature restoration and establishment (i.e., curb/gutter, sidewalk if required, etc.).
	Property Acquisition Costs	• No property required.	• No property needed if sewers installed within existing right of way.	• No property needed if sewers installed within existing right of way.	• No property needed if sewers installed within existing right of way.
	Operation and Maintenance Costs	• Maintenance costs paid by assessed landowners in accordance with the Drainage Act.	• Maintenance costs paid through municipal budget.	• Maintenance costs paid through municipal budget.	• Maintenance costs paid through municipal budget.

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.12 Thompson Municipal Drain – Evaluation Matrix

Thompson Drain					
Evaluation Criteria		**Alternative 1 - Do Nothing**	**Alternative 2 - Abandon Municipal Drain and Realign Storm Sewer**	**Alternative 3 – Proposed Storm Sewer**	**Alternative 4 – Improve Minor System and Incorporate with Wellington St**
		• Root penetration in area of drain along rear lots may further reduce pipe capacity and require future maintenance.			
	Overall				
TOTAL		Does not address key issues	Does not address key issues	Addresses key issues, with some minor/temporary property impacts.	Addresses key issues, but requires additional work within Cummings Drain which is not identified as the preferred alternative for that catchment area.

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.13 Forsythe Municipal Drain – Evaluation Matrix

Forsythe Drain				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Improve Minor System**	**Alternative 3 – Divert Prince Albert Street System**
Social/Cultural				
	Public Health and Safety	• Ponding anticipated along south end of York Street and low point along Garden Avenue. Risk to public safety due to temporary ponding during severe storm events.	• Mitigates risk to public safety during major flood events. • Addresses ponding issue at south end of York Street and low point along Garden Avenue.	• Mitigates risk to public safety during major flood events. • Addresses ponding issue at south end of York Street and low point along Garden Avenue.
	Cultural Heritage Resources	• No built heritage properties registered within this catchment area, therefore no impacts. • No impact to archaeological resources as there is no work involved with this option.	• No built heritage properties registered within this catchment area, therefore no impacts. • Potential impact to archaeological resources as a result of construction of a new storm outlet.	• No built heritage properties registered within this catchment area, therefore no impacts. • Potential impact to archaeological resources as a result of construction of a new storm outlet.
	Aesthetics	• No anticipated additional impact as no work is planned with this alternative. • Aesthetic impacts related to standing/ponding water.	• Short-term impacts during construction should be anticipated. • Proposed infrastructure located in Conservation Area therefore aesthetic impacts to be expected. • Aesthetic impacts associated with tree removals to accommodate new storm sewers.	• Short-term impacts during construction should be anticipated. • Proposed infrastructure located in Conservation Area therefore aesthetic impacts to be expected. • Aesthetic impacts associated with tree removals to accommodate new storm sewers.
	Property Impacts/Acquisitions	• Portion of drain currently located within private property, therefore potential disruption due to required maintenance activities over time.	• Need to negotiate drainage easement for existing and proposed sewers on private land. • Property required to construct proposed Wellington Street outlet and to realign Pleasant Street outlet.	• Need to negotiate drainage easement for existing and proposed sewers on private land. • Property required to construct proposed Wellington Street outlet and to realign Pleasant Street outlet. • Significant disruption to Longwoods Road.
	Policy/Guidelines	• Catchment area within existing development, not subject to specific OP SWM policies.	• Catchment area within an existing development, not subject to specific OP Policies.	• Catchment area within an existing development, not subject to specific OP Policies.
	Aboriginal Impacts	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.	• No concerns from aboriginal communities expressed, will continue consultation throughout study.
	Overall			
Natural Environment				
	Floodplain Impact/Policy	• No additional floodplain impacts anticipated.	• Subject area located within Thames River floodplain, subject to LTVCA regulations.	• Subject area located within Thames River floodplain, subject to LTVCA regulations.
	Erosion and Sedimentation Impacts	• No additional impact on downstream erosion and sedimentation.	• Higher peak flows to Thames River with storm sewer upgrades noted. Potential erosion risks associated with new outfall. • Erosion risk to be mitigated by erosion	• Higher peak flows to Thames River with storm sewer upgrades noted. Potential erosion risks associated with new outfall. • Potential erosion risks associated with directing Prince Albert Street system to

Most Preferred

Neutral

Least Preferred

Stantec

Table 6.13 Forsythe Municipal Drain – Evaluation Matrix

Forsythe Drain				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Improve Minor System**	**Alternative 3 – Divert Prince Albert Street System**
			protection measures in proposed outfall design.	Victoria Street outfall. • Erosion risk to be mitigated by erosion protection measures in proposed outfall design.
	Aquatic Habitats	• No additional impacts.	• Higher peak flows to Thames River as a result of storm sewer upgrades. Potential impact to habitat at location of new Wellington Street outlet.	• Higher peak flows to Thames River as a result of storm sewer upgrades, including higher flows at existing Thompson Drain outlet due to redirection of Prince Albert system. Potential impact to habitat at location of new Wellington Street outlet.
	Terrestrial Habitats	• No additional impacts.	• Low potential impact to SAR within Thames River corridor to accommodate new and upgraded outlet. • May include some loss of vegetation/trees.	• Low potential impact to SAR within Thames River corridor to accommodate new and upgraded outlet. • May include some loss of vegetation/trees.
	Migratory/Other Birds	• No additional impacts.	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing. • Low potential impact to SAR within Thames River Corridor (Bald Eagle).	• May require tree clearing to permit construction, therefore consideration of breeding periods for construction timing. • Low potential impact to SAR within Thames River Corridor (Bald Eagle).
	Groundwater/ Water Quality	• No additional impacts. • Majority of catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• No anticipated impacts. • Majority of catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).	• No anticipated impacts. • Majority of catchment area is within a Significant Groundwater Recharge Area (SGRA). • Entire catchment area is within a Highly Vulnerable Aquifer Zone (HVA).
	Overall	🟢	🟡	🟡
Technical				
	Compliance with Stormwater Design Targets	• No existing SWM controls.	• No proposed SWM controls implemented with this alternative.	• No proposed SWM controls implemented with this alternative.
	Effects on Local Ponding Depths	• No anticipated change, as no work is anticipated. Surface ponding possible at south end of York Street and on Garden Avenue.	• Proposed storm sewer mitigates existing ponding in identified areas.	• Proposed storm sewer mitigates existing ponding in identified areas.
	Effect on Groundwater Levels	• No anticipated change.	• Groundwater levels may be impacted during construction due to temporary dewatering requirements.	• Groundwater levels may be impacted during construction due to temporary dewatering requirements.
	Capacity (for existing and future development)	• Existing storm sewer has insufficient capacity for design peak flows.	• Proposed system improvements provide sufficient capacity to convey the peak design flows to viable outlets.	• Proposed system improvements provide sufficient capacity to convey the peak design flows to viable outlets. • Existing sewers along Davis Street, Hillcrest

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.13 Forsythe Municipal Drain – Evaluation Matrix

Forsythe Drain				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Improve Minor System**	**Alternative 3 – Divert Prince Albert Street System**
			• Existing sewers along Davis Street, Prince Albert Street, Hillcrest Court, Longwoods Road and select areas have insufficient capacity in comparison to design peak flows, however major flows can still be directed to outlets.	Court and select areas have insufficient capacity in comparison to design peak flows, however major flows can still be directed to outlets. • Proposed system improvements mitigate surcharging in the Longwoods Road storm sewer and reduce major flows by redirecting a portion of flow to the Thompson Drain outlet.
	Compliance with Applicable Floodplain Policies	• No anticipated floodplain impacts.	• Work within floodplain required to construct new outlet and upgrade existing outlet.	• Work within floodplain required to construct new outlet and upgrade existing outlet.
	Site Design and Operational Challenges	• Limited access to significant portions of the Forsythe Drain.	• Minimize impacts of proposed Wellington Street outfall on conservation area. • Challenges associated with steep slopes at realigned Pleasant Street outfall. • Limited access to portions of Green Valley and Davis systems.	• Minimize impacts of proposed Wellington Street outfall on conservation area. • Challenges associated with steep slopes at realigned Pleasant Street outfall. • Limited access to portions of Green Valley and Davis systems. Davis system would now be directed to Thompson Drain.
	Geotechnical Considerations	• No additional issues as there would be no work associated with this option.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts. • Discussion with the County required to confirm geotechnical requirements for potential repairs to Longwoods Road as a result of construction.	• Given proximity to surface water features and local topography, groundwater impacts during construction should be anticipated. Native soils not expected to cause impacts. • Discussion with the County required to confirm geotechnical requirements for potential repairs to Longwoods Road as a result of construction.
	Consequences of System Failure	• System failure results in local flooding and property damage.	• Possibility of system failure mitigated by high capacity pipe located on Wellington Street.	• Possibility of system failure mitigated by high capacity pipe located on Wellington Street.
	Construction	• No construction impacts as no work is associated with this alternative.	• Significant disruption to local residents caused by proposed storm sewer construction. • Significant dewatering may be required for proposed storm sewer construction. • Difficulties constructing proposed Pleasant Street outlet on steep slopes. • Difficulties constructing new Wellington Street outlet due to site conditions.	• Significant disruption to local residents caused by proposed storm sewer construction. • Disruption of Longwoods Road (County Road) due to new storm sewer construction. • Significant dewatering may be required for proposed storm sewer construction. • Difficulties constructing proposed Pleasant Street outlet on steep slopes. • Difficulties constructing new Wellington

Most Preferred

Neutral

Least Preferred

Table 6.13 Forsythe Municipal Drain – Evaluation Matrix

Forsythe Drain				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Improve Minor System**	**Alternative 3 – Divert Prince Albert Street System**
				Street outlet due to site conditions.
	Operation and Maintenance	• No change to current operation/maintenance requirements. • Difficulties accessing significant portions of the Forsythe Drain due to accessibility restrictions.	• Access improved by locating minor system in right-of-ways and secured drainage easements. • With abandonment of municipal drains, Municipality would continue undertaking maintenance activities.	• Access improved by locating minor system in right-of-ways and secured drainage easements. • With abandonment of municipal drains, Municipality would continue undertaking maintenance activities.
	Approval and Regulatory Requirements	• None required.	• Construction works may be subject to MOECC Permit to Take Water (PTTW). • Storm sewer and outfall works will be subject to MOECC ECA. • Work on outfalls will require LTVCA permit. • County approval required for work on County roads.	• Construction works may be subject to MOECC PTTW. • Storm sewer and outfall works will be subject to MOECC ECA. • Work on outfalls will require LTVCA permit. • County approval required for work on County roads.
	Overall	🔴	🟡	🟡
Economic/Financial				
	Initial Capital Costs	• No initial capital costs.	• Higher cost due to new storm sewer system installation and outfalls. • Existing sewers along Davis Street has insufficient capacity in comparison to design peak flows, however the system is newer and road condition is in good shape. There are no known flooding or ponding issues in this area, however the Municipality may want to consider replacement in conjunction with future roadwork initiatives. • Other segments with insufficient capacity do not appear to result in impacts at present. Future replacement could be postponed to coincide with other municipal initiatives (i.e., roadworks).	• Highest anticipated cost due to extent of new storm sewer works and outfalls. • Works related to potential decommissioning of Davis Street connection and direction of portion of system to Thompson Drain would coincide with Alternative 3 or 4 of Thompson Drain. • Existing sewers along Davis Street has insufficient capacity in comparison to design peak flows, however the system is newer and road condition is in good shape. There are no known flooding or ponding issues in this area, however the Municipality may want to consider replacement in conjunction with future roadwork initiatives. • Other segments with insufficient capacity do not appear to result in impacts at present. Future replacement could be postponed to coincide with other municipal initiatives (i.e., roadworks).
	Property Acquisition Costs	• No property required.	• Potential costs associated with obtaining drainage easements required for new construction and to permit access for future maintenance of existing sewers.	• Potential costs associated with obtaining drainage easements required for new construction and to permit access for future maintenance of existing sewers.

Most Preferred 🟢

Neutral 🟡

Least Preferred 🔴

Table 6.13 Forsythe Municipal Drain – Evaluation Matrix

Forsythe Drain				
Evaluation Criteria		**Alternative 1 – Do Nothing**	**Alternative 2 – Improve Minor System**	**Alternative 3 – Divert Prince Albert Street System**
	Operation and Maintenance Costs	• High maintenance and costs associated with repairing the Forsythe Drain in its existing alignment. Root penetration in area of drain along private property (off right of way) may further reduce pipe capacity and require future maintenance. • Maintenance costs paid by assessed landowners in accordance with the Drainage Act.	• Lower maintenance costs associated with improved access to storm sewer and newer system. • Costs paid by municipal budget as Municipality would now own the infrastructure.	• Lower maintenance costs associated with improved access to storm sewer and newer system. • Costs paid by municipal budget as Municipality would now own the infrastructure.
	Overall			
TOTAL				

Most Preferred

Neutral

Least Preferred

7.0 PREFERRED ALTERNATIVES

The preferred alternatives for stormwater servicing for each catchment area were chosen based on the results of the evaluation, and were modified based on comments received from the public and other stakeholders after the Public Information Centre (a summary of the comments received and the resultant modifications can be found in Appendix A5, A6, and A7). The preferred alternatives per catchment area are discussed below, and shown in Figure 7.1.

7.1.1 Prior Municipal Drain – Alternative 3A Improve Major System and Abandon Municipal Drain

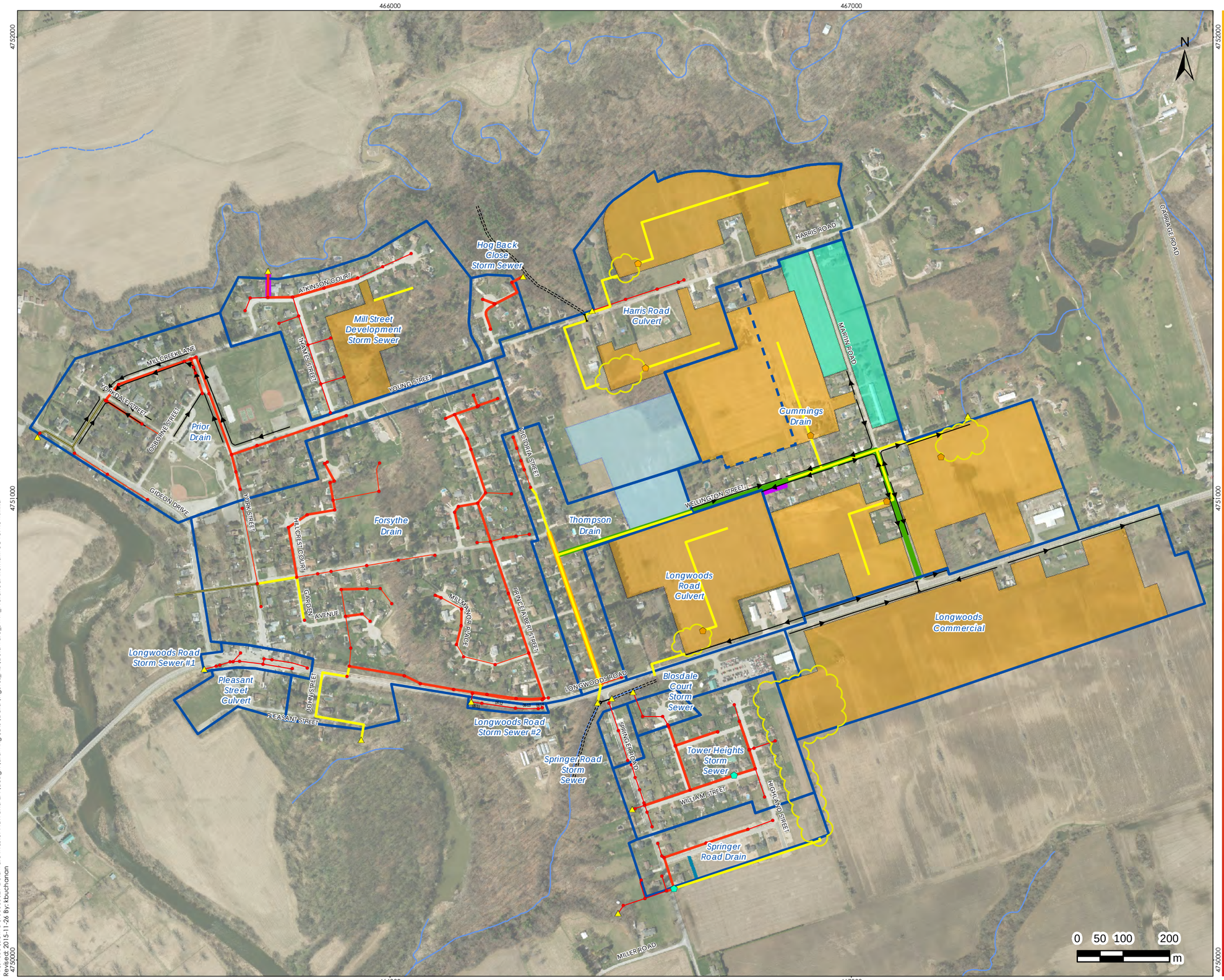
This alternative addresses existing capacity issues by improving roadside ditches in order to convey all flows that exceed the capacity of the minor system. The roadside ditches will also provide water quality treatment which would not be provided by minor system improvements. A storm sewer with sufficient capacity to convey the 100-year peak flows is constructed from the Millcreek Lane/Yorkdale Street intersection to the existing outlet in order to provide a major system outlet (a portion of the outlet was recently replaced as a result of failure). Although there may be minor disruption to fronting properties during implementation of ditch improvements and the new storm sewer, this option can be implemented at a lower cost with less impact to affected roads. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

7.1.2 Mill Street Development Storm Sewer – Alternative 2 Improve Major System

This alternative addresses existing ponding issues at the east end of Atkinson Court by regrading the overland flow route to improve drainage. Capacity issues caused by future development are addressed by providing on-site SWM controls (quality and quantity), and a ditch-inlet catchbasin is installed to address rear-yard flooding. Minor ponding may still occur at the eastern end of Atkinson Court, but it will be below Municipal standards and unlikely to threaten safety or property. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

7.1.3 Hog Back Close Storm Sewer – Alternative 1 Do Nothing

Although the existing storm sewer is over capacity to convey peak flows, the system is functioning sufficiently, and any ponding likely to occur will be below Municipal standards and unlikely to threaten safety or property. The existing conditions do not warrant the construction impacts and cost associated with the other alternatives.



V:\01655\active\165630021 Delaware Master Plan and EA\design\drawing\GIS\Data\Figures_AB\Delaware_SWM_PreferredAlternativeOverview.mxd
Revised: 2015-11-26 By: kbuchanan

Stantec

Legend

- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Existing Storm Sewer
- Proposed Storm Sewer (2-Year Capacity)
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (100-Year Capacity)
- Roadside Ditch
- Existing Culvert
- Existing Ravine
- Watercourse (Permanent)
- Watercourse (Intermittent)
- Proposed Dry SWM Pond (Approximate Location)
- Proposed Regrading
- Proposed Drainage Easement
- Proposed Urban R.O.W.
- Proposed Semi-Urban R.O.W.
- Proposed Drainage Boundary
- Proposed Interior Drainage Boundary
- Existing School
- Potential Future Development
- Future Development Serviced by Planned SWM Infiltration Measures

1:8,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

November 2015
165630021

Client/Project

Municipality of Middlesex Centre
Delaware Community Settlement Area
Stormwater Master Plan

Figure No.

7.1

Title

Delaware SWM EA
Overview of Preferred Alternatives

7.1.4 Tower Heights Storm Sewer – Alternative 1 Do Nothing

Although the existing storm sewer is over capacity to convey peak flows, the existing conditions do not warrant the construction impacts and cost associated with replacement. Concerns have been received from residents regarding excessive reliance on sump pumps, however, these issues are primarily related to high groundwater levels, and may not be sufficiently addressed by SWM improvements. The costs and property impacts associated with replacing the over capacity system are not warranted by existing SWM concerns.

7.1.5 Springer Road Municipal Drain – Alternative 2 Abandon Municipal Drain and Negotiate Drainage Easement

Although the existing storm sewer is over capacity, ponding is not likely to cause risk to safety or property. Ensuring that the existing overland flow route does not become obstructed further mitigates the potential for ponding during storm events. The existing conditions do not warrant the construction impacts and costs associated with replacement of the storm sewer. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

7.1.6 Cummings Municipal Drain – Alternative 2 – Urban Right of Way within Future Development Areas and Dry SWM Pond

The existing drain south of Wellington Road is decommissioned, and the south roadside ditch profile is modified to convey major flows from the low point westward to the Longwoods Road Culvert. Future development areas (excluding approved Draft-Plans along Martin Road) will incorporate urban right-of-way (ROW) to convey minor and major flows. Flows from the future development areas will be conveyed by proposed storm sewers along Wellington Street and Martin Road to a regional dry SWM pond located on development lands east of Martin Road prior to discharge to the ravine. The proposed SWM pond, in conjunction with oil-grit separators (OGSs) located at each of the development lands, provides the required stormwater treatment and quantity control.

The proposed storm sewer along Wellington Street would be extended to address existing surface ponding at the Wellington Street low point.

Funding for implementation of works associated with future development will be provided through the development process, and improvements to existing stormwater system would be provided by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses key issues related to capacity and accessibility. While higher disruption and construction impacts to Wellington Street and Martin Road are anticipated over the other alternatives, this option could align with planned roadwork improvements and is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.

7.1.7 Longwoods Road Culvert – Alternative 3 Urban Right of Ways within Future Development Areas and Dry SWM Pond

Urban ROW within the future development area incorporates SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties. A proposed dry SWM pond and OGS provides the required stormwater treatment and quantity control.

The existing concrete box culvert beneath Longwoods Road is replaced with a new outlet which must be lowered to accommodate the proposed upstream sewers.

Improvements to the Longwoods Road north roadside ditch will mitigate flooding on commercial property. Funding for implementation of works associated with new development to be provided through development process, and improvements to existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses key issues related to post-development impacts. While this option is considered a higher cost alternative, it is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.

7.1.8 Longwoods Commercial Lands – Alternative 3 Dry SWM Pond

Flows from the Longwoods Road roadside ditches are conveyed through the development lands through a drainage easement. Quality and Quantity controls are provided by proposed OGSs within the future development area, and a dry SWM pond located within the development lands or potentially within the existing buffer lands (Special Policy Area #8) subject to approval/acquisition of land from the current landowner and municipal approval to address current SPA designation/development constraints. Flows are conveyed from the dry SWM pond to the Springer Road Drain outfall location by a proposed pipe located within a drainage easement south of the Tower Heights Subdivision. Funding for implementation of works associated with new development to be provided through development process, and improvements to existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses stormwater runoff from the future development lands, with less potential for aggravating existing high groundwater levels within the adjacent Tower Heights subdivision, as well as providing the opportunity for incorporating flows from the Springer Road Drain catchment area.

7.1.9 Harris Road Culvert – Alternative 2A Urban Right of Way & Dry SWM Ponds within Future Development Areas

Urban ROW within the future development areas incorporate SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties. Proposed dry SWM ponds and oil/grit separators provide the required stormwater treatment and quantity

control. Flows will be directed to the existing ravine outlet via proposed storm sewers constructed within drainage easements. Funding for implementation of works associated with new development to be provided through development process, and improvements to existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality.

The Harris Road culvert is lowered to accommodate the proposed upstream storm sewers. With exception of minor roadworks to accommodate storm sewer installation, no significant alterations to road cross-sections would be undertaken.

This alternative addresses capacity issues in the existing system and addresses stormwater servicing for the future development areas with less impact to existing residences (tree removal, road reconstruction), and is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.

7.1.10 Thompson Municipal Drain – Alternative 3 Proposed Storm Sewer

The proposed storm sewer provides an outlet for the existing roadside ditches along Wellington Street to limit ponding depths in front of Our Lady of Lourdes school property. The storm sewer along Victoria Street is replaced with a new storm sewer within the right of way, and a portion of sewer currently draining to the Davis Street system is connected to proposed Victoria Street sewer to alleviate impacts on the adjacent Forsythe System. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.

This alternative addresses existing capacity and ponding issues, and although fronting properties will experience temporary disruption during construction, future impacts to private property will be mitigated by aligning the sewer within the right of way, and increasing conveyance capacity.

Consultation during the Public Information Centre and subsequent comments received expressed concern over the preservation of trees along the Victoria Street streetscape. The urban right of way proposed for Victoria Street has the benefit of preserving a greater amount of trees than would a semi-urban right of way. During detailed design, however, it is recommended that a Tree Preservation Plan be completed to document and assess any impact on existing trees along the right of way, and to identify appropriate mitigation measures for any trees requiring removal.

7.1.11 Forsythe Municipal Drain Alternative 2 – Improve Minor System

A new storm sewer with sufficient capacity to convey the 100-year peak discharge would be constructed from the York Street low point south of Wellington Street to a new outfall to the Thames River. Segments of pipe located on private property are decommissioned, and the identified sections are replaced. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality. This alternative also includes the option to

divert flows to the Thompson Drain outfall should over capacity of sewer along Longwoods Road become a concern.

Although segments of the existing storm sewer remain over capacity, the proposed sewer upgrades address areas of identified and anticipated ponding, mitigates risks to safety and property, minimizes impacts to residents during construction, and can be implemented at a lower cost.

8.0 CONCLUSION AND RECOMMENDATIONS

8.1 FUNDING STRATEGY

As discussed in Section 5.3.1, under the *Drainage Act*, funding for the maintenance and repairs of Municipal Drains as classified are to be assessed to the benefiting land owners; however, these costs have typically been paid for through from municipal operating budgets, which are not intended to fund these works. Similarly, capital and maintenance costs related to the existing municipal stormwater system within Delaware has been paid for through municipal wastewater reserves, of which the residents of Delaware do not contribute to as wastewater servicing is not provided.

In order to address stormwater servicing throughout the entire settlement area in a consolidated manner, the Master Plan recommends the abandonment of the Municipal Drains as discussed within each relevant catchment area. Abandonment of all or part of a municipal drain can be initiated by a minimum of three quarters of the owners of the land assessed (representing at least three quarters of the total area assessed), OR the municipal council can send a notice to abandon a municipal drain to each benefitting landowner, regardless of whether any landowners have requested abandonment or not. If no appeal is issued, the Municipality may abandon the municipal drain under its obligations through the Drainage Act.

Once abandoned and assumed by the Municipality as a municipal stormwater system, and in conjunction with the existing municipal stormwater system in place, a Stormwater Reserve Fund should be initiated by the Municipality to fund future capital and maintenance works to ensure the long-term financial sustainability of the system. Should sanitary servicing be provided in the future, the Municipality may choose to transfer any accumulated reserves into the overall wastewater reserve and introduce billing consistent with existing mechanisms already in place for Ilderton, Kilworth, and Komoka.

In order to establish proper reserve costs, the Municipality should ensure that the works, once consolidated, are evaluated as part of the overall Municipal Asset Management Plan.

8.2 COSTS AND PROJECT IMPLEMENTATION

8.2.1 Levels of Cost Opinions

ASTM E 2516-06 (Standard Classification for Cost Estimate Classification System) provides a five-level classification system based on several characteristics, with the primary characteristic being the level of project definition (i.e., percentage of design completion). Section 7.5.4 of ASTM E 2516 acknowledges that other "secondary" characteristics impact the accuracy of the estimate, and provides as follows:

"In summary, estimate accuracy will generally be correlated with estimate classification (and therefore the level of project definition), all else being equal. However, specific accuracy ranges will typically vary by industry. Also, the accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as differing technological maturity, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by-estimate basis, usually in conjunction with some form of risk analysis process."

Opinions of probable cost for each of the preferred alternatives are included in Appendix C, and should be considered as Class 4 estimates (as extent of work is considered within 1% to 15% of "complete"). A Class 4 estimate is defined by 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 upon the above discussion, Stantec does not guarantee the accuracy of this opinion of probable cost. The actual final cost of any identified project will be determined through the bidding and construction process, and subject to further refinement of design and determination of overall scope of work. Furthermore, these costs are intended to represent the cost to complete the stormwater upgrades, including all required restoration works. As the majority of upgrades involve work within existing roads, significant costs are attributed to the re-establishment of asphalt surfaces, curbs/sidewalks (where indicated), and subbase materials (granulars). Where work is deemed not to be critical (i.e. stormwater works that are not required immediately to address public health/safety risk or to allow development to proceed), the Municipality may wish to align upgrades with other capital initiatives such as the road upgrades program. Coordination of municipal projects will reduce overall costs and minimize overall impacts to residents.

8.2.2 Project Triggers

The implementation of improvements identified within the Master Plan should generally be triggered by the following:

- Infrastructure failure or works required immediately to address public health/safety risks;

- Projects required during development applications to allow development to proceed;
- Improvements that can be coordinated with required road maintenance;
- The availability of municipal funding; and/or
- The ability to secure Provincial and/or Federal level funding (i.e., future infrastructure funding programs, Gas Tax programs, etc.).

8.2.3 Stormwater Management Facilities

Preferred alternatives for future development areas incorporates dry SWM ponds paired with oil-grit separators (OGSs) to provide stormwater treatment to the runoff from future development areas. The location of the dry SWM ponds shown on mapping within the Master Plan for each alternative, where applicable, are estimates only, determined based on topography within the catchment areas and existing drainage patterns. The exact location and size of ponds will be determined during the development application process, and coordination with landowners will be required.

Although noted as preferred through the MOMC design standards, wet SWM ponds are not recommended to treat the runoff from the future development areas for the following reasons:

- Design Drainage Areas - Existing and proposed design service areas for the future SWM ponds are relatively small. In contrast, the design guidance presented in the 2003 MOE Stormwater Management Planning and Design Manual suggests that the design drainage area for wet ponds should be at least 10 ha to maintain a permanent pool. Since the design service areas are less than or very near to 10 ha, there may be insufficient drainage area to maintain wet ponds;
- Safety - SWM facilities are generally proposed within, or adjacent to future residential areas (exact locations to be determined). The standing water in wet ponds can present a safety hazard to local residents, particularly children. While limiting access to the permanent pool may be possible using measures such as fencing or obstructive vegetation, these solutions present their own aesthetic and safety concerns; and
- Maintenance Requirements - Dry SWM pond maintenance requirements are typically less intensive that those of wet ponds. For instance, trash removal can be performed without the need to enter a permanent pool, structures can be inspected without dewatering, and sediment accumulation can be easily monitored. Since there is no permanent pool, problems associated with algae growth are avoided. While the upstream OGSs will require more frequent sediment removal than a wet pond forebay, cleaning can be accomplished with a vacuum truck without the need to dewater the pond, dry the sediment prior to removal, or restore the site. Furthermore, funding for the OGS maintenance can be easily managed by the municipality through the annual

maintenance budgets. In contrast, wet pond cleanouts are typically performed as capital projects, with associated costs that are much more difficult to predict.

The proposed dry SWM ponds combined with upstream OGSs will form a stormwater treatment train to provide the necessary water quality control. The OGSs will provide water quality pre-treatment and the dry SWM ponds will provide water quality "polishing" to the runoff from future development.

8.2.4 Drainage Easements

Some preferred alternatives require the negotiation of easements. Municipal Servicing Easements are required for storm sewers, stormwater management ponds, and channels, and will need to be negotiated in accordance with Section 2.18 of the Municipality's Infrastructure Design Standards.

8.2.5 Permit Requirements

For any oil-grit separators proposed within the Master Plan, Environmental Compliance Approvals (ECAs) will be required from the Ministry of the Environment and Climate Change (MOECC), and maintenance of the units must be performed in accordance with the terms and conditions within the ECAs. Similarly, ECAs will be required prior to the construction of any new storm sewers and related appurtenances or where replacement works require modification to sizing/capacity or modification to the drainage areas, particularly for systems currently defined under the Drainage Act which are presently excluded from MOECC approval requirements.

Section 28 permits will be required from the appropriate Conservation Authority for any modifications to existing outlets, or for the installation of new outlets within Conservation Authority regulated lands.

Permitting and/or Registration will be required for any activities that have the potential for disruption to habitat for Endangered or Threatened Species under the Endangered Species Act, through the Ministry of Natural Resources and Forestry.

8.2.6 Recommended Natural Environment Protection and Mitigation Measures

During the planning, design, and construction of recommended projects, the potential exists for adverse environmental impacts on the natural features and ecological functions identified within the study area. During the evaluation of servicing alternatives, potential environmental impacts were noted. Assuming appropriate mitigation measures are followed, these impacts will be preventable or minimal to the surrounding environment.

Table 8.1 summarizes typical recommended mitigation and enhancement measures, and suggested application to minimize and mitigate the potentially adverse environmental impacts associated with the Master Plan and any proposed projects where potential for habitat

disturbance exists. This information should be used in further planning studies, preparing detailed designs, construction timing, agency approvals, and on-going monitoring to ensure that the natural environment features identified within this report are protected, maintained, and restored through the implementation of any identified projects.

Table 8.1 Potential Impact and Mitigation Measures

Potential Impact	Typical Recommended Mitigation and Enhancement Measures
Aquatic Habitat, Fisheries and Water Quality	
Direct loss, alteration, or disruption of fish habitat	• Ensure sufficient fish passage is provided through all in-water works. • Restore vegetation and aquatic habitat (substrate) to pre-construction condition (or better), ensuring that any habitat features (pools, riffles, structure) are restored or enhanced. • Any Harmful Alteration, Disruption or Destruction (HADD) of fish habitat that may result from the proposed dyke improvements will require prior authorization from DFO. A compensation plan will be required for review and approval and should be discussed with DFO. • Opportunities to enhance riparian vegetation through the planting of other hanging grasses, shrubs and trees will improve stream cover, reduce temperature impacts, and provide allochthonous inputs (food source for various fish species).
Increased turbidity and siltation in downstream areas resulting in "smothered" plants and animals due to the deposition of silt and increased turbidity of surface watercourses	• Ensure enhanced erosion control measures are installed and maintained throughout all phases of construction to protect exposed surfaces, control run-off and minimize the deposition of silt or suspended sediments within downstream habitats. • Worksite isolation and dewatering plans should be prepared to identify appropriate isolation methods, siltation controls and dewatering measures to be implemented. • Any pumped water resulting from dewatering activities should be discharged to settling areas or through filter media before entering the surface water bodies. • Utilize suitable backfill material along banks and footings. • Stage construction activity to minimize the frequency and duration of any in-water work, as much as feasible. • Re-vegetate all disturbed areas as soon as possible following disturbance to stabilize the area and minimize erosion potential.

Potential Impact	Typical Recommended Mitigation and Enhancement Measures
	• Effective monitoring and reporting is required.
Impacts on species at risk	• Improve water quality enhanced erosion control. • Restore riparian vegetation cover through the planting of overhanging grasses, forbs and shrubs, to provide cover, shade and a source of food (insects). • Any work along or in the watercourse margins should be timed/scheduled to minimize impacts to fish and mussel species. A review of the particular activity may assist in negotiating the timing window.
Stress on fish communities	• Any fish that may occur within isolated work areas should be captured and released in accordance with appropriate MNRF protocols.
Terrestrial Habitat and Species	
Removal or disturbance of significant trees or ground flora	• Relocate or replant any significant species in a timely manner following construction. • Minimize tree removal during construction. • Stabilize all disturbed areas upon completion of any grading works through re-vegetation of the disturbed areas utilizing native plant species (ex. seed and mulch, compost mix, tree and shrub planting).
Migratory Birds	• Avoidance of construction during the recommended May 1 to July 31 nesting period for southern Ontario. If construction is necessary, nest searches must be completed within three days of clearing.
Stress on biological communities	• Avoid construction impacts during sensitive wildlife periods, such as breeding seasons for various bird species.
Introduction of invasive species through disturbance and material removal	• Restore disturbed areas as soon as possible. • Use only native species for all re-vegetation work. • Monitoring plans should include invasive species. • All soils removed from the project site containing invasive species material to be dealt with in a manner to prevent spreading to a new area.
Interference with ecological corridors and linkages	• Minimize vegetation disturbance in grassland areas to ensure habitat protection.
Physical Impacts	
Slope Stability	• Minimize potential for increased flows to receiving areas with known erosion susceptibility to reduce slope stability issues through implementation of upstream quantity controls. • Where increase of flows may occur or where slope stability

Potential Impact	Typical Recommended Mitigation and Enhancement Measures
	issues exist, implementation of slope stability measures to be incorporated in design.

8.2.7 Class EA Projects and Schedule

This Master Plan has been completed in accordance with Approach 2 under the MEA Class EA approach for Master Plans which satisfied Phase 1 and 2 of the planning process. Accordingly, this document provides information to support any future studies or investigations in relation to each of the preferred solutions identified within the Master Plan.

Projects identified as part of the Master Plan are outlined in Table 8.2, along with their respective Class EA schedule. In determining the proposed Class EA schedule for each project, recommendations are provided based on the anticipated magnitude of the preferred alternatives environmental impact, and input received by stakeholders as part of the consultation process. For drainage areas where development may occur and stormwater works are required on development lands (i.e., dry SWM pond, OGS) with no additional land acquisition or perceived impact on the environment, works are noted as Schedule A activities as the SWM facilities and related appurtenances will be addressed as part of the Planning Act.

Upon completion of the Master Plan and subject to the 30-day review period (assuming no Part II Orders or bump up requests), Schedule A, A+, and B projects are pre-approved and may proceed to design and construction subject to approval by Council. During subsequent design and construction, proposed alignments and locations of infrastructure may be refined as necessary, but within the general context of the project as defined in this Master Plan.

The Notice of Completion of this Master Plan is issued on the basis of the identification of the following projects and Class EA schedules.

Table 8.2 Identified Class EA Project and Schedule

Project/Drainage Area	Preferred Alternative	Class EA Schedule
Prior Municipal Drain	Alternative 3A – Improve Major System and Abandon Municipal Drain	Schedule A
Mill Street Development Storm Sewer	Alternative 2 – Improve Major System	Schedule A
Hog Back Close Storm Sewer	Alternative 1 – Do Nothing	Not applicable
Tower Heights Storm Sewer	Alternative 1 – Do Nothing	Not applicable
Springer Road Municipal Drain	Alternative 2 – Abandon Municipal Drain and Negotiate Drainage	Schedule B

Project/Drainage Area	Preferred Alternative	Class EA Schedule
	Easement	
Cummings Municipal Drain	Alternative 2 – Urban ROW within Future Development Areas and Dry SWM Pond	Schedule A
Longwoods Road Culvert	Alternative 3 – Urban ROW within Future Development Areas and Dry SWM Pond	Schedule A
Longwoods Commercial Lands	Alternative 3A – Dry SWM Pond	Schedule A
Harris Road Culvert	Alternative 2A – Urban ROW within Future Development Areas and Dry SWM Pond	Schedule B
Thompson Municipal Drain	Alternative 3 – Proposed Storm Sewer	Schedule B
Forsythe Municipal Drain	Alternative 2 – Improve Minor System	Schedule B
Longwoods Road Storm Sewer #1	Do Nothing	Not applicable
Longwoods Road Storm Sewer #2	Do Nothing	Not applicable
Springer Road Storm Sewer	Do Nothing	Not applicable
Pleasant Street Culvert	Do Nothing	Not applicable
Blosdale Court Storm Sewer	Do Nothing	Not applicable

8.2.8 Master Plan Filing Procedure and Notice of Completion

The draft Master Plan document was placed on public record for the mandatory 30 day review period at the Middlesex Centre Clerk's Office, the Delaware Public Library, and the office of Stantec following the publication of the Notice of Completion (Banner and Londoner Newspapers on February 10th, 11th, and 17th, 2016). Comments and/or concerns are to be submitted to the Municipality of Middlesex Centre and Stantec within the 30 day review period (ending March 14th, 2016). Anyone who has outstanding concerns relating to Schedule B projects identified, within the 30 day review period may request the Minister of Environment to issue an order to comply with Part II of the EA Act if the concern cannot be addressed. The work undertaken in preparing this report represents the completion of the EA process for the Delaware Community Settlement Area Stormwater Master Plan. Subject to approval of the recommendations identified herein, the Municipality of Middlesex Centre intends to proceed with design and implementation.

Appendix A PUBLIC CONSULTATION

Appendix B GEOTECHNICAL REVIEW

Appendix C OPINION OF PROBABLE COST

Appendix C Opinion of Probable Cost

APPENDIX A - CONSULTATION

A1 - Stakeholder Contact List

A2 – Notice of Commencement

A3 – Notice of Study Update and Results of Online Survey

A4 – Public Information Centre

A5 – Public Comment TRACER Table

A6 – Aboriginal Consultation

A7 – Agency Consultation

Appendix A8 – Notice of Completion

Appendix A1 – Stakeholder Contact List

Delaware Community Settlement Area Stormwater Master Plan
Environmental Assessment
Stakeholder Distribution List

Interest	Agency	Title	First Name	Last Name	Division	Title	Address	City	Pr	Postal
Government										
Federal	Fisheries and Oceans Canada	Mr.	Dave	Gibson	Southern Ontario District - London Office	Senior Biologist	P.O. Box 850603027 Harvester Ro	London	ON	N6E 2V2
Federal	Health Canada	Ms.	Kitty	Ma	Ontario Region	Regional Environmental Assessmer	180 Queen Street West, 10th floor	Toronto	ON	M5V 3L7
Provincial	Ministry of Natural Resources and Forestry	Ms.	Andrea	Fleischhauer	Aylmer District	District Planner	615 John St.N.	Aylmer	ON	N5H 2S8
Provincial	Ministry of Environment and Climate Change	Mr.	Craig	Newton	Southwestern Region	Regional Environmental Assessmer	733 Exeter Road	London	ON	N6E 1L3
Provincial	Ministry of Environment and Climate Change	Ms.	Angela	Whiteley	Southwest Regional Office	District Supervisor	733 Exeter Road	London	ON	N6E 1L3
Provincial	Ministry of Community and Social Services	-	-	-	South West Regional Office		PO Box 5217	London	ON	N6A 5R1
Provincial	Ministry of Economic Development and Innovation	-	-	-	Business Development		659 Exeter Road, 2nd floor	London	ON	N6E 1L3
Provincial	Ministry of Municipal Affairs and Housing	Mr.	Bruce	Curtis	Community Planning and Development	Manager	659 Exeter Road, 2nd floor	London	ON	N6E 1L3
Provincial	Ministry of Agriculture, Food and Rural Affairs	Mr.	Drew	Crinklaw	Southwestern Ontario	Rural Planner	667 Exeter Road	London	ON	N6E 1L3
Provincial	Ministry Infrastructure	Mr.	Chris	Giannekos	Infrastructure Policy and Planning Division	Assistant Deputy Minister	Frost Building S 7 Queen's Park Cr	Toronto	ON	M7A 1Y7
Provincial	Ministry of Health and Long-Term Care	Mr.	Tony	Amalfa	Environmental Health Policy & Programs		393 University Avenue, 21st Floor	Toronto	ON	M7A 2S1
Provincial	Ministry of Tourism, Culture and Sport	Ms.	Penny	Young	Culture Services Unit	Heritage Planner	401 Bay Street Suite 1700	Toronto	ON	M7A 0A7
Provincial	Ministry of Tourism, Culture and Sport	Mr.	Joe	Muller	Culture Services Unit	Heritage Planner	401 Bay Street Suite 1700	Toronto	ON	M7A 0A7
Provincial	Ministry of Tourism, Culture and Sport	Mr.	Chris	Stack		Manager	900 Highbury Avenue	London	ON	N5Y 1A4
Provincial	Ministry of Aboriginal Affairs	Ms.	Pauline	Wakegijig	Consultation Unit		160 Bloor Street, East 4th Floor	Toronto	ON	M7A 2E6
Municipalities, MPs & MPPs										
Local	County of Middlesex	Mr.	Jerry	Rychlo		Engineering Supervisor	399 Ridout St.N.	London	ON	N6A 2P1
Local	County of Middlesex	Mr.	Chris	Traini		County Engineer	399 Ridout St.N.	London	ON	N6A 2P1
Local	County of Middlesex	Ms.	Kathy	Bunting		Clerk	399 Ridout St.N.	London	ON	N6A 2P1
Federal	Federal MP	Mr.	Bev	Shipley		MP-Elgin-Middlesex-London	380 Albert Street PO Box 141	Strathroy	ON	N7G 3J1
Provincial	Provincial MPP	Mr.	Jeff	Yurek		MPP-Elgin-Middlesex-London	750 Talbot StreetSuite 201 West W	St. Thomas	ON	N5P 1E2
Local										
Middlesex	Middlesex-London Health Unit	Mr.	Wally	Adams	Environmental Health & Chronic Disease Prevention Service	Manager-Environmental Health	Unit 50 King St.	London	ON	N6A 5L7
Middlesex	Middlesex-London Health Unit	Dr.	Christophe	Mackie		Medical Officer of Health	50 King Street	London	ON	N6A 5L7
OPP	Ontario Provinicial Police					Detachment Commander	28444 Centre Road	Strathroy	ON	N7G 3H6
Rogers/Londor	Rogers Cablesystems Utilities Coordinating Committe	Mr.	Ted	Feeney			800 York St.	London	ON	N5W 2S9
Bell/London	Bell Canada	Mr.	Jeff	Holmes	Access Network Facilities		100 Dundas St. 4th Floor	London	ON	N6A 4L6
London	Union Gas	Mr.	Taylor	Jones		Construction Project Manager	108 Commissioners Road West	London	ON	N6A 4P1
London	Union Gas	Ms.	Shellie	Chowns		Construction Project Manager	108 Commissioners Road West	London	ON	N6A 4P1
Conservation Authorites										
Local	Upper Thames River Conservation Authority	Ms.	Karen	Winfield	Hydrology & Regulatory Services Unit	Land Use Regulations Officer	1424 Clarke Road	London	ON	N5V 5B9
Local	Lower Thames Valley Conservation Authority	Ms.	Valerie	Towsley		Resource Technician	100 Thames St.	Chatham	ON	N7L 2Y8
Aboriginal Communites										
Local	Southern First Nations Secretariat	Mr.	Paul	Schisler	Manager Technical Services		22361 Austin Line	Bothwell	ON	N0P 1C0
Local	Chippewas of the Thames	Chief	Leslee	White-Eye	Chief		320 Chippewa Road	Muncey	ON	N0L 1Y1
Local	Chippewas of the Thames	Ms.	Mary	Alikakos	Consultation Coordinator		320 Chippewa Road	Muncey	ON	N0L 1Y1
Local	Chippewas of the Thames	Ms.	Rolanda	Elijah	Lands and Environment Director		320 Chippewa Road	Muncey	ON	N0L 1Y1
Local	Oneida Nation of the Thames	Chief	Sheri	Doxtator			2212 Elm Ave.	Southwold	ON	N0L 2G0
Local	Oneida Nation of the Thames	Ms.	Holly	Elijah	Council Assisstant		2212 Elm Ave.	Southwold	ON	N0L 2G0
Local	Munsee-Delaware Nation	Chief	Roger	Thomas			279 Jubilee Road	Muncey	ON	N0L 1Y0
Local	Munsee-Delaware Nation	Mr.	Glen	Jones	First Nation Manager		279 Jubilee Road	Muncey	ON	N0L 1Y0
Local	Delaware Nation (Moravian of the Thames)	Mr.	Greg	Peters			14760 School House Line RR #3	Thamesville	ON	N0P 2K0
Local	Delaware Nation (Moravian of the Thames)	Mr.	Justin	Logan	Lands & Resources Consultation Assistant		14760 School House Line	Thamesville	ON	N0P 2K0
Local	Chippewas of Kettle and Stony Point First Nation	Mr.	Tom	Bressette	0		6247 Indian Lane	Forest	ON	N0N 1J0
Local	Chippewas of Kettle and Stony Point First Nation	Ms.	Lorraine	George	First Nation Manager		6247 Indian LaneRR#2	Forest	ON	N0N 1J0
Local	Chippewas of Kettle and Stony Point First Nation	Me.	Suzanne	Bressette	Communications Relations Officer		6247 Indian LaneRR#2	Forest	ON	N0N 1J0
Local	Bkejwanong Territory (Walpole Island)	Chief	Dan	Miskokomon			RR #3	Wallacebu	ON	N8A 4K9

Stantec

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Delaware Stormwater Management Master Plan
Public Survey Participants

Address	City	Pr	Postal
64 Thames St.	Delaware	ON	N0L 1E0
P.O. Box 69	Delaware	ON	N0L 1E0
14	Delaware	ON	N0L 1E0
	Delaware	ON	N0L 1E0
102 Harris Road	Delaware	ON	N0L 1E0
PO Box 283, 51 thames st	Delaware	ON	N0L 1E0
18	Delaware	ON	N0L 1E0
PO Box 13, 2574 Gideon dr.	Delaware	ON	N0L 1E0
77 Wellington Street	Delaware	ON	N0L 1E0
88 Wellington St	Delaware	ON	N0L 1E0
3593 Springer Rd	Delaware	ON	N0L 1E0
66 Thames St	Delaware	ON	N0L 1E0
P.O. Box 415	Delaware	ON	N0L 1E0
P.O. Box 174, 45 Davis St	Delaware	ON	N0L 1E0
PO Box 218, 66 Atkinson Court	Delaware	ON	N0L 1E0
50 Davis St	Delaware	ON	N0L 1E0
2 Blosdale Crescent	Delaware	ON	N0L 1E0
11154 Longwoods rd	Delaware	ON	N0L 1E0
3603 Carriage Rd	Delaware	ON	N0L 1E0
11110 Longwoods Road	Delaware	ON	N0L 1E0
11334 Longwoods Rd	Delaware	ON	N0L 1E0
11 Victoria Street	Delaware	ON	N0L 1E0
25 Victoria Street	Delaware	ON	N0L 1E0
47 Victoria, Box 142	Delaware	ON	N0L 1E0
62 Young Street	Delaware	ON	N0L 1E0
6 Millcreek Lane Box 334	Delaware	ON	N0L 1E0
P.O. Box 211	Delaware	ON	N0L 1E0

Please note: Names,
phone numbers, and email addresses have been hidden
for privacy purposes

Delaware Stormwater Management Master Plan
Public Survey Participants

Box 362, 45 Victoria St.	Delaware	ON	N0L 1E0
51 Davis Street, PO Box 287	Delaware	ON	N0L 1E0
9 Highland Street	Delaware	ON	N0L 1E0
82 Harris Road	Delaware	ON	N0L 1E0
59 Hog Back Close	Delaware	ON	N0L 1E0
21 Young St.	Delaware	ON	N0L 1E0
29 Prince Albert Street Box 93	Delaware	ON	N0L 1E0
33 Prince Alber St	Delaware	ON	N0L 1E0
87 William Street	Delaware	ON	N0L 1E0
19 Young Street, Box 66	Delaware	ON	N0L 1E0
16 Prince Albert st, P.O. box 358	Delaware	ON	N0L 1E0
59 Davis St. PO Box 419	Delaware	ON	N0L 1E0
166 wellington street	Delaware	ON	N0L 1E0
103 William Street	Delaware	ON	N0L 1E0
129 Martin Rd.	Delaware	ON	N0L 1E0
113	Delaware	ON	N0L 1E0
138 Wellington Street	Delaware	ON	N0L 1E0
33Hillcrest	Delaware	ON	N0L 1E0
Box 250, 51 Miullmanor	Delaware	ON	N0L 1E0
167 Wellington Street	Delaware	ON	N0L 1E0
Box 5 17 Millcreeklane	Delaware	ON	N0L 1E0
47 MillManor Place	Delaware	ON	N0L 1E0
137 Wellington St.	Delaware	ON	N0L 1E0
29 Millmanor Place	Delaware	ON	N0L 1E0
PO Box 77, 2522 Gideon Dr.	Delaware	ON	N0L 1E0
18 Victoria Street	Delaware	ON	N0L 1E0
9 Victoria St.	Delaware	ON	N0L 1E0
12 Highland Street	Delaware	ON	N0L 1E0

Please note: Names,
phone numbers, and email addresses have been hidden
for privacy purposes

Delaware Stormwater Management Master Plan
Public Survey Participants

19 Victoria St.	Delaware	ON	N0L 1E0
Box 412, 73 Atkinson Crt	Delaware	ON	N0L 1E0
107 Elizabeth St	Delaware	ON	N0L 1E0
10 Blosdale Cres	Delaware	ON	N0L 1E0
58 MILLMANOR PLACE	Delaware	ON	N0L 1E0

Delaware Stormwater Master Plan
Potentially Impacted Property Owners

Address	C/O	PO Box	City	Province	Postal
86 Atkinson Crt		PO Box 202	Delaware	Ontario	N0L 1E0
80 Atkinson Crt		PO Box 365	Delaware	Ontario	N0L 1E0
78 Atkinson Crt		PO Box 206	Delaware	Ontario	N0L 1E0
74 Atkinson Crt		PO Box 98	Delaware	Ontario	N0L 1E0
55 Atkinson Crt		PO Box 257	Delaware	Ontario	N0L 1E0
57 Atkinson Crt		PO Box 31	Delaware	Ontario	N0L 1E0
2452 Gideon Drive		PO Box 11	Delaware	Ontario	N0L 1E0
2436 Gideon Drive		PO Box 128	Delaware	Ontario	N0L 1E0
2522 Gideon Drive		PO Box 77	Delaware	Ontario	N0L 1E0
58 Hog Back Close		RR1	Delaware	Ontario	N0L 1E0
56 Hog Back Close		RR1	Delaware	Ontario	N0L 1E0
2 Towerline Street	3587 Woodhull Rd RR32		London	Ontario	N6P 1P2
10747 Longwoods Road		RR1	Delaware	Ontario	N0L 1E0
137 Wellington Street			Delaware	Ontario	N0L 1E0
133 Wellington Street		RR1	Delaware	Ontario	N0L 1E0
101 Harris Road			Delaware	Ontario	N0L 1E0
94 Harris Road			Delaware	Ontario	N0L 1E0
92 Harris Road			Delaware	Ontario	N0L 1E0
10915 Longwoods Rd	2800 Woodhull Rd		London	Ontario	N6K 4S5
94 Harris Road	96 Harris Road		Delaware	Ontario	N0L 1E0
34 Garden Ave		PO Box 242	Delaware	Ontario	N0L 1E0
32 Garden Ave		PO Box 28	Delaware	Ontario	N0L 1E0
6 John Street		PO Box 69	Delaware	Ontario	N0L 1E0
2 John Street		PO Box 371	Delaware	Ontario	N0L 1E0
35 Pleasant Street		PO Box 235	Delaware	Ontario	N0L 1E0

Appendix A2 – Notice of Commencement

NOTICE OF STUDY COMMENCMENT

Delaware Community Settlement Area Stormwater Master Plan

The existing storm drainage infrastructure within the Community of Delaware was designed and constructed on a site-by-site basis as development occurred, without the benefit of an overall storm management strategy. This has resulted in a fragmented drainage system that does not efficiently service the existing community, and which has limited capacity to service future growth.

