DILLON CONSULTING

TOWN OF TECUMSEH

STORM DRAINAGE MASTER PLAN

VOLUME 1 - FINAL ENVIRONMENTAL ASSESSMENT REPORT

June 2019 – 16-4880

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PART A: PROJECT APPROACH AND CONTEXT

1.0 Introduction

The Town of Tecumseh has experienced several significant storm events over the years that have resulted in widespread surface and basement flooding. Since the Town has been keeping records of surface and basement flooding calls, extreme rainfall events resulting in flooding have been noted in September 1981, July 1983, February 1985, February 1990, June 2010, September 2011, July 2013, September 2016 and August 2017. A number of storm and sanitary assessment studies have been completed over the last 20 years to review the existing municipal infrastructure, including the Sanitary Sewage Collection System Improvements Class Environmental Assessment (EA) (Dillon, 2013). Upon finalizing the Sanitary Class EA, the Town began discussions of completing a Storm Drainage Master Plan for the areas serviced by storm pump stations within the Town. At that time, a proactive decision was made to begin reviewing the condition of the existing storm pump stations and storm drainage in service areas where road reconstruction was proposed in the future. Three studies were finalized in 2016 and included:

- Pump and Metering Station Condition Assessment Report (Dillon, November 2016);
- Peter Cecile (PJ Cecile) (Kensington) Storm Pump Station – Review of Drainage Area and Contributing Flow (Dillon, September 2016); and
- St. Mark's and Scully (Edgewater) Storm Pump Stations – Review of Drainage Areas and Storm Servicing Alternatives (Dillon, August 2016).

On September 28 and 29, 2016 an extreme rainfall event hit the Region which well exceeded a 1:100 year event over a 24 hour period. This rainfall event overwhelmed the existing storm sewer system and storm pump stations and led to widespread surface flooding along both municipally-owned roadways and private property. Surface flooding in lower-lying areas made vehicular traffic impassable causing temporary road closures. During this time, the extent of surface flooding impacted the municipal sanitary system through direct inflow, leading to extensive basement flooding.

Following this extreme rainfall event, the Town of Tecumseh initiated this Storm Drainage Master Plan *(hereafter referred to as Storm Drainage MP),* following the Master Plan process outlined in the Municipal Class Environmental Assessment (2000, as amended in 2007, 2011 and 2015).

1.1 Study Objectives and Justification

The purpose of this Storm Drainage MP is to address the impacts of surface flooding on the mainly urbanized residential areas of the Town located along the northern and eastern limits of the Town. This includes the assessment of storm pump stations, gravity outfalls and the respective service areas minor (sewer) and major (roadway) systems discharging to Lake St. Clair and Pike Creek. The Storm Drainage MP will:

- Confirm the factors contributing to surface flooding from significant storms that exceeds the current guidelines;
- Determine surface flooding problem areas throughout the study area based on existing conditions;
- Identify areas of future development and incorporate the future level of service design into a future conditions model;
- Identify and evaluate alternative solutions within the future conditions model to reduce the risk and impacts of surface flooding;
- Identify recommended design solutions based on a traditional level of service for the design;
- Simulate the effects of climate change on the recommended solutions and further enhance the level of service, if warranted; and
- Outline a recommended long-term implementation strategy with preferred surface flooding solutions.

Technical Report (Volume 2) of this document is the comprehensive Stormwater Management (SWM) Technical Report. The report documents in detail the technical analysis completed for the study, including the model developed to analyze rainfall-runoff within the study area and assess and evaluate the alternatives developed for the study. Technical Report (Volume 2) is referred to throughout this Master Plan document and should be reviewed for the detailed technical analysis completed.

The Storm Drainage MP followed the requirements of the Municipal Class Environmental Assessment (Class EA) (2000, as amended) - Approach No. 2. The study included completing Phases 1 and 2 of the Class EA process, including a "screening" of Schedule B projects. The preferred surface flooding solutions are designed to a functional level to satisfy these requirements.

This Storm Drainage MP does not directly focus on basement flooding resulting from sanitary sewer surcharging, which the Town of Tecumseh has been addressing separately through other studies, initiatives, and subsidy programs since 2010. The study also does not take into consideration surface flooding due to high lake levels, which is expected to be addressed in a future study outlined within the Town's Flood Mitigation Strategy.

1.2 Climate Change Guidelines and Local Considerations

The changing climate is causing an increase in storm frequency and intensity, rainfall duration, and water levels on a global scale. The shift in weather patterns is associated with an increase in the global average temperatures, resulting in increased storm activity. Much of the Town's infrastructure is older and in some cases, there are challenges in accommodating the effects of climate change.

There have now been improvements to watershed management practices throughout the province that require a greater understanding of the watersheds themselves. An evolution in stormwater management has occurred in Ontario and planners, engineers and designers must now address a broad set of technical issues relating to the development of land, including the maintenance of hydrologic processes and the mitigation of the observed and forecasted impact of climate change. Climate change is now playing an important role in the design of new storm drainage infrastructure and the development of drainage solutions in existing developed areas that experience surface flooding. At this time, there is no clear and consistent provincial guidance with regard to climate change and the impact that the increased amount and intensity of rainfall has on the municipal storm drainage system. Due to a number of extreme rainfall events in the local region and across the province, a number of guidelines have been updated and adopted to adapt to climate changes both regionally and provincially.

The Ministry of the Environment, Conservation and Parks (MECP) has developed draft Provincial policies regarding the need to consider the resiliency and vulnerability of stormwater infrastructure under increasing rainfall conditions. Combined with recent updates to local guidelines, these climate change considerations form an important element in the analysis of existing vulnerabilities in the Town's storm drainage systems, as well as the development and evaluation of alternative solutions that address climate change.

1.3 Study Area

As shown in Figure 1.1, the Master Plan Study Area is approximately 12.64 km^2 in size, forming the urbanized portion of the Town of Tecumseh that is located north of County Road 42. It is bordered by Lake St. Clair to the north, Pike Creek and the Town of Lakeshore to the east, County Road 42 to the south and the City of Windsor to the west. The majority of the area is developed with residential land uses.

Within the Study Area, there are five (5) municipal drains; the East Townline Drain, the Cyr Drain the Antaya Drain, the Baillargeon Drain and the Manning Road Drain.

The study area is within the Lake St. Clair Watershed and is served by eight (8) storm pump station outlets and three (3) gravity storm sewer outfalls (Figure 1.2), including:

- Lesperance Storm Pump Station;
- West St. Louis Storm Pump Station;

- East St. Louis Storm Pump Station;
- East Townline Drain (ETLD)/Manning Road Storm Pump Station;
- Scully (Edgewater) Storm Pump Station;
- St. Mark's Storm Pump Station;
- PJ Cecile (Kensington) Storm Pump Station;
- Brighton Storm Pump Station;
- Pilots Cover Storm Gravity Outfall;
- Southwind/Starwood Storm Gravity Outfall; and
- Mei-Lin Storm Gravity Outfall.

2.0 Master Plan Process

The *Ontario Environmental Assessment* (EA) *Act* ensures all relevant social, environmental and engineering factors are considered in project planning and design, and public and agency input is integrated into the decision-making process. An environmental assessment is required when municipalities propose projects that have potential for environmental impacts. The Municipal Engineer's Association Municipal Class Environmental Assessment (Class EA) (2000, as amended in 2007, 2011 and 2015) is an approved process under the EA Act.

Master Plans are long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. The plans examine an infrastructure system(s) or group of related projects to outline a framework for planning for subsequent projects and/or developments. At a minimum, Master Plans address Phase 1 (Identify Problem/Opportunity) and Phase 2 (Alternative Solutions) of the Municipal Class EA process. Master Plans typically outline a set of specific projects across a geographic area that will be implemented over a period of time.

The Class EA Process outlines four approaches to undertaking a Master Plan. This Storm Drainage MP is following Approach #2. This approach involves the preparation of a Master Plan upon completion of Phases 1 and 2 of the EA process "where the level of investigation, consultation and documentation are sufficient to fulfill the requirements for Schedule B projects." Once completed, the Master Plan is to be reviewed every five years to determine whether there is a need for updating.

As environmental effects vary from project to project, the Class EA process is divided into four Schedules (A, A+, B, and C) (or groups of projects) to address this variability. The Storm Drainage MP identified a number of Schedule B projects. Schedule B projects include "improvements and minor expansions to existing facilities" that have the "potential for adverse environmental impacts," and require the proponent to consult with those potentially affected by the project's environmental impacts.

3.0 Project Context and Background Information

Since 2016, the Town of Tecumseh has experienced several extreme rainfall events (Exhibit 3.1), which resulted in extensive surface flooding in roadways and private property that negatively affected the community. The Town initiated the Storm Drainage MP to identify potential municipal infrastructure improvements that would lead to an improved level of surface related to surface flooding. Level of service in a storm sewer system is defined as a measure used to relate to the designed capacity of a piece of infrastructure.

Exhibit 3.1 Surface flooding on roadways and private property during September 2016 rainfall event.

3.1 What Causes Surface Flooding

Surface flooding is typically the result of:

- High intensity, short or long duration rainfall events that produce high runoff;
- High levels of impervious surfaces (Exhibit 3.2) that limit infiltration;
- Dynamic interaction between municipal storm sewer network (minor system) and overland flow routes (major system) during larger storm events;
- Saturated or frozen ground conditions that reduce the infiltration capacity of pervious surfaces;
- Snowmelt, including ice blockage that may restrict the conveyance of runoff; and,
- Shoreline flooding from high lake and river levels (not included as part of this study).

Although a shoreline flooding assessment from high lake levels is not included as part of this study, an evaluation of historic monthly and yearly high lake levels was reviewed as part of this study and used as a boundary condition for gravity storm sewer outlets in the study area. A boundary condition on a gravity storm outlet can cause a backwater effect on the system, thus reducing the amount a storm sewer system can discharge to the watercourse. This is described in further detail in the Technical Modelling Report that forms Technical Report (Volume 2) of this MP document.

Asphalt Roads	Concrete Driveways	Roofs of Homes/Buildings

Exhibit 3.2. Examples of Impervious Surfaces.

Water from precipitation events may be transported/collected through the following processes, which vary depending on the characteristics of the ground surface:

- Evaporation and evapotranspiration - Surface water vaporizes into the atmosphere through ground level evaporation and through plants;
- Infiltration - Soaks into the ground through pervious surfaces, like grass or soil;
- Runoff or overland drainage - Flows overland into creeks and sewers; and,
- Depression storage or overland storage - Stays temporarily in lower-lying areas until it infiltrates into the ground.

3.2 Surface Flooding Considerations

As outlined in the following section of, the Town's flooding risk is influenced by a number of factors, including:

- Topography, soil conditions and ground cover;
- Rainfall amount, including duration and distribution;
- Minor and major system conveyance and outlet capacity; and
- Climate change.

3.2.1 Topography, Soil Conditions and Ground Cover

The Town of Tecumseh is located south of Lake St. Clair. The study area is relatively flat, falling from south to north with a grade difference of approximately 8.5m (28 feet). Lower lying areas identified as being susceptible to surface flooding were noted along the northwest (from Lesperance Rd. to Lacasse Blvd.) and northeast (from Edgewater Blvd. to Brighton Rd.). Based on a review of the topography, potential areas of surface flooding were noted along the central (Lemire St. and Lanoue St.) and south end (St. Anne's St. area) of the study area where barrier land forms, such as rail lines, and larger roadways limit overland flow conveyance and result in localized surface ponding (Figure 3.1).

The Town's soil conditions also impact the level of infiltration and rate at which runoff is produced during a rainfall event. Soil type and saturation levels also affect the amount of water than can soak into

the ground, impacting the volume and rate of runoff. Most of Tecumseh consists of clay soils, which have a low infiltration rate, thereby increasing the amount of runoff (Figure 3.2). In addition, extended periods of rainfall, and spring conditions (ie. snowmelt) may result in saturated soil and frozen ground conditions that further decrease soil infiltration rates.

Hard, impervious surfaces allow limited infiltration and have less storage, resulting in more runoff than pervious surfaces (ie. grass and soil). The study area within the Town is predominantly urbanized with impervious surfaces, such as buildings, asphalt roadways, and paved driveways that increase storm runoff.

3.2.2 Rainfall Amount, Duration and Distribution

In the past, the Town has experienced significant rainfall events that resulted in surface flooding, including the extreme storm events in September 2016 and August 2017. Figure 3.3 provides a comparison of these storm events to current design storms for the region. The term 1 in 100 year storm means that in any given year, there is a one-percent (1%) risk that a storm of this magnitude could occur.

While a 1:100 year storm has been the design standard for overland drainage systems, rainfall events can vary across time and space based on the storm patterns, resulting in differing impacts across the Town. For instance, the 24 hour September 28th/29th, 2016 storm event exceeded the 1:100 year design storm, though approximately 50% (110mm) of the total 220mm of rainfall occurred between 8:00am – 10:00am. During this time, the soils in the area were fully saturated from the earlier portion of the rainfall, which resulted in a higher degree of runoff.

3.2.3 Minor and Major System Conveyance and Outlet Capacity

Storm Sewers (Minor System)

Storm sewer systems are underground systems for the conveyance of storm runoff from more frequent storm events, designed to an accepted level of service when implementation. Accepted levels of service for storm sewer systems generally range from a 1:2 year event (50% chance of occurrence in a given year) to a 1:5 year event (20% chance of occurrence in a given year).

Municipal Drains

A municipal drain is traditionally an open drainage system that is primarily located in rural agricultural areas of the province. The municipal drains have been a fixture of rural Ontario's infrastructure since the 1800's and most municipal drains were constructed to improve the drainage of agricultural land, but as development has occurred, they have now become part of the urban drainage system in many communities, including the Town of Tecumseh. They generally provide a 1:2 year level of service based on an undeveloped condition, and may also be located in naturally lower lying areas that provide a degree of major storm runoff conveyance. Some drains within more urbanized areas are enclosed, which can be designed for a greater level of service than the 1:2 year.

Overland Drainage Systems (Major System)

Overland drainage systems (roadways, surface conveyance) are designed to convey storm runoff beyond the capacity (level of service) of the storm sewers and open channels (minor system). Overland flow routes, including roadway networks and low lying areas, are meant to convey runoff from less frequent events that are up to and including the 1:100 year event (1% chance of occurrence in a given year). Current provincial guidelines (MECP Stormwater Management Planning and Design – 2003) indicate that ponding depths are to be limited to less than 0.30 m for the 1:100 year event.

The study area is relatively flat, with a gradient towards Pike Creek and Lake St. Clair. While roadways and low-lying areas serve to provide a degree of overland drainage towards these outlets, there are barriers that prevent the discharge of this overland drainage by gravity. . As a result, the existing storm pump stations serve as the outlet for both the minor storm sewer and major overland drainage systems.

3.2.4 Climate Change

The changing climate is causing an increase in storm frequency and intensity, rainfall duration, and water levels on a global scale. The shift in weather patterns is associated with an increase in the global average temperatures, resulting in increased storm activity.

The Ministry of the Environment, Conservation and Parks (MECP) has developed draft Provincial policies regarding the need to consider the resiliency and vulnerability of stormwater infrastructure under increasing rainfall conditions. Combined with recent updates to local guidelines, these climate change considerations formed an important element in the analysis of existing vulnerabilities in the Town's storm drainage systems, as well as the development and evaluation of alternative solutions that address climate change.

4.0 Problem and Opportunity Statement

Phase 1 of the Class EA process involves preparing a problem/opportunity statement to guide the decision making for the study. The problem/opportunity statement developed for this Master Plan is:

The Town of Tecumseh is completing a Storm Drainage Master Plan to address the impacts of surface flooding on the communities that currently discharge stormwater to Lake St. Clair and Pike Creek. This Master Plan will:

- Confirm the factors contributing to surface flooding resulting from significant storm events that exceed the guidelines;
- Determine existing condition problem areas throughout the study area with surface ponding exceeding acceptable levels;
- Identify areas of future development and incorporate the future level of service design into a future conditions model;
- Identify and evaluate alternative solutions within the future conditions model to reduce the risk and impacts of surface flooding;
- Identify recommended design solutions based on a traditional level of service for the design;
- Simulate the effects of climate change on the recommended solutions to consider a more enhanced the level of service, if warranted; and
- Outline a recommended long-term implementation strategy for the preferred surface flooding solutions.

PART B: EXISTING CONDITIONS

5.0 Study Area Overview

5.1 Land Use

Existing land uses within the study area are primarily residential, with some industrial, commercial and institutional uses. Land uses were reviewed to quantify the impervious surface area component. The land use schedules are included in Technical Report (Volume 2), Appendix A.2.

5.2 Natural Environment

The Town of Tecumseh primarily consists of agricultural and urbanized lands with minimal natural areas remaining. The Essex Region Conservation Authority commissioned the *Essex Region Natural Heritage System Strategy* in 2013 to determine a strategy to protect the area's natural heritage features as part of an Official Plan update. The study indicates that while nearly 10,000 ha in size, the Town of Tecumseh has just over 450 ha of total Natural Area Coverage. Since European settlement in the area, the region has lost the vast majority of its Carolinian woodlands, wetlands and tallgrass prairies as a result of direct or indirect clearing and drainage for timber, agriculture, and urban development. Located within the southwest quadrant of the Carolinian Canada Forest Zone and in the northern limit of Southern Ontario's Species at Risk (SAR) zone, the town has 429 ha of isolated, non-contiguous forest patches and 30 ha of other terrestrial habitat (primarily made up of Tallgrass Prairie Community) remaining. As a result, the town has limited levels of natural vegetation remaining to protect itself from stormwater flooding incidents. High levels of natural vegetation provide stormwater supports through ground infiltration and groundwater recharge, slowing of overland runoff, and evapotranspiration through photosynthetic processes.

Essex County is located in a low-lying area of Southern Ontario, and stormwater drains northerly towards Lake St. Clair. Due to the flat topography, stormwater is also able to pool within the urbanized area of the Town. With reductions in natural vegetation, high levels of urban development along the shoreline, and minimal grading in the landscape, there are limited natural methods to mitigate overland stormwater runoff within the Town of Tecumseh.

6.0 Identification of Problem Areas

Potential surface flooding problem areas were identified based on existing topography and resident complaints. To confirm these problem areas under a range of design storm conditions, as well as to evaluate the effectiveness of alternative solutions, an integrated 1-Dimensional/2-Dimensional storm drainage model was developed to simulate the existing conditions for the minor (sewers) and major (overland) storm drainage systems for the study area. A seven month flow monitoring program was completed in 2018 to collect sewer flow data to further assess the model during smaller, more frequent storm events.

The model was used to assess existing conditions and identify flooding problem areas where surface ponding is exceeding the regionally acceptable level of 0.30 m during the 1:100 year event. Any surface ponding depths beyond the regionally accepted level of 0.30 m was considered a surface flooding problem area which required further review to determine if an economic solution is feasible. Further details regarding the model and how it was used are included in Technical Report (Volume 2).

The surface flooding problem areas for the 1:100 year storm event were delineated and separated between those on the west and east sides of Manning Road for ease of reference. The surface flooding problem areas were determined based on either a regional surface flooding problem area or an isolated surface flooding problem area, as described below:

- *Regional Surface Flooding Problem Area*: Where the surface flooding was widespread throughout a large portion of the service area and surface flooding was dispersed over long lengths of roadway, or flooding was caused by a more regional issue (ie. trunk sewer capacity constraints, pump station capacities, regional surface grading). Localized issues are also identified within the problem area, such as bottlenecks and lack of overland flow routes; and

- *Isolated Surface Flooding Problem Area:* Surface flooding is more isolated in nature, where the spread of surface flooding is maintained within small portions of a roadway, or caused by only a localized issue (ie. roadway grading, sewer bottleneck, inlet capacity).

Figures 6.1 to 6.3 illustrate the existing condition surface flooding within the study area for a 1:100 year event and the identification of surface flooding problem areas across the study area. A more comprehensive review of the existing conditions and problem areas for the study are further detailed in Technical Report (Volume 2).

PART C: ALTERNATIVE SURFACE FLOODING SOLUTIONS

7.0 Developing Alternative Solutions

7.1 Current Storm Drainage Design Criteria

The following sections provide an overview of the Town's stormwater infrastructure and stormwater management guidelines used in the past.

7.1.1 Storm Sewers and Open Drains (Minor System)

Storm sewer systems are underground systems for the conveyance of storm runoff during frequent storm events (Exhibit 7.1). The majority of the municipal storm sewer system within the Town of Tecumseh has been designed for a 1:2 year storm. This level of service is typical for municipalities throughout the region and was widely accepted across the Province.

Open drainage channels are also often used for the conveyance of minor system runoff and can include roadside ditches in roadways with semi-urban cross sections or municipal drains. The open drainage channels are traditionally sized in the region for a 1:2 year level of service.

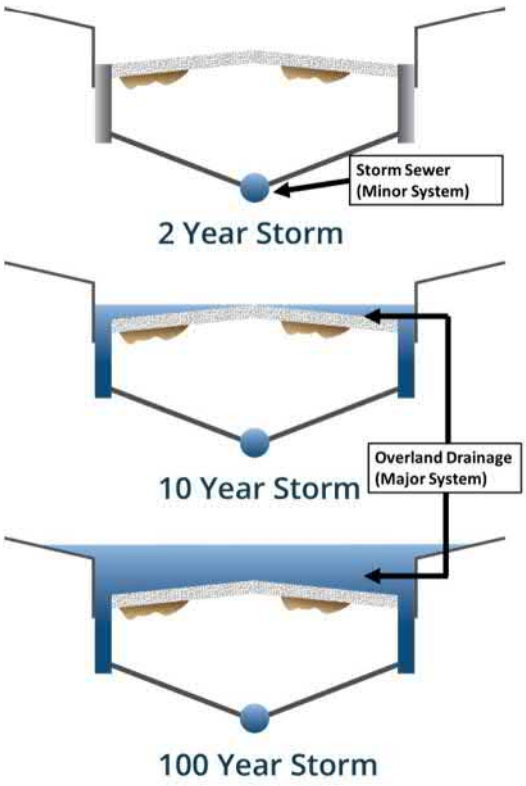


Exhibit 7.1. Sewer Drainage Design and Overland Drainage Design.

7.1.2 Storm Pump Stations

Storm pump stations are traditionally constructed at the most downstream end of a system and are required in low lying areas where gravity storm outlets are not feasible due to grading constraints. Pump stations are also used in areas where the outlet of the storm sewer system discharges to a waterway in which water levels negatively affect the functionality of the storm sewer. In the past, pump stations have typically been designed to a level of service that was comparable to the upstream storm sewer system. More recently, pump stations have also been designed in consideration of limiting sewer

surcharging during minor system storm events and surface (roadway) ponding to below 0.30m during more infrequent large storm events. Storm pump stations also serving as overland drainage outlets rely on the temporary storage of runoff on roadways until the pump station is able to draw it down through the storm sewer system.

7.1.3 Overland Drainage Systems (Major System)

Overland drainage systems (roadways, surface conveyance) are typically designed to convey flows beyond the storm sewer (minor system) level of service storm. Overland flow routes consist of roadway networks that temporarily store storm runoff during larger storm events above a 1:2 year storm. During larger rainfall events, the Town of Tecumseh's standard is no more than 0.30m of surface ponding during the 1:100 year event.

7.2 Future Storm Drainage Level of Service

7.2.1 Storm Sewers (Minor System)

Based on the changing climate and review of the newly adopted Windsor/Essex Region Stormwater Management Standards Manual (December 2018),future storm sewers for new developments within the study area are proposed to have a 1:5 year level of service with no surface ponding along roadways during the minor system event. Existing municipal storm sewers being replaced in the future are also to be designed to a 1:5 year level of service, if considered practical and if there is sufficient downstream capacity to accept the increased conveyance of flows.

7.2.2 Overland Flow (Major System)

Based on the changing climate and review of the newly adopted Windsor/Essex Region Stormwater Management Standards Manual (December 2018), overland flow networks, including roadway sags for any future development areas, are to maintain dynamic surface ponding depths to below 0.30 m during rainfall events up to and including the 1:100 year event. Existing roadways proposed to be reconstructed in the future are to incorporate best efforts to reduce surface ponding depths to below 0.30 m.

7.3 Adaptive Approach to Solution Development

For the development of solutions within the study, the design level of service is dependent on the local surface flooding conditions identified. In some instances, a traditional engineering approach will be applied to the development of solutions. This involves static design criteria meeting the requirements of regulatory agencies, based on a standard level of service and flood risk mitigation. In other instances, an adaptive level of design approach to the development of solutions will be applied that accounts for a degree of uncertainty related to climate change. This approach is based on a more enhanced level of service and flood risk mitigation that varies based on the vulnerability of the problems areas being addressed (Exhibit 7.2).

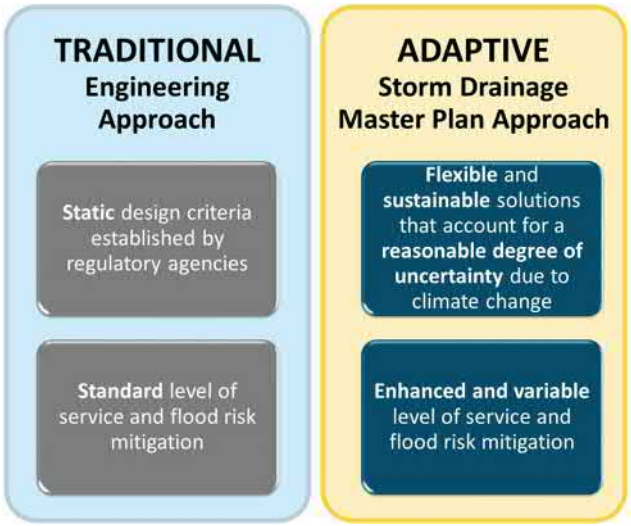


Exhibit 7.2. Traditional and Adaptive Approaches to preferred flooding solutions.

An enhanced level of service adds more resiliency to the storm system, but at a higher capital cost. A decision making framework has been developed to determine the preferred design solution and identify areas that are best suited to a traditional or further adaptive and enhanced level of service.

7.4 Climate Change Considerations

A key component of the study was to consider climate change adaptation in the decision making process in the development of resilient solutions. As discussed in Section 2.6.1 of the Technical Report (Volume 2) technical document, two climate change events were reviewed:

1. *High Intensity Climate Change Event:* Chicago 1:100 year 4 hour storm event distribution + 40% incremental intensity. This rainfall event produced a total rainfall volume of 115 mm with a maximum 10 minute intensity of 241 mm/hr.

2. *High Volume Climate Change Event:* 150mm rainfall event with a 15 minute time step, representing a 39% increase in volume uniformly distributed across the rainfall event, as compared to the Windsor Airport 1:100 year 24-hour rainfall of 108mm. Maximum intensity of 145 mm/hr.

The existing and future conditions model have been simulated under both climate change storm events above. The high intensity climate change event was used first to design the recommended surface flooding solutions and the high volume climate change event was then used to validate and confirm the design.

7.5 Decision Making Framework

Alternative solutions were developed to improve the resiliency of the storm drainage infrastructure, taking into consideration the impacts of climate change. A surface flooding solution decision framework was developed to outline an approach to developing solutions that address both the required level of service and added resiliency for each surface flooding problem area, as appropriate.

The decision framework was developed to determine the scope of the preferred design solution and identify areas that require either a traditional or a more adaptive approach to the design level of service to suit the risks and vulnerability of the area.

