EXECUTIVE SUMMARY

INTRODUCTION

In 2015, the Ministry of Environment, Conservation and Parks (MECP) were in the process of preparing a new document titled Low Impact Development (LID) Stormwater Management Guidance Manual (Aquafor, 2018). This document, which will be a companion document to the 2003 Stormwater Management Planning and Design Manual, places an emphasis on the requirement of future development to mimic pre development conditions from the perspective of managing peak flows and increases to runoff volume. This will lead to the use of a wider range of stormwater measures including Low Impact Development measures to infiltrate flow that otherwise would become runoff. LID practices include perforated third pipe systems, rainwater harvesting, water reuse, bioretention units and permeable materials which naturally infiltrate, filtrate, evaporate or reuse stormwater runoff.

In February 2015, the MECP issued a bulletin stating “The natural hydrologic cycle should be maintained to the greatest extent possible. Going forward, the Ministry expects that stormwater management plans will reflect the findings of watershed, subwatershed, and environmental management plans, and will employ LID in order to maintain the natural hydrologic cycle to the greatest extent possible”. The City of London recognized that imminent future development pressures within the Dingman Creek Subwatershed would require the construction of up to 12 new stormwater management facilities. Knowing the Ministry expected future stormwater approaches to consider the natural hydrologic cycle, the City identified the need to update the Stormwater Management Servicing Strategy for Dingman Creek to consider LIDs and initiated this study.

STUDY AREA

The study area is the entire Dingman Creek within the City of London’s boundary, although as noted later, the level of analysis will vary depending on which tributary is being considered. The Dingman creek subwatershed (see **Figure ES 1**) is approximately 17,200 ha in size and is located in Middlesex County with 74% within the City of London. The watershed extends from Highway 73 in the east to Delaware at the Thames River in the west. The main watercourse extends a distance of approximately 45 km. The subwatershed encompasses approximately 30 tributaries, the majority of which have been altered from their natural state as a result of agricultural practices or urbanization.

The dominant land use is rural; with approximately 47 percent of the lands being used for agricultural purposes. Urban land uses account for approximately 30 percent of the land. The remaining uses include transportation corridors (Highways 401 and 402), floodplains and Environmentally Significant Areas. The majority of the subwatershed lies within the City of London, roughly 10 percent of the lands lie within the Municipalities of Thames Centre and Middlesex Centre.

STUDY PURPOSE AND APPROACH

The study purpose may be defined as follows:

> "***To develop an innovative stormwater servicing strategy with consideration for current and potential flooding, erosion concerns, groundwater as well as wildlife/aquatic habitat and natural corridor development***"

The objectives of this study are summarized below, according to the three study phases.

- Phase 1: Subwatershed Characterization
- Phase 2: Subwatershed Management Strategies
- Phase 3: Implementation and Monitoring Plans

ENVIRONMENTAL ASSESSMENT APPROACH

The original intent was to undertake the study for the entire Dingman Creek and to carry out the study in accordance with Schedule "C" of the Municipal Class Environmental Assessment. In parallel with the City's EA study, the UTRCA is currently undertaking an update to the Regulatory Floodplain throughout the subwatershed. The interim findings of the UTRCA study identified flows and associated floodplains that were significantly higher than previously defined in the City's Official Plan. The UTRCA Regulatory Floodplain remains under review at the time that this EA is being filed. For this reason, the scope of this study was revised and streamlined to allow areas that were less impacted by the updated floodplain to proceed with development in a timely fashion. **Figure ES 1** illustrates the location of the four tributaries as well as the extents for the Stage 1 and Stage 2 lands

The four tributaries that will be considered in this study include:

- White Oaks Drain;
- Pincombe Drain;
- North Lambeth (Thornicroft Drain); and
- North Lambeth (Tributary 12)

Stage 1 lands coincide with lands planned for development within the 10-year development period as defined in the City's Growth Management Implementation Strategy for works identified for Growth in the 2019 Development Charges Study. It should be noted that development lands with Draft Plans approved prior to the beginning of this study in November 2015 already have Stormwater Management infrastructure that are being implemented under previously completed EAs.

Stage 2 lands generally include lands adjacent to the main branch of Dingman Creek, generally located south of Exeter Road and east of Wonderland Road South. These lands will be assessed under an upcoming Schedule C EA process and may include options to mitigate the increase in Regulatory Floodplain that is being developed by the Upper Thames River Conservation Authority (UTRCA). It is important to note that the Regulatory Floodplain Update is being done by the UTRCA in parallel to the City's Master Plan EA process but does not form part of this EA study.

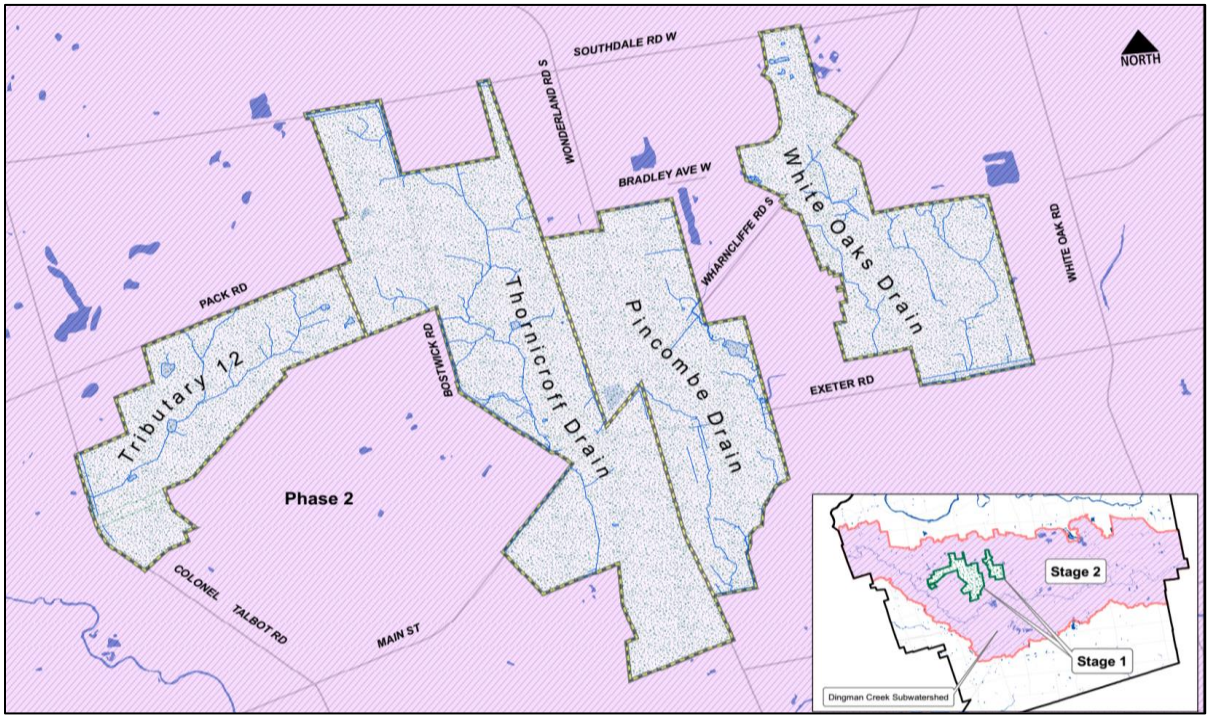

Figure ES 1: Study Area; Stage 1 and Stage 2 Lands

As a result of the changes as noted above, the study will now follow Approach #2 of the Class EA process. This study will, therefore, satisfy the requirements for Schedule A, A+ and B projects. Additional studies will be required for any project which falls under Schedules "C".