A comprehensive stormwater master plan is now being developed for the Delaware Community Settlement Area to identify necessary storm drainage system improvements to better service the existing community, and to provide a drainage servicing strategy to accommodate future growth and development. The proposed servicing plan will identify the stormwater infrastructure required to mitigate the possibility of flooding and erosion, provide adequate stormwater treatment, and protect downstream aquatic habitat. The proposed stormwater management strategy will be the solution that best balances the following responsibilities:

- Provide adequate drainage servicing and stormwater treatment;
- Protect the natural environment;
- Reduce negative impacts on affected landowners; and
- Minimize stormwater servicing costs.

Furthermore, a funding strategy will be developed to verify that implementation of the proposed master plan is feasible. Any other relevant responsibilities identified through the Class EA process will also be integrated into the proposed stormwater servicing strategy.

This study is being conducted as a Master Plan (Phases 1 and 2) under the Municipal Class Environmental Assessment process (Municipal Engineer's Association, as amended in June 2007 and 2011). Under this process, agency and public input is invited for incorporation into the planning and design for this study.

If you have any questions, comments or wish to be added to the project contact list, please contact:

Municipality of Middlesex Centre
Brian Lima, P.Eng.
Director – Public Works and Engineering
10227 Ilderton Road RR2
Ilderton, ON N0M 2A0
Fax: (519) 666-0271
Email: blima@middlesexcentre.on.ca

Stantec Consulting Ltd.
Michele Oxlade, B.Sc.,EP, ENV SP
Environmental Coordinator
600-171 Queens Avenue
London, ON N6A 5J7
Fax: (519) 645-6575
Email: michele.oxlade@stantec.com

This Notice issued on January 14, 2015.

From:	Oxlade, Michele
To:	Bergman, Stephanie
Subject:	FW: Delaware Community Settlement Area Stormwater Master Plan & Class EA - Notice of Study Commencement
Date:	Friday, June 12, 2015 5:27:27 PM
Attachments:	image001.png image002.png image003.png image004.png Notice of Commencement FINAL_15January2015.pdf

---

From: Brian Lima [mailto:lima@middlesexcentre.on.ca]
Sent: Thursday, January 08, 2015 10:57 AM
To: Frank Berze; Al Edmondson; Clare Bloomfield
Cc: Michelle Smibert; Oliveira, Nelson; Oxlade, Michele; Heather Pierce; Mike Barnier
Subject: Delaware Community Settlement Area Stormwater Master Plan & Class EA - Notice of Study Commencement

Good Morning Council Members,

Please find attached the public Notice of Commencement associated with the Delaware Community Settlement Area Master Plan and Class Environmental Assessment. A copy of the notice will be found in the following publications:

1. The LONDONER on Thursday, January 15th and posted to their website from January 9th-17th;
2. The BANNER on Wednesday, January 14th; and,
3. An electronic version posted to the Municipal website accordingly.

Best Regards,

Brian Lima P. Eng.
Director of Public Works and Engineering
Middlesex Centre | lima@middlesexcentre.on.ca
10227 Ilderton Road, RR#2 | Ilderton, Ontario, N0M 2A0
Tel: 519.666.0190 Ext. 233 | Fax: 519.666.0271

From: Brad Harness [mailto:editor@banner.on.ca]
Sent: Thursday, January 08, 2015 10:00 AM

To: Brian Lima
Subject: RE: Middelsex Centre - Delaware Community Settlement Area Stormwater Master Plan - Notice of Study Commencement
Importance: High

Hi Brian,
We can get that in next week's edition dated 14 Jan 15.

5"x8" black & white = $244.09 + hst (15% extra for colour)

We'll send a proof over by tomorrow morning.

Tear sheet will come with the invoice we send to you.

Cheers,
Brad

Brad Harness
Publisher/Editor
The Middlesex BANNER
BANNER Publications
Phone/Fax: 519-293-1095
Email: editor@banner.on.ca
Website: www.banner.on.ca

From: Brian Lima [mailto:lima@middlesexcentre.on.ca]
Sent: 7-Jan-15 5:06 PM
To: bradharness@execulink.com
Cc: editor@banner.on.ca; Heather Pierce; Oxlade, Michele; Oliveira, Nelson
Subject: Middelsex Centre - Delaware Community Settlement Area Stormwater Master Plan - Notice of Study Commencement

Hi Brad,

Can I please get the attached notice published in the BANNER's edition next week? I have dated the notice for January 15, 2015, as I understand this is the publication date for the Middlesex Banner next week…?

Please provide me with a tear sheet as well since our consultant doesn't have access to the paper.

Thanks

Brian Lima P. Eng.
Director of Public Works and Engineering
Middlesex Centre | lima@middlesexcentre.on.ca
10227 Ilderton Road, RR#2 | Ilderton, Ontario, N0M 2A0

Appendix A3 – Notice of Study Update and Online Public Survey

NOTICE OF STUDY UPDATE

Delaware Community Settlement Area Stormwater Master Plan

A comprehensive Stormwater Master Plan is being developed for the Delaware Community Settlement Area to identify necessary storm drainage system improvements to better service the existing community, and to provide a drainage servicing strategy to accommodate future growth and development.

The Study Team is currently developing alternative solutions to address the known stormwater management concerns within the Delaware Community Settlement Area. In accordance with the Municipal Class Environmental Assessment Process, and in order to fully address the stormwater concerns experienced by residents of the Settlement Area, we invite you to take part in this stage of the study by completing the online survey found at the link below. The survey gives residents the opportunity to provide input on municipal drains, and any flooding experienced on their own properties or elsewhere in the community.

Your input is important to the Study, so please visit the link below to access the survey BY AUGUST 21, 2015. Paper copies of the survey will also be made available at the Delaware Public Library (29 Young Street) and the Delaware Community Centre (2652 Gideon Drive). You may also contact members of the project team below with any additional questions or concerns, or if you would like to be added to the Study mailing-list.

A Public Information Centre will be held in September, 2015 to present the alternative planning solutions and the information collected up to this point in the study.

Follow this link to access the Delaware Stormwater Master Plan Survey:

https://www.surveymonkey.com/s/DelawareSWM

You can also access the survey by scanning this QR Code:

Municipality of Middlesex Centre
Brian Lima, P.Eng.
Director – Public Works and Engineering
10227 Ilderton Road RR2
Ilderton, ON N0M 2A0
Fax: (519) 666-0271
Email: blima@middlesexcentre.on.ca

Stantec Consulting Ltd.
Corri Marr
Senior Planner
600-171 Queens Avenue
London, ON N6A 5J7
Fax: (519) 645-6575
Email: corri.marr@stantec.com

From: Brian Lima
To: Bergman, Stephanie
Cc: Marr, Corri; Oliveira, Nelson
Subject: RE: Delaware SWM Master Plan EA
Date: Monday, July 20, 2015 12:56:20 PM
Attachments: image005.png
image006.png
image007.png
image008.png

Hi Stephanie,

Please be advised that the Notice of Study Update as produced will be published in the Banner on July 29th and the Londoner on July 30th. The Notice has also been posted to the Municipality's website, Facebook and Twitter account.

Any idea when a map (previously requested) may be provided?

Regards,

Brian Lima
Director of Public Works & Engineering
Middlesex Centre | lima@middlesexcentre.on.ca
10227 Ilderton Road, RR#2 | Ilderton, Ontario, N0M 2A0
Tel: 519.666.0190 | Fax: 519.666.0271

The benefits of mindful gift-giving

Pat Copps
Special to Londoner

Theresa Perera has learned to live purposefully and in the moment. But it took an illness and journey into the Brazilian jungle in search of healing for her realize living a life of purpose was essential.

"It was a very, very profound awakening in my life. What I needed to do was take charge of my life to put systems in place, empower myself and take command of what I was going through," says Perera, the owner of Bow Tye Gifts.

"And it was what I went through personally and those system strategies that I was putting in place that I found I needed to really focus and drive my business into gifts of mindfulness, to give it meaning and intention for the purpose of empowering people to live that kind of life -- bring awareness to the moment.

"Enjoy the moment, not five minutes ago or five minutes from now but the moment, and bring all five senses into your being and have a great appreciation of what you're experiencing in the now."

Perera is a former oncology nurse turned radiation therapist, who spent 10 years at the London Regional Centre before resigning after the birth of her fourth child. In 2006, she started Bow Tye Gifts, a home-based business, for greater flexibility.

But her business was brought to a halt when Perera experienced several troublesome symptoms that were revealed to be the result of toxins running through her body from a prescribed topical cream.

Faced with uncertainty for the future, deep reflection and soul searching became priority as did her own self-healing, which included meditation, diet, fitness, and hot yoga. Then the life-altering two-week trip to a remote village in the interior of Brazil, to visit a healer. This is where she was introduced to the healing powers of crystals and gemstones, which are now a backbone of her company's line of gifts.

Returning from Brazil to her general gift business Perera knew changes were in order. She knew the biggest gift she could give her business was to assist those in need of their own healing and provide a service for people who want to reach out to others with a gift of healing.

Today Bow Tye Gifts strives to empower people to live a more mindful life. To take care of "self," and to reach out to others to give thanks, show gratitude, and give your support to family, friends, and colleagues when they need it.

"There was a real void in the market for gift-giving. There just weren't any meaningful gifts out there. I think it's not uncommon for individuals to not give a gift, not because they don't want to, but rather because they simply do not have the time to troll the mall and search online to unearth distinctive and beautiful gifts," she says.

"Choosing a gift is a difficult thing, and buying the card and matching it with the gift, in my opinion is just as important as the gift itself. And the whole process can be quite overwhelming."

When Perera was approached by the "FACE IT" organization - which assists and supports patients with a new breast cancer diagnosis - to create a line of gifts for breast cancer patients, she was immediately on board.

"I think the most important part is they feel being supported and having the tools to be able to get through the moment during this journey of dealing with this type of diagnosis," she says.

"Not just for the now, but for the future because it's something that they can hold onto, something they can have long term and they can always go to. And that's sort of the impetus behind these gifts : empowering tools for the long term."

For more information: www.bowtyegifts.com or 1-866-519-9211.

Theresa Perera

PLEASE RECYCLE

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NOTICE OF STUDY UPDATE

Delaware Community Settlement Area Stormwater Master Plan

A comprehensive Stormwater Master Plan is being developed for the Delaware Community Settlement Area to identify necessary storm drainage system improvements to better service the existing community, and to provide a drainage servicing strategy to accommodate future growth and development.

The Study Team is currently developing alternative solutions to address the known stormwater management concerns within the Delaware Community Settlement Area. In accordance with the Municipal Class Environmental Assessment Process, and in order to fully address the stormwater concerns experienced by residents of the Settlement Area, we invite you to take part in this stage of the study by completing the online survey found at the link below. The survey gives residents the opportunity to provide input on municipal drains, and any flooding experienced on their own properties or elsewhere in the community.

Your input is important to the Study, so please visit the link below to access the survey BY AUGUST 21, 2015. Paper copies of the survey will also be made available at the Delaware Public Library (29 Young Street) and the Delaware Community Centre (2652 Gideon Drive). You may also contact members of the project team below with any additional questions or concerns, or if you would like to be added to the Study mailing-list.

A Public Information Centre will be held in September, 2015 to present the alternative planning solutions and the information collected up to this point in the study.

Follow this link to access the Delaware Stormwater Master Plan Survey:
https://www.surveymonkey.com/s/DelawareSWM

You can also access the survey by scanning this QR Code:

Municipality of Middlesex Centre
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Stantec Consulting Ltd.
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Senior Planner
600-171 Queens Avenue
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Marlene's Fun Tours
464923 Curries Rd. R.R. #4, Woodstock, Ont. N4S 7V8
Hours Mon to Fri 9:00 am to 4:00 pm

DAY TOURS

Aug 13	A Day at NIAGARA on the LAKE/Lavender Farm
Aug 22	ZURICH BEAN FEST Car Show & More
Sep 3	ST JACOB's NEW Market & Outlets
Sep 10	CHRIS HADFIELD Astronaut Brantford*****
Sep 12	BINDER TWINE FEST
Sep 27	DAVE HOY'S RAGTIME RAILWAY BAND
Sep 28	Beatle/B.G.'s/BeachBoys/4 Seasons Waiter's
Oct 1	MYSTERY MYSTERY ???
Oct 16	CAROUSEL, Stratford
Dec 4	CANADIAN TENORS In concert

LONGER TOURS

Sep 11	1000 Islands/Kingston/cruise/playhouse 3 days $25. discount-booked by Aug 1st
Sep 21	SHIPSHEWANA/Amish Acres 4 days $25 discount if booked by Aug 1st
Sep 26	AGAWA CANYON Bushplane & Timber Museum $50 discount if booked by Aug. 15
Oct 2	MEAFORD APPLE HARVEST CRAFT SHOW $25. discount prior Aug 15th 2 days
Oct 5	SMOKEY MOUNTAINS/Remfro Valley 6 days $75. discount prior Aug 20th
Oct 16	SHOPPING Erie PA (No Tax) 3 days $25.00 discount prior Sep 1st
Oct 23	SHOPPING BIRCH RUN/LAKESIDE AREA 3 DAYS $25.00 discount prior Sep 1st
Nov 23	NASHVILLE CHRISTMAS Opry Hotel 6 days $50 discount if booked by Oct. 24
Dec 29	NEW YEAR'S In SMOKY'S 5 days $100 discount if booked by Nov. 15

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RETAIL $33,995 SPECIAL $26,900

NEW LAYTON 28'
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ONE ONLY $23,900

2016 CATALINA 39'
Park Model, Front Kitchen, Triple Slides, Wood Table & Chairs, Residential Fridge, A/C, Loaded.
SPECIAL $36,900

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2 Power Slide Outs, Front Kitchen, Rear Bedroom, Queen Bed, Air, Awning
WAS $29,999 SPECIAL $24,500 NO TAX

2016 NOMAD 30'
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Delaware Stormwater Master Plan

Welcome to the Delaware Settlement Area Stormwater Master Plan Survey

We want to hear from you! Thank you for taking the time to fill out the survey. The information you provide here will be used to better understand the existing stormwater drainage concerns within the Delaware Community Settlement Area.

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Delaware Stormwater Master Plan

The Basics - Location

* 1. What street do you live on?

* 2. Have you ever experienced surface flooding on your property in Delaware?

- Yes
- No

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Delaware Stormwater Master Plan

Experience

3. If so, how often and how severe is the flooding?

	More than once a month	About once a month	About once every 3 months	About once every 6 months	About once a year	Less than once a year
Mild flooding	◯	◯	◯	◯	◯	◯
Moderate flooding	◯	◯	◯	◯	◯	◯
Severe flooding	◯	◯	◯	◯	◯	◯

Provide specific examples of flooding experience

Provide specific examples of flooding experience

Provide specific examples of flooding experience

* 4. Have you ever seen surface flooding in Delaware after heavy rainfall or spring snowmelts?

◯ Yes

◯ No

If yes, please describe the location and severity of the flooding.

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Delaware Stormwater Master Plan

Municipal Drains

* 5.

Stormwater runoff for much of Delaware is conveyed by municipal drains rather than urban storm sewers. The main difference is that maintenance for municipal drains is paid as a lump sum by the benefitting property owners to the municipality, while maintenance for urban storm sewers is paid through general property taxes.

Is your home serviced by a Municipal Drain?

- ◯ Yes
- ◯ No
- ◯ Don't know

6. Have you ever received a Notice of Assessment for Municipal Drain maintenance?

- ◯ Yes
- ◯ No
- ◯ N/A

7. Would you prefer to pay for drainage servicing as a lump sum or through your general property taxes?

- ◯ Lump Sum
- ◯ Property Taxes

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Delaware Stormwater Master Plan

Sump Pumps

* 8. Does your home have a sump pump?

- ◯ Yes
- ◯ No
- ◯ Don't know

9. If so, how frequently does your sump pump typically run?

- ◯ Hourly
- ◯ Daily
- ◯ Weekly
- ◯ Monthly
- ◯ Less
- ◯ N/A

10. Do you think your sump pump runs too frequently?

- ◯ Yes
- ◯ No
- ◯ N/A

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Delaware Stormwater Master Plan

Infrastructure

* 11. Does your street have curbs along the road?

- ◯ Yes
- ◯ No

12. Do you think your street needs curbs?

- ◯ Yes
- ◯ No
- ◯ N/A

* 13. Does your street have a sidewalk?

- ◯ Yes
- ◯ No

14. Do you think that your street needs a sidewalk?

- ◯ Yes
- ◯ No
- ◯ N/A

15. Does your home have a roadside ditch along the frontage of your property?

- ◯ Yes
- ◯ No
- ◯ Don't know

16. Are you willing to mow the grass in a roadside ditch along your property frontage?

- ◯ Yes
- ◯ No

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Delaware Stormwater Master Plan

Additional Information

17. Have you recently experienced any issues with your septic system?

- ◯ Yes
- ◯ No

18. If yes, do these problems occur during...

- ☐ storm events
- ☐ spring snow melt
- ☐ neither

Other - Please provide any additonal information regarding septic system issues

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Delaware Stormwater Master Plan

The end!

Thank you for taking the time to fill out the survey, and for your participation in the Delaware Stormwater Servicing Master Plan. If you would like to be kept up to date on the Study, please include your contact information below.

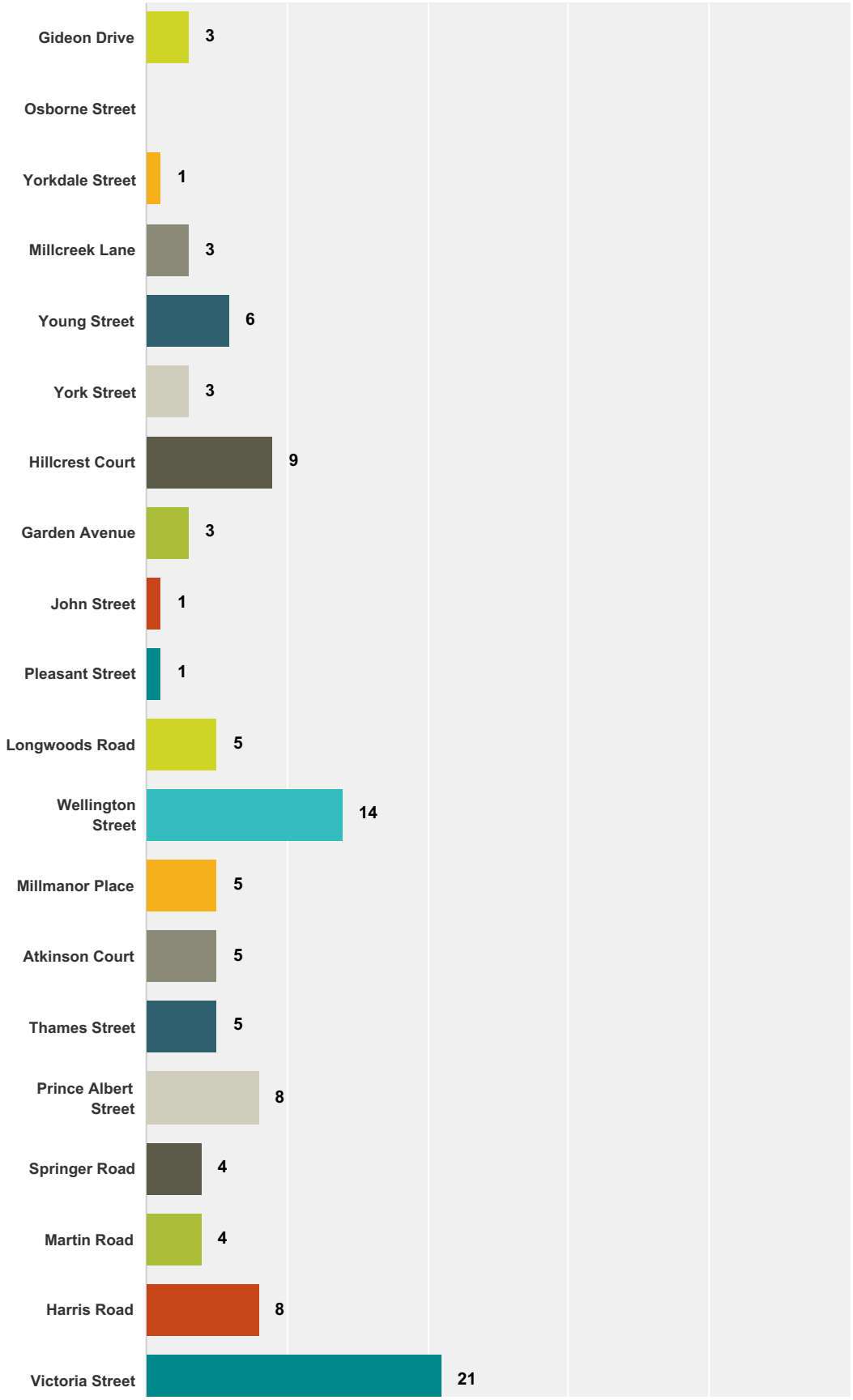
19. Address

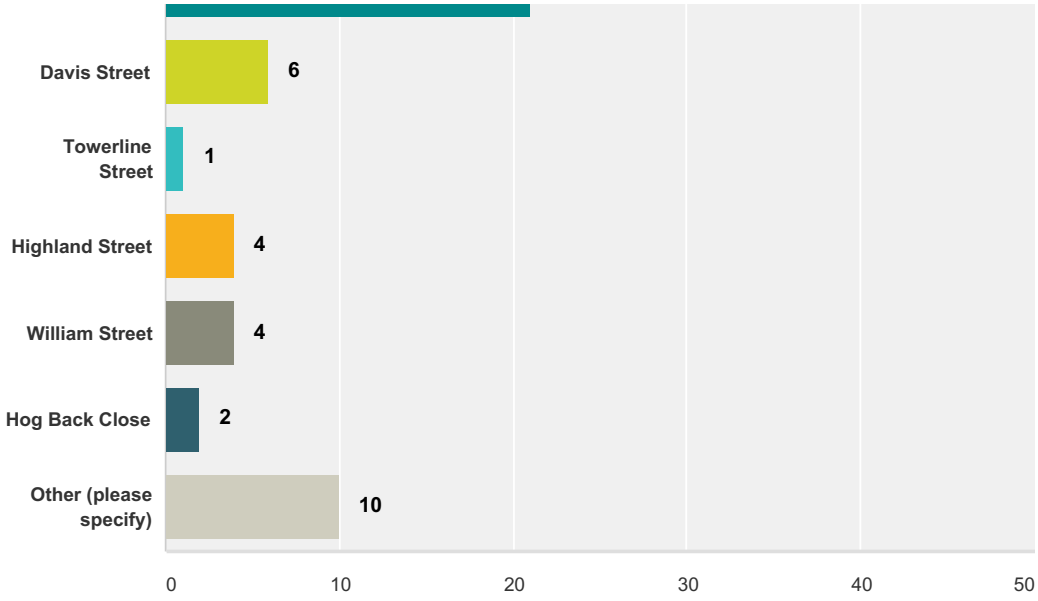
Name	
Address	
Address 2	
City/Town	
State/Province	
ZIP/Postal Code	
Country	
Email Address	
Phone Number	

Delaware Community Settlement Area Stormwater Master Plan
Result Summary from Online Public Survey

Q1 What street do you live on?

Answered: 136 Skipped: 0





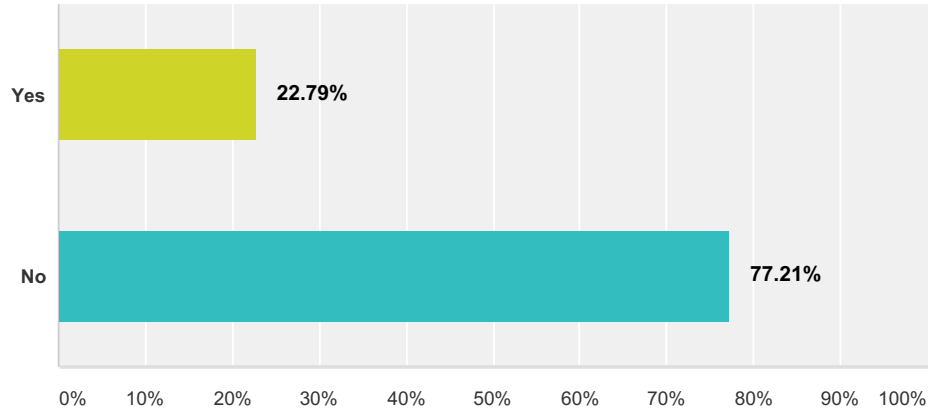
Answer Choices	Responses	
Gideon Drive	2.21%	3
Osborne Street	0.00%	0
Yorkdale Street	0.74%	1
Millcreek Lane	2.21%	3
Young Street	4.41%	6
York Street	2.21%	3
Hillcrest Court	6.62%	9
Garden Avenue	2.21%	3
John Street	0.74%	1
Pleasant Street	0.74%	1
Longwoods Road	3.68%	5
Wellington Street	10.29%	14
Millmanor Place	3.68%	5
Atkinson Court	3.68%	5
Thames Street	3.68%	5
Prince Albert Street	5.88%	8
Springer Road	2.94%	4
Martin Road	2.94%	4
Harris Road	5.88%	8
Victoria Street	15.44%	21
Davis Street	4.41%	6

Towerline Street	**0.74%**	1
Highland Street	**2.94%**	4
William Street	**2.94%**	4
Hog Back Close	**1.47%**	2
Other (please specify)	**7.35%**	10
Total		**136**

#	Other (please specify)	Date
1	Davis Street	9/1/2015 8:59 AM
2	Carriage Rd	9/1/2015 8:50 AM
3	Atkinson Crt.	8/1/2015 7:30 PM
4	Elizabeth St	8/1/2015 6:04 PM
5	Blosdale Crescent Blosdale Cres	8/1/2015 3:26 PM
6	Garden	7/31/2015 10:43 PM
7	Blosdale Crescent Blosdale	7/30/2015 1:07 PM
8	Elmview Drive	7/29/2015 7:55 PM
9	Blosdale Crescent Blosdale	7/29/2015 1:40 PM
10	Springer road	7/21/2015 8:34 PM

Q2 Have you ever experienced surface flooding on your property in Delaware?

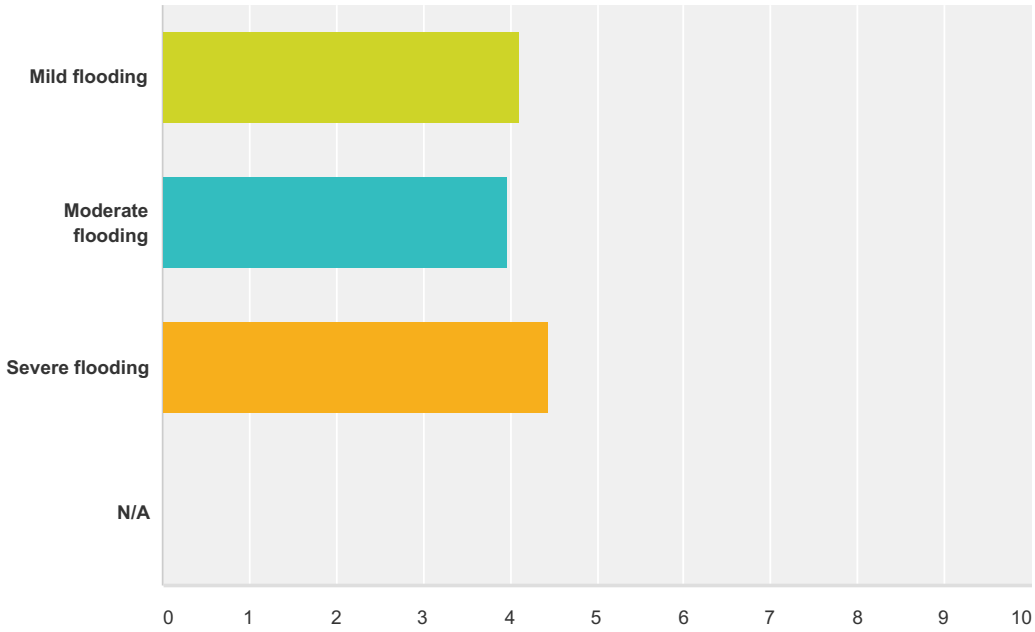
Answered: 136 Skipped: 0



Answer Choices	Responses	
Yes	**22.79%**	31
No	**77.21%**	105
Total		**136**

Q3 If so, how often and how severe is the flooding?

Answered: 71 Skipped: 65



	More than once a month	About once a month	About once every 3 months	About once every 6 months	About once a year	Less than once a year	Total	Weighted Average
Mild flooding	**6.78%** 4	**3.39%** 2	**5.08%** 3	**11.86%** 7	**11.86%** 7	**61.02%** 36	59	4.12
Moderate flooding	**10.34%** 3	**3.45%** 1	**6.90%** 2	**6.90%** 2	**17.24%** 5	**55.17%** 16	29	3.97
Severe flooding	**4.55%** 1	**0.00%** 0	**4.55%** 1	**9.09%** 2	**4.55%** 1	**77.27%** 17	22	4.45
N/A	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	0	0.00

#	Comments for "Mild flooding"	Date
1	Spring run off	9/1/2015 8:50 AM
2	winter thaw and heavy rainfall flooding occurs at storm drain	8/23/2015 2:23 PM
3	runoff from heavy precipitation	8/20/2015 11:27 AM
4	Any day of rain up to 10mm	8/20/2015 9:18 AM
5	Spring melt in open field	8/17/2015 3:18 PM
6	starts in library parking lot & continues in our back yard	8/13/2015 7:08 AM
7	When it rains	8/11/2015 4:45 PM
8	spring thaw	8/11/2015 4:32 PM
9	Large Puddles in low area of lawn	8/11/2015 4:31 PM
10	Not overly significant but at times the yard may get an inch or two of water	8/8/2015 8:23 AM
11	I believe water seeps through my foundation floor along with entering via window wells	8/7/2015 2:54 PM
12	water pools in the easement beside our lot for months in the spring	8/7/2015 12:10 PM
13	During heavy rain	8/6/2015 8:09 AM
14	n/a	8/4/2015 8:31 PM

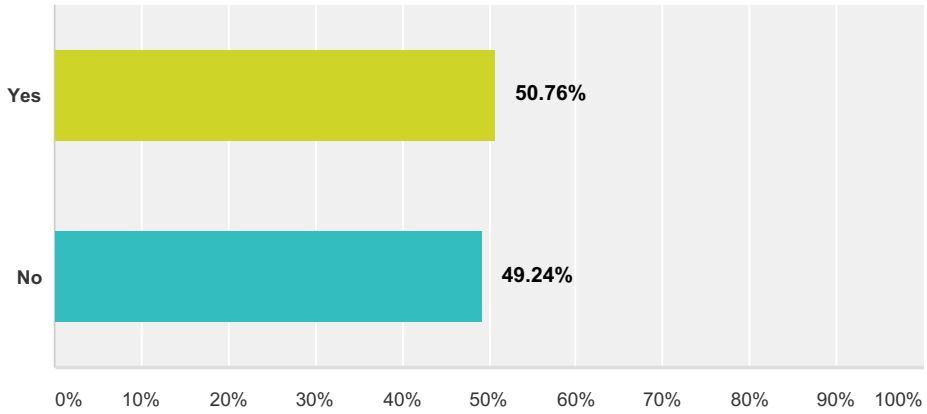
15	no surface flooding but if water table gets high it will enter home	8/3/2015 7:10 PM
16	Only after a heavy rainstorm, creates puddle at end of driveway. Gone in a day.	8/2/2015 1:01 PM
17	No flooding on my property	8/2/2015 9:39 AM
18	Answerd "NO" to question 2 - however question 3 requires an answer to continue? - checked box should read "more than once a year" ?	7/31/2015 11:07 PM
19	Very minor water pooling after heavy rains. Sandy soil area so it drains quickly.	7/31/2015 3:00 PM
20	Bottom 6 feet of driveway to the road will flood every time there is significant rainfall or melt	7/31/2015 2:37 PM
21	none	7/31/2015 11:00 AM
22	The back 10 to 15 feet of the property gets flooded with standing water after a heavy or prolonged rainfall. Usually only lasts a day or two. It has gotten worse in the past few years - my immediate neighbour (at #86) also now gets some flooding and he believes it's because his neighbour to the east (#88) has built up his rear yard preventing stormwater from draining. My recollection of the engineer's drainage plan was that water from our back yards was supposed to flow east along our rear property lines and then north once it got to the back of the last house at end of the crescent. However, the flooding is not a major problem in my opinion, just some standing water for a day or two.	7/31/2015 10:21 AM
23	I answerd NO to Q2 but it's forcing me to answer this question...	7/31/2015 9:55 AM
24	---	7/30/2015 5:59 PM
25	Never seen any flooding	7/30/2015 1:09 PM
26	no flooding	7/30/2015 12:34 PM
27	driveway	7/30/2015 11:55 AM
28	back of property ubder water	7/30/2015 9:25 AM
29	side drainage ditch floods every time sump pump goes off	7/29/2015 8:33 PM
30	we are located in a gully so we have water build up	7/29/2015 8:27 PM
31	none	7/29/2015 2:56 PM
#	**Comments for "Moderate flooding"**	**Date**
1	We built 9 years ago and during this time i have replaced 3 sump pumps. on average my pump runs every 12 mins or more after a heavy rain.	9/20/2015 5:12 PM
2	Any day of rain 10 - 20mm	8/20/2015 9:18 AM
3	large river in back yard	8/13/2015 7:08 AM
4	Rain water drains off roads onto my front lawn. 10 inches deep.	8/10/2015 4:34 PM
5	I believe water seeps through my foundation floor along with entering via window wells	8/7/2015 2:54 PM
6	n/a	8/4/2015 8:31 PM
7	No	8/2/2015 1:01 PM
8	dingman creek overflows banks	8/1/2015 7:32 PM
9	as aboove	7/31/2015 11:07 PM
10	none	7/31/2015 11:00 AM
11	---	7/30/2015 5:59 PM
12	Every time it rains	7/29/2015 9:16 PM
13	3" diameter Municipal drain cannot keep up with thaws	7/29/2015 5:21 PM
14	I live along the Dingman Creek and when there is severe rainfall or ice melt it can be severe. However the water does not reach the level of the house or main backyard area.	7/29/2015 4:52 PM
15	none	7/29/2015 2:56 PM
16	low grass areas covered	7/29/2015 1:28 PM
17	puts our septic system out of order for days at a time.	7/29/2015 11:39 AM
#	**Comments for "Severe flooding"**	**Date**

1	water in ditch doesnt have an outlet and overflows on front of proerty	8/30/2015 6:15 PM
2	Any day of rain 20mm - and above	8/20/2015 9:18 AM
3	Severe Rain & Flooded Basement	8/7/2015 12:15 PM
4	n/a	8/4/2015 8:31 PM
5	We are fairly new to the community but twice in the last 8 months, our property has flooded when the Storm sewer/catch basin in front of our house could not keep up with heavy rainfall. The latest was the heavy rains on June 28th, 2015 when the ditch filled almost to road level. Our basement flooded as a result. Our sump pump, which normally runs very infrequently, ran non-stop for almost a week. It ran frequently for an additional week. It was over two weeks before the water level dropped to normal. The storm drains were not taking the water away fast enough. It took several days for the water to drop below the top of the catch basin cover. There definitely seems to be a blockage in the drainage system somewhere.	8/4/2015 10:40 AM
6	No	8/2/2015 1:01 PM
7	as above	7/31/2015 11:07 PM
8	after a large rain fall back yard flooded in June 2015	7/31/2015 5:46 PM
9	none	7/31/2015 11:00 AM
10	---	7/30/2015 5:59 PM
11	spring thaw	7/29/2015 4:52 PM
12	none	7/29/2015 2:56 PM
13	severe enough to keep our septic system from functioning for weeks at a time, requiring the rental of a portable toilet.	7/29/2015 11:39 AM

#	Comments for "N/A"	Date
	There are no responses.	

Q4 Have you ever seen surface flooding in Delaware after heavy rainfall or spring snowmelts?

Answered: 132 Skipped: 4



Answer Choices	Responses	
Yes	50.76%	67
No	49.24%	65
Total		132

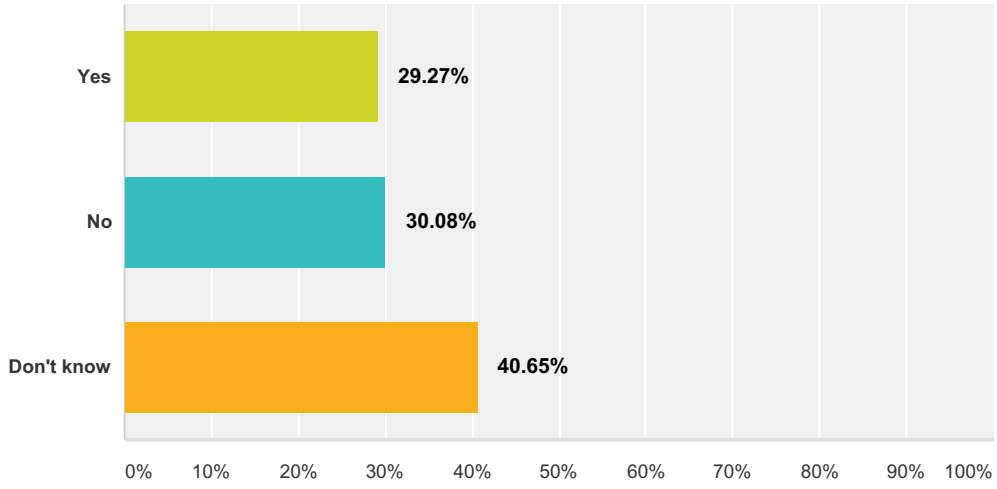
#	If yes, please describe the location and severity of the flooding.	Date

1	some roads and intersections	12/1/2015 4:17 PM
2	Culverts completely filled all along Wellington Street.	10/2/2015 11:46 PM
3	The property to the east of us will have 6-8 inches of standing water after a heavy rain or spring snowmelt.	9/20/2015 5:12 PM
4	Sidewalks on York Street	9/1/2015 8:57 AM
5	on north side of property	9/1/2015 8:50 AM
6	11110 Longwoods (TRY) office, large pond forms	8/30/2015 6:15 PM
7	along longwoods rd enough water to cover roadway and ditches	8/23/2015 2:23 PM
8	Once, June 23 on Longwoods Road, across from Grace Motors (forget the name of the business)	8/21/2015 3:01 PM
9	The big one seven years ago or so....up to the shoulders of Gideon Rd	8/20/2015 11:27 AM
10	West side and rear of my lot - where 3 other properties join.	8/20/2015 9:18 AM
11	Near the river, out on the edge of town up on the hill	8/20/2015 9:11 AM
12	field behind Legion (south); towards Thames River	8/18/2015 6:39 PM
13	Along the Thames, Gideon Dr.	8/17/2015 3:45 PM
14	9736 Longwoods Road - 3 times in 9 months, water was 3 feet deep while standing on driveway. The entire hom was surrounded by flooding. Hwy 2 had 3-5 inches of water running over it	8/17/2015 3:41 PM
15	Short term flooding on west side of martin road	8/17/2015 3:18 PM
16	Along Thames river and behind legion	8/17/2015 3:16 PM
17	near the school and church	8/17/2015 8:13 AM
18	by the river, Legion area	8/13/2015 1:14 PM
19	Library parking lot to our back yard	8/13/2015 7:08 AM
20	Gideon rd at oldcatholic school and church	8/12/2015 2:05 PM
21	In front of Don's variety/baitshop	8/11/2015 4:45 PM
22	Catholic Church	8/11/2015 4:42 PM
23	Moderate flooding in back yard	8/11/2015 4:32 PM
24	In backyard	8/11/2015 4:31 PM
25	Rain water drains off roads onto my front lawn. 10 inches deep.	8/10/2015 4:34 PM
26	The Thames river	8/9/2015 10:52 AM
27	Longwoods Rd between Springer & Martin	8/8/2015 10:28 AM
28	Fields, some properties close to home on wellington and Martin street	8/8/2015 8:23 AM
29	Basement - Moderate	8/7/2015 2:54 PM
30	Back yard catch basin & neighbours front catch basin	8/7/2015 12:15 PM
31	water pools in the easement and in the culvert on our front property and also in the corn field behind our house	8/7/2015 12:10 PM
32	Front and back of my yard	8/7/2015 9:45 AM
33	Roadside near Grace Motors	8/6/2015 8:12 AM
34	Ditch on Victoria Street	8/6/2015 8:09 AM
35	Fields - Wellington St.	8/6/2015 8:05 AM
36	york street	8/4/2015 8:31 PM
37	as above	8/4/2015 10:40 AM
38	Similar to above question. Doesn't last, except maybe in a farm field	8/2/2015 1:01 PM
39	The adjacent property behind our property floods after both heavy rains and snow melt to the extent of 6-8 inches of waterways for several days	8/2/2015 10:31 AM

40	By the river--The yard at OLOL the Old School & the bridge by the river	8/2/2015 9:39 AM
41	River flats	8/1/2015 7:32 PM
42	Down by the river	8/1/2015 6:05 PM
43	goes away after frost leaves ground	8/1/2015 3:31 PM
44	23 York st side yard large pond and side walk from Longwoods to Wellington on York east side.	7/31/2015 5:46 PM
45	Near the River, Severe at times	7/31/2015 3:00 PM
46	only near the river after a major snow thaw	7/31/2015 11:00 AM
47	Mostly farmer's fields either side of the river but some residential properties very close to river. Also sometimes on the east side of Gideon (again farmer's fields)	7/31/2015 9:55 AM
48	The soccer field near the legion floods fairly regularly	7/30/2015 4:45 PM
49	22 Garden Ave - Severe flooding of Back Yard. Pleasant Street - road flooded near #578 Legion causing road closure	7/30/2015 1:34 PM
50	2 John St, and Pleasant St, behind the legion and surrounding fields, all severe	7/30/2015 12:34 PM
51	property at the bottom of hill along York street and in area beside Upper Thames	7/30/2015 11:55 AM
52	Numerous locations on Longwoods at the top of Delaware, on Gideon in the flats around Vanos, Sacred Heart, etc.	7/30/2015 9:26 AM
53	Every rain and when the snow melts	7/29/2015 9:16 PM
54	fields located south and north of Longwoods Rd, east of Springer Rd and Victoria St	7/29/2015 8:33 PM
55	river swells severly	7/29/2015 8:27 PM
56	Gideon Rd. near old Catholic School	7/29/2015 7:33 PM
57	All/any low lying areas	7/29/2015 5:21 PM
58	on Gideon along the Thames River near Vanos Insulation	7/29/2015 4:52 PM
59	Near blocked storn sewers and near the old Catholic school. Flooding was usually moderate.	7/29/2015 4:28 PM
60	low grass areas are so covered grass cutting not possible	7/29/2015 1:28 PM
61	THAMES RIVER OVERFLOW	7/29/2015 1:05 PM
62	our location on Longwoods rd, this year there was enough standing water to support a mother duck and her 13 ducklings	7/29/2015 11:39 AM

Q5 Stormwater runoff for much of Delaware is conveyed by municipal drains rather than urban storm sewers. The main difference is that maintenance for municipal drains is paid as a lump sum by the benefitting property owners to the municipality, while maintenance for urban storm sewers is paid through general property taxes. Is your home serviced by a Municipal Drain?

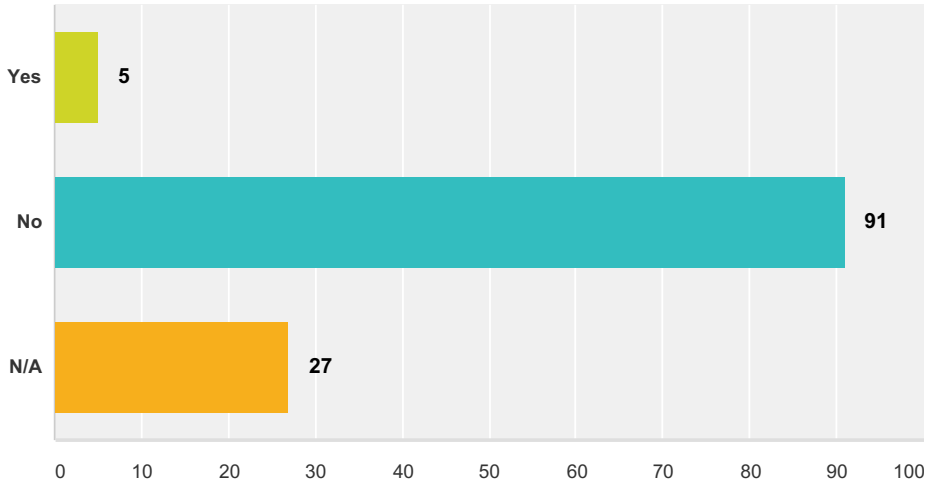
Answered: 123 Skipped: 13



Answer Choices	Responses	
Yes	**29.27%**	36
No	**30.08%**	37
Don't know	**40.65%**	50
Total		**123**

Q6 Have you ever received a Notice of Assessment for Municipal Drain maintenance?

Answered: 123 Skipped: 13

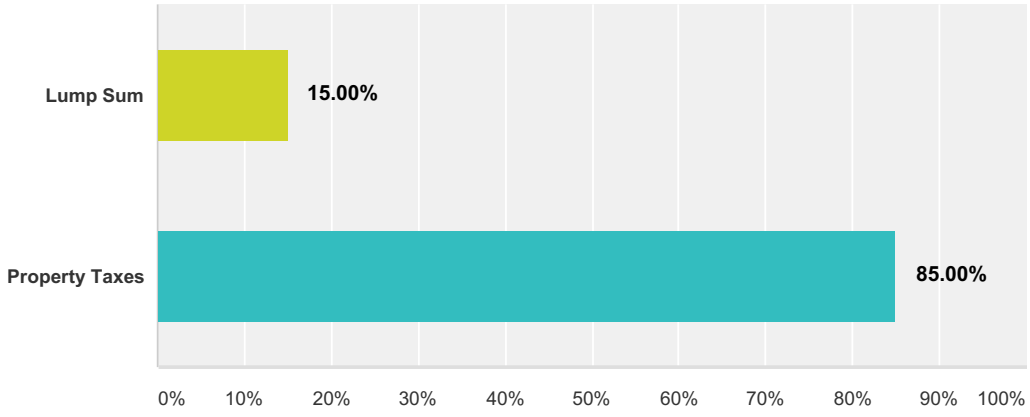


Answer Choices	Responses	
Yes	**4.07%**	5
No	**73.98%**	91
N/A	**21.95%**	27

Total	123

Q7 Would you prefer to pay for drainage servicing as a lump sum or through your general property taxes?

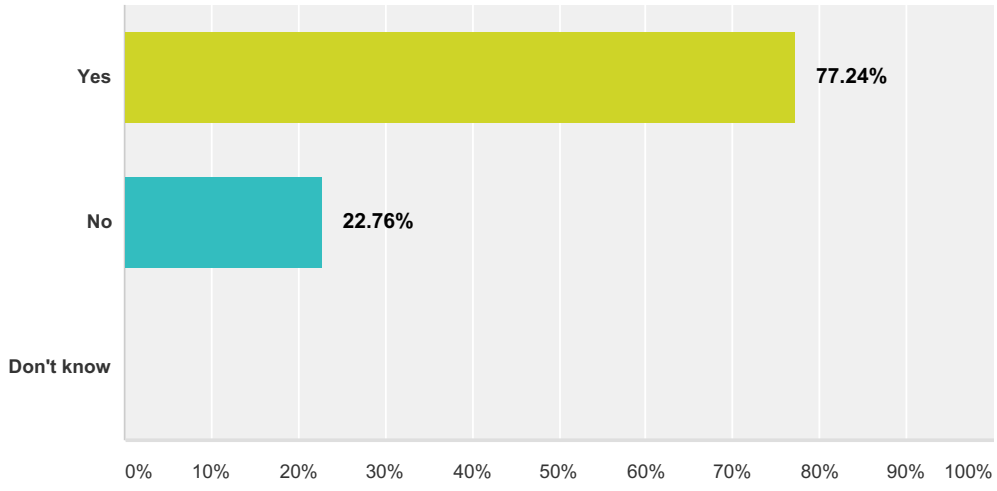
Answered: 120 Skipped: 16



Answer Choices	Responses	
Lump Sum	**15.00%**	18
Property Taxes	**85.00%**	102
Total		**120**

Q8 Does your home have a sump pump?

Answered: 123 Skipped: 13

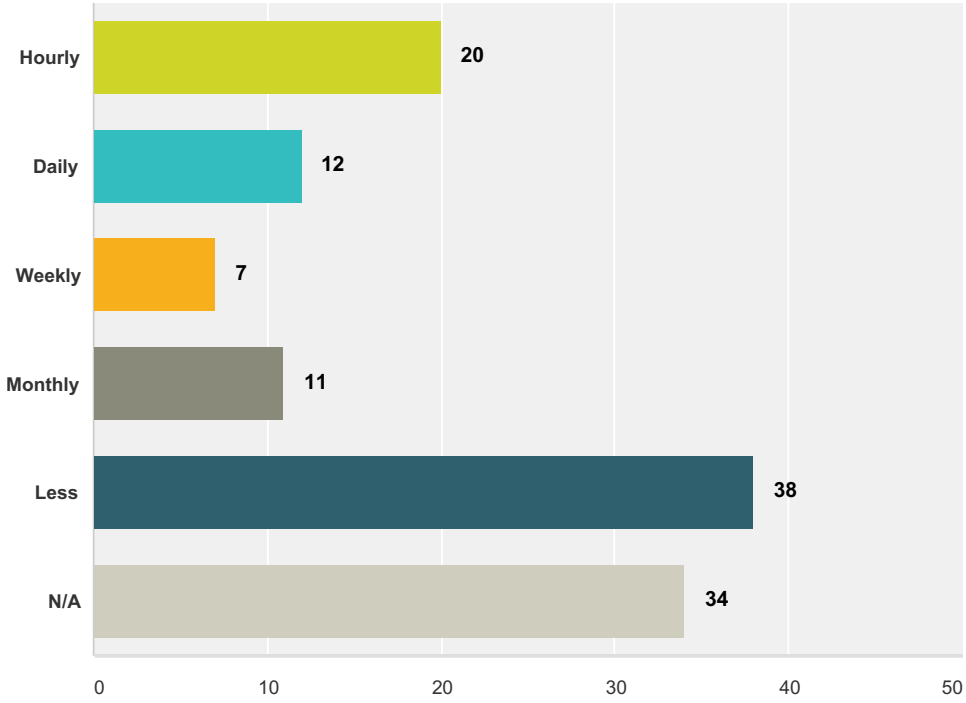


Answer Choices	Responses	
Yes	**77.24%**	95
No	**22.76%**	28

Don't know	**0.00%**	0
Total		**123**

Q9 If so, how frequently does your sump pump typically run?

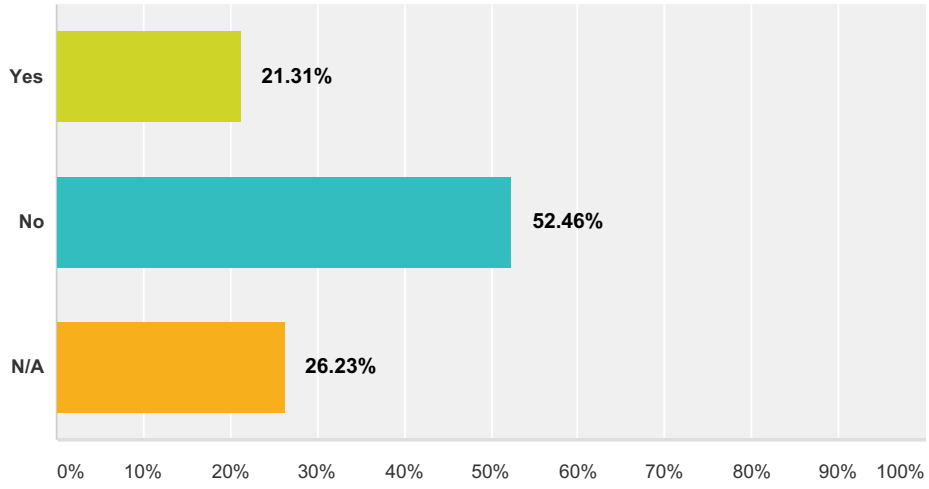
Answered: 122 Skipped: 14



Answer Choices	Responses	
Hourly	**16.39%**	20
Daily	**9.84%**	12
Weekly	**5.74%**	7
Monthly	**9.02%**	11
Less	**31.15%**	38
N/A	**27.87%**	34
Total		**122**

Q10 Do you think your sump pump runs too frequently?

