



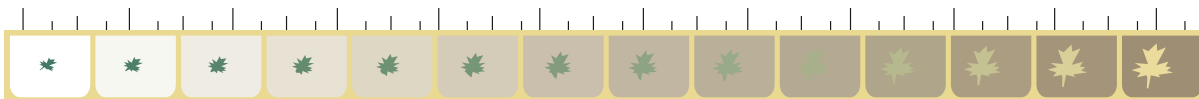
London
CANADA

Design Specifications & Requirements Manual

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Design Specifications & Requirements Manual

The design information contained in this manual is intended to provide guidance beyond legislative and standard design practices for use in the City of London (the City). There will be site specific situations where the design will depart from these practices as it is not possible nor is it the intention of the City to anticipate every situation. The City intends to review and revise the Manual from time to time. The City also acknowledges that other references such as the '*Standard Contract Documents for Municipal Construction Projects*' are to be used in conjunction with this manual. The 2012 update of this manual incorporates design information from the City's former *Subdivision & Development Guide Manual* to provide consistent and current design information for development projects.

The City of London maintains its right to accept or refuse any design submissions and requires an acceptable design for any given circumstance.



Design Specifications & Requirements Manual

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INTRODUCTION

The information contained herein comprises the “Design Specifications and Requirements” which are to be utilized for the design of works within the City of London on municipally owned road allowances, municipally owned property and for municipally owned infrastructure on easements.

The design information contained in this manual is intended to provide guidance beyond legislative and standard design practices for use in the City of London (the City). There will be specific situations where the design will depart from these practices as it is not possible nor is it the intention of the City to anticipate every situation.

This document, along with the City of London Standard Contract Documents for Municipal Construction Projects, the Ontario Provincial Standard Specifications, the Ontario Provincial Standard Drawings, and the City of London Facility Accessibility Design Standards (FADS) provide the basis for the design of municipal construction projects and works intended for assumption by the City of London. Where specific design information for new subdivisions is not applicable to other sections in this manual, it is added to Section 18 ‘Drafting and Design Requirements for New Subdivisions.

These specifications and drawings may be revised from time to time as considered necessary by the City of London. It will be the responsibility of the professional engineer who is performing the contract administration for the work to verify that the installation of these systems will be in accordance with the latest revision of these Specifications.

The City of London maintains its right to accept or refuse any design submissions. The City requires an acceptable design for any given circumstance. Notwithstanding any item that may be contained or not included herein, the decision of the City concerning any matter shall be final.

Both municipally managed and development led projects should be considered a service delivery to present or future tax payers of that area. Responsible service delivery is achieved through balancing the technical needs of the project proponent with the social costs to the taxpayers.

The recently published National Guide to Sustainable Municipal Infrastructure, known as the Infraguide Best Practices, has listed numerous initiatives which better recognize social costs of construction and suggest methods to address these costs. One of the primary requests of the public is to pay greater attention to reducing disruption to businesses and to the traveling public. A post 2004 Environmental and Engineering Services Department construction survey confirmed that although London taxpayers were generally happy with construction quality, they desired better attention to maintaining through traffic, maintaining accesses, and more communication of planned closures.

The primary goals of managing projects, whether City or development led, in right of ways include:

1. Public and worker safety;
2. Quality of work and appropriate payments;
3. Maintaining access to businesses and homeowners whenever possible;
4. Maintaining through traffic for vehicles and pedestrians;

5. Ensuring proper insurance coverage and risk management;
6. Minimizing inconvenience from noise, dust, delay, and vibration; and
7. Providing timely and accurate information regarding ongoing construction.

1.1 GENERAL INFORMATION

1.1.1 Definitions

For the purpose of these specifications, the following definitions will be recognized:

- a. **"City"** shall mean The Corporation of the City of London
- b. **"Contractor"** means a person, partnership, or corporation who contract to undertake the execution of work commissioned by the City to install or maintain sewers, private drain connections, maintenance holes, catch basins and other appurtenances.
- c. **"Developer"** shall mean the Owner or party specifically named in a Development Agreement or in a Subdivision Agreement.
- d. **"Engineer"** shall mean the City Engineer for the City of London or the City Engineer's authorized representative.
- e. **"Inspector"** means the person(s) authorized and supplied by the City to see that the installation is executed according to the specifications and the approved plan(s) in a good workmanlike manner according to the latest City of London practices and standards.
- f. **"Main"** means every water pipe, except services and portions of private mains as herein defined, installed on the public road allowance or on any other land upon which the City has obtained easements.
- g. **"OPSD"** means Ontario Provincial Standard Drawings
- h. **"Owner"** Shall include any person who or any firm or corporation that is the registered owner of the property under consideration or any agent thereof, a person entitled to a limited estate in land, a trustee in whom land is vested, a committee of the estate of a mentally incompetent person, an executor, an administrator and a guardian.
- i. **"OBC"** means Ontario Building Code
- j. **"PDC"** means a private drain connection
- k. **"Product Approval Committee"** means the committee that approves products which may be used for construction of works which on City of London Projects or works which will be assumed by the City of London.
- l. **"Subdivider"** means the Owner or Party specifically named in a Subdivision Agreement.
- m. **"Water Service"** means every water pipe installed from a connection on a main or private main to the meter location or, for a fire service, to the inside of the exterior wall of a structure.

- n. **"Water Service extension"** means the portion of a water service from the property line to the meter location, or for a fire service to the inside of the exterior wall of a structure, ie. an extension of a service stub.
- o. **"Water Service stub"** means the portion of a water service from a main to the property line which will always include one control valve.
- p. **"UCC"** means Utilities Coordinating Committee which is a committee made up of representatives of utility companies and City of London Administrative staff coordinating the construction of and the location of utilities within City road allowances.

1.1.2 Metric Usage

All plans, drawings, specifications, details, descriptions, notes or any other terms included in the Engineering drawings, specifications and tender package are to be dimensioned or referred to in the Metric system of measurement.

1.1.3 Location of Utilities

- a) Typical Right-of-ways - all works to be located in a City right-of-way are to be located in accordance with UCC drawing UCC-1M (2002-05-23). Refer to Figure 1.1 of the The City of London Utilities Coordinating Committee (U.C.C.) Orientation Manual for additional details. Locating works in non-standard locations from these must be approved by the appropriate division Development Services and the Utility Coordinating Committee. Additional information about the UCC can be found on the City of London web page at: http://www.london.ca/business/Resources/Consultant-Resources/Documents/UCC_Orientation_Manual.pdf
- b) Window Street Rights-of Ways - all works to be located in a window street right-of-way are to be located in accordance with UCC drawing UCC-2M. Refer to Figure 1, 2, 3.1, 3.2, 3.3 of the City of London Utilities Coordinating Committee (U.C.C.) Orientation Manual. Additional information about the UCC can be found on the City of London web page at: http://www.london.ca/business/Resources/Consultant-Resources/Documents/UCC_Orientation_Manual.pdf

1.1.4 Drawing Standards

Information relating to Drawing Standards, Legal Plan submission requirements, Record Drawings, and Digital drawing submission requirements can be found under "Plan Submission Standards" on the City of London Web Page at: <http://www.london.ca/business/Resources/Consultant-Resources/Documents/EngineeringDrawingsLibrary.zip>

1.1.5 Standard Drawings

Reference to City of London SR, SW and W-CS are City of London Standard Drawings and are found in the City of London Standard Contract Documents for Municipal Projects.

*"Standard Contract Documents for Municipal Construction Projects" can be found on the City of London web at: <http://www.london.ca/business/Resources/Consultant-Resources/Pages/Standard-Contract-Documents-For-Municipal-Construction.aspx>

1.1.6 Municipal Consent Application (MCA)

Prior to construction of works on public property, the Owner or their agent must file a Municipal Consent Application and receive approval from the Utilities Co-ordinating Committee (UCC) for work on Public Property.

The City's Municipal Consent Application (MCA) process has been computerized and is accessed from the following URL <http://www.london.ca/business/Resources/Consultant-Resources/Pages/UCC.aspx> . A copy of the [MCA program manual](#) in pdf* can be downloaded by clicking on the link. All users and applicants must first register to gain access. To register, please download and print the [MCA Registration Form](#) in pdf* and return the completed form to the attention of the UCC Secretary by [email](#) or by fax 519-661-6422. Once registered, you will be sent a login and password by email.

In situations where the road will be assumed by the City at a future date, and the works are in a non-standard location, this deviation must also be approved by UCC.

1.1.7 Innovative Design Submissions

These requirements must be applied to all design applications. It is recognized that in some instances, unique circumstances may arise where some requirements cannot be accommodated. In these cases, the onus is on the proponent to demonstrate how the proposed design deviates from the requirements, yet still meets the spirit and intent of this overall document. Deviations must be reviewed and accepted by the appropriate divisions in Environmental Services and approved by the City Engineer.

1.1.8 File Manager Process

New Draft Plan Applications will be processed through the new File Manager Process (implemented May/June 2008). Additional information, reference material, Guidelines, Templates, etc. relating to the File Manager Process can be found on the City of London web page at: <http://www.london.ca/business/Planning-Development/planning-applications/Pages/Subdivisions.aspx>

1.1.9 Facility Accessibility Design Standards

All works to be constructed within a City of London road allowance, municipally owned property or on municipally owned easements are to be consistent with the Facilities Accessibility Design Standards.

1.1.10 Design Manual Standard Drawings

All standard drawings contained within this Design Specifications and Requirements Manual are not to scale.

1.2 ACKNOWLEDGEMENT OF SOURCES

This document consists of a compilation of design practices used by the City of London. It has not been the City of London's objective to develop servicing design information. Rather, this compilation consists primarily of information that has been developed by the other agencies and governments, chosen by the City of London for use within our municipality.

The City of London acknowledges the following sources of design practices in the development of this document.

1. Corporation of the City of London Water By-Law W-1, Regulation of Water Supply in the City of London;
2. Corporation of the City of London Drafting Standards and Submission Requirements (Revised February 2, 2018);
3. Corporation of the City of London Sanitary Sewerage Servicing Study;
4. Corporation of the City of London Standard Contract Documents for Municipal Construction Projects;
5. Corporation of the City of London Stormwater Management Pond Guidelines (Rev. June 1998, and Council amended July 2002);
6. Corporation of the City of London Zoning By-Law No. Z-1, (October 2011);
7. Corporation of the City of London Policy Manual;
8. Corporation of the City of London Official Plan
9. Fire Underwriters Survey, Water Supply for Public Fire Protection, A Guide to Recommended Practice, (1999) ;
10. Ministry of the Environment, Guidelines for the Design of Water Distribution Systems, (latest revision);
11. Ministry of the Environment, Stormwater Management Practices, Planning and Design Manual, (March 2003);
12. Ministry of the Environment, Noise Assessment Criteria in Land Use Planning, (October 1997);
13. Ministry of Natural Resources, Guidelines on Erosion & Sediment Control for Urban Construction Sites, (December 2006);
14. Ministry of Transportation, Geometric Design Standards for Ontario Highways;
15. Ministry of Transportation, Noise Barrier Wall Guidelines;
16. Municipal Engineer's Association Municipal Works Design Manual (2nd Edition, 1984);
17. Ontario Building Code;
18. Ontario Concrete Pipe Association;
19. Ontario Provincial Standard Specifications;
20. Ontario Provincial Standard Drawings;
21. Ontario Traffic Manuals;
22. Ontario Water Resources Act;
23. Public Utilities Act;
24. Transportation Association of Canada, Geometric Design Guide for Canadian Roads, (2017);
25. Transportation Association of Canada, Canadian Guide to Neighbourhood Traffic Calming (Second Edition 2018).



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2 TRANSPORTATION

2.1 ROADS DESIGN

2.1.1 Design Speed

Design speed shall be based on the following chart:

Posted Speed (km/h)	Design Speed (km/h)
50 and below	60
60	70
70	80
80	90
90	110
100	120

Design speed for Neighbourhood Connectors shall be 60km/h unless adjacent to schools or high pedestrian generators such as regional parks in such cases a design speed of 50km/h is to be used. Design Speed for Neighbourhood Streets shall be 60km/h if the number of residential unit is equal to or exceeds 45, in cases where the Neighbourhood Street serves less than 45 units, or is adjacent to a school or high pedestrian generator such as a regional park a design speed of 50km/h is to be used.

2.1.2 Centreline Radii

- a. Expressway, Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare in Primary Transit Area, Main Street, Rural Thoroughfare, and Rural Connector shall be derived from Table C3-3 of the Geometric Design Standards for Ontario Highways. This chart is a summary of typical design speeds versus standard super elevation grades taken from C3-3.

Design Speed (km/h)	Minimum Radius (m)			
	Normal Crown	Reverse Crown 2%	Superelevation 4%	Superelevation 6%
40	700	500	160	55
50	1100	750	250	90
60	1600	1100	365	130
70	2200	1500	500	190
80	3000	2000	675	250
90	3500	2500	875	340
100	4500	3500	1100	420

1. Source: Geometric Design Standards for Ontario Highways – Table C3-3

- b. Neighbourhood Connectors and Neighbourhood Streets for new Construction
 - i. Neighbourhood Connectors and Neighbourhood Streets shall have centerline horizontal curves which meet or exceed the City of London Standard “Minimum Centreline Radii of Curvature for Roads in Subdivisions”. Refer to Fig.2.1.
 - ii. Neighbourhood Streets with bends of approximately 90 degrees are to have a minimum inside street-line radius in accordance with the following:

Road Allowance	Street Line Radius
20.0m	9.0m

Note: Bends of 90 degrees are only permitted on Neighbourhood Streets.
Refer to Fig.2.2.

- iii. For window street design information reference should be made to Section 1.1.3.b).
- iv. The use of back to back horizontal curves or reverse curves will not be permitted on any new street. Straight tangents are required between curves, minimum tangents for varying road types will be determined by the City Engineer.

c. Reconstruction Projects

The reconstruction of existing roads are to have the centreline horizontal alignments reviewed by the applicable Project Manager on a site specific basis.

2.1.3 Radii for Curb & Gutter

- a. Intersection Radii for curb and gutter should be measured at edge of pavement. The following chart illustrates the required radii.

		To:		
		Rapid Transit Boulevard, Urban Thorough, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare	Neighbourhood Connector	Neighbourhood Street
From:	Rapid Transit Boulevard, Urban Thorough, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare	15m	15m	12m
	Neighbourhood Connector	15m	7.5m	7.5m
	Neighbourhood Street	7.5m	7.5m	7.5m
	Industrial Streets	15m	15m	15m

b. Intersection Radii on Bus Routes & Daylighting Requirements

- i. All intersections that have, or are proposed to be, future bus routes are to have 15.0m radii regardless of the classification of the road;
- ii. a 3.0m daylighting triangle is required where a 15.0 m radius is needed at the intersection of a Neighbourhood Connector or a Neighbourhood Street;
- iii. a 6.0m daylighting triangle is required for any road type connection to a Rapid Transit Boulevard, Urban Thorough, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare.

c. Cul-de-sacs

The minimum required radii of curvature for curb & gutters for a residential and industrial cul-de-sac are as per City of London SR-5.0 and SR-5.1.

2.1.4 Lane Widths

For multi-lane roads or channelized intersections, minimum lane widths shall be based on the following chart.

Description	Width (m)
Right Turn Lane	3.0
Left Turn Lane	3.0
Through Lane*	3.3
Curb Lane (single lane per direction)	3.5
2-way Left Turn Lane	4.0

*For Rural Thoroughfares a paved 2.5m wide and 0.5m wide gravel shoulder is required adjacent to the travel lane, for Rural Connectors a paved 0.5m wide and 2.5m wide gravel shoulder are required adjacent to the curb lane.

NOTE: In situations with higher design speeds or higher road classifications, wider lane widths may be required.

2.1.5 Right of Way, Pavement and Boulevard Widths

Pavement widths, right of way widths and boulevard widths shall be based on the following chart. (edge of pavement to edge of pavement)

Usage ³	R.O.W. (m)	Pavement (m)	Boulevard (m) Both Sides ⁶
Expressway	100	Varies	Varies
Rapid Transit Boulevard	50	Varies	Varies
Urban Thoroughfare, Main Street	45	Varies	Varies
Civic Boulevard, Urban Thoroughfare/ Civic Boulevard in Primary Transit Area, Rural Thoroughfare	36	Varies	Varies
Rural Connector	26	Varies	Varies
Neighbourhood Connector	23	Varies	Varies
Neighbourhood Street	20	Varies	6.5 (0-44 units) 7.5 (45 units or greater)
Neighbourhood Street	20	7.5	6.25

- 1) The pavement width of Neighbourhood Connectors shall be widened to 11m when they connect to Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Streetm Neighbourhood Connector, Rural Thoroughfare and Rural Connectors. The storage length shall be 45m, taken from the end of the curb and gutter radii and the return taper should be 30m. The right-of-way at these widening should be increased to 24.0m.
- 2) The pavement width of Neighbourhood Streets serving 60 units or more shall be widened to 10m when they connect to Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Streetm Neighbourhood Connector, Rural Thoroughfare and Rural Connectors. The storage length shall be 30m, taken from the end of the curb and gutter radii and the

return taper should be 30m. The right-of-way at these widening should be increased to 21.5m.

- 3) For Road Classifications refer to Table 6 and Map 3 of the London Plan and/or Schedule C – Transportation Corridors – Official Plan of the City of London.
- 4) For reconstructed Neighbourhood Streets: If the measurement of the existing road width is less than defined in the previous chart, then use the chart width. If the measurement of the existing road width is greater than 8m, then reconstruct at 8m.
- 5) The pavement width of Neighbourhood Connectors designated as a cycling route in the Cycling Master Plan shall be increased to 13.0m.
- 6) Total number of units is based on number of units serviced by the Neighbourhood Connector and Neighbourhood Street including the window street units.
- 7) The boulevard widths are all to be in accordance with UCC-1M where applicable and UCC-2M. Refer to Section 1.1.3 a) for further UCC-1M design criteria and Section 1.1.3 b) for further UCC-2M design criteria.
- 8) Any development that exceeds 80 units shall provide for a second public access.

2.1.6

K Values

On vertical curves, K factor shall be derived from the following table:

Design Speed (km/h)	60	70	80	90	100	110	120
Crest Vertical Curve Minimum K ¹	15	25	35	50	70	90	120
Sag Vertical Curve Minimum K ²	18	25	30	40	45	50	60

1. Source: Geometric Design Standards for Ontario Highways, Table C4-6.

2. Source: Geometric Design Standards for Ontario Highways, Table C4-8. For more information on design speed, refer to section 2.1.1.

2.1.7

Maximum and Minimum Road Grades

- a. The maximum grades of roads shall be derived from the following table:

Road Type	Maximum Grade (%)
Expressway	4
Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, and Rural Connector	6
Neighbourhood Connector	6
Neighbourhood Street	8

The minimum road grades on all roads shall be 0.5%.

- b. Flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.

- c. In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.

2.1.8 Vertical Curves

When the numerical difference between two road grades exceeds 1% a vertical curve must be incorporated using the following criteria:

- Use k value from 2.1.6
- Vertical curve length shall be numerically greater than or equal to the design speed
- When matching new vertical curves into existing ones, match the K values to provide continuity.

2.1.9 Drainage Issues

a. Overland Flow Routes

- i. The design of all road profiles for New Development Projects are required to accommodate and direct major overland flow routes (OLFR) to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the SWM Unit for information, assistance, review and acceptance, all to the satisfaction of the City Engineer.
- ii. The design of all major road profiles for Capital Works Projects (i.e. existing Rural Thoroughfare, and Rural Connectors, Transportation EA's, etc.) are required to consider major overland flow routes (OLFR) and where possible, accommodate and direct the OLF's to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the SWM Unit for information, assistance, review and acceptance, all to the satisfaction of the City Engineer.
- iii. In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a formalized OLF Route, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.
- iv. In order of preference, OLFR should be directed along:
 - a. Expressway;
 - b. Rapid Transit Boulevard;
 - c. Urban Thoroughfare;
 - d. Civic Boulevard;
 - e. Main Street;
 - f. Neighbourhood Connector;
 - g. Neighbourhood Street;
 - h. Parks, open spaces;
 - i. Dedicated municipal easement - Refer to Stormwater Engineering Section 6.

b. Culverts Under Roads

- i. New culverts or culverts that are being redesigned, replaced or impacted by road works/road widening must be designed to meet the hydraulic requirements established by MTO for inlet or outlet control culverts.
- ii. City practice requires that culverts must convey the minimum storm events as specified below:

Classification of Road	Minimum Storm Event To Be Conveyed By Culvert
Neighbourhood Street	25 year storm event
Rapid Transit Boulevards, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, Rural Connector, and Neighbourhood Connector	50 year storm event
Bridges	100 year storm event or Regional storm event (250 year), subject to the UTRCA conditions

- iii. Further design information regarding culvert designs can be found in Section 18 – Drafting and Design Requirements for New Subdivisions.
 - iv. Information, coordination and acceptance for this design element must be received from the SWM Unit, and should be considered at the earliest stages of design.
- c. In the areas where parking bays are introduced, subdrain pipes should be installed longitudinally for the entire length of the parking bay. For material type and construction details refer to SW-3.1, located in the Supplemental O.P.S.S Sewers & Water section of Standard Contract Documents for Municipal Construction Projects Manual.

2.1.10 Rural Asphalt Lift Edge Taper

On rural roads, asphalt in all lifts shall be laid so that the edge of pavement is inclined at a 45-degree angle. Base lifts of asphalt shall be laid wider than surface lifts, so that a consistent slope is maintained.

2.1.11 Pavement Structure

- a) Geotechnical Report: A geotechnical report shall be completed unless otherwise noted by the City's Project Manager.

b) Maximum Benkelmen Beam Spring Rebound

Class of Road	Maximum Spring Benkelmen Beam Rebound (mm)
Neighbourhood Street	1.90
Neighbourhood Connector	1.25
Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, Rural Connector	0.64
Expressway	0.50

c) Municipal Projects

The pavement structure of all roads being constructed or repaired under a Municipal Project, and in New Subdivisions, shall be based on the following table:

Subgrade Type	Component	Neighbourhood Street	Neighbourhood Connector	Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, Rural Connector
"Weak" Lacustrine Clay	Asphalt	90	130	180
	Gran. A	150	150	150
	Gran. B	300	450	600
	EGT	531	712	912
"Medium" Glacial Till	Asphalt	90	130	180
	Gran. A	150	150	150
	Gran. B	300	450	450
	EGT	531	712	812
"Strong" Clayey Gravel	Asphalt	90	130	180
	Gran. A	150	150	150
	Gran. B		150	300
	EGT	330	511	711

If the geotechnical investigation determines the native material is stronger & free draining, a reduction in the Granular B thickness could be considered.

Equivalent Granular Thickness (EGT) Factors:

Component	Factor
Asphalt	2.00
Recycled Asphalt	1.80
Granular A	1.00
Granular B	0.67

1. Source: TAC - Pavement Design and Management Guide, Table 6.5, 6.6, 6.7

- Top-coat asphalt laid on Expressways, Rapid Transit Boulevards, Urban Thoroughfares, Civic Boulevards, Urban Thoroughfare/Civic Boulevard in Primary Transit Areas, Main Streets, Rural Thoroughfares, Rural Connectors and Neighbourhood Connectors shall be placed over existing or freshly laid hot mix asphalt, cold in-place recycled, or milled asphalt, and shall have a minimum lift thickness of 50mm.
- Granular A shall be placed at a minimum depth of 150mm.
- A tack coat shall be applied on all milled surfaces and in situations where placement of asphalt lifts is separated by more than two weeks.

d) Asphalt Selection by Road Classification

Classification of Road	Traffic Category	PGAC	Binder Asphalt	Surface Asphalt
Neighbourhood Street	B	58-28	HL 8 or Superpave 19.0	HL 3 or Superpave 12.5
Neighbourhood Connector***	C	58-28	HL 8 or Superpave 19.0	HL 3 or Superpave 12.5
Rural Connector	C	58-28	HL 8 or Superpave 19.0	HL 3 or Superpave 12.5
Rapid Transit Boulevard, Urban Thorough, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare*	D	58-28	HL 8 or Superpave 19.0	-
Rapid Transit Boulevard, Urban Thorough, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare*	D	64-28	-	HL 1 or Superpave 12.5**
Expressway****	****	****	Superpave 19.0	Superpave 12.5FC1

NOTE – Superpave Mix design as per OPSS MUNI 1151, Table 1 and Table 2.

- * With approval from TP&D, Marshall Mixes (HL8, and HL3) may be used for minor tie-in work or slip-arounds for new Subdivisions, and maintenance repairs. Road classifications above Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare are to be discussed with Transportation Planning and Design Division (TP&D)
- ** Subject to Surface Course Asphalt Policy (Section 2.1.11.e), this may need to be Superpave 12.5FC1.
- *** For Neighbourhood Connectors with bus routes/truck routes consideration to upgrading to the major road standard (Mix and/or PGAC) shall be discussed with TP&D.
- **** Expressways must be discussed with Transportation Planning & Design.

e) Surface Course Asphalt Policy

Transportation Planning & Design has set a criteria to establish a consistent application of asphalt selection on City Roads based on traffic volumes and expected life span.

Superpave 12.5FC1 is a premium surface asphalt mix with coarse aggregate that is more resistant to rutting and maintains good skid resistance. HL 4 is a coarser mix with slightly higher stability suitable for rural uses. HL3 and Superpave 12.5 are a finer mix with improved aesthetic qualities for use in urban applications with pedestrians and other active transportation uses.

Superpave 12.5FC1	<ul style="list-style-type: none">• 20,000 AADT OR Average Daily Truck Traffic > 1,000 AND <ul style="list-style-type: none">• Pavement life expectancy of at least 10 years
HL4	<ul style="list-style-type: none">• Rural applications
HL3 and/or Superpave 12.5	<ul style="list-style-type: none">• All other applications

f) PGAC

All Superpave 12.5FC1 applications shall use of PGAC 64-28 asphalt cement with a higher quality aggregate. The aggregate shall be on the MTO designated sources list and the City of London Standard Contract Documents for Municipal Projects.

HL3 and Superpave 12.5 shall use PGAC 58-28, unless a higher grade PGAC is specified by the City of London.

Where warranted and practical (typically major roads), the City is also encouraging the use of a Material Transfer Vehicle (Shuttlebuggy), echelon paving and a joint heater for the placement of the surface course asphalt. Please discuss the use of these with the Transportation Planning and Design Division (TP&D) for specific projects as this approach can produce a more durable road surface for long term use.

2.1.12 Transition Between Road Types

Transition from two lanes to four or from four lanes to six should be made using the taper dimensions noted in the table in Section 2.1.14 in relation to design speed. The transition should be clearly signed with a Wa-23 and a Wa-40 as per the Ontario Traffic Manual – Book 6. Transition from hard surface to loose surface should be signed with a Wa-25 and a Wa-25T.

2.1.13 Access and Sight Distance

As determined from Figure E3-8 of the *Geometric Design Standards for Ontario Highways*, the following stopping sight distances shall be provided at intersections and accesses:

- a. On new intersections and major accesses such as large commercial or industrial development, the desirable decision sight distance shall be provided.
- b. On all other new accesses, the minimum decision sight distance shall be provided.

- c. For existing accesses and single family residences, the minimum stopping sight distance shall be provided.

This figure assumes a line of sight from the driver of a vehicle entering the intersection (1.05m above the pavement surface) to the headlights of an approaching vehicle (at a height of 0.38m). Design speeds for the intersecting roadways are listed in Section 2.1.1 of this manual. Note also that section 4.24 of City of London By-law Z-1 may require a further setback from the right-of-way of structures over 1m in height.

2.1.14 Length of Turning Lanes

Requirement for a turning lane shall be determined by the Transportation Division during the site plan review process, subdivision review, design or redesign of a major roadway.

Length of the tapered and parallel portions of the turn lane shall be determined using the following table:

Design Speed (km/h)	50	60	70	80	90	100
Taper Length (m)	60	65	70	80	90	100
Parallel Length ¹ (m)	20	30	40	50	60	70

1. Source: Geometric Design Standards for Ontario Highways, Table E9-1.

- For more information on design speed, refer to section 2.1.1. Note that distances should be increased for grades above 2% or unusual traffic conditions. Distances may be decreased if there are physical limitations on lane lengths.
- Storage requirements should be determined by a traffic study. The minimum storage on an Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, and Rural Connector intersection shall be 45m. On Neighbourhood Connectors that intersect Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, and Rural Connectors minimum storage shall be 45m. On all other types of intersections and accesses, minimum storage shall be 30m. In either case, storage distance starts 15m from the centreline of the cross street or at the stop bar.
- Where constrained in an urban situation, parallel length may be reduced to 0m and taper length may be reduced to 45m.

2.1.15 Sidewalks, Bicycle Lanes and Pedestrian Walkways

a. Residential Subdivisions

- i. Sidewalk shall be installed on both sides of all streets (residential and industrial subdivisions). Exceptions to this requirement may be considered in the following instances, noting that in most of these instances, sidewalk will be required on both sides of the new street (subject to the outcome of the London Plan appeal):
 - a) Portions of streets flanking natural heritage features or areas
 - b) Portions of streets flanking a Green Space that includes alternative active mobility infrastructure parallel to the street
 - c) Portions of streets that have a designated multi-use pathway within the boulevard on one side

- d) Road reconstruction projects, where the existing conditions, such as mature trees, right of way widths, or infrastructure would impede sidewalks on both sides of the streets.
 - ii. Sidewalk Gradient – All sidewalk should follow the road gradient in a residential subdivision. The minimum gradient of a sidewalk in a subdivision is 0.5% and the maximum gradient of a sidewalk is 8%.
 - iii. All sidewalks constructed in residential subdivisions shall have a minimum crossfall of 2% and a maximum crossfall of 4% consistent with the boulevard crossfall.
 - iv. At commercial, multi-family and industrial driveway the thickness shall be 150mm reinforced, together with a granular base, unless otherwise approved by the City Engineer.
- b. General

Sidewalk widths on Rapid Transit Boulevards & Main Streets shall be 2.0m-5.0m in width. All sidewalks are to be set back 1.5m from the edge of asphalt, all in boulevard cycling infrastructure are to be setback 1.0m from the edge of asphalt. In areas with high pedestrian activity the sidewalk width is to be increased to 4.0m in width. Sidewalks are required on both sides of any street if it forms part of the pedestrian system of a particular area.

- c. Sidewalks that are separated from the curb and gutter by a boulevard shall be constructed at 1.5m in width and 100mm in depth using concrete. Sidewalk constructed as curb-face, shall be constructed at 1.8m in width and 100mm in depth. Depth of concrete should be increased to 150mm when sidewalk crosses a commercial access or egress. Depth of concrete shall be increased to 150mm at ramps on Neighbourhood Connectors and higher road classifications where a risk exists of vehicles driving over them (refer to City of London SR 1.0, 1.1, 1.2, 1.3, 1.4 & 1.5, and UCC-1M).

To review the City of London SR's please follow the link below:

<http://www.london.ca/business/Resources/Consultant-Resources/Pages/Standard-Contract-Documents-For-Municipal-Construction.aspx>

For window street design information reference should be made to Section 1.1.3 b).

- d. Reconstruction projects are to have the sidewalk replaced or repaired if an existing sidewalk is in place. In the absence of a sidewalk the designer is to verify with the Transportation Division – Warranted Sidewalk List to determine if a new sidewalk is to be installed.
- e. 1.5m wide on-street bicycle lanes are to be incorporated into the road network in accordance with the City of London Bicycle Transportation Network Plan. The designer is to review and confirm requirements with the Transportation Division.

Pavement structure for the on-street bicycle lanes are to be as per the required pavement structure for the class of road on which the bicycle lane is being constructed.
- f. Pedestrian Walkways - are to be constructed as per City of London SR-7.0.
 - i. General & Widths

When designing a standard 3.0m or 4.6m width walkway, ensure that the full width of the walkway is sidewalk and no grassed area. As well, ensure that catch basins are located in a manner as not to disrupt walkway usage. An example is a catch basin at the end of a walkway, as per City of London Drawing Standards SR-7.0.

ii. Sidewalk

To have a crossfall of 20mm/m or alternative swales, as per City of London Drawing Standard 7.0.

iii. Removable Posts

Are to be installed at both ends of the walkway or as approved by the City Engineer, as per City of London Drawing Standard SR-8.0.

iv. Chain Link Fence

Chain link fences are to comply with the requirements of OPSS-541 and OPSD-900.01 except for the following amendments:

- the height of the fence shall read 1.2m
- the footing detail, part a: shall read in concrete.

v. Pedestrian Handrail

Where walkway grades exceed 8%, pedestrian handrails are to be constructed on one side of the walkway in line with the removable posts. Hot dipped galvanized handrails are to conform to OPSD-915.01.

vi. Stairs on Walkways

Where walkway grades exceed 10%, stairs with footings are to be constructed in accordance with City of London Drawing Standard SR-6.0.

vii. Rise and Run Dimensions for Stairs in Walkways

Are to comply with the following:

- Minimum rise – 125mm
- Maximum rise – 200mm
- Minimum run – 255mm
- Maximum run – 380mm

viii. Intermediate Landings

Where the total change in grade exceeds 1.8m, intermediate landings (no less than 1.5m) are to be provided.

ix. Sidewalk and Stair Concrete

To have at least a minimum strength of 30 MPa with 5% to 7% air entrainment and low slump.

x. Stair Reinforcement

To be #15M diameter bars with 40mm of cover in accordance with City of London Drawing Standard SR-6.0.

xi. Driveway Locations

To be located as far from the walkway as possible.

xii. Details

A plan & profile is required for all pertinent walkway designs together with all pertinent details.

xiii. Sidewalk Alignment

When there is a jog in the street line then a smooth transition (radius of 30.0m) should be shown between the two sidewalks.

xiv. Barricade and/or Warning Sign

A barricade and/or warning sign is required at the limit of a dead end street and/or end of a proposed sidewalk on an existing right-of-way where the sidewalk terminates (Refer to OPSD-912.532).

xv. Sidewalk Termination

A temporary sidewalk shall be constructed from the end of a proposed sidewalk to the adjacent road edge, at the curb & gutter and/or gravel shoulder as required by the City Engineer.

- g. Trees to be planted in accordance with the “City of London Tree Planting Guidelines”.

h. Sidewalk Ramps With Tactile Plates At Signalized and Non-Signalized Intersections

- i. All sidewalk ramps at signalized and non-signalized intersections shall have cast iron tactile plates installed on them to meet the needs of AODA as following:

Exterior paths of travel, curb ramps

In this section, “curb ramp” means a ramp that is cut through a curb or that is built up to a curb. O. Reg. 413/12, s.6.

Where a curb ramp is provided on an exterior path of travel, the curb ramp must align with the direction of travel and meet the following requirements:

1. The curb ramp must have a minimum clear width of 1,200 mm, exclusive of any flared sides.
2. The running slope of the curb ramp must,
 - i. Be a maximum of 1:8, where elevation is less than 75 mm, and
 - ii. Be a maximum of 1:10, where elevation is 75 mm or greater and 200 mm or less.
3. The maximum cross slope of the curb ramp must be no more than 1:50.
4. The maximum slope on the flared side of the curb ramp must be no more than 1:10.
5. Where the curb ramp is provided at a pedestrian crossing, it must have tactile walking surface indicators that,
 - i. Have raised tactile profiles,
 - ii. Have a high tonal contrast with the adjacent surface,

- iii. Are located at the bottom of the curb ramp,
- iv. Are set back between 150 mm and 200 mm from the curb edge, and
- v. Are a minimum of 610 mm in depth. O. Reg. 413/12, s. 6.

Exterior paths of travel, depressed curbs

In this section, “depressed curb” means a seamless gradual slope at transitions between sidewalks and walkways and highways, and is usually found at intersections. O. Reg. 413/12, s.6.

Where a depressed curb is provided on an exterior path of travel, the depressed curb must meet the following requirements:

1. The depressed curb must have a maximum slope of 1:20.
2. The depressed curb must be aligned with the direction of travel.
3. Where the depressed curb is provided at a pedestrian crossing, it must have tactile walking surface indicators that,
 - i. Have raised tactile profiles,
 - ii. Have high tonal contrast with the adjacent surface,
 - iii. Are located at the bottom portion of the depressed curb that is flush with the roadway,
 - iv. Are set back between 150 mm and 200 mm from the curb edge, and
 - v. Are a minimum of 610 mm in depth. O. Reg. 413/12, s.6.

For sidewalk ramp with tactile plate details for signalized intersections, please refer to drawings STS 11.01 to STS 11.09. Refer to the same drawings for non-signalized intersections as well, with the exception of not having a pedestrian push button poles.

Approved manufacturers are as follows:

- East Jordon Iron Works Inc.
- Neenah Foundry Co.
- OR; approved equivalent

2.1.16 Curb and Gutter

a. Types and Applications

- i. For all road classifications - excluding Neighbourhood Connector and Neighbourhood Streets - Concrete Barrier Curb with Wide Gutter as per OPSD 600.01 shall be used.

Concrete Barrier Curb with Standard Gutter as per OPSD 600.04 shall be used on all Neighbourhood Connector and Neighbourhood Streets, for any new applications from January 1st, 2021 onwards. During the transition period barrier curb will be placed in accordance with 2.1.16.a.iii. below.

- ii. Concrete Barrier Curb with Wide Gutter as per OPSD 600.01 shall be used for all reconstruction projects unless otherwise noted by the City's Contract Administrator. The designer is to verify curb and gutter type with the appropriate contract administrator.

- iii. Concrete Barrier Curb with Standard Gutter as per OPSD 600.04 shall be used in the following locations:
 - 1. On both sides of a road adjacent to a school block, plus a length of 30m at each end;
 - 2. Along all park frontages and natural heritage features, plus a length of 30m at each end;
 - 3. Wherever curb extensions (i.e. parking bays) are utilized, as per Fig. 2.3;
 - 4. Wherever raised traffic calming measures are utilized, plus 30m at each end;
 - 5. At all through intersections including tees and roundabouts, plus 30m in all directions;
 - 6. On both side of a road where any centreline curvature is present;
 - 7. Wherever a Parking Plan is implemented;
 - 8. As required by the City Engineer.
- iv. The placement of barrier curbs within new subdivisions may require curb cuts to be placed in appropriate locations to accommodate future homes along the roadway. The location of the curb cut will match the driveway location and shall be away from other features in the boulevard (i.e. hydrant, street light pole, etc.).
- v. Concrete Semi-mountable Curb with Standard Gutter as per OPSD 600.06 shall be used in locations not specified in Section 2.1.16 a. iii) above or as required by the City Engineer.
- vi. Concrete Barrier Curb as per OPSD 600.11 shall be used on an island in a cul-de-sac and medians on roads.
- b. Transition/Termination
 - i. A transition of 3.0m is required between curb types. Curb transitions must occur on the road with the lower classification, minimum 1.0m away from the end of the radius.
 - ii. Curb termination as per OPSD 608.01 shall be used within temporary turning circles and dead end streets or intersections which abut or are adjacent to a future phase of a subdivision.
- c. Catchbasins
 - i. Refer to Storm Sewer Section 5.16 in this manual for design information regarding catchbasins.
 - ii. A concrete curb setback is required for all catchbasins and curb inlet catchbasins located on the right-of-ways. Refer to City of London SR-3.0.
 - iii. Curb inlet catchbasins shall be used exclusively on roads classified as Expressway, Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, Rural Connector, or in areas where there is an interest to drain the road surface more quickly.

- iv. Mini-catchbasins should be installed at low points in Expressway, Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, Rural Connector until placement of top asphalt. (see Section 5.16.15).

d. Curb Radii Elevations

Required at all Beginning of Curves (B.C.) and End of Curves (E.C) of curvatures of intersections, cul-de-sacs, islands and medians.

Note: a gutter elevation is required at the top end of all cul-de-sacs.

Curb Radii Grades – A minimum of 0.5%.

Curb & Gutter Around Full Radius – Required at all intersections of subdivision streets and boundary road works adjacent to existing and future development. The curb & gutter is to be extended around the full radius at the corner and the sidewalk is to meet.

Concrete Strength – Refer to OPSS 353.05.01

e. New Access

Any new accesses to existing roads are required to attain a permit from the Environmental Programs and Customer Relations Division.

2.1.17 Erosion Control Blanket

Straw mat and curled wood excelsior type erosion blankets shall conform to OPSS-804. For types not described in this standard, North American Green SC150 or approved equal shall be used. See also Sediment & Erosion Control, Section 10 in this manual.

2.1.18 Pavement Markings

Centre line pavement markings will be required on all Street classifications except Neighbourhood Streets.

All pavement markings are to be designed in accordance with the Ontario Traffic Manual and City of London Standards. Proposed designs shall be submitted to the Roads and Transportation for approval a minimum of two weeks prior to application. Temporary pavement markings shall include lane divider lines, lateral crosswalk lines and stop bars may be traffic paint. All final pavement markings shall be of a durable material as defined in OPSS. Green surface treatment for cycling facilities, longitudinal crosswalk markings and stop bars to have an anti-skid resistance of 50 BPN to 65 BPN (British Pendulum Number).

Pre-marking of top coat and base asphalt shall be completed within 24 hours. The application of the pavement markings shall be within 24 hours after acceptance of the pre-markings by Roads and Transportation. Temporary pavement markings will be required if the top coat of asphalt is scheduled more than 2 weeks after the base asphalt is complete.

Traffic signage shall be designed in accordance with the applicable Ontario Traffic Manual and City of London Standards. Cycling Facility Signs to be installed with the appropriate lane divider lines.

Pavement markings and traffic signs shall be shown on the same drawing. Traffic signs shall include the OTM reference number, a graphic of the sign and station/offset.

2.1.19 Pavement Reinforcement

Pavement reinforcement in the form of stepped milled joints shall be used for road widening, lane additions, and utility cuts greater than 1m in width and 3m in length.

Utilize the requirements noted in City of London SR-13.1: *Stepped Milled Joint Pavement Reinforcement Detail*. Joints should be out of the alignment where tires will normally track. The pavement and granular base for the reinforcement shall be identical to or greater than the existing road structure. Notwithstanding this, a minimum of 150mm of granular 'A' (to 98% Proctor) and 100mm of compacted hot mix asphalt (to 97% Marshall) shall be used. Where there is significant truck transport traffic, increase this minimum to 200mm of granular 'A'.

2.1.20 Roadside Protection

Roadside protection shall be applied in accordance to the Ministry of Transportation's Roadside Safety Manual.

2.1.21 Sediment & Erosion Control

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area; an ESCP is not required, unless otherwise directed by the City Engineer. Where an ESCP is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.

2.1.22 Bus Bays

Bus Bays shall be constructed at 200mm in depth of concrete. It shall have a cross fall of 2%. Standard Bus Bay shall have a minimum taper of 15.0m and minimum storage of 15.0m.

Storage dimensions are for one bus. Add 14.5m for each additional standard bus and 20.0m for each additional articulated vehicle.

Actual dimensions should be consulted with London Transit Commission.

See Figure 2.1.22 Concrete Bus Bay for details.

2.1.23 Access Configurations

- i. **Single Family** accesses are to be in accordance with Standard Contract Documents Drawings SR-2.0.

Should a conflict occur between the location of a driveway and the location of a curb inlet catchbasin (CICB), then the Owner shall correct the conflict by either relocating the driveway, except when a parking plan governs, or replacing the CICB with a twin inlet catchbasin in the same location as the original CICB, all to the specifications of the City Engineer and at no cost to the City.

- ii. **Development blocks for site plan approvals** access configurations shall be in accordance with Ontario Provincial Standard Drawing 350.010 with dimensions as set out in the City's Access Management Guidelines.

No catchbasins, existing or proposed shall be located within the limits of site entrances. In situations where existing catchbasins would be within proposed site entrances, the access shall be realigned so to avoid catchbasins or the catchbasin shall be relocated outside the access curb return.

2.2 INTERSECTIONS

2.2.1 At Grade Road/Rail Intersections

All railway crossings at grade in built-up areas shall be protected by the text warning sign "Cyclists Use Caution Crossing Tracks".

2.2.2 Road/Road Approach Grades

Refer to TAC – Geometric Design Guide for Canadian Roads – Figure 2.3.2.2.

2.2.3 Road Layouts

When two (2) streets connect at an intersection they shall connect at 90 degrees with 10 metre straight sections measured back from the street line.

2.3 TRAFFIC CALMING

2.3.1 Application and Methodology

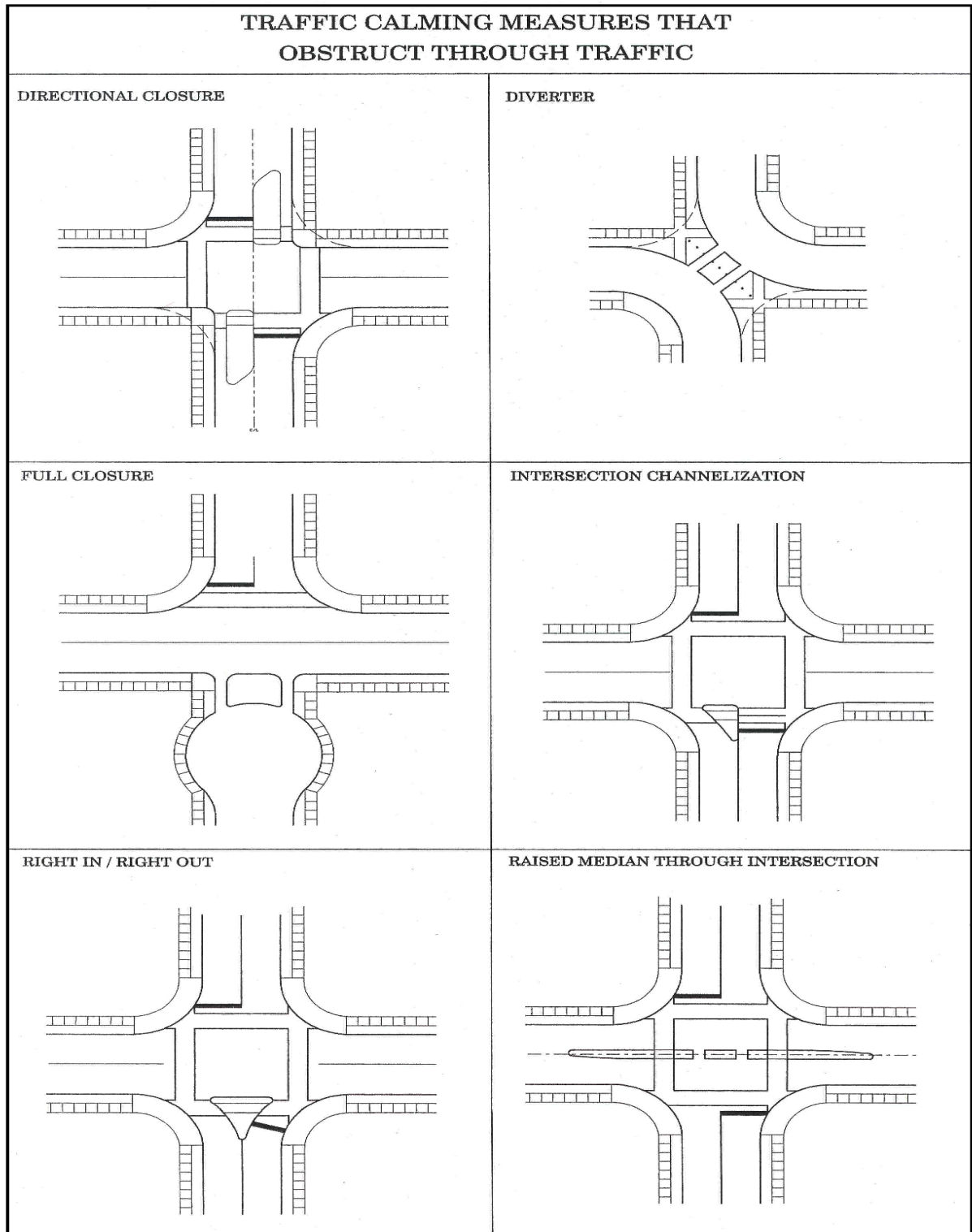
Traffic calming measures are applied on Neighbourhood Connectors in residential areas, and occasionally on Neighbourhood Streets. They enhance residents' quality of life by encouraging low traffic speeds and volumes, minimizing conflicts between types of street users, and discouraging through traffic. Traffic calming makes the area safer and more inviting for pedestrians and cyclists, without restricting local motorists' access to the transportation network.

To be effective, traffic calming shall be applied only after careful study of the local transportation network and land use. It should be implemented on an area-wide basis, considering impacts on the surrounding road system. Non-motorized modes of travel should not be impeded by the applied measures. Consultation on the impact of the measures on emergency services, transit, snow plowing, street cleaning, garbage removal and stormwater overland flow routes as well as opportunities for stormwater infiltration (Low Impact Development) where appropriate shall be completed as part of the planning process.

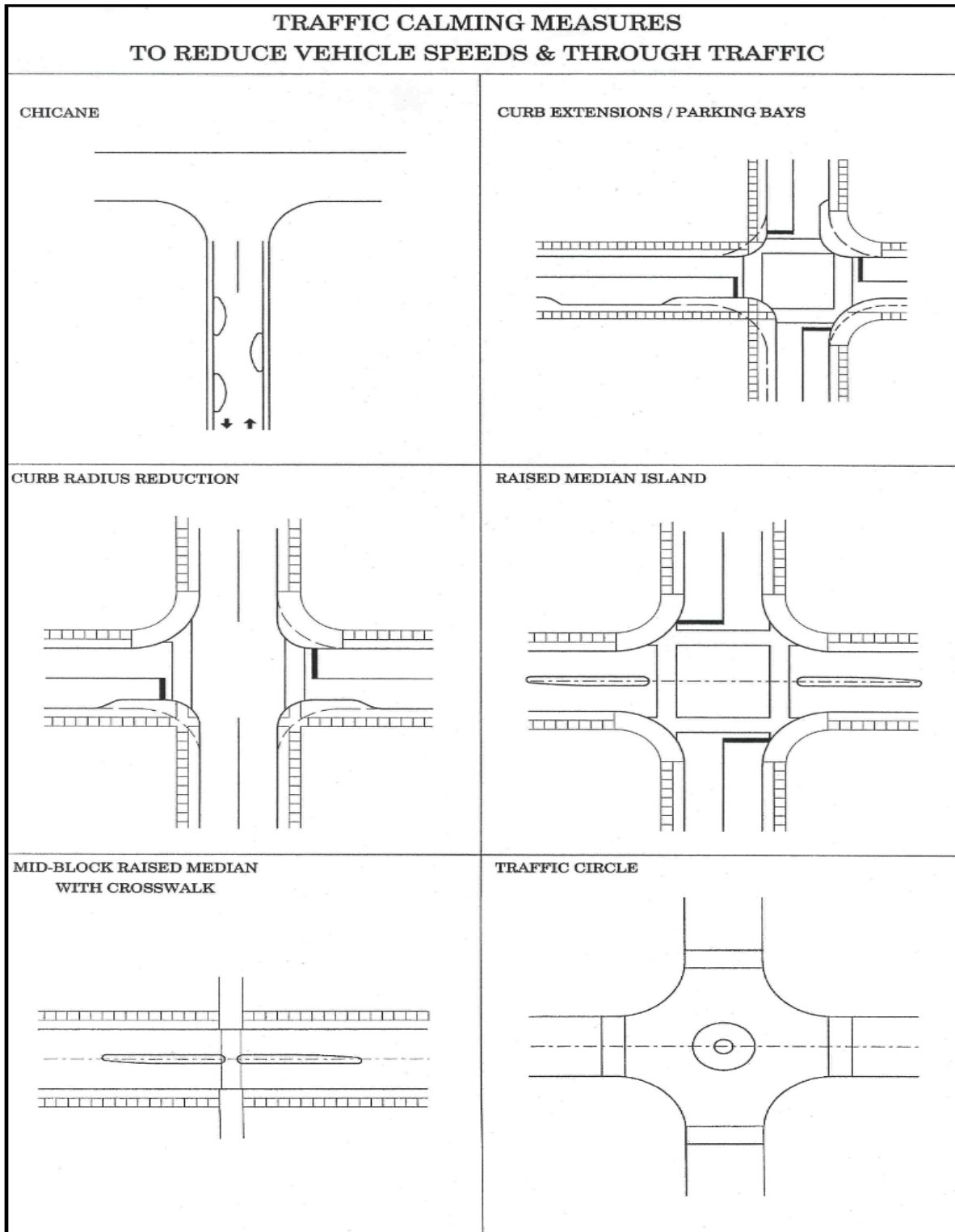
Traffic calming is only one design tool for safer roads. The most effective traffic calming measures have modest negative impacts on some aspects of the area in which they are installed. Because of this, other techniques such as education and enforcement, and design factors such as pavement width and street network design, should be considered in any traffic calming study.

Generally, traffic calming features should be spaced no more than 200m apart to achieve maximum efficiency.

The following 6 measures can be used to obstruct through traffic.



The following 6 measures can be used to reduce vehicle speeds and through traffic.



2.3.2

Signage

- a) Entrance points to areas in which traffic calming measures have been installed, shall be posted with the Traffic Calmed Neighbourhood sign. See section 4.5.2 in the T.A.C. *Canadian Guide to Neighbourhood Traffic Calming*.

The Transportation Division may elect to use appropriate regulatory signs from the Ontario *Manual of Uniform Traffic Control Devices* as a traffic calming measure. Appropriate signage may include, but is not limited to, Maximum Speed, Right or Left Turn Prohibited, One Way, and Stop signs.

- b) Street Name Signing; refer to Figure 2.3.1
- c) Street Name Signs, Traffic Control Signs and steel round post locations to be determined during the subdivision design review stage. Locations may be included on the street light design drawings or on stand-alone traffic control drawings.
- d) Steel round posts and Street Name Signs to be installed as per OTM Book 1b Sign Design Principles within 2 months after curb and gutter is placed. Once Steel round posts and Street Name Signs are installed, the Roadway Lighting & Traffic Control Division will inspect the locations to verify before adding appropriate traffic control to a Traffic & Parking & By-law amendment report for future Civic Works Committee and Council Meetings to review. Once passed at Council meeting the appropriate traffic control signs can be installed.

2.3.3

Curb Extensions and Reduced Radii

Curb extensions are the delineation of the parking lane through the addition of a roll-over curb and gutter. The impact is that the through lanes are visually and spatially constricted at all times like they are when vehicles are parked along one side of a roadway. Tangent sections should be 5m at intersections, fire hydrants and public walkways. Tangent sections should be 15m at bus stops. Tapers in and out of curb extension streets should be made over a minimum of 30m. Reduced radii are used on the inbound radius into a local street. The impact of the reduced radii is to force vehicles to slow down considerably before making the turn. This calms the traffic speeds on the collector road as well as the local street. Refer to Fig. 2.3 – Curb Extensions and Reduced Radius.

2.3.4

Speed Cushions

Speed cushions are used to reduce vehicle speeds, by causing discomfort to occupants of vehicles crossing them at high speeds. Speed cushions shall be made of HL3 Asphalt Mix, unless directed otherwise by the City Engineer

Refer to Fig. 2.3.4 - Speed Cushions.

All sides of the cushions shall be ramped to allow drainage. All edges of the ramps should be formed and keyed into the existing asphalt to provide adequate drainage and a continuous road surface. The leading edge of the ramps shall be marked with durable solid white reflective triangles, with the point at the top of the ramp. A Speed Cushion sign (T.A.C. *Canadian Guide to Neighbourhood Traffic Calming* Wa-50) shall be installed beside the leading edge of the ramp.

2.3.5 Raised Crosswalk Design

Raised crosswalks are crosswalks constructed in concrete to a height of 150mm above the elevation of the street. Raised crosswalks are very effective at reducing vehicle speeds specifically where pedestrians will be crossing a street (see Figure 2.3.12)

Note: Catchbasins are to be provided at upstream end of raised crosswalks to allow for drainage.

2.3.6 Diverter

A diverter is a barrier placed diagonally across an intersection, to force turns and prevent travel in a straight line. It is used to reduce through traffic by prohibiting travel in some directions.

The diverter should be not less than 1.5m in width at its narrowest point. The barrier shall consist of semi-mountable curbs to allow emergency vehicles to negotiate the turn in an emergency, and either

- a) bollards spaced at 1.5m intervals along its centreline, or
- b) sufficiently dense landscaping to prevent crossing by vehicles.

2.3.7 Rights In/Rights Out Raised Concrete Median (“Pork Chop”)

- a. A raised concrete median is used to prohibit straight-through and left turn movements both into and from the protected approach and shall be designed in accordance with the most current City of London Access Management Guidelines, section 2.1. To review the City of London Access Management Guidelines please follow the link below:

<http://www.london.ca/residents/Roads-Transportation/Transportation-Planning/Pages/Transportation-Study-Guidelines.aspx>

- b. A rights in/rights out island should only be used in locations where it is very difficult/or impossible to implement on street raised concrete median. A rights in/rights out island is roughly triangular, and placed in the centre of an intersection approach. A minimum size of 10m² is required to provide pedestrian refuge. Both the in and out lanes shall be not less than 6m in width. The island shall be protected by barrier curb OPSD 600.01, except at pedestrian crossings.

The signage shall be in compliance with Figure 4.16 in the *Canadian Guide to Neighbourhood Traffic Calming*, with equivalent signs for those required by the drawing.

2.3.8 Directional Closure

A directional closure is a concrete island or curb extension that physically obstructs one or more lanes of a roadway at an intersection. It may restrict entry or exit. The closure shall be protected by barrier curb OPSD 600.01, except at pedestrian crossings.

Signage shall be equivalent to the following:

- a) for an exit-only closure, Figure 4.11(a), Canadian Guide to Neighbourhood Traffic Calming, or
- b) for an entrance-only closure, Figure 4.11(b), Canadian Guide to Neighbourhood Traffic Calming

Equivalent signs shall be substituted for the signs required in the drawings.

2.3.9 In/Rights Out (“Banana”) Island

An In/Rights Out Island is a curved island positioned to discourage left turns and through traffic movements from the protected approach. The island shall be not less than 5m in length and 1.5m in width. A minimum size of 10m² is required to provide pedestrian refuge. Both the in and out lanes shall be not less than 6m in width. The island shall be protected by barrier curb OPSD 600.01, except at pedestrian crossings.

Where possible, the island should terminate so that it does not intersect the crosswalk. Signage shall consist of:

- a) a Hazard Marker sign Wa-33L mounted under a Keep Right sign Rb-25 at the leading edge of the island, and
- b) a Right Turns Only sign Rb-42 on the right hand side of the protected lane, opposite the signs in (a).

2.3.10 Roundabouts

A roundabout is a raised island located in the centre of an intersection, which requires vehicles to travel through the intersection in a counter-clockwise direction around the island.

Refer to Figures 2.5, 2.5A, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14 and/or 2.15 as required for appropriate details.

All approaches to the circle shall be protected by a Yield sign, so that vehicles already traveling on the roundabout have right-of-way over vehicles entering it. A One Way sign Rb-21A, indicating a counter-clockwise direction of travel, shall be installed on the centre island opposite each approach.

For curb and gutter types within the roundabouts refer to Figure 2.7 Typical Roundabout Section.

For maintenance purposes, sanitary maintenance holes are not permitted to be located within the raised centre island of the roundabout. The sanitary maintenance hole is to be located within the apron of the island. Storm maintenance holes may be located within the centre island of the roundabout, provided the proposed landscaping does not hinder access to the maintenance hole.

2.3.11 Raised Median Traffic Islands

Raised median traffic islands may be installed in the centre of roads with at least 8m pavement width. A concrete island is used to reduce pavement width and thereby reduce the speed of passing traffic.

A minimum width of 3.5m shall exist between the curb faces on both sides of the island. The island shall be no less than 5m in length, with the maximum length dictated by local conditions. A longer island is desirable. The island shall be not less than 15m distance from all intersections. It should have barrier curb around its perimeter, except at pedestrian ramps, driveways or openings to accept road runoff in to a planted or sodded median. Wherever possible, the grade of the road should be designed to allow water to drain into planted or sodded medians. In this case, gutter-less curb may be installed around the perimeter of the island. Both ends of the island shall be marked with Keep Right Rb-25 sign, mounted over a Hazard Marker Wa-33L sign.

The median island can also have a pedestrian refuge feature. The requirement for such design should be determined in the planning stages by Transportation Planning and Design Division.

For Pedestrian Refugee Island Design refer to figures.

- Pedestrian Refuge Island - Figure 2.3.10
- Pedestrian Refuge Island – Sections - Figures 2.3.10A&B

A minimum width of 4.0m shall exist between the curb faces on both sides of the island. The island shall be not less than 5m in length, with the maximum length dictated by local conditions. A longer island is desirable. The island shall be not less than 15m distant from all intersections. It should have barrier curb around its perimeter, except at pedestrian ramps and driveways if not restricted by Transportation Division. Wherever possible, the grade of the road should be restored so that water drains to the existing curb and gutter. In this case, gutter-less curb may be installed around the perimeter of the island. Both ends of the island shall be marked with Keep Right Rb-25 sign, mounted over a Hazard Marker Wa-33L sign.

2.3.11.1 Raised Intersections

Raised intersections are raised areas covering an entire intersection, with ramps on all approaches. Raised Intersections rise above the road level to provide a “lip” that is detectable by the visually impaired. By modifying the level of the intersection, the crosswalks are more readily perceived by motorists to be “pedestrian territory”.

Raised intersections are good for intersections with substantial pedestrian activity, and areas where other traffic calming measures would be ineffective.

For Raised Intersection Design refer to figures.

- Raised Concrete Intersection - Figure 2.3.2
- Raised Concrete Intersection Detail and Cross-Section – Figure 2.3.2a

2.3.12 **Subdivision Neighbourhood Connector Entrance**

In general, Neighbourhood Connector entrances into subdivisions from Rapid Transit Boulevards, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in a Primary Transit Area, Main Street, Rural Thoroughfare, and Rural Connectors should be as per Fig. 2.16 (no median). Where a Neighbourhood Connector is proposed opposite an existing Neighbourhood Connector which includes a widened gateway treatment, the new road is to be widened and aligned to be compatible with the existing road and consistent with Fig. 2.16B, to the satisfaction of the City Engineer.

2.3.13 **Temporary Measures**

Temporary traffic calming measures shall be reviewed and approved by the Transportation Division prior to installation.

2.3.14 **Box Forms**

When islands (medians) are being constructed, Box Forms are to be placed where future road signs or hazard markers are to be installed, when the sign or marker will be located in concrete or asphalt. The Box Form should be located approximately 1.0m from the end of the island, and centred in the island at this location (typical). The Box

Forms are available, free of charge from the City of London Transportation Operations Division (661-2500 ext. 4923).

2.4 TRAFFIC SIGNALS

2.4.1 Traffic Control Signal Warrants

Traffic signals shall be considered warranted if:

- a) intersection conditions meet or exceed the warrant requirements of Section 4.3 of the Ontario Traffic Manual – Book 12;
- b) approval is granted by the Roadway Lighting and Traffic Control Division; and
- c) approval is granted by City Council as per City Policy 25(15).

2.4.2 Intersection Pedestrian Signal (I.P.S.) Warrants

Intersection pedestrian signals shall be considered warranted if:

- a) conditions meet or exceed the warrant requirements of Section 4.8 of the Ontario Traffic Control Manual – Book 12;
- b) approval is granted by the Roadway Lighting and Traffic Control Division, and
- c) approval is granted by City Council as per City Policy 25(15).

2.4.3 Electrical Design

Electrical design for intersections shall be governed by the following three documents, in order:

- a) The City of London's Traffic Signal and Street Lighting Specifications (STS);
- b) items not addressed in (a) shall conform to the Ministry of Transportation *Traffic Signal Design* manual, where addressed; and
- c) items not addressed in (a) or (b) shall conform to the Ontario Provincial Standards & Specifications (O.P.S.S.).

To review the City of London STS document, please follow the link below:

<http://www.london.ca/business/Resources/Consultant-Resources/Pages/Standard-Contract-Documents-For-Municipal-Construction.aspx>

2.4.4 Signal Plant Design

The design of Traffic Signals, Temporary Traffic Signals and the Relocation of Existing Traffic Signals must be completed, signed and sealed by a fully qualified *Professional Electrical Engineer* that meets the criteria identified in the Registry, Appraisal and Qualification System (RAQS) list. Designs must be submitted to the Roadway Lighting and Traffic Control Division for review and acceptance prior to any construction work being undertaken.

2.4.5 Pavement Markings

Permanent pavement markings shall be designed in accordance with the Ontario Traffic Manual – Book 11. Proposed designs shall be submitted to the Roadway Lighting and Traffic Control Division for approval, prior to application.

2.4.6 Materials

Materials used for traffic signals shall be in conformance with the requirements of the City of London Traffic Signals and Street Light Specifications.

2.5 STREET LIGHTING

2.5.1 Warrants

Street lighting shall be considered warranted on all roads in urban areas. At isolated rural intersections with non-continuous lighting on the intersecting roads, street lighting shall be considered warranted if the roadway meets or exceeds the requirements of the warrant provided in the Transportation Association of Canada Illumination of Isolated Rural Intersections guide.

Reconstruction of a substandard, isolated rural intersection should be considered before illumination. Street lighting may also be installed at isolated rural intersections at the direction of the Roadway Lighting & Traffic Control Division. Situations when this is warranted may include but are not limited to the occurrence of rare but severe collisions, an inability to maintain adequate hazard markings for raised channelizing islands, or the presence of an unusual number of long combination vehicles with reduced accelerating and braking abilities.

2.5.2 Materials

All street and walkway light fixtures shall be LED, full cut-off, 120V, integrated 7 pin dimming control capability utilizing an external 0-10VDC control signal. Street light fixtures on Neighbourhood Connectors and Neighbourhood Streets shall conform to the Figures 2.17 to 2.21B. Fixtures on all other roads must have a correlated colour temperature (CCT) of 4,000 +/- 500 K. The CCT of fixtures on Neighbourhood Connectors, Neighbourhood Streets and walkway lights shall be 3,000 +/- 500 K. Materials used for street lights shall be in conformance with the City of London's Traffic Signal and Street Light Specifications. The current list of accepted LED street light fixtures for Rural Thoroughfares, Rural Connectors, Main Street, Civic Boulevards, Rapid Transit Boulevards, Urban Thoroughfares and Expressways can be found on the [Design Specifications and Requirements Manual web page](#).

2.5.3 Street Light Designs

The design of street lights for Neighbourhood Connectors and Neighbourhood Streets must be designed, signed and sealed by a Professional Engineer. The design of street lights on all other roads must be designed, signed and sealed by a pre-qualified Professional Electrical Engineering Consulting Companies.

The design of street illumination shall conform to the requirements set out by American National Standard Practice for Roadway Lighting (ANSI/IESNA RP-8-14)

1. Street light designs for Neighbourhood Connectors and Neighbourhood Streets shall conform to the standards shown in Figures 2.17 and to 2.21B18 with **NO SUBSTITUTION** of street light fixtures. Photometric designs are not required for these roads.
2. Detailed photometric designs shall be submitted for all other roads, intersections and sidewalks demonstrating how the RP-8-14 standards have been satisfied without excessive over lighting. Illumination at intersections may require a higher

wattage fixture than the remainder of the road. Contact the Roadway Lighting and Traffic Control Division to confirm the appropriate road classification and pedestrian conflict **prior** to undertaking the photometric design. In addition to the photometric drawings, the results of the photometric design must be displayed in a table similar to the following: (see table below)

	L _{avg}	L _{avg} /L _{min}	L _{max} /L _{min}	L _{max} /L _{avg}
Major Road with Medium Pedestrian Conflict	0.9	3.0	5.0	0.3
Luminaire name	RESULTS	RESULTS	RESULTS	RESULTS
	E _H (lux/fc)	E _{Vmin} (lux/fc)	E _{avg} /E _{min}	
Sidewalk with Medium Pedestrian Conflict	5.0/0.5	2.0/0.2	4.0	
Luminaire name (near side)	RESULTS	RESULTS	RESULTS	
Luminaire name (far side)	RESULTS	RESULTS	RESULTS	

- Street light fixtures shall be located such that current and future tree canopies do not interfere with the distribution of the light.
- The use of street light fixtures mounted over the travelled portion of the road is encouraged to avoid trees and to achieve improved street light spacing.
- The drawings shall show the location of the street lights (indicated by an open circle), street light conductors, the location of transformers and the location of power disconnects. The drawings shall specify the type of pole, fixture, conduit, fixture wattage, conductor and 20kv 10ka breakers being used.
- Street lights should be placed wholly on one lot at the property line whenever possible.
- The maximum number of lights that can be attached to a single circuit is 10 unless voltage drop calculations are provided that demonstrate the circuit can accommodate the load.
- Existing street lights shall be shown as solid black circles.
- The street light cable should be indicated by a black line with an SL imposed on the line.
- All street light wire road crossings shall be placed in a 50 mm RPVC duct with handholds at either end of the road crossing.
- Designers should be aware of driveway locations and living room windows when determining the location of lights.
- The design is to be drawn at a 1:500 scale.
- Street light poles on Neighbourhood Connectors and Neighbourhood Streets with residential dwelling units to utilize a maximum mounting height of 4.5m.
- Final designs must be accepted by the City of London's, Roadway Lighting & Traffic Control Division. Main Street and Rapid Transit Boulevards are to have

pedestrian scale lighting using poles capable of accommodating banners, hanging baskets and other decorative elements.

2.5.4 Walkway Lighting Design

Walkway lighting designs shall be comprised of the following:

1. 26 W Eaton AVS or 35 W Lithonia KAD LED fixtures.
2. 4.6m pole base mounted (black powder coated galvanized square tapered steel or aluminium).
3. The first light from the street should be 15m from the back of the sidewalk or 15m from the edge of pavement if no sidewalk is present;
4. Spacing along of the light along the walkway should be approximately every 30m, noting most walkways require only one additional light usually located at the rear of the residential property line; severe bends or stairs may require tighter spacing;
5. Walkway lights are to intersect street circuits at a junction box located at one end of the walkway.
6. Street light wire shall be placed in a 50mm RPVC duct.
7. The pole base shall be located immediately adjacent to the fence line so that the pole is placed as close as possible to the fence line.
8. Bollards located at either end of a lit walkway must be removable for maintenance purposes.

2.5.5 Residential Street Light Installation & Inspection Guidelines

1. The same or similar light standard must be used from one end of a street to the other regardless of how many phases of construction are involved. Acceptance of alternative designs by the City on a case by case review.
2. Poles and luminaries take a minimum of 8 weeks to be delivered. The City does not stock any residential street lights for new construction.
3. A power disconnect utilizing 20kv 10ka breakers must be installed at the first street light from the transformer. All installations must be inspected by the Electrical Safety Association (ESA) prior to London Hydro doing the power connection. The Contractor is responsible for arranging inspection with ESA.

2.6 CONSTRUCTION SIGNAGE

2.6.1 General

Use the Ontario Traffic Manual - Book 7 - Temporary Conditions for all construction signage applications.

2.6.2 Traffic Management Plans

2.6.2.1 Definition

The Traffic Management Plan (TMP) is a construction scheduling tool that effectively harmonizes the construction project's physical requirements with the operational requirements of the City of London, the transportation needs of the road users within the City and access concerns of the local residents.

2.6.2.2 Traffic Control Plan vs. Traffic Management Plan

The requirements of the Ministry of Labour and the Ontario Traffic Manual Book 7 construction works (the requirements for a Traffic Control Plan (TCP) and Traffic Protection Plan (TPP)) are different from the City of London's Traffic Management Plan (TMP). The TMP is a plan that shows the construction methodology that will ensure through traffic movement, utility services, pedestrian traffic and vehicular access to the areas adjacent to the construction site, while allowing for the construction of the desired works. TCP's and TPP's list specific temporary signs and barricades to be installed.

For basic, straightforward utility projects, the City will receive a TCP/TPP, review it for General Conformance with City of London Traffic Management Plan Requirements, and OTM Book 7, and decide whether or not to accept the TCP/TPP to allow for the issuance of a PAW. However, the City of London will not complete an in-depth review or accept a Contractor's Traffic Control Plan or Traffic Protection Plan. For ALL Development related projects and complex, multi stage/multi-phase capital works or utility projects; a TMP is required. Please refer to Section 2.6.2.4 TMP Submission Requirements, for further information.

2.6.2.3 When is a TMP Required?

A TMP is required whenever development/utility related works (closure, resurfacing or reconstruction) affect any portion of the City roadway as itemized below:

- a) A TMP is required:
 - i. For any work being done on the paved portion of an Expressway, Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/ Civic Boulevard in a Primary Transit Area, Main Street, Neighbourhood Connector, Rural Thoroughfare, Rural Connector;
 - ii. Where a full road closure of any class of road is proposed for longer than ½ a day duration;
 - iii. For any partial road closure on an Expressway, Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/ Civic Boulevard in a Primary Transit Area, Main Street, Neighbourhood Connector, Rural Thoroughfare, Rural Connector, Neighbourhood Street where the road closure is for any length of time; or
 - iv. Any work on downtown core streets (as defined by the London Plan).
 - v. For any work that may affect LTC services, emergency services or will have direct impact on pedestrians.
- b) A TMP is not required for work on Neighbourhood Streets, except as noted in 2.6.2.3.a) ii), above, or in 2.6.2.3 c) exceptions, below.
- c) Exceptions:

Some exceptions due to depth of work, width of work, use of road (i.e. fronting a hospital, bus routes, school, etc.), may apply. In these site specific situations, discussion with the Transportation Division will be required to determine if a TMP is required.

TMP's are required for both assumed and unassumed roads if there is an impact on traffic flow. For example, an undeveloped dead end unassumed street may have no public traffic and may not need a TMP.

2.6.2.4 Traffic Management Submission Requirements

The complexity of the TMP required is determined by the complexity of the proposed works.

2.6.2.4.1 For basic, straight forward UTILITY projects, the following information shall be provided:

- a) a brief description of the work, including the anticipated duration of the work;
- b) the location of the buildings/driveways and the municipal address, street names, including cross streets and intersections if any;
- c) show all lanes for each road on the drawing and define the proposed lane widths;
- d) state the impact on sidewalks, cycling infrastructure, LTC bus stops/school bus stops, driveways (if any), and how they will be addressed;
- e) submit 3 copies to the Transportation Planning & Design Division for review and acceptance 14 days prior to applying for a PAW.

The Traffic Management Plan should be a reflection of a suitable layout from OTM Book 7; quote the Fig. No. for our reference, and refer to Table A for short duration work and Table B for long duration work. The signage and the distances between the signs should reflect the appropriate typical layout figure and tables¹.

2.6.2.4.2 For ALL Development related projects, and complex, multi stage/multi-phase Capital Works or Utility projects, more detailed information shall be provided, and these plans should form part of the construction detailed design drawing package and tender:

- a) The TMP is required to demonstrate the design staging in a set of drawings, sealed by a Professional Engineer;
- b) written verification that all works will be conducted within the Ministry of Labour, OPSS and the Ministry of Transportation standards;
- c) Full plan coverage of the work area that is drawn to scale, and shows:
 - i. property lines
 - ii. utility plant locations
 - iii. proposed areas of removals (show all physical infrastructures to be removed, including bushes & trees)
 - iv. planned restoration
 - v. construction staging
- d) Typical cross sections drawn to scale showing:
 - i. widths of lanes (temporary pavement markings)
 - ii. location of temporary traffic barriers & barricades (off set distances)
 - iii. depth location and size
 - iv. offset distances to 1:1 side slopes

- e) The exact/specific location's road section or intersection affected
- f) The type of closure required (e.g. sidewalk, bike path, one lane, two lanes, full closure, etc.), the duration of the closure
- g) How the closure relates to the stages/phasing of the project (if applicable)
- h) How the closure relates to stages of adjacent projects
- i) How the closure protects the safe movement of pedestrians and traffic on the right of way, or accessing/egressing the right-of-way, including but not limited to:
 - i. LTC bus stops
 - ii. sidewalks
 - iii. para transit stops
 - iv. school bus stops
 - v. illumination
 - vi. edge drop-offs
 - vii. emergency vehicle access
- j) How the work accommodates: traffic signal operations, storm/sanitary sewer installations, and winter maintenance
- k) How notification is planned to coordinate with the above agencies/departments of the public.

2.6.2.5 Specific Requirements of the Plan during Road Resurfacing or Reconstruction

- a) On a two lane road section, one lane be open at all times and two-way traffic managed,
- b) On a four lane road sections, two lanes (one in each direction) be open at all times,
- c) Complete temporary pre-marking of the pavement marking plan, laid out on all new asphalt at the end of each construction day
- d) Maintain all traffic signing (by the Contractor) throughout the duration of the project
- e) Complete a pavement marking and traffic signing inventory (by the contractor) before and after the project and subsequent re-installation
- f) Complete all required sidewalks, turn lanes, traffic islands, traffic signals, pavement marking, traffic signing and associated works/restoration prior to opening a facility to the public.
- g) Detour Maintenance Plan that will ensure the quality of the temporary riding surface. Specifically, this shall detail
 - i. If Hot Mix Asphalt: the type of asphalt, thickness of asphalt, smoothness of surface layer, frequency of cleaning, and any provision for emergency pothole repair in the detour.
 - ii. If Gravel surface: The type of granular to be placed, the amount of compaction, the smoothness of the surface layer, frequency of maintenance and any provision for emergency grading (grader on site or standby), frequency of calcium to be added for dust suppression

- h) A site specific paving schedule that will detail the Contractor's paving schedule to ensure that on any of the roadway or portion thereof that is open to the public that all vertical deflections in the pavement are reduced to less than 10mm. This plan should include the contractor's plans to place temporary asphalt, milling out of temporary asphalt and final paving.
- i) In unique circumstances, alternative solutions will be considered for approval by the Director of Transportation.

2.6.3 Detour Plans

Detour plans must be authorized through the Transportation Division, two weeks prior to construction. Signs will be placed by the Contractor's own forces.

2.6.4 Traffic Control Plan

Traffic Control plans must be submitted to Transportation for acceptance.

2.6.5 Pedestrian Safety

Construction Projects in proximity to high pedestrian areas, including schools, commercial areas and any other source of high pedestrian volumes should take extra precaution to separate construction activity from pedestrian movements.

Sidewalks that are closed or removed should have signed alternate detour routes. Pedestrian paths of travel impacts must be addressed in accordance with AODA. If it is not possible to retain a smooth hard-surface sidewalk, appropriate closure and pedestrian detour signage is required identifying an AODA compliant path of travel. Impactful closures where reasonable detours are not available require informational signage placed for a 2-week period prior to the event in combination with identification on Renew London.

Any material deliveries or construction vehicle movements crossing pedestrian areas should be carefully monitored by a traffic control person.

Schools in close proximity to projects should be notified in the preconstruction letters and kept informed of progress.

NOTES:

1. NEIGHBOURHOOD CONNECTORS

C/L RADII

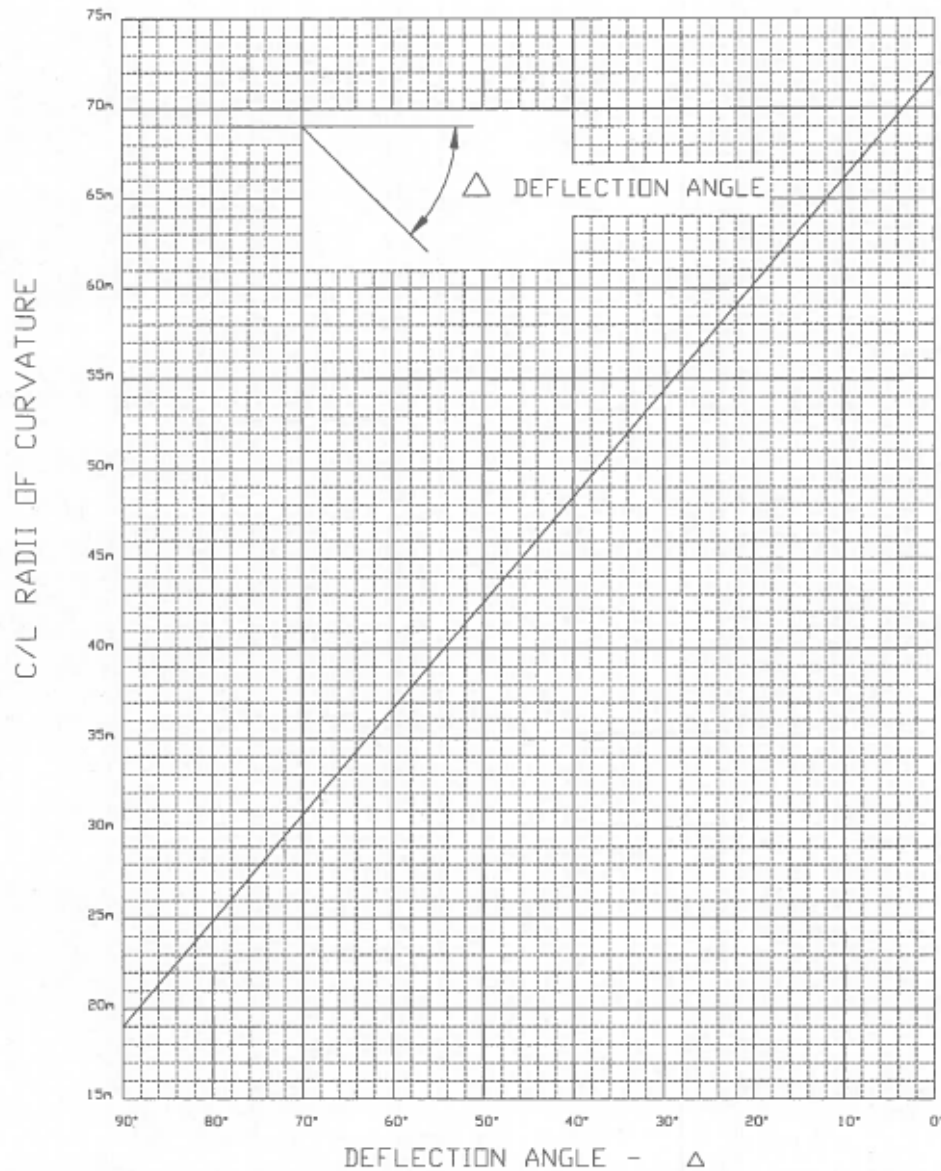
150 METRES

2. NEIGHBOURHOOD STREETS

a) 90° BENDS (DESIRABLE - 2 MAX./CRES.)

19 METRES

b) OTHER BENDS



CITY OF LONDON STANDARD DRAWING

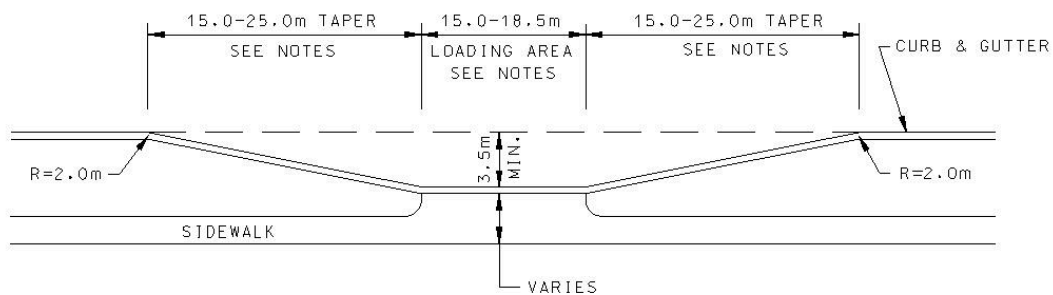
MINIMUM C/L RADII OF CURVATURE OF
ROADS IN SUBDIVISIONS

DWG FIG. 2.1

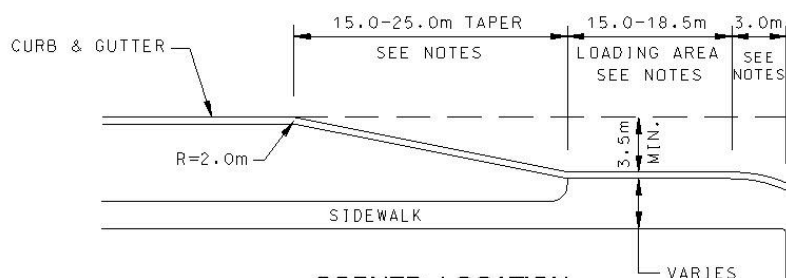
DATE 2012 01 26
REV'D 2019 07 31

APPROVED BY
CITY ENGINEER

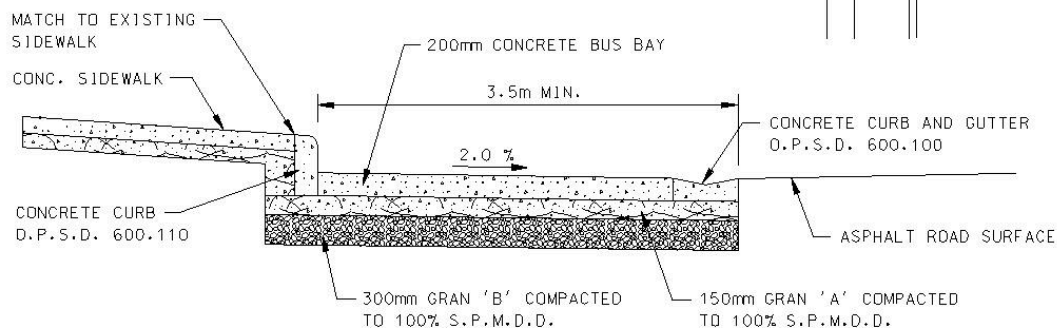
Belu



BETWEEN INTERSECTIONS



CORNER LOCATION



TYPICAL CROSS-SECTION

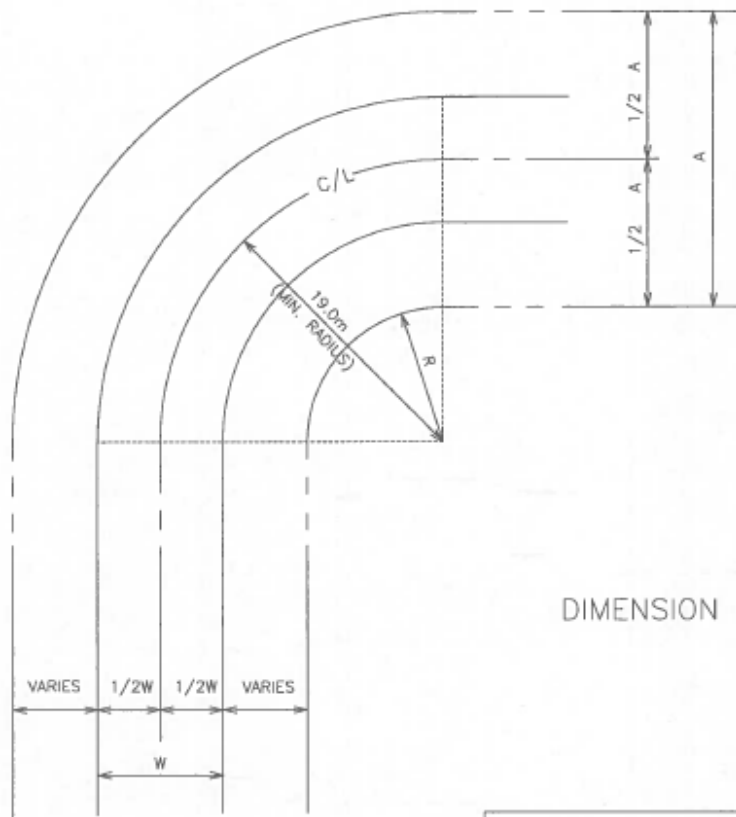
NOTES:

1. FOR STANDARD BUS USE 15.0m TAPER AND 15.0m LOADING AREA.
2. STORAGE BAY DIMENSIONS ARE FOR 1 BUS; ADD 14.5m FOR EACH ADDITIONAL STANDARD BUS, 20.0m FOR EACH ADDITIONAL ARTICULATED VEHICLE..
3. WHEN THE BUS BAY SURFACE IS CONCRETE ON AN ASPHALT ROAD, IT SHALL BE EXTENDED BY 3.0m.
4. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN.

CITY OF LONDON STANDARD DRAWING

CONCRETE BUS BAY

DWG	FIG. 2.1.22	DATE	2014 01 23	APPROVED BY	CITY ENGINEER
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DIMENSION TABLE (M)

A - ROAD ALLOWANCE	
20.0	
MINIMUM C/L RADIUS	19.0
R - MINIMUM INSIDE STREET LINE RADIUS	9.0
W - MINIMUM ROAD WIDTH (EDGE OF PAVEMENT TO EDGE OF PAVEMENT)	7.5 OR 6.5*

NOTES:

1. SCALE: N.T.S.
2. ALL DIMENSIONS SHOWN ARE MINIMUM REQUIREMENTS.
3. ALL DIMENSIONS ARE IN METRES.
4. W* PAVEMENT WIDTH MAY BE NARROWED WHEN SERVICING FEWER THAN 45 UNITS AND THAT HAVE LOW PARKING UTILIZATION.