PROBLEM STATEMENT

The following problem statement was developed with the members of the Dingman Creek Stakeholder Group:

"The original problem statement for the Dingman Creek Subwatershed (DCS) was defined as the DCS suffers from poor water quality, a lack of wildlife habitat, loss of trees and vegetation, as well as flooding and erosion issues. Sustainable growth within the Urban Growth Boundary of the DCS is a City of London priority. To maintain, enhance and restore the DCS the City needs a comprehensive plan to support both environmental and development goals. This plan must:

- Build on the 1995 and 2005 Dingman Creek Subwatershed Studies and be consistent with the goals and objectives of the Official Plan and Southwest Area Secondary Plan;
- Meet the targets established in the Environmental Compliance Approval; and
- Create a "complete corridor" that provides a continuous natural area for the movement of water, wildlife and people.

Note: It should also be noted that the intent of the Dingman EA is not to delay construction of approved site plans or D subdivisions."

EXISTING SUBWATERSHED CONDITIONS

A variety of information was collected, reviewed and assessed in order to define existing conditions. The type of assessments that were undertaken include:

- Hydrology and Hydraulics (Surface Water Resources) including headwater drainage features, fluvial geomorphic resources, and hydrology/hydraulics and floodplain modelling;
- Water Quality;
- Groundwater Resources; and
- Ecological resources and the natural heritage system.

EVALUATION OF ALTERNATIVES

The evaluation process involved the development of criteria and an associated ranking system for the criteria. A general approach was used to assess the impact on water quality. The focus of the evaluation will consider alternative stormwater solutions and the associated impact on flooding, erosion, water quality and water balance.

Chapter 6 of the report identified alternative stormwater strategies together with the selection of the preferred alternative. Four (4) alternative stormwater management strategies were identified:

- Option 1: Do Nothing Approach
- Option 2: Traditional (Conventional) Stormwater Management
- Option 3: Low Impact Development (LID) Approach
- Option 4: Traditional plus Low Impact Development

The preferred alternative for the Dingman Creek Subwatershed study area is Option 4, which consists of LID source controls and conveyance controls combined with end-of-pipe facility controls. This alternative ranks highly under the natural environment criteria and social criteria. It also ranks relatively well under the economic criteria. Summaries of evaluation scoring results for each criterion are summarized below with **Table ES 1** provided as an overall reference. A

schematic of a perforated pipe system which represents one type of LID measure is presented in **Figure ES 2**.

Table ES 1: Evaluation Results

Evaluation Criteria	Do Nothing	Conventional SWM Strategy (end-of-pipe only)	Low Impact Development (LID) Strategy	Combined Conventional & LID
1. Natural Environment				
Potential to improve water quality based on existing water quality conditions and ability to provide required water quality as per the MECP requirements	0	3	3	4
Potential Impact on Flooding	0	3	2	4
Potential Impact on Erosion	0	2	3	4
Potential Impact on Aquatic Habitat	0	2	3	4
Potential Impact on Water Balance	0	0	3	3
Total Natural Environment Score	**0**	**10**	**14**	**19**
2. Social				
Aesthetics/Recreation	1	3	3	4
Integration with other City/Agency plans, policies and initiatives (programs)	0	2	2	4
Compatibility with adjacent land uses	0	2	2	4
Potential to increase private property values	0	2	2	3
Total Social Score	**1**	**9**	**9**	**15**
3. Economic				
Construction Costs	4	2	3	1

Evaluation Criteria	Do Nothing	Conventional SWM Strategy (end-of-pipe only)	Low Impact Development (LID) Strategy	Combined Conventional & LID
Long Term Operation and Maintenance Costs	4	3	2	1
Infrastructure Protection	0	3	1	4
Total Economic Score	**8**	**8**	**6**	**6**
Total Normalized Score for Stormwater Management Alternative	**24.3**	**54.9**	**61.5**	**79.6**

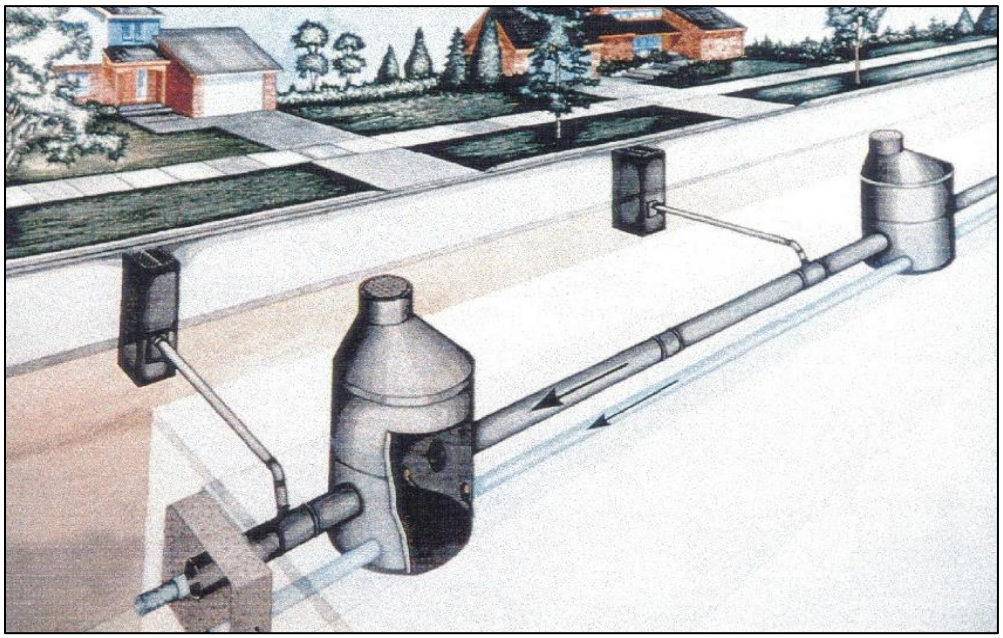

Figure ES 2: Schematic of a Perforated Pipe System

DESCRIPTION OF THE PREFERRED ALTERNATIVE

Chapter 7 of the report provides a description of the Preferred Alternative. This chapter summarizes the overall Management Strategy for the Stage 1 lands. The discussion focuses on targets related to:

- stormwater management (surface water) including water quality, water balance, flooding and erosion control targets;
- natural heritage plans; and
- groundwater.