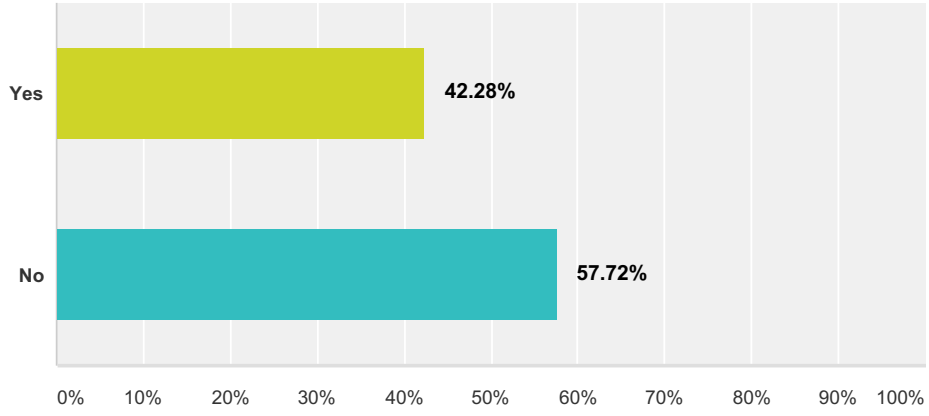
Answered: 122 Skipped: 14



Answer Choices	Responses	
Yes	21.31%	26
No	52.46%	64
N/A	26.23%	32
Total		122

Q11 Does your street have curbs along the road?

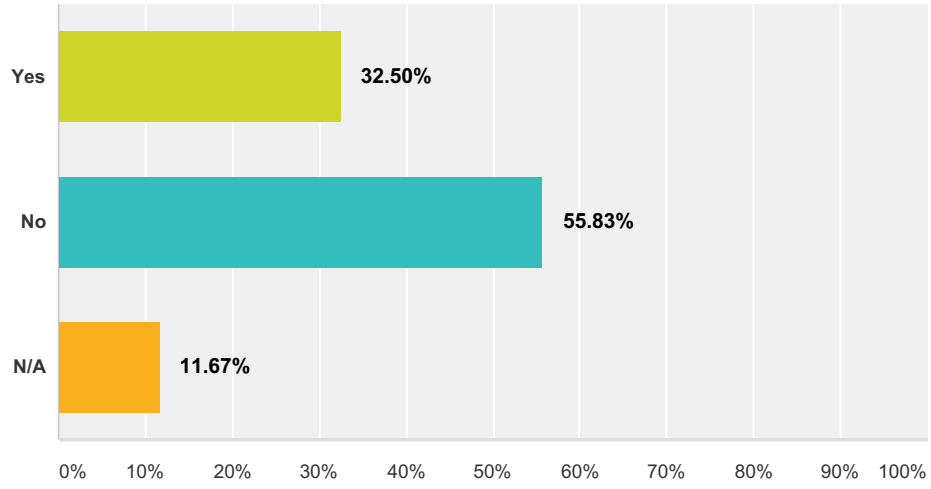
Answered: 123 Skipped: 13



Answer Choices	Responses	
Yes	42.28%	52
No	57.72%	71
Total		123

Q12 Do you think your street needs curbs?

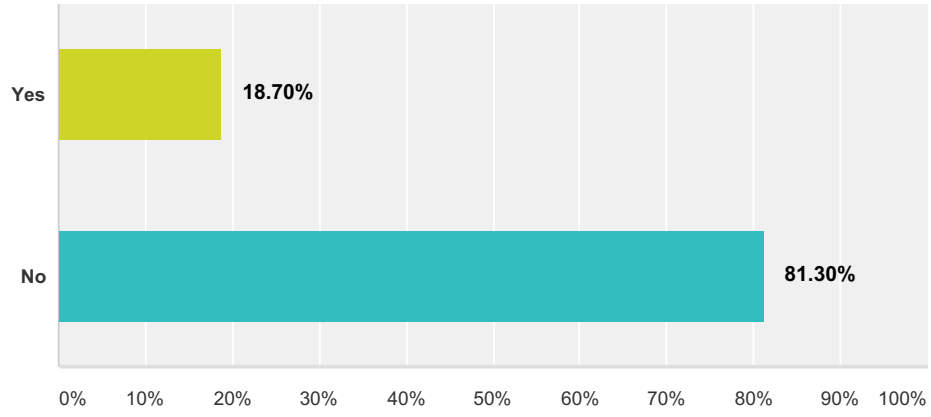
Answered: 120 Skipped: 16



Answer Choices	Responses	
Yes	32.50%	39
No	55.83%	67
N/A	11.67%	14
Total		120

Q13 Does your street have a sidewalk?

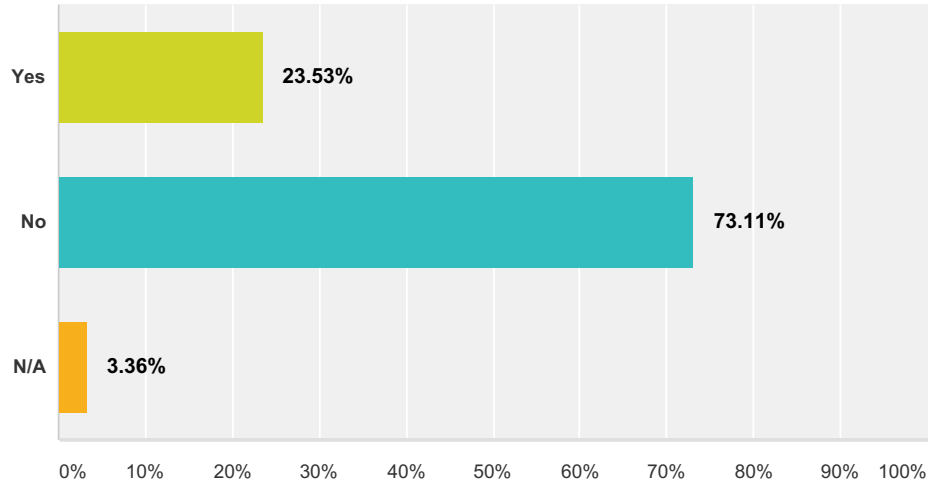
Answered: 123 Skipped: 13



Answer Choices	Responses	
Yes	18.70%	23
No	81.30%	100
Total		123

Q14 Do you think that your street needs a sidewalk?

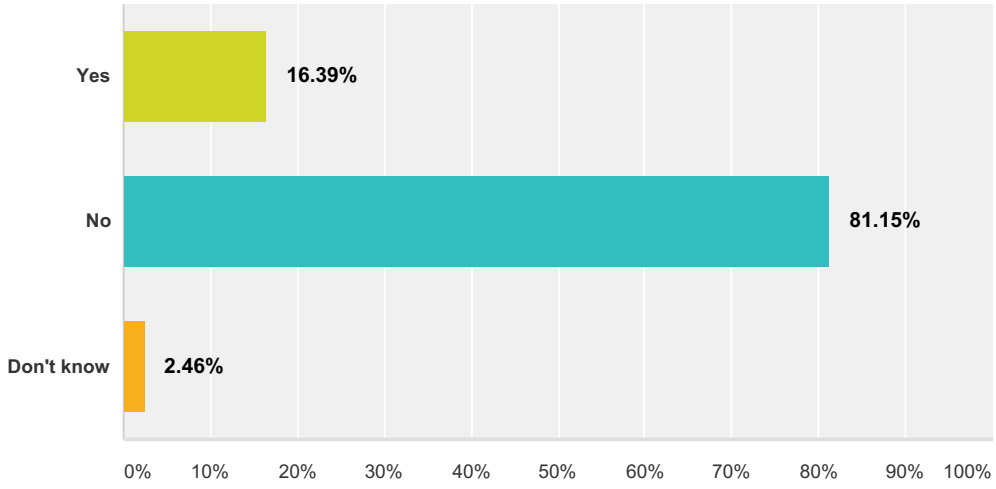
Answered: 119 Skipped: 17



Answer Choices	Responses	
Yes	23.53%	28
No	73.11%	87
N/A	3.36%	4
Total		119

Q15 Does your home have a roadside ditch along the frontage of your property?

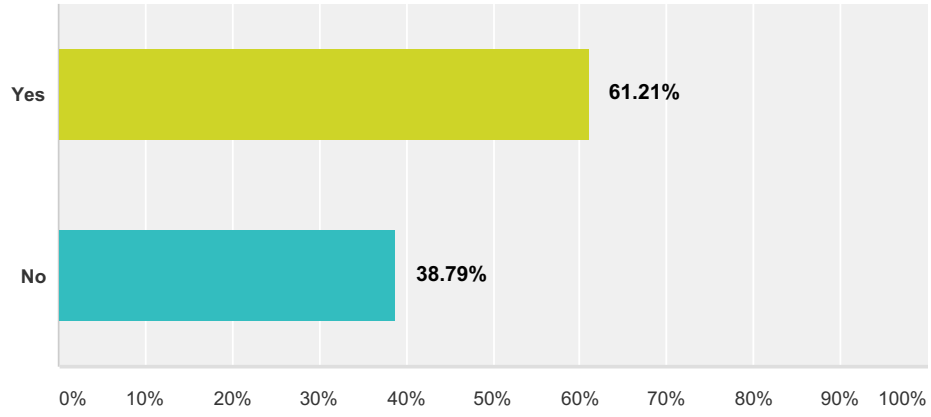
Answered: 122 Skipped: 14



Answer Choices	Responses	
Yes	16.39%	20
No	81.15%	99
Don't know	2.46%	3
Total		122

Q16 Are you willing to mow the grass in a roadside ditch along your property frontage?

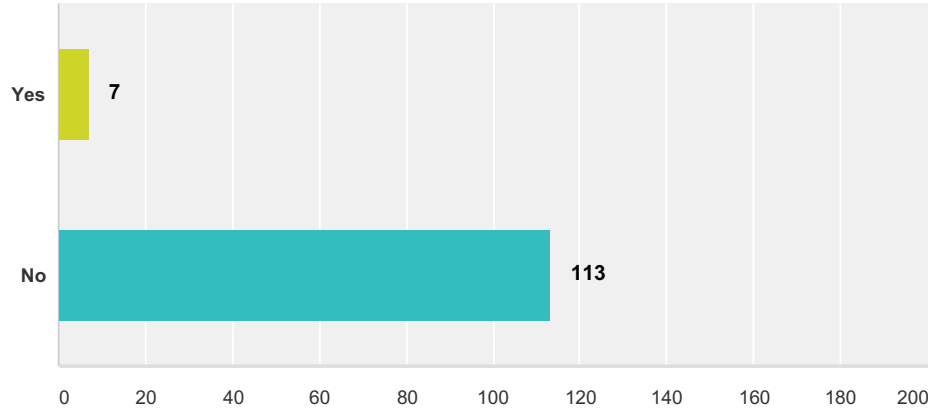
Answered: 116 Skipped: 20



Answer Choices	Responses	
Yes	61.21%	71
No	38.79%	45
Total		116

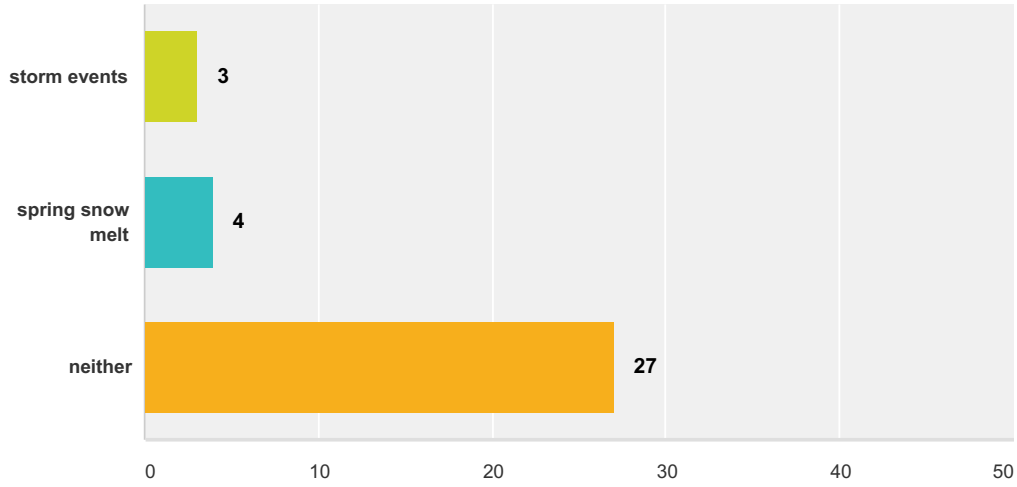
Q17 Have you recently experienced any issues with your septic system?

Answered: 120 Skipped: 16



Q18 If yes, do these problems occur during...

Answered: 32 Skipped: 104



Answer Choices	Responses	
storm events	**9.38%**	3
spring snow melt	**12.50%**	4
neither	**84.38%**	27
Total Respondents: 32		

#	Other - Please provide any additonal information regarding septic system issues	Date
1	Not Applicable	8/20/2015 12:25 PM
2	I have only once in the last 10 years seen any water in my sump and only then less than a cup full. I check my sump monthly to ensure it still operates correctly without seeing any water.	8/20/2015 11:10 AM
3	From question 5. ? catch basin along front corner of lot. Question 7.... this is a problem from adjoining lots draining on to my lot - they have no drainage!	8/20/2015 9:25 AM
4	Recently pumped; no problems	8/18/2015 6:41 PM
5	No septic system issues but storm water will potentially cause issues if it is not kept under control. I would much prefer good storm water management over other local improvements like sanitary sewers or sidewalks. Storm water management has to be the first priority.	8/4/2015 10:43 AM
6	no issues	8/3/2015 7:10 PM
7	It is just old and small so a bit slow	8/2/2015 1:04 PM
8	We feel that the loam is 5 feet of sand and a ditch would bring us closer to the water table	8/2/2015 9:43 AM
9	Every spring we have multiple issues with our septic system	7/29/2015 8:30 PM
10	I have a storm sewer runoff into a creek located beside my property. This has caused an increase of erosion along my property.	7/29/2015 5:08 PM
11	my sump pump runs almost continuously due to county error in approving my home being built to low in the ground. It has cost my thousands of dollars.	7/29/2015 1:31 PM

Q19 Address

Answered: 70 Skipped: 66

Answer Choices	Responses	
Name	**95.71%**	67
Company	**0.00%**	0

 Please Note: Names and Contact Information have been removed to protect privacy of survey participants

Appendix A4 – Public Information Centre

NOTICE OF PUBLIC INFORMATION CENTRE

Delaware Community Settlement Area Stormwater Master Plan

A comprehensive Stormwater Master Plan is being developed for the Delaware Community Settlement Area to identify necessary storm drainage system improvements to better service the existing community, and provide a drainage servicing strategy to accommodate future growth and development. The study is following a Master Planning approach under the Municipal Class Environmental Assessment Process in compliance with the Municipal Engineers Association document "Municipal Class Environmental Assessment," (October 2000, as amended in 2007 and 2011). The study will enable the Municipality of Middlesex Centre to identify opportunities and implement individual storm drainage works over time, which collectively become part of a larger stormwater management system.

A key component of the study is consultation with members of the public, landowners and regulatory agencies. An online survey was previously distributed to gather input from residents on their existing stormwater conditions or concerns. The input received from these surveys has been incorporated into the development of alternative solutions to better address the existing stormwater drainage concerns within the community of Delaware.

A Public Information Centre (PIC) is scheduled to review existing environmental conditions and solicit input on the overall stormwater management plan. The PIC is scheduled for Thursday, October 8th, 2015 from 4:30pm-6:30pm at the Delaware Community Centre, 2652 Gideon Drive. Subject to comments received and the receipt of necessary approvals, Middlesex Centre intends to proceed with the finalization of this project in 2015.

All information presented at the PIC will be made available on the Municipality of Middlesex Centre website http://www.middlesexcentre.on.ca. If you are unable to attend the PIC, and would like to provide comments or receive further information, please contact either of the following:

Municipality of Middlesex Centre
Brian Lima, P.Eng.
Director – Public Works and Engineering
10227 Ilderton Road RR2
Ilderton, ON N0M 2A0
Phone: (519)-666-0190 ext.233
Fax: (519) 666-0271
Email: lima@middlesexcentre.on.ca

Stantec Consulting Ltd.
Corri Marr, H.B.Sc.
Senior Planner
600-171 Queens Avenue
London, ON N6A 5J7
Phone: (519) 675-6668
Fax: (519) 645-6575
Email: corri.marr@stantec.com

Designing the future

By Jason Rip
Special to Londoner

Melanie and Mike Rhora have built an ultra-modern business in a beautiful heritage building.

Partners both in business and in life, the Rhoras are celebrating their fifth anniversary as a designer of websites. Melanie is Chief Web Strategist (the business takes its name from Melanie's initials) and Mike is Director of Marketing.

Even though their staff of eight "coders" work mostly from home, MVR Solutions has its head office in the Hyde Park Olde School Professional Building at 1124 Gainsborough Road. Although their business originated in Hamilton, the Rhoras began to take on many London clients, including Western University, and decided "to move to where the business was." MVR has been in London for a little over a year.

MVR Solutions is also in the business of donating their design services to worthy causes. They recently created the webpage for an initiative they support, the Oxford Invitational Youth Robotics Challenge.

The Oxford Invitational Youth Robotics Challenge began in 2005 and has been providing a decade of fun and learning for young engineers throughout the region.

Their mission is "To give youth hands-on experience in design, construction, and team problem solving by building and programming a robot for an industrial-type task."

They are a community-based partnership that "encourages youth of high school age to consider rewarding careers in engineering, technology, or the skilled trades."

Young people work closely with mentor coaches, mostly recruited from industry partners such as Toyota and Execulink. Teams of four to five high school-aged students come to the Challenge representing their school, club, or youth group under such colourful team names as "Wildbots" and "Cyber Huskies."

They are given a Lego Mindstorms kit and very little else (No glue, tape, wire, etc. allowed.) The challenge is issued eight weeks in advance: last year's challenge was to construct a "factory part supplying robot" that could sort objects of various colours.

CONTINUED ON PAGE 44

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NOTICE OF PUBLIC INFORMATION CENTRE

Delaware Community Settlement Area Stormwater Master Plan

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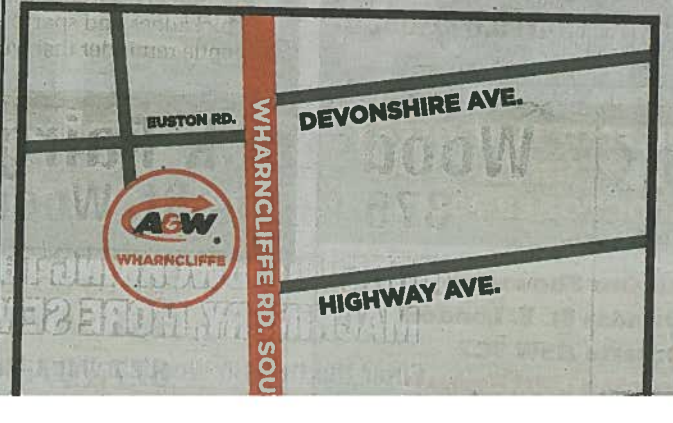

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londoner listings

Women's Group
A support group for women who have a loved one involved in the criminal justice system. Takes place every Tuesday from 5:30 pm to 7:30 pm at the John Howard Society of London and District, 601 Queens Avenue. Contact Juli at 519-438-4168 Ext. 225 or jmcgrenere@jhslondon.on.ca

- **Suicide Bereavement Peer Support Group**
- The peer support group is run by individuals who have experienced a suicide loss. Meetings are held on the 2nd Tuesday of the month, from 7-9 pm, and are open to anyone who has been affected by a loss resulting from suicide. Contact: Bereave-ment Services Coordinator, CMHA London-Middlesex, 648 Huron St. London, 519-434-9191 ext. 244 or grief@london.cmha.ca

Grief Share
is a 13-week seminar and support group for people grieving the loss of a spouse, child, family member, or friend. It is led by people who understand what you are experiencing and want to offer you comfort and encouragement during this difficult time. Each week is a DVD instruction and group discussion. GriefShare happens Thursday evenings from 7:00-9:00 p.m. beginning September 17. The cost is $20. For more information or to register, please contact West Park Church at 519.471.7460 or griefshare@westpark.on.ca.

(SWIM) Single Women in Motherhood
is excited to announce its new life coaching program for moms. The first part of the program is a six-week workshop that includes practical goal setting, creating new patterns of thinking and providing empowerment through education. Part 2 includes individual life coaching sessions. The program begins on Monday, March 2. Women are encouraged to register quickly to ensure a spot in the program. Contact the SWIM office at (519) 432-5454 or email admin@singlewomeninmotherhood.com.

Nar-Anon
Nar-Anon Family Group is a Twelve Step program for relatives and friends affected by someone's addiction. Steps to Serenity Group meet each Thursday evening 7:00 - 8:00 at Salvation Army Church, 1190 Southdale Rd E at Millbank Dr (side door).
email: stepslondon@gmail.com
Toll Free Helpline: 1-877-239-0096
Website: www.naranonontario.com

Crohn's and Colitis Canada - London chapter invites you to their monthly get togethers. Join the CCC to talk to others with irritable bowel disease (IBD). Friends and family are welcome. Next meeting: Thursday April 9 Cherryhill Library (small meeting room), 7pm. No topic this evening but please join us for a year-end social gathering & potluck (if you want to, please bring a snack to share). Email: London@crohnsandcolitis.ca

Brain Tumour Foundation Support Group
If you have been diagnosed with a brain tumour, this group offers support to you in your journey. Caregivers are welcome. Meetings are the first Tuesday of each month, 7-9 pm at the First Baptist Church, 568 Richmond St.,London. For more info call 519-642-7755 or visit www.braintumour.ca or thhttp://www.braintumour.ca/282/london-ontario

Y.A.N.A.
You Are Not Alone
Are you giving support to a person with a mental illness? Come Share your wisdom and resources, lighten your worries and deepen your faith. We meet at 7:00pm. The second Wednesday of the month. Mark your calendar. All welcome. For more information call Cathie: 519-850-0600.

Alcoholics Anonymous
If you drink that's your business. If you want to stop, that's ours. 24 hours hotline 519-438-1122

NEW DAY: A Support Group
Faith in Recovery for persons with a Mental Illness. Tuesdays 1:30 – 3:00pm at St. Peter's Cathedral Basilica, Parish Centre Rm. 105, 533 Clarence St. Info: 226-377-4831

London Ballroom Dance Club Registration
Join us for our annual registration at the Woodland Heights Public School (474 Springbank Drive) starting at 7 pm. Register for classes, workshops, become a member, make new friends and have fun! Open to 16+. Partner required. www.londonballroomdanceclub.ca

TOPS (Take Off Pounds Sensibly)
Affordable weight loss with weekly support, $36/yr and then $2.50 a week includes monthly magazine. Fish and Game at 790 Southdale Road East. Every Tuesday 6:00pm – 8:00pm. email barbkilcan@gmail.com for more info.

London And District Stroke Recovery Association/March Of Dimes Canada
Meetings: 3rd Tuesday of the month 1:30pm - 3:30pm. Cards:Every Friday,10am at the Moose Lodge, 6 Weston St. .London. 1-800-263-3463, ext. 7763

SARI Therapeutic Riding is proud to offer "Little Britches"
A program for children of all abilities, aged 4 to 12. Activities include crafts, games, songs, horsemanship lessons, farm discovery, and pony rides. Program cost is $120 and meets one Sunday per month: April 19th, May 24th, June 14th. Children aged 4-8 can register for morning (9am-12pm), children aged 8-12 can register for afternoon (1-4pm). Applicants with special needs will require an assessment by staff and a therapist for the pony rides. Applications available at www.sari.ca or call 519-666-1123.

Alzheimer Outreach Services Presents "Caregiver Tools": Essentials in Alzheimer Disease and Related Dementias".Join us for our regular series of eight Tuesday evening sessions helping caregivers through professional presentations, practical demonstrations and group learning. These sessions are offered four times per year and are open to all caregivers of persons with Alzheimer disease and related dementia's. These free sessions will be held Tuesdays from 7:00 to 9:00 p.m. at Alzheimer Outreach Services of McCormick Home, 2022 Kains Road. Please call 519-439-9336 or e-mail smcinnis@alzheimeroutreach.org to register.

Bosom Buddies
A support group for breast cancer survivors, meets for a discussion hour on Tuesdays at 2:00 pm, Central YMCA, 382 Waterloo St. Aquafit class Tues. & Thurs. From 1-1:30 pm. Free admission. Contact Carolyn: 519-452-7260 or Margaret: 519-474-1357.

Parkinson Support Groups
Do you or someone you know have Parkinson's? Parkinson Society Southwestern Ontario has a large network of support groups for people living with Parkinson's, their care partners and loved ones. New members are always welcome. To find a Parkinson's support group in your area, please call 1-888-851-7376 or visit www.parkinsonsociety.ca

The London Newcomers' Club
is a non-profit organization for women who are new to the London area, or have recently been widowed, separated, or divorced (within the last three years). Numerous exciting activities take place every month such as: dinners and lunches in various venues, bridge, sightseeing excursions, golf, book clubs, scrabble, euchre, and more. Visit our website at www.londonnewcomersclub.com or call 519-641-5777 for additional information. Come and join the fun and meet new people!

Free English Conversation Group
Open to newcomers with permanent residence interested in learning and improving their English speaking. The group is open to all levels. Once a month, the group discusses different subjects. Saturdays 10am – 11:30am. ACFO de London-Sarnia, 495 Richmond Street, Suite 200 (Corner of Richmond and Dufferin). Contact us for more information: 519-850-2236, ext. 223 or email : aca@acfo-ls.org

Conversational English
Classes are for new English speakers! Experienced, friendly teachers will engage you at your level of speaking ability, discussing Canadian culture and interesting topics helpful to everyday life. You will have many opportunities to speak and make new friends. Classes happen on Mondays and Wednesdays from 1:00-3:00 p.m. and on Tuesdays from 6:30-8:30 p.m. at West Park Church (955 Gainsborough Road). Registration takes place Monday, September 14 at 12:30 p.m. and Tuesday, September 15 at 6:15 p.m. The cost for new students is $30 and $25 for returning students for 13 weeks of classes. For more information, please contact us at 519.471.7460 or visit our website at www.westpark.on.ca

Direct Funding Program Inviting Applications
People with disabilities who use attendant care on a regular basis can take charge and manage their own care. The Direct Funding Program makes this possible. Taking on some responsibility leads to choice, flexibility and control in one's life. If you are interested in learning more or possibly applying, contact The Independent Living Centre London and talk to Pamela at 519-660-4667 or visit www.dfontario.ca

St. Paul's Cathedral
472 Richmond Street (Queens & Richmond), London
For a complete list of interactive, fun and engaging classes and workshops at the church please go to www.stpaulscathedral.on.ca or call 519-434-3225

Weight Loss and Maintenance
Learn why you gain weight and how to manage stress to lose weight. Free seminar with food samplings. Every Thursday at 6PM. Call to reserve your seat 519-433-3434

DivorceCare
is a friendly, caring group of people who understand what you are going through and will walk alongside you through one of life's most difficult experiences. You will learn how to deal with the pain of your past and how to begin rebuilding your life. The group meets at West Park Church (955 Gainsborough Road) every other Saturday beginning September 19 from 9:30 a.m. to 11:30 am and features DVD sessions with experts on divorce and recovery topics, along with a workbook to stimulate helpful discussion. The cost is $20. For more information or to register, please contact West Park at 519.471.7460 or divorcecare@westpark.on.ca.

SEND US YOUR INFO

Listings are provided free of charge to local non-profit organizations.

To list your event, please format according to listings on these pages

Submission space is limited and not guaranteed

LONDONER LISTINGS
c/o Londoner
email: listings.londoner@sunmedia.ca
fax: 519-673-4624
mail: 1147 Gainsborough Road
London ON N6H 5L5

DEADLINE: Thursday 5pm

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NOTICE OF PUBLIC INFORMATION CENTRE

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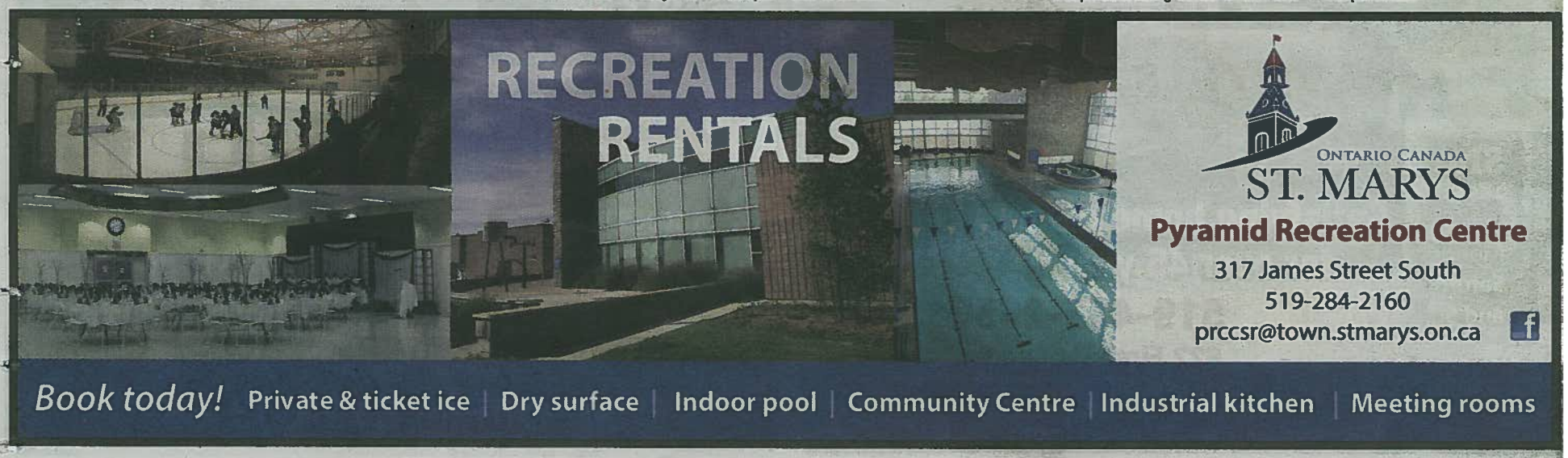

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Delaware Community Settlement Area Stormwater Servicing Master Plan
Municipal Class Environmental Assessment
Public Information Centre #1
Thursday October 8th, 4:30pm-6:30pm

Stantec

Delaware Community Centre

PLEASE SIGN IN TO STAY UPDATED ON STUDY PROGRESS

NAME	ADDRESS	POSTAL CODE	PHONE NUMBER	EMAIL
Rick Richman	[redacted]			
David Pavletic	[redacted]			
Barry & Dawn Madg	[redacted]			
David & Susan Jhu	[redacted]			
Doug & Anne Perkin	[redacted]			
Wes Taylor	[redacted]			
Dave Noorder Meer	[redacted]			
Perry Buren 38	[redacted]			
John de Jeu Sen. 45	[redacted]			
Gene Humphrey	[redacted]			
Mary Alikakos	[redacted]			
Karen Winfield	UTRCA			winfieldk@thamesriver.on.ca

(15)

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Municipal Class Environmental Assessment
Public Information Centre #1
Thursday October 8th, 4:30pm-6:30pm

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Delaware Community Centre

PLEASE SIGN IN TO STAY UPDATED ON STUDY PROGRESS

NAME	ADDRESS	POSTAL CODE	PHONE NUMBER	EMAIL
Stephen Harvey	Student			
Joe + Kelly Keller	[redacted]			
Matthew Creighton	[redacted]			
Lindsay Hird	[redacted]			
Lee Noordermeer	[redacted]			
Murray McDonald	[redacted]			
Audrey Held	[redacted]			
Don Black	[redacted]			
LINDA McLEAN	[redacted] VICTORIA ST		519-652-5430	
DARCY GEGEAR				
HAROLD M	[redacted]			
HELEN THOMP	[redacted]			
LEE DONELY	[redacted]			
Charlie Scott	[redacted]			

(14)

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Delaware Community Settlement Area Stormwater Servicing Master Plan
Municipal Class Environmental Assessment
Public Information Centre #1
Thursday October 8th, 4:30pm-6:30pm

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NAME	ADDRESS	POSTAL CODE	PHONE NUMBER	EMAIL
Yolande McIntyre	[redacted]			
Jessica Unwin	[redacted]			
Rick Kloss	[redacted]			
HENRY VANDER	[redacted]			
Dave Kyle	[redacted]			
RANDY WONG	[redacted]			ute and randy
Bill Lemmon	[redacted]			
Eta Gaoyi	[redacted]			
R. LADE	[redacted]			

15

Delaware Stormwater Servicing Master Plan

Welcome to Public Information Centre (PIC) No. 1 for the Delaware Stormwater Servicing Master Plan.

The purpose of this PIC is to present…

- a description of the Master Plan approach as part of the Municipal Class Environmental Assessment process;
- an overview of the general project area;
- an inventory of existing stormwater infrastructure serving the community;
- a summary of deficiencies associated with the existing stormwater infrastructure;
- a description of alternative solutions considered for resolving the identified deficiencies;
- a synopsis of the decision-making process conducted to select the preferred alternatives;
- a detailed description of the preferred alternatives for public comment.

Welcome!

Your comments are important to us. After reviewing the information, please complete one of the comment forms provided and place it in the box provided, or forward to the address on the form by **THURSDAY OCTOBER 22, 2015**.

If you have any questions, our representatives will be happy to assist you:

Nick Emery, P. Eng.
Water Resources Engineer
Stantec Consulting Ltd.

Nelson Oliveira, P. Eng.
Project Manager
Stantec Consulting Ltd.

Corri Marr, H.B.Sc.
Senior Planner
Stantec Consulting Ltd.

Brian Lima, P. Eng.
Director of Public Works and Engineering
Municipality of Middlesex Centre

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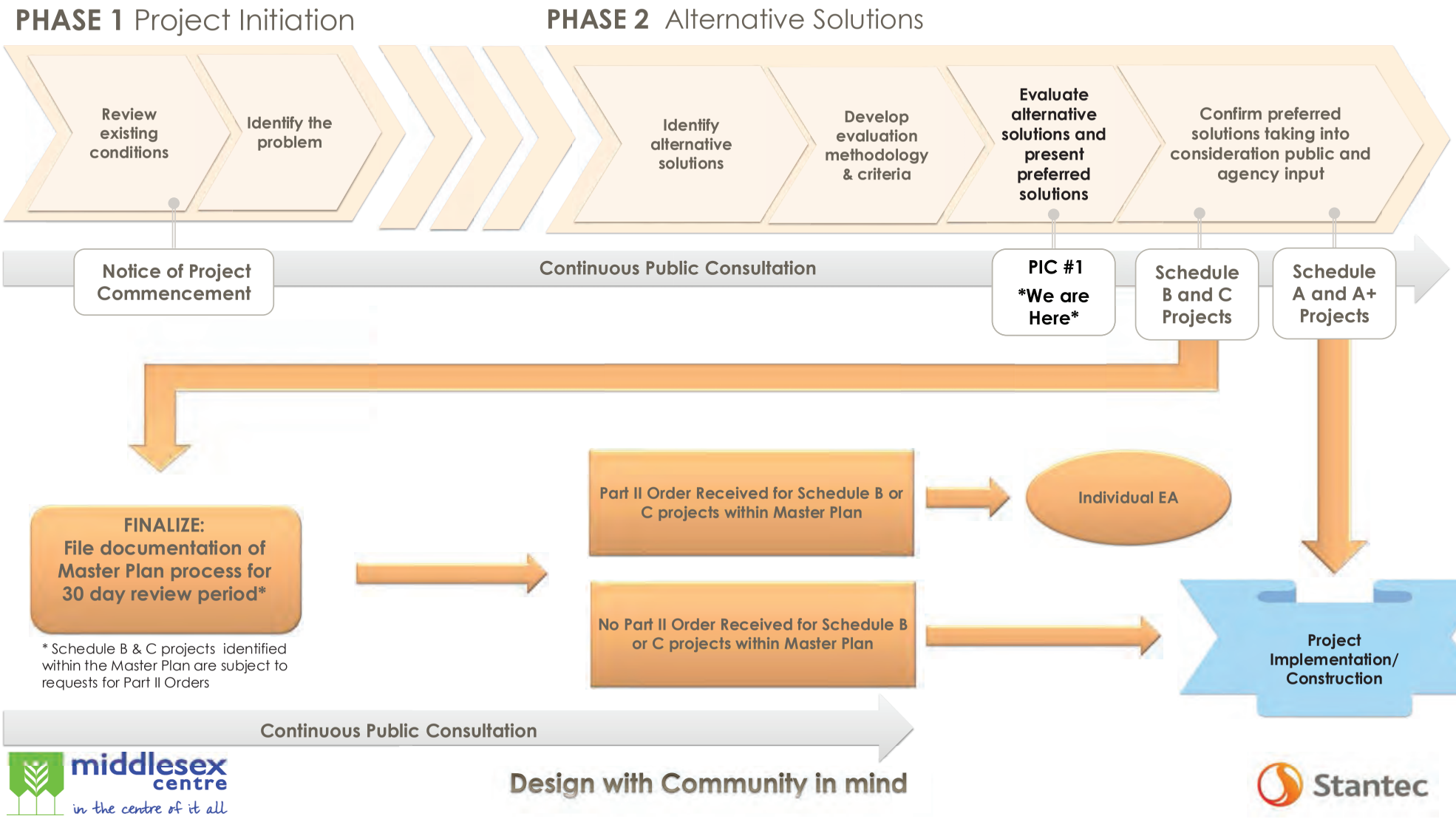
What is a Master Plan?

The Master Plan approach within the Municipal Class Environmental Assessment process was developed to recognize the benefits of considering a group of related projects or an overall system such as stormwater management. Key objectives of the approach include:

- Long range planning which integrates infrastructure requirements with Environmental Assessment Planning Principles;
- To examine a group of related projects in order to outline a framework for planning subsequent projects and/or developments;
- To consult with the public, regulatory agencies, and adjacent property owners to address their concerns;
- To use a system-wide approach to planning which relates infrastructure either geographically or by function;
- To address, at a minimum, the first two phases of the Municipal Class Environmental Assessment process;
- To recommend an Infrastructure Master Plan which can be implemented through the completion of separate individual projects.

Municipal Class Environmental Assessment Master Plan Approach



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Definitions

Stormwater is rain, melted snow, or any other form of precipitation that has come into contact with the ground or any other surface. This water either seeps into the ground, is absorbed by vegetation, evaporates, or runs off the land into storm sewers, streams, or lakes.

Stormwater Management is how we manage this precipitation as it interacts with municipal infrastructure (roads and storm drains) before ultimately being absorbed into the soil or discharged to a receiving water body.

Shallow Roadside Ditch

A Storm Drainage System is a system for receiving, conveying and controlling discharges in response to precipitation and snowmelt. Systems consist of ditches, culverts, swales, roadways, curbs and gutters, catchbasins, manholes, pipes, detention ponds, etc.

A Major Storm Drainage System is the storm drainage system in which water will flow in a major storm when the capacity of the minor system is exceeded. The major system includes many features such as streets, curb and gutter systems, swales, and major drainage channels. Design of a major system is based on a storm frequency of 1 in 100 years.

A Minor Storm Drainage System is the storm drainage system which is designed to eliminate or minimize inconveniences or disruption of activity as a result of runoff from the more frequent, less intense storms. The minor system usually includes street gutters, storm sewers, and catchbasins. Design of a minor system is based on a storm frequency of 1 in 2 years.

Road Right-of-Way (ROW)/Cross Section refers to the configuration of the roadway. Urban ROWs typically include curbs and storm sewers, whereas rural ROWs contain roadside ditches. Semi-urban ROWs may contain ditches and/or storm sewers, but generally exclude curbs.

Pleasant Park Culverts

Rural Road Right of Way/Cross Section

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Definitions

Lot-Level/On-Site Controls refer to measures that address stormwater before it exits a site and enters the storm sewer system. These controls can include reduced lot grading, redirection of downspouts, and other site-design considerations such as porous concrete.

End-Of-Pipe Controls typically involve multi-purpose stormwater management facilities (SWMFs) which address objectives relating to water quality, erosion control, and peak flow control. SWMFs include wet/dry ponds, wetlands, oil/grit separators, etc.

Conveyance refers to the movement of stormwater by means of storm sewers, ditches, swales, roads, etc.

Dry Detention Pond

Culvert

Outfalls/Outlets are the points at which stormwater discharges from a storm sewer or other conveyance system, usually into a creek, stream, or river.

Culverts are structures (often pipes or concrete structures) that allow water to pass under a road, through an embankment or similar obstruction.

Cummings Drain Outfall

Municipal Drains are storm drainage systems which were typically constructed to service rural or agricultural lands but may be present within existing residential areas. Under Ontario's *Drainage Act*, funding for the maintenance of Municipal Drains is provided by the benefiting property owners.

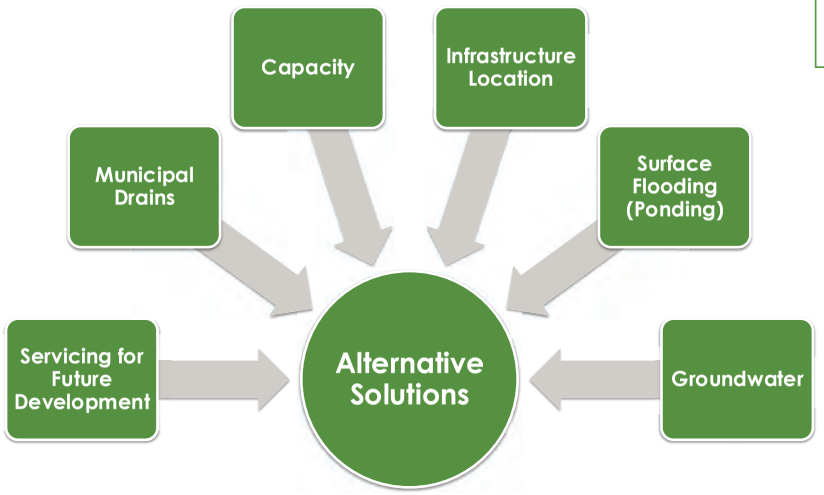
Key Issues by Drainage Area & Problem Statement

- **Prior Drain**
  - Capacity
  - Infrastructure Location
  - Surface Flooding (Ponding)
  - Municipal Drain
  - Groundwater
- **Forsythe Drain**
  - Capacity
  - Infrastructure Location
  - Surface Flooding (Ponding)
  - Municipal Drain
  - Groundwater
- **Mill Street Development Storm Sewer**
  - Capacity
  - Surface Flooding (Ponding)
  - Servicing for Future Development
- **Thompson Drain**
  - Capacity
  - Infrastructure Location
- **Hog Back Close Storm Sewer**
  - Capacity
  - Infrastructure Location
  - Surface Flooding (Ponding)
- **Harris Road Culvert**
  - Capacity
  - Servicing for Future Development
- **Longwoods Road Culvert**
  - Servicing for Future Development
- **Longwoods Commercial Development**
  - Servicing for Future Development
- **Springer Road Drain**
  - Capacity
  - Surface Flooding (Ponding)
- **Tower Heights Storm Sewer**
  - Capacity
  - Surface Flooding
  - Groundwater
- **Cummings Drain**
  - Capacity
  - Infrastructure Location
  - Surface Flooding (Ponding)
  - Servicing for Future Development
  - Groundwater

Problem Statement

The existing storm drainage infrastructure within the Community of Delaware was designed and constructed on a site-by-site basis as development occurred, without the benefit of an overall stormwater management strategy. This has resulted in a fragmented drainage system that does not efficiently service the existing community, and which has limited capacity to service future growth.

Key Issues



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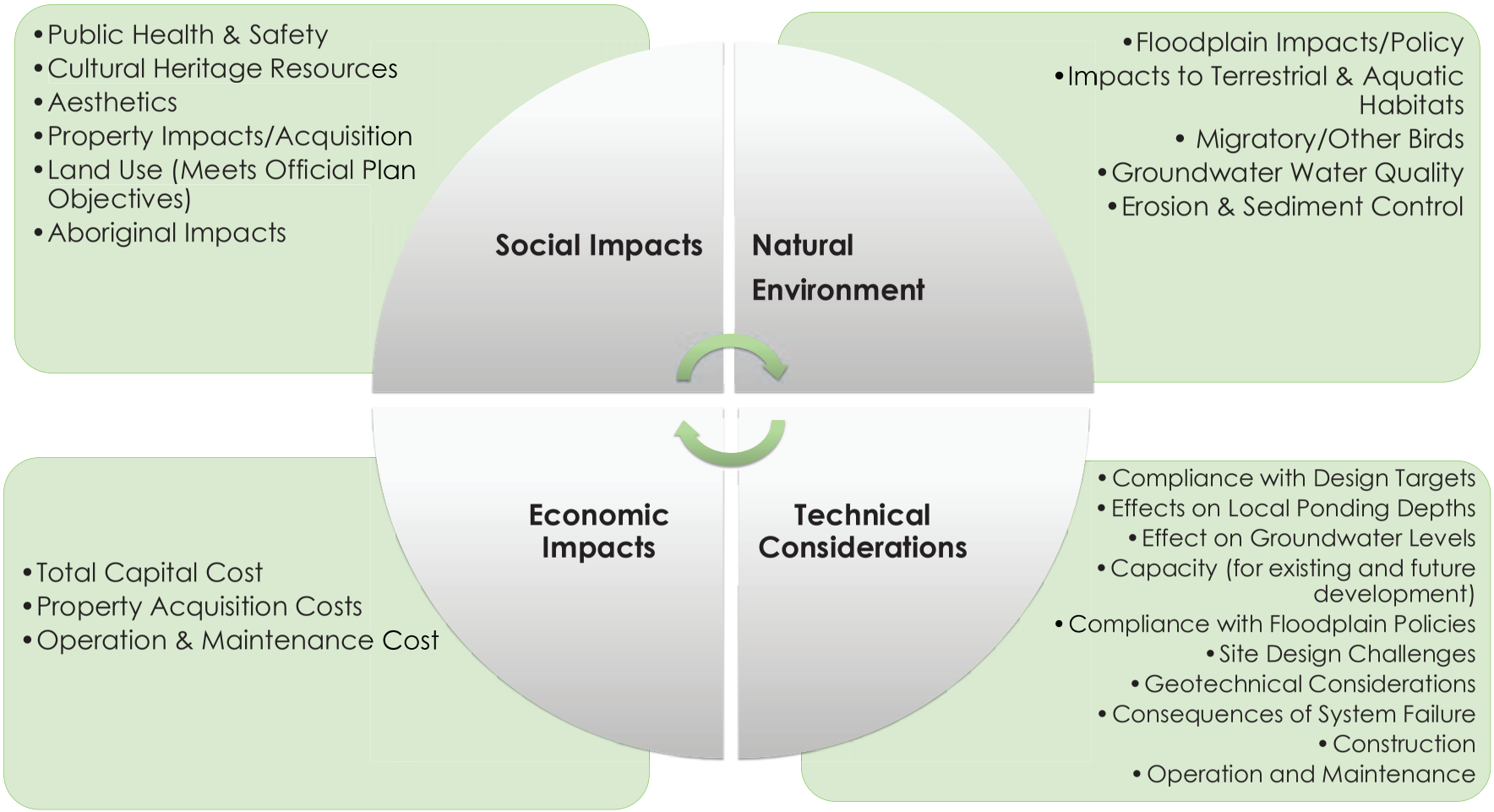
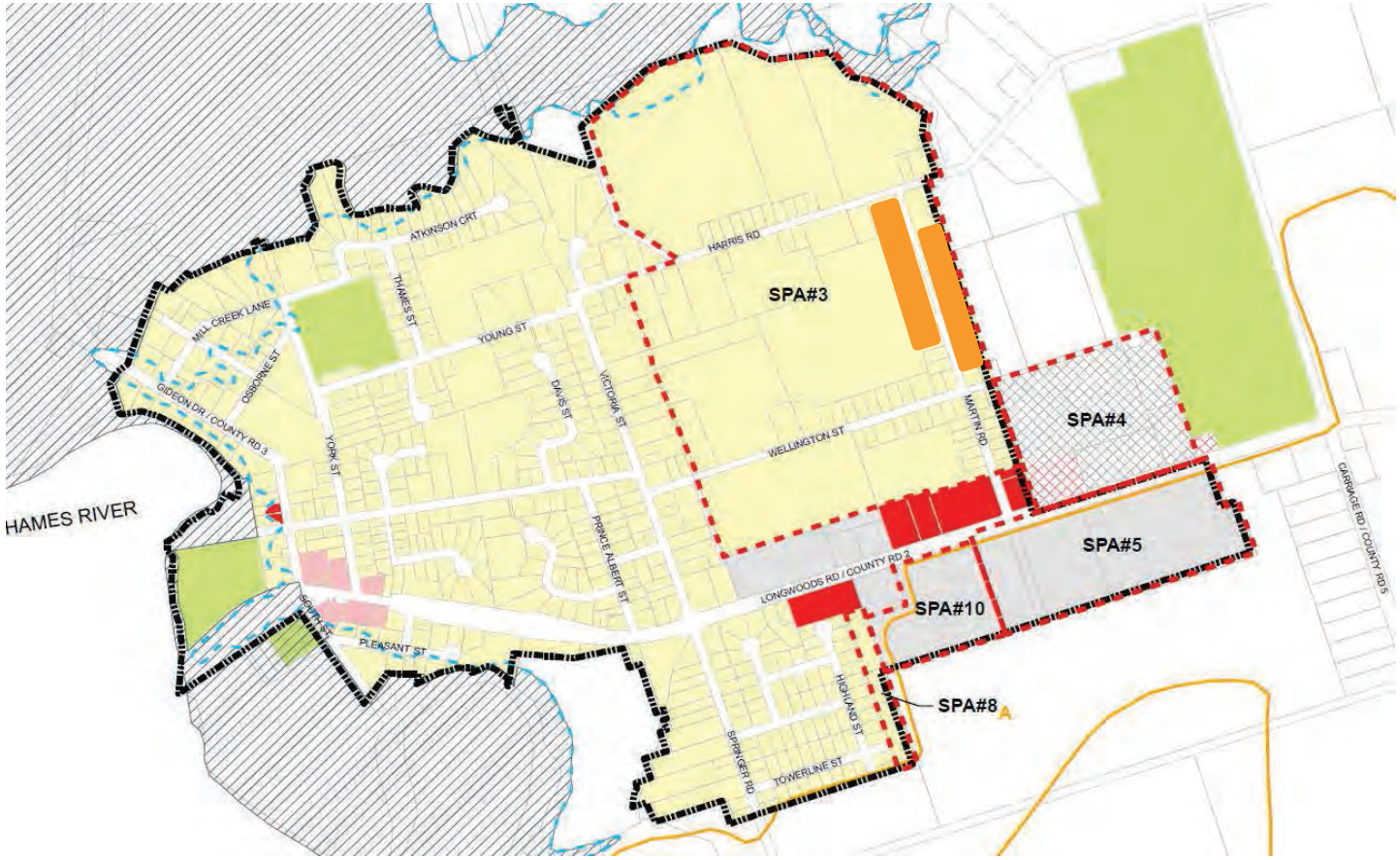
Evaluation Criteria

The following evaluation criteria were taken into consideration for each of the alternatives in order to arrive at the preferred alternatives:



Existing Conditions - Land Use



Schedule A-4 Delaware Community Settlement Area, Middlesex Centre Official Plan

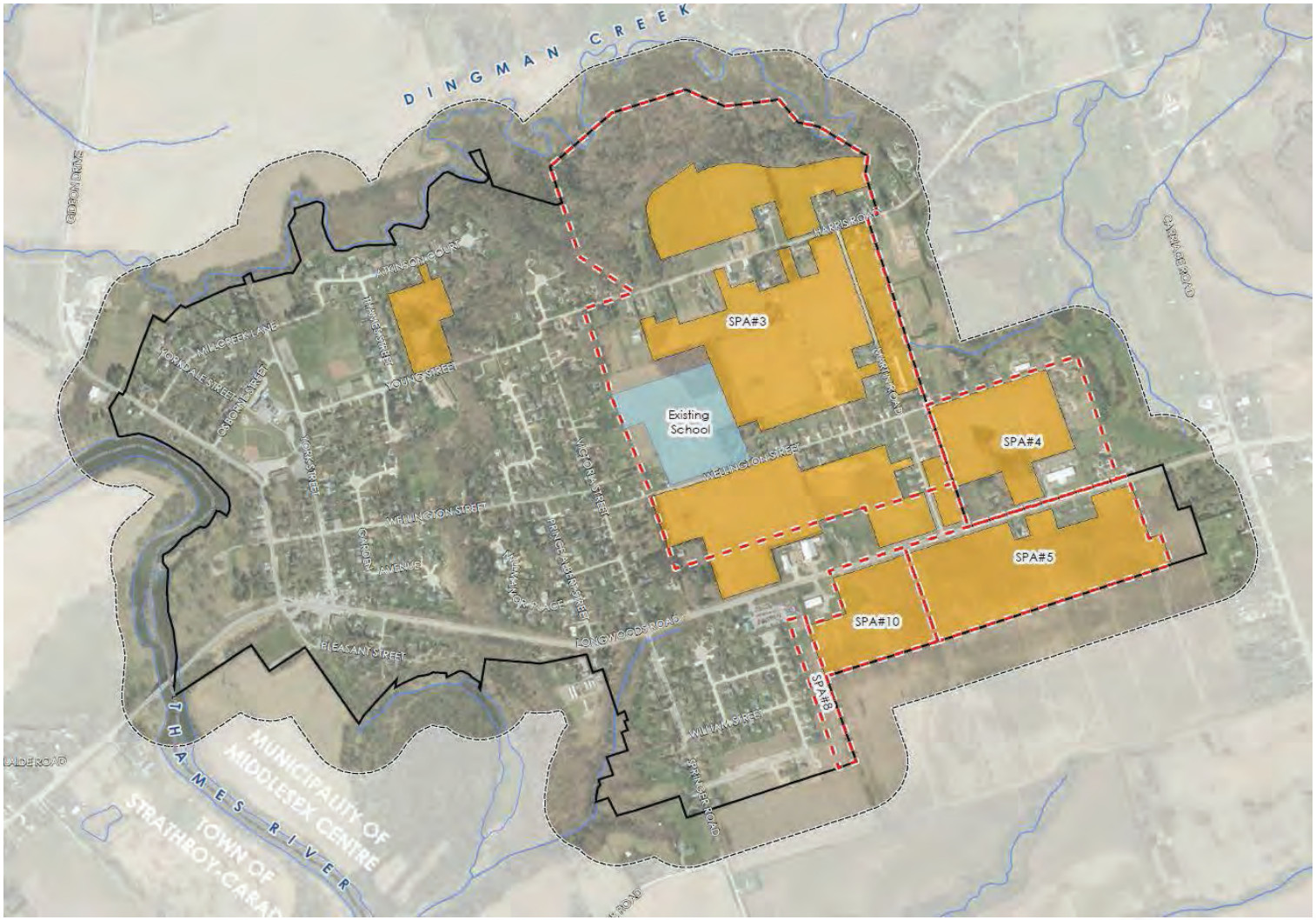
- Special Policy Areas (SPAs)
- Settlement Boundary
- Flood Plain
- Flood Line
- Agriculture
- Parks and Recreation
- Residential
- Settlement Commercial
- Settlement Employment
- Village Centre
- Existing Approved Draft Plans

The majority of Delaware consists of existing residential developments, with undeveloped residential lands north of Harris Rd, and north and south of Wellington Street (SPA #3). There are also undeveloped Settlement Employment and Commercial lands along Longwoods Road.

