

DRAFT



**ENGINEERING DEVELOPMENT AND
INFRASTRUCTURE MANUAL**

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Definitions and Abbreviations

Definitions

“*Acceptance*” shall mean following a technical review, the *Township* accepts privately constructed utilities and roadway as being designed to the accepted standards.

“*Agreement*” shall mean the *Development*, Site Plan or Consent Agreement including all schedules attached.

“*Assumption*” shall mean following *Acceptance* and construction, the *Township* assumes the constructed infrastructure, utility and right of way as municipal property. (may include a conditional *Maintenance Period*).

“*Capital and Development Infrastructure Project*” shall mean a new construction, expansion, renovation, or replacement project to help maintain or improve a *Township* asset.

“*Contractor*” shall mean a person, partnership, or corporation who contract to undertake the execution of work commissioned by the *Township* or a *Subdivider / Developer* to install or maintain infrastructure or assets.

“*Consultant*” shall mean Architect or *Engineer* or *Landscape Architect* or Geoscientist who is licensed to practice in Ontario in their appropriate discipline and are acceptable to the *Township*.

“*Developer*” shall mean the *Owner* or party specifically named in the *Development Agreement* or in a Subdivision Agreement.

“*Development*” shall mean the *Lands* on which the Subdivision, Site Plan or Consent are proposed.

“*Easement*” shall mean a right of use over the property of another.

“*Engineer*” shall mean a Professional *Engineer* licensed and in good standing with the Professional *Engineers* Association of Ontario, who holds a Certificate of Authorization for municipal engineering applications and has relevant experience and training in their discipline. The *Engineer* may be employed by a consulting firm or consist of multiple *Engineers* responsible for their specific expertise related to the design of the *Development*.

“*Fee*” shall mean the costs related to administering and enforcing the conditions of the *Agreement*, as set out in the *Agreement* and in accordance with the current Fees and Charges By-law adopted by the *Township*.

“*Inspector*” shall mean the person(s) authorized and supplied by the *Township* or the *Subdivider / Developer* to ensure that the installation and construction of the project is executed according to the accepted design and in a good workmanlike manner according to federal, provincial and *Township* standards.

“*Land*” shall mean these *Lands* described in the *Agreement* and includes all *Easement* rights and obligations granted in connection with the *Agreement* i.e., the *Development*.

“*Landscape Architect*” shall mean a Professional *Landscape Architect* duly qualified and a member in good standing of the Ontario Association of *Landscape Architects*.

“*Low Impact Development*” (LID) shall mean stormwater management practices that seeks to mitigate the impacts of increased runoff and stormwater pollution.

“*Maintenance Period*” shall mean the period of time. At the discretion of the *Township*, that the *Developer* is responsible for maintenance of the installed services, features and structures identified in the accepted project design, following *Assumption* of the Subdivision or *Acceptance* of the Site Plan or Consent Agreement Works.

“*Municipal Consent*” shall mean Municipal authorization for a company to occupy a specific location within the *Township* Right-of-Way (also identified as MC).

“*Municipal Drain*” shall mean drainage *Works* assumed, constructed, and maintained under the provisions of the Drainage Act, R.S.O. 1990, c.D.17, as amended, including both open and closed drain channels.

“*Owner*” shall mean any person who or any firm or corporation that is the registered *Owner* of the *Lands* under consideration or any agent thereof and shall include a person entitled to limited estate in Land, a trustee in whom *Land* is vested, a committee of the estate, an executor, an administrator, or a guardian.

“*Peer Review(er)*” shall mean any *Consultant* or person contracted by the *Township* to act on their behalf.

“*Security*” shall mean all forms of *Security* including but not limited to cash, letters of credit, performance bonds and insurance to be provided by the *Developer*, pursuant to the requirements of the *Agreements*.

“*Subdivider*” shall mean the *Owner* or party specifically names in the Subdivision *Agreement*.

“*Township*” shall mean The Corporation of the Township of Woolwich.

“*Township Staff*” shall mean the Director of Infrastructure, Director of Development Services or any other *Township Staff* member or *Peer Reviewer* directed to administer this document.

“*Works*” shall mean the *Lands* and infrastructure to be constructed by the *Developer* on the lands, or as are necessary to provide adequate services to the *Development* on the Lands, including the extension, improvement, enlargement or upgrading of existing infrastructure.

Abbreviations

AODA - Accessibility for Ontarians with Disabilities Act

DGSSMS - Region of Waterloo and Area Municipalities Design Guidelines and Supplemental Specifications for Municipal Services

DFO - Federal Department of Fisheries and Oceans

GRCA – Grand River Conservation Authority

MC – *Municipal Consent*

MECP – Ministry of the Environment, Conservation and Parks

MTO – Ministry of Transportation

MNRF – Ministry of Natural Resources and Forestry Services

NFPA – National Fire Protection Association

OBC - Ontario Building Code

OPS – Ontario Provincial Standards

OPSD - Ontario Provincial Standard Drawings

OPSS - Ontario Provincial Standard Specifications

R.O.W. – Township of Woolwich, Region or Provincial Right of Way

RWP – Township of Woolwich Road Work Permit

SWM – Stormwater Management

TAC – Traffic Association of Canada

TWSS - Township of Woolwich Standard Specifications

Table of Contents

1. Introduction	13
1.1. Purpose	13
1.2. Acknowledgements	14
1.3. Updates	15
1.4. General	15
1.5. Applicable Legislation	16
1.6. Applicable Township By-Laws	17
1.7. Disclaimer	17
2. Submission Requirements	18
2.1. Introduction	18
2.2. Engineering Submission Process	18
2.3. Original Drawings and Engineering Drawing Requirements	20
2.4. Drawing Standards	21
2.5. AutoCAD Drawing Standards	21
2.6. Engineering Drawings	22
2.7. Engineering Submission	24
2.8. As-Recorded Drawings	41
2.9. Site Alteration	44
3. Municipal Consent Requirements	45
3.1. Introduction	45
3.2. General Requirements	45

3.3.	Work Permitted without MC.....	45
3.4.	Emergency Work.....	46
3.5.	Service Drops.....	46
3.6.	Road Work Permits	46
3.7.	Municipal Consent Application	46
3.8.	Acceptance Procedures	47
3.9.	As-Constructed / As-Recorded Drawings.....	48
3.10.	Security Deposit.....	48
3.11.	Municipal Consent / Road Work Permit Fees	48
3.12.	Other Considerations	49
3.13.	Municipal Consent Manual.....	49
4.	Landscape Requirements.....	50
4.1.	Introduction	50
4.2.	Requirements.....	50
5.	Roadway Design.....	51
5.1.	Introduction	51
5.2.	Road Classification.....	51
5.3.	Road Pavement Design	52
5.4.	Visibility Triangles within Right of Way.....	53
5.5.	Boulevards	54
5.6.	Sidewalks	54
5.7.	Cul-De-Sacs.....	55
5.8.	Driveways.....	56

5.9.	Roundabouts and Traffic Circles	57
5.10.	Road Sub Drains.....	57
5.11.	Concrete Curb and Gutter.....	58
6.	Lot Grading Design	59
6.1.	Introduction	59
6.2.	Design Criteria	60
6.3.	General Design Criteria.....	62
6.4.	Retaining Walls	65
6.5.	Individual Lot Grading Plans and Certification.....	66
6.6.	Certification	69
6.7.	Infill Residential Design/Construction Requirements.....	70
6.8.	Additions to Existing Residential Developments	71
6.9.	Lot Grading Acceptance and Certification Process	72
7.	Sanitary Sewer Specifications	74
7.1.	Introduction	74
7.2.	Private and Public Sewage Systems.....	74
7.3.	Sanitary Sewer Design Criteria	75
7.4.	Inflow and Infiltration	82
7.5.	Bulkheads	82
7.6.	Rainfall Monitoring.....	84
7.7.	Flow Monitoring Performance Analysis and Results	84
7.8.	Acceptance of Servicing.....	84
8.	Watermain Specifications	85

8.1.	Introduction	85
8.2.	Watermain Design Criteria	85
8.3.	Watermain Construction Specifications.....	86
8.4.	General / Emergency Maintenance	89
9.	Stormwater Management Design	90
9.1.	Introduction	90
9.2.	Stormwater Quantity and Quality	91
9.3.	Stormwater Management Securities	94
9.4.	Stormwater Systems Design Criteria.....	95
9.5.	Analytical Methods for Stormwater Design.....	102
9.6.	Watercourse Systems	108
9.7.	Stormwater Management Erosion Control/Geomorphology	113
9.8.	Stormwater Management Facilities in Development and Re-Development.....	114
9.9.	Monitoring	125
9.10.	SWM Facility Acceptance Requirements	129
10.	Site Plan Development Submissions.....	138
10.1.	Introduction	138
10.2.	Drawing Requirements	138
10.3.	Reports	140
11.	Minimum testing Requirements	143
11.1.	Introduction	143
11.2.	Trenches.....	143
11.3.	Asphalt and Concrete	146

11.4.	Lot Grading	151
11.5.	Erosion and Sediment Control	152
11.6.	Watermains.....	152
11.7.	Sewer.....	153
11.8.	Closed Circuit TV (CCTV) Inspections.....	153
12.	Transportation Impact Study Guidelines.....	157
12.1.	Introduction	157
12.2.	Purpose of Transportation Impact Study Guidelines.....	158
12.3.	Recommended Threshold for Study	159
12.4.	Qualifications to Conduct Transportation Impact Study	160
12.5.	Transportation Impact Study Process.....	160
12.6.	Transportation Impact Study Report Contents.....	162
13.	Hydrogeological Study Requirements	167
13.1.	Introduction	167
13.2.	Background Review	168
13.3.	Initial Field Program.....	170
13.4.	Hydrogeological Study Report Requirements	173
13.5.	Additional Investigations and Reporting.....	174
14.	Erosion and Sediment Control.....	176
14.1.	Introduction	176
14.2.	General Requirements.....	177
14.3.	Erosion Control Criteria.....	178
14.4.	Inspection and Performance Monitoring	178

15.	Survey Control Requirements	183
15.1.	Introduction	183
15.2.	Survey Control Points	183
15.3.	General Requirements	184
15.4.	Monuments and Benchmarks	185
15.5.	Subdivision, Site Plan, Infill Lot Acceptance	187
15.6.	As-Recorded Field Drawings	187
16.	Fees, Securities, and Insurance	190
16.1.	Introduction	190
16.2.	Cost Estimate.....	190
16.3.	Engineering Fees.....	190
16.4.	Letter of Credit	191
16.5.	Letter of Credit Reduction Process	191
16.6.	Stormwater Management Fees and Security	192
16.7.	Obligations during the Maintenance Period	193
16.8.	Perpetual Maintenance Fees	195
16.9.	Insurance	196
17.	Appendices.....	198

1. Introduction

1.1. Purpose

The prosperity of the *Township* depends upon long-term planning for strong and sustainable communities. This includes mitigating environmental impacts, providing quality infrastructure, and identifying full life cycle infrastructure costs. The Township of Woolwich Engineering *Development and Infrastructure Manual* has been prepared as a reference guide to assist with *Capital and Development Infrastructure Projects, Municipal Consent, Municipal Drains* and Land Development Applications including but not limited to general lot grading, consents / zone change, infill *Development*, Site Plans, Condominiums and Subdivision applications. This document outlines policies, procedures and standards governing the engineering / infrastructure review, inspection, and *Acceptance* process.

The Engineering *Development and Infrastructure Manual* includes design criteria and Best Management Practices specific to the *Township* to provide a general overview of the Engineering Review, *Acceptance* and Maintenance Process; however, it is not intended to be a comprehensive document. The intention of this document is to provide general design criteria for the *Engineer / Designer* for completion of the grading, servicing, storm water management, road design, traffic studies, hydrogeology, erosion control, minimum testing requirements, landscaping etc. to allow for the *Township* to provide a more efficient review and *Acceptance*.

Development infrastructure activity, *Municipal Consents, Municipal Drains* and *Capital and Development Infrastructure Projects* are to be prepared in a manner that meets the design criteria contained in this document. This Engineering *Development and Infrastructure Manual* will be periodically updated to include revisions where required. Design submissions will be reviewed by *Township Staff*.

The *Consultant / Applicant* is to perform all professional services in accordance with the standard of care customarily observed by professional consulting firms performing similar services. The standard of care will include adherence to all applicable published standards of the profession and laws, regulations, by-laws, building codes and governmental rules and requests. A complete and thorough design submission that applies these design criteria as well as other legislative, reference documents, etc. will ensure a more efficient review process.

It is noted that each engineering submission is unique and will be reviewed based on its own merit, including evolving operational practices, legislative requirements and additional items that may be required to address site specifics for any given project. Special circumstances may require items over and above these design standards. The *Township* reserves the right to apply discretion in the interpretation of the enclosed design criteria, and require the use of other applicable design guidelines, Best Management Practices, operational / utilities

practices, and good engineering judgement when reviewing each project to protect the best interest of the corporation and the general public. Current legislation shall be followed at all times.

This document is an official Infrastructure Services and Development Services Policy document. The Engineering *Development* and Infrastructure Manual is to be read in conjunction with various other *Township* master planning documents, by-laws, guidelines, and policies.

The *Township* has adopted the “Ontario Provincial Standard Drawings and Specifications MUNI (OPSS, OPSD)”, “Region of Waterloo and Area Municipalities Design Guidelines (DGSSMS)” and the Township of Woolwich Standard Specifications (TWSS) except where amended as indicated in this Document.

1.2. Acknowledgements

The Engineering *Development* and Infrastructure Manual has been prepared by the *Township* in consultation with industry representatives, agencies, professionals, and utility corporations. Infrastructure Services and Development Services staff wish to thank the following for their comment and input into the preparation and update of this document:

Township of Wilmot

Township of Woolwich

GHD Limited

Salvini Consulting Inc

Hydrogeology Consulting Services

City of Kitchener

City of Waterloo

Waterloo Region Homebuilder's Association

Conestoga Heavy Construction Association

Region of Waterloo

Consulting Engineers of Ontario

1.3. Updates

Periodic updates of this document will be completed to address revised information, as applicable. Revision Information Sheets at the beginning of this document will indicate which items/sections have been revised. This document is available on the *Township* website, and it is the responsibility of the user to obtain the latest version available. Comments and questions may be forwarded by email to the Township of Woolwich at woolwich.mail@woolwich.ca

1.4. General

The *Township's* Infrastructure Services and Development Services departments are responsible for infrastructure review and *Acceptance*, permits and operations / maintenance for the following.

- *Municipal Drains,*
- *Municipal Consents,*
- *Development Infrastructure,*
- *Capital and Development Infrastructure Projects,*
- Infrastructure Asset Management,
- Transportation Infrastructure Management.

These departments are structured into specific administrative divisions. Table 1-1 (below) lists each division and its corresponding function with respect to the infrastructure review, *Acceptance*, permits, inspections, and maintenance responsibilities.

Table 1-1: Infrastructure Services and Development Services

Division	Key Roles & Service Deliverables
Development Services	<ul style="list-style-type: none"> • General grading review and Acceptance (Additions, Severances, Pool permits etc.) • Infill lot engineering. Landscape Review in the Right of Way • Site Plan Engineering. within the Right of Way • Subdivision Engineering in the Right of Way • Field Inspection Services • Site Alteration Permits

Infrastructure Services	<ul style="list-style-type: none"> • Watermain Form 1 review, sign off and Acceptance • Road Work Permits • Municipal Drain review and Acceptance • Special Servicing Agreements • Municipal Consents • Municipal Consent Agreements • Transportation Engineering review and Acceptance • Transportation Operations • Infrastructure Asset Management • Right of Way Encroachment Agreement • Storm Sewer Operations and Maintenance • Road Maintenance and Construction within the Municipal Right of Way • Capital and Development Infrastructure Projects • Water Operations • Water Service Programs • Sanitary Sewer and Pumping Station Operations and Maintenance • Sidewalk Clearing • Locates
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1.5. Applicable Legislation

The Divisions in Infrastructure Services and Development Services conduct work under the authority or direction of various pieces of legislation listed below but not limited to:

- Environmental Protection Act
- Environmental Assessment Act
- Species at Risk Act
- Endangered Species Act
- Invasive Species Act
- Forestry Act
- Professional Engineers Act
- Safe Drinking Water Act
- Clean Water Act

- Ontario Water Resources Act
- Accessibility for Ontarians with Disabilities Act (AODA)
- Municipal Act
- Drainage Act
- Planning Act
- Building Code Act
- Infrastructure for Jobs and Prosperity Act 2015
- Broader Public Sector Accountability Act
- Ontario Underground Infrastructure Notification System Act
- Occupational Health and Safety Act
- Public Service Works on Highways Act
- Construction Act
- Highway Traffic Act
- Telecommunications Act
- Canadian Transportation Act and Rail Safety Act
- Applicable By-laws of the Township of Woolwich and the Regional Municipality of Waterloo

1.6. Applicable Township By-Laws

In addition to applicable provincial statutes related to *Development*, environmental protection and public utilities etc. various by-laws govern the engineering and *Development* process in the *Township*.

Relevant by-laws are available online at the Township of Woolwich and Region of Waterloo website. It is the applicants' responsibility to ensure that the most recent version of the by-law is used.

1.7. Disclaimer

The Township of Woolwich has supplied this manual with the express understanding that the *Township* shall not be liable in any manner whatsoever to any person, corporation or organization for damages, injuries or costs resulting from the use of the information supplied. The Township of Woolwich reserves the right to amend, alter or accept revisions to this manual at any time without further notice. It is the user's responsibility to contact the Township of Woolwich for the current version of this manual.

2. Submission Requirements

2.1. Introduction

The purpose of this section is to outline the general engineering submission requirements for *Capital and Development Infrastructure Projects* and *Works* in support a *Development Application*. These *Works* are contained within schedules of a *Development Agreement*.

2.2. Engineering Submission Process

In general, the following is the process for submitting engineering documents in support of a complete Development Application for review by the *Township*;

- Pre-Submission Meeting
- Functional Plans and Reports Submission
- 1st Engineering Submission
- 2nd Engineering Submission
- Final Engineering Submission
- Township Engineering Acceptance

Note: Subsequent submissions beyond the 3rd submission may be necessary and may be subject to additional review fees.

Prior to the first engineering submission, please contact Development Services to arrange a pre-submission meeting to review the engineering requirements in detail. An incomplete engineering submission will be returned without a complete review and comments. This can result in unnecessary and avoidable time delays.

Unless otherwise discussed with *Township Staff*, the following is a list of information required for the 1st Engineering Submission:

- Reference Plans,
- General Above Ground Services Plan,
- General Underground Services Plan,
- Storm Drainage Plans,
- Storm Sewer Design Sheets,
- Stormwater Management Report,
- Plan and Profile Drawing,
- Miscellaneous and Special Detail Drawings (i.e., detailed drawings for outlets and watercourse improvements),
- Erosion and Sediment Control Plan,
- Grading Plans,

- Pavement Marking Plan,
- Signage Plan,
- Utility Plan,
- Streetscape/Landscape Plans,
- Geotechnical Soils Report,
- Phase One Environmental Site Assessment,
- Traffic Impact Study,
- Draft Agreement Schedules,
- Noise Report,
- Street Lighting – Photometrics Plan,
- Proposed Plan for Registration (M-Plan),
- Tree Survey Plan and Arborist Report,
- A letter of Retention from the Consulting Engineer stating that they have been engaged for the design and complete general construction supervision of all municipal services,
- A copy of the Consulting Engineer's letter to the Region of Waterloo forwarding the 1st engineering submission in accordance with their requirements and,
- Proof of payment of any applicable fees.

Unless otherwise discussed with *Township Staff*, the following is a list of information required for the 2nd Engineering Submission:

- All first Engineering Submission plans, drawings and reports that were marked up by *Township Staff* as part of the 1st Engineering Submission Review,
- A comment response matrix explaining how each outstanding comment has been addressed,
- All revised materials which must satisfactorily address the 1st Engineering Submission Comments.

If a Stormwater Management Facility is included;

- Stormwater Management Pond Planting Plans prepared and stamped by a *Landscape Architect*, including detailed drawings, pond plant list and detailed cost schedule for the proposed landscaping works,
- A copy of the MECP Environmental Compliance Approval applications, which must be signed by the *Owner* and Consulting Engineer.

Final Engineering Submission

- Complete digital set of drawings and reports,
- Securities for the development as per the *Agreement*,
- Original Certificates of Insurance as per the *Agreement*,

- Written confirmation from the Region of Waterloo that includes a final approval letter for municipal *Works* and payment confirmation of required *Fees* and contributions,
- A copy of the final M-Plan signed and dated by the Owner,
- A Street numbering (address) Plan (addresses provided by the *Township*),
- Asset management data in an Esri compatible format. Once the proposed data is incorporated into the *Township* GIS, Asset Numbers will be provided by the *Township*,
- A letter from the Ontario *Land* Surveyor certifying that the final M-Plan has not been changed since the Zoning By-law came into effect.

2.3. Original Drawings and Engineering Drawing Requirements

The latest revision of the Ontario Provincial Standard Drawings (OPSD) and Specifications (OPSS) MUNI must be used unless otherwise specified in this document. A list of OPSS and OPSD along with *Township* standards used is to be included as part of the engineering drawings for all submissions to *Township Staff* and must be referred to by number on the affected plan and profile drawings. All designs are to be in accordance with this document and the Region of Waterloo Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS).

The *Engineer* shall be responsible to check the suitability of the details provided on these standard drawings for the proposed application. Site specific details shall be provided by the *Engineer* for all special features not covered by the Ontario Provincial Standards.

Site Specific individual details shall be drawn on standard size sheets and shall be included as part of the engineering drawings. The minimum scale to be used for any maintenance hole or sewer detail shall be 1:50.

Upon receipt of all approvals and / or *Acceptance* from all affected agencies, the original drawings shall be submitted to *Township Staff*. These originals shall be signed and dated by *Township Staff* indicating the *Acceptance* and returned to the Engineer. No changes or revisions may be made to the drawings after being signed by *Township Staff* unless written authorization is provided by *Township Staff*.

If, after one year from the date of the original *Acceptance* of the engineering drawings by the *Township*, the *Subdivider / Developer* fails to enter into a *Development Agreement* with the *Township*, or the work has not been initiated, the *Township* reserves the right to revoke all permits and/or *Acceptances* related to the engineering drawings.

2.4. Drawing Standards

All engineering drawings shall be prepared in a neat and legible fashion and to the satisfaction of the *Township*. The information presented on these drawings shall be completed using AutoCAD current within 3 years.

All General Services Plans, *Municipal Drain Plans*, catchment area plans, *Municipal Consent plans*, Plan and Profile Drawings, Grading Plans and Detail Drawings, etc. shall be prepared and submitted on standard D size sheets – 558.8 mm x 863.6 mm (22" x 34").

Each individual drawing must give clear instructions / context as to the materials, methods and details of the design and constructability of the services.

Each drawing shall include the following;

- The lot numbering and block identification in accordance with the Registered Plan and *Easement* number / PIN # shall be shown on all engineering drawings,
- All elevations shown on the engineering drawings are to be related to UTM 17N NAD 83 Geodetic datum. Refer to Section 15 for further information,
- All plan and profile drawings are to be prepared so that each roadway can be filed separately. Road names shall be identified on the plan portion of the drawings,
- When the roads are of a length that requires more than one drawing, match lines are to be used with no overlapping of information,
- The reference drawing numbers for all intersecting roads and match lines shall be shown on all plan and profile drawings,
- A title block depicting the drawing number, drawing title, date, date of revisions, and scale of the plan in metric units shall be on all drawings,
- A north arrow shall be referenced on all drawings as well as construction north,
- The name and contact information for the *Consultant* for the project,
- All engineering drawings must be stamped and signed by a Professional *Engineer* Registered to practice in Ontario.

2.5. AutoCAD Drawing Standards

- The drawing scale for plan and profile drawings shall be in metric, using a scale of 1:500 horizontally and 1:50 vertically. A scale of 1:250 horizontally should be used in congested areas,
- Drawings shall be oriented such that North points up and/or to the right (or left if required),
- Dimensions and elevations shall be provided in metric units,

- Existing conditions are to be shown on a separate plan and shall appear faded in comparison to the items which are to be removed. The final copy should use a text size of 1.6mm,
- The various utility lines (telecom, hydro, gas, etc.) should be identified and appear slightly darker than existing topography,
- Proposed work should appear heavier than existing conditions and use a text size of 2.0mm for notes, elevations, and dimensions,
- All similar line work and text should be drawn using a layer, colour and line type named to easily identify the linework and text.

2.6. Engineering Drawings

Functional Submission

Where the *Township* requires a Functional Servicing Report (FSR) to be completed, this guideline shall be followed. A FSR will address the impacts of the proposed *Development* on, but not limited to, servicing, grading and drainage, water quality or quantity, hydrogeology, geotechnical, traffic, environmental features, project constraints or technical issues including potential impacts to adjacent properties including the right of way. The functional design report must provide sufficient information to confirm that the proposed *Development* is constructable, the existing *Township* / Region infrastructure is sufficient for the proposed demand and usage of the system.

Prior to the commencement of the design and the FSR, it is recommended that the *Developer's* Professional Consulting *Engineer* / Planning *Consultant* shall determine the report scope with the *Township* and discuss the requirements and any other relevant studies that might be required (Pre-Study Conference).

The Functional Servicing Report shall provide, as a minimum, all details, calculations, costs, alternatives, and recommendations necessary to facilitate logical and appropriate decision-making. Preliminary engineering review of the functional design and other studies as required may indicate inadequate servicing capacity; other critical issues that may require an alternative approach to site *Development*; or that may impact the viability of the project. The scope and requirements of the feasibility study as it relates to *Township* infrastructure will be at the discretion of *Township Staff*.

The report shall provide all relevant background information with respect to Site Constraints / Existing Conditions such as but not limited to:

- Topography and drainage,
- All pipelines (Trans Canada, Enbridge, etc.),
- *Easements* / corridors,
- Main sewer lines and watermains,

- Utilities,
- Environmental features (protected watercourses, terrestrials, etc.).

The functional servicing report should include, but will not necessarily be limited to the following considerations:

- Concept Plan,
- Contour Plan,
- Existing Conditions Plan,
- Existing *Easements* / legal plan,
- Phase 1 and 2 Environmental Site Assessments,
- Water well interference studies,
- Tree clearing and grubbing plan,
- Tree Preservation Plan,
- Trails / Walkway plans,
- General Plan of Services,
- Drainage and Erosion Control Plan,
- Lot Grading Plan,
- Geodetic Benchmark / Demarcation post plan,
- Geotechnical Investigation,
- Hydrogeological Investigation / Groundwater Contour Plan,
- Major roadway alignments, cross-sections, and intersections,
- Roadway structures / roundabouts,
- Watercourse improvement and channelization,
- Railway crossings,
- Parkland development,
- Major sewer lines, storm and sanitary,
- Storm drainage systems, including overland flow routes and outlets,
- Storm water management plan / reports,
- Sanitary drainage systems, including assimilative capacity analysis of the receiving system (if applicable),
- Landscape / vegetation plan,
- Tree Preservation Plan,
- Water distribution systems, including independent pressure zones and flow testing of the existing systems and network modelling,
- Detail plans,
- Pumping station locations,
- Photometric,
- Traffic Impact study,
- Traffic Plan showing parking, line painting, signage.

In cases where the subdivision *Development* under consideration forms part of a larger area set aside for future *Development* or potential in the fullness of time, the functional servicing report shall be a requirement to confirm that the servicing design will allow for orderly and efficiently planned future *Development* visioning. The functional servicing report shall be signed and sealed by a professional Engineer. The relevant studies related to a particular *Development* will be outlined in consultation with *Township Staff*, outside agencies and other interested parties, and will be required as conditions of planning or engineering approval.

All engineering drawings included in the functional engineering design submission must be fully coordinated with all other drawings in the Land Development Application submission. Functional Servicing Report submissions containing uncoordinated drawings and missing information will be returned to the applicant before further review work proceeds.

2.7. Engineering Submission

Cover Sheet

A cover sheet shall be provided and include the following but not limited to:

- Name of the *Capital and Development Infrastructure Project*, *Municipal Consent* and/or *Development* project,
- Name of the *Municipal Drain / Municipal Consent / Subdivider / Owner / Developer* and contact information,
- Township logo,
- Name of the *Consultant* and contact information,
- Key Plan at scale of 1:10,000 indicating the location of the proposed *Works* and the proposed infrastructure alignment,
- Index to all drawings in the set indicating drawing number and title,
- Draft Approvals (30T and 58M, 58R plan numbers if applicable), and
- Submission description i.e., 1st Submission, 2nd Submission, etc.

Existing Conditions Plan

This plan will be used as a benchmark for all future *Development Infrastructure*, *Municipal Drain*, *Municipal Consent* and *Capital and Development Infrastructure Project* conditions on the site and is required so *Township Staff* may familiarize themselves with the present site conditions. In addition, this plan will be used to validate the *Pre-Development* parameters used in the *Pre-Development* storm water management modeling. The professional responsible for the preparation of this plan must seal the plan with their professional seal (i.e., Professional Engineer,). The requirement for this plan may not be substituted by information illustrated jointly or wholly on other required plans.

The following information is required to be shown on this plan but not limited to:

- Geodetic Benchmark
- Legend
- North Arrow
- Municipal Address
- Professional seal (signed & dated)
- Key Plan
- Legal Property Description
- Property lines and all applicable bearings and distances of each property line
- Easements
- Street Names
- Site Area (in hectares)
- Contours to be drawn to 0.5m intervals minimum. Flat areas may require contours to be drawn at closer intervals to define drainage patterns. Contours to extend beyond the property line to a point which confirms the drainage on the neighbouring property will not be impeded by the proposed *Development*.
- Spot elevations are required at all lot corners and should be used to delineate depressions and ridges within the site.
- Show all existing site surface features such as but not limited to buildings, sheds, walkways, driveways, trees, fences, major drainage channels, surface texture (i.e., concrete, gravel, asphalt)
- All existing above ground and underground services, within the site, on adjacent sites and within the road allowance, fronting the site:
 - Dimensions of road allowance/carriage ways/boulevards,
 - Location of sidewalks/hydrants/trees/utility poles/signs/storm & sanitary sewers/infiltration galleries/water & gas mains/maintenance holes/catchbasins/curbs & gutters,
 - Location of all existing buildings, culverts, drains, wells, and utilities,
 - Diameter/length/slope/inverts of all storm and sanitary sewers,
 - Location and depth of all telecom and hydro ducts,
 - Elevations along centreline, top/bottom of curbs, and property line.
- *Pre-Development* drainage boundaries and corresponding areas,
- Drainage patterns on neighbouring properties.

Note: This plan may not be required if the proposed *Development* is located within a registered plan of subdivision with an accepted lot grading control plan.

If this plan is prepared by someone other than the *Engineer* responsible for the SWM design, it is the Engineer's responsibility to ensure the accuracy of the Existing Conditions Plan for which the SWM design is based upon.

Each Existing Conditions Plan shall bear a note referring to all other plans included with the SWM Report. Reference should also be made to the storm water management report itself, the date of the report, and the Landscaping Plan (e.g., This plan to be read in conjunction with but not limited to the Existing Conditions Plan, Grading and Sediment and Erosion Control Plan, Storm Water Management Plan, Landscaping Plan, and the Storm Water Management Report dated XXX.)

General Plan of Services

A General Plan of Services shall be prepared for all subdivisions and large *Municipal Consents* and include, but not limited to, the following:

- the general overall scope of the project and the geographic relationship to surrounding Lands,
- a scale of no greater than 1:1000,
- When more than one General Plan of Services drawing is required for any *Development*, the division of drawings shall reflect the limits of the Registered Plans as closely as possible,
- Location and description of all available benchmarks, the reference Geodetic Benchmark and the Site Benchmarks to be used for construction shall be identified on the General Plan of Services. Iron property bars are not acceptable construction benchmarks. Refer to Section 15 for more information,
- A Key Plan and the area covered by each drawing shall be clearly identified within the Key Plan,
- Road allowances, lots, blocks, *Easements*, and reserves are to be shown and are to be identified in the same manner as the Registered Plan,
- Existing services, dry utilities and abutting properties are to be shown and flow direction of wet utilities,
- All proposed services to be constructed are to be shown,
- All sewers are to be shown and labelled with length, size, pipe class, material, and flow directions,
- Sewer maintenance holes and catchbasins are to be shown and numbered in accordance with the *Township's* numbering system,
- All watermains, valves, hydrants, reducers, tees, and blow-offs, etc. are to be shown. Watermains are to be identified by size and material,
- All curb and sidewalks are to be shown,
- All fencing to be indicated by the height and type of fence,
- All streetlight poles and transformers are to be shown,
- Registered Plan number must be shown on the As-Constructed General Plan of Services,
- All site details for parks, schools, institutional, commercial, and industrial *Development*, etc. must be shown,

- If a subdivision / site plan / infill lot encroaches on an existing floodplain, the approved fill lines and restrictions must be shown, as specified by the conservation authority,
- Mailbox locations must be shown on the As-constructed General Plan of Services.

Plan and Profile Drawings

Plan and Profile Drawings shall provide sufficient detailed information required for construction of roads, municipal services, and future maintenance of the assets.

Plan and Profile drawings are required for all roadways, blocks and *Easements* within Capital, *Municipal Drain and Development*, for all outfalls beyond the project to the permanent outlet, for all boundary roadways abutting the project and for other areas where underground utilities are being installed.

- All plan and profile drawings are to be drawn at scales of:
 - 1:500 horizontally
 - 1:50 vertically
- The sewer, storm and watermain profiles shall be drawn so that each street and *Easement* may be filed separately,
- Refer all datum to a benchmark of geodetic origin,
- Show all existing and proposed lot numbers, addresses and blocks,
- Show all existing and proposed curbs, road allowances and street names and indicate them as such,
- Show all existing sidewalks, walkways, and trails,
- Where two or more sheets are required for one street, match lines must be used with no overlaps,
- Where intersecting streets are shown on a plan and profile drawing, only the diameter of the pipe and direction of flow of the intersecting sewers are to be shown. This also applies to *Easements* for which a separate plan and profile drawing has been drawn,
- Pavement designs for the particular roadway are to be indicated on each plan and profile drawing,
- The detail information from all the borehole logs is to be plotted on the profile and located on the plan. Borehole information shall contain a borehole location plus a brief description of soils and the water level,
- Where roundabouts are proposed, a plan and profile drawing shall indicate detailed design dimensions including radius, lane width, etc.,
- Profiles of roadways shall be produced sufficiently beyond the limits of the proposed roads, to confirm the feasibility of possible future extensions and grading details, etc.,
- The basement elevation of all existing dwellings on the streets where sewers are to be constructed shall be noted.

Plan View

The following information and details are to be included, but not limited to;

- Street names,
- Block/lot number and frontage dimension,
- Block/lot type (single, semi, multiple),
- Servicing locations for storm, sanitary and water, ditches, and swales, etc.,
- All existing (as needed) and proposed sewers and watermains, maintenance holes, catchbasins,
- Third pipe systems,
- Valve chambers,
- Hydrants,
- Sidewalk,
- Setback of proposed driveway to above ground structures (poles, signs, pedestals, etc.,
- Centreline chainage (every 20.0 m) noted by a point or small cross,
- Road allowance and pavement dimensions,
- Driveway locations,
- Curb radii,
- *Easements*,
- Reserves,
- Road sections where clarification is required,
- Detail gutter grades on large radius bends, roundabouts, and cul-de-sacs (minimum 1.0%). Details of the gutter grades around all 90-degree bends, crescents and cul-de-sacs shall be provided on plan view as a separate detail at a scale of 1:250,
- Light standard and transformer locations,
- Above ground utility pedestals, and
- The type, slope, diameter, and grade of the sewers are to be indicated on the Plan view.

Profile View

The following information and details are to be included, but not limited to;

- The type of underground service (existing and proposed watermain, sanitary, storm, water), the diameter, length, material grade and class of pipe. The watermain shall be plotted to true scale size on the profile view,
- All the proposed services, utilities and features are to be shown on the plan view. Those services and utilities below grade that are critical to the new construction shall also be shown in the profile. Test holes may be required to determine actual elevation of these services and utilities,
- Service connections where possibility of a conflict with other services exists,

- road profile, existing and proposed. All structural fill areas are to be identified and shaded,
- original ground elevation at centreline and the proposed centreline road grade. The proposed centreline grades shall be fully labelled including length, grade, P.I stations and elevations, etc.,
- centreline chainage and elevations. Indicate the elevation at grade changes and provide the slope and length of each section. The P.I., B.H.C., E.H.C., B.V.C., and E.V.C. chainages shall also be noted along with LVC, K factor and HP/LP station and elevation,
- vertical curve data on the top of the profile view,
- existing (as needed) and proposed maintenance hole information, pipe inverts at entry and exit, catchbasin lateral inverts, drop structure details. Indicate safety platforms and elevations where required,
- Provide detailed information for all outfalls external to Capital, *Development* Infrastructure, and *Municipal Drains*,
- Borehole data including soils and water table,
- Hydraulic grade line of the sewers,
- Minimum basement elevations,
- Pipe crossing clearance, and
- Match lines

Lot Grading Plan

The following information and details are to be included, but not limited to;

- Key plan indicating the area of the proposed *Development*,
- Drawings at a scale of 1:500,
- Legend including all symbols and elevation formats shown on the plan,
- North arrow,
- Street names of all roads within and bordering the proposed *Development*,
- Lot numbers, plan numbers or municipal addresses,
- All existing and proposed *Easements*,
- All elevations shall be referred to the geodetic metric datum (NAD83),
- Existing contours to be shown at a maximum interval of 0.5m, and shall extend 20m beyond the limits of the property/*Development*,
- Borehole locations with stabilized groundwater elevations c/w date of measurement,
- Locations of catchbasins, maintenance holes, hydrants, valves, streetlights, transformers, telephone pedestals, sidewalk walkways, mailboxes, and hydro poles
- Defined limits of tree preservation in accordance with the approved Tree Preservation Plans,
- Previous phase as constructed elevations to 20m beyond phasing boundary,

- Location of existing and proposed buildings, including those on adjacent Lands,
- Proposed building envelopes,
- Proposed driveways,
- Proposed ground elevations at the front and rear of the building envelope,
- Top of foundation wall for proposed structures,
- Maximum underside of footing for buildings beside underground service leads,
- Details showing the style of the proposed lot grading, with detail for each style indicating orientation, typical relative high point, overall slope through the property limits,
- Proposed and existing elevations at lot corners,
- Intermediate grade change points,
- Direction of flow on lot lines,
- Any underground drainage must be identified,
- Identify all lots where Engineered fill has been placed or will be placed,
- Surface water runoff for all lots and roadways indicating direction of flow,
- Location and grade of swales,
- Water courses and drainage ditches,
- Typical grading cross-sections for all distinct lot drainage and configurations,
- Proposed centerline elevations, road grades and right of way limit elevations at 20m intervals along roads,
- Crossfall for boulevards,
- Retaining walls, top and bottom elevations, and locations,
- Well and septic locations (if applicable); including dimensions for septic locations,
- Entrance locations to the property and adjoining properties as well as those on the opposite side of roadways,
- *Low Impact Development* features,
- Location of any Railway Lines or Pipelines, showing all offsets, and
- Area regulated by Conservation authority with *Development* setbacks and floodline limits (if applicable).

Detail Plan

A Detail Plan will be required when there is not sufficient space on the Plan and Profile Drawings or other drawings to fully describe the necessary Works. See examples below;

- A Typical Road cross section shall be shown on the Detail Plan, illustrating R.O.W. dimensions, pavement structure, sewer and watermain locations, curb and sidewalk locations, and proposed utility locations,
- Swales / ditches details to be shown,
- Legal outlets to be noted,
- *Easements* / reference plans to be shown,
- Details of special chambers, such as metering chambers shall be shown,

- Details of special structures, such as storm sewer inlets and outlets or retaining walls shall be shown,
- Details of special drainage features, including stormwater retention/detention ponds shall be shown,
- Pumping station details shall be shown,
- Service connection layout,
- Any other details or notes as required shall be shown,
- Silt fence detail,
- Grading details and engineering details shall be shown on separate drawing sheets. Grading detail drawings shall include details with respect to lot grading type, swales, etc. while engineering details drawings shall include maintenance hole types, infrastructure details etc.,
- Lot grading plan should also include groundwater elevations, indicate major flow routes, direction of drainage / swales, regulatory flood line elevations as well as existing drainage directions. To show all details of groundwater more clearly, a separate Groundwater Separation Plan can be included.