Stormwater Management (Surface Water)

In order to mitigate the impact of urbanization of the Dingman Creek Subwatershed, stormwater management in the form of source, conveyance and end-of-pipe facilities will need to provide:

- Water quality treatment consistent MECP "enhanced" level quality control;
- Infiltration opportunities to maintain pre-development water balance characteristics and Support Significant Groundwater Recharge Areas (SGRAs);
- Detention of peak flows to mitigate flooding in tributaries and critical reaches of Dingman Creek; and
- Erosion controls to ensure critical erosion thresholds are not exceeded.

The control hierarchy is shown in Figure 7.1 of the report.

In terms of stormwater management objectives, the use of LID source controls as part of this strategy would provide water balance, water quality, and erosion benefits. The end-of-pipe controls would provide flood control benefits.

Water Quality Target

Following the approach outlined in Section 7.1 and Figure 7.1 of the report, new development areas within the Dingman Creek Subwatershed are recommended to follow the following stormwater control strategy:

The water quality target will not vary and will remain as control of the runoff generated from a 25 mm event. Where new development areas are designed to meet the pre-development water balance and the water balance target meets or exceeds an event capture depth corresponding to the runoff generated from a 25 mm event, additional end-of-pipe water quality measures will not be required unless intended to address a project specific water quality concern identified by the City or regulatory agency. SWM quantity controls to control peak flows will still be required at the end-of-pipe.

Water Balance Target

Two methods; the Thornthwaite and Mather model as well as the PCSWMM model were used For the Dingman Creek subwatershed to estimate the water balance components.

A basic water budget was prepared for the existing land use condition using monthly values of precipitation and temperature for the London Airport meteorological station (Environment Canada). The two methods provide an annual infiltration rate of between 97 and 103 mm/year on a watershed basis. Given that there are approximately 40 rainfall events per year the

average infiltration rate per event is relatively modest (2-3 mm per event). The actual values on a site by site basis will vary depending on soil type, slopes, vegetation cover and depth to water table.

The above recharge targets can be achieved by incorporating appropriate LID source and conveyance control measures as outlined in Section 5 of the report together with the requirements to meet the Water Quality targets as noted above. Collectively the LID measures should ensure that post development infiltration rates equal or exceed pre development levels.

Erosion Control Target

As shown in Section 8.2.5 implementation of LID measures on a tributary basis will maintain or reduce runoff volumes on a seasonal basis. Given the balancing of flow volumes as presented in Section 6.2.5 and based on the LID measures which are required to meet water quality and water balance targets, the recommended preferred alternative for SWM is expected to meet the erosion control requirements

Flood Control Target

This section will address the flood control strategy to ensure that proposed development does not increase flows within the Stage 1 tributaries or the lands downstream the Stage 1 lands (the main branch of Dingman Creek). The PCSWMM model was used to estimate flow rates within the four tributaries of interest. The results are provided in Error! Reference source not found. of the report. It was also applied to estimate storage requirements for future stormwater detention facilities.

A total of 14 future municipal dry ponds are recommended across the study area. Medium and high density residential lands as well as employment/commercial lands will be expected to implement controls (see **Figure ES 3**) in accordance with the City's Permanent Private Systems Policy.

KEY IMPLEMENTATION CONSIDERATIONS

Section 8 of the report summarizes the investigations, inventories and analyses used to better define existing environmental conditions, future impacts, and recommended management measures which comprise the Stage 1 study area lands. The subsequent studies would be required once development patterns, transportation and servicing requirements are better known and would fit into the overall stormwater development process as identified in The City of London Design Specifications & Requirements Manual – Chapter 6 Stormwater Management (August 2019). The recommended measures include actions to address stormwater management requirements, protection of the natural heritage system and associated ecological features, as well as restoration and enhancement works for two corridors along North Lambeth - Tributary 12 and the White Oaks Drain.