CITY OF LONDON STANDARD DRAWING

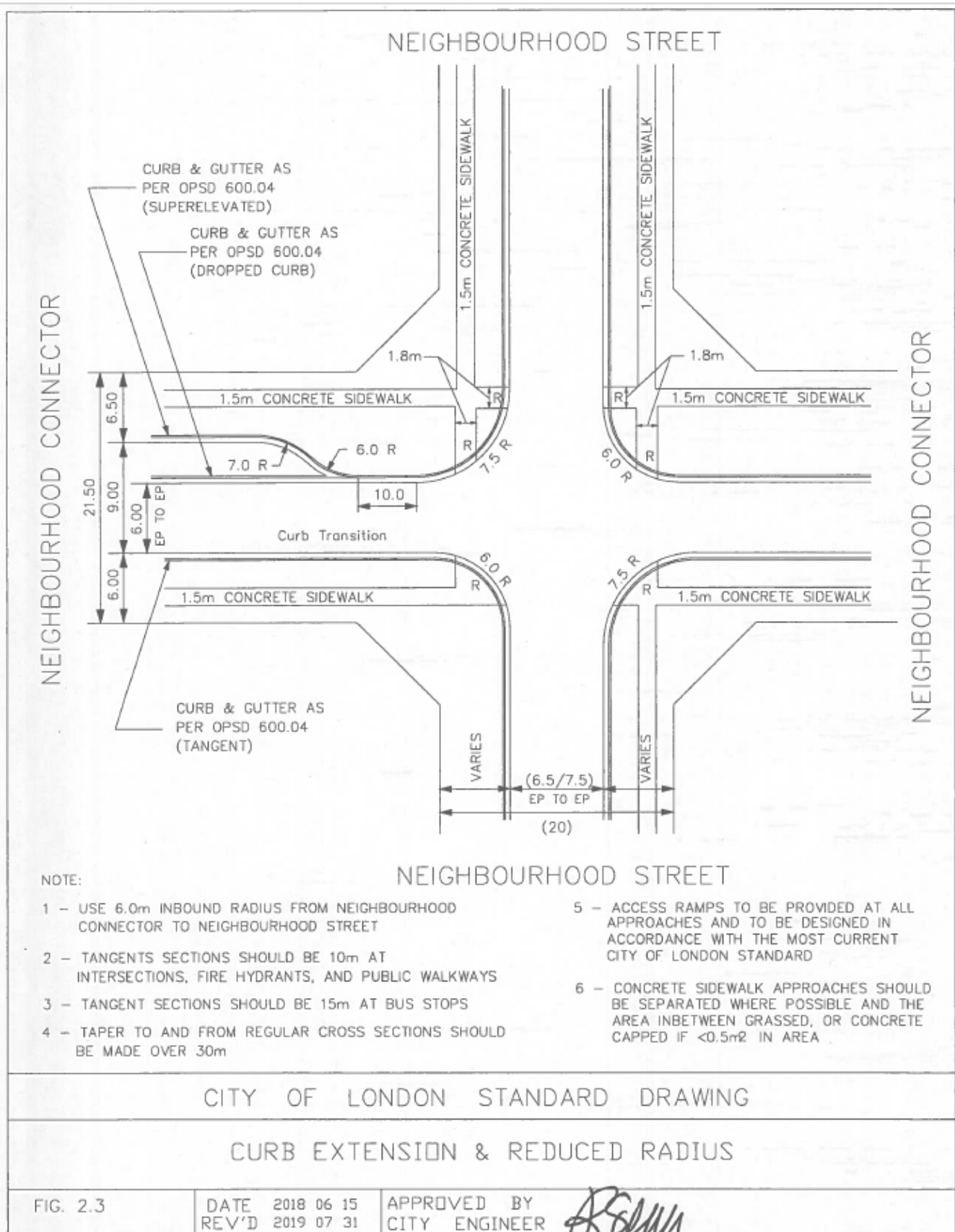
90° STREET CURVE - NEIGHBOURHOOD STREET

DWG FIG. 2.2

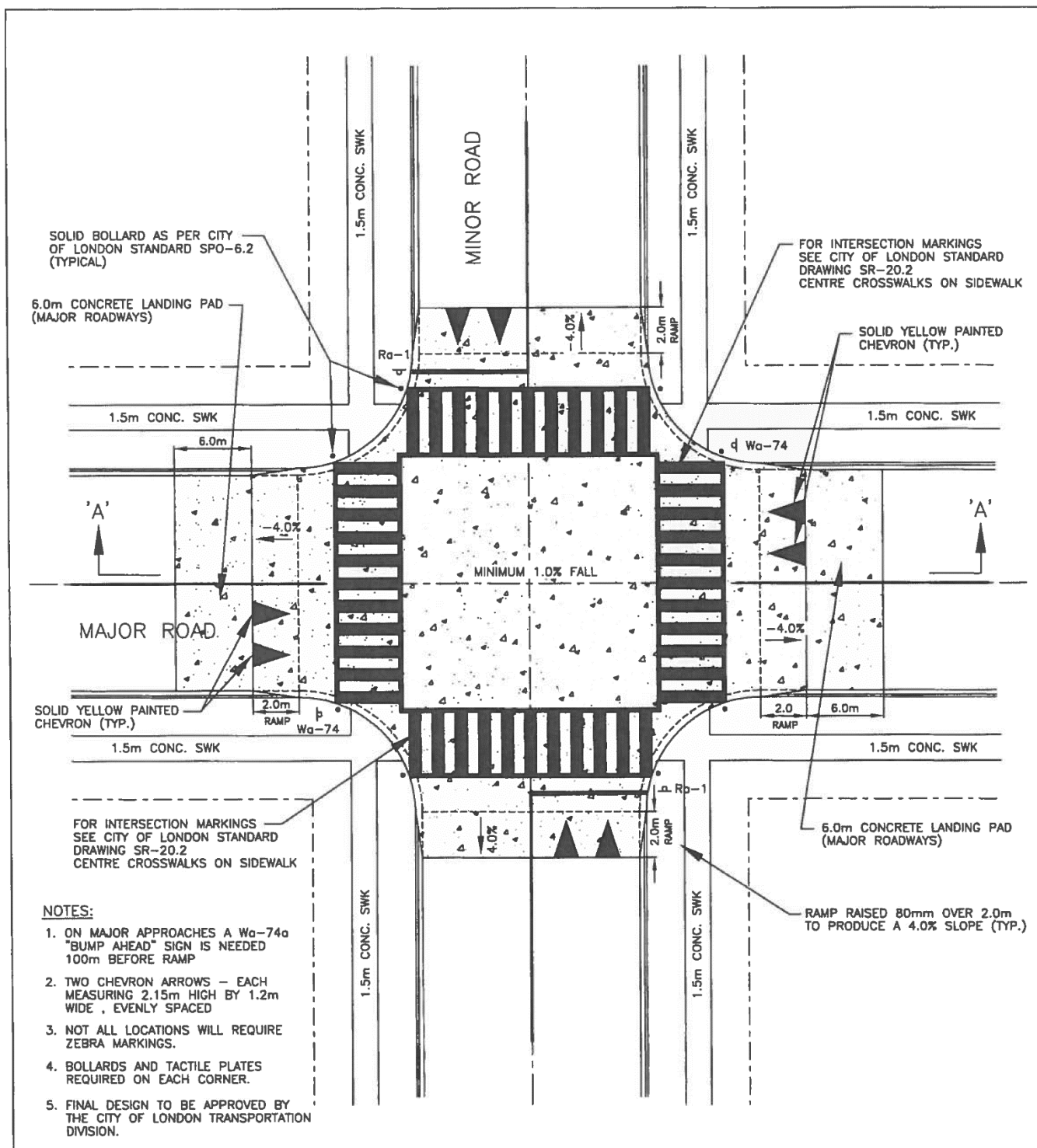
DATE 2002 12 11
REV'D 2019 07 31

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CITY ENGINEER

RSW



Clearview 3w (8" or 15cm letter height unless depicted otherwise)		Clearview 1w	
 <p>12" x 36" / 30cm x 90cm</p> <p>18cm / 4cm sign</p>			
 <p>12" x 60" / 30cm x 150cm</p>		 <p>12" x 48" / 30cm x 114cm</p>	
 <p>12" x 60" / 30cm x 150cm</p>		 <p>12" x 48" / 30cm x 114cm</p>	
 <p>12" x 60" / 30cm x 150cm</p> <p>18cm / 7cm sign</p>			
 <p>12" x 66" / 30cm x 167cm</p>		 <p>12" x 62" / 30cm x 155cm</p>	
 <p>12" x 72" / 30cm x 183cm</p>		 <p>12" x 66" / 30cm x 165cm</p>	
 <p>12" x 62" / 30cm x 155cm</p> <p>18cm sign</p>			
 <p>12" x 72" / 30cm x 183cm</p>		 <p>12" x 66" / 30cm x 165cm</p>	
 <p>12" x 82" / 30cm x 209cm</p>		 <p>12" x 82" / 30cm x 209cm</p>	
CITY OF LONDON			
STREET NAME SIGNING			
FIG 2.3.1	DATE 2012 06 01	APPROVED BY 	



CITY OF LONDON STANDARD DRAWING

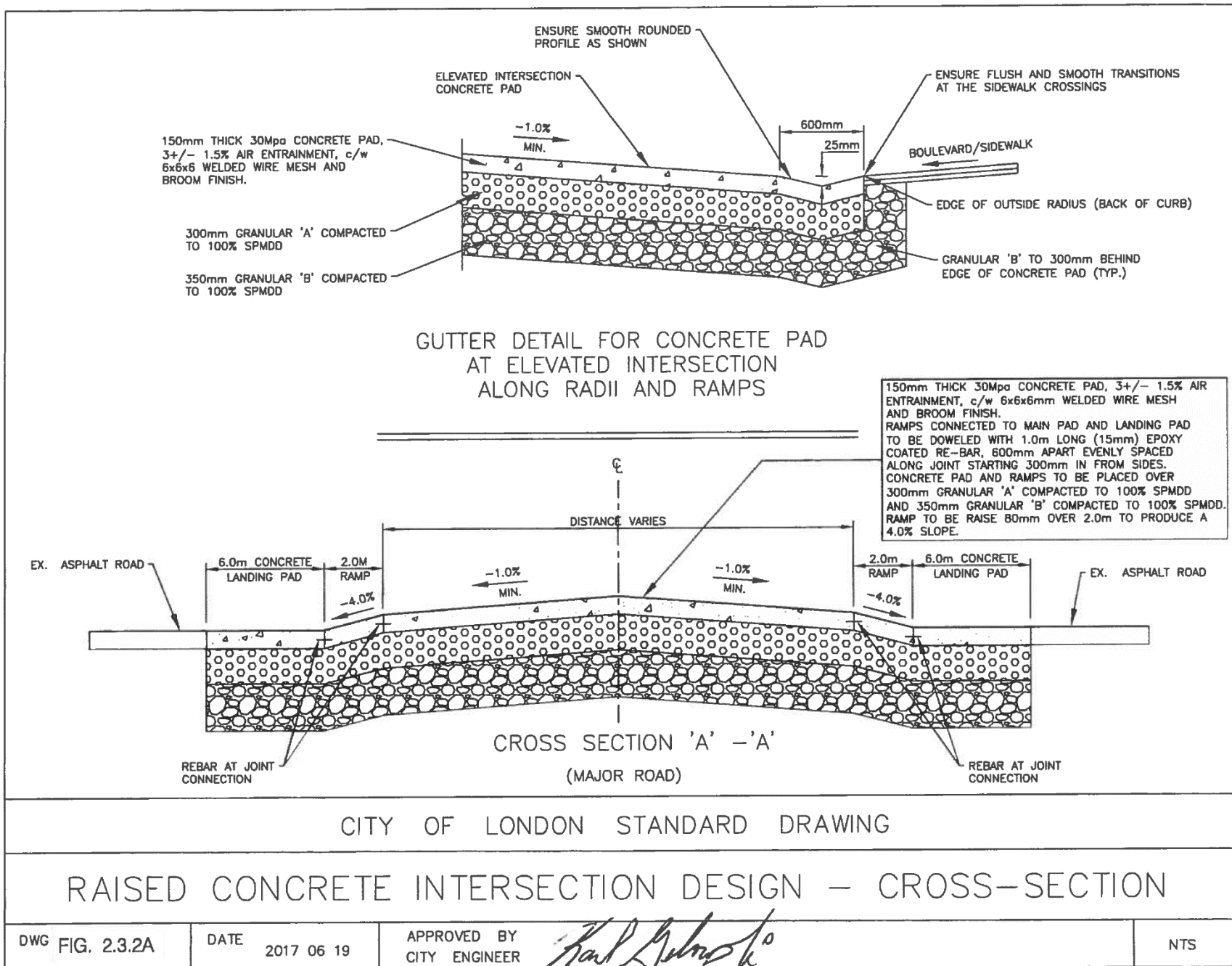
RAISED CONCRETE INTERSECTION DESIGN

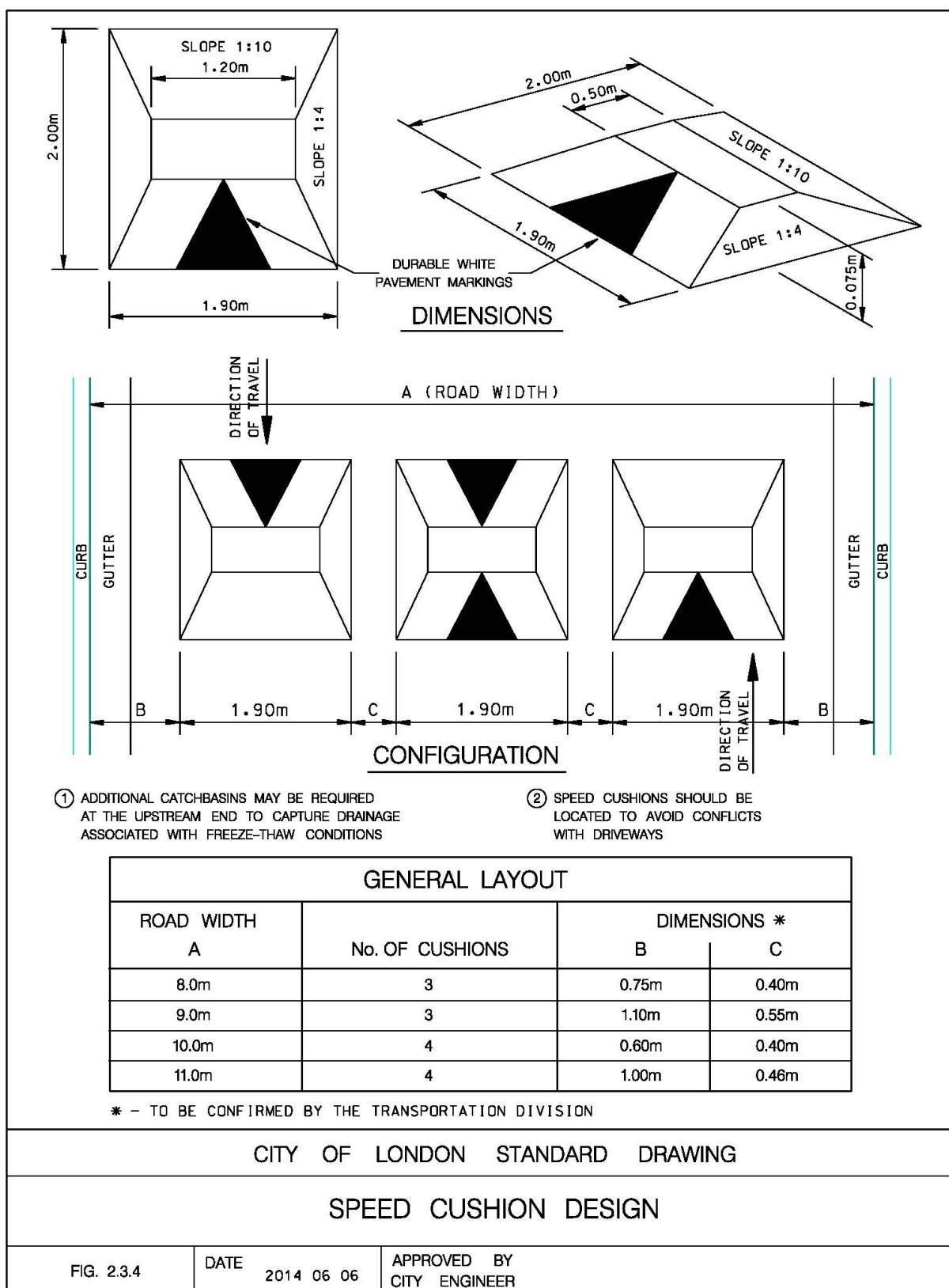
DWG FIG. 2.3.2

DATE 2017 06 19

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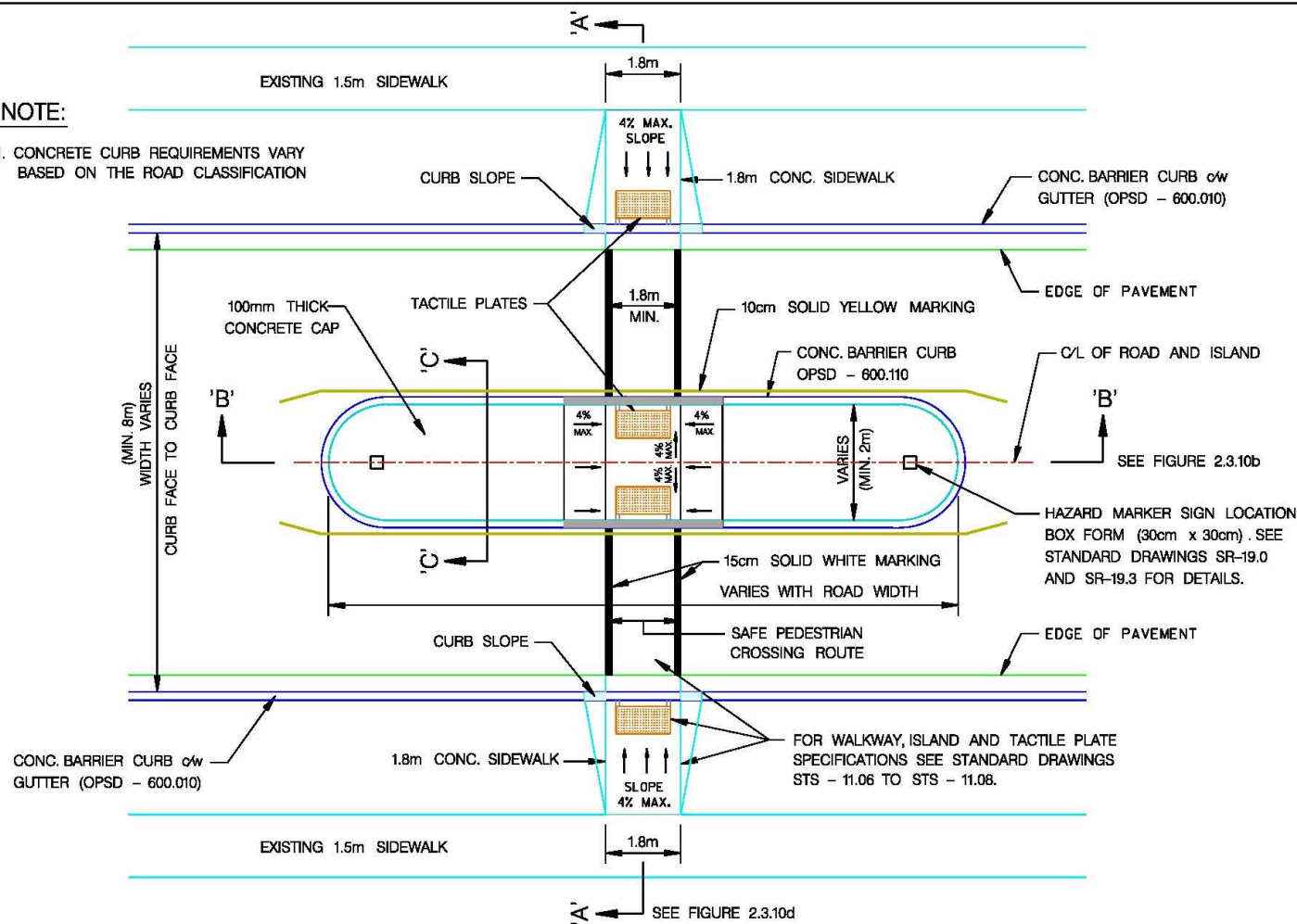
Khalid Salah





NOTE:

1. CONCRETE CURB REQUIREMENTS VARY
BASED ON THE ROAD CLASSIFICATION



CITY OF LONDON STANDARD DRAWING

PEDESTRIAN REFUGE ISLAND

DWG: FIG. 2.3.10

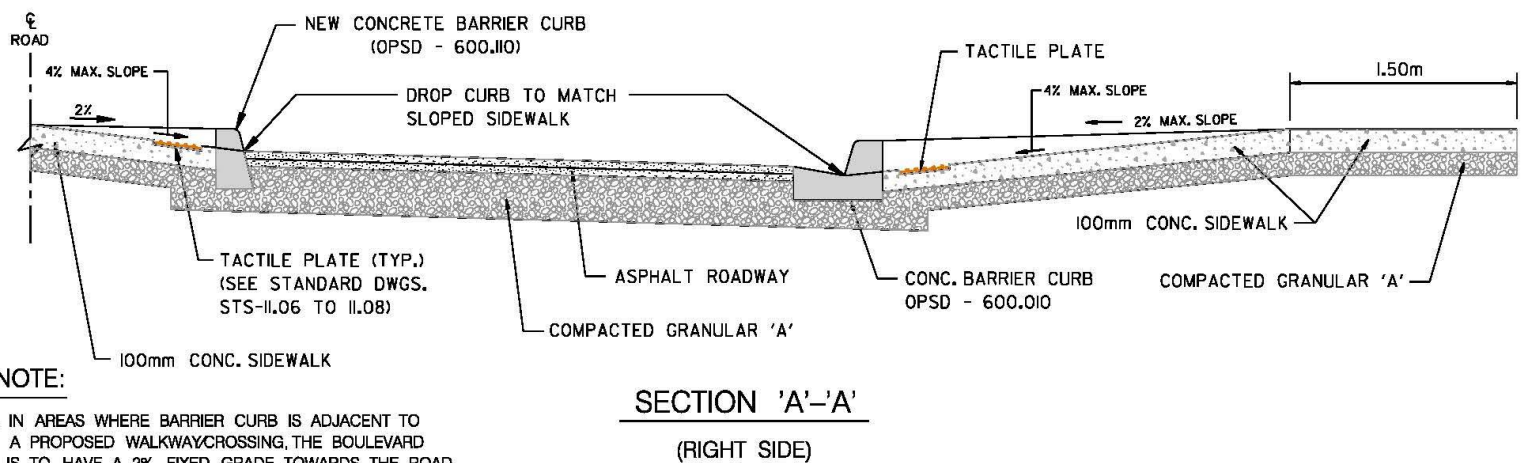
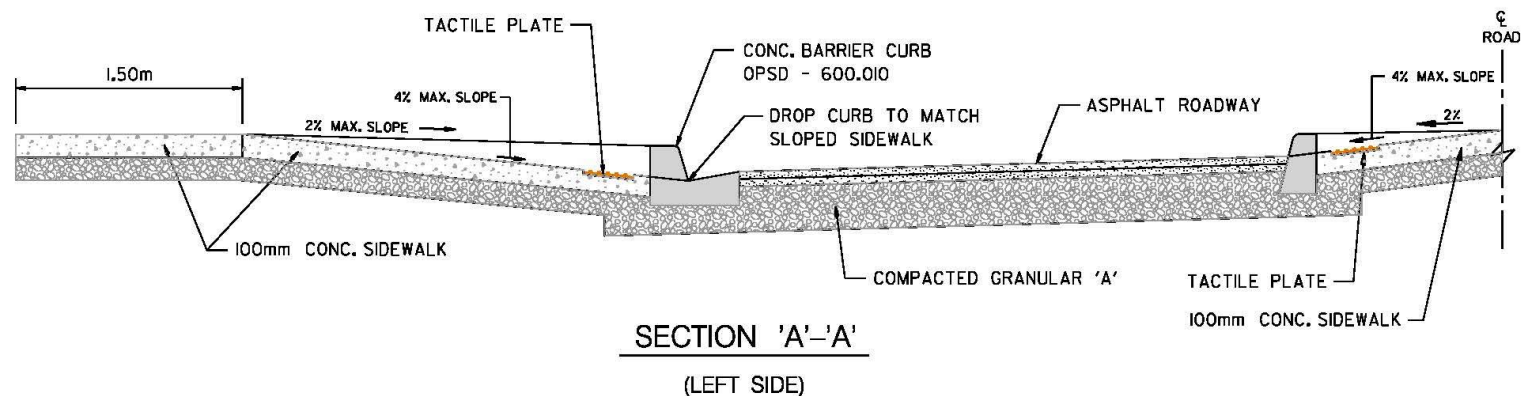
SHEET 1 OF 3

DATE

2014 06 06

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CITY ENGINEER:

NTS



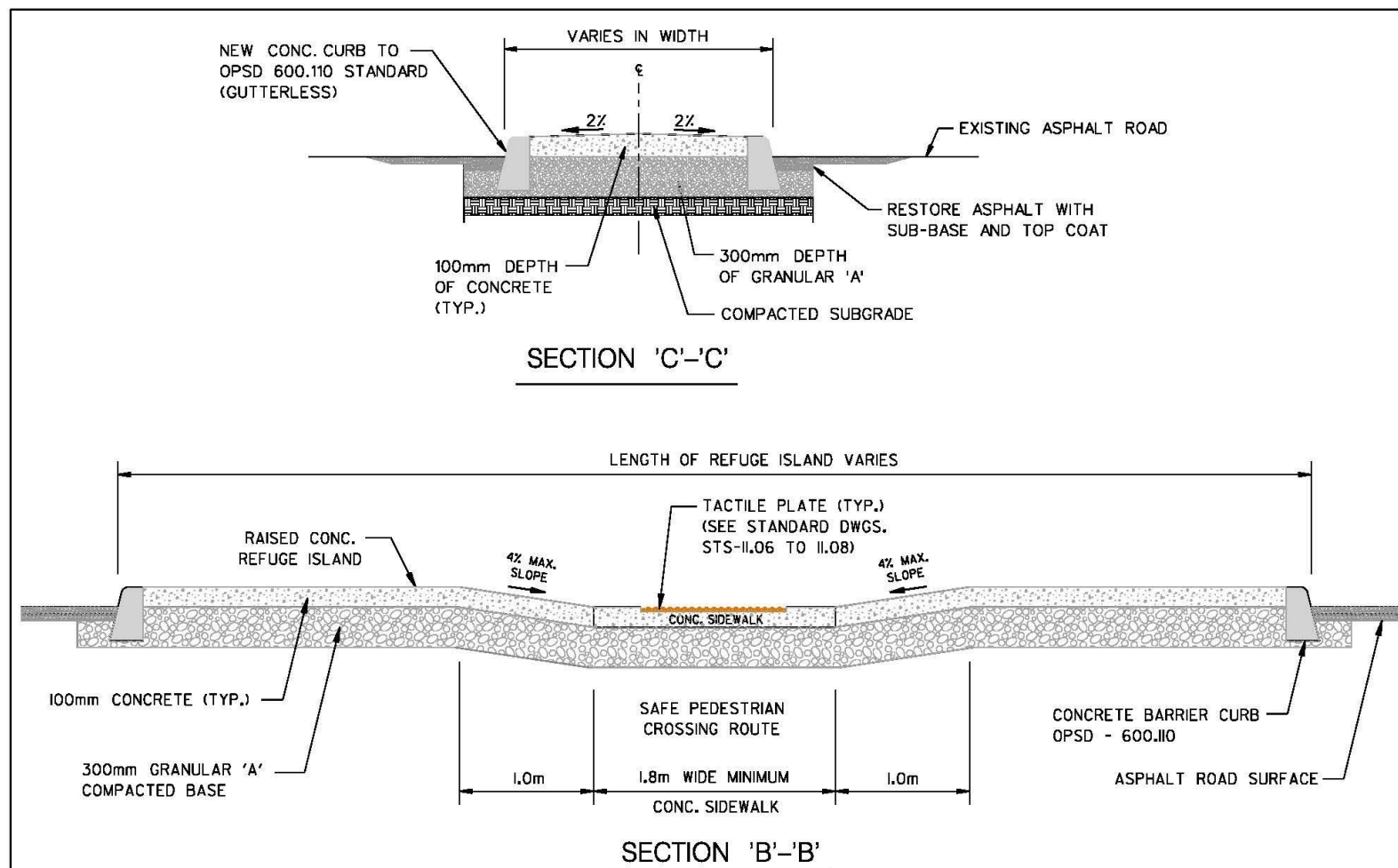
NOTE:

1. IN AREAS WHERE BARRIER CURB IS ADJACENT TO A PROPOSED WALKWAY CROSSING THE BOULEVARD IS TO HAVE A 2% FIXED GRADE TOWARDS THE ROAD

CITY OF LONDON STANDARD DRAWING

PEDESTRIAN REFUGE ISLAND – SECTIONS

DWG:	FIG. 2.3.10A	SHEET 2 OF 3	DATE	2014 06 06	APPROVED BY CITY ENGINEER:	NTS
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CITY OF LONDON STANDARD DRAWING

PEDESTRIAN REFUGE ISLAND – SECTIONS

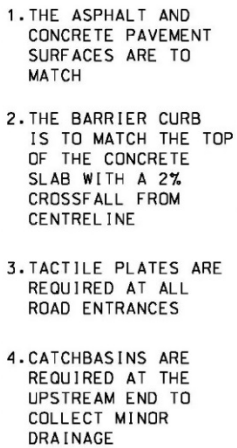
DWG: FIG. 2.3.10B

SHEET 3 OF 3

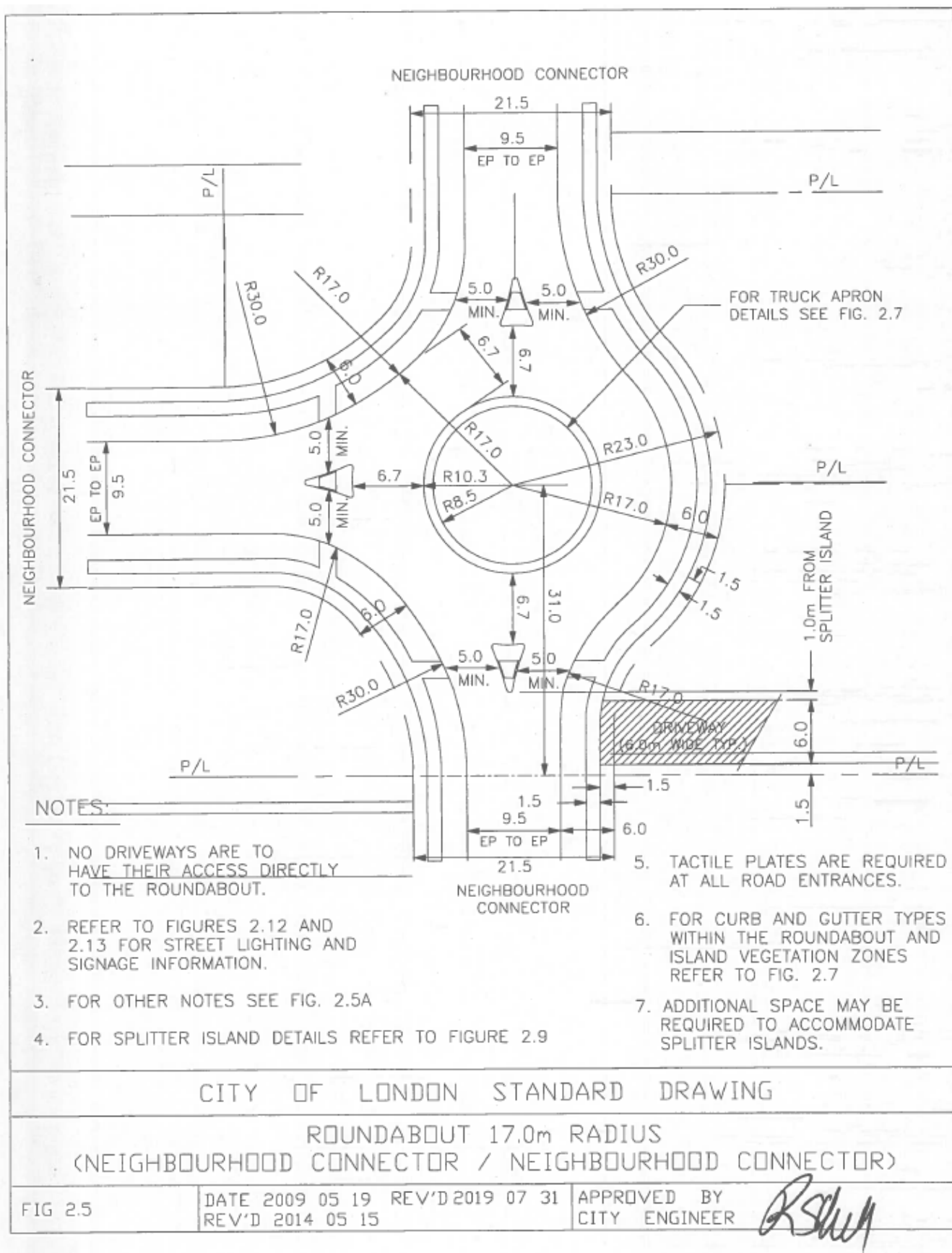
DATE 2014 06 06

APPROVED BY
CITY ENGINEER:

NTS



CITY ENGINEER



NOTES:

1. FOR STREETS THAT INTERSECT AT APPROXIMATELY 90° THE PROPERTY LINE MUST BE SETBACK 31.0m FROM THE INTERSECTION OF THE CENTRE LINE OF THE R.O.W. OR 8.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 6.0m DRIVEWAY WIDTH.

OR

THE PROPERTY LINE MUST BE SETBACK 28.0m FROM THE INTERSECTION OF THE CENTRE LINE OF THE ROUNDABOUT OR 5.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 3.0m DRIVEWAY WIDTH.
2. FOR MAJOR ROADS OR IF THE ROADWAYS DO NOT INTERSECT AT 90 DEGREES THE PROPERTY LINE MUST BE SET BACK 8.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 6.0m DRIVEWAY WIDTH OR 5.5m FROM THE NOSE OF THE SPLITTER ISLAND FOR A 3.0m DRIVEWAY WIDTH.
3. ALL DIMENSIONS ARE TO EDGE OF PAVEMENT (EP).
4. FOR MINOR ROADS THE SPLITTER ISLAND MUST BE A MINIMUM OF 5.5m IN LENGTH (FIG. 2.9). FOR MAJOR ROADS THE SPLITTER ISLAND MUST BE A MINIMUM OF 15.0m IN LENGTH (FIG. 2.8).
5. CROSSFALL SHALL BE AWAY FROM THE CENTER ISLAND.
6. FOR ISLAND VEGETATION ZONES AND TYPICAL CROSS-SECTION WITH CURB AND GUTTER TYPES REFER TO FIGURE 2.7 "TYPICAL SECTION AND LANDSCAPE OF CENTRE ISLAND"
7. FOR SIGNAGE DESIGN REFER TO ROUNDABOUT LIGHTING AND SIGNAGE DRAWINGS (FIG. 2.12 – FIG. 2.15).
8. SPLITTER ISLANDS SHALL BE CONSTRUCTED AT THE SAME TIME AS THE CENTER ISLAND IS CONSTRUCTED.

WHEN SPLITTER ISLANDS ARE BEING CONSTRUCTED:

BOX FORMS ARE TO BE PLACED WHERE FUTURE ROAD SIGNS OR HAZARD WARNING MARKERS ARE TO BE INSTALLED WHEN THE SIGN OR MARKER WILL BE LOCATED IN CONCRETE OR ASPHALT. THE BOX FORM SHOULD BE LOCATED APPROXIMATELY 1.0m FROM THE END OF THE ISLAND AND CENTERED IN THE ISLAND AT THIS LOCATION (TYPICAL).

THE BOX FORMS ARE AVAILABLE FREE OF CHARGE FROM: THE CITY OF LONDON – TRANSPORTATION OPERATIONS DIVISION [(519)661-2500 EXT. 4923].


CITY OF LONDON STANDARD DRAWINGS

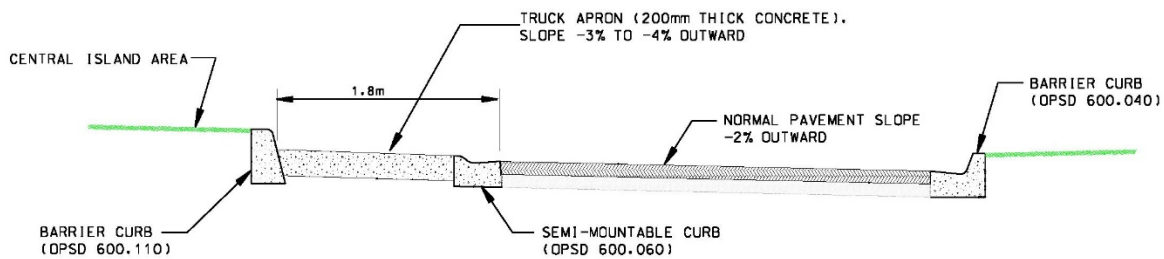
ADDITIONAL ROUNDABOUT NOTES

FIG 2.5A

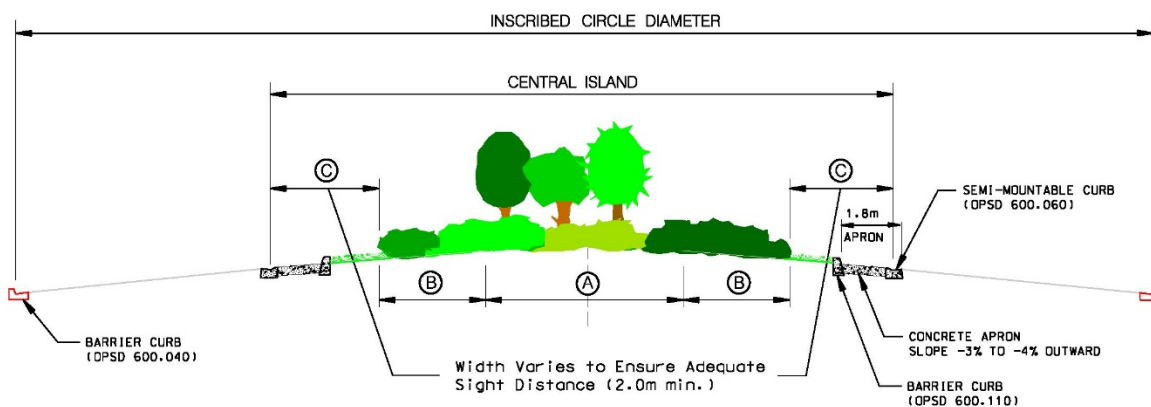
DATE 2014 06 06
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TYPICAL SECTION WITH A TRUCK APRON



ISLAND VEGETATION ZONES				
	17m ROUNDABOUT		15.6m ROUNDABOUT	
(A)	0-5m	UNRESTRICTED HEIGHT	0-4m	UNRESTRICTED HEIGHT
(B)	> 5-8.3m	1.0m MAX. HEIGHT	> 4-6m	1.0m MAX. HEIGHT
(C)	> 8.3-10.3m	0.3m MAX. HEIGHT	> 6-8m	0.3m MAX. HEIGHT

LANDSCAPING OF THE
CENTRAL ISLAND

CITY OF LONDON

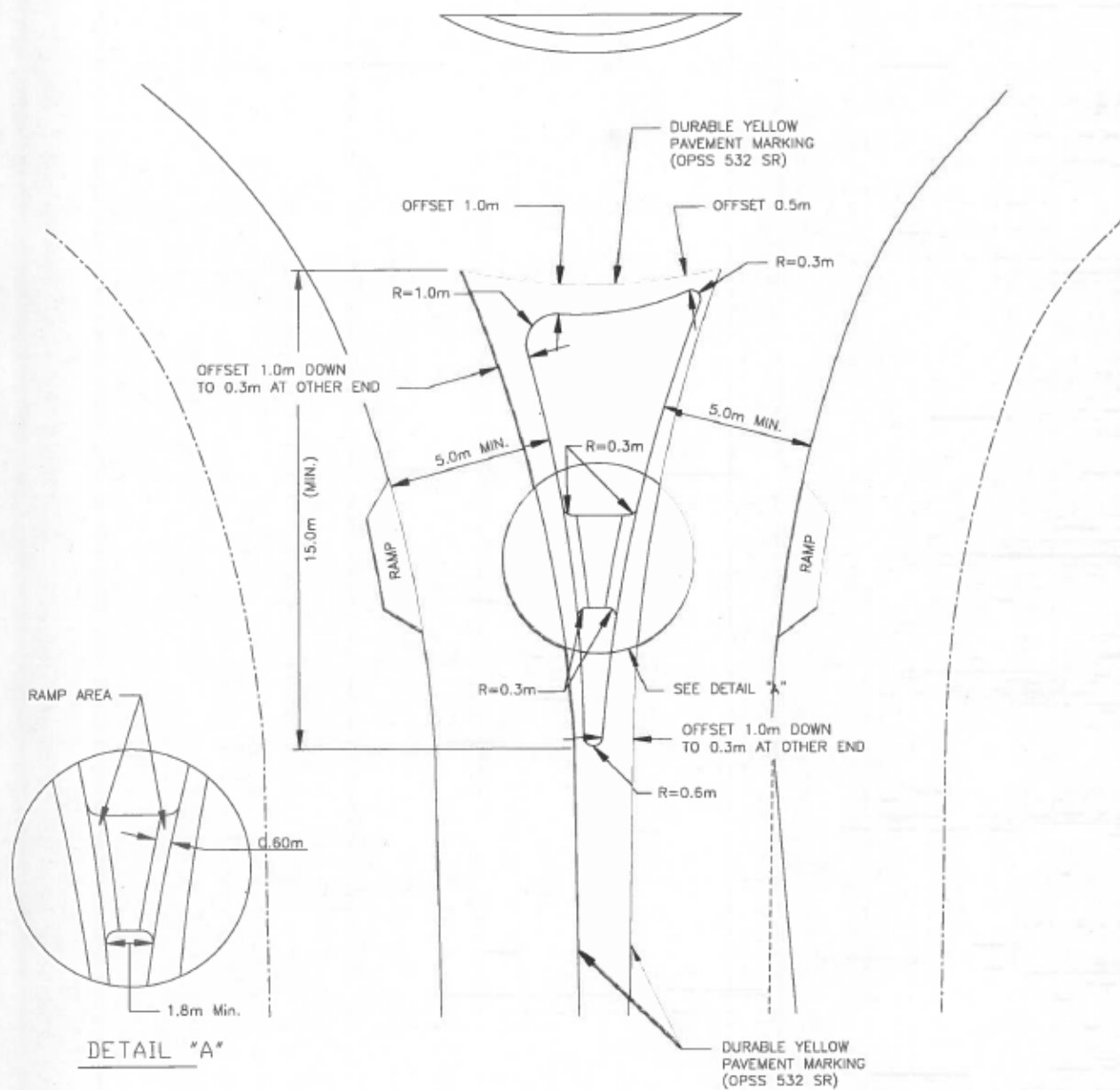
TYPICAL SECTION AND LANDSCAPING OF CENTRAL ISLAND

FIG. 2.7

DATE

2014 06 06

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CITY OF LONDON STANDARD DRAWING

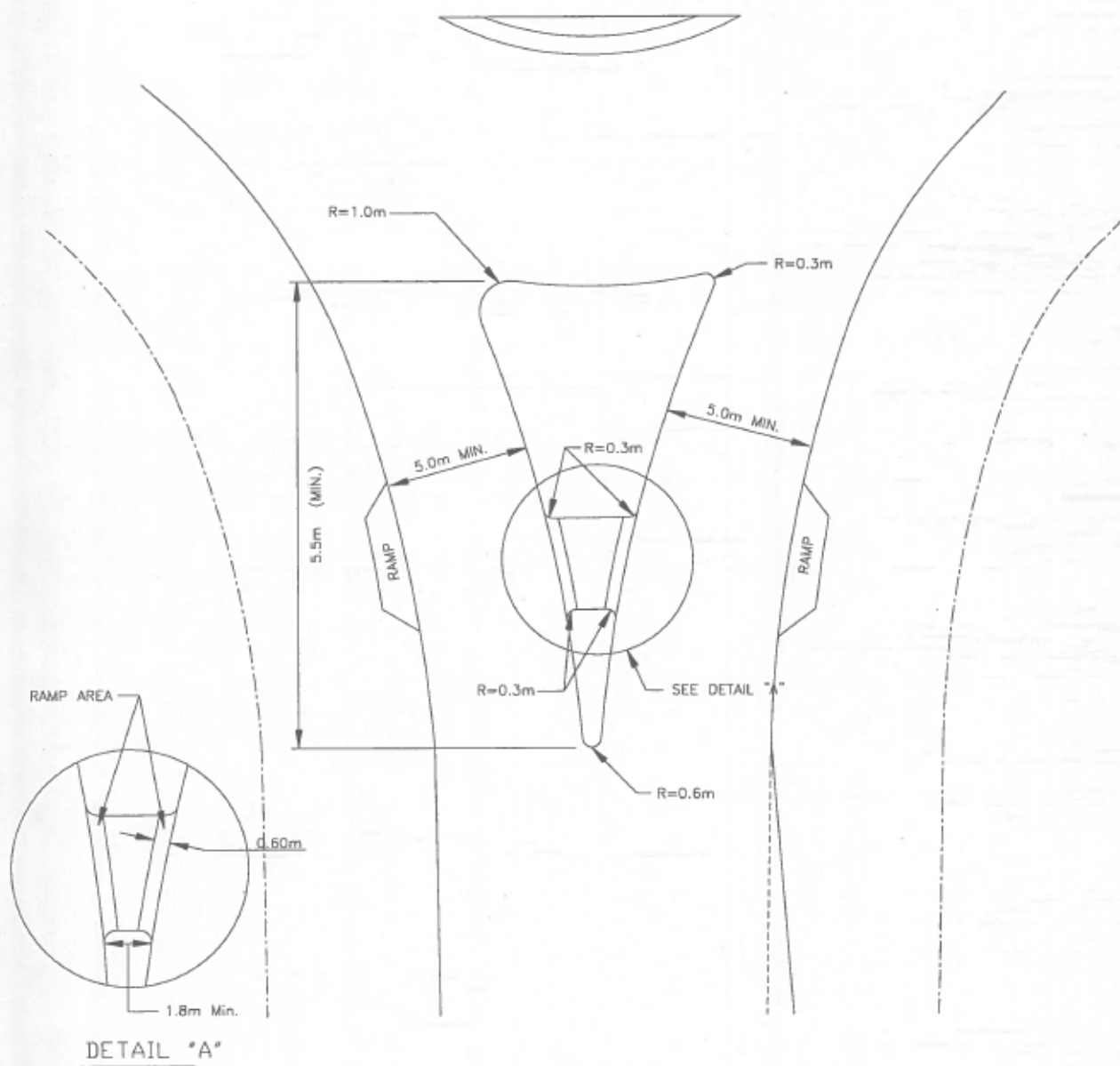
15.0m SPLITTER ISLAND DESIGN (MAJOR ROAD / NEIGHBOURHOOD CONNECTOR)

FIG. 2.8

DATE 2009 05 19
REV'D 2019 07 31

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[Signature]



CITY OF LONDON STANDARD DRAWING

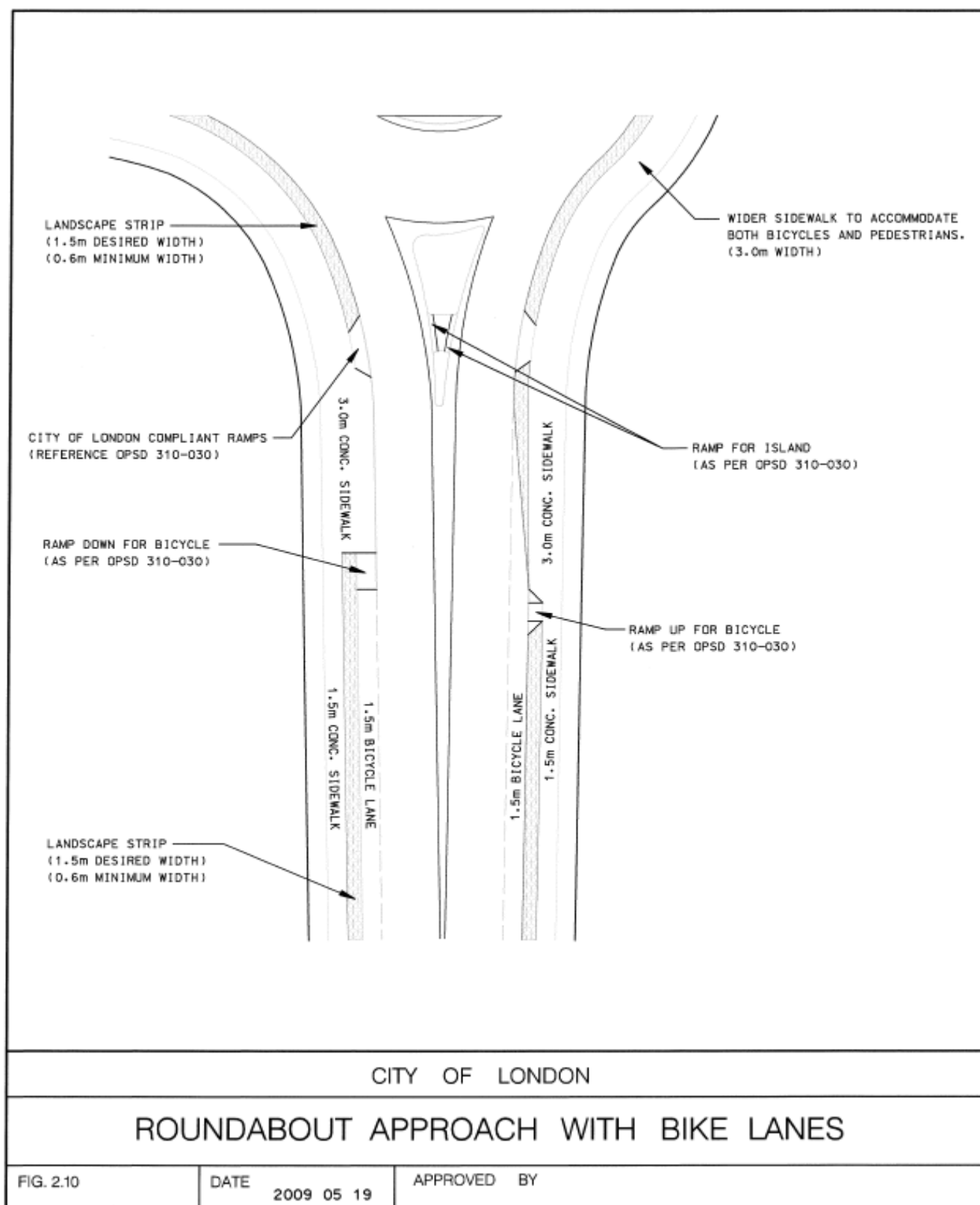
5.5m SPLITTER ISLAND DESIGN
(NEIGHBOURHOOD CONNECTOR / NEIGHBOURHOOD STREET)

FIG. 2.9

DATE 2009 05 19
REV'D 2019 07 31

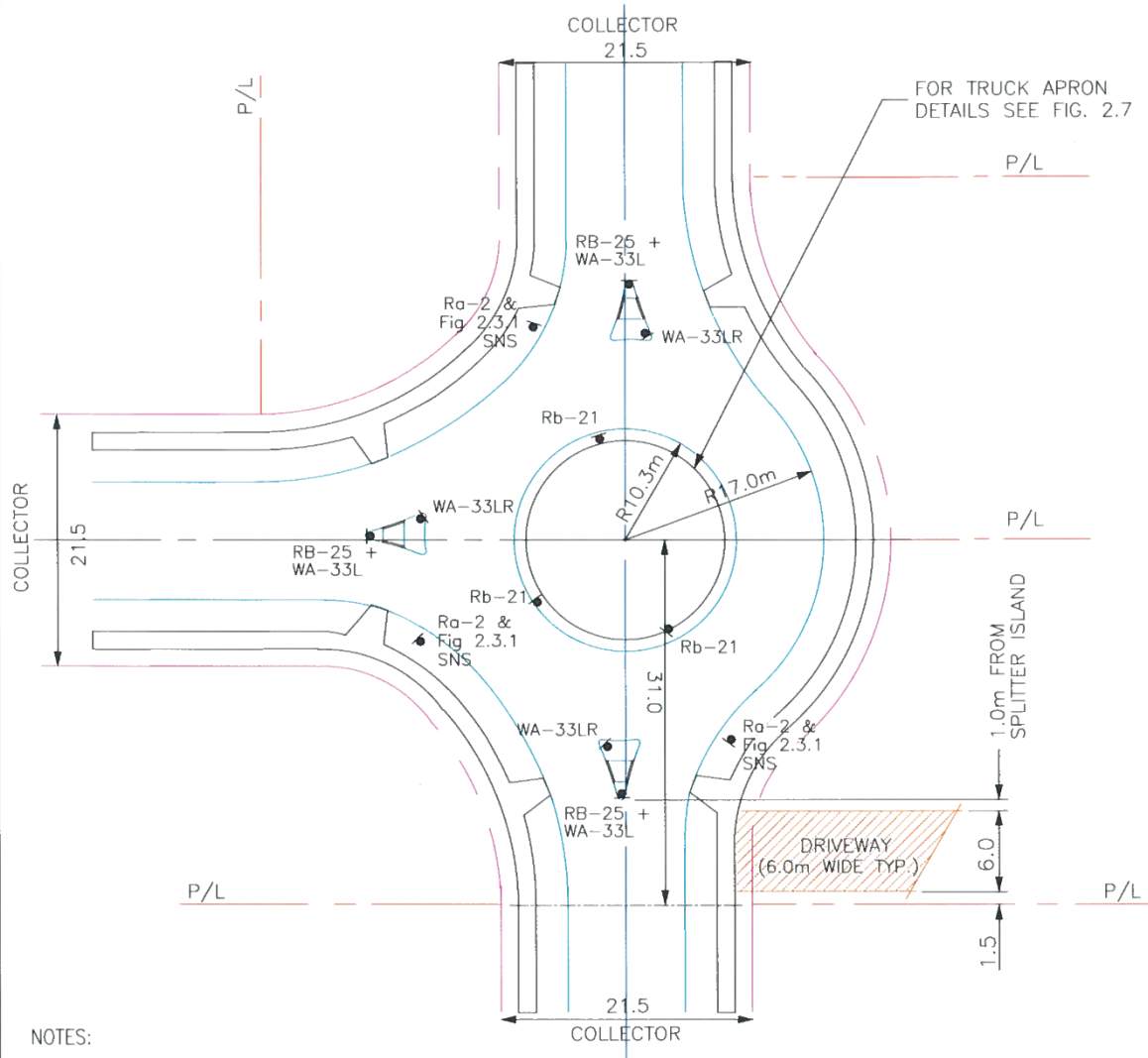
APPROVED BY
CITY ENGINEER


[Signature]



LEGEND

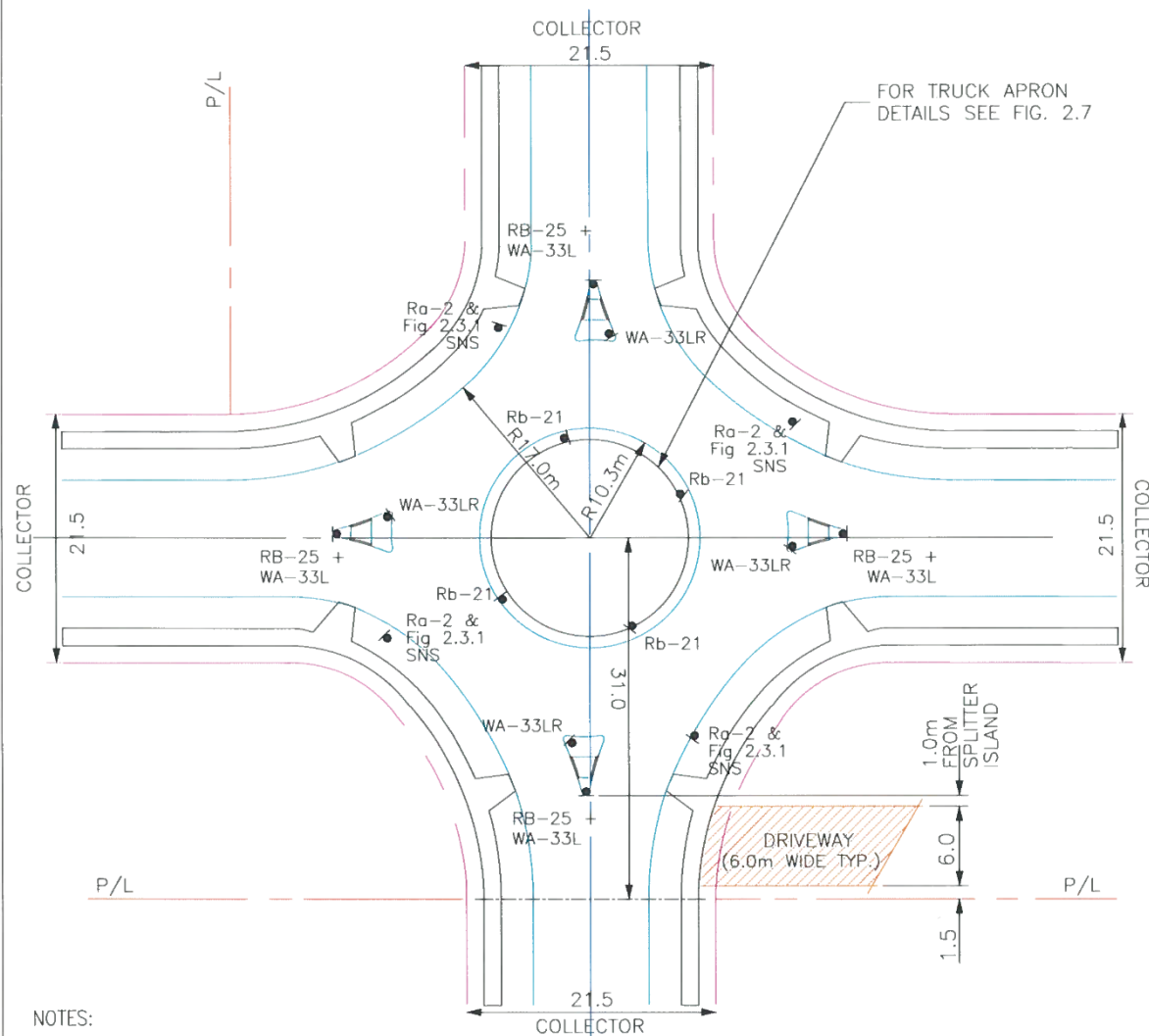
 SIGN
 SNS STREET NAME SIGN



CITY OF LONDON		
ROUNABOUT 17.0m RADIUS – SIGNAGE (3-LEG INTERSECTION)		
FIG. 2.12	DATE 2018 07 19	APPROVED BY 

LEGEND

- SIGN
- SNS STREET NAME SIGN



NOTES:

1. FOR ROAD GEOMETRY INFORMATION REFER TO FIG. 2.5
2. FOR ISLAND DESIGN NOTES REFER TO FIG. 2.5A
3. REFER TO THE ONTARIO TRAFFIC MANUAL FOR SIGN TYPES
4. FOR A 3.0m DRIVEWAY WIDTH REFER TO FIG. 2.5A.

CITY OF LONDON

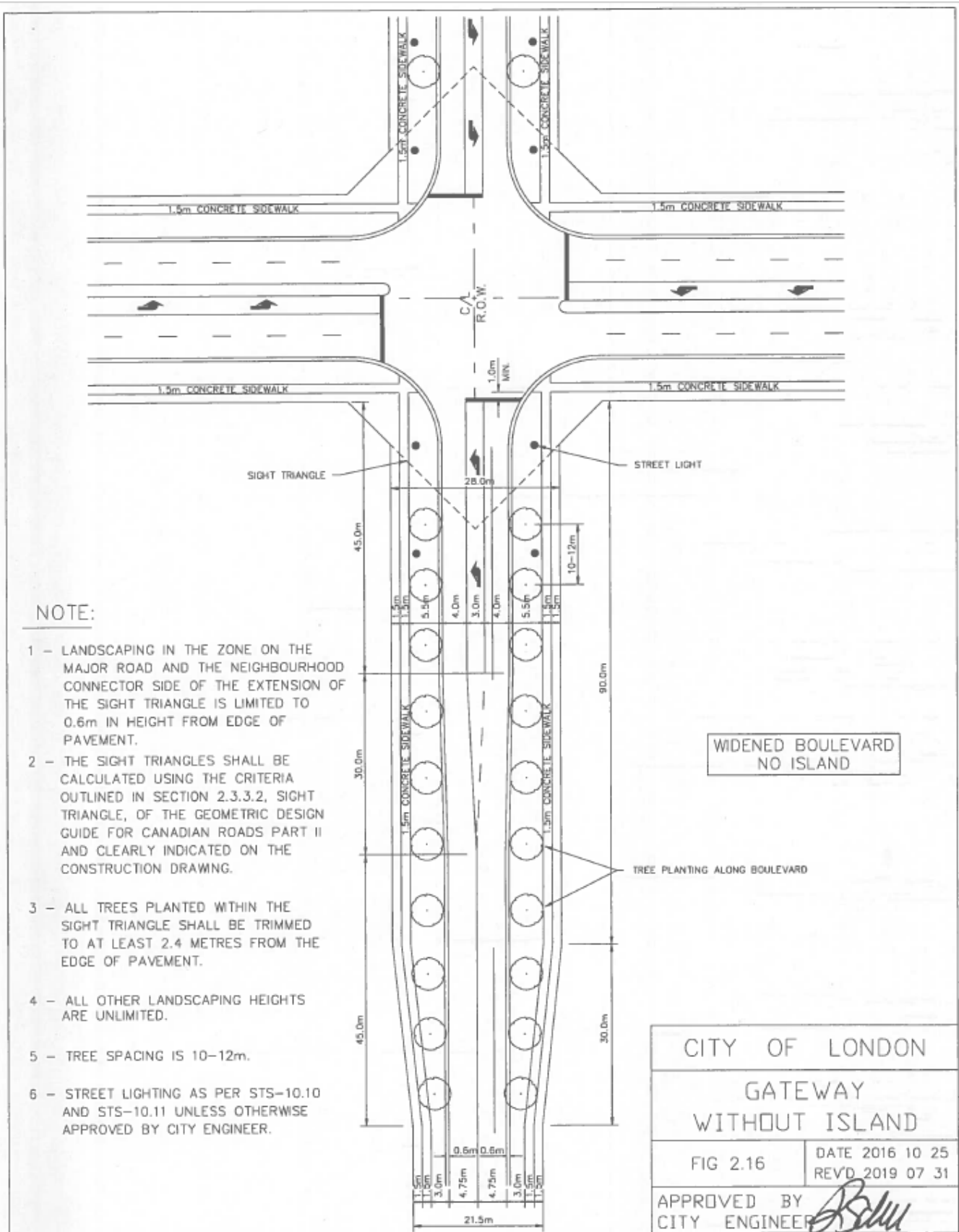
ROUNDABOUT 17.0m RADIUS – SIGNAGE
(4-LEG INTERSECTION)

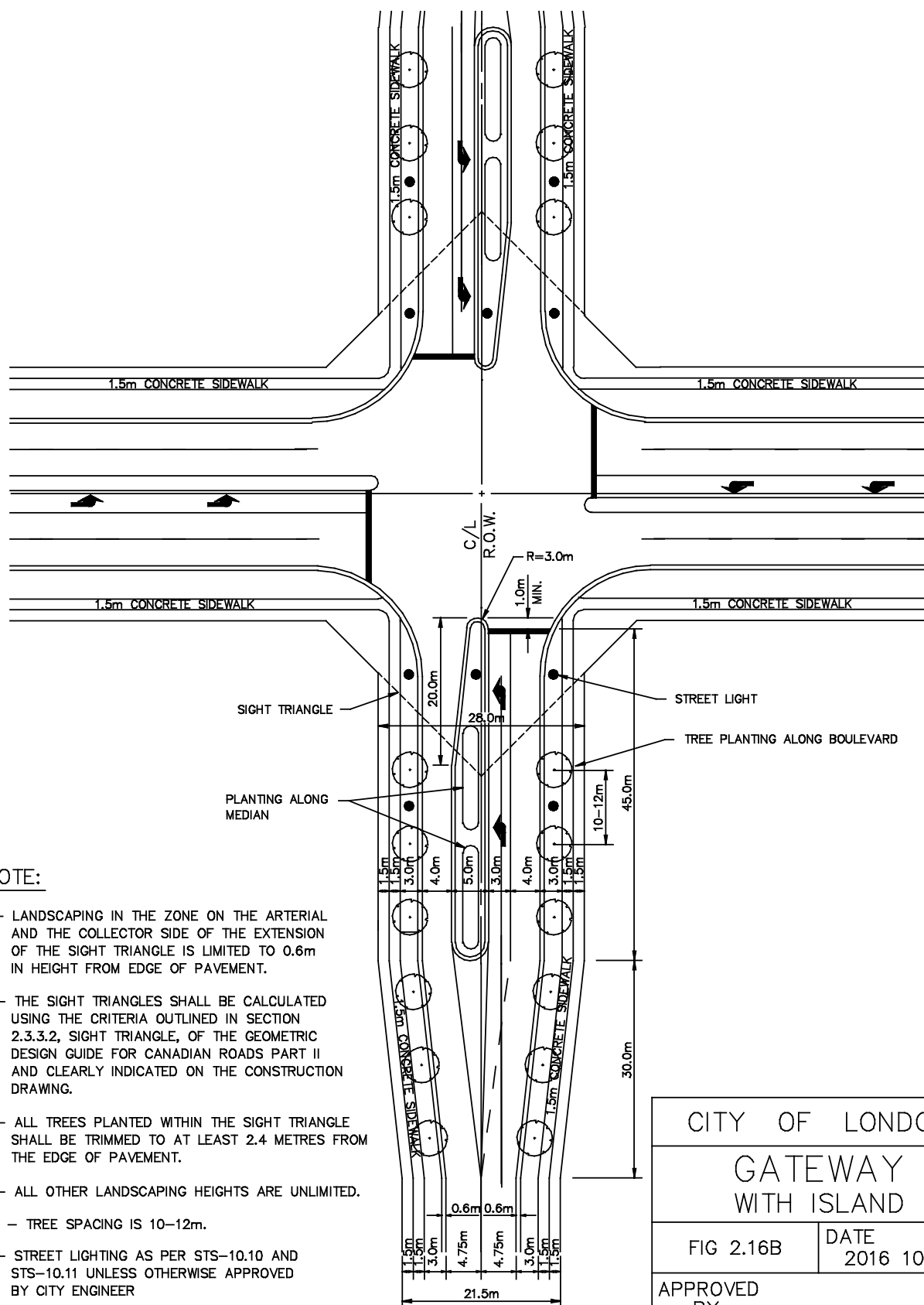
FIG. 2.13

DATE 2017 07 19

APPROVED BY

Shane Noyes





CITY OF LONDON

GATEWAY
WITH ISLAND

FIG 2.16B

DATE
2016 10 25

APPROVED
BY:

Manufacture	Road Width (Fixtures spacing 25 to 32 m)		Colour*
	8 m or less		
		Catalogue No.	
Eaton	52 W	MSA-EO2-LED-E1-SL3-AP-PER7-7030-DIM-HSS	AP (Grey)
Lumec	56 W	MPTRRC-55W32LED-3K-G2-LE3-120-DMG-HS-RCD7-COLOUR*	GY3 (Medium Grey), BK (Black), GN8 (Dark Forest Green)
		MPTCRC-55W32LED-3K-G2-LE3-120-DMG-HS-RCD7-COLOUR*	
		MPTCRR-55W32LED-3K-G2-LE3-120-DMG-HS-RCD7-COLOUR*	
Quattro	55 W	SRA400H-L3-55LEDL3.0-120-COLOUR*-HS-PTL1	BK (Black), GND (Dark Green)
		SRA420H-L3-55LEDL3.0-120-COLOUR*-HS-PTL1	
		SRA422H-L3-55LEDL3.0-120-COLOUR*-HS-PTL1	
	9.5m		
		Catalogue No.	
Eaton	75 w	MSA-EO3-LED-E1-SL3-AP-PER7-7030-DIM-HSS	AP (Grey)
Lumec	72 W	MPTRRC-72W32LED-3K-G2-LE3-120-DMG-HS-RCD7-COLOUR*	GY3 (Medium Grey), BK (Black), GN8 (Dark Forest Green)
		MPTCRC-72W32LED-3K-G2-LE3-120-DMG-HS-RCD7-COLOUR*	
		MPTCRR-72W32LED-3K-G2-LE3-120-DMG-HS-RCD7-COLOUR*	
Quattro	70 w	SRA400H-L3-70LEDL3.0-120-COLOUR*-HS-PTL1	BK (Black), GND (Dark Green)
		SRA420H-L3-70LEDL3.0-120-COLOUR*-HS-PTL1	
		SRA422H-L3-70LEDL3.0-120-COLOUR*-HS-PTL1	

CITY OF LONDON STANDARD DRAWING

RESIDENTIAL SUBDIVISION STREET LIGHT LAYOUT

FIG 2.17

DATE: 2018-11-26

APPROVED BY:



NOTE:

-
- Figure 10 is a detailed cross-section of a boulevard, showing a total width of 45.0m. The central portion is a 3.0m wide Right-of-Way (R.O.W.) with a 1.5m wide concrete island. On either side of the island are 3.5m wide travel lanes. The boulevard is flanked by 2.0m wide concrete sidewalks. The drawing also shows the placement of various signs and markings, including "CYCLISTS YIELD TO PEDESTRIANS" signs, zebra pavement markings, and concrete island "bullnose" details. The drawing is labeled "CIVIC BOULEVARD" on the right side.
- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" sign (Rb-73 AS PER OTM BOOK 18) SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
- 9 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 10 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 11 - PEDESTRIAN TWO STAGE CROSSINGS SHOULD BE INSTALLED IN ACCORDANCE WITH OTM BOOK 15.
- 12 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m.
- 13 - TWO-WAY CYCLE TRACKS CAN BE USED WHERE CROSSINGS ARE INFREQUENT. ALL APPROPRIATE SIGNAGE, PAVEMENT MARKINGS, AND TRAFFIC SIGNALS TO BE ACCOMMODATED AT INTERSECTIONS AND DRIVEWAYS.
- 14 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 15 - RIGHT TURN LANES FROM AN URBAN THOROUGHFARE ARE TO BE DETERMINED BY AND COORDINATED WITH CITY OF LONDON TRANSPORTATION PLANNING & DESIGN AND ARE NOT TYPICAL.
- 16 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.
- 17 - THE REQUIREMENT FOR DAYLIGHTING TRIANGLES MAY PROMPT THE NEED FOR ADDITIONAL PROPERTY DEDICATION.
- 18 - LEFT TURN GUIDE LINES MAY NOT BE REQUIRED AT ALL INTERSECTIONS.

FIG. 2.17

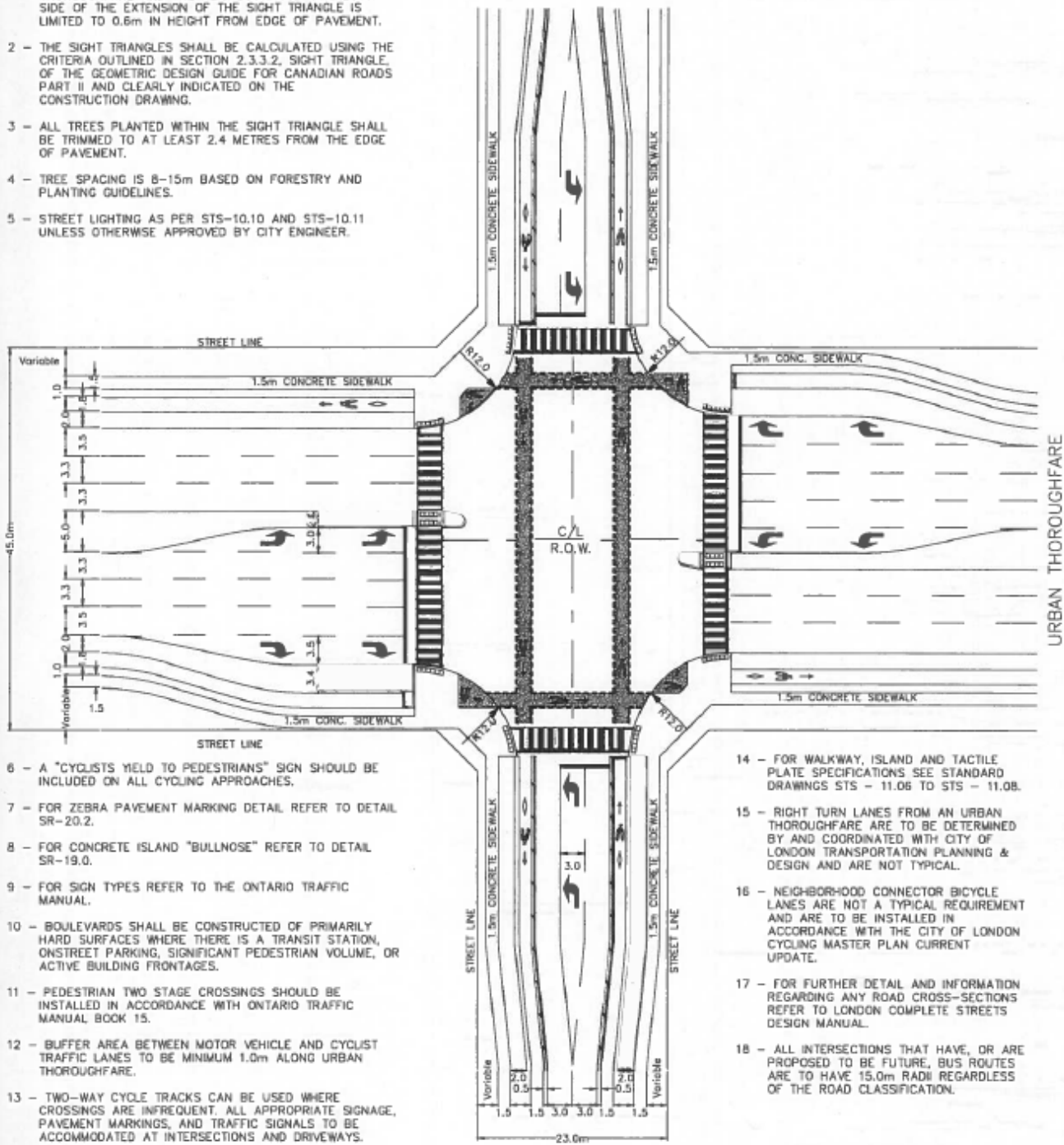
APPROVED BY
CITY ENGINEER

Becky

NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE URBAN THOROUGHFARE AND THE NEIGHBOURHOOD CONNECTOR SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 6-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

NEIGHBOURHOOD CONNECTOR



CITY OF LONDON STANDARD DRAWING

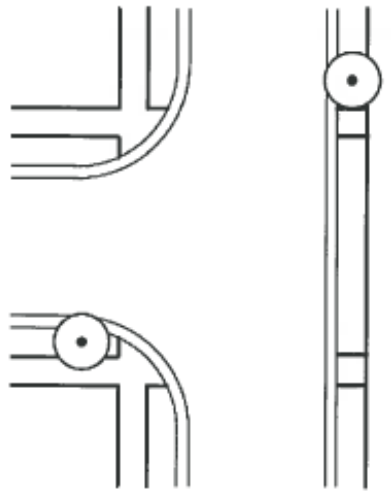
URBAN THOROUGHFARE & NEIGHBOURHOOD CONNECTOR INTERSECTION

FIG. 2.18

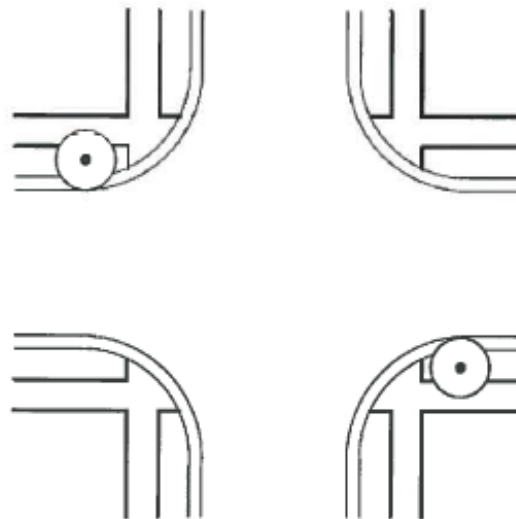
DATE 2019 07 31

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[Signature]



3-Leg Intersection



4-Leg Intersection

CITY OF LONDON STANDARD DRAWING

RESIDENTIAL SUBDIVISION INTERSECTION STREET LIGHT LAYOUT

FIG 2.18

DATE: 2018-11-26

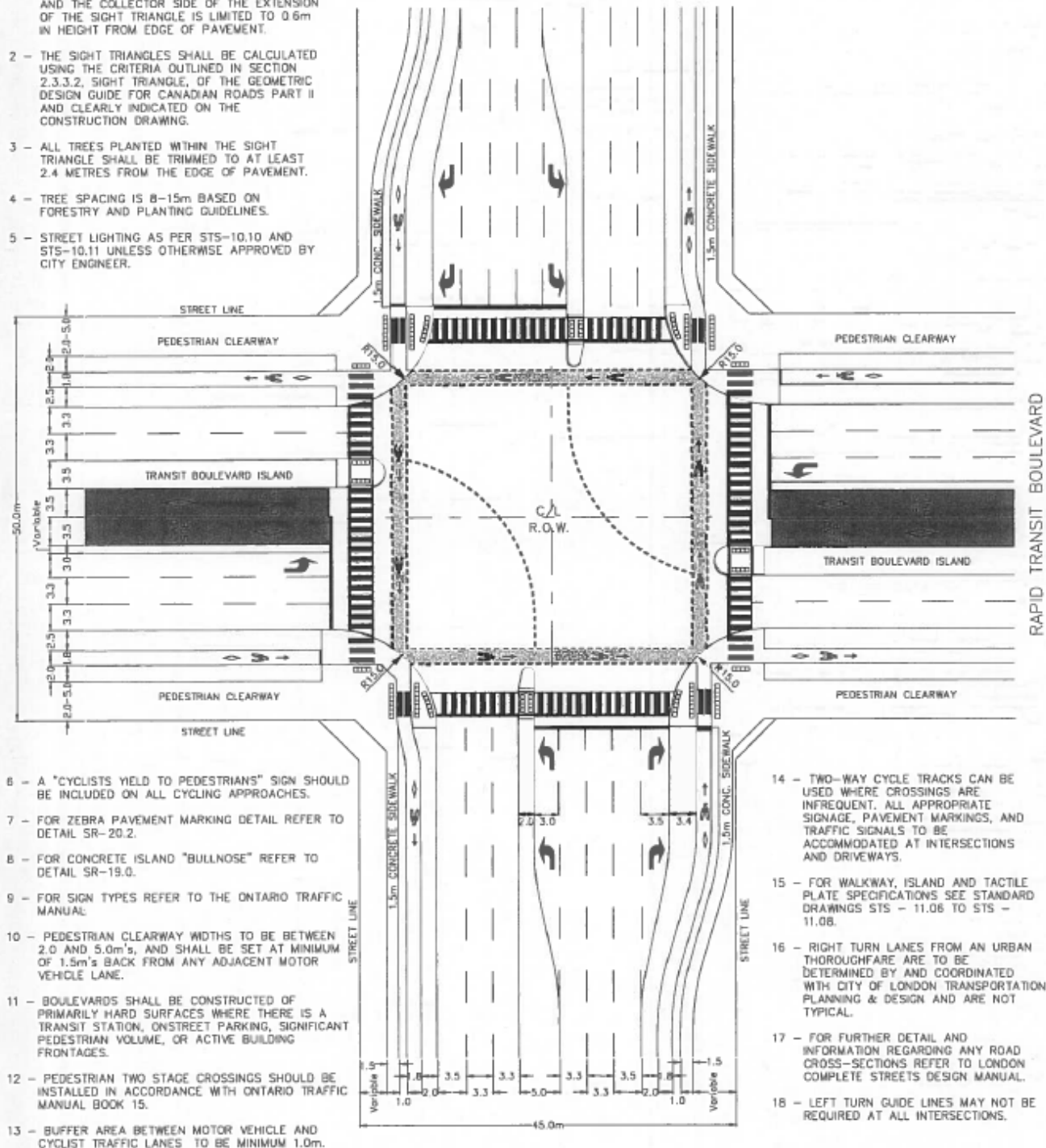
APPROVED BY:

Steve Haggis

NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE ARTERIAL AND THE COLLECTOR SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2. SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

URBAN THOROUGHFARE



- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
- 9 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 10 - PEDESTRIAN CLEARWAY WIDTHS TO BE BETWEEN 2.0 AND 5.0m's, AND SHALL BE SET AT MINIMUM OF 1.5m's BACK FROM ANY ADJACENT MOTOR VEHICLE LANE.
- 11 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 12 - PEDESTRIAN TWO STAGE CROSSINGS SHOULD BE INSTALLED IN ACCORDANCE WITH ONTARIO TRAFFIC MANUAL BOOK 15.
- 13 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m.

- 14 - TWO-WAY CYCLE TRACKS CAN BE USED WHERE CROSSINGS ARE INFREQUENT. ALL APPROPRIATE SIGNAGE, PAVEMENT MARKINGS, AND TRAFFIC SIGNALS TO BE ACCOMMODATED AT INTERSECTIONS AND DRIVEWAYS.
- 15 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 16 - RIGHT TURN LANES FROM AN URBAN THOROUGHFARE ARE TO BE DETERMINED BY AND COORDINATED WITH CITY OF LONDON TRANSPORTATION PLANNING & DESIGN AND ARE NOT TYPICAL.
- 17 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.
- 18 - LEFT TURN GUIDE LINES MAY NOT BE REQUIRED AT ALL INTERSECTIONS.

CITY OF LONDON STANDARD DRAWING

URBAN THOROUGHFARE & RAPID TRANSIT BOULEVARD INTERSECTION

FIG. 2.19

DATE 2019 07 31

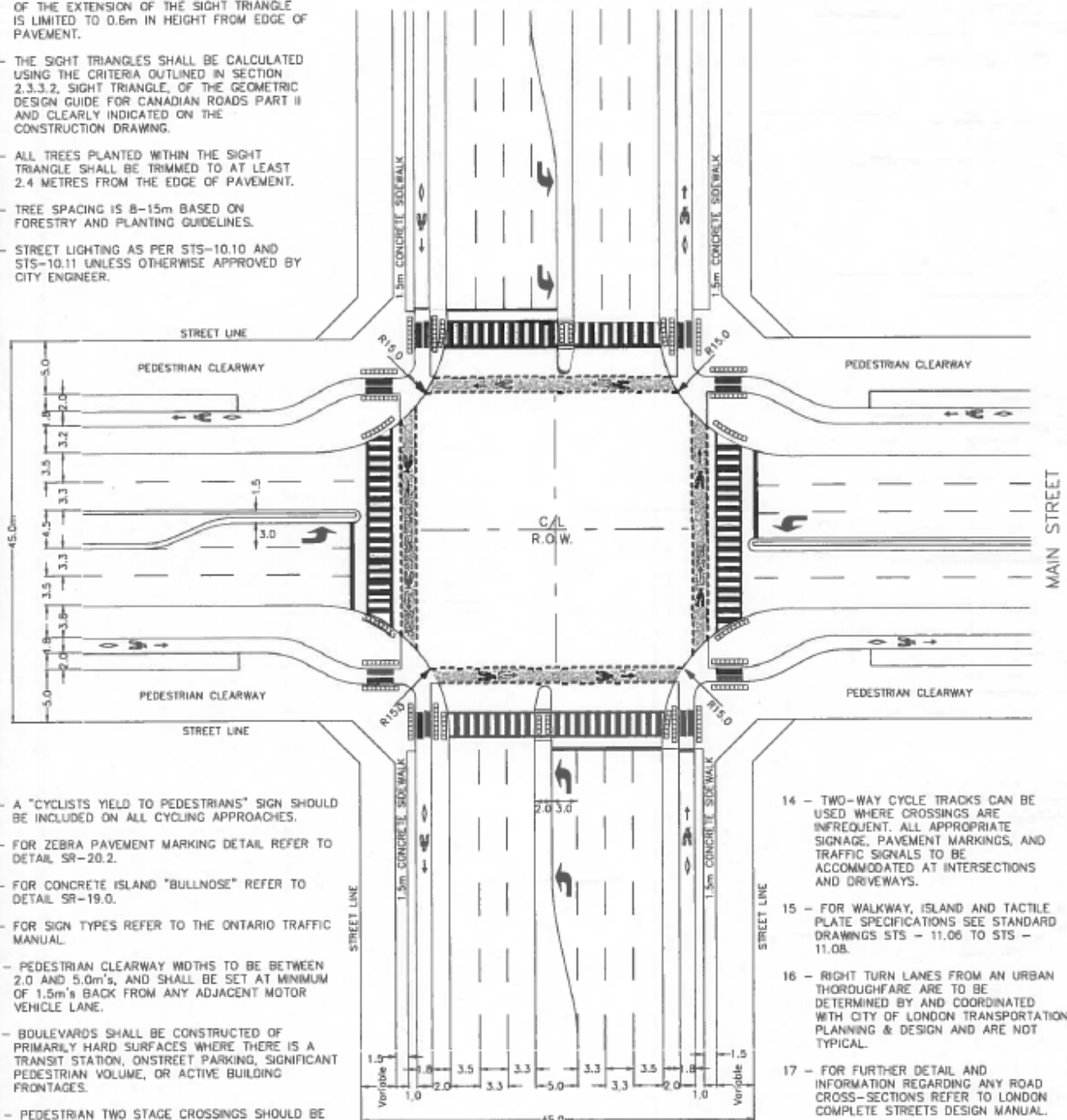
APPROVED BY
CITY ENGINEER

[Signature]

NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE URBAN THOROUGHFARE AND THE MAIN STREET SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

URBAN THOROUGHFARE



- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
- 9 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 10 - PEDESTRIAN CLEARWAY WIDTHS TO BE BETWEEN 2.0 AND 5.0m's, AND SHALL BE SET AT MINIMUM OF 1.5m's BACK FROM ANY ADJACENT MOTOR VEHICLE LANE.
- 11 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 12 - PEDESTRIAN TWO STAGE CROSSINGS SHOULD BE INSTALLED IN ACCORDANCE WITH ONTARIO TRAFFIC MANUAL BOOK 15.
- 13 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m.

- 14 - TWO-WAY CYCLE TRACKS CAN BE USED WHERE CROSSINGS ARE INFREQUENT. ALL APPROPRIATE SIGNAGE, PAVEMENT MARKINGS, AND TRAFFIC SIGNALS TO BE ACCOMMODATED AT INTERSECTIONS AND DRIVEWAYS.
- 15 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 16 - RIGHT TURN LANES FROM AN URBAN THOROUGHFARE ARE TO BE DETERMINED BY AND COORDINATED WITH CITY OF LONDON TRANSPORTATION PLANNING & DESIGN AND ARE NOT TYPICAL.
- 17 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.

CITY OF LONDON STANDARD DRAWING

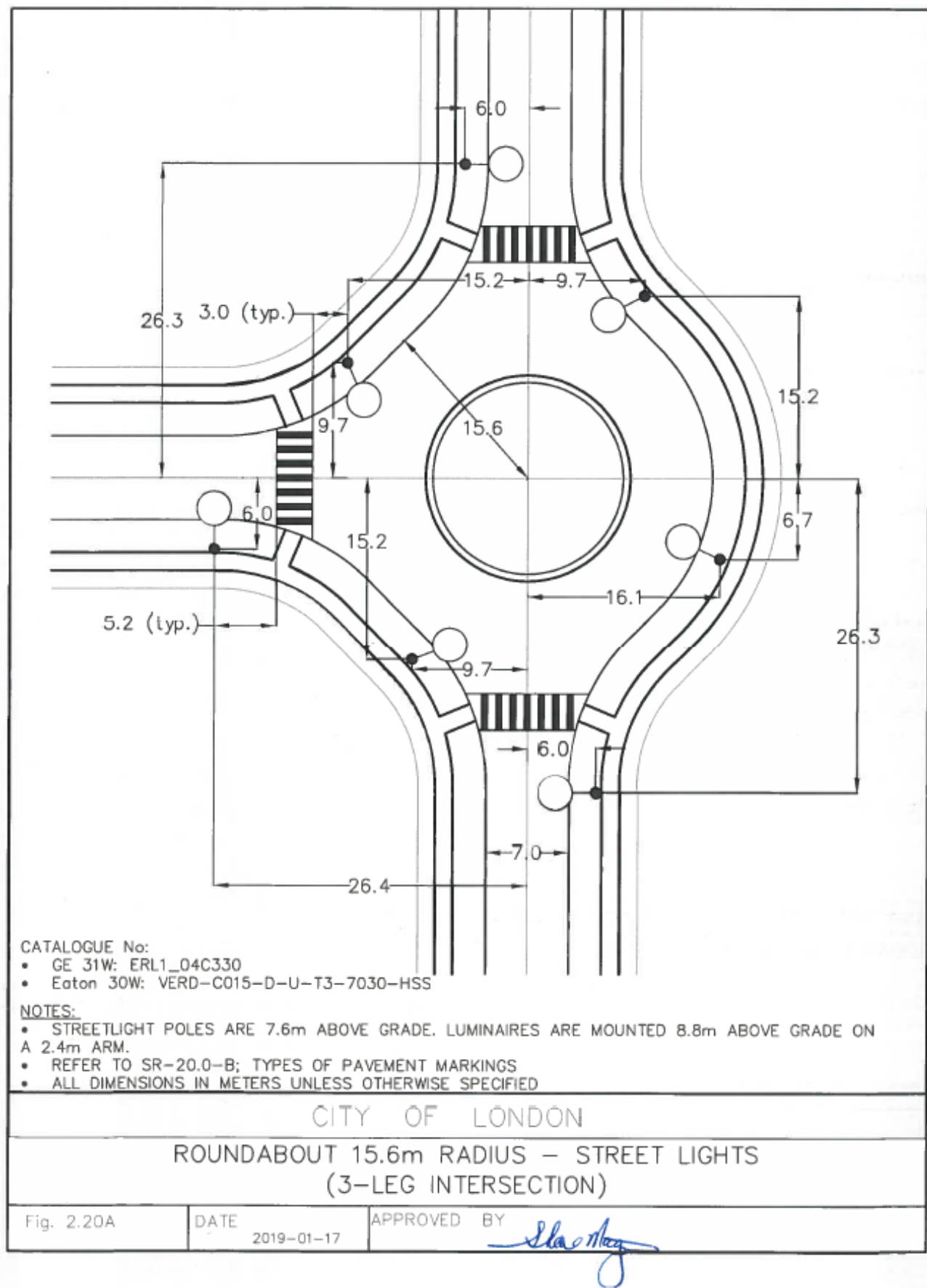
URBAN THOROUGHFARE & MAIN STREET INTERSECTION

FIG. 2.20

DATE 2019 07 31

APPROVED BY
CITY ENGINEER

RSchuy



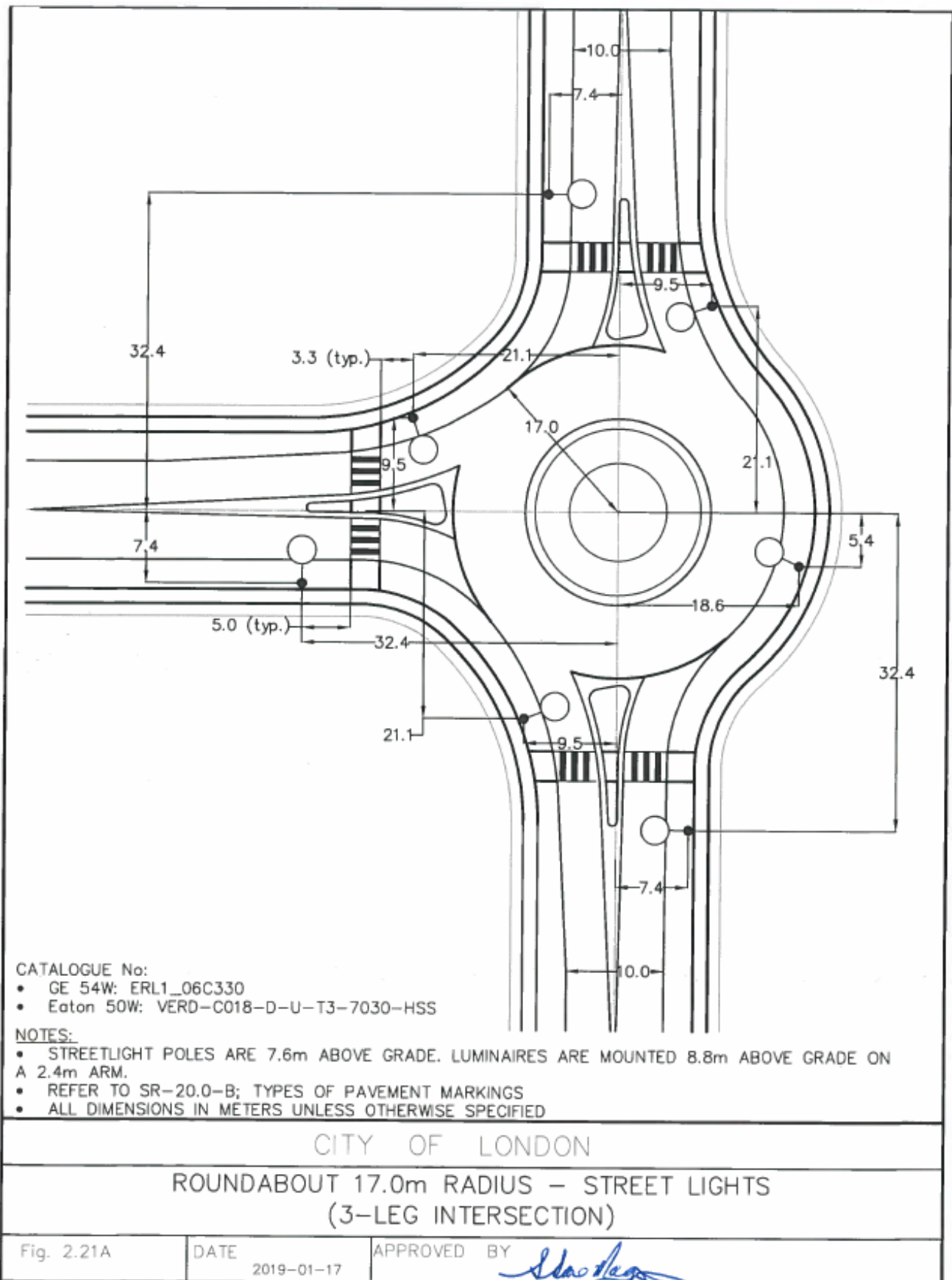
URBAN THOROUGHFARE

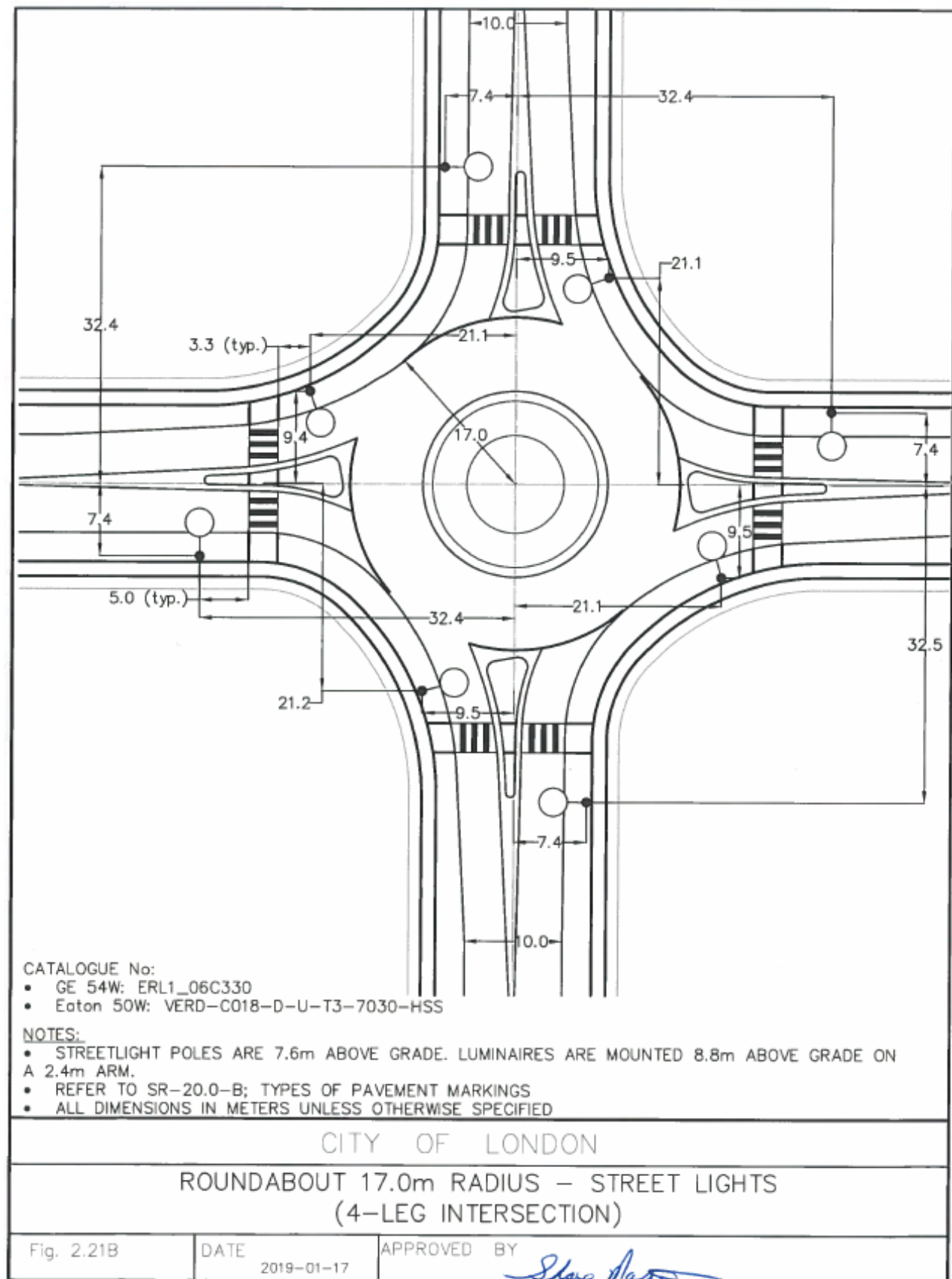
- SIGHT TRIANGLES SHALL BE LOCATED USING THE CRITERIA SET OUT IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN MANUAL FOR CANADIAN ROADS PART II. SIGHT TRIANGLES SHALL BE CLEARLY INDICATED ON THE SECTION DRAWING.
- TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO A MAXIMUM HEIGHT OF 2.4 METRES FROM THE PAVEMENT.
- PLANTING IS 8-15m BASED ON CITY ENGINEER'S PLANTING GUIDELINES.
- LIGHTING AS PER STS-10.10 TO STS-10.11 UNLESS OTHERWISE SPECIFIED BY CITY ENGINEER.
- PEDESTRIANS MUST YIELD TO PEDESTRIANS' RIGHT OF WAY. PEDESTRIANS SHOULD BE INCLUDED ON ALL APPROACHES.
- PAVEMENT MARKING SHALL REFER TO DETAIL SR-20.2.
- PEDESTRIAN CROSSOVERS SHALL BE PROVIDED AT THESE LOCATIONS, WITH A TWO STAGE CROSSING BEING CONSIDERED IN ACCORDANCE WITH THE ONTARIO HIGHWAY DESIGN MANUAL BOOK 15, INCLUDING APPROPRIATE MARKINGS AND SIGNAGE FOR PEDESTRIAN CROSSINGS.
- SIGN TYPES REFER TO THE ONTARIO HIGHWAY DESIGN MANUAL.
- SIDEWALKS SHALL BE CONSTRUCTED ON HARD SURFACES WHERE THERE IS A TRANSIT STATION, BUS STOP, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE FRONTAGES.
- AREA BETWEEN MOTOR
-
- The diagram illustrates a cross-section of a street intersection. Key features include:
 - Central Area:** Labeled 'C/L R.O.W.' (Center Line Right of Way) with a width of 2.0m.
 - Streets:** Two streets intersect at a 90-degree angle. The 'STREET LINE' is marked on both.
 - Sidewalks:** '1.5m MIN. CONCRETE SIDEWALK' is specified on all four sides of the intersection.
 - Dimensions:** Various dimensions are provided, including 'Variable' for sidewalk widths, '1.5m' for sidewalk depth, and '2.0m' for the central R.O.W. width.
 - Curbs:** Radii of 'R12.0' and 'R7.5' are indicated for the curb and sidewalk transitions.
 - Signage:** A 'YIELD' sign is shown on the left side of the intersection.
 - Other Labels:** 'STREET LINE', 'C/L R.O.W.', and '1.5m MIN. CONCRETE SIDEWALK' are repeated throughout the diagram.

- 14 - RIGHT TURN LANES FROM AN URBAN THOROUGHFARE ARE TO BE DETERMINED BY AND COORDINATED WITH CITY OF LONDON TRANSPORTATION PLANNING & DESIGN AND ARE NOT TYPICAL.
- 15 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.

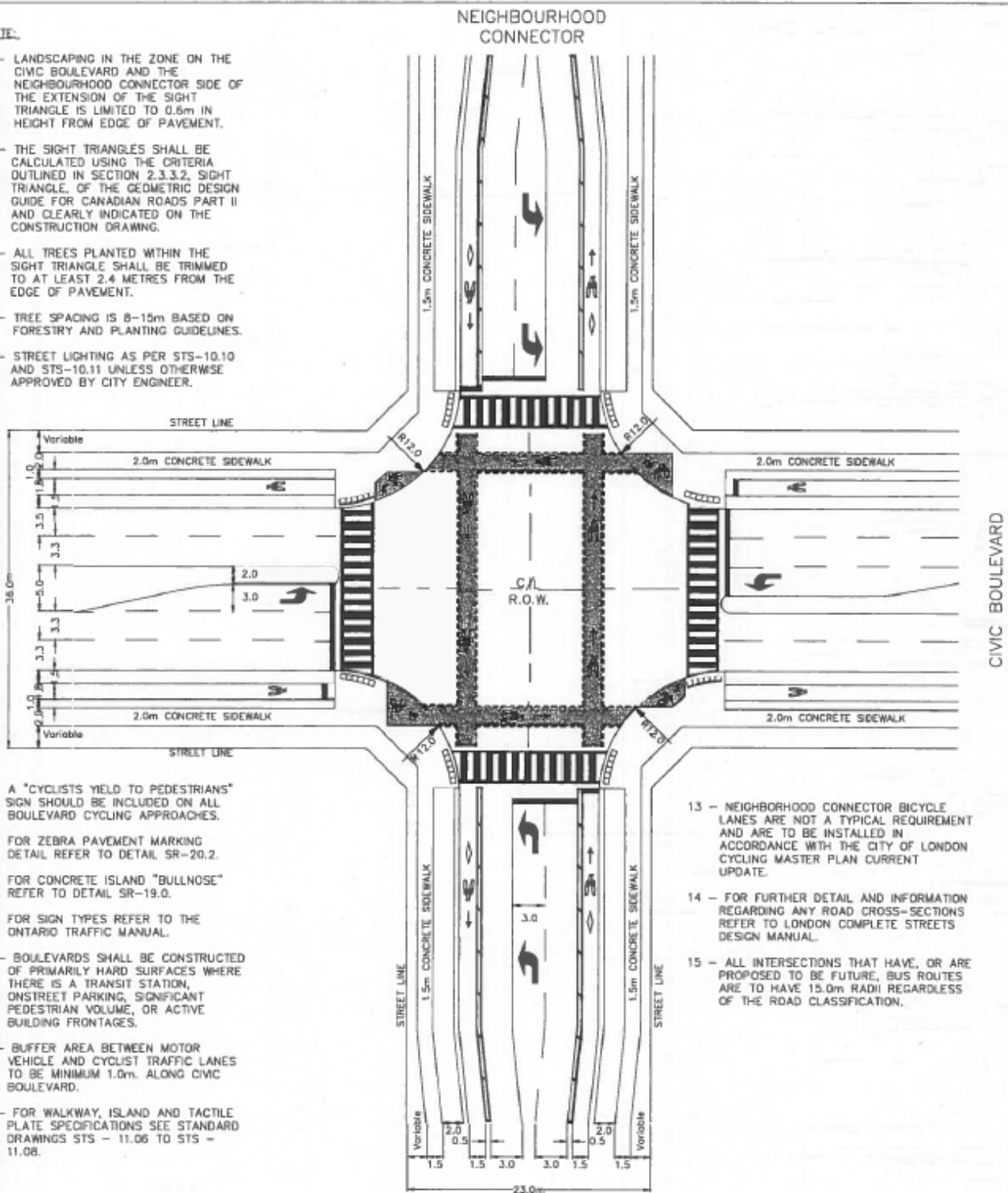
URBAN THOROUGHFARE & NEIGHBOURHOOD STREET
INTERSECTION

APPROVED BY
CITY ENGINEER





- 1 - LANDSCAPING IN THE ZONE ON THE CIVIC BOULEVARD AND THE NEIGHBOURHOOD CONNECTOR SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.



- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL BOULEVARD CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
- 9 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 10 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTS.
- 11 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m. ALONG CIVIC BOULEVARD.
- 12 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.

- 13 - NEIGHBORHOOD CONNECTOR BICYCLE LANES ARE NOT A TYPICAL REQUIREMENT AND ARE TO BE INSTALLED IN ACCORDANCE WITH THE CITY OF LONDON CYCLING MASTER PLAN CURRENT UPDATE.
- 14 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.
- 15 - ALL INTERSECTIONS THAT HAVE, OR ARE PROPOSED TO BE FUTURE, BUS ROUTES ARE TO HAVE 15.0m RADII REGARDLESS OF THE ROAD CLASSIFICATION.

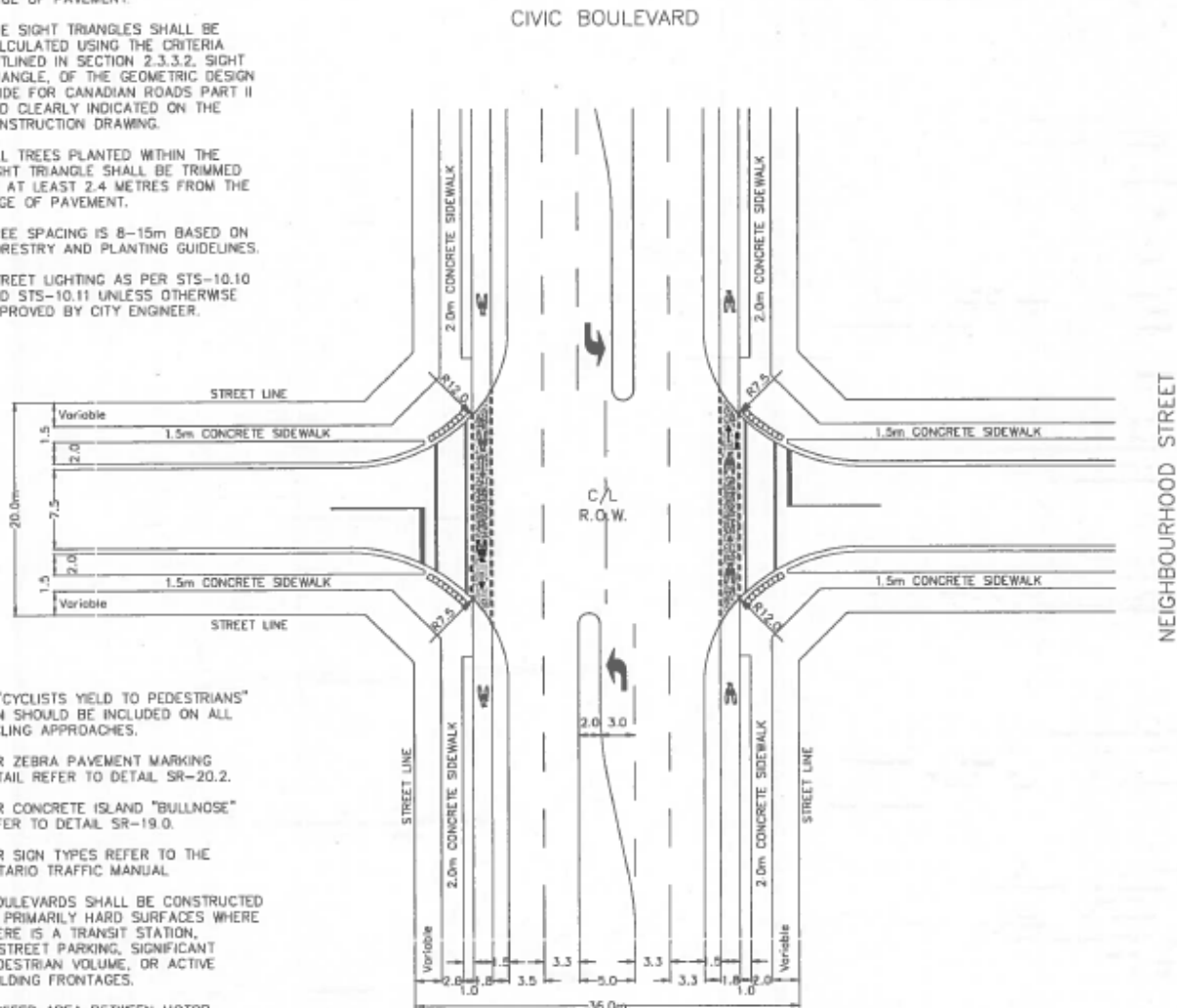
CIVIC BOULEVARD & NEIGHBOURHOOD CONNECTOR
INTERSECTION

APPROVED BY
CITY ENGINEER

NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE CIVIC BOULEVARD AND THE NEIGHBOURHOOD STREET SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2. SIGHT TRIANGLE OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
- 9 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 10 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 11 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m, ALONG CIVIC BOULEVARD.
- 12 - OPTIONAL PEDESTRIAN CROSSOVER MAY BE PROVIDED AT THESE LOCATIONS, AS PER ONTARIO TRAFFIC MANUAL BOOK 15.
- 13 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 14 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.



CITY OF LONDON STANDARD DRAWING

CIVIC BOULEVARD & NEIGHBOURHOOD STREET
INTERSECTION

FIG. 2.23

DATE 2019 07 31

APPROVED BY
CITY ENGINEER

[Signature]

CIVIC BOULEVARD

-
- Diagram illustrating the intersection layout and dimensions for a four-way intersection. The diagram shows the intersection of two streets, with dimensions for various clearances and sight triangles.
- Dimensions and Labels:**
- Street Line:** Indicated on all four approaches.
 - Pedestrian Clearway:** Indicated on all four approaches.
 - 2.0m CONC. SIDEWALK:** Indicated on all four approaches.
 - 50.0m:** Total width of the intersection area.
 - Variable:** Dimensions for the variable width sections of the sidewalks.
 - 2.0m:** Width of the concrete sidewalks.
 - 3.3m:** Width of the pedestrian clearways.
 - 3.5m:** Width of the travel lanes.
 - 3.0m:** Width of the travel lanes.
 - 3.4m:** Width of the travel lanes.
 - 1.0m:** Width of the travel lanes.
 - 1.5m:** Width of the travel lanes.
 - 2.0m:** Width of the travel lanes.
 - 3.0m:** Width of the travel lanes.
 - 3.3m:** Width of the travel lanes.
 - 3.5m:** Width of the travel lanes.
 - 36.0m:** Total width of the intersection area.
 - C/L R.O.W.:** Center Line Right of Way.
 - STREET LIGHTING:** Indicated by small circles on the sidewalks.
 - TRAFFIC SIGNALS:** Indicated by small circles on the sidewalks.
 - TRAFFIC MARKINGS:** Indicated by dashed lines for the center line and solid lines for the lane boundaries.
 - TRAFFIC SIGNALS:** Indicated by small circles on the sidewalks.
 - TRAFFIC MARKINGS:** Indicated by dashed lines for the center line and solid lines for the lane boundaries.
- Notes:**
- STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.
 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ON-STREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME.

- CITY OF LONDON STANDARD DRAWING

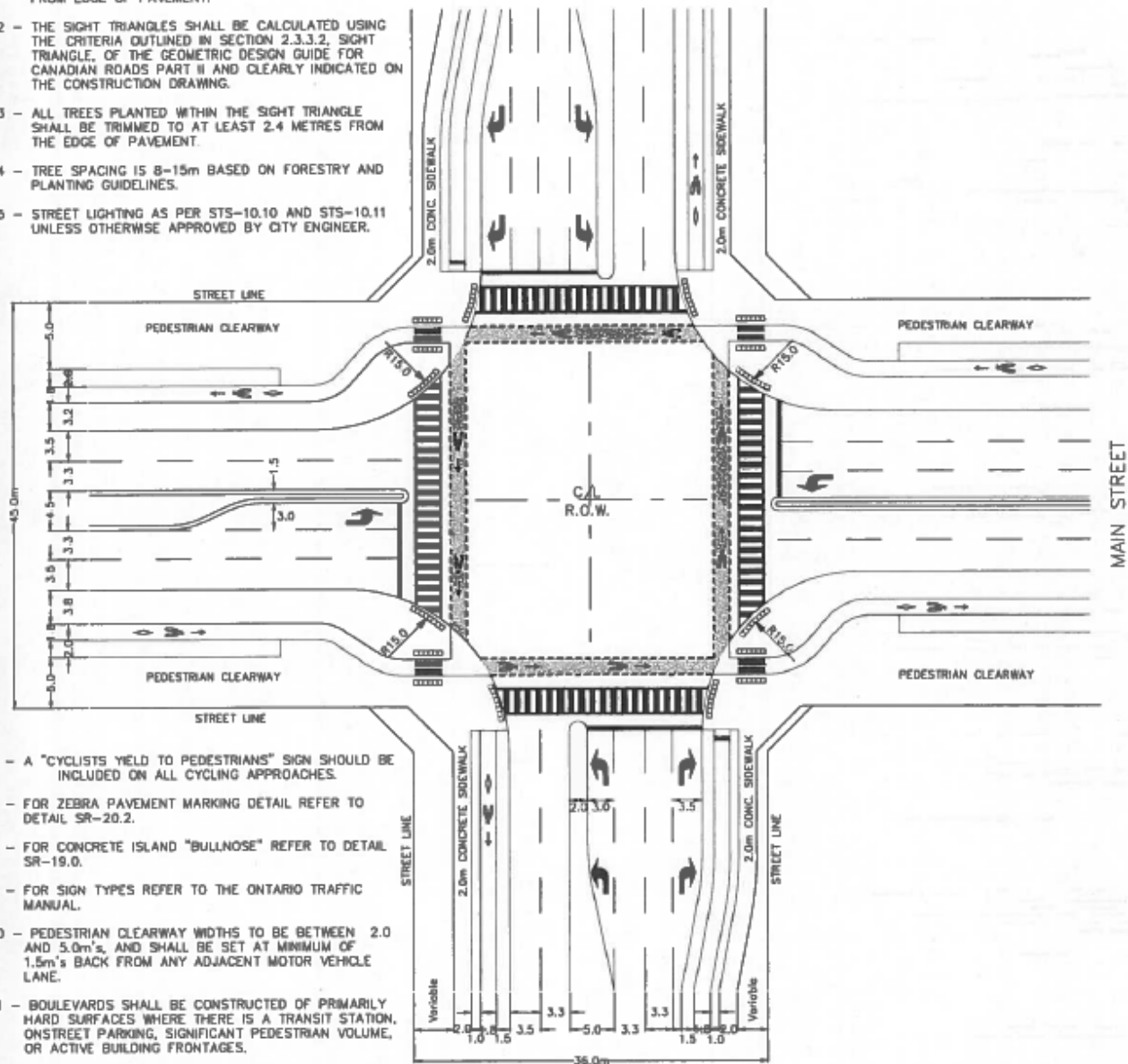
CIVIC BOULEVARD & RAPID TRANSIT BOULEVARD
INTERSECTION

APPROVED BY
CITY ENGINEER

NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE MAIN STREET AND THE CIVIC BOULEVARD SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

CIVIC BOULEVARD



- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
- 9 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 10 - PEDESTRIAN CLEARWAY WIDTHS TO BE BETWEEN 2.0 AND 5.0m's, AND SHALL BE SET AT MINIMUM OF 1.5m's BACK FROM ANY ADJACENT MOTOR VEHICLE LANE.
- 11 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 12 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m. ALONG CIVIC BOULEVARD.
- 13 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 14 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.

CITY OF LONDON STANDARD DRAWING

CIVIC BOULEVARD & MAIN STREET INTERSECTION

FIG. 2.25

DATE 2019 07 31

APPROVED BY
CITY ENGINEER

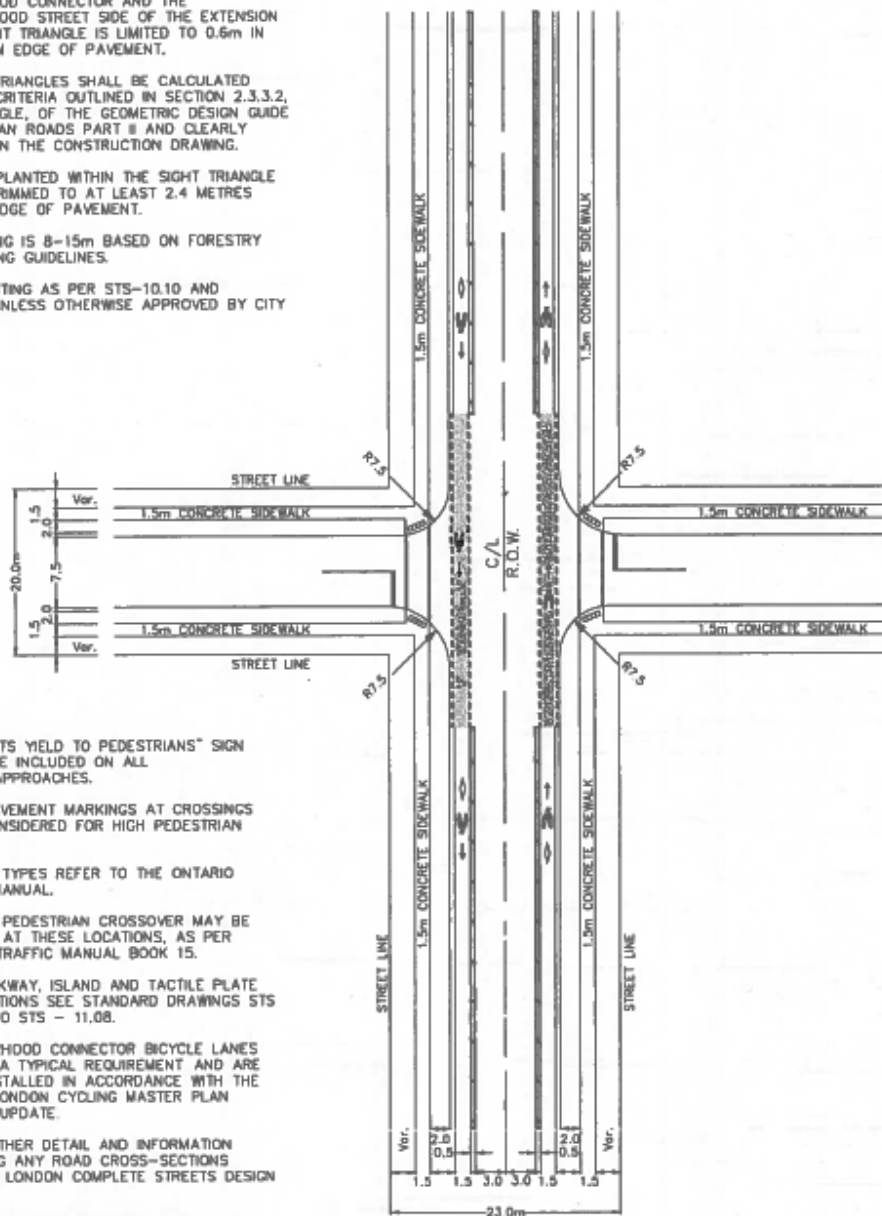
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NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE NEIGHBOURHOOD CONNECTOR AND THE NEIGHBOURHOOD STREET SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - ZEBRA PAVEMENT MARKINGS AT CROSSINGS TO BE CONSIDERED FOR HIGH PEDESTRIAN VOLUMES.
- 8 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 9 - OPTIONAL PEDESTRIAN CROSSOVER MAY BE PROVIDED AT THESE LOCATIONS, AS PER ONTARIO TRAFFIC MANUAL BOOK 15.
- 10 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 11 - NEIGHBORHOOD CONNECTOR BICYCLE LANES ARE NOT A TYPICAL REQUIREMENT AND ARE TO BE INSTALLED IN ACCORDANCE WITH THE CITY OF LONDON CYCLING MASTER PLAN CURRENT UPDATE.
- 12 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.
- 13 - LEFT-TURN LANES FROM NEIGHBOURHOOD CONNECTORS TO NEIGHBOURHOOD STREETS ARE NOT NECESSARY IN ALL SITUATIONS AND SHALL BE CO-ORDINATED WITH TRANSPORTATION PLANNING & DESIGN.

**NEIGHBOURHOOD
CONNECTOR**



NEIGHBOURHOOD STREET

CITY OF LONDON STANDARD DRAWING

NEIGHBOURHOOD CONNECTOR & NEIGHBOURHOOD STREET
INTERSECTION

FIG. 2.26

DATE 2019 07 31

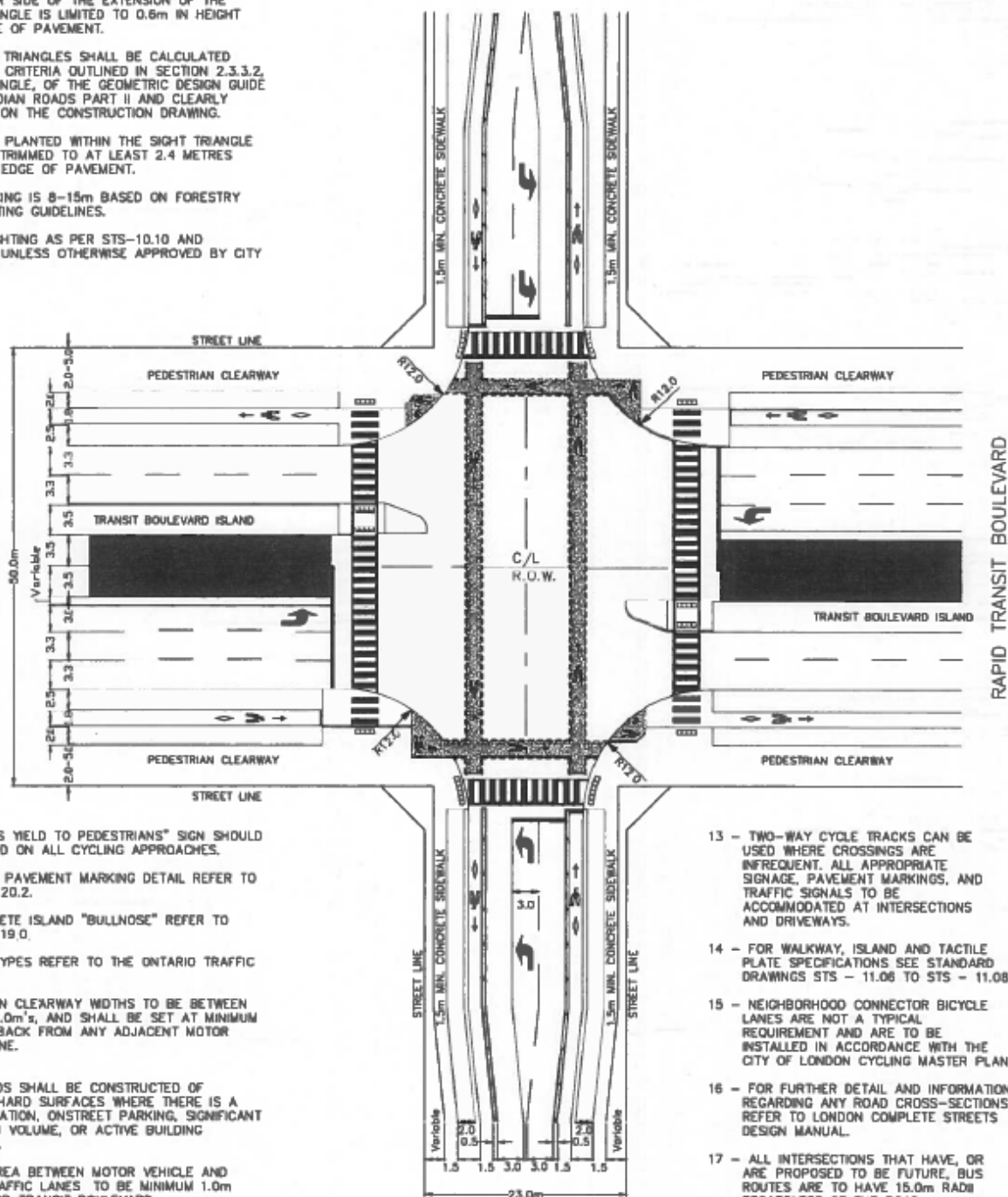
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CITY ENGINEER

[Signature]

NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE RAPID TRANSIT BOULEVARD AND THE NEIGHBOURHOOD CONNECTOR SIDE OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

NEIGHBOURHOOD CONNECTOR



- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR CONCRETE ISLAND "BULLNOSE" REFER TO DETAIL SR-19.0.
- 9 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 10 - PEDESTRIAN CLEARWAY WIDTHS TO BE BETWEEN 2.0 AND 5.0m's, AND SHALL BE SET AT MINIMUM OF 1.5m's BACK FROM ANY ADJACENT MOTOR VEHICLE LANE.
- 11 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 12 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m ALONG RAPID TRANSIT BOULEVARD.

- 13 - TWO-WAY CYCLE TRACKS CAN BE USED WHERE CROSSINGS ARE INFREQUENT. ALL APPROPRIATE SIGNAGE, PAVEMENT MARKINGS, AND TRAFFIC SIGNALS TO BE ACCOMMODATED AT INTERSECTIONS AND DRIVEWAYS.
- 14 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 15 - NEIGHBORHOOD CONNECTOR BICYCLE LANES ARE NOT A TYPICAL REQUIREMENT AND ARE TO BE INSTALLED IN ACCORDANCE WITH THE CITY OF LONDON CYCLING MASTER PLAN.
- 16 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.
- 17 - ALL INTERSECTIONS THAT HAVE, OR ARE PROPOSED TO BE FUTURE, BUS ROUTES ARE TO HAVE 15.0m RADIUS REGARDLESS OF THE ROAD CLASSIFICATION.

CITY OF LONDON STANDARD DRAWING

RAPID TRANSIT BOULEVARD & NEIGHBOURHOOD CONNECTOR INTERSECTION

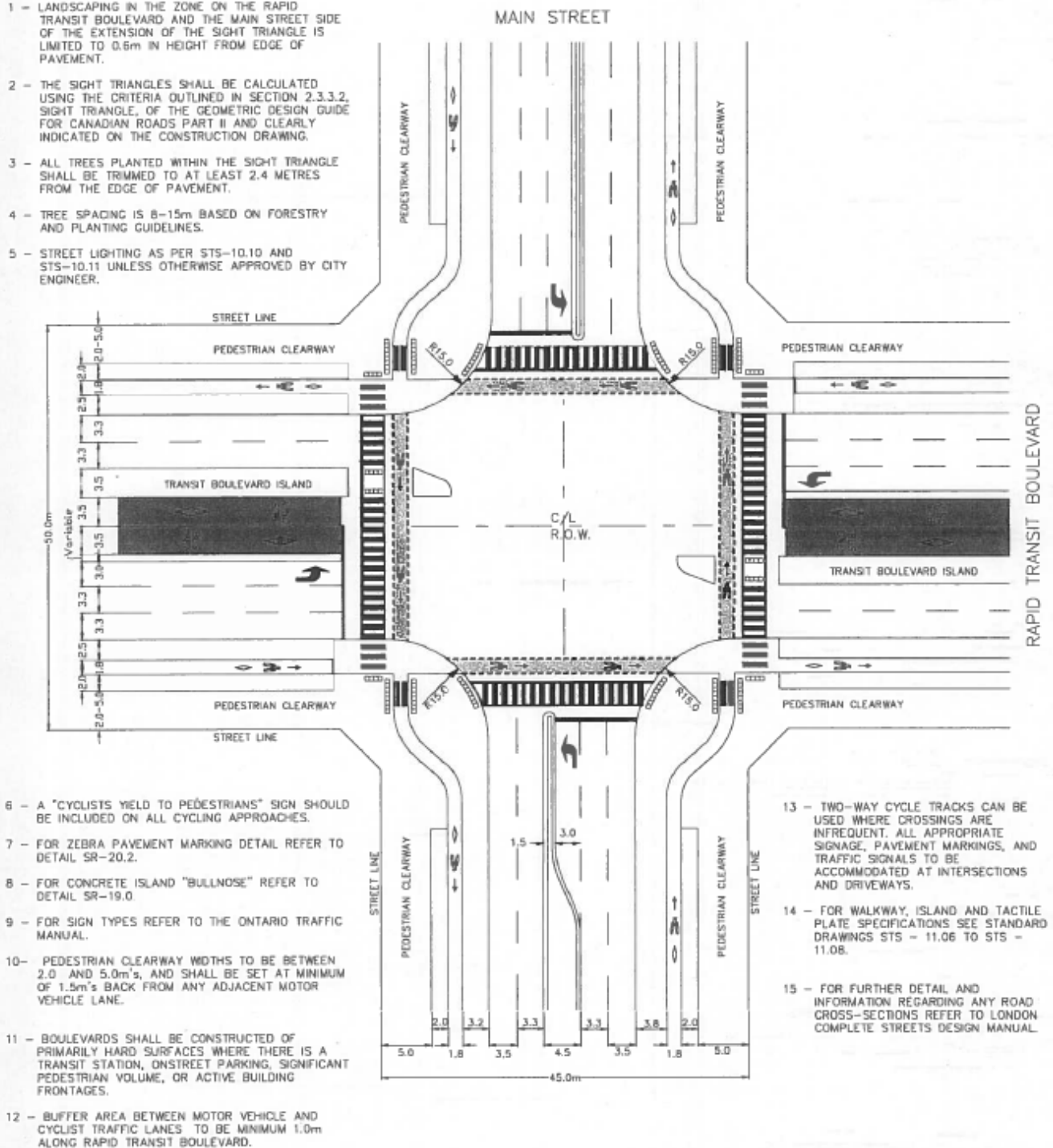
FIG. 2.27

DATE 2019 07 31

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CITY ENGINEER

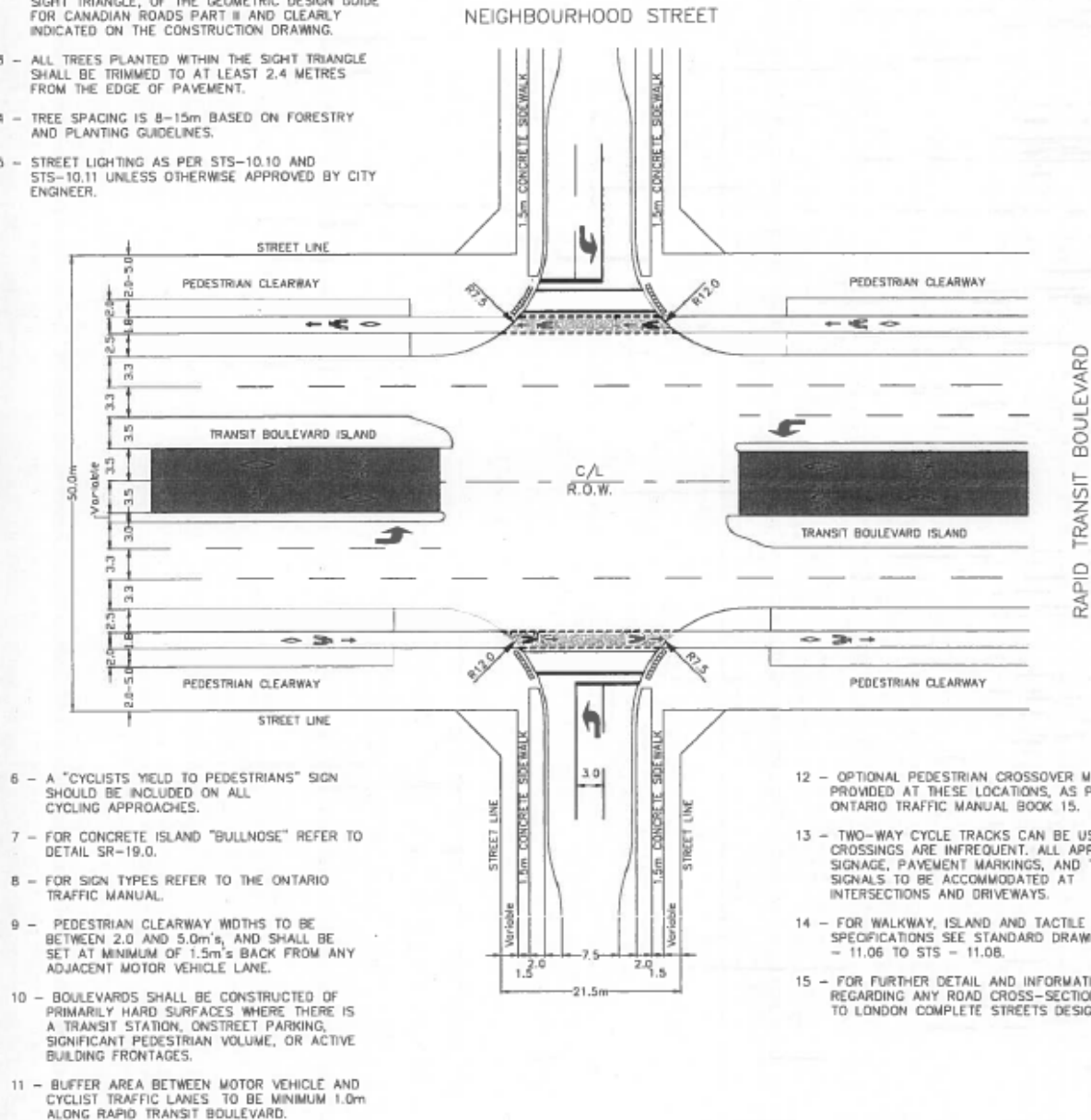
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- 1 - LANDSCAPING IN THE ZONE ON THE RAPID TRANSIT BOULEVARD AND THE MAIN STREET SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
- 3 - ALL TREES PLANTED WITHIN THE SIGHT TRIANGLE SHALL BE TRIMMED TO AT LEAST 2.4 METRES FROM THE EDGE OF PAVEMENT.
- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

RAPID TRANIST BOULEVARD & MAIN STREET
INTERSECTION

APPROVED BY
CITY ENGINEER

- 1 - LANDSCAPING IN THE ZONE ON THE RAPID TRANSIT BOULEVARD AND THE NEIGHBOURHOOD STREET SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2. SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
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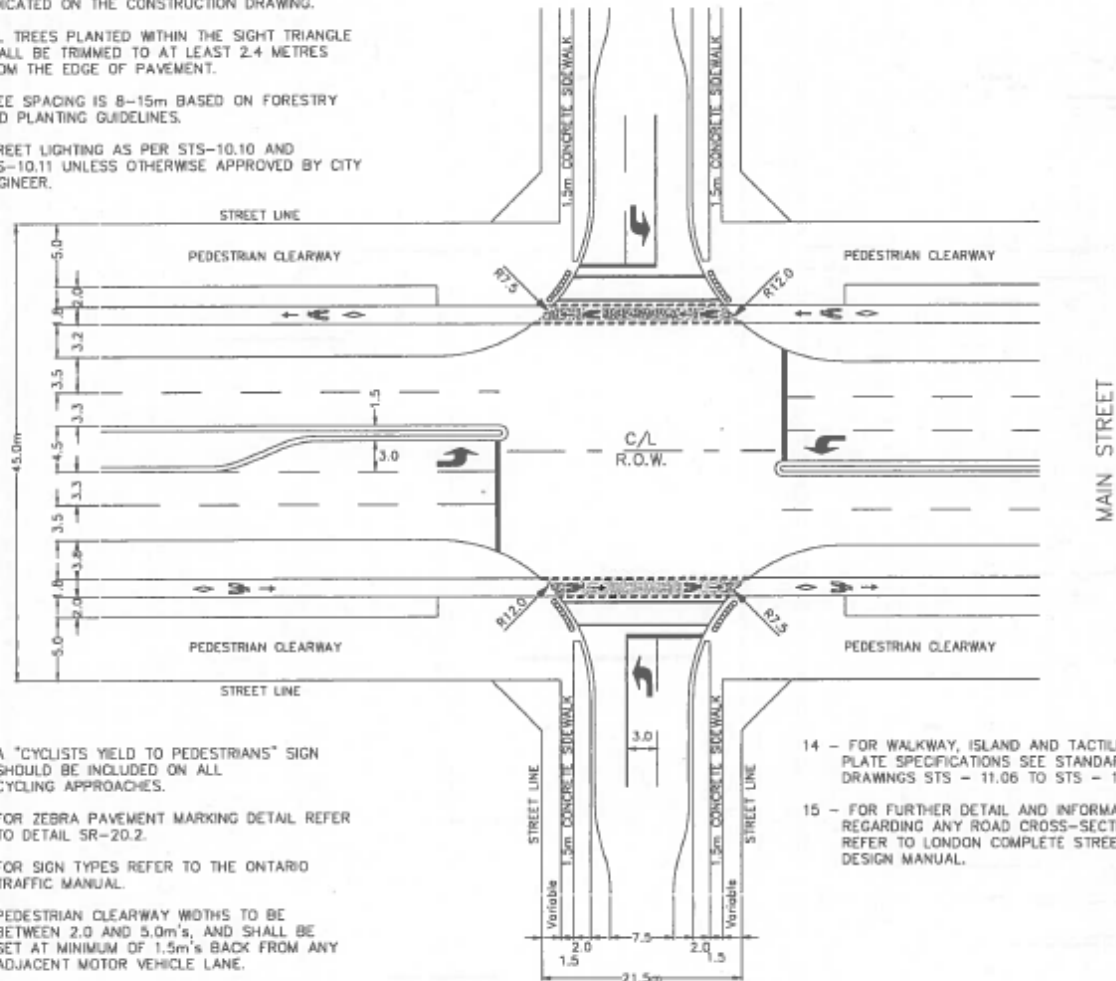
RAPID TRANSIT BOULEVARD & NEIGHBOURHOOD STREET
INTERSECTION

APPROVED BY
CITY ENGINEER

NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE MAIN STREET AND THE NEIGHBOURHOOD STREET SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
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- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

NEIGHBOURHOOD STREET



- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
- 8 - FOR SIGN TYPES REFER TO THE ONTARIO TRAFFIC MANUAL.
- 9 - PEDESTRIAN CLEARWAY WIDTHS TO BE BETWEEN 2.0 AND 5.0m's, AND SHALL BE SET AT MINIMUM OF 1.5m's BACK FROM ANY ADJACENT MOTOR VEHICLE LANE.
- 10 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 11 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m ALONG RAPID TRANSIT BOULEVARD.
- 12 - OPTIONAL PEDESTRIAN CROSSOVER MAY BE PROVIDED AT THESE LOCATIONS, AS PER ONTARIO TRAFFIC MANUAL BOOK 15.
- 13 - TWO-WAY CYCLE TRACKS CAN BE USED WHERE CROSSINGS ARE INFREQUENT. ALL APPROPRIATE SIGNAGE, PAVEMENT MARKINGS, AND TRAFFIC SIGNALS TO BE ACCOMMODATED AT INTERSECTIONS AND DRIVEWAYS.

- 14 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 15 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.

CITY OF LONDON STANDARD DRAWING

MAIN STREET & NEIGHBOURHOOD STREET
INTERSECTION

FIG. 2.30

DATE 2019 07 31

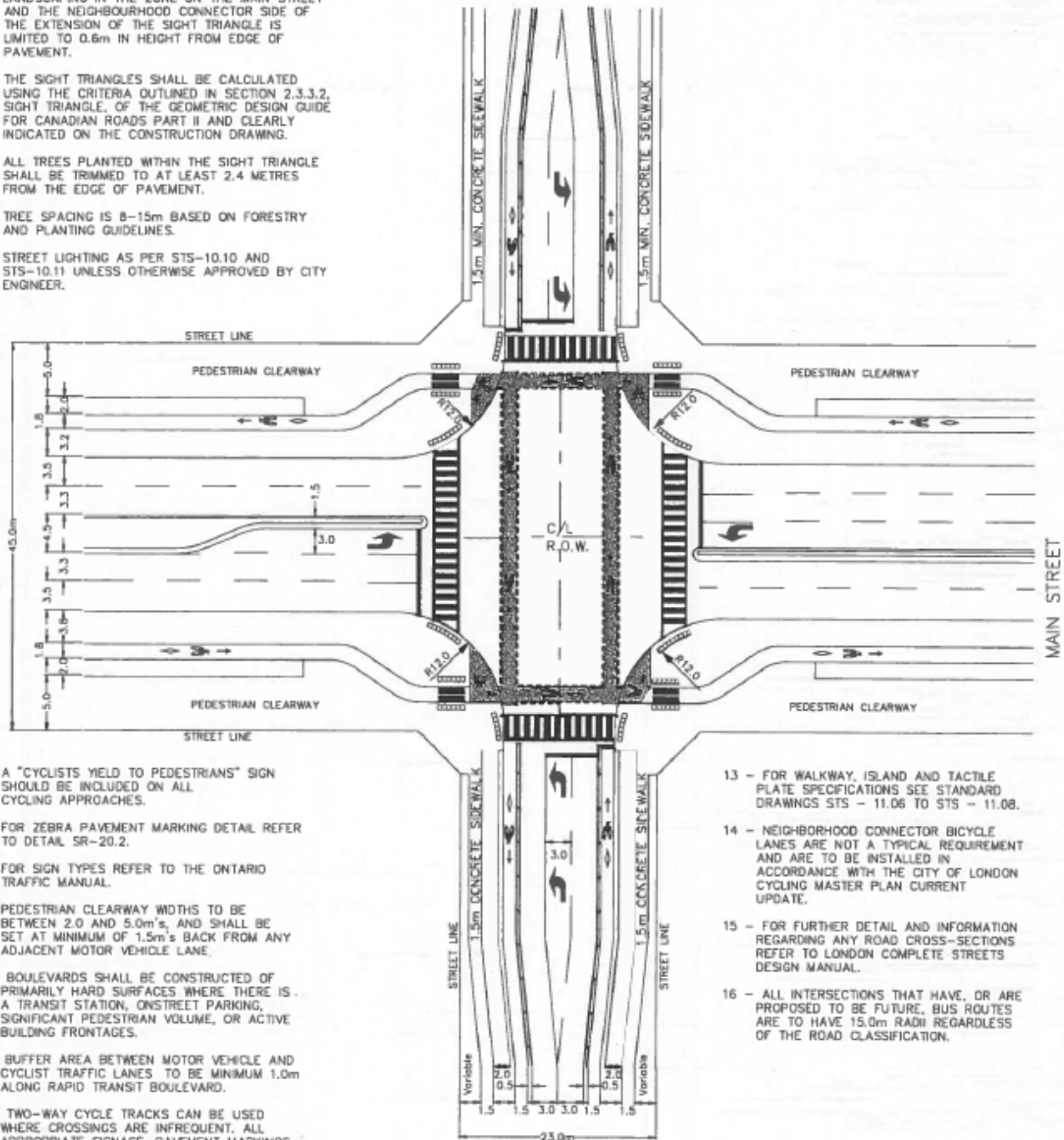
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CITY ENGINEER

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NOTE:

- 1 - LANDSCAPING IN THE ZONE ON THE MAIN STREET AND THE NEIGHBOURHOOD CONNECTOR SIDE OF THE EXTENSION OF THE SIGHT TRIANGLE IS LIMITED TO 0.6m IN HEIGHT FROM EDGE OF PAVEMENT.
- 2 - THE SIGHT TRIANGLES SHALL BE CALCULATED USING THE CRITERIA OUTLINED IN SECTION 2.3.3.2, SIGHT TRIANGLE, OF THE GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS PART II AND CLEARLY INDICATED ON THE CONSTRUCTION DRAWING.
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- 4 - TREE SPACING IS 8-15m BASED ON FORESTRY AND PLANTING GUIDELINES.
- 5 - STREET LIGHTING AS PER STS-10.10 AND STS-10.11 UNLESS OTHERWISE APPROVED BY CITY ENGINEER.

NEIGHBOURHOOD CONNECTOR



- 6 - A "CYCLISTS YIELD TO PEDESTRIANS" SIGN SHOULD BE INCLUDED ON ALL CYCLING APPROACHES.
- 7 - FOR ZEBRA PAVEMENT MARKING DETAIL REFER TO DETAIL SR-20.2.
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- 9 - PEDESTRIAN CLEARWAY WIDTHS TO BE BETWEEN 2.0 AND 5.0m's, AND SHALL BE SET AT MINIMUM OF 1.5m's BACK FROM ANY ADJACENT MOTOR VEHICLE LANE.
- 10 - BOULEVARDS SHALL BE CONSTRUCTED OF PRIMARILY HARD SURFACES WHERE THERE IS A TRANSIT STATION, ONSTREET PARKING, SIGNIFICANT PEDESTRIAN VOLUME, OR ACTIVE BUILDING FRONTAGES.
- 11 - BUFFER AREA BETWEEN MOTOR VEHICLE AND CYCLIST TRAFFIC LANES TO BE MINIMUM 1.0m ALONG RAPID TRANSIT BOULEVARD.
- 12 - TWO-WAY CYCLE TRACKS CAN BE USED WHERE CROSSINGS ARE INFREQUENT, ALL APPROPRIATE SIGNAGE, PAVEMENT MARKINGS, AND TRAFFIC SIGNALS TO BE ACCOMMODATED AT INTERSECTIONS AND DRIVEWAYS.

- 13 - FOR WALKWAY, ISLAND AND TACTILE PLATE SPECIFICATIONS SEE STANDARD DRAWINGS STS - 11.06 TO STS - 11.08.
- 14 - NEIGHBORHOOD CONNECTOR BICYCLE LANES ARE NOT A TYPICAL REQUIREMENT AND ARE TO BE INSTALLED IN ACCORDANCE WITH THE CITY OF LONDON CYCLING MASTER PLAN CURRENT UPDATE.
- 15 - FOR FURTHER DETAIL AND INFORMATION REGARDING ANY ROAD CROSS-SECTIONS REFER TO LONDON COMPLETE STREETS DESIGN MANUAL.
- 16 - ALL INTERSECTIONS THAT HAVE, OR ARE PROPOSED TO BE FUTURE, BUS ROUTES ARE TO HAVE 15.0m RADI REGARDLESS OF THE ROAD CLASSIFICATION.

CITY OF LONDON STANDARD DRAWING

MAIN STREET & NEIGHBOURHOOD CONNECTOR INTERSECTION

FIG. 2.31

DATE 2019 07 31

APPROVED BY
CITY ENGINEER

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Design Specifications & Requirements Manual

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3 SANITARY SEWER COLLECTION SYSTEM

3.1 DEFINITION

3.1.1 Public Sewage Systems

A piped collection system that transports wastes of domestic origins which is human body waste, toilet or bathroom waste, waste from other showers and tubs, liquid or water borne culinary and sink water or laundry waste, and such other waste as is suitable for treatment at a sewage treatment facility in accordance with City of London Waste Discharge By-law WM-16 and Drainage By-law No. WM-4.

3.1.2 Private Sewage Systems

A sewage system (or systems), with a total design capacity of 10,000 litres per day or less, shall be designed, constructed, operated and maintained in accordance with Part 8 of the Ontario Building Code.

A sewage system (or systems), with a total design capacity greater than 10,000 litres per day, falls under the jurisdiction of the Ministry of the Environment, Conversation and Parks.

3.2 NON-PERMITTED FLOWS

Connections from foundation, weeping tile drainage or roof drainage are not permitted to enter the sanitary sewer system, in accordance with City of London Drainage By-law No. WM-4, or any hazardous waste as defined under the EPA Regulation 347.

3.3 LOCATION AND ALIGNMENT

Generally sanitary sewers are to be located in front of, or are in locations accessible to each lot and block facing a City Street. Sanitary sewers are to be located 1.5meters from the centreline of the road (see DWG. U.C.C.-1M and U.C.C.-2M for details and additional design information). Sanitary sewers are to be located on the inside loop of a proposed crescent with the maintenance hole located at a 1.5 metre offset from the centreline of the road.

Where a maintenance hole is designed to be located within the vicinity of a roundabout, sanitary maintenance holes are not permitted to be located within the grassed area of the roundabout. Sanitary maintenance holes must be located in the asphalt area of the street, for maintenance purposes.

3.3.1 Sanitary Sewers on Private Property

Sanitary sewers on private property are regulated by the Ontario Building Code (OBC). Where there are no specific regulations in the OBC, details from this manual will apply.

3.4 DRAINAGE/SUB-DRAINAGE AREA PLANS

Drainage/sub-drainage area limits for which sewers are to be designed for are to contain and follow the lot/block lines to the proposed maintenance holes located on the R.O.W.

Note: All areas and populations are to be shown for each drainage/sub-drainage areas.

3.5 EXTERNAL SEWERSHED LIMITS AND DRAINAGE AREAS

When design abuts undeveloped or un-serviced areas, identify the external sewershed limit to be designed for.

Note:

- a) All areas and populations are to be shown for all drainage areas within external sewershed limits; and
- b) For new subdivisions, references should be made to Chapter 18 New Development.

3.6 DESIGN CHART

Sanitary sewer design calculations for approved drainage area plans are to be completed on the standard design chart. See Figure 3.1 for details and additional design information.

3.7 PEAKING FACTOR CALCULATION

Peaking factor calculations are to be determined based on the Harmon formula:

Harmon formula

$$M = 1 + \frac{14}{4 + P^{1/2}}$$

where: M = ratio of peak flow to average flow

P = tributary population in thousands

3.8 DESIGN CRITERIA

For determining the peak sanitary flows contributing to a sanitary sewer, different criteria are followed depending on the size of the catchment area. These areas are defined as those less than 200 hectares and those greater than 200 hectares.

3.8.1 Tributary Areas Less Than 200 ha

When designing for parcels of land less than 200 hectares, the following criteria will apply:

- a) Residential Commercial & Institutional

- i) Zoning

Low Density = 30 Units/hectare @ 3 people/unit

Medium Density = 75 units/ hectare @ 2.4 people/unit

High Density = 150-300 units/hectare @ 1.6 people/unit

Location	Density (Unit/Hectare)	Density with bonusing provision (25%)	People/Unit
Downtown Area	350	432.5	1.6
Central Area	250	312	
Outside Central Area	150	187.5	

(Allowance needs to be made for the bonusing provision in the City's Official Plan and Zoning By-Law. The minimum density which may be used in the sewer design is 187.5 upha)

- ii) Lot Basis

Single Family = 3 people/unit
Semi-detached = 6 people/unit

iii) Area Basis

Single Family = 30 units/hectare @ 3 people/unit
Semi-detached = 30 units/hectare @ 3 people/unit
Multi-family = 75 units/hectare @ 2.4 people/unit

iv) Commercial/Institutional = 100 people/hectare

v) Elementary School = maximum design number of students and employees, with consumption at 30 Litres/person/day. In calculating the peak flow, it is assumed that the total daily flow will occur over an 8 hour day and an equivalent population will be determined by dividing the total flow by the standard per capita flow of 230 Liters/day. If the design number is not known, the population will be assumed to be 600.

vi) Secondary School = maximum design number of students and employees, with consumption at 30 Litres/person/day. In calculating the peak flow, it is assumed that the total daily flow will occur over an 8 hour day and an equivalent population will be determined by dividing the total flow by the standard per capita flow of 230 Liters/day. If the design number is not known, the population will be assumed to be 1500.

vii) Church = 100 people/hectare

viii) Per Capita Flow = 230 litres/capita/day

ix) Uncertain Development Factor = 1.1

x) Peaking Factor = Harmon

xi) Infiltration = 8640 litres/hectare/day (0.100 l/s/ha)

NOTE: The above maximum densities under subsection i) Zoning correspond to the maximum densities for each type of residential land use which is permitted by the City of London Official Plan/London Plan (as applicable). The density of residential land use for sanitary sewer design purposes may be adjusted where deemed appropriate by the City Engineer as more information becomes available in terms of the development proposed for a specific parcel(s) of land and the proposed residential land use densities. For specific development applications, the above populations and/or per capita flow may be adjusted where deemed appropriate by the City Engineer. In such cases, the adjustment will be supported by alternate design standards (e.g. Ontario Building Code, Ministry of the Environment, Conservation and Parks)

b) Industrial

i) Flow Allowance – industrial = 25,000litres/hectare/day. This equals 100 pph.

NOTE: Industrial users with water consumption/sewage discharge design criteria greater than this will be considered heavy water users. Heavy water users should consult with the City of London with respect to their specific requirements for water use and sewage discharge in

terms of confirming capacity is available within the municipal infrastructure to meet their needs. Heavy water users should also consult with the City of London prior to any upgrades which will increase their discharge rates to the municipal sewer system.

- ii) Uncertain Development Factor = 1.1
- iii) Peaking Factor = 0.8 x Harmon
- iv) Infiltration = 8640 litres/hectare/day (0.100 l/s/ha)

3.8.2 Tributary Area 200 ha and Larger

When designing for parcels of land 200 hectares and larger, the following criteria will apply:

a) Residential, Commercial and Institutional

- i) Population Allowance = 55 people per hectare (gross area with any ESA areas netted out)

Note: The above maximum density is from the City of London Official Plan. The density may be adjusted by the City Engineer as more information becomes available on a specific parcel of land.

- ii) Per Capita Flow = 230 litres/capita/day
- iii) Peaking Factor = Harmon
- iv) Uncertain Development Factor = 1.0
- v) Infiltration Allowance = 8640 litres/hectare/day (0.100 l/s/ha)

b) Industrial

- i) Flow Allowance – industrial = 20,000 litres/hectare/day [for our internal discussion as to whether this should be 20 or 25,000]

Note: Industrial users with water consumption/sewage discharge design criteria greater than this will be considered heavy water users. Heavy water users should consult with the City of London with respect to their specific requirements for water use and sewage discharge in terms of confirming capacity is available within the municipal infrastructure to meet their needs. Heavy water users should also consult with the City of London prior to any upgrades which will increase their discharge rates to the municipal sewer system.

- ii) Peaking Factor = 0.8 x Harmon
- iii) Uncertain development factor = 1.0
- iv) Infiltration allowance = 8640 litres/hectare/day (0.100 l/s/ha)

3.9 PEAK FLOW CALCULATION

Peak flow calculations are to be determined based on the following formula:

$$Q \text{ (peak flow L/s)} = \left(\frac{\text{population} \times \text{per capita flow} \times \text{peaking factor} \times \text{uncertainty}}{24 \times 60 \times 60} \right) + \text{infiltration}$$

where: Peak Flow (Q) = L/s

Per Capita Flow = 230 litres/capita/day

Peaking Factor (H) = Harmon (section 3.7)

Uncertain Development Factor = 1.0 or 1.1 (situation dependant)
Infiltration Allowance = 8640 litres/hectare/day (0.100L/ha/s)

3.10 **MANNINGS ROUGHNESS COEFFICIENT**

A coefficient of 0.013 is to be used for all concrete and PVC pipe.

3.11 **PIPE SIZE**

Pipe size is determined using the formula where the pipe design flow is equal to or greater than the calculated peak design flow:

$$Q = \frac{1}{n} \times A \times R^{2/3} \times S^{1/2}$$

where: Q = Design flow (m³/sec.)

n = Mannings roughness coefficient

A = cross sectional area of flow (m²)

R = hydraulic radius (area/wetted perimeter)

S = slope of pipe (m/m)

Notwithstanding the above, the minimum allowable size of a sanitary sewer shall be 200mm.

On private property, the minimum size for sanitary building sewer shall be 100mm, in accordance with Part 7 of the OBC.

3.12 **FLOW VELOCITY**

Velocities in sanitary sewers shall be calculated using the following formula:

$$V = \frac{Q}{A}$$

where: V = flow velocity (m/sec)

Q = Design flow (m³/sec)

A = cross sectional area of flow (m²)

3.12.1 **Minimum and Maximum Velocities**

The minimum velocity permitted in sanitary sewers is 0.6 m/sec.

The maximum velocity permitted in sanitary sewers is 4.5 m/sec.

To determine velocities based on actual flow, refer to Figure 3.2 "Hydraulic Elements Graph for Circular Pipe".

3.12.2 **Minimum Grades**

- a) The minimum grade on a 200mm diameter sanitary sewer is 0.33%. Where there are only a few dwelling units connected to the upper section of a 200mm sanitary sewer, the minimum grades shall be adjusted as follows:

1 to 5 units	0.61%
6 to 8 units	0.52%
9 to 12 unit	0.43%
13 or more units	0.33%

- b) The minimum grade on all other sewer sizes shall be established by determining the minimum grade necessary to achieve a velocity of at least 0.6m/sec.

3.13 PIPE MATERIAL

Both rigid and flexible pipe are permitted in the construction of sanitary sewer systems including private drain connections. These materials include concrete and polyvinyl chloride.

The criteria for these materials are described in City of London Standard Contract Documents - Section 410.05.01.

On private property, materials for sanitary building sewers and private sewers shall comply with Part 7 of the OBC.

3.14 PIPE DEPTH AND BEDDING MATERIAL

3.14.1 Minimums

The minimum depth of a sanitary sewer shall be 2.4 m from the finished ground elevation to the obvert of the pipe unless otherwise approved by the City Engineer.

Note, where frost protection is warranted, insulation is required, as per the City of London Drawing Standard W-CS-68.

3.14.2 Maximum Depth of Cover

a) Concrete Pipe

- i) See City of London SW-1.0 and SW-1.1 for details and additional design information for bedding standards for Class A, B and C beddings.

- ii) Municipal Projects

The maximum allowable cover permitted on concrete pipe to be constructed under a Municipal or Capital Works Project is to be based on OPSD 807.010, 807.030, 807.040 and 807.050.

Where the pipe required exceeds the OPSD charts, the Pipe Pac Program 2000 will be used, utilizing the following variables:

- all units are in metric and conform to C.S.A. standards
- wall thickness is based on C.S.A. A257.2M, Type B wall
- soil density = 2000 kg/m³
- Ontario Highway Bridge Design Code (OHBDC)
- live load magnitude = 25 tons
- projection ratio = 0.70
- lateral pressure ratio = 0.33
- lateral pressure friction 'm' = 0.70
- settlement ratio = 0.70
- $k\text{-}\mu(\mu) = 0.1924$
- variable bedding factors B - $L_f = 1.9$ C - $L_f = 1.5$
- $r_{sdP} = 0.49$ (calculated)
- factors of safety

0.3mm crack D-load = 1.00

ultimate earth and live load = (ASTM C 76M)

DL.03 ≤ 100 N/m/mm = 1.50

DL.03 ≥ 140 N/m/mm = 1.25

DL.03 between 100 and 140 N/m/mm = interpolated

- positive projection embankment installation
- maximum depth of cover is based on transition width design
- depth of ground is measured from the ultimate finished ground elevation to the outside top of pipe.

iii) New Subdivisions:

The maximum allowable cover permitted on concrete pipe to be constructed in a new subdivision is to be designed based on transition width, and utilize reinforced concrete pipe only, in accordance with OPSD 807.030 and 807.050 (Positive Projecting Embankment Installation only).

Where the pipe required exceeds the OPSD Charts, the Pipe Pac Program 2000 utilizing the variables noted in 3.14.2.ii) or 5.13.2.ii) above, or First Principles (using City of London Variables) will be used.

b) Flexible Pipe

The maximum allowable cover permitted on flexible pipe is 10.5 m. The following bedding types are to be used:

- for up to 4.5 m - Type 1 (see City of London SW-1.0)
- for up to 10.5 m Type 2 (see City of London SW-1.0)

c) Maximum Depth of Cover

Where trench conditions are expected to exhibit seeping ground water in silt or fine sand, specified bedding will be defined as 19mm crushed stone entirely surrounded by geotextile.

3.14.3 Crossing Clearances

There are minimum clearances required when sanitary sewers cross other services. In all cases this is measured from outside wall diameter to outside wall diameter.

When crossing over or under a storm sewer, 230mm clearance is required.

For vertical clearances from the sanitary sewer to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

3.14.4 Minimum Distance Between Sewers

The minimum distance between sewers shall be 3.0m as per drawing UCC-1M and UCC-2M. Special cases to be reviewed for site specific design choices and depths.

3.14.5 Trenchless Technologies

When trenchless installation methods are being considered for new works, please refer to Section 17 – Trenchless Technologies (for New Construction).

3.15 MAINTENANCE HOLES

3.15.1 Spacing of Maintenance Holes

The maximum spacing between sanitary maintenance holes shall be 99 metres measured horizontally or 110 metres measured vertically from the top of the maintenance hole, to the springline of the pipe, along the springline to the next maintenance hole and vertically to the top of the maintenance hole.

When spacing of a maintenance hole dictates that the maintenance hole should be placed within the vicinity of a roundabout, sanitary maintenance holes are not permitted to be located within the grassed area of the roundabout. Sanitary maintenance holes must be located within the apron of the island, for maintenance purposes.

Required where there is a change in the direction of the flow, slopes, a change in the diameter of sewers, and/or a lateral sewer connection. **Note, a minimum 300mm clearance is required between services within a maintenance hole.**

3.15.2 Precast Maintenance Hole Sizing Criteria

All sizing of sanitary precast maintenance holes are based on incoming and outgoing pipe sizes and should be sized and conform to Figure 3.3.

Note, a minimum 300mm clearance is required between services within a maintenance hole.

3.15.3 Maintenance Hole Diameters

Precast maintenance hole diameter requirements are as follows:

a) 1200mm Diameter

See OPSD 701.010 and OPSD 701.030 for details and additional design information.

b) 1500mm Diameter

See OPSD 701.011 and OPSD 701.040 for details and additional design information.

c) 1800mm Diameter

See OPSD 701.012 and OPSD 701.050 for details and additional design information.

d) 2400mm Diameter

See OPSD 701.013 and OPSD 701.060 for details and additional design information.

e) 3000mm Diameter

See OPSD 701.014 and OPSD 701.070 for details and additional design information.

f) 3600mm Diameter

See OPSD 701.015 and OPSD 701.080 for details and additional design information.

Poured Maintenance Holes

Required for maintenance holes which exceed the above maximum pipe sizes for precast maintenance holes. **Note, certification by a Structural Engineer is required for all poured maintenance holes.**

3.15.4 Maintenance Hole Tees

Maintenance Hole tees are not allowed for any sanitary sewer less than 1200mm diameter. For sanitary trunk sewers greater than 1200mm diameter, refer to the storm sewer section 5.14.4. Ensure sewers which slope away from the maintenance hole, but are not intended to take flows from the maintenance hole, have the inverts high enough to not accept sewage.

3.15.5 Maintenance Hole Frame and Covers

Maintenance hole frames and covers are required for all maintenance holes and shall conform with OPSD 401.01. See OPSD 401.01 for details and additional design information.

- a) Maintenance hole frames and covers are to be clear of curb and gutters on bends in the road for new construction. Maintenance hole frames and covers may be located in the curb and gutter on reconstruction projects, only as approved.
- b) Maintenance hole frames and covers and by association steps must be aligned to avoid being located in the wheel path of the street, and to be located above a benching platform, i.e. to avoid conflict with an inletting or outletting sewer pipe, respectively. Proposed location of maintenance hole frames and covers and by association steps must be shown in plain view on the engineering drawings, represented by a solid circle reflecting the above requirements.

3.15.6 Maintenance Hole Inserts

3.15.6.1 Use of Maintenance Hole Inserts Required During Construction

The use of inserts in sanitary maintenance holes will be required in areas of new construction until such time as the roadway is paved with the top asphalt layer.

3.15.6.2 Watertight Maintenance Hole Lids/Covers

Watertight maintenance hole lids are required when sanitary maintenance holes are located within overland storm flow routes. These locations are within flood plain areas, within gutter locations and within an easement and/or open space area where overland flow is directly over and or adjacent to the maintenance hole lids. Watertight maintenance hole lids are also required under sanitary surcharge conditions. (See City of London SW-5.3 for details and additional design information).

Watertight maintenance hole lids are not required under the following circumstances:

- a) Where design dictates that the maintenance hole lids end up in the curb and gutter and where it is possible to rotate the cone so that the maintenance hole lid is clear of the gutter, the cone should be rotated such that a water tight lid would not be required;
- b) Where, in the profile design of the street, the maintenance hole is located in the low point of an overland flow route, the maintenance hole may be in standard location, but would be submerged under a greater than two year storm event. Maintenance holes located in a standard location on streets that carry an overland flow route with a continuous grade, or cascading grade (even though some of these may be briefly submerged) do not require water tight lids.

3.15.7 Lockable Maintenance Hole Covers

Lockable maintenance hole covers are required to reduce access by the public. They can be located through park blocks, open space blocks, pumping stations or pollution control plants. See OPSD 401.06 for details and additional design information.

3.15.8 Maintenance Hole Steps

Maintenance hole steps are required for access and are to conform with one of the following:

a) Maintenance Hole Steps - Hollow

See OPSD 405.010 for details and additional design information.

b) Maintenance Hole Steps - Solid

See OPSD 405.020 for details and additional design information.

Note:

- i) All steps are to be galvanized steel or aluminium; and
 - ii) A detail or restoration plan is required for the relocation of maintenance hole steps within existing maintenance holes, where applicable; and
 - iii) Maintenance hole steps shall be located to avoid conflict with an inletting or outletting sewer pipe. Access to maintenance holes must be above the benching platform.
- c) Reference to Section 3.15.5 for alignment information for location requirements for the maintenance hole frame and cover.

3.15.9 Maintenance Hole Drop Structures

Sanitary drop structures are required when the difference in invert elevations between the upstream and outlet sewers in the maintenance hole is equal to or greater than 0.6 metres. (See City of London SW-2.0 for details and any additional design information).

3.15.10 Maintenance Hole Safety Landings

Maintenance hole safety landings are required at the mid-point depth of the maintenance hole, when the depth of the maintenance hole is between 5.0 and 10.0 metres.

Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0m to 15.0m deep. See City of London SW-2.5 for details and additional design information.

Note: Incoming pipes are to be below safety landings, where possible.

3.15.11 Benching

All maintenance holes require benching at the bottom of the maintenance hole and should conform to OPSD 701.021. Benching height should be increased to obviate to increase hydraulic benefit as required.

Note: Where benching is different from OPSD 701.021, a benching detail is required.

3.15.12 Steps in Benching

Steps in maintenance hole benching are required when the pipe diameter is greater than 900mm and benched to springline, and when the pipe diameter is greater than 450mm and benched to crown. See City of London SW-5.2 for details and additional design information.

3.15.13 Adjustment Units

Maintenance hole adjustment units are required on all maintenance holes to ensure that proper grade is provided between the top of the maintenance hole and the maintenance hole lid. Ensure that the difference in grade between the maintenance hole lid and the first ladder rung does not exceed 600mm. See City of London SW-5.0 for details and additional design information. Clay brick will not be allowed for use as maintenance hole adjustment units.

3.15.14 Head Losses

- a) Generally, when velocities in the downstream pipe from a maintenance hole exceed a velocity of 1.2 m/s, head losses must be accounted for in the design of the sewer and larger PDC's. In order to absorb head losses that may exist in maintenance holes, it may be necessary to improve the benching in the maintenance hole or increase the size of the downstream pipe where possible. Lowering the crown of the outgoing sewer below the crown of the incoming sewer by the amount equal to the head loss, however, is the most effective method of accounting for head loss in most cases.

- b) Drops in maintenance holes to compensate for Head Loss (H_L) shall be calculated using the following formula:

$$H_L = K_L \frac{V^2}{2g}$$

where: K_L = Head loss coefficient
 V = downstream velocity (m/s)
 g = 9.8 m/sec²

Note: Also see Figure 5.6 for quick reference for head losses in maintenance holes, and Section 5.14.10 for benching.

- c) Head loss coefficients (K_L) are to be applied as follows:

- i) 90 degrees

No benching or deflector, or where they are only up to spring line.

$$K_L = 1.5$$

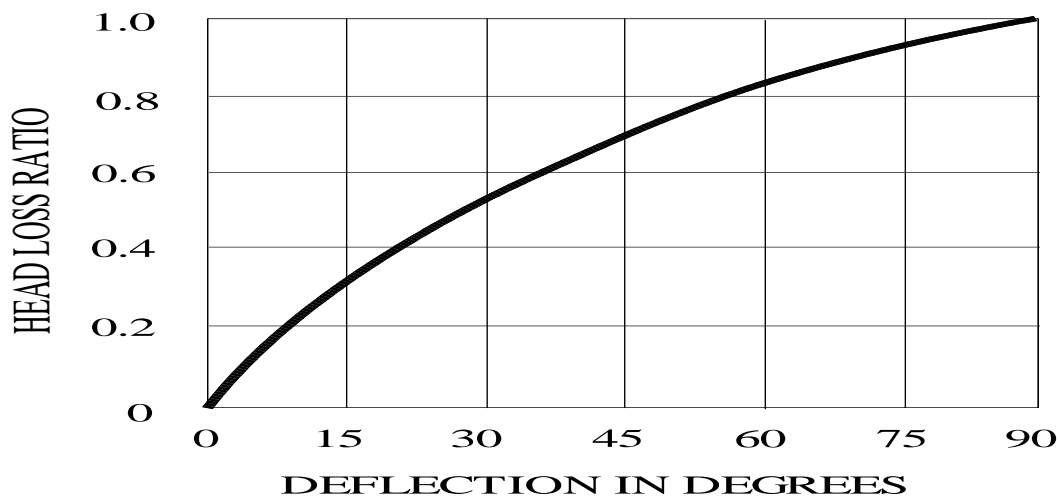
- ii) 90 degrees

Benching or deflector to crown of sewers.

$$K_L = 1.0$$

- iii) Less than 90 degrees

Multiply the head loss coefficient for a 90 degree bend by a head loss ratio factor from the following chart:



iv) Junctions

Tee

Outlet at right angles to inlets and no deflector between inlets.

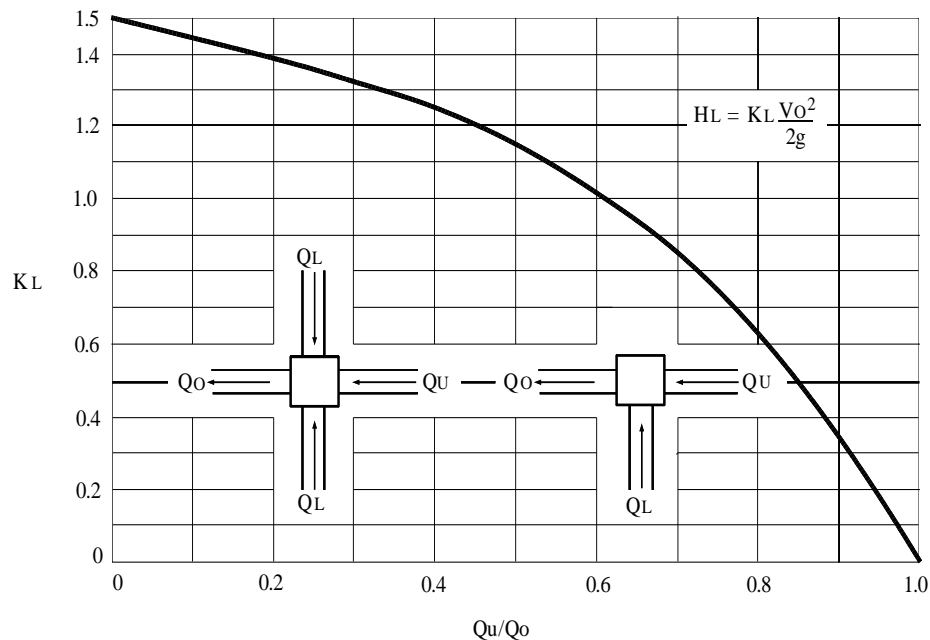
$$K_L = 1.5$$

Deflector between inlets for full height and width of incoming flows.

$$K_L = 1.0$$

Side and Cross Junctions

Value of K_L is obtained from the following chart:



v) For K_L values for calculating head losses in curved sewers (radius pipe), see Figure 3.5.

3.15.15 Maintenance Hole Access

- 1) Maintenance Hole Access for Municipal Sewers Located within Easements or Where Sewers Located Outside of Paved Road Surface

- a) Access to maintenance holes for the purpose of maintenance is to be provided in all circumstances. When designing maintenance access roads for sewers, generally the maintenance access road/path will have a 3.0 meter wide hard asphalt surface with a 4.0 meter wide granular base.

Adequate curves and turn-around facilities are required for maintenance vehicles to manoeuvre. Slopes (4% maximum), cross falls (2% minimum to 4.5% maximum) and drainage of access roads are also to be addressed in the design.

- b) Where sanitary sewer maintenance holes are installed below the flood line, the engineer shall be consulted and access road alternatives may be considered in this situation.

Note:

- i. A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s); and
- ii. The design and construction of sewer maintenance access roads in City Parks and Open Spaces will require the review and approval of both Parks Planning & Design and the Environmental & Engineering Services Department. Wherever possible, sewer access roads in City Parks and Open Spaces shall be integrated into the public open space pathway networks and respect the City's natural heritage features.

See Section 3.17 for easement requirements.

2) **Maintenance Hole Access Below Flood Line**

Where sanitary sewer maintenance holes are installed below the 100 year flood line, the engineer shall be consulted, and access road alternatives may be considered in this situation.

In this situation, maintenance hole lids must conform to 3.15.6.

3.15.16 Maintenance Hole Construction Practices

- a) The void between the sewer pipe and the cored hole of the precast maintenance hole section shall be filled with cement bricks and approved non-shrinkable grout. Pre booted maintenance holes will be allowed but only with previous approval by the City. All joints between bricks are to be completely filled with concrete mortar. Bricks are to be parged on the outside. Parging shall contain an approved bonding agent. All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with the manufactures specifications.
- b) All precast maintenance hole section joints shall contain an approved rubber gasket. In areas of high groundwater, exterior joint collars or external wrapping (eg. 'Cretex' waterproofing or equivalent, installed as per manufacturer's specifications) of the maintenance hole joints will be required. This requirement may be waived if it can be demonstrated that, based on specific groundwater conditions, the standard rubber gasket is sufficient to prevent infiltration.
- c) A minimum 300mm vertical/horizontal clearance between openings on the inside of the maintenance hole is required for all sewer and PDC connections.
- d) All maintenance hole frame and covers shall be adjusted to the finished road grade by means of metal shims at each corner or by means of an approved precast adjustment

ring. Metal shims are to be at least 75mm x 200mm (3" x 8") and their thickness is to be determined by the adjustment required. The space between the bottom of the maintenance hole frame and cover and the top of the precast maintenance hole is to be at minimum the thickness of one adjustment unit and at maximum 300mm. See City of London SW-5.0 for details and additional design information.

- e) Where adjacent maintenance holes are located in close proximity to one another, the area between the adjacent maintenance holes shall be backfilled in accordance with the specifications in the following table:

Distance Between Adjacent Maintenance Holes	Material
0.6 metres or less	concrete or crushed stone
0.6 metres to 2.4 metres	granular material
more than 2.4 metres	approved native material or granular material

The above noted backfill shall be compacted to the standard Proctor Density specified in the soils report, or as approved by the City Engineer.

3.15.17 Private Drain Connections to Maintenance Holes

Residential sanitary private drain connections are **NOT** to be constructed into any sanitary maintenance holes.

3.15.18 Sampling/Inspection Maintenance Holes

a) Requirements

Sampling/Inspection maintenance holes are typically required where Institutional, Commercial and Industrial developments outlet to sanitary sewers owned and maintained by the City. Sampling/inspection maintenance holes are required for all industrial and commercial sites.

b) Location

If required, Sampling/Inspection Maintenance Holes shall be located on private property as close as possible to the property line, or as approved by the City Engineer.

c) Minimum Size

Sampling/Inspection Maintenance Holes shall be a minimum of 1200mm diameter. A larger diameter Maintenance Hole may be required if noted on the Building Permit Application Drawings.

Sampling/Inspection Maintenance Holes that have more than one inlet sewer shall be increased in size to ensure that there is a minimum of 0.9m benching length downstream of all inlet sewers.

There are to be no drop structures (internal or external) located at sampling/inspection maintenance holes that are required for City sampling purposes.

Maintenance Holes shall be to OPSD standards – see Section 3.15.3, and Figure 3.7 for further details.

3.16 PRIVATE DRAIN CONNECTIONS (PDCS)

3.16.1 Location

PDCs to single family and semi-detached lots are to be located in accordance with City of London SW-7.0.

PDCs to multi-family (town housing, row housing and apartments), commercial and industrial blocks are to be connected to a maintenance hole on the R.O.W. See section 3.16.3 for further details.

PDC's shall be installed at 90° to the sewer main where possible. Under no circumstances will flow from the PDC enter the main against the flow in the main. Where horizontal or vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable. Single family and semi-detached lot Sanitary PDC's shall NOT be connected to a maintenance hole.

Note: Where design constraints arise (ie: top end of cul-de-sac or crescent), PDCs may have to be located in reverse location and identified as such on the servicing drawings.

3.16.2 Minimum Size and Grade

- a) The minimum diameter and grade of a PDC for residential, single family and semi-detached lots is 100mm @ 2.0%.
- b) The minimum diameter and grade of a PDC for a residential multi-family block is 150mm diameter @ 1.0%.
- c) The minimum diameter and grade of a PDC for a non-residential block is 150mm diameter @ 1.0%.
- d) The minimum diameter and grade of a PDC for a commercial block is 150mm diameter @ 1.0%.
- e) The minimum diameter and grade of a PDC for an institutional block is 200mm diameter @ 1.0%.

Note: The actual size of the PDC required for multi-family, non-residential, commercial and institutional blocks is dependent on the flows.

All PDC's must have a minimum slope of 1% at a constant gradient.

3.16.3 Connections to Sewers/Maintenance Holes

a) Residential

PDCs 100mm and 150mm in diameter must be connected to the main sewer. Residential sanitary PDCs are not to be constructed into any sanitary maintenance hole.

b) Multi-family, Commercial, Institutional and Industrial

PDCs 200mm in diameter and larger are to be connected to the main sewer at maintenance holes.

c) Connections to Existing Sewers for Lot Infill Situations

- i. In a situation where a lot severance or lot infill condition exists, and a new sanitary service will be connected to an existing sanitary mainline, the advocate

of the severance/infill, or his agent, must determine if the existing sanitary sewer is a combined or poorly separated sewer and is therefore at risk of surcharging, or if the sewer is a dedicated sanitary sewer but has a history of surcharging. This information can be obtained from Wastewater Engineering Division. If it is determined that there is a surcharge risk, the development advocate must provide surcharge protection to his development.

- ii. When connecting PDC's to existing sewers in a lot infill situation, connections must be made utilizing an approved saddle or premanufactured tee, in accordance with OPSS 410, as amended by the Supplemental Standards for Sewer and Water (SW) in the City of London Standard Contract documents for Municipal Connection Projects.

d) **Maximum Depth of Sewer Where Direct PDC Connections Permitted**

Direct connection of private drain connections to sanitary sewers greater than 8 meters in depth will not be permitted. Where a sanitary sewer is greater than 8 meters in depth, and local servicing is required, it will be required to provide a shallower local sewer to which private drain connections may be made. Deviations from this will require the approval of the Director of Wastewater and Treatment or the City Engineer.

3.16.4 Vertical Clearance

For vertical clearances from the sanitary PDC to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

3.16.5 PDC Detail

Typical PDC connection to the main shall be as per City of London SW-6.0.

3.16.6 PDC Risers

a) **Type I**

Required for sewer depths greater than or equal to 4.5 m and for excavations in stable bank conditions, see City of London SW-6.1 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

b) **Type II**

Required for sewer depths greater than or equal to 4.5 m and for excavations in unstable bank conditions, see City of London SW-6.2 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

3.16.7 PDC Cleanouts

Where removal is requested and approval is granted by the City Engineer, the cleanout and tee must be removed entirely. The owner may be required to install a new PDC. Approval will be given on a case-by-case basis and will apply to the entire phase of development.

3.16.8 Pipe Material

Refer to Section 3.13

3.16.9 Depth and Bedding

The minimum depth of a sanitary PDC shall be 2.4 metres from the finished property line elevation to the obvert of the PDC. The maximum cover on a sanitary PDC shall be based on the following:

a) Concrete Pipe

The maximum allowable cover permitted on concrete PDCs is to be as per Section 3.14.2 a).

b) Flexible Pipe

The maximum allowable cover permitted on flexible PDCs is to be as per Section 3.14.2 b).

3.16.10 Marking and Recording PDC Service Connections

Brown painted surface stakes 40mm X 90mm (standard 2" X 4") shall be placed after trench restoration to mark the termination of sanitary PDC's. These stakes shall extend from PDC invert to minimum 450mm above finished boulevard grade.

Plugged or capped service connections shall be marked on the top surface of the last 3m of the upstream end of the pipe with yellow PVC adhesive tape (50mm wide) labeled continuously in black lettering (40mm wide) **"CAUTION SANITARY SEWER"**.

New PDCs to Existing Properties – To be constructed to 1.2m inside the road allowance.

PDCs to Parklands – Location, design and where warranted to be reviewed and approved by Parks Planning & Design.

3.17 EASEMENTS

Easements are required for all sewers to be assumed by the municipality located outside a road allowance on privately owned property.

An easement is required to ensure the municipal services and utilities crossing the site can be properly installed and maintained by the appropriate authority (municipality or private). An easement provides the right to use private land for a specific purpose which is in the public's interest.

All maintenance holes located within easements require hard surface access. Refer to Section 3.15.15 for hard surface details.

3.17.1 Types of Easements

a) Multi-purpose Easement for Municipal Services

Are required for sanitary sewers and access roads that cross a site and which are maintained by the City.

b) Utility Easement

Utility easements are required for telephone, hydro, gas and cable television services. Each utility company should be consulted for their specific requirements.

c) Private Easements

Private easements are required for private sanitary sewers and access roads that cross a parcel of land to service other private lands. A joint access and maintenance agreement between the interested parties shall be entered into.

d) Temporary Easements and Working Easements

Temporary easements are required for sanitary sewers and access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

Working easements are required, as necessary during construction, to allow for the safe construction and finishing of the surface restoration. Once construction is completed, the working easement is released.

3.17.2 Minimum Easement Widths

Easement widths are determined by the diameter of the pipe being installed and the depth of cover from the centreline of the road/ground over the pipe to the invert of the sewer or watermain. Fig 3.6 shows how an easement width is to be determined. The minimum width of a sewer easement at a depth of up to 2.4 metres, shall be 4.8 metres (2.4 metres each side of sewer).

3.18 ODOUR CONTROL

Odour Control and Design Considerations for Sanitary Sewers/Systems to Reduce Sewer Gas and H₂S Creation

The MOE Design Guidelines for Sewage Works also provides information and guidelines with respect to odours and corrosion in sewers.

In general, problems have been experienced with the development of sewer gases which cause odours and corrosion of concrete sewer infrastructure due to:

- a) hydraulic design which induce turbulence in flow and encourage the release of sewer gases (i.e. sewer forcemains which jet into maintenance holes or chambers, poor benching or transitions where sewers outlet into an existing sewer, high sewer slopes which induce hydraulic jumps, elevation changes with poor transitions)
- b) long residence time of sewage in sewer systems (i.e.: sewer systems, pumping stations and forcemains which service new developments and have low flows initially, pumping stations and forcemains with long forcemains)

It should be noted that effluent quality which exceeds Waste Discharge By-laws also contributes to the potential to create sewer gases.

Every effort should be made to minimize the conditions or designs which may lead to the creation of sewer gases (odours and corrosion). Where it is not possible to avoid these types of situations, it will be a requirement to mitigate the impacts through the use of means acceptable to the City of London. Examples of this may be:

- 1. The use of chemical dosing of City approved or accepted oxidizing agents to address pumping stations and forcemains with long retention times, either on a short term or long term basis.
- 2. The use of corrosion resistant materials (such as plastic pipe or liners) in situations where it is not possible to improve hydraulic conditions which will introduce turbulence and sewer gas creation.

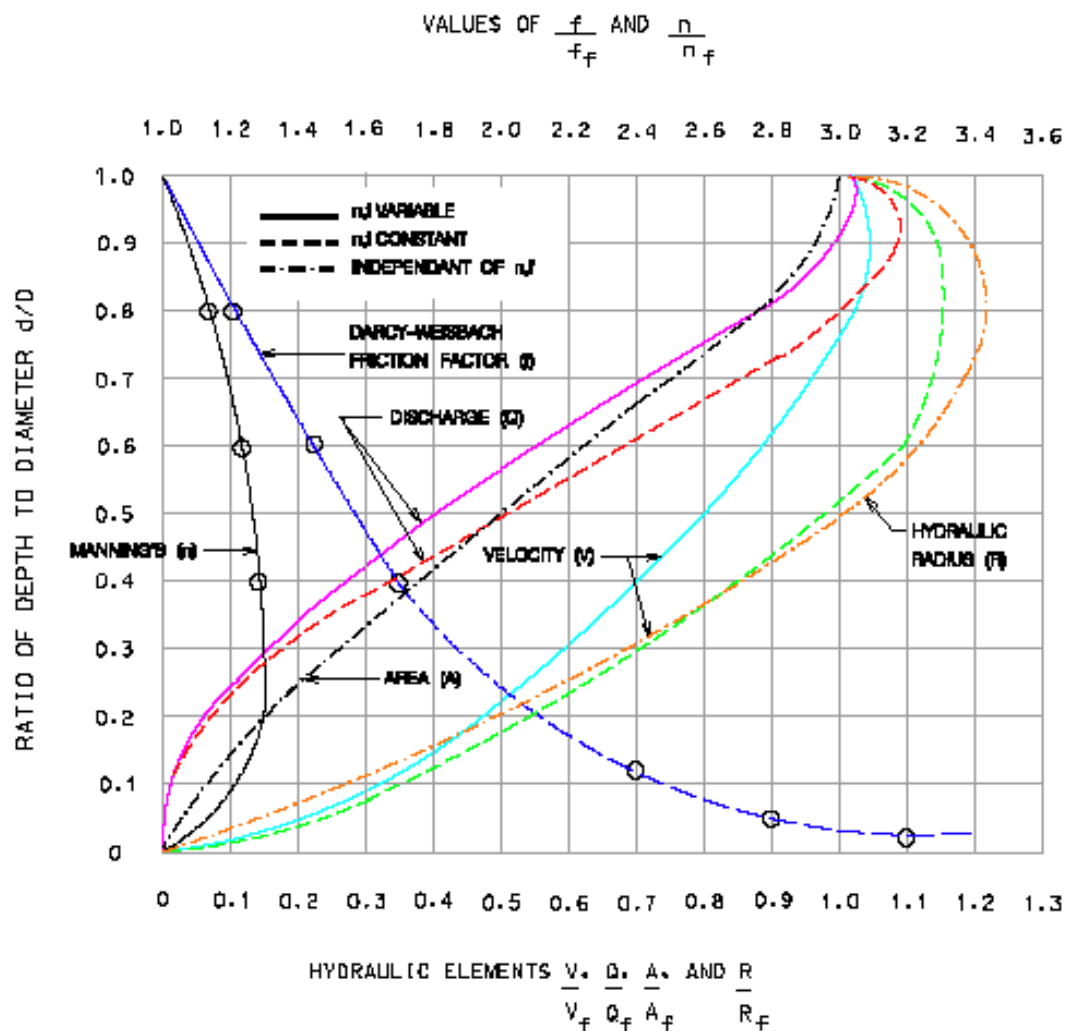
3.19 EROSION & SEDIMENT CONTROL PLAN

The City of London requires an Erosion and Sediment Control Plan (E&SC Plan) be designed for most Capital Works, Operational and Development Projects. The

complexity of the E&SC Plan is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area; an E&SC Plan is not required, unless otherwise directed by the City Engineer. Where an E&SC Plan is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the E&SC Plan, please refer to Section 10 – Erosion & Sediment Control, within this manual.



NOTE:

1. INFORMATION TAKEN FROM THE AMERICAN SOCIETY OF CIVIL ENGINEERS (A.S.C.E.) MANUAL.

CITY OF LONDON

HYDRAULIC ELEMENTS GRAPH FOR CIRCULAR SEWERS

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FIG 3.2





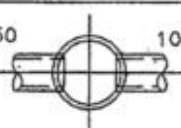
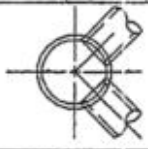
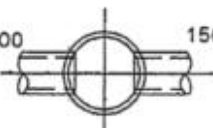
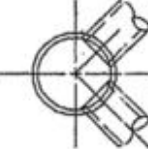
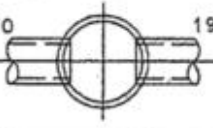
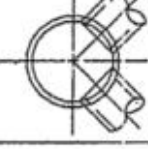
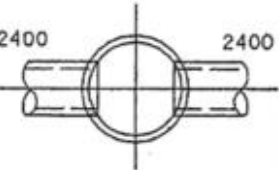

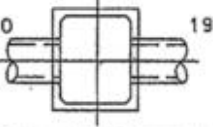
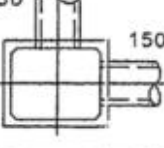
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Figure 3.2

Hydraulic Elements Graph for Circular

MAINTENANCE HOLE INSIDE DIAMETER (mm)	MAX. PIPE SIZE FOR STRAIGHT THROUGH INSTALLATION (mm)	MAX. PIPE SIZE FOR RIGHT ANGLE INSTALLATION (mm)
1200	600 	 450 450
1500	825 	 600 600
1800	1050 	 825 825
2400	1500 	 1050 1050
3000	1950 	 1500 1500
3600	2400 	 1650 1650
3000 x 2400	1950 	1950  1500

NOTES

1. ALL DIMENSIONS ARE FOR CONCRETE PIPE.
2. ALL DIMENSIONS ARE IN MILLIMETRES
3. KNOCKOUTS FOR SMALL DIAMETER CATCH BASINS LEAD SIZES 300mm OR LESS COULD BE PROVIDED IN ADDITION TO WHAT IS SHOWN.
4. INFORMATION TAKEN FROM THE ONTARIO CONCRETE PIPE ASSOCIATION (O.C.P.A.)

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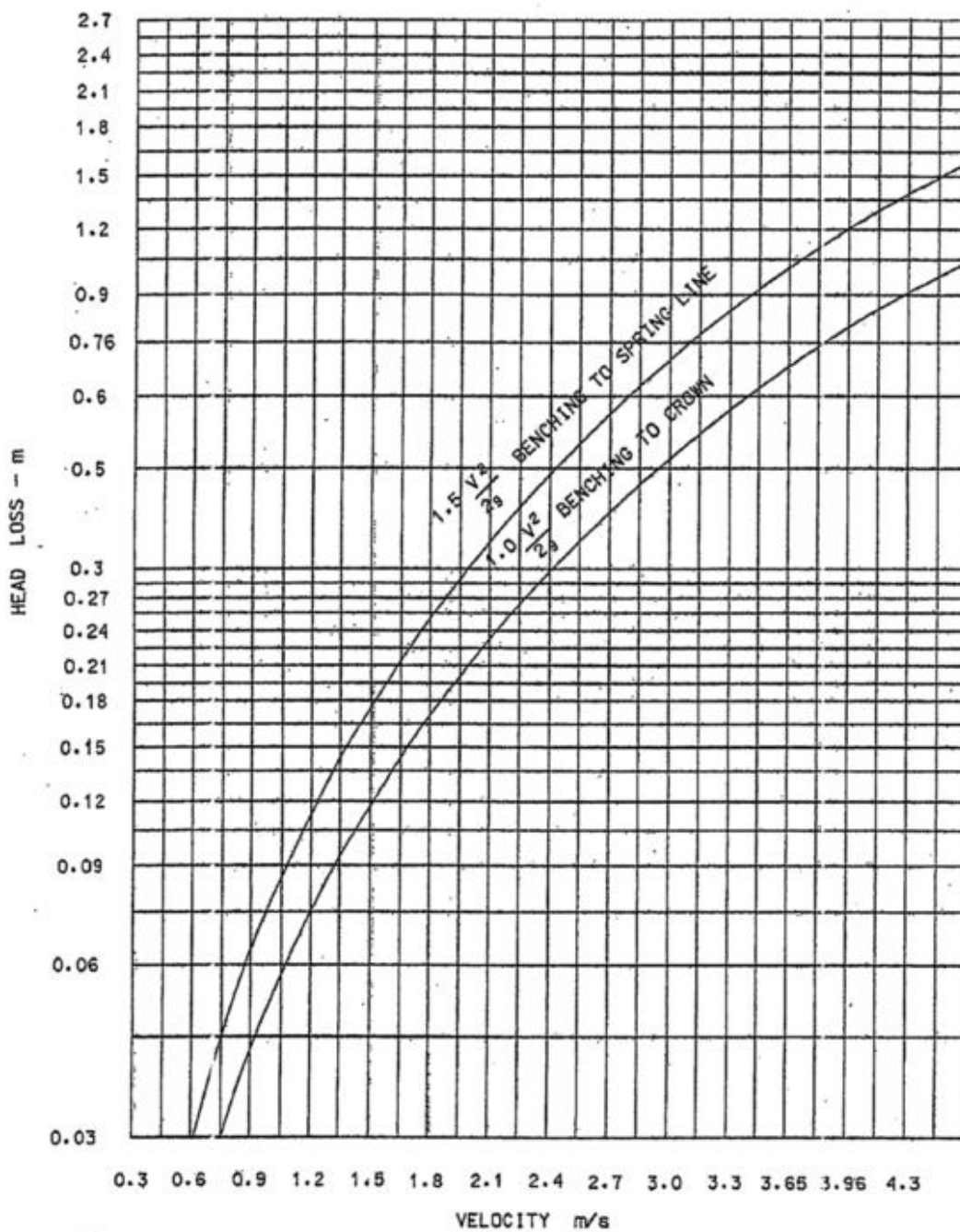
MAXIMUM PIPE SIZES FOR PRECAST MAINTENANCE HOLES

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FIG. 3.3

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CITY OF LONDON

HEAD LOSSES IN MAINTENANCE HOLES

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FIG. 3.4

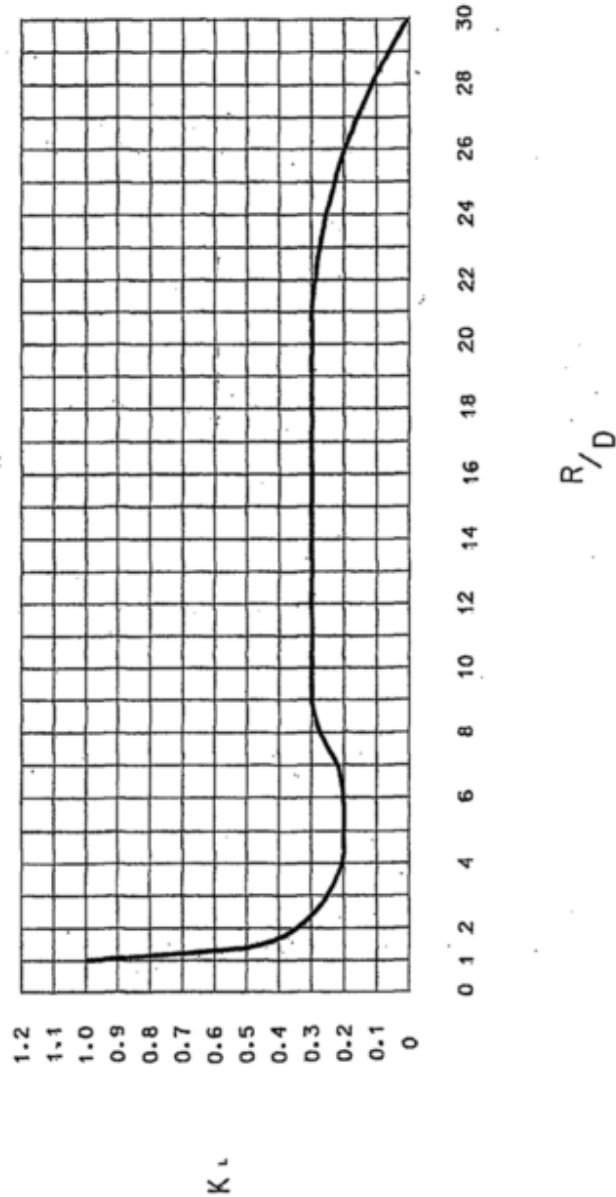
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APPROVED BY

WASTEWATER ENGINEERING

$H_L = K_L \frac{V^2}{2g}$
 R = C/L RADIUS OF BEND - METRES
 D = DIAMETER OF LARGEST PIPE - METRES



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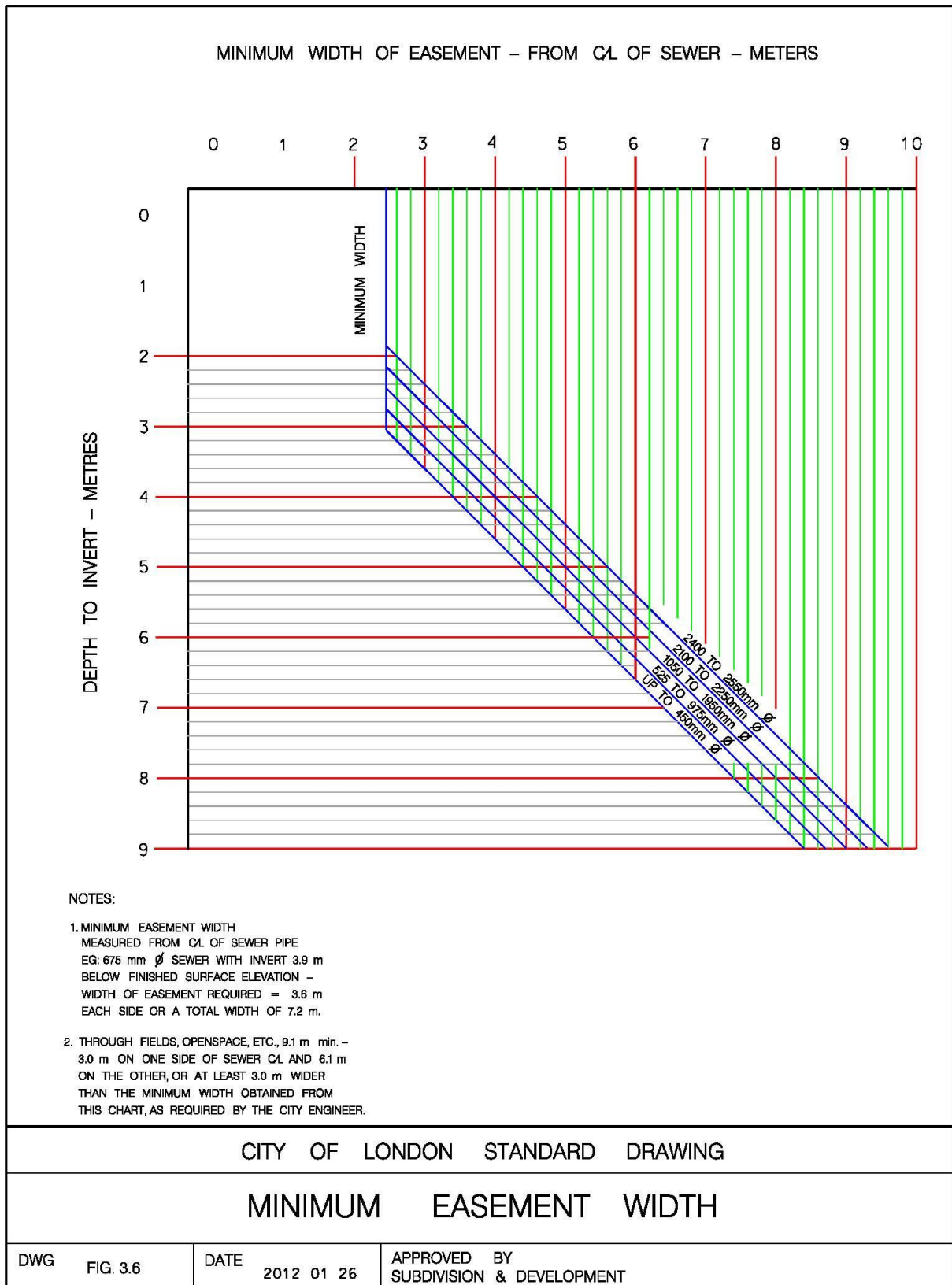
K_L VALUES FOR CALCULATING HEAD LOSSES IN CURVED SEWERS

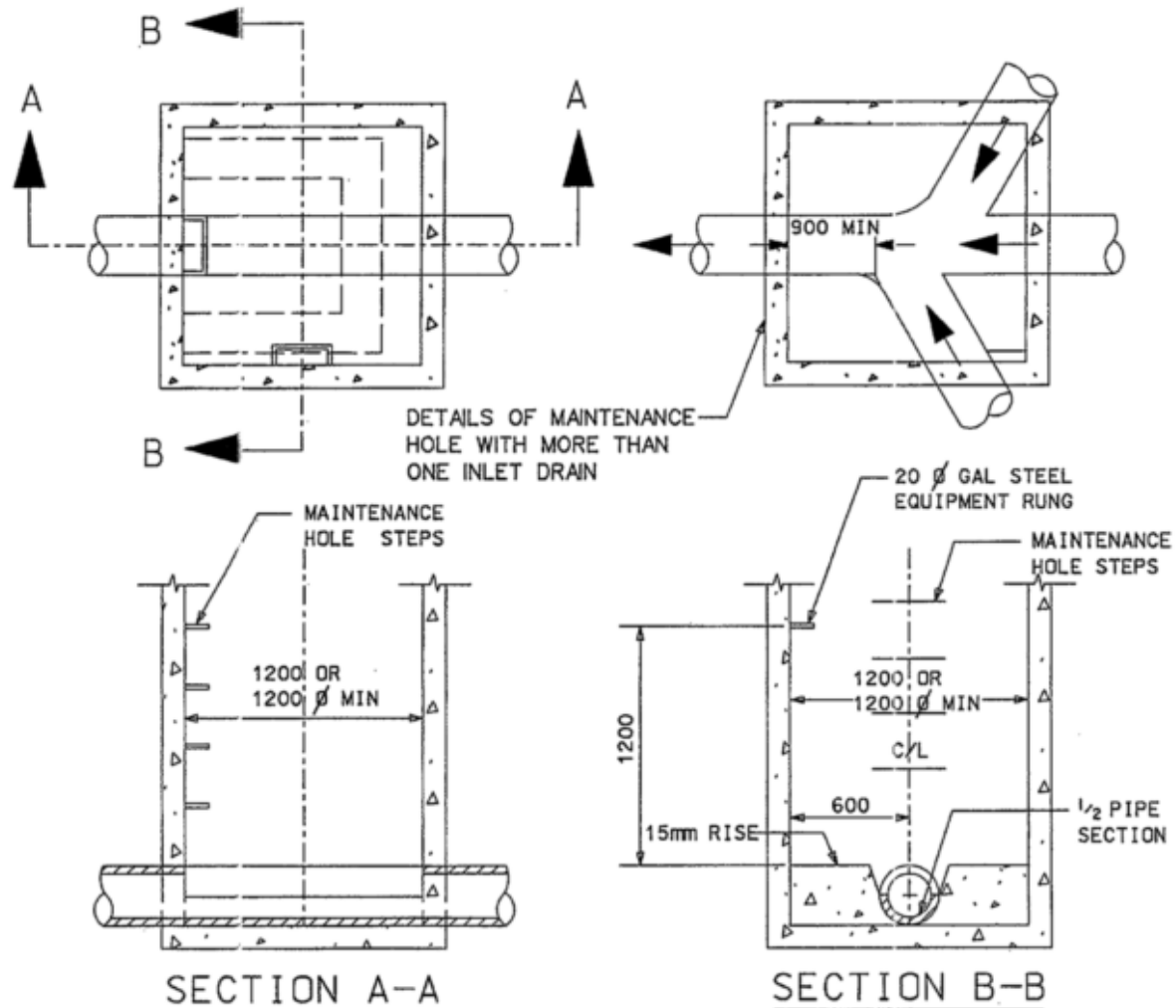
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FIG. 3.5

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NOTES:

- 1) DETAILS NOT INDICATED SHALL BE IN ACCORDANCE WITH CITY OF LONDON STANDARDS FOR MAINTENANCE HOLE CONSTRUCTION
- 2) MAINTENANCE HOLE SHALL BE LOCATED ON PRIVATE PROPERTY AS CLOSE AS POSSIBLE TO THE PROPERTY LINE OR AS APPROVED BY THE CITY ENGINEER.
- 3) 1200mm DIAMETER, OR LARGER, PRECAST MAINTENANCE HOLE TO THE CITY OF LONDON STANDARDS IS ACCEPTABLE.
- 4) LARGER MAINTENANCE HOLE SIZE WILL BE REQUIRED IF NOTED ON BUILDING PERMIT APPLICATION DRAWINGS.
- 5) MAINTENANCE HOLES THAT HAVE MORE THAN ONE INLET SEWER WILL BE INCREASED IN SIZE TO ENSURE A MINIMUM OF 900mm BENCHING LENGTH DOWNSTREAM OF ALL INLET SEWERS (SEE DETAILS ABOVE)
- 6) MAINTENANCE HOLE STEPS TO BE IN ACCORDANCE WITH OPSD-405.010 & OPSD-405.020
- 7) CLASS OF CONCRETE :30MPA AT 28 DAYS

NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

CITY OF LONDON

SAMPLING MAINTENANCE HOLE SANITARY & STORM SEWERS

FIG 3.7.