The guidelines for Special Policy Areas (SPAs) are outlined in Section 10 of the Middlesex Centre Official Plan, and contain site-specific policies to address various issues such as servicing and land use for future development.

Areas of Potential Future Development

Areas of potential future development were identified in order to address future stormwater drainage needs within the overall stormwater Master Plan. These areas are approximate, and based on Official Plan designation, Natural Environment mapping, and topographical considerations.



- Study Area
- Settlement Boundary
- Special Policy Area
- Potential Development Areas
- Existing School

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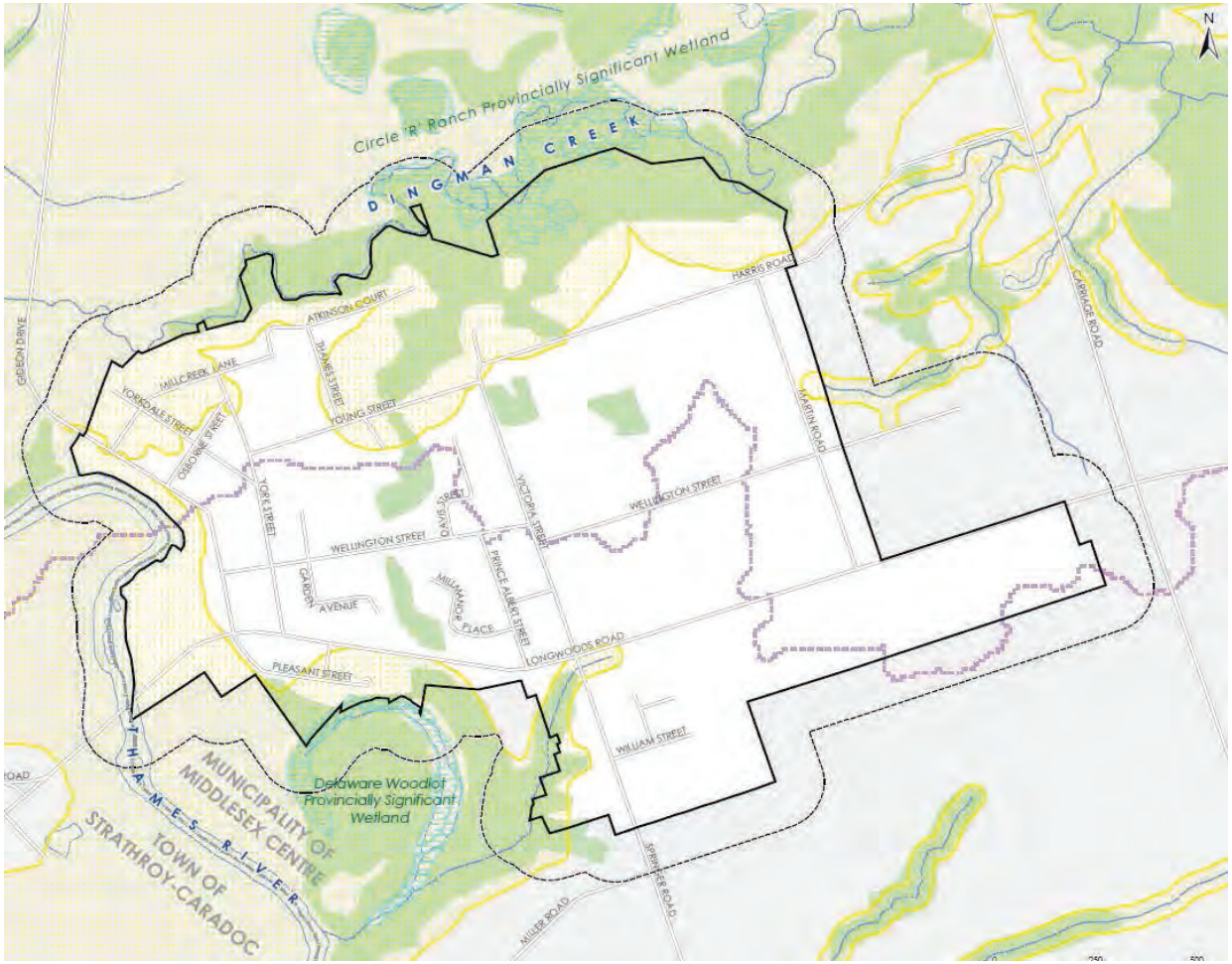
Existing Conditions – Natural Environment



Natural Features and Regulated Areas

- Study Area
- Settlement Boundary
- Municipal Boundary
- Conservation Authority Boundary
- Wetland (MNR)
- Regulated Area (UTRCA, LTVCA)
- Significant Woodlot (MNHS)

Portions of the study area are regulated by the Upper Thames River Conservation Authority (UTRCA), and the Lower Thames Valley Conservation Authority (LTVCA).

An inventory of the natural environment features and associated ecological functions within the study area was undertaken. The Master Plan will have regard for the Middlesex Natural Heritage Study (Draft 2014), which will be referenced during the evaluation of alternative solutions, and identification of mitigation measures.

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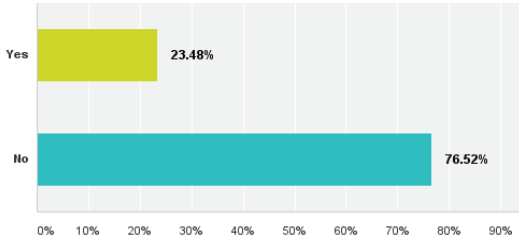
What We've Heard So Far…

Residents were encouraged to participate in an online survey in order to gather information on existing stormwater drainage conditions. A total of 132 responses were received

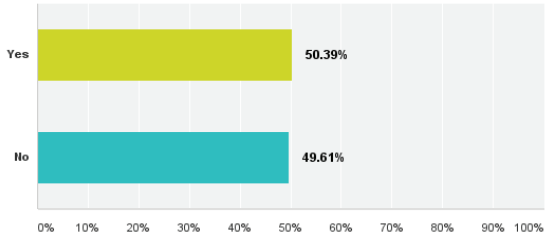
Q2 Have you ever experienced surface flooding on your property in Delaware?

Answered: 132 Skipped: 0



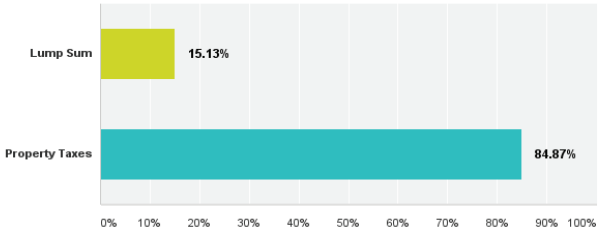
Q4 Have you ever seen surface flooding in Delaware after heavy rainfall or spring snowmelts?

Answered: 129 Skipped: 3



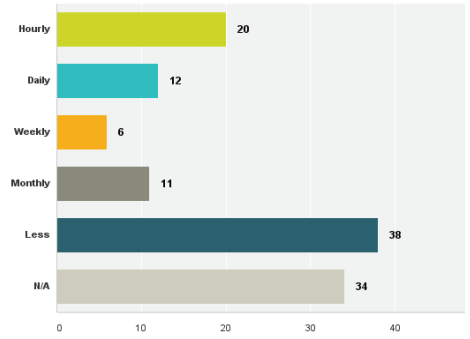
Q7 Would you prefer to pay for drainage servicing as a lump sum or through your general property taxes?

Answered: 119 Skipped: 13



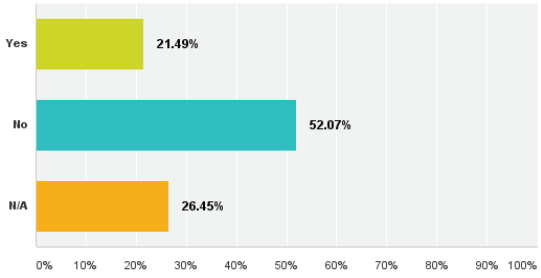
Q9 If so, how frequently does your sump pump typically run?

Answered: 121 Skipped: 11



Q10 Do you think your sump pump runs too frequently?

Answered: 121 Skipped: 11



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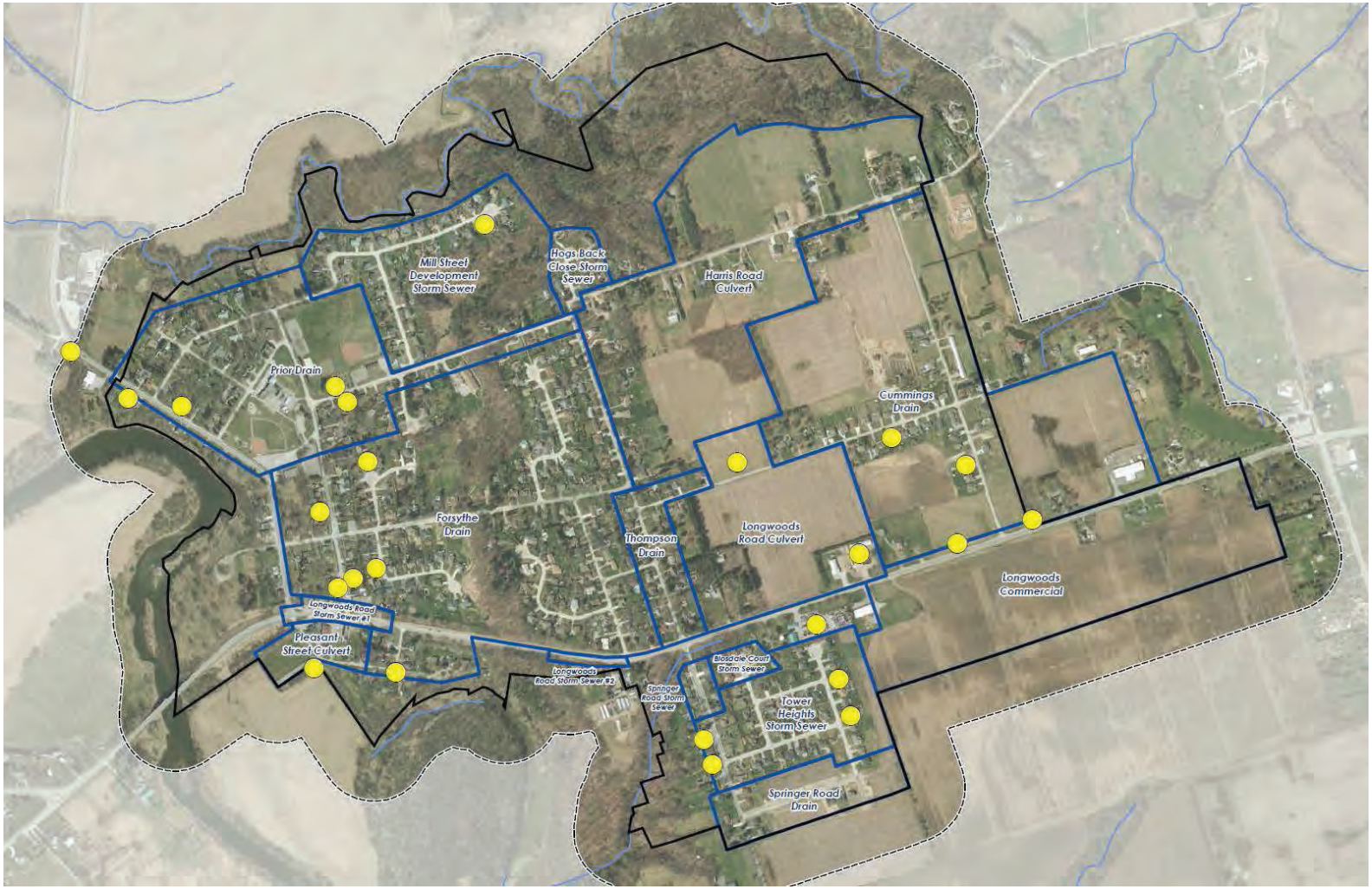
What We've Heard So Far…



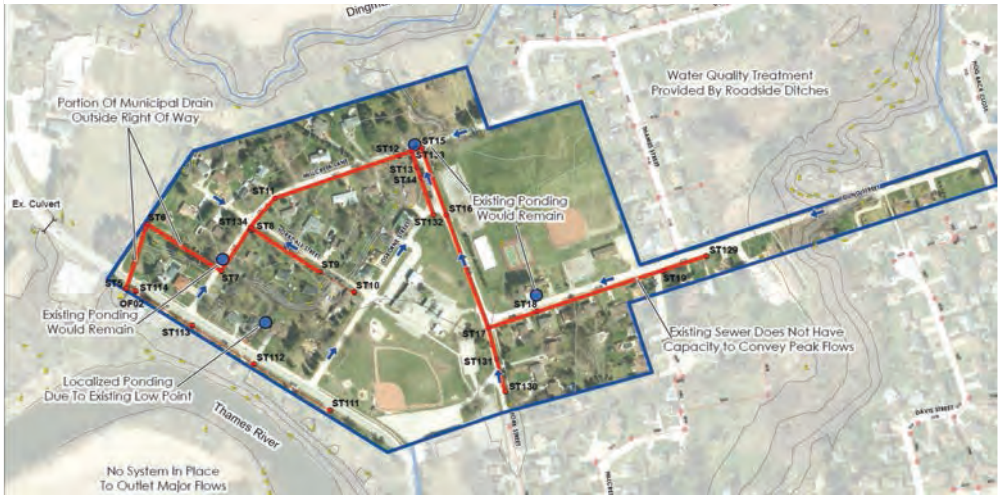
Instances of Flooding Reported on Online Survey

- Location of Reported Drainage Issues
- Study Area
- Settlement Boundary
- Existing Drainage Boundary

*The extent, duration, or cause of reported flooding is not confirmed (i.e. high groundwater levels in much of Delaware likely responsible for private sump pump issues and/or property flooding)

Prior Municipal Drain

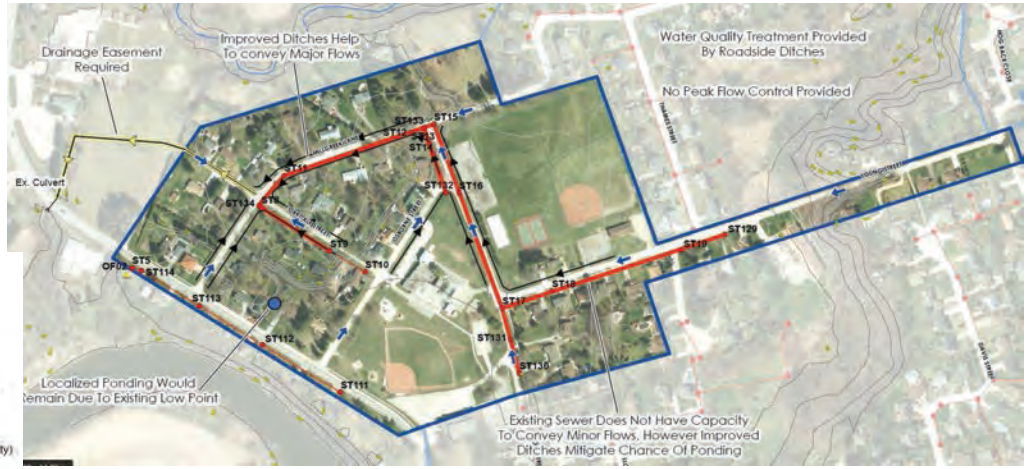
Alternative 1 – Do Nothing



Alternative 2 – Replace Minor System, Provide Urban ROW, & Abandon Municipal Drain

Alternative 3A – Improve Roadside Ditches, Provide 100-Year Storm Outlet, and Abandon Municipal Drain*

Alternative 3B – Improve Roadside Ditches, Provide 100-Year Storm Outlet, and Abandon Municipal Drain



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* Preferred Alternative

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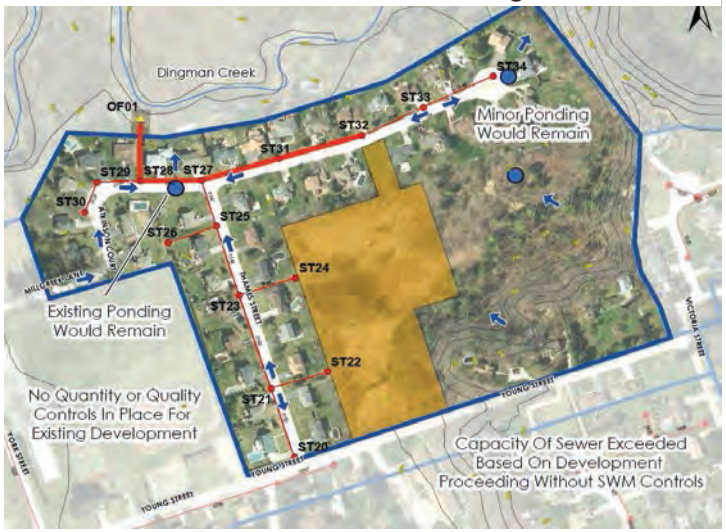
Mill Street Development

Alternative 1 – Do Nothing



- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Storm Sewer (100-Year Capacity)
- Potential Future Development
- Drainage Boundary
- DICB Ditch Inlet Catchbasin

Alternative 2 – Improve Major System*

Alternative 3 – Improve Minor System

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* Preferred Alternative

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Hog Back Close

Alternative 1 – Do Nothing*

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Drainage Boundary

Alternative 2 – Replace Existing Storm Sewer

Alternative 3 – Improve Major System

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* Preferred Alternative

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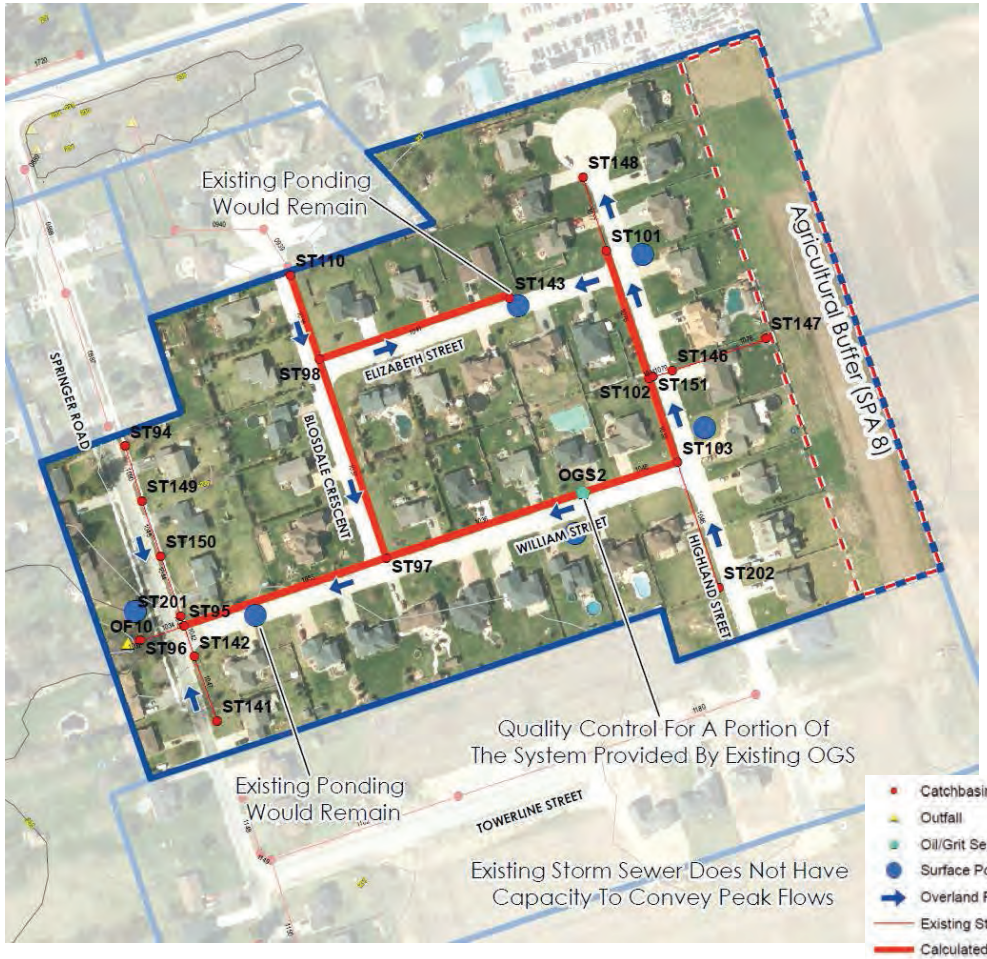
Tower Heights Storm Sewer

Alternative 1 – Do Nothing*



Alternative 2 – Replace Existing Storm Sewer and Modify Road Profiles

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed StormSewer (2-Year Capacity)
- Drainage Boundary
- Special Policy Area

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* Preferred Alternative

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Springer Road Municipal Drain

Alternative 1 – Do Nothing

Alternative 2 – Abandon Municipal Drain & Negotiate Drainage Easement*

Alternative 3 – Replace Existing Storm Sewer, Negotiate Drainage Easement, & Abandon Municipal Drain

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Drainage Boundary

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* Preferred Alternative

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Cummings Drain

Alternative 1 – Do Nothing

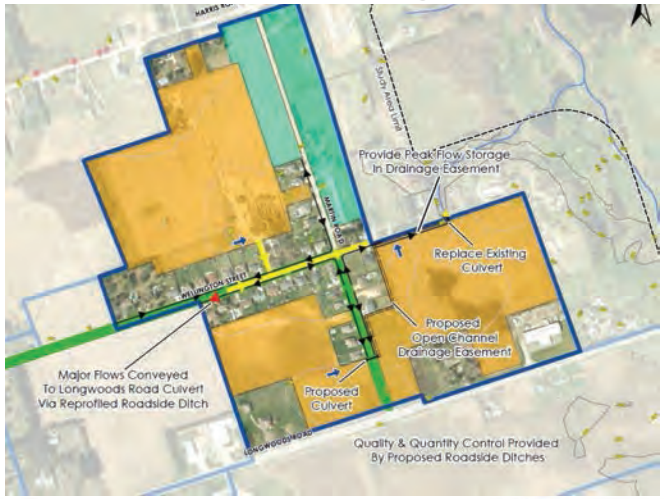
Alternative 3A – Semi-Urban ROW Within Future Development

- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Roadside Ditch
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Semi-Urban R.O.W.
- Drainage Boundary (Interior)
- Drainage Boundary
- Potential Future Development
- Future Development Serviced by SWM Infiltration Measures

Note: Alternatives 2, 3A & 3B also involve abandonment of the Municipal Drain

Alternative 2 – Urban ROW Within Future Development, and Dry SWM Pond*

Alternative 3B – Semi-Urban ROW Within Future Development (Alt. Alignment)



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* Preferred Alternative

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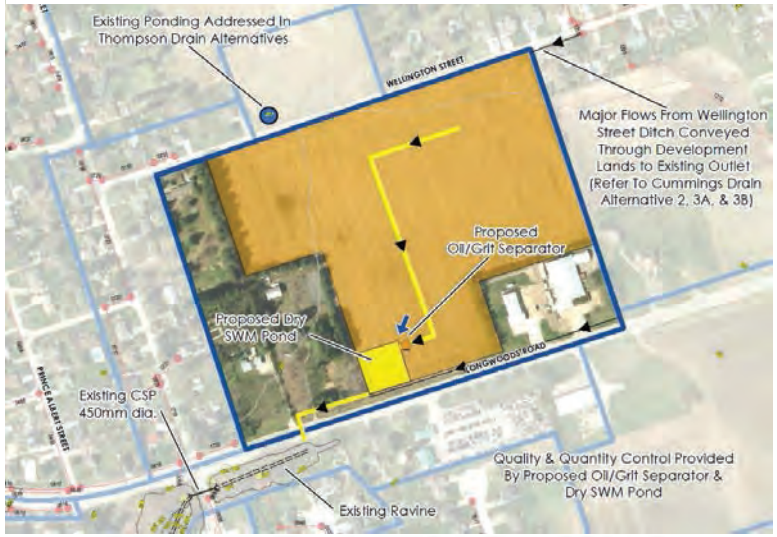
Longwoods Road Culvert

Alternative 1 – Do Nothing

Alternative 2 – Semi-Urban ROW Within Future Development

Alternative 3 Urban ROW Within Future Development & Dry SWM Pond*



- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Roadside Ditch
- Proposed Trunk Storm Sewer
- Potential Future Development
- Drainage Boundary

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* Preferred Alternative

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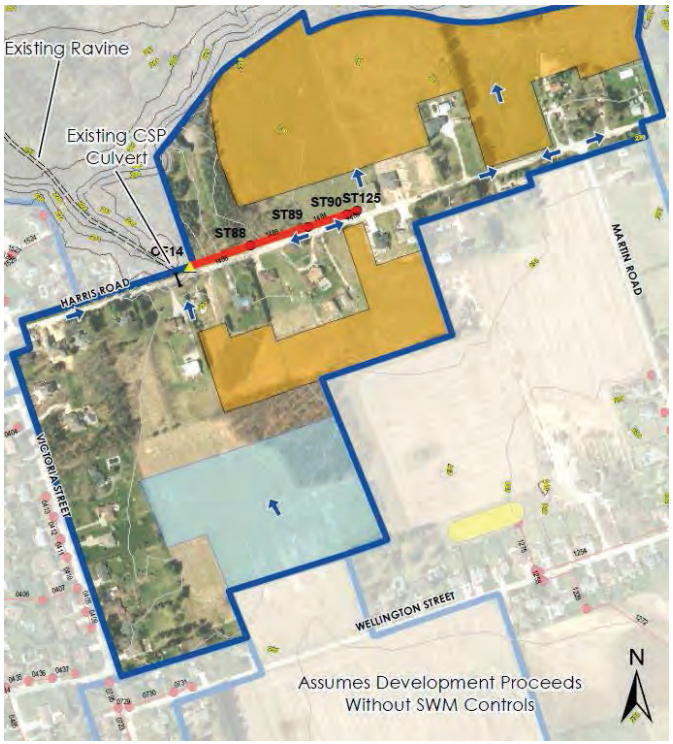
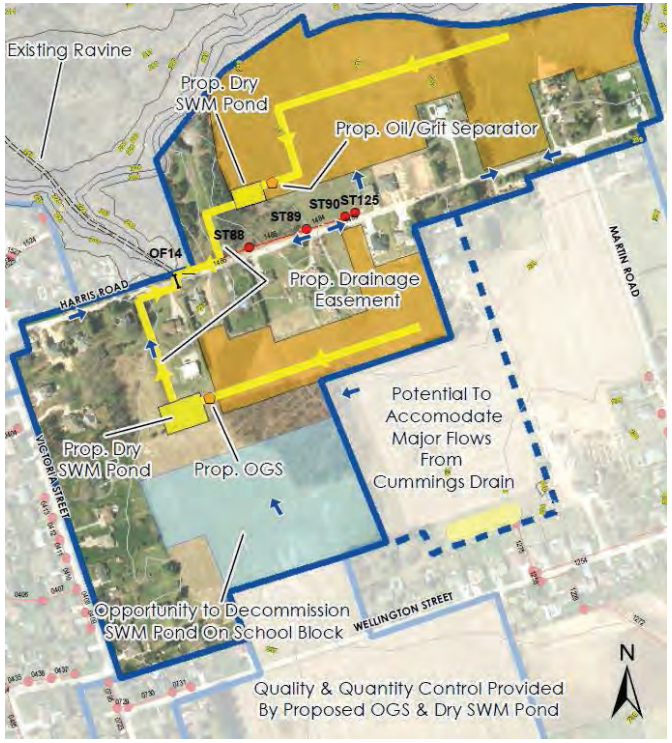
Harris Road Culvert

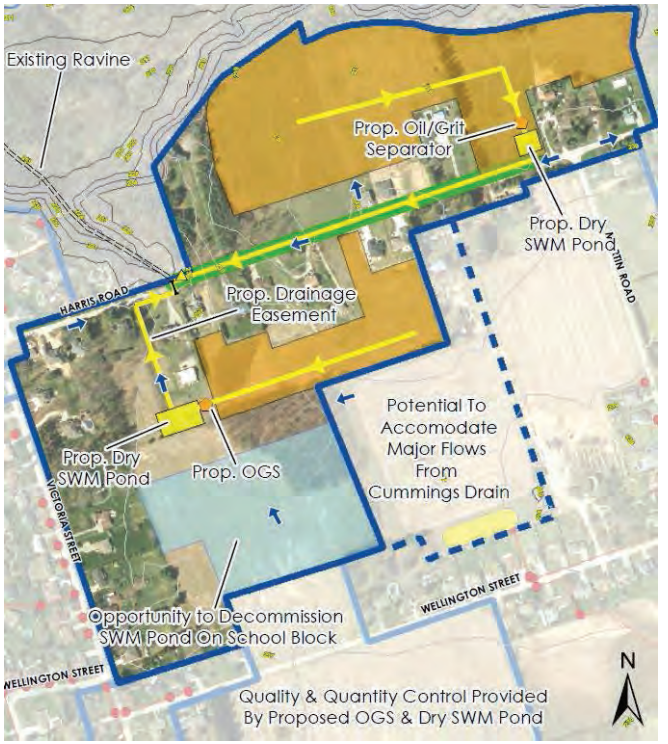
Alternative 1 – Do Nothing



Alternative 2A – Urban ROW Within Future Development & Dry SWM Pond*



Alternative 2B – Urban ROW Within Future Development & Dry SWM Pond (Alt. Alignment)



- Catchbasin/Manhole
- Outfall
- Existing Oil/Grit Separator (OGS)
- Proposed Oil/Grit Separator (OGS)
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Roadside Ditch
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Semi-Urban R.O.W.
- Drainage Boundary (Interior)
- Drainage Boundary
- Potential Future Development
- Existing School

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* Preferred Alternative

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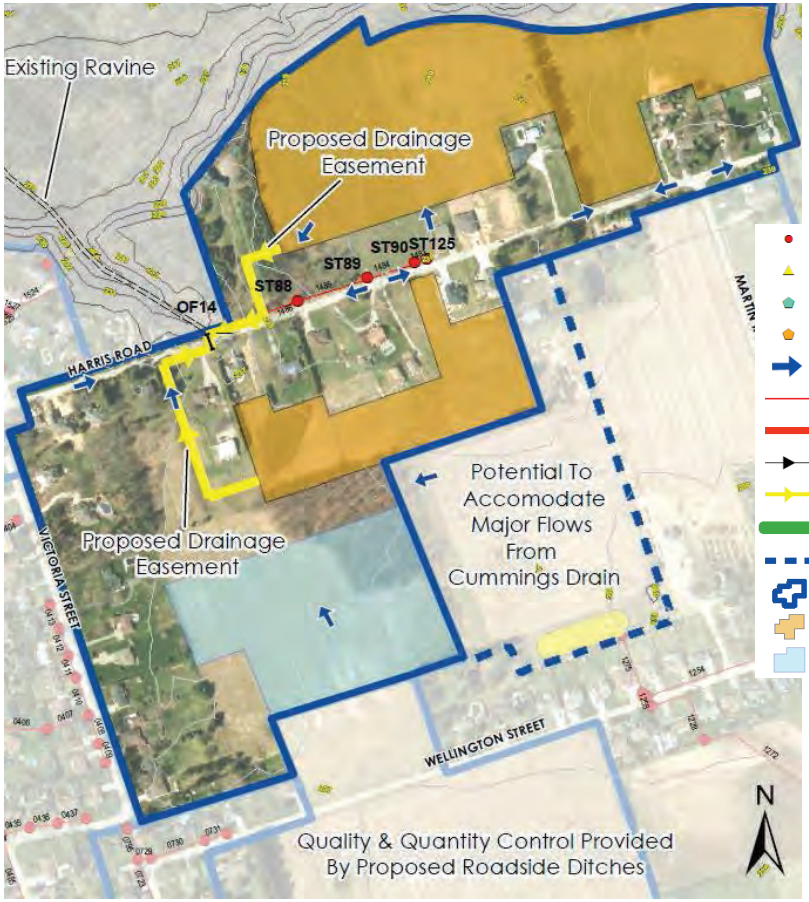
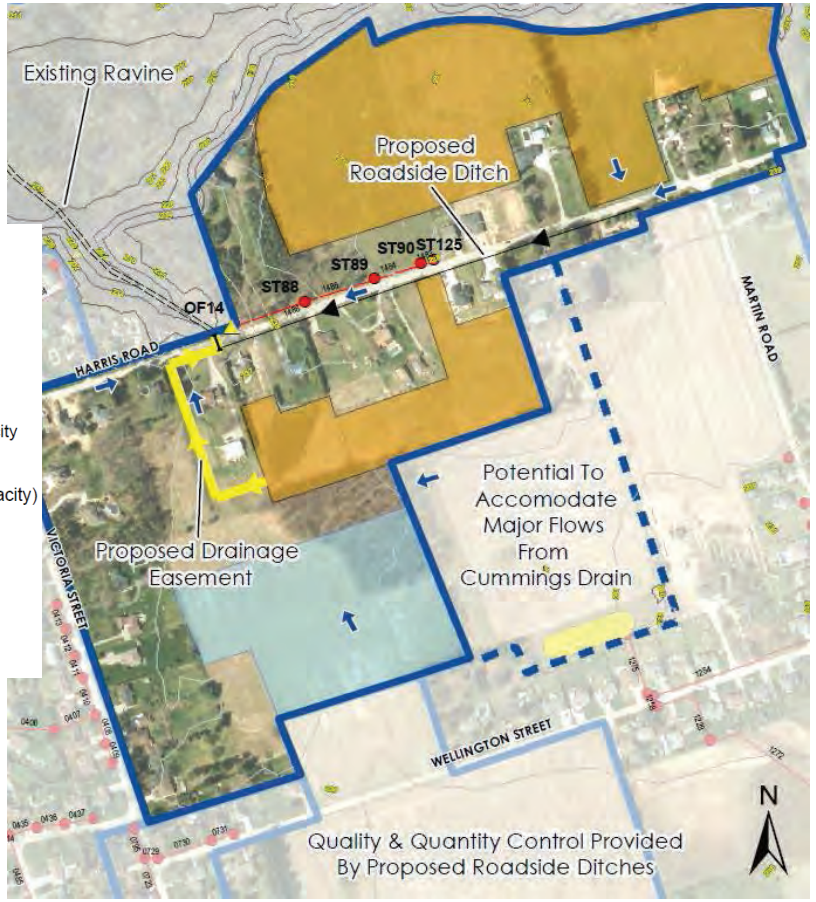
Harris Road Culvert Continued

Alternative 3A – Semi-Urban ROW Within Future Development*



Alternative 3B – Semi-Urban ROW Within Future Development



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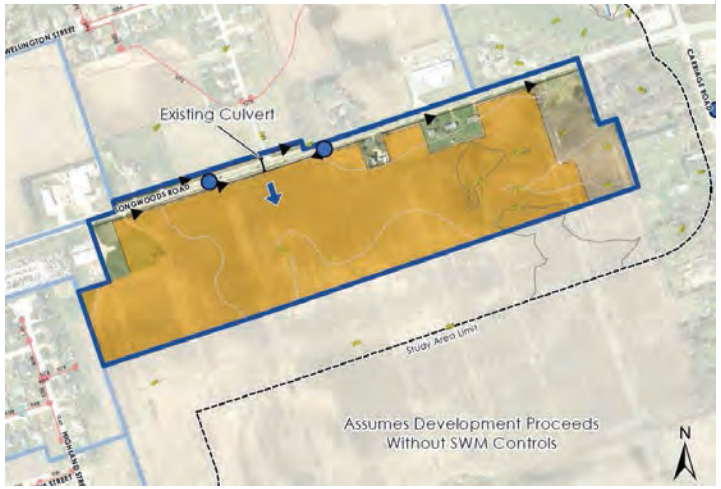
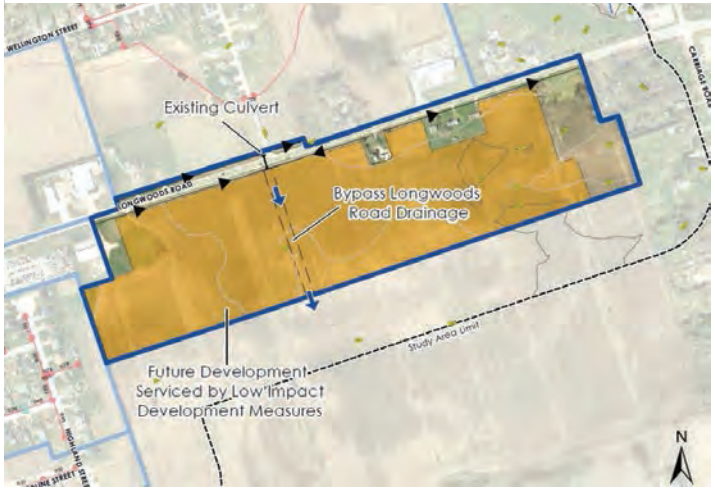
Longwoods Commercial

Alternative 1 – Do Nothing



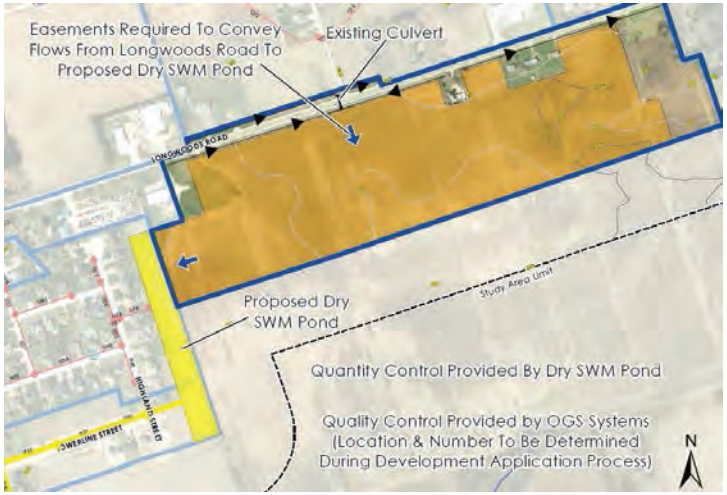
Alternative 2 – Control All Stormwater On-Site



Alternative 3A – Dry SWM Pond*

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Roadside Ditch
- Proposed Storm Sewer (2-Year Capacity)
- Potential Future Development
- Drainage Boundary

Alternative 3B – Dry SWM Pond (Alt. Alignment)



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* Preferred Alternative

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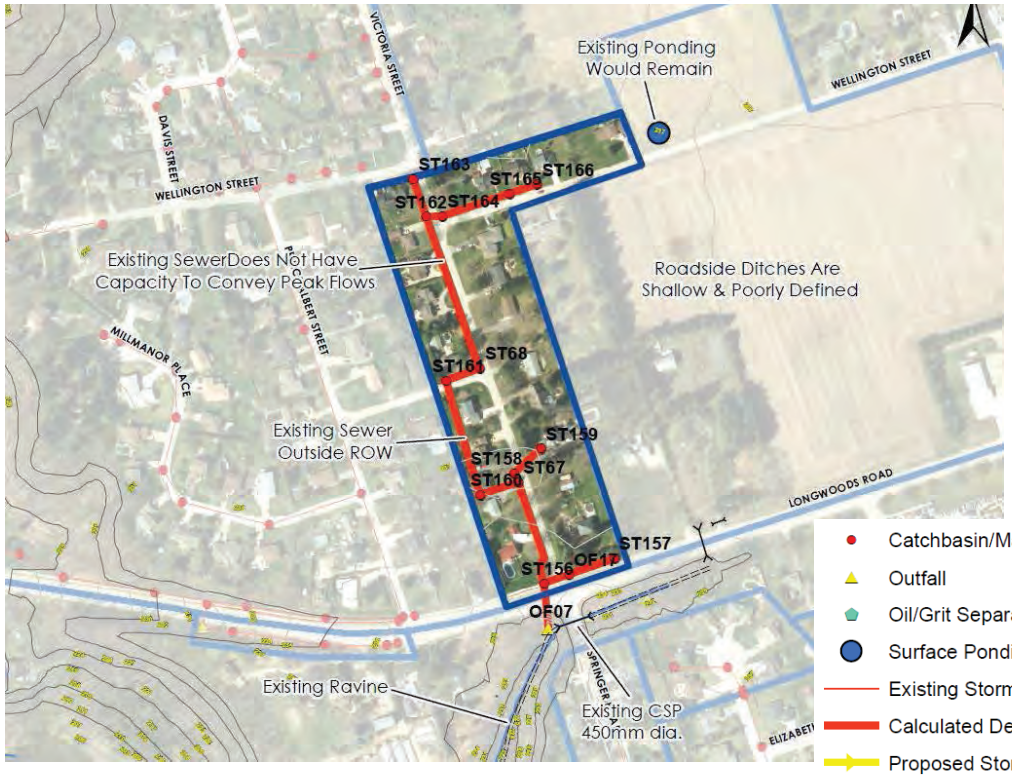
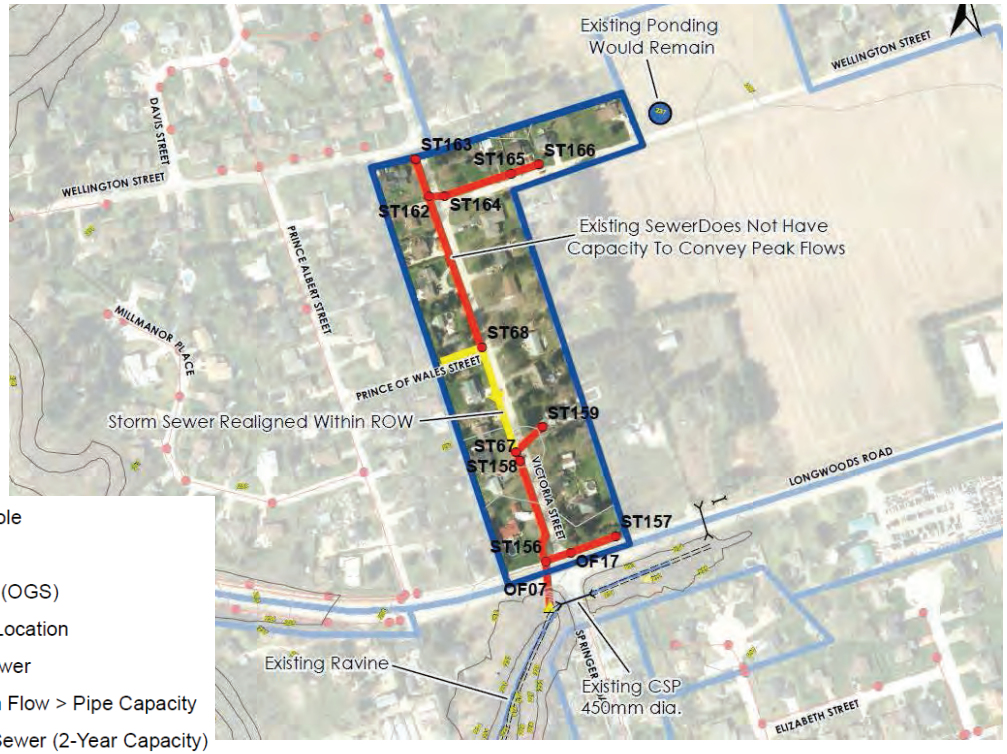
Thompson Municipal Drain

Alternative 1 – Do Nothing



Alternative 2 – Abandon Municipal Drain & Realign Storm Sewer



- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Urban R.O.W.
- Proposed Semi-Urban R.O.W.
- Drainage Boundary
- Existing School

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* Preferred Alternative

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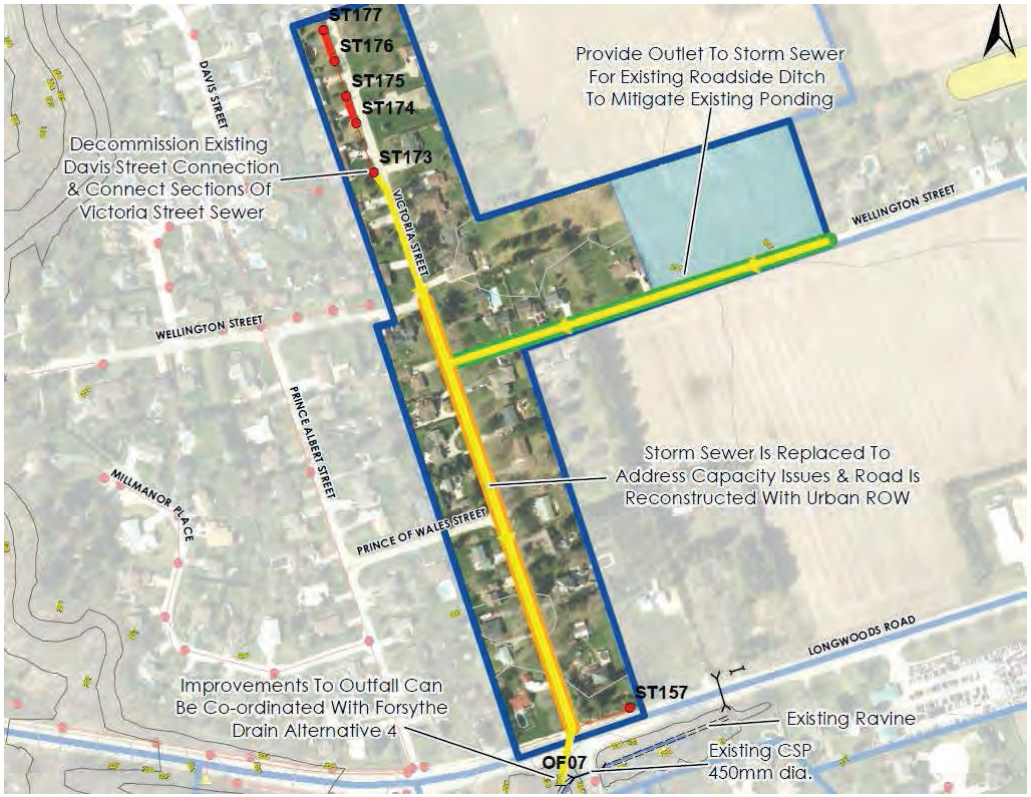
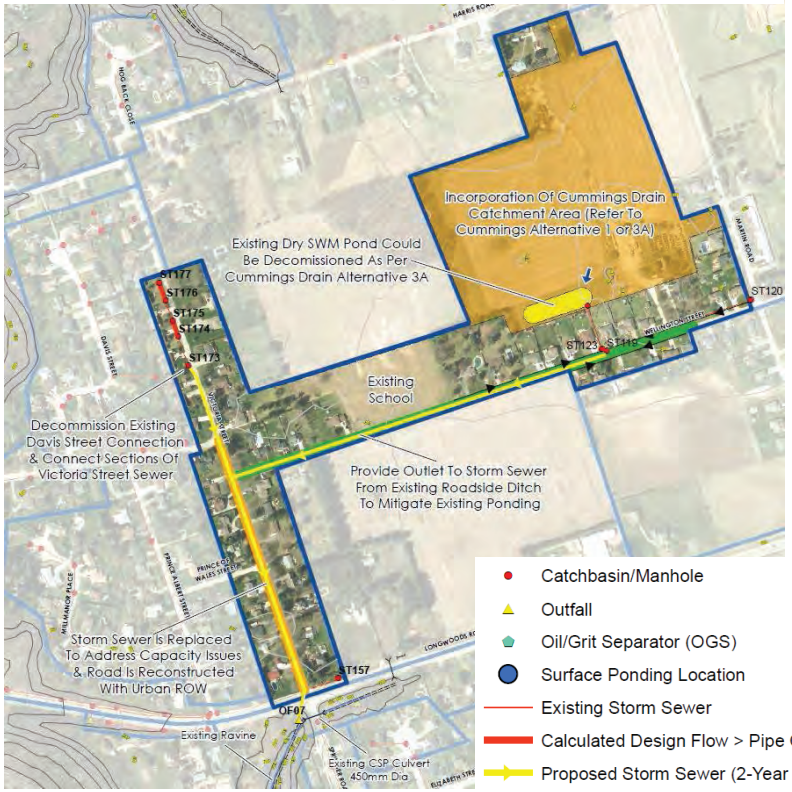
Thompson Drain Continued

Alternative 3 – Proposed Storm Sewer and Abandon Municipal Drain*



Alternative 4 – Proposed Storm Sewer (With Wellington Branch)



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* Preferred Alternative

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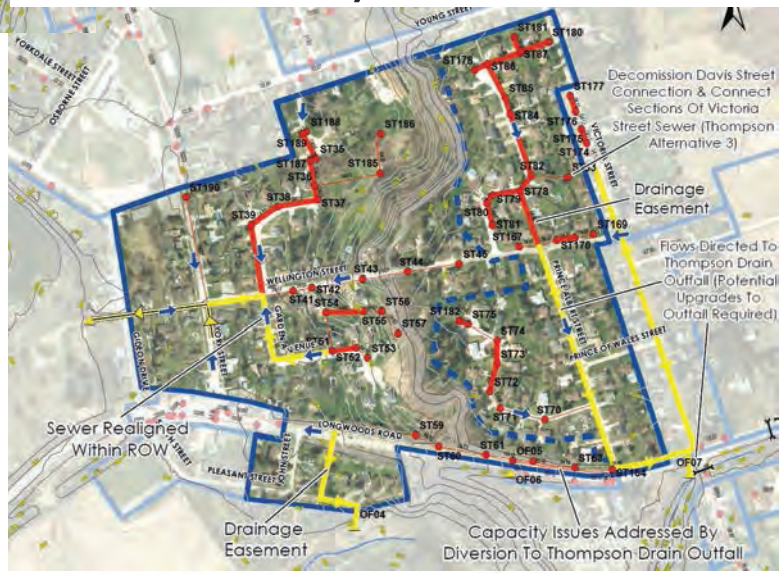
Forsythe Municipal Drain

Alternative 1 – Do Nothing

- Catchbasin/Manhole
- Outfall
- Oil/Grit Separator (OGS)
- Surface Ponding Location
- Overland Flow Direction
- Existing Storm Sewer
- Calculated Design Flow > Pipe Capacity
- Proposed Storm Sewer (2-Year Capacity)
- Proposed Storm Sewer (100-Year Capacity)
- Drainage Boundary (Interior)
- Drainage Boundary

Alternative 2 – Improve Minor System*

Alternative 3 – Divert Prince Albert Street System



Note: The Forsythe catchment area is comprised of: Hillcrest Drain, Garden Avenue Drain, Prince Albert Street Drain, Millmanor Place Storm Sewer, and Davis Street Drain.

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* Preferred Alternative

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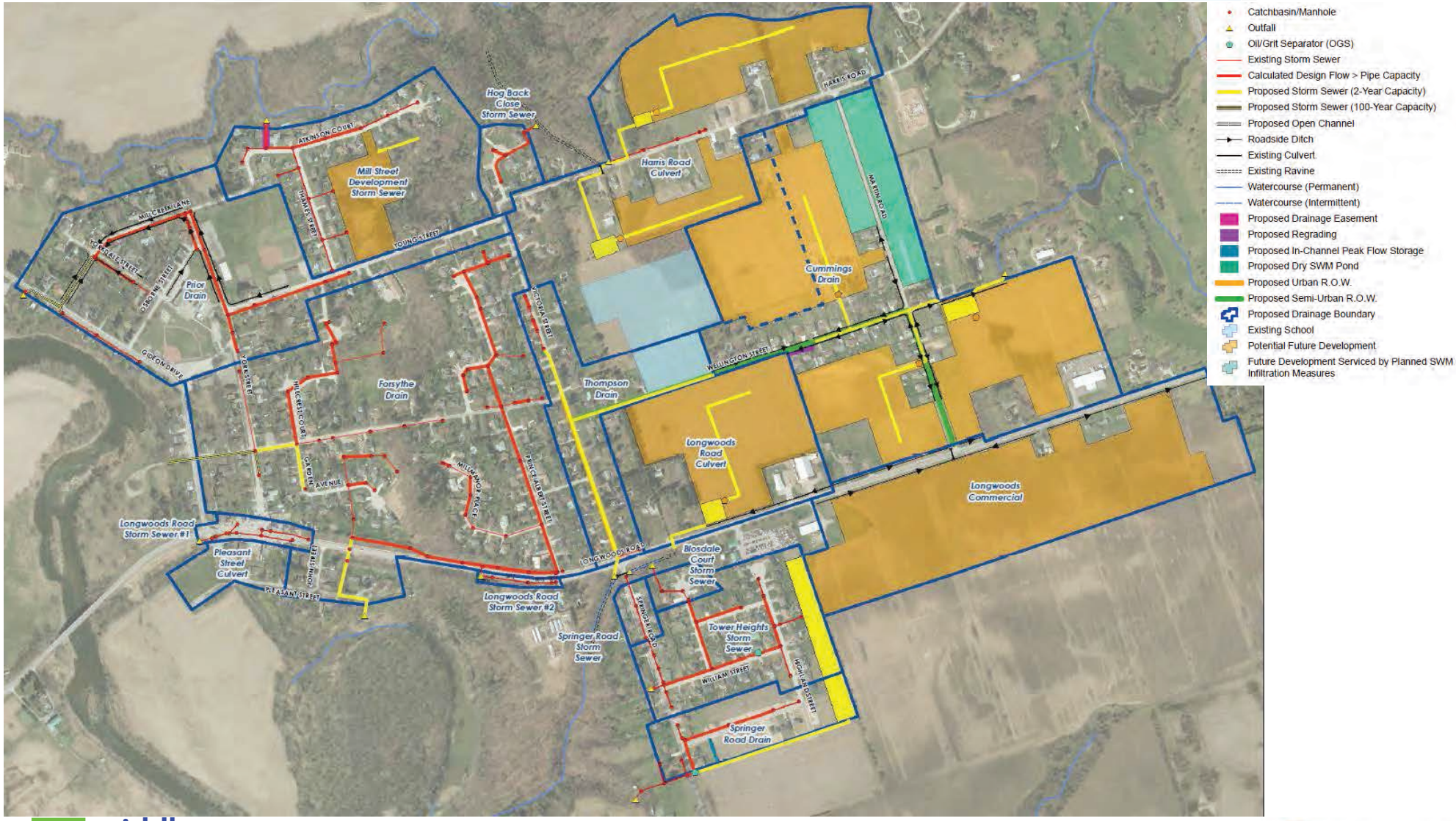
Master Plan - Preferred Alternatives



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Funding

Municipal Drains

In accordance with the *Drainage Act* (1990), funding for repairs or maintenance of Municipal Drains are to be assessed to the benefiting property owners, according to the engineer's report completed at the creation of the drain, or as amended as a result of significant upgrades. Under the *Drainage Act*, the Municipalities have the right to accumulate the cost of maintaining a drain for up to five years or $5,000 before being accessed to the property owners.