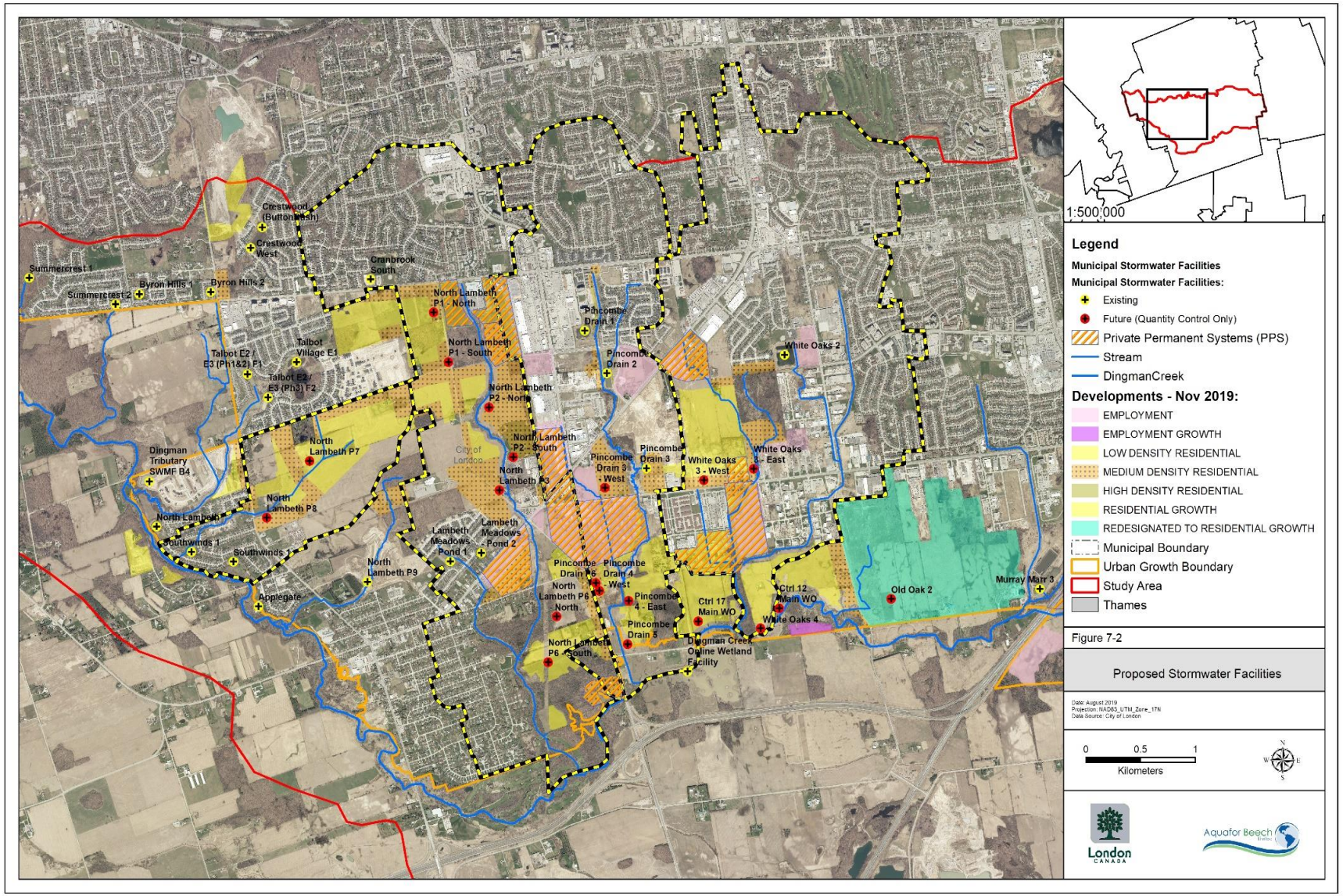

Figure ES 3: Proposed Stormwater Facilities and Control Facilities within the Four Tributaries of Interest

In terms of the land development and environmental planning process, the role of the Subwatershed-wide Dingman SWM EA is to provide a framework and broad-scale guidance to the next level of planning and design study as urban development proceeds. As such, the focus of this chapter is to provide guidance for the future work required to implement the Dingman SWM EA recommendations. This includes direction with respect to future studies, timing/phasing of the works, policy/design guidance, and approvals.

Stormwater Management Controls

Stormwater management controls consist of the recommended works required to mitigate the impacts from proposed future development. This includes:

- End-of-pipe stormwater ponds for flood control; and
- Low Impact Development (LID) source control techniques to meet water quality, water balance and erosion requirements.

The PCSWMM model was used to define flows for existing and proposed development conditions. Table 7.4 of the report summarizes the names, type, drainage area and flood storage requirements for each of the proposed facilities. The location of the proposed facilities is shown in **Figure ES 3**.

Meeting the (RVC_T) requirement will, subject to confirmation via field investigations, meet all of the water quality, water balance and erosion control targets.

The City of London Design Specifications & Requirements Manual – Chapter 6 Stormwater Management (August 2019) provides direction with respect to a number of items that are required to undertake conceptual and detail design of stormwater measures. An overview of each of the major sections within the design document together with cross-referencing to this study is provided in Section 8 of the report. Additional requirements from this study which are generally complimentary to the City of London requirements have also been provided.

Natural Heritage System (NHS)

Identification of the City of London's NHS was completed as part of this process to ensure significant natural features and areas are protected. Opportunities for restoration and maintenance/enhancement of linkages between components of the NHS were also considered a priority for this study. An overview of natural heritage in the study area, with focus on the focus areas associated with the four tributaries of interest and the proposed SWM facility locations, was provided in Section 3.4 of the report. Section 7.1.6 provided the basis for the protection of the NHS in the City.

The requirements for site investigation and impact assessment for the identified SWM facility locations together with overall NHS requirements are presented in Table 8.1 of the report.

An overview of natural heritage in the study area, with focus on the four tributaries of interest and the proposed SWM facility locations, was provided in Section 3.4 of the report. Section 7.1.6 provided the basis for the protection of the Natural Heritage System in the City.

The requirements for site investigation and impact assessment for the identified SWM facility locations together with overall NHS requirements are presented in Table 8.1 of the report.

Stream Systems

Characterization and assessment of the stream systems are to be carried out to confirm fluvial geomorphic conditions, headwater drainage feature (HDF) protection classes, and stream corridor erosion hazards, and to direct stream restoration objectives. Much of the available information for stream systems in the study area has been summarized from previous studies in Section 3.2 (e.g., Parish, 2014); however, it is recommended that this previous work is to be updated. Select field work completed by Aquafor in 2019 includes a fluvial geomorphic assessment of one tributary (i.e., Thornicroft) and HDF assessments for two tributaries according to standard procedures developed by CVC and TRCA (2014) (i.e., North Lambeth Tributary 12 and a portion of Pincombe Drain). HDF investigations were limited in scope due to private landowner considerations and should be completed in greater detail during future stages. It is also recommended that HDF considerations be incorporated into UTRCA development policy as originally discussed.

While critical discharge erosion control targets have been recommended in previous studies, it is expected for this study area that LID approaches and water balance targets will address SWM erosion control requirements (Section 7.1.4), so further detailed erosion threshold analyses will not likely be necessary.

The detailed stream system assessment requirements for each of the four tributaries are explained in Section 8.5 of the report. It is also expected, based on discussions with the City, that one consultant will be responsible for completing all of the necessary investigations and assessments for the entire area so that a consistent approach may be applied throughout. That consultant will be responsible for confirming the appropriate scope of work via pre-consultation with the City (and other stakeholders as appropriate) at project initiation. The required study tasks to be completed for the stream systems prior to project implementation are outlined generally below, and then specifically for each tributary in Table 8.2 and the following sub-sections:

Flood Susceptible Reaches

The stormwater requirements as provided in Chapter 6 are suitable to meet agency requirements for proposed development with respect to flood control, erosion, water quality and water balance. Implementation of these measures, from a flooding perspective, will result in 2 to 100-year flows which do not exceed existing values.

Current MNRF policy (see section 7.1.5 of the report) does not consider the benefit of storm water management facilities in reducing peak flows for regulatory storm (250-year). Therefore, assessments were undertaken to define stream reaches where problems currently exist or future development would result in adverse conditions (as the storage value of the proposed facilities is not considered by MNRF). Measures such as flood proofing, structural measures or constructing the proposed SWM Facilities to meet MNRF criteria will likely be required to alleviate problems within these reaches. The proposed Environment Assessment for the Stage 2 studies will address this topic in further detail. However, a map showing preliminary areas where flooding problems occurs is provided in **Figure ES 4**.

Discussions will need to be undertaken between the City, UTRCA and development groups to further refine the flood susceptible reaches (once the UTRCA mapping becomes available) and to develop an approach which allows development to proceed while protecting potential flood susceptible areas.

Complete Corridor Initiatives

As part of this study the opportunity to provide flood storage for North Lambeth P7 and P8 as well as the tributaries to White Oaks Drain (WTC3 and WTC5) within a stream corridor was identified. The City is choosing to name these areas as “complete corridors” to convey water, people and wildlife. As a result, the more detailed objectives of the proposed complete corridors would be to:

- Water: Provide the necessary flood control requirements within a stream corridor with a minimum width to be defined by ecologic and water resources (regulatory flood control) requirements;
- People: Create associated recreational amenities;
- Wildlife: Provide terrestrial and aquatic habitat enhancement and restoration improvements, including potential ecological linkages between existing NHS features.

The alteration and interference of valley and stream corridors, including modifications to watercourses, flood hazards, and lands within valley and stream corridors will require approval by the City, UTRCA and potentially MNRF. Alterations and modifications may be supported where it can be demonstrated to the satisfaction of the City, UTRCA and appropriate agencies that modifications will meet the above noted objectives.