DATE

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Design Specifications & Requirements Manual

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4 SEWAGE PUMPING STATIONS

4.1 DEFINITION AND PURPOSE

A pumping station is a component of the sanitary sewage collection system that conveys domestic and other suitable sewage to a sewage treatment facility. The need for pumping sewage arises when:

- The existing topography and required minimum sewer grades create deep sewers that have high construction costs. The sewage is raised and then conveyed by gravity.
- Basements are too low to discharge sewage to the main sewer.
- Sewage must be conveyed over a ridge.
- The sewage must be raised to get head for gravity flow through a treatment plant.
- Discharge outlets are below the level of the receiving body of water.
- An existing gravity system is not yet available. A pumping station will enable development and growth in accordance with the applicable Community Plan.

4.2 PERMITTED USES

Discharges to sanitary sewer systems shall comply with:

- The City of London Waste Discharge By-law 16
- The City of London Drainage By-law WM-4

4.3 DESIGN CRITERIA

4.3.1 General

The design of the pumping station must conform to the current City of London standard, SEWAGE PUMPING STATION PHILOSOPHY, as described in the SCADA standard on the City's website, and all other related standards, codes and regulations, unless authorized and approved by the City Engineer and other approval authorities.

The following information is to be provided prior to the commissioning of any pumping station:

- Provide a pre-start health and safety review as per OHSA, NFPA-820 and the Ontario Electrical Safety Code
- Provide a plastic laminate fact sheet on the pumping station, including lowest basement elevation, location of forcemain outlet to gravity system and bypass invert elevation. The fact sheet shall be a minimum size of 11" x 17" and mounted adjacent to the control panel.
- Provide a plastic laminate with process flow diagram indicating valves and key interlocks shall also be included.
- A separate information document providing firm design range for inflow rate, optimum inflow rate for station that they are designing to, estimated operating costs for the pumping station including HVAC, heating and odour control, estimated pump life, retention time, volume and drain time of the forcemain, life of pumping station

and when next upgrade is required due to estimated projected flow, detention time in forcemain and odour potential considerations.

4.3.2 Site Layout and Servicing

Pumping stations and access to pumping stations are to be located above the 100 year flood limits unless approved otherwise by the City Engineer and other regulatory agencies. The site shall have good vehicular access and maneuvering area, and minimize potential adverse environmental impacts. The facilities layout shall allow for future expansion, and comply with front, rear and side yard setbacks according to the applicable zoning and site plan standard and requirements, and convenient location of portable generator.

Building construction shall be architecturally pleasing, in relation to surrounding community, and low maintenance. Permanent structures shall be masonry or concrete construction. Temporary structures shall not be of wood frame construction. Cladding for temporary structures shall be of pre-formed FRP or pre-finished metal and include provisions to protect the building from vehicles.

Building insulation requirements, interior finish, and minimum interior building temperature shall be as directed by the City Engineer.

Building design, layout and construction materials shall be to the satisfaction of the City Engineer. Facility design and layout shall have regards to making confined space entry user friendly, optimizing sight and retrieval lines and comply with OHSA regulation.

Landscaping of the site shall be low maintenance and architecturally pleasing, well-graded, minimal grass areas and landscaped to the satisfaction of the City Engineer. Site drainage shall not drain onto adjacent private property.

Fencing shall be 1.8m high chain link fence with lockable gates that are sized appropriately. Include warning and municipal address signage as per current City standards. Barbed wire fence shall be used as per current City fence by-law PS-1, and as directed by the City Engineer.

Provide adequate exterior lighting of the pumping station facilities such as access, parking, provide security hardware and alarms for all exterior doors, windows and exterior equipment to the satisfaction of the City Engineer.

Exterior lighting may be controlled by motion sensor or photo-eye as directed by the City Engineer.

All control equipment and panels shall be indoors unless approved by the City Engineer.

All utility meters such as gas, hydro, water meter reader, shall be mounted on the exterior of the building.

Access to the site shall include provision for parking of maintenance vehicles and standby/emergency equipment. Roads shall be asphalt surfaced in parking and maneuvering areas and provide convenient removal and storage of snow, and turn around for trucks, tankers and heavy equipment.

All utilities including phone and computer communications servicing the site shall be underground unless authorized by the City Engineer. Design, installation and planning of services shall be according to requirements of applicable codes, regulations and the local utility authority.

4.3.3 Structural

The pumping station shall be evaluated for uplift and resistance to all combined or single loadings considering soil conditions, ground water level, and frost action. Uplift shall be determined when the structure is completely empty and dry, free of equipment, roof slab removed, and the structure watertight. Design the base slab to withstand all earth loadings when the structure is completely filled to maximum level, roof slab on, and all equipment installed. Provide crane and hoist design including appropriately sized hatches for convenient pump and equipment removal.

Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

4.3.4 Flow Capacity

The pumping station flow capacity shall be based on the peak hourly flow rate determined from the peak flow calculation as outlined in Section 3.0, SANITARY SEWER DESIGN and consider low flow conditions, as approved by the City Engineer. The flow capacity of the pumping station should be able to maintain a desirable cleansing velocity of 0.9m/s with a minimum velocity of 0.60m/s, and a maximum velocity of 3.0m/s in all piping. The design of new pumping stations shall allow for future modification or expansion to meet the requirements of the tributary area of the pumping station

4.3.5 Pumps

Multiple pumps shall be provided and sized to provide firm capacity. When two pumps are used, firm capacity shall be maintained by one pump and shall be of the same size.

When multiple pumps are used, firm capacity shall be maintained by the remaining pumps when the largest pump is out of service. The capacity of the largest pump will be equal to the required firm capacity. All pumps must undergo a hydrostatic and operating test performed by the manufacturer prior to installation.

All pumping stations that are required to handle screenings shall be designed to handle the screenings in a method that is in keeping with the low maintenance philosophy of the pollution control operation. Pumping stations shall be equipped with in-channel grinders upstream of pumps and shall be installed so that sewage flow by-passes the grinders through coarse screens in the event the grinders fail or require maintenance. Pumping stations equipped with chopper pumps or inline grinders and screens shall match the model and manufacturer of equipment currently being installed in the City's sanitary collection system.

Pumps handling raw wastewater shall be capable of passing spheres of at least 76mm diameter. Pump suction and discharge openings shall be at least 100mm in diameter.

Pumps shall be positioned so that under normal operating conditions, they will operate under a positive suction head. When the pump is a suction-lift type, it shall be a self-priming or a vacuum-priming type pump.

Electrical equipment and components such as motors, lights, cables, conduits, switch boxes, control circuits, etc., shall comply with the Ontario Electrical Safety Code (OESC), CSA approved, and comply with the City SCADA Standards. A copy of the SCADA standard can be found on the City website.

Each pump shall have a separate intake. The configuration of the wet well and pump intakes shall prevent vortex formation and air locking.

Design a sump with two pumps in the dry well to remove leakage or drainage and discharge above the maximum high water level of the wet well. Provide dual check valves and gauges on discharge and suction lines for each sump pump. Do not connect water ejectors to a potable water supply. Provide drainage for all floor and walkway surfaces. Pump seal leakage is to be conveyed via appropriately sized channel/s complete with grating directly to the sump. Size the sump pump to convey the maximum pump seal water discharge that would occur in the event of a pump seal failure and provide necessary alarm activation. All sump pumps are to be submersible.

The pumps and controls of pumping stations, and pumping stations operated as part of treatment facilities, shall be selected to operate at varying delivery rates and designed to deliver as uniform a flow as practicable in order to minimize hydraulic surges.

The minimum efficiency, duty life, type and materials of construction for pump and impeller shall be approved by the City Engineer. Preferred voltage is 600 VAC, 3PH.

Dry pit submersible pumps are to be considered in areas susceptible to flooding.

Design all pumps to prevent air locking.

4.3.6 Channels

Dual channels will be utilized and equipped to allow isolating and de-watering each unit. The channel invert shall be 75-150mm below the inlet of the sewer and the entrance to channels shall be designed for equal flow distribution. Design guards to protect maintenance personnel from equipment and drainage to prevent slippery floor areas.

4.3.7 Pump Controls

All controls shall comply with the City SCADA Standards that are located on the City's website.

4.3.8 Valves and Fittings

Provide suitable shut off valves on the suction line of dry pit pumps. Pump suction lines should be designed using 90o short radius down-turned flared elbows; wall pipe shall be flanged with water stop collar; all valves including eccentric reducer shall be flanged; all flanges welded; minimum pipe size shall be NPS-4. All isolation valves shall be located inside chambers for access.

Shutoff and check valves with suitable guards are required on the discharge line of all pumps except screw type pumps. Locate check valves between the shut off valve and pump. Use appropriate check valves and install horizontally on the discharge piping. Ball checks may be installed vertically on the discharge pumping. All valves shall be capable of withstanding normal pressure and water hammer. All valves shall be operable from the floor level and be readily accessible for maintenance. Use outside levers for swing check valves with suitable guarding. All valves, valve operators, fittings, concentric increasers, elbows, double branch elbows, and risers shall be flanged, all flanges welded. Spacers shall be 150-300mm long with one flanged end and one grooved end for Victaulic coupling.

Valves, check valves, drains, fittings and headers shall be of stainless steel, 316 or better, construction. Pipe materials shall be approved by the City Engineer.

Identification including flow direction of all piping is required. Painting of non-stainless piping is also required.

Pump discharge to connect to main header pipe with a “Y” connection above the spring-line so that any gravel in the system doesn’t flow back into the discharge pipe causing blocking of check valves.

4.3.9 Flow Measurement

Flow measurement devices are required for all pumping stations and properly located for accurate readings with valving and fittings for maintenance with minimum downtime. Flow monitoring equipment shall be able to determine and record rate of flow, duration, volumetric sum, and frequency for each pump and each bypass, and interface with City SCADA requirements.

Provide a spool piece for each mag meter and provide a spool piece for each bypass as directed by the City Engineer. The spool piece depends on forcemain location and wet well retention time. If it is determined that enough time is available to remove the forcemain and install a spool piece safely, then a forcemain by-pass would not be required.

4.3.10 Wet Wells

All pumping stations with a capacity greater than 100 litres/sec shall have divided wet wells that are properly interconnected. The wet well shall have provisions such as a shear or sluice gate or knife valve to facilitate continuous operation during maintenance and to allow dewatering of one portion of the wet well.

The volume of the wet well shall be based on the design average flow with a filling time of a minimum of 30 minutes between the firm capacity start and by-pass. When the wet well is designed for flow equalization, provisions to prevent septicity shall be included. Factors to consider when determining the size are: the volume required for pump cycling based on the pump manufacturer’s duty cycle recommendations; appropriate dimensions to minimize turbulence; vertical separation between pump control points; sewer inlet elevation; capacity required between alarm levels, basement flooding and overflow elevations; and the number, spacing and size of pumps. The high water level shall be set 300mm below the invert of the inlet sewer and the low water level shall be 300mm minimum or twice the pump suction diameter above the centre line of the pump volute. The wet well floor shall have adequate slope to the intake hopper and the horizontal area of the hopper shall be kept to a minimum.

Provision for air displacement in wet wells shall be made by natural means consisting of 0.10% of the well cross-sectional area, or a minimum two 100mm diameter inverted “J” or gooseneck pipes with insect screens extending 900mm above finished grade. One vent pipe should extend to within 300mm above the obvert of the inlet sewer. The other vent pipe should extend to the underside of the wet well roof slab.

Wet wells are to be designed to be self-cleaning and to minimize grit accumulation.

4.3.11 Heating and Ventilation

Adequate ventilation, as per O.H.S., Building Code and NFPA shall be provided for all pumping stations. Underground dry wells and wet wells with screens or mechanical equipment require mechanical ventilation. The ventilating fan should be orientated to direct fresh air into the wet well at a point 900mm above the alarm level rather than just

exhaust from the wet well. Interconnection between the wet well and dry well is not allowed and vents shall not open or be connected to any building ventilation system. Where continuous ventilation is required, air shall be pre-heated. Consideration for the installation of air scrubbers shall be made as directed by the City Engineer.

For dry wells, over 4.6m deep, multiple air inlets and outlets should be used. Dampers, fine screens or other obstructions are not to be used on exhaust or fresh air ducts.

Switches and controls to operate ventilation equipment shall be conveniently located and marked. All intermittently operated ventilation equipment shall be interconnected with the respective lighting system. Consideration should also be given to automatic controls where intermittent operation is used. The manual lighting and ventilation switch shall override the automatic controls.

The fan blades shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment shall be designed for all dry wells. The electrical equipment and components shall meet the requirements for electrical equipment in Section 4.3.5.

Wet well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by NFPA 820. Air shall be forced into the wet well by mechanical means rather than solely exhausted from the wet well. The air change requirements shall be based on 100 percent fresh air. When permanent ventilation equipment is not practical, portable ventilation equipment shall be designed for use at submersible pump stations and wet wells.

Dry well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by NFPA 820. A two-speed ventilation system may be used to conserve heat. The air change requirements are based on 100 percent fresh air.

Locate the fan switch for ventilation equipment to the satisfaction of the City Engineer.

An engineered heat recovery system that considers energy efficiency and recovery is to be designed where:

- There is a requirement for 100% fresh air into a space within a pumping station;
- An air scrubber system is required for wet well odour control.

Engineering designs should consider potential for a heat recovery system in the sewage wet well such as a glycol recovery system to capture and return heat to the station.

4.3.12 Water Supply

Water supply shall be potable unless authorized by the City Engineer.

Water supply shall be equipped with back-flow preventers to prevent contamination of the water system and all plumbing shall conform to the Ontario Building Code.

Water supply shall be a minimum 25mm.

4.3.13 Access

Access shall consider the City's Confined Space Entry procedures and policy. Provision shall be made to facilitate easy and efficient removal of pumps, motors, and other mechanical and electrical equipment. A suitable and safe means of access for persons

wearing self-contained breathing apparatus shall be provided to wet and dry wells and valve chambers.

Stairs shall be provided for vertical heights greater than 1.2 metres. Maximum vertical distance between work platforms and landings shall be 3 metres. Safety landings shall be constructed as work platforms.

Provide davit base anchors where required for DBI Sala standard equipment that complies with City confined space standards.

Equipment such as access hatches, ladders, service platforms, guards, grates and handrails, shall be constructed of a suitable material when exposed to wet/and or corrosive conditions.

4.4 SUCTION-LIFT PUMP STATIONS

Suction lift pumps shall also meet the applicable design requirements of Section 4.3 above.

Suction-lift pumps shall be of the self-priming or vacuum-priming type. Suction-lift pump stations using dynamic suction lifts exceeding the limits outlined in the following sections may be approved upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction-lift as measured from "lead pump off" elevation to centerline of pump suction, friction, and other hydraulic losses of the suction piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 1.8 m.

Self-priming pumps shall be capable of rapid priming and re-priming at the "lead pump on" elevation. Such self-priming and re-priming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 7.6 m in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 1.2 m from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 6.7 m.

Vacuum-priming pump stations shall be equipped with dual vacuum pumps capable of removing air from the suction-lift pump automatically and completely. The vacuum pumps shall be adequately protected from damage due to wastewater. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 6.7 m.

The pump equipment compartment shall be above grade or offset and shall be effectively isolated from the wet well to prevent a hazardous and corrosive sewer atmosphere from entering the equipment compartment. Wet well access shall not be through the equipment compartment and shall be at least 1m by 1m clear opening with spring-loaded, shock assist hatches. Gasketed replacement plates shall be provided to cover the opening to the wet well for pump units removed for servicing. Valving shall not be located in the wet well.

4.5 SUBMERSIBLE PUMP STATIONS

Submersible pumps shall meet the applicable requirements under Section 4.3, except as modified in this Section.

Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle and shall meet the requirements of the Ontario Hydro Electrical Safety Code and CSA for such units. An effective method to detect shaft seal failure or potential seal failure shall be provided.

Submersible pumping stations shall be designed so that pumps are readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well. Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be outside the wet well. Controls shall be designed in accordance with City SCADA Standards.

The motor control center shall be located outside the wet well, be readily accessible, and be protected by a conduit seal or other appropriate measures meeting the requirements of the Ontario Hydro Electrical Safety Code, to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal.

Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage. They shall meet the requirements of the Ontario Hydro Electrical Safety Code standards for flexible cords in wastewater pump stations. Ground-fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal-fittings shall be corrosion resistant and constructed in a manner to prevent the entry of moisture into the cable. They shall also be provided with strain relief appurtenances and be designed to facilitate field connecting.

Valves required under Section 4.3.8 shall be located in a separate valve chamber. Provisions shall be made to remove or drain accumulated water from the valve chamber. The valve chamber may be dewatered to the wet well through a drain line with a gas and watertight valve. Check valves that are integral to the pump need not be located in a separate valve chamber if the valve can be removed from the wet well in a convenient and efficient manner.

Separate valve chambers shall be insulated and heated to prevent freezing.

4.6 ALARM AND MONITORING SYSTEMS

Pumping station alarms and equipment shall comply with the pumping station control philosophy as described in the City SCADA Standards.

Integration into the SCADA system is to be complete by City forces. This includes PLC programming and operator interface all as per the current applicable charge-out rates.

4.7 EMERGENCY OPERATION

The objective of emergency operation is to prevent the discharge of raw or partially treated wastewater to any waters and to protect public health by preventing back up of wastewater and subsequent discharge to basements, streets, and other public and private property. Pumping stations shall be designed to provide temporary pumping

around the station and enable isolation of the forcemain and pumping station, by means of isolation valves inside and outside the pumping station.

4.7.1 Emergency Power

Emergency power is required for all pumping stations. There shall be sufficient capacity of emergency power to start up and maintain the total confirmed pumping station capacity of the station, the SCADA system and all other electrical equipment for 24 hours, unless otherwise approved by the City Engineer.

All pumping stations shall be equipped with an onsite generator. A genset plug compatible with existing City generators may be installed as directed by the City Engineer.

Generators shall be capable of running full station load powered by natural gas or diesel as directed by the City Engineer. The design of generators shall meet all applicable regulations.

4.7.2 By-pass Overflows

By-pass overflow shall be provided by gravity to existing storm sewer system or allow for emergency pumping to other gravity outlet. Emergency sanitary sewer overflow (SSO) outletting upstream of the SWM facility or directly to a SWM facility is not permitted.

By-pass and overflow monitoring and totalization is required and shall comply with City SCADA Standards.

4.7.3 Instructions and Equipment

Wastewater pumping stations and portable equipment shall be supplied with a minimum of five complete sets of operational instructions, including emergency procedures, maintenance schedules (1 Consultant, 2 Operations, 1 pumping station, 1 Wastewater Division), and such tools and spare parts as may be necessary. The consultant will ensure that this documentation will be provided along with the necessary training for operation and maintenance of the equipment prior to commissioning.

4.8 FORCEMAINS

At design pumping rates, a desired cleansing velocity of at least 0.90 m/s) shall be maintained. The minimum force main diameter for raw wastewater shall not be less than 100 mm.

An air relief valve shall be at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves. Fittings and isolation valves shall be stainless steel.

Forcemain design shall include transient analysis and consider the provision of water hammer relief.

Force mains should enter the gravity sewer system at a point not more than 200 mm above the flow line of the receiving maintenance hole.

Pipe and joints shall be equal to water main strength materials suitable for design conditions. The force main, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. The need for surge protection

chambers shall be evaluated. Forcemain pipe materials shall be approved by the City Engineer.

Force main construction near streams or water works structures and at water main crossings shall meet applicable requirements.

Friction losses through force mains shall be based on the Hazen and Williams's formula or other acceptable methods. When the Hazen and Williams formula is used, the following value for "C" shall be used regardless of pipe material:

<u>Pipe Diameter</u>	<u>C-Factor</u>
100-150mm	100
200-250mm	110
300-600mm	120
Over 600mm	130

When initially installed, force mains may have a significantly higher "C" factor.

The force main shall be appropriately identified when they are constructed of material that may cause the force main to be confused with potable water mains.

Force main shall be tested to ensure there is no leakage. Specify method of testing.

4.9

SAFETY

The design of the pumping station shall give due regard to safety for the protection of maintenance personnel and visitors from hazards:

- a) Enclose the station site with 1.8m chain link fence, lockable gates, designed to discourage entry by unauthorized persons and animals; provide safety, unauthorized entry and municipal address signage, as per City standards;
- b) Handrails and guards are to be installed around tanks, trenches, pits, stairwells, and other hazardous areas;
- c) Gratings are to be installed over areas where access for maintenance is required;
- d) Confined space entry shall comply with the Pollution Control Operation and OHSA regulations. Facility design and layout shall have due regard to make confined space entry user friendly, optimizing sight and retrieval lines;
- e) All personnel must be trained to operate and maintain pumping station equipment and facilities to the satisfaction of the Pollution Control Operation;
- f) Gas detection and monitoring equipment where required. Where gas alarms are provided, install an indicator light outside the building so that the operator can check gas levels before entering the building
- g) Portable ventilation and blower equipment, intrinsically safe, with sufficient hose, where required;
- h) Portable lighting equipment intrinsically safe, where required;
- i) Appropriately placed warning signs for slippery areas, non-potable water fixtures, low head clearance, open service maintenance holes, hazardous material storage areas, flammable fuel storage areas, etc.;
- j) Adequate ventilation in pumping chambers;

- k) Provisions for lockout and tag-out of mechanical and electrical equipment;
- l) Eyewash fountains and safety showers were required;
- m) Fire extinguishers and emergency lighting.

4.10

EROSION & SEDIMENT CONTROL PLAN

The City of London requires an Erosion and Sediment Control Plan (E&SC Plan) be designed for most Capital Works, Operational and Development Projects. The complexity of the E&SC Plan is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area; an E&SC Plan is not required, unless otherwise directed by the City Engineer. Where an E&SC Plan is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the E&SC Plan, please refer to Section 10 – Erosion & Sediment Control, within this manual.



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5 STORM SEWER COLLECTION SYSTEM

5.1 DEFINITION AND PURPOSE

Storm sewers are commonly thought of as closed conduit drainage systems below the surface of the ground that collect surface water created from rainfall or other forms of precipitation. However, storm systems may consist of one or any combination of pipes, ditches, culverts, open channels and storm water management facilities that carry storm water flows.

5.2 PERMITTED USES

Storm sewers shall be designed to collect storm water discharge from pervious and impervious areas both on private lands and public lands via catchbasins and storm private drain connections. Indirect connections of foundation drains (footing tile) via sump pumps to storm PDCs are permitted. Drainage of foundation drains (footing tiles) shall be in accordance with City of London Drainage By-law No. WM-4.

Storm Drainage on private property requires a building permit before installation.

5.3 LOCATION AND ALIGNMENT

Generally storm sewers are to be located in front of, or are in locations accessible to each lot and block facing a City Street. Sanitary sewers and maintenance holes are to be located 1.5meters from the centreline of the road (see DWG. U.C.C.-1M and U.C.C.-2M for details and additional design information).

Storm sewers are to be located on the outside loop of a proposed crescent with the maintenance holes at a 1.5 m offset from the centre line of the road.

Where a maintenance hole is designed to be located within the area of a roundabout, storm maintenance holes are permitted to be located within the grassed area of the roundabout, provided any proposed landscaping does not hinder the access to the maintenance hole.

5.3.1 Storm Sewers on Private Property

Storm sewers on private property are regulated by the Ontario Building Code (OBC). Where there are no specific regulations in the OBC, details from this manual will apply.

5.4 DRAINAGE/SUBDRAINAGE AREA PLANS

Drainage/sub-drainage area limits for which sewers are to be designed for are to contain and follow the lot/block lines to the proposed maintenance holes located on the R.O.W.

Note: All areas and coefficients are to be shown for each drainage/sub-drainage areas.

5.5 EXTERNAL WATERSHED LIMITS AND DRAINAGE AREAS

When design abuts undeveloped areas, identify the external watershed limit to be designed for.

Note: All areas, coefficients and time of concentrations are to be shown for all drainage areas within external watershed limits.

5.6 DESIGN CHART

Storm sewer design calculations are to be completed on the standard design chart. See Figure 5.1 for details and additional information.

5.7 PEAK FLOW CALCULATION

Flows shall be calculated using the formula:

$$Q = 2.78 \times A \times C \times I$$

where: Q = peak flow (l/s)
A = area (hectares)
C = runoff coefficient
I = average rainfall intensity (mm/hr)

5.8 DESIGN CRITERIA

5.8.1 Storm Design Curve

The criterion used in the design of storm sewers is generally to be based on the 1 in 2 year City of London Rainfall Intensity curve. (See Figure 5.2). Major overland flow routes are to be designed for storms greater than a 2 year storm. This is explained further in Section 9.0, Grading.

5.8.2 Time of Concentration

- a) The time of concentration for residential areas (single family/ semi detached) at the upstream end of a system shall be 19.0 minutes. For all other areas refer to Figure 5.3.
- b) The time of concentration is to be adjusted when lateral flows account for 50% or more in the design flows.
 - i) Adjusted time of concentration shall be calculated using the formula:

$$T_{c-adj} = \frac{(T_{ct})(Q_t) + (T_{cl})(Q_l)}{(Q_t + Q_l)}$$

where: T_{c-adj} = adjusted time of concentration (min.)
 T_{ct} = time of concentration in the trunk sewer (min.)
 Q_t = design flow in the trunk sewer (l/s)
 T_{cl} = time of concentration in the lateral sewer (min.)
 Q_l = design flow in the lateral sewer (l/s)

- ii) The adjusted time of concentration is used downstream of the junction maintenance hole.

5.8.3 Runoff Coefficients

Runoff coefficients are based on the amount of impervious area for a particular land use:

- | | |
|--|-------------|
| • Parks, open space and playgrounds | 0.20 |
| • Single family/semi detached | 0.50 |
| • Townhouse/row house | 0.65 |
| • Apartments | 0.65 - 0.70 |
| • Commercial, institutional and industrial | 0.70 - 0.90 |

- Densely built, paved

0.90

5.8.4 Intensity

Rainfall intensity is to be taken from Figure 5.2 “Rainfall Intensity - Duration Curve for Storm Sewer Design”.

5.9 MANNINGS ROUGHNESS COEFFICIENT

A coefficient of 0.013 is to be used for all concrete and PVC pipe.

5.10 PIPE SIZE

Storm sewer pipe sizing is based on the following formula, where the pipe design flow is equal to or greater than the calculated peak sewage flow:

$$Q = \frac{1}{n} \times A \times R^{2/3} \times S^{1/2}$$

where: Q = Design flow (m³/sec.)

n = Mannings roughness coefficient

A = cross sectional area of flow (m²)

R = hydraulic radius (area/wetted perimeter)

S = slope of pipe (m/m)

Notwithstanding the above, the minimum size storm sewer pipe permitted is 300 mm.

On private property, the minimum size for storm building sewer shall be 100mm, in accordance with Part 7 of the Ontario Building Code.

5.11 FLOW VELOCITY

Velocity shall be calculated using the following formula:

$$V = \frac{Q}{A}$$

where: V = flow velocity (m/sec)

Q = Design flow (m³/sec)

A = cross sectional area of flow (m²)

5.11.1 Minimum Velocity

The minimum velocity permitted in storm sewers is 1.0 m/sec.

5.11.2 Maximum Velocity

The maximum velocities permitted in storm sewers are:

- 4.5 m/sec for 300 mm to 825 mm diameter sewers, and
- 6.0 m/sec for 900 mm diameter and larger storm sewers.

To determine velocities based on actual flow, refer to Figure 5.4 “Hydraulic Elements Graph for Circular Pipe”.

Note, anchoring or concrete encased sewers are required for steep grades and/or velocities.

5.11.3 Minimum Grades

- a) The minimum grade on a 300 mm diameter storm sewer is 0.54%.

- b) The minimum grade on all other sewer sizes shall be established by determining the minimum grade necessary to achieve a velocity of at least 1.0m/sec.

5.12 PIPE MATERIAL

Both rigid and flexible pipe are permitted in the construction of storm sewer systems including private drain connections and catchbasin leads. These materials include concrete, polyvinyl chloride and high-density polyethylene.

The criteria for using these materials is described in the City of London Standard Contract Documents for Municipal Construction Projects - Section 410.05.01.

On private property, materials for storm building sewers and private sewers shall comply with Part 7 of the OBC.

5.13 PIPE DEPTH AND BEDDING MATERIAL

5.13.1 Minimums

The minimum depth of a storm sewer shall be 1.5 m from the finished ground elevation to the obvert of the pipe. Where minimum depths cannot be achieved and therefore frost protection is warranted, insulation is required as per City of London W-CS-68.

5.13.2 Maximum Depth of Cover

a) Concrete Pipe

- i) See City of London SW-1.0 and SW-1.1 for details and additional design information for bedding standards for Class A, B and C beddings.
- ii) Municipal Projects

The maximum allowable cover permitted on concrete pipe to be constructed under a Municipal or Capital Works Project is to be based on OPSD 807.010, 807.030, 807.040 and 807.050.

Where the pipe required exceeds the OPSD charts, the Pipe Pac Program 2000 will be used, utilizing the following variables:

- all units are in metric and conform to C.S.A. standards
- wall thickness is based on C.S.A. A257.2M, Type B wall
- soil density = 2000 kg/ m³
- Ontario Highway Bridge Design Code (OHBDC)
 - live load magnitude = 25 tons
- projection ratio = 0.70
- lateral pressure ratio = 0.33
- lateral pressure friction 'm' = 0.70
- settlement ratio = 0.70
- $k\text{-}\mu(\mu) = 0.1924$
- variable bedding factors B - Lf = 1.9 C - Lf = 1.5
- rsdp = 0.49 (calculated)
- factors of safety
 - 0.3mm crack D-load = 1.00
 - ultimate earth and live load = (ASTM C 76M)
 - $DL.03 \leq 100 \text{ N/m/mm} = 1.50$
 - $DL.03 \geq 140 \text{ N/m/mm} = 1.25$

- DL.03 between 100 and 140 N/m/mm = interpolated
- positive projection embankment installation
- maximum depth of cover is based on transition width design
- depth of ground is measured from the ultimate finished ground elevation to the outside top of pipe.

iii) New Subdivisions

The maximum allowable cover permitted on concrete pipe to be constructed in a new subdivision is to be designed based on transition width, and utilize reinforced concrete pipe only, in accordance with OPSD 807.030 and 807.050 (Positive Projecting Embankment Installation only).

Where the pipe required exceeds the OPSD Charts, the Pipe Pac Program 2000 utilizing the variables noted in 3.14.2.ii) or 5.13.2.ii) above, or First Principles (using City of London Variables) will be used.

b) Flexible Pipe

The maximum allowable cover permitted on flexible pipe is 10.5 m. The following bedding types are to be used:

- for up to 4.5 m - Type 1 (see City of London SW-1.0)
 - for up to 10.5 m Type 2 (see City of London SW-1.0)
- c) Where trench conditions are expected to exhibit ground water in silt or fine sand, specified bedding will be defined as 19mm crushed stone entirely surrounded by geotextile.

5.13.3 Crossing Clearances

There are minimum clearances required when storm sewers cross other services. In all cases this is measured from outside wall diameter to outside wall diameter.

When crossing over or under a sanitary sewer, 230mm clearance is required.

For vertical clearances from the storm sewer to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

5.13.4 Minimum Distance Between Sewers

The minimum distance between sewers shall be 3.0m as per drawing UCC-1M and UCC-2M. Special cases to be reviewed for site specific design constraints and depths.

5.13.5 Trenchless Technologies

When trenchless installation methods are being considered for new works, please refer to Section 17 – Trenchless Technologies (for New Construction).

5.14 MAINTENANCE HOLES

5.14.1 Spacing of Maintenance Holes

The maximum spacing between storm maintenance holes is dependent on the pipe size. The maximum spacing between maintenance holes when the pipe is 300-975mm diameter shall be 99m measured horizontally or 110m measured vertically from the top of the maintenance hole to the springline of the pipe, along the springline to the next maintenance hole and vertically to the top of the maintenance hole.

Following are the maximum allowable horizontal spacing for the corresponding pipe sizes:

Length	Sewer Diameter
99m	300 – 975mm
130m	1050 – 1350mm
160m	1500 – 1650mm
305m	1800mm & larger

When spacing of a maintenance hole dictates that the maintenance hole should be placed within the area of a roundabout, storm maintenance holes are permitted to be located within the grassed area of the roundabout, provided any proposed landscaping does not hinder the access to the maintenance hole.

Required where there is a change in the direction of the flow, slopes, a change in the diameter of sewers, and/or a lateral sewer connection. **Note, a minimum 300mm clearance is required between services within a maintenance hole.**

5.14.2 Pre-cast Maintenance Hole Sizing Criteria

All sizing of storm pre-cast maintenance holes are based on incoming and outgoing pipe sizes and should be sized and conform to Figure 5.5.

Note, a minimum 300mm clearance is required between services within a maintenance hole.

5.14.3 Maintenance Hole Diameters

Pre-cast maintenance hole diameter requirements are as follows:

a) 1200 mm Diameter

See OPSD 701.010 and OPSD 701.030 for details and additional design information.

b) 1500 mm Diameter

See OPSD 701.011 and OPSD 701.040 for details and additional design information.

c) 1800 mm Diameter

See OPSD 701.012 and OPSD 701.050 for details and additional design information.

d) 2400 mm Diameter

See OPSD 701.013 and OPSD 701.060 for details and additional design information.

e) 3000 mm Diameter

See OPSD 701.014 and OPSD 701.070 for details and additional design information.

f) 3600 mm Diameter

See OPSD 701.015 and OPSD 701.080 for details and additional design information.

Poured Maintenance Holes

Required for maintenance holes which exceed the above maximum pipe sizes for precast maintenance holes. **Note, certification by a Structural Engineer is required for all poured maintenance holes.**

5.14.4 Maintenance Hole Tees

Maintenance hole tees can be constructed in lieu of regular maintenance holes on 1200 mm diameter or greater trunk sewers. See City of London SW-5.1 for details and additional design information.

Note:

- a) No deflections or lateral connections are to be constructed within the proposed maintenance hole tee.
- b) Maintenance hole tees are to be located upstream to a deflection or change in sewer sizes.

5.14.5 Maintenance Hole Frame and Covers

Maintenance hole frames and covers are required for all maintenance holes and shall conform with OPSD 401.01. See OPSD 401.01 for details and additional design information.

Maintenance hole frames and covers and by association steps must be aligned to avoid being located in the wheel path of the street, and to be located above a benching platform, i.e. to avoid conflict with an inletting or outletting sewer pipe, respectively. Proposed location of maintenance hole frames and covers and by association steps must be shown in plan view on the engineering drawings, represented by a solid circle reflecting the above requirements.

Note, maintenance hole frame & covers are to be clear of curb & gutters on bends in the road.

5.14.6 Lockable Maintenance Hole Cover

Lockable maintenance hole covers are required to reduce access by the public. They can be located through park blocks, open space blocks, pumping stations or pollution control plants. See OPSD 401.06 for details and additional design information.

5.14.7 Maintenance Hole Steps

Maintenance hole steps are required for access and are to conform with one of the following:

- a) Maintenance Hole Steps - Hollow

See OPSD 405.010 for details and additional design information.

- b) Maintenance Hole Steps - Solid

See OPSD 405.020 for details and additional design information.

Note:

- a) All steps are to be galvanized steel or aluminum.
- b) A detail or restoration plan is required for the relocation of maintenance hole steps within existing maintenance holes, where applicable.
- c) Maintenance hole steps shall be located to avoid conflict with an inletting or outletting sewer pipe. Access to maintenance holes must be above the benching platform.

- d) Refer to Section 5.14.5 for alignment information for location requirements for the Maintenance hole frame and cover.

5.14.8 Maintenance Hole Drop Structures

Storm drop structures are required when the difference in invert elevations between the upstream and outlet sewers in the maintenance hole is equal to or greater than 0.9 m. See City of London SW-2.0 for details and any additional design information.

5.14.9 Maintenance Hole Safety Landings

Maintenance hole safety landings are required at the mid-point depth of the maintenance hole, when the depth of the maintenance hole is between 5.0m and

10.0m. Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0 m to 15.0 m deep. See City of London SW-2.5 for details and additional design information.

Note: Incoming pipes are to be below safety landings, where possible.

5.14.10 Benching

All maintenance holes require benching at the bottom of the maintenance hole and shall conform to OPSD 701.021. Benching height should be increased to obviate to increase hydraulic benefit as required.

Note: Where benching is different from OPSD 701.021, a benching detail is required.

5.14.11 Steps in Benching

Steps in maintenance hole benching are required when the pipe diameter is greater than 900 mm and benched to spring line, and when the pipe diameter is greater than 450 mm and benched to crown. See City of London SW-5.2 for details and additional design information.

5.14.12 Adjustment Units

Maintenance hole adjustment units are required on all maintenance holes to ensure that proper grade is provided between the top of the maintenance hole and the maintenance hole lid. Ensure that the difference in grade between the maintenance hole lid and the first ladder rung does not exceed 600 mm. See City of London SW-5.0 for details and additional design information. Clay brick will not be allowed for use as maintenance hole adjustment units.

5.14.13 Head Losses

- a) Generally, when velocities in the downstream pipe from a maintenance hole exceed a velocity of 1.2 m/s, head losses must be accounted for in the design of the sewer and larger PDC's. In order to absorb head losses that may exist in maintenance holes, it may be necessary to improve the benching in the maintenance hole or increase the size of the downstream pipe where possible. Lowering the crown of the outgoing sewer below the crown of the incoming sewer by the amount equal to the head loss, however, is the most effective method of accounting for head loss in most cases.
- b) Drops in maintenance holes to compensate for Head Loss (H_L) shall be calculated using the following formula:

$$H_L = K_L \frac{V^2}{2g}$$

where: K_L = Head loss coefficient
 V = downstream velocity (m/s)
 $G = 9.8 \text{ m/sec}^2$

Note: Also see Figure 5.6 for quick reference for head losses in maintenance holes, and Section 5.14.10 for benching.

c) Head loss coefficients (K_L) are to be applied as follows:

i) 90 degrees

No benching or deflector, or where they are only up to spring line.

$K_L = 1.5$

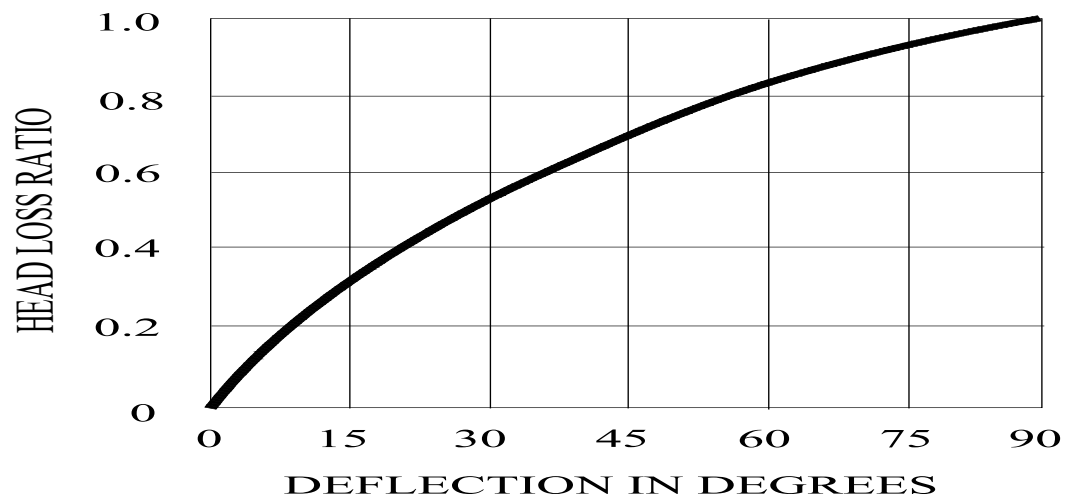
ii) 90 degrees

Benching or deflector to crown of sewers.

$K_L = 1.0$

iii) Less than 90 degrees

Multiply the head loss coefficient for a 90 degree bend by a head loss ratio factor from the following chart:



iv) Junctions

Tee

Outlet at right angles to inlets and no deflector between inlets.

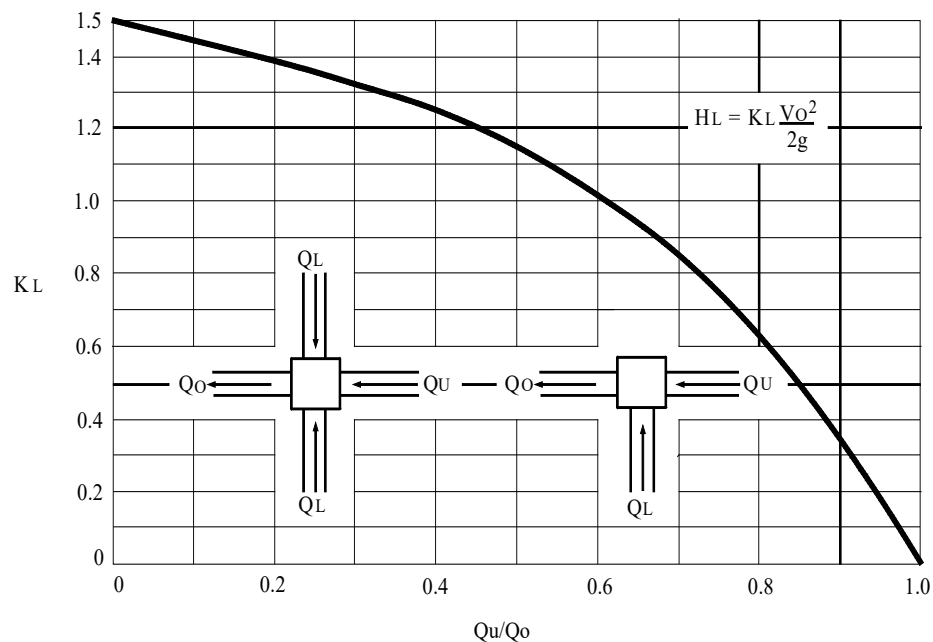
$K_L = 1.5$

Deflector between inlets for full height and width of incoming flows.

$K_L = 1.0$

Side and Cross Junctions

Value of K_L is obtained from the following chart:



v) For K_L values for calculating head losses in curved sewers (radius pipe), see Figure 5.7.

5.14.14 Maintenance Hole Access

A 3.0m to 4.6m wide topsoil and sodded access without trees, plantings or other obstructions is required for maintenance vehicles and equipment used to access and service all storm maintenance holes with easements, open space areas, designated blocks and existing right-of-ways (i.e. boulevard). Adequate curves and turn-around facilities are required for maintenance vehicles to maneuver. Slopes (10% maximum), crossfalls (2% minimum) and drainage of access roads are also to be addressed in the design.

Note: A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s).

See Section 5.17 for easement requirements.

5.14.15 Maintenance Hole Construction Practices

- The void between the sewer pipe and the cored hole of the precast maintenance hole section shall be filled with cement bricks and approved non-shrinkable grout. Pre booted maintenance holes will be allowed but only with previous approval by the City. All joints between bricks are to be completely filled with concrete mortar. Bricks are to be parged on the outside. Parging shall contain an approved bonding agent. All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with the manufactures specifications.
- All pre-cast maintenance hole section joints shall contain an approved rubber gasket.
- A minimum 300 mm vertical/horizontal clearance between openings on the inside of the maintenance hole is required for all sewer and PDC connections.
- All maintenance hole frame and covers shall be adjusted to the finished road grade by means of metal shims at each corner or by means of an approved pre-cast adjustment ring. Metal shims are to be at least 75 mm x 200 mm (3" x 8") and their

thickness is to be determined by the adjustment required. The space between the bottom of the maintenance hole frame and cover and the top of the pre-cast maintenance hole is to be at minimum the thickness of one adjustment unit and at maximum 300 mm. See City of London SW-5.0 for details and additional design information.

- e) Where adjacent maintenance holes are located in close proximity to one another. The area between the adjacent maintenance holes shall be backfilled in accordance with the specifications in the following table:

Distance Between Adjacent Maintenance Holes	Material
0.6 metres or less	concrete or crushed stone
0.6 metres to 2.4 metres	granular material
more than 2.4 metres	approved native material or granular material

The above noted backfill shall be compacted to the Standard Proctor Density specified in the soils report, or as approved by the City Engineer.

5.14.16 Sampling/Inspection Maintenance Holes

a) Requirements

Sampling/Inspection Maintenance Holes are required where Commercial, Industrial and sometimes Institutional developments outlet to storm sewers owned and maintained by the City. The requirement for sampling/inspection maintenance holes will be reviewed on a site specific basis, through the Site Plan Review Group.

b) Location

If required, sampling/inspection Maintenance Holes shall be located on private property as close as possible to the property line, or as approved by the City Engineer.

c) Minimum size

Sampling/Inspection Maintenance Holes shall be a minimum of 1200mm diameter. A larger diameter Maintenance Hole may be required if noted on the Building Permit Application Drawings.

Sampling/Inspection Maintenance Holes that have more than one inlet sewer shall be increased in size to ensure that there is a minimum of 0.9m benching length downstream of all inlet sewers.

There are to be no drop structures (internal or external) located at sampling/inspection maintenance holes that are required for City sampling purposes.

Maintenance Holes shall be to OPSD standards – see Section 5.14.13, and Figure 5.10 for further details.

5.15 PRIVATE DRAIN CONNECTIONS (PDCS)

5.15.1 Location

PDCs to single family and semi-detached lots are to be located in accordance with City of London SW-7.0.

PDCs to multi-family (townhousing, rowhousing and apartments), commercial and industrial developments are to be connected to a maintenance hole or sewer within the right-of-way. See section 5.15.3 for further details.

PDCs shall be installed at 90° to the sewer main where possible. Under no circumstance will flow from the PDC enter the main against the flow in the main. Where horizontal or vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable.

Note: Where design constraints arise (i.e. top end of cul-de-sac or crescent) PDCs may have to be located in reverse location and identified as such on the servicing drawings.

5.15.2 Minimum Size and Grade

- a) The minimum diameter and grade of a PDC for a residential, single family and semi-detached lot is 100 mm @ 2%.
- b) The minimum diameter and grade of a PDC for a residential multi-family block is 300mm diameter @1.0%.
- c) The minimum diameter and grade of a PDC for a non-residential block is 375mm diameter @ 1.0%.
- d) The minimum diameter and grade of a PDC for a commercial block is 300mm diameter @ 1.0%
- e) The minimum diameter and grade of a PDC for an institutional block is 375 mm @ 1.0%.

Note: The actual size of the PDC required for multi-family non-residential, commercial and institutional blocks is dependent on the flows.

5.15.3 Connections to Sewers/Maintenance Holes

a) Residential

Storm PDCs 100mm, 150mm, 200mm and 250mm in diameter are to be constructed to the main sewer, except in cases where a maintenance hole is located at the top end of a system (i.e. cul-de-sac).

b) Multi-family, Commercial and Institutional

Storm PDCs 300mm in diameter and larger are to be connected to the main sewer at the maintenance hole, except in cases where the main sewer is 900 mm in diameter or larger, in which case the PDC may be connected directly into the sewer.

c) Connections to Existing Sewers for Lot Infill Situations

- i. In a situation where a lot severance or lot infill condition exists, and a new storm service will be connected to an existing storm mainline, the advocate of the severance/infill, or their agent, must determine if the existing storm sewer is a combined or poorly separated sewer and is therefore at risk of surcharging. This information can be obtained from Wastewater Engineering Division. If it is determined that there is a surcharge risk, the development advocate must provide surcharge protection to their development.
- ii. When connecting PDC's to existing sewers in a lot infill situation, connections must be made utilizing an approved saddle or pre manufactured tee, in

accordance with OPSS 410, as amended by the Supplemental Standards for Sewer and Water (SW) in the City of London Standard Contract Documents for Municipal Construction Projects.

5.15.4 Vertical Clearance

For vertical clearances from the storm PDC to the watermain see Water Design Standards Chapter 7 Section 7.4.7.2.

5.15.5 PDC Detail

Typical PDC installation to the main, as per City of London SW-6.0.

5.15.6 PDC Risers

a) Type I

Required for sewer depths greater than or equal to 4.5 m and for excavations in stable bank conditions, see City of London SW-6.1 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

b) Type II

Required for sewer depths greater than or equal to 4.5 m and for excavations in unstable bank conditions, see City of London SW-6.2 for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

5.15.7 PDC Cleanouts

Where removal is requested and approval is granted by the City Engineer, the cleanout and tee must be removed entirely. The owner may be required to install a new PDC. Approval will be given on a case-by-case basis and will apply to the entire phase of development.

5.15.8 Pipe Material

See Section 5.12 for acceptable pipe material.

5.15.9 Depth and Bedding

The minimum depth of a storm PDC shall be 1.5 m from the finished property line elevation to the obvert of the PDC. The maximum cover on a storm PDC shall be based on the following:

a) Concrete Pipe

The maximum allowable cover permitted on concrete PDCs is to be as per Section 5.13.2 a.)

b) Flexible Pipe

The maximum allowable cover permitted on flexible PDCs is to be as per Section 5.13.2.b).

5.15.10 Marking and Recording PDC Service Connections

Green painted surface stakes 40mm X 90mm (standard 2" X 4") shall be placed after trench restoration to mark the termination of storm PDC's. These stakes shall extend from PDC invert to minimum 450mm above finished boulevard grade.

Plugged or capped service connections shall be marked on the top surface of the last 3m of the upstream end of the pipe with orange PVC adhesive tape (50mm wide) labeled continuously in black lettering (40mm wide) **“CAUTION STORM SEWER”**

New PDCs to Existing Properties – To be constructed to 1.2m inside the road allowance.

PDCs to Parklands – Location, design and where warranted to be reviewed and approved by Parks Planning & Design.

PDCs Not Required – When the Geotechnical Engineer certifies that storm PDCs are not required, as per the City of London Drainage By-Law (WM-4).

5.16 CATCHBASINS

Catchbasins are to be provided to collect drainage from both pervious and impervious areas. The following are the general guidelines to be used in the provision of catchbasins and catchbasin leads.

5.16.1 Location

- a) Street - On street corners and intersections, the catchbasin is to be located 0.6m from the BC or EC of the curvature, and/or located on the lot/property line or 1.5m from the centre of the lot to avoid conflicts with driveway and lot servicing respectively.
- b) Lot/Rear Yard - The catchbasin and lead are to be located 0.6 m from the property line, entirely on one lot or block.
- c) Parks - Catchbasins are to be located to minimize flow across pathways and provide positive drainage from park facilities.

5.16.2 Minimum Lead Diameter and Grade

- a) Street - The minimum diameter and grade of a catchbasin lead on a street is 250mm @ 0.69% (velocity of 1.0 m/s).
- b) Lot - The minimum diameter and grade of a catchbasin lead in a rear yard is 300 mm @ 0.54% (velocity of 1.0 m/s).
- c) Parks - The minimum diameter and grade at the catchbasin lead in a park is 250mm at 0.69% (velocity of 1.0m/s).

5.16.3 Spacing

The desired maximum distance between catchbasins or from a crest in a road to a catchbasin is 90 m, measured along the curb line for each side of the road.

5.16.4 Types of Catchbasins

- a) Catchbasin - 600 mm x 600 mm

Catchbasins (CB) are to be constructed on all streets and some rear yards, see OPSD 705.010 for details and additional design information. Also, refer to Section 5.16.7 for details and additional design requirements.

- b) Curb Inlet Catchbasin

Curb inlet catchbasins (CICB) are to be constructed at all low points in the curb and gutter on Neighbourhood Street and Neighbourhood Collectors. Curb inlet catchbasins are to be constructed exclusively on all Rapid Transit Boulevard, Urban

Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area and Main Streets. See City of London SW-3.0.

Note: Driveway locations are to be identified where curb inlet catchbasins are required.

c) Catchbasin Maintenance Hole

Catchbasin maintenance holes (CBMH) are to be constructed in rear yards, see City of London SW-4.0 for details and additional design information. Also, refer to 5.16.7 for additional design requirements.

d) Ditch Inlet Catchbasins

Ditch inlet catchbasins (DICB) are to be constructed for ditch drainage along major roads, where Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area and Main Streets grading cannot be provided. They are also to be constructed for temporary block drainage and for outlets/inlets within a stormwater management pond. See OPSD 702.040 and OPSD 702.050 or OPSD 705.030 and OPSD 705.040 for details and additional design information.

e) Twin Inlet Catchbasins

Twin Inlet catchbasins (OPSD 705.020) are to be used in lieu of curb inlet catchbasins under specific circumstances such as:

- a) At a sag in a street with no curb and gutter
- b) In industrial subdivisions where barrier or mountable curb is specified, where driveway locations are not determined.
- c) As approved on a site specific circumstance by the City engineer.

5.16.5 Depth of Cover

The minimum depth of cover over a catchbasin lead is to be 1.5 m within the road allowance and 1.2 m off the road allowance.

Note: Where minimum depths cannot be achieved and therefore frost protection is warranted, insulation is required as per City of London W-CS-68.

5.16.6 Allowable Ponding

- a) No surface ponding is allowed to develop under a 2 year design storm event. Ponding on major overland flow routes allows for 300 mm on street catchbasins and 450 mm on rear yard catchbasins. See Grading Section 9.2 and 9.4 for further design information.
- b) In new developments, flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.
- c) Flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.

- d) In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.

5.16.7 Requirements for Length of Leads

Standard catchbasins (600 x 600), maintenance hole catchbasins and maintenance holes are to be constructed/connected in accordance with the following:

- a) Catchbasin leads up to 15.0 m in length may be constructed by:
 - i) connecting into the main sewer using an approved connection, or by,
 - ii) connecting into a maintenance hole.
- b) Catchbasin leads 15.0 to 30.0m in length may be constructed by:
 - i) having a catchbasin at one end and the other connected into a maintenance hole or a sewer 900mm in diameter and larger, or by
 - ii) having the lead connected into a sewer 825mm in diameter or smaller at one end with a maintenance hole catchbasin at the other end.
- c) Catchbasin leads over 30.0m in length, are to be connected into a maintenance hole or a sewer 900mm in diameter or larger at one end and have a maintenance hole catchbasin at the other end.

5.16.8 Catchbasin Frame and Grates

- a) Catchbasin Cast Iron Frame and Flat Square Grate

To be constructed in conjunction with a catchbasin - 600 mm x 600 mm and a catchbasin maintenance hole. See OPSD 400.02 for details and additional design information.

- b) Catchbasin Cast Iron Curb Inlet Overflow Plate

To be constructed in conjunction with a curb inlet catchbasin. See OPSD 400.09 for details and additional design information.

- c) Ditch Inlet, Galvanized Steel, Honey Comb – Grating

To be constructed in conjunction with a ditch inlet catchbasin. See OPSD 403.01 for details and additional design information.

5.16.9 Catchbasin Steps

- a) Maintenance Hole Steps – Hollow

To be constructed in conjunction with a pre-cast catchbasin maintenance hole. See OPSD 405.010 for details and additional design information.

- b) Maintenance Hole Steps – Solid

To be constructed in conjunction with a catchbasin maintenance hole. See OPSD 405.020 for details and additional design information.

5.16.10 Catchbasin Connections

- a) Catchbasin Connection - Rigid Pipe Sewer

To be constructed in conjunction with a catchbasin - 600 mm x 600mm. See OPSD 708.010 for details and additional design information. Catchbasin lead bedding Class B & Class C to be in accordance with **City of London Standard SW – 1.0**. Structural design of concrete catch basin leads to be in accordance with section 5.13.

b) **Catchbasin Connection - Flexible Pipe Sewer**

To be constructed in conjunction with a catchbasin - 600 mm x 600mm. See OPSD 708.030 for details and additional design information.

c) **Flexible Pipe:**

Catchbasin lead bedding type 1 (up to 4.5m) & type 2 (up to 10.5m), in accordance with **City of London Drawing Standard SW-1.0**.

d) **Vertical Requirements**

Where Catch Basin leads are to be installed at greater than 45° vertically, installation shall be as per OPSS 410.07.13, as amended by City of London Supplemental Standards for Sewer and Water.

5.16.11 Maintenance Hole Adjustment Unit

Maintenance adjustment units are required to ensure that the difference in grade between the top of the catchbasin maintenance hole lid and the first ladder rung does not exceed 600 mm. See City of London SW-5.0 for details and additional design information.

5.16.12 Catchbasin Lead Material

Both rigid and flexible pipes are permitted for the construction of catchbasin leads. These materials include concrete and polyvinyl chloride. In most cases flexible catchbasin leads are constructed.

The criteria for using these materials are described in the Standard Contract Documents for Municipal Construction Projects, Section 410.05.01.

5.16.13 Concrete Curb Setbacks

Concrete curb setbacks are to be constructed in conjunction with all catchbasins (600 mm X 600 mm and curb inlet catchbasins) located within curb and gutter within the right-of-ways. Concrete curb setbacks shall not be implemented when curb face sidewalk is specified. See City of London SR-3.0 for details and additional design information.

5.16.14 Minimum Building Setbacks

Required for all catch basin leads which abut a lot line adjacent to a building. These setbacks are to be equivalent to the City of London sewer easement setbacks. If setbacks cannot be achieved then the following is required:

- a) Reduced setbacks and adjacent underside of footing elevations (i.e. footings to be outside of the trench excavation)
- b) A separation of at least 3.0m between buildings adjacent to the catch basin lead.
- c) A minimum 1.0m offset from the face of the wall of the building to the catch basin must be provided.

Details – Plan & profiles of all rear yard catch basin leads are required together with all pertinent details.

5.16.15 Mini Catchbasins

Mini Catchbasins shall only be installed on Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Streets as per a), b) and c) below. Mini catchbasins shall not be used on Neighbourhood Street and Neighbourhood Collectors or lower classification roads unless otherwise directed by the Engineer.

- a) Mini Catchbasins shall be installed to collect runoff water when major roadways are reconstructed during the period between installation of base asphalt and surface asphalt. The mini catchbasins shall conform to the ABT Polydrain 900 Series. (See Fig. 5.9)
- b) Mini catchbasins shall only be installed at the sag points of vertical curves, directly in front of the Curb Inlet Catchbasin, and finished flush with the base asphalt. The mini catchbasin shall be connected to the CICB with a 150mm PVC lead. The frame and grate of the mini catchbasin shall be D.I., with stainless steel latches, have a nominal 67% open area, be bicycle proof, and meet HS25 load ratings for roads and highways. Mini catchbasins are to be retrofitted, installed after the base asphalt is applied.
- c) Prior to surface asphalt placement, the mini catchbasin frame and grate shall be removed and the catchbasin pot and lead shall be completely filled with concrete. The CICB shall be completely sealed with concrete and parged.

5.16.16 Catch Basin Subdrains

Pipe subdrains shall be provided on both sides of all catchbasins installed in hard surface areas. Subdrains are not required in rear lot catch basins or in catch basins located in grassed areas, with the exception of parks and open spaces.

All subdrains shall be 150mm diameter, minimum 3.0m long, either of perforated corrugated steel pipe or PVC pipe. Perforations shall consist of 6mm holes in four rows positioned at 4, 5, 7 and 8 o'clock and 75mm apart longitudinally in both materials.

Pipe subdrains shall be connected to the 200mm knockout provided in the catch basin pot, typically at subgrade elevation, shall be laid parallel with the curb, and at the same grade as finished road grade. Pipe subdrains shall be capped at the upstream end with a pre manufactured end cap or with cement brick and non shrink grout.

Where pipe subdrains are required for use as a French drain in lot drainage situations, pipe subdrains shall be fully bedded in 19mm stone, which, in turn, will be completely surrounded by geotextile.

For all other conditions, pipe subdrains shall be completely wrapped in Terrafix 270R or approved equivalent.

All connections should be in accordance with **City of London Drawing Standards SW-3.1**.

5.17 EASEMENTS

Easements are required for all sewers to be assumed by the municipality located outside a road allowance on privately owned property.

An easement is required to ensure the municipal services and utilities crossing the site can be properly installed and maintained by the appropriate authority (municipality or

private). An easement provides the right to use private land for a specific purpose which is in the public's interest.

All maintenance holes located within easements require surface access. Refer to Section 5.14.14 for access details. Maintenance vehicle access is not required for rear lot catch basin maintenance holes.

5.17.1 Types of Easements

a) Multi-purpose Easement for Municipal Services

Are required for watermains, sanitary & storm sewers, catchbasins, drains, stormwater management ponds, channels and/or access roads that cross a site and which are maintained by the City.

Note: Typically, easements are not required for rear yard catchbasins. If rear yard catchbasins are designed to receive water from municipal lands, such as parklands, easements are required.

b) Utility Easement

Utility easements are required for telephone, hydro, gas and cable television services. Each utility company should be consulted for their specific requirements.

c) Private Easements

Private easements are required for private storm sewers, access roads and other private services that cross a parcel of land to service other private lands. A joint access and maintenance agreement between interested parties shall be entered into.

d) Temporary and Working Easements

Temporary easements are required for watermains, sanitary & storm sewers, drains, stormwater management ponds, channels and/or access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

Working easements are required, as necessary during construction, to allow for the safe construction and restoration of the disturbed surface area. Once construction is completed, the working easement is released.

Temporary easements are required for storm sewers and access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

5.17.2 Easement Widths

Easement widths are determined by the diameter of the pipe being installed and the depth of cover from the centreline of the road/ground over the pipe to the invert of the sewer or watermain. Figure 3.6 shows how an easement width is determined. The minimum width of a sewer easement shall be 4.8 m (2.4 m per side).

5.18 STORM SEWER INLET AND OUTLET STRUCTURES - HEADWALLS

Headwalls are required at the end of all storm sewer systems which provide for a transition from the storm sewer to an open channel, river, creek, SWM pond or other

receiving body of storm water. In some cases headwalls are required at the inlet of a storm sewer and/or large storm drain.

5.18.1 Types of Headwalls

The following headwall designs are based on the velocity and in certain cases the diameter of the storm sewer, which was taken from Municipal Works Design Manual (Municipal Engineers Association - MEA) and Ontario Provincial Standard Drawings.

There are five types of headwall designs and they are as follows:

- a) Under 1.3 m/s with pipes diameters under 600 mm - see OPSD 804.03 for details and additional design information.
- b) Under 2.1 m/s – MEA Type I (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04)
- c) 2.1 m/s to 2.7 m/s - MEA Type II (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04; and 1 baffle post)
- d) 2.7 m/s to 4.6 m/s - MEA Type III (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04; and 3 baffle posts)
- e) 4.6 m/s to 10.0 m/s - MEA Type IV (stilling basin), or detail design.

5.18.2 Concrete Strength

The concrete for all headwalls is to have a minimum strength of 30 MPa with a 5% to 7% air entrainment and 70 to 90 mm slump.

5.18.3 Chamfers

All exposed corners of all headwalls should be chamfered 25 mm or more depending on the size of the headwall.

5.18.4 Weeping Tiles

Weeping tiles are to be provided on each side at the base of the sewer outlet and extended through the headwall. On larger headwalls they are placed on the side or wing walls.

5.18.5 Baffle Posts

Baffle posts are to be provided for sewer flows between 2.1 m/s and 4.6 m/s. The location of the posts are per the type of headwall (refer to Municipal Works Design Manual). The height of the baffle posts should be equal to the full depth of flow. Sizing of the posts are 1/6 the size of the pipe diameter together with reinforcing bars.

5.18.6 Grill/Grates

Hot dipped galvanized grills/grates are to be placed over the storm outlets horizontally or vertically as required and should be fixed to the headwall with anchor bolts. Grills and grates shall comply with OPSD 804.05.

5.18.7 Railing

A railing is required on all headwalls which exceed 1.0 m in height from the top of the headwall to the proposed top of slope. See OPSD 980.101 for details and additional design information. All headwalls are to have a swale at the top of the structure to allow for surface drainage.

5.18.8 Rip Rap/Rock Protection

Rip rap is to be constructed at the end of all headwalls of all storm sewer systems and is to be placed in accordance with OPSD 810.01 and the following design criteria:

- a) on the bottom and sides up to design water levels;
- b) downstream until the projection of the side walls meet the channel side slopes at half the design water depth of flow; and
- c) for headwalls at creeks and rivers, extend rip rap or gabion protection to creek or river.

Protection is to provide a smooth hydraulic flow for headwall discharge and creek or river flows.

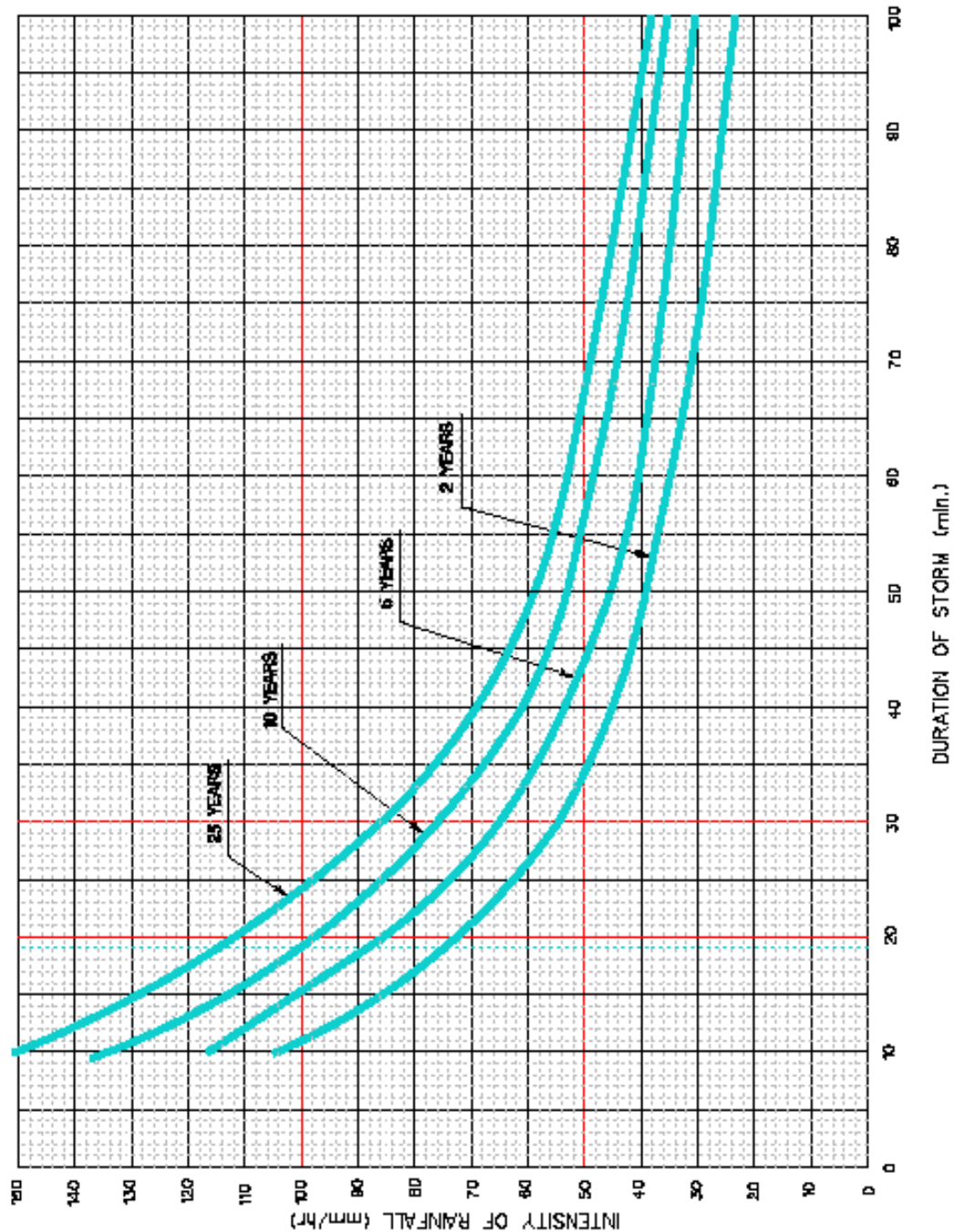
Note: Rip rap design information etc. is to be in compliance with OPSS-1004. The minimum size of rip rap is 100 mm and the maximum size is 200 mm. Rock protection shall be well-graded in sizes ranging from 100mm to 500mm.

5.19 EROSION & SEDIMENT CONTROL

The City of London requires an Erosion & Sediment Control Plan (E&SC Plan) be designed for most Capital Works, Operational and Development Projects. The complexity of the E&SC Plan is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area; an E&SC Plan is not required, unless otherwise directed by the City Engineer. Where an E&SC Plan is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the E&SC Plan, please refer to Section 10 – Sediment & Erosion Control, within this manual.



NOTE: 1. ALL INFORMATION TAKEN FROM JAMES F. MacLAREN
ASSOC. LIMITED / 1962 REPORT

CITY OF LONDON

RAINFALL INTENSITY – DURATION CURVES FOR STORM SEWER DESIGN

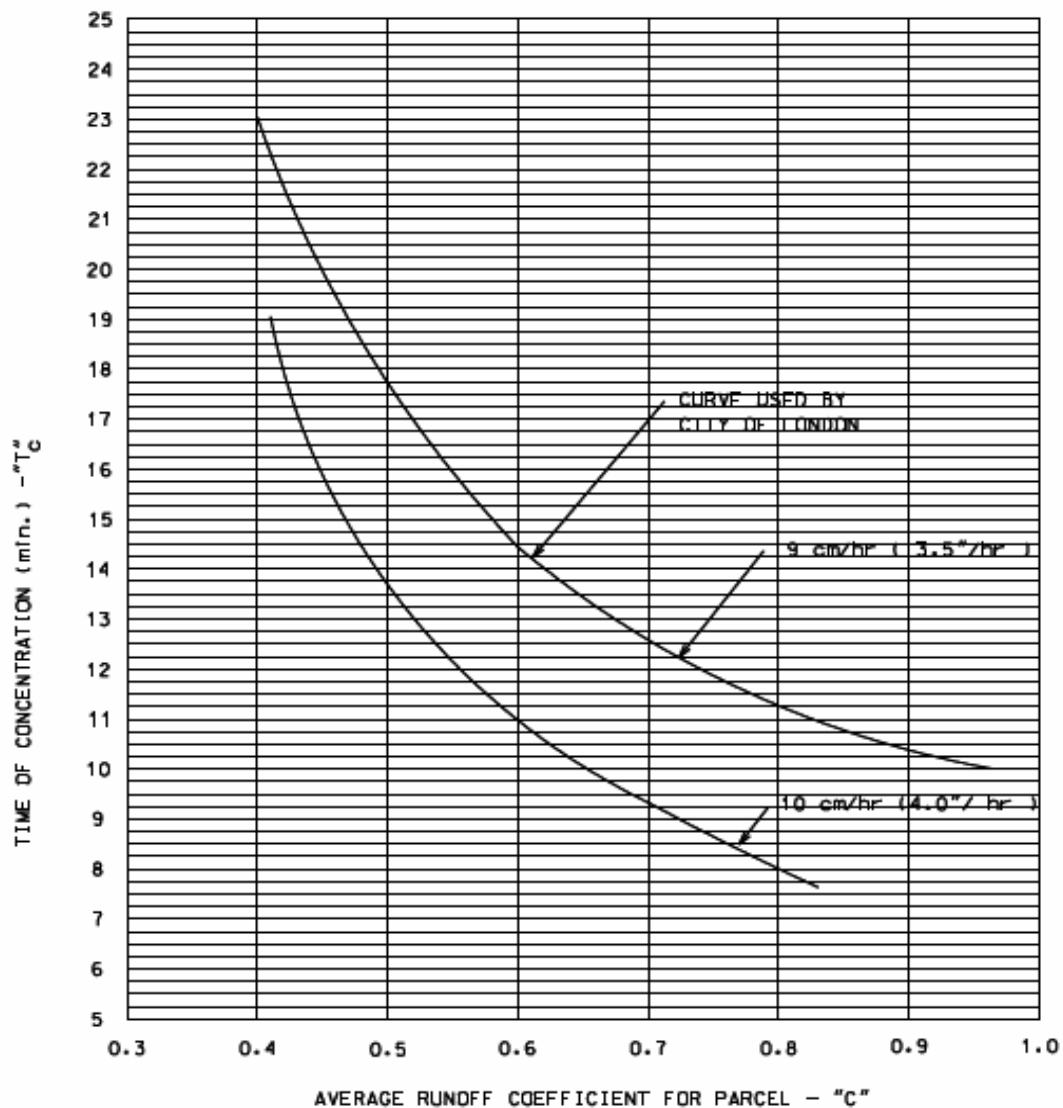
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FIG. 5.2

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CITY OF LONDON

AVERAGE RUNOFF COEFFICIENT TO TIME OF CONCENTRATION

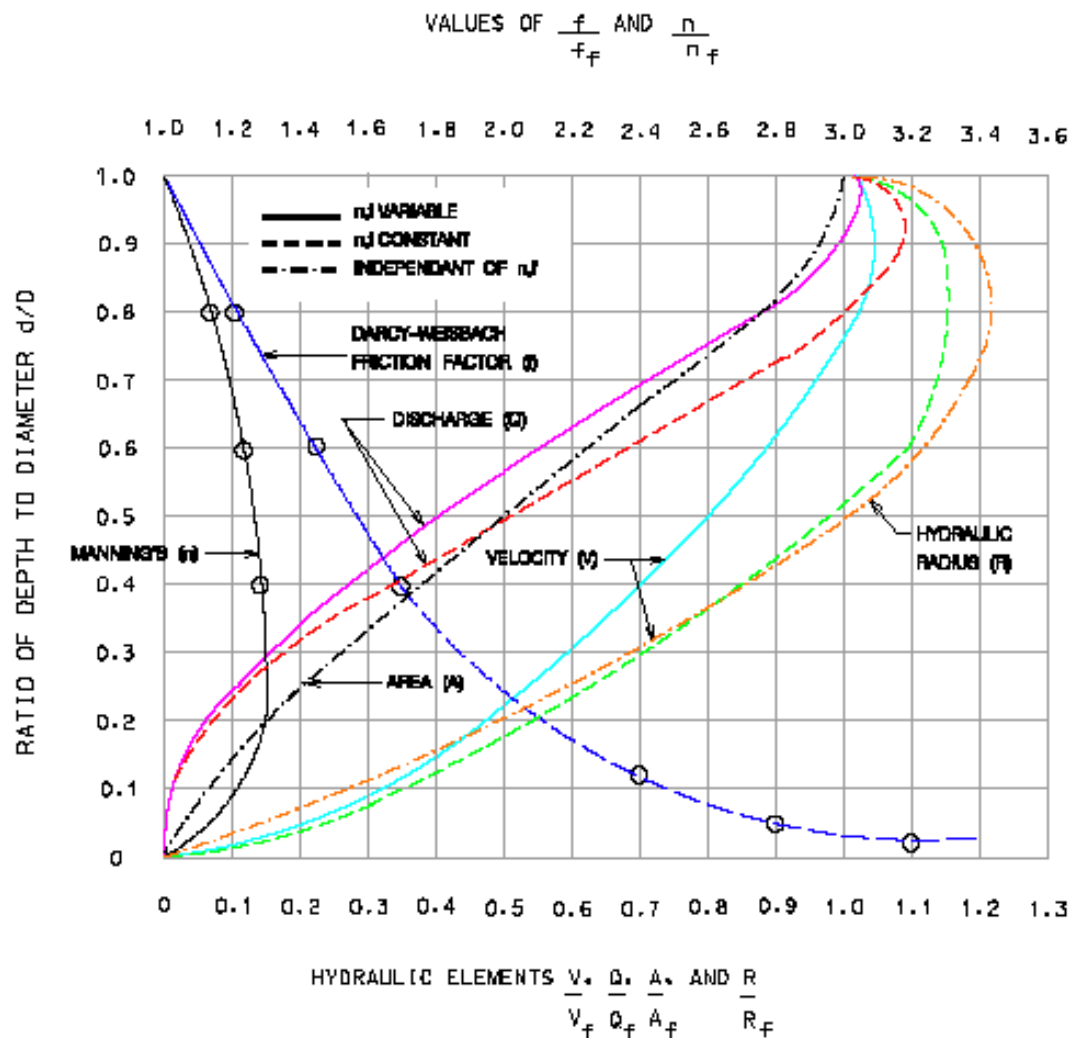
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FIG. 5.3

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Figure 5.3 Average Runoff Coefficient to Time of Concentration



NOTE:

1. INFORMATION TAKEN FROM THE AMERICAN SOCIETY OF CIVIL ENGINEERS (A.S.C.E.) MANUAL.

CITY OF LONDON

HYDRAULIC ELEMENTS GRAPH FOR CIRCULAR SEWERS

DWG

FIG 5.4



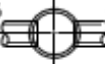

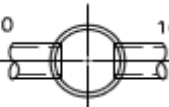

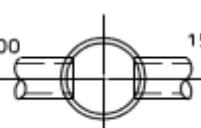
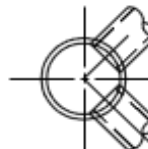
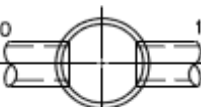

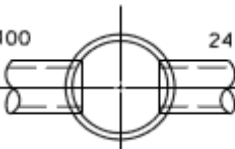

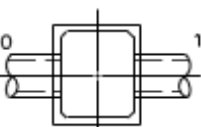
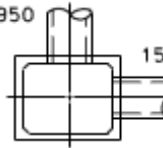
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Figure 5.4

Hydraulic Elements Graph for Circular Sewers

MAINTENANCE HOLE [INSIDE DIAMETER (mm)]	MAX. PIPE SIZE FOR STRAIGHT THROUGH INSTALLATION (mm)	MAX. PIPE SIZE FOR RIGHT ANGLE INSTALLATION (mm)
1200	600 	 450 450
1500	825 	 600 600
1800	1050 	 825 825
2400	1500 	 1050 1050
3000	1950 	 1500 1500
3600	2400 	 1650 1650
3000 x 2400	1950 	 1950 1500

NOTES

1. ALL DIMENSIONS ARE FOR CONCRETE PIPE.
2. ALL DIMENSIONS ARE IN MILLIMETRES
3. KNOCKOUTS FOR SMALL DIAMETER CATCH BASINS LEAD SIZES 300mm OR LESS COULD BE PROVIDED IN ADDITION TO WHAT IS SHOWN.
4. INFORMATION TAKEN FROM THE ONTARIO CONCRETE PIPE ASSOCIATION (O.C.P.A.)

CITY OF LONDON

MAXIMUM PIPE SIZES FOR PRECAST MAINTENANCE HOLES

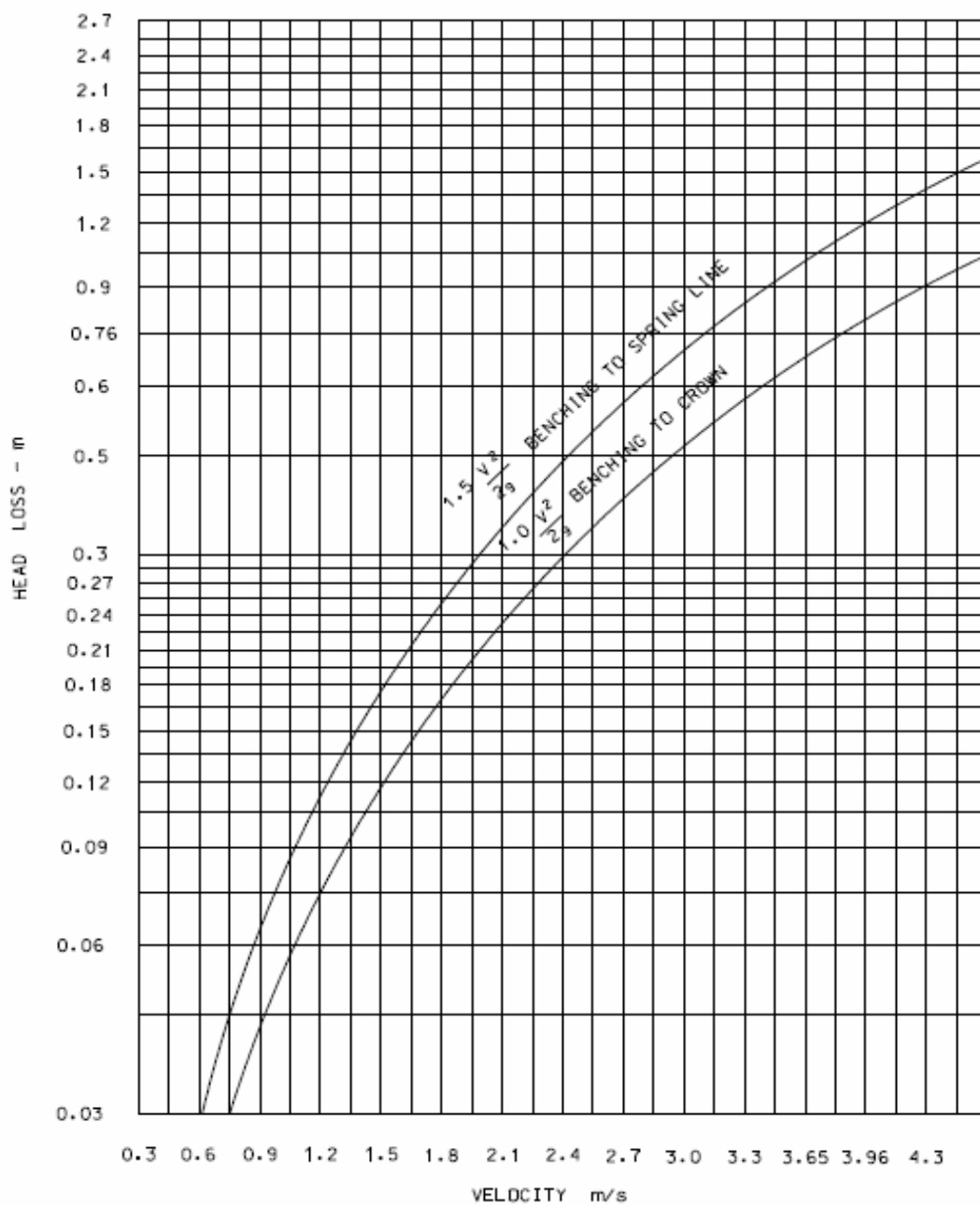
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FIG. 5.5

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Figure 5.5 Maximum Pipe Sizes for Precast Maintenance Holes



CITY OF LONDON

HEAD LOSSES IN MAINTENANCE HOLES

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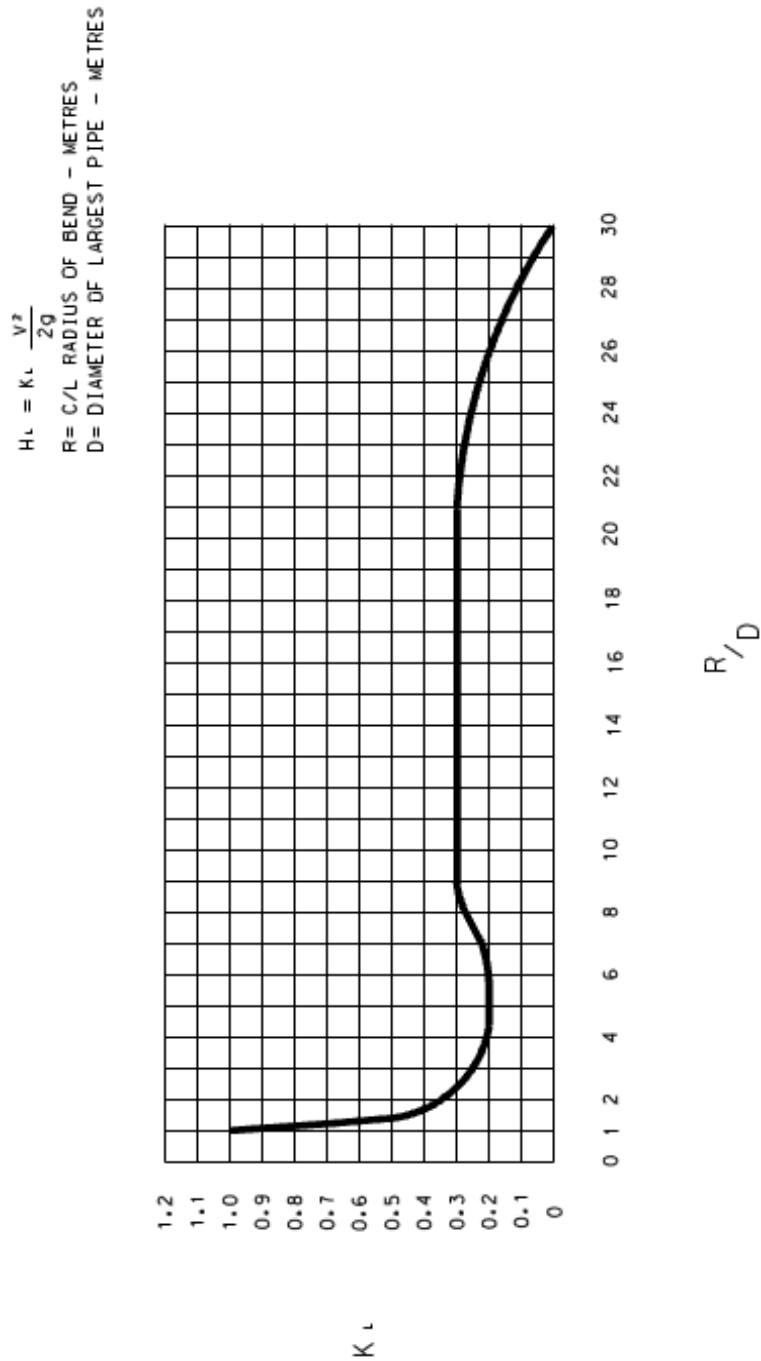
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Figure 5.6

Head Losses in Maintenance Holes



CITY OF LONDON

K_L VALUES FOR CALCULATING HEAD LOSSES IN CURVED SEWERS

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FIG. 57

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Figure 57 K_L Values for Calculating Head Losses in Curved Sewers

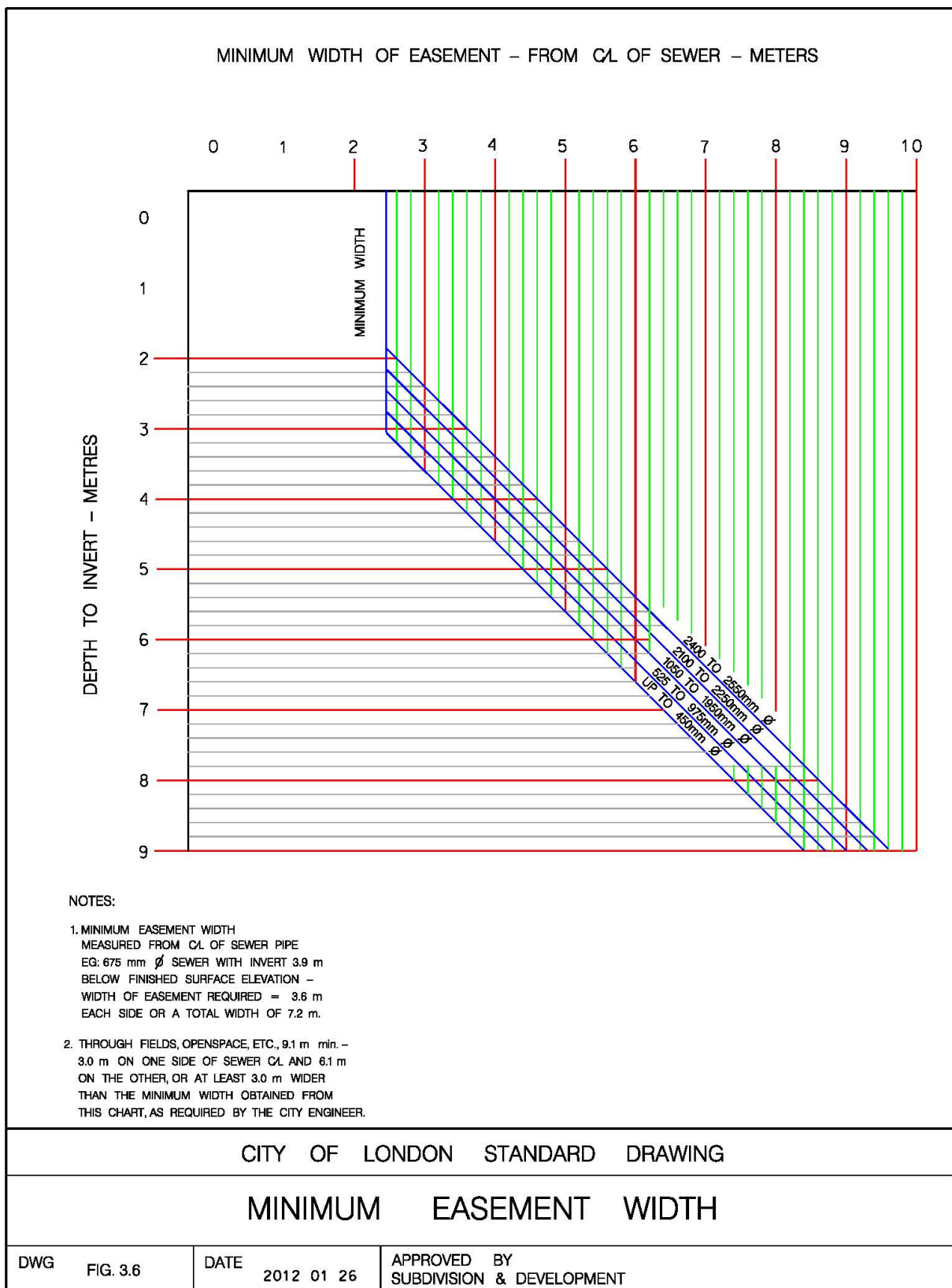
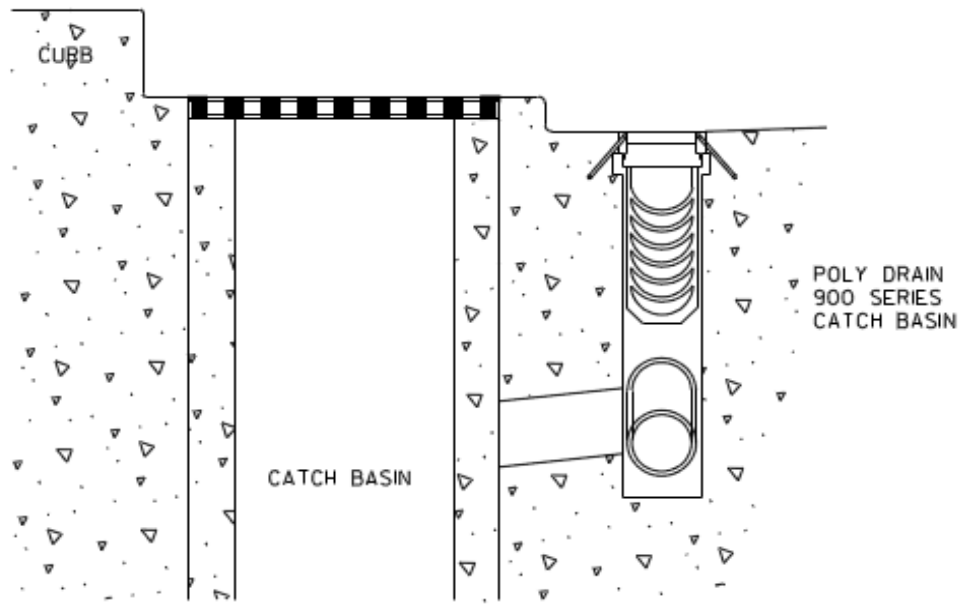
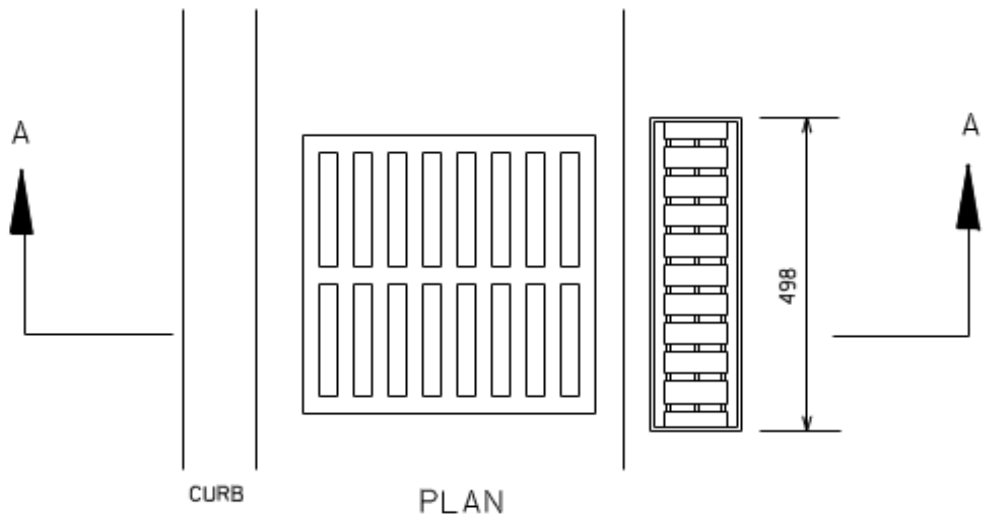


Figure 3.6

Minimum Easement Width



SECTION A-A



*2542A
D.I. FRAME AND GRATE
W/ STAINLESS STEEL LATCHES

CITY OF LONDON

ABT SERIES 900 MINI CATCH BASINS

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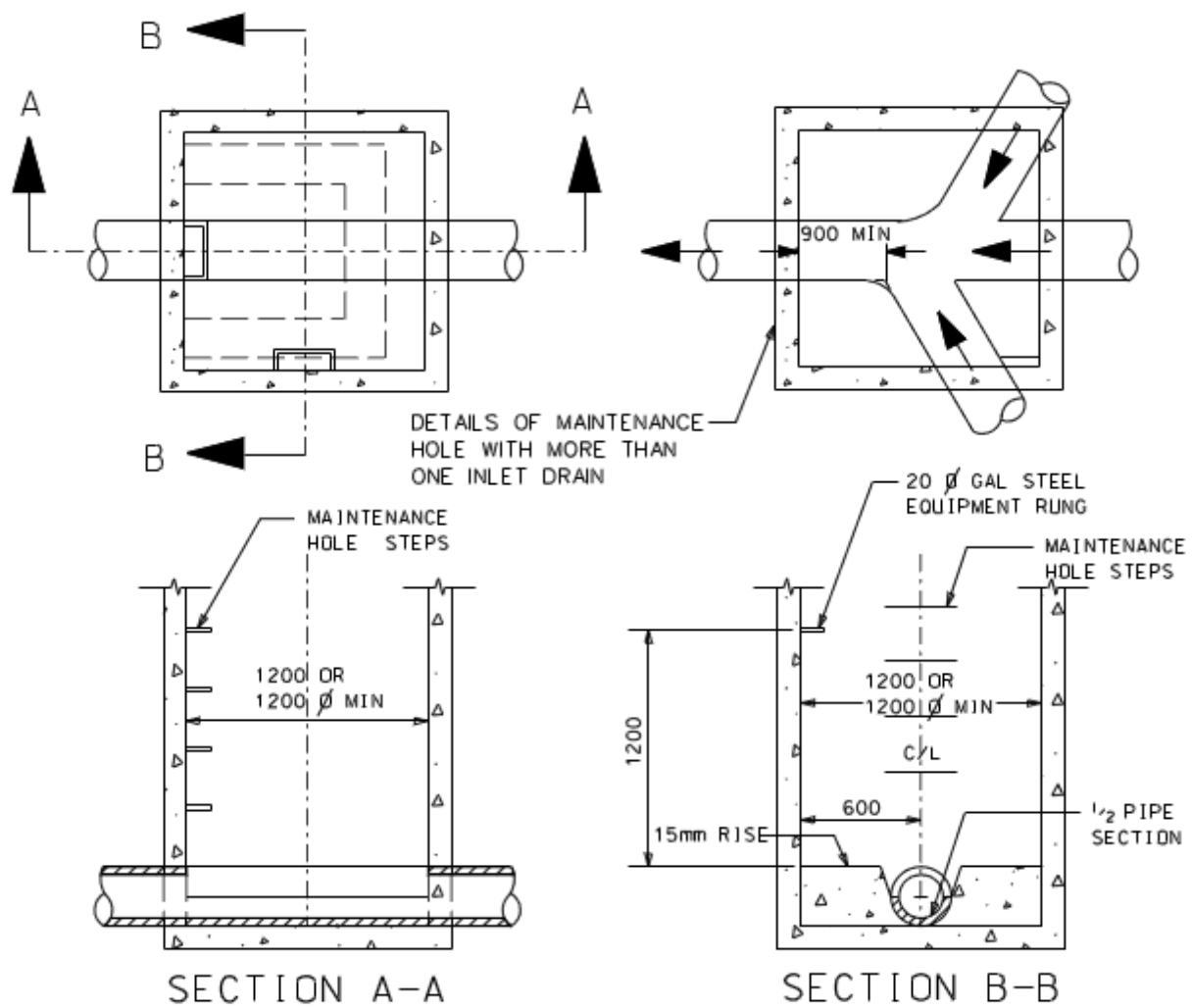
FIG. 5.9

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Figure 5.9

ABT Series 900 Mini Catch Basins



NOTES:

- 1) DETAILS NOT INDICATED SHALL BE IN ACCORDANCE WITH CITY OF LONDON STANDARDS FOR MAINTENANCE HOLE CONSTRUCTION
- 2) MAINTENANCE HOLE SHALL BE LOCATED ON PRIVATE PROPERTY AS CLOSE AS POSSIBLE TO THE PROPERTY LINE OR AS APPROVED BY THE CITY ENGINEER.
- 3) 1200mm DIAMETER, OR LARGER, PRECAST MAINTENANCE HOLE TO THE CITY OF LONDON STANDARDS IS ACCEPTABLE.
- 4) LARGER MAINTENANCE HOLE SIZE WILL BE REQUIRED IF NOTED ON BUILDING PERMIT APPLICATION DRAWINGS.
- 5) MAINTENANCE HOLES THAT HAVE MORE THAN ONE INLET SEWER WILL BE INCREASED IN SIZE TO ENSURE A MINIMUM OF 900mm BENCHING LENGTH DOWNSTREAM OF ALL INLET SEWERS (SEE DETAILS ABOVE)
- 6) MAINTENANCE HOLE STEPS TO BE IN ACCORDANCE WITH DPSD-405.010 & DPSD-405.020
- 7) CLASS OF CONCRETE :30MPA AT 28 DAYS

NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

CITY OF LONDON STANDARD DRAWING

SAMPLING MAINTENANCE HOLE SANITARY & STORM SEWERS

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FIG 5.10

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Figure 5.10 Sampling Maintenance Hole Sanitary & Storm Sewers

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Design Specifications & Requirements Manual

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6 STORMWATER MANAGEMENT REQUIREMENTS

INTRODUCTION

Since the late 1990s, municipalities in Ontario have constructed wet ponds to provide water quality benefits and to attenuate increased peak flows generated by new development. Wet ponds effectively reduce downstream flooding and provide water quality benefits; however, they do not reduce the additional **volume** of rainwater that is generated by increased imperviousness. This additional volume may cumulatively increase sustained peak flow that can be attributed to flooding, degradation, and disruption of water balance in downstream streams, wetlands, and woodlands.