Traditional Design Solution

- Static design criteria established by regulatory agencies.
- Standard level of service and flood risk mitigation.

Adaptive Design Solution

- Assess and review higher risk areas susceptible to surface flooding and provide a flexible and sustainable solution that accounts for a reasonable degree of uncertainty due to climate change.
- Enhanced and variable level of service and flood risk mitigation for the respective higher risk surface flooding areas.

Exhibit 7.3 illustrates the decision making process used to determine the level of design for the preferred solutions. The design process includes a climate change analysis of the proposed design in areas where surface flooding is more problematic.

Although recommended solutions will improve the risk and impact of surface flooding, some private and public properties in lower-lying areas may still be susceptible to localized flooding during extreme rainfall events due to a number of factors, including local lot grading.

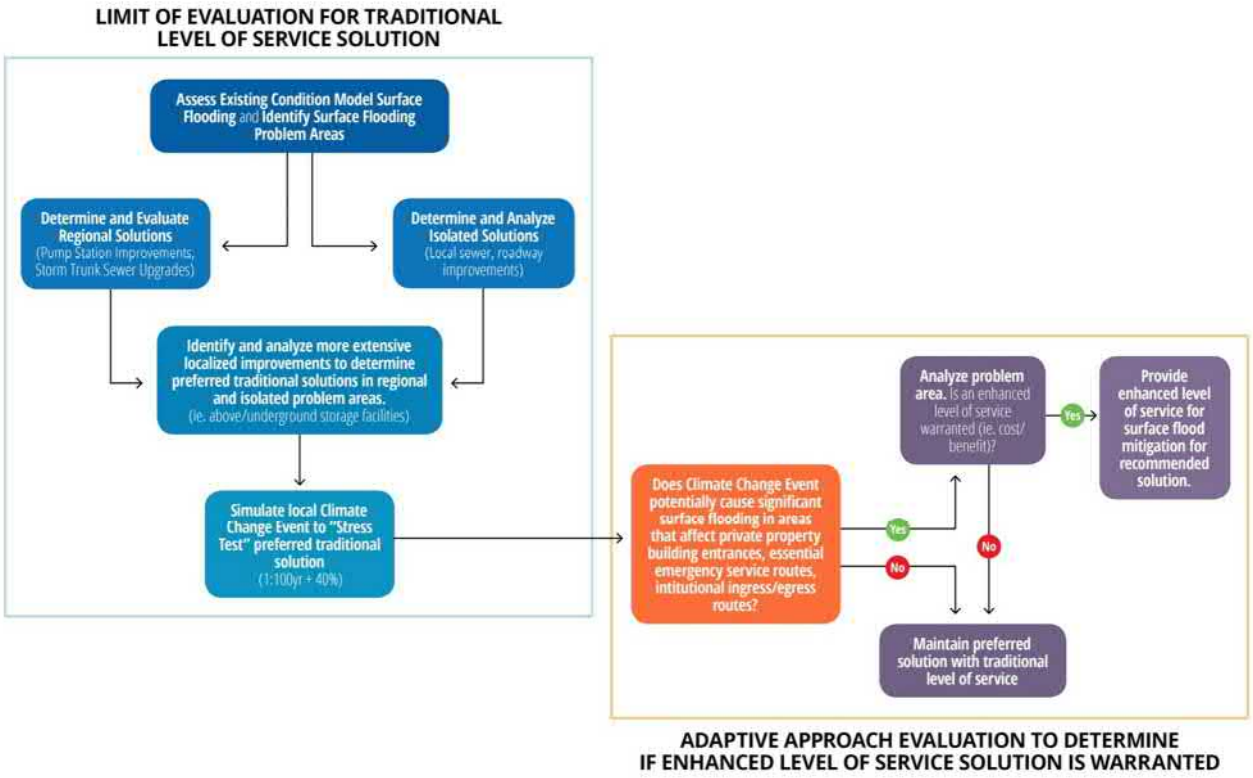


Exhibit 7.3 Surface Flooding Solution Decision Framework

7.6 Evaluation Criteria

As part of the decision making process, a comparative evaluation of the alternative solutions was completed for each problem area identified (Appendix B).

- Meets Study Objective:
    - Addresses Study Problem/Opportunity Statement: If the alternative does not address the objective, it was not considered further.
- Technical Factors:
    - Impact on Minor System (sewers) drainage: Ability to increase flow conveyance during minor storm events.
    - Impact on Major system (roadway) drainage: Ability to enhance major system flow routing and reduce ponding to provincially accepted standards during major storm events.
    - Ease of construction and implementation: Ease of construction based on a technical, regulatory and practical basis. Alternatives that are easier to construct/implement are preferred.

- Social/Economic Factors:
    - Future land uses: Potential to influence infill development in currently developed areas.
    - Impact on Urban Community: Potential for disruption or displacement of existing residents, greenspace/recreational uses (streets, trees, parks, open spaces).
- Environmental Factors:
    - Natural Environment: Potential for significant negative impacts on terrestrial and aquatic resources, including Species at Risk habitat
- Cultural Factors:
    - Archaeological resources: Potential to impact lands with archaeological resources.
    - Built heritage and/or cultural heritage resources: Potential impacts on built heritage and/or cultural heritage resources.
- Cost Factors:
    - Relative capital cost: Relative overall capital costs, including restoration/enhancement costs for the alternative. Lower cost alternatives are preferred.

8.0 Future Conditions Development

Prior to the development of alternative solutions, the model was adjusted to account for known future developments and road and sewer reconstruction projects proposed within the study area. The future conditions model was used to re-analyze each surface flooding problem area and determine the alternative regional surface flooding solutions. The future development areas built in the model include the following:

Future Private Development

- 103 hectare development consisting of a mixture of residential, commercial, and institutional development referred to as the Manning Road Secondary Planning Area;
- SWM design as per the "Town of Tecumseh MRSPA SWM Environmental Study Report Addendum (April 2015) which assumed the redirection of the Baillargeon Drain into the MRSPA storm trunk sewer and proposed SWM Facility; and;
- One SWM facility with a controlled 500 L/s pump release rate into the East Townline Drain for the proposed development; and

Two of the larger property owners within the MRSPA expressed their desire to review the SWM strategy for the MRSPA development to consider alternative solutions that may vary from the approved MRSPA SWM Class EA Addendum Report (2015). Once the developers have initiated the detailed design of the SWM solution for this site, the PCSWMM Storm Drainage MP Model may be used to confirm that the development does not result in any adverse impacts on the downstream drainage system.

Future Municipal Roadway and Sewer Reconstruction

Based on discussions with the Town, proposed municipal roadway and storm sewer reconstruction areas have been identified within the study area. These municipal roadway and sewer reconstruction improvements impact the amount of runoff to the respective outlets and were taken into consideration when designing each alternative surface flooding solution.

The following areas (Figure 8) have been identified by the Town of Tecumseh as roadways with semi-urban cross sections that in the future are to be reconstructed with accompanying sewer improvements. These areas have been included in the model with their respective future storm drainage design, which was further detailed within this study.

1. Streets within the "Kensington Dish" Area;
2. Streets within the "Coronado Dish" Area;
3. Arlington Boulevard;
4. St. Marks Road;
5. Edgewater Boulevard;
6. St. Anne Area including:

- St. Anne Street between North Pacific Avenue and Gouin Street;
- Portions of North Pacific Avenue, Intersection Road, Maisonneuve Street and Gouin Street within the study area;

7. Tecumseh Road Storm Sewer Extension; and
8. Enclosure of the East Townline Drain, incorporation of a new local Manning Road sewer and re-direction of flow to the existing Lakewood Park Drainage Channel (hereafter referred to as Manning Road Phase 2 Drain Enclosure).

Locations 1 through 6 noted above were further analyzed and storm sewers designed using the decision making framework to determine whether a traditional or more enhanced level of service was warranted.

9.0 Alternative Solutions

Based on the regional and isolated surface flooding problem areas identified, several solutions were designed and assessed for each surface flooding problem areas. The surface flooding solutions for the study were divided into two types: regional solutions and localized solutions, as identified in Table 9.1.

Table 9.1: Initial Surface Flooding Solution Alternatives

Regional Surface Flooding Solutions	Localized Surface Flooding Solutions
Storm Trunk Sewer Upgrades	Local Storm Sewer Upgrades
Pump Station Upgrades	Aboveground/Underground Relief Storage
Redirection of Storm Drainage	Roadway Grading
Sewer Overflows	Backflow Prevention
	Catch basin Inlet Improvements

Section 10 of Technical Report (Volume 2) describes in detail the alternatives considered for the regional surface flooding areas as well as the localized areas. For all of the alternatives, a "do nothing" alternative was considered, consistent with the requirements of the Class EA.

For each of the Schedule B projects identified, additional alternative layouts and designs were developed and evaluated, as shown in Appendix D of Technical Report (Volume 2). These alternatives were primarily developed to assess the cost/benefit of each alternative.

Appendix B documents the evaluations completed to select the preferred alternative for each specific area.

9.1 West of Manning Road/CR19 Alternative Surface Flooding Solutions

The alternative solutions for each of the surface flooding problem areas west of Manning Road/CR19 have been separated into the respective pump station service areas. Alternative regional surface flooding solutions were determined for each of the following:

- Regional Problem Area W-1: Lesperance Pump Station Service Area (Figure 6.1);
- Regional Problem Area W-1: West St. Louis Pump Station Service Area (Figure 6.1);
- Regional Problem Area W-2: East St. Louis Pump Station Service Area (Figure 6.1); and
- Regional Problem Area W-3: Baillargeon Drain Area (East Townline Drain Pump Station Service Area) (Figure 6.2);

Details of the proposed improvements within each problem area for each alternative are outlined in Section 10.4 in Technical Report (Volume 2). The following provides a brief overview of the problem areas and alternatives.

9.1.1 Problem Area W-1 Solutions – Lesperance Pump Station Service Area

Under existing conditions, the Lesperance and West St. Louis Pump Station service areas are interconnected by a shared manhole along Riverside Drive, directly east of St. Pierre Street. Under each alternative, it is proposed to remove this interconnection or install a backflow prevention device to eliminate the hydraulic connection between the two service areas.

Four alternatives were considered for Problem Area W-1:

1) Do nothing;
2) Alternative 1: Improvements to the Lesperance Trunk Sewer and Pump Station;
3) Alternative 2: Improvements to St. Pierre Trunk Sewer and Pump Station (Preferred); and
4) Alternative 3: Improvements to St. Pierre and Lesperance Trunk Sewers and Lesperance Pump Station.

Do Nothing

The "Do Nothing" alternative identifies no regional or localized solutions within the problem area where widespread surface flooding is identified. The evaluation of this alternative is required by the EA process; however as part of this study, the "Do Nothing" approach does not reduce surface flooding in the identified problem areas. With the risk of more intense storm events in the future and the aging infrastructure in the problem area, this alternative is not recommended.

Alternative 1: Improvements to the Lesperance Trunk Sewer and Pump Station

This alternative scenario includes improvements to the existing Lesperance storm pump station and the existing Lesperance storm trunk sewer from St. Jacques Street directly north of the VIA railway to the pump station at the intersection of Riverside Drive and Lesperance Road. The existing Lesperance storm trunk sewer is proposed to be upgraded from an 1800 mm – 1950 mm diameter circular storm sewer to a 2400 mm – 3600 mm diameter circular storm sewer. The existing storm sewer connections along the east of Lesperance Road from the St. Pierre storm sewer system to the Lesperance storm trunk sewer are to be improved as follows:

- 600mm diameter sewer from Clapp Street upgraded to a 975mm diameter;
- 600mm diameter sewer from Wood Street upgraded to a 975mm diameter; and
- 675mm diameter sewer from Riverside Drive upgraded to a 1350mm diameter.

As part of this regional solution, additional localized solutions are proposed within the regional surface flooding area to provide the added resiliency to improve surface flooding in the service area. This includes:

- Storm sewer conveyance, roadway grading and catch basin inlet improvements along Meander Crescent and Clapp Street; and
- Catch basin inlet improvements along Oakpark Drive.

Alternative 2: Improvements to St. Pierre Trunk Sewer and Pump Station (Preferred)

This alternative scenario introduces a new storm trunk sewer along St. Pierre Street from Clapp Street to Riverside Drive and along Riverside drive west of St. Pierre to the proposed improved Lesperance storm pump station. The St. Pierre storm trunk sewer is proposed to be constructed as a 1200 mm – 1500 mm diameter circular storm sewer.

As part of this regional solution, additional localized solutions are proposed within the regional surface flooding area to provide the added resiliency to improve surface flooding in the service area. This includes:

- Storm sewer conveyance, roadway grading and catch basin inlet improvements along Meander Crescent and Clapp Street;
- Catch basin inlet improvements along Oakpark Drive;
- Underground/aboveground stormwater storage behind the existing Tecumseh Townhall; and
- Underground storage along Evergreen and Gauthier Drive.

Alternative 3: Improvements to St. Pierre and Lesperance Trunk Sewers and Lesperance Pump Station

This alternative scenario includes both the introduction of a new storm trunk sewer along St. Pierre Street and improvements to the existing Lesperance storm trunk sewer. For this alternative, the St. Pierre storm trunk sewer is proposed to be constructed as a 1200 mm – 1500 mm diameter circular storm sewer. The existing Lesperance storm trunk sewer is proposed to be upgraded to a 2400 mm – 2700 mm diameter circular storm sewer.

As part of this regional solution, localized solutions are reduced from previous alternatives. This includes:

- Storm sewer conveyance, roadway grading and catch basin inlet improvements along Meander Crescent and Clapp Street; and
- Catch basin inlet improvements along Oakpark Drive.

Pump Station Improvements

As part of Alternative 1 through 3, pump station improvements were considered for all alternatives to improve the pump capacity and level of service in the catchment area. Two options for pump capacity were considered; increasing the pump capacity to a traditional level of service (8 m^3/s) or increasing the pump capacity to an enhanced level of service (9 m^3/s).

Based on the analysis of the service area and the decision framework for the solutions, the Lesperance storm pump station was determined to warrant an enhanced level of service with a firm pump capacity upgrade to 9 m^3/s.

The alternatives for this problem area are illustrated in Figure 9.1.

9.1.2 Problem Area W-1 Solutions– West St. Louis Pump Station Service Area

For the West St. Louis pump station service area, no significant regional surface flooding was identified to warrant a regional surface flooding solution within the problem area. The proposed storm sewer and roadway improvements within the Coronado Dish area and along Barry Avenue improve the current level of service to convey all future condition runoff from the road reconstruction areas into the Riverside Drive storm trunk sewer to the West St. Louis Pump Station. Based on the increase in storm runoff from the proposed road reconstruction area, the West St. Louis Pump Station is proposed to be improved.

Each alternative for Regional Problem Area W-1 within the West St. Louis pump station service area therefore considered storm sewer improvements in the following locations:

- Coronado Dish Area;
- Barry Avenue; and
- Lacasse Boulevard from Riverside Drive to Little River Boulevard.

The level of service for the design of the local storm sewers followed the decision making framework to determine whether a traditional or enhanced level of service was warranted.

Based on the future road and storm sewer improvements proposed within the Coronado Dish area, Barry Avenue and along Lacasse Boulevard, two regional alternatives were therefore considered for the West St. Louis Pump Station area within Problem Area W-1:

<u>Do Nothing</u>

Under this alternative, no regional or localized solutions are implemented within the problem area where widespread surface flooding is identified. The evaluation of this alternative is required by the EA process; however as part of this study, the "Do Nothing" approach would not reduce surface flooding in the identified problem areas. With the risk of more intense storm events in the future and the known aging infrastructure in the problem area, this alternative is not recommended.

<u>Alternative 1: West St. Louis Pump Station Improvements (Preferred)</u>

The existing West St. Louis storm pump station was identified to be a required improvement within the regional problem area. The pump station design was assessed to provide either a traditional level of service or an enhanced level of service. The existing pump capacity of 3.38 m^3/s was determined to be improved based on the following options:

- Traditional Level of Service firm capacity upgrade to 5 m^3/s; and
- Enhanced Level of Service firm capacity upgrade to 7 m^3/s.

Based on the analysis of the service area and the decision making process illustrated previously, the West St. Louis pump station was determined to warrant an enhanced level of service with a firm pump capacity upgrade to 7 m^3/s.

As part of this regional solution, additional localized solutions are proposed to provide the added resiliency to improve surface flooding in the service area. This includes:

- Storm sewer conveyance, roadway and catch basin inlet improvements within the Coronado Dish Area, Lacasse Boulevard, Dillon Drive, Kimberly Drive and Jelso Place;
- Underground storage along Little River Boulevard from Lacasse Boulevard to Barry Avenue;
- Installation of a backflow prevention device at the storm sewer interconnection along Riverside Drive of the Lesperance and West St Louis storm pump station service areas between St. Pierre Street and Lacasse Boulevard; and
- Catch basin inlet improvements along Michael, Revland and Woodridge Drive south of Little River.

9.1.3 Problem Area W-2 Solutions – East St. Louis Pump Station Service Area

Four regional alternatives were considered for Problem Area W-2:

1) Do nothing;
2) Alternative 1: St. Thomas Storm Sewer Overflow to Lakewood Park Drainage Channel (Preferred);
3) Alternative 2: St. Thomas Storm Sewer Overflow to Proposed Manning Road Local Sewer; and
4) Alternative 3: East St. Louis Trunk Sewer and Pump Station Improvements.

Do Nothing

Under this alternative, no regional or localized solutions would be implemented within the problem area where widespread surface flooding is identified. The evaluation of this alternative is required by the EA process; however as part of this study, the "Do Nothing" approach would not reduce surface flooding in the identified problem areas. With the risk of more intense storm events in the future and the known aging infrastructure in the problem area, this alternative is not recommended.

Alternative 1: St. Thomas Storm Sewer Overflow to Lakewood Park Drainage Channel (Preferred)

This alternative includes the incorporation of a 1050 mm diameter storm sewer overflow within the existing 1350 mm diameter storm trunk sewer along St. Thomas Street at the intersection with the Green Valley Drive storm sewer. The overflow sewer is proposed to convey flows easterly down St. Thomas Street and through the proposed 1.8 m x 3.0 m box culvert crossing Manning Road to the Lakewood Park Drainage Channel, eventually discharging into the existing East Townline Drain storm pump station. The box culvert is proposed to be constructed as part of the Manning Road Phase 2 and 3 project, which also includes the enclosure of the East Townline Drain south of St. Thomas Street and the redirection of flows to the Lakewood Park Drainage Channel through a new box culvert. The overflow sewer is not expected to convey flows unless the St. Thomas storm trunk sewer is surcharged.

As part of this regional solution, additional localized solutions are proposed to provide the added resiliency to improve surface flooding in the service area. This includes:

- Catch basin inlet improvements upstream of the St. Thomas overflow sewer along Green Valley Drive, Brunelle Crescent, St. Gregory's Drive, Primrose Place and Harvest Lane; and

- Installation of a backflow prevention device along St. Thomas Street within the 1050 mm diameter overflow sewer directly west of the connection with the proposed 1.8 m x 3.0 m box culvert crossing Manning Road.

Alternative 2: St. Thomas Storm Sewer Overflow to Proposed Manning Road Local Sewer

This alternative includes the same 1050mm diameter overflow sewer proposed in Alternative 1. Alternative 2, however, proposes to convey flows easterly down St. Thomas and through the proposed localized Manning Road storm sewer to be constructed along the west side of Manning Road, eventually discharging into the existing East Townline Drain storm pump station. The local Manning Road storm sewer is to be constructed as part of the Manning Road Phase 2 and 3 project to provide conveyance of runoff for the residential properties along the west side of Manning Road to the pump station. This solution includes increased storm sewer designs for the local Manning Road storm sewer from St. Thomas Street to the East Townline Drain pump station to accommodate the runoff from the St. Thomas overflow sewer during the 1:100 year storm event. The proposed local Manning Road storm sewer is proposed to be upgraded from an original design ranging from 825mm – 975 diameter circular storm sewer to a 1050mm – 1350mm diameter circular storm sewer.

As part of this regional solution, additional localized solutions are proposed to provide the added resiliency to improve surface flooding in the service area. This includes:

- Catch basin inlet improvements upstream of the St. Thomas overflow sewer along Green Valley Drive, Brunelle Crescent, St. Gregory's Drive, Primrose Place and Harvest Lane.

Alternative 3: East St. Louis Trunk Sewer and Pump Station Improvements

This alternative includes improvements to the existing East St. Louis storm pump station and the existing storm trunk sewer for the service area along Green Valley Drive. The storm trunk sewer improvements are proposed beginning directly north of the intersection with Green Valley Drive and Brunelle Crescent and continuing along Green Valley Drive northerly down St. Thomas Drive, Dillon Drive and Shannon Place to the East St. Louis storm pump station located along Riverside Drive.

For this alternative, the East St. Louis storm trunk sewer is proposed to be upgraded from a 1200 mm – 1650 mm diameter circular storm sewer to a 1500 mm – 2100 mm diameter circular storm sewer.

Under this alternative, the proposed storm trunk sewer upgrades for the service area increased the amount of runoff entering the East St. Louis storm pump station. Based on this solution, the existing East St. Louis storm pump station was identified to be a required improvement. The pump station design was assessed to provide either a traditional level of service or an enhanced level of service upgrade. The existing pump capacity of 5.07 m^3/s was identified to be upgraded based on the following options:

- Traditional Level of Service firm capacity upgrade to 6 m^3/s; and
- Enhanced Level of Service firm capacity upgrade to 8 m^3/s.

As part of this regional solution, additional localized solutions are proposed to provide the added resiliency to improve surface flooding in the service area. This includes:

- Catch basin inlet improvements upstream of the St. Thomas overflow sewer along Green Valley Drive, Brunelle Crescent, St. Gregory's Drive, Primrose Place and Harvest Lane.

The alternatives for this problem area are illustrated in Figure 9.2.

9.1.4 Problem Area W-3 Solutions – Baillargeon Drain Service Area

Each alternative for Regional Problem Area W-3 considered storm sewer improvements in the following locations:

- St. Anne Area including:
    - St. Anne Street between North Pacific Avenue and Gouin Street; and
    - Portions of North Pacific Avenue, Intersection Road, Maisonneuve Street and Gouin Street within the study area.

The level of service for the design of the local storm sewers followed the decision making framework to determine whether a traditional or enhanced level of service was warranted.

Three regional alternatives were considered for Problem Area W-3 within this service area:

1) Do nothing;
2) Alternative 1: Charlene Storm Relief Sewer to MRSPA Development (Preferred); and
3) Alternative 2: Localized Underground Storage (Preferred).

Do Nothing

Under this alternative, no regional or localized solutions would be implemented within the problem area where widespread surface flooding is identified. The evaluation of this alternative is required by the EA process; however as part of this study, the "Do Nothing" approach would not reduce surface flooding in the identified problem areas. With the risk of more intense storm events in the future and the known aging infrastructure in the problem area, this alternative is not recommended.

Alternative 1: Charlene Storm Relief Sewer to MRSPA Development (Preferred)

As part of this alternative, a storm relief sewer is proposed along Charlene Lane to intercept all storm sewer runoff East of Lesperance Road and south of Charlene Lane from the existing residential lands to reduce surface flooding within the regional problem area. The Charlene relief sewer design ranges from 675mm – 900mm in diameter and is proposed to convey flows east through the existing 4.0 m storm easement between two residential properties and into the future development storm trunk sewer. A 600mm diameter overflow sewer is also proposed to connect to the Charlene relief sewer from the Lesperance storm sewer system at the intersection of Charlene Lane and Lesperance Road. Under

existing conditions, the 4.0m storm easement is used as an overland flow route for the residential development along Charlene Lane to the currently undeveloped future development lands to the east.
As part of the 2015 MRSPA Functional Servicing Report and MRSPA SWM Class EA Addendum Report, the Baillargeon Drain service area is to incorporate a new storm outlet from Gouin Street into the future MRSPA storm trunk sewer. This outlet consists of a 900 mm diameter sewer along Gouin Street at Deslippe Drive. As part of this study, the Gouin Street storm outlet is not required to be directed into the MRSPA storm trunk sewer to reduce the surface flooding in the area, but recommended as part of this alternative.

Alternative 2: Localized Underground Storage (Preferred)
As part of this alternative, underground storage is proposed along Charlene Lane, St. Martin Crescent and St. Agnes Crescent to reduce surface flooding within the regional problem area. The underground storage proposed includes:

- 825 mm diameter underground storage sewer along St. Martin directly upstream of the existing 675 mm diameter storm sewer outlet from St. Martin Crescent to Charlene Lane;
- 900 mm diameter underground storage sewer Charlene Lane directly north of Eugeni Street; and
- 900 mm x 1800 mm underground storage rectangular box chambers along Charlene Lane and St. Agnes upstream of the existing 1200 mm diameter enclosed Baillargeon Drain.

The alternatives for this problem area are illustrated in Figure 9.3.

9.1.5 Expanded Localized Surface Flooding Solutions

Based on the extent of regional surface flooding solutions identified through this study, more enhanced localized solutions were incorporated in areas where the surface flooding is isolated where a regional surface flooding solution would not be warranted or within a regional problem area to reduce the design for the regional solution.

The localized solutions identified within this section followed the same decision making framework as the regional solutions to identify whether the design warranted a traditional or enhanced level of service.

Lemire and Lanoue Street
Based on the decision framework, a more extensive localized surface flooding solution was required within the Lemire and Lanoue Street area to reduce surface flooding along both the localized roadways and within existing residential private properties. To reduce surface flooding within the area, two alternatives were reviewed, as follows:

Alternative 1 (Preferred):

- Redirection of storm drainage and upgrade of local storm sewers (675 mm – 825 mm diameter) along Lanoue and Lemire street through to Buster Reaume Park and discharge flows into the existing 900 mm diameter CN Railway Ditch outlet;

- Construction of a 0.80 m depression along the southwestern portion of Buster Reaume Park to provide approximately 4,100 m^3 of aboveground surface storage with a connection to the upgraded municipal storm sewers;
- Installation of a catch basin and a 750 mm diameter storm sewer outlet from the Buster Reaume Park aboveground storage to the existing 900 mm diameter storm sewer to the CN Railway ditch; and
- Installation of a backflow prevention device at the outlet of the 900 mm diameter sewer to the CN Railway ditch within the Buster Reaume pathway from Lemire Street.

Alternative 2

- 551 meters of 3048 mm x 2438 mm (a total of 4,100 m^3 of storage) underground rectangular box chambers along Lemire and Lanoue Street within the municipal right-of-way upstream of the existing 900 mm diameter outlet through the pathway into the CN Railway ditch; and
- Installation of a backflow prevention device at the outlet of the 900 mm diameter sewer to the CN Railway ditch within the Buster Reaume pathway from Lemire Street.

Due to the complexity and extensive improvements proposed for the localized surface flooding area, a high level evaluation was completed for the two alternatives detailed above. Advantages and Disadvantages of each were identified and illustrated for Pubic Information Centre #2. This high level evaluation is included in Appendix D in Technical Report (Volume 2).

9.2 East of Manning Road/CR19 Alternative Surface Flooding Solutions

The alternative solutions for each of the surface flooding problem areas east of Manning Road/CR19 have been separated into the respective pump station service areas. Alternative regional surface flooding solutions were determined for each of the following problem areas (Figure 6.3):

- Scully Pump Station Service Area;
- St. Mark's Pump Station Service Area; and
- PJ Cecile Pump Station Service Area.