Storm and Sanitary Drainage Plans

A separate drainage area plan for storm and sanitary drainage shall be prepared. The external drainage area plan shall be prepared and shall be submitted to the *Township* at the functional report stage and prior to the commencement of the detail storm sewer design. In the case of large areas under single Ownership and/or blocks requiring future *Site Plan Agreements*, the design shall be prepared based on the whole area being contributory to one maintenance hole in the abutting storm sewer. If more than one private storm connection is necessary to service the property, the appropriate area tributary to each connection shall be clearly shown and considered in the storm sewer design.

The following information and details are to be included, but not limited to;

- The street and lot layout of the subdivision, street names and property descriptions,
- All existing and proposed sewers, maintenance holes, catchbasins shall be shown and labeled with identifying numbers, sizes, lengths, grades, and direction of flow,
- In cases of *Capital and Development Infrastructure Projects*, the *Consultant* is required to establish the geodetic invert elevations and ties of all sanitary / storm sewer connections at street line and to make this information available on the as constructed plans to *Township Staff*,
- All external areas. If the external drainage areas are too large to be accommodated, a separate drawing for the external drainage areas shall be included in the set,
- Storm drainage areas shall be delineated on an actual contributing drainage area and maintenance hole to maintenance hole basis. The actual contributing drainage area,

storm services, roof area shall be evaluated in the upstream storm sewer from where the services are connected to,

- Sanitary drainage areas shall be delineated on a lotline by lotline and maintenance hole to maintenance hole basis,
- All drainage areas shall be numbered and shall include area in hectares, run-off coefficients for storm or population densities for sanitary in accordance with *Township* standards,
- The design sheets (excel and pdf) shall be included with the submission of the storm and sanitary drainage plans.

Storm Drainage Plans are to be drawn to a scale of 1:1,000 or larger. If large external drainage areas affect the *Municipal Drain, Capital and Development Infrastructure Project*, a separate External Drainage Area Plan is to be produced. The Plan is to be produced to a scale of 1:5,000 and is to indicate the total area to be drained by the proposed storm sewers.

The following information and details are to be included, but not limited to;

- Existing contours (0.5 m intervals). Extend contours a minimum 20 m past site boundary or to the limits of sufficient distance to clearly indicate the contributing area,
- Existing culverts, ditches, drains,
- Drainage patterns of adjacent *Lands* and a breakdown of contributing external areas,
- The run-off coefficients and area of tributary areas internal and external to the *Development* for each section of the storm sewers within the *Development*,
- Direction of surface run-off (overland flow),
- Street names,
- Maintenance hole and Catchbasin numbers,
- Sewer sizes – Diameter and length,
- Directions of flow in the sewers,
- Any infrastructure off the right of way to be accepted by the *Township* and or drainage patterns to be maintained by *Owners* e.g., rear lot catchbasins or swales, *Municipal Drains*, on lots, parks, or blocks, required to accept storm runoff,
- Complete major and minor storm systems,
- Label legal outlets,
- Proposed and existing *Easements*.

Sanitary Drainage Plans are to be drawn to a scale of 1:1,000, unless otherwise accepted by *Township Staff*.

The following information and details are to be included, but not limited to;

- Existing sanitary sewers and services to the limits of the catchment area,

- Proposed and existing sanitary sewers, forcemains, maintenance holes and appurtenances, indicating grade, pipe size, length of each section of pipe and direction of flow,
- Drainage areas within the project limits draining into the proposed system,
- Catchment area in hectares, direction of flow and section population or population density.

Composite Utility Plan

To ensure that conflicts are avoided among utilities, street trees, municipal services, driveways etc. the *Consultant* will compile the Composite Utility Plan for utilities other than water and sewer from the requirements of the various public and private utility agencies. The Utility Plan shall also detail the layout for street lighting. The Utility Plan shall be submitted prior to the *Acceptance* and sign-off of the civil engineering design drawings. The Composite Utility Plan is to be accepted / approved by all individual utility agencies present on the drawing and Canada Post, prior to final *Acceptance* by *Township Staff*.

The following information and details are to be included, but not limited to;

- A legend using standard symbols,
- The location and name of all existing and proposed utilities (Hydro, Telephone, Cable TV, Gas, Streetlight), including those in common trenches,
- The location of all existing and proposed utility structures and pedestals, including Canada Post community mailboxes,
- Typical utility trench details and duct locations shall be shown,
- Any specific duct and trenches cross section details for road crossing shall be shown,
- Any other utility details or notes shall be shown on the Utility Plan,
- Existing and proposed fences, retaining walls, structures,
- surface features for watermain, sewer structures, *Low Impact Development*, street trees, etc.,
- Proposed and existing driveway locations c/w minimum setbacks from utilities and structures,
- All trees on private and municipal property.

The Composite Utility Plan shall be prepared at a scale of 1:500, unless otherwise approved. It is the *Consultant's* responsibility to ensure there are no conflicts resulting from the design and location of the various utilities.

Landscape Plan

Refer to Township of Woolwich document Urban Design Guidelines for the Public Realm for Landscape Requirements.

Sediment and Erosion Control Plan

The Sediment and Erosion Control Plan must illustrate how the site will be graded to provide erosion protection during construction considering phasing of the *Development* where applicable, how the final grading will ensure positive drainage away from all buildings, how the rainfall runoff will be directed to an accepted legal outlet and ensure that the site grading is compatible with the neighbouring properties. All downspouts outletting to the surface must be directed to a landscaped area away from existing adjacent properties and are required to be equipped with splash pads to minimize the effect of erosion from rainwater.

The site grading is to be implemented in a fashion to allow SWM to be implemented using both the minor and major drainage systems.

The following information is required to be shown on this plan but not limited to:

- Geodetic Benchmark,
- Legend,
- North Arrow,
- Municipal Address,
- Key Plan,
- Legal Property Description,
- Property lines and all applicable bearings and distances of each property line
- Street Names,
- Proposed grades,
- Floodline limits
- Top of foundation and/or finished floor elevation and basement elevations (if applicable). 2 yr. seasonally high groundwater table elevations,
- Location of all proposed maintenance holes and catch basins,
- Clear indication of where existing grades are to be matched,
- Direction of flow with corresponding gradient,
- Swales /ditches with corresponding gradient,
- Top and bottom elevations of all curbing, retaining walls and embankments,
- Embankments 6:1 or steeper to be shown using a series of alternating long and short lines with corresponding slope ratio. Maximum embankment slope is 3.5:1.,
- *Easements* both aerial and Land: Storm, sanitary, water, gas, hydro, telecom, environmentally significant areas, access, etc.,

- Drainage patterns on neighbouring properties +/- 20m outside the subject property line. Existing drainage patterns must be considered and respected in the design of infill *Development*. Legal outlets will be required for infill / Site Plan *Development*,
- Trees to be retained/protected, or removed and the location of any proposed tree/root protection measures,
- Location of all proposed stockpiles,
- Location of all proposed and existing Silt Fencing,
- Major overland flow routes,
- Sedimentation ponds with cross sections, contributing drainage areas with storage volumes and outlet controls. Fences are required around water bodies with 91cm or more of standing water within a 24-hour period,
- Check dams,
- Diversion swales,
- Erosion protection for catch basins and maintenance holes,
- All permanent structures (i.e., decorative features, light standards, deep well units, sheds),
- Construction details for swales, silt fencing, sedimentation ponds, check dams, diversion swales, erosion protection for catchbasins and maintenance holes, mud mats, etc.,
- Show delineation between light duty and heavy-duty asphalt on grading plan as per geotechnical report,
- Rip rap sizing calculations as per MTO requirements are required to verify that stone size and slope of its placement are acceptable as per OPSD 810.010 (Type B).
- Table of revisions,
- Professional *Engineers* stamp, date, and signature,

Site Servicing Plan

A Site Servicing Plan showing all internal site services for storm, *Low Impact Development*, storm water management, sanitary, water etc. is required for review and *Acceptance* by the *Township* prior to final issuance of construction plans and / or execution of an *Agreement*. The Site Servicing Plan must also show the location of all service structures or cleanouts so *Township Staff* may assess the impact a particular site may have on the municipal system. *Township Staff* must be satisfied that proper engineering practices have been applied to the design of all services within the site and within the R.O.W..

NOTE: All sanitary maintenance holes located within the storm water management ponding areas to be fitted with watertight covers, as per OPSD 401.050 and 401.030.

NOTE: It is the Engineer's responsibility to ensure the accuracy of the existing plan shown on the drawings submitted to the *Township* for review. The *Township* does not guarantee the

accuracy of the information presented on any drawings that are obtained from the *Township*, for design purposes.

The following information is required to be shown on the Site Servicing Plan but not limited to:

- Geodetic Benchmark,
- Legend,
- North Arrow,
- Municipal address,
- Professional Engineer's seal (signed & dated),
- Key plan,
- Street Names,
- All existing underground services to the site such as:
 - storm/sanitary laterals,
 - water.
- Distance from curb to property line,
- Tie in dimensions for the position of new services to ensure connections are placed in the proper location,
- Notation of all existing services to be removed or disconnected,
- Proposed services from the street to the building including, but not limited to, the following:
 - size, material, length and slope of all sewers and laterals, top of grate elevations and sewer inverts of all maintenance holes and catch basins.
- Pipes located within frost zones to be insulated. Detail to be provided on plan.
- Location and size of all silva cells or accepted equivalent,
- Details for all appurtenances related to servicing to include, but not limited to, the following:
 - all specialized Engineered structures, pipe bedding, insulation, flow control device, weirs, rip rap, etc.
- Specifications for all on-site *Low Impact Development*, stormwater management, storm / sanitary sewers, and water services to the property line (i.e., pipes, grates, maintenance holes, catchbasins, seepage collars, etc.),
- Location and size of all *Easements* (existing and proposed),
- Clear identification of *Works* to be completed, within the municipal right-of-way, by the *Contractor* (i.e., closing of redundant driveway entrances, curb & gutter replacement, curb cuts, sidewalks, boulevard restoration, etc.),
- Identify existing drainage patterns adjacent to the *Municipal Drains*, Mutual Drain *Agreements*,
- Clearly identify downspout locations and ensure downspouts are directed to landscaped areas, splash pads or infiltration galleries. Adjacent property not to be affected by artificial collected water and discharge,

- Identify vertical and horizontal separation between services. Minimum vertical separation is 0.5m and minimum horizontal separation is 2.5m as per OBC / MECP procedure F-6-1,
- Show all fire hydrant locations. Fire hydrant separation between permanent structures must meet NFPA & DGSSMS,
- Infiltration galleries with two observation wells must be shown on the plan, including size and overflow and storm connections to and from the gallery. Infiltration galleries must be 5m away from a structure (structure defined under the Building Code),
- All servicing structures in the municipal or Regional right-of-way require benching as per DGSSMS,
- The max Modulock height is 300mm. The Region of Waterloo DGSSMS states that Modulock to be as per OPSS 407 and OPSD 704.010. Additionally, ladder rings to conform to the OPSD 704.010,
- Safety grates are required in structures 5.0m deep or greater,
- As per Region of Waterloo DGSSMS, drop structures shall be provided in accordance with MECP design guidelines,
- The Region of Waterloo DGSSMS states that 300mm or larger on open inlet/outlet requires rodent grate. Refer to OPSD 800.010. Other details/designs may be acceptable upon *Township* review. Additionally, in the Region of Waterloo DGSSMS, it states that headwalls with 450mm and smaller outlet require headwall as per OPSD 804.030 and with 525 and larger outlet requires a headwall as per OPSD 804.040. The grating for a headwall is as per OPSD 804.050,
- If an oil/grit separator is required on the site add the Stormceptor (STC) model and size,
- Through the Site Plan or Committee of Adjustment process if it is determined that a sanitary/storm sewer or a water main must be extended to service a particular property a MECP Environmental Compliance Approval will be required, and all *Fees* associated to the extension must be paid prior to final Site Plan *Acceptance* from the *Township*,
- Each new building that requires a sump pump must provide a storm sewer connection to the street. If a storm sewer is not located on the street, one must be extended if the storm sewer is located within 90 meters from the *Development*. The extension of the storm sewer is 100% the *Developers* cost. A sump pump is required in every new building through the Building Code,
- New services are required to be connected to the property if the existing services are undersized, older than 50 years and / or of a material that is no longer acceptable within the *Township* (ex. clay). The existing services then must be capped at the sanitary sewer main,
- Each property shall be supplied with a maximum of one water service and one sanitary service,
- Connections to a sewer less than 200mm in diameter do not need a structure unless it is tapping into the same size pipe. The connection must be a “Y” connection at a 45-degree angle with directional flow above the spring line.

Standard Notes

The following notes are to be placed on all Site Servicing Plans, as a minimum:

- The property *Owner* is responsible for restoration of all damaged and/or disturbed property within the municipal right-of-way to *Township* or Regional standards,
- Each Site Servicing Plan shall bear a note referring to all other plans included with the SWM Report. Reference should also be made to the storm water management report itself, the date of the report, and the Landscaping Plan (e.g., This plan to be read in conjunction with but not limited to the Existing Conditions Plan, Grading and Sediment and Erosion Control Plan, Storm Water Management Plan, Landscaping Plan, and the Storm Water Management Report dated XXXX.).

General Notes Plan

This plan shall list the following and project specific notes determined by the Engineer

- General *Township* design criteria that apply to all sheets. The pertinent notes for the project can be extracted from the design criteria chapter (i.e., lot service, pipe sizes, curb type, catch basin grate type, etc.),
- Special warnings from utility companies and government agencies (i.e., existing structures and buried services),
- General *Township* policies and by-laws which apply to the construction activity (i.e., hours of work, mud tracking, fire permits, construction access, etc.),
- The Owner's consulting *Engineer* shall certify in writing that all site Works, grading and servicing has been constructed in accordance with the approved site servicing and grading plans,
- All *Works* and services to be installed with a municipally owned right-of-way or *Works* and services to be assumed by the municipality shall require full time inspection from the Owner's consulting Engineer,
- All *Works* within the road allowance are to be constructed to meet the minimum standards as noted in the Region of Waterloo's Design Guidelines and Supplemental Specifications for Municipal Services, latest revision,
- The applicant / *Contractor* is to notify the *Township* to schedule an inspection, 2 days prior to undertaking the installation of the water services and sanitary and storm sewers and private drain connections.

Traffic Management Plan

Traffic Management Plan(s) to be drawn to a scale of 1:1,000 and shall show (as a minimum) proposed *Land* uses (e.g. Residential, commercial, parks etc.), road layout, driveways, sidewalks, drop off areas, bicycle paths, bicycle lanes, multi-use trails, entrances to parks and open space areas, signage for bicycle circulation, pedestrian routing, storage and tapers for

turn lanes, traffic control signs including the specific locations of each regulatory, warning and information sign, pavement markings, on-street parking in accordance with the Zoning By-law, restricted parking in school zones and any traffic calming measures (if proposed/required). Grand River Transit should be consulted for transit stops and routing as applicable.

Urban Forest Asset – Tree Planting Plan

Urban Forest Asset – Street Tree Planting Plan are to demonstrate and provide planting locations for trees within the public realm. This plan must clearly show (as a minimum) the soil volumes available to each tree, their species, and locations. The Urban Forest Asset – Street Tree Planting Plan is to be a scale of 1:500 unless otherwise approved by the *Township*.

Refer to Section 4 Landscape Requirements of this manual for all tree planting and soil habitat zone requirements.

Signal Wiring Plan and Signalized Intersection Plan

Should traffic signals be required, a separate Signal Wiring Plan; and Signalized Intersection Plan showing location of all poles and mounted hardware, hand wells, ducts/cables, the controller, and full turn lanes (storage and taper) shall be submitted for review and acceptance by the Region of Waterloo. The plans shall be submitted at a scale of 1:500.

Staging Plan

If a phase within a *Capital and Development Infrastructure Project, Municipal Drain or Municipal Consent* project is to be constructed in stages, a Staging Plan showing current and future stages is to be prepared at a scale of 1:1,000, unless otherwise required by *Township Staff*. *Township Staff* may request specific scales to create composite plans other ongoing projects, etc. Access the site and haul routes are to be shown and notes provided.

If this information can be clearly shown on the General Plan/Underground Services Plan, the two drawings can be combined.

The Staging Plan's function must be substantiated with an interim Stormwater Management Report (and other reports as required by the *Township*).

Provide a phasing and construction schedule that shows the *Works* required to mitigate sediment contamination of affected creeks, adjacent Lands, and storm sewer systems and how they are to be staged.

Construction Management Plan

The Construction Management Plan (CMP) provides an overview of the proposed site *Works* and actions undertaken to identify and minimise the negative effect to local residents and

property *Owners* during the Works. Examples of activities included in in the CMP are management of;

- construction material,
- machinery and equipment,
- schedule of construction activities,
- excess fill,
- demolition,
- vegetation,
- fencing,
- air quality (dust),
- surface encroachment,
- aerial encroachment,
- site *Security*,
- access point,
- temporary traffic,
- groundwater, and
- health and safety.

Park/Multi-Use Pathway Development Plans and Grading Plans

Park/Multi-Use Pathway Development Plans are to demonstrate that the proposed park facility program, including buffers, can be satisfactorily achieved. Both Park/Multi-Use Pathway Development Plan and Park/Multi-Use Pathway Grading Plan are to be a scale of 1:500 and designed in accordance with the Township of Woolwich document Urban Design Guidelines for the Public Realm.

Street Lighting and Electrical Distribution Drawings

To a scale of 1:1,000 showing the following but not limited to:

- Roads, lots, and their numbers,
- The position of all new light standards within the *Development*,
- The position of existing light standards surrounding the *Development* and their relation to the proposed work,
- Photometric plan,
- Existing and proposed transformer locations, primary electrical supply, secondary electrical supply, and road crossings,
- A detail of and tabulated specifications for the type of luminaries proposed.

All street lighting designs shall be carried out by Waterloo North Hydro Inc., except for ornamental lighting. All ornamental lighting designs shall be in accordance with *Township*

standards and follow the American National Standard Practice – RP- 8 2018 requirements. All electrical, street, and ornamental lighting design shall be done with awareness to the proposed street tree locations and the minimum tree planting and soil volume requirements identified in Section 4 Landscape Requirements. Temporary hydro pole locations shall be approved by the local hydro authority in conjunction with the *Consultant*. Street poles shall include future connections for the 5G network infrastructure / capabilities.

2.8. As-Recorded Drawings

As-Recorded Drawings constitute the original engineering drawings which have been plotted again to show As-Recorded conditions. The As-Recorded drawing and a copy of the AutoCAD drawing files on a USB drive shall be submitted to the *Township* for permanent records. Files shall be provided in AutoCAD Civil 3D and exported to PDF files.

The information shown on the As-Recorded drawings may be checked by the *Township* at any time before the “Final Acceptance” of the *Development* and if discrepancies are found between the information shown on the drawings and the field conditions, the drawings will be returned to the Engineering *Consultant* for rechecking and future revisions. The Engineering *Consultant* shall be required to explain, in writing, any major differences between the As-Recorded drawing and actual field conditions. Any costs incurred by the *Township* or a future applicant due to inaccurate data produced by the *Consultant*, invoices will be sent to the *Consultant* for payment.

As-recorded drawings shall be submitted along with the initial Maintenance Package and the drawings shall conform to the following criteria:

As-Recorded Field Survey

The As-Recorded Records revisions shall be based upon an As-Recorded Records survey of all the proposed services installed including previous phases to 20m beyond the phasing limit.

Refer to Section 15 for more information regarding Survey drawing requirements.

As-Recorded Records Drawings

The As-Recorded Records drawings for all Municipal Services shall incorporate all revisions found in completing the As-Recorded Records field survey and include a check of the following items but not limited to and incorporation of the necessary revisions:

- Identify the General *Contractor* and any Sub-*Contractors* involved in the work,
- Substantial performance date, contract completion date, start of warranty period and end of warranty period,
- Date of subdivision registration,

- Date of installation of the following:
 - Storm Sewer
 - Sanitary Sewer
 - Watermain
 - Road Pavement (Granular A, Granular B, Base, and surface asphalt).
- Sewers - Percent grade, pipe size, type, class, bedding, and length,
- Invert elevations – sewer at maintenance holes, at plugs for future extensions,
- Top of pipe and/or invert elevations – watermain, where necessary (i.e., Where watermain has been varied from normal depth requirements) in filed, to avoid conflict with other buried services,
- Top of watermain and invert/obvert of sanitary sewer at centreline of water crossing,
- Note: Original design information (inverts, grades, etc.) are to be removed from the drawing and replaced by the As-Recorded Records information,
- Pipe type, class, and bedding,
- Service connections at street line – sanitary, storm and water,
- Label As-Recorded Records Drawings (shown in revisions column with date), and on cover sheet,
- Registered Plan Number is to be shown on plan view of each drawing including general plans,
- Lot and block numbers shall be in conformity with the registered plan,
- Street names shall be in conformity with the registered plan / project name or as accepted by the *Township*,
- Benchmark,
- *Easements* to be shown with *Easement* numbers; and
- A table indicating the manufacturer, supplier, model number and material for each sanitary, storm and water structure installed.

As-Recorded General Services Plans

Prior to initial *Acceptance* of services, the required location plans for As-Recorded measurements are to be completed and submitted showing all necessary details for underground service installations. The DGSSMS and *Township* requirements are to be followed.

As-Recorded General Services Plans are required for the following but not limited to:

- Sanitary Sewers
 - *Consultant* is to provide the *Township* with as-recorded inverts at property line and chainage from the downstream maintenance hole (0+000) or measurement from lotline monument / iron bar, etc.
- Storm Service and Catchbasin

- *Consultant* is to provide the *Township* with as-recorded inverts at property line and chainage from the downstream maintenance hole (0+000) or measurement from lotline benchmark,
- Location of service and catchbasin lead tie connections at the main line sewer are to be dimensioned along the mainline sewer from each downstream maintenance hole.
- Watermain Valves, Tees and Appurtenances and Water Services
 - Location of watermain valve box and valve chambers are to be dimensioned up or down the road from the nearest maintenance hole and an offset distance from the centreline of the road or back of curb,
 - Water main stops are to be dimensioned along the alignment of the watermain from the nearest valve and curb stops, and boxes are to be dimensioned from lot corners,
 - As-Recorded watermain top of pipe elevation at 50.0 m intervals, changes in gradients and offsets,
 - The drawings shall incorporate information shown on standard drawings. In addition, the manufacturer, make and model of the following must be provided:
 - Pipe (mains, services & fire hydrant leads)
 - Joint Restrainers
 - Fire Hydrants
 - Valves
 - Curb Stops
 - Main Stops
 - Saddles
 - Wrapping Products (paste, mastic, and tape)
 - Anodes
 - Tracer Wire
 - Pipe Fittings
 - Water Boxes (curbstop at mainline)

Where watermains are not within road allowances or near sewers, ties to property corner shall be used. Red line drawings shall be provided before the final watermain connection is scheduled / completed.

Additional as-recorded information may be requested at the discretion of the *Township*.

2.9. Site Alteration

The *Township* Site Alteration By-law was approved to control site alteration activities within the *Township* such as the placing or dumping of fill, the removal of topsoil, and the alteration of the grade of land.

A permit process has been established to balance environmental and administrative considerations for site alterations. The requirement of a permit will grant the *Township* the ability to ensure that:

- Unanticipated drainage and site alteration is prevented,
- Appropriate drainage patterns are maintained,
- Interference and damage to watercourses or water bodies is limited,
- Water quality is maintained,
- The use of hazardous and/or improper fill is prevented,
- Erosion and sedimentation are prevented,
- Natural heritage features such as wetlands, valley lands, and woodlands and areas of archaeological resources are protected; and
- The *Township* 's natural topography, soils, and vegetative features are considered.

Unless exempt from the provisions of the by-law, site alteration activities within the *Township* will be regulated, and a permit from the *Township* will be required.

For *Development* works, a Site Alteration Permit will be required for all properties in accordance with the Site Alteration By-law and for all properties not included in a registered *Development* agreement.

3. Municipal Consent Requirements

3.1. Introduction

A *Municipal Consent* or MC is the municipal authorization for a utility company, and/or corporation, to occupy a specific location above or below ground within the *Township* rights-of-way. *Municipal Consents* are only issued to utility companies, commissions, agencies, and private Applicants who have the authority to construct, operate and maintain their infrastructure within the right-of-way as established through legislation, terms of an *Agreement* with the *Township*, or a Municipal Access Agreement.

All utility work, with a few exceptions, within rights-of-way requires *Municipal Consent* (MC) and a Road Work Permit (RWP) from the *Township's* Infrastructure Services and Development Services, except for Emergency Works. A RWP for utility *Works* will not be granted until MC is granted by the *Township*. The Applicant understands and agrees that in making an application for MC the Applicant agrees to abide by the terms and conditions of the MC and Municipal Consent Requirement Manual.

The approval of a MC is valid for a period of one year from the date of issuance. If the work is not completed in its entirety within the one-year period, the Applicant must reapply for consent to locate the remaining work within the right-of-way.

3.2. General Requirements

In making an application for an installation within the road allowance, the applicant must agree to the following, but not limited to:

- If the work arising out of an application does not commence within six (6) months of the issuance of the consent, the applicant will be required to apply for an extension of the *Municipal Consent*,
- A RWP must be issued prior to the commencement of work on the *Township* Road Allowance; and
- The applicant shall provide as-constructed or as-recorded drawings of the completed work to the *Township*.

3.3. Work Permitted without MC

The following types of work require only an RWP:

- Emergency work required to maintain or restore existing service,
- Exploratory work to investigate existing Plant (any poles, cables, pedestals etc.) condition,

- All other types of work require both a MC and a RWP including,
- Installing new Plant,
- Repair of existing Plant (same horizontal and vertical location),
- Making additions or upgrades/alterations to existing Plant,
- Excavating, trenchless work within the right-of way,
- Any service drops not requiring the removal, relocation, or alteration of any adjacent infrastructure.

3.4. Emergency Work

Emergency work is permitted prior to submission of a RWP Application. The completed RWP Application must be submitted to the *Township* on the same day the work is commenced, or if the *Township* offices are closed, no later than the start of the next working day. If the installation of new or additional plant is required for the emergency repair, a MC Application must be submitted to the *Township* within five business days of the work commencement.

3.5. Service Drops

A RWP must be obtained from Development Services prior to installing any service drop. Wherever possible, services and service connection to property line shall be designed and constructed directly in front of the customer being serviced, perpendicular to the roadway.

3.6. Road Work Permits

Prior to the commencement of work on the Right-of-Way, a RWP is to be obtained from the *Township*. The issuance of a RWP to make an installation within the right-of-way does not relieve the Applicant of the responsibility to ensure that all affected parties are notified of the work and that the appropriate locates and clearances are obtained prior to commencing any installation.

3.7. Municipal Consent Application

Applications for MC shall be submitted through the *Township* website. The MC Application shall be completed in its entirety and shall include: one copy of the completed application form, one copy of the detailed design drawings, one copy of the required signoffs from impacted parties, where applicable, and full Fees, where applicable. Applications can be submitted to the address below.

Attention; Infrastructure Services
24 Church Street West
Elmira, ON N3B 2Z2
municipalconsents@Woolwich.ca
(519) 669 1647 Ext. 6041

Changes to the Accepted Drawing

Any request for changes to an accepted MC drawing must be reviewed and accepted by the *Township*.

Cancelled Projects

The *Township* must be notified of any cancelled projects for which a MC Application has been submitted or a MC has been issued.

Incomplete or Non-Approved Applications

MC Applications that are not in strict conformance with the MC Requirements, particularly with regards to the drawing standards, will not be accepted. Applications submitted without the full MC *Fee* will not be reviewed until the full MC *Fee* is received. In the event the application is not accepted, the Applicant will be contacted by the *Township Staff* via e-mail to the address specified on the application. The Applicant will be advised of the general deficiencies of the application. If the Applicant does not address the deficiencies identified within two months time, the application form will be returned to the Applicant together with correspondence from *Township Staff* indicating that a new application is required, and any *Fees* have been forfeited and additional resubmission *Fees* are required.

Circulation and Signoffs

Prior to submitting an application, the Applicant is advised to circulate drawings of their proposed work to all utility companies, agencies and commissions that may be impacted by the work.

Application Review Period

Applications shall be submitted to the Development Services at least 30 business days prior to the planned date of commencing the work. The date of application will be the date on which the complete and compliant application is received by the *Township*. Applications will normally be processed within 20 business days.

3.8. Acceptance Procedures

Upon completion of the MC application review, a copy of the accepted application will be emailed to the Applicants address as listed on the application. The issuance of a MC by the Township of Woolwich does not relieve the Applicant of the responsibility to ensure that the notification requirements of the procedure's manual are properly carried out and that the appropriate locates, insurances and clearances etc. are obtained prior to acquiring an RWP and commencing the installation of the proposed work.

Review of Applications for Work in or under New Road Surfaces

To ensure the long-term sustainability of the *Township's* infrastructure, the *Township* dictates a moratorium on all new or recently reconstructed streets. In the event an application is received for work in or under any infrastructure that is 15 years old or less, *Township Staff* shall undertake a comprehensive review of the proposed working area, type, and methods of construction to mitigate the potential negative impacts.

Disputes

In the event of any dispute regarding the review of a specific application, the Director of Infrastructure Services and/or the Director of Development Services shall make the final determination.

3.9. As-Constructed / As-Recorded Drawings

The Applicant shall submit within 90 days of project completion, as-constructed/as-recorded drawings in PDF and AutoCAD DWG format to Development Services.

3.10. Security Deposit

Township Staff shall be satisfied that the Applicant has posted sufficient *Security* with the Township of Woolwich as outlined within the terms of *Municipal Access Agreements*, *Franchise Agreements*, or other *Township* requirements or as an individual *Security* deposit, to guarantee the performance by the Applicant of its obligations in connection with the proposed work prior to granting *Acceptance* for the MC.

3.11. Municipal Consent / Road Work Permit Fees

Application Fee

The *Fee* for MC Applications and Road Work Permit shall be in accordance with the *Township Fees and Charges By-Law*, per individual application. Applications with multiple drawings or extensive work shall be determined at the discretion of *Township Staff's* standard practice.

Construction Fees

If required at the discretion of the *Township*, *Construction Fees* may be required by the *Township*. The *Fee* for MC *Construction Fees* shall be in accordance with the current *Fees and Charges By-law*, (Pavement degradation, inspection, *Security*, etc.) and will be estimated based on hourly rates for staff, vehicles, and administrative *Fees*. The *Fee* will be estimated at the time of the MC review and will be required prior to MC *Acceptance* is granted.

3.12. Other Considerations

The Applicant shall comply with all applicable Legislation, *Township* and Region By-Laws, Policies and Guidelines, *Township* Engineering Development and Infrastructure Manual, including but not limited to:

- Municipal Act
- Telecommunications Act
- Rulings by the Canadian Radio-television and Telecommunications Commission (CRTC)
- Rulings by the Ontario Energy Board (OEB)
- Right-of-way Work Permit
- Tree Protection and Preservation

3.13. Municipal Consent Manual

For a complete description of the MC process, and all requirements, please see the *Township's Municipal Consent Requirements Manual*.

4. Landscape Requirements

4.1. Introduction

The *Township* seeks to achieve communities with well designed landscapes and features which will promote a healthy environment, sustainable green infrastructure and enhance our connected communities through the *Township's Capital, Municipal Consents, Municipal Drain and Development* projects. This includes, but is not limited to, measures to ensure:

- A standardized and highly interconnected pattern of lotting for *Development* blocks,
- Consistent built form, pleasing streetscapes and active transportation,
- Safety, accessibility, and comfort in the pedestrian environment,
- Promotion of *Development* that is compatible with the existing community and respectful of its heritage context,
- Achievement of an overall density that is appropriate for the surrounding context, considerate of Provincial and Regional requirements, and consistent with the overall growth management strategy of the *Township*,
- Promote native plant species and sustained life cycle costs.

4.2. Requirements

For detailed requirements, standards, and specifications for planting, maintaining and the protection of trees in the R.O.W. and on public property, see Township of Woolwich document titled Landscape and Design Guide.

For any landscape requirements for Site Plans, Subdivisions, Parks and Trails, the *Developer / Subdivider* shall contact the Township of Woolwich Development Services.

5. Roadway Design

5.1. Introduction

The geometric design of *Township* roads shall, as a minimum, conform to standards set out in the latest edition of the “Geometric Design Guide for Canadian Roads and Streets” issued by the Transportation Association of Canada (TAC), and the Ontario Provincial Standards (OPS). Generally, the *Township* will recognize a hierarchy of roads as Provincial Highways, Regional Roads and *Township* Roads.

Township Roads are roads serving the joint functions of facilitating traffic movement throughout the *Township*, providing direct access to abutting *Land* uses, and connecting to the Provincial and Regional road system.

5.2. Road Classification

All roadways shall be classified according to the traffic volume expected and the intended use of the roadway. Generally, roads are classified as Arterial, Collector and Local.

Arterial Roads means Class 1 and Class 2 highways as determined under the Table to Section 1 of Ontario Regulation 239/02 (minimum Maintenance Standards for Municipal Highways) made under the Municipal Act, 2001. Arterial Roads are intended to distribute large volumes of traffic between other Arterial Roads and Major Collector Roads. The primary purpose of Arterial Roads is to carry through traffic within and between municipalities.

Collector Roads means Class 3 and Class 4 highways as determined under the Table to Section 1 of Ontario Regulation 239/02. Collector Roads provide for both traffic service and *Land* access. The primary traffic service function is to carry traffic between Local Streets, other Collector Roads and the Arterial Road system.

Local Roads means Class 5 and Class 6 highways as determined under the Table to Section 1 of Ontario Regulation 239/02. Local Roads generally serve only the abutting properties and are not intended to carry through traffic.

Roadway Classification Design Criteria

The proposed classification of all streets within the project limits, minimum maintenance standards and traffic volume as per the TAC manual, as well as the following, shall be confirmed with *Township Staff* prior to commencement of the design. The following table is presented as a guide to the determination of the road / street classification within the urban boundary limits. For rural road requirements please refer to TAC manual.

All other requirements including the following shall be designed in accordance with the latest revision of the Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads Part 1 and 2 including the following;

- Minimum Stopping Sight Distance,
- Minimum Sag Curve K Value,
- Minimum Crest Curve K Value,
- Minimum Curve Radius,
- Minimum Lane Width,
- Minimum Width of Pavement,
- Pavement Crossfall,
- Minimum Grade: The *Township* acceptable minimum grade is 0.7% along the centreline of road,
- Maximum Grade,
- Intersection Angles,
- Minimum Tangent Length between Intersections,
- Minimum Tangent Length between Reverse Curves,
- A minimum centreline radius of 20 metres is required for local urban situations at 90-degree bends.

5.3. Road Pavement Design

The following are minimum design requirements. The *Subdivider / Design Engineer* is required to engage a Geotechnical *Consultant* with experience in pavement design to confirm the minimum design based on results of the Geotechnical Investigation. The composition and construction thickness of the road pavement shall, as a minimum, be designed based upon the following factors as outlined in the geotechnical soils report:

- Mechanical analysis of the subgrade soil,
- Drainage,
- Frost susceptibility, and
- The future volume and class of traffic expected to use the pavement.

Pavements shall be designed for a minimum ADT of 1000 vehicles and an anticipated life of 25 years.

Copies of all test results and proposed road designs and supporting calculations shall be submitted with the engineering drawings. Pavement design not meeting the minimum standards indicated in this section for the particular road classification, will not be acceptable.

Minimum Road Structure

Arterial

- 50mm HL3: Surface Course
- 100 mm HL4: Binder Course
- 200 mm Granular 'A': Base
- 520 mm Granular 'B': Base

On roads that are designated Arterial, a concrete edge strip of “kill strip” shall be constructed.

Collector

- 50 mm HL3: Surface Course
- 90 mm HL4*: Binder Course*
- 210 mm Granular 'A': Base
- 450 mm Granular 'B': Base

Local

- 50mm HL3: Surface Course
- 90 mm HL4*: Binder Course*
- 210 mm Granular 'A': Base
- 450 mm Granular 'B': Base

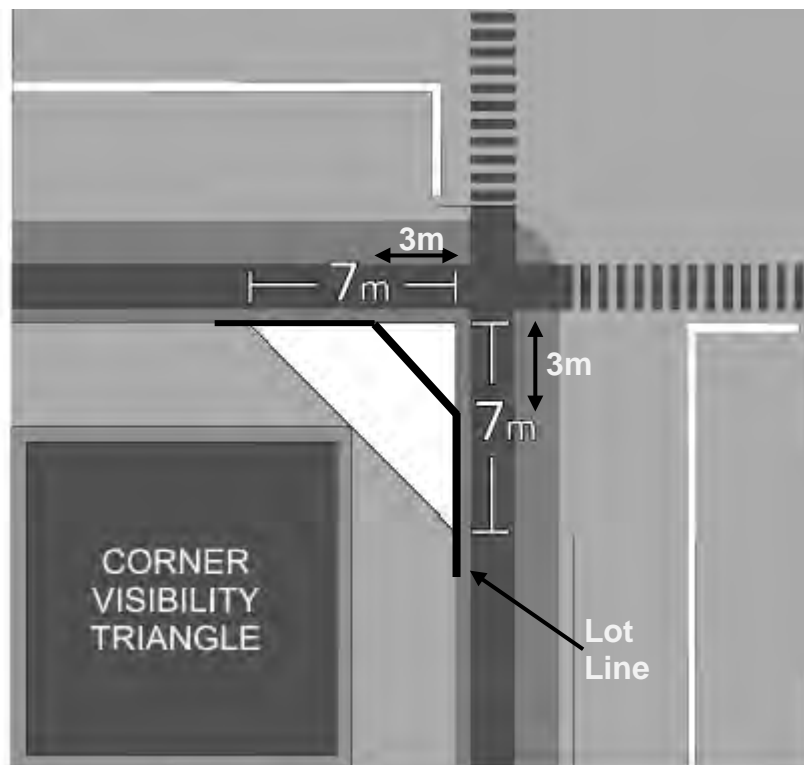
5.4. Visibility Triangles within Right of Way

Corner Lot(s): A lot situated at the intersection of and abutting upon two streets, or upon two parts of the same street, the adjacent sides of which street or streets (or, in the case of a curved corner, the tangents at the street extremities of the side lot lines) contain an angle of not more than one hundred and thirty-five (135) degrees. In the case of a curved corner, the corner of the building lot shall be deemed to be the point of the street line nearest to the point of intersection of the said tangents.

Driveways and parking spaces shall not be located within a visibility triangle.

The *Township* requires that a 3m x 3m triangle of *Land* be added to the road allowance at the intersections of two streets and measured from the intersection of the street lines. Refer to Figure 5-1 below for details. Any encroachments in accordance with the Township of Woolwich Zoning By-law.

Figure 5-1 Visibility Triangles



5.5. Boulevards

Boulevards shall be graded and constructed according to Section 6 of this document.

All construction debris and surplus granular materials will be removed to the required depth upon completion of the initial stage of road construction. The boulevards shall be maintained in a clean state until the roadway section is completed.

All boulevards shall be sodded to the right-of-way limit.

5.6. Sidewalks

Concrete sidewalks within the *Township* are to be constructed as per OPSD 310.010 and their locations are to be constructed to the following minimum standards in accordance with OPSS 351:

- Accordance with the cross-sections provided,
- Minimum crossfall of 2% and Maximum crossfall of 4%,

- 2.0 m curb face,
- Minimum Depth of 150 mm Granular 'A',
- Concrete sidewalk to be 125 mm thick across boulevards, 150 mm across residential driveways and adjacent to curbs,
- At intersections a minimum of 200mm thick concrete shall be used for wheelchair ramps and sidewalks,
- Sidewalks at driveway ramps within Commercial, Industrial and multi residential *Development* shall be a minimum of 200 mm thick concrete as per OPSD 310.01.

The location requirements for sidewalks in *Capital and Development Infrastructure Project* shall be as per *Township* Standard Drawings. This shall be confirmed with the *Township* prior to commencing the detailed design. Sidewalks shall be installed on both sides of all streets (residential and industrial subdivisions). Exceptions to this requirement may be considered by the *Township*.

In cases where the sidewalk has been constructed prior to the establishment of an entrance, the existing sidewalk shall be removed and replaced with a thickened sidewalk section. Sidewalk depth shall be transitioned from a thickened section to a standard section at a slope of 10:1.

At street intersections the curb and the sidewalk shall be depressed to meet the roadway elevations as shown on the Region of Waterloo standards. Wheelchair ramps in accordance with OPSD/Region of Waterloo and AODA requirements to be provided. Tactile walking surface indicators shall be provided at all pedestrian crossings in accordance with Ontario Regulation 413/12 under the Accessibility for Ontarians with Disabilities Act 2005.

Sidewalk construction immediately adjacent to a curb shall generally be avoided. If at the discretion of the *Township* a sidewalk is constructed adjacent to curb, a 50mm key shall be provided along the back of the curb if required, and the sidewalk constructed 2.0m minimum wide.