In February 2015, the Ministry of Environment Conservation and Parks (MECP) issued an Interpretation Bulletin stating the provincial expectation as “going forward, the Ministry expects that stormwater management plans....will employ Low Impact Development (LID) in order to maintain the natural hydrologic cycle to the greatest extent possible”. The primary goals of Low Impact Development are to better mimic the natural hydrologic cycle by infiltrating (soak it up) or filtering (slow it down) stormwater runoff where it falls (at the source), rather than sending all flows to one central facility.

The City of London recognizes LID practices as important tools in an expanding toolbox for stormwater management. In recognition of the provincial direction and the evolving practices of stormwater management, the City of London’s design standards include guidance on water balance and best management practices associated with implementing LIDs.

INTENT

The SWM design standards are intended to communicate the City of London’s SWM design expectations, all in the context of current provincial and federal legislation, with regard for local conditions and municipal experiences related to operations and maintenance.

The City of London design standards are not exhaustive and there may be additional design criteria that emerge through consultation with internal and external partners, or due to emerging provincial or federal legislation. The Stormwater Engineering Division is available for consultation related to site specific design criteria and encourages open discussion, particularly as it relates to complex sites.

2019 UPDATES

The following chapters of the SWM Design Standards were included or revised in 2019:

- **6.1 Design References** provide the governing legislation, as well as the City of by-laws, design guidance and applicable background studies that should be considered when engineering consultants are embarking on a stormwater management design. The City’s SWM checklists have been streamlined from the previous versions.
- **6.2 Surface Water Considerations** describes general water quality, quantity, and erosion control objectives and introduces a stormwater servicing hierarchy and runoff volume control targets to promote infiltration, filtration, or attenuation.
- **6.3 Groundwater Considerations** provides direction on how to effectively evaluate the influences of the sub-surface groundwater table and guidance towards

presenting a meaningful water balance, or feature-based water balanced as required.

- **6.4 Design Requirements** defines expectations to include during the stormwater design process including overland flow routes and catchment delineation as well as general expectations with respect to hydrologic modelling and the selection of parameters.
- **6.5 Stormwater Practices** consider various types of SWM facilities within the City of London, including Low Impact Development (e.g. biofiltration cells, third pipe systems), smaller water quality systems (e.g. oil grit separators), as well as end of pipe facilities (e.g. wet ponds, dry ponds). The order of this section reflects the provincial hierarchy related to managing stormwater runoff: (1) infiltrate, (2) filtrate, and (3) attenuate.

The following sections remain largely unchanged from the 2018 design standards, although some sections have been removed/edited to reflect current practices:

- Interim Conditions,
- Sediment and Erosion Controls,
- Permanent Private Stormwater Systems,
- “Just in Time” Design and Construction of SWM Facilities Policy, and,
- Commissioning Considerations,

Objectives

The objectives of the proposed SWM Design Standards and Requirements are to:

- 1) Minimize the risk of threat to life, health of the public, and property damage as it relates to surface flooding and overland flows;
- 2) Ensure compliance with all applicable municipal requirements and provincial/federal legislation;
- 3) Protect watercourses against erosion, degradation, and sediment loading;
- 4) Design and construct stormwater management facilities that are sustainable to operate and maintain, integrate within the urban community, and support ecosystems and watershed requirements;
- 5) Protect the natural water balance, particularly in areas that influence the health of the Natural Heritage System; and,
- 6) Promote and support innovation in stormwater management practices.

6.1 DESIGN REFERENCES

6.1.1 Applicable Acts

Provincial

[Clean Water Act \(2006\)](#)

[Conservation Authorities Act \(1990\)](#)

[Drainage Act \(1990\)](#)

[Environmental Bill of Rights \(1993\)](#)

[Municipal Act \(2001\)](#)

[Ontario Water Resources Act \(1990\)](#)

[Ontario Endangered Species Act \(2007\)](#)

[Ontario Environmental Protection Act \(1990\)](#)

[Ontario Provincial Policy Statement](#)

[Environmental Assessment Act \(1990\)](#)

Federal

[Species at Risk Act \(2002\)](#)

[Fisheries Act \(1985\)](#)

[Canadian Environmental Assessment Act \(1999\)](#)

6.1.2 Applicable City of London By-laws and Official Plan

[Wastewater & Stormwater By-law - WM-28](#)

[Drainage By-law - WM-4](#)

[Basement Flooding Grant Program - A.-7562-160](#)

[Industrial Oversizing Reserve Fund By-law - A.-5840-172](#)

[Development Charges By-law](#)

[Official Plan](#)

6.1.3 General Stormwater Design References

[Stormwater Management Practices Planning and Design Manual](#) (MOE, 2003)
Ministry of the Environment, 2003

Ministry of Transportation, Drainage and Hydrology Section, Quality and Standards Branch, 1995

[Low Impact Development Stormwater Management Planning and Design Guide](#)
Sustainable Technologies Evaluation Program, Living Website

[Low Impact Development Stormwater Planning and Design Guide](#)
Credit Valley Conservation and Toronto Region Conservation, 2011

[Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications](#)

Conservation Authorities Geoscience Group, June, 2013

[Wetland Water Balance Monitoring Protocol](#)

Toronto and Region Conservation Authority, 2016

[Water Management, Policies, Guidelines, Provincial Water Quality Objectives \(PWQO's\)](#)

Ministry of Environment, Conservation and Parks, 1994

[Land Development Guidelines for the Protection of Aquatic Habitats](#)

Department of Fisheries and Oceans, Ministry of Environment, Lands and Parks, 1992

Thornthwaite, C.W.; Mather, J.R. 1957. Instructions and tables for computing potential evapotranspiration and the water balance. Publication in Climatology 10: 185-311.

[Environmental Planning Policy Manual for the Upper Thames River Conservation Authority](#)

Upper Thames River Conservation Authority, 2006

[Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications, June, 2013.](#)

6.1.4 City of London Background Information

The City of London has and continues to complete subwatershed studies, Municipal Class Environmental Assessments, and Functional Designs for SWM facilities across the City. These studies provide subwatershed-wide or area-specific design criteria or may assist to inform the stormwater management strategy for your site. All consultants must review the applicable studies to verify if there are any watershed or area specific design criteria applicable to the site.

These reports are posted online as “Stormwater Consultant Resources” at the following link:

<http://www.london.ca/business/Resources/Consultant-Resources/Pages/Stormwater-Consultant-Resources.aspx>

All engineering drawings, GIS files, and topographic/LIDAR information are available to engineering consultants via a request to the Geomatics Division using the following link:

[Open Data – Dataset Request Form](#)

6.1.5 City of London SWM Checklists

The City of London has developed checklists to itemize the general requirements for stormwater management designs as follows:

- Table 1 Subdivision Application, Stormwater Engineering Checklist
- Table 2 Site Plan Application, Stormwater Engineering Checklist
- Table 3 Low Impact Development Design Checklist
- Table 4 Hydrogeology Assessment Checklist

6.1.6 Agency Approvals

In accordance with Section 53 of the Ontario Water Resources Act, stormwater management works are considered Sewage Works that may require an Environmental Compliance Approval (ECA). The following guidance is available from the province:

[Guide to applying for an environmental compliance approval](#)

[O. Reg 525/98: Approval Exemptions](#)

The province has granted the City of London an expanded Transfer of Review Program for stormwater Sewage Works. Please contact the Stormwater Engineering Division to determine if your project qualifies under this program.

Please note that a Section 28 permit from the applicable Conservation Authority (CA) is required as part of the ECA application and is also often required for stormwater works

within or in proximity to lands regulated by the CA. See Section 28 of the Conservation Authorities Act for details. When in doubt, please contact the applicable CA to confirm.

Other approvals may apply. The onus is on the consulting engineer to confirm all necessary approvals.

6.2 SURFACE WATER CONSIDERATIONS

The purpose of this section is to communicate the City of London's expectations related to the water quality, and quantity control targets. This section introduces a runoff control hierarchy to satisfy water quality, erosion, quantity and water balance requirements.

6.2.1 Water Quality Control Objectives

One of the main purposes of stormwater management is to reduce the impact of development and urbanization on our natural watercourses. Stormwater management water quality objectives and targets are intended to protect aquatic habitat in the downstream receiver.

In London, specific water quality control targets may be specified by subwatershed studies or be required to protect and enhance a sensitive feature identified through a natural heritage review of the study area (e.g. Environmental Impact Study (EIS)). Typically, all discharge to the Thames River and major tributaries will be required to meet a Normal (70% TSS removal) water quality standard. Some studies such as, but not limited to the Medway, Stanton and Mud Creeks Subwatershed Study and the Pottersburg and Crumlin Subwatershed Study specify an Enhanced (80% TSS) water quality standard in some areas.

These studies may identify the protection of wildlife habitat, Species at Risk, wetland/woodland features, a cold or cool water fishery, or other sensitive features that will need to be considered through the development of stormwater control measures and requirements as agreed upon by appropriate City staff (i.e. Stormwater Engineer, Ecologist, Hydrogeologist, etc.), all the satisfaction of the City Engineer.

6.2.1.1 Water Quality Targets

The City of London requires engineered stormwater management systems to satisfy water quality requirements for peak flows and volumes up to the 25 mm storm event.

A 25mm volume capture target represents the first flush runoff event and generally 90% of storm events in Ontario. The water quality event is also identified by the province to be a 25mm, 4 hour event in accordance with Section 4.6 of the 2003 MOE manual.

Development applications within a site plan or subdivision process, are encouraged to capture the first 25mm of any rain event on site within a stormwater management system to satisfy water quality and water balance criteria.

Implementing infiltration or filtration measures for a volume representing the 25mm event will be accepted to meet Total Suspended Solids (TSS) reduction target requirements. It should be noted that infiltration systems often require a water quality pre-treatment system to reduce sediment loading and prolong maintenance intervals.

6.2.1.2 Stormwater Management Control Hierarchy

To meet current water balance and water quality requirements, source controls should be included as a part of the overall stormwater management strategy to complement traditional solutions or to stand alone as a complete lot level solution.

When initiating a stormwater management design, consultants are recommended to first evaluate the types of SWM infrastructure systems to be designed within the following hierarchy:

- **Priority 1 (Infiltration – Retention by native soils):** infiltration to the extent possible, evapotranspiration, re-use to recharge shallow or deep groundwater, reuse collected rainwater for internal or external uses; generally applicable in highly favorable soil conditions without high groundwater.

General outcomes: *no discharge to the municipal storm sewer system; can partially or fully satisfy water quality and water balance requirements.*

- **Priority 2 (Filtration - Volume Capture and Release):** LID filtration technologies filter runoff and typically include a subdrain connected to the storm sewer or conveyance system; generally applicable to tighter soils.

General Outcomes: *peak shaving/controlled discharge to the municipal conveyance system; can partially or fully satisfy water quality and water balance requirements.*

- **Priority 3 (Other Volume Detention and Release):** filtration, hydrodynamic separation (i.e. end-of-pipe facilities, oil grit separators) to detain and/or treat runoff; generally applicable to tight soils, high groundwater table or contaminated sites.

General outcomes: *attenuated discharge to the receiving watercourse or storm sewer; these systems can satisfy water quality requirements but do not benefit the water balance.*

NOTE:

- Water quality requirements may be satisfied through implementing a combination of Priority 1, 2, or 3 stormwater management systems to manage the first 25mm of stormwater volume.
- However, water balance mitigation can only be achieved through design and implementation of Priority 1 or Priority 2 stormwater management systems. Therefore, the City strongly encourages the implementation of Priority 1 or 2 systems to satisfy both water quality and water balance criteria.

6.2.1.3 Clarification: Where to apply Water Quality Targets

Providing Water Quality Control applies to both new and applicable redevelopment or retrofit projects as follows:

- (a) For site plan applications,
 - i. Water quality control shall be provided to all new and redeveloping industrial, commercial, institutional and medium/high density residential developments where the number of new or pre-existing at-grade parking spaces is 30 or greater.

- ii. See Section 6.9 policy regarding the roles of Permanent Private Systems and municipal stormwater systems in Site Plan servicing.
- (b) For single family residential subdivisions,
- i. Water quality control shall be provided through municipal stormwater management systems.
 - ii. The consultant should confirm if a Master Plan or Municipal Class Environmental Assessment has (1) been completed for the drainage area of the subdivision and (2) identifies an associated SWM facility.
 - iii. New SWM Facilities are constructed in accordance with the City's "Just in Time" servicing policy. See Section 6.10.

(c) Municipal Road Reconstruction Projects

- i. Best efforts should be made to retrofit water quality controls for Rapid Transit Boulevard, Main Street, Urban Thoroughfare, or Civic Boulevard roads during reconstruction projects. Water quality control shall be provided for any additional impervious surface area (e.g. road widening projects).
- ii. Water quality controls should be retrofitted on neighbourhood streets where feasible and practical.

As part of a complete development application, consultants should identify the type of systems being recommended as Priority 1, 2, or 3 systems and provide a brief rationale regarding the type of SWM that is being recommended. The rationale should identify any constraints that would prohibit the implementation of Priority 1 or 2 systems including but not limited to:

- High groundwater table (a separation of less than 1.0 m may be acceptable upon review of site conditions);
- Site is located in a high salt loading area (i.e. expressways, urban thoroughfares, civic boulevards, bus routes, some neighbourhood collectors or receives snow storage melt) **and** the seasonal high groundwater elevation poses a concern;
- Conflicts with existing utilities or infrastructure; or,
- Contaminated soils.

NOTE: See Section 6.5 for details. In some cases, it may be possible to mitigate these constraints through implementing a liner or subdrain within the system.

6.2.1.4 Additional Water Quality Considerations

(a) Phosphorus

The City of London is committed to the Lake Erie Action Plan aiming to reduce phosphorus loadings to Lake Erie by 40% before 2025 and a 20% phosphorus loading reduction by 2020. Stormwater systems, including but not limited to, at source controls, are recommended to be considered and included in the planning and design of stormwater management systems for their role in trapping, storing and processing phosphorus.

(b) Groundwater protection

Stormwater activities with the potential to adversely affect groundwater may require provincial approval. Infiltration based stormwater features shall not be used to infiltrate runoff from high risk site activity area or within a contaminated site. For runoff from areas with high chloride loading, consideration for the potential salt loading to the downstream receiver should be considered to mitigate degradation of both surface water and groundwater quality.

(c) Provincial Water Quality Objectives

Provincial water Quality Objectives (PWQOs) and the interim PWQOs can be used as general background conditions of water quality parameters for surface water system in the absence of sampling or any known issues. Overall, the stormwater control objective is maintain or enhance existing surface water quality conditions.

6.2.2 Erosion Control Objectives

In cases where the stormwater management facility outlets to a storm sewer or ditch, a general erosion control storage of 40m³/ha may be applied (MOE, 2003)

In cases where the stormwater management facility outlets to an open watercourse, specific erosion control requirements are to be used. This information may be found within a related to Subwatershed Study or Municipal Class Environmental Assessment.

Where erosion control target information is not available, the consulting engineer shall complete a site specific fluvial geomorphological study to determine the erosion threshold velocity and associated erosion control volume. Continuous simulation modelling may be required as part of this study to demonstrate that there is no net increase in erosive hours within the watercourse. The size of the contributing area of the site relative to the receiver's overall catchment area and the sensitivity of the downstream receiver may be considered to determine erosion control requirements.

In all cases, alteration or updates to the erosion control volume requirements may be considered where a consultant has done a site specific fluvial geomorphological assessment.

Erosion control storage (40m³/ha) is only typically applied to regional wet ponds with long extended detention drawdown for larger developments and is not to be used on smaller site development projects unless specified as a requirement by the City Engineer.

6.2.3 Minor and Major Systems

The City of London design standards require that storm sewers are designed to convey, at a minimum, up to the 2-year storm event, using City of London standards per Section 5. The "Minor System" incorporates storm sewer pipes, catchbasins, roadway gutters and swales, and private storm drain connections for all land uses. The stormwater minor system is designed and constructed to convey the minor flows to prevent frequent flooding in our municipal right of ways, parks, and developed parcels.

Stormwater runoff in excess of the "Minor System" capacity is referred to as the "Major System". During higher intensity storm events, major system flow surcharges the minor system capacity, resulting in overland flows. The major system generally includes infrastructure designed to attenuate up to the 100-year peak flow and safely convey storm events up to the 250-year storm event via road allowances, easements, spillways and channels.

For new developments, stormwater designs are required to control and attenuate up to the 100-year design storm and safely convey the 250-year storm event via overland flow routes. A “major system” area plan and supporting calculations must be submitted as part of the design package during the development approvals process to demonstrate safe conveyance of the major system, identify ponding depths below the maximum as per City of London Grading Standards, and provide erosion protection for events up to the 250-year event.

For all municipal road or renewal projects, a “major system” catchment area plan (including external lands) shall be submitted to the City as part of the Engineering Drawing package and as part of the as-built drawing package to the Geomatics Division. A major system area plan can be incorporated with the grading plan if it includes external areas in addition to ponding limits and overland flow routes.

6.3 GROUNDWATER CONSIDERATIONS

The purpose of this section is to communicate the City of London’s expectations related to the level of detail provided in hydrogeological assessments, and promote consistency of the resulting technical studies.

Where required, a hydrogeological assessment is required to demonstrate:

- Responsible development and infrastructure improvements can proceed without adversely impacting the quantity or quality of existing groundwater and surface water resources, or the ecological community; and,
- The on-site and off-site (i.e., adjacent or downstream) groundwater quality and quantity and its users/receptors will not be adversely affected.

The level of detail to be included in the hydrogeological assessment will depend on the nature of the project, stage in the design process and general location of the site relative to downstream sensitive receivers.

It should be noted that designs that include a subsurface infiltration component, including Low Impact Development (LID) measures or sites that have the potential to impact sensitive receivers, may require long-term groundwater monitoring (i.e. pre and post construction) to adequately establish or monitor seasonal groundwater fluctuations and/or evaluate potential impacts related to developments. This should be considered in the early stages of the planning and design process to ensure the seasonal groundwater fluctuations are captured and used to influence/confirm the proposed design.

6.3.1 Hydrogeological Assessment Requirements

Hydrogeological studies will vary in scope, level of detail, and methodologies depending upon project scale, project location, design constraints, design function, and the study objectives. The overall purpose of the hydrogeological assessment is to evaluate if the proposed development has the potential risk to result in negative short-term or long term impacts to the on-site and off-site (adjacent or downstream) groundwater system(s).

Depending on the actual location of the site and its proximity to potential groundwater receptors, additional information may be required to fully assess the impacts of the development on the natural environment. **It is strongly recommended, that prior to the commencement of a hydrogeological assessment study, the proponent and their consultant undertake pre-consultation with City of London staff to confirm the scope of the required technical study.**

Overall, hydrogeological assessments should generally conform to the requirements listed in the following document:

“Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications, June, 2013.”

As listed in the Conservation Authority Guidelines (2013), a hydrogeological assessment should include, at minimum:

- Evaluation of existing conditions, prior to the proposed development;
- Evaluation of potential impact of the proposed development on the natural system and assessment; and,
- Evaluation of monitoring and/or mitigation measures to reduce the risk of negative short-term or long term impacts to the quality or quantity of the groundwater system.

The City reserves the right to request additional investigation(s) and/or data collection above that listed above, based on criteria and site location that include, but are not limited to, the following:

- Areas of significant groundwater recharge;
- Areas either in proximity to, or within, a wellhead protection area or domestic wells;
- Areas deemed vulnerable with respect to groundwater, surface water, or nearby natural features (e.g. wetlands, woodlands);
- Areas with existing groundwater contamination issues; and,
- Any other conditions deemed relevant by the City.

As it relates to development applications, Table 4 – Hydrogeological Assessment Checklist should be included as part of a hydrogeological assessment report.

6.3.2 Water Balance Requirements

A water balance analysis is required for all developments proposing changes to the site's impervious cover or drainage conditions. Sites proposing alterations which may introduce opportunities for reasonable improvements to overall water balance conditions may also require a water balance analysis as part of the development application process or detailed design process.

The purpose of the water balance exercise is to estimate pre- and post-development infiltration and runoff conditions and identify how proposed stormwater management strategies achieve water balance objectives. The maintenance of pre-development infiltration conditions is a general requirement as groundwater frequently supports significant watershed features that are necessary components to the maintenance of a healthy watershed. The level of detail required in the water balance may vary depending on the site, proposed works, and nearby sensitive receivers.

A detailed water balance assessment would be expected to consider, at minimum, estimates of water surplus and/or deficit using the Thornthwaite and Mather approach (Thornthwaite and Mather, 1957). Depending on the complexity of the site and its proximity to nearby sensitive features, alternate approaches can be considered,

including modeling to assess short-term (event scale) and long-term (annual scale) water balance objectives.

A feature-based water balance may be required to ensure the protection of hydrological sensitive natural features such as wetlands, woodlands, or watercourses. For sites where a simple model would meet the water balance objectives (i.e. no sensitive downstream receiver, no groundwater recharge or baseflow maintenance requirements), analysis utilizing Hydrologic Cycle Component Values included in Table 3.1 of the Stormwater Management Planning and Design Manual (MOE, 2003) may be suitable. It should be noted that the provincial Stormwater Manual (MOE, 2003) offers example estimates only and where possible, local estimates of evapotranspiration and water surplus are to be provided using the Thornthwaite and Mather approach and data obtained from a local climatic station.

Considerations for water balance analysis include:

- A single water balance assessment should be completed as part of a development site or project to identify and mitigate impacts to surface runoff and groundwater infiltration conditions.
- Potential impacts from external drainage areas and their future land uses per the City's Official Plan.

The water balance analysis may be completed as part of a Hydrogeological Assessment (see Section 6.3.1), a stormwater management report, or as a standalone document.

6.4 DESIGN REQUIREMENTS

SWM Facility requirements are to generally conform to the design criteria in this manual, all to the satisfaction of the City Engineer. This section discusses potential systems to meet current SWM criteria.

6.4.1 Catchment Delineation

A catchment area is the delineation of all surface points draining toward one specific outlet that is topographically located at the lowest elevation within the area. Catchment delineation areas shall be provided for both minor (up to 2-year storm events) and major system (up to 250-year storm event). These drainage areas shall be shown and identified in the stormwater management functional report or servicing brief and engineering drawings for the project.

For projects incorporating LID solutions, catchment areas associated with the LID feature shall be provided in addition to the minor catchment areas for the storm sewer and/or catchment areas for major storm events.

Once a project design is accepted by the City Engineer, the final storm catchment areas are to be included in the final as-built drawing package.

6.4.2 Overland Flow Routes

Major flows must be safely conveyed via a defined Overland Flow Route (OLFR) to an appropriate outlet without causing damage to private property or municipal infrastructure, and with minimum risk to the public.

OLFRs must identify any potential barriers to the safe conveyance of stormwater. Any roadways with traffic calming measures such as raised intersections, speed bumps, or raised pedestrian crossings shall provide the following items to demonstrate that the

traffic calming measure(s) will not negatively impact the OLFR conveyance and surrounding municipal and private infrastructure:

- a) R.O.W. flow conveyance calculations/details through the traffic calming measure(s);
- b) Ponding limits and associated depths for the 100 year and 250 year storm events demonstrating conformance to the City's Grading Standards;
- c) Delineation of overland flow catchment area(s);
- d) Inclusion of additional inlets (e.g. curb inlet catchbasin, linear catchbasin, etc.) to allow for increased inflow capacity upstream of the traffic calming measure(s) and to reduce the ponding duration on the R.O.W.;
- e) Items b) and c) shall be shown on the applicable lot grading drawings or on a separate drawing for clarity.

Only under extenuating circumstances will OLFRs be routed through private property and in these extenuating circumstances, a dedicated municipal easement will be required to the satisfaction of the City Engineer and will not be used as a precedent for other developments.

6.4.3 Hydrologic Modeling

SWMHYMO and Visual OTTHYMO are the preferred hydrologic models to be used within the City of London. The City also has a license for PCSWMM. Most industry standard models will be considered, and the City is available for consultation if confirmation is required. For smaller sites, Rational Method or Modified Rational Method may be appropriate.

Consultants may make use of available water resources management manuals and texts as a reference to aid in the selection of hydrologic modeling parameters. Any externally referenced material employed in parameter selection should be properly referenced in the SWM Report and included in the document appendices.

A Professional Water Resources Engineer (Subdivider's Consulting Engineer) is responsible for recommending all SWM modeling parameters to ensure the application of adequate engineering knowledge is applied. At the same time, the City is required to review the proposed SWM systems and selection of the SWM modeling parameters/criteria to ensure compliance with City and Provincial standards, requirements and practices, and also ensure the adequate protection of the people and properties of the City of London.

6.4.3.1 Imperviousness

Current City of London practices for determining site runoff for Conceptual and/or Preliminary SWM plans use the values for Total Impervious Percentage (TIMP) and Directly Connected Impervious Percentage (XIMP).

TIMP represents the ratio of area covered by an impervious surface (e.g. asphalt, concrete) to the entire area. XIMP represents the ratio of impervious areas directly connected to the conveyance system. An example of a directly connected impervious area would be a parking lot, a portion of roof areas, driveways, or roads that contain catchbasins draining to the storm sewer. An example of a non-directly connected

impervious area is an outdoor basketball court surrounded by park land or roof area draining to a rear yard.

The table below lists current City of London preferred TIMP and XIMP values based on land use. These allowable ranges for TIMP and XIMP should be applied at the conceptual/preliminary design stage to ensure sufficient land is allocated for the proposed facility. Adjustment of Impervious Percentage values at the functional/detailed design stage will be considered subject to the consulting engineer providing engineering calculations to justify the revision of these parameters.

Table 6.1: City of London TIMP and XIMP Values

Land Use	TIMP	XIMP
Residential	55% 51% - 60%	45% 43% - 48%
Medium and High Density Residential	70% 65% - 75%	55% 45% - 55%
Commercial/Industrial	75% - 90%	70% - 80%

- i) At the Master Plan level, TIMP and XIMP should be assigned the MAXIMUM (not average) imperviousness allowed by the City.
- ii) At the detail design level, TIMP and XIMP can be assigned the “actual” imperviousness.

6.4.3.2 Methodology for Losses

Losses for the purposes of this section, refer to Initial Abstraction, infiltration, and surface depression storage. The majority of water resources submissions received by the City of London apply the SCS Method, fewer submissions apply the Horton Method and there have been no submission to date that applies the Green-Ampt Method of quantifying runoff. SCS Method, Horton, or Green-Ampt methods are all acceptable modeling techniques.

The LDI recommendation of applying the Horton Method is practiced by the City of London.

6.4.3.3 Initial Abstraction

Initial abstraction (Ia) represents the interception, infiltration, and surface depression storage of rainfall at the beginning of storm events. Current City of London modeling practices recommend the Ia values summarized below:

Table 6.2: Typical Initial Abstraction Values

Land Cover	Typical Values (mm)
Impervious	2
Pervious – lawns	5
Pervious – meadows	8
Pervious - woods	10

Deviation from the above values may be approved at the discretion of the City Engineer. The onus will be on the consultant to provide sufficient rationale to support the alternate

value(s), noting that the values in Table 6.2 are irrefutable and the City retains the right to refuse alternate values.

6.4.3.4 Curve Number

The curve number (CN) is a parameter used to determine the extent of rainfall that infiltrates, rather than becoming surface runoff. CN values must be consistent with provincial guidelines and standard water resources management practices and correspond with the specific geotechnical conditions of proposed developments.

If using a HYMO based model, selection of CN should be correlated with the applied Initial Abstraction (Ia). OTTHYMO model recommends the use of CN*. The CN* procedures account for recalculating CN when an initial abstraction of less than $0.2 \cdot S$ is used. OTTHYMO does not recommend the use of $0.2 \cdot S$ as initial abstraction, requiring the use of CN*.

The N parameter in the SWMHYMO model representing the number of linear reservoirs used for the derivation of the Nash unit hydrograph must be 3.

6.4.3.5 Design Storm Selection

In the design of site plans or subdivisions, the consulting engineer is required to evaluate the study area (i.e. total area, urban vs. rural) and recommend “critical storms” that generate the highest peak flow or the greatest volume.

The storm duration should be selected dependent on the size of catchment and attenuation within the catchment. For smaller, urbanized catchments a shorter duration event (i.e. 3, 4, or 6 hour events) may be a reasonable duration. For larger, rural catchments a 12 or 24 hour event should be considered. Subwatershed studies should be reviewed for specified preferred watershed based design storms.

The most common design storms distributions include the Chicago, Atmospheric Environmental Service (AES), and SCS Type II distributions. The 3 and 6-hour Chicago event distributions are widely accepted as a synthetic distribution to be used in the design of urban areas and the 24-hour SCS event is widely accepted as a synthetic distribution to be used in rural catchments.

Rainfall intensity duration frequency (IDF) storm parameters for the City of London are based on the Environment and Climate Change Canada February 2019 IDF update, with the exception of the 2-year event which remains consistent with the City’s storm sewer design standards (Section 5, Figure 5.2). The table below includes a synthetic 25-mm event for application of the 4-hour water quality event (MOE, 2003). The UTRCA defines the Regional (i.e. regulatory) event as the 250-year event. The UTRCA’s accepted IDF curve values for the 250-year event are included below and should be considered as part of major storm system evaluation for the protection of municipal infrastructure and public safety.

Table 6.3: AES Parameters for Intensity Duration Frequency Curves

Parameter	25mm*	2yr**	5yr	10yr	25yr	50yr	100yr	250yr
A	538.85	1290.00	1183.74	1574.382	2019.372	2270.665	2619.363	3048.22
B	6.331	8.500	7.641	9.025	9.824	9.984	10.5	10.03
C	0.809	0.860	0.838	0.860	0.875	0.876	0.884	0.888

*IDF parameters for the 25 mm event must use a four-hour storm duration.

**Approximate fit to 2 year MacLaren storm sewer design curve (Section 5, Figure 5.2)

Where: Rainfall intensity (mm/hr) = $A/(t+B)^C$, t=duration (minutes)

6.5 STORMWATER PRACTICES

This sections aims to guide the planning and design of stormwater quality and quantity controls that include Low Impact Development (LID) or source control concepts as well as traditional stormwater control measures.

Each site or project will present unique options and challenges. The City encourages innovation as part of any stormwater project.

6.5.1 Best Management Practice Design

During the initial phases of design, consideration for runoff reduction and onsite infiltration should be paramount. The City will accept Best Management Practices (BMPs) that are designed by a Professional Engineer and demonstrate at-source runoff control. These systems may be eligible towards achieving water balance, quality, quantity or erosion control for the project. These stormwater best management objectives can be achieved by:

- **Decreasing Impervious Areas:** The Stormwater Engineering Division strongly supports reductions in impervious area as part of the runoff reduction strategy. This can be presented by demonstrating a decrease in the standard TIMP or XIMP values.
- **Intercepting Runoff:** Runoff from hard surfaces should be conveyed to landscape gardens or grassed area to promote onsite filtration and infiltration, and reduce the volume of water collected by the City storm sewer.
- **Increased Top Soil Depth:** Will not formally meet stormwater management criteria but, to a reasonable extent, may be considered to mitigate water balance deficits.
- **Reduced Lot Grading:** will not formally meet stormwater management criteria but are important factors to better site design, peak flow reduction and are worthwhile to include as part of any SWM strategy.

6.5.2 Low Impact Development (LID)

To provide a short-list of LID types to be planned and designed for land-use types (i.e. Municipal Right-of-Way (ROW), Single Family Residential, and Multifamily, Commercial, and Institutional Sites), the City reviewed LID measures using the following criteria:

- Effectiveness in meeting the 25mm volume capture;
- Ease of construction and integration into current construction practices;
- Cost; and,
- The City's ability to conduct long-term operations and maintenance.

The following identifies appropriate LID stormwater control measures based on land use type:

(a) Municipal Right-of-Way or Easement

1. Third Pipe Systems: consisting of a perforated stormwater exfiltration pipe laid in a granular bedding. This system may be constructed as part of the storm sewer system (e.g. Etobicoke Exfiltration System) or as a perimeter French drain in the boulevard. Third pipe-systems are designed for both conveyance and infiltration of stormwater runoff.
2. Bioretention Systems: describes a vegetated basin that collects stormwater at the source for infiltration and filtration. Bioretention systems can be covered with landscaped plantings and mulch, or grass (naturalized or sod). Most bioretention systems will require an underdrain and an overflow catch basin connected to the storm sewer.

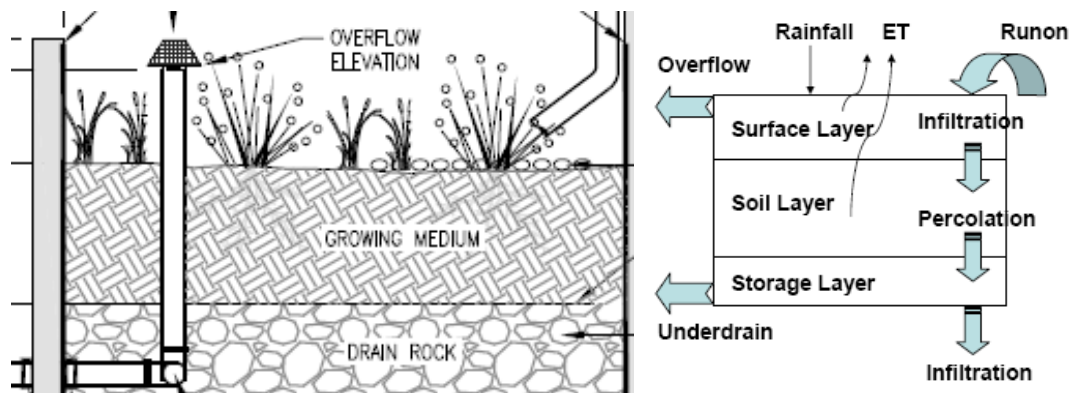


Figure 1: Bioretention System

Source: Rossman, L.A. (2010). Modelling Low Impact development Alternatives with SWMM. Journal of Water Management Modelling, 6062, 167-182. <https://www.chijournal.org/Content/Files/R236-11.pdf>

3. Infiltration Swales or Dry Swales: similar to creating a rural cross section with ditches, swales may be designed to convey stormwater runoff as part of the minor or major system. In favourable soil conditions, the infiltration swale may be able to retain stormwater runoff at-source whereas the dry swale will result in slower flow rates in comparison to a storm sewer system.

Stormwater LIDs located within the ROW or City property will be owned and maintained by the City.

(b) Single Family Residential

Within single family subdivisions, LID features are to be located within the municipal ROW or dedicated municipal easement, where they can be accessed and maintained.

The 2019 Development Charges (DC) One Water Background Study identifies a subsidy for LIDs constructed as part of single family residential subdivisions. Please refer to the DC by-law for details.

(c) Multifamily, Commercial, and Institutional Sites

Bioretention, bioswales, rain gardens, green roofs, permeable pavers, or any other LID features are encouraged for Site Plans where private landscapers and maintenance personnel will be employed on regular contracts.

Multifamily, commercial and institutional sites are likely to provide a large number of parking spots in the form of a parking lot. Parking lots are large areas of impervious surface. The Site Plan Control By-law C.P.-1455-541 dictates *“One “planter” (island) should be provided for every 50 parking spaces”*. It is recommended that these planters be used as small scale LID units to capture and treat a portion of the parking lot runoff through filtration and infiltration.

6.5.2.1 Stormwater Charge Reductions with LID

As an incentive for private site implementation, Section 3.4.2 of the City's Wastewater By-law identifies the opportunity for up to a 50% reduction to the monthly Stormwater Charge for sites greater than 0.4 hectares in size. This reduction is available to sites that implement at-source LIDs or demonstrate reduced impervious areas.

To be eligible to participate in the program the water customer must meet all the following criteria (full program details is listed below):

- Industrial, Commercial, or Institutional property;
- Property area is greater than 0.40 hectares; and,
- Account is not exempt from Stormwater charges.

There are two avenues for a reduction in stormwater billing charges:

- The property classification meets the criteria listed under Section 5.3. of the Wastewater & Stormwater By-law.
- The customer submits a Professional Engineering Storm Drainage Report which demonstrates that there is a stormwater reduction in runoff which is above and beyond the current site plan requirements. The reduction in the stormwater charge will depend on the increased amount of onsite management of stormwater. This report may be submitted independently or as part of the Site Plan process.

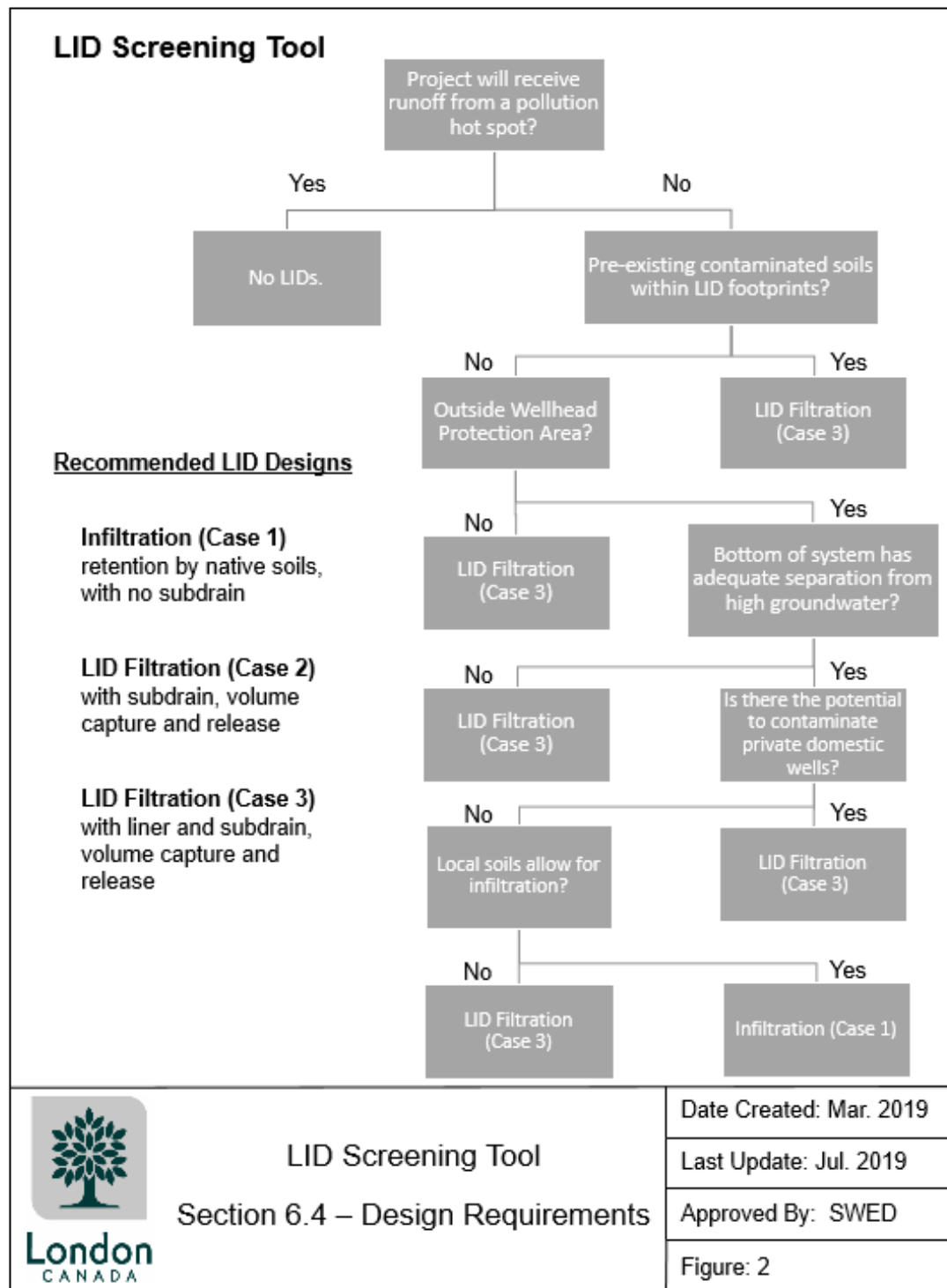
6.5.2.2 LID Screening Tool

The implementation of LIDs or source controls is highly site specific. Some systems may be more appropriate for Site Plans or parking lots rather than the municipal right-of-way. The design of each system must consider a number of factors, including but not limited to site layout, soil conditions, elevation of the seasonal high groundwater table, and

grading. It is equally important to consider lifecycle costs and ongoing operations and maintenance.

Although some sites will have constraints, the provided screening tool will assist with determining which LID options may be applied at each site:

The recommended LID designs highlighted in the Screening Tool will meet **Priority 1** or **Priority 2** of the Stormwater Management Control Hierarchy.



Considerations for LID planning, design and implementation are as follows:

1. **Low Permeability “Tight” Soils:** LIDs can be implemented in all soil types. “Tight soils” with low infiltration rates do not preclude the implementation of LIDs. It is expected that any water that cannot be infiltrated can be filtrated. Adaptations such as underdrains connected to downstream LID facilities or storm sewers may be required for successful implementation. In soils with an infiltration rate of less than 15mm/hr, a subdrain will be required. Site specific infiltration testing may be required to support LID design.
2. **Risk of Groundwater Contamination:** It is important to assess if there are any potential sources of contamination (both surface and subsurface) within the LID drainage area or within surrounding soils prior to the implementation of any LID solution to evaluate the possibility for contaminating groundwater and/or mobilizing contaminant plumes. Although the majority of pollutants in stormwater runoff should be contained within filter media and underlying soils, special attention shall be made to prevent contaminants (particularly de-icing road salts) from reaching the groundwater table.
3. **Groundwater Table:** A reasonable separation distance between the bottom of the infiltration feature and the seasonal high groundwater table should be determined based on local site conditions. For smaller sites that are not in proximity to a natural heritage system, manual groundwater level information collected from monitoring wells may be adequate to assess the location of the water table. In more sensitive cases, it may be necessary to install groundwater monitoring wells equipped with continuous data loggers to capture the seasonal high groundwater elevation.
4. **Winter Operation:** It may be necessary to consider seasonal decommissioning of the LID to avoid damage from ice or winter road salt loadings, particularly if the LID outlets to a sensitive receiver.
5. **Pollution Hot Spot Runoff:** Installation of LIDs should be avoided in areas with the potential for high levels of contaminated runoff (e.g. gas stations, hazardous materials, some heavy industry).
6. **Clogging:** Stormwater directed to LIDs may contain sediment and fines that pose a risk to clogging the system. To reduce the potential for clogging, the following should be considered:
 - i. Implement Pretreatment: Pretreatment is essential to promote settling and capture of sediment prior to entering the infiltration system and must be included as part of a complete LID design. Options for pretreatment, include but are not limited to, deeper catchbasin sumps, manufactured products (e.g. goss traps, CB shields), oil and grit separator (OGS), vegetated filter strips, or pretreatment forebays.
 - ii. Avoid Filter Fabric: The use of filter fabric should be minimized to reduce the opportunity for an LID system to become clogged. A choking gravel layer is recommended to be used instead of filter fabric where suitable. The use of filter fabric should be limited to aspects of the design that will not become clogged and reduce the infiltration function and capacity of the feature. The

use of filter fabric may be desirable early on during construction and in final stages of site stabilization to mitigate premature clogging of filter media.

- iii. **Erosion and Sediment Controls (ESCs):** Do not commission LIDs until the contributing drainage area is no longer under construction. See Section 6.5.2.4.

7. **Porosity:** A porosity of 0.35 is to be used in LID design for granular material. Other porosities may be considered where literature or field testing supports design values.
8. **Emergency Overflow:** for surface features, such as a bioretention cell, an emergency overflow to a storm sewer or ditch will be required.
9. **Vegetation:** Bioretention cells are to be planted in accordance with the neighbourhood aesthetic with paramount consideration for maintenance requirements. Naturalized plantings are encouraged and are appropriate for high volume traffic corridors. For projects within the municipal right of way or easement, the plant list must be approved by Parks Operations during the design phase.

If the native soils do not possess the required nutrient levels for proper vegetation establishment, then the soil should be tilled at least 300mm and organic material should be introduced to amend the soils.
10. **Erosion:** Limiting the slopes within an LID is important to avoid excessive erosion from occurring. If applicable, rip rap, spill aprons, check dams, and vegetation can be incorporated to help minimize erosion internally.
11. **Private Property:** If the LID is to be located on private property, the consultant shall prepare an operation and maintenance manual for the LID to ensure proper functionality. The City will not accept certain LIDs on private property where no operation and maintenance plan has been presented.
12. **Standing Water and Mosquitoes:** Surface ponding of stormwater should be limited to discourage mosquitoes. Standing water should be drained in less than 24 hours. In the case of high density urban landscapes a shorter ponding time may be more visually appealing.
13. **Setbacks from Buildings:** It is recommended to construct LIDs no closer than four (4) metres from building foundations to prevent water damage in accordance with the Zoning By-law and the Ontario Building Code. In some cases, the 4m setback requirement may be reduced, subject to installation of mitigation measures.
14. **Proximity to Underground Utilities:** Location of underground utilities needs to be determined in consultation with the City's Utility Coordination Committee to ensure proper offsets from utilities and to avoid damaging existing utilities.
15. **Overhead Wires:** Ensure future tree canopies (if applicable) will not interfere with existing overhead phone and power lines.
16. **Wellhead Protection:** Any stormwater runoff received from parking lots or roads should not be located within a two (2) year time-of-travel wellhead protection area.

6.5.2.4 LID Submission Requirements

Design Brief

A design brief shall be prepared, as part of any LID design. The design brief may be a stand-alone document or included as part of a Functional Stormwater Management report. The design brief will form part of the ECA application for the LID system. A LID design brief should include the following:

- Design objectives, considerations and constraints;
- Modeling methods and results;
- Design calculations;
- Field testing results including groundwater monitoring, soil analysis and in-situ infiltration testing results;
- Construction considerations;
- Operation and maintenance requirements; and
- Relevant design drawings.

Any supporting documentation or relevant reports are to be included as an appendix to the design brief.

Design Drawings

A clear and comprehensive LID design drawing is important to communicate the uniqueness of the LID systems form and function to the contractor, site inspector and operator/owner. The drawings are a critical component to the success of the project.

Where LIDs will be incorporated within the City ROW, the linear works and cross section drawings should include all relevant LID features and appurtenances within the drawing sheets. A single LID details sheet should be prepared to include:

- Limits of construction
- Detail cross sections and/or profiles showing critical LID aspects including slopes, low points;
- Construction sequencing and protection of LID components;
- Erosion and sediment control notes and inspection requirements specific to the LID design;
- Additional construction notes to address protection and mitigate compaction of the LID feature;
- Proprietary devices;
- Landscape or planting plans; and
- Soil or fill specifications and placement notes.

Examples of construction best practices that should be considered when developing a Sediment and Erosion plan for LID BMPs include:

- Installing barriers in front of curb cuts to prevent sediment from washing into facilities where curbs are part of the design.

- Excavating the final grade (invert) of the infiltration bed immediately prior to backfilling with specified aggregate and media to avoid premature facility clogging.
- Redirection of runoff including overland flow routes and roof drainage away from LID facilities during construction.
- Storing all construction materials down gradient of LID features (where possible). Construction materials stored up gradient of excavated site are to be enclosed by appropriate sediment control fencing.
- Ensuring all pipes are laid in a true line and gradient on a firm bed, free from loose material.
- Installing a sacrificial piece of filter cloth to collect dust and debris during construction. This is to be removed before biomedial is installed.

6.5.2.5 Operation of Maintenance Requirements of LID

The development of an Operations and Maintenance plan is a critical element for creating an effective LID feature.

For LIDs within the City's ROW, the operation and maintenance program shall be consistent with the City's existing overall LID Operation and Maintenance program (available on the Stormwater Consultant Resources webpage, see Section 6.1.4) . Any deviation or specific O&M requirements in addition to the City's standard practices should be identified in a fact sheet to be included in an Appendix to the City's overall O&M maintenance guide.

For privately owned LID systems, an O&M is to be prepared as part of the design and provided to the owner to conduct ongoing maintenance. For more information on O&M plan considerations refer to Section 6.8.

6.5.3 **Small-Scale, Traditional Water Quality Systems**

Small-scale water quality systems refer to treatment areas of approximately 5 hectares. Where LIDs are not feasible to meet water quality objectives, traditional stormwater quality control systems may be implemented to comply with the provincial design requirements and include:

- Oil Grit Separators (OGS)
- Catchbasin hoods and proprietary catchbasin inserts

6.5.3.1 Oil Grit Separators (OGS)

Oil/grit separators are typically used for small drainage areas, for the following lands uses:

1. Industrial, commercial, institutional and medium/high density residential developments (site plans) in compliance with the stormwater Permanent Private Systems (PPS) policy
2. Municipal ROW as part of capital projects/City Renewal programs.

The City accepts technologies verified to meet water quality objectives through the Environmental Technology Verification Canada program. The OGS design methodology shall include the associated catchment area in hectares, the percentage of

imperviousness used to size the OGS and the particle size distribution (PSD) used to define the % of TSS removal.

OGS Design Requirement:

1. **Inspection Maintenance Hole:** Every OGS shall be provided with a downstream sampling/inspection maintenance hole. This sampling maintenance hole shall be located on private property as close as possible to the property line.

To the satisfaction of the City Engineer, the City may exempt the need for an additional inspection maintenance hole in cases where:
 - a) An existing municipal maintenance hole is available close to the property line, or,
 - b) The City has permanent access to inspect the OGS unit on private property.
2. **Location:** The OGS location shall allow the greatest portion of the site to be treated and access for routine inspection and repairs/maintenance.
3. **Maintenance:** OGS operation and maintenance shall be in accordance with the manufacture's operation and maintenance manual. This manual should be included in the stormwater functional design report for the proposed development and a copy of this manual shall be provided to the owner for future and regular operation and maintenance activities.
4. **Drafting standard:** Engineering drawings for the proposed development shall delineate and indicate the size in hectares of the storm catchment area used to size the proposed OGS. Construction notes and details drawings shall include the type of OGS, the percentage of TSS removal, the associated storm catchment area in hectares, the location of the OGS and the downstream sampling maintenance hole, and a reference of to the associated OGS operation and maintenance manual.
5. **OGS special cases.** For developments proposing gas stations, an additional OGS shall be installed in the vicinity of the gas bars to capture oil spills. The additional OGS shall be sized using a reduced catchment area (the area of gas bars) and shall be provided with a separate downstream sampling/inspection maintenance hole. This additional OGS does not preclude the applicant to comply with applicable Technical Standards and Safety Authority's (TSSA) Fuels Safety Programs/regulations.

6.5.3.2 Catchbasin hoods and proprietary catchbasin inserts

Catchbasin hoods (e.g. goss traps) and proprietary catchbasin inserts are typically used as pre-treatment devices intended to work in tandem with downstream treatment such as LIDs, OGSs, or SWM facilities.

Design requirements

1. Catchbasin hoods and proprietary catchbasin inserts may be acceptable as a stand-alone water quality measure in redevelopment scenarios where no significant work on existing grading or sewers is proposed and the total of existing plus proposed parking spaces is less than 30. Catchbasin hoods and proprietary catchbasin inserts in existing developments, such as existing parking areas are intended to reduce concentrations of oil and grit to acceptable levels until a more permanent solution can be implemented to meet current provincial standards.

2. Catchbasin hoods are only credited for providing a Basic level of water quality treatment or up to 60% TSS removal.
3. No sampling/inspection maintenance hole is required downstream of any catchbasin hoods and proprietary catchbasin inserts unless they are working in tandem with a downstream OGS.
4. Catchbasin hoods and proprietary catchbasin inserts shall be maintained in accordance with the manufacture's operation and maintenance manual. This manual should be included in the stormwater functional design for the proposed development and a copy of this manual shall be provided to the owner for future and regular operation and maintenance activities.

6.5.4 Design of Municipal SWM Ponds

The following design guidance applies to the design of municipal SWM Facilities including, wet ponds, wetlands, and dry ponds. The majority of new municipal SWM ponds are regional facilities that are funded by the Development Charges and constructed as Capital Works by the City of London.

Any private stormwater management facilities must comply with the standards outlined by the province (MOE, 2003).

6.5.4.1 Figures

Attached, Figures 1, 2 and 3, which accompany these requirements, incorporate generalized design features as published in recognized manuals or guidelines, as adapted and modified to reflect accepted practice in southern Ontario municipalities.

The figures are based on the use of Attenuation/Extended Detention and/or Wet/Hybrid Wet Facilities. However, they can also apply to dry facilities if the wet pond and sediment forebay components are removed.

6.5.4.2 Water Quality Storage

Impervious percentage is described by two parameters, Total Impervious Percentage (TIMP) and Directly Connected Impervious Percentage (XIMP) values. The required storage is to be determined using the TIMP value in accordance with Table 3.2 of the Ministry of the Environment's Stormwater Management Planning and Design Manual (2003).

The water quality storage volumes per hectare are established in Table 3.2 of the MOE Manual and consist of two components: 40m³/ha of extended detention quality control storage (live storage) and the remaining portion represents permanent pool quality storage (dead storage). The required 40 m³/ha of quality extended detention storage is constant and required in all cases. The remaining permanent pool component of water quality storage is dependent upon the three following factors:

- i) Total Impervious Percentage (discussed in Section 6.4.3.1);
- ii) Protection Level of the Receiving Watercourses; and
- iii) Proposed type of SWM facility (i.e. wet pond, dry pond, wetland, infiltration).

Additional extended detention storage may be required for erosion/stream morphology and attenuation control to comply with the Council accepted Subwatershed Study requirements and/or to address lack of conveyance capacity in the outlet system. These

parameters are to be established by the Subdivider's Consulting Engineer all to the satisfaction of the City Engineer.

6.5.4.3 Erosion Control Storage

Erosion control storage volumes reflect the need to maintain existing fluvial geomorphology, protect watercourses from further deterioration and ensure protection of public safety and property. The City of London completed 13 Subwatershed Studies all of which were adopted by City Council in 1995 and the Dingman Creek Subwatershed Study Update which was adopted by City Council in 2005. The Subwatershed Studies identified SWM erosion control criteria on an individual basis, in some cases even establishing requirements for each tributary of subwatershed (i.e. Dingman Creek Subwatershed)

All facilities require a minimum of 40 m³/ha of extended detention storage. Additional erosion control protection may be required if the facility is to be located within a subwatershed that identifies specific erosion control requirements on top of the quality control extended detention. Should the consulting engineer complete a site specific geomorphological/fluvial assessment, alteration to the erosion control requirements may be considered.

6.5.4.4 SWMF Inlet Pipe Design Criteria

According to the 2003 MOE Guidelines for the Design of Storm Drainage Systems, the SWM facility inlet pipe should represent a free outlet. Therefore, the inlet pipe invert is to be above the projected 2-year storm ponding elevation. Non-compliance with this standard may create surcharge conditions within the new storm sewer system requiring additional maintenance associated with the potential sediment accumulation, as well as create potential liabilities under the Ontario Highways Act should surface ponding occur on streets.

Should, in rare cases, we need to consider deviation on the above noted design criteria, the consulting engineer will be required to undertake an engineering analysis to demonstrate that the proposed deviation will have a minimum effect on the proposed sewer Hydraulic Grade Line and will not create an adverse effect on the system.

6.5.4.5 SWMF Outlet Pipe Design Criteria

The City supports innovative SWMF outlet design to reduce operation and maintenance burden and ensure long-term functionality of the SWMF outlet. Submerged or reverse grade outlets can reduce debris accumulation at outlet structures. Submerged outlet openings should be a minimum of 0.3 m above the pond bottom to allow for account for sediment accumulation.

Additionally, the location of any orifices within the outlet design should be considered to ensure future debris clearing can be reasonably accomplished.

6.5.4.6 Specific Design Features

Fifteen key SWM Facility design features have been identified to reduce the risk of injury, while maintaining facility function. These biophysical safety features are intended to restrain access to deep standing water through a series of spatial, physical, natural and aesthetic barriers or through alternatives to direct access. The intent is to replace fencing with an appropriate alternative, while maintaining SWM function and public safety. The 15 key SWM Facility design features include:

- 1) A sediment forebay is incorporated to induce treatment and trap sediments in an isolated basin to reduce maintenance efforts during sediment cleanout works:
 - a) the City encourages innovation in forebay design to reduce suspension of settled particle during high flow events.
 - b) the sediment forebay must be at least 1.0-1.5m deep to minimize a potential re-suspension and ecological conditions for West Nile Virus,
 - c) the sediment forebay sizing must be done in accordance with the MOE's SWM Practices Planning and Design Manual, and
 - d) the sediment forebay should be constructed with a maintenance access route to permit future monitoring and maintenance as well as provide access in the event of an emergency;
- 2) A facility depth of 1.5-2.0m is preferred. Shallow facilities of less than 1.0m are likely to be ineffective, and should be discouraged due to the possible re-suspension of sediment and greater land requirements. The maximum SWM facility depth shall not exceed 3.0m plus a minimum 0.3m freeboard. A positive overland flow path must be provided at the 3.3m water level. The permanent pool depth in wet SWM facilities must be 1.0-1.5m deep. A minimum 0.3m freeboard must be incorporated into all SWM facility designs.
- 3) A naturalized low flow channel with a shallow channel depth (0.3 to 0.6m preferred) leading to the area of pond draw down; SWM facility inlet sewers must be designed to enter the facility as free outlet systems during 1:2-year storm events. This standard is in accordance with the Ministry of the Environment Guidelines for the Design of Storm Sewer Systems.
- 4) For extended detention/hybrid and wet facilities 5:1 side slopes maximum or flatter, for dry facilities 4:1 side slopes maximum must be applied around the perimeter of the sediment forebay and upper and lower cell; slopes may vary around a facility to create a natural appearance with the preferred slopes being maximums;
- 5) Steeper slopes (maximum 3:1) may be allowed to be used when these slopes are:
 - representing only 15-20 % from the total perimeter at the 0.3 m above the 100 year storm event elevation;
 - combined with a minimum buffer of 5.0m from 0.3 m above the 100 year storm event elevation to the property line; and
 - combined with unfriendly vegetation.
- 6) The two year storm event extended detention and storage component of wet facilities should discharge over a 24 to 48 hour period and the quality control facilities are not allowed to be located in line. Dry facilities should be used mostly as an attenuation/flood control system and ponding will be of relatively short duration and infrequent in occurrence; the permissible discharge for all facilities is based on detailed engineering analysis.

All maintenance holes located within stormwater management facilities require hard surface access. Access roads below the 100 year flood line will require a turfstone surface or approved alternative on a granular base. The turfstone voids shall be

filled with granular A. For all other requirements, refer to Section 3.15.15 for hard surface details.

- 7) Stormwater from the forebay shall be held in a permanent wet retention facility and should be located in the facilities lower cell (assuming the general main cell design reflects an overall safety criteria of gentle slopes and aquatic safety benches or suitable barriers);
- 8) Any SWM facility proposed to be located within Flood Plain lands are subject to:
 - a) UTRCA guidelines and approvals;
 - b) forebays being located above the 50 year storm line with any deviation from this requirement being subject to specific technical justifications approved by the City;
 - c) main facilities being located above the 25 year flood line;
- 9) A naturalized landscape plan, approved by Parks Planning and Design in consultation with the City Engineer, is required for all stormwater retention and detention facilities.

Seeding of exposed soil surfaces should be done as soon as possible after fine grading is complete. All landscape treatments specified in the approved plan should be installed after seed has established;

- 10) In lieu of fencing, unmowed vegetated buffers will be required around the perimeter. This buffer should be comprised of tall grasses and wild flowers, followed by trees and densely planted shrubs. A densely vegetated margin on the aquatic safety bench would serve as an aesthetic amenity and an additional natural barrier.

The requirements for fencing stipulated in Section 11.5, Parks & Open Spaces, Fencing, are not applicable to SWM Facilities.
- 11) An aquatic safety bench must be constructed around the forebay and the main treatment cells with the lower edge to be located 0.9 m above the facility bottom with a minimum 2 m width and incorporate a minimum slope of 10:1 or flatter.
- 12) Pedestrian and cycle paths must always be located no lower than the 5 year storm event water elevation and used in conjunction with the preferred slopes discussed in item (4) to further maximize recreational user safety and minimize public risk and liability. Paths below this point and leading to the lower portions of a facility should be posted to warn the public of potential safety hazards during facility operation;
- 13) Restricted area signage will be necessary to warn the adult public to avoid areas or activities under certain conditions if a number of these features are modified extensively and/or not included.
- 14) The minimum buffer width (separation area between the SWMF and land features such as ESA, main watercourses, significant ecological features and open space designation, etc.), is subject to City Official Plan requirements, policies, Provincial and Federal Acts, Policies and Requirements.
- 15) A Sediment and Erosion Control Plan during the construction activities must be developed and included in the Functional SWM Report for the proposed SWM Facility, to be reviewed and accepted by the City. Specific requirements for the protection of adjacent natural areas may be required as outlined in the relevant Environmental Impact Statement for the development.

These requirements must be applied to all SWM applications. It is recognized that in some instances, unique circumstances may arise where some requirements cannot be accommodated. In these cases, the onus is on the proponent to demonstrate how the proposed design deviates from the requirements, yet still meets the spirit and intent of this overall document. Deviations must be approved by City Council. Additional design guidelines for inlet structures, outlet structures, maintenance access, pathways, etc. is available in Chapter 18 – Drafting and Design Requirements for New Subdivisions. All SWM Facility design standards identified in this document, Environmental Services Design Specifications and Requirements, are based on the revised standards approved by City Council in July 2002.

6.6 INTERIM CONDITIONS

In situations where stormwater from a road widening or development will be designed prior to the ultimate storm/drainage flow path being established, the interim conditions must be designed to the same degree as the ultimate design in accordance with City Standards and Requirements.

6.7 SEDIMENT & EROSION CONTROLS

The City of London requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

For further information on the requirements of the ESCP, please refer to Section 10 – Sediment & Erosion Control, within this manual.

6.8 OPERATION & MAINTENANCE

For both public and privately owned stormwater control systems, an O&M program is required as part of the design to ensure the owner has adequate information to safeguard long-term functionality of their system. An Operation and Maintenance plan should include but not be limited to the following information:

- Site location
- Details and locations of stormwater feature(s) on site (i.e. LID, OGS, Stormwater Facility, etc.)
- Delineation of drainage area to stormwater feature
- Understanding of system design and nuisances (i.e. filter media, underdrains, inlet and outlet control functions)
- Connections to the municipal storm sewer
- Emergency overflow location and function
- Identify significant sources of sediment accumulation and how this can be managed (e.g. street sweeping)
- Provide a list of short and long-term maintenance tasks for the LID systems with a recommended maintenance schedule (i.e. monthly or seasonal inspection or frequency for each maintenance task).

- A short-term maintenance example would be ensuring standing water within an LID infiltrates within a 24-hour time period - if not, this could be an indication of a sub-drain malfunction or clogged filter media.
 - A long-term maintenance example would be monitoring to determine pollutant saturation within the filter media and replacement/clean-outs of the filter media.
- Recommended Maintenance schedule

6.9 PERMANENT PRIVATE STORMWATER SYSTEMS

Effective January 1, 2012 the Design Requirements for Permanent Private Stormwater Systems are a mandatory part of a regional stormwater servicing strategy for all Medium and High Density Residential, Institutional, Commercial and Industrial (ICI) subdivisions and site plan developments. This condition was stipulated by City Council resolution, at its session held on January 18, 2010.

The Design Requirements for Permanent Private Stormwater Systems will apply to all locations for subdivision and site plan and condominium development applications with the following land uses:

- Medium and high density residential,
- Institutional,
- Commercial, and,
- Industrial

Case 1: A SWM Facility exists downstream, addressing subwatershed quality, erosion, and peak flow control targets:

- On-site private stormwater systems are not required.

Case 2: An EA and/or SWM study have been completed and a SWM Facility has been constructed or will be constructed in a timely manner:

- The on-site private stormwater system must be integrated with the permanent regional storm/drainage and SWM solution within the drainage/watershed area (if the permanent regional system has been proposed for this drainage area) and attempt to maximize stormwater retention and quality control on site subject to site constraints.
- The on-site private stormwater system must be designed and constructed in accordance with the SWM criteria and the environmental targets, identified in the Subwatershed studies accepted by City Council and be consistent with the City's Design Standards and Requirements. In most cases, the water quality component should be implemented by oil-grit-separators or other applicable measures for sites less than 10 hectares. SWM facilities with a water quality component may be considered if the land development (under the site application) exceeds approximately 10 hectares.
- For development areas less than 10 hectares, the water quantity component should ensure that peak flow from the site does not exceed pre-development conditions and shall comply with riparian right (common) law. For sites larger than 10 hectares, it must be designed to meet the discharge requirements (flow targets) outlined in the applicable subwatershed study;

- Control maintenance holes must be located within the site plan prior to discharging to the municipal storm/drainage system in order to monitor private side discharges to the allowable flow rate and/or velocities;
- Monitoring may be required if the outlet from the site discharges to an open watercourse and/or Natural Heritage System in accordance with the City's Official Plan.
- A private permanent stormwater system will not be considered for site plans which are located on lands required for the construction of the conveyance and/or the regional permanent SWM system.

Case 3: Where a municipal SWM facility is unlikely to be constructed in a timely manner:

- The on-site private stormwater system must be provided completely within the area to be developed and serve the entire area to be developed;
- The on-site private stormwater system must provide 100% of the quality, erosion and quantity control for the lands to be developed as per the applicable Subwatershed Study;
- The on-site private stormwater system must be designed and constructed in accordance with the SWM criteria and the environmental targets, identified in the Subwatershed studies accepted by City Council and be consistent with the City's Design Standards and Requirements. In most cases, the water quality component should be implemented by oil-grit-separators or other applicable measures;
- The on-site private stormwater system must be designed to meet the discharge requirements (flow targets) outlined in the applicable subwatershed study;
- A control manhole must be located within the site plan prior to discharging to the municipal storm/drainage system in order to inspect private site discharges to the allowable flow rate and/or velocities;
- Monitoring may be required if the outlet from the site discharges to an open watercourse and/or Natural Heritage System in accordance with the City's Official Plan.
- A private permanent stormwater system will not be considered for site plans which are located on lands required for the construction of the conveyance and/or the regional permanent SWM system.

Case 4: Where the land to be developed is located in the Central Thames Subwatershed:

- On-site private stormwater systems located in the Central Thames Subwatershed must be designed and constructed based on the following design criteria:
- the flow from the site must be discharged at a rate equal to or less than the existing condition flow,
- the discharge flow from the site must not exceed the capacity of the stormwater conveyance system,

- the design must account the sites unique discharge conditions (velocities and fluvial geomorphological requirements),
- “normal” level water quality is required as per the MOE guidelines and/or as per the EIS field information; and
- shall comply with riparian right (common) law.

Design Standards and Requirements Implementation:

In conformance with these Design Standards and Requirements a variety of requirements must be incorporated into Development Agreements associated with these developments. The following conditions must be included:

- The Developer must obtain an Environmental Compliance Approval for the Private Permanent Stormwater Servicing works;
- The Developer must develop a maintenance and operational program in compliance with the flow rates, and erosion control requirements for implementation by the Owner;
- The Developer must provide the adequate site plan security allocations for the identified works (until 2 years of operation); and
- The Private Permanent Stormwater Servicing design must meet all of the standards and specifications of the City Engineer.

6.10

“JUST IN TIME” DESIGN AND CONSTRUCTION OF STORM WATER MANAGEMENT FACILITIES POLICY

The Design and Construction of Storm Water Management Facilities process policy was endorsed by Council July 31, 2013. Prior to the construction of the SWM facility the developer will enter into a subdivision agreement which includes the following requirements and provisions:

- The land for the SWM facility will initially be transferred to the City at no cost.
- Repayment of the SWM facilities land cost will be made when 25% of the building permits have been pulled within the storm catchment area.
- The City will tender the SWM facility following the completion of Design Studies or upon the first submission of design drawings, at the discretion of the City Engineer.

The purpose of the noted provisions is ensure that the following two key objectives are met:

1. Cash flow to the Stormwater City Services Reserve Fund is modestly improved by withholding payment for the land (approximately 25% of the value of the facility) until 25% of the building permits have been pulled within the storm catchment area, and
2. The requirement that the developer has made a substantial investment in development providing the City with the confidence that they can be reasonably expected to proceed in a timely fashion.

The overall goal of the policy is ensure that SWM facilities are constructed on a “Just in Time” basis. A figure outlining the process is included as Figure 4: SWM Design and Construction Process with Discussion.

6.11 COMMISSIONING CONSIDERATIONS

6.11.1 Operation Prior to Assumption

Operation of the SWM facility or LID feature, prior to the City’s assumption, shall be in compliance with the Operational and Maintenance Manual developed by the subdivider’s Consulting Engineer and approved by the City’s Environmental Services Department.

LID features are to remain offline and be protected until the upstream catchment area has stabilized. Once the contributing catchment area has developed and there is no threat of the system becoming clogged, the LID can be brought online. An interim SWM strategy will be required prior to connection of the LID system that is primary comprised of erosion and sediment control features.

6.11.2 Maintenance and Monitoring Prior to Assumption

Maintenance and monitoring of the SWM facility and/ or LID feature prior to City’s assumption, must be:

- carried out by the Subdivider/Developer to demonstrate the effectiveness of the performance of these facilities in accordance with the approved design construction practices;
- in compliance with the City and MOE’s “Monitoring and Operational Procedure for the SWM Facilities Prior to the City’s Assumption”, October 1996;
- able to demonstrate the Stormwater feature is functioning as designed (i.e. infiltrating as per design);
- carried out by the Subdivider, prior to the City’s assumption, at no cost to the City;
- in compliance with Planning Division’s Landscape Monitoring Guidelines. There may be other site specific monitoring requirements as a result of an EA or EIS for the facility or development; and
- all landscape materials are to be maintained in a healthy state in accordance with the approved landscape plan until the time of assumption. A final inspection is required by the Planning Division, prior to assumption of the facility.

6.11.3 Maintenance After Assumption

Maintenance of the SWM facility site, replacement of biophysical components such as dead trees and shrubs or soil erosion, after the City’s assumption, will be the responsibility of the City’s Planning, Environmental and Engineering Services Department.

6.11.4 Operation After Assumption

Operation of the SWM facility after the City’s assumption, will be carried out by the City’s Planning, Environmental and Engineering Department and will include periodic dredging of silt deposits from the sediment forebay of the SWM facility. Removal of potentially contaminated sediments may require compliance with regulations under the Environmental Protection Act. Lawn mowing, litter removal, trail maintenance and

vegetation inspection (especially where a SWM facility is part of an open space scenario) will be subject to the Planning, Environmental and Engineering Department's maintenance and operations budget.

6.11.5 Proportional Cost Sharing


Proportional Cost Sharing for maintenance and monitoring of the SWM facility amongst benefiting developers will be required.

The Subdivider/Developer constructing a SWM Facility which services other subdivisions and that carry out maintenance, operations and monitoring of SWMF's prior to the City's assumption, should be allowed proportional cost sharing by others serviced by these SWMF's. The above noted proportional cost sharing shall be based on contributing storage volume of a SWM facility. Contributing Subdivider /Developer's payments to third parties shall:

- commence upon completion of the subdivider's service work connections to the existing unassumed SWM services; and
- continue until the time of assumption of the affected services by the City.

STORMWATER ENGINEERING CHECKLISTS

Table 1 - Subdivision Application, Stormwater Engineering Checklist


	TABLE 1 – Stormwater Servicing Submissions for Subdivisions
	Draft Plan of Subdivision Application
	Confirm the submitted Final Proposal Report (FPR) is updated to respond to all comments provided by the City in the Initial Proposal Report (IPR) submission.
	Confirm that the proposed land use is consistent with the Area/Community Plan, Natural Heritage System (NHS) buffers and setback requirements, as well as all policies and acts of applicable agencies including the DFO, MECP, UTRCA and City.
	Identify/Review previously completed studies (Municipal Class EAs, subwatershed study requirements, Functional and Detailed Design Reports, Geotechnical, Hydrogeological, EIS, drawings etc.) and identify how the proposed design meets all applicable stormwater design targets. Note any deviations in the proposed approach from previous studies with a supporting rationale for the change.
	Provide geotechnical assessment with specific recommendations regarding soil conditions and how they inform the design of the proposed SWM system.
	Provide a hydrogeological assessment that demonstrates how the water balance will be maintained as part of the subdivision or SWM design and confirm compensation/mitigation measures.
	Provide hydrological and hydraulic modeling analysis in accordance with Table 4 and incorporate results into the design. Refer to file Manager Process.
	If outlet is to a natural watercourse, conduct fluvial geomorphic study to identify the threshold erosion velocity. Conduct continuous simulation modelling to evaluate potential impact to the watercourse from the new development and identify mitigation measures.
	Identify and demonstrate available capacity in the receiving storm/drainage and SWM system, all in accordance with City design standards.
	Identify minor/major system catchments and dedicated major overland flow routes. Drawings to show catchment area boundaries for the minor and major systems, including all external areas.
	Review and ensure compliance with the Regulatory Floodplain, hazardous slope lines, fill regulations and new storm outlet requirements associated with the UTRCA approvals. Identify any deviation and additional mitigation measures required.
	*Refer to Table 5 if Low Impact Development (LID) design elements are included.
	Engineering (Detailed Design) Submission
	Where applicable, provide design input and calculations to consider site specific engineering/ecological challenges, including but not limited to, energy dissipation, or assessment of how stormwater may impact environmentally sensitive areas from a terrestrial or aquatic perspective.

STORMWATER ENGINEERING CHECKLISTS

	Confirm 100 yr storm event ponding elevations, provide calculations and conveyance routes for 250 yr storm event overland flow routes. Identify traffic calming measures and indicate any interference with overland flow route.
	Identify implementation triggers such as construction phasing and interim measures.
	Provide georeferenced shapefiles identifying the minor and major system subcatchments and dedicated major system overland flow route.
	Develop and finalize the Sediment Erosion Control plan (SEC) in accordance with the City, federal and provincial requirements unless part of site alteration agreement.
	Confirm and finalize operational and maintenance requirements for any non-standard proposed SWM systems.
	Confirm and finalize monitoring requirements (if applicable) for all proposed SWM systems.
	Finalize sign-off for submission to the MECP for the proposed work
	Other Site Specific Considerations as Identified by the Consultant:


STORMWATER ENGINEERING CHECKLISTS

Table 2 - Site Plan Application, Stormwater Engineering Checklist

	TABLE 2 – Stormwater Servicing for Site Plan Applications	
	Identify and Review previously completed studies (Municipal Class EAs, subwatershed study requirements, Functional and Detailed Design Reports, Geotechnical, Hydrogeological, EIS, drawings etc.) and identify how the proposed design meets all applicable stormwater design targets. Note any deviations in the proposed approach from previous studies with a supporting rationale for the change.	
	Confirm that the proposed land use is consistent with the SWM quality, quantity/flood, stream morphology control, baseflow augmentation, infiltration, groundwater recharge/discharge and NHS requirements for the SWM facility and identify any deviation and additional mitigation measures required.	
	Finalize minor and major catchment areas boundaries including all external areas. Identify any deviations to the area or runoff coefficient in relation to the Functional Report, drawings, etc. and confirm that the proposed site plan servicing meets all stormwater targets and requirements.	
	Review and confirm available outlet capacity in the receiving storm/drainage and SWM system.	
	Finalize review and design of the proposed minor/major system & Best Management Practices	
	If a hydrogeological assessment is requested at the pre-consultation stage. Refer to Table 4 for scoping and requirements.	
	Develop and finalize the Sediment Erosion Control plan (SEC) in accordance with the DFO, Applicable Conservation Authorities, City and provincial requirements (this plan must be finalized and accepted by the City prior to any development activity being approved on the subject lands)	
	Review and ensure compliance with Flood Plain Lines, storages, hazardous slope lines, fill regulations and new storm outlet requirements associated with the appropriate Conservation Authority approvals	
	Review and ensure compliance with all applicable acts, standards, policies and requirements of the DFO, MECP, MNRF, Applicable Conservation Authority and City	
	Other Site Specific Considerations as Identified by the Consultant:	


STORMWATER ENGINEERING CHECKLISTS

Table 3 - Low Impact Development Design Checklist

	TABLE 3 – Low Impact Development Engineering Design Checklist	
	Confirm seasonal high groundwater levels of the site to an appropriate level of detail. For the hydrogeological assessment checklist, see Table 4.	
	Consult Stormwater Design Standards for municipally accepted LIDs based on the Screening Tool provided in Section 6.4.1.1.	
	Evaluate insitu percolation rates/ infiltration rates at proposed LID locations.	
	Review recent design guidance documents for Low Impact Development systems, including Credit Valley Conservation Authority, Toronto and Region Conservation Authority, Sustainability Technologies, or other reputable source.	
	Demonstrate how the stormwater design criteria are met through LIDs (quantity, quality or erosion) or identify the level of service that is being provided.	
	Identify an overflow outlet for the proposed system (if required).	
	Develop an Operations and Maintenance detailed manual for the proposed system(s).	
	For works to service new subdivisions, consult the Development Charges by-law for any applicable subsidies.	
	For site plans, consult the latest Wastewater and Stormwater By-law for potential reductions to the City's monthly stormwater charges.	
	Provide a finalized georeference shapefiles identifying the minor system subcatchments associated with each LID system.	
	Other Site Specific Considerations as Identified by the Consultant:	

STORMWATER ENGINEERING CHECKLISTS

Table 4 Hydrogeology Assessment Checklist

	TABLE 4 – Hydrogeological Assessment Checklist	
	Site location and description of development, including planned servicing for the site.	
	Description and mapping of relevant site features, including topography and surface water drainage, physiography, regional overburden and bedrock geology, regional hydrogeology, and proximity to nearby natural heritage features (e.g., stream, ponds, wetlands, woodlots, etc.). Consideration should be given if the site falls within Highly Vulnerable Aquifers (HVAs) and/or Significant Groundwater Recharge Areas (SGRAs), as defined in the Thames - Sydenham & Region Source Water Protection Plan.	
	Description and mapping of field activities completed as part of the assessment (e.g., advancement of boreholes, installation of monitoring wells, advancement of test pits, installation of piezometers, etc.).	
	Description of the relevant site hydrogeological information, including aquifer properties (e.g., hydraulic conductivity), static groundwater levels, groundwater flow direction, groundwater gradients, etc. Note that if Low Impact Development (LID) measures are being considered for the site, seasonal fluctuations in water levels must be considered.	
	Description of water quality characteristics (groundwater and surface water).	
	Evaluation of potential domestic wells, in the area if the proposed development. In some cases, a door-to-door domestic well survey may be required.	
	Evaluation of potential water takings required to support construction activities. This should include a summary of anticipated servicing depths, anticipated pumping rates, discharge locations, and erosion and sediment control (ESC) measures to be implemented during construction.	
	Evaluation of the potential impact from the development to the natural environment including impacts on groundwater levels, water quality (groundwater and surface water), groundwater baseflow, etc. Both short-term (e.g., construction) and long-term impacts should be considered. If LID measures are being considered, an evaluation of the anticipated performance of the system(s) as it relates to the hydrogeological environment will be required.	
	Completion of a water balance for the site, as per Section 6.3.2 of the design standards. For sites located adjacent to sensitive natural features, the water balance should consider baseflow requirements of downstream receptors, and ensure they are maintained in the post development scenario.	
	Evaluation of mitigation measures to be implemented at the site. Mitigation measures should be used to minimize potential impacts groundwater and surface water resources, and potential receptors. Consideration should be given to maintaining infiltration and groundwater recharge (as practical), and maintaining overall water quality.	
	Evaluation of monitoring and contingency plans, as necessary.	
	Other Site Specific Considerations as Identified by the Consultant:	

STORMWATER ENGINEERING CHECKLISTS

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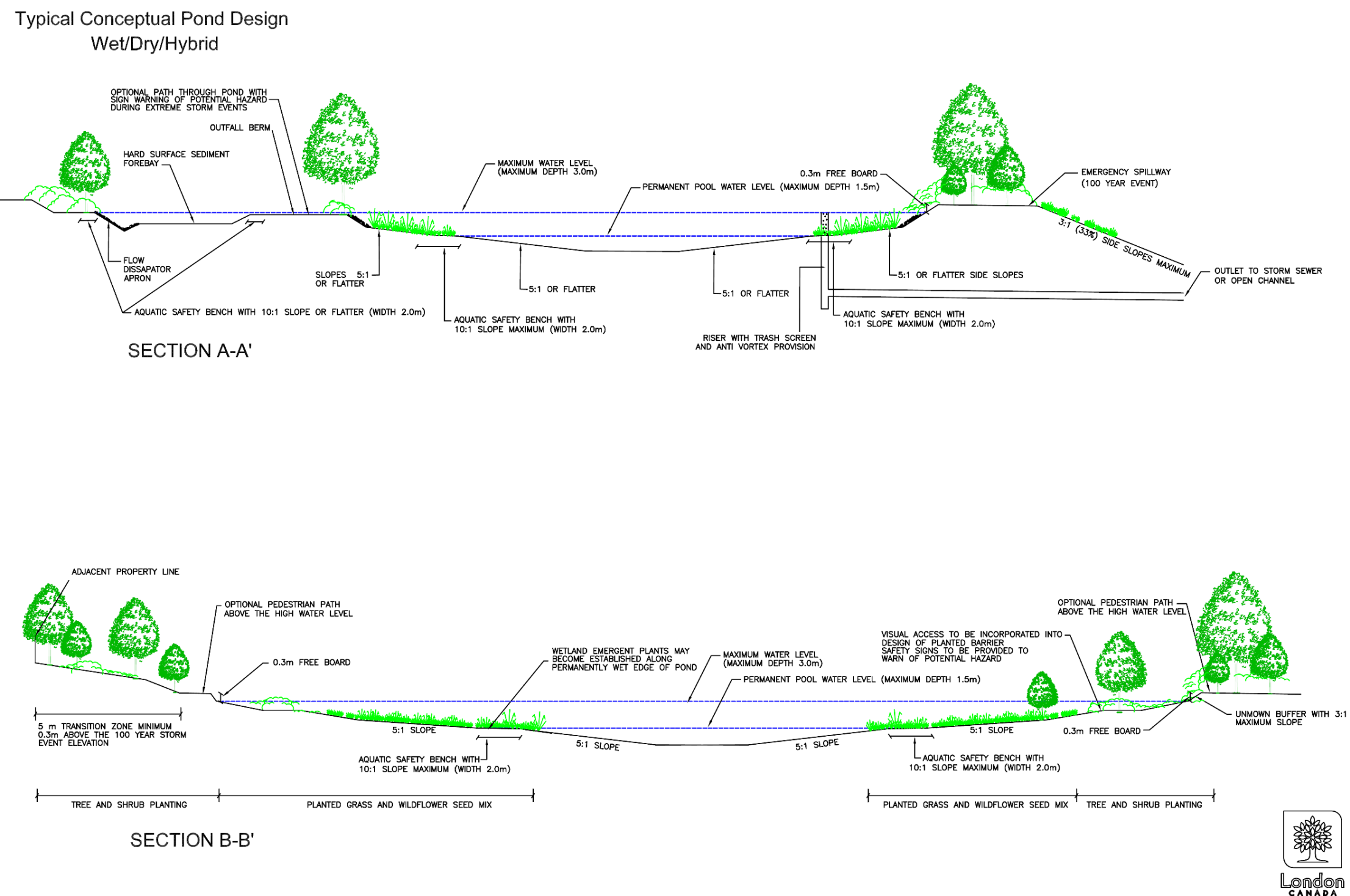


Figure 1 Plan View Typical Conceptual Facility Design Wet/Dry/Hybrid

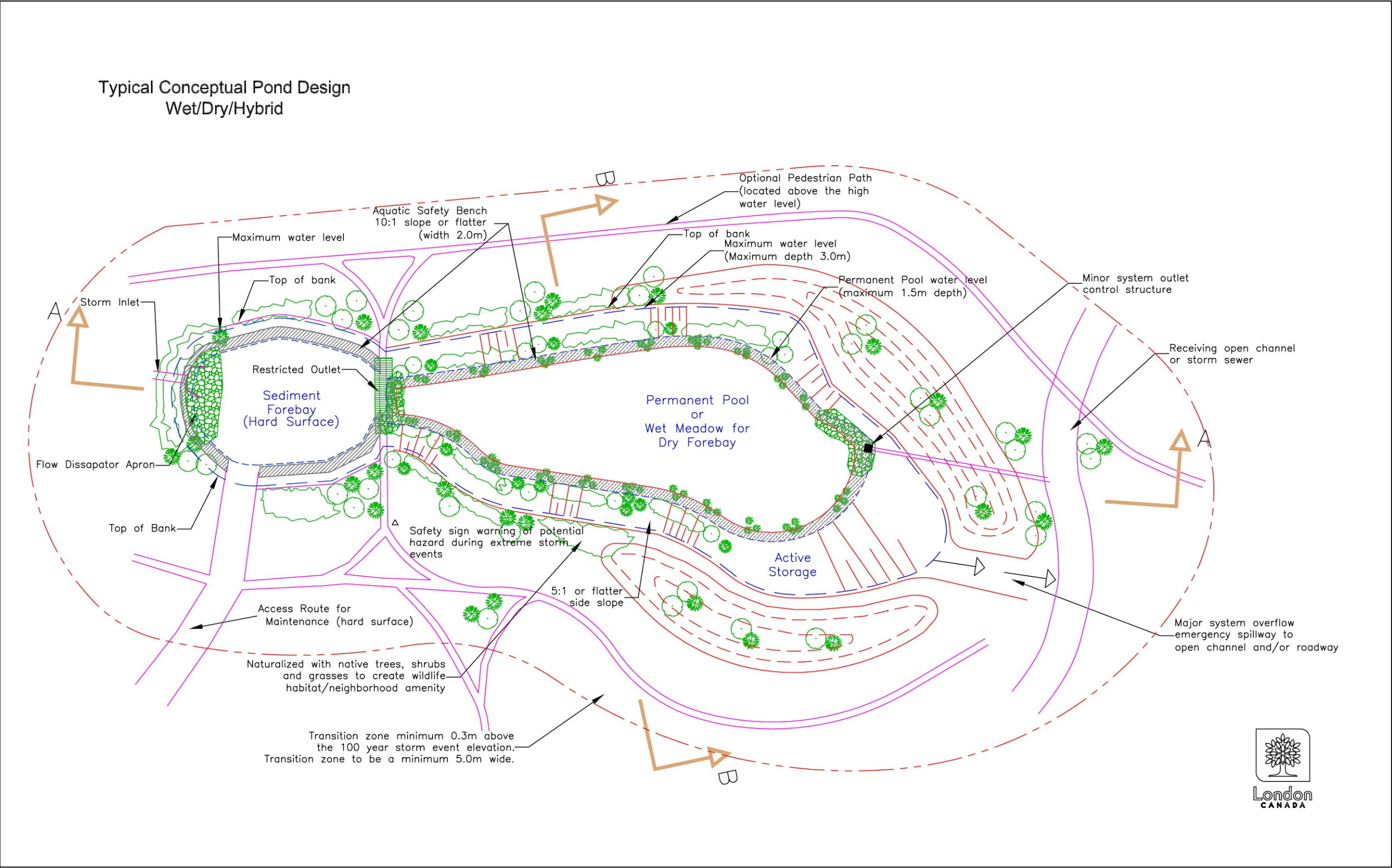


Figure 2 Sectional Views of Typical Conceptual Facility Design Wet/Dry/Hybrid

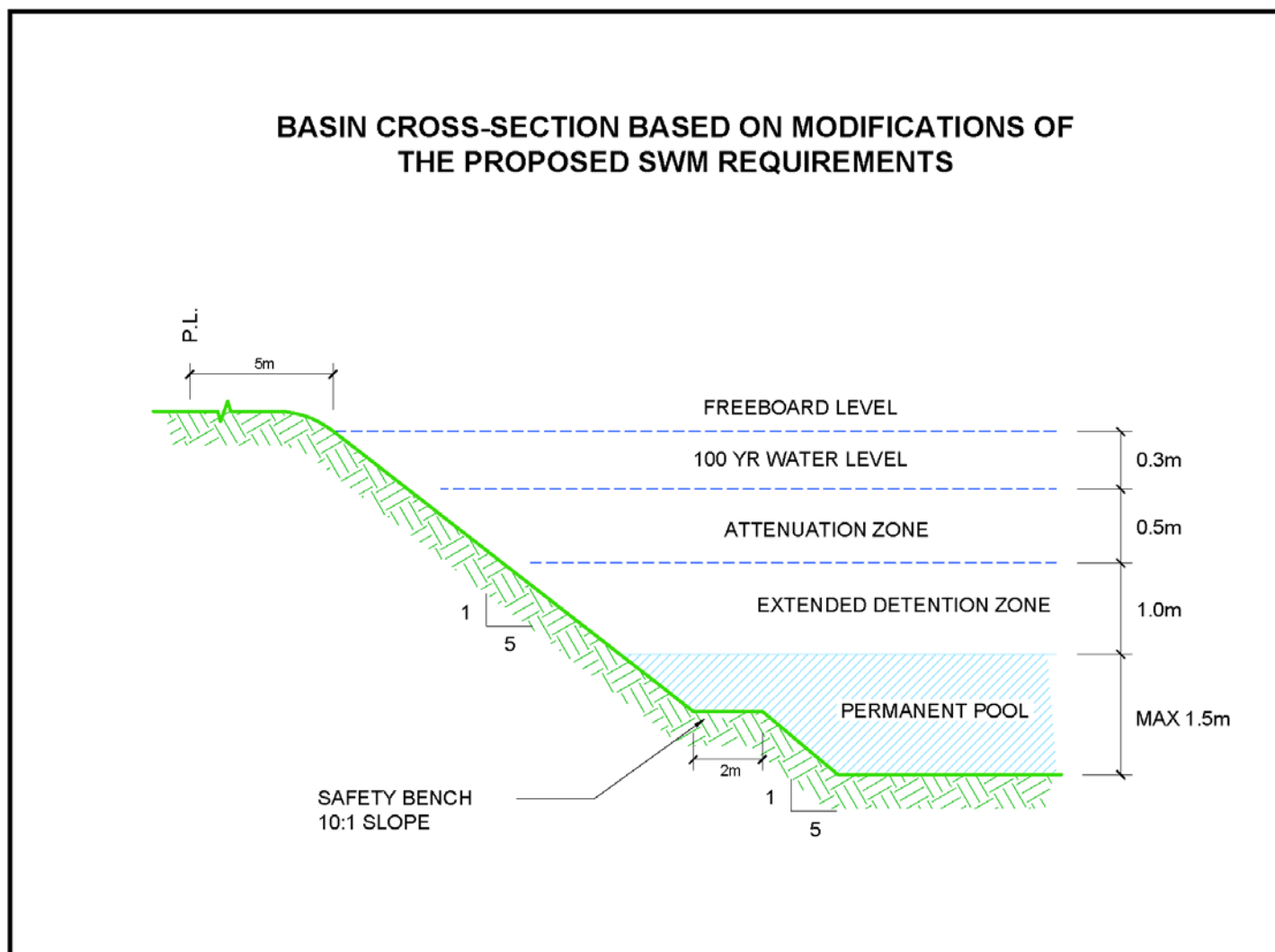
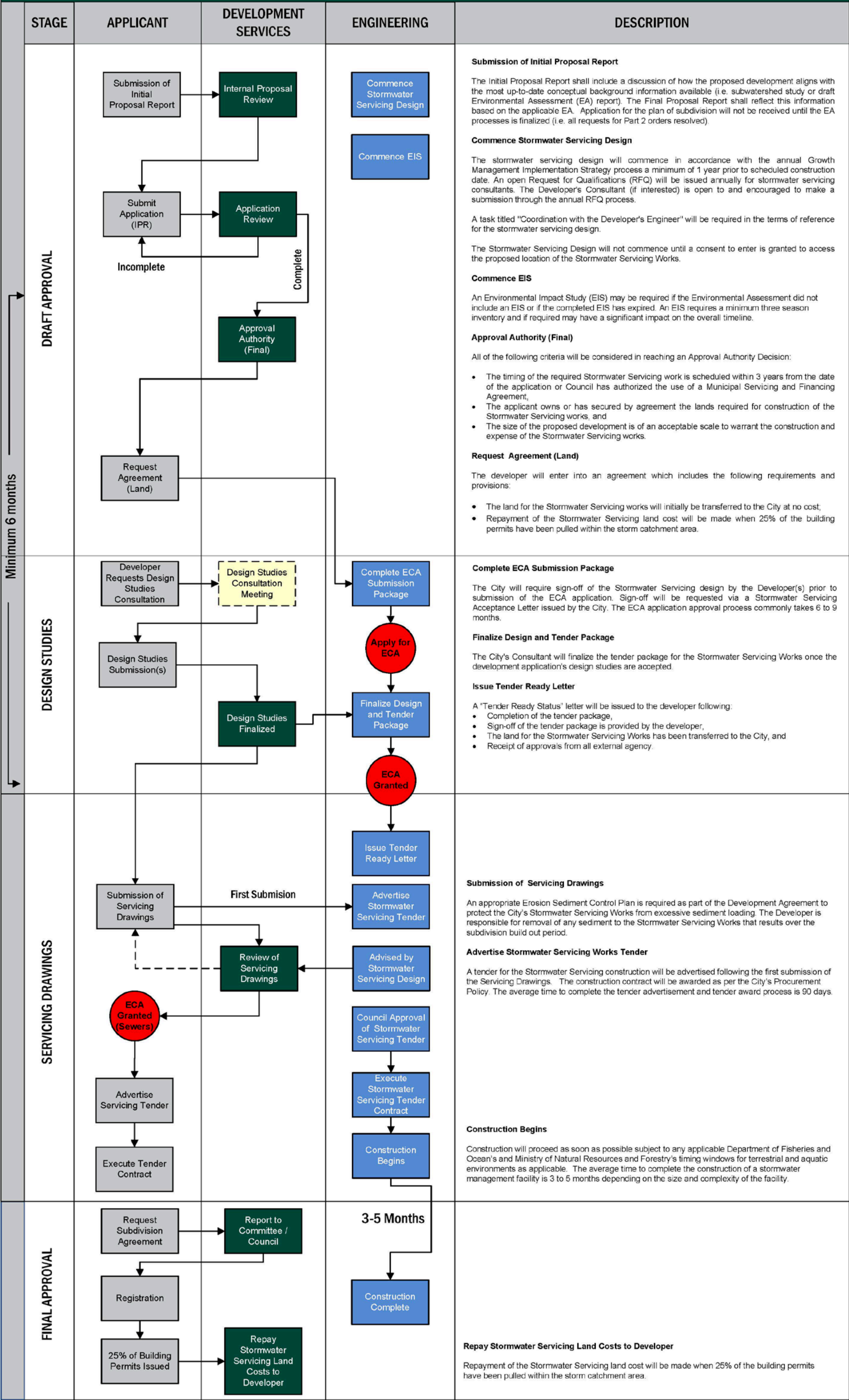


Figure 3 Basin Cross-Section Based on Modification of the Proposed SWM Requirements

Figure 4: Stormwater Servicing Design and Construction Process with Discussion DRAFT (April 2016)





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7 WATER DISTRIBUTION SYSTEM DESIGN AND LAYOUT OF WATERMAINS AND WATER SERVICES

7.1 DEFINITION AND PURPOSE

These specifications shall apply to all water services and to all water mains up to 450 mm diameter including appurtenances which are located within the City road allowance, or on property which will be transferred to City ownership. These specifications shall also apply to all water meter placements.