Details of the proposed improvements within each problem area for each alternative are outlined in Section 10.5 in Technical Report (Volume 2). The following provides a brief overview of the problem areas and alternatives.

9.2.1 Regional Problem Area E-1 Solutions – Scully, St. Mark's, PJ Cecile Pump Station Service Area

Each alternative for Regional Problem Area E-1 considered storm sewer improvements in the following locations:

- Edgewater Boulevard (Existing Scully Storm Pump Station Service Area);
- St. Marks Road (Existing St. Mark's Storm Pump Station Service Area);
- Arlington Boulevard (Existing St. Mark's Storm Pump Station Service Area);
- Streets within the Kensington Dish Area (Existing PJ Cecile Storm Pump Station Service Area);

The level of service for the design of the local storm sewers followed the decision making framework to determine whether a traditional or enhanced level of service was warranted.

Four regional alternatives were considered for Problem Area E-1 within the service areas:

1) Do nothing
2) Alternative 1: Scully, St. Mark's and PJ Cecile PS Upgrades
3) Alternative 2: Consolidated Scully/St. Mark's PS and PJ Cecile PS Upgrades (Preferred)
4) Alternative 3: Consolidated Scully/St. Mark's/PJ Cecile PS Upgrades

Do Nothing

Under this alternative, no regional or localized solutions would be implemented within the problem area where widespread surface flooding is identified. The evaluation of this alternative is required by the EA process; however as part of this study, the "Do Nothing" approach would not reduce surface flooding in the identified problem areas. With the risk of more intense storm events in the future and the known aging infrastructure in the problem area, this alternative is not recommended.

Alternative 1: Scully, St. Mark's and PJ Cecile PS Upgrades

This alternative consisted of the improvement to each of the three pump stations and respective service area storm sewers. The service areas for each of the three pump stations were analyzed under the following upgrade options:

Traditional Level of Service Upgrades

- Scully pump station firm capacity upgrade to 2.47 m^3/s;
- St. Mark's pump station firm capacity upgrade to 1.89 m^3/s; and
- PJ Cecile pump station firm capacity upgrade to 2.2 m^3/s.

Enhanced Level of Service Upgrades

- Scully pump station firm capacity upgrade to 3.5 m^3/s;
- St. Mark's pump station firm capacity upgrade to 2.7 m^3/s; and
- PJ Cecile pump station firm capacity upgrade to 3.0 m^3/s.

Based on the analysis of the service areas and following the surface flooding decision framework process illustrated previously, the three pump stations were determined to warrant an enhanced level of service based on the firm pump capacity upgrades outlined above.

Alternative 2: Consolidated Scully/St. Mark's PS and PJ Cecile PS Upgrades (Preferred)

This alternative considered decommissioning St. Mark's storm pump station and consolidating that service area into that of the Scull storm pump station. This alternative included a new consolidated Scully/St. Mark's storm pump station on the Scully site and upgrades to improve the PJ Cecile Storm Pump Station.

The service areas for the proposed two pump stations were analyzed under the following upgrade options:

Traditional Level of Service Upgrades

- Consolidated Scully/St. Mark's pump station firm capacity upgrade to 4.0 m^3/s; and
- PJ Cecile pump station firm capacity upgrade to 2.2 m^3/s.

Enhanced Level of Service Upgrades

- Consolidated Scully/St. Mark's pump station firm capacity upgrade to 6.0 m^3/s; and
- PJ Cecile pump station firm capacity upgrade to 3.0 m^3/s.

Based on the analysis of the service areas and following the surface flooding decision framework process illustrated previously, the two pump stations were determined to warrant an enhanced level of service with the firm pump capacity upgrades noted above.

Alternative 3:

This alternative considered decommissioning both the Scully and the PJ Cecile storm pump stations and consolidating the service areas with that of St. Mark's storm pump station. The scenario would then include a new consolidated Scully/St. Mark's/PJ Cecile storm pump station on the St. Mark's site.

The pump station improvement for this alternative of one consolidated pump station included the following upgrade options:

Traditional Level of Service Upgrades

- Consolidated Scully/St. Mark's/PJ Cecile pump station firm capacity upgrade to 6.2 m^3/s.

Enhanced Level of Service Upgrades

- Consolidated Scully/St. Mark's/PJ Cecile pump station firm capacity upgrade to 8.7 m^3/s.

Based on the analysis of the service areas and following the surface flooding decision framework process illustrated previously, consolidation of the three pump stations to one large station was determined to warrant an enhanced level of service with a firm pump capacity of 8.7 m^3/s.

The alternatives for this problem area are illustrated in Figure 9.4.

9.2.2 Expanded Localized Surface Flooding Solutions

Based on the extent of regional surface flooding solutions identified through this study, localized solutions were incorporated in areas where the surface flooding is isolated where a regional surface

flooding solution would not be warranted or within a regional problem area to reduce the design for the regional solution.

The localized solutions identified within this section followed the same decision framework as the regional solutions to identify whether the design warranted a traditional or enhanced level of service.

St. Gregory's Road

Based on the decision framework, it was identified during the climate change analysis that a more extensive localized surface flooding solution beyond the traditional level of service was required along St. Gregory's Road between Village Grove Drive and Cada Crescent. A traditional solution is proposed along St. Gregory's which includes the following:

- Incorporation of a backflow prevention device at the St. Gregory's Road storm outlet to the East Townline Drain at the intersection of St. Gregory's and Manning Road;
- Elimination of the storm sewer interconnection along St. Gregory's Road fronting L'Essor School with the East Townline Drain and Scully storm pump station service areas; and
- Redirection of the storm sewer outlet for St. Gregory's Road, East of L'Essor School to extend further east from the Cada Crescent storm outlet to the proposed Edgewater Drive storm sewer.

During extreme rainfall events, the model simulation identified that extensive surface flooding occurs specifically within the ingress and egress routes of the L'Essor Highschool. To reduce surface flooding within the area and provide, two alternatives were reviewed. This included:

Alternative 1 (Preferred):

- Construction of a 0.70 m depression of the existing northern soccer fields within the Tecumseh Soccer Fields Park currently owned by the L'Essor high school and Conseil Scolaire Catholique (CSC) Providence to provide approximately 3,200 m^3 of aboveground surface storage with a 200mm diameter storm sewer connection to the existing 750 mm diameter storm sewer along St. Gregory's Road.

Alternative 2

- 430 meters of 3048 mm x 2438 mm (providing 4100 m^3 of storage) underground rectangular box chambers along St. Gregory's Road within the municipal right-of-way.

Starwood Lane/Southwind Crescent

For each of the localized solution alternatives for the Starwood/Southwind area, storm pump station is proposed to provide a hydraulic disconnect of the storm system from the water levels at the existing outlet along Pike Creek. A traditional level of service was warranted for the new pump station with a firm capacity of 0.2 m^3/s for each alternative. The alternatives reviewed as part of this localized solution included the location of the proposed pump station.

Alternative Location # 1 (Preferred)

- Storm pump station located within existing 4.5 m storm easement with a connection to the existing storm outlet; and
- Incorporation of a backflow prevention device at the existing storm outlet.

Alternative Location # 2

- Storm pump station located within the existing Southport Sailing Club lands;
- New pump station storm outlet within the existing Southport Sailing Club lands; and
- Incorporation of a backflow prevention device at the existing storm outlet.

Alternative Location #3

- Storm pump station located within existing Southwind Crescent municipal right-of-way with a connection to the existing storm outlet; and
- Incorporation of a backflow prevention device at the existing storm outlet.

Due to the complexity and extensive improvements proposed for each localized surface flooding area above, a high level evaluation was completed for the alternatives detailed. Advantages and Disadvantages of each were identified and illustrated for Pubic Information Centre #2. This high level evaluation and illustration for each alternative is provided in Appendix D in Technical Report (Volume 2)

PART D: OVERVIEW OF PREFERRED SOLUTIONS AND RECOMMENDATIONS

10.0 Recommended Functional Design Solutions

Provided in Appendix B of the report includes the evaluation completed for each alternative regional surface flooding solution detailed above for the regional surface flooding problem areas. The preferred solutions from the evaluations were presented at Public Information Centre No. 2 for public and agency input.

The following summarizes the preferred solutions to address regional surface flooding within the study area:

Problem Area W-1 Regional Solution:
- Lesperance Pump Station Service Area: ALTERNATIVE 2; and
- West St. Louis Pump Station Service Area: ALTERNATIVE 1.

Problem Area W-2 Regional Solution:
- East St. Louis Pump Station Service Area: ALTERNATIVE 1

Problem Area W-3 Regional Solution:
- Baillargeon Drain Service Area: ALTERNATIVE 1 or ALTERNATIVE 2

Problem Area E-1 Regional Solution:
- Scully/St. Mark's/PJ Cecile Pump Station Service Area: ALTERNATIVE 2

Where local surface flooding solutions were identified, these solutions were further assessed for the preferred solution to reduce surface flooding. This included localized solutions in the following areas:

Localized Solutions West of Manning Road/County Road 19
- Underground and Surface Storage along Lesperance Road within Tecumseh Centre Park;
- Underground Storage along Evergreen Drive and Gauthier Drive;
- Underground Storage, Storm Sewer and Roadway Grading Improvements along Meander Crescent and Clapp Street;
- Underground Storage along Little River Boulevard between St. Pierre Street and Barry Avenue;

- Manning Road Phase 2 Drain Enclosure; and
- Surface storage along Lemire Street and Lanoue Street at Buster Reaume Park.

Localized Solutions East of Manning Road/County Road 19

- Tecumseh Road Storm Sewer Extension;
- Surface Storage along St. Gregory's Road at Tecumseh Soccer Fields; and
- Starwood Lane/Southwind Crescent Pump Station.

Figure 10.1 through Figure 10.11 Illustrates the preferred solutions throughout the study area, including both the regional and more extensive localized solutions. Further details for each solution are outlined in Section 11 of Technical Report (Volume 2).

11.0 Low Impact Development Alternatives

The Ontario Ministry of Environment, Conservation and Parks (MECP) produced a Low Impact Development (LID) Stormwater Management Guidance Manual (Draft) in 2017 to provide guidance on the design, construction and maintenance of LIDs which advocated a "treatment train" approach to treat and store stormwater runoff. This approach encouraged the use of lot-level and conveyance controls along with end-of-pipe measures to manage stormwater runoff.

Because residential streets account for a significant share of a community's impervious surfaces, conveyance control measures present an important opportunity to improve downstream water quality conditions (e.g. sediment, nutrient, bacteria, oil/grit, thermal impact reduction, etc.), minimize watercourse erosion and reduce peak flows associated with urban flooding. Conveyance control measures can most feasibly be incorporated into existing right-of-way's as part of planned road reconstruction works as storm sewers and inlets can be replaced and reconfigured during this process.

As part of the stormwater modelling completed for this study, an example area within the study limits was completed to evaluate the effectiveness of incorporating LIDs into the preferred solutions. The Coronado Dish was chosen as the representative area to test the effectiveness of LIDs. This area has been identified where road reconstruction is recommended to upgrade roadway cross-sections from rural or semi-urban to an urban cross-section.

The use of exfiltration trenches were simulated in the preferred solution for this area (Problem Area W1: East St. Louis Pump Station – Alternative 1). Based on the modelling analysis, a reduction in peak flow was observed in the downstream sewer from the Coronado Dish area for all the modelled storm event simulations due to the increased as-source storage within the exfiltration trenches. Improvements in the hydraulic gradeline (HGLs) in the storm sewers and reduction in roadway ponding was also observed due to the incorporation of the exfiltration trenches. Further details of the LID case study area, including the modelling methodology used and description of the exfiltration trench design is provided within Section 12.0 of Technical Report (Volume 2).

Although the incorporation of LID controls show a reduction in HGL and peakflow at the downstream end of the system during all storm events, the use of LID techniques within a municipal system are not to be a basis for reducing the storm sewer design level of service. Any LID design technique included in a municipal roadway storm design shall be for added resiliency in the system and be in addition to the traditional storm sewers.

Incorporation of LID controls is to be further assessed during the detail design stage for the areas in which full roadway re-construction is proposed as part of this study.

12.0 Schedule B Class EA Projects

The Schedule B projects included for approval as part of this Master Plan (Figure 12.1) are designed to be functional in nature and provide sound direction on the nature of the designs that would be effective in addressing surface flooding concerns. These solutions include the following:

Storm Pump Stations:

- Lesperance Storm Pump Station Improvements;
- West St. Louis Storm Pump Station Improvements;
- New Consolidated Scully/St. Mark's storm pump station;
- PJ Cecile Storm Pump Station Improvements; and
- New Southwind Crescent Storm Pump Station.

Underground/Aboveground Storage

- Surface storage within the "Tecumseh Soccer Fields" Park at École Secondaire L'Essor;
- Surface storage within Buster Reaume Park; and
- Surface and Underground Storage within Tecumseh Centre Park.

As discussed, additional alternatives were developed for each Schedule B project and are included in Appendix D, Technical Report (Volume 2). A comparison of advantages and disadvantages of the alternatives is also included.

The projects have been "screened" to meet the requirements of a "Schedule B" project. Appendix C includes an assessment of potential impacts and mitigation measures, as well as additional investigation that must be completed during detailed design, prior to construction start.

The following provides a description of each Schedule B project.

12.1 Pump Station Improvements

The following section provides an overview of the pump station improvements identified within the Master Plan. Section 13.0 of Technical Report (Volume 2) provides additional detail regarding recommended improvements. The Functional design drawings for the pump station improvements are provided in Appendix G, Technical Report (Volume 2).

12.1.1 Lesperance Storm Pump Station Improvements

There are currently three different types of pumps at the existing Lesperance pump station:

- 1957 vertical turbine pump with a horizontal electrical motor and a gearbox

- 1986 a single screw pump station was constructed beside the existing facility
- 2002 expansion included a duplex submersible turbine pump station.

It is recommended that the 1957 vertical pump station and the screw pump station be demolished and the 2002 expansion pump station be kept in service. It is recommended to construct a new pump station expansion equipped with vertical submersible axial flow pumps similar to the 2002 pump station. The expansion of the pump station would be located east of the existing screw pump station.

The outfall from the existing and expansion pump station will merge to a single outfall pipe connected to the existing outfall structure. The outfall structure will have to be modified within its existing footprint to accommodate a larger size outfall pipe and to convey the increased flow.

12.1.2 West St. Louis Storm Pump Station Improvements

The pump station was construction in 1991 and is in good condition. The existing pump station design identified an expansion to the station to the east and through a review of the as-built drawings, the outfall was originally constructed to accommodate the expansion.

It is recommended to leave the existing pump station in service and to construct an expansion to the pump station east of the existing structure. The expansion would utilize vertical submersible axial flow pumps consisting of one duty and one stand-by pump in the expansion structure. An interconnection to the new pump station would be constructed from the existing inlet chamber. The outfall would be connected to the existing outfall structure by new outfall pipes.

12.1.3 Consolidated Scully/St. Mark's Storm Pump Station Improvements

There are currently three vertical turbine pumps installed at the existing Scully pump station. No upgrades have been completed since the station was put into operation in 1974. The electrical equipment is approaching end of its life. The St. Mark's pump station currently has two vertical turbine pumps and was constructed in 1957 and is also reaching its end of its life. The current pump station structures on both sites cannot be expanded to accommodate the increased flow.

Based on the age of the pump station infrastructure at this location and through the modelling analysis, it is recommended that a new pump station is constructed at the Scully pump station site to handle flow from a consolidated service area of the Scully and St. Mark's pump stations. The new station would utilize vertical submersible axial flow pumps. The station would be located north of the existing structure and will require a new inlet and outfall pipe, and expanded outfall structure. The existing pump stations would be kept in service during construction.

12.1.4 PJ Cecile Storm Pump Station Improvements

There are currently two vertical turbine pumps installed at the pump station both equipped with 40 hp motors. No upgrades have been completed since the station was put into operation in 1974. The electrical equipment is approaching end of its life.

It is recommended that a new pump station is constructed at the PJ Cecile PS site. Due to site restraints, the construction of the new pump station is proposed to be constructed over the footprint of the existing structure. The new station would utilize vertical submersible axial flow pumps. The installation of temporary pumps using portable pump stations is recommended to provide servicing during the construction. A new outfall pipe will be required to provide increased flow capacity. At this time, it is recommended to extend the new outfall to the northern end of the jetty bank to eliminate additional flow from entering the Beach Grove harbour, which is the location of the existing outfall. The inlet pipe to the pump station will be replaced with a larger diameter pipe in the existing alignment.

12.1.5 New Southwind/Starwood Pump Station

It is recommended a new pump station is constructed for the existing gravity outfall servicing the Southwind and Starwood residential development. The station is proposed to be constructed within the existing easement directly east of the Southwind right-of-way. The pump station will comprise of a below grade wet well and an above grade electrical panel. The existing outfall pipe will be maintained as the outlet and structure will be constructed within the existing easement.

12.2 Underground/Aboveground Storage

Three projects related to storage of surface water were identified as Schedule B undertakings and are outlined below.

12.2.1 Incorporate Surface Storage within the "Tecumseh Soccer Fields" at École Secondaire L'Essor

The Tecumseh Soccer Fields Park is owned by the L'Essor High School and Conseil Scolaire Catholique (CSC) Providence.

The proposed works include construction of a 0.70 m surface depression at the existing northern soccer fields to provide approximately 3,200 m^3 of aboveground surface storage with a 200mm diameter storm sewer connection to the existing 750 mm diameter storm sewer along St. Gregory's Road.

12.2.2 Incorporate Surface Storage within Buster Reaume Park

A surface flooding solution within the Lemire and Lanoue Street area to reduce surface flooding along both the localized roadways and within existing residential private properties was identified to be required. The preferred option includes constructing a 0.80 m depression along the southwestern portion of Buster Reaume Park to provide approximately 4,100 m^3 of aboveground surface storage with a connection to the upgraded municipal storm sewers.

12.2.3 Incorporate Underground/Surface Storage within Tecumseh Centre Park

Underground and surface storage of stormwater runoff in Tecumseh Centre Park is proposed to provide added resiliency to improve surface flooding in the Lesperance pump station service area, specifically along Lesperance Road fronting essential emergency service buildings including the Tecumseh OPP Police Station and Tecumseh Fire. The following SWM solution is recommended:

- Depression of open space green areas for approximately 1,081 m^3 of surface storage within Tecumseh Centre Park; and
- Incorporation of approximately 2,000 m^3 of underground system storage (Modelled as a series of Stormtech MC4500 units).

12.3 Estimated Capital Construction Costs and Implementation

The recommended surface flooding solutions outlined within this document have been designed to a level satisfying Approach 2 of the Master Planning process, in which all recommended surface flooding solutions are completed to a functional level of detail.

The recommended surface flooding solutions throughout the study area including, pump station improvements, storm sewer infrastructure improvements and localized storage area solutions for infrastructure upgrades are shown on Figure 12.2. Cost estimates for all the proposed infrastructure upgrades have been developed and are included in Table 12.1.

The cost assumptions for all recommended improvements for each of the service areas include the following:

- Construction cost estimates, including labour are based on 2018 unit prices and the accuracy of each estimate is +/- 10% and dependent on the timing of implementation;
- 30% contingency added for Capital Construction Costs;
- Future engineering costs calculated as 15% of capital construction costs;
- Future Geotechnical Investigations as 2% of capital construction costs;

As part of this study, it has been identified that no potential land acquisition is required to construct any of the recommended surface flooding solutions.

The implementation phasing outlined below has been broken down into each service area within the study. The service areas have been listed in order of need for the respective solutions to be constructed based on the existing conditions surface flooding identified through this study. The recommended improvements itemized for each service area have been listed based on the recommended phasing for each of the service areas. The recommended phasing has been determined based on both order of importance to the service area and the requirement for the improvement to be constructed for further solutions to commence with construction.

The implementation for the recommended solutions may be subject to change based on current capital works requirements, including road reconstruction and other municipal service improvements. At this time, the implementation of each solution has not been phased based on capital construction costs.

Table 12.1: Capital Cost Estimates and Implementation Phasing

Implementation Stage ID	Improvement Details	Estimated Construction Cost and Contingency	Engineering Cost	Total
LESPERANCE PUMP STATION SERVICE AREA				
PS-1	Lesperance Pump Station Improvements	$14.30M	$2.43M	$16.73M
LE-1	Lesperance PS Storm Trunk Sewer – Riverside Drive (St. Pierre Street to PS)	$1.30M	$0.22M	$1.52M
LE-2	St. Pierre Street Trunk Sewer	$3.93M	$0.67M	$4.60M
LE-3	Clapp Street Local Sewers	$0.64M	$0.11M	$0.75M
LE-4	Meander Crescent Local Sewers	$0.90M	$0.15M	$1.05M
LE-5	Underground/Aboveground Storage (Tecumseh Centre Park)	$3.21M	$0.55M	$3.76M
LE-6	Evergreen Drive Local Sewers	$0.93M	$0.16M	$1.09M
LE-7	Gauthier Drive Local Sewers	$0.88M	$0.15M	$1.03M
	SUBTOTAL =	*$26.09M*	*$4.44M*	*$30.53M*
CONSOLIDATED SCULLY/ST. MARK'S PUMP STATION SERVICE AREA				
PS-2	New Consolidated Scully/St. Mark's Pump Station	$9.88 M	$1.68M	$11.56M
SM-1	Scully/St. Mark's PS Storm Trunk Sewer – Riverside Drive (Arlington Boulevard to PS)	$1.63M	$0.28M	$1.91M
SM-2	Grant Avenue Diversion Sewer	$0.58M	$0.10M	$0.68M
SM-3	Aboveground Storage (Tecumseh Soccer Fields)	$0.25M	$0.04M	$0.29M
SM-4	Edgewater Drive Local Sewers	$2.22M	$0.38M	$2.60M
SM-5	St. Gregory's Road Local Sewers and Diversion	$0.68M	$0.12M	$0.80M
SM-6	St. Marks Road Local Sewers	$1.83M	$0.31M	$2.14M
SM-7	Arlington Boulevard Local Sewers	$2.34M	$0.40M	$2.74M
	SUBTOTAL =	*$19.39M*	*$3.31M*	*$22.70M*

Implementation Stage ID	Improvement Details	Estimated Construction Cost and Contingency	Engineering Cost	Total
WEST ST. LOUIS PUMP STATION SERVICE AREA				
PS-3	West St. Louis Pump Station Improvements	$7.15M	$1.21M	$8.36M
WSL-1	West St. Louis PS Storm Trunk Sewer – Riverside Drive (Barry Avenue to existing 2000mm storm sewer)	$1.72M	$0.30M	$2.02M
WSL-2	Little River Boulevard Underground Storage	$2.24M	$0.38M	$2.62M
WSL-3	Coronado Dish Local Sewers*	$5.14M	$0.88M	$6.02M
WSL-4	Lacasse Boulevard Local Sewers	$0.98M	$0.17M	$1.15M
WSL-5	Kimberly Drive and Jelso Place Local Sewers	$0.73M	$0.05M	$0.78M
	SUBTOTAL =	*$17.96M*	*$2.99M*	*$20.95M*
EAST ST. LOUIS PUMP STATION SERVICE AREA				
ESL-1	St. Thomas Street Overflow Sewer to Lakewood Park & Backflow Prevention	$0.62M	$0.10M	$0.72M
	SUBTOTAL =	*$0.62M*	*$0.10M*	*$0.72M*
EAST TOWNLINE DRAIN SERVICE AREA				
ETD-1	Aboveground Storage (Buster Reaume Park) & Backflow Prevention Device	$0.18M	$0.03M	$0.21M
ETD-2	Lemire/Lanoue Street Local Sewers and Sewer Diversion	$1.46M	$0.25M	$1.71M
ETD-3	Manning Road Phase 2 Drain Enclosure	$3.70M	$0.63M	$4.33M
	SUBTOTAL =	*$5.34M*	*$0.91M*	*$6.25M*
BAILLARGEON DRAIN SERVICE AREA				
BD-1	Charlene Lane Flooding Solution	$3.00M	$0.51M	$3.51M
BD-2	St. Anne Area Local Sewers*	$3.60M	$0.62M	$4.22M
	SUBTOTAL =	*$6.60M*	*$1.13M*	*$7.73M*
PJ CECILE PUMP STATION SERVICE AREA				
PS-2	PJ Cecile Pump Station Improvements	$7.02M	$1.20M	$8.22M
PJ-1	Kensington Dish Area Local Sewers	$3.96M	$0.68M	$4.64M
	SUBTOTAL =	*$10.98 M*	*$1.88M*	*$12.86M*

Implementation Stage ID	Improvement Details	Estimated Construction Cost and Contingency	Engineering Cost	Total
	SOUTHWIND/STARWOOD AREA			
PS-5/SS-1	New Starwood/Southwind Pump Station and Backflow Prevention Device	$0.90M	$0.15M	$1.05M
	SUBTOTAL =	*$0.90M*	*$0.15M*	*$1.05M*
	BRIGHTON PUMP STATION SERVICE AREA			
B-1	Tecumseh Road Storm Sewer Extension	$3.25M	$0.55M	$3.80M
	SUBTOTAL =	*$3.25M*	*$0.55M*	*$3.80M*
	TOTAL =	$91.13M	$15.46M	$106.59M

Construction costs include 30% contingency, Engineering costs include 15% engineering and 2% Geotechnical Investigations
All estimated costs above exclude applicable taxes
**Lumped areas for storm sewer reconstruction have the potential to be phased to implement upstream solutions earlier*

Beyond the larger scale projects identified above, a number of smaller catch basin inlet improvements are proposed within the study area to reduce surface flooding at a localized level. These minor storm inlet improvements have not been costed out at this time and include:

- Incorporation of Inlet Control Devices (ranging in sizes of 100 mm – 200 mm in diameter with flow restrictions ranging from 28 L/s – 129 L/s) within catch basins to promote surface ponding in areas currently not susceptible to surface flooding to reduce inflows into the storm sewer system; and
- Introduction of additional catch basins along roadways to increase inlet efficiency to reduce surface flooding.

Figure 12.3 illustrates the recommended localized storm inlet improvement locations.

Subject to resolving any concerns that may arise following the Notice of Completion and the required 30-day public and agency review period, implementation of any of the stages outlined above may proceed with detailed design and following the necessary agency and regulatory approvals, proceed to construction.

PART E: CONSULTATION

13.0 Public and Agency Consultation

This section of the Master Plan summarizes the public and agency consultation completed throughout the study. The consultation completed complies with the requirements of the Municipal Class EA. All consultation materials are included in Appendix A.

The contact list was updated throughout the study and included agencies, local Indigenous Communities and members of the public with an interest in the study.

13.1 Notice of Study Commencement

On April 28, 2017, Dillon mailed a copy of the Notice of Study Commencement to the study contact list, including all local indigenous communities. A copy of the contact list can be found in Appendix A. The notice was published in the April 28 and May 5, 2017 editions of the Tecumseh Shoreline newspaper, and uploaded to the Town of Tecumseh website.

Table 13.1 summarizes the input received as well as the study team response.

Table 13.1: Comments Received After Notice of Study Commencement

Comment	Project Team Response
Agencies	
Essex Region Conservation Authority (ERCA) ERCA advised staff are available to work with the study team throughout the project. ERCA has background information that can be provided to the team.	Comments noted. ERCA has meet with the study team and provided input, including in regards to high lake levels within Lake St. Clair.
General Public	
Email received on July 22, 2018 from individual asking if the ditch on the west side of Manning Road will be filled in from to Riverside Drive East.	Response indicated that the final design to enclose the remainder of the drain along the West side of Manning was being completed by the end of 2018. No specific timeline is identified by the Town for construction work to be completed.