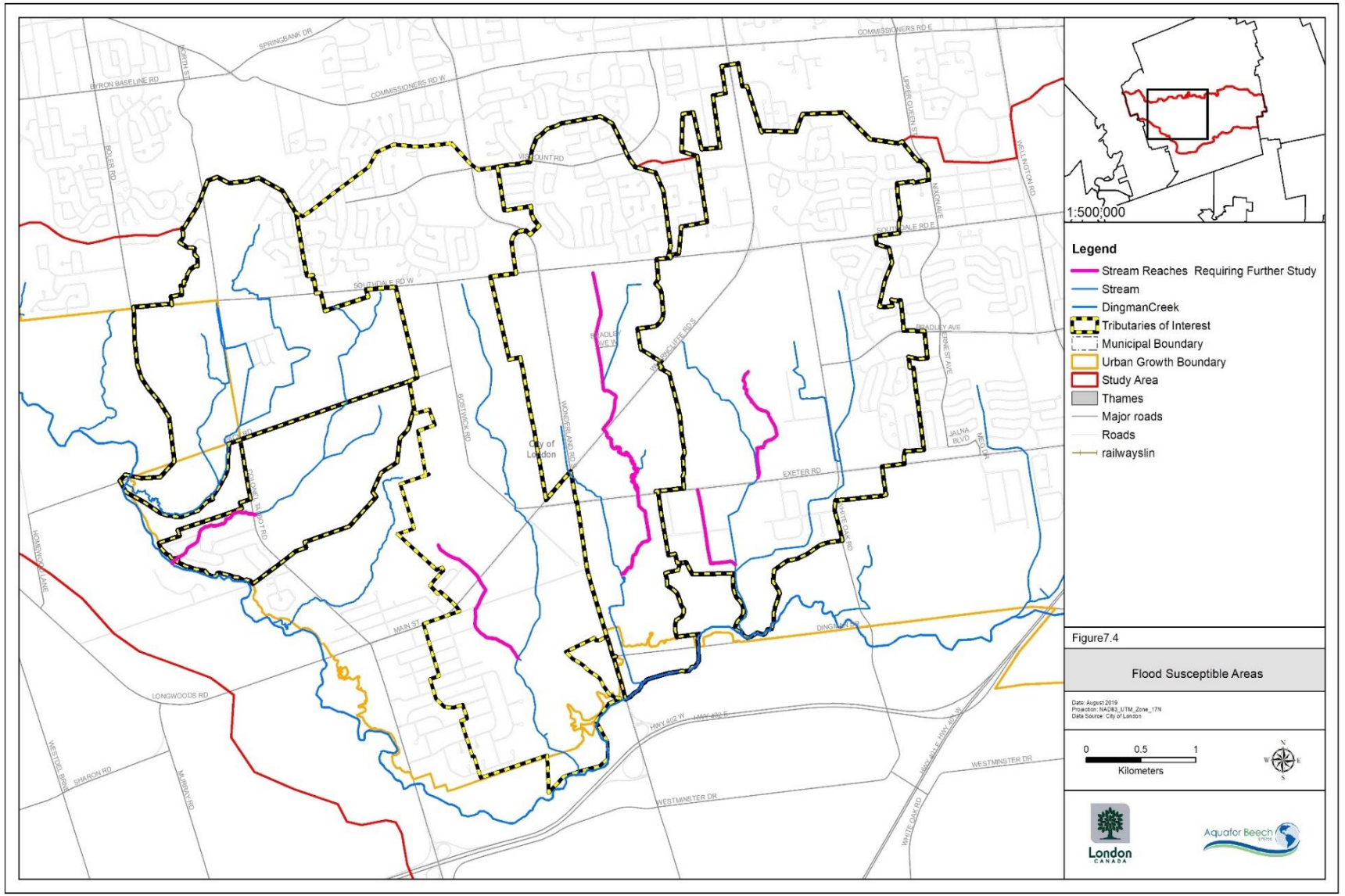

Figure ES 4: Flood Susceptible Reaches

Restoration Efforts

Restoration efforts within and outside the corridor are intended to meet some environmental and engineering objectives which are listed in Section 8.4. The conceptual sizing identified through the EA Study will need to be confirmed and/or refined through preliminary and detailed design during the future planning stages. Consideration for Stream Corridor Width Requirements are presented in Table 8-3. For example, further hydraulic modelling, grading plans, and technical analyses will need to be completed to ensure that the proposed corridor will convey the complete range of flood flows, and preserve existing flood storage volumes. Further details will be coordinated with the stormwater management and grading plans for the adjacent development lands. Restoration, grading, planting and landscaping plans will also need to confirm that the overall NHS coverage targets are met, including woodland, meadow and wetland targets.

Future Study Requirements

Chapter 8 of the report provides direction for the functional and detail design studies that are required. Preliminary design of the Dingman Creek corridor restoration works should be completed at the functional design stage and should demonstrate how the proposed design will meet all of the targets identified in this study (Section7.1).

Potential Flood Related Item

As part of the public consultation process it was brought forward that a landowner within the Pincombe Drain study area experience flooding that may be attributable to a number of factors including private property issues, the capacity of the existing storm sewer system, or the receiving stream.

As a result, the City agreed to assess the hydraulics of the Pincombe Drain channel and the storm sewer system on Southdale Road as part of the functional and detailed design for channel improvements/restoration to the Pincombe Drain, noting that final water surface elevations within the Pincombe Drain would be provided by UTRCA upon completion of the floodplain update within the Dingman Creek.

Summary Mapping

A series of maps have been provided for each of the four tributaries which are subject to further study. Each of the maps include features such as location of existing and proposed stormwater management facilities, the location of various features within the NHS, and general restoration areas (**Figure ES 5** to **Figure ES 9**). The maps, together with a description of the types and extent of the studies that are required as development proceeds may be used as a basis for undertaking the subsequent studies as development proceeds.