5.7. Cul-De-Sacs

All local roads which permanently terminate at one end (dead end streets) shall be provided with a turning circle (cul-de-sac) of sufficient area to enable the turning of garbage trucks, snow removal equipment and emergency vehicles. A road allowance with a 20.0 m radius will be required for a cul-de-sac with a pavement radius of 15.5 m. Permanent cul-de-sacs shall be constructed in accordance with the *Township* Standard Drawings.

Minimum gutter grades of 1% shall be maintained along the flow line of all gutters around the cul-de-sacs, the design road grade on the tangent section of the cul-de-sac and at the beginning of the bulb area where catchbasins are to be located. All cul-de-sacs, bulbs and

intersections shall be detailed at a scale larger than the road plan. The details shall show gutter, crown, and other grades sufficient to determine that the road will properly drain and shall be used as a basis for layout.

Cul-de-sacs exceeding 150 metres in length shall require an emergency access leading to a public right-of-way within 150m of the farthest point of the property line of the bulb, or in accordance with National Fire Protection Association at the discretion of Staff.

5.8. Driveways

The *Subdivider* shall be required to provide for the excavation, paving and maintenance in good condition, until final *Assumption* of the road allowance by the *Township*, of each driveway from the travelled portion of the road to the lot line if there is no sidewalk. If there is sidewalk, the limit shall be from the travelled portion of the road to the sidewalk (ramp). All driveway ramps in new *Development* shall be constructed of concrete. Where there is no curb and gutter on the road, or where there is no sidewalk, asphalt or concrete pavement can be used for the ramp construction. Should a conflict occur between the location of a driveway and the location of a side inlet catchbasin (SICB), then the *Subdivider/Developer* shall correct the conflict by either relocating the driveway, except when a parking plan governs, replacing the SICB with a twin inlet catchbasin in the same location as the original SICB, all to the specifications of the *Township* and at no cost to the *Township*, or other options as discussed with *Township Staff*.

Residential, commercial, and industrial entrances to be as per Township of Woolwich Zoning By-law.

No driveway shall meet the travelled portion of the road allowance at an angle of less than seventy (70) degrees.

On a residential lot, a driveway or parking space is not to project beyond the side of the garage. Where no garage exists, the minimum setback from the edge of a driveway or parking space and a side or rear property line is 1.0m.

Where driveways are constructed between adjoining properties and where the barrier curb is less than 1 meter between driveways, the curb cut-out shall be continuous.

Where a driveway ramp is located on a stubbed street, a minimum of 8m between the ramp and dead-end-barricade is to be provided for snow maintenance, and this area must be included within the phase of the project and within the registered Plan of Subdivision. The number of lots allowed to front onto a stub street shall not exceed one per side. Any temporary roads or turning circles must be contained within the subject registered Plan of Subdivision.

5.9. Roundabouts and Traffic Circles

Roundabouts and traffic circles are intended to calm traffic and direct traffic flows without requiring stop signs and traditional intersections. The open spaces created in the traffic circles add to the character of neighbourhoods.

Whenever Traffic Circles/Roundabouts are used they should be treated as significant landscape features in the public realm, as well as serve traffic calming devices.

The design of the Traffic Circle/Roundabout shall be in accordance with the Canadian Roundabout Design Guide

The design of a Traffic Circle/Roundabouts shall ensure ease of snow removal and maintenance.

The minimum radius for a Traffic Circle/Roundabout shall be in accordance with Table 5-1.

Table 5-1

Intersection	Inscribed Circle Radius (m) (i.e., outside circle dimension)	Radius of Inside Circle (at Mountable Apron) (m)	Turning Road Width (m)
Local-Local	12	6	6
Collector-Local or Collector-Collector	15	8	7
Collector-Single Lane	20	12	8
Arterial	27.5	18.4	9.1

5.10. Road Sub Drains

In general, sub-drains will be required to run continuous along both sides of all roads, as per OPSD 216.021. Perforated High Density Polyethylene sub-drain shall be 150mm in diameter, and below road base.

5.11. Concrete Curb and Gutter

Barrier curb with standard gutter as shown on Ontario Provincial Standard Drawing OPSD 600.040 shall be used on all streets including cul-de-sacs islands except with reverse slope gutter. Approved *Contractor* machine cutting of curb or entrance depressions will be allowed. "Capping" of curb depressions will not be permitted. All depressions not used as property entrances shall be replaced with full barrier type curbing. Granular A and B are to be compacted 300mm past the back of curb. Concrete barrier curb with standard gutter shall have additional width where sidewalk is adjacent to curb or concrete driveway ramps, as per OPSD 600.040.

6. Lot Grading Design

6.1. Introduction

These design requirements have been prepared to provide guidance in the preparation of Grading Plans that the *Township* requires as a condition of approval. This includes but is not limited to individual lot grading plans under control of a Subdivision *Agreement*, as well as lots or *Developments* with infill status, Severances and Site Plans.

These requirements have also been prepared to provide technical and procedural criteria to designers on the acceptable surface drainage, practices and techniques that are required by the Township of Woolwich. All *Development*-related grading design proposals are to be prepared in a manner that conforms and is consistent with the design criteria contained in this document.

The design standards for lot grading ensures that surface water runoff is effectively managed in a manner that directs surface water away from a building's foundation and towards a suitable location without negatively affecting adjacent properties as water damage is the leading cause of property claims and *Township* complaints. Grading must be designed to be in accordance with the criteria below and constructed so that surface water flows away from buildings, over vegetated surfaces where possible, to an appropriate receiving area. This will promote infiltration, reduce the velocity of runoff, and prevent nuisance flooding and erosion. Exterior foundation walls shall be extended not less than 150 mm (6") above finished ground level.

Documents beyond this Engineering Development and Infrastructure Manual that may be applicable for an engineering design include, but are not limited to, the as amended versions of:

- Township of Woolwich By-laws,
- Township of Woolwich Standard Drawings,
- Township of Woolwich Trails Master Plan,
- Ontario Building Code,
- Accessibility for Ontarians with Disabilities Act,
- CSA Z800-18 Guideline on Basement Flood Protection and Risk Reduction,
- CSA W204:19 Flood Resilient Design of New Residential Communities,
- Ontario Provincial Standard Drawings,
- Applicable Legislation.

6.2. Design Criteria

The following table provides acceptable grading limits for all *Developments* requiring *Township* review and *Acceptance*:

Note: Although minimum and maximum limits are specified below, initial grading design shall avoid minimum and maximum grades.

Table 6-1

Lot Grading Criteria		
Driveways (including ramps, aprons)	Minimum slope	2%
	Maximum slope	8%
Slope towards Side Property Line	Maximum grade	3 Horizontal to 1 Vertical (3H:1V) 3:1
Useable Yard Space (6.0 metres from back of house or 80% of rear yard setback, whichever is less) measured from the rear property line to the closest wall at the rear of the house.	Minimum yard slope	2%
	Maximum yard slope	6%
Park and Block Grading	Minimum slope	2%
	Maximum slope	6%
	Topsoil depth	Refer to Township of Woolwich document titled Urban Design Guidelines for the Public Realm

Regional overland stormwater flow routes	Flow depth on roads R.O.W. (to be contained within R.O. W.)	Max. 0.15m at centreline of road Refer to Stormwater Management Standards for further guidance on depth and velocity of flooding.
	Flow depth on other overland flow routes. To be contained within municipally owned <i>Easements</i> and/or blocks.	Max. 0.3m
Embankment	Maximum Slope	3H:1V
Swales	Minimum Longitudinal slope	2%
	Max. Longitudinal slope	6%
	Max. Side slopes	3H:1V
	Rear yard swale depth to catchbasin	Max Depth: 0.30m Min. Depth: 0.15m Max length: 50.0m
	Side yard swale	Min. Depth: 0.15 m Max. Depth: 0.30m
Walkways / Trails	Minimum Gradient (Running Slope)	2%
	Maximum Gradient (Running Slope)	5%

	(hard surface required for 4% or greater gradients)	
	Maximum Cross Slope	5%
Parking Areas	Minimum Slope paved	1%
	Minimum slope not paved	2%
	Maximum Slope	5%
Barrier Free Parking	Maximum Slope	In accordance with AODA

6.3. General Design Criteria

Grading design shall provide for proper surface drainage and maximize usable *Land* area, in accordance with the Township of Woolwich Zoning By-law, applicable standards and specifications, and the following criteria:

- Overall grading must account for and accommodate external drainage tributary to the *Development*,
- Grading must direct storm runoff to major and/or minor system,
- All overland major flow (above the minor system) route must be designed within the public road allowance to safely convey flows to a legal outlet. Any other overland flow routes (e.g., swale) must also be designed to safely convey flows to a legal outlet,
- Drainage shall be directed away from buildings (as defined by *Township By-Law 96-64* and the Ontario Building Code),
- Lot grading for each phase of the Subdivision is to be self contained within the subdivision limits even if it was not prior to *Development* and must be directed to a legal outlet contained within the applicable phase i.e., Subsequent phases of a subdivision *Development* shall not drain into a previous phase of a subdivision unless downstream Stormwater Management designs accepted by the *Township* were previously designed to accommodate the expected runoff,
- Existing trees shall be preserved, where identified, as per the Tree Preservation Plan,
- For lots which require Stormwater Management designs to control increased storm water runoff, a Report shall be prepared, stamped, signed, and dated by a Professional Engineer, licensed in the Province of Ontario,
- 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 landowner and Municipality. All additional flows are to be considered in *Development* drainage calculations,

- Design is to consider future *Land* use (i.e., fences, walkways along the side of the house, decks etc.), roof leader discharge points, percolation rate of the soil after construction etc.,
- Additional reports and/or studies maybe required to address any other issues which may arise because of the proposed *Development* (i.e., soils report to address slope stability issues, compaction concerns, or any other condition which may seem relevant),
- Where drainage patterns have changed because of the artificial collection of water, the *Township* may require that neighboring landowners provide written permission for an *Easement* to be added or a mutual drain *Agreement* due to the revised drainage pattern.

Driveways

All driveways shall be designed as per OPSD 350.010 and 351.010 and relevant *Township* Specifications and Standard Drawings and shall be graded to drain towards the street and slope away from the dwelling units.

Residential driveways with reverse slopes are not permitted. Industrial/commercial loading docks may utilize an approach with reverse fall if drained by a catchbasin that is part of an overall integrated storm system.

The maximum slope for a residential driveway is 8% unless otherwise accepted by the *Township*.

Yards

Front yards of residential lots shall be graded to drain towards the street. In preparing grading plans for house sitings, the *Engineer* shall establish maximum driveway grades which allow for a 50mm vertical construction tolerance.

If the maximum yard or embankment slope is exceeded, a retaining wall will be required. Refer to Section 6 for more information.

Clear stone (20mm), rather than topsoil and sod, installed 0.1m thick with an approved filter fabric underneath, shall be provided where the combined side yards between two buildings is 1.8m or less. Native soil under the clear stone shall be scarified to a depth of 0.45m. Subgrade below the clear stone shall be graded and compacted in accordance with swale requirements. Where the combined side yards between two buildings is greater than 1.8m, clear stone may be provided subject to approval by the *Township*.

Rear yards which drain through abutting lower back-to-front type lots are permitted where:

- Grades within the allowable limits outlined in this document can be obtained between the adjacent streets to achieve proper drainage of the lower lots,
- A maximum of 0.1 hectares may drain to a single rear or side yard swale,
- Intercept swales are provided to direct runoff from the upper lots into the lower lot side yards swales and are to be located entirely on the upper lot.

Elevations

A minimum of 0.15m shall be provided between the highest lot grade adjacent to the house and the top of the foundation wall as per CSA Z800-18.

Basement openings to be minimum 0.3m above the centerline of road unless otherwise approved by the *Township*.

Ground elevations at houses abutting Right-of-way overland flow routes are to be minimum 0.30m above the maximum allowable overland flow route elevations and basement openings to be minimum 0.15m above the ground elevation.

Basement openings at houses abutting rear yard swales are to be minimum 0.3m above the centerline of swale.

Swales

Drainage flows which are carried around houses for surface and roof water drainage are to be confined in defined swales, located as far from the house as possible.

In situations where connections are required in the road R.O.W., additional permits are required.

No surface ponding around catchbasins is allowed during a five-year design storm event.

Above a 5-year design storm and under a 100-year design storm event, 300mm surface ponding is allowed at catchbasins on roads, and 300mm surface ponding is allowed at rear yard catchbasins but must have no detrimental impact on private property.

Rear yard swales are to be located on the common property line. In situations where a new *Development* is abutting an existing *Development*, the swale must be located on the side of the new *Development*.

All side yard swales, except for infill lots that collect drainage from more than one lot, shall be located on the common property line.

Driveways are not permitted as outlets for drainage swales.

All swales shall have legal outlets.

Lot / Block Grading

The grading design for lots/blocks on the Subdivision Grading Plans shall be as follows:

- Addition of Topsoil / Hydro seed / sediment and erosion control is required after 30 days of no activity,
- Lot/Block drainage shall be self-contained, with overland flow directed to adjacent roads or other legal outlet as accepted by the *Township*.

Foundation drainage systems shall not be designed to drain large quantities of water away from foundation footings. Emphasis should be placed on keeping water away from the foundation draining system as the primary method. Footing drainage should be recognized as the weakest link in the system in the overall drainage plan, hydrogeology study and stormwater management design. Infiltration galleries shall be utilized to achieve water balance targets.

Park Grading

The grading design for park blocks on the Subdivision Grading Plans shall be as follows:

- Park drainage shall be self-contained, with overland flow directed to adjacent roads or other legal outlets as accepted by the *Township*,
- Where parks abut residential or commercial lots, intercept swale(s) shall be constructed to intercept all surface flow and convey such flow to a legal outlet accepted by the *Township*. Additionally, a 3.5m wide *Easement* may be required if the swale is located on private property.

6.4. Retaining Walls

The use of retaining walls shall be avoided unless no other option for grade change is available. When required, the following will apply:

- All retaining wall systems higher than 1.0m are to be designed, stamped, and signed by a qualified structural *Engineer* and subject to *Acceptance* by the Chief Building Official or *Peer Review* at the *Developers* expense,
- The retaining wall must comply with the (OBC),
- All retaining walls falling under the OBC definition of “buildings” will require a building permit,
- All retaining walls are to be dry-stone (interlocking, stacking type) or reinforced concrete,

- All retaining walls shall be constructed entirely on the higher property, with a minimum setback of 0.15m from the property line. A private *Easement* shall be established between the property *Owners* on the lower property to provide access to the wall for maintenance purposes,
- Retaining walls on private property must be noted in the purchase of sale documents,
- Refundable security deposit is required for retaining walls,
- If tiebacks are required, a minimum setback of 1.0m shall be maintained from the end of the tiebacks to the foundation of any structure and/or underground service,
- Certification by the *Developer's Engineer* and/or Geotechnical *Engineer* stating that the retaining wall is designed and constructed to meet the most recent design standards including but not limited to granular backfill, structural integrity, materials, tie backs, line and grade is required,
- Weepers behind retaining walls are required and shall drain to an acceptable outlet that doesn't affect icing on public or private walkways/driveways,
- A drainage swale shall be constructed along top and bottom of retaining wall to divert flows to an acceptable outlet,
- No retaining wall shall resist or support public property,
- All retaining walls shall have barriers installed in accordance with the OBC,
- Retaining walls may require additional post certification testing.

6.5. Individual Lot Grading Plans and Certification

A Lot & Grading Plan shall be prepared for each individual housing unit, or group of units, to confirm conformance with the general grading concept as shown on the Subdivision/Site Plan/Infill Lot Grading Plan. Each Lot & Grading Plan shall be certified by the *Subdivider's/Developers' Consulting Engineer* for conformance with the accepted Grading Plan. Lot & Grading Plan certification is to be accepted and reviewed by the *Township* before a building permit is released. All elevations shall be relative to the benchmarks provided on the accepted Grading Plans.

Information to be Shown on Individual Lot and Grading Plans

Prior to any technical review by *Township Staff*, each lot and grading plan shall include, but not limited to, the following information:

- Drawing to be completed in Metric (SI Units),
- Title Page which includes;
 - Municipal address and street name and lot number
 - Legal description of the property
 - Name of Owner/Applicant
 - Name and address of firm preparing the drawing
 - Scale

- Table of revisions
- Name of Builder
- Topsoil thickness to be placed on lot
- Pervious/Impervious area percentages
- *Easements*
- Rear Yard Catch Basins
- Drawing to be prepared and printed at a scale of 1:200 minimum on appropriate paper size (8.5"x14"),
- Key plan showing the site location in respect to the *Township/Development* road network,
- North Arrow,
- Legend for existing and proposed information as required,
- Drawings must be clearly identified as being "proposed" or "final" plans,
- Location and elevation of the controlling benchmark (geodetic datum is required)
- Clear identification of property lines and Right-Of-Way (R.O.W.) limits, including any proposed widening(s),
- Location of any regulatory flood lines or *Development* limit lines (i.e., setback and slope stability limits),
- Any *Easement(s)* within the property and of whom the *Easement(s)* are in favour (including registration number and pin number),
- Current native soil elevations,
- Location and elevation of all existing surface features located within the R.O.W. including but not limited to abutting roads, edges of pavement and shoulders, curbs, traffic islands, sidewalks, walkways/pathways, utility poles and pedestals, transformers, streetlight poles, hydrants, bus shelters, mailboxes, watercourses, ditches, culverts, catch basins, embankments, and overhead utilities. Existing surface features within the R.O.W. to be clearly identified whether they will be maintained during *Development* or will require modification, removal, and replacement, etc.,
- Identification of any existing swales, ditches, culverts (including size and material), sewer and water creeks, watercourses, ravines, and drainage routes complete with elevation, inverts, and arrows indicating the surface drainage direction,
- Location and details of infiltration galleries/trenches (if any),
- All existing access/driveway entrances to the subject property and the adjacent properties including widths and slopes as well as their building locations,
- Location and elevation of all existing features within the subject property (buildings, structures, foundations, septic tanks, tile beds, wells, holding tanks for firefighting, fences, trees, bushes, etc.) Existing features within the subject property shall be clearly identified whether they will remain or be removed upon completion of *Development*,
- Identification of any existing services (e.g., water, sanitary, storm, etc.) within the subject property including size and material along with location from property boundary,
- Existing spot elevations within the subject property at a minimum 5.0m interval,

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- Existing spot elevations at a minimum of 10 – 20m (depending on size of lot/*Development*/adjacent terrain) beyond the subject property limit,
 - Location of proposed building(s) and structures, including but not limited to fences, porches, stairs, retaining walls, culverts, decks, and pools,
 - Top of Floor / Finished Floor level,
 - Top of wall elevation for each proposed foundation wall,
 - Proposed ground elevation at each proposed foundation wall,
 - Proposed finished first floor elevation,
 - Proposed sill elevations at side entrances where elevation differs from the proposed finished first floor,
 - The number of risers at each entrance to the dwelling,
 - Proposed garage floor elevation,
 - Proposed elevation of driveway at garage entrance,
 - Proposed elevation of driveway at property line,
 - Proposed grade of driveway and driveway ramp,
 - Proposed basement elevation (if applicable),
 - Proposed underside of footing elevation,
 - Engineered fill and extended footing information (if applicable),
 - RYCB lead protection – maximum underside of footing,
 - Existing and proposed elevation of ground at all lot corners,
 - Location of proposed roof downspouts and direction of flow,
 - Elevations at proposed swale inverts and intermediate points of grade change at reasonable intervals along the boundaries of the lot to illustrate the drainage of the lot in relation to the surrounding *Lands* and buildings,
 - Direction of surface water runoff shall be shown by an arrow; double stem arrows shall be used at swale locations,
 - Grate and invert elevations of all catch basins,
 - Ponding and Hydraulic Grade Line elevation shall be shown on rear yard catchbasins to confirm the required limits are met,
 - A detailed cross section schematic of all retaining walls. The cross section must contain, as a minimum, the following information:
 - Wall width/height,
 - Handrail,
 - Property line,
 - Drainage outlet,
 - Material.
 - A detailed design drawing showing the design and location of all retaining walls. The detail must contain, as a minimum, the following information:
 - Proposed product/material the walls will be constructed of,
 - The minimum and maximum proposed height(s) of the walls,

- The maximum width of capping proposed on top of the wall and maximum proposed base of wall,
- Drainage/Backfill/Compaction Requirements,
- Tiebacks, footing,
- Cross-section detailing the proposed wall,
- Fastening details of the fence to the wall (if applicable),
- A note that the final design must be stamped by a Professional Engineer,
- The Landscape Plan must show to scale the accurate widths of any proposed retaining walls,
- Top and bottom wall elevations.
- Grading Plans must be stamped, signed, and dated by a Professional Engineer.

Based on the proposed Works, a Site Servicing Plan and subsequent Right-of-Way Permit may be required.

The following notes are to be included on the Grading Plans:

- Existing drainage of abutting lands is not to be disturbed without permission from the adjacent landowner along with a registered drainage *Easement*,
- Basement openings to be minimum 0.3m above the centreline of road,
- Ground elevations at houses abutting overland flow routes are to be 0.30m 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.

6.6. Certification

Each individual lot will require the following:

- Three (3) copies of the Final Lot & Grading Plan, certified by the *Subdivider's* Consulting Engineer, shall be submitted to the *Township* subject to review and *Acceptance* prior to lot release,
- The lot grading shall be inspected by the *Consultant* and prior to topsoil grading,
- Final Lot & Grading Certification shall be completed by the *Consultant*, and the certificates shall be provided to the *Township*. The certification shall include;
 - Letter of certification,
 - As constructed topographic survey including lot corners, changes in grade, top of foundation wall swale inverts, driveway grades and location and elevation of any additional grading features

All submitted certification documents shall be stamped, signed and dated by a the engineering *Consultant* for the *Development* project.

At the build-out of the *Development*, the *Consultant* for the subdivision design shall certify that the Subdivision Grading Plan has been constructed according to the Professional Engineering Design for the Site Grading Plan. At the discretion of the *Township*, a complete topographic survey of all individual lots may be required for all final grading conditions and combined into one AUTOCAD Drawing and submitted to the *Township*.

6.7. Infill Residential Design/Construction Requirements

Lot and Grading design for infill residential *Developments* shall conform to Section 6 and the following additional requirements:

- Post *Development* lot drainage discharge shall at least maintain or reduce *Pre-Development* lot drainage discharge. To achieve this standard, the implementation of on-site storm water control (soak-away pits, infiltration trench or chamber, green roof, ponding, cistern, permeable pavement, etc.) may be required,
- Overall *Development* and grading shall be performed to preserve existing trees, where possible,
- A 0.6m minimum undisturbed strip shall be maintained along all sides and rear property boundaries,
- Siltation control measures (e.g., silt fence, erosion control blanket, straw bale flow check dams) shall be used during and after construction to prevent the migration of silt. Siltation control measures shall be placed at the limit of construction (i.e., at the 0.6m undisturbed strip) and within the Right-of-Way to mitigate silt movement in storm sewer and water courses,
- Grades shall be compatible with adjacent road grades, abutting properties and any proposed local improvements,
- The capacity and alignment of boundary swales shall not adversely affect adjacent properties,
- The builder/*Developer* must perform all necessary *Works* to ensure that no surface drainage problems are created on or adjacent to private or public *Lands* because of their *Development*,
- If servicing and/or storm water management facilities are required, design shall be completed by a professional Engineer,
- Location of sump pump discharge clearly identified.
- Existing residential homes which were constructed with no perimeter sub drains and are now placing an addition to the existing home require perimeter drains around the new footings and a sump pit for storm water discharge. Discharge of storm water at grade must not affect adjacent properties,

- Roof leaders to discharge to surface and directed towards the road unless infiltration galleries have been installed. Roof leaders are to have an overflow discharge when connected to infiltration galleries/trenches,
- Identify all existing street furniture i.e., streetlights, utility poles/pedestals, etc..

Based on the proposed Works, a Site Servicing Plan and subsequent Road Work Permit shall be required.

6.8. Additions to Existing Residential Developments

To minimize drainage impacts caused by the addition of pools, backyard landscaping, retaining walls etc.. The *Township* requires a permit for any proposed additions to existing *Developments*. The *Subdivider / Developer* or *Owner* shall submit to the *Township* for review details of any proposed additions. Details include but are not limited to:

- Setbacks of proposed additions from lot lines,
- Current lot grading plan showing current drainage lines,
- Area and type of hard surface proposed,
- Location of accessory buildings.

If initial review is determined by the *Township* that the application is non-intrusive, no further information from the applicant is required. However, should there be any concerns, the *Township* may require the following additional requirements as a minimum:

- Separate Hard Surface Control Plan, stamped and signed by a Professional *Engineer* registered in the Province of Ontario. This includes, but is not limited to, the following details:
 - Total lot area,
 - House footprint area,
 - Driveway area,
 - Shed area,
 - Pool deck area,
 - Patio area,
 - Walkway area,
 - Other hard surface area,
 - Impervious Area Calculation as a percentage of total lot area.

Information to be Shown on Infill Lot and Grading Plans

Lot and Grading Plans for infill residential *Developments* shall comply with Section 6. Additional information to be shown on the drawing shall include but not limited to the following:

- Location of tree protection fencing,

- Location of siltation control measures,
- The plan must include a note as follows:

Note:

The building shall be located, and the building site graded so that water will not accumulate at or near the building and will not adversely affect adjacent properties.

Exterior foundation walls shall be extended not less than 150mm (6") above finished ground level

6.9. Lot Grading Acceptance and Certification Process

Proposed Lot and Grading Plan

Prior to application for a building permit, an individual Lot and Grading plan shall be prepared and sealed by the *Subdivider's* Consulting Engineer, for the lot on which the proposed building is to be built on.

Fees as outlined in the Township of Woolwich Fees and Charges By-Law is required prior to processing the Proposed Lot and Grading Plan. A deposit will also be required. The deposit will be refunded upon successful completion / *Acceptance* of the work, minus any inspection *Fees* as per the Fees and Charges By-law.

The Proposed Lot and Grading Plan shall be reviewed and accepted by *Township Staff* prior to a building permit being issued.

If an adequate/acceptable outlet cannot be provided due to topographical or other physical constraints, the designer is to consider and implement other practices to retain the water on site (i.e., infiltration gallery, bio swales, water harvesting, etc.) and ensure that surface runoff does not adversely impact neighbouring properties.

The proposed lot and building grading must be generally compatible to the existing and surrounding *Development* or adjacent properties.

Final Lot and Grading Plan

The *Consultant* will be responsible to certify that the "As-Constructed" lot and grading, and the location and elevation of any rear lot catch basins or other drainage appurtenances, are in conformance with the lot grading plan submitted at time of building permit. Certification of the final lot grades will only take place once the building has been fully constructed, any deficiencies have been corrected, and the property is fine graded, top-soiled and sodded. The refundable deposit will be returned to the applicant, minus any inspection *Fees*, once the

certification letter and as-constructed lot grading plan have been accepted by the *Township* and the *Township* has performed a site inspection. The certification documents shall include;

- Subdivision Name, if applicable,
- Builder / *Developer* Name,
- Date surveyed,
- Legal property information,
- Municipal Address,
- Professional seal or signatory of the designer,
- Building Permit Number.

The certification letter shall include the following statement:

"I have verified the as-constructed lot elevations for the above noted lot through field survey methods, as shown on the attached drawing and hereby certify that:

- *The as-constructed lot and grading is in general conformance with the proposed lot and grading plan submitted at time of building permit; and*
- *The as-constructed grades as shown will produce adequate surface drainage away from proposed building(s) without negatively impacting existing drainage patterns or adjacent properties.*

Final lot grading certificates are required to be completed prior to any application for additions to the property as referenced in Section 6.

7. Sanitary Sewer Specifications

7.1. Introduction

The purpose of the Sanitary Sewer Specifications is to outline the design criteria for sanitary sewer infrastructure within the Township of Woolwich.

Documents beyond this Engineering Development and Infrastructure Manual that may be applicable for an engineering design include, but are not limited to, the as amended versions of:

- MECP Design Guidelines for Sewage Works,
- Ontario Provincial Standard Specifications (MUNI),
- Previous studies / Masterplans,
- Provincial Acts / legislation,
- Region of Waterloo Water and wastewater Monitoring report,
- Canadian Standards Association (CSA),
- American Society for Testing and Materials (ASTM),
- Provincial / Regional / *Township* planning documents,
- Inflow / Infiltration Best Management Practices,
- Region of Waterloo Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS),
- Ontario Building Code,
- Region of Waterloo By-laws,
- *Township* By-laws.

The *Township's* Engineering Development and Infrastructure Manual is to be read in conjunction with the Region of Waterloo and Area Municipal Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS). In the case that the *Township's* Engineering Development and Infrastructure Manual differs from the DGSSMS, this document will supersede the DGSSMS.

7.2. Private and Public Sewage Systems

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 waterborne culinary and sink water or laundry waste, and such other waste as is suitable for treatment at a sewage treatment facility. All to be in accordance with *Township* and Regional Sewer use By-law.

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 MECP.

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 document will apply.

Building and private sewers will be inspected by *Township Staff* or their designate and building drains will be reviewed by Municipal Building Officials to confirm compliance with the applicable codes.

All services from the property line to 1.0 m outside the building envelope, more specifically both “private sewers” and “building sewers” as defined in the Ontario Building Code (OBC), shall be designed using MECP Guidelines.

7.3. Sanitary Sewer Design Criteria

The Region of Waterloo and Area Municipal DGSSMS Part B – Design Guidelines form the basis of the design criteria except as extended or amended herein. This section’s headings have been matched to the section headings of the DGSSMS. The following outlines the supplementary design criteria to be applied to the design of sanitary sewer *Works* for *Development* in the *Township*.

Sanitary Sewer Design Guidelines

Sanitary sewers which are studied, designed, and constructed in accordance with the most recently revised specifications of the *Township's* Engineering Development and Infrastructure Manual shall be required in all *Capital and Development Infrastructure Projects* unless specifically exempted from this requirement by the *Township*. All sanitary sewers shall be designed in such a manner to ensure the absence of extraneous flows using best available technology. Sanitary sewers shall also be designed for adequate size and depth to provide for the service of adjacent *Lands* where so required by the *Township*. A lateral sewer connection from the sewer main to the edge of the road allowance shall be constructed for each property within *Capital and Development Infrastructure Projects* unless other direction is provided by the *Township*.

All sanitary sewers, appurtenances and connections shall be guaranteed for a minimum period of two (2) years after initial inspection and *Acceptance* of all underground services by

Township Staff and shall not be released from the *Maintenance Period* until the sewers and services have been video inspected, and final *Acceptance* issued by *Township Staff*.

Field verification of the location and invert elevations of the proposed connection point is a required part of the engineering design. Prior to commencement of the *Maintenance Period* for sanitary connections, as required invert elevations at the property line in table form shall be provided to the *Township*.

Conditional approval of the functional design and signing of the *Development Agreements* for construction notwithstanding, the *Township* does not guarantee that sufficient capacity is available in existing infrastructure to provide adequate servicing capacity for a proposed *Development*. A sanitary Sewer Design based on MECP / DGSSMS must be completed by the *Engineer* using the proposed *Development* flows to confirm that sufficient capacity is available in the municipal system. Field verification of the location and invert elevations of the proposed connection point is a required part of the engineering design.

Sanitary sewers are not permitted to accept foundation or weeping tile drainage or roof drainage.

All sewers shall be designed for an embankment condition.

Residential

Refer to DGSSMS

The Township of Woolwich uses an average flow of 305 L/c/d.

Use populations projections based on the *Township* Official Plan.

Population densities for sanitary sewer capacity calculations are to be based on the current Region Official Plan, *Township* Official Plan, and/or Master Plan studies.

Extraneous Flows

In addition to the below requirements, refer to the DGSSMS for details.

Note: Person Per Unit (ppu) densities are not to be used for sanitary flow calculations.

Should the design flow of proposed sewers, using flow from zoning calculations, revised standards result in undersized downstream sewers that were designed using different methodology; the *Township* will require the applicant to evaluate / study the downstream sewers.

Design Flow Calculations

Design Flow = Av. Dry Weather Flow x Av. Peak Sanitary Flow Factor + Infiltration Allowance

Note: sewer mains to be designed to maximum 85% of full pipe capacity. Local sewers are not to be designed over 85% of full pipe capacity. Minimum velocities must be met.

Pipe Depth

Refer to DGSSMS

The maximum pipe depth over sanitary sewers is 8.0 m. Sewers deeper than this requires additional structural review by the *Township / Peer Review*.

Structure

All sewer maintenance holes shall be benched to the obvert of the outlet pipe on a vertical projection from the spring line of the sewer. The minimum width at the top of benching in all maintenance holes shall be 250mm.

All sanitary maintenance holes constructed in the vicinity of low points, flood plain areas, overland flow, within 0.6m of the seasonally high-water table shall have the precast maintenance hole sections and Moduloc watertight wrapped on the outside of the structure and include watertight frames and covers.

Structure Size

Precast concrete maintenance hole requirements are to conform to OPSS requirements identified in OPSD.

Maintenance Holes

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

NOTE: All sanitary maintenance holes located within the storm water management ponding areas to be fitted with watertight covers, as per OPSD 401.050 and 401.030.

Location

Maintenance holes in boulevards shall be located, wherever possible, a minimum of 1.5m from the face of curb or other utilities or street furniture.

Sampling maintenance holes are required to be installed on private property adjacent to the property line fronting the sanitary sewer for all commercial, industrial, and multi-residential *Developments* with six (6) or more units, or as deemed required by *Township Staff* on a case-by-case bases.

A maintenance hole at the property line may be required at the discretion of *Township Staff*. A maintenance hole is required on an existing sanitary main within the right-of-way where the proposed service connection is 200 mm or greater in diameter and/or 30 m or greater in length; measured from point of connection horizontally along the service connection to nearest upstream maintenance hole or point of entry into a building.

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.

External Drop Structures

Refer to OPSD 1003.01 and OPSD 1003.02 for details and requirements of external drop structures.

Services

All sanitary sewer connections shall be inspected and tested at the same time as the sanitary sewer mains. All abandoned services are to be capped at the main with a pre-manufactured end cap.

All sanitary sewer connections shall be guaranteed for a period of two (2) years. This guarantee period shall commence at the same time that the sanitary sewer mains are placed on Maintenance Guarantee.

Note: The standard *Maintenance Period* is two (2) years, however the *Township* reserves the right to extend this term if and where significant deficiencies have existed and been left unattended, or repairs have not been made to the satisfaction of the *Township*.

Odour Control

The MECP 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:

- Hydraulic design which induces 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),
- 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 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 is to 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 *Township*. Examples of this may be but not limited to:

- The use of chemical dosing of *Township* approved or accepted oxidizing agents to address pumping stations and forcemains with long retention times, either on a short term or long-term basis,
- 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,
- Epoxy coating on manholes with forcemain inlet.

Private Drain Connections (PDCs)

Location

PDCs to public street fronting single family, semi-detached and townhouse lots are to be located in accordance with Township of Woolwich Standard 301.

PDCs to multi-family (private property townhouses and apartments), commercial and industrial blocks are to be connected to a maintenance hole on the property line.

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. The 2 (two) PDC connections located at the top end of a dead end pipe run are to be connected to the mainline sewer with a "Y" and a long radius bend.

Minimum Size and Grade

The minimum grade for all PDCs is 2.0%.

The minimum diameter size of PDC pipe is;

- Residential – 100mm
- non-residential - 150mm
- commercial - 150mm
- institutional - 200mm

Connections to Sewers/Maintenance Holes

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.

Multi-family, Commercial, Institutional, and Industrial

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

Connections to Existing Sewers for Lot Infill Situations

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 applicant of the severance/infill, or their agent, must determine if the existing sanitary sewer is at risk of surcharging, or if the sewer is a dedicated sanitary sewer but has a history of surcharging. This information may be obtained from the *Township*. If it is determined that there is a surcharge risk, the *Development* applicant must provide surcharge protection to the *Development* property (s). Any existing clay services are to be replaced.

When connecting PDC's to existing sewers in a lot infill situation, connections must be made utilizing an approved pre-manufactured tee, in accordance with OPSS 410. Inserta Tees, rubber saddles, etc. are only to be used at the discretion of *Township Staff*. These products are not preferred in the *Township*.

PDC Risers

Type I

Required for sewer depths greater than or equal to 4.5 m and for excavations in stable bank conditions. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

Type II

Required for sewer depths greater than or equal to 4.5 m and for excavations in unstable bank conditions. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

PDC Cleanouts

Where removal of an existing PDC is requested and *Acceptance* is granted by *Township*, the cleanout and tee must be removed entirely. The *Owner* may be required to install a new PDC.

Acceptance will be given on a case-by-case basis and will apply to the entire phase of *Capital and Development Infrastructure Projects*.

Marking and Recording PDC Service Connections

Green painted surface stakes 40mm X 90mm X 3.0m shall be placed at the invert cap of the service to mark the termination of sanitary PDC's and shall extend above grade 1.2m.

New PDCs to existing properties shall be constructed to property line.

Sewer Material Specifications

The Region of Waterloo and Area Municipal DGSSMS Part C – Material Specifications form the basis of the design criteria except as extended or amended herein. This section's headings have been matched to the section headings of the DGSSMS. The following outlines the supplementary design criteria to be applied to the design of sanitary sewer *Works* for *Capital and Development Infrastructure Projects* in the *Township*.

Sewers

Pipe Materials Refer to DGSSMS

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

Sanitary sewer pipes shall be comprised of PVC DR 35 (or better) based on the pipe depth and shall be installed with bell and spigot gasketed joints, as per Local Area Municipal Standards.

C900 PVC pipe (or concrete pressure pipe) will be specified in areas of seasonally high-water table and / or where the sewer is greater than 8 metres deep.

In areas where native soil is identified with low permeability (e.g., silt, clay), embedment materials shall be selected such that native soil migration from the trench walls to the bedding material cannot occur. The migration of native soil into the bedding material could lead to the loss of structural support over the course of time. As such, granular bedding material shall be well-graded and compacted to a minimum of 100% Proctor Density, and filter cloth shall be used and wrapped around the trench. Maximum Groundwater Infiltration allowance shall be 0.075 L/mm diameter per 100 m of sewer pipe per hour, as per OPSS 410. Refer to DGSSMS if using clear stone wrap.

Sewer Construction Specifications

The Region of Waterloo and Area Municipal DGSSMS Part D – Construction Specifications form the basis of the design criteria except as extended or amended herein. This section's headings have been matched to the section headings of the DGSSMS. The following outlines the supplementary design criteria to be applied to the design of sanitary sewer *Works for Capital and Development Infrastructure Projects* in the *Township*.

Sewers

Refer to DGSSMS and OPSS

Note: Refer to Section 11 of this document for all Minimum Testing Requirements.

7.4. Inflow and Infiltration

The *Township* geographical site characteristics indicates high groundwater table, fluvial channels, flood prone areas and extreme inflow and infiltration currently in the system. Through the numerous Wastewater and Inflow and Infiltration studies completed by the Region of Waterloo and *Township*, long term quality life cycle infrastructure investment is a continued performance recommendation in these documents and Asset Management plan. A complete system that reduces Inflow and Infiltration will continue to provide capacity for future growth within the community.

The *Township* is committed to reducing the impact of extraneous flows within the wastewater collection systems through the proactive introduction of improved design and construction standards and hydraulic performance specifications for new wastewater collection infrastructure and through the tactical abatement of existing extraneous flow sources via infrastructure rehabilitation and replacement.

7.5. Bulkheads

Sewers under construction shall be bulkheaded, sealed from the existing collection system, as required, in such a manner as to prevent infiltration or flushing water entering existing sanitary sewers during construction and prior to commissioning. Installation of bulkheads and their subsequent removal shall be at the *Developers / Subdivider's* expense.

Approval for the removal of bulkheads from the sanitary sewer post commissioning and testing will not occur without the written consent of the Director of Infrastructure Services and/or Development Services.

Extraneous Flow Performance Testing

If bulkheads are removed, during construction, the *Township* will install flow meters at the proposed outlet to the existing sewage collection system at the *Subdivider's / Developer's* expense. The inflow and infiltration recorded will be billed to the *Subdivider / Developer* including administration and engineering costs.

Sanitary sewer flow monitoring shall take place during a minimum eight-month period commencing within 15 days of April 1, in such a manner as to capture any wet weather flows above the dry weather flow, at the following stages of construction:

- Immediately following the removal of bulkhead(s) and / or the issuance of the first building permit, for every catchment connection,
- At 40% - 50% Occupancy; and,
- One year after 85% Occupancy, for every catchment.

Flow monitoring shall continue for at least eight months, until at least five (5) storm events are captured, and results reviewed with:

- Average intensity of 5 mm/hr. or greater, and/or,
- Minimum rainfall depth of 15 mm over a 24-hour period (with at least one storm event of total volume of 25 mm or greater over a 24-hour period).