13.2 Public Information Centre (PIC) No. 1

The first PIC was held July 25th, 2018 from 3:00 to 5:00pm and 6:00 to 8:00pm at the Royal Canadian Legion Branch 261 on Lanoue St in the Town of Tecumseh. The purpose of the PIC was to present:

- Project need, including information on why surface flooding occurs;
- Problem areas identified in the storm sewer and overland drainage systems; and,
- Alternative storm drainage solutions considered and recommended regional solutions.

The Notice was sent to the study Contact List and Indigenous Communities on July 12, 2018. It was published in the July 13th and 20th, 2018 editions of Tecumseh Shoreline newspaper, and posted on the Town of Tecumseh website.

The PIC was attended by 33 people. Table 13.2 summarizes the input received at and following the PIC.

Table 13.2: Comments Received from PIC #1

Comment	Project Team Response
Comment Forms	
Concern regarding surface flooding that has extended 15-20 feet up driveways.	Comments noted.
Concern regarding the affect new development has on flooding in existing residential areas.	Comments noted.
Ditches should be free of trees and vegetation to allow for the free flow of stormwater.	Comments noted.
Can sensors be used to monitor water flow and use this information to inform residents of potential flooding events.	Comments noted.
Attendee questioned when construction would be completed, requested the ability to have discussions on resident needs at PIC #2, and a request to clean the ditches out.	Comments noted.
Notes from Project Team Interactions with Attendees	
Implementation of an alert system to residents once accumulated rainfall amounts reach a point of basement flooding potential.	Comments noted.
Has the Victoria School site has been properly assessed in its fully developed state for stormwater solutions?	The developer will be responsible to provide adequate SWM controls to not negatively impact external lands.
Concerns regarding basement flooding and the overwhelming of private sump pumps, increased pressure on basement walls and	This study focused on surface flooding and did not review basement flooding. The

Comment	Project Team Response
floors.	Town has other programs to address basement flooding issues.
Feedback Provided from Notes Left on PIC Panels	
The recommended plan needs to be affordable.	Comments noted.
Redirection of priorities for the Town from indoor sports to public infrastructure.	Comments noted.
Larger diameter storm drains along Riverside Drive E. from Arlington Boulevard to Kensington Boulevard are required	Comments noted.
Prevent Beach Grove Golf Course from pumping ponding areas during heavy rain events.	Comments noted.
Increase permeable paving.	Comments noted.
Look at new technologies that allow piped stormwater to infiltrate into the ground.	Comments noted.
Continue downspout disconnection.	Comments noted.
Limithardscape on residential driveways.	Comments noted.
Increase high density planning to reduce impervious surfaces.	Comments noted.
Emails Received After PIC #1	
Email received on July 26, 2018. Resident expressed concern regarding the potential increases in standing water of 15-30 cm during high water events on Oak Park Drive. Asked if localized flooding solutions can be implemented over entire street. Requested clarification on modeling using 2016 water levels for proposed alternative and the calculations used, and clarification. Asked if there are additional localized flooding solutions for drainage when capacity is reached.	Modelling suggests that the surface flooding on Oak Park Drive is a more localized matter. The Study Team identified the opportunity to introduce inlet control devices at catchbasins along Oak Park to distribute surface flooding more evenly. This results in some areas having an increased level of surface flooding, although within the allowable provincially and regionally accepted limits of less than 0.30m. A climate change scenario was run and

Comment	Project Team Response
	surface flooding solutions were adapted to a higher level of service, where warranted based on the evaluation decision framework.
Email received February 10, 2018. Concern that during flooding events, the stormwater pipes are unable to accommodate the surface water and it then backs up through the storm drain into the resident's back yard and basement. The issue may be caused by the 30" storm drain supplied by the Town.	Public Works Department will review existing sewer system to confirm there are no blockages downstream of the resident's location. Drainage Superintendent to contact the resident to investigate foundation drains and discharge pipes in basement, and provide suggestions on further flood-proofing techniques. Provided resident with detailed schematic of sump pump discharge conversion.

13.3 Public Information Centre (PIC) No. 2

The second PIC was held February 6th, 2019 from 3:00 to 5:00pm and 6:00 to 8:00pm at the Royal Canadian Legion Branch 261 on Lanoue St in the Town of Tecumseh. The purpose of the PIC was to present:

- Recommended solutions to reduce surface flooding for each problem area; and
- Information on recommended Schedule B projects.

The Notice was sent to the Contact List and Indigenous Communities on January 22nd, 2019. It was published in the January 25th and February 1st, 2019 editions of Tecumseh Shoreline newspaper, and posted on the Town's website.

The PIC was attended by 27 people. Table 13.3 summarizes the comments received.

Table 13.3: Comments Received from PIC #2

Comment	Project Team Response
Comments received from one attendee include: • Cost of the project • Concern regarding the lack of stormwater treatment prior to discharge into the lake • No beautification or landscaping has been included in	Comments noted.

Comment	Project Team Response
the alternative solutions for temporary storage of stormwater in the parks • Improving bioswales and reducing hardscapes should be considered.	
Prioritize the prevention of stormwater discharge into sanitary sewers. Comments that mandatory disconnection be implemented.	Comments noted. Being assessed further under a separate study of the Town's sanitary system.
Focus on more efficiencies with the pumping stations to expel water to Lake St. Clair	Improvements to the pumping stations through this study prioritize enhanced level of service with added resiliency for climate change.
Concern over how long it will take to improve the flood zone on Dillon Drive with a focus on the areas around the Lesperance Road Pump Station. Consideration be taken to improve the roadway of Dillon Drive.	Comments noted.
A resident emailed photos on February 7, 2019 of flooding that occurred on their property.	Comments noted.

13.4 Indigenous Communities Consultation and Engagement

Indigenous Communities identified as potentially interested in the project include Walpole Island, Caldwell, Aamjiwanaang, Chippewas of the Thames, and Moravian of the Thames (Delaware Nation).

All project Notices were sent to the Indigenous Communities on the contact list along with a covering letter.

Table 13.4 summarizes the comments received from Indigenous Communities, as well as the study team response. A full consultation log and detailed communications with Indigenous Communities is included in Appendix A.

Table 13.4: Comments Received from Indigenous Communities

Comment	Project Team Response
Caldwell First Nation On May 10, 2017, Dillon spoke with Caldwell First Nation to ask if there were any questions or comments regarding the project. Caldwell requested an Executive Summary of the project, indicated concern over Species At Risk	Comments noted. Project Team indicated: • Provided a brief project description, a map of the Pump Station Service Area, and directed them to review the Project website for more information. PIC slides were also provided. • A desktop review of the existing natural environment,

Comment	Project Team Response
within the study area, and water quality mitigation.	including a screening for species at risk, will be completed as part of the study. Site reconnaissance by a biologist will be completed at specific locations based on the alternative solutions to determine potential impacts. • Water quality considerations will be addressed through the identification of potential Best Management Practices and confirmed during detailed design.
Chippewas of the Thames First Nation On May 5, 2017, the First Nation indicated it does not have any concerns regarding the study. They requested to be kept informed if any major changes are made to the study.	Comments noted.

One presentation was made by Dillon and Town of Tecumseh staff to the Aamjiwanaang First Nation (AFN) Environmental Committee on February 5th, 2019 addressing comments received on September 7, 2018.

Table 13.5 includes a summary of comments in the letter from September 7, 2018.

Table 13.5: Comments Received from AFN Environmental Committee, September 7, 2018

Comment	Project Team Response
Concerns with road mortalities during construction. Requests information on Project Team's plan to mitigate impacts on wildlife	Advised that majority of the recommended flooding solutions will be constructed within the fully urbanized portion of the Town within the municipally-owned roadway right-of-way where very limited natural wildlife is present. Based on field investigations completed, it is unlikely wildlife and/or natural habitats will be impacted by the construction works. Further investigation will be required as part of detailed design.
Requests that any habitat areas disturbed or removed as a result of project be restored, wherever possible.	Comments noted. This will be included in the EA commitments and addressed during detailed design.
Any wildlife corridors that are disturbed due to the project be restored after completion of the project	Comments noted. This will be included in the EA commitments and addressed during detailed design.
Requests that native plant species be re-planted	Comments noted. This will be included in the EA

Comment	Project Team Response
or planted in another significant area near the project area	commitments and addressed during detailed design.
Requested copies of the existing mitigation plans	Mitigation plans will be included in the EA document.
What watercourses to the outlets go to?	The existing stormwater outfalls will be maintained under future conditions. The outfalls are directed to Lake St. Clair and Pike Creek.
What stage of phosphorus treatment will be implemented and will be project meet criteria for the domestic action plan for phosphorus reduction.	There are currently no reduction targets identified for runoff directly discharging from the shorelines within the Town of Tecumseh into Lake St. Clair. Water quality and phosphorous loading requirements will be confirmed during detail design.
What efforts are being made to include best available technology?	Comments noted. During detailed design of each solution, the best available materials will be used, utilizing the latest in storm sewer and underground storage technology. The current study is already using the best available software technology (2 Dimensional modelling) to more accurately predict surface flooding throughout the study area during design 1:100 year and climate change storm events.

Table 13.6 includes a summary of comments received at the Environmental Committee meeting on February 5, 2019. Comments not addressed from the September 7, 2018 letter at the second EC meeting presentation were addressed in the meeting minutes provided to the AFN Environmental Committee members on February 20th, 2019.

Table 13.6: Comments Received from AFN Environmental Committee, February 5, 2019

Comment	Project Team Response
How is debris removed from storm runoff prior to being pumped to the lake/river?	Large suspended solids are typically held back by stand-in-place bar screens prior to reaching the pumps and being pumped into Lake St. Clair. There are several ways to mitigate against solids entering the pump station such as large stand-in-place bar screens or mechanical multi-rake bar screen devices. Example images of the two types of screens were provided to the Environmental Committee.

Comment	Project Team Response
Request to review any documentation regarding assessments completed for Species at Risk (SAR).	Provided Natural Environment Team summary memo documenting the SAR considerations that have been completed to date. Further investigations to be completed during future detailed design.
Concern with the SAR and the potential for habitat impacts from the project. Asked if the previous Manning Road Improvements Class EA and if any input was provided from the Walpole Island First Nation.	The study team will review the Manning Road Improvements, Class EA (2009) for any documented concerns regarding SAR. Will follow up on any SAR concerns found in the Manning Road EA and address them as part of the Drainage Study Master Plan. A recent SAR assessment was completed as part of this study surrounding all proposed pump station improvements.

13.5 Consultation Regarding Schedule B Projects

Five meetings were held with residents directly impacted by the pump station projects in January 2019 (prior to PIC 2):

- Lesperance, West St. Louis and Scully Pump Station: 18 properties were notified of the project on January 23, 2019 and invited to attend PIC2. A meeting regarding the Lesperance Pump Station was held January 30, 2019 and was attended by two residents.
- Southwind Pump Station: 6 residential homes and 1 business were invited to attend a meeting on January 28 and 30, 2019. Four residents and one representative from Southport Sailing Club attended the meetings.
- PJ Cecile Pump Station:
    - Beachgrove Golf and Country Club was contacted in early January and a meeting was held on January 22, 2019 to discuss the pump station potential relocation. Two representatives from Beachgrove Golf and Country Club attended the meeting.
    - A second meeting with the Kensington Beach Owners Group was held on January 30, 2019. 10 people were notified and six individuals attended.
- Tecumseh Soccer Fields Surface Storage:
    - A meeting was held with CSC Providence on January 11th, 2019 to discuss the study. A presentation to the board was made February 11th.No comments were received.

The presentation slides and minutes from the meetings are included in Appendix A. Table 13.7 summarizes the comments received at the meetings.

Table 13.7: Comments Received from Meetings Associated with Schedule B Pump Station Projects

Comment	Project Team Response
Lesperance Pump Station	
Expressed concerns regarding the work proposed within the Lesperance Pump Station park area. Currently unhappy with the noise of the pump station and the size of the structure.	Acknowledged the concerns of the residents. Noise reduction technology will be used surrounding the pump station generators and will be further reviewed during detailed design.
Identified Alternative 2 as the preferred option	Comments noted.
What is the difference between the pump types?	Vertical pumps are typically used for storm pump stations. Screw pumps, although simplistic in design and highly reliable, are expensive to maintain when they break down.
Southwind Pump Station – Residents	
One resident would prefer to have the pump station located outside of the easement, as it is along the front side yard of their property.	Comments noted.
Could the pump station be built under the roadway?	This would be more costly due to potential utility conflicts and the need to reconstruct the roadway. The aboveground electrical panel for the pump station could be constructed within the municipally owned right-of-way.
Is the pump station legally allowed within a storm water easement?	Identified that details of maintenance easements are very general, but typically allow for storm infrastructure to be built.
One resident does not prefer Option 2, as the pump station would be directly across the street from home.	Comments noted.
One resident requested assurance that Option 3 was not in front of home, but on the adjacent sailing club property	Identified that for Option 3, the pump station would be on the sailing club property.
Southwind Pump Station – Southport Sailing Club	

Comment	Project Team Response
Concerns over Option on sailing club property. Potential long term plans which may include future gravel laneway at the location of the outlet alignment.	Comments noted. Identified that a maintenance easement would be required for the pump station, but a gravel laneway could be accommodated.
Concern that outlet location in Option 3 is in the existing area of boat.	Initial review identified that the outfall would need to be positioned at this location for Option 3 to be feasible.
All members must weigh-in on decision regarding location of the pump station.	Comments noted.
PJ Cecile Pump Station – Beachgrove Golf and Country Club	
ERCA advised the outfall is a benefit to the harbour, as it eliminates stagnant water and encourages flow through the marina.	Comments noted.
The existing jetty is predominantly made of armour stone and larger concrete pieces.	A rock cairn outfall similar to the East Townline Drain pump station could be incorporated in the design to make it aesthetically pleasing. De-watering the jetty during construction to excavate could be very challenging and costly.
The Club is considering plans for the proposed Option 4 pump station outfall location.	Identified that the outfall for Option 4 could be orientated and constructed in a way to complement the potential development along the waterfront.
Elimination of parking spaces for pump station.	The building footprint for either pump station option could be very minor (minimum 3m x 4m building) to reduce the number of parking spaces being eliminated. The housing for the pump station could also be architecturally pleasing to fit in with the clubs existing buildings.
Opposed Option 2 & 4 due to the constraints already known within the clubs parking area	Comments noted.
PJ Cecile Pump Station – Kensington Beach Residents Association	

Comment	Project Team Response
Kensington Beach has a maintenance access of approximately 20 feet needs to be maintained post-construction.	Comments noted.
Beach access needs to be maintained. Residents identified Alternative 1 – Option C as not their preferred choice.	Comments noted. The project team identified that Alternative 1 - Option C of a new pump station outlet through the Kensington Beach would require that the beach be no longer accessible to residents, as it would be reconstructed to an outlet channel. Identified that it would be difficult to maintain the existing 20 foot maintenance access to the beach under Alternative 1- Location Option 4 where the station would be constructed north of the existing site.
Concerns with the condition of roadways, in particular Kensington Blvd. Prioritize reconstruction of area.	Identified that it is always recommended to construct the pump station first prior to upstream stormwater works, but that phasing could be further reviewed in the future. The PJ Cecile pump station was identified to be 10-15+ years from being replaced.
Alternative 2 as preferred option. Not opposed to Alternative 1 – Location Option 1/Outfall Option B.	Comments noted.

14.0 Implementation/Phasing and Detailed Design

14.1 Implementation Considerations

The recommended solutions outlined with this study to reduce surface flooding are generally extensive, broader-based projects that are expected to be phased over a long-term implementation plan. In particular, the majority of the storm sewer infrastructure improvements that form solutions are expected to be implemented in conjunction with the planned reconstruction of roadways and other municipal infrastructure based on schedules defined within the Town of Tecumseh's Long Term Capital Works Plan.

In order to achieve more immediate surface flood relief in certain areas, phasing of larger storm sewer infrastructure solutions may be deemed beneficial in improving the resiliency of the system to address flood vulnerability and climate change considerations. If phasing of the broader-based storm infrastructure improvements is preferred, the PCSWMM model should be further evaluated based on the interim phasing of projects to assess the impacts on the system prior to full build out of the solutions.

The findings of this study and solutions are functional in nature and provide sound direction on the nature of the designs that would be effective in addressing surface flooding concerns. A proposed construction implementation strategy has been identified above in Section 12.3 with implementation considerations further detailed for the study area in Section 15.0 of the Technical Report (Volume 2).

14.2 Detailed Design Considerations

During detailed design of the functional design solutions outlined within this study, it is recommended that the following design considerations be included:

- Further geotechnical assessments;
- Erosion and coastal assessment surrounding areas of pump station and outlet improvements;
- Erosion and sediment control plans;
- Water management plan during construction of in-water works at pump station outfalls;
- Further archaeological investigation, as required, for submission to the Ministry of Tourism, Culture and Sport (MTCS);
- Additional natural environment investigations, if required in support of permits/approvals from MECP;
- Potential requirements for water quality control for any of the recommended solutions involving upgrades to the storm sewer infrastructure where roadways are being reconstructed from semi-urban cross sections to fully urban roadway cross sections as directed by the MECP during the Environmental Compliance Process;

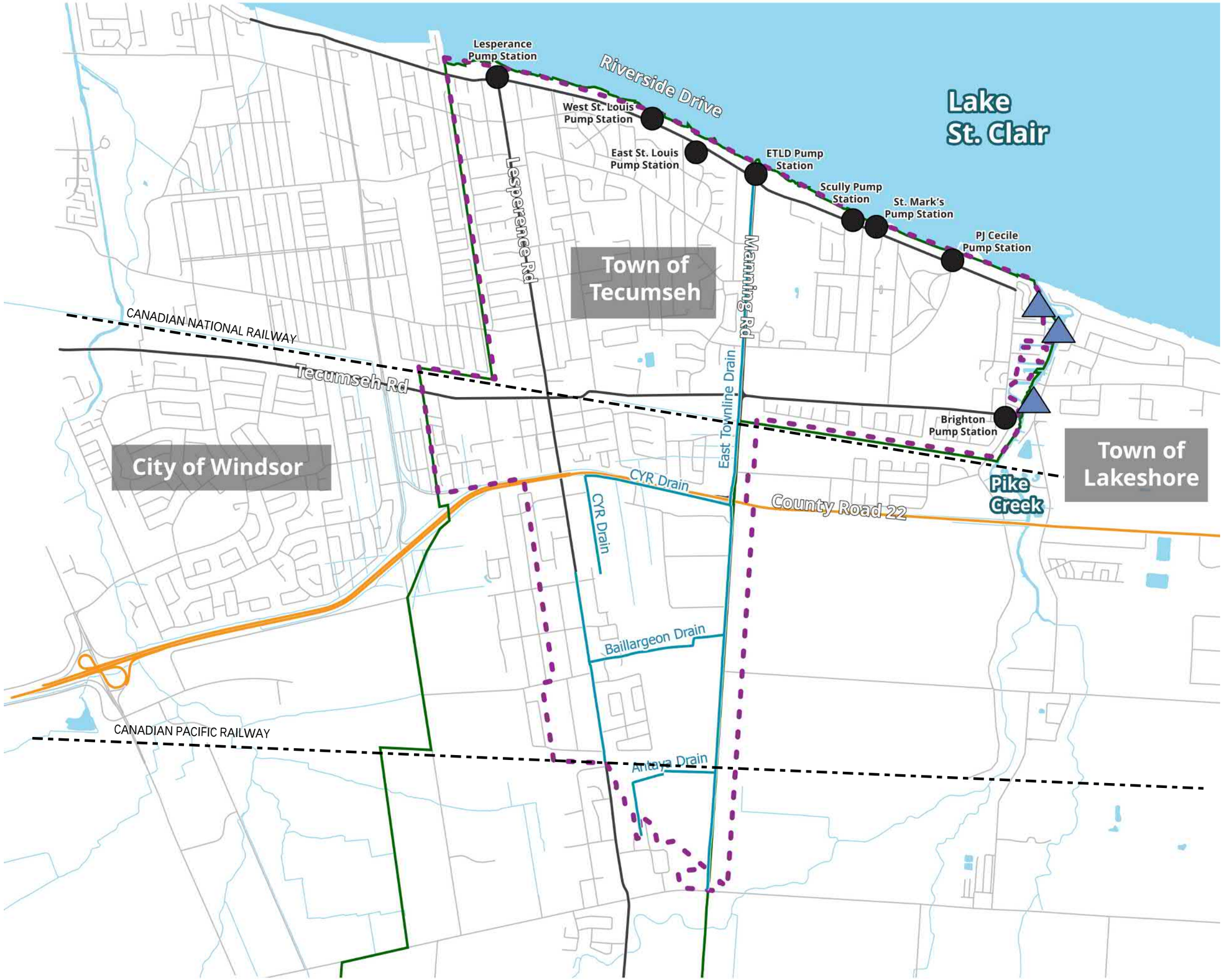
- Obtain permits from appropriate agencies as required; and
- Use of Low Impact Development techniques.

14.3 Next Steps

The following studies, design and approval requirements will influence the schedule for implementation of the solutions outlined in this report:

- Potential refinement of the recommended solutions based on any future developments (greenfield or infill) not assessed within this study that could impact the design of each solution;
- Detailed design of all recommended improvements;
- Environmental Compliance Approvals for all storm sewer and pump station infrastructure works; and
- Essex Region Conservation Authority and municipal permitting and approvals.

Figures



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

STUDY AREA AND MUNICIPAL DRAINAGE MAP
FIGURE 1.1

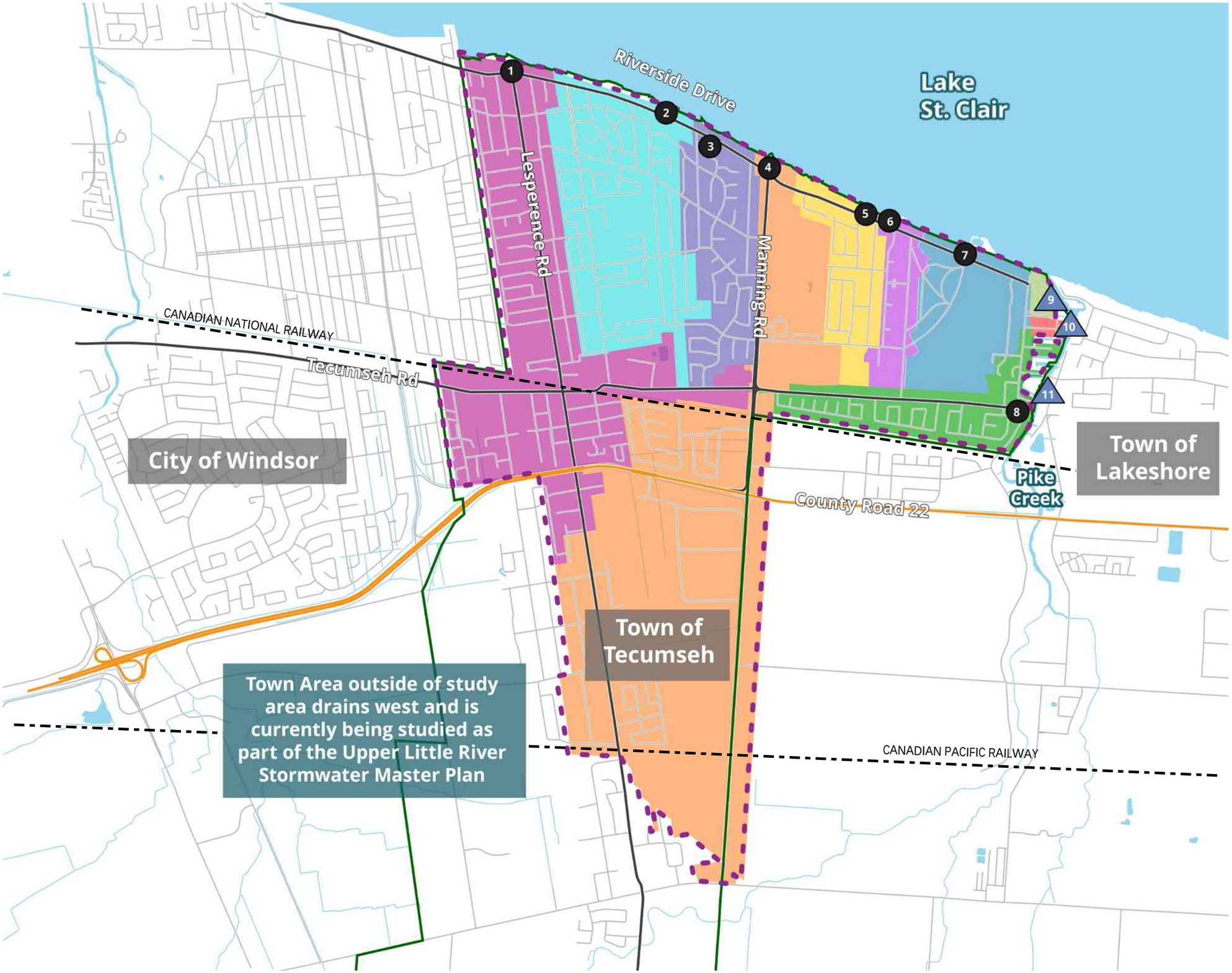
- SEWER GRAVITY OUTFALLS
- PUMP STATION (PS)
- STUDY BOUNDARY
- RAILWAY
- MUNICIPAL DRAIN
- MUNICIPAL BOUNDARY
- MINOR STREET
- MAJOR STREET
- HIGHWAY

SCALE 1:NTS 2

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 16-4880
STATUS: FINAL
DATE: JUNE 2019



TOWN OF TECUMSEH
ONTARIO · CANADA

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

STORM PUMP STATION SERVICE AREA AND GRAVITY OUTFALL MAP
FIGURE 1.2

- SEWER GRAVITY OUTFALLS
- PUMP STATION (PS)
- STUDY BOUNDARY
- RAILWAY
- MUNICIPAL DRAIN
- MUNICIPAL BOUNDARY
- MINOR STREET
- MAJOR STREET
- HIGHWAY

PUMP STATION CATCHMENT AREAS

- 1. LESPERANCE PUMP STATION
- 2. WEST ST. LOUIS PUMP STATION
- 3. EAST ST. LOUIS PUMP STATION
- 4. EAST TOWNLINE DRAIN PUMP STATION
- 5. SCULLY PUMP STATION
- 6. ST. MARK'S PUMP STATION
- 7. PJ CECILE PUMP STATION
- 8. BRIGHTON PUMP STATION

OUTFALL CATCHMENT AREAS

- 9. PILOTS COVER OUTFALL
- 10. SOUTHWIND/STARWOOD OUTFALL
- 11. MEI-LIN OUTFALL

SCALE 1:NTS 2

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

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LESPERANCE P.S.
RIVERSIDE DRIVE
WEST ST. LOUIS P.S.
EAST ST. LOUIS P.S.
EAST TOWNLINE DRAIN P.S.
SCULLY P.S.
ST. MARK'S P.S.
PJ CECILE P.S.
MANNING ROAD
LESPERANCE ROAD
PILOTS COVER OUTFALL
SOUTHWIND / STARWOOD OUTFALL
BEACH GROVE
BRIGHTON ROAD
TECUMSEH ROAD
MEI-LIN OUTFALL
BRIGHTON ROAD P.S.
CANDIAN NATIONAL RAILWAY
COUNTY ROAD 22
FUTURE DEVELOPMENT AREA
MANNING ROAD
CANDIAN PACIFIC RAILWAY
COUNTY ROAD 42