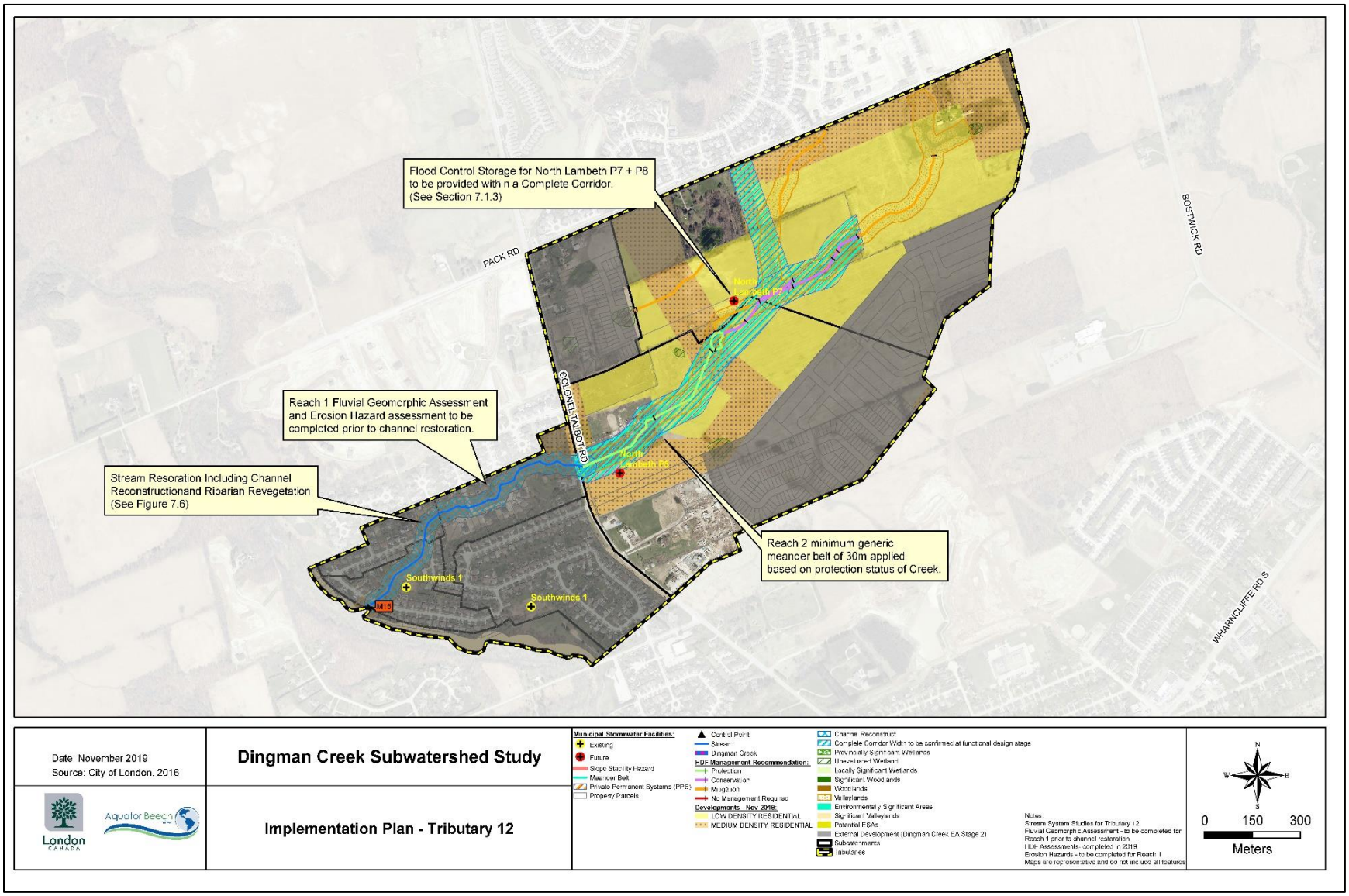

Figure ES 5: Implementation Plan – Tributary 12

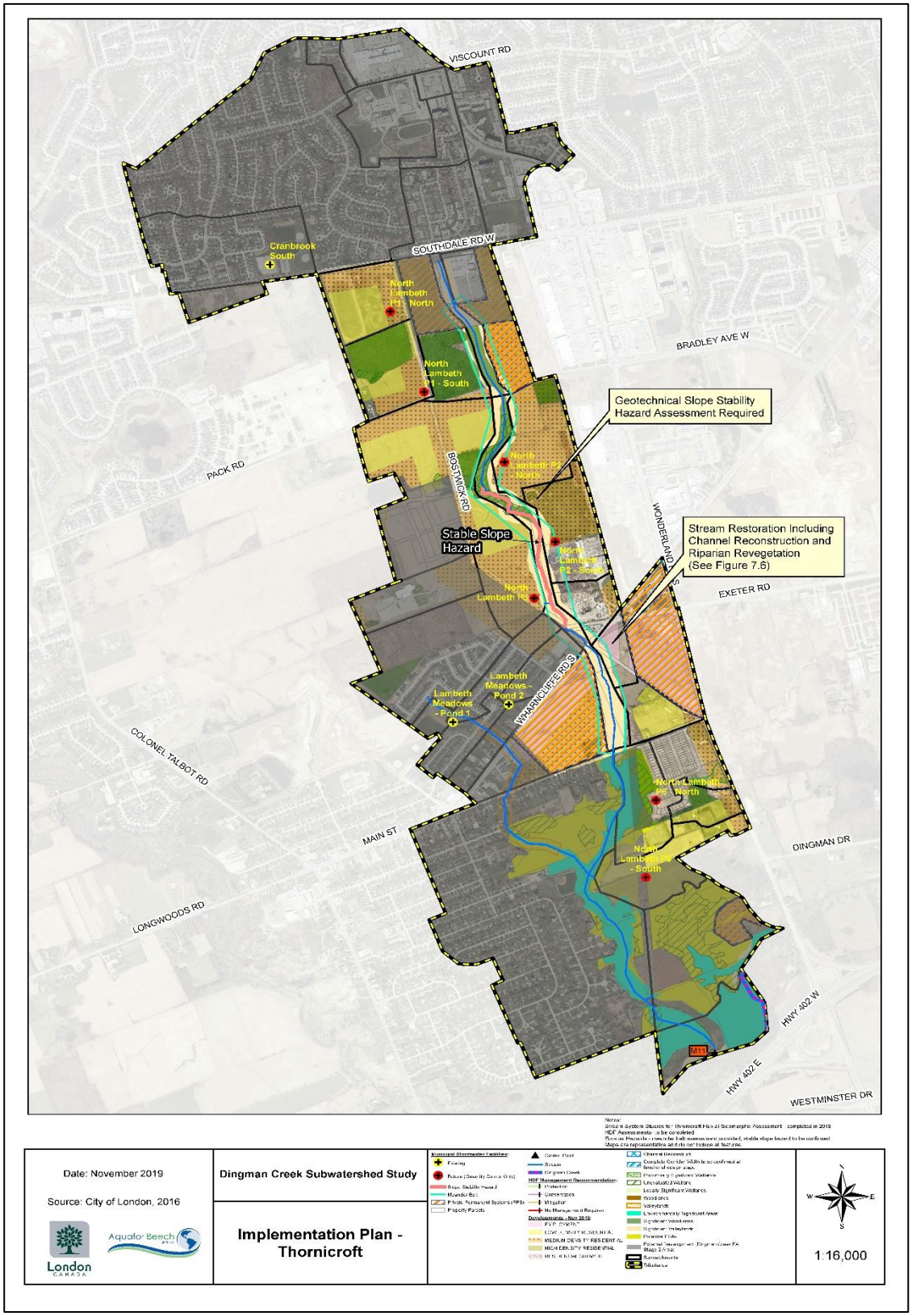

Figure ES 6: Implementation Plan – Thornicroft

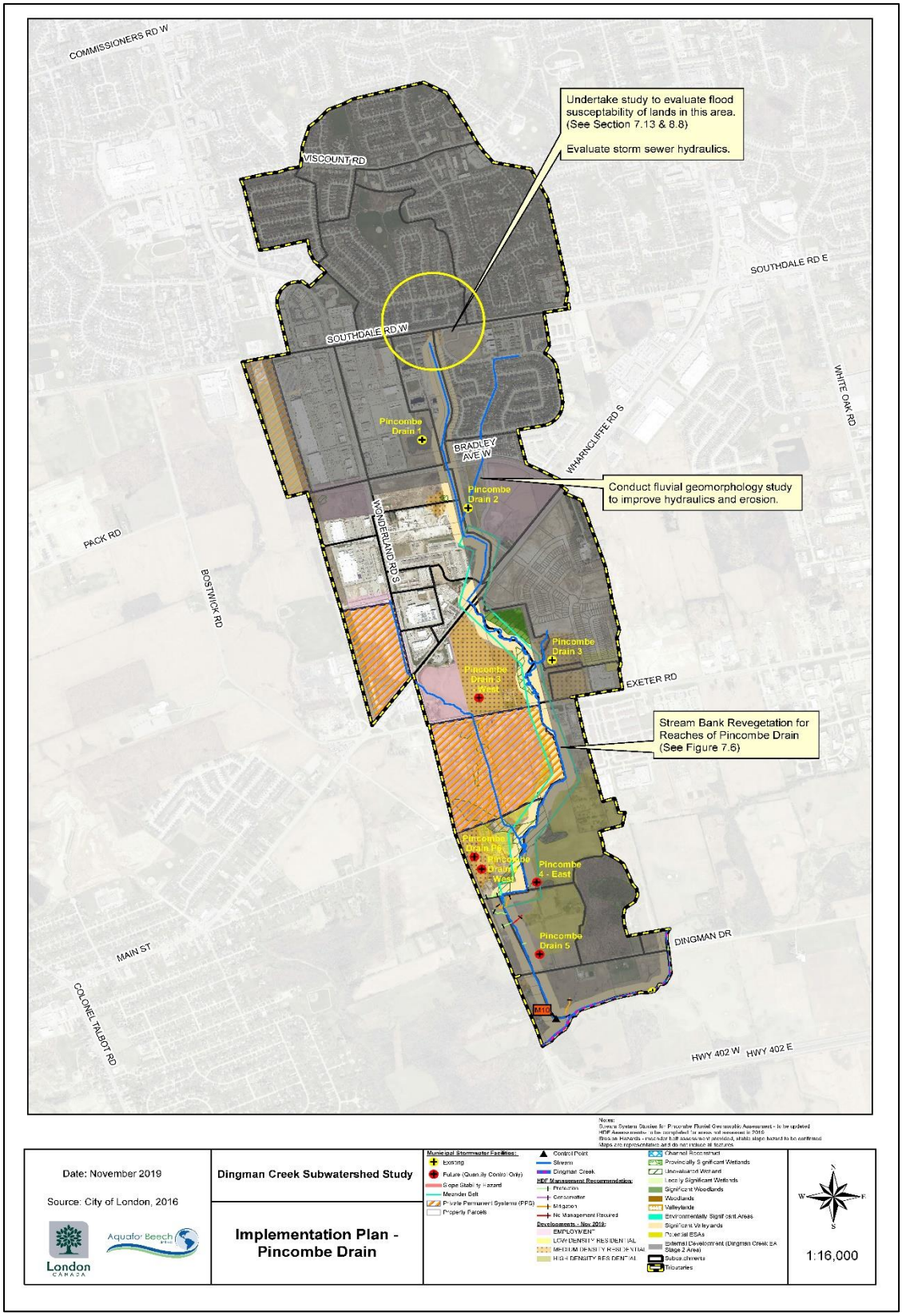

Figure ES 7: Implementation Plan – Pincombe

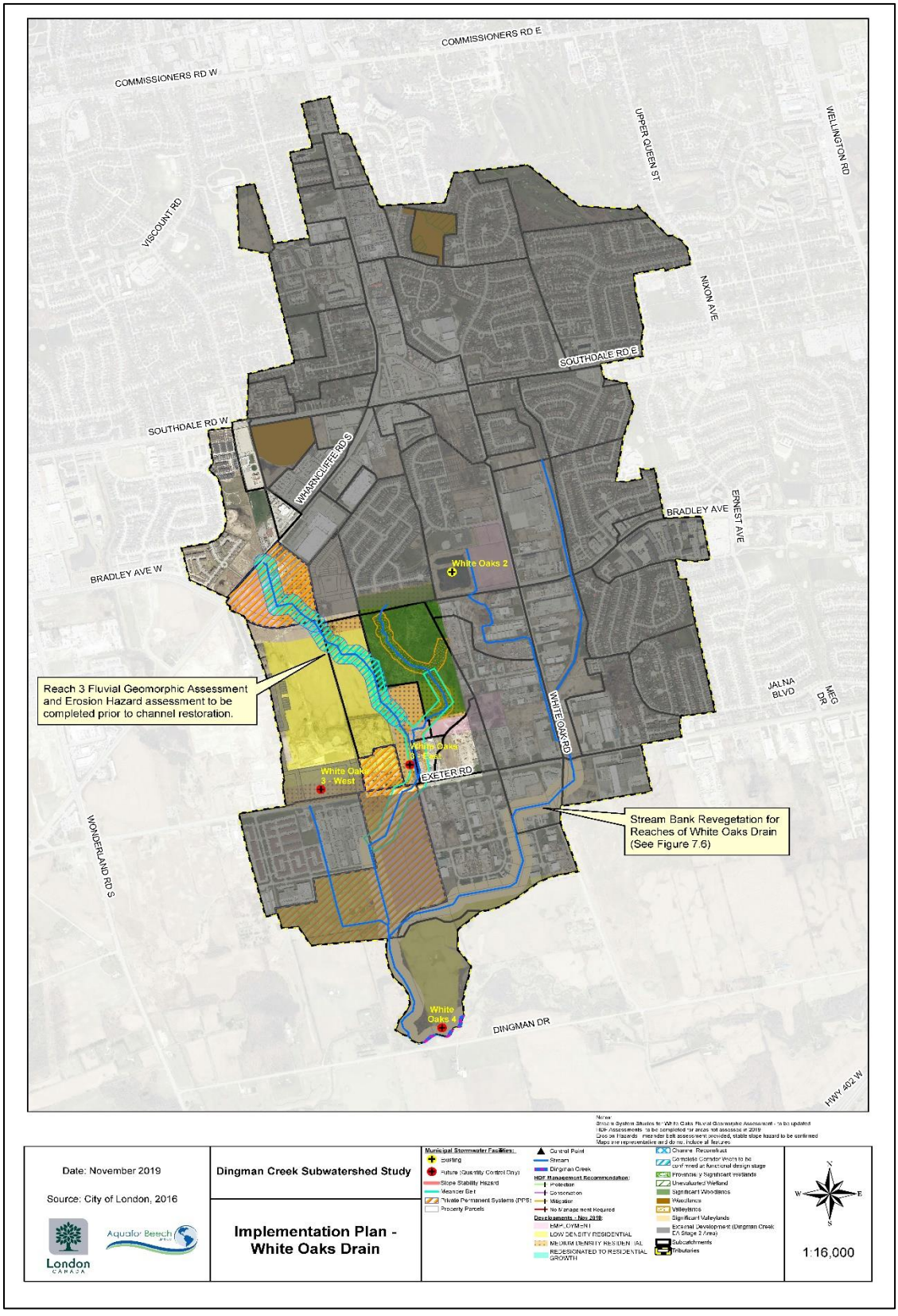

Figure ES 8: Implementation Plan – White Oaks

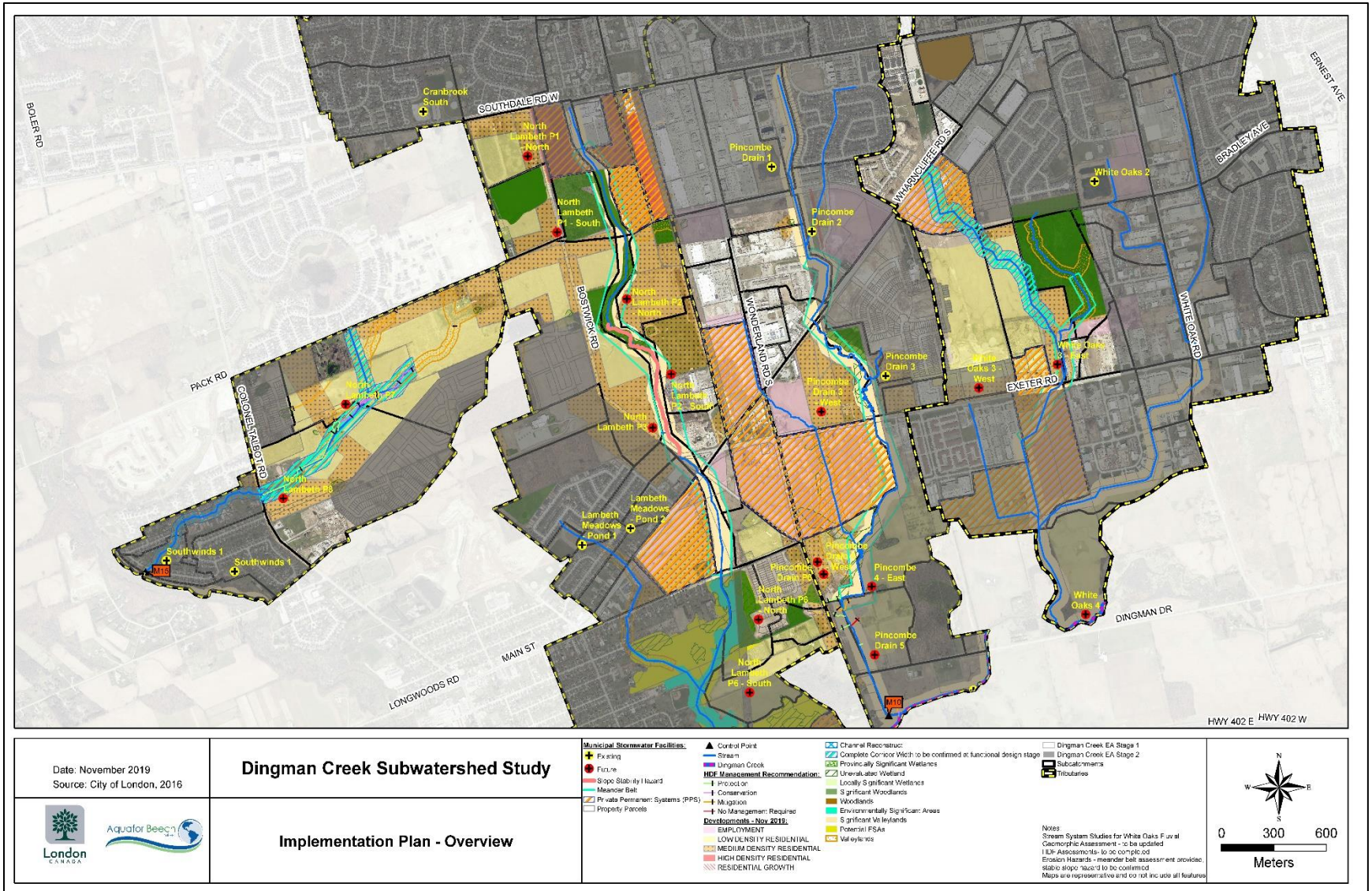

Figure ES 9: Implementation Plan – Overview

COST ESTIMATES/ENVIRONMENTAL ASSESSMENT UNDERTAKINGS

Costs Estimate

The planning level cost estimates for the preferred alternative in the "Dingman Subwatershed: Stormwater Servicing Study" include the following items:

- SWMF facilities in Stage 1 lands (14 municipal facilities),
- Complete Corridors and Stream Restoration Works; and