The designer shall design to City Specifications and also make reference to the Ministry of the Environment “Design Guidelines for Drinking-Water Systems” and to the Ministry of the Environment “Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit”. If there is a discrepancy between the City Specifications and the MOE Guidelines then the Water Engineering Division shall be contacted to resolve the issue.

Any deviation from these specifications must be submitted in writing to the Water Engineering Division, Environmental Services Engineer for approval.

For water mains larger than 400 mm diameter and for any other water system installation, special specifications must be prepared for and approved by the Water Engineering Division, Environmental Services Engineer. These specifications are to be used as a supplement to all other specifications approved by the Water Engineering Division, Environmental Services Engineer for water system installation.

The water distribution system is for the purpose of supplying and distributing water, but does not include plumbing or other works to which the Ontario Building Code applies.

“Water Distribution System” means watermains with connections to feeder watermains, feed watermains within subdivision lands, private watermains, water services, fire hydrants, and shut-off valves and all other appurtenances thereto.

A water distribution system may exist for the purpose of distributing potable or non-potable water, however water distribution systems for potable and non-potable water may not be intermixed or cross-connected. Private supplies of potable water may not be cross-connected to the municipal or public water distribution system.

Watermain Classifications

Trunk Main - Large diameter watermain (over 600mm diameter)

Feeder Main - Large diameter watermain (400mm, 450mm and 600mm)

Distribution Main – Watermain diameters of 300mm and smaller

7.2 PERMITTED USES

Permitted and non-permitted uses of water are identified by By-law W-1 - A by-law to provide for the REGULATION OF WATER SUPPLY IN THE CITY OF LONDON.

7.3 WATERMAIN DESIGN

7.3.1 Pressure and Flow Requirements

Watermains shall be sized to maintain the greater of:

- i) maximum day demand plus fire flow at a pressure not less than 140 kPa (20 psi) at any hydrant lateral or potential fire service connection. Pressures to be taken at the most critical locations.
- ii) maximum hourly demand at a pressure not less than 275 kPa (40 psi).
- iii) average day demand at a pressure not less than 275 kPa (40 psi).
- iv) maximum residual pressure should not exceed 550 kPa (80 psi) and a minimum residual pressure shall not be below 275 kPa (40 psi).
- v) All pressures shall be calculated/determined assuming minimum hydraulic grade line conditions apply. Refer to section 7.3.7 of this document and confirm with the Water Engineering Division, Environmental Services Engineer.

7.3.2 Design Water Demands

7.3.2.1 Total Water Demands

Gross water consumption rate recorded for the City is 470 to 600 L/d (121 IGPD to 132 IGPD) average per capita.

7.3.2.2 Domestic Water Demands

Average day domestic (residential) unit demand for design shall be 255 litres per capita per day.

Peaking factors of 3.5 for maximum day and 7.8 for maximum hour are to be used for design for the purposes of subdivisions and site plans unless written authorization from the Water Engineering Division, Environmental Services Engineer is received.

For design purposes, the following densities shall be used:

Type Of Use	People / Unit
Low density residential	3 people per unit
Medium density residential	2.4 people per unit
High density residential	1.6 people per unit

7.3.2.3 Commercial, Institutional and Industrial Water Demands

These demands vary greatly with the type of water using facilities or process present in the development. If the Owner (designer) does not know the required demand they should refer to Ontario Ministry of the Environment "Guidelines for the Design of Water Distribution Systems" or find other suitable references and justification for selecting water demands. The designer can also provide typical demand and peaking factor data. For industrial demands the Owner (designer) shall discuss water requirements with the Water Engineering Division, Environmental Services Engineer.

7.3.2.4 Friction Factors

The following Hazen-Williams “C” values shall be used for design, regardless of material:

Pipe Diameter	C-Factor
100 and 150 mm	100
200 and 250 mm	110
300 to 600 mm	120
Over 600 mm	130

7.3.3 **Fire Demands**

To estimate the fire flow requirements for an area of the Municipality, the designer should refer to the guide “Water Supply for Public Fire Protection - A Guide to Recommended Practice” (latest revision) prepared by Fire Underwriters Survey, Insurers’ Advisory Organization. For single family detached low density residential areas, a minimum fire demand of 76 l/s is to be used.

On private property, adequate water for firefighting shall be determined in accordance with the Ontario Building Code.

7.3.4 **Minimum Pipe Sizes/Acceptable Pipe Sizes**

The minimum size for watermains shall be 150 mm diameter except beyond the last hydrant on cul-de-sacs where smaller diameter pipe shall be used which is designed for domestic and maximum hour demands only.

Accepted pipe sizes are 50mm and 100 mm (see above), 150mm, 200mm, 250mm, 300mm, 400mm, 450mm, 600 mm. For larger pipe sizes, the designer should consult with the Water Engineering Division, Environmental Services Engineer.

7.3.5 **Water Quality**

Watermains and watermain networks shall be designed so that water shall not remain unused in the watermain for more than three (3) days under average day demand.

To demonstrate a three (3) day turnover, the designer shall provide a hydraulic analysis as outlined in 7.14 of this document. The hydraulic analysis shall also provide calculations to determine if and where automatic flushing devices are required and determine the appropriate size of the automatic flushing device (25mm or 50mm).

The City of London has primary responsibility to ensure that the minimum chlorine residuals are maintained in the distribution system and therefore reserves the right to require watermain looping and/or automatic flushing devices and/or blow-offs to facilitate the maintenance of the required chlorine residual under the Safe Drinking Water Act. Refer to W-CS-2 sht.1, 2, 3 and W-CS-5.

On private property, where there is a concern that there may be degradation of the water quality (when a three (3) day water turn-over cannot be achieved), the City reserves the right to require perimeter isolation. This shall consist of a testable device (DCVA) on the water service and shall be installed at the property line and at the owners expense.

In situations where there is a concern with respect to water quality and perimeter isolation is required, Designers shall also address water quality on private property. The designer is encouraged to consult with the Water Engineering Division.

It will be a requirement that a testable device (DCVA) be installed at property line for all site plans with a private watermain connected to the municipal water supply system which services more than one commercial building. The testable devices (DCVA) are to be maintained in accordance with the manufacturer's suggested requirements at the owner's expense.

7.3.6 Maximum Velocities

The watermain shall be sized so that the maximum velocity in the pipe shall not exceed 1.5 meters per second during maximum hour domestic flow conditions or 2.4 meters per second during fire flow conditions unless otherwise approved by the Engineer.

7.3.7 Boundary Conditions

For the purposes of hydraulic analysis the designer shall contact the Water Engineering Division, Environmental Services Engineer for appropriate boundary conditions rather than using information from fire flow test directly. This is because operating pressures and flows are subject to fluctuation.

In general, the minimum hydraulic grade lines (HGL) for each of the various service areas of the City are:

- 301.8m for the low level system
- 335.0m for the Springbank / Westmount / Pond Mills / Wickerson Pumping Station high level system
- 317.0m for Hyde Park Pumping Station and Uplands Pumping Station
- 319.0m for the Southeast Pumping Station System

The designer shall assume a reservoir with the appropriate HGL for water supply to the area being designed.

7.4 LAYOUT OF WATERMAIN

7.4.1 Watermain Location within Road Allowance

- a) Watermains are to be located in standard location as indicated on the City of London Standard Utility Locations for all streets, U.C.C.-1M (UCC1), on straight streets, unless otherwise approved. Deviation from the standard location must be approved by the Utilities Coordinating Committee.
- b) Window Street Right-of-ways - all watermains to be located in a window street right-of-way are to be located in accordance with UCC-2M. Refer to Section 1.1.3 b) for additional details.

On watermain bends, the watermain may deviate from the standard location by up to 1.0 m, provided that the deviation is towards, or closer to the street line.

7.4.2 Watermain Pipe Depth

The objective when designing and installing watermain is to have watermain which is below the frost line and protected from freezing as well as watermain which is constructed with as few offsets or joint deflections as possible. The designer should have an objective depth of 1.7m when designing watermain. However variations in depth of up to 2.2 m will be permitted in order to address variations in topography and to avoid conflicts with other utilities.

Open ditch and unimproved roads - Watermains shall be laid 2.1m minimum below road grade or 1.1m below the bottom of the ditch, whichever is greater. On unimproved roads within the City, the designer should also review the vertical alignment of the road so that, where possible, future road improvements will not result in an unacceptable watermain depth, as defined in this specification.

7.4.2.1 Pipe Insulation

Where joint deflections or offsets require the pipe to be laid with less than 1.7m of cover, insulation shall be placed to prevent freezing. Refer to City of London W-CS-68 for insulation requirements.

Where storm drains or culverts cross over or under a watermain, insulation is required per City of London W-CS-68 unless there is a minimum 1.7m separation.

7.4.3 Pipe Offsets/Bends/Deflection

Offsets must be made according to City of London W-CS-12. Use of offsets must be indicated on the approved plans or in the case of unforeseen obstructions found after approval of the watermain design, written approval of the Engineer must be obtained.

For watermain diameter up to 400 mm, a maximum bury depth of 2.3 m should be utilized. Situations deviating from this should be approved by the Engineer.

If using joint deflection, full lengths of pipe must be used. Maximum deflection for various pipe materials to be in accordance with half (1/2) the pipe manufactures specifications. Where it is not possible to lay pipes to the required radius to utilize allowable joint deflection, manufactured pipe bends must be used. Axial deflection (bending of the pipe barrel) is prohibited for P.V.C. pipe. Any change in the direction of the watermain in excess of the pipe joint deflection tolerance shall be made using an appropriate fitting. Thrust or joint restraint shall be provided as in 7.4.6.

7.4.4 Termination of Watermains

Watermains shall be terminated opposite street lines or property lines.

Where caps and plugs are installed without a blow-off to provide for future watermain extension, a 20 mm watermain stop shall be tapped into the watermain no further than 0.5 m from the cap or plug to release trapped air/pressure from the watermain prior to removal of the cap or plug.

7.4.5 Blow-Offs /Automatic Flushing Devices/Addressing Water Quality

1. The design of the watermain shall be undertaken to ensure adequate water quality requirements are met. Refer to Section 7.14 for requirements relating to Hydraulic Modelling.
2. Dead end watermain which are part of an interim phase of a subdivision build-out shall meet water quality requirements by:
 - i. demonstrating adequate turnover by use; o
 - ii. installation of an automatic flushing device.
 - iii. Alternately, consideration can be given to building watermain systems in smaller phases or stages to meet development needs, but reduce the amount of watermain for which water quality must be maintained.

3. Where an automatic flushing device is used to maintain water quality, a water meter (in a meter pit) shall be installed to measure the volume of water discharge. The owner will be charged for the water used. The designer shall provide calculations which indicate the volume of water to be discharged by the automatic flushing device and the sizing of the automatic flushing device as well as indicate the timer settings to be used. This information shall be clearly indicated on the drawings. The Owner's contractor shall initially set up the automatic flushing device to the indicated settings. (prior to Conditional Approval). Subsequent adjustments to the automatic flushing device when the system is operated by the Municipality shall be made by Water Operations, based on approval of information submitted by the Owner's Consulting Engineer.
4. Where an automatic flushing device is not required to maintain water quality a standard 50mm blow-off (W-CS-5) will be required to allow flushing to take place.
5. On cul-de-sac or similar streets, blow-offs, when required, shall terminate in the boulevard. Blow-offs must be operable without the necessity of excavating.
6. Automatic Flushing Devices – notes for Designers with Regard to Automatic Flushing Device Discharge Rates is available in the City of London Standard Contract Documents, W-CS-5 Sheet 4.
7. Automatic Flushing Devices – Notes for Designers with Respect to Limitations on Locations Where Automatic Flushing Devices Can be Used
 - i. Automatic flushing devices may not be used to discharge directly to a ditch or to the natural environment as municipal water contains chlorine.
 - ii. Any water discharged from an automatic flushing device must have a total chlorine residual less than 1.0 mg/L in accordance with the Waste Discharge By-Law for discharges to storm sewers.
 - iii. Normal Conditions for the use of an automatic flushing device it is assumed that the device discharges to a storm sewer which in turn discharges to a storm water management pond where the remaining chlorine can be dissipated before being released or discharged to the natural environment. In any situation where there are large volumes of water potentially being discharged from an automatic flushing device, or where the receiving storm system is a sensitive system, further consultation must take place to confirm if the use of an automatic flushing device is appropriate in the situation. Consultation should be with Development Services, Water Engineering and the Storm Water Management Division.

Temporary connections for automatic flushing devices (150mm) may be made directly to a storm maintenance hole or to a storm catchbasin. If into a maintenance hole, the drainage pipe must outlet just above the benching, at the bottom of the structure. To remove the flushing device, the drainage pipe to the storm sewer should be fully grouted and properly bricked and mortared at the catchbasin, maintenance hole or storm sewer.

8. Temporary connections for automatic flushing devices (150mm) may be made directly to a storm maintenance hole or to a storm catchbasin. If into a maintenance hole, the drainage pipe must outlet just above the benching, at the bottom of the structure. To remove the flushing device, the drainage pipe to the storm sewer

should be fully grouted and properly bricked and mortared at the catchbasin, maintenance hole or storm sewer.

9. Location of the last water service on a dead end watermain. The last water service on a dead end watermain which is a permanent dead end or a temporary dead end as part of an interim phase or stage of subdivision; shall be located as close as possible to the Termination of Watermain (within 0.5m of the end or tapped into the end cap) regardless of whether there is a manual blow-off or automatic flushing device installed.

7.4.6 Thrust Restraint

Refer to section 441.07.23 Thrust Restraints of the City of London Standard Contract Documents

7.4.7 Watermain and Other Utilities Separation

Designers should refer to Ontario Ministry of the Environment Guidelines for the Design of Water Distribution Systems (latest revision) and the Ontario Plumbing Code (latest revision) regarding the location of watermains and water services relative to sewers and to the Public Utilities Act of Ontario regarding the location of watermains relative to other utilities.

Encroachment of utilities, structures, sewers and/or any utility appurtenances, which may impact the watermain, the integrity of its bedding, and/or structural capabilities, shall have design consideration(s) applied to adequately protect the watermain.

7.4.7.1 Parallel Installations of Watermains and Sewers

Sewers and watermains located parallel to each other should be constructed in separate trenches maintaining the maximum practical horizontal separation.

Under Normal conditions, watermains shall be laid with at least 2.5m horizontal separation from any sewer, sewer manhole, catch basin, or other sewer appurtenances.

In situations where this requirement cannot be met, alternatives which meet the requirements of the MOE Procedure F-6-1 Procedure to Govern the Separation of Sewers and Watermains for Parallel Installations shall be followed.

Link to MOE Procedure F-6-1

<https://www.ontario.ca/page/f-6-1-procedures-govern-separation-sewers-and-watermains>

7.4.7.2 Crossings of Watermains and Sewers

The designer shall refer to the Ministry of the Environment Procedure F-6-1, Procedures to Govern the Separation of Sewers and Watermains.

Watermain up to and including 450 mm diameter (New Construction)

Watermains shall cross above sewers and Private Drain Connections (PDC's) with sufficient vertical separation to allow for proper bedding and structural support of the watermain, sewer or PDC. If the watermain is less than 1.7 meters below grade at the crossing, the watermain shall be insulated per section 441.07.14 of the City of London Standard Contract Documents for Municipal Construction Projects.

Where it is not possible for the watermain to cross above the sewer or PDC, the watermain shall pass under a sewer or PDC and shall be protected by providing:

- a. A vertical separation of at least 0.5 meters between the invert of the sewer or PDC and the crown of the watermain.
- b. That a minimum 5.0 meter length of water pipe shall be centred at the point of crossing so that the watermain joints will be equidistant and as far as possible from the sewer or PDC.
- c. Adequate structural support for the sewers to prevent excessive deflection of joints and settling.

Watermain Greater than 450 mm Diameter (New Construction)

Watermains shall cross above sewers and Private Drain Connections (PDC's) with a minimum vertical separation of 0.60 meters to allow for proper bedding and structural support of the watermain, sewer or PDC. Joints for the watermain shall be located a minimum horizontal distance of 2.0 meters from the crown of the sewer pipe or PDC.

If the watermain is less than 1.5 meters below grade at the crossing, the watermain shall be insulated as per section 441.07.14 of the City of London Standard Contract Documents for Municipal Construction Projects. Where it is not possible for the watermain to cross above the sewer or PDC, the watermain shall pass under a sewer or PDC and shall be protected by providing:

- a vertical separation of at least 0.60 meters between the invert of the sewer or PDC and the crown of the watermain; and adequate structural support for the sewers to prevent excessive deflection of joints or settling, and
- that a minimum 5.0 meter length of water pipe shall be centred at the point of crossing so that the watermain joints will be equidistant and as far as possible from the sewer or PDC.

7.4.7.3 Utility Crossings of Existing Watermains larger than 450 mm Diameter

It is desirable for new servicing, sewers or PDC to cross above existing trunk watermains wherever possible. The watermain shall be protected by providing:

- vertical separation of at least 0.60 meters between the invert of the sewer or PDC and the crown of the watermain; and
- adequate structural support for the sewers to prevent excessive deflection of joints or settling, and
- that the crossing is not within 2.0 m of a joint in the watermain.

Where it is not possible to cross above the watermain, the sewer or PDC shall pass under the watermain, and the watermain shall be protected by providing:

- i. a vertical separation of at least 0.60 meters between the crown of the sewer or PDC and the invert of the watermain; and
- ii. adequate structural support for the watermain must be provided during construction, and post construction to support the structure and prevent excessive deflecting of the watermain or joints.

For either situation (crossing over or under an existing watermain) details of the crossing proposed and the method of reinstatement to be used must be approved prior to construction. Refer to W-CS-69.

It is preferable to design the crossing of the watermain by the utility being constructed so that the crossing is at 90 degree angle. This will reduce the length of the support required during construction.

Notes for Designers

When designing a utility crossing of an existing watermain, it is the responsibility of the designer to:

- obtaining a reliable SUE locate for the elevation and location of the watermain and not relying on as-built drawing information for the purposes of the design to be implemented;
- the designer should obtain shop drawings for the watermain pipe from the manufacturer in order to obtain information about pipe design and restraint and additional design information as will be necessary for the purposes of the design;
- the constructability of the crossing;
- the risk posed to the water utility;
- the health and safety of the contractor and their employees who will be undertaking the crossing;
- whether the crossing can be carried out safely with the watermain in operation;
- where the watermain needs to be taken out of operation to perform the crossing safely, the designer shall address shutdown and dewatering requirements and necessary temporary provision of water to customers. All works and all costs associated with draining the watermain, dechlorinating and discharging the watermain, monitoring of discharges, obtaining necessary approvals from the MOECP for the planned discharge of water as necessary and the setup of temporary bypass watermain shall be designed by the designer, and the costs shall be borne by the Owner of the project.

The Designer is encouraged to consider design alternatives for the utility crossing which pose less risk and operational impact. Crossing by trenchless technology where feasible is encouraged.

Where a utility crossing is to be undertaken by open cut construction, the designer shall identify the acceptable movement or deflection of the pipe being crossed.

It should be noted that when crossing under a concrete or steel watermain pipe by open cut construction that a support system with zero or no deflection must be achieved so as to not negatively impact the watermain. It is also recommended that the pipe be taken out of service for the purposes of working safely.

7.4.8 Looping of Watermain/Supply Redundancy

Water distribution systems shall be designed to exclude any dead-ended pipe, unless meeting the requirements in 7.4.5. Water distribution systems shall be designed so that no more than eighty (80) units with individual water services and meters shall be

served from a single source of supply. If the looped watermain is connected to a single watermain, a valve must be installed in the watermain to permit isolation of supplies.

Where looping or supply redundancy is proposed to be achieved from two water mains/supply sources, the hydraulic modelling must include scenarios whereby each water supply source would be a single source of supply, and the watermains will be sized accordingly.

For requirements for looping for private property, see section 7.9.5.

7.4.9 Connections between High Level and Low Level Water System (security of water Supply/Supply Redundancy in critical scenarios)

Areas which are serviced by high level water distribution systems shall have periodic and an appropriate number of interconnections between the high level and low level system, by means of the installation of a checked connection between the high and low level system. In general this would supply water from the low level system to the high level system. The purpose of this connection is to ensure redundancy of water supply. These interconnections shall be sized in order to provide adequate water supply under all situations including emergency scenarios.

The designer/modeler is encouraged to discuss critical scenarios with the City Engineer, and this will vary, however; as an example this might be a watermain break in a high level supply source under a max day plus fire scenario.

7.5 WATERMAIN PIPE MATERIAL

7.5.1 Reference Specifications

All waterworks material used shall be new and shall conform to those listed in the City of London Standard Contract Documents for Municipal Construction Projects and the latest revision of the Standards of the American Waterworks Association (AWWA).

Material other than that listed in the City of London Standard Contract Documents for Municipal Construction Projects may be used if it is approved in writing by the Water Engineering Division. The Water Engineering Division will designate the AWWA Standard and/or other specifications and conditions applicable for use of such approved material.

The City reserves the right to select any materials or product it deems appropriate for the application. The City also reserves the right to remove from the specifications any product previously approved but found inappropriate for the application. This includes but is not limited to pipe material, valves, or fittings. The designer shall clearly indicate on drawings and contract documents the materials which are acceptable for use in a particular application where the use of one or more of the approved materials list is not acceptable.

7.5.2 Transitions in Pipe Material - Watermains

Transitions from one pipe material to another must be made at a valve or tee. Where PVC pipe is used, a tracer wire must be provided along the entire pipe and CAD welded to the valve and terminated at grade elevation as per the Standard Contract Documents for Municipal Construction Projects Section SW 441.05.04 Polyvinyl Chloride Plastic Pipe Products.

7.6 SWABBING, FLUSHING, DISINFECTING AND BACTERIOLOGICAL TESTING OF WATERMAINS

For requirements regarding swabbing, flushing and disinfecting and bacteriological testing of watermains see section 441.07.25 of the City of London Standard Contract Documents for Municipal Construction Projects. The usual test pressure in the London water system is 1035 kPa (150 psi).

7.7 LOCATION AND SPACING OF VALVES

7.7.1 Location and Spacing of Watermain Valves

In accordance with the Ministry of the Environment, Watermain Design Criteria for Future Alterations Authorized Under a Drinking Watermain Works Permit, Table 2: Shut-Off Valves.

7.7.1.1 Residential Developments

In residential developments, valves shall be located so that any section of watermain serving up to a maximum of sixty (60) residential water services can be isolated by operating not more than four (4) valves. Phasing of developments should be considered and valving should be logical (i.e. at intersections). In residential areas, valves shall be spaced no more than 250 m apart.

7.7.1.2 High Density Residential, Commercial and Industrial Developments

In high density residential, industrial and commercial areas, valves shall be located to be no more than 150 m apart.

7.7.1.3 Feeder Watermains

Feeder watermains (400mm, 450mm and 600mm) should have valves at 400 m intervals.

7.7.1.4 Intersections of Watermains

At intersections where smaller watermains connect to larger feeder watermains, each smaller watermain shall be valved with an isolation valve whereas the larger watermain shall be valved as required above.

7.7.1.5 Valves for Looped Services/Private Watermains

Valves shall be installed on looped services or private watermains to isolate buildings or groups of buildings so that no more than eighty (80) individual water services or apartment complex containing 300 dwelling units or more are on any one valved section. The Owner shall install a valve on the street watermain between connections to a looped private watermain if there is not an existing valve, at no expense to the City.

7.7.1.6 Crossings of Watermain, Rivers, Railway, Controlled Access Highways, Bridges

Watermains crossing rivers, railways and controlled access highways shall be valved on each side of the crossing.

7.7.1.7 Hydrant Laterals

Valves shall be located on all hydrant laterals according to City of London W-CS-1.

7.7.1.7.1 Maximum Length of Hydrant Laterals

The maximum length of hydrant laterals (W-CS-1 Sht. 1) shall be 6.1m (one standard pipe length) in order to address concerns of water quality and to meet the requirements of section 441.07.25 of the Standard Contract Documents for Municipal Construction Projects. On private property, where a hydrant lateral / fire service is longer than 6.1m, a testable device (DCVA) shall be installed at property line on the private property side to protect the municipal water system.

Where the hydrant lateral is located on private property, the testable device (DCVA) shall be located as close as possible to the private main in order to protect the water quality in the private water system.

The cost for the installation and maintenance of testable devices (DCVA) shall be the owner's.

7.7.1.8 Location of Valves at Street Intersections

Valves shall be located on the extension of street lines or according to City of London W-CS-45.

7.7.1.9 Location of Valves at Intersections with Roundabouts

Water valves may be placed within the raised roundabout island where possible. However, if placement of the valves creates a potential conflict with the curb & gutter of the island, then the valves are to be placed in the boulevard clear of the curb and gutter of the approaching streets.

7.7.1.10 Valve Boxes and Extensions Rods Required

All valves shall be provided with valve boxes. Valve extension rods as detailed on City of London W-CS-6 shall be installed on every valve and are to be purchased from the City of London Purchasing & Supply Division.

7.7.2 **Valve Locations - Phasing of Subdivision Developments**

Valves shall be located to meet the requirements of 7.7.1. As well, location and number of valves shall take into consideration reducing shutdowns and inconvenience to customers during the construction of additional phases. Valves may be installed on a temporary basis and relocated in order to accomplish this.

7.7.3 **Sizing of Valves**

For watermain 400 mm in diameter and below, valves shall be sized to be the same size as the watermain on which the valve is installed. Restraints for pipe sizes greater than 300 mm is not addressed by the City of London Standards and Specifications and will have to be designed by the consultant/designer and/or provided by the pipe manufacturer as part of the drawing submissions.

7.8 **FIRE HYDRANTS AND FIRE DEPARTMENT CONNECTIONS**

All fire hydrants situated within the road allowance and on private property are the sole property of the City of London and shall be installed in accordance with The City of London Standard Contract Documents for Municipal Construction Projects, and shall be maintained by and operated only by the City of London.

The detail of hydrant and valve installations shall be according to The City of London Standard Contract Documents for Municipal Construction Projects (441.05.10) and drawing W-CS-1

Fire Hydrants and Fire Department Connections

All new PUBLIC hydrants installed are to be flow tested and colour coded in accordance with the requirements of NFPA 61. Colour coding is for the purpose of indicating available fire flows at 20psi residual pressure. Colour coding shall be by means of placing reflective markers on each of the two 65 mm hydrant outlets.

In new subdivisions and site plans, the designer shall create a table on the drawings for fire hydrants and their colour coding marker. The hydrant markers shall be installed by City staff.

Class	Rated Capacity	Colour
Class AA	1500 usgpm (5680 L/min) or greater	Light Blue
Class A	1000-1499 usgpm (3785-5675 L/min)	Green
Class B	500-999 usgpm (1900-3780 L/min)	Orange
Class C	500 usgpm (1900 L/min) or less	Red

7.8.1 Location/Spacing of Hydrants on Public Streets

The location of hydrants is subject to the requirements and approval of the City Fire Department in accordance with the Ontario Building Code. As a general guide, hydrants must be located not more than 170 m apart along the length of the watermain and should be located at intersections where possible. Hydrants shall be installed a minimum of 1.5m from the edge of a driveway.

For a more detailed discussion of hydrant spacing requirements refer to “Water Supply for Public Fire Protection - A Guide to Recommended Practices”.

7.8.2 Location of Hydrants to Sprinkler or Standpipe Systems

For use with sprinkler or standpipe systems the hydrant must be located not more than 45 m from the Fire Department connection.

7.8.3 Hydrants on Dead-end Streets

Hydrants shall not be located on dead-end streets unless such streets exceed 90 m in length. Where located on dead-end street the hydrant shall be located at 90 m from the end and a smaller size watermain (minimum 50mm) shall be used beyond the hydrant so that water quality is maintained.

7.8.4 Addition or Relocation of Hydrants

Regardless of hydrant location shown on accepted subdivision plans, additional hydrants may be required or existing hydrants may have to be relocated due to circumstances unknown at the time of plan acceptance such as the position of a structure, Fire Department connection, driveway or landscaping feature.

Such addition and/or relocation shall be requested when the City approves the service plan and must be done at the expense of the Owner of the subdivision or, if the subdivision has been assumed, at the expense of the Owner of the property for which the additional or relocated hydrant is required.

7.8.5 Hydrants on Private Property

Hydrants shall be located on private property where required to meet spacing in accordance with the Ontario Building Code, subject to the approval of the Building Division.

Fire hydrants shall be installed at grades such that they are readily accessible to the fire department.

For average conditions, fire hydrants shall be placed at least 12.2m from the buildings being protected, in accordance with NFPA 24.

Exception: When hydrants cannot be placed at this distance, they shall be permitted to be located closer, or wall hydrants used, provided they are set in locations by blank walls where the possibility of injury by falling walls is unlikely and from which people are not likely to be driven by smoke or heat. Usually, in crowded plant yards, they can be placed beside low buildings, near brick stair towers or at angles formed by substantial brick walls that are not likely to fall.

Fire hydrants shall be located a minimum distance of 3.0m from a fence or other such obstruction.

Fire hydrants shall not be placed near retaining walls where there is danger of frost through the wall, in accordance with NFPA 24.

Where municipal water is not available, and an on-site water supply is utilized for firefighting purposes, a fire hydrant shall not be installed, but instead a standpipe connection, meeting the requirements of the Building Division, Standard Practice Sheet B2.2, On-Site Water Supply for Fire Fighting shall be provided.

The cost for the supply and installation of hydrants located on private property must be paid by the Property Owner. The fire hydrant must meet the specification set out in section 441.05.10 Hydrants, of The City of London Standard Contract Documents for Municipal Construction Projects and drawing W-CS-1 since they become the property of the City of London and are maintained by the City.

7.8.6 Hydrants for Fire Department Connections

Requirements are given in the Ontario Building Code.

7.8.7 Protection of Hydrants

If the placement of a hydrant on public or private property is such that it will be susceptible to damage by vehicular traffic, bollards are to be installed, at the owners cost, in sufficient number to protect the hydrant. Minimum spacing between any bollard and a hydrant shall be 1.0 meter, and bollards shall be a minimum of 1.0 meter in height. Bollards shall be painted hydrant yellow as per section 441.05.10 of the Standard Contract Documents for Municipal Construction Projects. Bollard construction to be steel with concrete fill.

7.9 WATER SERVICES, FIRE SERVICES AND PRIVATE WATERMAINS

For the design and materials requirements all water service pipe and fire service mains on private property, the Ontario Building Code shall apply. It shall be noted that water quality requirements are not addressed in the Ontario Building Code. Where there is a concern that there may be a degradation of water quality in the private servicing that has

the potential to enter the municipal water supply system, the Water Engineering Division reserves the right to require premise isolation. Premise isolation shall consist of appropriate backflow prevention measures to the risk posed, and shall be installed at the property line at the owners expense.

The following apply to the water services on public property up to the property line.

Water Service Size and Design

The Owner will be responsible for water service sizing. The Water Engineering Division, Environmental Services Engineer shall be consulted for available pressures and flows at the watermain under design conditions given in Section 7.3.1. If the results of hydrant flow tests are to be used, the Water Engineering Division, Environmental Services Engineer shall be consulted for necessary adjustments since flow tests are not usually done at design conditions.

On private property, adequate water required for fire protection shall be determined in accordance with the Ontario Building Code. Fire flow and hydraulic calculations shall be reviewed by the Building Division.

It is a requirement to provide fire flow information (i.e. hydrants on private property and fire sprinkler requirements) in conjunction with site plan submissions for water servicing in order to determine the correct water service sizing.

7.9.1

Minimum Service Size for Single Family Residential Homes

Pressure Area	Ground Elevation	Minimum Water Service Size
		PEX
Low level	Above 267m	25mm
Upland / Hyde Park	Above 278m	25mm
Springbank / Westmount / Pondmills / Wickerson	Above 300m	25mm
Southeast	Above 286m	25mm

In general, these pressure areas are where water pressures are between 275m (40psi) and 345kpa (50psi). Location of pressure areas can be obtained from the Water Engineering Division, Environmental Services Engineer.

It is recommended that the designer determine the water service sizing based on flow requirements for water services which service single family homes which are estate lots, larger homes, have deep setbacks or where automatic lawn sprinkler systems or fire sprinkler systems are to be used.

As required by the Ontario Building Code on private property, the minimum size for fire service mains and water service pipes, combined with fire service mains, shall be 150mm, in accordance with NFPA 24.

Exception: For mains that do not supply hydrants, sizes smaller than 150mm may be used, subject to:

- the main supplies only automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems or Class II standpipe systems;

- hydraulic calculations show that the main will supply the total demand at the appropriate pressure. Systems that are not hydraulically calculated shall have a main at least as large as the riser.

7.9.1.1 Accepted Water Service Sizes

Acceptable water service sizes are 25 mm, 40 mm, 50 mm, 100 mm, 150 mm, 200 mm, 250 mm, and 300 mm diameter.

7.9.2 **Pressure Reducing Valves Recommended Where Water Pressure Exceeds 550 kPa (80 PSI)**

In some lower elevation areas of the City, water distribution pressures may exceed 690 kPa (100 psi) and it is recommended that when pressures in the municipal water distribution system exceed 550 kPa (80 psi) that owners provide pressure reducing valves, at no cost to the City. System pressures available at points of supply should be obtained from the Water Engineering, Environmental Services Engineer.

7.9.3 **Cathodic Protection**

Cathodic protection to be provided where connection made to steel mains in accordance with W-CS-24 or W-CS-25.

7.9.4 **General Requirements - Water Services**

Water service shall mean the pipe, fittings and shut off valve that convey potable water from a connection on a watermain or private watermain to the meter location.

- a) Water Services to Residential Dwelling Units (Detached, Semi-detached, Townhouses, Row-housing).

Each dwelling unit in a detached, semi-detached, townhouse or row house block, must be serviced with a separate water service connected to a watermain or private watermain.

Water Services must front the dwelling unit. On private sites connecting to a private watermain, Water services may connect to the rear of the dwelling unit if the following measures are included on the site plan and undertaken:

- i. A sign noting the location of the water service and distance from the unit it is to be placed on the rear outside wall to allow for identification on the curbstop location. The location of the sign shall be horizontally in line with the curbstop and vertically above the rear point of entry. The sign shall be embossed and include the unit number, a rain drop (indicating the water service) complete with a reflective surface (raindrop only), as well as the curbstop distance from the rear face of the unit. The final design of the sign shall be to the satisfaction of the City.
- ii. A paved 1.5m pathway is to be installed in the back of the units which cannot meander (must be straight). The private water main for the services must be located under this pathway.
- iii. Curbstops to units are to be located 0.3m off the paved pathway in the landscaped area.

- iv. Curbstops shall remain free and unencumbered into perpetuity (not impeded by decks, fences, sheds, etc.)
- v. The development agreement and condo declaration shall specify that: Any and all defects to the paved pathway over the private watermain, or the rear-yard sign indicating curbstop location, shall be repaired by the Owner of the Premises. Should the City become aware of any such defect, and upon written notification to the Owner, the said defect is not repaired, within (7) seven days of the date of the notification or within such time as the Engineer may deem reasonable, then the City may turn off the water supply to the Premises. If the City is ordered under statutory authority to restore the water supply, then the City may repair the defective service extension, private main and meter pit and charge the cost to the Owner and collect such cost according to law, and until paid, such cost shall remain a lien on such Premises, and may also be collected in the like manner as taxes. The Owner shall be held responsible for the cost of restoration.

b) Water Services to Commercial/Industrial Malls

Each structure in a commercial or industrial mall shall have one water service connected to a watermain or private watermain. Units in such a mall may have an individual water service connected to a watermain or private watermain outside the unit.

c) Water Services to Swimming Pools/Lawn Sprinkler Systems

Swimming pool facilities and lawn sprinkler systems must be serviced by connecting to the metered side of a water service that is within a heated structure.

Connections to lawn sprinkler systems are to have backflow prevention devices in accordance with CAN CSA B64 and are subject to the approval of the Building Department. Direct Pool Makeup Water Connections are to have backflow prevention devices in accordance with CAN CSA B64 and are subject to the approval of the Building Department.

d) Water Services to Other Structures

Unless otherwise approved in writing by the Water Engineering Division, all structures not covered in (a), (b), and (c) including commercial, industrial and institutional shall have one water service connected to a watermain or private watermain.

e) Water Engineering Division to Designate Watermain to Provide Service

When there are two (2) watermains on a road allowance, the water service shall be laid from the structure to the watermain which, in the opinion of the Water Engineering Division, Environmental Services Engineer, provides adequate flow and/or pressure. Water services shall not be tapped off transmission Watermains 24" (600 mm) and larger where an alternate source is available.

f) Water Services to Residential Apartment Buildings (5 dwelling units or more)

Apartment buildings (5 dwelling units or more), shall have one metered water service connected to a watermain or private watermain.

g) Water Services to Residential Dwelling Units in Townhouse/Condominium Blocks

Each dwelling unit in a private block must be serviced with a separate water service connected to a watermain or private watermain. Water services must front the dwelling unit they service unless otherwise approved in writing by the Water Engineering Division.

Where it is proposed that servicing of individual dwelling units is not in accordance with the standard above, bulk metering of the site at the point(s) where the water service enters the property will be required. Individual metering of dwelling units by the City of London will not be provided in this circumstance.

h) Water Services to Multi Family Residential Buildings

This section will describe the requirements for individually servicing/metering new or converted multi-family (4 residential units or less) residential buildings. This may include but is not limited to the following configurations:

1. An existing single family home that has been converted to a multi-family residence such as a duplex, triplex or a fourplex. The newly created units may have several different layouts such as side by side, upstairs/downstairs units, front/back, etc.
 - In this case, the building must be supplied by a water service pipe from the municipal watermain in the street to the property line that is adequately sized for the intended use of the building. The City of London minimum water service pipe sizing is 25mm PEX.
 - The internal plumbing of the building must be arranged in such a manner that each residential unit must have a separate hot and cold water supply that can be isolated by a main valve and not interfere with the water supply of the other units.
 - The City of London allows one water service pipe from the municipal watermain to the property line with a shut off valve located 300mm from the property line on the City right-of-way. Once the water service pipe crosses the property line it can be branched off in to two - four separate water services, one for each new customer. Each branch is to have a shut off valve located at 300mm from the property line on private property. A meter pit will have to be installed for each unit which will house the City of London water meter. From this point the water service pipes will enter the building and be connected to the building plumbing system.
2. Similar to item 1 above but newly constructed building purpose built multi-family residence.

- As described above, each dwelling unit may be serviced by a meter pit located at the front of each unit.
3. Other multi-family (that may or not be stacked) residential condominium or rental units that cannot be serviced as described in the previous sections (7.9.4 a – f).
- Each residential unit may be individually serviced by a meter pit located in front of the residential unit it is servicing. The developer is to ensure that there is adequate space to locate the meter pits and associated valving in the front and that the meter pit is accessible for maintenance. Regardless of the configuration of the building, it is important to understand that each metered water service consists of a water service pipe, an isolation valve and a water meter. The meter pits are to be located in the front of the residential unit being serviced and the must be accessible for maintenance.

7.9.5 Looped Water Servicing Required

A looped water service connected to a public or private watermain or watermain must be installed:

- a) when one water service will not supply the required flow for domestic use and fire protection or,
- b) for an apartment complex containing one or more structure and more than 300 dwelling units or,
- c) for a townhouse, condominium or similar complex having more than eighty (80) units with individual water services and meters.
- d) for buildings over 84 m in height, 2 water service connections will be required in accordance with the OBC. These 2 water services shall be able to be isolated from each other by a valve in the municipal water distribution system.

The looped water servicing must be installed to service the private development from two sources. If the looped watermain is connected to one public watermain, an isolating splitter valve must be installed in the public watermain to permit isolation of supplies, at no cost to the City.

Where a private water system is connected to the municipal water system by two (2) or more connections, the municipal water system shall be protected by perimeter isolation of the private system. This shall mean the installation of testable device (DCVA) at the property line. These devices shall be owned and maintained by the owner.

7.9.6 Material Type

Material type shall be an approved material type as indicated in the City of London Standard Contract Documents for Municipal Construction Projects to the property line. On private property, material for water service pipes and fire service mains shall comply with Part 7 of the Ontario Building Code.

7.9.7 Location and Layout of Water Services

Single Family and Semi-Detached Lots:

The standard residential water service will be located as per City of London SW-7.0, and W-CS-8.

Street Townhouse Blocks;

At this time no standards exist. Approval will be on a case by case basis. Approval is to be given by the Water Engineering Division.

The water service pipe must be installed at right angles to the watermain and in a straight line from the watermain to the water meter.

Water services connected to a private watermain are subject to the same requirements as water services connected to a public watermain.

7.9.7.1 Water Service Pipe Depth

Water services shall have no less than 1.7m nor more than 1.9m of cover from final surface grade. Variations from this cover may be made only if approved on plans or in writing by the Water Engineering Division.

The Owner must ensure that water services and private watermains are located so that “berm” or “mound” type landscaping will not cause excessive cover over water services.

7.9.8 **Approved Deviations in Location of Water Services**

Deviations from the above may be approved by the Water Engineering Division for the following conditions:

a) Cul-de-sacs, Street Curves and Bends

On cul-de-sac streets and on street curves and bends the water service stubs may be installed at other than right angles to the watermain and not necessarily through the midpoint of the lot frontage. The water service must be in a straight line from the watermain to the meter.

b) Water Service Cannot be Located in Accordance with SW-7.0

Where the water service cannot be located in line with the centre of the lot, the water service stub may be installed at any point on the front of the lot but must be at right angles to the watermain and in a straight line from the watermain to the meter and must maintain the appropriate separation distances from other utilities.

c) Water Service Cannot Extend in a Straight Line from the Watermain to the Water Meter

In (a) and (b), if the water service stub has been installed on the lot frontage but the water service cannot be in a straight line from watermain to water meter then the water service extension may be installed in a straight line from the curb stop to the meter provided the meter is inside the front wall of the structure.

d) Water Meter to be Located at the Side of a Structure

Where the water service entrance must be located at the side of a structure, the water service stub must be located on the front of the lot such that the water service extension can be installed in a straight line from the watermain to a point outside the structure adjacent to the meter. Such a water service shall be a minimum of 1.5 m from the structure and centered about a 3.0 m clear space.

e) Cold Cellar on Front of Building

Where there exists a cold cellar on the front of the building and the water service stub has been installed in the standard location on the lot frontage, the water service extension may be installed under the porch or cold cellar in a straight line from the watermain to inside the first heated wall. A maximum distance of 2 metres of water service pipe may be located under the porch or cold cellar floor slab.

The water service shall be continuous between the curb stop and the water meter, with no coupling permitted.

The water meter shall not be located within the cold cellar as this is subject to freezing.

7.9.9 Nonconforming Installation of Water Service or Private Watermain

a) Water Service does not Conform with Location Requirements

If the water service stub is to be extended and it is found that the water service will not conform to the above location requirements in Section 7.9, the water service stub shall be disconnected from the watermain and a new stub installed which will conform with the requirements.

b) Water Service or Private Watermain not in Accordance with Specifications or with Approved Service Drawing

If a water service stub, a water service or a private watermain is installed that is not in accordance with these specifications or with the service drawing approved by the City, such installation will be required to be removed and relocated to conform with the specifications or approved drawings.

c) Existing Water Service to Relocated, Rebuilt or Replaced Structures

If an existing water service cannot conform to the above location requirements, or is of lead or other unsuitable material, a new water service must be installed which will conform to the requirements. If a Demolition Permit was issued for an existing structure on the lot, then the existing water service must be abandoned at the watermain and a new water service installed to service the structure.

d) Relocation to be at Owner or Contractor's Expense

All relocation work required in (a), (b) or (c) shall be at the expense of the Owner or Contractor. The Owner will be responsible, upon approval of the demolition permit, to cut and cap the existing water service(s) at the watermain to City of London standards and at no cost to the City of London.

7.9.10 Fire Service Design

The determination of fire service requirements and the sizing of supply piping shall be the responsibility of the Owner. If a domestic water service is combined with a fire supply service, the Owner is responsible to ensure that the supply pipe is large enough to carry the combined demand. Design and installation of sprinkler and standpipe systems and their supply services shall conform to the requirements of the Ontario Building Code, Section 3.2, and the Fire Code. The design of Fire Services must be approved by the Chief Official (Fire Prevention Office) of the City.

The designer should obtain information from the Engineer regarding flows and pressures available for fire systems. If the flows and pressures required are in excess of the minimum design standards given in Section 7.3.1 and in excess of the actual capacity of the system the Owner shall install booster pumps and/or storage to satisfy the required demand.

7.9.10.1 Separated Water and Fire Services

Domestic water, sprinkler and standpipe services may be installed as a separated services from the watermain to the structure.

Sprinkler and standpipe services may be combined. The Owner is advised to consult with the Insurance Underwriter before combining these services.

7.9.10.2 Combined Water and Fire Services

A domestic water service may be combined with a sprinkler or standpipe service or with a combined sprinkler/standpipe service. The Owner is advised to consult with the Insurance Underwriter before combining these services.

The owner/designer is advised that water quality should be considered; domestic water demands may not achieve a sufficient turnover rate (see 7.3.5) to prevent poor water quality.

7.9.11 **Water Service Size or Location Not Determined**

Where water service stub size and/or location for any block cannot be determined prior to street construction the Water Engineering Division will not approve installation of the water service stub.

7.9.12 **Water Services Valves**

All water services shall be equipped with a corporation stop and a curb stop. The curb stop shall be provided with a curb box.

All water service valves and curb stops shall be installed with valve boxes and operating rods. All in accordance with the City of London Standard Contract Documents for Municipal Construction Projects.

7.9.12.1 Location of Water Service Valves

7.9.12.1.1 Valves for Water Services up to 50 mm Diameter

On water services of 50 mm diameter and smaller, a main stop or corporation stop shall be installed at the watermain and a curb stop shall be installed 0.3 m from, and on the street side of, the property line in accordance with City of London W-CS-8 and W-CS-22.

7.9.12.1.2 Valves for Water Services 100 mm Diameter and Larger

For water services of 100 mm diameter and larger, water service valves shall be placed in accordance with City of London W-CS-31.

Where the watermain cannot be closed off for the water service connection, a tapping sleeve and valve will be required at the watermain. It should be noted that size on size taps (eg; 150mm x 150mm tap) is not allowed and a tee will have to be cut in.

Where the watermain can be closed and a tee cut into it, or where a new watermain is being installed, a valve shall be installed 0.3 m from and on the street side of the property line.

The requirement to use a tapping sleeve and valve or to cut in a tee to make the service connection will be made at the discretion of the Water Engineering Division.

7.9.12.1.3 Valves for Water Services to be Connected to a Private Watermain

Water services to structures in a complex that are to be connected to a private watermain shall have the curb stop or valve placed 3 meters (10 feet) from the face of the building. If this distance locates the curb stop in the paved portion of the complex, a deviation in the curb box location may be requested. All deviations from standard location to be approved by the Water Engineering Division.

7.9.12.2 Locates for Curb Stops or Valves

The layout for water services must be such that the curb stop or valve can be easily found by referring to two directional dimensions from a plaque located on the building where the water service enters.

7.9.12.3 Water Service Control Valves Not to be Covered

The Owner shall ensure that water service control valves on his property are not covered by “mound” or “berm” type landscaping.

7.9.13 **Water Service Entrances**

Water services of all sizes shall enter through the building wall or under the wall footing into a heated area, leaving sufficient pipe and working space for meter installation.

A length of between 0.3 and 0.45 metres shall be exposed above the finished floor. The pipe shall enter the building not less than 0.15m and not more than 0.3m from the wall.

7.9.14 **Protection from Contamination**

Connections to the municipal potable water system shall be designed and installed so that non-potable water or substances that may render the water non-potable cannot enter the system. This shall be in accordance with the requirements of the Ontario Building Code, Part 7 Plumbing.

7.9.14.1 Backflow Prevention Devices Required on Water Services In High Elevation Areas of the City

In some high elevation areas of the City, the Owner may be required to install a check valve on the water service to prevent backflow into the watermain in the event of a loss of pressure in the system.

The Owner will be responsible for the supply, installation and maintenance of all check valves and protective devices, at no cost to the City.

7.9.15 **Electrical Grounding**

7.9.15.1 New Installations

Effective June 30, 1993 electrical systems of all new developments shall not be grounded to the water system. Refer to Ontario Hydro Electrical Safety Code (Section 10) for grounding requirements.

7.9.15.2 Upgrade of Existing Plant

Where an existing watermain is replaced or upgraded, the grounding of electrical systems to the water service may not be adequate. It will be the Owner's responsibility to ensure grounding is adequate after the watermain is installed.

7.10 **CORROSION PROTECTION**

Where ductile iron, steel or concrete watermain pipe are to be used, soil samples shall be taken on each street to identify soil class and resistivity for the purposes of designing corrosion protection systems for these pipe materials. The corrosion protection systems for the watermain shall be designed by a consulting engineer who is NACE (National Association of Corrosion Experts) Certified.

7.11 **EASEMENTS**

Easements are required for any publicly/City owned watermain which is located outside a road allowance on privately owned property.

The minimum width of easement shall be 6.0 m for a single watermain only. When the easement is 6.0m, the watermain will be installed 2.0m from one side of the easement to provide an adequate working area to access and repair infrastructure placed within the easement. Where there is more than one utility, adequate width of easement and separation of utilities for both construction and future access and maintenance shall be provided.

Where a watermain is installed on an easement which is located on private property or between private properties which have or may have a building(s) located on the property(ies) in the future, the watermain shall be installed in a casing.

7.12 **INSTRUMENTATION**

For design and installation standards related to instrumentation and control equipment, refer to "Scada and Instrumentation Standards", (latest version from the City of London website:

<http://www.london.ca/business/Resources/Consultant-Resources/Pages/SCADA-Standards.aspx>

7.13 **WATER METERS**

7.13.1 **General Requirements**

Refer to Section 7.9.4 for acceptable servicing configurations.

a) All Domestic Services to be Metered

All domestic water services must be metered.

b) Fire Services Not Metered, Exception

Fire services are not metered with the exception of sprinkler systems located in individually metered dwelling units.

7.13.2 **Supply of Water Meters and Water Meter Remote Read Registers and Meter Strainers for Services 150 mm and Larger**

The City will supply and install all water consumption meters that are used for billing process. Water meters up to 20 mm size will be supplied at no charge.

Strainers for 75 mm and larger installations where required shall be supplied by the City.

7.13.3 Location of Water Meter

The water meter shall be installed on the water service immediately inside the point of entry of the water service into the building (see Section 7.9.13 Water Service Entrance). Any variation from this location must be approved in writing by the Engineer.

The Owner shall provide sufficient space for installation and maintenance of the meter. The water meter must be accessible for reading and maintenance and must be protected from freezing and other damage. In accordance with Section 7.9.8, water meters shall not be installed within a cold cellar.

The meter or piping shall be no closer than 1 metre to any electrical panel or above or below any electrical panel unless provided with a meter enclosure as outlined in 7.13.3.2.

7.13.3.1 Meter Pits will be Required

Meter pits will be allowed only with approval of the Water Engineering Division when no other suitable location is feasible. Meter pit design and installation must be submitted for approval as per section 7.9.4. All costs associated with the supply and installation of the meter pit will be the responsibility of the Owner.

7.13.3.2 Water Meter Enclosures

Water meters may be installed in electrical rooms provided a shield is installed between the water meter and any electrical panel located within one (1) meter. The shield must be of metal construction (or approved alternative) and affixed securely to the wall and must be of sufficient width to isolate the water meter from the electrical panel. It must not impede the maintenance of the water meter.

7.13.4 Installation of Water Meters

Water meters up to 20 mm size - single family residential units with individual water services. This applies to single family residential, semi-detached dwelling units and townhouses with individual services (constructed after 1985). Water meters up to 20 mm size shall be installed in accordance with City of London W-CS-7.

Water meters larger than 20 mm in size shall be installed in accordance with AWWA C700, C701 or C702.

7.13.4.1 Water Meter Valving

All new and replacement installations shall require a valve on each side at the meter.

The City will supply, install and maintain the valve on the inlet side of the meter for 16 mm and 20 mm meters for water service sizes up to and including 25 mm diameter.

The Owner must supply and install the outlet valving and bypass valve (when required) for all sizes of meters and the inlet valve when the water service piping is over 25mm diameter. The Owner will be responsible for maintaining and keeping the meter inlet and outlet valving operational and in good working order.

All meter setting valves must open left (counter clockwise).

7.13.4.2 Meter Strainers

Meter strainers shall be supplied and installed by the City on 75 mm size and larger meter installations in accordance with City of London W-CS-30. The Owner shall consult the Engineer regarding dimensions of supports required for the meter and strainer.

7.13.4.3 Water Meter-by-pass Required

The Owner shall install, at his expense, a meter bypass when any of the following conditions exist:

- i) the water meter is 40 mm or larger in size.
- ii) shutting the water supply off for approximately thirty (30) minutes during normal working hours of the City would create a production or other problem to the Owner.
- iii) any water service which supplies coin-operated equipment cannot be shut down for thirty (30) minutes or longer during the normal working hours of the City.

Meter bypasses shall be installed according to City of London W-CS-30. Bypass valves shall be closed and sealed for use by the City only.

7.13.5 Meter Sizing

The size of meters will generally be one size smaller than the water service. Owners should obtain advice from the Engineer on meter sizing. Meter ratings are as follows:

<u>METER SIZE</u>	MAXIMUM RATING	CONTINUOUS RATING
	<u>L/MIN</u>	<u>L/MIN</u>
16 mm	76	38
20 mm	114	57
25 mm	189	95
40 mm	378	189
50 mm	606	303

<u>COMPOUND METERS</u>	MAXIMUM RATING	CONTINUOUS RATING
	<u>L/MIN</u>	<u>L/MIN</u>
75 mm	1136	568
100 mm	1893	946
150 mm	3785	1893

7.14 HYDRAULIC MODELING

7.14.1 General

Hydraulically model water distribution systems for all new developments, or as otherwise exempted by the City Engineer. Submit the results of the analyses to the City for review and provide an electronic version of the hydraulic model for incorporation in the City's overall hydraulic model.

Include all watermains 50mm diameter and larger, control valves (pressure reducing valves and flow regulating valves), reservoirs and pumping stations.

For phased developments, submit updated hydraulic models incorporating the distribution system for all phases at the first phase stage. It should be noted that phases will need to match with anticipated requests for conditional approval to be made. Where a submission is made at a later date for a phase which doesn't match a phase considered during the design studies approval process, additional hydraulic modelling will be required. The City may require hydraulic analyses beyond the development boundaries in situations where the operation of water system facilities such as control valves, reservoirs and pumping stations, are influenced by changing demands in the new development.

The model shall also include calculations to ensure water quality in the subdivision during the buildout of the phases and ultimately as well as in any temporary dead-end watermains and specify the installation of automatic flushing devices as required

The City has adopted InfoWater as its standard for hydraulic modelling. Other software packages may be used for analysis and reporting but all model input files provided to the City must be directly readable by InfoWater or EPANET without modification. The accuracy and readability of the input files are the sole responsibility of the developer.

As a minimum, conduct steady-state hydraulic analysis for each proposed development phase under the following demand conditions:

- Average day
- Peak hour
- Maximum day plus fire flow
- Water quality under buildout of the phase, and Water quality under zero buildout for the phase

All Hydraulic reports shall include detailed maps/layouts of the watermain system (valves, hydrants, etc.) and shall clearly show the pipe and node numbering.

Extended period simulations are not required unless specifically requested by the Water Engineering Division.

7.14.2 Information Provided by the City

The City of London Water Engineering Division will provide minimum steady-state pressures at the connection node(s). The designer is cautioned that only the pressures provided by the City will be acceptable for the model and that flow tests cannot be used for boundary conditions as they are not representative of design flow conditions.

7.14.3 Design Criteria

In accordance with Section 7.3 Watermain Design.

7.14.4 Hydraulic Model Input Standards

7.14.4.1 Units

Parameter	Units	Accuracy
Elevation	metres	x.xx
Length	metres	x.x
Diameter	millimetres	x (hard conversion)
Demand	litres per second	x.xxx
Tank diameter	metres	x.
Tank volume	cubic metres	x.xx
Pressure	metres (of water)	x.xx
Power	kilowatts	x.xx
Time	hours	x.x

7.14.4.2 Node Elevations

In metres to geodetic datum and estimated final grading contours.

7.14.4.3 Node and Link Identification

Nodes and links are to be graphically identified on a map.

7.14.4.4 Demands

Use average day demands and global demand multipliers for demand patterns.

7.14.5 Submission Requirements

Submit electronic versions of the following files in EPANET format:

- model input file
- map or shape file

Submit a report, sealed by an Ontario Professional Engineer, including:

- summary of demand scenarios and points of connection to the City system
- network map (in colour) for each scenario which identifies node and link numbers
- node tables for all scenarios listing node numbers, elevation, demands, and pressures
- link tables for all scenarios listing link numbers (with up and downstream nodes indicated), diameters, lengths, roughness, velocities, flows, headlosses, and age of water calculations
- for multi-phase developments, provide model data and summaries for all phases as part of the first phase submission.

Reports containing results that indicate operating parameters outside the acceptable Design Criteria will be automatically rejected without further review and returned to the Owner for correction.

7.14.6 Review by the Water Engineering Division

The Water Engineering Division will review the report and advise on the need for any further analysis to be carried out at the Owner's cost.

7.14.7 Submission Requirements for Interim Water Quality Reports – request to change settings of automatic flushing devices based on partial buildout of subdivision

The owner or their consultant may request changes to automatic flushing device settings based on partial buildout of a subdivision. This request should be submitted to the Development Services Compliance Group who will then circulate this request to the Water Engineering Division for review, and to Water Operations for the purposes of making the change to the automatic flushing device settings.

Where this water distribution system has been modelled fully, the submission can contain only water quality information.

Where this application is being made for a stage or phase of subdivision buildout that has not been fully modelled for fire flow, max day and peak hour, it will be necessary to submit hydraulic modelling for all demand scenarios as well as water quality.

7.15 EROSION & SEDIMENT CONTROL

The City of London requires an Erosion & Sediment Control Plan (E&SC Plan) be designed for most Capital Works, Operational and Development Projects. The complexity of the E&SC Plan is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area; an E&SC Plan is not required, unless otherwise directed by the City Engineer. Where an E&SC Plan is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the E&SC Plan, please refer to Section 10 – Sediment & Erosion Control, within this manual.

WATER DISTRIBUTION SYSTEM REFERENCES

Fire Underwriters Survey

Water Supply for Public Fire Protection, A Guide to Recommended Practice, 1981

Ontario Water Resources Act

Public Utilities Act

Ontario Building Code

Corporation of the City of London

Zoning By-Law, No. Z. - 1, March 1995

Water By-Law W-1

Regulation of Water Supply In The City of London

Ministry of the Environment

Design Guidelines for Drinking-Water Systems (Latest Revision)

<https://www.ontario.ca/document/design-guidelines-drinking-water-systems-0>

Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit

<https://www.london.ca/business/Resources/Consultant-Resources/Pages/PlanSubmissionStandards.aspx>

Form 1 – Record of Watermains Authorized as a Future Alteration

<http://www.forms.ssb.gov.on.ca/mbs/ssb/forms/ssbforms.nsf/ODAGetFormDetail?openagent&lang=E&env=ODA&NO=012-2202E>

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8 WATER PUMPING STATIONS

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9 GRADING

9.1 GRADING REQUIREMENTS FOR VARIOUS SITUATIONS

Grading in a plan of subdivision, site plan (guidelines where applicable) and infill lots are to be designed by a Professional Engineer and certified by a designated professional (as per the Subdivision Agreement clauses, Drainage By-Law (WM-4) and Building By-Law (B-4)) and are to be in accordance with the following standards:

9.1.1 Subdivisions

Developments created by a draft plan of subdivision shall conform to the following lot grading standards and will not adversely affect the abutting or adjacent properties.

9.1.2 Site Plans

Developments subject to site plan approval are to be graded and drained internally in compliance with the Drainage By-Law and should not adversely affect adjacent properties. The sites grading and drainage shall conform to the overall drainage pattern of the adjacent lands as certified by the design engineer at the time of the permit for each building. On site grading will also be subject to the Site Plan Control By-law.

9.1.3 Severances, Lifting of Part Lot Control & Infill Lots

Developments created by severance, lifting of Part Lot Control and infill lots for residential lots shall conform to the lot grading standards in a plan of subdivision and are not to adversely affect the abutting and/or adjacent properties.

9.1.4 Blocks

Development on blocks within registered plans of subdivision are subject to site plan approval (as above). Drainage and grading of such blocks shall conform to the accepted overall subdivision design and shall be certified by the site design engineer.

9.1.5 Capital Projects

When grading is required, the designer shall determine match points that appear to naturally blend proposed design grades with existing topography. Consideration shall be given to transitions with intersecting streets, driveway profiles, drainage, utilities, existing retaining walls, potential impacts on trees and other landscaping features. Wherever possible, the designer shall take every opportunity to eliminate or reduce the size of existing retaining wall owned and maintained by the City. Consideration should also be given to maintenance and aesthetics of grassed areas such as lawns and boulevard areas.

Grades should not be altered around trees on the basis of 30cm of distance from the stem for each 3cm of trunk diameter at breast height 1.5m above ground.

While a 4:1 slope or greater is desirable from a maintenance perspective, a maximum 3:1 slope is acceptable.

Proposed driveway grades shall not exceed 10% unless approved by the City's Contract Administrator.

9.1.6 Parks and Open Space

Overall grading of Park and Open Space Blocks within new plans of subdivision shall conform to the master grading plan for the subdivision and must accommodate overland

flow routes, etc. Detailed grading within Parks and Open Space areas will be according to Section 11. Technical servicing requirements will be subject to the provisions of Section 5.

9.1.7 Variations / Modifications

There will be site specific situations where all the criteria may not apply. Proposed grading that does not conform to the appropriate grading requirements standards will be reviewed taking into account the mitigating circumstances that require the proposed variations or modifications.

9.2 MAJOR / MINOR STORM DESIGN

As storm sewer systems (referred to as the minor system) are designed to accommodate storm runoff from a 2 year storm event, the lot grading design (referred to as the major storm system), must be designed to accommodate runoff from storm events that exceed the design capacity of the storm sewer system. These allowances, in the form of major overland flow routes, shall provide for the effective routing of major overland storm flow from residential areas to an acceptable overland flow outlet location.

When designing overland flow routes, the following criteria shall apply:

- The Major overland flow routes are generally to follow low areas in subdivision grading, and be in compliance with an accepted SWM report.
- In order of preference, overland flow routes should be directed along:
 - Expressway;
 - Rapid Transit Boulevard;
 - Urban Thoroughfare;
 - Civic Boulevard;
 - Main Street;
 - Neighbourhood Connector;
 - Neighbourhood Street;
 - Parks, open spaces;
 - Dedicated municipal easement - Refer to Stormwater Engineering Section 6.
- The conveyance of major overland flows up to the 100 yr storm event should be contained within the municipal right-of-way or dedicated easement(s) and the 250 year flows safely conveyed.
- In addition to the above, the adequate conveyance capacity of major overland flow routes must be demonstrated for the proposed design of raised intersections and/or raised crosswalks and shall also comply with section 5.16.6.
- The conveyance of major overland flow between adjacent buildings on private property/properties must be avoided. For example, major overland flow from an upstream catchment should not be conveyed between residential houses.
- The maximum allowable ponding at gutters on roads is 300mm.
- Building opening elevations adjacent to overland flow routes on roadways shall be at least 300mm above the road centreline elevation.
- For buildings abutting overland flow routes, the 250 year storm elevation should be identified and must be safely conveyed (i.e. ground elevations and any window openings must be higher than the 250 year storm). For small rear yard drainage

catchments (maximum 16 lots), a minimum freeboard of 225mm must be provided between the 'spill point' and the ground elevation of the abutting buildings.

- The maximum ponding permitted at rear yards catch basins is 450mm.
- The maximum ponding permitted at parking areas in Multi-family, commercial and institutional blocks is 300mm.
- Accommodate all overland flow routes into a stormwater management pond (if applicable).
- Show existing and proposed major overland flow route directional arrows on all grading drawings.

9.3 GRADING REQUIREMENTS ALONG PROPOSED/EXISTING ROADS

9.3.1 Major Roads

Please see Figure 9.1

9.3.2 Other Situations

On all other streets not mentioned in 9.3.1 above, the owner shall grade the property line and adjacent boulevards so that they blend with the proposed or existing street grades in accordance with the City of London Standard "Utility Coordinating Committee Standard Utility Locations, U.C.C.-1M and U.C.C.-2M, and to the specifications of the City Engineer. Refer to Section 1.1.3 a) for further UCC-1M design criteria and Section 1.1.3 b) for further UCC-2M design criteria.

9.4 GRADING STANDARDS

The following standards are to be considered when designing lot and adjacent boulevard grading:

9.4.1 Drainage

- The boulevard and a minimum 6.0m at the front of any residential lot must drain towards the abutting road.
- Show the location and direction of drainage along the rear and side lot lines. Show one drainage direction arrow for each change in grade for all lots.
- The drainage from single-family lots in the same subdivision may be drained between other single-family lots (from back to front).
- The drainage from impervious areas on lots in a new subdivision is not to flow across existing lots abutting the new subdivision.
- The drainage from single-family and semi-detached lots is not to drain onto Multi-family, Commercial or Institutional blocks (with the exception of the overland flow routes).
- All multi-family, commercial and institutional block drainage is to be self-contained.
- Where a new subdivision abuts an existing development or undeveloped land, the existing ground elevations at the common property line are to remain unchanged and existing drainage of abutting lands is not to be disturbed, or obstructed, unless written permission is granted by the affected land owner.

- Localized surface drainage from abutting properties, to be developed in future, may be discharged onto the proposed lots in a subdivision.
- Identify existing vegetation and set grades to retain where possible.

9.4.2

Elevations

- Show existing elevations by contours. Contours are to extend a minimum of 30m beyond the limit of the site plan, or subdivision.
- Show existing spot elevations at all lot/block corners along the boundary of the development, and along all major overland flow routes.
- Show existing centreline of road elevations every 30m for existing, abutting and connecting streets.
- Show existing spot elevations around existing house/units and at house/unit openings for new proposed major overland flow routes through existing developments.
- Show proposed elevations on ALL corners of the proposed lots.
- Show finished ground elevations around house/unit.
- Show final centreline road elevations, every 30m as well as at break points and high and low points in the road profile. Identify (label) the break points, high/low points.
- Show proposed elevations at all high points or break points where the direction of drainage along rear and side lot lines changes.
- Show proposed bottom of swale elevations at pertinent intervals, and at property lines.
- Show proposed elevations at the top and bottom of all steep slopes (3H: 1V, max.).
- Show proposed top and bottom retaining wall elevations.
- Show proposed top and bottom noise barrier wall elevations.

9.4.3

Slopes

- Yard surfaces shall have a minimum slope of 2%.
- Front yard surfaces shall have a maximum slope of 10%.
- Rear yard/side yard (walkouts/back splits) surfaces including swale cross-falls shall have a maximum slope of 3H: 1V.
- Berms shall have a maximum slope of 3H: 1V.
- Road and boulevard surfaces shall have a minimum cross-fall grade of 2% and a maximum cross-fall grade of 4% in new subdivisions or developments.
- Driveway surfaces shall have a minimum grade of 2% and a maximum grade of 10%.
- Specify stepped foundations, side to side for lots fronting streets with a road grade of more than 3%.

9.4.4

Swales

- Drainage flows which are carried around houses are to be confined in defined swales, located as far from the house as possible.
- Minimum swale grade is 2%.
- Maximum of 16 lots draining to a rear yard swale, outletting to a rear yard catch basin.
- Maximum length of swales permitted is 76m, outletting to a rear yard catch basin.
- The maximum flow allowable in a side yard swale or a swale discharging across a boulevard onto a City Right-of-Way shall be that from 4 backyards.
- The side yard swale is to be a minimum of 150mm lower than the finished ground elevation at the house.
- The average rear yard swale depth is 225mm. The minimum swale depth allowed is 150mm. The maximum swale depth is variable, but is dependent on location and safety considerations.
- Show the location and direction of flow in swales by means of arrows. Show at least one arrow at the rear of each lot.

9.4.5

Catch Basins

- The maximum length of swales permitted to drain to a catch basin is 76m.
- A maximum of 16 lots draining to a rear yard catch basin is allowed.
- Front yard catch basins are not permitted, except in unusual circumstances where a rear-yard catch basin cannot be provided.
- No surface ponding is allowed during a two year design storm event.
- Under a 100 year design storm event, 300mm surface ponding is allowed at catchbasins on roads, and 450mm surface ponding is allowed at rear yard catchbasins.
- Flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.
- In reconstruction projects within existing developed areas of the City, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to the City Engineer.

9.5

ADDITIONAL INFORMATION TO BE SHOWN ON PLAN

Grading Plans shall be designed in accordance with the standards listed above, and will contain the following information where applicable:

REQUIRED INFORMATION	WHERE APPLICABLE INFORMATION
Standard City of London title block North arrow P. Eng. stamp Street Names Lot and Block frontages Lot and Block Numbers 0.3m reserves Existing features (trees, fences, houses, etc.) Sediment and Erosion Control Measures Delineation of proposed unit/house Maintenance holes and Fire Hydrants Catch basins	Sidewalk ramps Sewer easements and widths Building setbacks for rear yard catch basin leads Steep slope lines (3:1 desirable) Sidewalks to be constructed Headwalls (inlets/outlets) Channels Pedestrian walkways (fencing, posts, width and driveways) Noise barrier walls and details

9.6 GRADING NOTES

The following notes are to be included on the Grading Drawings:

- Existing drainage of abutting lands is not to be disturbed.
- Localized surface drainage from abutting properties to be developed in future may be discharged onto the proposed lots in this subdivision.
- Basement openings to be minimum 300mm above the centreline of road unless otherwise approved by the City Engineer.
- Ground elevations at houses abutting overland flow routes are to be 225mm above overland flow route elevations.
- Retaining walls, 1.0m high or greater, are to be designed by and constructed to the specifications of a registered professional engineer in accordance with the Ontario Building Code.
- For Subdivisions and Site Plans: Sump pump discharge must be directed to the storm sewer via the storm PDC as per the WM4 Drainage Bylaw Section 5.7 (i) and 5.7 (v).

- OR -

- For Other Cases: Sump pump discharge must be directed away from driveways and sidewalks.

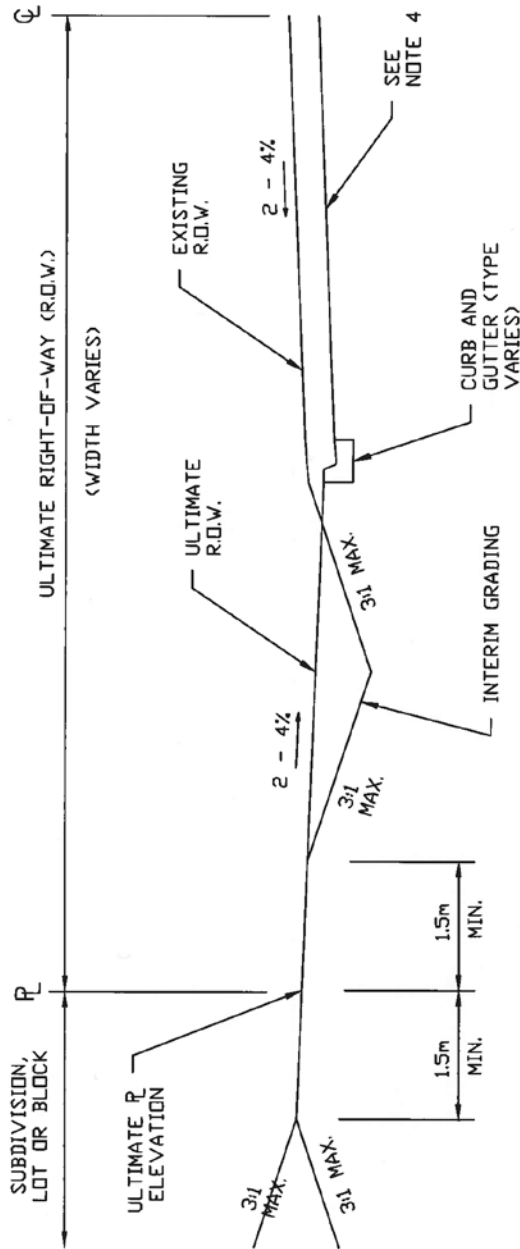
9.7 EROSION & SEDIMENT CONTROL

The City of London requires an Erosion & Sediment Control Plan (E&SC Plan) be designed for most Capital Works, Operational and Development Projects. The complexity of the E&SC Plan is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open

watercourse, woodlands, ESA's, steep slopes or other natural area; an E&SC Plan is not required, unless otherwise directed by the City Engineer. Where an E&SC Plan is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the E&SC Plan, please refer to Section 10 – Sediment & Erosion Control, within this manual.



NOTES:

1. MAJOR ROADS INCLUDE RAPID TRANSIT BOULEVARDS, URBAN THOROUGHFARES, CIVIC BOULEVARDS, MAIN STREETS AND RURAL THOROUGHFARES.
2. ULTIMATE R.O.W. WIDTH VARIES DEPENDING ON ROAD CLASSIFICATION.
3. PAVEMENT WIDTH MAY VARY AND IS DEPENDENT ON ROAD CLASSIFICATION, RECOMMENDATIONS FROM AN APPROVED ENVIRONMENTAL ASSESSMENT AND SPECIFIC LANE CONFIGURATIONS.
4. ULTIMATE ∇ ELEVATION SHALL BE AS PER RECOMMENDATION FROM AN APPROVED ENVIRONMENTAL ASSESSMENT (EA). IN THE EVENT THAT AN EA HAS NOT BEEN COMPLETED, THE DEVELOPERS CONSULTING ENGINEER SHALL PREPARE A DESIGN FOR THE PURPOSE OF DETERMINING PROPERTY LINE GRADES TO THE SATISFACTION OF THE CITY.
5. GRADING SHALL BE PROVIDED AS REQUIRED AT THE DEVELOPMENT'S INTERFACE TO THE ULTIMATE R.O.W., ALL TO THE SATISFACTION OF THE CITY.

GRADING ALONG MAJOR ROADS

CITY OF LONDON

N.T.S.

CITY OF LONDON

GRADING ALONG MAJOR ROADS

DWG NO. FIG. 9.1

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APPROVED BY

Figure 9.1

Grading Along Major Roads

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Design Specifications & Requirements Manual

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10 EROSION AND SEDIMENT CONTROL

10.1 INTRODUCTION

Construction Sites by their nature result in the disturbance of the on-site existing vegetation and soils. Erosion Sediment Control measures are intended to mitigate transfer of sediment and reduce erosion to protect adjacent properties, infrastructure and the natural environment. Sediment and erosion control measures are to be used on ALL construction sites. The City of London requires an Erosion Sediment Control (E&SC) Plan be designed for most Development, Capital Works and Operational Projects. The complexity of the E&SC PLAN is determined by the scope of the proposed works and the sensitivity of the area.

10.2 REFERENCE

The following guidelines rely on the Ministry of Natural Resources Guidelines on erosion and sediment control for urban construction sites, unless otherwise noted. The Erosion and Sediment Control Guidelines for Urban Construction (CVC, December 2006) provides additional information on the design, installation and maintenance of erosion and sediment controls and is a resource that should be utilized.

Erosion Sediment Control (E&SC) Plan:

The requirement for an E&SC Plan within the City of London has developed through the City's ongoing commitment to ensure water quality protection in sewers and open watercourses/ditch systems within the City's boundaries. More information relating to the E&SC Plan policy can be found in:

- i) Planning Committee Report, June 20, 2005, Agenda Item # 3; and
- ii) Joint ETC/Planning Committee Report, June 18, 2007, Agenda Item # 12.

10.3 GENERAL INFORMATION REQUIREMENTS

10.3.1 E&SC Plan

An E&SC Plan for all Capital Works, Operational, and Development Projects is to be designed ensuring that all the requirements identified in the General Requirements for Erosion Sediment Control Plan (E&SC Plan) chart (See Table 10.1) are addressed. For all construction projects, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

- i) For Site Alteration Agreements, the E&SC Plan is to be provided as part of the application.
- ii) For Subdivision related developments, the E&SC Plan is to form part of both the Servicing Report and Engineering Design Drawings for the project.
- iii) For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area, an E&SC Plan is not required however, a strategy to manage erosion and sediment on-site shall be provided unless otherwise directed by the City Engineer.
- iv) For Capital Works and Operational Projects, the E&SC Plan is to be submitted during detailed design.

The complexity of the project will determine the required complexity of the E&SC Plan.

10.3.2 Servicing Drawings

Erosion and Sediment Control measures are to be identified on all applicable engineering drawings such as grading plans, site plans, and detail drawings and notes. If extensive measures are required, or the scale of the drawing is such that the measures are not clear, then the sediment and erosion control measures must be identified on a separate plan. The measures shown on the servicing drawings are to reflect the requirements identified in the E&SC Plan.

10.4 REVIEW AND ACCEPTANCE OF EROSION AND SEDIMENT CONTROL PLANS

The City of London, Environmental and Engineering Services is responsible for reviewing and accepting the E&SC Plan. Consultation with the UTRCA will be conducted as required.

10.5 UTRCA

Approvals are to be obtained from the UTRCA for works which are within or adjacent to the UTRCA's regulated areas prior to City approval of the engineering plan/drawings and construction.

10.6 PARKS AND OPEN SPACES

Approvals are to be obtained from the Planning Division for sediment and erosion control measures adjacent to any open space areas – flood plain, Environmentally Significant Areas, natural areas, ravines, parks, etc, prior to "Site Alteration", construction of services or approval of engineering plans.

10.7 SEDIMENT CONTROL MEASURE NOTES

The following sediment control measure notes are to be shown on the construction drawings, either on the plan that details the sediment and erosion control measures, or on the notes and details drawing.

Please note that the following sediment control measure notes are examples only, and may vary to suit the individual project:

- a) Minimize area disturbed during construction.
- b) Protect exposed surfaces
- c) Control runoff during construction.
- d) All erosion control measures are to be in place before starting construction and remain in place until restoration is complete.
- e) Regularly and following major rainfall events, inspect and maintain erosion control measures during all phases of construction.
- f) All collected sediment required to be disposed of off-site, must be at an approved location.
- g) All dewatering must be conducted using an approved outlet control method such as a sedimentation basin or filter sock. Effluent monitoring shall be required to ensure discharge is consistent with the receiver's background quality.

- h) Protect all catchbasins, maintenance holes and pipe ends from sediment intrusion using catchbasin filter sacks or equivalent.
- i) Keep all sumps clean during construction and identify a regular maintenance program to do so.
- j) Have a plan to minimize/prevent wind-blown dust such as spraying calcium chloride or water, and/or street sweeping.
- k) Straw bales to be used in localized overland flow areas as shown and as directed by the engineer during construction for works.
- l) Straw bales to be terminated by rounding bales to contain and filter runoff.

TABLE 10.1 GENERAL REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (E&SC)

No.	Proposed Measures and Site Conditions	Timing	Comments
1 (1st bullet identified in PC report on June 20/05)	Identify all types of “erosion/sediment control (E&SC) devices” that are selected for the proposed construction activities.	For Development Projects with a Functional SWM Report – the E&SC PLAN is to be included in the Functional SWM Servicing Works Report. For Development Projects with no Functional SWM Report component – the E&SC PLAN is to be included in the Servicing Report for the Project For Operational & Capital Works Projects – the E&SC PLAN is to be submitted prior to detailed design.	E&SC devices/measures have to be listed and identified in detail including, but not be limited to: <ul style="list-style-type: none">• the type of silt fences and/or link silt fences (silt/robust/heavy duty or others),• the proposed berms in relation to the identified areas All this information is required to be identified on the E&SC’s attached plan as part of the engineering drawings, the storm/drainage section, and SWM Functional Design Report.
2 (3rd bullet identified in PC report on June 20/05)	Identify the land slopes and proposed land alterations.	same	The relation of these recommended control devices to the proposed storm/drainage flow routes and grading on the attached plan shall be clearly established. All temporary fencing, rock check dams, and swales, where appropriate, are intended to attenuate flows and to provide sediment depositing. All these measures should be identified and attached to the E&SC PLAN in order to ensure that the ecological health of the system will be well protected and not compromised. During construction activities, any proposed diversion swales/channels, berms or silt fencing must direct all surface runoffs to the temporary sedimentation/settling basins or perimeter ditches in order to minimize sediment loading to the open watercourses or municipal system.

TABLE 10.1 GENERAL REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (E&SC)			
No.	Proposed Measures and Site Conditions	Timing	Comments
3 (2nd bullet identified in PC report on June 20/05)	Identify when and where these devices are to be installed.	same	The relation of these identified control devices to the proposed storm/drainage flow routes and grading on the attached plan shall be clearly established. All recommended temporary swales shall be identified on the plan and the detailed information should be included in the report (locations, elevations, geotechnical conditions and separation distances should be identified).
4 (5th bullet identified in PC report on June 20/05)	Identify the potential downstream sensitivity of water resources.	same	All applicable and relevant background information related to the Official Plan (OP) Natural Heritage System (NHS) requirements, the Subwatershed Studies, Environmental Impact Studies, the City's Design Standards and Requirements and the No cost implications requirements must be identified.
5 (6th bullet identified in PC report on June 20/05)	Identify the proximity to Environmental Significant/Sensitive Areas.	same	All applicable and relevant background information related to the Official Plan (OP) Natural Heritage System requirements (NHS), the Subwatershed Study, Environmental Impact Studies, the City's Design Standards and Requirements and the UTRCA (or other Conservation Authority) requirements must be identified.
6 (7th bullet identified in PC report on June 20/05) Amended July 2019	Identify the proposed infiltration measures and E&SC measures being proposed for the protection of infiltration measures.	same	Compliance with the Hydrogeotechnical report recommendations for the subject lands.

TABLE 10.1 GENERAL REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (E&SC)

No.	Proposed Measures and Site Conditions	Timing	Comments
7 (4th bullet identified in ETC report on July 18/07)	Identify dewatering requirements, the type of permits and existing groundwater and open watercourses levels.	same	Compliance with the Hydrogeotechnical report recommendations for the subject lands and the MECP's Permit to Take Water (if it is applicable).
8 (2nd bullet identified in ETC report on July 18/07)	Identify the type(s) and predominant characteristics of the soils within the area (e.g. particle size/structure, moisture content and compactness).	same	Compliance with the Geotechnical report recommendations for the subject lands.
9 (1st bullet identified in ETC report on July 18/07)	Provide specific provisions for all disturbed areas that are left inactive for 30 days or more. These areas must be re-vegetated in order to minimize the soil to be exposed and washed out by the storm flows.	same	The areas where the vegetation was removed for the proposed construction activities should be minimized and the phasing approach should be considered and discussed. The time period between the initial vegetation removal and final grading/seeding should be kept to a minimum. Temporary soil stabilization measures should be implemented where application and reasonable.
10 (4th bullet identified in ETC report on June 20, 2005 and 3rd bullet identified in ETC report on July 18/07)	Identify the need for enhanced E&SC measures that may be warranted by the site conditions and/or the proximity to Environmental Significant/Sensitive Areas and/or open watercourses.	same	<p>The requirement to provide various levels of the enhanced E&SC measures that encompass:</p> <p>a multi-barrier approach that will collect the sediment at the source first rather than through conveyance; and end-of-pipe controls that will collect the sediment within the proposed perimeter ditches and settling/contingency detention basins to protect ecological health of the system.</p> <p>Enhanced E&SC measures should include the use of sediment control socks (or equivalent filtration system) adjacent to watercourses and other critical areas as part of the multi-barrier approach.</p>

TABLE 10.1 GENERAL REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (E&SC)

No.	Proposed Measures and Site Conditions	Timing	Comments
11 (8th bullet identified in ETC report on July 18/07)	A Contingency Plan must be included in the E&SC PLAN and is required to address potential non-typical site and weather conditions, the efficient reporting system and the emergency contact list including all applicable agencies.	same	The need for enhanced and sustainable E&SC measures using the multi-barrier approach should be implemented. The main objectives of these measures are to provide the required control and containment of the sediment at the source within the proposed perimeter ditches and settling/contingency detention basins. The by-pass channels must be designed for a minimum of the 10 year storm event unless otherwise agreed to in writing.
12 (5th bullet identified in ETC report on July 18/07)	The Owner's Engineer will be responsible to develop and obtain all approvals for the proposed E&SC Plan (including a Contingency Plan) for any construction sites/subdivisions.	same	The commencing of any construction activity at the subject lands is not allowed to proceed without all approvals being in place including the E&SC Plan and the dewatering permits
13 (10th bullet identified in PC report on June 20, 2005 and 9th bullet identified in ETC report on July 18/07) Amended July 2019	<p>A cost estimate for the E&SC PLAN's security allocations for potential remediation works is required to be calculated based on approximately 15% of the total projected cost for the Storm/Drainage and SWM Servicing Works.</p> <p>For Site development, a cost estimate of the proposed E&SC measures can be provided to the City and a percentage of that cost (to be determined based on site specific conditions) could be retained for security purposes.</p>	same	It is required that the E&SC PLAN's security allocations for potential restoration works be included in the Subdivision security and should the Owner fail to provide the adequate implementation of the approved E&SC Plan, the City would use the security to undertake the remediation works.

TABLE 10.1 GENERAL REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (E&SC)

No.	Proposed Measures and Site Conditions	Timing	Comments
14	The Owner's Engineer will be required to obtain all required approvals for any proposed modifications that will compromise the effectiveness of the originally approved E&SC Plan and obtain the acceptance by the Contractor.	same	<p>The Owner's Engineer will be required to discuss the recommended modifications and obtain approval from EESD staff. These suggested changes must be supported by the presented justification merits and required to include, but not be limited to: the subject site conditions, sensitivity and proximity to watercourses and/or Environmental Significant Areas (ESA) and the acceptance by Contractor to implement the suggested modifications.</p> <p>Should these recommended modifications be considered:</p> <ul style="list-style-type: none">Minor changes- Upon discussing the presented justifications, and if the City agrees with the Engineer's definition, the E&SC PLAN's recommended modifications may be implemented by Contractor;Major changes-The Owner's Engineer must submit the E&SC PLAN's recommended modifications for review and acceptance by the City Engineer and implemented by the Contractor, all to the specification of the City Engineer.

TABLE 10.1 GENERAL REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (E&SC)

No.	Proposed Measures and Site Conditions	Timing	Comments
15	The Owner's Engineer will be required to ensure the implementation of the E&SC PLAN and to assign inspection throughout all construction stages. Also, the Owner's contractor shall undertake decommissioning of all E&SC measures under the supervision of the Owner's Consulting Engineer when the removal of the E&SC measure are deemed warranted by the Owner's Consulting Engineer.	same	Control features that fail should be repaired and evaluated as to whether or not additional measures are required, and prior to removal of any E&SC measures, joint inspection is required to be conducted with the applicable City staff.

TABLE 10.1 GENERAL REQUIREMENTS FOR EROSION SEDIMENT CONTROL PLAN (E&SC)

No.	Proposed Measures and Site Conditions	Timing	Comments
16	<p>The Owner's Engineer will be required to incorporate the following main components of the E&SC Plan's reporting system: Inspection on all days of the construction (failure of any E&SC Plan shall be reported immediately within a period of 2-3 hours), Inspect if the precipitation exceeds the 25 mm storm event; Inspection logs must be reviewed on a regular monthly basis; The semi-annual summary status reports are required to be provided to the City; and The inspection reports shall be submitted to the City every three months.</p> <p>Private, small scale projects will require the Owner's Consulting Engineer to provide proactive inspection of all E&SC measures to ensure they are in good working order, maintained and installed in accordance with the current accepted E&SC plan(s) on file.</p>	same	<p>The Owner/Subdivider to implement, maintain and ultimately decommission the E&SC measures contained in the approved E&SC Plan and their Consulting Engineer will be required to comply with the following requirements:</p> <p>"Certify" that all E&SC measures were installed prior to construction; "Certify" that all E&SC measures are being maintained and operating as intended; Submit E&SC monitoring reports. They are to be submitted by April 1, July 1, and November 1 of each year until all works and services of the plan are assumed; Submit semi-annual SWM monitoring reports for a minimum period of two years (implemented in 1996 and updated in February of 2002) and ensure that E&SC measures are decommissioned at the various stages of the project.</p>

10.8 SITE ALTERATION AGREEMENT

At the site alteration agreement stage, the site alteration agreement shall include:

- A proposed temporary site grading and drainage design that identifies site alteration parameters and any impacts on the adjacent lands and must be reviewed and accepted by the City prior to the agreement being finalized.
- The proposed site grading and drainage design that will incorporate the hydrogeotechnical study recommendations;
- The proposed site alteration activities that will be in compliance with hydrogeotechnical study recommendations; and
- The Consulting Engineer provides formal “certification” that E&SC measures were properly installed and were regularly maintained.

10.9 FINAL SERVICING DRAWINGS REVIEW

At the final servicing drawings review stage for various land development applications, all required E&SC measures and procedures are identified on these drawings, and are to be in compliance with the approved E&SC PLAN and applicable standards, all to the specifications and satisfaction of the City Engineer.



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11 PARKS & OPEN SPACE

11.1 DEFINITIONS

11.1.1 Neighbourhood Parks

Neighbourhood parks are intended to function as focal points within a neighbourhood and are designed to serve the needs of local neighbourhood residents by supporting both organized and unprogrammed activities. Typical features include: play structures, pathway loops, seating/gathering areas, unlit sports fields, multi-use pads and basketball courts.

11.1.2 District Parks

District parks are intended to serve groups of neighbourhoods and are designed with an emphasis on facilities for organized sports and unorganized activities. Typical features may include lit sports fields, spray pads, tennis courts, skateboard parks, parking lots, major play structures, multi-use pads, gathering areas and benches. Facilities such as community centers, arenas, pools and washrooms may also be closely integrated with district parks.

11.1.3 Sport Parks

Sport parks are designed to accommodate multiple high-end sports fields and service larger areas of the City. These parks are generally programmed by the City to service sports associations and tournaments. Sports fields in this park category are often irrigated and fully lit; they may contain lit parking lots and asphalt pathways, as well as washroom and change room facilities. A sports Park may serve as the neighbourhood park for the surrounding community and provide neighbourhood amenities as well.

11.1.4 Urban Parks

Urban parks are intended to be focal points within a neighbourhood that serves as a formal gathering space for area residents. Urban parks provide a high level of design quality, including extensive hard surfaces, outdoor lighting, irrigation, seating and horticultural features. These public spaces should be highly visible with maximum street frontage, strategically located in close proximity to densely populated areas and ideally linked to surrounding park corridors within the development.

11.1.5 Civic Spaces

Civic spaces are generally located in the downtown core and/or along 'main streets' in close proximity to high density development. These spaces are designed to accommodate casual seating areas, key urban linkages, public art, public gatherings and community events. Civic spaces serve the entire population of London, but can also serve adjacent buildings, streetscapes and neighborhoods. Civic spaces typically include extensive hard surfaces, seating areas, high-end horticultural components, irrigation and are fully lit to encourage evening use throughout the year.

11.1.6 Open Space System

The open space park category protects natural heritage features and is often linear in nature following tributaries of the Thames River, upland corridors, or utility easements. The open space system typically includes asphalt multi-use pathways that link neighbourhoods to surrounding parks and community amenities such as schools, business areas, shopping areas and community centers.

11.1.7 Woodland Parks

Woodland parks protect existing areas of environmental significance, such as woodland patches. These environmental features may have been identified in the City of London's official plan, through a previous City led study, or by a development related environmental impact study with recommendations for their protection, management and enhancement. Woodland parks typically include a managed trail system that serves the surrounding neighbourhood and consists of woodchip trails, boardwalks and occasional asphalt pathways where appropriate.

11.1.8 Environmentally Significant Areas (ESAs)

Environmentally significant areas include lands that are to be maintained in their natural state. These natural areas may contain significant species and habitat diversity, species at risk and critical habitat for species at risk. Details of the management and use of an ESA can be found within a City led conservation master plan document, as well as within the natural heritage policies of the City Official Plan.

11.1.9 Thames Valley Parkway

The Thames Valley Parkway (TVP) is the City's primary multi-use/recreational pathway system which follows the Thames River corridor. The TVP is asphalt and typically 3-4m wide with convenient connections to surrounding neighbourhoods. Future extensions of the Thames Valley Parkway will occur as lands along the three branches of the Thames River come under urban development.

11.1.10 Stormwater Management Facilities

Stormwater management facilities (ponds or low impact development (LID) features) are constructed in conjunction with, or as part of the servicing requirements for various developments. Where feasible, storm water management facilities should be integrated with surrounding park land and open space uses. Official plan policies protection of natural heritage features and open space pathway linkages, as well as the recommendations made in associated environmental impact studies and/or environmental assessments must be considered when integrating storm water management facilities into the park and open space system.

11.2 LAYOUT

As a general rule, all City of London parks shall be designed with the goal of protecting natural heritage features, as well as meeting the Accessibility for Ontarians with Disabilities Act and City specific accessibility standards. Careful consideration must be given during the design process to minimize short term capital costs and long term operating costs.

11.2.1 Neighbourhood Parks

Neighbourhood parks should be centrally located within the service area radius of 0.8km and serve a population of up to 5,000 people. Neighbourhood parks should be located within a convenient and safe walking distance to the majority of residents and users should not have to cross Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Streets to access their neighbourhood park. Wherever practical, neighbourhood parks should be coordinated with school sites to maximize outdoor space for school use and hard surface/parking for park users.

Neighbourhood parks should be from 1.5 – 4.0 ha in size and roughly rectangular to accommodate facilities with a minimum 15m setback to adjacent houses and to reduce “blind” corners. Typically, a 30-60m minimum frontage to suit block configuration is required, with at least one secondary entrance to the park. Generally, a flat site is desirable for facility development, but some topography may provide for a variety of un-programmed recreational uses. Stands of vegetation and healthy mature trees must be retained where possible.