EXISITING GROUND ELEVATIONS

- 175.001 m - 175.500 m
- 175.501 m - 176.000 m
- 176.001 m - 176.250 m
- 176.251 m - 176.500 m
- 176.501 m - 176.750 m
- 176.751 m - 177.000 m
- 177.001 m - 177.250 m
- 177.251 m - 177.500 m
- 177.501 m - 177.750 m
- 177.751 m - 178.000 m
- 178.001 m - 178.500 m
- 178.501 m - 179.000 m
- 179.001 m - 179.500 m
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- 181.501 m - 182.000 m
- 182.001 m - 182.500 m
- 182.501 m - 183.000 m
- 183.001 m - 183.500 m
- 183.501 m - 184.000 m
- 184.001 m - 184.500 m

PUMP STATION LOCATION (P.S.)
GRAVITY OUTFALLS
PUMP STATION CATCHMENT AREAS
FUTURE DEVELOPMENT AREA
RAILWAY

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

STUDY AREA TOPOGRAPHIC LiDAR MAP

FIGURE 3.1

TOWN OF Tecumseh ONTARIO · CANADA

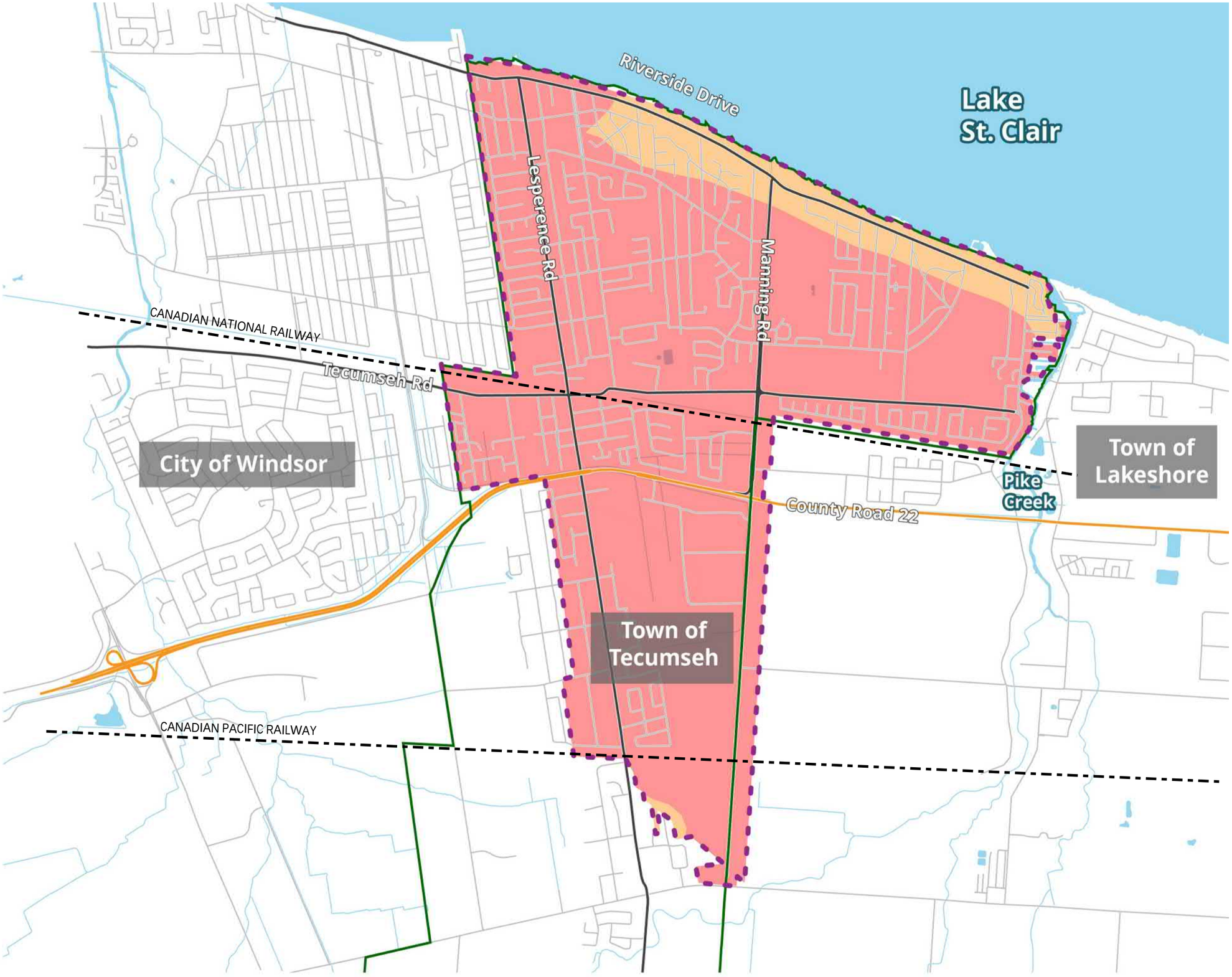
DILLON CONSULTING

MAP CREATED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

SCALE 1:NTS

2

PROJECT: 16-4880 STATUS: FINAL DATE: JUNE 2019



TOWN OF TECUMSEH
ONTARIO · CANADA

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

OMAFRA SOILS MAP
FIGURE 3.2

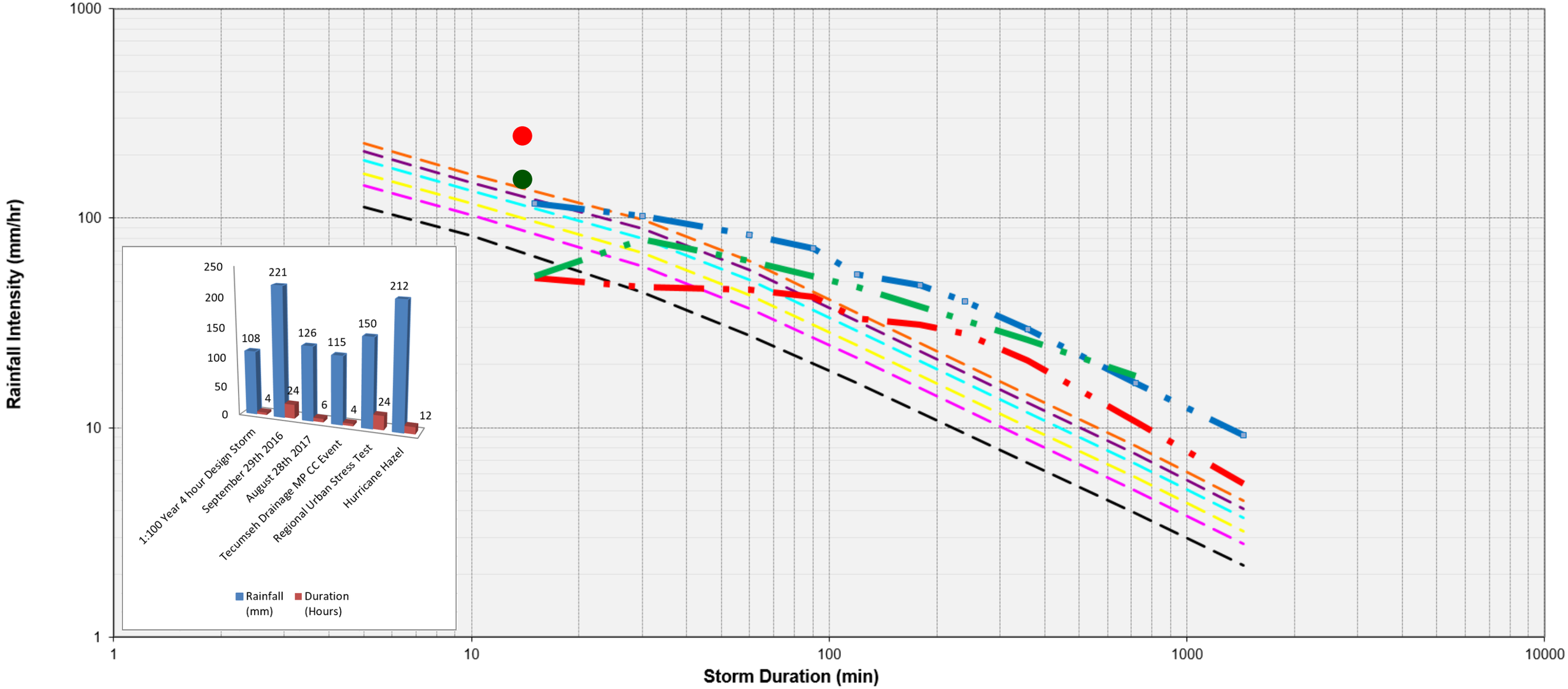
- HYDROLOGIC SOIL TYPE C
- HYDROLOGIC SOIL TYPE D
- STUDY BOUNDARY
- RAILWAY
- WATER COURSE
- MUNICIPAL BOUNDARY
- MINOR STREET
- MAJOR STREET
- HIGHWAY

SCALE 1:NTS 2

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 16-4880
STATUS: FINAL
DATE: JUNE 2019



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

CLIMATE CHANGE AND HISTORICAL STORM EVENT COMPARISON
FIGURE 3.3

TOWN OF Tecumseh ONTARIO · CANADA

- TECUMSEH STORM DRAINAGE MP CLIMATE CHANGE EVENT MAXIMUM INTENSITY (241 mm / hr)
- REGIONAL URBAN STRESS TEST EVENT MAXIMUM INTENSITY (145 mm / hr)
- 1:2 - YEAR (WINDSOR IDF)
- 1:5 - YEAR (WINDSOR IDF)
- 1:10 - YEAR (WINDSOR IDF)
- 1:25 - YEAR (WINDSOR IDF)
- 1:50 - YEAR (WINDSOR IDF)
- 1:100 - YEAR (WINDSOR IDF)
- SEPTEMBER 29TH 2016 EVENT
- AUGUST 28TH 2017 EVENT
- HURRICANE HAZEL

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MAP CREATED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 16-4880 STATUS: FINAL DATE: JUNE 2019

TOWN OF TECUMSEH
ONTARIO · CANADA

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

SURFACE FLOODING PROBLEM AREAS - W-1 & W-2
FIGURE 6.1

- PUMP STATION (P.S.)
- ISOLATED SURFACE FLOODING PROBLEM AREAS
- STUDY AREA
- PARKLAND/ PRIVATE PROPERTY NOT TO BE ANALYZED
- STREETS
- REGIONAL SURFACE FLOODING PROBLEM AREAS

1:100 SURFACE PONDING

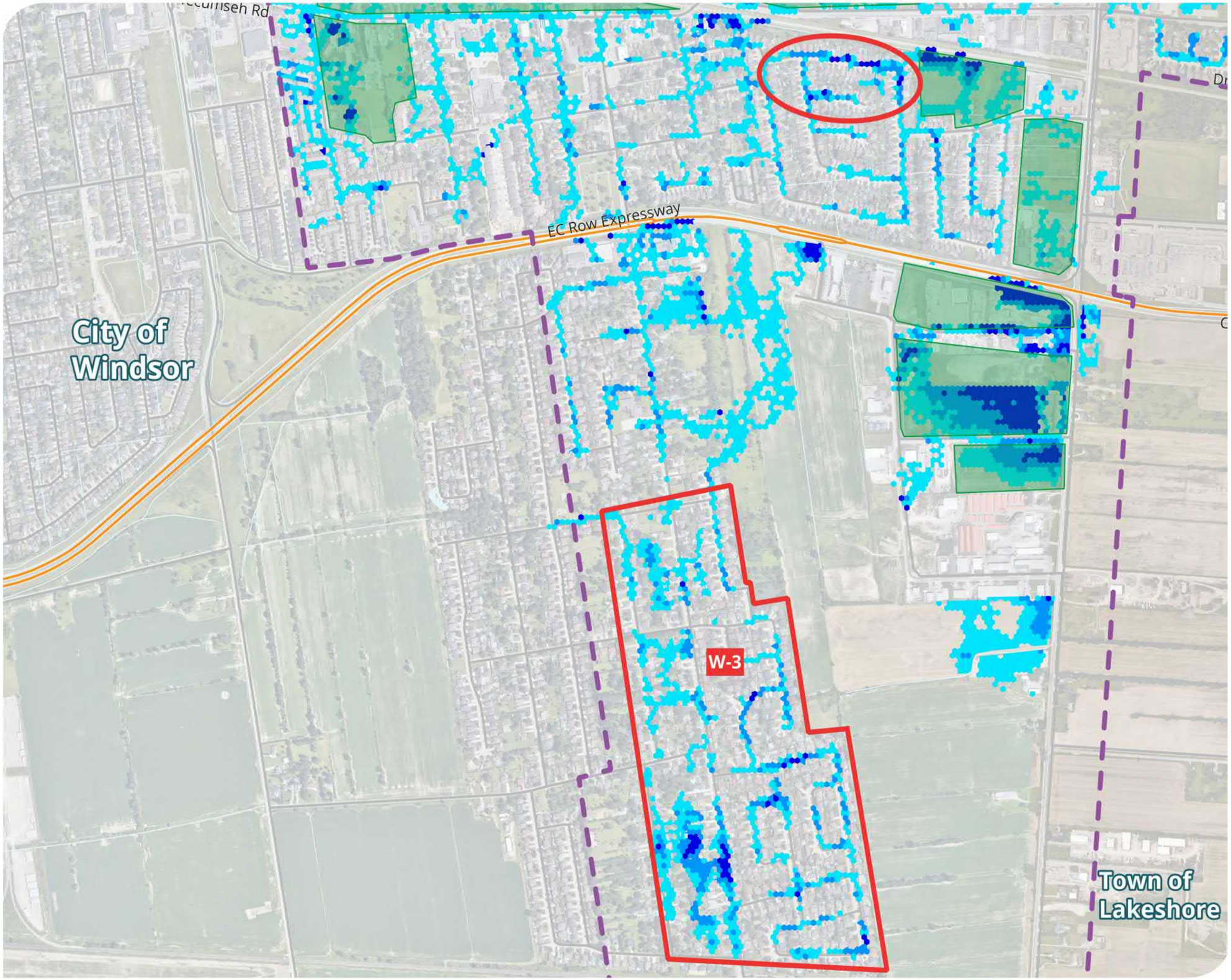
- LESS THAN 0.15m DEPTH
- BETWEEN 0.15m - 0.30 m DEPTH
- OVER 0.30m DEPTH

SCALE 1:NTS 2

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 16-4880
STATUS: FINAL
DATE: JUNE 2019



TOWN OF TECUMSEH
ONTARIO · CANADA

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

SURFACE FLOODING PROBLEM AREAS - W-3
FIGURE 6.2

- ISOLATED SURFACE FLOODING PROBLEM AREAS
- STUDY AREA
- PARKLAND/ PRIVATE PROPERTY NOT TO BE ANALYZED
- STREETS
- REGIONAL SURFACE FLOODING PROBLEM AREAS

1:100 SURFACE PONDING

- LESS THAN 0.15m DEPTH
- BETWEEN 0.15m - 0.30 m DEPTH
- OVER 0.30m DEPTH

SCALE 1:NTS 2

MAP CREATED BY: SZ
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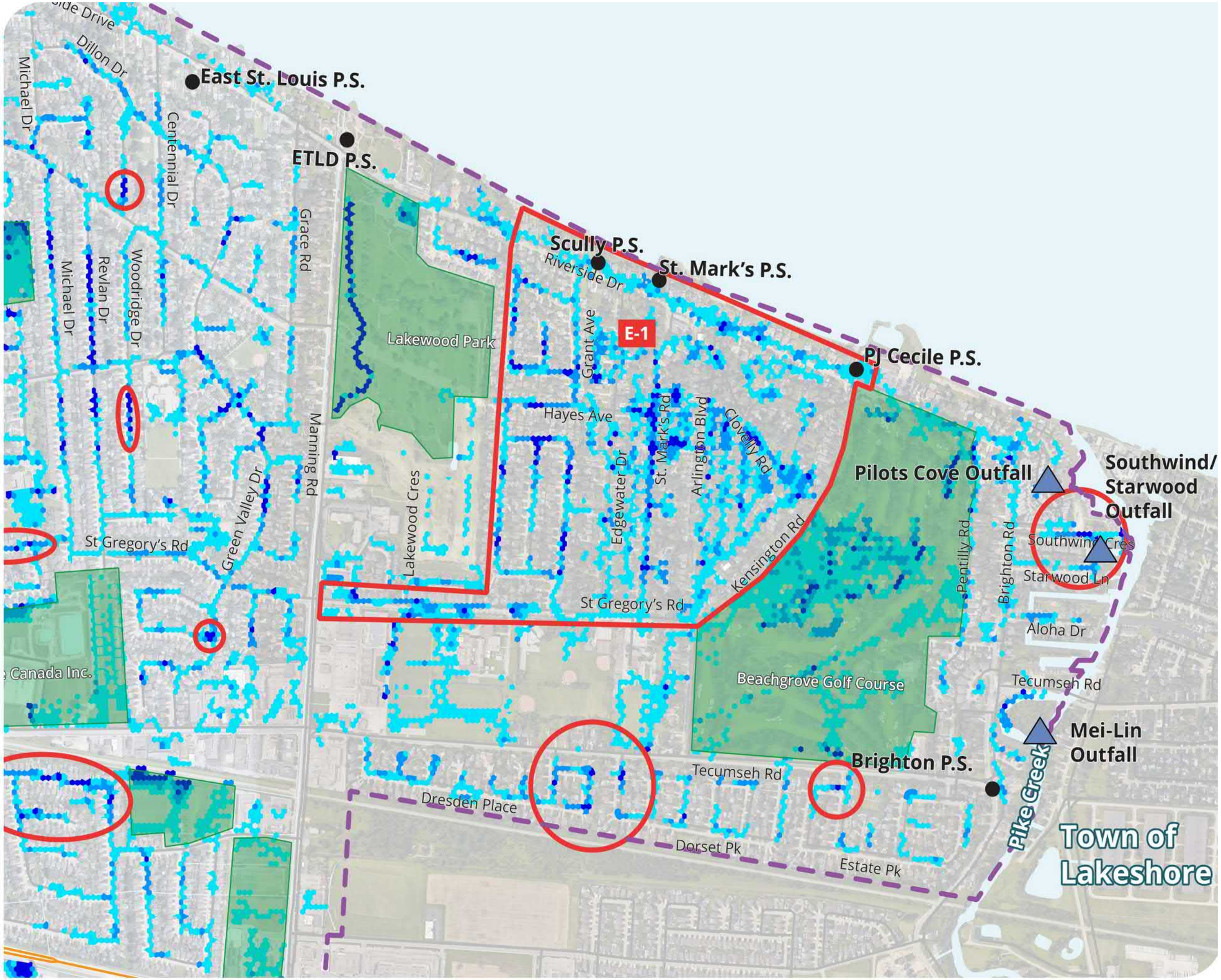
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 16-4880
STATUS: FINAL
DATE: JUNE 2019



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

SURFACE FLOODING PROBLEM AREAS - E-1

FIGURE 6.3

- PUMP STATION (P.S.)
- SEWER GRAVITY OUTFALLS
- ISOLATED SURFACE FLOODING PROBLEM AREAS
- STUDY AREA
- PARKLAND/ PRIVATE PROPERTY NOT TO BE ANALYZED
- STREETS
- REGIONAL SURFACE FLOODING PROBLEM AREAS

1:100 SURFACE PONDING

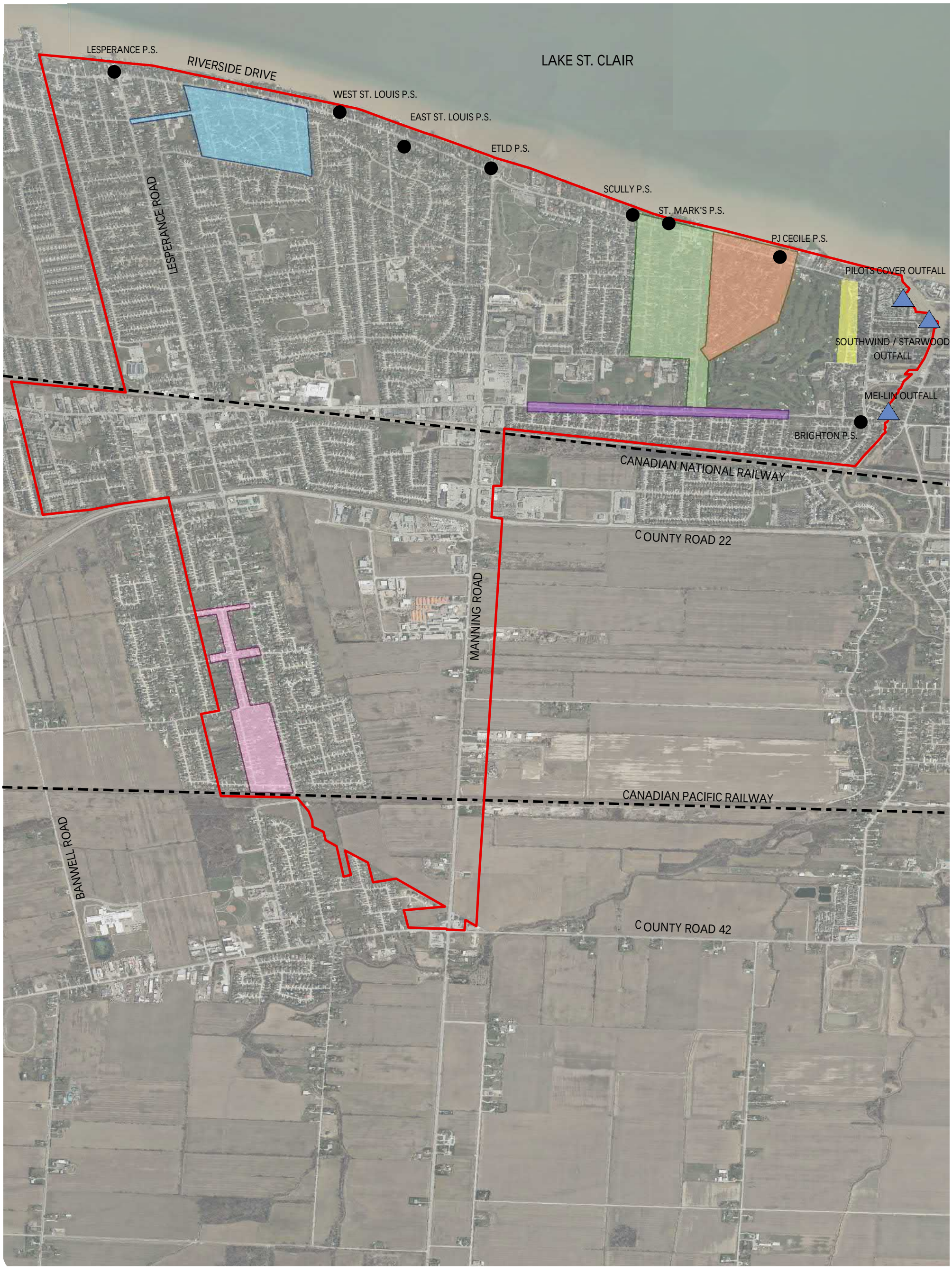
- LESS THAN 0.15m DEPTH
- BETWEEN 0.15m - 0.30 m DEPTH
- OVER 0.30m DEPTH

SCALE 1:NTS 2

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 16-4880
STATUS: FINAL
DATE: JUNE 2019



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

STUDY AREA ROADWAYS WITH SEMI-URBAN CROSS SECTIONS
FIGURE 8.0

SEWER GRAVITY OUTFALL
PUMP STATIONS (P.S.)
STUDY AREA
RAILWAY
TECUMSEH ROAD
ST. ANNE AREA
CORONADO DISH AREA
PENTILLY ROAD (ALREADY RECONSTRUCTED)
EDGEWATER/ ST. MARKS/ ARLINGTON AREA
KENSINGTON DISH AREA

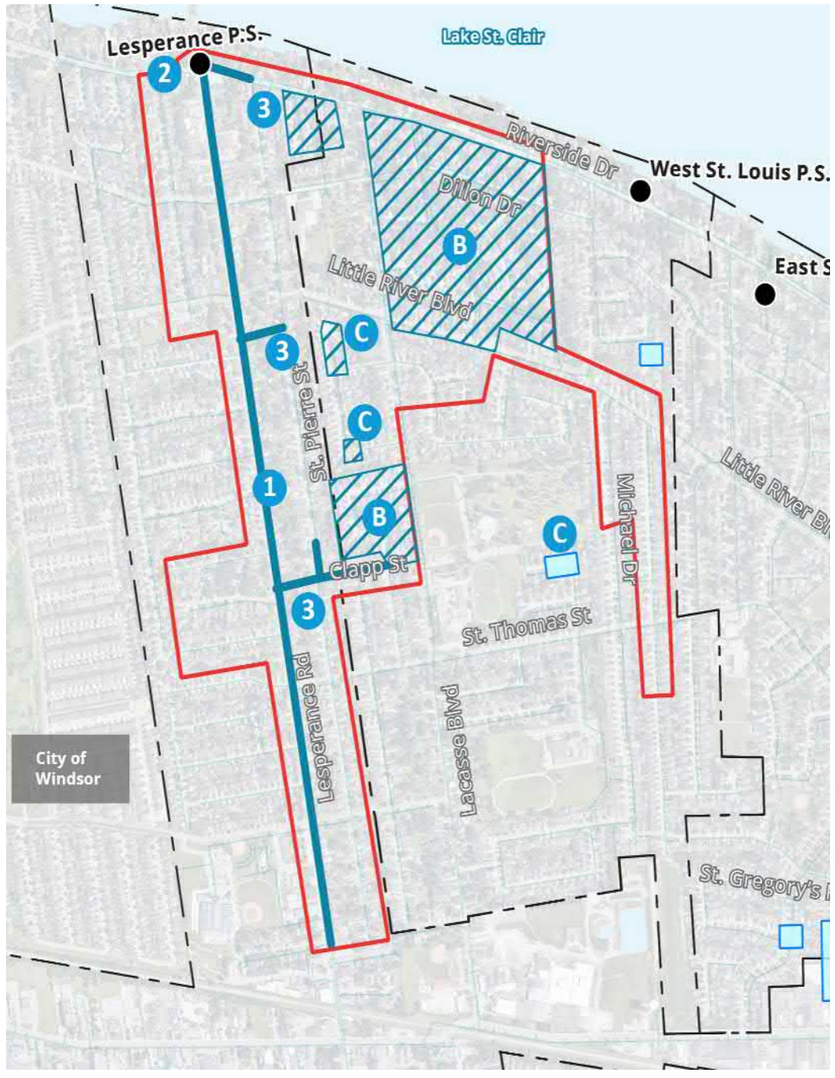
MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