Municipal Storm Sewers

In general, municipal storm sewers are either constructed through development driven processes and ultimately assumed by the Municipality or otherwise are constructed and paid for by the Municipality.

Who is currently paying for maintenance for existing Municipal Drains?

Maintenance or repairs of Municipal drains have not been accessed to the benefitting property owners as per the *Drainage Act*, but have been funded by the Municipality through municipal operating budgets.

Who is currently paying for maintenance for existing Municipal Storm Sewers?

Since Delaware currently does not have Municipal Storm Sewer reserves, funding for maintenance or repairs for existing municipal storm sewers have been paid for from Municipal Wastewater Reserves. These reserves are paid into by residents throughout Middlesex Centre who are serviced by Municipal wastewater servicing. Residents in Delaware, however, are currently serviced by private septic systems, therefore they do not pay into these reserves.

In order to institute sustainable stormwater infrastructure, a Stormwater Reserve Fund may be initiated by the Municipality. A stormwater servicing fee may be incorporated into the existing tax program or monthly servicing fees in order to build reserves to address future maintenance and upgrades.

Preferred Alternatives

Catchment Area	Preferred Alternative and Key Rationale
Prior Municipal Drain	**Alternative 3A – Improve Major System and Abandon Municipal Drain** This alternative addresses existing capacity issues by improving roadside ditches in order to convey all flows that exceed the capacity of the minor system. The roadside ditches will also provide water quality treatment which would not be provided by minor system improvements. A storm sewer with sufficient capacity to convey the 100-year peak flows is constructed from the Millcreek Lane/Yorkdale Street intersection to the existing outlet in order to provide a major system outlet (a portion of the outlet was recently replaced as a result of failure). Although there may be minor disruption to fronting properties during implementation of ditch improvements and the new storm sewer, this option can be implemented at a lower cost with less impact to affected roads. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.
Mill Street Development	**Alternative 2 – Improve Major System** This alternative addresses existing ponding issues at the east end of Atkinson Court by regrading the overland flow route to improve drainage. Capacity issues caused by future development are addressed by providing on-site SWM controls (quality and quantity), and a ditch-inlet catchbasin is installed to address rear-yard flooding. Minor ponding may still occur at the eastern end of Atkinson Court, but it will be below Municipal standards and unlikely to threaten safety or property. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.
Hog Back Close	**Alternative 1 – Do Nothing** Although the existing storm sewer is over capacity to convey peak flows, the system is functioning sufficiently, and any ponding likely to occur will be below Municipal standards and unlikely to threaten safety or property. The existing conditions do not warrant the construction impacts and cost associated with the other alternatives.
Tower Heights Storm Sewer	**Alternative 1 – Do Nothing** Although the existing storm sewer is over capacity to convey peak flows, the existing conditions do not warrant the construction impacts and cost associated with replacement. Concerns have been received from residents regarding excessive reliance on sump pumps, however, these issues are primarily related to high groundwater levels, and may not be sufficiently addressed by SWM improvements. The costs and property impacts associated with replacing the over capacity system are not warranted by existing SWM concerns.
Springer Road Municipal Drain	**Alternative 2 – Abandon Municipal Drain and Negotiate Drainage Easement** Although the existing storm sewer is over capacity, ponding is not likely to cause risk to safety or property. Ensuring that the existing overland flow route does not become obstructed further mitigates the potential for ponding during storm events. The existing conditions do not warrant the construction impacts and costs associated with replacement of the storm sewer (Alternative 2). Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality.
Cummings Drain	**Alternative 2– Urban ROW within Future Development and Dry SWM Pond** The existing drain south of Wellington Road is decommissioned, and the south roadside ditch profile is modified to convey major flows from the low point westward to the Longwoods Road Culvert. Future development areas (excluding approved Draft-Plans along Martin Road) will incorporate urban ROW to convey minor and major flows. Flows from the future development areas will be conveyed by proposed storm sewers along Wellington Street and Martin Road to a regional dry SWM pond located on development lands east of Martin Road prior to discharge to the ravine. The proposed SWM pond, in conjunction with oil/grit separators located at each of the development lands, provides the required stormwater treatment and quantity control. The proposed storm sewer along Wellington Street would be extended to address existing surface ponding at the Wellington Street low point. Funding for implementation of works associated with future development will be provided through the development process, and improvements to existing stormwater system would be provided by Stormwater Reserve Funds to be established by the Municipality. This alternative addresses key issues related to capacity and accessibility. While higher disruption and construction impacts to Wellington Street and Martin Road are anticipated over the other alternatives, this option could align with planned roadwork improvements and is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.

Preferred Alternatives Continued

Catchment Area	Preferred Alternatives and Key Rationale
Longwoods Road Culvert	**Alternative 3 – Urban ROW within Future Development & Dry SWM Pond** Urban ROW within the future development area incorporates SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties. A proposed dry SWM pond and oil/grit separator provides the required stormwater treatment and quantity control. The existing concrete box culvert beneath Longwoods Road is replaced with a new outlet which must be lowered to accommodate the proposed upstream sewers. Improvements to the Longwoods Road north roadside ditch will mitigate flooding on commercial property. Funding for implementation of works associated with new development to be provided through development process, and improvements to existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality. This alternative addresses key issues related to post-development impacts. While this option is considered a higher cost alternative, it is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.
Harris Road Culvert	**Alternative 2A – Urban ROW within Future Development & Dry SWM Pond** Urban ROW within the future development areas incorporate SWM control measures to allow for development to proceed with minimal impact to the ravine or existing properties. Proposed dry SWM ponds and oil/grit separators provide the required stormwater treatment and quantity control. Flows will be directed to the existing ravine outlet via proposed storm sewers constructed within drainage easements. Funding for implementation of works associated with new development to be provided through development process, and improvements to existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality. The Harris Road culvert is lowered to accommodate the proposed upstream storm sewers. With exception of minor roadworks to accommodate storm sewer installation, no significant alterations to road cross-sections would be undertaken. This alternative addresses capacity issues in the existing system and addresses stormwater servicing for the future development areas with less impact to existing residences (tree removal, road reconstruction), and is consistent with the Municipality's intention to ensure new development meets the urban ROW standard.
Longwoods Commercial	**Alternative 3A – Dry SWM Pond** Flows from the Longwoods Road roadside ditches are conveyed through the development lands through a drainage easement. Quality and Quantity controls are provided by proposed oil & grit separators within the future development area, and a dry SWM pond located in the buffer lands (Special Policy Area #8). Flows are conveyed from the dry SWM pond to the Springer Road Drain outfall location by a proposed pipe located within a drainage easement south of the Tower Heights Subdivision. Funding for implementation of works associated with new development to be provided through development process, and improvements to existing stormwater system will be funded by Stormwater Reserve Funds to be established by the Municipality. This alternative addresses stormwater runoff from the future development lands, with less potential for aggravating existing high groundwater levels within the adjacent Tower Heights subdivision, as well as providing the opportunity for incorporating flows from the Springer Road Drain catchment area.
Thompson Municipal Drain	**Alternative 3 – Proposed Storm Sewer and Abandon Municipal Drain** The proposed storm sewer provides an outlet for the existing roadside ditches along Wellington Street to limit ponding depths in front of Our Lady of Lourdes school property. The storm sewer along Victoria Street is replaced with a new storm sewer within the ROW, and a portion of sewer currently draining to the Davis Street system is connected to proposed Victoria Street sewer to alleviate impacts on the adjacent Forsythe System. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality. This alternative addresses existing capacity and ponding issues, and although fronting properties will experience temporary disruption during construction, future impacts to private property will be mitigated by aligning the sewer within the ROW, and increasing conveyance capacity.
Forsythe Municipal Drain	**Alternative 2 – Improve Minor System** A new storm sewer with sufficient capacity to convey the 100-year peak discharge would be constructed from the York Street low point south of Wellington Street to a new outfall to the Thames River. Segments of pipe located on private property are decommissioned, and the identified sections are replaced. Funding for improvements would be provided by Stormwater Reserve Funds to be established by the Municipality. This alternative also includes the option to divert flows to the Thompson Drain outfall should over capacity of sewer along Longwoods Road become a concern. Although segments of the existing storm sewer remain over capacity, the proposed sewer upgrades address areas of identified and anticipated ponding, mitigates risks to safety and property, minimizes impacts to residents during construction, and can be implemented at a lower cost.

Next Steps…

- **Review and consider public input**
  - Confirm or refine recommended alternatives
  - Identify mitigation measures to offset potential impacts
- **Finalize Master Plan Document**
- **Issue Notice of Completion, and file Master Plan Document for 30 day public review**
  - Address all concerns received
  - If there are any outstanding concerns that cannot be resolved during the 30-day review period, members of the public can contact the Minister of the Environment to issue a Part II Order, bumping up the status of the project
- **If no Part II Orders are received, the project is completed and the Master Plan Document will serve as a framework for future projects; the Municipality may proceed to implementation of the individual improvements identified within the Master Plan Document**

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Delaware Stormwater Servicing Master Plan
Municipal Class Environmental Assessment

Stantec

Public Information Centre #1
Thursday, October 8th, 4:30pm-6:30pm
Delaware Community Centre

COMMENT SHEET

Name: ROBERT LADE

Mailing Address: [redacted]

Interest (*i.e.* property owner, agency):

Response Required? YES/~~NO~~

Comments:

PLEASE CHECK DRIVEWAY DRAIN
WATER GO TO DEAD END ?

MAY BE BELOW STREET DRAIN PIPE

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
Stantec Consulting Ltd.
600-171 Queens Ave., London
ON, N6A 5J7
Phone: (519) 675-6668
Fax: (519) 645-6575
Corri.marr@stantec.com

Information will be collected in accordance with Ontario's Municipal Freedom of Information and Protection of Privacy Act. With the exception of personal information all comments will become part of the public record.

Delaware Stormwater Servicing Master Plan
Municipal Class Environmental Assessment

Public Information Centre #1
Thursday, October 8th, 4:30pm-6:30pm
Delaware Community Centre

COMMENT SHEET

Name:	Lindsay Hirt
Mailing Address:	[redacted]
Interest (*i.e.* property owner, agency):	Property owner.
Response Required? YES/NO	
Comments:	Concerned that storm pond and pipe will isolate us from potential development.

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
Stantec Consulting Ltd.
600-171 Queens Ave., London
ON, N6A 5J7
Phone: (519) 675-6668
Fax: (519) 645-6575
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Public Information Centre #1
Thursday, October 8th, 4:30pm-6:30pm
Delaware Community Centre

COMMENT SHEET

Name: LEE DONELY

Mailing Address: [redacted]

Interest (*i.e.* property owner, agency): PROPERTY OWNER

Response Required? YES/NO

Comments: I'M CONCERNED ABOUT THE LOCATION OF THE PROPOSED STORM SEWER RE-LOCATION FACT OF JOHN ST AS IT APPEARS TO RUN THROUGH MY BACK YARD. WOULDN'T IT BE POSSIBLE TO PUT IT UNDER JOHN ST?

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
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Delaware Community Centre

COMMENT SHEET

Name: Joe Keller
Mailing Address: [redacted]
Interest (*i.e.* property owner, agency): property owner
Response Required? YES/NO
Comments:

(1) I like the storm water proposal to help take away standing water and the fear of basement flooding

(2) My child walks down Martin Road & Wellington Road to OLOL. I fear for the safety of my child & the neighbourhood children because there are no sidewalks

(3) I would like to see low level lighting on Martin Road & Wellington for safety not bright light but soft lighting

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

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Delaware Stormwater Servicing Master Plan
Municipal Class Environmental Assessment

Public Information Centre #1
Thursday, October 8th, 4:30pm-6:30pm
Delaware Community Centre

COMMENT SHEET

Name:	Anne Perkins
Mailing Address:	[redacted]
Interest (*i.e.* property owner, agency):	
Response Required? YES/NO	
Comments:	

① Preferred Alternative must STILL save as many trees as possible. No, the MAXIMUM number of trees. Road widening and boulevard width should be at minimum in order to maintain trees on Victoria St.

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
Stantec Consulting Ltd.
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ON, N6A 5J7
Phone: (519) 675-6668
Fax: (519) 645-6575
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Delaware Stormwater Servicing Master Plan
Municipal Class Environmental Assessment

Public Information Centre #1
Thursday, October 8th, 4:30pm-6:30pm
Delaware Community Centre

COMMENT SHEET

Name: DOUG PERKINS

Mailing Address: [redacted]

Interest (*i.e.* property owner, agency): PROPERTY OWNER

Response Required? YES/NO

Comments:

(1) "PREFERRED ALTERNATIVE" FOR VICTORIA ST. MUST HAVE THE NARROWEST FOOTPRINT POSSIBLE TO SAVE THE MAXIMUM NUMBER OF TREES.

(2) WE HAVE DRAINS ON THE NORTH & SOUTH SIDE OF OUR PROPERTY. THEY RUN WEST INTO THE THOMPSON DRAIN. IF THE THOMPSON DRAIN IS DECOMMISSIONED WHAT WILL HAPPEN TO THE WATER/ RUNOFF GOING INTO THESE DRAINS?

(3) PLEASE CONSIDER ~~[illegible]~~ LOCATING SIDEWALK CLOSE TO ROADWAY TO MINIMIZE DAMAGE TO TREES ALONG VICTORIA ST.

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
Stantec Consulting Ltd.
600-171 Queens Ave., London
ON, N6A 5J7
Phone: (519) 675-6668
Fax: (519) 645-6575
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Delaware Community Centre

COMMENT SHEET

Name: RICK RICHMAN

Mailing Address: [redacted]

Interest (*i.e.* property owner, agency): PROPERTY OWNER.

Response Required? YES/NO

Comments:

INITIAL REVIEW OF THE "PREFERRED" SOLUTION ON VICTORIA ST APPEARS TO MEET THE OBJECTIVES AS REQUESTED IN PREVIOUS MEETINGS.

SUBJECT TO FULL DISCLOSURE OF ACTUAL ROAD / CURB + BOULEVARD DIMENSIONS AND LOCATIONS.

WE WOULD ALSO WELCOME A FINAL REPORT CONFIRMING WHICH IF ANY TREES WILL BE NEGATIVELY IMPACTED.

X OF PARTICULAR CONCERN MY HOME IS CURRENTLY SERVICED BY A CATCH BASIN ABOUT 5' IN FROM VICTORIA STREET WHICH THEN RUNS WEST AND DRAINS INTO THE THOMPSON DRAIN. THIS REMOVES BOTH SURFACE WATER AND WATER FROM EAVESTROUGH. HOW WILL THESE CONNECTIONS BE MAINTED WITH NEW STORM SEWER ON VICTORIA?

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
Stantec Consulting Ltd.
600-171 Queens Ave., London
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Phone: (519) 675-6668
Fax: (519) 645-6575
Corri.marr@stantec.com

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Delaware Community Centre

COMMENT SHEET

Name: DARCY GEGEAR

Mailing Address: [redacted]

Interest (*i.e.* property owner, agency [redacted]

Response Required? YES/NO

Comments:

Proposed installation of new storm and sanitary sewers on Victoria St. makes sense, especially with new URBAN STANDARD design for road widening.

NOTE many homes on Victoria St. are currently connected to the Thompson drain for storm water run off. We must continue this connection into this new system.

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
Stantec Consulting Ltd.
600-171 Queens Ave., London
ON, N6A 5J7
Phone: (519) 675-6668
Fax: (519) 645-6575
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Delaware Stormwater Servicing Master Plan
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Public Information Centre #1
Thursday, October 8th, 4:30pm-6:30pm
Delaware Community Centre

COMMENT SHEET

Name: NOORDERMEER BROS INC

Mailing Address: [redacted]

Interest (*i.e.* property owner, agency):

Response Required? YES/NO

Comments:

REGARDING LONGWOOD CULVERT

WE ARE IN FAVOR OF ALTERNATIVE 3 WHICH SHOWS A PROPERLY WORKING DITCH WITH THE FLOW GOING ~~TOWARDS~~ WEST. THIS WOULD GET RID OF THE RAINWATER AND THE CURRENT PONDING

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

Corri Marr
Senior Planner
Stantec Consulting Ltd.
600-171 Queens Ave., London
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Municipal Class Environmental Assessment

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Thursday, October 8th, 4:30pm-6:30pm
Delaware Community Centre

COMMENT SHEET

Name: HELEN THOMPSON

Mailing Address: [redacted]

Interest (*i.e.* property owner, agency): PROPERTY OWNER

Response Required? YES/NO YES

Comments:

Alternative 3A is preferred by me — I don't want to lose my maple trees along Victoria Street — they are over 100 years old.

Please do everything you can to save my trees — especially the maples.

Try to make the ditch & sidewalk shallower & narrower if possible

TRY VERY HARD NOT TO DESTROY OUR TREES ON VICTORIA STREET

Please place comments in the comment box provided, or return to the following BY OCTOBER 22, 2015:

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OCT 14 2015
STANTEC CONSULTING LTD.

Corri Marr
Senior Planner
Stantec Consulting Ltd.
600-171 Queens Ave., London
ON, N6A 5J7
Phone: (519) 675-6668
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Corri.marr@stantec.com

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Appendix A5 – Public Comment TRACER Table

TRACER
Team Response and Commitment to Environmental Requirements
Delaware Community Settlement Area Stormwater Master Plan
Agency Consultation Tracer

Stakeholder	Name and Contact Information	Comment Received	Response/Commitment to Carry Forward
Landowner/Developer	Perry Buren	Email received on September 21, 2015 – Currently has a development application that has been put on hold pending the finalization of the stormwater Master Plan. Originally report was to be finalized in the summer of 2015, but has not received any updates, and is inquiring regarding the timeline of the report.	Mr. Buren was added to the contact stakeholder list, and was directly emailed a copy of the Notice of PIC 1 via email on September 22, 2015.
Property Owner	Lee Donely	Comment Sheet received at PIC (October 8th, 2015) Concerned that the location of the proposed storm sewer east of John St. (Forsythe drainage area) runs through their property, requesting that it be realigned within John Street.	**Email response sent on November 24th, 2015** The proposed sewer from Longwoods Road to the outfall located south of Pleasant Street has been realigned to the John Street right of way to minimize impacts to private property.
Property Owner	Lindsay Hird	Comment Sheet received at PIC(October 8th, 2015) Concerned that location of proposed SWM pond and sewer (Harris Rd. Culvert) will impact their ability to develop their property.	**Email response sent on November 24th**: The location of the dry SWM pond servicing the future development lands south of Harris Road will be determined and coordinated during future development applications. Technical considerations allow for flexibility in the location of the dry SWM pond including within the future development lands. Since the area is generally landlocked, coordination will need to be made between the developer and neighbouring landowners to secure an easement to convey flows to the existing outlet on Harris Road. **Response received Nov. 25th:** Mr. Hird's replied that his questions were generally answered by project representatives during the PIC, and that they do not have an issue with SWM pond being located on their property.
Property Owner	Joe Keller	Comment Sheet received at PIC(October 8th, 2015) In favour of installation of storm sewer, and requesting that sidewalks and low level lighting on Martin Rd and Wellington Street be installed along Wellington Street.	No response required.
Property Owner	Helen Thompson	Comment Sheet received at PIC(October 8th, 2015) In favour of preferred alternative (urban ROW), but does not want trees removed along Victoria St.	No response required. The urban ROW proposed for Victoria Street has the benefit of preserving a greater amount of trees than would a semi-urban ROW, and mitigation will be provided for any trees requiring removal.
Business Owner	Noordmermeer Bros Inc.	Comment Sheet received at PIC(October 8th, 2015) In favour of preferred alternative (improved ditch to resolve existing ponding)	No response required.
Property Owner	Rick Richman	Comment Sheet received at PIC(October 8th, 2015) In favour of preferred solution for Thompson Drain catchment area, but would like to be informed regarding actual road/curb and Boulevard dimensions, and would like a report confirming which trees will be impacted. Would also like confirmation regarding the connection of existing catch basins to proposed storm sewer (catch basin servicing his property is 5 feet from Victoria Street).	**Email response sent on November 24th**. The urban ROW proposed for Victoria Street has the benefit of preserving a greater amount of trees than would a semi-urban ROW, and mitigation will be provided for any trees requiring removal. Existing catchbasins will be connected to new storm sewers, and will be addressed during the detailed design process.
Property Owner	Doug Perkins	Comment Sheet received at PIC(October 8th, 2015) Concerned regarding trees along Victoria Street, would like sidewalks as close to road as possible to minimize footprint. Concerned regarding the catchbasins on the north and south of property, would like confirmation on how these will be impacted with installation of storm sewer.	**Email response sent on November 24th,** Existing catchbasins will be connected to new storm sewers, and will be addressed during the detailed design process.
Property Owner	Robert Lade	Comment Sheet received at PIC(October 8th, 2015) Concerned that the drain on his driveway goes to a dead end. ?	No response required. Existing catchbasins will be connected to new storm sewers, and will be addressed during the detailed design process.
Property Owner	Anne Perkins	Comment Sheet received at PIC(October 8th, 2015) Concerned regarding the trees along Victoria Street.	**Email response sent on November 24th.** No response required. The urban ROW proposed for Victoria Street has the benefit of preserving a greater amount of trees than would a semi-urban ROW, and mitigation will be provided for any trees requiring removal.
Property Owner	Darcy Gegear	Comment Sheet received at PIC(October 8th, 2015) In favour of installation of storm sewers and urban standard along Victoria Street, but would like to ensure existing catchbasins are connected to the new system.	No response required. Clarification will be made within Master Plan document that existing catchbasins are to be connected to the new system, and will be addressed during detailed design.

TRACER
Team Response and Commitment to Environmental Requirements
Delaware Community Settlement Area Stormwater Master Plan
Agency Consultation Tracer

Landowner/Developer	Bill Timmerman	Fax received on October 21st, 2015 Concerned that the location of the dry SWM pond servicing future development lands within the Longwoods Road Commercial Lands and the Cummings Drain catchment areas were not appropriate, and may negatively impact the ability to develop the parcels in the future.	A meeting was held on October 29th with Mr. Timmerman , Brian Lima, and Nelson Oliveira. The location of the dry SWM ponds shown on the drawings presented are conceptual based on high level topography/drainage, and do not reflect the ultimate size or location of the ponds, which will be determined during detailed design/development applications. The drawings for the Master Plan document were revised and wording included allowing greater flexibility in the location of stormwater management facilities. Mr. Timmerman was in agreement with the modifications.

Appendix A6 – Aboriginal Consultation

TRACER
Team Response and Commitment to Environmental Requirements
Delaware Community Settlement Area Stormwater Master Plan
Aboriginal Consultation Tracer

Name and Contact Information	Notice of Commencement (September 10, 2014)	Response/Follow-Up	Notice of PIC 1 (September 21, 2015)	Response/Follow-Up	Notice of Completion (February 8th, 2016)	Response/Follow-Up
Moravian of the Thames Chief Greg Peters Justin Logan 14670 School House Line, RR#3 Thamesville, ON N0P 2K0	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Follow-up email was sent to Chief Peters and Justin Logan on November 9th, 2015 with PIC presentation materials.	Delivered by Canada Post Letter mail	
Chippewas of the Thames Chief Joe Miskokomon Ms. Fallon Burch 320 Chippewa Rd. Muncey, ON NOL 1Y1	Delivered by Canada Post Letter mail	Jan 28, 2015 email response letter. Community would like to receive Master Plan for review and any additional environmental documentation.	Delivered by Canada Post Letter Mail	M. Alikakos attended PIC, and requested a copy of material presented, which was sent via email on October 9th. Letter response was received on October 15, stating that due to the proximity of Delaware to lands subject to the Longwoods Treaty (1820), and its location within lands subject to the Big Bear Creek Additions to Reserve land selection area, the community has expressed a high value of interest; direct consultation will be conducted at the next stages of the study.	Delivered by Canada Post Letter mail	
Munsee-Delaware Nation Chief Roger Thomas Glen Forrest 290 Jubilee Rd. Muncey, ON N0L 1Y1	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Follow-up call on November 9th. Message was left with Band Manager Glen Forrest, and presentation material was sent via email.	Delivered by Canada Post Letter mail	
Oneida Nation of the Thames Chief Sheri Doxtator Cherilyn Hill 2212 Elm Ave. Southwold, ON N0L 2G0	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Follow-up phone call on November 9th 2015 to confirm that community did not require further consultation. Presentation material was forwarded via to Chief's Assistant Cherilyn Hill.	Delivered by Canada Post Letter mail	
Bkejwanong Territory (Walpole Island) Chief Dan Miskokomon Dr. Dean Jacobs	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter mail	Follow-up email was sent to Chief Miskokomon, Jared Macbeth, and Dean Jacobs on November 9th, 2015 with PIC presentation materials.	Delivered by Canada Post Letter mail	
Caldwell First Nations **Chief Louise Hillier**	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter mail	Follow-up email was sent to Chief Hillier on Novemeber 9th, 2015with PIC presentation materials.	Delivered by Canada Post Letter mail	

TRACER
Team Response and Commitment to Environmental Requirements
Delaware Community Settlement Area Stormwater Master Plan
Aboriginal Consultation Tracer

Chippewas of Kettle and Stony Point First Nation Thomas Bressette, Suzanne Bressette 6247 Indian Lane, Forest ON N0N 1J0	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail	Letter received November 19th, 2015: Acknowledgement of Study Commencement. The Community does not require that we engage in consultation regarding the Delaware Master Plan project; however, the Community would like to be informed of any changes in scope and/or amendments to the project that may impact their Traditional Territory. The Community welcomes any additional consultation requests. Consultant Response: No response required. We will continue to provide information and encourage input from the Community throughout the project.	Delivered by Canada Post Letter mail	
Southern First Nations Secretariat Ms. Jolene Whiteye 22361 Austin Line Bothwell, ON N0P1C0	Delivered by Canada Post Letter mail	Correspondence received during previous projects has indicated that project information should be sent to the individual Chiefs under this council, and that this council does not review individual projects. The project team will continue to include the Southern First Nations Secretariat in future project correspondence.	Delivered by Canada Post Letter Mail		Delivered by Canada Post Letter mail	
Ministry of the Environment Ms. Wendy Comet Ms. Ashley Johnson 135 St Clair Ave W - 3rd Floor Toronto, ON M4P 1V5	Delivered by Canada Post Letter mail		Delivered by Canada Post Letter Mail		Delivered by Canada Post Letter mail	
Ministry of Aboriginal Affairs Lands & Trust Services Consultation and Accommodation Unit	Delivered by Canada Post Letter mail	May 26, 2015 - Letter response providing information on First Nations Communities (2) that may have claims impacted by project and additional communities (2) that may be interested based on proximity to project study area. All four communities have already been engaged.	Delivered by Canada Post Letter Mail		Delivered by Canada Post Letter mail	

Stantec Consulting Ltd.
171 Queens Avenue, 6th Floor
London ON N6A 5J7
Fax: 519-645-6575

January 13, 2015
File: 165630021

Attention: Pauline Wakegjijig
Ministry of Aboriginal Affairs
Consultation Unit
160 Bloor Street East, 9th Floor
Toronto, ON M7A 2E6

Dear Ms. Wakegjijig;

Reference: Notice of Commencement for the Delaware Community Settlement Area Stormwater Master Plan

The Municipality of Middlesex Centre is undertaking a comprehensive stormwater master plan for the Delaware Community Settlement Area to identify necessary storm drainage system improvements to better service the existing community, and to provide a drainage servicing strategy to accommodate future growth and development. The proposed servicing plan will identify the stormwater infrastructure required to mitigate the possibility of flooding and erosion, provide adequate stormwater treatment, and protect downstream aquatic habitat. The proposed stormwater management strategy will be the solution that best meets the following responsibilities:

- Provide adequate drainage servicing and stormwater treatment;
- Protect the natural environment;
- Reduce negative impacts on affected landowners; and
- Minimize stormwater servicing costs.

Furthermore, a funding strategy will be developed to verify that implementation of the proposed master plan is feasible. Any other relevant responsibilities identified through the Class EA process will also be integrated into the proposed stormwater servicing strategy.

This study is being conducted as a Master Plan (Phases 1 and 2) under the Municipal Class Environmental Assessment process (Municipal Engineer's Association, as amended in June 2007 and 2011). Under this process, agency and public input is invited for incorporation into the planning and design for this study.

We have included the following communities in our project contact list due to study area proximity and previous project interest:

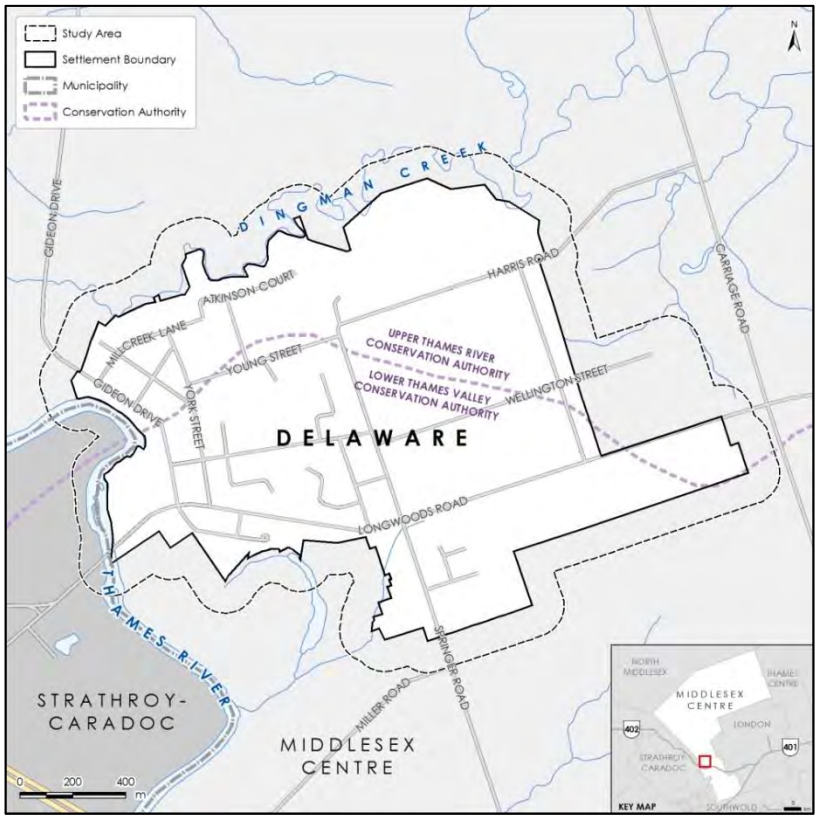
- Caldwell First Nation;
- Bkejwanong Territory;
- Delaware Nation - Moravian of the Thames;
- Munsee-Delaware First Nation;
- Chippewas of the Thames; and
- Oneida Nation of the Thames.

Reference: Notice of Commencement for the Delaware Community Settlement Area Stormwater Master Plan

Anticipated future approvals related to this project are:

- Section 28 (Conservation Authorities);
- Environmental Compliance Approval (MOECC); and
- Dewatering permit (MOECC).

We respectfully request any additional information specific to Aboriginal federal and provincial land claims and litigation that may be within the project study area illustrated below.



Regards,

STANTEC CONSULTING LTD.

Michele Oxlade, B.Sc., EP, ENV SP
Environmental Coordinator
Phone: (519) 675-6652
Michele.Oxlade@stantec.com

c. Brian Lima, Municipality of Middlesex Centre, Director – Public Works and Engineering,

Ministry of Aboriginal Affairs

160 Bloor St. East, 9th Floor
Toronto, ON M7A 2E6
Tel: (416) 326-4740
Fax: (416) 325-1066
www.aboriginalaffairs.gov.on.ca

Ministère des Affaires Autochtones

160, rue Bloor Est, 9e étage
Toronto ON M7A 2E6
Tél. : (416) 326-4740
Téléc. : (416) 325-1066
www.aboriginalaffairs.gov.on.ca

Ontario

RECEIVED
MAY 26 2015
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Reference: EA #2015-28

Michele Oxlade, B.Sc., EP, ENV SP
Environmental Coordinator
Stantec Consulting Ltd.
171 Queens Avenue, 6th Floor
London, ON N6A 5J7

Re: Notice of Commencement for the Delaware Community Settlement Area Stormwater Master Plan

Dear Michele Oxlade:

Thank you for informing the Ministry of Aboriginal Affairs (MAA) of your project. Please note that MAA treats all letters, emails, general notices, etc. about a project as a request for information about which Aboriginal communities may have rights or interests in the project area.

We acknowledge that you have identified the following Aboriginal communities/organizations:

- Caldwell First Nation;
- Bkejwanong Territory;
- Delaware Nation – Moravian of the Thames;
- Munsee-Delaware First Nation;
- Chippewas of the Thames;
- Oneida Nation of the Thames.

As a member of the government review team, the Ministry of Aboriginal Affairs (MAA) identifies First Nation and Métis communities who may have the following interests in the area of your project:

- reserves;
- land claims or claims in litigation against Ontario;
- existing or asserted Aboriginal or treaty rights, such as harvesting rights; or
- an interest in the area of the project.

MAA is not the approval or regulatory authority for your project, and receives very limited information about projects in the early stages of their development. In circumstances where a Crown-approved project may negatively impact a claimed Aboriginal or treaty right, the Crown may have a duty to consult the Aboriginal community advancing the claim. The Crown often delegates procedural aspects of its duty to consult to proponents. Please note that the information in this letter should not be relied on as advice about whether the Crown owes a duty to consult in respect of your project, or what consultation may be appropriate.

Should you have any questions about your consultation obligations, please contact the appropriate ministry.

You should be aware that many First Nations and/or Métis communities either have or assert rights to hunt and fish in their traditional territories. For First Nations, these territories typically include lands and waters outside of their reserves.

In some instances, project work may impact aboriginal archaeological resources. If any Aboriginal archaeological resources could be impacted by your project, you should contact your regulating or approving Ministry to inquire about whether any additional Aboriginal communities should be contacted. Aboriginal communities with an interest in archaeological resources may include communities who are not presently located in the vicinity of the proposed project.

With respect to your project, and based on the brief materials you have provided, we can advise that the project appears to be located in an area where First Nations may have existing or asserted rights or claims in Ontario's land claims process or litigation, that could be impacted by your project. Contact information is below:

Chippewas of the Thames First Nation 320 Chippewa Road R.R. #1 MUNCEY, Ontario N0L 1Y0	Chief Richard "Joe" Miskokomon (519) 289-5555 (Fax) 289-2230 chief@cottfn.com cdeleary@cottfn.com
Oneida Nation of the Thames 2212 Elm Avenue SOUTHWOLD, Ontario N0L 2G0	Chief Sheri Doxtator (519) 652-3244 (Fax) 652-9287 Sheri.Doxtator@oneida.on.ca

For your information, MAA notes that the following Métis communities or First Nations may be interested in your project given the proximity of their community or reserve lands to the area of the proposed project or because of your project's potential environmental impacts:

Munsee-Delaware Nation R. R. #1 MUNCEY, Ontario N0L 1Y0	Chief Roger Thomas (519) 289-5396 (Fax) 289-5156 Chief.thomas@munsee-delaware.org
Moravian of the Thames R.R. #3 THAMESVILLE, Ontario N0P 2K0	Chief Greg Peters Ph: (519) 692-3936 Fax: (519) 692-5522

The information upon which the above comments are based is subject to change. First Nation or Métis communities can make claims at any time, and other developments can occur that could result in additional communities being affected by or interested in your undertaking.

Through Aboriginal Affairs and Northern Development (AANDC), the Government of Canada sometimes receives claims that Ontario does not receive, or with which Ontario does not become involved. AANDC's Consultation and Accommodation Unit (CAU) established a "single window" to respond to requests for baseline information held by AANDC on established or potential Aboriginal Treaty and rights. To request information from the Ontario Subject Matter Expert send an email to: UCA-CAU@aadnc-aandc.gc.ca

Additional details about your project or changes to it that suggest impacts beyond what you have provided to date may necessitate further consideration of which Aboriginal communities may be affected by or interested in your undertaking. If you think that further consideration may be required, please bring your inquiry to whatever government body oversees the regulatory process for your project. MAA does not wish to be kept informed of the progress of the project; please be sure to remove MAA from the mailing list.

Yours truly,

Corwin Troje
Manager, Ministry Partnerships Unit
Aboriginal Relations and Ministry Partnerships Branch

UNCLASSIFIED
Report as of 2015/02/04

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Aamjiwnaang (BAND-172)		
Clench Defalcation	**In Negotiations** Active (Band previous name: Chippewas of Sarnia). Misappropriation of sale proceeds.	- Date Claim Filed: 2008/10/16 - Date Legal Opinion Signed: 2011/05/16 - Canada Offered to Negotiate: 2011/09/23 - Pending FN's BCR Accepting to Negotiate: 2011/09/24 - Claimant Agreed to Negotiate: 2011/11/21
Enniskillen (SPLIT #01) Aamjiwnaang	**Settled** Settled Through Negotiations (Band previous name: Chippewas of Sarnia). Alleged that certain lands in Enniskillen Township were sold without surrender between 1866 and 1918.	- Canada Offered to Negotiate: 2002/04/13 - Settlement Signed by Canada: 2004/03/29
Caldwell (BAND-165)		
Land Entitlement	**Settled** Settled Through Negotiations Alleged members are the original inhabitants, occupants and owners of Point Pelee & Pelee Island, that it never surrendered Point Pelee in 1790, & that the 999 year lease to Pelee Island was invalid.	- Not Accepted for Negotiations: 1974/09/05 - Date Legal Opinion Signed: 1995/08/16 - Canada Offered to Negotiate: 2008/10/16 - Settlement Signed by Claimant: 2010/09/17 - Settlement Signed by Canada: 2011/03/02
Pelee Island	**Concluded** No Lawful Obligation Found Alleges FN didn't surrender Pelee Island and that the 999 year lease is invalid since the Crown's patent is void.	- Date Claim Filed: 2008/10/16 - Research Start Date : 2009/04/17 - Date Legal Opinion Signed: 2011/04/26 - Not Accepted for Negotiations: 2011/08/19

UNCLASSIFIED
Report as of 2015/02/04

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Chippewas of Kettle and Stony Point (BAND-171)		
1927 Surrender	**Concluded** File Closed Alleged 1927 surrender of part of the Kettle Point Indian reserve no.44 & its subsequent sale in 1929 is invalid.	- Date Legal Opinion Signed: 1993/03/18 - Not Accepted for Negotiations: 1993/03/31 - Date of ISCC Process/Active: 1994/02/02 - Date Litigation Became Active : 1997/03/15 - File Closed: 2012/03/31
1928 Surrender at Stoney Point	**Concluded** File Closed Alleged 1928 Surrender & Sale of 377 acres of the Stoney Point Reserve is invalid. 1928 Surrender at Stoney Point (Ipperwash Provincial Park).	- Research Start Date : 2001/10/16 - Date Legal Opinion Signed: 2004/08/03 - Pending FN's BCR Accepting to Negotiate: 2005/04/27 - Claimant Agreed to Negotiate: 2008/07/15 - Canada Offered to Negotiate: 2008/10/16 - File Closed: 2012/09/10
Clench Defalcation	**In Negotiations** Active Misappropriation of sale proceeds.	- Date Claim Filed: 2008/10/16 - Date Legal Opinion Signed: 2011/05/16 - Canada Offered to Negotiate: 2011/09/23 - Pending FN's BCR Accepting to Negotiate: 2011/09/24 - Claimant Agreed to Negotiate: 2011/11/21
Enniskillen (SPLIT #02) Chippewas of Kettle and Stony Point	**Settled** Settled Through Negotiations Alleged that certain lands in Enniskillen Township were sold without surrender between 1866 and 1918.	- Canada Offered to Negotiate: 2002/04/13 - Settlement Signed by Canada: 2004/03/29
Lot 27 - Bosanquet Lands	**Concluded** No Lawful Obligation Found Misappropriation of sale proceeds of Lot 27, Concession 6, Township of Bosanquet.	- Date Claim Filed: 2008/10/16 - Date Legal Opinion Signed: 2010/09/02 - Not Accepted for Negotiations: 2011/09/20

UNCLASSIFIED
Report as of 2015/02/04

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Chippewas of the Thames First Nation (BAND-166)		
Big Bear Creek Reserve	**Settled** Settled Through Negotiations Alleged that the 5,120 acre Big Bear Cree Reserve was patented and sold by the Crown in the 1830s without a proper surrender by the FN. Furthermore, the compensation paid by the Crown for the loss of the reserve in 1849-50 was inadequate. The land in question was reserved for the FN under the Longwoods Treaties (1819-1822).	- Research Start Date : 2001/04/17 - Date Legal Opinion Signed: 2008/06/20 - Negotiations Inactive: 2008/08/02 - Pending FN's BCR Accepting to Negotiate: 2008/08/03 - Canada Offered to Negotiate: 2008/10/16 - Claimant Agreed to Negotiate: 2008/11/05 - Settlement Signed by Claimant: 2013/04/26 - Settlement Signed by Canada: 2013/11/25
Caradoc IR Railway Right of Way	**Concluded** No Lawful Obligation Found Alleges failure to properly manage 3 railway transactions on Caradoc IR and failure to provide proper and lawful consideration to protect FN interest.	- Date Claim Filed: 2010/05/05 - Research Start Date : 2010/05/06 - Date Legal Opinion Signed: 2012/03/20 - Not Accepted for Negotiations: 2013/04/11
Caradoc Reserve 1834 Surrender	**In Negotiations** Active Alleges that Canada breached its fiduciary duties and duty of honour and integrity in relation to the 1834 Surrender.	- Date Claim Filed: 2010/11/03 - Research Start Date : 2010/11/04 - Date Legal Opinion Signed: 2012/07/13 - Canada Offered to Negotiate: 2013/08/23 - Pending FN's BCR Accepting to Negotiate: 2013/08/24
Clench Defalcation	**Settled** Settled Through Negotiations Misappropriation of sale proceeds from 1845-1854.	- Not Accepted for Negotiations: 1975/02/21 - Date of ISCC Process/Active: 1998/08/25 - Date Legal Opinion Signed: 2000/08/03 - Canada Offered to Negotiate: 2001/06/18 - Settlement Signed by Claimant: 2004/07/06 - Settlement Signed by Canada: 2004/11/03

UNCLASSIFIED
Report as of 2015/02/04

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Chippewas of the Thames First Nation (BAND-166)		
Hydro - Right-Of-Way	**Concluded** File Closed Alleged breach of fiduciary obligations by the Crown for wrongfully renewing a Hydro easement in 1956 after the option to renew expired, and for failing to obtain appropriate compensation for the renewal of the easement. Fast Track. The claim is located in the townships of Caradoc and Deleware.	- Date Legal Opinion Signed: 2005/03/30 - Not Accepted for Negotiations: 2006/07/18 - Date of ISCC Process/Active: 2006/09/22 - File Closed: 2009/01/30
Muncey	**Settled** Settled Through Negotiations Alleged lots 12 & 13 of Caradock Township were illegally patented in 1831, on the basis that no surrender was obtained from the Chippewa Indians for those lots.	- Research Start Date : 1975/03/17 - Not Accepted for Negotiations: 1976/09/07 - Date Legal Opinion Signed: 1983/03/01 - Canada Offered to Negotiate: 1983/06/15 - Date of ISCC Process/Active: 1993/11/09 - Settlement Signed by Canada: 1995/03/01
Moravian of the Thames (BAND-167)		
Orford Township	**Concluded** No Lawful Obligation Found Alleged unlawful alienation of 26,325 acres in Orford township.	- Research Start Date : 1985/07/15 - Date Legal Opinion Signed: 1992/08/19 - Not Accepted for Negotiations: 1993/06/17
Munsee-Delaware Nation (BAND-168)		
Reserve Allocation	**Concluded** File Closed Claimant alleges that they were to receive more land than was allotted to them.	- Date Claim Filed: 2008/10/16 - Research Start Date : 2008/10/17 - File Closed: 2009/08/19

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Walpole Island (BAND-170)		
1790 Huron Church Reserve	**Under Assessment** Research Alleges a breach of lawful obligations under the Treaty of 1790 by failing to set apart the proper amount of land to form the Huron Church Reserve for the ancestors of the Walpole Island First Nation.	- Date Claim Filed: 2014/09/10 - Research Start Date : 2014/09/11
1853 Huron Church Reserve	**Under Assessment** Research Alleges a breach of lawful obligations due to the taking of and patenting of lands in 1853 that were part of the Huron Church reserve without obtaining a surrender from the ancestors of the Walpole Island First Nation.	- Date Claim Filed: 2014/09/10 - Research Start Date : 2014/09/11
1958 Seaway Treaty	**Concluded** No Lawful Obligation Found Claim concerns construction of 16mi x 1000ft channel on IR #46. FN alleges Crown did not conduct sufficient evaluation or impact studies prior to surrender, inadequate compensation provided, injurious affection to remaining lands, loss of economic opportunity related to lands and damages resulting from construction of the channel; FN alleges no consideration was given to a lease rather than surrender.	- Research Start Date : 2006/04/24 - Date Legal Opinion Signed: 2007/11/09 - Not Accepted for Negotiations: 2008/10/01

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Walpole Island (BAND-170)		
Anderdon	**Other** Active Litigation Alleged that the Crown failed to carry out the terms of the surrender of 300 acres in Anderdon Township in 1848. Also raises questions regarding the sale of the land, including whether fair value was paid for the land.	- Date Claim Filed: 2008/10/16 - Date Litigation Became Active : 2011/06/22
Attempted Survey	**Settled** Settled Through Negotiations Alleged that the government attempted to survey Walpole Island 1890-1910 against the wishes of the First Nation. Seeks return of First Nation trust funds used to pay for the survey. Survey never completed.	- Research Start Date : 1993/08/15 - Date Legal Opinion Signed: 1994/03/11 - Canada Offered to Negotiate: 1994/10/14 - Settlement Signed by Claimant: 2005/12/19 - Settlement Signed by Canada: 2006/03/19
Bob Lo (Bois Blanc) Island	**Other** Active Litigation Alleged the surrender in 1786 was invalid and that no compensation was ever paid to the FN.	- Research Start Date : 1993/03/15 - Date Legal Opinion Signed: 1995/10/05 - Not Accepted for Negotiations: 1995/11/24 - Date of ISCC Process/Active: 1996/04/25 - Date Litigation Became Active : 2000/04/27
Chenail Ecarte Reserve	**Concluded** No Lawful Obligation Found Alleged that Chenail Ecarte Reserve was intended to be 144 sq. miles. Surrender #7 document specified on 12 sq. miles. Further the terms of treaty re. payment were never fulfilled. (Sombra Townships)	- Date Claim Filed: 2008/10/16 - Date Legal Opinion Signed: 2009/02/23 - Not Accepted for Negotiations: 2010/09/16

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Walpole Island (BAND-170)		
East Sister Island	**Other** Active Litigation Alleged the Crown breached its fiduciary obligations regarding the use, licence and disposition of the island.	- Date Claim Filed: 2008/10/16 - Date Litigation Became Active : 2011/06/22
Enniskillen (SPLIT #03) Walpole Island	**Concluded** File Closed Alleges that certain lands in Enniskillen Township were sold without surrender. Other Claimants - Kettle and Stony Point and Aamjiwnaang FN's have settled this claim.	- Canada Offered to Negotiate: 2008/10/16 - File Closed: 2008/10/17
Fawn Island	**Concluded** No Lawful Obligation Found The WIFN claims that Canada was negligent in breach of its fiduciary duty regarding the disposition of Fawn Island and that the lands were sold for less than their fair market value. The Island was surrendered in 1857, but only sold in 1875.	- Date Claim Filed: 2008/10/16 - Date Legal Opinion Signed: 2010/06/23 - Not Accepted for Negotiations: 2010/12/13
Fighting Island	**Other** Active Litigation Alleged that Fighting Island and the adjacent fishery and waters have never been lawfully surrendered by Walpole Island First Nation.	- Research Start Date : 1995/04/15 - Date Litigation Became Active : 2000/04/27

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Walpole Island (BAND-170)		
Grass Island	**Other** Active Litigation Alleged that Canada illegally patented Grass Island in 1890, that the island was never surrendered and no compensation for it was paid to Walpole Island.	- Research Start Date : 1995/04/15 - Date Litigation Became Active : 2000/04/27
Hen and Chicken Island	**Other** Active Litigation Alleged the Crown breached its fiduciary obligations regarding the use, licence and disposition of the island.	- Date Claim Filed: 2008/10/16 - Date Litigation Became Active : 2011/06/22
Lower Indian Reserve	**Settled** Settled Through Negotiations Seeks the return of lower reserve, or compensation and questions the price paid for the land. The claim is located in the township of Moore.	- Date Legal Opinion Signed: 1995/12/08 - Research Start Date : 2008/02/20 - Negotiations Inactive: 2008/08/14 - Pending FN's BCR Accepting to Negotiate: 2008/08/15 - Canada Offered to Negotiate: 2008/10/16 - Claimant Agreed to Negotiate: 2008/11/21 - Settlement Signed by Claimant: 2013/02/13 - Settlement Signed by Canada: 2013/03/21
Middle Island	**Other** Active Litigation Alleged the Crown breached its fiduciary obligations permitting Middle Island to be occupied pursuant to a license of occupation with no renumeration to the FN. The Crown also failed to advertise the sale of Middle Island.	- Date Claim Filed: 2008/10/16 - Date Litigation Became Active : 2011/06/22

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Walpole Island (BAND-170)		
Middle Sister Island	**Concluded** No Lawful Obligation Found Alleged the Crown breached its fiduciary obligations regarding the use, licence and disposition of the island, and sold the island for less than Fair Market Value.	- Date Claim Filed: 2008/10/16 - Not Accepted for Negotiations: 2010/12/24
North Harbour Island	**Other** Active Litigation Alleged the Crown breached its fiduciary obligations regarding the use, licence and disposition of the island.	- Date Claim Filed: 2008/10/16 - Date Litigation Became Active : 2011/06/22
Peche Island (Fishing / Peach Island)	**Other** Active Litigation Claimant alleges licenses and leases were issued to Peche Island without any compensation paid to First Nation. Claimant also alleges that they did not receive fair market value for Peche Island at time of surrender in 1857.	- Date Claim Filed: 2008/10/16 - Date Legal Opinion Signed: 2008/10/30 - Date Litigation Became Active : 2011/06/22
Pelee Island	**Other** Active Litigation Alleged Pelee Island was never surrendered, that 1870 surrender did not include Pelee Island and that no compensation has been paid to the FN for the island.	- Research Start Date : 1993/03/11 - Date Legal Opinion Signed: 1995/10/26 - Not Accepted for Negotiations: 1995/11/24 - Date of ISCC Process/Active: 1996/03/28 - Date Litigation Became Active : 2000/04/27

Status Report on Specific Claims

ONTARIO (40)

Claimant & Claim Name	Current Status & Description	Key Dates (yyyy/mm/dd)
Walpole Island (BAND-170)		
Sawmill and Dock Lease Surrender	**Concluded** No Lawful Obligation Found FN alleges the Crown broke its fiduciary obligations to the Band regarding a 5 year lease of 3 acres of reserve land in 1883, for the purposes of constructing a dock and lumber mill.	- Research Start Date : 2004/08/01 - Date Legal Opinion Signed: 2007/07/13 - Not Accepted for Negotiations: 2007/10/10
St. Clair Flats	**Other** Active Litigation Alleges that in 1892 Ontario illegally sold and patented part of St. Clair Flats.	- Research Start Date : 2002/04/04 - Date Litigation Became Active : 2004/07/14
Surrenders for Timber on Walpole Island	**Concluded** No Lawful Obligation Found FN alleges that Canada breached its fiduciary obligation by upholding the Jan. 30, 1883 vote when the Indian Agent provided only one proposal for consideration and in suggesting or threatening that if the FN didn't vote in favour of the proposal, the timber would be surrendered to the Crown for sale by tender.	- Date Claim Filed: 2008/10/16 - Date Legal Opinion Signed: 2008/12/08 - Not Accepted for Negotiations: 2009/11/13
Turkey Island	**Other** Active Litigation Alleged Walpole Island Indians and the Chippewas of Anderdon were the rightful owners of Turkey Island. Canada erred in seeking a surrender from the Wyandotts of Anderdon in 1874.	- Research Start Date : 1995/04/15 - Date Litigation Became Active : 2000/04/27

Appendix A7 – Agency Consultation

From: Valerie Towsley
To: Bergman, Stephanie
Cc: Karen Winfield (winfieldk@thamesriver.on.ca); Imtiaz Shah (ShahI@thamesriver.on.ca); Jason Wintermute
Subject: RE: Delaware Stormwater Drainage Master Plan
Date: Tuesday, November 10, 2015 2:59:07 PM

Hi Stephanie

Thanks for forwarding this information on to us. The LTVCA concerns will be fairly similar to UTRCA's concerns i.e. alteration of watershed boundaries.