- Other SWM Programs including Low Impact Development Measures.

The costs are calculated based on the information obtained from the 2019 Development Charge (DC) Update Study (City of London 2019). The costs for the SWMF facilities include construction, inlet/outlet sewer costs, land as well as 20% engineering and 20% contingency. For the Complete Corridors and Stream Restoration Works the costs include construction, land, engineering and contingency.

The total estimated cost for implementing the recommended solution is approximately $65.4M, including Engineering and Contingency.

EA Undertakings

Table ES 2 summarizes the EA Schedule for all undertakings associated with the Preferred Alternatives.

Table ES 2: Summary of EA Undertakings

Description	Municipal Class EA Schedule
SWMF Facilities	Schedule B
Complete Corridors and Stream Restoration Works	Schedule B
Low Impact Development with Local Storm Sewer Servicing (DC Subsidy)	Not Applicable
Pincombe Drain/Storm Sewer Upgrade	Schedule A^{+}

Implementation Schedule

In accordance with the City's 2019 Growth Management Implementation Strategy (GMIS) timing, the general order of tributary works would proceed approximately as follows. This timing is subject to the ability to obtain all necessary permits to complete the work:

- 2021: North Lambeth (Tributary 12) and Pincombe Drain Improvements
- 2022: White Oaks Drain
- 2026: Thornicroft Drain: East side of Bostwick Road
- 2033: Thornicroft Drain: West side of Bostwick Road

The timing of specific facilities will be confirmed during the upcoming 2020 GMIS process, which will be initiated in February 2020.