SCALE 1:NTS

2

PROJECT: 16-4880 STATUS: FINAL DATE: JUNE 2019

ALTERNATIVE 1



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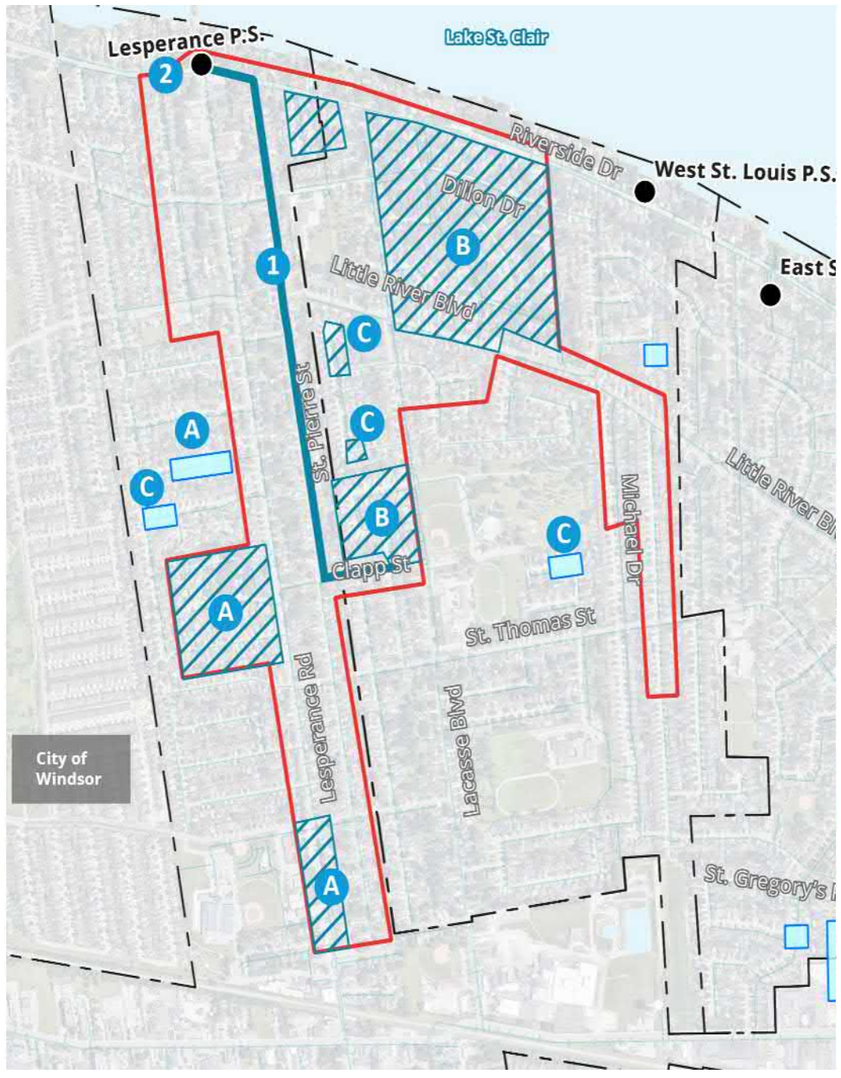
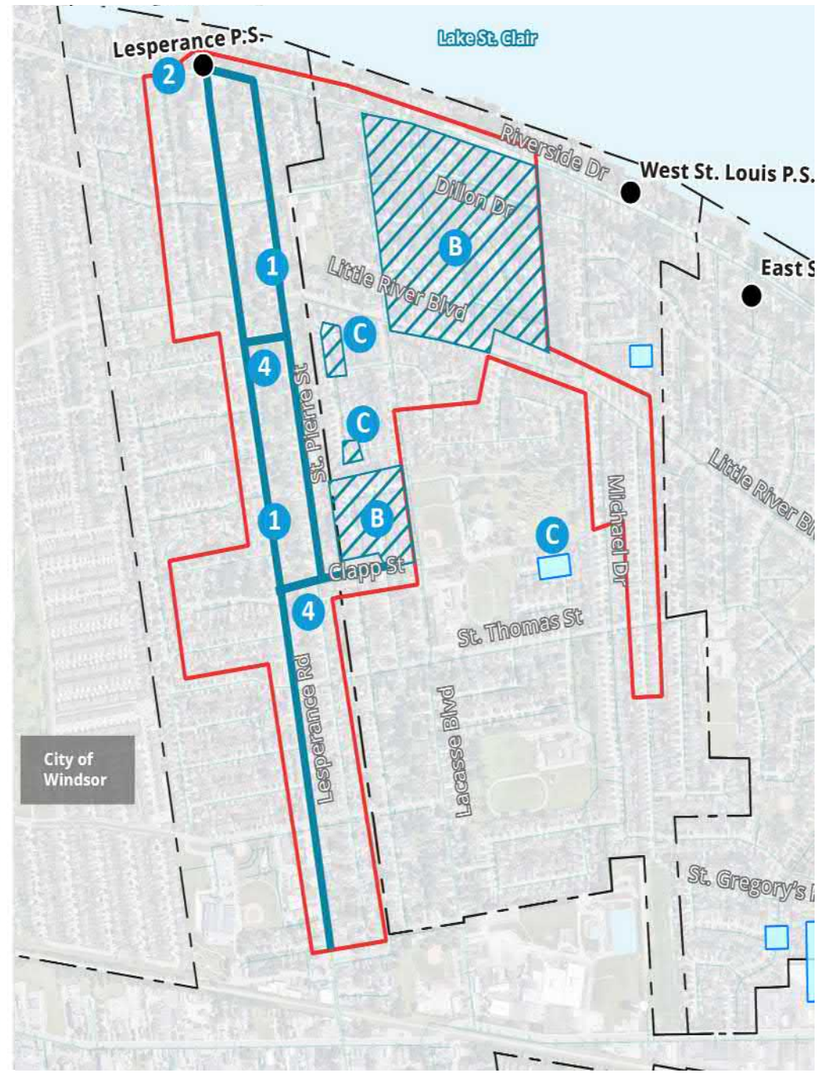


ALTERNATIVE 3



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

ALTERNATIVE SURFACE FLOODING SOLUTIONS PROBLEM AREA - W-1
FIGURE 9.1

TOWN OF Tecumseh ONTARIO · CANADA

- PUMP STATION (P.S.)
- PUMP STATION SERVICE AREA
- EXISTING STORM SEWER ALIGNMENT
- REGIONAL SURFACE FLOODING PROBLEM AREA
- REGIONAL SURFACE FLOODING SOLUTIONS
- LOCALIZED SURFACE FLOODING SOLUTIONS
- ISOLATED LOCAL SURFACE FLOODING SOLUTIONS

REGIONAL ALTERNATIVE SOLUTIONS

1. STORM TRUNK SEWER IMPROVEMENTS
2. PUMP STATION IMPROVEMENTS
3. STORM SEWER OUTLET IMPROVEMENTS TO PUMP STATION
4. STORM OVERFLOW SEWER TO LESPERANCE TRUNK STORM SEWER

LOCALIZED SOLUTIONS

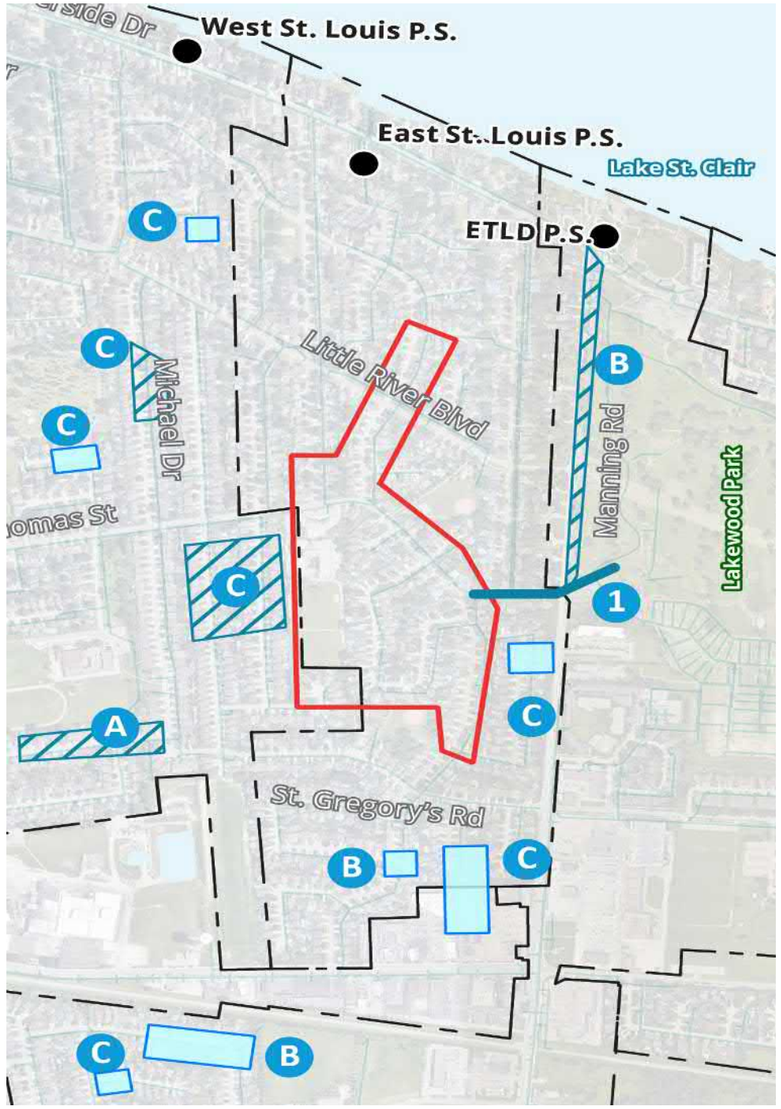
- A UNDERGROUND STORAGE/ STORM OUTLET IMPROVEMENTS
- B STORM SEWER CONVEYANCE/ ROAD GRADING IMPROVEMENTS
- C CATCH BASIN INLET IMPROVEMENTS

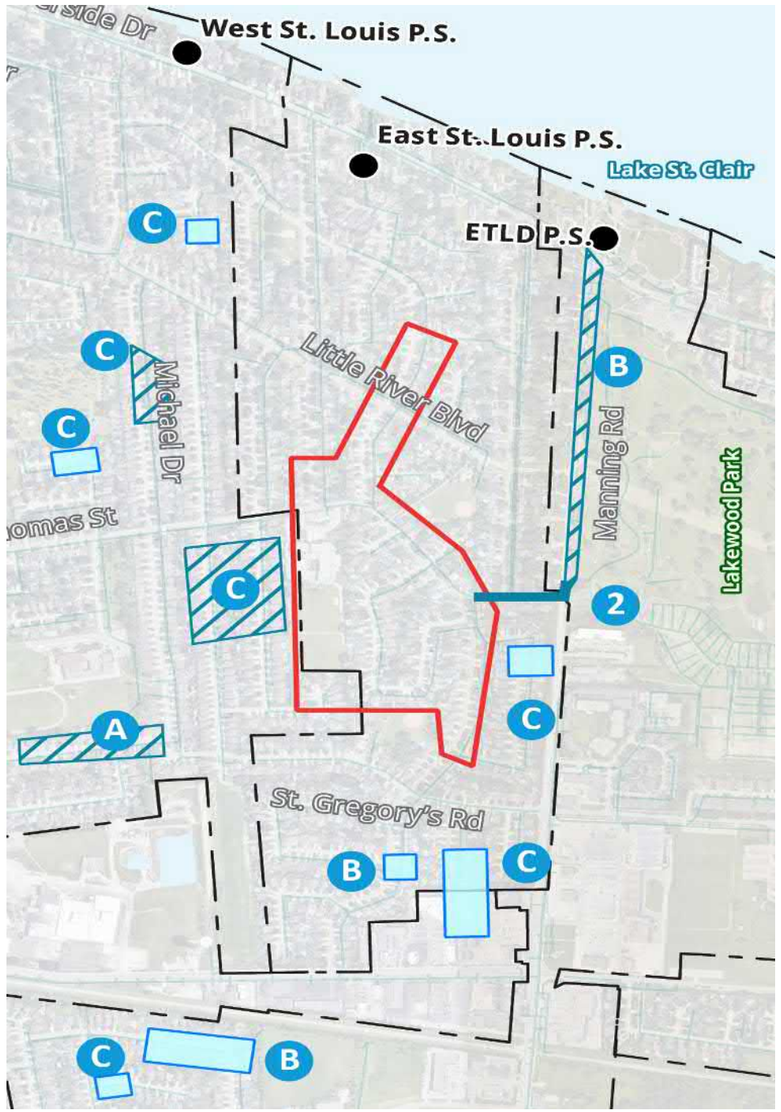
DILLON CONSULTING

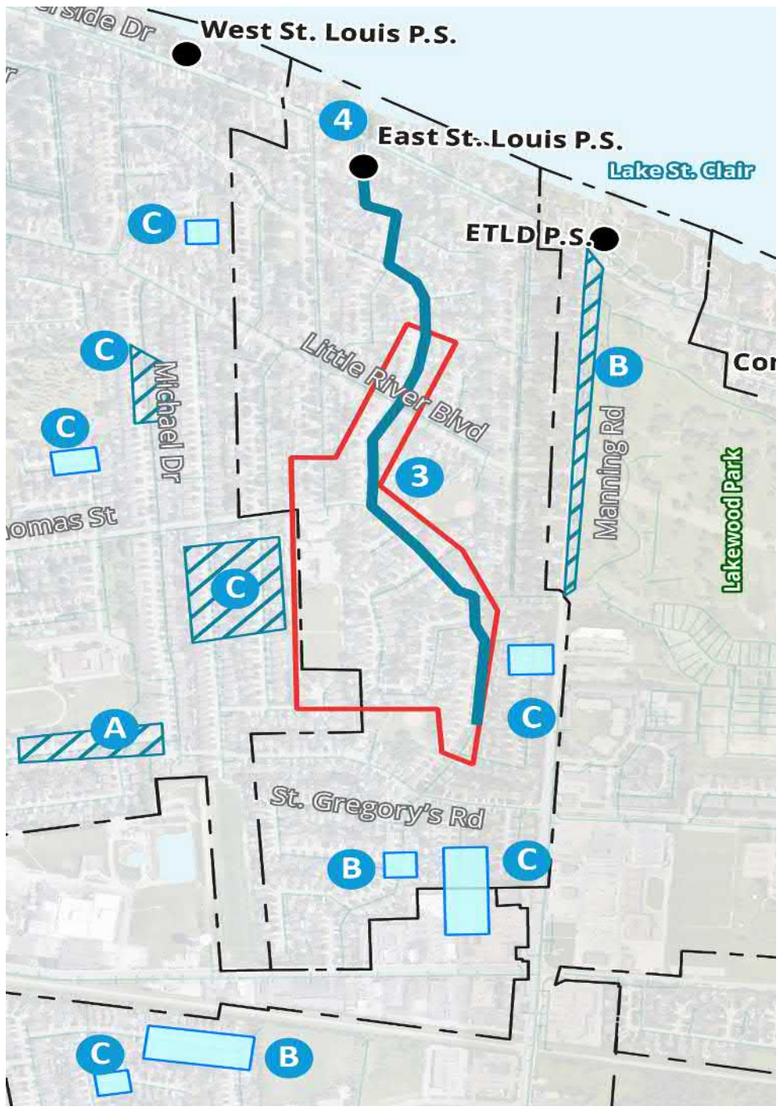
MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

SCALE 1:NTS

PROJECT: 16-4880 STATUS: FINAL DATE: JUNE 2019







TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

ALTERNATIVE SURFACE FLOODING SOLUTIONS PROBLEM AREA - W-2
FIGURE 9.2

TOWN OF Tecumseh ONTARIO · CANADA

PUMP STATION (P.S.)	LOCALIZED SURFACE FLOODING SOLUTIONS	REGIONAL ALTERNATIVE SOLUTIONS	LOCALIZED SOLUTIONS
PUMP STATION SERVICE AREA	ISOLATED LOCAL SURFACE FLOODING SOLUTIONS	1 STORM OVERFLOW SEWER TO LAKEWOOD PARK CHANNEL	A UNDERGROUND STORAGE
EXISTING STORM SEWER ALIGNMENT		2 STORM OVERFLOW SEWER TO LOCAL FUTURE MANNING ROAD SEWER	B STORM SEWER CONVEYANCE/ ROAD GRADING IMPROVEMENTS
REGIONAL SURFACE FLOODING PROBLEM AREA		3 STORM TRUNK SEWER IMPROVEMENTS	C CATCH BASIN INLET IMPROVEMENTS
REGIONAL SURFACE FLOODING SOLUTIONS		4 PUMP STATION IMPROVEMENTS	

DILLON CONSULTING

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

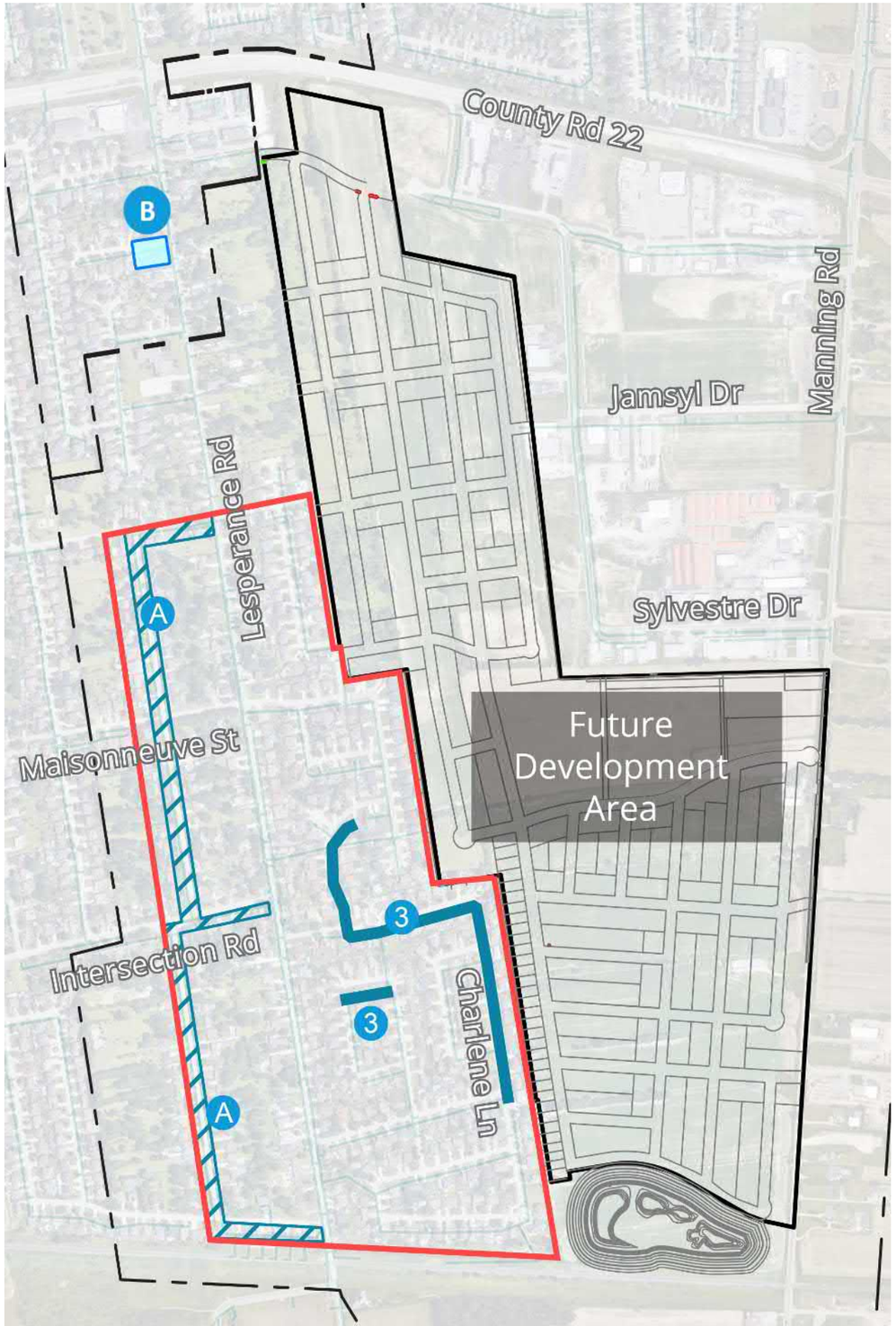
SCALE 1:NTS

2

PROJECT: 16-4880 STATUS: FINAL DATE: JUNE 2019

ALTERNATIVE 1

ALTERNATIVE 2



TOWN OF TECUMSEH
ONTARIO · CANADA

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

ALTERNATIVE SURFACE FLOODING SOLUTIONS PROBLEM AREA - W-3

FIGURE 9.3

- PUMP STATION SERVICE AREA
- EXISTING STORM SEWER ALIGNMENT
- REGIONAL SURFACE FLOODING PROBLEM AREA
- REGIONAL SURFACE FLOODING SOLUTIONS
- LOCALIZED SURFACE FLOODING SOLUTIONS
- ISOLATED LOCAL SURFACE FLOODING SOLUTIONS

REGIONAL ALTERNATIVE SOLUTIONS

1. LESP. STM OVERFLOW SEWER TO CHARLENE RELIEF SEWER
2. STM SEWER OUTLET TO FUTURE DEVELP. AREA TRUNK SEWER
3. UNDERGROUND STORAGE
4. STORM SEWER CONVEYANCE IMPROVEMENTS

LOCALIZED SOLUTIONS

- A UNDERGROUND STORAGE/ STORM SEWER CONVEYANCE/ ROAD GRADING IMPROVEMENTS
- B CATCH BASIN INLET IMPROVEMENTS

SCALE 1:NTS 2

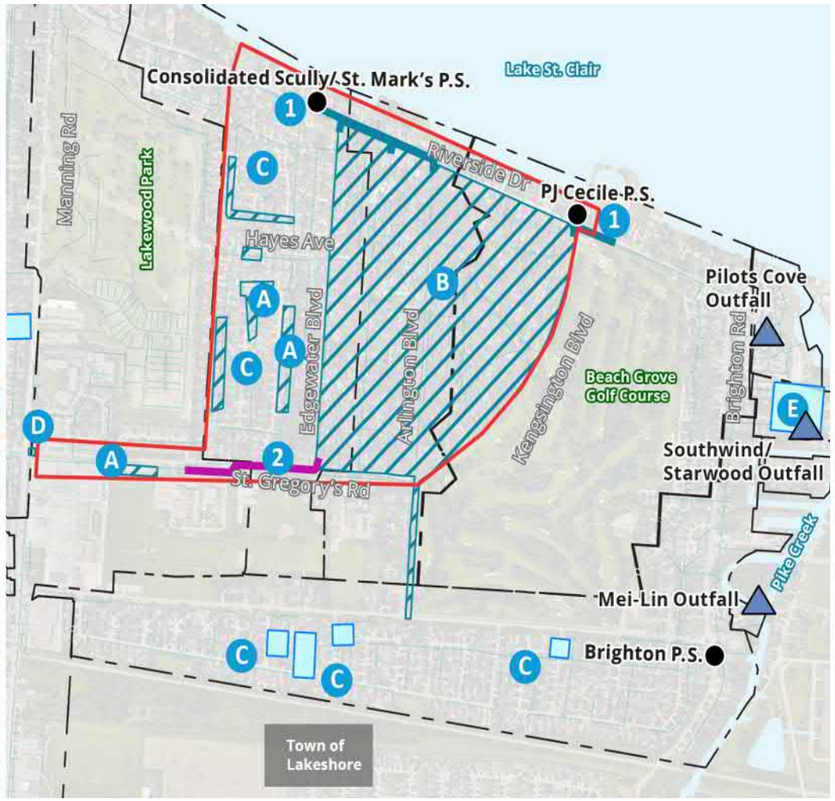
MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

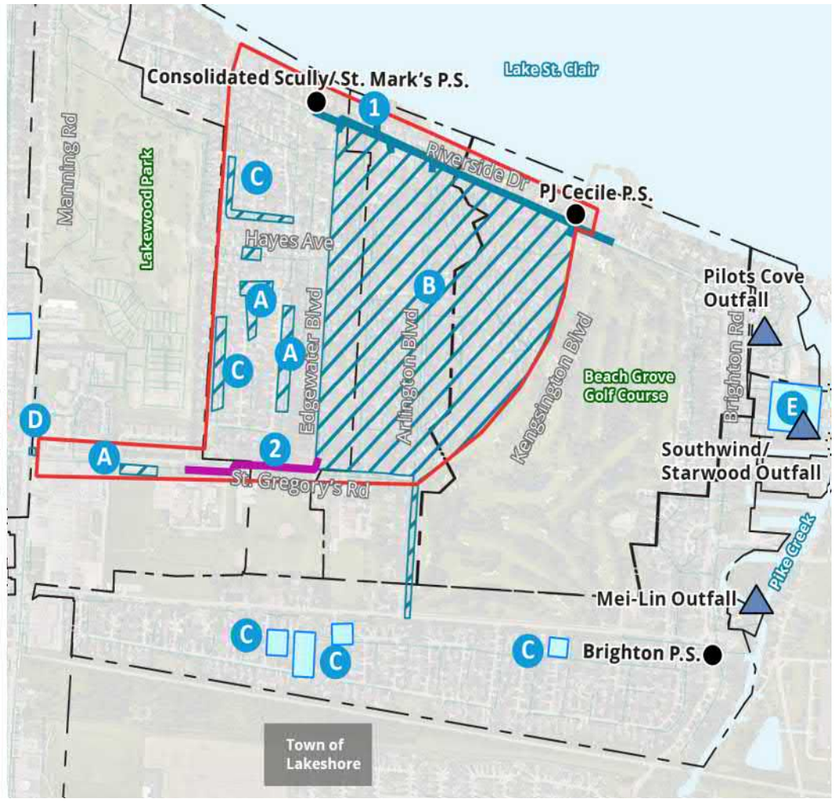
PROJECT: 16-4880
STATUS: FINAL
DATE: JUNE 2019

ALTERNATIVE 1

ALTERNATIVE 2



ALTERNATIVE 3



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

ALTERNATIVE SURFACE FLOODING SOLUTIONS PROBLEM AREA - E-1
FIGURE 9.4

TOWN OF Tecumseh ONTARIO · CANADA

SEWER GRAVITY OUTFALL
PUMP STATION (P.S.)
PUMP STATION SERVICE AREA
EXISTING STORM SEWER ALIGNMENT
REGIONAL SURFACE FLOODING PROBLEM AREA

REGIONAL SURFACE FLOODING SOLUTIONS
SUPPLEMENTARY SURFACE FLOODING SOLUTIONS
LOCALIZED SURFACE FLOODING SOLUTIONS
ISOLATED LOCAL SURFACE FLOODING SOLUTIONS

REGIONAL ALTERNATIVE SOLUTIONS

1. PUMP STATION AND RIVERSIDE DRIVE STORM SEWER TRUNK IMPROVEMENTS
2. STORM SEWER REDIRECTION TO EDGEWATER STORM SEWER SYSTEM