Flow monitoring period could be extended at the discretion of *Township Staff*.

Flow monitors and equipment shall be installed, at a minimum, at the point of connection to the existing system, whenever possible, whereby at least 90% of new *Development* flow is captured. A flow monitoring plan shall be submitted to the *Township* as part of the draft plan and Site Plan approval processes, including:

- Flow monitoring locations,
- Type of flow monitoring equipment,
- Rain gauge locations.

All flow data collected by a *Peer Review Consultant* at the *Subdivider's / Developer's* cost shall be collected and provided to *Township Staff* on a minimum bi-weekly basis. *Township Staff* shall determine and advise if the quality of flow data provided satisfies program requirements.

Approval of servicing performance in accordance with Part 5 of this document shall be at the sole discretion of the Director of the *Township* upon completion of the monitoring and inspection program and meeting the performance criteria to the satisfaction of the Director.

7.6. Rainfall Monitoring

Rainfall gauges within 2 km of the flow monitoring locations shall be utilized to log rainfall data at a minimum of 5-minute intervals for the entirety of the flow monitoring period. If there is no existing Regional / GRCA rainfall gauge within 2 km of the site, the *Subdivider / Developer* shall install one at their expense.

Rainfall data produced by the local rain gauge, if not a Region / GRCA gauge, shall be vetted against precipitation data records from Environment Canada and/or Regional station.

7.7. Flow Monitoring Performance Analysis and Results

Flow monitoring data at a minimum of 5-minute intervals shall be plotted against rainfall data such that the volume of extraneous flows is computed for each separate storm event, based on the contributing gross drainage area of the catchment. The effective area tributary to the flow monitoring locations will be determined by the *Township* and Region.

Maximum extraneous rainfall derived inflow and infiltration (RDII) flow allowance shall be 0.12 L/s/ha, under a 25-year event in the newly constructed sanitary sewer system. This shall be considered the Performance Limit. An extraneous flow less than the Performance Limit shall be deemed acceptable by the *Township*.

A variation of this Performance Limit, specified above, can be considered acceptable at the sole discretion of the *Township*. Should it not be deemed acceptable, the *Developer / Subdivider* shall repair the problem within a three-month period from the confirmation of performance results. The performance of the system will then be reassessed via flow monitoring prior to *Acceptance* of the *Works* by the *Township*.

Maximum groundwater infiltration (GWI) allowance shall be 0.075 L/mm diameter per 100 m of sewer pipe per hour, as per OPSS 410.

7.8. Acceptance of Servicing

Acceptable performance of the servicing will be determined at the sole discretion of the *Township* through flow monitoring and achievement of performance criteria.

Flow monitoring and subsequent analysis of RDII and GWI flows will be based on methodology approved and adopted by the *Township* and will be considered in conjunction with water consumption records to determine savings.

8. Watermain Specifications

8.1. Introduction

The purpose of the Watermain Specifications design criteria is to outline the watermain infrastructure within the Township of Woolwich.

Documents beyond this Engineering Development and Infrastructure Manual that may be applicable for an engineering design include, but are not limited to, the as amended versions of:

- MECP Design Guidelines for Sewage Works,
- Ontario Provincial Standard Specifications (MUNI),
- Previous studies / Masterplans,
- Provincial Acts / legislation,
- Region of Waterloo Water and wastewater Monitoring report,
- Canadian Standards Association (CSA),
- American Society for Testing and Materials (ASTM),
- American Water Works Association (AWWA),
- Provincial / Regional / *Township* planning documents,
- Region of Waterloo Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS),
- Ontario Building Code,
- Region of Waterloo By-laws,
- *Township* By-laws.

The *Township's* Engineering Development and Infrastructure Manual is to be read in conjunction with the Region of Waterloo and Area Municipal Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS). In the case that this document differs from the DGSSMS, this document will supersede the DGSSMS.

To perform any pre-authorized watermain alterations (addition, modification, replacement, or extension), Form 1 – Record of Watermains Authorized as a Future Alteration must be completed. All costs to complete the Form 1 are to be paid in accordance with the *Township* Fees and Charges By-law. Watermain alterations shall be performed in accordance with the conditions of the *Township's* Drinking Water Works Permit and License.

8.2. Watermain Design Criteria

The Region of Waterloo and Area Municipal DGSSMS form the basis of the design criteria except as extended or amended herein. This section's headings have been matched to the section headings of the DGSSMS. The following outlines the supplementary design criteria to

be applied to the design of water *Works for Capital and Development Infrastructure Projects* in the *Township*.

External pipe loading shall be calculated and based on a trench width equal to the outside diameter of the pipe, plus 800mm. For purposes of pipe design, the Design *Engineer* shall consider the pipe to be installed in sand or granular “A” bedding, with load factor of 1.9 and/or as per geotechnical and pipe manufacturer recommendations.

In addition to DGSSMS requirements, the design of mains and valves for water mains of 50 mm dia. around a cul-de-sac bulb should be configured to allow for easier flushing in the future. See drawing detail in appendix.

In addition to the DGSSMS requirements, private hydrants are to be painted red. Woolwich hydrant colours are yellow for the body bonnet and side arm caps, and black for the Storz cap (if required). Black numbering 150 mm high indicating the main pipe size shall be painted on the hydrant body facing the street.

A minimum landscape buffer of 3.0m shall be provided around all municipal fire hydrants unless otherwise approved by the *Township*.

Service boxes (curb stops) shall be located at the street property line. Where the water distribution system has been assumed by the *Township*, the *Township* is responsible for water services up to the property line, after which the water service between the property line and the building becomes the responsibility of the property Owner.

Service boxes shall be installed to the middle of the property frontage.

No water service shall be connected to a premises served by a private well until the *Engineer* is satisfied that no cross connection can take place between the private well and the new municipal service, all in accordance with the Public Health Act.

Fire Flow

Please refer to the DGSSMS. The fire flow requirements shall also be determined in accordance with latest edition of “Water Supply for Public Fire Protection” A Guide to Recommended Practice by Fire Underwriters Survey.

8.3. Watermain Construction Specifications

The Region of Waterloo and Area Municipal DGSSMS Part D – Construction Specifications form the basis of the design criteria except as extended or amended herein. This section’s headings have been matched to the section headings of the DGSSMS. The following outlines

the supplementary design criteria to be applied to the design of Watermain *Works* for *Capital and Development Infrastructure Projects* in the *Township*.

Construction Specifications

All watermain installation shall be inspected by a representative of the *Township*, and/or the Consulting *Engineer* herein referred to as the *Inspector*. The work shall be stopped by the *Inspector* if approved drawings are not on the site, there is an insufficient quantity of suitable materials on the site, defective material or improper workmanship is being used. Work done in the absence of an *Inspector* may be ordered to be opened for thorough examination and may be required to be rebuilt or replaced at no expense to the *Township*.

At no time will an *Inspector* be requested to approve the installation of defective material or improper work. No verbal approval by an *Inspector* covering defective material or improper work will be construed as *Acceptance*. Directives given by an *Inspector* relating to the material and /or workmanship shall be followed by the *Contractor*. *Township Inspectors* do not have the authority to layout work, stake, line, level, or grades. *Inspectors* shall take their own survey shots to confirm grade for quality assurance. The constructor will ensure that the trench is in accordance with the Occupational Health and Safety Act. The responsibility for ensuring that these Acts are adhered to will not be part of the *Inspector's* responsibility.

If an *Inspector* from the *Township* is required, the *Subdivider / Developer* will pay the *Township* for the services of an *Inspector* and all equipment.

If the work on a site is widespread in the opinion of the *Township*, so that more than one *Inspector* is required, the *Engineer* shall provide additional *Inspectors*.

Provision of an *Inspector* by the *Township* is not to be considered a substitute for supervision by the *Engineer*.

Watermains

Refer to DGSSMS and OPSS

Layout Plan

Refer to the DGSSMS. The Township of Woolwich requires that service connections for temporary watermains are to be connected to property line / curb stop instead of hose bib, and the service area at the property line is to be left in a safe condition.

Refer to Section 11 Minimum Testing

Watermain Material

Pipe – PVC DR 18 for pipe less than 450mm diameter. PVCO not permitted. Fittings and appurtenances – per DGSSMS.

Watermain Installation

The watermain shall be installed in accordance with AWWA C600 for Ductile Iron (DI) and AWWA C605, OPSS 441 for Polyvinyl Chloride (PVC), CSA, MECP and Manufacturer's requirements.

When watermain is to be installed, Utility staff are to be present during commissioning of new system and connection to the existing public system. All costs associated with *Development* are the responsibility of the *Developer*.

Wrapping

Refer to the DGSSMS. In the Township of Woolwich, all sizes of appurtenances including saddles, valves, tees, bends etc. are to be wrapped with an approved petrolatum system consisting of paste, mastic, and tape. The *Township* also requires that all curb/main stops and brass fittings are to be wrapped.

The following additional requirements are applicable for watermain construction:

Method of Construction

Refer to the DGSSMS and OPS.

Setting of Hydrants

Refer to the DGSSMS. In the *Township*, bags are used to identify hydrants out of service.

Installation

Approved Service Saddles as per the DGSSMS must be used with all PVC mains and as per the following Schedule with Ductile Iron (DI) mains:

If water service boxes must be raised beyond the extension height, only threaded couplers will be used to install extensions. Extensions utilizing set screws or other means are not acceptable.

Services shall be installed perpendicular to the watermain. Bends / curves shall not be installed without the written approval of *Township Staff*. Gooseneck bends are to be installed as per CSA and pipe manufacturer requirements.

New Water Service Connection to Existing at Property Line

Refer to DGSSMS

Live Tapping

Refer to DGSSMS

All water connections great or equal to 100mm to be complete with a tapping sleeve and valve.

Watermain Commissioning

Refer to Section 11.

8.4. General / Emergency Maintenance

When repairs are undertaken by the *Subdivider / Developer / Contractor* during the warranty period, such repairs shall be made while a *Township's* licenced water representative / *Inspector* is onsite. The labour, equipment, administration *Fees* shall be paid by the *Subdivider / Developer / Contractor*.

During the warranty period, where maintenance of water service to the customer or customers is required, or where, in the opinion of *Township Staff*, a faulty or damaged installation may cause inconvenience or further damage, immediate repairs shall be undertaken by the *Township*.

The *Township* will not be required to notify the *Subdivider / Developer* before these repairs are undertaken and the cost of such repairs will be collected from the *Subdivider / Developer*

9. Stormwater Management Design

9.1. Introduction

The Township of Woolwich Stormwater Management Guidelines documents the primary goals and objectives for stormwater management within the *Township*.

The purpose of the stormwater management guidelines is to outline the design criteria for storm drainage infrastructure within the *Township* and specify the storm drainage criteria for all storm infrastructure design. This storm infrastructure includes, but is not limited to, municipal projects and new *Land Development*, as well as *Re-Development* of existing Lands. These guidelines also specify the design guidelines for storm drainage design and reporting at various stages of the *Land Development* process, and provide reference and context to applicable Federal, Provincial, Regional and Municipal policies, regulations and best management practices which must be followed when planning, designing, and constructing and monitoring storm drainage systems and SWM facilities.

Documents beyond this Engineering Development and Infrastructure Manual that may be applicable for an engineering design include, but are not limited to, the as amended versions of:

- Region of Waterloo Groundwater Source Protection Plan,
- Grand River Source Protection Plan,
- Clean Water Act,
- Stormwater Management Monitoring Best Management Practice (Federation of Canadian Municipalities),
- Stormwater Management Design Best Management Practice (Federation of Canadian Municipalities),
- Stormwater Management Planning and Design Manual, MECP 2003,
- Ontario Ministry of Natural Resources Natural Hazards Technical Guides, 2001,
- Erosion and Sediment Control Guideline for Urban Construction, GHHA CA, December 2006,
- Low Impact Development Stormwater Management Planning and Design Guide, CVC & TRCA, 2010,
- Grand River Conservation Authority Stormwater Management Submission Guidelines,
- CSA Z800-18: Guideline on Basement Flood Prevention,
- CSA W204:19 Flood Resilient Design of New Residential Communities,
- Region of Waterloo Sewer Use By-Law,
- Ontario Water Resources Act,
- MECP Interpretation Bulletin: Ontario Ministry of Environment and Climate Change Expectations Re: Stormwater Management,

- Canadian Environmental Protection Act,
- Region of Waterloo Risk Management Plan for Source Water Protection,
- Ontario Ministry of Natural Resources and Forestry documents.

The *Subdivider/Developer* is responsible for obtaining all other necessary permits and approvals from, but is not limited to, the following agencies:

- Grand River Conservation Authority,
- Region of Waterloo,
- Ontario Ministry of Transportation,
- Ontario Ministry of the Environment, Conservation and Parks (MECP),
- Ontario Ministry of Natural Resources,
- Federal Department of Fisheries and Oceans,
- Environment Canada,
- Township of Woolwich/Woolwich,
- Transport Canada.

The *Township's* Engineering Development and Infrastructure Manual is to be read in conjunction with the Region of Waterloo and Area Municipal Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS). In the case that this document differs from the DGSSMS, this document will supersede the DGSSMS.

9.2. Stormwater Quantity and Quality

The *Township* advocates the requirements of stormwater quality and quantity to reduce the additional volume of rainwater that is generated by increased imperviousness and protect the existing environment, private and public property from flooding, degradation, and disruption. Stormwater management techniques are usually more effective when applied at the source.

Effective stormwater management practices are continuously evolving, and current techniques are part of an expanding toolbox. The following list of available techniques are not exhaustive and there may be additional techniques that emerge through consultation with the industry or due to updates to applicable provincial or federal legislation, best management practices and guidelines. The *Subdivider/Developer/Consultant* is required to consult with *Township Staff* throughout the design process, particularly regarding complex sites.

Available techniques for stormwater management can be grouped under the following headings (listed in order of preferred application):

- Lot Level Techniques and Source Application:
 - Roof leader discharge to surface,
 - Roof leader discharge to infiltration facilities,

- Parking lot storage,
 - Rooftop storage (roof to be structurally Engineered to include ponding loads),
 - Permeable pavement,
 - Cisterns, Drywells,
 - Oil/Grit Separators.
- Conveyance
 - Perforated Pipe Systems,
 - Enhanced grassed swales / bio retention,
 - Oversized pipes.
- End-of-Pipe
 - Oil/Grit Separators,
 - Wetlands,
 - Hybrid wet pond / wetland,
 - Wet ponds,
 - Dry ponds,
 - Infiltration facilities,
 - Filter strips,
 - Buffer strips,
 - Sand filters.

Water Quality Targets

Quality controls shall be in place to protect aquatic habitat in the downstream receiver and reduce the impact of *Development* and urbanization. Water quality treatment will be required for all new subdivision and Site Plan(s) within the *Township*. The *Township* requires that all discharge from new *Developments* meet an Enhanced (corresponding to the end-of-pipe storage volumes required for the long-term removal of 80% of suspended solids) water quality standard as outlined in the MECP 2003 SWM guidelines or as updated version. It is also required that a risk assessment, according to Policy RW-CW-19 in the Grand River Source Protection Plan (2019), and as amended versions, be conducted to determine if the *Development* is a threat to drinking water sources, including measures to mitigate the threats.

The following shall be considered general requirements in providing stormwater quality management for the *Township's* review; however, it should not be considered exhaustive:

- Provide the background hydrologic data for the stormwater quality management control being proposed,
- Indicate the criteria that the quality management control is being developed from, whether it is MECP 2003 guidelines, a Subwatershed Study or other,
- Provide plans/reports of the quality management measure(s) with cross-sections of the facility (or facilities), details of inlets, outlets, maintenance access, berm construction and landscaping.

- Provide calculations for stormwater quality control facilities such as, but not limited to, the following:
 - volumetric sizing,
 - stage/storage/discharge relationship,
 - volume calculations at various facility stages,
 - outlet control calculations – drawdown time,
 - forebay dispersion length,
 - minimum forebay deep zone bottom width,
 - length/width ratios,
 - maintenance requirements,
 - Storage disposal / drying area within SWM block.
- The *Consultant* must provide dimensions for all facility attributes and provide verification that the facility meets minimum MECP 2003 guidelines,
- For Industrial sites and Industrial zones Land, other high-risk sites or an oil/grit separator is proposed, an ECA, as per O. Reg 525/98 and as amended versions, is required for Facility / Site Plan approval,
- The *Consultant* must provide a Landscape Plan for all applicable facilities, which would include background text and comparison to MECP 2003 guidelines and current Best Management Practices,
- The *Consultant* must provide soils information for the facility site and, in the case of proposed infiltration, document the quantity and quality impacts to groundwater recharge,
- The *Consultant* must minimize external drainage area overland flow impacts on the proposed stormwater quality control facility,
- The *Consultant* must indicate proposed flow by-pass conditions and impacts on stormwater quality,
- The *Consultant* must provide a maintenance and operation manual with the detail design of the facility, which outlines requirements for the *Township*,
- The *Consultant* must develop a monitoring program for all applicable stormwater quality control facilities, which not only fulfills Ministry of the Environment requirements, but also the requirements of the *Township*, the Grand River Conservation Authority, the Region of Waterloo, and other relevant approval agencies,
- The *Consultant* must address winter operations for the proposed stormwater quality control facility (ref. Stormwater Management Planning and Design Manual, MECP, 2003),
- For Gas Stations / Industrial sites and other high-risk sites, a Pollution Protection Plan and/or Risk Management Plan shall be required.

Oil/grit Separators

Areas subject to the collection of contaminants or spills shall be fitted with adequate oil/grit separators. Oil/grit separators are most appropriate for commercial/industrial *Land* use and

shall not be used as a standalone Stormwater Management Plan, but rather part of a “treatment train” approach to achieve the required water quality treatment. Oil/grit separators typically serve drainage areas under 2 ha and are predominantly required by the *Township* to be used for spill control. In situations that involve spill management controls, effluent from oil/grit separators is governed by the Region of Waterloo Sewer Use By-Law. Oil/grit separators are also appropriate for providing water quality control for *Re-Development*, or infill areas which typically have space limitations. The MECP 2003 guidelines shall be followed in incorporating an oil/grit separator as part of the water quality protection for a site. Oil/grit separator manufacturer’s technical guidelines shall be consulted in the sizing, installation, maintenance frequency, warranty etc. of a unit.

Inlet pipes into oil/grit separators shall have a maximum slope of 1% and in accordance with manufacturer specifications.

Additional Post Certification testing may be required by the *Township* for oil/grit separators. Refer to Section 9 for more information.

Oil/grit separators are required to be Environmental Technology Verification (ETV) certified units and require ECA approval as per O’Reg 525/98 as amended version, unless approved otherwise by the *Township*.

The Township will only accept Stormceptor (STC) brand of oil and grit separators.

Water Quantity Targets

The *Township* requires the implementation of proven quantity controls where feasible and following approval by the *Township*. To meet water balance, post *Development* peak flows must be designed to match *Pre-Development* flows, the capacity of the receiving system, or an alternate value determined by the *Township*. The *Consultant* shall provide details on how the peak flow is to be controlled. A legal outlet must always be provided for storm drainage. *Low Impact Development* designs proposed will be required to receive an ECA approval.

9.3. Stormwater Management Securities

In accordance with the *Development Agreement*, the *Township* will require *Security* for the following items for stormwater management monitoring and maintenance:

- 100% cost for Facility clean-out,
- Stormwater management monitoring.

These items are to ensure that the whole of the monitoring program and facility clean outs are completed, as detailed in the accompanying Stormwater Management Report and Cost Estimate. Should the *Consultant’s* annual reporting not be considered appropriate or

compliant, the *Township* may draw from the *Security* and have the monitoring program completed by accredited professionals. The *Security* may also be used by the *Township* to adjust channels and stormwater management facilities to the satisfaction of the *Township*, Grand River Conservation Authority and the Department of Fisheries and Oceans.

9.4. Stormwater Systems Design Criteria

Minor System

The minor system, which incorporates storm sewer pipes, catchbasins, roadway gutters, ditches, culverts, swales, and private storm drain connections for all *Land* uses, shall be designed according to, but not limited to the following design principles and criteria.

If an existing storm sewer network is proposed to be included as part of the servicing design, a video closed circuit TV (CCTV) inspection of the existing system in an acceptable format consistent with *Township* requirements shall be completed to verify the existing system is function as per existing design and in good working condition.

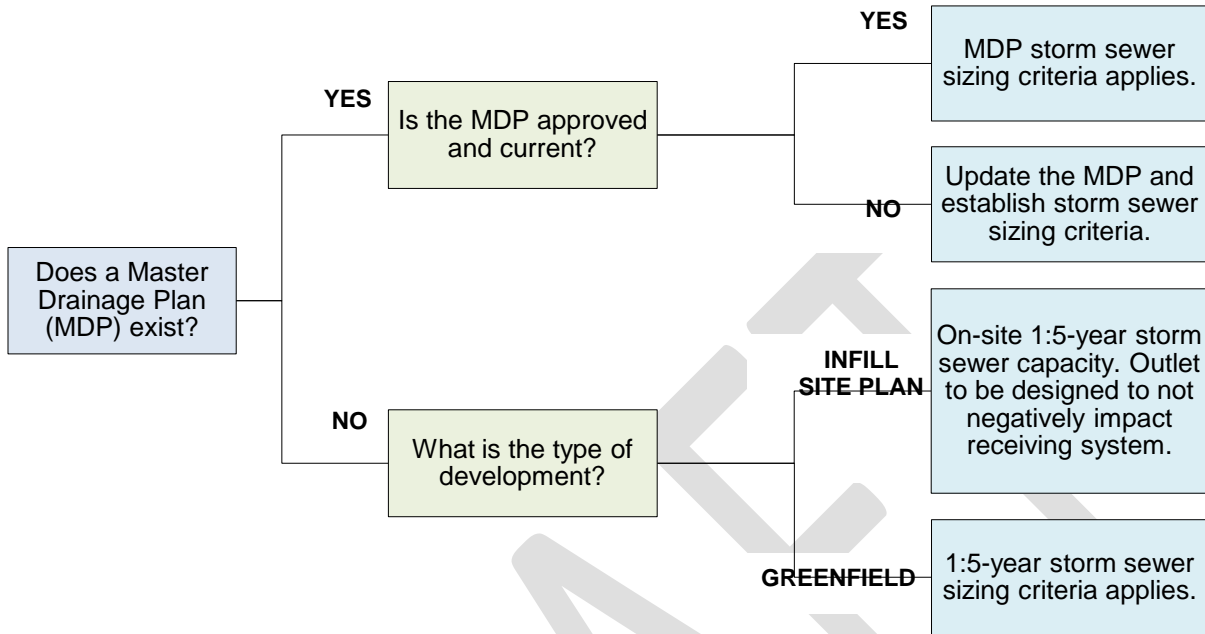
Storm Sewers

All storm sewers must be designed to adequate size and depth to accommodate the *Land Development* upstream within the watershed and/or to accommodate the drainage of areas designated by the *Township*. Storm sewers are required on all streets within a subdivision. Sewers must extend at least halfway across the frontage or flankage of every lot and block within the subdivision.

Any channel improvements, bridges, culverts and all other drainage structures or improvements shall be designed and constructed in accordance with the Canadian Highway Bridge Design Code and other local standards and specifications and to the approval of *Township Staff*.

Approved Master Drainage Plans (MDP's), *Municipal Drainage Reports* and/or Watershed and Subwatershed Plans, which have established storm sewer sizing criteria other than 1 in 5-year return storm event standard will govern. Please refer to Figure 9.1 for more information. In the absence of approved MDP's, storm sewers shall be designed to a minimum 1 in 5-year return storm event. All sewers must be designed to maximum 90% of full pipe capacity. For any storm sewer installed within the *Township* the minimum allowable pipe diameter for the storm mains is 300 mm. Flows entering the receiving existing storm system shall not be increased from *Pre-Development* flows and/or existing capacity of the downstream storm sewer.

Figure 9-1 Minor Storm Sewer Sizing Criteria Decision Tree



All storm sewers, appurtenances, and connections will be guaranteed for a minimum period of two (2) years, and/or 2 winter seasons, after Registration and initial inspection and placed into *Maintenance Period* by the *Township*. However, they will not be released from the *Maintenance Period* until the sewers have been inspected and final *Acceptance* is granted by the *Township*. As-Recorded information must be provided prior to commencement of the *Maintenance Period*, this includes, but is not limited to, storm connection invert elevations at property line, as-recorded drawings, videos, Geographic Information Systems (GIS) maps and Public Sector Accounting Board (PSAB) attribute drawings and any other information outlined in the DGSSMS, *Subdivision Agreement* and any other *Township* requirements.

Storm Sewer Design Guidelines

The Region of Waterloo and Area Municipal DGSSMS Part B – Design Guidelines form the basis of the design criteria except as extended or amended herein.

Rainfall Intensity

Values of rainfall intensity (I) shall be determined by:

$I = A / (T_c + B) C$, where

A, B, & C are defined as follows:

- Refer to the City of Kitchener IDF curves, for parameters and events ranging from 12.5mm to 100 years and with a duration less than 6 hours,
- When calculating the 12.5mm or 25mm event the storm duration is to be 4 hours.

Time of Concentration and Inlet Time

Refer to DGSSMS. T_c (time of concentration) and inlet time shall conform to the latest MECP guidelines.

Runoff Coefficient by Land Use

The minimum runoff coefficients (R) for storm drainage (unless otherwise specified in watershed plans) are as follows:

Parks:

Parks – Over 4.0 ha	0.30
Parks – 4.0 ha and under	0.35

Single Family Residential:

Lots greater than 15m frontage	0.65
Lots 12-15m frontage	0.70
Lots smaller than 12m frontage	0.80
Semi-detached	0.80
Townhouse	0.85

Multi Residential:

Apartments	0.85
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Commercial / Institutional

Schools and Churches	0.90
Heavily Developed Areas	0.95

Impervious values for overall storm analysis and modelling of new *Development* shall reflect maximum impervious coverage through Zoning By-Law regulations and/or the requirements above whichever is more stringent.

Pipe Slope

Refer to DGSSMS for the first reach of permanent dead-end sewer. All other slopes shall be determined as a function of the flow velocity (described below) for each specific run.

Blind Connections

Refer to DGSSMS. Maintenance holes are required on the road for all rear yard catchbasins.

Head Walls

Refer to DGSSMS. A pedestrian guardrail as per OPSD 980.101 shall be installed on headwalls.

Structure

Refer to DGSSMS. All catchbasin maintenance holes and maintenance hole structures are to be installed with 600mm sumps except for rear yard catchbasins.

Tee Maintenance Holes

Refer to DGSSMS and use OPSD 707.010.

Drop Inlet Structures

The *Township* only permits external drop structures. Drop structures shall be provided in accordance with MECP Design Guidelines and OPSD 1003.01 (external). Note: MECP requirement applies for a difference of 0.61 m.

Catchbasins

Refer to DGSSMS and all catchbasins are to be designed to accommodate design accumulated storm runoff, including catchbasin leads etc. Catchbasins shall not be placed in front of driveway entrances and pedestrian walkways.

Minimum Diameter

Refer to DGSSMS. Storm sewer services shall be provided for each property requiring a sump pump in residential *Development*.

Open Ditch and Culvert Design

The minimum allowable culvert size shall be 450 mm in diameter.

Sewer Material Specifications

The Region of Waterloo and Area Municipal DGSSMS Part C – Material Specifications form the basis of the design criteria except as extended or amended herein. This section's headings have been matched to the section headings of the DGSSMS. The following outlines the supplementary design criteria to be applied to the design of storm sewer *Works* for *Development* in the *Township*.

Material Specifications

Pipe Materials

Refer to the DGSSMS for acceptable materials. PVC profile pipe is not permitted for *Township* infrastructure.

Flexible Couplings

Refer to DGSSMS

Township does not allow flexible couplings on stormwater infrastructure for new *Developments*. PVC hard sleeve and gasketed pipe connectors are required and must be a hand buried connection.

Watertight Connectors

Refer to DGSSMS

Sewer Construction Specifications

The Region of Waterloo and Area Municipal DGSSMS Part D – Construction Specifications form the basis of the design criteria except as extended or amended herein. This section's headings have been matched to the section headings of the DGSSMS. The following outlines the supplementary design criteria to be applied to the design of storm sewer *Works* for *Development* in the *Township*.

Construction Specifications

General

Refer to DGSSMS.

Inspection and Testing

Refer to Section 11 for all Inspection and Testing Requirements.

Inlet Systems – Catchbasins

The minor system shall be designed so that the conveyance capacity complements the inlet capacity. *Subdivider/Developer's Consultant* must ensure that all storm sewers and catchbasin leads are sized adequately and calculations provided to the *Township*.

Outlet Treatment

All storm sewer outfalls shall be designed to prevent erosion. Where discharging to a watercourse it should blend into the natural surroundings, in an environmentally acceptable and aesthetically pleasing manner, given the size and location.

An access road with a minimum width of 4.0 m and cross fall of 2% shall be provided to all outfalls.

Outlets shall be provided with safeguards to prevent entry by unauthorized personnel / animals into the outfall. Refer to OPSD to determine what outfall sizes require grating to prevent unauthorized entry.

Outlets shall not be fitted with orifice plates as flow control. Smaller diameter pipes shall be used instead.

The invert of the outlet shall be located 450mm (freeboard) above the receiving watercourse five (5) year flood elevation (or where not available, the approved otherwise high-water level), and the invert of the overflow weir shall be 450mm (freeboard) above the 100-year storm event or regional storm event (whichever is greater) of the receiving watercourse. The highest design storm water elevation within the pond shall be below the underside of footing elevations of the surrounding buildings. The outfall shall be adequately protected from erosive forces in the receiving watercourse to prevent scouring and undermining. The design shall consider the limits of any tail water effects and ensure that the invert of the outlet is above such limits.

The outlet should be positioned no greater than 45 degrees to minimize the outlet angle to normal creek flow and the outlet should be located flush with the creek bank for minor creeks with no valley flow and at the intersection of the overbank area/valley wall for major creeks. Reference Section 14 "Erosion and Sediment Control" of these Guidelines and the Erosion and

Sediment Control Guidelines published by the Grand River Conservation Authority and the Greater Golden Horseshoe Area Conservation Authorities (“Erosion & Sediment Control Guide for Urban Construction, 2006”).

Storm sewer outfalls to regulated watercourses require a permit from the Grand River Conservation Authority. Storm sewer outfall design is to be submitted to the *Township* as part of the full engineering submission.

Prior to Draft Plan Approval the *Subdivider/Developer/Consultants* must demonstrate that the storm drainage is directed to a legal outlet and that *Easements*, blocks or other *Agreements* have been obtained if appropriate.

Additional Post Certification testing may be required by the *Township* for SWM outlets.

Major System

Roadway Conveyance

Major roadways and local streets often convey runoff during severe storm events and, as such, shall be incorporated as elements of the major drainage system. Major overland flow must be confined to public roadways and legal outlets and not through residential lots.

For new *Development*, public road grades must be designed/constructed to provide positive conveyance to major watercourses, storm sewer inlets and/or SWM Facilities.

The public roadway major system interface between existing and proposed *Development* must be positively graded to convey roadway overland drainage to the flow capacity of the existing roadway system while maintaining public roadway flooding depths, velocities, outlet capacity etc. to the foregoing standards. Should overland flows from the proposed *Development* be above the existing receiving overland flow system, storage of overland flow or other methods of reducing flows to the receiver flow capacity will be required. Should a positively graded major system interface not be possible under normal site grading conditions, as demonstrated by the *Subdivider/Developer*, then alternative grading and/or methods of conveying the overland flow such as, but not limited to, sag roadways (saw tooth grading), overland relief points and enlarged storm sewers, shall be reviewed with the *Township*. Street flooding depths, velocities, etc. must be maintained at/or below *Township* standards.

Overland Flow Routes

All overland flow from rear yards must be conveyed to roadways and/or legal outlets via swales or rear yard catch basins with connecting leads. The use of rear yard catch basins should be actively discouraged. The overland flow routes, through and from lots, must be designed such that water levels remain below the finished yard grade adjacent to the swale. All overland flow routes must be designed to convey the 100-year event within the confines of the

overland flow route and must maintain flow velocities below the erosion threshold for the swale (refer to Section 14 for sediment and erosion control details). The detailed design must show how the overland flow route will convey the flows within the subdivision and all contributing upstream areas. Overland flow routes are to be identified during the preliminary stormwater management design.

Roads that are proposed to be used as an overland flow route shall be designed as stated in Section 9.

Flood Management

All proposed new *Development* or *Re-Development* areas must assess the potential impacts on local and regional flooding and mitigate accordingly. The depth and extent of street flooding in new *Developments* is limited to 0.15 m above the centerline elevation of the roadway and velocity must not exceed 1.5 m/s to protect property and public safety and allow emergency vehicle access. The design must be in accordance with but not limited to GRCA, *Township* and CSA W204 standards. The design should also assess flood risk as per current Ministry of Natural Resources and Forestry's (MNRF) practices for flood risk mapping (refer to MNRF Technical Guide – River and Stream Systems: Flooding Hazard Limit) and should be evaluated as "low risk".

In areas where no watershed plan has been completed and in certain site-specific circumstances, the *Township* will require that *post-Development* runoff peak flows are controlled to *Pre-Development* levels or less. As such, discussion regarding the over-control of *post-Development* flows would be required with the *Township*. Examples of *Development* post-construction leading to an increase in flows include, the addition of concrete pads, outdoor paved areas, accessory buildings, decks etc. The *Consultant* shall provide a table with pervious vs impervious area of the proposed *Development*.

Where Subwatershed or Master Drainage Plans have been completed, the *Consultant* will be required to comply with the recommendations of the specific plan. Any variations will need to be appropriately supported by detailed analysis and be approved by any agencies having jurisdiction.

Sizing flood management controls (i.e., stormwater management quantity control facilities) is typically an iterative procedure. Details for the expectations for modelling flood management are discussed in more detail in Section 9.

9.5. Analytical Methods for Stormwater Design

Analytical methods can be subdivided into two categories, hydrology, and hydraulics, representing the establishment of flows and flow levels, respectively. Hydrology typically precedes the determination of hydraulics for all new *Development* and *Re-Development*, as

flows are required to establish the hydraulic characteristics of open and closed systems. The analytic methods described below represent established techniques that are accepted by the *Township*. The *Consultant* is not limited to the methods herein, although discussion with the *Township* and review agencies would be required to confirm the appropriateness of using alternative hydrologic and hydraulic analytical techniques, prior to their use.

Hydrology

Rainfall

Intensity – Duration – Frequency (IDF)

The most recent City of Kitchener IDF Curves/Hydrographs for the design storm events shall be used to design storm infrastructure.

Rational Method

The *Township* will not accept the Rational Method for determination of time/stage and required storage volumes of SWM facilities. The Rational Method is a conservative approach calculation with many Assumptions built in. The Rational Method provides the designer with a peak discharge value but does not provide a time series of flow or flow volume. The *Consultant* must ensure the specific flow restrictions proposed on the site work with the entire modelling system.

Event Based Hydrologic Models

Single Event Modeling

The Flood Plain Management in Ontario Technical Guidelines, Ontario Ministry of Natural Resources, 2001 and the Drainage Management Manual Parts 3 and 4, Ministry of Transportation, 1997 provide general guidelines on the selection of hydrologic models. The Ministry of Transportation document lists the characteristics of each model, from which the *Consultant* can evaluate the appropriateness of certain event based hydrologic models.

A list of event based hydrologic models considered appropriate has been provided below. Should a *Consultant* wish to use another model, documentation as to the validity of the model should be provided to *Township Staff* for review prior to use.

List of Approved Hydrologic Models

1. SWMHYMO/OTTHYMO
2. VISUAL OTTHYMO
3. SWMM

4. XP-SWMM
5. MIKE SWMM
6. MOUSE (DHI)
7. HSPF/WINHSPF
8. GAWSER
9. MIDUSS

List of Approved Hydraulic Models

1. XP-SWMM
2. SWMM
3. MOUSE (DHI)
4. HEC-RAS (If HEC-2 is used, it should be converted to HEC-RAS)
5. Flow Master
6. Culvert Master

Sound hydrologic modelling standards of practice shall be followed in developing an event based hydrologic model. The following standards of practice are intended to guide general model preparation for most hydrologic programs and techniques, however, this list should not be considered exhaustive:

- The modeller must provide the purpose for developing the hydrologic model, such as determining flow rates, runoff volumes, flow routing effects for proposed *Development*, existing *Land* use conditions etc.,
- The modeller must provide the study objectives and how they relate to the hydrologic modelling,
- The modeller will provide the model selection criteria and how the model matches the criteria,
- The modeller shall provide the basis for the storm design information, outlining how the design storm has been selected,
- The modeller shall provide drainage area plans outlining both internal and external catchments, modelling schematics and tables providing drainage area parameters,

- Background information on the selection of the drainage area parameters must be provided to assist the *Township* in understanding on the Assumptions leading to the drainage area parameters,
- Background data on overland and minor storm systems shall be provided with plans clearly presenting and labelling both systems,
- Data to be provided on routing through natural and manmade storage systems, with detailed plans and calculations outlining how the stage/discharge relationship has been developed,
- Sensitivity analysis must be conducted on a minimum number of parameters which varies with model complexity,
- Verification or validation of results must be provided through various methods such as calibration to recorded streamflow, unit flow rates and runoff volume comparisons using the techniques such as the MTO index method or equivalent. The application of the validation technique (number and type) will depend on the availability of data and the sensitivity of the analysis,
- The modeller must provide all input and output details in a logical manner, with an explanation for potential errors.

Continuous Event Modelling

Continuous models differ from event based hydrologic models in that rather than using a synthetic design storm based on Intensity Duration Frequency (IDF) data, a long-term time series of historical meteorological data is used for the input driving function. In addition to historical rainfall data, continuous models typically require seasonal state variables. Continuous models are usually more complex than event based hydrologic models, as typically the models consider more processes including temperature, evapotranspiration, snow conditions and groundwater. Notwithstanding, the modelling standards of practice for event based hydrologic models also apply to continuous models. Continuous models are typically used but are not limited to higher level studies such as watershed and subwatershed studies. Continuous modelling may also be used for studies with a scope requiring historical data inclusion.

In addition to the standards of practice for event based hydrologic models, the *Consultant* shall demonstrate that the historical meteorological time series selected has been obtained from the nearest rainfall gauge to the *Consultant's* study area. This will often lead to a trade-off between duration of record and proximity. Typically, the minimum duration for meaningful continuous simulation is 20 to 25 years. Historical rainfall data is available from Grand River Conservation Authority, the Region of Waterloo, and Environment Canada.

The *Consultant* in selecting a continuous hydrologic model usually intends to develop frequency flows for the historical data period. The *Consultant* should specify the Assumptions and methodology for determining the frequency flows and typical year hydrographs. The

Consultant should provide validation of the selected probability distribution by using statistical tests.

The *Consultant* shall select the continuous model considering *Development* and/or *Re-Development* characteristics to the satisfaction of the *Township*. In addition, approval agencies (i.e., Grand River Conservation Authority, MNR, MTO, Region of Waterloo and other applicable agencies) other than the *Township* must be consulted to determine modelling requirements.

Hydraulic Capacity

Drainage systems can be subdivided into both closed and open systems. The hydraulic capacity of the receiving minor and major storm system is to be determined to verify that drainage can be safely conveyed as proposed. For each system various analytical techniques can be employed. The *Consultant* is not limited to the methods herein, although discussion with the *Township* and review agencies (Conservation Authorities, Ministry of Natural Resources, Ministry of Transportation, Region of Waterloo, and others) would be required to confirm the appropriateness of using alternative hydraulic analytical techniques.