Some general preliminary comments are noted below for your consideration:

Are the dry ponds to be located on municipal owned property? If not the CA has concerns with placing what is in effect, swales through the rear lots of private property where access to maintenance is an issue for the municipality (i.e. Alternative 3 A – Longwoods Commercial, page 23). Over time these swales get infilled or have structures placed on them by property owners and once altered are an on-going issue to resolve, sometimes ending up in the courts. The CA also receives complaints about similar type structures in that they become ponded with time, holding back water and become breeding grounds for mosquitoes and other water born insects. Pressure to infill or eliminate these 'ponds' become an issue for the municipalities where these types of retention areas are located.

Master Plan – Preferred Alternatives, page 27 – There are several concerns that staff have for several of the alternatives:

1. A proposed outlet through flood plain lands and potentially lands owned by the LTVCA at the west end of Wellington Street (south portion of this parcel in the flood flats is owned by the LTVCA). This conservation area was purchased to prevent development pressures and infilling from occurring. This entire area is highly flood prone, with several meters depth of water accumulating in this area during a spring freshet event or a season flood event. A permit from this office will be required for any proposed outlet, with detailed engineering/design plans required to specifically address flooding and back pressure on any infrastructure proposed in this area.
2. Similar to #1, the Storm Sewer outlet #1 for Longwoods Road is located in a flood prone area. Similar requirements as above will be required.
3. The outlet south off of Pleasant Street, south of Longwoods Road appears to be outletting into the old Thames River oxbow. Again, permits from this office will be required for any outlet work and erosion protection under flood flow conditions.
4. The CA has grave concerns with the proposed increase in flows to the outlet located in the SW corner of Longwoods Road and Springer Road. The properties immediately south of Longwoods Road on the west side of Springer Road are already experiencing erosion concerns and have bank stability issues. Increasing the amount of flows being directed to this area from another watershed has staff concerned. As such, the LTVCA requests that an alternate outlet be considered so as to not jeopardize the bank stability in this area any further and try to maintain watershed boundaries where possible. It is unclear from the

information provided what, if any, engineering/slope stability review went into selecting this as an alternative and the reasoning behind it. If these studies/reports are available can you please forward them to this office for review and comment.

5. The outlet for the Springer Road Drain at the very southerly limits of this work area will once again require a permit from this office dealing with slope stability issues and erosion.

If we note any other concerns upon further review, we'll get back to you.

If you have any questions regarding the above noted comments please contact the office.

Valerie Towsley
Resource Technician
Lower Thames Valley Conservation Authority
100 Thames Street
Chatham, Ontario
N7L 2Y8

Phone: 519-354-7310 Ext.: 226
Fax: 519-352-3435

E-mail: Valerie.Towsley@ltvca.ca

Web site: www.ltvca.ca

'Common sense and sense of humor are the same thing, moving at different speeds. A sense of humor is just common sense dancing.' William James (1842-1910)

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From: Bergman, Stephanie [mailto:Stephanie.Bergman@stantec.com]
Sent: November-10-15 8:24 AM
To: Valerie Towsley
Cc: Oliveira, Nelson
Subject: Delaware Stormwater Drainage Master Plan

Good morning Valerie,

I just wanted to touch base with you regarding the Delaware Stormwater Master Plan currently being undertaken by the Municipality of Middlesex Centre. The Public Information Centre was held on October 8th, 2015, and I have attached the display boards that were presented at the

PIC as well as the Notice of PIC that was mailed on September 21. We are currently in the process of addressing comments on the preferred alternatives expressed by the public and agencies in order to prepare the Master Plan document and file for 30-day review.

Please note that in the past you have received information from Michele Oxlade regarding this project, but I would be happy to provide any further information, and accept any concerns you may have on behalf of the LTVCA.

Again, please let me know if you require any further information.

Have a great day,

Stephanie L Bergman, Hons.B.A., M.A.
Planner
Stantec
600-171 Queens Avenue London ON N6A 5J7
Phone: (519) 675-6614
stephanie.bergman@stantec.com

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

November 12, 2015
File: 1656-30021

Attention: Valerie Towsley, Resource Technician
Lower Thames Valley Conservation Authority
100 Thames Street
Chatham, Ontario N7L 2Y8

Dear Valerie Towsley,

Reference: Delaware Stormwater Drainage Master Plan
Public Information Centre Comments

Thank you for your comments dated November 10, 2015 regarding the information provided at the October 8, 2015 Public Information Centre. We have reviewed your input and will incorporate your comments and concerns into the project file as follows:

In response to your preliminary general comments, we anticipate that all proposed drainage and stormwater servicing works will be owned and operated by the Municipality, with the exception of the proposed on-site SWM controls. The difficulties in operating and maintaining drainage infrastructure located outside of municipal right-of-ways was identified early in the EA process. Page 7 of the PIC presentation materials notes "infrastructure location" as a key issue in several drainage areas. These areas contain drainage infrastructure on private lands which, as noted in your comments, presents access and maintenance challenges. The alternatives were developed to relocate existing drainage infrastructure within the municipal right-of-ways and to situate future drainage works within right-of-ways, where feasible. The location of the proposed Longwoods Commercial and Cummings Drain dry SWM ponds will likely be revised based on feedback received following the PIC, and all necessary easements/property agreements will be recommended.

We have reviewed your input and will incorporate your comments and concerns into the project file as follows:

1. The final report recommendations will identify the need for an LTVCA permit for the proposed Wellington Street outlet and the need for mitigation measures to reduce backwater effects from the Thames River on the proposed storm sewer.

2. The final report recommendations will identify the need for an LTVCA permit for the proposed Longwoods Road outlet.

3. The final report recommendations will identify the need for an LTVCA permit for the proposed Pleasant Street outlet.

Reference: Delaware Stormwater Drainage Master Plan
Public Information Centre Comments

4. We understand LTVCA staff's concern over the increase in flows to the outlet located in the SW corner of Longwoods Road and Springer Road. The feedback provided by LTVCA will be used to incorporate additional recommendations to be carried over into detailed design. This includes, but is not limited to the possibility of discharging additional flows upstream, utilizing the channel to provide storage and peak flow control. Planning level analysis was completed to ensure the suitability and feasibility of the recommendations; however, additional analysis will be required during detailed design in order to identify the most appropriate mitigation measures to address slope and erosion concerns.

5. The final report recommendations will identify the need for an LTVCA permit for the proposed Springer Road Drain outlet.

Thank you for your feedback regarding this project. If you have any additional concerns or comments, please feel free to contact either myself or Nelson Oliveira, the Project Manager.

Regards,

STANTEC CONSULTING LTD.

Stephanie Bergman Hons.B.A., M.A.
Planner
Phone: 519-675-6614
Fax: 519-645-6575
Stephanie.bergman@stantec.com

c. Brian Lima (Municipality Middlesex Centre)
Nelson Oliveira (Stantec)
Corri Marr (Stantec)

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From:	Karen Winfield
To:	Bergman, Stephanie; Valerie Towsley
Cc:	Marr, Corri; Imtiaz Shah; Jason Wintermute; Oliveira, Nelson; blima@middlesex.ca
Subject:	RE: Delaware Stormwater Drainage Master Plan
Date:	Thursday, November 12, 2015 6:54:41 AM
Attachments:	ATT00001

Hi Stephanie,

UTRCA staff have reviewed as well and would like to provide the following comments to add to those from LTVCA below:

1. The Mill Street Development area shows a large parcel of land as "proposed future development". We note virtually all of this parcel is regulated by the Conservation Authority and listed as erosion hazard and/or protected wetland. The woodland covering the entire site has been identified as significant in the Middlesex County Natural Heritage Study. This site would not be an appropriate candidate for development. We note the future development identifier should be removed from this parcel in the Master Drainage Study as it implies future development is possible. We also recommend the preferred alternative addresses this by removing the reference to future SWM for the site - i.e. "Provide On-Site SWM Controls for new development (Quantity & Quality)". We further note removing this parcel from the need for future SWM may alter the preferred alternative approach for this catchment. Please address;
2. We note a very typical approach to the drainage issues has been suggested without considering the local hydrology and soil type. While these traditional approaches may solve the problem in the short term, they generally cause future long term issues for municipalities related to quantity and quality as areas become more heavily developed. The UTRCA recommends site specific Stormwater Management (SWM) Low Impact Developments (LIDs) be considered in conjunction with the proposed conventional system based on the local site soil information and considering local hydrologic information using a water balance approach. The water balance approach based on the local soil and groundwater for various sites considered in the Master Drainage Plan will help in improving the quality of the runoff by holding a portion of the rainfall on the site thus helping delaying the peak and will help in resolving capacity issues. It will also help in improving the quality of the runoff. In short, LIDs alleviate future capacity issues and help improve water quality;

3. The UTRCA regulatory storm event is the 250-year storm and not the 100-year storm. The 250-year storm as regulatory storm should be considered in the Master Drainage Plan for the various alternatives;

4. The Master Drainage Plan proposed several dry ponds in Delaware without considering the depth of the groundwater at those sites. The performance and functioning of dry ponds may be affected due to high and/or fluctuating ground water levels on site. We note there has been failure of other dry ponds in our watershed of late where groundwater levels were not investigated prior to the installation of the ponds;
5. We suggest a catchment area approach (with limit and recommendation for quantity and quality of runoff and maximum limit of imperviousness under the ultimate proposed condition with the base flow consideration and requirements) be considered. This may result in downgrading the size of the proposed trunk sewer system and will decrease reliance on Oil and Grit Separators to convey flows during the major storm events. It will also help the local groundwater and mimic the natural hydrology on the site;

6. If the Cummings Drain preferred alternative still recommends a dry pond, we recommend the dry pond be considered in combination with an open channel to eliminate the need for an Oil and Grit Separator. Further the channel shall be designed to convey future flows;

7. The study proposed several Oil and Grit Separators (OGS) units for the proposed Master Drainage Plan. The OGS units are very expensive and cost money to be maintained. The efficiency of OGS unit depends on the schedule of the operation and maintenance as they fill with sediment over time. Once they are filled with sediment, their efficiency is affected. The operation and maintenance cost of the proposed OGS units will increase the SWM Operation and Maintenance budget for the municipality in the future;

8. Some of the storm sewers are directed to outfall into open receiving water as the preferred alternative for Forsyth Municipal Drain. The quality of runoff has not been considered. What quality measure has been proposed for the runoff conveyed to open water thorough an outlet?

Please let us know if you have any questions.

Thank-you,

Karen Winfield

Land Use Regulations Officer

1424 Clarke Road London, Ontario, N5V 5B9

519.451.2800 Ext. 237 | Fax: 519.451.1188

winfieldk@thamesriver.on.ca

UPPER THAMES RIVER

CONSERVATION AUTHORITY

>>> Valerie Towsley <Valerie.Towsley@ltvca.ca> 11/10/2015 2:58 PM >>>

Hi Stephanie

Thanks for forwarding this information on to us. The LTVCA concerns will be fairly similar to UTRCA's concerns i.e. alteration of watershed boundaries.

Some general preliminary comments are noted below for your consideration:

Are the dry ponds to be located on municipal owned property? If not the CA has concerns with placing what is in effect, swales through the rear lots of private property where access to maintenance is an issue for the municipality (i.e. Alternative 3 A – Longwoods Commercial, page 23). Over time these swales get infilled or have structures placed on them by property owners and once altered are an on-going issue to resolve, sometimes ending up in the courts. The CA also receives complaints about similar type structures in that they become ponded with time, holding back water and become breeding grounds for mosquitoes and other water born insects. Pressure to infill or eliminate these 'ponds' become an issue for the municipalities where these types of retention areas

E-mail: Valerie.Towsley@ltvca.ca

Web site: www.ltvca.ca

'Common sense and sense of humor are the same thing, moving at different speeds. A sense of humor is just common sense dancing.' William James (1842-1910)

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From: Bergman, Stephanie [mailto:Stephanie.Bergman@stantec.com]
Sent: November-10-15 8:24 AM
To: Valerie Towsley
Cc: Oliveira, Nelson
Subject: Delaware Stormwater Drainage Master Plan

Good morning Valerie,

I just wanted to touch base with you regarding the Delaware Stormwater Master Plan currently being undertaken by the Municipality of Middlesex Centre. The Public Information Centre was held on October 8th, 2015, and I have attached the display boards that were presented at the PIC as well as the Notice of PIC that was mailed on September 21. We are currently in the process of addressing comments on the preferred alternatives expressed by the public and agencies in order to prepare the Master Plan document and file for 30-day review.

Please note that in the past you have received information from Michele Oxlade regarding this project, but I would be happy to provide any further information, and accept any concerns you may have on behalf of the LTVCA.

Again, please let me know if you require any further information.

Have a great day,

Stephanie L Bergman, Hons.B.A., M.A.
Planner
Stantec
600-171 Queens Avenue London ON N6A 5J7
Phone: (519) 675-6614
stephanie.bergman@stantec.com

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

November 12, 2015
File: 1656-30021

Attention: Karen Winfield, Land Use Regulations Officer
Upper Thames River Conservation Authority
1424 Clarke Road
London, Ontario N5V 5B9

Dear Karen Winfield,

Reference: Delaware Stormwater Drainage Master Plan
Public Information Centre Comments

Thank you for your comments dated November 12, 2015 regarding the information provided at the October 8, 2015 Public Information Centre. We have reviewed your input and will incorporate your comments and concerns into the project file as follows:

1. The limits of future development areas were estimated by Stantec to identify future drainage servicing requirements that must be addressed by the preferred alternative. The purpose of this study is to present the drainage servicing strategy for the study area, and the resulting preferred alternatives will not endorse or preclude development on any particular parcel. Potential future development was identified on the subject parcel because it was included in the Mill Street Subdivision and the lands are zoned as Community Residential. We do not anticipate that the preferred alternative approach will change for this catchment if this parcel does not develop. However, the construction timing and alignment of the proposed rear yard DICB may be affected. Additionally, we have noted the boundaries of the regulated area within the Natural Environment Review which will become part of the Master Plan Document, and have made clear within the document that the recommendations do not endorse future development applications, which will be subject to all applicable permitting and application processes.

2. LID measures were considered in both the development and evaluation of alternatives. However, due to high groundwater level concerns, uncertainty with respect to both year-round and long-term performance, maintenance concerns, and the age and condition of the existing systems, conventional stormwater treatment methods were selected.

3. The Master Plan considers the 100-year design storm in accordance with the Municipality of Middlesex Centre design standards, which are consistent with other local design standards such as those of the City of London.

4. As part of this study, EXP Services Inc. undertook a review of available geotechnical and hydrogeological documentation in addition to a site investigation to provide an overview of soil and groundwater conditions. These findings were considered as part of the

Reference: Delaware Stormwater Drainage Master Plan
Public Information Centre Comments

development of servicing alternatives. The final report will provide recommendations for future hydrogeological investigations to assist in implementing the preferred alternative, including the proposed dry SWM ponds.

5. Drainage conditions within the study area were evaluated on a catchment-by-catchment basis and drainage servicing solutions were developed accordingly. Post-development peak discharges from new development will be controlled to pre-development magnitudes and MOE "Normal" Protection Level water quality control will be provided to the runoff from new development.

6. Open channels for stormwater conveyance and treatment were considered in Cummings Drain Alternatives 3A and 3B. However, OGSs are more compatible with the proposed urban cross sections included in the preferred alternative than open channels.

7. The evaluation of alternatives did consider maintenance requirements associated with these unites. MOECC ECAs will be required for the proposed OGSs, and operation and maintenance will be performed in accordance with the conditions of the ECAs.

8. The effects of each alternative on water quality were considered in the alternative evaluation, which will be presented in the final report. Under existing conditions, stormwater from the Forsythe Municipal Drain discharges to the existing oxbow without receiving water quality treatment. Opportunities to provide water quality treatment to the runoff from this drainage area are limited, since the catchment is fully developed. The results of the alternative evaluation concluded that the preferred alternative would not significantly alter the water quality of the runoff from the Forsythe Drain service area.

Thank you for your feedback regarding this project. If you have any additional concerns or comments, please feel free to contact either myself of Nelson Oliveira, the Project Manager.

Regards,

STANTEC CONSULTING LTD.

Stephanie L Bergman, Hons.B.A., M.A.
Planner
Stantec

Design with community in mind

Reference: Delaware Stormwater Drainage Master Plan
Public Information Centre Comments

600-171 Queens Avenue London ON N6A 5J7
Phone: (519) 645-2007
Fax: (519) 645-6575
Stephanie.Bergman@stantec.com

c. Brian Lima (Municipality Middlesex Centre)
Nelson Oliveira (Stantec)
Corri Marr (Stantec)

Oxlade, Michele

From: Valerie Towsley <Valerie.Towsley@ltvca.ca>
Sent: Friday, January 16, 2015 9:54 AM
To: Oxlade, Michele
Cc: Jason Wintermute; Jessica Schnaithmann; Karen Winfield (winfieldk@thamesriver.on.ca)
Subject: Delaware Community Settlement Area Stormwater Master Plan

Hi Michele

Please keep the LTVCA advised on this project as there are flooding and erosion concerns that will need to be addressed. The Regulations apply to a fair portion of the developed area of this community.

I trust this is satisfactory, but if you should have any questions please contact the office.

Valerie Towsley
Resource Technician
Lower Thames Valley Conservation Authority
100 Thames Street
Chatham, Ontario
N7L 2Y8

Phone: 519-354-7310 Ext.: 226
Fax: 519-352-3435

E-mail: Valerie.Towsley@ltvca.ca

Web site: www.ltvca.ca

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UPPER THAMES RIVER
CONSERVATION AUTHORITY

The Thames
A Canadian
Heritage River

"Inspiring a Healthy Environment"

February 13, 2015

Stantec Consulting Limited
171 Queens Avenue, 6th Floor
London, Ontario
N6A 5J7

Attention: **Michele Oxlade** (michele.oxlade@stantec.com)

Dear Ms. Oxlade:

Re: **Notice of Study Commencement**
Delaware Community Settlement Area
Stormwater Master Plan (Phases 1 and 2)
Municipality of Middlesex Centre

Upper Thames River Conservation Authority (UTRCA) staff are in receipt of the "Notice of Study Commencement" regarding review of the Delaware Community Settlement Area Stormwater Master Plan. We offer the following comments under Ontario Regulation 157/06 and our responsibilities as a commenting agency providing technical review and advisement related to natural heritage, water resources and natural hazard management pursuant to relevant legislation and policies set out in the UTRCA Planning Policy Manual (June 28, 2006):

General Comments

1) We would appreciate the opportunity for our technical staff to review and provide comments on any upcoming draft documents and proposed alternatives including any draft Master Plan. We respectfully request review of copies of any public presentation documents as well. Please note that our scope of review is based on the policies set out in the Upper Thames River Conservation Authority Planning Policy Manual (June 28, 2006). EA and subsequent detail design project review for the Delaware Community Settlement Area Stormwater Master Plan (Phases 1 and 2) would generally be guided by, but not limited to, natural heritage, natural hazard and pollution prevention areas of concern for lands regulated within our jurisdiction.

UTRCA Regulated Areas

2) According to the enclosed project location mapping, portions of the study area occur within natural hazard and natural heritage areas regulated by the Conservation Authority. The UTRCA regulates development within the Regulation Limit in accordance with Ontario Regulation 157/06 made pursuant to Section 28 of the *Conservation Authorities Act*. This regulation requires proponents to obtain written approval from the UTRCA prior to undertaking any works in the

regulated area including filling, grading, construction, alteration to a watercourse and/or interference with a wetland.

3) A portion of the study area lies outside our ("Upper Thames" portion of the) watershed and falls under the jurisdiction of the Lower Thames Valley Conservation Authority (LTVCA). We recommend you contact them directly for their comments regarding any works/plans proposed in that portion of the Thames watershed.

Digital Mapping

4) Our staff can provide digital mapping which outlines the boundaries of the natural heritage and natural hazard features as well as Drinking Water Source Protection Areas present within the study area. Our digital mapping may be obtained by contacting our GIS department (contact: Phil Simm, 519-451-2800 x 247). Generally the fee involved with obtaining digital mapping of our natural heritage and natural hazard features is $100 but this fee will be waived as the mapping is intended for use by one of our member municipalities for a Municipal Class EA.

Stormwater Management

5) For details on our policies regarding stormwater management, you may wish to refer to Section 3.5.2 – Policies for Stormwater Management and Erosion and Sediment Control Measures contained within our Environmental Planning Policy Manual for the Upper Thames River Conservation Authority (June 2006), available on our website at:

   http://thamesriver.on.ca/planning-permits-maps/utrca-environmental-policy-manual/

6) We also recommend you review the (attached) UTRCA Stormwater Management Policy Guideline we have prepared to assist our municipal partners in the development of their own municipal SWM policies.

Terrestrial and Aquatic Species At Risk

7) Our data indicates the potential presence of federally and/or provincially protected aquatic (fish/mussels) species at risk (SAR) within the Thames River, Dingman Creek and a variety of other watercourses through the study area. Impacts on water quality (including thermal impacts) from stormwater effluent that may affect this vulnerable aquatic community should be addressed within the Masterplan/EA.

8) The Thames River through the study area has been identified as critical habitat for federally protected aquatic species at risk.

9) Our data indicates the presence of federally and/or provincially protected terrestrial species at risk along the Thames River and Dingman Creek corridors through Delaware.

   a) There are a variety of SAR snakes (Eastern Hog-Nosed, Milksnake, Queensnake - at Komoka Park) and turtles (Spiny Softshell, Blandings, Northern Map, Snapping, etc.) that rely on this corridor. Spiny Softshell Turles utilize not just the Thames River through Delaware, but also much of Dingman Creek from the mouth to upstream as least as far as the Green Hills Golf Course.

b) There are Bald Eagles and a number of swallow spp. that utilize the aquatic habitat and terrestrial habitat in the corridor.

Our experience in other municipalities has shown that long terms plans are tricky and can be complicated when these sensitive species are not taken into consideration in the planning stages - i.e. maintenance cleanouts of SWM ponds where SAR species have moved in. Location of SWM facilities close to the river may be an additional concerns and outlet locations should be chosen very carefully.

Water Quality, Woodlands and Other Natural Heritage Features

10) The study area lies within a portion of the Komoka Creek and River Bend subwatersheds. Please refer to our latest (2012) edition of the Upper Thames River Watershed Report Cards for information related to water quality, woodlands and other natural heritage features in these subwatersheds, available on our website at:

http://thamesriver.on.ca/watershed-health/watershed-report-cards/

Drinking Water Source Protection

11) The proponent should be aware that the Municipal Engineers Association (MEA) is updating the Class EA to account for Source Water Protection. We understand that one set of revisions has been consulted on and that more detail is being added through further revisions. Both revisions, among other things, highlight the importance of considering the Clean Water Act and local Source Protection Plan (SPP) in assessing the alternatives through the EA process. The EA is the best time to consider regulatory requirements of the Clean Water Act and Source Protection Plan as well as designated vulnerable areas. The EA planning process offers an excellent opportunity to document how these factors have been considered in the planning process.

12) The Delaware area is predominantly Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas as identified in the approved Assessment Report for the Upper Thames River Source Protection Area. These are areas where certain activities (including storm water management) may be a threat to drinking water. These areas are also considered designated vulnerable areas which the Provincial Policy Statement (MMAH, 2014) requires municipalities to protect (2.2.1e). Storm Water Management is an activity which may be considered a drinking water threat and thus any SWM plan should consider its impact to these designated vulnerable areas and features. This should include an assessment of the risks of any storm water management proposed or assessed through the management plan and how these risk may be mitigated. While it is important to maintain the quantity of water recharged to these vulnerable aquifers it is also important to consider the quality of the water recharged in these vulnerable areas. The Tables of Drinking Water Threats (MOE, 2009) identify the chemicals which make this activity a threat to drinking water.

13) You may wish to contact the UTRCA to request digital mapping (refer to Item #4 above) of the vulnerable areas which can be utilized for your study.

14) Please also note that the Significant Groundwater Recharge Area (SGRA) has been updated (abd awaiting approval) and the newer information should be considered along with the information in the approved assessment report. This is important as the new information, although not yet

contained in an approved Assessment Report, is likely to be approved prior to the approval of any works resulting from the master plan.

15) We encourage you to discuss with municipal planners how the plan will help to satisfy their obligations under the PPS and may wish to engage the municipality's Risk Management Official (RMO) in those discussions. If the works proposed through the management plan would require Environmental Compliance Approvals by the MOECC, the consultant may wish to discuss the plan with appropriate staff at the MOECC to determine what impact, if any, these designated vulnerable areas would have on the approval process for storm water management in these areas.

16) If the proponents have questions on how source protection and the local plan may affect the proposed alternatives they may contact UTRCA Drinking Water Source Protection (DWSP) staff or their municipal Risk Management Official (RMO).

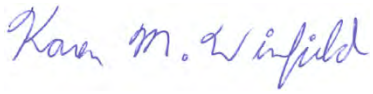
Summary

Please be advised that we have not yet received enough information to provide detailed comments regarding the project. However, we appreciate being contacted early in the process and are always open to meeting with you to discuss and work through any concerns or complications along the way.

Our office would like to be included in future circulations regarding this project. We would appreciate receiving information and reports as they become available in order to ensure that we can meet the project deadlines with our comments.

If you have any questions regarding the above information, please contact the undersigned.

Yours truly,
UPPER THAMES RIVER CONSERVATION AUTHORITY



Karen M. Winfield
Land Use Regulations Officer
SG/IS/JS/CT/KW/kw

c.c. – Brian Lima, Municipality of Middlesex Centre – (via e-mail: lima@middlesexcentre.on.ca)
Arnie Marsman, Municipality of Middlesex Centre – (via e-mail: marsmana@middlesexcentre.on.ca)
Valerie Towsley, LTVCA – (via e-mail: Valerie.Towsley@ltvca.ca)

Stormwater Management Policy Guideline

The Upper Thames River Conservation Authority (UTRCA) offers the following policy guidance regarding stormwater management.

In the absence of guidance provided through the completion of subwatershed or catchment wide strategies, the UTRCA recommends that stormwater quantity and quality requirements be as follows:

1. Qualifying Areas:
The following criteria are used to determine the applicable stormwater policies:

A. Where the product of runoff coefficient and area (Ha) is equal to, or less than 0.65, Best Management Practices using a treatment train approach are acceptable.
B. For areas where the product of runoff coefficient and area (Ha) is between .66 and less than 2, it is recommended that a water quality unit be required as a component of the BMP treatment train approach.
C. For areas where the product of runoff coefficient and area (Ha) is greater than 2, stormwater management is required in accordance with the current MOE "Stormwater Management Practices Planning and Design Manual, 2003" (SWMPPDM, 2003).

Notes:

- It is noted that the runoff coefficient for residential is generally 0.4 – 0.75 and for commercial/industrial it is generally 0.7 – 0.85
- The runoff coefficient will be determined based on the specific information for the subject site
- This policy applies to both new development and infill development
- In the case of expansions to existing development, it is recommended that the qualifying area be based on the amount of net increase in area (Ha) and the runoff coefficient of the expansion area
- It is recommended that stormwater management be required for re-development and that the qualifying area be determined based on the site size (Ha) and runoff coefficient values for the re-development.

2. Quality Controls:

- Level 1 (enhanced level) of treatment as per the MOE SWMPPDM, 2003 is required. A lower standard may only be justified through the completion of a catchment wide comprehensive study.
- For sites that meet the Qualifying Area type C, wetlands and wet ponds are required. At source and conveyance water quality controls along with oil grit separators may be helpful in achieving the enhanced level of protection. For Example: Oil and grit separators may be used as part of a multi-component approach to achieve enhanced quality control provided they are sized in accordance with the recommendations set out by both the MOE Manual and the Manufacturer. Manufacturer claims of performance are subject to MOE review. For type C Qualifying Areas, oil grit separators are not to be used independently (i.e. without the incorporation of other quality control measures, such as stormwater ponds, naturalized buffers, grassed swales, etc.).

- A sediment forebay should be a component of a SWM pond for quality control purposes.

3. Quantity Controls: (in-stream erosion control)

- In-stream erosion control shall conform to requirements of the MOE Stormwater Practices Manual, 2003, will be applied, requiring the 25 mm 24 hr Chicago storm be stored and released over a 24 hour period.
- Treatment train approach is preferred
- Typical design requirements include:
    - Simplified Method of analysis as per MOE SWMPDM (2003) for areas less than 20 ha
    - Distributed Runoff Controls
    - For areas greater than 20 ha, a broader stream sensitivity analysis is required
- If the receiving watercourse is already showing signs of erosion, mitigation measures may be required as part of the development approval.

4. Quantity Controls: (flooding)

- Control is required post to pre for 2 Year to 250 Year. It is noted that limitations in the capacity of the municipal storm sewer system may be a more limiting factor.
- Multi-duration storms and types should be run to confirm the critical storm for worst case scenarios. The critical storm for a site is one which gives low pre-development flows and higher uncontrolled post development flows.
- In the case of end of pipe facilities (ponds, wetlands, etc) a long duration storm should also be run to confirm the volumetric contribution to the proposed facilities. For example, a 24 hour storm should be run to ensure safe facility operation.
- In the absence of a watershed or catchment study, the proponent may use a rough estimate of a composite run-off co-efficient times the area to size the storm sewers, as mentioned under Item #1 above.
- Quantity control facilities are to be designed at minimum in accordance with recommendations set out in the MOE SWMPDM (2003).

5. Water Balance:

- Depending on the soil characteristics, a water balance assessment may be required as per the MOE SWMPDM (2003). SCS Group A soils will require design of infiltration measures.
- Land use planning and design of infiltration measures shall not impair groundwater supplies in accordance with legislated requirements. Pre-treatment measures may be required as a minimum.
- Every attempt should be made to match post development infiltration volumes to pre development levels on an annual basis. Infiltration targets may be achieved through the incorporation of a variety of best management practices including: reduced lot grading, roof leaders discharging to ponding areas or soak away pits, infiltration trenches, grassed swales/enhanced grassed swales, and pervious pipe and catch basin systems.

6. Geotechnical Planning:

- Geotechnical assessment reports, prepared by a qualified professional, may be

required to ensure the subsurface conditions will support the proposed SWM structures and their long term viability while ensuring no adverse impacts on adjacent natural hazard and natural heritage features.
- A geotechnical assessment (supported by borehole information) maybe required for a SWM pond and the outlet associated with the pond.
- Geotechnical analysis may also be required for a storm sewer outlet.

7. Geomorphology/ Hydrogeology Planning:

- A Geomorphological and/or hydrogeological assessment may be required to ensure no adverse affects on the stream and/or longevity of the infrastructure (i.e. the SWM outfall). Assessments should demonstrate outfall location is acceptable and the stream is stable enough to receive storm discharge.

8. Erosion and Sediment Control Planning (during construction):

- Erosion and sediment control plans shall be developed and implemented with consideration for in- stream requirements.
- For areas larger than 5 Ha, sediment basins are required.
- Erosion and Sediment Control Plans may be required to conform with specific in-stream receiving water body guidelines and potential spill assessment.
- For general information on sediment and erosion control, please refer to the Greater Golden Horseshoe Conservation Authority's: *Erosion and Sediment Control Guideline for Urban Construction (*December 2006*)* available online at www.sustainabletechnologies.ca . However, as this is an evolving science, proponents are encouraged to consult other sources of information to supplement their plans.

9. Standard Hydrological Modelling Requirements:

- Stormwater runoff must be determined using a hydrologic model approved by the Authority. Visual OTTHYMO, SWMHYMO, MIDUSS and PCSWMM, are some of the approved hydrologic models. Other models may be used provided the model is first accepted by the Conservation Authority. The modified rational method and SCS Unit Hydrograph method are also acceptable for small drainage areas less than 5 ha in size.
- The information/guidelines on hydrological modelling parameters may be provided if required during the pre-consultation meetings.
- Reference Manual on the Use of Design Storms in the Upper Thames River Watershed. This manual can be downloaded from the UTRCA website and is available at: www.thamesriver.on.ca/Planning_Permits_and_Maps/design_storms.htm.

10. Revegetation/Landscape Plans (for all areas under Criteria C of Qualifying Area noted earlier):

- Landscape plans, prepared by a qualified professional, will be required. Proponents are encouraged to refer to the attached (Appendix) Landscape Guidelines for Stormwater Management Ponds.

11. Maintenance and Monitoring Plans:

- Maintenance and Monitoring plans should be incorporated into the stormwater management report and it is recommended the proponent conduct pre and post construction monitoring as a condition of site plan approval. Plans should

address: details on sediment clean-out including frequency required; access for operation and maintenance of facilities; contingency plans for remediation; and monitoring to determine effectiveness of measures in meeting stormwater management objectives for the development.

12. UTRCA Policies Regarding Stormwater Management Facilities:

- On-line Stormwater Management Ponds and the use of natural wetlands for Stormwater Management will not be supported.
- No stormwater measures, except for outlet sewers if required, shall be located in a natural hazard potential area. Some UTRCA policy exceptions may apply as per the UTRCA Stormwater Management in the Flood Plain Policy available from UTRCA.

13. **Other :**

- Structural Measures proposed should wherever possible be located on public property or be accessible through easement or proximity to public property.
- All reports and modifications to reports will be required to be bound in one document for final submissions.
- Reports must be signed and stamped by all qualified professionals involved in any component of design.
- Landowners (living adjacent all areas under Criteria C of Qualifying Area noted earlier) should be provided with a Home Owner Environmental information package.
    - Home Owner package should identify that the SWM ponds are not natural features but rather engineered facilities that will eventually need to be cleaned and maintained (with regular frequency) to return them to the original operting standard and to ensure proper operation.
- In cases where there are numerous properties requiring stormwater management in a logical catchment area, developers will be encouraged to coordinate stormwater planning to optimize the number of facilities
- The Municipality, in cooperation with the UTRCA, may support the development of catchment or area specific compensation plans which allow for cash in lieu of stormwater management to be taken and utilized to establish joint facilities to provide treatment for multiple properties. The approval of such a plan will include the identification of an appropriate threshold percentage of development which may proceed in advance of construction of the treatment facility.
- The UTRCA recommends proponents and/or the municipality maximize opportunities for retrofit of existing infrastructure for both quality and quantity control.
- It is recommended that the proponents meet with all review agencies prior to initiating any studies to develop an agreed upon Terms of Reference. Pre-consultation with the UTRCA is encouraged. Monitoring and mapping information can be provided at the pre-consultation stage.
- Early in the consultation process, the design engineer must identify areas where the policy can not be met. Discussion is encouraged to determine alternative approaches where applicable to meet the needs of both the stormwater management facility and the municipality.

DRAFT

Appendix A – Landscape Guidelines for Stormwater Management Ponds

Stormwater management (SWM) facilities perform many functions; they receive runoff from developed lands, hold excess water during storm events, reduce the exchange of sediments and toxins into creeks and rivers, contribute to groundwater recharge, etc. As a result of these functions some SWM ponds may contain contaminated and potentially toxic water and sediment. Vegetation around stormwater management ponds helps to control erosion and the input of sediment, removes toxins from the water and decreases water temperatures. Appropriate species selection for these areas is critical for long-term survivability of the vegetation and function of the pond.

Detailed plans should be submitted for proposed revegetation/landscaping adjacent SWM ponds. The drawings should include a list of all vegetation proposed for restoration of disturbed areas including common and scientific names, size, condition and quantity. The plan should also include information on the seed mixes to be used such as the species included in the mixture as well as the composition.

In general for plantings around a SWM pond, we recommend:

- Proposed tree density after planting should be at least 5-7/100m2.
- Trees should be planted no closer than 2.5 m on centre.
- No single species should account for more than 20% of the total tree quantity.
- Shrubs should be planted between 0.75m and 1.5m apart.
- The shrub to tree ratio should be approximately 5:1.
- A minimum of 4 aquatic species should be included.
- Aquatic species should include at least 1 species of submergent or floating-leaved plants, **and** at least 1 species of robust, broadleaved or narrow-leaved emergent.
- Aquatic plants within groupings should be spaced 0.5m to 1m apart and cover 40% (at full growth) of the area defined by the normal water level up to 0.75m deep.
- The use of sod adjacent the pond and creek is discouraged. Preferred revegetation of grasses should be done via the use of a layer of approved local topsoil and hydroseeding.
- Ground cover should include no-maintenance, non-invasive species with a minimum of 70% regionally native flowers and grasses, though we encourage the use of 100% regionally native due to the ready availability of these mixes.
- Revegetate with an approved seed mix, as soon as practical. Incorporate a cover crop seed (i.e. biannual fall rye, annual oats or barley) into mix as a cover crop. (Note: Biannual fall rye should be incorporated for summer or fall seeding and annual oats for winter or spring seeding).
- To reduce thermal warming, shade southern exposure of pond, inflow and outflow channels whenever possible.
- Signage in stormwater management pond area is recommended, indicating the purpose of the pond, safety considerations (i.e. no swimming/wading), and that aside from the trimming and/or clearing of vegetation along access points there should be no mowing.

- Please note: the use of non-native or invasive species in locations adjacent to natural areas is not encouraged.

DRAFT

Ministry of Tourism, Culture and Sport

Culture Services Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Tel: 416 212 7420
Fax: 416 212 1802

Ministère du Tourisme, de la Culture et du Sport

Unité des services culturels
Direction des programmes et des services
401, rue Bay, Bureau 1700
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Tél: 416 212 7420
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Ontario

January 29, 2014 (EMAIL ONLY)

Michele Oxlade
Stantec Consulting Ltd.
171 Queens Avenue, 6Th Floor
London, ON N6A 5J7
E: michele.oxlade@stantec.com

MTCS file #: 0002353
Proponent: Community of Delaware
Subject: Notice of Study Commencement
Delaware Community Settlement Area Stormwater Master Plan
Location: Middlesex County

Dear Michele Oxlade:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Notice of Study Commencement for this project. MTCS's interest in this master plan relates to our mandate of protecting, conserving and preserving Ontario's culture heritage, which includes:

- Archaeological resources, including land-based and marine resources;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

As part of the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources.

Archaeological Resources
Your master plan study may identify areas for future servicing that may impact archaeological resources and to address this is the attached link to the MTCS ***Criteria for Evaluating Archaeological Potential*** to determine if an archaeological assessment is needed. MTCS archaeological site data is available at ***archaeologicalsites@ontario.ca***. A municipal archaeological review procedure using an archaeological management plan may also be used to determine archaeological potential where one exists. If your study area exhibits archaeological potential, and there are to be impacts as a result of this study, then an archaeological assessment by an ***Ontario Heritage Act*** (***OHA***) licensed archaeologist, who is responsible for submitting the report directly to MTCS for review, will be required.

Built Heritage and Cultural Heritage Landscapes
The attached MTCS checklist ***Screening for Impacts to Built Heritage and Cultural Heritage Landscapes*** helps determine whether your master plan study may identify areas for future servicing that may impact cultural heritage resources. Municipal Clerks can provide information on property registered or designated under the ***Ontario Heritage Act***.

If your master plan study area has the potential to impact heritage resources, a Heritage Impact Assessment (HIA) prepared by a qualified consultant will be required. Our Ministry's ***Info Sheet #5: Heritage Impact Assessments and Conservation Plans*** outlines the scope of HIAs. Please send HIAs to

MTCS for review, and make them available to local organizations or individuals who have expressed interest in heritage.

Environmental Assessment Reporting
All technical heritage studies and their recommendations are to be addressed and incorporated into EA projects. Please advise MTCS whether an archaeological assessment and/or a heritage impact assessment will be completed for your EA project, and provide them to MTCS before issuing a Notice of Completion. If your screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the master plan report or file. MTCS is in no way liable if the information in the completed checklists is found to be inaccurate or incomplete.

Thank-you for circulating MTCS on this project: please continue to do so through the EA process, and contact me for any questions or clarification.

Sincerely,

Penny Young
Heritage Planner
penny.young@ontario.ca
416-212-7420

Appendix A8 – Notice of Completion

APPENDIX B – EXP INC. GEOTECHNICAL REVIEW

- **Stantec Consulting Ltd.**

Preliminary Geotechnical and Hydrogeological Review

Project Name
Municipality of Middlesex Centre, Delaware Settlement Area, Storm Drainage Master Plan

Project Number
LON-00014043-GE

Prepared By: **exp** Services Inc.

exp Services Inc.
15701 Robin's Hill Road
London, ON, N5V 0A5
Canada

Date Submitted
September 2, 2015

Stantec Consulting Ltd.

Preliminary Geotechnical and Hydrogeological Review

Project Name:
Municipality of Middlesex Centre, Delaware Settlement Area, Storm Drainage Master Plan

Project Number:
LON-00014043-GE

Prepared By:
Reuben Davis, P. Eng.
Project Engineer

Reviewed By:
Robert Renaud, M.Sc., P.Geo
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September 2, 2015

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Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

Table of Contents

1 Introduction

As requested, **exp** Services inc. has conducted a preliminary geotechnical and hydrogeological review in conjunction with the Municipality of Middlesex Centre, Delaware Settlement Area, Storm Drainage Master Plan. This report summarizes the results of the geotechnical and hydrogeological desk top review to support the Municipal Class Environmental Assessment (EA) Study for the proposed development.

1.1 Terms of Reference

This preliminary geotechnical and hydrogeological review was carried out in general accordance with **exp**'s proposal (P14-246) dated August 20, 2014. Authorization to proceed with the review was received from Mr. Nelson Oliveira of Stantec Consulting Ltd.

The objective of the review was to formulate an opinion on the geological and hydrogeological settings of the site by reviewing the following resources: OBM and topographic mapping; quaternary geology and topographic mapping; previous subsurface investigations conducted by **exp**; site and aerial photographs records; MOECC well records; and watershed and tributary data.

Based on information obtained from the above noted resources and based on a site reconnaissance, **exp** Services Inc. has provided preliminary engineering discussion to assist with geotechnical and hydrogeological design considerations for the Municipal Class EA Study for the proposed Storm Drainage Master Plan.

This report is provided on the basis of the Terms of Reference presented above. If there are any changes in the design features relevant to the preliminary geotechnical and hydrogeological review, or if any questions arise concerning the geotechnical and hydrogeological aspects of the codes and standards, this office should be contacted to review the design.

The information in this report in no way reflects on the environmental aspects of the soil and groundwater conditions.

2 Methodology

The scope of work for the preliminary geotechnical and hydrogeological review consisted of the following tasks:

1. Desktop Study: This task consisted of a review of existing information including: site plans; previous reports and drawings provided by Stantec Consulting; geological maps; available groundwater level information; and Ontario Ministry of the Environment and Climate Change (MOECC) Water Well Records.

2. Site Reconnaissance: A site reconnaissance was conducted to review site topography, observe and document site conditions and surface water features, including existing slopes, water courses and existing control structures which may be present.

3. Date Evaluation: This task consisted of the evaluation of the available field observations and background data

4. Reporting: This task consisted of preparing this preliminary geotechnical and hydrogeological review. With respect to the hydrogeological portion of the preliminary review; it has been prepared in accordance with recommendations outlined in the document titled "*Hydrogeological Assessment Submissions: Conservation Authority Guidelines to Support Development Applications – June 2013*". An excerpt from the document is included on the following pages.

Table 1: Hydrogeological Assessment Check List intended to Support Development Applications

Groundwater Assessment	Master Environmental Servicing Plan or Equivalent	Environmental Assessment (EA)	Site Plan Commercial, Institutional, or Industrial	Subdivision or Condominium Development		Single lot Residential	Dewatering
				Municipal Servicing	Private Servicing		
1. EXISTING CONDITIONS:							
Introduction and background	☐	☐	☐	☐	☐	☐	☐
Site location and description	☐	☐	☐	☐	☐	☐	☐
Description of: • Topography & Drainage • Physiography • Geology & Soils	☐	☐	☐	☐	☐	☐	☐
Test pits/Boreholes	☐	☐	☐	☐	☐	GNR	☐
Monitoring Wells	☐	☐	☐	☐	☐	GNR	☐
Private Well Survey	☐	☐	☐	☐	☐	GNR	☐
Hydrostratigraphy/Hydrogeology: • Aquifer properties • Groundwater Levels • Groundwater flow direction	☐	☐	☐	☐	☐	☐	☐
Description of surface water features and functions	☐	☐	☐	☐	☐	☐	☐
Water Taking Permit details	GNR	GNR	GNR	GNR	GNR	GNR	☐
Water Quality	☐	☐	☐	☐	☐	GNR	☐
D-5-5 (Water Supply)	GNR	GNR	GNR	GNR	☐	GNR	GNR

Groundwater Assessment	Master Environmental Servicing Plan or Equivalent	Environmental Assessment (EA)	Site Plan Commercial, Institutional, or Industrial	Subdivision or Condominium Development		Single lot Residential	Dewatering
				Municipal Servicing	Private Servicing		
2. IMPACT ASSESSMENT:							
Groundwater Levels	☐	☐	☐	☐	☐	GNR	☐
Pumping Tests*	☐	☐	GNR	GNR	☐	GNR	☐
Groundwater Discharge (Baseflow)	☐	☐	☐	☐	☐	GNR	☐
Water Balance	☐	☐	☐	☐	☐	GNR	GNR
Groundwater Quality	☐	☐	☐	☐	☐	GNR	☐
D-5-4 (Onsite Sewage Systems)	GNR	GNR	GNR	GNR	☐	GNR	GNR
3. MITIGATION MEASURES:							
Maintenance of Infiltration/Recharge	☐	☐	☐	☐	☐	GNR	GNR
Maintenance Groundwater Quality	☐	☐	☐	☐	☐	GNR	☐
Monitoring Program	☐	☐	☐	☐	☐	GNR	☐
Contingency Plans**	GNR	GNR	GNR	☐	☐	GNR	☐

NOTES: This table outlines the type of planning application and associated requirements most commonly required by Conservation Authorities in the review of Hydrogeological Assessments. This table is not a complete list of all types of applications dealt with by each Conservation Authority nor is the checklist appropriate for every development situation. Individual Conservation Authorities should be consulted with for specific requirements.

☐ - *Recommended*
GNR – Generally Not Required
** Where development is municipally serviced, these tests will be necessary on a case by case basis (sensitive aquifer/ aquatic considerations).*
***May be scoped, Contingency Plans will not be needed in most cases.*

3 Preliminary Geotechnical Review

3.1 Site Location and Description

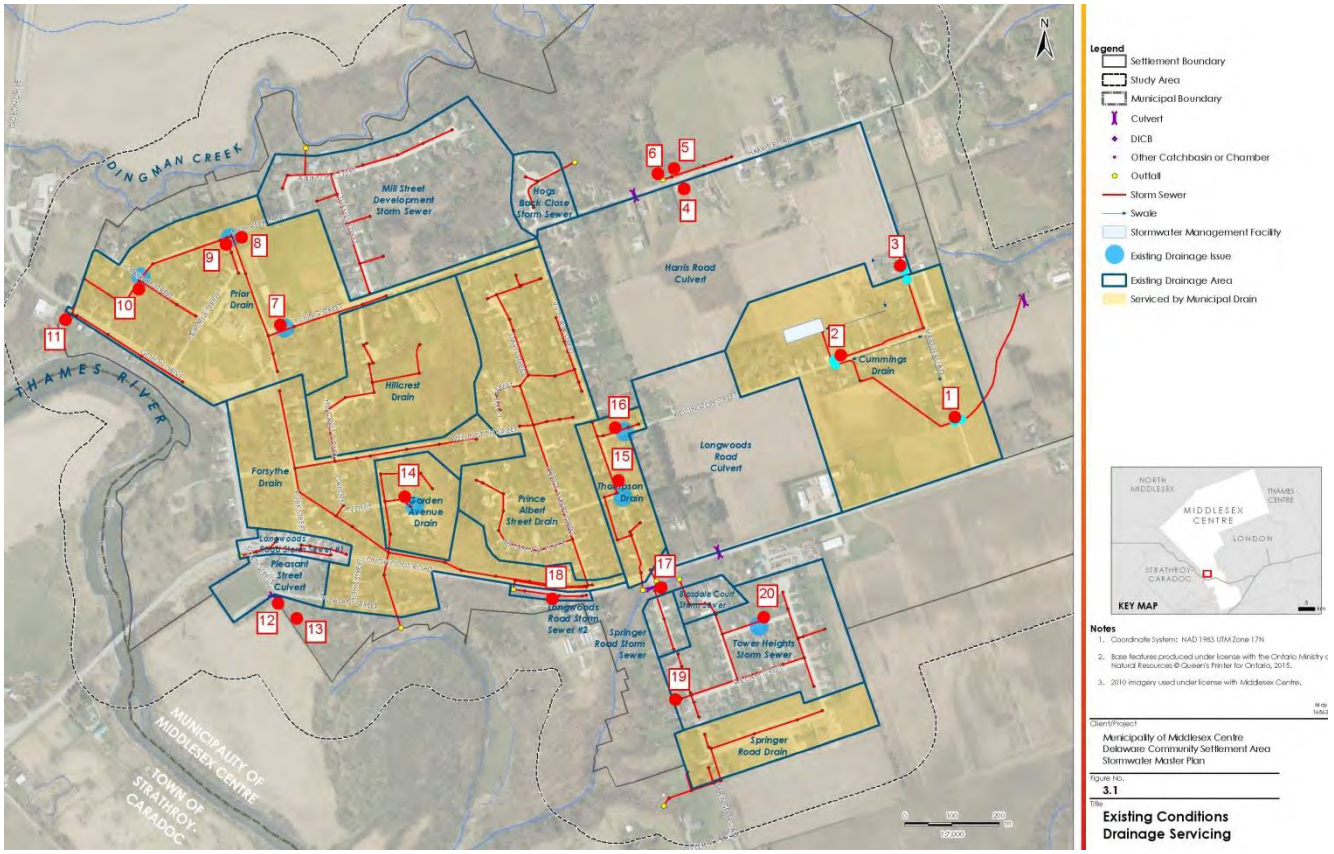
The study area consists of an area identified as the Delaware Community Area and is outlined in the figure below. The Delaware Community is located about 10 kilometers west of London Ontario and is situated in the southwest portion of the Municipality of Middlesex Centre. The Delaware Community consists primarily of single family residential development with some light commercial and industrial development throughout. The area surrounding the Delaware community consists primarily of agricultural lands and wooded lots. Significant surface water features located within close proximity to the Delaware Community consist of The Thames River (located west perimeter of the community) and The Dingman Creek (located along the north perimeter of the community). Figure 1 was provided to **exp** by Stantec Consulting.

Figure 1: Site Location and Description

3.2 Site Reconnaissance

As part of our preliminary geotechnical and hydrogeological review, a site reconnaissance was conducted on July 31st, 2015 to: review site topography; and observe site conditions as well as any existing slopes, water features, or control structures. The following figure was provided to **exp** by Stantec Consulting and illustrates the location of existing drainage control structures (i.e. storm sewers, catch basins, culverts, swales, etc.) and also indicates the location where existing drainage issues have been occurring. Where access was possible, a series of photographs were taken at these various locations throughout the Delaware Community, and are indicated in red (red numbering with red dot) on the following figure. A photographic record is provided in Appendix A, attached.

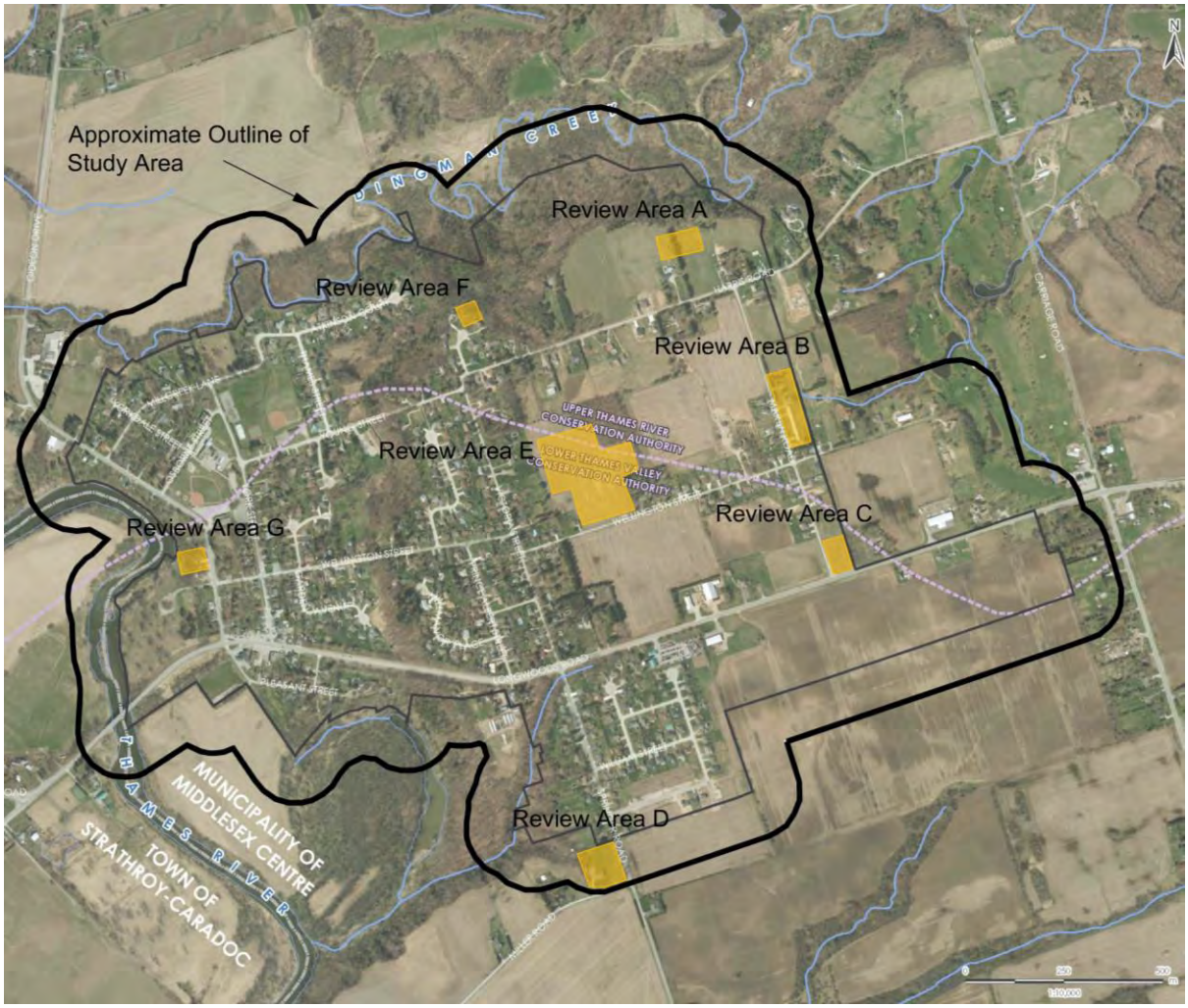
Figure 2: Photographic Record Location



3.3 Previous Field Work & Reporting

In addition to the current work program, **exp** has previously carried out field work (boreholes or test pits) within the Delaware Community Area. The soil and groundwater conditions encountered at the test hole locations during the previous field work has been considered during the creation of this report. The approximate locations of **exp**'s previous work areas have been illustrated on Figure 3 below (indicated by orange hatch and labelled as Review Areas A through G) and, the soil and groundwater conditions are summarized in the following paragraphs and described in more detail on the attached borehole logs or test pit summaries (Appendix B). The soil and groundwater conditions encountered at the previously advanced test hole locations should be considered for preliminary purposes only.