LOCALIZED SOLUTIONS

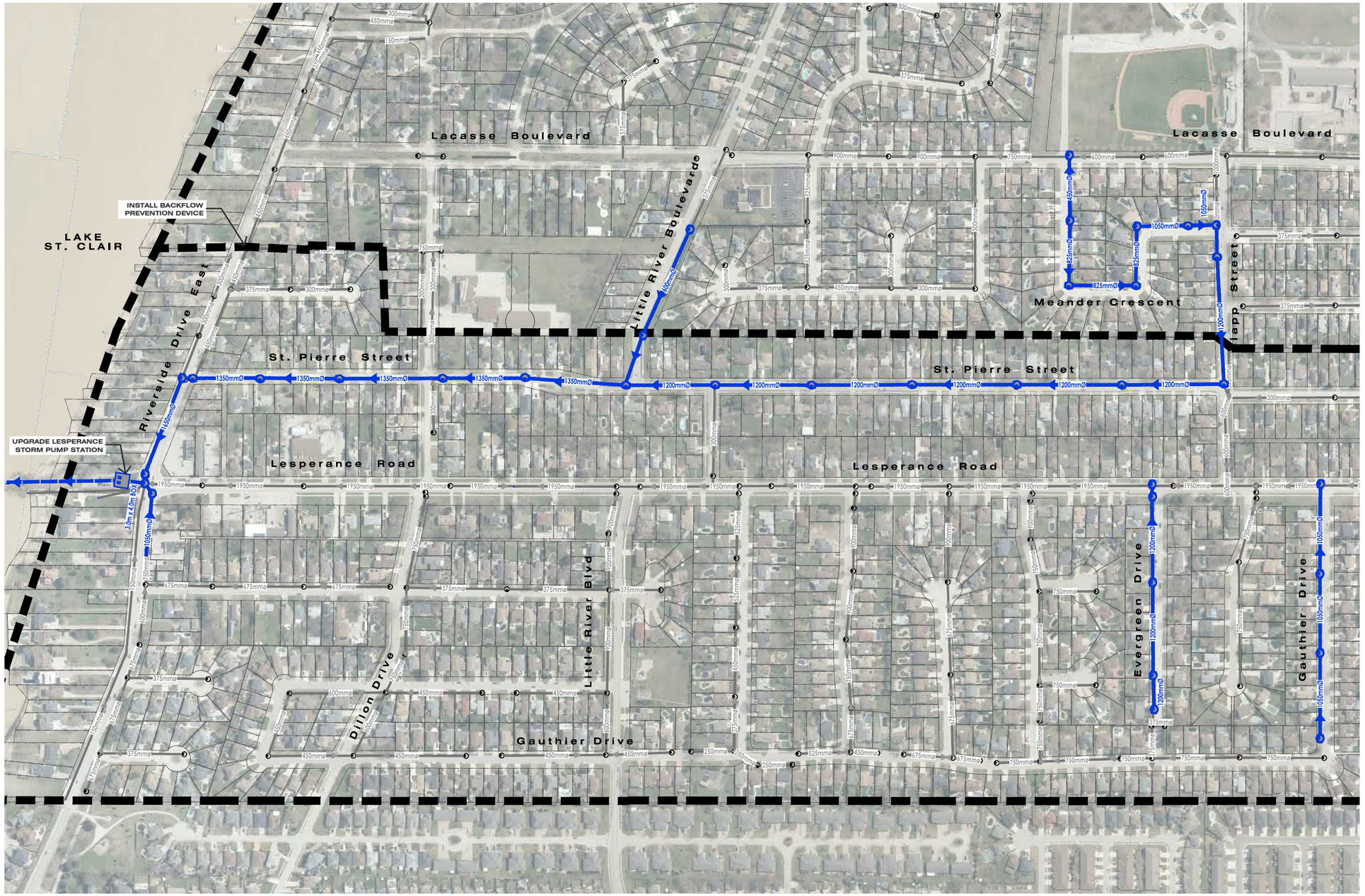
- A. UNDERGROUND STORAGE/ ROAD GRADING IMPROVEMENTS
- B. STORM SEWER CONVEYANCE/ ROAD GRADING IMPROVEMENTS
- C. CATCH BASIN INLET IMPROVEMENTS
- D. BACKFLOW PREVENTION FROM EAST TOWNLINE DRAIN
- E. PUMP STATION TO PIKE CREEK

DILLON CONSULTING

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

SCALE 1:NTS

PROJECT: 16-4880 STATUS: FINAL DATE: JUNE 2019



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SURFACE FLOODING MITIGATION SOLUTION: WEST OF MANNING ROAD - LESPERANCE PS SERVICE AREA
FIGURE 10.1

PROPOSED MANHOLE
PUMP STATION
450mmØ PROPOSED STORM SEWER
EXISTING MANHOLE
100mmø EXISTING STORM SEWER
P.S. SERVICE AREA BOUNDARY

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TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SURFACE FLOODING MITIGATION SOLUTIONS: WEST OF MANNING ROAD - WEST ST. LOUIS PS SERVICE AREA

FIGURE 10.2

PROPOSED MANHOLE
PUMP STATION
450mmØ PROPOSED STORM SEWER
EXISTING MANHOLE
100mmø EXISTING STORM SEWER
P.S. SERVICE AREA BOUNDARY

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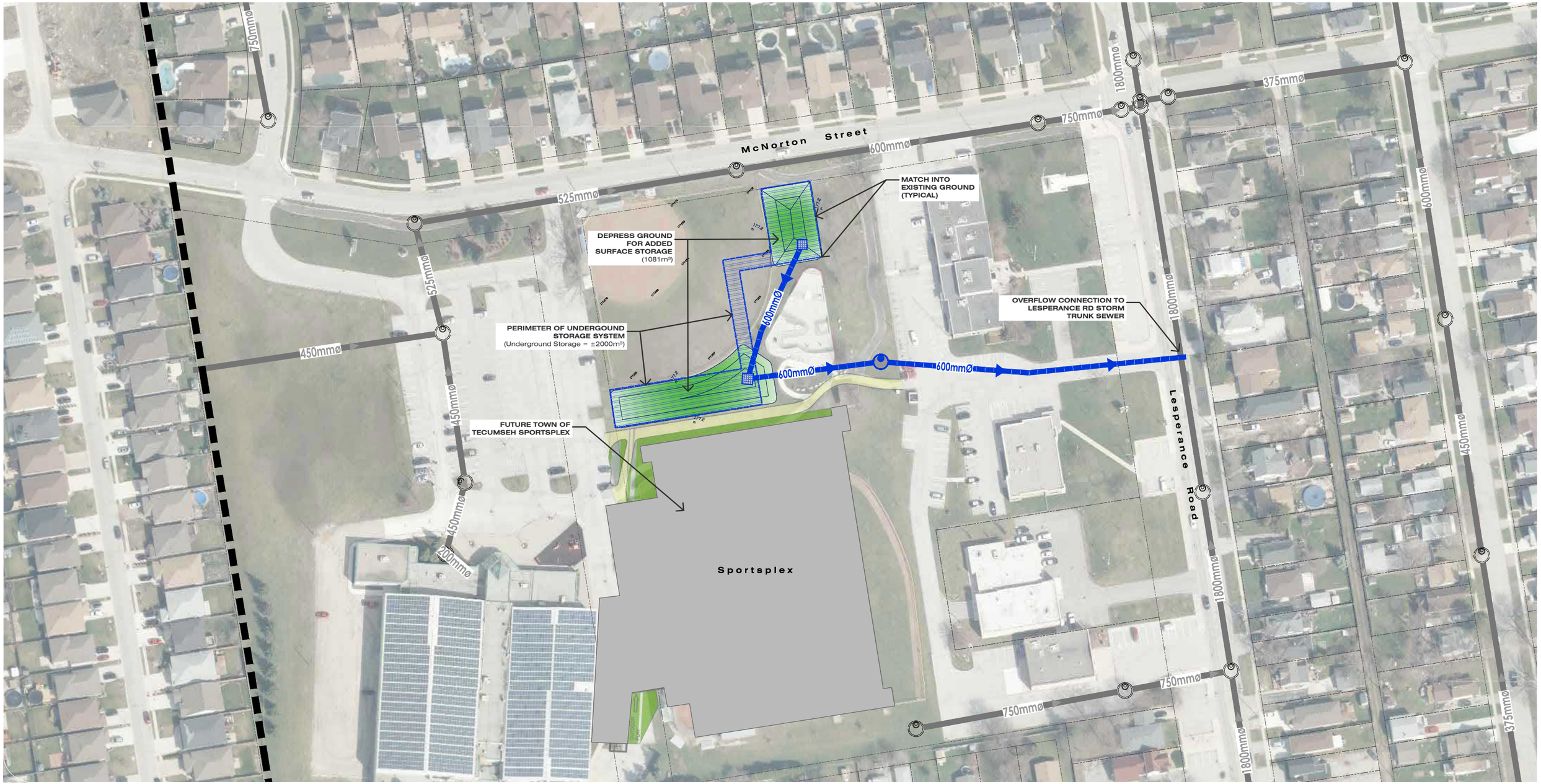

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SOLUTION: LESPERANCE ROAD LOCALIZED SOLUTION (TECUMSEH TOWN HALL)
FIGURE: 10.3

TOWN OF Tecumseh ONTARIO · CANADA

PROPOSED MANHOLE
450mmø PROPOSED STORM SEWER
PROPOSED CATCH BASIN
EXISTING MANHOLE
100mmø EXISTING STORM SEWER
DEPRESSED LAND
UNDERGROUND STORAGE CHAMBERS (STORMTECH MC-4500)
P.S. SERVICE AREA BOUNDARY

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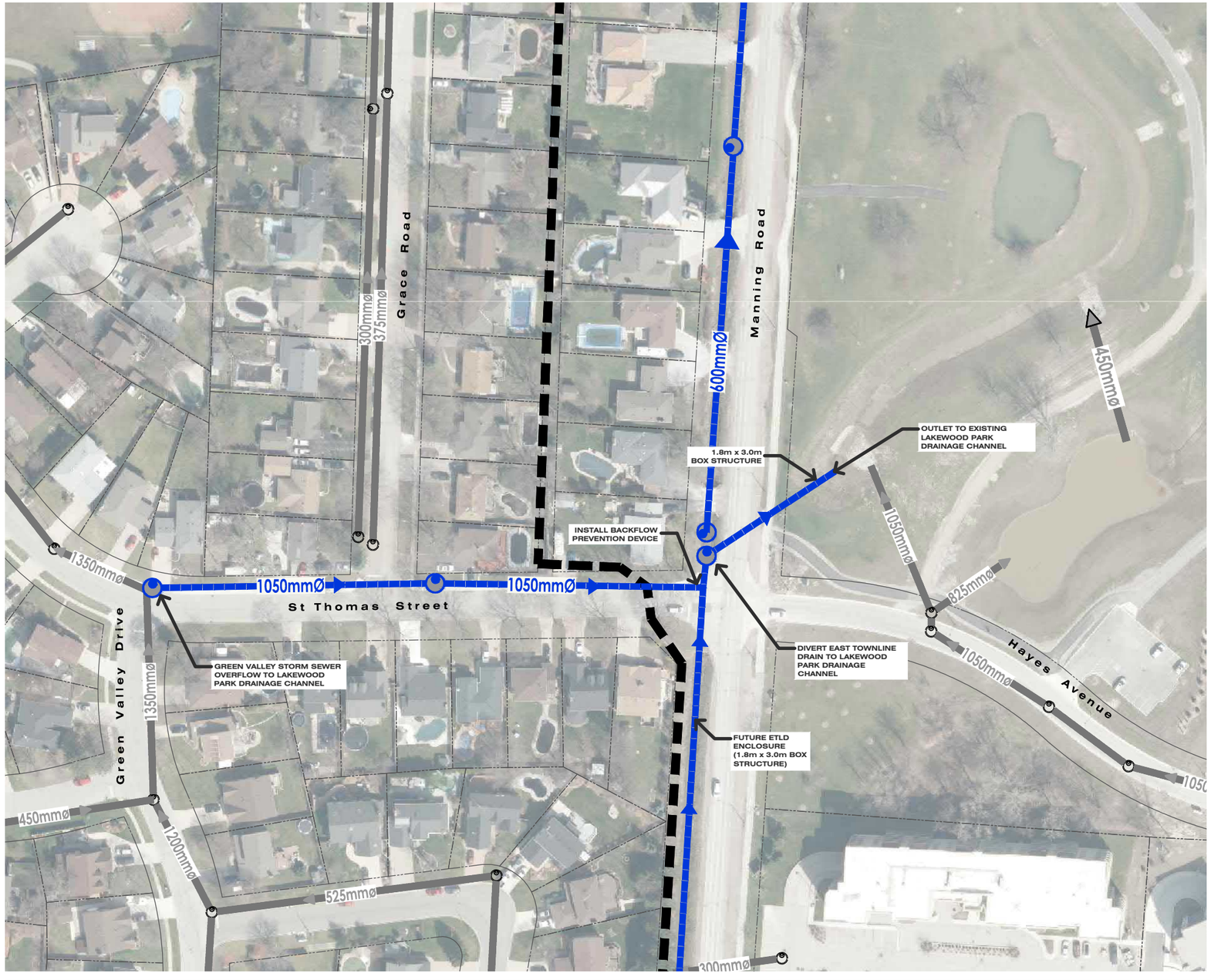
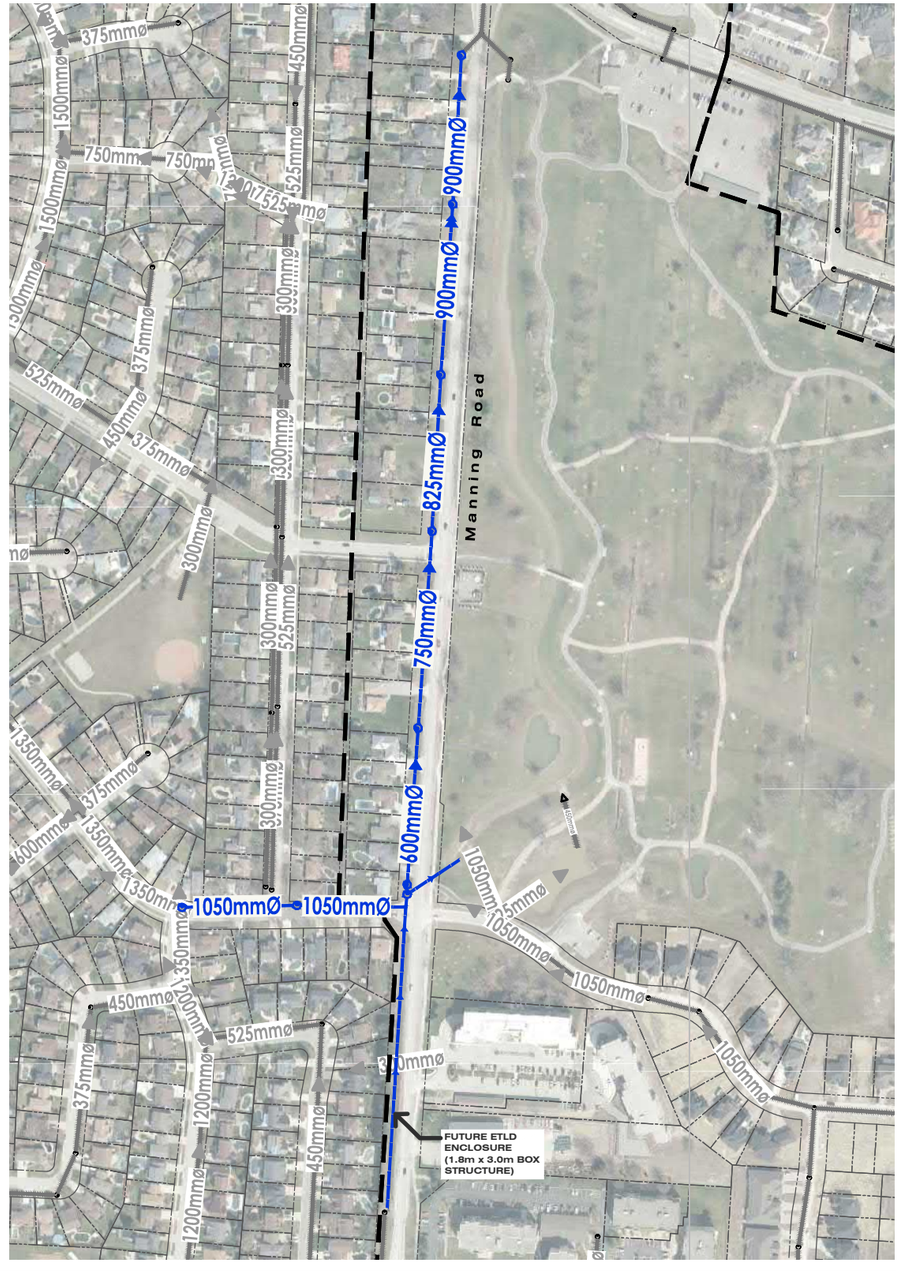
EAST ST. LOUIS PS SERVICE AREA RECOMMENDED SOLUTION



MANNING ROAD PHASE 2 DRAIN ENCLOSURE DESIGN



TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SURFACE FLOODING MITIGATION SOLUTIONS: WEST OF MANNING ROAD - EAST ST. LOUIS/ EAST TOWNLINE DRAIN PS SERVICE AREA
FIGURE 10.4

PROPOSED MANHOLE
EXISTING MANHOLE
P.S. SERVICE AREA BOUNDARY
450mmØ PROPOSED STORM SEWER
100mmØ EXISTING STORM SEWER

DILLON CONSULTING

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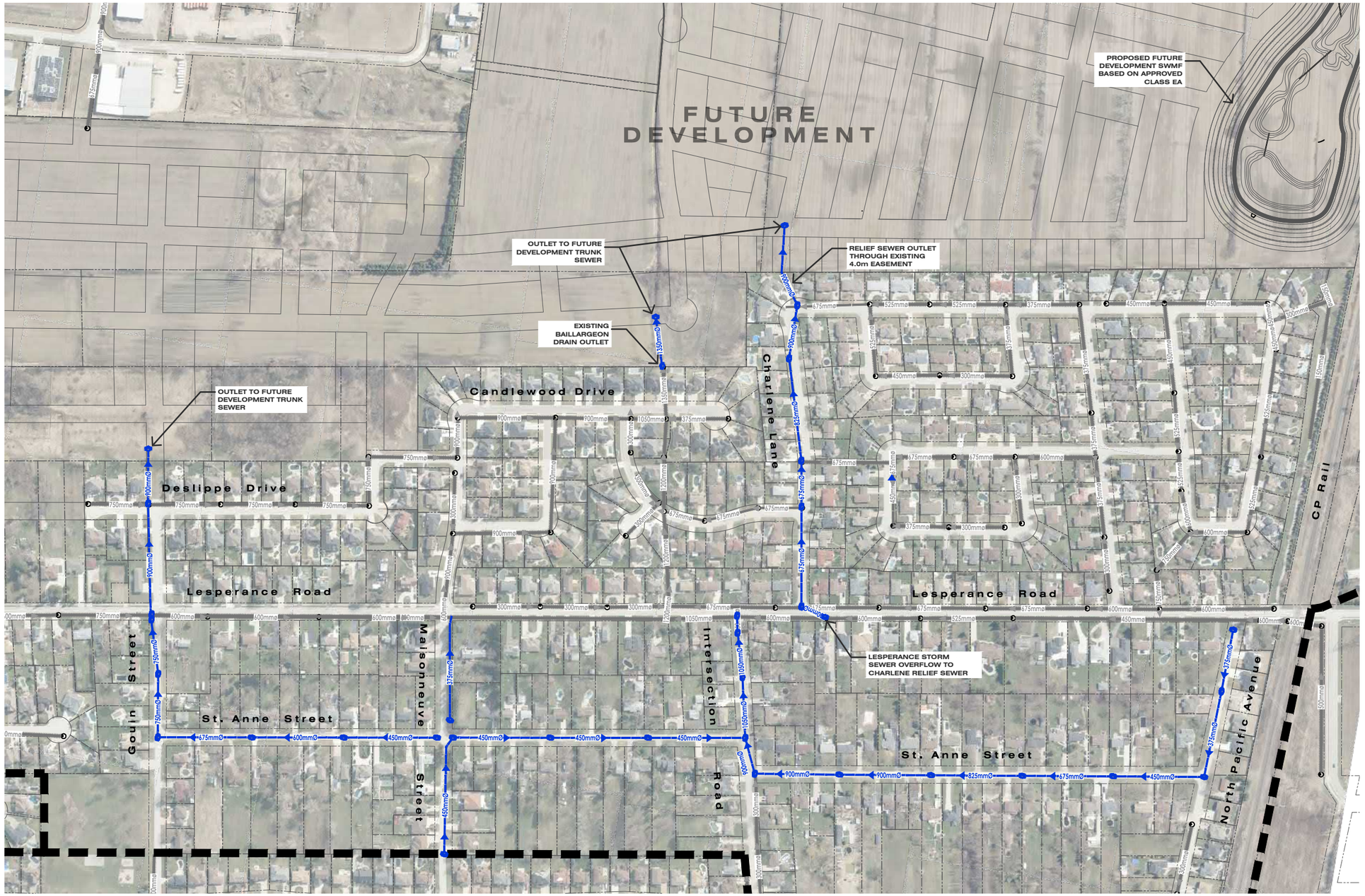

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SURFACE FLOODING MITIGATION SOLUTION OPTION 1: WEST OF MANNING ROAD - BAILLARGEON DRAIN SERVICE AREA
FIGURE 10.5

PROPOSED MANHOLE
EXISTING MANHOLE
P.S. SERVICE AREA BOUNDARY
PROPOSED STORM SEWER
EXISTING STORM SEWER

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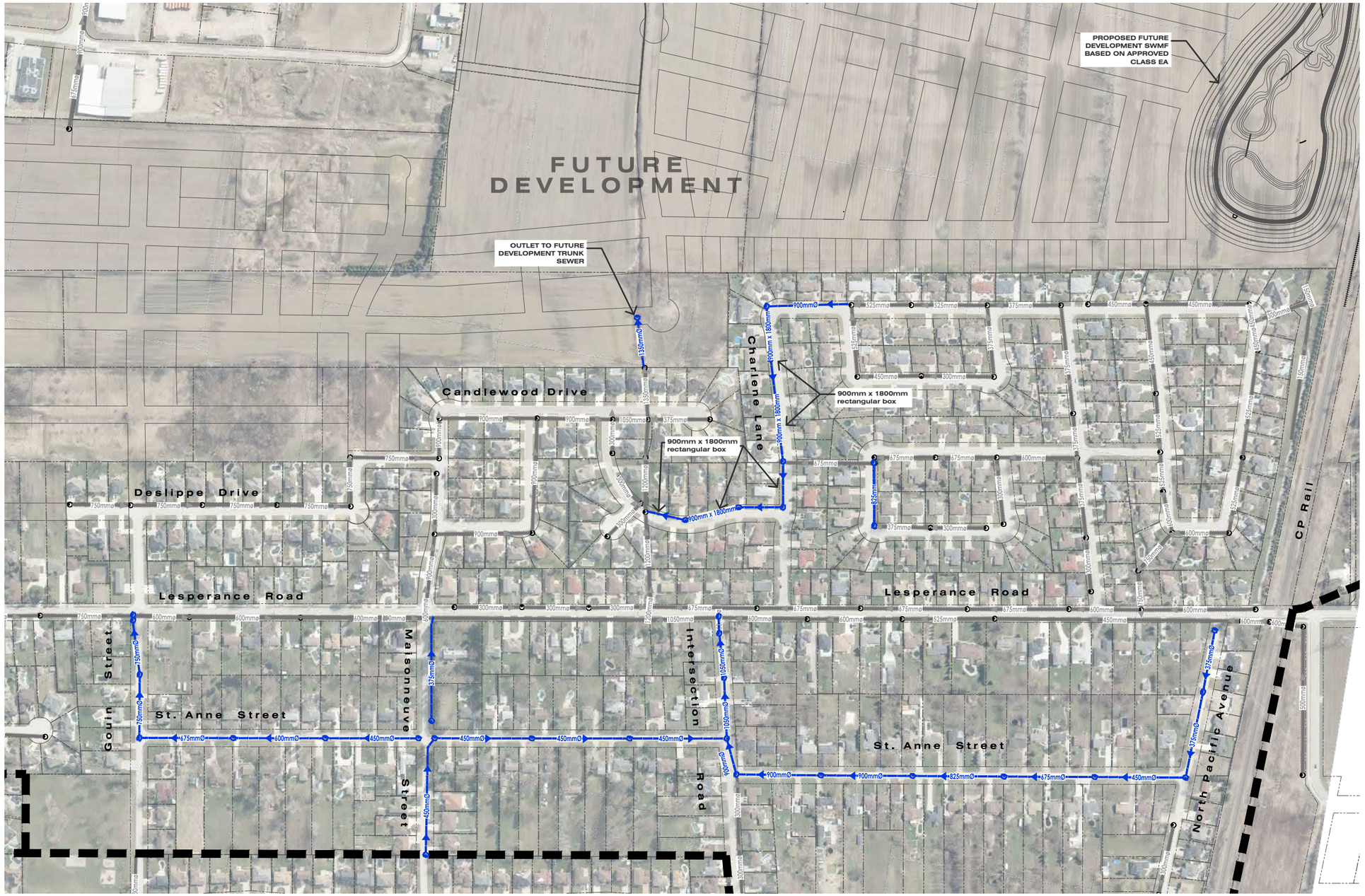

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SURFACE FLOODING MITIGATION SOLUTION OPTION 2: WEST OF MANNING ROAD - BAILLARGEON DRAIN SERVICE AREA
FIGURE 10.6

PROPOSED MANHOLE
EXISTING MANHOLE
P.S. SERVICE AREA BOUNDARY
450mmØ PROPOSED STORM SEWER
100mmØ EXISTING STORM SEWER

DILLON CONSULTING

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MAP PROJECTION: NAD 1983 UTM Zone 17N

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TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SOLUTION: LEMIRE/LANOUE STREET LOCALIZED SOLUTION (BUSTER REAUME PARK)
FIGURE 10.7

TOWN OF Tecumseh ONTARIO · CANADA

PROPOSED MANHOLE
EXISTING MANHOLE
DEPRESSED LAND
450mmØ PROPOSED STORM SEWER
100mmø EXISTING STORM SEWER
P.S. SERVICE AREA BOUNDARY
PROPOSED CATCH BASIN
EXISTING CATCH BASIN

DILLON CONSULTING

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MAP PROJECTION: NAD 1983 UTM Zone 17N

SCALE: N.T.S.