Park facilities should be separated by suitable buffers and designed to be visible from the street. Pathways should connect all points of entry into the park. All layout of pathways and facilities is to be reviewed and approved on site by the City prior to proceeding with construction.

11.2.2 District Parks

District parks are generally 6-9 hectares in size and should be centrally located within the anticipated service area, as identified in the City of London Parks & Recreation Master Plan. District Parks are meant to service a 2km radius and a population of approximately 20,000 people. In some cases, district parks may incorporate more regional facilities such as indoor pools, community centers and arenas. They can be integrated with schools and should be located on Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, Rural Connector, Neighbourhood Connector or Neighbourhood Streets for access by public transit.

Some degree of topography variation in district parks is considered an asset as it can provide aesthetic enhancements and/or buffers between facilities and adjacent houses. Natural heritage features such as woodlands and/or small patches of vegetation are also desirable features and should be incorporated into district park layout where feasible. Pathways are to connect all park facilities and park entrances. All layout of pathways and facilities is to be reviewed and approved on site by the City prior to proceeding with construction.

11.2.3 Sports Parks

Sport parks are generally 10-13 hectares and should be centrally located and/or added onto existing sport park facilities where feasible. They should be situated on Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare, Rural Connector or Neighbourhood Connectors for access by public transit. These parks may involve an interior road/driveway network and extensive parking, but must also provide a clear network of pedestrian walkways and paths that minimize vehicular/pedestrian conflicts. Sport Parks are typically 9-13 hectares, incorporate maximum street frontage and adequate buffers between sport facilities and nearby residential properties.

11.2.4 Urban Parks

Urban parks are small blocks of land that range between 0.5 and 0.8 hectares in size and are walk to destinations meant to service a radius of approximately 800 meters. Urban parks should be situated on Neighbourhood Streets or Neighbourhood Connector routes, with maximum street frontage and in close proximity to high density development. These parks should function as high-end, attractive public gathering spaces and where feasible, they should be strategically located at the entrance to

broader park and open space systems. Urban parks should also function as gateways and/or prominent design features within a neighbourhood.

11.2.5 Civic Spaces

Civic spaces are typically smaller than urban parks (usually less than 0.5 hectares), but are designed to service the broader community. They are community destinations, often used for formal civic gatherings and both formal, and informal public events. These dynamic spaces are generally located in the downtown core and/or along 'main streets' and in close proximity to high density development. The design treatment within a civic space should integrate with surrounding right-of-ways and act as an important architectural/urban design feature that influences the design and layout of surrounding development. Surrounding buildings should be oriented to front onto civic spaces and should be designed to encourage access to and use of the public space.

11.2.6 Open Space System

The open space system is laid out and developed to protect natural heritage features. Appropriate buffers that protect the natural heritage system and that meet official plan policies also form part of the open space system. Management objectives for an open space system are usually identified in an environmental impacts study and/or other City documents. The pathway and trail network implemented within the open space system shall have regard for the natural heritage features and shall adhere to official plan policies. Access points into the open space system should be located every 500 meters on average, should incorporate maximum street frontage and act as a significant focal points in an areas development proposal.

11.2.7 Woodland Parks

Woodland parks and their associated buffers are designed to protect natural heritage features as per official plan policies. Subdivision development surrounding woodland parks shall maintain public access with maximum street frontage on all sides. The creation of 'dead zones' without public access in a woodland park shall be avoided where feasible. The pathway and trail network implemented within woodland blocks shall have regard for the natural heritage feature being protected and shall adhere to official plan policies.

11.2.8 Environmentally Significant Areas (ESAs)

Environmentally significant areas and their associated buffers are designed to protect important ecological features as per official plan policies. Entrances to ESAs and their associated hike only trail system shall be located and designed carefully to ensure protection of sensitive features. The management and use of an ESA are typically found within a City led conservation master plan document, an Environmental Impact Study, as well as within the natural heritage policies of the City Official Plan.

11.2.9 Pathways and Facilities

The design and layout of pathways and facilities is to be reviewed and approved on site by the City prior to proceeding with construction.

Recreational pathways will be constructed in accordance with City standard details and/or site specific geotechnical recommendations. All recreational pathways must incorporate a 0.5m turf 'run-out' zone that is generally flat (2 to 5%) on both sides of the pathway.

11.2.10 Thames Valley Parkway

The design and layout of the TVP will be done through City capital projects and through the subdivision development process where the TVP crosses developing lands. Typically, layout, design and construction of the TVP is subject to detailed environmental assessments as it is sometimes routed through, or adjacent to natural heritage features and floodplain. In general, convenient access points that provide visibility from an adjacent street are required every 500m minimum.

The TVP will be constructed in accordance with City standard details and/or site specific geotechnical recommendations. All recreational pathways must incorporate a 0.5m turf 'run-out' zone that is generally flat (2 to 5%) on both sides of the pathway.

11.2.11 Stormwater Management Facilities

The technical requirements and design of storm water management facilities is approved under Section 6 of this manual. Through that process, integration with adjacent parks or open spaces may be desirable. Where storm facilities are located and designed to integrate with parks and open spaces, additional land around the pond may be required beyond the minimum technical setbacks to property lines to permit suitable pathway systems and/or EIS requirements that meet Parks Planning & Design approval. Pathway design must meet Bicycle Master Plan requirements and standards. Appropriate compensation will be provided for additional land requirements.

LID features where proposed should be integrated carefully and not interfere with the functional use of the park. They should blend visually with the rest of the space and require low maintenance standards once established.

Facilities located away from parks and open spaces and not intended to be used as a community amenity are not subject to these additional setback requirements.

11.3 GRADING

Park grading for all park categories shall integrate with the surrounding lands and provide positive flow from all facilities and adjacent private lands. Drainage from private lands may be directed to parkland if it can be accommodated within the park drainage design.

Pathways shall be set as high points through the park with positive drainage away from them. Limited amounts of sheet flow may be permitted to cross pathways in certain circumstances.

Park grading shall be smooth flowing and shown with contours, with spot elevations as required to demonstrate desired slopes, top-of-bank, field corners, and hard surface grades. Swales are to curve to suit facility layout, pathway alignments and natural topographical design

Specific grading standards are:

- 1) Sports fields: 1.0%, directed to suit field layout and site conditions
- 2) Asphalt Pathways: 1 – 2% cross slope, up to 8% linear (4% preferred)
- 3) Concrete surfaces: generally 1-2% cross slope
- 4) Hike Only Trails (woodchip and dirt surfaces): generally 2-3% cross slope and up to a 15% linear slope (8%, or less is preferred).

- 5) Swales —2 – 4%, for a maximum length of 76m
- 6) Topography – 3:1 maximum with undulating surfaces. 2:1 is permitted if an area is to be naturalized.

Retaining walls are generally unacceptable within a park block unless they are required to maintain existing grades of adjacent facilities or for the protection of significant vegetation.

Grading plans for new subdivisions are to be included in engineering packages and meet all applicable requirements from the Engineering Review Division. The completion of grading, servicing and seeding of park blocks is typically required prior to the issuance of building permits within the subdivision.

Grading within the open space system, or woodland parks is to be kept to a minimum and subject to review on a case by case basis. Grading of parks and open spaces adjacent to natural heritage areas shall be delineated by appropriate erosion & sediment control measures and/or as directed by a site specific Environmental Impact Study (EIS).

Grading within stormwater management ponds is approved by EESD. If ponds are to be integrated with parks and open space areas, pathway grades (as above) and pond side-slope grades should mesh with surrounding landforms.

All rough grading for parks and open spaces is to be reviewed and approved on site by the City prior to proceeding with fine grading. When associated with a new subdivision, servicing/grading/seeding shall occur within 1-year of registration and all as per approved engineering plans.

11.4 SERVICING

Park and open space blocks generally require storm sewer systems and occasionally sanitary sewers and water lines to service community facilities such as field houses and pools. For specific sewer design requirements, refer to Section 3 - Sanitary Sewer Collection System, Section 5 - Storm Sewer Collection System and Section 7 – Water Distribution System.

The City of London encourages the use of green infrastructure LID features, and stormwater best management practices in park environments in an effort to reduce servicing and long term operating costs and a projects ecological footprint.

When associated with a new subdivision, servicing/grading/seeding shall occur within 1-year of registration and all as per approved engineering plans.

11.5 FENCING

All Parks and Open Space blocks shall require fencing adjacent to private owned lands. Fencing shall always be located on a common property line. Fencing shall be constructed in accordance with the specifications in the Standard Contract Documents for Municipal Projects, SP0-4.8. Fencing shall conform to the current City of London Fence By-law. Fencing shall not be located adjacent to a public right of way, School Block and any other City Facility, except where fencing is required under another section of this document.

Fencing that is an integral part of a park recreational facility (i.e.: baseball diamonds, batting cages, etc...) are not subject to the above.

When associated with a new subdivision, fencing shall be installed within 1-year of registration and all as per approved engineering plans at no cost to the City.

11.6 BOUNDARY MONUMENTS

Boundary Monuments shall only be used in substitution for fencing where it can be demonstrated that fencing will have a significant adverse impact on the site or fencing is not physically possible. Boundary Monuments shall be located entirely on City property, offset the common property line by 100mm. Boundary monuments shall be constructed in accordance with the specifications in the Standard Contract Documents for Municipal Projects, SP0-4.7. As a minimum Boundary Monuments shall be located at every change in direction of the property line and at 30 metre intervals. Where site topography is such that the line-of-sight between the Boundary Monuments is obscured at above intervals, additional Boundary Monuments are required at these locations to the satisfaction of the City.

When associated with a new subdivision, installation of boundary monuments shall occur within 1-year of registration and all as per approved engineering plans.

11.7 SEEDING

Seeding of park blocks is carried out in accordance with the specifications in the Standard Contract Documents for Municipal Construction Projects.

Maintenance of the seeded areas is the responsibility of the developer up to assumption. For manicured areas, this includes mowing to maintain a height of no more than 63mm, weed control and over-seeding, if required. Inspections for assumption will only take place between May 30 and October 15. At assumption, the turf must be healthy and vigorous, cut to 50mm height with very few bare patches or weeds.

For naturalized areas, native seed mixes are best applied in the fall, from October 15th to November 15th. Maintenance includes weed control, repair and reseeding of dead or bare spots as needed to allow establishment. At assumption at the end of the second full growing season, a majority of the specified species shall be visually evident and non-native, invasive species shall not exceed 20% of the seeded area.

When associated with a new subdivision, servicing/grading/seeding shall occur within 1-year of registration and all as per approved engineering plans.

11.8 TREE PRESERVATION

The City of London requires a Tree Preservation Plan (TPP) be prepared for most Capital works, Operational and Development projects, consistent with Section 12 – Tree Planting and Tree Preservation Requirements, within this manual. In many parks, community linkages and open space blocks, existing vegetation is to be maintained as an amenity feature. Protection of existing trees during park development shall be done in accordance with tree preservation guidelines out in Section 12 of this manual.

11.9 NATURAL HERITAGE SYSTEM

Natural areas which could include open space blocks, woodland parks, or environmentally significant areas have stringent design requirements, often specific to the area. Generally, through the land development process they have been set aside for their environmental/ecological significance and through the preparation of an EIS will have recommendations for their protection, management and enhancement that are to

be accommodated in engineering plans. Some of the City's ESAs have conservation master plans that would also outline specific requirements.

Typically, standard grading, servicing and development requirements do not apply to natural areas, but pathway/trail development is usually required and will require some level of design and construction as directed by the City.

Prior to assumption of natural areas, all hazards such as tree forts, old fencing, and construction materials and general debris must be removed from the block. Hazard trees along existing or proposed trails and pathways and abutting adjacent lands should be removed.

New naturalization projects proposed in a park environment should preferably be located adjacent to an existing natural feature (woodland, wetland, etc.). Only native woody and herbaceous plant material shall be utilized and efforts to minimize the spread of invasive species shall be an important consideration during the planning process. All naturalization projects shall be approved by the Parks Planning & Design section.

11.10 BIO-ENGINEERING

Within parks, open spaces, natural areas and ESAs, bio-engineering is to be used as the preferred approach for slope stabilization, channel creation or restoration, storm outlet design and any other "engineered" feature. Limited use of rip-rap or other erosion control materials is permitted where the situation warrants if used in conjunction with other "natural" approaches.

Conveyance channels from stormwater management facilities that outlet into parks and open spaces require suitable bio-engineered design to blend with the surrounding landscape.

Bio-engineering design may require specialized consultants to successfully implement parks standards and /or EIS recommendations.

11.11 TREE PLANTING

Tree planting within parks, open spaces, linkages, natural areas and stormwater management facilities is to be carried out in compliance with Section 12 of this manual.

11.12 EROSION & SEDIMENT CONTROL

The City of London requires an Erosion & Sediment Control Plan (E&SC Plan) be designed for most Capital Works, Operational and Development Projects. The complexity of the E&SC Plan is determined by the sensitivity of the area that is to be protected.

For reconstruction or resurfacing of existing roads, or for infill sites less than 3.0 ha in land area within existing urbanized areas, that are not in close proximity to an open watercourse, woodlands, ESA's, steep slopes or other natural area; an E&SC Plan is not required, unless otherwise directed by the City Engineer. Where an E&SC Plan is not required, all reasonable protective measures must be taken during construction to control sediment and prevent erosion from occurring.

For further information on the requirements of the E&SC Plan, please refer to Section 10 – Sediment & Erosion Control, within this manual.



Design Specifications & Requirements Manual

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TREE PLANTING AND PROTECTION GUIDELINES

12.1

INTRODUCTION

Tree protection is a fundamental requirement of any urban forest. To encourage the health and enhancement of the urban forest, it is necessary to take the provisions outlined in this document while working in close proximity to trees. Trees provide many benefits that include temperature regulation, CO₂ absorption, rainfall interception, and reducing pollution. These benefits become more prominent when a tree reaches maturity. Therefore in order to maximize these benefits, tree retention needs to be accompanied by proper tree protection where there is a risk of damage to trees and their rooting systems.

Prior to any construction, it is important to evaluate the existing trees to ensure we retain as many trees as possible and we recommend a certified arborist or Registered Professional Forester or other qualified person with appropriate training and experience be employed to carry out such evaluations on both private and public lands.

All trees located on City boulevards are subject to protection under the Boulevard Tree Protection By-law P.-69. Other sites may also be subject to the Tree Conservation By-law or Parks By-law.

Types of Tree Damage

Physical tree damage can occur when construction equipment is allowed to come in close proximity to tree. This can lead to broken branches, wounds on the trunk, scorching of branches or other physical wounds which may be fatal, give cause to remove the tree, or require remedial action.

Root damage may occur if there is any excavation within the rooting area of the tree. Depending on the extent of excavation, the health of a tree can be seriously affected, causing a tree to decline to the point where the tree may need to be removed. Most of the fibrous roots of the tree, which are responsible for the uptake of nutrients and water, are contained in the top 30 cm of soil and are easily severed during excavation, structural roots are located deeper. Hand digging, low pressure hydro-vac, or air spade exploratory digging will aid in determining the extent of the root system and what steps will need to be taken to minimize impacts.

Soil compaction happens when vehicles cross over the rooting area, especially when the soil is wet. This compaction reduces the pores with in the soil which contain the water and air needed for the proper biological function of the tree. This reduces soil function with the potential to cause

a decline in the health of the tree, killing off many of the feeder roots which sustain the tree. This could also lead to a premature removal of a once healthy tree.

The following standards and guidelines have been produced so that adequate care can be taken to ensure the health of trees when there is potential risk of damage during construction or demolition. They are a combination of standards, guidelines and best management practices from London, other major municipalities and jurisdictions. The requirements and measures may include an arboricultural impact assessment, a tree protection plan, identification of tree protection zones,

installation of tree protection barriers, pruning of branches and roots and remediation measures to mitigate the impact of damage.

12.1.1 SCOPE

This document outlines the tree protection procedures that shall be followed when a City tree of any size is present on, or adjacent to, a construction or demolition site. Trees that are adjacent to a proposed site and have a Root Protection Area (RPA) that falls within the boundary must be included and considered for protection.

All new subdivisions require a Tree Protection Plan.

For site plans, the City will recommend at the site plan pre-consultation meeting whether a tree protection plan is warranted for a site or adjacent trees.

A Tree Protection Plan is required for every Capital Works project. Current City practices have included the preparation of a Tree Protection Plan for any projects which will affect City trees in some way, where there is excavation within the roadway of a City street or on other City property or equipment is moving past City trees to enter a worksite.

12.1.2 TERMS DEFINED FOR THE USE OF THIS DOCUMENT

“Tree Protection Zone (TPZ)” shall refer to the calculated area around the base of a tree that is designated for tree protection both above and below ground.

“Arborist” is an educated professional with a recognized ISA (International Society of Arboriculture) certification which is current and valid.

“RPF” is a Registered Professional Forester who is a member in good standing with the Ontario Professional Foresters Association (OPFA) and eligible to work in Ontario.

“Landscape Architect” shall mean a person who is in good standing with the OALA and has demonstrated competence in arboriculture, urban forestry, tree identification and tree risk assessment.

“Qualified Person” means an Arborist, RPF or Landscape Architect as per the definition.

“Damage” shall mean any activity that may injure or kill a tree, above or below the ground.

“injure a tree” includes but is not limited to cutting of trees or branches, topping, removing tree bark, leaves or fruit, removing whole tree or cutting or breaking of tree roots.

The “barrier” is the fence placed a specific distance away from and around either a single tree or grouping of trees to create a Tree Protection Zone (TPZ).

“Developer or Contractor” means the landowner, or a landowner’s agent who represents and acts on behalf of and with the consent of the landowner, applying for any kind of Permit which would include any sort of work around City trees.

“City” means The Corporation of the City of London.

“Good Forestry Practices” shall be as defined by the Forestry Act R.S.O. 1990, c. F-26 and any amendments thereto.

“habitat” by reference to wildlife or Species At Risk shall have the same definition as that defined in the Endangered Species Act R.S.O. 2007 and any amendments thereto.

the “dripline” is the location on the ground directly beneath the theoretical vertical line from the tips of the outermost branches of the tree.

“Diameter at breast height (DBH)” is the diameter of the tree measured at 1.4 meters above the ground.

12.2 PRIOR TO CONSTRUCTION

12.2.1 Requirements for Approved Tree Protection Plan (TPP)

There shall be a requirement for a Tree Protection Plan, approved by the City, for all City trees which are on a boulevard in front of a construction or demolition site or on property adjacent to a developing property. Trees on lands adjacent to the developing property will be included if they are within 3m of the property line.

A Tree Protection Plan shall be completed by a qualified person and submitted to the City for approval by the Urban Forestry section and/or the Forestry Operations department prior to the start of construction or other works.

No onsite construction or other works that could cause damage to trees either above or below ground is permitted without an approved Tree Protection Plan.

The tree protection plan shall include, but is not limited to:

A complete inventory of all trees on site, on the boulevard in front of the site, or on adjacent properties within 3m of the property line. This includes tree species, DBH, and recommendations for future tree management described in detail. If there is a recommendation for removal, a detailed explanation including photographs, must be included with the tree quality assessment of that tree; any proposed removal of City trees will be conditional and subject to the approval of a consensual removal as per the Boulevard Tree protection By-law Schedule B and any fees there in.

Any existing structures or grade changes;

A map showing:

- i. The location of all existing trees and the extent of their crowns;
- ii. The location of all trees to be retained, removed, replaced or relocated;
- iii. The Tree Protection Zones and the precise location of their barriers;
- iv. Any additional ground protection that is required;
- v. Designated travel corridors and storage compounds, portable rooms/buildings, and any other facilities for on-site work for both workers and equipment;

The plan will include a recent aerial photograph of the site.

Foreseeable remedial actions to ensure the health of the remaining trees such as but not limited to branch pruning, deep root fertilization, tree watering, soil replacement or planting;

When addressing young trees (DBH <15cm) especially ones that occur as individual specimens, it may be acceptable to consider relocation. If the tree is of no particular significance, replacement is also a viable option. Any tree replacement will be addressed in a post construction remediation plan.

If there is maintenance required on any tree that is designated for retention, that maintenance should be completed prior to construction or demolition. This can include but is not limited to crown pruning, deep root fertilization, tree watering, and/or soil replacement.

12.3 TREE PROTECTION ZONES

Tree protection zones (TPZ) shall be established based on the criteria in Table 1;

Barriers will not be placed within the TPZ rather on the outside of the predetermined area.

Table 1 Tree Protection Zones:

Trunk Diameter (DBH)	Minimum Protection Distances Required City-owned Trees	Minimum Protection Distances Required for Areas Designated Open Space or Woodlands
	Whichever of the two is greater:	Whichever of the two is greater:
< 10cm	The drip line or 1.2 m	The drip line or 1.2 m
10-29 cm	The drip line or 1.8 m	The drip line or 3.6 m
30-40 cm	The drip line or 2.4 m	The drip line or 4.8 m
41-50 cm	The drip line or 3.0 m	The drip line or 6.0 m
51-60 cm	The drip line or 3.6 m	The drip line or 7.2 m
61-70 cm	The drip line or 4.2 m	The drip line or 8.4 m
71-80 cm	The drip line or 4.8 m	The drip line or 9.6 m
81-90 cm	5.4 m	The drip line or 10.8 m
91-100 cm	6.0 m	The drip line or 12.0 m
>100 cm	6 cm protection for each 1 cm diameter	12 cm protection for each 1cm diameter or the drip line

An exception to the minimum distance of the TPZ may be when the tree is flanked by a curb, sidewalk, and or asphalt road. In such cases the barrier may be limited to the furthest extent of the grassed boulevard area however root pruning using approved methods must be incorporated to reduce impacts on tree roots due to ripping or tearing of roots. Hand digging, low pressure hydro-vac or air spades may be used to uncover roots for pruning or avoidance by an arborist and roots may be pruned to a depth which will meet the construction requirements. This operation is only to be done with the approval of the City. Roots that are exposed should be covered with wet burlap or soil as soon as possible and watered regularly to prevent them from drying out. Watering is required until such time as the topsoil and sod has been replaced satisfactorily or as otherwise directed by the City.

Within a TPZ there must be:

- No construction;
- No altering of grade by adding fill, excavating, trenching, scraping, dumping or disturbance of any kind.
- No storage of construction materials, equipment, soil, construction waste or debris wash facilities, portable rooms/buildings.
- No disposal of any liquids e.g. concrete slurry, gas, oil, paint.

- e) No movement of vehicles, equipment or pedestrians.
- f) No parking or storage of vehicles or machinery.
- g) Directional micro-tunneling and boring may be permitted within the limits of the TPZ subject to approval from the City.

12.4 TREE PROTECTION BARRIERS

All barriers shall be erected, secure, and complete with signage posted prior to any demolition, construction or other works.

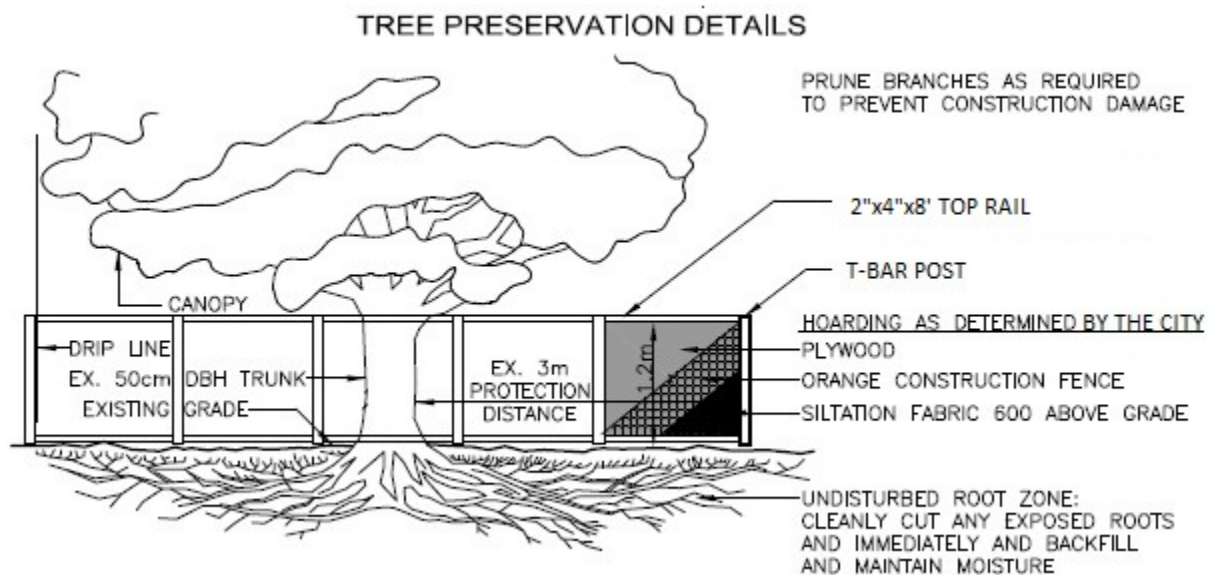
Materials must comply with all barrier specifications, as well as all supports and bracing used to secure the barrier should be located outside the TPZ. All supports and bracing shall be located as to minimize damage to roots.

Barrier Specifications Figure 1

- i. Height can be 1.2 m (4'), visibility on boulevards must be maintained;
- ii. T-Bar Posts are to be used for support
- iii. 2"x4"s are to be used for top rails;
- iv. Spacing between vertical posts to be no further apart than 2.4 m (8');
- v. Structure must be sturdy with posts driven firmly in to the ground;
- vi. Continuous plastic mesh screening (e.g. orange snow fencing) is to be used;
- vii. Signage must be posted, sign must be a minimum of 40cm x 60cm and water proof, Figure 2;
- viii. Where some excavate or fill has to be temporarily located near tree protection barrier, plywood must be used to ensure no material enters the Tree Protection Zone;
- ix. In addition to tree protection fencing, sediment fencing might be required, this will be determined in the Tree Protection Plan by a Qualified person

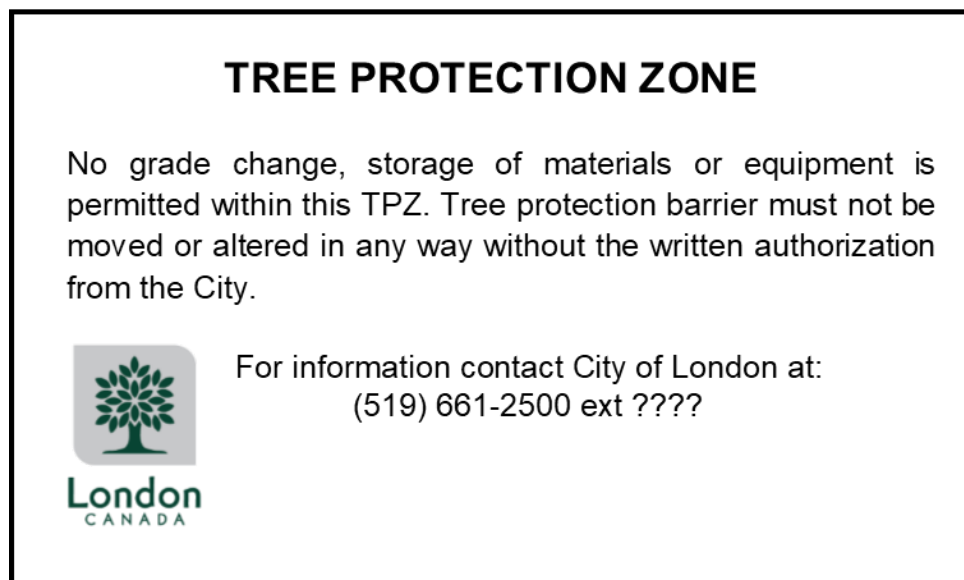
12.4.1 Example for Boulevard Trees

Figure 1 Tree Preservation Details



12.4.2 Tree protection signage

Figure 2 Tree Protection Zone Signage



12.5 DURING CONSTRUCTION

12.5.1 Site monitoring

Site monitoring will be the responsibility of the developer, contractor or project manager. Random checks may be done by City staff at any time and without notice.

A weekly photograph will be taken by the developer, contractor or project manager and submitted to the City depicting a well maintained and intact barrier with weather proof signage posted.

If there are any proposed changes to the TPZ, the City will require notification immediately and no changes may be made without prior written approval from the City.

Any damage to a tree during construction must be reported to the City immediately and a Qualified person shall make recommendations on how remediation will take place. Any remediation will take place as soon as possible to protect the health of the tree. Failure to do so may result in penalties under the Boulevard Tree Protection By-law or as listed in the Standard Contract Documents for Municipal Construction Section 5 part B

12.5.2 Avoiding damage to trees above ground

Any tree damage during construction must be reported to the City Forester or designate immediately. This includes the following:

- a) The topping or removal of branches from a tree other than in accordance with the approved Tree Protection Plan and accepted arboricultural practices;
- b) The cutting or tearing of the roots of a tree within the drip line other than in accordance with the approved Tree Protection Plan and accepted arboricultural practice;
- c) The scraping, gouging or compaction of the soil within the Tree Protection Zone by the placement of soil, fill, heavy equipment, vehicles, building or other materials thereon or by the movement of vehicles or equipment there over;
- d) Depositing within the tree's drip line any fill, or toxic/harmful substance;
- e) The removal of soil from within a tree's drip line.

12.5.3 Avoiding damage to trees below ground

Any roots outside the TPZ that require pruning or exposure, shall be located by hand digging or low pressure hydro vac/ Air spade excavation and pruned to the face of the excavation by a Certified Arborist.

If at any point, roots that have grown out past the drip line, become exposed or severed it is required that a qualified person is notified and proper root pruning procedures are employed.

If roots are exposed but not severed and do not require pruning it is mandatory that they are properly covered with soil or burlap and watered at least twice a day or as needed. This shall continue until the soil and sod have been replaced or until otherwise directed by the Qualified person, or the City.

To avoid damage to tree roots, existing ground levels shall be retained within the TPZ

Subject to justification, in a circumstance where digging within the TPZ is permitted, only hand held tools or a displacement tool such as compressed air or hydro-vac systems are permitted.

Where equipment must travel across City property to access the work area, designated travel corridors shall be established to the satisfaction of the City in order to minimize soil compaction or damage to trees and other values.

If there is a barrier within 1 metre of a path that is to be used by any vehicle or machinery during work at any time, additional protection is required (3.3.8).

A 4 inch mulch path will be laid that spans the width of the widest piece of equipment that will be used on site for the duration of the work. Plywood boards will then be placed on top of the mulch. An image of this will be included in the photograph that is to be submitted weekly to the Urban Forester or designate.

Any amendments required by the City to maintain the tree protection measures on site shall be implemented to the satisfaction of the City.

Failure to maintain an approved Tree Protection Plan will result in a warning by the City with 1 day to comply and bring the tree protection measures in line with the approved Tree Protection Plan. A second infraction may be dealt with by the issuance of a Stop Work order and possible fines as per the Boulevard Tree Protection By-law or the Tree Conservation By-law or as listed in the Standard Contract Documents for Municipal Construction Section 5 part B.

12.6 POST CONSTRUCTION

12.6.1 Inspection

An ISA certified arborist or RPF or approved Landscape Architect shall inspect all retained trees and their rooting area to assess if any additional remediation work is required to ensure their future health and survival.

12.6.2 Remediation Plan

If the inspection indicates damage to retained trees, the Qualified person shall prepare a post construction remediation plan for approval to the City Urban Forester or delegate. The remediation plan may include but is not limited to: Pruning, deep root fertilization; irrigation; aeration; tree planting; either as a single activity or as a combination.

12.6.3 Remediation Plan Inspection

A Qualified person shall inspect the project site and certify that any and all measures specified in the tree protection plan or post construction remediation plan have been completed as per the plan. This certification is required before final acceptance and approval of the work by the city.

12.6.4 Project Approval

An assessment will be done by a Qualified person to confirm that all protocols were met during construction or demolition.

12.7 TREE PLANTING

12.7.1 INTRODUCTION

Tree planting on the public right-of-way is a long term initiative. What is done today can have a serious impact on street tree maintenance activities for years to come. It is therefore imperative that tree planting be done with care and planning. Planning is critical to ensure that the final product is sustainable and aesthetically pleasing. Trees of similar shape but different species, if carefully selected, will provide the desired effect of tree arch over the street. The mix of species is essential to reduce the chances of insect epidemics, to guard against the spread of disease as trees are trimmed in efficient block treatments, to prevent widespread neighbourhood complaints and to eliminate extensive tree removal programs when single species plantings die (eg. Dutch Elm Disease on American Elm, Verticillium wilt on Norway Maples).

Designs should reflect patterns which show a use of random plantings of diversified species. Consideration should be given to adjacent lands where existing street trees may exist to ensure that continuous plantings are not created, in particular infill projects of limited frontage.

The City of London recognizes the difficulties in coordinating tree planting within the development process for new subdivisions. Trees are a living entity and, as such, cannot always be planted or inspected at convenient times. As well, difficulties with tree species availability, the seasonal nature of planting operations and administration make it more difficult to coordinate tree planting operations within the framework in place for assumption and end of warranty processes currently in place for new developments. The City of London, therefore, has instituted a 'cash-in-lieu' system whereby the developer will participate in providing a planting plan at the time of assumption and the City will implement the tree planting.

12.8 POLICY

12.8.1 Security (at Development Agreement Stage)

Security is required to ensure that funds are available in the event of default by the developer. Currently, this is a standard subdivision development requirement and will continue to be required in the amount of \$25.00 per linear metre of street frontage (both sides) within the plan of subdivision.

12.8.2 Planting Plan (at time of assumption request by developer)

The developer will submit a planting plan showing actual planting locations (with all site amenities known and shown on the plan) and proposed species of trees (common and Latin names shown). **The services of an Ontario Registered Professional Forester or a member of the Ontario Association of Landscape Architects in good standing must be retained.** This will ensure that an appropriate planting plan is in place which considers species diversity, tree form location and design. The planting plan must be stamped by the R.P.F. or L.A. and be shown on the standard plan of subdivision drawing or grading plan which shows lot dimensions (particularly frontages) as prepared by the consulting engineer. The plan will be reviewed and approved by City staff. The plan is to be submitted to the Coordinator, Forestry Programs, Planning Division, City Hall for review.

12.8.3 Guidelines for Planting Plan Preparation All trees are to be planted on City property.

Tree planting locations will be determined on a site specific basis. As a goal, no less than one tree should be planted for each lot. Larger lots and corner lots may have more than one tree.

Since large trees contribute more to the environment and the neighbourhood than small ones, the largest tree that is suitable for the location is to be planted, considering eventual size at maturity. Plantable space may include the boulevard in front of or rear of the sidewalk (where present). Tree locations may be staggered and/or grouped where appropriate to make the best use of available planting and growing space. The preferred location for trees will be in the boulevard between sidewalk and curb, where present. All trees are to be planted on City property.

Adjacently planted trees will be shown approximately every 3.0m – 12.0m o.c. where practical and where growing space is available, according to species. Ornamental trees will be spaced more closely than medium trees, and medium trees more closely than large trees.

The following guidelines will assist:

		Lot width		
		<9.0m	9.0m – 15.0m	>15.0m
Blvd width	>2.0m	Ornamental or Medium	Medium or Large	Large
	1.5m – 2.0m	Ornamental or Medium	Medium	Medium or Large
	<1.5m	Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone	Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone	Select Ornamental, Medium or Large tree (or no tree) on site specific basis e.g. consider adjacent use of structural soil to reach breakout zone
No sidewalk		Ornamental or Medium or Large (site specific)	Ornamental or Medium Large (site specific)	Ornamental or Medium or Large (site specific)

12.8.4 Curb to Property Line Considerations

- Where no sidewalks exist or where sidewalk construction is not planned, trees are to be shown no closer than 0.6m to the private property boundary on City property. However this location should not be so far from the curb as to not contribute to a street canopy.

12.8.5 Site Considerations

- Plant only ornamental tree varieties under or within 3m of high voltage overhead utility wires or poles. Large and medium shade trees maturing to an upright or vase shape are permitted no closer than 3m from high voltage overhead utility wires or their poles. Large and medium shade trees are not permitted immediately under but may be planted near other overhead cables including single phase and service wires and their poles.
- Trees may be planted at 0m (measured horizontally) from buried street light cable, not closer than 0.9m (measured horizontally) from other buried electric cables and not closer than 0.3m (measured horizontally) from buried telephone and/or TV service cables
- No tree is to be shown closer than 2.0m to a driveway or 0.5m from a lead sidewalk going into a property
- No tree is to be planted closer than 1.5m to the doors or within 1.2m from the sides of an above ground hydro vault (transformer).
- No tree is to be shown closer than 6m in line of sight to a stop sign on a residential street only (i.e. not a collector or arterial road).
- No tree is to be shown closer than 15.0m in line of sight to a stop sign or traffic signal light on any collector or arterial road.

- No tree is to be shown closer than 3m to the front and sides of a fire hydrant.
- No tree is to be shown closer than 0.3m (measured horizontally) to a water main, or 0.7m from a shutoff.
- No tree is to be shown closer than 0.2m (measured horizontally) to a gas line.
- No tree may be shown closer than 2.0m (measured horizontally) to a sanitary sewer.
- No tree may be shown closer than 3.0m to another tree.
- No tree is to be shown closer than 1.5m to a street light pole.
- Trees only are required for cul-de-sac island or roundabout areas and will be shown on the planting plan. The cost for any shrub or perennial plantings will be at the expense of the developer and will be shown on the planting plan for review and approval in accordance with city guidelines and specifications. Planting of shrubs and/or perennials should coincide with City guidelines and specifications. Should this be required in advance of scheduled planting operations by City staff (ie: for model homes, etc), the developer should discuss the scheduling of this planting with City Staff prior to work being carried out.

12.8.6 Design and Species Considerations

- Mature street trees are the most visible and desirable component of our streetscapes. However, to increase resistance to insect and disease problems, tree species must be mixed in order to avoid a continuous mono-culture situation. Where several phases make up the M-Plan, the plan should reflect the character of planting in adjacent phases.
- Use of native species over non-native species is desirable. Native means naturally occurring (indigenous) in Ontario.
- Invasive species (see Appendix 5) will be avoided except in special circumstances.
- 'Ornamental' tree means a tree that typically achieves a mature height of not more than 6m.
- 'Medium' tree means a tree that typically achieves a mature height greater than 6m and less than 16m.
- 'Large' tree means a tree that typically achieves a mature height greater than 16m.
- No more than five of any one species or variety is to be shown on one side of the street in a row. Trees should be matched one side of the street to the other (maximum of 10 matched trees) to provide a 'closed canopy' effect at maturity.
- Where several phases make up the M-Plan, the plan should reflect the landscape character of plantings in adjacent phases. It is not necessary and may not be desirable to match species on adjacent phases, but consideration should be given to a neighbourhood identity with similar tree shape and size at maturity.
- In order to integrate species diversity into each plan, the species mix shall provide no more than 15% of any one species (percentage of the entire number of trees within the plan). Individual phases may diverge from this percentage if deemed reasonable (e.g. cul-de-sac of 12 lots) so long as the overall object of 15% species mix is maintained within the plan of subdivision.

- Trees with similar shape (i.e.: vase, oval, upright) are to be selected to provide a neighborhood landscape character.
- No species other than those listed in Appendix 5 are to be shown on the planting plan without prior consultation with City of London staff. Other species may be considered for approval if it can be shown the proposed species are appropriate to the proposed planting locations and to permit trial plantings of new (to the City) species or cultivars.
- Trees with large or messy fruit may be planted only in limited situations;
- Trees with large thorns are not permitted and species such as poplar and willow are banned by by-law for street tree planting.
- Coniferous needle-bearing trees will not be shown in the boulevard where they will cause sight line obstructions but may be planted rear of the sidewalk.
- Ash (*Fraxinus*) species may not be shown or planted on any City boulevard until further notice – no exceptions.

12.9 PLANTING

12.9.1 Planting (Post Assumption)

Once the planting plan is approved at the time of assumption, the City of London will implement street tree planting before end of warranty of the subdivision through City of London tender processes and administration.

12.9.2 Species Substitutions

The City will implement the approved tree planting plan, as accurately as possible, with the tree species specified. Once the planting plan is prepared, substitutions will be done only as necessary and should not be a common occurrence, -. Should substitution be required due to unforeseen circumstances, the City reserves the right to substitute with a suitable species without further consultation or approvals through the developer.

Note: Substitute species will endeavour to match the size and shape of the originally planned species. The overall 15% maximum by species limit shall still apply.

12.9.3 Timely Planting

The City of London will commit to planting trees within one year of assumption. Any subdivisions assumed prior to October 1 of the current year would be incorporated into the Tender process for planting the following year. If assumptions are processed after that date, they could be planted the following year, depending upon availability of plant material specific to the planting plan, and depending upon when the Tender documents are distributed.

If assumption of the subdivision is unduly delayed, with at least 50% of homes already occupied, the City of London may work with the developer to arrange for planting of trees prior to assumption by the City, recognizing the high benefit to the neighbourhood and the environment of planting trees as early as possible.

12.9.4 Fee

There are several components which comprise the cash-in-lieu amount charged for street tree planting. The fee must cover all costs associated with implementing the

program, including the cost to supply and install the tree, a two year replacement warranty policy and associated administration costs (planning, organizing and implementing of tree planting as well as surveying and compliance checks).

Once the trees are planted, the City will forward an invoice to the developer reflecting the actual cost of planting trees in that subdivision with an additional 10% administration fee (plus all applicable taxes).

12.10 AT END OF SUBDIVISION WARRANTY

12.10.1 Fee

Payment for tree planting as invoiced by the City of London is a requirement at the time of end of warranty of the subdivision. If payment is not received, end of subdivision warranty will not be granted.

12.10.2 Security

Once payment for street tree planting has been received (as invoiced), the developer will be released from all obligations in this regard and the City's Engineering Review Department will be authorized to release all securities held for such.

12.10.3 Public Relations

Should homeowners inquired about tree planting operations, the developer will explain that trees will be planted post-assumption. Further inquiries may be directed to the City of London.

12.10.4 PROCEDURE SUMMARY

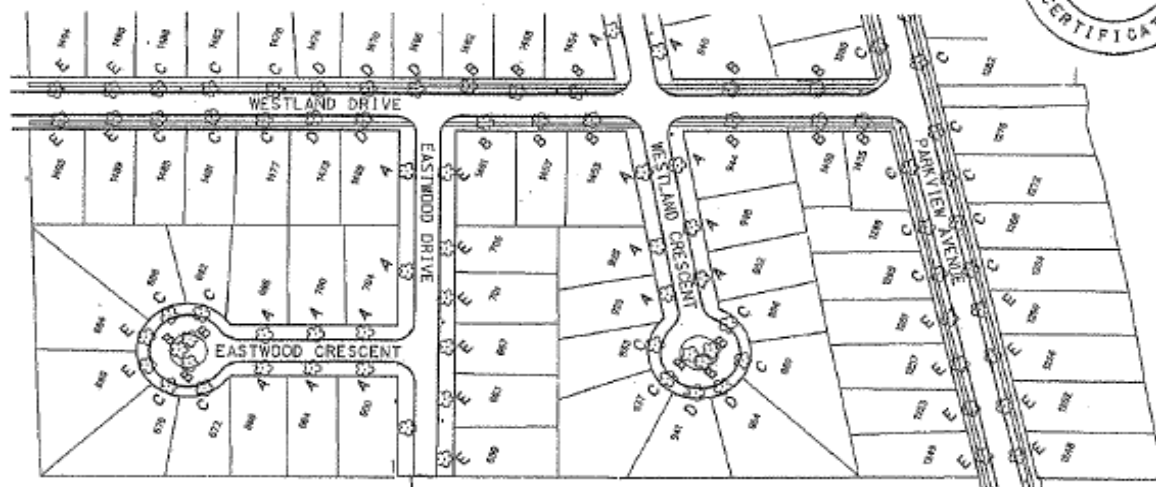
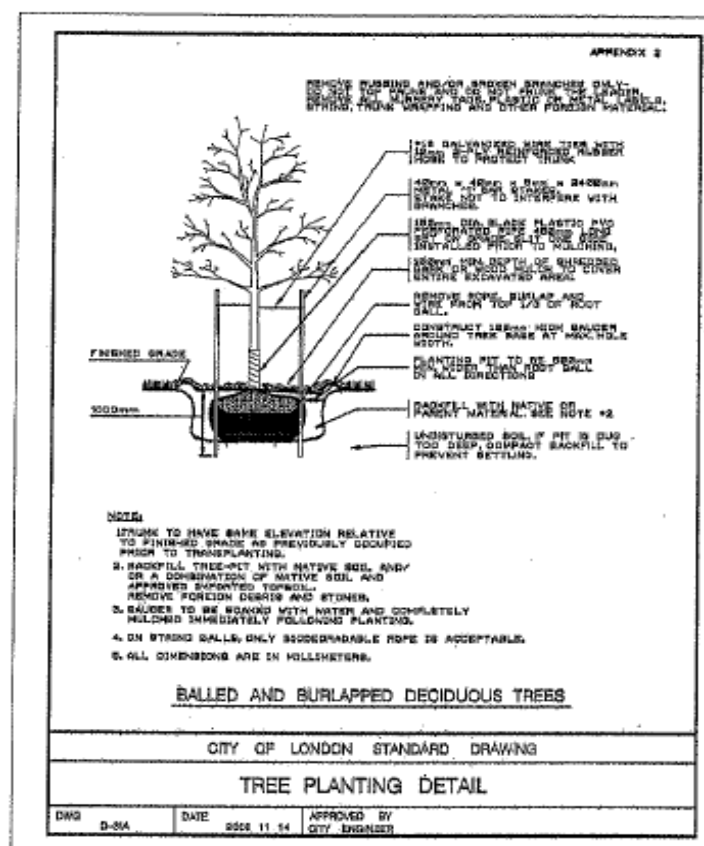
- The developer will submit security amount at time of development agreement;
- The developer will provide a planting plan for review and approval at time of assumption;
- City Staff will plant trees between assumption and end of warranty of the subdivision;
- The City will invoice the developer for tree planting operations;
- The developer will forward payment as invoiced to the Finance Division, City Hall, Room 406;
- City staff will acknowledge receipt of payment and communicate to the Engineering Review Department that all requirements with regards to tree planting have been met for the area being assumed;
- City staff will authorize release of securities held;
- Payment for street tree planting is a requirement at end of warranty. If payment has not been received, end of warranty will not be awarded and securities will continue to be held until such time as payment is received by the consulting engineer. The plan will be reviewed and approved by City staff. The plan is to be submitted to the Coordinator, Forestry Programs, Planning Division, City Hall for review.

12.10.5 END OF TREE WARRANTY – INSPECTION PROCEDURE

Trees shall be planted under a 2-year warranty from time of planting, as prescribed in the tender documents. A tree warranty inspection shall be conducted prior to the expiry of the 2-year warranty period. This shall be conducted as per the guidance in Appendix 7

and included in the tree planting tender (contract). Trees that fail inspection shall be replaced within a suitable timeframe.

KEY	BOTANICAL NAME	COMMON NAME	TOTAL	SIZE (CAL IPER) mm
A	GLADIOLIA TRIACANTOS "SKYLINE"	SKYLINE EUNEY LOCUST	16	50mm
B	ACER RUBRUM	RED MAPLE	17	50mm
C	FRAXINUS PENNSYLVANICA "PATMORE"	PATMORE ASH	23	50mm
D	QUERCUS MACROCARPA	BUR OAK	7	50mm
E	TILIA CROATA "GREENSPHERE"	GREENSPHERE LINDEN	20	50mm

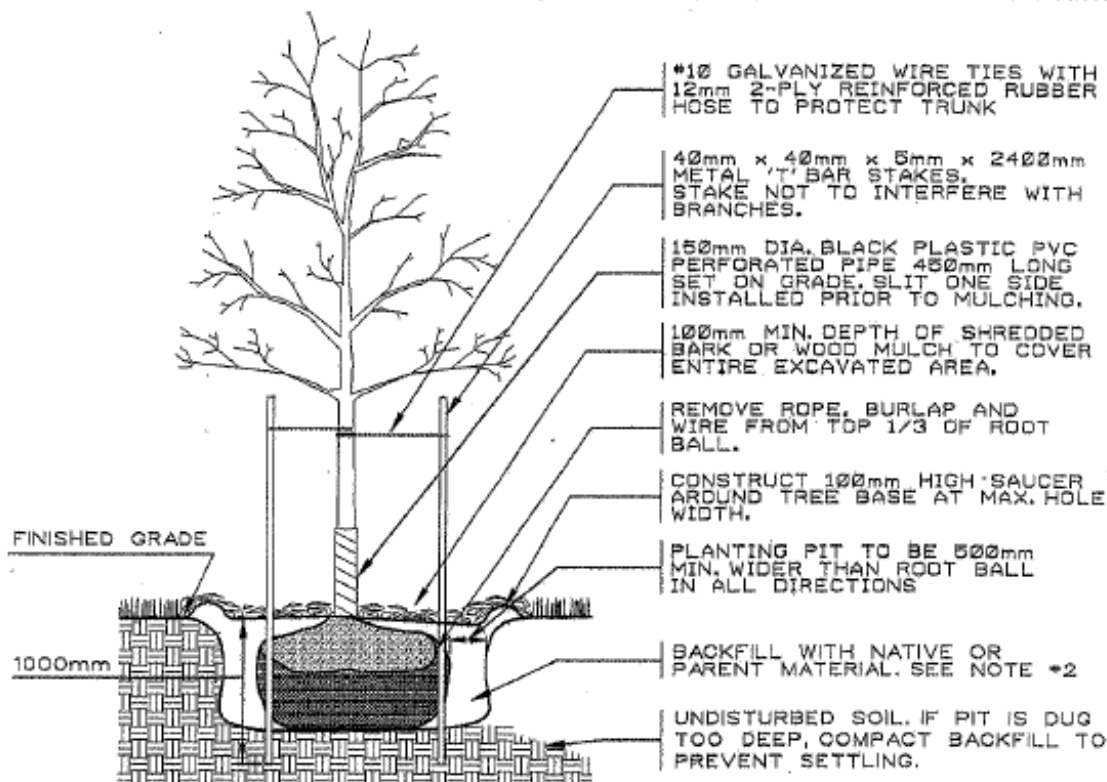


CITY OF LONDON STANDARD DRAWING

TREE CONCEPT PLAN

DWG D-37	DATE 2002 11 14	APPROVED BY CITY ENGINEER
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REMOVE RUBBING AND/OR BROKEN BRANCHES ONLY-
DO NOT TOP PRUNE AND DO NOT PRUNE THE LEADER.
REMOVE ALL NURSERY TAGS, PLASTIC OR METAL LABELS,
STRING, TRUNK WRAPPING AND OTHER FOREIGN MATERIAL.



NOTE:

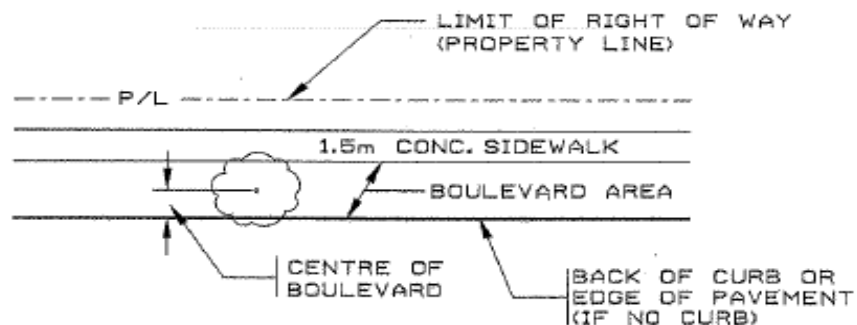
1. TRUNK TO HAVE SAME ELEVATION RELATIVE TO FINISHED GRADE AS PREVIOUSLY OCCUPIED PRIOR TO TRANSPLANTING.
2. BACKFILL TREE-PIT WITH NATIVE SOIL AND/OR A COMBINATION OF NATIVE SOIL AND APPROVED IMPORTED TOPSOIL. REMOVE FOREIGN DEBRIS AND STONES.
3. SAUCER TO BE SOAKED WITH WATER AND COMPLETELY MULCHED IMMEDIATELY FOLLOWING PLANTING.
4. ON STRING BALLS, ONLY BIODEGRADABLE ROPE IS ACCEPTABLE.
5. ALL DIMENSIONS ARE IN MILLIMETERS.

BALLED AND BURLAPPED DECIDUOUS TREES

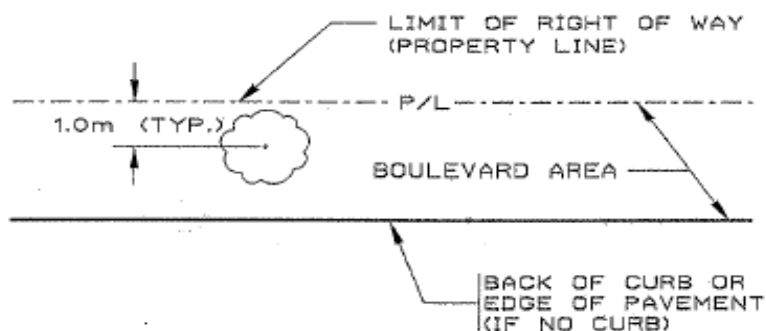
CITY OF LONDON STANDARD DRAWING

TREE PLANTING DETAIL

DWG D-31A	DATE 2002 11 14	APPROVED BY CITY ENGINEER	Pg. 12-11
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**TYPICAL TREE LOCATION DETAIL
ON BOULEVARD WITH SIDEWALK**



**TYPICAL TREE LOCATION DETAIL
WITHOUT BOULEVARD SIDEWALK**

CITY OF LONDON STANDARD DRAWING

BOULEVARD TREE PLANTING DETAIL

DWG D-36	DATE 2002 11 14	APPROVED BY CITY ENGINEER
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APPENDIX 4

GENERAL NOTES

1. All plant materials shall be #1 nursery stock meeting Canadian standards.
2. Stake all deciduous trees.
3. Dig all tree pits 500.0 mm larger all around than the root ball and place tree centred in pit on undisturbed soil. Backfill with parent material and replace debris (eg. Brick, dry wall, etc) with screened topsoil.
4. For grading and drainage, see engineering plans.
5. Specific tree locations for each lot are to be determined by Tree Planting Guidelines set by the City of London Environmental Services Department and as shown on Lot Grading Certification Plans.
6. All dimensions are in millimetres unless otherwise noted.
7. All plant materials to be guaranteed for two growing seasons from the date of provisional acceptance.
8. Prior to the commencement of construction, all existing underground utilities within the limits of the construction site shall be located and marked. Any utilities damages or disturbed during construction shall be repaired or replaced to the satisfaction of the City of London at the Contractor's expense.
9. Plant materials to be installed as shown; with the following exceptions to the Tree Planting Detail (12-18):
 - a) Remove: Galvanized wire ties with hose
Replace: Untreated jute twine which will photo-degrade within two (2) years
 - b) Remove: Metal T Bar Stakes
Replace: 2" x 2" wooden stakes
 - c) Remove: Black PVC Perforated Pipe
Replace: Dimex ArborGuard Tree Protectors or equivalent as approved by the City of London, set on grade and installed prior to the installation of wood mulch and not locked in any way that would prevent diameter tree growth.
10. Substitutions allowed only after consultation with the Landscape Consultant and the City of London.
11. Predominant soil type in the area.

APPROVED TREES

The selection of trees for individual locations is a difficult process. It must give careful consideration to the neighbourhood and the existing conditions including soil type, moisture, available growing space above ground, proximity to hard physical plant (hydro wires, gas, lighting, hydrants, vaults, sidewalks) and future rooting and growing space demands.

In recommending the species in the table we recognize that they are not all suitable for all locations. Carefully select the species which possess the characteristics that most closely meet the environmental conditions of each site. As well, not all cultivars of each species are listed. The design professional may suggest species not listed and they will be reviewed by City staff through the approval process.

Other concerns include:

- ◆ **STRESS** considers the tolerance to conditions such as compacted soil, diseases, drought, insects, road salt spray
- ◆ **TIME** considers which species can be transplanted/moved at specific times in the year eg. spring only
- ◆ **NATIVE** considers the suitability of trees indigenous to this region for use in highly disturbed soils, traditionally found in streetscapes and new subdivisions
- ◆ **FRUIT** consider the size and season and abundance of fruit produced by some species making them less desirable in specific locations
- ◆ **DISEASE** consider the potential for widespread mortality and costly removal and replacement programs generating public and political complaints with trees such as Norway maple (Verticillium wilt) American Elm (Dutch Elm Disease) Austrian Pine (Diplodia Tip Blight). Avoid mass planting of single species.

Variety

In an effort to promote long term sustainability, cost effective block trimming operations and increase ability to manage street tree risk management, we encourage a variety of tree species on each and every street. We also support aesthetically pleasing street tree designs and therefore encourage the planting of tree species mixtures which have similar form.

Commonly the landscape architect or registered professional forester is responsible for proper design and species selection taking the above points into consideration.

In an attempt to assist the design and species selection process, a list of recommended street trees is included. The list has been prepared using a number of references and you are encouraged to search these out and provide input with respect to other species for consideration.

APPENDIX 5

References include:

Dirr, M.A. 1990 Manual of Woody Landscape Plants

Farrar, J.L. 1995 Trees in Canada

Gerhold, H.D. et.al., 1989 Street Tree Factsheets

Himelick, E.B., 1981 Tree & Shrub Transplanting Manual

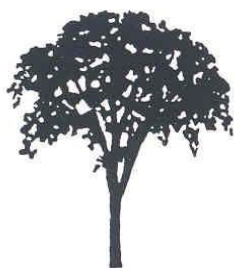
Poor, J.M. (Editor) 1984 Plants That Merit Attention Vol. 1

Rehder, A. 1940 Manual of Cultivated Trees & Shrubs

Sternberg, G, & J. Wilson 1995 Landscaping with Native Trees

Watson, G.W. 1992 Selecting and Planting Trees

TREE FORMS:



VASE



PYRAMIDAL



OVAL



COLUMNAR



ROUNDED



SPREADING

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Acer campestre</i>** Hedge Maple	Non-Continental	Boulevard	Compact form/trunk suckers require extra maintenance.	Large	Rounded	7
<i>Acer x freemanii</i> Hybrid Soft Maple	Native to Ontario	Boulevard	Caution: Many cultivars of <i>Acer rubrum</i> and <i>A. saccharinum</i> exist under the name Freemanii, each with different characteristics	Large	Oval-Rounded	Autumn Fantasy, Indian Summer and Morgan all 1 Autumn Blaze 7
<i>Acer ginnala</i>** Amur Maple	Non-Continental	Boulevard	(by prior approval Only) Multi-stem Compact form/red & yellow face colour/lots of seeds/tends to sucker/specify single stem form	Small	Rounded	4
<i>Acer nigrum</i> Black Maple	Native to Ontario	Boulevard Park	Lots of seed for winter interest/rare/needs moist soil	Large	Oval	~7 (assumed to be same as sugar maple)
<i>Acer pennsylvanicum</i> Striped Maple	Native to Ontario	Boulevard Park	Specify single stem.	Medium	Rounded	6
<i>Acer pseudoplatanus</i> ** Sycamore Maple	Non-Continental	Boulevard	Very pollution and salt tolerant Cankers cause high maintenance	Large	Oval-Rounded	8
<i>Acer rubrum</i> Red Maple ▪ 'October Glory' ▪ 'Red Sunset'	Native to Ontario	Boulevard Park	Green summer foliage & yellow to red fall colour tolerates wet soil	Large	Oval-Rounded	*1 *1
<i>Acer saccharinum</i> Silver Maple	Native to Ontario	Boulevard Park	Fast growing softwood maple; Maintenance issues as tree nears maturity due to weak wood.	Large	Oval-Rounded	Males: 9 Females: *1
<i>Acer saccharum</i> Sugar Maple	Native to Ontario	Boulevard Park	Upright form/fall colour varies/prefers good drainage/shallow roots/salt sensitive	Large	Oval-Rounded	7
<i>Acer spicatum</i> Mountain Maple	Native to Ontario	Boulevard Park	Specify single stem. Shade tolerant, seldom thriving in the open. Prefers cool shade. May spread by root shoots.	Small	Oval-rounded	Not available
<i>Acer tataricum</i>** Tatarian Maple	Non-Continental	Boulevard	Specify single stem. Good red & yellow fall	Medium	Rounded	5
<i>Aesculus glabra</i> Ohio Buckeye	Native to Ontario	Boulevard	Untested in London area and may suffer winter problems. Likes moist soil. <i>For use in limited circumstances</i>	Medium	Oval	7

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Aesculus hippocastanum</i> Horsechestnut ▪ 'Baumannii'	Non-Continental	Boulevard	Good spring flower with no fruit/limit use due to disease susceptibility	Large	Rounded	7
<i>Amelanchier Arborea</i> Downy Serviceberry	Native to Ontario	Boulevard Park	Showy flower & fruit/ tolerant of wet & dry soil	Medium	Rounded	Not available
<i>Amelanchir canadensis</i> Shadblow Serviceberry	Native to Ontario	Boulevard Park	Difficult to maintain single stem Four-season interest Tolerates moist soil	Medium	Rounded	Not available
<i>Amelanchier laevis</i> Smooth Serviceberry	Native to Ontario	Boulevard Park	Multi-stem specimens by prior approval only	Small	Rounded	3
<i>Asimina triloba</i> Pawpaw	Native to Ontario	Park	Large fruit has food value to humans	Large	Rounded	
<i>Betula alleghaniensis</i> Yellow Birch	Native to Ontario	Parks	Interesting bark features and good fall colour	Large	Rounded-Spreading	7 (but only has a short blooming period)
<i>Betula papyrifera</i> White Birch	Native to Ontario	Parks	Interesting bark features and good fall colour	Large	Rounded-Oval	7
<i>Carpinus betulus</i> European Hornbeam 'Fastigiata'	Non-Continental	Boulevard	Difficult to transplant Keep away from road salt & spray	Medium	Pyramidal-Oval	8
<i>Carpinus caroliniana</i> Blue beech or Musclewood	Native to Ontario	Boulevard Parks	Difficult to transplant/keep away from road salt & spray/likes wet soil/thin bark and sculptured trunk	Medium	Rounded	8 (Rating for genus only)
<i>Carya cordiformis</i> Bitternut Hickory	Native to Ontario	Parks	Difficult to transplant due to large tap root, messy fruit	Large	Oval-Vase	8-10* (Rating for genus only)
<i>Carya glabra</i> Pignut Hickory	Native to Ontario	Parks	Difficult to transplant due to large tap root, messy fruit	Large	Oval-Vase	8-10*
<i>Carya laciniosa</i> Big Shellbark Hickory	Native to North America	Parks	Difficult to transplant due to large tap root, messy fruit	Large	Oval-Vase	8-10*
<i>Carya ovata</i> Shagbark Hickory	Native to Ontario	Parks	Difficult to transplant due to large tap root, messy fruit	Large	Oval-Vase	10
<i>Celtis laevigata</i> Sugarberry	Native to North America	Boulevard Park	Compact form/good in moist soils	Large	Vase	8
<i>Celtis Occidentalis</i> Common Hackberry	Native to Ontario	Boulevard Park	Requires pruning for general form. Very tolerant.	Large	Vase	8

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Cercidiphyllum japonicum</i> Katsura Tree	Non-Continental	Boulevard	Multi-stem by prior approval only. Difficult to transplant. Thin bark. Needs supplemental water.	Large	Rounded	Males: 8 Females: *1
<i>Cercis canadensis</i> Redbud	Native to Ontario	Boulevard Park	Seeds readily. Suitable for lawns but not formal boulevard due to low branching.	Medium	Vase-Rounded	5
<i>Cladrastis kentukea (lutea)</i> Yellowwood (Single Stem Only)	Native to North America	Boulevard	Few problems/use local seed sources or stock only/prune early	Large	Rounded	5
<i>Cornus alternifolia</i> Alternate-leaf Dogwood	Native to Ontario	Boulevard Park	Use local winter hardy material only Specify single stem	Medium	Rounded	5
<i>Cornus florida</i> Flowering dogwood	Native to Ontario	Park	Specify single stem only. Use local winter hardy material only/ good flower/ specify single stem Can be very sensitive. Prefers acid soil, Limited use only.	Small	Rounded	5
<i>Cornus kousa</i> Kousa dogwood	Non-Continental		Resistant to dogwood anthracnose; berries have human food value	Small	Vase	5
<i>Corylus colurna</i> Turkish Hazel	Non-Continental	Boulevard	Good form/ difficult to transplant/ winter interest/ needs supplemental water	Large	Pyramidal	8
<i>Crataegus (varieties)</i> Hawthorns	(Dependent on species)	Boulevard Park	<u>Thornless & disease resistant</u> varieties only. * For use in limited circumstances <i>Crataegus monogyna</i> is invasive*	Medium	Rounded	4
<i>Fagus grandifolia</i> American Beech	Native to Ontario	Boulevard Park		Large	Oval	7
<i>Fagus sylvatica</i> European Beech	Non-Continental	Park	Needs moist soil/different leaf colours with varieties/sensitive to activity within root zone/leaves persist through winter/thin bark	Large	Oval-Rounded	7
<i>Fagus orientalis</i> Oriental beech	Non-Continental	Park		Large	Oval-Rounded	7
<i>Ginkgo biloba</i> Maidenhair tree (Male cultivar only)	Non-Continental	Boulevard	Good yellow fall colour/thin bark/tolerant of city conditions & pollution/slow growing but very large at maturity/virtually pest and disease free	Large	Pyramidal Spreading	Males: 7 Females: *2

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Gleditsia triacanthos</i> var. <i>inermis</i> Thornless Honey Locust ▪ 'Shademaster' ▪ 'Skyline'	Native to North America	Boulevard	Provides a filtered shade/susceptible to defoliation by leafhopper/susceptible to canker and other pests and diseases	Large	Spreading	Males: 7 Females: *1 Bisexual: 4
<i>Gymnocladus dioicus</i> Kentucky Coffee tree	Native to Ontario	Park	Male variety only in boulevard <i>*For limited circumstances</i>	Large	Oval	Males: *9 Females: *1
<i>Halesia tetraptera</i> Carolina Silverbell	Native to North America	Park	Low branched tree with broad, rounded crown/reserve for lawn areas	Medium	Large	3
<i>Juglans nigra</i> Black Walnut	Native to North America	Park	Messy fruit/needs large area <i>* For use in limited circumstances</i>	Large	Oval	8-*9
<i>Koelreuteria paniculata</i> Goldenrain tree	Non-Continental	Boulevard Park	Good yellow flower & fruit/susceptible to winter damage/weak	Medium	Rounded	4
<i>Laburnum</i> (varieties) Golden chain tree	Non-Continental	Park	Poisonous pea-like seeds. yellow chain like flower/winter hardy local varieties only/borderline hardiness <i>* For use in limited circumstances</i>	Medium	Rounded	7
<i>Liquidambar styraciflua</i> Sweetgum	Native to Eastern Europe & North America	Boulevard Park	Borderline hardy – good for sheltered locations, lawn areas <i>*For limited circumstances</i>	Large	Rounded	7
<i>Liriodendron tulipifera</i> Tulip tree	Native to Ontario	Boulevard Park	Good flowers and yellow fall colour/local sources/moist well drained soil/very large tree most appropriate for lawn areas/somewhat weak wooded	Large	Rounded	4
<i>Maackia amurensis</i>** Amur Maackia	Non-Continental	Boulevard	Small, round headed tree/slow growing/summer flowering/bronze coloured bark	Small	Rounded	3
<i>Maclura pomifera</i> Osage Orange	Native to Ontario	Park only	<i>*For use in limited circumstances</i>	Large	Rounded	Males: *9 Females: *2
<i>Magnolia acuminata</i> Cucumber tree	Native to Ontario	Boulevard Park	Status: Endangered	Medium	Oval-Rounded	Deciduous: 6 Evergreen: 5
<i>Malus</i> (most) ** Flowering & Domestic Crab Apple:	(Dependent on species)	Boulevard	Maintenance problems/disease & insect problems/tolerates most soils Choose persistent fruit- holding, or poorly-fruited types.	Small to Medium	Rounded-Spreading	4

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Malus coronia</i> Wild Crabapple	Native to Ontario	Park		Large	Rounded	4 (Genus only)
<i>Nyssa sylvatica</i> Black Gum	Native to Ontario	Park	Difficult to transplant due to tap root, interesting summer and fall foliage, not for heavily polluted areas	Medium	Rounded -Oval	Males: 9 Females: 1
<i>Ostrya virginiana</i> Hop Hornbeam or Ironwood	Native to Ontario	Boulevard Park	Mainly an understory species	Medium	Oval	7
<i>Phellodendron amurense</i> Amur corktree	Non-Continental	Boulevard	Good winter texture in bark/lots of black berries/use in protected areas	Medium	Spreading	Males: 8 Females: 1
<i>Pinus strobus</i> White Pine	Native to Ontario	Park Boulevard	Locate with care in boulevards, due to possible sight line and access issues when mature (bushy). Avoid <i>Ribes</i> (alternate host for white pine blister rust)	Large	Pyramidal	4
<i>Platanus x acerifolia</i> London Planetree	Hybrid of <i>Platanus occidentalis</i> (N. America) and <i>Platanus orientalis</i> (Europe), so has no native range ¹¹	Boulevard	Frost cracks on trunk/attractive peeling bark/fruit can cause problems/very large at maturity – reserve for large lots and lawn areas	Large	Spreading	9
<i>Platanus occidentalis</i> Sycamore	Native to Ontario	Boulevard Park	Frost cracks on trunk/attractive peeling bark/fruit can cause problems/very large at maturity – reserve for large lots and lawn areas	Large	Spreading	9
<i>Populus ssp.</i> Balsam Poplar, Eastern Cottonwood, Large-tooth Aspen, Trembling Aspen	Balsam Poplar, Eastern Cottonwood, Large-tooth Aspen: Native to Ontario Trembling Aspen: (TBD)	Park. Not permitted in Boulevard	Wood is light, soft and weak, breaks easily in storms, drops flowers, fruit, twigs and branches	Large	Pyramidal – Vase and Spreading	Males: 9 Females: 1
<i>Populus ssp.</i> Dwarf varieties.		Boulevard or Park	Limited numbers may be considered in Boulevards on a trial basis	Medium	Varies	

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Prunus Americana</i> American plum	Native to Ontario	Park	Somewhat thorny. Untested in boulevard.	Small	Rounded	2
<i>Prunus nigra</i> Canada plum	Native to Ontario	Park	Thorny. Untested in boulevard.	Medium	Rounded	3
<i>Prunus pensylvanica</i> Pin Cherry	Native to Ontario	Park	Excellent flowers with no fruit/single stem to be specified/weeping cankers * For use in limited circumstances	Small	Oval	5
<i>Prunus serotina</i> Black Cherry	Native to Ontario	Boulevard Park	Interesting bark, messy fruit; Better in lawns than in formal boulevard.	Large	Oval	5 (Genus only)
<i>Prunus</i> (flowering varieties) Small Cherry	(Dependent on species; most popular flowering cherries are non-continental)	Boulevard	Weeping cankers; prone to fungal infections * For use in limited circumstances *	Small	Vase	
<i>Prunus virginiana</i> Choke Cherry	Native to Ontario	Boulevard Park	green spring foliage & red in summer/bark tends to split	Small	Rounded	6
<u><i>Ptelea trifoliata</i></u> Hop-tree	Native to Ontario	Boulevard Park	Adaptable to wide range of growing conditions. Easily grown in average, dry to medium, well drained soils in part shade to full shade. Tolerates full sun. One of two native larval host plants for the rare Giant Swallowtail butterfly.	Medium	Rounded	Males: 7 Females: 1
<i>Quercus alba</i> White Oak	Native to Ontario	Boulevard Park	Needs moist soil/fruit maintenance/needs large space at maturity Monitoring use on a case by case basis due to Oak Wilt	Large	Rounded	8
<i>Quercus bicolor</i> Swamp White Oak	Native to Ontario	Boulevard Park	Grows in wetter conditions with acidic soils Monitoring use on a case by case basis due to Oak Wilt	Large	Rounded	8
<i>Quercus ellipsoidalis</i> Northern Pin Oak	Native to Ontario	Boulevard Park	Monitoring use on a case by case basis due to Oak Wilt			8

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Quercus macrocarpa</i> Bur Oak	Native to Ontario	Boulevard Park	Large size at maturity – reserve for large lots and lawn areas/fruit drop/difficult to transplant/requires good soils Monitoring use on a case by case basis due to Oak Wilt	Large	Rounded	8
<i>Quercus muhlenbergii</i> Chinquapin Oak	Native to Ontario	Boulevard Park	Attractive tree, especially in old age Monitoring use on a case by case basis due to Oak Wilt	Medium	Rounded	8
<i>Quercus robur</i> 'Fastigata' Fastigate English Oak	Non-Continental	Boulevard	Needs well drained soil/holds leaves through the winter/ difficult to transplant/very upright in form – reserve for sites with specific need for this form Monitoring use on a case by case basis due to Oak Wilt	Large	Columnar	8
<i>Quercus robur</i> English Oak	Non-Continental	Boulevard Park	Needs well drained soil/difficult to transplant/large size at maturity Monitoring use on a case by case basis due to Oak Wilt	Large	Rounded	8
<i>Quercus rubra</i> Red Oak	Native to Ontario	Boulevard Park	Needs sandy loam soil/difficult to transplant/more salt tolerant and faster growing than other oaks Monitoring use on a case by case basis due to Oak Wilt	Large	Rounded	8
<i>Quercus velutina</i> Black Oak	Native to Ontario	Boulevard Park	Needs well drained soil/difficult to transplant/large size at maturity Monitoring use on a case by case basis due to Oak Wilt	Large	Rounded	8
<i>Rhus ssp.</i> Staghorn Sumac, Smooth Sumac	Native to	Boulevard Park	Spreads quick, freely suckers from roots creating wide spreading colonies. Tolerates dry sterile soils	Small	Rounded - Spreading	Males: 10 Females: 7
<i>Sassafrass albidum</i> Sassafrass	Native to Ontario	Boulevard Park	Prefers sandy soils			Males: 7 Females: 1
<i>Sophora japonica</i> Japanese Pagoda Tree	Non-Continental	Boulevard	Excellent white flower/green stem when young/limit use due to messy characteristics	Large	Spreading	5

APPENDIX 5

APPROVED TREES						
Tree Species	Native Range	Use	Comments and Notes	Size	Form	OPALS Rating ⁷
<i>Syringa reticulata</i> Japanese Tree Lilac ▪ 'Ivory Silk'	Non-Continental	Boulevard	Good white summer flower/excellent small specimen. Prone to over-use	Small	Rounded	6
<i>Tilia americana</i> Basswood	Native to Ontario	Boulevard Park	Prefers deep moist fertile soil/will grow on drier heavier soil/needs large space	Large		7
<i>Tilia cordata</i> Littleleaf Linden ▪ 'Glenleven' ▪ 'Greenspire' ▪ 'Greenglobe'	Non-Continental	Boulevard	Aphid & borer problems; suckers from base; messy species	Medium	Pyramidal	7
<i>Tilia x euchlora</i> Crimean Linden	Non-Continental	Boulevard	Fruit messy/suckers from base <i>* For use in limited circumstances</i>	Medium	Rounded	7
<i>Tilia tomentosa</i> Silver Linden	Non-Continental	Boulevard	Heat and drought tolerant.	Medium	Pyramidal-Oval	7
<i>Ulmus americana</i> Elm ▪ 'Homestead' ▪ 'Pioneer' ▪ 'Sapporo Autumn Gold'	<i>Specific cultivars hybridized for disease resistance</i>	Boulevard	Choose with care. Cultivars vary in resistance to Dutch elm disease and elm leaf beetle.	Large	Vase	8
<i>Zelkova serrata</i> Japanese Zelkova ▪ 'Green Vase' ▪ 'Village Green'	Non-Continental	Boulevard	Rapid growth/narrow branch angles promote fork split/frost susceptibility when young	Large	Vase	*10

APPENDIX 5

SPECIES NOT PERMITTED FOR USE					
Tree Species	Native Range	Comments and Notes	Size	Form	OPALS Rating ⁷
Acer platanoides Norway Maple (many cultivars)	Non-Continental	Surface roots conflict with and turf/girdling roots/aphid and wilt problems.	Medium	Various Forms	8
Ailanthus altissima Tree of Heaven	Non-Continental				
Alnus glutinosa European Alder (Single Stem Only)	Non-Continental	Tolerant of wet & dry soil. Invasive tendencies checked by dry sites.	Medium	Pyramidal	9
Caragana arborescens	Non-Continental	Toxic	Small	Varies	
Carpinus betulus European Hornbeam 'Fastigiata'	Non-Continental	Difficult to transplant Keep away from road salt & spray	Medium	Pyramidal-Oval	8
Eleagnus angustifolia Russian Olive	Non-Continental				
Maackia amurensis Amur Maackia	Non-Continental	Small, round headed tree/slow growing/summer flowering/bronze coloured bark	Small	Rounded	3
Paulownia spp.	Non- Continental				
Pyrus calleryana Callery Pear 'Chanticleer' 'Bradford'	Non-Continental	Fireblight problems Graft incompatibility problems with some rootstocks. Poor branch attachments and form. Objectionable smell.	Small	Pyramidal	Ornamentals:4 Fruiting: 3
Sorbus aria Whitebeam Mountain Ash	Non- Continental		Medium	Pyramidal-Oval	4
Sorbus aucuparia European Mountain Ash	Non-Continental	Scab disease & insect problems; Limit use due to fruit and other problems.	Medium	Oval	4
Sorbus x thuringiaca Oakleaf Mountain Ash	Non- Continental		Small	Rounded	4

TREE ASSESSMENT CRITERIA

It is critical that the inspections of trees are done in a consistent manner so that all developers and landscapers are treated fairly. We must also ensure that the City assumes a quality product that will not result in high maintenance costs.

To help facilitate this, the following tree assessment criteria are to be followed by the L.A. or R.P.F. in recommending tree assumption to the City. If these criteria are followed, City staff should be able to quickly approve trees for assumption.

Tree assessments are to be conducted from May 1 to September 1 only.

TREE CROWN

- leaf area must be 75% or more
- branch ratio must be 50% of total tree height and there must be 9 to 11 branches, well spaced and ascending the main trunk in a spiral fashion. The crown must be well balanced.
- leaf size must be normal for the species
- leaf colour must be normal for the species

TREE STEM

- the main leader must be intact – not cut
- the trunk must be single and straight
- the tree must be planted straight
- there must be 175 – 200 cm of clean stem below the branches
- there must be no major scrapes or cuts on the bark
- the tree must meet the diameter class as specified on the concept plan
- trees must be planted as on the concept plan or an explanation provided
- trees must be planted at the same height as in the nursery. We will accept maximum 4 inches high where necessary for survival. We will not accept trees planted deep, ie: below the level they were in the nursery.

PLANTING METHODS

- stakes, ties, labels and wrap must be removed prior to acceptance
- saucer and mulch are to be left in place
- NO mounding of soil or avolcano@ acceptable.

A professionally stamped report by address is to be submitted with your recommendation to the Parks and Forestry Division. The following form is to be completed and submitted with your recommendation for assumption.

APPENDIX 6

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13 MATERIAL SUBSTITUTIONS FOR CITY OF LONDON PROJECTS

13.1 INTRODUCTION

There is a history of confusion surrounding the substitution of a material during construction projects, for example, using PVC pipe instead of HDPE pipe. This chapter is intended to clarify the City's position on the matter of substitution of a material specified on an approved set of drawings with an alternative material. In no case can a substitution occur without the consent of the City.

13.2 SPECIFICATIONS

In the most simple of terms, the City of London has, at the minimum, two basic needs:

- the material must work for its intended use and life.
- the City must be able to maintain the works.

The City applies two decision-making tools to meet these needs:

- general acceptance of a material through the Product Approval Committee.
- specific acceptance, through the detailed design and drawing review process of a material based on the site specific design criteria.

13.3 LISTS OF MATERIALS

13.3.1 Lists of Acceptable Products

- The City of London Standard Contract Documents for Municipal Construction Projects has partial lists of acceptable products for use on construction projects where the City will ultimately be assuming the works.
- There is also a list of products that have been previously approved for use in the City of London, by the Products Approval Committee.

13.3.2 Utilization of the Lists

The materials listings have been developed to meet a multitude of general City needs such as durability and future maintenance, spare parts inventories, etc. The lists are not tailored to site specific needs.

Selecting from the pre-approved list allows the designer to avoid the additional process of having a material approved for use through the Product Approval Committee. The designer may choose to offer options of all acceptable materials for a given application, or may specify one product only, depending on site specific design constraints. If for example the designer chooses to allow either PVC, or Concrete Pipe, then the design drawings and related contract tender items must specify both, with full details for each with respect to class of pipe, and bedding requirements for type of material, taking into account depth of cover, soil conditions, etc. If the designer only specifies one material type for site specific reasons, then no substitutions may be allowed.

13.4 PRODUCT APPROVALS

13.4.1 Product Approval Committee

- a) The Product Approval Committee is a committee comprised of City of London Environmental Services Department staff. If a new product is being proposed for future routine use in the City of London, the material must be reviewed, evaluated and approved by the Product Approval Committee, prior to its being used. The review, evaluation and approval of a new product takes, on average, six months to one year, depending on the product.
- b) The designer is expected to select materials approved by the Product Approval Committee if any are available that are suitable for the use.

13.4.2 Materials Not Subject to Product Approval Committee Review

On occasion, the Product Approval Committee (PAC) excludes materials from the review process which they do not consider to be 'products'. Examples include recycled asphalt as a granular base or painted glue. In these cases the City relies on acceptance of detailing drawings and/or contract specifications and/or manufacturer's specifications. In all cases, the City has the final say as to whether a material may be used.

If the designer is unsure as to whether the material should be reviewed by the PAC, they should contact the PAC for confirmation.

13.5 DRAWING APPROVAL

The City requires all substitutions for items that are specified on an approved set of drawings, be approved by the City Engineer before use on that project. A note to this effect is included on all sets of servicing plans, as part of the City's standard "Construction Notes for Engineering Drawings". Consequently, after the design drawings have been accepted by the City, the designer **MUST** discuss and receive approval from the appropriate City of London staff, for any proposed changes of material prior to its being used on a project.

For the purposes of future maintenance and development, the As Constructed Drawings **must** accurately reflect the material or product used.

13.6 HOW TO PROPOSE A SUBSTITUTION

(in accordance with OPS General Conditions GC5.0)

- a) A tenderer may propose a material substitution to the designer. However the tenderer may not assume that the approved lists of materials (10.3.1.) are an approved equal and alternate' materials list, especially, for the purposes of tendering and construction.
- b) The designer must evaluate the proposed material substitution, and discuss any changes with the City Engineer or designate. If the designer determines that the proposed substitution is 'not suitable for use' for the proposed municipal works, then that substitution can not be used.
- c) If the proposed substitution is acceptable to the designer, then the City Engineer must review and accept the proposal. The City Engineer has the final acceptance authority for any proposed material substitution.

- d) If the material substitution is approved, then an addendum for the tendering process or a change order for the construction process must be processed. In no cases can a tenderer/constructor independently decide to substitute a material.
- e) The 'As Constructed' drawings must also accurately reflect the material or product used. The City does routinely consent to viable alternatives provided the appropriate process is followed and the attendant paperwork is in place.



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14 CONTACT INFORMATION

14.1 ENVIRONMENTAL AND ENGINEERING SERVICES

Roads and Transportation

Geomatics.....	519	661-2489 ext.6642
Roadway Lighting & Traffic Control.....	519	661-2489 ext.4580
Parks and Recreation Operations	519	661-2489 ext.6426
Transportation Planning and Design	519	661-2489 ext.4580
Transportation and Roadside Operations.....	519	661-2489 ext.8489

Wastewater and Treatment

Pollution Control Operations	519	661-2489 ext.4480
Sewer Operations	519	661-2489 ext.8489
Stormwater Management.....	519	661-2489 ext.4574
Wastewater and Drainage Engineering.....	519	661-2489 ext.5489

Water

Water Engineering	519	661-2489 ext.5081
Water Operations.....	519	661-2489 ext.8489
Regional Water Supply	519	474-0451

Environmental Programs & Solid Waste

Environmental Programs.....	519	661-2489 ext.8414
Forestry	519	661-2489 ext.4980

14.2 DEVELOPMENT & COMPLIANCE SERVICES

Building Control	519	661-4555
Development Services	519	930-3500
Customer Relations	519	661-2489 ext.4570
Parking	519	661-2489 ext.4537

14.3 PLANNING SERVICES

Planning Services	519	661-4980
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14.4 WEB SITE

www.london.ca (see Consultant Resources in the Business Section)

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15 INSTALLATION, INSPECTION OF SEWER AND WATER WORKS

The following addresses specifications and requirements to be met by the Owner or Contractor for the installation and construction of sewer and water works.

15.1 APPROVALS OF SEWERS AND WATERMAINS

Prior to installation of sewers and watermains, the Owner must have obtained:

- Final Approval from the Engineer,
- the Environmental Compliance Approvals from the Ontario Ministry of the Environment for all sewer and watermain work, and
- the execution of all required agreements with the City.

Installation shall be in accordance with applicable OPSS and City of London Standard Contract Drawings for Municipal Construction Projects.

15.2 INSPECTION OF SEWERS & WATERMAINS

A City Inspector shall, at all times, have access to the work. At least 24 hours before commencing installation, the Owner or Contractor shall apply to the City Technical Services Division for inspection and the Engineer shall determine the extent of inspection required.

15.2.1 Owner's Supervision

The provision of inspection by the City is not to be considered a substitute for supervision by the Owner or Contractor.

A Consultant's Inspector engaged by the Owner to inspect the sewer and watermain installation must have successfully completed the five day OGRA & MEA Inspector's Course called "Sewer and Watermain Construction Inspection (TM43)" or a consultant may obtain approval from the Engineer upon written request for use of Inspectors with a minimum of ten (10) years related construction experience in lieu of MEA/MOE Inspector's Course.

The Owner or Contractor shall provide and leave a competent and reliable agent or foreman in charge for him and such person shall be considered as acting in his place and all notices, communications, instructions or orders given, sent or served upon such person shall be taken as served upon the Owner or Contractor.

15.2.2 Revisions to Plans

Any changes required by the Owner to plans which have received final approval must be resubmitted to the Engineer for approval before the inspector will permit such changes to be made during installation.

15.2.3 City Inspector's Authority

An Inspector may stop the work entirely if there is not a sufficient quantity of suitable and approved material on the site to carry out the work properly, if approved drawings and Specifications are not on the site, or if material or workmanship that is contrary to the plans or Specifications is being used.

If the Owner or Contractor covers or permits to be covered, work that has been designated for tests, inspections or approvals before such tests, inspections or approvals are made, given or completed, he shall, if so directed, uncover such work to have the inspections or tests satisfactorily completed and make good such work at his own expense.

15.2.4 Charges for Inspection

When an Owner or Contractor is required to have a City Inspector on the job, he shall be charged at the prevailing rate plus a trucking charge. In the event the Inspector is required during premium time periods the applicant shall be charged at current overtime rates.

If the work at any site is widespread to a point where an Inspector may not, in the opinion of the Engineer, give proper supervision to a job, then the Engineer shall determine whether extra Inspectors are required.

If required, the Engineer will place these extra Inspectors on the job and charge the Owner or Contractor for the services at the prescribed rate.

15.2.5 Emergency Repairs to Sewer and Water Service by City during Guarantee Period

During the guarantee period, where maintenance of water service to the consumer or consumers is required, or where, in the opinion of the Engineer or his representative, a faulty or damaged installation may cause inconvenience or further damage, the City will act immediately to make safe the condition for consumers after which the owner will be contacted and advised of the problem and given the opportunity to immediately affect repair. If the owner chooses not to respond forthwith or cannot be contacted, immediate repairs will be undertaken by the City. The cost of such repairs will be charged to the Owner. The decision of the Engineer or his representative will be final as to the necessity of repairs done or required and the amount expended for these repairs.

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16 NOISE ATTENUATION MEASURES

16.1 DEFINITIONS

Noise Attenuation Measures are required in site specific situations to mitigate existing or anticipated noise levels which exceed the MECP Criteria for acceptable noise levels for specific land uses. Typical locations where Noise Attenuation Measures may be required occur where residential land uses are adjacent to Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Streets, industrial lands, and railway lines. Noise Attenuation Measures can be setbacks, building orientation, earthen berms, noise walls, or any combination necessary to achieve an acceptable noise level, based on MECP Criteria.

16.2 NEW DEVELOPMENTS (DRAFT PLANS, COMMUNITY PLANS)

Where new applications for residential development are being proposed along Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Streets, Rural Thoroughfare or Rural Connectors refer to the related Official Plan/London Plan Policies which can be found on the City of London web page at: <http://www.london.ca/business/Planning-Development/Official-Plan/Pages/default.aspx> ; for the criteria to be applied.

16.3 CAPITAL WORKS

16.3.1 Application & Methodology

For municipal projects, detailed fabrication and layout drawings of the proposed barrier, sealed by a Professional Engineer, shall be submitted to the Transportation Division for approval prior to manufacture or construction.

16.3.2 Dimensions and Location

- a) The minimum height of the barrier shall be 2.44m above the finished centreline elevation on the road allowance side of the wall. The minimum height of the barrier on the private property side should be 1.8m. In rolling terrain, the barrier height may reduce to a minimum of 1.1m, in which case the combined height of the noise barrier and retaining wall shall not be less than 2.44 m. A concrete curb and gutter shall be erected along the base of the wall to a height of 0.15m or the bottom panel shall be a material resistant to damage from mowers or trimmers. There shall be no gaps or holes from the finished grade to the top of the barrier, except along the base of the barrier where they can be demonstrated as necessary for drainage.
- b) Masonry or concrete noise walls are to be constructed on the road allowance within the 0.3m reserve, and maintained by the City. If no 0.3m reserve exists, the masonry or concrete noise barrier shall be placed adjacent to the property line, located entirely within the right of way.
- c) Wooden noise walls are to be located entirely on private property, and maintained by the owner.

16.3.3 Materials

- a) Panel materials shall be durable and impervious to ultraviolet light, with a predicted maintenance-free lifespan of 20 years. The barrier system and its components shall be designed in accordance with the requirements of the Ontario *Highway Bridge*

Design Code. The barrier shall be constructed to meet a reference wind pressure of 0.36kPa for a 10-year return period, and the wall surfaces are to be “sound absorptive.” For a barrier, the material shall have a surface density not less than 20kg/m², and a demonstrated Effective Sound Transmission Class (E.S.T.C.) of 32 or greater.

- b) Concrete for the post footings shall be 20MPa, in conformance with OPSS 1350
- c) Wooden Noise Walls shall have steel posts.

16.4 NOISE ATTENUATION MEASURES WHERE RESIDENTIAL LANDS ABUT PROVINCIAL HIGHWAYS OR RAILWAY LINES

16.4.1 Noise Assessment Study

A Noise study or report is required when a proposed development is situated within certain design setbacks from a provincial highways or a railway line. The noise study is to comply with Ministry of the Environment “Noise Assessment Criteria in Land Use Planning”. All recommendations and details from the Noise Assessment Study are to be met or exceeded and reflected on the servicing drawings.

16.4.2 Dimensions & Location

Are to comply with the Noise Assessment Study, the Railway Line Setbacks, and the Draft Plan Conditions.

16.4.3 Materials

Are to comply with the Noise Assessment Study, Railway Line Requirements, Draft Plan Conditions, and Section 16.3.3 (above).

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17 TRENCHLESS TECHNOLOGIES (FOR NEW CONSTRUCTION)

17.1 APPLICATION

Trenchless installation of gravity sewers, watermains and forcemains is becoming more prevalent as a design alternative as the capabilities of the trenchless technologies advance. Trenchless Technologies can be a requirement of the City or proposed by a Consulting Engineer, as a viable alternative, given the particular design challenges for the specific site. Trenchless applications allow for the installation of the infrastructure with minimal disturbance of the surface area. Typical examples of where Trenchless Technologies may be viable alternatives to conventional methods include the installation of servicing through Environmentally Significant Areas (ESA's), under major roadways or railway lines, in built up areas where space is limited and the social costs would be excessive or even residential streets with mature trees.

In the past, when a Trenchless Technology was proposed, the Design Engineer relied heavily on the expertise of the contractor for any given scenario. As new methods come on stream, and the technologies are advancing, the onus will be shifting from the Contractor to the Design Engineer to design specific elements of the trenchless installations. It is important that the Design Engineer be qualified to design and oversee (certify) the specific types of technology being proposed.

17.2 GEOTECHNICAL BASELINE REPORT (GBR)

A Geotechnical Baseline Report (GBR) is required when a Trenchless installation is being considered. The GBR will provide detail information related to the anticipated groundwater and soils conditions, including defining and assigning the various risks and liabilities to the Owner and/or the Contractor associated with the possible changes in ground conditions that may be encountered on the proposed alignment. This information will help the designer and contractor determine the appropriate trenchless method(s) for the proposed design application. The Design Engineer should provide necessary design parameters for the trenchless installation.

17.3 TRENCHLESS DESIGN REQUIREMENTS

17.3.1 Items to be Considered by the Design Engineer as Part of the Design Process

As a minimum, the Design Engineer is to give due regard for designing the following elements of an appropriate Trenchless Installation:

- i. Pipe design (casing and/or carrier pipe as applicable)
 - a) Material, along with specific characteristics of this material
 - b) Dimensional Ratio (pulling forces, live loads, dead loads – as applicable)
 - c) Diameter
 - d) Alignment
 - e) Radius of Curvature (if applicable)
 - f) Grade
- ii. Adequate room for staging areas, pipe assembly, entry and exit portals (as appropriate)

- iii. Blocking and grouting requirements (of carrier pipe within a casing pipe)
- iv. Slurry/spoil disposal
- v. Erosion/Sediment Control Measures
- vi. Bore Geometry
- vii. Annular Space Plug
- viii. GBR Recommendations
- ix. Define the need for Dewatering and/or Permit to Take Water (if applicable)
- x. Timing as it relates to other activities, i.e. order of operations
- xi. Prequalification of the contractor

17.3.2 Information to be Included on the Construction Servicing Drawings/Tender Documents

This information should be shown on the engineering drawings and/or form part of the Tender Documents:

- i. Pipe design (casing and/or carrier pipe)
 - a) Diameter
 - b) Alignment
 - c) Grade (plus or minus if applicable and acceptable)
- ii. Adequate room for staging areas, pipe assembly, design of entry and exit portals (as appropriate)
- iii. Erosion/Sediment Control Measures
- iv. GBR Recommendations
- v. Define the need for Dewatering and/or Permit to Take Water (if applicable)

17.3.3 Items to be Considered in the Contract Tender Documents

Consideration should be given to addressing and/or including the following items as part of the contract tender:

- i. a tender item for a 911 emergency shaft
- ii. a tender item for "Frac Out" mitigation measures
- iii. cutter head requirements
- iv. over cut dimensions
- v. Swab run (depending on diameter and site specifics)
- vi. Bentonite lubrication
- vii. Machine launch & retrieval (groundwater impacts)
- viii. Annular space grouting
- ix. Settlement/heave
- x. Mitigation/contingency plans

- xi. Damaged Pipe
- xii. Tracking requirements
- xiii. Spoil/slurry disposal
- xiv. Methods of restraint against pull-back (as applicable)
- xv. Complete GBR
- xvi. Quality control (i.e. – videos, joint testing, etc. as appropriate for the technology being installed)

17.3.4 Record Drawing

As part of the Record Drawing submission, at the conclusion of the project, the drawings are to be updated to show what was installed including:

- i. Identify method of installation
- ii. Pipe design (casing and/or carrier pipe as applicable)
 - a) Material
 - b) Dimensional Ratio
 - c) Diameter
 - d) Alignment
 - e) Grade
- iii. Blocking and grouting measures (as applicable)
- iv. Location of staging areas, entry/exit portals – in case of settlement issues later



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18 DRAFTING AND DESIGN REQUIREMENTS

Except where identified as a specific requirement pertaining to subdivision or site plan, all drafting and design requirements noted herein are required for development submissions.

18.1 BASIC DRAWING REQUIREMENTS

Drawings are to contain the following details:

- a) A list of “Construction Notes for Engineering Drawings”. Note, all required reports associated with the design and as per Council Conditions, Approval Authority Conditions and Ontario Municipal Boards Conditions are to be listed onto the details drawings;
- b) A general list of most common standards used [Ontario Provincial Standard Drawings (OPSD) & City of London]; and
- c) A typical road and sewer trench cross-section detail identifying road, boulevard, sidewalk, curb & gutter, subdrains, watermain, forcemain sanitary & storm sewers, trench zones/slopes, bedding, together with all applicable dimensions and construction notes for the above.

18.1.1 Transportation Drawing Requirements

a) Road Plan Profiles

Road plan profiles are required for all roads constructed within or in conjunction with a plan of subdivision. As well, additional road profiles are required as follows:

60m Road Plan Profile of Adjoining Existing Street:

To ensure proper drainage is maintained and/or evaluated a profile extending into the existing subdivision is required.