The hydraulic capacity of a storm system can be determined through hydraulic modelling and for certain applications using standard 'hand calculations. As for hydraulic modelling, standards of practice relate to the use of various techniques. The following minimum standards of practice are intended to provide guidance:

- The *Consultant* shall clearly identify the study objectives and how they relate to the hydraulic modelling,
- The *Consultant* must provide the purpose for the hydraulic modelling,
- The modeller must provide the model selection criteria and how the model matches the criteria,
- The *Consultant* must provide plans clearly presenting the closed and/or open hydraulic system,
- For plans describing open systems, the *Consultant* must note cross-sections, study limits, *Land* use, crossing details, spill areas, ineffective flow areas, and flooding limits and elevations for the appropriate design event(s),
- For plans describing closed systems such as storm sewers, the *Consultant* must note the storm sewer network details including maintenance hole numbers, storm sewer size, length, study limits, *Land* use, slope, and sewer and ground elevations,
- For combined hydrologic/hydraulic models such as SWMM, the *Consultant* must provide plans that not only describe the closed system but also the contributing drainage areas and overland flow system,
- For all hydraulic models, the *Consultant* must provide the downstream and, if applicable, the upstream boundary conditions for each storm modeled and the Assumptions used to define the boundary conditions,

- For all hydraulic models, the *Consultant* will document the parameters established for hydraulic losses such as Manning's 'n', inlet and outlet losses and other appropriate losses,
- The *Consultant* must summarize the selection of procedures for determining the computed energy grade line and water surface elevations,
- The *Consultant* must document the hydraulic results in summary form for the relevant storm events,
- The *Consultant* must prepare the model of an open system such that it fully contains the modeled flows without exceeding the hydraulic cross-section. Should it not be possible to contain the flows within the defined geometry of the open storm system, the *Consultant* should provide details on the spill characteristics. In the event of a spill, a rationale should be provided on whether or not to include a flow loss in the calculation,
- The *Consultant* must document potential impacts on existing infrastructure and possible mitigation measures,
- Sensitivity analysis shall be conducted on a limited number of parameters depending on the model type and complexity,
- The *Consultant* must verify hydraulic results for an existing closed/open storm system by documenting historical flood elevations (i.e., Hurricane Hazel) for specific storm events and comparing the hydraulic modelling results to the historical data; calibration of losses should be included, if sufficient data exists,
- The *Consultant* must provide the input and output data in a logical manner with an explanation of the potential error.

The hydraulic capacity of storm sewers is to be determined using the Region of Waterloo and Area Municipal Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS) storm sewer design sheet and the MECP design guidelines. In addition, the *Consultant* must document, in both plans and text, the hydrology for the storm sewer design. The storm sewer design must be conducted using the City of Kitchener's 5-year IDF storm data of the *Township's* approved storm event for the study area (regardless of the return period used previously to size downstream storm sewers). A minimum 10% contingency shall be added to calculations.

Flood Management Sizing

The following are requirements for sizing flood management controls. The *Consultant* must develop a stage/storage/discharge curve for a stormwater management control facility / inlet control device by determining the required runoff volume to be detained for various storm events.

The procedure for runoff determination typically requires the modeller to use either an event based or a continuous hydrologic model. The modeller should determine which modelling methodology to use. The first step in methodology selection should be whether or not a

Subwatershed, Master Drainage Plan or similar previous study has been completed and the type of modelling used. If no previous study has established the modelling requirements, the following must be considered in selection of a methodology:

- The sensitivity of the watercourse from fisheries and erosion perspectives,
- The availability of stream flow data,
- The potential for stormwater management long-term monitoring, and
- Approval agency and *Township* requirements.

In providing the *Township* details on flood management, the *Consultant* must follow standard codes of practice. The following standards are intended as a guide of requirements; however, this list should not be considered exhaustive:

- The *Consultant* shall provide the background hydrology behind the *Pre-Development*, post- *Development* and controlled *post-Development* scenarios,
- The *Consultant* shall provide a table on the stage/storage/discharge relationship of the flood control facility. Methodology of determining the relationship shall be provided,
- The *Consultant* shall provide cross-sections of the facility and details of the inlet(s) and outlet(s),
- The facility shall have an overflow weir which is typically required for flows greater than the controlled storm events,
- The facility shall have a maintenance access for both the inlet(s) and outlet(s), and
- The *Consultant* shall provide landscaping details (to be approved by GRCA).

9.6. Watercourse Systems

Sites located near watercourses present unique challenges for stormwater management. During a *Development*, there may be a need to discharge to or alter/remediate an existing watercourse or design a new watercourse/channel. Consultation with the Grand River Conservation Authority is required.

Discharge to Existing Watercourse

If a *Development* is to discharge directly to a watercourse, the reduction of pollutant loads is essential before stormwater is discharged to these features to preserve or enhance the ecological habitat.

For sites that discharge via private or municipal conveyance systems to a watercourse that is within 1,000m of the site: The proponent will ensure the site achieves complete water quality control of runoff that is generated from all surfaces on the entire site by achieving enhanced protection.

Watercourse Alterations (In Relation to Stormwater Outlets)

Where watercourse alterations are proposed as part of the *Development*, the design of such alterations shall consider and incorporate the following as a minimum:

Channel design is to be based on natural channel forming processes to achieve a dynamically stable system. The channel evaluation methodology and design approach are to be consistent with the most current Provincial guidelines (ref. Ontario Ministry of Natural Resources Natural Hazards Technical Guides, March 2003 and “Adaptive Management of Stream Corridors in Ontario”, MNR, 2001) and CSA W204.

Alteration to a regulated watercourse will require a permit from the Grand River Conservation Authority (*Development*, Interference with Wetlands and Alterations to Shorelines and Watercourses) and potentially clearance/authorization from the Federal Department of Fisheries and Oceans (Fisheries Act) and Ontario Ministry of Natural Resources (Lakes and Rivers Improvement Act).

Remedial *Works* shall incorporate fish habitat protection/mitigation or compensation in accordance with the requirements of the Federal Department of Fisheries and Oceans (DFO) and Ontario Ministry of Natural Resources (MNR), related to stream type and significance.

Remedial *Works* shall incorporate as a minimum, the requirements of the governing Official Plan (Region of Waterloo and/or Township of Woolwich), as well as the requirements of provincial Ministries and other public agencies for the protection of natural heritage features and ecological functions such as:

- Township of Woolwich,
- Regional Municipality of Waterloo,
- The Grand River Conservation Authority,
- Ontario Ministry of Natural Resources,
- Transport Canada for Navigable Waters Permit,
- Fisheries and Oceans Canada, and
- Ontario Ministry of Tourism, Culture and Recreation.

Watercourse/Channel Design Requirements

Watercourse/Channel Design should be applied and/or considered under the following circumstances:

- Channel realignment,
- Watercourse erosion/stabilization Works, and
- New creek corridors.

Watercourse/channel design involves numerous disciplines such as qualified geomorphologists, water resources *Engineers*, terrestrial specialists, and fisheries biologists to interpret existing watercourse / channel conditions and to develop, through an integrated design approach, a 'successful' channel design. The watercourse / channel design must incorporate hydrology, stream hydraulics, fluvial morphology, and fisheries habitat assessment. Each discipline must determine design parameters which will be beneficial in the integrated design approach. Design approaches must consider the following characteristics as a guideline (not exhaustive) to developing a watercourse/channel design:

Physical (Watershed and Watercourse/Channel) Characteristics

- Run-off characteristics
- Flow regimes
- Channel geometry
- Floodplains
- Alignment and meandering
- Bed-forms, riffles, and pools
- Slopes
- Soils
- Erosions and tractive forces
- Shading
- Channel roughness, and
- Light penetration.

Chemical Characteristics

- Sediment load
- Suspended sediment
- pH
- Hardness
- Temperature
- Dissolved oxygen
- Nutrient levels, and
- Toxic Substances

Biological Characteristics

- Fisheries and fish habitat (including habitat potential)
- Presence of plants and macroscopic animal life
- Other terrestrial, riparian characteristics, and
- Stream bank cover.

There are numerous guidelines which consider the foregoing characterization in developing a natural channel design, such as the following examples:

- 1994 MNR Natural Channel Design Manual
- Dr Dave Rosgen, Applied River Morphology, 1994
- Dr William Annable, Morphologic Relationships of Rural Watercourses in Southern Ontario and Selected Field Methods in Fluvial Geomorphology, August 1996
- Dr Robert Newbury, Canadian Stream Reference Book (Ongoing)
- 2001 MNR and
- Adaptive Management of Stream Corridors in Ontario, Natural Hazards Technical Guidelines, MNR 2003

The *Consultants* should demonstrate that due care has been taken in establishing the watercourse/channel design to the satisfaction of the *Township* and relevant approval agencies (DFO, GRCA etc.).

Design Documentation for Watercourse/Channel Design

The following is considered a minimum for documentation of watercourse/channel design and is not intended to be exhaustive:

- The *Consultant* must provide the background existing, proposed hydrologic data and *Pre-Development* monitoring data,
- The *Consultant* must provide plans outlining the following:
 - Existing and proposed plan and profile,
 - Existing and proposed channel sections,
 - Details for proposed typical channel sections,
 - Sediment and erosion controls,
 - Staging plans,
 - Seeding and Landscaping plan,
 - Flood line delineation – existing and proposed,
 - Trails and maintenance access routes.
- The *Consultant* must document how the proposed watercourse/channel design matches and/or enhances existing watercourse/channel characteristics,
- The *Consultant* must document how the proposed watercourse/channel will function within the watercourse block/valley system,
- The *Consultant* must document existing and proposed watercourse/channel hydraulics, including storage discharge relationships,
- The *Consultant* must document potential impacts on both the existing terrestrial and fisheries conditions,
- The *Consultant* must provide a monitoring program outlining monitoring requirements for the various design principles.

In addition to the watercourse/channel design, the following shall be incorporated:

- Access will be required consisting of a 4.0m wide pathway with cross fall not to exceed 4%,
- Special consideration must be given to the vegetation. Landscape Plan must be designed by a member of OALA in good standing,
- Area must be posted as naturalized area and wording within the purchase and sales *Agreement* should reflect this requirement,
- No access gates permitted directly from private properties.

Roadway Crossings

Waterway openings for culverts and bridge crossings shall be designed in accordance with the Ministry of Transportation Ontario (MTO) policies and guidelines and CSA W204.

Arterial and collector roadways in new *Developments* shall be, where possible, the only road classifications permitted to cross a watercourse having a drainage area more than 125 ha. Road design must have overflow that does not impact private property. Spacing and location of roadway crossings other than arterial or collector roads may be considered by the *Township* when documented within the Stormwater Management Plan. Freeboard and clearance (as defined in the governing MTO manuals and the Ontario Bridge Code) requirements for watercourse crossings shall be based on current MTO criteria.

Culvert replacements may require a Class Environmental Assessment as outlined within the MEA Municipal Class Environmental Assessment document, October 2000, as amended in 2007.

Setbacks

The size of setbacks from the watercourse edge to developable *Lands* is typically a function of the significance of the valley form, the sensitivity of the watercourse and the type of *Development* (building or other).

The Grand River Conservation Authority requires that setbacks from watercourse shorelines, and/or wetlands be established through watershed; subwatershed studies (Comprehensive Environmental Impact Study (EIS)), scoped EIS or through a full EIS. The Grand River Conservation Authority may establish setbacks using “Technical Guide, River and Stream Systems: Erosion Hazard Limit OMNR 2002” to define the erosion hazard limit using stable slope allowances. *Consultants* should be aware that watercourse setbacks will typically be established by the Conservation Authority using the greater of the fisheries, valley, and floodplain setbacks. Further guidance on establishing setbacks is provided within the Grand River Conservation Authority policies relating to Ontario Regulation 150/06.

Watercourse Access/Maintenance

Prior to Draft Plan Approval the *Subdivider/Developer/Consultants* must demonstrate that the storm drainage is directed to a legal outlet and that *Easements* have been obtained if appropriate.

Land dedication for watercourses adjacent to private *Land* in new *Developments* may require fencing and/or demarcation posts to prevent human access and encroachment. The need for the fencing or demarcation requirements shall be assessed on a *Development-by-Development* basis based on the Environmental Impact Study or the General Vegetation Overview recommendations. Should fencing be required, it shall be on public property, 150 mm from the property line. Private access gates to creek block areas are not allowed.

Natural channel design shall consider channel maintenance requirements by incorporating access routes. Access routes may be located within the appropriate top of bank setback limit (with a 450mm freeboard elevation) or adjacent to the low flow area in appropriately designated areas.

9.7. Stormwater Management Erosion Control/Geomorphology

Depending on the downstream receiver and the nature of the soil strata, aquatic and flora species, stream banks can be subject to increased erosion. In these cases, the *Consultant(s)* will be required to provide appropriate protection in accordance with the appropriate Watershed, Subwatershed or Master Drainage Plan, Stormwater Management Planning and Design Manual, Ministry of the Environment, 2003 and current Best Management Practices available.

In areas where no Subwatershed Plan exists, it shall be the responsibility of the *Consultant* to provide adequate erosion protection in accordance with the Grand River Conservation Authority, Provincial and Federal Regulations and Guidelines and *Township Staff*.

Erosion control and management involves, but is not limited to, one of the following:

- Extended Detention storage for the “Simplified or Detailed Design Approach” or the 25mm storm event as outlined in the Provincial Guidelines (ref. Stormwater Management Planning and Design Manual, Ministry of the Environment, 2003),
- Assessment of downstream erosion susceptibility and critical flow values in conjunction with event modelling,
- Assessment of downstream erosion critical velocity or shear forces in conjunction with continuous simulation techniques (duration analysis).

In areas where the downstream receiving watercourse is determined to be unstable, or where control/over control of flow rates is ineffective or not feasible, design of channel alterations may

be considered, subject to design in accordance with natural channel design principles (ref. Ontario Ministry of Natural Resources Natural Hazards Technical Guidelines, March 2006).

Storm sewer outfalls in watercourses shall be provided with proper protection against erosion which includes appropriate bank scouring protection on either side of the outfall and watercourse. When storm sewer outfalls outlet to steep and/or deep valleys, drop structures shall be designed in such a manner as to provide integral bank stability. Such local erosion protection measures shall be designed so as not to interfere with the watercourse forming processes of the receiving watercourse system or the system's ecological features or functions.

As a minimum, the *Consultant* must provide the following erosion control documentation:

- The *Consultant* shall provide the rationale and background information for the methodology used in assessing the required erosion controls,
- The *Consultant* shall provide downstream erosion threshold parameters based upon field investigation and background information,
- The *Consultant* shall demonstrate how the erosion controls have adequately addressed downstream erosion conditions,
- The *Consultant* shall, in the case of an erosion control stormwater management facility, provide:
 - Stage/storage/discharge details and calculations,
 - Outlet control details,
 - Facility plan and cross-sections, and
 - Watercourse configuration at outlet.
- The *Consultant* shall document any proposed mitigation measures and provide the calculations performed in determining the measures.

9.8. Stormwater Management Facilities in Development and Re-Development

Stormwater Management (SWM) facilities are to be centralized to provide a more cost-effective approach through lower capital costs and long-term maintenance costs, however site grades must be considered in the approach. New subdivisions must consider upstream developable Lands, future road widening, Zoning By-laws, future roads, and future *Owner* use of the property, with coordinated efforts between all affected landowners. SWM facilities and related sewers must be designed to accommodate *post-Development* flows from the surrounding undeveloped *Lands* within the overall catchment area. After 95% build out of a *Subdivider/Developer's* Plan of Subdivision is achieved, surface asphalt has been completed, and all SWM conditions (i.e., clean-out monitoring, revegetation, as constructed surveys, etc.) have been met, as well as the 2-year *Maintenance Period*, the *Subdivider/Developer* can be released from the maintenance responsibilities of such facility.

If a new Subdivision will outlet to an existing downstream SWM facility, the *Subdivider/Developer* must be responsible for the maintenance, cleanout, performance (quality and quantity), and plantings (including aquatic plantings) of such facility until 95% of the *Subdivider/Developer's* Plan of Subdivision is built out and all SWM conditions including monitoring have been met.

A 1.8m high black vinyl coated chain link fence is to be installed between all stormwater management facilities and residential, commercial, or industrial *Development*.

In recognition of diverse *Development* conditions, the *Township* will consider all innovative approaches and/or techniques that can be demonstrated to meet its storm water management objectives. It is encouraged that *Consultants* use best management practices and provide innovative approaches to unique *Development* conditions.

Stormwater management areas for subdivisions must be on *Lands* conveyed at no cost to the *Township* in addition to any *Lands* required to be dedicated for park purposes. Construction costs will be borne by the Owner/*Developer* while long term maintenance of the storm water management facility will be borne by the *Township* once final *Acceptance* certificate is issued. Stormwater management areas, subject to Site Plan approval, will be on *Lands* retained by the property Owner. All costs associated with the construction and continuing maintenance of stormwater management facilities shall be borne by the property Owner.

Slope

A maximum 5:1 slope shall extend from the bottom of the pond to the limit of maximum extended detention, with a minimum horizontal length of 3.0m. The minimum allowable gradient on the bottom of the basin shall be 1.0% and the maximum gradient shall be 5.0%. From the point of maximum extended detention to the lower limits of the "safety separation" area or property line where it abuts private property, slopes shall vary between 3.5:1 to 6:1 and have a maximum average slope of 4:1, not including the maximum 10:1 maintenance access slope. Designed pedestrian access areas shall not exceed a maximum slope as per AODA requirements.

Dry Ponds

Stormwater management Dry Ponds shall be designed to limit the maximum depth of water to 1.8m above the lowest point of the stormwater basin. An additional 0.45m freeboard is required above the maximum peak flow flood level. The maximum depth of the extended detention zone shall not exceed 1.0m above the lowest point of the pond. The Dry Pond design must adhere to the MECP 2003 guidelines. All slopes 5:1 and steeper ranging from a minimum horizontal distance of 3.0m from the pond bottom level to the property line (not including walkways and trails) shall also be planted.

Wet Ponds

Stormwater management Wet Ponds require a minimum 5 ha drainage area to function effectively. Subwatershed plans will provide the required guidelines for the Stormwater Management Practices in conjunction with the MECP 2003 guidelines, but should a subwatershed plan not exist, the MECP 2003 guidelines and current best practices shall be followed. Stormwater management Wet Ponds shall be designed to limit the maximum depth of water to 3.3m above the lowest point of the stormwater basin. An additional 0.45m freeboard is required above the maximum peak flow flood level. The maximum depth of the extended detention zone shall not exceed 1.0m above the permanent pool elevation. Maximum peak flow attenuation zone shall not exceed 1.8m above the permanent pool elevation. The permanent pool depth shall range between a minimum depth of 1.0m to a maximum depth of 1.5m.

A maximum 5:1 slope below the permanent pool level is permitted around the entire stormwater management pond. The horizontal distance of this slope must be a minimum of 3.0m. A slope commencing from this point to the lowest point of the stormwater basin shall be a maximum of 3:1. A maximum 5:1 slope above the permanent pool level shall be permitted around the entire stormwater management pond. The slope shall extend from the permanent pool level to the limit of maximum extended detention. The horizontal distance of this slope shall be a minimum of 3.0m. All slopes 5:1 and steeper ranging from a minimum horizontal distance of 3.0m from the permanent pool level to the property line (not including walkways and trails) shall be planted.

The *Consultant* shall determine cleanout frequency in the main cell. Refer to Section 9 for details on pond lining and existing groundwater elevations.

Wetlands

Stormwater management wetlands require a minimum 5 ha drainage area to function effectively. The wetland design must adhere to the MECP 2003 guidelines. Stormwater management wetlands shall be designed to limit the maximum depth of water to 2.1m above the lowest point of the stormwater basin excluding micro pools. An additional 0.45m freeboard is required above the maximum peak flow flood level. The maximum depth of the extended detention zone shall not exceed 1.0m above the permanent pool elevation. Maximum peak flow attenuation zone shall not exceed 1.8m above the permanent pool elevation. The permanent pool depth shall range between a minimum depth of 0.15m to a maximum depth of 0.3m.

A maximum 5:1 slope below the permanent pool level is permitted around the entire stormwater management pond. A maximum 5:1 slope above the permanent pool level shall be permitted around the entire stormwater management pond. The slope shall extend from the permanent pool level to the limit of maximum extended detention. The horizontal distance of

this slope must be a minimum of 3.0m. Micro pools shall not exceed an additional maximum depth of 0.3m below the permanent pool level. Micro pools shall not exceed 5% of the total wetland permanent pool surface area. All slopes 5:1 and steeper ranging from a minimum horizontal distance of 3.0m from the permanent pool level to the property line (not including walkways and trails) shall be planted.

Forebays

Where groundwater interference or contamination is determined to be an issue, lining will be required. The *Consultant* must outline how access to the forebay is to be provided for the purpose of maintenance. In addition, the *Consultant* must determine sediment removal frequency and how sediment removal would be conducted (i.e., equipment, forebay design). A layer of gravel material (300 mm thick) shall be placed above the liner to ensure that it is protected during sediment removal. The forebay must be dewatered prior to sediment removal. Dewatering procedures shall be provided as part of the Operation and Maintenance Manual.

Forebays are required for all stormwater management facilities. The permanent pool depth shall range between a minimum depth of 1.0m to a maximum depth of 1.5m in which a maximum depth of 0.5m shall be used for sediment accumulation. During construction, cleanout of the forebays may be required based on monitoring results and visual inspections. Forebays shall not exceed 33% of the total wet pond surface area and 20% of the wetland permanent pool surface area. All other aspects regarding the design of forebays shall conform to the above Wet Pond standards, MECP Design Guidelines and Best Management Practices. Low flow quality control shall be considered in forebay design. Low flow quality shall not be controlled in the main cell of the SWM pond and shall be contained solely in the forebays. All stormwater calculations (e.g., low flow calculations, sediment settling time etc.) are to be provided to the *Township* for review.

Splitter maintenance holes shall be used upstream of the forebay to ensure that only low flows (up to a 1-in-2-year event) are contained within the forebay.

Excluding maintenance access routes, all access to forebays shall be discouraged through shrub plantings. Consideration should be given to provide a liner and a means to draw the forebay via gravity to facilitate maintenance. Maintenance access roadways shall provide vehicle access to forebays.

Berming

Berming around the perimeter of a facility shall be designed with a minimum top width of 1.5 m (where trail or maintenance access is not located on berm). The top of berm elevation shall be established at a minimum 0.45m above the 100-year storm quantity control water level or the highest water level. Berm subgrade shall be comprised of low permeability silt of glacial till as approved by the geotechnical Engineer.

Geotechnical considerations should be discussed in the design of the facility berming. Earth dam type constructions of berms are acceptable to the *Township* with the addition of low permeability cut-offs to prevent underseepage and toe drains to control seepage.

Retaining walls within the stormwater block are not preferred by the *Township*, since the *Land* designated for stormwater management systems should be established based on no man-made retaining systems, although in special circumstances such as stormwater management retrofits, the *Township* may consider the use of retaining walls.

Hexagon cable concrete in the SWM block is only to be utilized under the five (5) year stormwater storage elevation. Where residential lots back onto a SWM facility, fencing shall be provided by the *Subdivider/Developer*. The *Subdivider/Developer* will install them in the locations and frequencies as prescribed by the *Township* between the lots and the SWM block.

Inlet Structures

Headwalls and grating shall conform to OPSD. A geodetic monument shall be established on the top of the inlet concrete headwall to assist in monitoring future water levels. The monument shall have horizontal and vertical controls in accordance with *Township* standards. The benchmark shall be installed prior to registration of contributing *Development*.

Erosion protection shall be provided between the inlet headwall and forebay bottom to prevent localized scouring. Erosion protection shall match the headwall width at the inlet and shall extend a minimum 1.5 m on either side of the headwall at the forebay bottom. Protection material shall consist of rip rap underlain with geotextile or other erosion protection schemes. The protection size and depth may be based on *Consultant* recommendations and subject to review and *Acceptance* by the *Township*.

The invert of the inlet shall be located above the five (5) year flood elevation plus 450mm of freeboard (or where not available, the approved otherwise high-water level). The highest design storm water elevation within the stormwater management facility shall be below the underside of footing elevations of the surrounding buildings.

Outlet Structures

The minimum allowable diameter for an outlet is 100mm. For diameters less than 100mm, pipe must be protected with a perforated riser pipe design with smaller perforations or trash grate. Outlets shall not be fitted with orifice plates as flow control. Smaller diameter pipes shall be used instead. Reverse slope pipe or perforated riser pipe outlet structures shall be used for both constructed wetland and wet pond facilities unless the *Consultant* can demonstrate to the *Township* and approval agencies that alternative outlet structures could be used. Alternatives shall then be provided for consideration by *Township Staff*. Geotextile wrapping may not be required for these structures. For stormwater management facilities located downstream of Site Plans or *Land* use areas with a high susceptibility for the occurrence of spills, a shut-off on

the outlet structure within the proposed *Development* may be required. Maintenance pipes shall be installed to allow the facility to drain by gravity flow whenever possible. Maintenance access roadways shall provide access to outlet structures.

A weir outfall/spillway shall be considered for discharge of less frequent events in combination with the ditch inlet type of structure. Spillway erosion protection shall be consistent with attributes described herein. Erosion protection for outfalls shall generally consist of, but not limited to, cable concrete or a combination of rip rap and vegetation, with the size and depth of stone based on calculations completed by the *Consultant* and subject to *Township* approval.

Outfalls to Environmentally Significant Areas are discouraged and in the rare instances when required they may require site-specific treatment as dictated by the *Township* and the Grand River Conservation Authority.

Prior to Draft Plan Approval the *Subdivider/Developer/Consultants* must demonstrate that the storm drainage is directed to a legal outlet and that *Easements*, blocks or other *Agreements* have been obtained if appropriate.

Emergency Overflow Spillway

Each stormwater management facility shall provide an emergency overflow spillway to allow drainage to safely exit the facility should the outfall structure fail to function or should the storm event have a frequency HIGHER than the 100 year or maximum design storm return period. The overflow spillway shall convey the Regional Event or design storm event *post-Development* controlled peak flow whichever is the greater. An additional 0.45m freeboard is required above the maximum peak flow flood level.

The design of the spillway shall be based on calculations provided by the *Consultant* and are subject to review and approval by the *Township*. Erosion protection shall be provided on the entirety of the spillway. Erosion protection may consist of a soil reinforcement system with a natural vegetated surface treatment or alternative protection measures as specified within the *Consultant* recommendations and approval by the *Township*. When access roads cross the top of the spillway, the road shall be paved with 150mm concrete (32 MPa). Side slopes at the top of the spillway shall be 3:1 maximum, and shall have a maximum slope of 10%, if used as an access roadway.

Stormwater Management Facility Access/Maintenance

Maintenance access requirements are to be determined on a site-by-site basis, however, the following general criteria are required.

Maintenance access routes shall be continuous around the SWM facility. Controlled maintenance access routes shall be provided to both inlet and outlet structures, forebays and main cells. Maintenance access roadways shall have a minimum width of 4 m; 450mm

compacted Granular “A” and 100mm crushed limestone. 60mm HL4 binder course and 50mm HL3 surface course asphalt is required on access routes where slopes are 4% or greater.

A minimum 10m turning radius (inside radius) and a flat 20m loading area is required to accommodate maintenance vehicles. Maintenance access routes shall not exceed a maximum slope of 10:1. The design of maintenance routes and loading areas shall be to the approval of *Township Staff*. Minimize the number of inlets/forebays to one (1) where possible. Access points shall be fenced using a lockable, galvanized swing p-gate. Fencing shall be on public property, 150mm from the property line. Fencing in accordance with *Township* standards, is required on all sites that are adjacent to private or residential properties. Turfstone or cable concrete in the SWM block is only to be utilized under the five (5) year stormwater storage elevation.

The joint use of maintenance access roadways as community trails is encouraged by the *Township*. Joint use community trails shall conform to maintenance access roadway requirements. No surface drainage shall sheet flow across maintenance access roads that are jointly used as community trails. Maintenance access roadways should be evaluated for trail potential and discussed with the *Township* during design.

Stormwater Management Facility Signage

The *Subdivider/Developer* shall supply and install a minimum of two signs at each Stormwater Management Facility in accordance with Township Detail 503. Signs must include the SWMF Number, Location, and applicable wording to the satisfaction of the *Township*.

The *Subdivider/Developer* shall supply and install warning signs (No Trespassing, No Dumping etc.) at the SWM Facility to the satisfaction of the *Township*

Oil/grit Separators

Stormwater management facilities fitted with oil/grit separators shall conform to the requirements as set out in Section 9.

Sediment Drying Area

The design of SWM facilities being transferred to *Township* Ownership shall incorporate a sufficient *Land* area within the SWM pond block for the *Townships* future sediment removal maintenance of the forebay and main cell. This SWM facility *Land* dedication will not be incorporated into the Park *Land* dedication. The location of the drying area is to be located immediately adjacent to the maintenance access road and to the sediment forebay to facilitate ease of access for sediment removal from the forebay and the main cell and sediment storage. The area should be graded to allow positive drainage to the forebay and main cell at a minimum slope of 2.0% and a maximum slope of 4%. The sediment drying area shall be designed to facilitate a 1.0 m maximum storage depth and an angle of repose of 4:1 of the

excavated sediment assuming 100% sediment capacity within the forebay. The drying area shall be rehabilitated at the time of maintenance.

The following must be considered and provided, as a minimum, to the *Township* for review:

- Calculations of the area and depth required,
- Information on existing groundwater levels on the site,
- Consideration given to sediment loading on the facility,
- Plan for testing of the sediment for contaminants.

Major System Flow Routes into Stormwater Management Facility

Major system flow routes shall be designed to safely convey the 100-year peak overland flow into the facility but shall not be directed into the sediment forebay area. Overland flow routes shall be flat bottomed channels with maximum 3:1 side slope, maximum flow depth of 0.3 m and 0.3 m of freeboard. Overland flow routes should be designed using standard hand calculations and/or hydraulic analytical techniques acceptable to the *Township*. Overland flow route erosion protection may consist of a soil reinforcement system with a natural vegetated surface treatment, based on the *Consultant* and/or the *Township's* recommendations, and subject to *Township* approval. All facilities must be designed to ensure the channel is sufficient to handle major overland subdivision flow. Major overland flow routes are not to flow through private property.

Existing Groundwater Elevation

Within the stormwater block a minimum of two (2) boreholes and monitoring wells shall be located near the centre of the main cell and forebay as part of the geotechnical investigation to assess the nature of existing soils and the groundwater elevation. The groundwater elevation shall be compared to the proposed permanent pool water elevation within the facility.

The base of the stormwater management (SWM) facility must have a minimum 1m vertical separation above the seasonally high groundwater elevation. The stormwater management facility design must demonstrate that the SWM facility will not be affected by an elevated groundwater table. In the case that the SWM facility cannot maintain a 1m separation from the seasonally high groundwater table, a system or solution must be designed to mitigate this issue and demonstrate the facility will not be affected. Additional maintenance cost associated with managing groundwater levels may need to be managed by a cash in lieu arrangement

Where soil conditions are permeable and the groundwater elevation is below the permanent pool water level, lining of the permanent pool area with an impermeable material will be required to ensure permanent pool levels are maintained. A liner will also be required when groundwater contamination may be a result of the permeable soils and the water quality within the stormwater management facility. The type and thickness of lining material shall be based

on geotechnical recommendations; however, a clay liner is preferred over synthetic materials for stormwater management facilities. When a clay liner is used there must be a minimum 1.0m thick layer of clay. Additionally, a granular layer is required over the liner as a warning to avoid damage to the liner during cleanout as well as to act as a ballast to counteract groundwater uplift. The granular layer shall be constructed minimum 500 mm thick with Granular A. A thicker layer will be required based on geotechnical investigations and expected uplift from groundwater. The liner shall be shown on the design drawings and shall be designed in such a way as to prevent planting puncture.

Where the groundwater elevation is above the permanent pool water elevation, an investigation must be conducted to assess, as a minimum, the impacts of a localized reduction in groundwater levels, potential impacts to groundwater aquifer systems and flow regimes, watercourse baseflow quantity and temperature, and to assess potential slope stability and groundwater seepage concerns within the facility. The groundwater assessment will consider implications to include existing data collected from source water protection plans. The scope of this investigation will be determined based on site specific conditions. The *Consultant* shall consider all feasible design alternatives to limit or negate any impact to local groundwater levels to the satisfaction of the *Township*.

Stormwater Management Facility (SWMF) Planting

The *Township* requires a Landscape Plan for the SWMF be submitted for review and approval by the *Township* prior to the registration of the Plan of Subdivision.

All landscaping of areas above the SWMF permanent pool level shall be installed at the *Subdivider/Developer's* cost, in accordance with the approved plan prior to initial *Acceptance* of the landscape work. SWM plantings above the permanent pool level is to occur during the growing season either prior to or immediately following approval by the *Township* for first occupancy.

Native and non-invasive trees, shrubs, ground covers and aquatic plants are required in a low maintenance landscape design, which has regard for the ecology of the site and the eco-region. Refer to Section 4 for more information regarding landscape requirements.

Where trees are to be planted, they must be planted at a minimum rate of 1 tree (60mm cal.) per 50 square metres. The density of shrub plantings, for safety purposes, shall vary depending on the degree of slope. Shrubs are to be planted to discourage public access. 100% density equals 1 shrub per square metre, 25% density equals 1 shrub per 4 square metres. The purpose of the bar scale is not to encourage repetitive landscape design but to act as a relative guide to associate shrub plant densities with the appropriate slope. Refer to Section 4 for thickness and specifications for topsoil. Willow trees are not permitted adjacent to the perimeter access road.

Deciduous trees should be planted at a minimum distance of 3.0 m from the edge of the trail. Maintenance is required to ensure that tree canopies are raised to a minimum of 2.2m and shrubs must be regularly prevented from naturalizing this zone. The planting of coniferous trees within this zone is not permitted.

For SWM ponds requiring a liner, no trees or deep-rooted species are to be planted where the roots may penetrate the liner. The planting selection to be located over the liner shall be stoloniferous and shallow rooted species. The SWMF planting plan is to clearly show the furthest extent of the pond liner in plan and to provide a cross section detail illustrating the actual depth of approved planting medium over the liner with proposed plants is to be included with the planting details.

The *Subdivider/Developer* shall maintain the planting above the permanent pool level for a period of two years from the date of final dredging. Landscape Plans are to be prepared by an Environmental Professional (as a minimum, member of the Ontario Association of *Landscape Architects*) acceptable to the *Township*.

Prior to the start of the two-year warranty, the *Subdivider/Consultant* is to co-ordinate the planting of the aquatics with the *Landscape Consultant*. All aquatic plantings are to be installed during the growing season after the final dredging. The *Landscape Consultant* is to document installation of the aquatic plantings and to provide a copy of the planting purchase order for submittal with the request for planting inspection review.

Community Trails

All Community trails located within a SWM facility are to be located either above the maximum extended detention level or 5-year storm level, whichever is greater plus 0.45m of freeboard. Trails shall have a minimum width of 3.0m. The standard trail surface shall be stone dust.

To enhance user comfort and safety, a 3.0m zone on each side of the community trail shall be designed in such a way that sightlines are preserved. If barriers are required, they must not interfere with visibility or create entrapment areas. In situations where a community trail is designed within the maximum peak flow depth zone, the 3.0m separation above the trail shall have a maximum slope of 3.5:1. Below the trail, the 3.0m separation shall have a maximum slope of 6:1.

For trails that are designed around SWM Facilities, overland drainage shall be collected in a swale. No overland sheet flow drainage shall cross the swale onto the public trail.

Community Trails shall be designed in accordance with the Outdoor Amenities Master Plan.

Temporary Stormwater Facilities

In *Development* situations where the ultimate downstream facilities have not been constructed and / or where sewers have not been completed to convey storm drainage to the ultimate facility, an interim or temporary on-site facility or facilities may be considered by the *Township*. Temporary facilities shall provide an equivalent level of quality and quantity control as per the ultimate facility. Temporary facilities shall remain in place until vegetation has been established and the ultimate facilities and sewers are constructed and approved by the *Township*.

Site plan or subdivision *Agreements* will be established to require the *Subdivider/Developers* to be solely responsible for maintenance and operation of temporary facilities, as well as any *Works* associated with decommissioning of the temporary facility, including disposal of collected sediments according to Provincial guidelines, regulations, and by-laws. The cost for a temporary stormwater facility including its removal shall be borne solely by the *Subdivider/Developer*. Estimated cost for the temporary stormwater facility is to be included in the detailed cost estimate for the *Development*.

The design criteria may be modified from those for ultimate/permanent facilities. This includes, but is not limited to the following:

- 3:1 max. side slope from facility bottom to top of berm, and
- Facility perimeter to be fenced with 1.8 m chain link on all sides with lockable access gate in accordance with OPSD.
- Signs including No Trespassing Private Property, No Dumping etc.

As-Recorded Requirements

This shall include monitoring requirements as determined by the applicable Subwatershed study or Watershed study, GRCA, MECP or *Township Staff*. An as-recorded topographic survey incorporated into the stormwater facility engineering plans shall be provided along with the engineering calculations to determine and verify, but is not limited to, the following:

- Permanent pool volume,
- Active storage volume,
- Liner thickness and type (clay, synthetic),
- Pond cover details (granular etc.),
- Cooling trench/infiltration pipe,
- Drying storage area,
- Legal outlet configuration,
- Outlet monitoring requirements, as per ECA requirements,
- Berm construction (earth material, compaction tests, etc.),
- Inlet and outfall structure details (headwall elevation, inverts),

- Forebay bottom, main pond bottom,
- Toe drain location and elevation.

In addition, As-recorded information shall certify and show as a minimum:

- Maintenance Access Road (Material, compaction test locations etc.),
- Fencing, Gates, Signage (incl. Reflectivity testing locations),
- Overflow Weir Construction,
- Groundwater Monitoring Levels,
- Creek Monitoring,
- Post Construction Certification,
- Drawdown time monitoring,
- Outlet velocity monitoring,
- Cooling trench details and elevations (if applicable).

The *Consultant* shall certify that the stormwater management facility has been constructed and is operating in general conformance with the *Consultant's* plans, design reports and ECA requirements. Should the *Township, Consultant, approval agencies or Peer Review Consultant* determine that the facility is not performing according to the Engineer's design, the *Consultant* shall provide recommendations for the constructed facility to be retrofitted by the *Subdivider/Developer*.

9.9. Monitoring

The purpose of the Monitoring Plan is to:

1. Evaluate the performance and effectiveness of the Stormwater and Environmental Management System (i.e., design of the stormwater quantity and quality mitigation techniques, groundwater level, water balance, sediment settling time, post *Development* flow (m³/s), presence of debris at inlets and outlets etc.). This does not include the storm sewer system.
2. Provide the necessary information to adjust and/or optimize the plan recommendations through a process of Adaptive Environmental Management. Adaptive Environmental Management is a process of monitoring various environmental parameters established within a monitoring plan for a *Development* site. Based on monitoring results, necessary adjustments to the site's environmental management controls would be made to meet the environmental objectives for the site by the *Subdivider/Developer* until Final *Acceptance* by the *Township*.

Types of Monitoring Plans

Generally, there are two types of monitoring. The first is a “development level” plan prepared for a single *Development* and its associated infrastructure. The details of this type of plan would be part of the Preliminary and Detailed Stormwater Management Design Reports and may be discussed in an Environmental Impact Statement. The scope is limited to direct on-site infrastructure that is part of the *Development*, however off-site monitoring may be required (e.g., creek monitoring, infiltration monitoring, groundwater monitoring etc.) to determine the effectiveness of the stormwater management infrastructure and possible impacts on the receiving system. This type of monitoring plan and implementation is paid for by the *Subdivider/Developer*.

The second type of monitoring is included in a Master Planning document, such as a Watershed Plan, Subwatershed Plan, Master Drainage Plan or Class Environmental Assessment. The scope typically includes numerous environmental indicators and infrastructure elements as determined through consultation with stakeholders and agencies. This plan is paid for by the *Development* Community. The monitoring recommendations contained within these Master Planning documents will provide direction for monitoring programs.

Process/Protocol

Each *Consultant* will be responsible to ensure that a Monitoring Plan is in place and is satisfactory to the *Township*. If the subject *Development* is part of an area where a Master Plan has been completed, the *Consultant* shall document how the subject *Development*, its infrastructure and its *Development* Impact Monitoring Plan complies within the Master Plan recommendations.

Monitoring plans must be established for all Greenfield Developments. Where the subject *Development* is ‘non-Greenfield’ (i.e., typically Infill, ‘Brownfield’ or *Re-Development* Plan) and is not part of an area covered by a Master Monitoring Plan, the *Consultant* shall consult with *Township Staff* during the Pre-Study Conference stage to determine if monitoring is required. The monitoring plan will determine the potential *Development* impacts on-site and within the receiving system. Monitoring plans for Infill, ‘Brownfield’ or *Re-Development* Plan *Developments* shall not be as extensive as required for ‘Greenfield’ *Development*. Costs of the monitoring program would be borne entirely by the *Developer/Builder*.

The *Subdivider/Developer’s Consultant*, who must be a qualified Professional *Engineer* in Ontario, will be responsible to prepare and submit at a minimum bi-monthly technical memorandums, annual reports, or as required by Master Monitoring Plan (as outlined in e.g., Watershed, Subwatershed or Master Drainage Plan), to demonstrate that monitoring has been completed to *Township* satisfaction. More frequent reporting may be required to monitor the performance of the stormwater management infrastructure.

Monitoring Periods

Important factors for *Development* impact monitoring include pre-construction, during construction and post-construction or substantially developed requirements. Subdivision and Site Plan Agreements and/or supporting studies to Development Applications detail the time periods for, and frequency of, monitoring. The monitoring plan will need to be detailed in the Preliminary and Detailed Stormwater Management Report.