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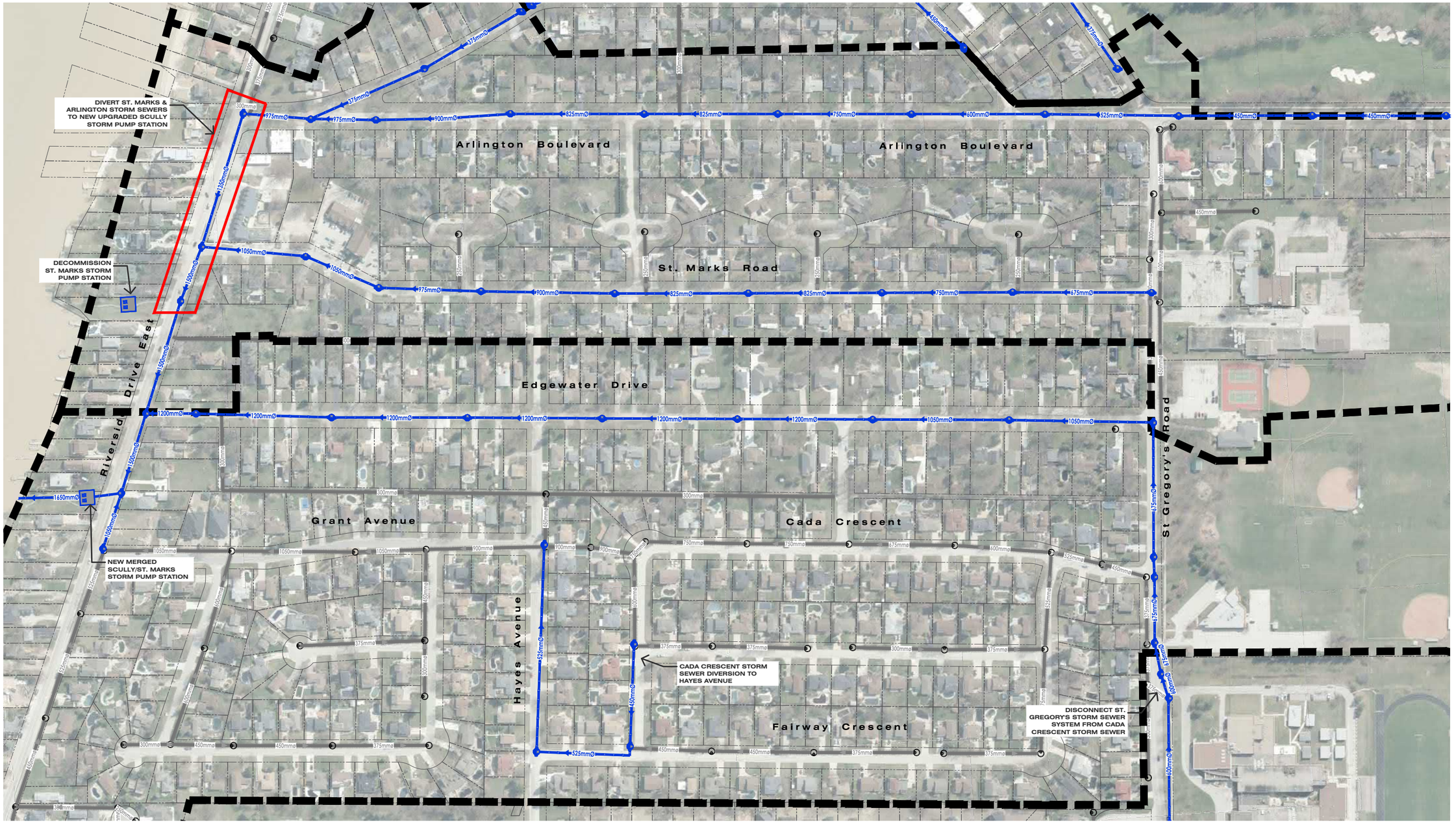

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SURFACE FLOODING MITIGATION SOLUTIONS: EAST OF MANNING ROAD - CONSOLIDATED SCULLY/ST.MARK'S PS SERVICE AREA
FIGURE 10.8

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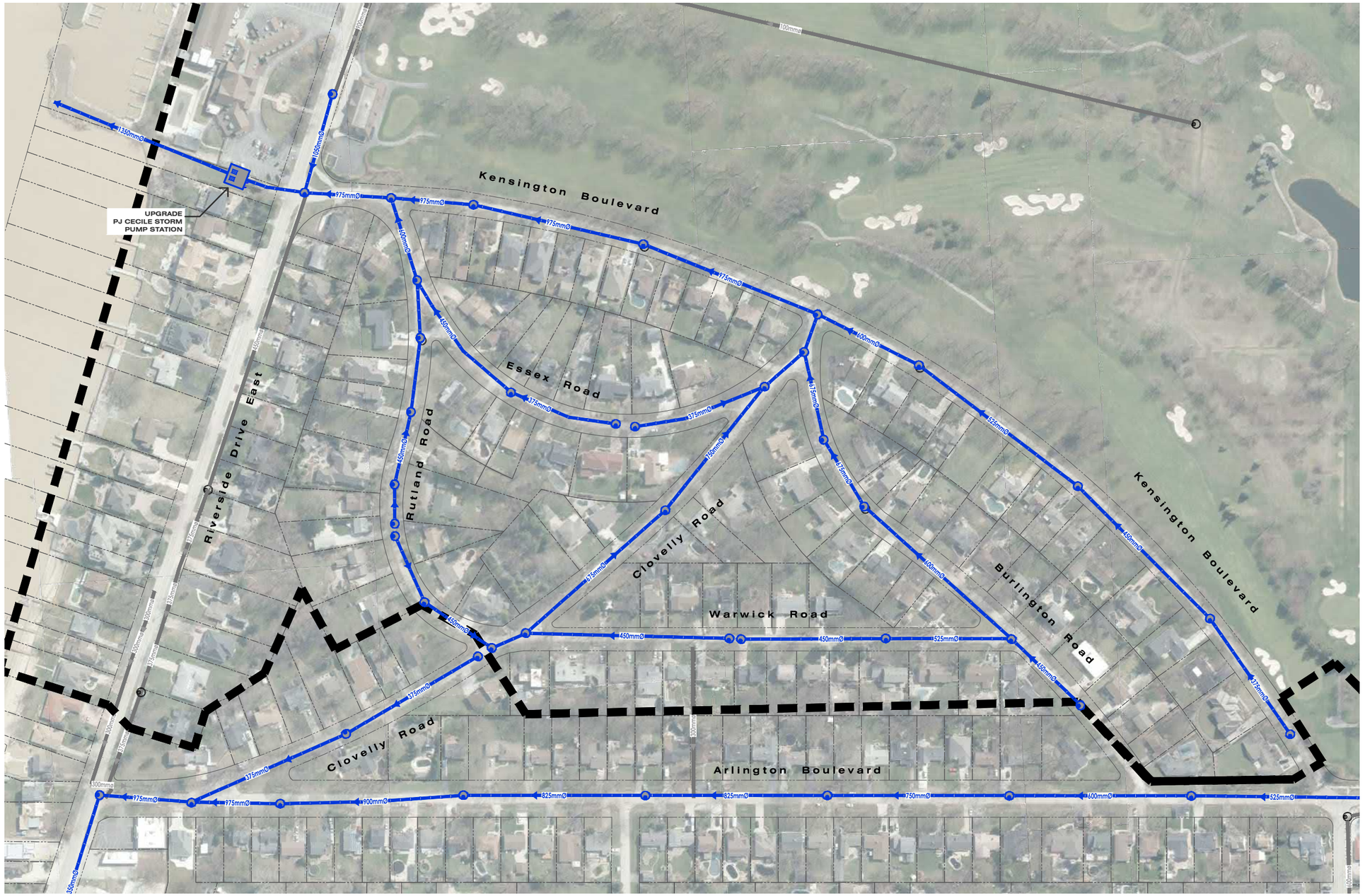

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SURFACE FLOODING MITIGATION SOLUTIONS: EAST OF MANNING ROAD - PJ CECILE PS SERVICE AREA

FIGURE 10.9

PROPOSED MANHOLE
EXISTING MANHOLE
P.S. SERVICE AREA BOUNDARY
PUMP STATION
100mmø EXISTING STORM SEWER
450mmØ PROPOSED STORM SEWER

DILLON CONSULTING

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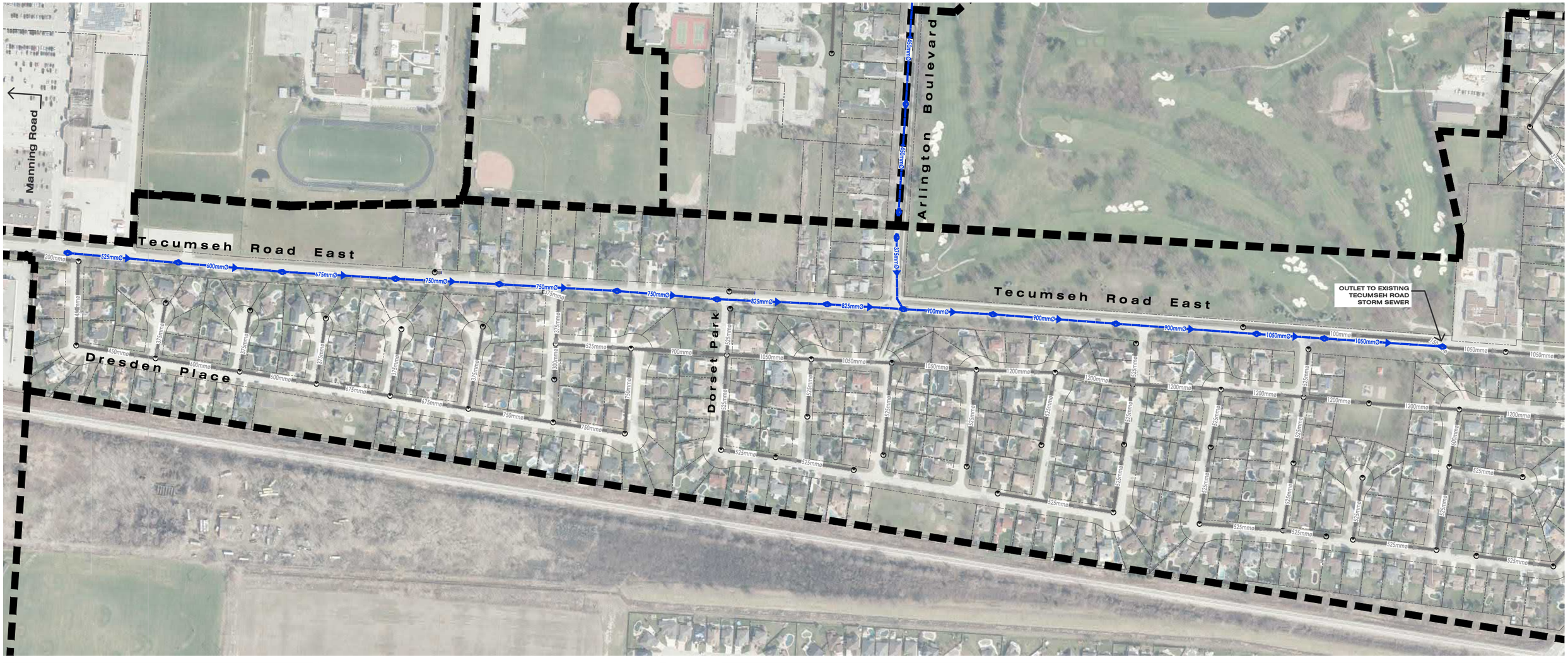

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SOLUTION: TECUMSEH ROAD LOCALIZED SOLUTION
FIGURE 10.10

PROPOSED MANHOLE
EXISTING MANHOLE
P.S. SERVICE AREA BOUNDARY
450mmØ PROPOSED STORM SEWER
100mmØ EXISTING STORM SEWER

DILLON CONSULTING

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CHECKED BY: RTL
DESIGNED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

SCALE: N.T.S.

N W E S

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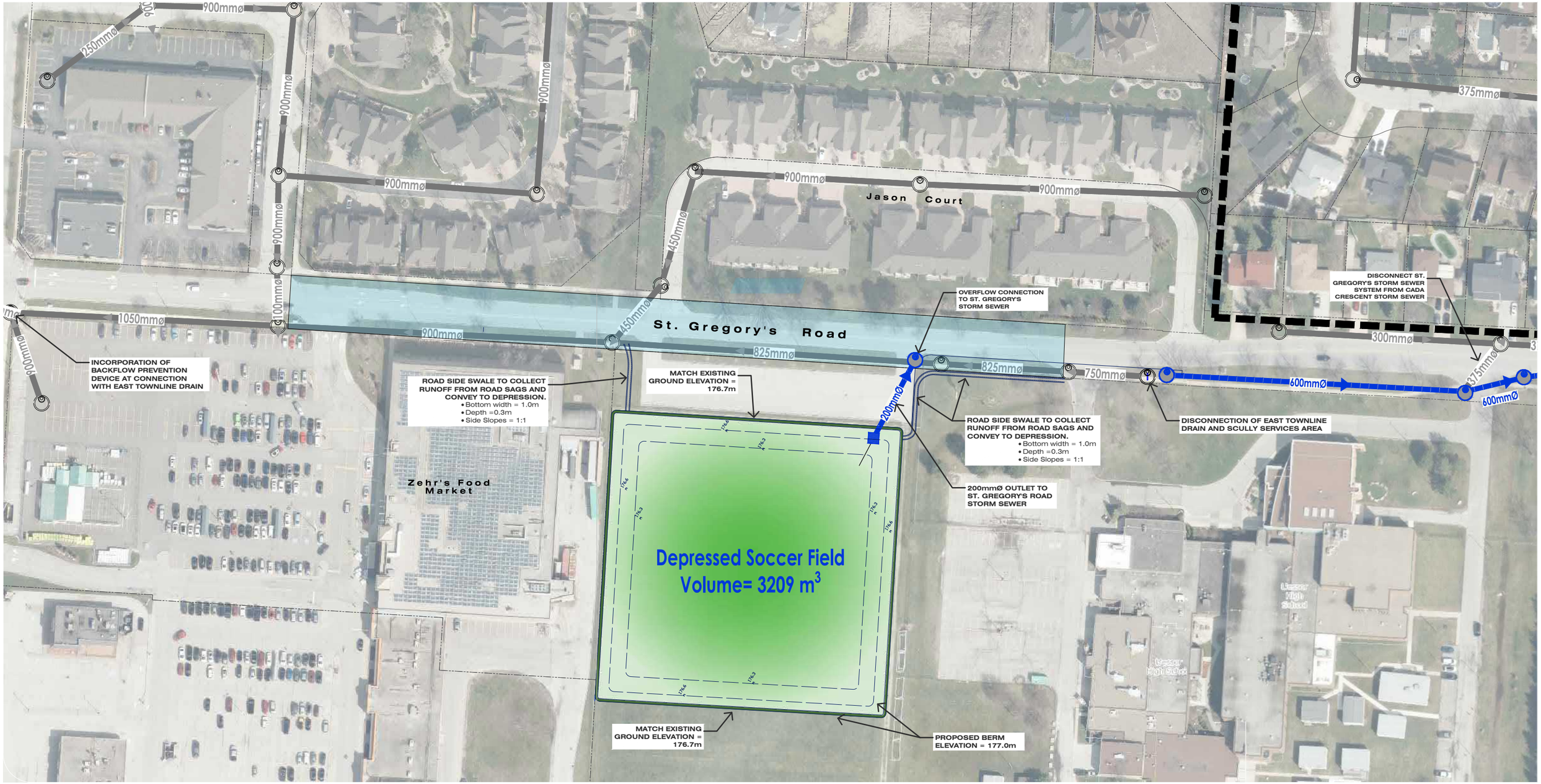

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SOLUTION: ST. GREGORY'S ROAD LOCALIZED SOLUTION (TECUMSEH SOCCER FIELDS)
FIGURE 10.11

PROPOSED MANHOLE
PROPOSED STORM SEWER
PROPOSED CATCH BASIN
EXISTING MANHOLE
EXISTING STORM SEWER
ROADWAY GRADING IMPROVEMENTS
DEPRESSED LAND
P.S. SERVICE AREA BOUNDARY

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TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

SCHEDULE B PROJECT MAP
FIGURE 12.1

TOWN OF Tecumseh ONTARIO · CANADA

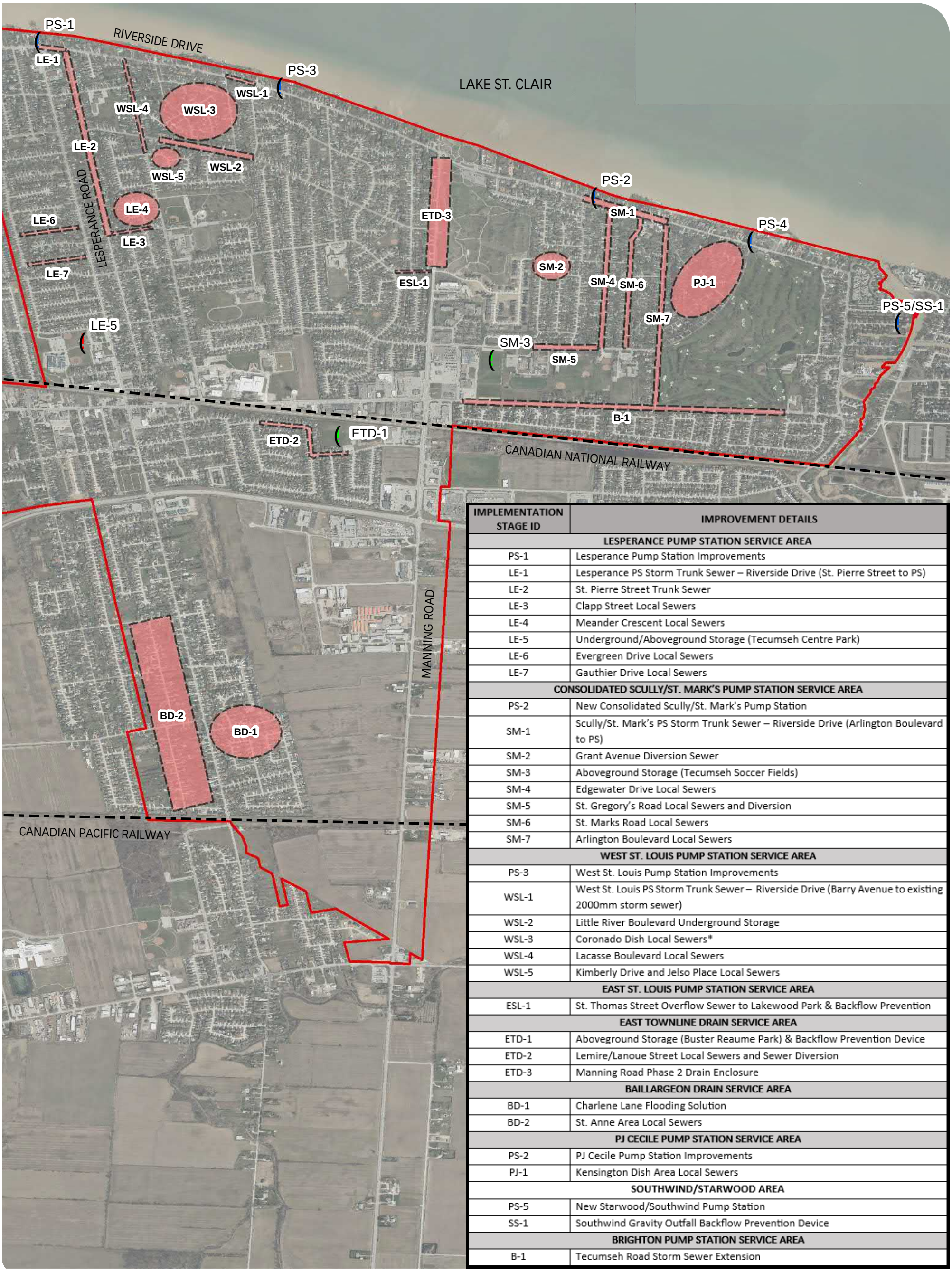
- PUMP STATION IMPROVEMENTS
- ABOVE GROUND STORAGE
- ABOVE / UNDERGROUND STORAGE
- 1 LESPERANCE STORM PUMP STATION IMPROVEMENTS
- 2 WEST ST. LOUIS STORM PUMP STATION IMPROVEMENTS
- 3 CONSOLIDATED SCULLY/ ST. MARKS STORM PUMP STATION
- 4 PJ CECILE STORM PUMP STATION IMPROVEMENTS
- 5 NEW SOUTHWIND CRES. STORM PUMP STATION
- 6 SURFACE STORAGE IN SOCCER FIELD
- 7 SURFACE STORAGE IN BUSTER REAUME PARK
- 8 SURFACE AND UNDERGROUND STORAGE (TECUMSEH CENTRE PARK)
- RAILWAY

DILLON CONSULTING

MAP CREATED BY: SZ
MAP CHECKED BY: RTL
MAP PROJECTION: NAD 1983 UTM Zone 17N

SCALE 1:NTS 2

PROJECT: 16-4880 STATUS: FINAL DATE: JUNE 2019



IMPLEMENTATION STAGE ID	IMPROVEMENT DETAILS
LESPERANCE PUMP STATION SERVICE AREA	
PS-1	Lesperance Pump Station Improvements
LE-1	Lesperance PS Storm Trunk Sewer – Riverside Drive (St. Pierre Street to PS)
LE-2	St. Pierre Street Trunk Sewer
LE-3	Clapp Street Local Sewers
LE-4	Meander Crescent Local Sewers
LE-5	Underground/Aboveground Storage (Tecumseh Centre Park)
LE-6	Evergreen Drive Local Sewers
LE-7	Gauthier Drive Local Sewers
CONSOLIDATED SCULLY/ST. MARK'S PUMP STATION SERVICE AREA	
PS-2	New Consolidated Scully/St. Mark's Pump Station
SM-1	Scully/St. Mark's PS Storm Trunk Sewer – Riverside Drive (Arlington Boulevard to PS)
SM-2	Grant Avenue Diversion Sewer
SM-3	Aboveground Storage (Tecumseh Soccer Fields)
SM-4	Edgewater Drive Local Sewers
SM-5	St. Gregory's Road Local Sewers and Diversion
SM-6	St. Marks Road Local Sewers
SM-7	Arlington Boulevard Local Sewers
WEST ST. LOUIS PUMP STATION SERVICE AREA	
PS-3	West St. Louis Pump Station Improvements
WSL-1	West St. Louis PS Storm Trunk Sewer – Riverside Drive (Barry Avenue to existing 2000mm storm sewer)
WSL-2	Little River Boulevard Underground Storage
WSL-3	Coronado Dish Local Sewers*
WSL-4	Lacasse Boulevard Local Sewers
WSL-5	Kimberly Drive and Jelso Place Local Sewers
EAST ST. LOUIS PUMP STATION SERVICE AREA	
ESL-1	St. Thomas Street Overflow Sewer to Lakewood Park & Backflow Prevention
EAST TOWNLINE DRAIN SERVICE AREA	
ETD-1	Aboveground Storage (Buster Reaume Park) & Backflow Prevention Device
ETD-2	Lemire/Lanoue Street Local Sewers and Sewer Diversion
ETD-3	Manning Road Phase 2 Drain Enclosure
BAILLARGEON DRAIN SERVICE AREA	
BD-1	Charlene Lane Flooding Solution
BD-2	St. Anne Area Local Sewers
PJ CECILE PUMP STATION SERVICE AREA	
PS-2	PJ Cecile Pump Station Improvements
PJ-1	Kensington Dish Area Local Sewers
SOUTHWIND/STARWOOD AREA	
PS-5	New Starwood/Southwind Pump Station
SS-1	Southwind Gravity Outfall Backflow Prevention Device
BRIGHTON PUMP STATION SERVICE AREA	
B-1	Tecumseh Road Storm Sewer Extension

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED SOLUTIONS SUMMARY MAP
FIGURE 12.2

PUMP STATION IMPROVEMENTS
ABOVE GROUND STORAGE
ABOVE/ UNDERGROUND STORAGE
STUDY AREA
STORM DRAINAGE AND INFRASTRUCTURE IMPROVEMENTS
RAILWAY

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SCALE 1:NTS

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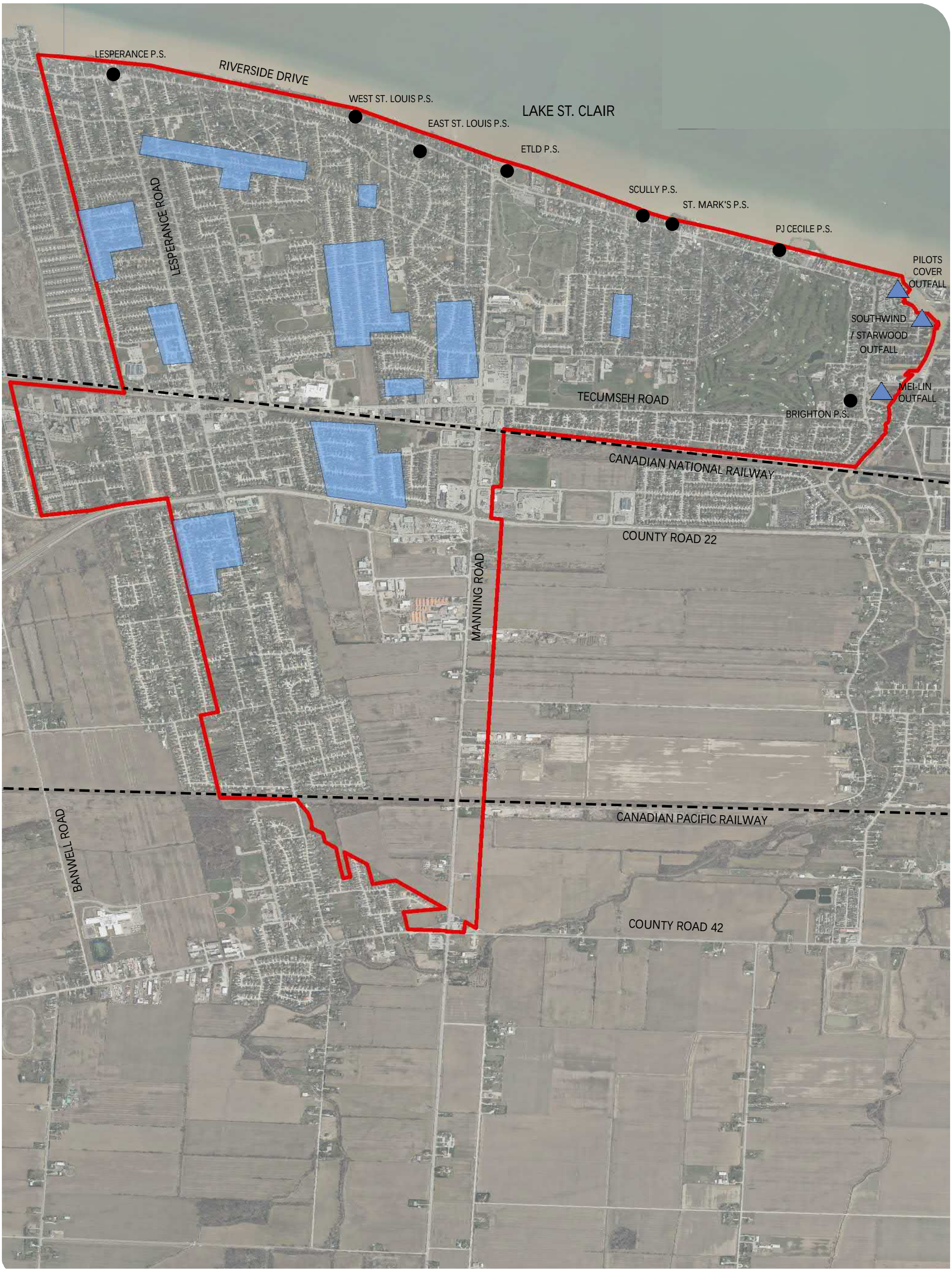

TOWN OF TECUMSEH
STORM DRAINAGE MASTER PLAN

RECOMMENDED LOCALIZED STORM INLET IMPROVEMENT LOCATIONS
FIGURE 12.3

SEWER GRAVITY OUTFALL
PUMP STATIONS (P.S.)
LOCATIONS OF LOCALIZED STORM INLET IMPROVEMENTS
STUDY AREA
RAILWAY

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MAP PROJECTION: NAD 1983 UTM Zone 17N

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