Figure 3: Location of Previous Fieldwork



In summary, seven (7) previous work areas have been reviewed and are identified as Review Areas A through G.

The field work within Review Area A was completed in April of 2010; in general the soil conditions encountered at the borehole locations within Review Area A can be described as sand or silty sand underlying topsoil. Each borehole was open and dry upon completion of excavation.

The field work within Review Area B was completed in August of 2013; in general the soil conditions encountered at the borehole locations within Review Area B can be described as sand, silty sand or silt deposits underlying topsoil. Two monitoring wells were installed during the previous fieldwork within Review Area B. Groundwater level measurements, from within the monitoring wells, were observed to be ranging between depths of about 1.6 m to 1.8 m below existing grades.

The field work within Review Area C was completed in May of 2008; in general the soil conditions encountered at the borehole locations within Review Area C can be described as silty sand underlying topsoil. Each borehole was open and dry upon completion of excavation.

The field work within Review Area D was completed in June of 2001. There were no test pits excavated or boreholes advanced at the site; however, one shallow auger hole was advanced (approximately 1.6 m below grade) in order to complete a percolation test to support onsite sewage disposal system design. The shallow subsurface soil conditions observed within the auger hole were described as sand with some gravel and trace silt. Within the auger hole, groundwater seepage was observed at a depth of about 1.0 m below existing grade.

The field work within Review Area E was completed in July of 2009; in general the soil conditions encountered at the borehole locations within Review Area E can be described as sand underlying topsoil. Occasional silt deposits were encountered underlying the shallow subsurface sandy soils. At the time of drilling, groundwater seepage was observed within the boreholes at depths ranging between about 0.9 m to 1.5 m below existing grades.

The field work within Review Area F was completed in May of 2013; in general the soil conditions encountered at the borehole location within Review Area F can be described as sand overlying silt till. At the time of drilling, groundwater seepage was observed within the boreholes at depth of about 15.5 m below existing grade.

The field work within Review Area G was completed in October 2002, in general the soil conditions encountered at the test hole locations within Review Area G can be described as sand and gravel underlying any surficial topsoil or fill material. Each test hole was open and dry upon completion of excavation.

3.4 Regulatory Approval

The Delaware Community Area is situated within both the Upper Thames River Conservation Authority (UTRCA) and the Lower Thames Valley Conservation Authority (LTVCA). As a result, approvals from the authorities may be required prior to any development within conservation authority regulated lands.

In May 2006, Ontario Regulation 157/06 and Ontario Regulation 152/06 came into effect, which locally implements the Generic Regulation (Development, Interference with Wetlands and Alterations to Shoreline and Watercourses). This regulation replaces the former Fill, Construction and Alteration to Waterways regulations, and is intended to ensure public safety, prevent property damage and social disruption, due to natural hazards such as flooding and erosion. Ontario Regulation 157/06 and 152/06 are implemented by the local Conservation Authority, by means of permit issuance for works in or near watercourses, valleys, wetlands, or shorelines, when required.

Property owners must obtain permission and/or a letter of clearance from the local Conservation Authority before beginning any development, site alteration, construction, or placement of fill within the regulated area. Permits are also required for any wetland interference, or for altering, straightening, diverting or interfering in any way with the existing channel of a creek, stream or river. Proposed development within the study area may be subject to the above referenced Regulation. Accordingly, consultation with the local Conservation Authority for review of site-specific development plans is recommended.

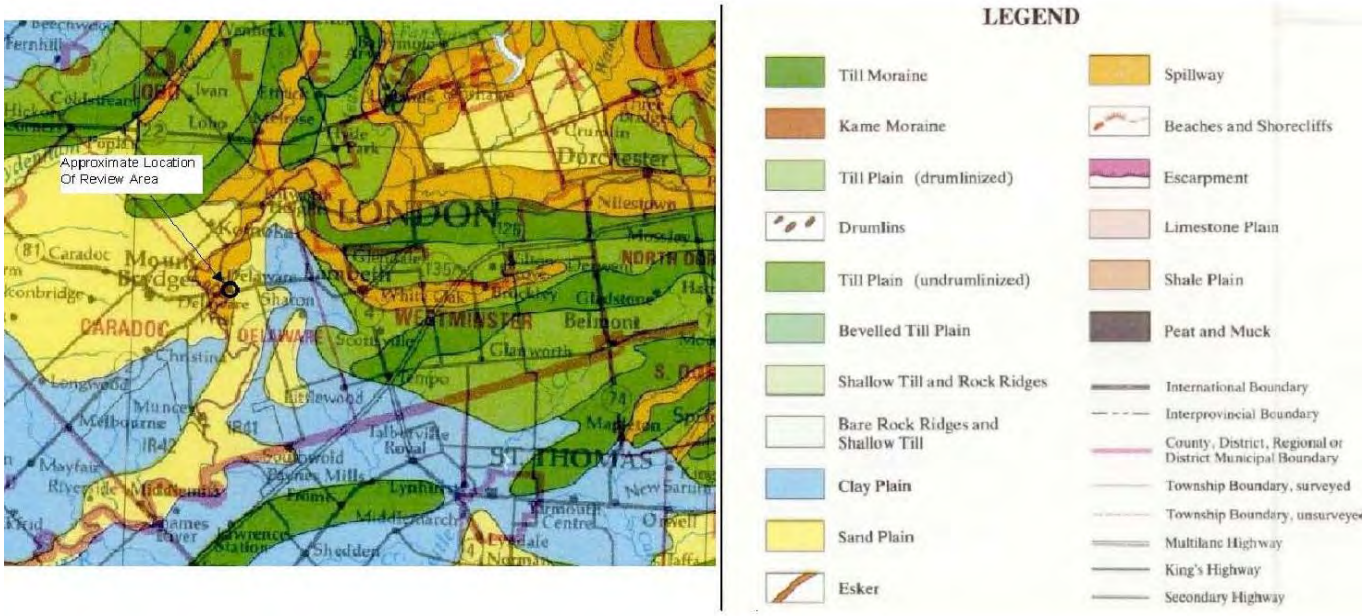
3.5 Site Physiography

Overburden deposits in the study area were formed by numerous glacial events during the Wisconsinan ice age approximately 15,000 to 25,000 years before present. Thick glacial ice sheets advanced several times into the southern part of the province from various directions and then receded creating the present configuration of moraines, abandoned spillways, drumlins, eskers, abandoned shorelines, and various still-water sediment deposits. The surficial deposits were mapped and categorized into a number of physiographic regions by Chapman and Putnam (1984).

A section of the map referenced below was reviewed to determine the nature of the site physiography at the subject site:

- Ontario Geological Survey. 1:600 000 scale, Physiography of Southern Ontario. Ontario Geological Survey, Map P.2715, 1984.

Figure 4: Site Physiography



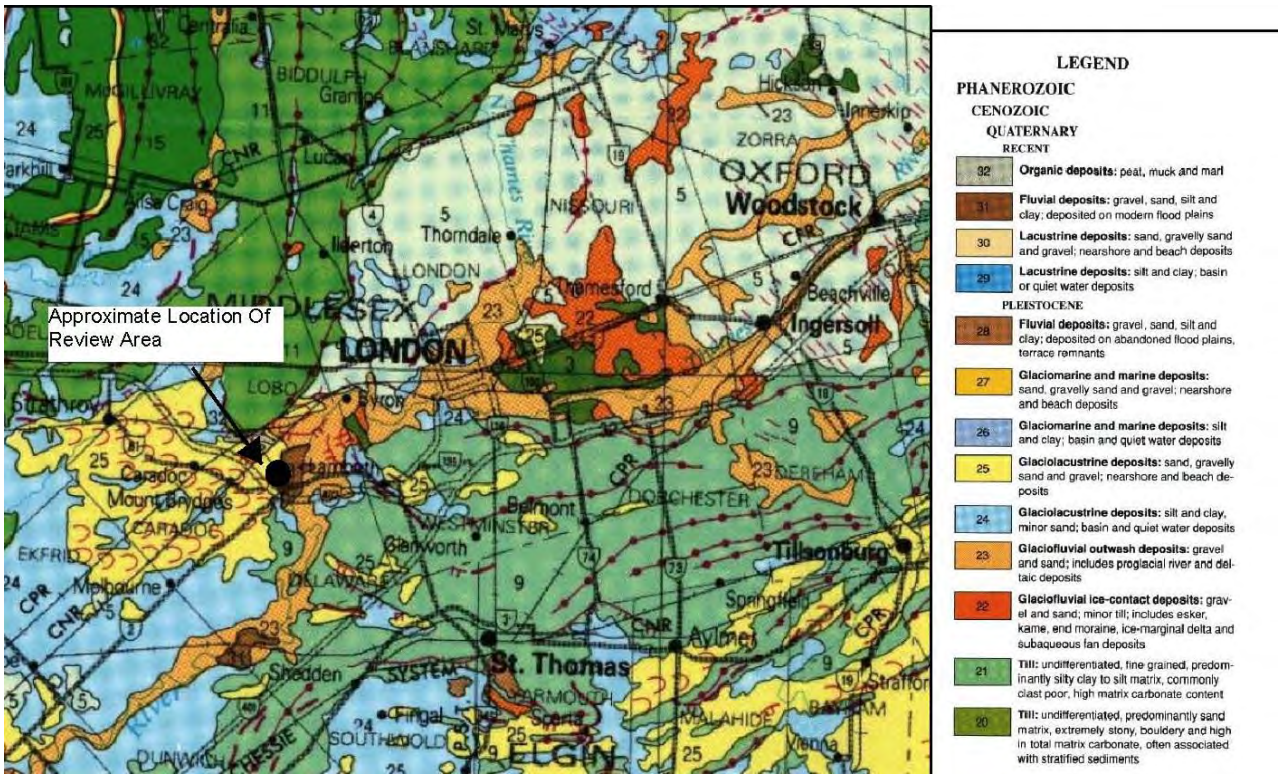
The above figure reveals that the local site physiography can be described as Spillways and Sand Plains.

3.6 Surficial Geology

The following information source was reviewed to formulate an opinion on the local surficial geology at the subject site:

- Ontario Geological Survey. 1:1 000 000 scale, Quarternary Geology of Ontario. Ontario Geological Survey, Map P.2556, 1991

Figure 5: Surficial Geology



The above figure reveals that the local surficial geology can be described as Fluvial Deposits: gravel, sand, silt and clay, deposited on modern flood plains; and Glaciolacustrine Deposits: sand, gravelly sand and gravel, nearshore and beach deposits.

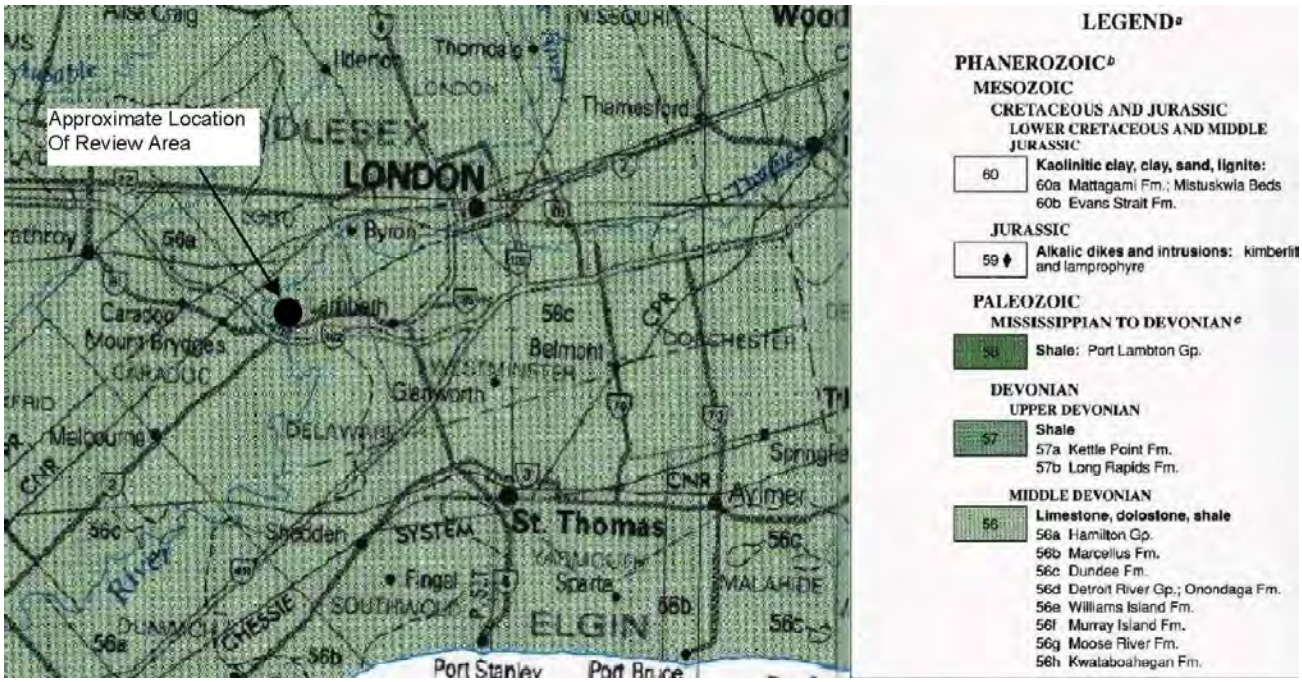
As mentioned previously, **exp** has conducted numerous subsurface investigations within the current review area. Information obtained from these previous subsurface investigations has been considered while creating this report. Based on the information provided above and based on our experience conducting investigations within the review area, it could be reasonably anticipated that (underlying any fill material that may be present on site) shallow subsurface soil conditions (within the review area) would consist of silty sand or sand and gravel deposits overlying a natural silt or clayey silt till. It may also be reasonable to anticipate that shallow deposits of silt or clayey silt till may be encountered underlying surficial topsoil layers at intermittent locations throughout the review area.

3.7 Bedrock Geology

The following information source was reviewed to determine the nature of the bedrock geology at the subject site:

- Ontario Geological Survey 1991. Bedrock Geology of Ontario, Southern Sheet; Ontario Geological Survey, Map 2544, Scale1:1 000 000.

Figure 6: Bedrock Geology



The above map revealed that the underlying bedrock, in the general, consists of limestone, dolostone and shales from the Hamilton Group. The Hamilton Group (from the Middle Devonian) is a calcareous shale-dominated unit with relatively thin carbonate horizons. It is subdivided into 6 formations: in ascending order, the Bell, Rockport Quarry, Arkona, Hungry Hollow, Widder and Ipperwash formations (OGS, 2007).

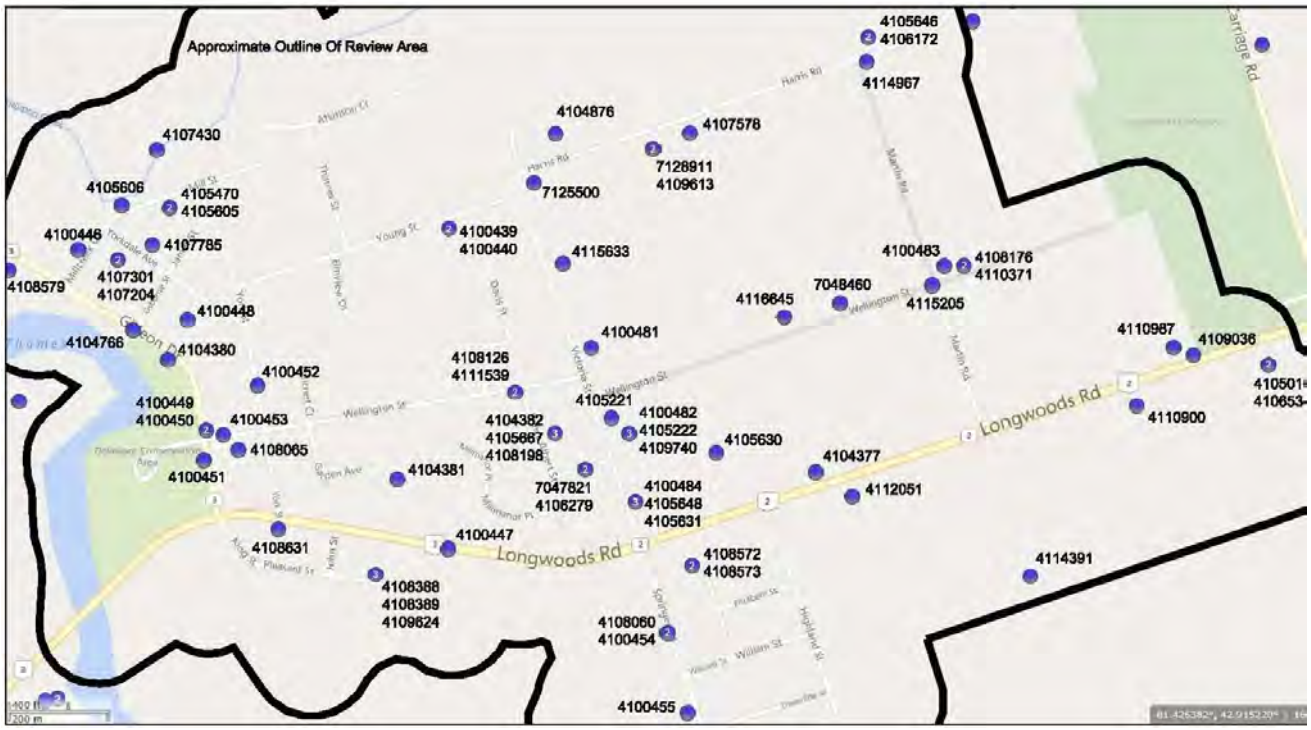
Bedrock was not encountered during previous geotechnical investigations.

4 Preliminary Hydrogeological Review

4.1 Summary of MOE Well Records

Information regarding potable wells located within the Delaware Settlement Area was examined, in order to confirm the primary potable water source for wells in the area. An approximate outline of the review area and the closest wells, recorded by the Groundwater Information Network (http://gw-info.net) are shown below.

Figure 7: Approximate Location of MOE Recorded Wells



A summary of the available Well Records are provided on a table on the following page.

Table 1 - MOE Well Record Summary

Well ID	Elevation (m)	Depth (m)	Water Level (m)	Water Yield (lpm)	Water use	Water status
4116645	-	5.33	1.83	22.73	Irrigation	Water Supply
7047821	-	-	1.52	-	-	Abandoned
7048460	-	5.64	2.44	45.46	Irrigation	Water Supply
7125500	-	6.40	3.05	-	-	Abandoned
7128911	-	7.01	-	-	-	Abandoned
4100439	234.70	50.60	-	-	-	Abandoned
4100440	237.74	19.81	-	-	-	Abandoned
4100446	213.36	4.88	0.91	22.73	Domestic	Water Supply
4100447	228.60	44.20	9.14	-	Not Used	Abandoned
4100448	216.41	56.39	8.53	-	Not Used	Abandoned
4100449	216.41	33.83	9.14	22.73	Domestic	Water Supply
4100451	216.41	9.14	4.88	9.09	Domestic	Water Supply
4100452	220.98	3.96	1.52	13.64	Domestic	Water Supply
4100453	216.41	8.53	6.10	9.09	Domestic	Water Supply
4100454	234.70	9.75	3.05	-	Domestic	Water Supply
4100455	236.22	9.75	6.71	13.64	Domestic	Water Supply
4100481	238.96	4.88	2.74	18.18	Domestic	Water Supply
4100482	238.35	8.23	5.79	4.55	Domestic	Water Supply
4100483	238.96	7.92	5.49	9.09	Domestic	Water Supply
4100484	237.13	8.53	3.35	4.55	Domestic	Water Supply
4104377	237.13	3.66	1.22	13.64	Public	Water Supply
4104380	210.31	6.10	4.27	13.64	Domestic	Water Supply
4104381	220.98	6.71	2.44	9.09	Livestock	Water Supply
4104382	237.74	3.05	1.52	13.64	Domestic	Water Supply
4104766	216.41	5.79	3.05	18.18	Domestic	Water Supply
4104876	237.74	9.14	3.96	18.18	Domestic	Water Supply
4105016	237.74	6.40	3.05	13.64	Domestic	Water Supply
4105221	239.27	4.27	2.74	27.28	Domestic	Water Supply
4105222	239.27	9.14	4.57	18.18	Domestic	Water Supply
4105470	212.75	7.32	1.52	13.64	Domestic	Water Supply
4105605	213.36	17.98	3.66	9.09	Domestic	Water Supply
4105606	213.36	11.28	-	-	-	Not A Well
4105630	237.74	7.01	3.96	13.64	Domestic	Water Supply
4105631	236.22	8.53	4.57	13.64	Domestic	Water Supply
4105646	237.74	6.71	3.66	-	Domestic	Water Supply
4105648	237.13	7.62	-	-	-	Unfinished
4105667	235.31	5.79	4.27	13.64	Domestic	Water Supply
4106172	238.35	6.71	3.05	-	Domestic	Water Supply
4106279	237.74	8.23	1.52	22.73	Domestic	Water Supply
4106534	237.74	8.23	2.44	18.18	Domestic	Water Supply
4107204	212.14	14.63	0.91	22.73	Domestic	Water Supply

Well ID	Elevation (m)	Depth (m)	Water Level (m)	Water Yield (lpm)	Water use	Water status
4107301	213.36	9.45	1.52	27.28	Domestic	Water Supply
4107430	213.97	13.72	2.44	22.73	Domestic	Water Supply
4107578	240.79	6.10	3.66	13.64	Domestic	Water Supply
4107785	228.60	6.10	1.83	13.64	Domestic	Water Supply
4108060	236.22	16.15	4.57	22.73	Domestic	Water Supply
4108065	216.41	6.71	4.27	13.64	Domestic	Water Supply
4108126	239.27	10.36	1.52	22.73	Domestic	Water Supply
4108176	239.27	7.62	4.57	13.64	Domestic	Water Supply
4108198	239.27	8.53	3.05	22.73	Domestic	Water Supply
4108388	240.49	10.06	1.22	22.73	Domestic	Water Supply
4108389	241.10	8.84	1.22	22.73	Domestic	Water Supply
4108572	235.61	11.58	4.88	22.73	Domestic	Water Supply
4108573	237.74	12.80	6.10	9.09	-	Abandoned
4108579	210.62	39.62	0.91	-	-	Observation
4108631	219.46	6.71	2.44	22.73	Public	Water Supply
4109036	237.74	9.75	3.96	22.73	Domestic	Water Supply
4109613	237.74	7.92	1.52	22.73	Domestic	Water Supply
4109624	213.36	9.75	2.74	22.73	Domestic	Water Supply
4109740	237.74	7.62	3.05	22.73	Domestic	Water Supply
4110371	237.74	11.58	3.66	22.73	Domestic	Water Supply
4110900	237.74	13.72	1.83	22.73	Commercial	Water Supply
4112051	235.00	8.23	1.52	22.73	Commercial	Water Supply
4114391	-	15.24	5.18	18.18	Domestic	Water Supply
4114967	-	53.34	20.42	13.64	Domestic	Water Supply
4115205	-	78.33	-	13.64	-	Water Supply
4115633	-	13.00	8.00	10.00	Irrigation	Water Supply
4100450	217.32	6.10	2.44	22.73	Commercial	Water Supply
4110987	237.74	9.14	4.57	22.73	Commercial	Water Supply
4111539	235.92	10.67	6.10	22.73	Commercial	Water Supply

The wells in the area are set at variable depths ranging between about 4.0 m to 78.0 m below existing grades. The wells are registered as being used for irrigation, domestic, public, livestock and commercial purposes. Stratigraphic information, for each well, is provided on the attached well records, See Appendix C. In general, the overburden soils noted in the MOECC Well Records are generally described as sand and gravel deposits with intermittent layers of clay or silt.

4.2 Significant Groundwater Recharge Areas (SGRA)

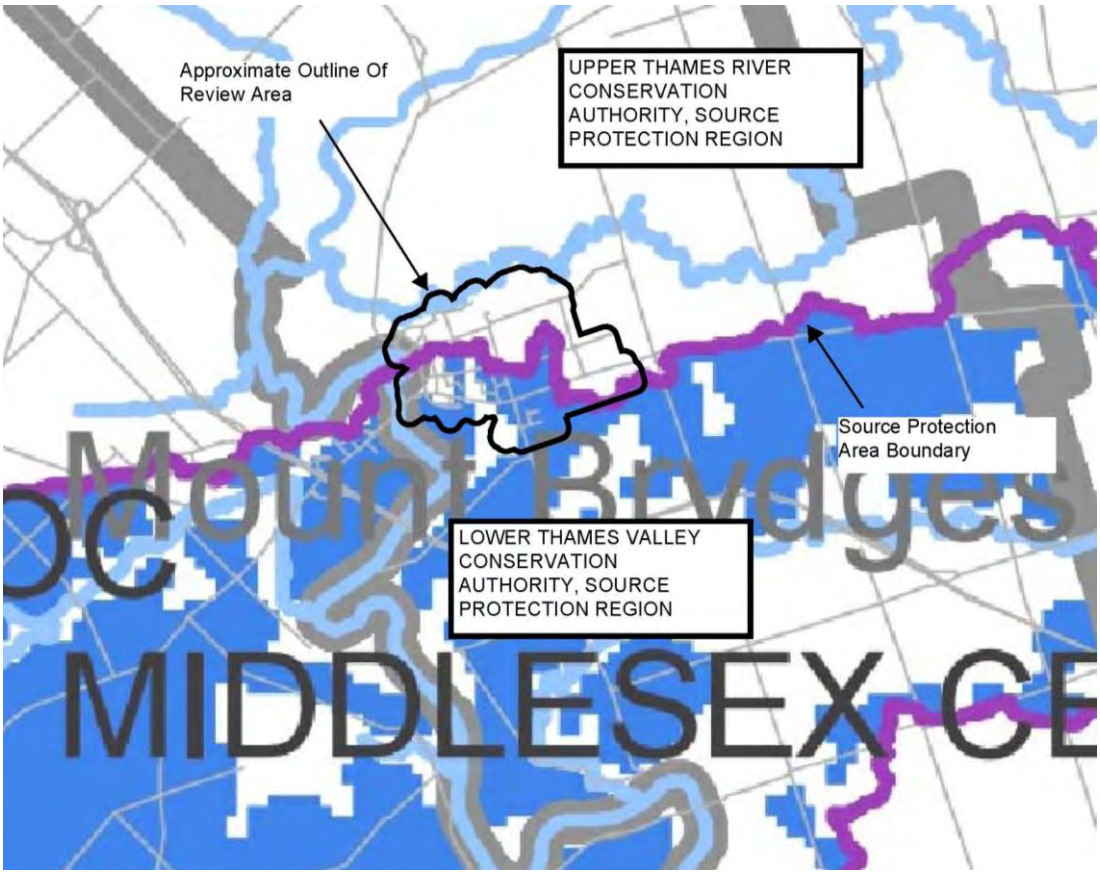
Groundwater recharge is largely controlled by soil conditions, and typically occurs in upland areas.

As defined in the *Clean Water Act (2006)*, an area is a significant groundwater recharge area if,

1. the area annually recharges water to the underlying aquifer at a rate that is greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more; or
2. the area annually recharges a volume of water to the underlying aquifer that is 55% or more of the volume determined by subtracting the annual evapo-transpiration for the whole of the related groundwater recharge area from the annual precipitation for the whole of the related groundwater recharge area.

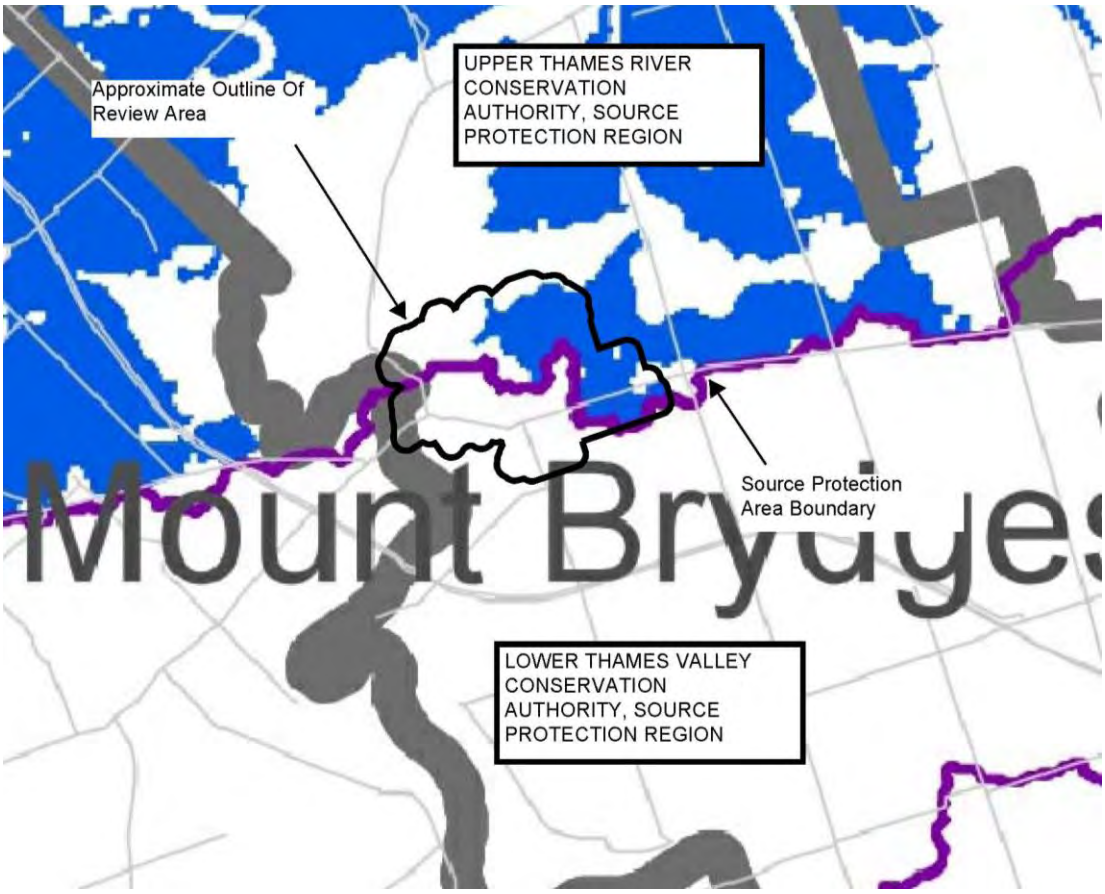
As previously mentioned the Delaware Community Area is situated on the border of the Lower Thames Valley and Upper Thames River Conservation Areas. The Thames-Sydenham and Region Source Protection Committee has prepared an assessment report for both the Lower Thames Valley and Upper Thames River Source Protection Areas. As defined by the *Clean Water Act (2006)* and identified by the Thames-Sydenham and Region Source Protection Committee, the blue overlay on figures 8 and 9 shown below show most of the Delaware Community Area as being identified inside an SGRA.

Figure 8: Significant Groundwater Recharge Area, LTVCA



Map 4-8, Lower Thames Valley Source Protection Area, Approved Assessment Report

Figure 9: Significant Groundwater Recharge Area, UTRCA



Map 4-2-1, Upper Thames River Source Protection Area, Approved Assessment Report

4.3 Highly Vulnerable Aquifer (HVA)

The susceptibility of an aquifer to contamination is a function of the susceptibility of its recharge area to the infiltration of contaminants. As defined in the *Clean Water Act (2006)*, the vulnerability of groundwater within a source protection area shall be assessed using one or more of the following groundwater vulnerability assessment methods:

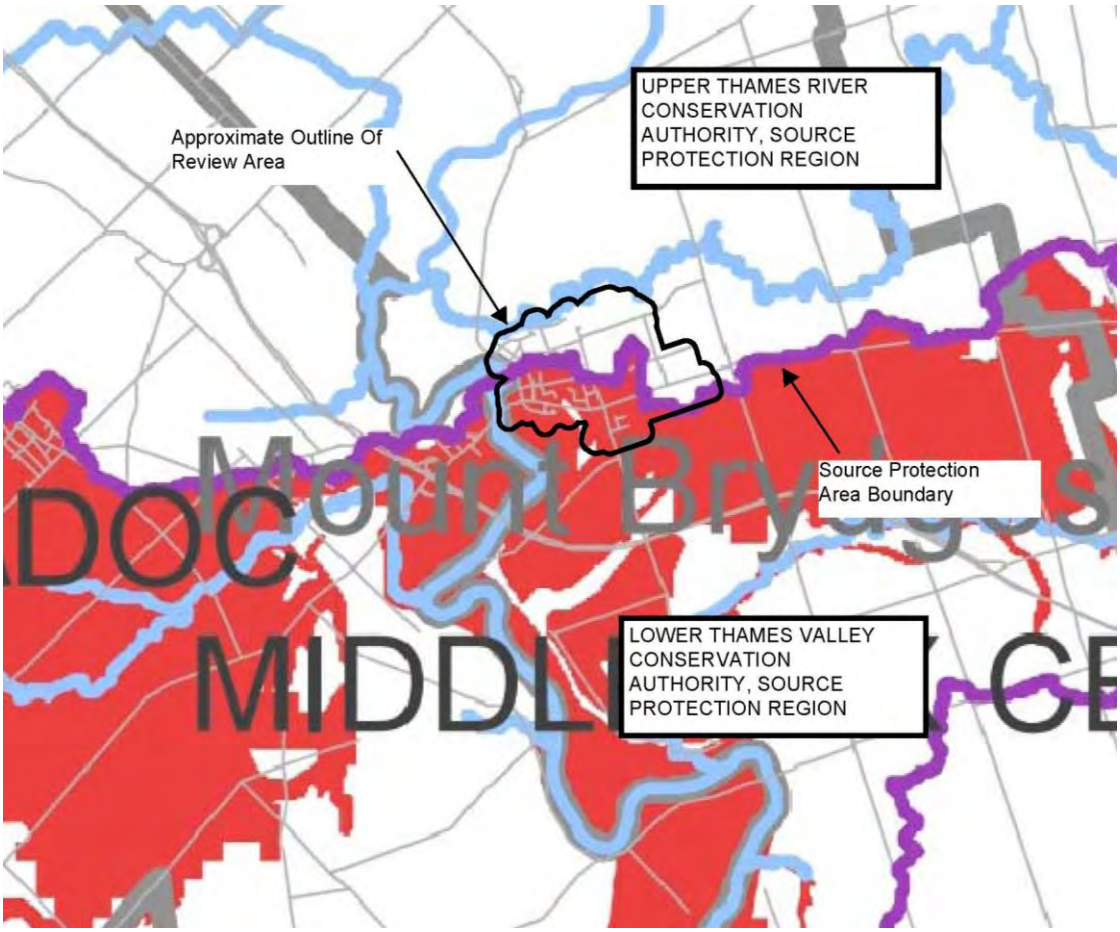
1. Intrinsic susceptibility index (ISI).
2. Aquifer vulnerability index (AVI).
3. Surface to aquifer advection time (SAAT).
4. Surface to well advection time (SWAT).

In the Thames-Sydenham and Region, HVAs were mapped using the ISI method. The ISI method is an indexing approach using existing provincial Water Well Information System (WWIS) database. The ISI method is described in detail in the MOECC's Technical Terms of Reference (2001). However, in short, the ISI method is a scoring system that takes into consideration the unique hydrogeological conditions at a particular location. The scores are determined using a combination of the saturated thickness of each unit and an index number related to the soil type, and as such, the scores reflect the susceptibility of the aquifer to contamination. As defined in the MOECC's 2008 Technical Rules,

- an area having an ISI score of less than 30 is considered to be an area of high vulnerability;
- an area having an ISI score greater than or equal to 30, but less than or equal to 80, is considered to be an area of medium vulnerability; and,
- an area having an ISI score of greater than 80 is considered to be an area of low vulnerability.

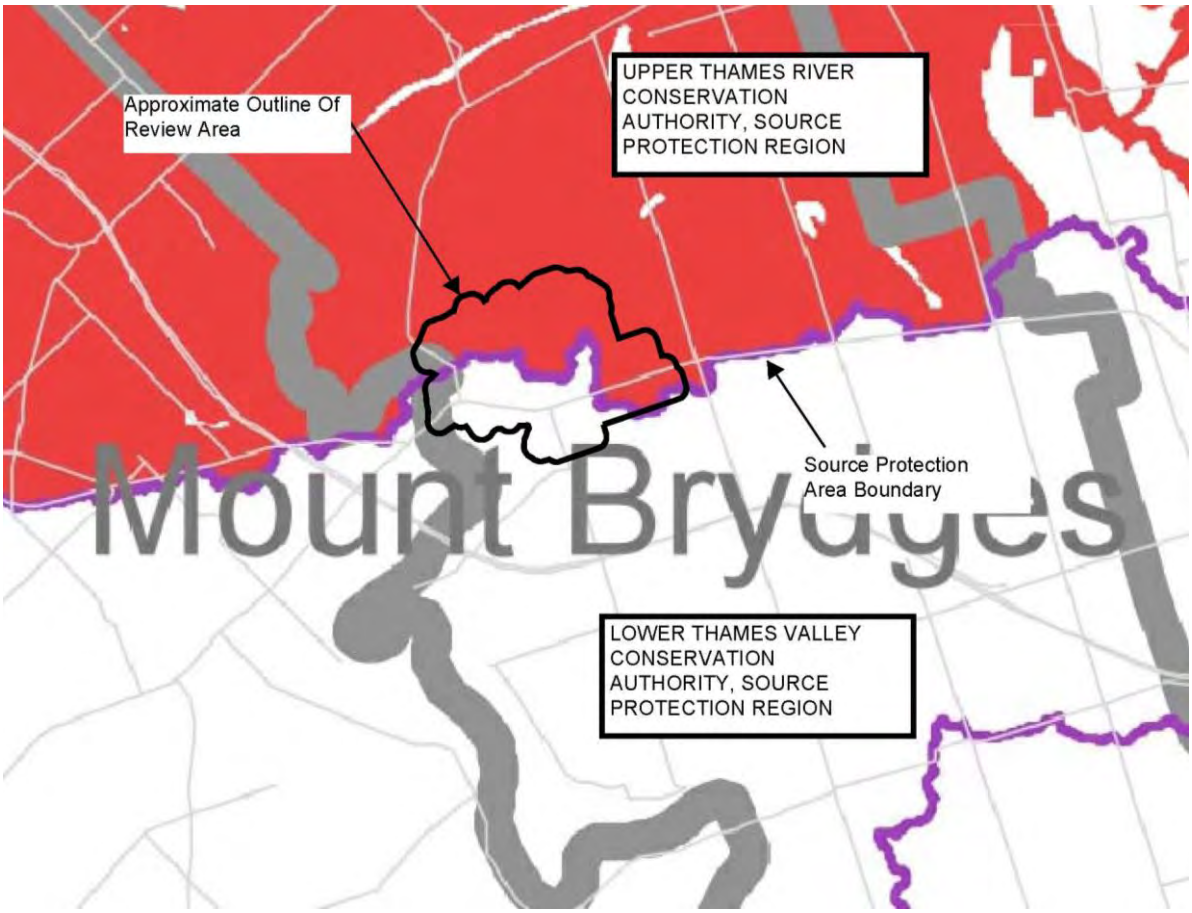
The Thames-Sydenham and Region Source Protection Committee has determined, using the ISI method that the subject site is located in an area that is classified as a highly vulnerable aquifer. The red overlay on figures 10 and 11 shown on the following page show the Delaware Community as being identified inside the High Vulnerable Aquifer zone.

Figure 10: Highly Vulnerable Aquifer Zone, LTVCA



Map 4-7, Lower Thames Valley Source Protection Area, Approved Assessment Report

Figure 11: Highly Vulnerable Aquifer Zone, UTRCA

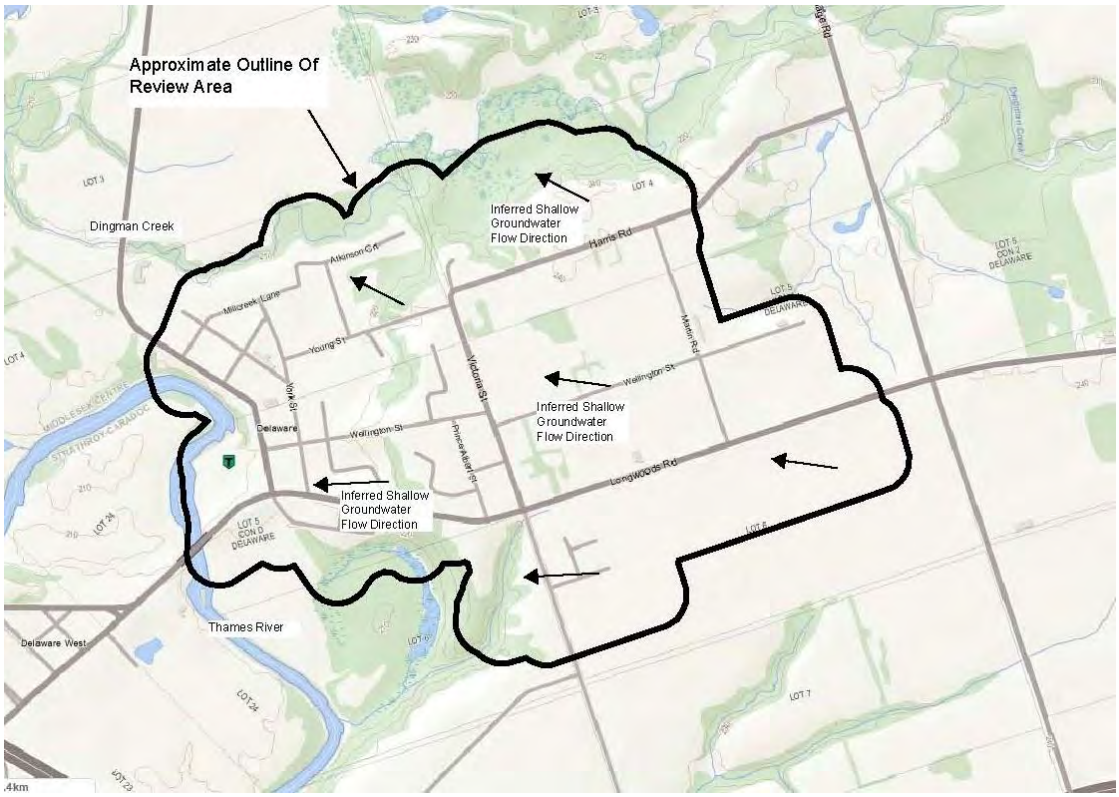


Map 4-3-2, Upper Thames River Source Protection Area, Approved Assessment Report

4.4 Topography and Surface Water Features

The Ministry of Natural Resources and Forestry Topographic Mapping was reviewed for the Delaware Community Area. Significant surface water features located within close proximity to the Delaware Community are the Dingman Creek (tributary to the Thames River) located to the north and the Thames River located to the west. The review area has a general decline in elevation heading towards both the Dingman Creek and Thames River; in general, declining in elevation from the east and southeast (approx. geodetic elevation ranging from about 230 m to 240 m) to the west and north (approx. geodetic elevation of about 210 m).

Figure 12: Topographic Mapping, Ministry of Natural Resources and Forestry



Based on a review of available topographic mapping the change in elevation is about 20 to 30 m over a distance of about 2.5 km. Based on information obtained during the site reconnaissance and based on information provided by Stantec, it is anticipated that surface water flows along existing drains and swales, located throughout the review area, follow this topographic trend and are most likely intermittent throughout the year, with flows most likely occurring during major storm events or seasonal spring thaw. It is further anticipated that the shallow overburden groundwater flow direction will mimic the existing topographic trend throughout the review area, and shallow groundwater flows have been inferred to be moving in the a west to northwest direction towards the significant surface water features. Surface saturated soil conditions and some minor ponding was observed at intermittent locations along the length of the Pleasant Street Culvert (Wellington Drain) located near the southwest of the review area.

4.5 Probable Groundwater Elevations

The following comments regarding probable groundwater elevations have been provided from a preliminary review standpoint and should only be used for preliminary design consideration. In the event that more accurate or recorded groundwater elevations are required, **exp** can provide assistance in this regard.

In general, shallow groundwater levels across the Community are typically affected by the soil permeability, topography and drainage. Based on the results of: previously advanced test holes located within the current review area (section 3.3); site reconnaissance (section 3.2); and a review of the MOECC shallow wells (wells recorded to have a depth of about 5.0 m or less, section 4.1); it is anticipated that shallow groundwater may be encountered where shallow sand and silt deposits are present; at depths ranging from about 0.9 to 2.7 m below existing grades. It is most likely that shallow groundwater will be encountered within close proximity to the existing surface drainage features located throughout the review area. It is also common to encounter shallow groundwater at intermittent locations throughout wooded areas or where the existing topography may encourage localized surface water ponding.

From a preliminary review standpoint, it is anticipated that the most significant amounts of groundwater would be encountered in centralized portions of the review area and also extending out towards the north, west and southwest boundary of the review area. As previously mentioned, shallow groundwater elevations may be encountered at depths ranging from about 0.9 to 2.7 m below existing grades.

In order to more accurately describe the groundwater elevations throughout the site, groundwater monitoring wells in conjunction with a groundwater monitoring program can be considered. **Exp** can provide assistance if requested and has provided more information in this regard in the following sections.

4.6 Construction Excavations and Groundwater Control

Depending on the design invert levels for the site servicing, the excavations may penetrate through shallow areas of wet silt, sand and gravel. Moderate to high groundwater inflow through the excavation sidewalls and base should be anticipated where the construction excavations extend below the groundwater table, or shallower if wet sandy areas are encountered.

In any event, in order to facilitate construction excavation activities, the groundwater level should be lowered at least 0.5 m below the base of the excavation. When conventional gravity systems and high capacity pumps are not sufficient for groundwater control where excavations extend well below the groundwater, consultation with a specialist dewatering contractor is recommended. The design of the dewatering system should be left to the contractor's discretion. Successful dewatering operations will depend on the contractor's own experience, construction techniques, seasonal influences, sequencing and scheduling of the work force.

It is recommended that future soil and groundwater studies be carried out at a more site specific scale to refine the geotechnical and hydrogeological understanding, potential groundwater impacts and mitigation in support of development applications or construction activities.

Minor settlement of the subgrade is possible for a general lowering of the water table, therefore the possible consequences of groundwater lowering on adjacent buildings and services, if any, should be reviewed by the designers once the final dewatering depths are determined. The amount of settlement is a function of the duration and volume of groundwater removal. This can be confirmed once the final design levels are available. A preconstruction survey of the surrounding structures, facilities, roads and services should be conducted prior to construction.

Collected water from service trenches and temporary excavations should be discharged a sufficient distance away from the excavated area to prevent the discharge water from returning to the excavation. Sediment control measures should be provided at the discharge point of the dewatering system. Caution should also be taken to avoid any adverse impacts to the environment.

As mentioned above, more extensive dewatering measures may be required. It should be noted that for projects requiring positive groundwater control with a removal rate in excess of 50,000 liters per day, a Permit to Take Water (PTTW) will be required. PTTW applications will need to be approved by the Ministry of Environment and Climate Change according to Sections 34 and 98 of the Ontario Water Resources Act R.S.O. 1990 and the Water Taking and Transfer Regulation O. Reg. 387/04. **Exp** can be of assistance in this regard, if requested.

It is important to note that the preparation of Supporting Documents for a PTTW can only be carried out when additional information regarding the design depths, and construction details are available. Generic calculations or rough estimates of proposed pumping volumes may be suitable for the tendering process; however the MOECC requires more stringent preparation and review of this type of supporting data, prior to issuing a Permit.

It is noteworthy to mention that where high water levels decrease or stabilize at lower levels in the summer and fall months, the requirement and anticipated volumes of water being pumped for excavation dewatering are expected to have a corresponding decrease.

4.7 Further Geotechnical and Hydrogeological Considerations

As previously noted, it is recommended that future soil and groundwater studies be carried out at a more site specific scale to refine the geotechnical and hydrogeological understanding, potential groundwater impacts and mitigation in support of development applications.

These future studies would typically include, but not limited to:

- Review geological and hydrogeological information from other relevant studies,
- Drill boreholes to determine the site-specific geology and overburden stratigraphy. Excavation of test pits may also be conducted to investigate the shallow soil and groundwater conditions,
- Prior to tendering, test pits should be dug to obtain a better appreciation of the behavior of excavations and to confirm the dewatering requirements. Contractors (including specialist dewatering contractors) who might be involved in the job should witness these test pits,
- Collect soil samples from selected boreholes and/or test pits and test for grain-size to characterize the soil types and to assist in determining soil hydraulic conductivity,
- Establish a network of groundwater monitoring wells and piezometers across the study area. The monitoring network must include sufficient number and distribution of shallow and deep monitors to determine the depth to the water table and measure vertical and horizontal groundwater gradients,
- Survey all monitoring locations for coordinates and geodetic elevation,
- Conduct bail-down, slug, or other appropriate field tests to confirm monitoring well function and assess the hydrogeological characteristics of stratigraphic units (e.g. in situ hydraulic conductivity),
- Inventory existing groundwater users and water supply wells, and carry out a private well survey within 500 m of the proposed development,
- Collect groundwater and surface water (base flow) samples to establish background water quality and aid in groundwater flow system characterization,
- Monitor groundwater levels in all monitoring wells,
- Assess the seasonally high water table and consider potential construction impacts and mitigation.

Exp can provide more information and assistance in this regard if requested.

5 General Comments

The comments given in this preliminary report are intended only for the guidance of design engineers. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretations of the facts presented, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

Exp services Inc. should be retained for a general review of the final design and specifications to verify that this preliminary report has been properly interpreted and implemented. If not afforded the privilege of making this review, **Exp** services Inc. will assume no responsibility for interpretation of the recommendations in this preliminary report.

We trust that this report is satisfactory to your present requirements and we look forward to assisting you in the completion of this project. Should you have any questions, please contact the undersigned at your convenience.

All the foregoing and attachments respectfully submitted,

Exp services Inc.

Appendix A, Site Photos

Photo 1, Beside grated inlet looking west at where Cummings Drain intersects with Martin Road.

Photo 2, Inlet grate and drainage swale located along north side of Wellington Street.

Photo 3, Drainage swale located along west side of Martin Road.

Photo 4, Inlet grate located along south side of Harris Road.

Photo 5, CSP outfall pipe located along north side of Harris Road.

Photo 6, BigO drainage tile located along north side of Harris Road.

Photo 7, Standing at York Street looking east along Young Street.

Photo 8, Raised inlet grate at intersection of Millcreek Lane and York Street.

Photo 9, Inlet grate at intersection of Millcreek Lane and York Street.

Photo 10, Inlet grate located at Yorkdale Street and Millcreek Lane.

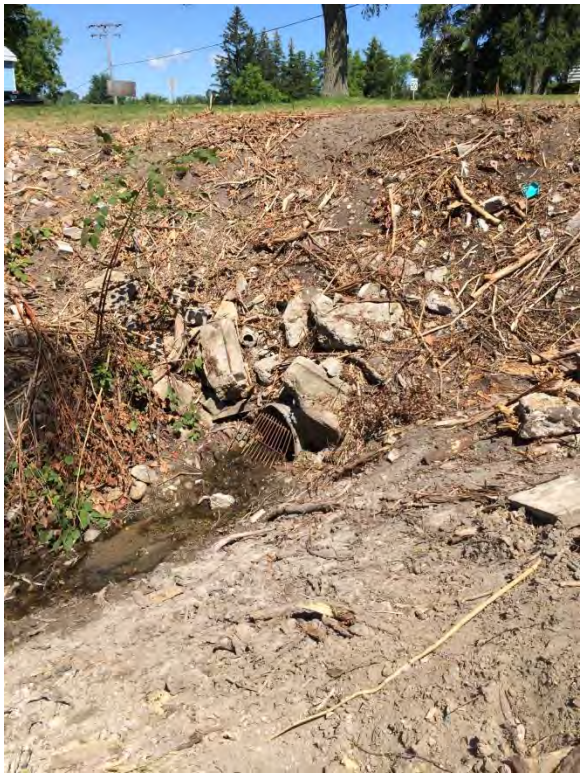


Photo 11, Outfall located along west side of Gideon Drive.

Photo 12, Pleasant Street Culvert.

Photo 13, Looking south from Pleasant Street Culvert.