120m Road Plan Profile of Adjoining Future Street:

To review future alignment extensions of existing ground and proposed finished ground.

b) Typical Road Cross-section Detail

A typical road cross-section detail, identifying recommended pavement structure and subgrade information (minimum to City of London standards, and as recommended by a Geotechnical Engineer) is required in conjunction with the typical sewer trench cross-section detail. Curb & gutter cross-sections to be incorporated into the typical combined road and sewer trench cross-section detail.

c) Driveway Locations (Subdivision Specific)

Driveway locations are to be identified where non-standard cul-de-sacs and curves in the roads are designed, adjacent to walkways, CICBs and the last lot on dead end streets.

d) Cul-de-sac Roads (Subdivision Specific)

- i. General: Minimum curb & gutter road grade around a cul-de-sac is 0.5%, and maximum road grade within the cul-de-sac is 3%.
- ii. Residential: As per City of London Drawing Standard SR-5.0.
- iii. Industrial: As per City of London Drawing Standard SR-5.1

e) Ultimate Road Profile

To achieve proper road design parameters on future/proposed major road networks. Limitations and designs are to be reviewed and accepted by Transportation Division.

Note: Existing abutting road plan & profiles are required for the full frontage of subdivision.

18.1.2

Sewer Design

a) Connections to Future Subdivisions

Sanitary and Storm sewers are to be extended to the edge of the subdivision limit for future servicing connections.

Note: All active sewers/stubs require a maintenance hole. If sewer/stub is not active, then maintenance hole is not required.

b) Plan & Profile Details

A plan & profile drawing is required for all sewer designs. A typical sewer trench cross-section and details are also required. This may be done in conjunction with the road cross section, if applicable and required when.

- For poured maintenance holes
- Unusual benching configurations within the maintenance holes

Note: Trench construction to be in accordance with the latest specifications regarding trench widths (Occupational Health and Safety Act – Regulation 213/91).

c) Steep Grades of Sewers

Note: Anchoring or concrete encased sewers are required for steep grades and/or velocities.

- d) Consultants shall provide a table demonstrating adequate crossing clearances between services (sanitary/storm/water) on the engineering drawings for site plan applications or when otherwise requested by the City. All crossings clearances shall be in accordance with City standards, to the satisfaction of the City. The table shall generally conform to the example as provided below:

Sewer Crossing Chart						
CID	Pipe Under	Elev.	Pipe Over	Elev.	Clearance required (m)	Clearance provided (m)
C1	300 STM	XXX.XXX	50 WM	XXX.XXX	0.XX	0.XXX
C2	300 SAN	XXX.XXX	200 STM	XXX.XXX	0.XX	0.XXX
C3	100 WM	XXX.XXX	600 STM	XXX.XXX	0.XX	0.XXX

18.1.3 General

a) Drafting Standards

All capital and subdivision drawings and calculations are to be completed in metric units and shall adhere to the City of London's Engineering Record Drawings - Drafting Standards (Revised February 2018) and templates (including title blocks, font sizes, and linetypes).

b) Layout Information

For all fire hydrants, maintenance holes, catch basins, etc., layout information is required or alternatively a note indicating the use of UTM Coordinates

c) Temporary Measures

Temporary measures (i.e. DICB, ditches, maintenance holes, turning circles, grading, barricades, easements, etc...) may apply to some designs depending on the planning and future connections of the development, and where applicable, these guidelines are to be adhered to, unless otherwise approved by the City Engineer.

Note: Details for the above should be provided on all pertinent drawings.

18.1.4 Urban Forestry

The following are to be shown on plan and profile drawings on existing streets and on the Tree Planting plan for new streets, as required by Urban Forestry:

- a) Tree planting;
- b) Tree preservation; and
- c) Tree removal.

18.1.5 Parks Planning & Design Division

The following are to be shown on lot grading plans, tree preservation plans and/or detail drawings within lots/blocks and open space areas, as required by Parks Planning & Design Division:

- a) Tree planting;
- b) Tree preservation;
- c) Tree removal;
- d) Park grading;
- e) Pedestrian system;
- f) Park design; and
- g) Landscaping plan.

18.1.6 Other Nonstandard Drawing Requirements

For more complex requirements, details drawings are required for the following:

Design Elements	Drawing Requirements
Stormwater Management Details and Notes	<ul style="list-style-type: none"> Longitudinal and lateral cross-sections of the stormwater management pond and sediment forebay and details; Inlet/outlet cross-section and details; Perforated riser cross-section and details; Maintenance/pedestrian access cross-section and details; Water level gauge cross-section and details; Outlet swale/ditch plan & profile and cross-section details; Orifice plate cross-section and details
Open Channels Details and Notes	<ul style="list-style-type: none"> Plan & profile; and Frequent cross-sections and details
Poured Concrete Box Culverts Details and Notes	<ul style="list-style-type: none"> Plan & profile; and Frequent cross-sections and details
Poured Maintenance Hole Chambers	<ul style="list-style-type: none"> Plan & profile; and Frequent cross-sections and details
Noise Barrier Wall Details and Notes	<ul style="list-style-type: none"> Typical profile view of noise barrier wall and footings; Cross-section view of noise barrier wall and footings; Cross-section view of brick pillars and footings; and Cross-section view of wood posts and footings
Noise Barrier Berms	<ul style="list-style-type: none"> Plan & profile; and Frequent cross-sections, details and notes.
Retaining Wall Details and Notes	<ul style="list-style-type: none"> Typical profile view of retaining wall and footings; Profile required for relatively high (1.0m or greater) and long retaining walls; and Cross-sections views of retaining wall.
Headwall Details	<ul style="list-style-type: none"> A plan & profile detail is required for all headwall designs together with all pertinent details.
Traffic Calming Measures Details and Notes	<ul style="list-style-type: none"> Plan & cross-section views of type of traffic calming measures and details; and Curb cross-section details.
Access Roads Details and Notes	<ul style="list-style-type: none"> Plan & profile of access road; and Cross-section view of access road and details.
Abutting an existing or proposed major road	<ul style="list-style-type: none"> Required where the common property line of the proposed development plan abuts an existing or proposed major road, as per City of London Standard "Grading Along Major Roads" (See Chapter 9 Figure 9.1.).
Construction Roads	<ul style="list-style-type: none"> Plan & profile of construction road; and Cross-section view of construction road.
Pedestrian Pathway Systems Details and Notes	<ul style="list-style-type: none"> Plan & profile drawing and details; and Cross-section view of pedestrian pathway systems.
Erosion & Sediment Control Measures	<ul style="list-style-type: none"> Plan & profile of checkdams; and Cross-section of all pertinent measures
Other Non-standard Works or Services	<ul style="list-style-type: none"> Plan & profile; and Cross-section details; as required by the City Engineer.

18.2 OTHER AGENCY APPROVALS

18.2.1 Utilities Coordinating Committee (U.C.C.)

a. Works on Existing Assumed Streets:

U.C.C. is to be advised about all works on existing assumed streets other than lateral connections.

b. Non-Standard Service Locations:

U.C.C. approval is to be obtained for all proposed services which are to be constructed in non-standard locations on new or existing streets.

c. Sub-Standard Boulevard Widths and/or Non-Standard Road Widths:

Consultant is to notify all utilities regarding sub-standard boulevard widths, non-standard R.O.W. widths and utility easements required adjacent to sub-standard boulevards through U.C.C.

18.2.2 Board of Education

Board of Education approval is required for all services which are constructed on their lands. As well their approval is required for proposed services to a proposed/existing school block.

18.2.3 Upper Thames River Conservation Authority (UTRCA)

Review and approval from UTRCA is required, prior to the construction, of works, services and Erosion & Sediment Control measures within flood plain areas and in or adjacent to open watercourses, ravines and natural areas under the jurisdiction of UTRCA.

18.3 TEMPORARY MEASURE DESIGN REQUIREMENTS

18.3.1 Temporary Turning Circles (Subdivision Specific)

Temporary turning circles are required if no intersecting street is within 45.0m of a dead end street as per City of London Drawing Standard SR-5.2.

18.3.2 Dead End Street (Subdivision Specific)

If a temporary turning circle is not warranted, then a dead end barricade is required, as per OPSD-912.532.

Note: A driveway for maintenance vehicles must be provided on the last lot of the dead end street, but not adjacent to the development limit. Sufficient snow storage area must be provided at the end of a dead end street without a temporary turning circle.

18.3.3 Work on Existing City Streets

When proposed works from a development are to extend and/or be constructed on existing City Streets, the following is required:

- a) limits of construction;
- b) sawcut/milling/steep milled joint;
- c) backfill & compaction specifications; and
- d) restoration details.

Note: Steeped milled joint is required for all proposed road widenings, and where proposed asphalt designs meet existing asphalt designs, as per City of London Drawing Standard SR-13.1.

18.4 EROSION & SEDIMENT CONTROL MEASURES

18.4.1 Rip Rap

Constructed in conjunction with an approved geotextile within inlet/outlet structures, over flow protection, channel banks, gabions and rockfill structures.

Graded in sizes ranging from 100mm to 200mm, as per Ontario Provincial Standard Specification (OPSS)-1004.05.06.01.

18.4.2 Rock Protection

Graded in sizes ranging from 100mm to 500mm, as per Ontario Provincial Standard Specification (OPSS)-1004.05.06.02

18.4.3 Turfstone.

Constructed in conjunction with an approved geotextile, for use as over flow protection, channel lining, and/or surface access roads using City approved products.

Note: Turfstone voids are to be filled with topsoil and seeded.

18.4.4 Geotextile

Constructed within inlet/outlet structures, sub-drains, blanket drains, gabion lining, retaining walls, ditch lining, channel linings, access roads, rockfill structures, dykes and energy dissipaters. Type and sizing of geotextile is to be approved by the City.

18.5 PLANNING RELATED DESIGN REQUIREMENTS

18.5.1 Road Geometrics / Design

a) Road Widening

Where a development abuts an existing City street, road widening may be required for future or present improvements to these streets. The City's Official Plan Transportation Map and the City of London's Zoning By-law Z-1 classifies roads throughout the City as Rapid Transit Boulevard, Urban Thorough, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Street, Rural Thoroughfare or Neighbourhood Connector. All other roads are considered to be Neighbourhood Streets.

b) 0.3 metre Reserves (Blocks)

0.3 meter reserves along block frontages and at the rear and/or flankage of lots which are adjacent to major roads, where applicable (outside of right-of-way) and are also required at the dead end of proposed road networks which abut future proposed road networks and where roads in a subdivision abut lands outside the subdivision.

18.5.2 Minimum Lot Frontages

In most cases the zoning by-law adequately satisfies requirements for minimum frontages for single-family and semi-detached lots. However, where bends in streets occur or on cul-de-sacs, lots must be designed such that when side lot lines are

projected to the fronting curb, an adequate frontage is provided at the curb line to avoid conflicting driveway locations. These minimum frontages at the curb line are as follows:

Single-family 5.5m

Semi-detached 9.0m

18.5.3 Noise Barrier Walls General

Noise barrier walls are required for residential developments which back onto or flank major roads, or as otherwise required in accordance with the draft plan of subdivision conditions and City practices.

All noise barrier wall designs are to comply with the accepted Noise report and meet the minimum requirements and specifications of the Ministry of Transportation noise barrier wall guidelines (MTO Environmental Guide for Noise).

Note: Noise barrier walls for uses other than along major roads are to comply with Ministry of the Environment “[Environmental Noise Guideline - Stationary and Transportation Sources - Approval and Planning \(NPC-300\)](#)” (Aug 2013), or as otherwise amended” requirements and approved by Development Services.

18.5.4 Noise Study/Report

Required when the proposed subdivision or development is situated within certain design setbacks from a Provincial Highway or Railway, as per the Ministry of the Environment “[Environmental Noise Guideline - Stationary and Transportation Sources - Approval and Planning \(NPC-300\)](#)” (Aug 2013)” and/or as indicated in the draft plan conditions and/or subdivision agreement, all approved by Development Services.

All recommendations and details from noise barrier wall studies/reports are to be reflected on the servicing drawings.

18.5.5 Noise Wall Location

Major Roads:

a) Masonry/Concrete:

Wall, posts and brick pillars are to be located on City property within the proposed 0.3m reserve and maintained by the City.

b) Wooden:

Wall, posts and brick pillars are to be located entirely on private property and maintained by the owner.

c) Other Situations:

Locations as per the approved Noise Study (i.e. berms/walls adjacent to railways, etc.).

18.5.6 Minimum Height

2.4m above ultimate centerline road profile design or as required by an accepted Noise Study.

18.5.7 Material Density

Ministry of Environment Criteria - Minimum surface density of 20 kg/sq.m. (4lbs/sq.ft.).

18.5.8

Materials

a) Masonry/Concrete:

Constructed of a concrete material with a surface density of 20kg/sq.m. (4lbs/sq.ft.).
Previously accepted masonry/concrete walls: Durisol and bricked.

b) Wooden:

Constructed of a wood material with a surface density of 20kg/sq.m. (4lbs/sq.ft.).
Previously accepted wooden walls: Western Red Cedar, Red Wood and Yellow Cyprus.

18.5.9

Noise Wall/Retaining Wall Combined

Where the property line along the road undulates requiring the use of retaining walls, the standard 2.4m wall can be reduced to a minimum of 1.1m wall in hill sections.

Note: the overall combined noise wall and retaining wall height, must be 2.4m above the ultimate centerline road profile design or as required in the accepted Noise Study.

18.5.10

Site Lines

Site lines to be maintained in accordance with Section 4.24 of Zoning By-Law Z-1.

18.5.11

Return End Walls

Required at the end of all proposed noise barrier walls which terminate at an abutting property which does not have an existing noise barrier wall present or where an opening is required (e.g. at a walkway).

18.5.12

Gaps/Holes

To be free of any holes or gaps within and at the bottom of all proposed noise barrier walls.

18.5.13

Drainage

Proper surface drainage to and away from the noise barrier wall is required for all proposed designs.

18.5.14

Overland Flow Routes Through Noise Barrier Walls

In exceptional situations, an adequately designed opening in the wall is required to allow overland flow route to pass through the wall, in conjunction with a toe wall or berm behind the opening in the wall to provide a supplemental noise attenuation measures at the opening.

18.5.15

Details

A typical profile view of the noise wall/footings is required together with cross-sections and details for any pertinent brick pillars/footings and wooden posts/footings, which are to comply with the Ontario Building Code.

18.6 STORM CHANNELS

18.6.1 General

Specifications and design information to be in accordance with the Ontario Provincial Standard Drawings the Municipal Works Design Manual (MEA) and as approved by SWED.

18.6.2 Channel and Hydraulic Report

To be reviewed and accepted by SWED. All recommendations and details from the report are to be shown on the servicing drawings.

18.6.3 Width/Depth/Freeboard/ Type

Dependent on accepted report by SWED.

18.6.4 Side Slopes

3:1 side slopes maximum.

18.6.5 Linings/Material

Grass-lined slopes, and where velocities are high, gabion-lined, approved erosion protection mat, or rip/rock protection side slopes, and/or as per the accepted Stormwater Management Report and the Geotechnical Report.

18.6.6 Inlet/Outlet Structures

As per Headwall and Culvert Sections, 5.18.

Note: All inlet/outlet structures which are different from those identified in the Ontario Provincial Standard Drawings and Municipal Works Design Manual (MEA) are to have Structural Engineer's certification.

18.6.7 Pedestrian System

Location, width and materials to be reviewed and approved by Parks Planning & Design Division, in conjunction with Development Services.

Note: Grades and drainage to be reviewed by Development Services.

18.6.8 Landscaping Plan

Reviewed and approved by Parks Planning & Design Division, in conjunction with Development Services.

18.6.9 Maintenance Access

A 3.0m to 4.6m wide topsoil and sodded access without any trees, plantings or other obstructions is required for maintenance vehicles and equipment used to service all inlets/outlets within the channel. Adequate curves and turn-around facilities are required for maintenance vehicles to maneuver. Slopes (10% maximum), cross-falls (2% minimum) and drainage of access roads are also to be addressed in the design.

Note: A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s); and sufficient room is to be provided on the top of each side of the channel, generally 6.0m.

18.6.10 Details

A plan & profile is required for all storm channel designs together with frequent cross-sections and details. Plan view, cross-sections and details of the inlet/outlet structures or other pertinent design features within the channel are also required.

18.7 STORM CULVERT

18.7.1 General

Precast Box: Constructed for access (i.e. road and pedestrian) crossings within a ditch, creek and/or river.

All major crossings, where applicable, are to be reviewed and approved by SWED.

Corrugated Steel: Same as precast box, where applicable.

18.7.2 Culvert Calculations and Report

Precast Box: To be reviewed and accepted by SWED.

All recommendations and details from the accepted report are to be reflected on the servicing drawings.

Corrugated Steel: Same as box, where applicable.

18.7.3 Minimum Diameter/Size

Precast Box: 1800mm (span) x 900mm (rise).

Corrugated Steel: 450mm diameter

18.7.4 Minimum Depth of Cover

Precast Box: As per OPSD-803.010.

Note: if depth of cover is less than the above, certification from a Structural Engineer is required.

Corrugated Steel: 300mm OR diameter divided by 6, whichever is greater. As per OPSD-805.01.

Note: If depth of cover is less than the above, certification from a Structural Engineer is required.

18.7.5 Culvert Crossings Over Services

Precast Box: In addition to the City's review and approval, where a culvert crosses an existing/proposed sewer and/or watermain, frost protection over the above existing/proposed services is warranted, and insulation is required, as per City of London Drawing Standard W-CS-68.

Corrugated Steel: Same as box culverts.

18.7.6 Railings

Precast Box: Required for concrete culverts where the drop is greater than 1.0m, as per the Ontario Building Code. As per OPSD-980.101.

Corrugated Steel: Same as box culverts, where applicable.

18.7.7 Flood Plain Areas

Precast Box: Upper Thames River Conservation Authority's review and approval is required where storm culverts are constructed within flood plain areas.

Corrugated Steel: Same as box culverts.

18.7.8 Rip Rap/Rock Protection

Precast Box: Required at the inlet/outlet with high velocities. As per the Erosion & Sediment Control Section 10.

Corrugated Steel: Same as box culverts, where applicable.

18.7.9 Erosion & Sediment Control Measures

Precast Box: As per the Erosion & Sediment Control Section 10 and as per the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.

Corrugated Steel: Same as box culverts.

18.7.10 Bedding

Precast Box: As per OPSD-803.010.

Corrugated Steel: As per OPSD-802.010.

18.7.11 Materials

Precast Box: Concrete.

Corrugated Steel: Corrugated Steel Pipe.

Note: For 300mm to 600mm diameters, specified minimum wall thickness to be 1.6mm. All other diameters, minimum wall thicknesses as per OPSD-805.01.

18.7.12 Maintenance Access

A 3.0m to 4.6m wide topsoil and sodded access without trees, plantings or other obstructions is required for maintenance access and equipment used to service all culverts. Adequate curves and turn-around facilities are required for maintenance vehicles to manoeuvre.

Slopes (10% maximum), cross-falls (2% minimum) and drainage of access roads are also to be addressed in the design.

Note: a 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s).

18.7.13 Details

Precast Box: Plan & Profiles are required for all culverts together with frequent cross-sections and details (e.g. inlets/outlets).

Corrugated Steel: Same as box culverts.

18.8 STORM DITCHES

18.8.1 General

Required for existing road network surface drainage in rural road situations without existing or proposed storm drainage systems have not been warranted.

- 18.8.2 Grade**
Minimum 0.3%. Maximum dependent on erosion velocity of soil and erosion protection provided.
- 18.8.3 Depths**
Dependent on right-of-way widths, safety features and other design constraints.
- 18.8.4 Slopes**
3:1 side slope maximum.
- 18.8.5 Lining/Materials**
Grass-lined, and where velocities are high, approved erosion protection mat, if warranted.
- 18.8.6 Inlets/Outlet Structures**
As per Types of Headwalls Section 5.18.1, Storm Culverts Section and Types of Catchbasins Section 5.16.4.
- 18.8.7 Subdrains**
May be required to be constructed adjacent to and/or drain to ditches, as required by the Geotechnical Engineer and Transportation Division, as per City of London Standard Contract Documents, Section 405.07.01.
- 18.8.8 Rip Rap/Rock Protection**
As per the Erosion & Sediment Control Section 10 and as per the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.
- 18.8.9 Erosion & Sediment Control Measures**
As per the Erosion & Sediment Control Section 10 and as per the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.
- 18.8.10 Details**
Plan & Profile required together with frequent cross-sections and details.



Design Specifications & Requirements Manual

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APPENDICES

Appendix 1	Subdivision Inspection Request Form
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19 DEVELOPMENT COMPLIANCE PROCEDURE

19.1 INTRODUCTION

The requirements and procedures for development related agreement compliance have been documented herein to assist industry, staff, consultants and associated stakeholders through inspection, compliance and assumption of new subdivisions, site plans, consents and external works within the Municipal right-of-way.

19.1.1 Overall Compliance Goals and Objectives

The goals of Development Agreement Compliance in the City of London are as follows:

- a) Ensure all site works are constructed in general conformity to the approved Site Plan / Plan of Subdivision and consistent with the clauses of the applicable Development Agreement.
- b) Ensure all infrastructure constructed within the municipal right of way, both assumed and un-assumed, is constructed in accordance with approved plans, consistent with City of London standards and specifications, and in general compliance with all applicable regulations.
- c) Ensure that materials, workmanship and all construction techniques and technologies used are inspected and certified by the Owner's Professional Engineering Consultant to be in accordance with City's standards.
- d) Ensure all private works constructed under Site Plan are completed in accordance with approved plans and to the satisfaction of the City prior to the release of securities.
- e) Ensure downstream infrastructure is not adversely impacted by the construction activity associated with the development application.
- f) Ensure works within existing municipal right-of-way which are necessary to accommodate private development have no adverse impacts to existing public infrastructure or unduly impede reliable services to the public.
- g) Protect the interest of property owners and/or residents, both within and surrounding development application by responding to compliance matters identified prior to the assumption/final security release.

19.1.2 Applicable Development Agreements

The Planning Act delegates the authority for municipalities to require Owners to enter into one or more agreements in order to ensure developments proceed in accordance with approved plans. The following types of development agreements are enforced through the development compliance procedures and requirements outlined in this document.

19.1.2.1 Subdivision Agreements

In accordance with the Planning Act, the City of London has delegated authority for the approval of Plan of Subdivision in accordance with the Provincial Policy Statement and the City's Official Plan to an officer of the municipality. Through the delegated authority the City may apply conditions of draft approval to plans of subdivision requiring owners to enter into a Subdivision Agreement with the City. This authority is provided under Section 51(25) (d) and 51(26) of the Planning Act.

The Subdivision Agreement is a legally binding contract between the land Owner and the City that spells out the Owner's obligations to the municipality for construction of roads, sewers, watermains, parks, open spaces and other services within subdivision limits, and any external works as required. In addition to all physical works requirements, the agreement specifies the additional requirements related to applicable fees, charges and securities, and indicates any dedication requirements for municipal right-of-ways, parks, easements and trail systems, and identifies triggers and administration for all of the above. When the plan of subdivision is registered at the registry office, the executed Subdivision Agreement is registered on title for each individual parcel of the divided land.

19.1.2.2 Site Plan Development Agreement

Pursuant to Section 41 of the Municipal Act, and in accordance with Section 19.9.2 of the Official Plan, the City of London designates all lands within City limits as a Site Plan Control Area.

The City of London utilizes Site Plan Control (By-Law C.P.-1455-541) to ensure a high quality site design, engineering efficiency, building architecture and landscape design. Site plan control is also intended to improve efficiency of land use and servicing as well as to encourage attractive and compatible forms of development. In accordance with the Planning Act the City of London has delegated authority for the approval of Site Plan in accordance with the Provincial Policy Statement and the City's Official Plan to an officer of the municipality. As a condition of Site Plan approval, the City may require the Owner to enter into a development agreement.

The Site Plan Development Agreement is a legally binding contract between the land Owner and the City outlining the terms and conditions for development including all approved plans and servicing drawings as schedules. This authority is provided under Section 41(7)(c) of the Planning Act RSO- 1990.

Upon approval of the Site Plan, a development agreement is executed by all parties and registered on the title with the lands. This agreement, as executed, would include schedules of approved (stamped & signed) plans. The Development Agreement remains on that property unless amended or released otherwise.

19.1.2.3 Consent Agreements

The consent approval process, described in Section 53 of the Planning Act, provides an alternative form of land division for proposals that are relatively less complex where a plan of subdivision is not required (e.g. the creation of one or two lots or easements). The City's Official Plan establishes criteria to be considered by the Consent Authority when reviewing application for land severance relating to the land use, infrastructure and servicing, transportation, the natural environment, community improvement, and urban design. In accordance with the Act, City Council may delegate the authority to grant consent to an officer of the municipality representing the Consent Authority.

Section 53(12) of the Planning Act empowers the Consent Authority to impose reasonable conditions through the provisional approval of consent applications. Final Consent (issuance of certificate) is granted when the Consent Authority is satisfied that all conditions imposed through the provisional decision of the consent have been fulfilled. All conditions of approval must be fulfilled within one (1) year of the decision.

In cases where it is not feasible to satisfy all conditions within the one year timeframe, the Owner may enter into a Consent Agreement with the City to cover outstanding

conditions of consent. The consent agreement represents a legal contract between the Owner and the City. In addition to any required physical works required, the consent agreement may specify any additional requirements relating to applicable fees, charges, securities, municipal right of way or easements, and identify associated triggers and administration.

19.1.2.4 Site Alteration Agreement

Pursuant to Section 223.1 of the Planning Act, and in accordance with Section 19.9.2 of the Official Plan, the City of London utilizes the Site Alteration By-Law (By-Law C.P.-1363-381) to regulate the placing or dumping of fill, and the alteration of the grade on lands within the municipality.

Unless otherwise exempted by the subject By-law, no person shall alter the grade of land or place or dump fill within any Environmental Protection Area or on any land that is subject to a draft plan of subdivision without having first entered into a Site Alteration Agreement and provide securities in order to carry out grading works. The City and pertinent agencies will require Erosion and Sediment Control plans, and other relevant information deemed necessary, prior to the execution of Site Alteration Agreement.

19.1.3 **Authority to Inspect**

19.1.3.1 Site Plan Compliance Inspection:

Schedule 2 of the Site Plan Control Bylaw (C.P.-1455-541) provides the standard template for development agreements and Section 10 of the agreement includes language that authorizes the City to enter into the private lands to inspect the constructed works.

19.1.3.2 Subdivision Inspection

For lands under active application for Draft Plan of Subdivision, the Owner's Consent Declaration on the plan of subdivision application form authorizes City staff to access the subject lands subject for purposes of evaluating the application.

Clause No.11 of the Council Approved standard subdivision agreement template, Right Of Inspection And Direction, requires the Owner to provide access to the City Engineer and other persons authorized by them to enter upon any part of the lands to complete any inspections or tests deemed necessary and to call for and obtain any document, contract, plan, specification, record or other writing required, and to give direction to the Owner in any matter relating to the due performance of the works and services required under the subdivision agreement.

19.1.3.3 Site Alteration Permit Inspection

The City of London Site Alteration By-law C.P.-1363-381 states that all lands subject to a draft approved plan of subdivision without an executed subdivision agreement shall require a Site Alteration Permit and enter into a site alteration agreement in order to carry out grading works. This by-law applies to all lands designated OS (Open Space) or ER (Environmental Review) Section 7.3 of the subject Bylaw (Inspectors – powers – enter and inspect) empowers the City staff to enter any land to which the by-law applies for inspection purposes.

19.2 SUBDIVISION COMPLIANCE

19.2.1 Introduction to Subdivision Compliance

Compliance for subdivision applications involves several stages of approval, from initial Conditional Approval, through to construction and final completion of all required works and services. The City uses inspections, certifications and ongoing communication with the Owner and their agents to ensure all aspects of the development complies with the conditions of approval and any relevant development agreement clauses.

The goal of Subdivision Compliance is to ensure the interests of the municipality and the public are protected throughout the development and ultimately reach the successful assumption of quality, sustainable municipal assets.

19.2.1.1 Definition of Stages

Agreement Compliance for Subdivisions can be described in several stages:

Conditional Approval

By issuing a Certificate of Conditional Approval, compliance staff in Development Services are confirming that full building permits for new house construction may be issued in a subdivision or a portion thereof. Conditional Approval may be issued once the City is satisfied the development complies with applicable legislation, the requirements of the subdivision agreement have been met, and the necessary works and services have been deemed complete and operational for use. The above is confirmed through the inspection of physical works, certification from the Owner's Professional Engineer, CCTV videos and confirmation that all relevant documentation has been provided. Section 19.2.2 provides more detail on the Conditional Approval stage.

Compliance During Subdivision Buildout

Following the issuance of a Certificate of Conditional Approval, the subdivision begins ongoing house construction and buildout of the subdivision. During this stage of subdivision agreement compliance, the Owner is fully responsible to maintain the subdivision in a proper state of repair and operation for all of works within the plan or external works required through the agreement. The Owner is also responsible for maintaining all sediment and erosion control measures.

Compliance issues during the buildout stage are typically flagged to the City on a complaint basis, at which point staff coordinate with the Owner to ensure that issues are resolved promptly to the satisfaction of and at no cost to the City. Section 19.2.3 provides more detail on the Owner's compliance responsibilities during the buildout stage.

Post Registration Timed Requirements

Certain requirements of subdivision agreement can have timing triggers tied to the date of registration such that the works are to be completed after Conditional Approval but prior to Assumption. Examples of timed requirements could include the installation of street lights, walkways, fencing, preparation and delivery of educational packages, grading and sodding of park blocks, and any other item as indicated in the agreement. The agreement clauses will clearly identify the specific timing for each requirement.

Section 19.2.3.2 provides more details on how compliance for these timed requirements is managed given the timing falls between standard inspection points.

Assumption

Assumption occurs when City Council passes a by-law to assume responsibility for the maintenance, repair and liability of works and services installed as part of plan of a subdivision. Assumption will only be considered for a subdivision, or a portion thereof, once a minimum of 70% of fronting lots have been built out or seven (7) years have lapsed from the date of registration. All works and services must be constructed per the approved plans, appropriate certification provided, and the Owner must demonstrate how all requirements of the subdivision agreement have been satisfied. Section 19.2.4 provides specifics on the process to request and reach assumption.

Warranty Period

In accordance with Council standard Subdivision Agreement Template clauses, the Owner shall guarantee all works and services from defects in workmanship or material for a minimum period of one (1) year post-assumption. The Warranty Period starts from the date as described in the Assumption By-law. At the end of the Warranty Period, any deficiencies subject to the warranty are to have been corrected to the satisfaction of the City. Section 19.2.5 provides more details on warranty responsibilities and the process to reach End of Warranty.

19.2.1.2

Key Process Steps of Subdivision Compliance

Figure 1 provides an overview of the key process steps for each stage of subdivision compliance.

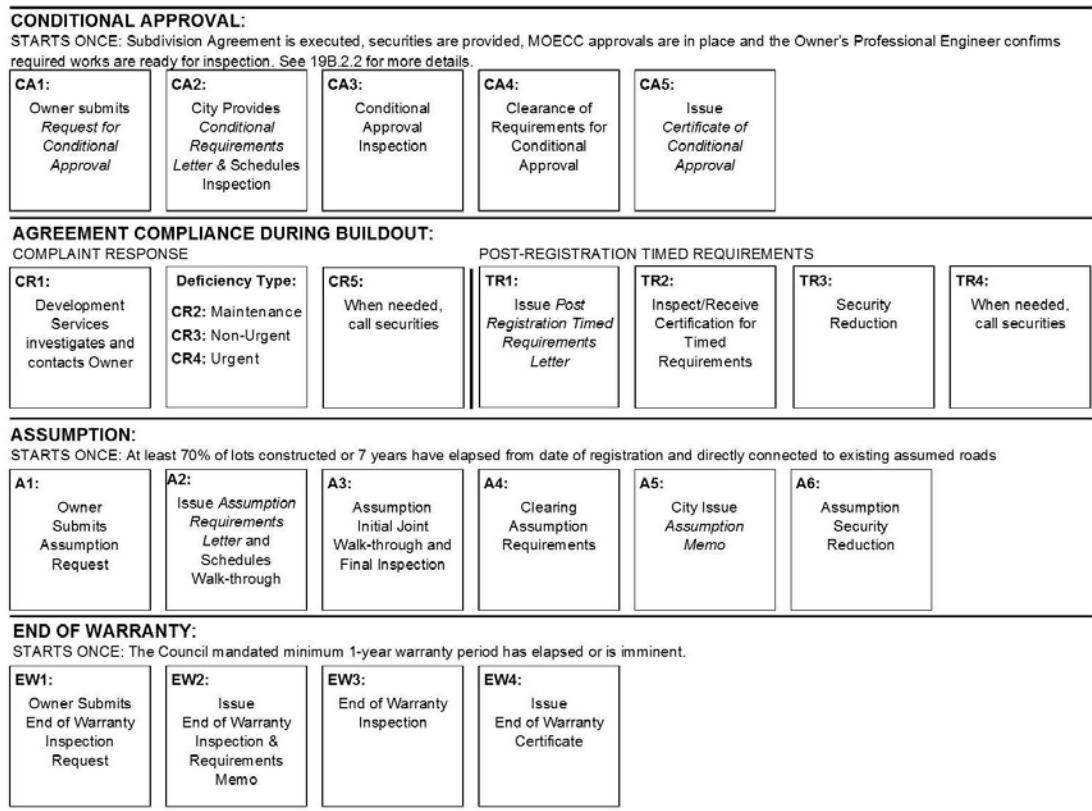


Figure 1 Key Process Steps of Subdivision Compliance Conditional Approval

19.2.2 Conditional Approval

A Certificate of Conditional Approval is issued when Development Services has confirmed that all requirements associated with conditional approval under the Subdivision Agreement have been satisfied and the minimum required physical works to support house construction have been inspected and deemed operational for use. Release of the certificate provides confirmation to the Building Division that full building permits may be issued and occupancy is permitted.

19.2.2.1 Requirements for Conditional Approval

What is required for the Conditional Approval?

All requirements for issuance of Certificate of Conditional Approval are outlined in the subdivision agreement. Upon receiving a request for Conditional Approval, City staff will provide the Owner a Conditional Requirements letter that summarizes all requirements to be fulfilled prior to the issuance of Certificate of Conditional Approval with clear references to the associated clauses of the subdivision agreement.

The following list outlines the minimum requirements to be satisfied prior to Condition Approval. Full building permits will not be issued until the following items have been cleared.

- a) The subdivision agreement must be registered;
- b) All necessary securities must be provided;
- c) All roads must be complete up to and including granular "B" to provide access for emergency vehicles;
- d) Sewers must be certified as constructed, flushed, tested and the video inspection cleared by the City staff;
- e) Watermains must be inspected, tested, commissioned and deemed operational;
- f) Submission of digital files of the accepted construction drawings;
- g) All required certifications must be submitted by the Owner's Professional Engineer (i.e. hydrogeological, engineered fill, methane gas, contamination and erosion and sediment control measures);
- h) Any tributary stormwater management facility must be cleared as operational;
- i) All downstream services being connected must be conditionally approved or assumed. If not assumed, an interim permission to connect must be obtained from the downstream owner; and
- j) Additional requirements identified in the subdivision agreement on a site by site basis, at the City's discretion.

Note: Specific Conditional Approval requirements will be clearly flagged in the Conditional Requirements letter, and at the City's discretion such requirements may be deferred to a later time in the process.

At what point would a request for Conditional Approval be considered?

Upon receiving a request for Conditional Approval, staff will not issue the Conditional Requirements letter or schedule the initial Conditional Clearance inspection until:

- The final subdivision agreement has been executed;
- Necessary securities have been provided; and
- The Owners Professional Engineer has confirmed through the request form that, in their opinion, all required works have been completed.

Staging Conditional Approval

Owners may request Conditional Approval for the entire limits of the registered plan or stage Conditional Approval for a portion of the plan. If a registered plan is staged, each stage of Conditional Approval must:

- be continuous with downstream development that is either conditional approved or assumed; and
- address any temporary measures associated with staged construction, as required, and as identified in the Conditional Requirements letter (ie. minimum two access roads, water quality requirements, temporary traffic measures, etc.)

19.2.2.2

Process for Conditional Approval

The process for Conditional Approval is illustrated in **Figure 2** below, followed by a description for each key process step.

CONDITIONAL APPROVAL:

STARTS ONCE: Subdivision Agreement is executed, securities are provided, MOECC approvals are in place and the Owner's Professional Engineer confirms required works are ready for inspection. See 19B.2.2 for more details.

CA1: Owner submits <i>Request for Conditional Approval</i>	CA2: City Provides <i>Conditional Re- quirements Letter and Schedules inspection(s)</i>	CA3: Conditional Approval Inspection	CA4: Clearance of Requirements for Conditional Approval	CA5: Issue <i>Certificate of Conditional Approval</i>
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Figure 2 Process for Conditional Approval

CA1: Owners Submits Request for Conditional Approval

Request for Conditional Approval can be made by completing the standard request form *DS-IRF-01* and submitting it to Development Services. The required form is illustrated in Appendix 1.

CCTV videos of the underground services shall be provided in conjunction with the Conditional Approval request form. This provides the opportunity to review the videos prior to the physical inspection. Sewers are to be benched at the time of the video recording. The video submission shall include commentary and sign off from the Owner's Professional Engineer

CA2: City Provides Conditional Requirements Letter and Schedules Inspection

The Conditional Requirements letter provides the Owner with an itemized summary of all physical works and documentation requirements to be cleared prior to Conditional Approval. Each item clearly references the associated subdivision agreement clause.

Development Services coordinates with the Owner's Professional Engineer to schedule the Conditional Approval Inspection. At the same time, Development Services sends an inspection notice to any other City division that will assist in the inspection of physical works (i.e. Water Operations, Environmental & Parks Planning, Stormwater Engineering, etc.)

CA3: Conditional Approval Inspection

The Conditional Approval Inspection is completed by the Development Inspection Technologist with the Owner's Professional Engineer in attendance. The hope is that with a well prepared site, the physical work requirements can be cleared with the initial inspection. Alternatively, staff will provide the Owner's Professional Engineer with a summary of deficiencies. Deficiencies may also be provided by other divisions such as Water Operations. The Owner's Professional Engineer shall address all deficiencies prior to requesting a follow-up inspection.

CA4: Clearance of Requirements for Conditional Approval

The Owner's Professional Engineer shall submit a complete Conditional Approval package containing all required documentation and certifications together with a cover letter clearly referencing and responding to each item in the Conditional Requirements Letter. Development Services will review the package and coordinate with the Owner's Professional Engineer to confirm as requirements are cleared and identify those requirements that remain outstanding. The Certificate of Conditional Approval can be issued once all items have been cleared.

CA5: Issue Certificate of Conditional Approval

Development Services prepares and issues the Certificate of Conditional Approval for the specified limits of the registered phase (or stage) of the Plan of Subdivision. This certificate is provided to the Owner as well as Building Services to give notice that full building permits for new home construction may be issued.

The certificate lists pertinent information related to building lots within the approved limits such as identifying lots with engineered fill and agreement clauses related to specific lots. The certificate also lists post registration requirements that are to be completed within a specific time period.

19.2.2.3 Security Requirements at Conditional Approval

The CASH portion of the subdivision security is required prior to the execution of the subdivision agreement. Prior to issuing the Certificate of Conditional Approval, the BALANCE portion of the subdivision securities are required. These amounts can be found in Schedule 'E' of the executed Subdivision Agreement. Please refer to the current Subdivision & Development Agreement Security Policy for further information by searching at www.london.ca

Post Conditional Approval, security reductions may be requested throughout construction of the subdivision in accordance with the current City's Subdivision & Development Agreement Security Policy.

19.2.3 **Compliance During Subdivision Buildout (Conditional Approval to Assumption)**

Following Conditional Approval, individual home construction begins and soon after, new homeowners may begin moving into the neighbourhood. While the essential infrastructure has been deemed operational for use, the subdivision remains an ongoing construction and building area. It is the Owner's responsibility to maintain the site and reasonably protect the interests of new homeowners, existing surrounding residents and the general public from potential impacts of construction.

The following sections clarify subdivision agreement compliance requirements enforced during the period from Conditional Approval to Assumption, including Complaint Response, Post Registration Timed Requirements and By-Law Enforcement.

19.2.3.1

Process for Complaint Response During Buildout

During construction and buildout of the subdivision, the Owner is required to maintain a general tidy appearance to the subdivision and repair any deficiencies considered an operational or safety risk by the City.

Development Services staff responds to maintenance and deficiency issues during Buildout on a complaint driven basis. Complaints can come from a number of sources including direct residents' calls, the Councillors' office, City Dispatch or other divisions. Typical issues include lot grading or drainage, streetlight outages, road condition, roadway maintenance (snow plowing or sweeping), weeds, waste building materials, construction traffic and more. These issues are brought to the attention of the Owner are to be resolved in a timely manner at the Owner's cost and to the satisfaction of the City.

The complaint may be a maintenance issue, non-urgent deficiency or urgent deficiency and staff will coordinate with the owner to respond accordingly. The process of complaint resolution in un-assumed subdivisions is illustrated in **Figure 3** below followed by description for each key process step.

COMPLAINT RESPONSE

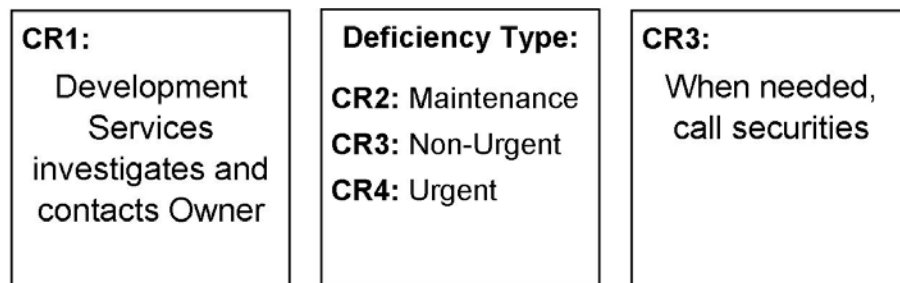


Figure 3 Process for Complaint Response

CR1: Development Services Investigates and Contacts Owner

Upon receiving a complaint, Development Services first confirms the registered plan (33M#) and assumption status of the subdivision. If needed, staff visit the site to observe and investigate the complaint first hand. The Owner is then informed of the complaint and remedies are discussed according to whether the concern is maintenance, non-urgent or urgent deficiency.

CR2: Maintenance Deficiency

Throughout the buildout period, the Owner and any purchasers of lots/blocks are required to maintain the site in accordance with the terms of the subdivision agreement, including but not limited to:

- keeping vacant lands free of debris and building waste;
- no dumping on lands dedicated to the City;
- carrying out weed cutting maintenance;
- controlling construction traffic;

- maintaining erosion and sediment controls measures;
- managing construction noise within acceptable limits;
- repairing streetlight outages;
- snow removal maintenance; and
- controlling dust and mud on City Streets (Council Policy section 19(37))

Owners are required to remedy complaints quickly and confirm with Development Services once the matter has been addressed.

CR3: Non-Urgent Deficiencies

A non-urgent deficiency is any defect in materials or workmanship (underground, surface or miscellaneous works) which is not considered an immediate safety or operational risk by the City. A non-urgent deficiency might also be a failure by the Owner to comply with any covenant, term, condition or requirement of the relevant Agreement. As there is minimal risk associated with these deficiencies, Development Services may consider whether the deficiency can be addressed as a requirement prior to assumption or as an immediate maintenance deficiency.

CR4: Urgent Deficiencies

Occasionally, more critical issues can arise on the construction site. An urgent deficiency is any defect related to materials or workmanship considered an immediate safety, environmental or operational risk by the City. Examples include water service breaks, leaning or tilted streetlight poles or breaches in erosion and sediment control measures.

When an urgent deficiency occurs, City staff provides immediate notification to the Owner. The Owner is required to provide a response within 24 hours of notification and confirm with Development Services once the work has been completed. If a response has not been received by the City within 24 hours, the City will immediately schedule the necessary remedial work and invoice the Owner for the total cost incurred.

CR5: When needed, Call Securities

Should the Owner fail to address identified maintenance deficiencies in a timely manner, the City may issue a Notice of Default for the outstanding deficiencies and draw down from held securities as necessary to complete works. The City's Subdivision and Development Agreement Security Policy can be found at by searching www.london.ca

19.2.3.2

Process for Post Registration Timed Requirements

Subdivisions Agreements often include specific requirements that must be completed within a specified timeframe, usually one (1) year from the Plan of Subdivision registration date. These items may include installation of street lights, grading/servicing/seeding of Park and Open Space Blocks, construction of fencing, retaining walls and/or walkways as required.

Post Registration Timed Requirements will be defined within the subdivision agreement clauses. In many cases, installation of these items prior to the Conditional Approval could risk damage to infrastructure while deferring the works to assumption is not appropriate either. Development Services coordinates with Owners to ensure these works are completed at an appropriate time in accordance with the Subdivision Agreement.

The process for Compliance of Post Registration Timed Requirements is illustrated in **Figure 4** below followed by a description of each process step.

POST-REGISTRATION TIMED REQUIREMENTS

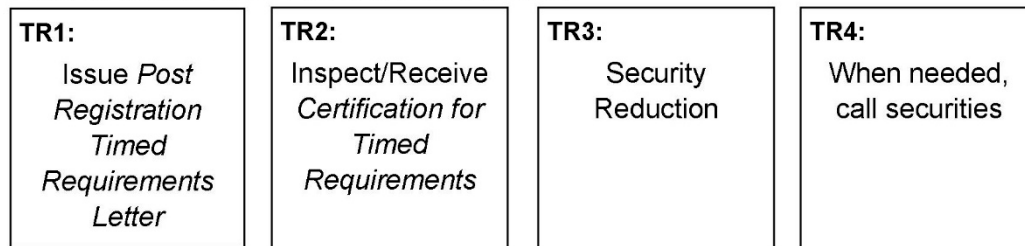


Figure 4 Process for Post Registration Timed Requirements

TR1: Issue Post Registration Timed Requirements Letter

Once the identified triggers for timed requirements have passed, Development Services will automatically issue a formal Post Registration Timed Requirements letter. Alternatively, the Owner may contact the City to request the requirements letter prior to the identified trigger if they feel they have satisfied the timed requirements.

TR2: Inspect / Receive Certification for Timed Requirements

Following receipt of the requirements letter, the Owner shall inform the City once the timed requirement(s) have been completed in order to schedule an inspection. Some timed requirements may be satisfied by providing certification from the Owner's Professional Engineer.

TR3: Security Reduction

Where appropriate, security reductions may be considered to reflect the completion of timed requirements.

TR4: When Needed, Call Securities

Should the Owner fail to satisfy the timed requirements in a timely manner, the City may issue a Notice of Default for the outstanding requirements and draw down from held securities as necessary to complete the works. The City's Subdivision & Development Agreement Security Policy can be found at www.london.ca

19.2.3.3

By-Law Enforcement in Un-assumed Subdivisions

All by-laws remain in force and effect regardless of the stage a development has reached. The responsibility for responding to certain by-law infractions resides with the Owner prior to assumption while other infractions are managed by municipal by-law enforcement. In general, by-law compliance during build out is dealt with on a complaint driven basis.

By-Law Enforcement prior to Assumption

Municipal by-law enforcement prior to assumption typically pertains to prohibited activities, such as:

- Noise Complaint;
- Parking infraction; and
- Property Standards

By-law infractions that pertain to construction activity are managed by Development Services similar to maintenance deficiencies. Owners and, by extension, builders, trades, contractors and subcontractors, are to follow applicable By-Laws and Council Policies as they pertain to:

- Street Cleaning;
- Construction/working outside of allowable hours; or
- Construction Traffic

Should lack of compliance persist, Development Services can engage the By-law Enforcement group to further pursue the matter with the Owner.

Per section 5, Standard of Work, of the standard Subdivision Agreement Template, the Owner is responsible to maintain all right-of-ways in compliance with applicable City By-Laws prior to the time of assumption. These items typical apply to physical works within the municipal right-of-way, for example:

- Driveway Widths;
- Boulevard landscaping;
- Boulevard obstructions; or
- Drainage By-law Infractions

The onus is on the Owner to educate the builders and homeowners of applicable by-laws and work with them to correct physical by-law infractions. At the time of assumption, all municipal right-of ways are to be in compliance with the City By-Laws.

Recognizing there are multiple parties involved in correcting these physical deficiencies, if at the time of assumption the Owner can demonstrate that all reasonable efforts have been exhausted to work with builders and homeowners to bring the road into compliance; the City may consider a small allowance for limited minor deficiencies to pass assumptions to be further pursued by City By-Law enforcement following assumption.

19.2.4 Assumption

Assumption occurs when City Council passes a by-law to assume responsibility for the maintenance, repair and liability of works and services installed as part of a plan of subdivision. In order for Assumption to proceed, all works and services must be constructed in accordance with accepted plans, appropriate certification provided and the Owner must demonstrate how all requirements of the subdivision agreement have been satisfied.

19.2.4.1 Requirements for Assumption

What is required for Assumption?

All requirements for Assumption are outlined in the Subdivision Agreement. Upon receiving a request for assumption, City staff will provide the Owner with an assumption requirements letter that summarizes the conditions that must be fulfilled prior to the issuance of the Assumption Certificate with clear links to the associated clauses of the Subdivision Agreement. The following list outlines the minimum requirements to be satisfied prior to assumption:

- a) All works, services, sewers and roads (physical works) have been constructed, inspected and accepted to be in general conformity with the accepted plans and specifications;
- b) All external works, if required, have been constructed to City's satisfaction and accepted.
- c) Water Operations has inspected and accepted the water system;
- d) Roads & Transportation has inspected and accepted the streetlighting;
- e) Urban Forestry Division has reviewed and accepted the Street Tree Planting Plan;
- f) Environmental and Parks Planning has inspected and accepted any parkland and open spaces areas, if applicable;
- g) Schedule 'G' prepared by the Owner's Professional Engineer certifying that all subdivision works have been constructed in general conformity to the accepted plans and specifications;
- h) Soils Certificate as per Schedule 'H' prepared by the Owner's Professional Engineer;
- i) "As-Constructed" drawings and digital files;
- j) Schedule 'K' prepared by the Owner's Professional Engineer certifying that all grading within the subdivision has been completed in accordance with the accepted drawings;
- k) Ontario Land Surveyor's Certificate;
- l) Final Lot Grading Certificates;
- m) Confirmation from the Owner's Professional Engineer that physical works within the right-of-way complies with applicable by-laws (i.e. driveway widths, boulevard landscaping, drainage discharge points etc);
- n) Confirmation from the Owner that payment of all accounts pertaining to construction of and operation and maintenance of the subdivision has been made;
- o) Confirmation that the Owner's Solicitor has submitted all records of the transference of easements, reserves and municipal lands; and,
- p) Completion of any other specific requirements under the Subdivision Agreement and all other requirements that may have been deferred at Conditional Approval.

Staging Assumption

Owners may request assumption for the entire limits of the registered plan or stage assumption for a portion of the plan. Each stage of assumption must be continuous with downstream assumed infrastructure.

Subdivision Agreements can include specific "prior to Assumption" requirements, for example intersection lighting or other external road improvements that may not be directly linked to the stage for which Assumption has been requested. However, the City may require the completion of any requirement in conjunction with any given stage of

assumption within a registered plan as warranted. The Assumption Requirements Letter will identify the conditions required for a given stage.

19.2.4.2 At what point will a request for Assumption be considered?

Upon receiving a request for Assumption, staff will not issue an Assumption Requirements Letter or schedule an inspection until:

- at least 70% of lots within the phase or stage to be assumed have been constructed or seven (7) years have elapsed from the date of registration;
- the phase or stage to be assumed is continuous and directly connected to existing assumed roads;
- the Owner's Professional Engineer has confirmed through the Assumption request form that, in their opinion, all required works have been completed;

For large block subdivisions and street town blocks the requirement for 70% buildout may not apply shall be at City's discretion to determine on case to case basis.

Note: A partially constructed street within a stage will not be considered for assumption.

19.2.4.3 Process for Assumption

The process for achieving Assumption is illustrated in Figure 5 below, followed by a description for each key process step.

ASSUMPTION:

STARTS ONCE: At least 70% of lots constructed or 7 years have elapsed from date of registration and directly connected to existing assumed roads

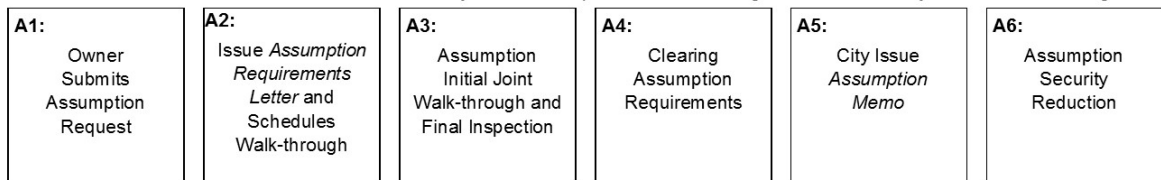


Figure 5 Process for Assumption

A1: Request Assumption

Requests for Assumption can be made by completing the standard request form *DS-IRF-01* and submitting to Development Services. The required form is illustrated in Appendix 1. By submitting an Assumption Request Form, the Owner's Professional Engineer is confirming the site is ready for assumption.

A2: Issue Assumption Requirements Letter and Schedules Joint Walk-through

The Assumption Requirements Letter provides Owner with an itemized summary of the requirements to be met prior to Assumption clearly referencing the associated Subdivision Agreement clauses.

Development Services notifies the applicable City divisions of the request for inspection and coordinates with the Owner's Professional Engineer to schedule a Joint Walk-through. At Assumption the divisions engaged for inspections could include Development Services, Water Operations, Roads & Transportation, Urban Forestry, Environmental & Parks Planning or Stormwater Engineering.

A3: Assumption Initial Joint Walk-through and Final Inspection

The initial Assumption Joint Walk-through inspection provides an opportunity for Development Services and the Owner's Professional Engineer to complete a joint review of all physical works for assumption. At the time of the joint walk-through, all works and services are to be completed and the road constructed to base course asphalt. In the event Development Services arrives on site and discovers the subdivision is unprepared, they have the authority to terminate the walk-through and reschedule.

The joint walk-through will identify all deficiencies to be repaired prior to Assumption. If required, divisional inspections shall be completed prior to the joint walk-through so that deficiencies identified by other City divisions can also be discussed while both parties are on site. Development Services will compile an Assumption Deficiency List to forward to the Owner and their Professional Engineer. Should the Owner disagree with any noted deficiency items, they shall raise those concerns prior to the list being finalized as the list will form an agreed upon summary of repairs to be completed.

The Owner's Professional Engineer may request the Final Assumption Inspection once all agreed upon deficiencies, identified in the consolidated deficiency letter, have been rectified and top coat asphalt is in place. Failure to complete all items identified on the deficiency list will result in further follow up inspections. Consideration may be given for minor outstanding deficiencies to be addressed prior to End of Warranty period on a case by case basis. If the Final Assumption Inspection is not requested within twelve (12) months of the finalized deficiency list, the City may require the Owner to schedule another joint walk-through to confirm the deficiency list prior to scheduling the Final Assumption Inspection.

A4: Clearing Assumption Requirements

The Owner's Professional Engineer shall submit a complete Assumption Requirements package containing all required documentation together with a cover letter clearly referencing and responding to each item identified in the Assumption Requirements Letter. Development Services will review the information and coordinate with the Owner's Professional Engineer to confirm as requirements are cleared and identify those requirements that remain outstanding.

A5: Issue Assumption Memo

Once all Assumption Requirements have been met, Development Services prepares the Council Assumption By-law Memo to be executed by an authorised Manger and the City Engineer and submits the memo to the Clerks Department to be placed on the next available agenda for Council approval. Upon passing of the Assumption By-Law, the Clerks Department assigns a By-Law Number and specifies the one year warranty period. Development Services then issues a formal Assumption Certificate and copies the Owner, their Professional Engineer and all pertinent City departments.

In accordance with standard subdivision agreement clauses, the City shall not be deemed to have legally assumed any work or service until such assumption is evidenced by an Assumption Certificate and the enactment of a specific by-law assuming said works.

A6: Assumption Security Reduction

Security reduction will be processed in accordance with the current Subdivision & Development Agreement Security Policy to retain at a minimum, the warranty holdback of 2.5%. For further information on security reduction policy please search www.london.ca.

19.2.4.4

Assumption of Works Outside Right-of-way

In addition to the Assumption of works and services within the City right of way, plans of subdivision can include miscellaneous Blocks such as Walkways, Parkland/Open Spaces, SWM Facilities, etc., that must also complete an assumption process. The City reserves the right to require assumption of the following elements in conjunction with any stage of a registered plan.

The process for assumption of these Blocks varies and is described below;

1. Walkway Blocks:

Walkway Blocks are dedicated to the City when the Plan of Subdivision is registered. The physical works for walkway Blocks undergo an assumption inspection and clearance process similar to the works and services within the right-of-way. The timings for assumption of walkway blocks correlates with the assumption of adjacent street/block. Walkways undergo one (1) year Warranty period that corresponds with the Council designated timespan for the adjacent assumed street/block.

2. Requirements for Parkland and Open Space Blocks:

These blocks are inspected in conjunction with Environmental and Parks Planning Division. The timing for assumption of Parkland and Open Space blocks shall be at the time of assumption of adjacent street or earlier if the park is ready for assumption to the satisfaction of the Environmental and Parks Planning Division. Typical assumption requirements for Parkland and Open Space blocks include grading, seeding, servicing, and fencing etc. Once satisfied, Development Services will issue an Assumption Certificate identifying the applicable Parkland and Open Space blocks. Environmental and Parks Planning Division will then take over operation and maintenance of the blocks. A Council by-law is not required and the one (1) year Warranty period does not apply unless the Block is serviced with municipal water, sanitary or storm sewers.

3. Stormwater Management Facility (SWM) Blocks:

New Stormwater Management Facilities will now be constructed by the City of London and therefore not subject to assumption process. All relevant subdivision clauses must still be met as they relate to these blocks. A number of un-assumed SWM ponds remain within past subdivisions. Assumption of these ponds shall follow the assumption guidelines set out by Stormwater Engineering Division (SWED). This process is managed by SWED in conjunction with Development Services as needed.

19.2.4.5 Assumption Over Winter Months

In general, the City will not issue Assumption Certificates between October 15th and April 30th of that year once the winter maintenance protocols have been established for the upcoming winter season. It is not possible for the City to assume winter operations of roadways part way through the season. Some accommodation post October 15th may be considered if weather permits.

19.2.5 **Warranty Period**

Following Assumption by the City, assumed infrastructure must complete the Council mandated one (1) year post-assumption Warranty Period. During this period, the Owner remains responsible and liable for warranty defects related to poor materials or workmanship. The requirements for End of Warranty are described in Section 10 of the Subdivision Agreement – COMPLETION, MAINTENANCE, ASSUMPTION and GUARANTEE.

19.2.5.1 Warranty Defects

Warranty defects shall be considered deficiencies that reasonably should not have occurred given the age of the infrastructure and are not related to damage.

Examples of warranty defects may include but are not limited to the following:

- Heaved/sunken sidewalks and major cracks;
- Heaved/sunken curbs and major cracks;
- Catastrophic failure or settlement of underground sewers;
- Displacement or grade differential in manhole and catch basin lids;
- Failure of private sanitary, storm and water services;
- Major road surface defects; or
- Other defects as determined through inspection.

19.2.5.2 Requirements for End of Warranty

End of Warranty is reached following the Council mandated one (1) year post-assumption warranty period. An End of Warranty Certificate will be issued upon successful completion of the warranty inspection and confirmation that any outstanding obligations of the Subdivision Agreement have been satisfied.

What is required for End of Warranty?

The following requirements must be met to clear the End of Warranty period;

- Obligatory one year warranty period has expired;
- Warranty inspection completed and all warranty defects cleared;
- If applicable, Water Operations has cleared any outstanding items not available for inspection at the time of Assumption;
- Street tree planting completed by the City and invoice paid by Owner;
- All outstanding Final Lot Grading Certificates provided; and

- Confirmation that all remaining obligations of the Subdivision Agreement have been satisfied.

19.2.5.3 Process for End of Warranty

The process for reaching End of Warranty is illustrated in **Figure 6** below, followed by a description of each key process step.

END OF WARRANTY:

STARTS ONCE: The Council mandated minimum 1-year warranty period has elapsed or is imminent.

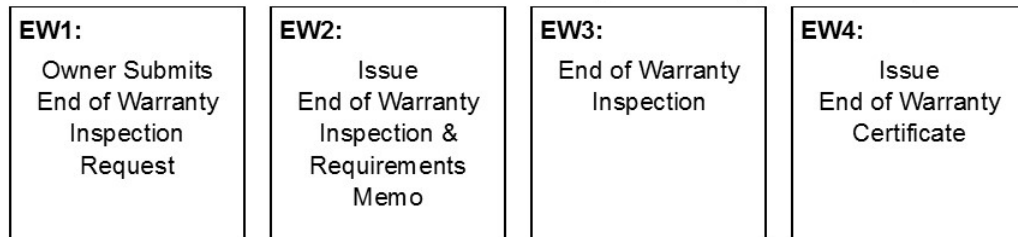


Figure 6 Process for End of Warranty

EW1: Owner Submits End of Warranty Inspection Request

The Owner's Professional Engineer submits End of Warranty inspection request form *DS-IRF-01* to Development Services in anticipation of the warranty period expiry identified in the Council By-law. The required form is illustrated in Appendix 1. The request for End of Warranty Inspection can be submitted up to 3 months prior to the warranty period expiry so the inspection can occur on or before the actual End of Warranty date.

The City will provide a reminder to Owner's approximately 2 months prior to the End of Warranty date. However, if no request is received, the City may notify the Owner and proceed with the warranty inspection regardless. The goal is to complete the warranty inspection as close to the expiry date as to accurately document any warranty defects present as of the one-year mark.

EW2: Issue End of Warranty Inspection & Requirements Memo

City staff prepares an End of Warranty Inspection and Requirements memo confirming the inspection and identifying any outstanding agreement requirements or deficiencies carried over from assumption. The memo is sent to the Owner and any other divisions that need to review post-assumption items or deficiencies.

EW3: End of Warranty Inspection

City staff complete the inspection together with the Owner's Professional Engineer and either provides clearance or advises the Owner of remaining deficiencies. Follow up inspections are coordinated as needed.

EW4: Issue End of Warranty Certificate.

Once all Subdivision Agreement requirements have been met, Development Services will issue the End of Warranty Certificate. At this time, the remaining 2.5% warranty security holdback can be released and the file is considered closed. Any outstanding invoices for the repair of urgent warranty defects during the warranty period will be reimbursed from the 2.5% holdback prior to its release.

19.2.5.4 Addressing Deficiencies during the Warranty Period

During one year warranty period, City assumes full responsibility for operation and maintenance (such as snow plowing on roads, sidewalks, boulevard maintenance, etc.) of all works and services within City right-of-way. Any defects/damage caused through regular maintenance by the municipality shall be City's responsibility. However, warranty defects will be identified through warranty inspection and summarized in a deficiency letter to be remediated prior to the release of security holdback.

On occasion, critical deficiencies can arise during the Warranty Period. An urgent deficiency is defined as any defect related to materials or workmanship that is considered an immediate safety, environmental or operational risk. Examples include water service breaks, sewer failures at manhole connections, and failures in road structure failure.

When an urgent deficiency occurs, City staff will provide immediate notification to the Owner. The Owner is required to provide a response within 24 hours of notification and confirm with Development Services once the work has been completed. If a response has not been received by the City within 24 hours, the City may immediately schedule necessary repairs and invoice the Owner for the total cost incurred. Addressing these types of deficiencies may require involvement from pertinent City Divisions. Non-urgent warranty defects observed during the warranty period may be deferred to End of Warranty.

19.2.5.5 Street Tree Planting

The City will install all street trees in accordance with the Street Tree Planting Plan accepted prior to assumption. Installation will occur within the first 2 planting seasons after assumption. The City will invoice the Owner for this work and payment must be received as a condition for End of Warranty.

19.3 SITE PLAN DEVELOPMENT AGREEMENT COMPLIANCE

19.3.1 Introduction to Site Plan Compliance

The City of London utilizes Site Plan Control (By-law C.P.-1455-541) to ensure functional and high quality developments are constructed throughout the City. At the time of site plan approval, a development agreement is registered on title with schedules including site plan and servicing drawings.

Compliance for site plans begin as soon as the development agreement is registered, at which point the City responds on a complaint driven basis to construction related concerns. Formal compliance procedures start with the Initial Reduction Inspection upon the substantial completion of the site works (as determined through the building permit process).

In accordance with the Planning Act, the City of London is authorized to enter onto the development lands for the purpose of carrying out inspections to confirm the site works comply with the registered development agreement, approved site plan drawings and applicable by-laws.

Section 19.4 provides more information on agreement compliance for external works within the right-of-way.

19.3.1.1 Definition of SP Compliance Stages

Agreement Compliance for Site Plans can be described in the following stages:

Construction Compliance and Site Management

Throughout the course of Site Plan construction, the Owner is responsible to maintain site construction activities in a manner that is acceptable to the City and ensure that all works are in conformity with the approved plans, policies, by-laws and development agreement provisions.

Compliance issues during construction are typically flagged to the City on a complaint driven basis, at which point staff coordinate with the Owner to ensure issues are resolved promptly. Section 19.3.2 provides more detail on the Owner's compliance responsibilities during the buildout stage.

Site Plan Compliance Reduction Inspections

In accordance with the City's Subdivision & Development Agreement Security Policy, Owners can request an "initial" and a "midpoint" security reduction inspection to assess the value of outstanding works and provide a summary of observed site deficiencies. Reductions will be considered when the value of outstanding works is less than the value of held securities and greater than the minimum final site plan security holdback per the security policy. The Owner's Professional Engineer will be responsible to provide engineering estimate of the works completed on the letter head sealed and signed by a Professional Engineer.

Section 19.3.3 provides more detail on the process for security reduction inspections.

Final Site Plan Compliance Inspection and Security Release

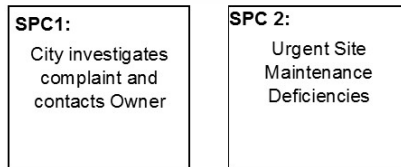
Upon confirmation of Substantial Completion through the City's Building Division, the Owner has nine (9) months to complete and satisfy all obligations of the Development Agreement and to complete underground & surface works as identified on the face of the approved site plan as well as required external works, where applicable.

The Owner's Professional Engineer can request a final site plan compliance inspection once, in their opinion, all required site works have been completed. Alternatively, if no inspection request is received within nine (9) months of substantial completion, the City inspector may initiate a compliance inspection and, where applicable, issue a notice of deficiency or a Notice of Default identifying works that remain outstanding or deficient by establishing a deadline for completion of outstanding works.

Upon confirmation by the Development and Compliance Services that the site has been constructed in accordance with the approved Site Plan and all obligations of the Development Agreement have been satisfied, the City will authorize release of all remaining securities and close the file. Section 19.3.4 provides more detail on the process for final site plan compliance inspections.

19.3.1.2 Key Process Steps

Following figure provides an overview of the key process steps for each stage of Site Plan agreement compliance.

CONSTRUCTION COMPLIANCE AND SITE MANAGEMENT:**Process for Site Plan Complaint Response**

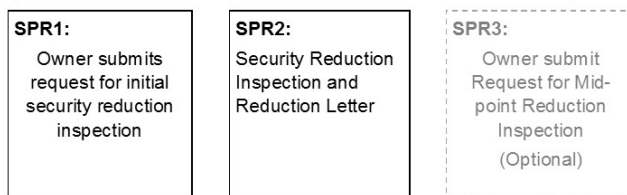
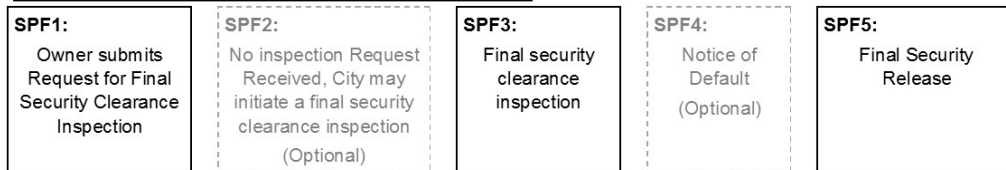
SITE PLAN COMPLIANCE REDUCTION INSPECTIONS:**Process for Site Plan Security Reduction Inspection:****Process for Final Security Clearance Inspection:**

Figure 5 Process for Construction Compliance and Site Management

19.3.2 Construction Compliance and Site Management

Throughout the course of site development and construction, the Owner will be responsible to undertake and maintain construction activity on the site in a manner acceptable to the City, ensuring that all works are carried out in conformity with the approved plans, by-laws and provisions of the Development Agreement. Any public complaint as a result of the development shall be given due priority and addressed appropriately, to the satisfaction of the City.

19.3.2.1 Site Management

In terms of good site management, the following are items to proactively consider during the construction phase of a development project.

- a) Development Notification Signage indicating Owner/Consultant/Contractor contract information and the City of London SP application file number.
- b) Maintain site in a neat and orderly condition, with regard to:
 - debris and waste management
 - operation and storage of construction equipment and building materials;
 - dust control
 - idling vehicles, generators and other equipment
 - public sidewalk and roadway maintenance (including snow and tracked soil/mud removal and to keep it in obstruction/damage free conditions)
 - Construction fencing to ensure public is not exposed to undue risk

- Manage surface drainage and grading
- c) Protect public property within the right-of-way in accordance with the policies and by-laws of the City.
- d) Ensure work undertaken does not damage or create a hazard to adjacent private property or unduly impact the surrounding public;
- e) Have regard for all applicable by-laws, for example: Parking and Noise;
- f) Maintain adequate erosion and Sediment Controls with continued monitoring and maintenance throughout construction

19.3.2.2 Process for Complaint Response During Site Plan Construction

Development Services staff respond to maintenance and deficiency issues during construction on a complaint driven basis. Complaints can come from a number of sources including direct resident calls, the Councillor's office, City Dispatch or other divisions. Typical issues include mud tracking onto road allowance, dust, noise, construction waste. The process for site development related complaint resolution is illustrated in **Figure 6** below followed by a description for each key process step.

CONSTRUCTION COMPLIANCE AND SITE MANAGEMENT:

Process for Site Plan Complaint Response

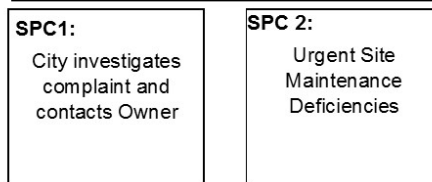


Figure 6 Process for Site Plan Complaint Response

SPC1: City Investigates Complaint and Contacts Owner:

If needed, Development Services will visit the site to observe and investigate the complaint first hand. Complaints regarding point in time activities such as construction traffic or noise, will be forwarded on without site investigation. Once the Owner has been informed of the complaint, staff will review requirements for site maintenance and, where required, discuss remedies.

SPC2: Urgent Maintenance Deficiency:

Occasionally, more critical site deficiency or maintenance issue can arise where the issue can be considered a safety or operational risk to the City or the general public. Should an urgent deficiency occur, the city will provide immediate notification to the Owner identifying a clear deadline by which the matter must be remedied. If the matter is not corrected by the identified deadline the City may proceed to schedule the necessary remedial work and invoice the Owner or drawdown on held securities for the total cost incurred.

19.3.3 **Site Plan Compliance Reduction Inspections**

The City's Subdivision & Development Agreement Security Policy, provides the opportunity for security reductions prior to a final inspection in recognition of site works that are progressing toward completion. Reductions will only be considered when the

value of outstanding works is less than the value of held securities and greater than the minimum final site plan security holdback per the security policy.

Initial Reduction: Following adequate completion of at least 50% of the agreed upon works, the Owner may apply for a first security reduction to the value of estimated outstanding works or the minimum holdback, whichever is greater

Midpoint Reduction: Following adequate completion of at least 75% of the agreed upon works, the Owner may apply for a midpoint security reduction to either the estimated value of outstanding work or the minimum holdback, whichever is greater. A mid-point reduction would not be applicable in cases where the initial reduction drops held securities to the minimum holdback.

Refer to Section 19.4 for more information on inspections related to external works within the right-of-way.

19.3.3.1 Process for Reduction Inspections

The process for requesting inspections for the purpose of reducing securities held under a site plan development agreement is illustrated in **Figure 7** below, followed by a description of each key process step.

Process for Site Plan Security Reduction Inspection:

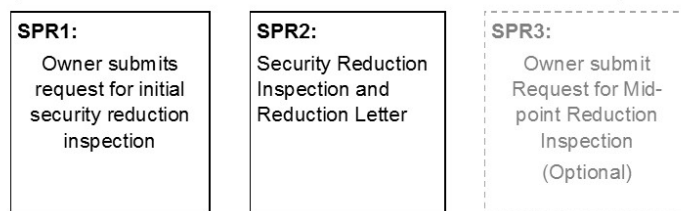


Figure 7 Process for Site Plan Security Reduction Inspection

SPR1: Owner Submits Request for Initial Reduction Inspection

Security reduction inspection requests can be submitted via email through the Development Services Site Plan Compliance email portal, LondonSPcompliance@london.ca. The request shall include the Security Reduction Tracking Summary Worksheet completed by the Owner's Professional Engineer.

Upon receiving a site plan security reduction inspection request, the City inspector will schedule an inspection within an anticipated window based on current workload and inform the Owner. Upon completion of the inspection the Owner will be notified of deficiencies, if any.

SPR2: Security Reduction Inspection

The City inspector will review the site to confirm the works completed to date are consistent with the submitted security reduction requested in the Tracking Summary Worksheet. Should deficiencies be observed in work for which a reduction has been requested the City may adjust the reduction request accordingly. However, security reduction will not be considered if any of the critical timed requirements, as identified in the Development Agreement, are not completed to the satisfaction of the City prior to inspection.

Following the inspection, Development Services will issue a letter to be sent to the Owner and the City's Finance Department listing any identified deficiencies and

confirming the approved reduction and establish date for follow-up review. City's Finance Department will process the release of the reduced securities.

SPR3: Owner submits Request for Mid-point Reduction Inspection

Similar to the initial inspection, requests for mid-point inspections can be submitted via email through the Development Services Site Plan Compliance email portal, LondonSPcompliance@london.ca. The request shall include the security reduction Tracking Summary Worksheet completed by the Owner's Professional Engineer. The inspection and subsequent reduction letter follow SPR2 as described above.

19.3.4 Final Security Clearance Inspection

Standard Development Agreement provisions require the Owner to complete all underground and surface works within the development limits (including external works where applicable) within nine (9) months of the established date of Substantial Completion. The City's Building Division determines the substantial completion date through permit process. Alternatively, where no permit is required, the nine (9) month timeline is from the date of the agreement.

The inspection shall include but not be limited to, landscaping works, surfacing details, fencing, visual barriers, site lighting, garbage locations, fire route signs and other site facilities as shown on the approved plans and/or noted in the provisions of the development agreement.

The following list outlines the minimum requirements to be satisfied prior to final release of site plan agreement securities:

- a) The Professional Engineer's certification verifying that the required works have been completed in accordance with approved plans and special provisions as per the development agreement, and other obligations have been fulfilled to the City's satisfaction such as;
 - registration of joint use maintenance agreement, where applicable
 - verification of easements, noise warning clauses etc.
 - certification of completion and submission of as constructed drawings for external works
 - review of claims for external works
 - restoration of City property, as applicable
 - tree preservation warranty
 - By-Law enforcement
- b) City staffs' site inspection to confirm the completion of all works shown on the drawings included in the Site Plan Approval package.

In general, Final Security Clearance Inspections should be completed between April 15th and October 31st (weather dependent). After this site inspection, if City determines that all identified deficiencies have been rectified and works are acceptable, a Security Release Letter is prepared and sent to the applicant for information purposes and to City's Finance Division for the release of the remaining securities.

The minimum site plan security holdback will not be released until such time as all works have been completed and all agreement requirements fulfilled to the satisfaction of the City of London.

19.3.4.1 Process for Final Security Clearance Inspections

The process for requesting inspections for the purpose of reducing securities held under a site plan development agreement is illustrated in **Figure 8** below, followed by a description of each key process step.

Process for Final Security Clearance Inspection:

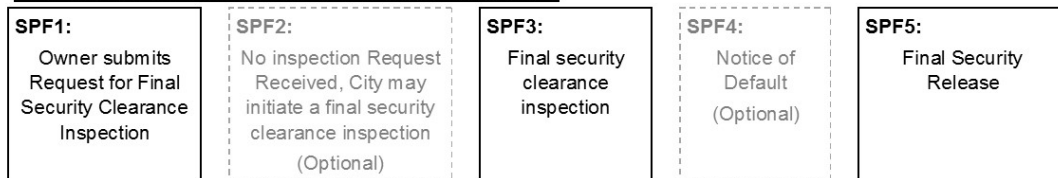


Figure 8 Process for Final Security Clearance Inspection

SPF1: Owner Submits Request for Final Security Clearance Inspection

Upon the Substantial Completion as determined by City's building division, the applicant has nine (9) months to complete all underground and surface works within the development limits including external works where applicable, and all other applicable provisions under Development Agreement.

Final Security Clearance Inspection requests can be submitted via email through the Development Services site plan compliance email portal, LondonSPcompliance@london.ca. The request email shall include certification from the Owner's Professional Engineer that all internal and external servicing, grading and storm water management works have been constructed in accordance with the approved Engineering drawings and reports, design standards and specifications, and comply with all applicable City By-Laws.

Upon receiving a site plan final inspection request, the City inspector will schedule an inspection within the anticipated window based on current workload and inform the Owner.

SPF2: No Inspection Request Received

Compliance Inspections are typically triggered at the Owner's request or may be initiated by staff if no request is received within nine (9) months of Substantial Completion date. If no inspection request is received within 9 months of the established substantial completion date, the City Inspector may initiate a Final Security Clearance Inspection. In this case, the Owner will be notified that the site is considered overdue for the final inspection and provided an anticipated inspection window.

SPF3: Final Security Clearance Inspection

The Compliance Inspections typically involves:

- Observing surface works internal to the Site Plan for consistency with the approved plans, Site Plan Control By-Law and all other applicable By-Laws, standards and specifications.

- Ensuring that all site works and landscape works have been completed in accordance with the approved Site Plans.
- Reviewing the Development Agreement clauses to determine whether all requirements and agreement obligations have been met.

Based on the Inspections, if required, a Deficiency Letter is prepared and sent to the applicant and a brought forward (BF) date is set for a second and subsequent inspection. If necessary, a second Deficiency Letter will be sent at the end of second inspection identifying new BF date. If deficiencies still remain unaddressed at the 3rd Inspection, the Site Plan Inspection Officer will prepare a notice of the City's intention to place the development agreement in default called "Notice of Default".

SPF4: Notice of Default

In cases where deficiencies have not adequately been addressed by the identified default deadline, a Final Notice of Default will be issued and a copy of the memo forwarded to the Owner and City's Finance Division identifying the lack of compliance. In case of ongoing non-compliance, the memo will recommend the cashing of securities. Once the securities are cashed, the City may proceed with addressing outstanding deficiencies as they see fit.

SPF5: Final Security Release

Upon confirmation that all notified deficiencies and works per the approved site plan, landscaping plans, grading plans and servicing plans have been completed to the satisfaction of the City and all clauses/conditions of the Development Agreement have been satisfied, a Security Release Letter will be prepared and sent to the Applicant and the City's Finance Division for release of securities and file will be closed.

The City will hold the securities until the required works and obligations set out in Development Agreement have been successfully completed, inspected and accepted by Site Plan Inspection Officer from City's Development Services.

Upon confirmation that all works on the approved site plan, landscape and grading plans, servicing plans and all provisions of the development have been satisfied, a Security Reference Letter is prepared and sent to the Owner and the Finance Division. The City's Finance Division will process the release of remaining securities.

19.4

CONSENT APPLICATION AND COMPLIANCE

Consent is a term used in provincial planning legislation (Ontario Planning Act) to describe the approval required to subdivide land without the requirement of a plan of subdivision. It is most commonly used to sever an existing lot or parcel into more than one lot. Section 19.1.2.3 provides additional background on the consent process, described in Section 53(12) of the Planning Act.

Upon approval of application, the Consent Authority may impose conditions of consent as part of the provisional decision. Conditions can include, for example, the requirement for Site Plan Approval or for the Owner to enter into a consent agreement with the City.

Should consent conditions necessitate the construction of external works within City right of way, the Owner will be required to enter into Consent Agreement and provide adequate securities to ensure construction of the applicable works. Any external works required under a consent agreement will be subject to the same compliance

requirements as if required through a development or subdivision agreement. Section 19.5 outlines the compliance procedures for external works.

19.4.1 Consent Agreement Compliance Objectives

The Consent Authority may impose reasonable conditions through the provisional approval of consent applications which may include the requirement to enter into a Consent Agreement to ensure that;

1. All existing works and services for both retained and severed parcels are in general conformity to the current City of London Standards, specifications, all applicable By-Law requirements and fulfill obligations imposed through the provisional decision of Consent;
2. All materials, workmanship and construction techniques and technologies used are inspected and certified by the Owner's Professional Engineer to be in compliance to City's standards;
3. Ensure all works and services (both, surface and ground structures) constructed within the municipal limits, if required, are per approved plans, consistent with City of London standards and specifications;
4. Protect the interest of the public, property owners and occupants of the new development, neighbouring properties and to eliminate or reduce negative impacts to adjacent lands as a result of new creating new lots/parcels.
5. Storm water drainage and erosion control management programs are in place to protect downstream property, infrastructure and natural features;

19.5 EXTERNAL WORKS

Works external to a site can be triggered by development related to subdivision, site plan or consent and, when required, the terms for external works compliance will be established through the associated agreement. Section 19.5 outlines the compliance procedures for external works associated with development.

19.5.1 Introduction to External Works

19.5.1.1 Definition of External Works

External works typically represent approved works constructed by the Owner outside the limits of their property such as extension of a sewer or minor road works as a result of proposed development. There are also circumstances where works internal to the site may be considered "external" if the proposed works benefit parties beyond the limits of the site such as a sewer servicing upstream lands that crosses the site through an easement.

External works may include items such as:

- installation of municipal infrastructure (i.e. watermains, sanitary sewers, pump stations, storm sewers, outlet control devices etc.);
- Traffic channelization and turning lanes;
- sidewalks and curbs; and
- traffic control devices (i.e. traffic signals).

19.5.1.2 Role of Professional Engineer in Delivering External Works

The Owner shall appoint a qualified Professional Engineer registered with the Association of Professional Engineers of Ontario, to design, supervise and certify the construction and installation of the external works, with the duties of the Professional Engineer to include, but not be limited to the following:

- a) prepare and certify the designs in accordance with the City of London Engineering Standards;
- b) obtain all necessary approvals from the Ministry of the Environment and Climate Change and coordinate with Upper Thames River Conservation Authority, and any other external agencies, as required;
- c) act as the Owner's representative in all matters pertaining to the construction;
- d) assist and coordinate with Owner's Contractor to obtain a Permit for Approved Works (PAW) prior to initiating work within the right-of-way. However, obtaining PAW permit remains the Owner's Contractor responsibility;
- e) provide contract administration and inspections for all external works, including utilities;
- f) undertake any required testing and certify the quality of external works;
- g) maintain all records of construction and upon completion to advise the City of all construction changes;
- h) provide final "as constructed" drawings in a form acceptable to the City prior to acceptance of external works by the City; and
- i) monitor external works for completion and restoration within the timelines specified in on the Permit of Approved Works (PAW) with the intent to minimize traffic disruptions.

19.5.1.3 Key Process Steps for External Works

Figure 9 provides an overview of the key process steps for each stage of external work compliance.

CITY INVOLVEMENT DURING CONSTRUCTION: Monitoring progress and responding to complaints

CI1: Construction Progress Meetings	CI2: Site Visits During Construction	CI3: Complaint Response
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TIMED REQUIREMENTS: Implement construction timing identified in Agreement.

TR1: Confirm Timed Requirements Operational For Use	TR2: Issue Timed Requirement Deficiency Letter	TR3: Reduce or Cash Security
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ACCEPTANCE OF EXTERNAL WORKS: Clearing external works as operational and release security

EWA1: Owner Submits Request for Acceptance of External Works	CA2: City Issues Acceptance of External Works Req'nts Letter	CA3: Joint External Works Inspection	CA4: Final Acceptance of External Works	CA5: 1 year Warranty Period for External Works
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Figure 9 External Works Process Steps

19.5.2

City Involvement During Construction

City Staff will remain engaged throughout construction of external works as Owner led work within the right-of-way has the potential to impact the public and will ultimately be accepted as municipal infrastructure. The City's involvement is outlined in **Figure 10**

CITY INVOLVEMENT DURING CONSTRUCTION: Monitoring progress and responding to complaints

CI1: Construction Progress Meetings	CI2: Site Visits During Construction	CI3: Complaint Response
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Figure 10 City Involvement During Construction

CI1: Construction Progress Meetings:

Where development projects involve external works, Development Services staff will attend pre-construction meetings as well as subsequent site construction meetings. Development Services staff will provide a single point of contact for issues that arise relating to unexpected design or scheduling changes, provide clarification and advice on interpretation and application of City policies, standards, methods and procedures and coordinate technical inquiries during construction with other Divisions. The Owner's Professional Engineer remains responsible for all contract administration and inspection during construction.

CI2: Site Visits During Construction:

Development Services staff will perform general visits to ensure compliance and will coordinate with Owners' Professional Engineer with regards to construction compliance, public complaints and design matters that may arise during construction. However, City will not be involved and responsible for contract administration and inspections during

construction. The Owner's Professional Engineer will be responsible for inspections and contract administration.

CI3: Complaint Response:

Development Services will investigate all complaints received relating to external works and coordinate with the Owner's Professional Engineer to determine any measures necessary to address the concern. Should a critical deficiency or maintenance issue arise which is considered to be a safety or operational risk to the City or general public, the City will provide immediate notification to the Owner identifying a clear deadline by which the matter must be remedied. If not corrected in a timely manner, the City may proceed to schedule the necessary remedial work and invoice the Owner or drawdown on held securities for the total cost incurred.

19.5.3 Timed Requirements

External works associated with development can be occasionally linked to specific timing as set out in the subdivision, development or consent agreement, for example prior to Conditional Approval, prior to occupancy, within one year of registration or the buildout of a specific number of units. Timed external works items may include installation of turn lanes, medians, street lights, traffic signals, noise attenuation or fencing.

Refer to section 19.2.3.2 for process information related to subdivision Post Registration Timed Requirements.

In the case of agreements related to site plans or consents, compliance for timed external work requirements is tied to the process for security reduction. The goal is to ensure timed external works are substantially complete and operational for use per the agreed timing. Final acceptance of external works comes later as described in Section 19.5.4.

19.5.3.1 Process for Timed External Works Requirements

The process for Timed External Works Requirements is illustrated in **Figure 11** below, followed by a description for each process step.

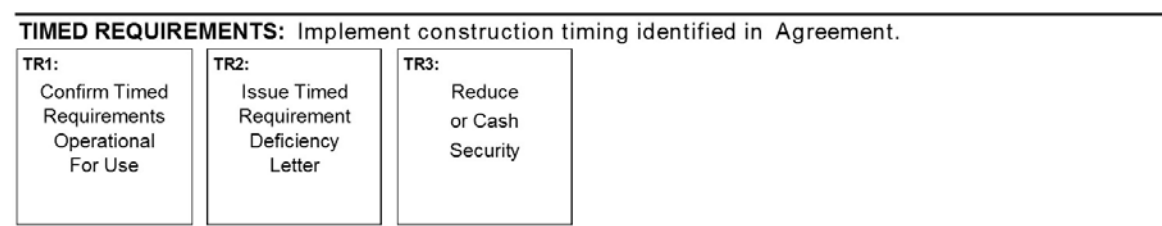


Figure 11 Timed Requirements Process

TR1: Confirm Timed Requirements Operational for Use

Development Services participation in site construction meetings will provide the opportunity to monitor and discuss the scheduling of timed external work requirements. Upon completion of timed works and a request from the Owner's Professional Engineer, the City will inspect to confirm the works are operational for use for the purpose of satisfying the timed requirements. Any deficiencies observed will be noted to provide an opportunity to address deficiencies prior to the acceptance of external works inspection.

TR2: Issue Timed Requirements Deficiency Letter

In the event that timed works are not completed or are deficient to the point they cannot be deemed operational for use, the City will issue a formal Time Requirements Deficiency letter. Security reductions will not be processed until outstanding timed requirements have been satisfied.

TR3: Reduce or Cash Securities

Security reduction requests will be accepted once timed requirements have been confirmed. However, should the Owner fail to satisfy the timed requirement, the City may issue a Notice of Default for the outstanding work and draw down from held securities as necessary to complete the works. The City's security policy can be found by searching Subdivision and Development Agreement Security policy at www.london.ca

19.5.4 Acceptance of External Works

Infrastructure installed or altered within an existing municipal right-of-way must be accepted by the City as operational for use prior to the City "assuming" maintenance.

External works acceptance occurs when all works and services are constructed in accordance with accepted plans, appropriate certification provided and the Owner demonstrates how all requirements of the Development Agreement have been satisfied.

This process differs from the two-stage Conditional Approval and Assumption process required when a new municipal road is created through development.

ACCEPTANCE OF EXTERNAL WORKS: Clearing external works as operational and release security

EWA1: Owner Submits Request for Acceptance of External Works	CA2: City Issues Acceptance of External Works Req'nts Letter	CA3: Joint External Works Inspection	CA4: Final Acceptance of External Works	CA5: 1 year Warranty Period for External Works
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Figure 12 Process for Acceptance of External Works

EWA1: Owner Submits Request for Acceptance of External Works

Requests for acceptance of external works can be submitted via email through the Development Services Site Plan Compliance email portal, LondonSPCompliance@london.ca. The request shall include the Security Reduction Tracking Summary Worksheet completed by the Owner's Professional Engineer.

EWA2: City issues Requirements Letter for Acceptance of External Works

All requirements for acceptance of external works shall be outlined in the clauses of the development or consent agreement. Upon receiving a request for acceptance inspection, the City will provide the Owner a requirements letter summarizing the agreement clauses to be satisfied prior to accepting and assuming maintenance of the external works. The following list outlines the minimum requirements to be satisfied prior to assumption:

- a) confirmation from City inspector that all works, services, sewers and roads (physical works) have been constructed, certified and inspected to be in general conformity to the accepted plans and specifications;

- b) as required, confirmation from applicable City Divisions that specialized external works are satisfactory.
- c) submission of all "As-Constructed" drawings and digital files by the Owner's Professional Engineer; and
- d) confirmation or certification on any other specific requirements under the Development Agreement.

The Owner's Professional Engineer shall submit a complete external works acceptance package containing all required documentation and certifications together with a cover letter clearly referencing and responding to each item in the issued Requirements Letter. Development Services will review the package and coordinate with the Owner's Professional Engineer to confirm as requirements are cleared and identify those requirements that remain outstanding. An acceptance of external works will be issued once all items identified in the requirements letter have been cleared.

EWA3: Joint External Works Inspection

The External Works Acceptance Inspection shall be completed by the Development Inspection Technologist with the Owner's Professional Engineer in attendance. The hope is that with a well prepared site, the physical work requirements can be cleared with the initial inspection. Alternatively, staff will provide the Owner's Professional Engineer with a summary of deficiencies. The Owner's Professional Engineer shall ensure that all deficiencies are rectified to the City's satisfaction prior to requesting a follow-up inspection.

At the time of the joint inspection, all works and services are to be completed and the road returned to base asphalt. The joint walk-through will identify all deficiencies to be repaired prior to acceptance of external works. If required, divisional inspections should be completed prior to the joint walk-through so that deficiencies identified by other City divisions (Water Operations, Roads & Transportation, Environmental & Parks Planning, Stormwater Engineering, etc.) can also be discussed while both parties are on site. Development Services will compile a deficiency list and forward to the Owner and their Professional Engineer. Should the Owner disagree with any noted deficiency items, they shall raise those concerns prior to the list being finalized as the list will form an agreed upon summary of repairs to be completed.

EWA4: Final Acceptance of External Works Inspection

The Owner's Professional Engineer may request the Final Acceptance Inspection once all agreed upon deficiencies, have been rectified and top coat asphalt is in place. Failure to complete all items identified on the deficiency list will result in the requirement for further follow up inspections. If the Final Assumption Inspection is not requested within twelve (12) months of the finalized joint walk-through, the City may require a follow up walkthrough prior to scheduling the final inspection.

EWA5: Issue Acceptance of External Works

Development Services prepares and issues an Acceptance of External Works letter, with a copy provided to the appropriate operations divisions, to signal the point when the City assumes maintenance of new or adjusted municipal infrastructure within an existing municipal right-of-way.

EWA6: 1-year Warranty Period for External Works

Following acceptance of external works for maintenance by the City, the infrastructure will remain under warranty for a one (1) year period or as indicated in the development agreement. During this period, the Owner remains responsible and liable for warranty defects related to poor materials or workmanship. Warranty defects shall be considered deficiencies that reasonably should not have occurred given the age of the infrastructure and are not related to maintenance damage. See Section 19.2.5.1 for examples of warranty defects.

A 2.5% warranty holdback will be maintained on external works until such time as the works have cleared a warranty inspection. Refer to Section 19.2.5.3 for information on the process for External Works End of Warranty, which parallels the process for subdivisions.

19.5.5 Permit of Approved Works (PAW)

Pursuant to the City of London's Street By-law S-1, Schedule 'B' (Public Street - Work Approval Permit), any work within City a right of way approved through Site Plan, Subdivision Approval or Consent Application process requires permit from the City prior to the start of construction. PAW's may be issued at the discretion of the City Engineer for work to be carried out in, over or under a City street, subject to conditions set out in the issued permit as well as the applicable sections of the above referenced By-law.

19.5.5.1 Requirements of PAW for Works on City Property

The following are requirements of a PAW for the purpose of completing construction within the City right of way:

- 1) Application form for Permit of Approved Works along with applicable fees per the Streets By-law S-1;
- 2) Submission of a Traffic Management Plan (TMP) for review and acceptance by the City's Transportation Division; and
- 3) proof of liability insurance on the City of London Standard Certificate of Insurance Form available online at www.london.ca . The form needs to be completed and signed by the insurance company.

19.5.5.2 Requirements of PAW to Occupy City Property:

Development related works that trigger the need to occupy City Property for the purpose of setting up cranes or other lifting devices on roads/sidewalks, diverting traffic, erecting scaffolding, etc., on the City right-of-way must obtain a PAW.

The following are requirements of a PAW for the purpose of occupying the City property:

- 1) application form for PAW along with applicable fees per Streets By-law S-1.
- 2) proof of liability insurance on file, naming The City in their policy, submitted on the City of London's Standard Certificate of Insurance form.
- 3) deposit as set out in the Streets By-law, refundable upon completion of work or restoration of damaged space occupied. Deposits can be in the form of cash, debit, cheque, letter of credit or bond.

Where an applicant anticipates occupying a street or a portion of a street for more than 30 days, the applicant shall enter into a licence agreement with the City prior to issuance

of a permit. Under that agreement, the applicant shall pay a fee as set out in Schedule 1 of the City of London's Various Fees and Charges By-Law and provide a Traffic Management Plan for disruption of Rapid Transit Boulevard, Urban Thoroughfare, Civic Boulevard, Urban Thoroughfare/Civic Boulevard in Primary Transit Area, Main Streets and Neighbourhood Connectors are to be approved by the City's Transportation Division for occupancy of roadways

19.5.5.3 Traffic Management Plan (TMP)

All development driven works within City right of way will require a Permit of Approved Works (PAW) and this permit would be contingent upon the Owner's Professional Engineer to submit a Traffic Management Plan (TMP) for review and approval by City's Transportation division prior to the issuance of a PAW.

The TMP is a tool that effectively harmonizes the construction project's physical requirements with the operational requirements of the City of London and the transportation needs of the road users within the City. For further details and requirements of TMP, see the City's current Design Specifications & Requirements Manual.

In general, a TMP sets out the general staging of the work that will ensure safe through traffic movement, utility services, pedestrian traffic and vehicular access to the areas and businesses adjacent to the construction site, while allowing for the construction of the desired works. However, the contractor is required to meet all requirements of the Ministry of Labor and Ontario Traffic Manual Book 7 while undertaking a separate Traffic Control Plan (TCP), affirming that TCP is in general conformity with the approved TMP. This should be added in a form of a note to the TMP drawings.

APPENDIX 1



DS – IRF – 01

SUBDIVISION INSPECTION REQUEST FORM

SUBDIVISION: _____ DATE: _____

REGISTERED PLAN # (If not registered provide 39T #): _____

OWNER: _____

CONSULTING ENGINEER: _____

INSPECTION CONTACT PERSON / NUMBER: _____

BY THE SUBMISSION OF THIS INSPECTION REQUEST, I CONFIRM THAT THE CONSULTING ENGINEER HAS INSPECTED THE WORKS & SERVICES IN ADVANCE, AND THE AREA IS READY FOR INSPECTION.

MANDATORY – For first Conditional Approval inspection request

MECP – Environmental Compliance Approval #s: _____

Date Construction Drawings Accepted: _____

TYPE OF INSPECTION: CONDITIONAL APPROVAL: _____

ASSUMPTION or EXTERNAL WORKS: _____

END OF WARRANTY: _____

LIMITS OF INSPECTION: List each street with to and from limits, or all. Include works, if any, on external streets, walkways, etc.

Note: *Prior to a Conditional Approval, Assumption, or End of Warranty inspection, the sewers must be flushed to ensure they are clean and functioning properly.*