Monitoring status reports must be provided to the *Township*, as a minimum, on a bi-annual basis or as prescribed by *Township Staff*.

What is Monitored

Defining what is monitored and the length of the monitoring program relate to the characteristics of the *Development* and in-situ conditions, including the sensitivity of the local receiving system and the availability of existing information. The monitoring scope requirements will be determined by *Township Staff*, commenting agencies and current Best Management Practices (BMP) through the review of the Preliminary and Detailed Stormwater Management Reports and EIS where applicable. DFO will require monitoring plans should a project constitute a Harmful Alteration, Disruption or Destruction (HADD) of fish habitat and are typically a minimum length of three (3) years. Additional monitoring requirements to those set out in this section may also apply as part of the Environmental Compliance Approval (ECA). Where the requirements of the ECA conflicts or differs from this document, the more stringent requirement applies.

Monitoring requirements shall follow the recommendations of the relevant Watershed study, or Subwatershed study. In the absence of this type of study, monitoring shall include the water quality parameters as noted by the GRCA and the *Township*. Two (2) hardcopies as well as a digital submission of all reports shall be provided to the *Township*. The digital submission may require entering the water quality results in a spreadsheet or database.

Post-Construction Monitoring Plans for Stormwater Management Facilities

After 95% build-out, the facility has been cleaned out and final aquatic / landscape plants have been planted and established, the *Subdivider/Developer* must request in writing, approval to begin the post-construction monitoring program.

The purpose of the post-construction monitoring program is to ensure that the stormwater management facility including end-of-pipe infiltration facilities (if any) meet the design criteria. It is also in place to identify any specific additional maintenance requirements and remedial *Works* that may be necessary.

The post-construction monitoring program must be in place for a minimum of 2 years prior to Final *Acceptance* of the SWM facility and is a continuation of the pre and during construction

monitoring program. The reports shall be submitted to the *Township* at six (6) month intervals. Should the monitoring results show that the SWM facility is not functioning as outlined per the ECA certificate and Development Application submittals, the *Subdivider/Developer* is responsible to remediate the SWM facility to meet the outlined objectives at the *Subdivider/Developer's* own expense.

Monitoring Criteria

The monitoring reports must compare results to the design criteria. At a minimum, the monitoring reports must indicate the designed Total Suspended Solids (TSS) removal percentage compared to the actual removal percentage, the temperature mitigation and facility outflow.

As a minimum, the locations selected for monitoring shall be at the inlet and outlet of the facility, as well as upstream and downstream of the receiving watercourse.

The locations of the monitoring equipment shall be such that ambient temperature and other physical characteristics do not misrepresent the data. During the monitoring period, if it is found that the data is being influenced by other conditions (ambient air temperatures etc.), the monitoring equipment shall be relocated to give an accurate representation of the SWM facility condition, with the relocation reflected in the monitoring report.

The parameters and frequency of testing shall be sufficient to provide an accurate depiction of how the facility is functioning.

TSS: Water samples shall be taken at the inlet and outlet of the facility and tested at an accredited laboratory or on site with calibrated testers to determine the facility's removal of TSS.

The recommended annual grab sampling frequency shall be as follows:

- 4 wet weather sampling events and,
- 5 dry weather sampling events and,
- 1 melt/wet weather event.

Wet samples are collected during the rising limb of a significant storm event (typically greater than 10mm). Dry weather sampling is limited to days without rain events and is not conducted within 48 hours of a significant storm event.

Flow Monitoring: To determine the outflow of the facility, flow measuring equipment must be installed at the inlet and outlet of the facility and should remain in place until final *Acceptance* is granted.

Detention Time: For all types of SWM facilities, including infiltration facilities, the detention time must be recorded to determine functionality of the facility.

Temperature: Where temperature mitigation techniques are part of the facility's design, temperature measuring equipment must be installed at the inlet of the facility, inlet of any cooling devices, outlet of the facility as well as in the receiving stream or watercourse to show the facility's ability to reduce the water temperature. If the devices are placed in such a way as to be influenced by external sources, the locations must be adjusted to provide the most accurate readings.

Chlorides: Where end of pipe infiltration facilities exist with winter by-pass systems, grab samples for chlorides should be taken at the infiltration facility both during and after the by-pass system is active to determine if the by-pass system is diverting chlorides from end-of-pipe infiltration cells.

Analysis of Test Results

The results of the monitoring report shall be summarized and compared to the design criteria, and the raw data must be provided. If the data is shown to be exceeding the design criteria in the first year of testing, an explanation as to why there are exceedances shall be included, as well as the implementation of proposed methods to mitigate the exceedances for the following year. An extension of the monitoring program may be required at this stage. If the test results still show exceedances to the criteria after the final year of monitoring, retrofit options must be implemented, by the *Subdivider/Developer* at their cost prior to final Assumption by the *Township*. The monitoring period shall also be extended at the *Subdivider/Developer's* cost. The monitoring reports shall include current sediment volume and storage summaries, as well as indicate when any clean-outs have taken place.

9.10. SWM Facility Acceptance Requirements

Initial SWM Facility Acceptance Requirements

The initial SWM facility *Acceptance* process includes, but is not limited to, inspections of the following Works:

- Inlet piping and structures within the SWM block (Splitter MHs, Headwalls, etc.),
- Outlet piping and structures (Weirs, Quantity and Quality control structures, etc.),
- Cooling trenches,
- Infiltration structures,
- Earthworks required within the SWM Block,
- Erosion protection such as gabion mats, rip rap treatment, etc.,
- Cable Concrete,
- Forebay Weir,

- Spillway,
- Maintenance access (asphalt/concrete/Turfstone),
- Landscaping above the 5-year elevation (tree types broken out),
- Landscaping below the 5-year elevation (tree types/aquatics broken out),
- Sod,
- Seed,
- Topsoil,
- Fine grading,
- Walkways (stone dust/asphalt etc. to be broken out separately),
- Fencing (types to be broken out separately),
- Gates or entrance features,
- Signage,
- Other infrastructure within the pond; and
- Surface asphalt.

Prior to initial *Acceptance* of the SWM facility, the following conditions are to be met as a minimum:

- Bathymetric survey of the facility,
- Satisfactory inspections (grading, trails, drainage, fencing etc.) from the *Township*,
- Pre-Construction and during construction monitoring reports / technical memorandums
- All test results (e.g., compaction, geotechnical, asphalt, concrete, CCTV, mandrel, flushing, signage reflectivity etc.) are found to be satisfactory by *Township Staff*,
- Daily inspection and E&S reports supplied and reviewed by *Township Staff*.
Subdivider/Developer to ensure that reports are provided to the *Township* on a regular basis during construction,
- Repair of any erosion that occurred during construction,
- Vegetation planting,
- Geodetic Monuments / Demarcation Posts,
- Certification letter provided to *Township Staff* to confirm the pond construction was as per the approved drawings (inverts, elevations of facility bottom, berm and soil materials, pond liner etc.); and
- An as-recorded survey of the SWM pond.

Where SWM facilities require seasonal valve operation, the *Subdivider/Developer* is responsible to operate the valves during the *Maintenance Period*, and to provide the operations and maintenance manual.

Final SWM Facility Acceptance Requirements

Prior to Final *Acceptance* of the facility, the following conditions must be met:

- Clean-out of the SWM facility after 95% buildout and after surface *Works* completion: After 95% build out of the catchment area, all cells of the facility must be cleaned out following best management practices and with all applicable permits obtained. A survey shall be provided to the *Township* to confirm all accumulated sediment has been removed. The survey shall consist of a bathymetric survey of all storage cells including the forebay and any main cells or overland areas to obtain the accumulated sediment volumes. These surveys shall be submitted to the *Township* for review with the formal request to commence the post construction monitoring program. The sediment volume shall be compared to the actual designed/constructed permanent pool volume,
- 2 years of post-construction monitoring: After 95% build-out has been reached and the clean-out completed, a formal request to commence the post-construction monitoring must be submitted to the *Township*. Any landscaping below the 5-year storm level that is required for water quality treatment shall be installed prior to monitoring,
- Bathymetric survey: When the 2-year post-construction monitoring is completed, a bathymetric survey of all cells must be conducted. If the sediment survey shows the required permanent pool volume is met, and there are no areas with sediment accumulation greater than 0.1m, then no further clean out is required by the *Subdivider/Developer*. After review and approval of the monitoring and sediment survey results, the *Consultant* may proceed to request final inspection,
- Satisfactory inspections and sign-off: All items in the SWM Block (underground and surface *Works*) are to be inspected and accepted as a whole after the 2 years of post-construction monitoring has been accepted and approved by the *Township*,
- Review and approval of final *Acceptance* package: The package shall include, as a minimum, the Monitoring Report, Operation and Maintenance Manual, As-recorded deliverables, Letter of Ownership transfer and the SWM Pond *Acceptance* Checklist,
- Change of Ownership: The *Developer/Subdivider* will need to notify the MECP regarding change of Ownership and receipt of this must be provided to *Township Staff*.

Engineering Submissions

The engineering submissions relating to Stormwater Management that must be submitted and approved by the *Township* prior to the start of construction (i.e., clearing and grubbing, earthworks, servicing etc.) are, but are not limited to:

- Outlet legal status,
- Pre-construction monitoring,
- Preliminary Stormwater Management report,
- Environmental Impact Study (EIS),
- Hydrogeology and Geotechnical Reports,
- Slope Stability Reports,
- SWMF Planting Plans,
- Final Design – Stormwater Management report,

- Erosion and Sediment Control detailed drawings and continuous construction monitoring plans/reports,
- Detailed Stormwater Management facility engineering drawings,
- Detailed Cost Estimate for the Works,
- MECP ECA Permit for Stormwater Management facilities, GRCA Permits and all other required permits,
- Operations and Maintenance Manual,
- SWM facility monitoring reports and/or Memorandums,
- External agency approvals.

Stormwater Management Report

The Stormwater Management Report shall include the following list of items viewed as a generic list applicable to both preliminary and detailed stormwater management reports.

- Plans showing:
 - Project name and pond ID number(s) (as applicable),
 - 30T or 58M numbers (if subdivisions),
 - Lot and road layout with *Land* use,
 - Elevations at key points (in a contour map),
 - Any surveyed constraint lines (e.g., top of bank, floodlines, wetlands),
 - Minor drainage system, with storm sewers, maintenance holes, catchbasins, ditches, swales, *Municipal Drains*,
 - Major drainage system with overland flow routes at key point and throughout the sites (e.g., Right of Way, natural channels, *Municipal Drains* etc.),
 - Site Plan *Land* use of quality and quantity controls (zoning requirements),
 - Details of stormwater management practices, e.g., storage facilities, groundwater elevation, slope stability, etc.; and
 - Erosion and sediment controls, requirements, and criteria.
- Descriptions of:
 - Receiving system and outlet including confirmation of legal status,
 - Classification of site and downstream aquatic habitat per DFO/MNR/MECP/GRCA guidelines and requirements,
 - SWM criteria for quantity, quality, flooding, and erosion control,
 - Hydraulic analysis, as required of floodplains for major flow elements,
 - Design of SWMPs to meet applicable criteria, policies, and guidelines,
 - Erosion and sediment control plan describing existing site conditions, erosion potential, down gradient risk assessment, and anticipated erosion and sediment controls, including staging,
 - Maintenance and monitoring.
- Tables showing:
 - Hydrologic parameters for existing and future *Land* use (Zoning Requirements),

- Pre- and *Post-Development* peak flows and volumes at all outlets,
 - Stage/storage/discharge relationships for SWMPs,
 - Overland flow depths and velocities on roads and at outfalls,
 - Total impervious area and pervious area of each lot and block.
- Figures/drawings showing:
 - General location plan,
 - Drainage catchment areas for existing and future *Land* use including all external areas,
 - Details of overland flow routes,
 - Details of SWMP facility appurtenances (inlets and outlets),
 - Details of erosion and sediment controls,
 - Schematic of computer models,
 - Overall map of swales through the site and detail of conveyance capacity,
 - Details of minor system conveyance (storm sewer, swales, ditches etc.), volume of system conveyance,
 - Detail of legal outlet control route.
- Detailed Calculations showing:
 - Minor Drainage System: Stormwater conveyance sizing through storm sewers, ditches, swales, natural channels,
 - Major Drainage System: Roadway conveyance calculations and sizing.

Note: all plans and reports are to be stamped, dated, and signed by a Professional *Engineer* licensed in Ontario.

Software

The MIDUSS software shall be the preferred software for hydrologic modelling however other software may be used based on discussions with *Township Staff*. The digital model and PDF output must be submitted to the *Township*.

Water Balance (Groundwater)

As required by applicable subwatershed studies and approval agency requirements to ensure *post-Development* infiltration targets are met as specified in the appropriate Master Drainage Plan or Subwatershed Study and any other type of studies. An as-recorded drawing and test results in table/report format and other such documents as required shall be provided to the satisfaction of the *Township*.

Preliminary Stormwater Management Report

Preliminary stormwater management reports precede detailed stormwater management reports and are typically a level of detail below the detailed stormwater management reports.

Preliminary stormwater management reports shall be provided at the time of Draft Plan of Subdivision Application for the review and approval of *Township Staff*.

The *Consultant*, before submitting a detailed stormwater management report, shall receive In-Principle Approval of the submitted preliminary Stormwater Management report from the *Township*, Grand River Conservation Authority and Region.

Final Design – Stormwater Management Report

The outline for a detailed stormwater management report is the same as the preliminary stormwater management report outline, but with proposed design detail documentation. The Detailed Final SWM report is submitted with the first engineering submission for the review of *Township Staff*.

MECP ECA Applications for Stormwater Management facilities

The *Consultant* shall prepare the MECP ECA Applications for Storm Sewers/Services and SWM Facilities and submit four (4) copies to the *Township* for signing of the Statement of Municipality prior to submission. The *Subdivider/Developer* shall be responsible for all documents required for the submission and payment of application Fees.

Prior to final *Acceptance* of the Stormwater Management Facility by the *Township*, the Ownership of the ECA certificate shall be changed from the *Subdivider/Developer* to the *Township*. The *Subdivider/Developer* is to notify the MECP of the change of Ownership and provide the *Township* with confirmation of transfer of Ownership.

Electronic Submission of As-Recorded Stormwater Management Works

As-Recorded Engineering Drawings includes plan and profiles, as well as details of stormwater management infrastructure.

The *Consultant* shall certify that the stormwater management facility has been constructed and is operating in general conformance with the accepted plans and design report. Should the *Township*, *Consultant* or Approval Agencies determine that the facility is not performing according to the Engineer's design, the *Consultant* shall provide recommendations for the constructed facility to be retrofitted by the *Subdivider/Developer*. The *Consultant* shall circulate the as-recorded survey, stormwater management certification and excel spreadsheet documenting as-built information (including *Township* Asset Management information) to *Township Staff*.

SWM Facility Topographical Survey

An as-recorded topographic survey incorporated into the stormwater facility engineering plans stamped and signed by the *Engineer* shall be provided along with the engineering calculations to determine and verify the following as a minimum:

- Permanent pool volume,
- Trails / Maintenance Access,
- Overflow spillway,
- Active storage volume,
- Berm, slope, bank construction,
- Inlet and outfall structure details; and
- SWMF planting plan.

Operations and Maintenance Manual

The submission of the Final Design – Stormwater Management Report must be accompanied by a separate “Operations and Maintenance Manual”, which will outline the operational and maintenance procedures required to ensure the proper functioning of the facility as defined within the report. The O&M Manual is to comply with the Environmental Compliance Approval (ECA) requirements, including monitoring. A copy of the ECA is to be included in the O&M Manual. This document is to be followed by the *Subdivider/Developer* during the *Maintenance Period* and include recommendations for the *Township* after final *Acceptance* of the pond. Updated inspection reports must also be included in the O&M Manual. The *Consultant*, in addition to reviewing materials herein and the most recent Ministry of the Environment guidelines, may also review the document Stormwater Management Facility Sediment Maintenance Guide, 1999 by Green/and International Consulting Inc. for typical operations and maintenance requirements. The following provides the minimum requirement for the format and content of the Operations & Maintenance Manual:

Facility Design Brief

Include general design information about the facility including but not limited to:

- The main function of the stormwater system,
- Any site-specific characteristics of the facility that need to be taken into consideration during operation and maintenance (e.g., vehicular access constraints, presence, or suspected species at risk in area, presence of invasive species in or around the site etc.),
- Expected quantity and quality performance of the facility under varying conditions such as dry weather conditions, winter conditions, frequent rainstorms and rainfall events exceeding the design capacity etc.,
- Presence and operation of any stormwater maintenance or by-pass valves.

Inspections

The *Consultant* shall develop an inspection protocol which follows Approval Agency and *Township* requirements. This protocol shall be included in the final SWM report.

Inspections shall be completed to ensure the safety of the public, assess property damage and the performance of the facility with respect to the design objectives and the Environmental Compliance Approval. It shall include but not be limited to what to inspect for, proposed method of inspection for sediment accumulation, proposed frequency of inspection and actions to be taken with respect to certain findings.

This section shall be separated into the following categories:

- During construction *Development* inspections,
- Post-construction *Development* inspections,
- *Post-Development* inspections.

Scheduled Maintenance

The anticipated maintenance activities for each facility shall be listed and outlined in detail. The steps to be followed by the *Subdivider/Developer* during and post-construction, and recommendations for the *Township* to follow after the final *Acceptance* shall be provided. The activities specified shall be site specific and include any specialized equipment needed, seasonal preparation if applicable, and frequency of maintenance for each activity. The list of activities shall include but not be limited to:

- Litter/Debris Removal,
- Access Path Maintenance,
- Vegetation Maintenance,
- Invasive Species Maintenance – include a strategy to follow for treatment and removal of invasive species anticipated,
- Infiltration Cell Maintenance,
- Valve Maintenance – Provide number of turns to open/close,
- Sediment Measurement,
- Sediment Removal including;
 - Forebay Sediment Removal,
 - Main Cell Sediment Removal.

Spills Action Plan / Pollution Prevention Plan

Although each facility should operate uninterrupted with a comprehensive preventative maintenance program, there may be unexpected failures that can lead to spills. Each SWM facility shall have a Spill Control and Response Plan outlined specific to the facility that the

Subdivider/Developer's Consultants will follow during construction, post construction and the *Township* after final *Acceptance*. This plan shall consider the type of potential failure events (oil spill, sediment breach due to construction, nutrient loading, chlorides, inflow from sewage pumping station overflows (if applicable) etc.), determine whether it is to be considered an emergency, identify who should be notified during regular hours and after regular hours and what actions should be taken in the interim.

This plan shall outline the recommendations on how to contain the spill at the stormwater management facility to prevent further release downstream and include number of outlets to plug or valves to operate. If the facility includes infiltration cells, the plan shall specify the risks associated with the various types of spills and include preventive measures specifically for the infiltration cells.

Significant mishaps should be reported immediately to the supervising Engineer, the Municipality, and environmental monitor who notifies the Spills Action Centre (1-800-268-6060) via the Contract Administrator. Details of the incident as well as updates on site conditions and containment/clean up efforts must be provided to the attending agency.

Cost

The "Operations and Maintenance Manual" shall include a detailed breakdown of estimated annual maintenance and operating costs.

10. Site Plan Development Submissions

10.1. Introduction

This section of the Manual is meant to be an aid for Owners, *Developers*, Architects or Planners when completing an Application for a Site Plan *Agreement*. Owners, *Developers*, Architects or Planners should address each point, where applicable, to accelerate the approval process.

The *Owner* shall retain the services of a single qualified agent to administer the site plan process and design requirements, and who will coordinate other *Consultants/Contractors* on his/her behalf. A pre-consultation meeting is to be held to discuss any unique situations that may exist on the site prior to the first submission.

In addition to the information below, all submissions must be submitted in both a hard copy and digital copy. Digital versions may be submitted as: two (2) discs, each with a full set of PDF drawings, or a link to an FTP server containing a complete set of drawings.

10.2. Drawing Requirements

All drawings shall be submitted with metric dimensions, be drawn in black and white, to a standard scale (1:50, 1:100, 1:200, 1:250, 1:500, etc.) and submitted on standard ARCH D (610mm x 914mm) sheets, bond paper.

In general, all drawings shall include the following information;

- Title block and revision block,
- Type of Plan i.e., Site Plan, Grading Plan, etc.,
- Identification of the proposed use of the site (*Development Name*),
- Name and address of firm preparing the Site Plan,
- Name of Owner,
- Municipal address and Legal Description (Reference Plan, Lot, Concession and Registered Plan Lot Number),
- Metric scale,
- Key Plan indicating general location of the *Development* in respect to the *Township* street network,
- Benchmark data used (geodetic) described and labeled on the drawing,
- Contour lines and/or spot elevations referenced to the Benchmark,
- North arrow,
- Legend.

The *Owner* shall retain a qualified Professional *Engineer* to prepare all engineering drawings and to supervise the construction of all engineering services. The Consulting *Engineer* shall act as the *Owner's* representative in all matters pertaining to the design and construction of the services in the *Development*. A declaration from the *Owner* is required at the time of application showing that the Consulting *Engineer* has been retained to design and supervise the construction of the proposed *Development*. Where a question arises over the requirements for professional design, the decision of the *Township* shall prevail.

The following engineering documents are to be prepared for each Development Application, as applicable:

Plans for the proposed *Development*, comprised of;

- **Cover Page & Drawing Index** – Showing; the *Development* name, Key plan showing the *Development* location relative to the nearby arterial roads, *Owner* and *Consultant* information, Drawing Index,
- **Site Plan** – The Site Plan drawing shall include, but not be limited to, the following information; a Site data table; Location, dimension and setbacks of all proposed buildings and structures; Location, dimensions and setbacks of all proposed yards, landscaped open spaces, planting strips, parking area, loading spaces, driveways, walkways, sight triangles and boundary fencing; Location of all proposed light standards & wall mounted lights, signs, refuse storage areas, snow storage areas and *Easements*; Location of sanitary sewers, watermain, storm sewers, ditches, roadways, sidewalks, road widenings, existing plantings, etc.; Location of all boulevard features (i.e. curbs, landscaping, trees, utilities, etc.),
- **Site Servicing Plan** – The Site Servicing Plan shall include, but not be limited to, the following information; Location of all existing municipal infrastructure (i.e. watermain, sanitary sewer, storm sewer, catchbasins, streetlights, traffic controls, sidewalk, signs, fences, trees or landscaping, etc.); All future local improvement *Works* agreed to in the Site Plan Control *Agreement*; Location of all proposed servicing (i.e. watermain, sanitary sewer, storm sewer, catchbasins, light standards, traffic controls, etc.); All details of any service connections to the *Township* infrastructure including methods and materials; All utility services,
- **Site Grading Plan** – Where applicable, lot grading is to be in accordance with the approved overall subdivision lot grading plan. The Site Grading Plan shall include, but not be limited to the following information; spot elevations at all locations where the grade changes on the site; retaining wall information; all swale and berm information; proposed elevations on all service lids and manhole covers; elevations at all building corners, underside of footing elevation & finished first floor elevation (F.F.E.), 100 year ponding limit and access points (i.e. ramps, entrances, and loading bays); the existing elevations at 15.0m and 30.0m beyond the site limits (where possible); elevations in driveways and parking lots to show drainage patterns.

- **Erosion and Sediment Control Plan** - Showing temporary erosion and sediment control measures to be implemented on the site, including topsoil stockpile location and siltation control pond location, refer to Stormwater Management Facilities Section 9 for additional information required on the plan. Temporary construction access location and details to be provided on this plan,
- **Landscaping Plan** - Landscape Plan shall include, but not be limited to, the following information in accordance with *Township* Design Guidelines; Location and identification of all proposed plant materials (using symbols and letters); A planting list, showing the botanical and common name, size, height, spread, spacing, condition, quantity or other pertinent information; Identification of any planting beds and existing trees to be preserved or transplanted; All proposed site furniture such as benches, bollards, tree grates, light standards, picnic tables, bike racks, etc. noted on the plan and details provided,
- **Landscaping Cost Estimate** – A detailed cost estimate of all proposed landscape works,
- **Tree Inventory & Preservation Plan** – The Tree Inventory/Preservation Plan shall include, but not be limited to, the following information: A detailed inventory of all existing trees, significant shrubs or hedgerows, natural features, etc., with exact surveyed locations; Location of tree protection fencing around trees and vegetation to be preserved,
- **Architectural Elevations Plans** - The Architectural Elevation Plans shall include, but not be limited to, the following information in accordance with the *Township* Design Guidelines; the massing and conceptual design of the proposed building; the relationship of the proposed building to adjacent buildings, streets, and exterior areas; the character, scale, appearance and design features of buildings, and their sustainable design; The elevations of all sides of all main and accessory buildings, showing all roof structures (penthouses, chimneys, roof top units, vents, air conditioning, etc.) with metric measurements,
- **Illumination Plan** – Illumination Plans are to show the location and design of all exterior lighting, including lighting specifications. All exterior lighting needs to be adequate for the site and directed inward and down into the site. Lighting should be designed to avoid causing ambient light pollution,
- **Detail Drawings & Notes.**

10.3. Reports

Digital copies of reports, including but not limited to;

- **Stormwater Management Report** - A Professional *Engineer* shall prepare a report detailing the modeling, design, and features of the proposed Stormwater Management System. The Stormwater Report is to provide system performance data for the 10-year to 100-year design storms and must include scale drawings showing delineated

drainage catchment areas, delineated surface pond limits for the 100-year design storms (where applicable), overland flow route and a schematic diagram reflecting the model (complex models),

- **Traffic Impact Study** - The purpose of the Traffic Impact Study (TIS) is to examine the impact of traffic generated by a new use at its access and at nearby intersections and interchanges and determine necessary road improvements. The TIS will be used to support the *Developments* internal parking lot layout and entrance locations. Impact assessment is to relate to current and future traffic volumes and the level of improvement required. The need for and content of a TIS shall be determined in consultation with the *Township Development Engineering Department*,
- **Acoustical Study** - All Industrial and commercial *Developments* and any *Development* adjacent to or within close proximity to residential dwellings or in any location determined to be sensitive by the *Township*, shall be required to conduct a noise impact analysis to demonstrate compliance to MOE guidelines,
- **Detailed Cost Estimate** – A detailed cost estimate shall be provided for all internal and external *Works* (separate),
- **Any other report that may be applicable to the *Development*** - such as Arborist Report, Servicing Design Brief, Archaeological Study, Flood Plain Analysis, Environmental Impact Study, Slope Stability Report, etc..

External Works

Installation of external *Works* may be required within the municipal right-of-way because of a proposed *Development*, the *Works* may include items such as the installation of municipal infrastructure (i.e., watermains, sanitary sewers, pump stations, storm sewers), traffic control devices (i.e., traffic signals), sidewalks and curbs, turning lanes, etc.

The *Owner* shall appoint a qualified Professional Engineer, acceptable to the Municipality, to design the external works.

The duties of the *Developer's Consulting Engineer* to include, but not be limited to the following:

- prepare the designs in accordance with the Engineering Standards of the Municipality,
- prepare and furnish all required drawings in accordance with the Engineering Standards of the Municipality,
- obtain all necessary approvals from the Minister of the Environment, the local Conservation Authority, Region of Waterloo and any other government or regulatory agency, as required,
- provide the field layout of the external *Works* including the utilities and certify the quality of the required testing of the external works,
- act as the Owner's representative in all matters pertaining to the construction,

- provide coordination and scheduling to comply with the timing provisions of the Site Plan *Agreement* and the requirements of the Municipality, for all external *Works* specified in the *Agreement*.
- Certify the completion of the *Works* in accordance with the accepted plans, reports, and *Agreement*.

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11. Minimum testing Requirements

11.1. Introduction

This section covers the minimum testing requirements for the following sections:

- Trench compactions,
- Asphalt and Concrete Works,
- Lot Grading Requirements,
- Erosion & Sediment Controls,
- Water Installation,
- Sewer Installation,
- Closed Circuit TV (CCTV) Inspections,
- Stormwater Management Monitoring.

The minimum testing requirements for each section are consistent with industry standards and typically follow Ontario Provincial Standard Specifications MECP, AWWA, CSA, ASTM, etc.

In addition to the above, minimum maintenance standards shall be met as per Ontario Regulation 239/02 and 366/18 as amended until final Assumption of the right of way corridor by the *Township*. Items that will be required to meet these O Reg. include but not limited to:

- Reflectivity Testing for regulatory / warning signs as per the Ontario Traffic Manual and O.Reg 239/02,
- Sidewalks,
- Roadway / bike lane platform,
- Luminaires as per O. Reg 366/18.

11.2. Trenches

Below table outlines the minimum testing requirements for compaction within trenches for different infrastructure within these trenches. Key requirements include spacing of testing, max lift and what compaction is required.

Table 11-1

Material	Area / Usage	Test	Sampling Frequency & Test Requirements	Test Location Identification
Native Material (following <i>Acceptance</i> by the <i>Township</i> after suitability assessment)	Sewer Trench	Compaction	Min. every 30m, 0.6m max. lift, Maximum Dry Density 95% (OPSS.MUNI 401)	Street, distance from downstream M.H., distance above pipe or below final grade i.e.: Street A, MH23 + 30m, 1.8m above pipe
	Watermain	Compaction	Min. ever 30m, 0.6m max. lift, 95% (OPSS.MUNI 401)	Street, station, offset, distance above pipe or below finished grade i.e.: Street A, 0 + 310, 5.5m Rt, 1m above pipe
	Subgrade	Compaction	Min. every 30m alternating lanes 95% (OPSS.MUNI 401), 98% desirable in top 1m	Street, Station, offset i.e., Street A, 0 + 105, 3.5m Lt
	Watermain Road Crossings	Compaction	Each Crossing, Subgrade (95%) and Granular (100%) (OPSS.MUNI 401)	Street, Station
	Utility Trenches ¹	Compaction	Each Crossing, Subgrade (95%) and Granular (100%) (OPSS.MUNI 401)	Street, Station
	Service Trenches ²	Compaction	Random Selection 50% of lots Subgrade (95%)	Lot Number

			and Granular (100%) (OPSS.MUNI 401)	
<p>1 Utility crossings are to be installed prior to base asphalt and curb</p> <p>2 If storm and sanitary services are installed with mainline sewer, then sewer trench sampling requirement applies. However, water service trenches will have to be reported separately.</p>				
Material	Area / Usage	Test	Sampling Frequency & Test Requirements	Test Location Identification
Granular A & B	Roadway	Compaction	Min. every 30m alternating lanes 100% (501.08.02)	Street, Station, offset i.e.: Street A, 0 + 105, 3.5m LT
		Moisture Content	Min. every 30m alternating lanes	Street, Station, offset i.e.: Street A, 0 + 105, 3.5m LT
		Gradation Percent Crushed	Granulars are to be sampled at source and gradation checked prior to delivery AND min. 1 check per 100m of road for an 8.5m road gradation to conform to OPSS 1010	Street, Station offset i.e.: Street A, 0 + 105, 3.5m LT
	Utility Trenches	Compaction	Each Crossing 100% (510.08.02)	Street, Station
	Curblin Bedding	Compaction	Every 30m	Street, Station Lt or Rt or North, South, East, West

	Driveway Apron	Compaction Contamination	33% of Driveways at random, 100% (510.08.02) Check to ensure there is 150mm of un-contaminated material	Lot or house #, distance from curb or garage
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11.3. Asphalt and Concrete

Below table outlines the minimum testing requirements for compaction testing of roadways, driveways, main access roads concrete footpaths/walkways, curbs, etc. Key requirements include spacing of testing, temperature restrictions and compressive strength. *Subdivider / Developer* to refer to OPSS 1101, 1103, 1150 and 1350 for further requirements. In particular, OPSS 1150 outline requirements for Asphalt Content %, Voids %, Flow, Stability, VMA% (Voids in Minerals Aggregate) and RAP % (Reclaimed Asphalt Pavement).

Surface asphalt to be a virgin mix and a clean dried surface with tac coat to be applied to base asphalt prior to surface being installed.

Table 11-2

Material	Area / Usage	Test	Sampling frequency & test requirements	Test location Identification
Asphalt HL3 & HL4 1101 1103 1150	Roadway	Compaction	Min. 30m each lane 96% (310.07.02.11.01) 97% w/nuclear device (310.07.02.11.02)	Street, Station, Lt or Rt or North, South, East, West or adjacent lot i.e.: Street A, 0 + 225, South lane
	Roadway	Asphalt Temperature	every 150m each lane, 115C to 165C (310.07.02.07, 1150.05.02.01)	As Above

		Ambient Temperature	Each Sample min. + 2 deg. C for HL4 min. + 7 deg. C for HL3	
	Roadway	Marshall Tests (1150.07.03)	1 per 500 tonnes from samples taken	As Above
	Roadway	Extraction Tests (1150.07.03)	1 per 500 tonnes from samples taken	As Above
Asphalt HL3,HL3a, HL4	Driveway Apron	Marshall Tests	2 per day of paving	Lot or house #, distance from curb or garage
	Driveway Apron	Extraction Tests	2 per day of paving	As Above
	Driveway Apron	Compaction	96% (310.07.02.11.01) 97% w/nuclear device (310.07.02.11.02) 33% of Driveways at random	As Above
	Driveway Apron	Temperature		As Above

			115C to 165C, with Samples	
Concrete (OPSS 1350)	Sidewalk	Compressive Strength	3 locations per 500m of sidewalk min 3 cyls. per location for 7 & 28 day breaks	Station, Lt. or Rt. or adjacent lot or house number
		Slump	First 3 trucks or until consistent, at sampling & every 3rd truck	As Above
		Air Content (7% +/- 1.5%)	First 3 trucks or until consistent, at sampling & every 3rd truck	As Above
	Curb and Gutter	Compressive Strength	3 locations per 500m of Curbing min. 3 cyls. per location for 7 & 28 day breaks	As Above
		Slump	First 3 trucks or until consistent, at sampling & every sample location	As Above
		Air Content (7% +/- 1.5%)	First 3 trucks or until consistent, at sampling & every sample location	As Above
	Structures	Compressive Strength	2 sets (3 samples ea.) per pour	As Above

		Slump	First 3 trucks and every 3rd truck after and with samples	As Above
		Air Content (7% +/- 1.5%)	First 3 trucks and every 3rd truck after and with samples	As Above

Inspection and Testing

All *Works* within the *Township* shall be done to the satisfaction of the Contract Administrator, the *Township* and / or of an Agent / *Inspector* authorized to act for the Contract Administrator / *Township*. The *Inspector* is required by the Contract Administrator / *Township* to ensure that the provisions of the Engineering Development and Infrastructure Manual, Contract, etc. are adhered to, especially regarding the quality of the workmanship and materials and may stop the work entirely but not limited to if there is not a sufficient quantity of suitable and / or approved material on the site to carry on the work properly or for any good and sufficient reason. In particular, but without limiting the powers of the *Inspector*, orders given by the *Inspector* relating to the quality of material or workmanship or in respect of safety or public convenience shall at once be obeyed by the *Contractor*. The *Inspector* shall have the power to suspend any worker as outlined in OPS GC 3.01.17 and the *Contractor* shall ensure that any worker so suspended is forthwith removed from the site.

Materials and equipment and the process of preparation or manufacture of materials or equipment shall always be subject to inspection, testing and rejection at any stage by the Contract Administrator or the Contract Administrator's agent(s) and *Township Staff*. The Contract Administrator will give the *Contractor* reasonable notice of the materials and equipment in respect of which the Contract Administrator proposes to have inspection or testing carried out during the process of preparation or manufacture, save that in the case of materials or equipment specifically stated in the Contract and or the Engineering Development and Infrastructure Manual as required to be tested or inspected by or in the presence of the Contract Administrator, the Contract Administrator shall not be obliged to give such notice.

The *Contractor* shall notify the Contract Administrator in writing at least seven (7) days before the commencement of preparation or manufacture of each item of such materials or equipment of the time and place at which such preparation or manufacture is to commence in order that the Contract Administrator may be present.

Notwithstanding compliance by the *Contractor* with the foregoing paragraph hereof, if any materials or equipment prepared or manufactured away from the site of the *Works* and required by the Contract or by the Contract Administrators to be inspected or tested by or in

the presence of the Contract Administrator at the place of preparation or manufacture become ready for delivery to the site of the *Works* but have not been inspected or tested as required, the *Contractor* shall so notify the Contract Administrator / *Township Staff* in writing and shall not have such materials or equipment delivered to the site of the *Works* until authorized to do so in writing by the Contract Administrator / *Township*.

In any event, materials or equipment required by the Contract / Engineering Development and Infrastructure Manual to be inspected or tested by or in the presence of the Contract Administrator / *Township* shall not be incorporated into the work until the required inspection or testing has been carried out to the satisfaction of the Contract Administrator / *Township*.

The *Contractor* shall provide and shall ensure that all *Subcontractors* and those carrying out the process of preparation or manufacture shall provide, every reasonable facility and cooperation to assist the Contract Administrator, or *Inspector* or others designated by the Contract, *Township* or by the Contract Administrator in carrying out inspection and testing.

The *Contractor* shall not backfill or otherwise cover up any work without either having it inspected and passed by the *Inspector* or first notifying the *Inspector* in a manner approved or as directed by the Contract Administrator / *Township* that the work is ready to be covered up and allowing the *Inspector* reasonable notice and opportunity for carrying out an inspection. The *Consultant* shall have the proper resources on site to adhere to the constructor's schedule and ensure the *Works* are inspected. Any work covered up other than in accordance with the foregoing shall, if ordered by the *Inspector* or the Contract Administrator, be uncovered or opened for the inspection and the *Contractor* shall, as directed by and to the satisfaction of the *Inspector*, *Township*, or the Contract Administrator, make good again all openings, excavations, and disturbances of any property, real or personal, resulting therefrom, all at the *Contractor's* expense.

No *Acceptance* / approval by an *Inspector*, *Township* representative or by the Contract Administrator or failure of an *Inspector*, *Township*, or the Contract Administrator to carry out an inspection shall relieve the *Contractors* of any obligations under the Contract or shall be interpreted as being an *Acceptance* of defective or improper work or material which shall be in every case be removed and replaced properly or otherwise rectified in a satisfactory manner whenever discovered at any time.

If in addition to the inspection provided for above, the *Contractor* is required by the Contract, by law, by local by-law, legislations, *Township* Infrastructure Standards and Specification Manual / *Township* representative and /or by the Contract Administrator to have any part of the *Works* inspected by others, the *Contractor* shall give the Contract Administrator and the others concerned reasonable notice of the time and date proposed for the additional inspection.

Testing

If there are failures, further testing will be done on the samples to determine the limits of the failures.

Corrective action will depend on nature and extent of failures.

Additional Testing may be required by *Township Staff*, and *Engineer* depending upon site conditions, design, construction methods, etc.

The Soils *Engineer* shall issue a certificate of compaction and approval of granular materials prior to the placement of Hot Mix Asphalt.

The following are the minimum tests required for roadway construction:

- Sieve Analysis shall be performed to assure that the granular base courses meet the current *Township* specifications. Representative samples are to be obtained by the *Consultant* prior to and during the road construction operation.
- Physical properties requirements as per OPSS (MUNI)
- "Density Tests" shall be performed to assure that the granular base courses have been properly compacted to the current *Township* Standard Specifications and OPSS (MUNI). Density Tests on the road subgrade shall be performed as directed by the geotechnical Engineer.
- A "Proof Roll" of the road subgrade shall be performed under the supervision of the geotechnical *Engineer* to assure unsuitable road subgrade material is removed. The Soils *Engineer* shall issue a certificate of compaction and approval prior to the placement of granular materials, stating that the trenches, services, and road subgrade have been backfilled, compacted, and tested and is suitable for the placement of granular materials
- "Asphalt Tests" shall be performed to assure that the binder and surface asphalt meets the above requirements and tolerances and as per OPSS (MUNI).
- "Concrete Tests" shall be performed on curbs, sidewalks, and driveway ramps to assure that the concrete meets the above requirements and tolerances and as per OPSS (MUNI).

11.4. Lot Grading

Once the house is fully constructed and the property is fine graded, top-soiled and sodded, the *Subdivider* will secure the services of the *Consultant* responsible for reviewing all the data and the *Consultant* will either certify or reject the lot grading upon inspection.

If the inspection reveals any deficiencies, the *Subdivider's Consultant* will notify the *Subdivider* what further work is required. It is the *Subdivider's* responsibility to ensure the required work is completed in accordance with their *Consultant's* recommendations.

Upon completion of the required work, the *Subdivider's Consultant* will re-inspect the property. This process will continue until the *Consultant* certifies the work conforms to the Detailed Lot Grading Plan.

Refer to Section 6 for more detail regarding lot grading requirements.