Photo 14, Inlet grates along Garden Avenue.

Photo 15, Standing at Prince of Wales Avenue looking north along Victoria Street.

Photo 16, Inlet grate located along north side of Wellington Street, looking east along Wellington Street.

Photo 17, Culvert and outlet structures located at southeast corner of Springer Rd. and Longwoods Rd.

Photo 18, Inlet grate located along south side of Longwoods Road.

Photo 19, Outfall located along west side of Springer Road at William Street.

Photo 20, Looking west along Elizabeth Street.

Appendix B, Borehole Logs

FIELD LOGS REVIEW AREA A

BH1
Sheet 1 of 1

BOREHOLE LOG

PROJECT **145 Harris Road, Delaware, ON** PROJECT NO. **LNGE00010675A**
CLIENT DATUM **N/A**
DRILL TYPE/METHOD **Track-mounted Geoprobe 6620** DATES: Boring **Apr 12/10** Water Level **N/A**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0	0.35	**TOPSOIL - 350 mm**							
		SAND , brown, medium grained, some fine gravel, loose to very loose, moist				S1	75	2	
1						S2	50	3	
2	2.30								
		SILTY SAND , brown, fine grained, very loose, moist				S3	50	1	
3	3.00								
		SAND , brown, fine grained, some intermittent silt layering, compact, moist				S4	100	19	
4		-becoming dense with intermittent clay layering at 3.8 m depth				S5	100	33	
5						S6	100	25	
6		-becoming very dense below 6.1 m depth				S7	100	50	
7						S8	100	75	
		-trace gravel below 7.6 m depth				S9	100	50	
8									
9	9.10								
	9.56	**SILTY SAND** , brown, fine grained, dilatant, very dense, wet				S10	100	54	
10		**End of Borehole at 9.56 m depth**							

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

75
54

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010685A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open and dry upon completion.

3) M.S.A. Explosimeter readings taken in the upper levels of the open boreholes at the time of drilling did not detect any significant level of methane gas concentration.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BH2
Sheet 1 of 1

BOREHOLE LOG

PROJECT **145 Harris Road, Delaware, ON** PROJECT NO. **LNGE00010675A**

CLIENT _____ DATUM **N/A**

DRILL TYPE/METHOD **Track-mounted Geoprobe 6620** DATES: Boring **Apr 12/10** Water Level **N/A**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	0.30	**TOPSOIL - 300 mm**								
		SAND , brown, fine to medium grained, some fine gravel, very loose to loose, moist								
1						S1	100	0		
						S2	100	4		
2		-becoming compact below 2.3 m depth				S3	100	20		
3						S4	100	35		
4		-becoming very dense below 3.8 m depth				S5	100	50		
						S6	100	54		54
5										
6						S7	100	45		
7										
						S8	100	52		52
8										
9				▼						
	9.56	-some intermittent, dilatant silty sand layering at 9.1 m depth				S9	100	52		52
		End of Borehole at 9.56 m depth								
10										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010685A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open upon completion; groundwater measured at 9.1 m depth upon completion of drilling.

3) M.S.A. Explosimeter readings taken in the upper levels of the open boreholes at the time of drilling did not detect any significant level of methane gas concentration.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

FIELD LOGS REVIEW AREA B

BH 1
Sheet 1 of 1

BOREHOLE LOG

PROJECT **New Residential Severances Development** PROJECT NO. **LON00012603**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Backhoe** DATES: Boring **Aug 15, 2013** Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0										✤ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane; 100 200 kPa; W_P W W_L; ● SPT N Value × Dynamic Cone; 10 20 30 40
	0.30	**TOPSOIL**, 300 mm			SA1					
1		**SILTY SAND**, light brown, moist greyish brown, moist GR SA SI 0% 85% 15%			SA2					
	1.80									
2		**SAND AND SILT**, grey, wet water seeping								
3					SA3					
					SA4					
4										
	4.60				SA5					
5		End of test pits at 4.6 m bgs								

NOTES

1) Test pit log interpretation requires assistance by exp before use by others. Test pit logs must be read in conjunction with exp Report LON-00012603. For definition of terms used on logs, see sheets prior to logs.
2) Test pit open to 4.6 m and dry upon completion of drilling.
3) Test pit backfilled with excavated soils and compacted with the excavator bucket.
4) bgs denotes below ground level.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BH 2 MW
Sheet 1 of 1

BOREHOLE LOG

PROJECT **New Residential Severances Development** PROJECT NO. **LON00012603**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Backhoe** DATES: Boring **Aug 15, 2013** Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0		**TOPSOIL**, 300 mm			SA1				
	0.30	**SILTY SAND**, light brown, moist							
1		grey/brown, wet			SA2				
	1.80	**SAND AND SILT**, grey, very moist water seeping GR SA SI 1% 54% 45%			SA3				
2									
3		fine grained sand, very moist			SA4				
4									
	4.60				SA5				
5		End of test pits at 4.6 m bgs							

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test pit log interpretation requires assistance by exp before use by others. Test pit logs must be read in conjunction with exp Report LON-00012603. For definition of terms used on logs, see sheets prior to logs.
2) Test pit open to 4.6 m and groundwater encountered at 0.7 m bgs.
3) Test pit backfilled with excavated soils and compacted with the excavator bucket.
4) bgs denotes below ground level.
5) Groundwater measured at 1.8 m bgs on August 22, 2013.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BH 3 MW
Sheet 1 of 1

BOREHOLE LOG

PROJECT **New Residential Severances Development** PROJECT NO. **LON00012603**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Backhoe** DATES: Boring **Aug 15, 2013** Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0		**TOPSOIL**, 300 mm							
	0.30	**SILTY SAND**, light brown, moist GR SA SI 1% 78% 21% silty sand very moist			SA1				
1		wet			SA2				
	1.82	**SAND AND SILT**, grey, wet							
2					SA3				
	2.70	**SAND**, grey, fine grain, saturated							
3					SA4				
4									
	4.60				SA5				
		End of test pits at 4.6 m bgs							
5									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L

● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test pit log interpretation requires assistance by exp before use by others. Test pit logs must be read in conjunction with exp Report LON-00012603. For definition of terms used on logs, see sheets prior to logs.
2) Test pit open to 4.6 m and groundwater at 0.7 m bgs.
3) Test pit backfilled with excavated soils and compacted with the excavator bucket.
4) bgs denotes below ground level.
5) Groundwater measured at 1.6 m bgs on August 22, 2013.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BH 4
Sheet 1 of 1

BOREHOLE LOG

PROJECT **New Residential Severances Development** PROJECT NO. **LON00012603**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Backhoe** DATES: Boring **Aug 15, 2013** Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0		**TOPSOIL**, 300 mm								
	0.30	**SILTY SAND**, light brown, moist			SA1					
1		grey/brown, moist								
		wet			SA2					
	1.80	**SAND AND SILT**, grey fine grained sand, wet								
2		grey fine grain sand with silt, saturated			SA3					
3					SA4					
4										
	4.60				SA5					
		End of test pits at 4.6 m bgs								
5										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Test pit log interpretation requires assistance by exp before use by others. Test pit logs must be read in conjunction with exp Report LON-00012603. For definition of terms used on logs, see sheets prior to logs.
2) Test pit open to 4.6 m and dry upon completion of drilling.
3) Test pit backfilled with excavated soils and compacted with the excavator bucket.
4) bgs denotes below ground level.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

FIELD LOGS REVIEW AREA C

Trow
London Branch

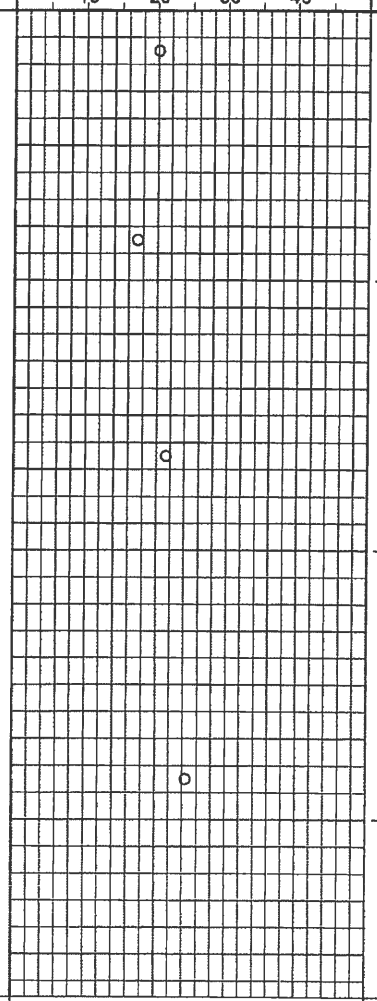
TEST PIT LOG

TP1
Sheet 1 of 1

PROJECT **Block 10, Martin Road and Longwoods Road** PROJECT NO. **LNGE00009663A**
CLIENT DATUM **Local**
EXCAVATOR **Rubber Tire Loader/Backhoe** DATES: Excavating **May 12/2008** Water Level **May 12/08**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	OTHER TESTS
0	99.46	**TOPSOIL**, sandy silt loam, dark brown, loose, moist			S1	
	99.08	**SILTY SAND**, light brown, fine grained, compact, moist				
1		-becoming grey below 0.9 m depth			S2	
		-becoming very moist below 1.5 m depth			S3	
2						
					S4	
3	95.80	End of Test Pit at 3.66 m depth				

SHEAR STRENGTH
✚ S Field Vane Test
▲ Penetrometer ■ Torvane
40 80 kPa
Atterberg Limits and Moisture
W_P W W_L
10 20 30 40



NOTES

1) Test pit interpretation requires assistance by Trow before use by others. Test pit logs must be read in conjunction with Trow Report LNGE00009663A. For definition of terms used on logs, see sheets prior to logs.

2) Test pit open and dry upon completion.

3) Ground surface elevation referenced to top of Ontario Highways Department Surveyor's Benchmark, located at the southeast corner of the property (see Drawing 1).

SAMPLE LEGEND
☒ BS Bulk Sample
⊠ BL Block Sample
■ ST Shelby Tube

OTHER TESTS
G Specific Gravity
H Hydrometer
S Sieve Analysis
γ Unit Weight
P Field Permeability
K Lab Permeability
C Consolidation
CD Consolidated Drained Triaxial
CU Consolidated Undrained Triaxial
UU Unconsolidated Undrained Triaxial
UC Unconfined Compression
DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

Trow — TEST PIT LOG — TP2

London Branch — Sheet 1 of 1

PROJECT **Block 10, Martin Road and Longwoods Road** — PROJECT NO. **LNGE00009663A**

CLIENT _____ — DATUM **Local**

EXCAVATOR **Rubber Tire Loader/Backhoe** — DATES: Excavating **May 12/2008** — Water Level **May 12/08**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	OTHER TESTS
0	99.21	**TOPSOIL**, sandy silt loam, dark brown, loose, moist				
	98.61	**SILTY SAND**, brown, fine to medium grained, compact, moist to very moist			S1	
1					S2	
		-becoming grey below 1.5 m depth			S3	
2		-becoming dilatant and wet below 2.0 m depth			S4	
3	96.16	**End of Test Pit at 3.05 m depth**				
4						

SHEAR STRENGTH
✚ S Field Vane Test
▲ Penetrometer ■ Torvane
40 80 kPa

Atterberg Limits and Moisture
W_P W W_L
10 20 30 40

NOTES

1) Test pit interpretation requires assistance by Trow before use by others. Test pit logs must be read in conjunction with Trow Report LNGE00009663A. For definition of terms used on logs, see sheets prior to logs.

2) Test pit open and dry upon completion.

3) Ground surface elevation referenced to top of Ontario Highways Department Surveyor's Benchmark, located at the southeast corner of the property (see Drawing 1).

SAMPLE LEGEND
☒ BS Bulk Sample
⊠ BL Block Sample
■ ST Shelby Tube

OTHER TESTS
G Specific Gravity
H Hydrometer
S Sieve Analysis
γ Unit Weight
P Field Permeability
K Lab Permeability
C Consolidation
CD Consolidated Drained Triaxial
CU Consolidated Undrained Triaxial
UU Unconsolidated Undrained Triaxial
UC Unconfined Compression
DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ⧫ Artesian (see Notes)

Trow
London Branch

TEST PIT LOG

TP3
Sheet 1 of 1

PROJECT Block 10, Martin Road and Longwoods Road — PROJECT NO. LNGE00009663A
CLIENT _____ — DATUM Local
EXCAVATOR Rubber Tire Loader/Backhoe — DATES: Excavating May 12/2008 — Water Level May 12/08

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	SAMPLES TYPE	SAMPLES NUMBER	OTHER TESTS
0	99.26	**TOPSOIL**, sandy silt loam, dark brown, loose, moist				
	98.83	**SILTY SAND**, brown/grey, fine grained, compact, moist to very moist				
1					S1	
2					S2	
		-becoming grey, compact to dense and very moist to wet below 2.4 m depth				
		-becoming dilatant and wet below 2.7 m depth			S3	
3						
					S4	
	95.60					
4		End of Test Pit at 3.66 m depth				

SHEAR STRENGTH
✤ S Field Vane Test
▲ Penetrometer ■ Torvane
40 80 kPa

Atterberg Limits and Moisture
W_P W W_L
10 20 30 40

NOTES

1) Test pit interpretation requires assistance by Trow before use by others. Test pit logs must be read in conjunction with Trow Report LNGE00009663A. For definition of terms used on logs, see sheets prior to logs.

2) Test pit open and dry upon completion.

3) Ground surface elevation referenced to top of Ontario Highways Department Surveyor's Benchmark, located at the southeast corner of the property (see Drawing 1).

SAMPLE LEGEND
☒ BS Bulk Sample
▩ BL Block Sample
■ ST Shelby Tube

OTHER TESTS
G Specific Gravity
H Hydrometer
S Sieve Analysis
γ Unit Weight
P Field Permeability
K Lab Permeability
C Consolidation
CD Consolidated Drained Triaxial
CU Consolidated Undrained Triaxial
UU Unconsolidated Undrained Triaxial
UC Unconfined Compression
DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

FIELD LOGS REVIEW AREA E

BH1
Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0	236.80								
	236.55	**TOPSOIL** , brown, sandy loam, loose, damp to moist							
		SAND , brown, trace silt, fine to medium grained, compact, moist				S1	375	11	
1									
						S2	225	13	
2		-becoming fine to coasrse grained with trace gravel below 2.3 m depth				S3	450	20	
3	233.75								
		SILT , brown/grey, some fine grained sand to sandy, compact, very moist -becoming dilatant below 3.3 m depth				S4	450	15	
4		-becoming grey with trace clay and loose below 3.8 m depth				S5	450	8	
						S6	350	8	
5	231.74								
		End of Borehole at 5.06 m depth							
6									
7									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BH2
Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0	236.90								
	236.65	**TOPSOIL** , brown, sandy loam, loose, damp to moist							
		SAND , brown, trace silt, fine to medium grained, very loose, very moist		▼					
1						S1	0	1	
		-becoming loose below 1.5 m depth				S2	350	7	
2									
		-trace fine gravel and wet below 2.3 m depth				S3	100	8	
3									
	233.55					S4	450	19	
		SILT , brown, some fine grained sand to sandy, dilatant, compact, very moist							
4		-becoming grey with trace clay, very loose and wet below 3.8 m depth				S5	450	4	
5	231.84					S6	450	10	
		End of Borehole at 5.06 m depth							
6									
7									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.2 m upon completion; groundwater measured at 0.9 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BH3
Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.90	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.60	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, trace silt, fine to coarse grained, very loose, moist to very moist				S1	300	1		
1		-trace fine gravel, compact and moist below 1.5 m depth		▼		S2	350	15		
2						S3	350	13		
3	233.10					S4	450	26		
		SILT , brown, some fine grained sand to sandy, dilatant, loose, very moist				S5	450	7		
4		-becoming grey with trace to some clay at 4.1 m depth								
5	231.84					S6	350	14		
		End of Borehole at 5.06 m depth								
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.8 m upon completion; groundwater measured at 1.5 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0	236.90								
	236.65	**TOPSOIL** , brown, sandy loam, loose, damp to moist							
		SAND , brown, fine to coarse grained, trace gravel, compact, moist				S1	300	21	
1				▼					
						S2	300	20	
2									
		-becoming fine grained with some silt, dilatant and wet below 2.6 m depth				S3	350	17	
3						S4	100	19	
	233.10								
4		**SANDY SILT** , brown, fine grained, dilatant, compact, wet				S5	250	10	
		-becoming grey with trace clay below 4.6 m depth				S6	250	16	
5	231.84								
		End of Borehole at 5.06 m depth							
6									
7									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L

● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.90	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.60	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, loose, damp to moist				S1	100	5		
1				▼						
						S2	225	8		
2		-becoming moist to very moist below 2.3 m depth				S3	225	11		
3	233.50					S4	300	16		
		SILT , brown, some fine grained sand to sandy, dilatant, compact, very moist								
4		-becoming grey with some fine grained sand, trace clay, loose and wet below 4.1 m depth				S5	450	9		
5	231.84					S6	350	4		
		End of Borehole at 5.06 m depth								
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.8 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.90	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.60	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, trace fine gravel, compact, moist				S1	450	19		
1				▼						
						S2	250	25		
2										
						S3	250	13		
3										
						S4	250	16		
	233.10									
4		**SANDY SILT** , brown, fine grained, dilatant, loose, very moist to wet				S5	450	6		
		-trace to some clay at 4.2 m depth								
		-becoming grey and compact below 4.6 m depth				S6	450	12		
5	231.84									
		End of Borehole at 5.06 m depth								
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0	237.10								
	236.85	**TOPSOIL** , brown, sandy loam, loose, damp to moist							
		SAND , brown, fine grained, loose, damp				S1	100	3	
1									
		-becoming fine to coarse grained, compact and moist below 1.5 m depth				S2	450	13	
2									
		-becoming dilatant with trace clay and very moist to wet below 2.3 m depth				S3	450	24	
3									
						S4	450	14	
		-some silt to silty below 3.8 m depth							
4						S5	450	11	
	232.50								
		SILT , brown, trace fine grained sand, trace clay, compact, very moist				S6	450	28	
5	232.04								
		End of Borehole at 5.06 m depth							
6									
7									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.8 m upon completion; groundwater measured at 1.5 m upon completion of drilling.

3) Ground surface elevations inferred from topographical information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 237.00	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.80	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, compact, moist				S1	300	15		
1				▼						
						S2	450	11		
2										
						S3	450	15		
3										
						S4	450	18		
	233.20	-trace to some silt, dilatant and very moist to wet below 3.4 m depth								
4		**SILT** , grey, trace clay, dilatant, loose, wet				S5	450	4		
						S6	300	7		
5	231.94									
		End of Borehole at 5.06 m depth								
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.90	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.70	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, trace gravel, loose, moist				S1	200	6		
1				▼						
		-becoming compact with trace to some gravel below 1.5 m depth				S2	350	20		
2										
						S3	450	13		
3		-becoming fine grained with some silt to silty, dilatant, compact and wet below 3.0 m depth				S4	450	13		
	233.10									
4		**SILT** , grey, trace clay, dilatant, loose, wet				S5	450	6		
5	231.84					S6	350	10		
		End of Borehole at 5.06 m depth								
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.10									S Field Vane Test (#=Sensitivity); Penetrometer; Torvane; 100 – 200 kPa; W_P W W_L; SPT N Value; Dynamic Cone; 10 – 20 – 30 – 40
	235.85	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, loose, moist		▼		S1	150	4		
1										
						S2	0	12		
2										
		-becoming compact and very moist below 2.3 m depth				S3	200	14		
3		-becoming silty, fine grained, dilatant and wet below 3.0 m depth				S4	450	16		
	232.59									
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 0.9 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.20	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.00	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, compact, moist								
1				▼		S1	450	13		
		-becoming very moist below 1.5 m depth				S2	450	12		
2										
						S3	450	9		
3		-becoming silty, fine grained, dilatant and wet below 3.0 m depth				S4	450	19		
	232.69									
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

SHEAR STRENGTH
✚ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.2 m upon completion; groundwater measured at 0.9 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.50									✤ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane; 100 200 kPa; W_P W W_L; ● SPT N Value × Dynamic Cone; 10 20 30 40
	236.25	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, trace gravel, loose to compact, moist		▼		S1	250	8		
1										
						S2	100	11		
2		-becoming moist to very moist below 2.3 m depth				S3	350	10		
3										
	232.99					S4	200	5		
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 0.9 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.60	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.40	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, trace gravel, compact, moist		▼		S1	450	19		
1						S2	0	15		
2						S3	375	8		
3		-becoming silty, fine grained, dilatant and very moist to wet below 3.0 m depth				S4	375	13		
	233.09	**End of Borehole at 3.51 m depth**								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.70	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.50	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, trace gravel, compact, moist								
1				▼		S1	0	4		
						S2	450	16		
2		-becoming moist to very moist below 2.3 m depth				S3	450	5		
3	233.19					S4	450	3		
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.8 m upon completion; groundwater measured at 1.5 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.90	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.70	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, trace gravel, compact, moist								
1				▼		S1	375	13		
						S2	375	13		
2		-becoming moist to very moist below 2.3 m depth				S3	225	15		
3						S4	450	17		
	233.39									
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.8 m upon completion; groundwater measured at 1.5 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.90	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.60	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, trace silt, very loose, moist				S1	375	1		
1		-trace gravel, compact and moist to very moist below 1.5 m depth		▼		S2	450	12		
2						S3	150	11		
3	233.39					S4	450	28		
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.8 m upon completion; groundwater measured at 1.5 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Hand Held Power Auger** DATES: Boring **Aug 07/09** Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	237.40									
	237.20	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine grained, some silt, loose, damp to moist				S1				
1										
						S2				
2										
		-becoming fine to coarse grained with trace silt and compact below 2.5 m depth				S3				
3	234.40									
		End of Borehole at 3.0 m depth								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open and dry upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Hand Held Power Auger** DATES: Boring **Aug 07/09** Water Level

DEPTH (m)	ELEVATION (m) 237.00	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.80	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to medium grained, some silt, loose, very moist				S1				
1						S2				
2		-becoming fine to coarse grained and compact below 2.5 m depth				S3				
3	234.00	**End of Borehole at 3.0 m depth**								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open and dry upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.80	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.60	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, compact, moist		▼		S1	450	19		
1		-trace fine gravel and moist to very moist below 1.5 m depth				S2	450	21		
2						S3	450	20		
3	233.29					S4	450	13		
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

SHEAR STRENGTH
✚ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

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Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.90									✚ S Field Vane Test (#=Sensitivity) ▲ Penetrometer ■ Torvane; 100 200 kPa; W_P W W_L; ● SPT N Value × Dynamic Cone; 10 20 30 40
	236.65	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, loose, moist								
1				▼		S1	350	8		
		-trace fine gravel and compact below 1.5 m depth				S2	450	16		
2										
						S3	450	13		
3										
	233.39					S4	200	22		
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BH21
Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.70	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.50	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine to coarse grained, loose, moist		▼		S1	450	5		
1		-becoming silty with trace clay and compact below 1.5 m depth				S2	350	20		
2		-becoming dilatant and very moist to wet below 2.3 m depth				S3	225	13		
3	233.70	**SILT** , brown, trace clay, dilatant, compact, very moist to wet				S4	250	11		
	233.19	**End of Borehole at 3.51 m depth**								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.5 m upon completion; groundwater measured at 1.2 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BH22
Sheet 1 of 1

BOREHOLE LOG

PROJECT **Proposed Our Lady of Lourdes Catholic Elementary School** PROJECT NO. **LNGE00010317A**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Track Mounted Geoprobe** DATES: Boring **July 28/09** Water Level **July 28/09**

DEPTH (m)	ELEVATION (m) 236.70	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	236.55	**TOPSOIL** , brown, sandy loam, loose, damp to moist								
		SAND , brown, fine grained, trace silt, loose, moist		▼		S1	100	4		
1										
		-becoming fine to coarse grained and compact below 1.5 m depth				S2	450	21		
2										
						S3	450	18		
3	233.50									
	233.19	**SILT** , grey, trace to some clay, dilatant, very stiff, moist				S4	450	22		
		End of Borehole at 3.51 m depth								
4										
5										
6										
7										

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole Logs must be read in conjunction with Trow Report LNGE00010317A. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 1.2 m upon completion; groundwater measured at 0.9 m upon completion of drilling.

3) Ground surface elevations inferred from topographical survey information provided by client. (see drawing 1)

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

FIELD LOGS REVIEW AREA F

BH1
Sheet 1 of 1

BOREHOLE LOG

PROJECT **Hog Back Close Slope Stability Assessment** PROJECT NO. **KCH00212307-GE**
CLIENT DATUM **Geodetic**
DRILL TYPE/METHOD **Hollow Stem Auger** DATES: Boring **May 27, 2013** Water Level **May 27/13**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES TYPE	NUMBER	RECOVERY (mm) or (%)	N VALUE (blows) or RQD (%)	Bulk Density (kg/m^3)
0	99.47						
0	99.17	**TOPSOIL** , Silty Sand, dark brown, rootlets, loose, moist		S1	80	7	
1		**SAND** , brown, fine-grained, some silt to silty, trace gravel, compact moist		S2	70	13	
2				S3	60	18	
3		-some clayey layering at 2.3 m depth		S4	50	14	
		-becoming loose at 3.1 m depth		S5	60	7	
4				S6	100	7	
5		-becomnig compact at 4.6 m depth		S7	70	29	
6		-becoming dense at 6.1 m depth		S8	70	32	
7							
8				S9	70	23	
9	90.37						
10		**SILT TILL** , grey, trace fine sand, dense, moist		S10	80	43	
11							
12		-becoming very dense at 12.2 m depth		S11	80	54	
13							
14							
15		-becoming grey and dense with some very moist to wet layering at 15.2 m depth		S12	80	30	
16							
17							
18		-becoming compact at 18.3 m depth		S13	80	17	
19							
20							
21							
	77.68	-becoming dense at 21.3 m depth		S14	80	36	
22		**End of Borehole at 21.79 m depth**					
23							

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report KCH00212307-GE. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open to 15.5 m depth upon completion; groundwater measured at 15.2 m depth upon completion of drilling.

3) Ground surface elevation surveyed by AGM Surveying and Engineering.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

FIELD LOGS REVIEW AREA G

GEOTECHNICAL

TEST PIT LOG

Project Name: Slope Assessment

Project No.: L06545AGI

Location: 2667 Gideon Drive
Delaware, Ontario

Test Pit No.: 1

Date: Oct 21, 2002

Field Supervisor: ~~R. Walker~~ P. Jansen

Elevation of Ground Surface: 196.7 m

~~Topsoil Thickness: _____ mm~~

Sample No.	Start Depth (ft)	Sample Length (ft)	% Rec.	Moisture Content (%)	Unit Weight kN/m³	Remarks
1	5	1	100	3		FILL - dark brown silt (topsoil) (½ft) - brown sand and gravel, some building rubble such as brick, tile pieces and cinders, damp
2	8	2	100	2		
3	10	1	100	3		(4.5ft) Topsoil - dark brown silt, damp
						(5ft) Sand - brown fine to medium grained, trace silt, damp
						(10ft) Sand+Gravel - brown, trace silt, damp
						(11ft) Sand - brown, fine-grained, trace silt, damp
						(14ft) TP Terminated

Note: Test pit data requires interpretation assistance from Trow before use by others:

1. Test pit advanced by rubber-tire backhoe supplied by client.
2. Upon completion, test pit side walls caving.
3. ~~Water Level Records:~~ ~~Depth to Water:~~ N/A ~~m~~
   ~~Hole Open to:~~ _____ ~~m~~
   ~~Elapsed Time:~~ _____

~~Additional Notes:~~

3. No free ground water encountered in the excavation

GEOTECHNICAL

TEST PIT LOG

Project Name: Slope Assessment

Project No.: L06845AGI

Location: 2667 Gideon Drive
Delaware, Ontario

Test Pit No.: 2

Date: Oct 21, 2002

Field Supervisor: ~~R. Walker~~ P. Jansen

Elevation of Ground Surface: 199.0 m

Topsoil Thickness: 150 mm

Sample No.	Start Depth (ft)	Sample Length (ft)	% Rec.	Moisture Content (%)	Unit Weight kN/m^3	Remarks
1	3	1	100	4		Topsoil - dark brown sandy silt, moist
2	6	1	100	3		(0.5 ft) Sand - brown, fine to medium grain, trace silt, moist
~~3~~	~~10~~	~~1~~	~~100~~	~~3~~		(9.5 ft) Sand and Gravel - brown, trace silt, moist
						(10.5 ft) TP Terminated

Note: Test pit data requires interpretation assistance from Trow before use by others:

1. Test pit advanced by rubber-tire backhoe supplied by client
2. Upon completion, test pit side walls caving.
3. Water Level Records: Depth to Water: m
   Hole Open to: m
   Elapsed Time:

~~Additional Notes:~~

3. No free groundwater encountered in the excavation

Appendix C, MOE Well Record

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4116645
External identity : ca.on.waterWell.4116645
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 5.33m
Elevation : NaNm
Water level : 1.83m
Water yield : 22.73lpm
Water use : Irrigation
Well status : Water Supply
Well type : Unknown
Well casings : From 0.00 to 4.27m.
Screen components : From 4.2672 to 5.33m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	5.33	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7047821
External identity : ca.on.waterWell.7047821
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 116.00m
Elevation : NaNm
Water level : 1.52m
Well status : Abandoned-Other
Well type : Unknown
Sealing components : From 0.00 to 17.07m; From 17.07 to 22.56m; From 22.56 to 35.36m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology
NaN	NaN		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7048460
External identity : ca.on.waterWell.7048460
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 5.64m
Elevation : NaNm
Water level : 2.44m
Water yield : 45.46lpm
Water use : Irrigation
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	5.64	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7125500
External identity : ca.on.waterWell.7125500
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.40m
Elevation : NaNm
Water level : 3.05m
Well status : Abandoned-Other
Well type : Unknown
Sealing components : From 1.83 to 2.44m; From 5.49 to 6.40m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.83	**Sand** **Anthropogenic material**	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
1.83	2.44				
2.44	5.49	**Sand** **Anthropogenic material**	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
5.49	6.40				

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7128911
External identity : ca.on.waterWell.7128911
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.01m
Elevation : NaNm
Well status : Abandoned-Other
Well type : Unknown
Sealing components : From 0.00 to 3.05m; From 3.05 to 3.35m; From 6.40 to 7.01m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology
0.00	0.00		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100439
External identity : ca.on.waterWell.4100439
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 50.60m
Elevation : 234.70m
Well status : Abandoned-Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	25.91	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
25.91	36.58	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
36.58	50.29	**Diamicton**	HARDPAN		
50.29	50.60	**Shale**	SHALE	[1,10]%	[1E-13,2E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100440
External identity : ca.on.waterWell.4100440
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 19.81m
Elevation : 237.74m
Well status : Abandoned-Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	12.19	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
12.19	13.72	**Sand**	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
13.72	19.81	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100446
External identity : ca.on.waterWell.4100446
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 4.88m
Elevation : 213.36m
Water level : 0.91m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	**Soil**	TOPSOIL		
0.61	1.83	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.83	4.88	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100447
External identity : ca.on.waterWell.4100447
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 44.20m
Elevation : 228.60m
Water level : 9.14m
Water use : Not Used
Well status : Abandoned-Quality
Well type : Unknown
Sealing components : From 0.00 to 44.20m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	9.14	**Sand** **Clay**	MEDIUM SAND CLAY	[26,53]% [34,57]%	[2E-7,6E-3]m.s-1 [1E-11,4.7E-9]m.s-1
9.14	37.80	**Clay** **Diamicton**	CLAY HARDPAN	[34,57]%	[1E-11,4.7E-9]m.s-1
37.80	44.20	**Bedrock**	ROCK		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100448
External identity : ca.on.waterWell.4100448
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 56.39m
Elevation : 216.41m
Water level : 8.53m
Water use : Not Used
Well status : Abandoned-Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.27	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
4.27	41.15	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
41.15	53.34	**Diamicton**	HARDPAN		
53.34	56.39	**Bedrock**	ROCK		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100449
External identity : ca.on.waterWell.4100449
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 33.83m
Elevation : 216.41m
Water level : 9.14m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.57	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
4.57	33.53	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
33.53	33.83	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	STONES	[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100451
External identity : ca.on.waterWell.4100451
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.14m
Elevation : 216.41m
Water level : 4.88m
Water yield : 9.09lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	2.13	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
2.13	3.05	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
3.05	4.88	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.88	6.71	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
6.71	7.01	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
7.01	9.14	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100452
External identity : ca.on.waterWell.4100452
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 3.96m
Elevation : 220.98m
Water level : 1.52m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	2.44	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
2.44	3.96	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100453
External identity : ca.on.waterWell.4100453
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.53m
Elevation : 216.41m
Water level : 6.10m
Water yield : 9.09lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.83	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.83	3.05	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.05	8.53	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100454
External identity : ca.on.waterWell.4100454
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.75m
Elevation : 234.70m
Water level : 3.05m
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.83	**Clay** **Sand**	CLAY MEDIUM SAND	[34,57]% [26,53]%	[1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
1.83	3.05	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.05	3.66	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
3.66	6.10	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
6.10	9.75	**Clay** **Sand**	CLAY MEDIUM SAND	[34,57]% [26,53]%	[1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100455
External identity : ca.on.waterWell.4100455
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.75m
Elevation : 236.22m
Water level : 6.71m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.57	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.57	9.75	**Clay**	CLAY MEDIUM	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100481
External identity : ca.on.waterWell.4100481
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 4.88m
Elevation : 238.96m
Water level : 2.74m
Water yield : 18.18lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.05	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
3.05	3.66	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.66	4.88	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Silt	SILT	[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100482
External identity : ca.on.waterWell.4100482
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.23m
Elevation : 238.35m
Water level : 5.79m
Water yield : 4.55lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.22	5.79	**Clay**	CLAY MEDIUM SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
5.79	8.23	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100483
External identity : ca.on.waterWell.4100483
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.92m
Elevation : 238.96m
Water level : 5.49m
Water yield : 9.09lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	2.74	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
2.74	7.92	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100484
External identity : ca.on.waterWell.4100484
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.53m
Elevation : 237.13m
Water level : 3.35m
Water yield : 4.55lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	7.01	**Clay**	CLAY MEDIUM SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
7.01	8.53	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4104377
External identity : ca.on.waterWell.4104377
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 3.66m
Elevation : 237.13m
Water level : 1.22m
Water yield : 13.64lpm
Water use : Public
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.66	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4104380
External identity : ca.on.waterWell.4104380
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.10m
Elevation : 210.31m
Water level : 4.27m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.52	4.57	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
4.57	6.10	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4104381
External identity : ca.on.waterWell.4104381
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.71m
Elevation : 220.98m
Water level : 2.44m
Water yield : 9.09lpm
Water use : Livestock
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	6.71	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4104382
External identity : ca.on.waterWell.4104382
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 3.05m
Elevation : 237.74m
Water level : 1.52m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.52	3.05	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4104766
External identity : ca.on.waterWell.4104766
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 5.79m
Elevation : 216.41m
Water level : 3.05m
Water yield : 18.18lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.27	**Gravel**	GRAVEL STONES	[24,44]%	[3E-4,3E-2]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
4.27	5.79	**Sand**	FINE SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4104876
External identity : ca.on.waterWell.4104876
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.14m
Elevation : 237.74m
Water level : 3.96m
Water yield : 18.18lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	1.83	**Clay**	CLAY MEDIUM	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.83	9.14	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105016
External identity : ca.on.waterWell.4105016
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.40m
Elevation : 237.74m
Water level : 3.05m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	5.18	**Clay**	CLAY MEDIUM	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
5.18	6.40	**Sand**	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105221
External identity : ca.on.waterWell.4105221
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 4.27m
Elevation : 239.27m
Water level : 2.74m
Water yield : 27.28lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.74	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
2.74	4.27	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105222
External identity : ca.on.waterWell.4105222
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.14m
Elevation : 239.27m
Water level : 4.57m
Water yield : 18.18lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.57	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
4.57	9.14	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105470
External identity : ca.on.waterWell.4105470
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.32m
Elevation : 212.75m
Water level : 1.52m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
1.52	1.83	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
1.83	7.32	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105605
External identity : ca.on.waterWell.4105605
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 17.98m
Elevation : 213.36m
Water level : 3.66m
Water yield : 9.09lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.91	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
0.91	1.52	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
1.52	1.83	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.83	3.66	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.66	17.98	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105606
External identity : ca.on.waterWell.4105606
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 11.28m
Elevation : 213.36m
Water level : 2.74m
Well status : Not A Well
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	5.49	**Unknown material**	PREVIOUSLY DUG		
5.49	11.28	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105630
External identity : ca.on.waterWell.4105630
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.01m
Elevation : 237.74m
Water level : 3.96m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.44	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
2.44	2.74	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
2.74	3.66	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.66	7.01	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105631
External identity : ca.on.waterWell.4105631
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.53m
Elevation : 236.22m
Water level : 4.57m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.52	4.57	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.57	8.53	**Sand**	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105646
External identity : ca.on.waterWell.4105646
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.71m
Elevation : 237.74m
Water level : 3.66m
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.27	**Unknown material**	PREVIOUSLY DUG		
4.27	6.71	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105648
External identity : ca.on.waterWell.4105648
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.62m
Elevation : 237.13m
Well status : Unfinished
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.66	**Unknown material**	PREVIOUSLY DUG		
3.66	7.62	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4105667
External identity : ca.on.waterWell.4105667
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 5.79m
Elevation : 235.31m
Water level : 4.27m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.66	**Sand** **Silt**	MEDIUM SAND SILT	[26,53]% [34,61]%	[2E-7,6E-3]m.s-1 [1E-9,2E-5]m.s-1
3.66	4.88	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.88	5.79	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4106172
External identity : ca.on.waterWell.4106172
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.71m
Elevation : 238.35m
Water level : 3.05m
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.13	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
2.13	2.44	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
2.44	3.66	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
3.66	4.88	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.88	6.71	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4106279
External identity : ca.on.waterWell.4106279
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.23m
Elevation : 237.74m
Water level : 1.52m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
1.22	2.44	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
2.44	4.57	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
4.57	6.40	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
6.40	7.01	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
7.01	8.23	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4106534
External identity : ca.on.waterWell.4106534
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.23m
Elevation : 237.74m
Water level : 2.44m
Water yield : 18.18lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.74	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
2.74	8.23	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4107204
External identity : ca.on.waterWell.4107204
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 14.63m
Elevation : 212.14m
Water level : 0.91m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.91	**Gravel**	GRAVEL LOOSE	[24,44]%	[3E-4,3E-2]m.s-1
		Unknown material			
0.91	9.14	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
9.14	14.63	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4107301
External identity : ca.on.waterWell.4107301
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.45m
Elevation : 213.36m
Water level : 1.52m
Water yield : 27.28lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
0.61	1.52	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
1.52	4.57	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.57	5.49	**Silt**	SILT	[34,61]%	[1E-9,2E-5]m.s-1
5.49	9.14	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
9.14	9.45	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
9.45	9.45	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4107430
External identity : ca.on.waterWell.4107430
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 13.72m
Elevation : 213.97m
Water level : 2.44m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	5.49	**Sand**	SAND PACKED	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
5.49	13.72	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4107578
External identity : ca.on.waterWell.4107578
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.10m
Elevation : 240.79m
Water level : 3.66m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	6.10	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4107785
External identity : ca.on.waterWell.4107785
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.10m
Elevation : 228.60m
Water level : 1.83m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
1.52	2.13	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
2.13	6.10	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108060
External identity : ca.on.waterWell.4108060
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 16.15m
Elevation : 236.22m
Water level : 4.57m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
0.61	2.44	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
2.44	7.62	**Clay**	CLAY SAND PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
7.62	16.15	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108065
External identity : ca.on.waterWell.4108065
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.71m
Elevation : 216.41m
Water level : 4.27m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.57	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
4.57	4.88	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
4.88	6.71	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108126
External identity : ca.on.waterWell.4108126
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 10.36m
Elevation : 239.27m
Water level : 1.52m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	10.36	**Sand** **Clay** **Unknown material**	SAND CLAY LOOSE	[26,53]% [34,57]%	[2E-7,6E-3]m.s-1 [1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108176
External identity : ca.on.waterWell.4108176
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.62m
Elevation : 239.27m
Water level : 4.57m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	7.62	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108198
External identity : ca.on.waterWell.4108198
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.53m
Elevation : 239.27m
Water level : 3.05m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.44	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
2.44	4.57	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
4.57	6.10	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
6.10	7.01	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
7.01	8.53	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108388
External identity : ca.on.waterWell.4108388
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 10.06m
Elevation : 240.49m
Water level : 1.22m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.44	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
2.44	10.06	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108389
External identity : ca.on.waterWell.4108389
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.84m
Elevation : 241.10m
Water level : 1.22m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.74	**Sand** **Unknown material**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
2.74	8.84	**Clay** **Unknown material**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108572
External identity : ca.on.waterWell.4108572
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 11.58m
Elevation : 235.61m
Water level : 4.88m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.91	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
0.91	4.88	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
4.88	11.58	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108573
External identity : ca.on.waterWell.4108573
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 12.80m
Elevation : 237.74m
Water level : 6.10m
Water yield : 9.09lpm
Well status : Abandoned-Supply
Well type : Unknown
Sealing components : From 0.00 to 12.80m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	**Soil**	TOPSOIL		
0.61	7.62	**Clay**	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
7.62	12.19	**Sand**	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
12.19	12.80	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108579
External identity : ca.on.waterWell.4108579
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 39.62m
Elevation : 210.62m
Water level : 0.91m
Well status : Observation Wells
Well type : Unknown
Screen components : From 34.1376 to 35.66m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	**Soil**	TOPSOIL		
0.61	3.05	**Gravel**	GRAVEL SANDY	[24,44]%	[3E-4,3E-2]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
3.05	9.14	**Clay**	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
9.14	14.02	**Clay**	CLAY SANDY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
14.02	34.14	**Clay**	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
34.14	35.97	**Gravel**	GRAVEL SANDY	[24,44]%	[3E-4,3E-2]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
35.97	37.80	**Clay**	CLAY GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
37.80	39.62	**Shale**	SHALE	[1,10]%	[1E-13,2E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4108631
External identity : ca.on.waterWell.4108631
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.71m
Elevation : 219.46m
Water level : 2.44m
Water yield : 22.73lpm
Water use : Public
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.05	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
3.05	6.71	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4109036
External identity : ca.on.waterWell.4109036
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.75m
Elevation : 237.74m
Water level : 3.96m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.44	**Sand** **Unknown material**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
2.44	9.75	**Sand** **Unknown material**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4109613
External identity : ca.on.waterWell.4109613
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.92m
Elevation : 237.74m
Water level : 1.52m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
1.22	5.49	**Sand**	SAND PACKED	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
5.49	7.92	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4109624
External identity : ca.on.waterWell.4109624
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.75m
Elevation : 213.36m
Water level : 2.74m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.83	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
1.83	3.66	**Gravel**	GRAVEL LOOSE	[24,44]%	[3E-4,3E-2]m.s-1
		Unknown material			
3.66	9.75	**Clay**	CLAY PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4109740
External identity : ca.on.waterWell.4109740
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 7.62m
Elevation : 237.74m
Water level : 3.05m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	7.62	**Sand** **Clay** **Unknown material**	SAND CLAY PACKED	[26,53]% [34,57]%	[2E-7,6E-3]m.s-1 [1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4110371
External identity : ca.on.waterWell.4110371
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 11.58m
Elevation : 237.74m
Water level : 3.66m
Water yield : 22.73lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Screen components : From 8.2296 to 10.67m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	7.62	**Unknown material**	PREVIOUSLY DUG		
7.62	7.92	**Sand**	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
7.92	11.28	**Sand**	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
11.28	11.58	**Sand**	SAND SILTY	[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4110900
External identity : ca.on.waterWell.4110900
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 13.72m
Elevation : 237.74m
Water level : 1.83m
Water yield : 22.73lpm
Water use : Commercial
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.83	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
1.83	3.05	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
3.05	7.92	**Sand**	SAND PACKED	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
7.92	13.72	**Sand**	SAND PACKED	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4112051
External identity : ca.on.waterWell.4112051
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 8.23m
Elevation : 235.00m
Water level : 1.52m
Water yield : 22.73lpm
Water use : Commercial
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.96	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
3.96	7.92	**Clay**	CLAY SAND PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
7.92	8.23	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4114391
External identity : ca.on.waterWell.4114391
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 15.24m
Elevation : NaNm
Water level : 5.18m
Water yield : 18.18lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Sealing components : From 0.00 to 2.44m.
Screen components : From 9.144 to 15.24m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	5.49	**Sand** **Clay** **Unknown material**	SAND CLAY PACKED	[26,53]% [34,57]%	[2E-7,6E-3]m.s-1 [1E-11,4.7E-9]m.s-1
5.49	13.41	**Sand** **Silt** **Sand**	SAND SILT QUICKSAND	[26,53]% [34,61]% [26,53]%	[2E-7,6E-3]m.s-1 [1E-9,2E-5]m.s-1 [2E-7,6E-3]m.s-1
13.41	15.24	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4114967
External identity : ca.on.waterWell.4114967
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 53.34m
Elevation : NaNm
Water level : 20.42m
Water yield : 13.64lpm
Water use : Domestic
Well status : Water Supply
Well type : Unknown
Sealing components : From 0.00 to 41.15m; From 41.15 to 48.77m; From 48.77 to 53.34m.
Screen components : From 49.9872 to 52.43m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	9.14	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
9.14	18.90	**Silt**	SILT CLAY	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
18.90	49.99	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
49.99	51.82	**Sand**	FINE SAND HARD	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
51.82	52.43	**Sand**	MEDIUM SAND LOOSE HARD	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
		Unknown material			
52.43	53.34	**Clay**	CLAY SAND STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4115205
External identity : ca.on.waterWell.4115205
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 78.33m
Elevation : NaNm
Water yield : 13.64lpm
Water use : Industrial
Well status : Water Supply
Well type : Unknown
Sealing components : From 0.00 to 1.83m; From 1.83 to 7.62m; From 7.62 to 47.24m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
1.22	6.71	**Silt**	SILT	[34,61]%	[1E-9,2E-5]m.s-1
6.71	42.67	**Clay** **Silt**	CLAY SILT	[34,57]% [34,61]%	[1E-11,4.7E-9]m.s-1 [1E-9,2E-5]m.s-1
42.67	44.20	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1
44.20	47.24	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
47.24	62.18	**Shale**	SHALE	[1,10]%	[1E-13,2E-9]m.s-1
62.18	78.33	**Limestone**	LIMESTONE	[7,56]%	[1E-9,6E-6]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4115633
External identity : ca.on.waterWell.4115633
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 13.00m
Elevation : NaNm
Water level : 8.00m
Water yield : 10.00lpm
Water use : Irrigation
Well status : Water Supply
Well type : Unknown
Well casings : From 0.00 to 10.00m.
Screen components : From 10.0 to 13.00m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	13.00	**Sand**	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4100450
External identity : ca.on.waterWell.4100450
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 6.10m
Elevation : 217.32m
Water level : 2.44m
Water yield : 22.73lpm
Water use : Commercial
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	**Soil**	TOPSOIL		
0.30	2.74	**Gravel**	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
2.74	6.10	**Clay**	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4110987
External identity : ca.on.waterWell.4110987
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 9.14m
Elevation : 237.74m
Water level : 4.57m
Water yield : 22.73lpm
Water use : Commercial
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.88	**Sand** **Unknown material**	SAND PACKED	[26,53]%	[2E-7,6E-3]m.s-1
4.88	9.14	**Sand** **Unknown material**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

Groundwater Information Network
Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.4111539
External identity : ca.on.waterWell.4111539
Source : Ontario Ministry of Environment
Online resource : http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm
Length : 10.67m
Elevation : 235.92m
Water level : 6.10m
Water yield : 22.73lpm
Water use : Commercial
Well status : Water Supply
Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	6.10	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
6.10	10.67	**Sand**	SAND LOOSE	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies

APPENDIX C – OPINION OF PROBABLE COST

Class 4 Cost Estimates - Preferred Alternatives
Class 4 Cost Estimates - All Alternatives

Delaware Community Settlement Area Stormwater Master Plan
Preferred Alternatives - Preliminary Cost Estimates

Location	Mill Street Alternative 2	Prior Drain Alternative 3A	Springer Drain Alternative 2	Cummings Drain Alternative 2	Longwoods Road Culvert Alternative 3	Harris Road Culvert Alternative 2A	Longwoods Commercial Alternative 3A	Thompson Drain Alternative 3	Forsythe Drain Alternative 2
Roadworks	$ 12,280.00	$ 105,775.00	$	$ 419,125.00	$ 31,055.00	$ 73,597.50	$ 28,900.00	$ 491,279.50	$ 201,540.00
Storm Sewers	$ 70,850.00	$ 255,580.00	$	$ 726,945.00	$ 201,950.00	$ 430,690.00	$ 495,675.00	$ 482,160.00	$ 508,825.00
Miscellaneous	$ 36,830.00	$ 29,265.00	$ 30,000.00	$ 66,950.00	$ 17,595.00	$ 120,075.00	$ 129,760.00	$ 48,420.00	$ 44,945.00
Sub Totals	$ 119,960.00	$ 390,620.00	$ 30,000.00	$ 1,213,020.00	$ 250,600.00	$ 624,362.50	$ 654,335.00	$ 1,021,859.50	$ 755,310.00
Contingency	$ 15,000.00	$ 40,000.00	$ 5,000.00	$ 125,000.00	$ 25,000.00	$ 65,000.00	$ 65,000.00	$ 100,000.00	$ 75,000.00
Totals	**$ 134,960.00**	**$ 430,620.00**	**$ 35,000.00**	**$ 1,338,020.00**	**$ 275,600.00**	**$ 689,362.50**	**$ 719,335.00**	**$ 1,121,859.50**	**$ 830,310.00**
Plus/Minus 20%	$ 26,992.00	$ 86,124.00	$ 7,000.00	$ 267,604.00	$ 55,120.00	$ 137,872.50	$ 143,867.00	$ 224,371.90	$ 166,062.00
High Range	**$ 161,952.00**	**$ 516,744.00**	**$ 42,000.00**	**$ 1,605,624.00**	**$ 330,720.00**	**$ 827,235.00**	**$ 863,202.00**	**$ 1,346,231.40**	**$ 996,372.00**
Low Range	**$ 107,968.00**	**$ 344,496.00**	**$ 28,000.00**	**$ 1,070,416.00**	**$ 220,480.00**	**$ 551,490.00**	**$ 575,468.00**	**$ 897,487.60**	**$ 664,248.00**

Delaware Community Settlement Area Stormwater Master Plan
Preliminary Cost Estimates - Non-Preferred Alternatives

Location	Prior Drain Alternative 2	Prior Drain Alternative 3A	Prior Drain Alternative 3B	Mill Street Alternative 3	Hog Back Close Alternative 2	Hog Back Close Alternative 3	Tower Heights Alternative 2	Springer Road Alternative 3	Cummings Drain Alternative 2	Longwoods Road Alternative 3	Harris Road Alternative 2B	Harris Road Alternative 3A	Harris Road Culvert Alternative 3B
Roadworks	$ 838,380.00	$ 105,775.00	$ 56,375.00	$ 29,866.25	$ 34,655.00	$ 5,050.00	$ 178,755.00	$ 77,270.00	$ 419,125.00	$ 31,055.00	$ 317,975.00	$ 65,397.50	$ 64,065.00
Storm Sewers	$ 524,235.00	$ 255,580.00	$ 251,360.00	$ 183,230.00	$ 54,880.00	$ 9,300.00	$ 214,575.00	$ 82,450.00	$ 726,945.00	$ 201,950.00	$ 531,950.00	$ 146,530.00	$ 149,645.00
Miscellaneous	$ 54,100.00	$ 29,265.00	$ 29,265.00	$ 36,830.00	$ 20,860.00	$ 22,310.00	$ 32,980.00	$ 58,225.00	$ 66,950.00	$ 17,595.00	$ 112,200.00	$ 112,215.00	$ 96,375.00
Sub Totals	$ 1,416,715.00	$ 390,620.00	$ 337,000.00	$ 249,926.25	$ 110,395.00	$ 36,660.00	$ 426,310.00	$ 217,945.00	$ 1,213,020.00	$ 250,600.00	$ 962,125.00	$ 324,142.50	$ 310,085.00
Contingency	$ 145,000.00	$ 45,000.00	$ 35,000.00	$ 28,000.00	$ 13,000.00	$ 5,000.00	$ 45,000.00	$ 25,000.00	$ 125,000.00	$ 28,000.00	$ 100,000.00	$ 35,000.00	$ 33,000.00
Totals	**$1,615,815.00**	**$464,885.00**	**$401,265.00**	**$314,756.25**	**$144,255.00**	**$63,970.00**	**$504,290.00**	**$301,170.00**	**$1,404,970.00**	**$296,195.00**	**$1,174,325.00**	**$471,357.50**	**$439,460.00**
Plus/Minus 20%	$ 323,163.00	$ 92,977.00	$ 80,253.00	$ 62,951.25	$ 28,851.00	$ 12,794.00	$ 100,858.00	$ 60,234.00	$ 280,994.00	$ 59,239.00	$ 234,865.00	$ 94,271.50	$ 87,892.00
High Range	**$ 1,938,978.00**	**$ 557,862.00**	**$ 481,518.00**	**$ 377,707.50**	**$ 173,106.00**	**$ 76,764.00**	**$ 605,148.00**	**$ 361,404.00**	**$ 1,685,964.00**	**$ 355,434.00**	**$ 1,409,190.00**	**$ 565,629.00**	**$ 527,352.00**
Low Range	**$ 1,292,652.00**	**$ 371,908.00**	**$ 321,012.00**	**$ 251,805.00**	**$ 115,404.00**	**$ 51,176.00**	**$ 403,432.00**	**$ 240,936.00**	**$ 1,123,976.00**	**$ 236,956.00**	**$ 939,460.00**	**$ 377,086.00**	**$ 351,568.00**