11.5. Erosion and Sediment Control

During active servicing and/or grading construction, all Erosion and Sediment Control Devices are to be inspected by the *Consultant* a minimum of once per week and after each rainfall of 25 mm or greater or significant snow melt. Daily inspections are required during extended rainfall or snow melt periods. These inspections are to ensure that the facilities are in proper working condition and all damaged Erosion and Sediment Control Devices are to be repaired and / or replaced within 48 hours of the inspection. A permanent record of these inspections must be forwarded to the Director of Development Services within five (5) days of the inspection.

Refer to Section 14 for more detail regarding erosion and sediment control requirements.

11.6. Watermains

Pressure Testing and Leakage

Refer to DGSSMS for requirements for;

- watermain pressure testing and leakage,
- swabbing,
- hydrostatic pressure testing,
- disinfection,
- de-chlorination,
- chlorine residual and bacteriological sampling tests,
- final connection to existing water systems,
- tracer wire conductivity testing and valve positioning

Watermain Commissioning Plan

Plan must be prepared and provided by the *Contractor* to *Township Staff* for review to ensure that all testing and sampling requirements for new watermain installation are satisfied

Plan provides outline of the acceptable procedures required for installation and testing of all new mains and services as required by the Safe Drinking Water Act and in accordance with the requirements of the Drinking Water *Works* Permit

Refer to DGSSMS for an example of a general Watermain Commissioning Plan and the criteria requirement

A Redline Drawing identifying any modifications that differ from the For-Construction set of drawings, and including measurements, swing ties, must be submitted before the final connection. Redline drawings must be submitted digitally (PDF) to the Project Manager and the Supervisor of Water / Wastewater. Final connection will not be made until the redline drawings have been submitted.

11.7. Sewer Leakage Testing

Refer to DGSSMS and OPSS for;

- Leakage for details, which also refers to OPSS 410 for infiltration and exfiltration requirements,
- Visual inspection,
- Cleaning and flushing,
- Deflection.

11.8. Closed Circuit TV (CCTV) Inspections

This section should be read in conjunction with DGSSMS. This section is applicable to the inspection of both sanitary and stormwater sewage systems.

The CCTV inspection shall be completed on all *Capital and Development Infrastructure Projects* on all mains, all laterals, catchbasin leads greater than 2 meters in length and rear yard leads. The CCTV inspection reports submitted to the *Township* shall be free of defects, debris, inflow and infiltration, soil materials, etc. The *Consultant* shall ensure that all sewer lengths are inspected and accounted for. Include with the CCTV Inspection Report, a General Services plan which highlights the inspected pipe.

If *Township Staff* determines through the sewer mainline and lateral videos that there is damage to one or more sewer laterals within the public road allowance, then the *Subdivider/Developer/Contractor* will be required to complete the work to repair the damage to the satisfaction of the *Township*, prior to final *Acceptance* by the *Township*.

The *Subdivider/Developer's/Township's Consultant* shall ensure that the Equipment Operators are fully conversant with all aspects of sewer inspections and capable of accurate observation and reporting of all conditions found. All Operators must possess PACP certification. Upon request by *Township Staff*, a copy of each pipeline *Inspector's* certification document must be provided.

The internal pipe inspection shall be carried out using specifically designed cameras, video recording equipment and synchronized computer data recording. A continuous visual record of the internal condition of the piping system shall be provided in digital format, with a playback visual resolution equivalent to the camera's recording resolution. The digital submission will also include the associated PDF report of the inspections and will be forwarded to the *Township* once the *Consultant* has completed their review.

Camera Equipment

Camera equipment shall consist of a self-contained, closed-circuit pan and tilt video camera and monitoring unit (OPSS 409). The unit shall have an adjustable lighting system capable of providing a clear monitor picture and a minimum illumination level of 100-foot candles. The camera travel speed shall be as per OPSS 409. CCTV videos not meeting the camera speed will be rejected.

Digital Images/Instant photos

The inspection unit shall be equipped with all equipment required for recording and producing colour digital still image captures of the inspection video image appearing on the operator's monitor during the inspection.

Cleaning/Flushing Precautions

During cleaning operations, satisfactory precautions shall be taken to ensure that the water flow volumes and pressures created do not damage or cause flooding of any public or private property, while still ensuring satisfactory cleansing of the interior of the pipe for inspection. When possible, the flow of sewage in the sewer shall be utilized to aid in the cleaning process. A maximum pressure of 1800psi shall be used in all locations to prevent damage to the sewer lines or flooding into private structures. It shall be at the *Contractor's* discretion and judgment that flow volumes and cleaning pressures are adjusted appropriately for the age, condition, and circumstances of the inspection site. If in the *Contractor's* opinion "normal" cleaning procedures cannot be undertaken, or satisfactory results cannot be achieved in any section of sewer, the CCTV *Contractor* must report the findings to the *Consultant* and *Township Staff*.

Material Removal

Debris such as dirt, sand, rocks, grease, and other solid or semi-solid materials, which is a result of cleaning or construction activities, shall be removed at the downstream maintenance hole of the section being cleaned. Passing material from maintenance hole to maintenance hole will not be permitted due to risk of line plugging. This material shall be removed using the vacuum system on a combination unit.

Material Disposal

Upon request, the *Contractor* shall provide a Ministry of Environment approved dumpsite for all material removed from the sewers during the cleaning operation.

Re-inspection

If in the opinion of the *Township*, re-inspection of the sewer is required because of inadequate cleaning, camera travel speed, quality of the CCTV video and inspection reports, the *Contractor* shall re-clean and re-inspect the sewer at no cost to the *Township*.

Flow Control and Bypass Pumping

When interruption of sewer line flows is necessary to effectively conduct the inspection operations, the CCTV *Contractor* shall, subject to the approval of the *Township*, control flows using plugging and blocking methods. The *Township* reserves the right, when necessary, to request bypass and de-watering of a sewer to be viewed to ensure that the full diameter of the pipe is visible. The CCTV *Contractor* may also be required to conduct some CCTV inspection during non-peak flow periods resulting in some work being required during late nighttime periods outside of established high flow periods.

Maintenance Hole Inspections

The CCTV *Contractor* will not be responsible for inspection or condition reporting of maintenance, except for reporting blockages or obstructions which may be deemed as potentially causing any flow restriction or backups.

Report

All reports will be submitted in English and be in a computer generated, typed format. The following information will be required to appear on the Front Cover of the Report

- 1st line Township of Woolwich
- 2nd Line *Consultants Name*
- 3rd Line *Subdivider/Developer's Name*

4th Line Subdivision's Name of Project Name, Phase, Stage

5th Line Sewer Type (Sanitary or Storm Video Inspection)

6th Line Report Number

7th Line Date of Report DD/MM/YYYY

Sewer Inspection Screen Information

While the camera is stationary, at the beginning of the section, the following shall appear on the screen:

1st Line From M.H# to M.H.# (Structure Number from drawings)

2nd Line Street Name

3rd Line Distance from center of maintenance hole base

4th Line Flow direction – Upstream vs. Downstream

5th Line Size of pipe, type of pipe

6th Line Date of inspection (MM/DD/YY)

While the camera is travelling the following information must appear at the bottom left hand of the screen.

1st Line From M.H# to M.H.# (Structure Number from drawings)

2nd Line Street Name

3rd Line Distance from center of maintenance hole base in meters

Defect Coding

When a defect is encountered during the inspection the camera shall be stopped for a reasonable period of time and the defect code will be displayed at the top left-hand corner of the screen. These defects will be coded at time of inspection in strict adherence to PACP v6 codes.

12. Transportation Impact Study Guidelines

12.1. Introduction

One of the *Township's* key objectives is to operate and maintain a safe and efficient roadway system. The Transportation Impact Study (TIS) guidelines outlined in this section have been established to meet this objective. The review and management of multi-modal *Development*-generated traffic is an integral part of operating and maintaining a safe and efficient roadway system. Transportation Impact Studies provide the opportunity to review and assess the impact of *Development* on the local road network and identify any improvements that are needed to accommodate the proposed *Development*.

The Ontario Ministry of Transportation (MTO) and the Region of Waterloo have established Transportation Impact Study Guidelines that apply to *Development* that may impact on either a Provincial Highway or a Regional road within the *Township*. The MTO “Guidelines for the Preparation of Traffic Impact Studies” and the Region of Waterloo “Transportation Impact Study Guidelines” can be found on their respective websites.

The *Township* Transportation Impact Study guidelines provide direction when, but not limited to:

- A proposed *Development* or zone change is not located near either a Regional road or a Provincial Highway and a Transportation Impact Study is required to assess the need for *Township* road improvements to support the applications, or
- A full Transportation Impact Study is not needed in accordance with Provincial and/or Regional guidelines, but the *Township* has questions about the site proposal that need to be addressed in a Transportation Assessment scoped to the local area and local transportation issues.

These guidelines identify transportation considerations that arise on a regular basis in the review of Development Applications in the *Township* and are more locally focussed along with a process to review and evaluate improvements that may be required to mitigate the impact of *Development* on *Township* roads. Generally speaking, these guidelines agree with and rely on the most recent version of the Region of Waterloo guidelines and reference the Regional guidelines for format, forms, analysis tools and parameters.

The TIS is an important tool in the overall *Township Development* planning process. The TIS assists *Subdividers/ Developers/ Consultants* and public agencies in making land-use decisions about applications for Official Plan amendments, Zoning By-law amendments, Draft Plans of Subdivision, Site Plans, and other planning approvals.

Transportation impact studies benefit the *Township* by:

- Providing decision-makers with a basis on which to assess transportation implications of proposed Development Applications,
- Providing a rational basis on which to evaluate the appropriateness of the scale of *Development* for a particular site, and determining required improvements, on and off the site, to provide safe and efficient movement of people and goods,
- Providing a basis for assessing existing or future localized transportation system deficiencies which require improvement,
- Addressing transportation-related issues associated with *Development* proposals that may be of concern to neighboring residents, businesses, and property Owners; and
- Providing a basis for negotiations for improvements and funding participation in conjunction with a *Development*.

A transportation impact study may vary in scope and complexity depending on the type and size of the proposed *Development*.

Documents beyond these Transportation Impact Study Guidelines that may be applicable include, but are not limited to, the as amended versions of:

- Ontario Ministry of Transportation (MTO) Guidelines
- Transportation Associate of Canada (TAC) Guidelines
- Institute of Transportation *Engineers* (ITE) Manuals
- Ontario Planning Act
- Ontario Traffic Manuals
- *Township* Traffic Calming Policy
- *Township* By-law
- *Township* Zoning By-law
- Region of Waterloo Implementation Guideline or Noise Policies
- Other applicable Provincial, Region, and Municipal documents, such as the Regional Traffic Collision Report

The approved transportation impact study is valid for one year from the date of approval. If a transportation impact study is older than one year, it will be reviewed by *Township Staff* and/or *Peer Reviewers* (at the cost of the applicant) and based on the review, the applicant may be required to provide an update.

12.2. Purpose of Transportation Impact Study Guidelines

The purpose of these guidelines is to ensure that transportation impact studies prepared for The *Township* meet, but are not limited to, the following criteria:

- Objective assessment – the study will evaluate the impacts of proposed new *Development* in a rational manner,

- Consistency – the study will utilize Assumptions consistent with the *Township's* accepted methodologies/parameters and industry best practices, and thus be comparable to other transportation studies in the *Township*, surrounding local Municipalities, Region, or Province,
- Recognized by *Subdivider/Developers* and *Consultants* – the guidelines will provide a standard approach to be followed and will reduce confusion and delay in processing *Development* proposals,
- Promote understanding of the process – the steps outlined in these guidelines will enable applicants, reviewers, the general public, and elected officials to understand the process more effectively; and
- Ease of review by *Township Staff* or a *Peer Reviewer* – a standardized set of guidelines will aid the efficiency of staff or a *Peer Reviewer* in reviewing Transportation Impact Studies.

12.3. Recommended Threshold for Study

In general, a transportation impact study shall be conducted whenever a proposed *Development* (or two or more *Developments* in the same area cumulatively) will generate more than 100, additional (new) peak-hour, peak direction trips to or from the site during the adjacent roadway's peak-hour or the *Development's* peak-hour, as per the Institute of Transportation *Engineers* (ITE).

The TIS must adhere to the as amended version of the Region of Waterloo Transportation Impact Study Guidelines. The *Township* may require the *Owner* of the *Land* to provide any improvements needed to accommodate the proposed *Development* to the satisfaction of and at no expense to the *Township*.

Although a *Development* may generate fewer trips than the peak-hour, peak direction threshold of 100 trips, a Transportation Assessment report outlining the current traffic conditions and information related to the proposed *Development* may be required by *Township Staff*. The Transportation Assessment must be signed by a licenced Professional Engineer. The Transportation Assessment may consider, but is not limited to, the following information:

- Proposed building use/zoning requirements,
- Peak hour traffic generation,
- Driveway locations,
- Sight distance assessment,
- Loading bay location and design,
- On and off-street parking design,
- Pedestrian and cycling infrastructure including, pedestrian crossings, bicycle facilities and parking,

- Existing, proposed future traffic calming (intersection control, roundabouts/traffic circles, etc.),
- Classification of new roads,
- Intersection capacity analysis,
- Need for a change in intersection control,
- Total traffic volumes (seasonal traffic variation, receiving operational traffic, etc.),
- Justification for a reduced parking provision, and
- Need for auxiliary lanes.

The required scope for the Transportation Assessment may be determined at the pre-study conference. Studies in support of Site Plan applications will be focused on the transportation needs on the site and at the site driveways. All other applications will also include a review of the need for off-site transportation improvements.

12.4. Qualifications to Conduct Transportation Impact Study

When the scale of the *Development/Re-Development* warrants a Transportation Impact Study or a Transportation Assessment, it is the applicant's responsibility to retain a qualified transportation professional experienced in transportation planning and traffic engineering.

Transportation studies must be prepared under the supervision of a qualified, experienced, and licenced Professional *Engineer* with specific training in traffic and transportation engineering and several years of experience related to preparing transportation studies for proposed *Developments*. The author shall also be a member of the Institute of Transportation *Engineers*. The report must be dated, signed, and stamped accordingly. The signing *Engineer* is verifying that appropriate Assumptions and methodologies have been utilized in the completion of the Transportation Impact Study and that they are the individual who is taking corporate/professional responsibility for the work.

Alternatively, at the discretion of the *Township*, the *Township* may retain a *Consultant* at the applicant's expense to undertake the study or the *Township* may retain a *Consultant* to undertake *Peer Reviewer*.

12.5. Transportation Impact Study Process

The Transportation Impact Study process must follow the as amended version of the Region of Waterloo Transportation Impact Study Guidelines.

Pre-Study Conference

Following the Official Pre-Consultation phase of the project, the applicant may be required to arrange for a pre-study conference with *Township Staff* and other relevant reviewing agencies (e.g., adjacent municipalities, Region of Waterloo, Ontario Ministry of Transportation, rail

authority, etc.). In the pre-study conference, *Township Staff* and other reviewing agencies will confirm the scope of the transportation impact study and determine data requirements and their availability. In addition to the *Township's* requirements, adjacent Municipal, Regional and Provincial (MTO) roadway authorities may require additional information or analysis to satisfy their requirements for a *Development/Re-Development* proposal.

The Applicant must follow the as amended version of the Region of Waterloo Transportation Impact Study Guidelines. When requesting a pre-study conference meeting, the *Consultant* will submit a plan for the *Development* along with a pre-study conference form outlining the proposed approach to the study.

When a proposal is relatively small and does not require a TIS, pre-study conference may be done by phone and e-mail where the scope of a Transportation Assessment can be proposed by the applicant's *Consultant* and agreed to with *Township Staff*.

Preliminary Review

The applicant is responsible for preparing minutes of the pre-study conference, updating the pre-study conference form to reflect items agreed to during the pre-study conference meeting, and distributing them to all appropriate parties for review and approval. The approved minutes must be included as an appendix in the TIS report.

Data Collection

The applicant is responsible for collecting, assembling, analyzing, and presenting all types of data required for the study. The assembly of available data shall be accompanied by a detailed investigation of the project site, area streets and the surrounding vicinity. This process shall include recording all relevant characteristics needed for the analysis (e.g., adjacent *Land* use, description and classification of area roads including speed limits, location of on-street parking, available sight lines near proposed driveways, and location of nearby driveways and intersections) plus observations and data collection of existing traffic patterns and travel characteristics in the study area.

Current data shall be collected to supplement the available data as necessary. All transportation survey data shall not be less than two years old. Such data shall be obtained through surveys consistent with procedures described in the current edition of the Manual of Traffic Engineering Studies published by the Institute of Transportation *Engineers*.

Any factors used in the transportation impact study analysis that are different than the Region of Waterloo standards must be justified and agreed upon with *Township Staff* and then documented in the final report.

A description of the TIS inputs, including but not limited to a list of the traffic counts, collision data, and traffic signal timings that were used in the study with the dates and sources shall be

included in the final TIS report. Where there are large amounts of data, they shall be submitted digitally as a separate item.

Post Traffic Study Functionality Testing

Once the *Development* is complete, and at the discretion of the *Township* and signed within a subdivision or *Site Plan Agreement*, the *Developer* must evaluate the traffic impact study based on current/future build-out condition to confirm the proposed traffic impact is correct. If the traffic impact does not meet the designed / approved traffic impact study, the *Developer* may be required to conduct post-remediation as needed at the cost of the *Developer*.

Transportation Impact Study Report Review

The TIS report must follow the format outlined in the most recent version of the Region of Waterloo guidelines. This format will facilitate and expedite review, discussion, and communication. The report shall consist of a main document containing the text and exhibits including summary tables, supplemented by technical appendices detailing the analysis. A site plan or concept plan of a suitable scale is required for consideration in the review of the transportation impact study. If the proposed *Development* is to be constructed in phases, a description of each phase and the proposed timing of implementation must be provided. All elements of the TIS report may not be requested depending on the size and nature of *Development*; this will be determined at the pre-study conference.

Two paper copies of the TIS report along with one electronic copy of the report including all technical appendices (in .pdf format) must be submitted to the *Township* for review. Additional copies may be required for other agencies as determined at the pre-study conference.

A preliminary review of the submitted TIS will occur. Any revisions, supplementary analysis, or change to the original study, must be documented and a consolidated final version must be submitted to the *Township*.

Approval of the TIS does not constitute approval of the Development Application. Conditions imposed by other *Township* reviewers must also be resolved.

12.6. Transportation Impact Study Report Contents

The TIS report must follow the format outlined in the most recent version of the Region of Waterloo Transportation Impact Study Guidelines. In addition to the above noted TIS guidelines the following items must be considered, as a minimum, and included in the TIS report.

Non-Auto Modes, Transit, Pedestrians, Bicycles

The study must analyze and evaluate the roadway's performance with regard to accommodating transit, pedestrians, and cyclists in the study area using the Highway Capacity Manual and any other generally accepted guidelines. This includes a safe passage for pedestrians within the *Development*.

The assessment considerations for transit include but are not limited to:

- Frequency and hours of service,
- Presence and location of bus stations and/or stops relative to the site,
- Future planned routes, stations and/or stops.

The assessment considerations for pedestrians may include but are not limited to:

- Presence, connectivity, and width of sidewalks and trails,
- Barriers and buffers from traffic,
- Crossing opportunities at intersections and midblock locations,
- Need for additional pedestrian crossings including signalized crossings, pedestrian crossovers, and pedestrian refuge islands in accordance with the most recent Ontario Traffic Manual (OTM) warrants,
- Facilities designed to AODA (Accessibility for Ontarians with Disabilities) standards,
- Presence of illumination,
- Relevant pedestrian destinations in the area including schools.

The assessment considerations for bicycles may include but are not limited to:

- Presence of dedicated facilities,
- Network connectivity (roads, MUT, local trails),
- Number and width of travel lanes adjacent to the route,
- Volume and speed of traffic,
- Percentage of trucks and buses encountered,
- Pavement condition,
- Proposed bicycle parking for visitors, employees, and residents,
- Other proposed amenities for cyclists including showers, change rooms, and indoor, secure parking.

The recommended measures to improve walking, cycling, and transit environment in the study area must comply with best industry practices and recognized success/approval within the *Township* and surrounding Municipalities.

Vehicular Site Access and Circulation

The number and location of access points must be reviewed to ensure only the minimum number necessary is provided to serve the project without negatively impacting the flow of traffic along abutting streets. Access points must be located on minor roads where feasible and justification for more than one access must be based on the capacity for site traffic, not design preference.

The locations must be adequately spaced from adjacent street and driveway intersections. The number of exit lanes, radii, and vehicle storage must be appropriate to accommodate traffic demands placed on them. The throat length at the road must be sufficiently long to minimize conflicts with street traffic and within the site.

Access points shall be evaluated in terms of capacity, safety, and adequacy of queue storage. Access points must be free of all visual encumbrances. Additionally, there shall be no utility boxes, hydrants, hydro poles etc. within 1 m of the edge of the access points.

Sight distance at new access points must be evaluated to ensure safe conditions in accordance with the Transportation Association of Canada Geometric Design guide for Canadian Roads. In addition, appropriate restrictions must be applied to access points and confirmed with *Township Staff* to ensure that sight distances are maintained.

On-site parking/circulation systems must be designed to avoid queues backing onto *Township* roads and the need for vehicles to reverse onto *Township* roads.

Proposed garbage and loading facilities and access to these facilities shall be designed to ensure that they are adequately sized and provided with suitable access so that they will not adversely affect traffic operations on *Township* roads.

An AutoTURN analysis is required to analyze path maneuvers of ingress and egress of all trucks, plows, emergency vehicles, loading and garbage vehicles needed on site. All trucks, plows emergency vehicles, loading and garbage vehicles must enter and exit in a forward motion and must be accommodated in the design. Any required turning restrictions or other restrictions must be identified and appropriate design implements be put in place to physically restrict the turning movements.

Turning restrictions, either by time of day or through physical barrier, may be considered at new access points that are close to existing intersections or where there are concerns about the operation of one or more of the turning movements, when queues from adjacent intersections are expected to block the new access.

Remedial Measures

The TIS must identify remedial measures to any impacts identified. These remedial measures include, but are not limited to the following:

- All transportation system improvements identified as necessary or desirable to serve the proposed *Development* or to accommodate the background traffic must be listed and the timing of their implementation must be identified,
- Criteria and timing that will trigger all street improvements must be documented and the improvements must be shown on a functional plan indicating dimensions, required pavement widening, line marking/signage, required right-of-way widening, traffic control and other significant characteristics including the location of all curbing, driveways, and intersections on both sides of the road. In some cases, a detailed design and cost estimates may be required,
- When improvements to an intersection are proposed, the design plans must show all legs of the intersection and at least 75m past the intersection on each leg, so that turning paths and lane continuity can be reviewed,
- All "critical" traffic movements or other traffic (including pedestrians and cyclists) /transit impacts that cannot be successfully mitigated must be identified,
- An analysis of the remedial measures must be undertaken and documented in the TIS,
- Once the traffic analysis has been accepted, approval of the Transportation Impact Study may be granted conditional upon the feasibility of the recommended plan,
- Cost estimates must be provided for all recommended improvements.

Conclusions and Recommendations

It is important to structure recommendations for improvements within appropriate time horizons. The conclusions and recommendations must include a summary of key conclusions with respect to the transportation impact of the proposed *Development* and a summary of recommended improvements and unresolved problems/issues. Recommendations must be sensitive to, but not limited to, the following issues:

- Timing of short-range and long-range network improvements that are already planned and scheduled,
- Anticipated schedule of adjacent *Developments*,
- Size and timing of individual phases of the proposed *Development*,
- Logical sequencing of various improvements or new transportation infrastructure,
- Right-of-way needs and availability of additional right-of-way within the appropriate time frames,
- Local/Regional/Provincial priorities for transportation improvements and funding,
- Cost-effectiveness of implementing improvements at a given stage of *Development*; and
- Necessary lead-time for additional design and construction.

Since improvements can often be implemented in more than one order, the recommendation must address an implementation sequence that would provide maximum compatibility with the overall roadway system configuration needed for network effectiveness.

As a minimum, designs and recommendations must comply with the Ministry of Transportation of Ontario Geometric Design Standards for Ontario Highways, the Ontario Traffic Manuals, and the Transportation Association of Canada Geometric Design Guide for Canadian Roads, Best Management Practices from area municipalities, as well as *Township* policies and practices.

Appendices

Appendices shall include, but are not limited to, the following:

- Approved minutes of the pre-study conference,
- Calculations for intersection capacity analyses, using software approved by the *Township* including all input parameters and full printouts detailing the traffic volumes, turning movement volumes, level of service, volume/capacity ratios, delays, and queues,
- Calculations for any auxiliary lane warrants,
- Calculations for any traffic control warrants,
- Calculations for any Initial Roundabout Screening; and
- Cost estimates and timing of proposed Works.

13. Hydrogeological Study Requirements

13.1. Introduction

The purpose of this document is to provide guidance on the details required for hydrogeological studies for proposed *Developments* (residential, commercial, industrial etc.) within the *Township*. These standards are intended to assist *Subdividers/ Developers* and their *Consultants* at the initial stages of *Development* design and site investigation, but an initial pre-study conference with *Township Staff*, Region of Waterloo and/or *Peer Reviewer* (as determined by the *Township*) is required prior to starting the hydrogeological assessment to determine the site-specific scope of work required. A concept plan and existing site information is to be provided 3 weeks before the pre-study conference.

These guidelines are not applicable to the following:

- A Single-lot *Development* (i.e., one lot with one single-family residential dwelling) with an area of 1.0 ha or larger that does not fall within identified Significant Groundwater Recharge Areas (SGRA), area of Groundwater Under Direct Influence (GUDI) of surface water, municipal wellhead protection sensitivity areas (WPSA) –1 or -2, or GRCA regulated areas,
- Municipal infill projects (i.e., *Development* or *Re-Development* supported by municipal services) consisting of less than three units.

Please Note: For municipally serviced projects of three units or more, a Pre-Study Conference scope meeting with *Township Staff* and/or a *Peer Reviewer* will be required to determine the hydrogeology study scope of work. All municipally serviced projects will be evaluated on a case-by-case basis, and the scope of work for municipally serviced projects can be expected to vary from the requirements outlined below.

This document outlines the minimum requirements for background review, initial fieldwork, monitoring requirements, and reporting for new *Developments*. This document is intended to be consistent with other guidelines and standards provided by the Region of Waterloo and the Ontario Ministry of the Environment, Conservation, and Parks (MECP).

It is important to consider that the standards outlined in this document are subject to review and modification by *Township Staff* to reflect individual site conditions and individual project scopes. As noted above, a Pre-Study Conference scope meeting with *Township Staff* and/or a *Peer Reviewer* (at the expense of the applicant) will assess the scope of work required for specific *Development* proposals.

As a minimum, the Hydrogeology Report submitted will provide information on the site water balance, soil infiltration rates, identified recharge/ discharge areas, and on water supply private

onsite wells and private septic tanks in accordance with Conservation Authority Guidelines to support Development Applications, MECP Technical Guidelines for Individual On-site Sewage Systems, Ontario Drinking Water Standards, and the Ontario Building Code. The report will also describe the planning context and relevant provincial, regional, and municipal legislation, and policies (e.g., Source Water Protection (O.Reg. 287/07) and the *Township Official Plan*).

Hydrogeological studies are required to evaluate whether the proposed application is likely to result in adverse/negative impacts to subsurface aquifers, existing groundwater users or natural functions of the ecosystem relying on groundwater, and both on-site and adjacent surface water features. The report must include sufficient investigation and analysis to assess groundwater infiltration and recharge, baseflow (supporting streams and wetlands), groundwater elevations and flow paths (and the potential to divert flow, cause flooding, or divert shallow flow causing impacts to shallow-rooted vegetation and wetland features) and cumulative watershed impacts.

Documents beyond these Engineering Design Standards that may be applicable for an engineering design include, but are not limited to, the as amended versions of:

- Environmental Protection Act,
- Health Protection and Promotion Act,
- Ontario Water Resources Act,
- Ontario Safe Drinking Water Act,
- MECP Technical Guideline for Private Wells: Water Supply Assessment (Procedure D-5-5),
- MECP Technical Guideline for Individual On-site Sewage Systems: Water Quality Impact Risk Assessment (Procedure D-5-4),
- MECP Servicing Options Statement (Procedure D-5-3),
- Ontario Building Code,
- Grand River Conservation Authority (GRCA) considerations for *Developments* that are within the regulation limit.

13.2. Background Review

The purpose of the background review includes but is not limited to collecting existing geological and hydrogeological information for the site and within the regional context.

Identification of Site Location

Identification of the site location shall include, but is not limited to, the following information:

- Lot number and concession,
- Roads and/or highways/railways/hydro corridors bordering the site,

- *Land* use designations of the Official Plan and permitted uses in the zoning of the site and *Lands* within a minimum radius of 500 metres from the site, or as deemed appropriate by the *Township*,
- Present *Land* use of the site and adjacent *Lands*,
- Location of all municipal wells and Wellhead Protection Areas (WHPAs) and private water supply wells within a minimum radius of 500 metres from the site, or as deemed appropriate by the *Township*,
- Location of GRCA-delineated wetland areas within a minimum radius of 500 metres from the site,
- Total area of the site and proposed developed area, including *Pre-Development* and *Post-Development* pervious and impervious areas.

Data Review

A review of all available geologic and hydrogeological information shall be conducted prior to commencing the preliminary field program. The data review shall include, but not be limited to, the following:

- Topographic maps (1:10,000),
- Quaternary geology maps and reports,
- Bedrock geology maps,
- Hydrogeological or geotechnical reports for adjacent existing and proposed *Developments*,
- MECP water well records,
- Water-supply reports for existing nearby *Developments*,
- Shallow dug wells and seeps,
- Groundwater quality or quantity data,
- MECP and/or GRCA hydrogeology/hydrology files,
- Hydrogeology maps,
- Source water protection plans including Wellhead Protection Area (WHPA) mapping,
- Soil maps,
- Slope stability evaluations,
- Existing tile maps for the proposed *Development* area and neighbouring farmer's fields,
- Source water information,
- GRCA information,
- *Municipal Drain* information.

Source water impacts must be evaluated based on current Region of Waterloo standards and procedures and the Grand River Source Protection Plan (Policy RW-CW-19). Potential drinking water quality threats must be identified and evaluated. This includes determining whether the planned activities/operations on the property are located within a vulnerable area

and identifying potential drinking water threats for which the source protection plan policies apply.

The information obtained from the existing data review must include, but is not limited to, the following:

- Site setting including surface relief, watercourses, Provincially Significant Wetlands (PSWs), ponds, Environmentally Sensitive Policy Areas (ESPAs), Sensitive Groundwater Areas (i.e., Regionally Significant Recharge/Discharge Areas), etc.,
- Regional and site geology including overburden thickness and soil types (e.g., glaciofluvial, outwash, etc.) and bedrock type (e.g., unit, age, etc.); and,
- Regional groundwater system including overburden and bedrock aquifers, general identifiable units, general characteristics, flow directions, municipal/communal well locations, private water supply well locations, recharge and discharge areas, Wellhead Protection Sensitivity Areas (WPSA), the potential for Groundwater under the Direct Influence of Surface Water (GUDI), etc.

13.3. Initial Field Program

Based on the results of the review of the available information, a field program will be designed and implemented to undertake a preliminary determination of site-specific groundwater conditions. The purpose of the Initial Field Program is to conduct a preliminary assessment of the potential impacts of the *Development* on existing natural features, private water supply wells, and private sewage effluent disposal (septic) systems. The initial field program also includes, but is not limited to, the seasonally high groundwater table level, seasonal trends in the water table, and whether a perched water table is present. Discussions with *Township Staff* and potential *Peer Review* professionals must be conducted as part of the Pre-Study Conference scope meeting prior to commencing the Initial Field Program. Any cost associated with requiring a *Peer Review* professional at the consultation meeting or reviewing submitted information will be at the expense of the applicant.

It is anticipated that this initial field program will be undertaken prior to the *Development* of the site's servicing scheme, lot design, and detailed *Land* use. As part of the detailed design work and/or the long-term monitoring for the site, additional field programs may be required and subject to change.

The site investigation and field program must be managed and overseen by a qualified professional *Engineer* or a professional geoscientist.

Door-to-Door Survey

A door-to-door inventory of water supply wells within a minimum radius of 500 m (a larger area may be warranted depending on local circumstances) of the proposed *Development* shall be

conducted. The survey will be conducted to field verify and augment information obtained during the data review. The survey shall collect information including, but not limited to, the method of construction and well depth, water level, pump intake and well depths, water use, general water quality, any reported quantity/quality issues, and suitability of private wells for future monitoring, if required. The survey will also investigate the location of private septic systems, type, and age of the systems when they were last serviced, and any issues identified by the homeowner. Where homeowners are not available during the survey, or are unwilling to participate during the survey, a copy of the survey form shall be left at the home along with an explanatory letter and a self addressed stamped envelope. A record of all homeowners who participate, and who received copies of the survey form, shall be included in the report.

Monitoring Well Installation

The investigation shall include the drilling and installation of a minimum of three monitoring wells to determine site-specific geologic and hydrogeological conditions. The exact number of monitoring wells will be dependent on the size of the *Development* and any anticipated changes in geological or hydrogeological conditions at the site. The rationale for the locations, depths, and quantity of the proposed monitoring wells must be provided during the Pre-Study Conference process with *Township Staff*. The depth of the monitoring wells shall be sufficient to identify the shallow groundwater table. If perched water conditions exist within 5 metres from the ground surface, three monitoring wells must be installed within the stratigraphic unit where the perched water table exists. Additionally, a minimum of one borehole shall be drilled a minimum of 10 metres into the underlying aquitard to assess the thickness and composition of the aquitard layer. If the aquitard is less than 10 m in thickness, a second monitoring well shall be installed in the underlying aquifer and the drilling plan revised to include sufficient monitoring wells installed in the underlying aquifer. If a continuous aquitard 10 metres in thickness is proved by the borehole, it can be concluded the aquitard is of sufficient thickness to protect underlying aquifers and additional deep monitoring wells are not required.

If no perched conditions (within 5 m) are encountered, the three monitoring wells shall be installed at the depth of saturated aquifer conditions.

Upon completion, all monitoring wells must be sufficiently flagged, protected, and maintained to ensure they are not damaged by agricultural or construction activities.

All monitoring wells are to be fully developed (purged) to ensure accurate water levels and quality information will be obtained as part of the monitoring program described in Section 13.

Single response in-situ hydraulic conductivity testing (slug testing) will be conducted in all monitoring wells to assess the saturated hydraulic conductivity of the water-bearing soils.

Surveying of Site

All groundwater and surface water monitoring locations shall be surveyed to UTM co-ordinates using the NAD 83 datum Zone 17. Surveying shall establish elevations with respect to metres above sea level (mASL) for all surface water and groundwater monitoring locations.

Monitoring Program

A groundwater level and chemistry monitoring program shall be established to gather technical information needed to support the hydrogeological interpretation. Water levels from all monitoring wells, and possibly adjacent private water supply wells depending on site conditions and availability, will be measured on a minimum of a quarterly basis continuously for at least two years prior to draft approval; however, continuous water level monitoring utilizing barometrically compensated electronic pressure transducers (data loggers) is the preferred method for data collection. The two years of continuous groundwater levels and groundwater chemistry data must be obtained within five years of the draft plan submission date.

Groundwater level monitoring is required for a minimum of one additional year following draft approval with the knowledge that any changes in hydrogeological conditions in the third year of monitoring could affect aspects of *Development* design. The monitoring is required to establish baseline hydrogeological conditions, including maximum/minimum water table elevations and seasonal fluctuations, groundwater flow directions, horizontal and vertical hydraulic gradients, and relationships between the groundwater and surface water features in the immediate vicinity of the site. Monitoring wells may need to be monitored for additional years prior to, during, and after *Development*, with the length of time established as part of the hydrogeological study discussed in Section 13. Per Ontario Regulation 903 (as amended), all monitoring wells and/or supply wells which are no longer in use must be decommissioned, and the decommissioning must be completed by a Licensed Well *Contractor*.

Groundwater chemistry samples shall be obtained from a minimum of two wells screened in the aquifer (or two wells screened in perched conditions plus one well screened in the underlying saturated aquifer) identified during drilling, with analysis of a general chemistry suite of parameters including but not limited to metals, anions, E. coli, Total Coliforms, and nutrients. Groundwater chemistry samples shall be collected annually (the same month each year) during the groundwater level monitoring program.

Long Term Groundwater Monitoring

The groundwater monitoring program described in Section 13 shall continue from the initiation of the monitoring program continuing through the draft plan approval until two years past 95% of *Development* buildout. The program must include, but is not limited to, the following:

Whether fluctuations in the groundwater table exceed the minimum separation of 0.6 m from the underside of foundation footings for residential/non-residential buildings and/or the minimum separation of 0.8 m from the underside of basement floor for walk-out residential/non-residential buildings.

Whether groundwater chemistry changes exhibit deleterious trends.

Whether groundwater fluctuations exhibit deleterious trends.

In the event long term monitoring data shows the minimum separation distance is exceeded, or negative impacts are occurring, *Township Staff* and/or *Peer Reviewer* and the applicant shall review the data and determine a course of action.

13.4. Hydrogeological Study Report Requirements

Following the completion of the evaluation of all existing data and test results, a hydrogeological study report shall be prepared. The report will be updated via an annual monitoring report at the end of each year with long term monitoring data as it is collected. The report will provide an evaluation of the potential impacts of the proposed *Development* on adjacent private water supply wells and septic systems, potential impacts to groundwater and surface water features and resources, and whether perched water table conditions exist. The hydrogeology report will include, but not be limited to, the methods of analysis and summarize the information obtained from Section 13. Additionally, the report will provide information including, but not limited to, the following:

- Meeting minutes from the Pre-Study Conference scope meeting,
- Geologic cross-section(s) summarizing the regional and local site conditions,
- The groundwater table elevation, including the highest and lowest measured water levels. For proposed *Developments* of one to four lots, a tabular summary of the seasonally high groundwater table vs. underside of footings at each lot shall be provided. For proposed *Developments* of five lots or more, a drawing of the seasonally high groundwater level contours vs. underside of footing elevations shall also be provided to visually illustrate the separation distance for each lot,
- A determination of whether the groundwater level monitoring period is representative of normal, above-average, or below-average annual precipitation conditions. This could include checking regional weather data, data from other sites that have long term monitoring data, weather station data, or information available from the Canadian Climate Centre, the Region of Waterloo, the GRCA, the City of Kitchener, and the University of Waterloo,
- An assessment of any potential interference with municipal or private water supply wells related to the proposed *Development*,

- An evaluation of the connection between perched groundwater, the shallow groundwater aquifer, and nearby surface water features (if present),
- An assessment of any potential impacts to surface water or changes in wetland function in the context of groundwater recharge (e.g., focused recharge areas) and groundwater discharge related to the proposed *Development*,
- If perched water or shallow groundwater aquifer conditions exist, is the seasonally high perched water table within 0.6 m of the underside of foundation footings (or within 0.8 m of the underside of foundation footings for basement walk-outs),
- Any implications for *Development* construction on groundwater and surface water resources,
- Recommendations for a continuous monitoring program to be undertaken during the design, construction, and post-construction stages for the proposed *Development*,
- *Pre-Development* and *Post-Development* site water balance calculations (using the Thornthwaite and Mather methodology) assessing changes in infiltration of precipitation,
- Water course category,
- Source water impact information,
- Recommend measures required during construction for installation of underground infrastructure, i.e., Requirement for dewatering, non EASR, or PTTW requirements, cut off collars etc.,

The results of the Hydrogeological Study Report will be reviewed by the *Township* (and/or a *Peer Review* agent selected by the *Township*) and/or third-party agencies such as the Region of Waterloo or the GRCA if required. The *Township* may require additional studies if deficiencies/ inconsistencies or concerns in the report are identified. Any costs associated with requiring *Peer Review* or third-party agencies' input will be at the expense of the applicant.

13.5. Additional Investigations and Reporting

As the servicing details, lot design and overall *Land* use for the *Development* is determined, it may be necessary to conduct additional investigations. Issues that could lead to these additional investigations include, but are not limited to, potential impacts as identified in initial reporting, insufficient data coverage based on *Development* size, design of a stormwater management pond, impacts from cut and fill activities, groundwater influence on building design, whether there is a phased-in approach to *Development* construction, or other issues identified by *Township* reviews. Any new monitoring wells installed on the property shall be incorporated into the groundwater monitoring program, with details of the new wells and monitoring included in the subsequent monitoring reports. Annual monitoring reports shall be submitted to the *Township* for review.

The *Township* requires the review and assessment of the Hydrogeological Study Report to ensure that the soil, groundwater, and surface water conditions of the Site have been sufficiently investigated and potential impacts properly assessed, and that appropriate

monitoring and mitigation methods are recommended. All costs associated with *Peer Review* or Third-Party review of submitted reports and documents shall be the responsibility of the applicant.

The hydrogeological study is anticipated to correspond with the level of risk posed to the groundwater and surface water resources.

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14. Erosion and Sediment Control

14.1. Introduction

The purpose of the erosion and sediment control (ESC) guidelines is to provide requirements for ESC measures, including design, installation, inspection, monitoring, and removal. Construction site water management and the control of erosion and sediment is a critical part of any construction activity that disturbs soil.

Most construction activities result in major modifications to the landscape. The removal of soil stabilizing vegetation and the exposure and compaction of fine-grained soils can result in significantly increased stormwater run-off and soil erosion rates. The International Erosion Control Association (IECA) indicates that, in the absence of practices to manage run-on, run-off, erosion, and sedimentation, the production of eroded sediment is typically 200 to 400 times greater on construction sites when compared to undisturbed conditions. Activities such as, construction site dewatering, are a potential source of sediment loading into storm sewers. Dust caused by disturbance of exposed, dry sub-soils by wind and equipment also have a significant impact.

Additionally, disturbed sediment or eroded soils can transport deleterious substances such as hydrocarbons, metals, and nutrients, negatively impacting water quality and aquatic habitat. Fish habitat can be disturbed or destroyed by increased sediment loading, as sediment can smother spawning beds and suffocate incubating eggs and benthic invertebrates. Chronic high turbidity can reduce productivity, irritate the eyes and gills of fish (reduces oxygen uptake and increases risk of infection and disease), and affect the Feeding ability of many species of fish.

The hydrology of a site changes during construction. Other impacts on erosion and sedimentation include soil-distributing activities. Exposed subsoil compacted by equipment, can result in increased imperviousness (reduced infiltration of surface water) which leads to increased quantity and rate of surface run-off. The increased surface flow raises the erosive potential of stormwater and snowmelt.

A wide variety of erosion and sediment control practices have been developed, many of which have proven effective when designed and implemented as intended. However, failure to properly control erosion and sediment during construction is still common. Damage to infrastructure, property, and the environment can be costly to repair and can lead to fines and legal action.

Sediment deposition in water bodies can affect stream channel morphology (increased flooding potential) and damage or destroy terrestrial habitat.

Documents beyond these Engineering Design Standards that may be applicable for an engineering design include, but are not limited to, the as amended versions of:

- Ontario Provincial Standard Specifications and Drawings (OPSS and OPSD),
- Greater Golden Horseshoe Area Conservation Authorities (GGHA CA) Erosion and Sediment Control Guideline for Urban Construction, December 2006,
- Ministry of Environment Conservation and Parks (MECP) Design Guidelines for Drinking Water Systems,
- MECP Design Guidelines for Sewage Works,
- MECP Stormwater Management Planning and Design Manual,
- MECP B-6 Guidelines for Evaluating Construction Activities Impacting on Water Resources,
- Ontario Building Code,
- National Standard of Canada CAN/CSA-W202-18 - Erosion and Sediment Control Inspection and Monitoring,
- Relevant municipal soils map,
- Grand River Conservation Authority Erosion and Sediment Control Guideline for Urban Construction,
- Ministry of Agriculture, Food and Rural Affairs Soils Survey Reports and Maps – Waterloo #44.

14.2. General Requirements

Erosion and sediment control measures are to be designed, constructed, and implemented in accordance with Grand River Conservation Authority (GRCA) guidelines entitled "Erosion and Sediment Control Guideline for Urban Construction, Greater Golden Horseshoe Area Conservation Authorities (GGHA CA), December 2006" and the National Standard of Canada CAN/CSA-W202-18 (CAN/CSA-W202-18) entitled "Erosion and Sediment Control Inspection and Monitoring." All ESC measures, including filter fabric and tree protection fencing, as required on-site must be maintained and kept in good repair considering weather conditions. The *Engineer* retained by the *Subdivider / Developer / Builder* will ensure that reputable and qualified *Contractors / Subcontractors* undertake the necessary work to maintain ESC measures and provide written confirmation of corrective action according to CAN/CSA-W202-18 and/or by the Municipality/GRCA and Engineering (Owner's) Representative.

To meet the goal of improved planning and implementation, the *Engineer* shall recognize that the erosion and sediment control report and drawings prepared at the project planning stage only provides an initial appraisal of the site conditions and prescribes practices which are based on that appraisal. Site conditions change and practices need to be easily modified and updated as the project proceeds. This requires ongoing involvement and assistance from regulatory agencies, including *Township Staff* and By-Law staff.

Inorganic materials are classified as follows: sand (0.05 – 2.0 mm diameter), silt (0.002 to 0.05 mm diameter) and clay (< 0.002 mm diameter).

No Assumption of any infrastructure will be completed until full restoration to the environment beyond the limits of the site (where applicable due to erosion from the site) and proper removal of the erosion and sediment control is complete.

14.3. Erosion Control Criteria

For all *Development* sites, the minimum erosion control requirement is extended detention of the 4 hour, 25mm Chicago distribution rainfall event for 24 hours.

14.4. Inspection and Performance Monitoring

Erosion and sediment control measures, inspection, and performance monitoring are to be implemented in accordance with Grand River Conservation Authority (GRCA) guidelines entitled "Erosion and Sediment Control Guideline for Urban Construction, Greater Golden Horseshoe Area Conservation Authorities (GGHA CA), December 2006" and the National Standard of Canada CAN/CSA-W202-18 entitled "Erosion and Sediment Control Inspection and Monitoring."

The erosion and sediment control plan shall provide the framework for the inspection, maintenance including the need for repair, removal, and record-keeping procedures during all stage of construction and warranty period.

Inspections of the ESC measures must be completed on a regular basis and after every significant rainfall/snow melt event. All inspection information, as per CAN/CSA-W202-18, must be sent to the *Township* within 1 week of completing the inspection. During inactive construction periods (where the site is left alone for 2 weeks or longer), as a minimum, a monthly inspection shall be conducted in addition to the above. All damaged ESC measures must be repaired and/or replaced within 48 hours of the inspection.

An effective inspection program must include, but is not limited to, the following:

- Identification of Personnel: Names and contact information of project members assigned to each task as well as agency/enforcement contacts. A communication protocol must also be developed to ensure effective reporting and compliance.
- Details and locations of the environmental constraints for an undertaking including maps, reports, approvals, and permits.
- Design and construction drawings detailing the erosion and sediment controls installed which shall be updated throughout the construction period.
- High-risk areas shall be identified in these drawings and routinely evaluated.
- Inspection schedule: This must include inspection times, areas, and person(s) responsible for the inspections. A 'walk-through' inspection of the construction site must be undertaken in advance of winter conditions or anticipation of large storm events (or a

series of rainfall and/or snowmelt days) that could potentially yield significant runoff volumes. The regular inspections shall occur during all construction stages and should be based on, at a minimum, the requirements identified in the permits and approvals.

- Condition of filter cloth shall be recorded during each inspection and changed as needed.
- Equipment used for verifying sediment effluent discharge.
- Post-construction erosion control plan for remediation.

Receiving Watercourse Monitoring

Receiving watercourse monitoring must be conducted if the *Development* meets the following industry best practice criteria, or as requested by the *Township* or approval agencies:

- The location of the site is adjacent to a watercourse; and
- The size of the site is greater than 10 hectares.

All receiving watercourse monitoring shall be in accordance with CAN/CSA-W202-18. The CAN/CSA-W202-18 standard is applicable to design rainfall events up to and including a 5-year design storm.

As per CAN/CSA-W202-18 the following levels shall not be exceeded:

- Measurements of total suspended solids (TSS) within a receiving watercourse shall not exceed 25 mg/L. TSS above the receiving watercourse's background levels for short-term exposure periods (e.g., 24 hours) and the maximum average increase above background for longer term exposure periods (e.g., 24 hours to 30 days) shall not exceed 5 mg/L,
- When the receiving watercourse's background levels are between 25 and 250 mg/L, the maximum increase in TSS above background shall not exceed 25 mg/L. When the receiving watercourse's background levels are greater than 250 mg/L, the increase in TSS above background shall not exceed 10% of the background level,
- Where turbidity (NTU) measurements are preferred and allowed by contract or permit, the maximum increase in NTU above the receiving watercourse's background level shall not exceed 8 NTU for short-term exposure periods (e.g., 24 h). For longer term exposure periods (e.g., 30 days), the maximum average increase above background shall not exceed 2 NTU,
- When the background level of a receiving watercourse is 80 NTU or less, the maximum increase above background shall not exceed 8 NTU. When the background level in the receiving watercourse is greater than 80 NTU, the maximum increase shall not exceed 10% of the background level.

Effluent Discharge Monitoring

All effluent discharge monitoring shall be in accordance with CAN/CSA-W202-18. Where effluent discharge monitoring is required by contract, permit, or authorization, the *Inspector* (consulting *Engineer* or *Township*) shall measure flow rate and collect water samples at the point of discharge.

Measurements of effluent water at the point of discharge from the construction site shall not exceed 25 mg/L TSS.

Inspection and Monitoring Documentation and Communication

Each inspection record shall be in accordance with CAN/CSA-W202-18 including, but not limited to, the date and time, weather conditions, and photos. This includes inspection before construction, inspection during construction, inspection post construction, and any other required inspections.

Spill Control and Response

The erosion and sediment control plan shall clearly outline the project-specific spill control and response plan procedures. Significant mishaps must be reported immediately to the supervising Engineer, the Municipality, and environmental monitor who notifies the Spills Action Centre via the Contract Administrator. Details of the incident as well as updates on site conditions and containment/clean up efforts must be provided to the attending agency.

Inspection and Monitoring Personnel

Erosion and sediment control measures inspection shall be carried out by a Qualified Erosion and Sediment Control *Inspector* (QESCI) before construction, during construction, and post-construction and in accordance with CAN/CSA-W202-18.

At a minimum, inspections by the QESCI should continue until the site achieves 80% stabilization. Any repair work and sediment removal must be completed as required to ensure that all measures are functioning as designed. No Assumption of any infrastructure will be completed until full restoration to the environment beyond the limits of the site (where applicable due to erosion from the site) and proper removal of the erosion and sediment control is complete.

The *Inspector's* role is to verify that the prescribed erosion and sediment control measures are installed and functioning in accordance with the erosion and sediment control plan.

Qualifications

The *Contractor/Consultant* shall use a qualified erosion and sediment control *Inspector* (QESCI) with qualifications in accordance with CAN/CSA-W202-18 and shall be able to effectively inspect and monitor erosion and sediment control measures.

Standard Notes – Site Plan and Infill Lots/Subdivisions

It is the Site Owners' responsibility to ensure that all ESC measures are implemented and maintained in accordance with the following criteria.

The following standard notes are to be included in the Grading and Erosion Control Plan in the *Development Agreement* along with the erosion control details. Since each site has its own unique characteristics, the *Engineer* is required to include additional site-specific measures/notes in their design.

1. All silt page wire fencing and tree protection to be installed prior to commencement of any area grading, excavating, or demolition. At a minimum, a single barrier of silt fencing to be installed in accordance with OPSD 219.130 Heavy-Duty Silt Fence Barrier. Where a double barrier of silt fencing is required, a single layer of Light-Duty Silt Fence and a single layer of Heavy-Duty Silt Fence shall be installed in accordance with OPSD 219.110 Light-Duty Silt Fence Barrier and OPSD 219.130 Heavy-Duty Silt Fence Barrier. (For example, double barrier silt fence is required in areas near, but are not limited to, a water course, steep slopes, buildings, infrastructure, etc.).
2. Erosion control fencing to be placed around the base of all stockpiles. All stockpiles must be kept a minimum distance of 4m from all property lines and 15m away from all watercourses.
3. All topsoil piles shall have a maximum height of 4.5m and side slope of 3:1 unless otherwise approved by *Township Staff*, contoured for natural drainage and erosion prevention, including appropriate seeding as per *Township* and/or GRCA guidelines.
4. Erosion protection to be provided around all storm and sanitary maintenance holes and/or catchbasins.
5. Additional erosion control measures may be required as site/infill *Development* progresses. *Consultant/Subdivider/Developer* to require the *Contractor* to provide all additional erosion control structures.
6. Erosion control structures to be monitored regularly, i.e., following a rainfall event greater than 25mm, by (*Owners Representatives Name*) and any damage repaired immediately. Sediments to be removed when accumulations reach a maximum of one third (1/3) the height of the silt page wire fence.
7. All erosion control structures to remain in place until all disturbed ground surfaces have been re-stabilized either by paving or restoration of vegetative ground cover.
8. No alternate methods of erosion control protection shall be permitted unless approved by the *Township* and the Grand River Conservation Authority.

9. The *Contractor* is responsible for removing sediments from the municipal roadway and sidewalks at the end of each workday. If mud tracking occurs on *Township* right of ways, the *Township* may execute its right through the *Agreement* to use the mud / erosion deposit to rectify the sediment / mud tracking / erosion which has occurred or face possible fines by *Township* By-law Enforcement.
10. Mud mats to be provided on-site at all locations where construction vehicles exit the site. Mud mats shall be a minimum of 4.0m wide, 15.0m long (length may vary depending on site layout) and 0.3m deep and shall consist of 200mm clear stone, angular or ground material or approved equivalent. *Contractor* to ensure all vehicles leave the site via the mud mat and that the mat is maintained in a manner to always maximize its effectiveness.
11. (*Owners* Representatives Name) to monitor the site *Development* to ensure all erosion controls are installed and maintained to Municipality/CSA/GRCA/Project requirements. *Contractor* to comply with the Engineer's instructions to install, modify, or maintain erosion control Works.
12. The property *Owner* is responsible for the restoration of all damaged and/or disturbed property within the municipal right-of-way to Municipality standards and adjacent neighbouring property damage.
13. If for unforeseen reasons, the *Owner* and/or their representative must encroach onto private *Lands* to undertake any Works, they must obtain written permission from the adjacent property *Owners* prior to entering upon the private property to perform any Works. Copies of these letters of consent must be submitted to the *Township* prior to any work being performed. Failure to comply with the above is at the *Developer/Subdivider's* property Owner's own risk.
14. Each Grading and Erosion Control Plan shall bear a note referring to all other plans included with the SWM Report. Reference should also be made to the SWM Report itself, the date of the report, and the Landscaping Plan (e.g., This plan to be read in conjunction with the Existing Conditions Plan, Site Servicing Plan, General Grading Plan), Storm Water Management Plan, Landscaping Plan, and the Storm Water Management Report dated).

15. Survey Control Requirements

15.1. Introduction

The *Township* completes / requires a variety of surveys for the design, *Acceptance* and construction of *Capital and Development Infrastructure Projects*, *Municipal Drains*, *Municipal Consents* and *Land Development Projects*. Below is a general outline of the criteria for the complete surveys to be submitted.

Documents beyond this Engineering Development and Infrastructure Manual that may be applicable for an engineering design include, but are not limited to, the as amended version of:

- Ontario *Land Surveyor Act*,
- Ontario Specifications for Horizontal Control Surveys (OS 79) and Ontario guidelines for Horizontal Control Surveys (OG 79),
- OPSS MUNI General Conditions,
- The Criminal Code of Canada.

15.2. Survey Control Points

Horizontal Control

As the survey information provided will be used for engineering and construction purposes it must be conducted in ground coordinates (no scale factor) according to the following parameters: UTM NAD83 Zone 17 North. Brought to ground coordinates on site. Preferably centered on the site. Ground scale point coordinates are to be identified as well as the ground calculated scale factor.

The plan shall show a bearing note, as follows: "Bearings herein are grid bearings, and are derived from (specify two or more horizontal control or integrated monuments used for bearing) and are referred to the central meridian (81 degrees of longitude) in Zone 17 and are based on a NAD83 (Original) datum.

The distance shown on a plan shall be adjusted horizontal ground distance, and the following note shall appear on the plan: "Distances shown on this plan are adjusted ground level distances and can be used to compute grid co-ordinates by multiplying by a combined scale factor of....."

Vertical control

Canadian Geodetic Vertical Datum of 1928, 1978 Southern Ontario Adjustment (CGVD28:78). The Survey must be referenced to a geodetic monument of this datum. Surveys will not be accepted if vertical reference is only to a geoid model based on GPS measurements.

Permanent Survey Control

Since this survey control information will likely be used by others for further engineering work and construction, benchmarks, and horizontal control points (which may be one in the same) will be placed on site in areas where they will not likely be disturbed. This will be done at intervals no greater than 100m. A minimum of four control points will be left on any *Development* site. Survey plans will be delivered in PDF and AutoCAD format with all survey data intact. Control points are to be easily identified and provided in text format.

15.3. General Requirements

The *Subdivider / Developer* shall install permanent geodetic benchmarks in such locations as required and approved by the *Township*. The elevations shall be transferred by a Professional Engineer, or an Ontario *Land* surveyor using Second Order precision and submitted to the *Township*.

The *Subdivider / Developer* shall provide *Township Staff* with a written statement by an Ontario *Land* Surveyor indicating that they have found or replaced all Standard Iron Bars and property bars shown on legal survey plans, prior to *Acceptance* into maintenance and at final Assumption.

The *Subdivider / Developer* shall provide grade stakes at each lot (or will arrange for the Builder to do so) to ensure that the dwellings are constructed at a grade which will be compatible with the road grade, and which will permit lot drainage, to the satisfaction of the *Township*. The *Developer* shall have the final accepted elevations for each lot verified by the *Consultant* following completion of construction on the lot. Verification of lot and building grades are required at the stages identified in Section 6 of this document.

Benchmarks on Drawings

Reference to the original geodetic benchmark and any site benchmarks used to complete the survey will be referenced on the topographic survey plan and all subsequent engineering drawings.

Property Markers

The surveyor will make every effort to find any property bars or markers within the scope of the survey. Property markers / boundary lines are to stay in place as per the Criminal code of Canada R.S. 1985, c. C-46 under Part XI, Sec. 442 and 443.

15.4. Monuments and Benchmarks

Monuments - General Requirements

The *Contractor* shall be responsible for the preservation of all Property Monuments while the work is in progress, except those Property Monuments that need removal to facilitate the excavation and servicing of the work. All Monuments disturbed, damaged, or removed by the *Contractor's* operations shall be documented in an inventory report and replaced under the supervision of an Ontario *Land Surveyor*. Monuments removed to facilitate the work shall be replaced at the Owner's expense, and all others shall be replaced at the *Contractor's* expense.

Prior to construction the *Contractor* shall locate on site those Monuments that are identified on the engineering drawings and protect them with highly visible T-bars and / or 36" tall stakes with survey ribbon set within 0.3 metres of them. Any monuments not shown on drawings but found during the construction process shall be protected in the same manner.

Horizontal control monuments and vertical control benchmarks were installed as set out by the "Ontario Specifications for Horizontal Control Surveys (OS 79)" and the "Ontario Specifications for Vertical Control Surveys (OS 79)" respectively, and confirmation from the Ministry of Natural Resources that the horizontal control monuments and vertical control benchmarks have been accepted into their Cosine Database.

The horizontal control monument shall be a round iron bar (0.025m x 1.22m) with brass cap or any monument approved by the "Ontario Specifications for Horizontal Control Surveys (OS 79)".

The location, description, and pertinent information with respect to the monuments shall be indicated on all engineering drawings and on the *Township's* Survey Monument Record Sheet.

Monuments are to be placed in each plan/phase of a *Development*, to establish both vertical and horizontal control.

Locations to be as directed by *Township Staff*. *Township Staff* will provide confirmation required prior to construction of concrete monument.

Establishment of subdivision, site plan control monumentation prior to start of maintenance
Acceptance

Prior to the start of maintenance of the subdivision, the *Subdivider / Developer's* Surveyor shall establish a network of second order control monuments that have both horizontal and vertical information associated with them. Horizontal values shall be UTM, NAD83 (CSRS), Zone N17. Vertical datum shall be based on the same benchmarks used for engineering and construction purposes.

Establishment of these monuments shall be at approved locations to the satisfaction of the *Township*.

In addition to the above, control monuments shall also be established on the top of the inlet concrete headwalls to assist in monitoring future stormwater management water levels for municipally owned ponds.

Demarcation Monuments

These shall be placed where lots back onto trails, green space, stormwater management facilities, outside project boundaries, etc.

- Placed every 30 metres and / or in the centre of the lot and / or where there is a change of direction in property line,
- Be 1.8 metres long with 0.9 metres above the finished grade,
- Be 9 cm by 9 cm in size; and
- Be made of grey recycled plastic.

Benchmarks

Work to be 2nd order surveying, with closure between 2 known benchmarks, using double-closure method.

Plaques to be used as stipulated by the *Township* and have an identification number stamped on them as directed by *Township Staff*. Numbers are to be stamped prior to final installation.

Submissions to be made in the format indicated by *Township Staff*, stamped/sealed by the OLS. Supporting calculations, leveling and adjustment sheets, to be provided verifying the methodology and calculations.

15.5. Subdivision, Site Plan, Infill Lot Acceptance

Prior to initial *Acceptance*, release of *Security* and placed into maintenance, the *Subdivider / Developer* shall engage an Ontario *Land Surveyor* to ensure that all Standard Iron Bars and lot corners shown on the legal plans have been found or replaced.

The *Subdivider / Developer* shall provide the *Township* with a written statement and map signed by an Ontario *Land Surveyor* indicating that they have found or replaced all Standard Iron Bars shown on legal survey plans, prior to the commencement of the *Maintenance Period*.

15.6. As-Recorded Field Drawings

General

The As-Recorded drawings constitute the original engineering drawings which have been amended to incorporate the construction changes and variances to provide accurate information on the *Works* as installed in the *Development*. The Registered Plan Number must be clearly shown on all As-Recorded General Plan of Services.

As-Recorded Field Survey

The As-Recorded revision shall be based upon a final survey of all the subdivision services and firm construction records. The final survey of the subdivision services shall include a field check of the following items:

- Location, top of grate and invert elevations of all sewer maintenance holes,
- Distances between all sewer maintenance holes,
- Location, top of grate and invert elevations of all catchbasins,
- Locations of all sidewalks and curbs,
- Location and ties to all valve boxes and valve chambers located in sodded areas,
- Location of all hydrants,
- Location and ties to all sample stations and other special watermain appurtenances,
- Road centerline elevations,
- Site benchmarks,
- Location of all service connections to all lots and blocks. Services are to be labelled with the centerline distance to the nearest downstream sanitary maintenance hole,
- Sewer and watermain pipe sizes and material,
- Location of all fencing constructed as part of the subdivision services,
- Location of all driveways, tree plantings, streetlight poles and transformers,
- Lot Servicing Records.

Drawing Revisions

The original plans shall be revised to incorporate all changes and variances found during the field survey and to provide ties and additional information to readily locate all underground services.

Two (2) original paper copies and a digital copy of the As-Recorded drawings in an AutoCAD Format acceptable to the *Township* shall be submitted to the *Township*.

The following information shall be verified by the As-Recorded field survey and updated on the As-Recorded drawings:

- All sewer and road grades are to be recalculated to two (2) decimal places,
- All street line invert elevations for storm and sanitary service connections to each lot or block shall be noted on the drawing,
- All street names, lot numbering and block identification shall be checked against the Registered Plan and corrected if required,
- The *Contractor*, the date of commencement of construction and the date of completion shall be noted on the General Plan of Services,
- The “As-Recorded” revision note, and date shall be placed on all drawings in the revision block,
- All civic address numbers shall be identified.

Tolerances

A maximum vertical plotting tolerance of 0.1 metres on the 1:50 vertical profile portion of the drawings and a maximum horizontal plotting tolerance of 1 metre on the 1:500 scale drawing shall be considered acceptable without replotting.

All sewer lengths are to be shown to the nearest 0.1 metres. The information shown on the As-Recorded drawings may be checked by *Township Staff* at any time up to two years after final *Acceptance* of the subdivision and if discrepancies are found between the information shown on the drawings and the field conditions, then the drawings will be returned to the *Consultant* for rechecking and further revisions.

The *Consultant* shall be required to explain; in writing, any major difference between the design and the As-Recorded data and to provide verification that alteration does not adversely affect the design of the subdivision services.

Submissions

Upon completion of all construction work and the As-Recorded revisions, the drawings shall be submitted to the *Township* for their permanent records.

The submission of the As-Recorded drawings to the *Township* must be completed before *Provisional Acceptance* of the above ground *Works* will be given (AutoCAD current within 3 years).

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16. Fees, Securities, and Insurance

16.1. Introduction

The *Township* requires various *Fees* and securities to be paid prior to and during the approvals and construction process of *Development*. Individual project and *Development Fees* and *Security* information is included in the *Development Agreement*.

16.2. Cost Estimate

An itemized cost estimate for the construction of all *Works* including 20% contingency in the standard form is required along with a breakdown of any items designated to be cost-shared.

A proposed construction schedule for all construction activities is to be provided to the *Township* with the cost estimate. During the progress of the work, any revisions to the original schedule shall be forwarded to the *Township*.

16.3. Engineering Fees

The total Subdivision Engineering *Fees* for all construction *Works* shall be provided to the *Township* and to be determined as a percentage of the final estimated construction costs. The percentage to be used is stated in the Subdivision *Agreement* and / or *Fees and Charges By-law*. These *Fees* shall cover *Township Staff* review, processing, and inspection time as per the *Fees and Charges By-Law* preliminary approval (initial *Acceptance*), Assumption, end of warranty, lot grading certificate review, *Security* release.

Initially the *Consultant* will determine the preliminary construction cost estimate including 20% contingency at the time of first engineering drawing submission. One half of the percentage of this cost estimate will be submitted to the *Township*, in the form of a cheque made payable to the *Township* along with the first submissions drawings and any *Peer Reviewer*, outstanding payments as required.

Prior to final *Acceptance* of the engineering drawings, the *Consultant* shall provide a final estimated construction cost. The remaining Engineering *Fees* to be submitted to the *Township* is calculated as the percentage of the final estimated cost less the Engineering *Fee* paid upon first submission drawings and any *Peer Reviewer*, outstanding payments as required.

Once the tender and contract are finalized and the *Subdivider* has decided on their *Contractor* and *Contractor* pricing is complete. Final documents are to be submitted to the *Township*.

16.4. Letter of Credit

Included in the *Subdivision Agreement* are provisions regarding security deposits to be held by the *Township* to ensure that the *Township* has sufficient money available to complete any outstanding works required for the development in the even that the *Owner* does no/cannot complete the works required of them under their respective *Agreement*. The *Subdivider* may propose to provide these securities in the form of an irrevocable Letter of Credit from a Chartered Bank or other *Security* satisfactory to the *Township* to guarantee the completion of the *Works* referred to in the *Agreement*. This amount includes:

- the total estimated and / or actual costs for underground services,
- the total estimated and / or actual costs for surface Works,
- Fees for lot grading.

The amount of required *Fees* and *Security* shall be in accordance with the *Development* agreement and/or *Fees* and *Charges By-law*.

The total estimated cost for the *Works* must show an engineering and contingency allowance of 20% and include HST. The contract documents between the *Subdivider* and its *Contractor* engaged to install the services shall provide for Performance and Maintenance Bonds in the amount of 100% of the contract value and the *Subdivider* shall provide the *Township* with proof of such bonding.

16.5. Letter of Credit Reduction Process

The irrevocable Letter of Credit may be reduced from time to time as the work is completed and accepted by *Township Staff*. The process for Letter of Credit reduction is outlined below and within the *Fees* and *Charges By-law*. Reductions of the Letter of Credit shall occur because of successful Initial and Final Inspections, adequate documentation, and description of the infrastructure assets to be released throughout the *Development*.

Initial Reduction

The initial reduction of the Letter of Credit shall be to no less than 15% of the total value or to \$15,000, whichever is the greater and shall occur after the initial *Acceptance* of the *Works*. Reductions less than \$15,000 will NOT be processed and will be returned to the *Consultant* unless otherwise approved by the *Township* prior to the request.

Only two (2) reductions to the Letter of Credit per stage will be permitted a year. See *Fees* and *Charges By-law* for each letter of credit request for processing.

The *Subdivider* may request the Letter of Credit be reduced to 15% of the accepted *Works*, and outstanding underground and aboveground *Works* be adjusted to 110%. The remaining

balance of the Letter of Credit will be reduced. The minimum value of a Letter of Credit to be held shall not be less than \$5,000.

Security shall not be reduced to an amount equal to or less than the estimated cost of the *Works* and services remaining to be completed, and Maintenance *Security* Requirements as provided by the *Engineer* and verified by the *Township*. Unit prices for items may need to be adjusted periodically to reflect current market conditions.

In order to reduce the Letter of Credit, the *Consultant* must provide a Letter of Credit Reduction Request package which contains the following documentation:

- Written letter requesting the reduction in Letter of Credit,
- Subdivision name including appropriate stage and phase,
- Initial and Final *Acceptance* summary spreadsheet,
- Detailed background information in the form of an itemized calculation spreadsheet on an item by item, street by street basis,
- Any *Acceptance* letters pertaining to the specific requested Letter of Credit reduction,
- Resident complaints and concerns tracking form to be submitted,
- Infrastructure issues that were rectified throughout the warranty period.

Final Reduction

The final reduction of the Letter of Credit shall be to zero dollars and shall occur after Final *Acceptance* has been issued by the *Township*. Final inspections on items can only be requested at a minimum of two (2) years after the initial *Acceptance* date, and after the *Maintenance Period* has expired.

Once the final *Acceptance* letter has been received the process for requesting the Letter of Credit reduction can commence similar to the Initial Reduction above.

Reductions less than \$15,000 will NOT be processed and will be returned to the *Consultant* unless it is approved by the *Township* prior to the request.

16.6. Stormwater Management Fees and Security

Where a new subdivision will outlet to an existing or proposed SWM pond, a cleanout maintenance *Security* will be required, and will form part of the *Subdivider's* Letter of Credit. The amount required for the maintenance *Security* will be the *Engineer's* estimated cost to clean out the pond two (2) times. Additionally, new subdivisions outletting to an existing SWM pond will be required to add the estimated cost to flush the storm sewers up to the SWM pond two (2) times. The estimated cost will be based on the *Township's* current sewer flushing rate per meter of pipe.

Where multiple *Subdividers* are responsible for the maintenance of the same pond, a *Subdivider* who has reached 95% build out can go through the pond *Acceptance* process or enter into an *Agreement* with all other *Subdividers* to be released of their pond maintenance obligations. By entering into the *Agreement*, the *Subdividers* agree to clean out the absolved *Subdivider's* sediment from the pond and pipes. Further, the other *Subdividers* must have pond maintenance *Security* posted with the *Township*.

The *Subdivider* shall install all landscaping of SWM areas above the five (5) year storm level in accordance with the approved plan, during the first planting season after occupancy of the first unit.

Prior to Final *Acceptance* the following conditions must be met:

- Clean out of the SWM pond at 95% buildout. (Provide as-recorded elevations to *Township*),
- 2 years of performance monitoring after 95% buildout has been reached and clean out completed,
- Satisfactory inspections from the *Township*.

At 95% build out of the catchment area, the pond must be surveyed and if necessary and at the sole discretion of the *Township*, cleaned out. After the pond has been cleaned, the minimum two (2) year performance monitoring of the SWM pond can commence. At this point the *Consultant* may request to have the pond cleanout *Security* reduced from two (2) cleanouts, to one (1).

After review of satisfactory monitoring results and prior to Final *Acceptance*, if necessary the pond must be cleaned out (not hold accumulated sediment), and landscaping below the five (5) year storm level can be planted. All items in the SWM Block (underground and surface Works) are to be inspected as a whole, for Final *Acceptance*. SWM pond undergrounds will require an updated CCTV inspection, and as-recorded survey submission at Final *Acceptance*.

Where SWM facilities require seasonal valve operation, the *Subdivider* is responsible to operate the valves during the *Maintenance Period*.

16.7. Obligations during the Maintenance Period

The *Subdivider* shall make good in a permanent manner satisfactory to the *Township*, any and all damage to the work during the *Maintenance Period*. Any deficiencies or defects noted during the *Maintenance Period* are the responsibility of the *Subdivider* and all complaints and concerns will be deferred to the *Consultant* for tracking and resolution. This shall be on an ongoing basis throughout the terms of this *Agreement*. The *Subdivider*, on receiving either written or oral notification from the *Township* that *Works* are required, shall immediately undertake such necessary work. If the *Subdivider* fails to comply, the *Township* may arrange

for such work to be undertaken at the expense of the *Subdivider*. The monies for this work may be drawn from the *Security* under the subdivision *Agreement*.

The *Subdivider's* obligations include, but is not limited to the following:

- Shall maintain or cause to be maintained all underground and surface *Works* and every part thereof in working order and in good repair for a period of not less than two (2) years from the date of the *Maintenance Period Acceptance*,
- Regardless of if the underground sewers have received final *Acceptance*, the *Subdivider* shall be responsible for sewer flushing maintenance until initial *Acceptance* of the surface asphalt,
- *Subdivider* will ensure that storm sewer system, which includes catchbasins, maintenance holes, infiltration trenches, soakaway pits and other quality control features, and appurtenances are in a satisfactory working condition and free from debris, silt etc. Should the efficiency of the storm sewer become reduced due to building activity the *Subdivider* shall be responsible for any cleaning, flushing etc. necessary to restore the storm sewer to full capacity for the duration of building activity. If the *Township* determines a *Subdivider* is not ensuring that the storm sewer is kept free of debris, silt, due to builder activity, an email to correct the defect will be sent to the *Subdivider*. If the storm sewer is not cleaned within five (5) business days, the *Township* will arrange to have the storm sewer cleaned, and the work will be invoiced to the *Subdivider* or deducted from the letter of credit or cash deposit,
- The *Subdivider* shall maintain all road allowances, lots, and blocks within the vicinity of the *Works* within the subdivision free of mud, dust, litter, construction debris, construction materials and obstruction that may occur directly or indirectly on account of construction or illegal dumping by others within the subdivision. The *Subdivider* will also ensure that abutting streets affected by the subdivision activity are also cleaned when they have been impacted. *Township Staff* will inspect the road condition on a periodic basis and/or on a complaint basis. If it is determined by the *Township* that the *Subdivider* is not adhering to the street sweeping requirements the *Subdivider* will be notified by the *Township* to clean the streets. The *Subdivider* will have 48 hours to comply with the directive. Should the *Township* deem it necessary to respond to a cleanup of the subdivision streets and / or abutting streets after having notified the *Subdivider*, this work will be invoiced to the *Subdivider* or deducted from the letter of credit or cash deposit,
- The *Subdivider* shall maintain or cause to be maintained, all surface and landscaping *Works* and every part thereof in acceptable order and in good repair for a period of not less than two (2) years from the date of the *Maintenance Period Acceptance*,
- The *Subdivider* shall maintain or cause to be maintained, all landscaping *Works* (including boulevards adjacent to open spaces and parks, and street trees) and every part thereof in acceptable order and in good repair for a period of not less than two (2) years from the date of the *Maintenance Period Acceptance* to the satisfaction of the

Township. It is recognized that within a subdivision, there may be a variety of *Maintenance Period Acceptance* dates.

Note: The standard *Maintenance Period* is two (2) years, however the *Township* reserves the right to extend this term if and where significant deficiencies have existed and been left unattended, or repairs have not been made to the satisfaction of the *Township*.

16.8. Perpetual Maintenance Fees

The *Township* shall collect 'Perpetual Maintenance Fees' from *Subdividers* when a Subdivision *Agreement* is entered into for landscape design elements placed on *Township* Property. These 'Fees' are required to offset costs of long-term maintenance, potential removal, and/or replacement. Maintenance *Fees* will be applied to design elements in the landscape, including but not limited to, subdivision entry features/walls, decorative perimeter fencing, and planted traffic islands.

The 'Fee' will be held specifically to pay for maintenance, removal and/or replacement of those elements ultimately assumed by the *Township*. The 'Fee' amount is based upon the type of materials utilized in the construction of the element. The 'Fee' will be collected as cash or certified cheque and will be non-refundable. The *Township* will have the ability to remove the design element if, after Assumption of the Subdivision, the design element maintenance costs are exceeded. Warning clauses in purchase and sale *Agreements* are necessary to ensure the future homeowner is made aware of this.

Any of these elements must be itemized separately within the landscape cost estimates.

The *Subdivider* is required to maintain these landscape elements until the subdivision servicing is completed and all lots within the subdivision are sold to the first home purchaser/occupant and/or end of warranty period whichever is greater. At that time the *Township* will assume maintenance responsibility.

All tree planting for landscape design elements will meet all tree and soil habitat zones requirements as identified in this Manual.

The *Subdivider* shall pay the *Township* the estimated cost to maintain the feature for half the life cycle following the *Acceptance* by the *Township*, AND half the cost to replace the feature (based on installation cost).

The *Township* has the option to remove the feature in the future.

16.9. Insurance

Prior to final acceptance of the design or any works on the *Lands*, the *Subdivider* shall deposit with the *Township*, a certificate of insurance in a form acceptable to the *Township* certifying that the *Subdivider* has obtained from an insurance company, acceptable to the *Township*, insurance coverage in respect to liability for property damage and personal injury. Such policy or policies shall:

- be issued in the joint names of the *Subdivider* and the *Township* (or include as an additional insured, the *Township*),
- provide insurance coverage in respect of any one accident or occurrence in the amount indicated in the *Development Agreement* exclusive of interest and costs,
- be effective for the period of the *Agreement*, until overall Final Acceptance (periodic renewal is acceptable),
- contain a clause indicating that the insurance coverage applies to both hazard from damage to new works and works already performed on the *Lands*,
- contain no exclusions for damage or loss from blasting or from any other work that may be associated with the *Development* and construction of a *Development*; and
- contain a provision that the policy or policies will not be changed or cancelled without at least thirty (30) days prior written notice being given by the *Township*.

The *Subdivider* shall prove to the satisfaction of the *Township* that all premiums on such policy or policies have been paid and that the insurance is in full force and effect.

In addition to liability insurance, the *Subdivider* may be required to provide Environmental Insurance to the satisfaction of the *Township* as stipulated in the *Agreement*.

This certificate of insurance is in addition to the certificate of insurance that the *Contractor* is required to provide to the *Township*. Prior to commencement of any works and services, the *Subdivider* shall furnish to the *Township*:

- Proof satisfactory that the *Contractors* engaged to construct the *Works* have sufficient and valid liability insurance policies:
 - includes as an additional insured, the *Township* and the Region,
 - provides insurance coverage in respect of any one accident or occurrence in the amount identified in the *Development Agreement*,
 - is effective during the period when the *Contractor* is occupying the *Lands*,
 - contains a clause indicating that the insurance coverage applies to both hazard from damage to new works and works already performed,
 - contains no exclusions for damage or loss from blasting or from any other work that may be associated with the installation of the *Works* within the *Development*; and

- contains a provision that the policy or policies will not be changed or cancelled without at least thirty (30) days prior written notice being given to and accepted by the *Township*.
- A Certificate from the Worker's Compensation Board showing that each contractor is in good standing; and
- Evidence, satisfactory to the Director of Development Services, that each *Contractor* is qualified, experienced, has equipment to successfully complete the works and has adequate security to guarantee performance and maintenance to the *Subdivider* as per the provisions of the *Agreement*.

The issuance of such policies of insurance shall not be construed as relieving the *Subdivider* or *Contractor* from the responsibility for other or large claims, if any, for which it may be held responsible.

17. Appendices

DGSSMS – <https://www.regionofwaterloo.ca/en/doing-business/Construction-Design-Standards-and-Guidelines.aspx>

OPSD, OPSS

<https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/opsSplash.aspx>

Development Inspection Form – In development

Traffic Calming - <https://www.woolwich.ca/en/living-here/Roads-and-Sidewalks.aspx#:~:text=Traffic%20calming%20is%20a%20method,reducing%20the%20frequency%20of%20collisions>.

Traffic by-law - <https://www.woolwich.ca/en/Township-services/resources/By-laws/Consolidated-Traffic-and-Parking-By-law-Updated-as-of-January-31-2022.pdf>

Trails Master Plan - <https://www.woolwich.ca/en/discover-us/Parks-and-Trails.aspx>

Water Meter Policy - <https://www.woolwich.ca/en/living-here/Water-and-Sewer.aspx>

Design Guidelines - <https://www.woolwich.ca/en/doing-business/resources/HUMMINGBIRD-64284-v1-Landscape and Design Guidelines 2019.pdf>

Standard Drawings – <https://www.woolwich.ca/en/township-services/Engineering-Planning-and-Building-Services.aspx>

Infrastructure Services Supplemental Standards - Attached

NOTE: For all appendices that are noted “in development”, once complete, will be posted on the Township of Woolwich website and added into this document. Please check their status by clicking the following link. <https://www.woolwich.ca/en/Township-services/Engineering-Planning-and-Building-Services.aspx>